TM 2320-34/13A
TM 9-2320-297-34
VOLUME 1 OF 2

UNITED STATES MARINE CORPS TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE

FOR

TRUCKS, 8 X 8
LOGISTICS VEHICLE SYSTEM (DIESEL)

CONSISTING OF

POWER UNIT, FRONT,
4 X 4, MK48 (NSN 2320-01-177-5167)
4 X 4, MK48A1 (NSN 2320-01-417-3180)

TRAILER, POWERED
CONTAINER HAULER,
4 X 4, MK14 (NSN 2320-01-176-0469)
4 X 4, MK14A1 (NSN 2320-01-417-5294)

TRAILER, POWERED,
WRECKER/RECOVERY
4 X 4, MK15 (NSN 2320-01-176-6928)
4 X 4, MK15A1 (NSN 2320-01-417-8144)

TRAILER, POWERED,
FIFTH WHEEL, SEMI-TRAILER ADAPTER,
4 X 4, MK16 (NSN 2320-01-176-0467)
4 X 4, MK16A1 (NSN 2320-01-417-5293)

TRAILER, POWERED,
DROPSIDE, CARGO W/CRANE,
4 X 4, MK17 (NSN 2320-01-176-0468)
4 X 4, MK17A1 (NSN 2320-01-417-5296)

OSHKOSH TRUCK CORPORATION
DAAE07-83-C-H418
DAAE07-95-C-X057

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THIS REPRINT INCLUDES CHANGES 1 - 4.

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DECEMBER 1996
PCN 180 002338 00

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TM 2320-34/13A VOL 1 of 2

WARNING

CARBON MONOXIDE (EXHAUST GAS) CAN KILL YOU. Carbon monoxide is without color or smell, but can kill you. Breathing air with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, a sleepy feeling, and coma. Brain damage or death can result from heavy exposure. Carbon monoxide is in the exhaust fumes of fuel-burning heaters and internal combustion engines. Carbon monoxide can become dangerously concentrated under conditions of no ventilation. Precautions must be followed to insure crew safety when the personnel heater or engine of any vehicle is operated for any purpose.

(1) DO NOT operate personnel heater or engine of vehicle in a closed place without proper ventilation.

(2) DO NOT drive any vehicle with inspection plates, cover plates, or engine compartment covers removed unless necessary for maintenance purposes.

(3) BE ALERT at all times during vehicle operation for exhaust odors and exposure symptoms. If either are present, IMMEDIATELY VENTILATE personnel compartments. If symptoms persist, remove affected crew to fresh air and keep warm. DO NOT PERMIT PHYSICAL EXERCISE. If necessary, give artificial respiration and get immediate medical attention.

THE BEST DEFENSE AGAINST CARBON MONOXIDE POISONING IS GOOD VENTILATION.

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 Lb
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches
1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

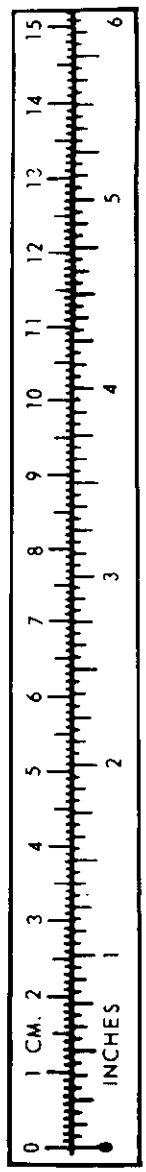
TEMPERATURE

5/9 (^{0}F − 32) = ^{0}C
212^0 Fahrenheit is equivalent to 100^0 Celsius
90^0 Fahrenheit is equivalent to 32.2^0 Celsius
32^0 Fahrenheit is equivalent to 0^0 Celsius
9/5 C^0 + 32 = F^0

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621



TA 298304

DEPARTMENT OF THE NAVY
Headquarters, U.S. Marine Corps
Washington, DC 20380-001

28 May 1999

1. This Technical Manual (TM), authenticated for Marine Corps use and effective upon receipt, provides general support maintenance instructions for the Logistics Vehicle System (LVS) series of vehicles, consisting of the Front Power Unit MK48/48A1, Trailer, Powered, Container Hauler MK14/14A1, Trailer, Powered, Wrecker/Recovery MK15/15A1, Trailer, Powered, Fifth Wheel, Semi-Trailer Adapter MK16/16A1, and Trailer, Powered, Dropside, Cargo with Crane MK17/17A1.

2. This manual is a reprint of the basic manual and includes changes 1 through 4. This manual supersedes TM 2320-34/13A of December 1996 and all changes.

3. Submit notice of discrepancies or suggested changes on NAVMC 10772 to: Commander, Marine Corps Logistics Bases, Attn: Code 826, 814 Radford Blvd., Albany, GA 31704-1128. In addition, forward an information copy to the Project Officer at the following address: Commander, MARCORSYSCOM, Attn: CSLE-MT, 2033 Barnett Ave., Suite 315, Quantico, VA 22134-5010.

BY DIRECTION OF THE COMMANDANT OF THE MARINE CORPS

OFFICIAL:

G. N. GEORGEADIS
Director, Program Support
Marine Corps Systems Command

DISTRIBUTION: PCN 180 002338 00

10-19. DIFFERENTIAL CARRIER REPAIR (NO. 3 AND 4 AXLES) (Continued)

(15) Install shift fork (4) into carrier housing (23) so fork tangs (92) point towards differential carrier assembly (6).

(16) Install sliding clutch (5) into differential carrier assembly (6) while alining shift fork (4) with shift fork groove (93).

(17) Install shift fork shaft (3) and new expansion plugs (1 and 2).

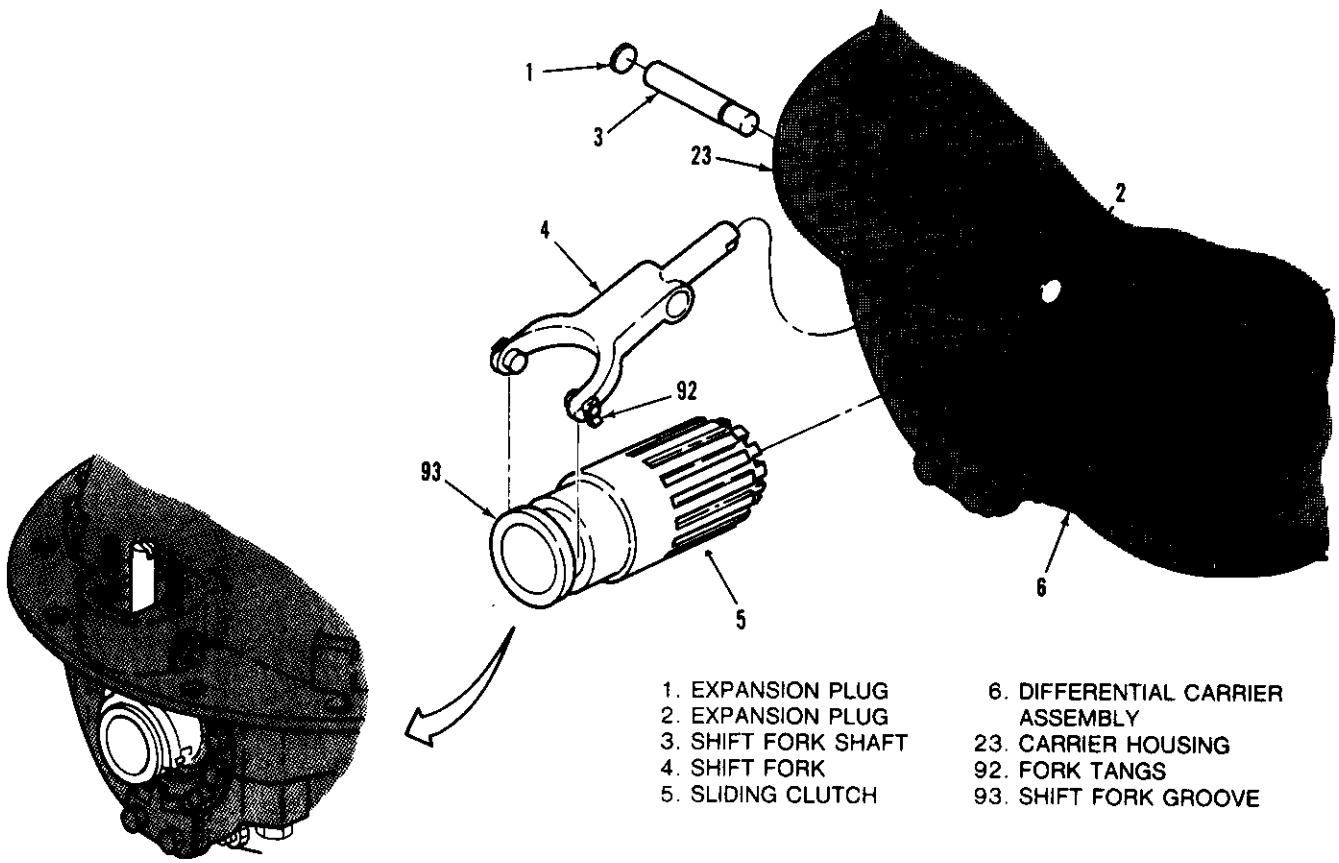
(18) Check shift fork (4) and sliding clutch (5) for free movement.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install differential carrier on No. 3 axle (para 10-16).
	Install differential carrier on No. 4 axle (para 10-17).



1. EXPANSION PLUG
2. EXPANSION PLUG
3. SHIFT FORK SHAFT
4. SHIFT FORK
5. SLIDING CLUTCH
6. DIFFERENTIAL CARRIER ASSEMBLY
23. CARRIER HOUSING
92. FORK TANGS
93. SHIFT FORK GROOVE

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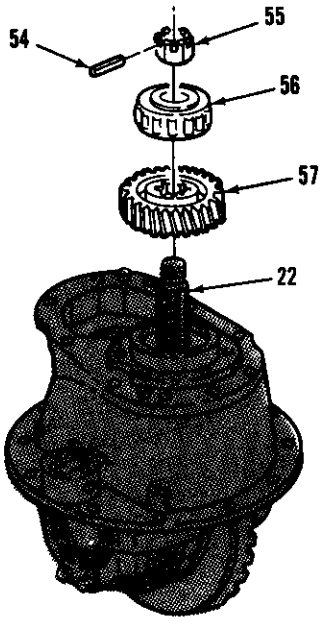


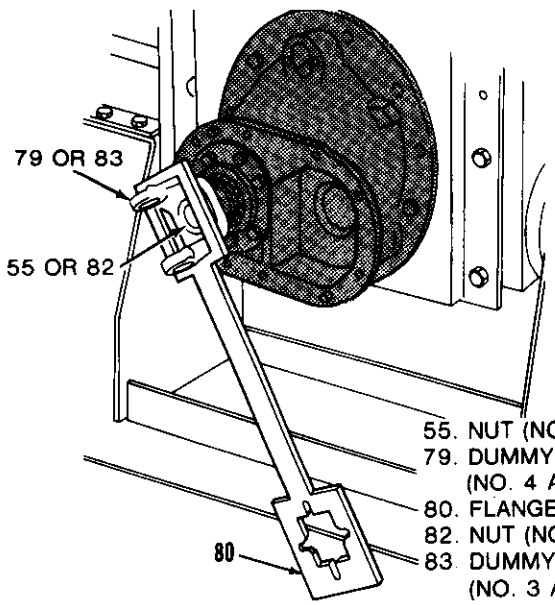
22. PINION
54. ROLL PIN
55. NUT
56. BEARING
57. GEAR

(11) Remove nut (55 or 82) and dummy yoke (79 or 83) using flange holder (80).

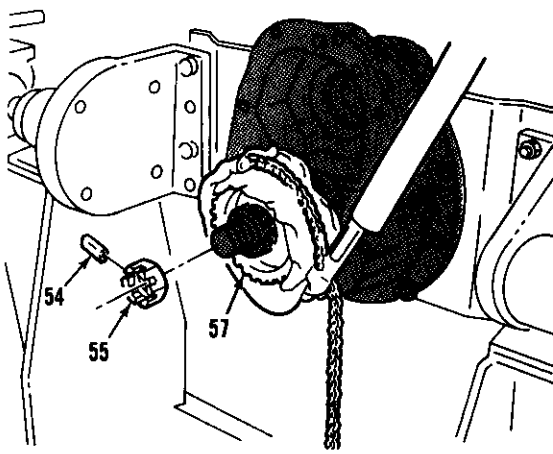
(12) For No. 3 axle (using a soft-faced hammer) install gear (57) and bearing (56) on pinion (22).

(13) Wrap a strap and chain wrench around gear (57).

(14) Install nut (55). Torque nut (55) to 840-1,000 foot-pounds (1,139-1,383 N·m). Install roll pin (54).



55. NUT (NO. 3 AXLE)
79. DUMMY YOKE (NO. 4 AXLE)
80. FLANGE HOLDER
82. NUT (NO.4 AXLE)
83. DUMMY YOKE (NO. 3 AXLE)



54. ROLL PIN
55. NUT
57. GEAR

TA 299083

WARNING SUMMARY

The following is a list of warnings that appear in this manual. LVS mechanics must become familiar with all warnings. Severe injury or death can be avoided by mechanics who understand the vehicle and are alert to possible dangers.

- Remove rings, bracelets, wrist watches, and neck chains before working around the vehicle or other vehicles. Jewelry can catch on equipment and can cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.
- Adhesives and solvents burn easily and give off harmful vapors. To avoid injury, use in a well ventilated area and keep away from flame.
- Compressed air used for cleaning purposes will not exceed 30 PSI. Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).
- Hydrochloric acid (muriatic acid) can burn you. It can give off harmful vapors if it is used on metals containing phosphorus. To avoid serious injury, wear protective rubber gloves, apron, and goggles and always use in well ventilated area.
- Improper cleaning methods and use of unauthorized cleaning solvents will injure personnel and damage equipment.
- When using a hydraulic press for removal or installation of bearings, wear a face shield to prevent possible injury to personnel.
- Snaprings are spring steel and may pop off when being removed. Wear a face shield when removing snaprings to prevent personal injury.
- Fuel is flammable and can explode. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. Smoking is prohibited while working with fuel.
- Do not reach into the radiator fan area with the engine running. The fan is thermostatically controlled and may engage without warning.
- Cooling system components become hot during operation. To avoid personal injury, do not service cooling system components until they have cooled down.
- Let radiator cool before removing cap. Remove radiator cap in two steps. First, place a thick cloth over the cap and slowly rotate cap counterclockwise to its first stop; pause, and let pressure escape from cooling system. Then rotate cap further counterclockwise until you can remove it. Failure to follow this procedure can result in serious burns.
- Always remove negative battery ground cables first or install them last to avoid sparks that can cause an explosion. Failure to follow this precaution may result in serious injury to you and other personnel.
- Never work on air system components without first draining air pressure. Failure to follow this precaution can result in serious injury.

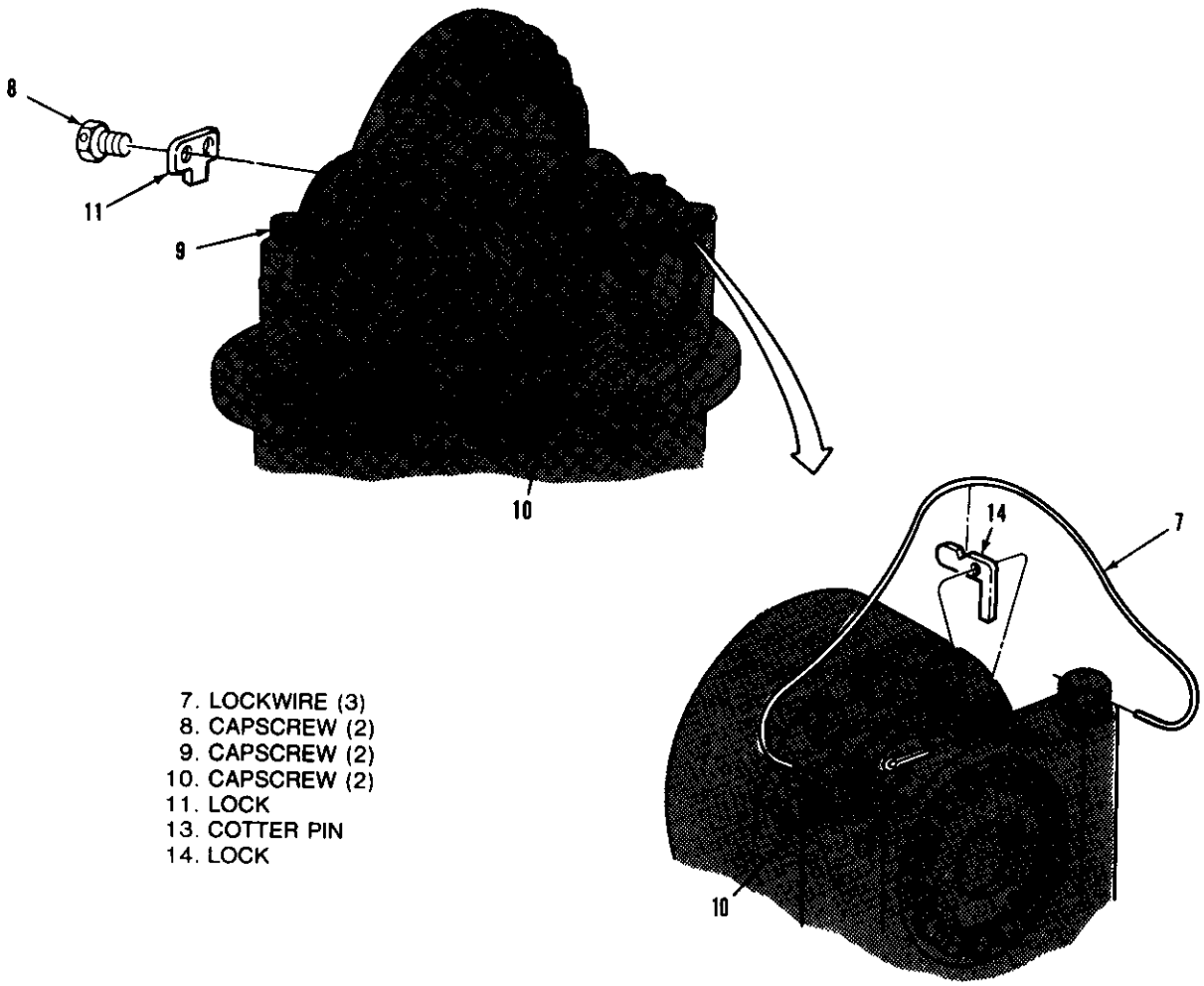
10-19. DIFFERENTIAL CARRIER REPAIR (NO. 3 AND 4 AXLES) (Continued)

(7) When contact pattern is correct, install lock (14) and new cotter pin (13).

(8) Install lock (11) and two capscrews (8). Torque capscrews (8) to 160-176 foot-pounds (217-239 N·m).

(9) Torque capscrews (9 and 10) to 370-430 foot-pounds (501-583 N·m).

(10) Install new lockwire (7) on capscrews (8, 9, and 10).



7. LOCKWIRE (3)
8. CAPSCREW (2)
9. CAPSCREW (2)
10. CAPSCREW (2)
11. LOCK
13. COTTER PIN
14. LOCK

TA 299062

HOW TO USE THIS MANUAL

a. **Overview**. This manual covers all components and systems in individual chapters. Each chapter is divided into the following sections as needed:

(1) GENERAL INFORMATION. This section provides necessary information and makes the chapter more useful.

(2) DESCRIPTION AND DATA. This section provides descriptions of components, theories of operation, and data tables that the user needs in order to understand the equipment. This information is limited to the maintenance level of this manual.

(3) GENERAL MAINTENANCE. This section provides simple replacement, repair, and maintenance instructions for the components and systems. These instructions are presented in a logical order, grouping similar tasks near each other.

(4) REPLACEMENT INSTRUCTIONS. This section provides replacement instructions for complex components. These tasks are more complicated than those found in the General Maintenance Section.

(5) REPAIR INSTRUCTIONS. This section provides repair instructions for simple components. Use of special tools and test equipment is explained as needed.

(6) DISASSEMBLY INTO SUBASSEMBLIES AND REASSEMBLY FROM SUBASSEMBLIES. This sections provides instructions for the disassembly of complex components (for example, the engine) into subassemblies. The user is then referred to the paragraph (or paragraphs) explaining how to repair the subassemblies. An explanation is also given on how to reassemble the component from the repair subassemblies. This arrangement enables the user to quickly find instructions for repair of a single subassembly (for example, the cylinder head) or for repair of the entire component (for example, the engine).

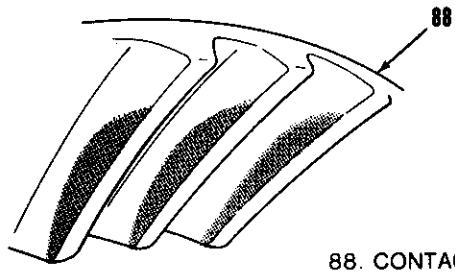
(7) SUBASSEMBLY CLEANING, INSPECTION, AND REPAIR. This section provides instructions for repair of separate subassemblies after they have been removed from a complex component.

(8) TESTS AND ADJUSTMENTS. This section explains how to test and adjust systems or components. This information can be used to either find problems within a system or to check for proper operation after performing repair procedures.

NOTE

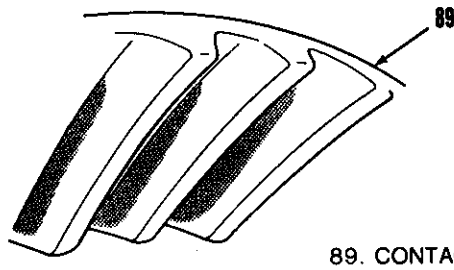
- Any time pinion depth is changed, backlash may change. Check and adjust backlash as needed.
- If shims (53 or 63) have to be changed, the differential carrier assembly (6) must be removed and readjusted.

(c) If pattern is similar to contact pattern (88), where it is too close to tooth top and off center, move pinion (22) towards ring gear (24) by removing shims (53 or 63) from shim pack. Paint ring gear (24) teeth and recheck pattern.



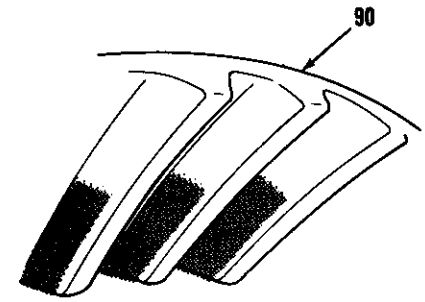
88. CONTACT PATTERN

(d) If pattern is similar to contact pattern (89), where it is too close or off tooth root, move pinion (22) away from ring gear (24) by adding shims (53 or 63) to shim pack. Paint ring gear (24) teeth and recheck pattern.



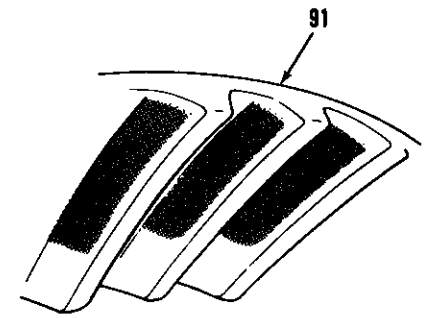
89. CONTACT PATTERN

(e) If pattern is similar to contact pattern (90), where it is too close to edge of tooth toe, move ring gear (24) away from pinion (22) by adding backlash. Paint ring gear (24) teeth and recheck pattern, refer to step (5), section b.



90. CONTACT PATTERN

(f) If pattern is similar to contact pattern (91), where it is too close to edge of tooth toward tooth heel, move ring gear (24) toward pinion (22) to remove backlash. Paint ring gear (24) teeth and recheck pattern, refer to step (5), section c.



91. CONTACT PATTERN

TA 299061

HOW TO USE THIS MANUAL

b. Manual Use. As a maintenance technician, you are responsible for maintaining the equipment covered in this manual. The best way to do this is with the aid of your maintenance manual. Below is a sample problem:

PROBLEM: Organizational Maintenance reports low oil pressure.

(1) How do you start?

Turn to the Cover of this manual.

On the right-hand side, you will find a listing for TROUBLESHOOTING. Along with the listing is a page number. Follow the page number reference to the first page in the TROUBLESHOOTING section.

(2) What is the quickest way to find the solution to the problem?

Turn to paragraph 2-2.

This paragraph begins with the Troubleshooting Symptom Index. Follow the Index until you find the problem (Low Oil Pressure, in this case). Now go to the page cited directly to the right of the malfunction.

(3) What caused the problem?

Use the Troubleshooting tables.

Here you will find the most likely causes of the problem. After following each step, in the order listed, and finding the problem (Let's say a defective engine oil pump) go to the referenced paragraph.

(4) How do you fix the problem?

Turn to paragraph 3-11, Oil Pump Maintenance.

This is the maintenance procedure for the engine's oil pump. It is arranged in step-by-step order so that everything you need to know to maintain the oil pump is covered. The INITIAL SETUP page provides preliminary data that you must know before starting the task. Remember, you must be familiar with all maintenance procedures before you begin the maintenance task.

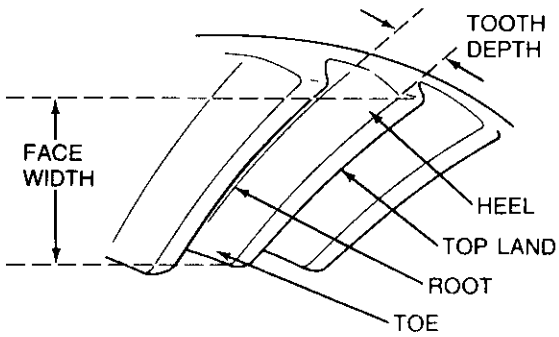
Your maintenance manual is easy to use. Plus, it eliminates mistakes you might make by warning you of possible problems before they occur. To protect personnel and equipment, you must read and follow these WARNINGS and CAUTIONS.

c. Repair Parts and Special Tools. For repair parts and special tools used on this vehicle, refer to TM 2320-24P/14, TM 9-2320-297-24P.

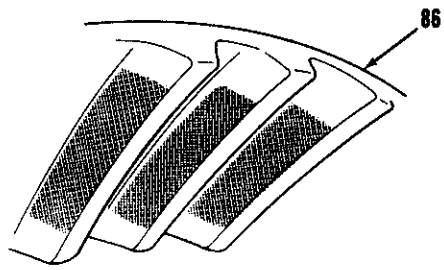
10-19. DIFFERENTIAL CARRIER REPAIR (NO. 3 AND 4 AXLES) (Continued)

(6) Check ring gear (24) and pinion tooth contact by painting 12 ring gear (24) teeth with marking compound. Roll ring gear (24) one complete turn to obtain contact pattern.

RING GEAR TOOTH NOMENCLATURE

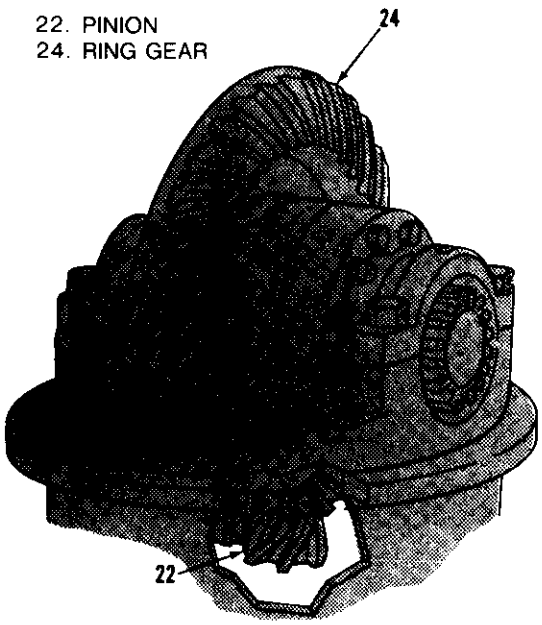


(a) If new gearing, ring gear (24) and/or pinion (22), has been installed, contact pattern (86) must be as shown. Pattern should cover one half width of face and should be evenly centered between tooth top and root. Pattern should be clear of tooth toe.

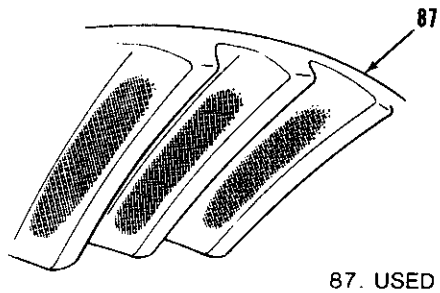


86. NEW GEARING CONTACT PATTERN

22. PINION
24. RING GEAR



(b) If used gearing, ring gear (24) and/or pinion (22), has been installed, contact pattern (87) must be as shown. A correct pattern is clear of toe and centers evenly along width of face between top and root. Length and shape of pattern may vary and is acceptable as long as pattern does not run off tooth at any point.



87. USED GEARING CONTACT PATTERN

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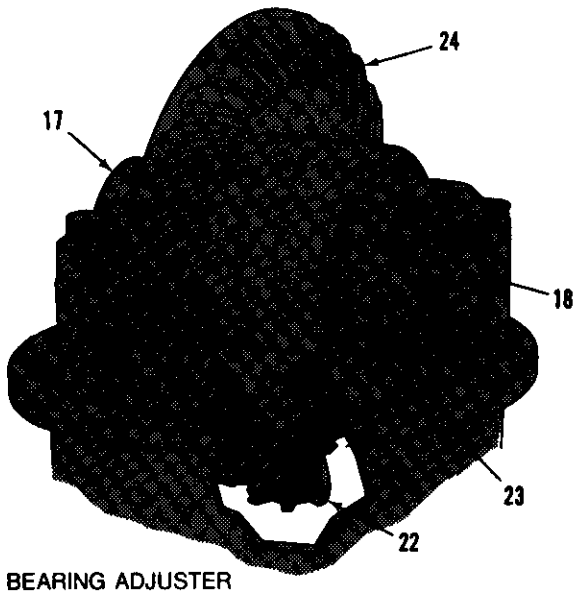


17. BEARING ADJUSTER
18. BEARING ADJUSTER
22. PINION
23. CARRIER HOUSING
24. RING GEAR

d. Adjustment

(1) On toothed side of ring gear (24), position bearing adjuster (18) so that one thread is visible on carrier housing (23).

(2) Tighten bearing adjuster (17) until there is no backlash. Backlash can be checked by facing toward teeth of ring gear (24) and pushing ring gear (24) away from you while rocking ring gear (24) from side to side. There should be no backlash between ring gear (24) and pinion (22).

(3) Rotate ring gear (24) and check for any point where ring gear (24) may bind. If binding, loosen and retighten side bearing adjuster (17).

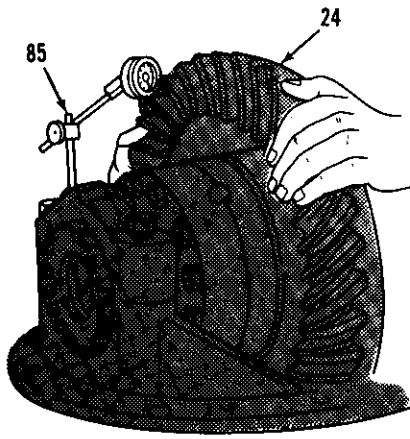
(4) Tighten bearing adjuster (18) until it contacts bearing cup. Continue to tighten bearing adjuster (18) two to three notches.

(5) Measure backlash with a dial indicator (85) at three different points on ring gear (24). Hold pinion (22) while taking backlash measurement.

(a) Using a dial indicator (85) with a magnetic base, position dial indicator (85) so that plunger contacts teeth of ring gear (24). Backlash should be 0.008-0.018 inch (0.203-0.457 N·m).

(b) To add backlash, loosen bearing adjuster (18) three notches. Loosen bearing adjuster (17) one notch. Tighten bearing adjuster (18) until it contacts bearing cup. Then tighten two or three notches further. Recheck backlash.

(c) To remove backlash, loosen bearing adjuster (18) three notches. Tighten bearing adjuster (17) one notch. Tighten bearing adjuster (18) until it contacts bearing cup. Then tighten two or three notches further. Recheck backlash.



24. RING GEAR
85. DIAL INDICATOR

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(52) Install bearing cups (19 and 20)

CAUTION

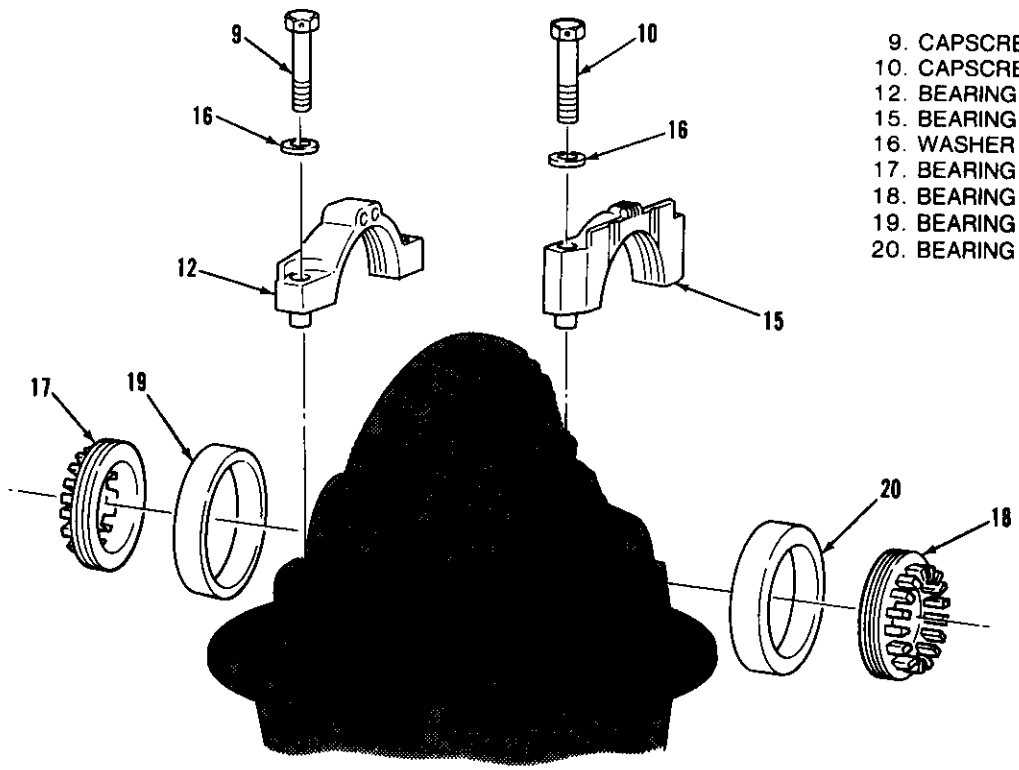
Make sure both bearing caps (12 and 15) are fully seated and bearing adjusters (17 and 18) are not cross threaded.

(53) Install bearing cap (12) and bearing adjuster (17).

(54) Install bearing cap (15) and bearing adjuster (18).

(55) Install two capscrews (9 and 10) and washers (16), on each bearing cap (12 and 15). Hand tighten capscrews (9 and 10).

(56) Rotate bearing adjusters (17 and 18). If adjusters (17 and 18) bind, loosen capscrews (9 and 10) and check to see if bearing adjusters (17 and 18) are cross-threaded.



9. CAPSCREW (2)
10. CAPSCREW (2)
12. BEARING CAP
15. BEARING CAP
16. WASHER (4)
17. BEARING ADJUSTER
18. BEARING ADJUSTER
19. BEARING CUP
20. BEARING CUP

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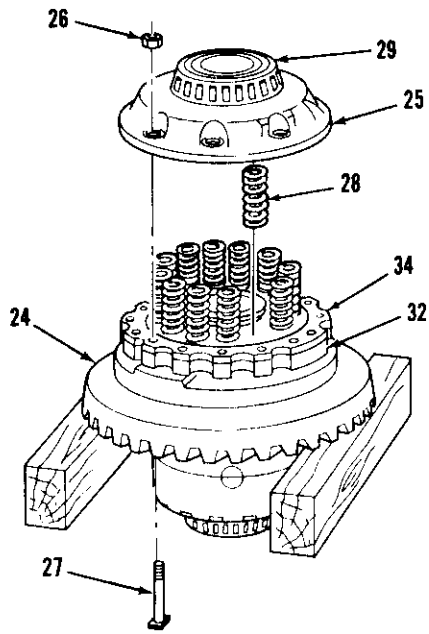


24. RING GEAR
25. CLUTCH PACK COVER
26. LOCKNUT (16)
27. CAPSCREW (16)
28. SPRING (12)
29. BEARING
32. DIFFERENTIAL CASE ASSEMBLY
34. PRESSURE PLATE

(39) Using a press, press bearing (29) on clutch pack cover (25) until seated.

(40) With teeth facing downward, place ring gear (24) on support blocks. Aline holes while inserting differential case assembly (32) through ring gear (24).

NOTE

Be sure ring gear (24) is supported in press to prevent ring gear from slipping down.

(41) Place ring gear (24) and differential case assembly (32) in press.

(42) Install 12 springs (28) in smallest possible circle onto pressure plate (34).

(43) Install clutch pack cover (25) over springs (28).

(44) Reach inside hole in clutch pack cover (25) and move springs (28) outward as far as they will go.

(45) Aline clutch pack cover (25) and ring gear (24) with two capscrews (27). Press clutch pack cover (25) down to compress springs (28) fully.

(46) Install remaining 14 capscrews (27) through ring gear (24), differential case assembly (32), and clutch pack cover (25). Install 16 new locknuts (26) on capscrews (27) and torque to 150-170 foot-pounds (203-230 N·m).

(47) Slowly remove press tension on clutch pack cover (25).

(48) Attach a lifting device (21) to differential carrier assembly (6).

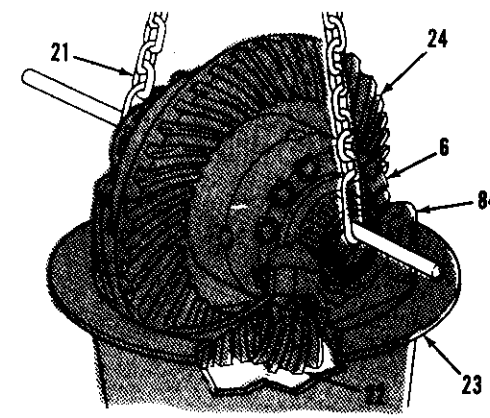
(49) Install two clean shop rags (84) on carrier housing (23) to protect carrier bearings.

NOTE

It may be necessary to tilt differential carrier assembly (6) to aline with pinion (22).

(50) Install differential carrier assembly (6) into carrier housing (23), making sure ring gear (24) alines with pinion (22).

(51) Remove lifting device (21) and shop rags (84).



6. DIFFERENTIAL CARRIER ASSEMBLY
21. LIFTING DEVICE
22. PINION
23. CARRIER HOUSING
24. RING GEAR
84. SHOP RAG (2)

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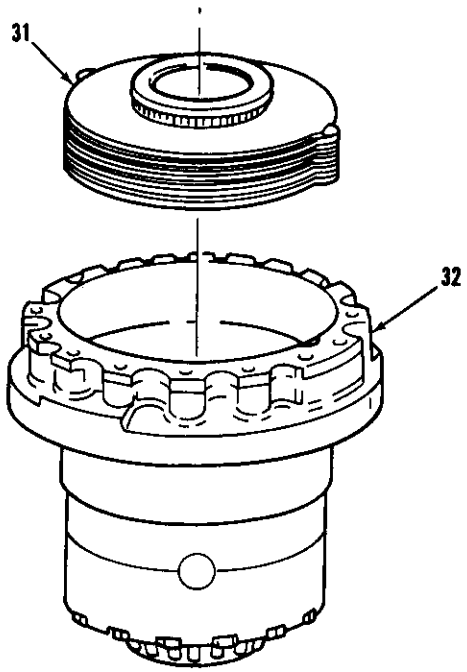
(34) Install square snapring (37) onto plate driver (38).

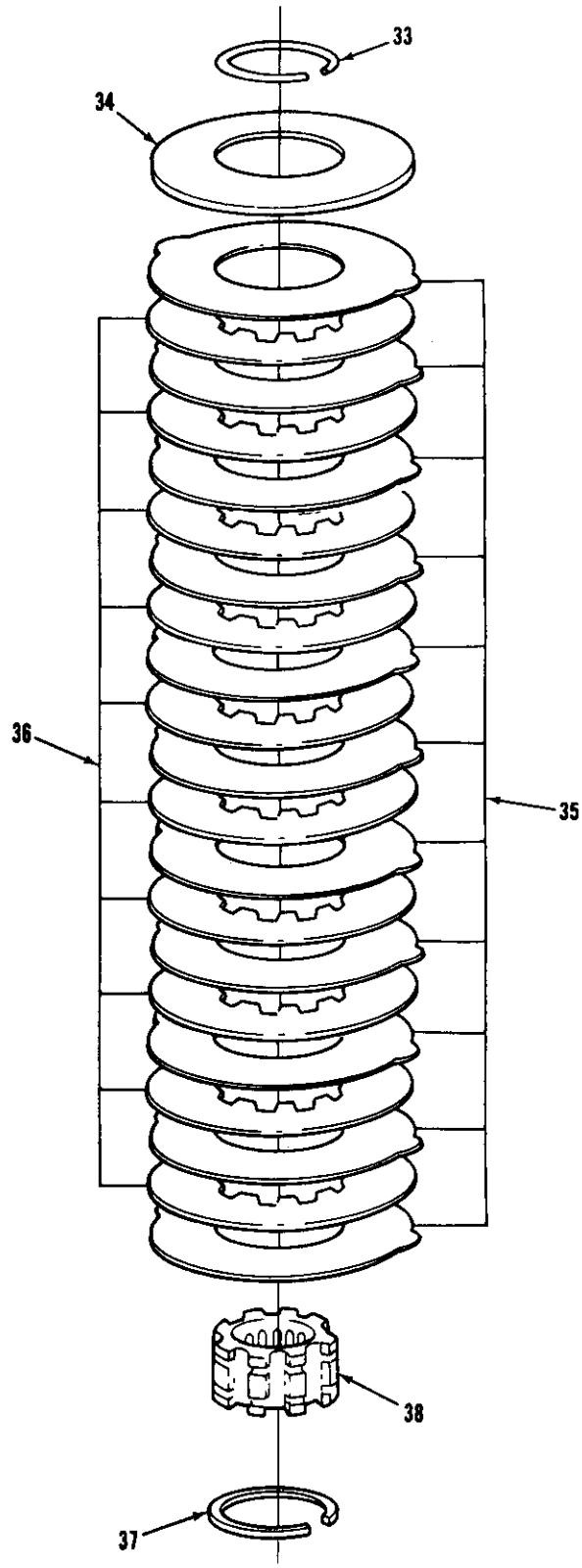
(35) Install plate driver (38) into center of differential case assembly (32).

(36) Starting with externally splined plate (35), alternately install 11 tanged plates (35) and 10 internally splined plates (36) onto plate driver (38).

(37) Install pressure plate (34) onto plate driver (38).

(38) Install round snapring (33) on plate driver (38).





31. CLUTCH PACK ASSEMBLY
32. DIFFERENTIAL CASE ASSEMBLY
33. ROUND SNAPRING
34. PRESSURE PLATE
35. EXTERNALLY SPLINED PLATE (11)
36. INTERNALLY SPLINED PLATE (10)
37. SQUARE SNAPRING
38. PLATE DRIVER

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(26) Using a press, press bearing (50) onto plain case half (39).

(27) Install thrust washer (48) and side gear (47) into flanged case half (40).

(28) Install four pinion gears (46) and thrust washers (45) onto spider (44).

(29) Install spider (44) into flanged case half (40) and rotate spider (44) to make sure gears (46 and 47) mesh.

(30) Install side gear (43) and thrust washer (42) onto spider (44).

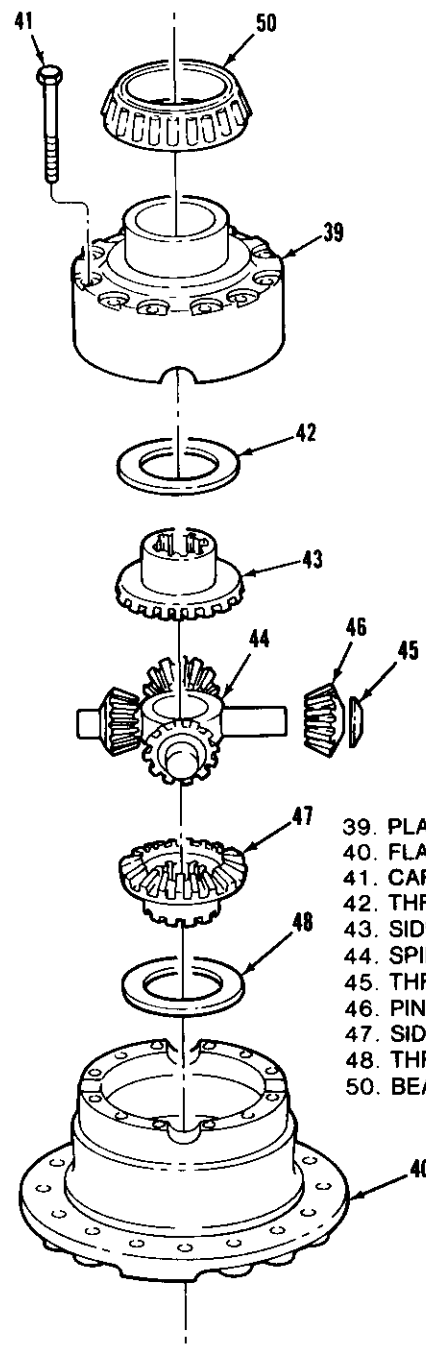
(31) Aline marks made during disassembly and install plain case half (39) onto flanged case half (40).

(32) Install 12 capscrews (41). Torque capscrews (41) to 116-130 foot-pounds (157-176 N·m).

NOTE

If may require up to 50 foot-pounds (68 N·m) of torque to rotate side gear (47).

(33) Check differential gears for free rotation by turning side gear (47).



39. PLAIN CASE HALF
40. FLANGED CASE HALF
41. CAPSCREW (12)
42. THRUST WASHER
43. SIDE GEAR
44. SPIDER
45. THRUST WASHER (4)
46. PINION GEAR (4)
47. SIDE GEAR
48. THRUST WASHER
50. BEARING

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10-19. DIFFERENTIAL CARRIER REPAIR (NO. 3 AND 4 AXLES) (Continued)

(25) For No. 3 axle, install pinion assembly (51) as follows:

NOTE

If original gear set is being reused, use same size shim pack as removed during disassembly. If new gear set is being used, use a shim pack of 0.024 inch (0.609 mm).

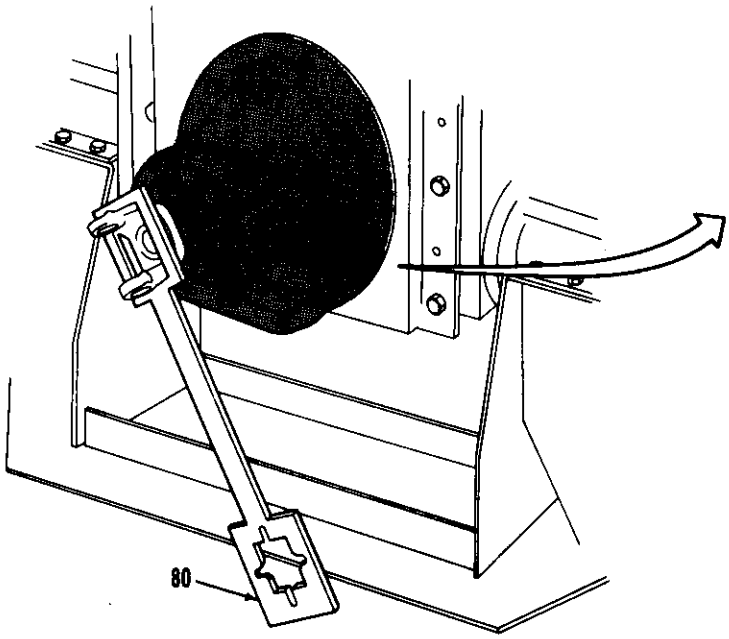
(a) Install shim (53) onto carrier housing (23).

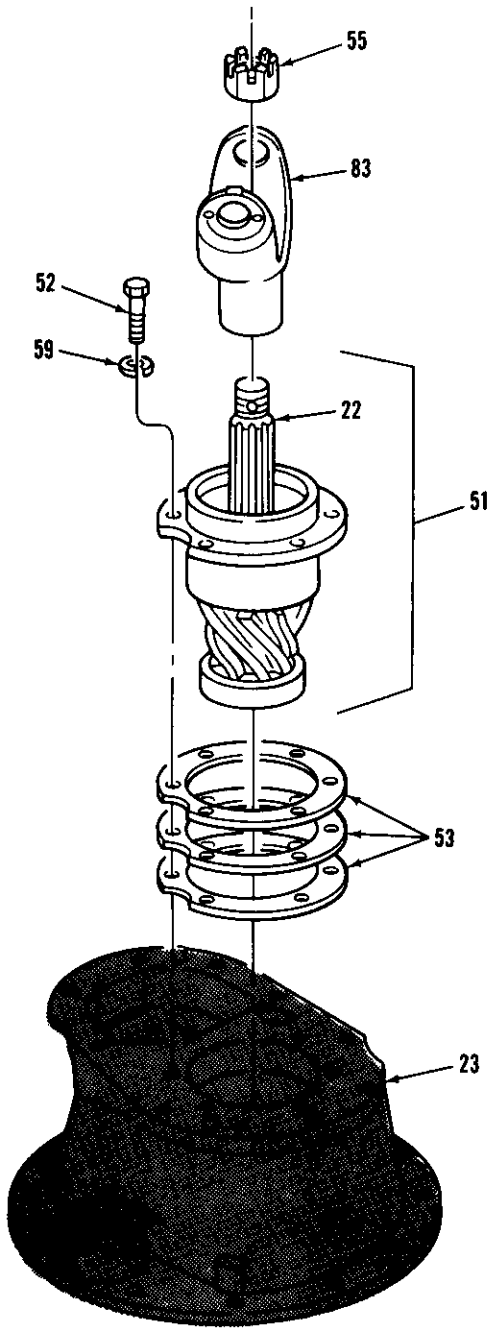
(b) Install pinion assembly (51) on carrier housing (23).

(c) Install six capscrews (52) and new lockwashers (59). Torque capscrews (52) to 155-175 foot-pounds (210-237 N·m).

(d) Install dummy yoke (83) and nut (55) on pinion (22).

(e) Install flange holder (80) on dummy yoke (83) and torque nut (55) to 840-1020 foot-pounds (1,139-1,383 N·m).





NO.3
AXLE

22. PINION
23. CARRIER HOUSING
51. PINION ASSEMBLY (NO. 3 AXLE)
52. CAPSCREW (6)
53. SHIM PACK
55. NUT
59. LOCKWASHER (6)
80. FLANGE HOLDER
83. DUMMY YOKE

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(24) For No. 4 axle, install pinion assembly (60) as follows:

NOTE

If original gear set is being reused, use same size shim pack as removed during disassembly. If new gear set is being used, use a shim pack of 0.024 inch (0.609 mm).

(a) Install shims (63) onto carrier housing (23).

(b) Install pinion assembly (60) on carrier housing (23).

(c) Install six capscrews (61) and new lockwashers (62). Torque capscrews (61) to 160-176 foot-pounds (217-239 N·m).

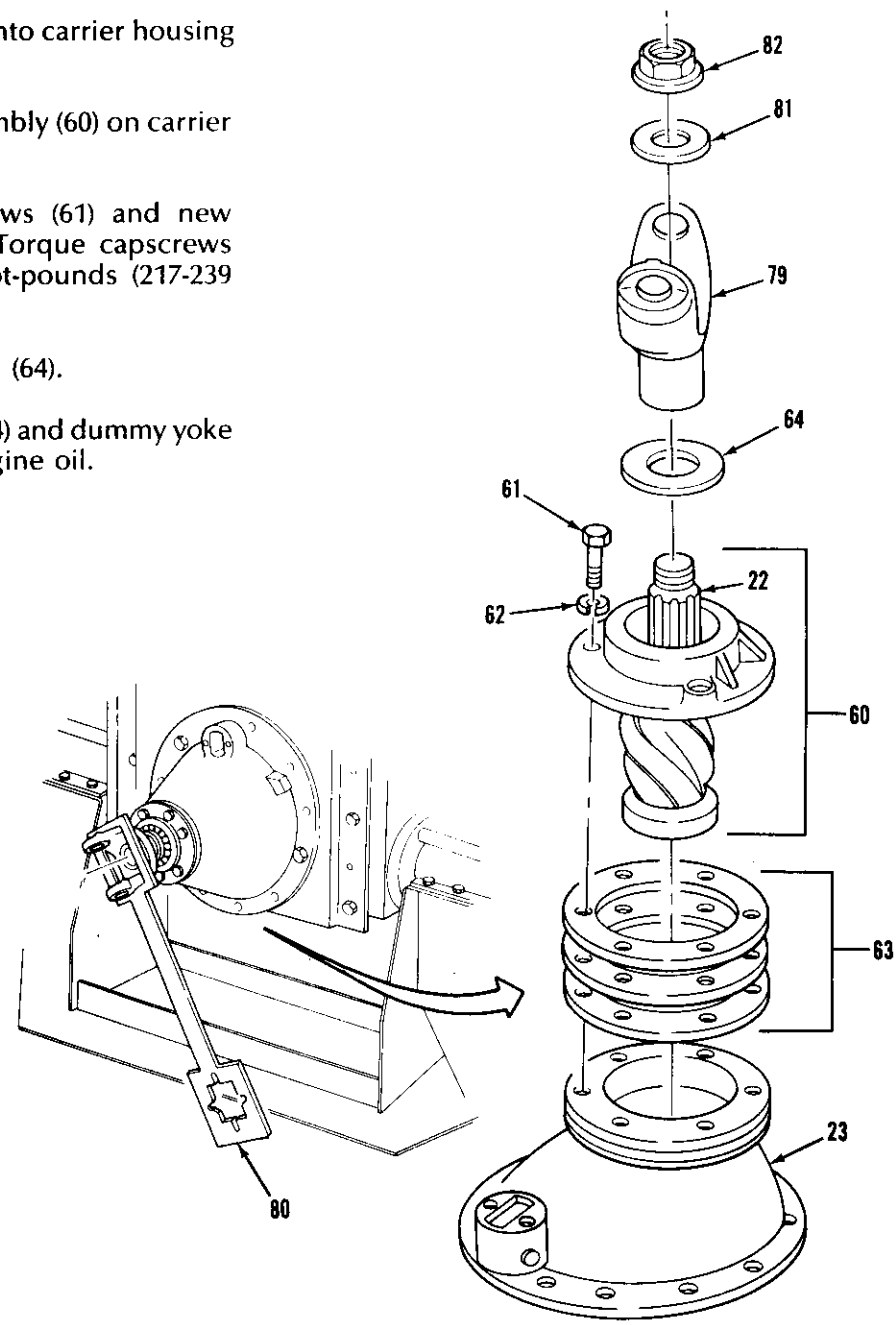
(d) Install new oil seal (64).

(e) Lubricate oil seal (64) and dummy yoke (79) with clean engine oil.

(f) Slide dummy yoke (79) onto pinion (22).

(g) Install flange holder (80) on dummy yoke (79).

(h) Install washer (81) and new locknut (82). Torque locknut (82) to 840-1020 foot-pounds (1139-1383 N·m).



22. PINION
23. CARRIER HOUSING
60. PINION ASSEMBLY (NO. 4 AXLE)
61. CAPSCREW (6)
62. LOCKWASHER (6)
63. SHIM
64. OIL SEAL
79. DUMMY YOKE
80. FLANGE HOLDER
81. WASHER
82. LOCKNUT

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10-19. DIFFERENTIAL CARRIER REPAIR (NO. 3 AND 4 AXLES) (Continued)

(13) Press pilot bearing (72) on end of pinion (22).

(14) Using a center punch and hammer, form a staking pattern (77).

(15) Remove inner bearing (71) from bearing cage (58).

(16) Press inner bearing (71) on pinion (22) so that bevel part of inner bearing (71) is towards threaded end of pinion (22).

(17) Install spacer washer (69) and 0.001 inch (0.0254 mm) larger spacer (68) on pinion (22). Spacer (68) thickness was determined when setting bearing preload.

(18) Install bearing cage (58) on pinion (22).

(19) Press outer bearing (65) on pinion (22).

(20) Install a sleeve (78) over outer bearing (65). Position sleeve (78) so that load is directly applied to outer bearing (65).

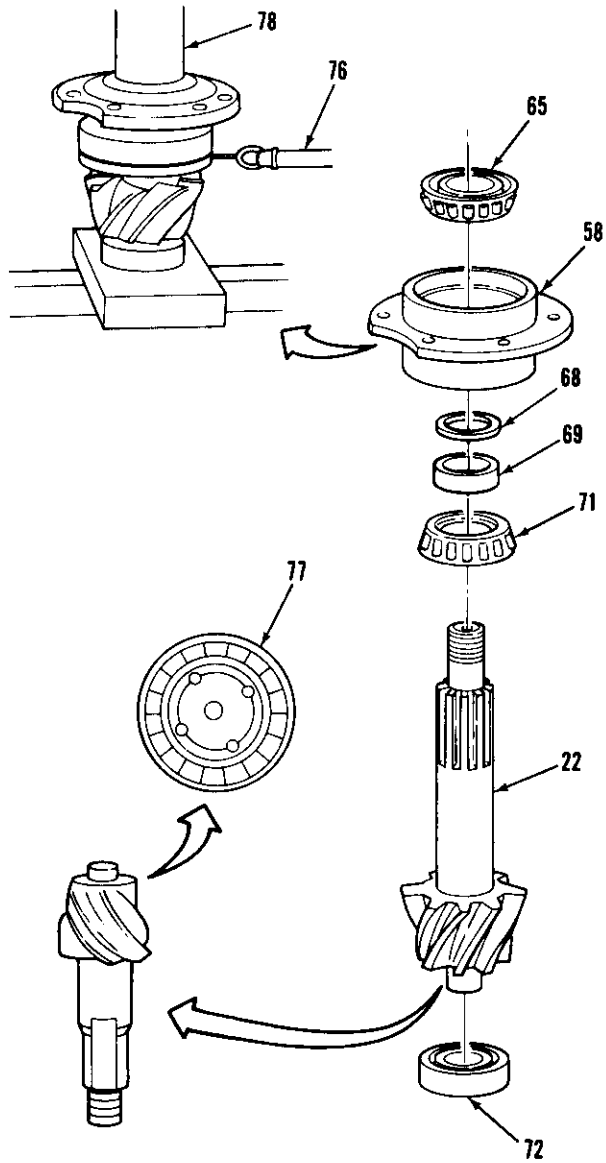
(21) Using a press, apply a load of 18-20 tons (16.3-18.0 metric tons) to outer bearing (65).

(22) Attach and wrap wire around bearing cage (58). Attach spring scale (76) and pull. Preload is correct when 5-12 pounds (2-5 kg) of pull will rotate bearing cage (58).

CAUTION

To prevent early failure of bearings and/or gear set, bearing preload must be 5-12 pounds (2-5 kg). Make sure final preload is within these specifications.

(23) Adjust preload if needed. Thicker spacer (68) will decrease preload, thinner spacer (68) will increase preload.



NO. 3 AXLE

22. PINION
58. BEARING CAGE
65. OUTER BEARING
68. SPACER
69. SPACER WASHER
71. INNER BEARING
72. PILOT BEARING
76. SPRING SCALE
77. STAKING PATTERN
78. SLEEVE

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c. Assembly

(1) If removed, press bearing cups (66 and 67) (beveled edge out) into bearing cage (58). Make sure bearing cups (66 and 67) are fully seated in bearing cage (58).

(2) Install inner bearing (71) on machined side of bearing cage (58). Coat with clean oil.

(3) Install spacer washer (69) inside bearing cage (58) on inner bearing (71).

(4) If bearings (65 and 71) are being reused, place spacer (68) (removed during assembly) inside bearing cage (58).

(5) If new bearings (65 and 71) are being used, place new spacer (68) 0.185 inch (4.699 mm) thick inside bearing cage (58).

(6) Install outer bearing (65) into bearing cage (58). Coat with clean oil.

(7) Place bearing cage assembly (73) into press so that outer bearing cup (66) is towards press ram (74).

(8) Install a sleeve (75) over outer bearing (65). Position sleeve (75) so that load is directly applied to outer bearing (65).

(9) Using a press, apply a load of 18-20 tons (16.3-18.0 metric tons) to outer bearing (65).

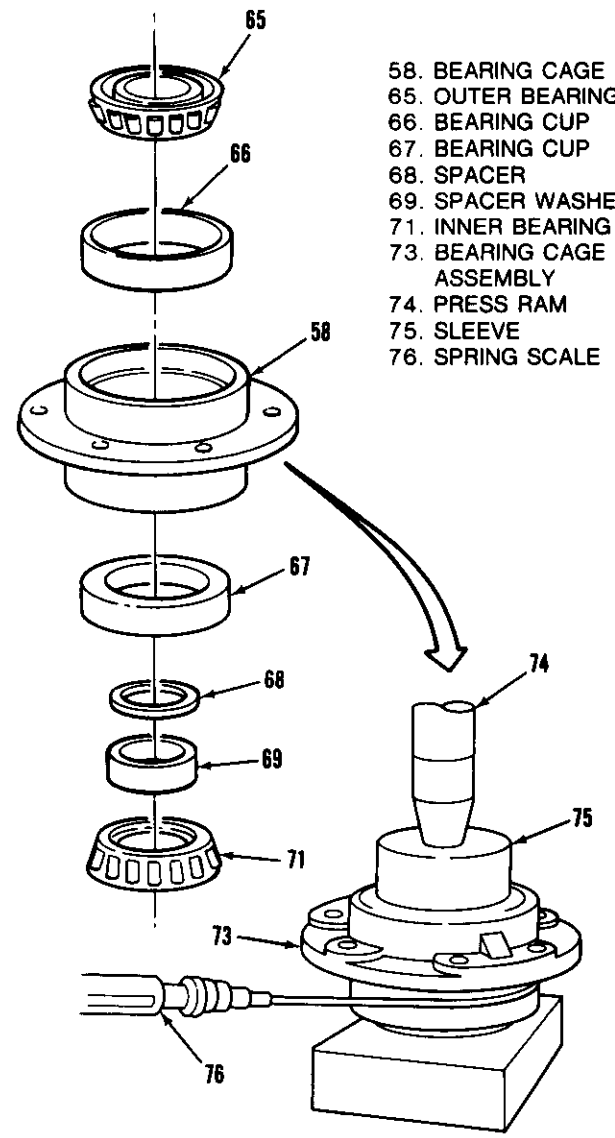
(10) Attach and wrap a piece of wire around bearing cage (58). Attach a spring scale (76) to wire and pull. Preload is correct when 3-7 pounds (2-3 kg) of pull will rotate bearing cage (58).

NOTE

Use a thicker spacer (68) to decrease preload or a thinner spacer (68) to increase preload.

(11) Remove outer bearing (65) and spacer (68). Exchange spacer (68) as needed to obtain correct preload.

(12) When proper preload has been found, select a spacer (68) 0.001 inch (0.0254 mm) thicker for use during final assembly.



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(32) Remove outer bearing (65) from bearing cage (58).

(33) If damaged, remove bearing cups (66 and 67) from bearing cage (58).

(34) Remove spacer (68) and spacer washer (69) from pinion (22).

(35) Using a split-type puller (70) and press, remove bearings (71 and 72) from pinion (22).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect gears for obvious damage or signs of overheating.

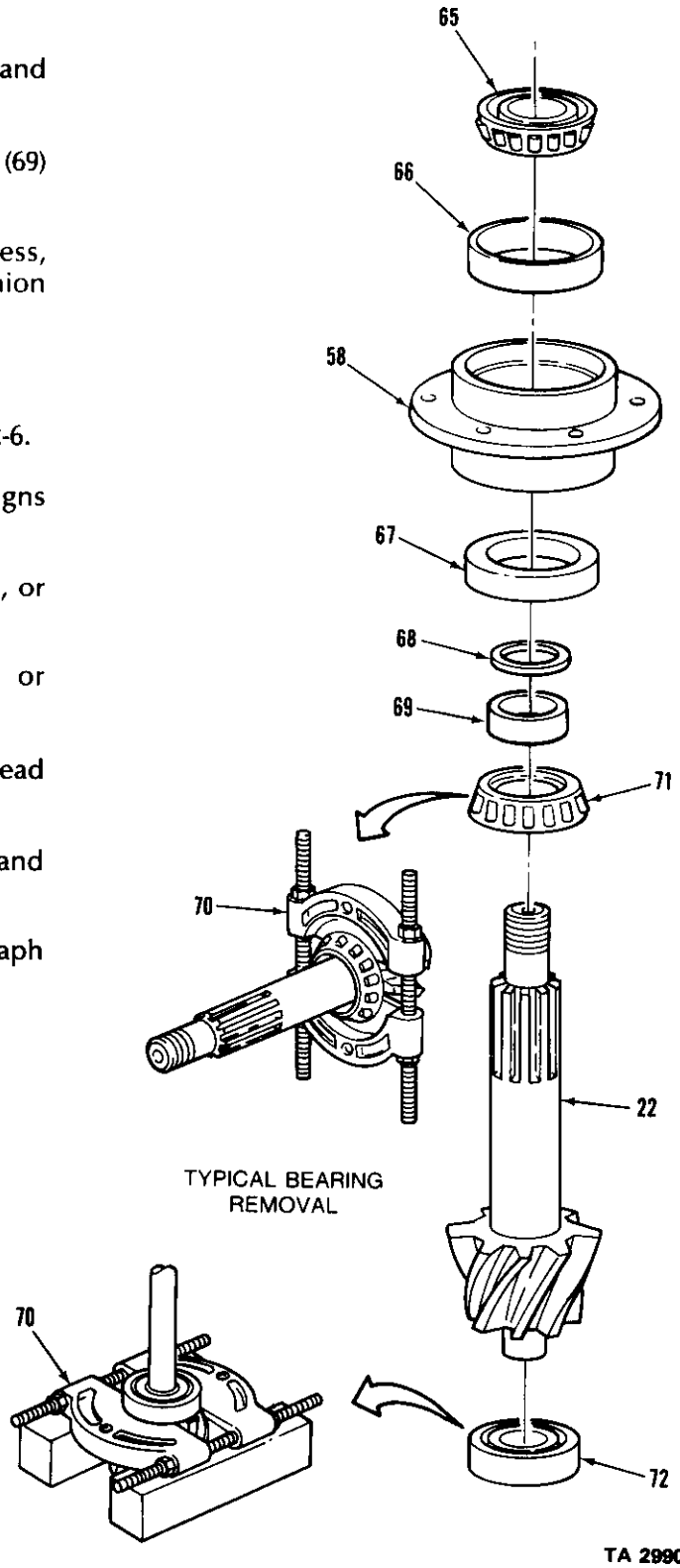
(3) Inspect bearings for damage, pitting, or scoring.

(4) Inspect clutch plates for scoring or burning.

(5) Inspect capscrews and nuts for thread damage.

(6) Inspect splines on side gears, clutch, and clutch plates for damage.

(7) Inspect all other parts. Refer to paragraph 2-7.



TYPICAL BEARING REMOVAL

22. PINION
58. BEARING CAGE
65. OUTER BEARING
66. BEARING CUP
67. BEARING CUP
68. SPACER
69. SPACER WASHER
70. SPLIT-TYPE PULLER (TOOL)
71. INNER BEARING
72. PILOT BEARING

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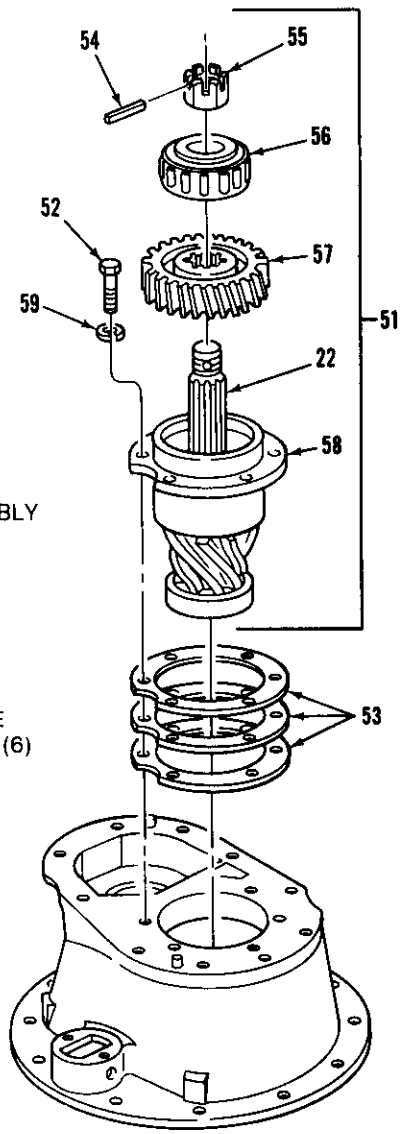
(c) Install pinion assembly (51) into a soft-jawed vise. Remove roll pin (54) and nut (55).

(d) Place pinion assembly (51) in a press.

(e) Press bearing (56) and gear (57) off pinion (22).

(f) Press pinion (22) from bearing cage (58).

(g) Remove six capscrews (52) and lockwashers (59). Discard lockwashers (59).



NO. 3 AXLE

22. PINION
51. PINION ASSEMBLY (NO. 3 AXLE)
52. CAPSCREW (6)
53. SHIM
54. ROLL PIN
55. NUT
56. BEARING
57. GEAR
58. BEARING CAGE
59. LOCKWASHER (6)

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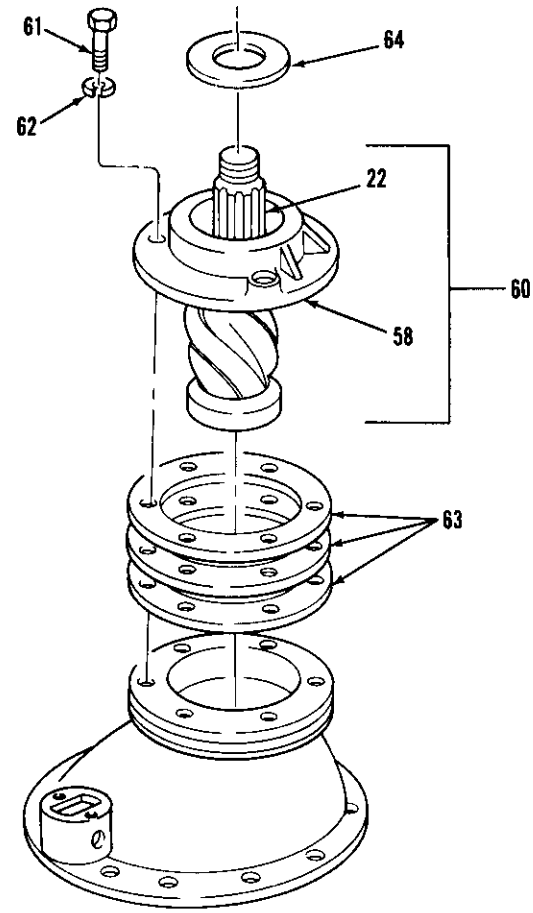

NO. 4 AXLE

22. PINION
58. BEARING CAGE
60. PINION ASSEMBLY (NO. 4 AXLE)
61. CAPSCREW (6)
62. LOCKWASHER (6)
63. SHIMS
64. OIL SEAL

(31) For No. 4 axle, remove pinion assembly (60) as follows:

(a) Remove six capscrews (61) and lockwashers (62). Discard lockwashers (62).

(b) Remove pinion assembly (60).

(c) Tag and remove shims (63).

(d) Place pinion assembly (60) into press. Press pinion (22) out of bearing cage (58).

(e) Remove and discard oil seal (64).

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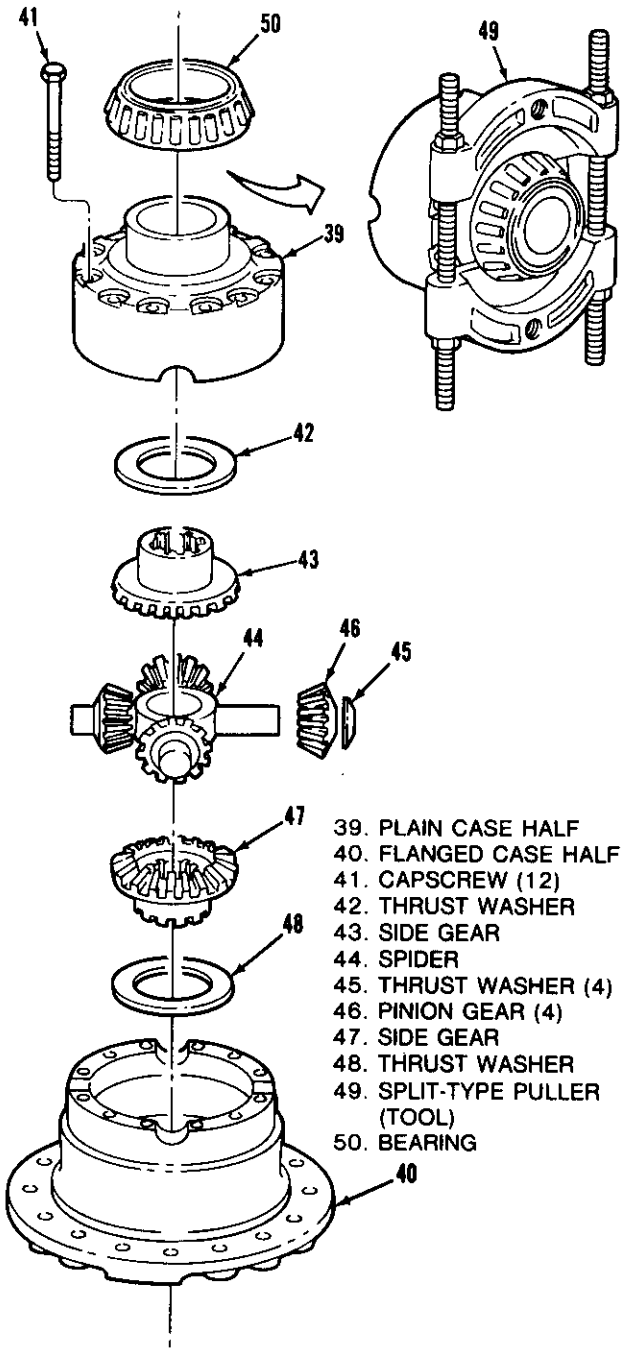

39. PLAIN CASE HALF
40. FLANGED CASE HALF
41. CAPSCREW (12)
42. THRUST WASHER
43. SIDE GEAR
44. SPIDER
45. THRUST WASHER (4)
46. PINION GEAR (4)
47. SIDE GEAR
48. THRUST WASHER
49. SPLIT-TYPE PULLER (TOOL)
50. BEARING

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(23) Matchmark differential case halves (39 and 40).

(24) Remove 12 capscrews (41).

NOTE

It may be necessary to tap plain case half (39) with a soft-faced hammer in order to break it loose.

(25) Remove plain case half (39), thrust washer (42), and side gear (43).

CAUTION

Pinion gears (46) are loose on spider (44) and may slide off when removing spider (44).

(26) Remove spider (44), four thrust washers (45), and pinion gears (46) from flanged case half (40).

(27) Remove four thrust washers (45) and pinion gears (46) from spider (44).

(28) Remove side gear (47) and thrust washer (48).

(29) If damaged, use split-type puller (49) to remove bearing (50) from plain case half (39).

NOTE

It may be necessary to lift up on pinion assembly (51) in order to completely loosen capscrews (52).

(30) For No. 3 axle, remove pinion assembly (51) as follows:

(a) Loosen six capscrews (52) and remove pinion assembly (51).

(b) Tag and remove shims (53).

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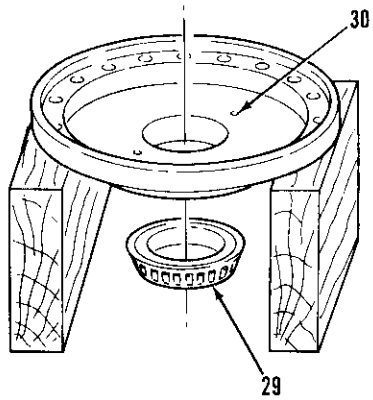


29. BEARING
30. COVER HOLE (2)

(16) Remove bearing (29), if damaged, by placing a punch in cover holes (30) and tapping on inner race of bearing (29).

(17) Remove clutch pack assembly (31) from differential case assembly (32).

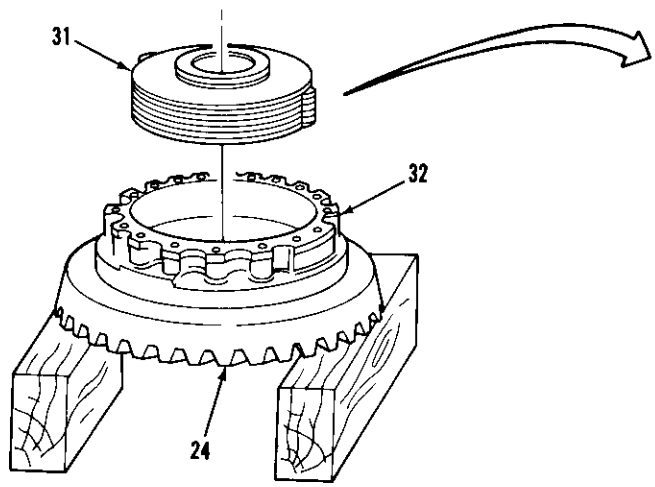
(18) Remove round snapring (33) and pressure plate (34).

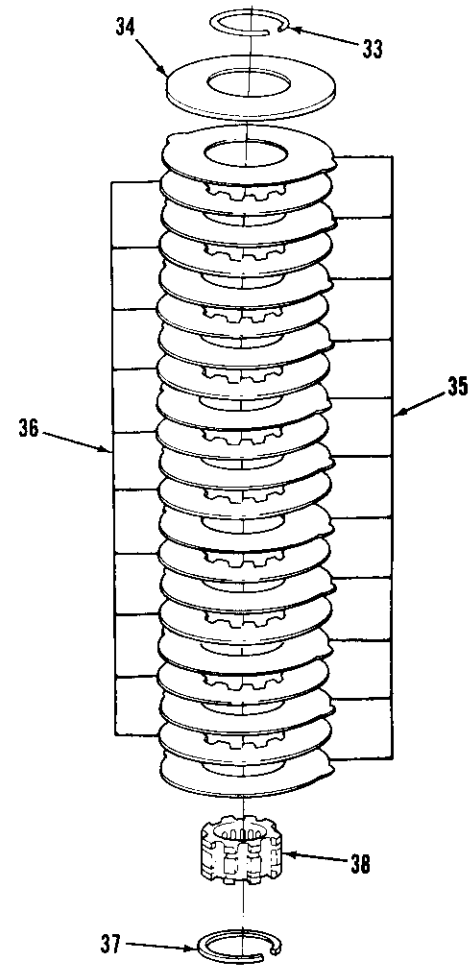
(19) Remove 11 externally splined plates (35) and 10 internally splined plates (36).

(20) Remove square snapring (37) from plate driver (38).

(21) Remove wooden blocks from below ring gear (24) and lower ring gear (24) from differential case assembly (32).

(22) Remove differential case assembly (32) and ring gear (24) from press.





24. RING GEAR
31. CLUTCH PACK ASSEMBLY
32. DIFFERENTIAL CASE ASSEMBLY
33. ROUND SNAPRING
34. PRESSURE PLATE
35. EXTERNALLY SPLINED PLATE (11)
36. INTERNALLY SPLINED PLATE (10)
37. SQUARE SNAPRING
38. PLATE DRIVER

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CHAPTER 1

INTRODUCTION

1-1. OVERVIEW

This chapter familiarizes the technician with standard forms, record data, and basic information about the Logistics Vehicle System (LVS), also referred to as non-A1 vehicles, and Logistics Vehicle A1 series vehicles (LVSA1).

Section I. General Information

Section II. Equipment Description and Data

SECTION I. GENERAL INFORMATION

1-2. SCOPE

a. **Type of Manual.** This technical manual contains instructions for the Direct Support (third echelon) and General Support/(fourth echelon) Intermediate Maintenance levels for the Logistics Vehicle System (LVS), also referred to as non-A1 vehicles, and Logistics Vehicle A-1 series vehicles (LVSA1).

b **Equipment Name and Model Numbers.** The components of the LVS covered in this manual include:

MK48 – Power Unit, front, 4 x 4
MK48A1 – Power Unit, front, 4 x 4

MK14 – Trailer, powered, Container Hauler, 4 x 4
MK14A1 – Trailer, powered, Container Hauler, 4 x 4

MK15 – Trailer, powered, Wrecker/Recovery, 4 x 4
MK15A1 – Trailer, powered Wrecker/Recovery, 4 x 4

MK16 – Trailer, powered, Fifth Wheel, Semitrailer Adapter, 4 x 4
MK16A1 – Trailer, powered, Fifth Wheel Semitrailer Adapter, 4 x 4

MK17 – Trailer, powered, Dropside Cargo w/Crane, 4 x 4
MK17A1 – Trailer, powered, Dropside Cargo w/Crane, 4 x 4

1-3. MAINTENANCE FORMS, RECORDS, AND REPORTS

Equipment record procedures, refer to TM-4700-15/1.

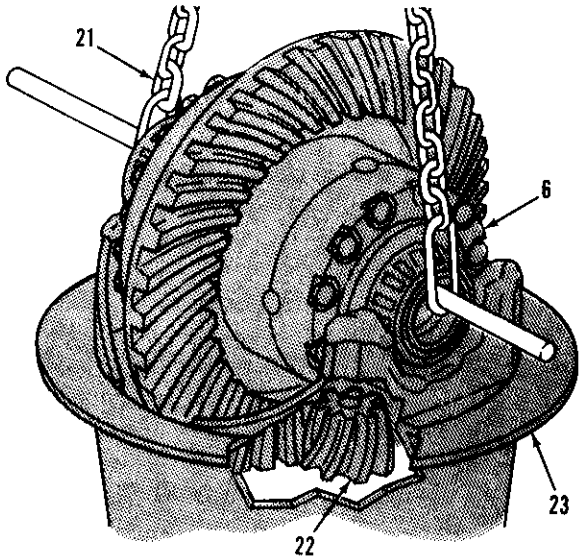
1-4. DESTRUCTION OF MATERIEL TO PREVENT ENEMY USE

Procedures for destruction of materiel to prevent enemy use can be found in TM 750-244-2.

1-5. REPAIR PARTS, SPECIAL TOOLS, AND SUPPORT EQUIPMENT

All repair parts, special tools, and support equipment are listed in TM 2320-24P/14, TM 9-2320-297-24P.

10-19. DIFFERENTIAL CARRIER REPAIR (NO. 3 AND 4 AXLES) (Continued)



6. DIFFERENTIAL CARRIER ASSEMBLY
21. LIFTING DEVICE
22. PINION GEAR
23. CARRIER HOUSING

WARNING

Differential carrier assembly (6) is extremely heavy. Use proper lifting device to prevent equipment damage and personal injury.

CAUTION

Use care not to damage pinion housing when removing differential carrier assembly from carrier housing. Do not lift straight up.

(10) Attach lifting device (21) to differential carrier assembly (6). Tilt differential carrier assembly (6) to avoid damaging pinion gear (22) and carrier housing (23). Remove from carrier housing (23).

(11) Place differential carrier assembly (6) in press, with teeth of ring gear (24) facing down.

(12) Support ring gear (24) to prevent it from falling when clutch pack cover (25) is removed.

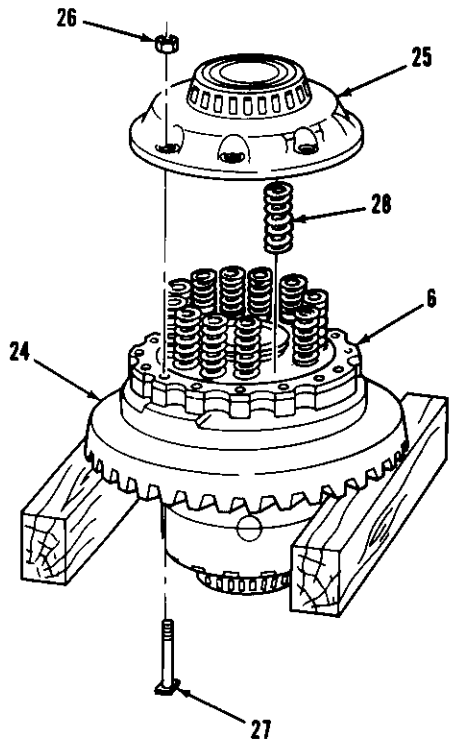
(13) Apply pressure to clutch pack cover (25) and remove 16 locknuts (26) and capscrews (27). Discard locknuts (26).

WARNING

Clutch pack cover is under spring tension. To prevent personal injury, release tension slowly.

(14) Slowly release press pressure until all spring tension is released, then remove clutch pack cover (25).

(15) Remove 12 springs (28).



6. DIFFERENTIAL CARRIER ASSEMBLY
24. RING GEAR
25. CLUTCH PACK COVER
26. LOCKNUT (16)
27. CAPSCREW (16)
28. SPRING (12)

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1-6. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS

If the Logistics Vehicle System needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Put it on an SF368 form (Quality Deficiency Report). Submit to:

Commanding General
Marine Corps Logistics Base
Code 808
Albany, Georgia 31704-5000

1-7. WARRANTY INFORMATION

The LVS Series vehicles are warranted by Oshkosh Truck Corporation for 15 months or 15,000 miles (24,135 km), whichever comes first. The LVSA1 Series vehicles are warranted by Oshkosh Truck Corporation for 24 months or 24,000 miles (38,616 km) whichever comes first. The warranty starts on the date found in block 2/A, DD Form 250. Report all defects in material or workmanship to your NCOIC, who will take appropriate action.

SECTION II. EQUIPMENT DESCRIPTION AND DATA

1-8. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

For a complete description of characteristics, capabilities, and features of the Logistics Vehicle System and the Logistics Vehicle System A1 Series, refer to TM 2320-10/11, TM 9-2320-297-10.

1-9. PRINCIPLES OF OPERATION

The principles of operation for the vehicle can be found in TM 2320-10/11, TM 9-2320-297-10. The principles of operation for individual components can be found in the applicable maintenance chapters within this manual.

1-10. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

Refer to TM 2320-10/11, TM 9-2320-297-10 for the location and description of the major components of the Logistics Vehicle System and the Logistics Vehicle System A1 Series.

1-11. DIFFERENCES BETWEEN MODELS

The major equipment and functional differences between models are given in TM 2320-10/11, TM 9-2320-297-10.

1-12. EQUIPMENT DATA

Refer to TM 2320-10/11, TM 9-2320-297-10 for all data and specifications for the Logistics Vehicle System and the Logistics Vehicle System A1 Series.

(4) Cut lockwire (7) from capscrews (8, 9, and 10). Discard lockwire (7).

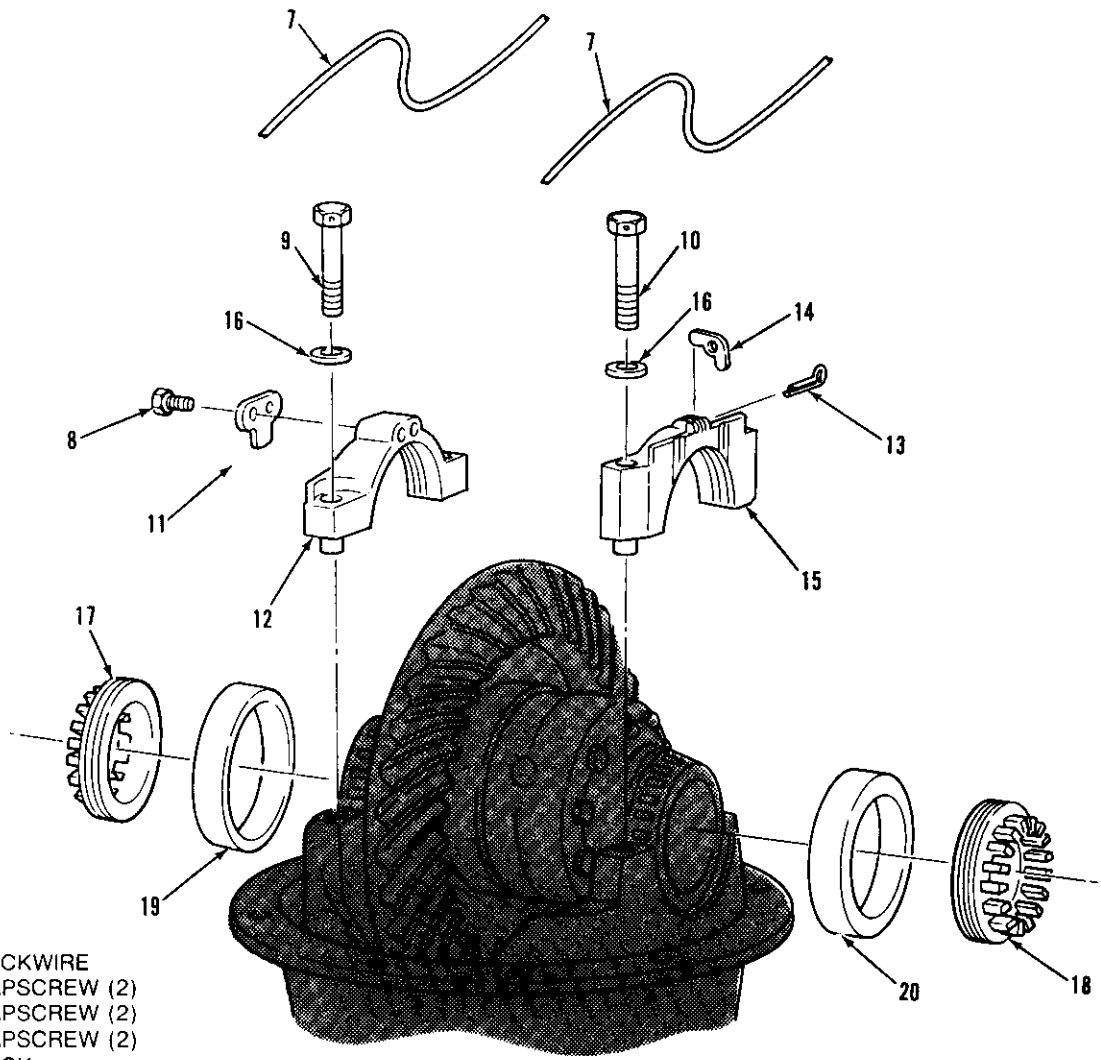
(5) Remove two capscrews (8) and lock (11) from bearing cap (12).

(6) Remove cotter pin (13) and lock (14) from bearing cap (15). Discard cotter pin (13).

(7) Remove two capscrews (9) and washers (16) from bearing cap (12). Remove two capscrews (10) and washers (16) from bearing cap (15).

(8) Tag and remove bearing adjusters (17 and 18) and bearing caps (12 and 15).

(9) Tag and remove bearing cups (19 and 20).



7. LOCKWIRE
8. CAPSCREW (2)
9. CAPSCREW (2)
10. CAPSCREW (2)
11. LOCK
12. BEARING CAP
13. COTTER PIN
14. LOCK
15. BEARING CAP
16. WASHER (4)
17. BEARING ADJUSTER
18. BEARING ADJUSTER
19. BEARING CUP
20. BEARING CUP

TA 299045

CHAPTER 2

VEHICLE MAINTENANCE

2-1. OVERVIEW

This section provides information authorized for Third and Fourth Echelon Maintenance level mechanics. The following sections cover troubleshooting and maintenance procedures for the LVS:

Section I. Troubleshooting

Section II. Maintenance Procedures

SECTION I. TROUBLESHOOTING

2-2. TROUBLESHOOTING PROCEDURES

The troubleshooting charts in this paragraph are presented in the same order as the chapters in this manual. Engine first, fuel systems second, exhaust systems third, etc. They provide information needed to correctly isolate, diagnose, and correct malfunctions within the systems. Each malfunction symptom given for an individual component or system is followed by step(s) leading to the cause of the malfunction and the actions needed to correct it.

To quickly find the troubleshooting procedure you need, use the Symptom Index. The symptoms are listed by components or system headings.

TROUBLESHOOTING SYMPTOM INDEX

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10-19. DIFFERENTIAL CARRIER REPAIR (NO. 3 AND 4 AXLES)

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly
d. Adjustment

INITIAL SETUP

Applicable Configurations

MK14
MK15
MK16
MK17

Special Tools

Flange yoke holding bar (J 3453)
Dial indicator (J 7872)
Chain wrench (P/N CW24)

Materials/Parts

Lockwire (item 33, Appendix C)
Marking compound (item 36, Appendix C)
Gear oil (item 40, Appendix C)
Expansion plug (P/N 9797) item 1
Expansion plug (NSN 5340-01-027-2592) item 2
Cotter pin (NSN 5315-00-135-7277) item 13
Locknut (16) (MS51943-46) item 26
Lockwasher (6) (MS35338-49) item 59
Oil seal (NSN 5330-01-158-2061) item 64
Dummy yoke (NSN 2520-01-159-9802) items 79 and 83
Locknut (NSN 5310-01-151-8344) item 82

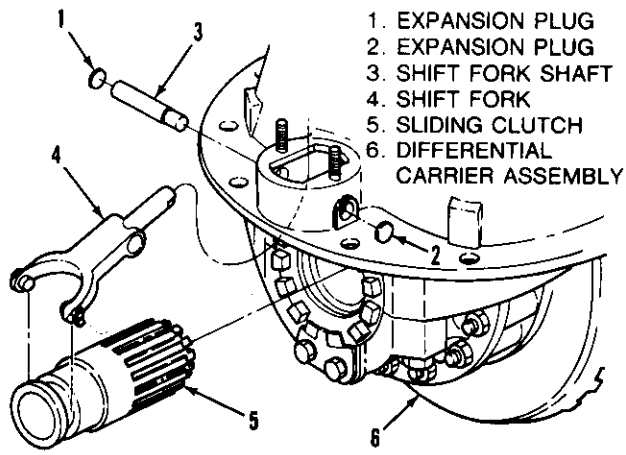
Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Remove differential carrier on No. 3 axle as needed (para 10-16). Remove differential carrier on No. 4 axle as needed (para 10!17).

a. Disassembly

(1) Using a punch, remove and discard expansion plugs (1 and 2).

(2) Drive out shift fork shaft (3) through top hole.

(3) Disengage shift fork (4) from sliding clutch (5). Remove sliding clutch (5) and shift fork (4) from differential carrier assembly (6).



1. EXPANSION PLUG
2. EXPANSION PLUG
3. SHIFT FORK SHAFT
4. SHIFT FORK
5. SLIDING CLUTCH
6. DIFFERENTIAL CARRIER ASSEMBLY

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(15) Install flange holder tool (77) on dummy yoke (65).

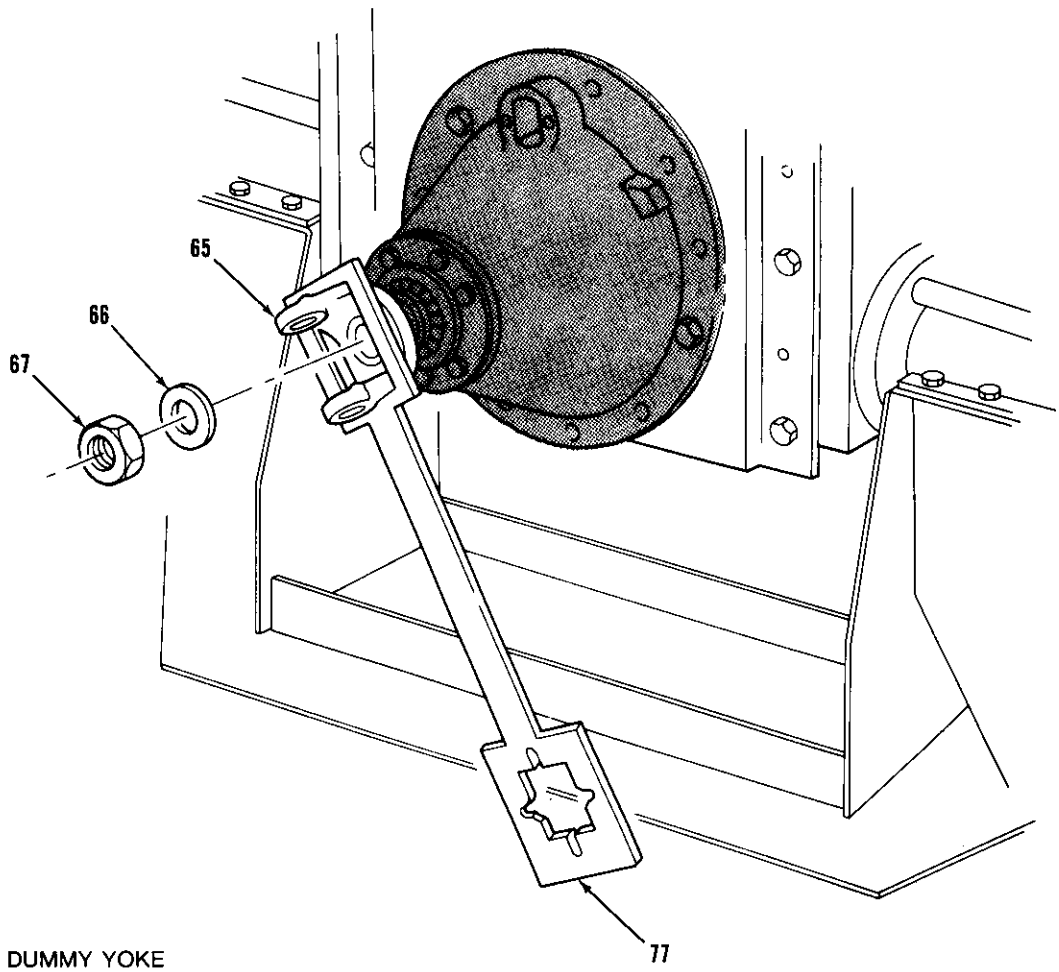
(16) Remove nut (67), washer (66), and dummy yoke (65).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install differential carrier (para 10-17).



65. DUMMY YOKE
66. WASHER
67. NUT
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END OF TROUBLESHOOTING SYMPTOM INDEX

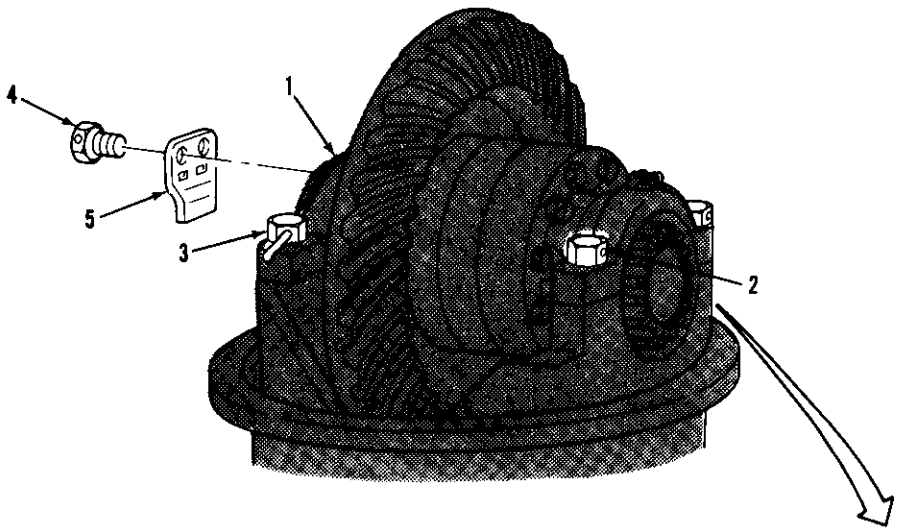
10-18. DIFFERENTIAL CARRIER REPAIR (NO. 2 AXLE) (Continued)

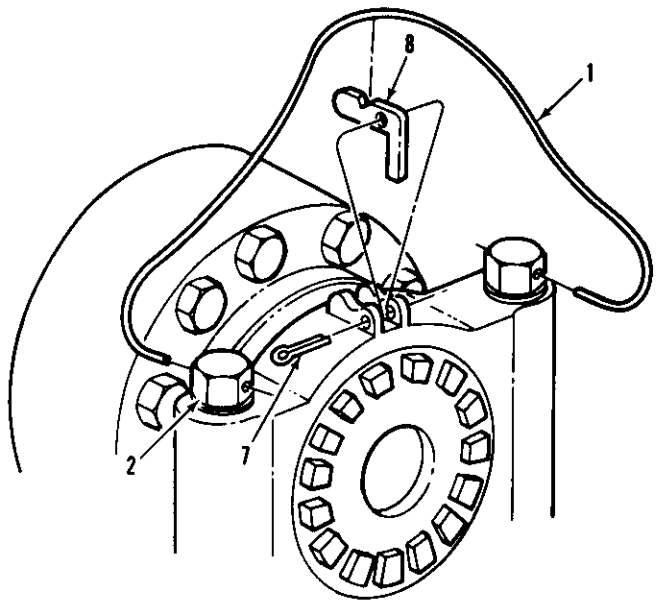
(11) Install lock (8) and new cotter pin (7).

(12) Install lock (5) and two capscrews (4). Torque capscrews (4) to 160-178 foot-pounds (217-239 N·m).

(13) Torque capscrews (2 and 3) to 360-440 foot-pounds (448-596 N·m).

(14) Install new lockwires (1) on capscrews (2 and 3) and two capscrews (4).





1. LOCKWIRE (3)
2. CAPSCREW (2)
3. CAPSCREW (2)
4. CAPSCREW (2)
5. LOCK
7. COTTER PIN
8. LOCK

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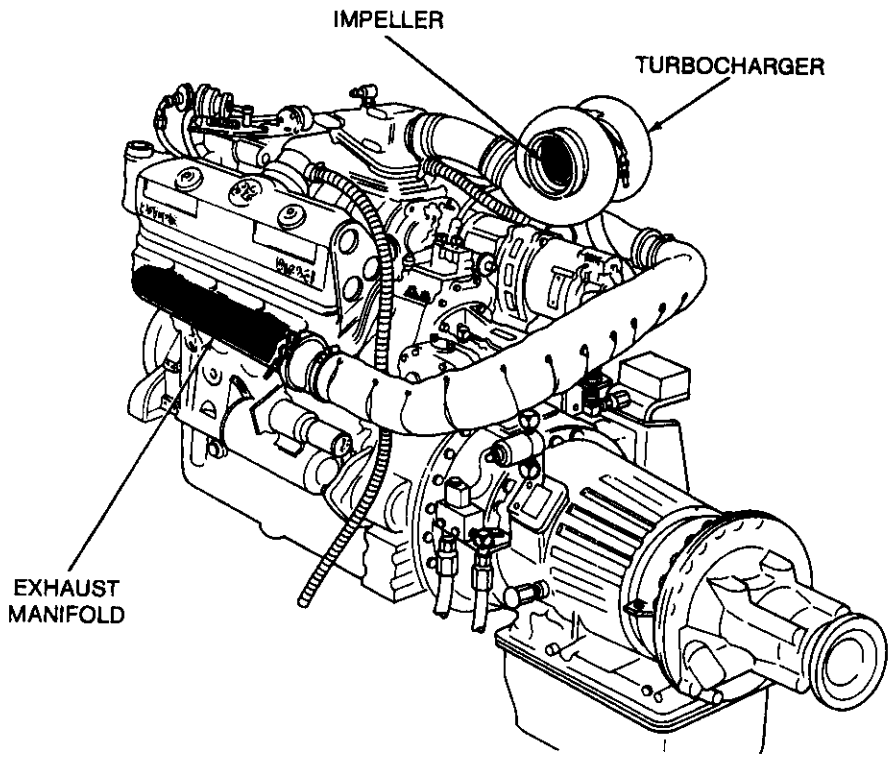
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ENGINE

1. ENGINE DOES NOT DEVELOP FULL POWER

Test 1. Check exhaust manifolds and blower gaskets for leaks or damage.
- If leakage or damage is not present, go to Test 2.
- If leakage or damage is present, repair or replace part as needed.



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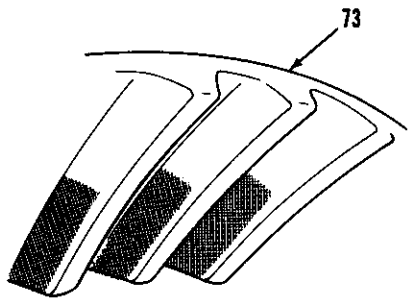
Test 2. Remove tube from air inlet side of turbocharger. Check that turbocharger impeller spins freely.
- If turbocharger impeller spins freely, go to Test 3.
- If turbocharger impeller does not spin freely, repair or replace turbocharger. Refer to paragraphs 4-10 or 4-11.

Test 3. Perform engine tune-up. Refer to paragraph 3-29.
- If problem still exists after engine tune-up, go to Test 4.

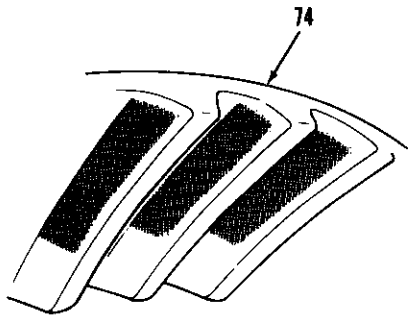
Test 4. Check for misfiring cylinder. Refer to paragraph 3-30.
- If all cylinders are firing properly, go to Test 5.
- If one or more cylinders are misfiring, repair or replace injector. Refer to paragraphs 4-3 or 4-4.

(e) If pattern is similar to contact pattern (73) where it is close to edge of tooth toe, move ring gear (24) away from pinion (23) by adding backlash. Paint ring gear (24) teeth and recheck pattern, refer to step (5), section b.



73. CONTACT PATTERN

(f) If pattern is similar to contact pattern (74) where it is too close to edge of tooth toward tooth heel, move ring gear (24) toward pinion (23) to remove backlash. Paint ring gear (24) teeth and recheck pattern, refer to step (5), section c.



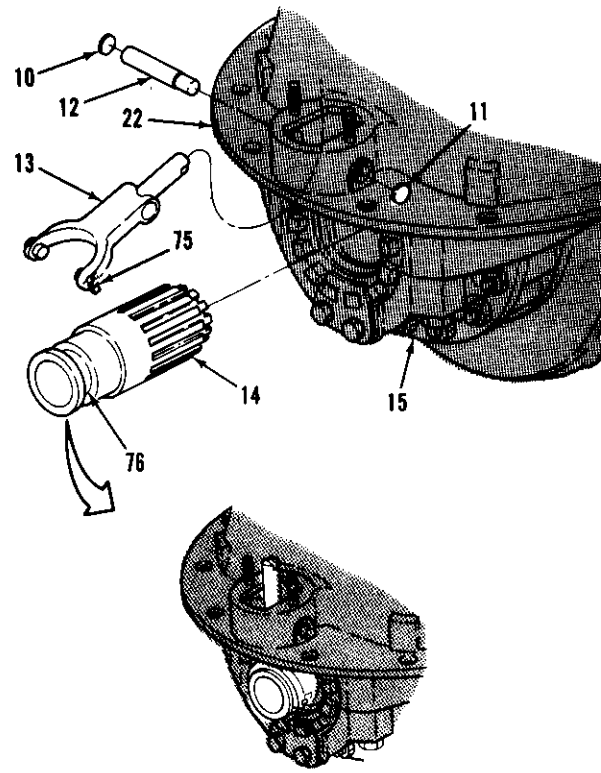
74. CONTACT PATTERN

(7) When contact pattern is correct, install shift fork (13) into carrier housing (22) so shift fork tangs (75) on shift fork (13) point towards differential carrier assembly (15).

(8) Install sliding clutch (14) into differential carrier assembly (15) alining shift fork (13) with shift fork groove (76).

(9) Install shift fork shaft (12) and new expansion plugs (10 and 11).

(10) Check shift fork (13) and sliding clutch (14) for free movement.



10. EXPANSION PLUG
11. EXPANSION PLUG
12. SHIFT FORK SHAFT
13. SHIFT FORK
14. SLIDING CLUTCH
15. DIFFERENTIAL CARRIE ASSEMBLY
22. CARRIER HOUSING
75. SHIFT FORK TANGS
76. SHIFT FORK GROOVE

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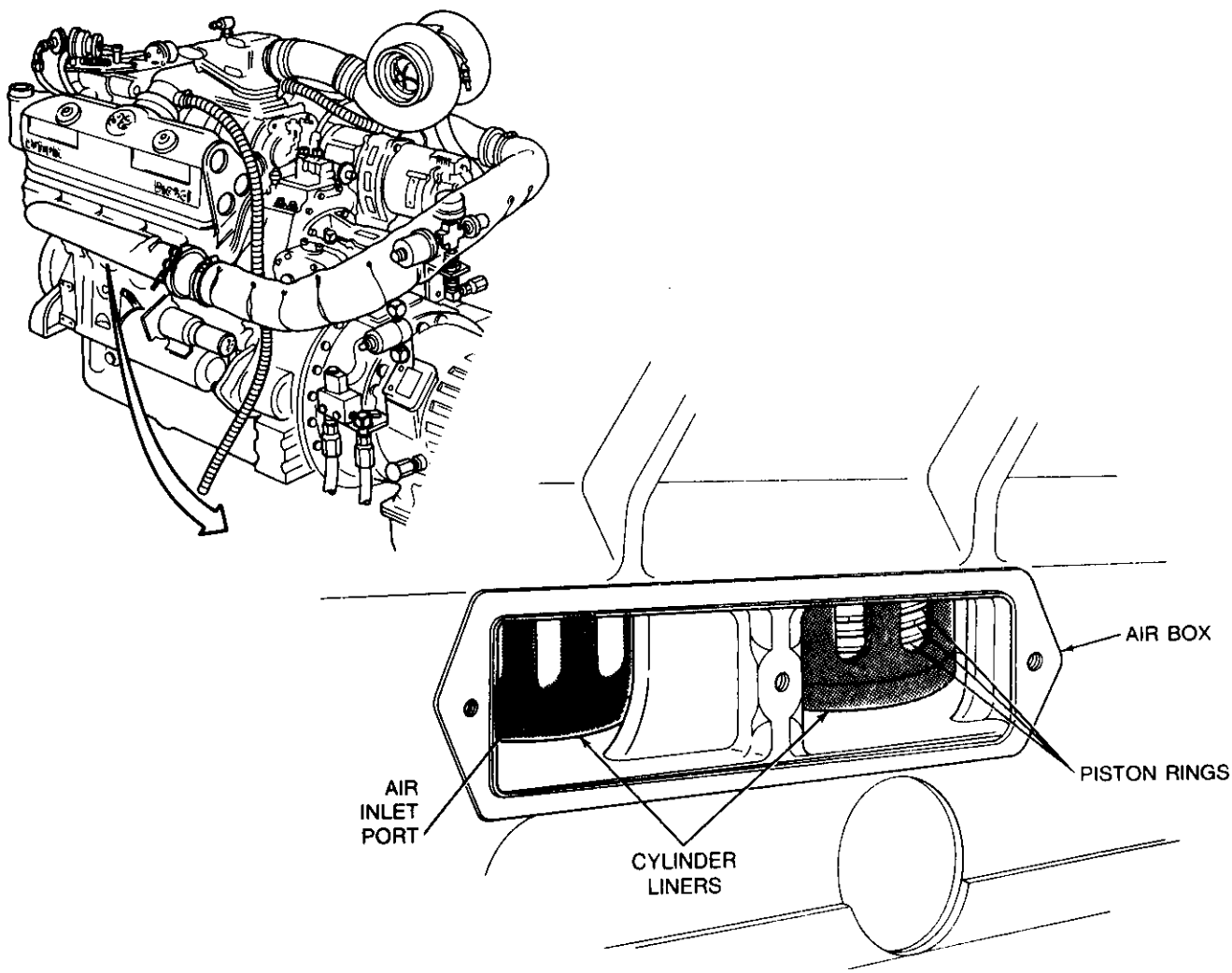
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 5. Remove engine air box covers. Check for clogged cylinder liner air inlet ports.
- If cylinder liner ports are not clogged, go to Test 6.
- If cylinder liner ports are clogged, clean cylinder ports as required.



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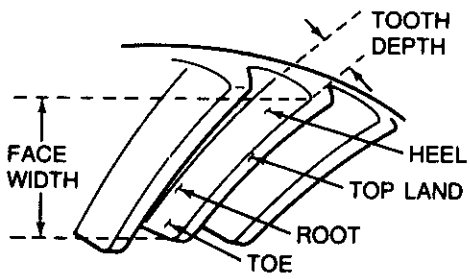
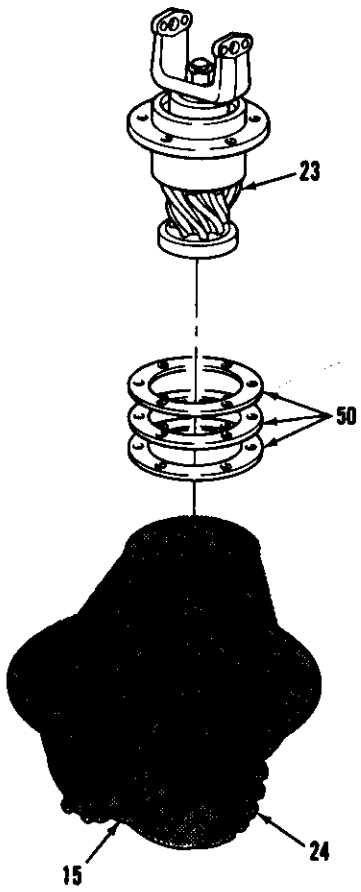
10-18. DIFFERENTIAL CARRIER REPAIR (NO. 2 AXLE) (Continued)

RING GEAR TOOTH NOMENCLATURE



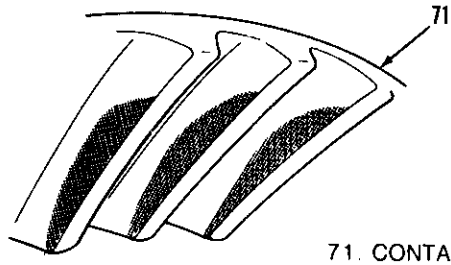


15. DIFFERENTIAL CARRIER ASSEMBLY
23. PINION
24. RING GEAR
50. SHIMS

NOTE

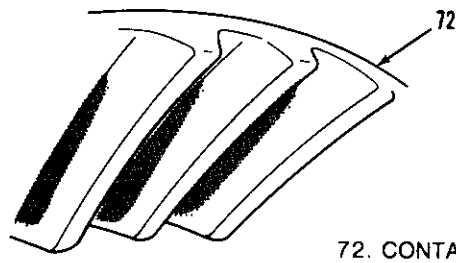
- Any time pinion depth is changed, backlash may change. Check and adjust backlash as needed.
- If shims (50) have to be changed, the differential carrier assembly (15) must be removed and adjusted.

(c) If pattern is similar to contact pattern (71) where it is too close to tooth top and off center, move pinion (23) towards ring gear (24) by removing some shims (50) from shim pack. Paint ring gear (24) teeth and recheck pattern.



71. CONTACT PATTERN

(d) If pattern is similar to contact pattern (72) where it is too close or off tooth root, move pinion (23) away from ring gear (24) by adding shims (50) to shim pack. Paint teeth of ring gear (24) and recheck pattern.



72. CONTACT PATTERN

TA 299040

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. ENGINE DOES NOT DEVELOP FULL POWER (Continued)

Test 6. Perform engine compression test. Refer to paragraph 3-30.
- If engine fails compression test, overhaul engine. Refer to paragraph 3-19.

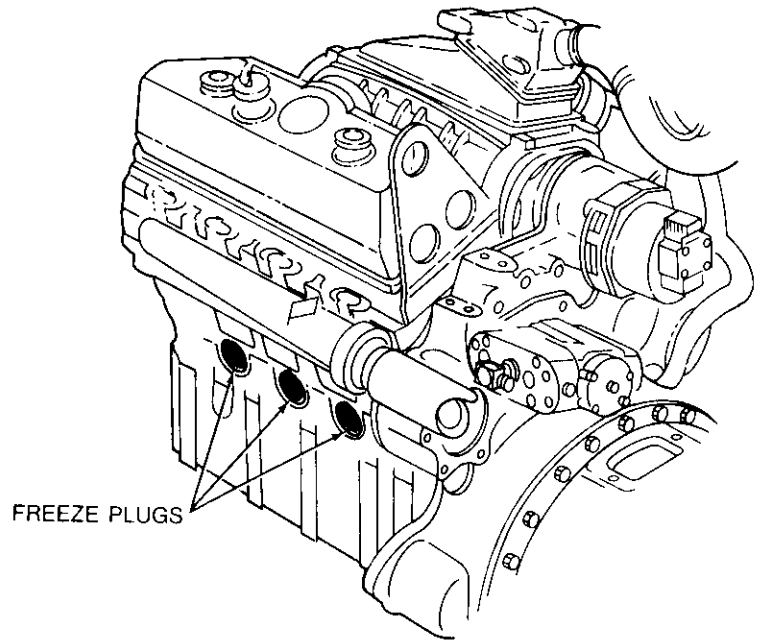
END OF TEST

2. ENGINE OVERHEATS

NOTE

Before performing the following tests, make sure hydraulic fan motor is operating correctly. Refer to Hydraulic Cooling System Troubleshooting.

Test 1. Check for leaking freeze plugs on both sides of the engine. Perform cooling system pressure test.
- If freeze plugs are not leaking, go to Test 2.
- If freeze plugs are leaking, replace freeze plugs as required.



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Test 2. Check water pump impeller shaft for excessive play. Drain coolant below water pump. Remove retaining ring, pump cover and O-ring. Try moving water impeller in and out to detect excessive play.
- If impeller play is normal, go to Test 3.
- If impeller has excessive play, replace water pump. Refer to paragraph 5-5.

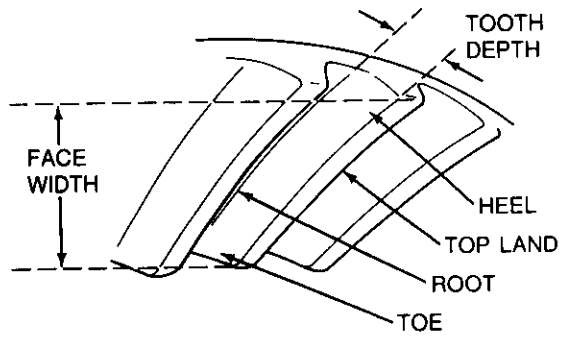
(5) Measure backlash with a dial indicator (68) at three different points on ring gear (24). Hold pinion (23) while taking backlash measurement.

(a) Using a dial indicator (68) with a magnetic base, position dial indicator (68) so that plunger contacts teeth of ring gear (24). Backlash should be 0.006-0.016 inch (0.1524-0.4064 mm).

(b) To add backlash, loosen bearing adjuster (17) three notches. Loosen bearing adjuster (18) one notch. Tighten bearing adjuster (17) until it contacts bearing cup. Then tighten two or three notches further. Recheck backlash.

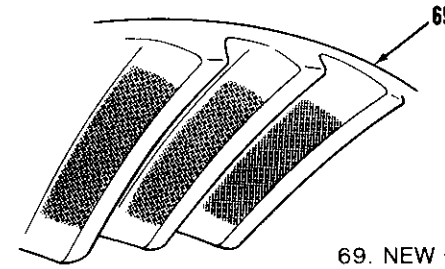
(c) To remove backlash, loosen bearing adjuster (17) three notches. Tighten bearing adjuster (18) one notch. Tighten bearing adjuster (17) until it contacts bearing cup. Then tighten two or three notches further. Recheck backlash.

RING GEAR TOOTH NOMENCLATURE



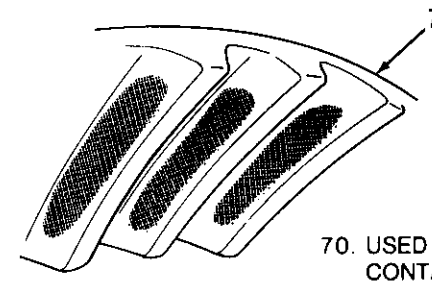
(6) Check ring gear (24) and pinion tooth contact by painting 12 ring gear (24) teeth with marking compound. Roll ring gear (24) a couple of turns to obtain contact pattern.

(a) If new gearing, ring gear (24) and/or pinion (23), has been installed, contact pattern (69) must be as shown. Pattern should cover one half the width of face and should be evenly centered between tooth top and root. Pattern should be clear of tooth toe.



69. NEW GEARING CONTACT PATTERN

(b) If used gearing, ring gear (24) and/or pinion (23), has been installed, contact pattern (70) must be as shown. A correct pattern is clear of toe and centers evenly along width of face between top and root. Length and shape of pattern may vary and is acceptable as long as pattern does not run off tooth at any point.



70. USED GEARING CONTACT PATTERN

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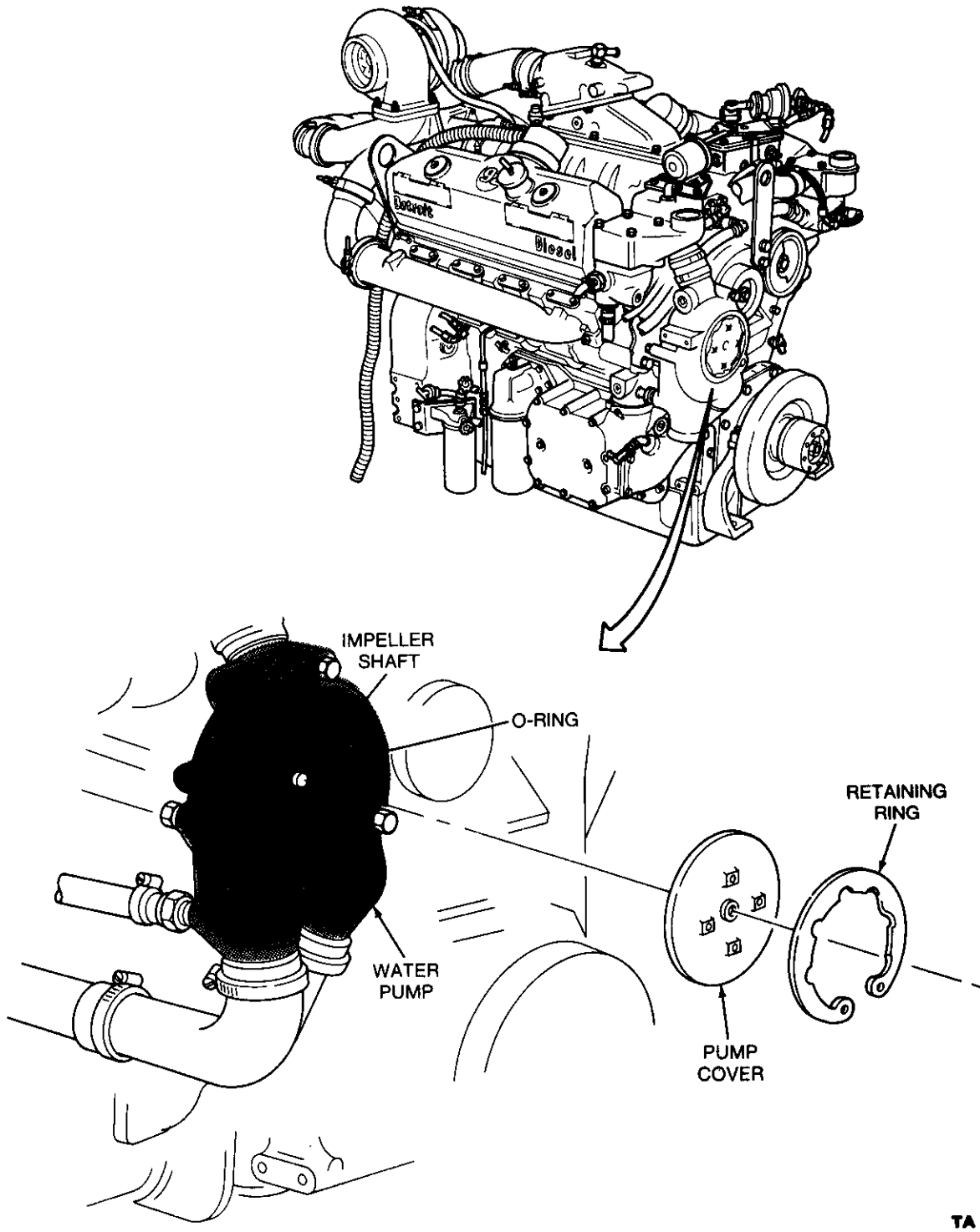
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 286338

10-18. DIFFERENTIAL CARRIER REPAIR (NO. 2 AXLE) (Continued)

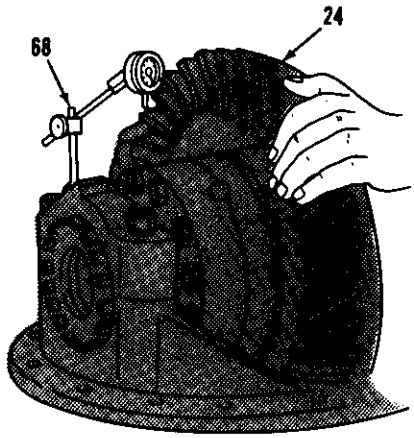
d. Adjustments

(1) On tooth side of ring gear (24), position bearing adjuster (17) so that one thread is visible on carrier housing (22).

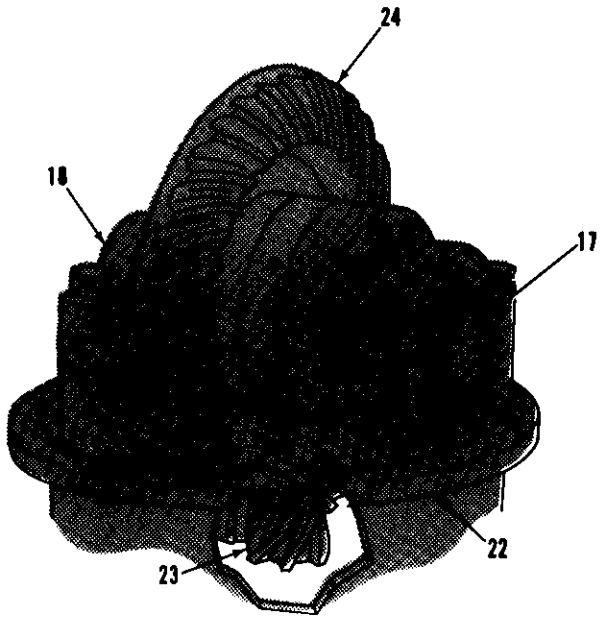
(2) Tighten bearing adjuster (18) until there is no backlash. To check backlash, face teeth of ring gear (24) and push ring gear (24) away from you while rocking ring gear (24) from side to side. There should be no backlash between ring gear (24) and pinion (23).

(3) Rotate ring gear (24) and check for any point where ring gear (24) may bind. If binding, loosen and retighten bearing adjuster (18).

(4) Tighten bearing adjuster (17) until it contacts bearing cup. Continue to tighten bearing adjuster (17) two to three notches.



24. RING GEAR
68. DIAL INDICATOR



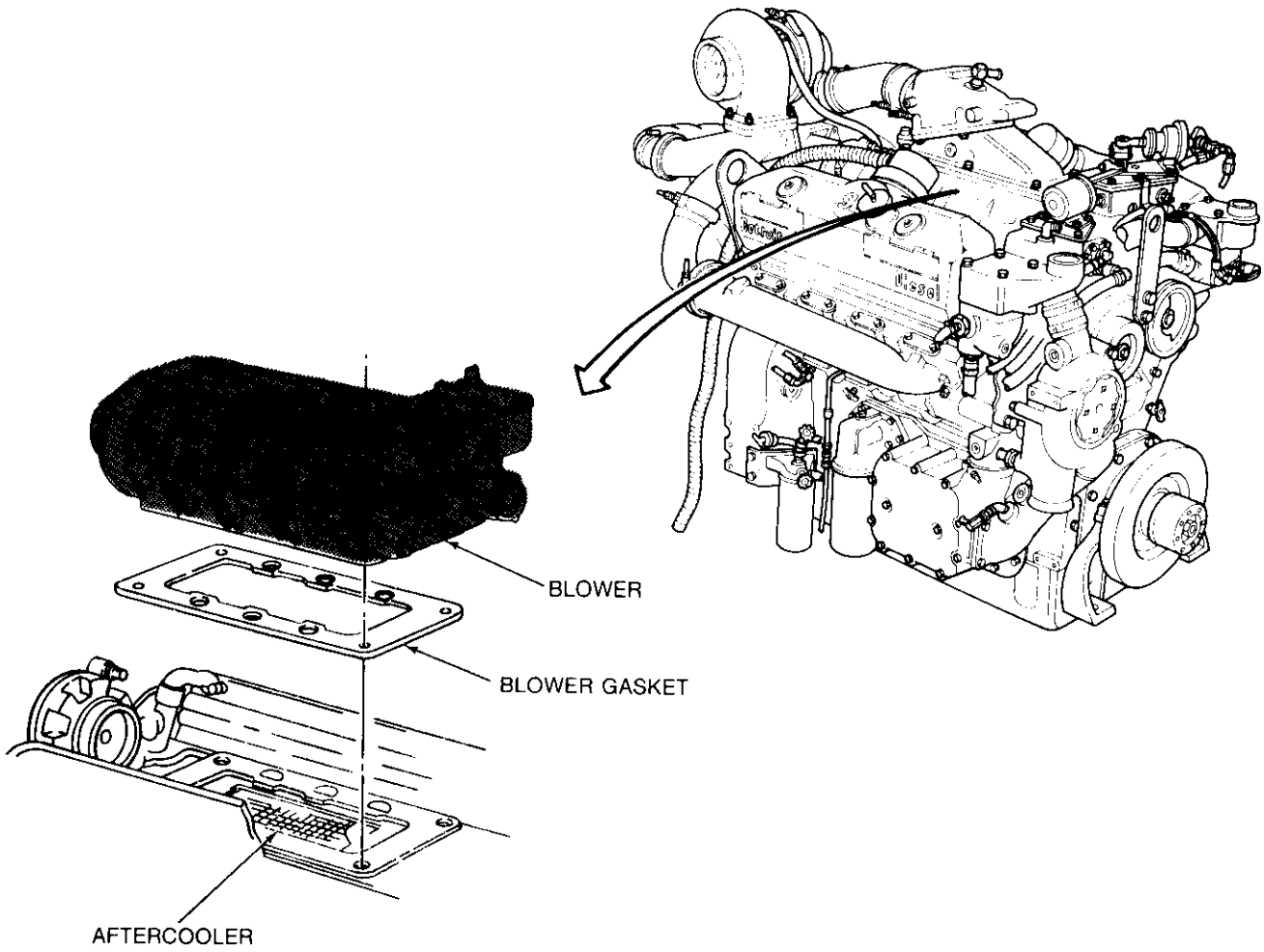
17. BEARING ADJUSTER
18. BEARING ADJUSTER
22. CARRIER HOUSING
23. PINION
24. RING GEAR

TA 299038

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

2. ENGINE OVERHEATS (Continued)

Test 3. Inspect aftercooler for leaks.
- If aftercooler is not leaking, go to Test 4.
- If aftercooler is leaking, replace aftercooler. Refer to paragraph 5-8.



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Test 4. Check for leaking head gaskets. Perform cooling system pressure test. Refer to paragraph 6-8 in TM 2320-20/12, TM 9-2320-297-20.
- If head gasket(s) is leaking, replace head gasket. Refer to paragraph 3-3.

END OF TEST

(56) Install bearing cups (19 and 20).

CAUTION

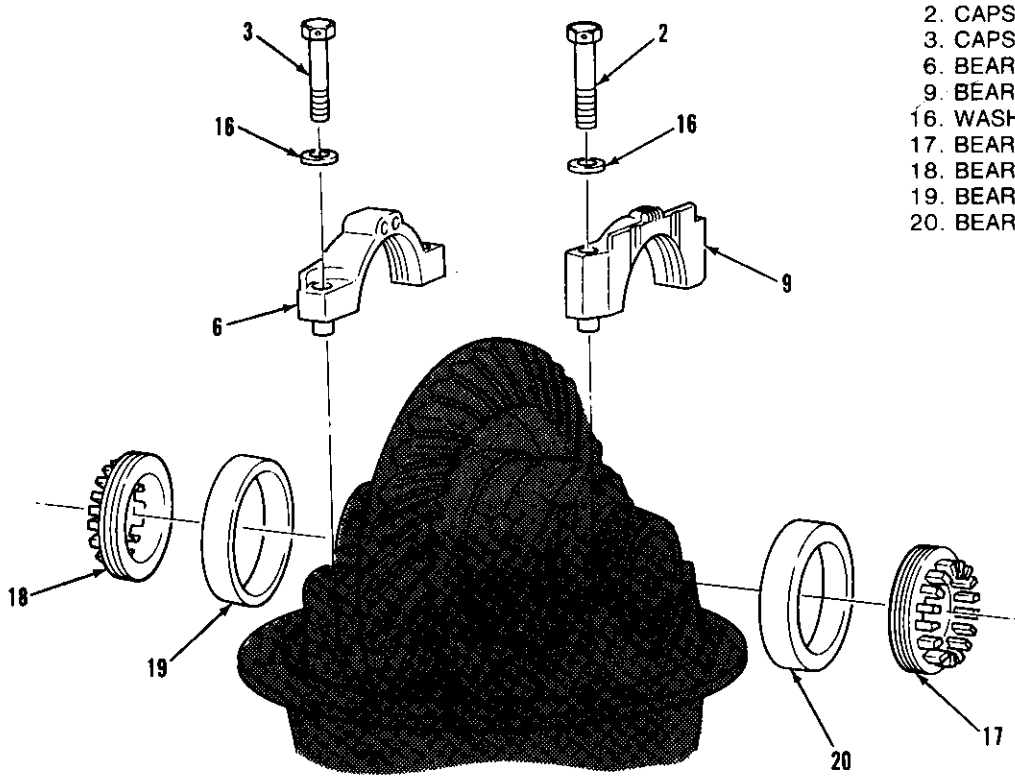
Make sure both bearing caps (6 and 9) are fully seated and bearing adjusters (17 and 18) are not cross threaded.

(57) Install bearing cap (9) and bearing adjuster (17).

(58) Install bearing cap (6) and bearing adjuster (18).

(59) Install two capscrews (2 and 3) and washers (16), on each bearing cap (6 and 9). Hand tighten capscrews (2 and 3).

(60) Rotate bearing adjuster (17 and 18). If adjusters (17 and 18) bind, loosen capscrews (2 and 3), and check to see if bearing adjusters (17 and 18) are cross threaded.



2. CAPSCREW (2)
3. CAPSCREW (2)
6. BEARING CAP
9. BEARING CAP
16. WASHER (4)
17. BEARING ADJUSTER
18. BEARING ADJUSTER
19. BEARING CUP
20. BEARING CUP

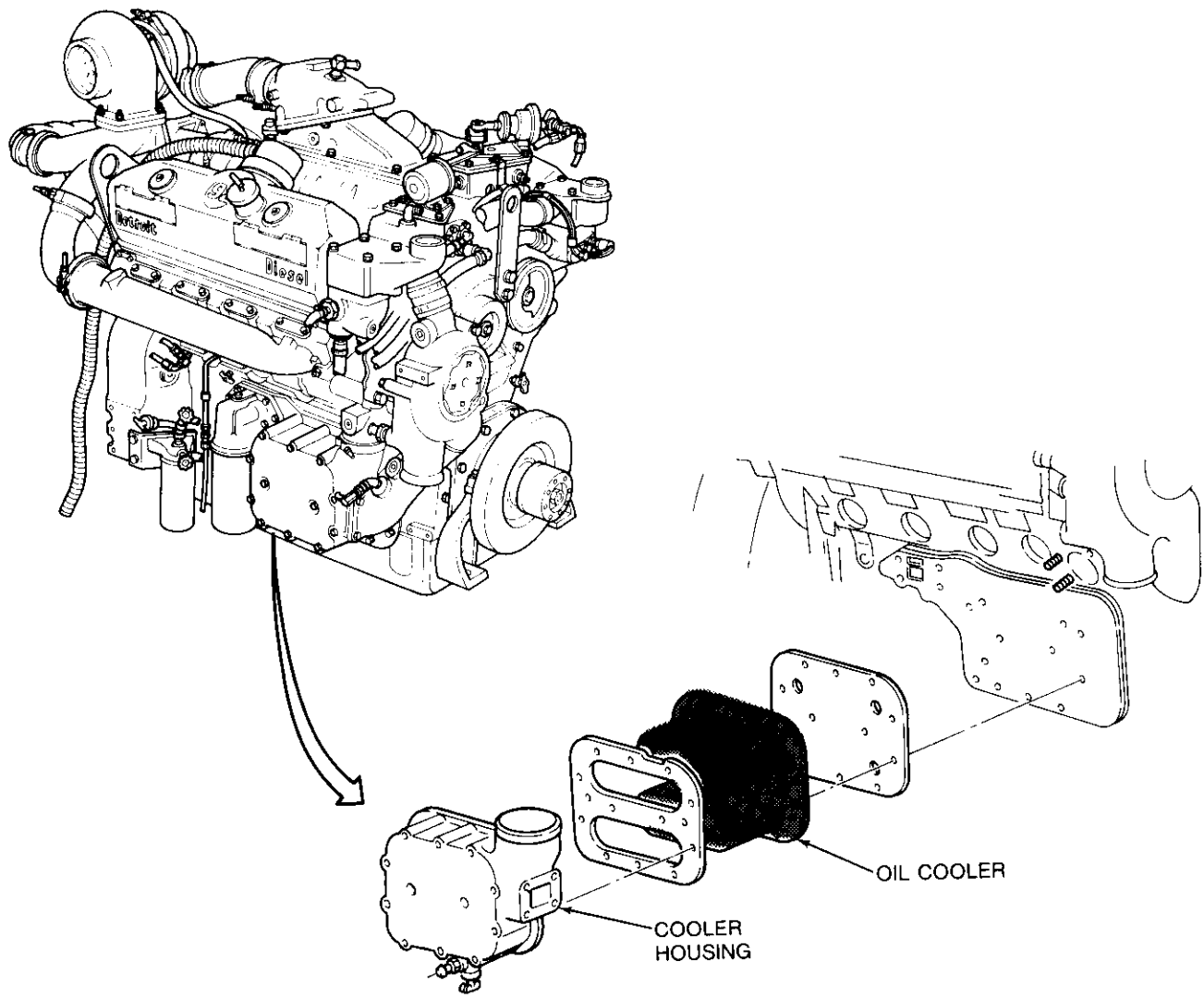
TA 299037

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. LOW ENGINE OIL PRESSURE

Test 1. Check engine for overheating. Refer to Malfunction 2.
- If engine is not overheating, go to Test 2.

Test 2. Remove oil cooler. Refer to paragraph 3-10. Check for blocked or clogged cooler passages and/or clogged bypass valve.
- If oil cooler or bypass valve is clean, go to Test 3.
- If oil cooler or bypass valve is clogged, replace oil cooler.



TA 298340

10-18. DIFFRENTIAL CARRIER REPAIR (NO. 2 AXLE) (Continued)

(46) Install 10 springs (28) in smallest possible circle onto pressure plate (29).

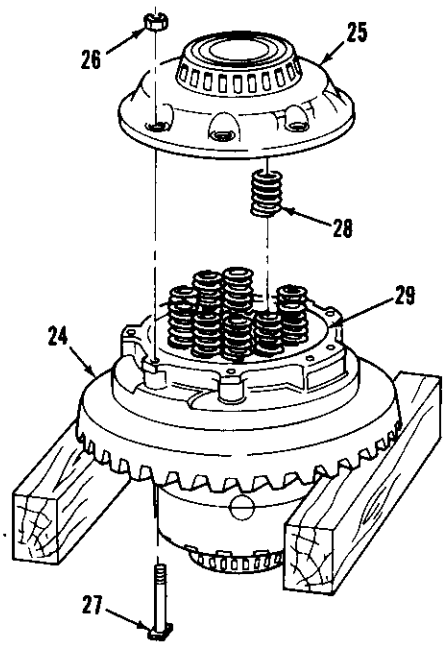
(47) Install clutch pack cover (25) over springs (28).

(48) Reach inside hole in clutch pack cover (25) and move springs (28) outward as far as they will go.

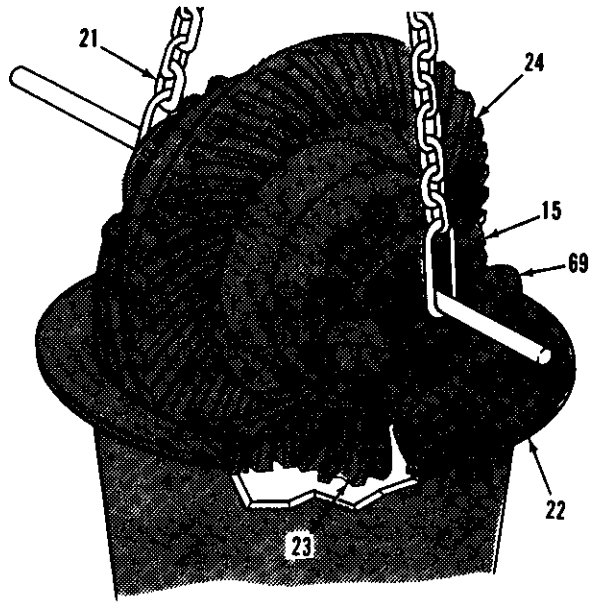
(49) Press clutch pack cover (25) down to compress springs (28) fully. Aline clutch pack cover (25) and ring gear (24) with two capscrews (27).

(50) Install remaining six capscrews (27) and eight new locknuts (26). Torque locknuts (26) to 195-245 foot-pounds (264-332 N·m).

(51) Slowly remove press tension on clutch pack cover (25).



24. RING GEAR
25. CLUTCH PACK COVER
26. LOCKNUT (8)
27. CAPSCREW (8)
28. SPRING (10)
29. PRESSURE PLATE



15. DIFFERENTIAL CARRIER ASSEMBLY
21. LIFTING DEVICE
22. CARRIER HOUSING
23. PINION
24. RING GEAR
69. SHOP RAG (2)

TA 299036

(52) Attach a lifting device (21) to differential carrier (15).

(53) Install two clean shop rags (69) on carrier housing (22) to protect carrier bearings.

NOTE

It may be necessary to tilt differential carrier assembly (15) to aline with pinion gear (23).

(54) Install differential carrier assembly (15) into carrier housing (22), making sure ring gear (24) alines with pinion (23).

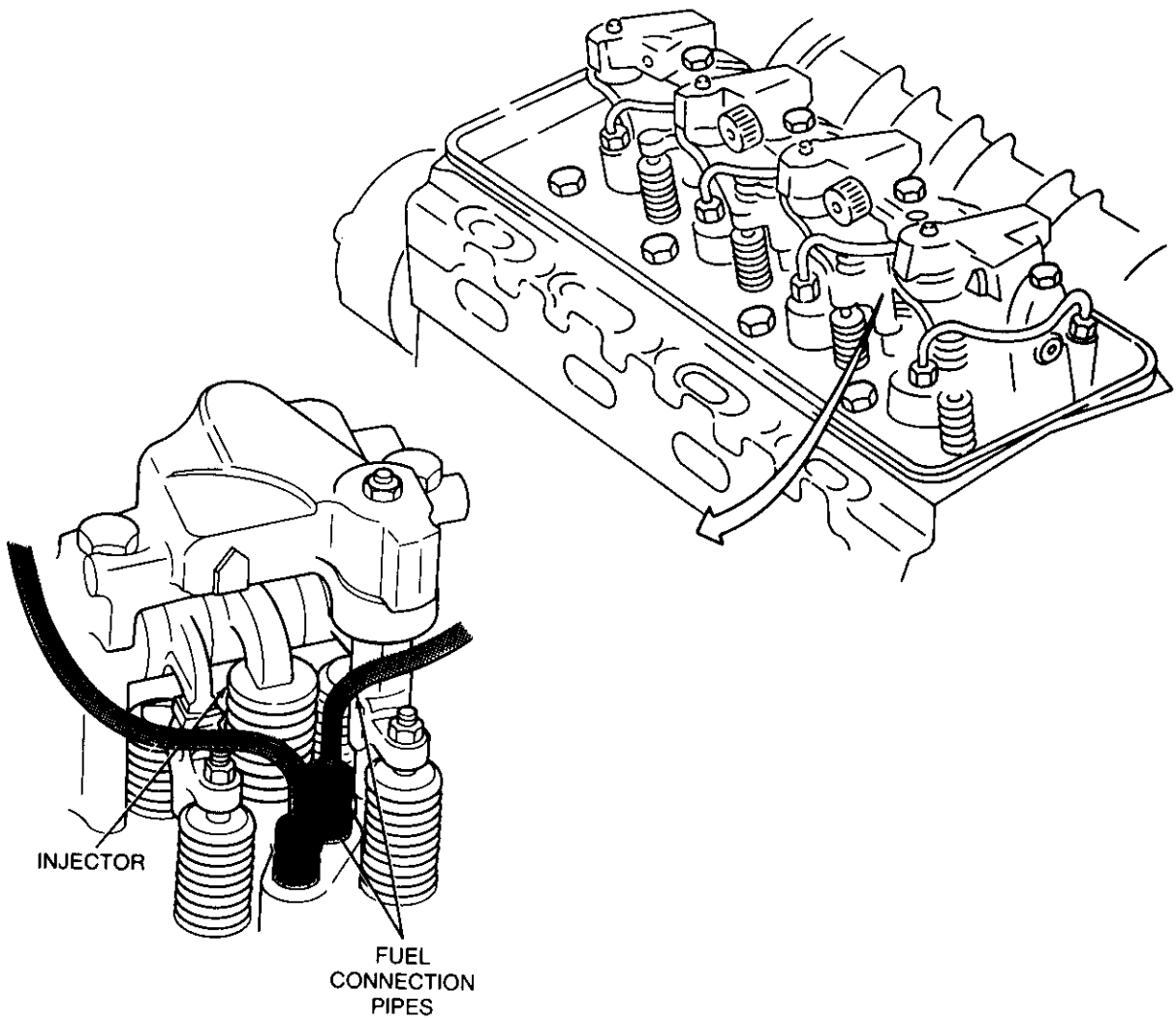
(55) Remove lifting device (21) and shop rags (69).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. LOW ENGINE OIL PRESSURE (Continued)

Test 3. Check for fuel leaks at fuel connection pipes and at injectors. Fuel leakage at these points can dilute oil.

- If fuel leaks are not present, go to Test 4.
- If fuel leaks are present, tighten nuts to proper torque or replace fuel connection tubes. Refer to paragraph 3-4 in this manual.



TA 296341

(37) Install one externally splined plate (30) into differential case assembly (32).

(38) Install one internally splined plate (31) into differential case assembly (32).

(39) Using sliding clutch (14), aline internally splined plate (31) into center of differential case assembly (32).

(40) Repeat steps (37) and (38) until the remaining seven externally splined plates (30) and six internally splined plates (31) have been installed.

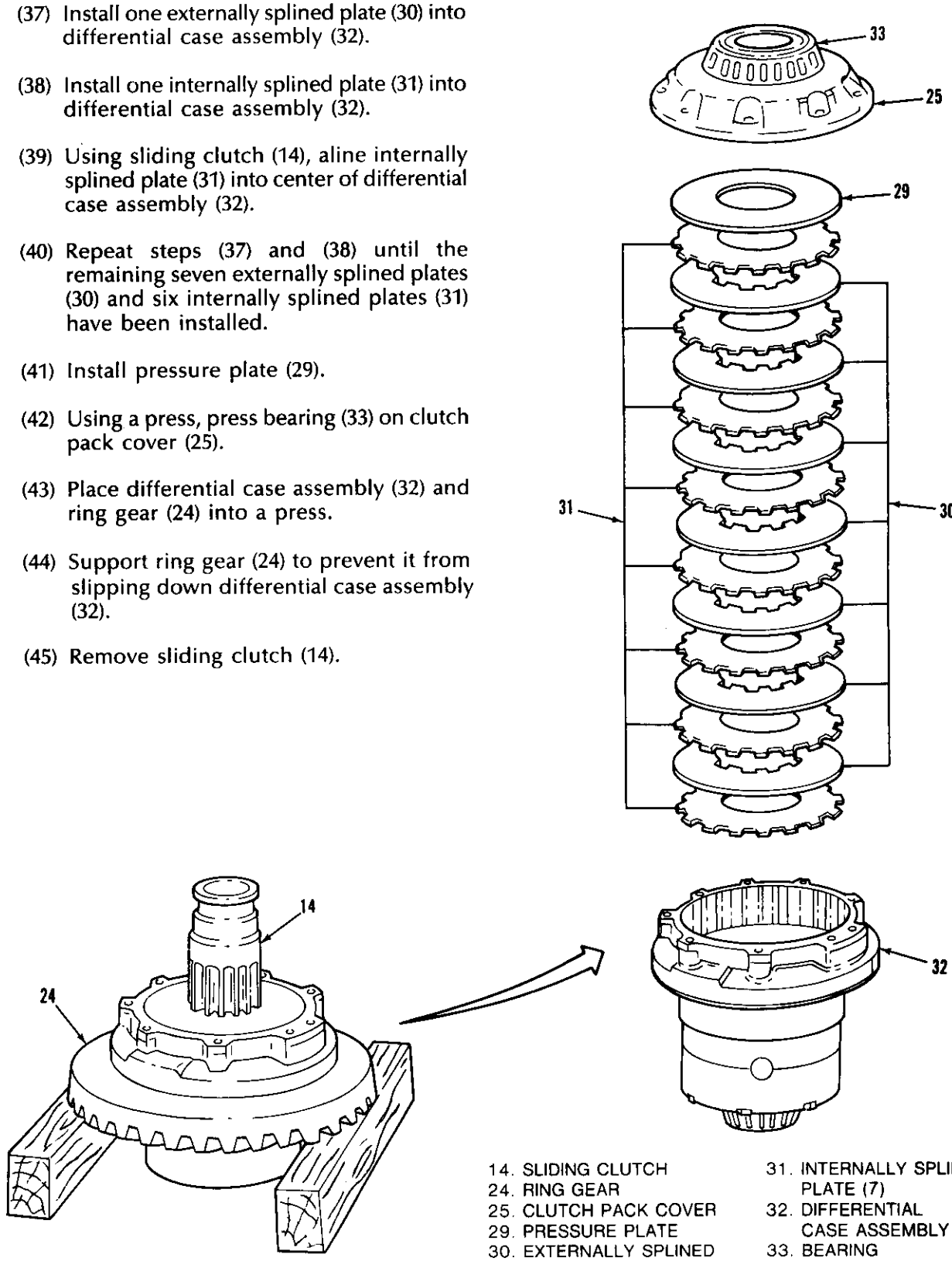
(41) Install pressure plate (29).

(42) Using a press, press bearing (33) on clutch pack cover (25).

(43) Place differential case assembly (32) and ring gear (24) into a press.

(44) Support ring gear (24) to prevent it from slipping down differential case assembly (32).

(45) Remove sliding clutch (14).

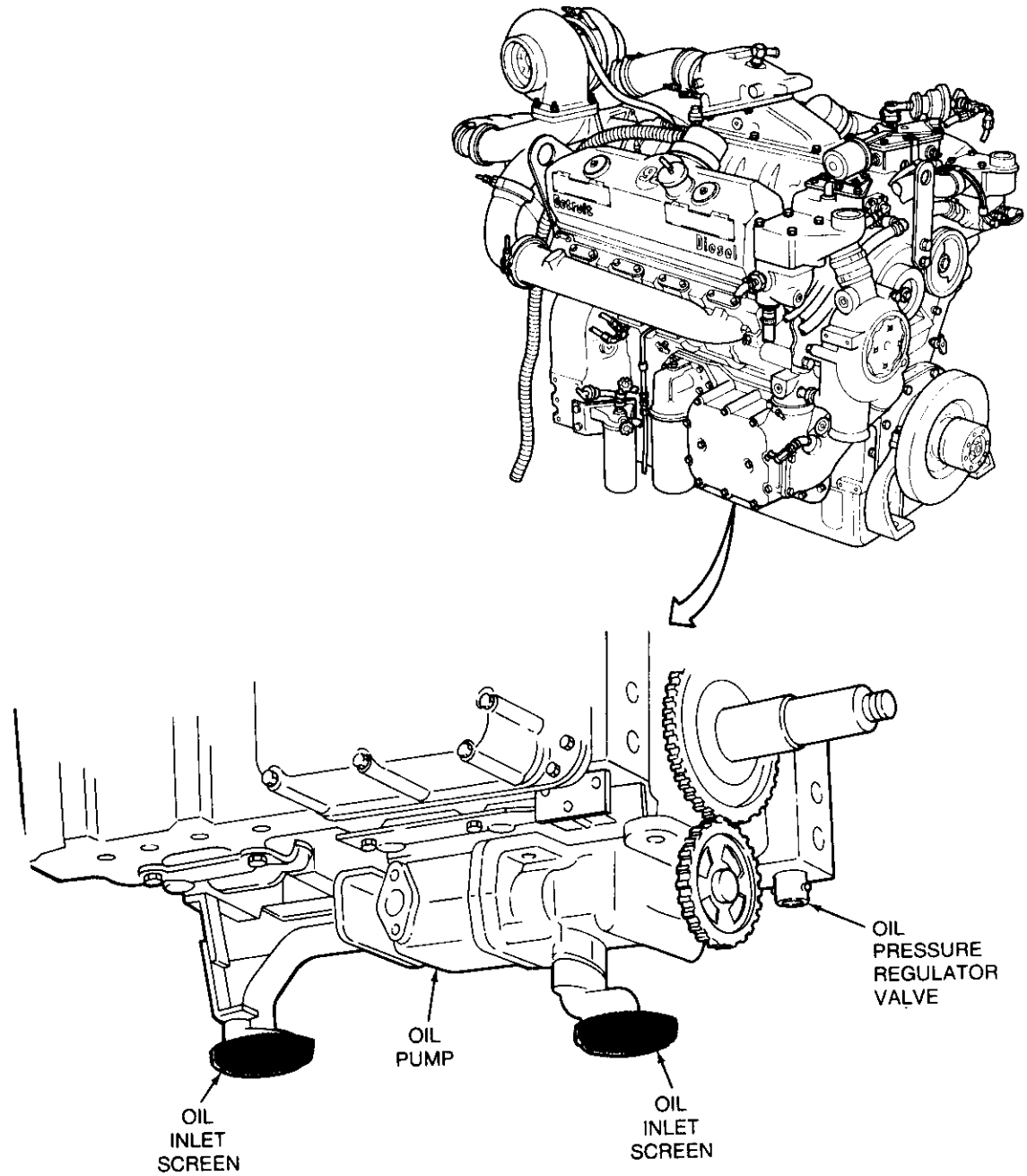


14. SLIDING CLUTCH
24. RING GEAR
25. CLUTCH PACK COVER
29. PRESSURE PLATE
30. EXTERNALLY SPLINED PLATE (8)
31. INTERNALLY SPLINED PLATE (7)
32. DIFFERENTIAL CASE ASSEMBLY
33. BEARING

TA 299035

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 4. Remove oil pan and check for clogged oil pump inlet screen.
- If screen is not clogged, go to Test 5.
- If screen is clogged, remove and clean oil inlet screen. Clean oil pan too.



TA 298342

10-18. DIFFERENTIAL CARRIER REPAIR (NO. 2 AXLE) (Continued)

(29) Using a press, press bearing (46) onto plain case half (35).

(30) Install thrust washer (44) and side gear (43) into flanged case half (36).

(31) Install four pinion gears (42) and thrust washers (41) onto spider (40).

(32) Install spider (40) into flanged case half (36) and rotate spider (40) to make sure gears (42 and 43) mesh.

(33) Install side gear (39) and thrust washer (38) onto spider (40).

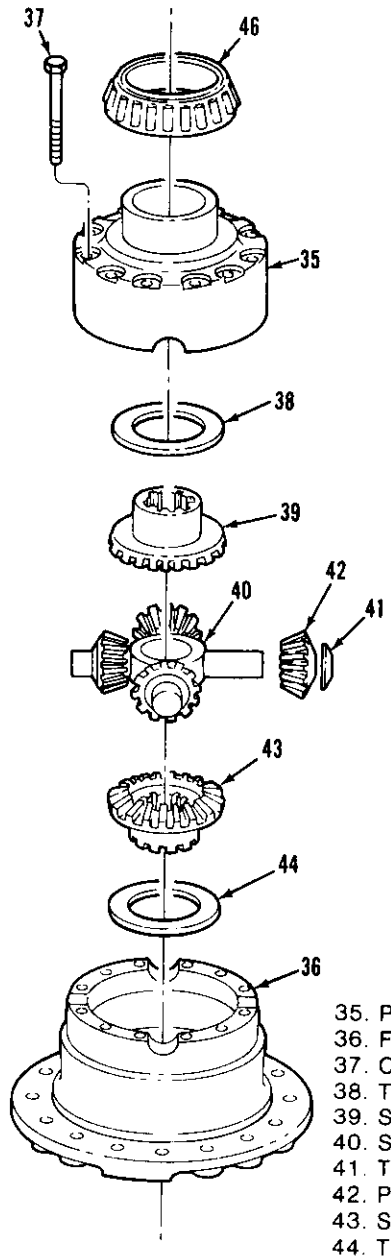
(34) Aline marks made during disassembly and install plain case half (35) onto flanged case half (36).

(35) Install 12 capscrews (37). Torque capscrews (37) to 150-180 foot-pounds (203-244 N·m).

NOTE

It may require up to 50 foot-pounds (68 N·m) of torque to rotate side gear (43).

(36) Check differential gears for free rotation by turning side gear (43).



35. PLAIN CASE HALF
36. FLANGED CASE HALF
37. CAPSCREW (12)
38. THRUST WASHER
39. SIDE GEAR
40. SPIDER
41. THRUST WASHER (4)
42. PINION GEAR (4)
43. SIDE GEAR
44. THRUST WASHER
46. BEARING

TA 299034

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. LOW ENGINE OIL PRESSURE (Continued)

Test 5. Inspect oil pressure regulator valve for clogging or damage.
- If oil pressure regulator valve is not clogged or damaged, go to Test 6.
- If oil pressure regulator valve is clogged or damaged, remove regulator valve and clean valve and seat, or replace regulator valve.

Test 6. Remove oil pump and inspect for worn or damaged gears. Refer to paragraph 3-11.
- If oil pump gears are not worn or damaged, go to Test 7.
- If oil pump gears are worn or damaged, repair or replace oil pump.

Test 7. Check for excessive wear on crankshaft main bearings. Refer to paragraph 3-26.
- If crankshaft main bearings are worn, replace bearings or rebuild engine.

END OF TEST

4. HIGH OIL CONSUMPTION

Test 1. Perform cooling system pressure test. Refer to paragraph 6-8 in TM 2320-20/12, TM 9-2320-297-20. If system leaks, check engine oil for antifreeze. Inspect for coolant leaks at oil cooler and at cylinder heads.
- If antifreeze is present in engine oil, repair or replace engine oil cooler (paragraph 3-10) or replace cylinder head water seal rings. Refer to paragraph 3-4. Flush cooling system after repairs are made.
- If antifreeze is not present in engine oil, go to Test 2.

Test 2. Check for leaking or damaged blower-to-block gasket.
- If gasket is not leaking or damaged, go to Test 3.
- If gasket is leaking or damaged, replace gasket. Refer to paragraph 4-6.

Test 3. Check for leaking blower front plate gasket.
- If gasket is not leaking, go to Test 4.
- If gasket is leaking, replace gasket. Refer to paragraph 4-7.

NOTE

If original gear set is being reused, use same size shim pack as removed during disassembly. If new gear set is being used, use a shim pack of 0.024 inch (0.609 mm).

(23) Install shims (50) onto carrier housing (22).

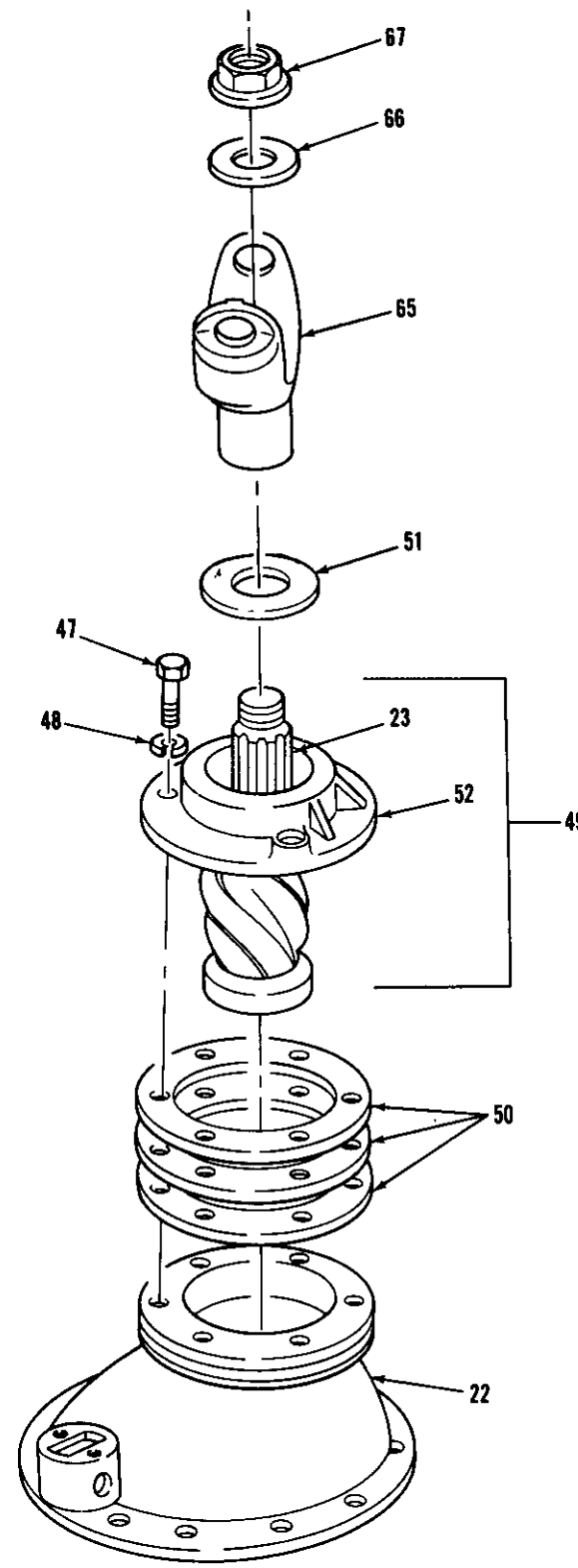
(24) Install pinion assembly (49) on carrier housing (22).

(25) Install six capscrews (47) and new lockwashers (48). Torque capscrews (47) to 100-125 foot-pounds (136-170 N·m).

(26) Install new oil seal (51) on bearing cage (52).

(27) Lubricate oil seal (51) with clean oil and slide dummy yoke (65) onto pinion (23).

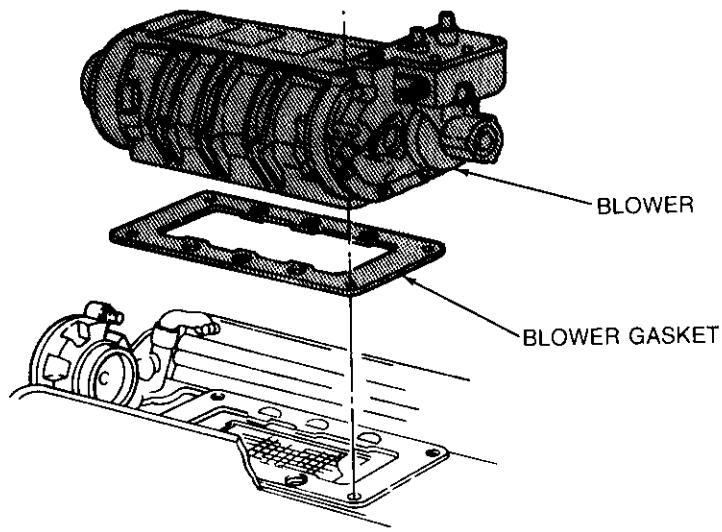
(28) Install washer (66) and new locknut (67). Torque locknut (67) to 560-700 foot-pounds (759-949 N·m).

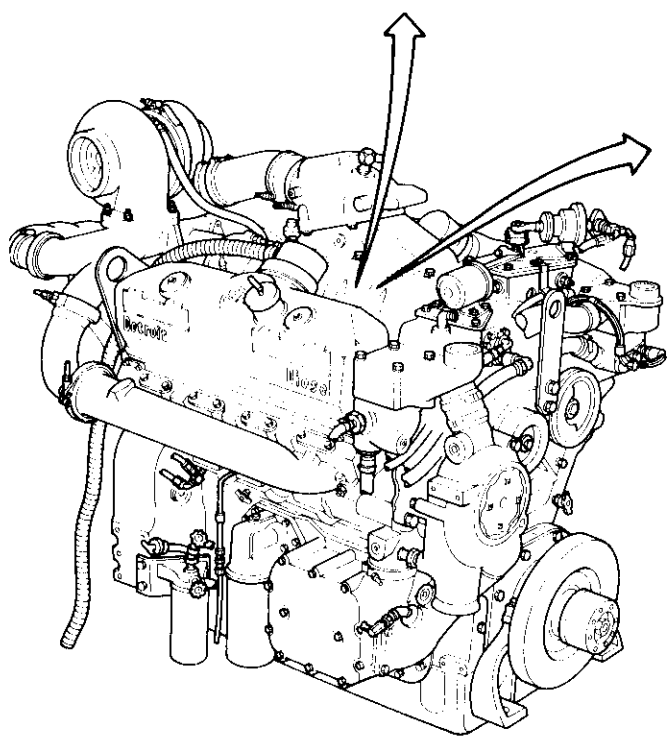


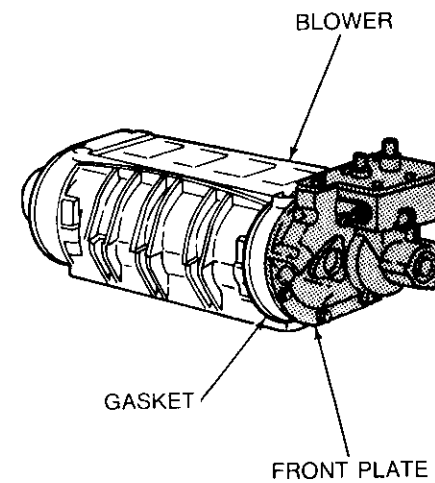
22. CARRIER HOUSING
23. PINION
47. CAPSCREW (6)
48. LOCKWASHER (6)
49. PINION ASSEMBLY
50. SHIM
51. OIL SEAL
52. BEARING CAGE
65. DUMMY YOKE
66. WASHER
67. LOCKNUT

TA 299033

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION







TA 298343

10-18. DIFFERENTIAL CARRIER REPAIR (NO. 2 AXLE) (Continued)

(12) Press pilot bearing (58) on end of pinion (23).

(13) Using a center punch and hammer, form a staking pattern (63).

(14) Remove inner bearing (57) from bearing cage (52).

(15) Press inner bearing (57) on pinion (23) so that bevel part of inner bearing (57) is towards threaded end of pinion (23).

(16) Install the 0.001 inch (0.0254 mm) larger spacer (56) on pinion (23). Spacer (56) thickness was determined when setting bearing preload.

(17) Install bearing cage (52) on pinion (23).

(18) Press outer bearing (53) on pinion (23).

(19) Install a sleeve (64) over outer bearing (53). Position sleeve (64) so that load is directly applied to outer bearing (53).

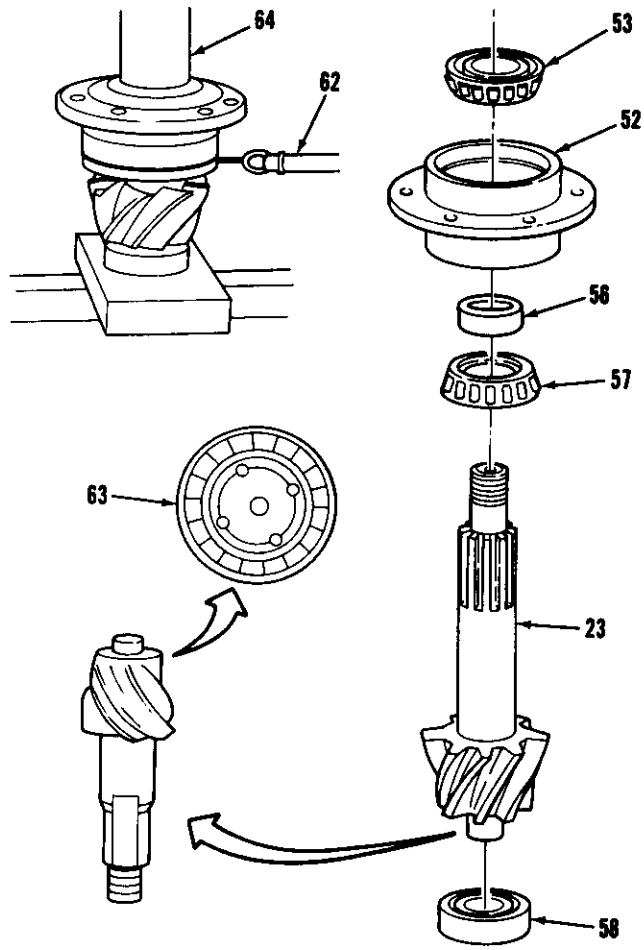
(20) Using a press, apply a load of 17-19 tons (15.4-17.2 metric tons) to outer bearing (53).

(21) Attach and wrap wire around bearing cage (52). Attach spring scale (62) and pull. Preload is correct when 5-12 pounds (2-5 kg) of pull will rotate bearing cage (52).

CAUTION

To prevent early failure of bearings and/or gear set, bearing preload must be 5-12 pounds (2-5 kg). Make sure final preload is within these specifications.

(22) Adjust preload if needed. Thicker spacer (56) will decrease preload, thinner spacer (56) will increase preload.



23. PINION
52. BEARING CAGE
53. OUTER BEARING
56. SPACER
57. INNER BEARING
58. PILOT BEARING
62. SPRING SCALE
63. STAKING PATTERN
64. SLEEVE

TA 299032

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. HIGH OIL CONSUMPTION (Continued)

Test 4. Check exhaust manifolds and pipes for wetness or oil discharge.
- If wetness or oil discharge is not present, go to Test 5.
- If wetness or oil discharge is present, replace valve guides. Refer to paragraph 3-4.

Test 5. Perform engine compression test. Refer to paragraph 3-30. Check for low cylinder readings.
- If no low readings were recorded, go to Test 7.
- If low readings are recorded, go to Test 6.

WARNING

Extreme care should be taken to prevent personal injury while air box covers are off and engine is running.

Test 6. With the engine running, remove air box covers (one at a time) from cylinder with low reading. Check for oil leaking (uncontrolled) past the cylinder ports or piston rings.
- If oil leakage is not present, go to Test 7.
- If oil leakage is present, rebuild cylinder and/or engine. Refer to paragraph 3-19.

Test 7. Remove tube from turbocharger to blower and exhaust pipe to turbocharger. Check for signs of oil on turbocharger impellers.
- If oil is not present, go to Test 8.
- If oil is present, replace turbocharger oil seals and or turbocharger. Refer to paragraph 4-11.

c. Assembly

(1) If removed, press bearing cups (54 and 55), beveled edge out, into bearing cage (52). Make sure bearing cups (54 and 55) are fully seated in bearing cage (52).

(2) Install inner bearing (57) on machined side of bearing cage (52). Coat with clean oil.

(3) If bearings (53 and 57) are being reused, place spacer (56) (removed during assembly) inside bearing cage (52).

(4) If new bearings (53 and 57) are being used, install new spacer (56) 0.496 inch (12.6 mm) thick.

(5) Install outer bearing (53) into bearing cage (52). Coat with clean oil.

(6) Place bearing cage assembly (59) into press, so that outer bearing (53) is towards press ram (60).

(7) Install a sleeve (61) over outer bearing (53). Position sleeve (61) so that load is directly applied to outer bearing (53).

(8) Using a press, apply a load of 13.5-15.5 tons (12.2-14.0 metric tons) to outer bearing (53).

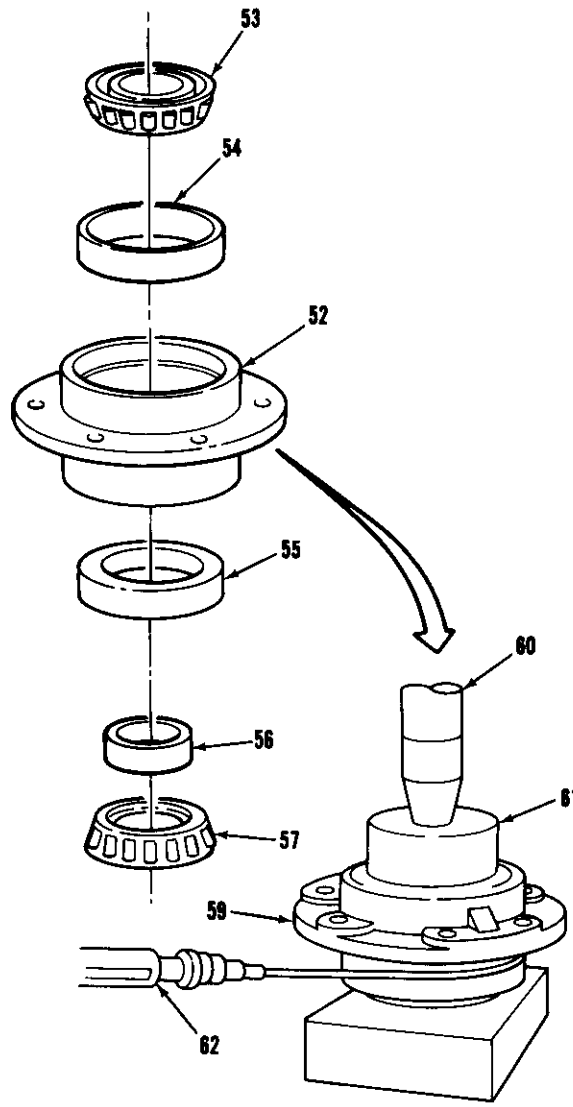
(9) Attach and wrap a piece of wire around bearing cage (52). Attach a spring scale (62) to wire and pull. Preload is correct when 3-7 pounds (2-3 kg) of pull will rotate bearing cage (52).

NOTE

Use a thicker spacer (56) to decrease preload and a thinner spacer (56) to increase preload.

(10) Remove outer bearing (53) and spacer (56). Exchange spacer (56) as needed to obtain correct preload.

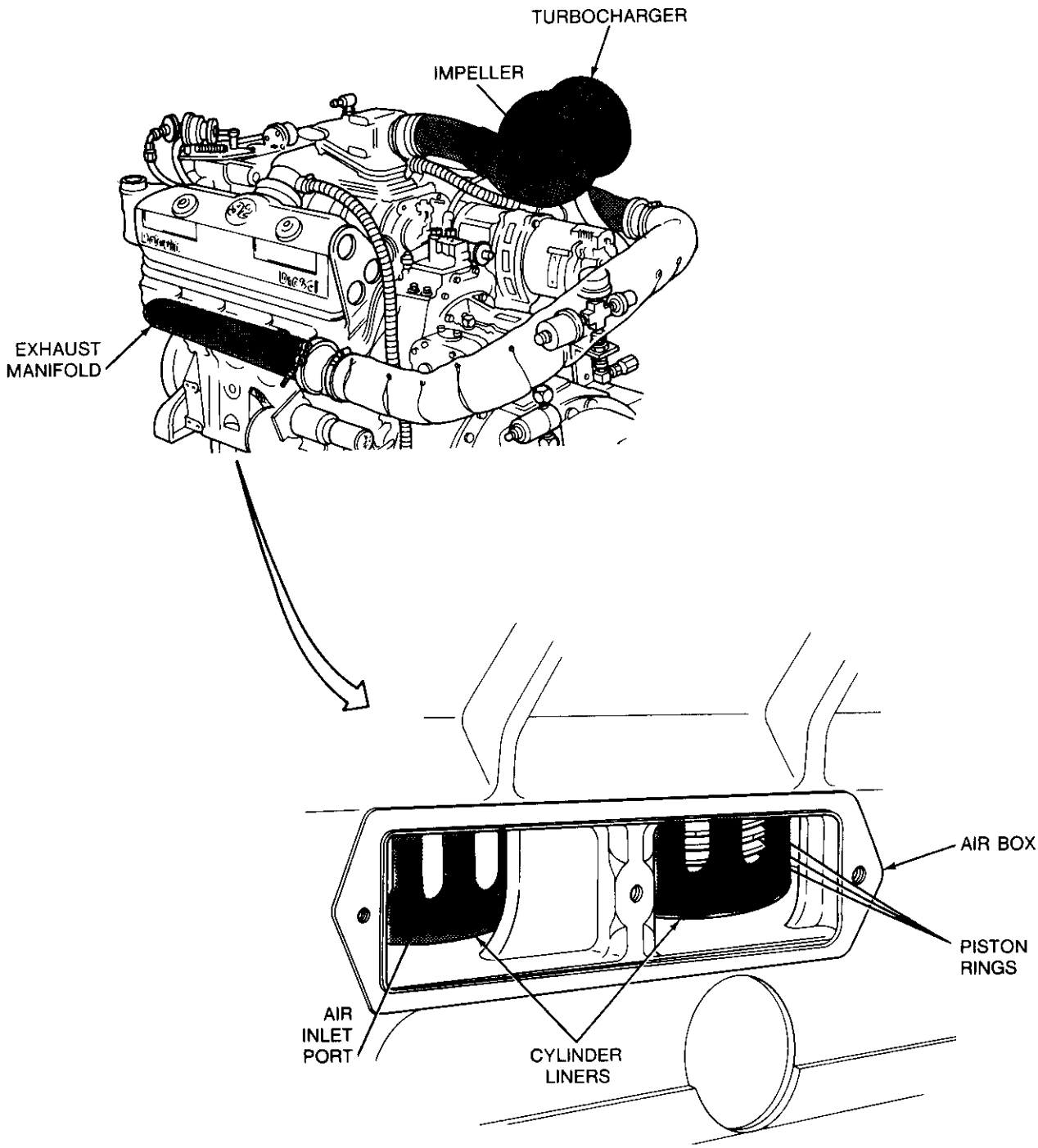
(11) When proper preload has been found, select a spacer (56) 0.001 inch (0.0254 mm) thicker for use during final assembly.



52. BEARING CAGE
53. OUTER BEARING
54. BEARING CUP
55. BEARING CUP
56. SPACER
57. INNER BEARING
59. BEARING CAGE ASSEMBLY
60. PRESS RAM
61. SLEEVE
62. SPRING SCALE

TA 299031

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298344

10-18. DIFFERENTIAL CARRIER REPAIR (NO. 2 AXLE) (Continued)

(33) Place pinion assembly (49) into a press. Press pinion (23) out of bearing cage (52).

(34) Remove outer bearing (53) from bearing cage (52).

(35) If damaged, remove bearing cups (54 and 55) from bearing cage (52).

(36) Remove spacer (56) from pinion (23).

(37) Use a split-type puller (45) and press to remove bearings (57 and 58) from pinion (23).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect gears for damage or signs of overheating.

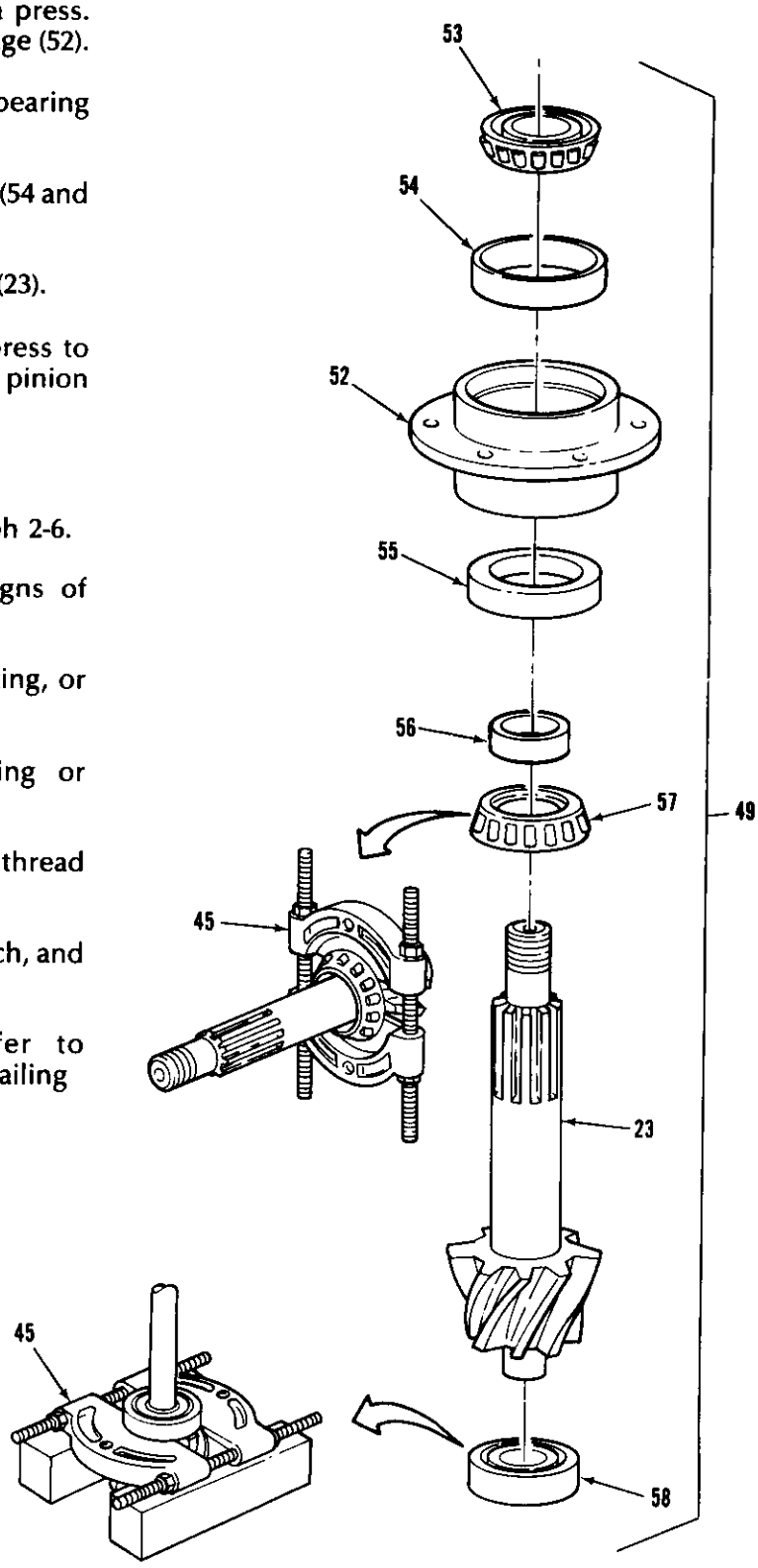
(3) Inspect bearings for damage, pitting, or scoring.

(4) Inspect clutch plates for scoring or burning.

(5) Inspect capscrews and nuts for thread damage.

(6) Inspect splines on side gears, clutch, and clutch plates for damage.

(7) Inspect all other parts. Refer to paragraph 2-7. Replace all parts failing inspection.



23. PINION
45. SPLIT-TYPE PULLER TOOL
49. PINION ASSEMBLY
52. BEARING CAGE
53. OUTER BEARING
54. BEARING CUP
55. BEARING CUP
56. SPACER
57. INNER BEARING
58. PILOT BEARING

TA 299030

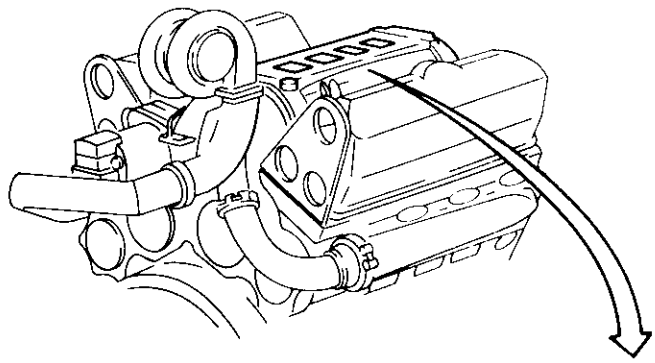
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

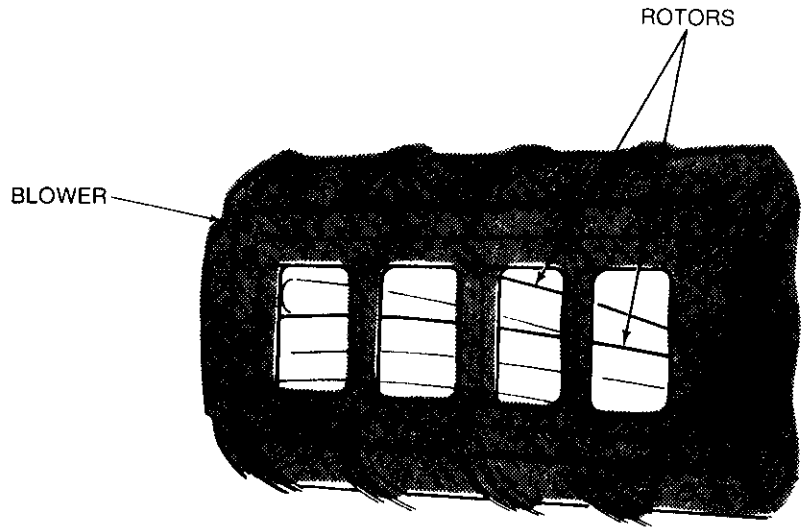
4. HIGH OIL CONSUMPTION (Continued)

Test 8. Remove air inlet housing from blower. Check blower rotors for signs of oil.
- If oil is not present, go to Test 9.
- If oil is present, replace rotor oil seal rings and/or replace blower. Refer to paragraph 4-7.

Test 9. Check for scored liners or pistons.
- If liners or pistons are scored, rebuild engine.

END OF TEST





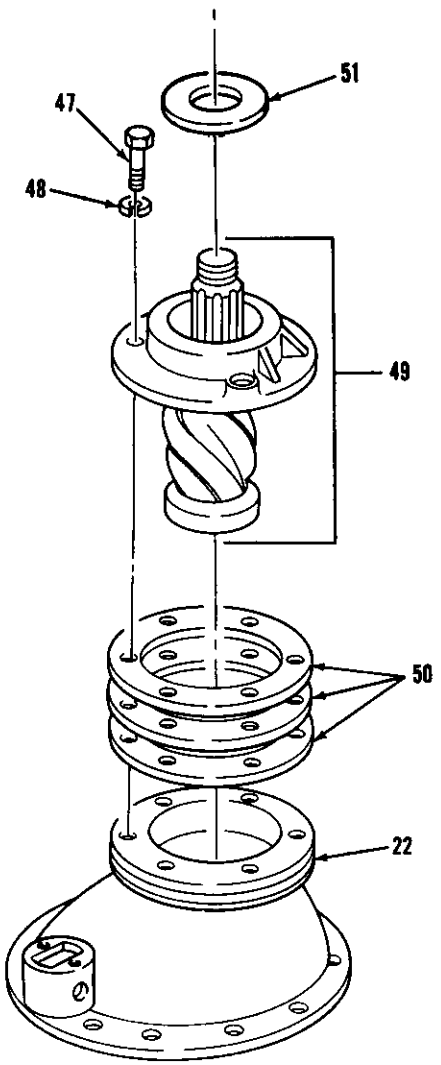
TA 298345

(29) Remove six capscrews (47) and lockwashers (48). Discard lockwashers (48).

(30) Remove pinion assembly (49) from carrier housing (22).

(31) Tag and remove shims (50).

(32) Remove and discard oil seal (51).

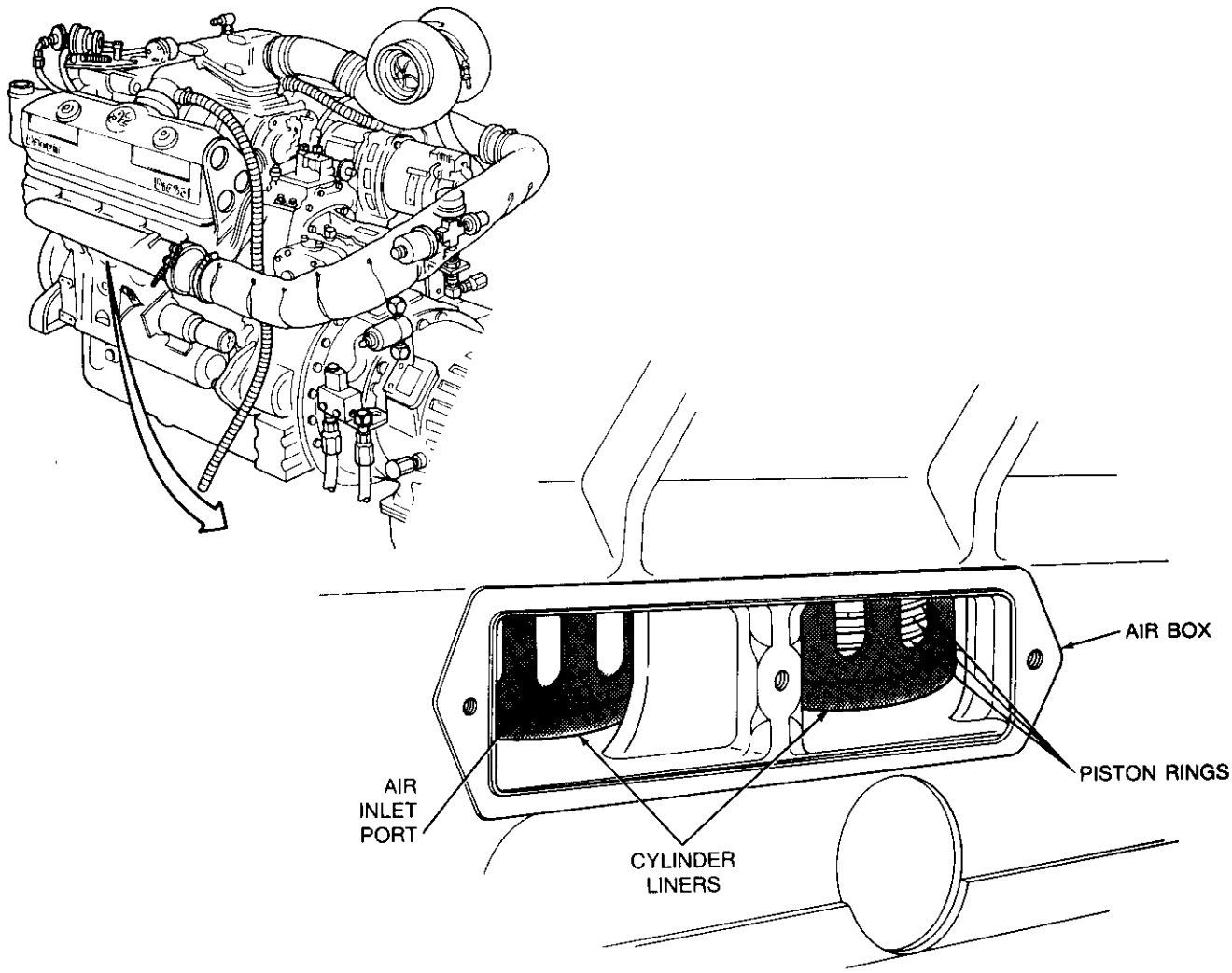


22. CARRIER HOUSING
47. CAPSCREW (6)
48. LOCKWASHER (6)
49. PINION ASSEMBLY
50. SHIM
51. OIL SEAL

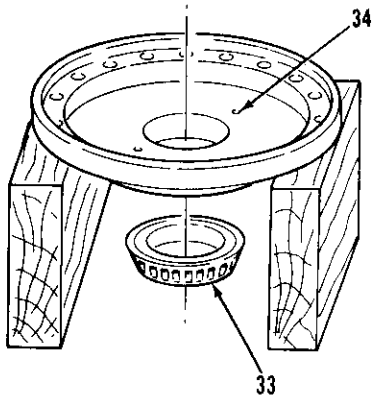
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

5. EXCESSIVE BLACK OR GRAY SMOKE

Test 1. Remove engine air box covers. Check for clogged cylinder liner air inlet ports.
- If cylinder liner ports are not clogged, go to Test 2.
- If cylinder liner ports are clogged, clean cylinder ports as required.



TA 296346



33. BEARING
34. COVER HOLE (2)

(21) Remove bearing (33) by placing a punch in cover holes (34) and tapping on inner race of bearing (33).

(22) Matchmark differential case assembly halves (35 and 36).

(23) Remove 12 capscrews (37).

NOTE

It may be necessary to tap plain case half (35) with a soft-faced hammer in order to break it loose.

(24) Remove plain case half (35), thrust washer (38), and side gear (39).

CAUTION

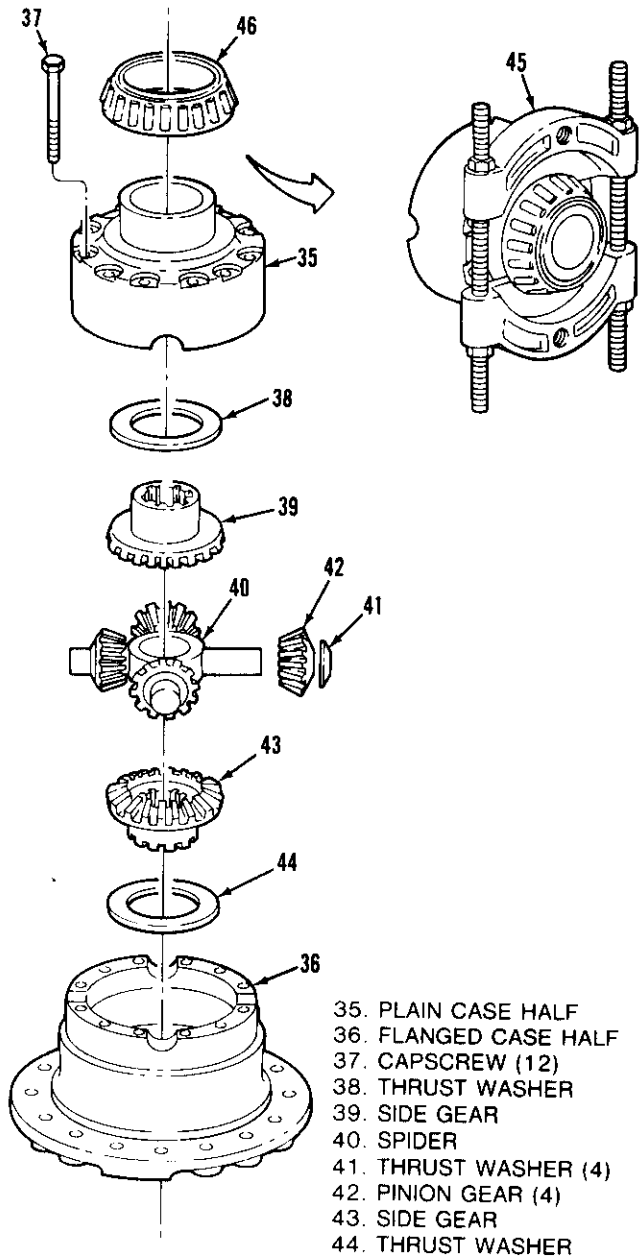
Pinion gears (42) are loose on spider (40) and may slide off when removing spider (40).

(25) Remove spider (40), four thrust washers (41), and pinion gears (42) from flanged case half (36).

(26) Remove four thrust washers (41) and pinion gears (42) from spider (40).

(27) Remove side gear (43) and thrust washer (44).

(28) If damaged, use a split-type puller (45) to remove bearing (46) from plain case half (35).



35. PLAIN CASE HALF
36. FLANGED CASE HALF
37. CAPSCREW (12)
38. THRUST WASHER
39. SIDE GEAR
40. SPIDER
41. THRUST WASHER (4)
42. PINION GEAR (4)
43. SIDE GEAR
44. THRUST WASHER
45. SPLIT-TYPE PULLER (TOOL)
46. BEARING

TA 299028

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

5. EXCESSIVE BLACK OR GRAY SMOKE (Continued)

Test 2. Check for improperly timed injectors. Refer to engine tune-up, paragraph 3-29.
- If injectors are properly timed, check for defective injector.
- If injectors are not properly timed, perform engine tune-up.

END OF TEST

6. BLUE EXHAUST SMOKE

- Oil blown through cylinder during scavenging period. Refer to Malfunction 4, HIGH OIL CONSUMPTION.

END OF TEST

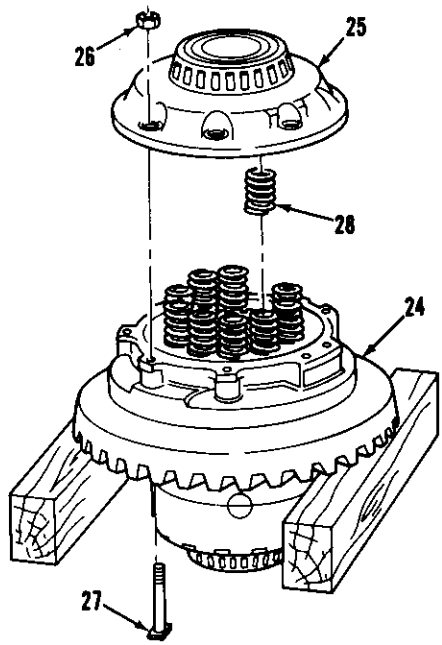
7. WHITE EXHAUST SMOKE

Check for misfiring cylinder. Refer to engine testing, paragraph 3-30.

END OF TEST

8. EXCESSIVE CRANKCASE PRESSURE

Test 1. Check for leaking or damaged blower-to-block gasket.
- If gasket is not leaking or damaged, go to Test 2.
- If gasket is leaking or damaged, replace gasket.



24. RING GEAR
25. CLUTCH PACK COVER
26. LOCKNUT (8)
27. CAPSCREW (8)
28. SPRING (10)

(13) Support ring gear (24) to prevent it from falling when clutch pack cover (25) is removed.

(14) Apply pressure to clutch pack cover (25) and remove eight locknuts (26) and capscrews (27). Discard locknuts (26).

WARNING

Clutch pack cover is under spring tension. To prevent personal injury, release tension slowly.

(15) Slowly release press pressure until all spring tension is released, then remove clutch pack cover (25).

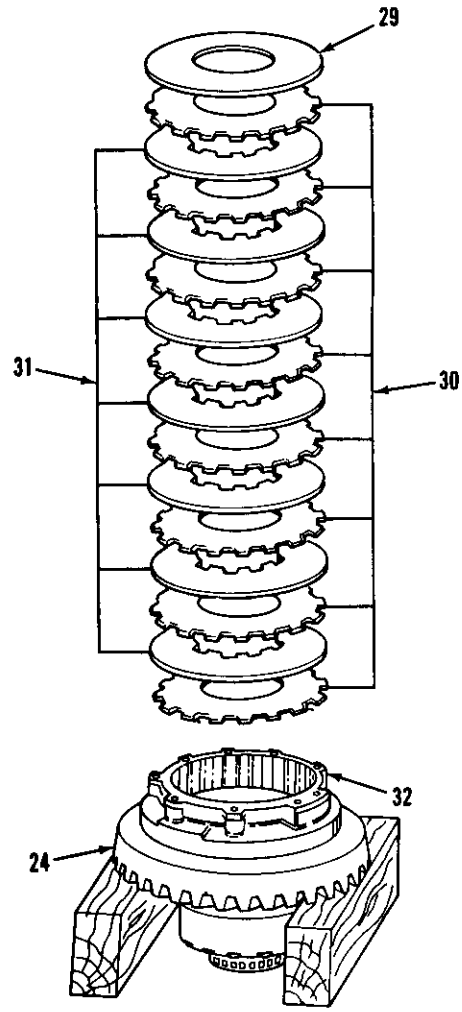
(16) Remove 10 springs (28).

(17) Remove pressure plate (29).

(18) Remove eight externally splined plates (30) and seven internally splined plates (31).

(19) Remove differential case assembly (32) and ring gear (24) from press.

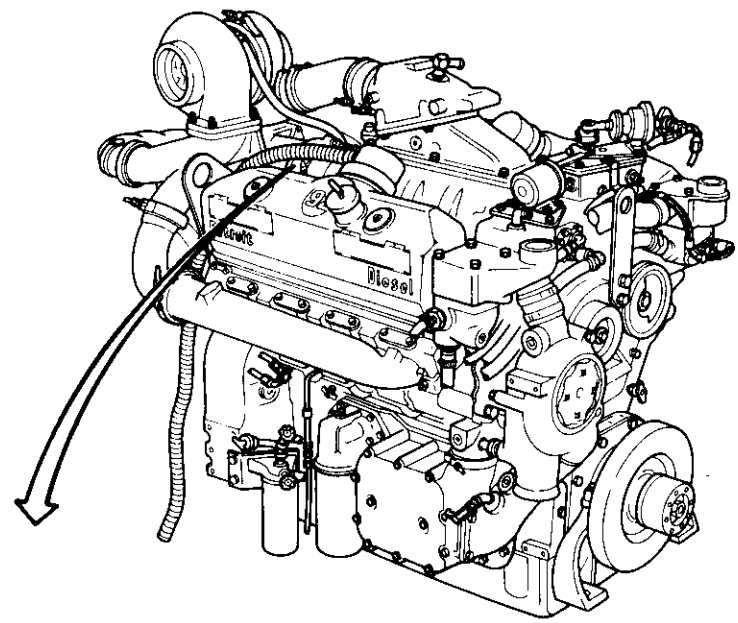
(20) Tap ring gear (24) off of differential case assembly (32).

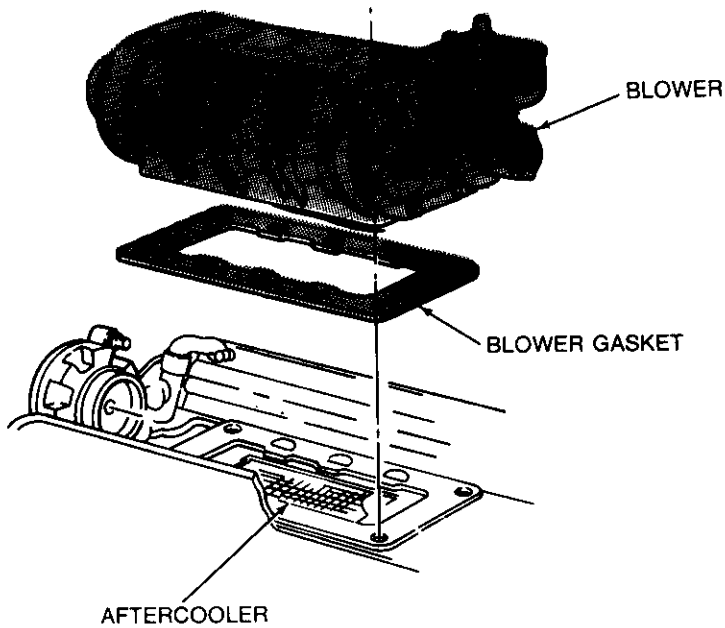


24. RING GEAR
29. PRESSURE PLATE
30. EXTERNALLY SPLINED PLATE (8)
31. INTERNALLY SPLINED PLATE (7)
32. DIFFERENTIAL CASE ASSEMBLY

TA 299027

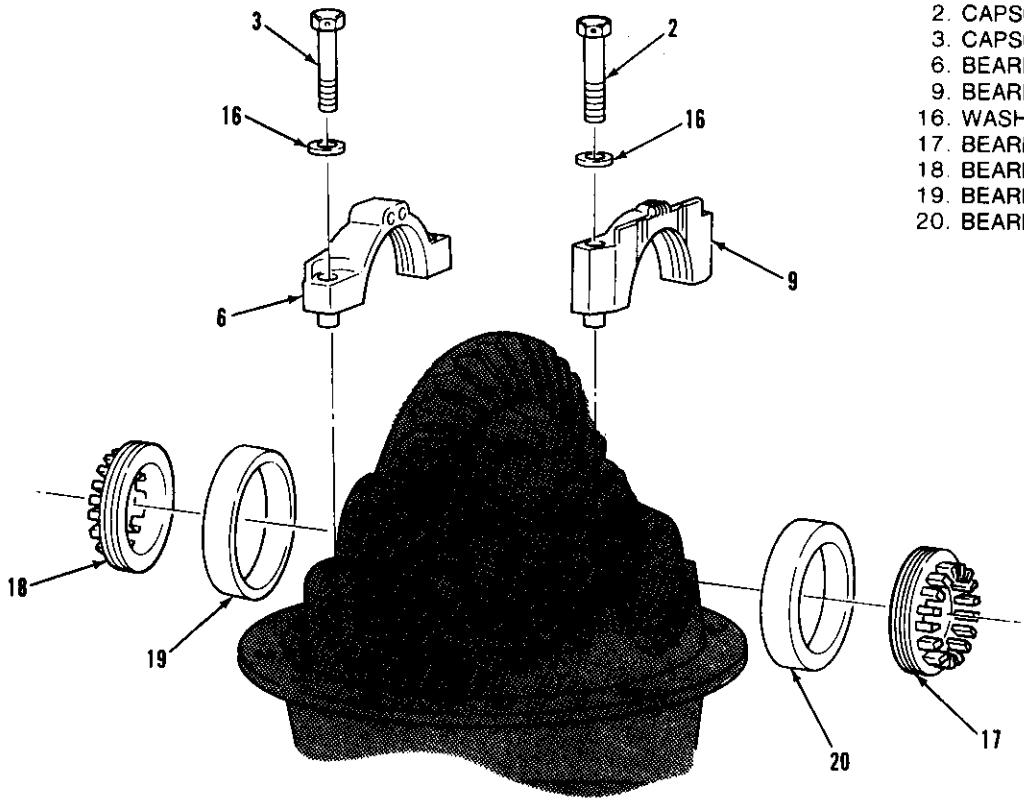
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION





TA 298347

10-18. DIFFERENTIAL CARRIER REPAIR (NO. 2 AXLE) (Continued)



2. CAPSCREW (2)
3. CAPSCREW (2)
6. BEARING CAP
9. BEARING CAP
16. WASHER (4)
17. BEARING ADJUSTER
18. BEARING ADJUSTER
19. BEARING CUP
20. BEARING CUP

(7) Remove two capscrews (2 and 3) and washers (16) from each bearing cap (6 and 9).

(8) Tag and remove bearing caps (6 and 9) and bearing adjusters (17 and 18).

(9) Tag and remove bearing cups (19 and 20).

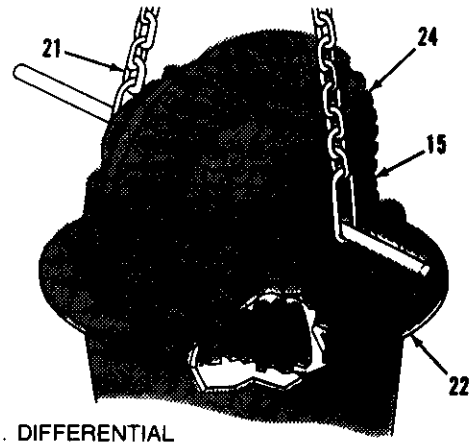
WARNING

Differential carrier assembly (15) is extremely heavy. Use proper lifting device to prevent damage to equipment and personal injury.

(10) Attach lifting device (21) to differential carrier assembly (15) and remove differential carrier assembly (15) from carrier housing (22) and pinion (23).

(11) Place differential carrier assembly (15) in press so teeth of ring gear (24) face down.

(12) Remove lifting device (21).



15. DIFFERENTIAL CARRIER ASSEMBLY
21. LIFTING DEVICE
22. CARRIER HOUSING
23. PINION
24. RING GEAR

TA 299026

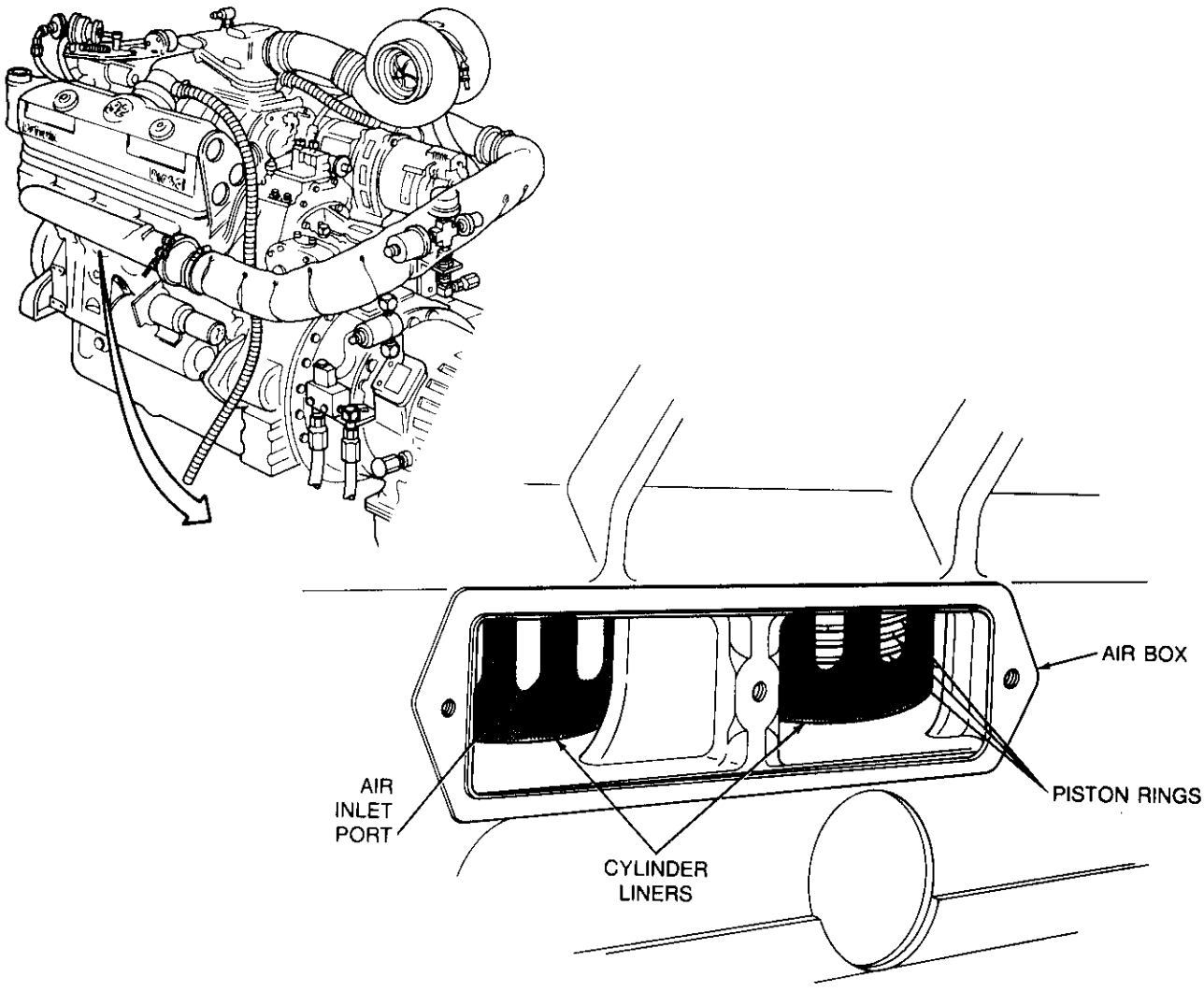
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

8. EXCESSIVE CRANKCASE PRESSURE (Continued)

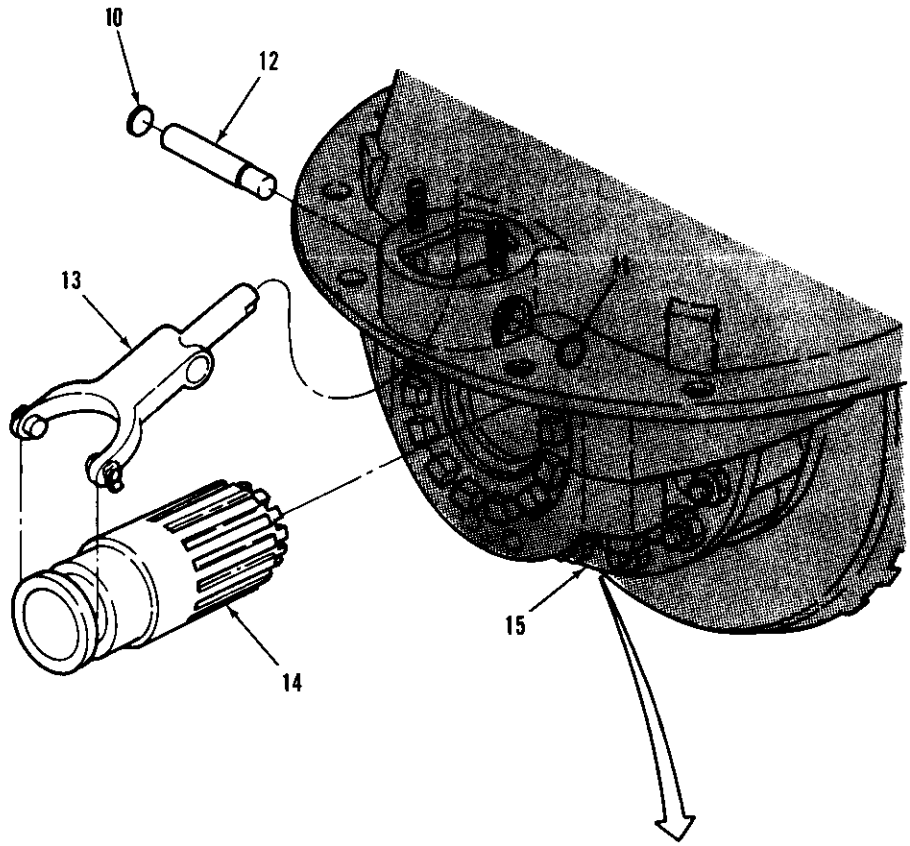
Test 2. Remove air box covers. Check for piston and liner damage and worn or broken rings.
- If piston and liner are damaged or rings are worn or broken, rebuild cylinder or engine.
- If piston and liners are not worn or broken, go to Test 3.

Test 3. Perform engine compression test. Refer to paragraph 3-30. Check for low pressure in one cylinder.
- If pressure is low in any one cylinder, rebuild cylinder or engine.

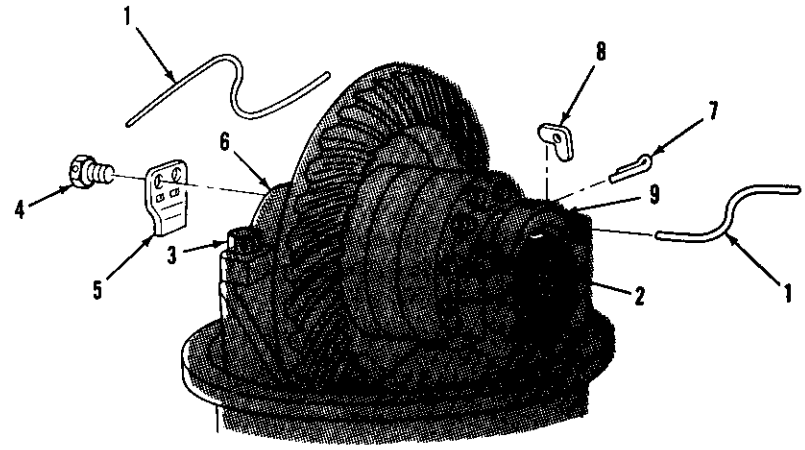
END OF TEST



TA 298348



1. LOCKWIRE (3)
2. CAPSCREW (2)
3. CAPSCREW (2)
4. CAPSCREW (2)
5. LOCK
6. BEARING CAP
7. COTTER PIN
8. LOCK
9. BEARING CAP
10. EXPANSION PLUG
11. EXPANSION PLUG
12. SHIFT FORK SHAFT
13. SHIFT FORK
14. SLIDING CLUTCH
15. DIFFERENTIAL CARRIER ASSEMBLY



TA 299025

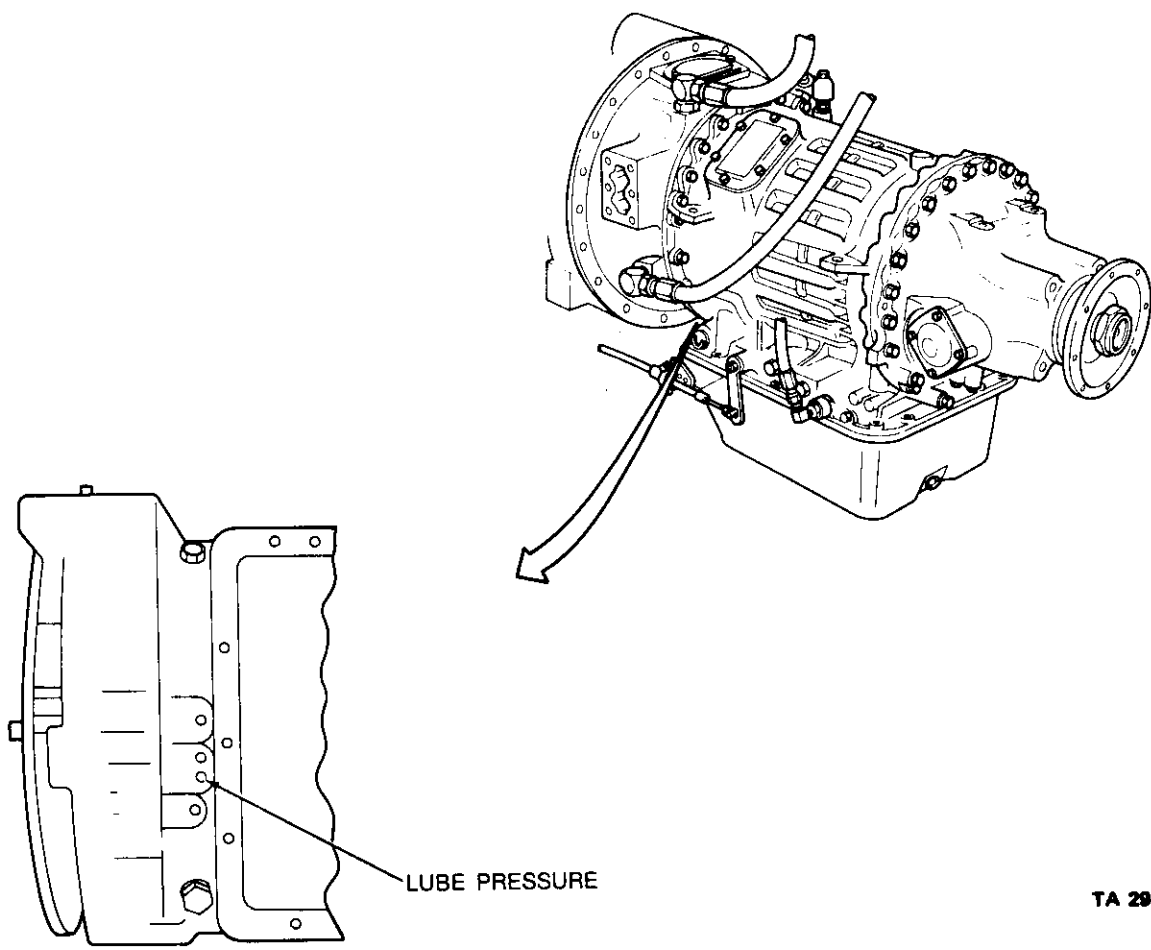
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

TRANSMISSION

1. TRANSMISSION OIL TEMPERATURE GAGE STAYS OVER 250°F (121°C)

Test 1. Check that the hydraulic fan motor is working properly.
- If fan motor is working properly, go to Test 2.
- If fan motor is not working properly, refer to Hydraulic Cooling System Troubleshooting.

Test 2. Check for low lubrication oil pressure. Remove plug from lube port on transmission. Install a 0-100 psi (0-689 kPa) gage at lube pressure port on bottom of converter housing. Start engine and increase speed to approximately 1900 RPM. Check for 25 psi (172 kPa) lube system pressure (minimum).
- If pressure is within specifications, disassemble transmission and check for damaged torque converter. Refer to paragraph 7-11.
- If pressure is not within specifications, go to Test 3.



TA 298349

SECTION IV. DIFFERENTIAL CARRIER REPAIR INSTRUCTIONS

10-18. DIFFERENTIAL CARRIER REPAIR (NO. 2 AXLE)

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly
d. Adjustment

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Dial indicator (J 7872)
Flange yoke holding bar (J 3453)

Materials/Parts

Lockwire (item 33, Appendix C)
Marking compound (item 36, Appendix C)
Gear oil (item 40, Appendix C)
Cotter pin (NSN 5315-00-135-7277) item 7
Expansion plug (2) (NSN 5340-01-027-2592) items 10 and 11
Locknut (8) (MS51943-46) item 26
Lockwasher (6) (MS35338-49) item 48
Oil seal (NSN 5330-01-158-2061) item 51
Dummy yoke (NSN 2520-01-159-9802) item 65
Washer (NSN 5310-01-145-9112) item 66
Pinion locknut (NSN 5310-01-151-8344) item 67

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Differential carrier removed (para 10-17).

a. Disassembly

(1) Cut lockwire (1) from capscrews (2, 3, and 4). Discard lockwire (1).

(2) Remove two capscrews (4) and lock (5) from bearing cap (6).

(3) Remove cotter pin (7) and lock (8) from bearing cap (9). Discard cotter pin (7).

(4) Using a punch, remove and discard two expansion plugs (10 and 11).

(5) Drive out shift fork shaft (12) through top hole.

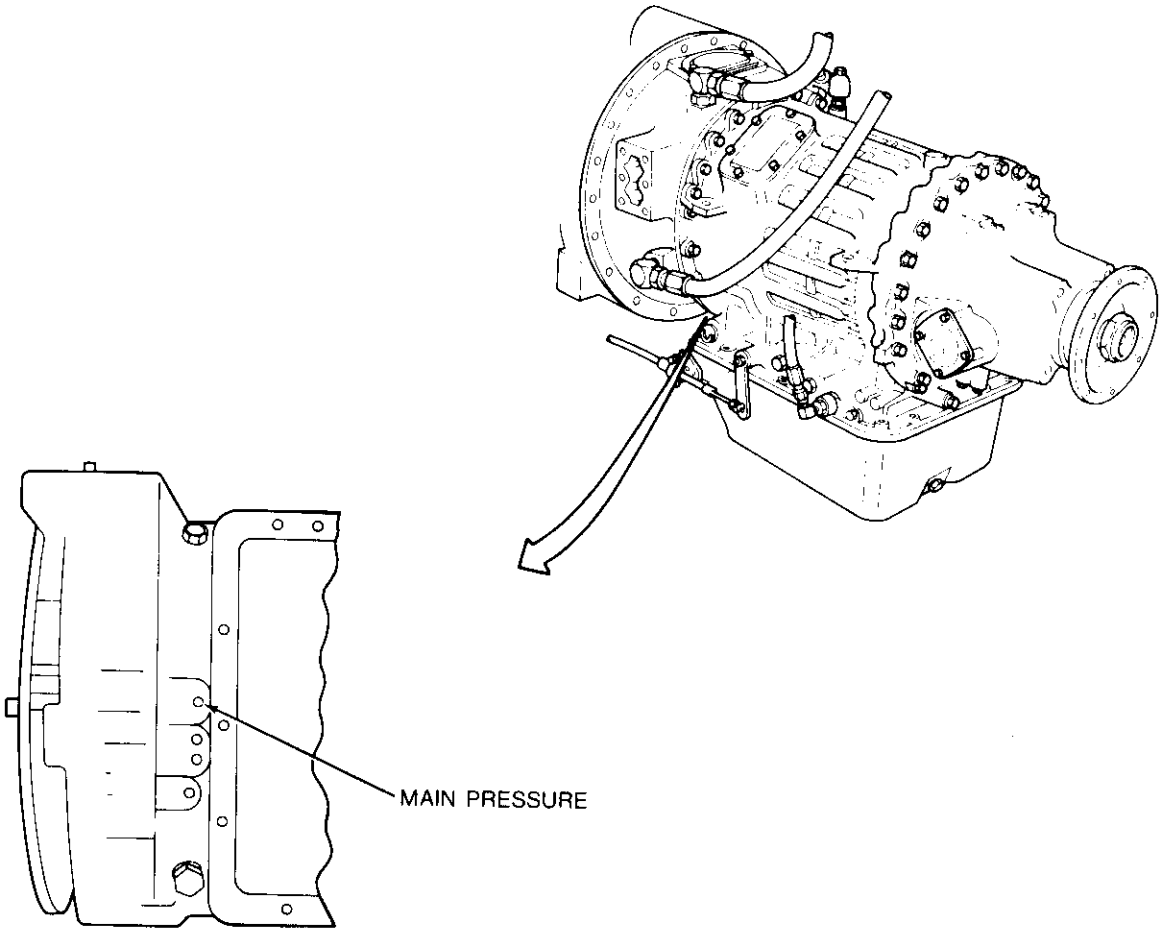
(6) Disengage shift fork (13) from sliding clutch (14). Remove sliding clutch (14) and shift fork (13) from differential carrier assembly (15).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

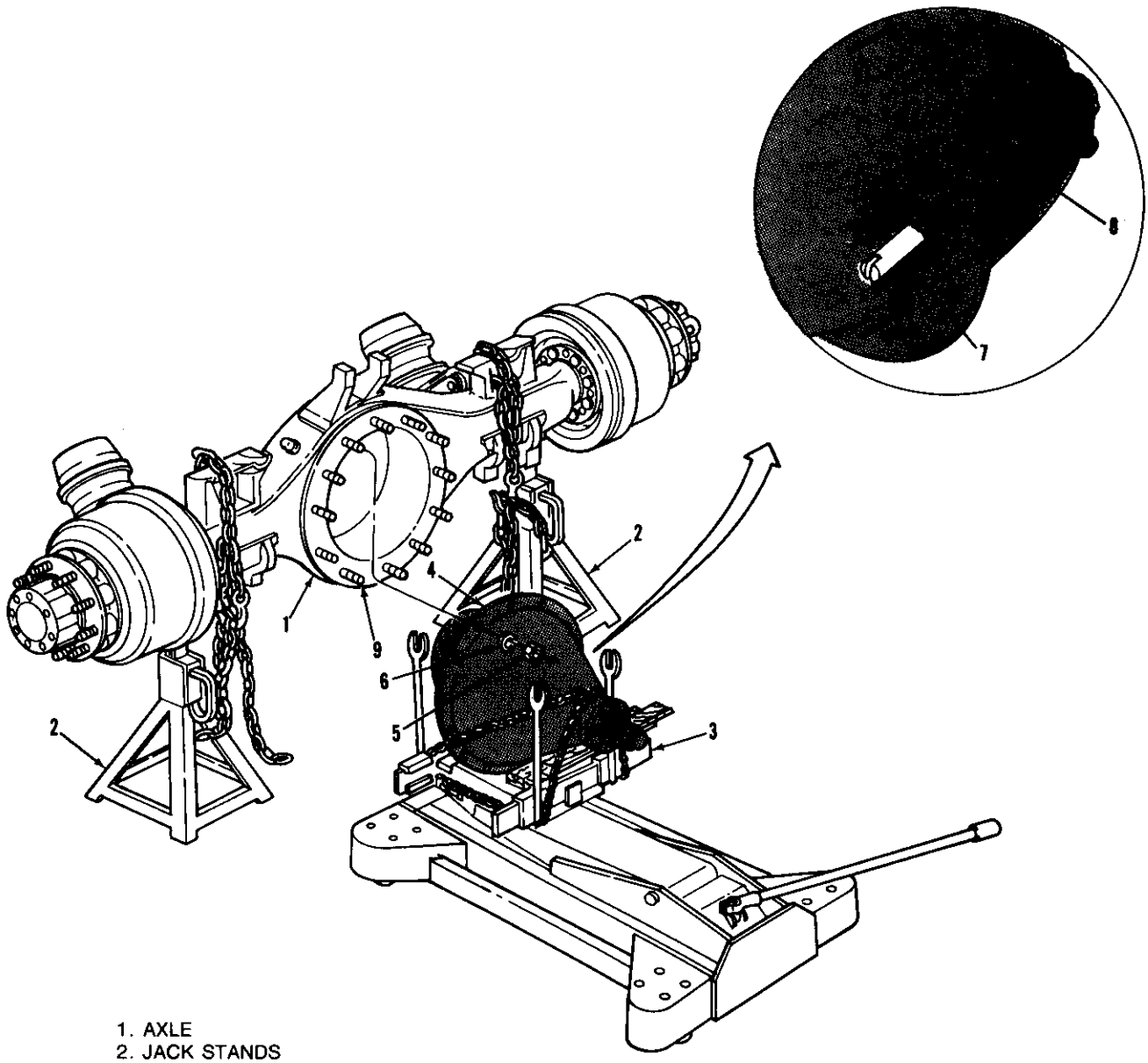
1. TRANSMISSION OIL TEMPERATURE GAGE STAYS OVER 250°F (121°C) (Continued)

Test 3. Check for low main pressure. Remove main pressure oil line from main pressure port on transmission converter housing and install a 0-300 psi (0-2068 kPa) gage in line. Start engine and allow to run at idle speed. With parking brake applied, shift transmission into drive. Check for a minimum of 110 psi (758 kPa) main system pressure.

- If pressure is within specifications, disassemble transmission and inspect lubrication check valve and converter bypass valve for damage. Inspect all other moving parts for damage from lack of oil. Refer to paragraphs 2-5, 7-10, and 7-12
- If pressure is not within specifications, go to Test 4.



TA 299878



1. AXLE
2. JACK STANDS
3. REMOVAL EQUIPMENT
4. DIFFERENTIAL CARRIER
5. NUT (12)
6. LOCKWASHER (12)
7. SHIFT LEVER
8. SHIFT COLLAR
9. STUD (12)

TA 299024

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

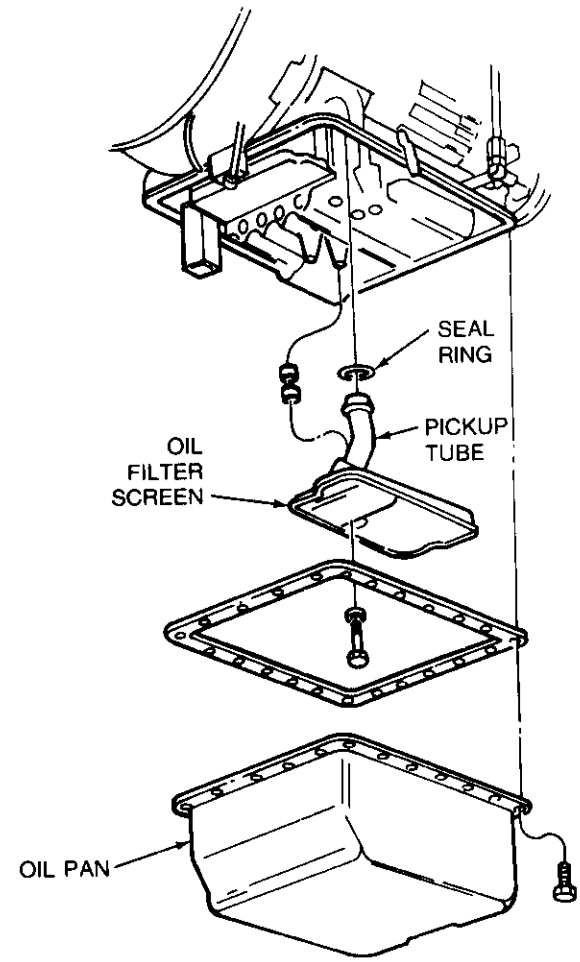
Test 4. Drain transmission and remove oil pan. Refer to paragraph 8-12 in TM 2320-20/12, TM 9-2320-297-20. Check for clogged internal oil filter screen.

- If filter screen is not clogged, go to Test 5.
- If filter screen is clogged, replace filter screen. Refer to paragraph 8-12 in TM 9-2320-297-20.

Test 5. Check for damaged, leaking, or missing seal ring on internal filter pickup tube.

- If seal ring is damaged, leaking, or missing, replace seal ring. Refer to paragraph 8-12 in TM 9-2320-297-20.
- If seal ring is not damaged, leaking, or missing, disassemble transmission and inspect oil pump, main pressure regulator valve and control valve body for leakage or sticking valves. Refer to paragraphs 7-10 and 7-12.

END OF TEST



TA 299739

10-17. DIFFERENTIAL CARRIER REPLACEMENT (NO. 2 AND 4 AXLES) (Continued)

c. Installation

(1) Install studs (9) if removed.

(2) Position differential carrier (4) on removal equipment (3).

(3) Coat mating surface of axle (1) housing with silicone sealant. Be sure to circle each stud (9) and capscrew hole.

(4) Secure shift lever (7) with safety wire to move shift collar (8) into differential carrier (4).

(5) Place differential carrier (4) into axle (1) housing.

(6) Install (12) new lockwashers (6) and nuts (5) onto studs (9).

(7) Torque all nuts (5) evenly to 230 foot-pounds (311.88 N·m).

(8) Remove safety wire from shift lever (7).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install axle yoke (para 10-12).
	Install axle shift unit (para 10-3).
	Install No. 2 axle (para 10-13).
	Install No. 4 axle (para 10-15).
TM 2320-20/12 TM 9-2320-297-20	Install axle shafts (para 12-4).
	Fill axle with lubricant (para 12-3).
TM 2320-10/11 TM 9-2320-297-10	Operate vehicle. Check axle for noise and leaks (para 2-13).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

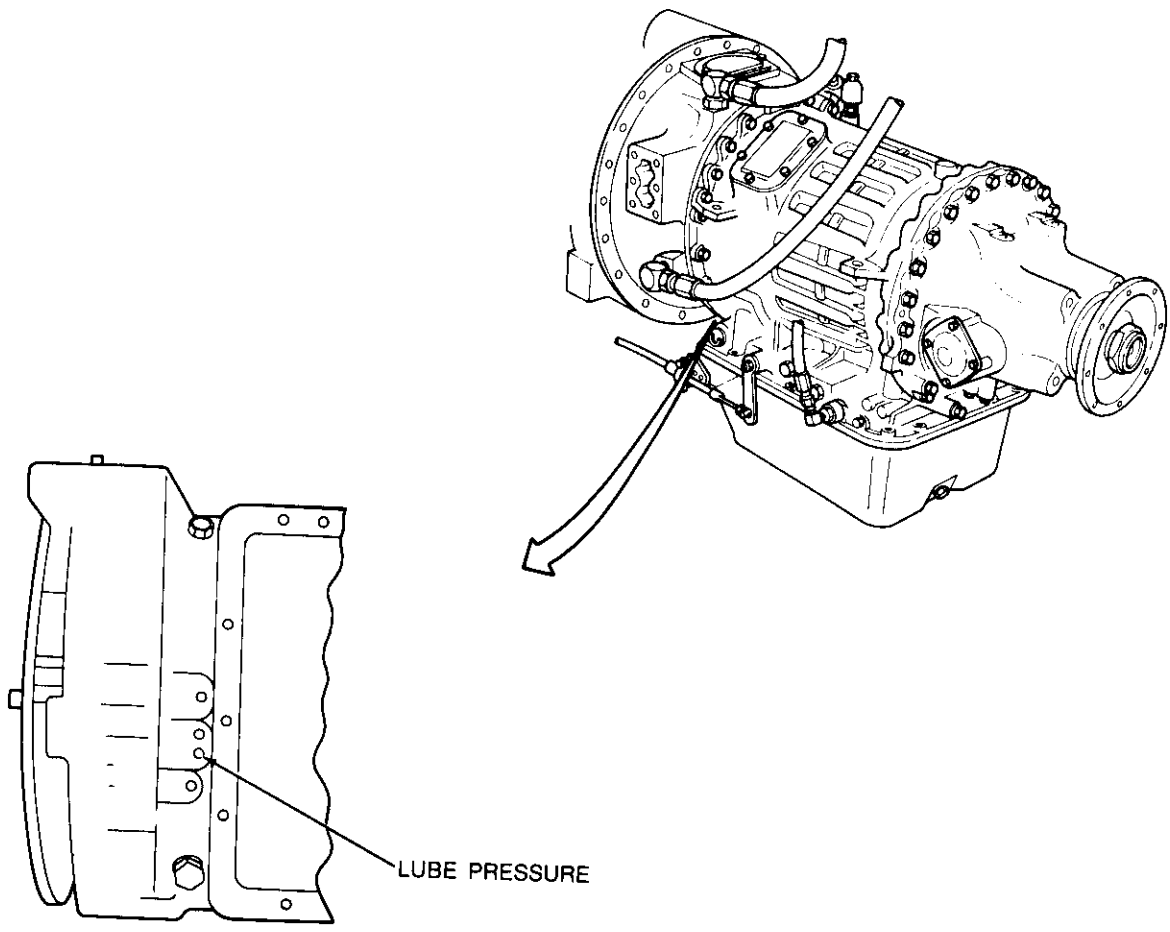
2. TRANSMISSION NOISY

Test 1. Remove propeller shaft from output flange or transmission. With engine running, shift transmission through gear ranges.

- If noise is now gone, check drive line for damage.
- If noise is still there, reconnect propeller shaft and go to Test 2.

Test 2. Check for low lubrication oil pressure. Remove plug from lube port on transmission. Install a 0-100 psi (0-689 kPa) gage at lube pressure port on bottom of converter housing. Start engine and increase speed to approximately 1900 RPM. Check for 25 psi (172 kPa) lube system pressure (minimum).

- If pressure is within specifications, disassemble transmission and check torque converter, planetary gear assemblies and bearings for damage. Refer to paragraph 7-5.
- If pressure is not within specifications, go to Test 3.



TA 298351

WARNING

The differential carrier is heavy. To prevent personal injury, be careful during removal procedures. Make sure differential carrier is supported and balanced when nuts (5) are removed.

(3) Remove 12 nuts (5) and lockwashers (6). Discard lockwashers (6).

(4) Secure shift lever (7) with safety wire to move shift collar (8) into differential carrier (4).

(5) Carefully guide differential carrier (4) out of axle (1) housing.

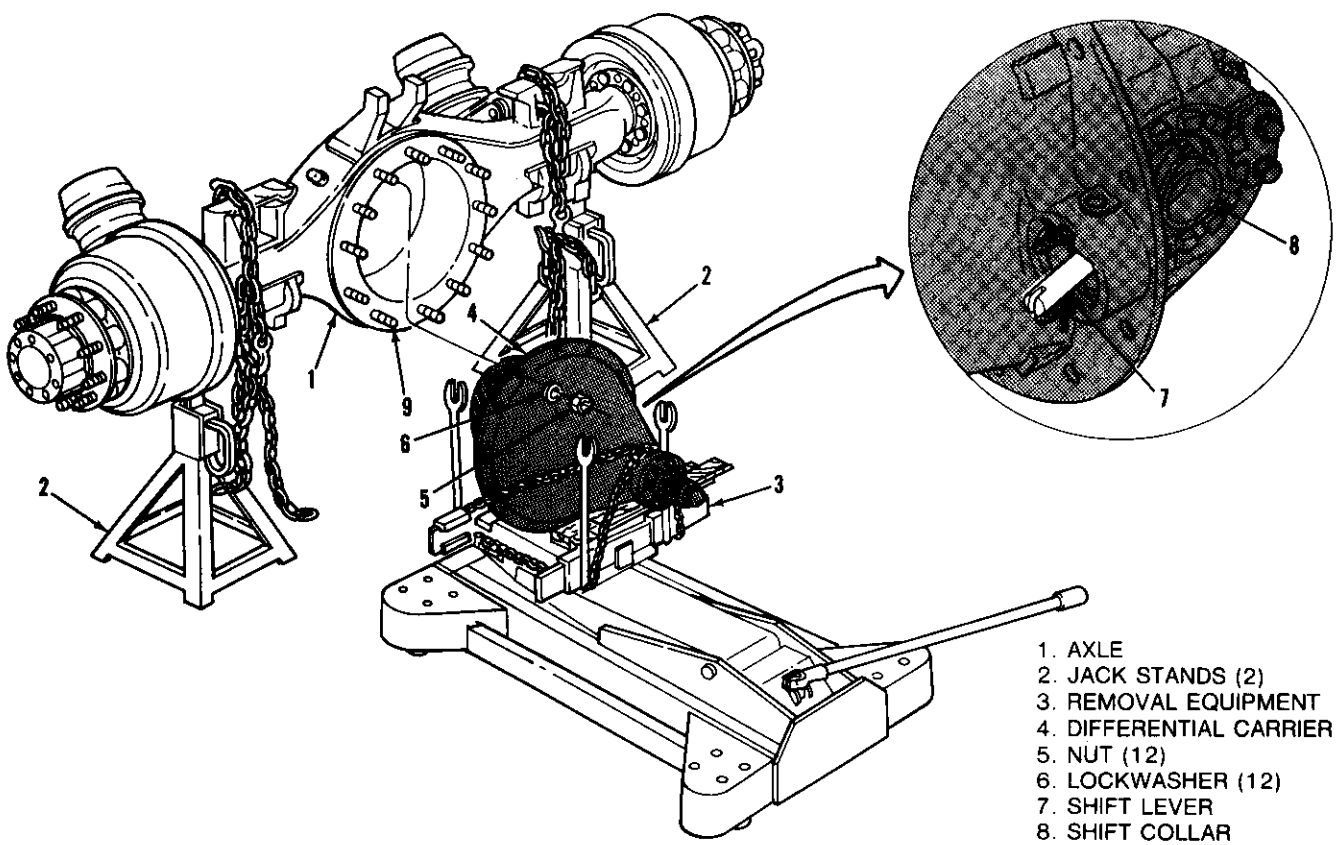
b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect studs (9) for damage. Remove if damaged.

(3) Inspect all other parts. Refer to paragraph 2-7.

(4) Replace all parts failing inspection.



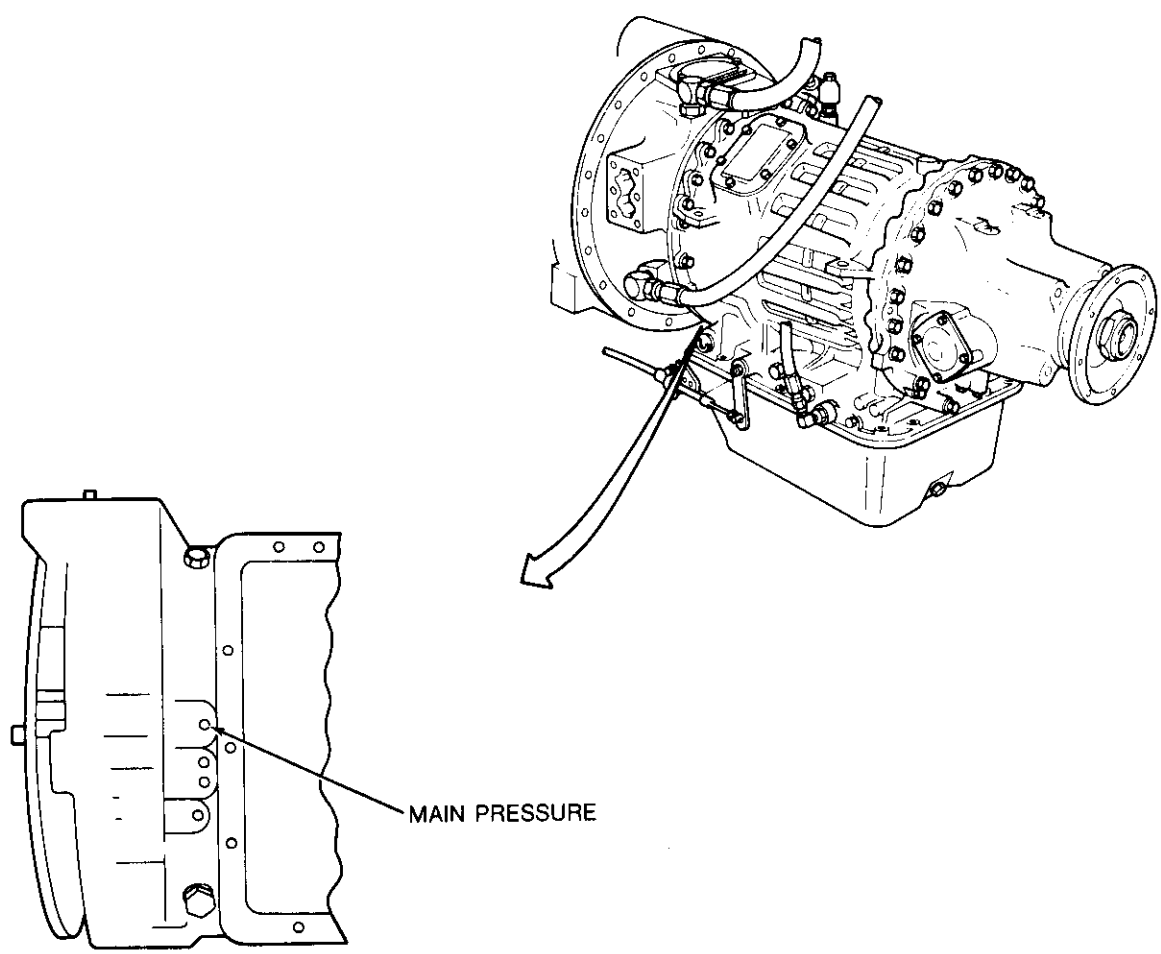
1. AXLE
2. JACK STANDS (2)
3. REMOVAL EQUIPMENT
4. DIFFERENTIAL CARRIER
5. NUT (12)
6. LOCKWASHER (12)
7. SHIFT LEVER
8. SHIFT COLLAR
9. STUD (12)

TA 299023

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 3. Check for low main pressure. Remove main pressure oil line from main pressure port on transmission and install a tee and a 0-300 psi (0-2068 kPa) gage. Start engine and allow to run at idle speed. With parking brake applied, shift transmission into drive. Check for a minimum of 110 psi (758 kPa) main system pressure.

- If pressure is within specifications, disassemble transmission and inspect lubrication check valve and converter bypass valve for damage. Inspect all other moving parts for damage from lack of oil. Refer to paragraphs 7-10 and 7-12.
- If pressure is not within specifications, go to Test 4.



TA 298352

10-17. DIFFERENTIAL CARRIER REPLACEMENT (NO. 2 AND 4 AXLES)

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Materials/Parts

Adhesive, silicone sealant (item 7, Appendix C)
Lockwasher (12) (MS35338-50) item 6

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Axle lubricant drained (para 12-3).
	Axle shafts removed (para 12-4).
TM 2320-34/13 TM 9-2320-297-34	No.2 or 4 axle assembly removed as needed (para 10-13 or 10-15).
	Axle yoke removed (para 10-12).
	Axle shift unit removed (para 10-3).

General Safety Instructions

Differential carrier is heavy. To prevent personal injury be careful during replacement procedures.

a. Removal

WARNING

Axle (1) is unbalanced and must be secured to jack stands (2) to prevent axle (1) from falling. Make sure axle (1) is stable and properly secured.

NOTE

The following procedures work for both the No. 2 and No. 4 differential carriers.

(1) Position axle (1) on two jack stands (2). Secure axle (1) to jack stands (2).

(2) Position removal equipment (3) below differential carrier (4).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

2. TRANSMISSION NOISY (Continued)

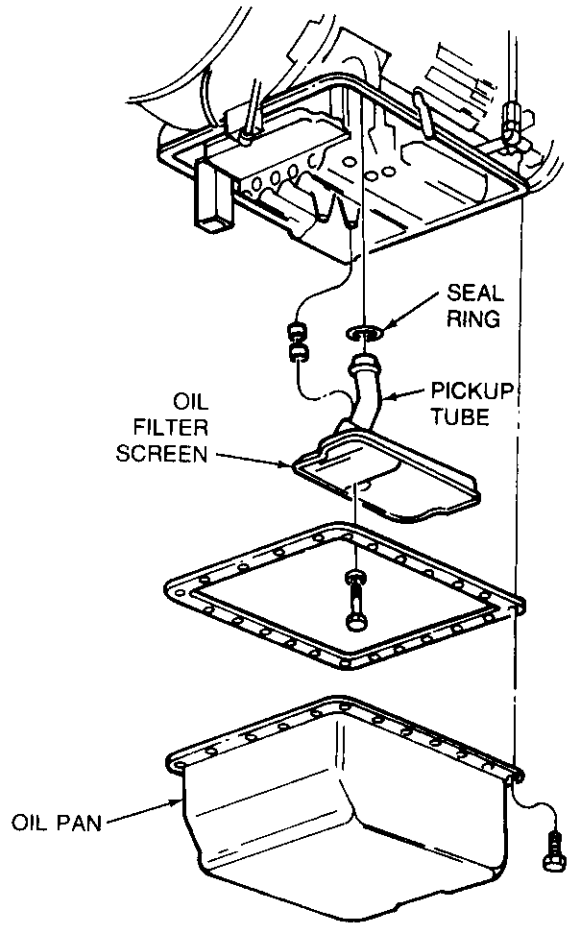
Test 4. Drain transmission and remove oil pan. Refer to paragraph 8-12 in TM 2320-20/12, TM 9-2320-297-20. Check for clogged internal oil filter screen.

- If filter screen is not clogged, go to Test 5.
- If filter screen is clogged, replace filter screen. Refer to paragraph 8-12 in TM 9-2320-297-20.

Test 5. Check for damaged, leaking, or missing seal ring on internal filter pickup tube.

- If seal ring is damaged, leaking, or missing, replace seal ring. Refer to paragraph 8-12 in TM 9-2320-297-20.
- If seal ring is not damaged, leaking, or missing, disassemble transmission and inspect oil pump, main pressure regulator valve and control valve body for leakage or sticking valves. Refer to paragraphs 7-10 and 7-12.

END OF TEST



TA 299736

(9) Install bracket (3), new lockwasher (2), and nut (1).

(10) Install bracket (6), new lockwasher (5), and capscrew (4).

(11) Torque four nuts (12) evenly to 160 foot-pounds (216.96 N·m).

(12) Torque six nuts (1 and 15) evenly to 230 foot-pounds (311.88 N·m).

(13) Torque two capscrews (4 and 10) evenly to 220 foot-pounds (298.32 N·m).

(14) Install output shaft (7).

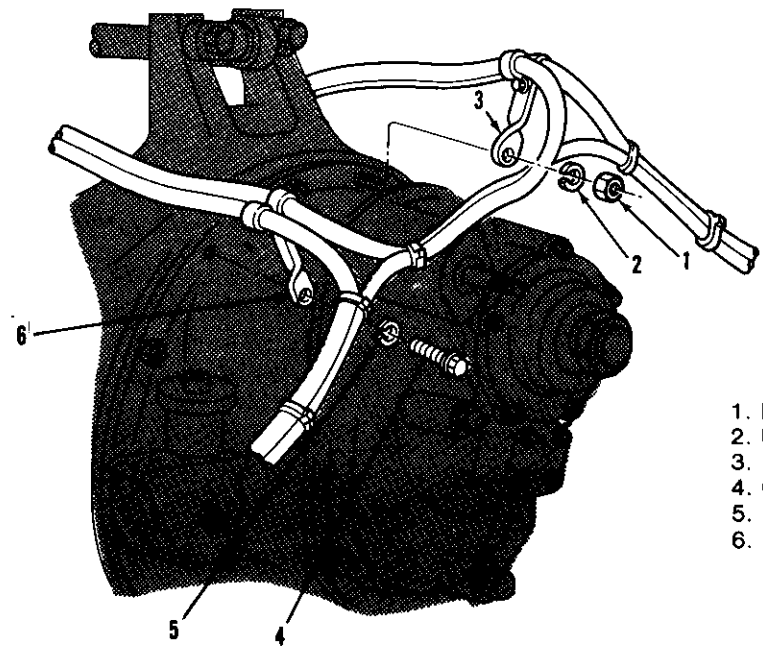
(15) Remove safety wire from shift lever (17).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install axle housing cover (para 10-4).
	Install differential carrier cover (para 10-6).
	Install axle shift unit (para 10-3).
TM 2320-20/12 TM 9-2320-297-20	Install axle shafts (para 12-4).
	Fill axle with lubricant (para 12-3).
TM 2320-10/11 TM 9-2320-297-10	Operate vehicle. Check axle for noise or leaks (para 2-13).



1. NUT
2. LOCKWASHER
3. BRACKET
4. CAPSCREW
5. LOCKWASHER
6. BRACKET

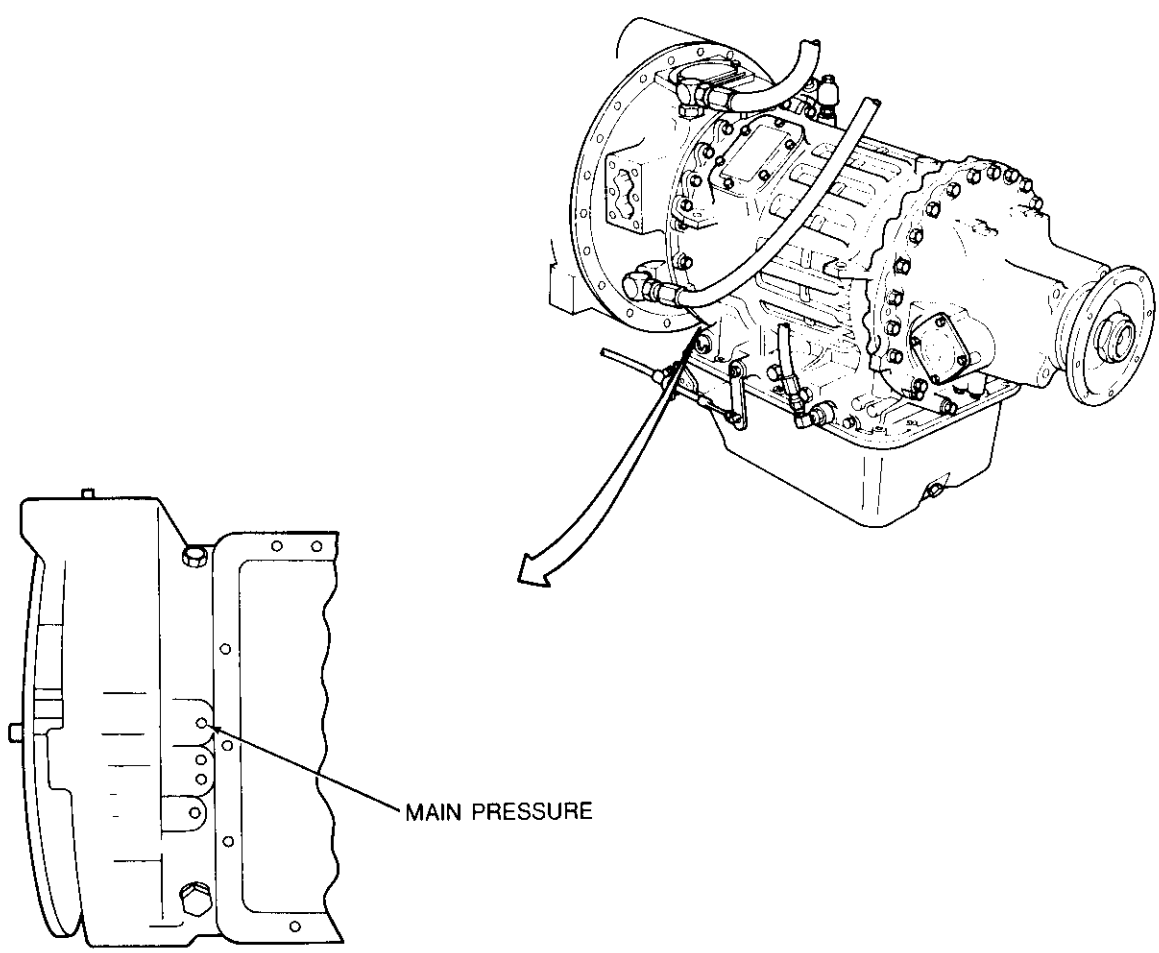
TA 299022

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. TRANSMISSION WILL NOT SHIFT INTO GEAR, SLIPS OUT OF GEAR OR OPERATES ERRATICALLY

Test 1. Check for low main pressure. Remove main pressure oil line from main pressure port on transmission and install a tee and a 0-300 psi (0-2068 kPa) gage. Start engine and allow to run at idle speed. With parking brake applied, shift transmission into drive. Check for a minimum of 110 psi (758 kPa) main system pressure.

- If pressure is within specifications, go to Test 4.
- If pressure is not within specifications, go to Test 2.



TA 298353

10-16. DIFFERENTIAL CARRIER REPLACEMENT (NO. 3 AXLE) (Continued)

c. Installation

(1) Install studs (20) if removed.

(2) Position differential carrier (8) on removal equipment.

(3) Coat mating surface of housing (19) with silicone sealant. Be sure to circle each stud (20) and capscrew hole.

(4) Secure shift lever (17) with safety wire to move shift collar (18) into differential carrier (8).

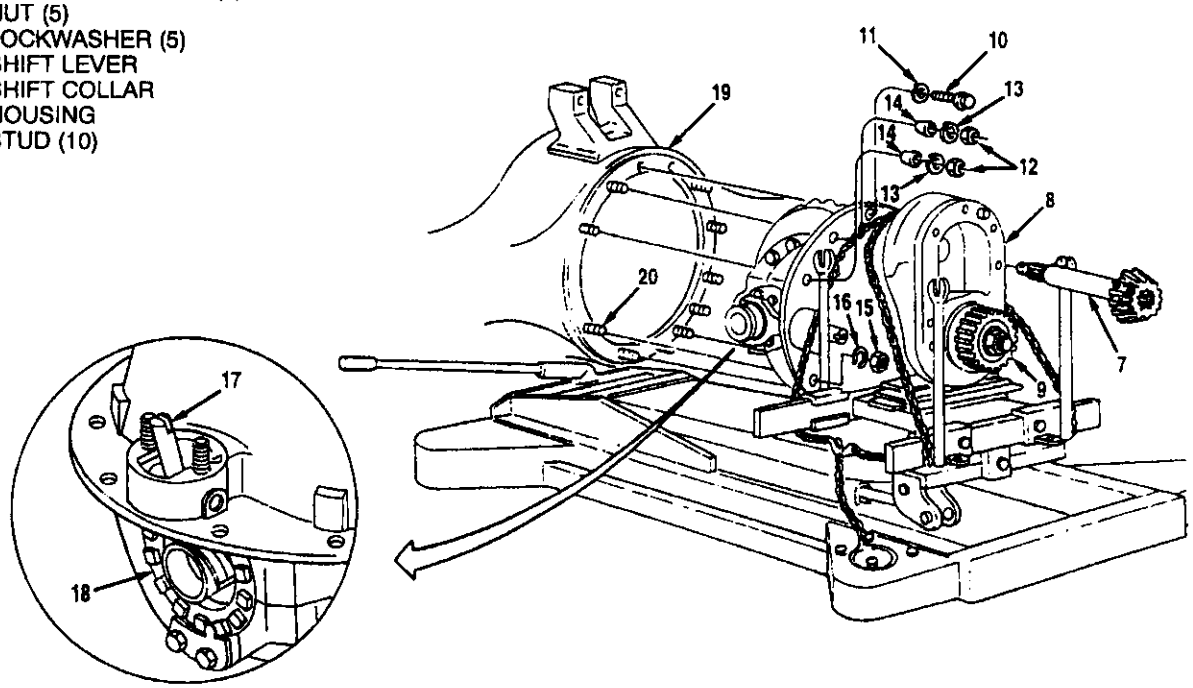
(5) Place differential carrier (8) into housing (19).

(6) Install four tapered bushings (14), new lockwashers (13), and nuts (12).

(7) Install five nuts (15) and new lockwashers (16).

(8) Install capscrew (10) and new lockwasher (11).

7. OUTPUT SHAFT
8. DIFFERENTIAL CARRIER
9. NUT
10. CAPSCREW
11. LOCKWASHER
12. NUT (4)
13. LOCKWASHER (4)
14. TAPERED BUSHING (4)
15. NUT (5)
16. LOCKWASHER (5)
17. SHIFT LEVER
18. SHIFT COLLAR
19. HOUSING
20. STUD (10)

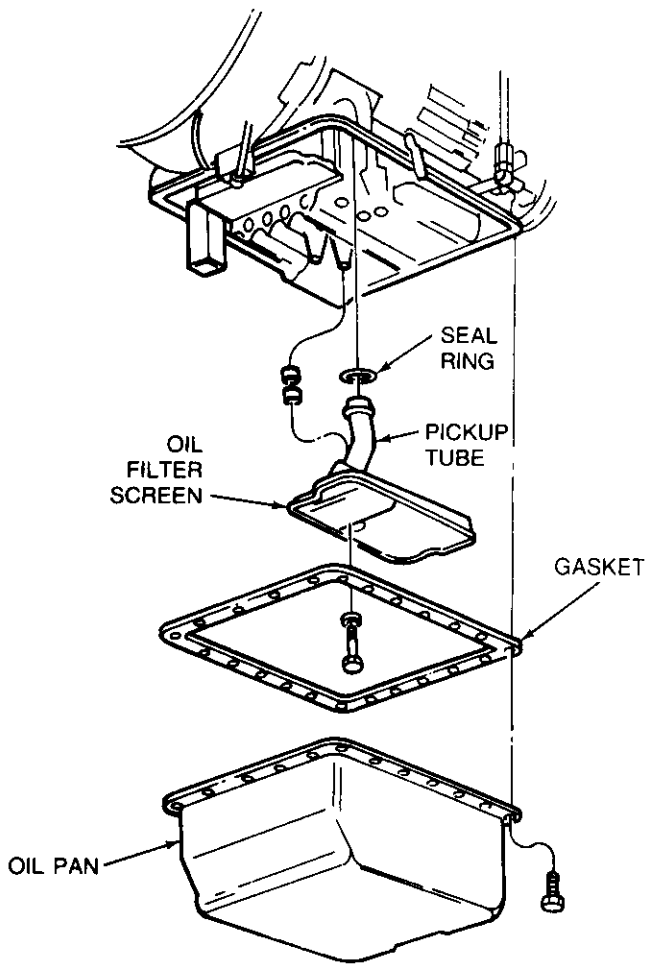


MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. TRANSMISSION WILL NOT SHIFT INTO GEAR, SLIPS OUT OF GEAR OR OPERATES ERRATICALLY (Continued)

Test 2. Drain transmission and remove oil pan. Refer to paragraph 8-12 in TM 2320-20/12, TM 9-2320-297-20. Check for clogged internal oil filter screen.
- If filter screen is not clogged, go to Test 3.
- If filter screen is clogged, replace filter screen.

Test 3. Check for damaged, leaking, or missing seal ring on internal filter pickup tube.
- If seal ring is damaged, leaking, or missing, replace seal ring and gasket.
- If seal ring is not damaged, leaking, or missing, disassemble transmission and inspect oil pump, main pressure regulator valve and control valve body for leakage or sticking valves. Refer to paragraphs 7-10 and 7-12.



TA 298354

(3) Remove output shaft (7) from differential carrier (8).

(4) If differential carrier (8) is to be repaired, loosen nut (9).

(5) Position removal equipment below differential carrier (8).

WARNING

The differential carrier is heavy. To prevent personal injury, be careful during removal procedures. Make sure differential carrier is supported and balanced before mounting hardware is removed.

(6) Remove capscrew (10) and lockwasher (11). Discard lockwasher (11).

(7) Remove four nuts (12), lockwashers (13), and tapered bushings (14). Discard lockwashers.

(8) Remove five nuts (15) and lockwashers (16). Discard lockwashers (16).

(9) Secure shift lever (17) with safety wire to move shift collar (18) into differential carrier (8).

(10) Carefully guide differential carrier (8) out of housing (19).

b. Cleaning/Inspection

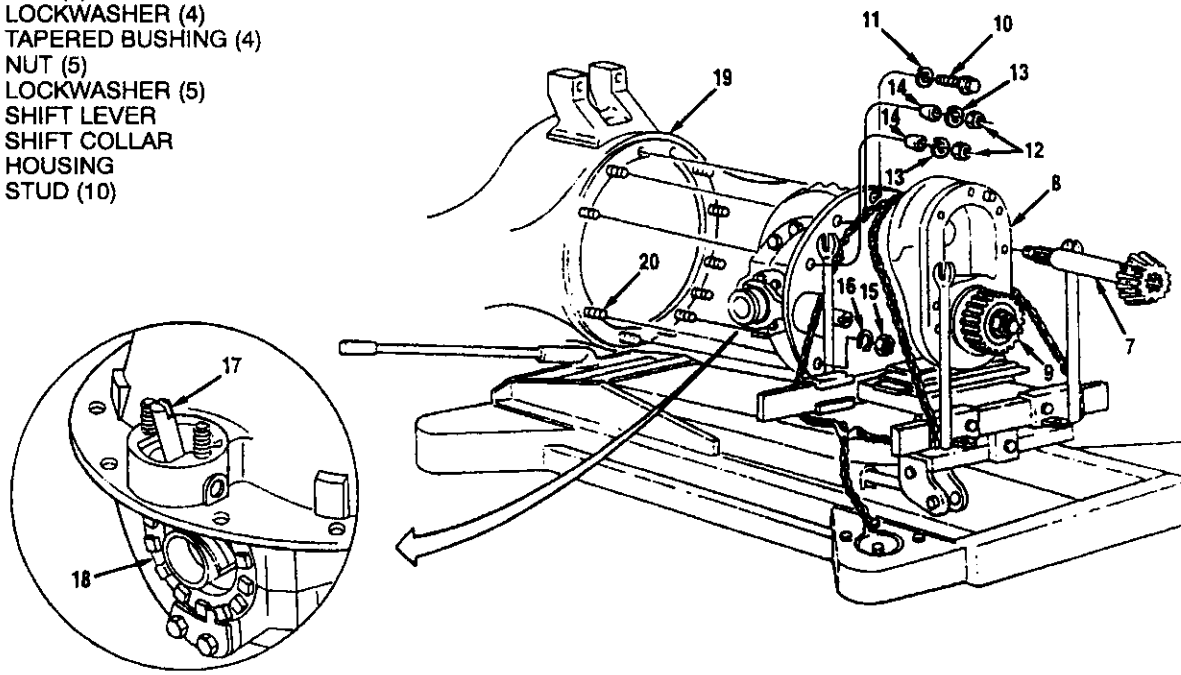
(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect studs (20) for damage. Remove if damaged.

(3) Inspect all other parts. Refer to paragraph 2-7.

(4) Replace all parts failing inspection.

7. OUTPUT SHAFT
8. DIFFERENTIAL CARRIER
9. NUT
10. CAPSCREW
11. LOCKWASHER
12. NUT (4)
13. LOCKWASHER (4)
14. TAPERED BUSHING (4)
15. NUT (5)
16. LOCKWASHER (5)
17. SHIFT LEVER
18. SHIFT COLLAR
19. HOUSING
20. STUD (10)

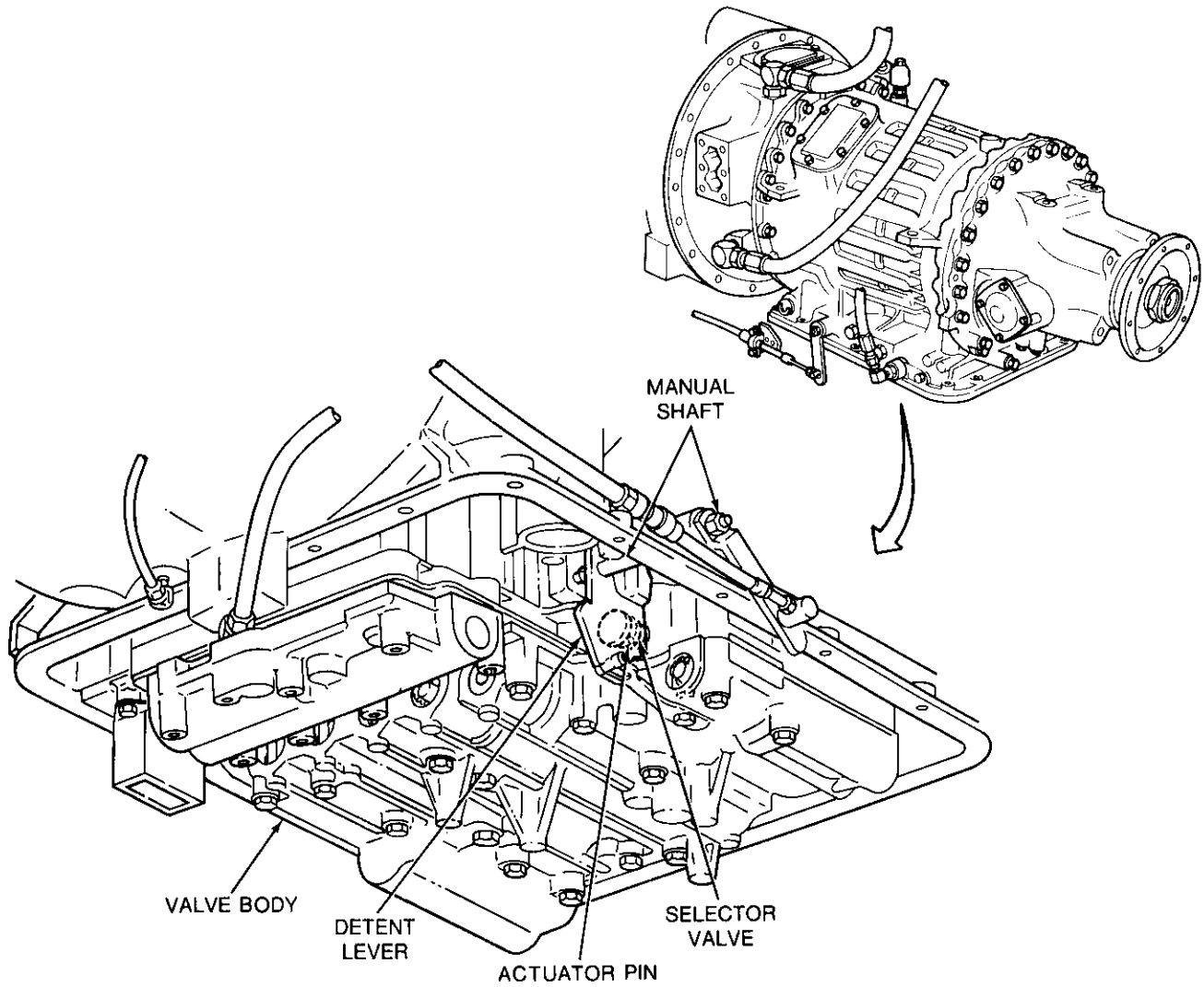


MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 4. Without engine running, manually shift transmission and see if the manual shaft and detent lever are engaging with selector valve and actuator pin is attached to detent lever.

- If selector valve is not engaging properly, repair or replace defective parts. Refer to paragraph 7-10.
- If selector valve is engaging properly, disassemble transmission and valve body to check for worn clutch packs in transmission or leaking or sticking valves in valve body. Refer to paragraphs 7-5 and 7-10.

END OF TEST



TA 299737

10-16. DIFFERENTIAL CARRIER REPLACEMENT (NO. 3 AXLE)

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK14
MK15
MK16
MK17

Special Tools

Jack stand, 10 ton (P/N 93525)

Materials/Parts

Adhesive, silicone sealant (item 7, Appendix C)
Lockwasher (2) (MS35338-48) items 2 and 5
Lockwasher (10) (MS35338-50) items 11, 13, and 16

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Axle lubricant drained (para 12-3).
	Axle shafts removed (para 12-4).
TM 2320-34/13 TM 9-2320-297-34	Axle shift unit removed (para 10-3).
	Axle differential carrier cover removed (para 10-6).
	Axle housing cover removed (para 10-4).

General Safety Instructions

Differential carrier is heavy. To prevent personal injury, be careful during replacement procedures.

Block wheels of truck to prevent personal injury.

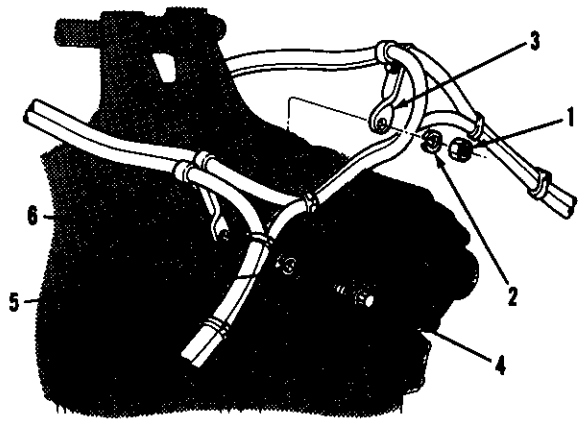
---

a. Removal

(1) Remove nut (1), lockwasher (2), and bracket (3). Discard lockwasher (2).

(2) Remove capscrew (4), lockwasher (5), and bracket (6). Discard lockwasher (5).

1. NUT
2. LOCKWASHER
3. BRACKET
4. CAPSCREW
5. LOCKWASHER
6. BRACKET



TA 299019

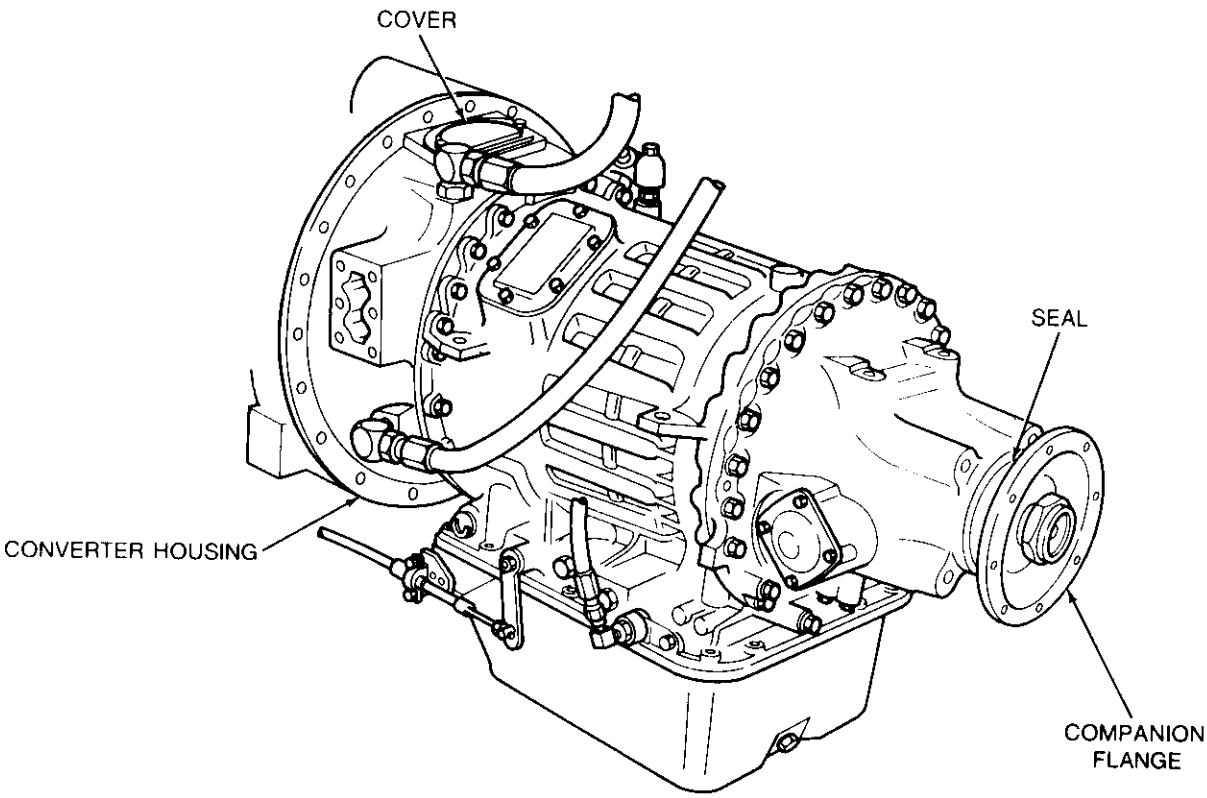
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. TRANSMISSION LEAKS

Test 1. Check for oil leaking from companion flange output seal.
- If seal is not leaking, go to Test 2.
- If seal is leaking, inspect companion flange seal surface and replace seal and/or companion flange. Refer to paragraph 7-3.

Test 2. Remove cover from top of converter housing. Check for signs of oil.
- If transmission oil is within housing, inspect inside converter housing mounting screws, charging pump to converter housing seal ring, converter housing gasket, torque converter cover seal ring, oil pump seal, pitot attachment screws, pump hub seal rings and/or converter pump hub. Replace damaged parts as needed. Refer to paragraphs 7-7, 7-10, 7-11, and 7-12.
- If engine oil is within housing, replace engine rear oil seal. Refer to paragraph 3-6.

END OF TEST

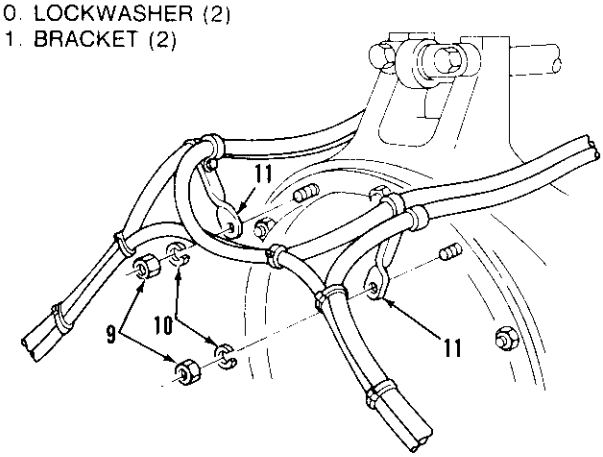


TA 298355

(10) Remove two nuts (9) and lockwashers (10). Discard lockwashers (10).

(11) Install two brackets (11), new lockwashers (10), and nuts (9). Tighten nuts (9) securely.

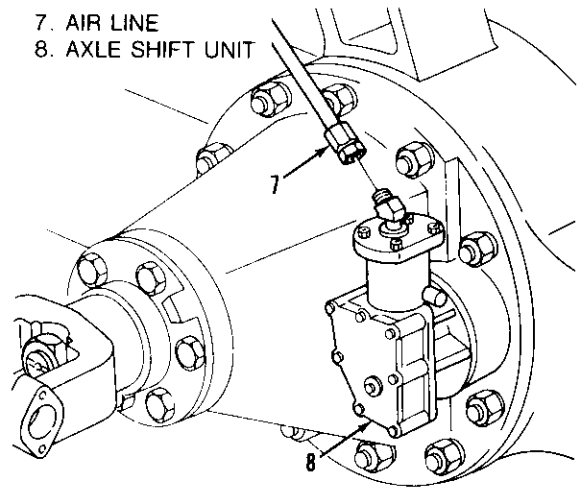
9. NUT (2)
10. LOCKWASHER (2)
11. BRACKET (2)



(12) Connect air line (7) to axle shift unit (8). Tighten securely.

(13) Connect two air lines (1 and 2) to left brake chamber (3). Tighten securely.

7. AIR LINE
8. AXLE SHIFT UNIT



(14) Connect two air lines (4 and 5) to right brake chamber (6). Tighten securely.

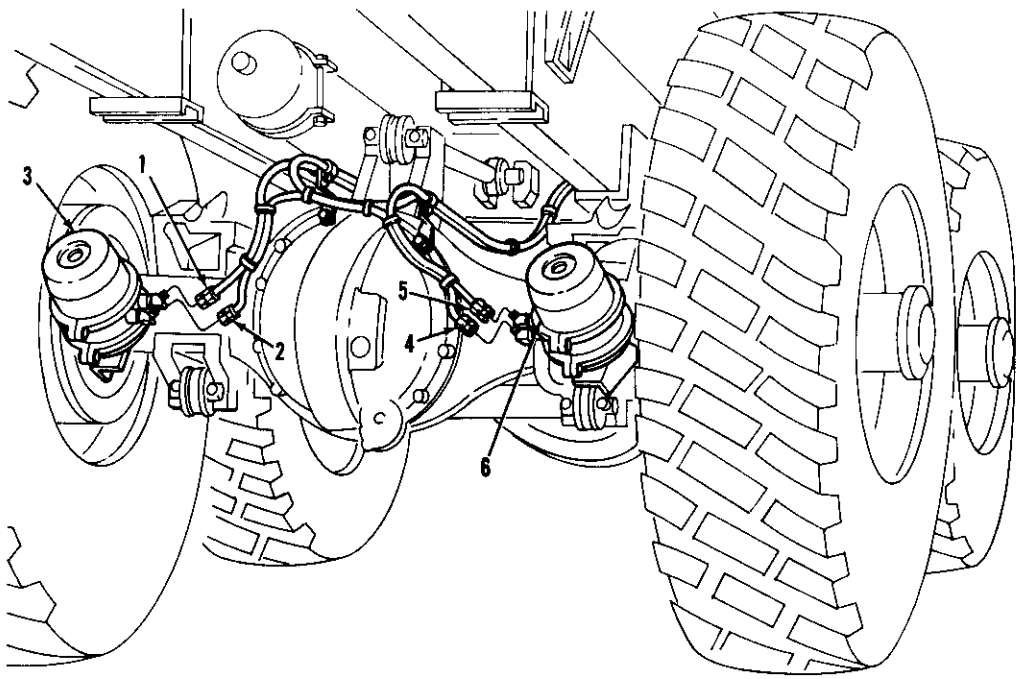
(15) Check axle lubricant level. Fill if needed. Refer to LI 2320-12/9, LO 9-2320-297-12.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install propeller shaft (para 10-3).
	Check alinement of No. 4 axle. Adjust if needed (para 15-17).



1. AIR LINE
2. AIR LINE
3. LEFT BRAKE CHAMBER
4. AIR LINE
5. AIR LINE
6. RIGHT BRAKE CHAMBER

TA 299018

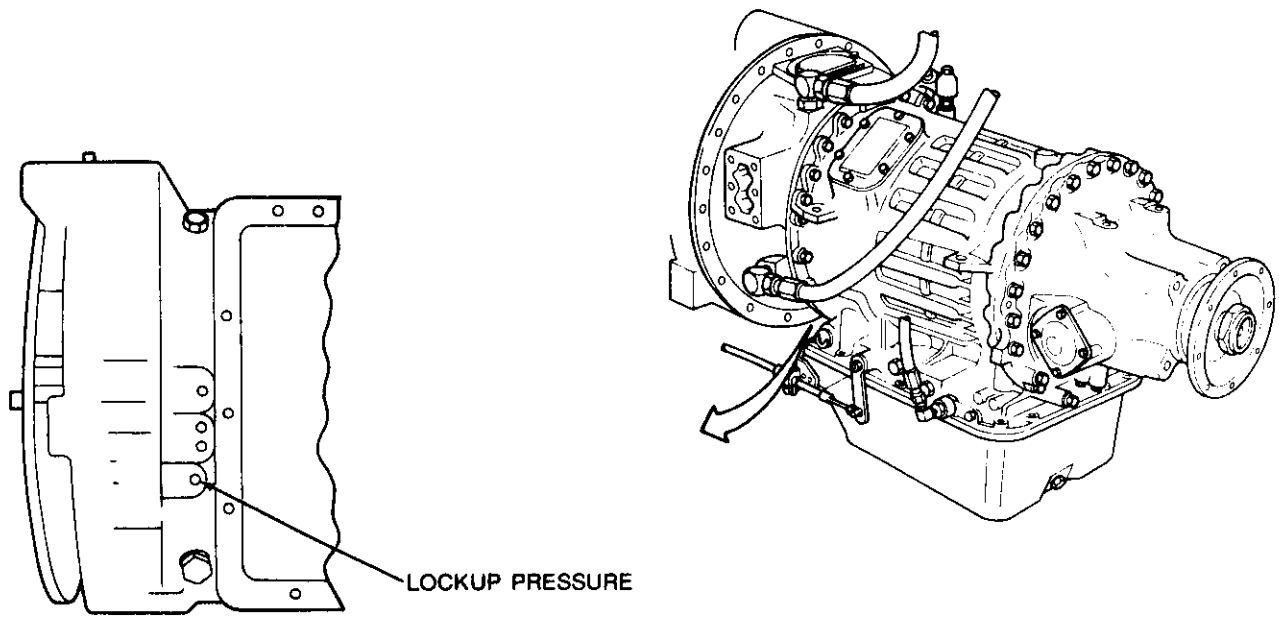
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

5. EXCESSIVE CREEP IN FIRST AND REVERSE

Test 1. Check for high engine idle setting. Refer to paragraph 3-29.
- If idle is not too high, go to Test 2.
- If idle is too high, adjust to correct idle.

Test 2. Check for lockup pressure at idle speed. Remove pressure switch from lockup port on transmission and install a 0-300 psi (0-2068 kPa) gage. Start engine and allow to run at idle speed. With parking brake applied, shift transmission into drive. Check for 0 psi lock up pressure.
- If any lockup pressure is available, remove oil pan and inspect lockup clutch valve for sticking pistons. Refer to paragraph 7-9.
- If no lockup pressure is found, disassemble transmission and check for grabbing clutch plates or clutch packs, stuck (applied) clutch pack pistons or a damaged torque converter to turbine support bearing. Refer to paragraphs 7-11, 7-13, 7-14, 7-15, and 7-17.

END OF TEST



TA 298356

6. TRANSMISSION OIL DIRTY

Check for clutch failure. Perform stall speed testing. Refer to paragraph 7-19.
- If transmission fails stall speed test, rebuild transmission. Refer to paragraph 7-5.

END OF TEST

10-15. AXLE REPLACEMENT (NO. 4 AXLE (Continued)

e. Installation

(1) Position axle assembly (15) on removal equipment (14).

(2) Position axle assembly (15) under rear body unit.

(3) Raise axle assembly (15) until it is in position near springs (28).

(4) Move axle assembly (15) onto springs (28).

(5) Install upper torque rod (27), two hardened washers (26), washers (25), capscrews (24), washers (23), and nuts (22). Torque nuts (22) to 460 foot-pounds (623.76 N·m).

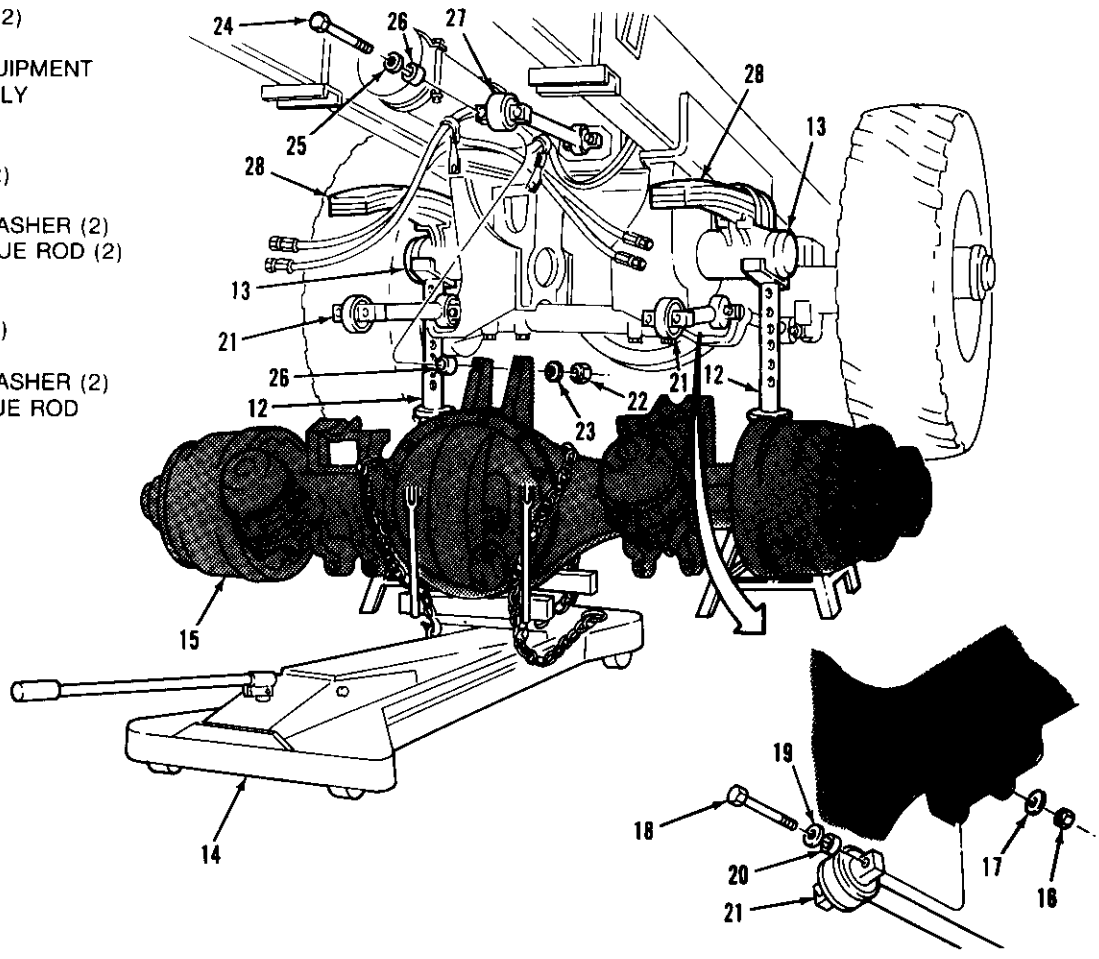
(6) Install both lower torque rods (21), hardened washers (20), washers (19), capscrews (18), washers (17), and nuts (16). Torque nuts (16) to 460 foot-pounds (623.76 N·m).

(7) Remove removal equipment (14) from axle assembly (15).

(8) Install two tire and wheel assemblies. Refer to paragraph 14-5 (TM 2320-20/12, TM 9-2320-297-20).

(9) Remove jack stands (12) from spring seats (13).

12. JACK STAND (2)
13. SPRING SEAT
14. REMOVAL EQUIPMENT
15. AXLE ASSEMBLY
16. NUT (2)
17. WASHER (2)
18. CAPSCREW (2)
19. WASHER (2)
20. HARDENED WASHER (2)
21. LOWER TORQUE ROD (2)
22. NUT (2)
23. WASHER (2)
24. CAPSCREW (2)
25. WASHER (2)
26. HARDENED WASHER (2)
27. UPPER TORQUE ROD
28. SPRING (2)



TA 299017

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

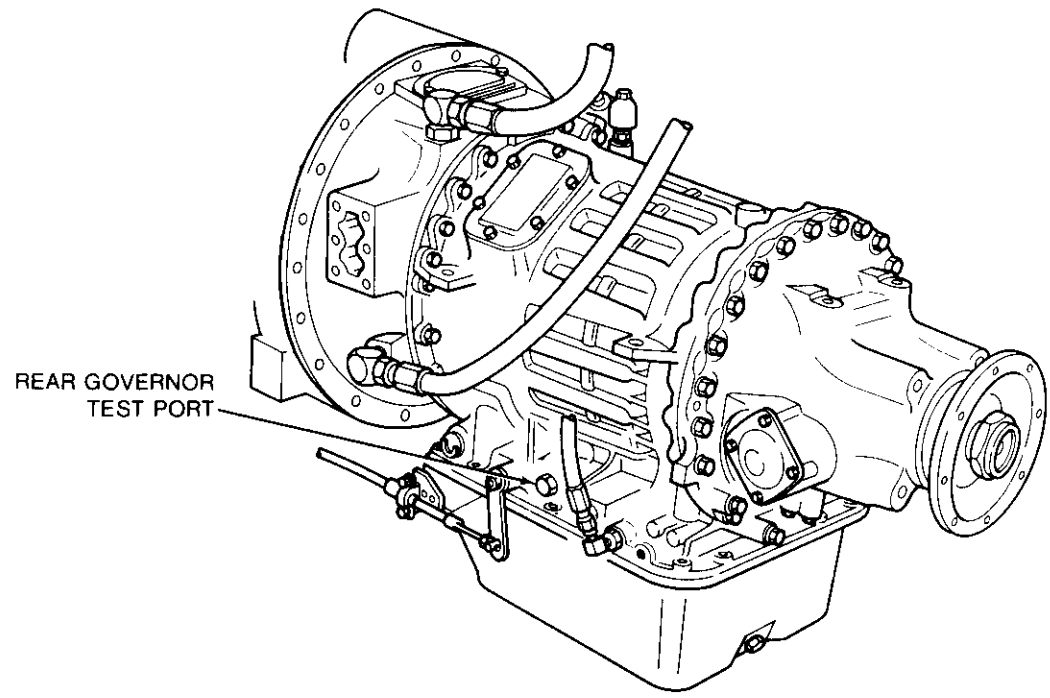
7. AUTOMATIC SHIFTS OCCUR AT TOO HIGH A SPEED

Test 1. Check vehicle tachometer for proper operation. Using tachometer on flow tester, check engine speed at idle, 1200 RPM and no load governed speed. Compare reading against vehicle tachometer.

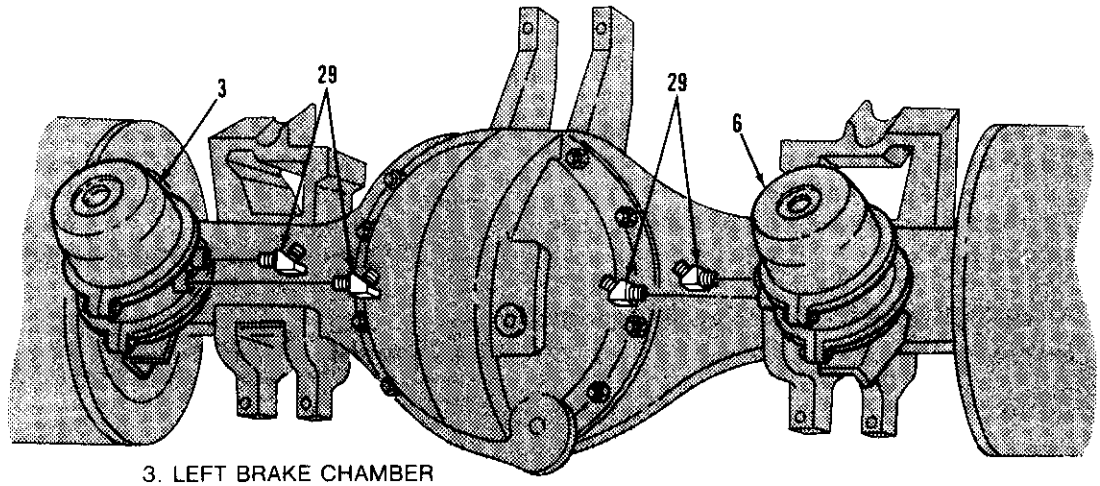
- If vehicle tachometer is accurate, go to Test 2.
- If vehicle tachometer is not accurate, repair or replace defective tachometer or sending unit. Refer to paragraph 7-17.

Test 2. Check rear governor pressure. Remove plug from rear governor test port. Install a 0-200 psi (0-1379 kPa) gage at rear governor test port. Start engine and select DRIVE. Release parking brake and drive vehicle until engine tachometer reads approximately 1650 RPM. Check for 83-91 psi (573-628 kPa) rear governor pressure on test gage.

- If pressure is within specifications, repair control valve body. Refer to paragraph 7-10, then perform transmission shift speed test and adjustments. Refer to paragraph 7-19.
- If pressure is not within specifications, go to Test 3.



TA 208357



3. LEFT BRAKE CHAMBER
6. RIGHT BRAKE CHAMBER
29. AIR FITTING (4)

b. Disassembly

(1) Remove four air fittings (29) from right and left brake chambers (3 and 6).

(2) Remove air fitting (30) from axle shift unit (8).

c. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

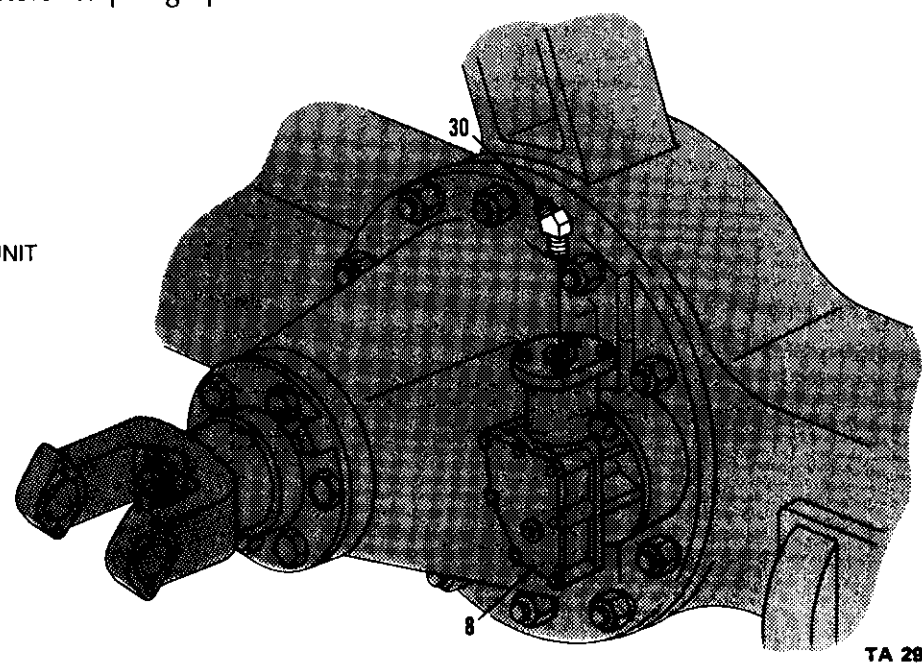
(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

d. Assembly

(1) Apply pipe sealant to threads and install air fitting (30) into axle shift unit (8). Tighten securely.

(2) Apply pipe sealant to threads and install four air fittings (29) into brake chambers (3 and 6).



8. AXLE SHIFT UNIT
30. AIR FITTING

TA 299016

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

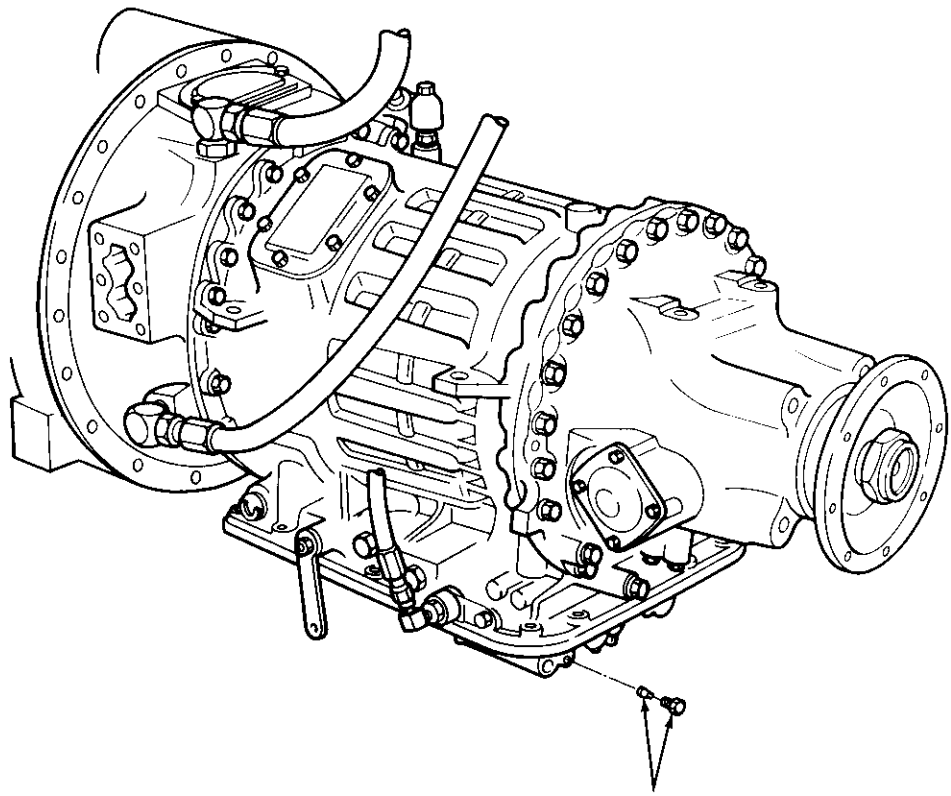
NOTE

Valve body does not have to be removed.

Test 3. Check for clogged governor screen assembly. Drain transmission and remove oil pan. Refer to paragraph 8-12 in TM 2320-20/12, TM 9-2320-297-20. Remove governor oil screen and plug. Refer to paragraph 7-6.

- If screen is clogged or damaged, clean or replace screen. Refer to paragraph 7-10.
- If screen is not clogged or damaged, refer to Malfunction 3, Transmission Troubleshooting, in this section of the manual.

END OF TEST



TA 298357

10-15. AXLE REPLACEMENT (NO. 4 AXLE) (Continued)

(6) Position two jack stands (12) at spring seats (13) and remove two tire and wheel assemblies. Refer to paragraph 14-5 (TM 2320-20/12, TM 9-2320-297-20).

WARNING

The axle assembly is very heavy. To prevent personal injury be very careful during removal procedures. Make sure axle is supported and balanced when torque rods are removed.

(7) Attach removal equipment (14) onto axle assembly (15).

(8) Remove nuts (16), washers (17), capscrews (18), washers (19), and hardened washers (20) from both lower torque rods (21).

(9) Remove two nuts (22), washers (23), capscrews (24), washers (25), and hardened washers (26) from upper torque rod (27). Tag hardened washers (26).

(10) Raise axle assembly (15) high enough to take weight off of springs (28).

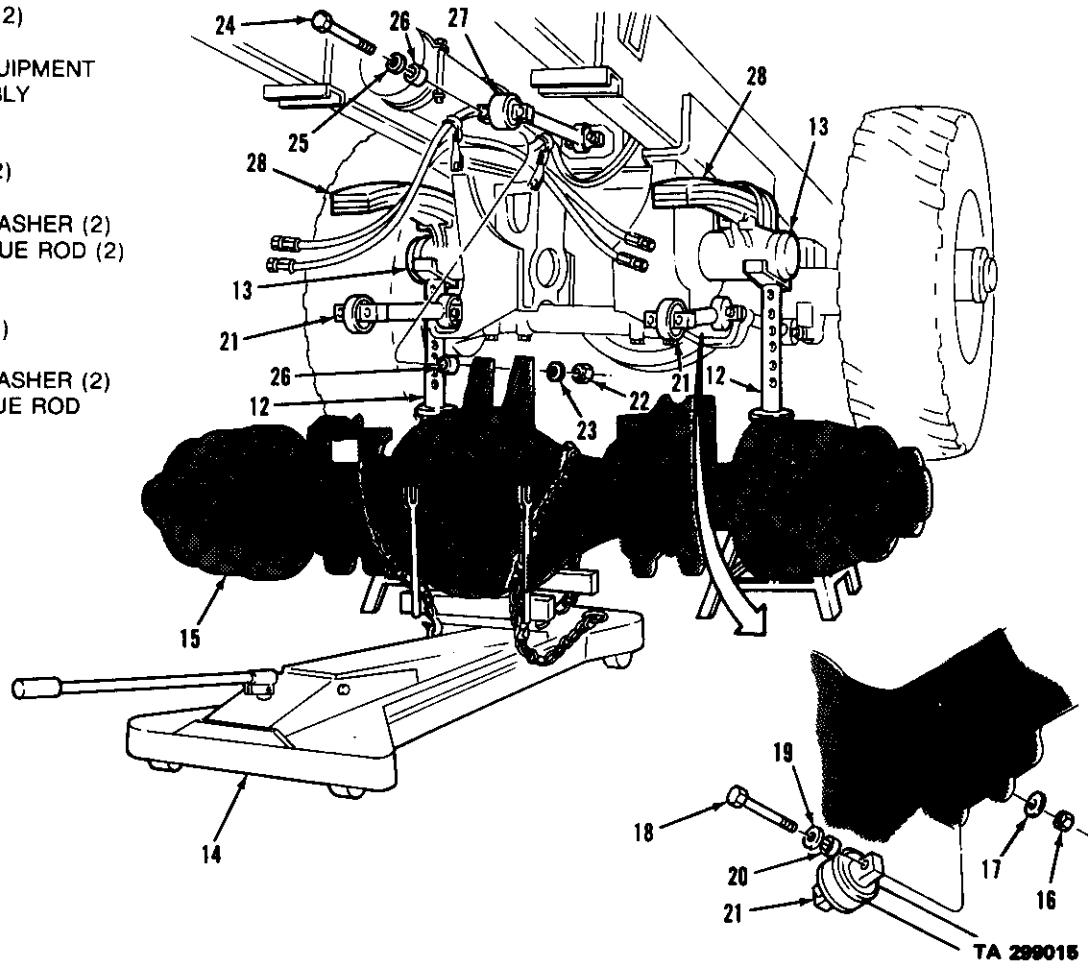
(11) Move axle assembly (15) toward rear until free of springs (28).

(12) Lower axle assembly (15) and remove it.

NOTE

The number of hardened washers (20 and 26) may vary on each vehicle.

12. JACK STAND (2)
13. SPRING SEAT
14. REMOVAL EQUIPMENT
15. AXLE ASSEMBLY
16. NUT (2)
17. WASHER (2)
18. CAPSCREW (2)
19. WASHER (2)
20. HARDENED WASHER (2)
21. LOWER TORQUE ROD (2)
22. NUT (2)
23. WASHER (2)
24. CAPSCREW (2)
25. WASHER (2)
26. HARDENED WASHER (2)
27. UPPER TORQUE ROD
28. SPRING (2)



MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

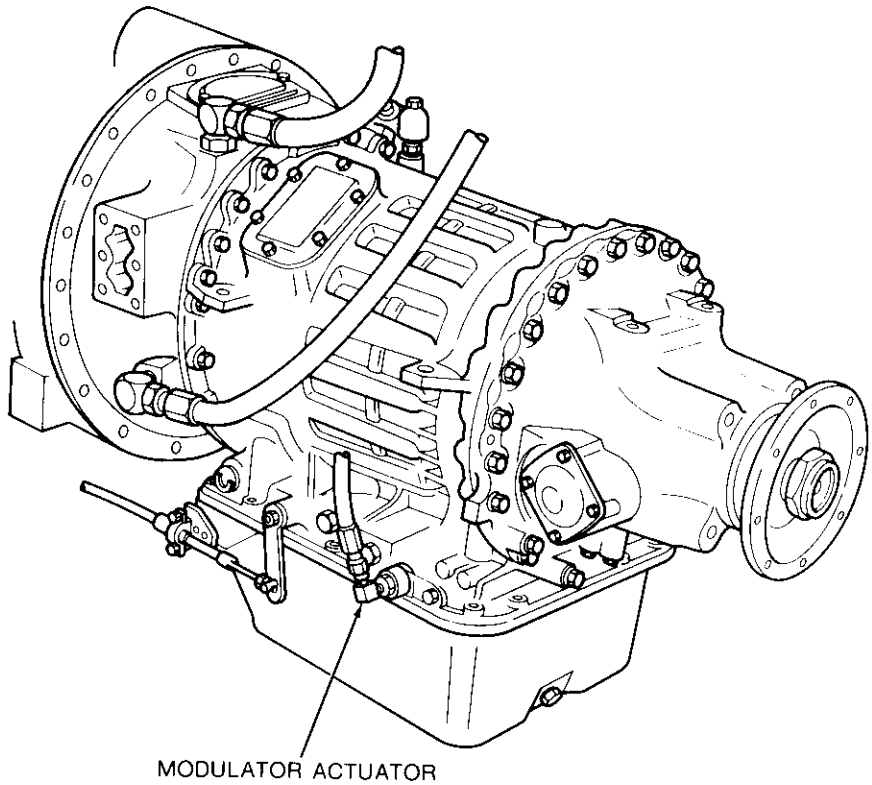
8. AUTOMATIC SHIFTS OCCUR AT TOO LOW A SPEED

Test 1. Check vehicle tachometer for proper operation. Using tachometer on flow tester, check engine speed at idle, 1200 RPM and no load governed speed. Compare reading against vehicle tachometer.

- If vehicle tachometer is accurate, go to Test 2.
- If vehicle tachometer is not accurate, repair or replace defective tachometer or sending unit. Refer to paragraph 7-17.

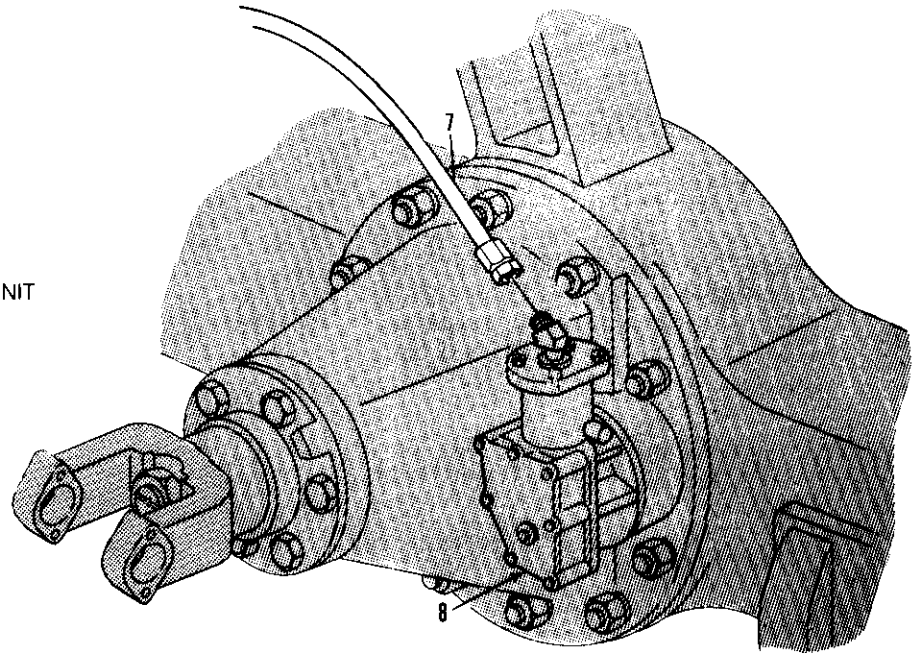
Test 2. Check for defective modulator actuator. Drain transmission and remove modulator actuator from transmission. Check for damage and proper operation. Modulator actuator must not leak air when operated.

- If modulator actuator is not damaged and operates properly, go to Test 3.
- If modulator actuator is damaged or does not operate properly, replace modulator actuator. Refer to paragraph 8-10 in TM 2320-20/12, TM 9-2320-297-20.



TA 299741

7. AIR LINE
8. AXLE SHIFT UNIT

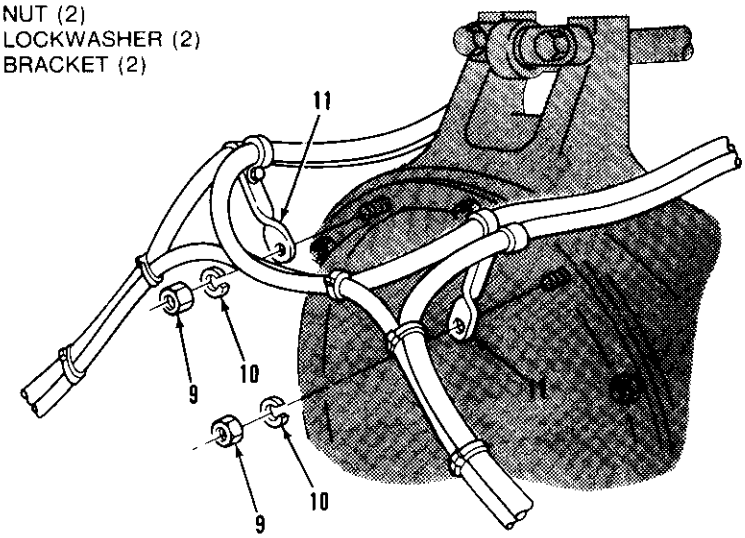


(3) Remove air line (7) from axle shift unit (8). Tie air line (7) up and out of the way.

(4) Remove two nuts (9), lockwashers (10), and brackets (11).

(5) Reinstall two lockwashers (10) and nuts (9).

9. NUT (2)
10. LOCKWASHER (2)
11. BRACKET (2)

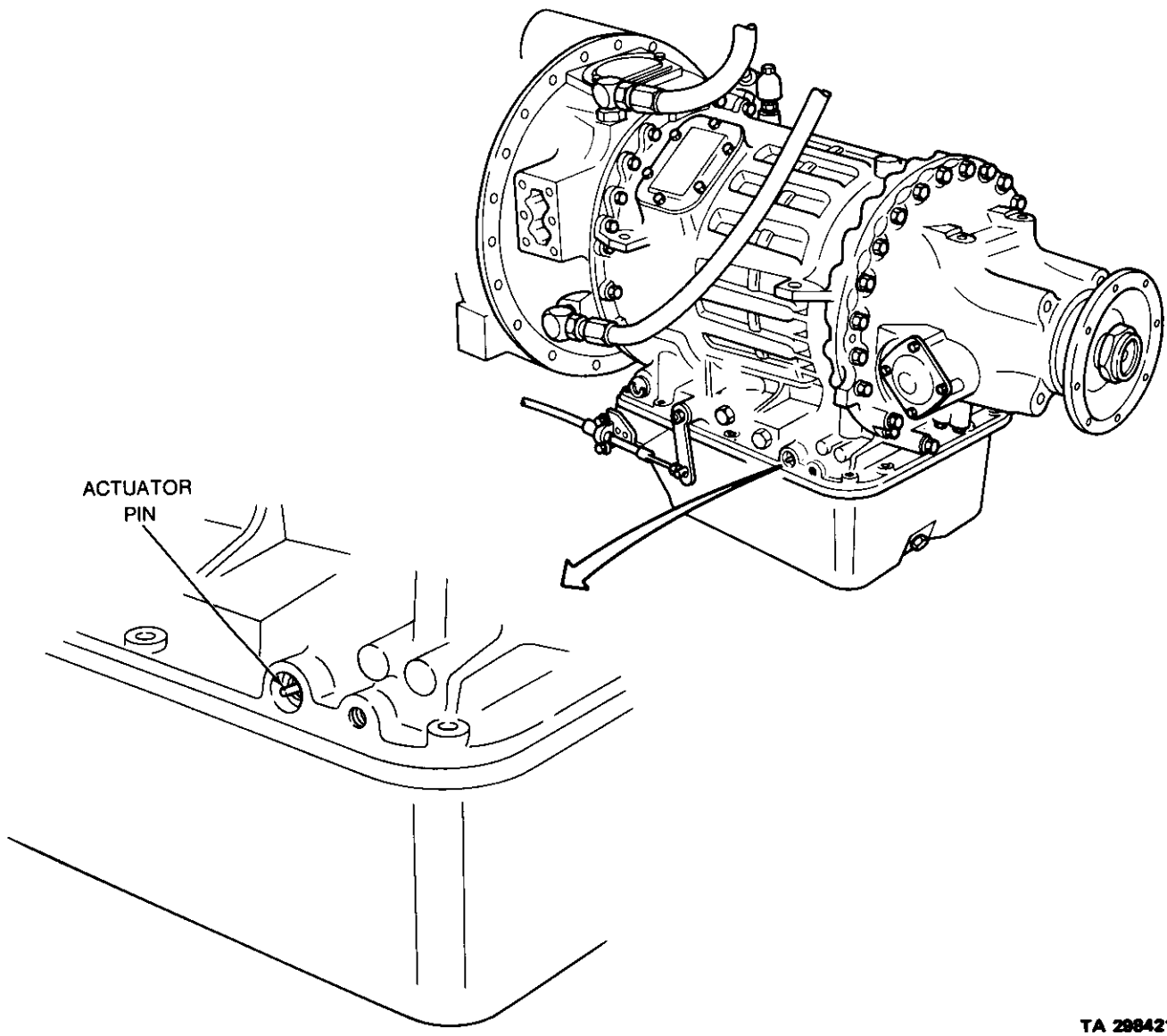


TA 299014

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 3. Check for defective modulator valve. Drain transmission and remove modulator actuator valve. Check modulator actuator pin in transmission for free movement in and for weak or damaged spring.

- If modulator valve moves freely and spring is not weak or damaged, go to Test 4.
- If modulator valve does not move freely and/or spring is weak or damaged, repair or replace modulator valve. Refer to paragraph 7-10.



TA 298421

10-15. AXLE REPLACEMENT (NO. 4 AXLE)

THIS TASK COVERS: a. Removal
b. Disassembly
c. Cleaning/Inspection
d. Assembly
e. Installation

INITIAL SETUP

Applicable Configurations

MK14
MK15
MK16
MK17

Special Tools

Jack stand, 10 Ton (P/N 93525)

Materials/Parts

Pipe sealant (item 60, Appendix C)
Lockwasher (2) (MS35338-50) item 10

Personnel Required

1 MOS 3522
2 Assistants

References

TM 2320-20/12
TM 9-2320-297-20
LI 2320-12/9
LO 9-2320-297-12

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Propeller shaft disconnected from No. 4 axle (para 10-3).
TM 2320-10/11 TM 9-2320-297-10	Air pressure drained (para 3-5).

General Safety Instructions

Axle assembly is very heavy. To prevent personal injury, be careful during replacement procedures.

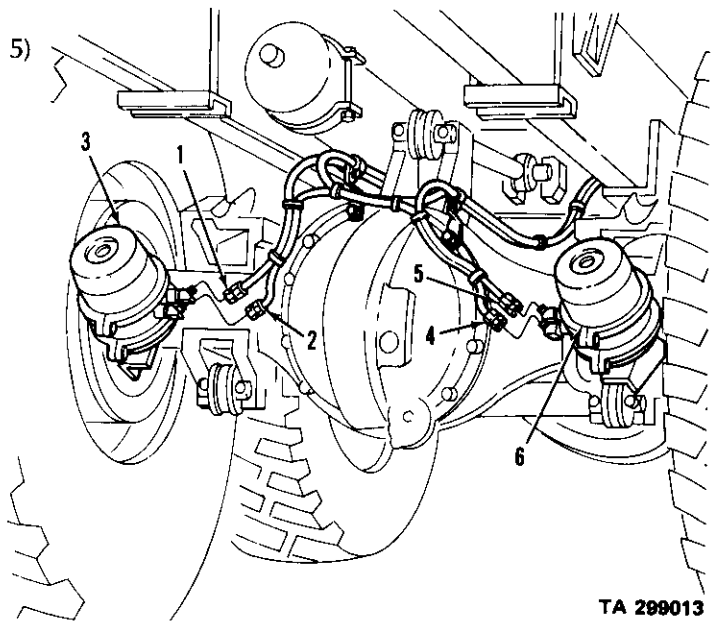
Block wheels of No. 3 axle to prevent movement.

---

a. Removal

(1) Tag and remove two air lines (1 and 2) from left brake chamber (3).

(2) Tag and remove two air lines (4 and 5) from right brake chamber (6).



1. AIR LINE
2. AIR LINE
3. LEFT BRAKE CHAMBER
4. AIR LINE
5. AIR LINE
6. RIGHT BRAKE CHAMBER

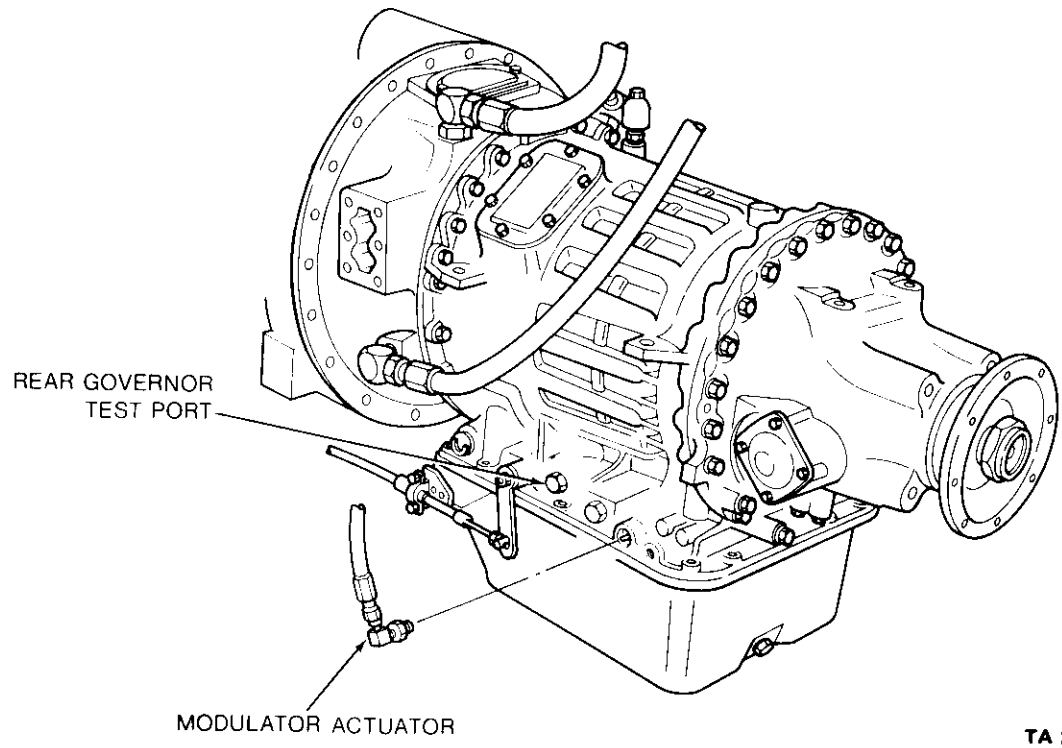
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

8. AUTOMATIC SHIFTS OCCUR AT TOO LOW A SPEED (Continued)

Test 4. Check rear governor pressure. Remove plug from rear governor test port. Install a 0-200 psi (0-1379 kPa) gage at rear governor test port. Start engine and select DRIVE. Release parking brake and drive vehicle until engine tachometer reads approximately 1650 RPM. Check for 83-91 psi (573-628 kPa) rear governor pressure on test gage.

- If pressure is within specifications, repair valve body. Refer to paragraph 7-10, then perform transmission shift speed test and adjustments. Refer to paragraph 7-19.
- If pressure is over 91 psi (628 kPa), inspect governor valve for undersized valve sealing surfaces (lands). Lands should be .800 inch when new and .799 inch when used. Refer to paragraph 8-9 in TM 2320-20/12, TM 9-2320-297-20.

END OF TEST



TA 298422

9. TRANSMISSION SHIFTS ROUGH

Test 1. Check for defective modulator actuator. Remove modulator actuator from transmission. Check for damage and proper operation.

- If modulator is not damaged and operates properly, go to Test 2.
- If modulator is damaged or does not operate properly, replace modulator. Refer to paragraph 8-10 in TM 9-2320-297-20.

(16) Remove jack stands (14).

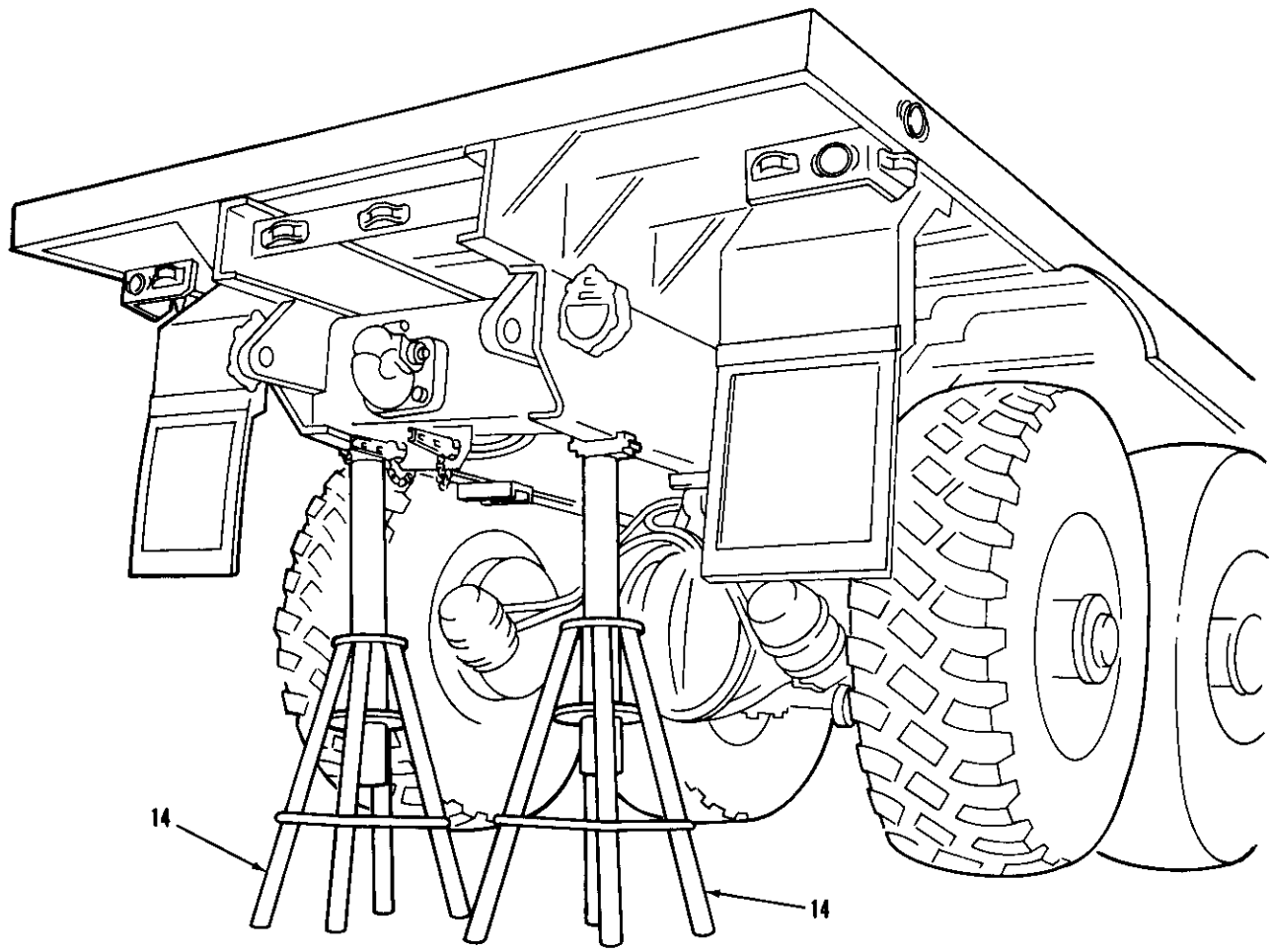
(17) Check axle lubricant level. Fill if needed. Refer to LI 2320-12/9, LO 9-2320-297-12.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install propeller shafts (para 10-3).
	Check alinement of axle No. 3. Adjust if needed (para 15-17).



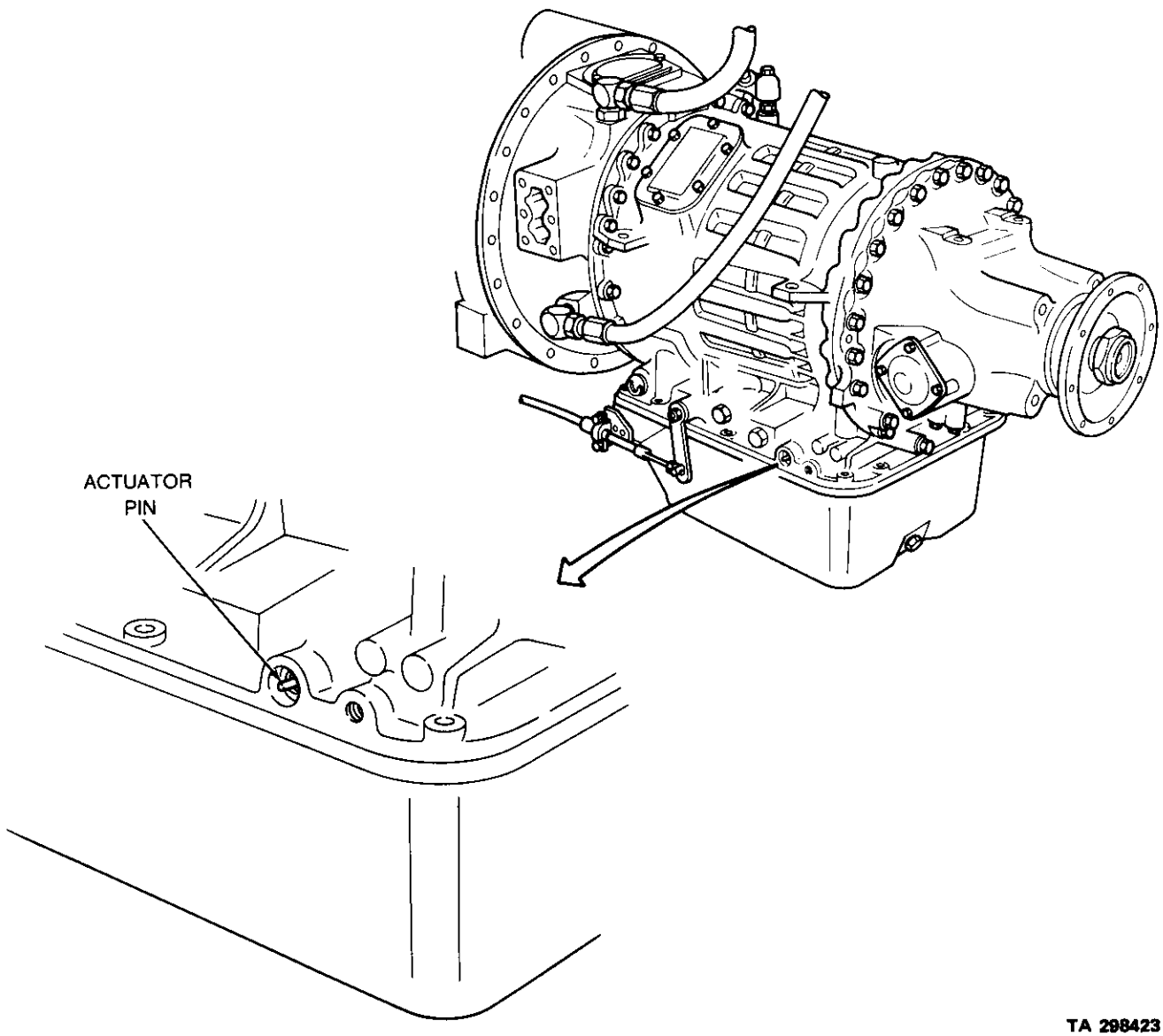
14. JACK STAND (2)

TA 299012

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

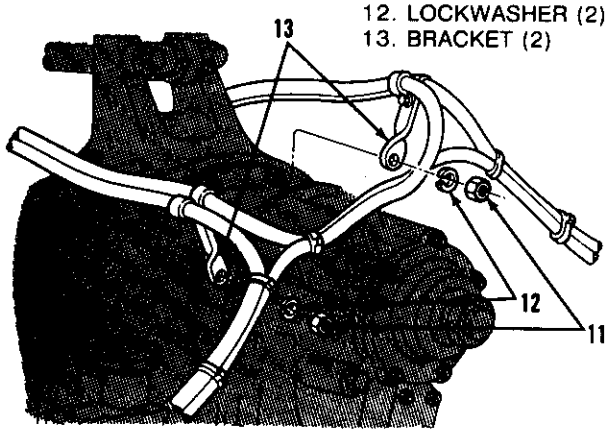
Test 2. Check for defective modulator valve. Drain transmission and remove modulator actuator valve. Check modulator actuator pin in transmission for free movement in and for weak or damaged spring.

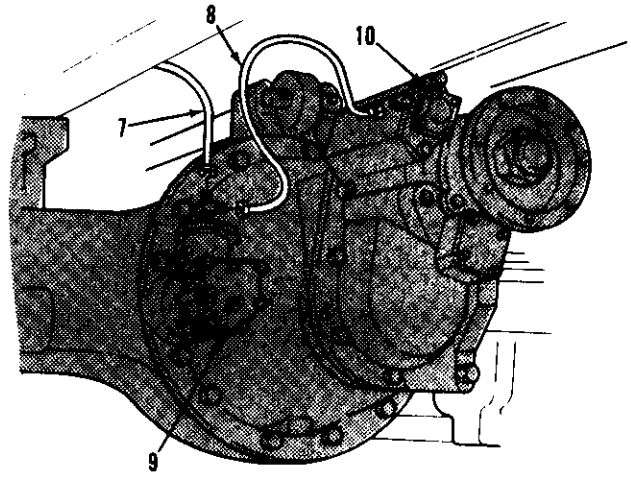
- If modulator valve moves freely and spring is not weak or damaged, go to Test 3.
- If modulator valve does not move freely and/or spring is weak or damaged, repair or replace modulator valve. Refer to paragraph 7-10.



TA 298423

10-14. AXLE REPLACEMENT (NO. 3 AXLE) (Continued)





7. AIR LINE
8. AIR LINE
9. AXLE SHIFT UNIT
10. LOCKOUT CHAMBER

(10) Remove two nuts (11) and lockwashers (12). Discard lockwashers (12).

(11) Install two brackets (13), new lockwashers (12), and nuts (11).

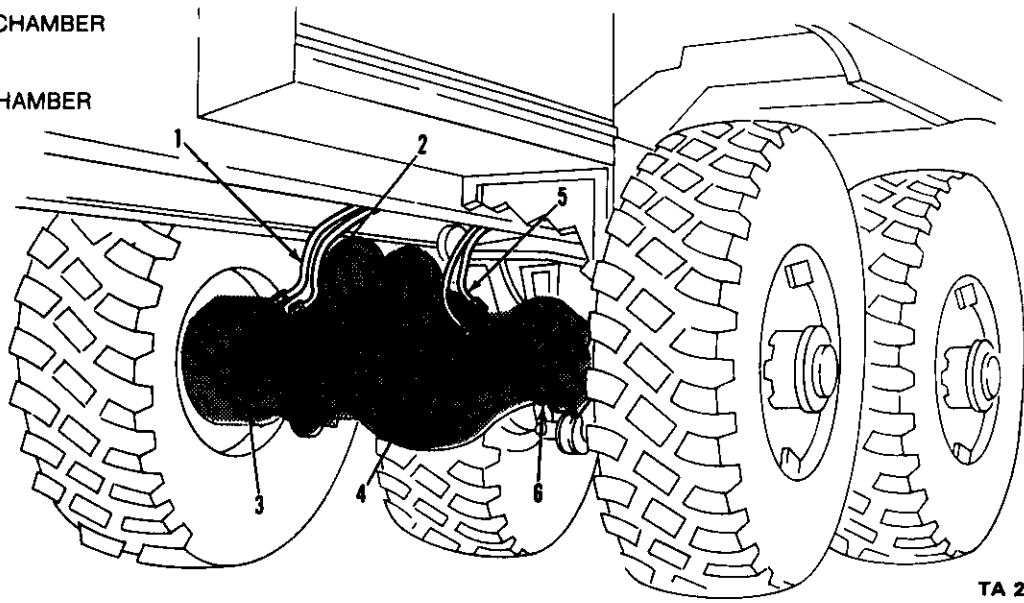
(12) Connect air line (8) to lockout chamber (10). Tighten securely.

(13) Connect two air lines (7 and 8) to axle shift unit (9). Tighten securely.

(14) Connect two air lines (1 and 2) to right brake chamber (3). Tighten securely.

(15) Connect two air lines (4 and 5) to left brake chamber (6). Tighten securely.

1. AIR LINE
2. AIR LINE
3. RIGHT BRAKE CHAMBER
4. AIR LINE
5. AIR LINE
6. LEFT BRAKE CHAMBER



TA 299011

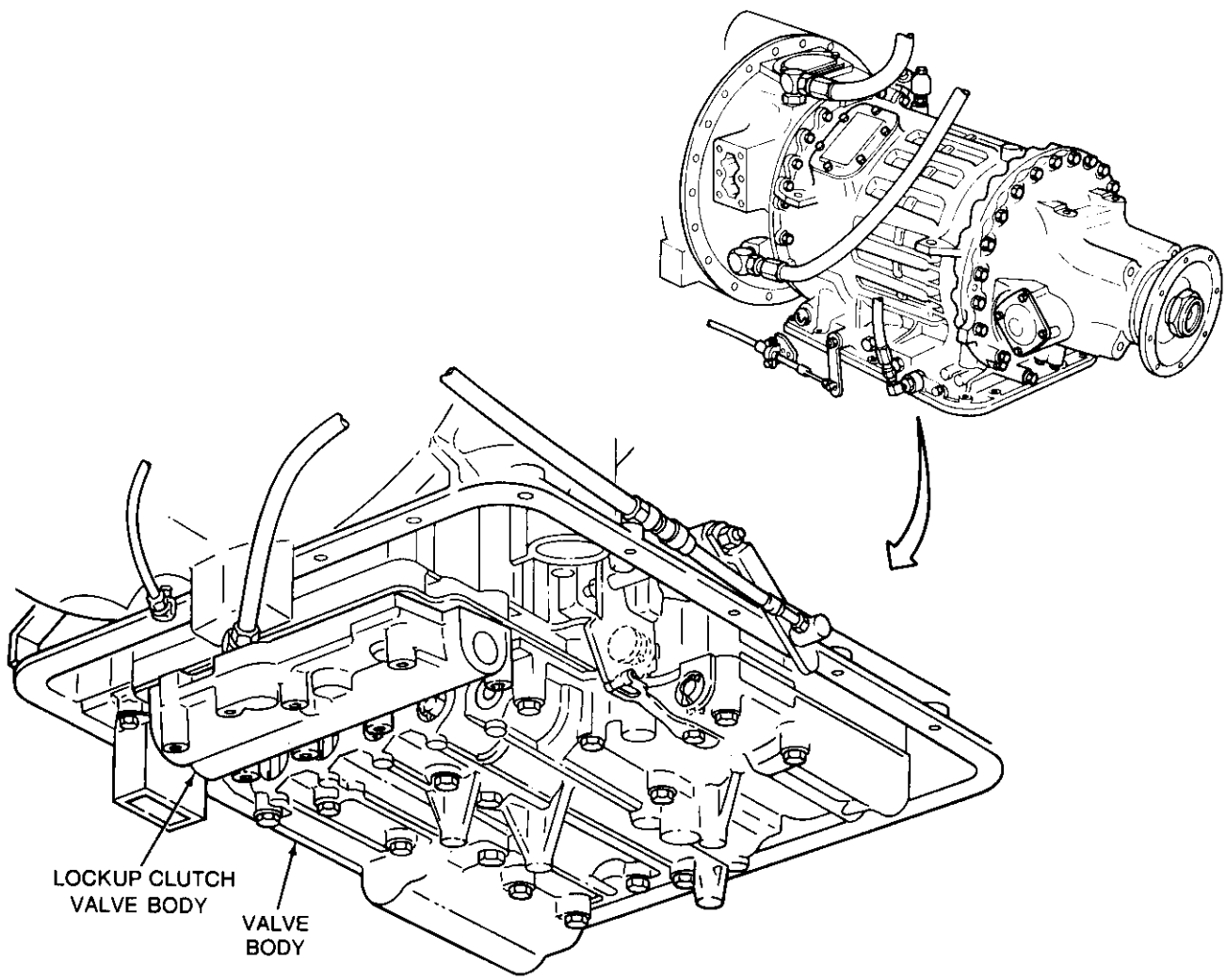
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

9. TRANSMISSION SHIFTS ROUGH (Continued)

Test 3. Remove valve body from transmission. Check trimmer valves, lockup clutch valve body, relay valves, shift signal valves, and modulator valves for dirt or sticking valves. Refer to paragraph 7-10.

- If valve body valves are either sticking or dirty, rebuild valve body.
- If valve body valves are not sticking or dirty, perform transmission shift speed adjustments. Refer to paragraph 7-19.

END OF TEST



TA 298424

e. Installation

(1) Position axle assembly (17) on removal equipment (16).

(2) Position axle assembly (17) under rear body unit, just forward of springs (30).

(3) Raise axle assembly (17) until even with springs (30).

(4) Move axle assembly (17) toward rear and onto springs (30).

NOTE

The number of hardened washers (22 and 28) may vary on each vehicle.

(5) Install upper torque rod (29), hardened washers (28), two washers (27), capscrews (26), washers (25), and nuts (24). Tighten nuts (24) finger tight.

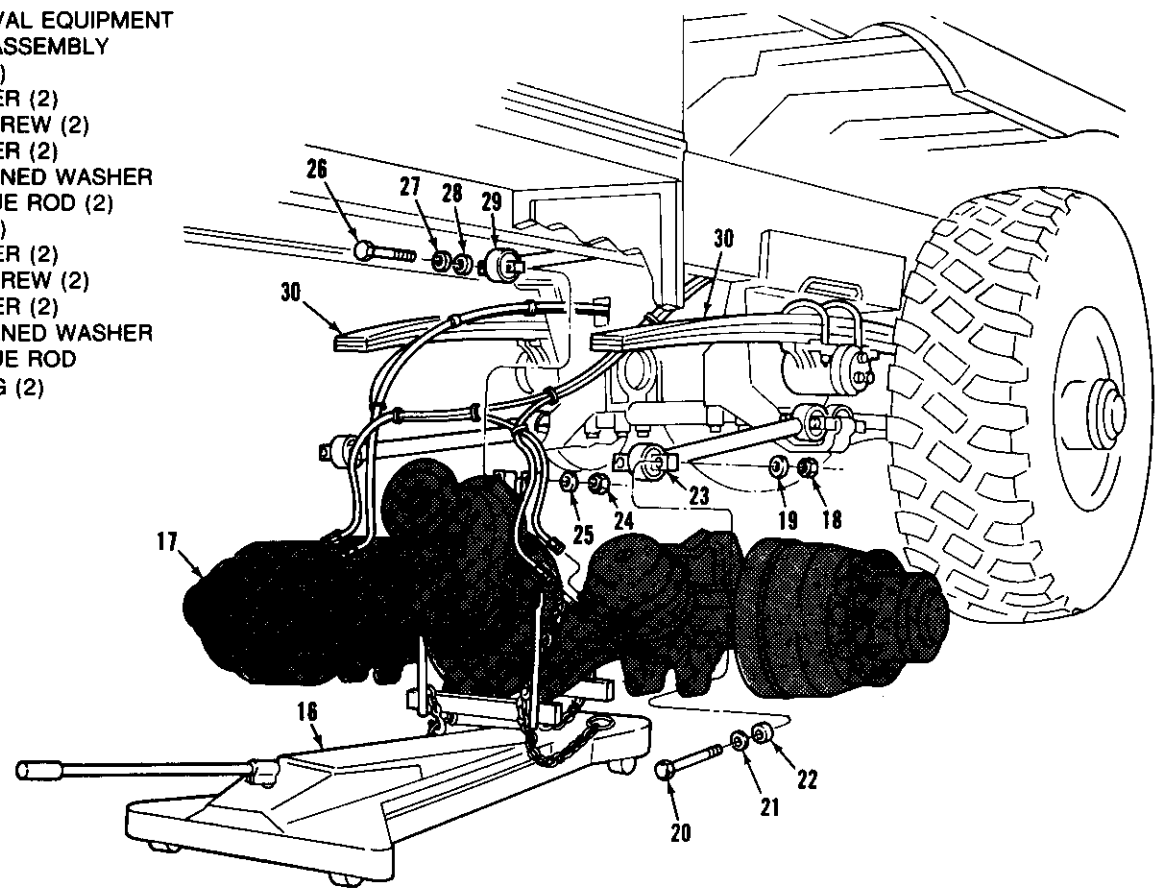
(6) Install both lower torque rods (23) with hardened washers (22), washers (21), capscrews (20), washers (19), and nuts (18). Tighten nuts (18) finger tight.

(7) Torque nuts (18 and 24) to 460 foot-pounds (623.76 N·m).

(8) Remove removal equipment (16).

(9) Install two wheel and tire assemblies. Refer to paragraph 14-5 (TM 2320-20/12, TM 9-2320-297-20).

16. REMOVAL EQUIPMENT
17. AXLE ASSEMBLY
18. NUT (2)
19. WASHER (2)
20. CAPSCREW (2)
21. WASHER (2)
22. HARDENED WASHER
23. TORQUE ROD (2)
24. NUT (2)
25. WASHER (2)
26. CAPSCREW (2)
27. WASHER (2)
28. HARDENED WASHER
29. TORQUE ROD
30. SPRING (2)



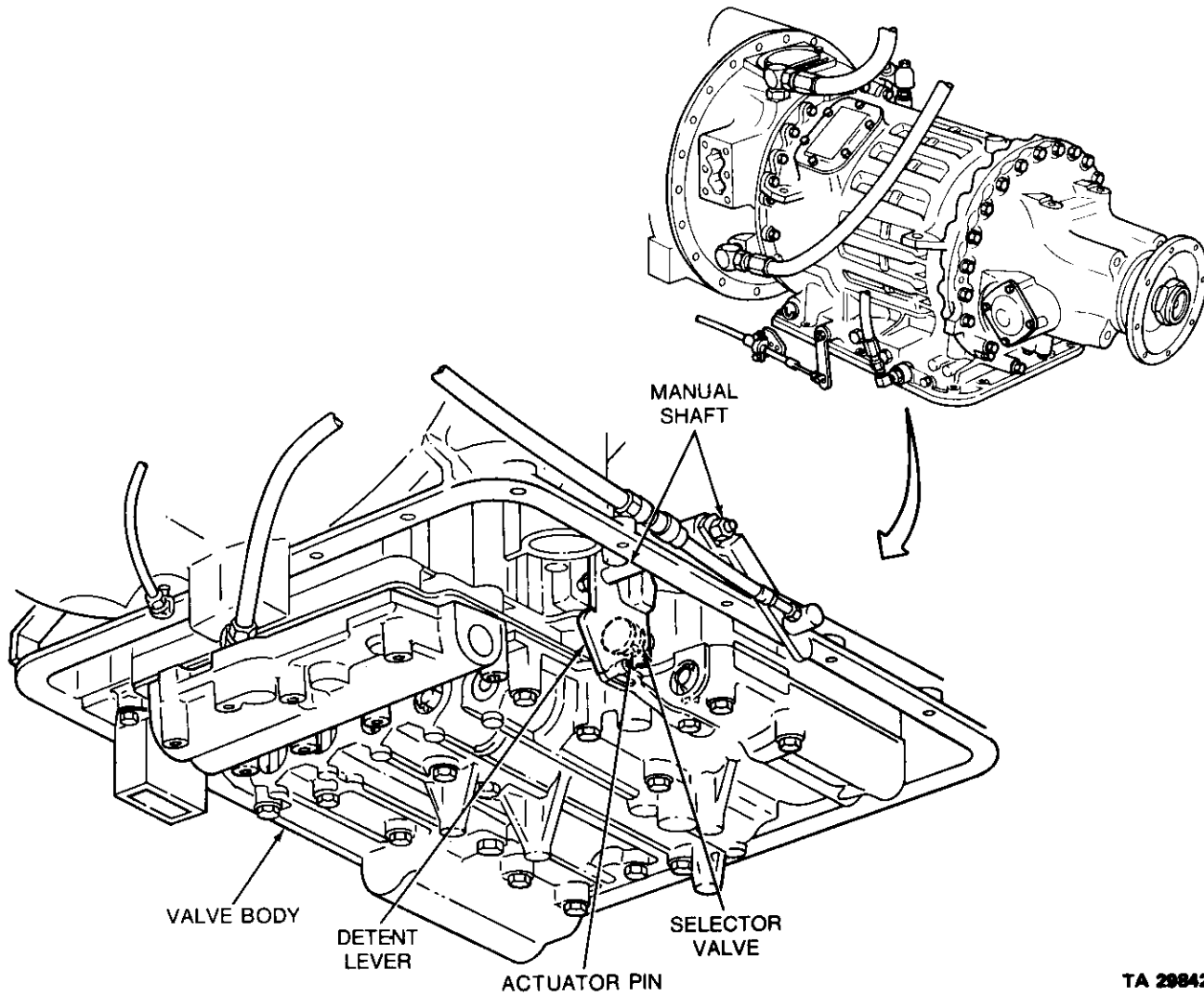
TA 299010

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

10. VEHICLE MOVES IN NEUTRAL

Without engine running, manually shift transmission and see if the manual shaft and detent lever are engaging with selector valve and actuator pin is attached to detent lever.

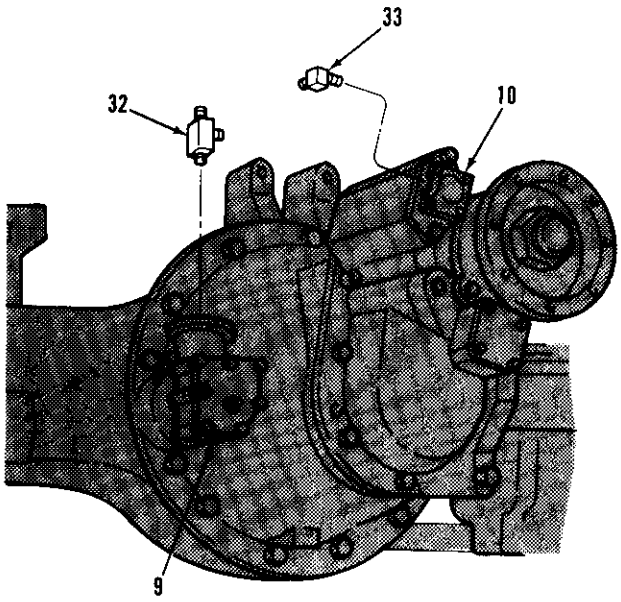
- If selector valve is not engaging properly, repair or replace defective parts. Refer to paragraph 7-10.
- If selector valve is engaging properly, disassemble transmission and valve body to check for applied clutch packs in transmission or leaking or sticking valves in valve body. Refer to paragraphs 7-10, 7-13, 7-14, 7-15, and 7-17.



TA 298425

END OF TEST

10-14. AXLE REPLACEMENT (NO. 3 AXLE) (Continued)



9. AXLE SHIFT UNIT
10. LOCKOUT CHAMBER
32. AIR FITTING
33. AIR FITTING

(2) Remove air fitting (32) from axle shift unit (9).

(3) Remove air fitting (33) from lockout chamber (10).

c. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

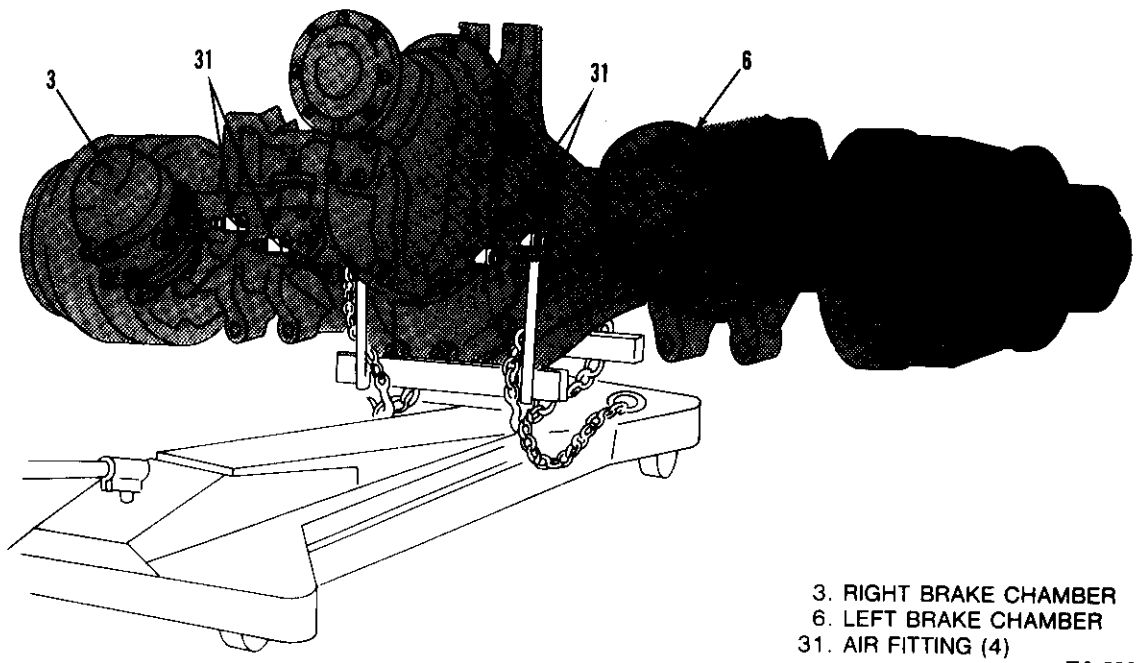
(3) Replace all parts failing inspection.

d. Assembly

(1) Apply pipe sealant to threads and install air fitting (32) into axle shift unit (9). Tighten securely.

(2) Apply pipe sealant to threads and install air fitting (33) into lockout chamber (10). tighten securely.

(3) Apply pipe sealant to threads and install four air fittings (31) into right and left brake chambers (3 and 6).



3. RIGHT BRAKE CHAMBER
6. LEFT BRAKE CHAMBER
31. AIR FITTING (4)

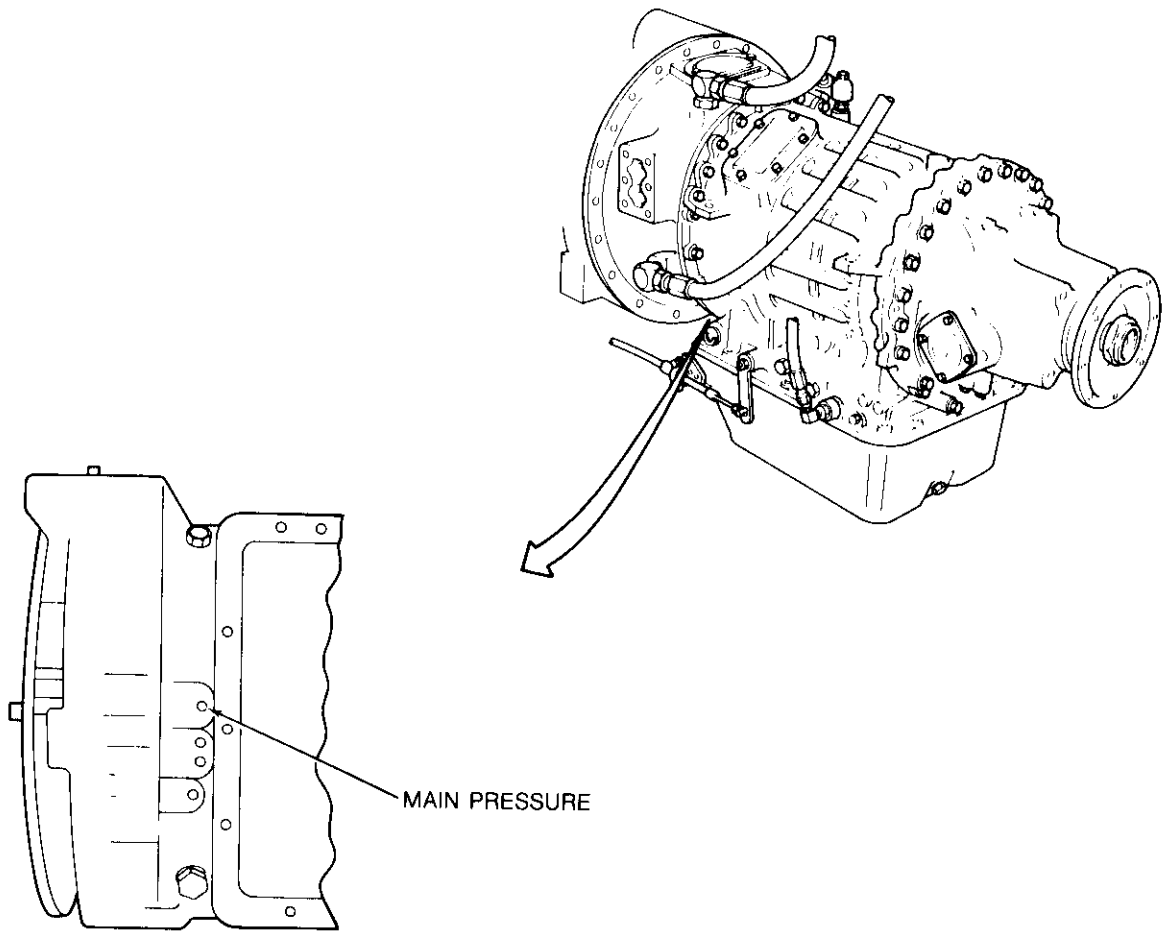
TA 299009

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

11. TRANSMISSION SLIPS IN ALL FORWARD GEARS

Test 1. Check for low main pressure. Remove main pressure oil line from main pressure port on transmission and install a tee and a 0-300 psi (0-2068 kPa) gage. Start engine and allow to run at idle speed. With parking brake applied, shift transmission into drive. Check for a minimum of 110 psi (758 kPa) main system pressure.

- If pressure is within specifications, rebuild forward clutch and replace forward clutch piston seal rings. Refer to paragraph 7-12.
- If pressure is not within specifications, go to Test 2.



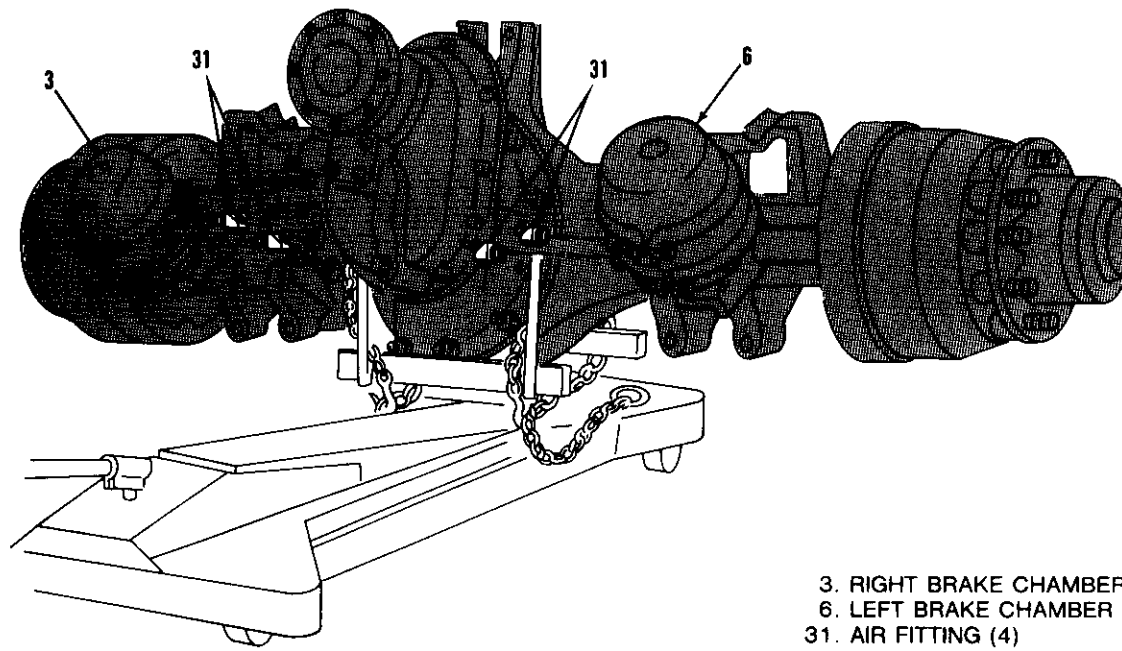
TA 298427

(12) Move axle assembly (17) forward until free of springs (30).

(13) Lower axle assembly (17) and remove it.

b. Disassembly

(1) Remove four air fittings (31) from right and left brake chambers (3 and 6).



3. RIGHT BRAKE CHAMBER
6. LEFT BRAKE CHAMBER
31. AIR FITTING (4)

TA 299008

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

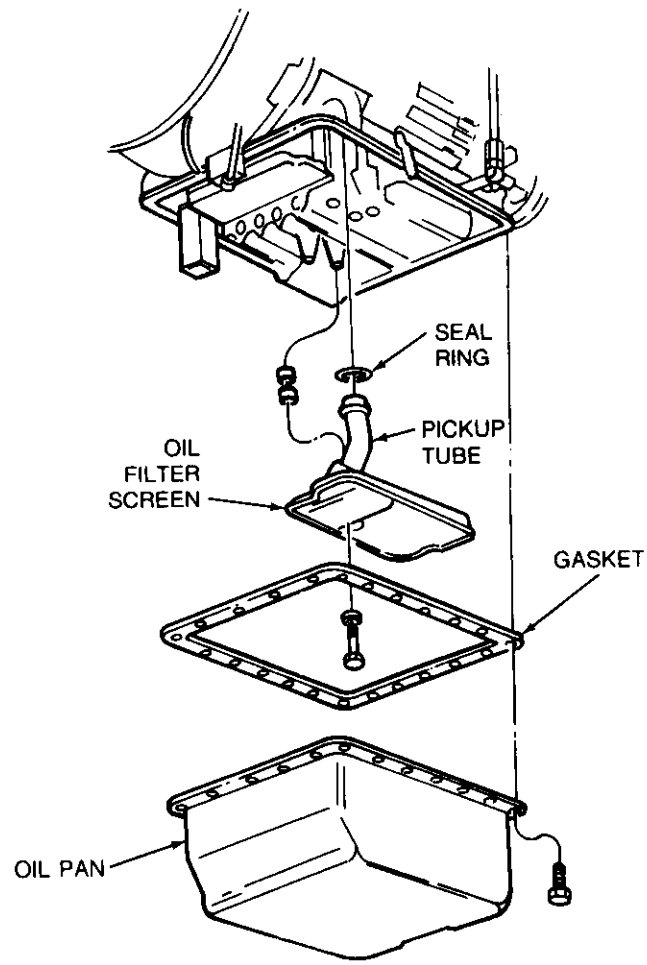
Test 2. Drain transmission and remove oil pan. Refer to paragraph 8-12 in TM 2320-20/12, TM 9-2320-297-20. Check for clogged internal oil filter screen.

- If filter screen is not clogged, go to Test 3.
- If filter screen is clogged, replace filter screen.

Test 3. Check for damaged, leaking, or missing seal ring on internal filter pickup tube.

- If seal ring is damaged, leaking, or missing, replace seal ring and gasket.
- If seal ring is not damaged, leaking, or missing, disassemble transmission and inspect oil pump, main pressure regulator valve, control valve body leakage, and sticking control valves. Refer to paragraphs 7-5, 7-6, and 7-12.

END OF TEST



TA 299738

10-14. AXLE REPLACEMENT (NO. 3 AXLE) (Continued)

WARNING

The axle assembly is very heavy. To prevent personal injury, be very careful during removal procedures. Make sure axle is supported and balanced as torque rods are removed.

(8) Attach removal equipment (16) onto axle assembly (17).

NOTE

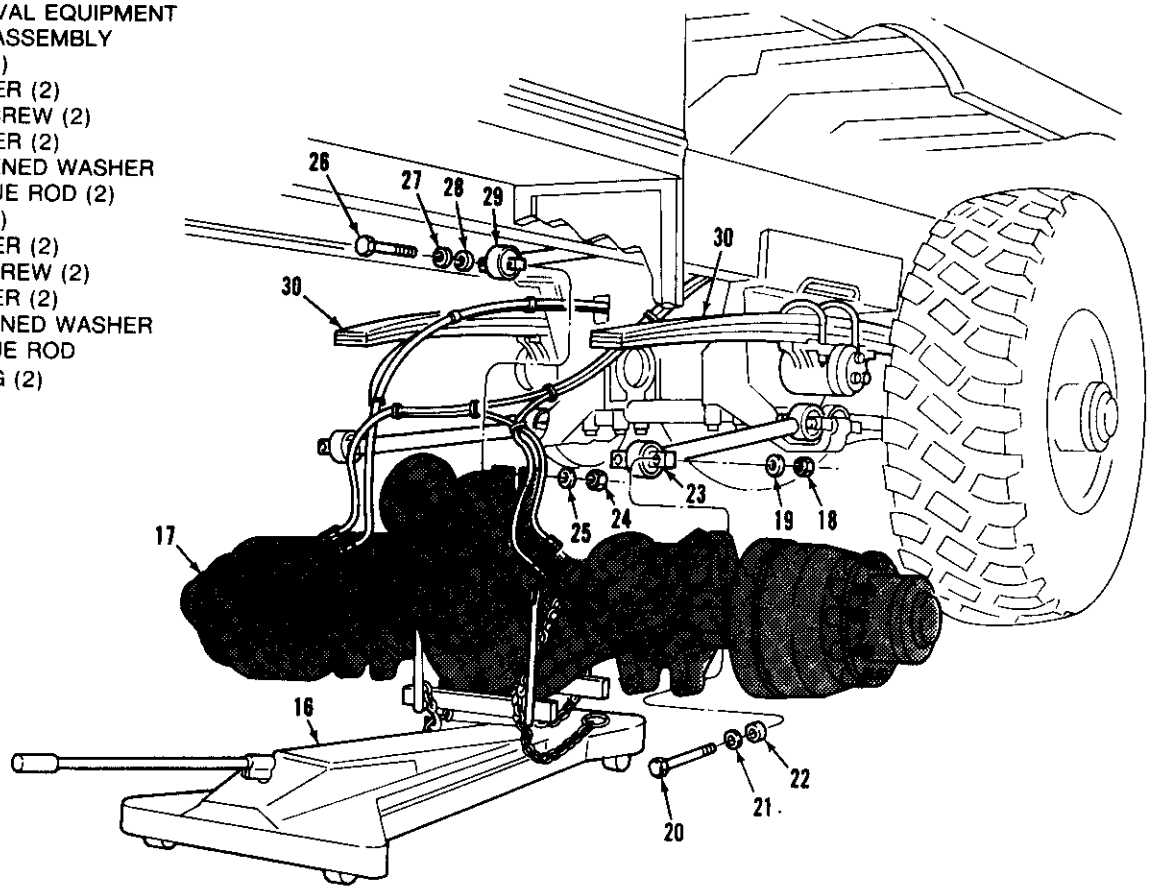
The number of hardened washers (22 and 28) may vary on each vehicle.

(9) Remove nuts (18), washers (19), capscrews (20), washers (21), and hardened washers (22) from both lower torque rods (23). Tag hardened washers (22).

(10) Remove two nuts (24), washers (25), capscrews (26), washers (27), and hardened washers (28) from upper torque rod (29).

(11) Raise axle assembly (17) high enough to take weight off springs (30).

16. REMOVAL EQUIPMENT
17. AXLE ASSEMBLY
18. NUT (2)
19. WASHER (2)
20. CAPSCREW (2)
21. WASHER (2)
22. HARDENED WASHER
23. TORQUE ROD (2)
24. NUT (2)
25. WASHER (2)
26. CAPSCREW (2)
27. WASHER (2)
28. HARDENED WASHER
29. TORQUE ROD
30. SPRING (2)



TA 299007

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

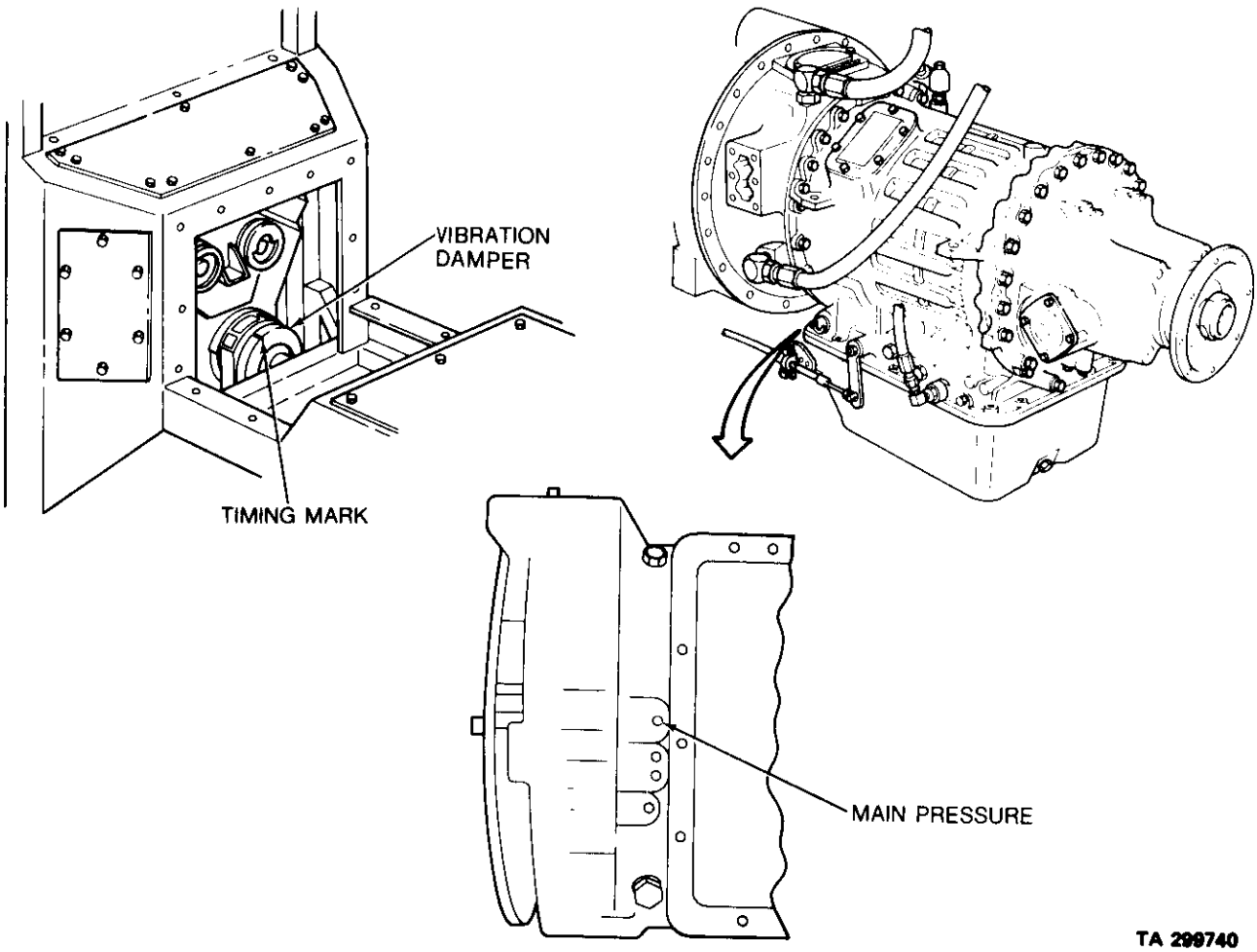
12. HIGH STALL SPEED

Test 1. Check vehicle tachometer for proper operation. Using tachometer on flow tester, check engine speed at idle, 1200 RPM and no load governed speed. Compare reading against vehicle tachometer.

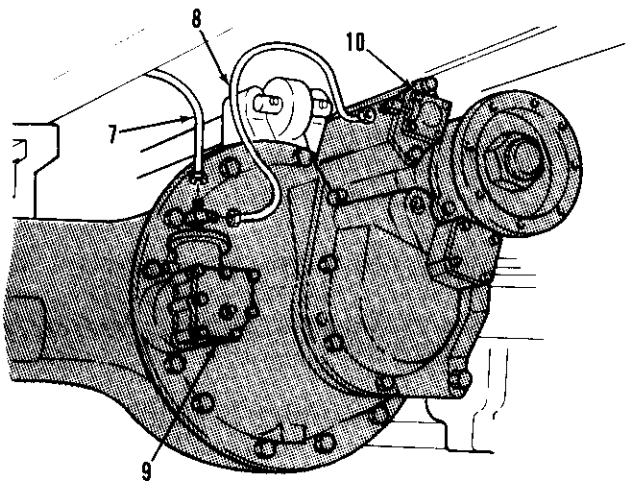
- If vehicle tachometer is accurate, go to Test 2.
- If vehicle tachometer is not accurate, repair or replace defective tachometer or sending unit. Refer to paragraph 7-46.

Test 2. Check for low main pressure. Remove main pressure oil line from main pressure port on transmission converter housing. Install a tee and a 0-300 psi (0-2068 kPa) gage. Start engine and allow to run at idle speed. Apply parking brake. Shift transmission into drive and accelerate engine to approximately 1200 RPM. Check for 140-175 psi (965-1206 kPa) main system pressure.

- If pressure is within specifications, disassemble transmission and inspect forward and first clutches for damage. Repair or replace clutches as required. Refer to paragraphs 7-13 and 7-17.
- If pressure is not within specifications, go to Test 3.



TA 299740

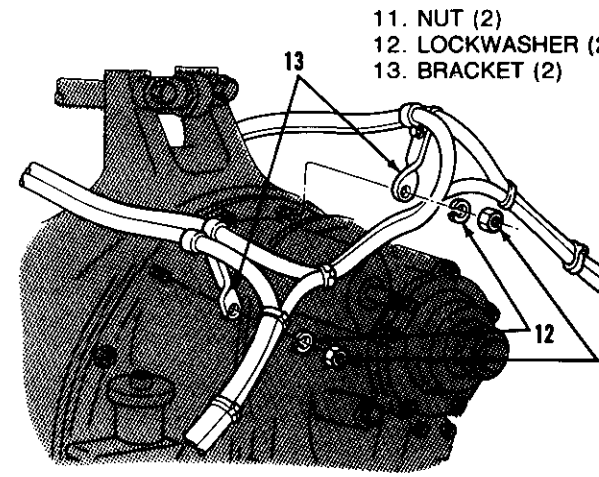


7. AIR LINE
8. AIR LINE
9. AXLE SHIFT UNIT
10. LOCKOUT CHAMBER

(4) Tag and remove airline (8) from lockout chamber (10).

(5) Remove two nuts (11), lockwashers (12), and brackets (13).

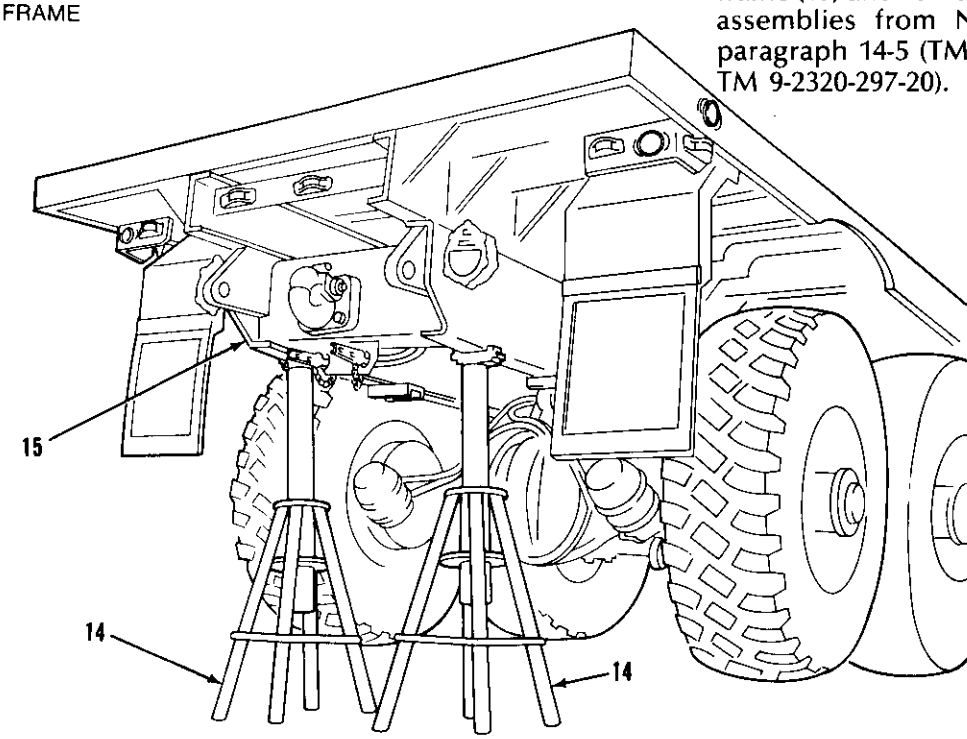
(6) Reinstall two lockwashers (12) and nuts (11).



11. NUT (2)
12. LOCKWASHER (2)
13. BRACKET (2)

(7) Position two jack stands (14) at rear of frame (15) and remove two wheel and tire assemblies from No. 3 axle. Refer to paragraph 14-5 (TM 2320-20/12, TM 9-2320-297-20).

14. JACK STAND (2)
15. FRAME



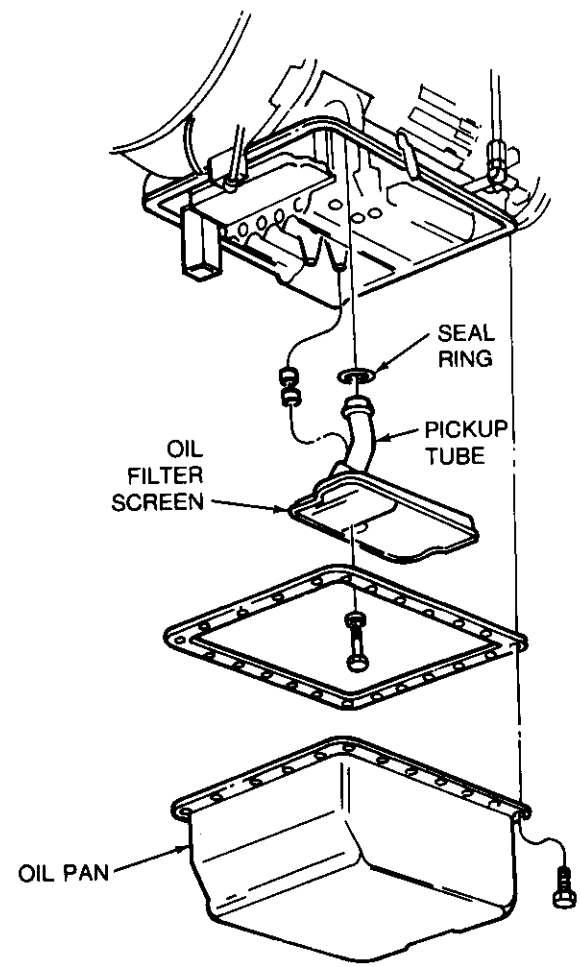
TA 299006

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 3. Drain transmission and remove oil pan. Refer to paragraph 8-12 in TM 2320-20/12, TM 9-2320-297-20. Check for clogged internal oil filter screen.
- If filter screen is not clogged, go to Test 4.
- If filter screen is clogged, replace filter screen.

Test 4. Check for damaged, leaking, or missing seal ring on internal filter pickup tube.
- If seal ring is damaged, leaking or missing, replace seal ring and gasket.
- If seal ring is not damaged, leaking or missing, disassemble transmission and inspect oil pump, main pressure regulator valve, control valve body leakage, and sticking control valves. Refer to paragraphs 7-5, 7-6, and 7-12.

END OF TEST



TA 299742

10-14. AXLE REPLACEMENT (NO. 3 AXLE)

THIS TASK COVERS: a. Removal
b. Disassembly
c. Cleaning/Inspection
d. Assembly
e. Installation

INITIAL SETUP

Applicable Configurations

MK14
MK15
MK16
MK17

Special Tools

Jack stand, 10 ton (P/N 93525)

Materials/Parts

Pipe sealant (item 60, Appendix C)
Lockwasher (2) (MS35338-50) item 12

Personnel Required

1 MOS 3522
1 Assistant

References

TM 2320-20/12
TM 9-2320-297-20

LI 2320-12/9
LO 9-2320-297-12

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Propeller shafts disconnected from axle No. 3 (para 10-3).
TM 2320-10/11 TM 9-2320-297-10	Air pressure drained (para 3-5).

General Safety Instructions

Axle assembly is very heavy. To prevent personal injury, be careful during replacement procedures.

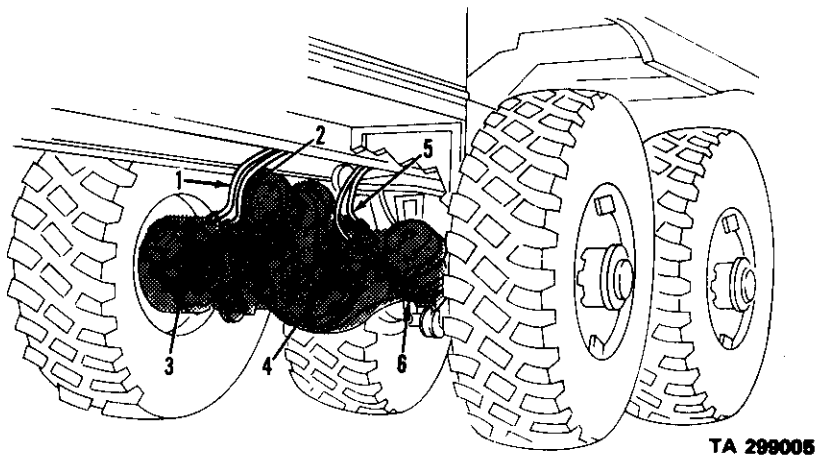
Block wheels of axle No. 4 to prevent movement.

a. Removal

(1) Tag and remove two air lines (1 and 2) from right brake chamber (3).

(2) Tag and remove two air lines (4 and 5) from left brake chamber (6).

(3) Tag and remove two air lines (7 and 8) from axle shift unit (9).



1. AIR LINE
2. AIR LINE
3. RIGHT BRAKE CHAMBER
4. AIR LINE
5. AIR LINE
6. LEFT BRAKE CHAMBER

TA 299005

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

13. LOW STALL SPEED

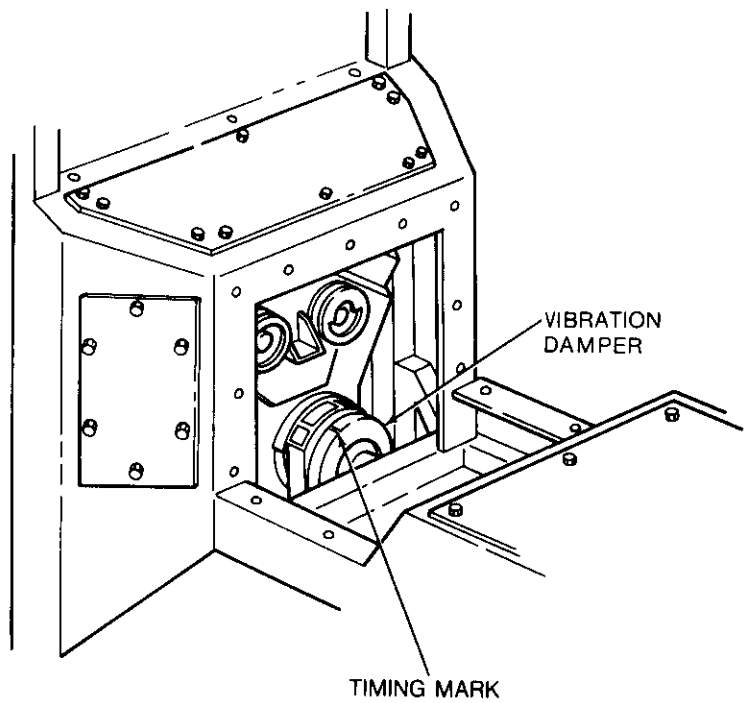
Test 1. Check vehicle tachometer for proper operation. Using tachometer on flow tester, check engine speed at idle, 1200 RPM and no load governed speed. Compare reading against vehicle tachometer.

- If vehicle tachometer is accurate, go to Test 2.
- If vehicle tachometer is not accurate, repair or replace defective tachometer or sending unit. Refer to paragraph 7-46.

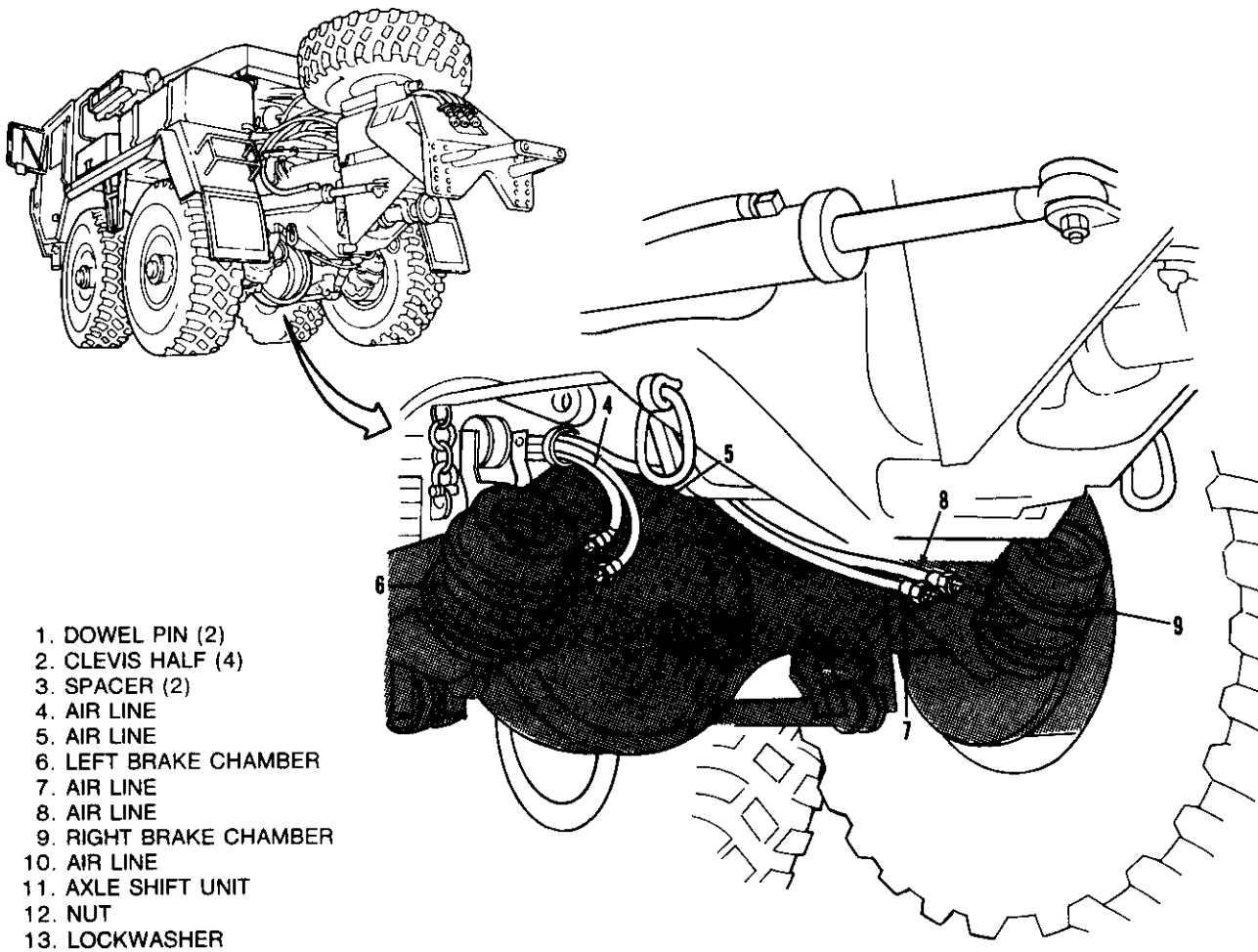
Test 2. Check for correct engine performance. Refer to paragraph 3-30.

- If engine is performing correctly, rebuild transmission and carefully inspect all torque converter parts. Refer to paragraph 7-5.
- If engine is not performing correctly, perform an engine tune-up. Refer to paragraph 3-29.

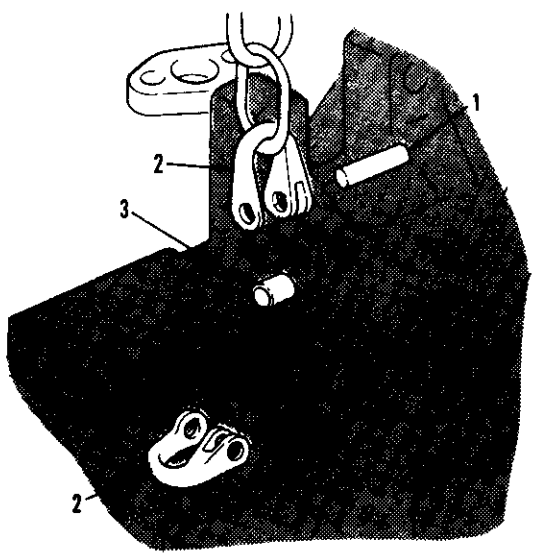
END OF TEST

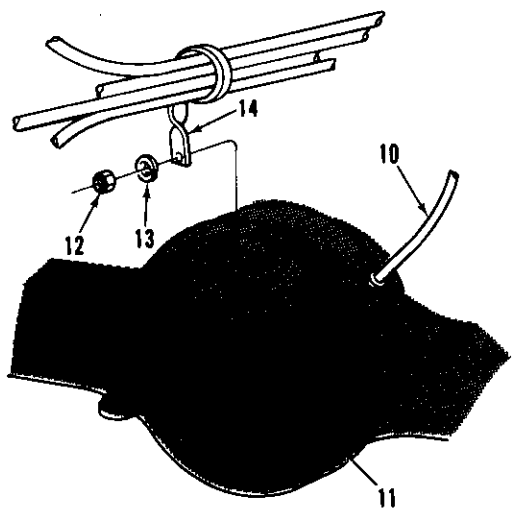


TA 299744



1. DOWEL PIN (2)
2. CLEVIS HALF (4)
3. SPACER (2)
4. AIR LINE
5. AIR LINE
6. LEFT BRAKE CHAMBER
7. AIR LINE
8. AIR LINE
9. RIGHT BRAKE CHAMBER
10. AIR LINE
11. AXLE SHIFT UNIT
12. NUT
13. LOCKWASHER
14. BRACKET





TA 29900

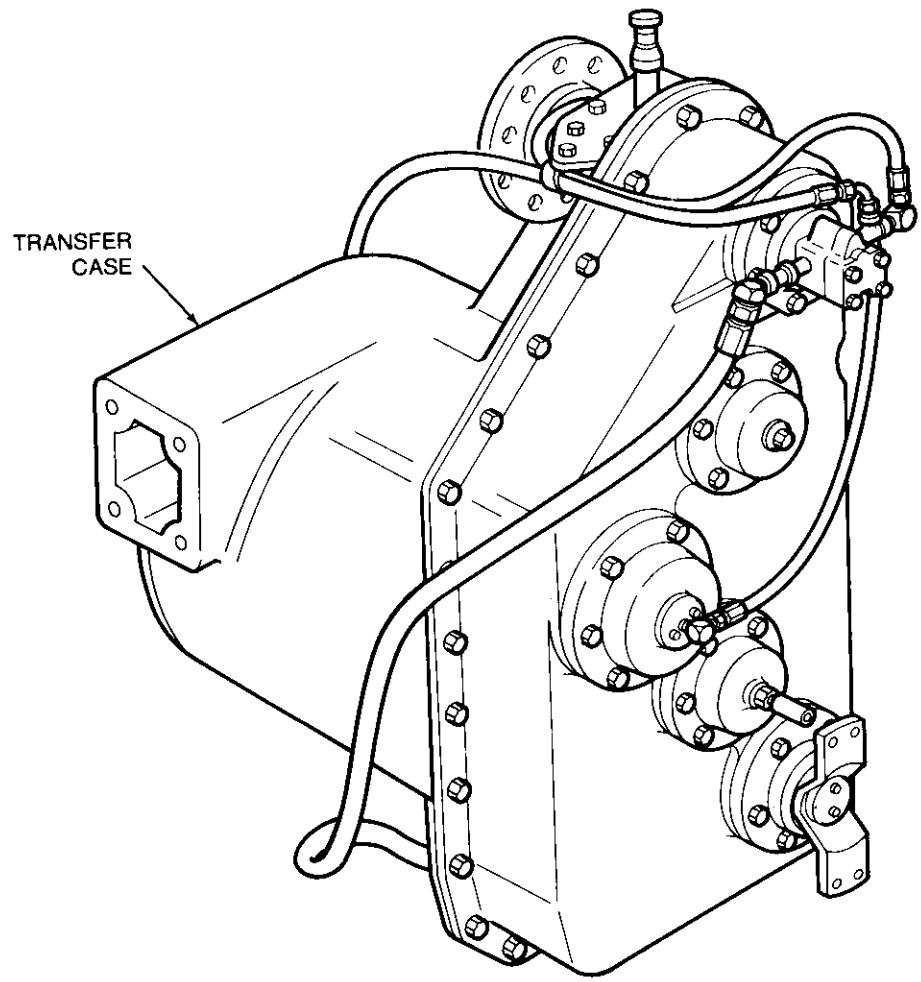
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

TRANSFER CASE

1. CONSTANT NOISE WHEN IN LOW AND/OR DIRECT RANGE

Test 1. Disassemble transfer case. Refer to paragraph 8-8. Check gears for wear, damage, chipped or broken teeth.

- If gears are defective, replace gears. Refer to paragraphs 8-10 thru 8-14.
- If gears are not defective, go to Test 2.



TA 298358

10-13. AXLE REPLACEMENT (NO. 2 AXLE) (Continued)

(8) Remove jack stands (15, 16, and 17).

(9) Remove nut (12) and lockwasher (13). Discard lockwasher (13).

(10) Install bracket (14), new lockwasher (13), and nut (12). Tighten nut (12) securely.

(11) Connect air line (10) to axle shift unit (11). Tighten securely.

(12) Connect two air lines (4 and 5) to left brake chamber (6). Tighten securely.

(13) Connect two air lines (7 and 8) to right brake chamber (9). Tighten securely.

(14) Install four clevis halves (2), two spacers (3), and two dowel pins (1).

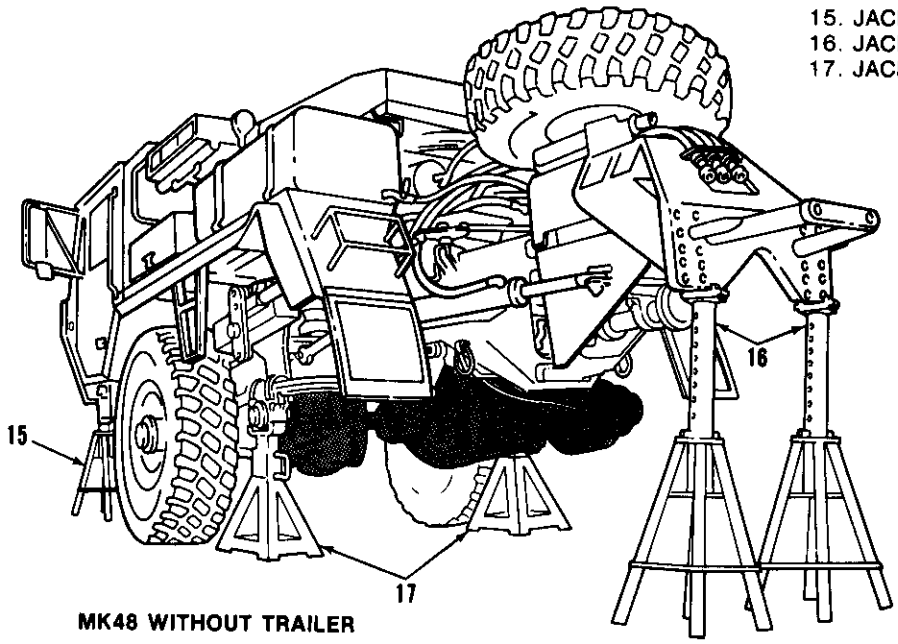
(15) Check axle lubricant level. Fill if needed. Refer to LI 2320-12/9, LO 9-2320-297-12.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install propeller shaft (para 10-3).
	Install shock absorbers (para 17-3).
	Check alinement of axle No. 2. Adjust if needed (para 15-17).



15. JACK STAND (2)
16. JACK STAND (2)
17. JACK STAND (2)

MK48 WITHOUT TRAILER

TA 289003

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. CONSTANT NOISE WHEN IN LOW AND/OR DIRECT RANGE (Continued)

Test 2. Inspect for worn or damaged bearings on rear output and idler shaft assembly, differential assembly, and input shaft assembly.

- If bearings are worn or damaged, replace defective bearing. Refer to paragraphs 8-11 thru 8-14.

END OF TEST

2. LUBRICANT LEAKS AT DRIVE YOKES OR COMPANION FLANGES

Remove yoke or companion flange from leaking seal. Refer to paragraph 8-3, 8-4, or 8-5. Check that the oil seal is not worn or has been installed incorrectly. Inspect yoke or companion flange for burrs or grooves where seal surface rides.

- If oil seal is worn or is installed incorrectly, replace oil seal. Refer to paragraph 8-3, 8-4, or 8-5.
- If yoke or companion flange has burrs, remove burrs and install new oil seal. Refer to paragraph 8-3, 8-4, or 8-5.
- If yoke or companion flange has grooves where seal surface rides, replace yoke or companion flange and oil seal. Refer to paragraph 8-3, 8-4, or 8-5.

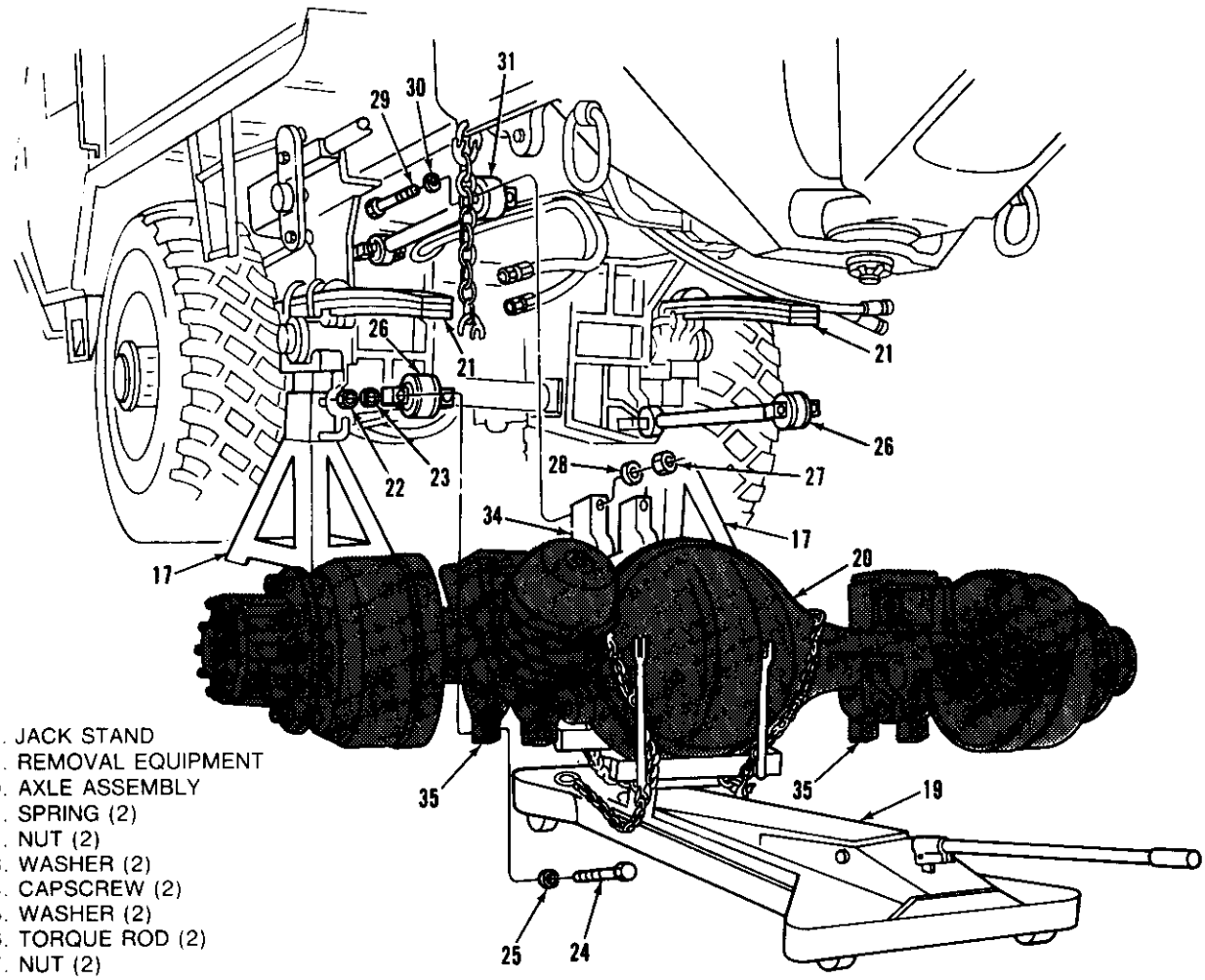
END OF TEST

CAUTION

Lower torque rods (26) must be installed behind brackets (35) for proper installation of axle assembly (20).

(6) Install both lower torque rods (26) with washers (25), capscrews (24), washers (23), and nuts (22). Make sure nuts (22) face to the front of axle assembly (20). Torque nuts (22) to 170-footpounds (231 N·m).

(7) Install two wheel and tire assemblies. Refer to paragraph 14-5 (TM 2320-20/12, TM 9-2320-297-20).

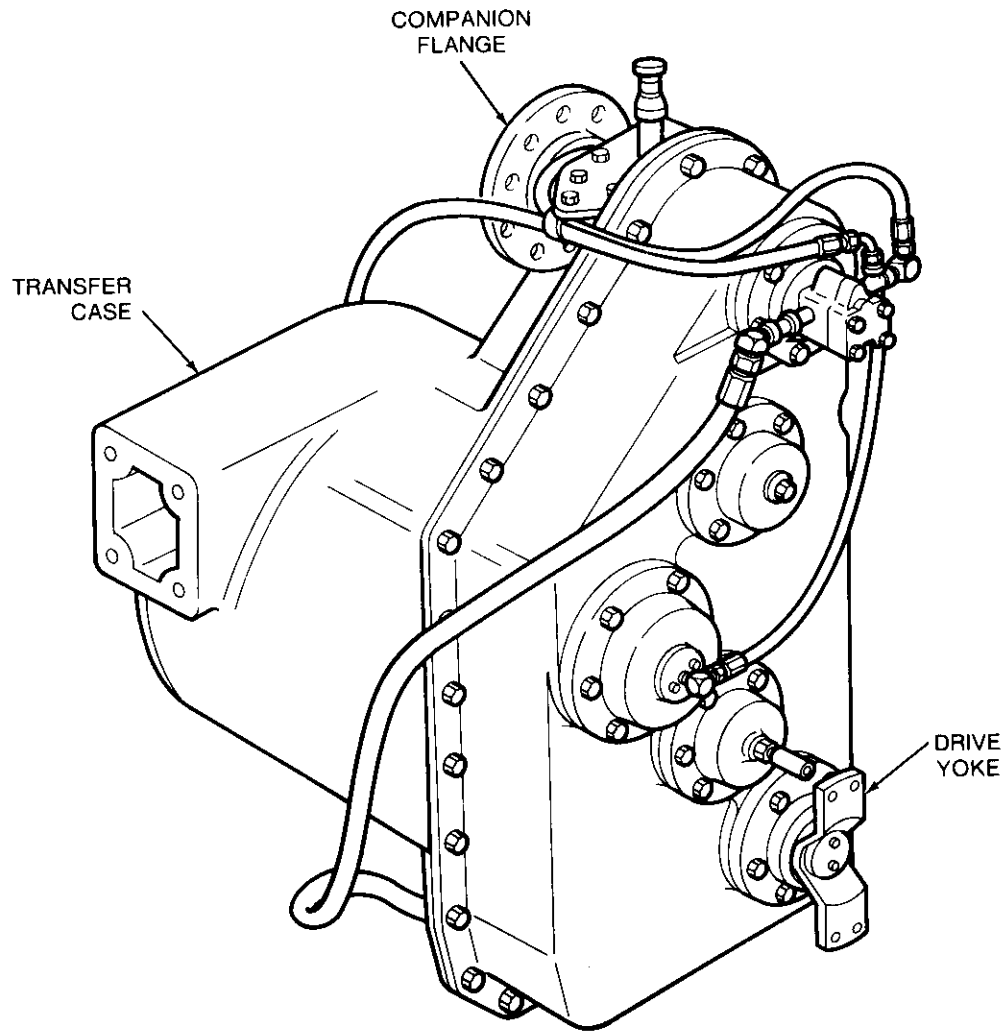


17. JACK STAND
19. REMOVAL EQUIPMENT
20. AXLE ASSEMBLY
21. SPRING (2)
22. NUT (2)
23. WASHER (2)
24. CAPSCREW (2)
25. WASHER (2)
26. TORQUE ROD (2)
27. NUT (2)
28. WASHER (2)
29. CAPSCREW (2)
30. WASHER (2)
31. TORQUE ROD
34. BRACKET
35. BRACKET

MK48 WITH TRAILER

TA 299002

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298359

10-13. AXLE REPLACEMENT (NO. 2 AXLE) (Continued)

b. Disassembly

(1) Remove air fitting (32) from axle shift unit (11).

(2) Remove four air fittings (33) from brake chambers (6 and 9).

c. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

d. Assembly

(1) Apply pipe sealant to threads and install air fitting (32) into axle shift unit (11). Tighten securely.

(2) Apply pipe sealant to threads and install two air fittings (33) into left brake chamber (6).

(3) Apply pipe sealant to threads and install two air fittings (33) into right brake chamber (9).

e. Installation

(1) Position axle assembly (20) on removal equipment (19).

(2) Position axle assembly (20) under MK48.

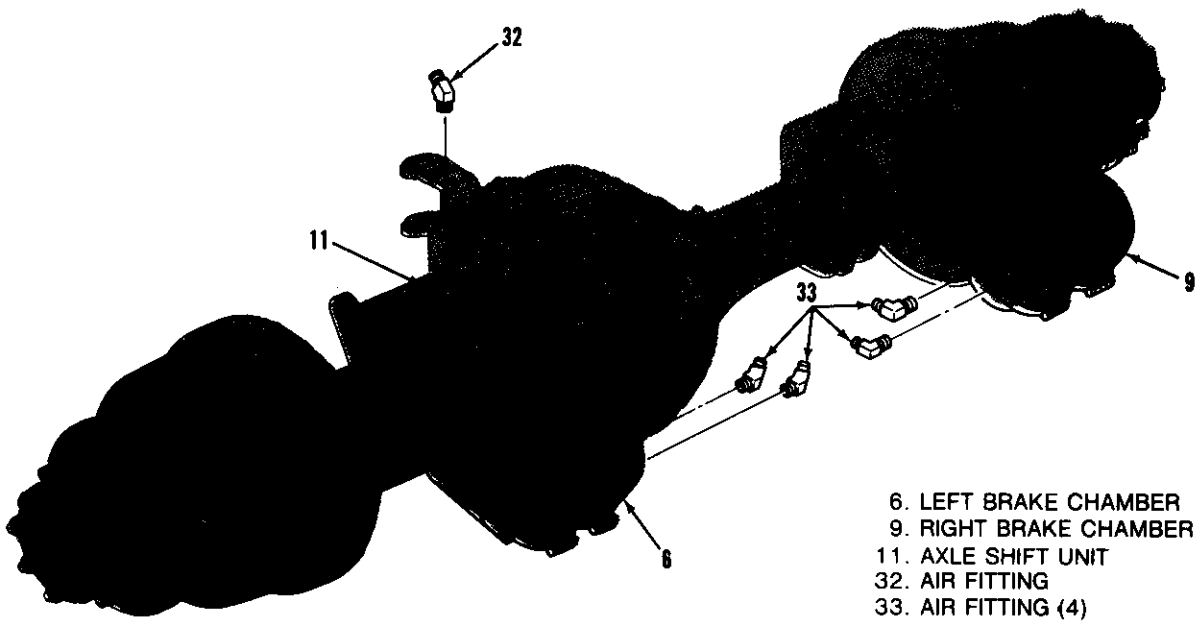
(3) Raise axle assembly (20) until it is in position near springs (21).

(4) Move axle assembly (20) onto springs (21).

CAUTION

Upper torque rod (31) must be installed in front of bracket (34) for proper installation of axle assembly (20).

(5) Install upper torque rod (31), two washers (30), capscrews (29), washers (28), and nuts (27). Make sure nuts (27) are to rear of axle assembly (20). Torque nuts (27) to 170 foot-pounds (231 N·m).



6. LEFT BRAKE CHAMBER
9. RIGHT BRAKE CHAMBER
11. AXLE SHIFT UNIT
32. AIR FITTING
33. AIR FITTING (4)

TA 298001

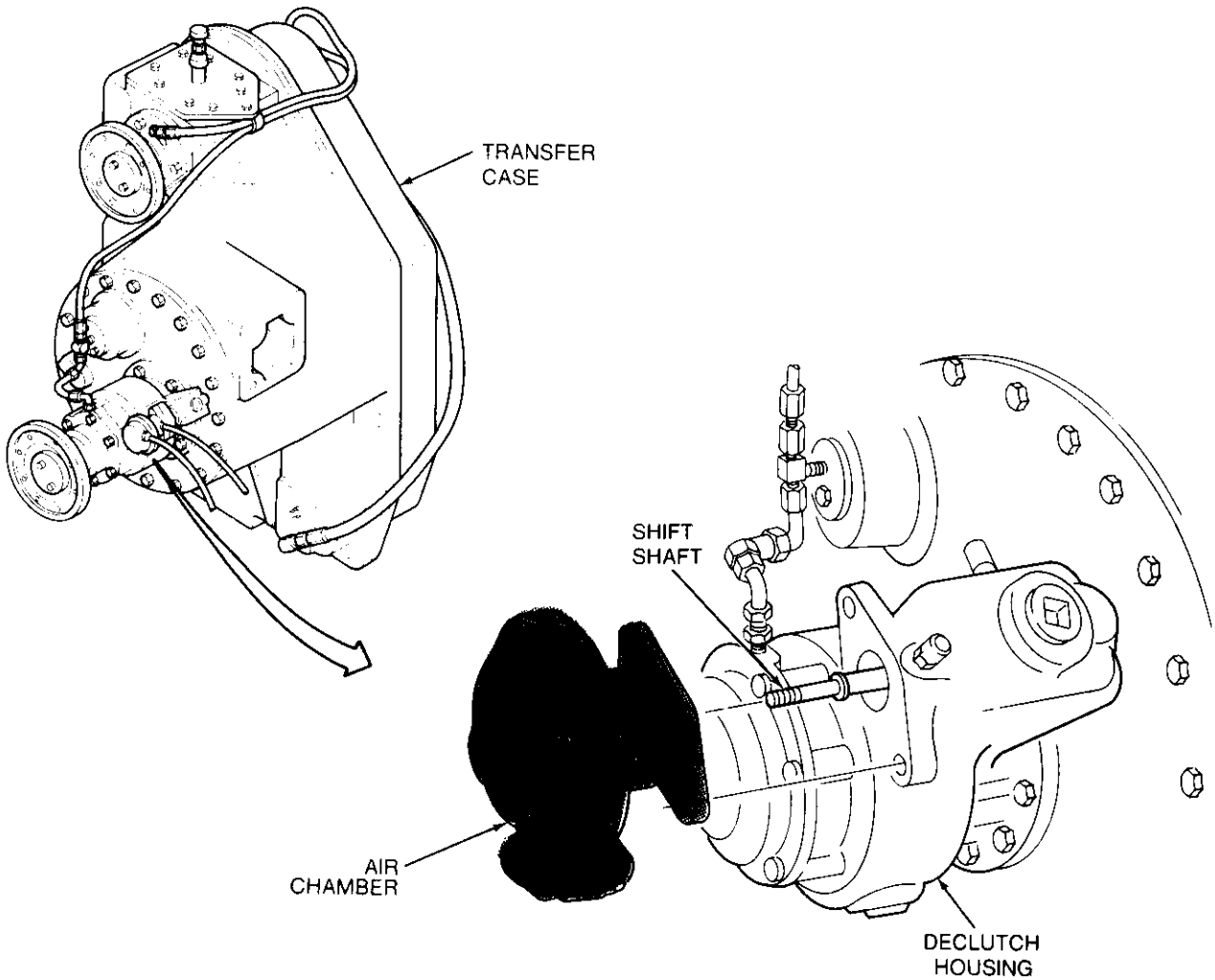
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. DIFFERENTIAL LOCKUP WILL NOT ENGAGE OR DISENGAGE

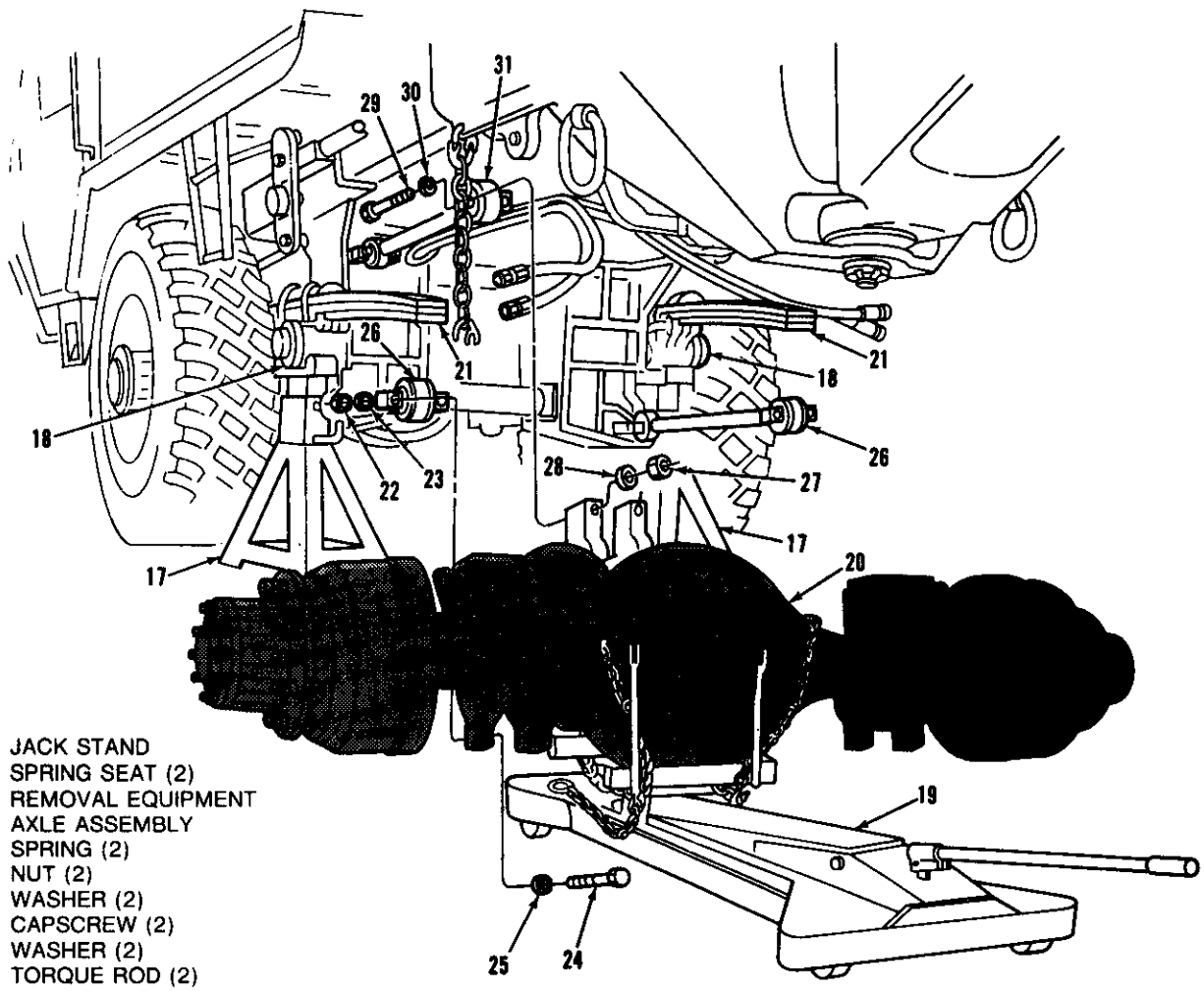
Test 1. Remove lockup air chamber from transfer case. Refer to paragraph 9-9 in TM 2320-20/12, TM 9-2320-297-20. Apply external air pressure to air chamber and watch for movement.
- If movement is not present, repair air chamber. Refer to paragraph 8-6.
- If movement is present, go to Test 2.

Test 2. Try to manually move shift shaft in and out.
- If shift shaft does not move, remove declutch housing and check for frozen shift shaft or clutch. Refer to paragraph 8-8.
- If shift shaft does move, remove declutch housing and check for loose shift shaft or damaged shift fork. Refer to paragraph 8-8.

END OF TEST



TA 298360



17. JACK STAND
18. SPRING SEAT (2)
19. REMOVAL EQUIPMENT
20. AXLE ASSEMBLY
21. SPRING (2)
22. NUT (2)
23. WASHER (2)
24. CAPSCREW (2)
25. WASHER (2)
26. TORQUE ROD (2)
27. NUT (2)
28. WASHER (2)
29. CAPSCREW (2)
30. WASHER (2)
31. TORQUE ROD

MK48 WITH TRAILER

TA 298000

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

NOSE BOX

1. LUBRICANT LEAKS AT COMPANION FLANGE

Remove companion flange from leaking seal. Refer to paragraph 9-7. Check that the oil seal is not worn or has been installed incorrectly. Inspect companion flange for burrs or grooves where seal surface rides.

- If oil seal is worn or is installed incorrectly, replace oil seal. Refer to paragraph 9-7.
- If companion flange has burrs, remove burrs and install new oil seal. Refer to paragraph 9-7.
- If companion flange has grooves where seal surface rides, replace companion flange and oil seal. Refer to paragraph 9-7.

2. NOSE BOX NOISY

Test 1. See if differential is receving lubrication from lubricating pump. Remove oil feed line from differential carrier cover on No. 1 axle. Jack up No. 1 axle so that front wheels are off the ground. Support axle with jack stands. Have assistant apply parking brakes, start engine and shift to drive. Allow vehicle to idle. Watch for oil to flow from disconnected feed line.

- If oil flow is not present, go to Test 2.
- If oil flow is present, go to Test 3.

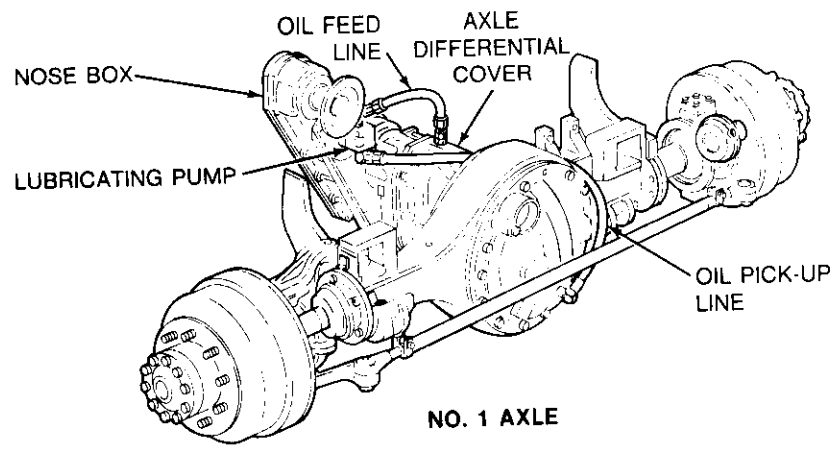
Test 2. Check for clogged lubricating pump pick-up and feed lines.

- If lubrication lines are clogged, clean or replace lines as required.
- If lubrication lines are not clogged, replace lubricating pump. Refer to paragraph 9-6.

Test 3. Disassemble nose box. Refer to paragraph 9-15. Check for worn, damaged, chipped, or broken gear teeth. Also check for worn or damaged bearings.

- If gears or bearings are defective, replace as required. Refer to paragraph 9-15.

END OF TEST



NO. 1 AXLE

TA 298361

10-13. AXLE REPLACEMENT (NO. 2 AXLE) (Continued)

NOTE

Perform steps (7), (8) and (10) thru (16) only if MK48 is not attached to a trailer. When MK48 is attached to a trailer, perform steps (9) thru (16).

(7) Block wheels of No. 1 axle and position two jack stands (15) just under front corners of MK48 frame. Do not raise frame.

(8) Position two jack stands (16) at rear of MK48, and two jack stands (17) under spring seats (18) near No. 2 axle.

(9) Position two jack stands (17) under spring seats (18) near No. 2 axle.

(10) Remove two tire and wheel assemblies. Refer to paragraph 14-5 (TM 2320-20/12, TM 9-2320-297-20).

WARNING

The axle assembly is very heavy. To prevent personal injury, be very careful during removal procedures. Make sure axle is supported and balanced as torque rods are removed.

(11) Attach removal equipment (19) to axle assembly (20).

(12) Raise axle assembly (20) high enough until weight is off springs (21).

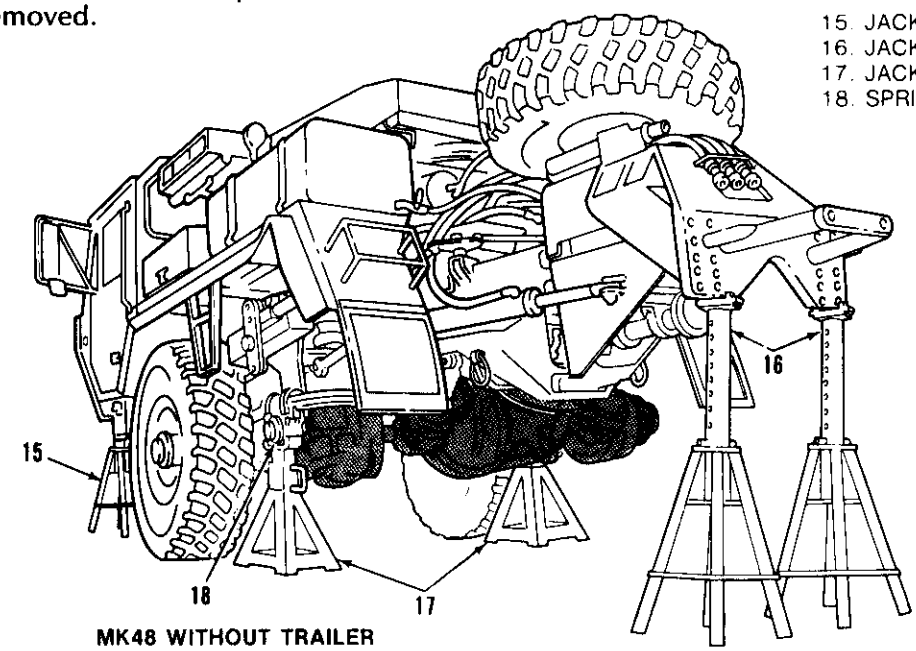
(13) Remove nuts (22), washers (23), capscrews (24), and washers (25) from both lower torque rods (26).

(14) Remove two nuts (27), washers (28), capscrews (29), and washers (30) from upper torque rod (31).

(15) Move axle assembly (20) toward rear until free of springs (21).

(16) Lower axle assembly (20) and remove it.

15. JACK STAND (2)
16. JACK STAND (2)
17. JACK STAND (2)
18. SPRING SEAT (2)



MK48 WITHOUT TRAILER

TA 298999

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

AXLES

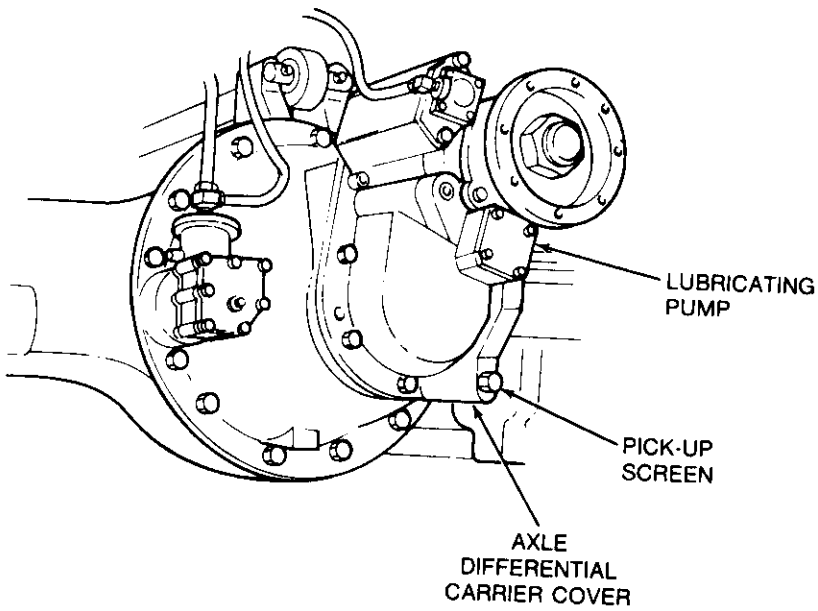
1. DIFFERENTIAL(S) NOISY

NOTE

Lubricating pump is only on No. 3 axle. To see if lubrication is reaching No. 3 axle differential carrier, start with Test 1. When working on axles No. 1, 2, or 4 go directly to Test 3.

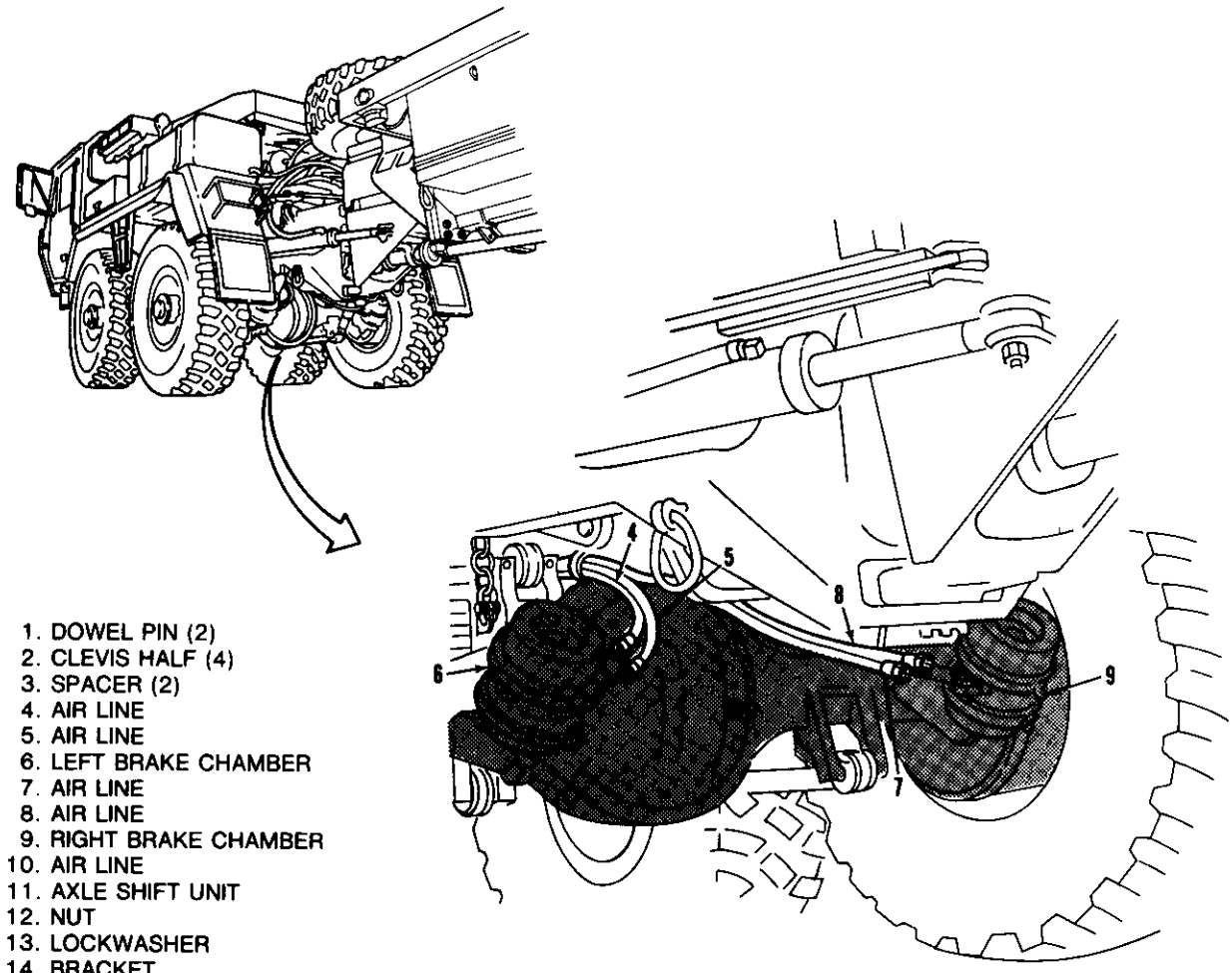
Test 1. Remove and check for clogged lubricating pump pick-up screen.
- If screen is clogged, clean or replace screen.
- If screen is not clogged, go to Test 2.

Test 2. See if differential is receiving lubrication from lubricating pump. Jack up and support No. 3 axle. Remove lubricating pump cover. Place transfer case shifter in neutral. Turn drive shaft clockwise and watch for lubricating pump gears to move. Turn drive shaft enough to allow full rotation of pump gears. Also inspect pump cover for signs of excessive wear or scoring.
- If lubricating pump cover is worn or scored, or gears bind, are worn or do not move, replace lubricating pump. Refer to paragraph 10-6.
- If lubricating pump gears work properly and cover is in good condition, go to Test 3.

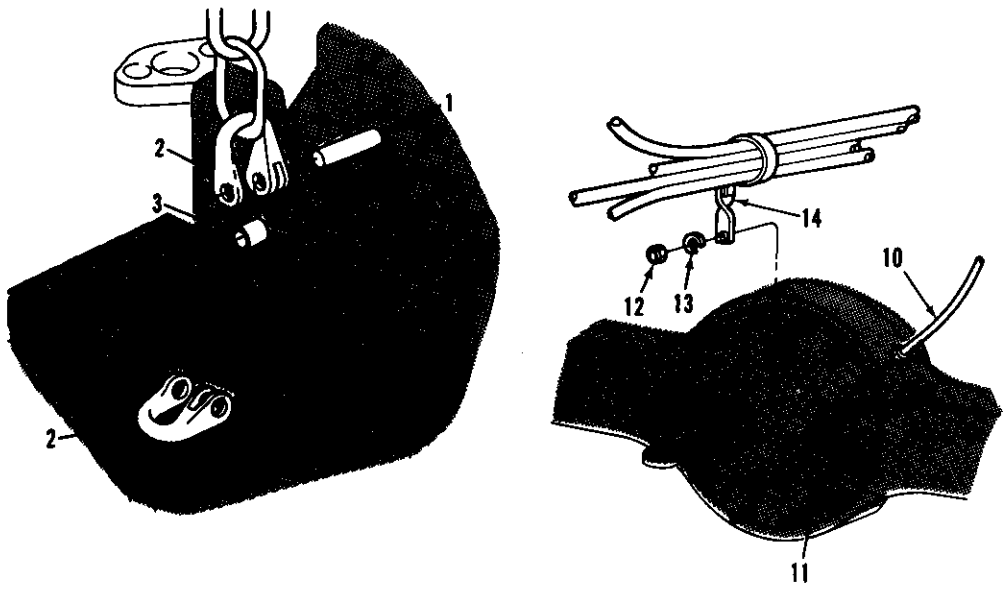


NO. 3 AXLE

TA 298362



1. DOWEL PIN (2)
2. CLEVIS HALF (4)
3. SPACER (2)
4. AIR LINE
5. AIR LINE
6. LEFT BRAKE CHAMBER
7. AIR LINE
8. AIR LINE
9. RIGHT BRAKE CHAMBER
10. AIR LINE
11. AXLE SHIFT UNIT
12. NUT
13. LOCKWASHER
14. BRACKET

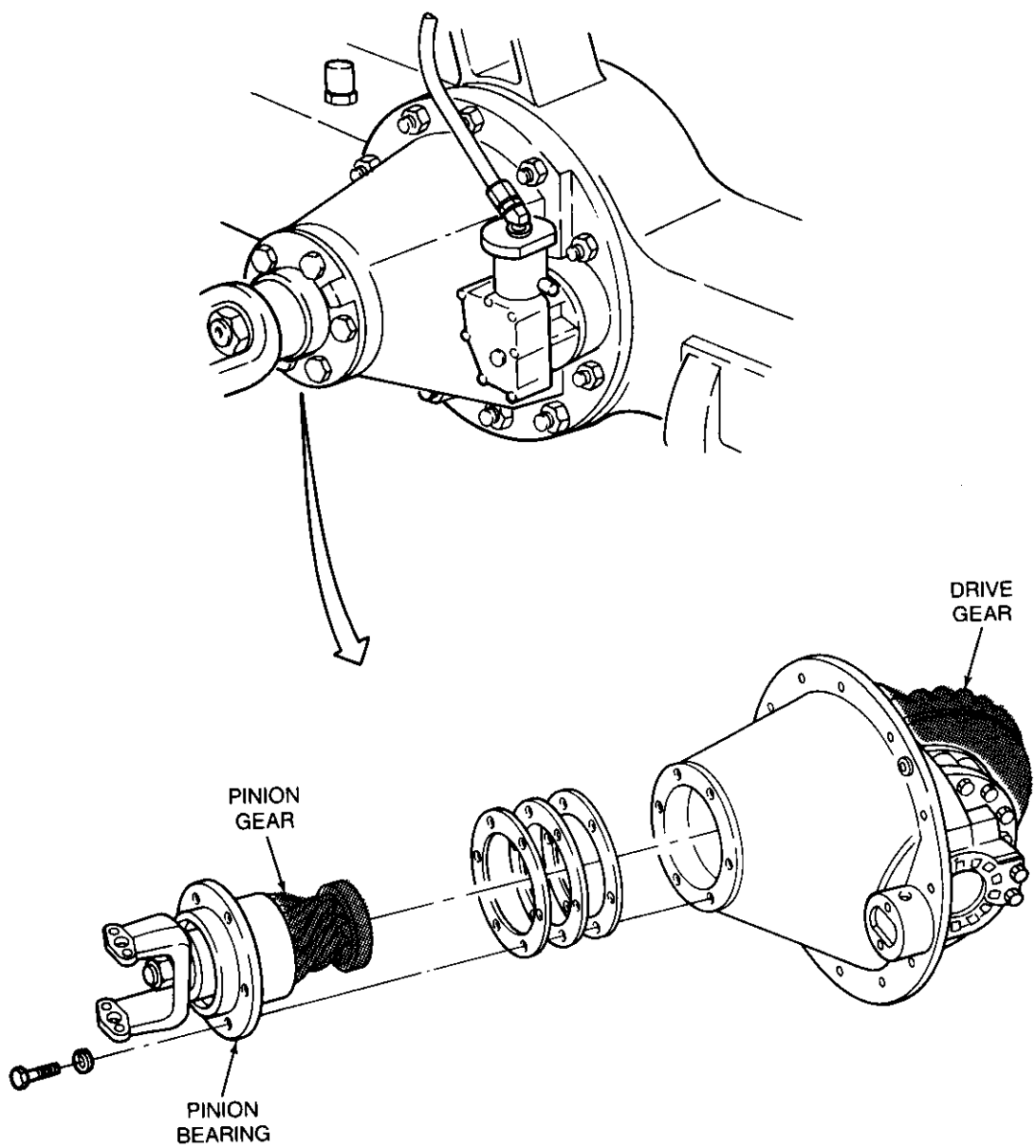


TA 298998

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 3. Remove differential carrier and check for chipped or worn drive gear and pinion. Refer to paragraphs 9-15, 10-16 or 10-17.

- If drive gear or pinion is worn, replace as needed.
- If drive gear and pinion are in good condition, go to Test 4.



TA 298363

SECTION III. REAR AXLE REPLACEMENT INSTRUCTIONS

10-13. AXLE REPLACEMENT (NO. 2 AXLE)

THIS TASK COVERS: a. Removal
b. Disassembly
c. Cleaning/Inspection
d. Assembly
e. Installation

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Jack stand, 10 ton (P/N 93525)

Materials/Parts

Pipe sealant (item 60, Appendix C)
Lockwasher (MS35338-50) item 13

Personnel Required

1 MOS 3522
1 Assistant

References

TM 2320-20/12
TM 9-2320-297-20

LI 2320-12/9
LO 9-2320-297-12

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	MK48 connected to any one of the trailers (para 2-15). Air pressure drained (para 3-5).
TM 2320-20/12 TM 9-2320-297-20	Shock absorbers removed (para 17-3). Propeller shaft removed from Axle No. 2 (para 10-3).

General Safety Instructions

The MK48 must be securely connected to any one of the trailers. This is the safest way to support the back of the MK48.

Axle assembly is heavy. To prevent personal injury, be careful during replacement procedures.

Block wheels of axles No. 1 and No. 3 to prevent movement.

---

a. Removal

(1) Remove two dowel pins (1), four clevis halves (2), and spacers (3).

(2) Tag and remove two air lines (4 and 5) from left brake chamber (6).

(3) Tag and remove two air lines (7 and 8) from right brake chamber (9).

(4) Tag and remove air line (10) from axle shift unit (11).

(5) Remove nut (12), lockwasher (13), and bracket (14).

(6) Reinstall lockwasher (13), and nut (12).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. DIFFERENTIAL(S) NOISY (Continued)

Test 4. Check pinion to drive gear backlash. Refer to paragraphs 9-17, 10-18 and 10-19.
- If backlash is incorrect, remove parts, inspect, and replace or adjust as needed.
- If backlash is correct, go to Test 5.

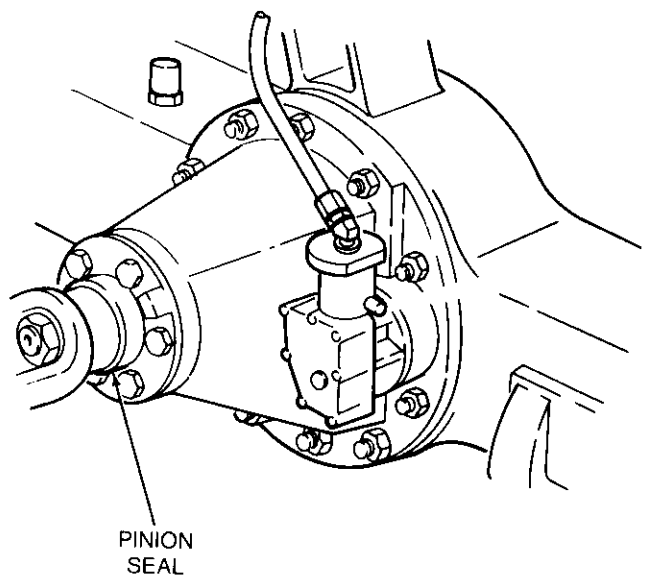
Test 5. Check for loose or worn pinion bearings.
- If bearings are loose or worn, remove and replace as needed. Refer to paragraphs 9-17, 10-18, and 10-19.

END OF TEST

2. LUBRICANT LEAKS AT PINION OR INTERAXLE COVERS

Remove yoke from leaking seal. Refer to paragraph 10-10 or 10-12. Check that the oil seal is not worn or has been installed incorrectly. Inspect yoke for burrs or grooves where seal surface rides.
- If oil seal is worn or is installed incorrectly, replace oil seal. Refer to paragraph 10-12.
- If yoke has burrs, remove burrs and install new oil seal. Refer to paragraph 10-10 or 10-12.
- If yoke has grooves where seal surface rides, replace yoke and oil seal. Refer to paragraph 10-10 or 10-12.

END OF TEST

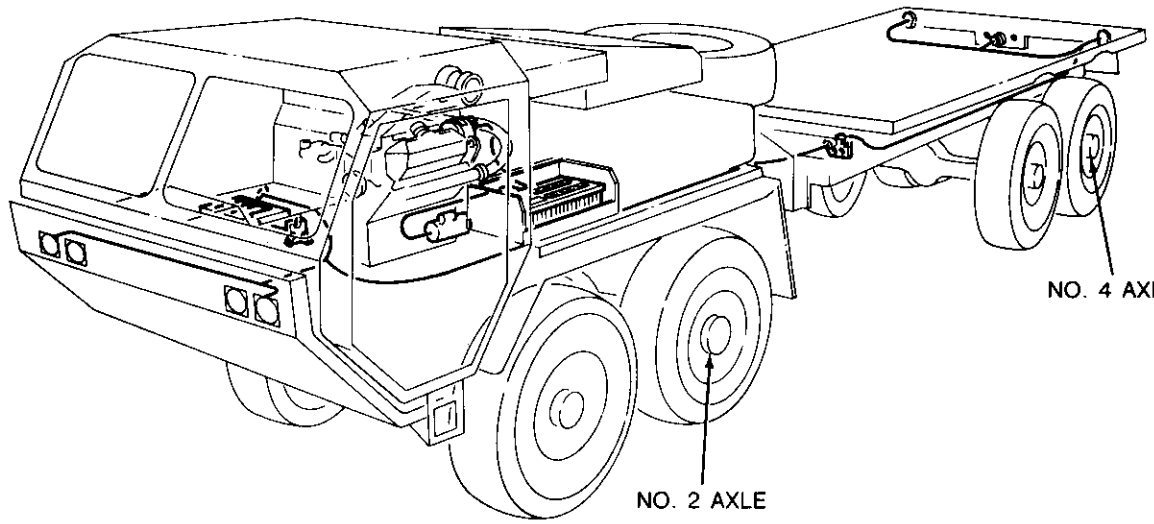


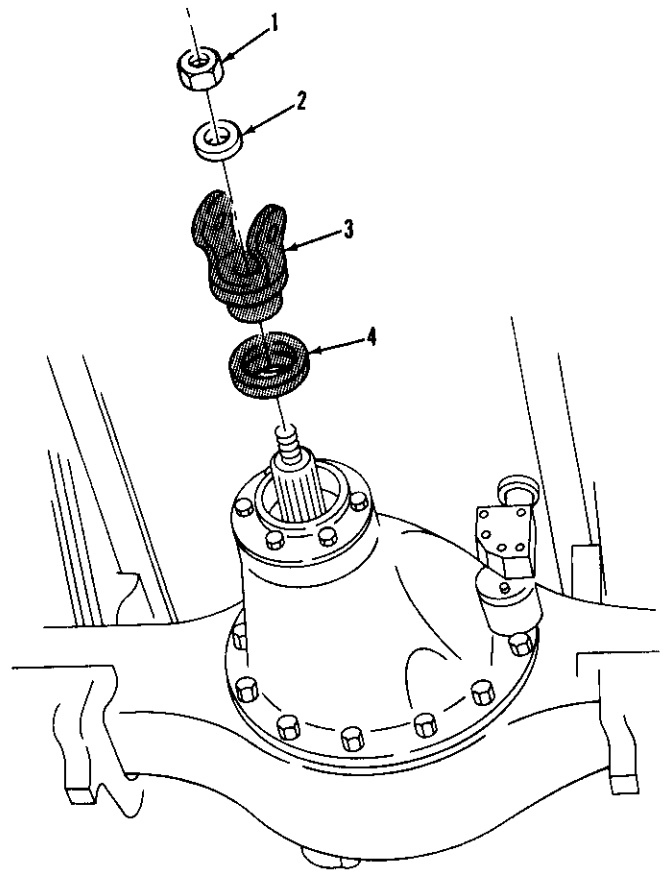
TA 298364

NOTE

Follow-On Maintenance

TM 2320-20/12 Install propeller
TM 9-2320-297-20 shaft (para 10-3).





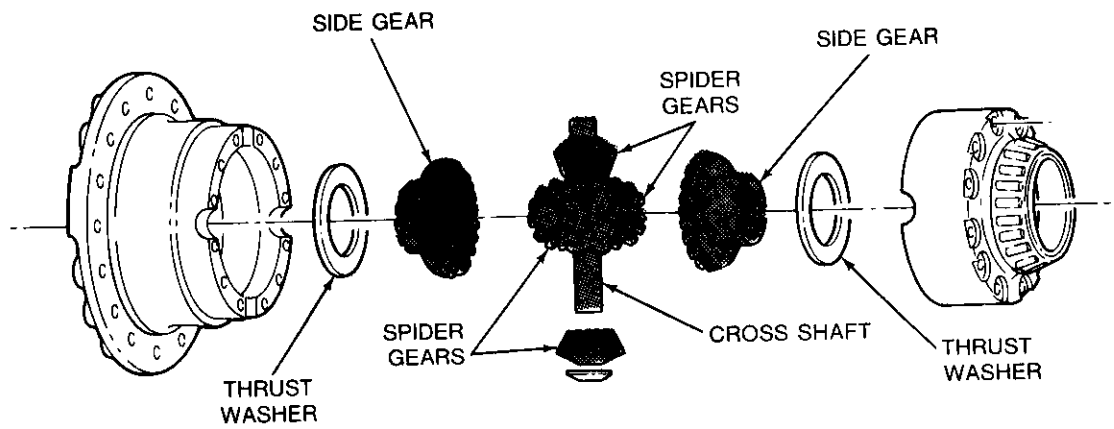
1. NUT
2. WASHER
3. YOKE
4. OIL SEAL

TA 298997

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. NOISY ON TURNS ONLY

Test 1. Disassemble differential and check for binding or frozen spider gears on cross shaft. Refer to paragraph 9-17, 10-18, or 10-19.
- If spider gears are defective, replace as required. Refer to paragraph 9-17, 10-18, or 10-19.
- If spider gears are not binding or frozen, go to Test 2.



TA 298365

Test 2. Check for defective or binding side gears and thrust washers.
- If thrust washers or side gears are defective or bind, replace side gears and thrust washers. Refer to paragraph 9-17, 10-18, or 10-19.
- If side gears and thrust washers are in good condition, go to Test 3.

Test 3. Check for worn or damaged pinion gear.
- If pinion gear is defective, replace pinion and drive gear. Refer to paragraph 9-17, 10-18, or 10-19.
- If pinion gear is in good condition, go to Test 4.

Test 4. Check for excessive backlash between side gears and spider gears.
- If excessive backlash is present, replace side gears, side gear thrust washers, spider gears, or spider gear thrust washers as required. Refer to paragraph 9-17, 10-18, or 10-19.

END OF TEST

10-12. AXLE CARRIER YOKE AND OIL SEAL REPLACEMENT (NO. 2 AND 4 AXLES)

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Materials/Parts

Oil seal (NSN 5330-01-158-2061) item 4

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Propeller shaft(s) removed as needed (para 10-3).

General Safety Instructions

Block wheels of truck to prevent personal injury.

a. Removal

(1) Remove nut (1) and washer (2).

(2) Using a puller, remove yoke (3).

(3) Remove oil seal (4) and discard.

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts for damage. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

(1) Install new oil seal (4).

(2) Being carefull not to damage oil seal (4), install yoke (3).

(3) Install washer (2) and nut (1). Torque to 560-700 foot-pounds (759-949 N·m) for axle No. 2, 840-1,020 foot-pounds (1,139-1,383 N·m) for axle No. 4.

END OF TASK

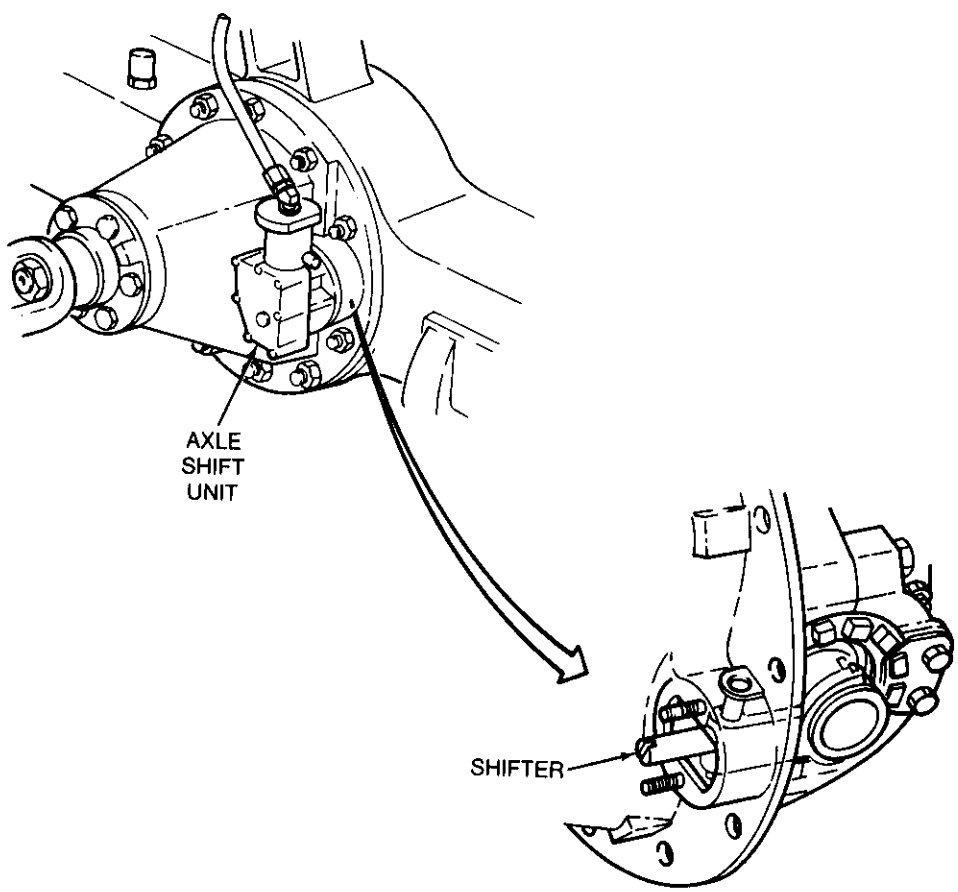
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. CONTROLLED TRACTION DIFFERENTIAL WILL NOT ENGAGE OR DISENGAGE

Test 1. Remove axle shift unit from differential. Refer to paragraph 9-4 or 10-3. Apply external air pressure to axle shift unit and watch for movement.
- If movement is not present, repair axle shift unit. Refer to paragraph 9-5.
- If movement is present, go to Test 2.

Test 2. Try to manually move shifter back and forth.
- If shifter does not move back and forth, remove differential carrier and check for frozen shift fork shaft, damaged shift fork, or sliding clutch. Refer to paragraph 9-17, 10-18, or 10-19.
- If shifter does move, disassemble differential carrier and check for worn friction plates. Refer to paragraph 9-17, 10-18, or 10-19.

END OF TEST



TA 296386

NOTE

Soak felt oilers in SAE 30 engine oil and lubricate O-rings with silicone lubricant before installing.

(3) Install two felt oilers (15) and new O-ring (16) onto piston (14).

(4) Install spring (13) and piston (14) onto push rod (9).

(5) Secure piston (14) in place using new O-ring (8), washer (7), and nut (6). Torque to 20-26 foot-pounds (27-35 N·m).

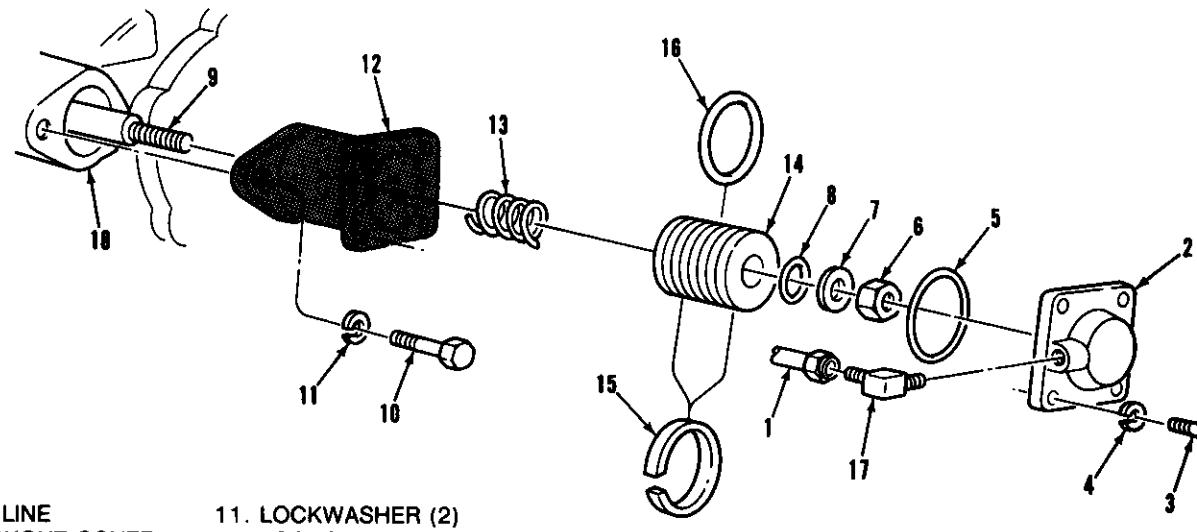
(6) Install new O-ring (5) into lockout cover (2).

(7) Install lockout cover (2) onto lockout body (12).

(8) Install four new lockwashers (4) and capscrews (3). Torque to 96-108 inch-pounds (11-12 N·m).

(9) Coat threads in lockout cover (2) with pipe sealant.

(10) Install air fitting (17) and air line (1).



1. AIR LINE
2. LOCKOUT COVER
3. CAPSCREW (4)
4. LOCKWASHER (4)
5. O-RING
6. NUT
7. WASHER
8. O-RING
9. PUSH ROD
10. CAPSCREW (2)
11. LOCKWASHER (2)
12. LOCKOUT BODY
13. SPRING
14. PISTON
15. FELT OILER (2)
16. O-RING
17. AIR FITTING
18. MOUNTING SURFACE

TA 298996

END OF TASK

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

AIR SYSTEM

1. NO AIR PRESSURE OR SLOW BUILDUP

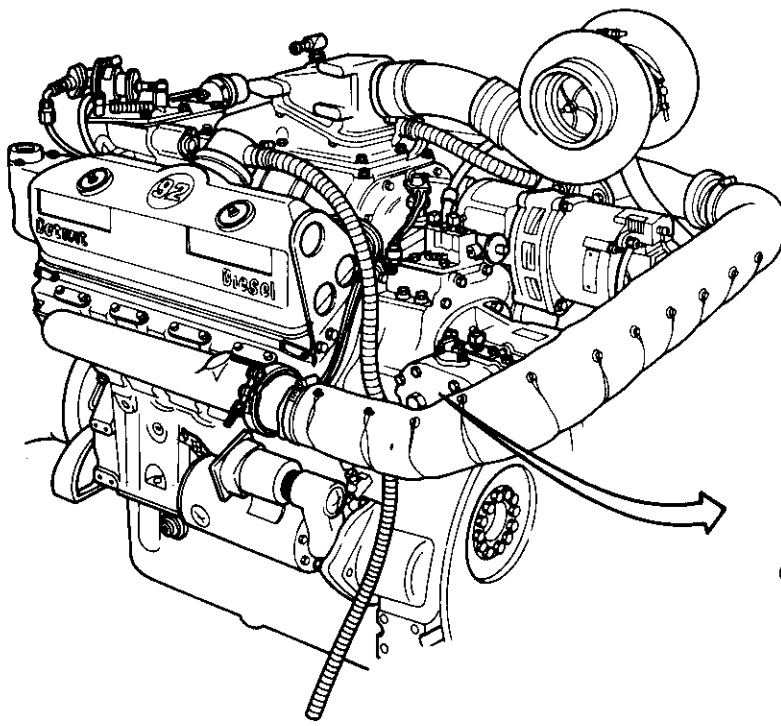
WARNING

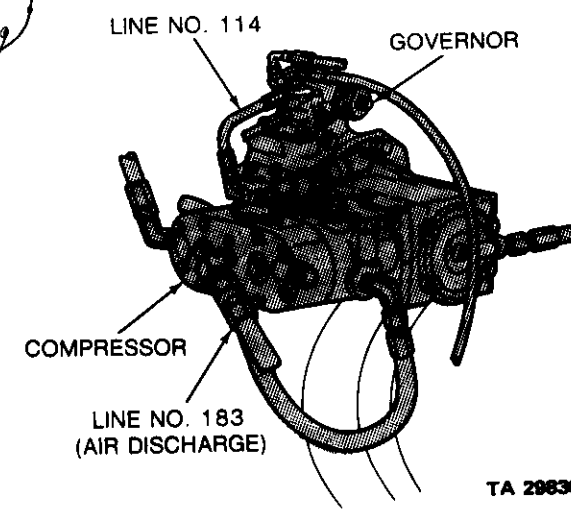
To prevent personal injury, be very careful when loosening or removing air lines. Air pressure can cause a line to whip. This may result in personal injury.

Carefully loosen and bleed air pressure from governor signal line 114 at governor. When air pressure is gone, disconnect air line. Start engine. Very carefully loosen air line 183 at compressor, and listen for air escaping.

- If no air is heard escaping, repair compressor valves and/or rebuild compressor. Refer to paragraph 11-8 or 11-9.

END OF TEST





TA 298367

10-11. LOCKOUT CHAMBER MAINTENANCE

THIS TASK COVERS: a. Disassembly
b. Cleaning
c. Assembly

INITIAL SETUP

Materials/Parts

Adhesive, silicone sealant (item 7, Appendix C)
Lubricant, silicone (item 35, Appendix C)
Oil, engine (item 46, Appendix C)
Pipe sealant (item 60, Appendix C)
Lockwasher (4) (MS35338-44) item 4
O-ring (NSN 5330-01-058-3785) item 5
O-ring (NSN 5330-01-150-7485) item 8
Lockwasher (2) (MS35338-47) item 11
O-ring (NSN 5330-01-136-7330) item 16

General Safety Instructions

To prevent personal injury, drain all pressure from the air system.

---

a. Disassembly

(1) Remove air line (1) from lockout cover (2).

(2) Remove four capscrews (3), lockwashers (4), and lockout cover (2). Discard lockwashers (4).

(3) Remove and discard O-ring (5).

CAUTION

Piston is under slight spring pressure. When removing nut be careful not to lose any parts.

(4) Remove nut (6), washer (7), and O-ring (8) from push rod (9). Discard O-ring (8).

(5) Remove two capscrews (10), lockwashers (11), and lockout body (12). Discard lockwashers (11).

(6) Remove spring (13) and piston (14).

(7) Remove two felt oilers (15) and O-ring (16) from piston (14). Discard O-ring (16).

(8) Remove air fitting (17) from lockout cover (2).

b. Cleaning

(1) Clean all parts. Refer to paragraph 2-6.

(2) Clean gasket material from mounting surface (18).

(3) Inspect all parts. Refer to paragraph 2-7.

c. Assembly

(1) Apply silicone sealant to mounting surface (18).

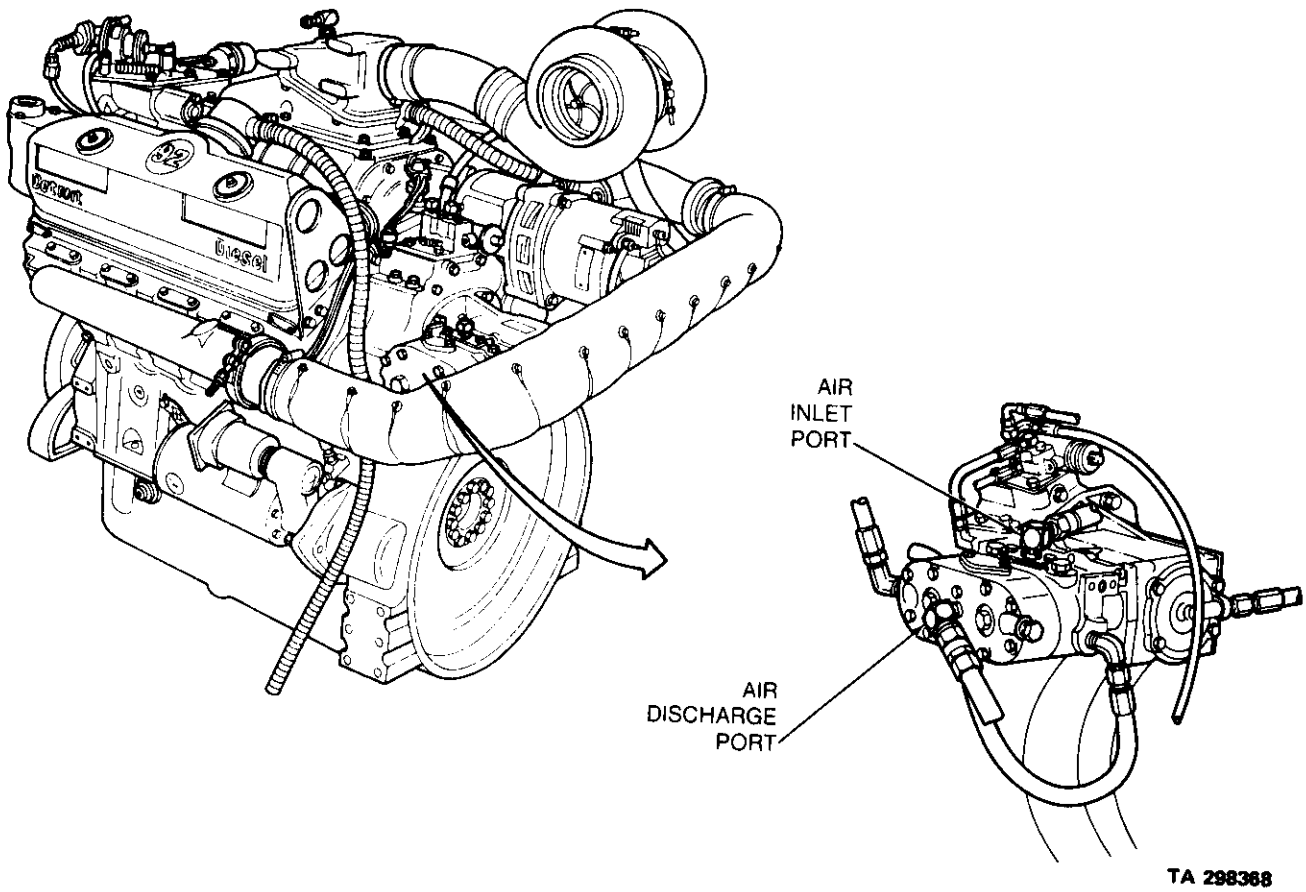
(2) Install lockout body (12), two new lockwashers (11), and capscrews (10).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

2. COMPRESSOR NOISY

Test 1. Remove compressor cylinder head and check compressor discharge port for carbon buildup. Refer to paragraph 11-8.

- If carbon buildup is not present, go to Test 2.
- If carbon buildup is present, service compressor valves.



TA 298368

Test 2. Remove compressor. Check for worn or damaged compressor drive plate and engine drive hub. Refer to paragraph 11-7.

- If drive plate and hub are in good condition, go to Test 3.
- If drive plate or hub is worn or damaged, replace defective parts. Refer to paragraph 11-7 or 11-9.

Test 3. Disassemble compressor and check for worn or burned out bearings. Refer to paragraph 11-9.

- If bearings are in good condition, replace compressor.
- If bearings are not in good condition, rebuild compressor.

END OF TEST

10-10. COMPANION FLANGE REPLACEMENT (NO. 3 AXLE)

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK14
MK15
MK16
MK17

Materials/Parts

Oil seal (NSN 5330-01-156-3759) item 4

Equipment Condition

TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Input propeller shaft removed (para 10-3).

General Safety Instructions

Block wheels of truck to prevent personal injury.

a. Removal

(1) Remove nut (1) and washer (2).

(2) Using a puller, remove flange (3).

(3) Remove and discard oil seal (4).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

(1) Install new oil seal (4).

(2) Being careful not to damage oil seal (4), install flange (3).

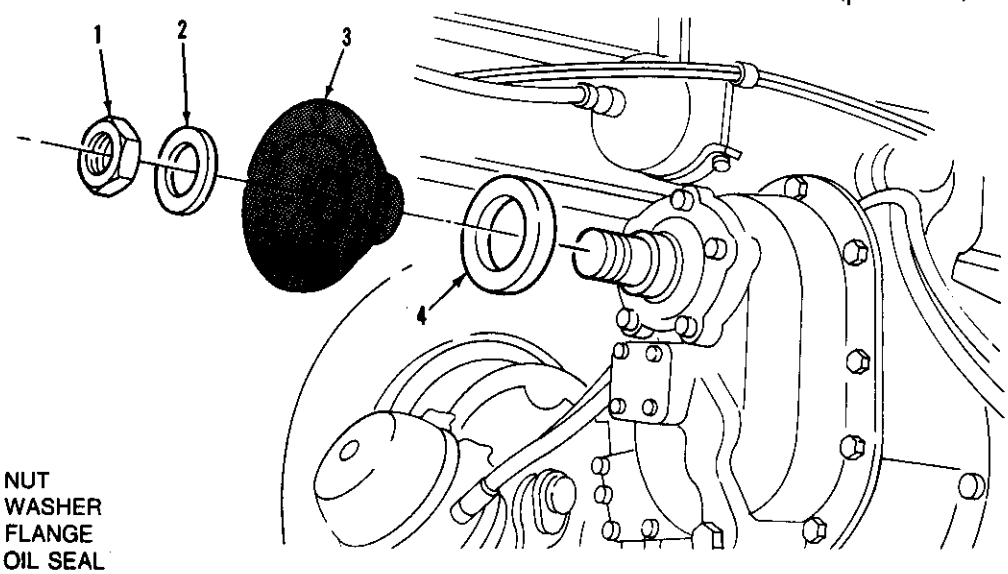
(3) Install washer (2) and nut (1). Torque nut (1) to 780-960 foot-pounds (1059-1301 N·m).

END OF TASK

NOTE

Follow-On Maintenance

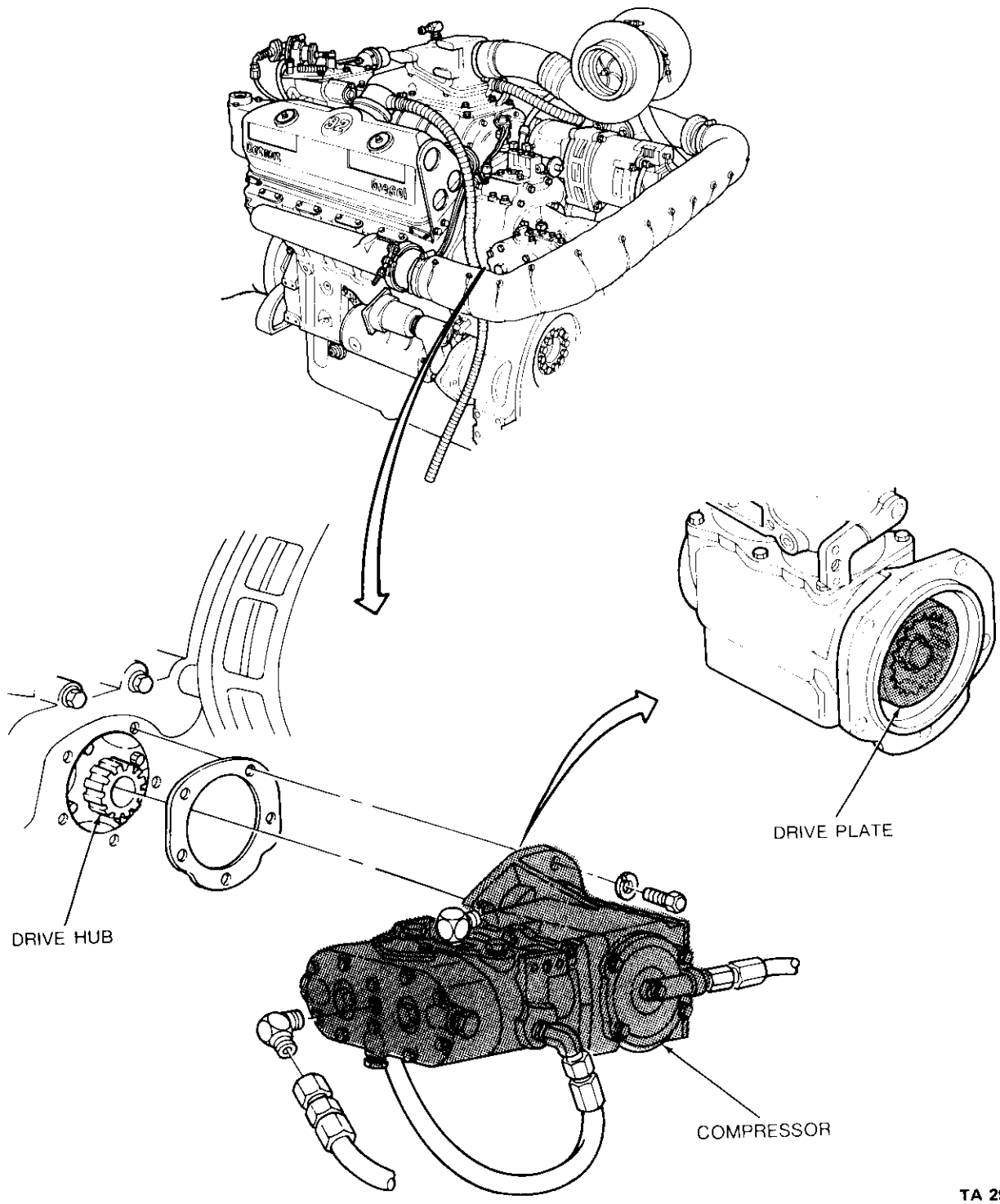
TM 2320-20/12 TM 9-2320-297-20	Install propeller shaft (para 10-3).



1. NUT
2. WASHER
3. FLANGE
4. OIL SEAL

TA 298995

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298369

10-9. OUTPUT SHAFT REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK14
MK15
MK16
MK17

Materials/Parts

O-ring (2) (P/N 78931) item 5

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Output shaft removed (para 10-7).

a. Disassembly

(1) Remove snapring (1), side gear (2), and bearing cone (3) from output shaft (4).

(2) Remove and discard two O-rings (5).

(3) If damaged, remove bushing (6) from output shaft (4).

(4) If damaged, remove bearing sleeve (7) from output shaft (4).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect gear, shaft, bearing, and bushing for damage. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Assembly

(1) If removed, press bearing sleeve (7) onto output shaft (4).

(2) If removed, install bushing (6) into end of output shaft (4).

(3) Install two new O-rings (5) onto output shaft (4).

(4) If removed, press bearing cone (3) onto side gear (2).

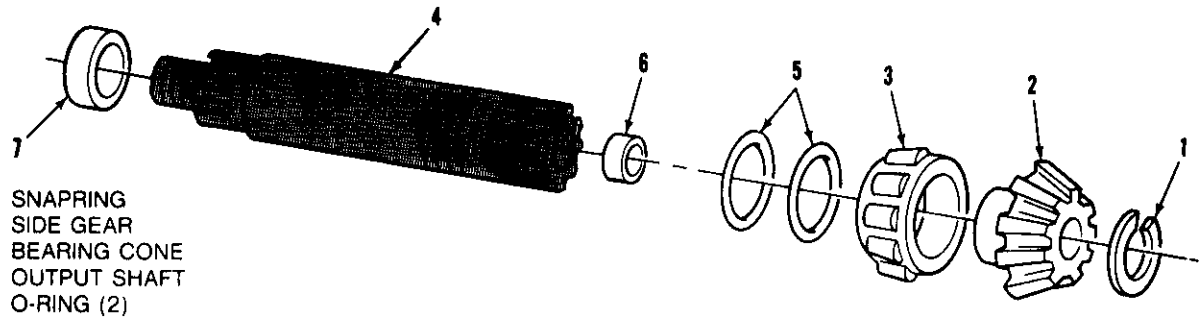
(5) Install side gear (2) and snapring (1) onto output shaft (4).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install output shaft (para 10-7).



1. SNAPRING
2. SIDE GEAR
3. BEARING CONE
4. OUTPUT SHAFT
5. O-RING (2)
6. BUSHING
7. BEARING SLEEVE

TA 298894

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. COOLANT AND/OR LUBRICANT LEAKS FROM COMPRESSOR

Test 1. Check compressor for leaking gaskets or seals.
- If gaskets or seals are not leaking, go to Test 2.
- Replace leaking gaskets or seals. Refer to paragraph 11-9.

Test 2. Check compressor for cracked or broken crankcase.
- If crankcase is cracked or broken, replace compressor. Refer to paragraph 11-7.

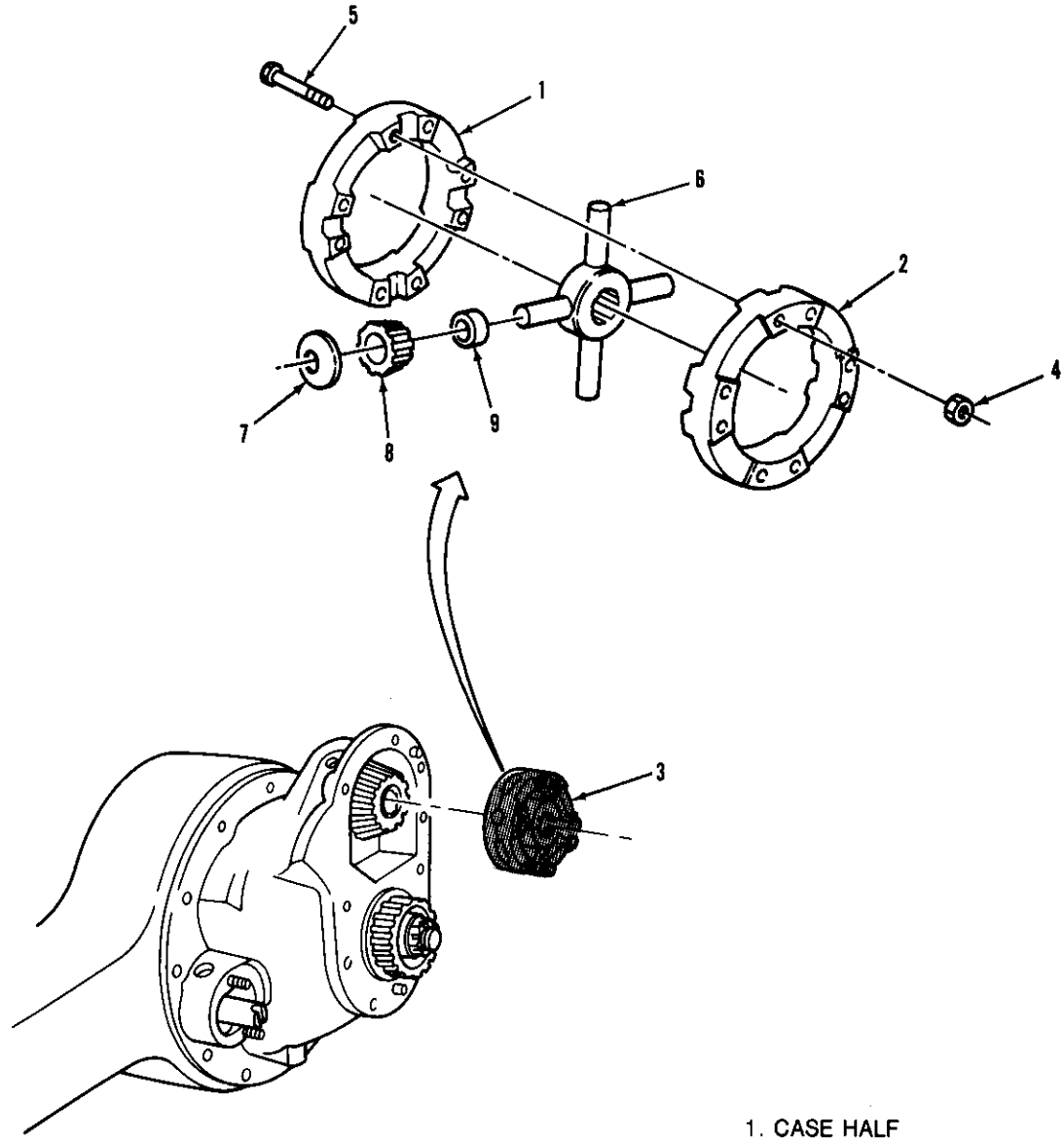
END OF TEST

4. DESICCANT MATERIAL EXPELLED FROM PURGE VALVE ON AIR DRYER

Test 1. Check for leaking purge valve in air dryer using soap and water solution.
- If purge valve is not leaking, go to Test 2.
- If purge valve is leaking, repair or replace purge valve. Refer to paragraph 13-36 in TM 2320-20/12, TM 9-2320-297-20.

Test 2. Check air dryer desiccant for oil or anti-freeze contamination. Refer to paragraph 13-36 in TM 2320-20/12, TM 9-2320-297-20.
- If desiccant is oil or anti-freeze contaminated, air compressor is damaged. Repair or replace air compressor. Refer to paragraph 11-7 in this manual.

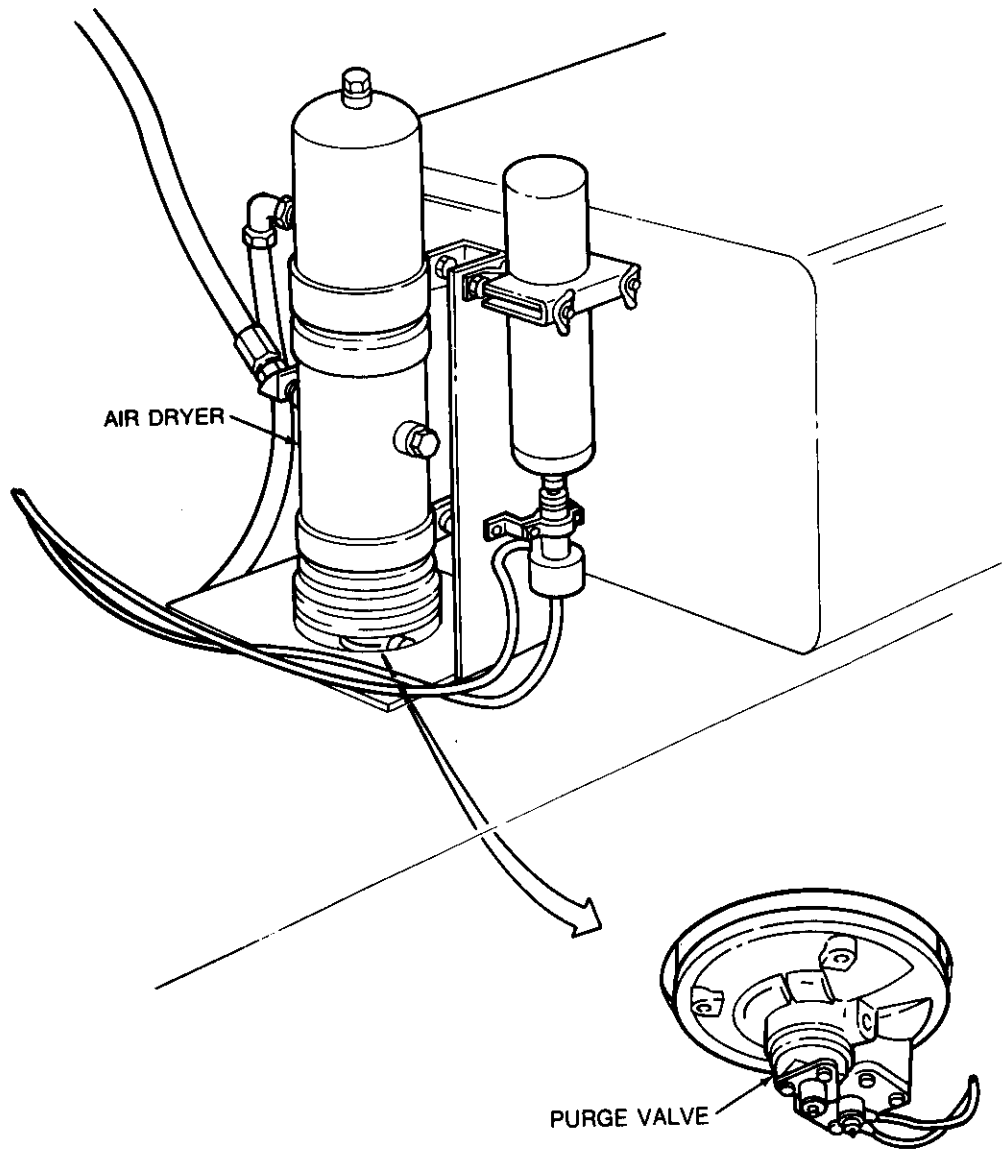
END OF TEST



1. CASE HALF
2. CASE HALF
3. INTER-AXLE DIFFERENTIAL
4. LOCKNUT (8)
5. CAPSCREW (8)
6. SPIDER
7. THRUST WASHER (4)
8. GEAR (4)
9. BUSHING (4)

TA 298993

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298370

10-8. INTER-AXLE DIFFERENTIAL REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK14
MK15
MK16
MK17

Materials/Parts

Locknut (8) (MS51922-13) item 4

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Inter-axle differential removed (para 10-6).

---

a. Disassembly

(1) Matchmark case halves (1 and 2) of inter-axle differential (3).

(2) Place inter-axle differential (3) in a soft-jawed vise and remove eight locknuts (4) and capscrews (5). Discard locknuts (4).

(3) Separate case halves (1 and 2) and remove spider (6).

(4) Remove four thrust washers (7), gears (8), and bushings (9) from spider (6).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect gears, shaft, bearing, and bushings for damage.

(3) Replace all parts failing inspection.

c. Assembly

(1) Install four bushings (9), gears (8), and thrust washers (7) onto spider (6).

(2) Install spider (6) into case half (2).

(3) Aline marks made during disassembly and install other case half (1).

(4) Install eight capscrews (5) and new locknuts (4).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install inter-axle differential (para 10-6).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

SUSPENSION

1. VEHICLE WANDERS OR SHIMMIES

Test 1. Check front and rear spring assemblies for visible damage, such as twisting or loose bolts
- If no damage is found, go to Test 2.
- If damage is found, replace spring assemblies. Refer to paragraph 15-3 or 15-4.

Test 2. Check for signs of grease leaking from seal on front spring seats. This is indicated by a grease buildup on the inside of the spring seat.
- If a grease buildup is indicated, seal is worn and must be replaced. Refer to paragraph 15-3.
- If a grease buildup is not present, go to Test 3.

Test 3. Check for metal contact between rear spring seat and spring seat cap or between spring seat and inner retainer on rear suspension.
- If metal to metal contact is present, replace trunnion bushing. Refer to paragraph 15-4.
- If metal to metal contact is not present, go to Test 4.

Test 4. Remove rear suspension spring seat cap. Refer to paragraph 15-4. Inspect cap and shim for signs of excessive wear or damage.
- If wear or damage is not found, assemble cap and shim and torque to specification. Refer to paragraph 15-4, then go to Test 5.
- If wear or damage is found, replace defective parts as required. Refer to paragraph 15-4.

Test 5. Check front and rear suspension cross tubes for looseness or damage.
- If looseness or damage is found, torque mounting capscrews or replace cross tube as required. Refer to paragraph 14-14.

END OF TEST

2. VEHICLE LEANS TO ONE SIDE

Check springs for weakness or damage.
- If weakness or damage is found, replace springs as needed. Refer to paragraph 15-3 or 15-4.

END OF TEST

(23) If removed, install bearing cup (43) into carrier (37).

(24) Install bearing (40) into carrier (37).

(25) Install snapring (39) and new oil seal (38).

(26) Install output shaft (36) into carrier (37).

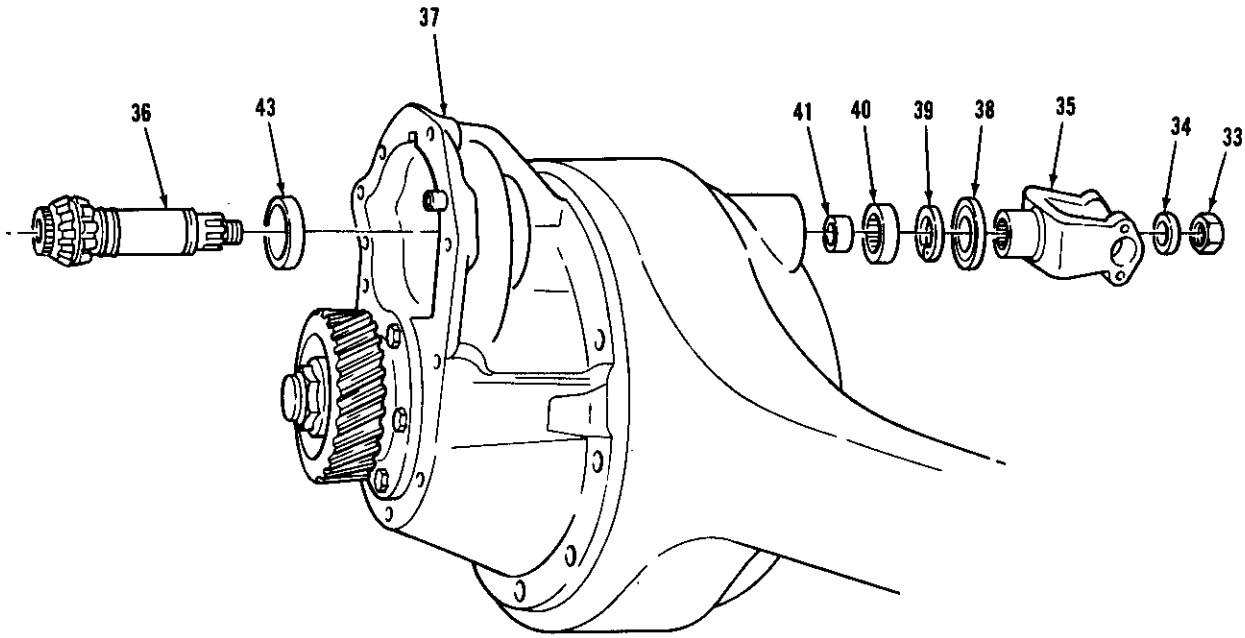
(27) Install yoke (35), washer (34), and nut (33). Torque to 480-600 foot pounds (651-814 N·m).

END OF TASK

NOTE

Follow-On Maintenance

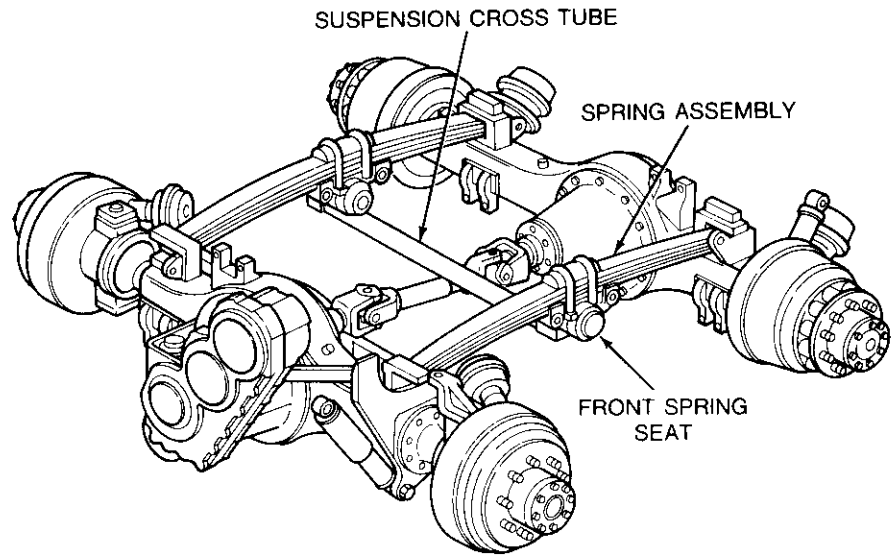
TM 2320-34/13 TM 9-2320-297-34	Install inter-axle differential and differential carrier cover (para 10-6).
TM 2320-20/12 TM 9-2320-297-20	Install propeller shaft (para 10-3).
	Refill axle with lubricant (para 12-3).



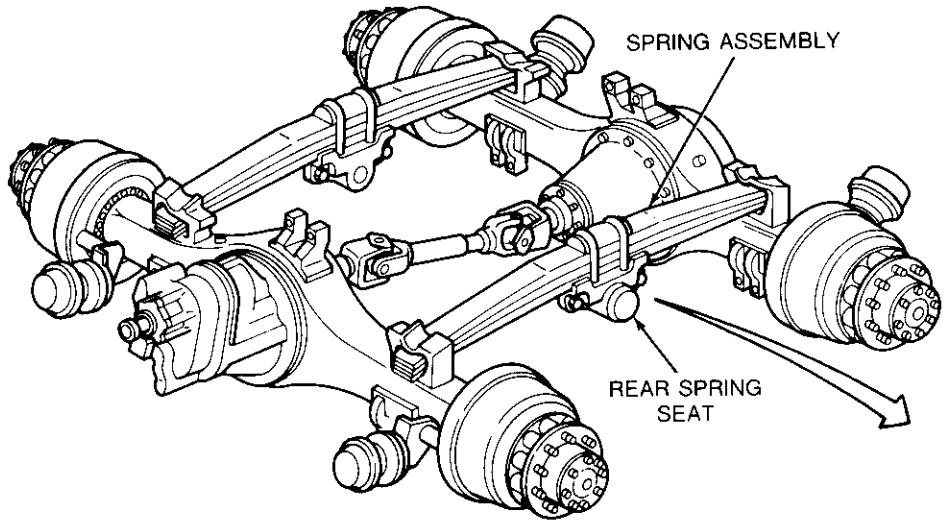
33. NUT
34. WASHER
35. YOKE
36. OUTPUT SHAFT
37. CARRIER
38. OIL SEAL
39. SNAPRING
40. BEARING
41. SLEEVE
43. BEARING CUP

TA 298992

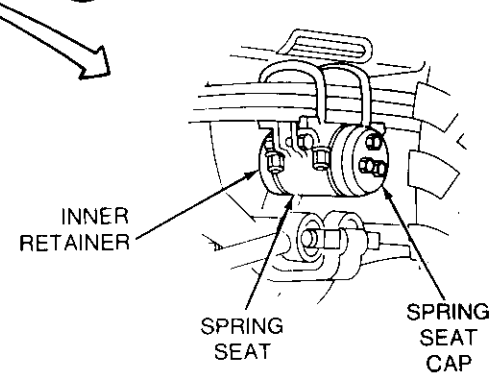
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



FRONT SUSPENSION



REAR SUSPENSION



TA 298371

10-7. AXLE DIFFERENTIAL CARRIER COVER REPAIR (NO. 3 AXLE) (Continued)

(17) Hold input shaft (7) and torque nut (8) to 35-45 foot-pounds (47-61 N·m).

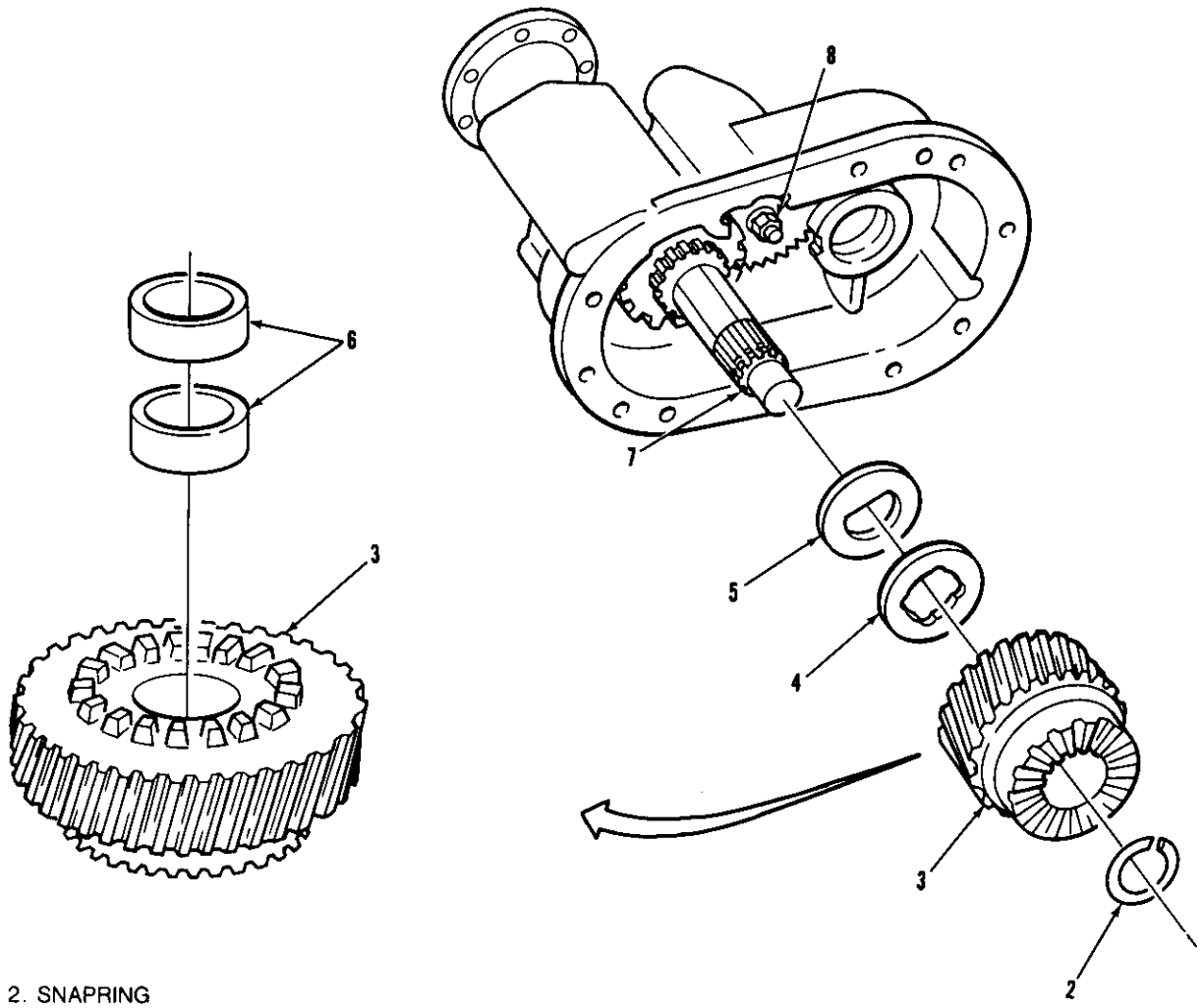
(18) Install two new bushings (6) into helical side gear (3), if removed.

(19) When properly seated, one bushing (6) will be 1/32 inch (.794 mm) below surface of large side of helical side gear (3). The other bushing (6) will be 5/32 inch (3.969 mm) below bottom of chamfer on small side of helical side gear (3).

(20) Install D-washer (5), making sure flat portion engages flat on input shaft (7).

(21) Install thrust washer (4).

(22) Install helical side gear (3) and snapring (2).



2. SNAPRING
3. HELICAL SIDE GEAR
4. THRUST WASHER
5. D-WASHER
6. BUSHING (2)
7. INPUT SHAFT
8. NUT

TA 298991

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

HYDRAULIC STEERING SYSTEM

1. VEHICLE STEERS HARD IN ONE OR BOTH DIRECTIONS

CAUTION

Always reinstall protective caps on hydraulic fittings after testing is complete. Failure to do so will allow dirt and moisture to enter hydraulic fittings.

Test 1. Apply parking brake and place transmission in neutral (N). Place hydraulic selector valve in the STEERING position. Start engine and attempt to use yaw steering. Yaw steering should not be possible.

- If yaw steering is not possible, go to Test 2.
- If yaw steering is possible, check for 24 volts at directional relief valve solenoid. If voltage is not present, check for damaged wiring or bad ground.

Test 2. Start engine and apply parking brake. Place hydraulic selector valve in the STEERING position. Place transmission in drive (D) and attempt to use yaw steering. Yaw steering should be possible.

- If yaw steering is possible, go to Test 3.
- If yaw steering is not possible, check for 24 volts at directional relief valve solenoid. If voltage is present, check for damaged wiring.

(10) Press bearing cone (20) onto input shaft (7).

(11) Press bearing cup (18) into bearing cover (16). Make sure it is fully seated.

(12) Turn bearing cover (16) over and install new oil seal (19). Oil seal (19) is fully seated when flush with bottom of chamfer.

NOTE

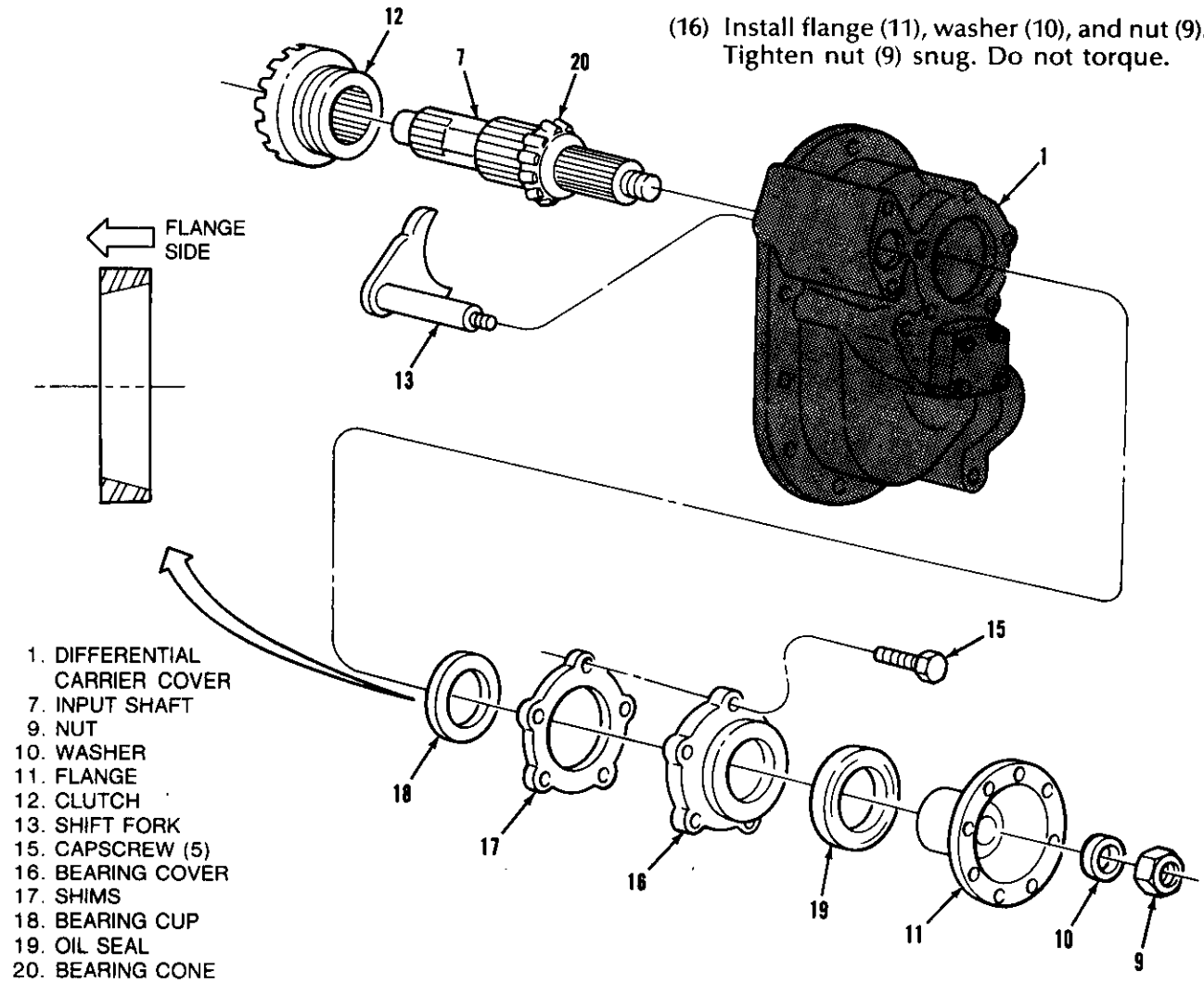
Shims (17) will be selected and nut (9) will be tightened during differential carrier cover installation.

(13) Install bearing cover (16) and capscrews (15). Tighten capscrews (15) finger tight.

(14) Install input shaft (7) into rear of differential carrier cover (1). Be sure to hold in place.

(15) Install shift fork (13) and clutch (12) onto input shaft (7).

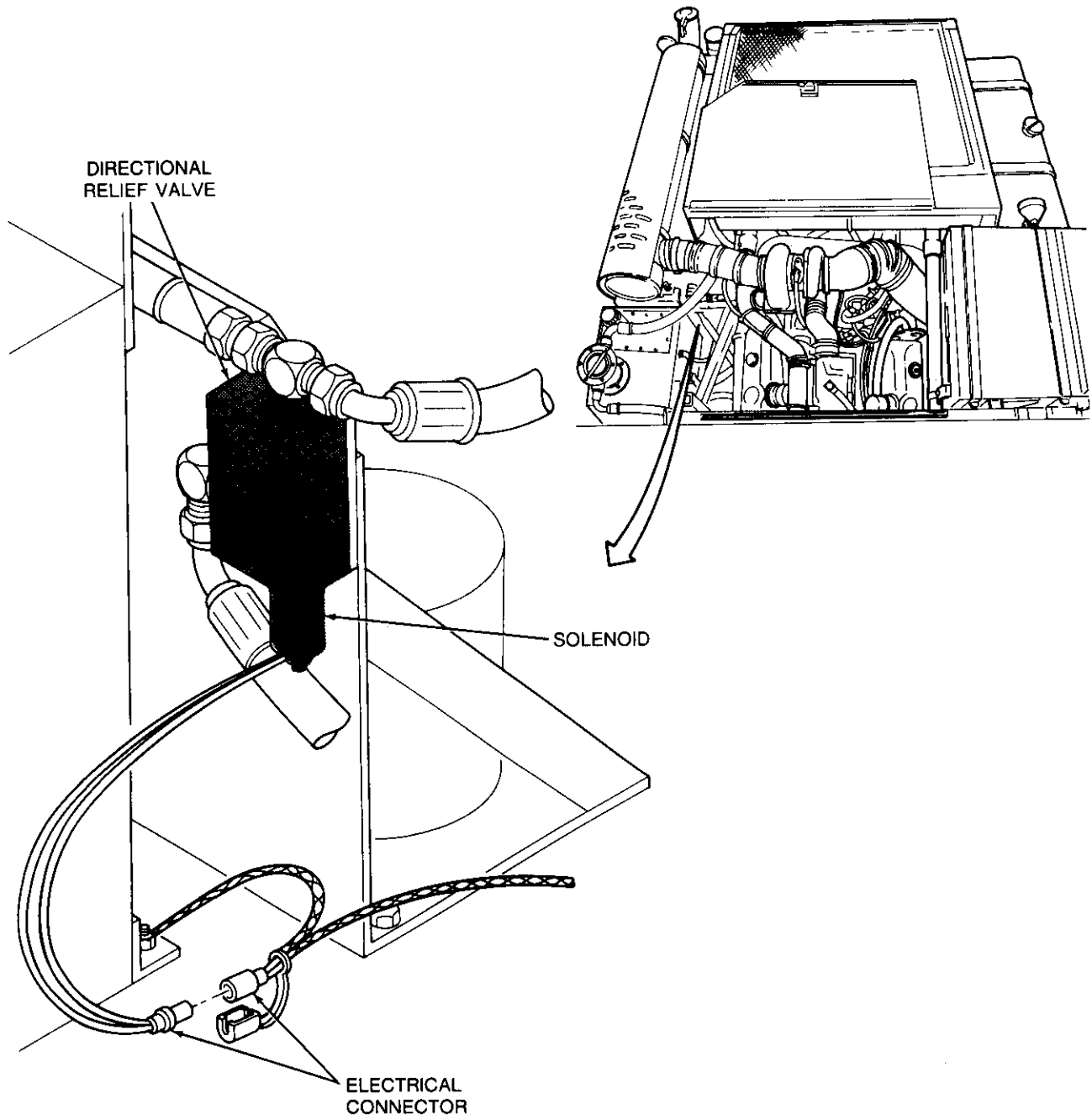
(16) Install flange (11), washer (10), and nut (9). Tighten nut (9) snug. Do not torque.



1. DIFFERENTIAL CARRIER COVER
7. INPUT SHAFT
9. NUT
10. WASHER
11. FLANGE
12. CLUTCH
13. SHIFT FORK
15. CAPSCREW (5)
16. BEARING COVER
17. SHIMS
18. BEARING CUP
19. OIL SEAL
20. BEARING CONE

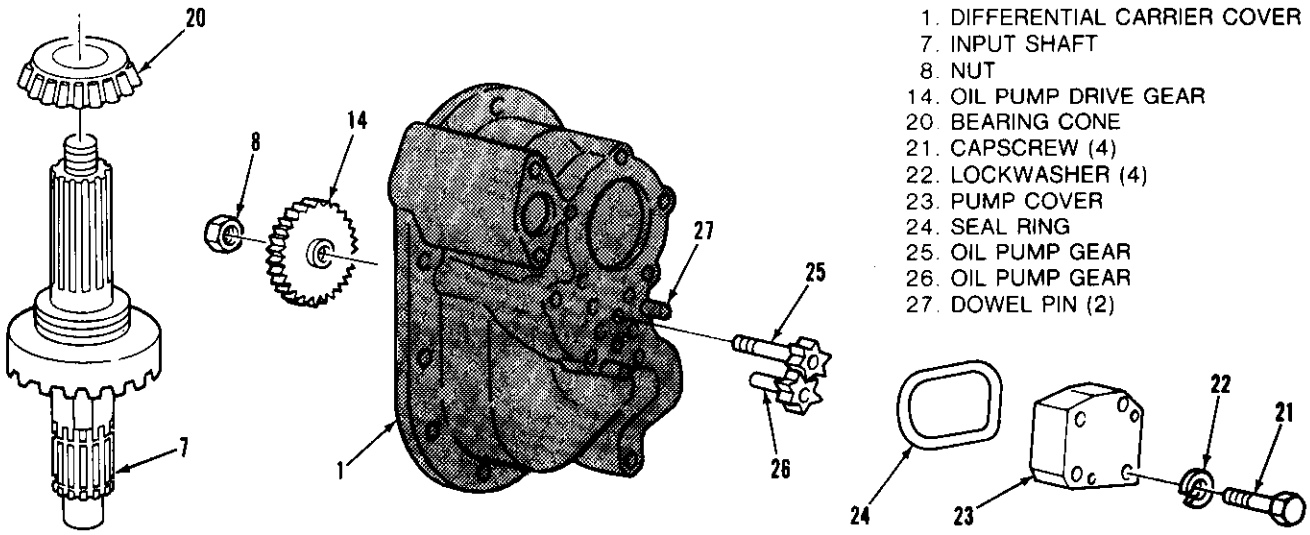
TA 298990

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298372

10-7. AXLE DIFFERENTIAL CARRIER COVER REPAIR (NO. 3 AXLE) (Continued)



1. DIFFERENTIAL CARRIER COVER
7. INPUT SHAFT
8. NUT
14. OIL PUMP DRIVE GEAR
20. BEARING CONE
21. CAPSCREW (4)
22. LOCKWASHER (4)
23. PUMP COVER
24. SEAL RING
25. OIL PUMP GEAR
26. OIL PUMP GEAR
27. DOWEL PIN (2)

c. Assembly

(1) Install oil pump gears (25 and 26). Make sure that oil pump gear (25) is in hole nearest to input shaft (7) opening.

(2) Install two dowel pins (27).

(3) Install new seal ring (24) into pump cover (23).

(4) Install pump cover (23) with four new lockwashers (22) and capscrews (21).

(5) Install oil pump drive gear (14) onto shaft of oil pump gear (25). Install and tighten nut (8) finger tight.

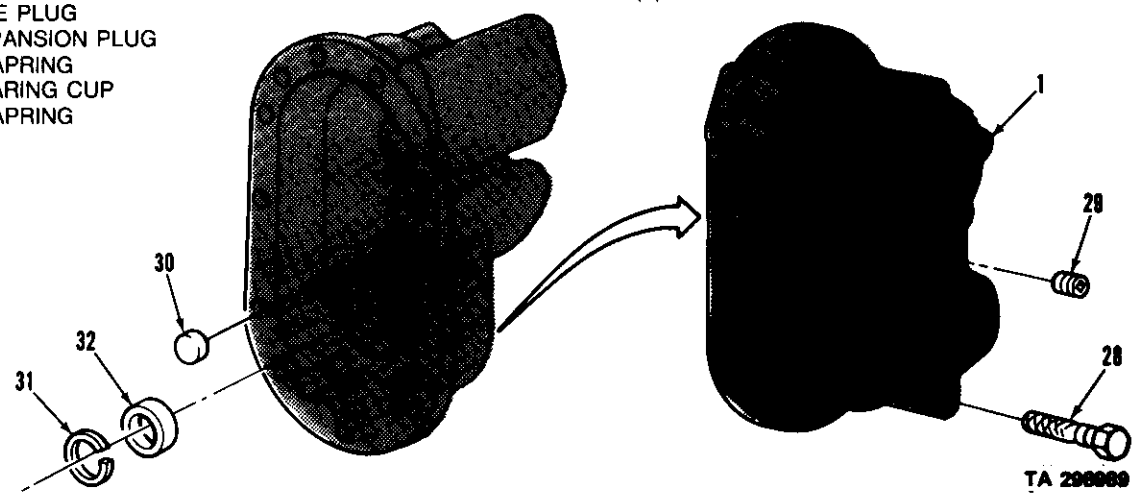
(6) Install magnetic screen (28). Torque to 40-60 foot-pounds (54-81 N·m).

(7) If removed, coat threads of pipe plug (29) with lubricating and wicking sealer and install.

(8) Install expansion plug (30) into differential carrier cover (1) if removed.

(9) If removed, install bearing cup (32) and snapring (31) into differential carrier cover (1).

1. DIFFERENTIAL CARRIER COVER
28. MAGNETIC SCREEN
29. PIPE PLUG
30. EXPANSION PLUG
31. SNAPRING
32. BEARING CUP
34. SNAPRING



MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. VEHICLE STEERS HARD IN ONE OR BOTH DIRECTIONS (Continued)

WARNING

To prevent personal injury, do not reach into fan area while engine is running.

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself.

Before testing hydraulic system with flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking hydraulic system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is obtained when pressure cannot be increased with pressure control valve and flow drops to zero. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake released, selector valve in STEERING position, directional relief valve solenoid electrical plug disconnected, and hydraulic oil temperature at 130-150°F (54-66°C).

(18) Remove nut (33), washer (34), and yoke (35) from output shaft (36).

(19) Remove output shaft (36) from carrier (37).

(20) Remove oil seal (38) and discard.

(21) Remove snapring (39) and bearing (40) from rear cover of carrier (37).

(22) If bearing (42) is damaged and will be replaced, remove bearing cup (43) from carrier (37).

(23) Refer to paragraph 10-9 to repair output shaft (36).

b. Cleaning/Inspection

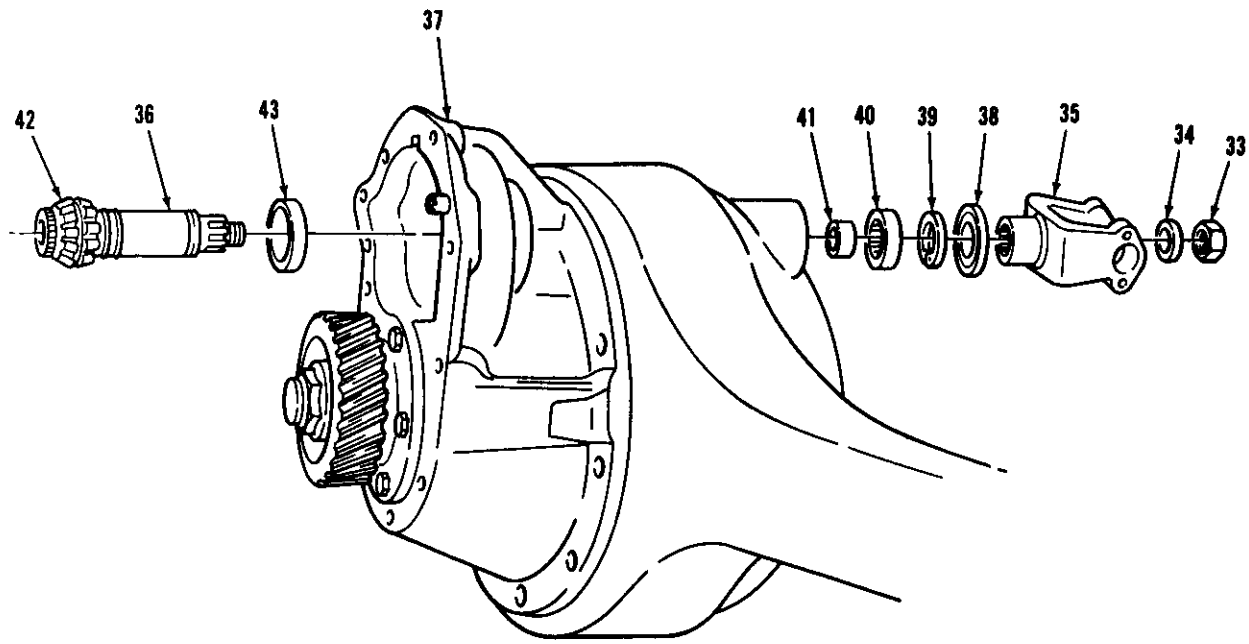
(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all gears for damage or signs of overheating.

(3) Inspect capscrews and nuts for thread damage.

(4) Inspect bearings and races for pitting, scratches, or signs of overheating.

(5) Replace all parts failing inspection.



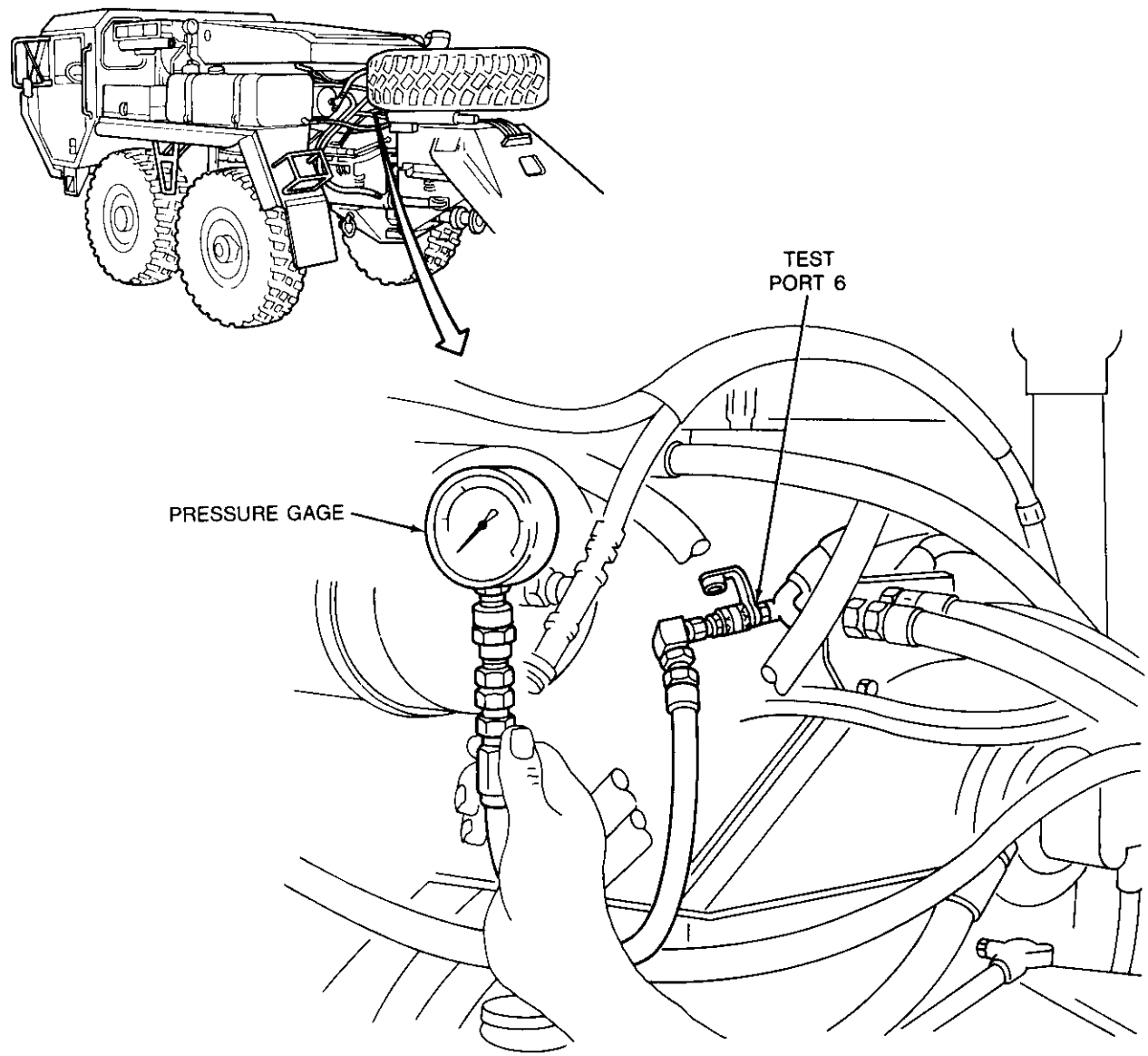
33. NUT
34. WASHER
35. YOKE
36. OUTPUT SHAFT
37. CARRIER
38. OIL SEAL
39. SNAPRING
40. BEARING
41. SLEEVE
42. BEARING
43. BEARING CUP

TA 298988

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

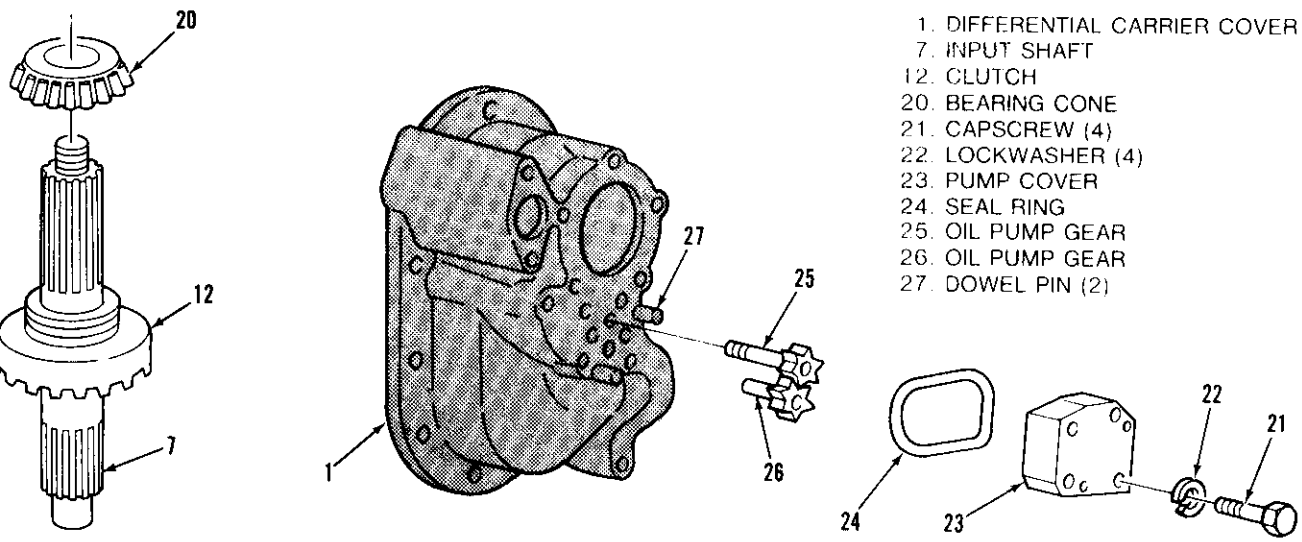
Test 3. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 6. Start engine and allow it to run at idle speed. Place hydraulic selector valve in the AUXILIARY HYDRAULICS position. Increase engine to maximum speed. Check for 3,150-3,250 psi (21,719-22,411 kPa).

- If pressure is within specifications, go to Test 5.
- If pressure is not within specifications, go to Test 4.



TA 298373

10-7. AXLE DIFFERENTIAL CARRIER COVER REPAIR (NO. 3 AXLE) (Continued)



1. DIFFERENTIAL CARRIER COVER
7. INPUT SHAFT
12. CLUTCH
20. BEARING CONE
21. CAPSCREW (4)
22. LOCKWASHER (4)
23. PUMP COVER
24. SEAL RING
25. OIL PUMP GEAR
26. OIL PUMP GEAR
27. DOWEL PIN (2)

(11) Temporarily install clutch (12) over rear of input shaft (7). Place in a press and press off bearing cone (20).

(12) Remove four capscrews (21), lockwashers (22), and pump cover (23). Discard lockwashers (22).

(13) Remove seal ring (24) and discard.

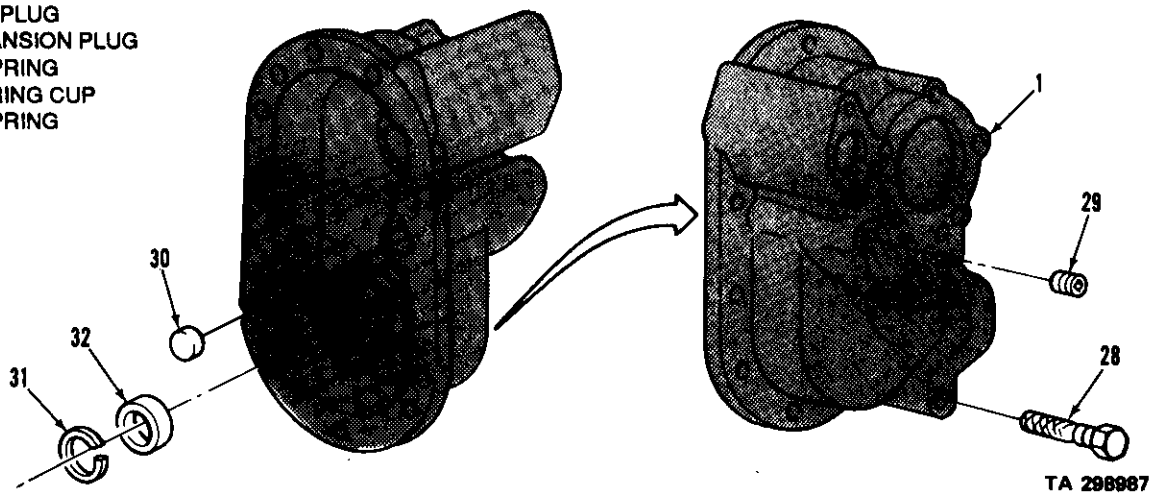
(14) Remove oil pump gears (25 and 26) and, if damaged, two dowel pins (27).

(15) Remove magnetic screen (28).

(16) If leaking, remove pipe plug (29) and/or expansion plug (30).

(17) If needed, remove snapring (31) and bearing cup (32) from differential carrier cover (1).

1. DIFFERENTIAL CARRIER COVER
28. MAGNETIC SCREEN
29. PIPE PLUG
30. EXPANSION PLUG
31. SNAPRING
32. BEARING CUP
34. SNAPRING



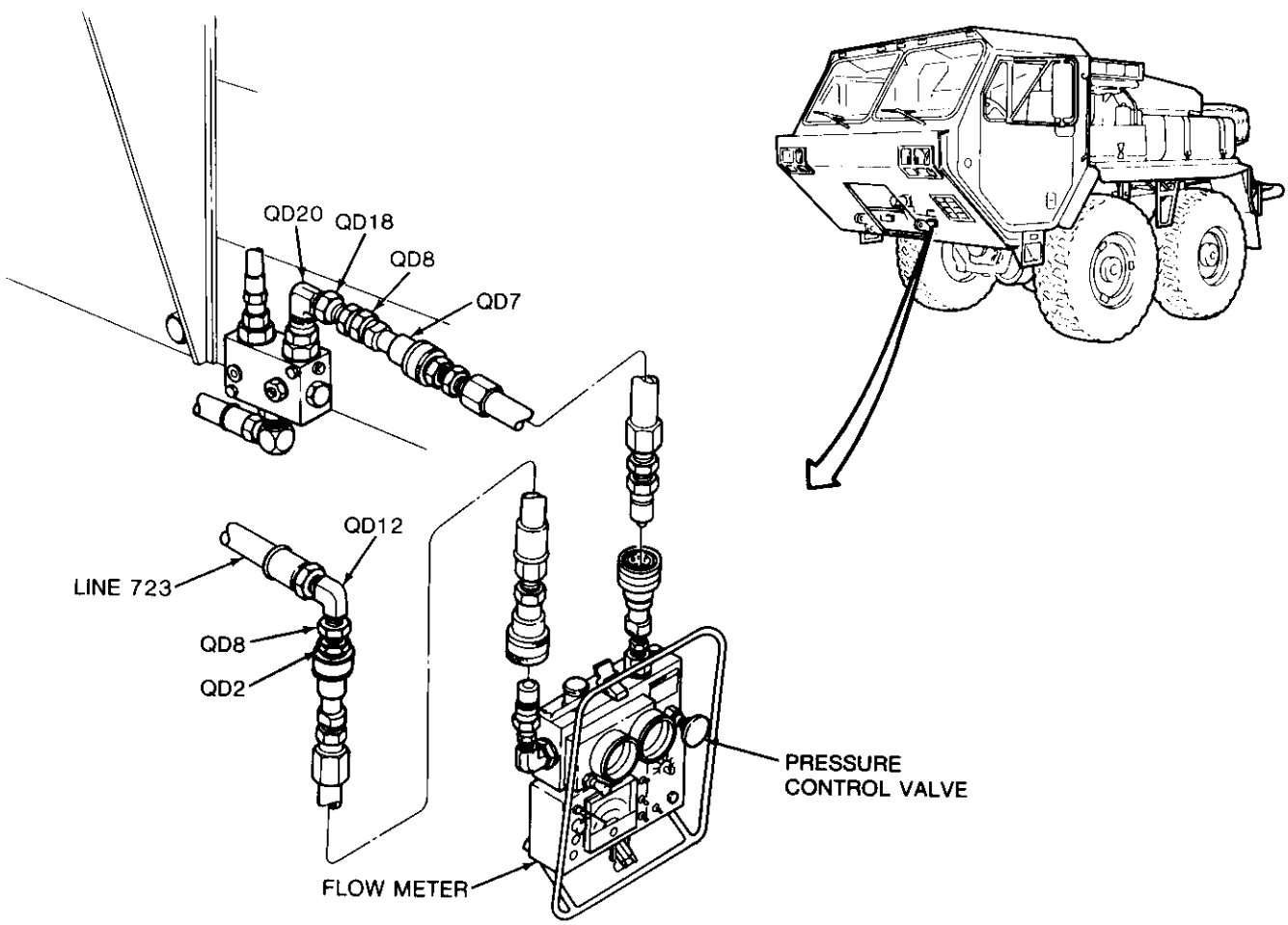
TA 298987

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. VEHICLE STEERS HARD IN ONE OR BOTH DIRECTIONS (Continued)

Test 4. Remove line 723 from priority flow valve. Install a flow meter in the line between the priority flow valve and line 723. Open pressure control valve fully by turning control knob counterclockwise to DECREASE. Start engine and allow to run at idle. Increase engine to maximum speed. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,150-3,250 psi (21,719-22,411 kPa) working pressure. Check for 22-25 gpm (83-94.6 lpm).

- If pressure and flow are within specifications, repair or replace main relief valve on hydraulic selector valve. Refer to paragraph 19-5. If problem still exists after repair or replacement, go to Test 5.
- If pressure and flow are not within specifications, repair or replace hydraulic pump. Refer to paragraph 19-20 or 19-21. If problem still exists after repair or replacement, go to Test 7.



TA 298374

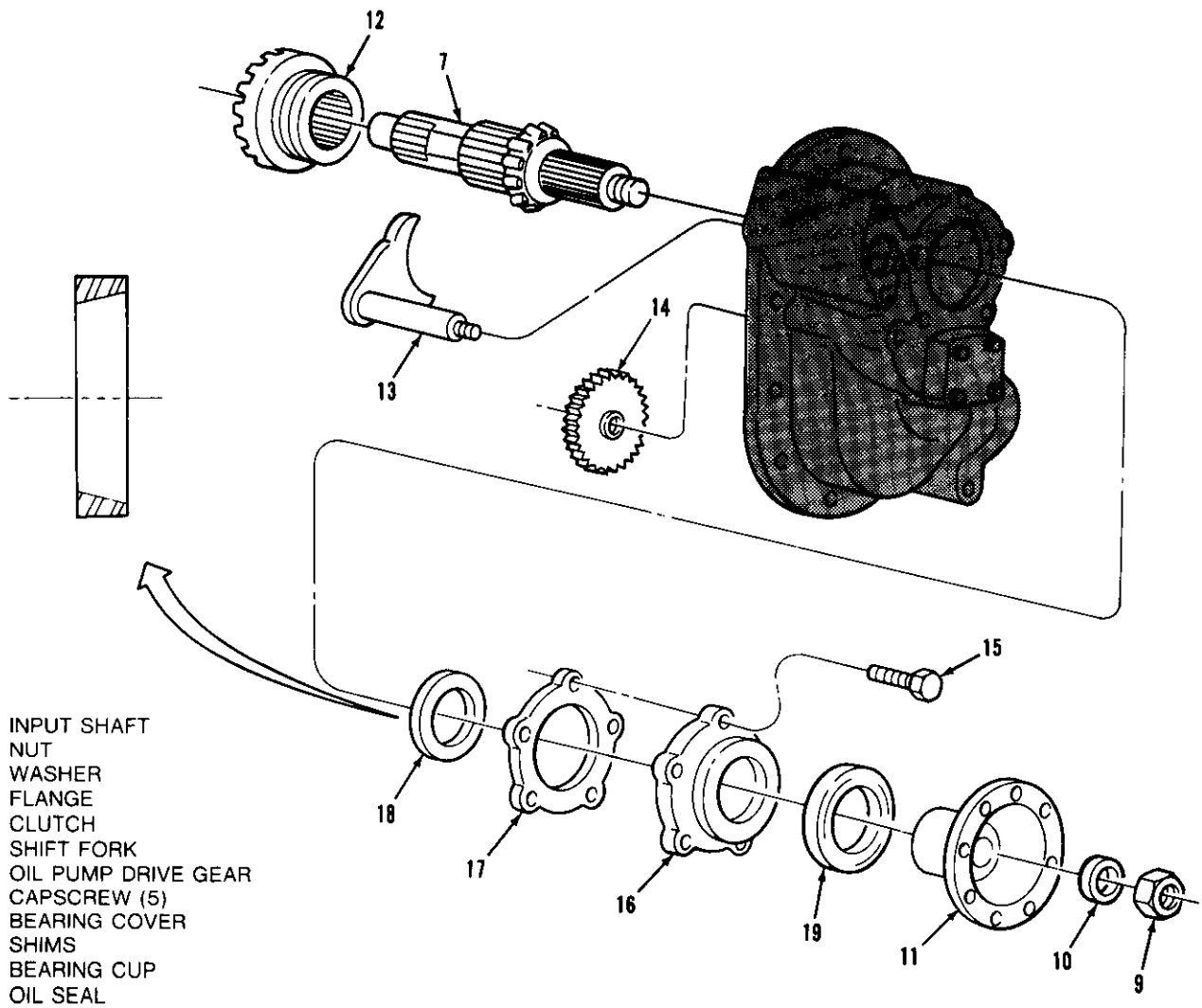
(6) Remove nut (9), washer (10), and flange (11).

(7) Remove clutch (12), shift fork (13), and oil pump drive gear (14).

(8) Remove input shaft (7) assembly.

(9) Remove five capscrews (15), bearing cover (16), and shims (17).

(10) Remove bearing cup (18) and oil seal (19) from bearing cover (16). Discard oil seal (19).



7. INPUT SHAFT
9. NUT
10. WASHER
11. FLANGE
12. CLUTCH
13. SHIFT FORK
14. OIL PUMP DRIVE GEAR
15. CAPSCREW (5)
16. BEARING COVER
17. SHIMS
18. BEARING CUP
19. OIL SEAL

TA 298986

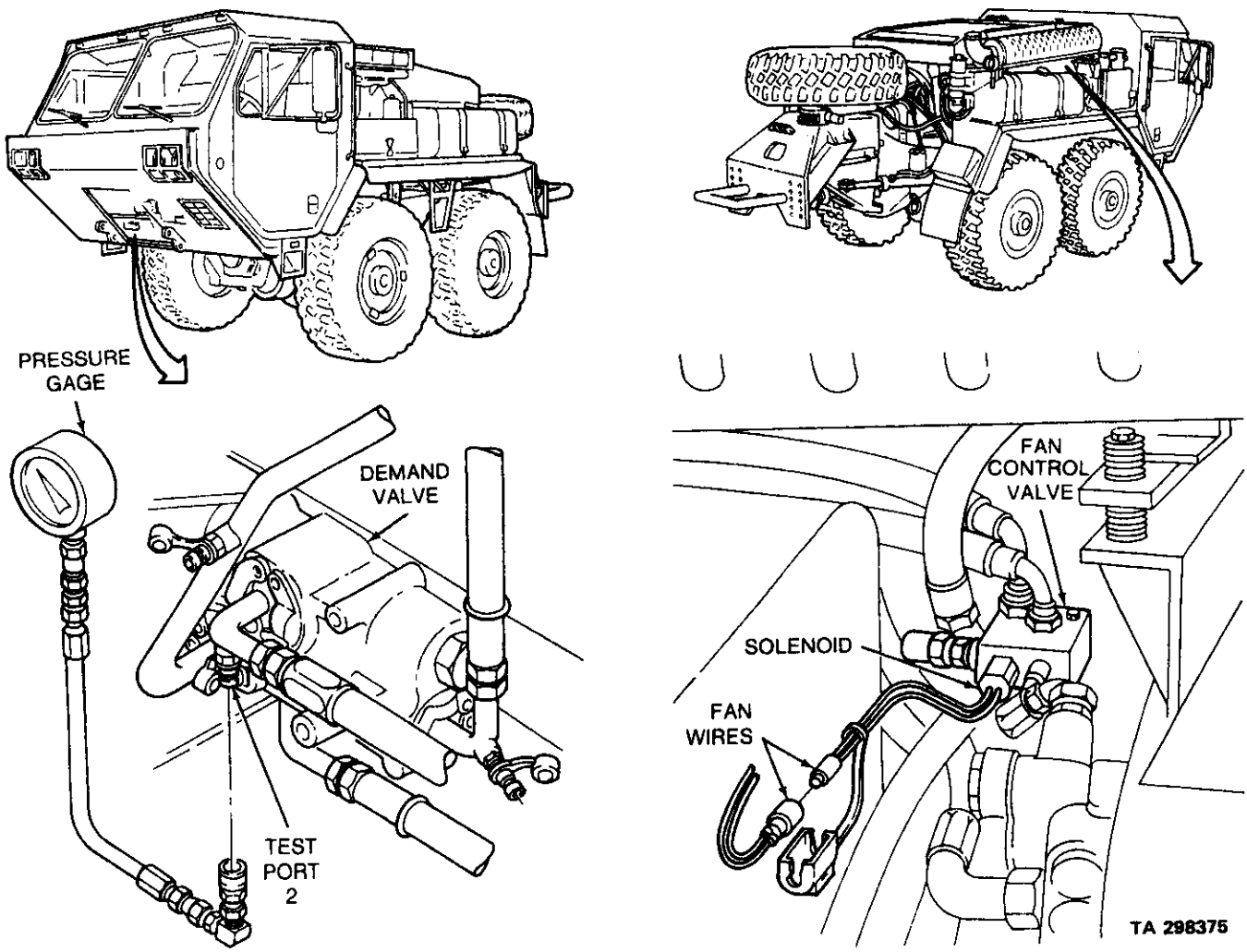
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

WARNING

To prevent personal injury, do not reach into fan area while engine is running.

Test 5. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 2. Start engine and allow to run at idle. Use yaw steering to turn fully left or right. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record pressure readings. Disconnect electrical wires at fan control valve solenoid. Fan will now run all the time. Increase engine to maximum speed. Do not use yaw steering, check for 1,600-1,700 psi (11,032-11,721 kPa). Reconnect wires.

- If pressures are within specifications, go to Test 8.
- If pressures are not within specifications, go to Test 6.



10-7. AXLE DIFFERENTIAL CARRIER COVER REPAIR (NO. 3 AXLE)

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK14
MK15
MK16
MK17

Materials/Parts

Sealer, lubricating and wicking (item 63, Appendix C)
Seal (NSN 5330-01-156-3759) item 19
Lockwasher (4) (MS35338-44) item 22
Seal ring (NSN 5330-01-159-2800) item 24
Oil seal (NSN 5330-01-157-0897) item 38

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Axle lubricant drained (para 12-3).
	Propeller shaft removed (para 10-3).
TM 2320-34/13 TM 9-2320-297-34	Differential carrier cover and inter-axle differential removed (para 10-6).

a. Disassembly

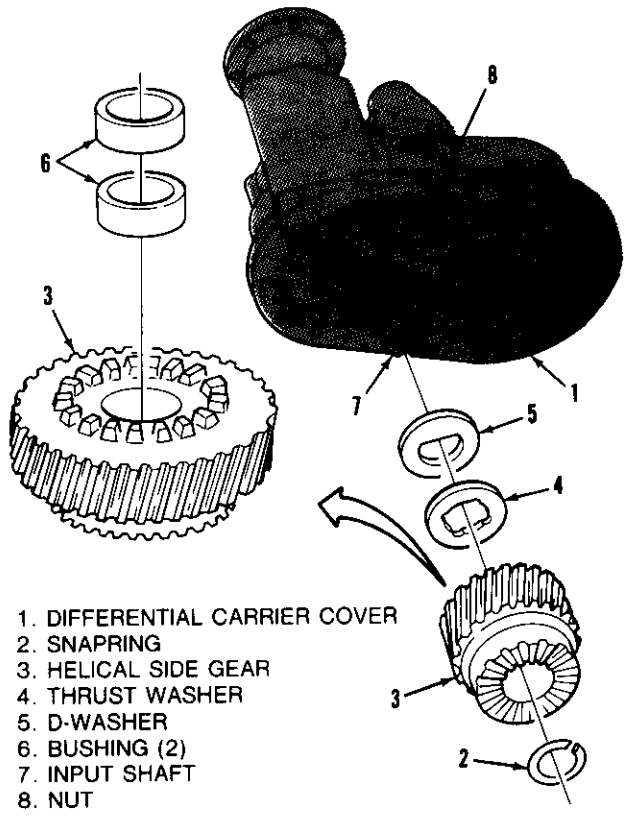
(1) Position differential carrier cover (1) on its side.

(2) Remove snapring (2).

(3) Remove helical side gear (3), thrust washer (4), and D-washer (5).

(4) Remove two bushings (6) from helical side gear (3) if worn or damaged.

(5) Hold input shaft (7) and remove nut (8).



1. DIFFERENTIAL CARRIER COVER
2. SNAPRING
3. HELICAL SIDE GEAR
4. THRUST WASHER
5. D-WASHER
6. BUSHING (2)
7. INPUT SHAFT
8. NUT

TA 298985

MALFUNCTION

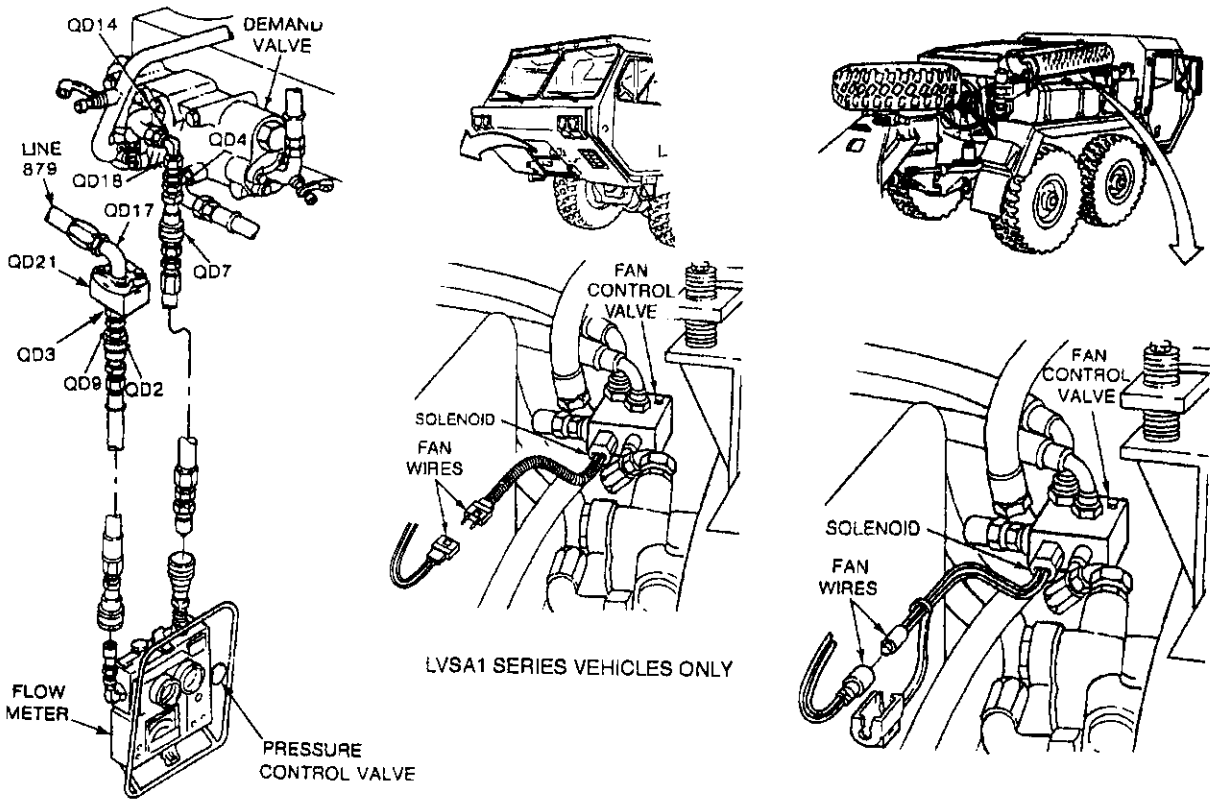
TEST OR INSPECTION

CORRECTIVE ACTION

1. VEHICLE STEERS HARD IN ONE OR BOTH DIRECTIONS. (Continued)

Test 6. Remove line 879 from demand valve. Install a flow meter in the line between the demand valve and line 879. Open pressure control valve fully by turning control knob counterclockwise to DECREASE. Disconnect electrical wires at fan control valve solenoid. Fan will run all the time. Start engine and allow to run at idle. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 2,200-2,300 psi (15,169-15,858 kPa) working pressure. Check for 11-12 gpm (41.6-45.4 lpm). Record readings. Open pressure control valve fully by turning control knob counterclockwise to DECREASE. Increase engine to maximum speed. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 1,600-1,700 psi (11,032-11,721 kPa) working pressure. Check for 49-53 gpm (187.5-200.6 lpm).

- If pressures and flow are within specifications, large side of hydraulic pump is working properly. Continue with Test 7.
- On non-LVSA1 vehicles, if pressures and flow are not within specifications, repair or replace hydraulic pump. Refer to paragraph 19-20 or 19-21. If problem still exists after repair or replacement, go to Test 7.
- On LVSA1 vehicles, if pressures and flow are not within specifications, replace hi-pressure hydraulic filter. Refer to TM 2320-20/12 (para 22-18). If pressures and flow are still not within specifications, after replacing the hi-pressure filter, repair or replace hydraulic pump. Refer to paragraph 19-20 or 19-21. If problem still exists after repair or replacement, go to Test 7.



LVSA1 SERIES VEHICLES ONLY

(13) Remove flange nut (2), washer (15), and flange (6).

(14) Remove five capscrews (16), lockwashers (17), and bearing cover (18). Discard lockwashers (17).

(15) Add or remove shims (19) as needed to obtain proper end play.

(16) Install bearing cover (18), five new lockwashers (17), and capscrews (16).

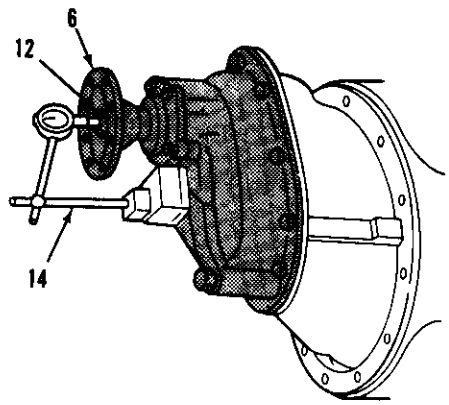
(17) Install flange (6), washer (15), and flange nut (2). Snug flange nut (2), it will be torqued later.

(18) Recheck end play. If necessary, repeat steps (10) thru (17).

(19) When end play is correct, repeat steps (13) and (14). Remove shims (19) and coat with silicone sealant. Repeat steps (16) and (17). Torque flange nut (2) to 780-960 foot-pounds (1,059-1,301 N·m).

(20) After final assembly, when parts are rotated, end play may change up to 0.010 inch (0.254 mm). This is normal.

END OF TASK

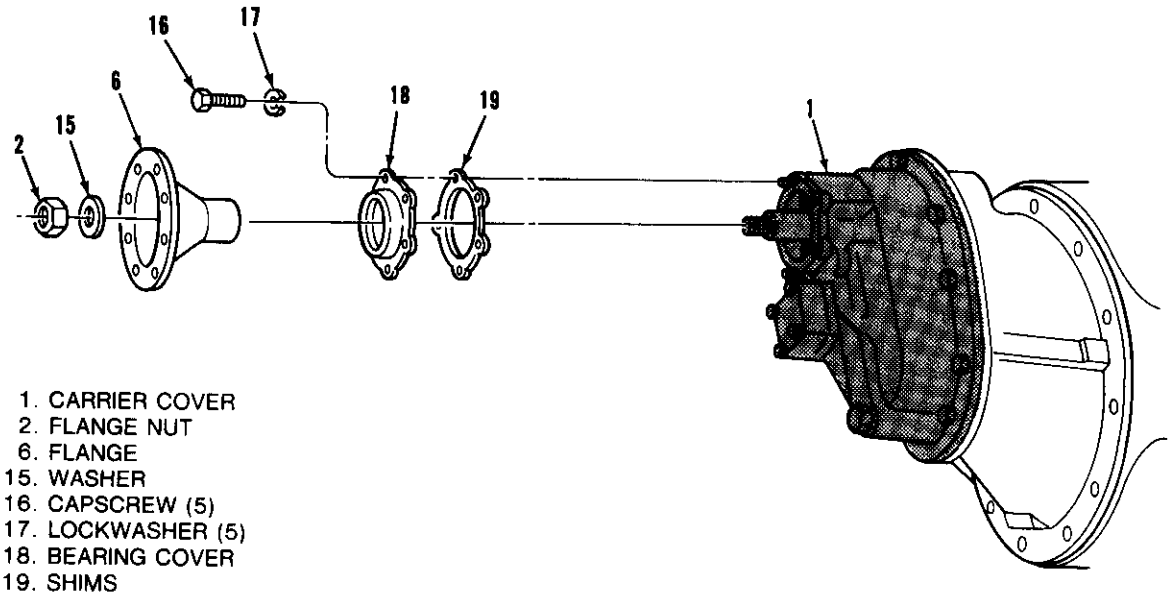


6. FLANGE
12. INPUT SHAFT
14. DIAL INDICATOR (TOOL)

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install propeller shaft (para 10-3).
	Fill axle with lubricant (para 12-3).
TM 2320-34/13 TM 9-2320-297-34	Install lockout chamber unit (para 10-11)



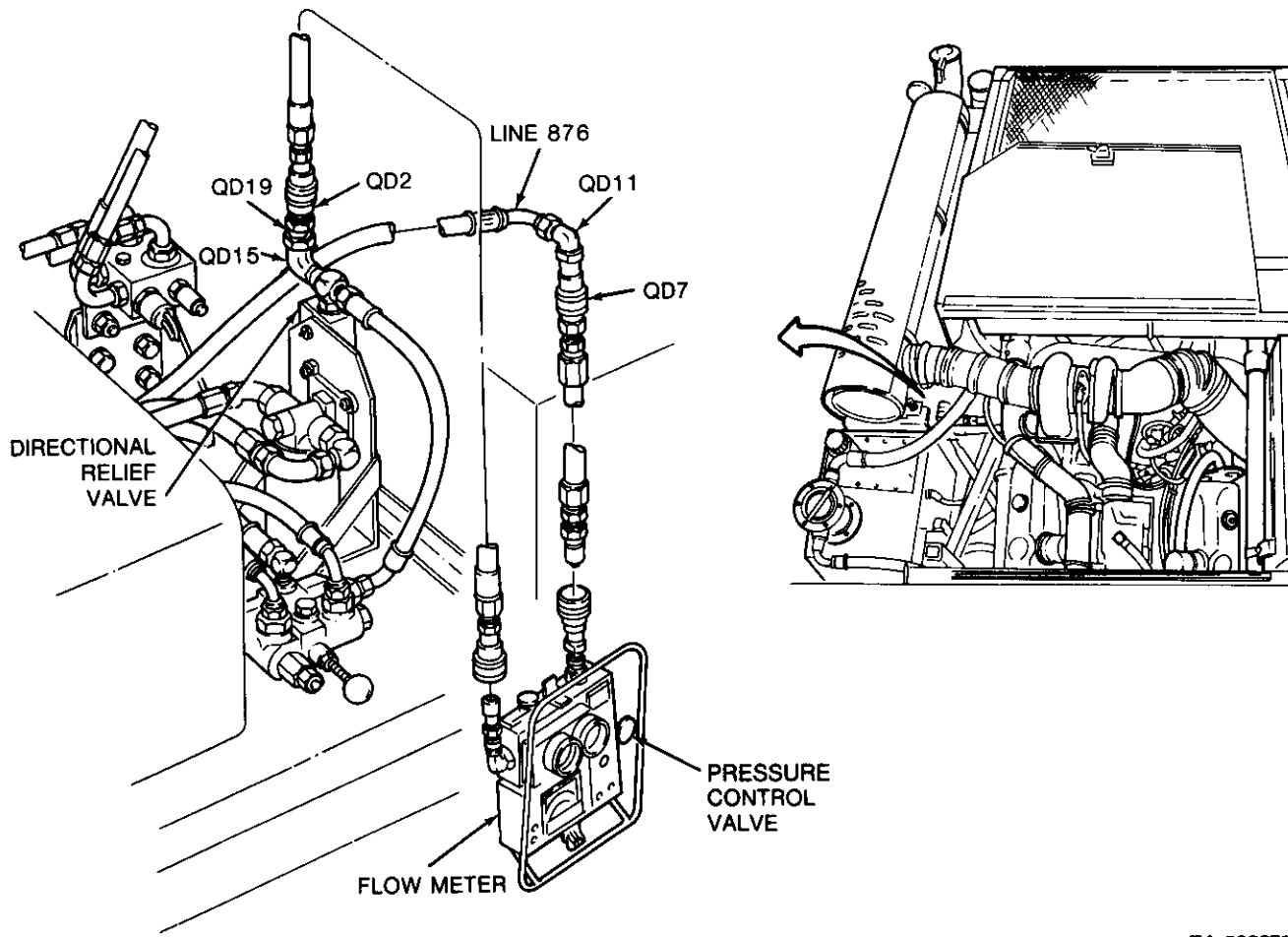
1. CARRIER COVER
2. FLANGE NUT
6. FLANGE
15. WASHER
16. CAPSCREW (5)
17. LOCKWASHER (5)
18. BEARING COVER
19. SHIMS

TA 298984

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 7. Remove line 876 from directional relief valve. Install a flow meter in the line between directional relief valve and line 876. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and increase to maximum engine speed. Slowly close pressure control valve by turning knob clockwise to INCREASE until relief valve goes into relief. Record pressure reading.

- If pressure is within 2,200-2,300 psi (15,169-15,858 kPa), the directional relief valve is working properly. Continue to Test 8.
- If pressure is not within 2,200-2,300 psi (15,169-15,858 kPa), repair or replace directional relief valve. Refer to paragraph 19-7 or 19-8. If problem still exists after repair or replacement, go to Test 8.



TA 298377

10-6. AXLE DIFFERENTIAL CARRIER COVER REPLACEMENT (Continued)

CAUTION

Be sure mating surface of axle (7) is clean and free of oil. Otherwise, the sealant may not seal properly.

(4) Apply silicone sealant to axle (7) mating surface. Be sure to circle all holes and dowel pins (11).

(5) During installation, rotate input shaft (12) to engage side gear splines with inter-axle differential (9).

(6) Install carrier cover (1) onto axle (7).

(7) After installation, rotate input shaft (12) to check for proper assembly. When input shaft (12) is turned, output shaft (13) should turn.

(8) Install socket head capscrew (3) with a new lockwasher (4).

(9) Install eight capscrews (5) with new lockwashers (4). Snug flange nut (2). It will be torqued later.

(10) Install dial indicator (14) onto carrier cover (1) so that gage is at center of input shaft (12).

(11) Pry outward on flange (6) and measure end play of input shaft (12).

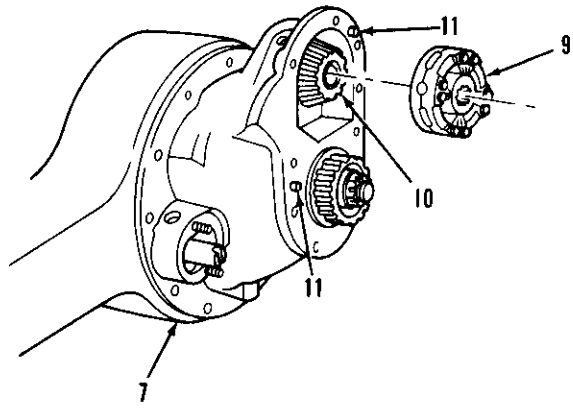
(12) End play must be within the following limits:

(a) New or rebuilt with new parts — 0.003 to 0.007 inch (0.076 to 0.177 mm).

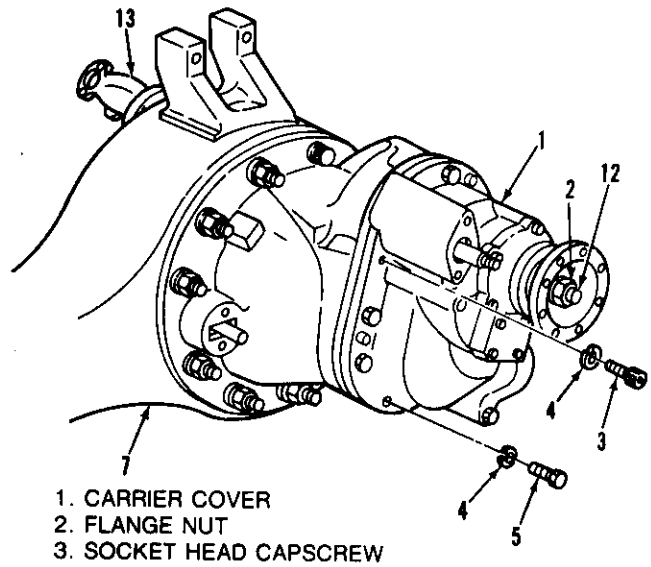
(b) Rebuilt with used parts — 0.013 to 0.017 inch (0.330 to 0.0431 mm).

(c) Over 100,000 miles (160,930 km) or one year off-road service — 0.060 inch (1.524 mm).

(d) Under 100,000 miles (160,930 km) or one year off-road service — 0.040 inch (1.016 mm).



7. AXLE
9. INTER-AXLE DIFFERENTIAL
10. OUTPUT SHAFT SIDE GEAR
11. DOWEL PIN (2)



1. CARRIER COVER
2. FLANGE NUT
3. SOCKET HEAD CAPSCREW
4. LOCKWASHER (9)
5. CAPSCREW (8)
7. AXLE
12. INPUT SHAFT
13. OUTPUT SHAFT

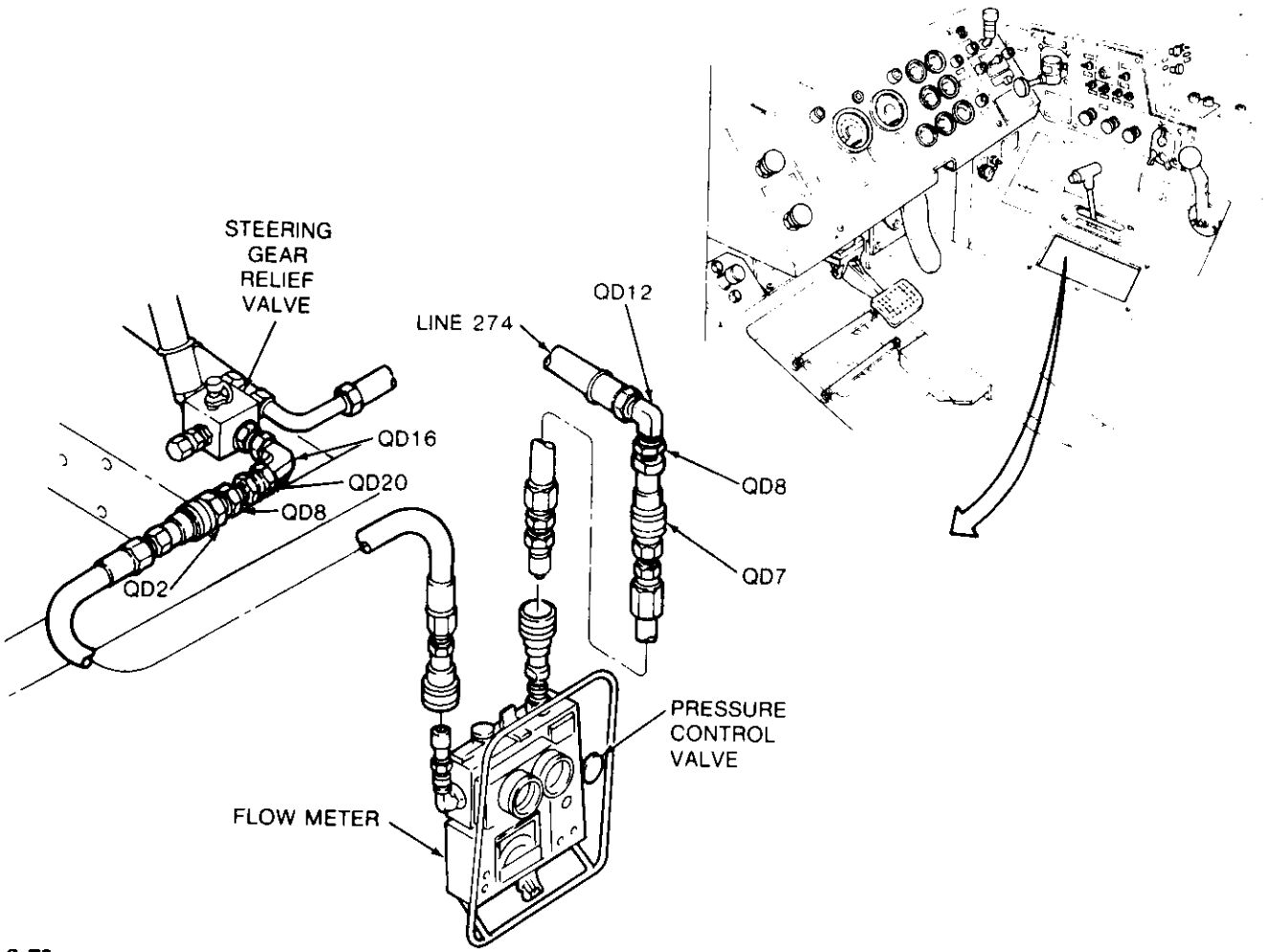
TA 298983

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. VEHICLE STEERS HARD IN ONE OR BOTH DIRECTIONS (Continued)

Test 8. Remove cab access panel below shifter. Remove line 274 from steering gear relief valve. Install a flow meter in the line between the steering gear relief valve and line 274. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and increase to maximum engine speed. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create a 1,000 psi (6,895 kPa) working pressure. Check for 2.8-3.0 gpm (10.6-11.3 lpm).

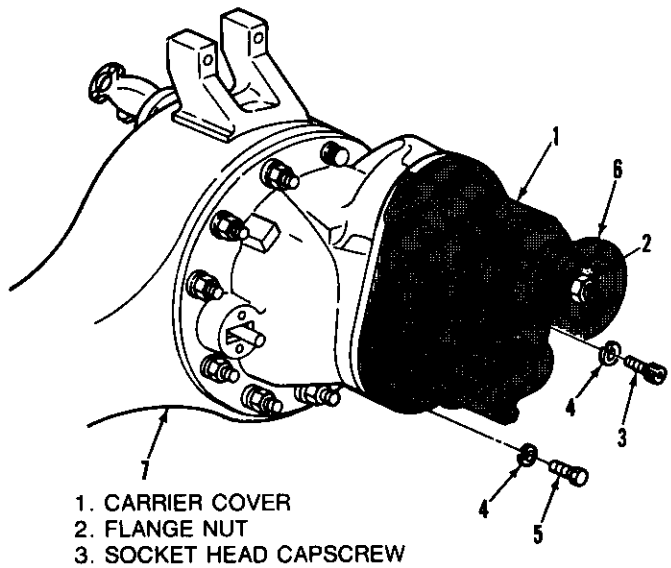
- If pressure and flow are within specifications, priority flow valve is working properly. Continue to Test 9.
- If pressure and flow are not within specifications, adjust priority flow valve. Refer to paragraph 19-4.1. If valve will not adjust, repair or replace priority flow valve. Refer to paragraph 19-3 or 19-4. If problem still exists after repair or replacement, go to Test 9.



(6) Using a soft-faced hammer, tap rear face of flange (6). If this does not loosen carrier cover (1) from axle (7), strike sides of carrier cover (1) near two dowel pin locations (8).

(7) Allow lubricant to drain into drain pan.

(8) Remove carrier cover (1) from axle (7).



1. CARRIER COVER
2. FLANGE NUT
3. SOCKET HEAD CAPSCREW
4. LOCKWASHER (9)
5. CAPSCREW (8)
6. FLANGE
7. AXLE
8. DOWEL PIN LOCATION (2)

WARNING

Inter-axle differential is sharp. Wear gloves to prevent personal injury.

(9) Remove inter-axle differential (9).

b. Cleaning/Inspection

(1) Clean all sealant from all mating surfaces.

(2) Clean all other parts. Refer to paragraph 2-6.

(3) Inspect all parts. Refer to paragraph 2-7.

(4) Replace all parts failing inspection.

c. Installation

WARNING

Carrier cover is heavy. Use lifting equipment capable of supporting and stabilizing carrier cover (1).

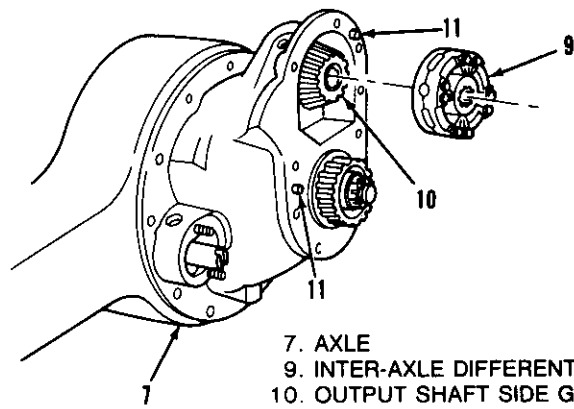
(1) Position carrier cover (1) onto floor jack or transmission jack.

(2) Install inter-axle differential (9) onto output shaft side gear (10) in axle (7). Make sure nuts face outwards.

CAUTION

During assembly, inter-axle differential may fall from axle. To prevent parts damage, make sure that all parts line up during assembly.

(3) Make sure that dowel pins (11) are installed in axle (7).



7. AXLE
9. INTER-AXLE DIFFERENTIAL
10. OUTPUT SHAFT SIDE GEAR
11. DOWEL PIN (2)

TA 298682

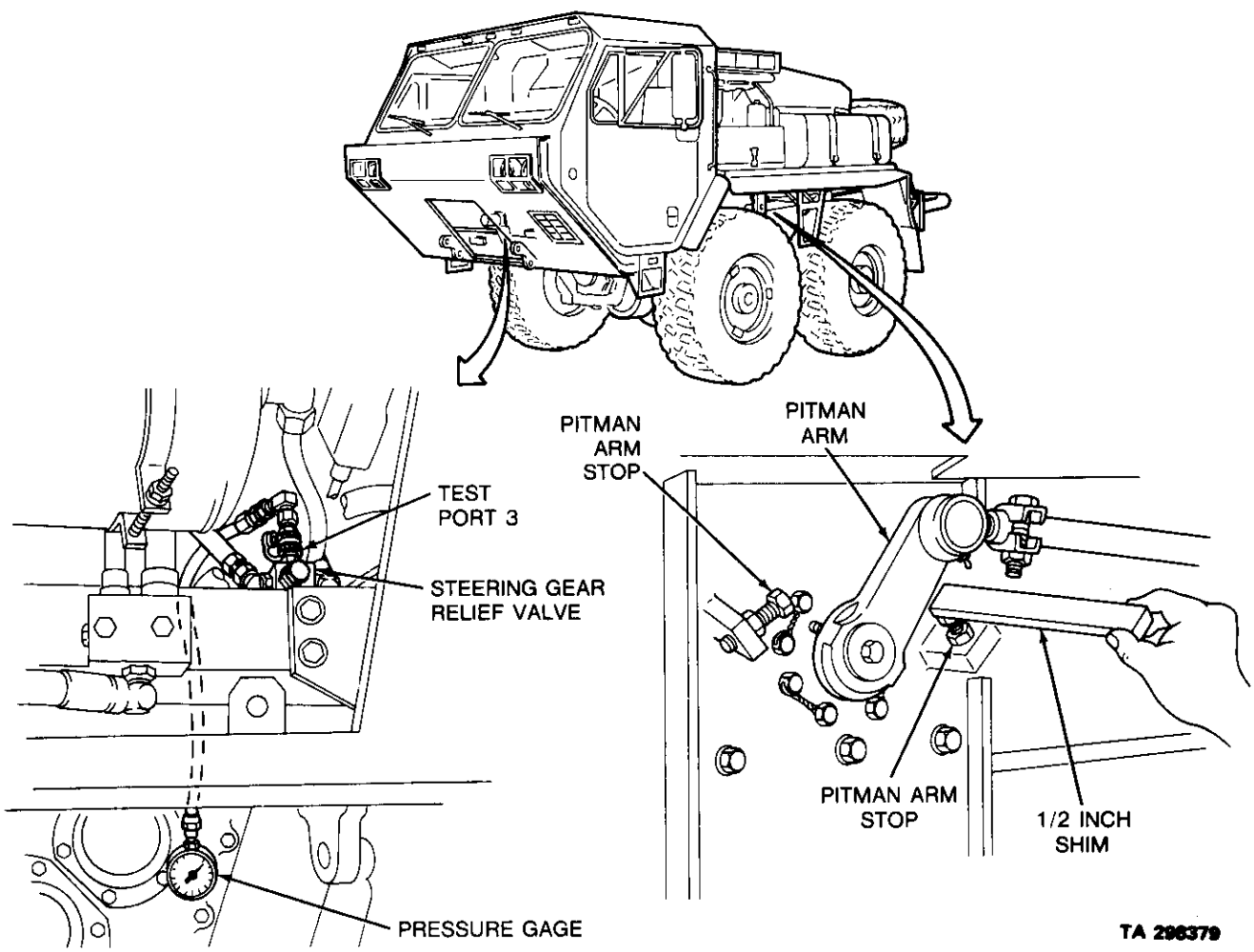
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

WARNING

When installing shim, keep hands clear of pitman arm and pitman arm stop. Pitman arm can crush hands if placed between arm and stop.

Test 9. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 3. Start engine and run at idle speed. Place a 1/2 inch (1.2 cm) shim between pitman arm and pitman arm stop. While assistant holds shim in place, turn steering wheel fully left and check for 1,700-1,800 psi (11,721-12,411 kPa). Record reading. Remove shim and place on opposite stop. Turn steering wheel fully right. Check for 1,700-1,800 psi (11,721-12,411 kPa).

- If pressures are within specifications in both directions, front steering system is working properly. Continue with Test 12.
- If pressures are not within specifications in one or both directions, go to Test 10.



10-6. AXLE DIFFERENTIAL CARRIER COVER REPLACEMENT (NO. 3 AXLE)

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK14
MK15
MK16
MK17

Special Tools

Dial indicator (P/N 7872)

Materials/Parts

Adhesive, silicone sealant (item 7, Appendix C)
Lockwasher (9) (MS35338-49) item 4
Lockwasher (5) (MS35338-48) item 17

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Axle lubricant drained (para 12-3).
	Propeller shaft removed (para 10-3).
TM 2320-34/13 TM 9-2320-297-34	Lockout chamber removed (para 10-11).

a. Removal

WARNING

Carrier cover is heavy. Use lifting equipment capable of supporting and stabilizing carrier cover (1).

CAUTION

When removing carrier cover, parts may come loose and fall. Be prepared to catch parts to prevent damage.

(1) Support carrier cover (1) from bottom with a floor jack or transmission jack.

(2) Loosen, but do not remove flange nut (2).

(3) Place a drain pan under carrier cover (1).

(4) Remove socket head capscrew (3) and lockwasher (4). Discard lockwasher (4).

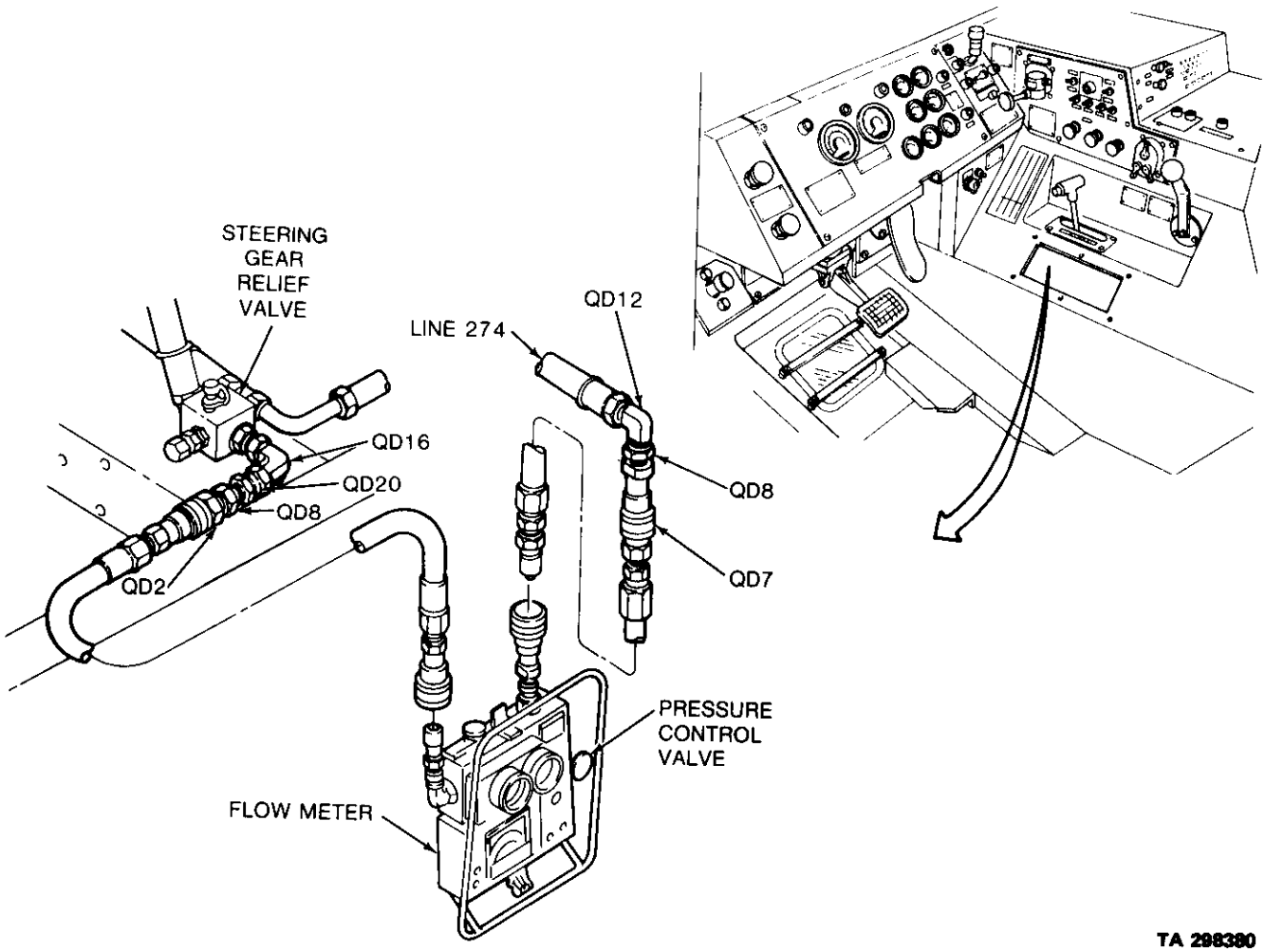
(5) Remove eight capscrews (5) and lockwashers (4). Discard lockwashers (4).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. VEHICLE STEERS HARD IN ONE OR BOTH DIRECTIONS (Continued)

Test 10. Remove cab access panel below shifter. Remove line 274 from steering gear relief valve. Install a flow meter in the line between the steering gear relief valve and line 274. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and allow it to run at idle speed. Slowly close pressure control valve by turning knob clockwise to INCREASE. Close pressure control valve until relief pressure is obtained. Record reading.

- If pressure is between 1,700-1,800 psi (11,721-12,411 kPa), adjust steering gear internal relief setting and/or repair or replace steering gear. Refer to paragraph 13-4 or 13-5.
- If pressure is not between 1,700-1,800 psi (11,721-12,411 kPa), repair or replace steering gear relief valve. Refer to paragraph 19-9 or 19-10. If after repair or replacement problem still exists, go to Test 11.



TA 298380

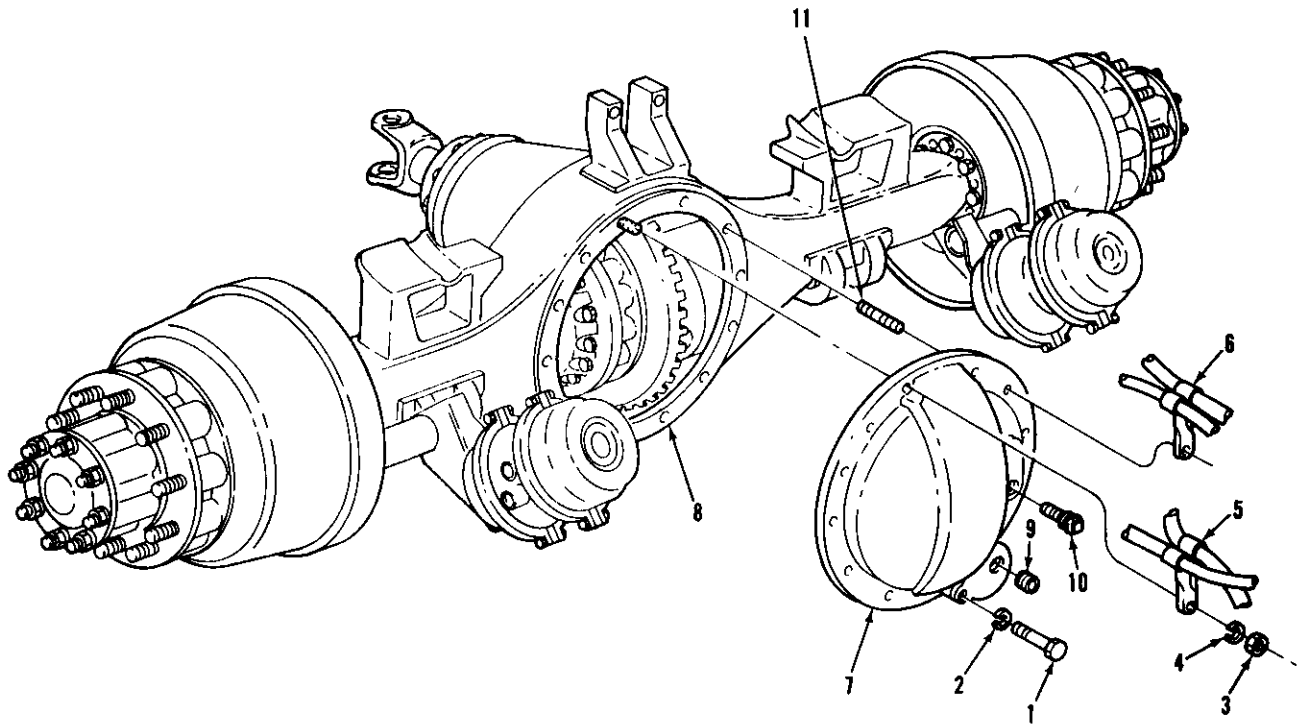
(7) Install plugs (9 and 10). Tighten securely.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 Fill axle with
TM 9-2320-297-20 lubricant (para 12-3).



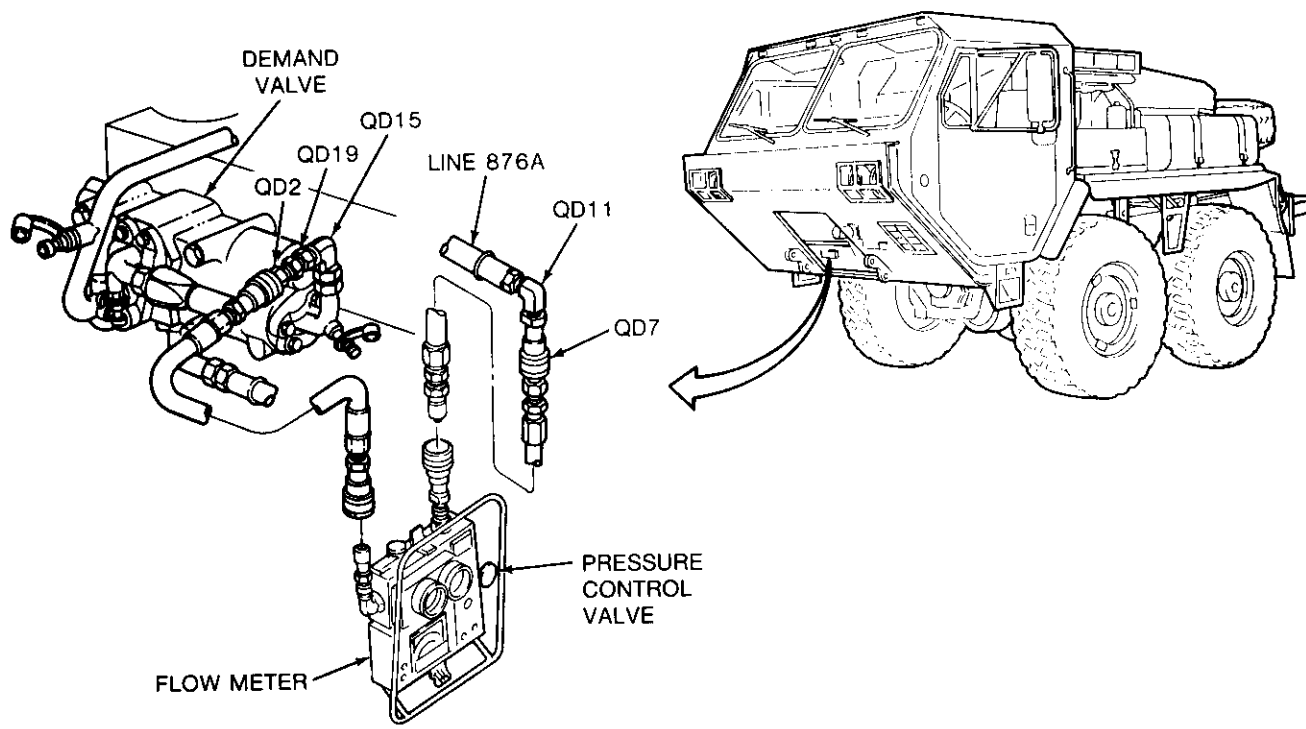
1. CAPSCREW
2. LOCKWASHER
3. NUT (11)
4. LOCKWASHER (11)
5. BRACKET
6. BRACKET
7. AXLE HOUSING COVER
8. AXLE HOUSING
9. PLUG
10. PLUG
11. STUD (11)

TA 298981

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 11. Remove line 876A from demand valve. Install a flow meter in the line between the demand valve and line 876A. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and allow to run at idle. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 2,200-2,300 psi (15,169-15,858 kPa) working pressure. Check for 10.0-12.0 gpm (37.8-45.4 lpm). Record reading. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Increase engine to maximum speed. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 2,200-2,300 psi (15,169-15,858 kPa) working pressure. Check for 19.5-21.0 gpm (73.8-79 lpm).

- If pressures and flow are within specifications at both speeds, the demand valve is working properly in the steering system. Continue with Test 12.
- If pressures and flow are not within specifications at both speeds, repair or replace demand valve. Refer to paragraph 19-18 or 19-19. If problem still exists after repair or replacement, go to Test 12.



TA 298381

10-5. AXLE HOUSING COVER REPLACEMENT (NO. 4 AXLE)

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK14
MK15
MK16
MK17

Materials/Parts

Adhesive, silicone sealant (item 7, Appendix C)
Lockwasher (12) (MS35338-47) items 2 and 4

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Axle lubricant drained (para 12-3).

---

a. Removal

(1) Remove capscrew (1) and lockwasher (2). Discard lockwasher (2).

(2) Remove 11 nuts (3) and lockwashers (4). Discard lockwashers (4).

(3) Remove brackets (5 and 6).

(4) Remove axle housing cover (7) from axle housing (8).

(5) Remove plugs (9 and 10) from axle housing cover (7).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect studs (11) for damage. Remove if damaged.

(3) Inspect all other parts. Refer to paragraph 2-7.

(4) Replace all parts failing inspection.

c. Installation

(1) Install studs (11) if removed.

(2) Coat mating surface of axle housing (8) with a bead of silicone sealant. Be sure to circle each stud (11).

(3) Install axle housing cover (7) onto axle housing (8).

(4) Set brackets (5 and 6) in place.

(5) Install 11 new lockwashers (4) and nuts (3). Tighten nuts (3) securely.

(6) Install capscrew (1) with new lockwasher (2). Tighten capscrew (1) securely.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

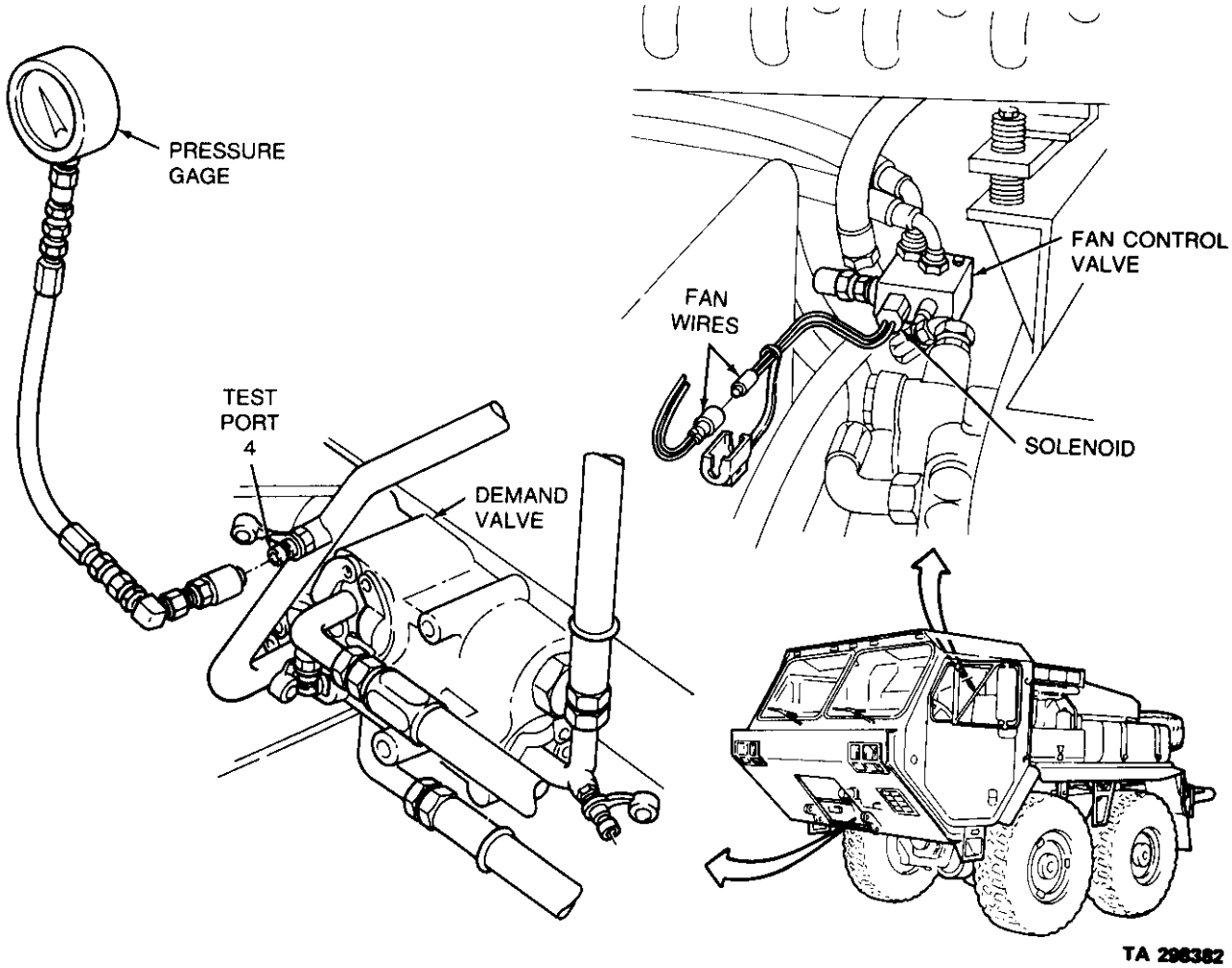
1. VEHICLE STEERS HARD IN ONE OR BOTH DIRECTIONS (Continued)

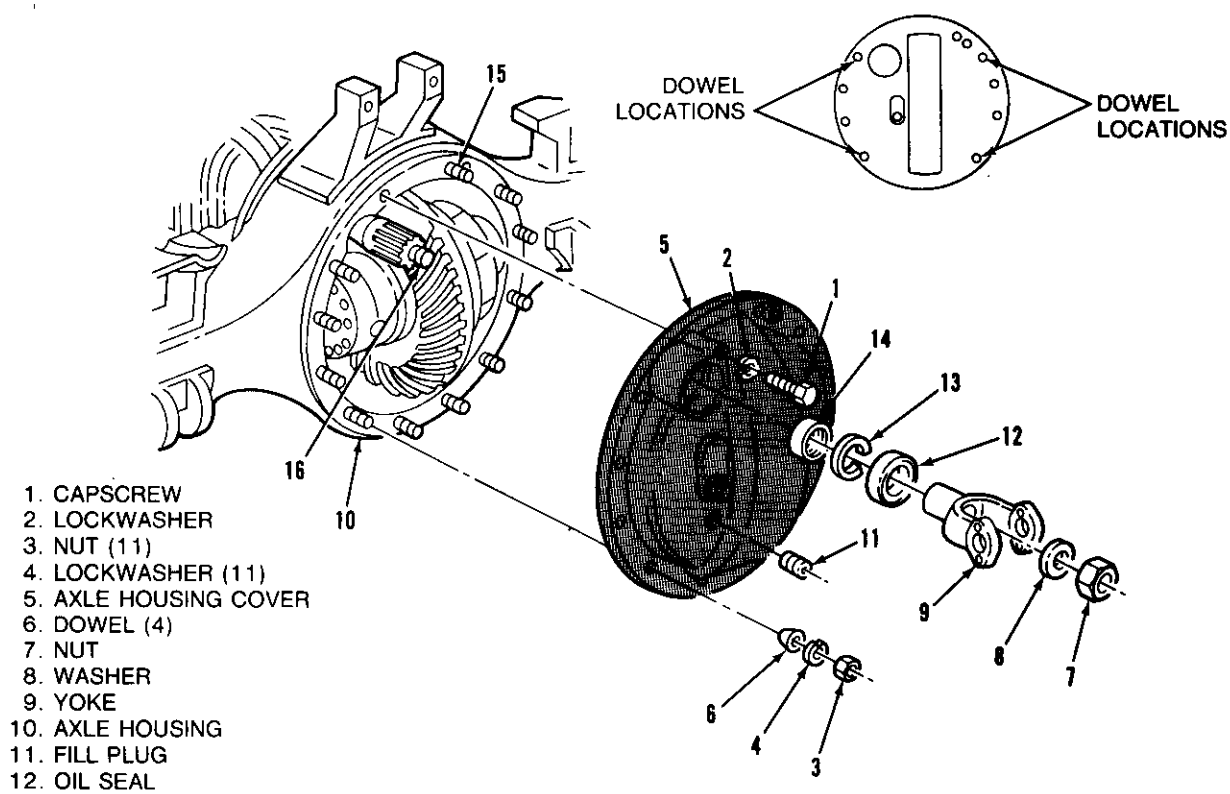
WARNING

To prevent personal injury, do not reach into fan area while engine is running.

Test 12. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 4. Disconnect electrical wires from fan control valve at solenoid. This will allow full flow to be available to the fan circuit. Fan will run all the time. Start engine and allow to run at idle speed. Check for 1,600-1,700 psi (11,032-11,721 kPa). Install wires at fan control valve solenoid.

- If pressure is within specifications, fan relief circuit is working properly. Continue to Test 14.
- If pressure is not within specifications, go to Test 13.





1. CAPSCREW
2. LOCKWASHER
3. NUT (11)
4. LOCKWASHER (11)
5. AXLE HOUSING COVER
6. DOWEL (4)
7. NUT
8. WASHER
9. YOKE
10. AXLE HOUSING
11. FILL PLUG
12. OIL SEAL
13. SNAPRING
14. BEARING
15. STUD
16. SHAFT

TA 298980

(3) Coat mating surface of axle housing (10) with a bead of silicone sealant. Be sure to circle each stud (15) and capscrew hole.

(4) Install axle housing cover (5) onto axle housing (10) being careful not to damage oil seal (12) with shaft (16).

(5) Install four dowels (6).

(6) Install 12 new lockwashers (2 and 4), one capscrew (1), and 11 nuts (3). Tighten nuts (3) securely.

(7) Install yoke (9), washer (8), and nut (7). Torque nut (7) to 480-600 foot-pounds (651-813 N·m).

END OF TASK

NOTE

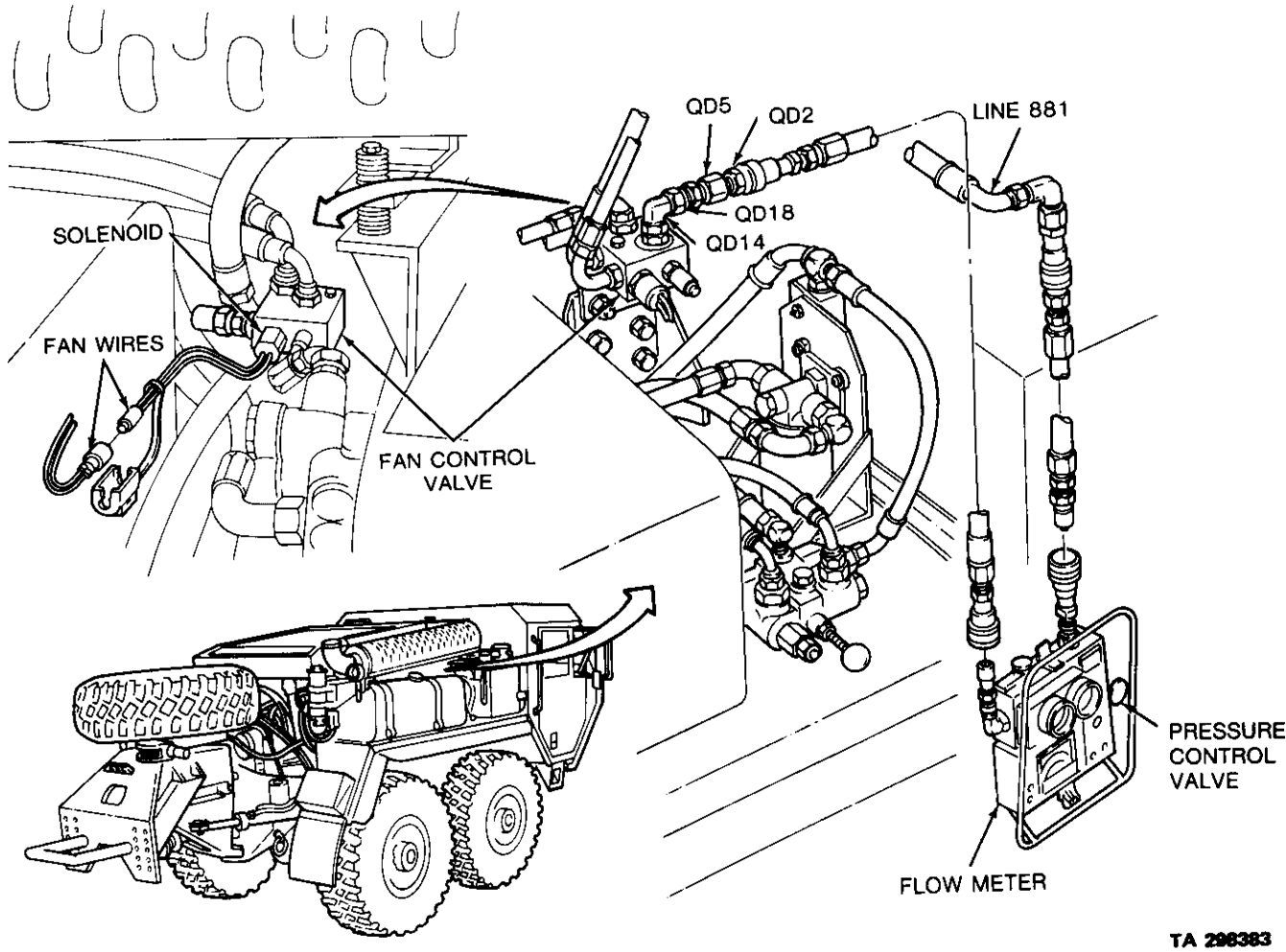
Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Refill axle lubricant (para 12-3).
	Install propeller shaft (para 10-3).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 13. Disconnect electrical wires from fan control valve at solenoid. Remove line 881 from fan control valve. Install a flow meter in the line between fan control valve and line 881. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and run at idle. Slowly close pressure control valve by turning knob clockwise to INCREASE. Close pressure control valve until relief pressure is obtained. Record pressure reading. Install electrical wires to fan control valve at solenoid.

- If pressure is between 1,550-1,650 psi (10,687.2-11,376.7 kPa), fan control valve is working properly. Repair or replace hydraulic fan motor. Refer to paragraph 19-24 or 19-25.
- If pressure is not between 1,550-1,650 psi (10,687.2-11,376.7 kPa), repair or replace fan control valve. Refer to paragraph 19-12 or 19-13. If problem still exists after repair or replacement, go to Test 14.



TA 298383

10-4. AXLE HOUSING COVER REPLACEMENT (NO. 3 AXLE)

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK14
MK15
MK16
MK17

Materials/Parts

Adhesive, silicone sealant (item 7, Appendix C)
Lockwasher (12) (MS35338-47) items 2 and 4
Oil Seal (NSN 5330-01-157-7283) item 12

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Axle lubricant drained (para 12-3). Propeller shaft removed (para 10-3).

---

a. Removal

(1) Remove capscrew (1) and lockwasher (2). Discard lockwasher (2).

(2) Remove 11 nuts (3) and lockwashers (4). Discard all lockwashers (4).

(3) Tap on axle housing cover (5) near dowels (6) with a hammer until dowels (6) are loose.

(4) Remove four dowels (6).

(5) Remove nut (7), washer (8), and yoke (9).

(6) Remove axle housing cover (5) from axle housing (10).

(7) Remove fill plug (11) from axle housing cover (5).

(8) Remove oil seal (12), snapring (13), and bearing (14) from axle housing cover (5). Discard oil seal (12).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect axle housing cover (5) for cracks or obvious damage.

(3) Inspect dowels (6) for damage.

(4) Inspect bearing (14) for damage, pits, or cracks.

(5) Inspect capscrew (1), nuts (3), and studs (15) for thread damage.

(6) Inspect yoke (9) for pits or burrs on seal surface.

(7) Replace all parts failing inspection.

c. Installation

(1) Install bearing (14), snapring (13), and new oil seal (12) into axle housing cover (5).

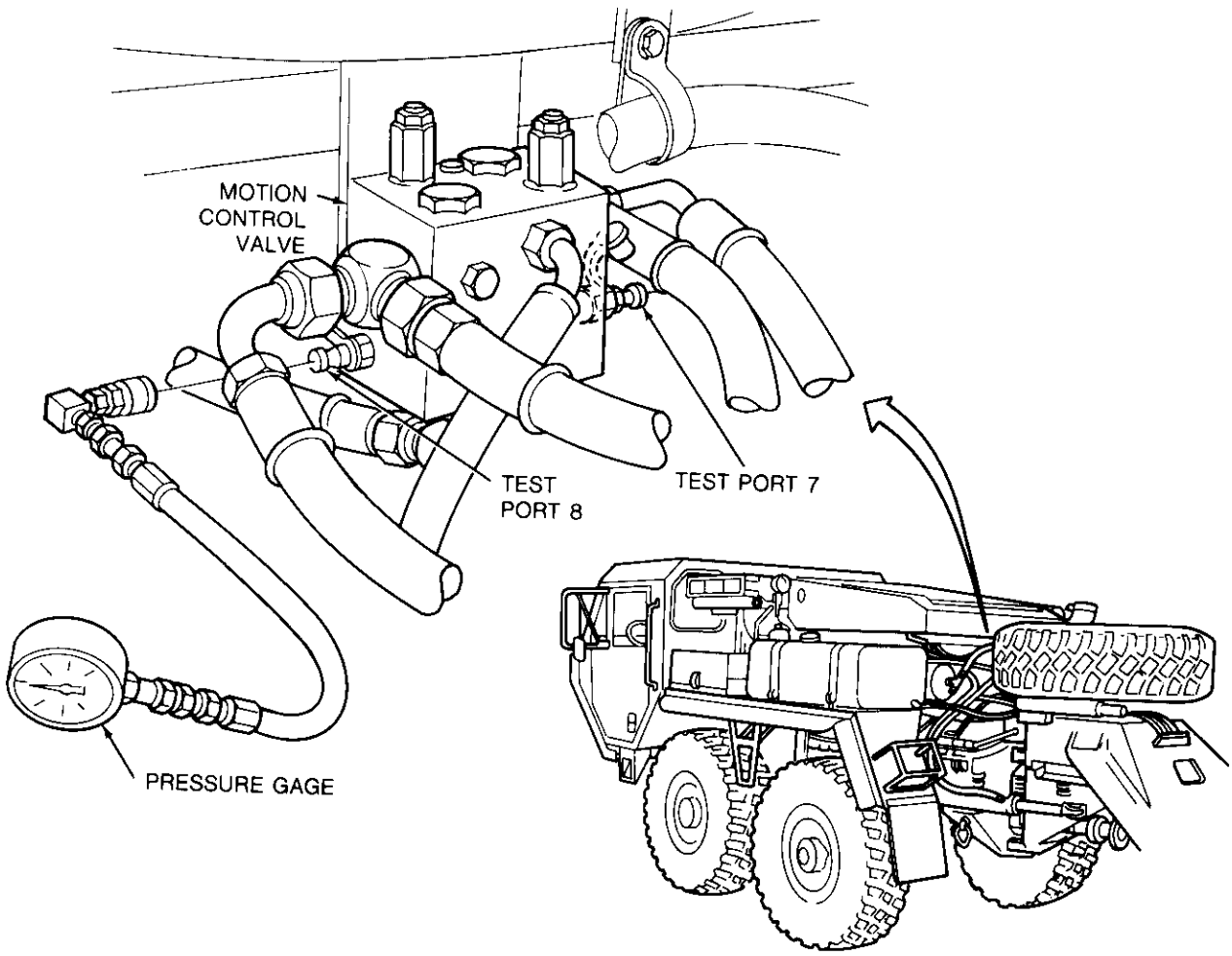
(2) Install fill plug (11), but do not tighten.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. VEHICLE STEERS HARD IN ONE OR BOTH DIRECTIONS (Continued)

Test 14. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 8. Start engine and allow it to run at idle speed. Turn steering wheel fully to the right until it stops. Check for a rise in pressure of 150-2,250 psi (1,034-15,513.7 kPa). Record readings. Stop engine and install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 7.Turn steering wheel fully left. Check for rise in pressure of 150-2,250 psi (1,034-15,513.7 kPa). Record readings. Install fan control wires on fan control valve at solenoid.

- If a pressure rise was found in both tests, yaw steering control valve is working properly. Go to Test 15.
- If no pressure rise was found in one or both tests, repair or replace yaw steering control valve. Refer to paragraph 19-6. If problem still exists after repair or replacement, continue with Test 15.



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(3) Install two washers (6) and new locknuts (5) onto studs (7).

(4) Coat threads of breather (10) with pipe sealant and install into axle shift unit (4).

(5) Coat threads of air fitting (3) with pipe sealant and install into top of axle shift unit (4).

NOTE

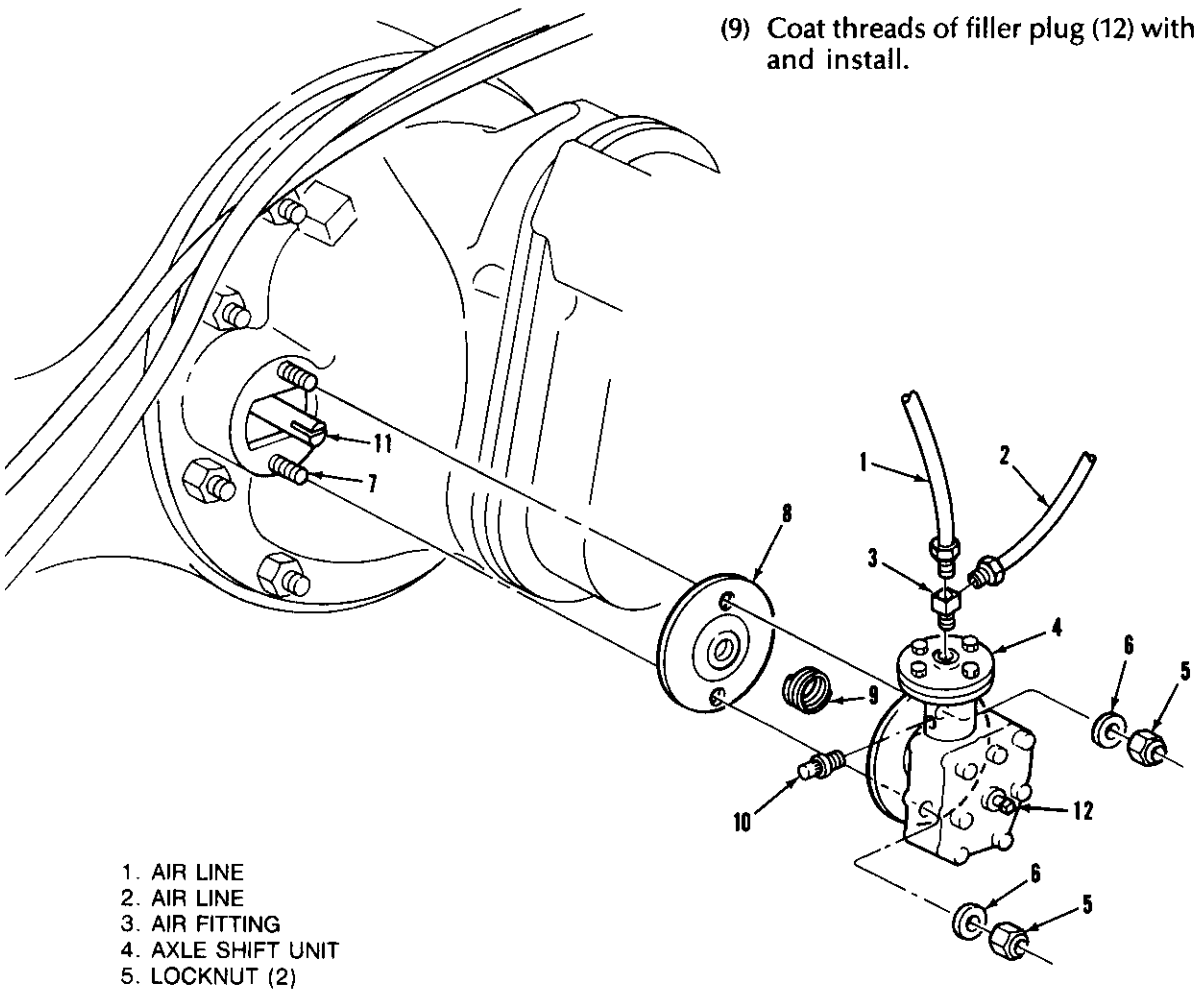
Axles 2 and 4 have only one air line (1). Axles 1 and 3 have two air lines (1 and 2).

(6) Install air lines (1 and 2) into air fitting (3).

(7) Remove filler plug (12).

(8) Fill axle shift unit (4) housing with lubricating oil to level of filler plug (12). Refer to LI 2320-12/9, LO 9-2320-297-12.

(9) Coat threads of filler plug (12) with sealant and install.



1. AIR LINE
2. AIR LINE
3. AIR FITTING
4. AXLE SHIFT UNIT
5. LOCKNUT (2)
6. WASHER (2)
7. STUD (2)
8. SHIFT FORK SEAL
9. SPRING
10. BREATHER
11. SHIFT FORK
12. FILLER PLUG

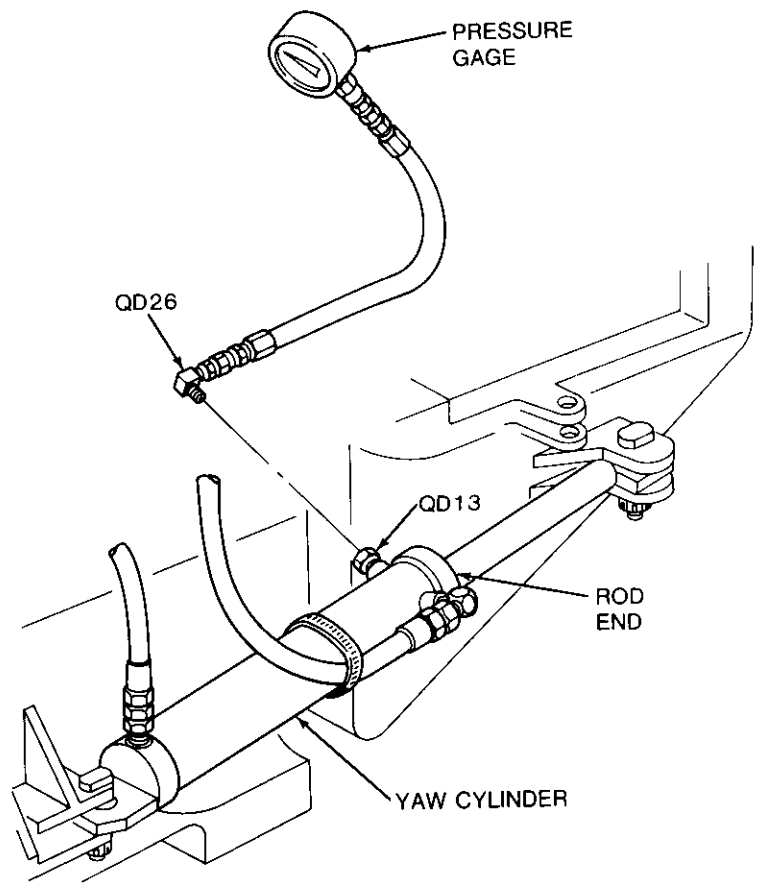
TA 298978

END OF TASK

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 15. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at rod end of left yaw cylinder. Start engine and allow it to run at idle speed. Slowly turn steering wheel fully left and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record readings. Stop engine and remove pressure gage and install at rod end of right yaw cylinder. Slowly turn steering wheel fully right and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record readings.

- If pressures are within specifications in both directions and vehicle steers hard, repair or replace motion control valve. Refer to paragraph 19-14 or 19-15.
- If pressures are not within specifications in both directions, go to Test 16.



TA 298384

SECTION II. GENERAL REAR AXLE REPAIR

10-3. AXLE SHIFT UNIT REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

References

LI 2320-12/9,
LO 9-2320-297-12

Materials/Parts

Pipe sealant (item 60, Appendix C)
Engine oil, (item 45, Appendix C)
Locknut (2) (MS17828-7F) item 5
Seal and spring assembly (P/N 119855) items 8 and 9

General Safety Instructions

Block wheels of truck to prevent movement.

---

a. Removal

NOTE

Axles 2 and 4 have only one air line (1). Axles 1 and 3 have two air lines (1 and 2).

(1) Tag and remove air lines (1 and 2) and air fitting (3) from top of axle shift unit (4).

(2) Place a drain pan under axle shift unit (4) and remove two locknuts (5) and washers (6) from studs (7). Discard locknuts (5).

(3) Remove axle shift unit (4).

(4) Remove shift fork seal (8) with spring (9) from either studs (7) or axle shift unit (4). Discard shift fork seal (8) and spring (9).

(5) Remove breather (10) from axle shift unit (4).

NOTE

For axle shift unit repair, refer to paragraph 9-5 in this manual.

b. Cleaning/Inspection

(1) Clean breather (10).

(2) Clean all other parts. Refer to paragraph 2-6.

(3) Inspect studs (7) for damage. Replace if damaged.

(4) Inspect all other parts. Refer to paragraph 2-7.

(5) Replace all parts failing inspection.

c. Installation

(1) Install new shift fork seal (8) with spring (9) onto shift fork (11) and studs (7). Shift fork seal (8) is marked with BOTTOM-FRT TANDEM AXLE near correct bottom hole.

(2) Install axle shift unit (4) onto studs (7). Make sure that shift fork actuating lever engages shift fork (11).

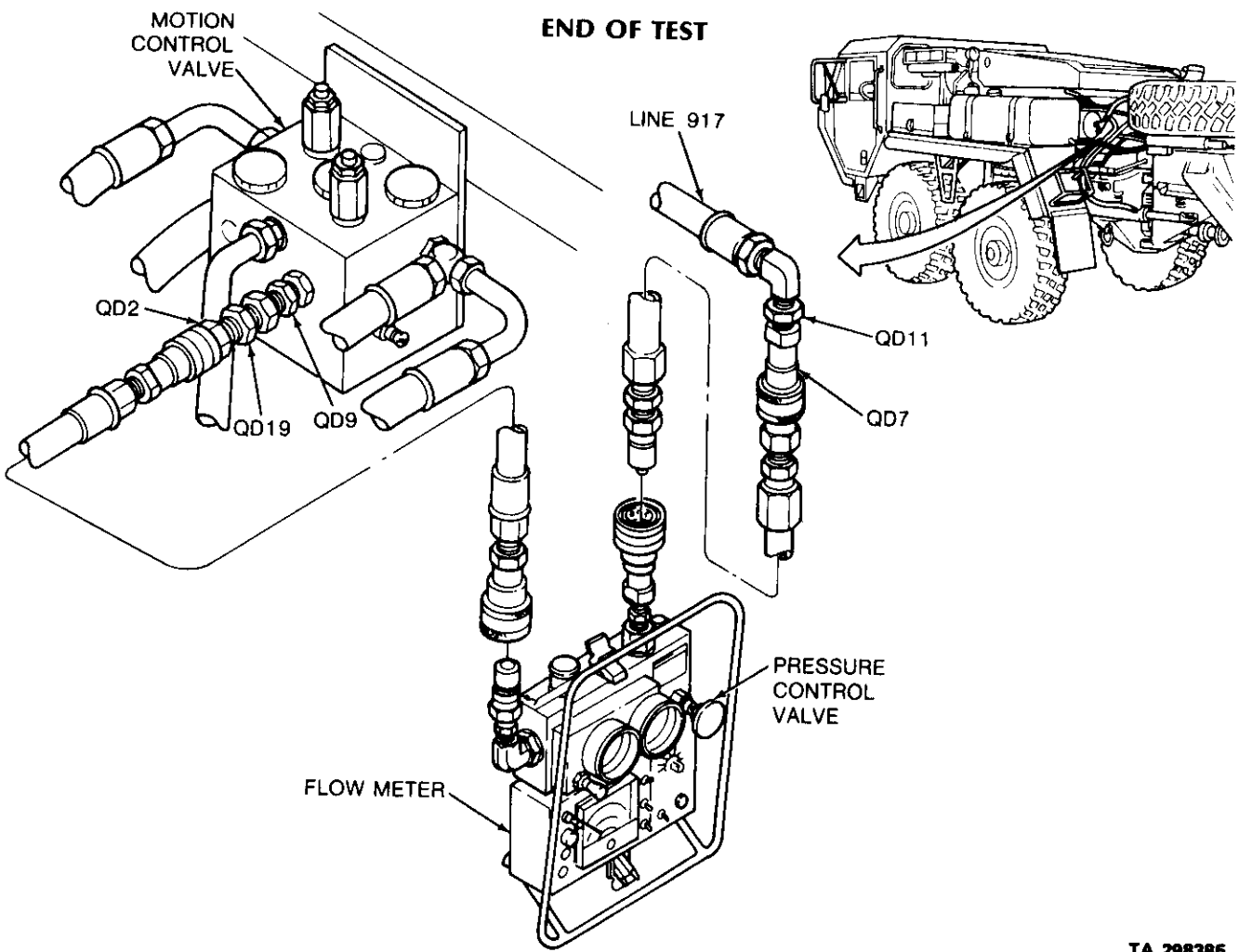
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. VEHICLE STEERS HARD IN ONE OR BOTH DIRECTIONS (Continued)

Test. 16. Remove line 917 from motion control valve. Install a flow meter in line between motion control valve and line 917. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at rod end of left yaw cylinder. Start engine and allow it to run at idle speed. Turn steering wheel fully left and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa) on pressure gage and less than 100 psi (689 kPa) on flow meter. Record readings. Remove pressure gage and install at rod end of right yaw cylinder. Start engine and allow it to run at idle speed. Turn steering wheel fully right and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa) on pressure gage and less than 100 psi (689 kPa) on flow meter. Record readings.

- If pressure is over 100 psi (689 kPa) on flow meter and 2,200-2,300 psi (15,169-15,858 kPa) is not present on yaw cylinder pressure gage, replace motion control valve. Refer to paragraph 19-14.
- If pressure is below 100 psi (689 kPa) on flow meter and 2,200-2,300 psi (15,169-15,858 kPa) is not present on yaw cylinder pressure gage, repair or replace yaw cylinders(s). Refer to paragraph 19-11.

END OF TEST



TA 298385

CHAPTER 10

REAR AXLES

10-1. OVERVIEW

This chapter provides information authorized for Third and Fourth Echelon Maintenance level mechanics. General information, maintenance, replacement, and repair procedures for the vehicle's rear axles are covered in the following sections:

Section I . Description and Data

Section II. General Rear Axle Repair

Section III. Rear Axle Replacement Instructions

Section IV. Differential Carrier Repair Instructions

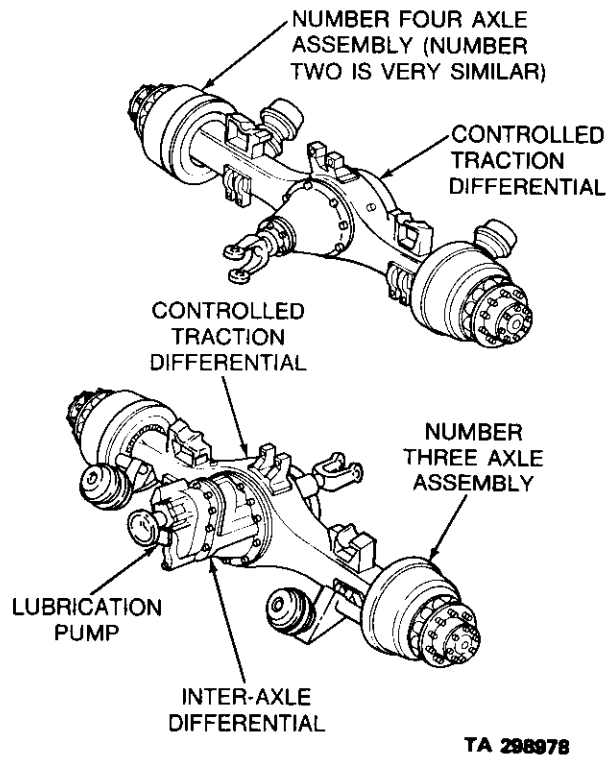
SECTION I. DESCRIPTION AND DATA

10-2. DESCRIPTION AND DATA

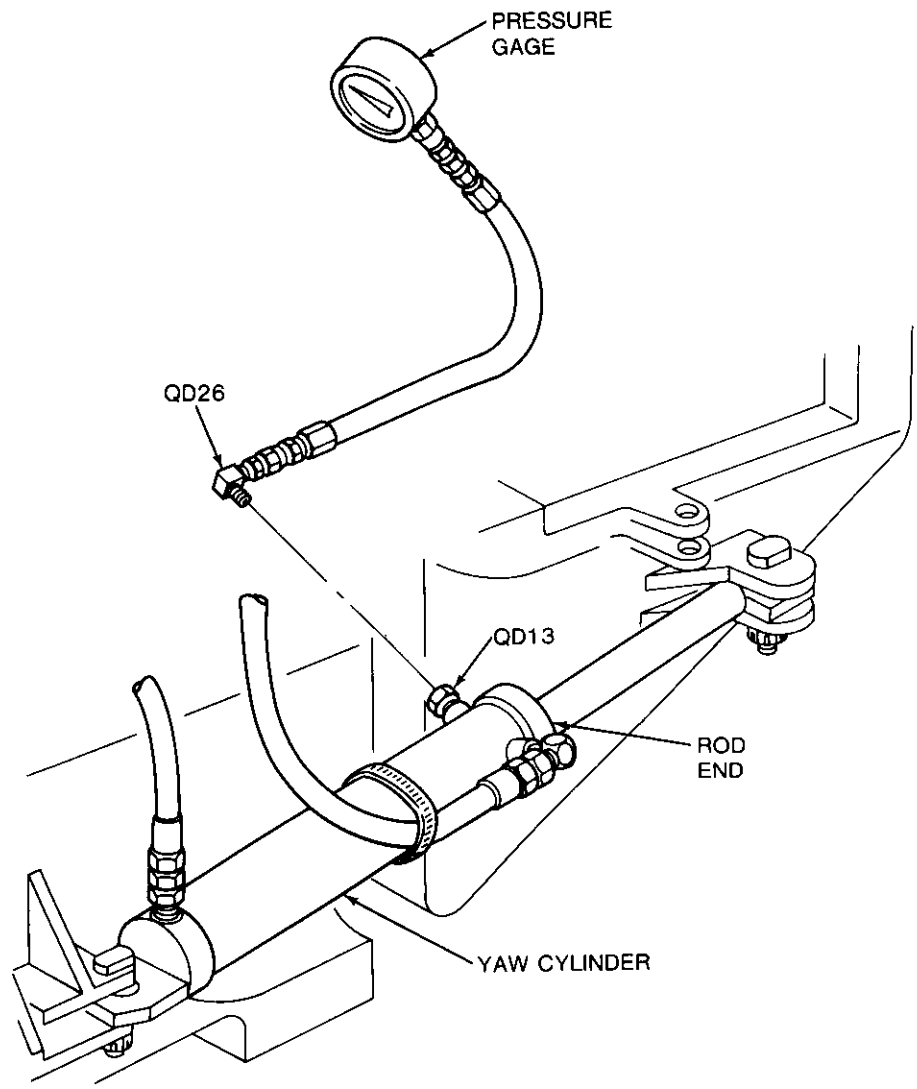
a. General The No. 2 axle is a single reduction, 5.57:1 gear ratio axle assembly with a Controlled Traction Differential (CTD). The No. 2 axle receives power from the No. 1 axle through the inter-axle differential of the No. 1 axle. The power is transmitted by a propeller shaft to the CTD of the No. 2 axle. The driver controls these differentials by a switch in the cab. The No. 3 and No. 4 axles are single reduction, 5.43:1 gear ratio axle assemblies with CTDs. The No. 3 axle also contains an inter-axle differential.

b. Inter-Axle Differential The inter-axle differential is controlled by the driver with a switch located in the cab. When unlocked, it allows the No. 3 and No. 4 axles to turn at different speeds. When locked, it makes both axles turn at the same speed.

c. Lubrication Pump The No. 3 axle has a lubrication pump mounted on the inter-axle differential. The drive gear for the pump receives power from the input shaft of the inter-axle differential. It picks up lubricant through passages in the carrier cover and returns it to the top of the cover through internal passages.



MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298386

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

2. FRONT AXLE TURNS, YAW CYLINDERS DO NOT MOVE

WARNING

To prevent personal injury, do not reach into fan area while engine is running.

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself.

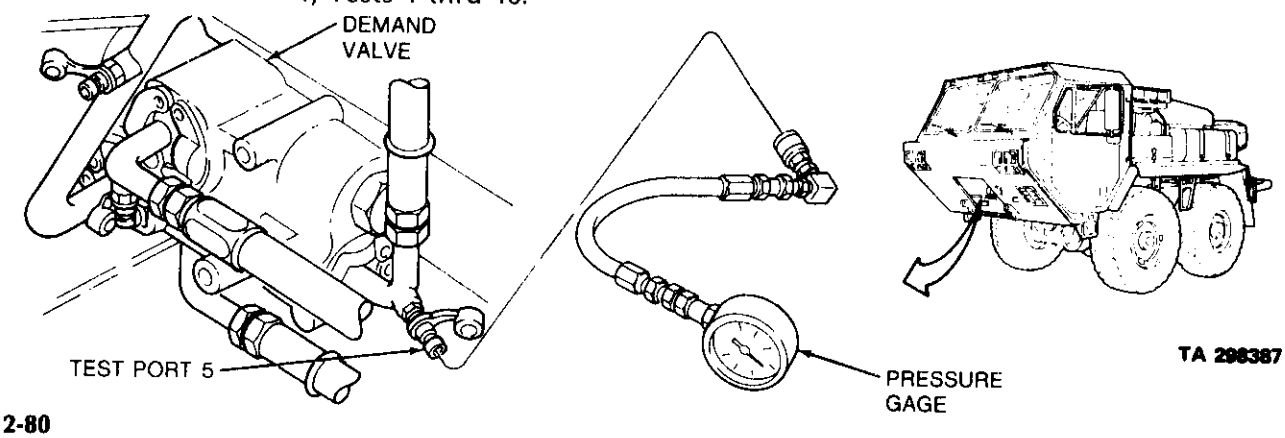
Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst causing personal injury.

NOTE

Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake released, selector valve in STEERING position, directional relief valve solenoid electrical plug disconnected, and hydraulic oil temperature at 130-150°F (54-66°C).

Test 1. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 5. Start engine and allow it to run at idle speed. Turn steering wheel left and right until it stops. Check for 2,200-2,300 psi (15,169-15,858 kPa).

- If pressure is within specifications in both directions, continue with Test 2.
- If pressure is not within specifications in both directions, refer to Malfunction 1, Tests 1 thru 16.

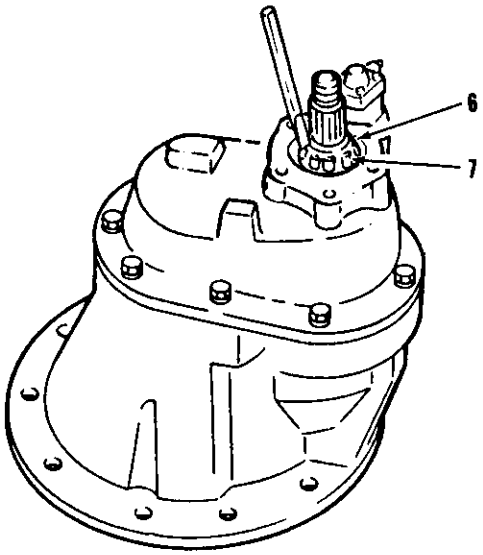


CAUTION

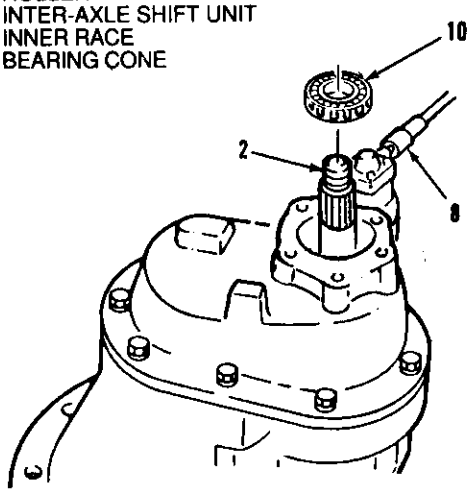
To prevent equipment damage, do not allow chisel to contact inner machined surface of carrier cover.

(5) Carefully break outer edge of bearing cage (6) with a sharp chisel in 4 locations, 90° apart.

(6) Remove bearing cage (6), rollers (7) and discard.



2. INPUT SHAFT
6. BEARING GAGE
7. ROLLER
8. INTER-AXLE SHIFT UNIT
9. INNER RACE
10. BEARING CONE

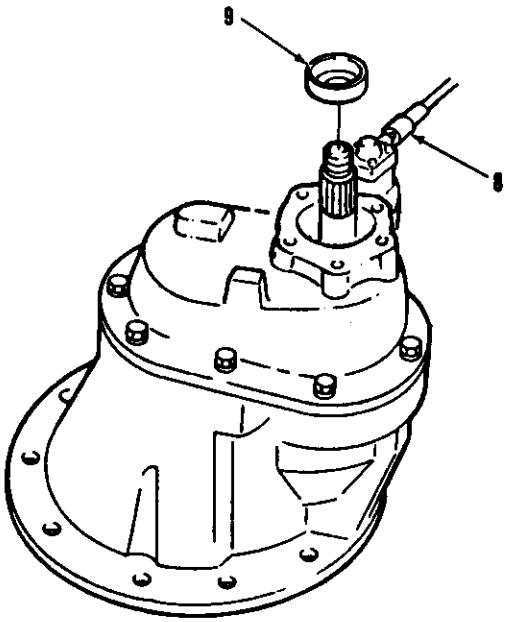


NOTE

It may be necessary to rotate thru shaft to lock inter-axle shift unit (8) fully.

(7) Apply a minimum of 80 psi (552 kPa) to lockup valve to lock inter-axle shift unit (8).

(8) Use bearing puller to remove bearing inner race (9). Discard bearing inner race (9).



b. New Bearing Installation

(1) Install new bearing cone (10) onto input shaft (2).

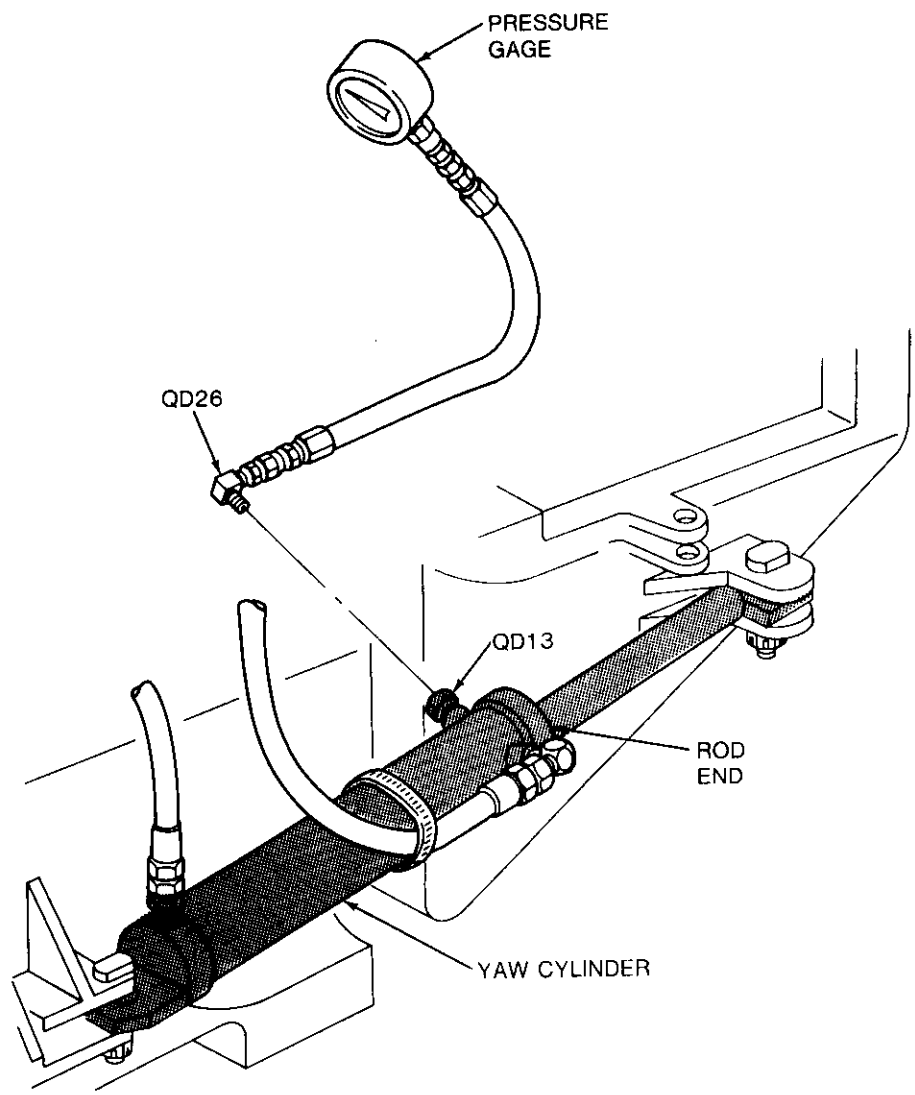
(2) Disconnect air supply at inter-axle shift unit (8).

END OF TASK

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 2. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at rod end of left yaw cylinder. Start engine and allow it to run at idle speed. Turn steering wheel left until it stops. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record reading. Remove gage and install it at the rod end of right yaw cylinder. Start engine and allow it to run at idle. Turn steering wheel to the right and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record reading.

- If pressures are within specifications in both directions and yaw cylinders will not move, go to Test 3.
- If pressures are not within specifications in both directions, continue with Test 4.



TA 298388

9-21. NEW AXLE DIFFERENTIAL CARRIER COVER PREPARATION

THIS TASK COVERS: a. Old Bearing, Shims and Cover Assembly, Removal
b. New Bearing, Installation

INITIAL SETUP

Applicable Configurations

MK48

Equipment Condition

TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	New differential carrier cover installed on carrier (para. 9-16). Lockout chamber installed (para. 9-3).

General Safety Instructions

Carrier parts are very heavy. To prevent personal injury, use care when moving or lifting parts.

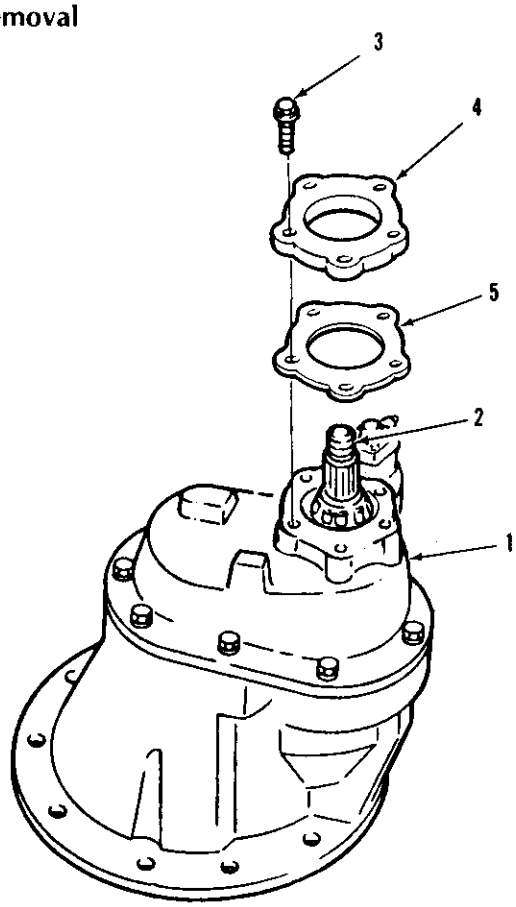
a. Old Bearing, Shims and Cover Assembly, Removal

(1) Position carrier (1) with input shaft (2) facing up.

(2) Remove and discard 5 capscrews (3).

(3) Remove and discard cover assembly (4).

(4) Remove and discard shims (5).



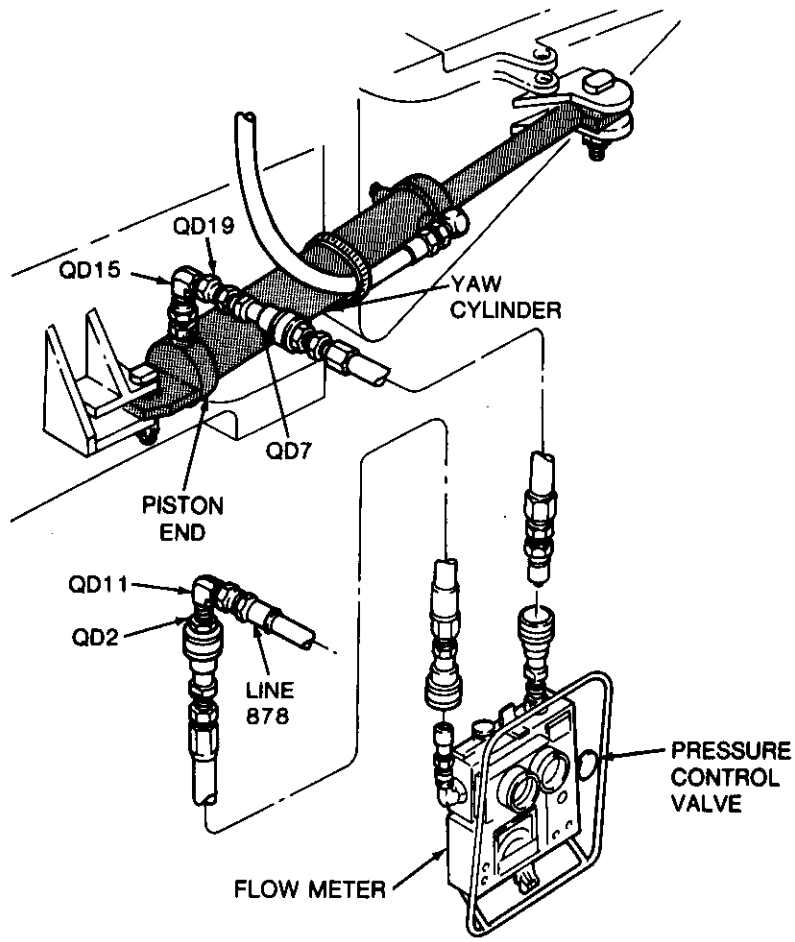
1. CARRIER
2. INPUT SHAFT
3. CAPSCREW
4. COVER ASSEMBLY
5. SHIM

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

2. FRONT AXLE TURNS, YAW CYLINDERS DO NOT MOVE (Continued)

Test 3. Remove line 878 from piston end of left yaw cylinder. Install a flow meter in the line between the yaw cylinder and line 878. Start the engine and increase to maximum speed. Turn steering wheel fully left and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record reading. Remove flow meter. Remove line 877 from the piston end of right yaw cylinder. Install flow meter in the line between yaw cylinder and line 877. Start engine and allow it to run at idle speed. Turn steering wheel fully to the right and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record reading.

- If pressures are within specifications in one or both tests and cylinder(s) will not move, repair or replace motion control valve. Refer to paragraph 19-14 or 19-15.
- If pressures are not within specifications in one or both tests and one or both yaw cylinders will not move, replace yaw cylinder(s). Refer to paragraph 19-11.



TA 298388

9-20. OUTPUT SHAFT REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

O-ring (2) (P/N 46526) item 6

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Output shaft removed (para 9-15).

a. Disassembly

(1) Remove snapring (1), side gear (2), bearing cone (3), and snapring (4) from output shaft (5).

(2) Remove and discard two O-rings (6).

(3) If damaged, remove bushing (7) from output shaft (5).

(4) If damaged, remove bearing sleeve (8) from output shaft (5).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect gears, shaft, bearing, and bushings for damage.

(3) Replace all parts failing inspection.

c. Assembly

(1) If removed, press bearing sleeve (8) onto output shaft (5).

(2) If removed, install bushing (7) into end of output shaft (5).

(3) Install two new O-rings (6) onto output shaft (5).

(4) If removed, press bearing cone (3) onto side gear (2).

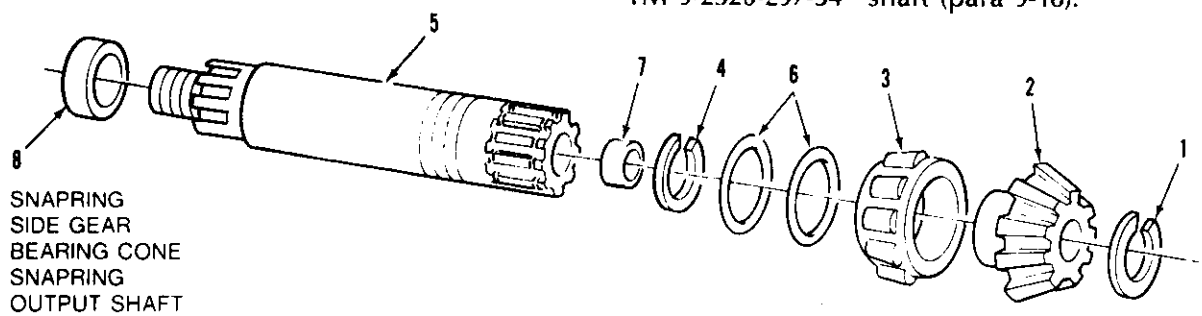
(5) Install snapring (4), side gear (2), and snapring (1) onto output shaft (5).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install output shaft (para 9-16).



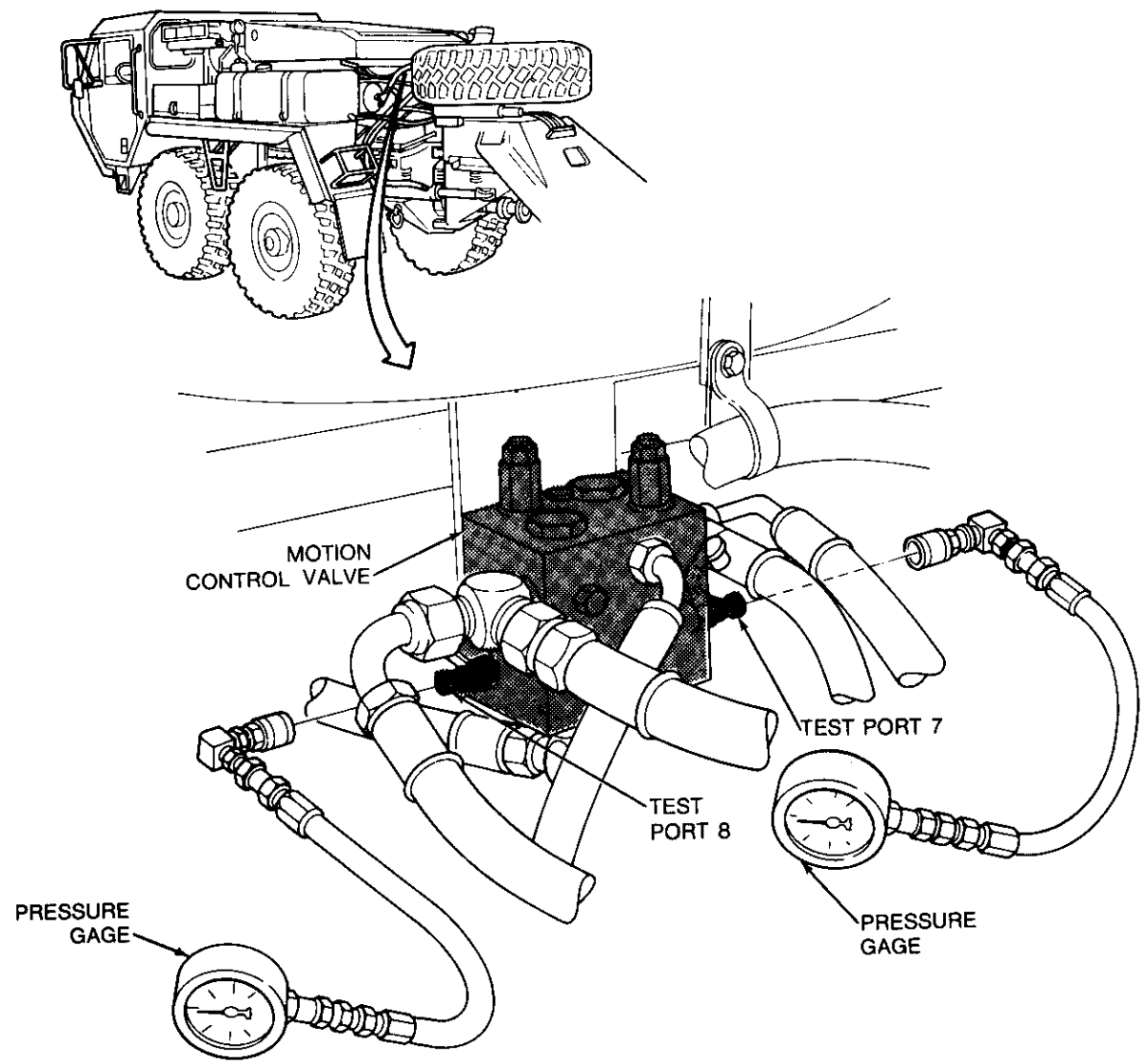
1. SNAPRING
2. SIDE GEAR
3. BEARING CONE
4. SNAPRING
5. OUTPUT SHAFT
6. O-RING (2)
7. BUSHING
8. BEARING SLEEVE

TA 298977

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 4. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 8. Start engine and allow it to run at idle speed. Turn steering wheel fully to the right. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record reading. Remove pressure gage and install at test port 7. Start engine and allow to run at idle speed. Turn steering wheel fully to the left. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record reading.

- If pressures are within specifications in both directions, continue with Test 6.
- If pressures are not within specifications, go to Test 5.



TA 298333

9-19. INTER-AXLE DIFFERENTIAL REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Locknuts (8) (MS51922-13) item 4

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Inter-axle differential removed (para 9-15).

a. Disassembly

(1) Matchmark case halves (1 and 2) of inter-axle differential (3).

(2) Place inter-axle differential (3) in a soft-jawed vice and remove eight locknuts (4) and capscrews (5). Discard locknuts (4).

(3) Separate case halves (1 and 2) and remove spider (6) assembly.

(4) Remove four thrust washers (7), gears (8), and bushings (9) from spider (6).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect gears, shaft, bearing, and bushings for damage.

(3) Replace all parts failing inspection.

c. Assembly

(1) Install four bushings (9), gears (8), and thrust washers (7) onto spider (6).

(2) Install spider (6) into case half (2).

(3) Aline marks made during disassembly and install other case half (1).

(4) Install eight capscrews (5) and new locknuts (4).

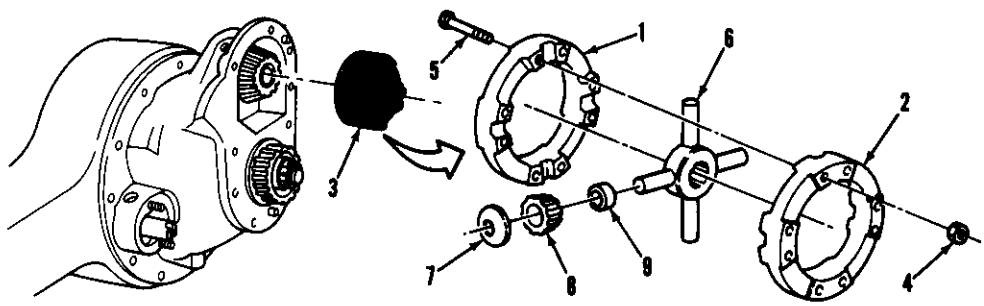
END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13
TM 9-2320-297-34 — Install inter-axle differential (para 9-16).

1. CASE HALF
2. CASE HALF
3. INTER-AXLE DIFFERENTIAL
4. LOCKNUT (8)
5. CAPSCREW (8)
6. SPIDER
7. THRUST WASHER (4)
8. GEAR (4)
9. BUSHING (4)



TA 296976

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

2. FRONT AXLE TURNS, YAW CYLINDERS DO NOT MOVE (Continued)

Test 5. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 8. Start engine and allow it to run at idle speed. Turn steering wheel fully right. Check for a rise in pressure of 150-2,250 psi (1,034-15,513 kPa). Record reading. Remove gage and install at test port 7. Start engine and allow it to run at idle speed. Turn steering wheel fully to the left. Check for a rise in pressure of 150-2,250 psi (15,168-15,858 kPa). Record reading.

- If pressures are within specifications in both tests, go to Test 6.
- If pressures are not within specifications in one or both tests, repair or replace yaw steering control valve. Refer to paragraph 19-6. If problem still exists after repair or replacement, go to Test 6.

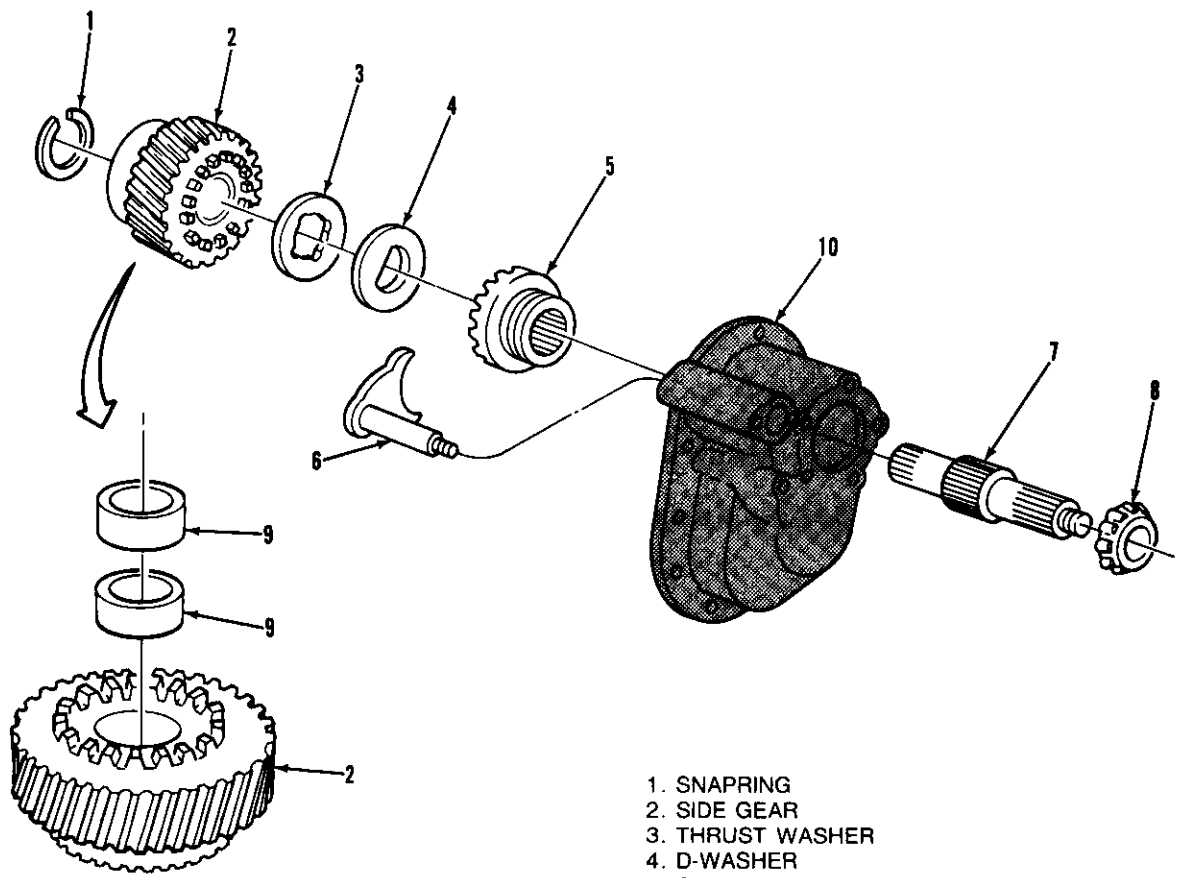
Test 6. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at rod end of left yaw cylinder. Start engine and allow it to run at idle speed. Turn steering wheel fully left and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record reading. Remove gage and install it at the rod end of right yaw cylinder. Start engine and allow it to run at idle. Turn steering wheel fully to the right and hold. Check for 2,200-2,300 psi (15,169-125,858 kPa). Record reading.

- If pressures are within specifications in both directions, repair or replace motion control valve. Refer to paragraph 19-14 or 19-15.
- If pressures are not within specifications in both directions, continue with Test 7.

Test 7. Remove line 917 from motion control valve. Install a flow meter in line between motion control valve and line 917. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at rod end of left yaw cylinder. Start engine and allow it to run at idle speed. Turn steering wheel fully to the left and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa) on pressure gage and over 100 psi (689 kPa) on flow meter. Record readings. Remove pressure gage and install at rod end of right yaw cylinder. Start engine and allow it to run at idle speed. Turn steering wheel fully to the right and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa) on pressure gage and over 100 psi (689 kPa) on flow meter. Record readings.

- If pressure is over 100 psi (689 kPa) on flow meter and 2,200-2,300 psi (15,169-15,858 kPa) is not present on yaw cylinder pressure gage, replace motion control valve. Refer to paragraph 19-14 or 19-15.
- If pressure is between 0-100 psi (0-689 kPa) on flow meter and 2,200-2,300 (15,169-15,858 kPa) is not present on yaw cylinder pressure gage, repair or replace yaw cylinder(s). Refer to paragraph 19-11.

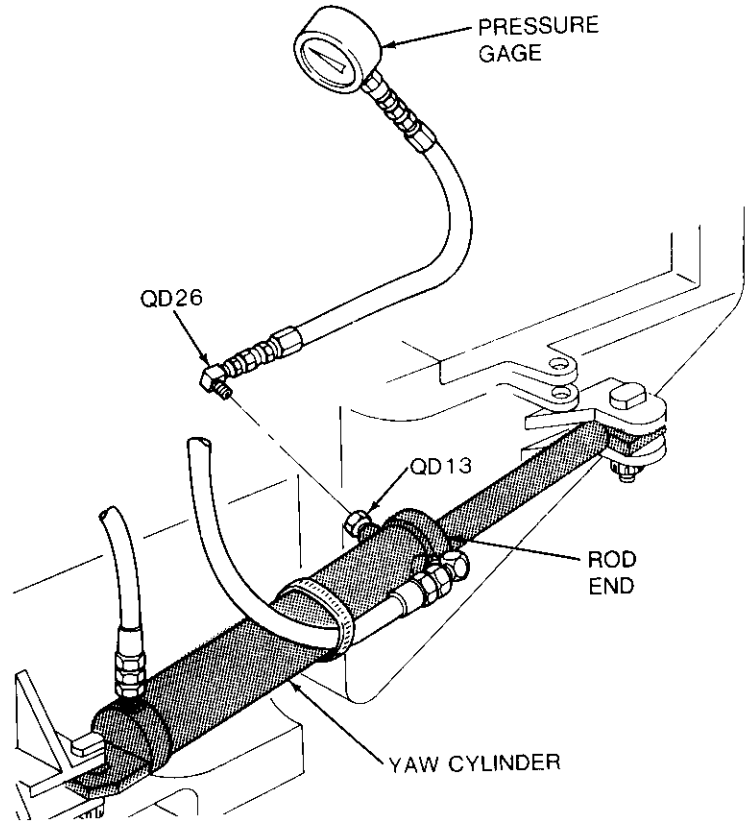
END OF TEST

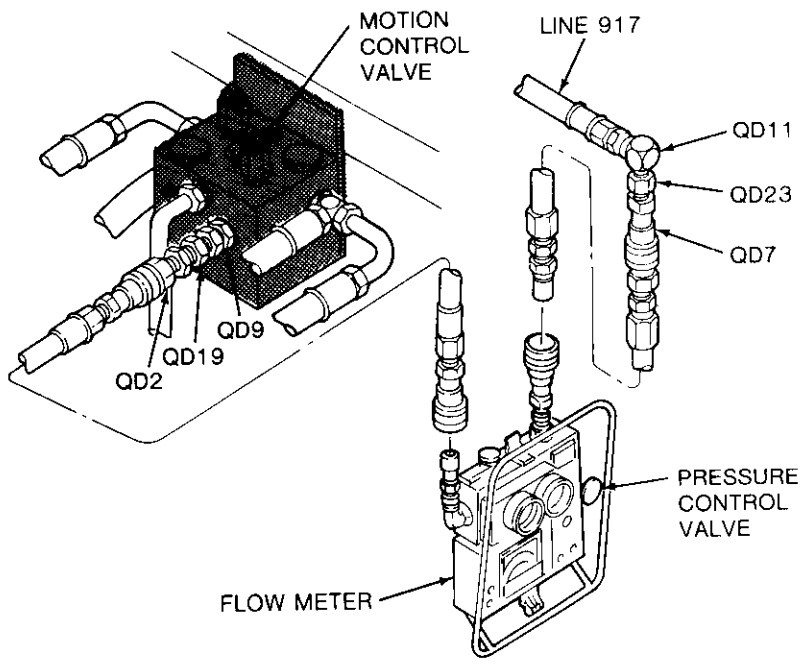


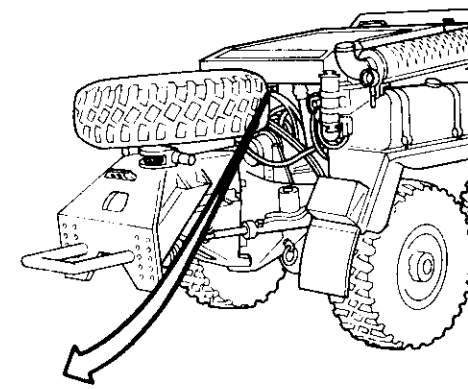
1. SNAPRING
2. SIDE GEAR
3. THRUST WASHER
4. D-WASHER
5. CLUTCH
6. SHIFT FORK
7. INPUT SHAFT
8. BEARING CONE
9. BUSHING (2)
10. COVER

TA 296975

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION







TA 298390

9-18. AXLE DIFFERENTIAL CARRIER COVER REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations
MK48

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Differential carrier cover removed (para 9-15). Lockout chamber removed (para 9-3).

a. Disassembly

(1) Remove snapring (1), side gear (2), thrust washer (3), and D-washer (4).

(2) Remove clutch (5) and shift fork (6).

(3) Remove input shaft (7) and bearing cone (8).

(4) If needed, remove bearing cone (8) from input shaft (7).

(5) If needed, remove two bushings (9) from side gear (2).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect gear, clutch, and shaft for damage.

(3) Replace all parts failing inspection.

c. Assembly

(1) If removed, install bearing cone (8) onto input shaft (7).

(2) Install clutch (5) onto input shaft (7).

(3) Install shift fork (6) into cover (10) and position it on clutch (5) while installing input shaft (7).

(4) If removed, install two bushings (9) into side gear (2). When properly seated, one bushing (9) will be 1/32 inch (0.79 mm) below surface of large side of side gear (2). The other bushing (9) will be 5/32 inch (3.95 mm) below bottom of chamber on small side of side gear (2).

(5) Install D-washer (4), thrust washer (3), and side gear (2) onto input shaft (7).

(6) Install snapring (1) onto input shaft (7).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install lockout chamber (para 9-3). Install differential carrier cover (para 9-16).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. FRONT AXLE WILL NOT TURN IN ONE OR BOTH DIRECTIONS

WARNING

To prevent personal injury, do not reach into fan area while engine is running.

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst. This can result in personal injury.

When installing shim keep hands clear of pitman arm and pitman arm stop. Pitman arm can crush hands if placed between arm and stop.

NOTE

Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in STEERING position, directional relief valve solenoid electrical plug disconnected, trailer disconnected from MK48, and hydraulic oil temperature at 130-150°F (54-66°C).

Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 3. Start engine and run at idle speed. Place a 1/2 inch (1.2 cm) shim between pitman arm and pitman arm stop. While assistant holds shim in place, turn steering wheel fully to the left and check for 1,700-1,800 psi (11,721-12,411 kPa). Record reading. Remove shim and place on opposite stop. Turn steering wheel fully to the right. Check for 1,700-1,800 psi (11,721-12,411 kPa).

- If pressures are within specifications in both directions, front axle steering system is working properly.
- If pressures are not within specifications in one or both directions, refer to Malfunction 1, Tests 1 thru 10.

END OF TEST

(15) Wrap a strap and chain wrench around gear assembly (3).

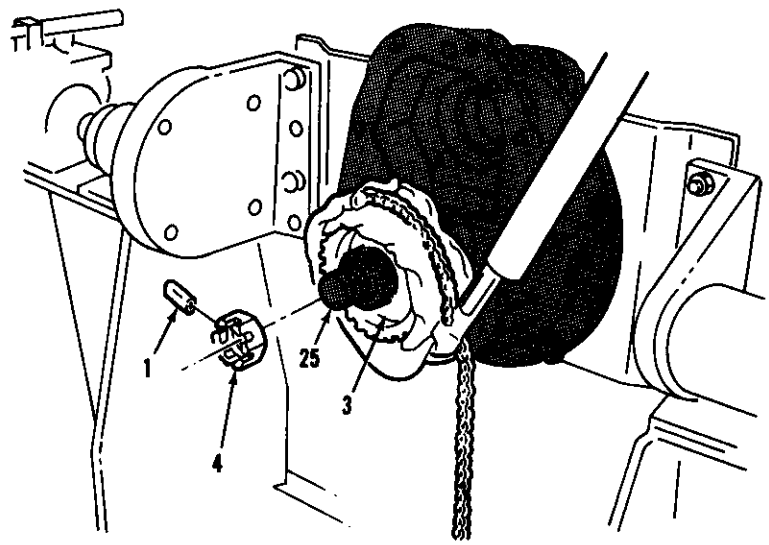
(16) Retorque nut (4) to 840 foot-pounds (1139 N·m). Continue to torque nut (4) until slot in nut (4) is alined with hole in pinion (25). Install new roll pin (1).

END OF TASK

NOTE

Follow-On Maintenance

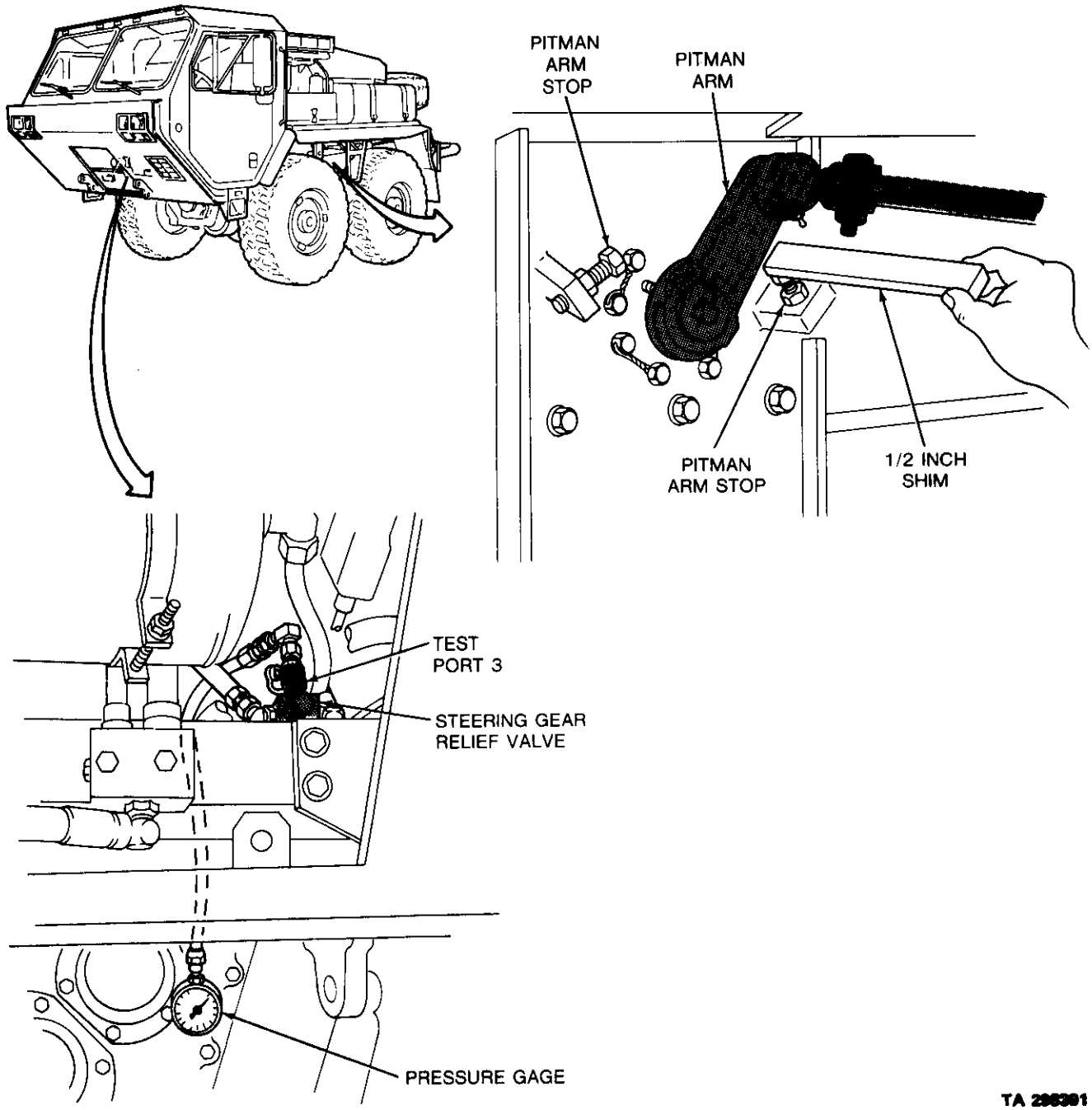
TM 2320-34/13 TM 9-2320-297-34	Assemble differential carrier to nose box (para 9-16).



1. ROLL PIN
3. GEAR ASSEMBLY
4. NUT
25. PINION

TA 298974

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 296391

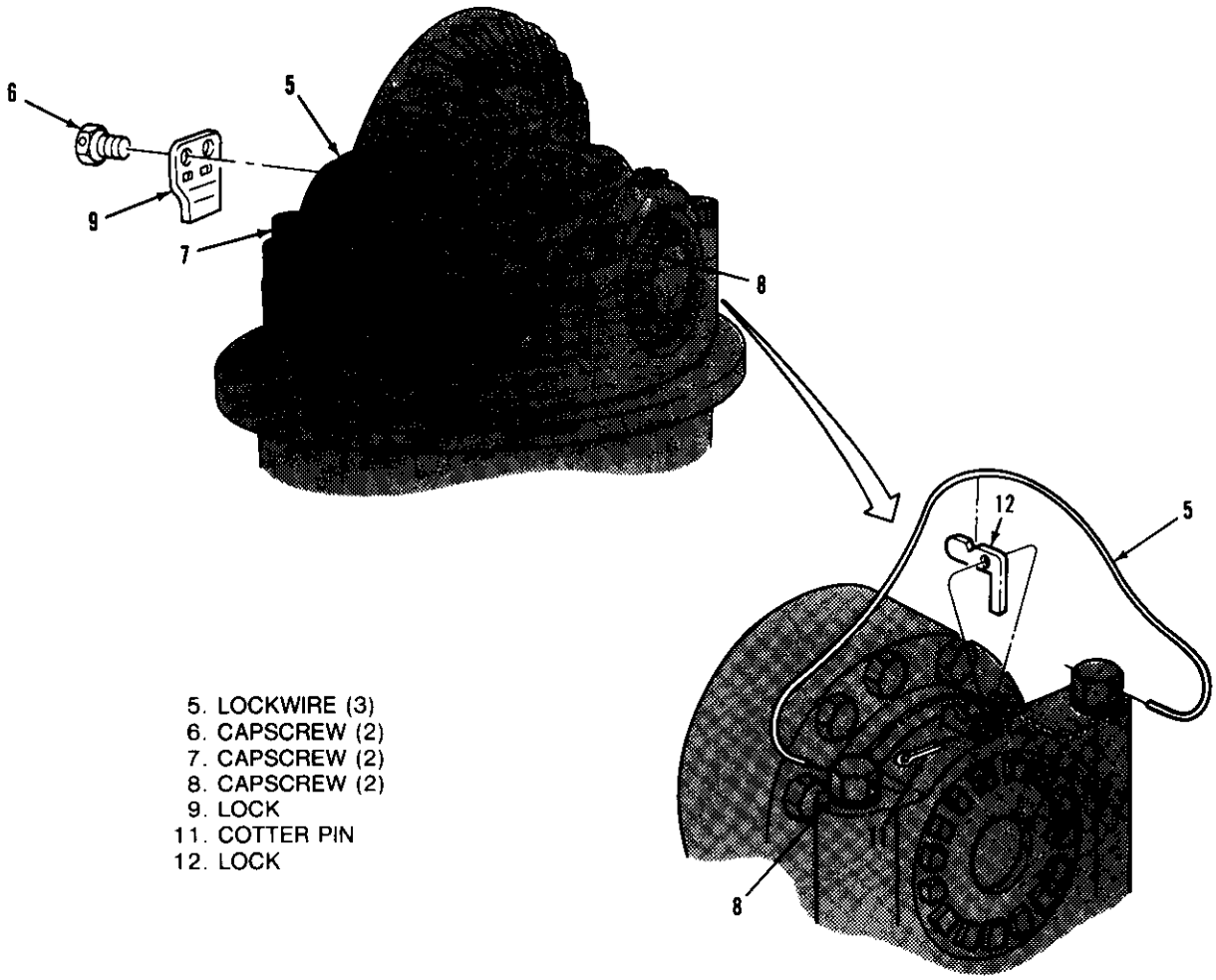
9-17. DIFFERENTIAL CARRIER REPAIR (Continued)

(11) Install lock (12) and new cotter pin (11).

(12) Install lock (9) and two capscrews (6). Torque capscrews (6) to 160-178 foot-pounds (217-239 N·m).

(13) Torque capscrews (7 and 8) to 360-440 foot-pounds (448-596 N·m).

(14) Install new lockwires (5) on capscrews (7 and 8) and two capscrews (6).



5. LOCKWIRE (3)
6. CAPSCREW (2)
7. CAPSCREW (2)
8. CAPSCREW (2)
9. LOCK
11. COTTER PIN
12. LOCK

TA 298973

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. OVERSENSITIVE STEERING

Test 1. Check hydraulic accumulator for correct charge of 375-400 psi (2,585-2,758 kPa).
- Recharge hydraulic accumulator. Refer to paragraph 19-16.

END OF TEST

5. VEHICLE WANDERS

WARNING

To prevent personal injury, do not reach into fan area while engine is running.

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself.

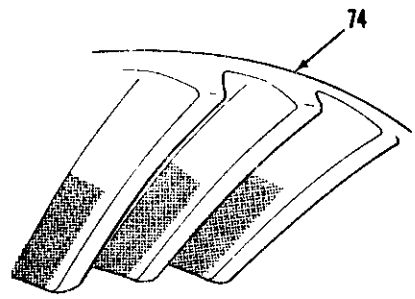
Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst. This can result in personal injury.

NOTE

Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in STEERING position, directional relief valve solenoid electrical plug disconnected, and hydraulic oil temperature at 130-150°F (54-66°C).

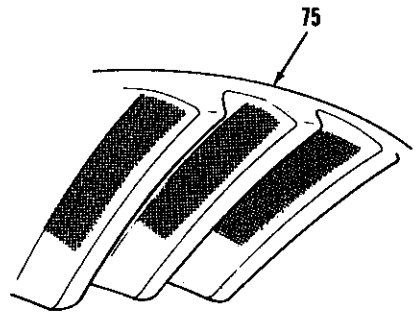
Test 1. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 6. Start engine and allow it to run at idle speed. Place hydraulic selector valve in the AUXILIARY HYDRAULICS position. Increase engine to maximum speed. Check for 3,150-3,250 psi (21,719-22,411 kPa).
- If pressure is within specifications, small section of hydraulic pump, relief valve, and selector valve are working properly. Go to Test 2.
- If pressure is not within specifications, refer to Malfunction 1, Tests 1 thru 4.

(e) If pattern is similar to contact pattern (74), where it is too close to edge of tooth toe, move ring gear (26) away from pinion (25) by adding backlash. Paint ring gear (26) teeth and recheck pattern, refer to step (5), section b.



74. CONTACT PATTERN

(f) If pattern is similar to contact pattern (75), where it is too close to edge of tooth toward tooth heel, move ring gear (26) toward pinion (25) to remove backlash. Paint ring gear (26) teeth and recheck pattern, refer to step (5), section c.



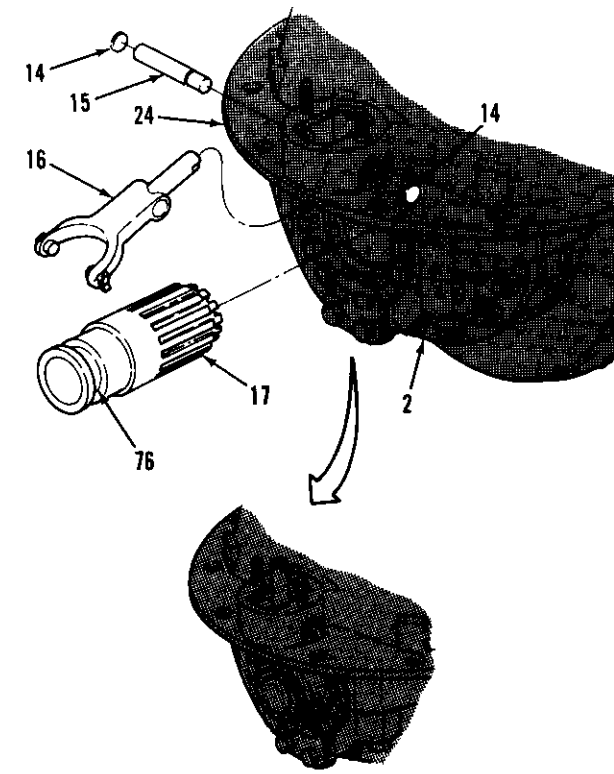
75. CONTACT PATTERN

(7) When contact pattern is correct, install shift fork (16) into carrier housing (24) so that tangs on shift fork (16) point toward differential carrier assembly (2).

(8) Install sliding clutch (17) into differential carrier assembly (2), while alining shifting fork (16) with shift fork groove (76).

(9) Install shift fork shaft assembly (15) and two new expansion plugs (14).

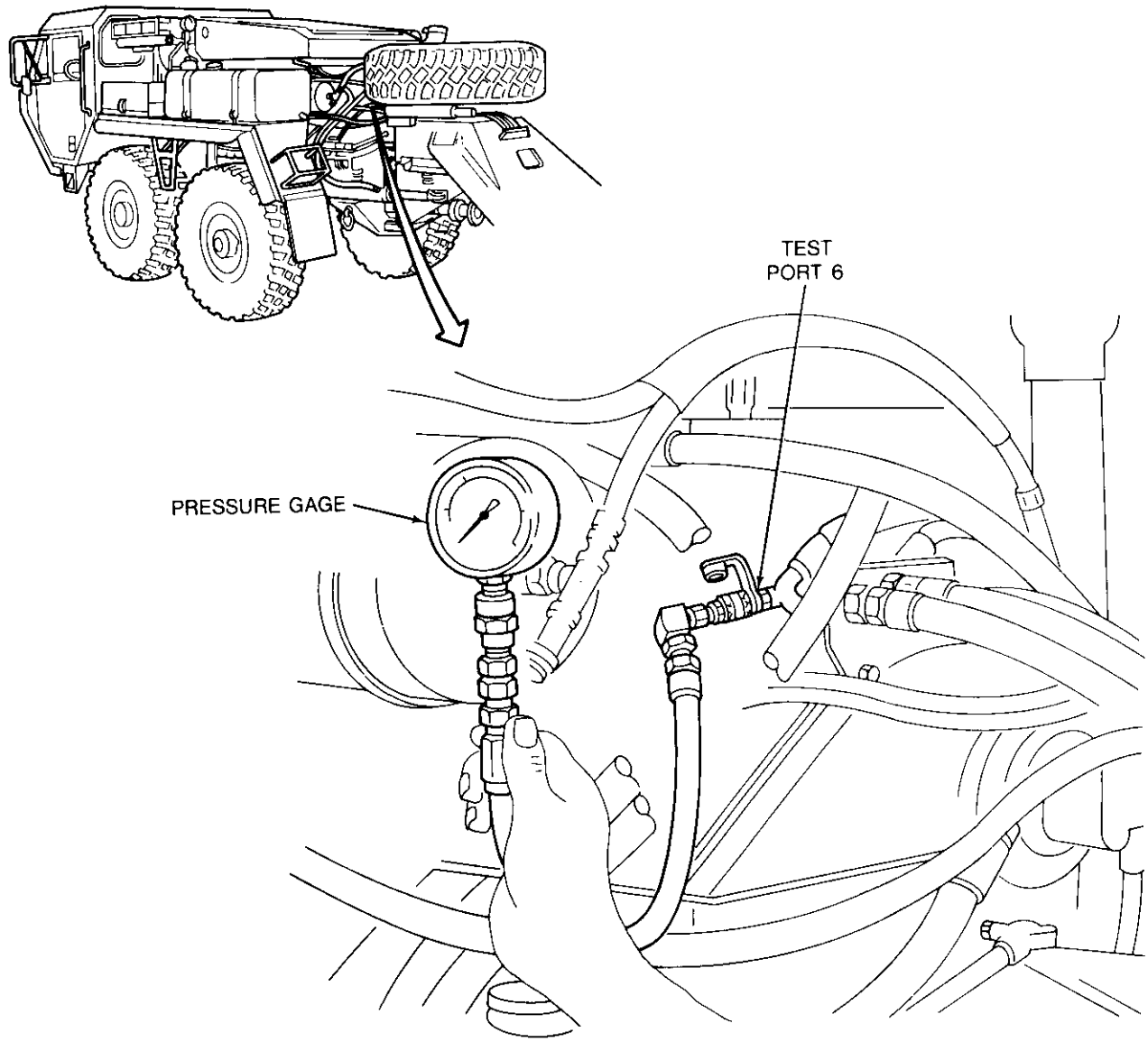
(10) Check shift fork (16) and sliding clutch (17) for free movement.



2. DIFFERENTIAL CARRIER ASSEMBLY
14. EXPANSION PLUG (2)
15. SHIFT FORK SHAFT ASSEMBLY
16. SHIFT FORK
17. SLIDING CLUTCH
24. CARRIER HOUSING
76. SHIFT FORK GROOVE

TA 298972

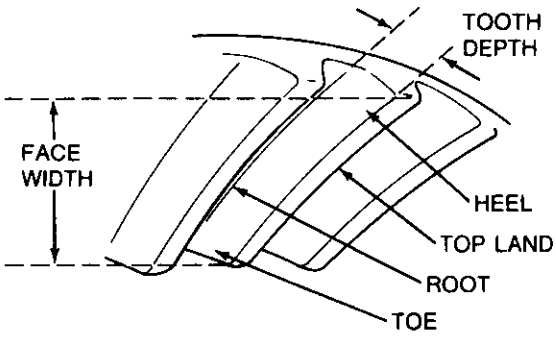
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

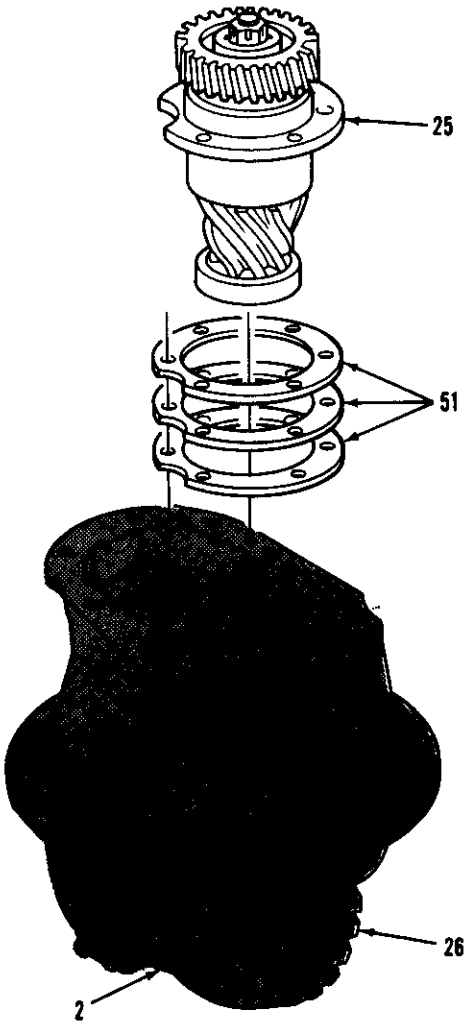


TA 298392

9-17. DIFFERENTIAL CARRIER REPAIR (Continued)

RING GEAR TOOTH NOMENCLATURE



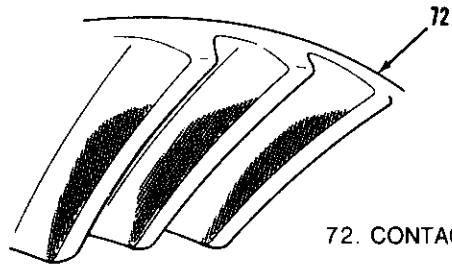


2. DIFFERENTIAL CARRIER ASSEMBLY
25. PINION
26. RING GEAR
51. SHIM

NOTE

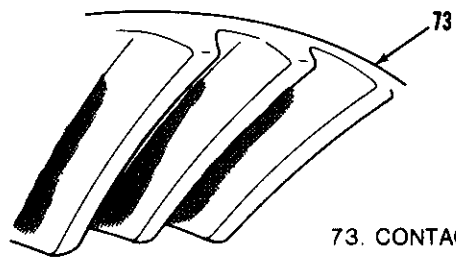
- Any time pinion depth is changed, backlash may change. Check and adjust backlash as needed.
- If shims (51) have to be changed, the differential carrier assembly (2) must be removed and readjusted.

(c) If pattern is similar to contact pattern (72), where it is too close to tooth top and off of center, move pinion (25) towards ring gear (26) by removing some shims (51) from shim pack. Paint ring gear (26) teeth and recheck pattern.



72. CONTACT PATTERN

(d) If pattern is similar to contact pattern (73), where it is too close or off tooth root, move pinion (25) away from ring gear (26) by adding shims (51) to shim pack. Paint ring gear (26) teeth and recheck pattern.



73. CONTACT PATTERN

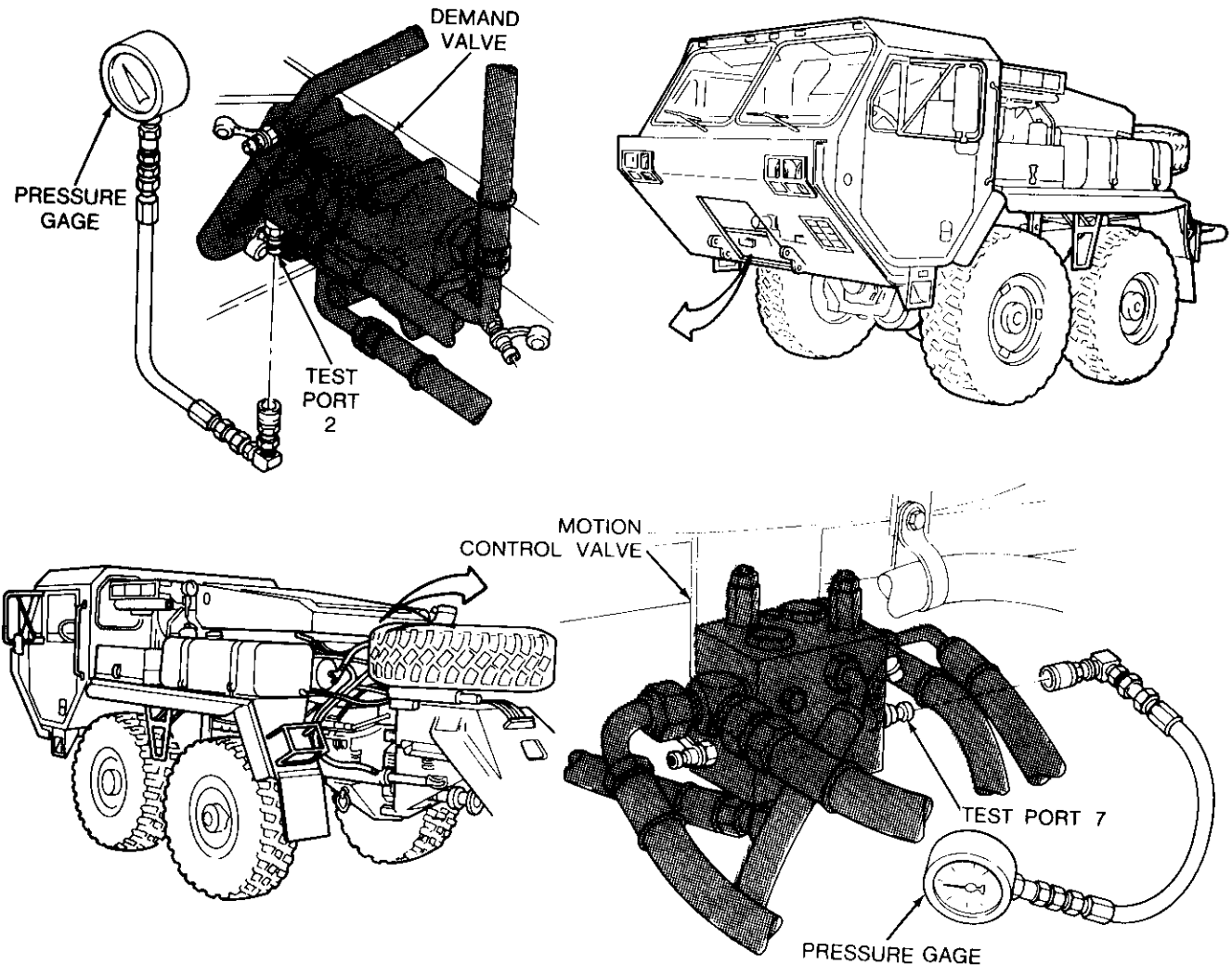
TA 298971

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

5. VEHICLE WANDERS (Continued)

Test 2. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 2. Start engine and allow it to run at idle speed. Turn steering wheel fully to the right until it stops. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record reading. Remove gage and install at test port 7. Turn steering wheel fully to the left until it stops. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record reading.

- If pressures are within specifications in both directions, large section of hydraulic pump is working properly. Go to Test 3.
- If pressures are not within specifications, refer to Malfunction 1, Tests 5 thru 7.



TA 296393

(5) Measure backlash with a dial indicator (69). At three different points on ring gear (26), hold pinion (25) while taking backlash measurement.

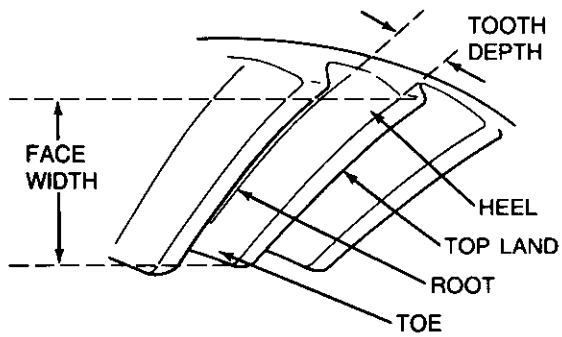
(a) Using a dial indicator (69) with a magnetic base, position dial indicator (69) so that plunger contacts ring gear (26) teeth. Backlash should be 0.006-0.016 inch (0.1524-0.4064 mm).

(b) To add backlash, loosen bearing adjuster (20) three notches. Loosen bearing adjuster (19) one notch. Tighten bearing adjuster (20) until it contacts bearing cup. Then tighten two or three notches further. Recheck backlash.

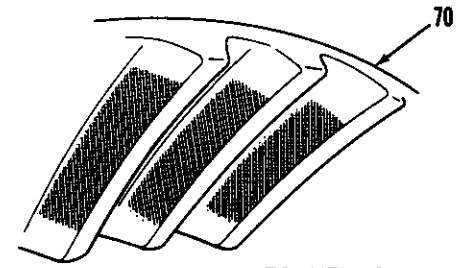
(c) To remove backlash, loosen bearing adjuster (20) three notches. Tighten bearing adjuster (19) one notch. Tighten bearing adjuster (20) until it contacts bearing cup. Then tighten two or three notches further. Recheck backlash.

(6) Check ring gear (26) and pinion tooth contact by painting 12 ring gear (26) teeth with marking compound. Roll ring gear (26) a couple of turns to obtain contact pattern.

RING GEAR TOOTH NOMENCLATURE

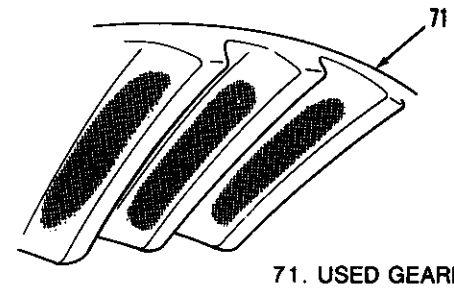


(a) If new gearing, ring gear (26) and/or pinion (25), has been installed, contact pattern (70) must be as shown. Pattern should cover one-half width of face and should be evenly centered between tooth top and root. Pattern should be clear of tooth toe.



70. NEW GEARING CONTACT PATTERN

(b) If used gearing, ring gear (26) and/or pinion (25), has been installed, contact pattern (71) must be as shown. A correct pattern is clear of toe and centers evenly along width of face between top and root. Length and shape of pattern may vary and is acceptable as long as pattern does not run off tooth at any point.



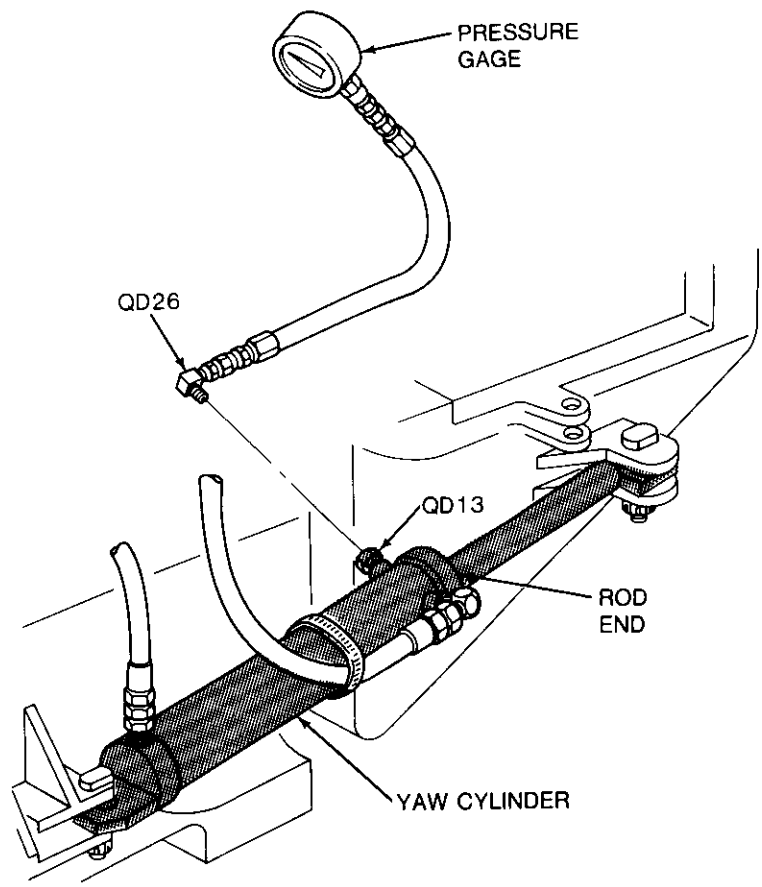
71. USED GEARING CONTACT PATTERN

TA 298970

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 3. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at rod end of left yaw cylinder. Start engine and allow it to run at idle speed. Turn steering wheel fully left and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record readings. Remove pressure gage and install at rod end of right yaw cylinder. Start engine and allow it to run at idle speed. Turn steering wheel fully right and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa). Record readings.

- If pressures are within specifications in both directions, yaw steering is working properly. Refer to SUSPENSION troubleshooting.
- If pressures are not within specifications in both directions, go to Test 4.



TA 298394

9-17. DIFFERENTIAL CARRIER REPAIR (Continued)

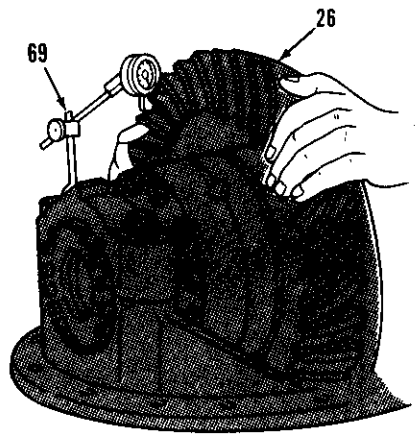
d. Adjustments

(1) On tooth side of ring gear (26), position bearing adjuster (20) so that one thread is visible on carrier housing (24).

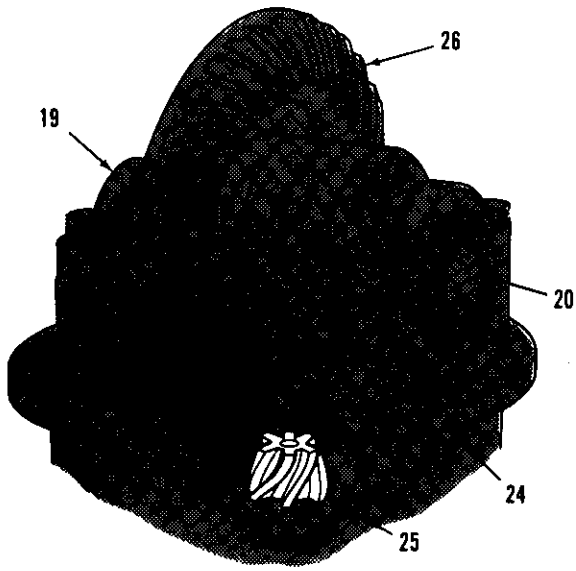
(2) Tighten bearing adjuster (19) until there is no backlash. To check backlash, face teeth of ring gear (26) and push gear (26) away from you while rocking ring gear (26) from side to side. There should be no backlash between pinion (25) and ring gear (26).

(3) Rotate ring gear (26) and check for any point where ring gear (26) may bind. If binding, loosen and retighten bearing adjuster (19).

(4) Tighten bearing adjuster (20) until it contacts bearing cup. Continue to tighten bearing adjuster (20) two to three notches.



26. RING GEAR
69. DIAL INDICATOR



19. BEARING ADJUSTER
20. BEARING ADJUSTER
24. CARRIER HOUSING
25. PINION
26. RING GEAR

TA 298969

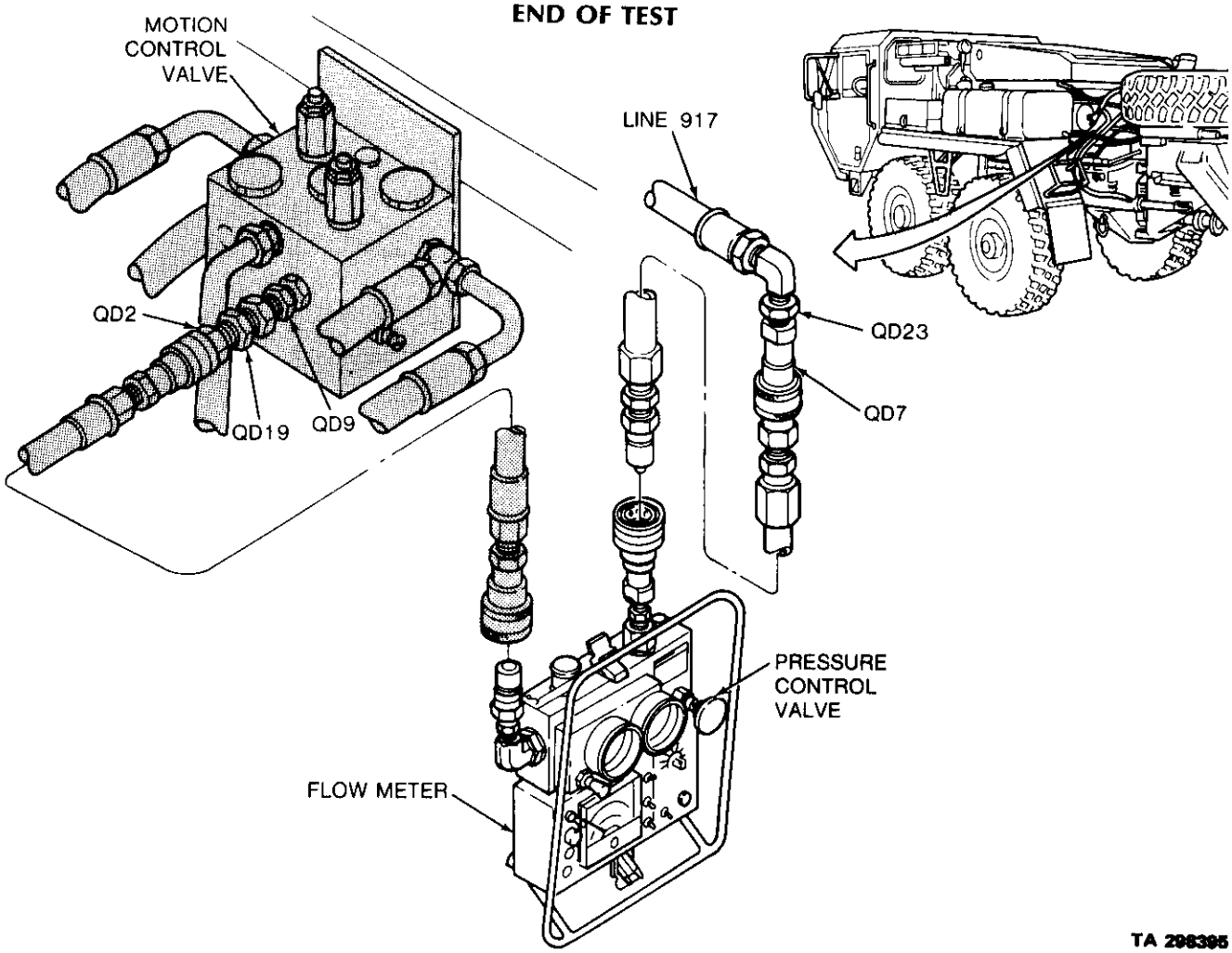
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

5. VEHICLE WANDERS (Continued)

Test 4. Remove line 917 from motion control valve. Install a flow meter in line between motion control valve and line 917. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at rod end of left yaw cylinder. Start engine and allow it to run at idle speed. Turn steering wheel fully to the left and hold. Check for 2,200-2,300 psi (15,169-15,858 kPa) on pressure gage and less than 100 psi (689 kPa) on flow meter. Record readings. Remove pressure gage and install at rod end of right yaw cylinder. Start engine and allow it to run at idle speed. Turn steering wheel fully right and hold. Check for 2,2000-2,300 psi (15,169-15,858 kPa) on pressure gage and less than 100 psi (689 kPa) on flow meter. Record readings.

- If pressure is over 100 psi (689 kPa) on flow meter and 2,200-2,300 psi (15,169-15,858 kPa) is not present on yaw cylinder pressure gage, replace motion control valve. Refer to paragraph 19-14 or 19-15.
- If pressure is below 100 psi (689 kPa) on flow meter and 2,200-2,300 psi (15,169-15,858 kPa) is not present on yaw cylinder pressure gage, repair or replace yaw cylinder(s). Refer to paragraph 19-11.

END OF TEST



TA 298395

(55) Install bearing cups (21 and 22).

CAUTION

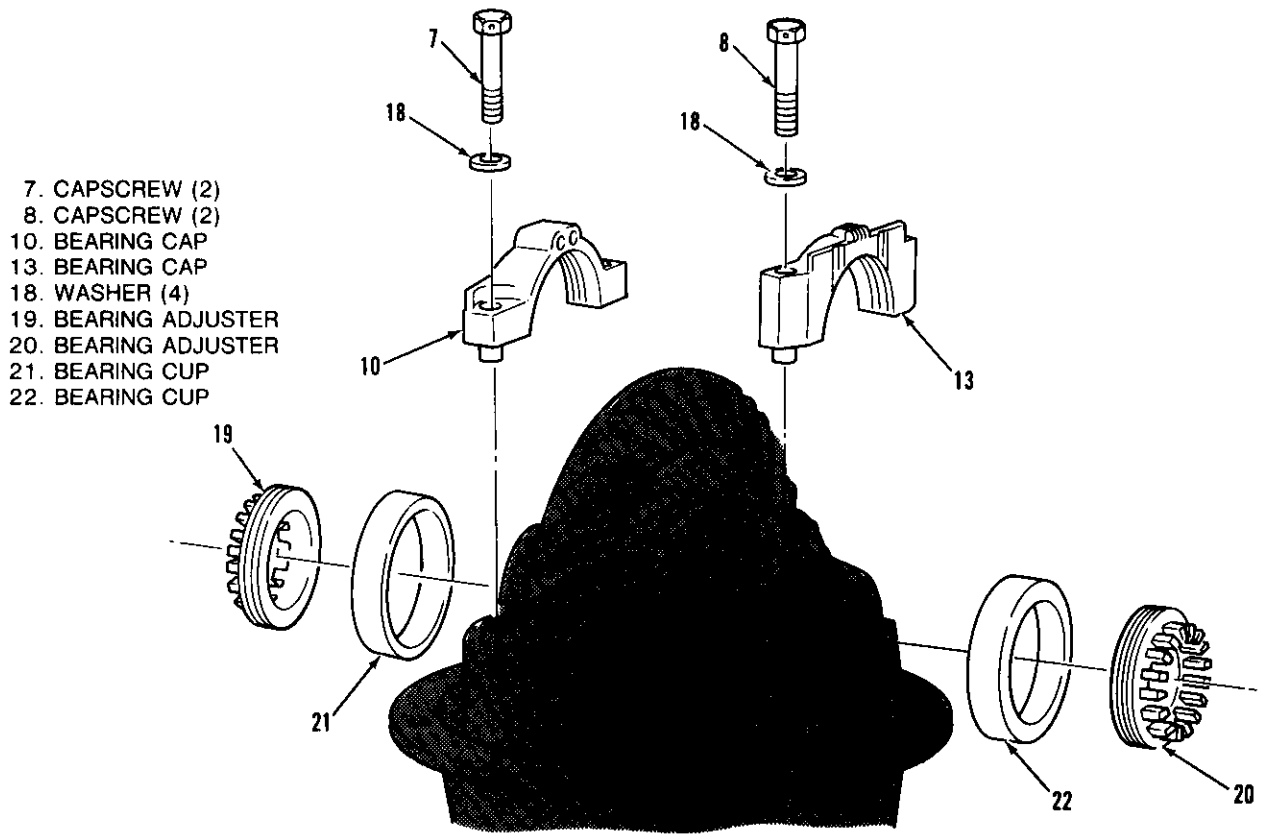
Make sure both bearing caps (10 and 13) are fully seated and adjusters (19 and 20) must not be cross threaded.

(56) Install bearing cap (10) and bearing adjuster (19).

(57) Install bearing cap (13) and bearing adjuster (20).

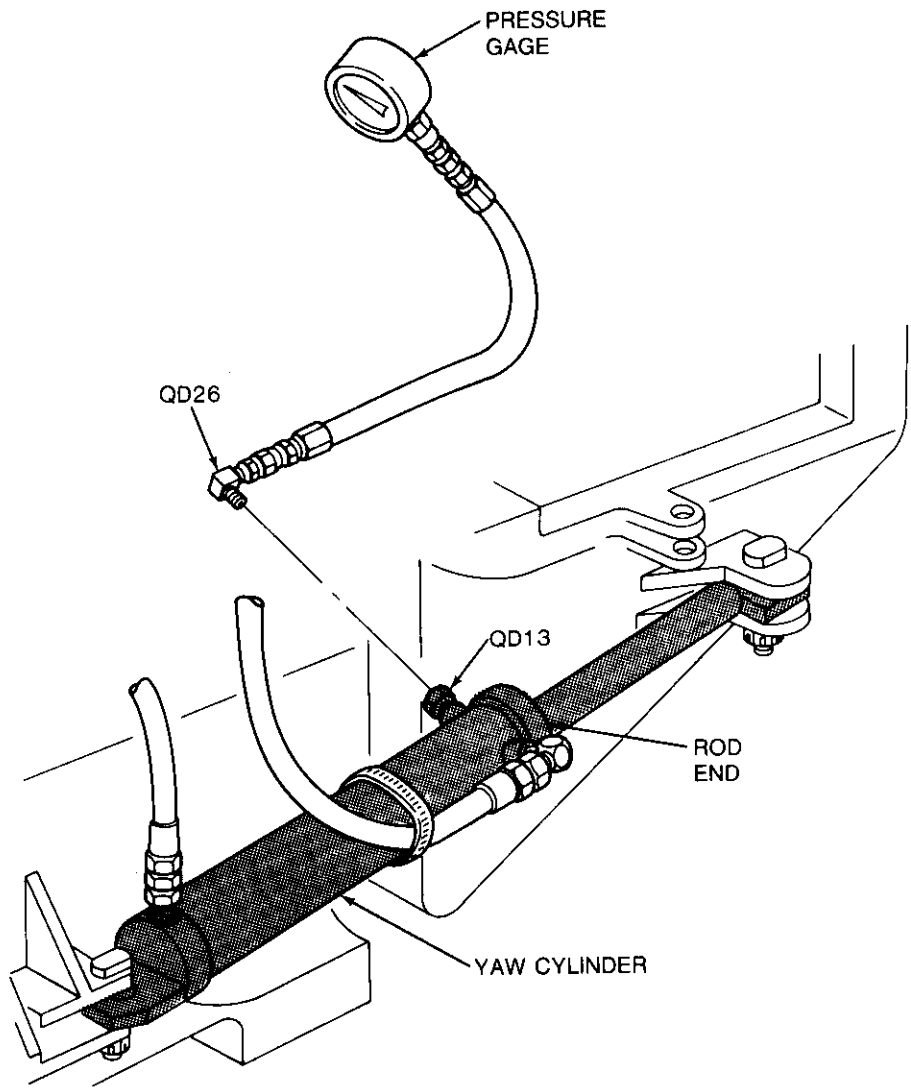
(58) Install two capscrews (7 and 8) and washers (18) on each bearing cap (10 and 13). Hand tighten capscrews (7 and 8).

(59) Rotate bearing adjuster (19 and 20). If adjusters (19 and 20) bind, loosen capscrews (7 and 8) and check to see if bearing adjusters (19 and 20) are cross threaded.



TA 298968

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298396

9-17. DIFFERENTIAL CARRIER REPAIR (Continued)

(45) Install 10 springs (30), in smallest possible circle, onto pressure plate (31).

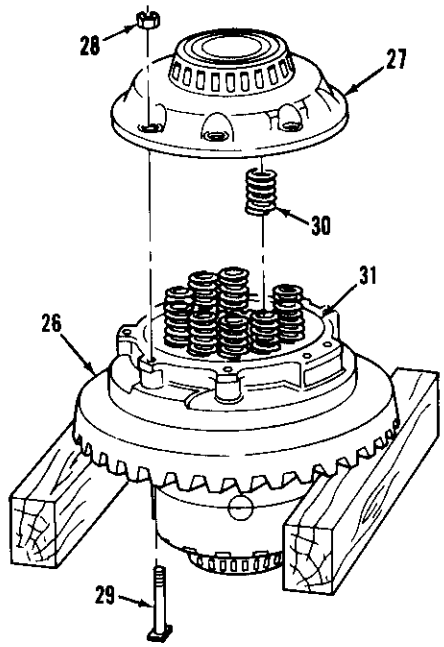
(46) Install clutch pack cover (27) over springs (30).

(47) Reach inside hole in clutch pack cover (27) and move springs (30) outward as far as they will go.

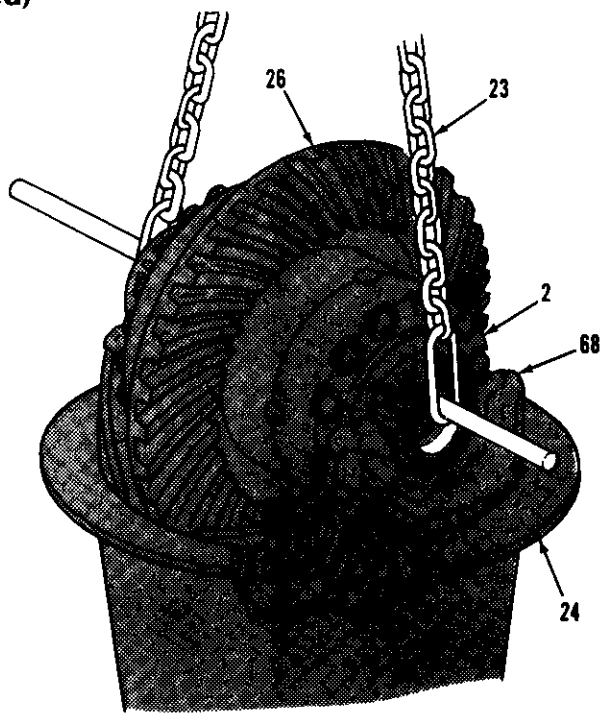
(48) Press clutch pack cover (27) down to compress springs (30) fully. Aline clutch pack cover (27) and ring gear (26) with two capscrews (29).

(49) Install remaining six capscrews (29) and eight new locknuts (28). Torque locknuts (28) to 110-130 foot-pounds (149-176 N·m).

(50) Slowly remove press tension on clutch pack cover (27).



26. RING GEAR
27. CLUTCH PACK COVER
28. LOCKNUT (8)
29. CAPSCREW (8)
30. SPRING (10)
31. PRESSURE PLATE



2. DIFFERENTIAL CARRIER ASSEMBLY
23. LIFTING DEVICE
24. CARRIER HOUSING
25. PINION
26. RING GEAR
68. SHOP RAG (2)

TA 298967

(51) Install two clean shop rags (68) on carrier housing (24) to protect carrier bearings.

(52) Attach a lifting device (23) to differential carrier assembly (2).

NOTE

It may be necessary to tilt differential carrier assembly (2) to aline with pinion (25).

(53) Install differential carrier assembly (2) into carrier housing (24), making sure ring gear (26) alines with pinion (25).

(54) Remove lifting device (23) and shop rags (68).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

WINCH MK15 AND MK16

CAUTION

Always reinstall protective caps on hydraulic fittings after testing is complete. Failure to do so will allow dirt and moisture to enter hydraulic fittings.

1. WINCH WILL NOT OPERATE IN EITHER DIRECTION

WARNING

Never disconnect any hose or part while engine is running. Allow several minutes for pressure to relieve itself.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, remote control connected, and hydraulic oil temperature at 130-150°F (54-66°C).
- Winch testing will be done with 10 feet (3 M) of cable payed out and no load on the end of the cable.

Remove brake release line from winch. Install a tee fitting and a 0-2,000 psi (0-13,790 kPa) pressure gage in line between winch and line. Operate winch in and out. Check for minimum of 200 psi (1,379 kPa) in both directions. Record readings.

- If pressure is within specifications in both directions, repair or replace winch brake assembly. Refer to paragraph 17-14.
- If pressure is not within specifications in both directions, repair or replace counterbalance valve. Refer to paragraph 17-10 or 17-11.

END OF TEST

(36) Install one externally splined plate (32) into differential case assembly (34).

(37) Install one internally splined plate (33) into differential case assembly (34).

(38) Using sliding clutch (17), aline plate (33) into center of differential case assembly (34).

(39) Repeat steps (36) and (38) until the remaining seven externally splined plates (32) and six internally splined plates (33) have been installed.

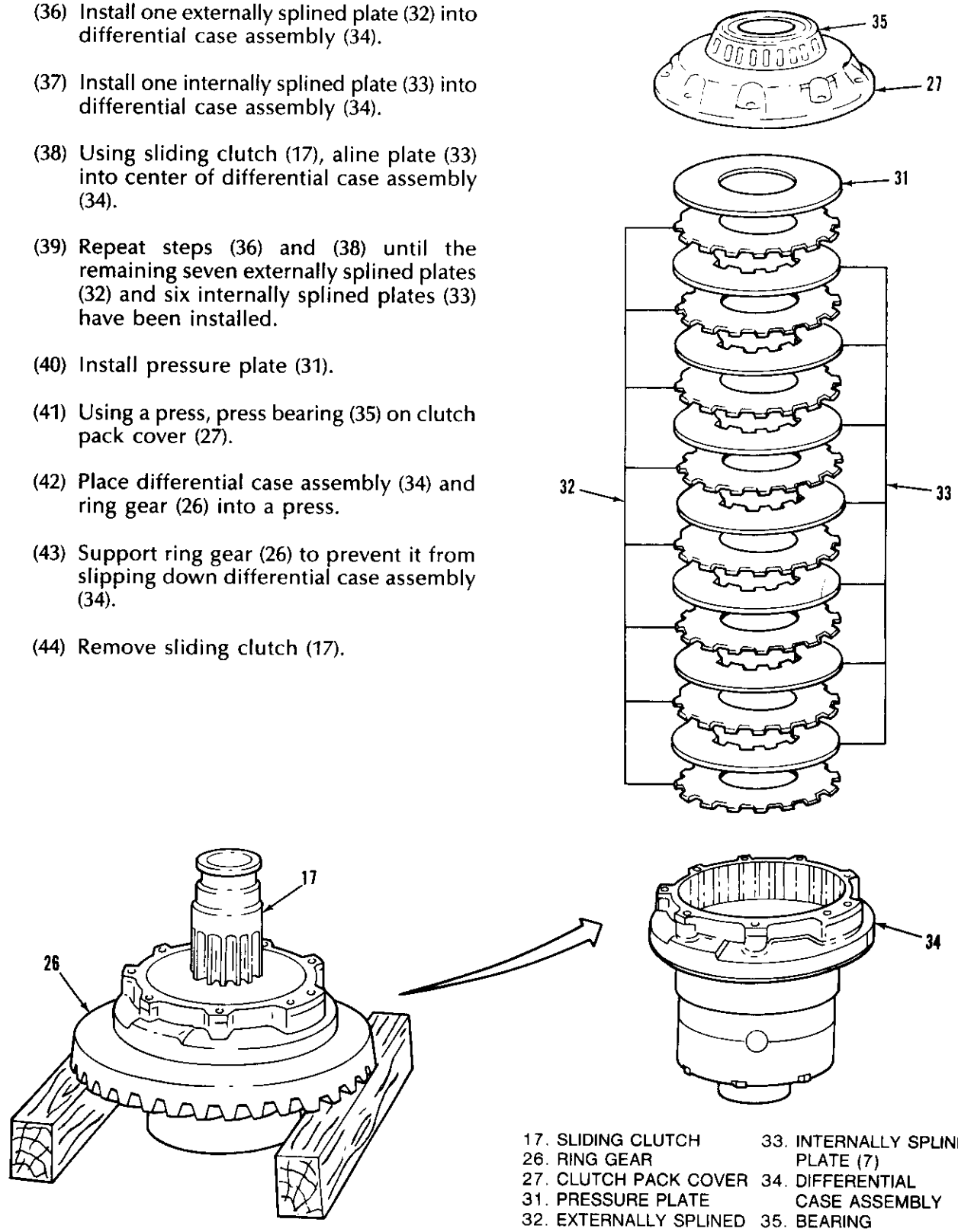
(40) Install pressure plate (31).

(41) Using a press, press bearing (35) on clutch pack cover (27).

(42) Place differential case assembly (34) and ring gear (26) into a press.

(43) Support ring gear (26) to prevent it from slipping down differential case assembly (34).

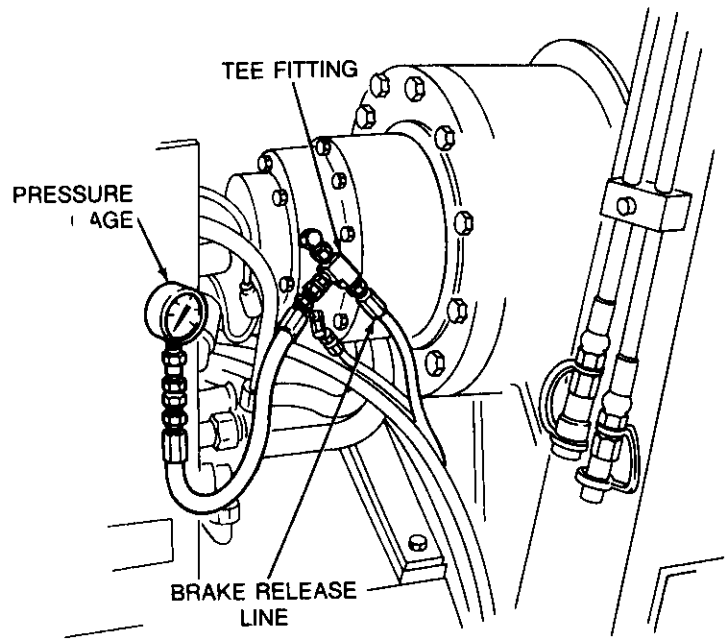
(44) Remove sliding clutch (17).



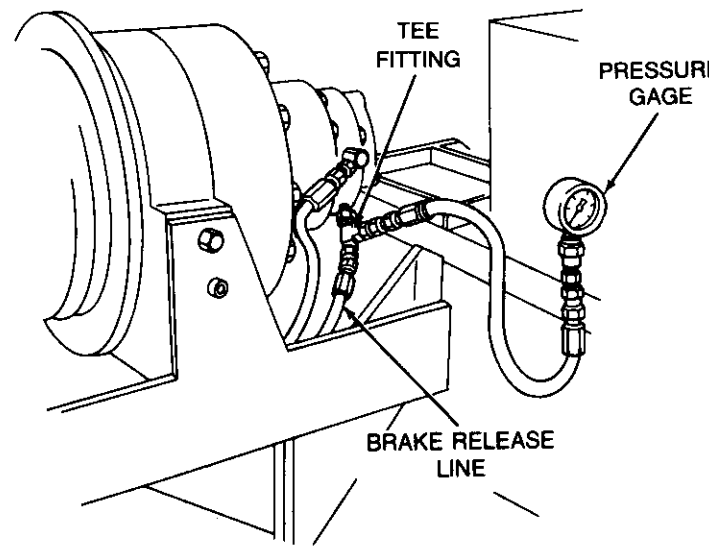
17. SLIDING CLUTCH
26. RING GEAR
27. CLUTCH PACK COVER
31. PRESSURE PLATE
32. EXTERNALLY SPLINED PLATE (8)
33. INTERNALLY SPLINED PLATE (7)
34. DIFFERENTIAL CASE ASSEMBLY
35. BEARING

TA 298966

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



MK15



MK16

TA 296397

9-17. DIFFERENTIAL CARRIER REPAIR (Continued)

(28) Using a press, press bearing (48) onto plain case half (37).

(29) Install thrust washer (46) and side gear (45) into flanged case half (38).

(30) Install four pinion gears (44) and thrust washers (43) onto spider (42).

(31) Install spider (42) into flanged case half (38) and rotate spider to make sure gears (44 and 45) mesh.

(32) Install side gear (41) and thrust washer (40) onto spider (42).

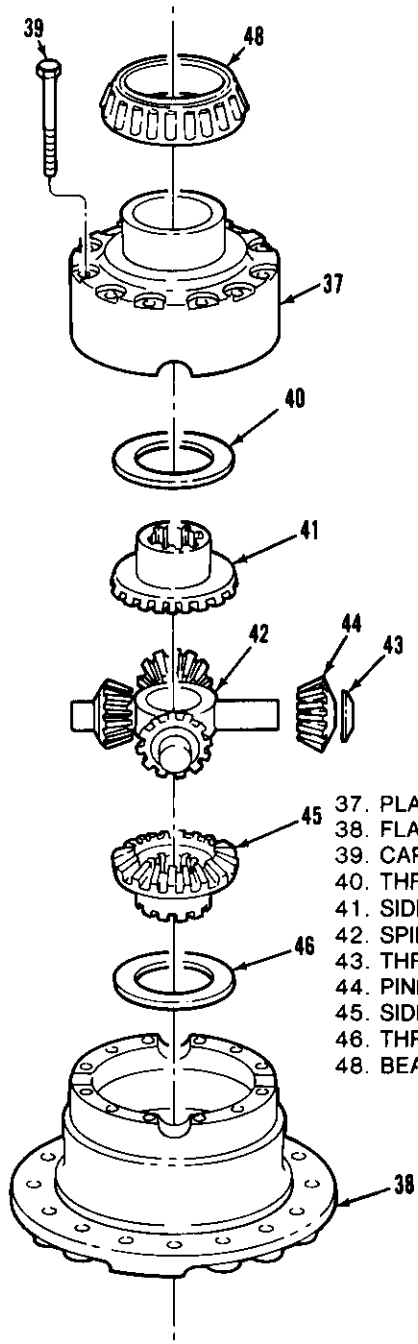
(33) Aline marks made during disassembly and install plain case half (37) onto flanged case half (38).

(34) Install 12 capscrews (39). Torque capscrews (39) to 150-180 foot-pounds (203-244 N·m).

NOTE

It may require up to 50 foot-pounds (68 N·m) of torque to rotate side gear (45).

(35) Check differential gears for free rotation by turning side gear (45).



37. PLAIN CASE HALF
38. FLANGED CASE HALF
39. CAPSCREW (12)
40. THRUST WASHER
41. SIDE GEAR
42. SPIDER
43. THRUST WASHER (4)
44. PINION GEAR (4)
45. SIDE GEAR
46. THRUST WASHER
48. BEARING

TA 298985

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

2. WINCH WILL NOT CONTROL LOAD WHEN PAYING OUT

WARNING

Never disconnect any hose or part while engine is running. Allow several minutes for pressure to relieve itself.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, resulting in personal injury.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, remote control connected, and hydraulic oil temperature at 130-150°F (54-66°C).

- Winch testing will be done with 10 feet (3 M) of cable payed out and no load on the end of the cable.

Test 1. Remove line 900 from winch motor. Install a flow meter in line between winch motor and line 900. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and operate winch IN. Record pressure reading. Remove flow meter and install line 900 to winch. Remove line 901 from winch motor. Install a flow meter in line between winch motor and line 901. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and operate winch OUT. Record pressure reading. Check for a 200-350 psi (1,379-2,413 kPa) increase from first reading.

- If pressure increase is not present, repair or replace counterbalance valve. Refer to paragraph 17-10 or 17-11.

END OF TEST

NOTE

If original gear set is being reused, use same size shim pack as removed during disassembly. If new gear set is being used, use a shim pack of 0.024 inch (0.609 mm).

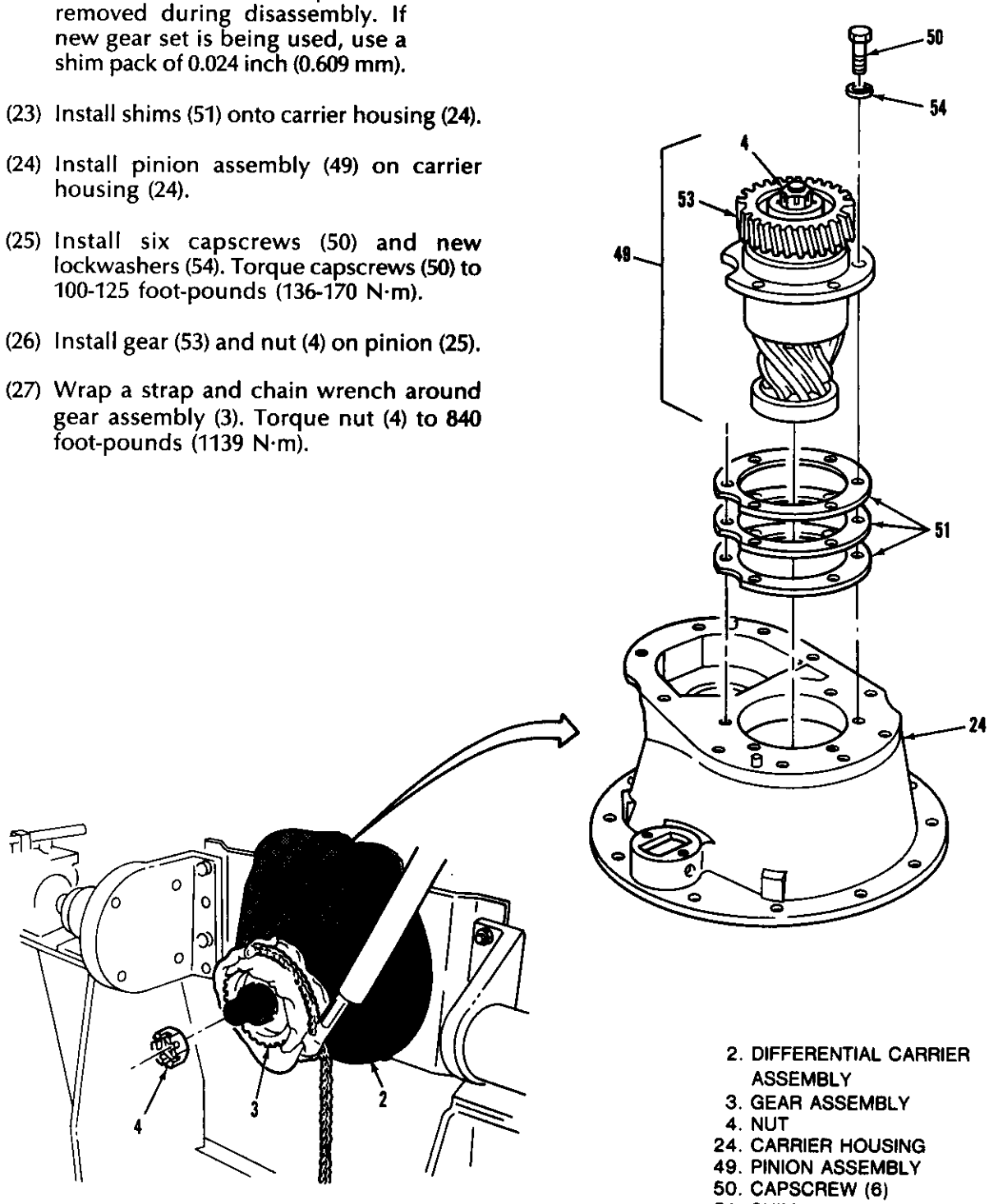
(23) Install shims (51) onto carrier housing (24).

(24) Install pinion assembly (49) on carrier housing (24).

(25) Install six capscrews (50) and new lockwashers (54). Torque capscrews (50) to 100-125 foot-pounds (136-170 N·m).

(26) Install gear (53) and nut (4) on pinion (25).

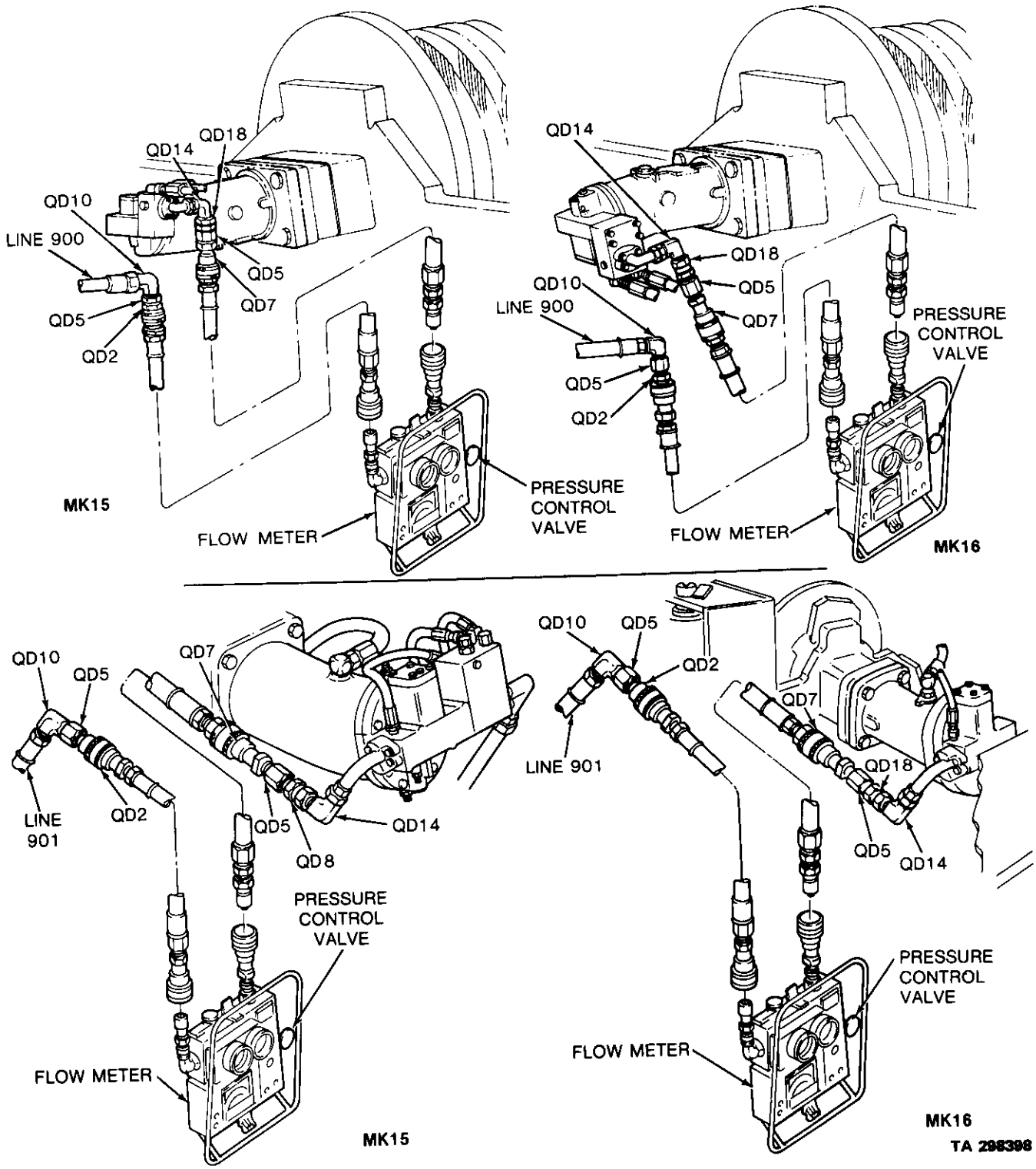
(27) Wrap a strap and chain wrench around gear assembly (3). Torque nut (4) to 840 foot-pounds (1139 N·m).



2. DIFFERENTIAL CARRIER ASSEMBLY
3. GEAR ASSEMBLY
4. NUT
24. CARRIER HOUSING
49. PINION ASSEMBLY
50. CAPSCREW (6)
51. SHIM
53. GEAR
54. LOCKWASHER (6)

TA 298984

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



9-17. DIFFERENTIAL CARRIER REPAIR (Continued)

(12) Press pilot bearing (61) on end of pinion (25).

(13) Using center punch and a hammer, form a staking pattern (66).

(14) Remove inner bearing (60) from bearing cage (52).

(15) Press inner bearing (60) on pinion (25) so that bevel part of inner bearing (60) is towards threaded end of pinion (25).

(16) Install the 0.001 inch (0.0254 mm) larger spacer (58) on pinion (25). Spacer (58) thickness was determined when setting bearing preload.

(17) Install bearing cage (52) on pinion (25).

(18) Press outer bearing (55) on pinion (25).

(19) Install a sleeve (67) over outer bearing (55). Position sleeve (67) so that load is directly applied to outer bearing (55).

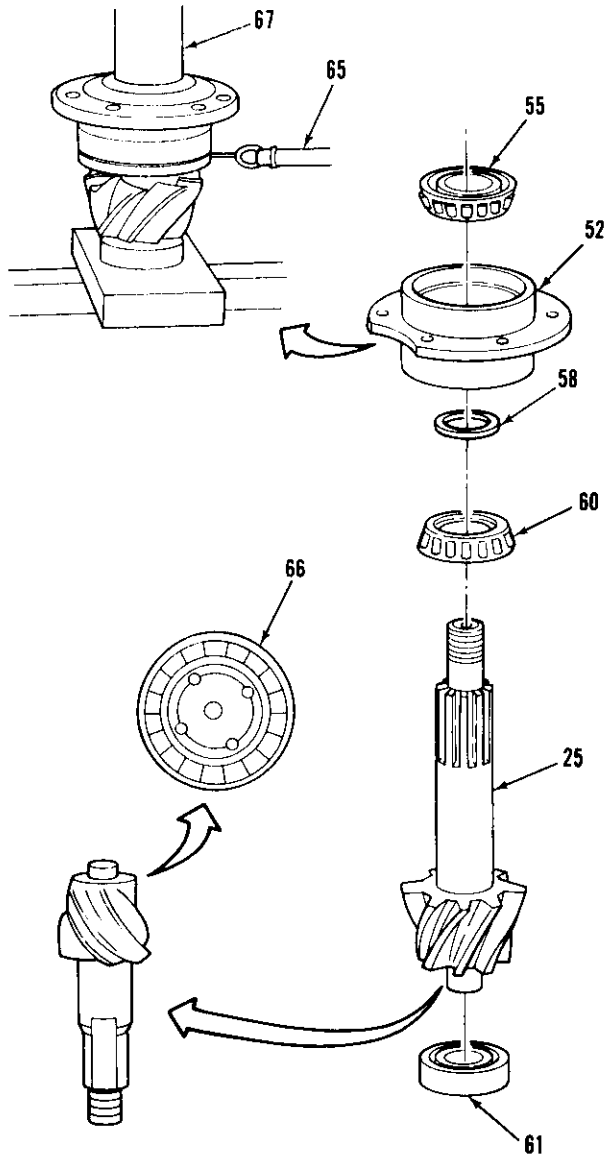
(20) Using a press, apply a load of 17-19 tons (15.4-17.2 metric tons) to outer bearing (55).

(21) Attach and wrap wire around bearing cage (52). Attach spring scale (65) and pull. Preload is correct when 5-12 pounds (2-5 kg) of pull will rotate bearing cage (52).

CAUTION

To prevent early failure of bearings and/or gear set, bearing preload must be 5-12 pounds (2-5 kg). Make sure final preload is within these specifications.

(22) Adjust preload if needed. Thicker spacer (58) will decrease preload, thinner spacer (58) will increase preload.



25. PINION
52. BEARING CAGE
55. OUTER BEARING
58. SPACER
60. INNER BEARING
61. PILOT BEARING
65. SPRING SCALE
66. STAKING PATTERN
67. SLEEVE

TA 298963

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. WINCH WILL NOT PULL A MAXIMUM LOAD

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, resulting in personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is obtained when pressure cannot be increased with pressure control valve and flow drops to zero. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, remote control connected, and hydraulic oil temperature at 130-150°F (54-66°C).

Test 1. Remove brake release line at winch. With suitable plugs, plug brake release line and its opening on winch. Remove line 900 from winch motor. Install a flow meter in line between winch motor and line 900. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and operate winch IN. Check for 2,800-2,875 psi (19,305-19,822 kPa). Install brake release line.

- If pressure is within specifications, repair or replace hydraulic winch motor. Refer to paragraph 17-12 or 17-13.
- If pressure is not within specifications, go to Test 2.

c. Assembly

(1) If removed, press bearing cups (56 and 57), beveled edge out, into bearing cage (52). Make sure bearing cups (56 and 57) are fully seated in bearing cage (52).

(2) Install inner bearing (60) on machined side of bearing cage (52). Coat surfaces with clean oil.

(3) If bearings (55 and 60) are being reused, place spacer (58) (removed during assembly) inside bearing cage (52).

(4) If new bearings (55 and 60) are being used, install new spacer (58) 0.496 inch (12.6 mm) thick.

(5) Install spacer (58) and outer bearing (55) into bearing cage (52). Coat surfaces with clean oil.

(6) Place bearing cage assembly (62) into press so that outer bearing (55) is towards press ram (63).

(7) Install sleeve (64) over outer bearing (55). Position sleeve (64) so that load is directly applied to inner race of outer bearing (55).

(8) Using a press, apply a load of 13.5-15.5 tons (12.2-14.0 metric tons) to outer bearing (55).

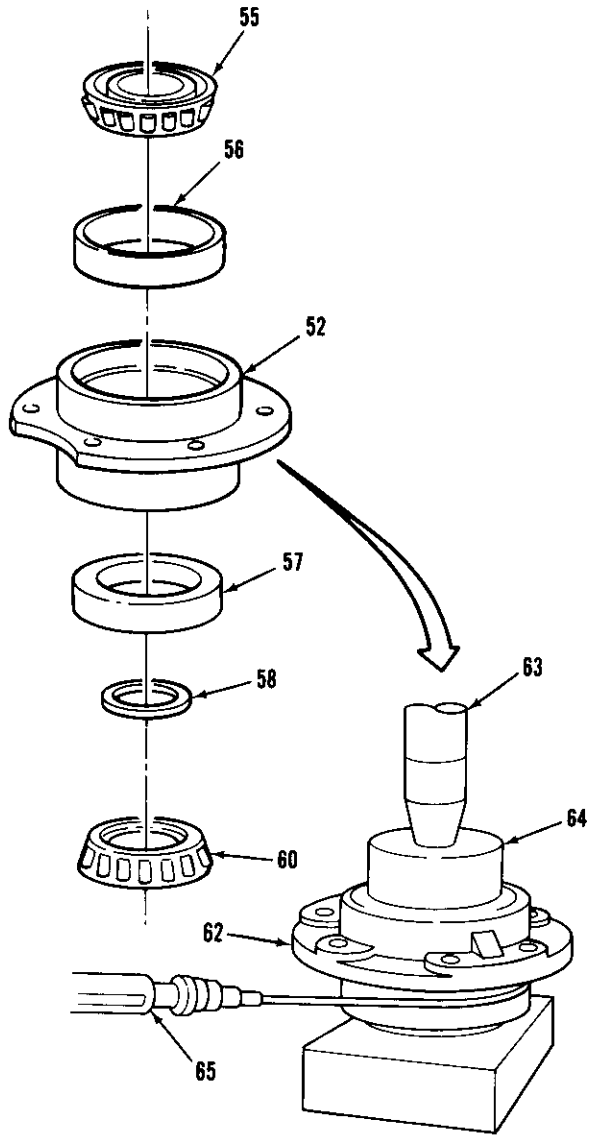
NOTE

Use a thicker spacer (58) to decrease preload and a thinner spacer (58) to increase preload.

(9) Attach and wrap a piece of wire around bearing cage (52). Attach a spring scale (65) to wire and pull. Preload is correct when 3-7 pounds (2-3 kg) of pull will rotate bearing cage (52).

(10) Remove outer bearing (55) and spacer (58). Exchange spacer (58) as needed to obtain correct preload.

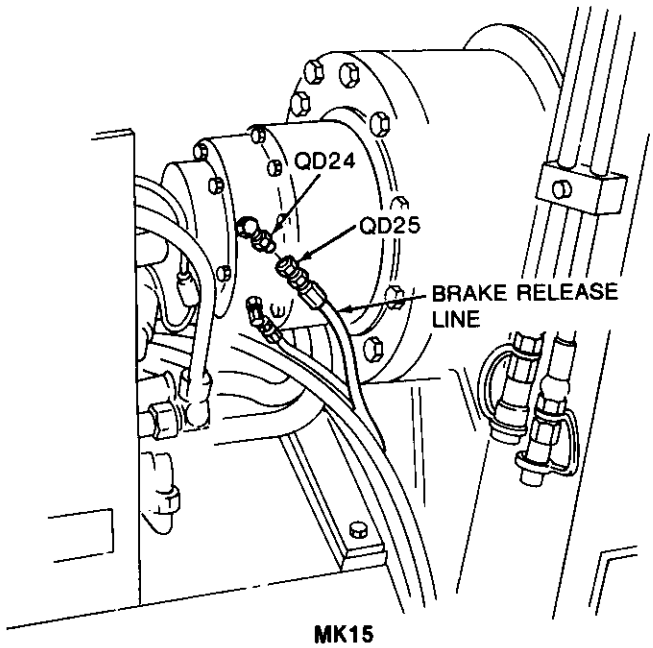
(11) When proper preload has been found, select a spacer (58) 0.001 inch (0.0254 mm) thicker for use during final assembly.



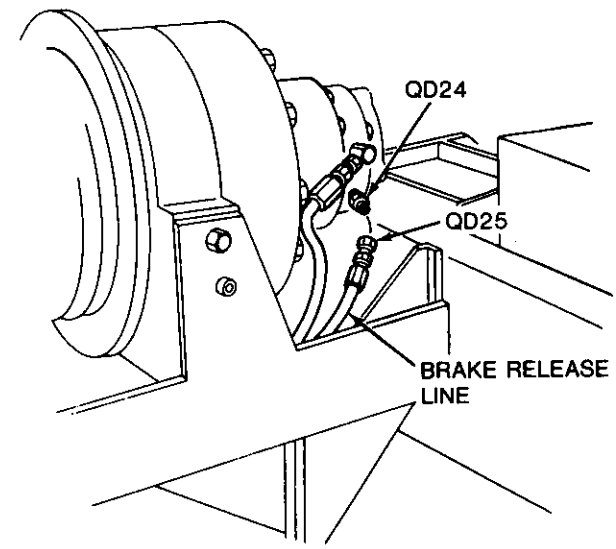
52. BEARING CAGE
55. OUTER BEARING
56. BEARING CUP
57. BEARING CUP
58. SPACER
60. INNER BEARING
62. BEARING CAGE ASSEMBLY
63. PRESS RAM
64. SLEEVE
65. SPRING SCALE

TA 298962

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



MK15



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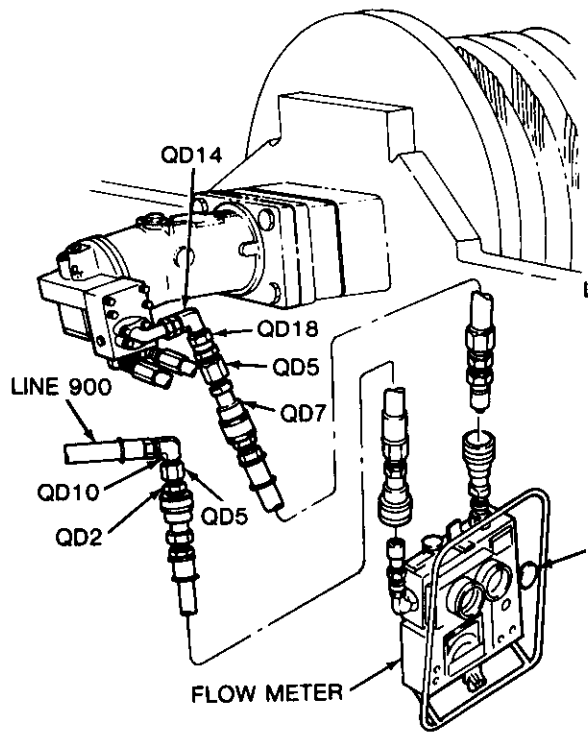

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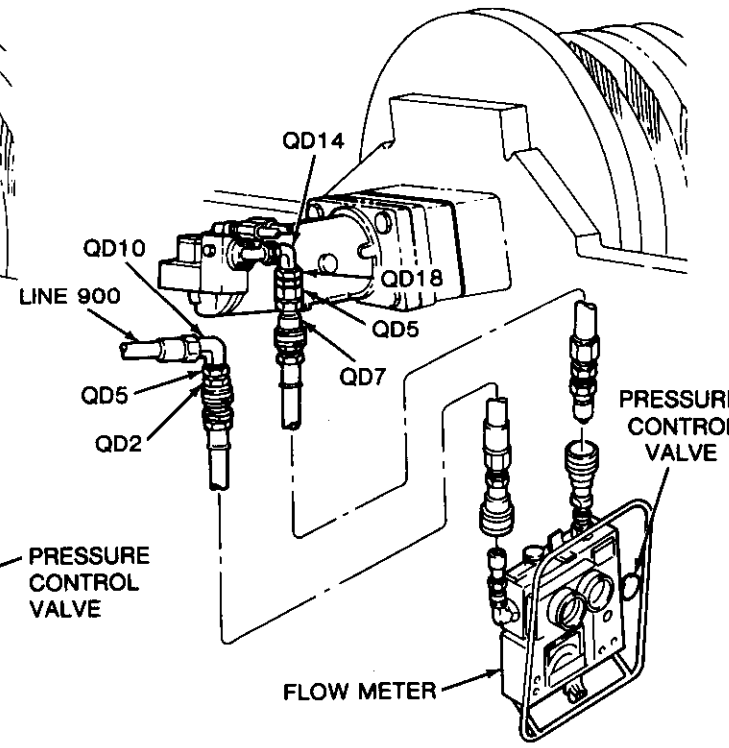


MK16

TA 298309

9-17. DIFFERENTIAL CARRIER REPAIR (Continued)

(38) Remove outer bearing (55) from bearing cage (52).

(39) If damaged, remove bearing cups (56 and 57) from bearing cage (52).

(40) Remove spacer (58) from pinion (25).

(41) Using a split-type puller (59) and press, remove bearings (60 and 61) from pinion (25).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect gears for damage or signs of overheating.

(3) Inspect bearings for damage, pitting, or scoring.

(4) Inspect clutch plates for scoring or burning.

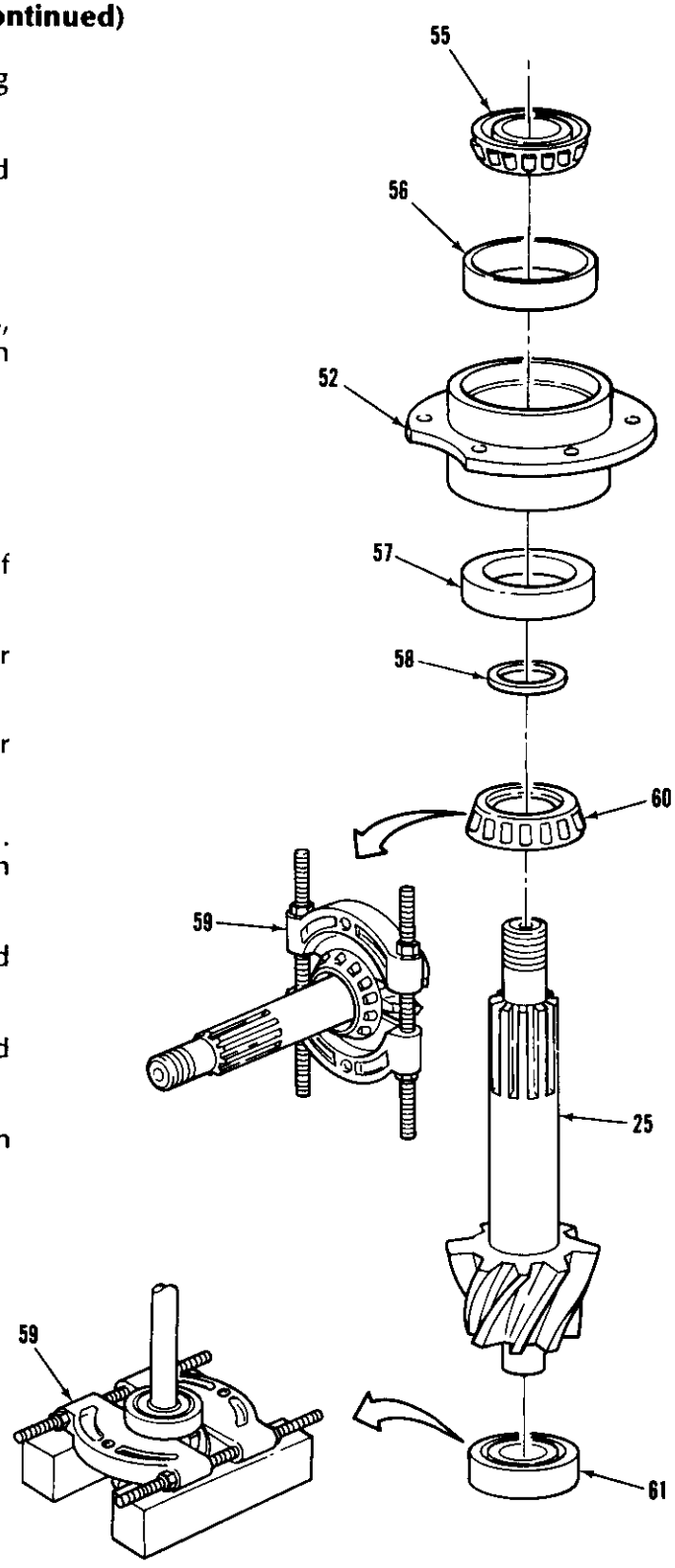
(5) Measure clutch plates thickness. Thickness must be no less than .064 inch (.016 mm).

(6) Inspect capscrews and nuts for thread damage.

(7) Inspect splines on side gears, clutch, and clutch plates for damage.

(8) Inspect all other parts. Refer to paragraph 2-7. Replace all parts failing inspection.

25. PINION
52. BEARING CAGE
55. OUTER BEARING
56. BEARING CUP
57. BEARING CUP
58. SPACER
59. SPLIT-TYPE PULLER (TOOL)
60. INNER BEARING
61. PILOT BEARING



TA 298961

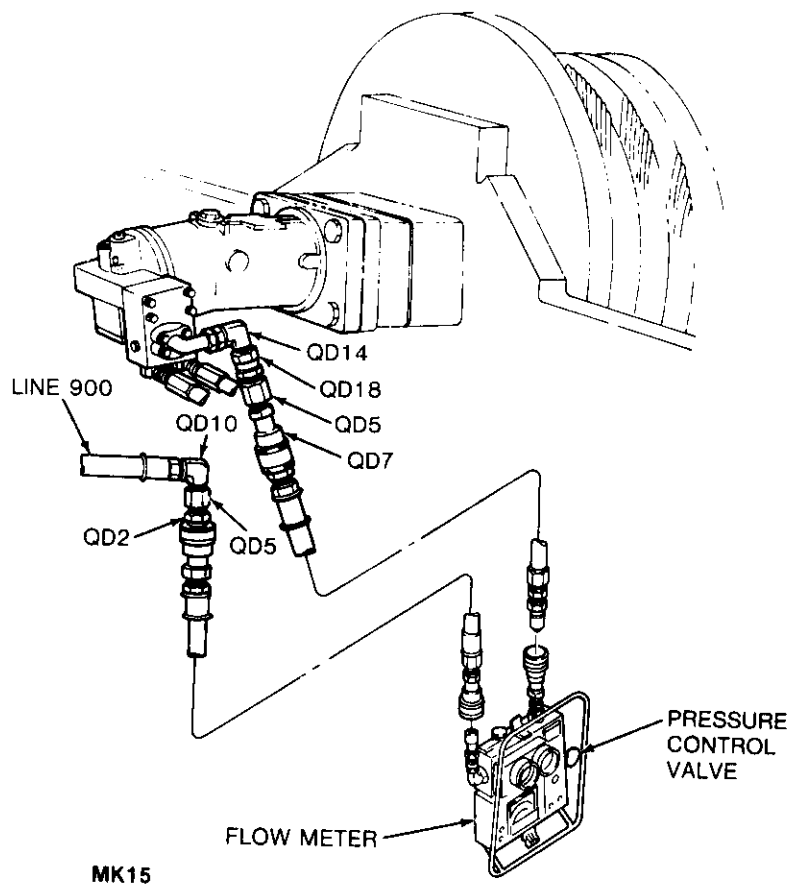
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. WINCH WILL NOT PULL A MAXIMUM LOAD (Continued)

Test 2. Remove line 900 from winch motor.Install a flow meter in line between winch motor and line 900. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and allow to run at idle. Operate winch IN and slowly close pressure control valve by turning knob clockwise to INCREASE. Determine system relief pressure. Record reading.

- If pressure is between 2,800-2,875 psi (19,305-19,822 kPa), repair or replace hydraulic motor. Refer to paragraph 17-12 or 17-13.
- If pressure is not between 2,800-2,875 psi (19,305-19,822 kPa) on the MK15, repai or replace winch control valve. Refer to paragraph 18-30).
- If pressure is not between 2,800-2,875 psi (19,305-19,822 kPa) on the MK16, repair or replace relief valve mounted on winch control valve. Refer to paragraph 17-20.

END OF TEST



MK15

TA 298400

NOTE

It may be necessary to lift up on pinion assembly (49) in order to completely loosen capscrews (50).

(32) Remove six capscrews (50) and remove pinion assembly (49) from carrier housing (24).

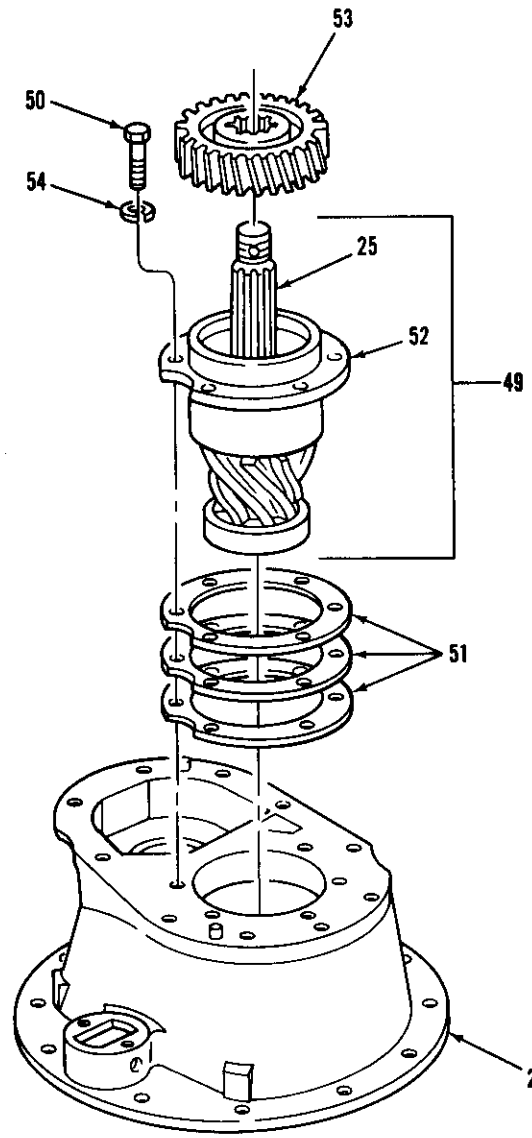
(33) Tag and remove shims (51).

(34) Place pinion assembly (49) in a press.

(35) Press pinion (25) out of pinion bearing cage (52).

(36) Remove gear (53).

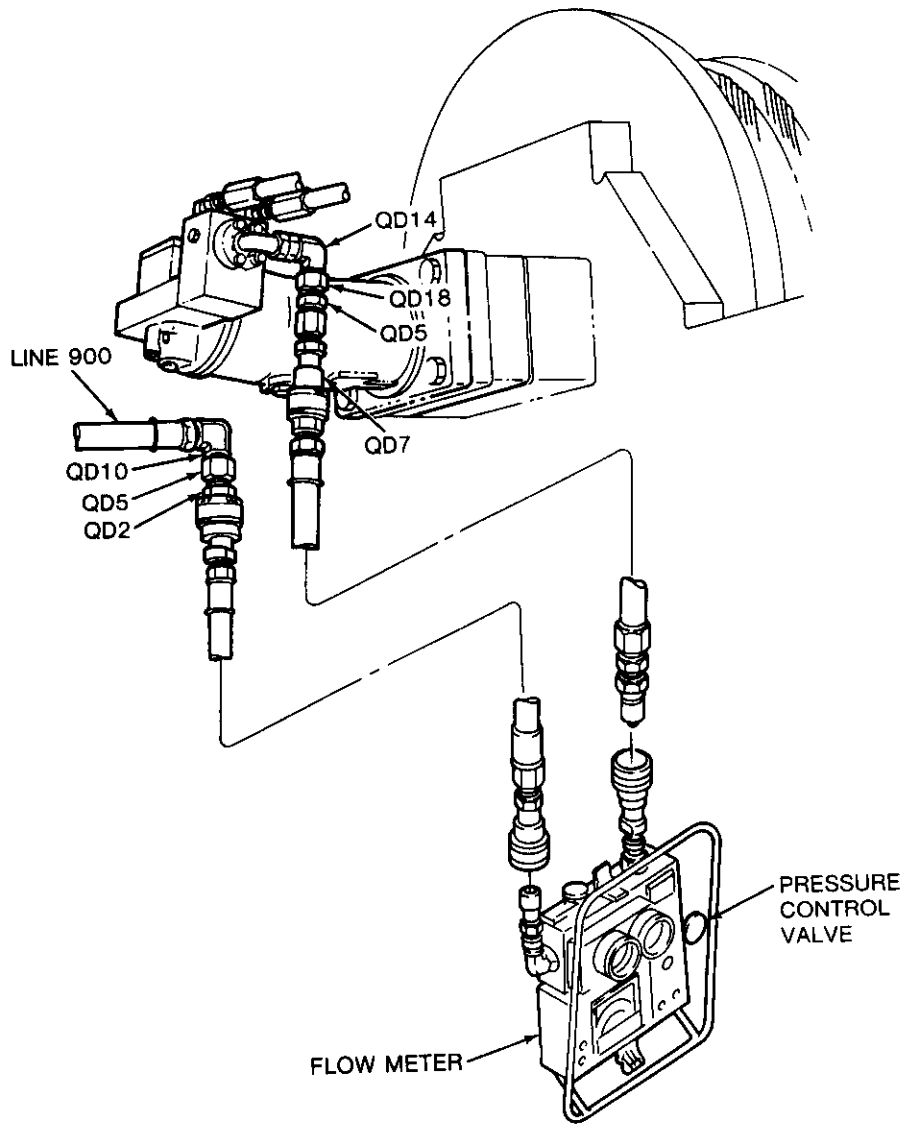
(37) Remove six capscrews (50) and lockwashers (54). Discard lockwashers (54).



24. CARRIER HOUSING
25. PINION
49. PINION ASSEMBLY
50. CAPSCREW (6)
51. SHIM
52. BEARING CAGE
53. GEAR
54. LOCKWASHER (6)

TA 298960

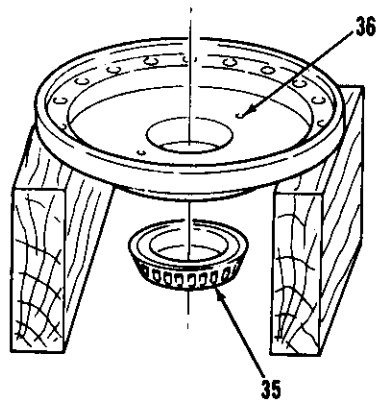
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



MK16

TA 298401

9-17. DIFFERENTIAL CARRIER REPAIR (Continued)



35. BEARING
36. COVER HOLE (2)

(24) Remove bearing (35) by placing a punch in cover holes (36) and tapping on inner race of bearing (35).

(25) Matchmark differential case assembly halves (37 and 38).

(26) Remove 12 capscrews (39).

NOTE

It may be necessary to tap plain case half (37) with a soft-faced hammer in order to break it loose.

(27) Remove plain case half (37), thrust washer (40), and side gear (41).

CAUTION

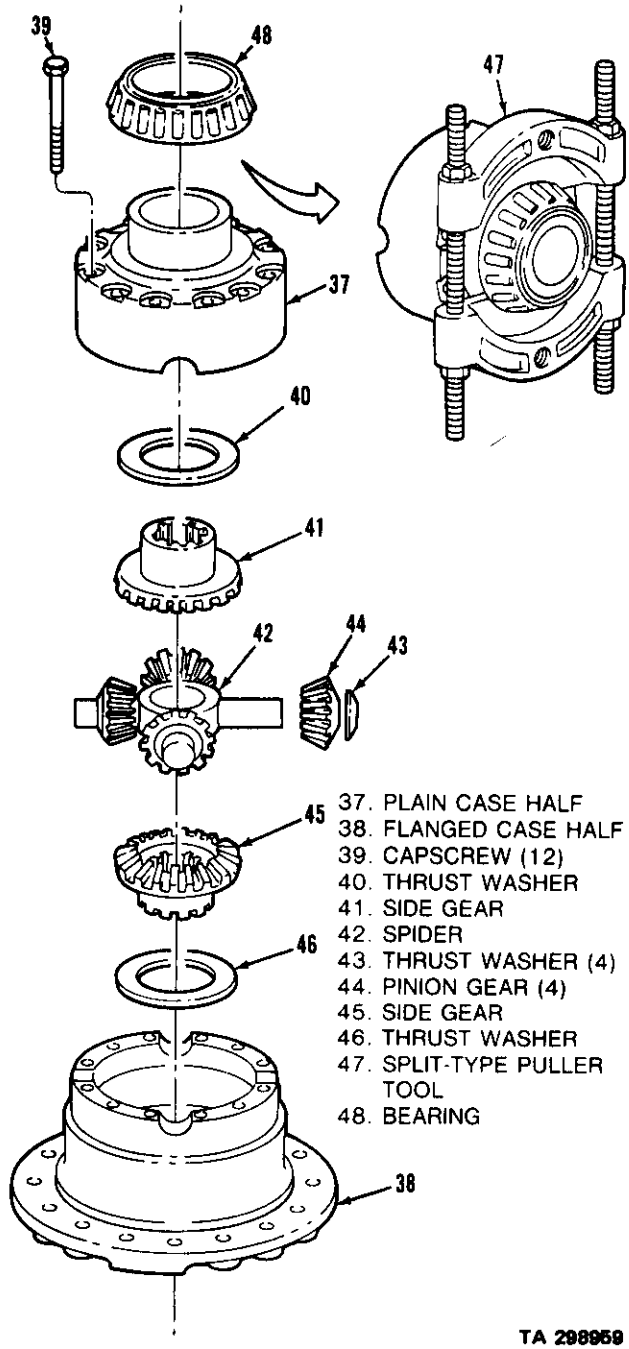
Pinion gears (44) are loose on spider (42) and may slide off when removing spider (42).

(28) Remove spider (42), four thrust washers (43), and pinion gears (44) from flanged case half (38).

(29) Remove four thrust washers (43) and pinion gears (44) from spider (42).

(30) Remove side gear (45) and thrust washer (46).

(31) If damaged, use a split-type puller (47) to remove bearing (48) from plain case half (37).



37. PLAIN CASE HALF
38. FLANGED CASE HALF
39. CAPSCREW (12)
40. THRUST WASHER
41. SIDE GEAR
42. SPIDER
43. THRUST WASHER (4)
44. PINION GEAR (4)
45. SIDE GEAR
46. THRUST WASHER
47. SPLIT-TYPE PULLER TOOL
48. BEARING

TA 298959

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. WINCH WILL NOT PULL A MAXIMUM SIDE LOAD

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, resulting in personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

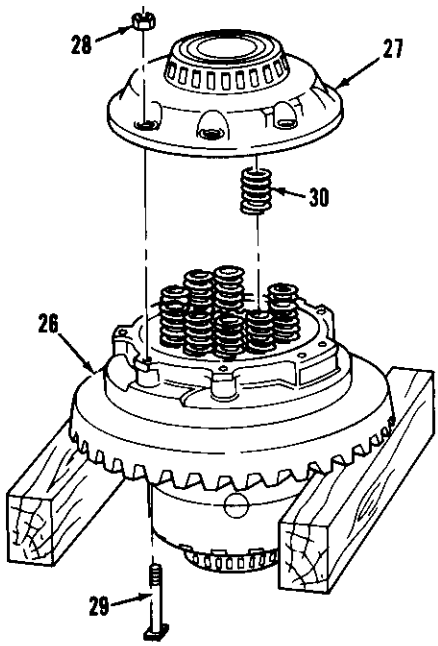
CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is obtained when pressure cannot be increased with pressure control valve and flow drops to zero. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, remote control connected, and hydraulic oil temperature at 130-150°F (54-66°C).

Test 1. Place winch relief valve in side pull position. Remove brake release line at winch. With suitable plugs, plug brake release line and its opening on winch.



26. RING GEAR
27. CLUTCH PACK COVER
28. LOCKNUT (8)
29. CAPSCREW (8)
30. SPRING (10)

(16) Support ring gear (26) to prevent it from falling when clutch pack cover (27) is removed.

(17) Apply pressure to clutch pack cover (27) and remove eight locknuts (28) and capscrews (29). Discard locknuts (28).

WARNING

Clutch pack cover is under spring tension. To prevent personal injury, release tension slowly.

(18) Slowly release press pressure until all spring tension is released, then remove clutch pack cover (27).

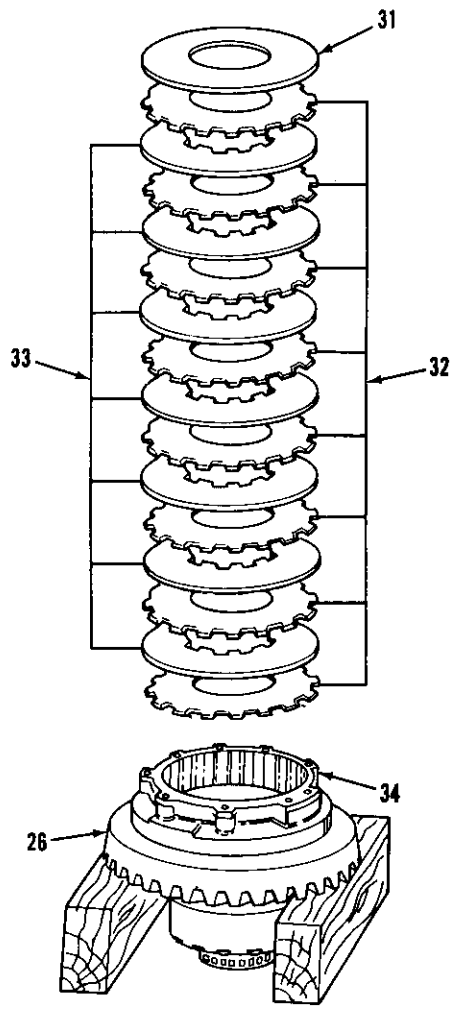
(19) Remove ten springs (30).

(20) Remove pressure plate (31).

(21) Remove eight externally splined plates (32) and seven internally splined plates (33).

(22) Remove differential case assembly (34) and ring gear (26) from press.

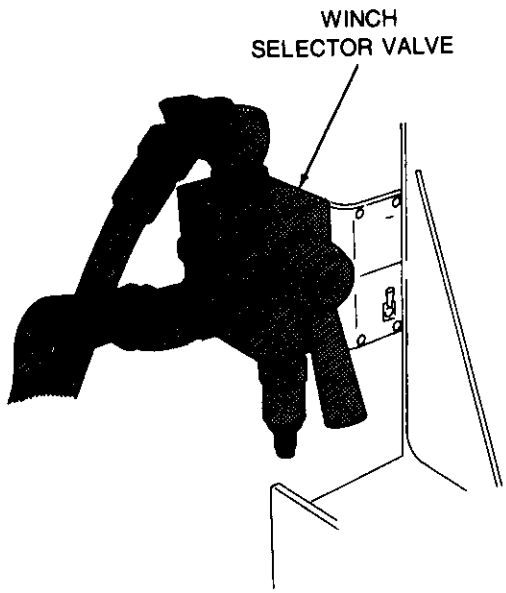
(23) Tap ring gear (26) off of differential case assembly (34).



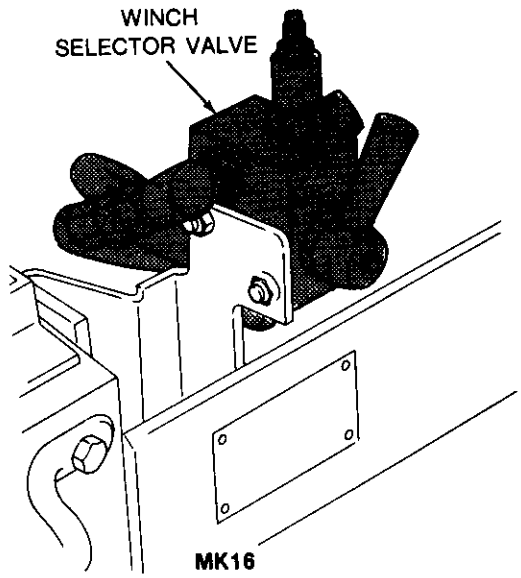
26. RING GEAR
31. PRESSURE PLATE
32. EXTERNALLY SPLINED PLATE (8)
33. INTERNALLY SPLINEI PLATE (7)
34. DIFFERENTIAL CASE ASSEMBLY

TA 298958

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



MK15



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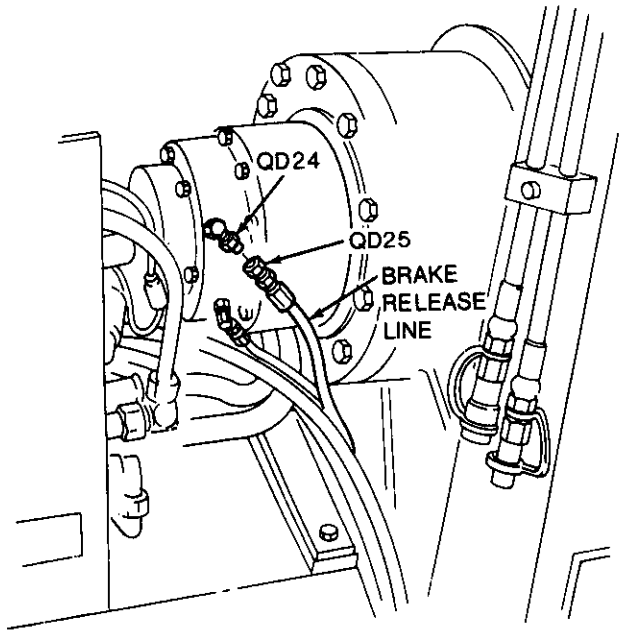
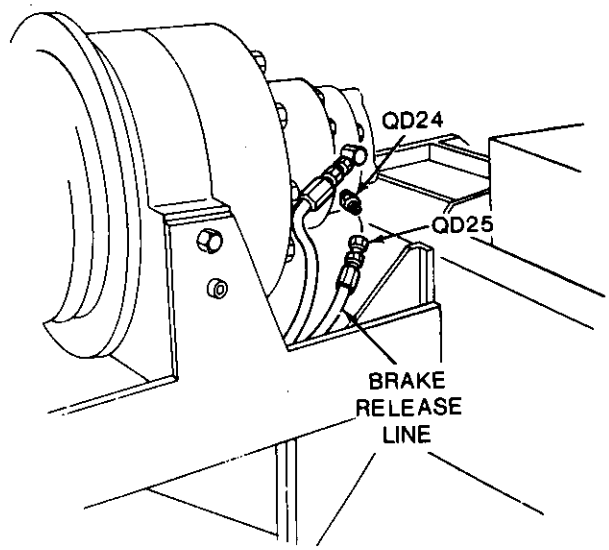


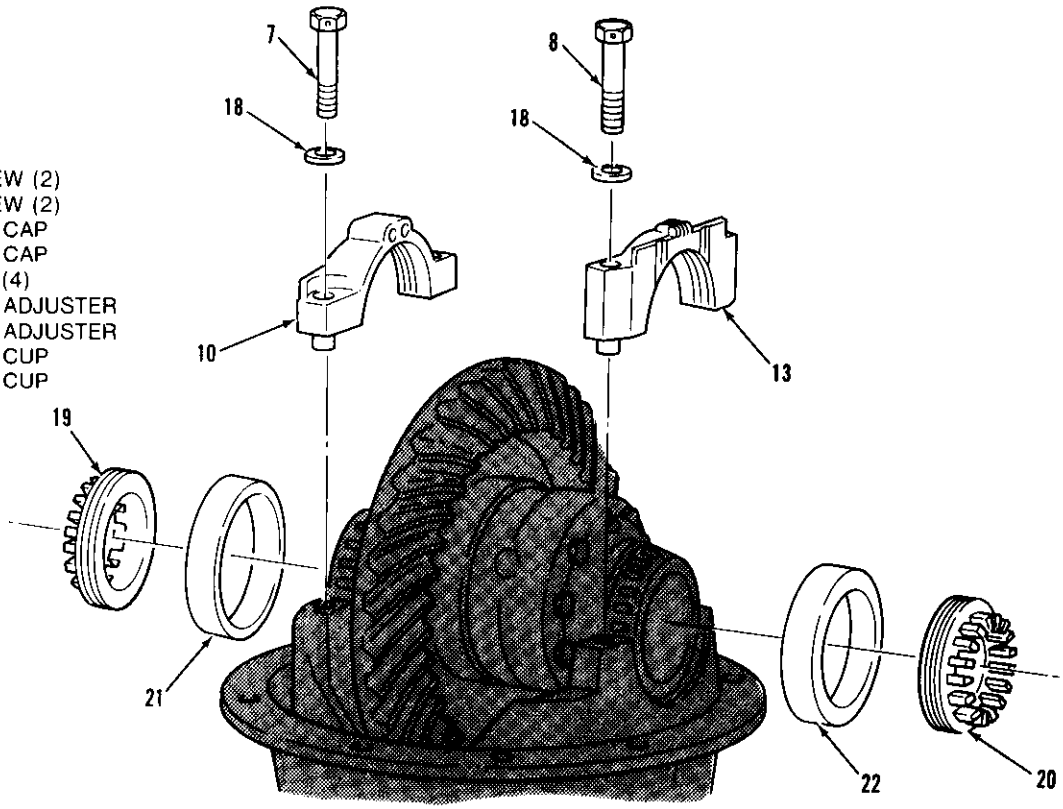
MK15



MK16

TA 298402

9-17. DIFFERENTIAL CARRIER REPAIR (Continued)



7. CAPSCREW (2)
8. CAPSCREW (2)
10. BEARING CAP
13. BEARING CAP
18. WASHER (4)
19. BEARING ADJUSTER
20. BEARING ADJUSTER
21. BEARING CUP
22. BEARING CUP

(10) Remove four capscrews (7 and 8) and washers (18) from each bearing cap (10 and 13).

(11) Tag and remove bearing caps (10 and 13) and bearing adjusters (19 and 20).

(12) Tag and remove bearing cups (21 and 22).

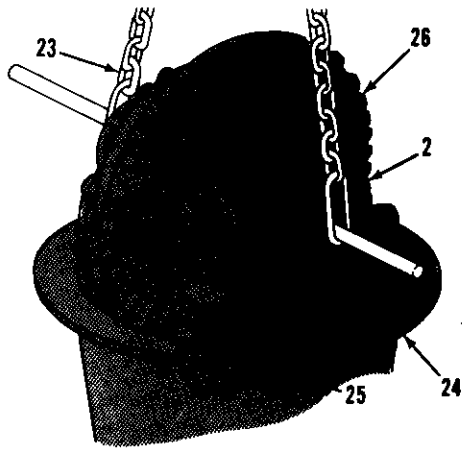
WARNING

Differential carrier assembly (2) is extremely heavy. Use proper lifting device to prevent damage to equipment or personal injury.

(13) Attach lifting device (23) to differential carrier assembly (2). Tilt and remove differential carrier assembly (2) from carrier housing (24) and pinion (25).

(14) Place differential carrier assembly (2) in press so teeth of ring gear (26) are face down.

(15) Remove lifting device (23).



2. DIFFERENTIAL CARRIER ASSEMBLY
23. LIFTING DEVICE
24. CARRIER HOUSING
25. PINION
26. RING GEAR

TA 298957

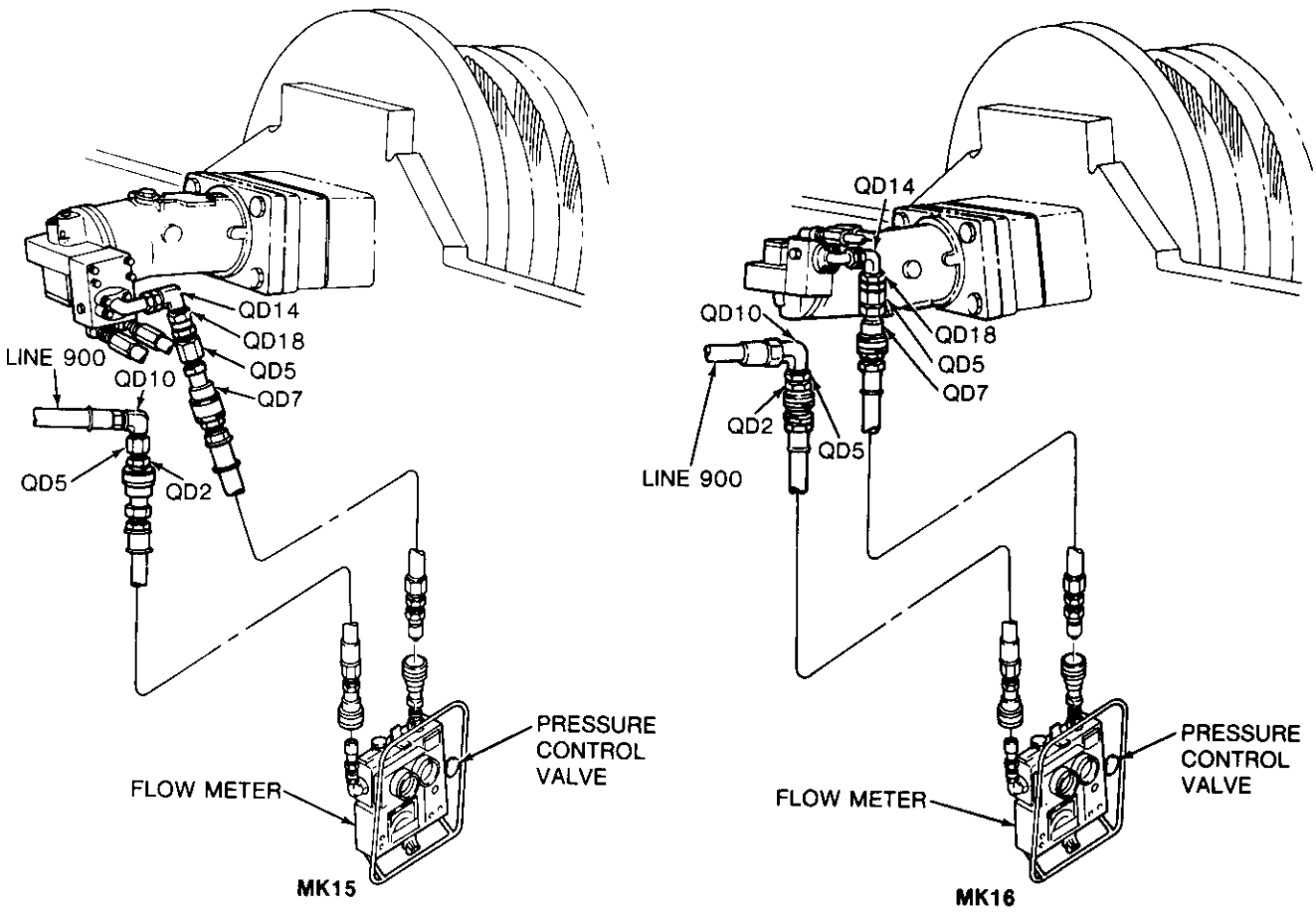
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. WINCH WILL NOT PULL A MAXIMUM SIDE LOAD (Continued)

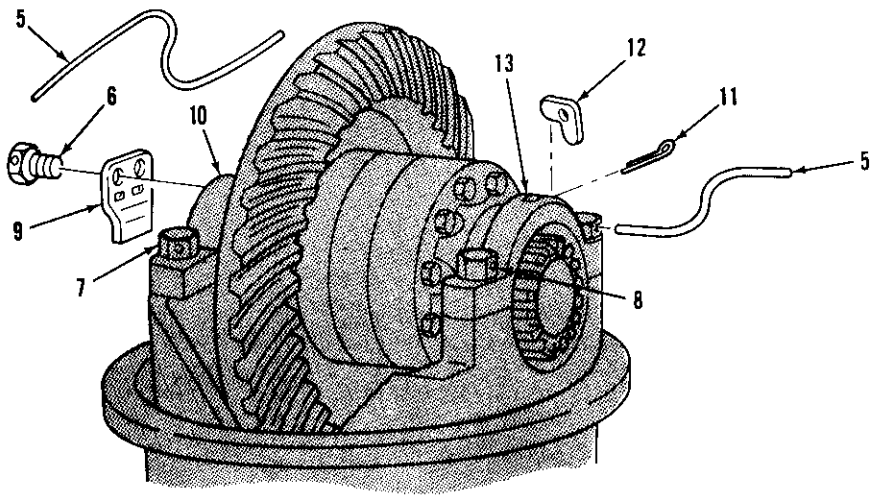
Test 1. (Continued)

Remove line 900 from winch motor. Install a flow meter in line between winch motor and line 900. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and operate winch IN. Check for 1,350-1,450 psi (9,308-9,997 kPa).

- If pressure is within specifications, repair or replace hydraulic winch motor. Refer to paragraph 17-12 or 17-13.
- If pressure is not within specifications, go to Test 2.



TA 298403



5. LOCKWIRE (3)
6. CAPSCREW (2)
7. CAPSCREW (2)
8. CAPSCREW (2)
9. LOCK
10. BEARING CAP
11. COTTER PIN
12. LOCK
13. BEARING CAP

(4) Cut lockwire (5) from capscrews (6, 7, and 8). Discard lockwire (5).

(5) Remove two capscrews (6) and lock (9) from bearing cap (10).

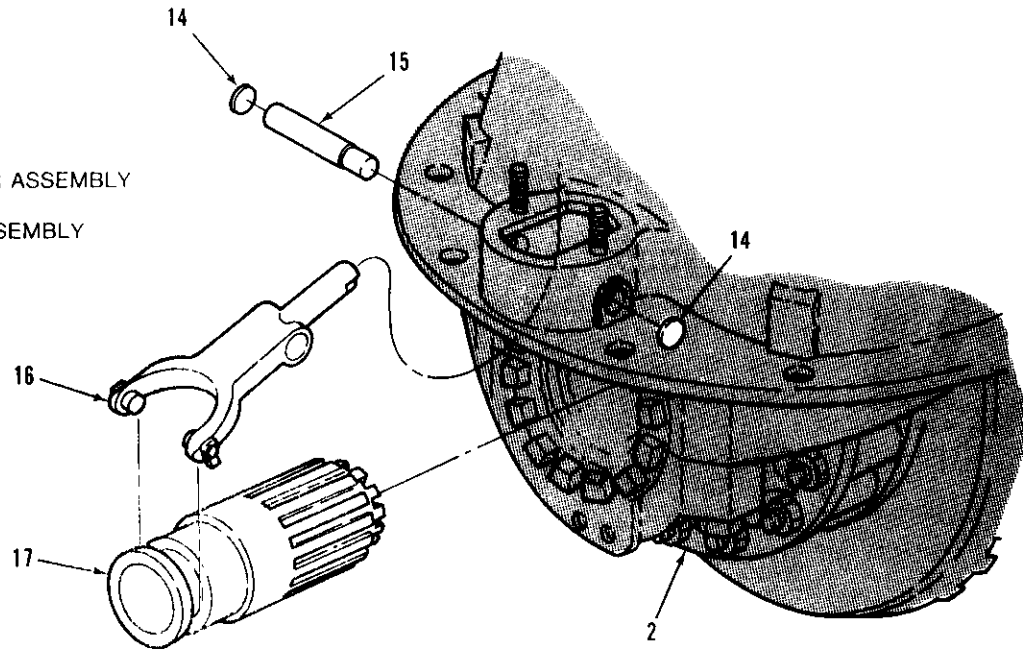
(6) Remove cotter pin (11) and lock (12) from bearing cap (13). Discard cotter pin (11).

(7) Using a punch, remove and discard two expansion plugs (14).

(8) Drive out shift fork shaft assembly (15) through top hole.

(9) Disengage shift fork (16) from sliding clutch (17). Remove sliding clutch (17) and shift fork (16) from differential carrier (2).

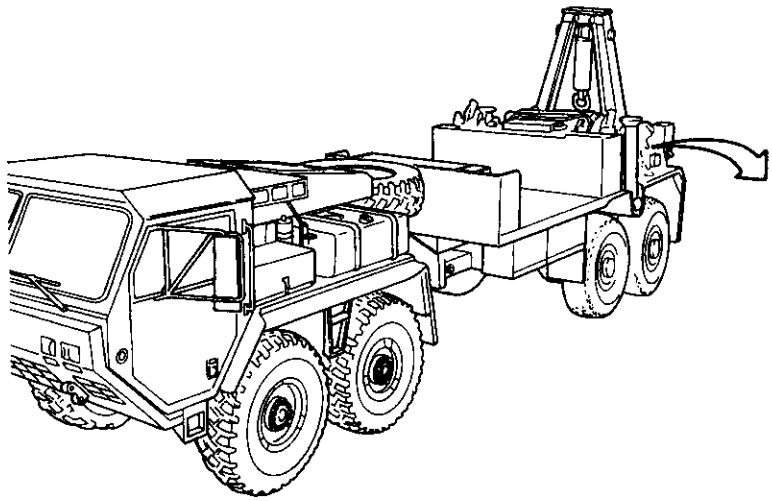
2. DIFFERENTIAL CARRIER ASSEMBLY
14. EXPANSION PLUG (2)
15. SHIFT FORK SHAFT ASSEMBLY
16. SHIFT FORK
17. SLIDING CLUTCH

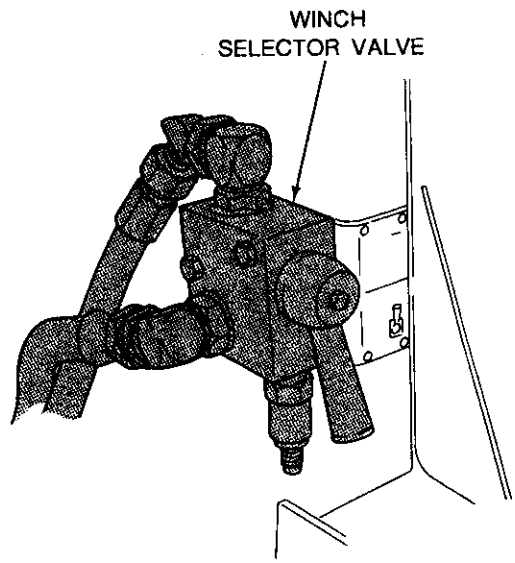


TA 298956

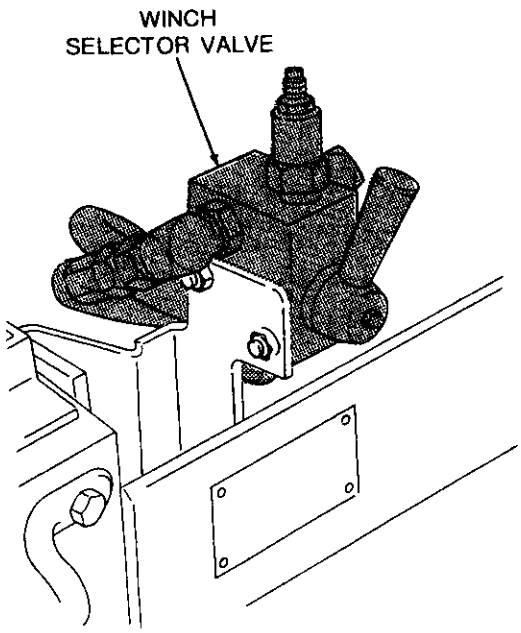
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

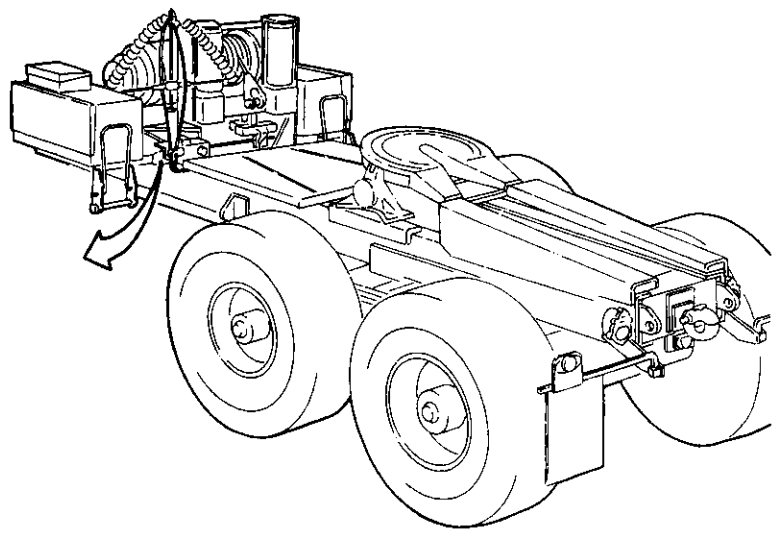
Test 2. Place side pull relief valve in side pull position.





MK15





TA 298404

MK16

SECTION V. FRONT AXLE SUBASSEMBLY CLEANING, INSPECTION, AND REPAIR

9-17. DIFFERENTIAL CARRIER REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly
d. Adjustments

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Flange yoke holding bar (J 3453)
Dial indicator (J 7872)
Chain wrench (CW24)

Materials/Parts

Lockwire (item 33, Appendix C)
Marking compound (item 36, Appendix C)
Gear oil (item 40, Appendix C)
Roll pin (P/N 118807) item 1
Cotter pin (NSN 5315-00-135-7277) item 11
Expansion plug (2) (P/N 9797, NSN 5340-01-027-2592) item 14
Locknut (8) (MS51943-46) item 28
Lockwasher (6) (MS35338-49) item 54
Spacer, item 58

Personnel Required

1 MOS 3522
1 Assistant

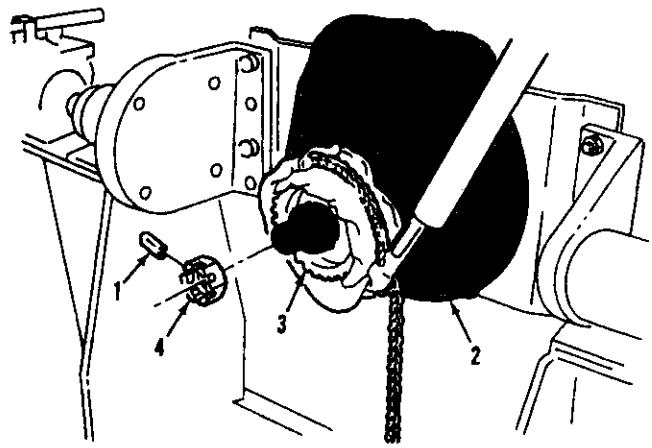
Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Differential carrier removed from nose box (para 9-15).

a. Disassembly

(1) Remove and discard roll pin (1) from differential carrier assembly (2).

(2) Wrap a strap and chain wrench around gear assembly (3).

(3) Remove pinion nut (4).



1. ROLL PIN
2. DIFFERENTIAL CARRIER ASSEMBLY
3. GEAR ASSEMBLY
4. PINION NUT

TA 298855

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

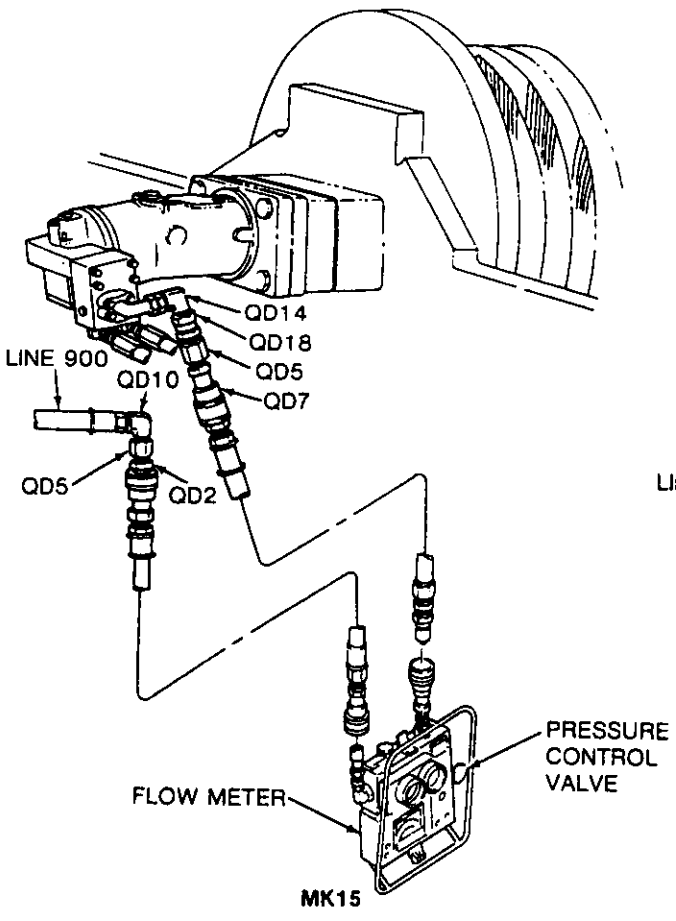
4. WINCH WILL NOT PULL A MAXIMUM SIDE LOAD (Continued)

Test 2. (Continued)

Remove line 900 from winch motor. Install a flow meter in line between winch motor and line 900. Open pressure control valve fully by turning know counterclockwise to DECREASE. Start engine and increase to maximum speed. Operate winch IN and slowly close pressure control valve by turning know clockwise to INCREASE. Determine system relief pressure. Record reading.

- If pressure is between 1,350-1,450 psi (9,308-9,997 kPa), repair or replace winch motor. Refer to paragraph 17-12 or 17-13.
- If pressure is not between 1,350-1,450 psi (9,308-9,997 kPa), repair or replace winch selector valve. Refer to paragraph 17-18.

END OF TEST



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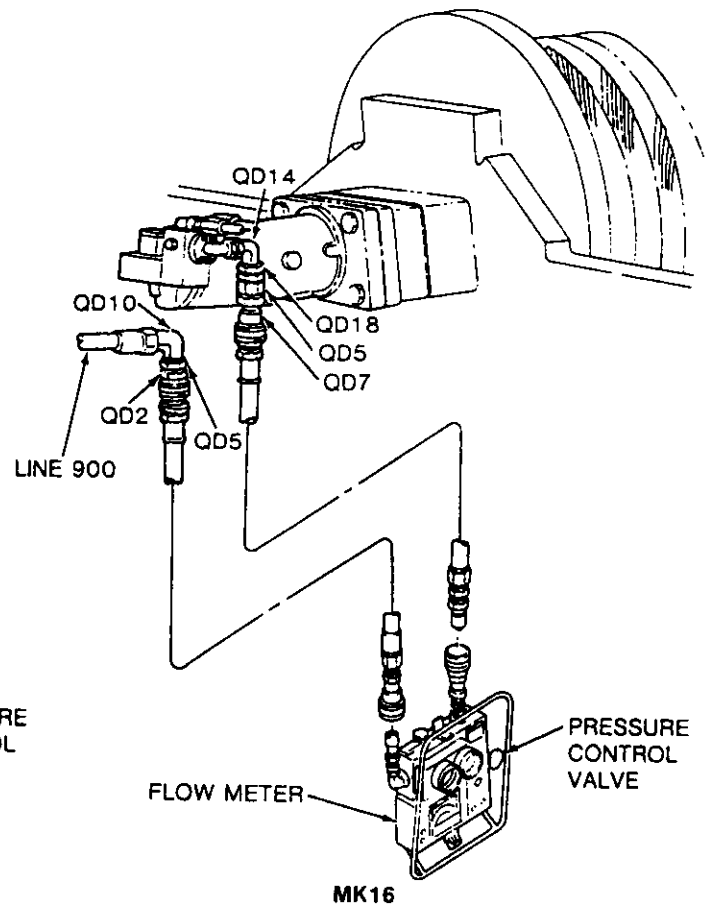


MK16

(49) Apply sealant to seven capscrews (59).

(50) Coat mating surface of bottom cover (57) with sealant and install with seven new lockwashers (58) and capscrews (59). Torque capscrews (59) to 39 foot-pounds (53 N·m).

NOTE

Apply pipe sealant to all plugs and pipe threads.

(51) Install elbow (60), reducer (61), and breather (62) into top cover (36).

(52) Install plug (63) into center cover (38).

(53) Install drain plug (64) and fill plug (65).

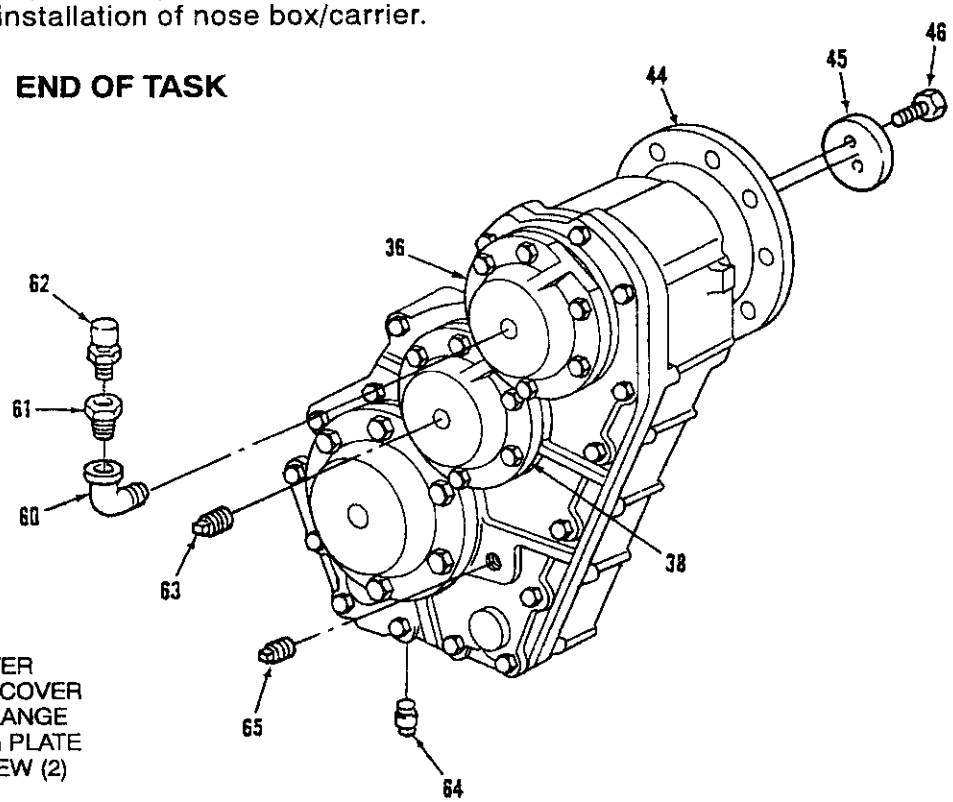
(54) Remove two capscrews (46), locking plate (45) and input flange (44) for proper installation of nose box/carrier.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 2320-297-34	Install nose box and carrier (para 9-14). Install nose box lube pump (para 9-6). Install axle shift unit (para 9-4).
TM 2320-20/12 TM 9-2320-297-20	Fill axle with lubricant (para 11-3).
TM 2320-10/11 TM 9-2320-297-10	Operate vehicle. Check axle for noise or leaks (para 2-13).



36. TOP COVER
38. CENTER COVER
44. INPUT FLANGE
45. LOCKING PLATE
46. CAPSCREW (2)
60. ELBOW
61. REDUCER
62. BREATHER
63. PLUG
64. DRAIN PLUG
65. FILL PLUG

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

CRANE ELECTRIC - MK15A1 AND MK17A1

1. OVERLOAD SHUTDOWN SYSTEM DOES NOT OPERATE PROPERLY.

NOTE

The following tests and inspections should be performed in the event of any of the following:

- Boom up and down, telescope out and hoist up functions are disabled.
- Intermittent cut-out of the above listed functions (with crane unloaded).
- Cut-out of the above listed functions too early or too late (with crane loaded).

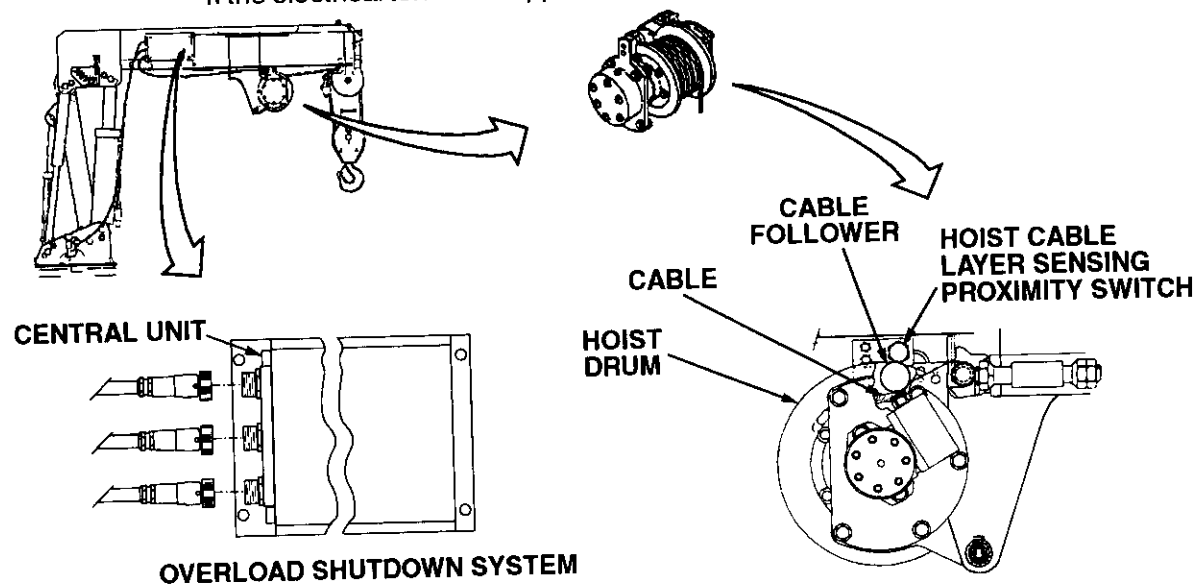
Before performing crane troubleshooting procedures, the following items must be verified:

- Make sure the PARKING BRAKE is applied.
- Make sure the transmission is in NEUTRAL.
- Make sure hydraulic steering system is functioning properly.
- Make sure the front power unit's electrical system is functioning properly.

Unless advised otherwise, the ignition, MAIN POWER, and TILT ALARM switches must be in the ON position for all voltage checks.

Test 1. Turn the ignition switch OFF. Remove the electrical connectors from the Overload Shutdown System central unit. Inspect the electrical terminals for damage or moisture.

- If electrical terminals are damaged or corroded, repair connector. Refer to TM 9-2320-297-20, paragraph 7-45.
- If there is moisture inside the connectors, let the connectors dry out. After the plugs have completely dried out, apply a light coat of dielectric grease to the wire terminals of the plug. Reassemble the connectors and close the shell tight. Make sure the cable strain reliefs are tight.
- If the electrical terminals appear to be OK, reinstall the connectors and go to Test 2.



OVERLOAD SHUTDOWN SYSTEM

9-13. NOSE BOX, DIFFERENTIAL CARRIER COVER, AND CARRIER REASSEMBLY (Continued)

(35) Install bearing support (40) and bearing (50) into nose box cover (32).

(36) Install nut locking plate (52) and gear support plate (53).

(37) Install eight capscrews (54) through gear support plate (53) and into bottom gear (31). Torque to 13 foot-pounds (17.63 N·m).

(38) Place dial indicator (23) on gear support plate (53) as shown.

CAUTION

Bearing support (40) may break. use care when tightening the three 3/8-16 capscrews.

(39) Install three 3/8-16 capscrews into threaded holes in bearing support (40). Tighten slowly and evenly to remove all end play.

(40) Using a feeler gage, measure gap between bearing support (40) and nose box cover (32) subtract 0.005 inch (0.127 mm) and selected shims (55) to equal that measurement.

(41) Remove the three 3/8-16 capscrews, eight capscrews (54), gear support plate (53), nut locking plate (52), bearing (50), and bearing support (40).

(42) Clean and degrease inner race of bearing (50) and bearing surface of bottom gear (31).

(43) Coat shims (55) with sealing, lubricating and wicking compound and install.

(44) Install bearing support (40).

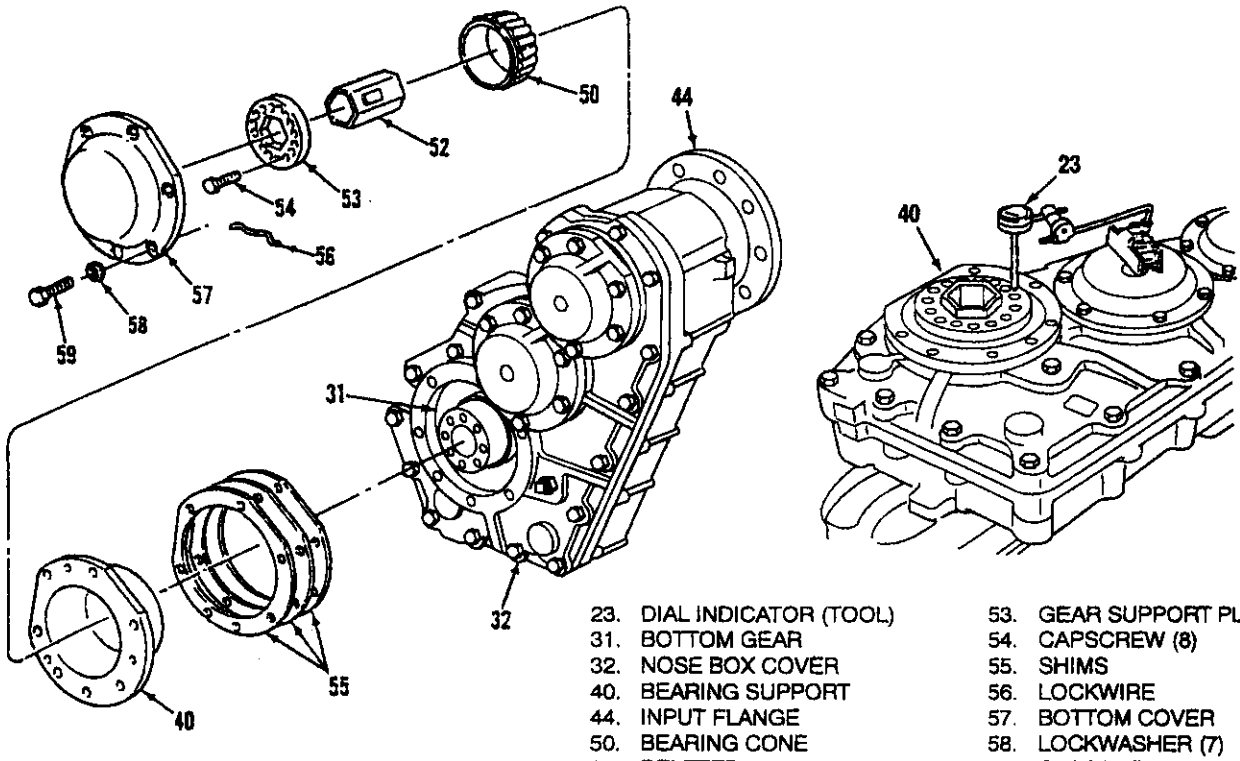
(45) Coat inner race of bearing cone (50) with retaining compound and install.

(46) Install nut locking plate (52) and gear support plate (53).

(46.1) Apply adhesive to eight capscrews (54).

(47) Coat threads in bottom gear (31) with adhesive and install eight capscrews (54). Torque to 13 foot-pounds (17.63 N·m).

(48) Install four lockwires (56) onto capscrews (54).



23. DIAL INDICATOR (TOOL)
31. BOTTOM GEAR
32. NOSE BOX COVER
40. BEARING SUPPORT
44. INPUT FLANGE
50. BEARING CONE
51. DELETED
52. NUT LOCKING PLATE
53. GEAR SUPPORT PLATE
54. CAPSCREW (8)
55. SHIMS
56. LOCKWIRE
57. BOTTOM COVER
58. LOCKWASHER (7)
59. CAPSCREW (7)

MALFUNCTION

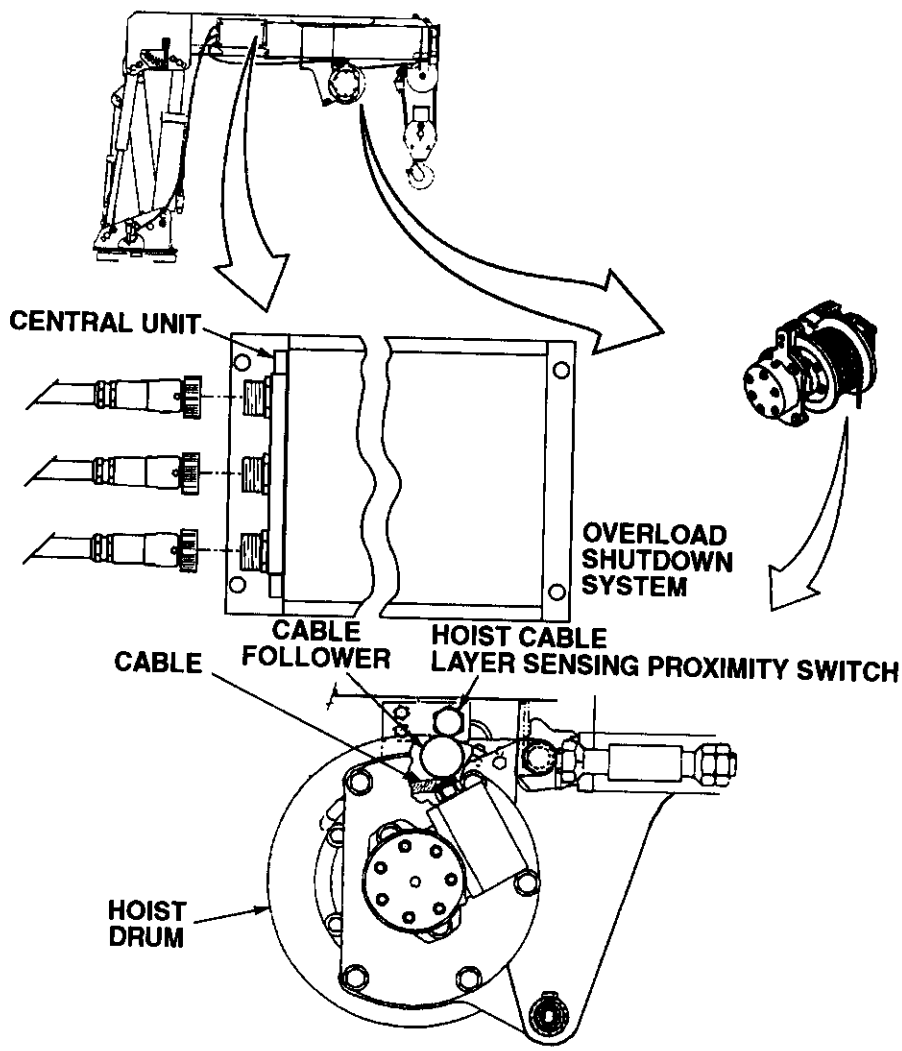
TEST OR INSPECTION

CORRECTIVE ACTION

OVERLOAD SHUTDOWN SYSTEM DOES NOT OPERATE PROPERLY. (Continued)

Test 2. Check the hoist cable layer sensing proximity switch and the cable follower (proximity switch target). As additional cable is wound onto the hoist drum, the cable follower raises and moves closer to the layer sensing proximity switch. The switch senses when more than two layers of hoist cable are on the hoist drum. With no hoist cable played out, check that the cable follower is at least partially covering the sensing area of the switch and the gap between the layer sensing proximity switch and the cable follower is no more than 0.125 in. (3.18 mm).

- If the layer sensing proximity switch is not positioned correctly, adjust the proximity switch. Refer to paragraph 18.1-25 in this manual.
- If the layer sensing proximity switch is OK, go to Test 3.



(30) Install shims (47) and center cover (38) onto nose box housing (15) using six new lockwashers (48) and capscrews (49). Torque capscrews (49) to 39 foot-pounds (53 N·m).

(31) Position dial indicator (23) with plunger through hole in center cover (38) and against center gear (28)

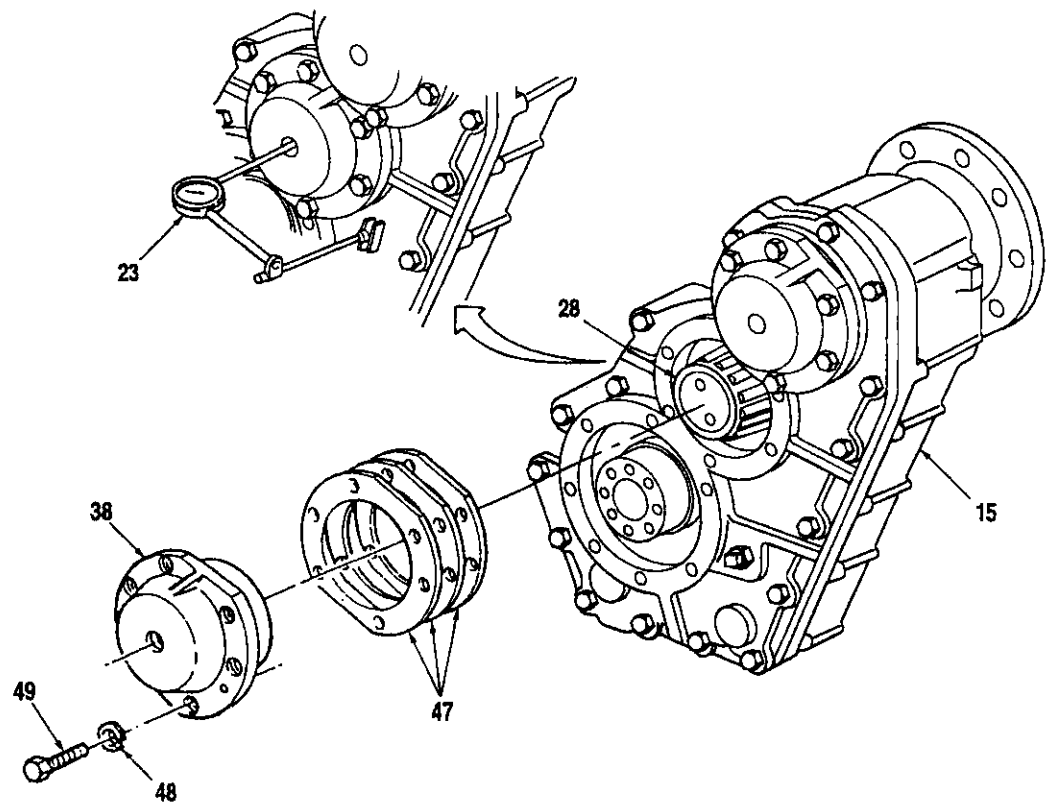
(32) Using hole in nose box housing (15), opposite center cover (38), move center gear (28) in and out to determine end play.

(33) Add or remove shims (47) to obtain proper end play 0-005-0.007 inch (0.127-0.177 mm).

(34) After correct end play is obtained, coat shims (47) with sealing, lubricating wicking compound.

(34.1) Apply sealant to six capscrews (49). Reinstall shims (47) and center cover (38) using six new lockwashers (48) and capscrews (49). Torque capscrews (49) to 39 foot-pounds (53 N·m).

15. NOSE BOX HOUSING
23. DIAL INDICATOR (TOOL)
28. CENTER GEAR
38. CENTER COVER
47. SHIMS
48. LOCKWASHER (6)
49. CAPSCREW (6)



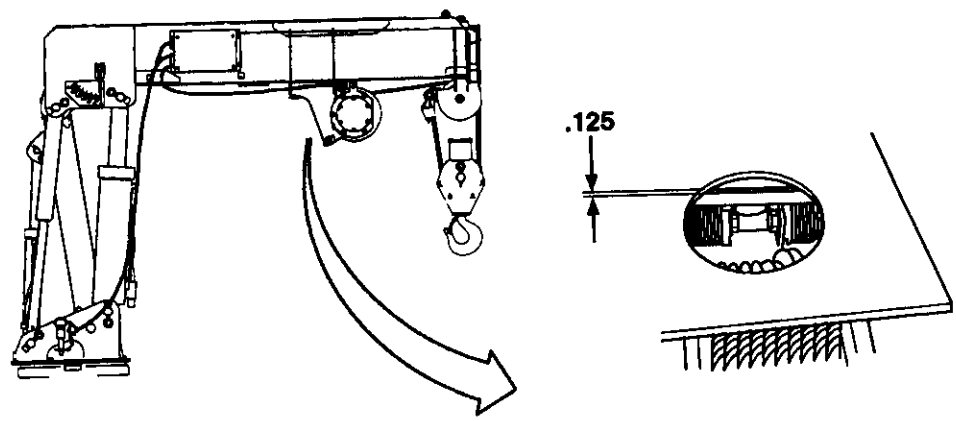
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 3. Visually check the gap between the hoist and the hoist mount. There should be a gap of 0.125 in. (3.18 mm) minimum between hoist and hoist mount. The plates should not touch.

- If the gap is not within specification refer to paragraph 18.1-31, in this manual, for adjustment procedures.
- If the gap is within specifications, go to Test 4.



9-13. NOSE BOX, DIFFERENTIAL CARRIER COVER, AND CARRIER REASSEMBLY (Continued)

(23) Install shims (41) and top cover (36) using six new lockwashers (42) and capscrews (43). Torque capscrews (43) to 39 foot-pounds (53 N·m).

(24) Carefully install input flange (44) onto top gear (26).

(24.1) Apply adhesive to two capscrews (46).

(25) Install retainer plate (45) and two capscrews (46). Torque capscrews to 107 foot-pounds (145 N·m).

(26) Move input flange (44) in and out to determine end play of top gear (26). End play should be 0.005-0.007 inch (0.127-0.177 mm).

NOTE

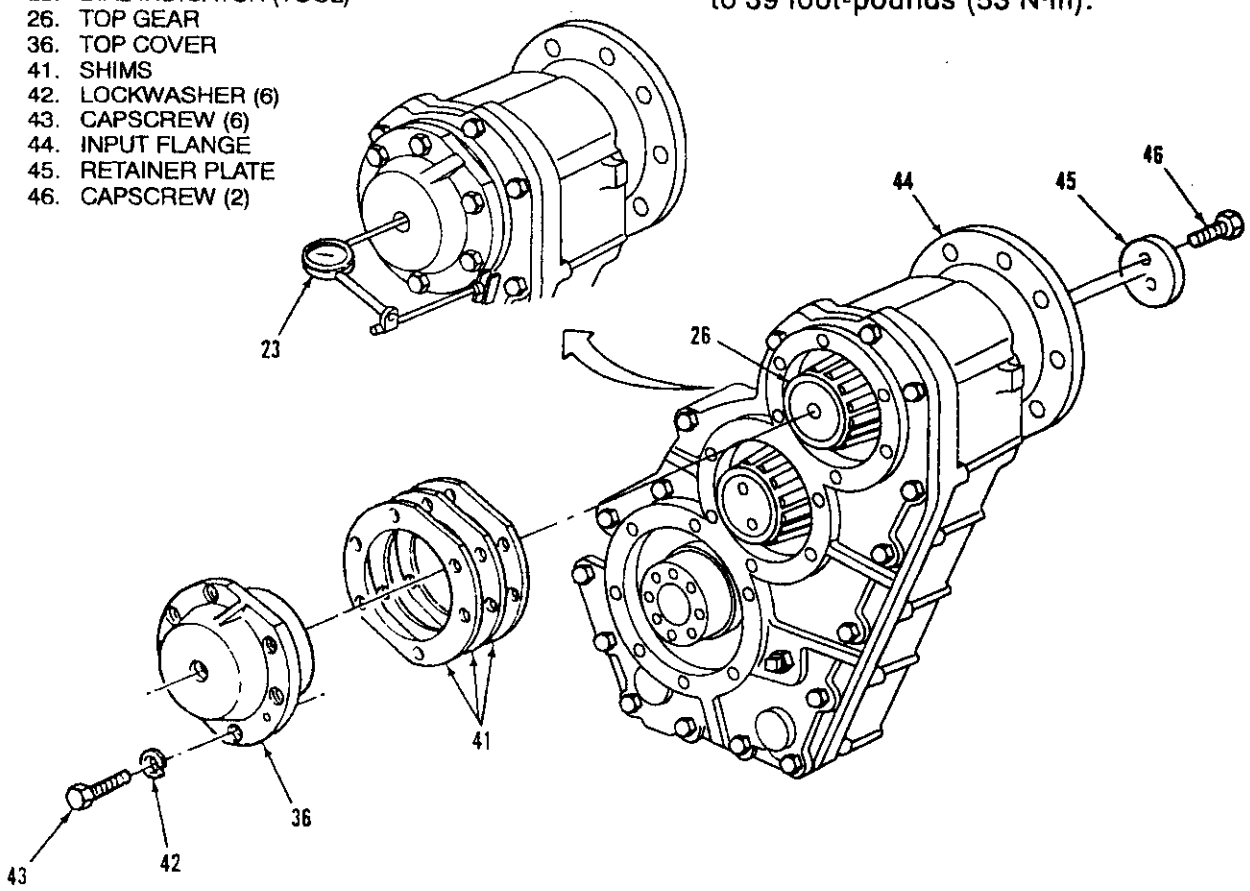
- Stay near low measurement of end play during initial set-up. When sealing, lubricating and wicking compound is added to shims, end play will change.
- Use minimum amount of sealing lubricating and wicking compound on shims to change end play as little as possible.

(28) Add or remove shims (41) as needed to obtain proper end play.

(29) After correct end play is obtained, coat shims with sealing, lubricating and wicking compound.

(29.1) Apply sealant to six capscrews (43). Reinstall shims (41) and top cover (36) using six new lockwashers (42) and capscrews (43). Torque capscrews (43) to 39 foot-pounds (53 N·m).

23. DIAL INDICATOR (TOOL)
26. TOP GEAR
36. TOP COVER
41. SHIMS
42. LOCKWASHER (6)
43. CAPSCREW (6)
44. INPUT FLANGE
45. RETAINER PLATE
46. CAPSCREW (2)



MALFUNCTION

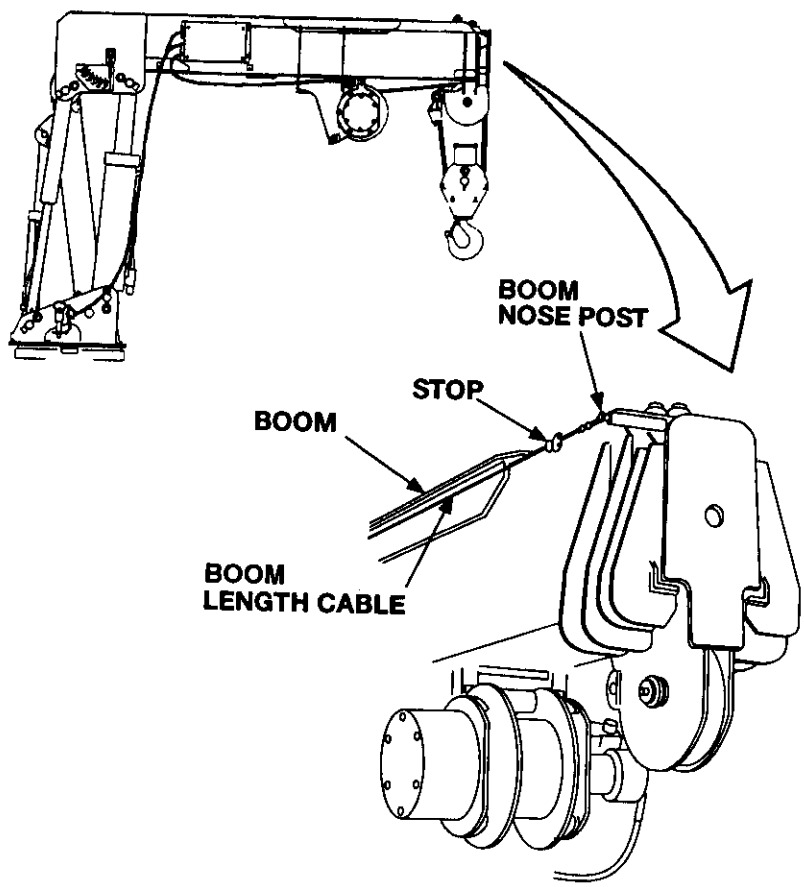
TEST OR INSPECTION

CORRECTIVE ACTION

OVERLOAD SHUTDOWN SYSTEM DOES NOT OPERATE PROPERLY. (Continued)

Test 4. Is the boom length cable mounted and secured at the boom nose post? A stop on the cable prevents the cable from spooling completely onto the drum.

- If the boom length cable is disconnected from the boom nose post, carefully pull out the boom length cable and attempt to clip the connector back on the boom nose post.
- If the boom length cable is broken, replace Overload Shutdown System central unit. Refer to paragraph 18.1-30 in this manual.
- If there is no tension at all on the boom length cable replace Overload Shutdown System central unit. Refer to paragraph 18.1-30 in this manual.
- If the boom length cable is OK, go to Test 5.



(16) Install center gear (28) into nose box housing (15), plate (29) first.

(17) Install top gear (26) into nose box housing (15) splined end first.

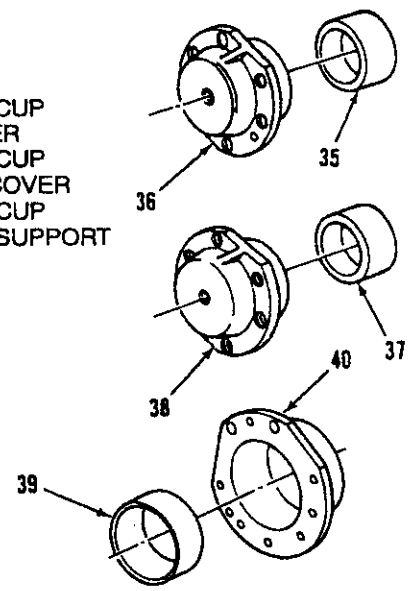
(18) Run a bead of sealant around mating surface of nose box housing (15). Be sure to circle each capscrew hole.

(18.1) Apply adhesive to 15 capscrews (34).

(18.2) Apply adhesive to two capscrews (34.3).

(19) Install nose box cover (32) onto nose box housing (15) using 17 new lockwashers (33), 15 capscrews (34), and two capscrews (34.3). Torque capscrews (34 and 34.3) to 39 foot-pounds (53 N·m).

35. BEARING CUP
36. TOP COVER
37. BEARING CUP
38. CENTER COVER
39. BEARING CUP
40. BEARING SUPPORT



(20) If removed, install bearing cup (35) into top cover (36).

(21) If removed, install bearing cup (37) into center cover (38).

(22) If removed, install bearing cup (39) into bearing support (40).

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 5. Verify the boom length sensor adjustment: Retract the boom fully. Refer to TM 9-2320-297-10, paragraph 2-16.1 and 2-23.1. If the boom does not retract, move the MAIN POWER switch to the OFF position, push the manual bypass valve and use the manual controls to retract the boom fully. Lower the boom to gain access to the Overload Shutdown System central unit and the boom nose. Turn the ignition switch OFF and remove three electrical connectors from the central unit.

CAUTION

A green-yellow wire connects the ground to the cover. This wire is connected to a terminal inside the base. Carefully disconnect the green-yellow wire from the terminal on the base before removing the cover completely.

Remove four nuts and cover from Overload Shutdown System assembly. Remove green-yellow wire from terminal on base.

CAUTION

- The boom length cable is connected to a potentiometer. Use caution when adjusting the potentiometer and only adjust when instructed in this test procedure. Use caution when approaching the adjustment stops at either end of travel. Failure to comply may result in damage to the potentiometer.
- The cable drum is under high tension. Do not allow the length cable to free-wheel into the central unit without leading it back into the central unit and onto the drum. Do not allow the cable wraps to build up on one side of the drum. Do not pull the length cable out past the post on the boom nose or allow the cable to jump over the side of the drum. Failure to comply may result in damage to equipment.

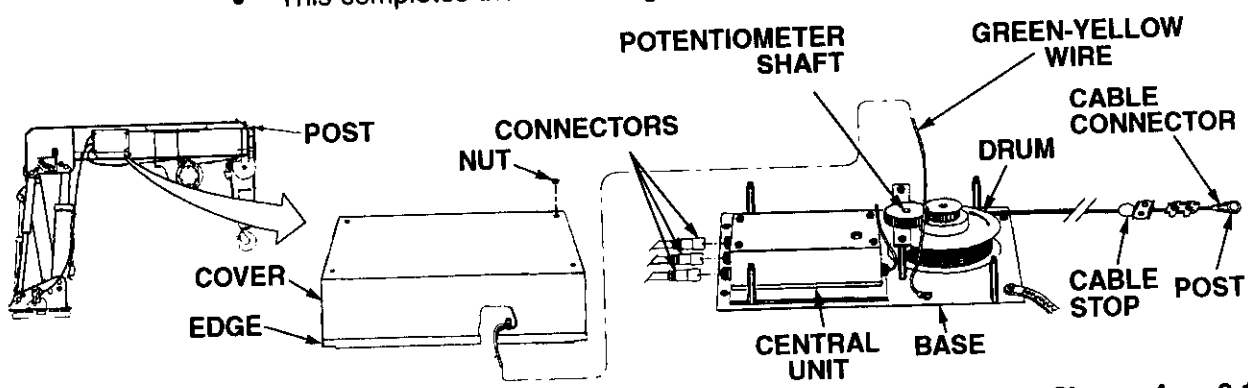
NOTE

The outside cover mark is the painted and non-painted line where the cover edge rests.

Adjust length sensor:

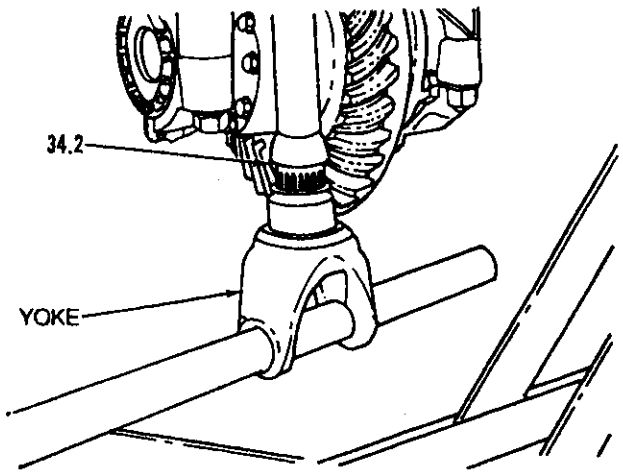
Un-clip the length cable connector from the post on the boom nose. Spool the cable back onto the drum in a straight line parallel to the boom. Stop spooling the cable back when the rubber length cable stop reaches the outside cover mark. Use a small screwdriver to carefully turn the potentiometer shaft clockwise until it stops, while ensuring that the rubber stop remains at the outside cover mark. Pull the length cable out in a straight line parallel to the boom and clip the length connector to the post on the boom.

- This completes the boom length sensor adjustment, go to Test 6.



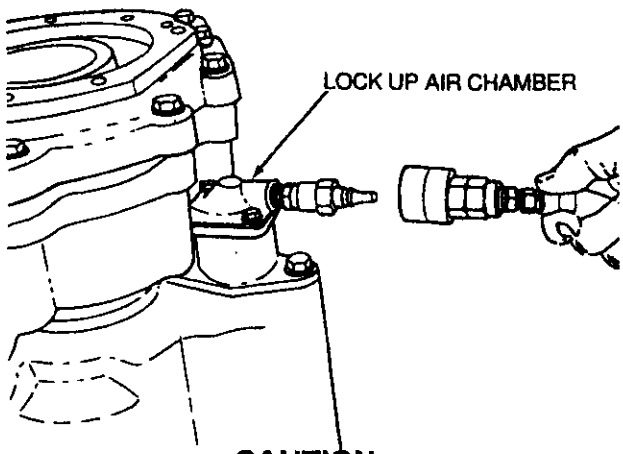
9-13. NOSE BOX, DIFFERENTIAL CARRIER COVER, AND CARRIER REASSEMBLY (Continued)

(15.4) Install yoke and locknut on axle thru shaft (34.2). Insert bar through yoke to prevent thru shaft from turning.



34.2 . AXLE THRU SHAFT

(15.5) Apply a minimum of 80 psi (552 kPa) to lock up air chamber. This will lock input shaft and thru shaft together.



CAUTION

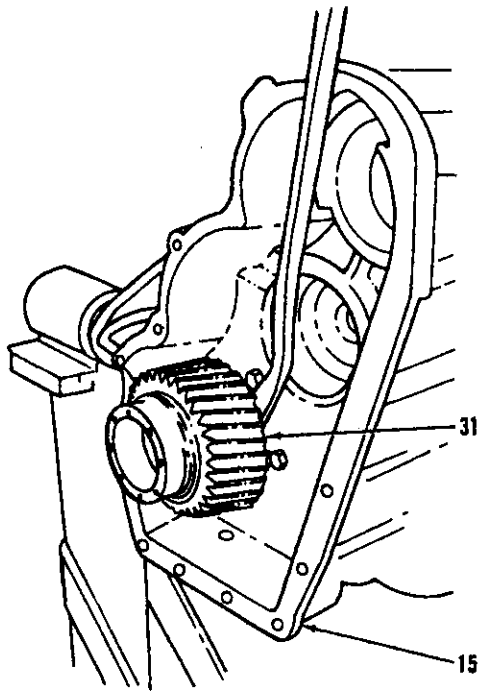
Tighten locknut (34.1) using hand tools only, to avoid seal damage.

NOTE

When outer oil seal (14) is correctly installed, top of seal will project slightly above seal housing.

(15.6) Tighten new locknut (34.1) using nose box socket to seat outer oil seal (14) into seal housing.

(15.7) Loosen locknut approximately 2-1/2 turns and pry bottom gear (31) away from nose box housing (15) enough to remove seal installer.



31. BOTTOM GEAR
15. NOSE BOX HOUSING

(15.8) Using nose box socket install new locknut (34.1). Torque to 780-960 foot-pounds (1058-1302 N·m).

(15.9) Remove air supply to lock up air chamber.

(15.10) Remove locknut and yoke from axle thru shaft (34.2).

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

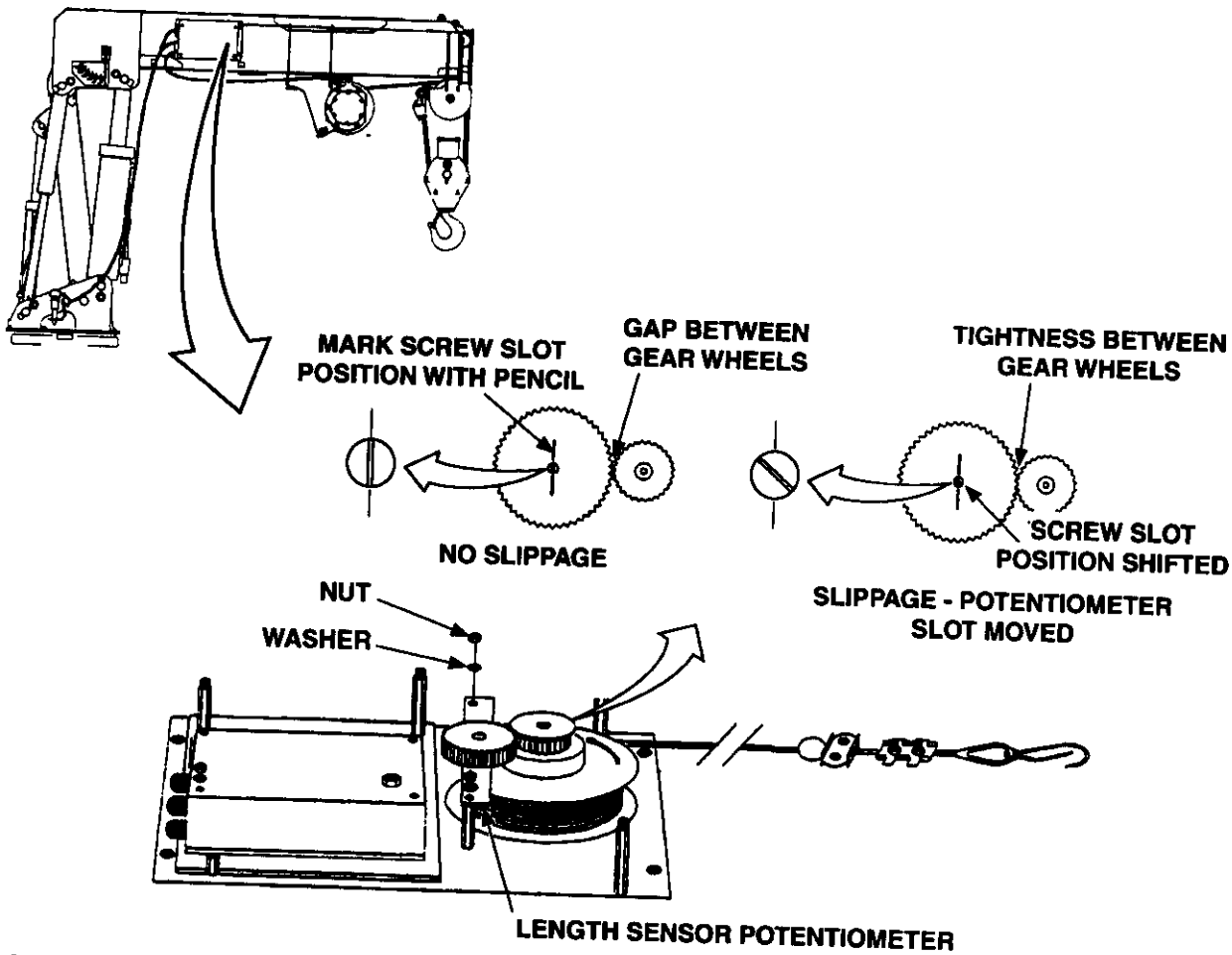
OVERLOAD SHUTDOWN SYSTEM DOES NOT OPERATE PROPERLY. (Continued)

Test 6. Check if the gear wheel has slipped on the potentiometer shaft: Mark, with a pencil, the position of the potentiometer adjusting screw slot on the nylon gear wheel. Using the manual override, telescope the boom fully out and verify that the adjusting screw slot is still aligned with the nylon gear.

- If the pencil mark is still aligned with the screw slot, go to Test 7.
- If the pencil mark is no longer aligned with the screw slot, there is insufficient clearance between the gears. Loosen the two nuts holding the length sensor potentiometer mounting plate. Adjust the plate until a gap is visible between the two gears and gear backlash can be felt in the large gear. Tighten the mounting plate and repeat Test 6.

Test 7. Attempt to operate the crane through all modes of operation.

- If crane operates normally, the boom length sensor adjustment corrected the Overload Shutdown System problem. Install cover on Overload Shutdown System assembly with four nuts and washers.
- If problem remains, go to Test 8.



(13) If removed, install two bearing cones (25) onto top gear (26).

(14) If removed, install two bearing cones (27) onto center gear (28).

(14.1) Apply adhesive to threads of two capscrews (30).

(15) Install plate (29) and two capscrews (30) onto center gear (28). Torque capscrews (30) to 107 foot-pounds (145 N·m).

CAUTION

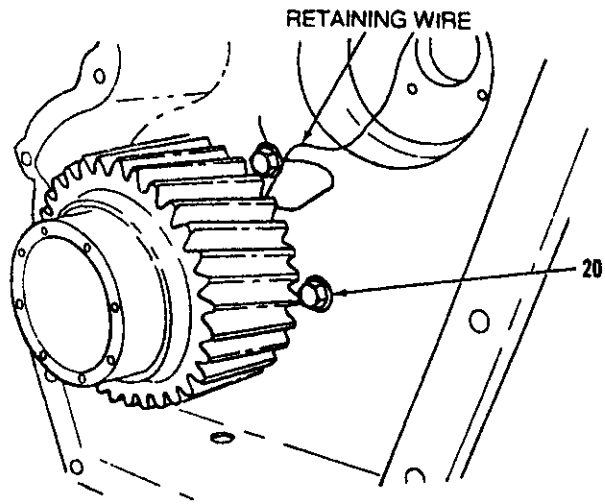
To prevent nose box damage, be sure that outer oil seal (14) is installed properly.

(15.1) Carefully install new outer oil seal (14) with lip towards nose box housing (15) on bottom gear (31). Install outer oil seal (14) only half-way on bottom gear (31).

CAUTION

Flat side of seal installer must face bottom gear (31) to prevent oil seal damage.

(15.2) Install seal installer, flat side towards bottom gear (31) between outer oil seal (14) and gear. Tighten retaining wire to hold seal installer in place.

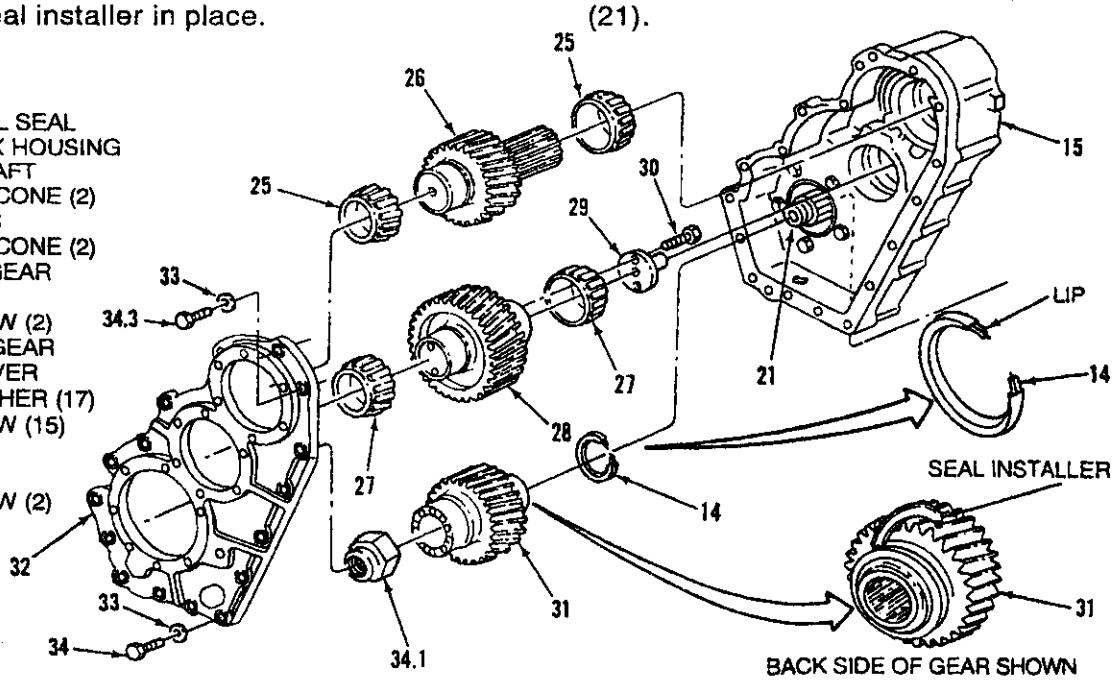


20. NOSE BOX HOUSING MOUNTING SCREWS

NOTE

Position bottom gear (31) on input shaft (21) with seal installer retaining wire centered between nose box housing mounting capscrews (20). This will aid in removal of seal installer.

(15.3) Install bottom gear (31) on input shaft (21).



14. OUTER OIL SEAL
15. NOSE BOX HOUSING
21. INPUT SHAFT
25. BEARING CONE (2)
26. TOP GEAR
27. BEARING CONE (2)
28. CENTER GEAR
29. PLATE
30. CAPSCREW (2)
31. BOTTOM GEAR
32. NOSE COVER
33. LOCKWASHER (17)
34. CAPSCREW (15)
34.1. LOCKNUT
34.2. SHAFT
34.3. CAPSCREW (2)

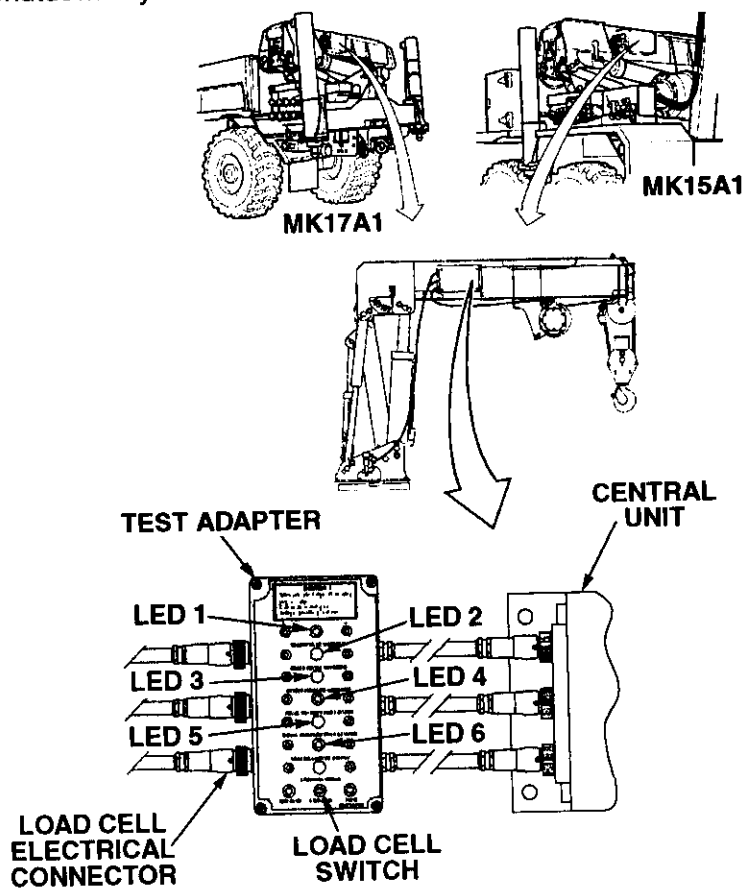
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 8. Turn IGNITION switch OFF. Install crane test adapter to central unit and three crane electrical connectors. Ensure all connectors are tight before energizing system. Turn IGNITION switch ON and move crane MAIN POWER switch to the ON position. Wait approximately 20 seconds for the system to perform a self-test. During this self-test some of the LEDs on the test adapter will flash,while some of the relays and components are actuated. Place loadcell switch to SIGNAL ON. After completion of the self-test note the status of the LEDs and their performance. Record status of LEDs for future use in this task.

- If LEDs 1, 2, 4 and 6 are illuminated, go to Test 9.
- LED 1 - Crane Power Incoming - should be illuminated at all times. If LEDs 1-6 all appear to be dim or off, there is a problem with the power to the Overload Shutdown System. Go to Test 11.
- LED 2 - Crane Power Outgoing - should be illuminated at all times. If LED 2 appears to be dim or off, there is a problem with the power output from the Overload Shutdown System, power relay or wiring. Refer to Malfunction 2, Crane Does Not Operate, in this manual.
- LED 4 - Power On Hoist Proximity Switch - should be illuminated at all times. If LED 4 appears to be dim or off, there is a problem with the power supply to the hoist proximity switch. Go to Test 27.
- LED 6 - Loadcell Power Supply - should be illuminated at all times. If LED 6 is off all the time, there is a problem with the power supply to the loadcell from the Overload Shutdown System. Go to Test 31.



9-13. NOSE BOX, DIFFERENTIAL CARRIER COVER, AND CARRIER REASSEMBLY (Continued)

b. Nose Box Assembly

NOTE

- Always replace cotter pins, shims, oil seals, lockwashers, and lockwires with new parts.
- If nose box is to be assembled to a **new replacement differential,** the differential must first be prepared to accept the nose box housing. Refer to paragraph 9-21, in TM 2320-34/13, TM 9-2320-297-34.

(1) If removed, install bearing cup (12) into spacer (13).

CAUTION

To prevent nose box damage, be sure the inner seal (14) is installed properly.

(2) Install new inner oil seal (14) into spacer (13). Position inner oil seal (14) with lip away from differential carrier cover (10).

NOTE

Apply sealant between spacer (13) and nose box housing (15).

(3) Aline holes for capscrews and press spacer (13) into nose box housing (15).

NOTE

Coat outside diameter of oil seal (17) with sealant before installing.

(4) Install spacer (16) and new oil seal (17) into nose box housing (15) with lip towards outside.

(5) Position nose box housing (15) up, and if removed, install bearing cups (18) into nose box housing (15).

(6) Install shims (19) onto spacer (13) and install nose box housing (15) onto differential carrier cover (10).

(7) Install five capscrews (20), and torque to 105 foot-pounds (142 N·m). Rotate input shaft (21) while tightening to seat bearing cone (22).

(8) Using a dial indicator (23) check end play of input shaft (21).

(9) Position dial indicator (23) so plunger is on nose box housing (15) end of input shaft (21).

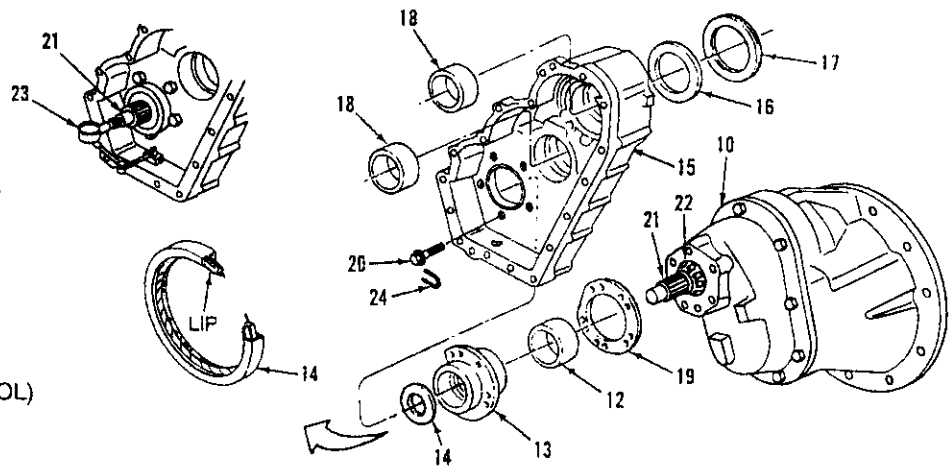
(10) Move input shaft (21) in and out. End play should be between 0.003-0.010 inch (0.0762-0.245 mm). Remove shims (19) to decrease end play. Add shims (19) to increase end play.

(10.1) Coat shims (19) with sealing, lubricating and wicking compound.

(11) After proper end play is obtained coat threads of five capscrews (20) with adhesive and install. Torque to 105 foot-pounds (142 N·m).

(12) Install new lockwire (24) through holes in capscrew (20) heads.

10. DIFFERENTIAL CARRIER COVER
12. BEARING CUP
13. SPACER
14. INNER OIL SEAL
15. NOSE BOX HOUSING
16. SPACER
17. OIL SEAL
18. BEARING CUP (2)
19. SHIMS
20. CAPSCREW (5)
21. INPUT SHAFT
22. BEARING CONE
23. DIAL INDICATOR (TOOL)
24. LOCKWIRE



MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

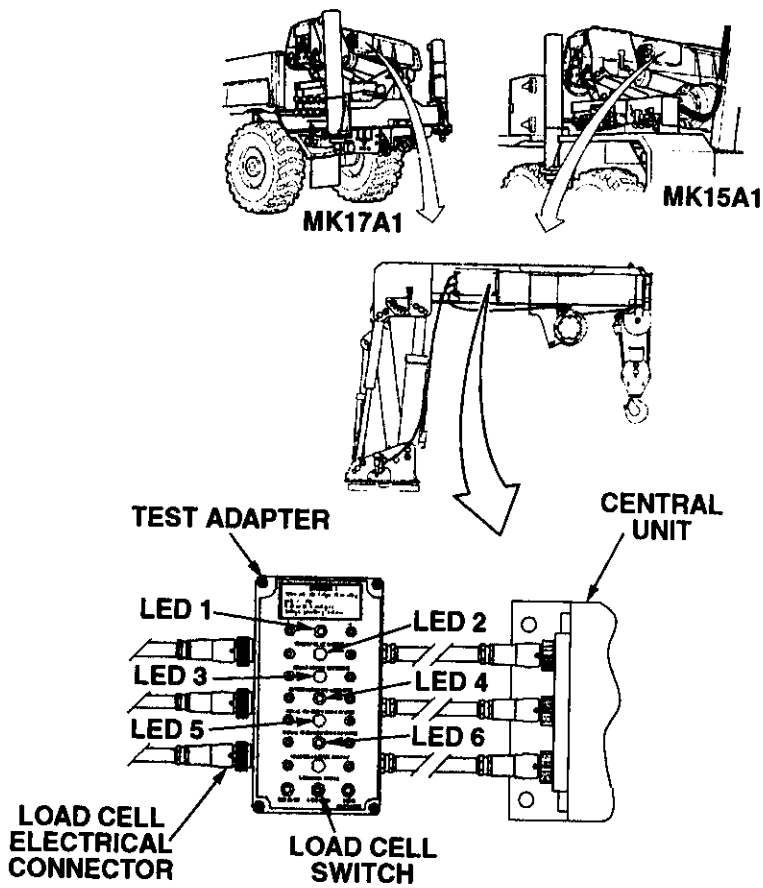
OVERLOAD SHUTDOWN SYSTEM DOES NOT OPERATE PROPERLY. (Continued)

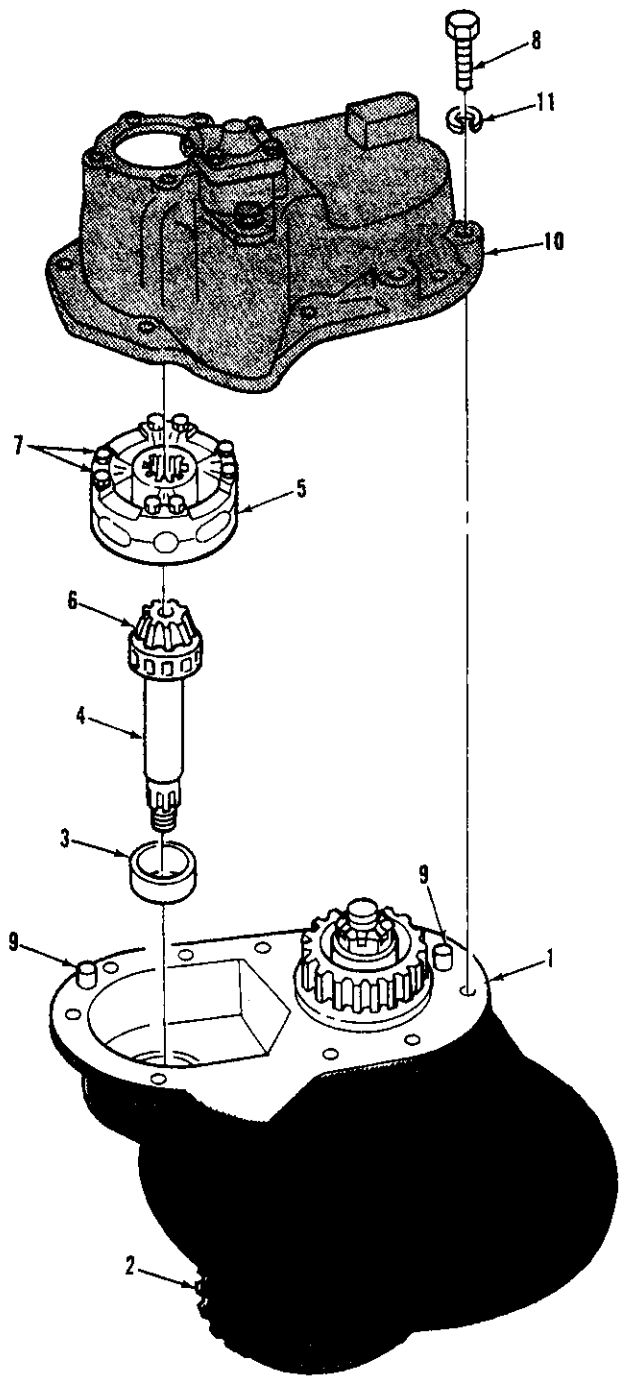
Test 9. First observe LED 3, then remove the loadcell electrical connector from the test adapter. Observe the status of LED 3 after the connector is removed from the test adapter, then reconnect connector.

- LED 3 - If LED 3 is off with connector installed and on with connector removed, go to Test 10.
- If LED 3 is on all the time, there is a problem with the cutoff signal from the Overload Shutdown System. Go to Test 12.
- If LED 3 is off all the time, there is a problem with the cutoff signal from the Overload Shutdown System. Go to Test 21.

Test 10. Extend boom and pay out the maximum length of hoist cable. Observe the status of LED 5 as the hoist cable is payed in.

- LED 5 - Hoist Proximity Switch Signal - illuminates when most of the hoist cable is about half-way payed in. If LED 5 illuminates as the hoist cable is being payed in, the hoist proximity switch is functioning properly.
- If LED 5 is on or off at all times, there is a problem with the hoist proximity switch. Go to Test 29.





1. CARRIER
2. RING GEAR
3. BEARING CUP
4. OUTPUT SHAFT
5. INTER-AXLE DIFFERENTIAL
6. SIDE GEAR
7. LOCKNUT (8)
8. CAPSCREW (9)
9. DOWEL PIN (2)
10. DIFFERENTIAL CARRIER COVER
11. LOCKWASHER (9)

TA 298948

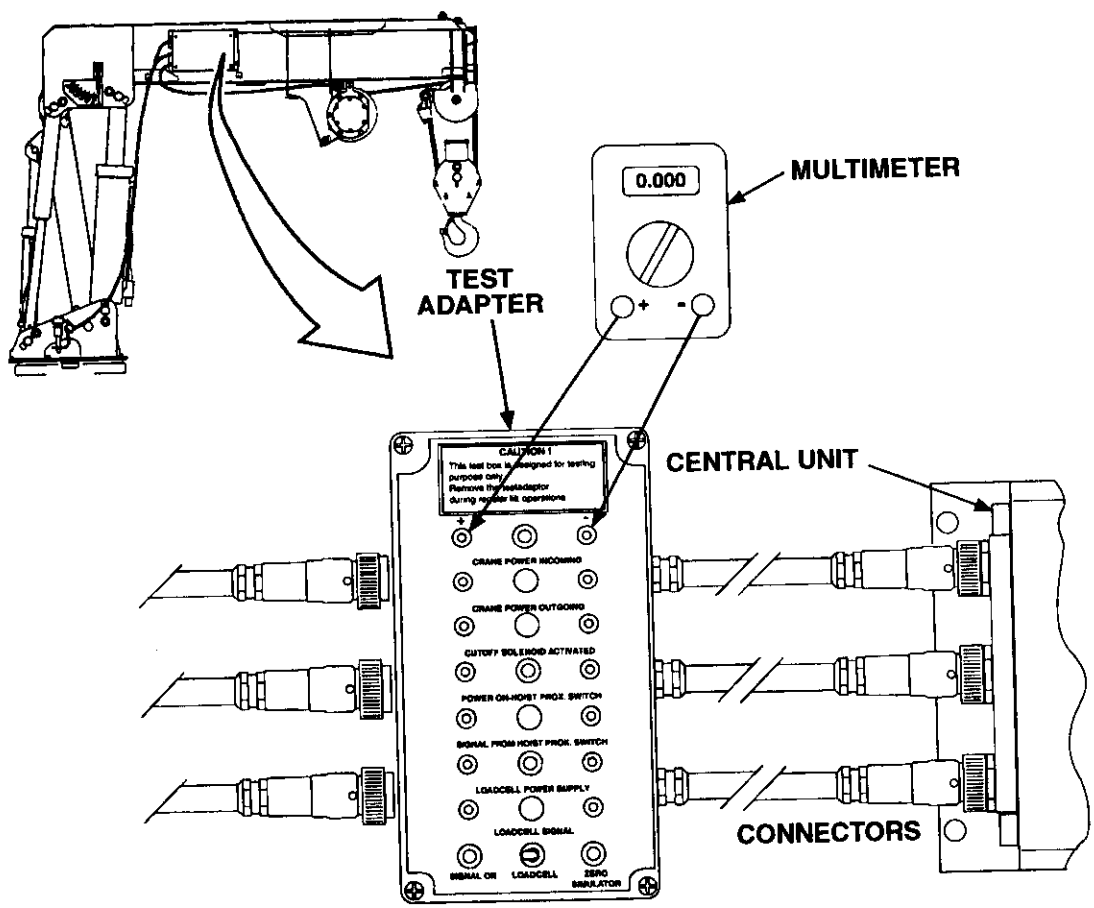
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 11. Using a digital multimeter, check the voltage reading between the "+" and "GND" CRANE POWER INCOMING terminals of the test adapter.

- If 24 volts are present, there is no problem with the incoming voltage to the Overload Shutdown System. Return to Test 8 to see if any other LED faults are present.
- If the correct voltage is not present, refer to TM 9-2320-297-20, Malfunction 1, Crane Does Not Operate, Test 3.



9-16. NOSE BOX, DIFFERENTIAL CARRIER COVER, AND CARRIER REASSEMBLY

THIS TASK COVERS:
a. Differential Carrier Cover to Carrier, Reassembly
b. Nose Box Assembly

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Dial indicator (P/N 7872)
Nose box socket (P/N 2CB157)
Seal installer (P/N 2DE351)
Yoke end (P/N 6-4-6451)
Lock nut (P/N 95205)

Materials/Parts
Adhesive (item 3, Appendix C)
Adhesive, silicone sealant (item 7, Appendix C)
Retaining compound (item 19, Appendix C)
Lockwire (item 33, Appendix C)
Sealant, (item 57, Appendix C)
Capscrew (3) (MS90725-62)
Lockwasher (9) (MS35338-49) item 11
Oil seal (2) (NSN 5330-00-515-4917) item 14
Oil seal (NSN 5330-00-207-8971) item 17
Lockwasher (36) (MS35338-47) items 33, 42, 48, and 58
Locknut (P/N 1377070) item 51
Sealing, lubricating and wicking compound (item 63, Appendix C)
Sealant, pipe (item 60, Appendix C)

Personnel Required
1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Nose box, differential carrier cover, and carrier disassembled (para 9-15).
	Carrier repaired (para 9-17).
	Differential carrier cover repaired (para 9-18).
	Inter-axle differential repaired (para 9-19).
	Output shaft repaired (para 9-20).

General Safety Instructions
Nose box and carrier parts are very heavy. To prevent personal injury, use care when lifting or moving parts.

---

a. Differential carrier cover to Carrier, Reassembly

(1) Position carrier (1) with ring gear (2) down.

(2) If removed, install bearing cup (3) into carrier (1).

(3) Install output shaft (4) into carrier (1).

(4) Install inter-axle differential (5) onto side gear (6) with locknuts (7) facing outward.

(5) Run a bead of adhesive, silicone sealant on mating surface of carrier (1). Be sure to circle each capscrew (8) hole and dowel pin (9).

(6) Install differential carrier cover (10) onto carrier (1).

(7) Install nine new lockwashers (11) and capscrews (8). Torque capscrews (8) to 110-125 foot-pounds (149-170 N·m).

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

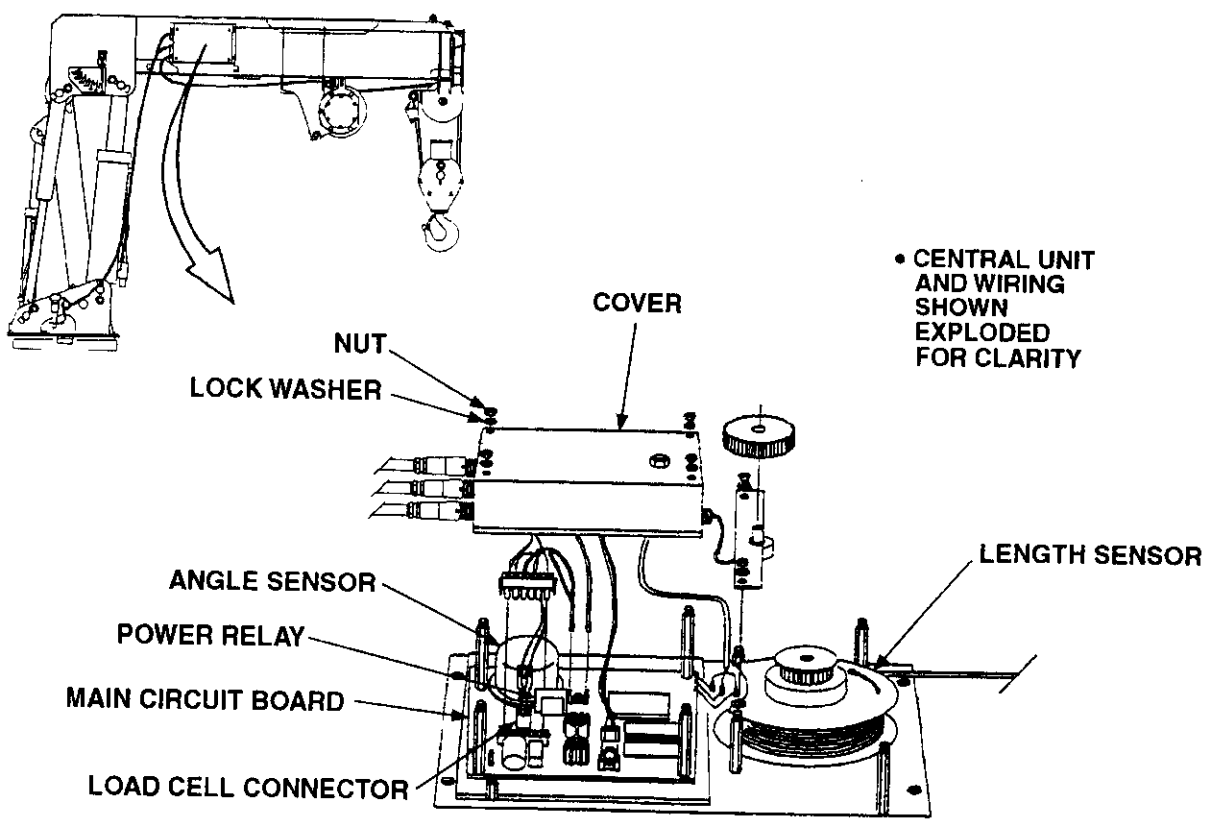
OVERLOAD SHUTDOWN SYSTEM DOES NOT OPERATE PROPERLY. (Continued)

CAUTION

- Ensure cover is supported or damage to wiring may occur.
- When performing troubleshooting on the crane overload shutdown system test only terminals called out in the test procedures to avoid causing a short circuit.

Test 12. Remove four nuts, lockwashers, and cover. Inspect Overload Shutdown System central unit internal wiring. Specifically check wires and connectors from load cell connector to main circuit board; wires from angle sensor to main circuit board; and wires and connectors from length sensor to main circuit board.

- Repair any loose connections or damaged wiring. Refer to TM 9-2320-297-20, paragraph 7-45.
- If connections and wiring are OK, go to Test 13.



b. Differential Carrier Cover Separation

(1) Remove nine capscrews (49) and lockwashers (50) from differential carrier cover (51). Discard lockwashers (50).

CAUTION

When differential carrier cover is removed, inter-axle differential may come loose and fall. Be prepared to catch it before it falls out.

(2) Remove differential carrier cover (51) from carrier (52).

(3) Remove inter-axle differential (53).

(4) Remove output shaft (54) from carrier (52).

c. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all gears, bearings, and cups for pitting, scoring, or signs of overheating.

(3) Inspect all fasteners for thread damage.

(4) Inspect all other parts. Refer to paragraph 2-7.

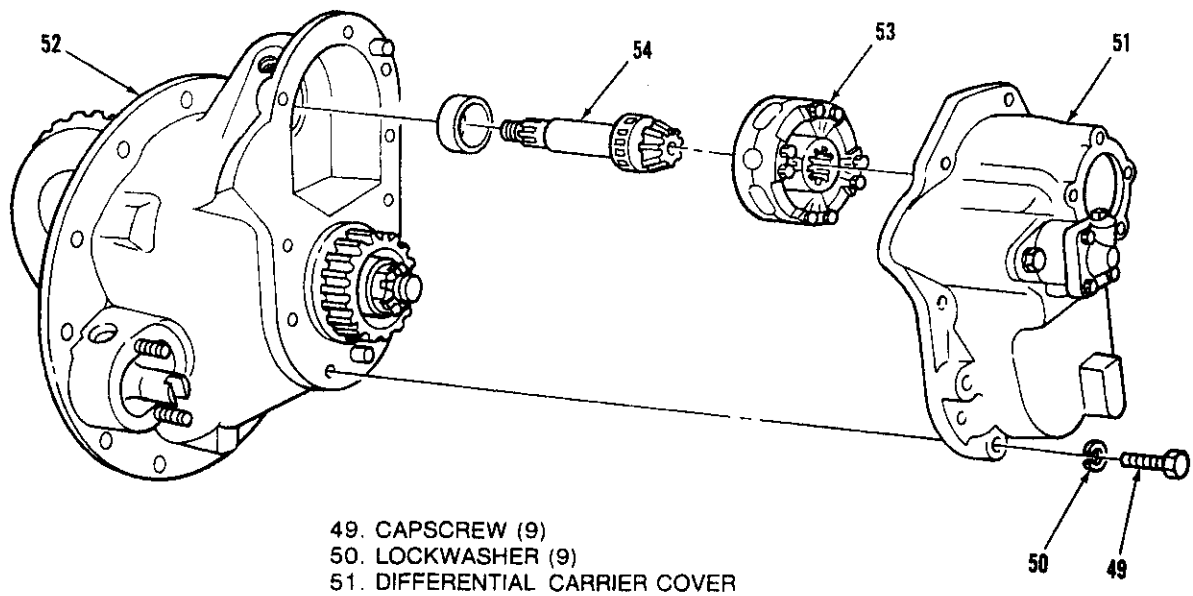
(5) Replace all parts failing inspection.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Repair carrier (para 9-17).
	Repair differential carrier cover (para 9-18).
	Repair inter-axle differential (para 9-19).
	Repair output shaft (para 9-20).
	Assemble differential carrier cover and nose box to carrier (para 9-16).



49. CAPSCREW (9)
50. LOCKWASHER (9)
51. DIFFERENTIAL CARRIER COVER
52. CARRIER
53. INTER-AXLE DIFFERENTIAL
54. OUTPUT SHAFT

TA 288947

MALFUNCTION

TEST OR INSPECTION

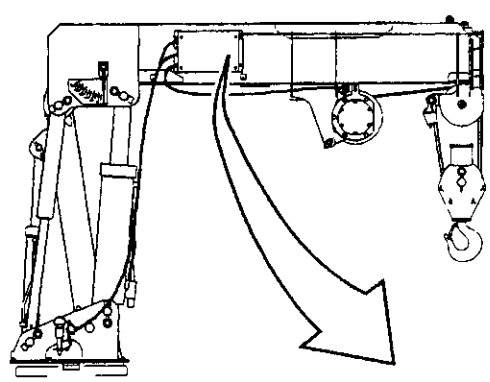
CORRECTIVE ACTION

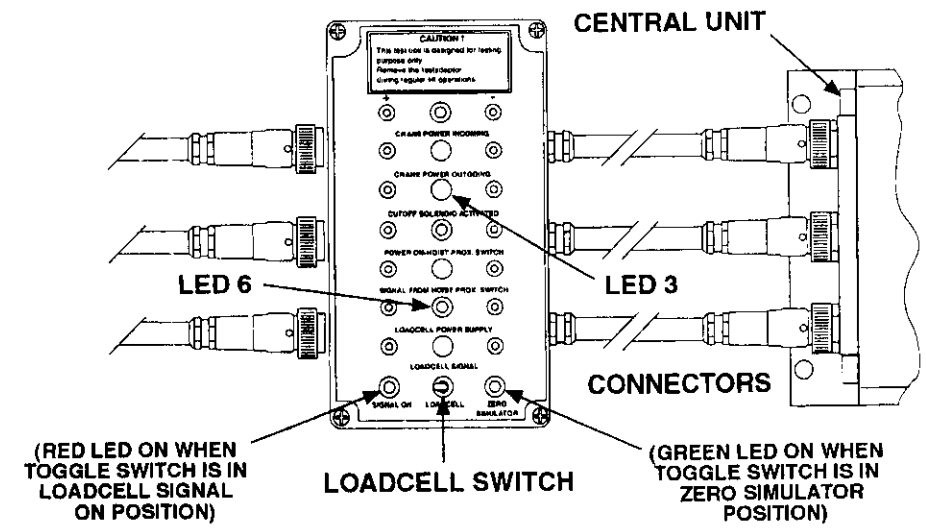
Test 13. During Test 8, was LED 6 (load cell power supply) also lit?

- If LED 6 was not lit, go to Test 33.
- If LED 6 was lit, go to Test 14.

Test 14. Move the test adapter LOADCELL switch to the ZERO SIMULATOR position. Did LED 3 change from on to off? Move test adapter LOADCELL switch back to the SIGNAL ON position.

- If LED 3 stayed on during Test 14, go to Test 17.
- If LED 3 went out during Test 14, go to Test 15.





9-15. NOSE BOX, DIFFERENTIAL CARRIER COVER, AND CARRIER SEPARATION (Continued)

(30) Remove two bearing cups (43) from nose box housing (29).

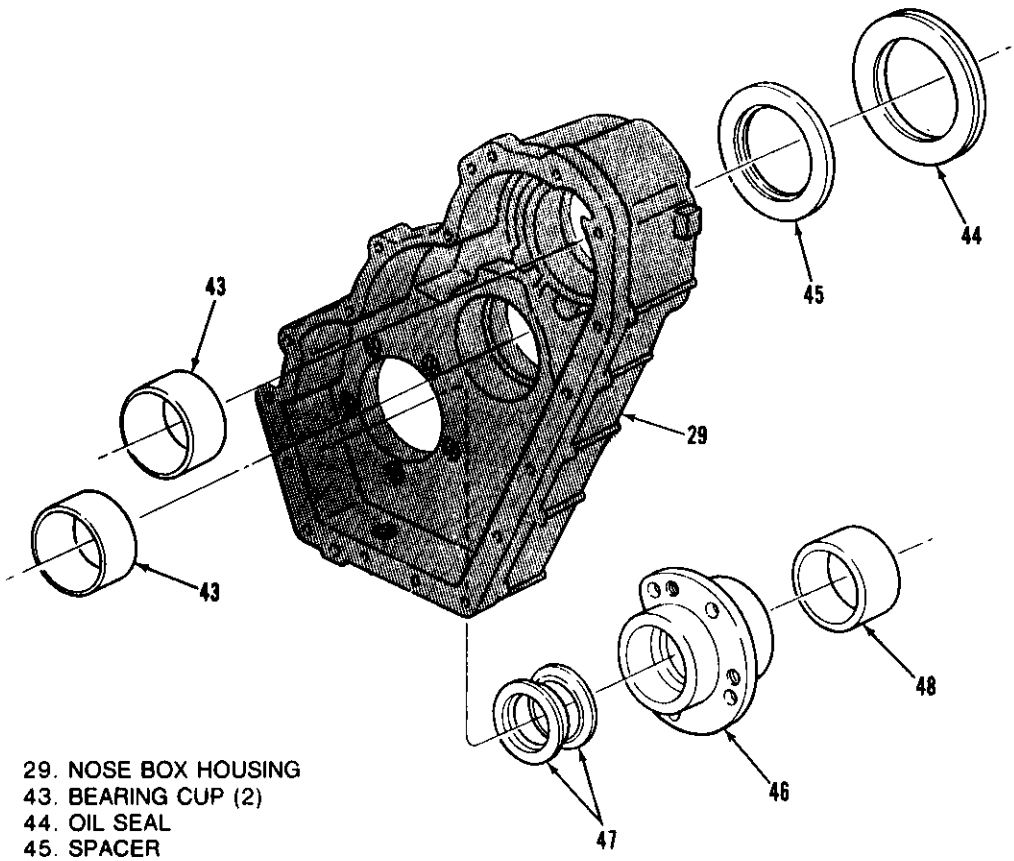
(31) Remove oil seal (44) and spacer (45) from nose box housing (29). Discard oil seal (44).

(32) Install three 1/2-13 capscrews into threaded holes in nose box spacer (46).

(33) Turn capscrews in until nose box spacer (46) comes loose. Remove nose box spacer (46).

(34) Remove two oil seals (47) from nose box spacer (46) and discard.

(35) Remove bearing cup (48) from nose box spacer (46).



29. NOSE BOX HOUSING
43. BEARING CUP (2)
44. OIL SEAL
45. SPACER
46. NOSE BOX SPACER
47. OIL SEAL (2)
48. BEARING CUP

TA 298948

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

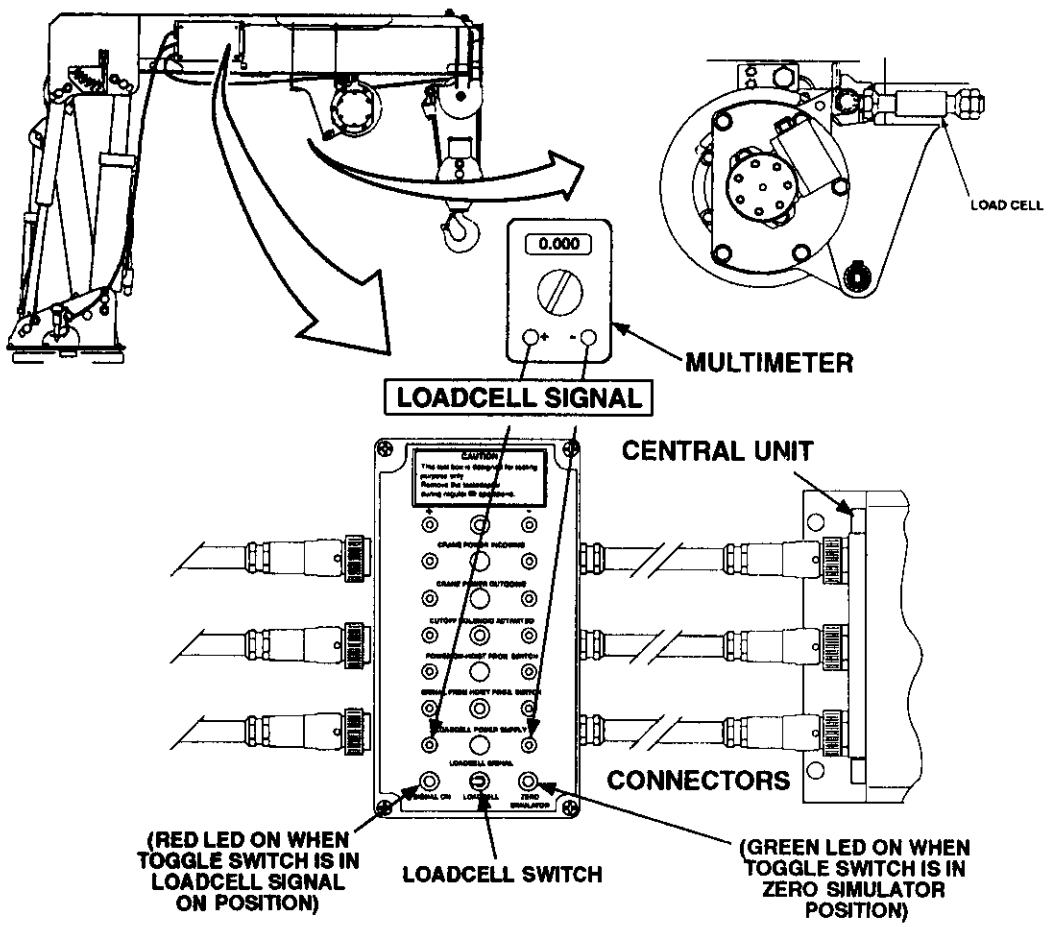
OVERLOAD SHUTDOWN SYSTEM DOES NOT OPERATE PROPERLY. (Continued)

Test 15. Inspect the crane tension loadcell and wiring for damage.

- If any damage to the loadcell or wiring is found, replace loadcell. Refer to para 18.1-31 in this manual.
- If the crane loadcell appears to be OK, go to Test 16.

Test 16. Using a digital multimeter, check the voltage reading between the "+" and "GND" LOADCELL SIGNAL terminals of the test adapter. Ensure that the test adapter LOADCELL switch is in the SIGNAL ON position.

- If 0-12.24 mV are found, go to Test 17.
- If 0-12.24 mV are not found, the loadcell is defective. Replace loadcell. Refer to para 18.1-31 in this manual.



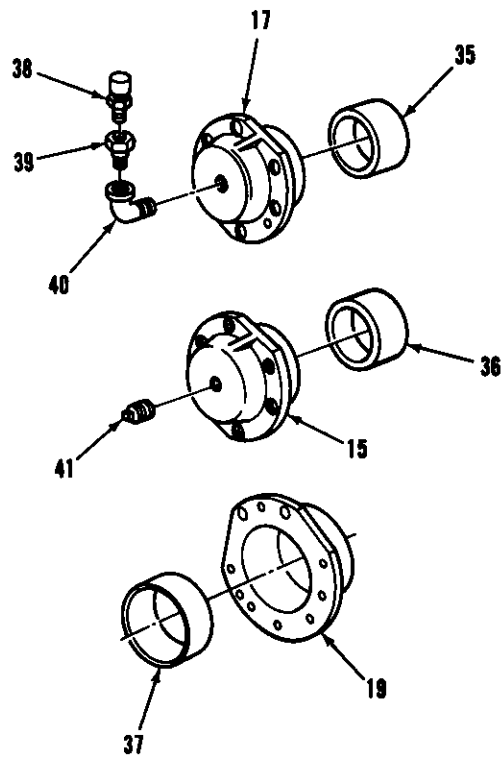
(25) Remove bearing cup (35) from top cover (17) and bearing cup (36) from center cover (15).

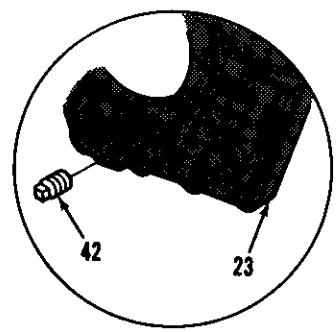
(26) Remove bearing cup (37) from bearing support (19).

(27) Remove breather (38), reducer (39), and elbow (40) from top cover (17).

(28) Remove plug (41) from center cover (15).

(29) Remove filler plug (42) from nose box cover (23).





15. CENTER COVER
17. TOP COVER
19. BEARING SUPPORT
23. NOSE BOX COVER
35. BEARING CUP
36. BEARING CUP
37. BEARING CUP
38. BREATHER
39. REDUCER
40. ELBOW
41. PLUG
42. FILLER PLUG

TA 296945

MALFUNCTION

TEST OR INSPECTION

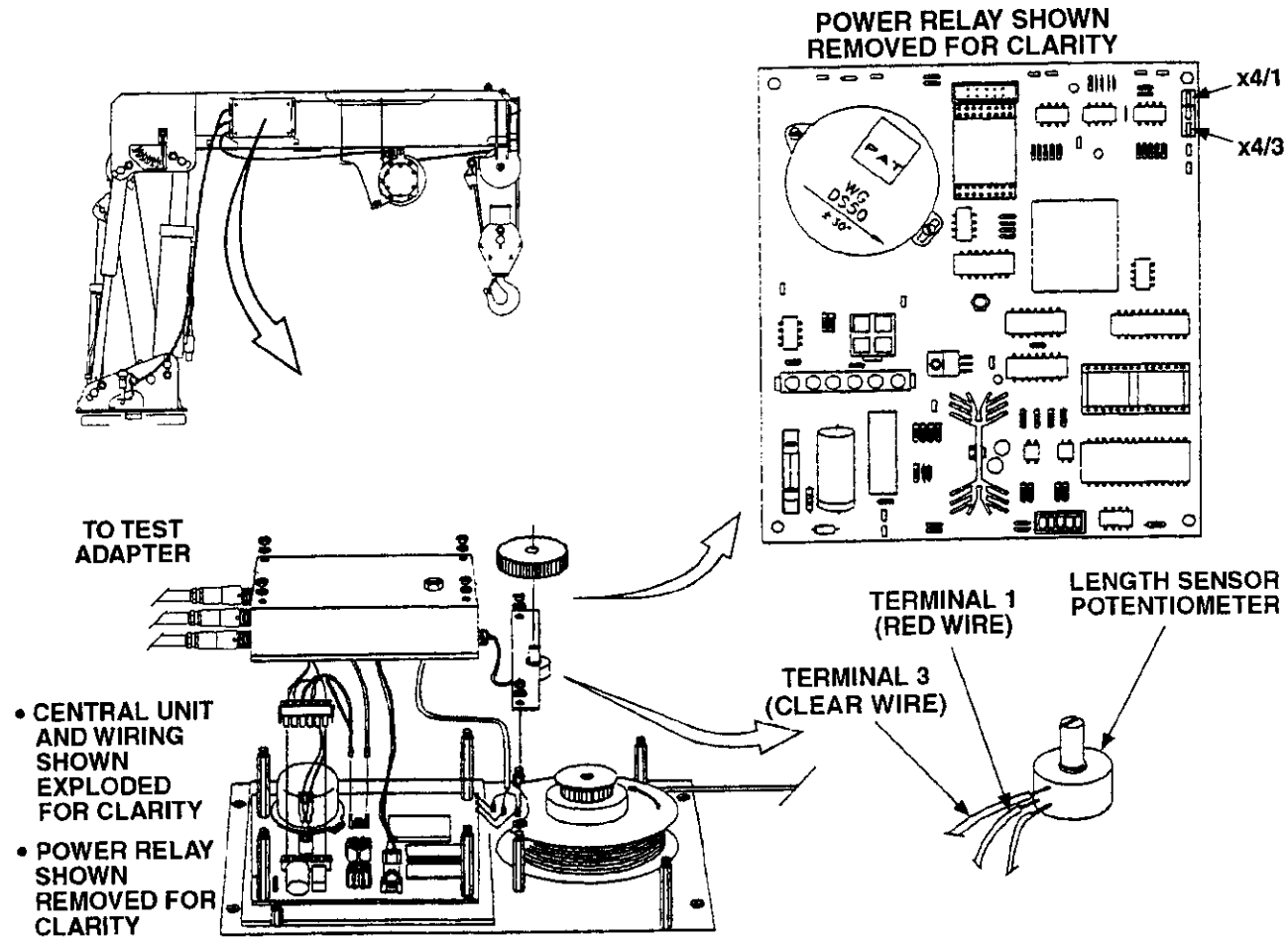
CORRECTIVE ACTION

Test 17. Using a digital multimeter, check voltage between Overload Shutdown System central unit main circuit board terminals X4/1 and X4/3.

- If 4.9-5.1 volts are found, go to Test 18.
- If 4.9-5.1 volts are not found, replace Overload Shutdown System central unit. Refer to paragraph 18.1-30 in this manual.

Test 18. Using a digital multimeter, check voltage between Overload Shutdown System central unit circuit board (potentiometer) terminals 1 and 3.

- If 4.9-5.1 volts are found, go to Test 19.
- If 4.9-5.1 volts are not found, repair wires or connectors. Refer to TM9-2320-297-20, paragraph 7-45.



9-15. NOSE BOX, DIFFERENTIAL CARRIER COVER, AND CARRIER SEPARATION (Continued)

(16) Have assistant hold nose box cover (23), then remove 17 capscrews (21) and lockwashers (22). Discard lockwashers (22).

(17) Install two capscrews (21) into threaded holes in nose box cover (23).

(18) Turn capscrews (21) in evenly and remove nose box cover (23).

(19) Remove upper gear (24), center gear (25), and lower gear (26).

(20) Cut, remove, and discard lockwires (27) from five capscrews (28).

(21) Have assistant hold nose box housing (29), then remove five capscrews (28), nose box housing (29), and shims (30). Tag shims for later use.

NOTE

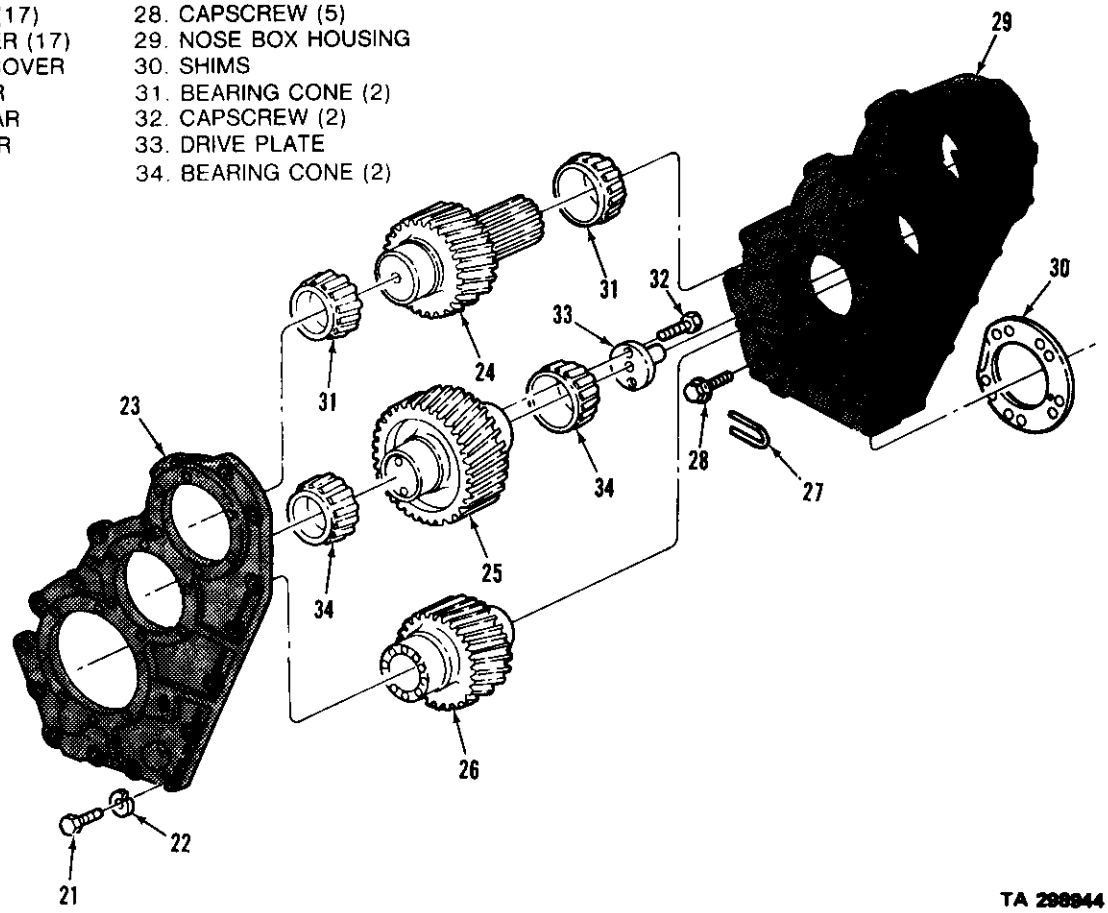
Remove pressed-on bearings and cups only if they are being replaced with new parts.

(22) Remove two bearing cones (31) from upper gear (24).

(23) Remove two capscrews (32) and drive plate (33) from center gear (25).

(24) Remove two bearing cones (34) from center gear (25).

21. CAPSCREW (17)
22. LOCKWASHER (17)
23. NOSE BOX COVER
24. UPPER GEAR
25. CENTER GEAR
26. LOWER GEAR
27. LOCKWIRE
28. CAPSCREW (5)
29. NOSE BOX HOUSING
30. SHIMS
31. BEARING CONE (2)
32. CAPSCREW (2)
33. DRIVE PLATE
34. BEARING CONE (2)



TA 298944

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

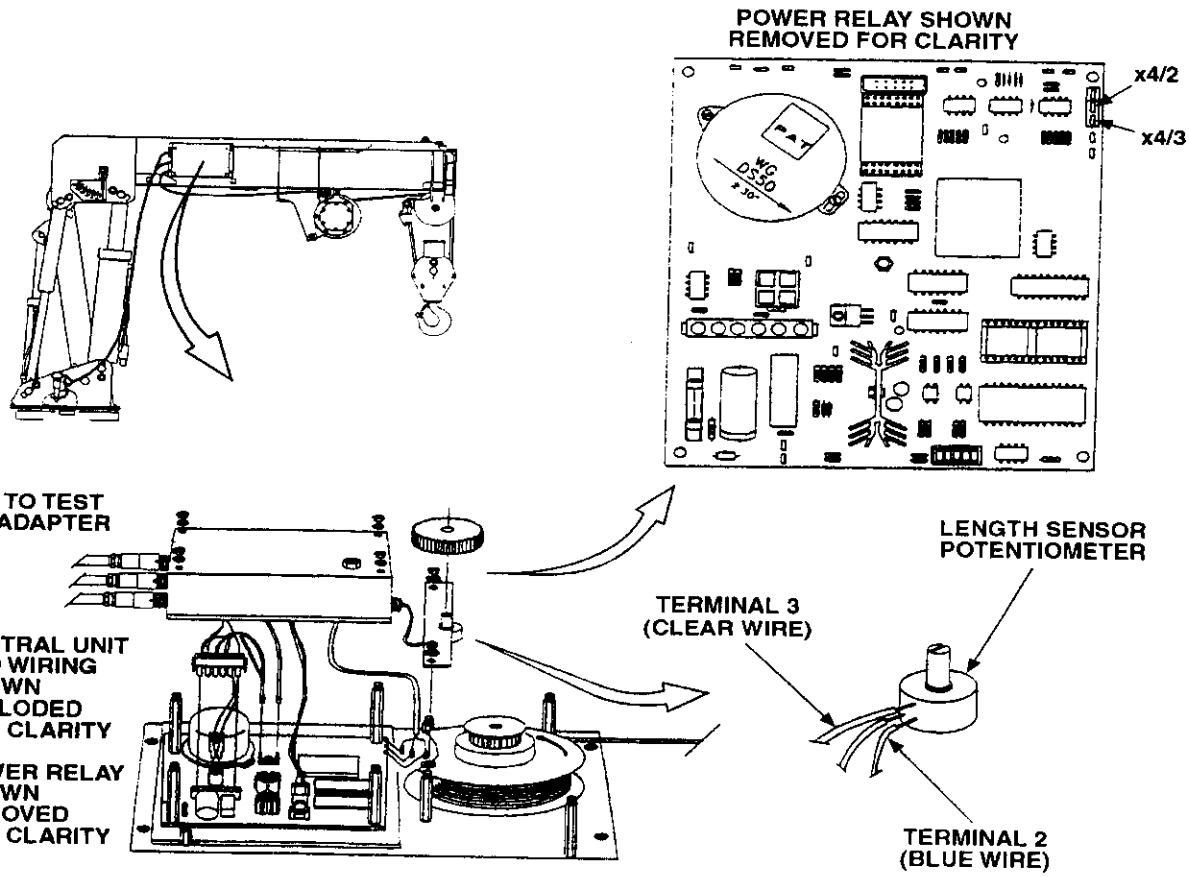
OVERLOAD SHUTDOWN SYSTEM DOES NOT OPERATE PROPERLY. (Continued)

Test 19. Connect positive probe of digital multimeter to Overload Shutdown System central unit circuit board (potentiometer) terminal 2. Connect negative probe of digital multimeter to Overload Shutdown System central unit circuit board (potentiometer) terminal 3. Turn the potentiometer screw fully counterclockwise and observe the voltage reading. Does the voltage gradually increase to 4.9-5.1 volts as screw is turned? (Five turns of the screw will equal approximately 2.5 volts.)

- If voltage does not increase, replace the Overload Shutdown System central unit. Refer to paragraph 18.1-30 in this manual.
- If the voltage increases turn potentiometer screw fully clockwise and go to Test 20.

Test 20. Connect positive probe of digital multimeter to Overload Shutdown System central unit circuit board terminal X4/2. Connect negative probe of digital multimeter to Overload Shutdown System central unit circuit board terminal X4/3. Turn the potentiometer screw fully counterclockwise and observe the voltage reading. Does the voltage gradually increase to 4.9-5.1 volts? (Five turns of the screw will equal approximately 2.5 volts.)

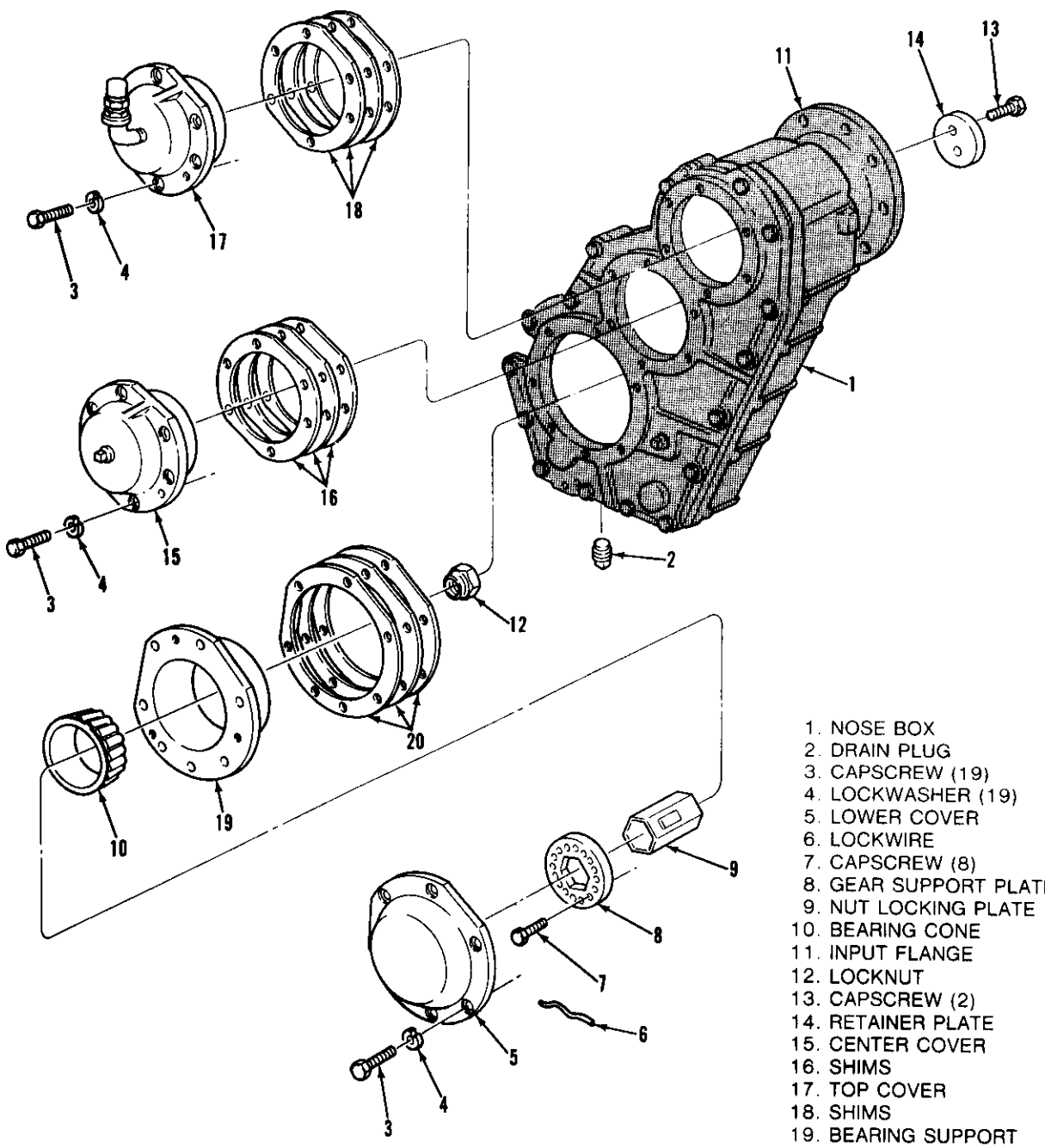
- If voltage does not increase, repair length potentiometer wiring and/or connections. Refer to TM 9-2320-297-20, paragraph 7-45.
- If the voltage increases as described above, return to Test 8 to see if any other LED faults are present.



(13) Install three 3/8-16 capscrews into threaded holes in bearing support (19).

(14) Turn capscrews in evenly until bearing support (19) comes loose.

(15) Remove bearing support (19) and shims (20). Tag shims (20) for later use.



1. NOSE BOX
2. DRAIN PLUG
3. CAPSCREW (19)
4. LOCKWASHER (19)
5. LOWER COVER
6. LOCKWIRE
7. CAPSCREW (8)
8. GEAR SUPPORT PLATE
9. NUT LOCKING PLATE
10. BEARING CONE
11. INPUT FLANGE
12. LOCKNUT
13. CAPSCREW (2)
14. RETAINER PLATE
15. CENTER COVER
16. SHIMS
17. TOP COVER
18. SHIMS
19. BEARING SUPPORT
20. SHIMS

TA 298943

MALFUNCTION

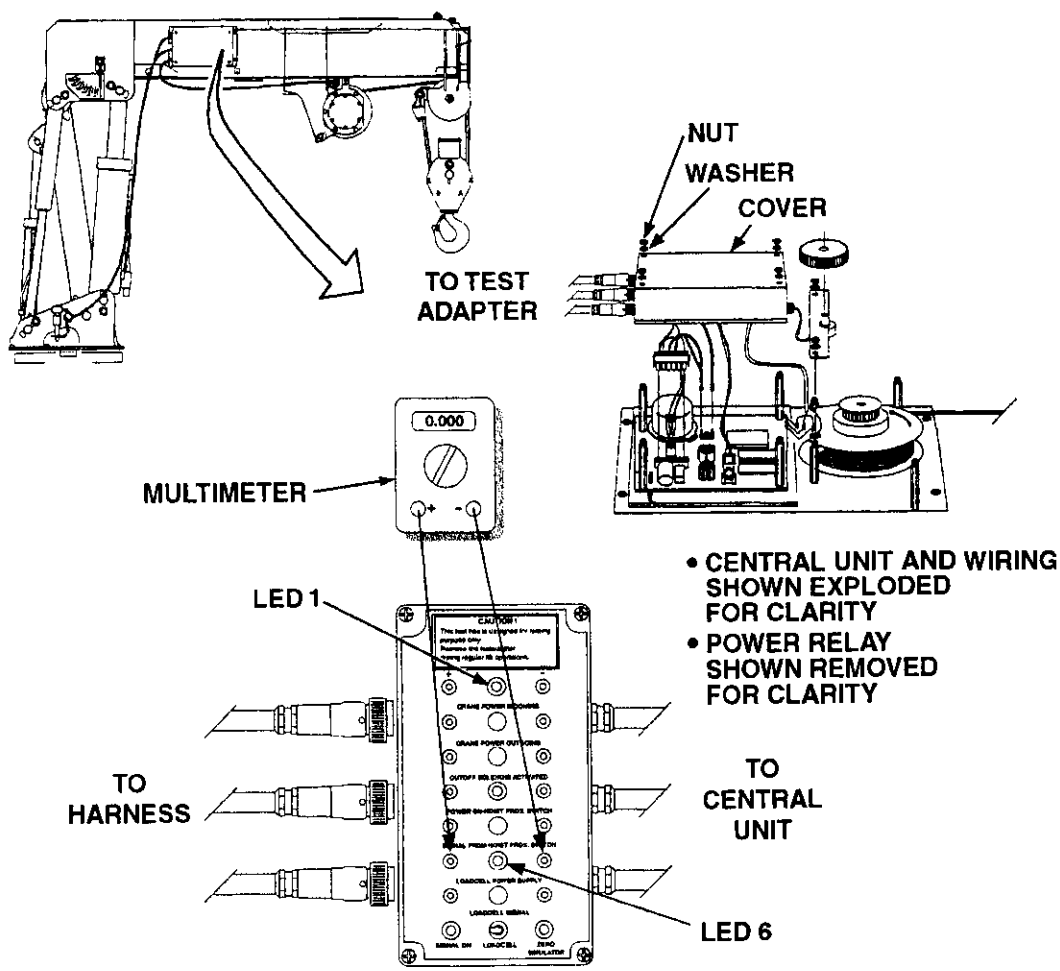
TEST OR INSPECTION

CORRECTIVE ACTION

Test 21. During Test 8, was LED 6 (loadcell power supply) also lit?
- If LED 6 was not lit, go to Test 22.
- If LED 6 was lit, reinstall both covers on the Overload Shutdown System central unit and go to Test 24.

Test 22. Using a digital multimeter, check the voltage reading between the "+" and "GND" LOADCELL POWER SUPPLY terminals of the test adapter.
- If 10-13 volts are present, the loadcell is defective. Replace loadcell. Refer to paragraph 18.1-31 in this manual.
- If 10-13 volts are not present, go to Test 23.

Test 23. Inspect Overload Shutdown System central unit internal wiring. Specifically check wires and connectors from load cell connector to main circuit board.
- Repair any loose connections or damaged wiring. Refer to TM 9-2320-297-20 paragraph 7-45.
- If connections and wiring are OK, replace Overload Shutdown System central unit. Refer to paragraph 18.1-30 in this manual.



SECTION IV. FRONT AXLE DISASSEMBLY INTO SUBASSEMBLIES AND REASSEMBLY FROM SUBASSEMBLIES

9-15. NOSE BOX, DIFFERENTIAL CARRIER COVER, AND CARRIER SEPARATION

THIS TASK COVERS: a. Nose Box Disassembly
b. Differential Carrier Cover Separation
c. Cleaning/Inspection

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Nose box socket (P/N 2CB157)

Materials/Parts

Lockwire (item 33, Appendix C)
Capscrew (3) (MS90725-62)
Oil seals, items 44 and 47

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Nose box and carrier assembly removed (para 9-14).
	Nose box lube pump removed (para 9-6).
	Axle shift unit removed (para 9-4).

General Safety Instructions

Nose box and carrier assembly internal parts are very heavy. Be careful when lifting or separating parts.

---

a. Nose Box Disassembly

(1) Place a container under nose box (1), remove drain plug (2) and allow lubricant to drain.

(2) Remove seven capscrews (3), and lockwashers (4), from lower cover (5). Remove lower cover (5). Discard lockwashers (4).

(3) Cut, remove, and discard lockwires (6) from eight capscrews (7).

(4) Remove eight capscrews (7) and gear support plate (8).

(5) Remove nut locking plate (9) and bearing cone (10). Install input flange (11).

(6) Hold input flange (11) and remove locknut (12) using nose box socket. Discard locknut (12).

(7) Remove two capscrews (13), retainer plate (14), and input flange (11).

(8) Remove six capscrews (3) and lockwashers (4) from center cover (15). Discard lockwashers (4).

(9) Install two 3/8-16 capscrews into threaded holes in center cover (15).

(10) Turn capscrews in evenly until center cover (15) comes loose.

(11) Remove center cover (15) and shims (16). Tag shims (16) for later use.

(12) Repeat steps (8) thru (11) to remove top cover (17) and shims (18). Tag shims (18) for later use.

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

OVERLOAD SHUTDOWN SYSTEM DOES NOT OPERATE PROPERLY. (Continued)

WARNING

- Never exceed 110% of the given crane capacity for the actual radius. Failure to comply may result in damage to equipment and/or injury to personnel.
- Stay clear of test load when supported by crane. If test load falls, serious injury or death may result.

Test 24. Install crane test adapter. Ensure the LOADCELL switch on the test adapter is in the SIGNAL ON position. Raise crane boom to the highest position and fully extend boom. Attach hook to (*8000 lb.*) test load. Lower the crane boom while keeping the test load elevated. Note the actual boom radius and LED 3 status as the boom is lowered. Does the red LED 3 change from OFF to ON when the radius is approached for 100-110% of the load?

- If the light stays OFF, lower the test load to the ground and go to Test 25.
- If the light changes from OFF to ON, the loadcell is functioning properly.

Test 25. Inspect the crane load cell and wiring for damage.

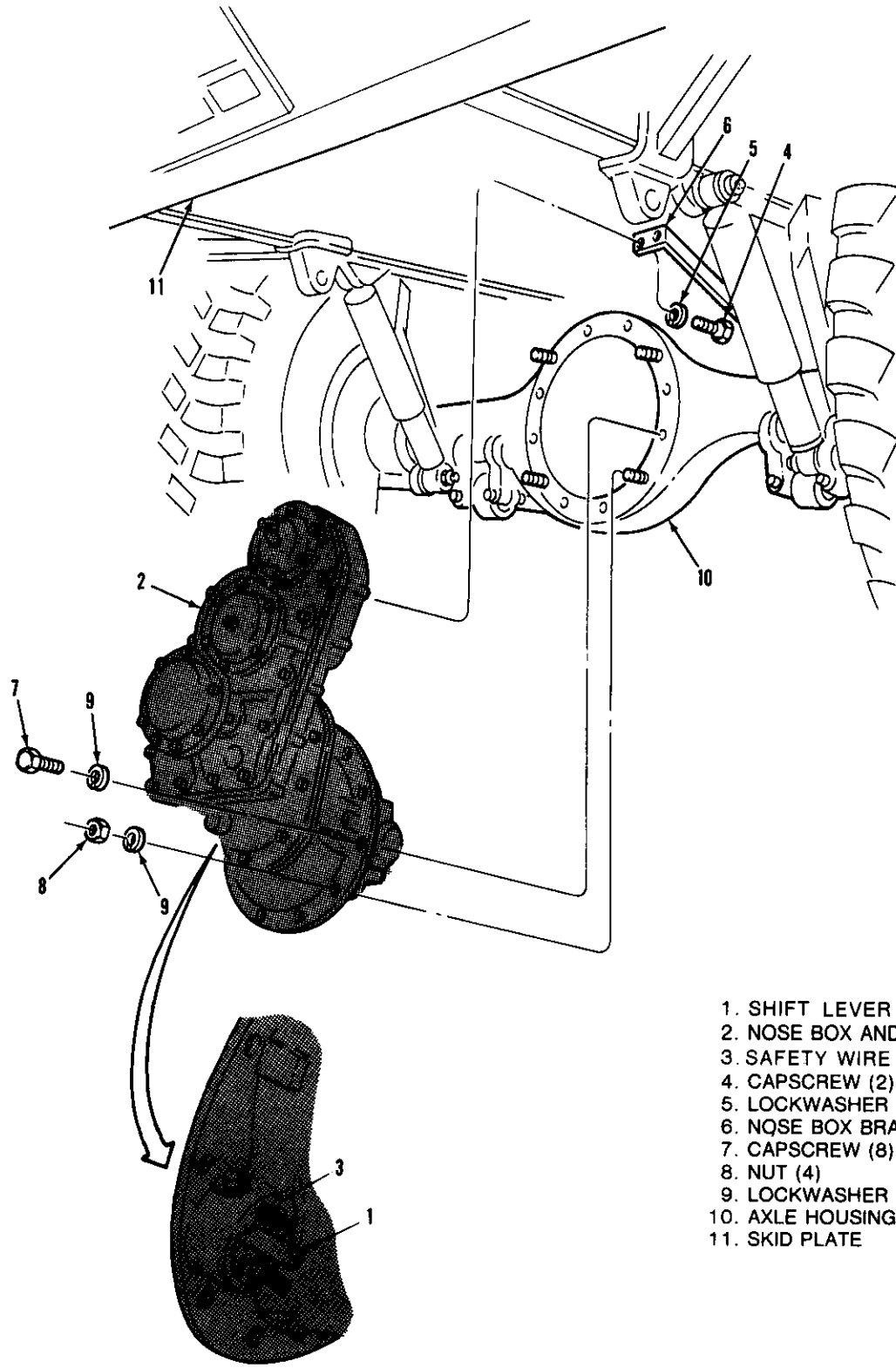
- If any damage to the loadcell or wiring is found replace loadcell. Refer to paragraph 18.1-31 in this manual.
- If the crane loadcell appears to be OK, go to Test 26.

Test 26. Using a digital multimeter, check the voltage reading between the "+" and "GND" LOADCELL SIGNAL terminals of the test adapter while attempting to lift the test load. Ensure that the test adapter LOADCELL switch is in the SIGNAL ON position. The voltage reading should increase as the load is raised and the voltage obtained should not exceed 11.76-12.24 mV.

- If voltage increases, replace the Overload Shutdown System central unit. Refer to paragraph 18.1-30 in this manual.
- If voltage fails to increase, or exceeds 11.76-12.24 mV, the loadcell is defective. Replace loadcell, refer to paragraph 18.1-31 in this manual.

Test 27. During Test 8, was LED 1 (crane power incoming) also lit?

- If LED 1 was not lit, go to Test 11 .
- If LED 1 was lit, go to Test 28.



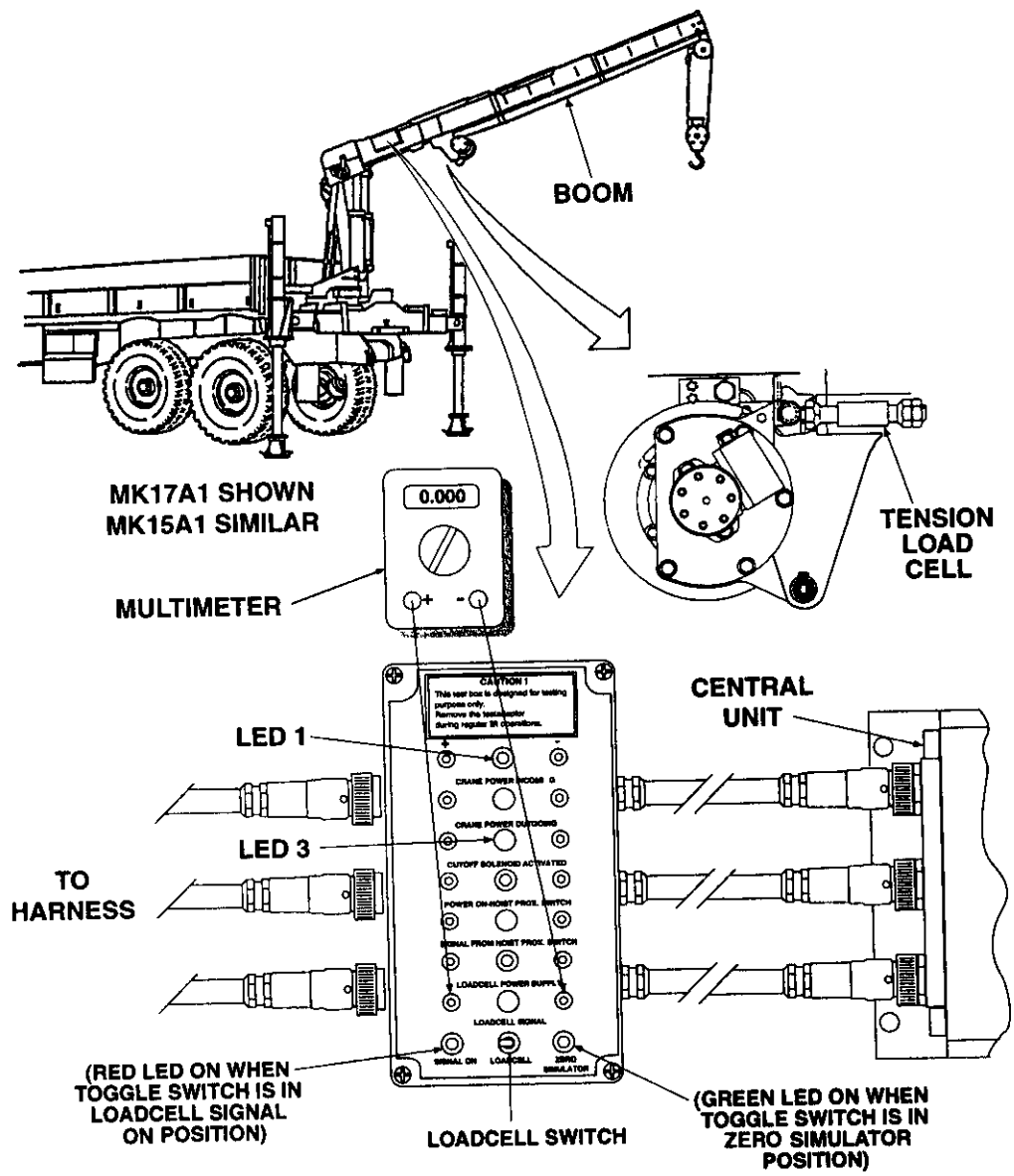
1. SHIFT LEVER
2. NOSE BOX AND CARRIER ASSEMBLY
3. SAFETY WIRE
4. CAPSCREW (2)
5. LOCKWASHER (2)
6. NOSE BOX BRACE
7. CAPSCREW (8)
8. NUT (4)
9. LOCKWASHER (12)
10. AXLE HOUSING
11. SKID PLATE

TA 298942

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION



9-14. NOSE BOX AND CARRIER ASSEMBLY REPLACEMENT (Continued)

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts for damage. Refer to paragraph 2-7.

(3) Repair or replace all parts failing inspection.

c. Installation

(1) Position nose box and carrier assembly (2) onto installation equipment and secure in place.

(2) Push shift lever (1) away from nose box and carrier assembly (2) to lock controlled traction differential in position. Secure shift lever (1) with safety wire (3).

(3) Lower nose box and carrier assembly assembly (2) so that nose box and carrier assembly will clear bottom of skid plate (11).

(4) Run a bead of silicone sealant onto mating surface of axle housing (10). Be sure to circle each capscrew hole and dowel hole.

(5) Position nose box and carrier assembly (2) in front of axle housing (10).

NOTE

Controlled traction differential must be in LOCKED position.

(6) Install nose box and carrier assembly (2) into axle housing (10).

(7) Install 12 new lockwashers (9), four nuts (8), and eight capscrews (7). Torque to 99 foot-pounds (134 N·m).

(8) Install two new lockwashers (5) and capscrews (4) at nose box brace (6). Torque capscrews (4) to 121 foot-pounds (164 N·m).

(9) Remove safety wire (3) from shift lever (1).

END OF TASK

NOTE

Follow-on Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install axle shafts (para 11-6).
TM 2320-34/13 TM 9-2320-297-34	Install axle housing cover (para 9-11).
	Install axle shift unit (para 9-4).
TM 2320-20/12 TM 9-2320-297-20	Install nose box companion flange (para 9-7).
	Install propeller shafts (para 10-3).
	Fill axle and nose box with lubricant (para 11-3).
	Install glad hands (para 13-34).

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

OVERLOAD SHUTDOWN SYSTEM DOES NOT OPERATE PROPERLY. (Continued)

Test 28. Using a digital multimeter, check the voltage reading between the "+" and "GND" POWER ON-HOIST PROX. SWITCH terminals of the test adapter.
- If 24 volts are found, go to Test 29.
- If 24 volts are not found, replace Overload Shutdown System central unit. Refer to paragraph 18.1-30, in this manual.

Test 29. Hold a small steel plate or screwdriver close to the sensing area of the hoist proximity switch and observe the status of LED 5. Then remove the steel plate or screwdriver and observe LED 5. Was LED 5 first on, and then go out when the steel object was removed?
- If LED 5 operates as described in above test, check the switch and cable follower adjustment. Refer to paragraph 18.1-25 in this manual.
- If LED 5 does not come on, go to Test 30.

Test 30. Inspect hoist proximity switch wiring and connectors.
- Repair damaged connectors or wiring, refer to TM 9-2320-297-20, paragraph 7-45.
- If connectors and wiring are OK, replace hoist proximity switch. Refer to paragraph 18.1-25 in this manual.

Test 31. Using a digital multimeter, check the voltage reading between the "+" and "GND" LOADCELL POWER SUPPLY terminals of the test adapter.
- If 10-13 volts are present, loadcell is faulty. Replace loadcell, refer to paragraph 18.1-31 in this manual.
- If 10-13 volts are not present, go to Test 32.

Test 32. Turn ignition switch to the OFF position. Remove both covers from the Overload Shutdown System central unit. Inspect Overload Shutdown System central unit internal wiring. Specifically check wires and connectors from load cell connector to main circuit board.
- Repair any loose connections or damaged wiring. Refer to TM 9-2320-297-20, paragraph 7-45.
- If connections and wiring are OK, go to Test 33.

Test 33. During Test 8, was LED 1 (crane power incoming) also lit?
- If LED 1 was not lit, go to Test 11.
- If LED 1 was lit, replace the Overload Shutdown System central unit. Refer to paragraph 18.1-30 in this manual.

END OF TEST

(1) Push shift lever (1) away from nose box and carrier assembly (2) to lock controlled traction differential in position. Secure shift lever (1) with safety wire (3).

(2) Remove axle shafts. Refer to paragraph 11-6 (TM 2320-20/12, TM 9-2320-297-20).

(3) Attach nose box and carrier assembly (2) securely to removal equipment.

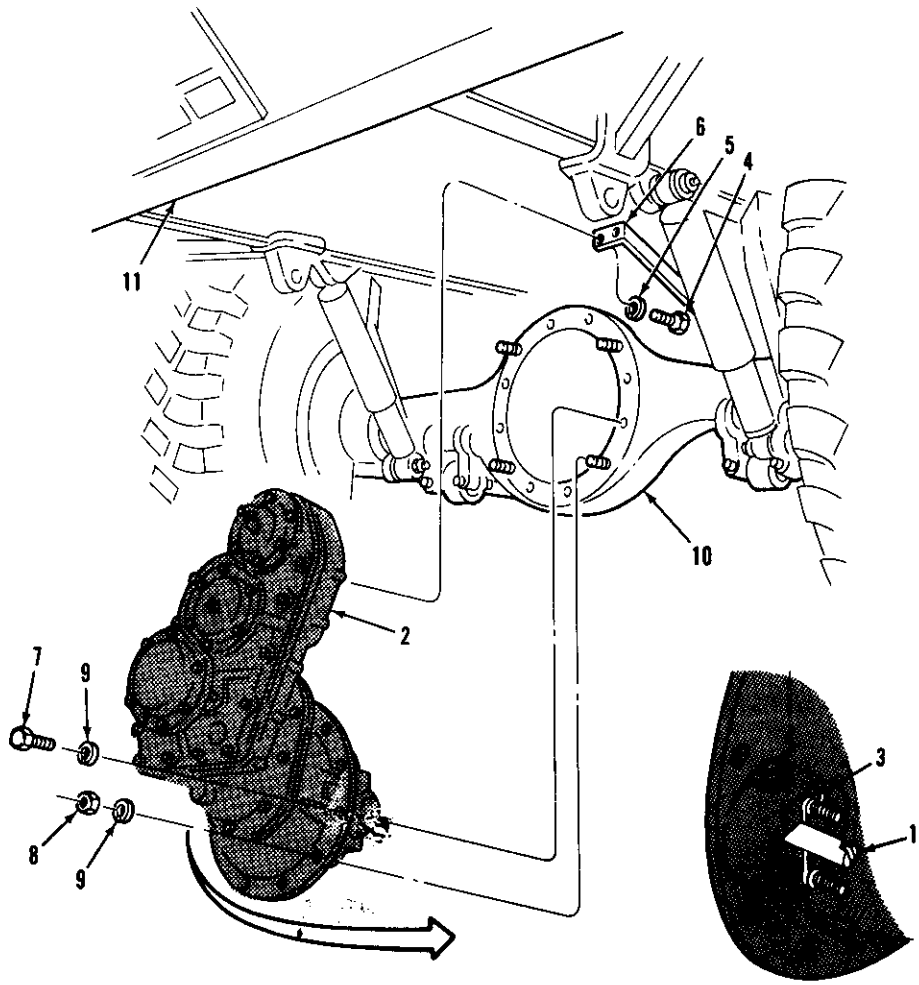
(4) Remove two capscrews (4) and lockwashers (5) from nose box brace (6). Discard lockwashers (5).

(5) Remove eight capscrews (7), four nuts (8), and 12 lockwashers (9). Discard lockwashers (9).

(6) Move nose box and carrier assembly (2) forward until free of axle housing (10).

(7) Lower nose box and carrier assembly (2) or raise front body of MK48 until nose box and carrier assembly (2) will clear bottom of skid plate (11).

(8) Remove nose box and carrier assembly (2).



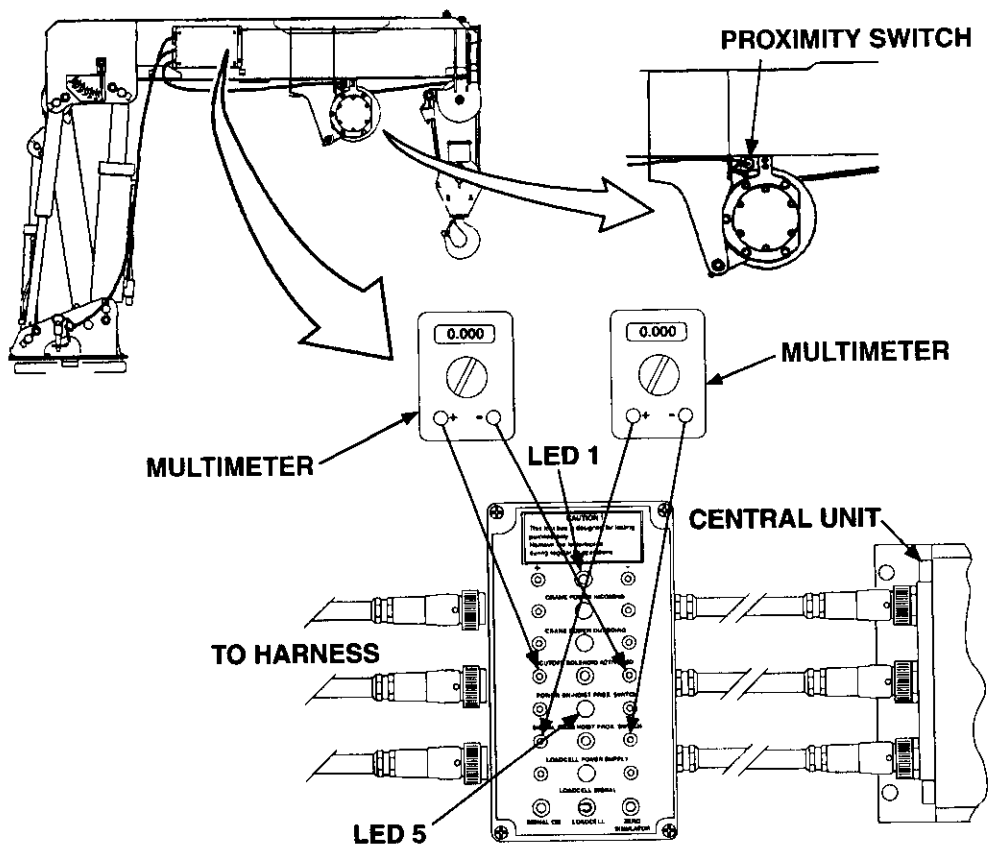
1. SHIFT LEVER
2. NOSE BOX AND CARRIER ASSEMBLY
3. SAFETY WIRE
4. CAPSCREW (2)
5. LOCKWASHER (2)
6. NOSE BOX BRACE
7. CAPSCREW (8)
8. NUT (4)
9. LOCKWASHER (12)
10. AXLE HOUSING
11. SKID PLATE

TA 298941

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION



9-14. NOSE BOX AND CARRIER ASSEMBLY REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Adhesive silicone sealant (item 7, Appendix C)
Lockwasher (14) (MS35338-50) items 5 and 9

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Drain axle and nose box lubricant (para 11-3).
	Remove propeller shafts (para 10-3).
TM 2320-34/13 TM 9-2320-297-34	Remove nose box companion flange (para 9-7).
TM 2320-20/12 TM 9-2320-297-20	Remove glad hands (para 13-34).
TM 2320-34/13 TM 9-2320-297-34	Remove axle shift unit (para 9-4).
	Remove axle housing cover (para 9-11).

General Safety Instructions

Nose box and carrier assembly is very heavy. Be very careful when moving to avoid possible injury or equipment damage.

Block wheels of truck to prevent movement.

Drain all air pressure from the air system.

---

a. Removal

WARNING

Nose box/carrier assembly (2) is very heavy. To prevent personal injury, make sure it is securely attached to the equipment being used to remove it.

CAUTION

Nose box and carrier assembly (1) cannot be removed unless controlled traction differential is in the LOCKED position. To prevent equipment damage, make sure that clutch is fully engaged.

NOTE

Hubs may have to be rotated to fully lock the controlled traction differential.

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

2. CRANE DOES NOT OPERATE.

NOTE

Before performing crane troubleshooting procedures, the following items must be verified:

- Make sure the PARKING BRAKE is applied.
- Make sure the transmission is in NEUTRAL.
- Make sure the hydraulic steering system is functioning properly.
- Make sure the front power unit's electrical system is functioning properly.

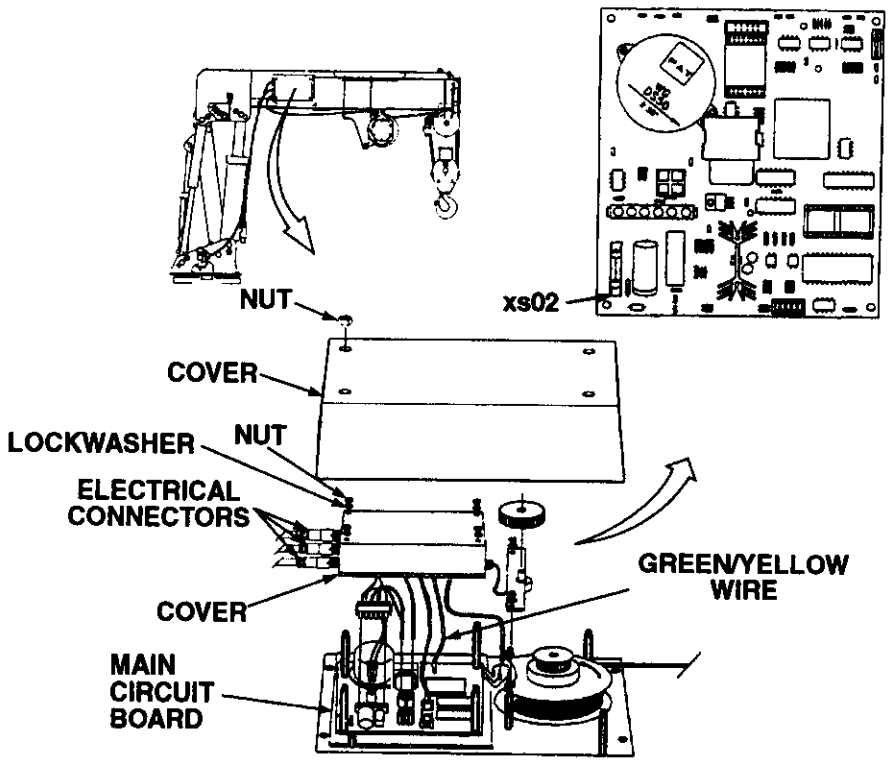
Unless advised otherwise, the ignition, MAIN POWER, and TILT ALARM switches must be in the ON position for all voltage checks.

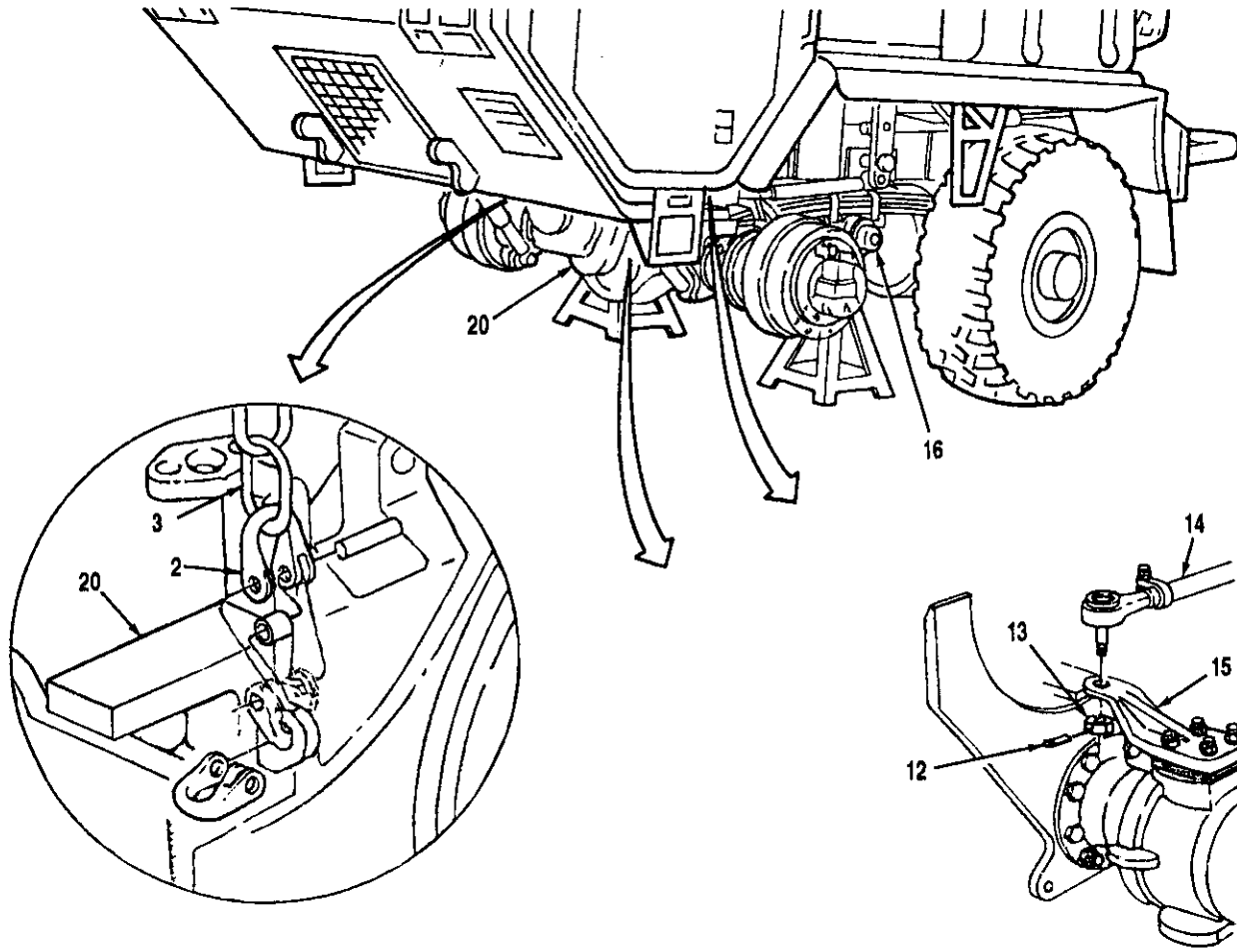
CAUTION

A green-yellow wire connects the ground to the cover. This wire is connected to a terminal on the base. Carefully disconnect the green-yellow wire from the terminal on the base before removing the cover completely.

Test 1. Remove three electrical connectors from the central unit. Remove four nuts and cover from Overload Shutdown System assembly. Remove green-yellow wire from terminal on base. Remove four screws and lockwashers and remove cover from main circuit board. Reconnect three electrical connectors to the central unit. Turn MAIN POWER switch to the ON position. Check for 24 volts at white wire connected to circuit board at terminal xs02.

- If 24 volts are found, go to Test 5.
- If 24 volts are not found, go to Test 2.





1. DOWEL PIN (2)
2. CLEVIS HALF (4)
3. LIMITING CHAIN (2)
4. SPACER (2)
5. LOCKNUT
6. DELETED
7. CAPSCREW
8. DELETED
9. CLAMP (2)
10. AIR LINE
11. AIR FITTING
12. COTTER PIN
13. NUT
14. DRAG LINK
15. STEERING ARM
16. SPRING SEAT (2)
20. AXLE ASSEMBLY

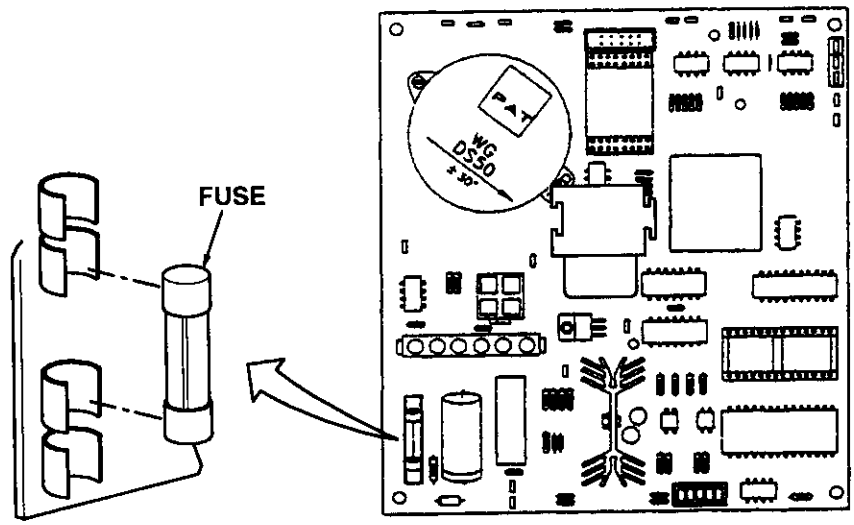
MALFUNCTION

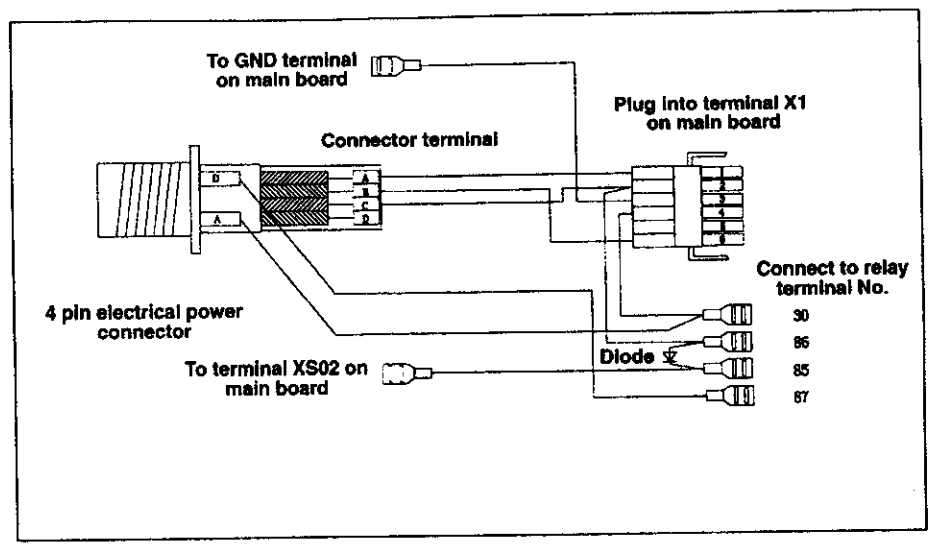
TEST OR INSPECTION

CORRECTIVE ACTION

Test 2. Is the fuse OK?

- If burned out, replace the fuse.
- If the fuse is OK, go to Test 3





9-13. FRONT AXLE REPLACEMENT (Continued)

(12) Install drag link (14) into steering arm (15).

(13) Install nut (13) and torque to 185-200 foot-pounds (250-271 N·m).

(14) Connect air line (10) to air fitting (11).

(15) Install two clamps (9) with capscrew (7) and new locknut (5). Tighten securely.

(16) Install clevis halves (2) through limiting chains (3) and axle assembly (20).

(17) Install dowel pins (1) with spacers (4) to connect clevis halves (2).

(18) Install tire and wheel assemblies. Refer to paragraph 14-5 (TM 2320-20/12, TM 9-2320-297-20).

(19) Remove two supporting jack stands from spring seats (16).

(20) Check nose box and axle lubricant levels. Fill if needed. Refer to LI 2320-12/9, LO 9-2320-297-12.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/1 TM 9-2320-297-20	Install shock absorbers (para 17-3).
	Install propeller shafts (para 10-3).
	Check alignment of axle. Adjust if needed. (para 15-17).

MALFUNCTION

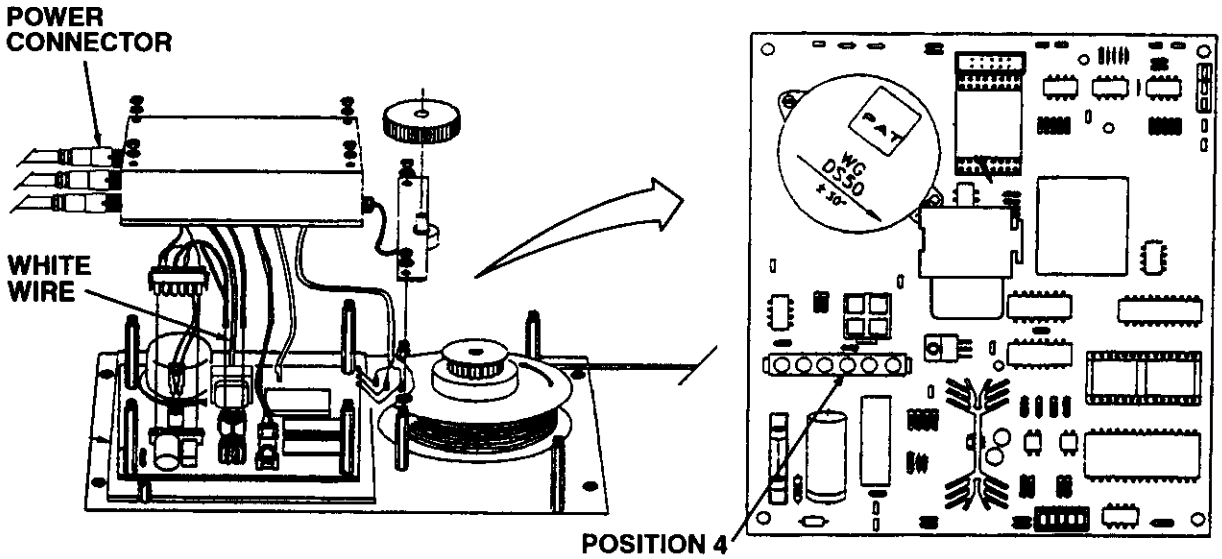
TEST OR INSPECTION

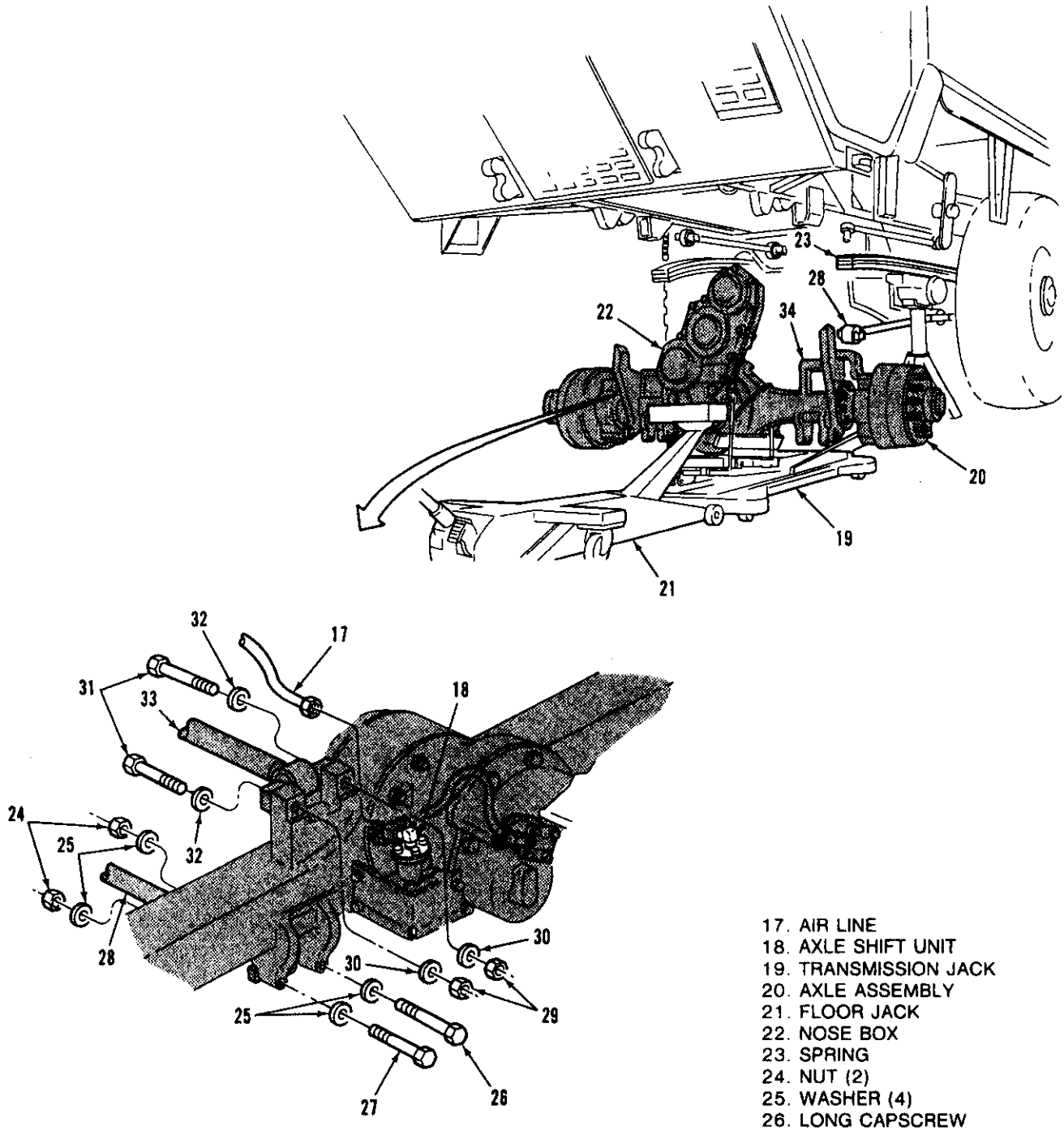
CORRECTIVE ACTION

CRANE DOES NOT OPERATE. (Continued)

Test 3. Check for 24 volts at white wire at position 4 on the connector at the circuit board.

- If 24 volts are not found, repair white wire or connectors between position 4 on circuit board connector and power connector. Refer to TM 9-2320-297-20, paragraph 7-45.
- If 24 volts are found, go to Test 4





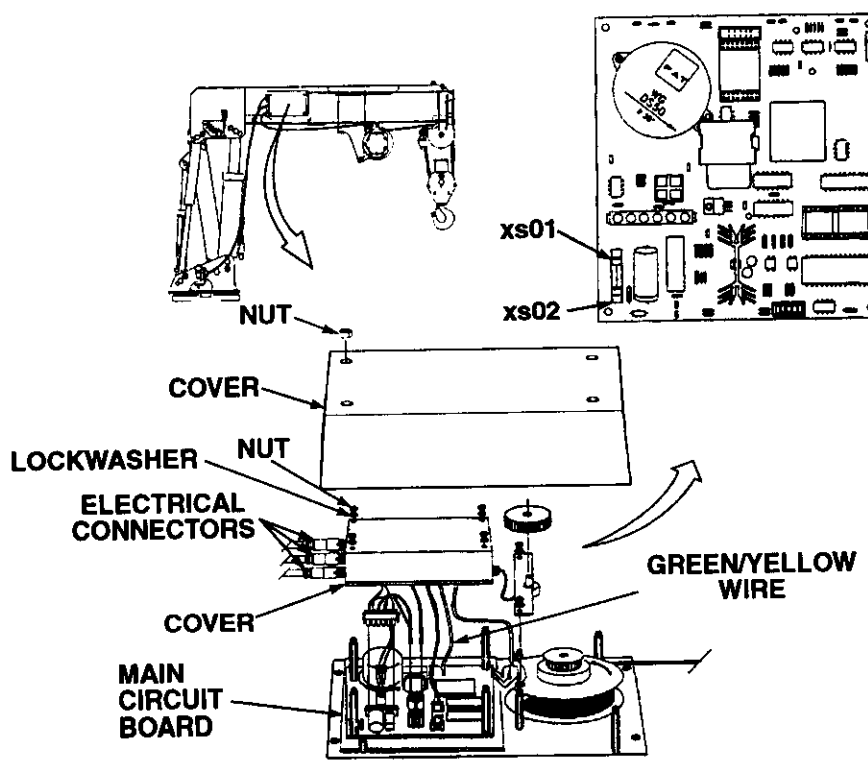
17. AIR LINE
18. AXLE SHIFT UNIT
19. TRANSMISSION JACK
20. AXLE ASSEMBLY
21. FLOOR JACK
22. NOSE BOX
23. SPRING
24. NUT (2)
25. WASHER (4)
26. LONG CAPSCREW
27. SHORT CAPSCREW
28. TORQUE ROD
29. NUT (2)
30. WASHER (2)
31. CAPSCREW (2)
32. WASHER (2)
33. TORQUE ROD
34. SPRING MOUNT (2)

TA 298939

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

Test 4. Check for 24 volts at terminal XS01, at top of fuse holder.

- If 24 volts not found, go to Test 5.
- If 24 volts are not found, replace Overload Shutdown System central unit. Refer to paragraph 18.1-30 in this manual.



9-13. FRONT AXLE REPLACEMENT (Continued)

e. Installation

WARNING

The axle assembly is very heavy. To prevent personal injury, be extremely careful during installation procedures. Make sure axle is supported and balanced as torque rods are connected. Axle is heavier on left side and must be chained to transmission jack to be properly supported. Axle must be supported under nose box with an additional floor jack to prevent axle from falling forward.

(1) Position axle assembly (20) on transmission jack (19) and secure with a chain. Position an additional floor jack (21) under nose box (22). Place axle assembly under MK48.

(2) Make sure axle assembly (20) is just forward of springs (23) and raise until spring mounts (34) are even with end of springs (23).

(3) Move axle assembly (20) to rear, making sure springs (23) enter mounts (34).

(4) Install upper torque rod (33). If needed, raise or lower axle assembly (20) to position torque rod (33).

(5) Install two washers (32) and capscrews (31) through torque rod (33) and axle assembly (20).

(6) Install two washers (30) and nuts (29).

(7) Install a torque rod (28). If needed, raise or lower axle assembly (20) to position torque rod (28).

(8) Install long capscrew (26), short capscrew (27), four washers (25), and nuts (24) into torque rod (28).

(9) Repeat steps (7) and (8) for remaining torque rod (28).

(10) Torque all nuts (24 and 29) to 170 foot-pounds (231 N·m).

(11) Connect air line (17) to axle shift unit (18). Tighten securely.

MALFUNCTION

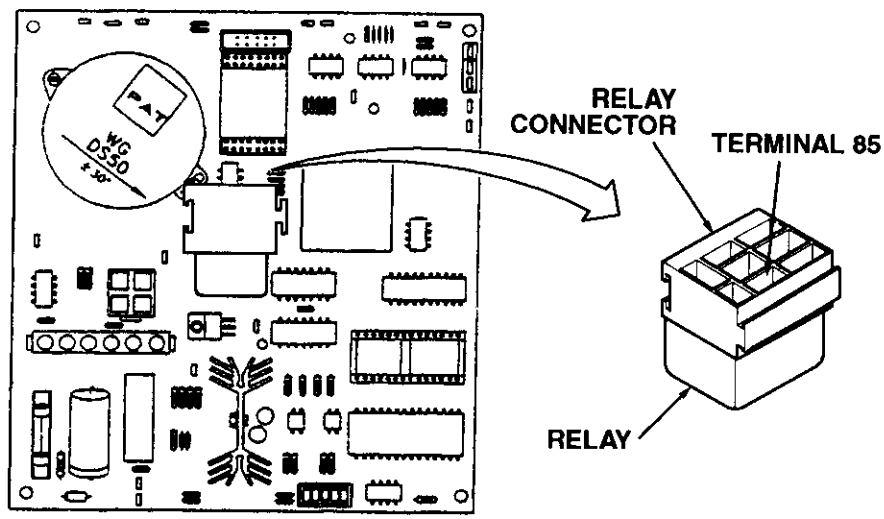
TEST OR INSPECTION

CORRECTIVE ACTION

CRANE DOES NOT OPERATE. (Continued)

Test 5. Check for 24 volts at top of relay connector, terminal 85.

- If 24 volts are found, go to Test 6.
- If 24 volts are not found, repair wire or connectors between terminal xs02 and relay terminal 85. Refer to TM 9-2320-297-20, paragraph 7-45.



(4) Apply pipe sealant on threads of air fittings (65). Install air fittings (65) into brake chambers (57 and 64). Tighten securely.

(5) Position air lines (56 and 63) on axle assembly (20).

(6) Connect air lines (56 and 63) to air fittings (65) on brake chambers (57 and 64). Tighten securely.

(7) Install two clamps (62) onto air line (63) with capscrews (59) and new locknuts (58). Tighten locknuts (58) securely.

(8) Install two clamps (55) onto air line (56) with capscrews (52) and new locknuts (51). Tighten locknuts (51) securely.

(9) Remove capscrews (47) and lockwasher (48). Discard lockwasher (48).

(10) Install bracket (50) with washer (49), new lockwasher (48), and capscrew (47). Tighten capscrew (47) securely.

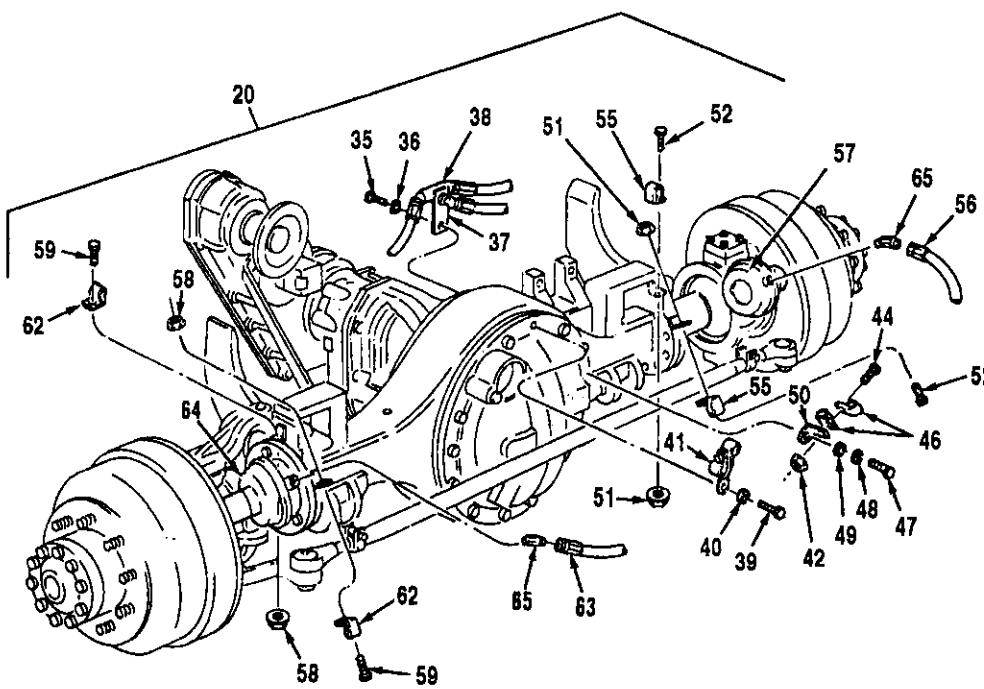
(11) Install two clamps (46) with capscrew (44) and new locknut (42). Tighten locknut (42) securely.

(12) Remove capscrew (39) and lockwasher (40). Discard lockwasher (40).

(13) Install bracket (41), new lockwasher (40), and capscrew (39). Tighten capscrew (39) securely.

(14) Remove capscrew (35) and lockwasher (36). Discard lockwasher (36).

(15) Install bracket (37) at tee fitting (38) with new lockwasher (36) and capscrew (35) securely.

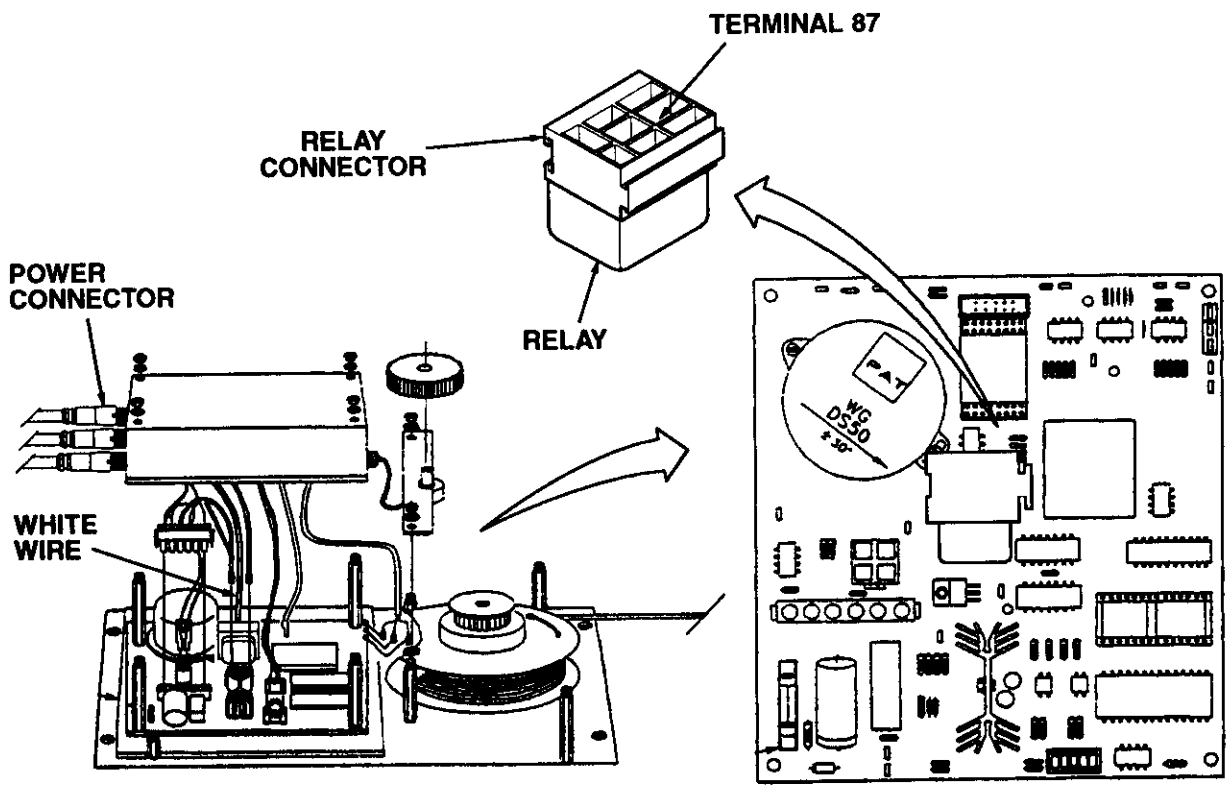


20. AXLE ASSEMBLY
35. CAPSCREW
36. LOCKWASHER
37. BRACKET
38. TEE FITTING
39. CAPSCREW
40. LOCKWASHER
41. BRACKET
42. LOCKNUT
43. DELETED
44. CAPSCREW
45. DELETED
46. CLAMP (2)
47. CAPSCREW
48. LOCKWASHER
49. WASHER
50. BRACKET
51. LOCKNUT (2)
52. CAPSCREW (2)
53. DELETED
54. DELETED
55. CLAMP (2)
56. AIR LINE
57. BRAKE CHAMBER
58. LOCKNUTS (2)
59. CAPSCREWS
60. DELETED
61. DELETED
62. CLAMP (2)
63. AIR LINE
64. BRAKE CHAMBER
65. AIR FITTING (2)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

Test 6. Check for 24 volts at white wire on top of relay connector terminal 87.

- If 24 volts are found, check for a damaged white wire between relay terminal 87 and the power connector. Repair any loose connections or damaged wiring. Refer to TM 9-2320-297-20, paragraph 7-45.
- If 24 volts are not found, go to Test 7.



9-13. FRONT AXLE REPLACEMENT (Continued)

(14) Disconnect air line (66) from axle shift unit (18).

(15) Disconnect air line (66) from lockout chamber (67). Remove air line (66).

(16) Remove air fittings (68 and 69) from axle shift unit (18).

(17) Remove air fitting (70) from lockout chamber (67).

c. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts for damage. Refer to paragraph 2-7.

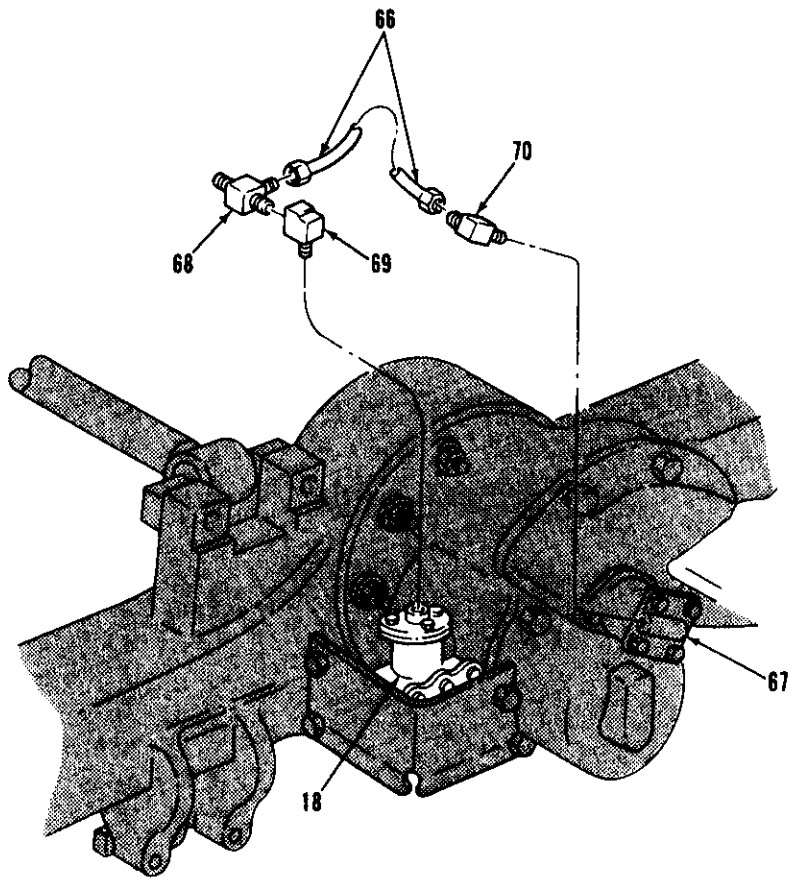
(3) Replace all parts failing inspection.

d. Assembly

(1) Apply pipe sealant on threads of air fittings (68 and 69). Install air fittings (68 and 69) into axle shift unit (18). Tighten securely.

(2) Apply pipe sealant on threads of air fitting (70). Install air fitting (70) into lockout chamber (67). Tighten securely.

(3) Connect air line (66) to fittings (68 and 70).



18. AXLE SHIFT UNIT
66. AIR LINE
67. LOCKOUT CHAMBER
68. AIR FITTING
69. AIR FITTING
70. AIR FITTING

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MALFUNCTION

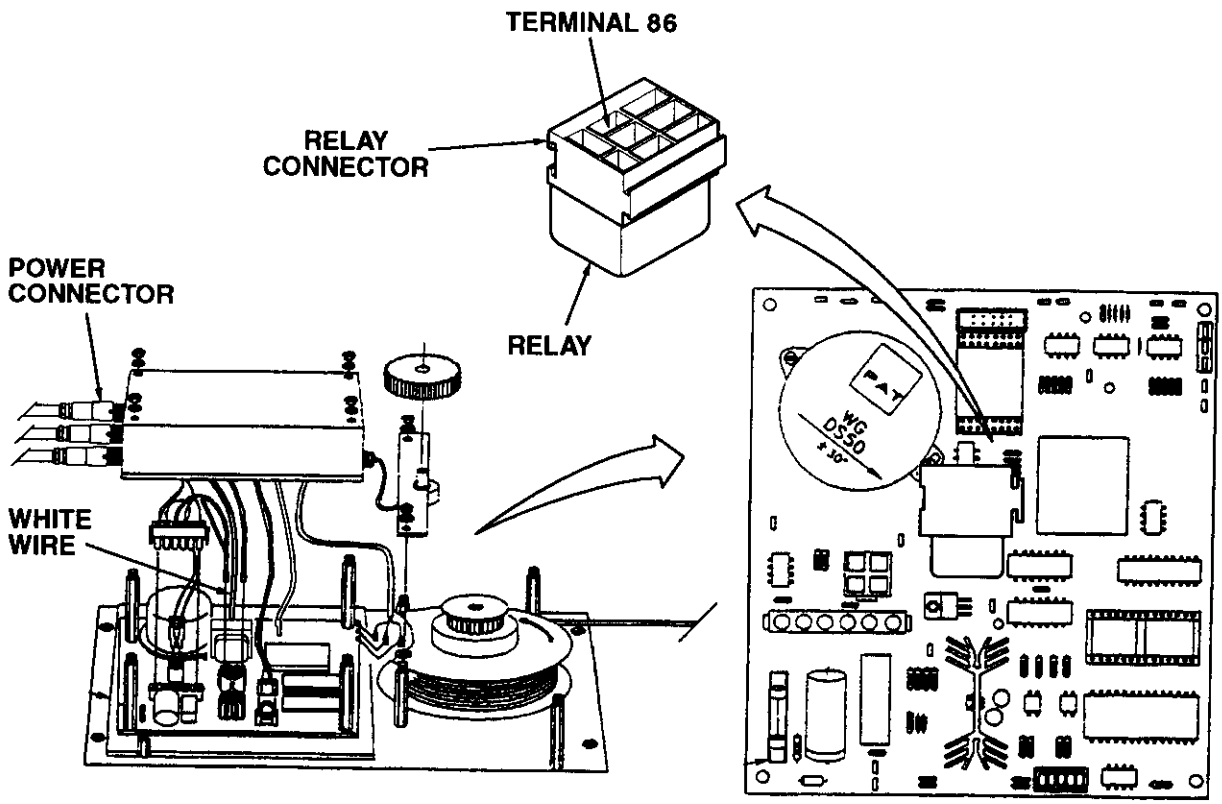
TEST OR INSPECTION

CORRECTIVE ACTION

CRANE DOES NOT OPERATE. (Continued)

Test 7. Connect relay terminal 86 to a known good ground. Are 24 volts now available at relay terminal 87?

- If 24 volts are found, check for damaged or loose white wire or connectors between relay terminal 86 and the circuit board connector. If no damage is found, replace the Overload Shutdown System central unit. Refer to paragraph 18.1-30 in this manual.
- If 24 volts are not found, replace relay. Refer to TM 9-2320-297-20, paragraph 7-26.



b. Disassembly

(1) Remove capscrew (35), lockwasher (36), and bracket (37) at tee fitting (38).

(2) Reinstall lockwasher (36) and capscrew (35).

(3) Remove capscrew (39), lockwasher (40), and bracket (41).

(4) Reinstall lockwasher (40) and capscrew (39).

(5) Remove locknut (42) and capscrew (44) to free two clamps (46). Discard locknut (42).

(6) Remove capscrew (47), lockwasher (48), washer (49), and bracket (50).

(7) Reinstall lockwasher (48), washer (49), and capscrew (47).

(8) Remove two locknuts (51), capscrews (52), and clamps (55) from right side of axle. Discard locknuts (51).

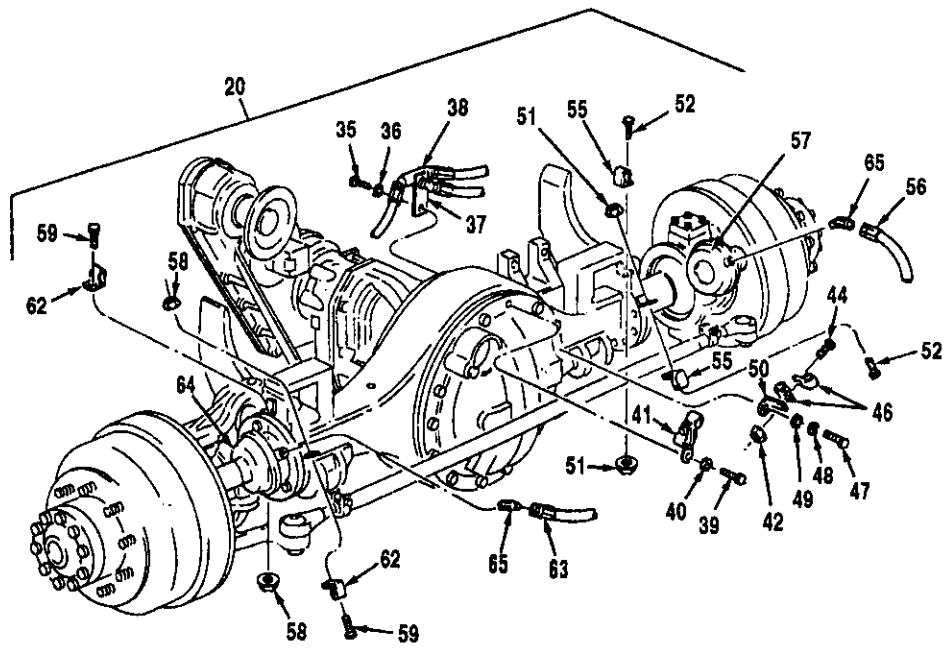
(9) Disconnect air line (56) from brake chamber (57).

(10) Remove two locknuts (58), capscrews (59), and clamps (62) from left side of axle. Discard locknuts (58).

(11) Disconnect air line (63) from brake chamber (57).

(12) Remove air lines (56 and 63) from axle assembly (20).

(13) Remove two air fittings (65) from brake chambers (57 and 64).



20. AXLE ASSEMBLY
35. CAPSCREW
36. LOCKWASHER
37. BRACKET
38. TEE FITTING
39. CAPSCREW
40. LOCKWASHER
41. BRACKET
42. LOCKNUT
43. DELETED
44. CAPSCREW
45. DELETED
46. CLAMP (2)
47. CAPSCREW
48. LOCKWASHER
49. WASHER
50. BRACKET
51. LOCKNUT (2)
52. CAPSCREW (2)
53. DELETED
54. DELETED
55. CLAMP (2)
56. AIR LINE
57. BRAKE CHAMBER
58. LOCKNUTS (2)
59. CAPSCREWS
60. DELETED
61. DELETED
62. CLAMP (2)
63. AIR LINE
64. BRAKE CHAMBER
65. AIR FITTING (2)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

CRANE HYDRAULIC - MK15A1 AND MK17A1

1. CRANE FUNCTIONS DO NOT OPERATE OR OPERATE SLOWLY.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.

- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

9-13. FRONT AXLE REPLACEMENT (Continued)

(7) Disconnect air line (17) from axle shift unit (18).

WARNING

The axle assembly is very heavy. To prevent personal injury be very careful during removal procedures. Make sure axle is supported and balanced as torque rods are removed from axle. Axle is heavier on left side and must be chained to transmission jack to be properly supported. Axle must be supported under nose box with an additional floor jack, to prevent axle from falling forward.

(8) Position transmission jack (19) under axle assembly (20) and secure with a chain. Position an additional floor jack (21) under nose box (22).

(9) Raise axle assembly (20) just enough to remove tension from springs (23).

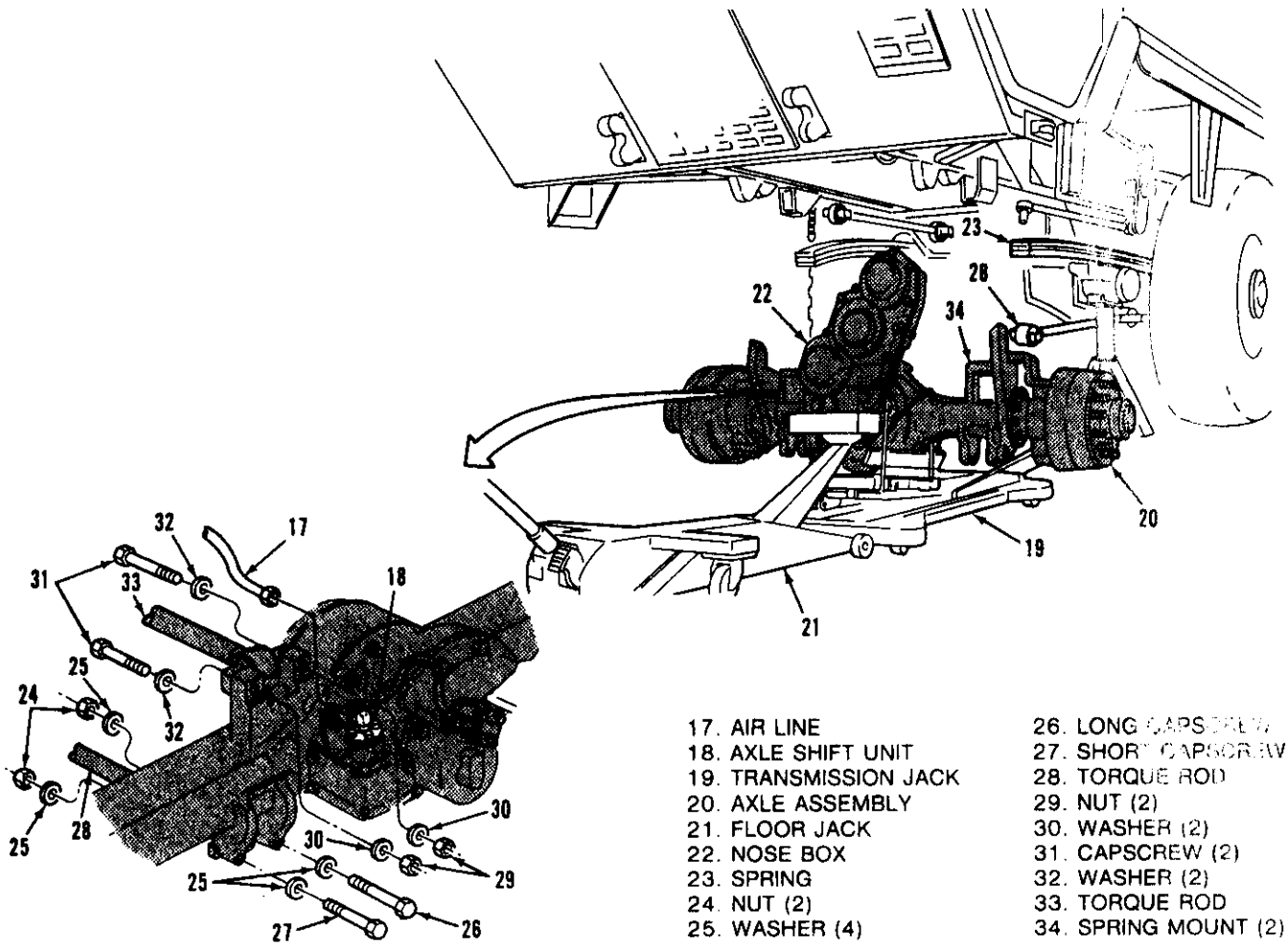
(10) Remove two nuts (24), four washers (25), long capscrew (26), and short capscrew (27), from each lower torque rod (28).

(11) Remove two nuts (29), washers (30), capscrews (31) and washers (32) from upper torque rod (33).

(12) Move axle assembly (20) forward until springs (23) are clear of spring mounts (34).

(13) Lower axle assembly (20) and/or raise front of MK48 until nose box (22) will clear bottom of MK48.

(14) Remove axle assembly (20).



17. AIR LINE
18. AXLE SHIFT UNIT
19. TRANSMISSION JACK
20. AXLE ASSEMBLY
21. FLOOR JACK
22. NOSE BOX
23. SPRING
24. NUT (2)
25. WASHER (4)
26. LONG CAPSCREW
27. SHORT CAPSCREW
28. TORQUE ROD
29. NUT (2)
30. WASHER (2)
31. CAPSCREW (2)
32. WASHER (2)
33. TORQUE ROD
34. SPRING MOUNT (2)

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MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

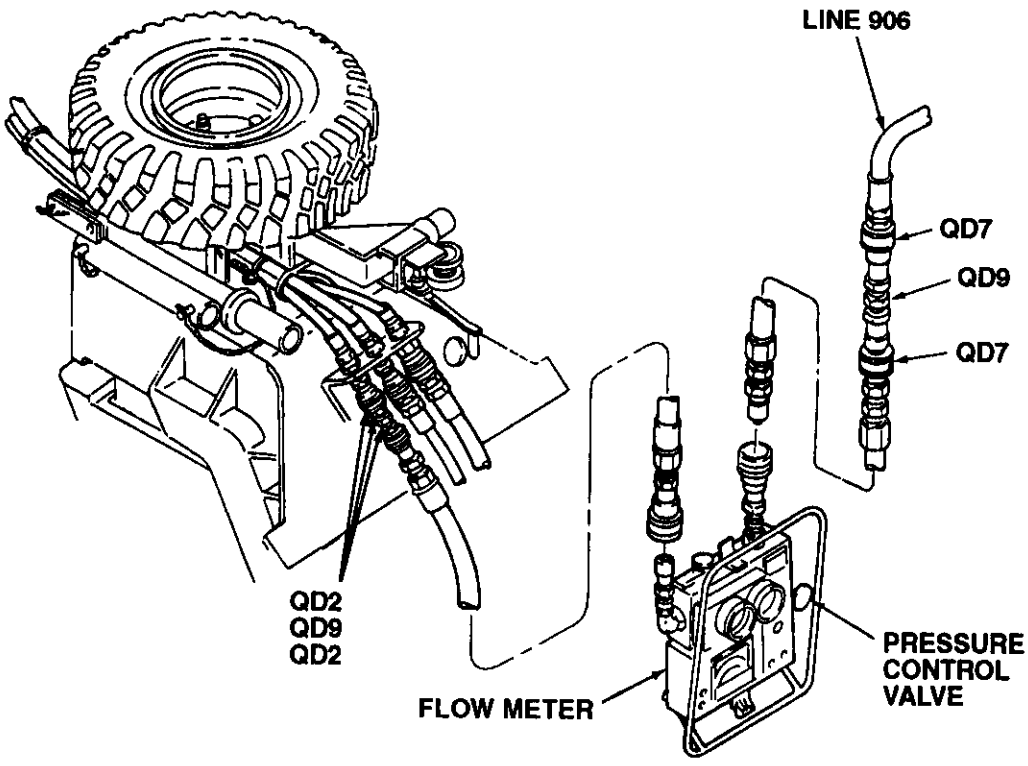
CRANE FUNCTIONS DO NOT OPERATE OR OPERATE SLOWLY. (Continued)

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines.

Test 1. Disconnect line 906 at articulation joint. Install flow meter in line between line 906 at articulation joint. Open pressure control valve fully by turning knob counter clockwise to DECREASE. Start engine and allow to run at idle. Slowly close pressure control valve by turning knob clockwise to INCREASE and create 3,250 psi (22,409 kPa) working pressure. Check that gpm flow rate of hydraulic line 906 is 10-12 gpm (37.8-45 lpm).

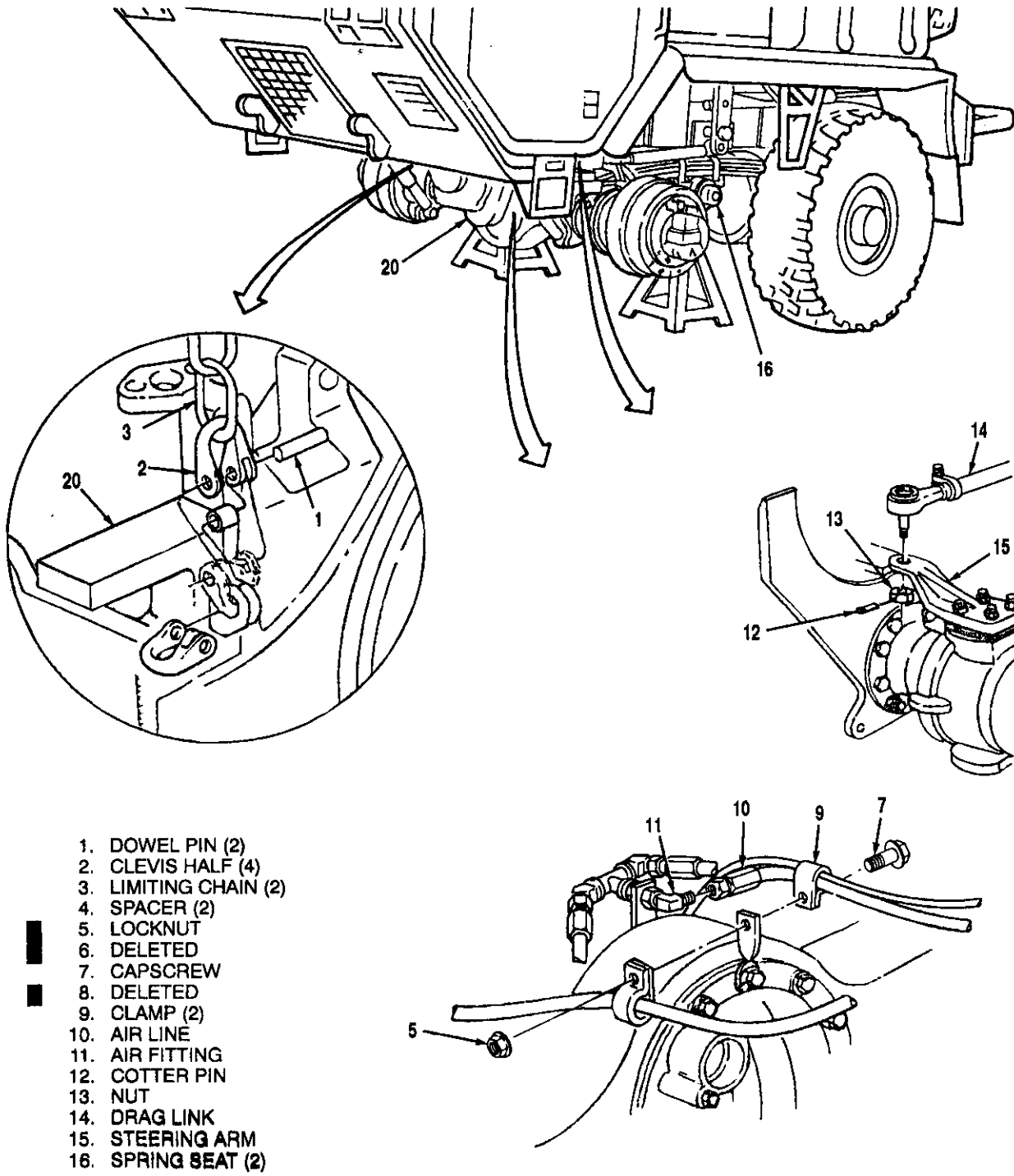
- If gpm flow rate is correct, go to Test 2.
- If gpm flow rate is not within specifications at system pressure, refer to HYDRAULIC STEERING System, Malfunction 1, Tests 3 through 6.



(4) Remove cotter pin (12), nut (13), and drag link (14) from steering arm (15). Discard cotter pin (12).

(5) Support MK 48 with two jack stands under spring seats (16).

(6) Remove two tire and wheel assemblies. Refer to paragraph 14-5 (TM 2320-20/12, TM 9-2320-297-20).



1. DOWEL PIN (2)
2. CLEVIS HALF (4)
3. LIMITING CHAIN (2)
4. SPACER (2)
5. LOCKNUT
6. DELETED
7. CAPSCREW
8. DELETED
9. CLAMP (2)
10. AIR LINE
11. AIR FITTING
12. COTTER PIN
13. NUT
14. DRAG LINK
15. STEERING ARM
16. SPRING SEAT (2)

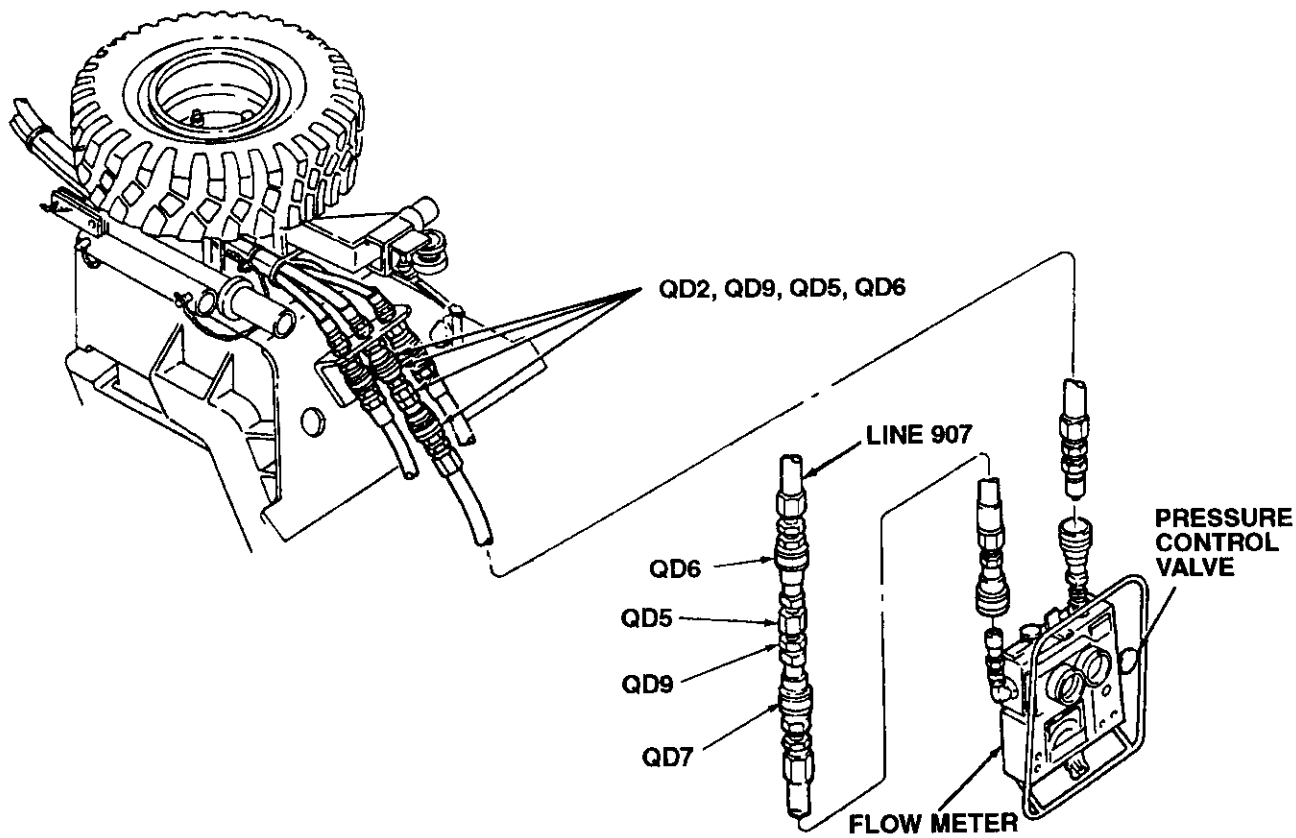
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 2. Disconnect line 907 at articulation joint. Install flow meter in line between line 907 at articulation joint. Open pressure control valve fully by turning knob counter clockwise to DECREASE. Start engine and allow to run at idle. Slowly close pressure control valve by turning knob clockwise to INCREASE and create 3,250 psi (22,409 kPa) working pressure. Check that gpm flow rate of hydraulic line 907 is 10-12 gpm (37.8-45 lpm).

- If gpm flow rate is within specifications, go to Test 3.
- If gpm flow rate is not within specifications, check for restrictions in return lines, return manifold, manual control valves, or hydraulic filter.



SECTION III. FRONT AXLE REPLACEMENT INSTRUCTIONS

9-13. FRONT AXLE REPLACEMENT

THIS TASK COVERS:
a. Removal
b. Disassembly
c. Cleaning/Inspection
d. Assembly
e. Installation

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Jack stand, 10 ton (P/N 93525)

Materials/Parts
Pipe sealant (item 60, Appendix C)
Cotter pin (MS 34665-359) item 12
Lockwasher (1600460) item 5
Lockwasher (21) (MS 35338-47) items 40 and 48

Personnel Required
1 MOS 3522
2 Assistants

References
LI 2320-12/9
LO 9-2320-297-12

TM 2320-20/12
TM 9-2320-297-20

Equipment Condition

TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Shock absorbers removed (para 17-3).
	Propeller shafts removed (para 10-3).
TM 2320-10/11 TM 9-2320-297-10	Air pressure drained (para 3-5).

General Safety Instructions
Axle assembly is very heavy. To prevent personal injury, be careful during replacement procedures.

Block wheels of axle No. 2 to prevent movement.

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a. Removal

NOTE

- Remove nylon ties as needed. Note location for replacement during assembly.
- Plug ends and tag air lines for identification as they are removed or disconnected.

(1) Remove two dowel pins (1) and four clevis halves (2) from two limiting chains (3). Remove two spacers (4).

NOTE

Mounting hardware for LVSA1 front axles has changed from a capscrew, lockwasher, and hex nut to a flanged type capscrew and locknut. When repairing a non-A1 vehicle, use the new style flanged mounting hardware to replace the old style hardware. Refer to TM 9-2320-297-24P for correct mounting hardware.

(2) Remove locknut (5), capscrew (7) to free clamps (9). Discard locknut (5).

(3) Disconnect air line (10) from air fitting (11).

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

CRANE FUNCTIONS DO NOT OPERATE OR OPERATE SLOWLY. (Continued)

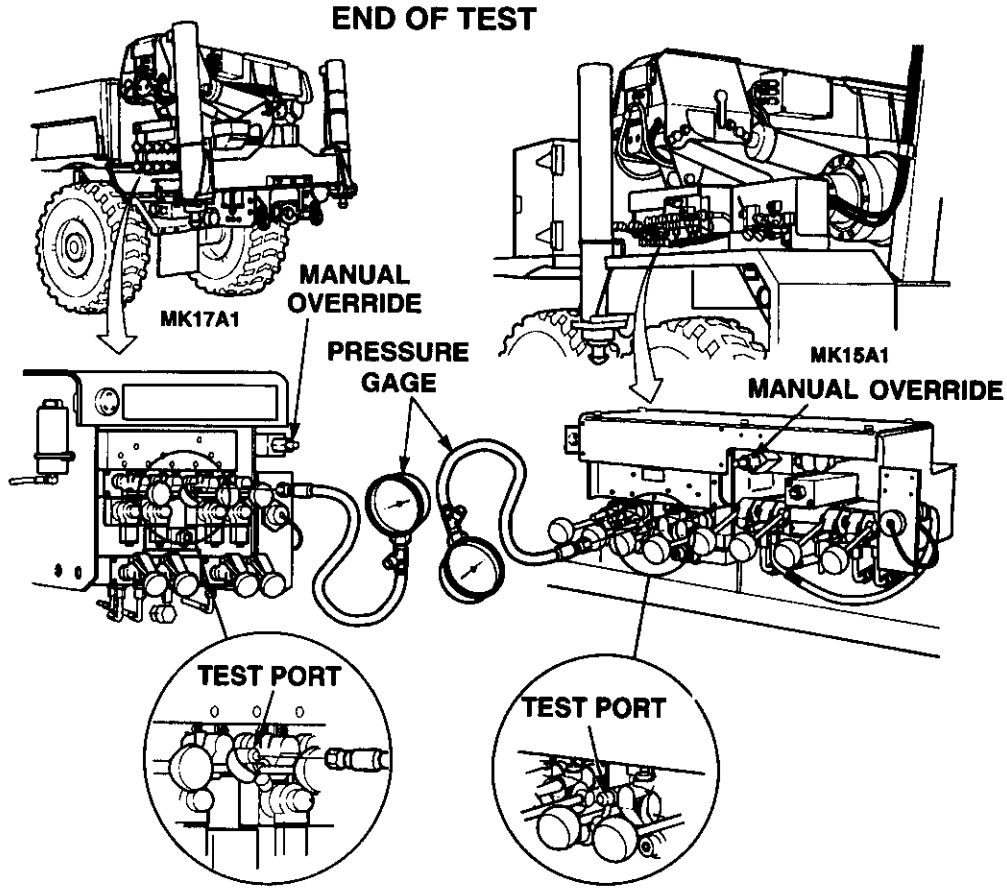
Test 3. Install hydraulic pressure gage, with adapter, on test port. Start engine and allow to idle. Observe hydraulic pressure gage. Have assistant operate control lever to fully retract boom. Check that hydraulic pressure to four valve bank assembly is 3,250 psi (22,409 kPa).

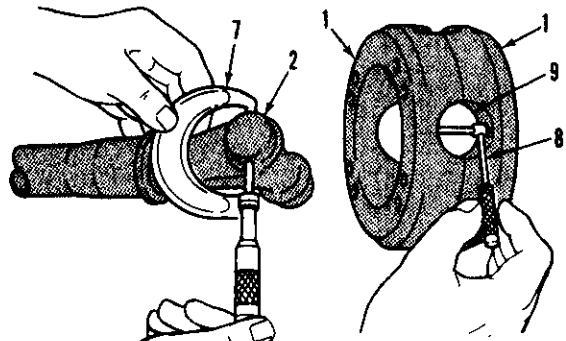
- If hydraulic pressure is correct, repair shuttle valve circuit(s). Refer to paragraph 18.1-56.
- If hydraulic pressure is not correct, go to Test 4.

Test 4. Install a 0-5000 psi (0-34,475kPa) hydraulic pressure gage, with adapter on test port. Check that hydraulic pressure to four valve bank assembly is correct with manual override valve depressed.

- While holding the telescope control lever in the RETRACT position, observe hydraulic pressure gage. If hydraulic pressure is 3,250 psi (22,409 kPa), perform Electrical Troubleshooting. Refer to CRANE ELECTRIC MK15A1-17A1 Troubleshooting, Malfunction 2., Crane Does Not Operate, in this manual
- If hydraulic pressure is not 3,250 psi (22,409 kPa) or override is stuck, adjust or replace main pressure relief valve or override valve. Refer to paragraph 18.1-64, or paragraph 18.1-43.

END OF TEST





1. CAGE RING HALF
2. AXLE SHAFT TRUNNION (4)
7. OUTSIDE MICROMETER
8. INSIDE MICROMETER
9. CAGE RING BORE (4)

(3) Assemble cage ring halves (1) using eight socket head bolts (5). Torque to 30 foot-pounds (41 N·m).

(4) Using an inside micrometer (8), measure inside diameter of cage ring bore (9).

NOTE

If the difference between these measurements is greater than 0.200 inch (0.508 mm), replace worn parts with new ones.

(5) Inspect all other parts. Refer to paragraph 2-7.

(6) Replace all parts failing inspection.

c. Assembly

(1) Put a light coat of grease on axle shaft trunnions (2) and cage ring bores (9).

(2) If removed, install two dowel pins (6) in cage ring halves (1).

(3) Bring cage ring halves (1) together around axle shaft trunnions (2). Make sure that marks on cage ring halves (1) and axle shaft trunnions (2) match.

NOTE

All torque values are wet values. Coat threads of bolts with lubricating oil.

(4) Place axle shaft assembly (4) in a soft-jawed vise and install eight socket head bolts (5) into cage ring half (1). Torque to 95 foot-pounds (129 N·m).

(5) Check axle shaft assembly (4) to insure that axle shafts (10) move freely to at least 30 degrees to both sides during a 360 degree rotation.

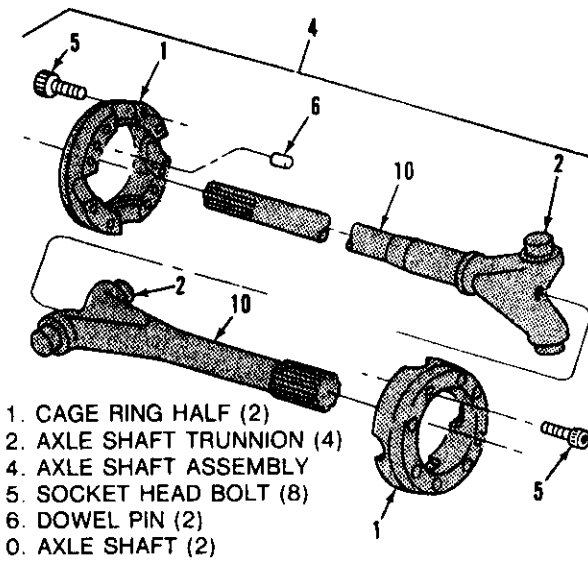
(6) Lock socket head bolts (5) with a punch mark across the threaded end of bolts (5).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12	Install axle shaft
TM 9-2320-297-20	(para 11-6).



1. CAGE RING HALF (2)
2. AXLE SHAFT TRUNNION (4)
4. AXLE SHAFT ASSEMBLY
5. SOCKET HEAD BOLT (8)
6. DOWEL PIN (2)
10. AXLE SHAFT (2)

TA 298933

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

2. OUTRIGGER BEAM DOES NOT EXTEND OR RETRACT.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines.
- If outrigger beams will not retract, go to Test 3.

9-12. AXLE SHAFT REPAIR (NO. 1 AXLE)

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

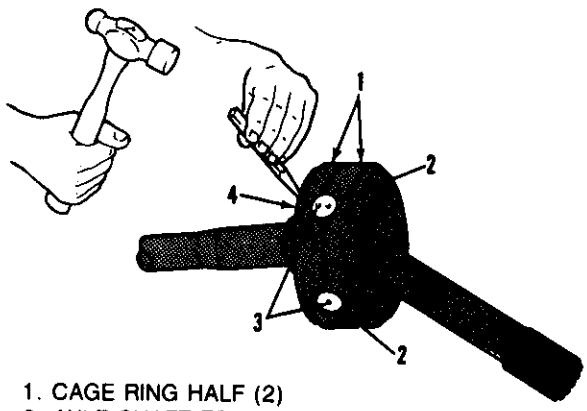
Special Tools

Micrometer set 0-6 inch inside (NSN 5210-00-473-4350)
Micrometer set 0-6 inch outside (NSN 5120-00-554-7134)

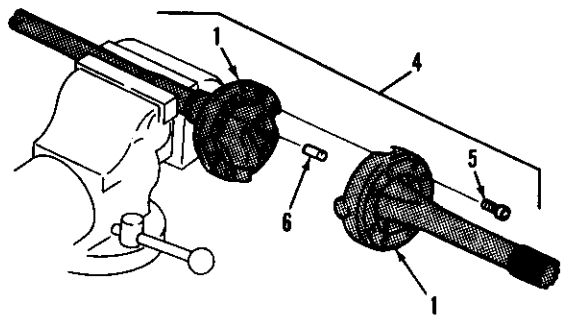
Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Axle shaft removed (para 11-6).

a. Disassembly

(1) Before splitting cage ring halves (1), mark axle shaft trunnions (2) and cage ring halves (1) to insure that trunnions are installed in the same holes during assembly. Mark parts with a series of punch marks (3).



1. CAGE RING HALF (2)
2. AXLE SHAFT TRUNNION (4)
3. PUNCH MARKS
4. AXLE SHAFT ASSEMBLY



1. CAGE RING HALF (2)
4. AXLE SHAFT ASSEMBLY
5. SOCKET HEAD BOLT (8)
6. DOWEL PIN (2)

TA 298932

(2) Install axle shaft assembly (4) in a soft-jawed vise and remove eight socket head bolts (5) holding cage ring halves (1) together.

(3) If damaged, remove two dowel pins (6) from cage ring halves (1).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Using an outside micrometer (7), measure the outside diameter of all four axle trunnions (2).

MALFUNCTION

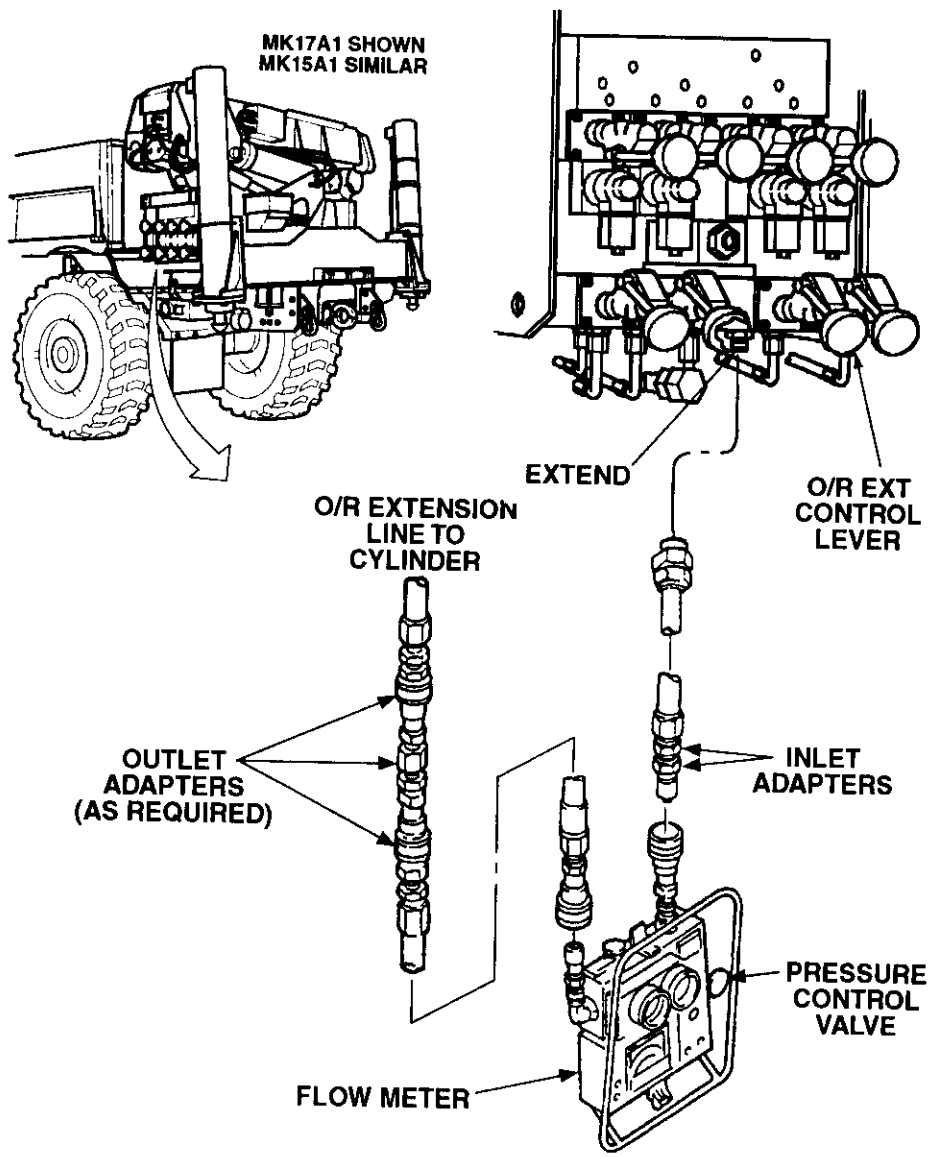
TEST OR INSPECTION

CORRECTIVE ACTION

OUTRIGGER BEAM DOES NOT EXTEND OR RETRACT (Continued)

Test 1. Remove the line that comes from the outrigger beam extend fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully extend outrigger beam. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair or replace outrigger beam extend/retract cylinder. Refer to paragraph 18.1-3 or 18.1-4.
- If pressure is not within specifications, go to Test 2.



c. Assembly

(1) Install fill plug (11) into axle housing cover (9). Do not tighten.

(2) Install bearing (14), snapring (13), and new oil seal (12) into axle housing cover (9).

(3) Run a bead of sealant onto mating surface of housing (10). Be sure to circle each capscrew hole and dowel hole.

(4) Install axle housing cover (9) onto housing (10), being careful not to damage oil seal (12) on output shaft (15).

(5) Install 11 new lockwashers (7) and capscrews (8).

NOTE

Apply pipe sealant to threads of elbow (5) where it threads into axle housing cover (9).

(6) Install one new lockwasher (7) and long capscrew (6). Install elbow (5) and connect lubrication line (4). Tighten securely.

(7) Install yoke (3), washer (2), and new locknut (1). Torque locknut (1) to 480-600 foot-pounds (650-813 N·m).

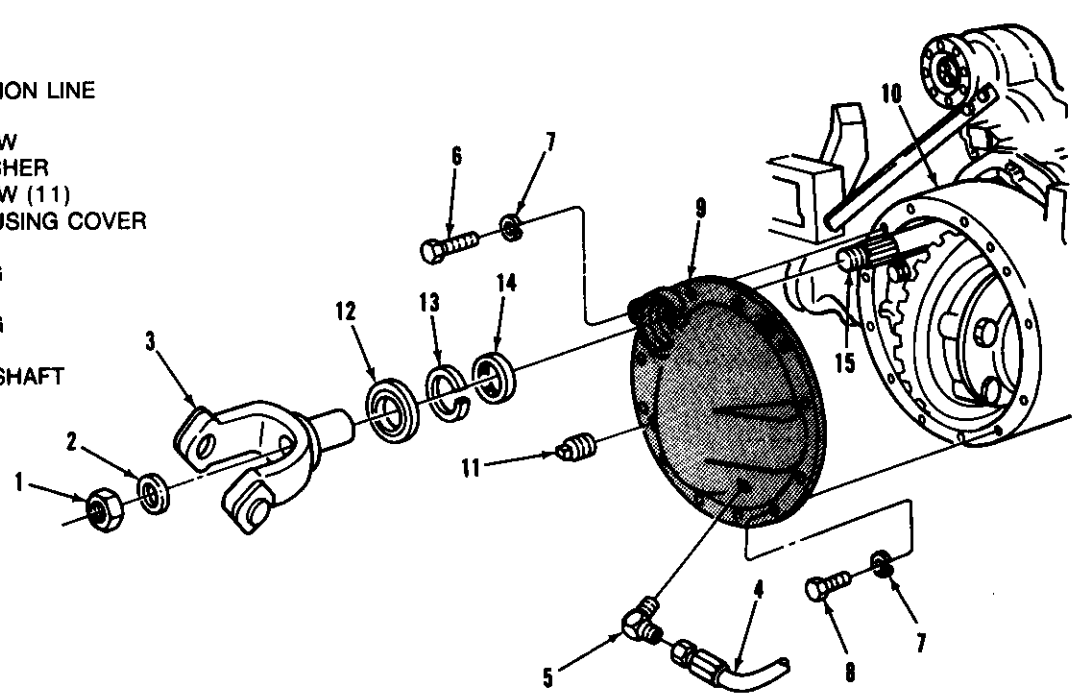
END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Refill axle lubricant (para 11-3).
	Install propeller shaft (para 10-3).
	Install tie rod (para 15-8).

1. LOCKNUT
2. WASHER
3. YOKE
4. LUBRICATION LINE
5. ELBOW
6. CAPSCREW
7. LOCKWASHER
8. CAPSCREW (11)
9. AXLE HOUSING COVER
10. HOUSING
11. FILL PLUG
12. OIL SEAL
13. SNAPRING
14. BEARING
15. OUTPUT SHAFT



TA 298931

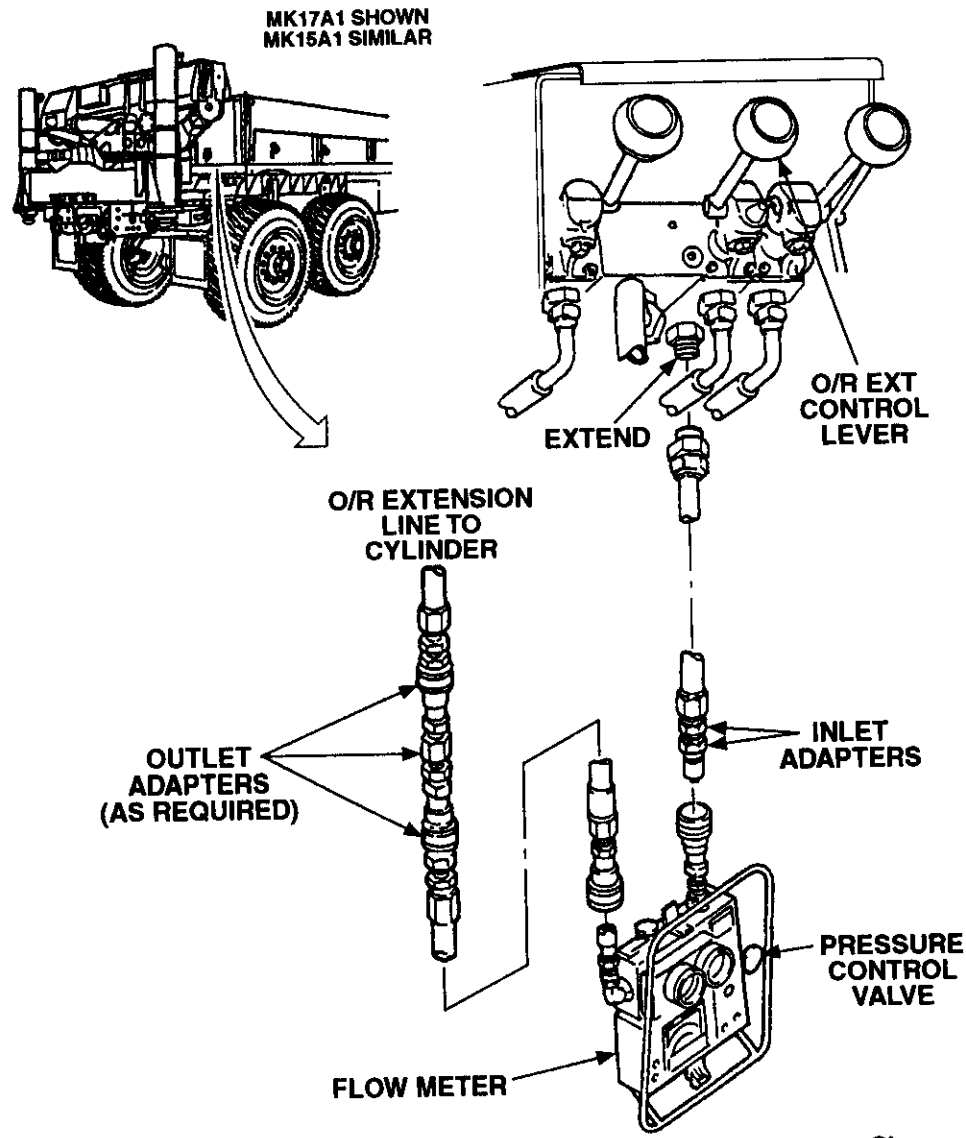
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 2. Remove the line that comes from the outrigger beam extend fitting at the right side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully extend outrigger beam. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.
- If pressure is not within specifications, repair right side control valve/shuttle valve circuit. Refer to paragraphs 18.1-51 and 18.1-53.



9-11. AXLE HOUSING COVER MAINTENANCE (NO. 1 AXLE)

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Adhesive, silicone sealant (item 7, Appendix C)
Locknut (NSN 5310-01-146-5980) item 1
Lockwasher (12) (MS35338-47) item 7
Oil seal (NSN 5330-01-157-7283) item 12
Pipe Sealant (Item 60, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Axle lubricant drained (para 11-3).
	Propeller shaft removed from rear of No. 1 axle (para 10-3).
	Tie rod removed (para 15-8).

a. Disassembly

(1) Remove locknut (1), washer (2), and yoke (3). Discard locknut (1).

(2) Disconnect lubrication line (4) and remove elbow (5).

(3) Remove one long capscrew (6) and lockwasher (7).

(4) Remove 11 short capscrews (8) and lockwashers (7). Discard lockwashers (7).

(5) Remove axle housing cover (9). If needed, insert a wedge between rear carrier cover (9) and housing (10).

(6) Remove fill plug (11) from axle housing cover (9).

(7) Remove oil seal (12), snapring (13), and bearing (14) from axle housing cover (9). Discard oil seal (12).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect axle housing cover (9) for breaks, cracks, or damage.

(3) Inspect capscrews (6 and 8) and fill plug (11) for thread damage.

(4) Inspect yoke (3) and bearing (14) for pits or damage.

(5) Replace all parts failing inspection.

MALFUNCTION

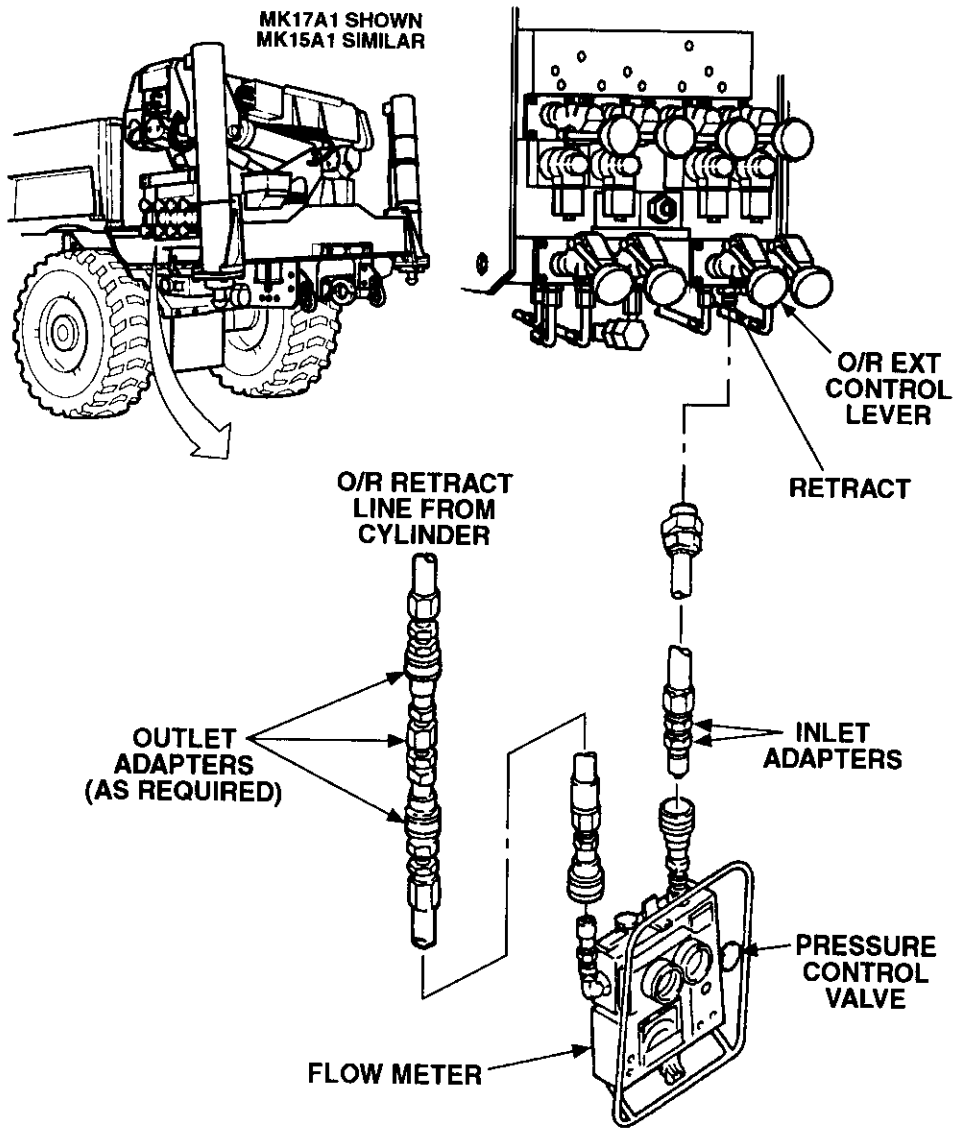
TEST OR INSPECTION

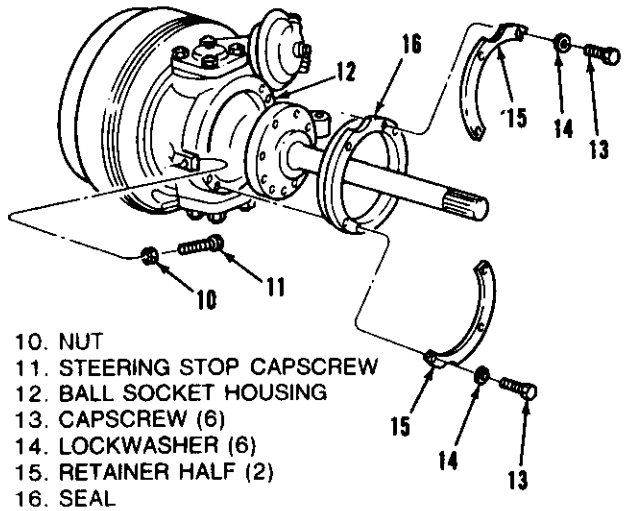
CORRECTIVE ACTION

OUTRIGGER BEAM DOES NOT EXTEND OR RETRACT (Continued)

Test 3. Remove the line that comes from the outrigger beam retract fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully retract outrigger beam. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair or replace outrigger beam extend/retract cylinder. Refer to paragraph 18.1-3 or 18.1-4.
- If pressure is not within specifications, go to Test 4.





10. NUT
11. STEERING STOP CAPSCREW
12. BALL SOCKET HOUSING
13. CAPSCREW (6)
14. LOCKWASHER (6)
15. RETAINER HALF (2)
16. SEAL

b. Cleaning/Inspection

(1) Clean exposed part of axle ball (8).

(2) Clean seal retainer halves (15).

(3) Inspect all parts. Refer to paragraph 2-7.

(4) Replace all parts failing inspection.

c. Installation

NOTE

Make sure that groove in seal (16) faces toward ball socket housing (12).

(1) Coat back of ball socket housing with silicone sealant and install new seal (16) over axle ball (8).

(2) Coat six capscrews (13) with silicone sealant. Install two retainer halves (15) with six new lockwashers (14) and capscrews (13). Torque capscrews (13) to 25 foot-pounds (34 N·m).

(3) Install steering stop capscrew (11) and nut (10) into ball socket housing (12). Preset to a length of 2.30 inches (5.9 cm).

(4) Coat mating surface of ball socket assembly (5) with silicone sealant.

WARNING

Ball socket assembly is heavy. To prevent personal injury, be sure the assembly is securely positioned on transmission jack during installation.

(5) Install ball socket assembly (5) onto studs (3) of axle housing (9).

(6) Install six washers (7) and capscrews (6) into top holes of axle housing (9).

(7) Remove transmission jack (4) from ball socket assembly (5).

(8) Install four washers (2) and nuts (1) on studs (3).

(9) Torque six capscrews (6) and four nuts (1) to 160 foot-pounds (217 N·m) using torque pattern (17).

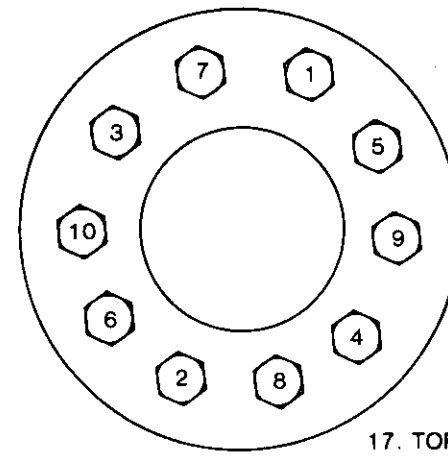
(10) Torque six capscrews (6) and four nuts (1) to 280 foot-pounds (380 N·m) using torque pattern (17).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install and connect tie rod assembly (para 15-8).
	Install wheel and tire assembly (14-5).
	Connect air line to brake chamber (para 13-12).



TA 298930

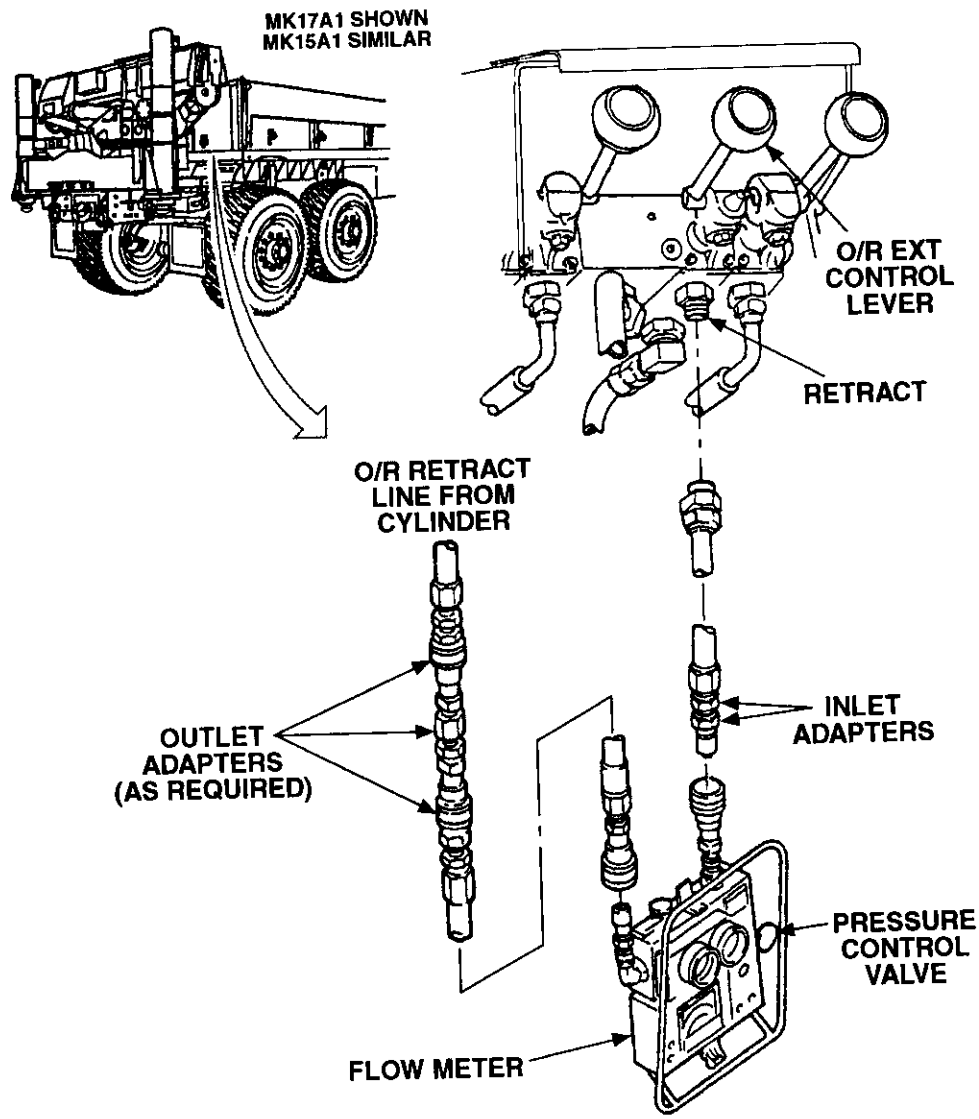
17. TORQUE PATTERN

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

Test 4. Remove the line that comes from the outrigger beam retract fitting at the right side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully retract outrigger beam. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.
- If pressure is not within specifications, repair right side control valve/shuttle valve circuit. Refer to paragraphs 18.1-51 and 18.1-53.

END OF TEST



9-10. BALL WIPER SEAL REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Adhesive silicone sealant (item 7, Appendix C)
Grease (item 28, Appendix C)
Lockwasher (6) (MS35338-46) item 14
Seal (P/N S-19226-LDS-MDS-2865) item 16

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Wheel and tire assembly removed (para 14-15).
	Tie rod disconnected and removed (para 15-8).
	Air line disconnected at brake chamber (para 13-12).

General Safety Instructions

Block wheels of truck to prevent personal injury.

Support axle with a jack stand rated at 10 tons or more.

a. Removal

(1) Remove four nuts (1) and washers (2) from studs (3).

(2) Position transmission jack (4) under brake drum on ball socket assembly (5).

(3) Remove six capscrews (6) and washers (7) from axle ball (8).

WARNING

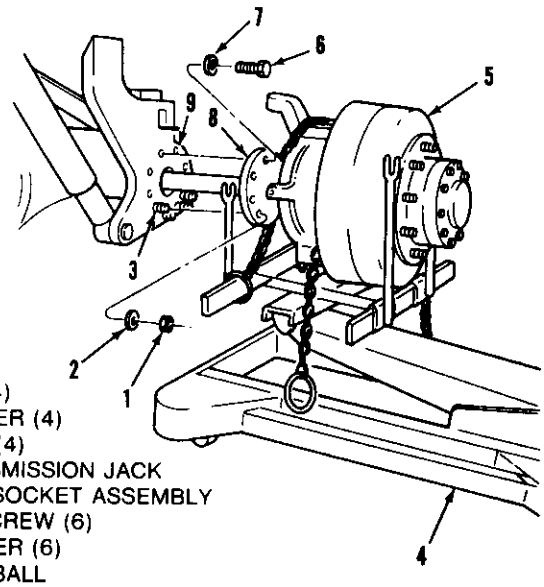
Ball socket assembly (5) is heavy. To prevent personal injury, be sure assembly is securely positioned on transmission jack (4) during removal from axle housing (9).

(4) Separate ball socket assembly (5) from axle housing (9).

(5) Remove nut (10) and steering stop capscrew (11) from ball socket housing (12).

(6) Remove six capscrews (13), lockwashers (14), and two retainer halves (15). Discard lockwashers (14).

(7) Remove and discard seal (16).



1. NUT (4)
2. WASHER (4)
3. STUD (4)
4. TRANSMISSION JACK
5. BALL SOCKET ASSEMBLY
6. CAPSCREW (6)
7. WASHER (6)
8. AXLE BALL
9. AXLE HOUSING

TA 298929

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

3. LEFT OUTRIGGER JACK CYLINDER DOES NOT RAISE OR LOWER.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

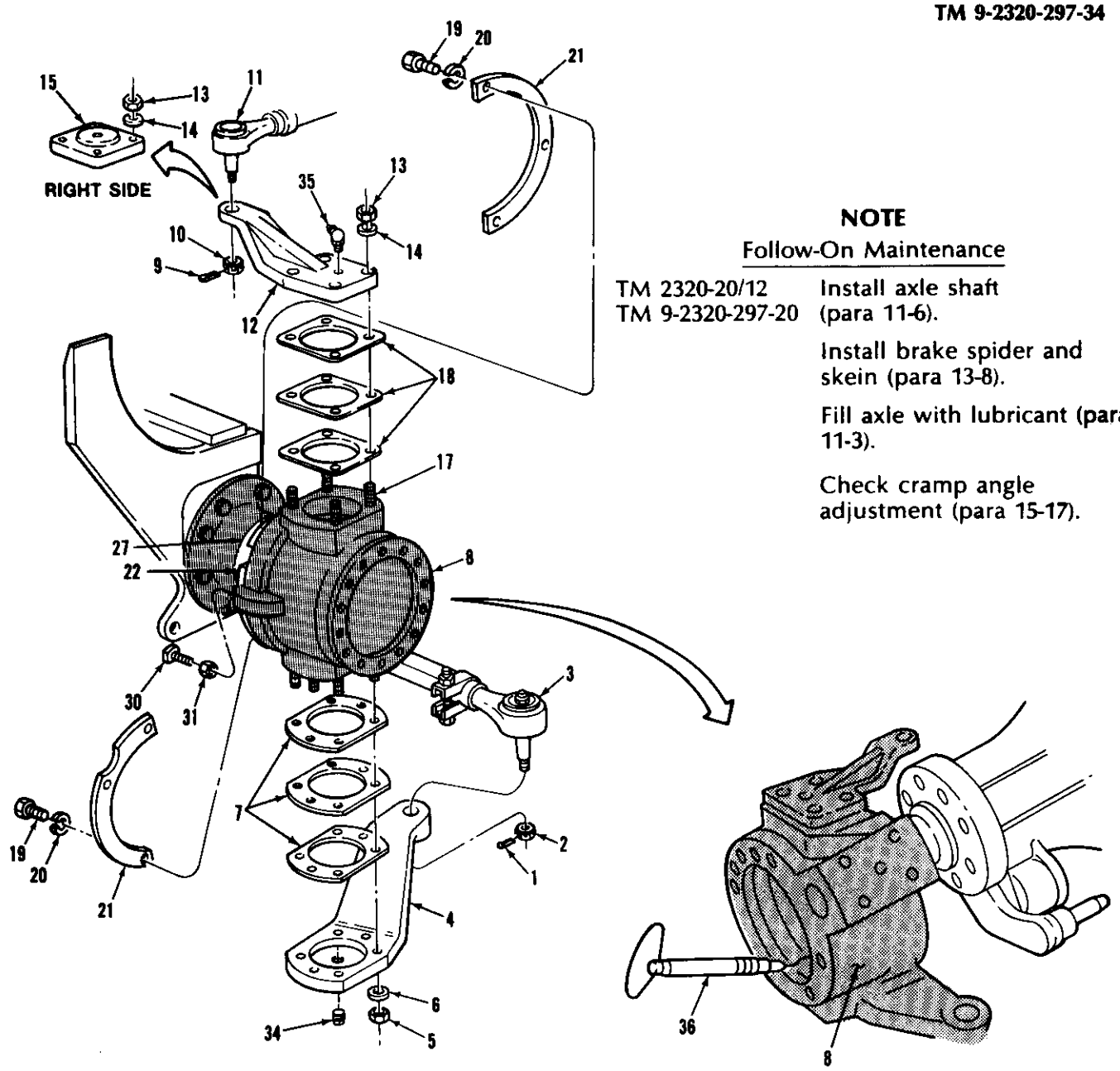
When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines.
- If outrigger jack cylinder will not raise, go to Test 3.



NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install axle shaft (para 11-6).
	Install brake spider and skein (para 13-8).
	Fill axle with lubricant (para 11-3).
	Check cramp angle adjustment (para 15-17).

1. COTTER PIN
2. CASTLE NUT
3. TIE ROD END
4. TIE ROD ARM
5. NUT (6)
6. LOCKWASHER (6)
7. SHIMS
8. BALL SOCKET HOUSING
9. COTTER PIN
10. CASTLE NUT
11. DRAG LINK
12. STEERING ARM (LH)
13. NUT (4)
14. WASHER (4)
15. TOP TRUNNION COVER (RH)
17. STUD (4)
18. SHIMS
19. CAPSCREW (6)
20. LOCKWASHER (6)
21. RETAINER HALVES
22. BALL WIPER SEAL
27. AXLE BALL
30. STEERING STOP CAPSCREW
31. NUT
34. PIPE PLUG
35. GREASE FITTING
36. SPRING SCALE

TA 298928

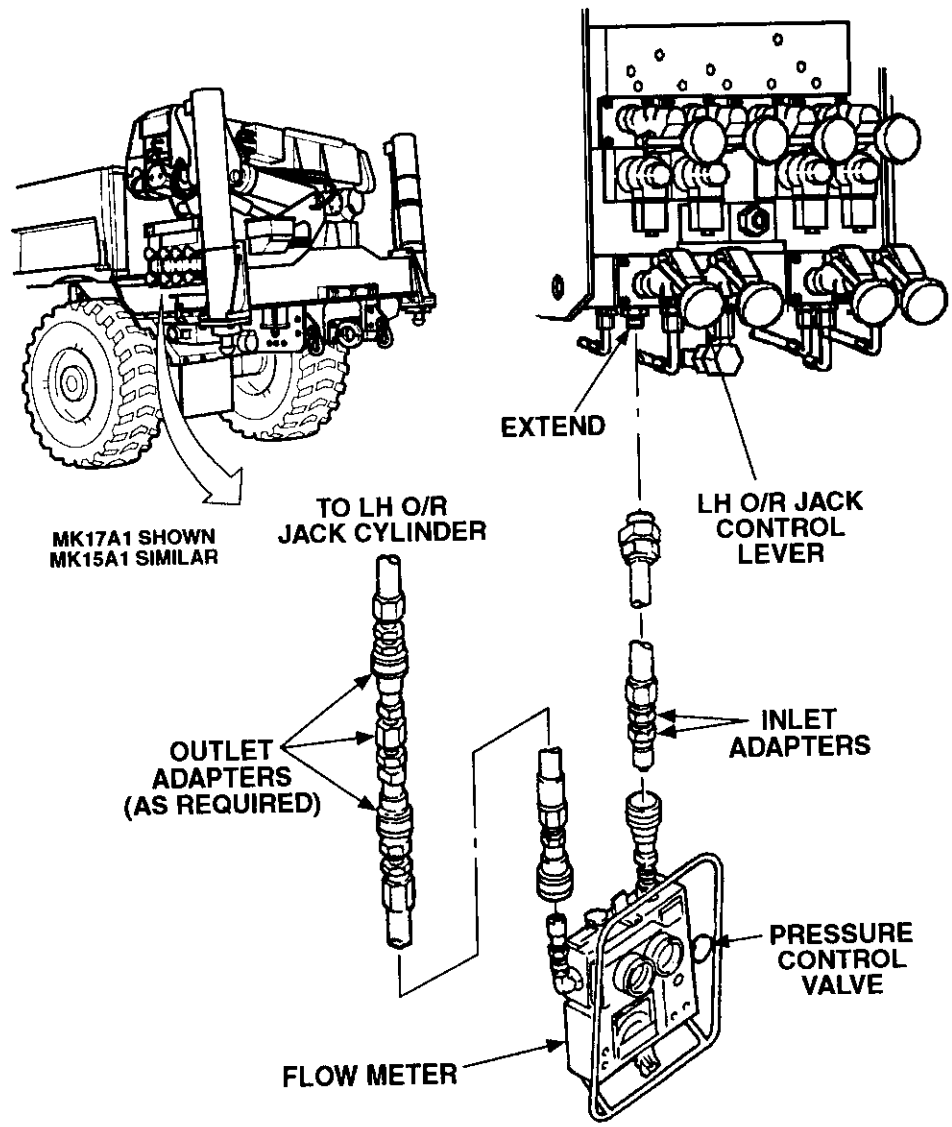
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 1. Remove the line that comes from the outrigger jack cylinder extend fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully extend outrigger jack cylinder. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair or replace outrigger jack cylinder cylinder. Refer to paragraphs 18.1-5 or 18.1-6.
- If pressure is not within specifications, go to Test 2.



9-9. BALL SOCKET AND TRUNNION BEARING REPLACEMENT (Continued)

NOTE

If ball socket housing, trunnion bearings, or trunnions have been replaced, start with an initial shim pack of 0.046-0.049 inch (1.168-1.254 mm) on top and bottom.

(16) Install shims (7) onto bottom of ball socket housing (8).

(17) Install tie rod arm (4) using six new lockwashers (6) and nuts (5). Torque to 320 foot-pounds.

(18) Remove pipe plug (34) from tie rod arm (4). Remove grease fitting (35) from steering arm (12) (left side) or top trunnion cover (15) (right side). Install grease fitting (35) in tie rod arm (4).

(19) Apply grease to grease fitting (35).

(20) Remove grease fitting (35) from tie rod arm (4). Install grease fitting (35) in steering arm (12) (left side) or top trunnion cover (15) (right side). Install pipe plug (34) in tie rod arm (4).

(21) Install shims (18) on top of ball socket housing (8).

(22) For left ball socket housing:

(a) Install steering arm (12) onto studs (17).

(b) Install four dowels (16) onto studs (17).

(c) Install four washers (14) and nuts (13) onto studs (17). Torque to 320 foot-pounds.

(23) For right ball socket housing:

(a) Install top trunnion cover (15) onto studs (17).

(b) Install four washers (14) and nuts (13) onto studs (17). Torque to 187 foot-pounds (253 N·m).

(24) Apply grease to grease fitting (35).

NOTE

The shims which are installed on top and bottom of housing are used to preload trunnion bearings and to center housing on ball.

(25) Check ball socket housing (8) to insure that it does not touch axle ball (27) at any point during normal travel.

(26) Connect a spring scale (36) to the ball socket housing (8) and check preload of bearings. It should take 38-42 pounds pull to continue movement once it has started moving.

(27) To adjust preload, add or remove one shim (7 and 18) from both the top and the bottom of ball socket housing (8).

(28) Apply silicone sealant to back of ball socket housing (8).

(29) Apply silicone sealant to six capscrews (19).

(30) Install ball wiper seal (22), two retainer halves (21), six lockwashers (20) and capscrews (19). Torque capscrews (19) to 25 foot-pounds (34 N·m).

(31) Lightly coat exposed portion of axle ball (27) with grease.

(32) Install steering stop capscrew (30) and nut (31). Preset to a length of 2.30 inches (5.9 cm) (1.5 degree turn).

(33) Install tie rod end (3) into tie rod arm (4). Install castle nut (2) and tighten until new cotter pin (1) can be installed.

(34) Install drag link (11) into steering arm (12). Install castle nut (10) and torque to 185-200 foot-pounds (250-271 N·m). Install new cotter pin (9).

END OF TASK

MALFUNCTION

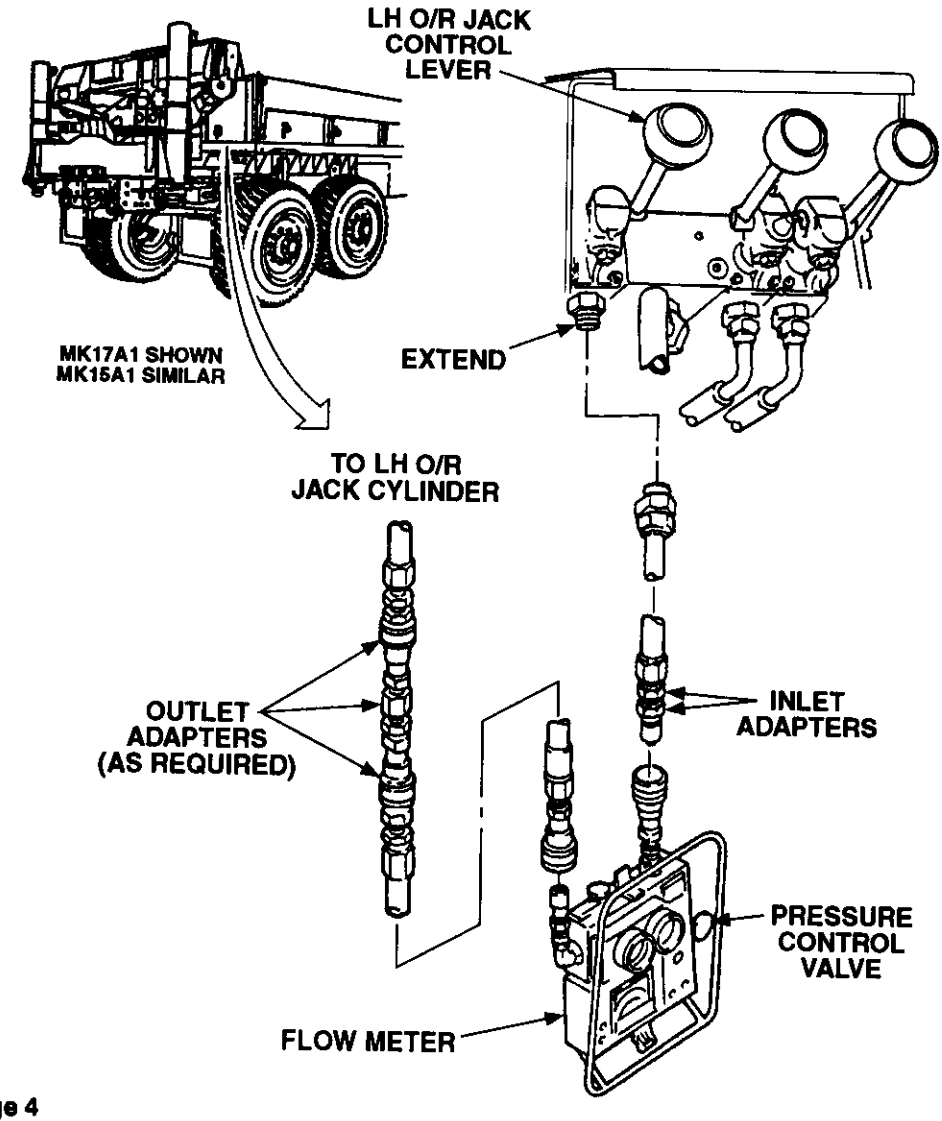
TEST OR INSPECTION

CORRECTIVE ACTION

LEFT OUTRIGGER JACK CYLINDER DOES NOT RAISE OR LOWER. (Continued)

Test 2. Remove the line that comes from the outrigger jack cylinder extend fitting at the right side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully extend outrigger jack cylinder. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.
- If pressure is not within specifications, repair right side control valve/shuttle valve circuit. Refer to paragraphs 18.1-51 and 18.1-53.



(5) Install lower trunnion (26) into axle ball (27) and ball socket housing (8) using a brass drift.

(6) Install upper trunnion (25) into axle ball (27) and ball socket housing (8).

(7) Place end plate (24) ground side toward bearing, over upper trunnion (25).

CAUTION

Use care not to damage trunnions (25 and 26) during installation.

(8) Install two 3/8 x 16 x 2 capscrews (33) into end plate (24) and upper trunnion (25).

(9) Alternately tighten capscrews (33) and carefully draw upper trunnion (25) up.

(10) Remove two capscrews (33).

(11) Install two capscrews (23) into end plate (24) and upper trunnion (25).

(12) Alternately tighten capscrews (23) and carefully draw upper trunnion (25) into position.

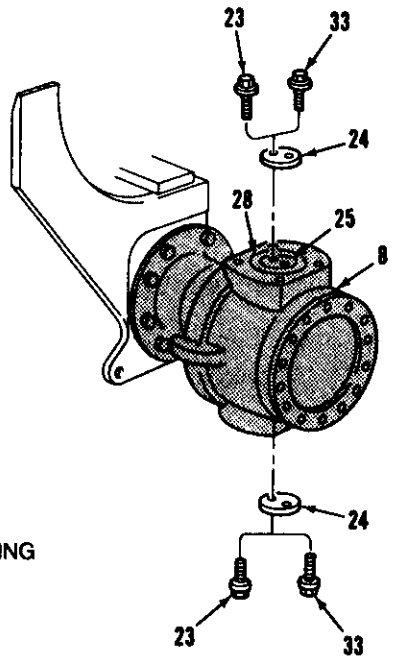
(13) Remove two capscrews (23) and end plate (24).

(14) Drive bearing cups (28) until flush with ball socket housing (8).

NOTE

All torque values are wet ratings. Lubricate all threads with lubricating oil.

(15) Install two end plates (24) ground side toward bearing. Install two bolts (23) in each end plate (24) and torque to 40 foot-pounds (54 N·m).



8. BALL SOCKET HOUSING
23. CAPSCREW (2)
24. END PLATE (2)
25. UPPER TRUNNION
28. BEARING CUP (2)
33. CAPSCREW (2)

TA 290927

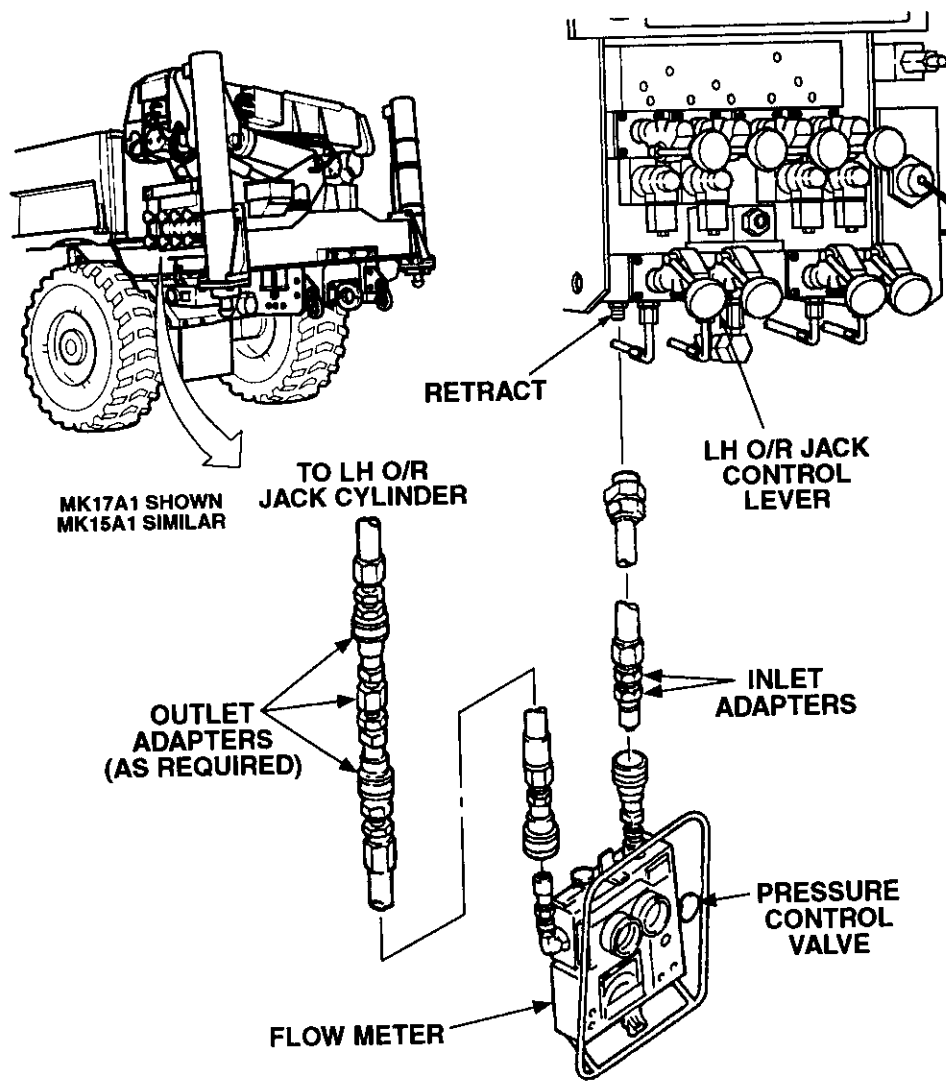
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 3. Remove the line that comes from the outrigger jack cylinder retract fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully retract outrigger jack cylinder. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair or replace outrigger jack cylinder cylinder. Refer to paragraphs 18.1-5 or 18.1-6.
- If pressure is not within specifications, go to Test 4.



9-9. BALL SOCKET AND TRUNNION BEARING REPLACEMENT (Continued)

(18) Remove steering stop capscrew (30) and nut (31).

(19) If ball socket housing (8) is being replaced, remove four studs (17) from top and six studs (32) from bottom of housing.

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts for damage, cracks, bends, and worn spots.

(3) Replace all parts failing inspection.

c. Installation

(1) Install two bearing cups (28) into ball socket housing (8). Tap two bearing cups (28) in until they are no more than 1/8 inch (3.175 mm) above ball socket housing (8).

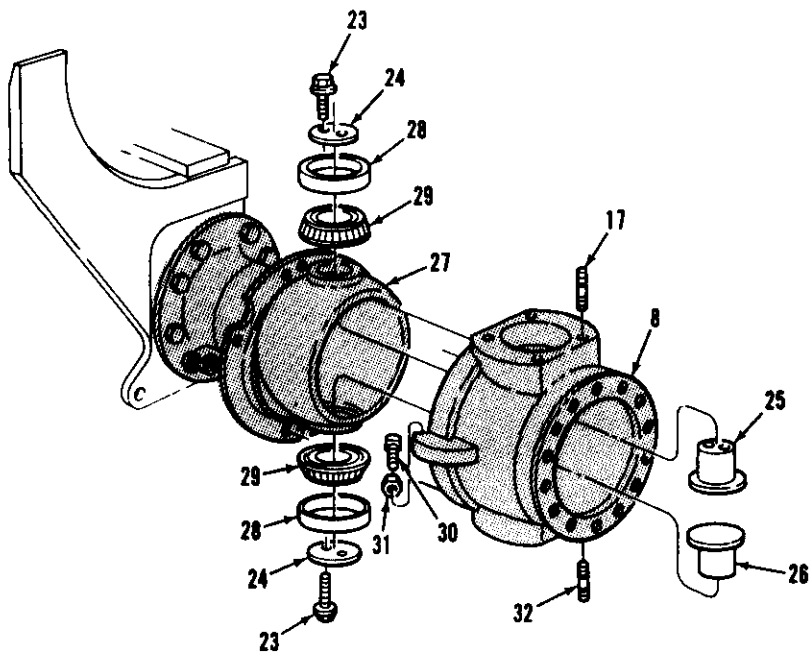
(2) If ball socket housing (8) is being replaced, install four studs (17) into top of housing and six studs (32) into bottom.

NOTE

Top studs on left ball housing are different from those on right housing.

(3) Pack two trunnion bearings (29) with grease and install into ball socket housing (8).

(4) Tip ball socket housing (8) and install onto axle ball (27).



8. BALL SOCKET HOUSING
17. STUD (4)
23. CAPSCREW (2)
24. END PLATE
25. UPPER TRUNNION
26. LOWER TRUNNION
27. AXLE BALL
28. BEARING CUP (2)
29. TRUNNION BEARING (2)
30. STEERING STOP CAPSCREW
31. NUT
32. STUD (6)

TA 298926

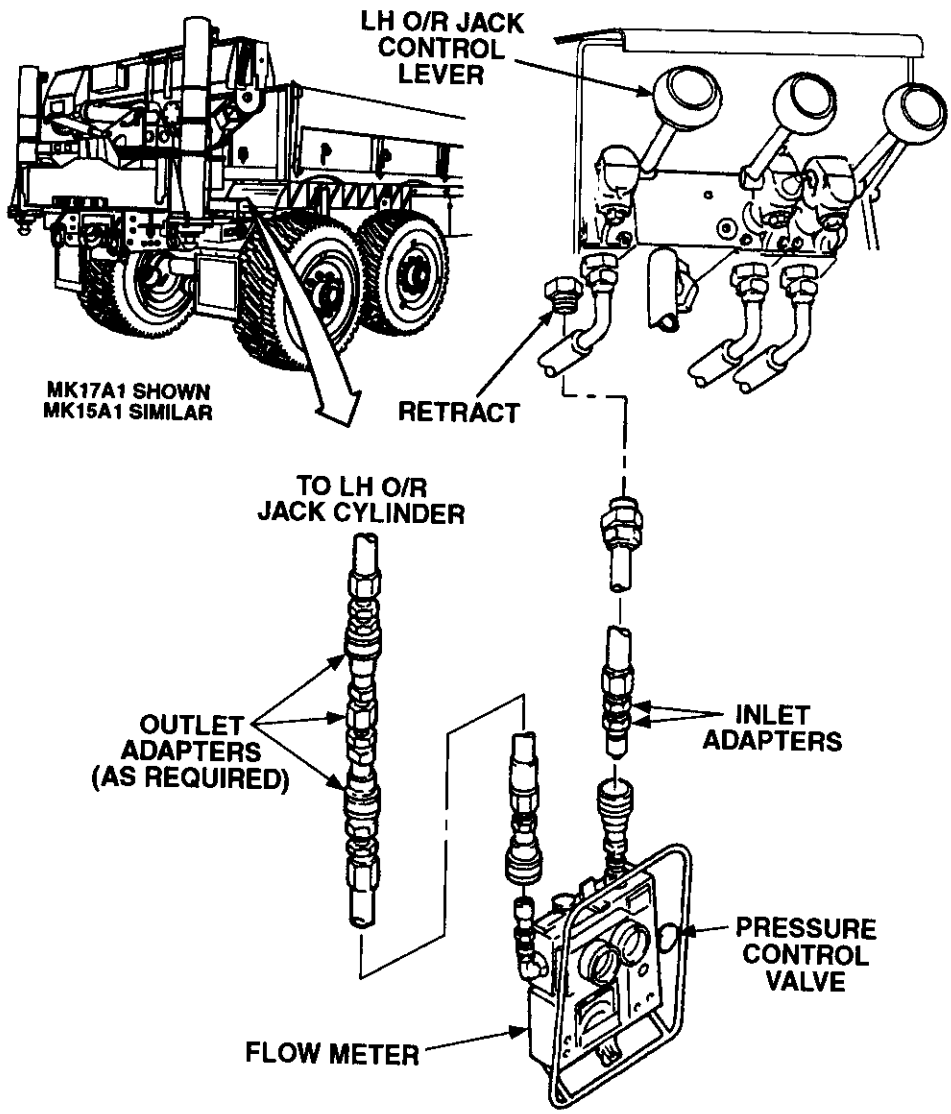
MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

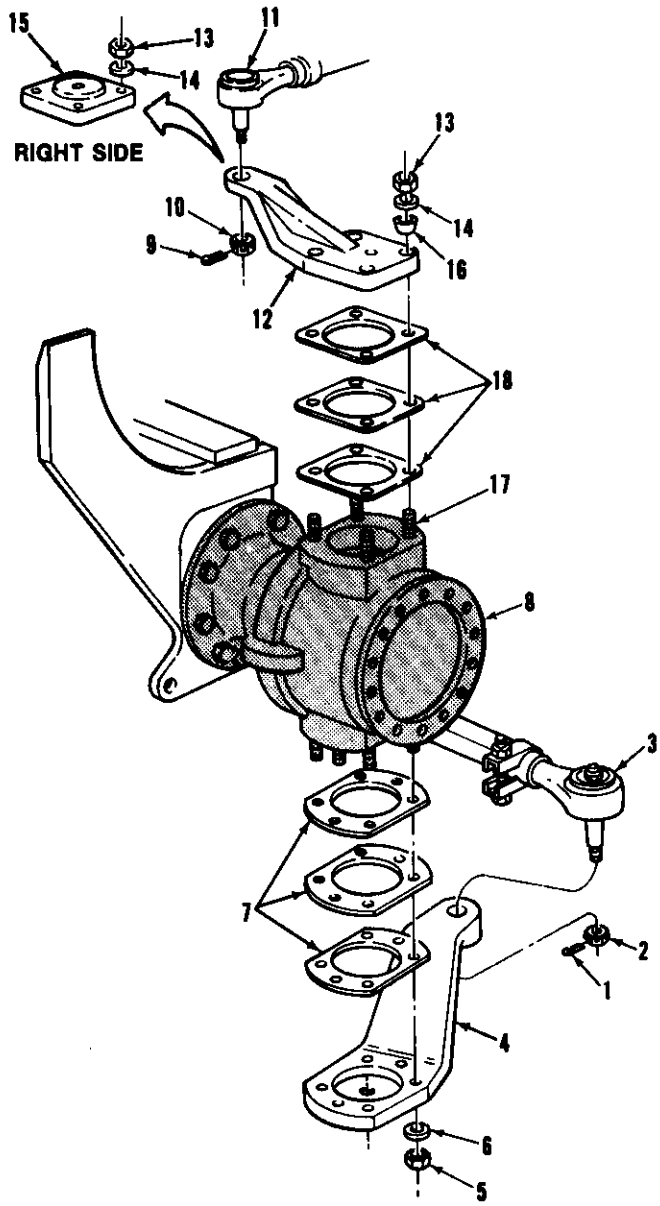
LEFT OUTRIGGER JACK CYLINDER DOES NOT RAISE OR LOWER. (Continued)

Test 4. Remove the line that comes from the outrigger jack cylinder retract fitting at the right side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully retract outrigger jack cylincer. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.
- If pressure is not within specifications, repair right side control valve/shuttle valve circuit. Refer to paragraphs 18.1-51 and 18.1-53.

END OF TEST





1. COTTER PIN
2. CASTLE NUT
3. TIE ROD END
4. TIE ROD ARM
5. NUT (6)
6. LOCKWASHER (6)
7. SHIMS
8. BALL SOCKET HOUSING
9. COTTER PIN
10. CASTLE NUT
11. DRAG LINK
12. STEERING ARM (LH)
13. NUT (4)
14. WASHER (4)
15. TOP TRUNNION COVER (RH)
16. DOWEL (4)
17. STUD (4)
18. SHIM
19. CAPSCREW (6)
20. LOCKWASHER (6)
21. RETAINER HALVES
22. BALL WIPER SEAL
23. CAPSCREW (2)
24. END PLATE
25. UPPER TRUNNION
26. LOWER TRUNNION
27. AXLE BALL
28. BEARING CUP (2)
29. TRUNNION BEARING (2)

(10) Remove six capscrews (19), lockwashers (20), and two retainer halves (21). Unseat ball wiper seal (22).

(11) Remove two capscrews (23) and end plates (24) from upper and lower trunnions (25 and 26).

(12) Carefully drive upper and lower trunnions (25 and 26) from axle ball (27).

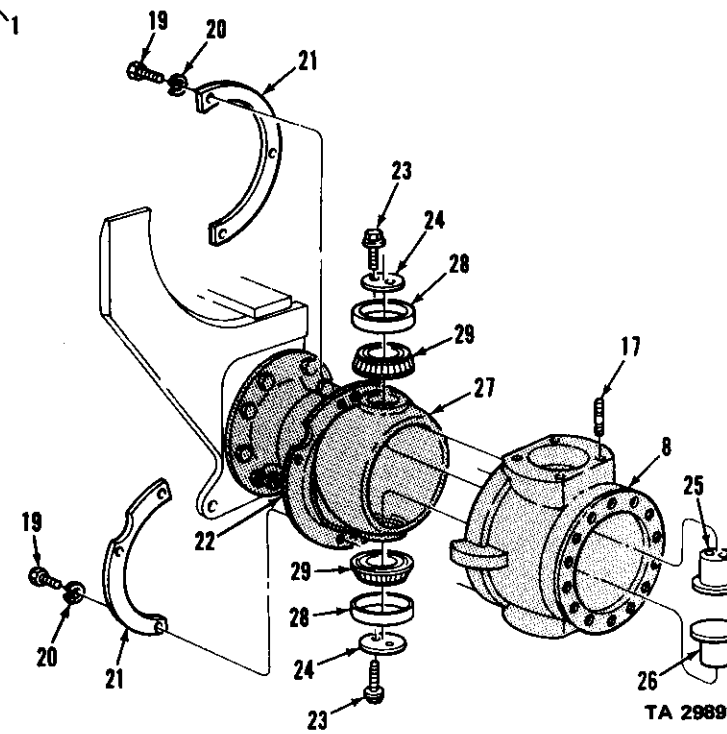
(13) Carefully drive ball socket housing (8) down until bearing cup (28) sticks out of top at least 1/8 inch (3.176 mm).

(14) Repeat step (13) for bottom bearing cup (28), driving ball socket housing (8) upwards.

(15) Tip ball socket housing (8) out at top and remove.

(16) Remove two trunnion bearings (29) from ball socket housing (8).

(17) Drive two bearing cups (28) from ball socket housing (8).



MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

4. RIGHT OUTRIGGER JACK CYLINDER DOES NOT RAISE OR LOWER.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines.
- If outrigger jack cylinder will not lower, go to Test 3.

9-9. BALL SOCKET AND TRUNNION BEARING REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Grease (item 28, Appendix C)
Lubricating oil, (item 46, Appendix C)
Cotter pin (MS24665-359) items 1 and 9
Lockwasher (6) (MS35338-51) item 6
Adhesive, silicone sealant (item 7, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Axle lubricant drained (para 11-3).
	Brake spider and skein removed (para 13-8).
	Axle shaft removed (para 11-6).

General Safety Instructions

Block wheels to prevent personal injury.

Support axle with a jack stand rated at 10 tons or more.

---

a. Removal

NOTE

Right and left axle ball socket housings are replaced in the same way, except where noted.

(1) Remove cotter pin (1) and castle nut (2) from tie rod end (3). Discard cotter pin (1).

(2) Remove tie rod end (3) from tie rod arm (4).

(3) Remove six nuts (5), lockwashers (6), and tie rod arm (4). Discard lockwashers (6).

(4) Remove and tag shims (7).

(5) If left ball socket housing (8) is being replaced, remove cotter pin (9) and castle nut (10) from drag link (11). Remove drag link (11) from steering arm (12). Discard cotter pin (9).

(6) Remove four nuts (13) and washers (14) from top trunnion cover (15). Left trunnion cover includes steering arm (12).

(7) Remove top trunnion cover (15).

(8) To remove steering arm (12) from left ball socket housing (8), spread and lift four dowels (16) from studs (17).

(9) Remove and tag shims (18).

MALFUNCTION

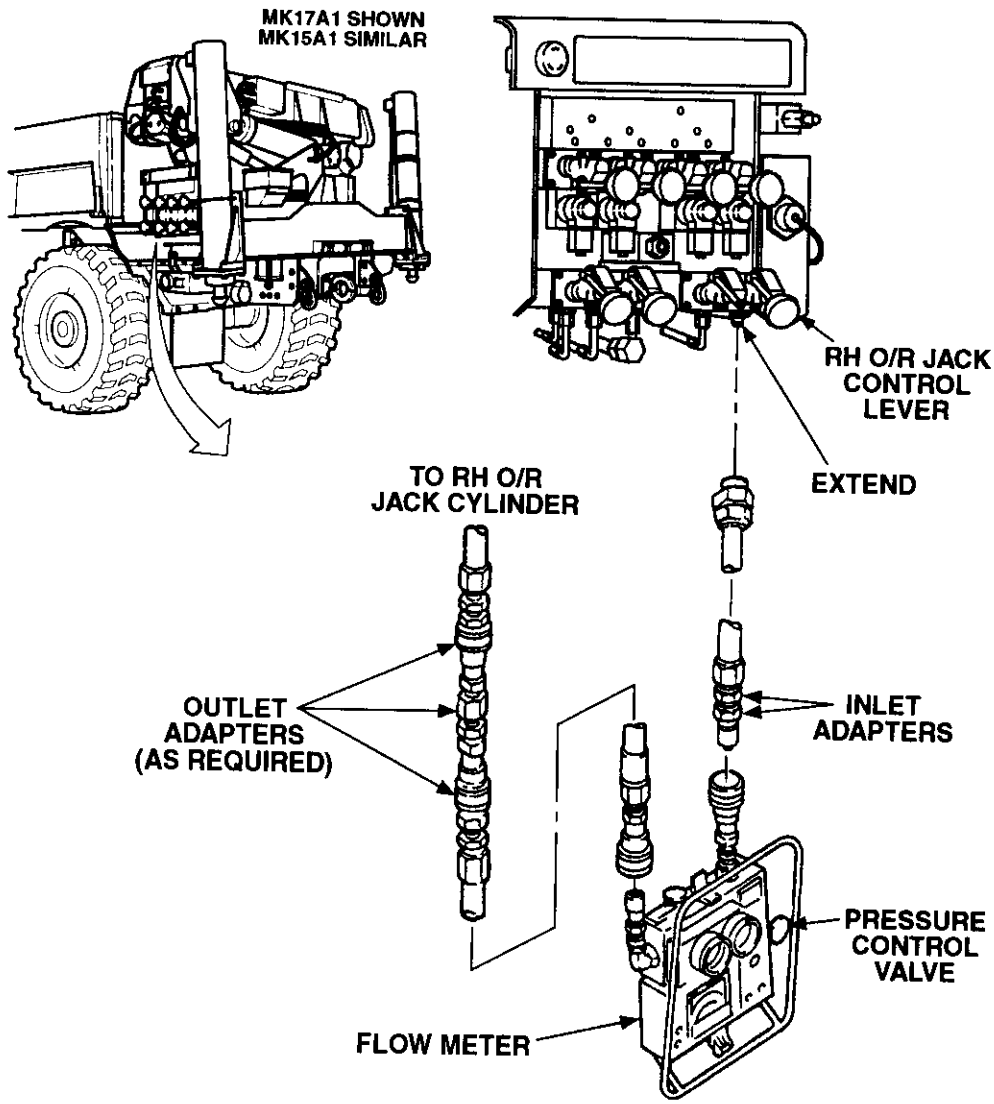
TEST OR INSPECTION

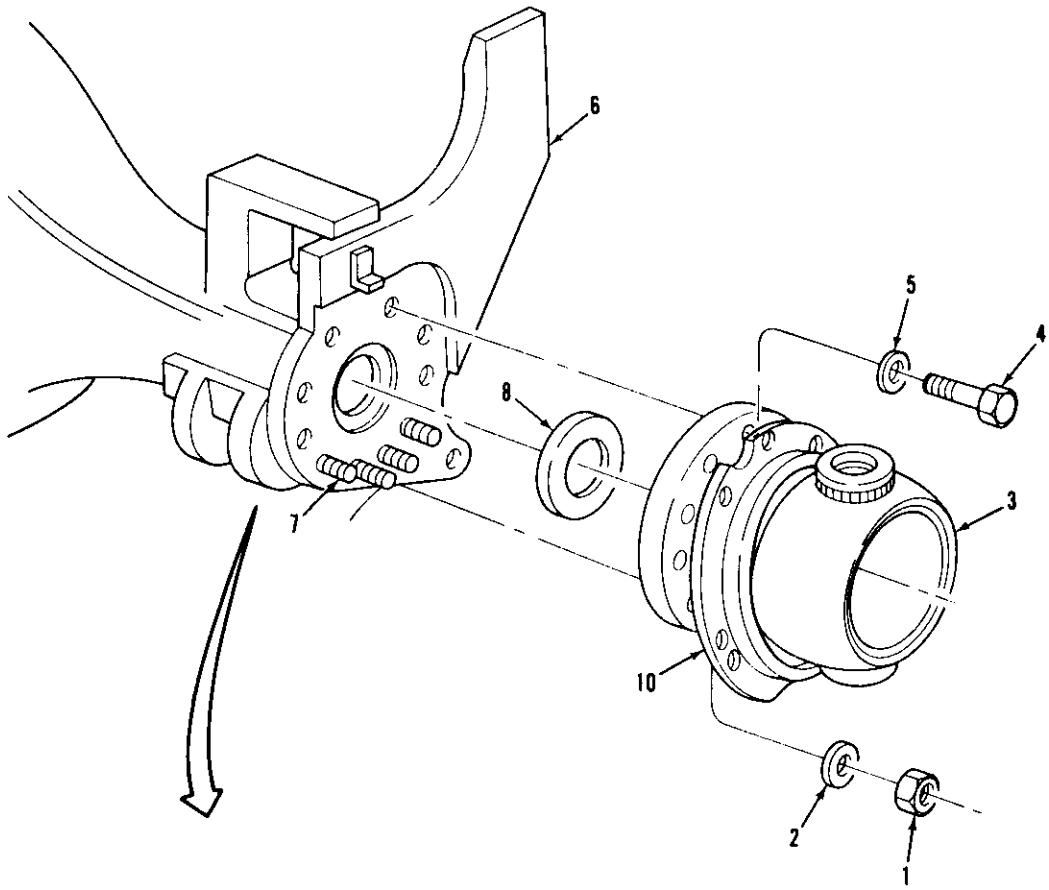
CORRECTIVE ACTION

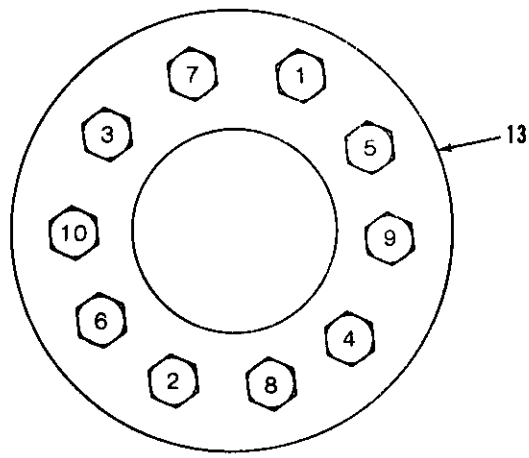
RIGHT OUTRIGGER JACK CYLINDER DOES NOT RAISE OR LOWER. (Continued)

Test 1. Remove the line that comes from the outrigger jack cylinder extend fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully extend outrigger jack cylinder. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair or replace outrigger jack cylinder cylinder. Refer to paragraphs 18.1-5 or 18.1-6.
- If pressure is not within specifications, go to Test 2.







1. NUT (4)
2. WASHER (4)
3. AXLE BALL
4. CAPSCREW (6)
5. WASHER (6)
6. AXLE HOUSING
7. STUD (4)
8. OIL SEAL
10. BALL WIPER SEAL
13. TORQUE PATTERN

TA 298924

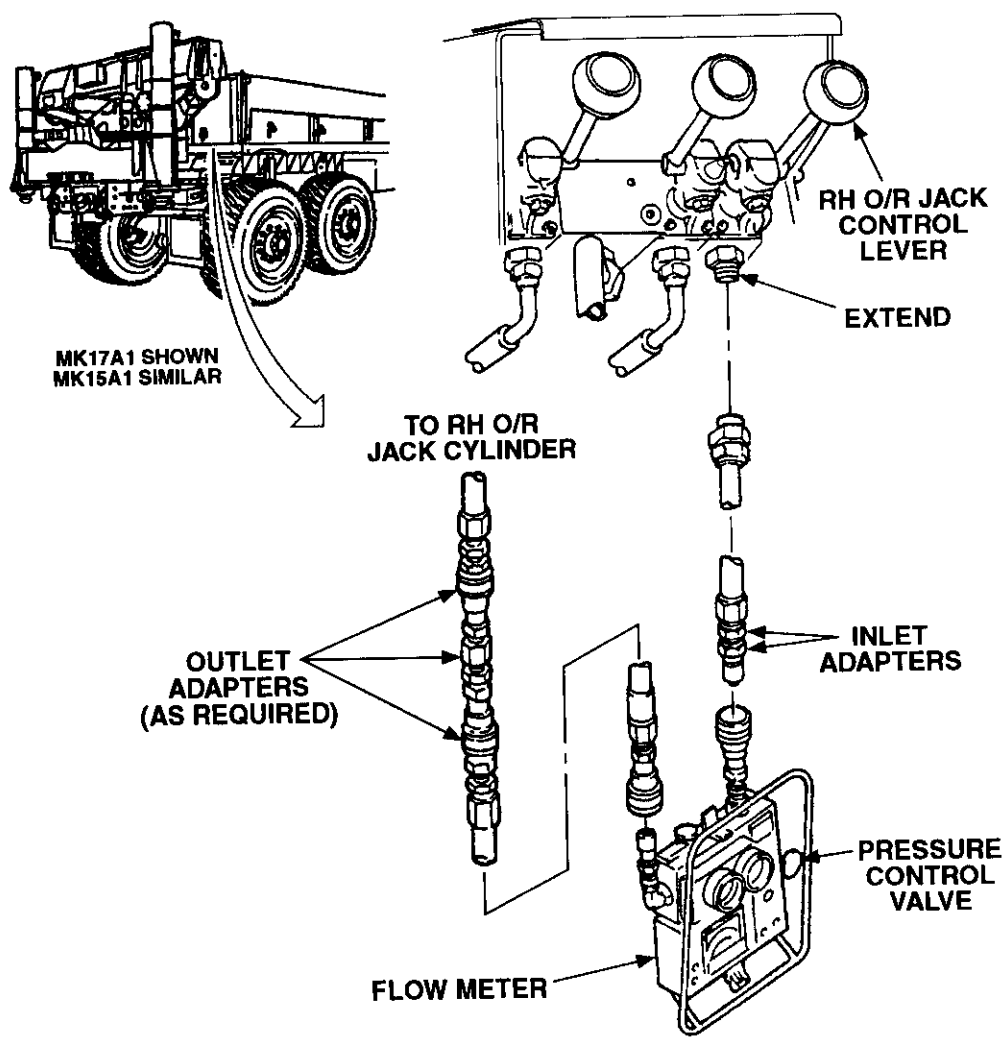
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 2. Remove the line that comes from the outrigger jack cylinder extend fitting at the right side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully extend outrigger jack cylinder. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.
- If pressure is not within specifications, repair right side control valve/shuttle valve circuit. Refer to paragraphs 18.1-51 and 18.1-53.



9-8. BALL SOCKET BUSHING AND OIL SEAL REPLACEMENT (Continued)

(5) Install new housing oil seal (8) into axle ball (3). Make sure that lip of oil seal (8) is facing away from axle ball (3).

(6) Install new ball wiper seal (10) over axle ball (3).

(7) Coat mating surface of axle ball (3) with silicone sealant and install onto studs (7) on axle housing (6).

(7.1) Apply adhesive to holes in axle housing (6).

(8) Install six washers (5) and capscrews (4) into top holes in axle ball (3).

(9) Install four washers (2) and nuts (1) onto studs (7) at bottom of axle ball (3).

(10) Torque six capscrews (4) and four nuts (1) to 160 foot-pounds (217 N·m) using torque pattern (13).

(11) Torque six capscrews (4) and four nuts (1) to 320 foot-pounds (434 N·m) using torque pattern (13).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install ball socket housing (para 9-9).
TM 2320-20/12 TM 9-2320-297-20	Install axle shaft (para 11-6).
	Install brake assembly (para 13-5).
	Fill axle with lubricant (para 11-3).

MALFUNCTION

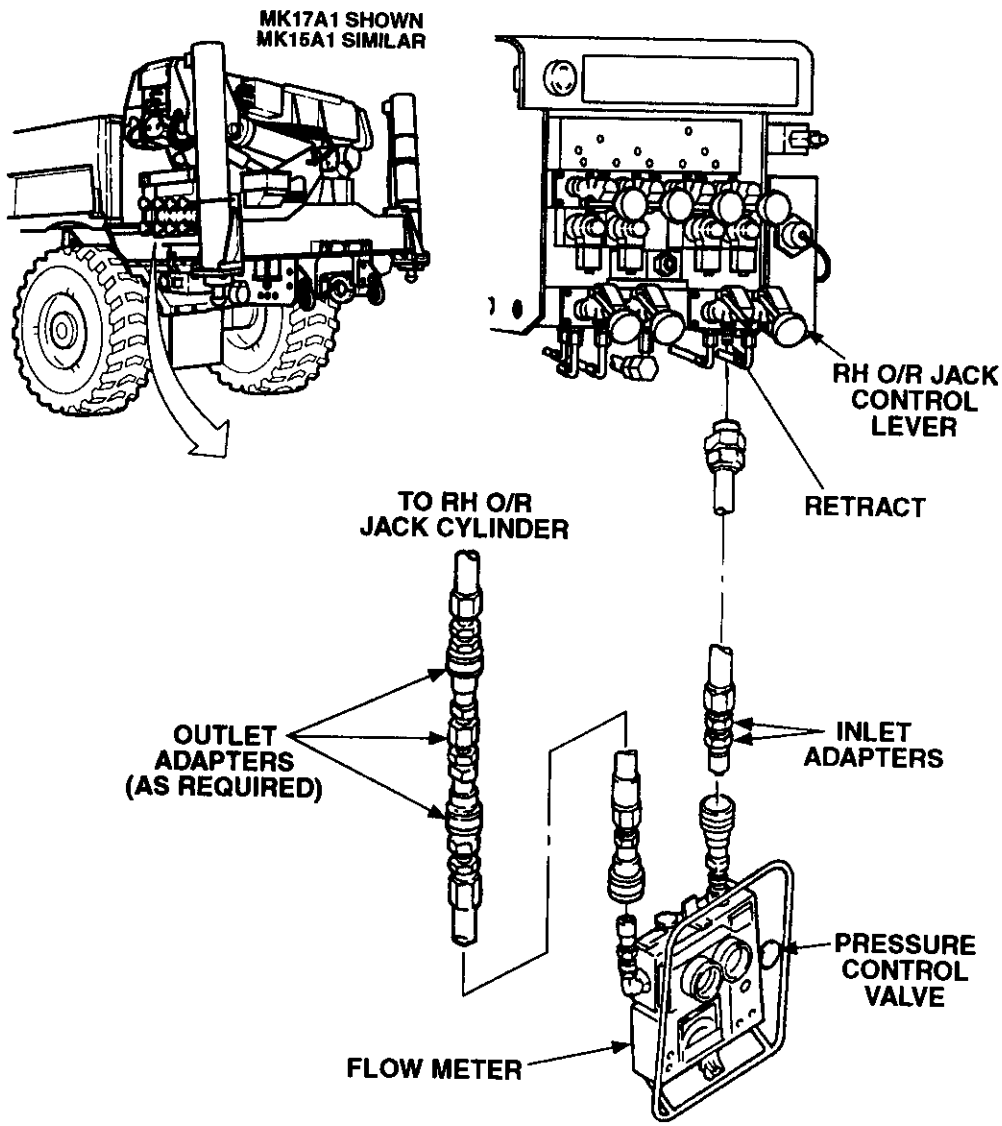
TEST OR INSPECTION

CORRECTIVE ACTION

RIGHT OUTRIGGER JACK CYLINDER DOES NOT RAISE OR LOWER. (Continued)

Test 3. Remove the line that comes from the outrigger jack cylinder retract fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully retract outrigger jack cylinder. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair or replace outrigger jack cylinder. Refer to paragraph 18.1-5 or 18.1-6.
- If pressure is not within specifications, go to Test 4.

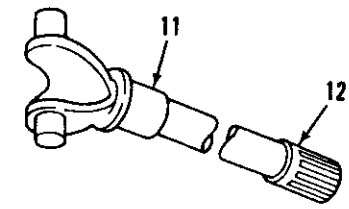


(4) Replace axle ball (3) if it fails inspection.

(5) Inspect studs (7). Replace if damaged.

c. Installation

(1) Install new axle ball bushing (9) into axle ball (3) with chamfered end down and grease slots alined with trunnion openings in axle ball (3).

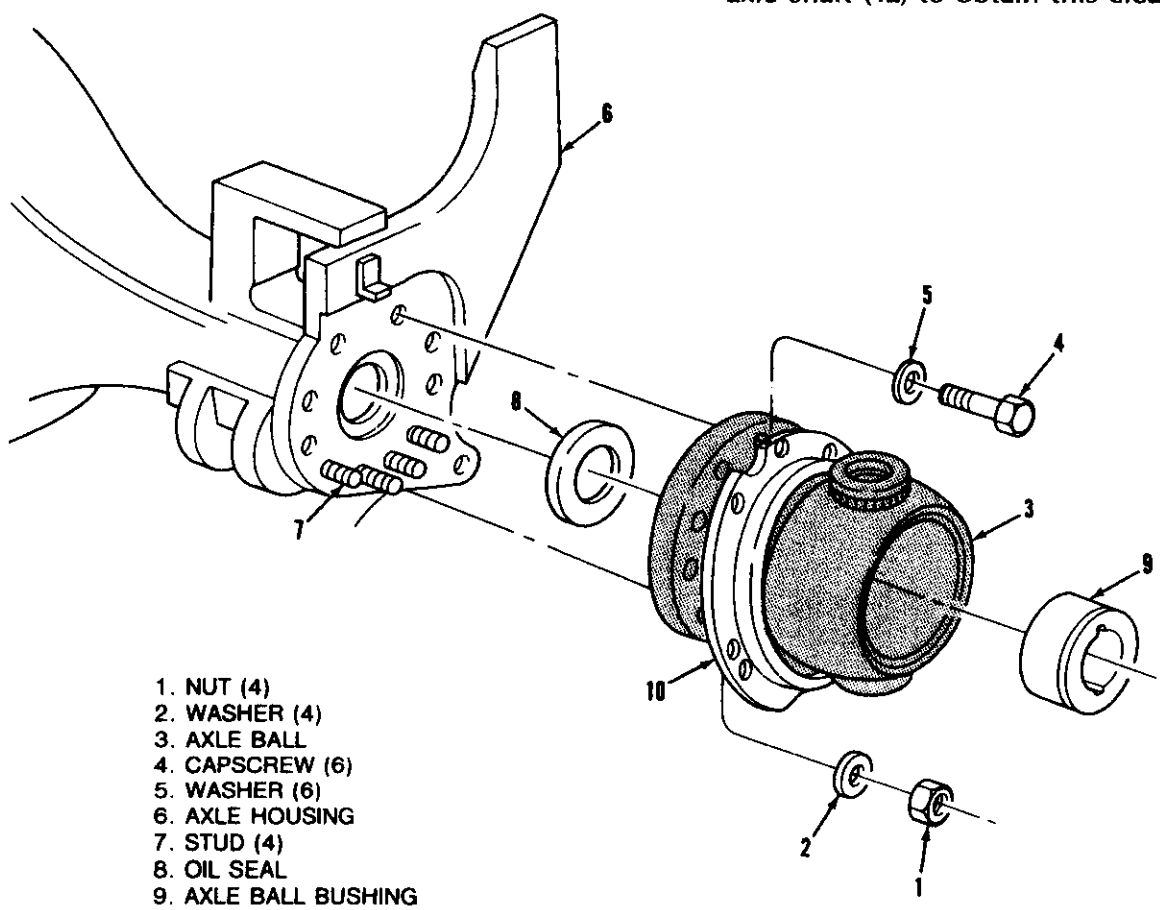


11. BUSHING AREA
12. AXLE SHAFT

(2) Measure outside diameter of axle shaft (11) where it rides in axle ball bushing (9).

(3) Measure inside diameter of axle ball bushing (9).

(4) The difference between these measurements must be between 0.003 and 0.005 inch. Ream axle ball bushing (9) or replace axle shaft (12) to obtain this clearance.



1. NUT (4)
2. WASHER (4)
3. AXLE BALL
4. CAPSCREW (6)
5. WASHER (6)
6. AXLE HOUSING
7. STUD (4)
8. OIL SEAL
9. AXLE BALL BUSHING
10. BALL WIPER SEAL

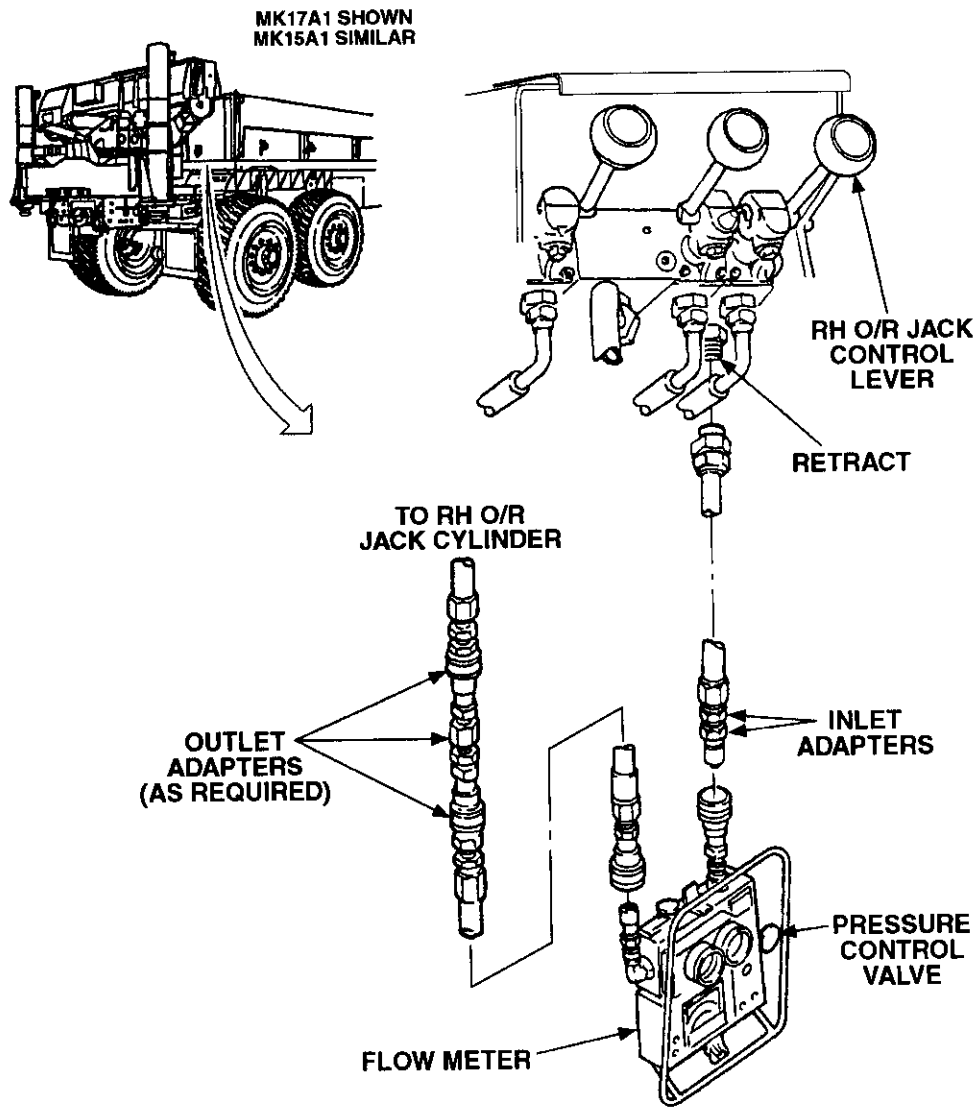
TA 298923

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

Test 4. Remove the line that comes from the outrigger jack cylinder retract fitting at the right side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully retract outrigger jack cylinder. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.
- If pressure is not within specifications, repair right side control valve/shuttle valve circuit. Refer to paragraphs 18.1-51 and 18.1-53.

END OF TEST



9-8. BALL SOCKET BUSHING AND OIL SEAL REPLACEMENT

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Micrometer set 0-6 inch inside
(NSN 5120-00-473-9350)
Micrometer set 0-6 inch outside
(NSN 5210-00-554-7134)

Materials/Parts
Adhesive (item 3, Appendix C)
Adhesive, silicone sealant (item 7, Appendix C)
Lubricating oil (item 46, Appendix C)
Oil seal (P/N 25043) item 8
Axle ball bushing, (P/N 15521FX) item 9
Ball wiper seal (P/N S-19226-LDS-MSD-2865) item 10

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Axle lubricant drained (para 11-3).
	Brake spider and skein removed (para 13-8).
	Axle shaft removed (para 11-6).
TM 2320-34/13 TM 9-2320-297-34	Ball socket housing removed (para 9-9).

General Safety Instructions
Block wheels of truck to prevent personal injury.

Support axle with a jack stand rated at 10 tons or more.

a. Removal

WARNING

Axle ball is heavy. To prevent personal injury, support with a jack stand until ready to remove from axle housing.

(1) Remove four nuts (1) and washers (2) from bottom of axle ball (3).

(2) Remove six capscrews (4) and washers (5) from top and sides of axle ball (3).

(3) Gently tap axle ball (3) on both sides until sealant releases.

(4) Remove axle ball (3) from axle housing (6) and studs (7).

(5) Place axle ball (3) with large opening down and pry out oil seal (8). Discard oil seal (8).

(6) Drive out axle ball bushing (9). Discard axle ball bushing (9).

(7) Remove ball wiper seal (10). Discard ball wiper seal (10).

b. Cleaning/Inspection

(1) Clean axle ball (3). Refer to paragraph 2-6. Make sure that all sealant is removed from mating surface.

(2) Clean sealant from mating surface of axle housing (6).

(3) Inspect axle ball (3) for cracks, deep scratches, or grooves.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

5. MAST DOES NOT RAISE OR LOWER.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines.

9-7. NOSE BOX COMPANION FLANGE REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Oil seal (NSN 5330-00-207-8971) item 4
Adhesive, silicone sealant (item 7, Appendix C)
Adhesive (Item 3, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Propeller shaft removed (para 10-3).

a. Removal

(1) Remove two capscrews (1) and lockplate (2).

(2) Remove companion flange (3).

(3) Remove oil seal (4) and discard.

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect splines and capscrew holes in companion flange (3) for damage.

(3) Inspect threads on capscrews (1) for damage.

(4) Replace all parts failing inspection.

c. Installation

NOTE

Coat outside diameter of oil seal (4) with adhesive before installing.

(1) Install new oil seal (4) into nose box (5) with lip inward.

(2) Install flange (3) onto output shaft (6).

(3) Coat end of output shaft (6) with silicone sealant.

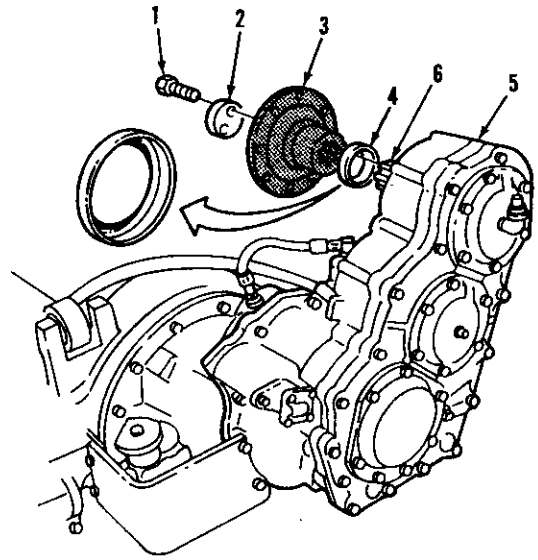
(4) Coat back of lockplate (2) with silicone sealant and install with two capscrews (1). Torque capscrews (1) to 107 foot-pounds (145 N·m).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install propeller shaft (para 10-3).



1. CAPSCREW (2)
2. LOCKPLATE
3. COMPANION FLANGE
4. OIL SEAL
5. NOSE BOX
6. OUTPUT SHAFT

TA 298922

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 1. Check that tension links are not damaged or seized up.

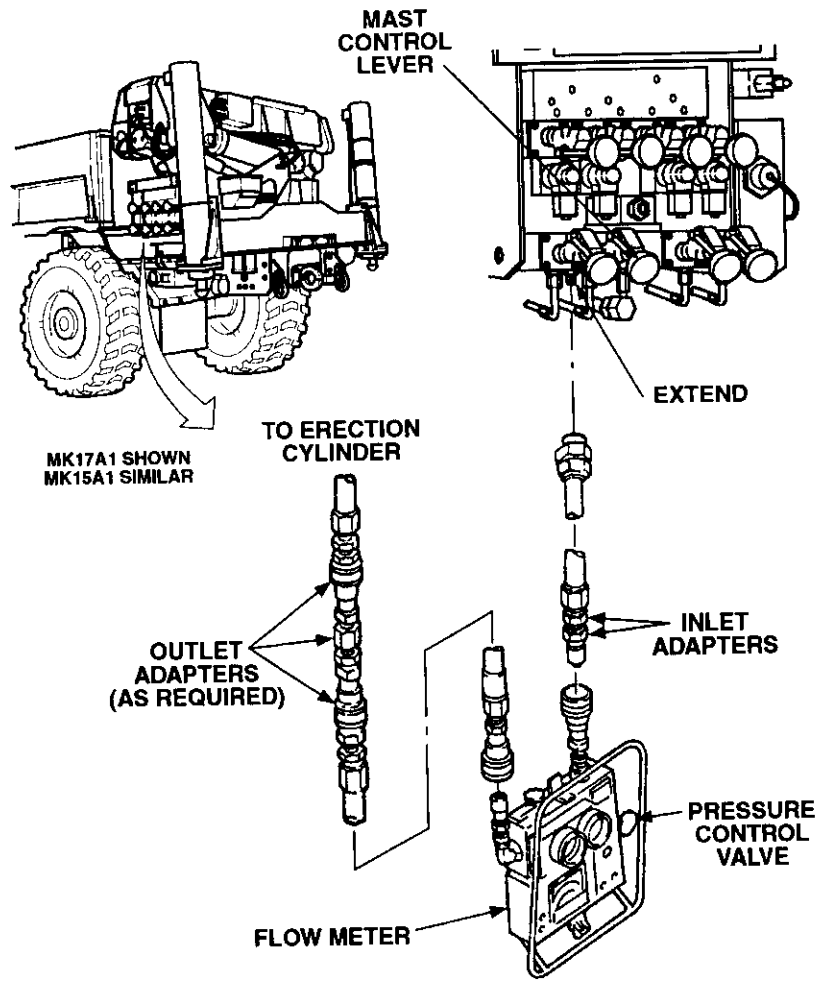
- If damage is not found, and tension links are not seized up, go to Test 2.
- If damage is found, or tension links are seized up, replace tension link cylinders. Refer to paragraph 18.1-22.

NOTE

If mast does not lower, go to Test 3.

Test 2. Remove the line that comes from the mast extend fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully extend mast. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair or replace erection cylinder. Refer to paragraphs 18.1-21 or 18.1-37.
- If pressure is not within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.



9-6. NOSE BOX LUBE PUMP REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Materials/Parts
Pipe sealant (item 60, Appendix C)

---

a. Removal

(1) Remove two lubrication lines (1 and 2) from lubrication pump (3).

(2) Remove four capscrews (4) and lubrication pump (3).

(3) Remove lubrication line fittings (5 and 6) from lubrication pump (3).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts for damage. Refer to paragraph 2-7.

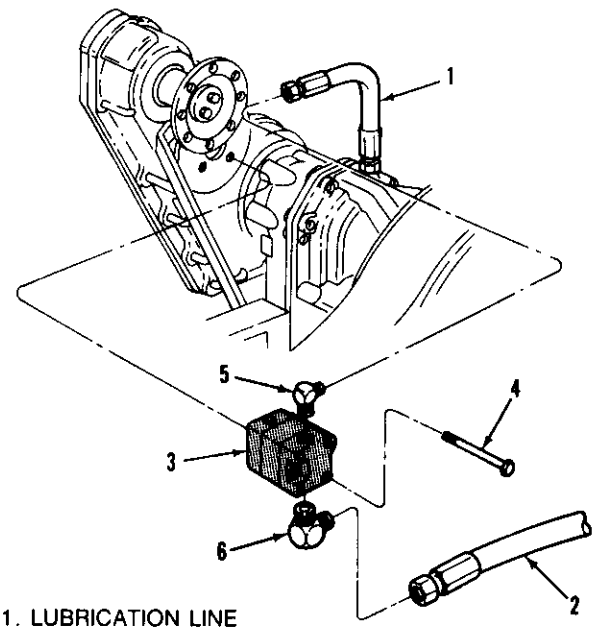
(3) Replace all parts failing inspection.

c. Installation

(1) Coat threads with pipe sealant and install lubrication line fittings (5 and 6) into lubrication pump (3).

(2) Install lubrication pump (3) with four capscrews (4). Torque capscrews (4) to 15 foot-pounds (20 N·m).

(3) Install two lubrication lines (1 and 2) into lubrication pump (3). Tighten securely.



1. LUBRICATION LINE
2. LUBRICATION LINE
3. LUBRICATION PUMP
4. CAPSCREW (4)
5. LUBRICATION LINE FITTING
6. LUBRICATION LINE FITTING

TA 298921

END OF TASK

MALFUNCTION

TEST OR INSPECTION

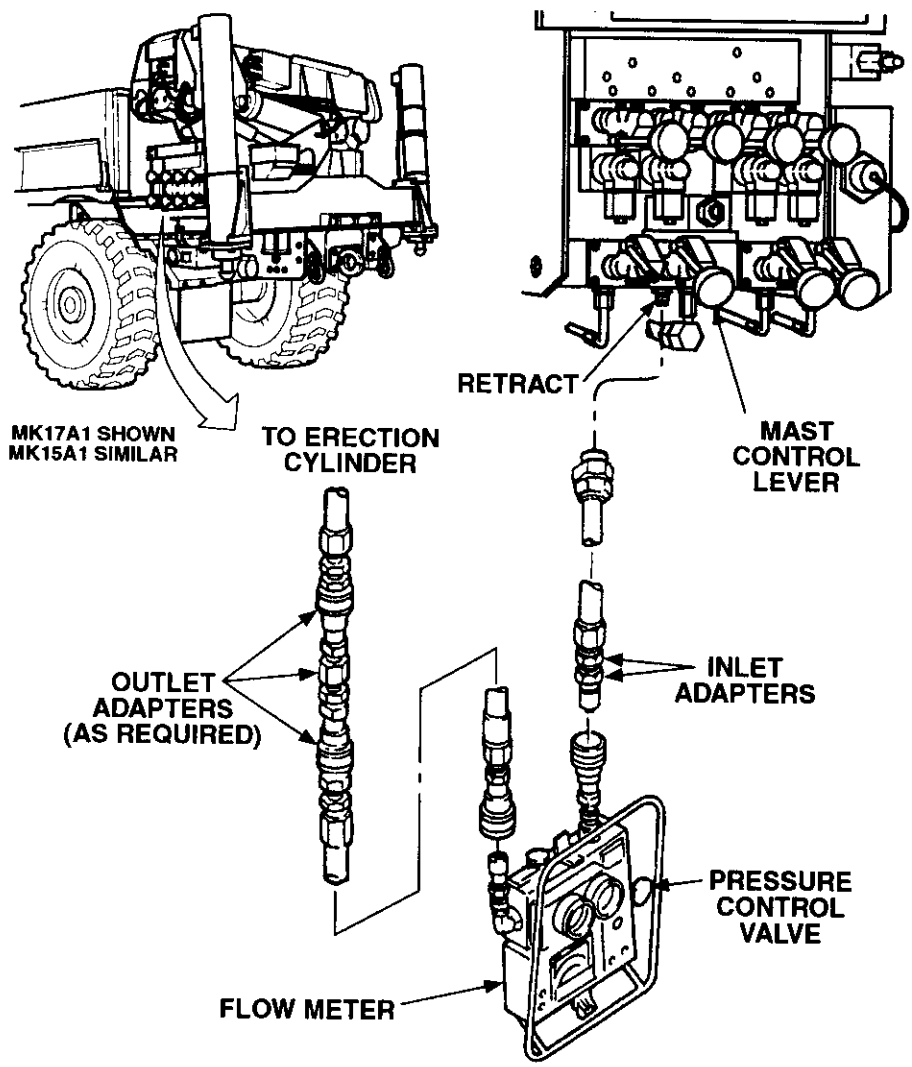
CORRECTIVE ACTION

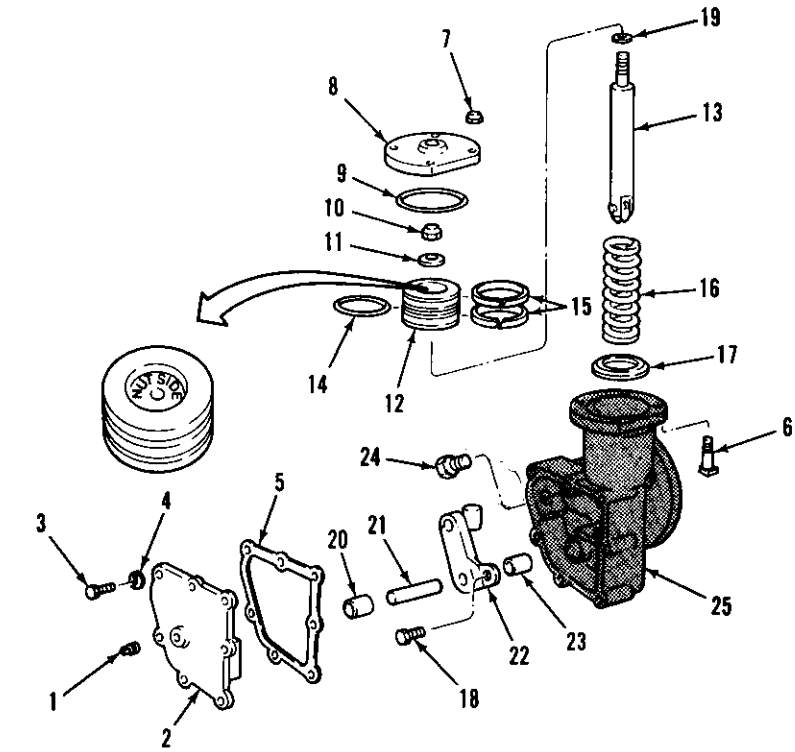
MAST DOES NOT RAISE OR LOWER. (Continued)

Test 3. Remove the line that comes from the mast retract fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully retract mast. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

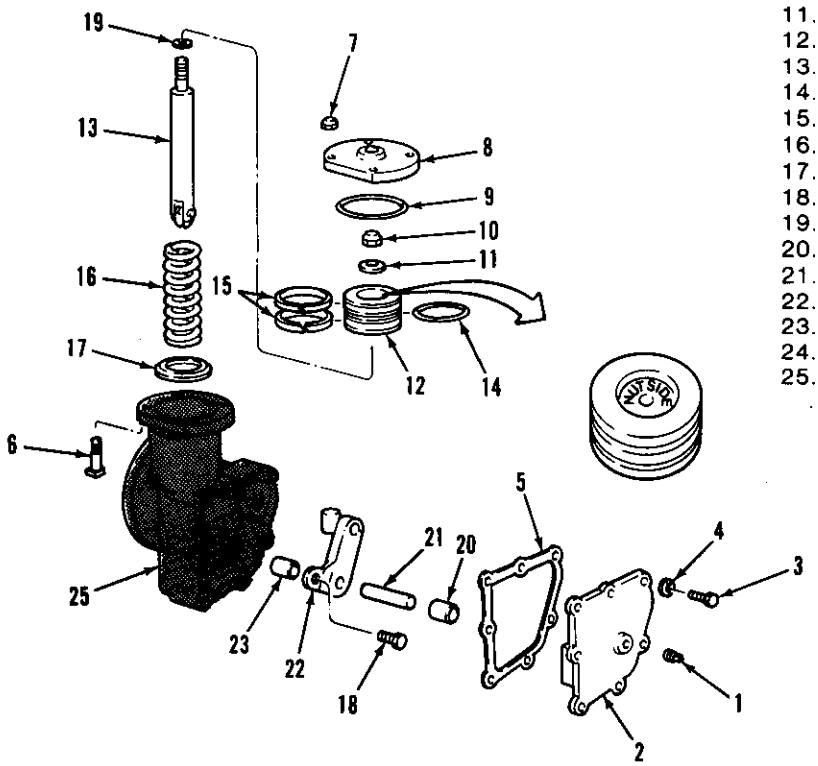
- If pressure is within specifications, repair or replace erection cylinder. Refer to paragraphs 18.1-21 or 18.1-37.
- If pressure is not within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.

END OF TEST





RIGHT HAND AXLE SHIFT UNIT
NOS. 2 AND 4 AXLES ONLY



LEFT HAND AXLE SHIFT UNIT
NOS. 1 AND 3 AXLES ONLY

1. PLUG
2. COVER
3. CAPSCREW (7)
4. LOCKWASHER (7)
5. GASKET
6. CAPSCREW (4)
7. LOCKNUT (4)
8. COVER
9. O-RING
10. LOCKNUT
11. WASHER
12. PISTON
13. PUSH ROD
14. O-RING
15. FELT OILER (2)
16. SPRING
17. PISTON STOP
18. CLEVIS PIN
19. O-RING
20. BEARING
21. SHAFT
22. LEVER
23. BEARING
24. PLUG
25. HOUSING

TA 298920

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

6. CRANE DOES NOT SWING OR SWINGS SLOWLY.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.

9-5. AXLE SHIFT UNIT REPAIR (Continued)

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts for wear and damage. Refer to paragraph 2-7.

(3) Inspect all threads for damage.

(4) Replace all parts failing inspection.

c. Assembly

NOTE

Before assembly, soak felt oilers in lubricating oil for one hour.

(1) Install shaft (21) into lever (22) and install bearings (20 and 23) on shaft (21).

(2) Install lever (22) assembly into housing (25).

(3) Install new O-ring (19) and piston (12) onto push rod (13).

(4) Install washer (11) and new locknut (10) onto push rod (13). Torque locknut (10) to 120-150 inch-pounds (13-16 N·m.).

(5) Install two new felt oilers (15) and new O-ring (14) onto piston (12).

(6) Install piston stop (17) and spring (16) into housing (25).

(7) Place piston (12) and push rod (13) assembly into housing (25).

(8) Place housing (25) in a press and apply pressure to piston (12) until lever (22) is alined with end of push rod (13).

(9) Install clevis pin (18) and remove housing (25) from press.

(10) Install new gasket (5) and cover (2) onto housing (25).

(11) Install seven new lockwashers (4) and capscrews (3).

(12) Install new O-ring (9) into groove of cover (8).

(13) Install four capscrews (6), cover (8), and new locknuts (7).

(14) Install plug (1) into cover (2), finger tight.

NOTE

Step 15 applies to right hand axle shift units only.

(15) Install plug (24) into housing (25). Tighten securely.

END OF TASK

NOTE

Follow-on Maintenance

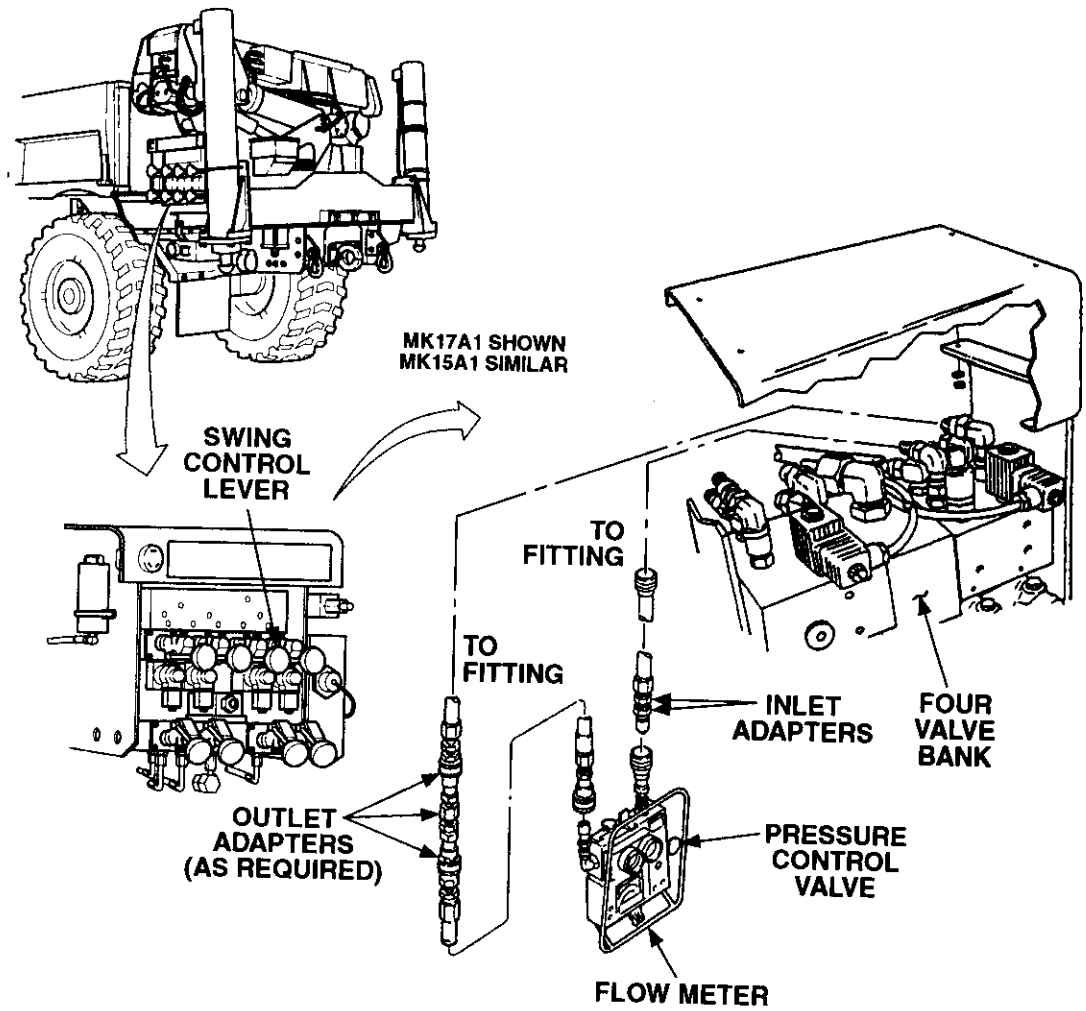
TM 2320-34/13 TM 9-2320-297-34	Install axle shift unit (para 9-4).

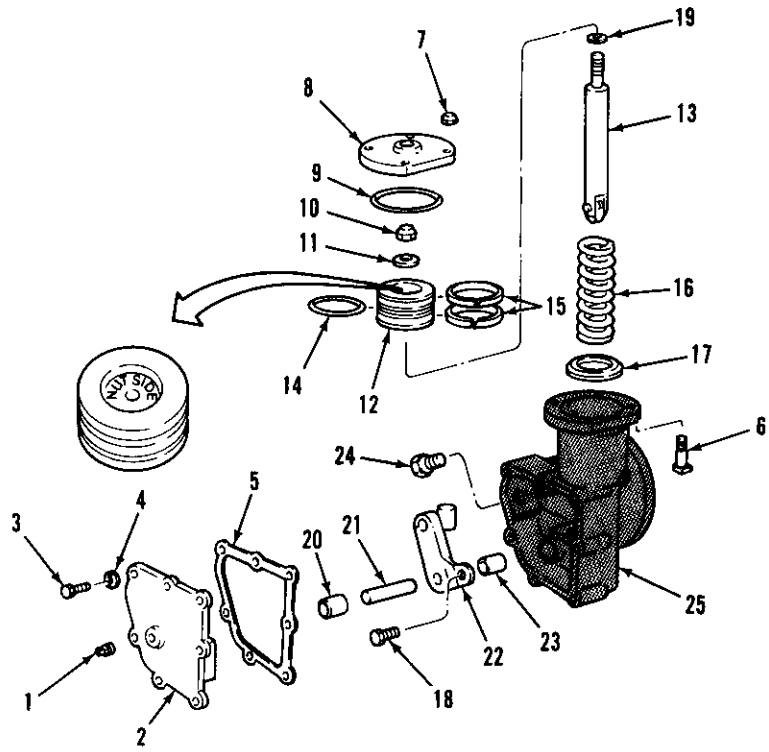
MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

CRANE DOES NOT SWING OR SWINGS SLOWLY. (Continued)

Test 1. Remove the lines that come from the swing clockwise and swing counterclockwise fittings at the left side control valve. Install a flow meter in line between fittings. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to swing clockwise and counter clockwise. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 1,400-1,600 psi (9,653-11,032 kPa) working pressure. Check for 8-9 gpm (30-34 lpm)

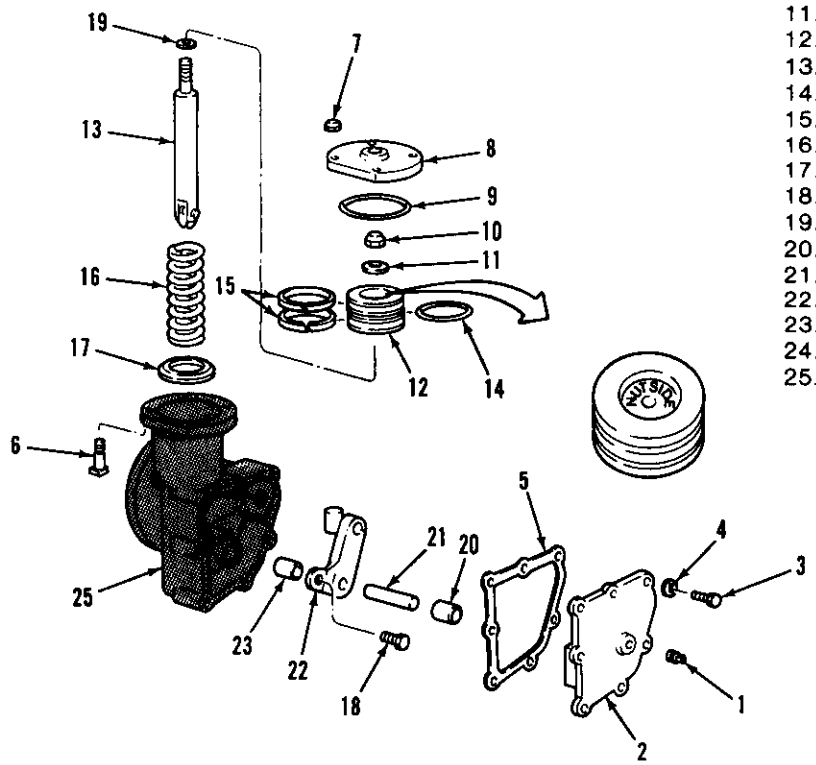
- If pressure and flow is within specifications, go to Test 2.
- If pressure and flow is not within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.





RIGHT HAND AXLE SHIFT UNIT
NOS. 2 AND 4 AXLES ONLY

1. PLUG
2. COVER
3. CAPSCREW (7)
4. LOCKWASHER (7)
5. GASKET
6. CAPSCREW (4)
7. LOCKNUT (4)
8. COVER
9. O-RING
10. LOCKNUT
11. WASHER
12. PISTON
13. PUSH ROD
14. O-RING
15. FELT OILER (2)
16. SPRING
17. PISTON STOP
18. CLEVIS PIN
19. O-RING
20. BEARING
21. SHAFT
22. LEVER
23. BEARING
24. PLUG
25. HOUSING



LEFT HAND AXLE SHIFT UNIT
NOS. 1 AND 3 AXLES ONLY

TA 288919

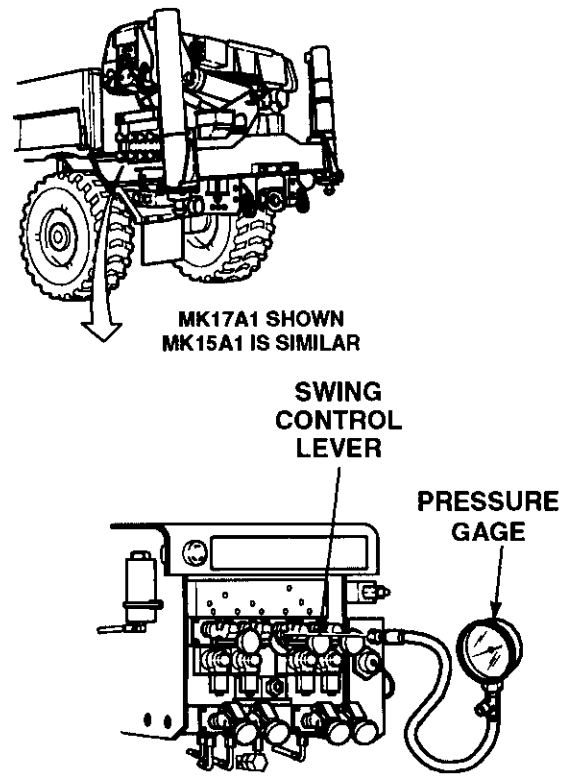
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 2. Install 0-5,000 psi pressure gage at test port on left side control valve bank. Start engine and allow to run at idle. Have assistant operate control lever to swing clockwise and counter clockwise. Check for 1,400-1,600 psi (9,653-11,032 kPa) swing pressure in both directions.

- If pressure is within specifications, go to Test 3.
- If pressure is not within specifications, repair or replace the cross relief valve. Refer to paragraphs or 18.1-41 or 18.1-42.



9-5. AXLE SHIFT UNIT REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Materials/Parts

Engine lubricating oil (SAE-10), (item 45, Appendix C)
Lockwasher (7) (NSN 5305-01-155-2566) item 4
Gasket (NSN 5330-01-114-3720) item 5
Locknut (4) (P/N 47641) item 7
O-ring (NSN 5330-01-112-7962) item 9
Locknut (P/N 73496) item 10
O-ring (NSN 5330-01-136-7330) item 14
Felt oilers (2) (NSN 5330-01-113-9892) item 15
O-ring (NSN 5330-01-150-4785) item 19

Equipment Condition TM

TM 2320-34/13
TM 9-2320-297-34

Condition Description

Axle shift unit removed (para 9-4).

a. Disassembly

NOTE

Oil will drain out when cover is removed. Work over a drain pan.

(1) Remove plug (1) from cover (2).

(2) Remove seven capscrews (3) and lockwashers (4). Discard lockwashers (4).

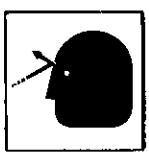
(3) Remove cover (2).

(4) Remove and discard gasket (5).

(5) Remove four capscrews (6) and locknuts (7). Discard locknuts (7).

(6) Remove cover (8) and O-ring (9). Discard O-ring (9).

WARNING



Piston is under spring tension and will pop out. Use care to prevent personal injury.

(7) Remove locknut (10), washer (11), and piston (12) from push rod (13). Discard locknut (10).

(8) Remove O-ring (14) and two felt oilers (15) from piston (12). Discard O-ring (14) and two felt oilers (15).

(9) Remove spring (16) and piston stop (17).

(10) Remove clevis pin (18) and push rod (13).

(11) Remove O-ring (19) from push rod (13). Discard O-ring (19).

(12) Remove bearing (20), shaft (21), lever (22), and bearing (23).

NOTE

Step 13 applies to right hand axle shift unit only.

(13) Remove plug (24) from housing (25).

MALFUNCTION

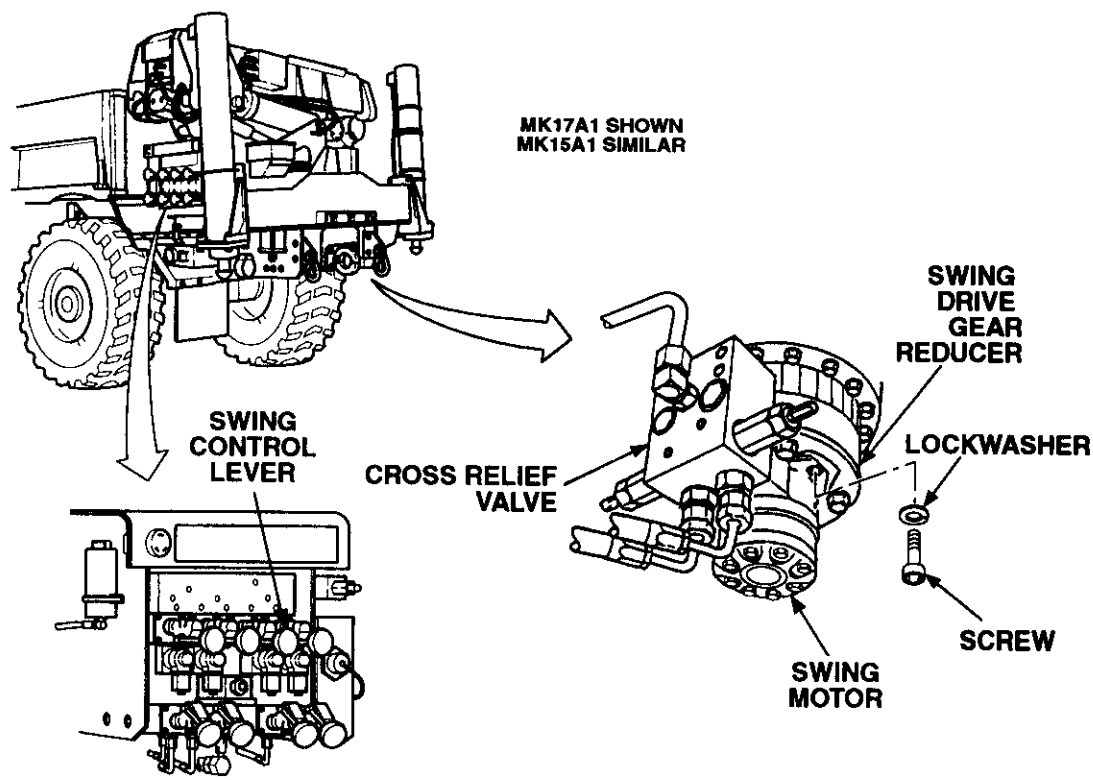
TEST OR INSPECTION

CORRECTIVE ACTION

CRANE DOES NOT SWING OR SWINGS SLOWLY. (Continued)

Test 3. Remove two screws, lockwashers, and swing motor from swing drive gear reducer. Start engine and allow to run at idle. Operate swing motor using SWING control lever.

- If swing motor operates, go to Test 4.
- If swing motor does not operate, repair or replace swing drive orbit motor. Refer to paragraphs 18.1-11 or 18.1-12.



(4) Coat threads of breather (18) with pipe sealant and install. Tighten securely.

(5) Coat threads of air fitting (10) with pipe sealant and install air fitting (10) into elbow (12).

(6) Coat threads of elbow (12) with pipe sealant and install elbow (12) with air fitting (10) into axle shift unit (11).

(7) Connect air lines (8 and 9) onto air fitting (10). Tighten securely.

(8) Fill axle shift unit (11) housing with lubricating oil to level of filler plug (19).

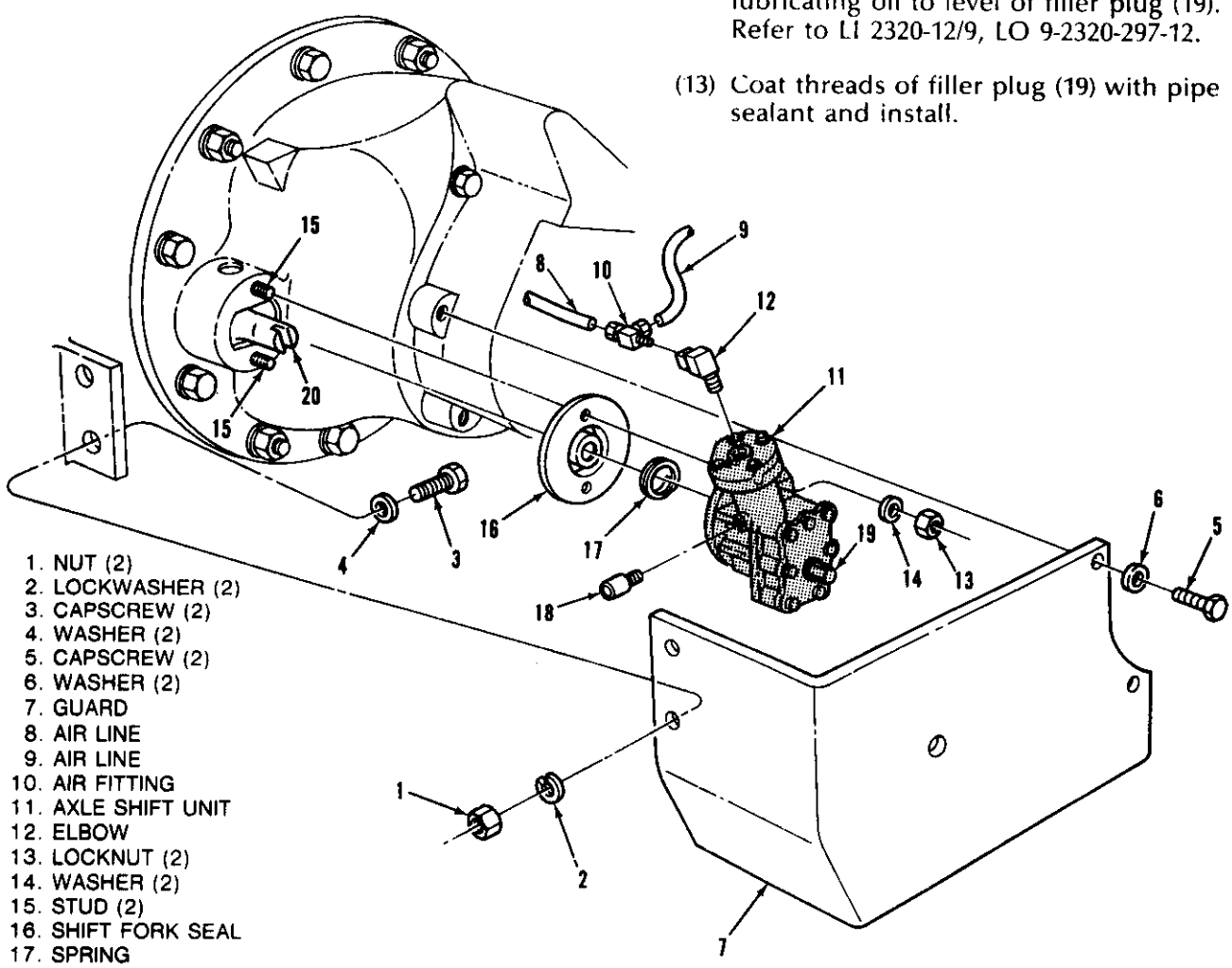
(9) Apply adhesive to holes and install guard (7) with two capscrews (5) and washers (6). Do not tighten capscrews (5) yet.

(10) Install two capscrews (3) with washers (4), new lockwashers (2), and nuts (1).

(11) Tighten capscrews (5) and nuts (1) securely.

(12) Fill axle shift unit (11) housing with lubricating oil to level of filler plug (19). Refer to LI 2320-12/9, LO 9-2320-297-12.

(13) Coat threads of filler plug (19) with pipe sealant and install.



1. NUT (2)
2. LOCKWASHER (2)
3. CAPSCREW (2)
4. WASHER (2)
5. CAPSCREW (2)
6. WASHER (2)
7. GUARD
8. AIR LINE
9. AIR LINE
10. AIR FITTING
11. AXLE SHIFT UNIT
12. ELBOW
13. LOCKNUT (2)
14. WASHER (2)
15. STUD (2)
16. SHIFT FORK SEAL
17. SPRING
18. BREATHER
19. FILLER PLUG
20. SHIFT FORK

END OF TASK

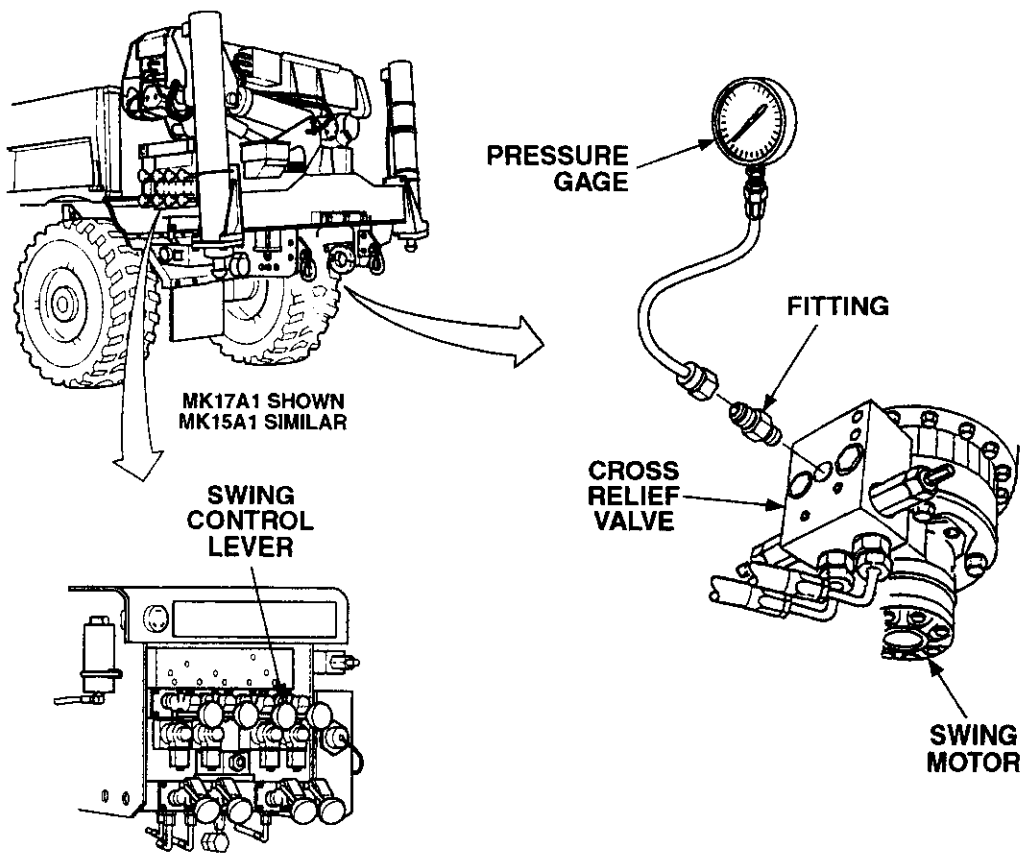
TA 298918

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

Test 4. Remove line and fitting from brake port on cross relief valve. Install test fitting and a 0-5,000 psi pressure gage. Start engine and allow to run at idle. Have assistant operate control lever to swing clockwise and counter clockwise. Check for a minimum of 1,300 psi (8,963 kpa) brake release pressure.

- If pressure is within specifications, repair or replace swing drive brake or swing drive assembly. Refer to paragraphs 18.1-13, 14, 15, or 16.
- If pressure is not within specifications, repair or replace the cross relief valve. Refer to paragraphs 18.1-41 or 18.1-42.

END OF TEST



9-4. AXLE SHIFT UNIT REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

References

LI 2320-12/9
LO 9-2320-297-12

Materials/Parts

Engine oil (item 45, Appendix C)
Pipe Sealant (item 60, Appendix C)
Lockwasher (2) (MS35338-48) item 2
Locknut (2) (MS17828-7F) item 13
Seal and spring assembly (P/N 119855) items 16 and 17
Adhesive (item 3, Appendix C)

General Safety Instructions

Block wheels of truck to prevent personal injury.

---

a. Removal

(1) Remove two nuts (1), lockwashers (2), capscrews (3), and washers (4). Discard lockwashers (2).

(2) Remove two capscrews (5), washers (6), and guard (7).

(3) Tag and remove air lines (8 and 9) from air fitting (10) at top of axle shift unit (11).

(4) Remove air fitting (10) and elbow (12) together.

(5) Remove air fitting (10) from elbow (12).

(6) Place a drain pan under axle shift unit (11) and remove two locknuts (13) and washers (14) from studs (15). Discard locknuts (13).

(7) Remove axle shift unit (11).

(8) Remove shift fork seal (16) with spring (17) from either studs (15) or axle shift unit (11). Discard shift fork seal (16) and spring (17).

(9) Remove breather (18) and filler plug (19).

b. Cleaning/Inspection

(1) Clean breather (18). Clean all other parts. Refer to paragraph 2-6.

(2) Inspect studs (15) for damage. Replace if damaged.

(3) Inspect all other parts. Refer to paragraph 2-7.

(4) Replace all parts failing inspection.

c. Installation

(1) Install new shift fork seal (16) with spring (17) onto shift fork (20) and studs (15). Shift fork seal (16) is marked with BOTTOM-FRT TANDEM AXLE near correct bottom hole.

(2) Install axle shift unit (11) onto studs (15). Make sure that shift fork actuating lever engages shift fork (20).

(3) Install two washers (14) and new locknuts (13).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

7. CRANE DOES NOT SWING CLOCKWISE.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.

c. **Assembly**

(1) Apply silicone sealer to mounting surface of power divider cover (18).

(2) Install lockout body (12), two new lockwashers (11), and capscrews (10).

NOTE

Soak felt oilers in SAE 30 engine oil and lubricate O-rings with silicone oil before installing.

(3) Install two felt oilers (15) and new O-ring (16) onto piston (14).

(4) Install spring (13), and piston (14) onto push rod (9).

(5) Secure piston (14) in place using O-ring (8), washer (7) and nut (6). Torque to 20-26 foot-pounds (27-35 N·m).

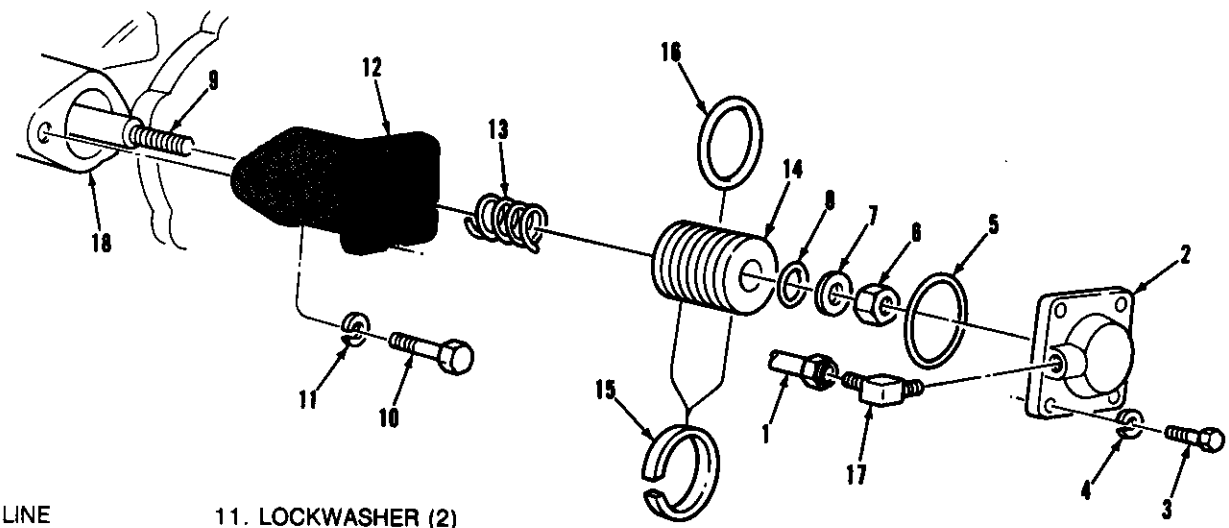
(6) Install new O-ring (5) into lockout cover (2).

(7) Install lockout cover (2) onto lockout chamber body (12).

(8) Install four new lockwashers (4) and capscrews (3). Torque to 96-108 inch-pounds (11-12 N·m).

(9) Coat threads in lockout cover (2) with pipe sealant.

(10) Install air fitting (17) and air line (1).



1. AIR LINE
2. LOCKOUT COVER
3. CAPSCREW (4)
4. LOCKWASHER (4)
5. O-RING
6. NUT
7. WASHER
8. O-RING
9. PUSH ROD
10. CAPSCREW (2)
11. LOCKWASHER (2)
12. LOCKOUT BODY
13. SPRING
14. PISTON
15. FELT OILER (2)
16. O-RING
17. AIR FITTING
18. MOUNTING SURFACE

TA 298917

END OF TASK

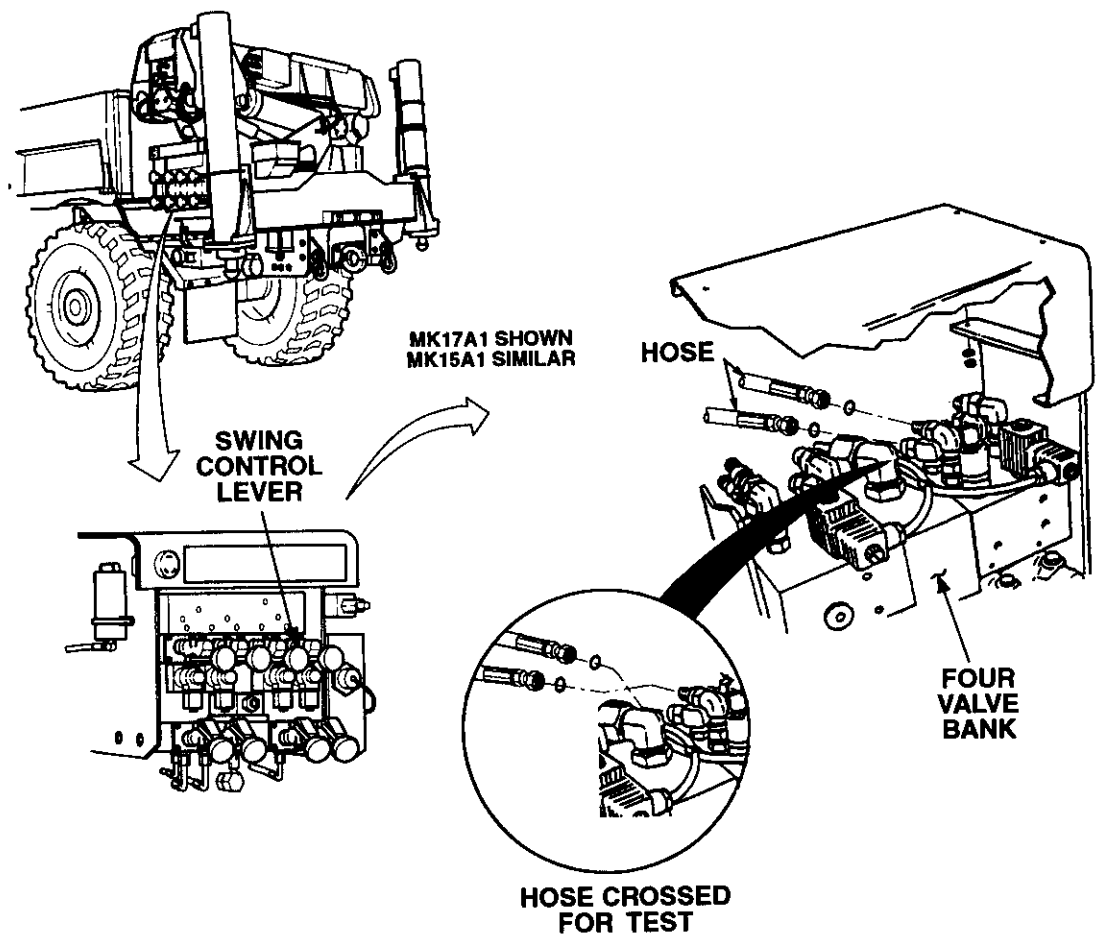
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 1. Remove and cross two outlet hoses at swing valve. Start engine and allow to run at idle speed. Operate swing control lever to swing counter clockwise.

- If crane swings clockwise, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.
- If crane does not swing clockwise, go to Test 2.



SECTION II. GENERAL FRONT AXLE MAINTENANCE

9-3. LOCKOUT CHAMBER MAINTENANCE

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Materials/Parts

Adhesive, silicone sealant (item 7, Appendix C)
Lubricant, silicone (item 35, Appendix C)
Oil lubricant, engine (item 46, Appendix C)
Pipe sealant (item 60, Appendix C)
Lockwasher (4) (MS35338-44) item 4
O-ring (NSN 5330-01-058-3785) item 5
O-ring (NSN 5330-01-130-4785) item 8
Lockwasher (2) (MS35338-47) item 11
O-ring (NSN 5330-01-136-7330) item 16

General Safety Instructions

To prevent personal injury, drain all pressure from the air system.

---

a. Disassembly

NOTE

If lockout chamber body is being replaced on No. 1 axle, the nose box must be removed. Refer to paragraph 9-15 of this manual.

(1) Remove air line (1) from lockout cover (2).

(2) Remove four capscrews (3), lockwashers (4), and lockout cover (2). Discard lockwashers (4).

(3) Remove and discard O-ring (5).

CAUTION

Piston is under slight spring pressure. When removing nut be careful not to lose any parts.

(4) Remove nut (6), washer (7), and O-ring (8) from push rod (9). Discard O-ring (8).

(5) Remove two capscrews (10), lockwashers (11), and lockout chamber body (12). Discard lockwashers (11).

(6) Remove spring (13), and piston (14).

(7) Remove two felt oilers (15) and O-ring (16) from piston (14). Discard O-ring (16).

(8) Remove air fitting (17) from lockout cover (2).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Clean gasket material from mounting surface of power divider cover (18).

(3) Inspect all parts. Refer to paragraph 2-7.

MALFUNCTION

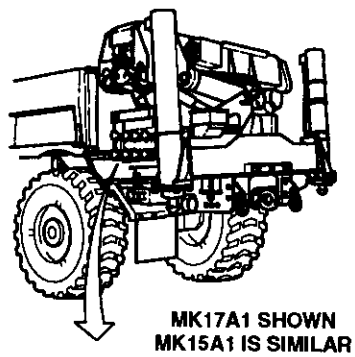
TEST OR INSPECTION

CORRECTIVE ACTION

CRANE DOES NOT SWING CLOCKWISE. (Continued)

Test 2. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at pressure test port on valve bank. Start engine and allow to run at idle speed. Operate control lever to swing clockwise. Check for 1,400-1,600 psi (9,653-11,032 kPa).

- If pressure is within spectifications, go to Test 3.
- If pressure is not within specifications, repair or replace cross relief valve. Refer to paragraph 18.1-41 or 18.1-42.



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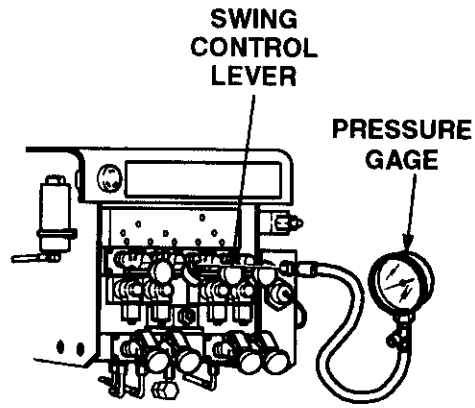
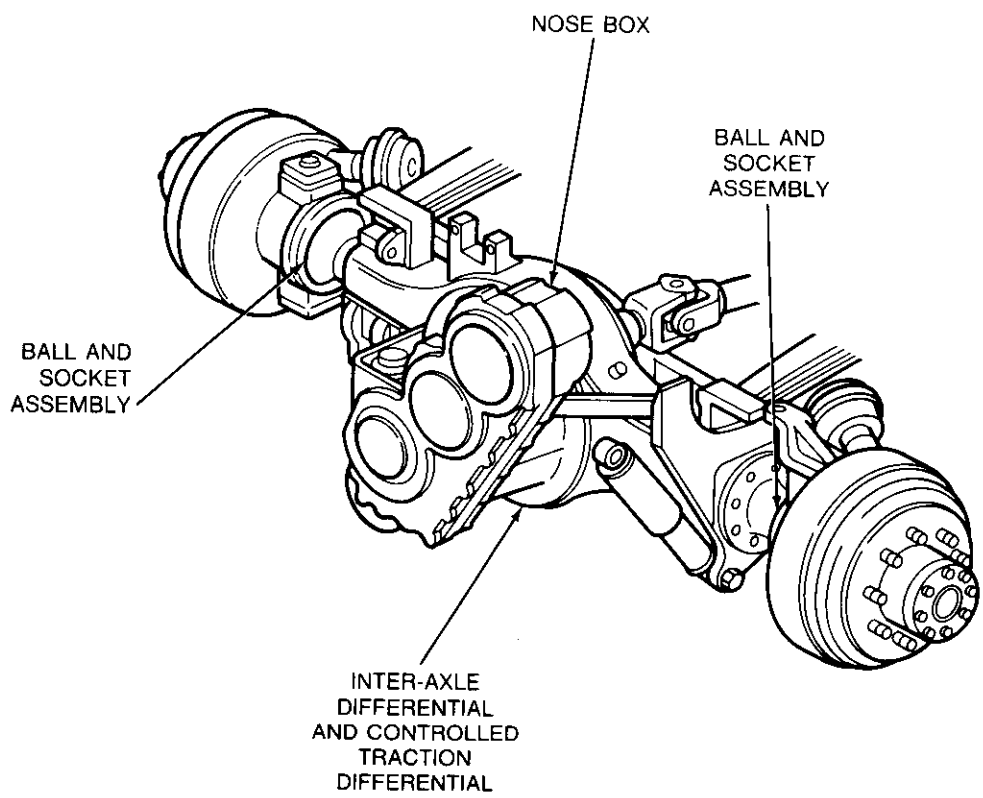



NOSE BOX
BALL AND SOCKET ASSEMBLY
BALL AND SOCKET ASSEMBLY
INTER-AXLE DIFFERENTIAL AND CONTROLLED TRACTION DIFFERENTIAL

TA 298916

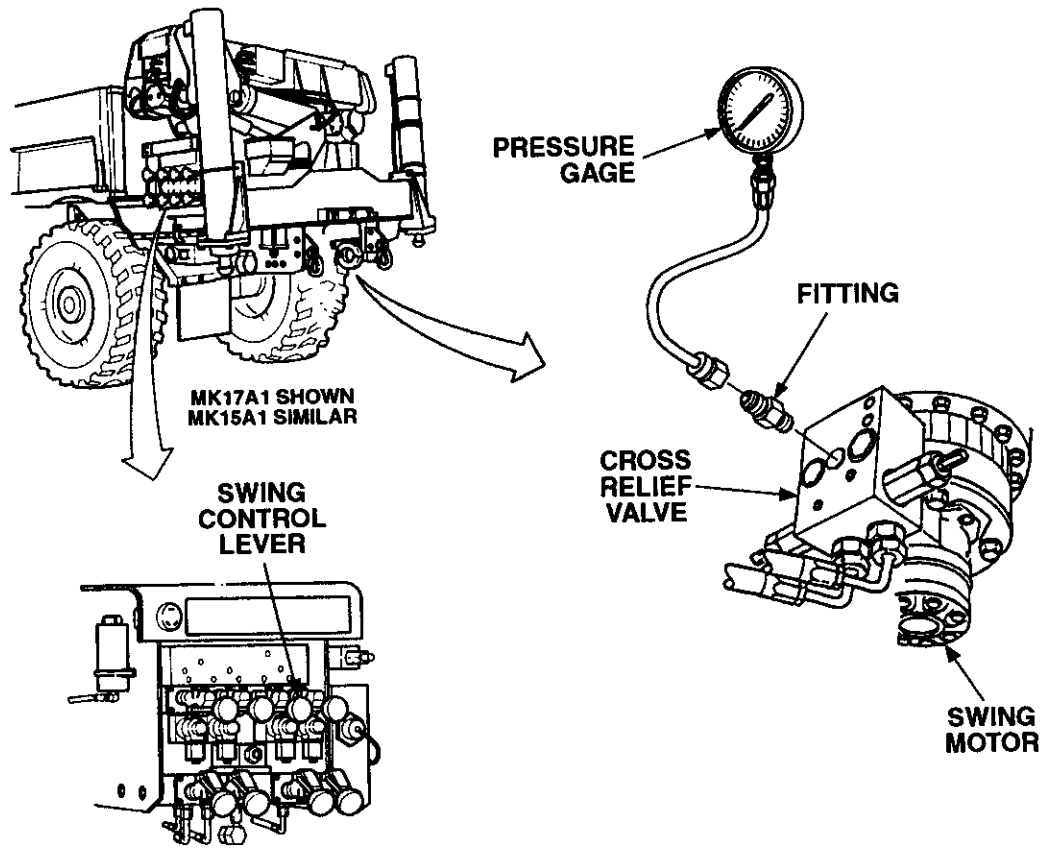
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 3. Remove line and fitting from brake release port on cross relief valve. Install test fitting and a 0-5,000 psi (0-34,475 kPa) pressure gage. Start engine and allow to run at idle. Have assistant operate control lever to swing clockwise. Check for a minimum of 1,300 psi (8,963 kPa).

- If pressure is not within specifications, repair or replace cross relief valve. Refer to paragraph 18.1-41 or 18.1-42.



9-2. DESCRIPTION AND DATA (Continued)

a. Nose Box The nose box receives power from the transfer case through a propeller shaft and an input flange. The flange is splined to the top gear inside the nose box. The top gear engages the center gear. The center gear drives the lubrication pump for the axle assembly and also engages the bottom gear. The bottom gear is splined to the input shaft of the inter-axle differential. The nose box lubricant is isolated from the axle lubricant by two oil seals at the input shaft.

c. Lubrication Pump The pump, which is driven by the center gear on the nose box, receives lubricant from the bottom of the axle housing cover and returns it to the top of the carrier cover. It is mounted on the rear of the nose box housing below the input flange.

d. Inter-Axle Differential The inter-axle differential is controlled by the driver with a switch located in the cab. When unlocked, it allows the No. 1 and No. 2 axles to turn at different speeds. When locked, it makes both axles turn at the same speed.

e. Controlled Traction Differential (CTD) When unlocked, the CTD allows the wheels to turn at different speeds. When locked, it causes the wheels to turn at the same speed until 4,000 foot-pounds (5424 N·m) of difference in torque between wheels is reached. At this point it directs power to the wheel with the most traction. The CTD is controlled by the same switch that controls the inter-axle differential.

f. Ball and Socket Assembly The ball and socket assemblies allow the front axle to turn either left or right without loss of power to the wheels. This is done through an axle shaft containing a universal joint which allows up to a 15 degree deflection angle without binding.

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

8. CRANE DOES NOT SWING COUNTER CLOCKWISE.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.

CHAPTER 9

FRONT AXLE

9-1. OVERVIEW

This chapter provides information authorized for Third and Fourth Echelon Maintenance level mechanics. General maintenance, replacement, repair, disassembly, and inspection procedures for the vehicle's front axle are covered in the following sections:

Section I. Description and Data

Section II. General Front Axle Maintenance

Section III. Front Axle Replacement Instructions

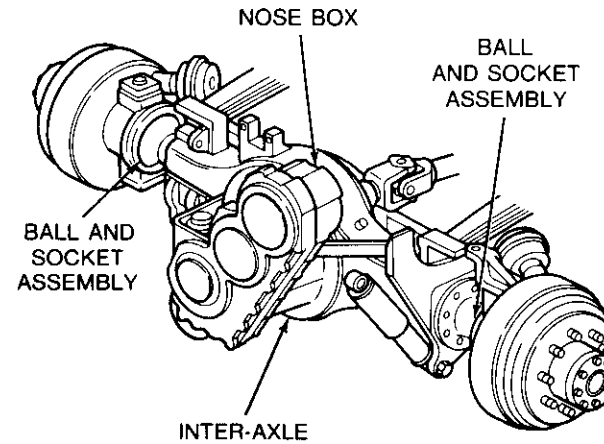
Section IV. Front Axle Disassembly into Subassemblies and Reassembly from Subassemblies

Section V. Front Axle Subassembly, Cleaning, Inspection, and Repair

SECTION I. DESCRIPTION AND DATA

9-2. DESCRIPTION AND DATA

a. General The front axle is a single reduction, steerable, 5.57:1 gear ratio assembly. It consists of a nose box, an inter-axle differential, a controlled traction differential, and two ball and socket assemblies. Power is received from the transfer case through the nose box and inter-axle differential. Power is then sent to the No. 1 axle controlled traction differential and the No. 2 axle controlled traction differential. The driver controls these differentials by a switch in the cab. In the front axle the power is sent from the controlled traction differential to the ball and socket assemblies, allowing steering and power to the front wheels at the same time.



TA 298915

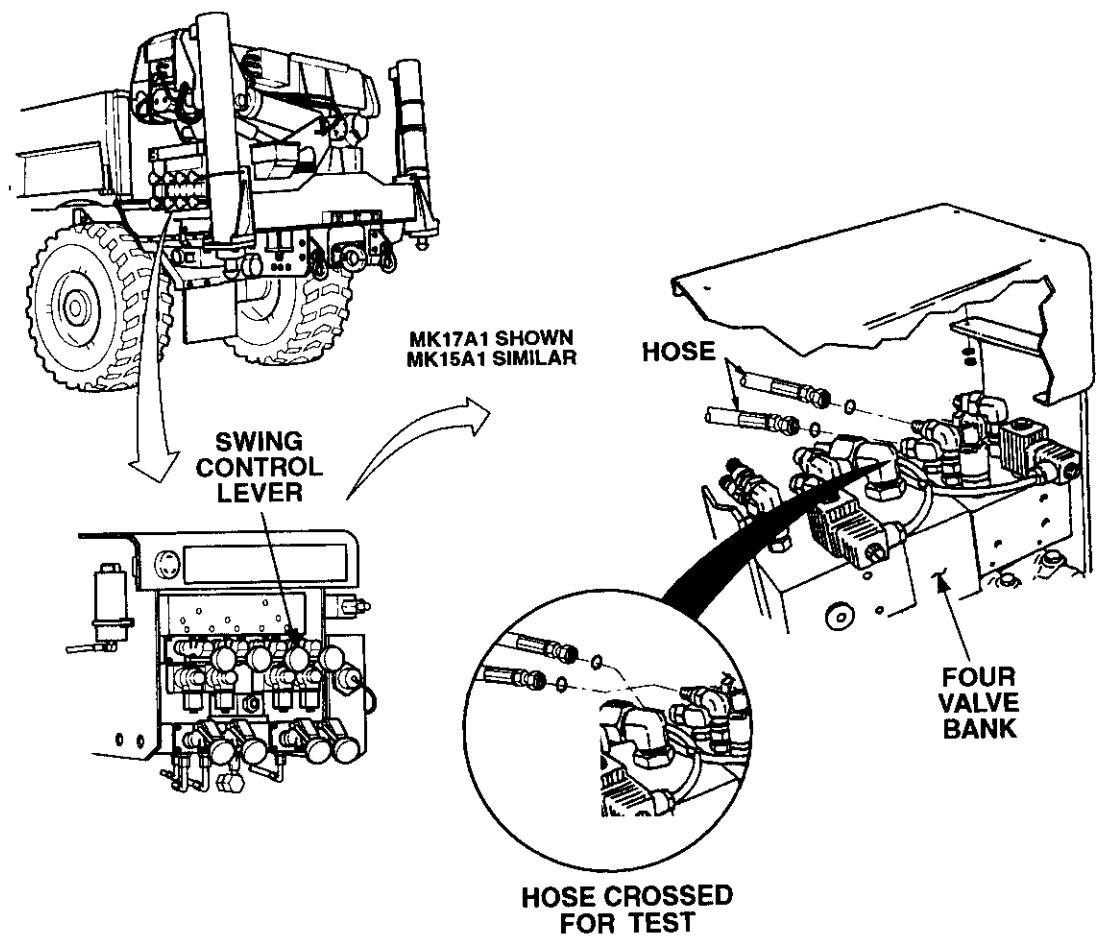
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 1. Remove and cross two outlet hoses at swing valve. Start engine and allow to run at idle speed. Operate control lever to swing clockwise.

- If crane swings counter clockwise, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.
- If crane does not swing counter clockwise, go to Test 2.



MALFUNCTION

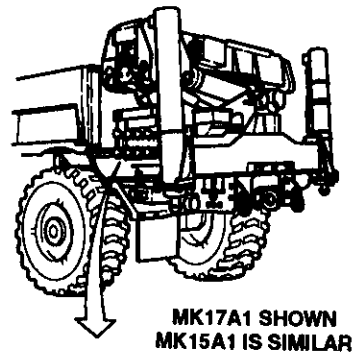
TEST OR INSPECTION

CORRECTIVE ACTION

CRANE DOES NOT SWING COUNTER CLOCKWISE. (Continued)

Test 2. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at pressure test port on valve bank. Start engine and allow to run at idle speed. Operate control lever to swing counter clockwise. Check for 1,400-1,600 psi (9,653-11,032 kPa).

- If pressure is within spectifications, go to Test 3.
- If pressure is not within specifications, repair or replace cross relief valve. Refer to paragraph 18.1-41 or 18.1-42.



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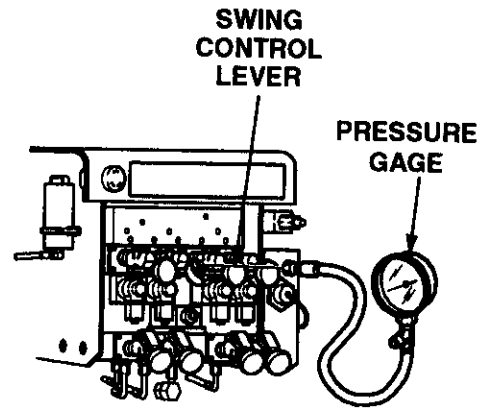
MK15A1 IS SIMILAR



NOTE

- Make sure unsplined side of gear (8) is toward spacer (9).
- Beveled edge of spacer (7) must face towards gear (8).

(3) Install gear (8), spacer (7), and bearing cone (6) onto input shaft (4).

(4) Install new piston ring (5) onto retainer plate (3).

(5) Install retainer plate (3) onto input shaft (4).

(6) Coat threads of three capscrews (2) with adhesive. Install three capscrews (2) into input shaft (4) and torque to 107 foot-pounds (145 N·m).

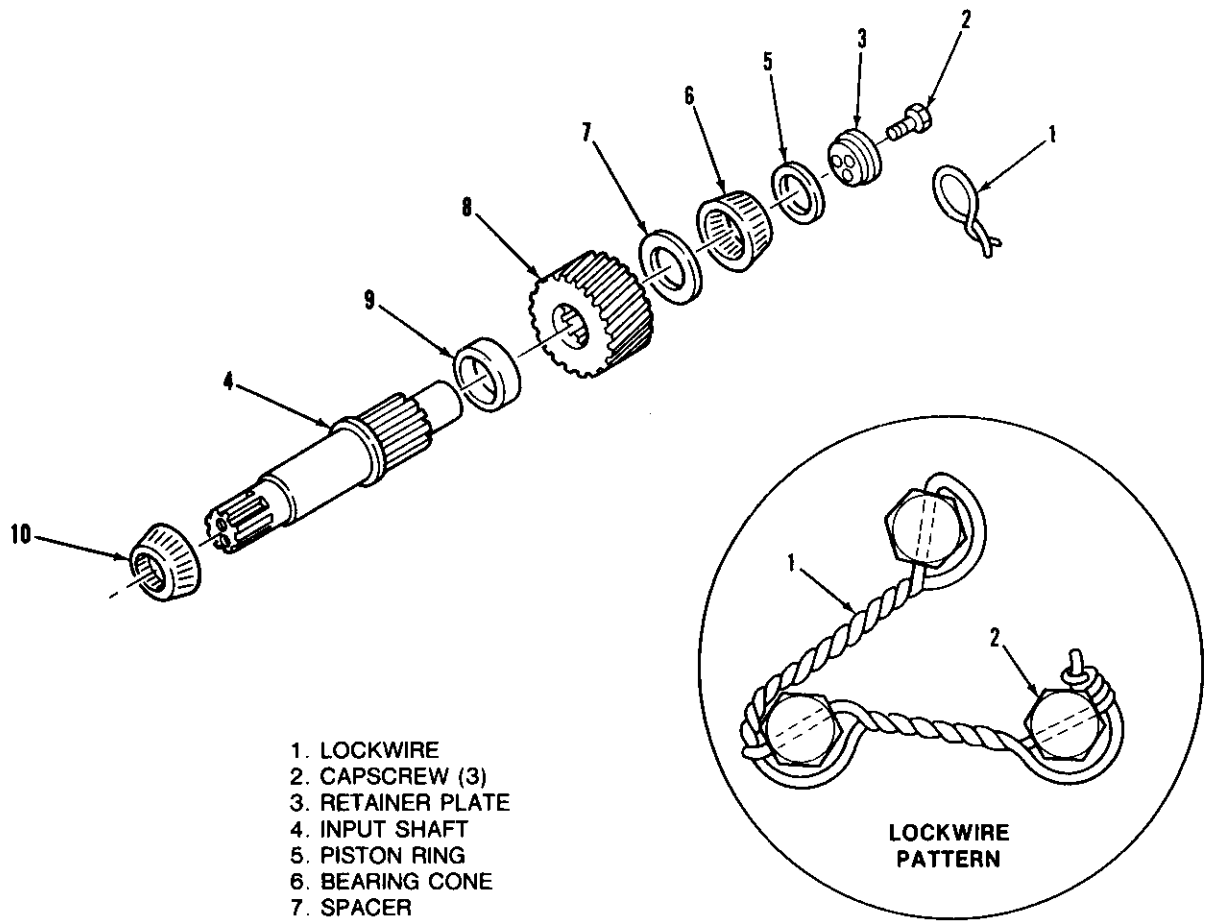
(7) Install new lockwire (1) into three capscrews (2) in pattern shown.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13
TM 9-2320-297-34 Install input shaft (para 8-9).



1. LOCKWIRE
2. CAPSCREW (3)
3. RETAINER PLATE
4. INPUT SHAFT
5. PISTON RING
6. BEARING CONE
7. SPACER
8. GEAR
9. SPACER
10. BEARING CONE

TA 298914

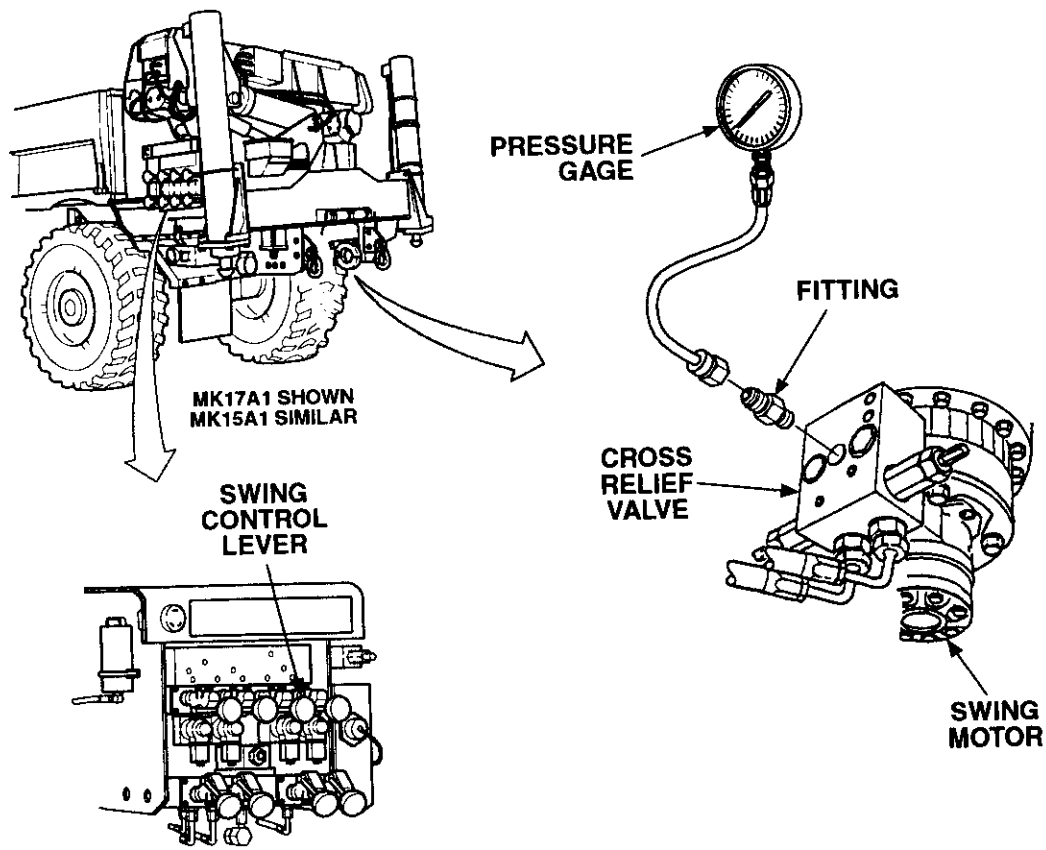
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 3. Remove line and fitting from brake release port on cross relief valve. Install test fitting and a 0-5,000 psi (0-34,475 kPa) pressure gage. Start engine and allow to run at idle. Have assistant operate control lever to swing counter clockwise. Check for a minimum of 1,300 psi (8,963 kPa) brake release pressure.

- If pressure is not within specifications, repair or replace cross relief valve. Refer to paragraph 18.1-41 or 18.1-42.



8-14. INPUT SHAFT REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Adhesive (item 3, Appendix C)
Lockwire (item 33, Appendix C)
Lubricant (item 46, Appendix C)
Piston ring (P/N T561-0329-001-7512) item 5

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Input shaft removed (para 8-8).

---

a. Disassembly

(1) Remove lockwire (1), three capscrews (2), and retainer plate (3) from input shaft (4). Discard lockwire (1).

(2) Remove piston ring (5) from retainer plate (3). Discard piston ring (5).

(3) Remove bearing cone (6), spacer (7) and gear (8).

CAUTION

When using chisel on spacer (9) care must be taken not to damage input shaft (4).

(4) If damaged, split spacer (9) with a chisel and remove.

(5) Remove bearing cone (10).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect threaded parts for damage.

(3) Inspect bearing cones (6 and 10) for damage.

(4) Inspect gear (8) and input shaft (4) for damage.

(5) Replace all parts failing inspection.

c. Assembly

NOTE

- If bearing cones (6 and 10) are replaced, bearing cups must be replaced. Refer to paragraph 8-9.
- Coat bearings with lubricant during assembly.

(1) Install bearing cone (10) onto input shaft (4).

(2) If removed, press new spacer (9) onto input shaft (4).

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

9. BOOM DOES NOT TELESCOPE OUT OR IN.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.
- If boom does not telescope in, go to Test 2.

(4) Install clutch (9), spacer (8), and bearing (7).

(5) Install spacer (6), bearing (5), and gear (4).

(6) Install temporary spacer (2).

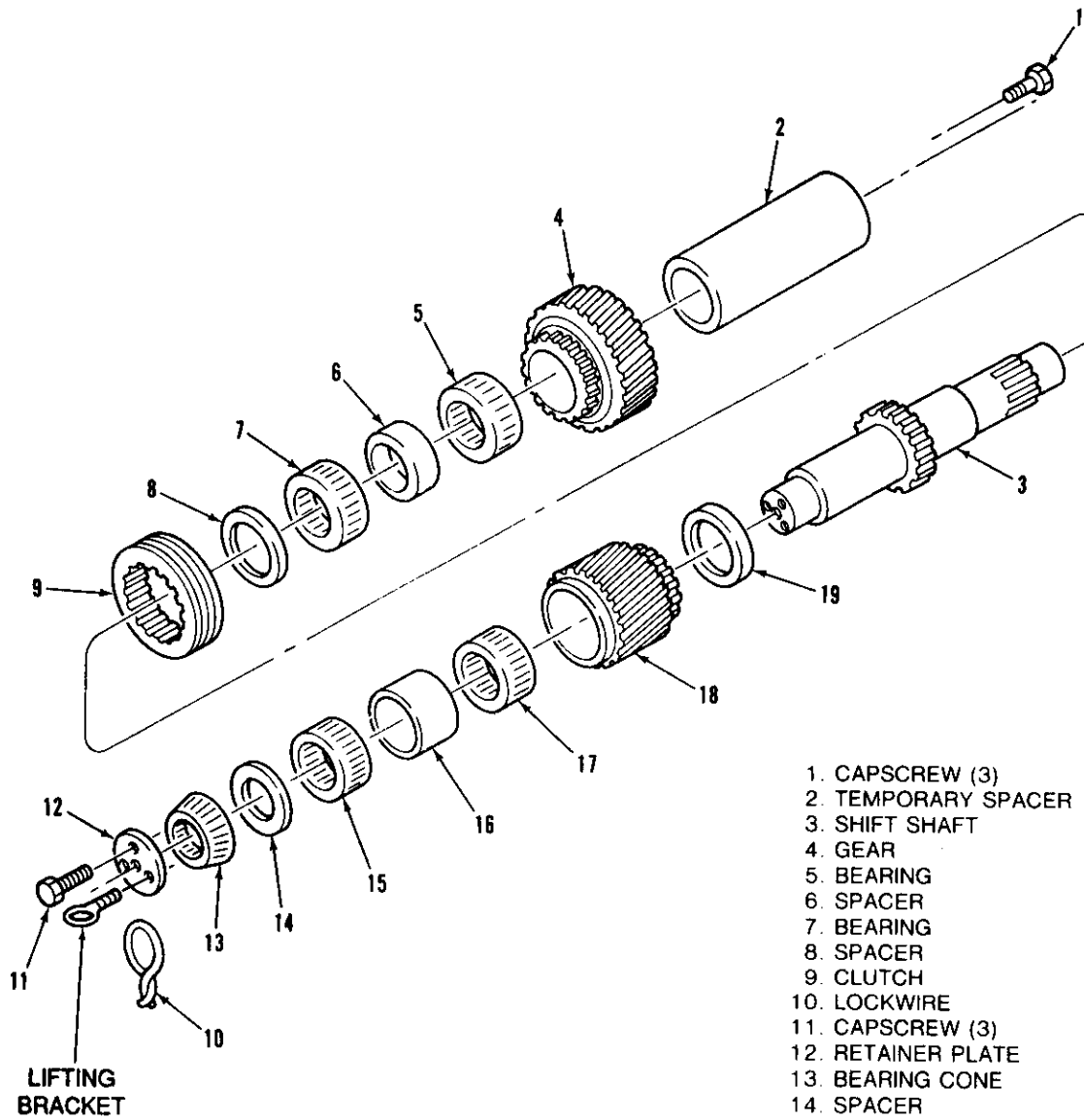
(7) Install three capscrews (1). Tighten capscrews (1) securely.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 Install shaft (para 8-9).
TM 9-2320-297-34



1. CAPSCREW (3)
2. TEMPORARY SPACER
3. SHIFT SHAFT
4. GEAR
5. BEARING
6. SPACER
7. BEARING
8. SPACER
9. CLUTCH
10. LOCKWIRE
11. CAPSCREW (3)
12. RETAINER PLATE
13. BEARING CONE
14. SPACER
15. BEARING
16. SPACER
17. BEARING
18. GEAR
19. SPACER

TA 298913

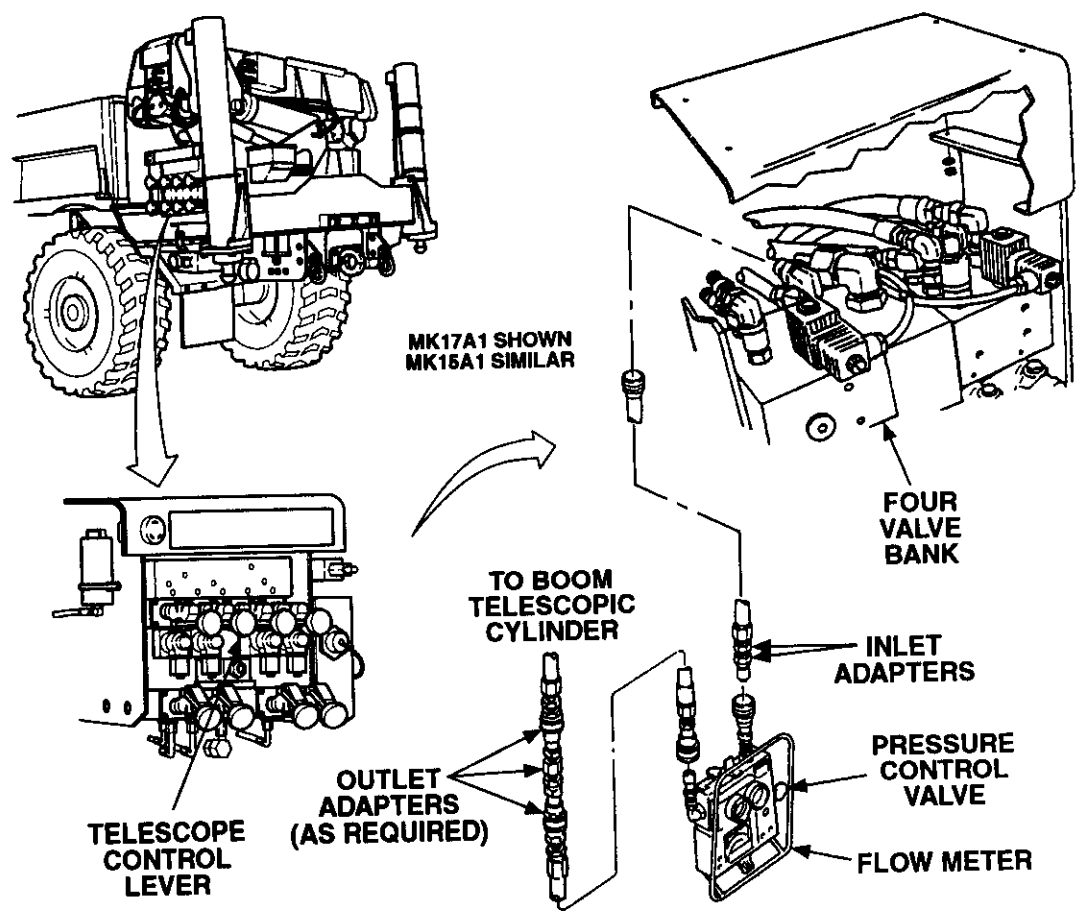
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 1. Remove the line that comes from the telescopic cylinder extend fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully extend boom. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair or replace boom telescopic cylinder. Refer to paragraph 18.1-17 or 18.1-38.
- If pressure is not within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.



8-13. 2-SPEED SHIFT SHAFT REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Lubricant (item 46, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Shaft removed (para 8-8).

a. Disassembly

(1) Remove three capscrews (1) and temporary spacer (2) from shift shaft (3).

(2) Remove gear (4), bearing (5), and spacer (6).

(3) Remove bearing (7), spacer (8), and clutch (9).

NOTE

One capscrew (11) has already been removed to allow lifting bracket to be installed.

(4) Remove lockwire (10), two capscrews (11), lifting bracket and retainer plate (12). Discard lockwire (10).

(5) Remove bearing cone (13), spacer (14), and bearing (15).

(6) Remove spacer (16), bearing (17), gear (18), and spacer (19).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect gears for damage.

(3) Inspect threaded parts for damage.

(4) Inspect bearings for damage.

(5) Replace all parts failing inspection.

c. Assembly

NOTE

- Temporary spacer (2) has replaced parts removed during disassembly. These parts were inspected during disassembly and if replacement is needed, it will be done during transfer case assembly.
- Coat all bearings with lubricant during assembly.

(1) Install spacer (19), gear (18), bearing (17), and spacer (16) onto shift shaft (3).

NOTE

If bearing cones are replaced, bearing cups must be replaced. Refer to paragraph 8-9.

(2) Install bearing (15), spacer (14), and bearing cone (13).

(3) Install retainer plate (12), lifting bracket and two capscrews (11), finger tight.

MALFUNCTION

TEST OR INSPECTION

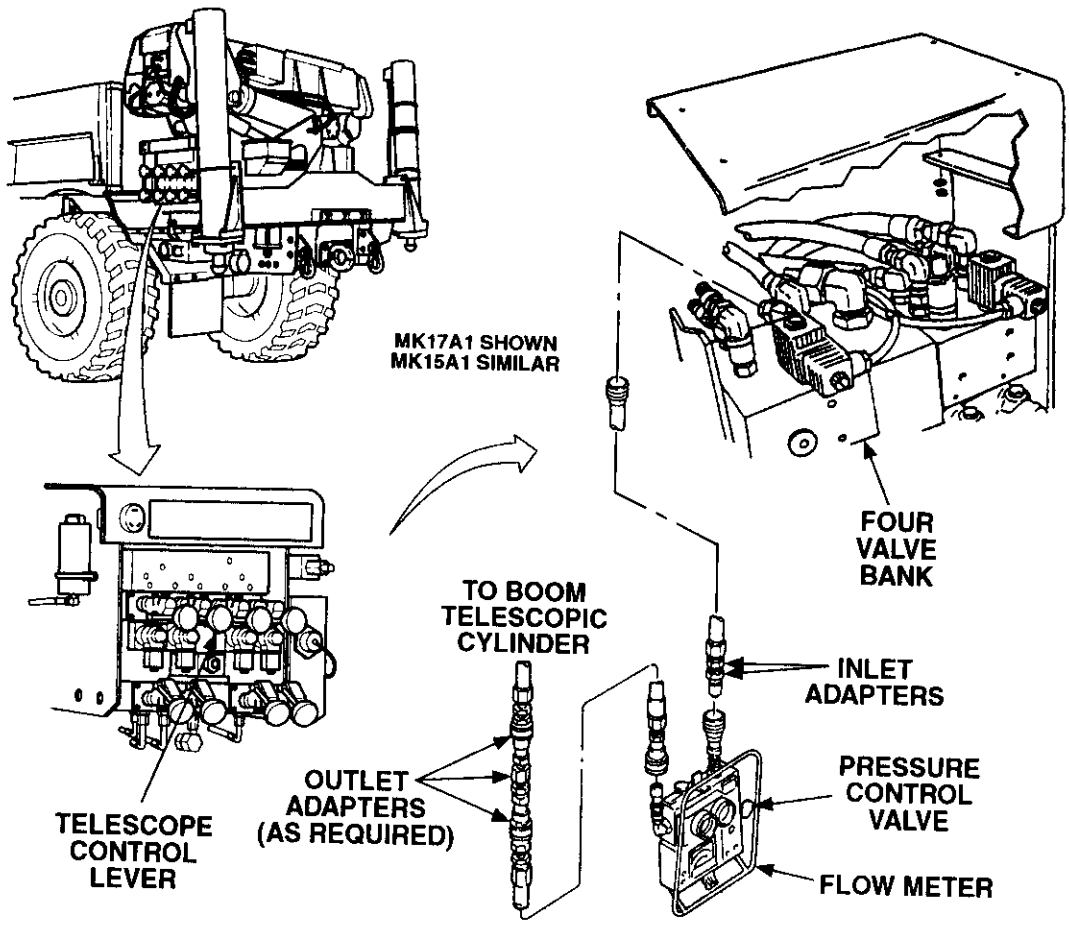
CORRECTIVE ACTION

BOOM DOES NOT TELESCOPE OUT OR IN. (Continued)

Test 2. Remove the line that comes from the telescopic cylinder retract fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully retract boom. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair or replace boom telescopic cylinder. Refer to paragraph 18.1-17 or 18.1-38.
- If pressure is not within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.

END OF TEST



(5) Install 12 capscrews (5) and nuts (4).

(6) Install bearing (3).

(7) Place differential assembly (14) on wooden blocks to support it.

(8) Place a pipe (15) through the differential assembly (14) to hold it down.

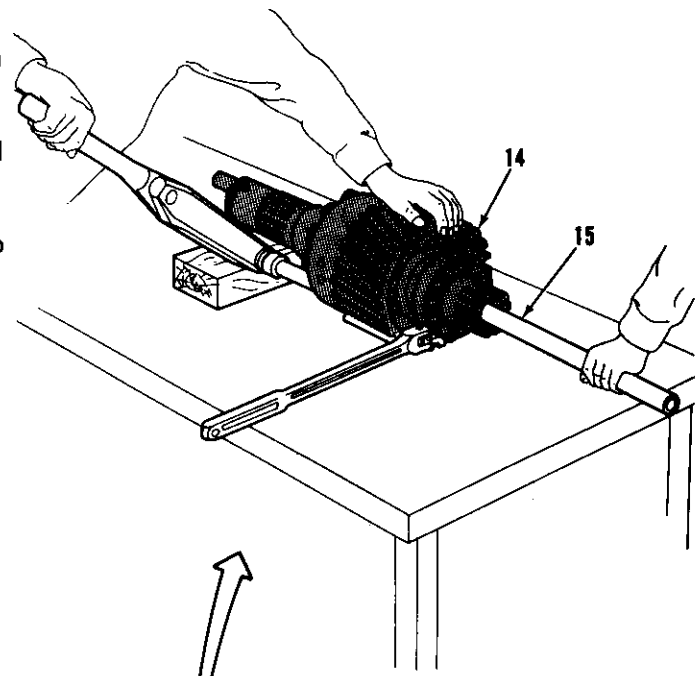
(9) Hold capscrews (5) and torque nuts (4) to 210 foot-pounds (285 N·m).

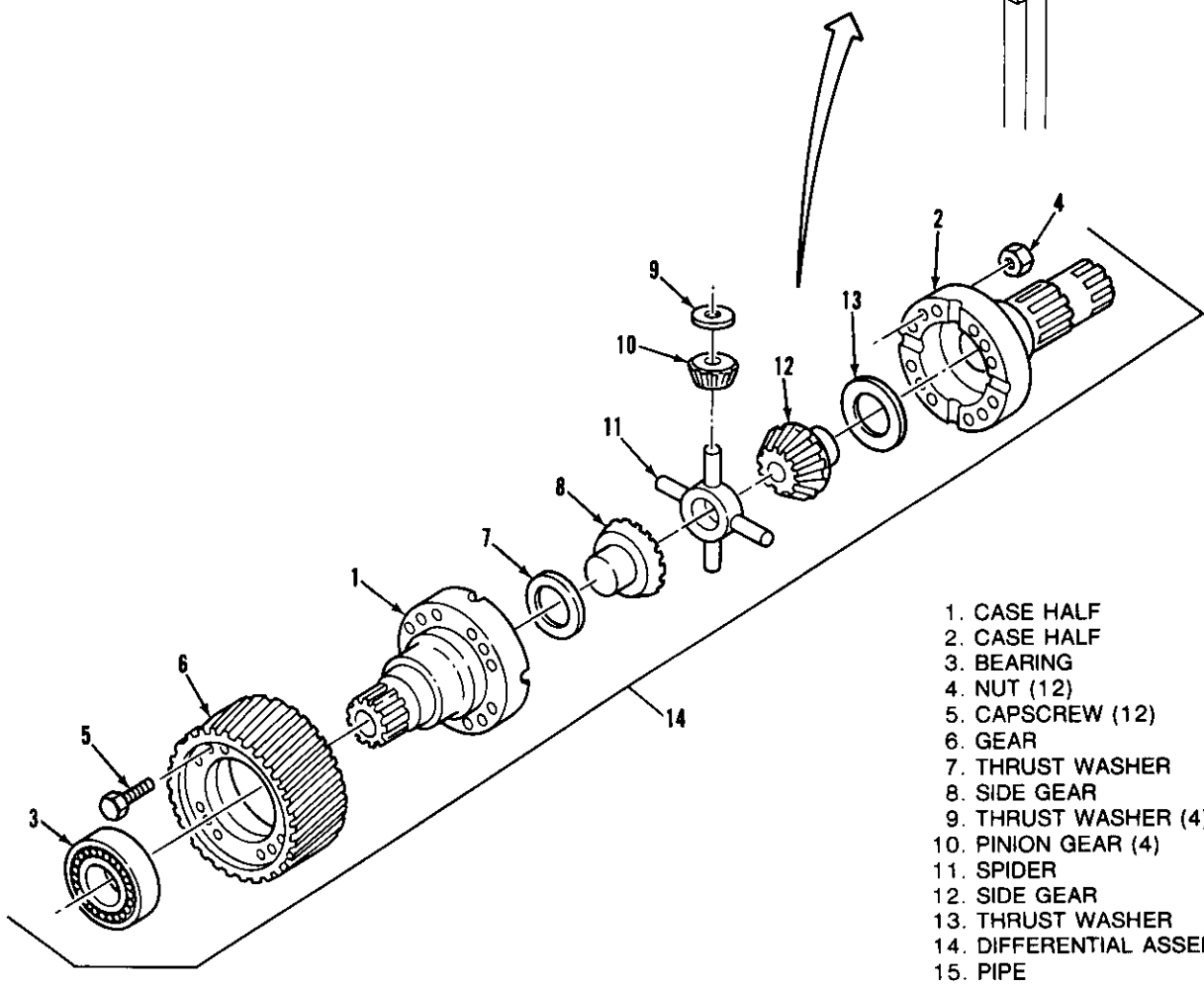
END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13	Install differential
TM 9-2320-297-34	assembly (para 8-9).





1. CASE HALF
2. CASE HALF
3. BEARING
4. NUT (12)
5. CAPSCREW (12)
6. GEAR
7. THRUST WASHER
8. SIDE GEAR
9. THRUST WASHER (4)
10. PINION GEAR (4)
11. SPIDER
12. SIDE GEAR
13. THRUST WASHER
14. DIFFERENTIAL ASSEMBLY
15. PIPE

TA 298912

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

10. BOOM DOES NOT RAISE OR LOWER.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.
- If a boom lift cylinder must be isolated, connect flow meter at cylinder and disconnect line between cylinders.
- If boom does not lower, go to Test 2.

8-12. DIFFERENTIAL ASSEMBLY REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Lubricant (item 46, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Differential assembly removed (para 8-8).

---

a. Disassembly

(1) Mark case halves (1 and 2) for location during assembly.

(2) Remove bearing (3) from case half (1).

(3) Remove 12 nuts (4) and capscrews (5).

(4) Remove gear (6) and separate case halves (1 and 2).

(5) Remove thrust washer (7) and side gear (8).

(6) Remove four thrust washers (9), four pinion gears (10), and spider (11).

(7) Remove side gear (12) and thrust washer (13).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect gears for damage.

(3) Inspect case halves for damage.

(4) Inspect threaded parts for damage.

(5) Inspect spider and thrust washers for damage.

(6) Replace all parts failing inspection.

c. Assembly

NOTE

Coat bearing, side gears, pinion gears, and thrust washers with lubricant during assembly.

(1) Position case half (2) with large end up. Install thrust washer (13) and side gear (12).

(2) Install four pinion gears (10) and thrust washers (9) onto spider (11). Install spider (11) onto side gear (12).

(3) Install side gear (8) and thrust washer (7) onto pinion gears (10).

(4) Install case half (1) and gear (6). Aline matchmarks made during disassembly.

MALFUNCTION

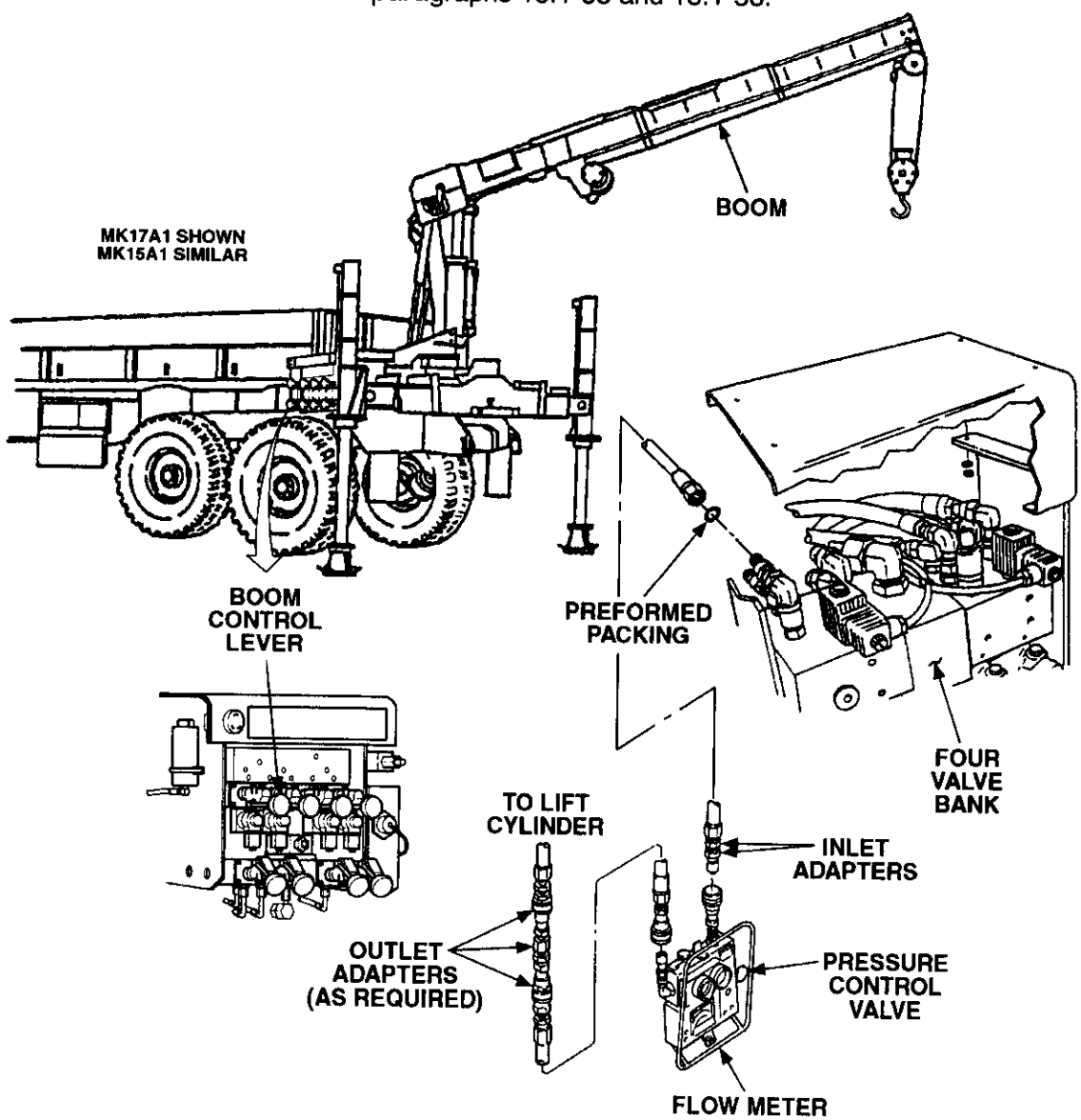
TEST OR INSPECTION

CORRECTIVE ACTION

BOOM DOES NOT RAISE OR LOWER. (Continued)

Test 1. Remove the line that comes from the boom cylinder up fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully raise boom. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair or replace boom lift cylinder. Refer to paragraph 18.1-20 or 18.1-36.
- If pressure is not within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.



(4) Coat threads of two capscrews (5) with adhesive and install into idler shaft (7). Torque to 107 foot-pounds (145 N·m).

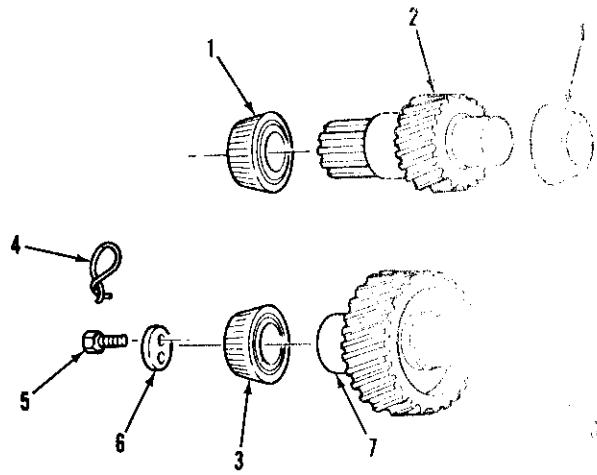
(5) Install new lockwire (4) through heads of capscrews (5) in pattern shown.

END OF TASK

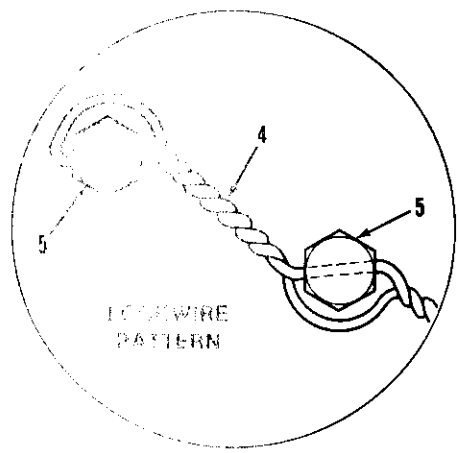
NOTE

Follow-On Maintenance

TM [illegible] Install rear output
TM [illegible] and idler shafts (para 8-9).



1. BEARING CONE (2)
2. OUTPUT SHAFT
3. BEARING CONE (2)
4. LOCKWIRE
5. CAPSCREW (2)
6. RETAINER PLATE
7. IDLER SHAFT



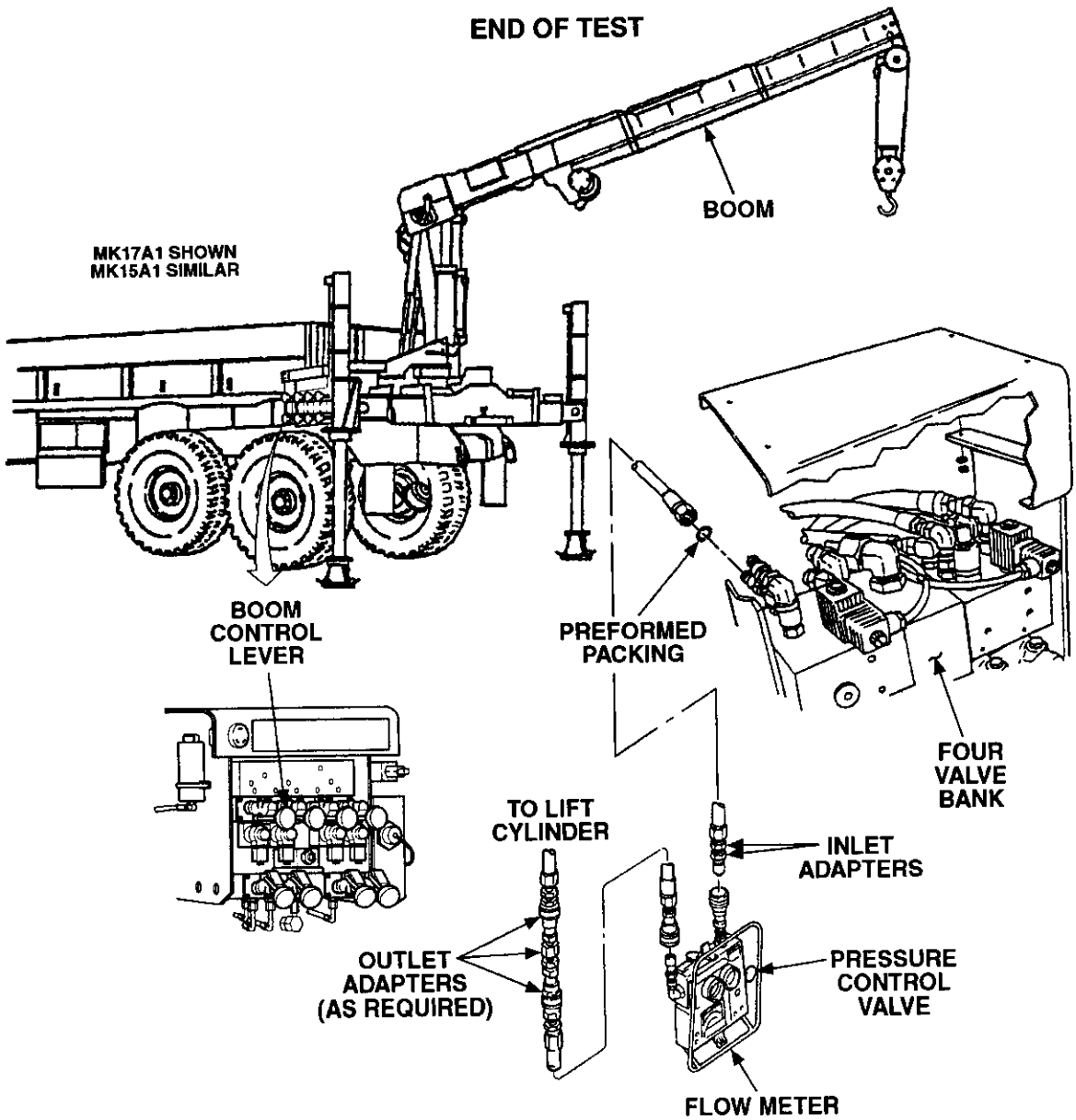
TA 298911

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

Test 2. Remove the line that comes from the boom cylinder lower fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully lower boom. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, repair or replace boom lift cylinder. Refer to paragraph 18.1-20 or 18.1-36.
- If pressure is not within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.

END OF TEST



8-11. REAR OUTPUT AND IDLER SHAFT REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Adhesive (item 3, Appendix C)
Lockwire (item 33, Appendix C)
Lubricant (item 46, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Rear output and idler shafts removed (para 8-8).

---

a. Disassembly

(1) If damaged, remove two bearing cones (1) from output shaft (2).

(2) If bearing cones (3) are damaged, remove lockwire (4), two capscrews (5), retainer plate (6), and two bearing cones (3) from idler shaft (7). Discard lockwire (4).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect shafts (2 and 7) for damage.

(3) Inspect bearings for damage.

(4) Inspect threaded parts for damage.

(5) Replace all parts failing inspection.

c. Assembly

NOTE

- Coat bearings with lubricant during assembly.
- If bearing cones (1 and 3) are replaced, bearing cups must be replaced. Refer to paragraph 8-9.

(1) Press two bearing cones (1) onto output shaft (2), tapered ends outward, until bearing cones (1) bottom out.

(2) Press two bearing cones (3) onto idler shaft (7), tapered ends outward, until flush with end of idler shaft (7).

(3) Install retainer plate (6) onto idler shaft (7).

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

11. BOOM CREEPS DOWN.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.

(19) Coat splines of output flange (1) with adhesive sealant and install onto front output shaft (10).

(20) Coat end of front output shaft (10) with adhesive sealant and install retainer plate (3).

(21) Install flange holding bar onto output flange (1).

(22) Coat threads of two capscrews (2) with adhesive and install. Torque to 107 foot-pounds (145 N·m).

(23) If removed, apply adhesive sealant to threads of lubrication fitting (29), install and lubricate.

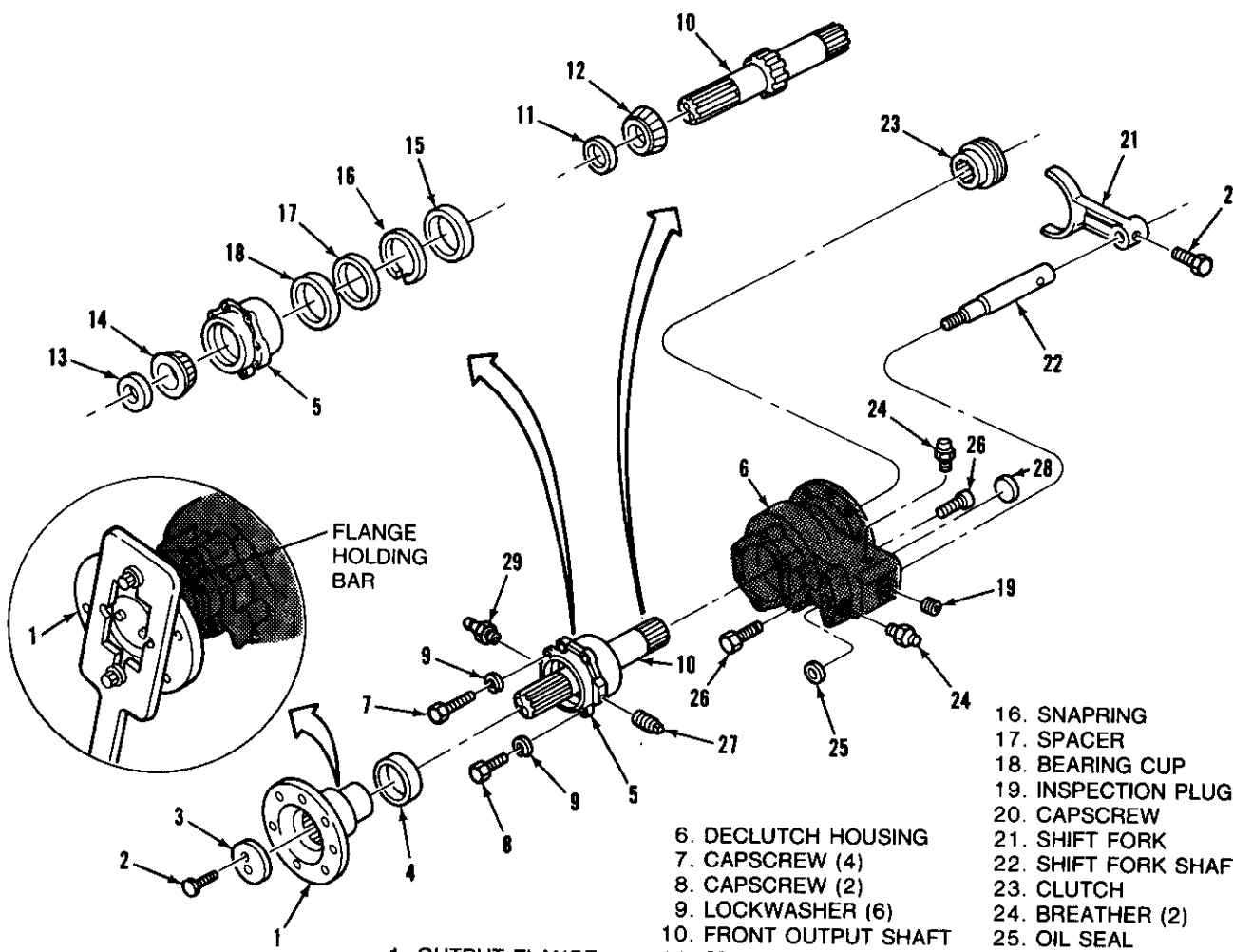
(24) Remove flange holding bar.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13
TM 9-2320-297-34 — Install declutch assembly (para 8-9).



1. OUTPUT FLANGE
2. CAPSCREW (2)
3. RETAINER PLATE
4. SPACER
5. BEARING CAP
6. DECLUTCH HOUSING
7. CAPSCREW (4)
8. CAPSCREW (2)
9. LOCKWASHER (6)
10. FRONT OUTPUT SHAFT
11. SPACER
12. BEARING CONE
13. OIL SEAL
14. BEARING CONE
15. BEARING CUP
16. SNAPRING
17. SPACER
18. BEARING CUP
19. INSPECTION PLUG
20. CAPSCREW
21. SHIFT FORK
22. SHIFT FORK SHAFT
23. CLUTCH
24. BREATHER (2)
25. OIL SEAL
26. STOP SCREW (2)
27. PLUG
28. EXPANSION PLUG
29. LUBRICATION FITTING

TA 298910

MALFUNCTION

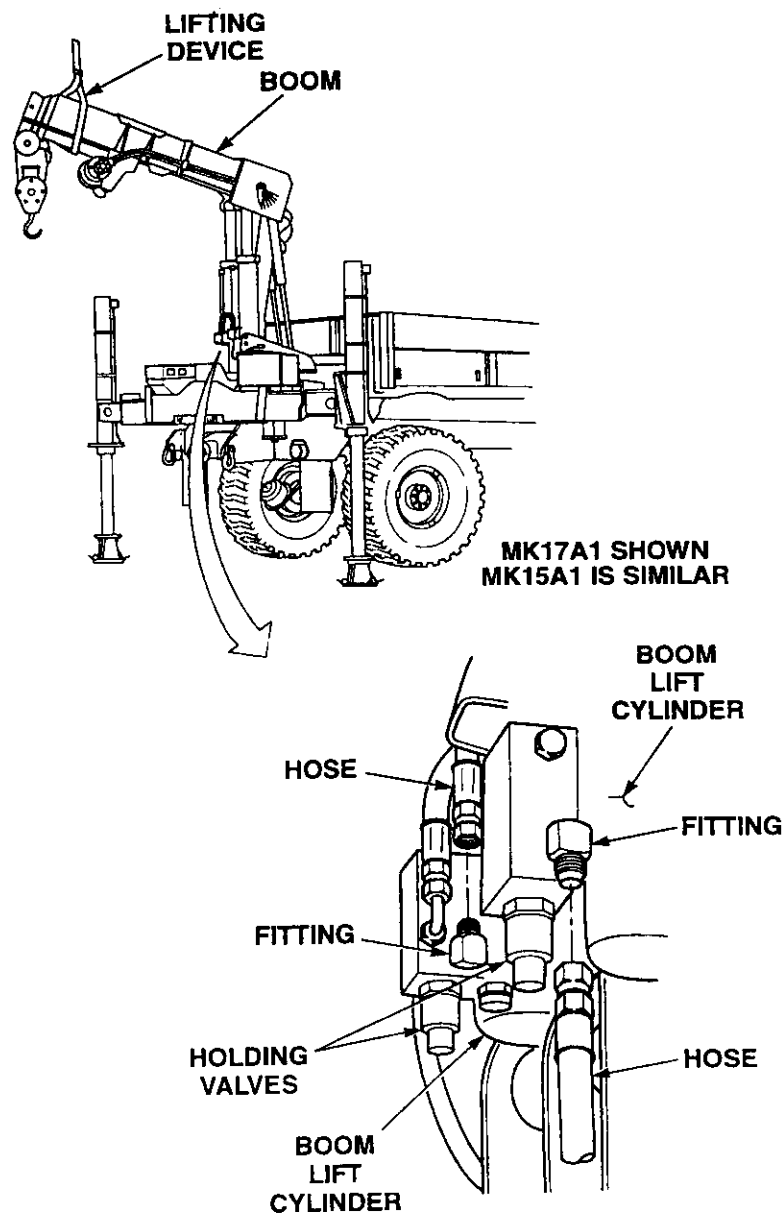
TEST OR INSPECTION

CORRECTIVE ACTION

Check for faulty boom lift cylinder or holding valve assembly. Attach lifting device to boom. Support boom with lifting device, stop engine and disconnect hose from fitting at bottom of each boom lift cylinder. Allow fluid in fitting to drain. Lower lifting device to exert pressure on lift cylinders. No drainage should be present at fitting.

- If drainage is present, replace holding valve assembly on cylinder. Refer to paragraph 18.1-58.
- If drainage is not present, repair or replace boom lift cylinder. Refer to paragraph 18.1-20 or 18.1-36.

END OF TEST



8-10. DECLUTCH HOUSING REPAIR (Continued)

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

CAUTION

Parts (11, 12, 14, 15, 16, 17, and 18) are a matched set. If any one part needs to be replaced, replace the entire set.

(2) Inspect bearing cones and cups for damage.

(3) Inspect front output shaft, shift fork, shift fork shaft, and clutch for damage.

(4) Inspect flange for damage.

(5) Inspect all threaded parts for damage.

(6) Inspect all other parts. Refer to paragraph 2-7 and replace all parts failing inspection.

c. Assembly

NOTE

Coat bearings with lubricant during assembly.

(1) If removed, apply silicone sealant to expansion plug (28) and install into declutch housing (6).

(2) If removed, coat threads of plug (27) with silicone sealant and install.

(3) If removed, install two stop screws (26).

(4) Install new oil seal (25).

(5) If removed, coat threads of two breathers (24) with adhesive sealant and install.

(6) Install shift fork (21) into declutch housing (6) with flat sides toward mounting surface.

(7) Install clutch (23) into shift fork (21) with rib side of shift fork (21) matching extended hub side of clutch (23).

(8) Install shift fork shaft (22) into declutch housing (6) and through shift fork (21).

(9) Install capscrew (20) into shift fork (21). Torque to 50 foot-pounds (67.1 N·m).

(10) Coat threads of inspection plug (19) with adhesive sealant and install.

(11) Install bearing cup (18), spacer (17), snapring (16), and bearing cup (15) into bearing cap (5).

(12) Press bearing cone (12) onto front output shaft (10).

(13) Install front output shaft (10) into bearing cap (5).

(14) Install spacer (11) and press bearing cone (14) onto front output shaft (10).

(15) Install new oil seal (13).

(16) Apply sealant to mating surface of bearing cap (5). Aline marks and install bearing cap (5) and front output shaft (10) into declutch housing (6) by tapping on bearing cap (5). Make sure splines of front output shaft (10) engage clutch (23).

(17) Apply lubricating and wicking sealer to threads and install six new lockwashers (9), four capscrews (7), and two capscrews (8). Torque to 28 foot-pounds (37.8 N·m).

(18) Install spacer (4) onto front output shaft (10).

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

11. HOIST DOES NOT RAISE OR LOWER.

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counter clockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached, causing excessive pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished either by operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating conditions. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Unless advised otherwise, the MAIN POWER and TILT ALARM switches must be in the ON position for all checks.
- If hoist will not lower, go to Test 2.

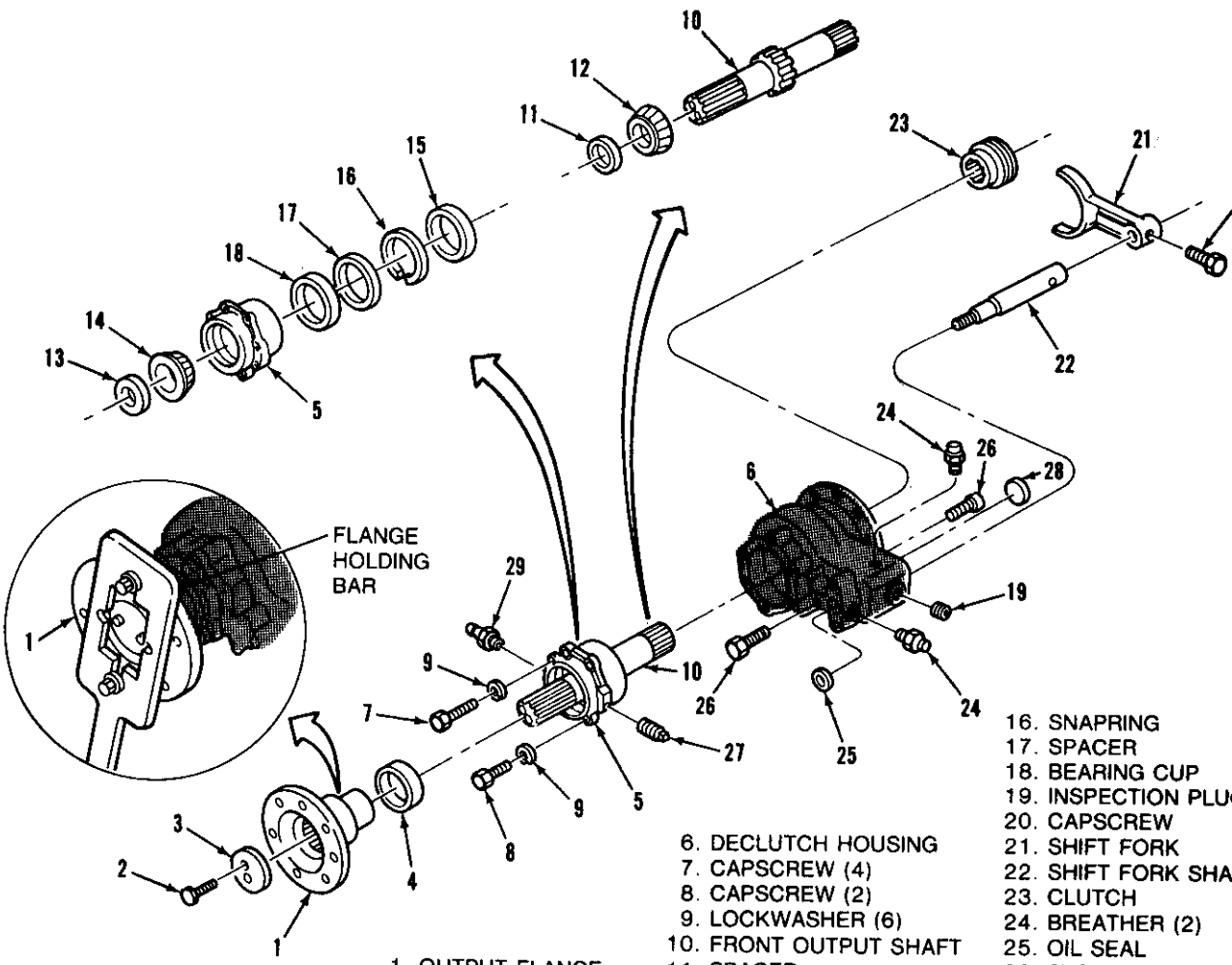
(17) Remove oil seal (25) and discard.

(18) If leaking, remove two stop screws (26).

(19) If damaged, remove plug (27).

(20) If leaking, remove expansion plug (28).

(21) If damaged, remove lubrication fitting (29



1. OUTPUT FLANGE
2. CAPSCREW (2)
3. RETAINER PLATE
4. SPACER
5. BEARING CAP
6. DECLUTCH HOUSING
7. CAPSCREW (4)
8. CAPSCREW (2)
9. LOCKWASHER (6)
10. FRONT OUTPUT SHAFT
11. SPACER
12. BEARING CONE
13. OIL SEAL
14. BEARING CONE
15. BEARING CUP
16. SNAPRING
17. SPACER
18. BEARING CUP
19. INSPECTION PLU
20. CAPSCREW
21. SHIFT FORK
22. SHIFT FORK SHA
23. CLUTCH
24. BREATHER (2)
25. OIL SEAL
26. STOP SCREW (2)
27. PLUG
28. EXPANSION PLUG
29. LUBRICATION FITTING

TA 2989

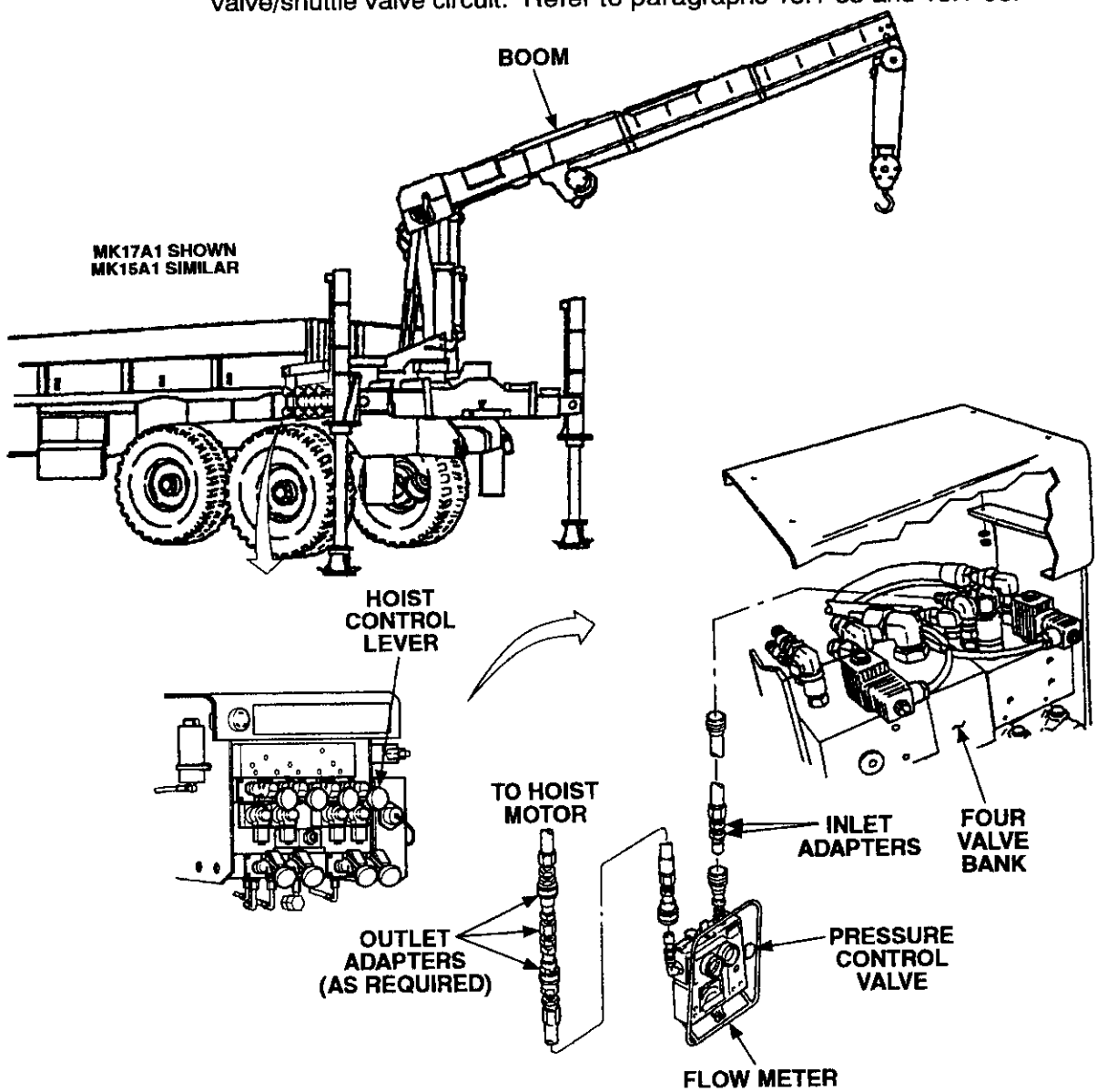
MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Test 1. Remove the line that comes from the hoist raise fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully raise hoist. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 2,200-2,400 psi (15,169-16,548 kPa) working pressure.

- If pressure is within specifications, repair hoist assembly. Refer to paragraph 18.1-26 or 18.1-34.
- If pressure is not within specifications, adjust relief valve. Refer to paragraph 18.1-63. If adjustment will not bring into specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.



SECTION V. TRANSFER CASE SUBASSEMBLY CLEANING, INSPECTION, AND REPAIR

8-10. DECLUTCH HOUSING REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Bar, flange yoke holding bar (J3453)

Materials/Parts

Adhesive (item 3, Appendix C)
Adhesive, silicone sealant (item 7, Appendix C)
Lubricant (item 46, Appendix C)
Sealant (item 57, Appendix C)
Sealer, lubricating and wicking (item 63, Appendix C)
Lockwasher (6) (MS35338-46) item 9
Oil seal (NSN 5330-01-033-2697) item 13
Oil seal (NSN 5330-01-041-1656) item 25

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Declutch assembly removed (para 8-8).

a. Disassembly

(1) Install flange holding bar onto output flange (1).

(2) Have assistant hold flange holding bar and remove two capscrews (2) and retainer plate (3).

(3) Using a puller, remove output flange (1) and spacer (4).

(4) Matchmark bearing cap (5) and declutch housing (6) for use during assembly.

(5) Remove four capscrews (7), two capscrews (8), and six lockwashers (9). Discard lockwashers (9).

(6) Using dead blow hammer, tap rear of front output shaft (10) and separate front output shaft (10) with bearing cap (5) from declutch housing (6).

(7) Place front output shaft (10) with bearing cap (5) in press.

(8) Pressing toward rear of bearing cap (5), remove from front output shaft (10).

(9) Remove spacer (11) and bearing cone (12) from front output shaft (10).

(10) Remove oil seal (13) and bearing cone (14) from bearing cap (5). Discard oil seal (13).

(11) Remove bearing cup (15), snapring (16), spacer (17), and bearing cup (18) from bearing cap (5).

(12) Remove inspection plug (19) from declutch housing (6).

(13) Remove capscrew (20) from shift fork (21).

(14) Slide shift fork shaft (22) from declutch housing (6).

(15) Remove shift fork (21) and clutch (23) from declutch housing (6).

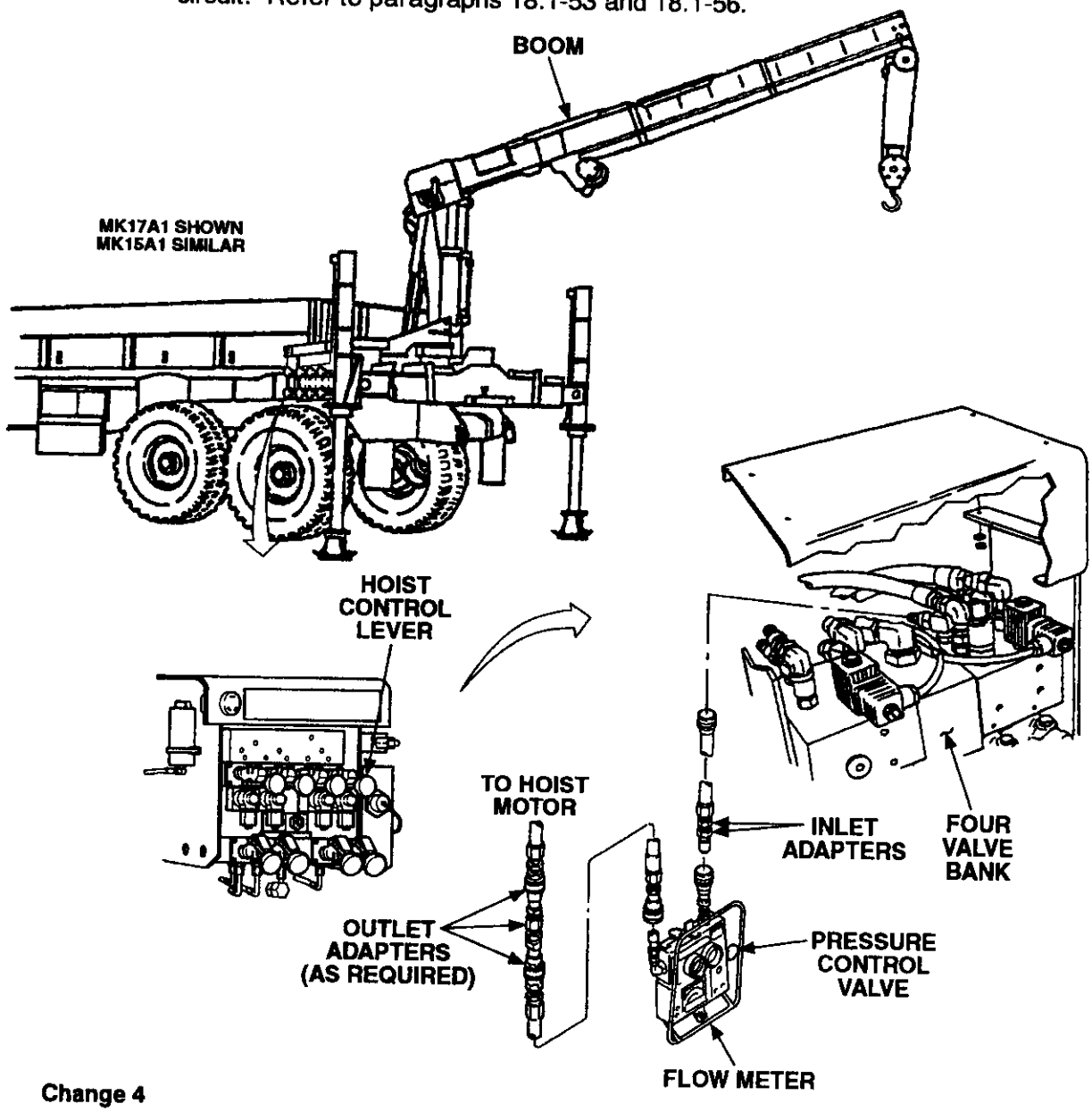
(16) If damaged, remove two breathers (24).

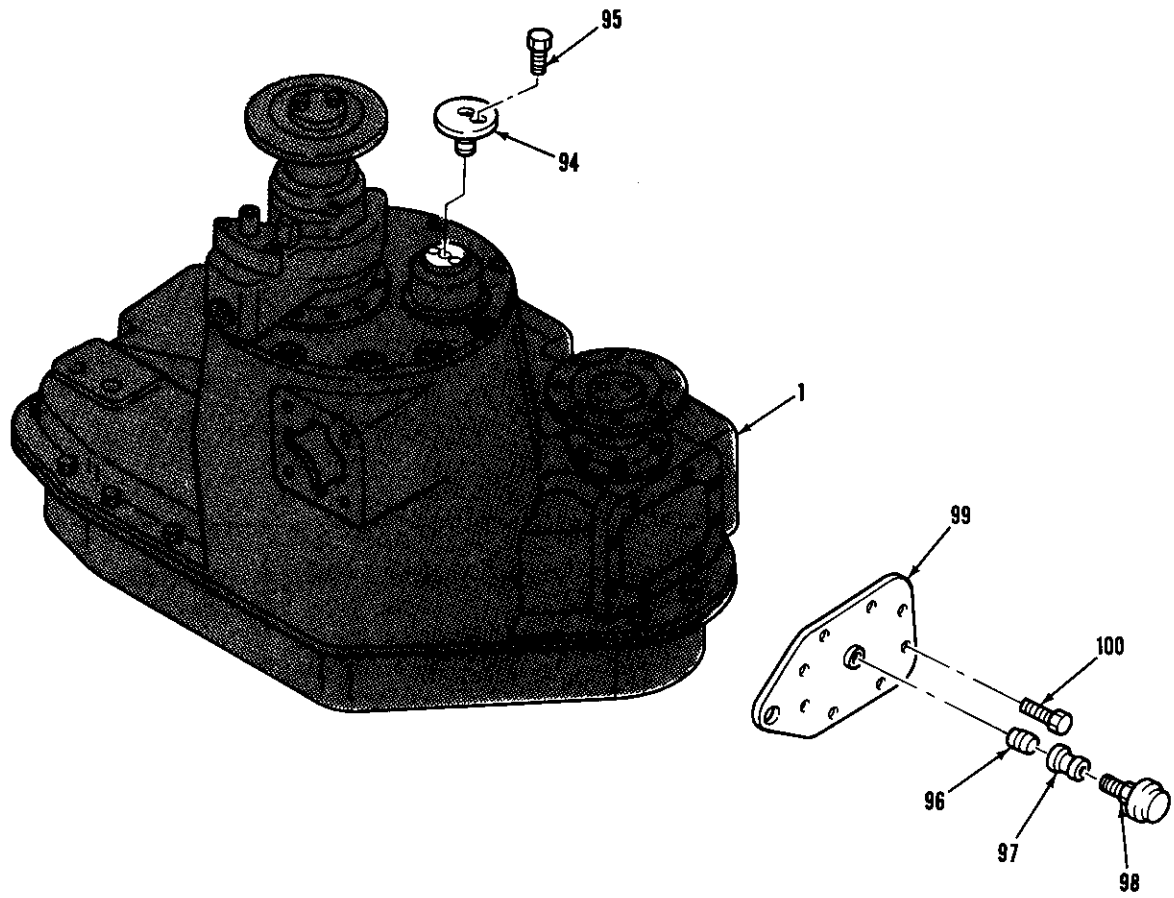
MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

HOIST DOES NOT RAISE OR LOWER. (Continued)

Test 2. Remove the line that comes from the hoist lower fitting at the left side control valve. Install a flow meter in line between control valve and line. Open pressure control valve fully by turning control knob counter clockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully lower hoist. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure.

- If pressure is within specifications, go to Test 3.
- If pressure is not within specifications, repair left side control valve/shuttle valve circuit. Refer to paragraphs 18.1-53 and 18.1-56.





1. FRONT HOUSING
94. OIL COVER
95. CAPSCREW (2)
96. NIPPLE
97. REDUCER
98. BREATHER
99. PTO COVER
100. CAPSCREW (8)

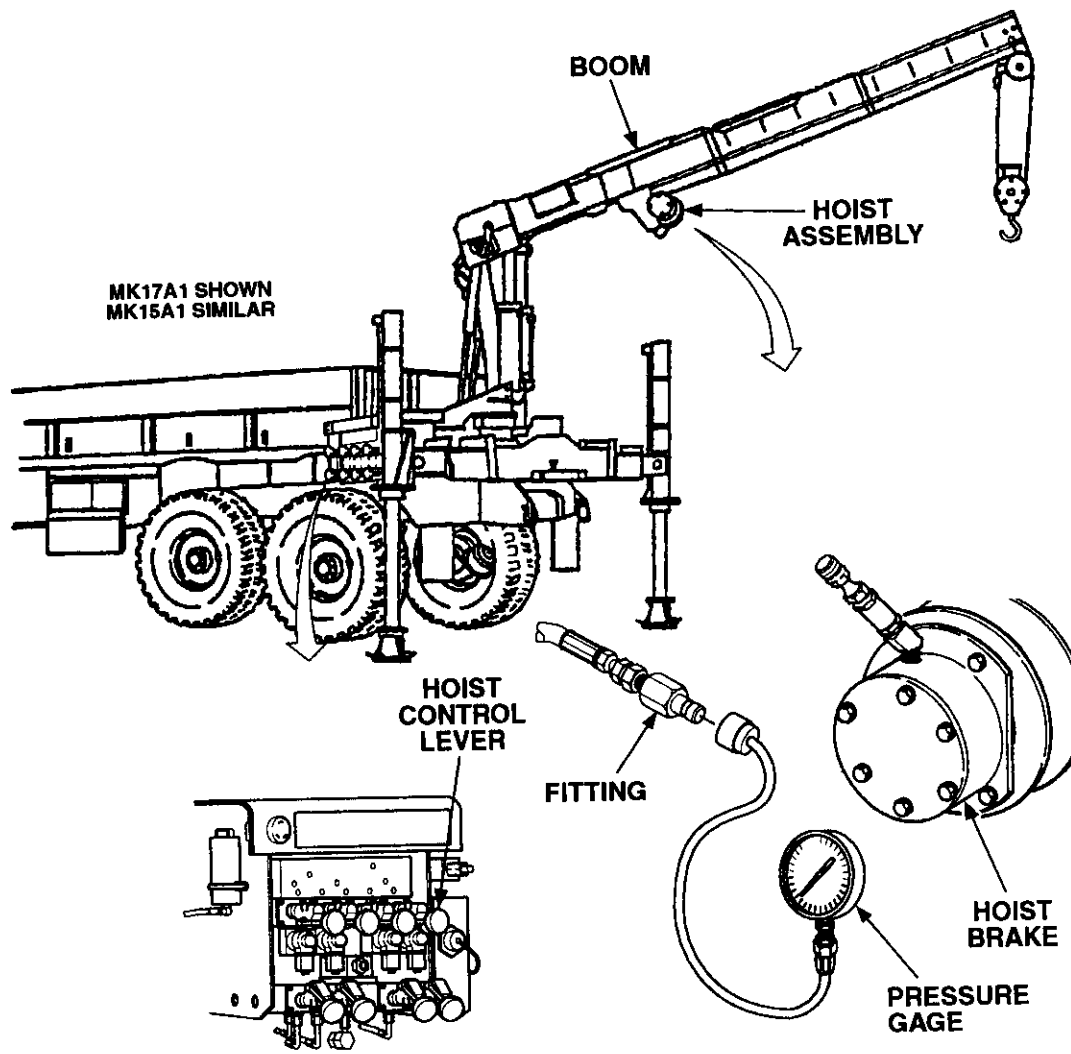
TA 288908

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

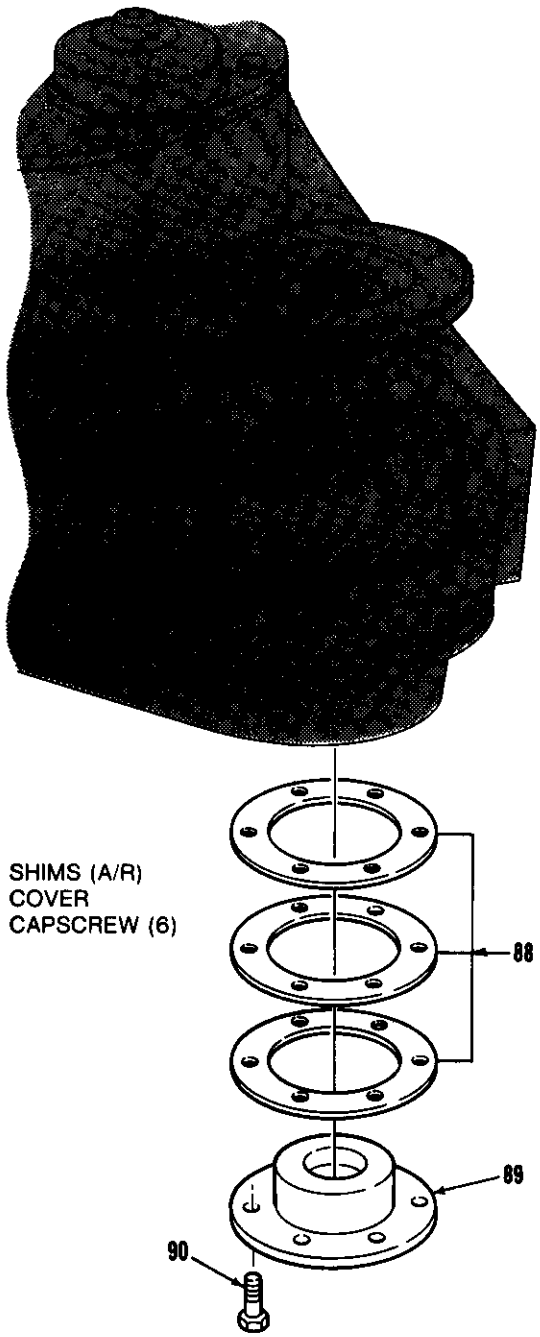
Test 3. Remove the brake release line at the hoist brake on the right side of boom. Install test fitting and 0-5,000 psi (34,475 kPa) gage in the brake release line. Start engine and allow to run at idle. Have assistant operate control lever to fully lower hoist. Check for 3,250 psi (22,409 kPa).

- If pressure is within specifications, repair hoist assembly. Refer to paragraph 18.1-34.
- If pressure is not within specifications, repair or replace hoist motor control valve. Refer to paragraph 18.1-57.

END OF TEST



8-9. TRANSFER CASE ASSEMBLY (Continued)



88. SHIMS (A/R)
89. COVER
90. CAPSCREW (6)

TA 298907

(33) Remove cover (89) and shims (88). Apply lubricating and wicking sealer to shims (88) and cover (89) and reinstall.

(34) Coat threads with lubricating and wicking sealer and install six capscrews (90). Torque to 110 foot-pounds (148 N·m).

(35) Apply sealant to mating surface of oil cover (94). Install oil cover (94). Coat threads of two capscrews (95) with lubricating and wicking sealer and install. Tighten securely.

(36) Coat threads of nipple (96), reducer (97), and breather (98) with silicone sealant and install into PTO cover (99).

(37) If removed, apply sealant to PTO cover (99) mating surface and install onto front housing (1).

(38) Coat threads of eight capscrews (100) with lubricating and wicking sealer and install. Torque to 50 foot-pounds (68 N·m).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install lockup air chamber (para 9-9).
TM 2320-34/13 TM 9-2320-297-34	Install transfer case (para (8-7).
TM 2320-20/12 TM 9-2320-297-20	Install lubrication pump (para 9-7).
	Install lubrication lines (para 9-6).
	Fill transfer case with lubricant (para 9-3).

(24) Install shims (88) and cover (89). Secure in place temporarily with six capscrews (90). Torque capscrews (90) to 50 foot-pounds (67.8 N·m).

(25) Position transfer case with front upward.

(26) Apply silicone sealant to splines of input flange (91). Install input flange (91) and retainer plate (92).

(27) Install flange holding tool onto input flange (91).

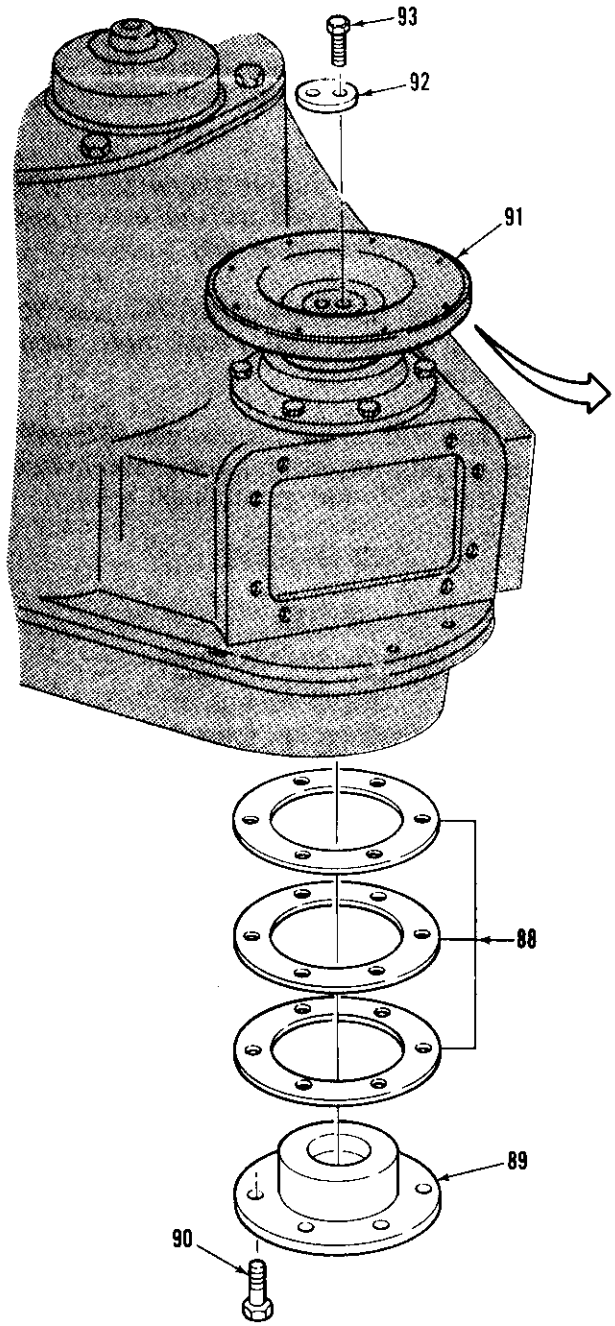
(28) Apply lubricating and wicking sealer to threads of two capscrews (93) and install. Torque to 28 foot-pounds (38 N·m).

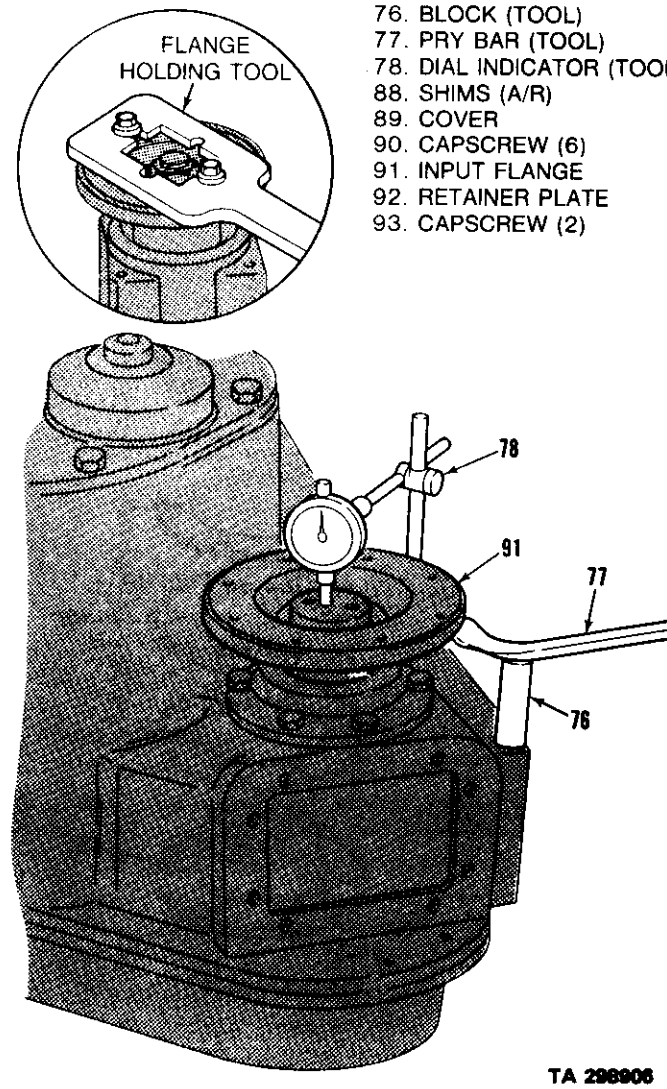
(29) Place dial indicator (78) at center of input flange (91).

(30) Using pry bar (77) and block (76), pry upward on input flange (91).

(31) End play must be 0.003-0.006 inch (0.0076-0.152 mm).

(32) Adjust thickness of shims (88) for proper end play.





76. BLOCK (TOOL)
77. PRY BAR (TOOL)
78. DIAL INDICATOR (TOOL)
88. SHIMS (A/R)
89. COVER
90. CAPSCREW (6)
91. INPUT FLANGE
92. RETAINER PLATE
93. CAPSCREW (2)

TA 298906

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

CRANE HYDRAULIC - MK15 AND MK17

1. CRANE INOPERATIVE OR ALL FUNCTIONS ARE SLOW

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

When increasing hydraulic system pressure with the pressure control valve, always increase pressure slowly. If pressure is increased too fast, damage to hydraulic system or test set will result.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.

- Relief is accomplished by either operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating condition. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150°F (54-66°C).

8-9. TRANSFER CASE ASSEMBLY (Continued)

(17) Install shims (84), cover (85), and six capscrews (86). Torque capscrews (86) to 50 foot-pounds (67.8 N·m).

(18) Using a pry bar (77), block (76), and rod (87), pry up on shaft through hole in front cover (11).

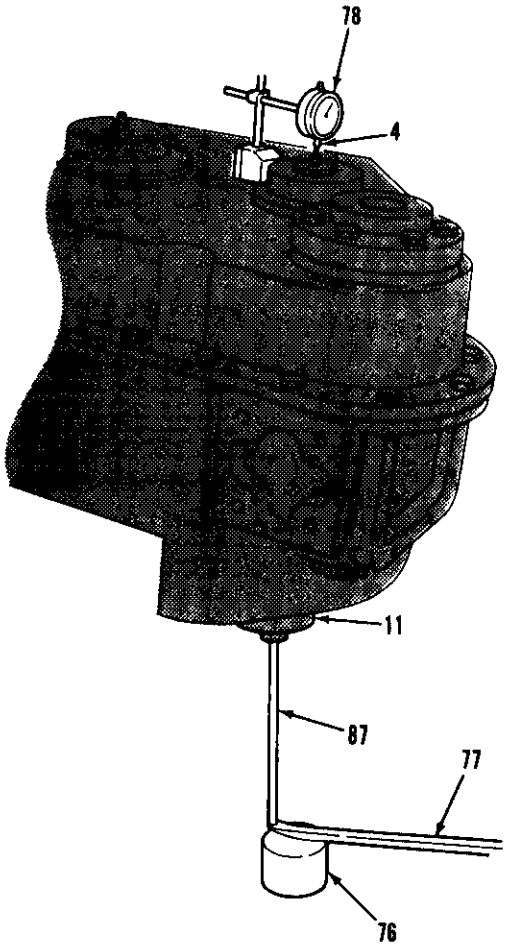
(19) Measure end play at top of 2-speed shift shaft (4) with a dial indicator (78). End play must be 0.003-0.006 inch (0.0076-0.152 mm).

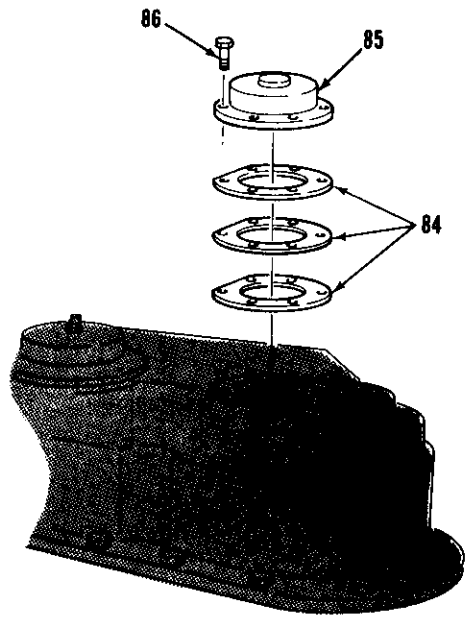
(20) Add or remove shims (84) to obtain proper measurement and recheck.

(21) Remove cover (85) and shims (84).

(22) Apply lubricating and wicking sealer to shims (84) and cover (85) and install.

(23) Coat threads with lubricating and wicking sealer and install six capscrews (86). Torque to 110 foot-pounds (148 N·m).





4. 2-SPEED SHIFT SHAFT
11. FRONT COVER
76. BLOCK (TOOL)
77. PRY BAR (TOOL)
78. DIAL INDICATOR (TOOL)
84. SHIMS (AR)
85. COVER
86. CAPSCREW (6)
87. ROD

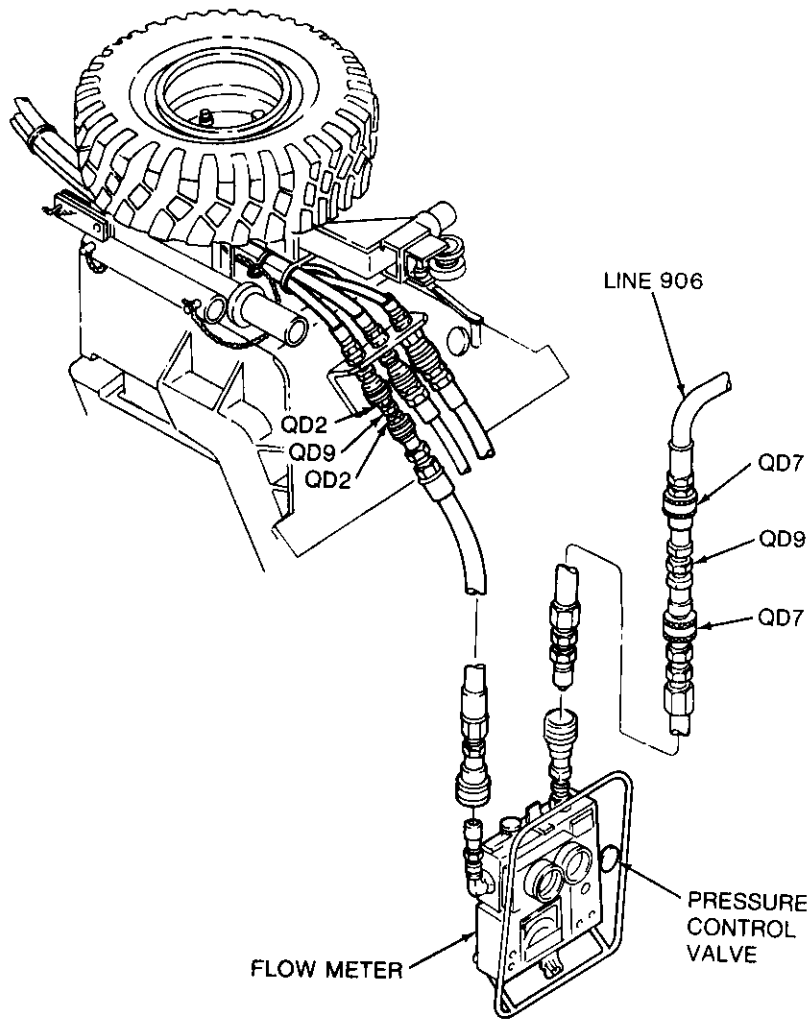
TA 298906

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. CRANE INOPERATIVE OR ALL FUNCTIONS ARE SLOW (Continued)

Test 1. Install a flow meter in line between line 906 at articulation joint. Open pressure control valve fully by turning control knob counterclockwise to DECREASE. Start engine and allow to run at idle. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 3,250 psi (22,409 kPa) working pressure. Check for 10-12 gpm (37.8-45 lpm).

- If gpm flow is within specifications at system pressure, front power unit's hydraulic system is working properly. Go to Test 2.
- If gpm flow is not within specifications at system pressure, refer to HYDRAULIC STEERING SYSTEM, Malfunction 1, Tests 3 thru 6.



TA 298406

(11) Install cover (80) and six capscrews (81). Do not install shims (82).

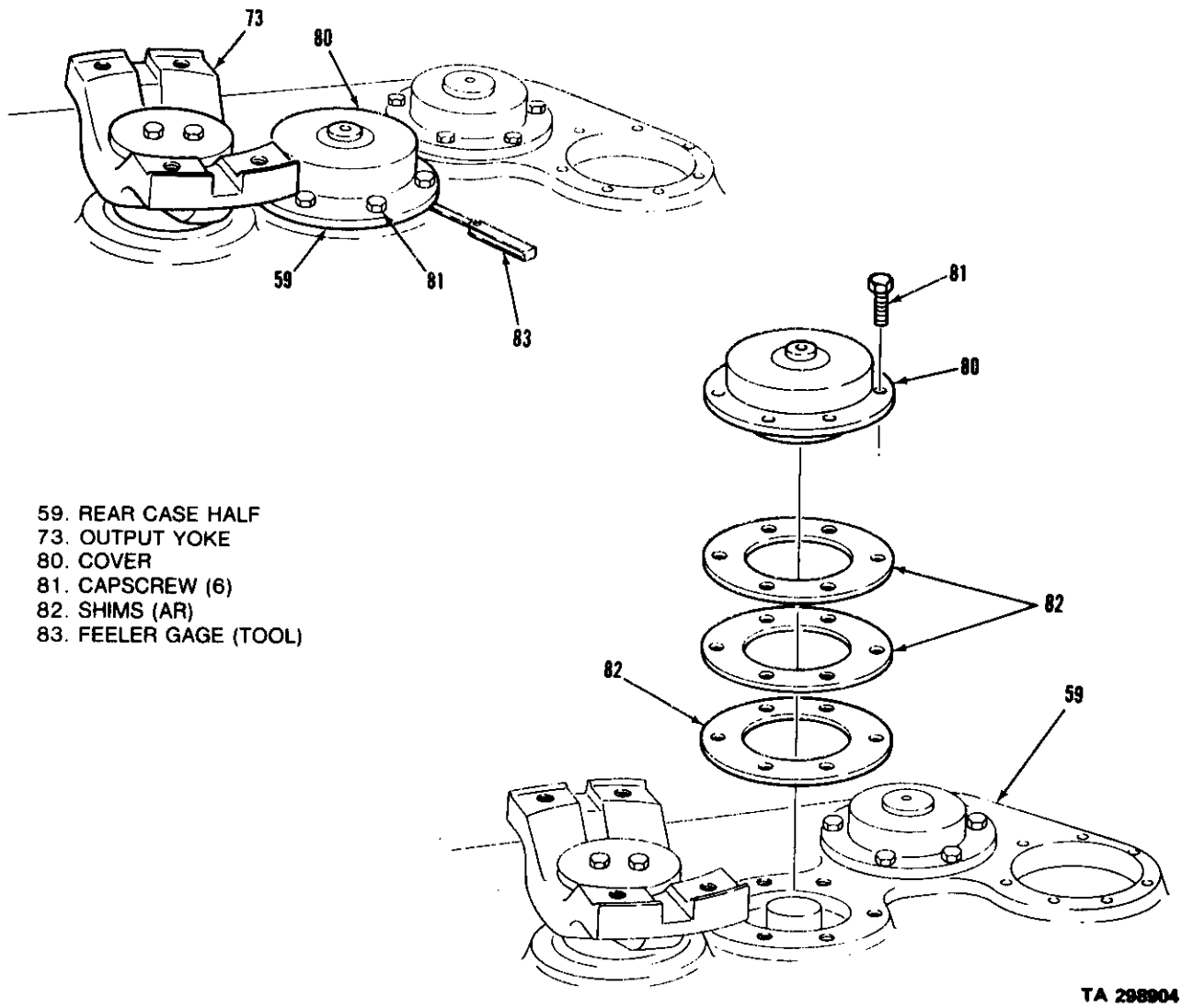
(12) Rotate output yoke (73) back and forth several times to seat bearing parts while torquing capscrews (81) to 50 foot-pounds (67.8 N·m). Loosen capscrews (81) and retorque to 10 foot-pounds (13.56 N·m).

(13) Using a feeler gage (83), take measurement between cover (80) and rear case half (59) at three places. Average and record these three measurements. Adjust shim pack as needed to equal recorded average, then add .003 to .006 inch (0.0076-0.152 mm). This will result in correct end play of .003 to .006 inch (0.0076 - 0.152 mm).

(14) Add or remove shims (82) to obtain proper thickness.

(15) Remove cover (80). Apply lubricating and wicking sealer to shims (82) and cover (80) and install.

(16) Coat threads with lubricating and wicking sealer, and install six capscrews (81). Torque capscrews to 110 foot-pounds (148 N·m).

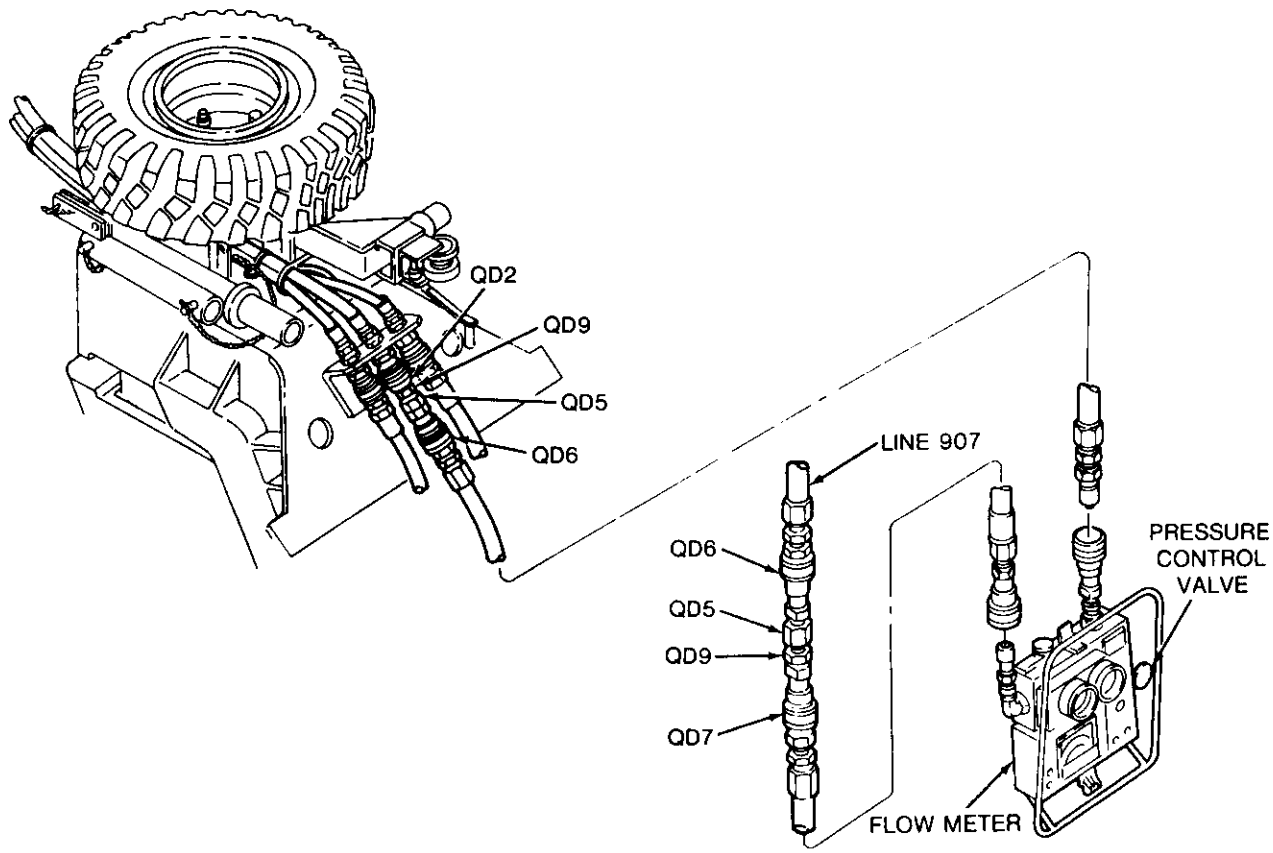


59. REAR CASE HALF
73. OUTPUT YOKE
80. COVER
81. CAPSCREW (6)
82. SHIMS (AR)
83. FEELER GAGE (TOOL)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 2. Install a flow meter in line between line 907 at articulation joint. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and allow to run at idle. Check for 10-12 gpm (37.8-45 lpm).

- If gpm flow is within specifications, go to Test 3.
- If gpm flow is not within specifications, check for restrictions in return lines, return manifold, manual control valves, or hydraulic filter.

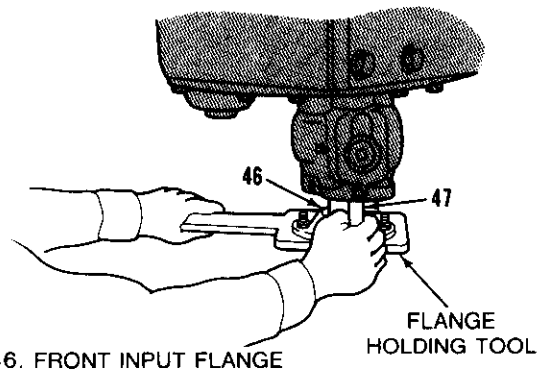


8-9. TRANSFER CASE ASSEMBLY (Continued)

e. Bearing Cover Installation/Adjustment

(1) Install flange holding tool onto front input flange (46) to stop transfer case gears from turning.

(2) Push up on declutch shift shaft (47) to lock declutch housing.



46. FRONT INPUT FLANGE
47. DECLUTCH SHIFT SHAFT

NOTE

- Make sure all bearings are fully seated before installing shims and checking end play.
- Do not reuse shims removed during disassembly. Use tagged shim pack sizes as starting points during end play adjustment.

(3) Install shim pack (70), end cap (71), and six capscrews (72). Torque capscrews (72) to 110 foot-pounds (148 N·m).

(4) Install output yoke (73), retainer plate (74), and two capscrews (75). Torque to 28 foot-pounds (38 N·m).

(5) Place a block (76) on rear housing (59) and, using a pry bar (77), check end play with a dial indicator (78).

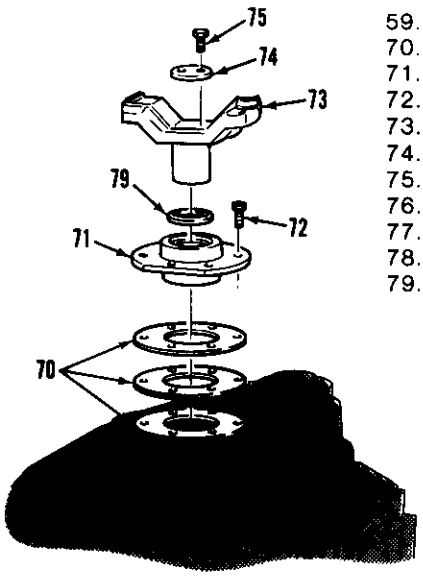
(6) End play must be between 0.003 and 0.006 inch (0.0076-0.152 mm). Adjust shim pack (70) as needed.

(7) Remove capscrews (75), retainer plate (74), output yoke (73), capscrews (72), and end cap (71). Install new oil seal (79).

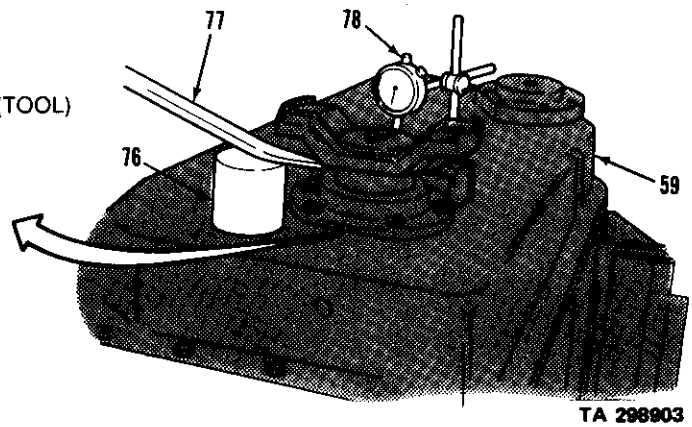
(8) Apply lubricating and wicking sealer to shim pack (70) and end cap (71) and install. Coat threads of six capscrews (72) with lubricating and wicking sealer and install. Torque to 110 foot-pounds (148 N·m).

(9) Apply silicone sealant to splines of output yoke (73) and install.

(10) Install retainer plate (74). Apply lubricating and wicking sealer to threads of two capscrews (75) and install. Torque to 28 foot-pounds (38 N·m).



59. REAR HOUSING
70. SHIM PACK (AR)
71. END CAP
72. CAPSCREW (6)
73. OUTPUT YOKE
74. RETAINER PLATE
75. CAPSCREW (2)
76. BLOCK (TOOL)
77. PRY BAR (TOOL)
78. DIAL INDICATOR (TOOL)
79. OIL SEAL



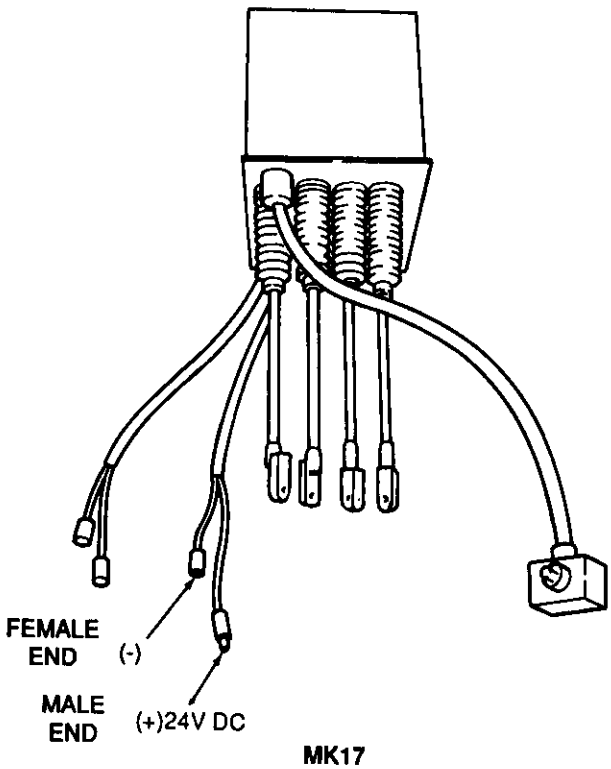
TA 298903

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

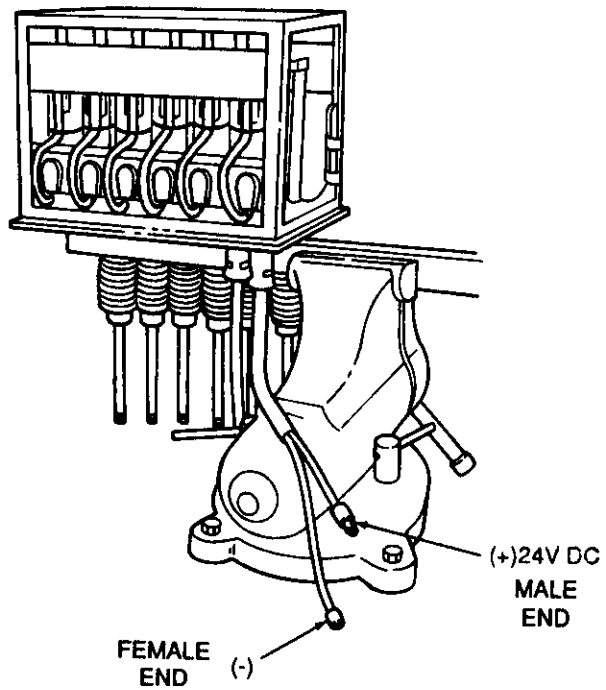
1. CRANE INOPERATIVE OR ALL FUNCTIONS ARE SLOW (Continued)

NOTE

- For the following tests, remove actuator box from vehicle, refer to paragraph 18-54.1 or 18-54.2, (TM 2320-34/13, TM 9-2320-297-34) and place actuator box on a suitable test stand.
- A 24V DC power supply is required.
- Actuator box cover must be removed and the MANUAL-OFF-REMOTE switch must be placed in the MANUAL position.



MK17



MK15

Test 3. Connect a 24 V DC power supply to input power leads on actuator box. Check for 24 volts at input terminals of power converter.

- If 24 volts are present, go to Test 4.
- If 24 volts are not present, replace input power cable. Refer to paragraph 18-45 or 18-46, (TM 2320-34/13, TM 9-2320-297-34).

(7) Install bearing (61) into rear housing (59).

(8) Install retainer plate (62).

(9) Coat threads of three capscrews (63) with adhesive and install. Torque capscrews (63) to 107 foot-pounds (145 N·m).

(10) Install new lockwire (64) through heads of capscrews (63) in pattern shown.

(11) Apply sealant to mating surface of cover (65). Be sure to circle six capscrew (66) holes.

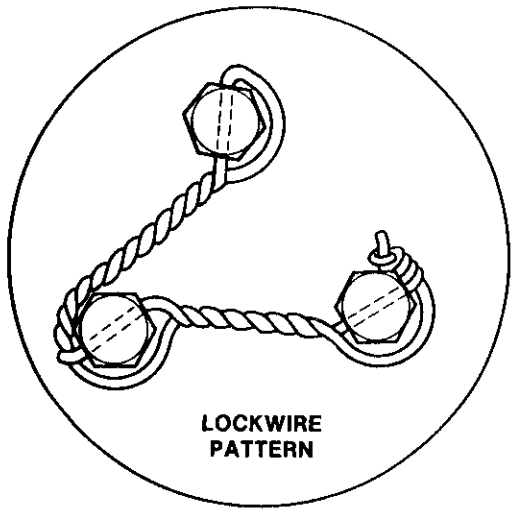
(12) Install cover (65).

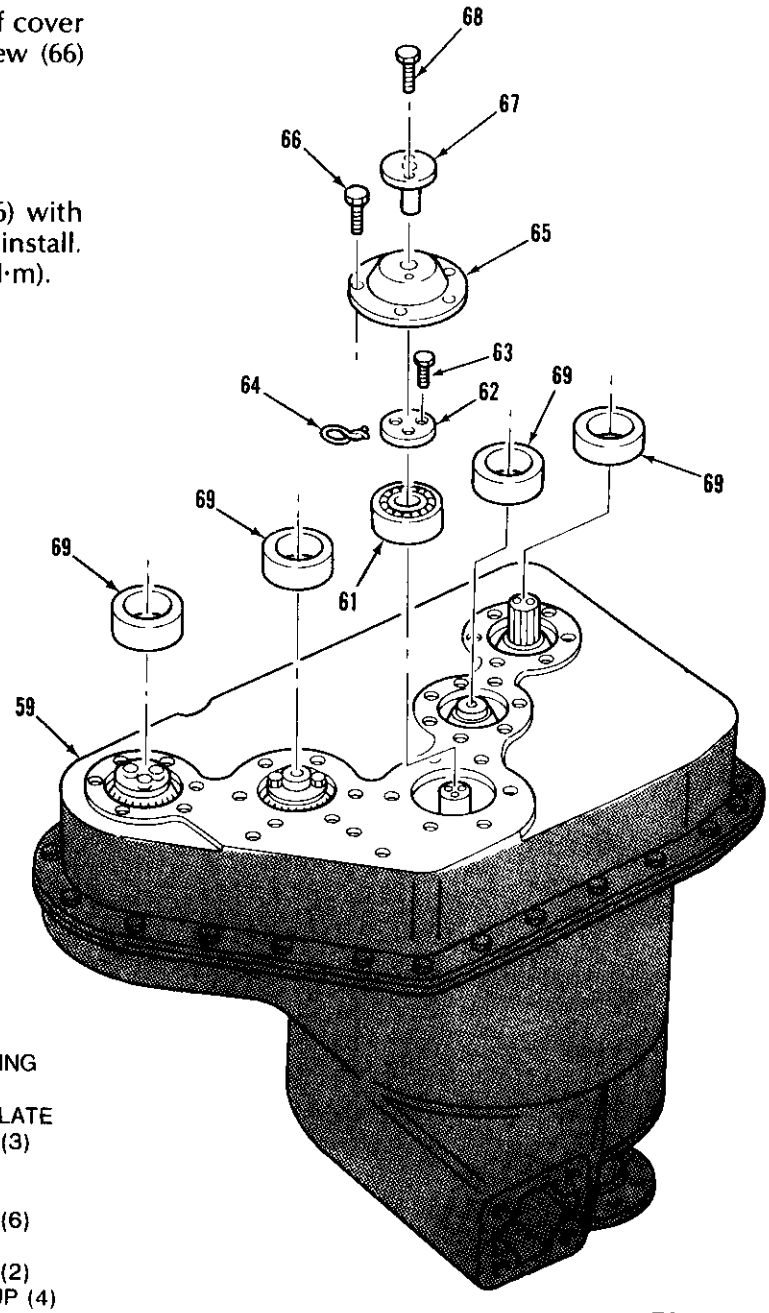
(13) Coat threads of six capscrews (66) with lubricating and wicking sealer and install. Torque to 110 foot-pounds (148 N·m).

(14) Apply sealant to mating surface of oil cover (67) and install into cover (65).

(15) Coat threads of two capscrews (68) with lubricating and wicking sealer and install. Torque to 28 foot-pounds (38 N·m).

(16) Install four bearing cups (69).





59. REAR HOUSING
61. BEARING
62. RETAINER PLATE
63. CAPSCREW (3)
64. LOCKWIRE
65. COVER
66. CAPSCREW (6)
67. OIL COVER
68. CAPSCREW (2)
69. BEARING CUP (4)

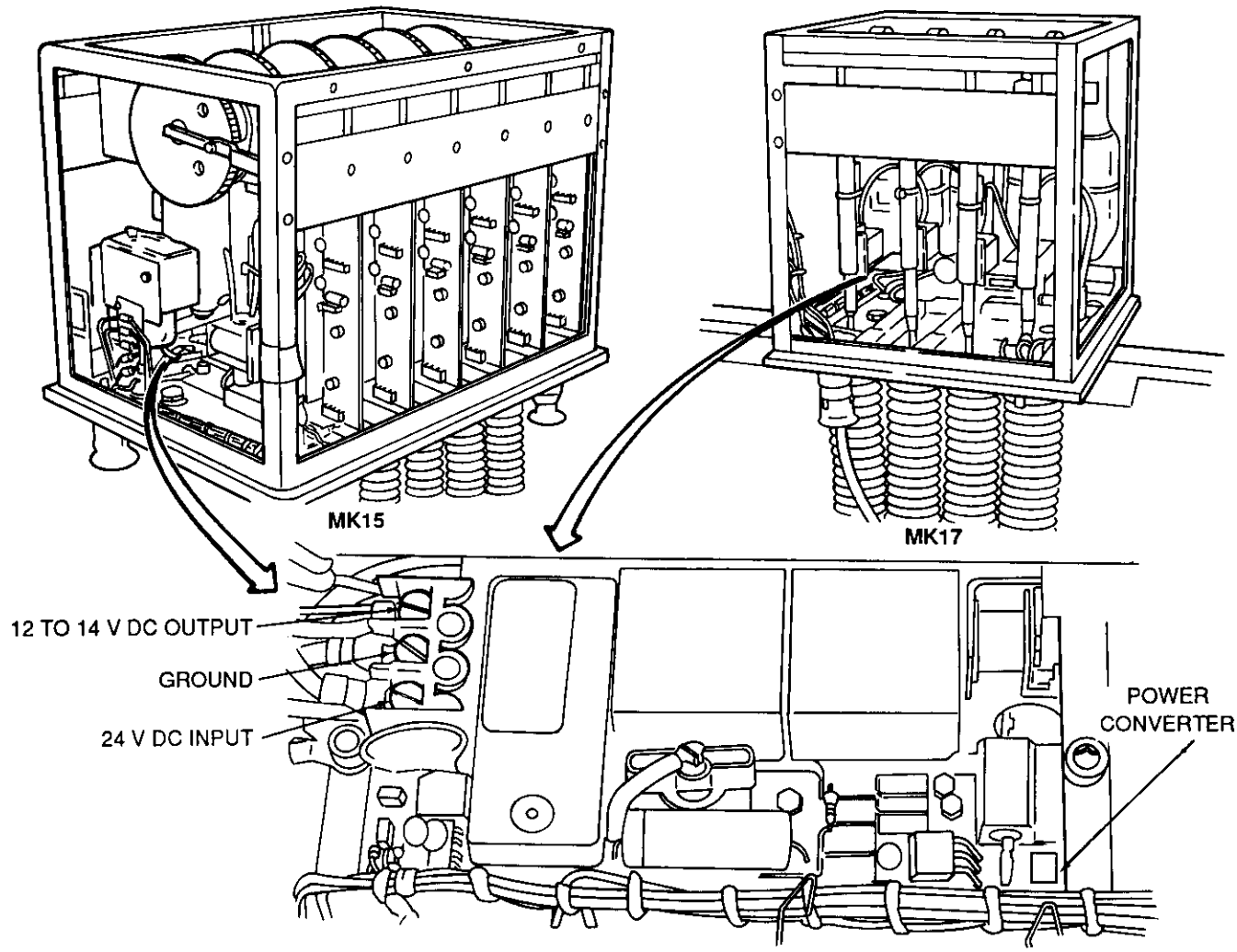
TA 298902

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. CRANE INOPERATIVE OR ALL FUNCTIONS ARE SLOW (Continued)

Test 4. Check for 12 to 14 volts at ouput terminals of power converter.

- If 12 to 14 volts are present, go to Test 5.
- If 12 to 14 volts are not present, replace power converter. Refer to paragraph 18-46 or 18-47, (TM 2320-34/13, TM 9-2320-297-34).



Test 5. Check center contact of OFF-ON-REMOTE switch for 12 to 14 volts.

- If 12 to 14 volts are present, go to Test 6.
- If 12 to 14 volts are not present, repair or replace wire between power converter and OFF-ON-REMOTE switch. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34).

8-9. TRANSFER CASE ASSEMBLY (Continued)

d. Rear Housing Installation

(1) Apply sealant to mating surface of front housing (1). Be sure to coat each capscrew (57) hole and dowel pin (58).

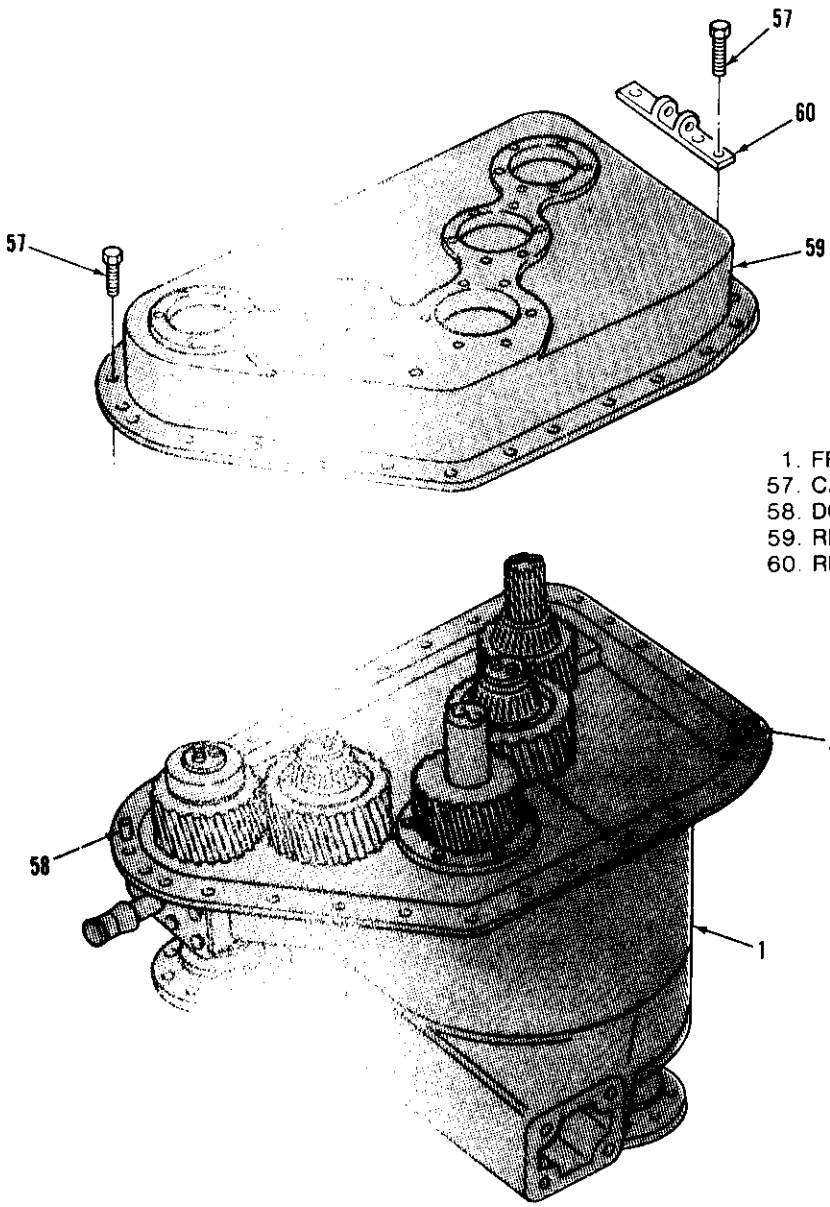
(2) Install rear housing (59) on front housing (1), making sure all bearings and dowel pins (58) align with rear housing (59).

(3) Position restraint bracket (60) on bottom of rear housing (59).

(4) Coat threads of three capscrews (57) with lubricating and wicking sealer and install.

(5) Coat threads of 23 capscrews (57) with lubricating and wicking sealer and install.

(6) Torque 26 capscrews (57) to 108 foot-pounds (146.45 N·m).



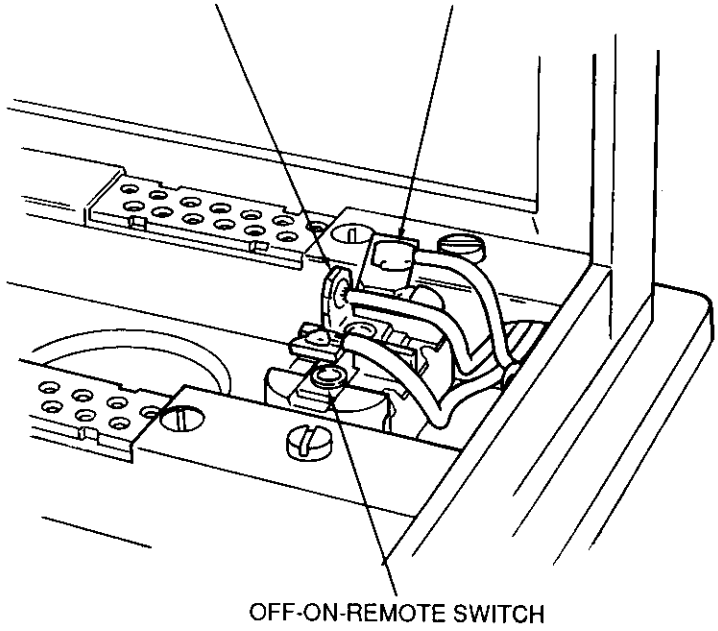
1. FRONT HOUSING
57. CAPSCREW (26)
58. DOWEL PIN (2)
59. REAR HOUSING
60. RESTRAINT BRACKET

TA 298901

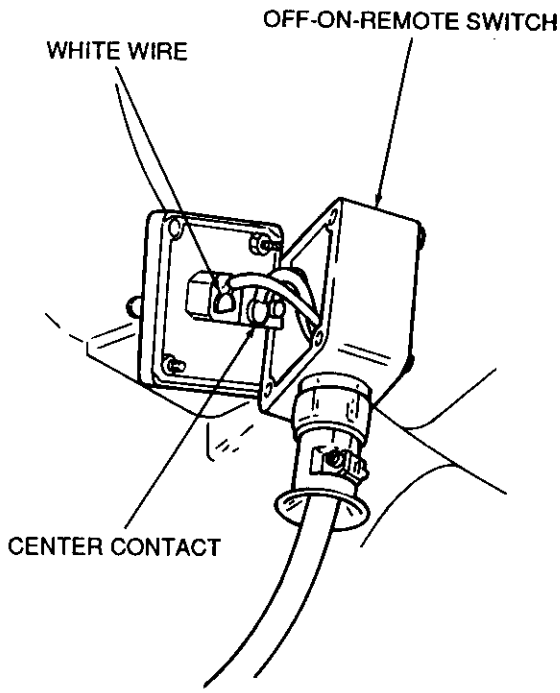
1. CRANE INOPERATIVE OR ALL FUNCTIONS ARE SLOW (Continued)

Test 6. Check for 12 to 14 volts at switch terminal where white wire is connected.

- If 12 to 14 volts are present, go to Test 7.
- If 12 to 14 volts are not present, replace MANUAL-OFF-REMOTE switch. Refer to paragraph 18-48 or 18-54, (TM 2320-34/13, TM 9-2320-297-34).



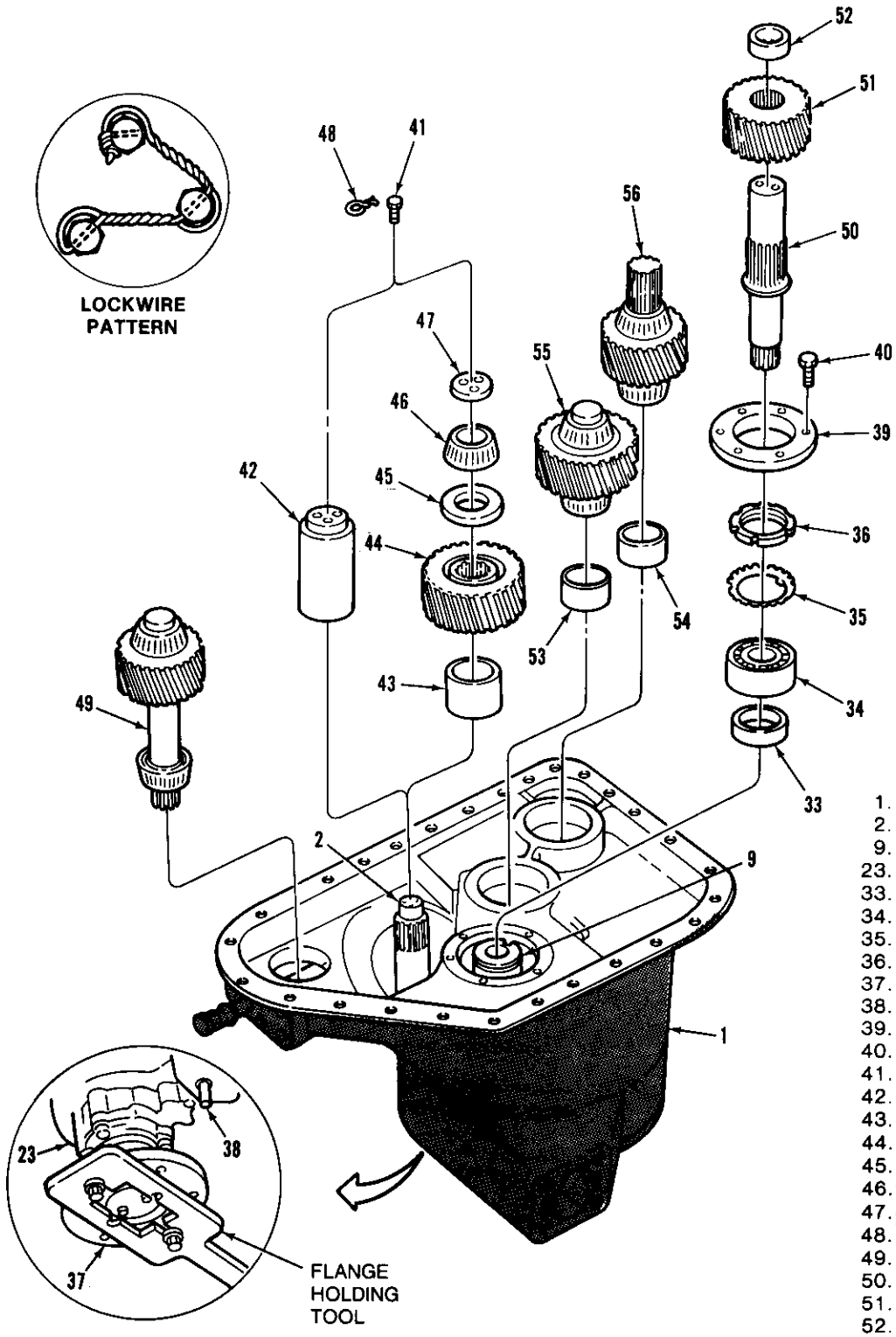
MK17



MK15

Test 7. While observing dump valve relay B, turn MANUAL-OFF-REMOTE switch to OFF position, then turn to MANUAL position. Check that dump valve relay B contacts can be observed pulling in.

- If contacts pull in, go to Test 9.
- If contacts do not pull in, go to Test 8.



1. FRONT HOUSING
2. 2-SPEED SHIFT SHAFT
9. DIFFERENTIAL ASSEMBLY
23. DECLUTCH HOUSING
33. SPACER
34. BEARING
35. LOCKWASHER
36. LOCKNUT
37. FRONT INPUT FLANGE
38. DECLUTCH SHIFT SHAFT
39. COVER
40. CAPSCREW (6)
41. CAPSCREW (3)
42. TEMPORARY SPACER
43. SPACER
44. GEAR
45. SPACER
46. BEARING CONE
47. RETAINER PLATE
48. LOCKWIRE
49. INPUT SHAFT
50. SHAFT
51. GEAR
52. SPACER
53. BEARING CUP
54. BEARING CUP
55. IDLER SHAFT
56. OUTPUT SHAFT

TA 298990

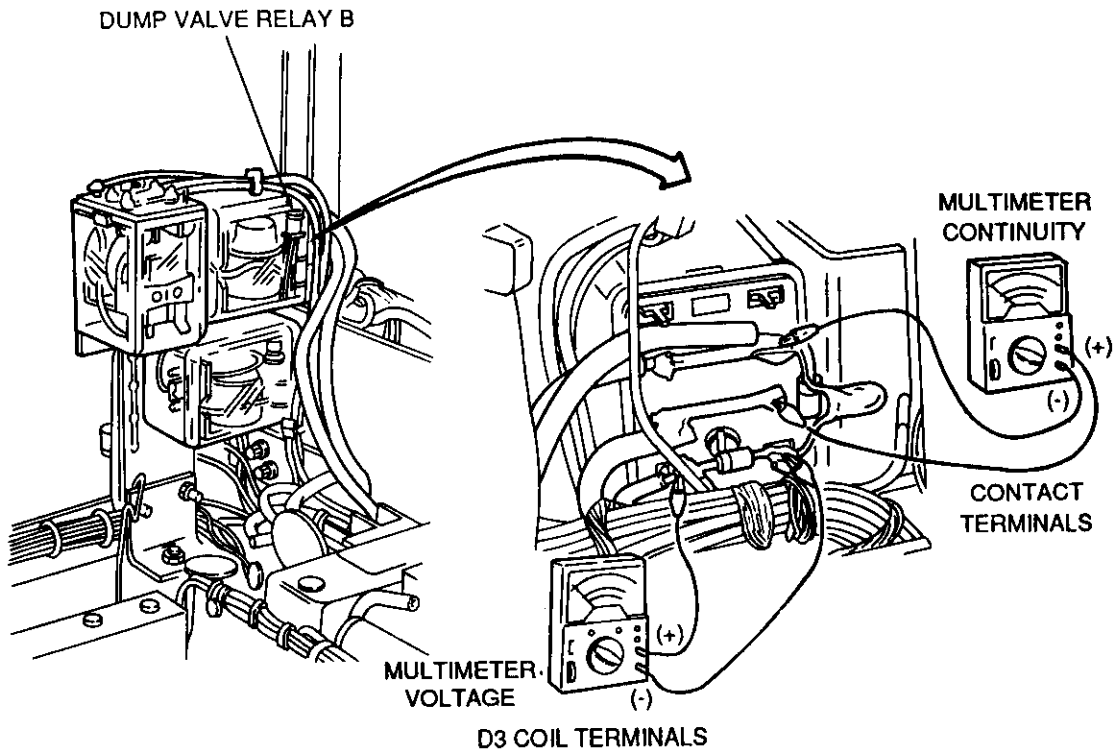
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. CRANE INOPERATIVE OR ALL FUNCTIONS ARE SLOW (Continued)

Test 8. Check for 12 to 14 volts across dump valve relay B diode D3 terminals.

- If 12 to 14 volts are present, replace dump valve relay B. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34).

- 12 to 14 volts are not present, repair or replace white wire between OFF-ON-REMOTE switch and dump valve relay B coil terminal. Refer to paragraph 7-45, (TM 2320-20/12, TM 9-2320-297-20).



MK15

Test 9. Connect an ohm meter across dump valve relay B ouput terminals. Check for continuity across terminals, indicating dump valve relay B contacts are working properly.

- If continuity is found, replace solenoid dump valve power cord or bullet connectors. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34).

- If continuity is not found, replace dump valve relay B. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34).

8-9. TRANSFER CASE ASSEMBLY (Continued)

c. Shaft Installation

(1) Position front housing (1) with rear up.

(2) If removed, install spacer (33), bevel side down, and bearing (34) into front housing (1). Tap bearing (34) with a soft-faced hammer until it is well seated in front housing (1).

(3) Install new lockwasher (35) and locknut (36).

(4) Temporarily install flange holding tool onto front input flange (37) to stop differential assembly (9) from turning.

(5) Push up on declutch shift shaft (38) to lock declutch housing (23).

(6) With declutch housing (23) locked, torque locknut (36) to 675 foot-pounds (915 N·m).

(7) Bend up one tab on lockwasher (35) to secure locknut (36) in place.

(8) Install cover (39). Coat threads of six capscrews (40) with lubricating and wicking sealer and install. Torque to 14 foot-pounds (19 N·m).

(9) Remove three capscrews (41) and temporary spacer (42).

NOTE

Bearing cone (46) fits tightly on the 2-speed shift shaft (2). A driver may be needed to seat bearing cone (46).

(10) Install spacer (43), gear (44), spacer (45), bearing cone (46), and retainer plate (47).

NOTE

To hold shafts still while capscrews (41) are being torqued, jam a clean shop rag between the 2-speed shift shaft and the input shaft (49) gear.

(11) Coat threads of three capscrews (41) with adhesive and install. Torque to 107 foot-pounds (145 N·m).

(12) Install new lockwire (48) through heads of three capscrews (41), in pattern shown.

(13) Install input shaft (49).

NOTE

Gear (51) is installed on differential assembly (9) with ledge side down.

(14) Install shaft (50) and gear (51).

(15) Install spacer (52) onto differential assembly (9), bevel side down.

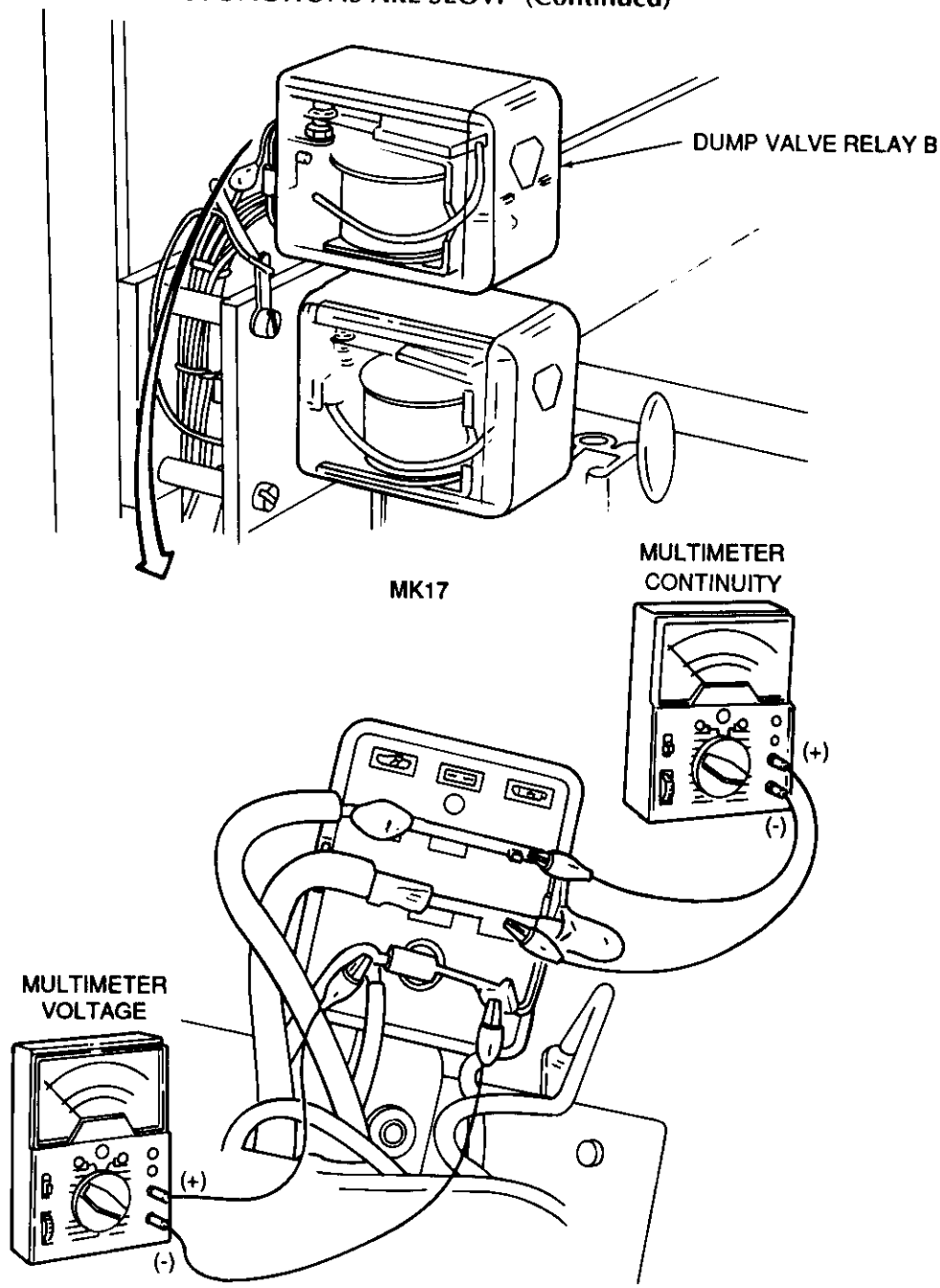
(16) Install bearing cups (53 and 54).

(17) Install idler shaft (55).

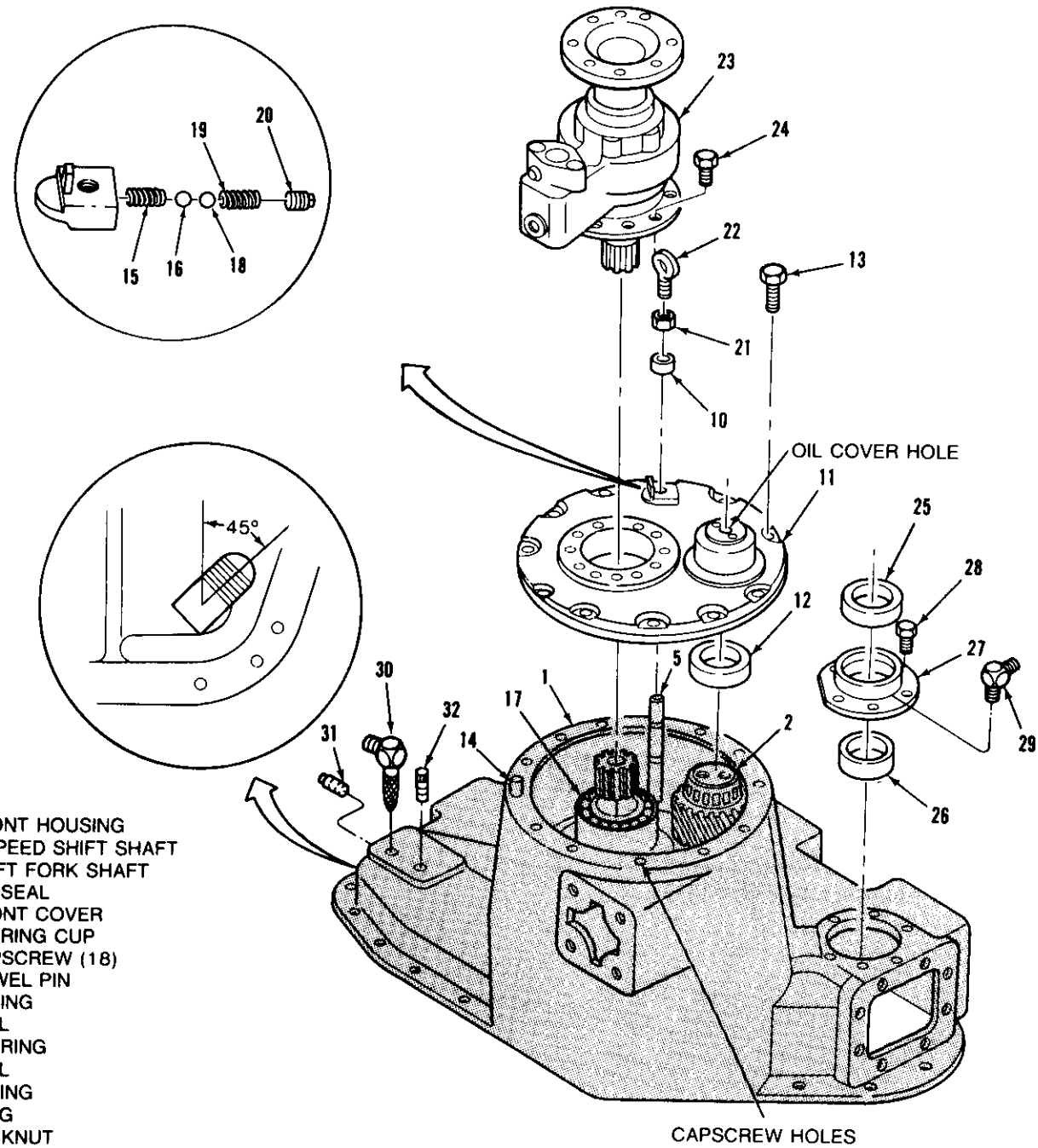
(18) Install output shaft (56).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. CRANE INOPERATIVE OR ALL FUNCTIONS ARE SLOW (Continued)



END OF TEST



1. FRONT HOUSING
2. 2-SPEED SHIFT SHAFT
5. SHIFT FORK SHAFT
10. OIL SEAL
11. FRONT COVER
12. BEARING CUP
13. CAPSCREW (18)
14. DOWEL PIN
15. SPRING
16. BALL
17. BEARING
18. BALL
19. SPRING
20. PLUG
21. LOCKNUT
22. EYELET
23. DECLUTCH HOUSING
24. CAPSCREW (10)
25. OIL SEAL
26. BEARING CUP
27. COVER
28. CAPSCREW (6)
29. LUBRICATION LINE FITTING
30. STRAINER
31. DRAIN PLUG
32. FILL PLUG

TA 298899

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

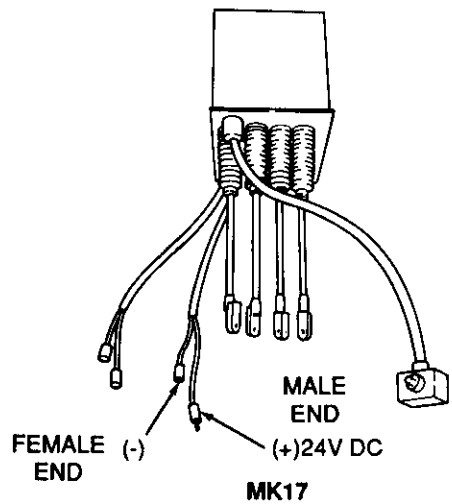
1.1. REMOTE CONTROL DOES NOT WORK

NOTE

- For the following tests, remove actuator box from vehicle, refer to paragraph 18-54.1 or 18-54.2 (TM 2320-34/13, TM 9-2320-297-34) and place actuator box on a suitable test stand.
- A 24V DC power supply is required.
- Actuator box cover must be removed and the MANUAL-OFF-REMOTE switch must be placed in the REMOTE position. Be sure to have a remote control cable and hand controller connected.

Test 1. Connect a 24 volt power supply to input power leads on actuator box. Check that red light on hand controller is ON.

- If red light is on, input power is available to actuator box, go to Test 3.
- If red light is not on, go to Test 2.



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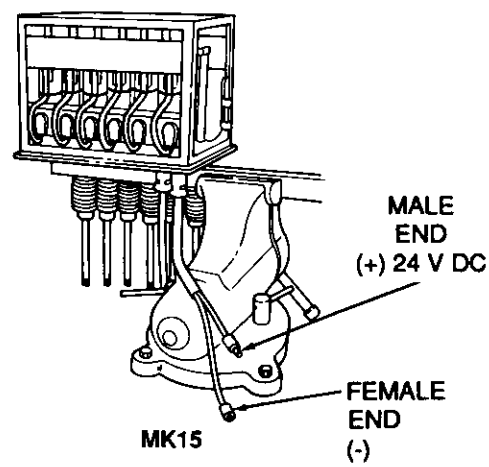

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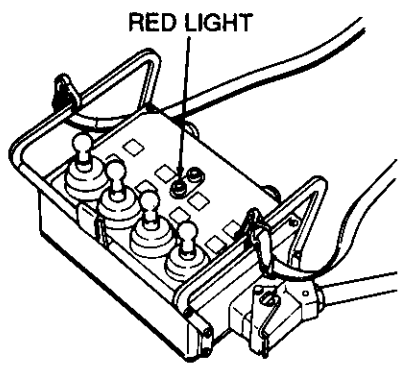

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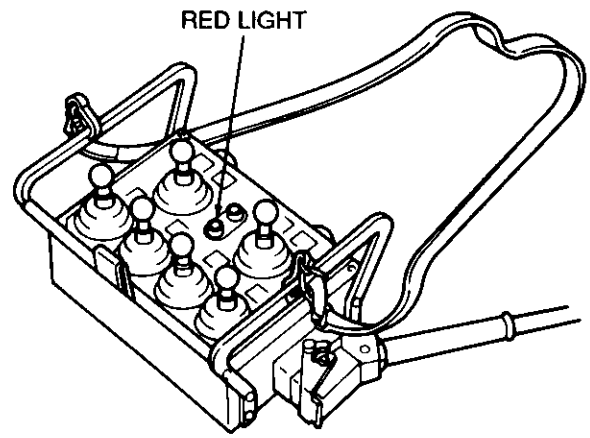


MK15

8-9. TRANSFER CASE ASSEMBLY (Continued)

b. Front Cover/Declutch Housing Installation

(1) Install new oil seal (10) into front cover (11).

(2) Install bearing cup (12) into front cover (11).

(3) Apply sealant to mating surface of front housing (1). Be sure to circle all capscrew (13) holes and dowel pin (14) with sealant.

(4) Have assistant slowly lower front cover (11) over shift fork shaft (5) until end of shift fork shaft (5) is just below hole for spring (15) and ball (16).

(5) Install spring (15) and ball (16). Holding ball (16) against spring (15) with a small screwdriver, compress spring (15) until ball (16) is inside blind hole.

(6) Lower front cover (11) until shift fork shaft (5) passes ball (16). Remove screwdriver and lower front cover (11) into position.

(7) Look down through oil cover hole to make certain that center hole of 2-speed shift shaft (2) lines up with oil cover hole.

(8) Make sure front cover (11) is properly positioned over dowel pin (14) and bearing (17).

(9) Using dead blow hammer, drive front cover (11) down until lip of front cover (11) evenly seats into front housing (1).

(10) Coat threads with lubricating and wicking sealer and install 18 capscrews (13). Tighten capscrews (13) alternately to draw front cover (11) down into position. Torque capscrews (13) to 110 foot-pounds (149.16 N·m).

(11) Install ball (18) and spring (19). Apply silicone sealant to plug (20) and install.

(12) Install locknut (21) and eyelet (22) onto shift fork shaft (5).

(13) Apply sealant to mating surface of declutch housing (23) and install onto front cover (11).

(14) Coat threads of 10 capscrews (24) with lubricating and wicking sealer and install. Torque to 99 foot-pounds (134 N·m)

(15) Install new oil seal (25) and bearing cup (26) into cover (27).

(16) Apply sealant to mating surface of cover (27) and install onto front housing (1).

(17) Coat threads of six capscrews (28) with lubricating and wicking sealer and install. Torque to 68 foot-pounds (91.5 N·m).

(18) Coat threads of lubrication line fitting (29) with lubricating and wicking sealer and install into cover (27).

(19) If removed, coat threads of strainer (30) with lubricating and wicking sealer and install as shown.

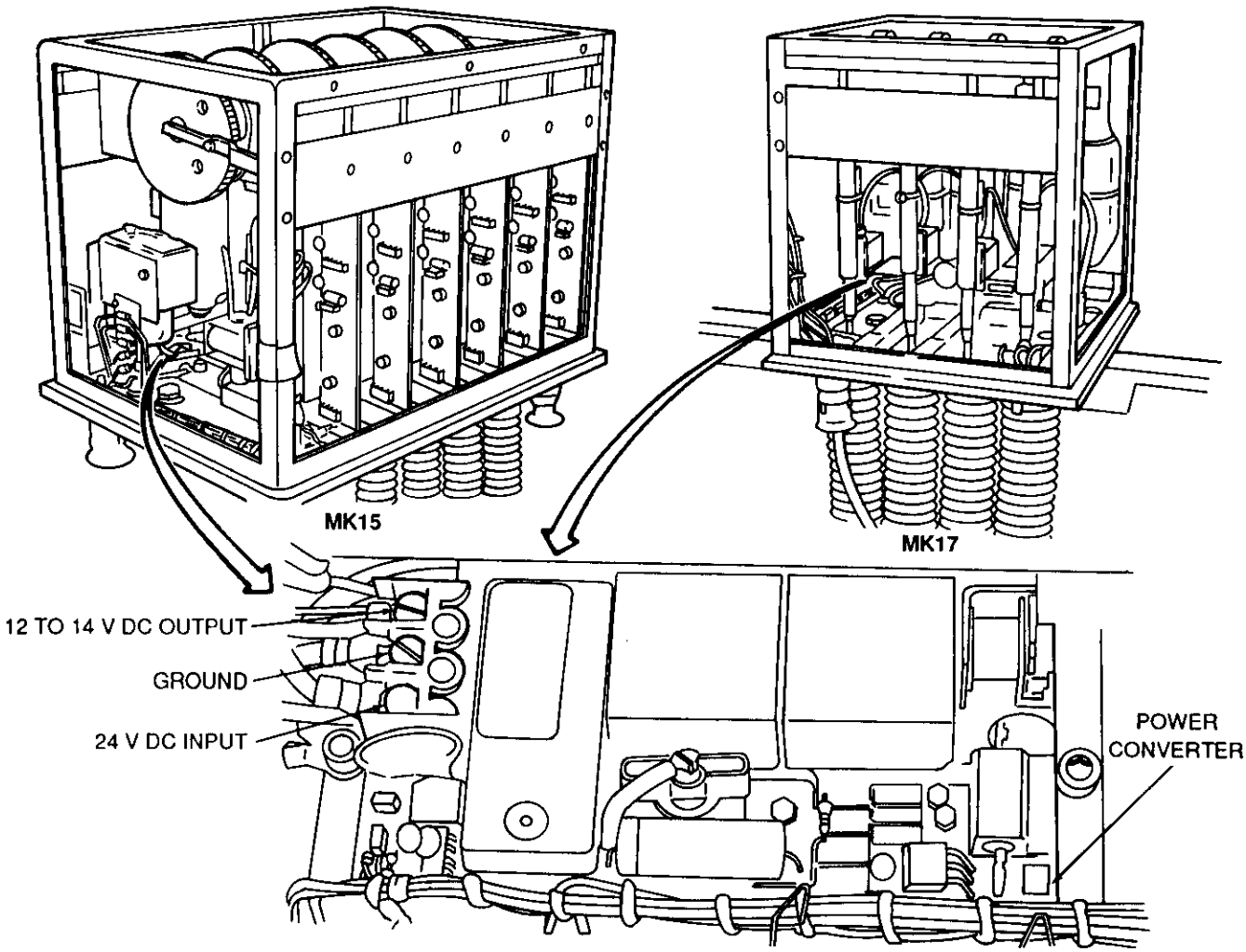
(20) Coat threads of drain plug (31) with silicone sealant and install.

(21) Install fill plug (32).

1.1. REMOTE CONTROL DOES NOT WORK (Continued)

Test 2. Check for 24 volts at input terminals of power converter.

- If 24 volts are present, go to Test 3.
- If 24 volts are not present, replace input power cable. Refer to paragraph 18-45 or 18-46, (TM 2320-34/13, TM 9-2320-297-34).



Test 3. Check that at least one function operates.

- If one function operates, power supply system is functioning properly, isolate inoperative function(s) and go to Test 13.
- If no functions operate, go to Test 4 to troubleshoot power distribution circuit.

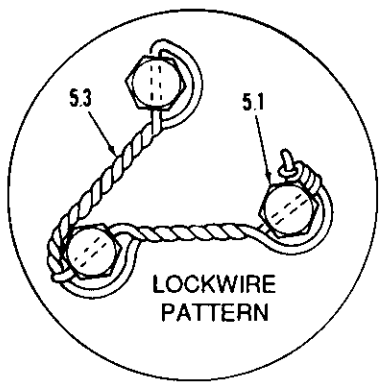
(5) Aline grooves in shift fork shaft (5) with holes in shift fork (3) and install two capscrews (6). Tighten securely.

(6) Install sleeve (7) onto shift fork shaft (5).

(7) Install gear (8) into front housing (1) with unsplined side up.

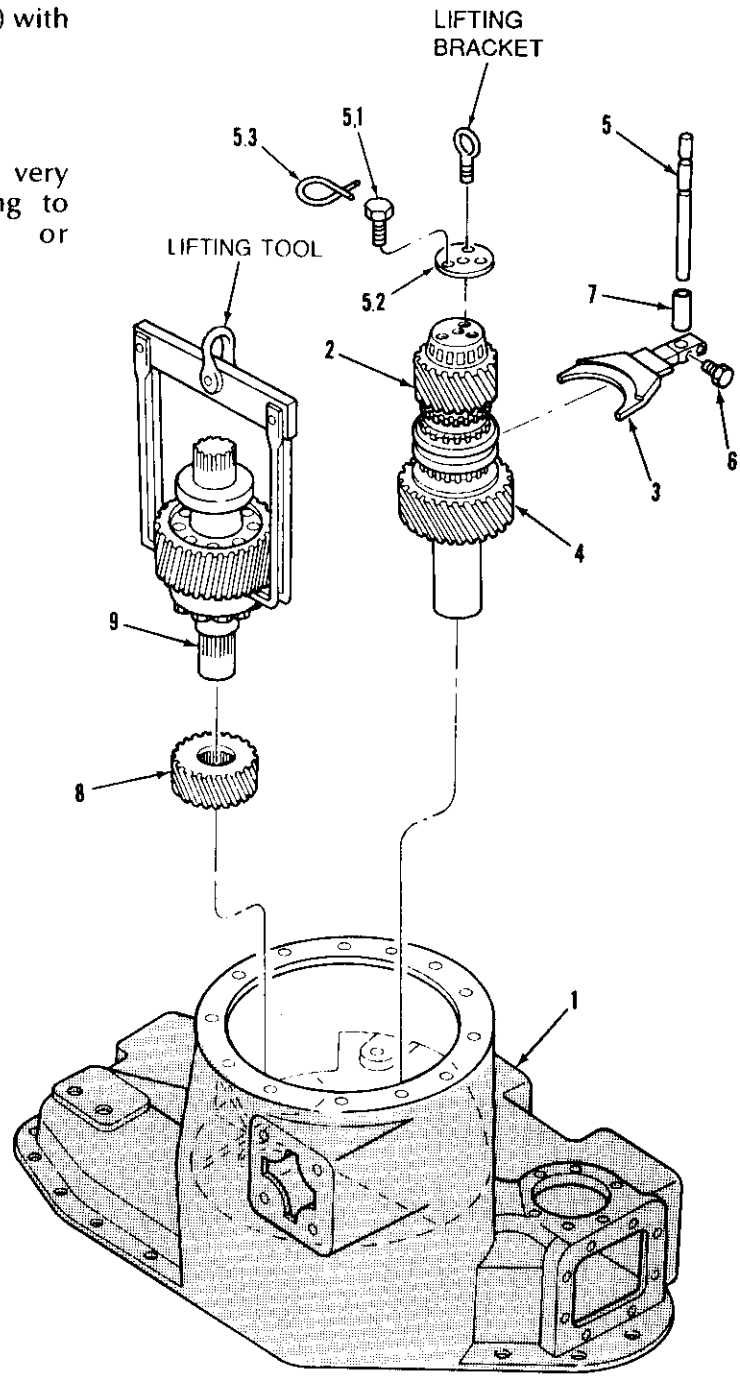
WARNING

Differential assembly (9) is very heavy. Use care when lifting to prevent personal injury or equipment damage.



1. FRONT HOUSING
2. 2-SPEED SHIFT SHAFT
3. SHIFT FORK
4. SLIDING CLUTCH
5. SHIFT FORK SHAFT
5.1. CAPSCREW (3)
5.2. RETAINER PLATE
5.3. LOCKWIRE
6. CAPSCREW (2)
7. SLEEVE
8. GEAR
9. DIFFERENTIAL ASSEMBLY

(8) Attach lifting tool to differential assembly (9) and install through gear (8).



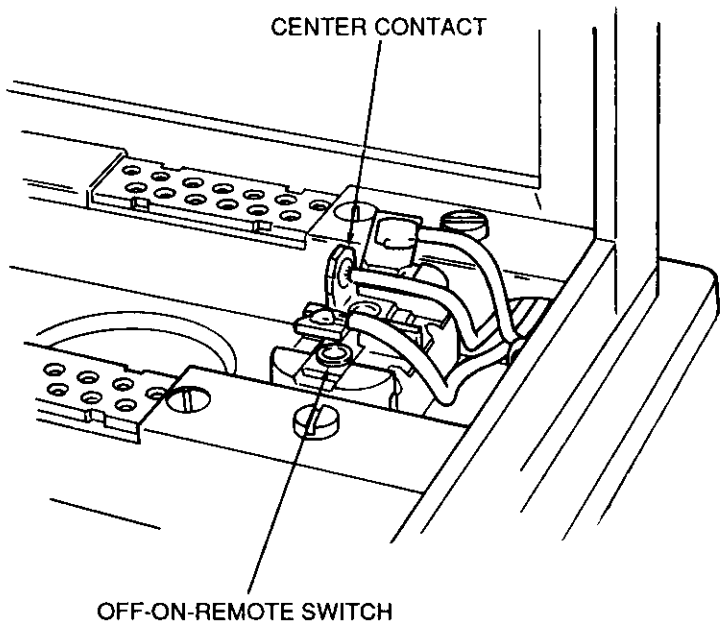
TA 298898

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1.1. REMOTE CONTROL DOES NOT WORK (Continued)

Test 4. Check for 12 to 14 volts at ouput terminals on power converter.

- If 12 to 14 volts are present, go to Test 5.
- If 12 to 14 volts are not present, replace power converter. Refer to paragraph 18-46 or 18-47, (TM 2320-34/13, TM 9-2320-297-34).



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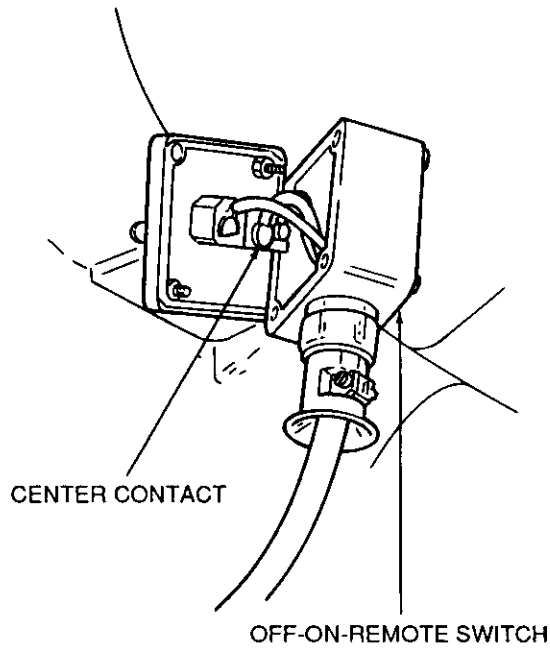


MK15

Test 5. Check center contact of OFF-ON-REMOTE switch for 12 to 14 volts.

- If 12 to 14 volts are present, go to Test 6.
- If 12 to 14 volts are not present, repair or replace wire between power converter and switch. Refer to paragraph 7-45, (TM 2320-20/12, TM 9-2320-297-20).

8-9. TRANSFER CASE ASSEMBLY

THIS TASK COVERS: a. Differential/2-Speed Shift Shaft Installation
b. Front Cover/Declutch Housing Installation
c. Shaft Installation
d. Rear Housing Installation
e. Bearing Cover Installation/Adjustment

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Differential lifting tool (2CS639)
2-speed shift shaft lifting bracket (2CS638)
Dial indicator (J 7872)
Temporary spacer (2CS640)
Flange holding bar (J 3453)
Spanner nut socket (2CS641)

Materials/Parts

Adhesive (item 3, Appendix C)
Adhesive, silicone sealant (item 7, Appendix C)
Lockwire (item 33, Appendix C)
Sealant (item 57, Appendix C)
Sealer, lubricating and wicking (item 63, Appendix C)
Lockwasher (NSN 5310-00-186-0977) item 35
Cotter pin (2) (MS24665-285)
Repair kit (NSN 2520-01-188-1898)

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Transfer case disassembled (para 8-8).

General Safety Instructions

Transfer case parts are very heavy. Be careful when lifting or moving parts.

---

a. Differential/2-Speed Shift Shaft Installation

(1) Position front housing (1) with front up.

WARNING

Two-speed shift shaft (2) is very heavy. Use care when lifting to prevent personal injury or equipment damage.

(2) Attach lifting bracket to 2-speed shift shaft (2) and install into front housing (1).

(3) Install shift fork (3) onto sliding clutch (4) as shown.

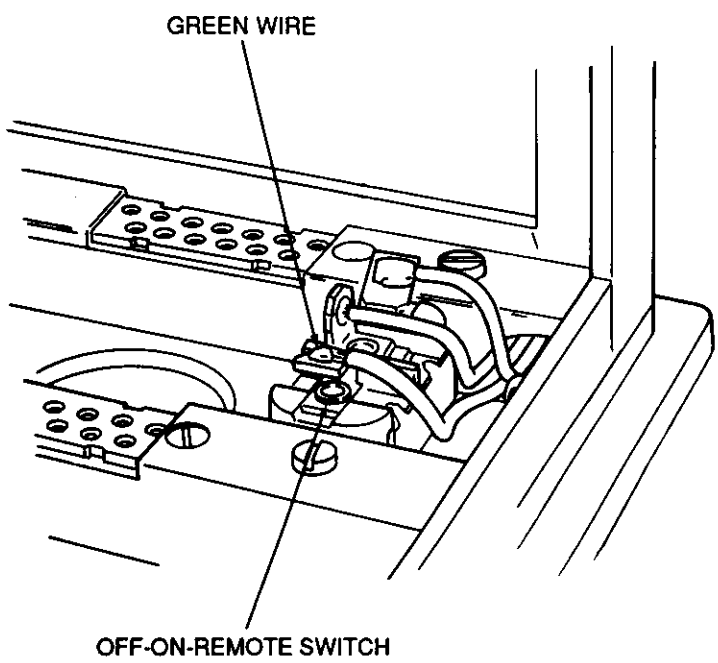
(4) Install shift fork shaft (5) through front housing (1) and into shift fork (3).

(4.1) Remove lift bracket.

(4.2) Coat threads of three capscrews (5.1) with adhesive and install retainer plate (5.2) and capscrews (5.1). Torque capscrews (5.1) to 107 foot-pounds (145 N·m).

(4.3) Install new lockwire (5.3) through heads of capscrews (5.1) in pattern shown.

1.1. REMOTE CONTROL DOES NOT WORK (Continued)



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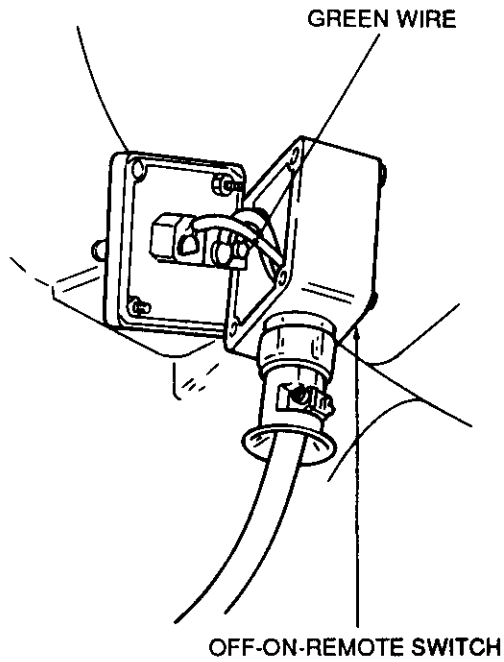


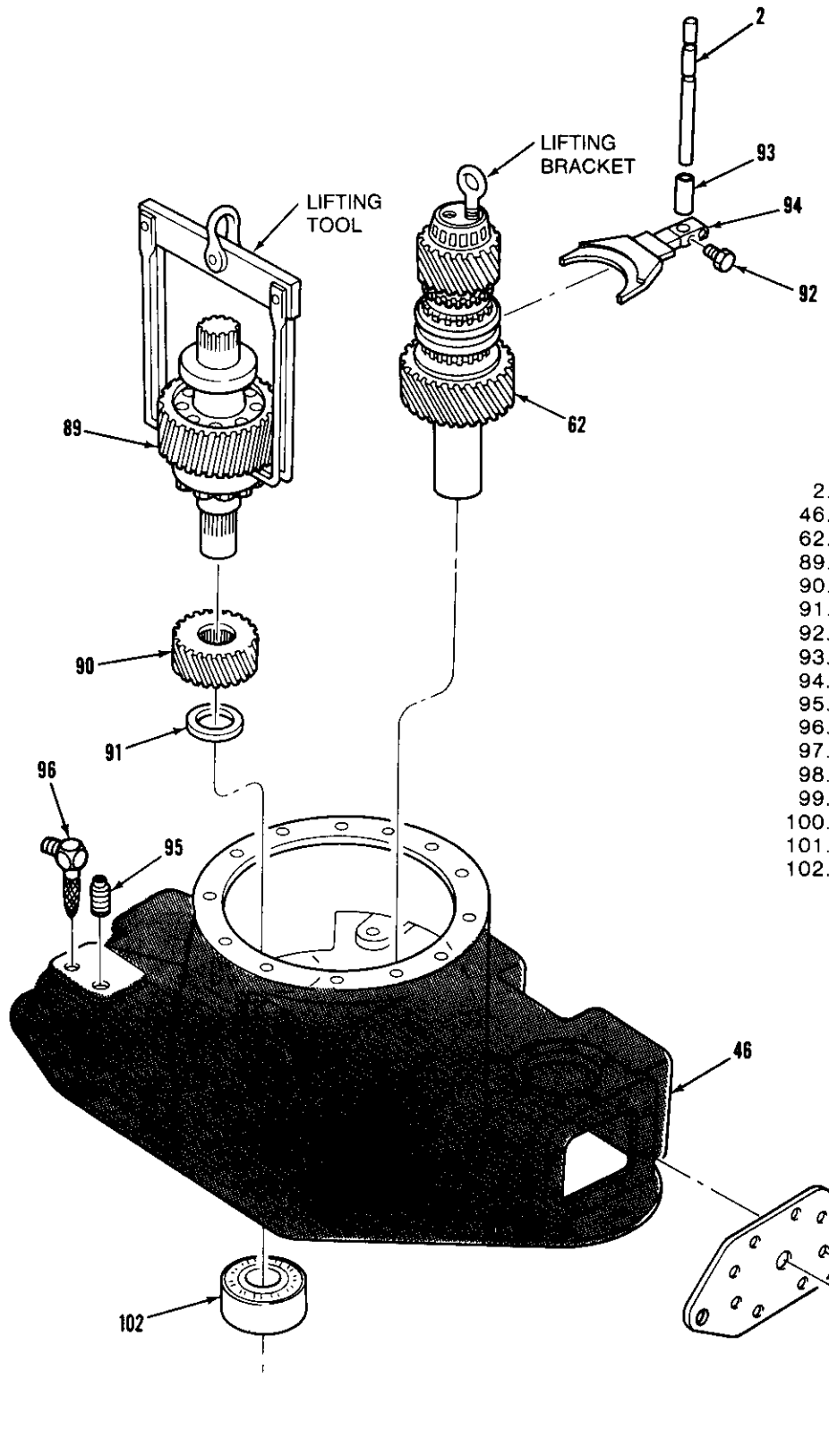
MK15

Test 6. Check for 12 to 14 volts at switch terminal where green wire is connected.

- If 12 to 14 volts are present, go to Test 7.
- If 12 to 14 volts are not present, replace MANUAL-OFF-REMOTE switch. Refer to paragraph 18-48 or 18-54, (TM 2320-34/13, TM 9-2320-297-34).

Test 7. Remove cover on hand controller and tilt back. Check for 12 to 14 volts on green wire connected to red indicator light.

- If 12 to 14 volts are present, go to Test 8.
- If 12 to 14 volts are not present, check remote controller wiring harness or replace remote control cable.



2. SHIFT FORK SHAFT
46. FRONT HOUSING
62. 2-SPEED SHIFT SHAFT
89. DIFFERENTIAL ASSEMBLY
90. GEAR
91. SPACER
92. CAPSCREW (2)
93. SLEEVE
94. SHIFT FORK
95. FILL PLUG
96. STRAINER
97. CAPSCREW (8)
98. PTO COVER
99. BREATHER
100. REDUCER
101. NIPPLE
102. BEARING

TA 298897

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1.1. REMOTE CONTROL DOES NOT WORK (Continued)

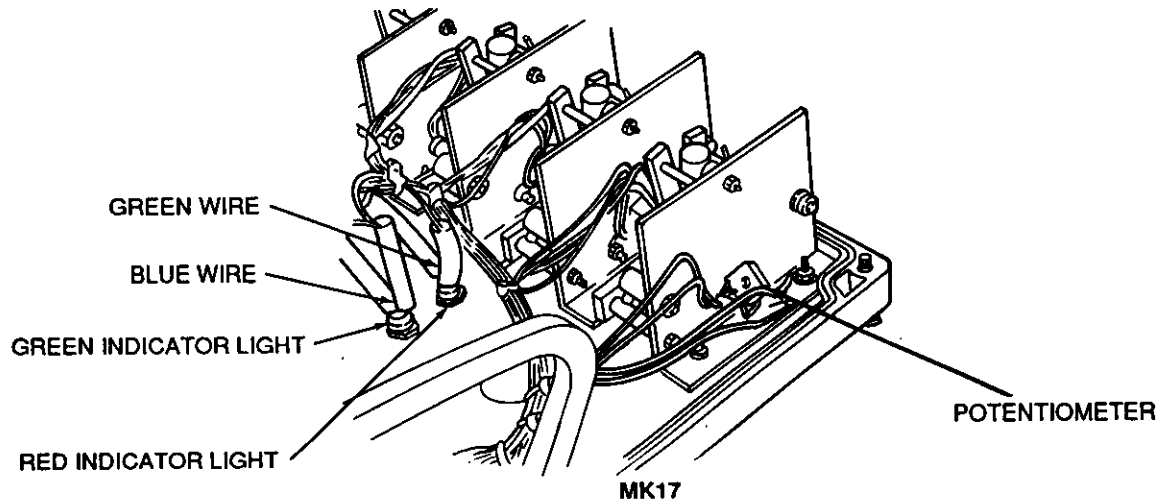
Test 8.

NOTE

Operate both deadman switches one at a time when performing test.

Depress deadman switch. Check for 12 to 14 volts on blue wire connected to green indicator light.

- If 12 to 14 volts are present, go to Test 9.
- If 12 to 14 volts are not present, repair defective wire harness in hand controller or replace defective deadman switch(s). Refer to paragraph 18-51 or 18-52 (TM 2320-34/13, TM 9-2320-297-34).



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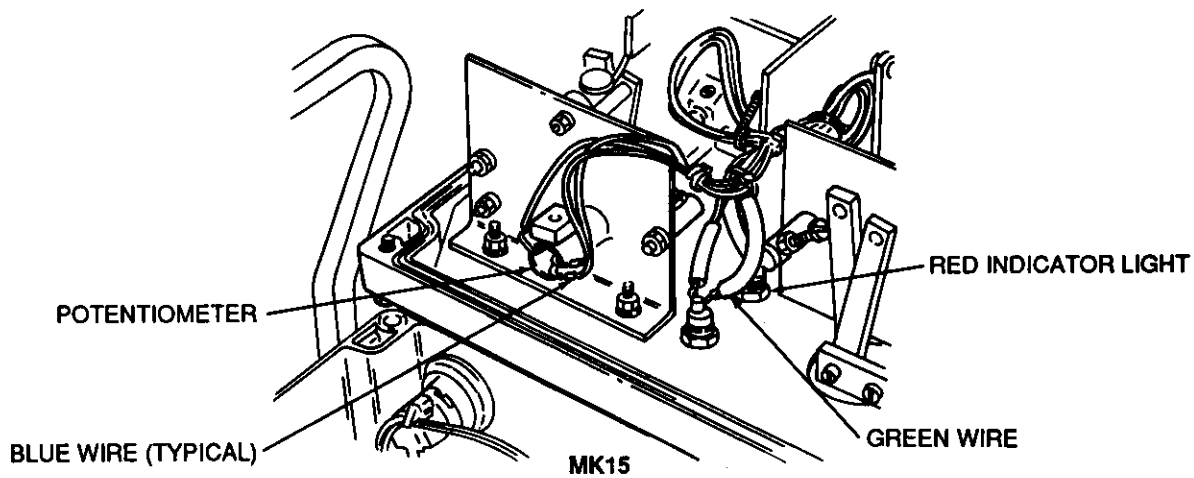


MK15

8-8. TRANSFER CASE DISASSEMBLY (Continued)

e. Differential/2-Speed Shift Shaft Removal

WARNING

Differential assembly (89) is very heavy. Use care when lifting to prevent injury to personnel or damage to equipment.

CAUTION

Gear (90) and spacer (91) may fall off and be damaged when differential assembly (89) is removed.

(1) Attach lifting tool to differential assembly (89).

(2) Using a jack, apply pressure to shaft of differential assembly (89) from below front housing (46), while lifting differential assembly (89). Refer to paragraph 8-12 for repair.

(3) Remove gear (90) and spacer (91) from front housing (46).

(4) Remove two capscrews (92), sleeve (93), shift fork shaft (2), and shift fork (94).

NOTE

Lockwire and one capscrew must be removed to allow installation of lifting bracket.

(5) Attach lifting bracket to 2-speed shift shaft (62) and remove. Refer to paragraph 8-13 for repair.

(6) Remove fill plug (95) and strainer (96).

(7) Remove eight capscrews (97) and PTO cover (98).

(8) If needed, remove breather (99), reducer (100), and nipple (101).

(9) Remove bearing (102).

f. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all gears, bearings, and clutches for damage.

(3) Inspect all threaded parts for damage.

(4) Inspect housings and covers for damage.

(5) Inspect all other parts. Refer to paragraph 2-7 and repair or replace all parts failing inspection.

END OF TASK

NOTE

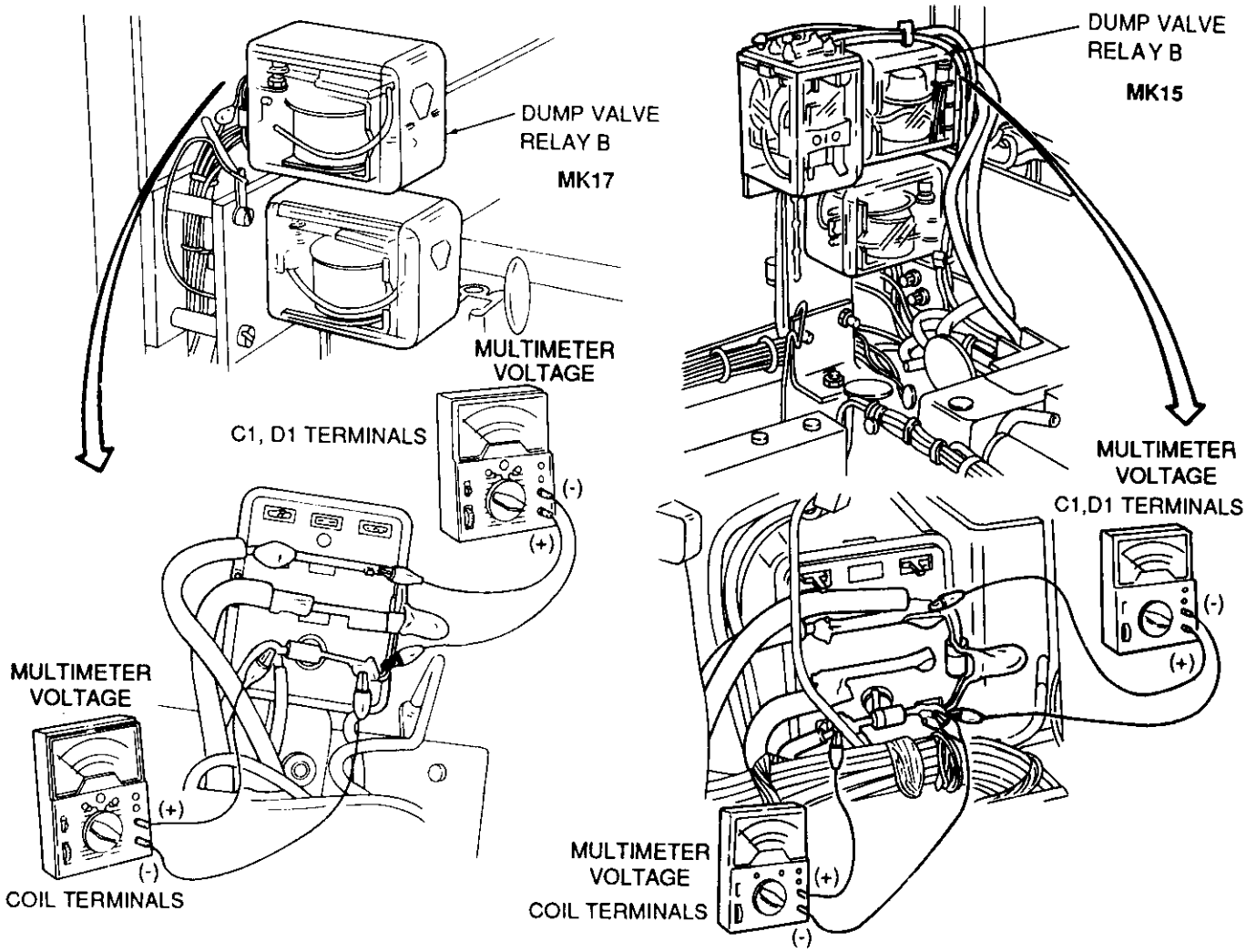
Follow-On Maintenance

TM 2320-34/13	Assemble transfer case
TM 9-2320-297-34	(para 8-9).

1.1. REMOTE CONTROL DOES NOT WORK (Continued)

Test 9. Depress deadman switch. Check for 12 to 14 volts across dump valve relay B coil terminals.

- If 12 to 14 volts are present, go to Test 10.
- If 12 to 14 volts are not present, replace remote control cable.



Test 10. Depress deadman switch. Check for 12 to 14 volts across C1 and D1 terminals on dump valve relay B.

- If 12 to 14 volts are present, go to Test 11.
- If 12 to 14 volts are not present, replace dump valve relay B. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34).

d. Declutch Housing/Front Cover Removal

(1) Position front housing (46) with front up.

(2) Remove six capscrews (69) and cover (70).

(3) Remove oil seal (71) and bearing cup (72). Discard oil seal (71) and tag bearing cup (72) for location.

(4) Remove two capscrews (73) and oil cover (74).

(5) Remove plug (75), spring (76), and ball (77).

(6) Remove eyelet (78) and locknut (79) from shift fork shaft (2).

NOTE

Mark surface of front cover (82) to indicate position of clutch shaft end of declutch housing (81).

(7) Remove 10 capscrews (80) and declutch housing (81). To repair declutch housing (81), refer to paragraph 8-10 in this manual.

CAUTION

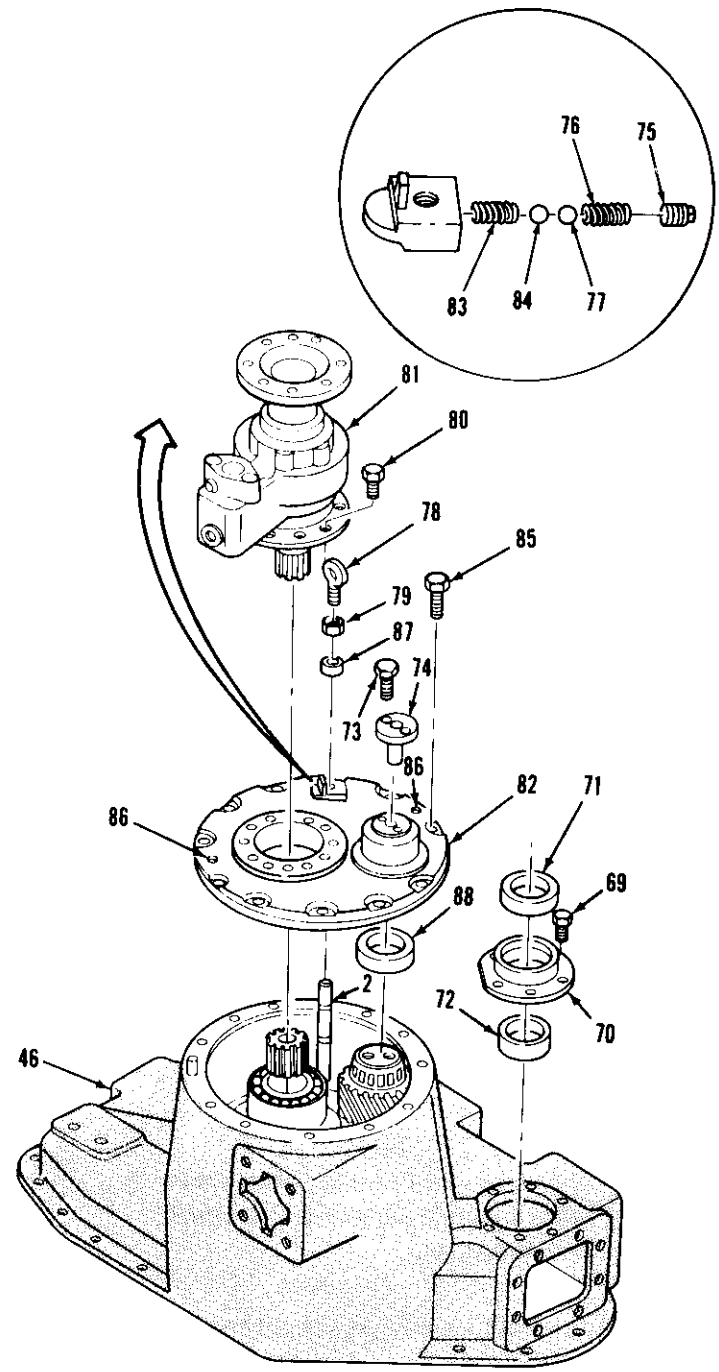
Remove front cover (82) slowly. Spring (83) and ball (84) will fall out and may become lost.

(8) Remove 18 capscrews (85). Install two capscrews (85) in threaded holes (86), turning clockwise evenly until front cover (82) comes loose.

(9) Remove front cover (82), ball (84), and spring (83).

(10) Remove oil seal (87) and discard.

(11) If needed, remove bearing cup (88) from front cover (82).

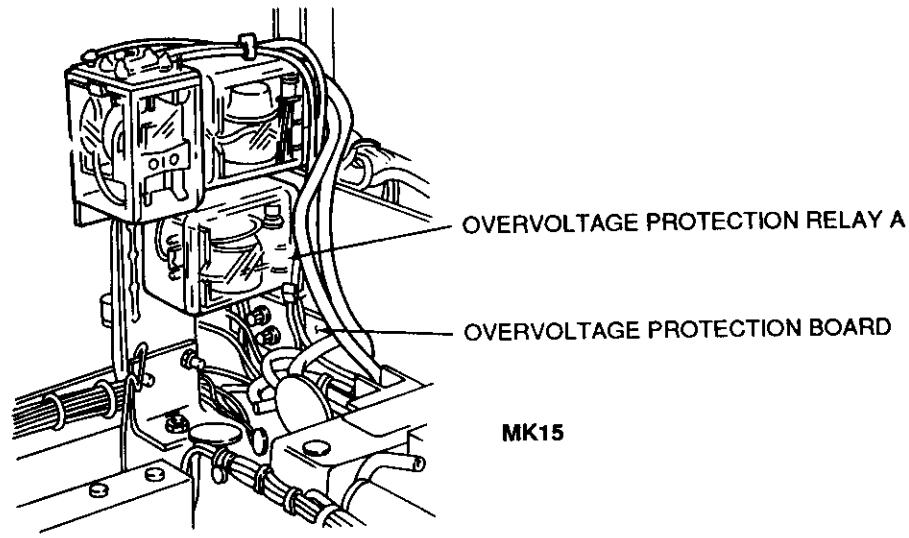


2. SHIFT FORK SHAFT
46. FRONT HOUSING
69. CAPSCREW (6)
70. COVER
71. OIL SEAL
72. BEARING CUP
73. CAPSCREW (2)
74. OIL COVER
75. PLUG
76. SPRING
77. BALL
78. EYELET
79. LOCKNUT
80. CAPSCREW (10)
81. DECLUTCH HOUSING
82. FRONT COVER
83. SPRING
84. BALL
85. CAPSCREW (18)
86. THREADED HOLE (2)
87. OIL SEAL
88. BEARING CUP

TA 298896

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

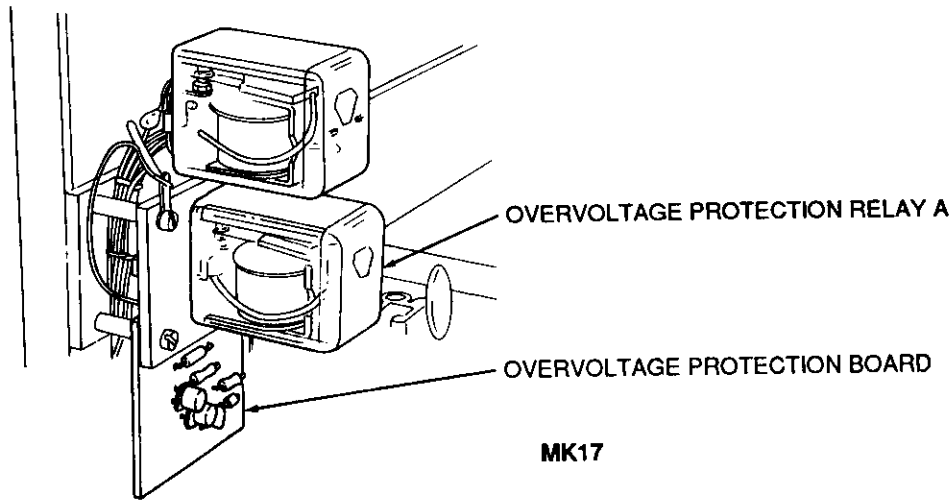
1.1. REMOTE CONTROL DOES NOT WORK (Continued)



MK15

Test 11. Depress deadman switch. Check that relay A contacts can be observed pulling in.

- If relay A contacts pull in, go to Test 12.
- If relay A contacts do not pull in, replace overvoltage protection board. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34).



MK17

Test 12. Depress deadman switch. Check for 12 to 14 volts at buss bar (input side of fuse holder).

- If 12 to 14 volts are present, go to Test 13.
- If 12 to 14 volts are not present, replace relay A. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34).

8-8. TRANSFER CASE DISASSEMBLY (Continued)

(12) Remove output shaft (53), idler shaft (54), and input shaft (55). Refer to paragraphs 8-11 and 8-14 for repair.

NOTE

- Attach flange holding bar to output flange (3) to prevent gear (60) from moving.
- Store retainer plate (57) for later use during reassembly.

(13) Remove lockwire (37), three capscrews (56), and retainer plate (57). Discard lockwire (37).

(14) Using a puller, remove bearing cone (58), spacer (59), and gear (60).

(15) Remove spacer (61).

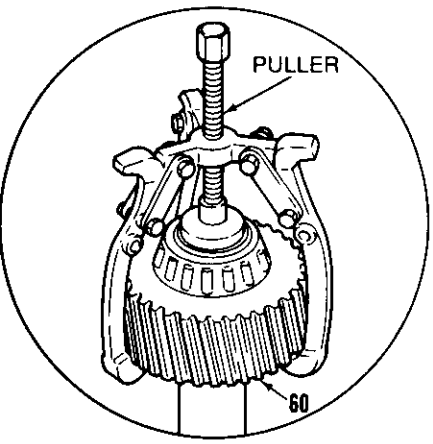
(16) Install temporary spacer over 2-speed shift shaft (62).

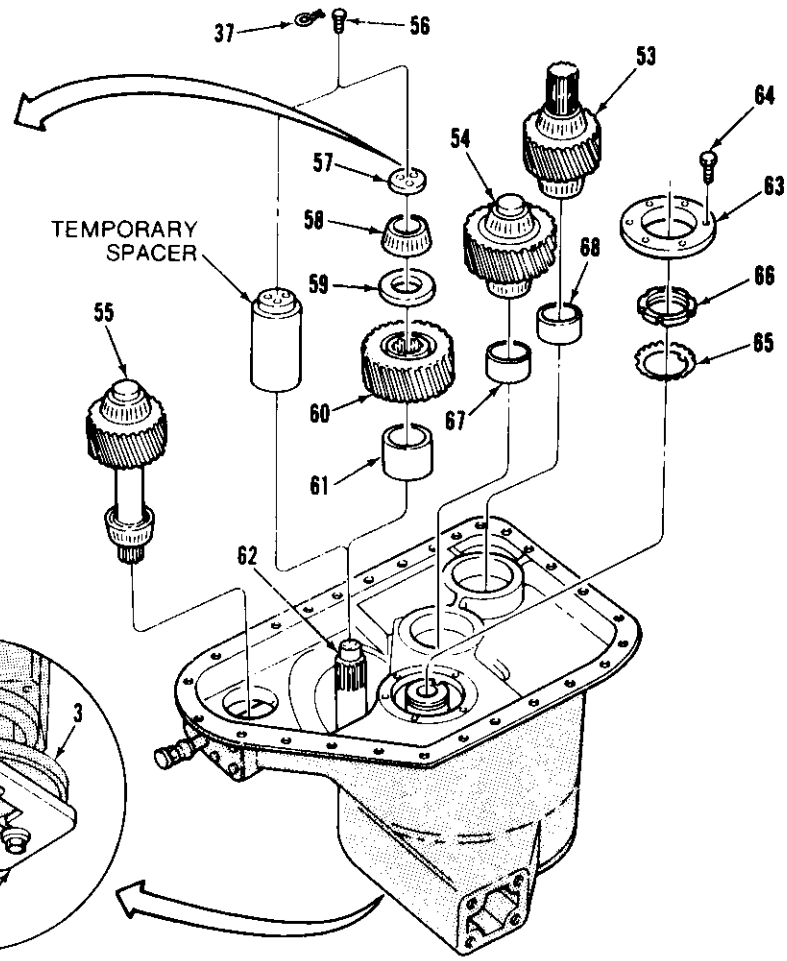
(17) Install three capscrews (56). Tighten securely.

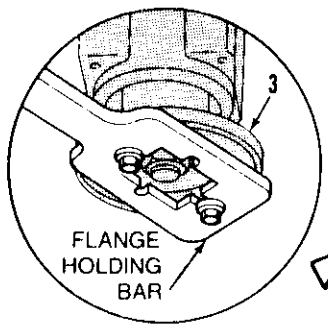
(18) Mark cover (63) for position during assembly. Remove six capscrews (64) and cover (63).

(19) Bend locking tab of lockwasher (65) down and using spanner nut socket, remove locknut (66) and lockwasher (65). Discard lockwasher (65).

(20) Remove and tag bearing cups (67 and 68) with matching shaft names for identification.







3. OUTPUT FLANGE
37. LOCKWIRE
53. OUTPUT SHAFT
54. IDLER SHAFT
55. INPUT SHAFT
56. CAPSCREW (3)
57. RETAINER PLATE
58. BEARING CONE
59. SPACER
60. GEAR
61. SPACER
62. 2-SPEED SHIFT SHAFT
63. COVER
64. CAPSCREW (6)
65. LOCKWASHER
66. LOCKNUT
67. BEARING CUP
68. BEARING CUP

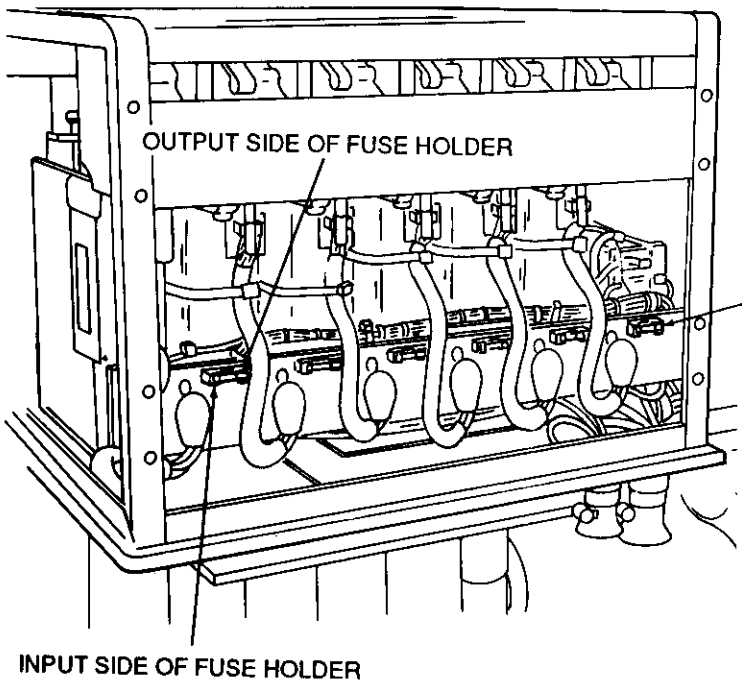
TA 298895

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

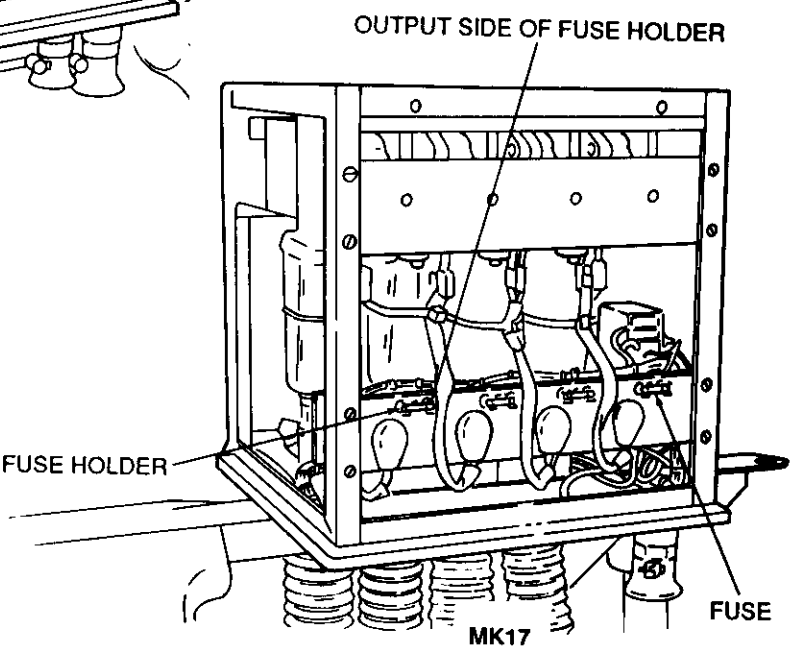
1.1. REMOTE CONTROL DOES NOT WORK (Continued)

Test 13. Depress deadman switch. Check for 12 to 14 volts at output side of fuse.

- If 12 to 14 volts are present, go to Test 14.
- If 12 to 14 volts are not present, replace fuse. Refer to paragraph 18-47 or 18-48 (TM 2320-34/13, TM 2320-297-34).



MK15



MK17

Test 14. Check that motor drive is not overdriven. An overdriven motor drive will engage one of the two micro switches mounted on the motor mounting bar on the top side or bottom side.

- If motor is not overdriven, go to Test 19.
- If motor is overdriven, go to Test 15.

c. Housing Disassembly/Shaft Removal

(1) Remove 23 capscrews (40), three capscrews (41), and restraint bracket (42).

(2) Attach lifting device to rear housing (7).

NOTE

When removing rear housing (7), bearing (43), and differential shaft (44) may stay in rear housing (7).

(3) Thread two capscrews (40) into threaded holes (45) in front housing (46). Turn capscrews (40) clockwise and raise rear housing (7), evenly.

(4) Install lifting device on rear housing (7) and raise rear housing (7) eight inches (20.3 cm).

(5) Place two 4-inch (10.15 cm) wooden blocks between front housing (46) and rear housing (7). Lower rear housing (7) onto the wooden blocks.

(6) Using a brass drift, drive differential shaft (44) from bearing (43).

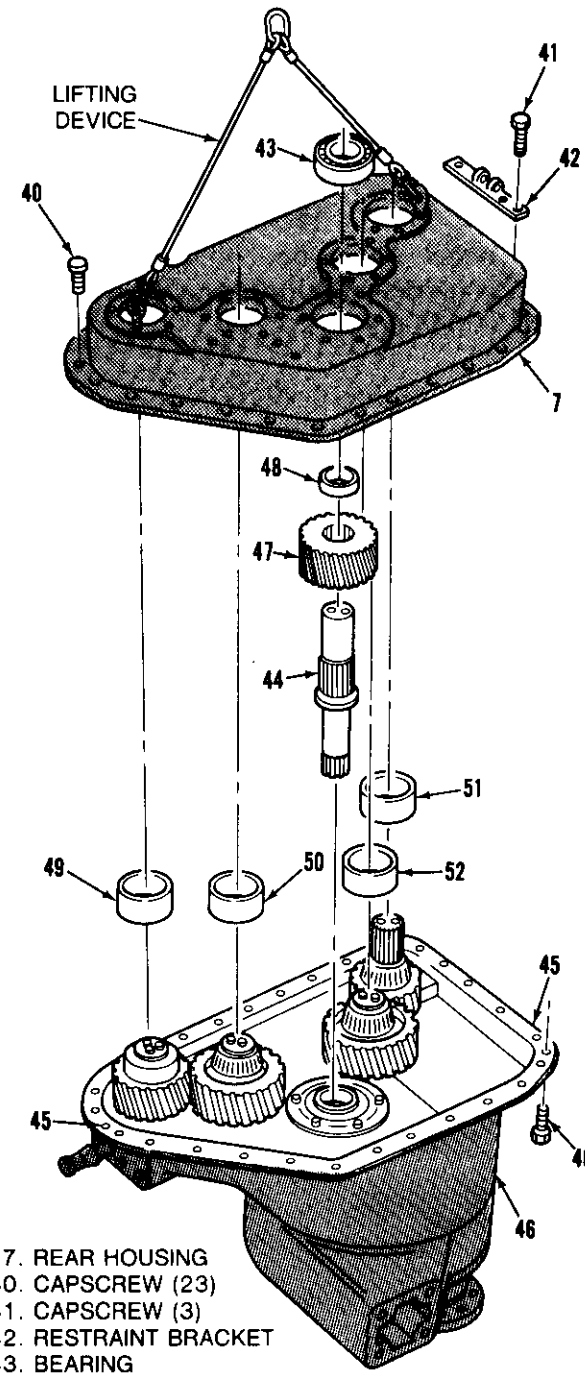
(7) Remove rear housing (7).

(8) Remove differential shaft (44), gear (47), and spacer (48).

(9) Remove bearing (43) from rear housing (7).

(10) If damaged, remove bearing cups (49 thru 52) from rear housing (7).

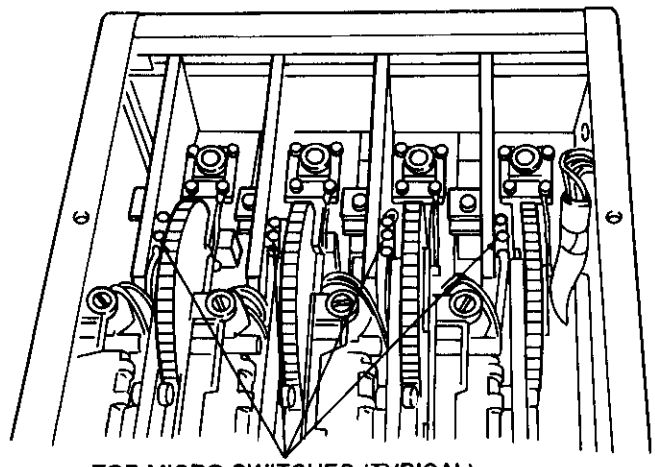
(11) Remove two capscrews (40) used to separate housings (7 and 46).



7. REAR HOUSING
40. CAPSCREW (23)
41. CAPSCREW (3)
42. RESTRAINT BRACKET
43. BEARING
44. DIFFERENTIAL SHAFT
45. THREADED HOLE (2)
46. FRONT HOUSING
47. GEAR
48. SPACER
49. BEARING CUP
50. BEARING CUP
51. BEARING CUP
52. BEARING CUP

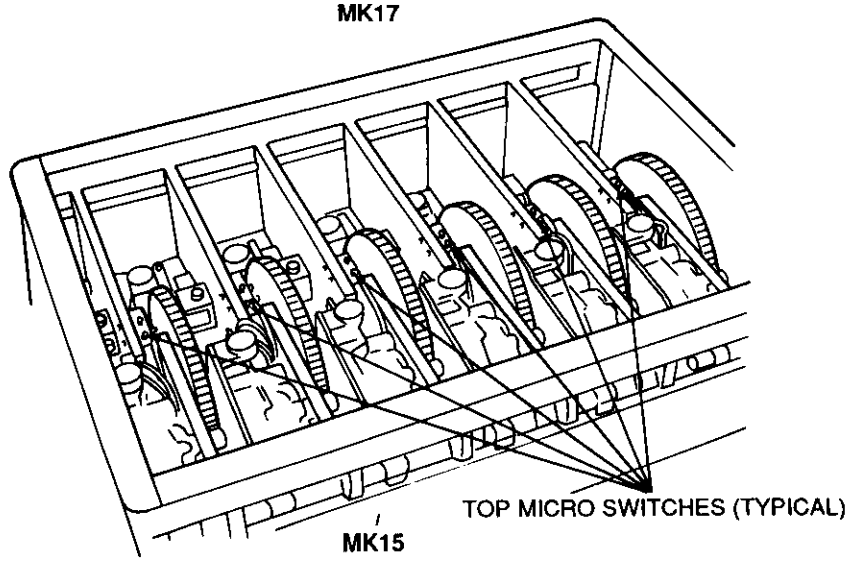
TA 298894

1.1. REMOTE CONTROL DOES NOT WORK (Continued)



TOP MICRO SWITCHES (TYPICAL)

MK17



TOP MICRO SWITCHES (TYPICAL)

MK15

Test 15. Disconnect remote control cable and install reset tool. Press red button briefly and release. Check that overdriven motor drive returns to the neutral position.

- If motor drive returns to neutral, adjust neutral position and motor drive stroke. Refer to paragraph 18-53, (TM 2320-34/13, TM 9-2320-297-34).
- If motor drive does not return to neutral and remote system is from an MK17, replace the reset tool. Adjust neutral position and motor drive stroke, refer to paragraph 18-53, (TM 2320-34/13, TM 9-2320-297-34).
- If motor drive does not return to neutral, and remote system is from an MK15, go to Test 16.

8-8. TRANSFER CASE DISASSEMBLY (Continued)

(10) Remove speedometer sending unit (26) and reducer (27).

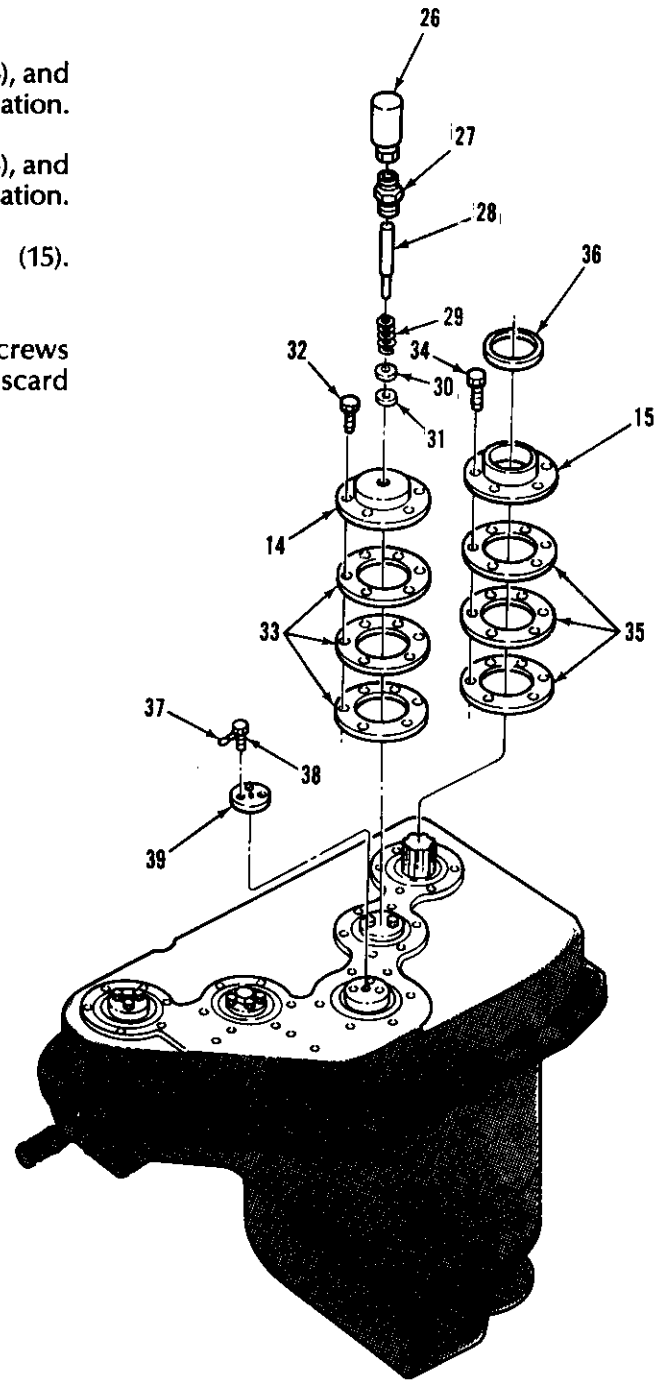
(11) Remove drive shaft (28), spring (29), steel washer (30) and fiber washer (31).

(12) Remove six capscrews (32), cover (14), and shims (33). Tag shims (33) for identification.

(13) Remove six capscrews (34), cover (15), and shims (35). Tag shims (35) for identification.

(14) Remove oil seal (36) from cover (15). Discard oil seal (36).

(15) Remove lockwire (37), three capscrews (38), and retainer plate (39). Discard lockwire (37).



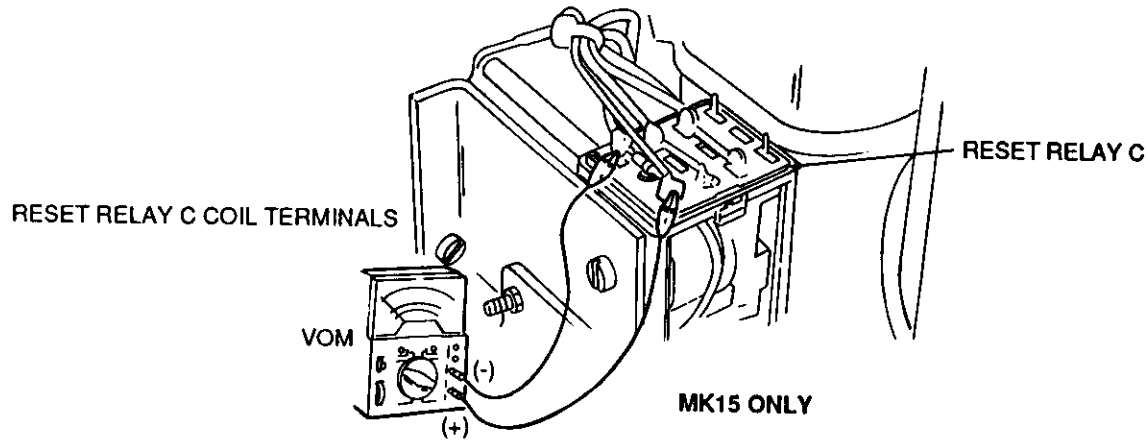
14. COVER
15. COVER
26. SPEEDOMETER SENDING UNIT
27. REDUCER
28. DRIVE SHAFT
29. SPRING
30. STEEL WASHER
31. FIBER WASHER
32. CAPSCREW (6)
33. SHIMS (A/R)
34. CAPSCREW (6)
35. SHIMS (A/R)
36. OIL SEAL
37. LOCKWIRE
38. CAPSCREW (3)
39. RETAINER PLATE

TA 298893

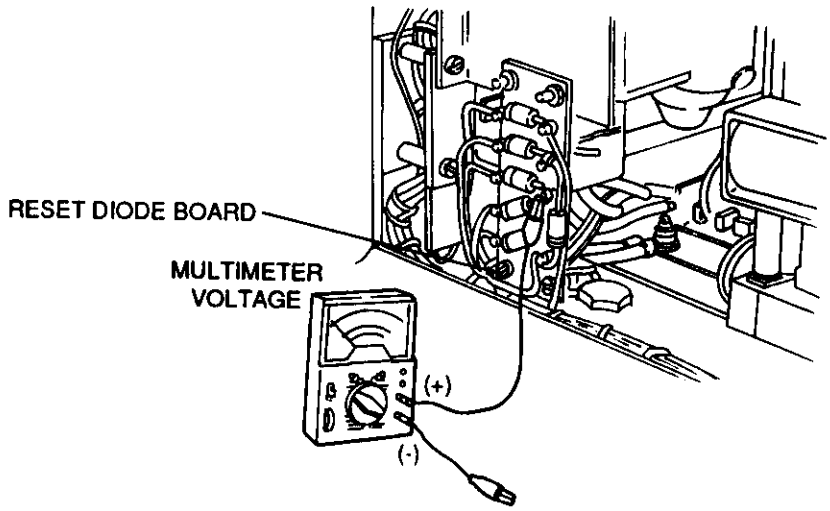
1.1. REMOTE CONTROL DOES NOT WORK (Continued)

Test 16. Install reset tool and connect a volt meter across coil terminals of reset relay C. Press red button briefly and release. Check for 12 to 14 volts across relay C coil terminals.

- If 12 to 14 volts are present, go to Test 17.
- If 12 to 14 volts are not present, replace reset tool.



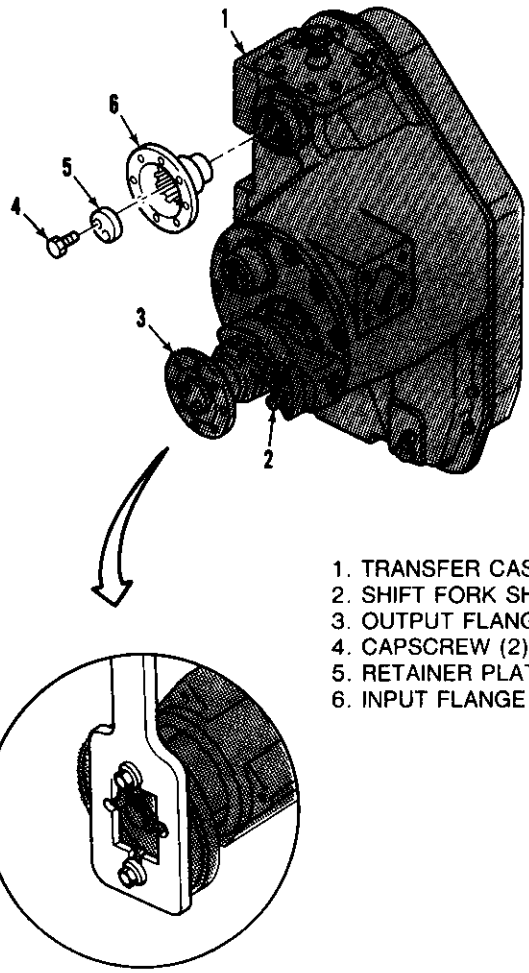
MK15 ONLY



MK15 ONLY

Test 17. Connect a volt meter at a common point on the reset diode board, and ground. Press red button on reset tool briefly and relese. Check for 12 to 14 volts.

- If 12 to 14 volts are present, go to Test 18.
- If 12 to 14 volts are not present, replace reset relay C. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34).



1. TRANSFER CASE
2. SHIFT FORK SHAFT
3. OUTPUT FLANGE
4. CAPSCREW (2)
5. RETAINER PLATE
6. INPUT FLANGE

b. Cover Removal

(1) Position transfer case (1) with rear housing (7) up.

(2) If still connected, remove cotter pin (8), pin (9), and restraint assembly (10). Discard cotter pin (8).

(3) Mark five covers (11 thru 15) for positioning during assembly.

(4) Have assistant hold output flange (3). Remove two capscrews (16) and end plate (17).

(5) Using a puller, remove output yoke (18).

NOTE

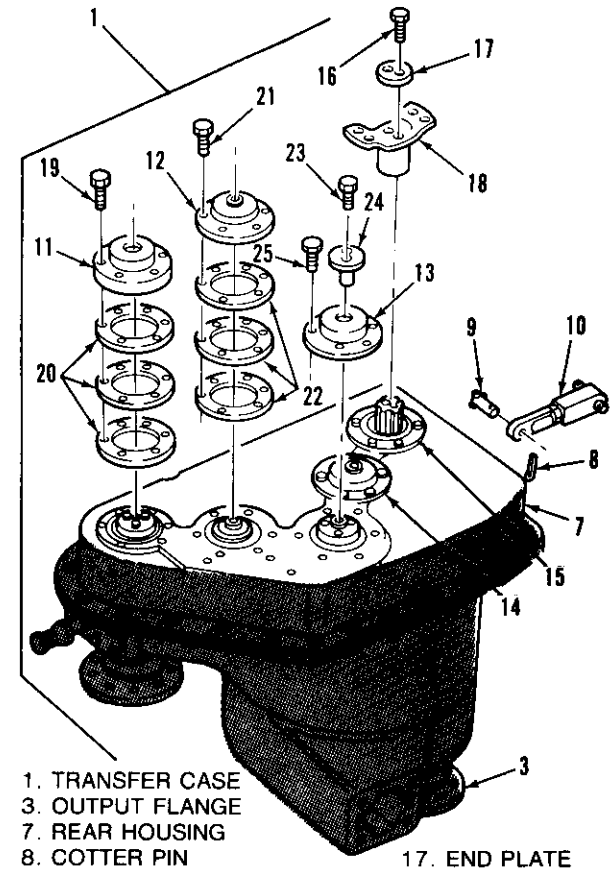
Number of shims may vary from the amount shown.

(6) Remove six capscrews (19), cover (11), and shims (20). Tag shims (20) for identification.

(7) Remove six capscrews (21), cover (12), and shims (22). Tag shims (22) for identification.

(8) Remove two capscrews (23) and oil cover (24).

(9) Remove six capscrews (25) and cover (13).



1. TRANSFER CASE
3. OUTPUT FLANGE
7. REAR HOUSING
8. COTTER PIN
9. PIN
10. RESTRAINT ASSEMBLY
11. COVER
12. COVER
13. COVER
14. COVER
15. COVER
16. CAPSCREW (2)
17. END PLATE
18. OUTPUT YOKE
19. CAPSCREW (6)
20. SHIMS (A/R)
21. CAPSCREW (6)
22. SHIMS (A/R)
23. CAPSCREW (2)
24. OIL COVER
25. CAPSCREW (6)

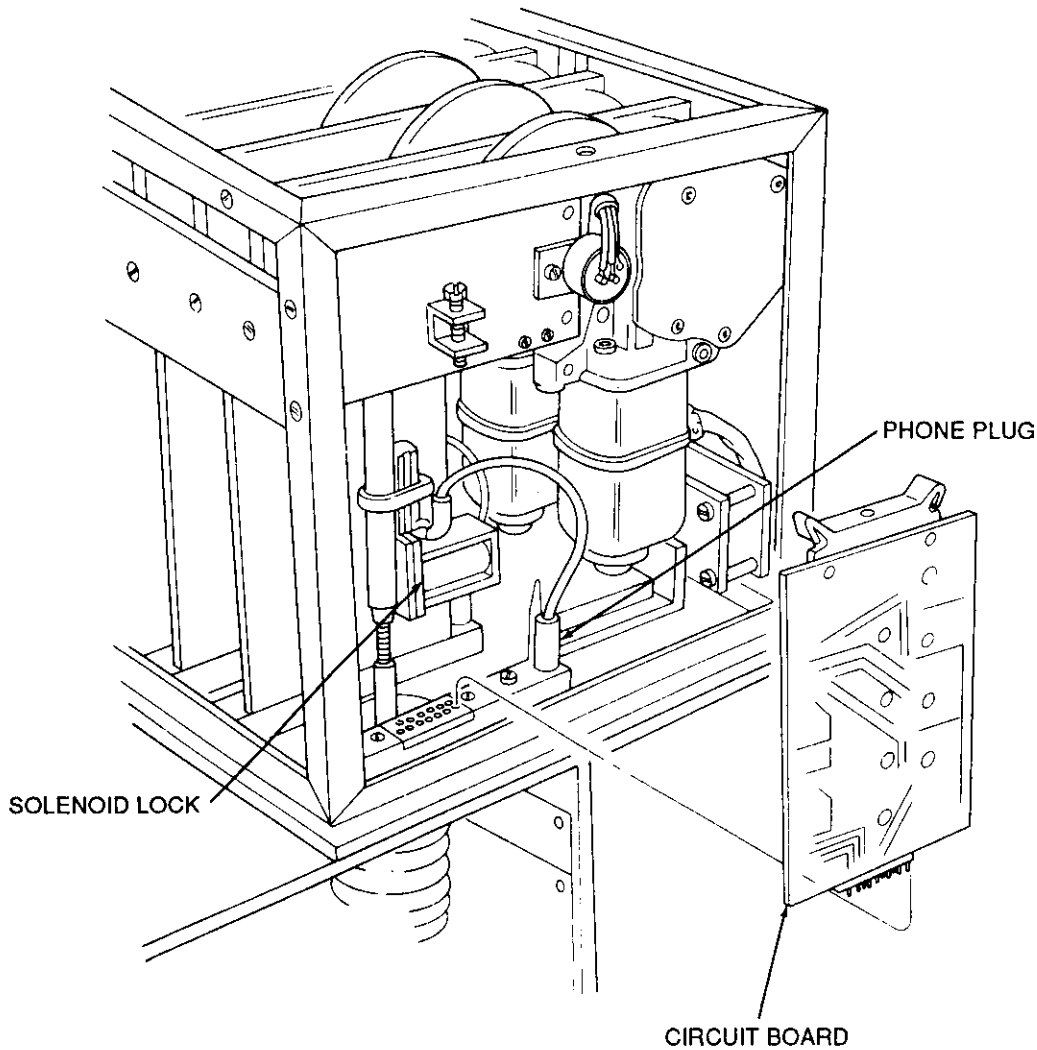
TA 298892

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1.1. REMOTE CONTROL DOES NOT WORK (Continued)

Test 18. Briefly press and release red button on reset tool. Check that magnet locks actuator rod to motor drive.

- If actuator rod locks in, replace printed circuit board. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34). Recheck motor stroke, refer to paragraph 18-53, (TM 2320-34/13, TM 9-2320-297-34).
- If actuator rod does not lock in, check for loose connection at phone plug and jack, or replace solenoid lock assembly. Refer to paragraph 18-47 or 18-48 (TM 2320-34/13, TM 9-2320-297-34).



SECTION IV. TRANSFER CASE DISASSEMBLY INTO SUBASSEMBLIES AND REASSEMBLY FROM SUBASSEMBLIES

8-8. TRANSFER CASE DISASSEMBLY

THIS TASK COVERS:
a. Input Flange Removal
b. Cover Removal
c. Housing Disassembly/Shaft Removal
d. Declutch Housing/Front Cover Removal
e. Differential/2-Speed Shift Shaft Removal
f. Cleaning/Inspection

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Flange holding bar (J 3453)
Spanner nut socket (2CS-641)
Lifting sling (J 25026)
Differential lifting tool (2CS639)
2-speed shift shaft lifting bracket (2CS638)
Temporary spacer (2CS640)

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Lubricant drained (para 9-3).
	Lubrication lines removed (para 9-6).
	Lockup air chamber removed (para 9-9).
	Lubrication pump removed (para 9-7).
TM 2320-34/13 TM 9-2320-297-34	Transfer case removed from vehicle (para 8-7).

General Safety Instructions

Transfer case parts are very heavy. Use care when lifting or moving parts. Mount the transfer case in a support stand to prevent injury.

---

a. Input Flange Removal

(1) Position transfer case (1) with top up.

(2) Install flange holding bar and push declutch shift fork shaft (2) in to lock differential.

(3) Have assistant hold output flange (3). Remove two capscrews (4) and retainer plate (5) from input flange (6).

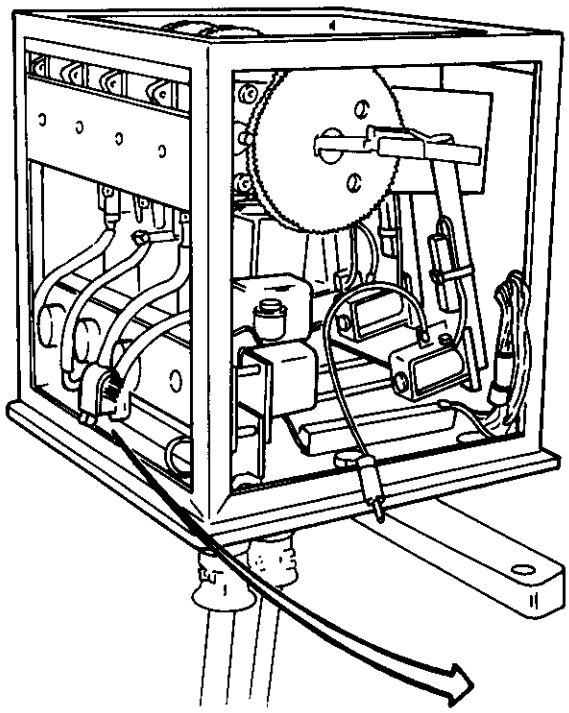
(4) Using a puller, remove input flange (6).

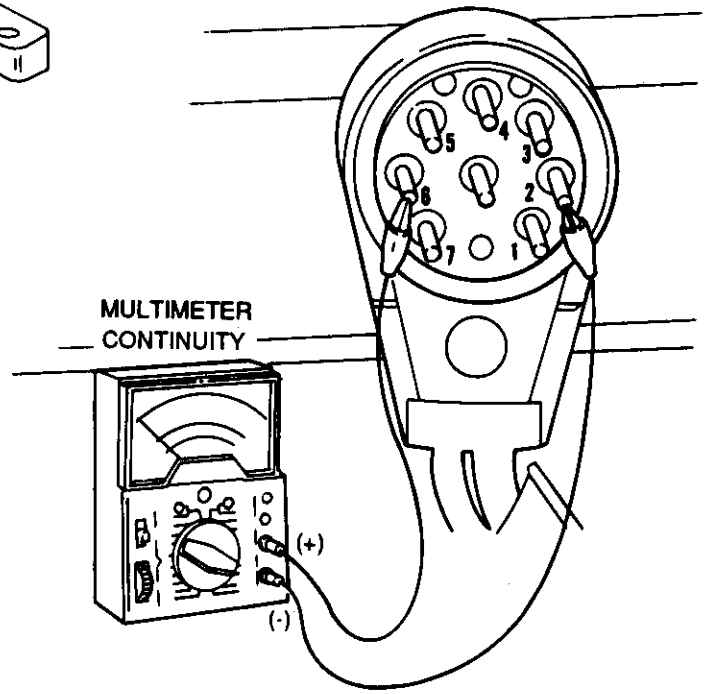
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

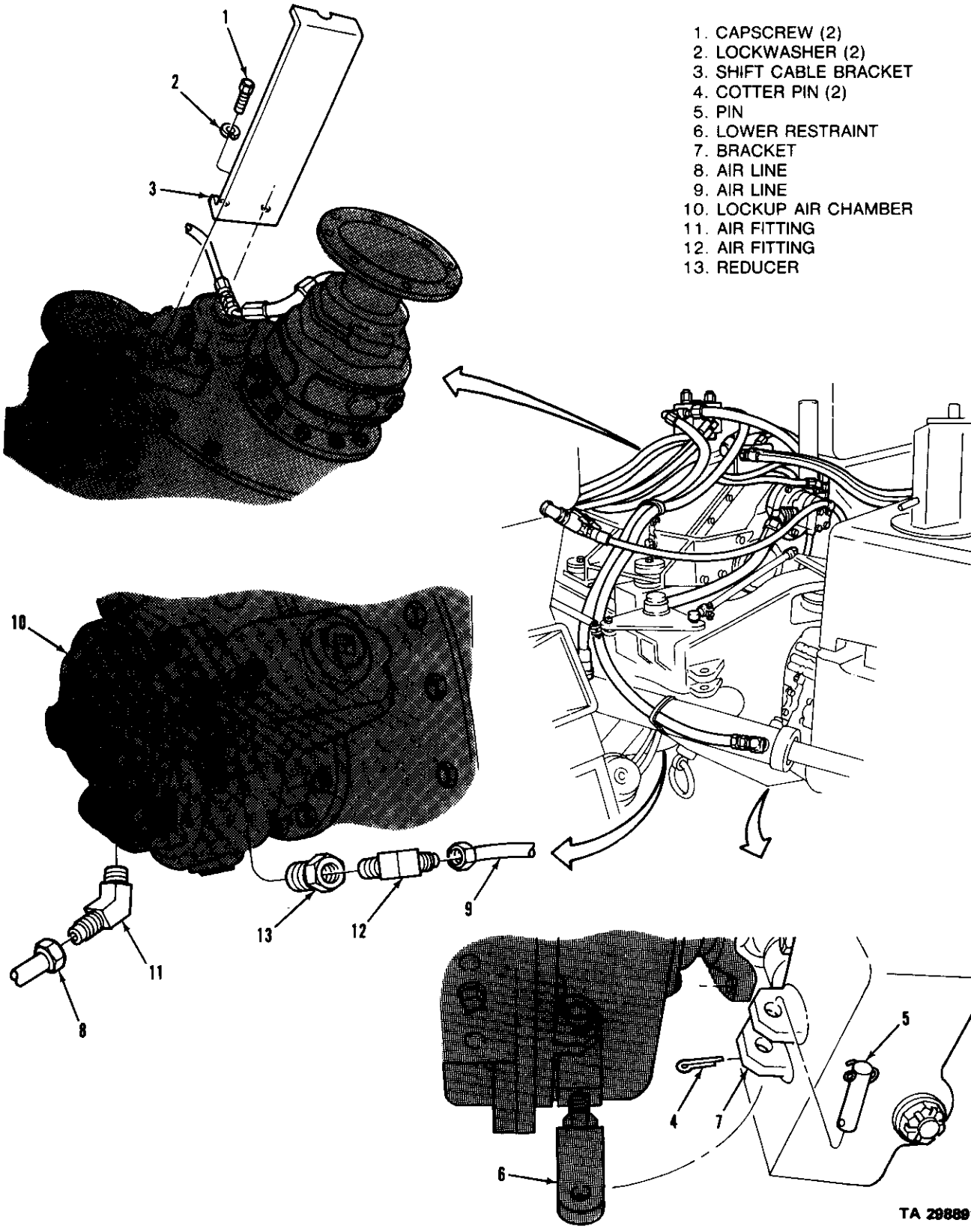
1.1. REMOTE CONTROL DOES NOT WORK (Continued)

Test 19. Unplug motor drive assembly at terminal board. Check continuity between pins 1 and 7, 2 and 6.

- If continuity exists thru all pins, go to Test 20.
- If no continuity exists, replace motor drive assembly. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34).






1. CAPSCREW (2)
2. LOCKWASHER (2)
3. SHIFT CABLE BRACKET
4. COTTER PIN (2)
5. PIN
6. LOWER RESTRAINT
7. BRACKET
8. AIR LINE
9. AIR LINE
10. LOCKUP AIR CHAMBER
11. AIR FITTING
12. AIR FITTING
13. REDUCER
1
2
3
10
13
12
9
11
8
5
4
7
6
TA 29889

MALFUNCTION TEST OR INSPECTION	CORRECTIVE ACTION
Test 20. Reconnect motor drive assembly and depress deadman switch. Check that solenoid can be heard locking in on actuator rod.	• If solenoid locks in, replace printed circuit board. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34). • If solenoid does not lock in, replace motor drive assembly. Refer to paragraph 18-47 or 18-48, (TM 2320-34/13, TM 9-2320-297-34).

END OF TEST

8-7. TRANSFER CASE REPLACEMENT (Continued)

(14) Apply sealant to threads and install reducer (13) and two air fittings (11 and 12) into lockup air chamber (10).

(15) Install two air lines (8 and 9) onto lockup air chamber (10).

(16) Install shift cable bracket (3), two new lockwashers (2), and two capscrews (1).

(17) Install lower restraint (6), pin (5), and two new cotter pins (4) into bracket (7).

CAUTION

Be careful during installation of fiber washer (50), steel washer (51) and spring (52) to prevent them from falling inside transfer case.

(18) Install fiber washer (50), steel washer (51) and spring (52) with drive shaft (53).

(19) Install reducer (54). Tighten reducer (54) securely.

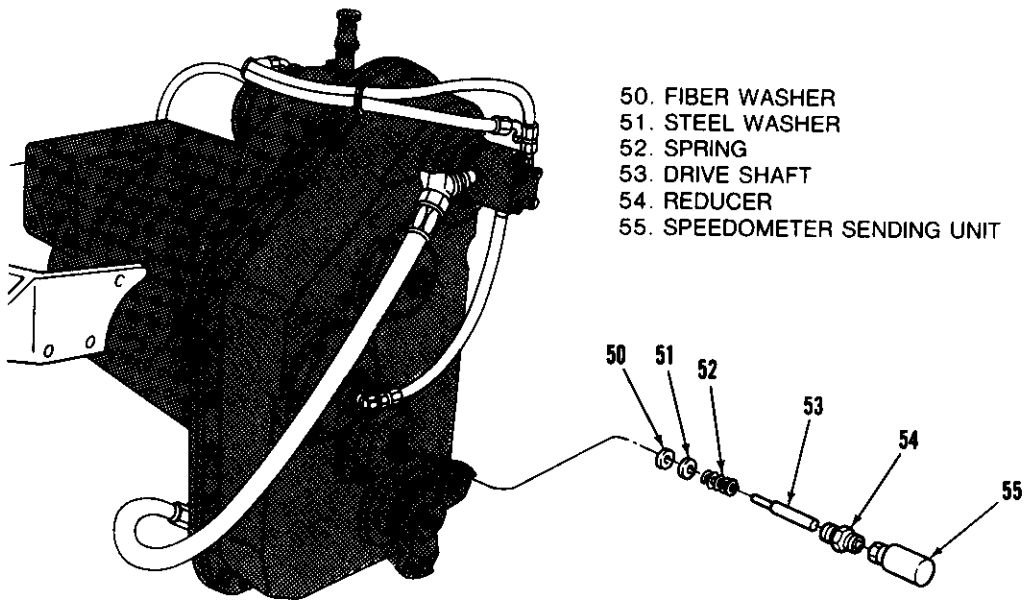
(20) Install speedometer sending unit (55). Tighten securely.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-10/11 TM 9-2320-297-10	Install spare tire (para 3-8).
TM 2320-20/12 TM 9-2320-297-20	Install 2-speed shift cable (para 9-4).
	Install propeller shafts (para 10-3).
	Install cardan joint (para 10-4).
	Install access panels (para 18-14, items 28 and 29).
TM 2320-34/13 TM 9-2320-297-34	Install radiator and air reservoir assembly (para 16-5).



50. FIBER WASHER
51. STEEL WASHER
52. SPRING
53. DRIVE SHAFT
54. REDUCER
55. SPEEDOMETER SENDING UNIT

TA 299733

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

2. OUTRIGGER BEAM WILL NOT EXTEND OR EXTENDS SLOWLY

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished by either operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating condition. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

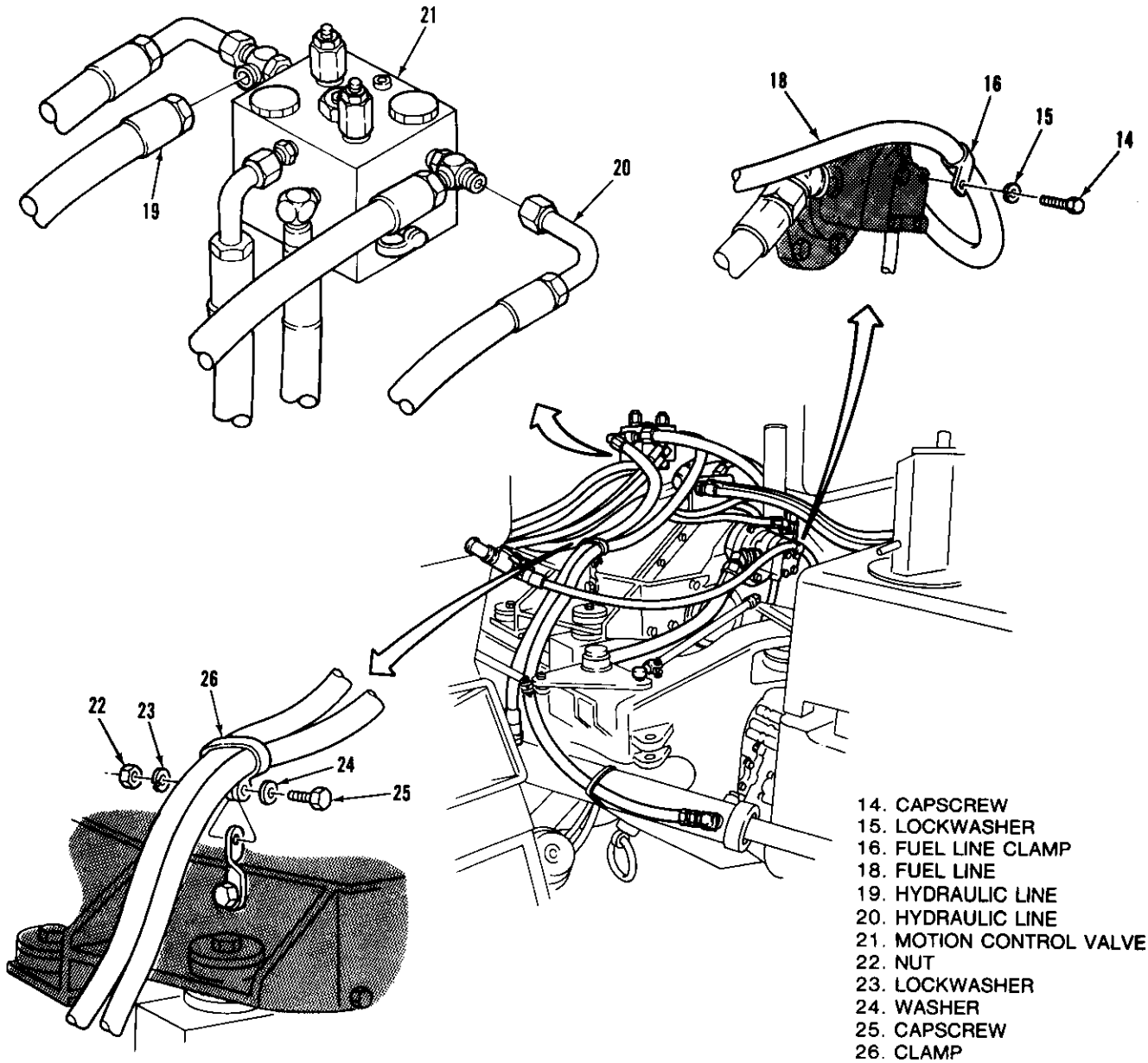
NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines.
- If relief pressure of 1,550-1,650 psi (10,687-11,377 kPa) for the outrigger beam function has not been confirmed, refer to TM 2320-20/12, TM 9-2320-297-20 for testing procedures.

Test 1. Remove the line that goes to piston end of extension cylinder. Install a flow meter in line between extension cylinder and line. Open pressure control valve fully by turning control knob counterclockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully extend outrigger beam. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 1,550-1,650 psi (10,687-11,377 kPa) working pressure.

- If pressure is within specifications, repair or replace extension cylinder. Refer to paragraph 18-3.
- If pressure is not within specifications, repair or replace defective control valve. Refer to paragraphs 18-27 thru 18-30.

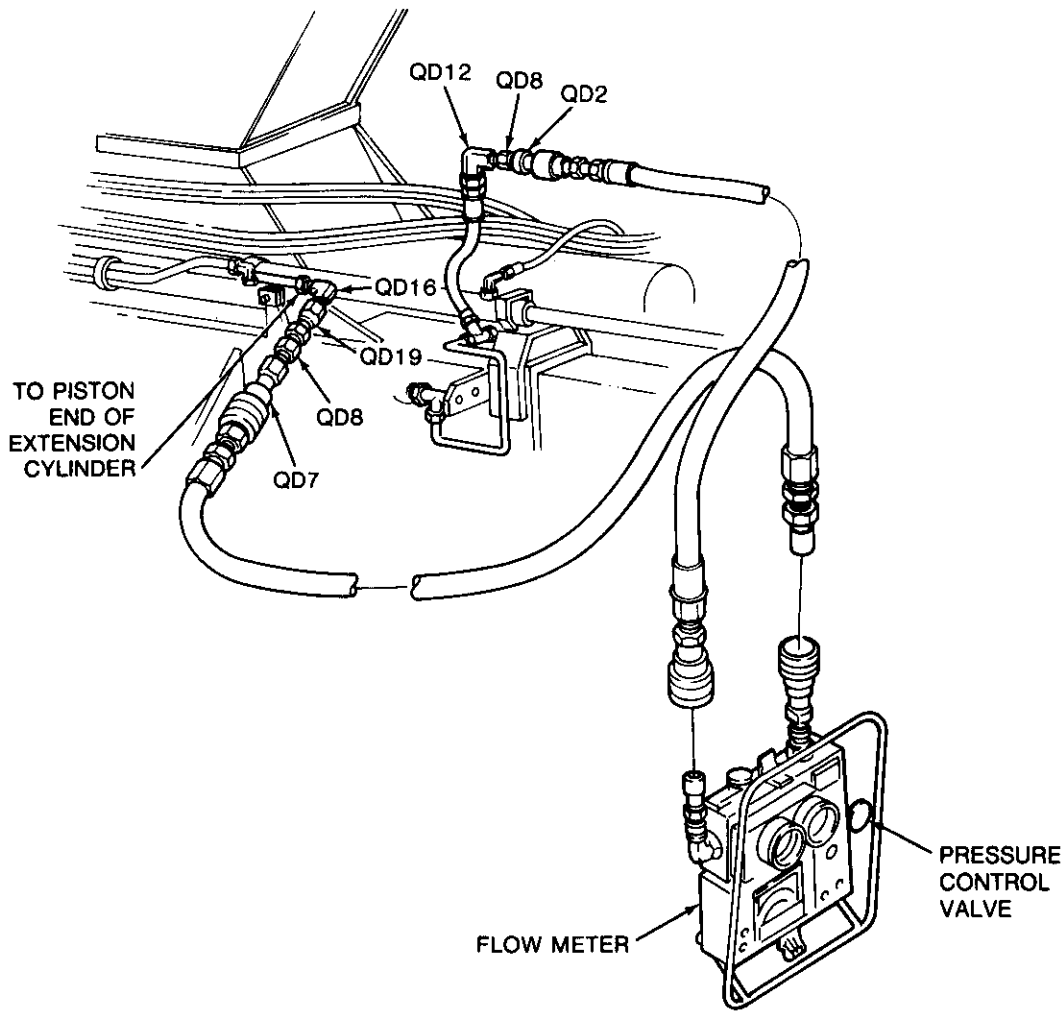
END OF TEST



14. CAPSCREW
15. LOCKWASHER
16. FUEL LINE CLAMP
18. FUEL LINE
19. HYDRAULIC LINE
20. HYDRAULIC LINE
21. MOTION CONTROL VALVE
22. NUT
23. LOCKWASHER
24. WASHER
25. CAPSCREW
26. CLAMP

TA 298890

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 296408

8-7. TRANSFER CASE REPLACEMENT (Continued)

(6) Remove lifting device (43), eye bolt (40) and nut (41) from PTO cover (42).

(7) Remove two capscrews (30) from top of transfer case (39).

NOTE

Perform step (7.1) on LVSA1 series vehicles only.

(7.1) Remove two capscrews (30), and washers (30.1) from top of transfer case (39).

(8) Position bracket (31) in place. Coat threads of capscrews (30) with sealant and install.

NOTE

Perform step (8.1) on LVSA1 series vehicles only.

(8.1) Position bracket (31) in place. Coat threads of capscrews (30) with sealant. Install two washers (30.1) and capscrews (30).

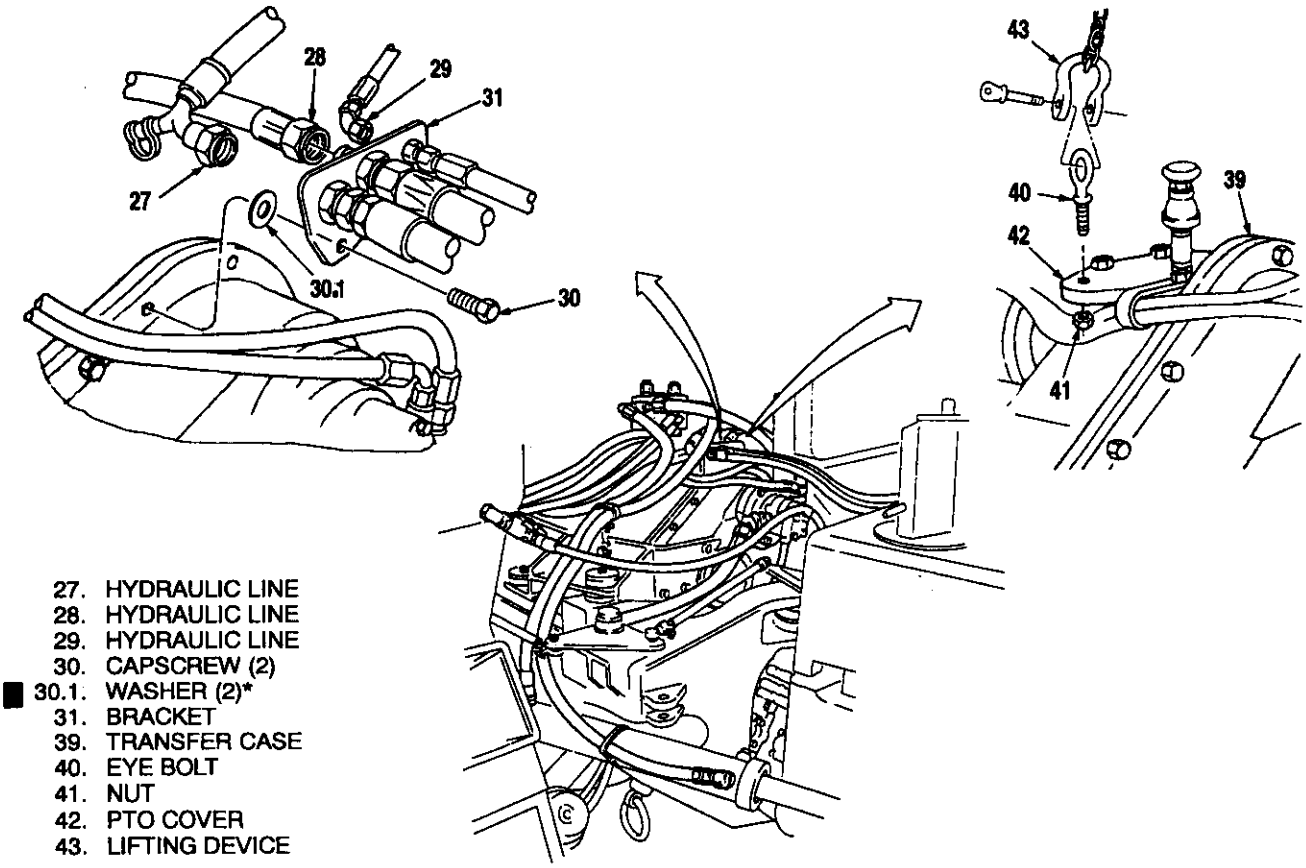
(9) Install three hydraulic lines (27, 28, and 29).

(10) Position motion control valve (21) in place and install hydraulic lines (19 and 20).

(11) Install clamp (26), washer (24), capscrew (25), new lockwasher (23), and nut (22).

(12) Remove capscrew (14) and lockwasher (15).

(13) Position fuel line (18) in place and install fuel line clamp (16), new lockwasher (15), and capscrew (14).



27. HYDRAULIC LINE
28. HYDRAULIC LINE
29. HYDRAULIC LINE
30. CAPSCREW (2)
30.1. WASHER (2)*
31. BRACKET
39. TRANSFER CASE
40. EYE BOLT
41. NUT
42. PTO COVER
43. LIFTING DEVICE

* LVSA1 SERIES VEHICLES ONLY

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. OUTRIGGER BEAM WILL NOT RETRACT OR RETRACTS SLOWLY

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished by either operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating condition. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines.
- If relief pressure of 2,950-3,050 psi (20,340-21,030 kPa) for the outrigger beam function has not been confirmed, refer to TM 2320-20/12, TM 9-2320-297-20 for testing procedures.

Test 1. Remove the line that goes to rod end of extension cylinder. Install a flow meter in line between extension cylinder and line. Open pressure control valve fully by turning control knob counterclockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully retract outrigger beam. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 2,950-3,050 psi (20,340-21,030 kPa) working pressure.

- If pressure is within specifications, go to Test 2.
- If pressure is not within specifications, repair or replace defective control valve. Refer to paragraphs 18-27 thru 18-30.

(22) Remove lifting device (43).

(23) Remove 15 capscrews (47) and two mounting brackets (48 and 49).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect brackets and rubber biscuits for cracks or other damage.

(3) Inspect capscrews, nuts, and fittings for damaged threads.

(4) Inspect all other parts. Refer to paragraph 2-7 and replace all parts failing inspection.

c. Installation

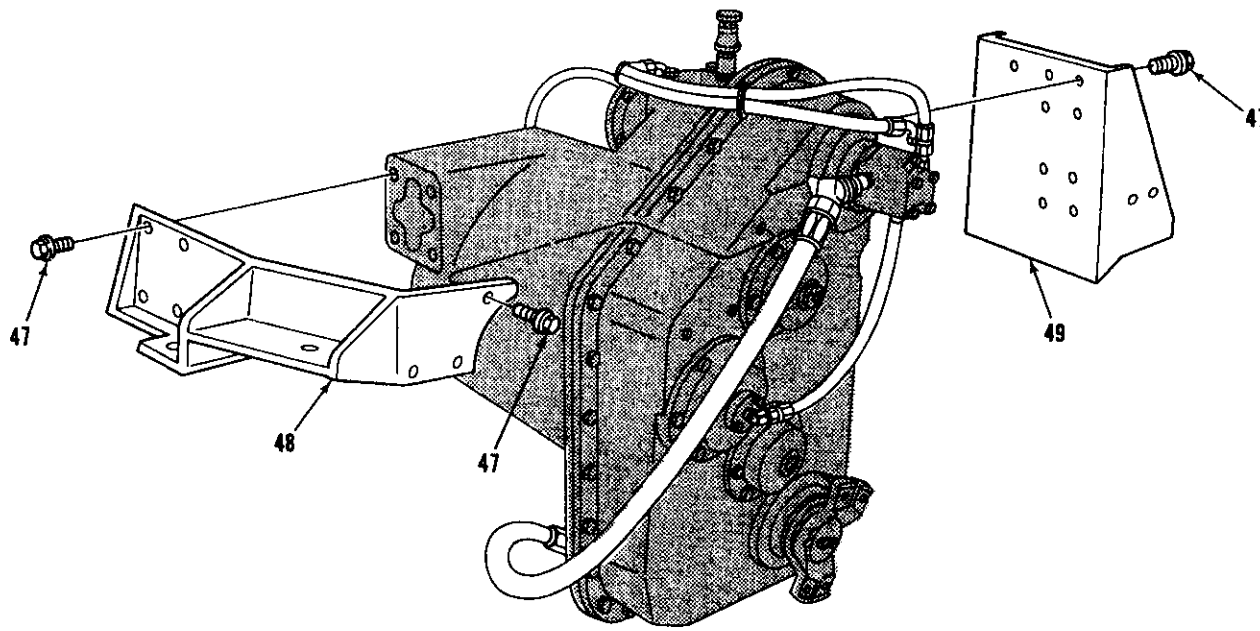
(1) Install two mounting brackets (48 and 49) using 15 capscrews (47).

(2) Install four rubber biscuits (44) into frame brackets (45 and 46).

(3) Attach lifting device (43) to transfer case (39) and install transfer case (39).

(4) Install four rubber biscuits (38), plates (37), washers (36), and capscrews (35).

(5) Install four washers (34), nuts (33), and new cotter pins (32).



47. CAPSCREW (15)
48. MOUNTING BRACKET
49. MOUNTING BRACKET

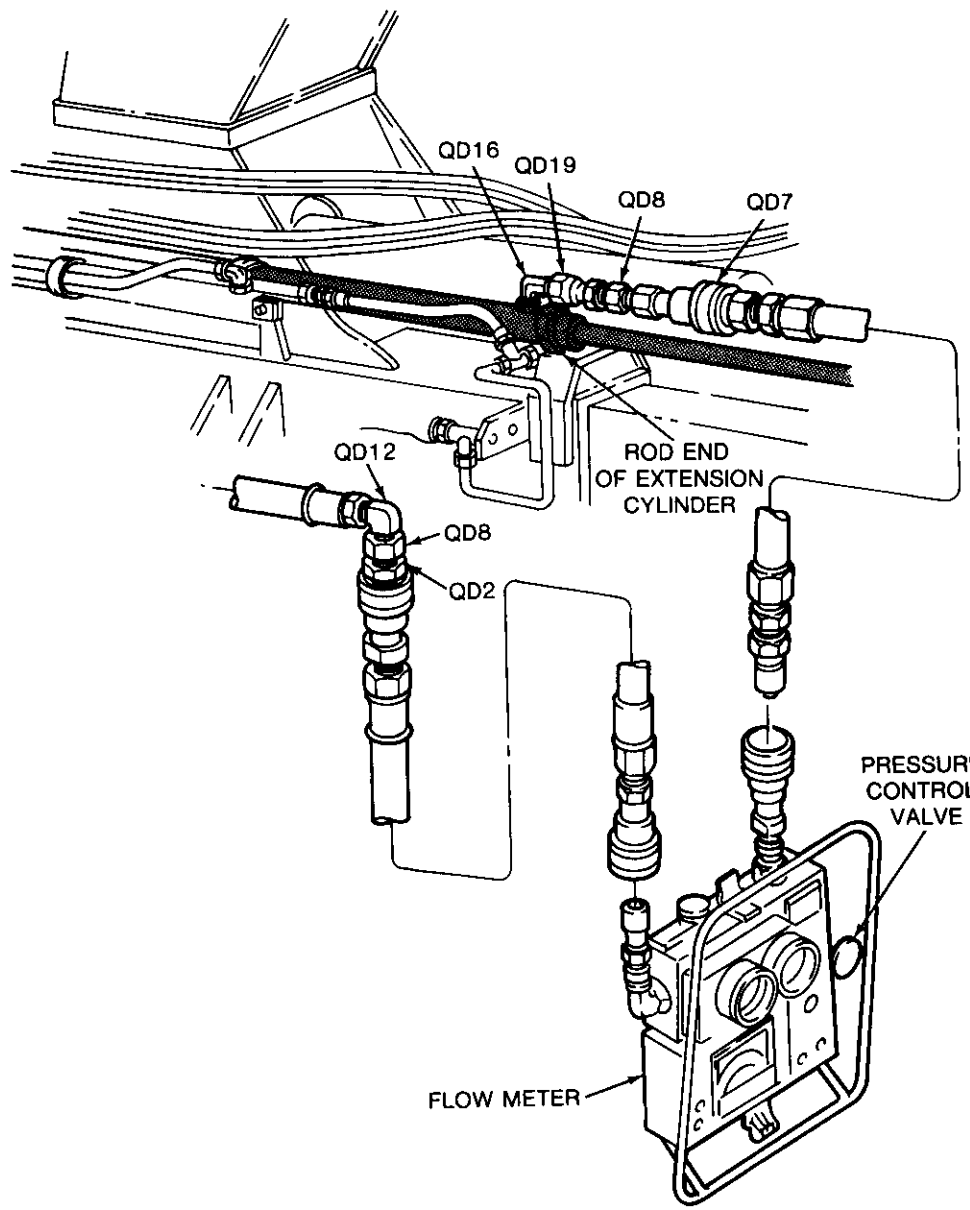
TA 298888

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 2. Check for maladjusted outrigger beam adjuster bolt or mechanical binding. Refer to paragraph 20-38 in TM 2320-20/12, TM 9-2320-297-20.

- If adjustment is correct or binding is not present, repair or replace extension cylinder. Refer to paragraph 18-3.
- If adjustment is incorrect, adjust as needed. If binding is present, lubricate outrigger beams. Refer to LI 2320-12/9, LO 9-2320-297-12.

END OF TEST



TA 298408

8-7. TRANSFER CASE REPLACEMENT (Continued)

(16) Remove four cotter pins (32), nuts (33), and washers (34). Discard cotter pins (32).

(17) Remove four capscrews (35), washers (36), plates (37), and rubber biscuits (38).

WARNING

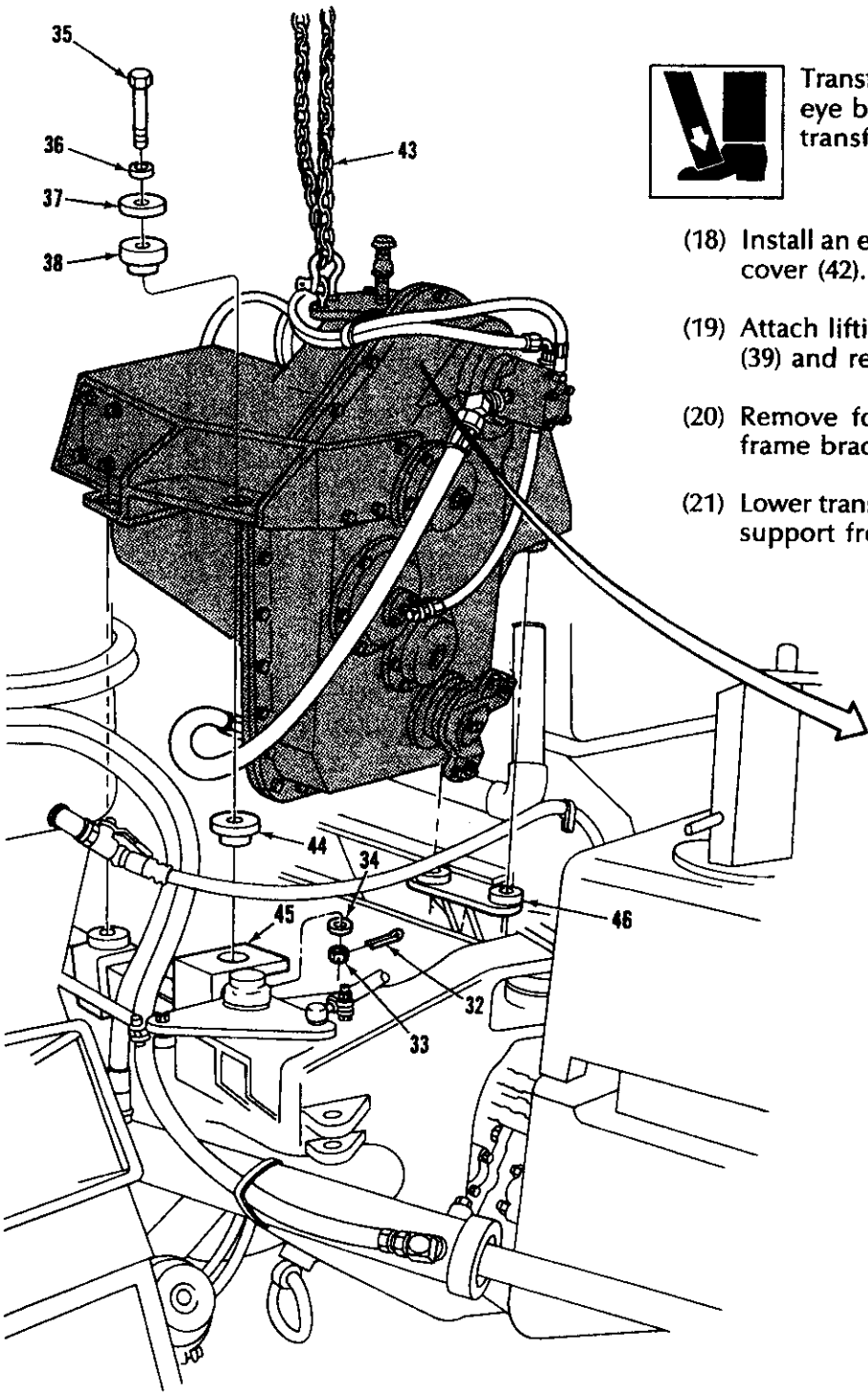
Transfer case (39) is heavy. Make sure eye bolt (40) can support weight of transfer case (39).

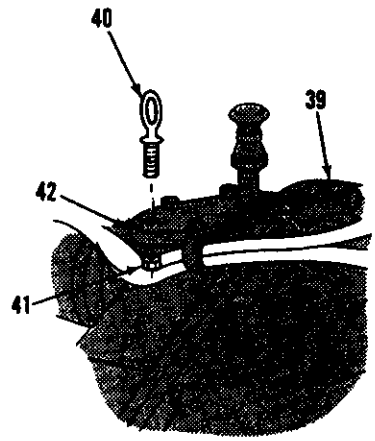
(18) Install an eye bolt (40) and nut (41) to PTO cover (42). Tighten securely.

(19) Attach lifting device (43) to transfer case (39) and remove.

(20) Remove four rubber biscuits (44) from frame brackets (45 and 46).

(21) Lower transfer case (39) to the ground and support from below and sides.





32. COTTER PIN (4)
33. NUT (4)
34. WASHER (4)
35. CAPSCREW (4)
36. WASHER (4)
37. PLATE (4)
38. RUBBER BISCUIT (4)
39. TRANSFER CASE
40. EYE BOLT
41. NUT
42. PTO COVER
43. LIFTING DEVICE
44. RUBBER BISCUIT (4)
45. FRAME BRACKET
46. FRAME BRACKET

TA 296887

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. STABILIZER LEG WILL NOT EXTEND OR RETRACT OR EXTENDS AND RETRACTS SLOWLY

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished by either operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating condition. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150°F (54-66°C).
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines.
- If relief pressure of 1,550-1,650 psi (10,687-11,377 kPa) for the stabilizer function has not been confirmed, refer to TM 2320-20/12, TM 9-2320-297-20 for testing procedures.
- If stabilizer leg will not extend, go to Test 1. If stabilizer leg will not retract, go to Test 2.

(12) Tag and disconnect three front hydraulic lines (27, 28, and 29) and secure them out of the way.

(13) Remove two capscrews (30) and bracket (31).

NOTE

Perform step (13.1) on LVSA1 series vehicles only.

(13.1) Remove two capscrews (30), washers (30.1), and bracket (31).

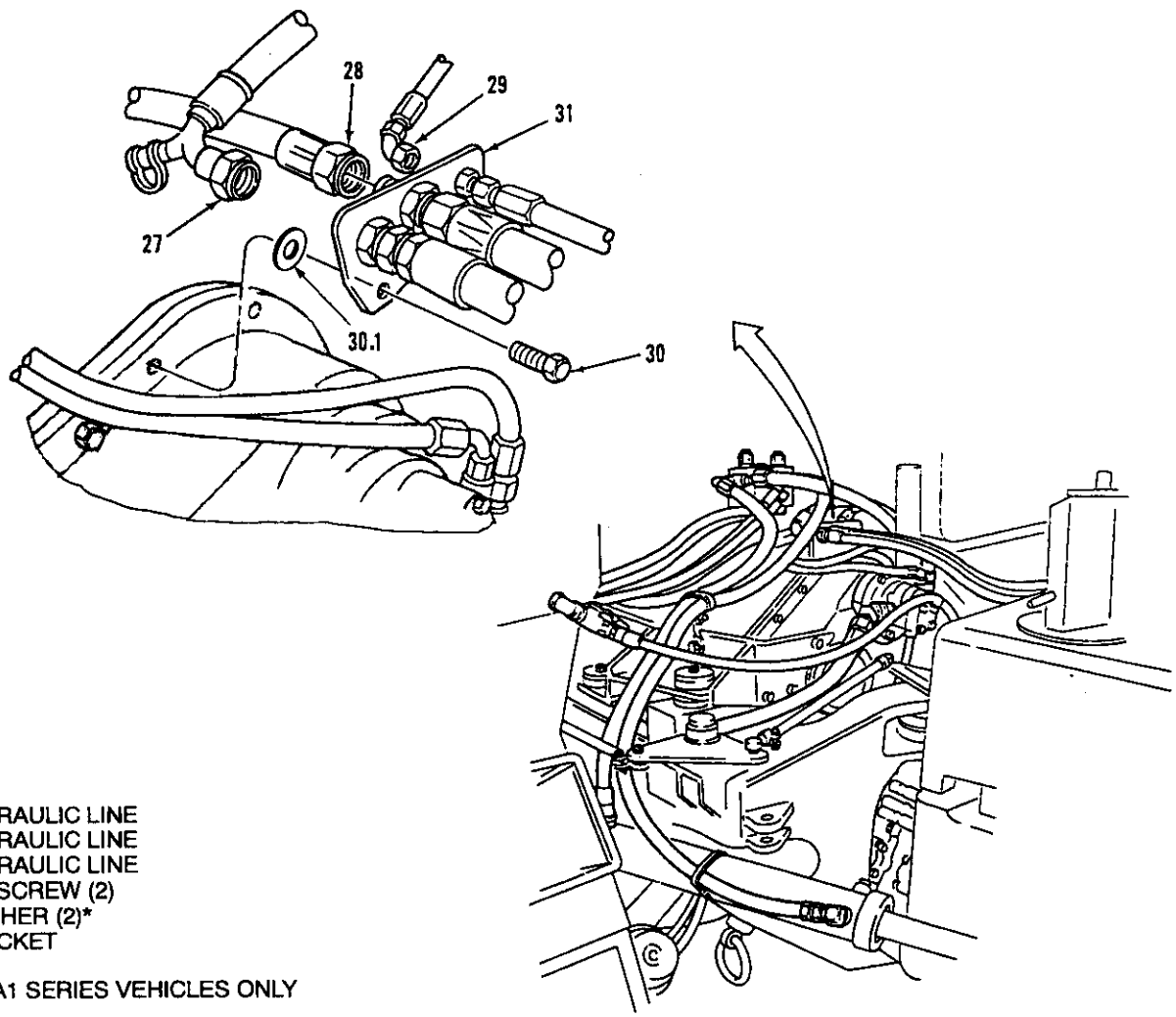
(14) Move bracket (31) and secure out of the way.

(15) Install two capscrews (30) finger tight.

NOTE

Perform step (15.1) on LVSA1 series vehicles only.

(15.1) Install two washers (30.1) and capscrews (30) finger tight.



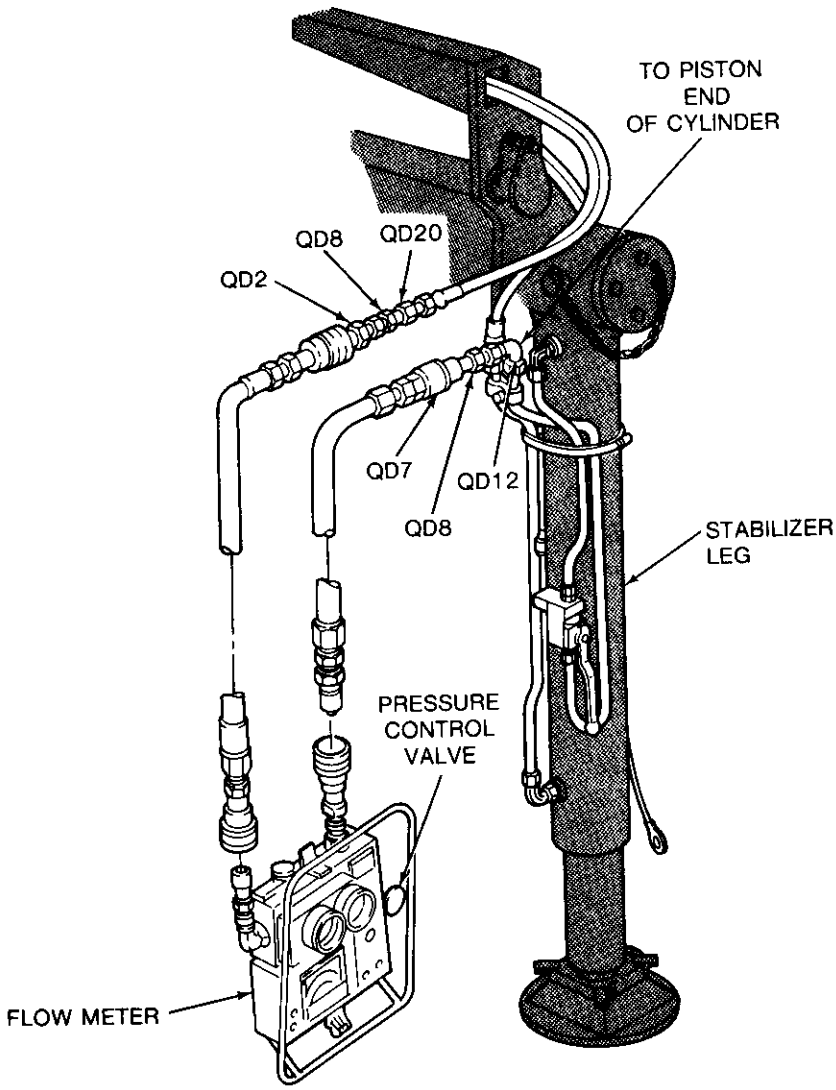
27. HYDRAULIC LINE
28. HYDRAULIC LINE
29. HYDRAULIC LINE
30. CAPSCREW (2)
30.1. WASHER (2)*
31. BRACKET

* LVSA1 SERIES VEHICLES ONLY

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Test 1. Remove line from piston end of stabilizer leg. Install a flow meter in line between stabilizer leg and line. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully extend stabilizer leg. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 1,550-1,650 psi (10,687-11,377 kPa) working pressure.

- If pressure is within specifications, repair or replace stabilizer cylinder. Refer to paragraph 18-24.
- If pressure is not within specifications, repair or replace defective control valve. Refer to paragraphs 18-27 thru 18-30.



TA 298412

8-7. TRANSFER CASE REPLACEMENT (Continued)

(6) Remove capscrew (14), lockwasher (15), and fuel line clamp (16) from lubrication pump (17). Do NOT discard lockwasher (15).

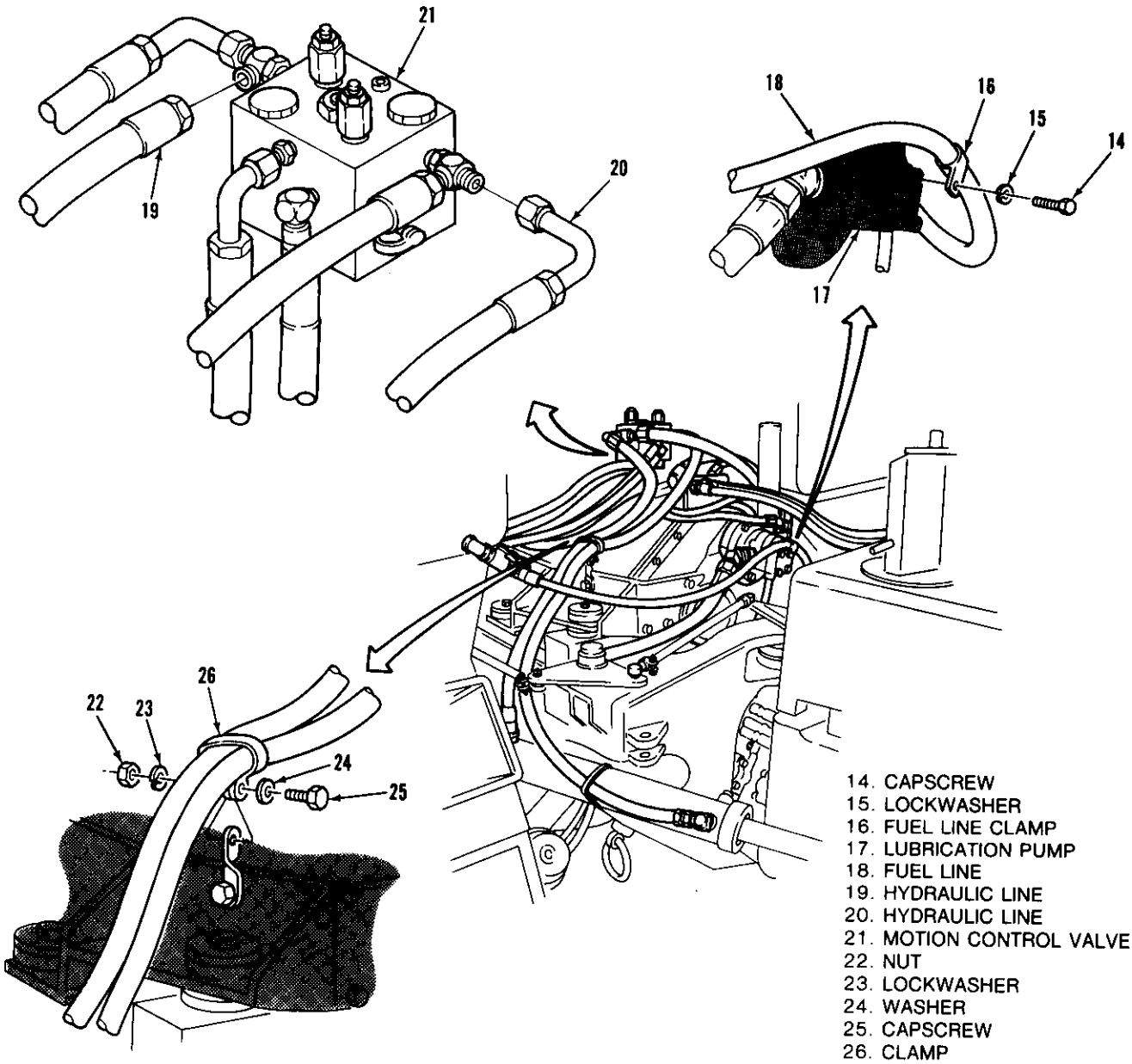
(7) Install original lockwasher (15) and capscrew (14) into lubrication pump (17) finger tight.

(8) Secure fuel line (18) and fuel line clamp (16) out of the way.

(9) Tag and disconnect hydraulic lines (19 and 20) from motion control valve (21) and secure them out of the way.

(10) Remove nut (22), lockwasher (23), washer (24), and capscrew (25) from clamp (26). Discard lockwasher (23).

(11) Move motion control valve (21) towards driver's side of MK48 and secure out of the way.



14. CAPSCREW
15. LOCKWASHER
16. FUEL LINE CLAMP
17. LUBRICATION PUMP
18. FUEL LINE
19. HYDRAULIC LINE
20. HYDRAULIC LINE
21. MOTION CONTROL VALVE
22. NUT
23. LOCKWASHER
24. WASHER
25. CAPSCREW
26. CLAMP

TA 296885

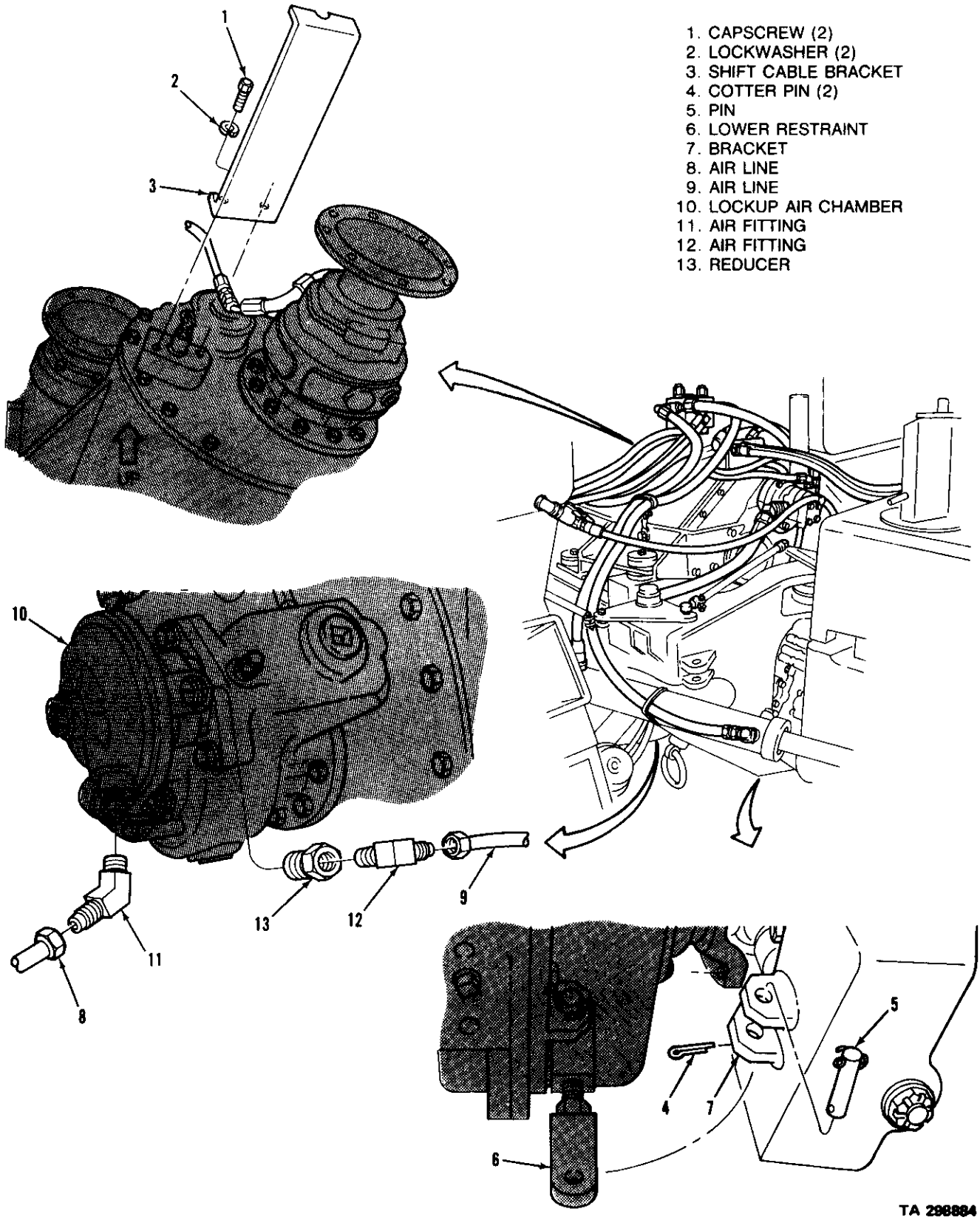
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. STABILIZER LEG WILL NOT EXTEND OR RETRACT OR EXTENDS AND RETRACTS SLOWLY (Continued)

Test 2. Remove line from rod end of stabilizer cylinder. Install a flow meter in line between stabilizer cylinder and line. Open pressure control valve fully by turning knob counterclockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully retract stabilizer leg. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 2,950-3,050 psi on retract (20,340-21,030 kPa) working pressure.

- If pressure is within specifications, repair or replace stabilizer cylinder. Refer to paragraph 18-24.
- If pressure is not within specifications, repair or replace defective control valve. Refer to paragraphs 18-27 thru 18-30.

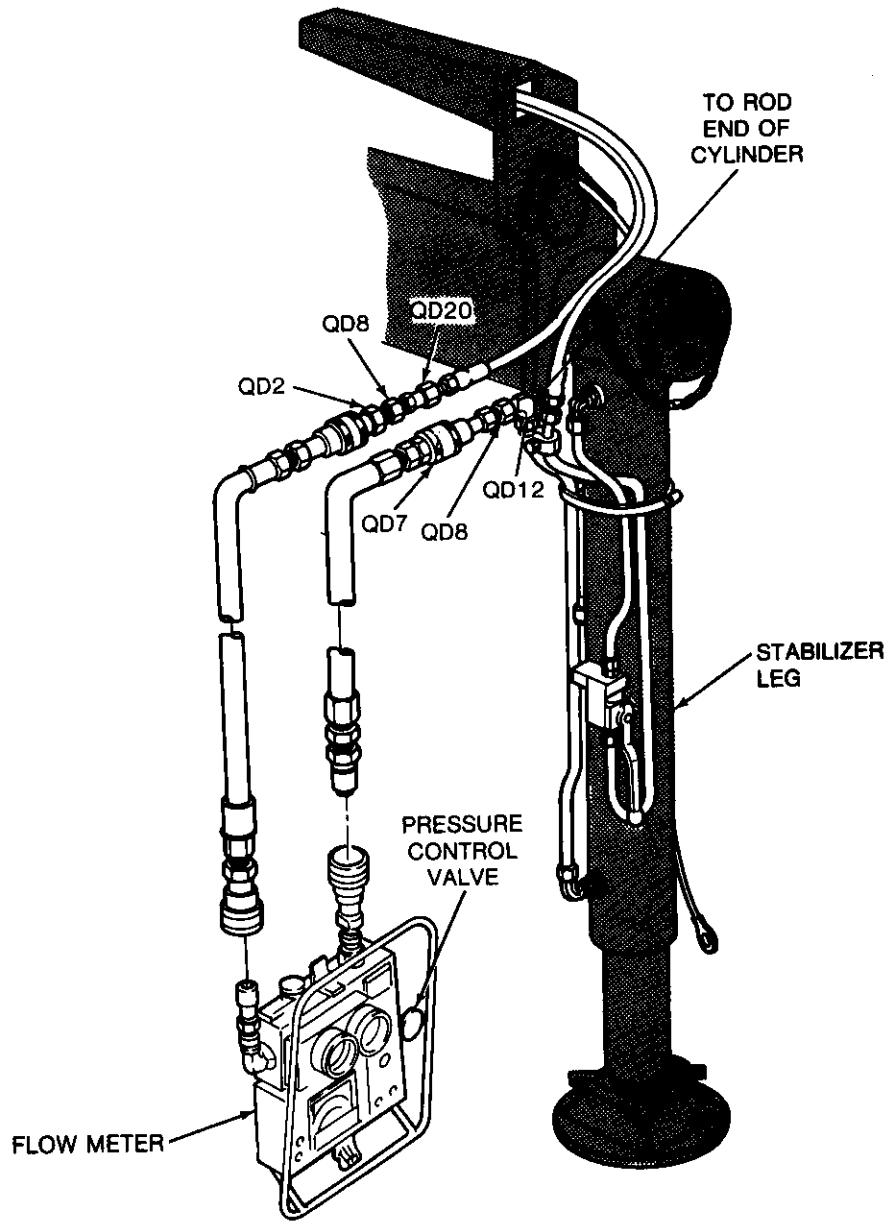
END OF TEST



1. CAPSCREW (2)
2. LOCKWASHER (2)
3. SHIFT CABLE BRACKET
4. COTTER PIN (2)
5. PIN
6. LOWER RESTRAINT
7. BRACKET
8. AIR LINE
9. AIR LINE
10. LOCKUP AIR CHAMBER
11. AIR FITTING
12. AIR FITTING
13. REDUCER

TA 298884

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 288413

SECTION III. TRANSFER CASE REPLACEMENT INSTRUCTIONS

8-7. TRANSFER CASE REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Adhesive, silicone sealant (item 7, Appendix C)
Lockwasher (3) (MS35338-45) items 2 and 15
Cotter pin (2) (MS24665-285) item 4
Lockwasher (MS35338-44) item 23
Cotter pin (4) (MS24665-287) item 32

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Spare tire removed (para 3-8).
TM 2320-20/12 TM 9-2320-297-20	Access panels removed (para 18-14, items 28 and 29).
	2-speed shift cable removed (para 9-4).
	Propeller shafts removed (para 10-3).
	Cardan joint removed (para 10-4).
TM 2320-34/13 TM 9-2320-297-34	Radiator and air reservoir assembly removed (para 16-5).
	Speedometer sending unit removed (para 8-8).

General Safety Instructions

Transfer case is very heavy. To prevent personal injury, use caution when moving.

---

a. Removal

NOTE

- Remove nylon ties as needed to move hydraulic lines, air lines, or electrical wiring. Note location and replace during installation.
- When disconnecting hydraulic lines and/or air lines, plug ends and tag for identification during installation.

(1) Remove two capscrews (1), lockwashers (2), and shift cable bracket (3). Discard lockwashers (2).

(2) Remove cotter pin (4) and pin (5) from transfer case lower restraint (6).

(3) Pull lower restraint (6) loose from bracket (7) and reinstall pin (5) and old cotter pin (4).

(4) Tag and remove two air lines (8 and 9) from lockup air chamber (10).

(5) Remove two air fittings (11 and 12) and reducer (13) from lockup air chamber (10).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

5. STABILIZER LEGS WILL NOT HOLD LOAD

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished by either operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating condition. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

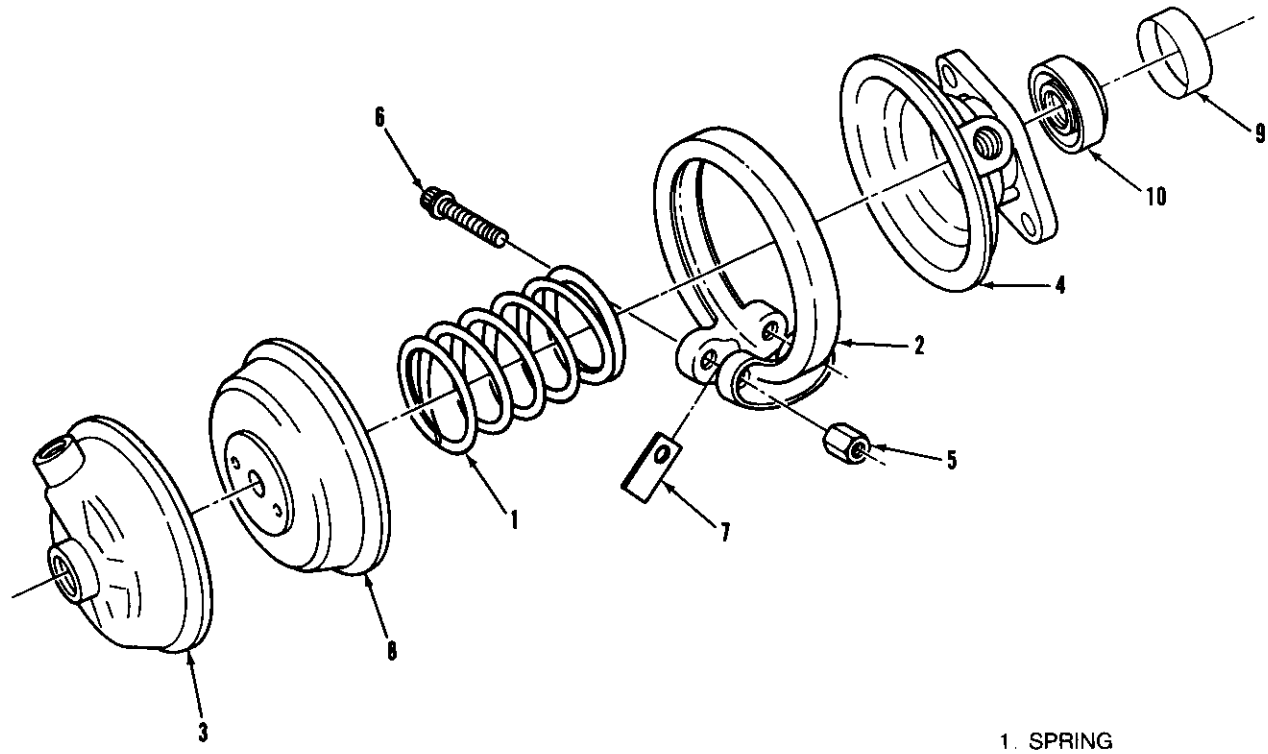
NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines.
- If relief pressure of 1,550-1,650 psi (10,687-11,377 kPa) for the stabilizer function has not been confirmed, refer to TM 2320-20/12, TM 9-2320-297-20 for testing procedures.

Remove line from piston side of stabilizer leg and lockout valve. Install a 0-2,000 psi (0-13,790 kPa) pressure gage in line between stabilizer leg and lockout valve. Extend stabilizer leg and close lockout valve. Check pressure gage and record reading. Have assistant operate control valve to extend stabilizer leg. Check pressure gage and record pressure reading.

- If pressure increase is noted, replace lockout valve. Refer to paragraph 20-22 in TM 2320-20/12, TM 9-2320-297-20.
- If no pressure increase is noted, replace stabilizer cylinder. Refer to paragraph 20-15 in TM 2320-20/12, TM 9-2320-297-20.

END OF TEST



1. SPRING
2. CLAMP RING
3. COVER
4. BODY
5. NUT (2)
6. CAPSCREW (2)
7. IDENTIFICATION PLATE
8. DIAPHRAGM
9. PILOT RING
10. OIL SEAL

TA 298883

c. Assembly

(1) Install pilot ring (9) and new oil seal (10) into body (4). Make sure lip of oil seal (10) is toward inside of chamber.

(2) Position body (4), spring (1), diaphragm (8), and cover (3) together.

(3) Place these parts in a vise and apply pressure to compress spring (1).

(4) Install clamp ring (2) around assembly.

(5) Aline marks made during disassembly and install two capscrews (6), identification plate (7) and nuts (5).

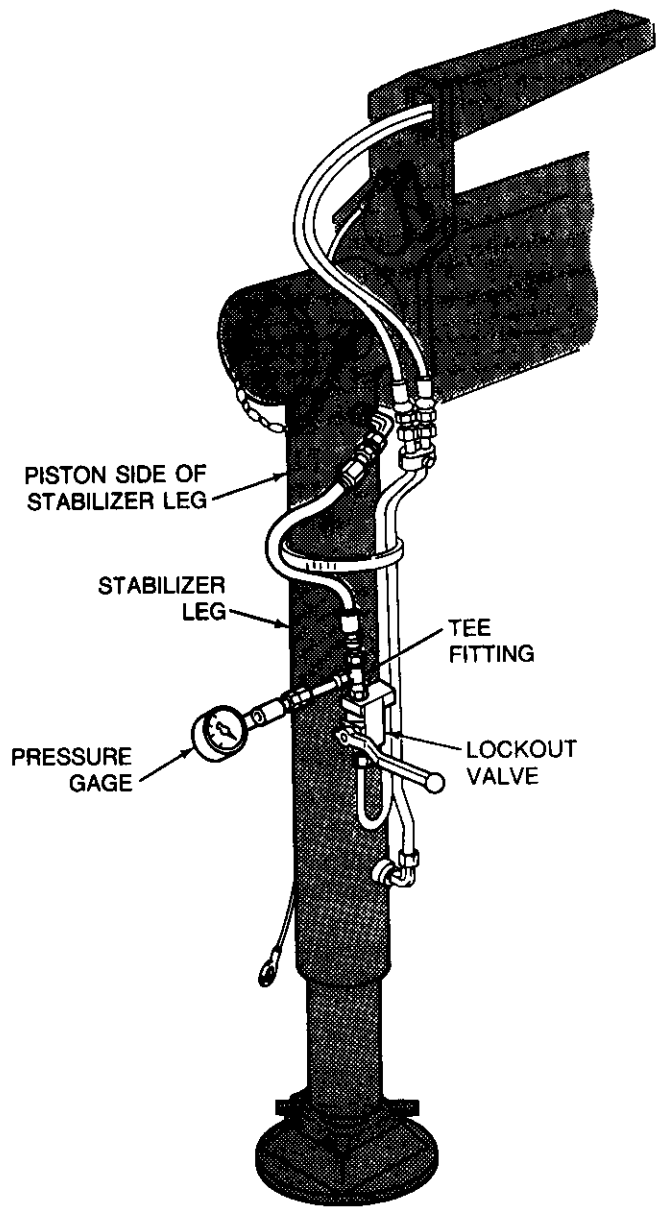
END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12	Install lockup chamber
TM 9-2320-297-20	(para 9-9).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298416

8-6. LOCKUP AIR CHAMBER REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Oil seal (NSN 5330-00-075-1919) item 10

Equipment Condition TM

TM 2320-20/12
TM 9-2320-297-20

Condition Description

Lockup air chamber removed (para 9-9).

General Safety Instructions

To prevent personal injury, drain all pressure from the air system.

---

a. Disassembly

WARNING

The air chamber contains a spring (1) under tension. To prevent personal injury, release tension slowly when removing clamp ring (2).

(1) Position air chamber in a vise so that cover (3) is held to body (4).

(2) Mark cover (3), clamp ring (2), and body (4) for position during assembly.

(3) Remove two nuts (5) and capscrews (6).

(4) Remove clamp ring (2) and identification plate (7).

(5) Slowly release tension of spring (1) and remove cover (3).

(6) Remove diaphragm (8) and spring (1).

(7) Press pilot ring (9) and oil seal (10) from body (4). Discard oil seal (10).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts for damage. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

6. CRANE WILL NOT ROTATE, ROTATES SLOWLY OR ROTATES IN ONLY ONE DIRECTION

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

Before testing hydraulic system with a flow meter, always open the pressure control valve all the way by turning the knob counterclockwise to DECREASE. Failure to do so may cause hydraulic lines to burst, causing personal injury.

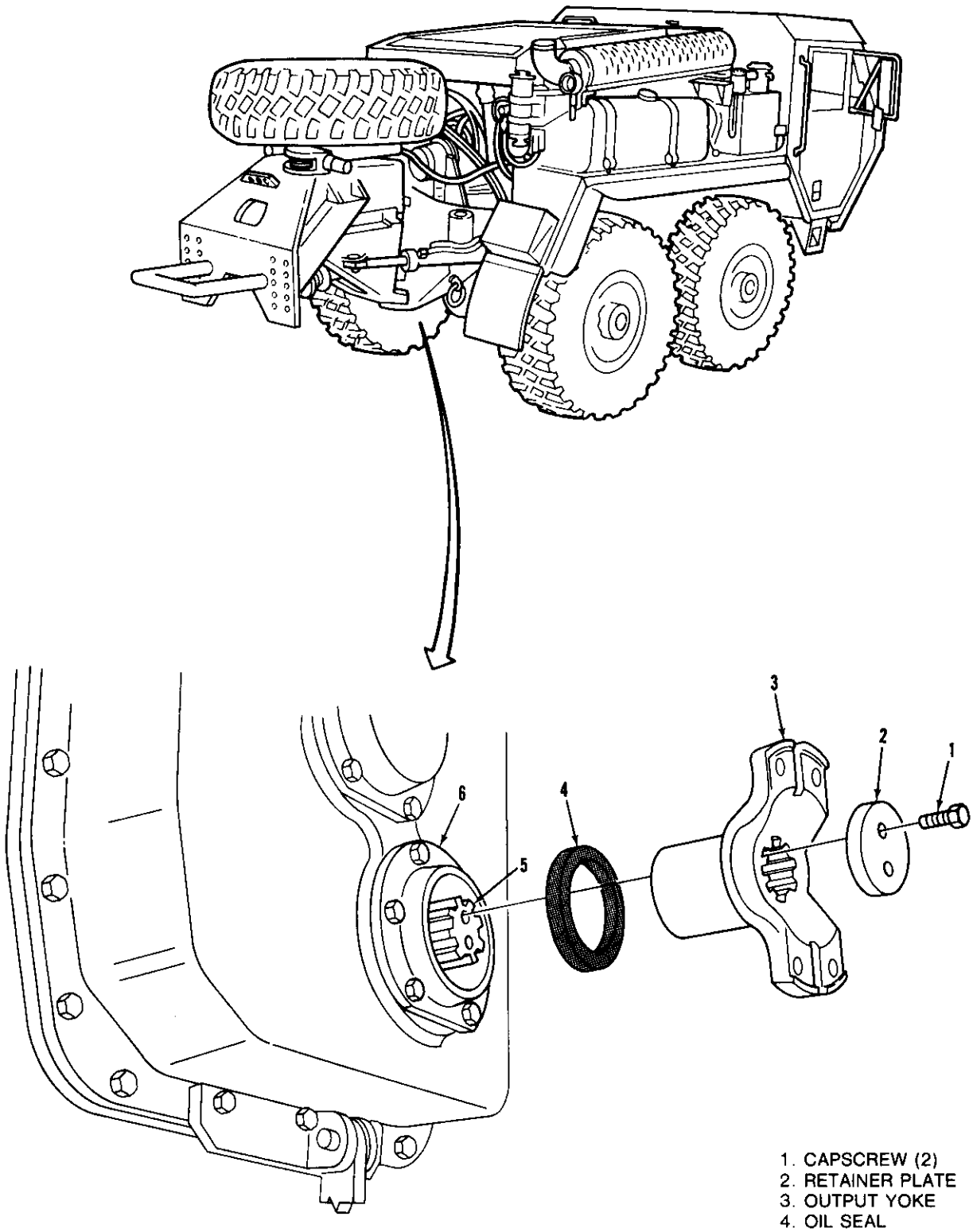
CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished by either operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating condition. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines and that the problem does not exist with the remote control.
- If relief pressure of 2,700-2,800 psi (18,616-19,306 kPa) for the rotation function has not been confirmed, refer to TM 2320-20/12, TM 9-2320-297-20 for testing procedures.

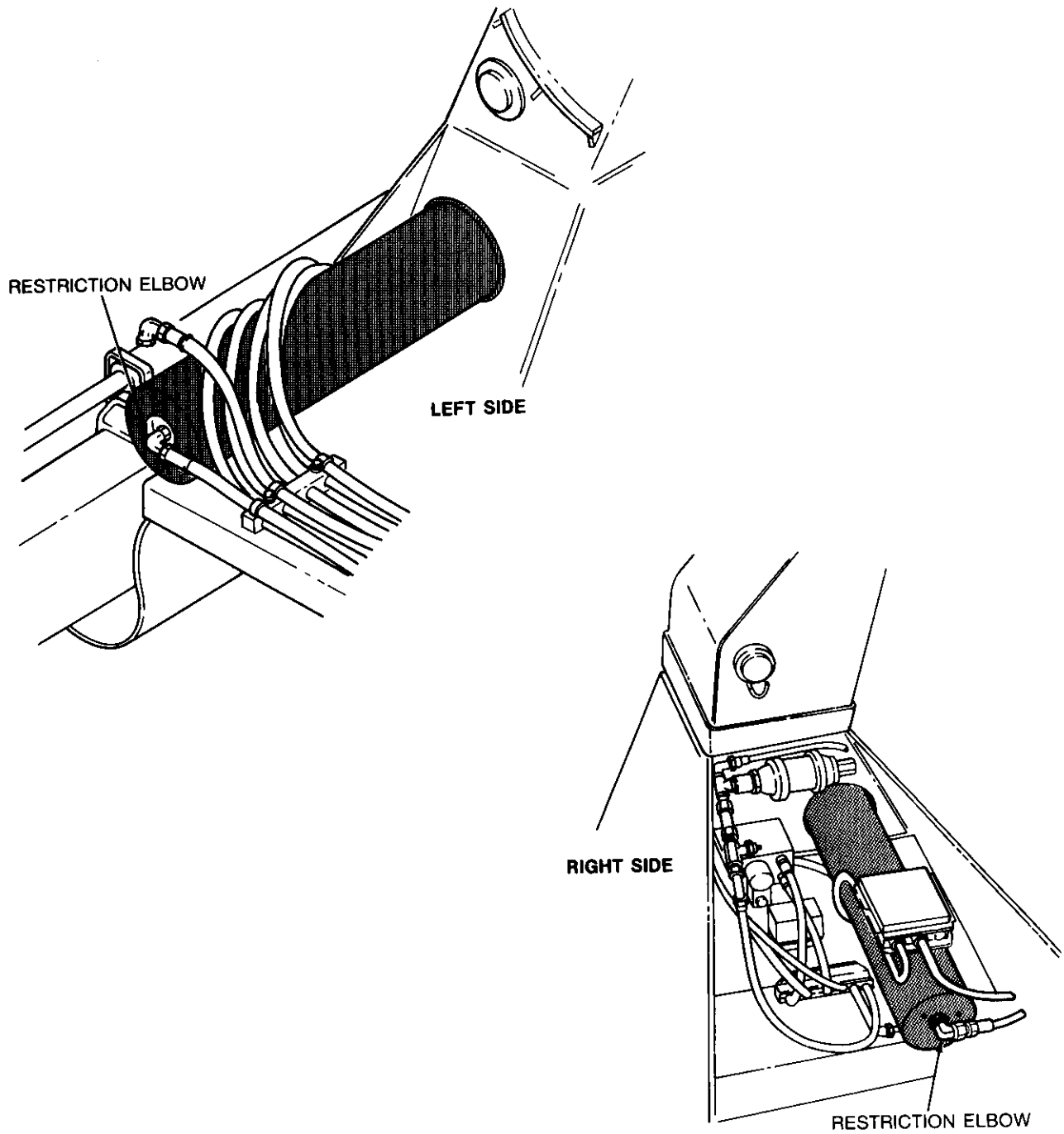
Test 1. Remove restriction elbows from the ends of left and right rotation cylinders. Check for blockage.
- If blockage is not present, go to Test 2.
- If blockage is present, flush restricter elbows.



1. CAPSCREW (2)
2. RETAINER PLATE
3. OUTPUT YOKE
4. OIL SEAL
5. OUTPUT SHAFT
6. COVER

TA 298882

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298417

8-5. REAR OUTPUT SHAFT OIL SEAL REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Adhesive, silicone sealant (item 7, A
Crocus cloth (item 20, Appendix C)
Sealer, lubricating and wicking (item 63, Appendix C)
Oil seal (NSN 5330-01-055-1200) item 4

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Cardan joint removed (para 10-4).

---

a. Removal

(1) Remove two capscrews (1) and retainer plate (2).

(2) Using a puller, remove output yoke (3).

(3) Remove and discard oil seal (4).

b. Cleaning/Inspection

(1) Clean sealant from output yoke (3) and output shaft (5).

(2) Clean sealer from two capscrews (1) and retainer plate (2).

(3) Inspect two capscrews (1) for damaged threads.

(4) Inspect output yoke (3) for damage at point where oil seal (4) touches. Small grooves may be removed with crocus cloth.

(5) Replace all parts failing inspection.

c. Installation

(1) Install new oil seal (4) into cover (6).

(2) Coat splines of output yoke (3) with silicone sealant and install onto output shaft (5).

(3) Install retainer plate (2) onto output shaft (5).

(4) Apply lubricating and wicking sealer to threads of two capscrews (1) and install.

END OF TASK

NOTE

Follow-On Maintenance

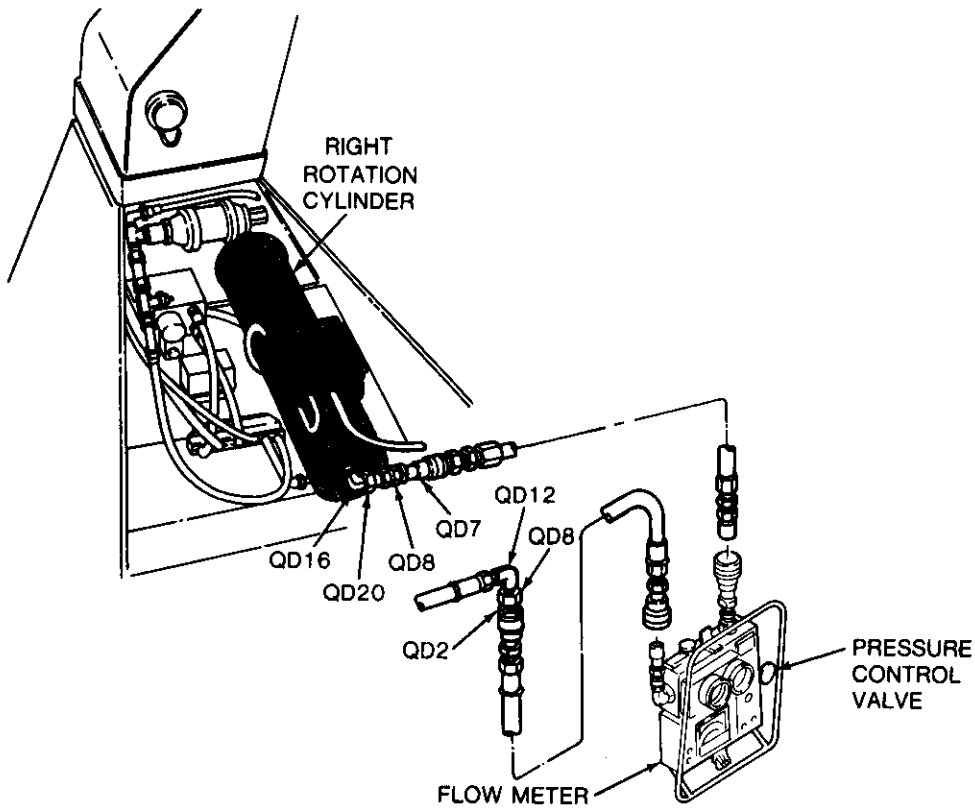
TM 2320-20/12 TM 9-2320-297-20	Install cardan joint (para 10-4).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

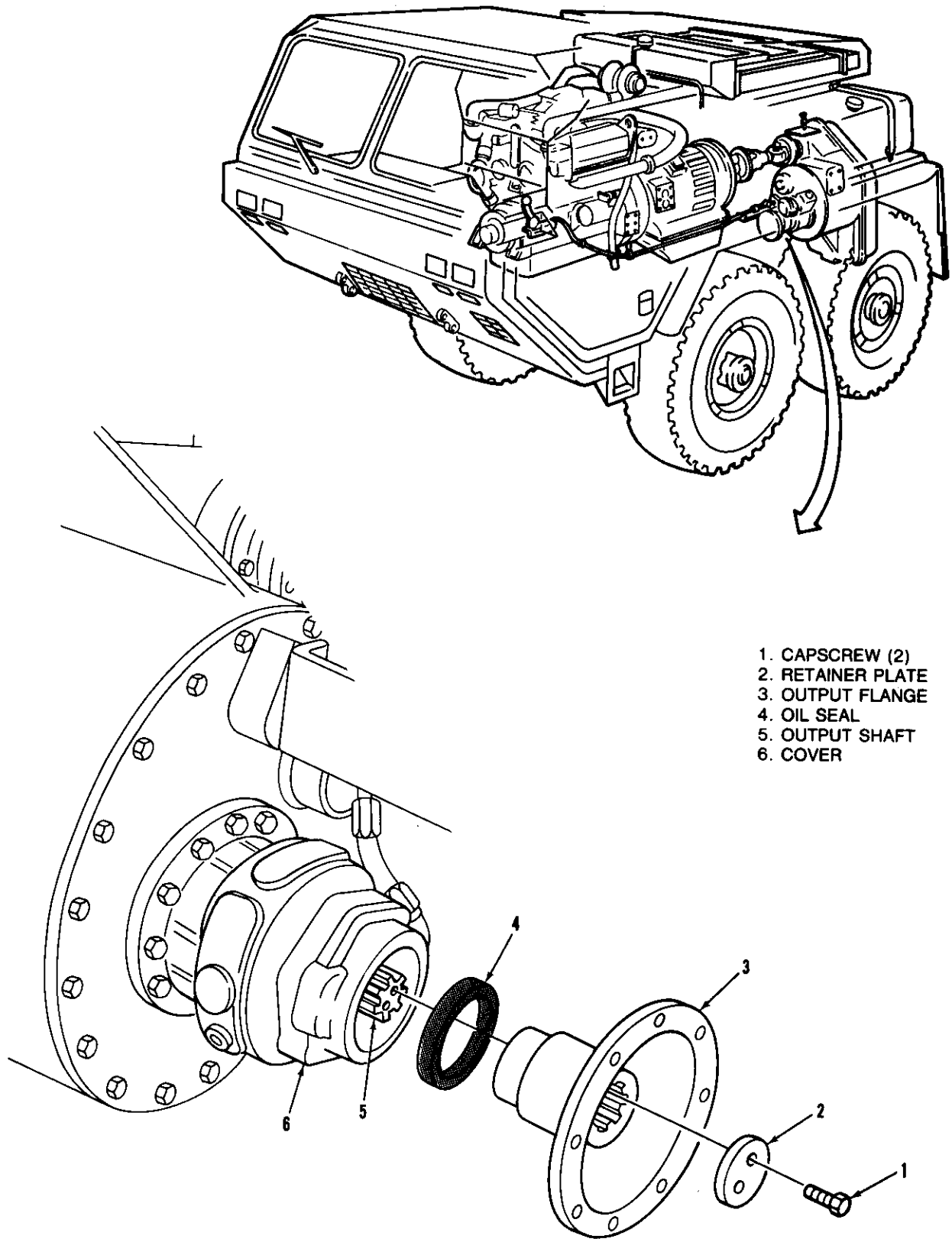
6. CRANE WILL NOT ROTATE, ROTATES SLOWLY OR ROTATES IN ONLY ONE DIRECTION (Continued)

Test 2. Remove line from the end of the right rotation cylinder. Install a flow meter in line between cylinder end and line. Open pressure control valve fully by turning control knob counterclockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control valve to rotate crane counterclockwise. Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 2,700-2,800 psi (18,616.5-19,306 kPa) working pressure.Record reading. Remove flow meter and install line in between left rotation cylinder and line.Open pressure control valve fully by turning control knob counterclockwise to DECREASE.Start engine and allow to run at idle.Have assistant operate control valve to rotate crane clockwise.Slowly close pressure control valve by turning knob clockwise to INCREASE. Create 2,700-2,800 psi (18,616-19,306 kPa) working pressure. Record reading.

- If pressure is within specifications in both directions, go to Test 3.
- If pressure is not within specifications, repair or replace defective control valve. Refer to paragraphs 18-27 thru 18-30.



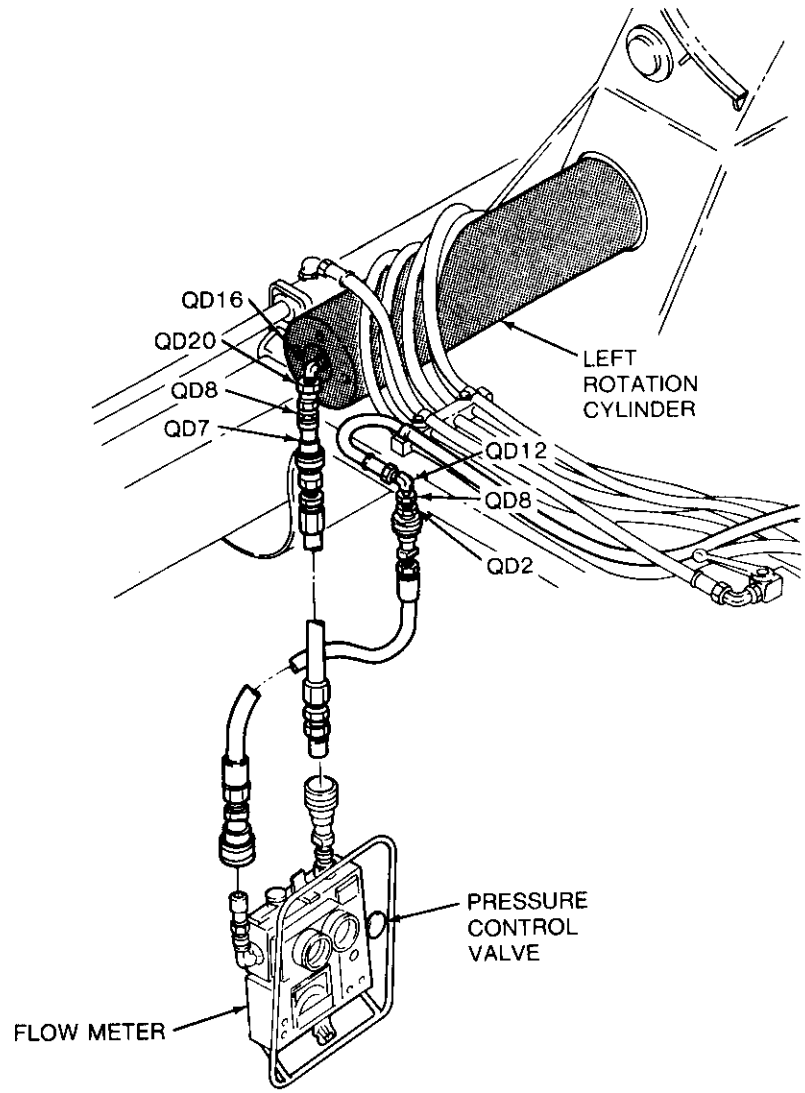
TA 296418



1. CAPSCREW (2)
2. RETAINER PLATE
3. OUTPUT FLANGE
4. OIL SEAL
5. OUTPUT SHAFT
6. COVER

TA 298881

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298419

8-4. FRONT OUTPUT SHAFT OIL SEAL REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Adhesive, silicone sealant (item 7, A
Crocus cloth (item 20, Appendix C)
Sealer, lubricating and wicking (item 63, Appendix C)
Oil seal (NSN 5330-01-164-8881) item 4

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Propeller shaft removed (para 10-3).

a. Removal

(1) Remove two capscrews (1) and retainer plate (2).

(2) Using a puller, remove output flange (3).

(3) Remove oil seal (4) and discard.

b. Cleaning/Inspection

(1) Clean sealant from output flange (3) and output shaft (5).

(2) Clean sealer from two capscrews (1) and retainer plate (2).

(3) Inspect two capscrews (1) for damaged threads.

(4) Inspect output flange (3) for damage at point where oil seal (4) touches. Small grooves may be removed with crocus cloth.

(5) Replace all parts failing inspection.

c. Installation

(1) Install new oil seal (4) into cover (6).

(2) Coat splines of output flange (3) with silicone sealant and install onto output shaft (5).

(3) Install retainer plate (2) onto output shaft (5).

(4) Apply lubricating and wicking sealer to threads of two capscrews (1) and install.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install propeller shaft (para 10-3).

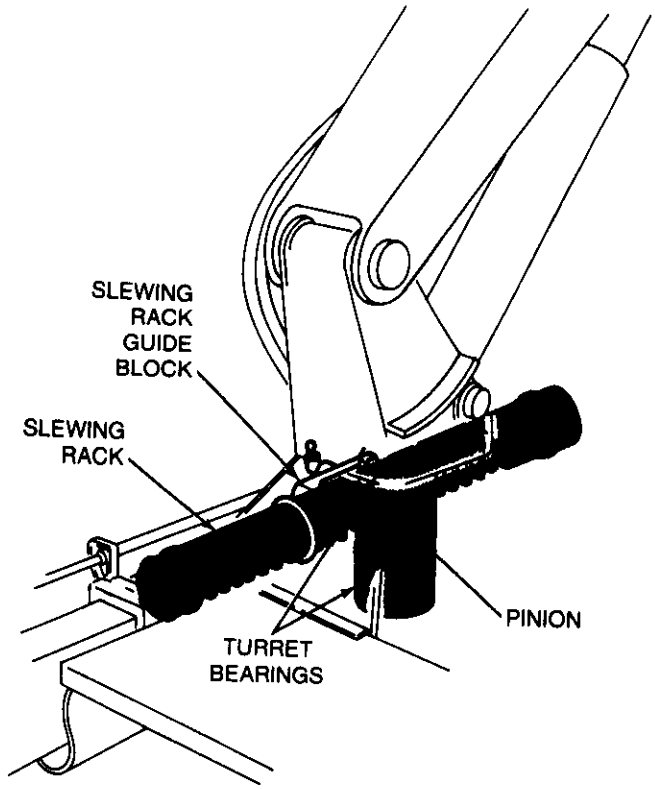
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

6. CRANE WILL NOT ROTATE, ROTATES SLOWLY OR ROTATES IN ONLY ONE DIRECTION (Continued)

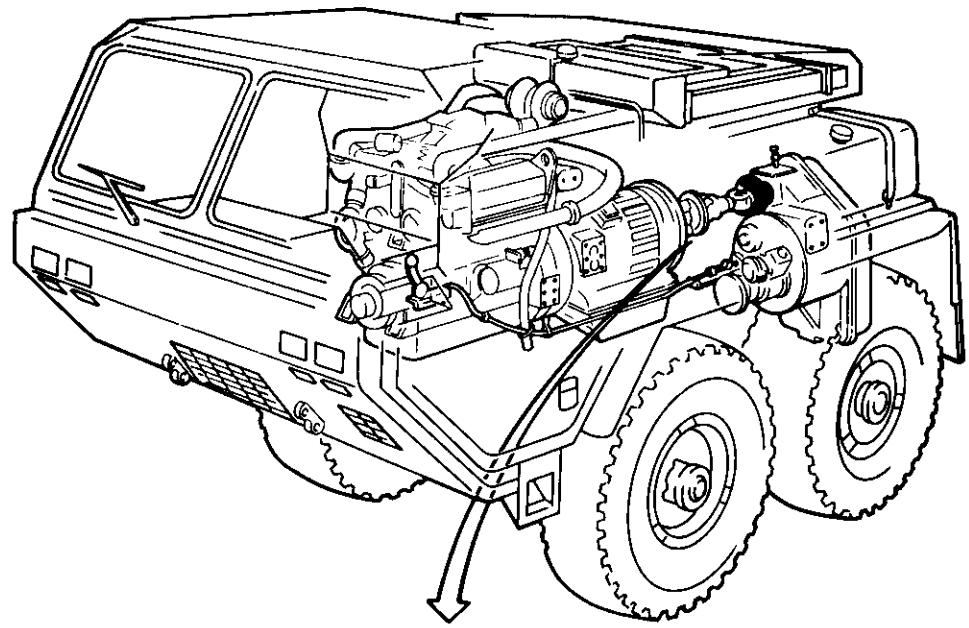
Test 3. Remove cylinder ends from both left and right slewing cylinder. Refer to paragraph 18-14 or 18-15. Check slewing rack, pinion, turret bearings, and slewing rack guide block for binding or damage.

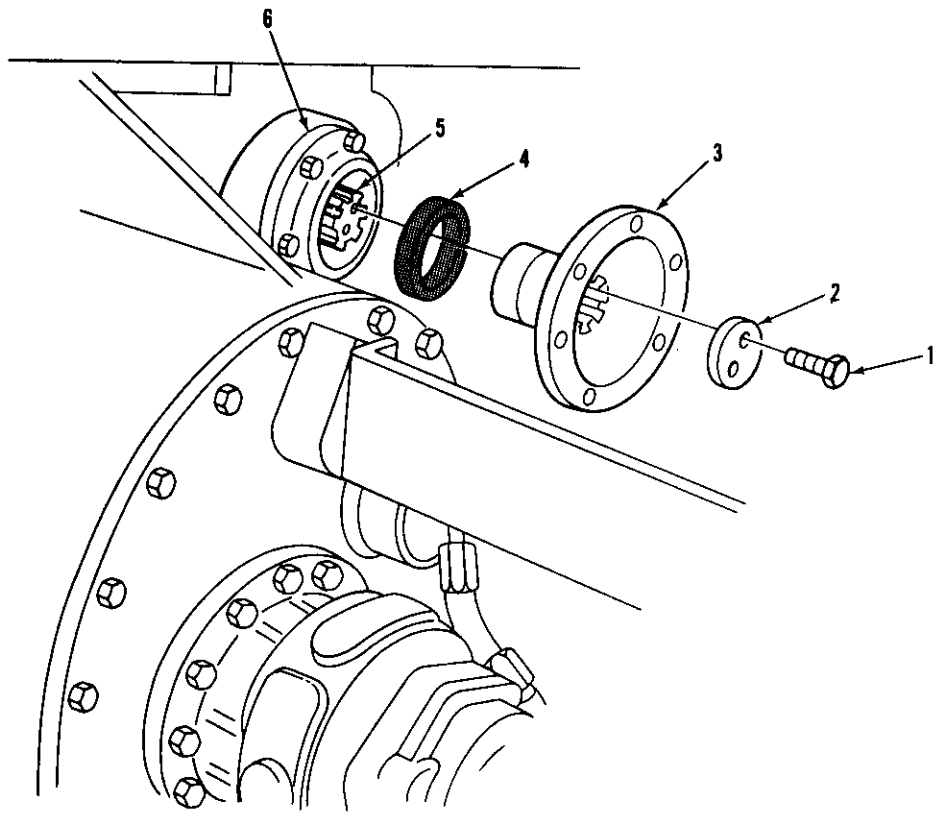
- If binding or damage is not present, repair or replace defective rotation cylinder(s). Refer to paragraphs 18-14 thru 18-16.
- If binding or damage is present, repair or replace slewing rack and pinion, turret bearings, or slewing rack guide block. Refer to paragraphs 18-17 and 18-19.

END OF TEST



TA 298420





1. CAPSCREW (2)
2. RETAINER PLATE
3. INPUT FLANGE
4. OIL SEAL
5. INPUT SHAFT
6. COVER

TA 298880

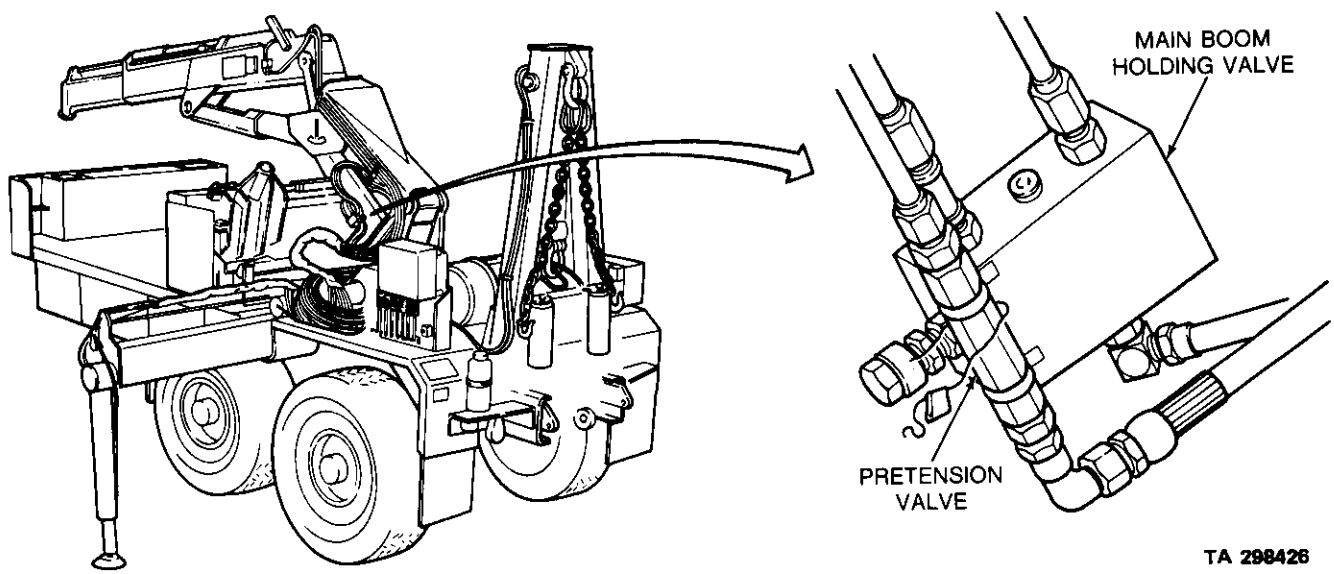
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

7. MAIN BOOM WILL NOT HOLD RATED LOAD

Test 1. Check for defective or misadjusted main boom holding valve. Start engine and let run at idle. Operate crane controls to lift load off ground approximately 5 feet (1.5 m). Turn crane main power switch to OFF. Pull main boom control lever down.

- If main boom drops quickly, flush and adjust main boom holding valve. Refer to paragraph 20-37 (TM 2320-20/12, TM 9-2320-297-20). If after flushing and adjustment of main boom holding valve, main boom still drops quickly, replace main boom holding valve. Refer to paragraph 18-32.
- If main boom does not drop quickly, repair or replace damaged main lift cylinder. Refer to paragraph 18-11 or 18-12.

END OF TEST



TA 298426

SECTION II. GENERAL TRANSFER CASE MAINTENANCE

8-3. INPUT SHAFT OIL SEAL REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Propeller shaft removed (para 10-3).

Materials/Parts

Adhesive, silicone sealant (item 7, A
Crocus cloth (item 20, Appendix C)
Sealer, lubricating and wicking (item 63, Appendix C)
Oil seal (NSN 5330-00-164-8881) item 4

---

a. Removal

(1) Remove two capscrews (1) and retainer plate (2).

(2) Using a puller, remove input flange (3).

(3) Remove oil seal (4) and discard.

b. Cleaning/Inspection

(1) Clean sealant from input flange (3) and input shaft (5).

(2) Clean sealer from two capscrews (1) and retainer plate (2).

(3) Inspect two capscrews (1) for damaged threads.

(4) Inspect input flange (3) for damage at point where oil seal (4) touches. Small grooves may be removed with crocus cloth.

(5) Replace all parts failing inspection.

c. Installation

(1) Install new oil seal (4) into cover (6).

(2) Coat splines of input flange (3) with silicone sealant and install onto input shaft (5).

(3) Install retainer plate (2) onto input shaft (5).

(4) Apply lubricating and wicking sealer to threads of two capscrews (1) and install.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install propeller shaft (para 10-3).

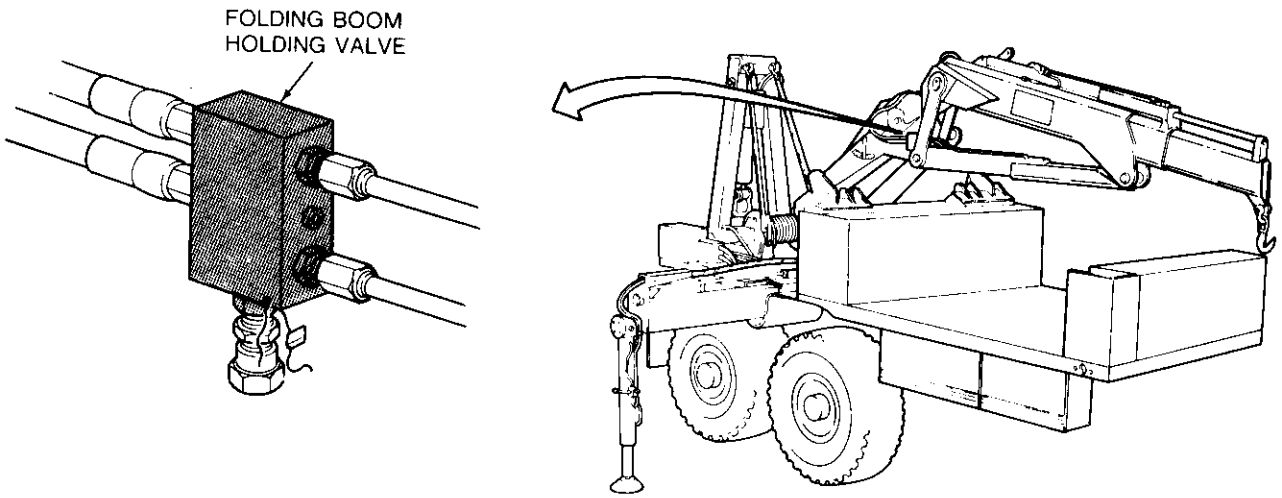
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

8. FOLDING BOOM WILL NOT HOLD RATED LOAD

Test 1. Check for defective or misadjusted folding boom holding valve. Start engine and let run at idle. Operate crane controls to lift load off ground approximately 5 feet (1.5 m). Turn crane main power switch to OFF. Pull folding boom control lever down.

- If folding boom drops quickly, flush and adjust folding boom holding valve. Refer to paragraph 20-37 (TM 2320-20/12, TM 9-2320-297-20). If after flushing and adjustment of folding boom holding valve, folding boom still drops quickly, replace folding boom holding valve. Refer to paragraph 18-31.
- If folding boom does not drop quickly, repair or replace damaged folding boom cylinder. Refer to paragraph 18-7 or 18-8.

END OF TEST



TA 298428

CHAPTER 8

TRANSFER CASE

8-1. OVERVIEW

This chapter provides information authorized for Third and Fourth Echelon Maintenance level mechanics. General information, maintenance, replacement, disassembly, inspection, and repair procedures for the vehicle's transfer case are covered in the following sections:

Section I. Description and Data

Section II. General Transfer Case Maintenance

Section III. Transfer Case Replacement Instructions

Section IV. Transfer Case Disassembly into Subassemblies and Reassembly from Subassemblies

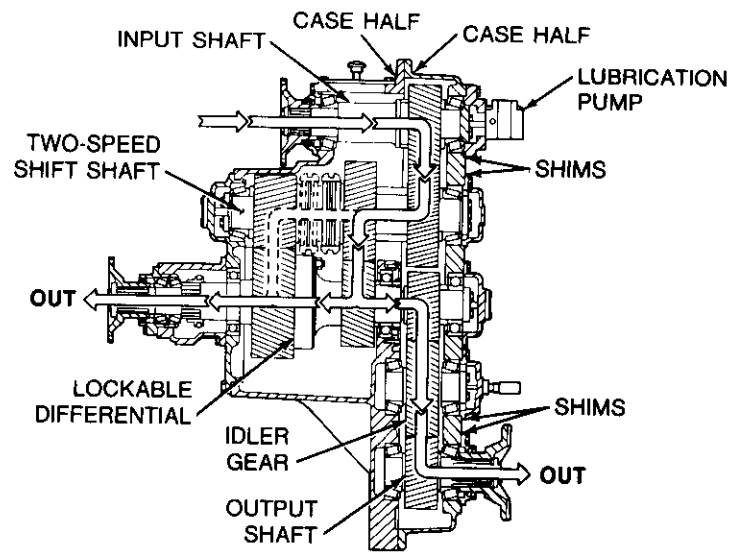
Section V. Transfer Case Subassembly Cleaning, Inspection, and Repair

SECTION I. DESCRIPTION AND DATA

8-2. DESCRIPTION AND DATA

a. General Description. The input shaft flange of the transfer case receives power through a propeller shaft that connects with the transmission. The input shaft drives both the two-speed shift shaft and the lubrication pump. The two-speed shift shaft drives the lockable differential. The differential drives the front output shaft and, through an idler gear, the rear output shaft. The idler shaft also drives the speedometer transducer.

b. Construction. The transfer case is made up of two cast iron case halves which support five gear shafts. Each gear shaft is supported at both ends by bearings. All gear shafts, except the main shaft, use shims to control end play. A lockable differential is used between the two outputs to allow for a difference in output speeds.



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MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

9. EXTENSION BOOM INOPERATIVE

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished by either operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating condition. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

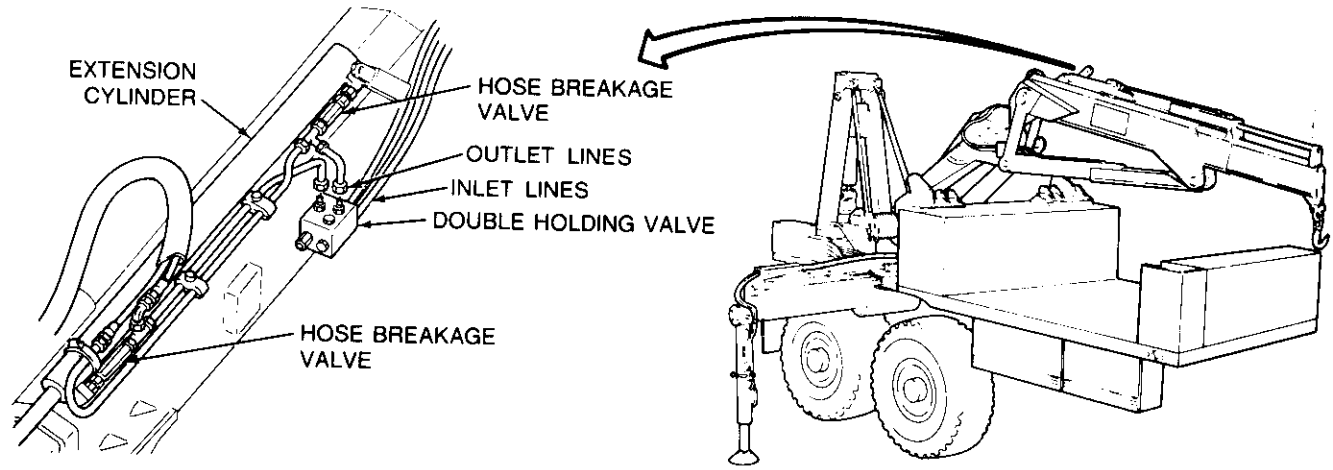
- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines and that the problem does not exist with the remote control.

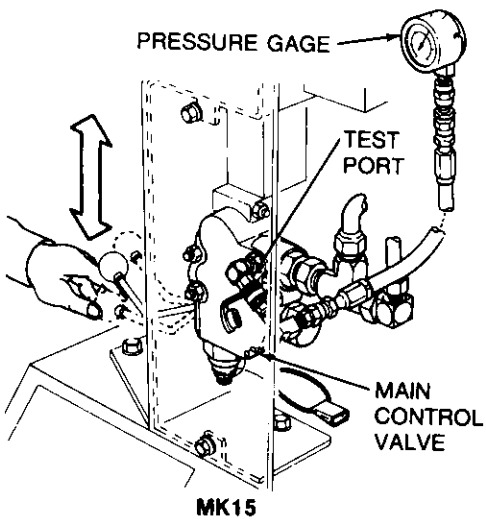
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

9. EXTENSION BOOM INOPERATIVE (Continued)

Test 1. Install a 0-5000 psi (0-34,475 kPa) pressure gage on test port at main control valve. Remove and plug both pressure inlet lines at the extension boom double holding valve. Cap fittings on double holding valve. Start engine and run at idle. Operate BOOM EXTENSION control lever to extend and retract extension boom. Check for 2950-3050 psi (20,340-21,030 kPa) in both directions. Reconnect lines.

- If pressures are within specifications in both directions, go to Test 2.
- If pressures are not within specifications in one or both directions, repair or replace main control valve. Refer to paragraph 18-27 thru 18-30.





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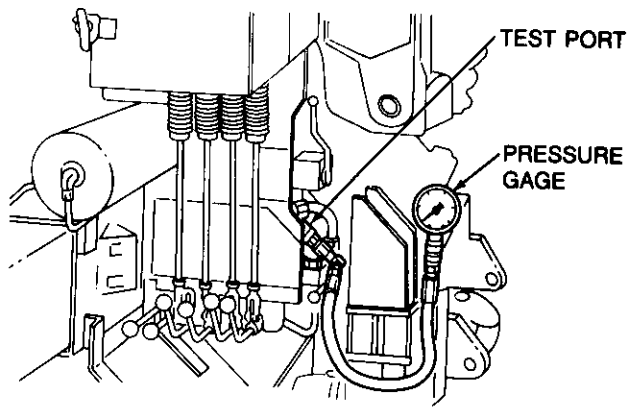

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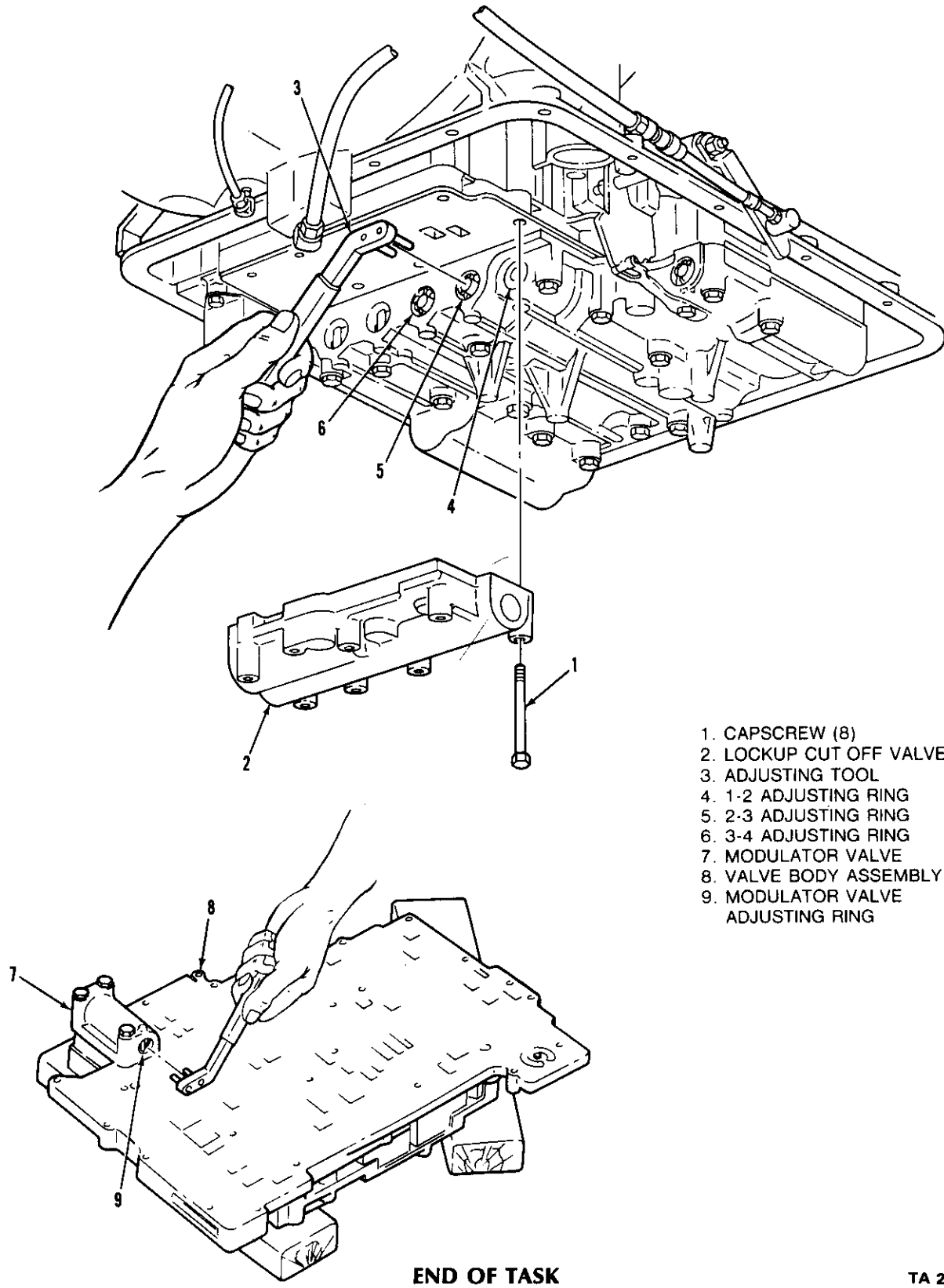


1. CAPSCREW (8)
2. LOCKUP CUT OFF VALVE
3. ADJUSTING TOOL
4. 1-2 ADJUSTING RING
5. 2-3 ADJUSTING RING
6. 3-4 ADJUSTING RING
7. MODULATOR VALVE
8. VALVE BODY ASSEMBLY
9. MODULATOR VALVE ADJUSTING RING

END OF TASK

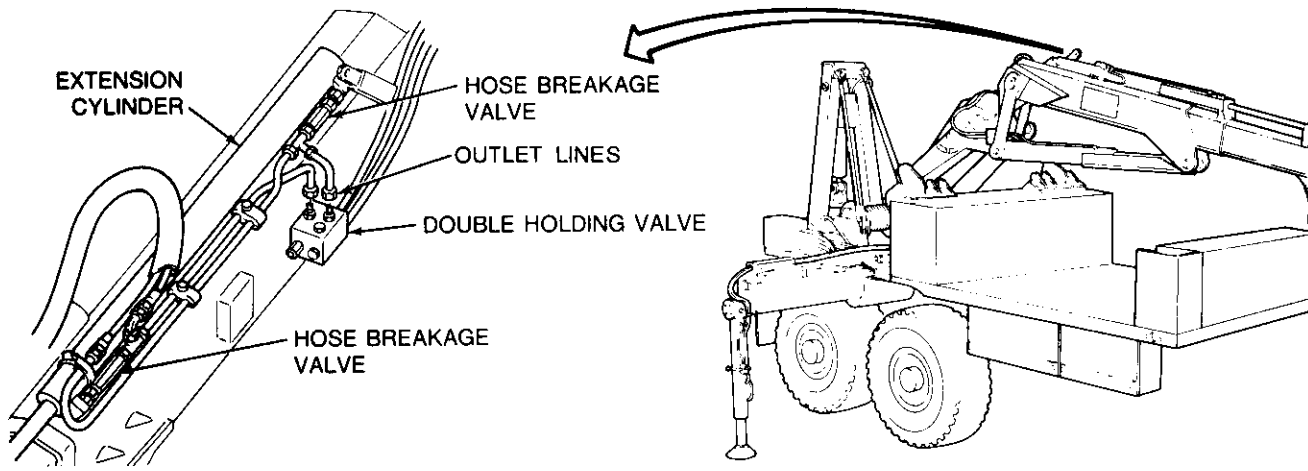
TA 298878

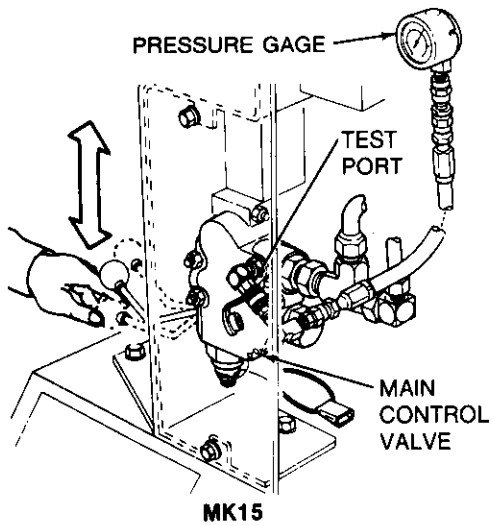
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

9. EXTENSION BOOM INOPERATIVE (Continued)

Test 2. Install a 0-5000 psi (0-34,475 kPa) pressure gage on test port at main control valve. Remove both outlet lines from extension cylinder double holding valve. Plug both lines. Install a flow meter in line between both outlet fittings on double holding valve. Open loading valve on flow meter fully. Start engine and run at idle. Operate BOOM EXTENSION control lever to extend and retract extension boom. Check for 2,950-3050 psi (20,340-21,030 kPa) in both directions. Reconnect lines.

- If pressures are within specifications in both directions, repair boom extension cylinder(s). Refer to paragraph 18-3.
- If pressures are not within specifications in one or both directions, repair or replace extension cylinder double holding valve. Refer to paragraph 18-50.





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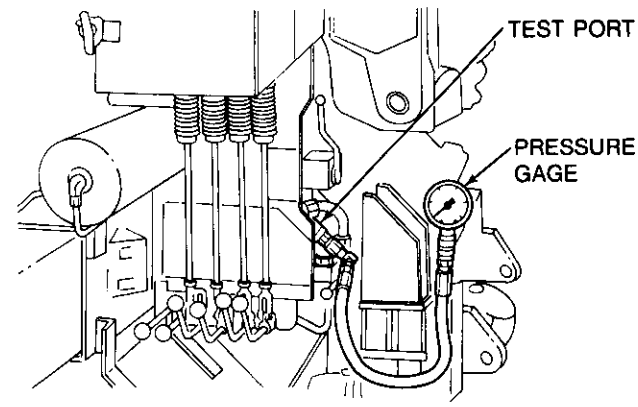

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7-19. TRANSMISSION TESTS AND ADJUSTMENTS (Continued)

NOTE

- If upshift speed points occur below 2100-2200 rpm, the shiftpoint speed may be raised by turning adjusting rings clockwise. If upshift speed points occur above 2100 to 2200 rpm, or do not occur at all, turn adjusting rings counterclockwise.
- Only the shift rings that do not upshift at the proper speed require adjustment.
- Use adjusting tool (3) to depress and rotate adjusting rings to proper positions.

(9) To adjust shift speed 1 to 2, push in and turn 1-2 adjusting ring (4). Each notch changes the shift speed 40 rpm.

(10) To adjust shift speed 2 to 3, push in and turn 2-3 adjusting ring (5). Each notch changes the shift speed 40 rpm.

(11) To adjust shift speed 3 to 4, push in and turn 3-4 adjusting ring (6). Each notch changes the shift speed 40 rpm.

NOTE

If more than one adjusting ring is turned in the same direction, the modulator valve (7) must be adjusted.

(12) Remove valve body assembly (8). Refer to paragraph 7-5 in this manual.

(13) Turn modulator valve adjusting ring (9) in the same direction that shift speed adjusting rings were turned.

(14) Install valve body assembly (8). Refer to paragraph 7-6 in this manual. Torque eight capscrews (1) to 108-132 inch-pounds (12.2-14.9 N·m).

(15) Install lockup cut off valve (2) and eight capscrews (1).

(16) Install internal oil filter. Refer to paragraph 8-12 (TM 2320-20/12, TM 9-2320-297-20).

(17) Install transmission oil pan. Refer to pararaph 8-12 (TM 2320-20/12, TM 9-2320-297-20).

(18) Fill transmission to proper level. Refer to paragraph 8-3 (TM 2320-20/12, TM 9-2320-297-20).

(19) Check shift speeds again for proper adjustment.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

10. ONE EXTENSION BOOM INOPERATIVE

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished by either operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating condition. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines and that the problem does not exist within the remote control.

Remove hose breakage valves from rod and piston ends of inoperative extension cylinder. Check for blockage.

- If blockage is present, flush hose breakage valve and reinstall.
- If blockage is not present, repair or replace extension cylinder. Refer to paragraph 18-3 for repair or paragraph 20-11 and 20-12 in TM 2320-20/12, TM 9-2320-297-20 for replacement.

END OF TEST

(5) Accelerate engine to full throttle. Note the maximum rpm that engine will still run (converter stall speed). Stall speed should be between 1900 and 2000 rpm.

(6) If stall speed is high, refer to transmission troubleshooting (para 2-2 of this manual).

(7) If stall speed is low, refer to transmission troubleshooting (para 2-2 of this manual).

b. Transmission Shift Speed Adjustments

NOTE

Proper timing of shift speed points is necessary for maximum transmission performance.

(1) Raise the temperature of the transmission fluid to 160-220 degrees F (71-104 degrees C).

(2) Check engine for satisfactory performance before making shift point adjustments. The engine no load governor setting must be correct.

(3) Make sure air line to modulator valve actuator on the transmission is not kinked, loose, or damaged.

(4) Check the shift selector linkage for proper range selection.

NOTE

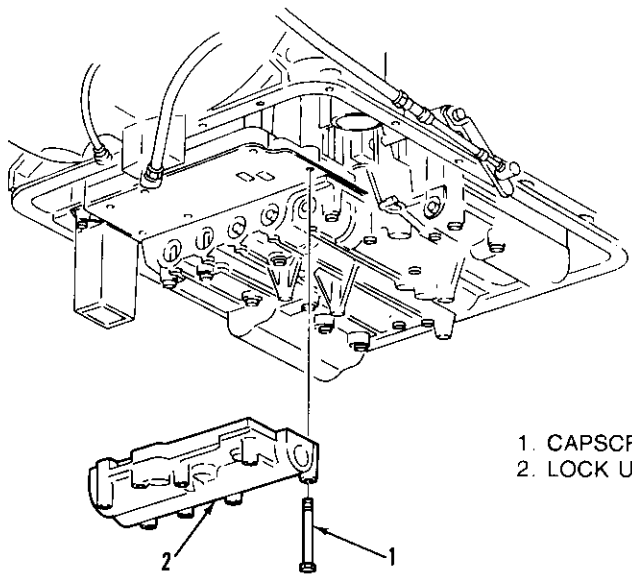
Before road test, check vehicle tachometer with a known good test tachometer for proper operation.

(5) While driving vehicle, have assistant note throttle shift points. Shift points wide open should occur at 2100-2200 rpm.

(6) If throttle shift points need adjustment, remove transmission oil pan and internal filter. Refer to paragraph 8-12 (TM 2320-20/12, TM 9-2320-297-20).

(7) Remove eight capscrews (1) from lockup cut off valve (2).

(8) Remove lockup cut off valve (2).



1. CAPSCREW (8)
2. LOCK UP CUT OFF VALVE

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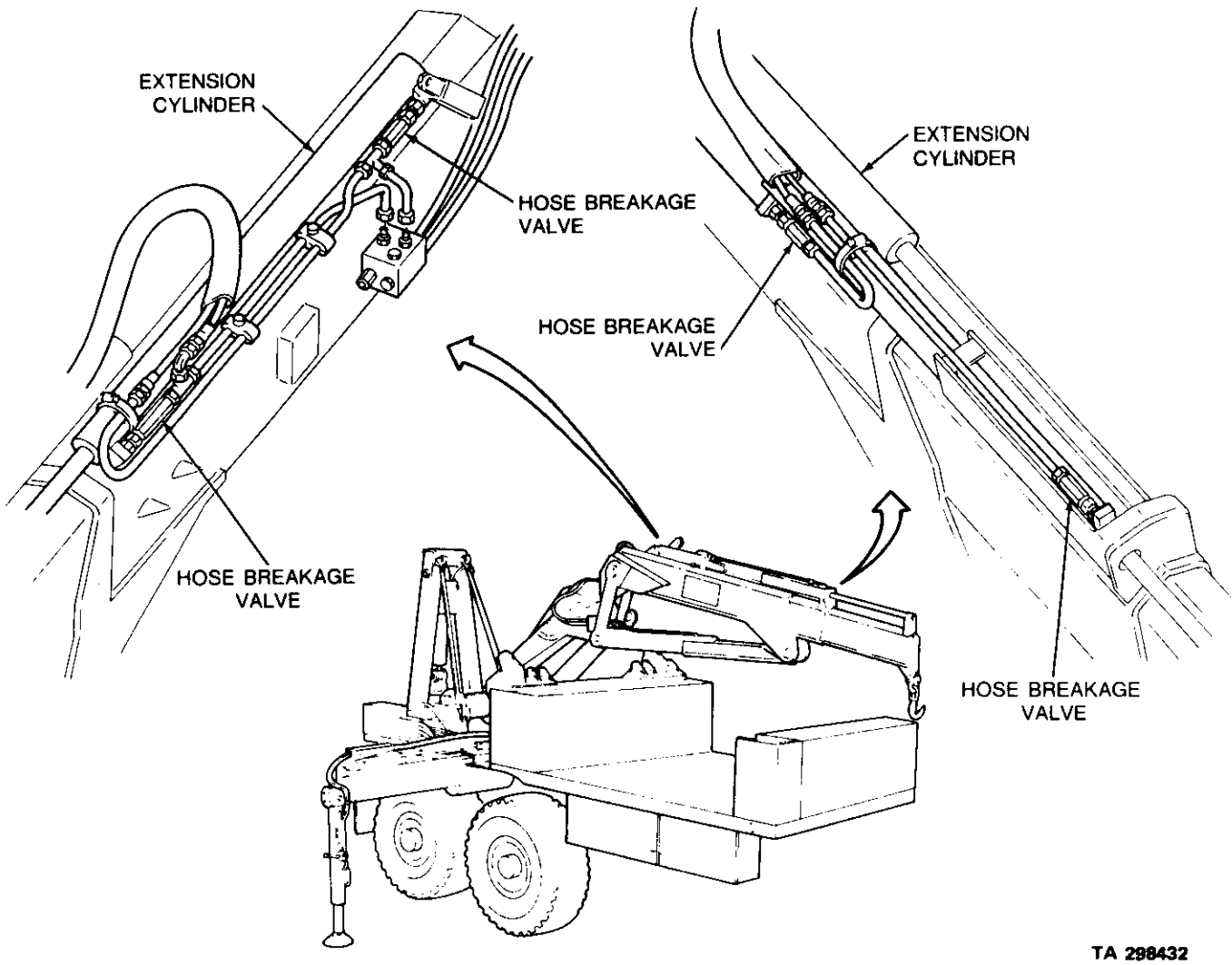
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



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11. CRANE WILL NOT LIFT LOAD

- Refer to Section V, Crane Adjusting and Testing in Chapter 18.

END OF TEST

12. CRANE WILL ROTATE, MAIN BOOM WILL LIFT, EXTENSION BOOM WILL RETRACT, ALL OTHER FUNCTIONS INOPERATIVE OR VERY SLOW

- Refer to Section V, Crane Adjusting and Testing in Chapter 18.

END OF TEST

SECTION VI. TRANSMISSION TESTS AND ADJUSTMENTS

7-19. TRANSMISSION TESTS AND ADJUSTMENTS

THIS TASK COVERS: a. Transmission Converter Stall Test
b. Transmission Shift Speed Adjustments

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Valve ring adjusting tool (J 24314)

References

TM 2320-20/12
TM 9-2320-297-20

Equipment Condition TM

TM 2320-20/12
TM 9-2320-297-20

Condition Description

Transmission filled to proper level (para 8-3).

General Safety Instructions

Block wheels of truck to prevent personal injury.

---

a. Transmission Converter Stall Test

WARNING

When performing a converter stall test, the vehicle must not move. Both the parking and service brakes must be applied. Keep clear of vehicle travel path. If the brakes fail or vehicle blocking fails serious injury or death could result.

CAUTION

Do not maintain the stalled condition longer than 30 seconds due to rapid heating of the transmission oil, do not let oil exceed 300 degrees F (149 degrees C). Run engine at 1200 to 1500 rpm for 2 minutes in neutral between stall tests to cool oil. Prevent engine cooling system from overheating. Severe damage to transmission may result if cautions are not followed.

(1) Block wheels to prevent vehicle movement.

(2) Set parking brake.

(3) Start engine and set service brake.

(4) Put transfer case in high position and set transmission to 2 position.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

MK15 A-FRAME HYDRAULICS

1. A-Frame Cylinder Will Not Operate or Operates Slowly

WARNING

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

CAUTION

- Checking system pressure involves putting valves into relief. Relief is defined as a point when a needed system pressure is reached causing excess pressurized hydraulic fluid to be directed to the hydraulic reservoir.
- Relief is accomplished by either operating the vehicle in a manner which will create relief or by using the loading valve on the flow meter, which will simulate the operating condition. Putting valves into relief should be limited to no more than 10 seconds to prevent excessive heat buildup.

NOTE

- Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the AUXILIARY HYDRAULICS position, and hydraulic oil temperature at 130-150° F (54-66° C).
- Before performing troubleshooting procedures, make sure there are no restrictions in pressure or return lines and that the problem does not exist within the remote control.

Test 1. Install a 0-5,000 psi (0-34,475 kPa) pressure gage on test port at main control valve. Start engine and run at idle. Operate A-frame control lever to fully retract A-frame cylinder. Check for 2,950-3,050 psi (20,340-21,029 kPa).

- If pressure is within specifications and cylinder will not move or moves slowly, check for a damaged or misadjusted holding valve. Refer to paragraph 20-37 (TM 2320-20/12, TM 9-2320-297-20).
- If pressure is not within specifications, go to Test 2.

(3) Install reverse signal switch plug (13).

(4) Install fourth clutch pressure tap plug (12).

(5) Install governor pressure tap plug (9).

(6) Install plug (10) and washer (11).

(7) Coat outside of new oil seal (7) with non-hardening sealer.

(8) Install new oil seal (7) into housing (8). Coat oil seal (7) with oil.

(9) Install manual shaft (3) by inserting shaft through oil seal (7) into housing (8).

(10) Position detent lever (6) in housing (8) and onto manual shaft (3).

(11) Install new locknut (5) on manual shaft (3).

(12) Tighten locknut (5) to 15-20 foot-pounds (20-27 N·m). Line up locknut (5) and install retaining pin (4).

(13) Install selector lever (2) onto manual shaft (3).

(14) Install new nut (1) onto manual shaft (3). Tighten securely.

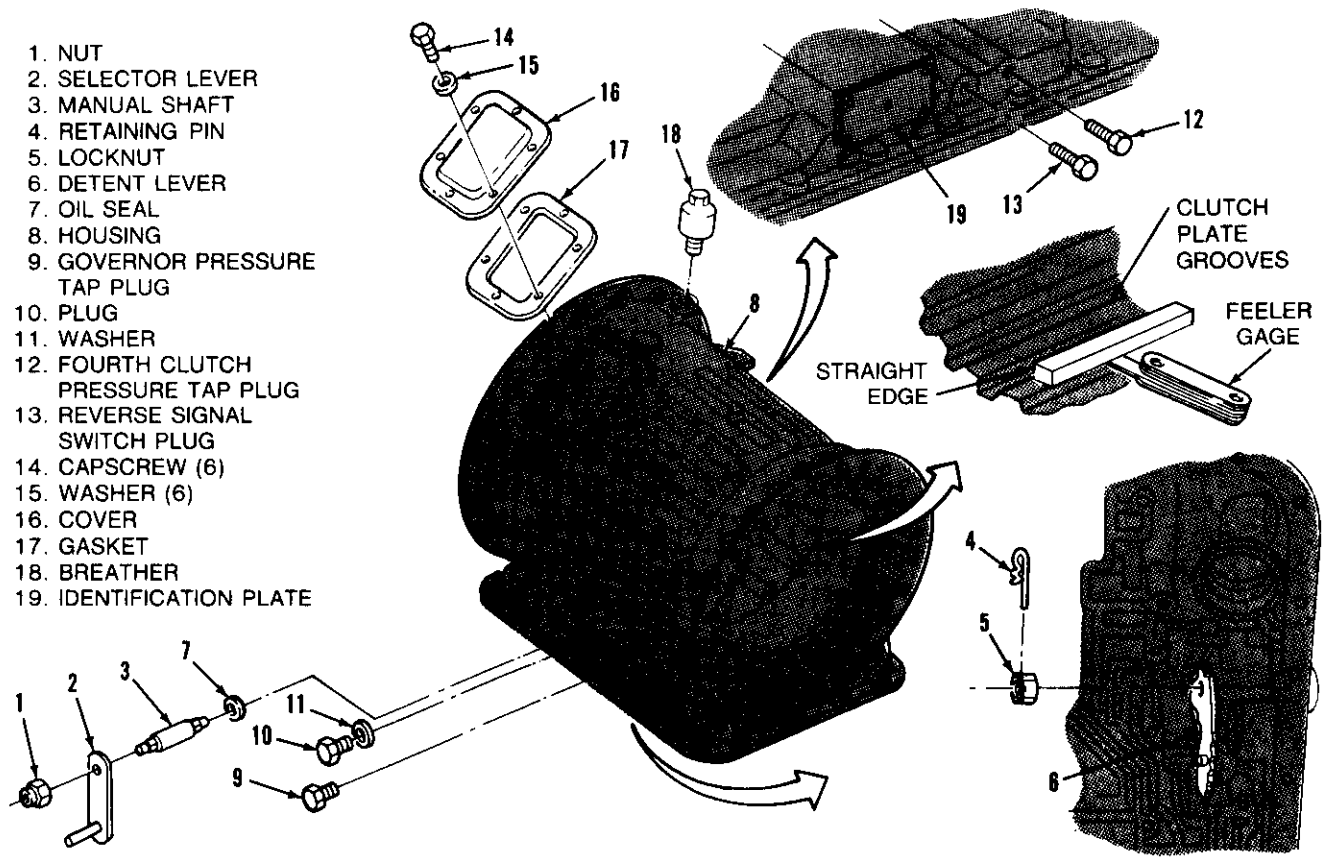
END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 Install all
TM 9-2320-297-34 subassemblies (para 7-6).

1. NUT
2. SELECTOR LEVER
3. MANUAL SHAFT
4. RETAINING PIN
5. LOCKNUT
6. DETENT LEVER
7. OIL SEAL
8. HOUSING
9. GOVERNOR PRESSURE TAP PLUG
10. PLUG
11. WASHER
12. FOURTH CLUTCH PRESSURE TAP PLUG
13. REVERSE SIGNAL SWITCH PLUG
14. CAPSCREW (6)
15. WASHER (6)
16. COVER
17. GASKET
18. BREATHER
19. IDENTIFICATION PLATE



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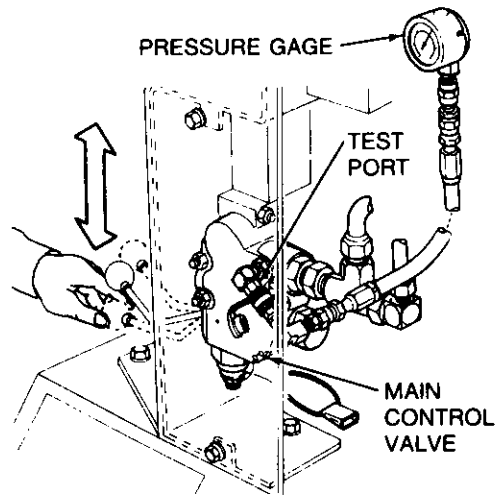
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



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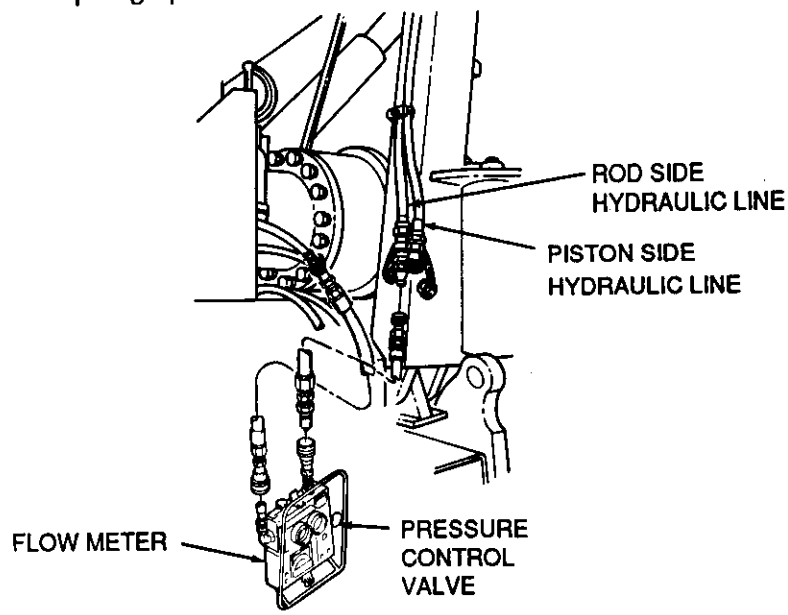
Test 2. Install flow meter in-line in A-frame cylinder rod side hydraulic line. Rod side hydraulic line has a male quick disconnect fitting for an end, and can be used to identify the line. Open pressure control valve fully by turning control knob counterclockwise to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully retract A-frame cylinder. Slowly close pressure control valve by turning knob clockwise fully. Check for 2,950-3,050 psi (20,340-21,030 kPa).

- If pressure is within specifications, repair or replace A-frame cylinder. Refer to paragraph 18-25.
- If pressure is not within specifications, repair or replace defective control valve. Refer to paragraph 18-30 in this manual.



7-18. TRANSMISSION HOUSING REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Materials/Parts

Oil, OE/HDO-10 (item 44, Appendix C)
Non-hardening sealer (item 62, Appendix C)
Nut (NSN 5310-01-143-0512) item 1
Retaining pin (NSN 5315-00-108-1112) item 4
Locknut (NSN 5310-00-568-6077) item 5
Oil seal (NSN 5330-01-141-9503) item 7
Gasket (NSN 5330-00-781-7774) item 17

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	All subassemblies removed (para 7-5).

Special Environmental Conditions

Work in a clean area free of blowing dust.

a. Disassembly

(1) Remove nut (1) from selector lever (2). Discard nut (1).

(2) Remove selector lever (2) from manual shaft (3).

(3) Remove and discard pin (4).

(4) Remove locknut (5). Discard locknut (5).

(5) Hold detent lever (6) with one hand, and remove manual shaft (3) by pulling shaft through oil seal (7).

(6) Remove detent lever (6) from housing (8).

(7) Remove oil seal (7). Discard oil seal (7).

(8) Remove governor pressure tap plug (9).

(9) Remove plug (10) and washer (11).

(10) Remove fourth clutch pressure tap plug (12).

(11) Remove reverse signal switch plug (13).

(12) Remove six capscrews (14), washers (15), cover (16), and gasket (17). Discard gasket (17).

(13) Remove breather (18).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Inspect clutch plate grooves in main housing (8). Wear must not exceed 0.090 inch (2.29 mm). Measure all surfaces of clutch plate grooves with a straight edge and a feeler gage as shown. If grooves are worn deeper, replace housing (8).

NOTE

If transmission housing is replaced, transfer the identification plate (19) to the new housing.

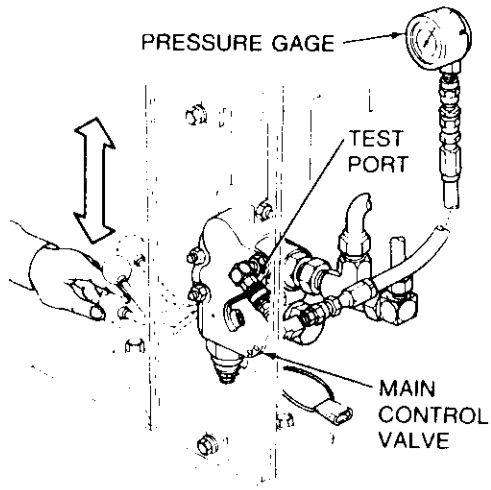
c. Assembly

(1) Install new gasket (17), cover (16), six washers (15), and capscrews (14). Tighten securely.

(2) Install breather (18).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. A-Frame Cylinder Will Not Operate or Operates Slowly (Continued)



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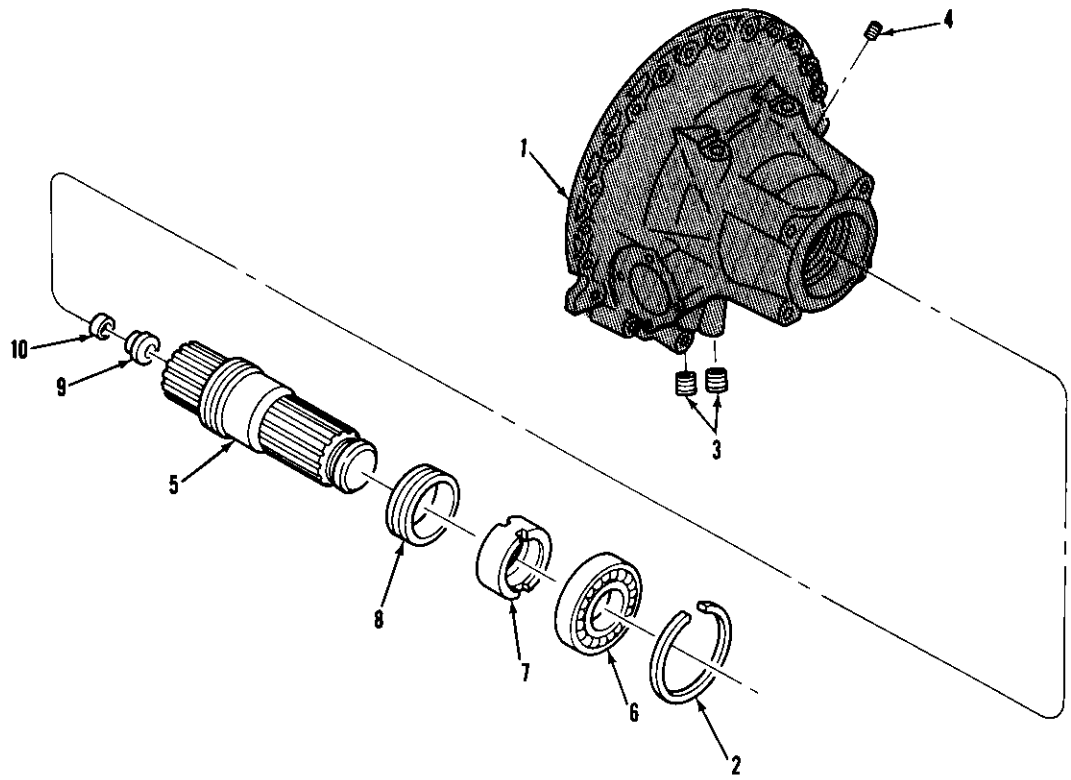
Test 3. Operate A-frame control lever to fully extend A-frame cylinder. Check for 950-1050 psi (6550-6895 kPa).

- If pressure is within specifications, and cylinder will not move or moves slowly, check for a damaged or misadjusted holding valve. Refer to paragraph 20-37 (TM 2320-20/12, TM 9-2320-297-20).
- If pressure is not within specifications, go to Test 4.

Test 4. Install a flow meter in-line in A-frame cylinder piston side hydraulic line. Piston side hydraulic line has a female quick disconnect fitting for an end, and can be used to identify the line. Open pressure control valve fully to DECREASE. Start engine and allow to run at idle. Have assistant operate control lever to fully extend A-frame cylinder. Slowly close pressure control valve by turning knob clockwise fully. Check for 950-1050 psi (6550-6895 kPa).

- If pressure is within specifications, repair or replace A-frame cylinder. Refer to paragraph 18-25.
- If pressure is not within specifications, repair or replace defective control valve. Refer to paragraph 18-30 in this manual.



1. REAR COVER
2. SNAPRING
3. PLUG (2)
4. PLUG
5. OUTPUT SHAFT
6. BEARING
7. SPACER
8. SPEEDOMETER DRIVE GEAR
9. BUSHING
10. ORIFICE PLUG

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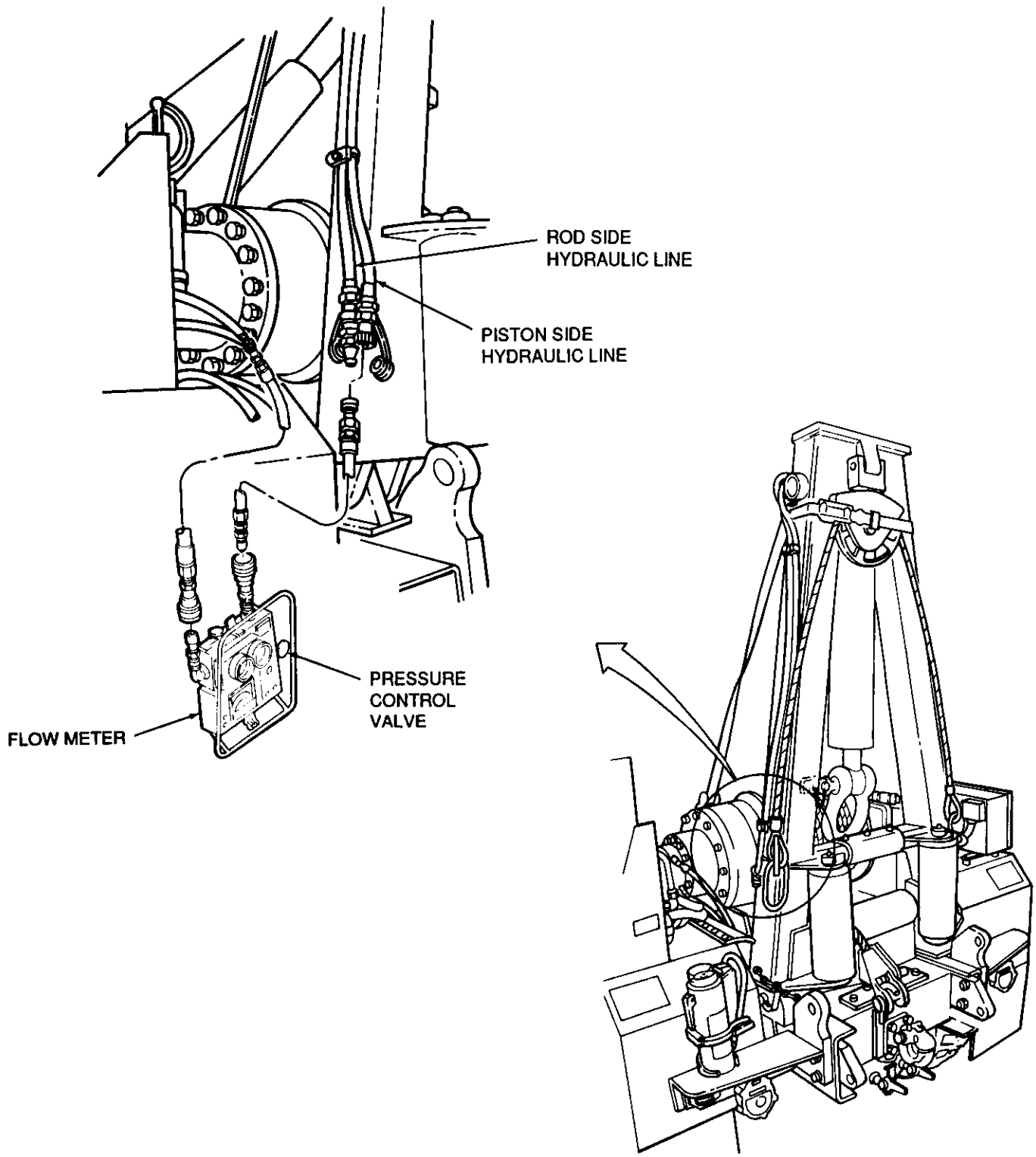
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



7-17. REAR COVER/FIRST REVERSE CLUTCH MAINTENANCE (Continued)

(18) If removed, install new orifice plug (10) into output shaft (5).

(19) If removed, install new bushing (9) into output shaft (5) using output shaft bushing installer.

(20) Install speedometer drive gear (8), spacer (7), and bearing (6) onto output shaft (5).

(21) Install output shaft (5) into rear cover (1).

(22) Install snapring (2) into rear cover (1).

(23) Lightly coat threads of two plugs (3) and plug (4) with pipe sealant.

(24) Install two plugs (3) and plug (4) into rear cover (1). Tighten securely.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13
TM 9-2320-297-34 Install rear cover (para 7-6).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

HYDRAULIC COOLING SYSTEM

HYDRAULIC SYSTEM OVERHEATS

WARNING

To prevent personal injury, do not reach into fan area while engine is running.

Never disconnect any hydraulic hose or part while engine is running. Allow several minutes for pressure to relieve itself. With engine shut down, operate control valves fully in each direction to relieve trapped pressure.

NOTE

Unless called for in the test being done, all pressure tests will be done with engine running at idle, ignition switch in the ON position, transmission in neutral, parking brake ON, selector valve in the STEERING position, directional relief valve solenoid electrical plug disconnected, and hydraulic oil temperature at 130-150° F (54-66° C).

Test 1. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 4. Disconnect electrical wires from fan control valve at solenoid. This will allow full flow to be available to the fan circuit. Fan will run all the time. Start engine and increase to maximum speed. Check for 1800-1900 psi (12,409-13,098 kPa).

- If pressure is within specifications, fan relief circuit is working properly. Continue to Test 2.
- If pressure is not within specifications, refer to HYDRAULIC STEERING SYSTEM, Malfunction 1, Tests 1 thru 16.

(12) Using piston inner seal protector (23), install first clutch piston (15) into rear cover (1).

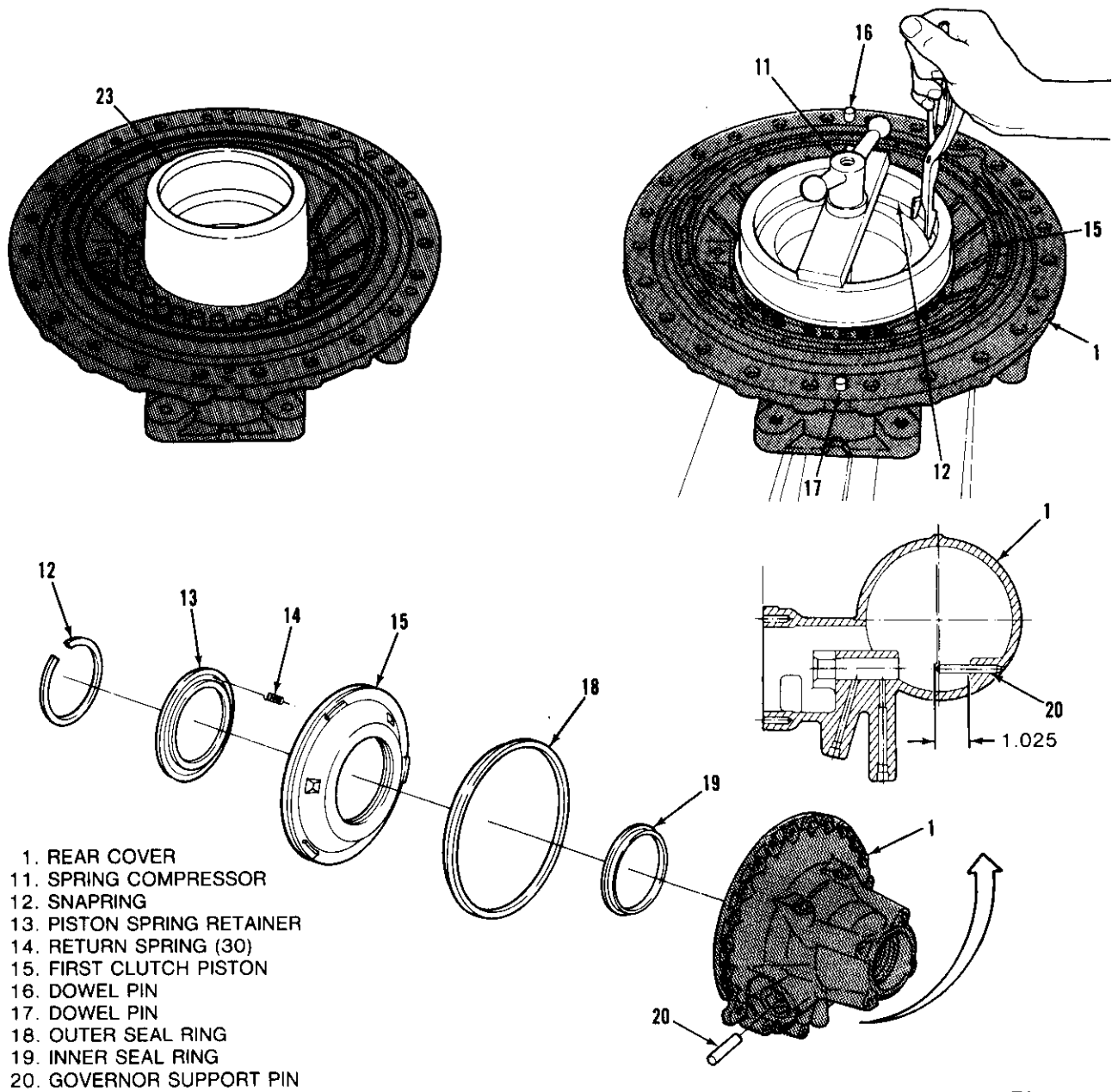
(13) Install two dowel pins (16 and 17), if removed.

(14) Install 30 return springs (14) into first clutch piston (15).

(15) Using spring compressor (11), push down on piston spring retainer (13) until snapring groove in rear cover (1) is cleared.

(16) Install snapring (12).

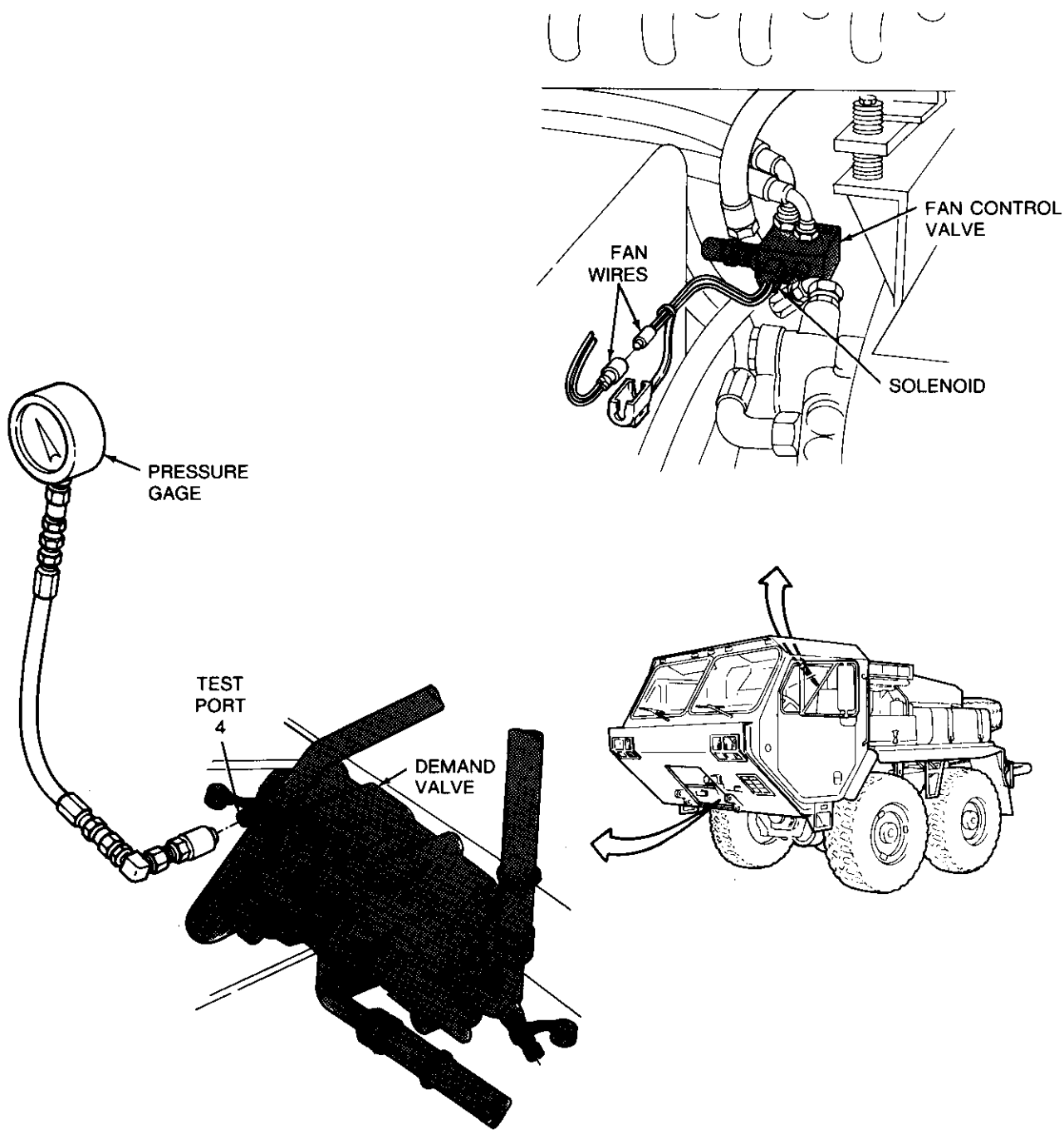
(17) Remove spring compressor (11).



1. REAR COVER
11. SPRING COMPRESSOR
12. SNAPRING
13. PISTON SPRING RETAINER
14. RETURN SPRING (30)
15. FIRST CLUTCH PISTON
16. DOWEL PIN
17. DOWEL PIN
18. OUTER SEAL RING
19. INNER SEAL RING
20. GOVERNOR SUPPORT PIN
23. PISTON INNER SEAL PROTECTOR

TA 298874

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298433

7-17. REAR COVER/FIRST REVERSE CLUTCH MAINTENANCE (Continued)

NOTE

Steel clutch plates are available in two sizes. If a plate measures 0.0955-0.1025 inch (2.44-2-62 mm), it is a thin plate. If it measures 0.1161-0.1231 inch (2.95-3.12 mm), it is a thick plate

(6) Measure steel plates (23). Replace any thin plate that is less than 0.0993 inch (2.522 mm) thick. Replace any thick plate that is less than 0.1161 inch (2.949 mm) thick. Place steel plates (23) individually on a flat surface and measure for clutch plate cone (22). Replace if clutch plate cone (22) exceeds 0.013 inch (.3302 mm).

(7) Measure friction plates (24). Replace any plate if less than 0.1347 inch (3.421 mm) thick.

c. Assembly

(1) Starting with steel plate (23) and alternating with friction plates (24), stack all plates on a flat surface in a press.

(2) Place first clutch piston (15) on top of clutch plates (23 and 24).

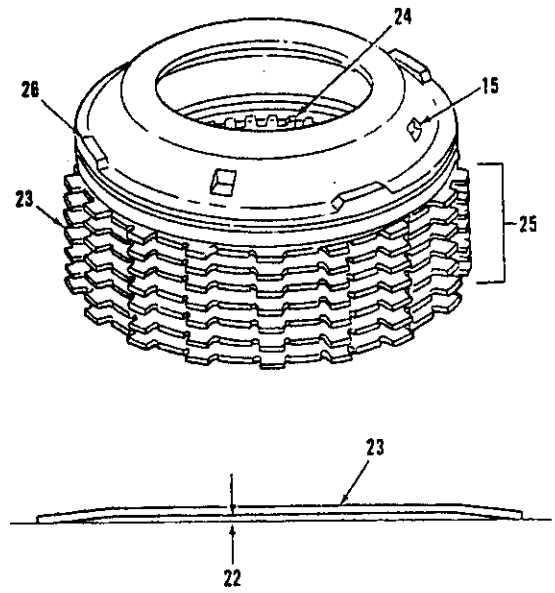
(3) Press evenly on first clutch piston (15) with a force of 980-1020 pounds (444-462 kg).

(4) Measure distance from base of clutch pack (25) to top of thrust pad (26).

(5) Clutch pack thickness must be 2.564-2.586 inches (65.1-65.7 mm).

(6) Replace steel plates (23) as needed to adjust clutch pack thickness.

(7) Remove clutch pack (25) from press after proper thickness has been obtained.



15. FIRST CLUTCH PISTON
22. CLUTCH PLATE CONE
26. STEEL PLATE (7)
24. FRICTION PLATE (6)
25. CLUTCH PACK
26. THRUST PAD

(8) Label the clutch pack (25) and set aside for later assembly.

(9) If removed, install governor support pin (20) so that it protrudes 1.025 inches (26.03 mm) as shown.

(10) Coat new inner sealring (19) and new outer sealring (18) with oil.

(11) Install inner sealring (19) and outer sealring (18) on first clutch piston (15).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

HYDRAULIC SYSTEM OVERHEATS (Continued)

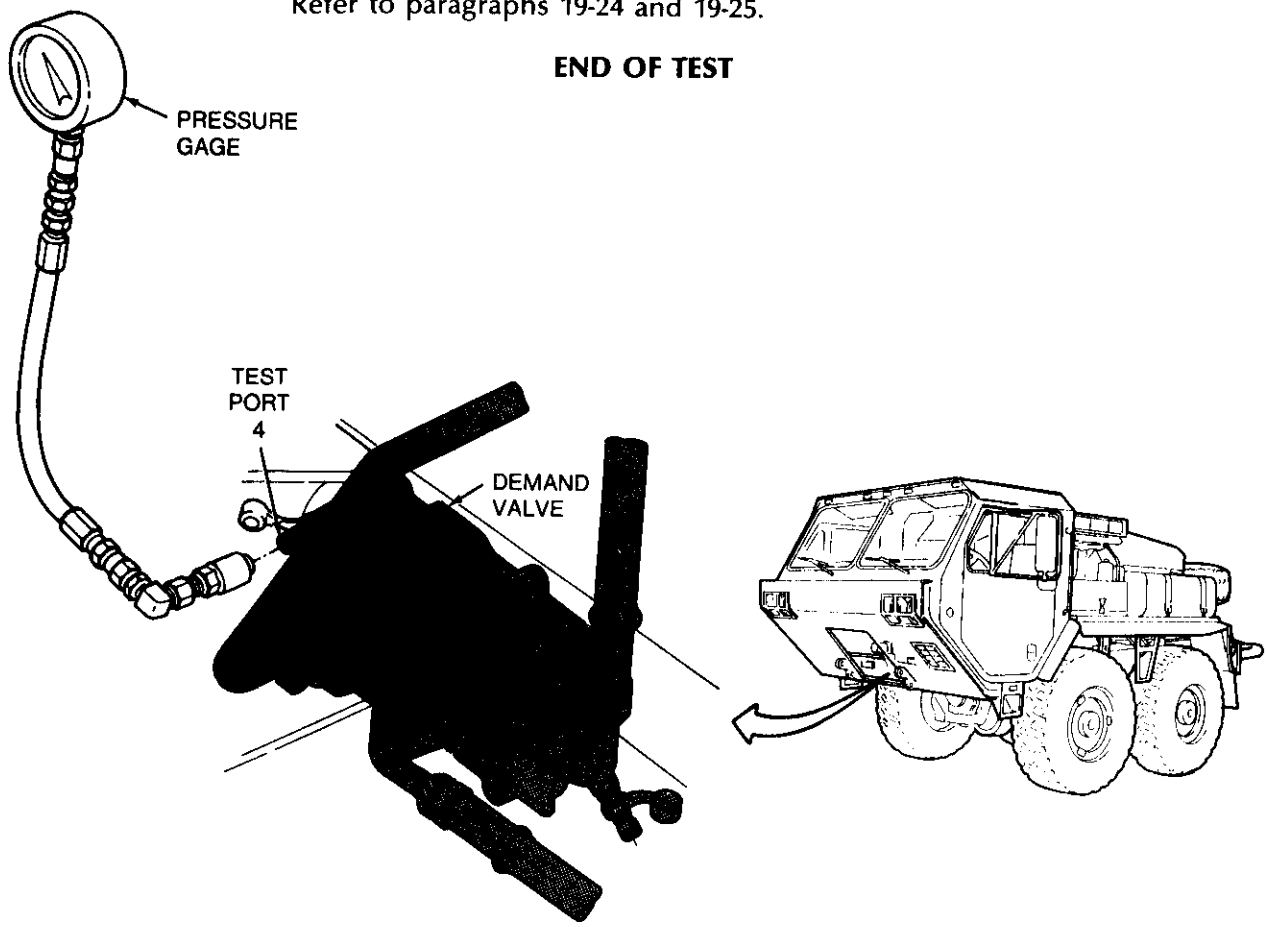
WARNING

To prevent personal injury, do not reach into fan area while engine is running.

Test 2. Install a 0-5,000 psi (0-34,475 kPa) pressure gage at test port 4. Disconnect electrical wires from fan control valve at solenoid. This will allow full flow to be available to the fan circuit. Fan will run all the time. Install a strobe tachometer light at fan to measure fan speed. Start engine and increase to maximum speed. Measure fan speed at 1800-1900 psi (12,409-13,098 kPa).

- If fan speed is between 1,500-1,700 rpm, fan circuit is working properly.
- If fan speed is not between 1,500-1,700 rpm, repair or replace hydraulic fan motor. Refer to paragraphs 19-24 and 19-25.

END OF TEST



TA 298434

(9) Install spring compressor (11) inside rear cover (1).

(10) Compress spring compressor (11) and remove snapring (12).

(11) Remove spring compressor (11).

(12) Remove piston spring retainer (13) and 30 return springs (14) from first clutch piston (15).

(13) Remove first clutch piston (15) from rear cover (1).

(14) If damaged, remove dowel pins (16 and 17) from rear cover (1).

(15) Remove outer seal ring (18) and inner seal ring (19) from first clutch piston (15). Discard seal rings (18 and 19).

(16) If worn or damaged, remove governor support pin (20).

b. Cleaning/Inspection

(1) Clean all parts, refer to paragraph 2-6.

(2) Inspect all parts for damage. Refer to paragraph 2-7.

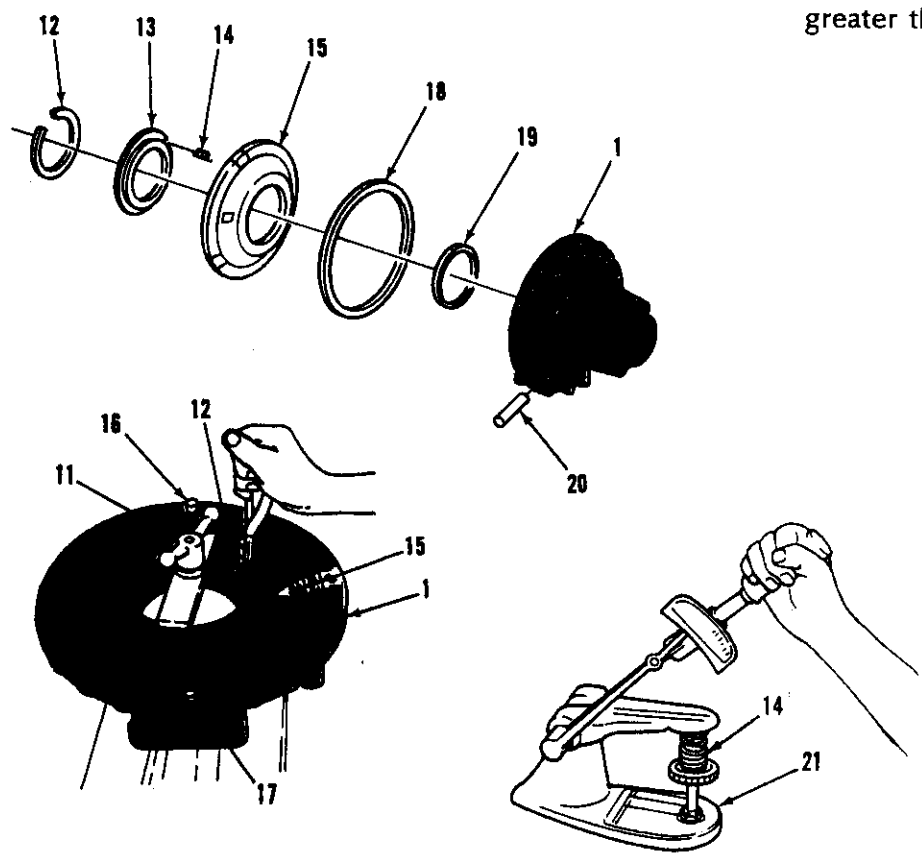
(3) Test return springs (14) using spring tester (21). Replace all springs (14) if any five springs do not meet the following load-height requirements:

(a) Length without load must be at least: 1.20 inches (32.77 mm).

(b) Length under load must be at least 0.82 inch (20.83 mm) with a load of 4.3 to 5.7 pounds (1.9 to 2.6 kg).

(4) Measure inside diameter of bushing (9).

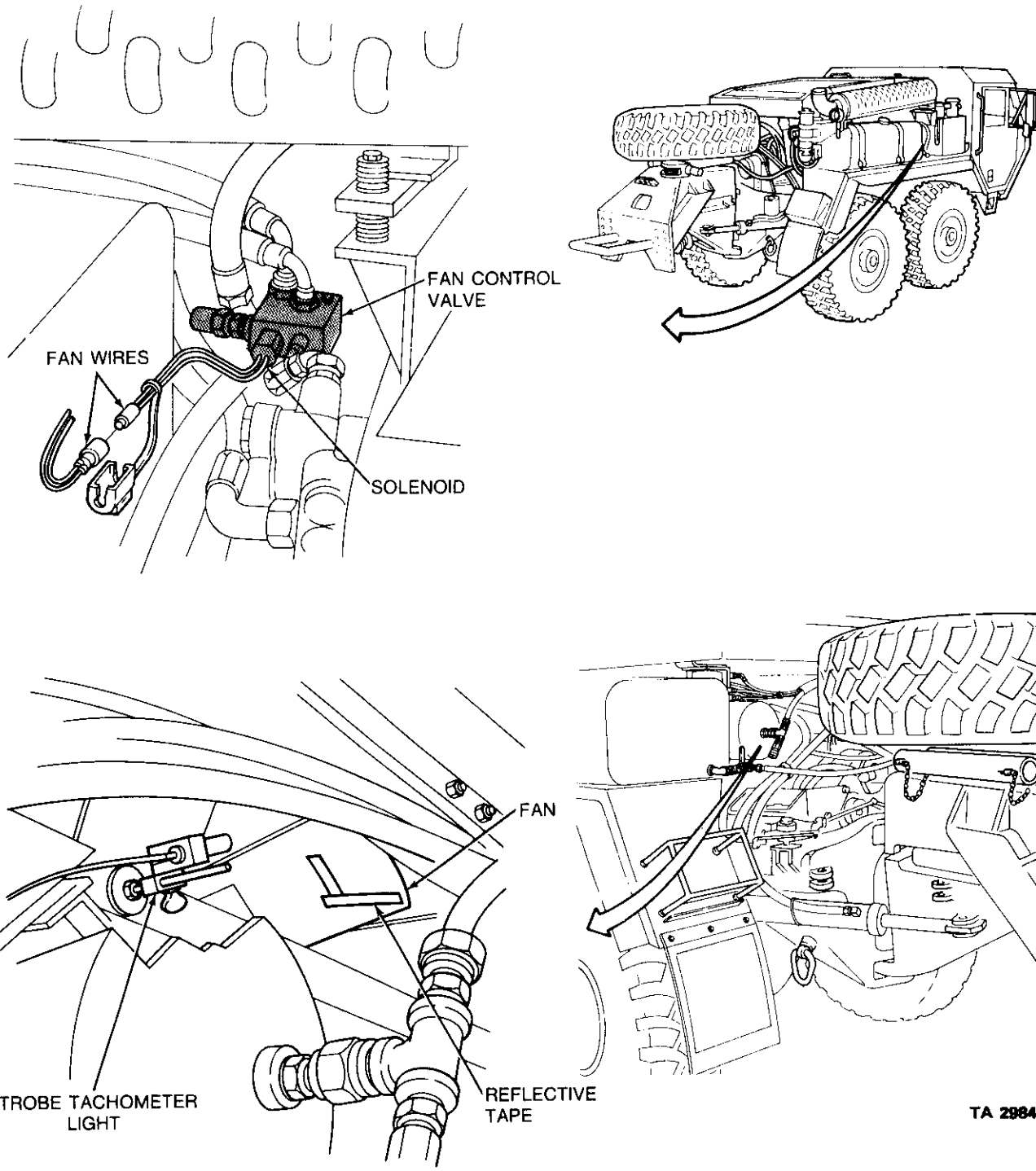
(5) Compare this measurement to the measurement of the main shaft bearing diameter taken in paragraph 7-18. Clearance between bearing diameter and inside diameter of bushing must be no greater than 0.004 inch (0.10 mm).



1. REAR COVER
11. SPRING COMPRESSOR (TOOL)
12. SNAPRING
13. PISTON SPRING RETAINER
14. RETURN SPRING (30)
15. FIRST CLUTCH PISTON
16. DOWEL PIN
17. DOWEL PIN
18. OUTER SEAL RING
19. INNER SEAL RING
20. GOVERNOR SUPPORT PIN
21. SPRING TESTER (TOOL)

TA 298872

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



TA 298435

7-17. REAR COVER/FIRST REVERSE CLUTCH MAINTENANCE

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Special Tools

Output shaft bushing installer (J 24203)
Clutch spring compressor (J 24204)
Piston inner seal protector (J 24210)
Spring tester (J 9666)
Micrometer set 0-6 inch outside
(NSN 5210-00-554-7134)

Materials/Parts

Oil, OE/HDO-10, (item 44, Appendix C)
Pipe sealant (item 60, Appendix C)
Seal ring (NSN 5365-01-084-5258) item 18
Seal ring (NSN 5330-01-151-7289) item 19

Equipment Condition

TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Rear cover removed (para 7-5).

Special Environmental Conditions

Work in a clean area free of blowing dust.

a. Disassembly

(1) Place rear cover (1) on its side and support with a wooden block.

(2) Remove snapring (2) from rear cover (1).

(3) Remove two plugs (3) and plug (4) from rear cover (1).

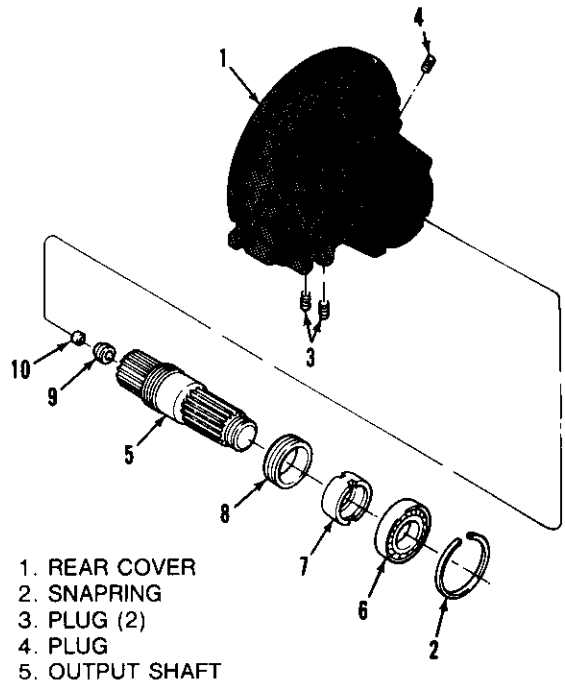
(4) Remove output shaft (5) from rear cover (1).

(5) Press bearing (6) from output shaft (5). Carefully remove bearing (6), spacer (7), and speedometer drive gear (8) from output shaft (5).

(6) If damaged, remove bushing (9) from output shaft (5).

(7) If damaged, remove orifice plug (10) from output shaft (5) using a slide hammer.

(8) Turn rear cover (1), flange side up.



1. REAR COVER
2. SNAPRING
3. PLUG (2)
4. PLUG
5. OUTPUT SHAFT
6. BEARING
7. SPACER
8. SPEEDOMETER DRIVE GEAR
9. BUSHING
10. ORIFICE PLUG

TA 298871

SECTION II. MAINTENANCE PROCEDURES

2-3. INTRODUCTION

This section describes general procedures that apply to all parts of this manual. To avoid repetition, these procedures will not be described in specific maintenance sections.

2-4. GENERAL REMOVAL INSTRUCTIONS

a. **Troubleshooting.** Before removing any item, refer to troubleshooting table. Data contained there will help to isolate troubles to a particular component or part.

b. **Preparation.** Before removing any part of electrical, hydraulic, or air systems, make certain system is not energized or pressurized. Disconnect battery ground cable. Relieve all pressure from air system. Make sure that all controls are in OFF position before starting any removal procedure.

c. **Removal.** Make sure there is enough clearance to remove part. Disassemble truck or adjacent parts as necessary to provide working clearance.

d. **Lifting.** Use a chain hoist, jack, or other aid when lifting heavy parts. Lifting device should be positioned and attached to part before removing mounting hardware.

e. **Identification.** Identify all parts of similar shape with tags or other markings. This will make proper reassembly easier. Be sure to identify mating ends of electric, hydraulic, and air lines as they are disconnected.

f. **Position of Valves.** Before removing valve handles, mark or sketch their positions when open and closed. This will help during assembly.

g. **Salvage Value.** Assemblies that are removed, even though defective, should be treated as valuable items. Some parts can be rebuilt for future use.

2-5. GENERAL DISASSEMBLY INSTRUCTIONS

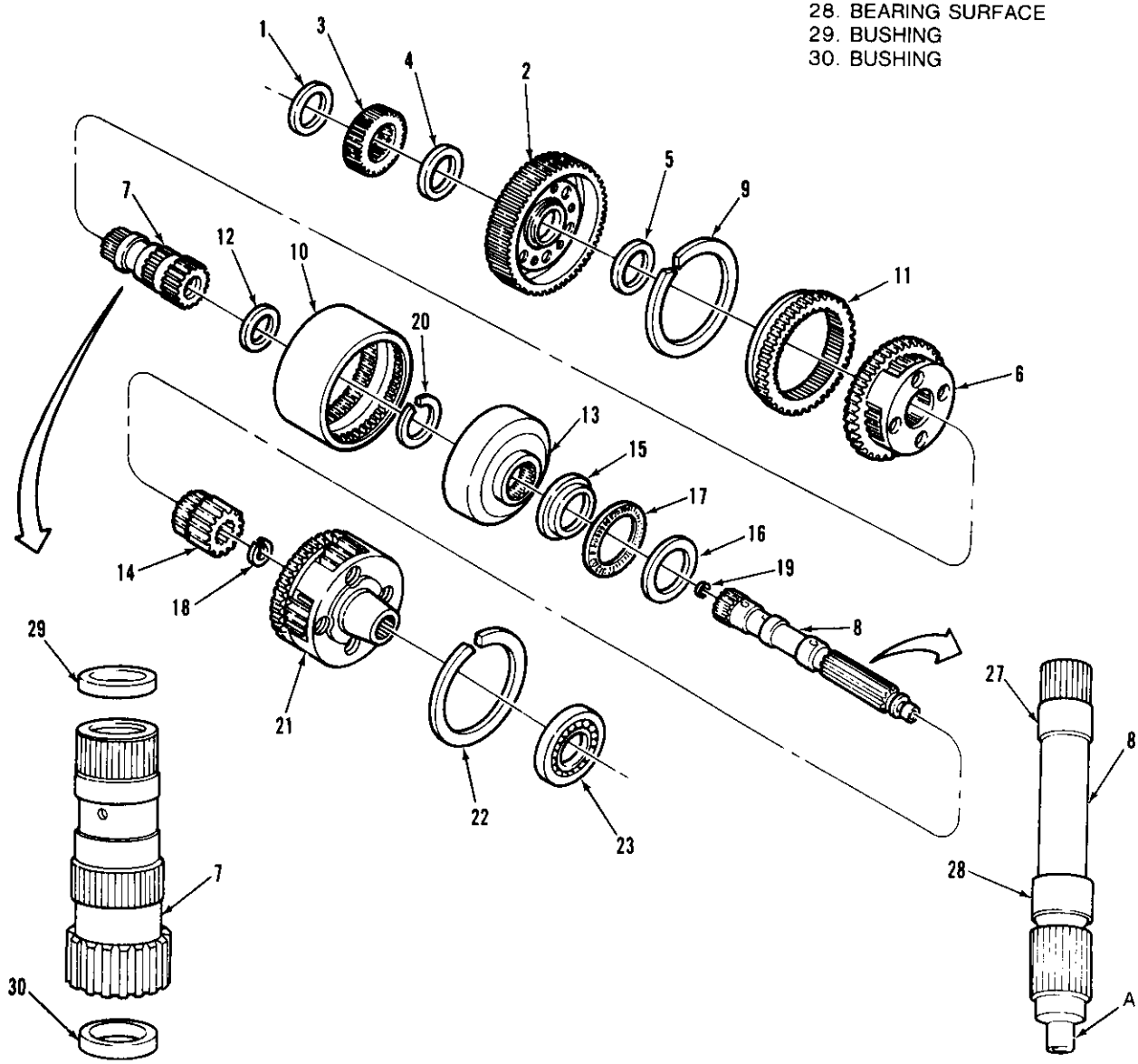
a. **Cleanliness.** The work area for disassembly of any item must be kept as clean as possible. This will avoid contamination of internal parts. This is especially true of control valves, cylinders, and other hydraulic or air system parts.

b. **Expendable Parts.** Whenever possible, all gaskets, packings, and seals removed during repair should be discarded and replaced with new parts. These items are usually damaged during removal. In the same way, all lockwire, lockwashers, cotter pins, and like items should be replaced at time of assembly.

c. **Removing Seals.** When removing gaskets, packings, or seals, do not use any metal tool that will scratch sealing surfaces next to these items.

d. **Disassembly.** Before disassembling any item, study the illustration carefully. Carefully study the relationship of internal parts. Knowing the details of construction will speed up disassembly and assembly and help avoid mistakes.

1. THRUST WASHER
2. FRONT CARRIER ASSEMBLY
3. SUN GEAR
4. THRUST WASHER
5. PLASTIC THRUST WASHER
6. CENTER CARRIER ASSEMBLY
7. SUN GEAR SHAFT
8. MAIN SHAFT
9. SNAPRING
10. DRUM
11. RING GEAR
12. THRUST WASHER
13. RING GEAR
14. SUN GEAR
15. BEARING RACE
16. BEARING RACE
17. BEARING
18. SPIRAL LOCKING RING
19. LUBE ORIFICE PLUG
20. SNAPRING
21. REAR CARRIER ASSEMBLY
22. SNAPRING
23. BEARING
27. BEARING SURFACE
28. BEARING SURFACE
29. BUSHING
30. BUSHING



TA 298870

e. **Identification.** Apply identifying tags to mating ends of electric, hydraulic lines, etc., when they are disconnected. Identify parts of similar shape to insure correct assembly.

f. **Parts Protection.** To prevent moisture and dirt from entering open housings, lines, and other openings, apply protective covers as soon as possible after disassembly. Wrap all parts in clean paper or dip parts in preservative oil.

g. **Work Required.** Remove only those parts needing repair or replacement. Do not disassemble a component any further than necessary.

2-6. GENERAL CLEANING INSTRUCTIONS

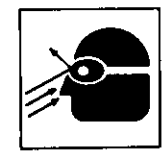
WARNING

Cleaning solvents may be toxic to skin, eyes, and respiratory tract. Skin and eye protection required. Avoid repeated or prolonged contact. Good general ventilation is normally adequate.

a. **Cleaning Solvents.** Whenever dry cleaning solvent is recommended for cleaning, use PD-680 in Appendix C. DO NOT USE GASOLINE TO CLEAN PARTS.

b. **Hydraulic Parts.** When cleaning valves, cylinders, pump parts, or any other part normally in contact with hydraulic fluid, use only dry cleaning solvent P-D-680 in Appendix C.

WARNING



Compressed air used for cleaning and drying purposes must be reduced to 30 psi (207 kPa) and used then only with adequate personal protection and chip guarding.

c. **Removing Deposits.** After soaking parts in solvent, wash away deposits by flushing or spraying. Where needed, brush with soft bristle brush moistened in solvent. Use compressed air to dry all parts, except bearings. Bearings must be allowed to air dry.

d. **Tools.** Do not use scrapers, wire brushes, abrasive wheels, or compounds in cleaning parts unless called for in detailed instructions. These procedures normally alter size of machined surfaces and may weaken a highly stressed part.

e. **Ball and Roller Bearings.** When cleaning ball or roller bearings, place them in a basket and suspend them in a container of dry cleaning solvent overnight. If needed, use a brush to remove caked grease, chips, etc. Avoid rotating bearings before solid particles are removed to prevent damaging races and balls. When bearings have been cleaned, spin them immediately in light lubricating oil to remove solvent.

f. **Rubber Parts.** Do not clean O-rings or other rubber parts in dry cleaning solvent. These parts should be wiped clean with clean, dry, lint-free cloth.

7-16. GEAR UNIT, MAINSHAFT, AND PLANETARY CARRIER REPAIR (Continued)

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect parts for damage. Refer to paragraph 2-7.

(3) Measure thickness of thrust washers. Thickness must be no less than 0.91 inch (2.31 mm).

(4) Measure diameter of bearing surfaces (27 and 28) on main shaft (8).

(5) Measure inside diameter of bushings (29 and 30) in sun gear shaft (7).

(6) If clearance between bushings (29 and 30) and bearing surfaces (27 and 28) is more than 0.0064 inch (0.16 mm), replace sun gear shaft (7).

c. Assembly

(1) If removed, install bearing (23) on rear carrier assembly (21).

(2) Position rear carrier assembly (21) into drum (10).

(3) Install snapring (22) into drum (10).

(4) Install ring gear (13) on sun gear (14).

(5) Install snapring (20) on sun gear (14).

(6) Install lube orifice plug (19) on large end of main shaft (8).

(7) Measure and note diameter of small end bearing surface at location A of main shaft (8). This measurement will be used later.

(8) Position main shaft (8) through ring gear (13) and sun gear (14).

(9) Install spiral locking ring (18).

(10) Install larger bearing race (16), bearing (17), and smaller bearing race (15) into drum (10) on rear planetary carrier (21).

(11) Install main shaft (8) into drum (10).

(12) Install thrust washer (12) onto base of main shaft (8).

(13) Install center carrier assembly (6) into drum (10).

(14) Install ring gear (11) into drum (10).

(15) Install snapring (9) in drum (10).

(16) Install sun gear shaft (7), large end first, onto main shaft (8).

(17) Install plastic thrust washer (5) onto top of center carrier assembly (6).

(18) Install front carrier assembly (2) onto center carrier assembly (6).

(19) Install thrust washer (4) onto front carrier assembly (2).

(20) Install sun gear (3) into front carrier assembly (2).

(21) Install thrust washer (1) onto front carrier assembly (2).

(22) Store the assembly in a clean, dry place until transmission assembly.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13	Install gear unit
TM 9-2320-297-34	(para 7-6).

2-6. GENERAL CLEANING INSTRUCTIONS (Continued)

WARNING

Steam or vapor pressure cleaning creates hazardous noise levels and severe burn potentials. Eye, skin, and ear protection are required.

g. **Exterior Parts.** Steam clean all exterior parts thoroughly before removing. This will make inspection and disassembly easier.

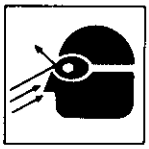
h. **Engine, Cab, and Body.** Use a spray gun and solvent mixture for cleaning exterior of engine, cab, and body. Allow mixture to remain on item surface for approximately 10 minutes before rinsing. Rinse with hot water under 80 to 120 pounds pressure, if available. An ordinary garden hose with nozzle may be used if other equipment is not available. Rinse thoroughly.

CAUTION

To prevent corrosion, parts should be dipped in rust preventive (Appendix C) within two hours after degreasing.

i. **Degreasing Machine.** A degreasing machine may be used to remove heavy grease and oil accumulations from metal parts. Follow operating instructions for the machine and use the correct solvent.

WARNING



Spray gun must be used in a spray booth with filter and face shield for personnel.

Dry cleaning solvent is toxic to skin, eyes, and respiratory tract. Skin and eye protection required. Avoid repeated or prolonged contact. Good general ventilation is normally adequate.

j. **Passages.** After removing parts from degreasing machine, and before coating with rust preventive, check all oil passages and cavities for dirt or blockage. A thin, flexible wire should be run through oil passages to make certain that they are not clogged. Individual passages that are dirty may be cleared using pressure spray gun and dry cleaning solvent.

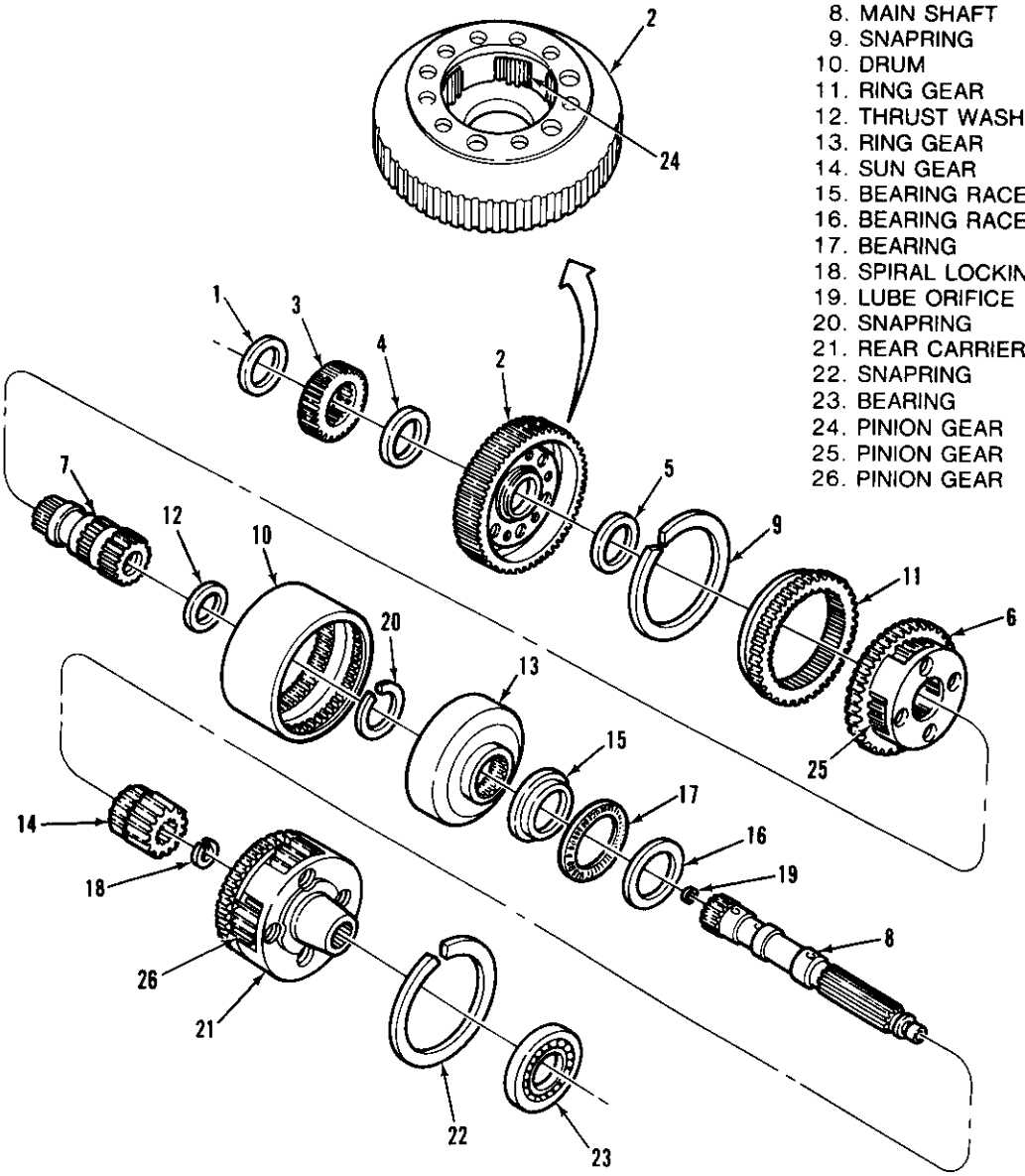
k. **Carbon Removal.** To remove carbon deposits from metal parts, soak parts in available heated solvent. Solvent container should be equipped with an exhaust system to expel fumes, and provide facilities for heating solution.

l. **Rinsing.** All parts that have been soaked in carbon removal solution should be rinsed with dry cleaning solvent. Rinse parts in a suitable solvent spray booth equipped with a filter and hand spray gun. A soft-bristle brush may be used to remove carbon deposits remaining after soaking. A cloth buffing wheel, used without compound, may also be used.

m. **Electrical Parts.** Electrical parts, such as coils, junction blocks, switches, and igniters, which use insulating materials, should not be soaked or sprayed with cleaning solutions. Clean these parts with a clean lint-free cloth moistened with dry cleaning solvent.

(20) Using a feeler gage, check end play between pinion gears (24, 25, and 26) and carriers (2, 6, and 21). End play must be between 0.008 and 0.031 inch (0.203 and 0.787 mm). If end play is outside these limits, replace carrier assemblies (2, 6, or 21).

1. THRUST WASHER
2. FRONT CARRIER ASSEMBLY
3. SUN GEAR
4. THRUST WASHER
5. PLASTIC THRUST WASHER
6. CENTER CARRIER ASSEMBLY
7. SUN GEAR SHAFT
8. MAIN SHAFT
9. SNAPRING
10. DRUM
11. RING GEAR
12. THRUST WASHER
13. RING GEAR
14. SUN GEAR
15. BEARING RACE
16. BEARING RACE
17. BEARING
18. SPIRAL LOCKING RING
19. LUBE ORIFICE PLUG
20. SNAPRING
21. REAR CARRIER ASSEMBLY
22. SNAPRING
23. BEARING
24. PINION GEAR
25. PINION GEAR
26. PINION GEAR



TA 298869

CAUTION

Do not use soap or alkalies for cleaning tank interiors.

n. **Oil and Fuel Tanks.** Oil, fuel tanks, and similar reservoirs should be flushed using spray gun and dry cleaning solvent.

o. **Battery.** The electrical system battery exterior surfaces should be cleaned with a weak solution of baking soda and water. Apply solution with a bristle brush to remove any corrosion on battery cable clamps, terminals, or battery tray.

p. **Radiator.** Radiator cores should be cleaned with steam or hot water. If sediment within core cannot be completely removed in this way, core may be boiled in available cleaning solvent. Flush with clean hot water or steam.

q. **Painted Surfaces.** Wash painted surfaces with a solution made of one fourth pound of soap chips to one gallon of water.

2-7. GENERAL INSPECTION INSTRUCTIONS

a. **Sealing Surfaces.** Inspect all surfaces in contact with gaskets, packings, or seals. Insure that no nicks, burrs, scratches, etc. exist. These might damage new seals during assembly. If any defect is found, correct it as outlined under General Repair Instructions before assembly.

b. **Bearings.** Check bearings for rusted or pitted balls, races, or separator. Check balls and races for wear pattern, abrasion, and serious discoloration. The following are causes for bearing rejection:

(1) Cuts or grooves parallel to ball or roller rotation.

(2) Fatigue pits (not minor machine marks or scratches).

(3) Cracks found during magnetic particle inspection.

NOTE

Do not reject bearings because of nicks or gouges unless these defects are in race load area or cause binding.

c. **Inspection.** Inspection consists of checking for defects such as distortion, wear, cracks, and pitting. It also includes checking parts for limit requirements in specific maintenance sections. Parts under heavy load or pressure must be inspected more thoroughly. These may require surface temper, magnetic particle, or fluorescent penetrant inspection procedures. Clean all parts before inspection.

d. **Drain Plugs.** When removing drain plugs from transmission, engine, or hydraulic system components, inspect sediment adhering to the plug. A buildup of grit and/or fine metal particles may indicate part failure. A few fine particles are normal. This inspection is effective in determining defective parts prior to internal inspection of parts.

7-16. GEAR UNIT, MAINSHAFT, AND PLANETARY CARRIER REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Special Tools

Micrometer set 0-6 inch inside (NSN 5120-00-473-9350)
Micrometer set 0-6 inch outside (NSN 5120-00-554-7134)

Materials/Parts

Oil, OE/HDO-10 (item 44, Appendix C)

Equipment Condition TM

TM 2320-34/13
TM 9-2320-297-34

Condition Description

Gear unit removed (para 7-5).

Special Environmental Conditions

Work in a clean area free of blowing dust.

---

a. Disassembly

(1) Remove thrust washer (1).

(2) Remove front carrier assembly (2).

(3) Remove sun gear (3) from front carrier assembly (2).

(4) Remove thrust washer (4) from bottom of front carrier assembly (2).

(5) Remove plastic thrust washer (5) from top of center carrier assembly (6).

(6) Remove sun gear shaft (7) from main shaft (8).

(7) Remove snapring (9) from drum (10).

(8) Remove ring gear (11).

(9) Remove center carrier assembly (6) from drum (10).

(10) Remove thrust washer (12) from base of main shaft (8).

(11) Remove main shaft (8) from front of drum (10) with ring gear (13) and sun gear (14) attached.

(12) Remove bearing races (15 and 16) and bearing (17).

(13) Remove spiral locking ring (18) from main shaft (8).

(14) Remove ring gear (13) and sun gear (14) from main shaft (8).

(15) Remove lube orifice plug (19) from main shaft (8).

(16) Remove snapring (20) and separate ring gear (13) and sun gear (14).

(17) Position drum (10) so that the rear carrier assembly (21) is up.

(18) Remove snapring (22) and separate rear carrier assembly (21) from drum (10).

(19) If damaged, remove bearing (23) from rear carrier assembly (21).

2-7. GENERAL INSPECTION INSTRUCTIONS (Continued)

e. Gears. Gear inspection cannot be described in detail here. There are too many differences in size and shape of gears. The following steps can be used to make a general visual inspection of all gears. Follow all steps listed within repair instructions for final inspection.

(1) NORMAL WEAR. Loss of metal from surface of gear teeth. Wear must not prevent gears from meshing or performing properly.

(2) INITIAL PITTING. This may occur when a pair of gears is first started in service. It may continue until most high spots have been reduced, but still not affect contact surfaces. This pitting is not necessarily serious.

(3) DESTRUCTIVE PITTING. This type of pitting occurs after initial pitting, often at an increasing rate. This will destroy contact area and reduce the gear's ability to carry a load. Rapid destruction will occur with use.

(4) ABRASIVE WEAR. This damage is caused by fine particles carried in lubricant or imbedded in gear tooth. These particles may come from many sources: Metal detached from gear tooth or bearings, abrasives not completely removed before assembly, sand or scale from castings, or other impurities in oil or air.

(5) SCORING. Slight scoring, scuffing, galling or other surface damage is identified by tears or scratches in the direction of sliding. It starts in areas having highest stress and speed. This is usually at tip of teeth.

(6) BURNING. Burning is indicated by discoloration and loss of hardness due to excessive heat. This is caused by too much friction resulting from overload, overspeed, lack of backlash, or faulty lubrication. If discoloring can be wiped off with clean cloth, such discoloring usually can be traced to oil-burn stains, which are not serious.

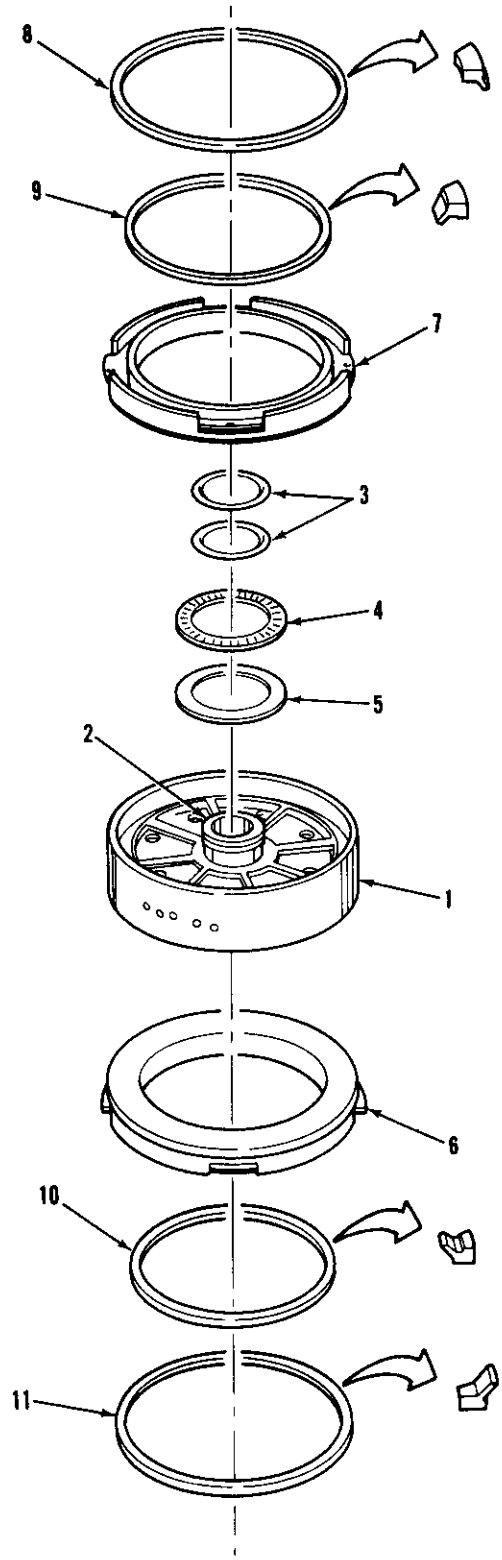
(7) ROLLING. This damage occurs mainly on plastic gears. Rolling is when material is pushed out of shape without breaking off. This is caused by heavy even loads, sliding, and overheating.

NOTE

If gears look faulty in any way, perform a surface temper and/or magnetic particle inspection (refer to step j).

f. Splines. Inspect shaft splines for wear, pitting, rolling, peening, and fatigue cracks. In many cases, the same inspection procedure will apply for gears. However, the problem, if present, will often be much less pronounced. Perform magnetic particle inspection on splines if needed (refer to step j).

g. Tubing and Hose. Check all hose surfaces for broken or frayed fabric. Check for breaks caused by sharp kinks or rubbing against other parts of truck. Inspect copper tubing lines for kinks. Inspect fitting threads for damage. Replace any part found defective. Following assembly and during initial truck operation, check for leaks.



1. CENTER SUPPORT HOUSING
2. HUB
3. SEAL RING (2)
4. NEEDLE BEARING
5. NEEDLE BEARING RACE
6. SECOND CLUTCH PISTON ASSEMBLY
7. THIRD CLUTCH PISTON ASSEMBLY
8. OUTER SEAL RING
9. INNER SEAL RING
10. INNER SEAL RING
11. OUTER SEAL RING

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h. Electrical Parts. Inspect all wiring harnesses for chafed or burned insulation. Inspect all terminal connectors for loose connections and broken parts.

i. Metal Parts. Visually inspect all castings and weldments for cracks. Parts that carry a great load should receive magnetic particle inspection. Critical nonferrous parts may be inspected with fluorescent penetrant (refer to step k).

j. Magnetic Particle Inspection

(1) A magnetic particle inspection may be performed on steel parts which are not easily replaced and only if inspection is deemed necessary. Such steel parts that have been reworked or reground, or parts containing areas where fatigue can be expected, may be tested. Shear sections and reground contact surfaces must show no defects. Any evidence of cracks is cause for rejection. Since some stainless steel materials cannot be magnetized, do not use this inspection on such parts. Once inspection is finished, pass parts through demagnetizing field. Then wash and airblow dry.

NOTE

Magnetizing amperage depends on parts being inspected. For solid section parts, amperage shall be 1000 amps per diameter-inch. For variable diameter thickness, amperage shall be adjusted for diameter inspected.

(2) Parts shall be rejected if there are indications of non-metallic inclusions (foreign body - gaseous, liquid, or solid) longer than one inch, or if indications are closer than 1/8 inch apart. Parts shall also be rejected if the following patterns appear:

(a) *Bursts.* Scattered, short, sharp bursts. Bursts are caused by working metals at temperatures that weaken and break the material. Such problems are usually internal. They seldom are detected by magnetic particle inspection until surface is cut to burst area.

(b) *Flakes.* Separate, short, wavy lines usually in same general direction. Flakes are caused by improper cooling. Such problems are usually internal. They seldom are detected by magnetic particle inspection until the part is cut open.

(c) *Grinding Cracks.* Fine sharp lines, tightly packed. On some surfaces, cracks may be shallow and hard to see. Grinding cracks are usually caused by a glazed wheel. Instead of cutting, the wheel rubs the surface and overheats parts. These are thermal cracks, similar to heat-treat and hardening cracks. Grinding cracks also may be caused by too little coolant, too much load, or too much speed.

7-15. SECOND CLUTCH, THIRD CLUTCH, AND CENTER SUPPORT MAINTENANCE (Continued)

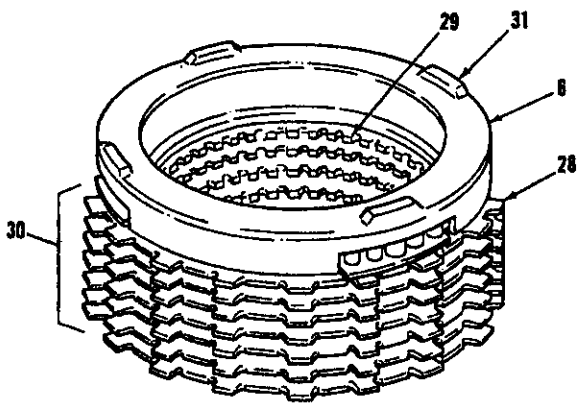
(21) Measure second clutch plates (28 and 29) as described in steps (11) and (12).

(22) Starting with a steel plate (28) and alternating with friction plate (29), stack 13 second clutch plates on a flat surface in a press.

(23) Place second clutch piston assembly (6) on top of plates (28 and 29).

(24) Press evenly on piston with a force of 980-1020 pounds (444-462 kg).

(25) Measure distance from base of second pack (30) to top of pad (31).



6. SECOND CLUTCH PISTON ASSEMBLY
28. STEEL PLATE (7)
29. FRICTION PLATE (8)
30. SECOND CLUTCH PACK
31. PAD

(26) Thickness of second clutch pack (30) must be 3.158-3.180 inches (8.021-8.077 cm).

(27) Replace steel plates (28) as needed to adjust thickness of second clutch pack (30).

(28) Remove second clutch pack (30) from press after proper thickness has been obtained.

(29) Label the second clutch pack (30) and set aside for later assembly.

(30) Apply oil to new sealrings (10 and 11) and install on second clutch piston assembly (6) as shown.

(31) Apply oil to new sealrings (8 and 9) and install on third clutch piston assembly (7) as shown.

(32) Install third clutch piston assembly (7) into hub side of center support (1). Install second clutch piston assembly (6) into the opposite side of center support (1).

NOTE

Needle bearing race (5), needle bearing (4), and sealrings (3) will be installed during transmission assembly.

(33) Store the assembly in a clean, dry place until transmission is assembled

END OF TASK

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install second clutch, center support, and third clutch (para 7-6).

2-7. GENERAL INSPECTION INSTRUCTIONS (Continued)

k. Fluorescent Penetrant Inspection. Perform fluorescent penetrant inspection on nonsteel metallic parts if necessary. Since some stainless steel materials cannot be magnetized, they should receive fluorescent penetrant inspections. After penetrant has been applied and pattern has developed, any evidence of cracks is cause for rejection. The following procedure may be used for fluorescent penetrant inspection:

(1) Clean and warm parts before applying penetrant. A vapor degreaser may be used.

(2) Apply penetrant by dipping, painting, or spraying. All surfaces to be examined must be completely covered. Penetration time for various materials are included as follows:

(a) Aluminum Alloy - no less than 20 minutes.

(b) Magnesium Alloy - no less than 20 minutes.

(c) Brass or Bronze - no less than 30 minutes.

(d) Ferrous Alloys - no less than 60 minutes.

(3) Clean penetrant from all surfaces using slightly warm water. Cool water may be used when necessary, but cleaning time will be longer. Water used to clean surfaces shall be no more than 120° F maximum to prevent removal of penetrant from cracks. Pressurized water spray may be used to shorten washing cycle.

(4) Use one of the following methods to dry and develop parts:

(a) Wet developer method - When using wet developer, parts must be completely covered with developer by spraying or dipping. Parts must then be dried and developed in a recirculating hot air dryer for one-half the penetration time.

(b) Dry developer method - When using dry developer, parts must be completely dried before application of the developer by dipping in (or dusting all surfaces with) developing powder. Develop parts for one-half the penetration time.

(c) No developer method - When no developer is to be used, drying and developing time shall be at least equal to penetration time to allow for sufficient bleeding of penetrant from defects. When needed for additional clarity during inspection, dry developer may be applied to questionable areas by means of a hand powder bulb.

(5) Inspect for cracks under black light. Any evidence of cracks is cause for rejection.

(6) Clean parts thoroughly with cleaning solvent (Appendix C) and lubricate with preservative oil (Appendix C).

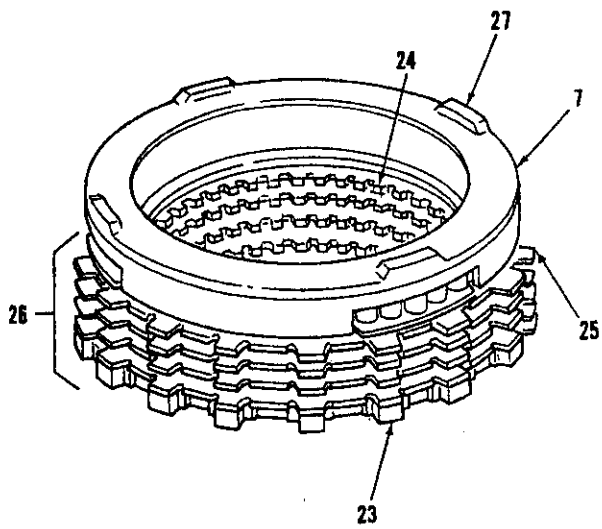
NOTE

- Clutch plates were removed and labeled during transmission disassembly (para 7-7).
- Steel plates (25) are available in two sizes. If a plate measures 0.099-0.106 inch (2.51-2-69 mm), it is a thin plate. If it measures 0.116-0.123 inch (2.95-3-12 mm), it is a thick plate

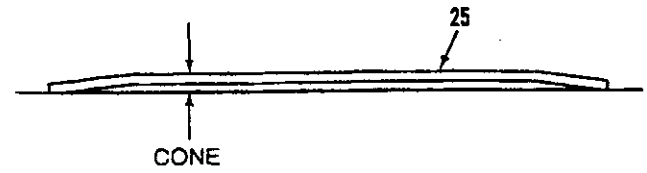
(9) Measure third clutch back plate (23). Replace plate if less than 0.490 inch (12.45 mm) thick.

(10) Put third clutch back plate (23) on a flat surface in a press.

(11) Measure friction plates (24). Replace any plate that is less than 0.1347 inch (3.421 mm) thick.



7. THIRD CLUTCH PISTON ASSEMBLY
23. THIRD CLUTCH BACK PLATE
24. FRICTION PLATE (4)
25. STEEL PLATE (4)
26. THIRD CLUTCH PACK
27. THRUST PAD



25. STEEL PLATE

(12) Measure steel plates (25). Replace any thin plate that is less than 0.0993 inch (2.522 mm) thick. Replace any thick plate that is less than 0.1161 inch (2.949 mm) thick. Place steel plates (25) individually on a flat surface and measure for cone. Replace plate if cone exceeds 0.013 inch (.3302 mm).

(13) Starting with friction plate (24) and alternating with steel plates (25), stack eight third clutch plates on back plate (23).

(14) Place third clutch piston assembly (7) on top of clutch plates (24 and 25).

(15) Press evenly on third clutch piston (7) with a force of 980-1020 pounds (444-462 kg).

(16) Measure distance from base of third clutch pack (26) to top of thrust pad (27).

(17) Third clutch pack (26) thickness must be 3.071-3.042 inches (7.800-7.728 cm).

(18) Replace steel plates (25) as needed to adjust clutch pack thickness.

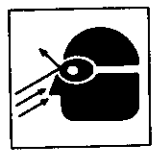
(19) Remove third clutch pack (26) from press after proper thickness has been obtained.

(20) Label the third clutch pack (26) and set aside for later assembly.

2-8. GENERAL REPAIR INSTRUCTIONS

a. Burrs. Remove burrs from gear teeth with a fine-cut file or hand grinder.

WARNING



Compressed air used for cleaning will be reduced to 30 psi and used only with adequate personnel protective equipment and chip guarding.

b. Commutators. Generator and starter commutators may be polished in a lathe, using a strip of emery cloth. After polishing, blow all dust and residue from commutator with compressed air.

c. Exterior Parts. Chassis and exterior painted parts may be resurfaced where paint is damaged, or where parts have been repaired, by using an abrasive disc driven through a flexible shaft.

NOTE

Take care to guard other parts of vehicle from abrasive dust. Do not grind near exposed working parts. All openings which would allow dust to reach working parts should be masked.

d. Bearings. Remove residue and oil stain from bearing races with crocus cloth.

e. Surface Preparation. Before resurfacing, scrape off loose and blistered paint from damaged areas. Clean area to be painted by sanding or buffing. Remove leftover cleaning material with paint thinner (Appendix C) and dry thoroughly.

f. Protecting Parts. During repair operations, protect bare steel surfaces from rusting when not actually undergoing repair work. Dip parts in, or spray them with, preservative lubricant (Appendix C). The same protective coating may be applied to other metals, if necessary, to prevent rust. Aluminum parts may require protection in atmospheres having high salt content. Steel parts must always be protected.

NOTE

The above procedure is used with polished and machined steel parts not protected by cadmium, tin, copper, or other plating or surface treatment. Bare metal surfaces must be free of moisture when applied. Acid present in sweat and skin oils may attack steel surfaces if fingerprints are not removed. Wipe off fingerprints, then dip parts in preservative lubricant after handling.

g. Welding. Welding and brazing may be used to repair cracks in external steel parts, such as brackets, panels, and light framework. Such repairs may, however, be more trouble than they are worth. They should be made only when replacement parts are not available. Do not weld or braze castings, running parts or parts under great stress, except in emergencies.

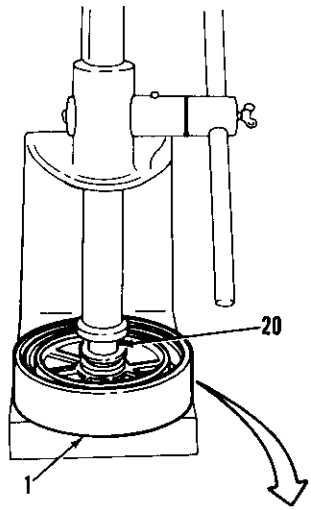
7-15. SECOND CLUTCH, THIRD CLUTCH, AND CENTER SUPPORT MAINTENANCE (Continued)

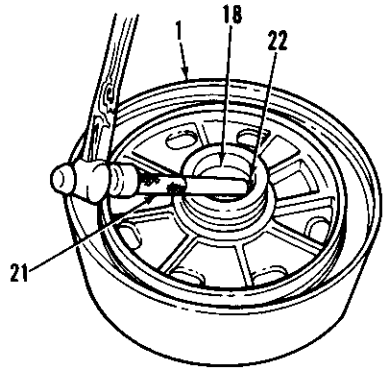
c. Assembly

(1) Place center support housing (1) on press, hub side up, using bushing installer (20) in a press.

(2) Install new bushing (18), if removed. Make sure oil hole (22) in bushing (18) lines up with oil hole in center support housing (1).

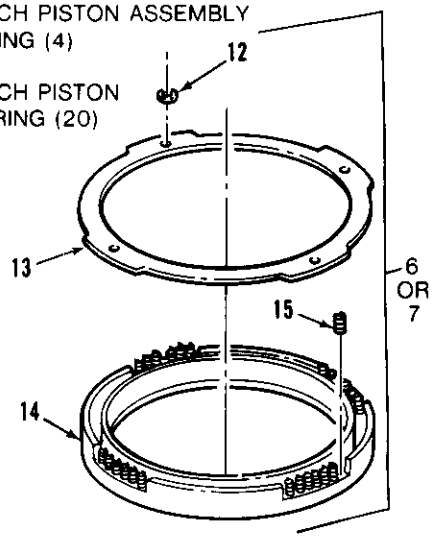
(3) Use staking tool (21) to stake bushing (18)into edges of oil hole (22).





1. CENTER SUPPORT HOUSING
18. BUSHING
20. BUSHING INSTALLER
21. STAKING TOOL
22. OIL HOLE

6. SECOND CLUTCH PISTON ASSEMBLY
7. THIRD CLUTCH PISTON ASSEMBLY
12. RETAINER RING (4)
13. RETAINER
14. THIRD CLUTCH PISTON
15. RETURN SPRING (20)



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(4) Set bottom of third clutch piston (14) into center support housing (1).

(5) Install 20 return springs (15) into pockets on third clutch piston (14).

(6) Install retainer (13) onto third clutch piston (14).

CAUTION

Spring retainer must be pushed down as far as it will go while installing retainer rings. Otherwise, clutch clearance will be wrong and transmission will not shift properly

(7) Push down retainer (13) and install four new retainer rings (12). Remove third clutch piston assembly (7) from center support housing (1).

(8) Repeat steps (4) thru (7) for the second clutch piston assembly (6).

2-8. GENERAL REPAIR INSTRUCTIONS (Continued)

h. Stud Installation. When installing studs in engine block and axle housings, use a driver designed for the stud to be installed. A worn stud driver may damage the end thread. This makes it necessary to use a chasing die before a nut can be screwed on. This procedure will remove cadmium plating and allow corrosion, which will make future disassembly difficult and cause stud to be backed out with nut. Before driving a stud, inspect hole for chips and liquid. Blow out any foreign matter. Start stud by hand. If it will not start into hole, it is too large or has defective end thread. Before final insertion, coat thread with a film of antiseize compound (Appendix C). Turn stud in slowly to prevent overheating and galling of casting metal. Drive stud to proper setting height, which is the total projecting length. While driving, observe torque required. This must be greater than nut tightening torque for same size, but not enough to damage casting, as stud approaches its correct engagement depth.

i. Electrical Parts. Replace all broken, worn, or burned electrical wiring. Wires with several broken strands must be replaced. Broken strands will increase the resistance of wire and lower the efficiency of electrical components, especially in the ignition system.

j. Hoses. Replace all broken, frayed, crimped, or soft flexible lines and hoses. Replace stripped or damaged fittings. Replace entire flexible hose if fittings are damaged. Make sure hose clamps do not crimp hoses.

k. Fasteners. Replace any bolt, screw, nut, or fitting with damaged threads. Inspect tapped holes for thread damage. If cross-threading or spalling is evident, retap hole for next oversize screw or stud. When retapping will weaken part, or when cost of the part makes retapping impractical, replace damaged part. Chasing the threads with proper size tap or die may often be enough.

l. Dents. Straighten minor body dents by bumping with a soft-faced hammer while using a wooden block backing.

m. Sheet Metal Repair. Repair minor skin cracks by installing patches.

n. Mounting Holes. Reshape oval mounting holes to round. Drill to receive bushing with required inner diameter. Stake bushing in place with center punch.

2-9. GENERAL ASSEMBLY INSTRUCTIONS

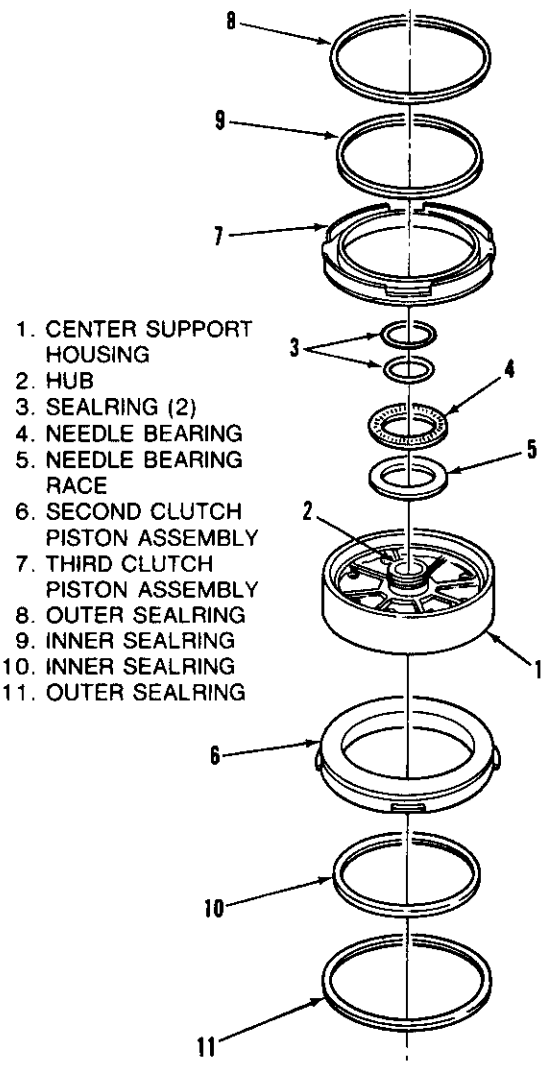
a. Preparation. Remove grease from new parts before installation as required.

b. Packing Installation. To install preformed packing, first dovetail groove, then stretch packing and place into position. Rotate part on flat surface. Apply downward pressure to uniformly press packing into position.

c. Pipe Joints. Use pipe sealant or Teflon tape (Appendix C) when joining system piping.

(8) Remove 20 return springs (15) from third clutch piston (14).

(9) Repeat steps (6) thru (8) for the second clutch piston assembly (6).



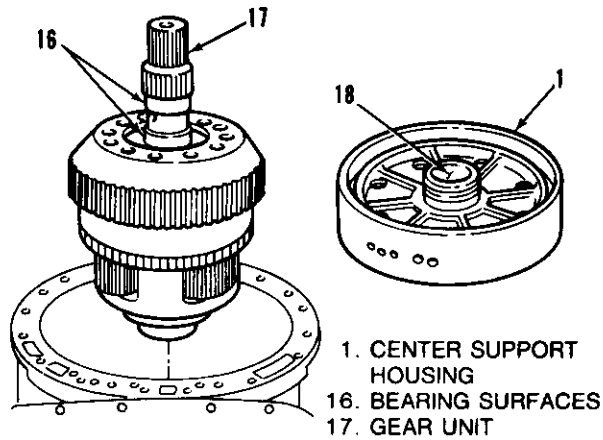
1. CENTER SUPPORT HOUSING
2. HUB
3. SEALRING (2)
4. NEEDLE BEARING
5. NEEDLE BEARING RACE
6. SECOND CLUTCH PISTON ASSEMBLY
7. THIRD CLUTCH PISTON ASSEMBLY
8. OUTER SEALRING
9. INNER SEALRING
10. INNER SEALRING
11. OUTER SEALRING

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

NOTE

Because the center support housing (1) rides on gear unit (17) both must be measured to obtain clearance.



1. CENTER SUPPORT HOUSING
16. BEARING SURFACES
17. GEAR UNIT
18. BUSHING

(2) Measure outside diameter of bearing surfaces (16) on gear unit (17).

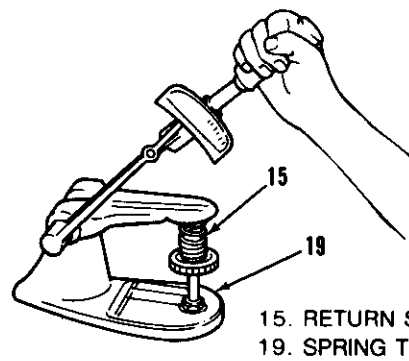
(3) Measure inside diameter of bushing (18).

(4) If bushing (18) to bearing surfaces (16) clearance is greater than 0.0065 inch (0.17 mm), remove bushing (18).

(5) Test return springs (15) using spring tester (19). Replace springs (15) if they do not meet the following load-height requirements:

(a) Length without load must be at least 1.29 inch (32.77 mm).

(b) Length under a load of 4.3 to 5.7 pounds (1.95 to 2.59 kg) must be at least 0.82 inch (20.83 mm).



15. RETURN SPRING (20)
19. SPRING TESTER (TOOL)

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d. Silicone Sealant

WARNING

On direct contact, uncured silicone sealant irritates eyes. In case of contact, flush eyes with water and seek medical attention. Avoid prolonged contact with skin.

Silicone sealant is often used instead of a gasket to seal mating parts. The mating parts must be clean, dry, and free of oil or grease for proper adhesion. After silicone sealant has been applied, the mating parts must be assembled within 15 minutes. Silicone sealant starts to set-up in 15 minutes and takes 24 hours to completely cure. Excess silicone sealant should be wiped off after assembling the mating parts.

e. Oil Seals. Install oil seals with seal lip facing in, applying an even force to outer edge of seal. Coat oil seals evenly with oil or grease before installing. If oil seals are installed over keyed or splined shafts, use a guide. This will prevent sharp edge of keyway of splines from cutting the leather or neoprene seal. Construct guides of very thin gage sheet metal and shape to required diameter. However, make certain the guide edges are not sharp. Bend them slightly inward so they do not cut the seal.

f. Bearings and Shafts. During assembly of shafts and bearings in housings, first mount bearing on shaft. Then install assembly by applying force to shaft. When mounting bearings on shafts, always apply force to inner races.

g. Packing Lubrication. Lubricate all preformed packings with a thin coating of oil before installation.

h. Bearing Lubrication. Lubricate bearings before assembly with the type of lubricant normally used in related housing or container. This will provide lubrication during first run-in until lubricant from system can reach bearings.

i. Installation. Refer to tags and sketches made at removal.

j. Testing. Test operation after installation. Inspect for leaks, vibration, noise, misalinement, or other problems. Recheck after a few days operation.

2-10. WORKMANSHIP AND STORAGE

a. Workmanship. Maintenance practices to be used when following the procedures within this manual must be of the highest standard. Proper tools for each task should be gathered before beginning work. Work area should be kept clean. New parts should not be laid out where they will be exposed to dirt or dust before installation. Where specific instructions for repair of an item are given, workmanship over and above the level described is encouraged.

b. Storage. Parts which are to be stored for some time prior to installation should be properly preserved. Bare steel parts should be sprayed or coated with preservative lubricant (Appendix C). All parts should be wrapped in plastic sheeting or moisture-proof paper, with all exposed ports plugged or taped to prevent contamination.

7-15. SECOND CLUTCH, THIRD CLUTCH, AND CENTER SUPPORT MAINTENANCE

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Special Tools

Spring tester (J 9666)
Center support bushing installer and staking set (J 28525)
Micrometer set 0-6" inside (NSN 5120-00-473-9350)
Micrometer set 0-6" outside (NSN 5120-00-554-7134)

Materials/Parts

Oil, OE/HDO-10 (item 44, Appendix C)
Sealring (2) (NSN 5330-01-087-6849) item 3
Sealring (2) (NSN 5365-01-084-5258) items 8 and 11
Sealring (2) (NSN 5330-01-088-5847) items 9 and 10
Retainer rings (4) (NSN 5365-01-143-0542) item 12

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Third clutch, second clutch and center support removed (para 7-5).

Special Environmental Conditions

Work in a clean area free of blowing dust.

a. Disassembly

(1) Place center support housing (1) with hub (2) facing up.

(2) Remove two sealrings (3), needle bearing (4), and needle bearing race (5). Discard sealrings (3).

(3) Remove second clutch piston assembly (6) and third clutch piston assembly (7) from center support housing (1).

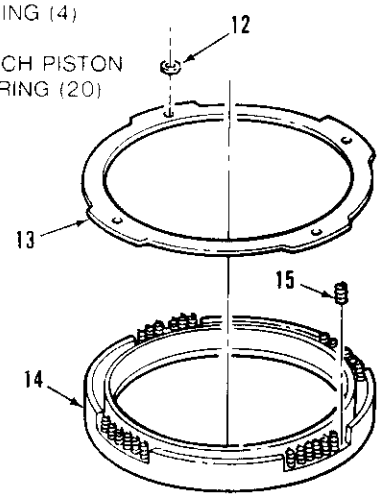
(4) Remove outer and inner sealrings (8 and 9) from third clutch piston assembly (7). Discard outer and inner sealrings (8 and 9).

(5) Remove inner and outer sealrings (10 and 11) from second clutch piston assembly (6). Discard inner and outer sealrings (10 and 11).

(6) Cut and remove four retainer rings (12) from third clutch piston (14). Discard retainer rings (12).

(7) Remove retainer (13) from third clutch piston (14).

12 RETAINER RING (4)
13 RETAINER
14 THIRD CLUTCH PISTON
15 RETURN SPRING (20)



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(16) Release pressure from spring retainer (8) and remove clutch spring compressor (9).

(17) Starting with steel plate (7) and alternating with friction plate (6), install 10 clutch plates.

(18) Install back plate (5) and snapring (4).

(19) Keep races (1 and 3) with fourth clutch assembly.

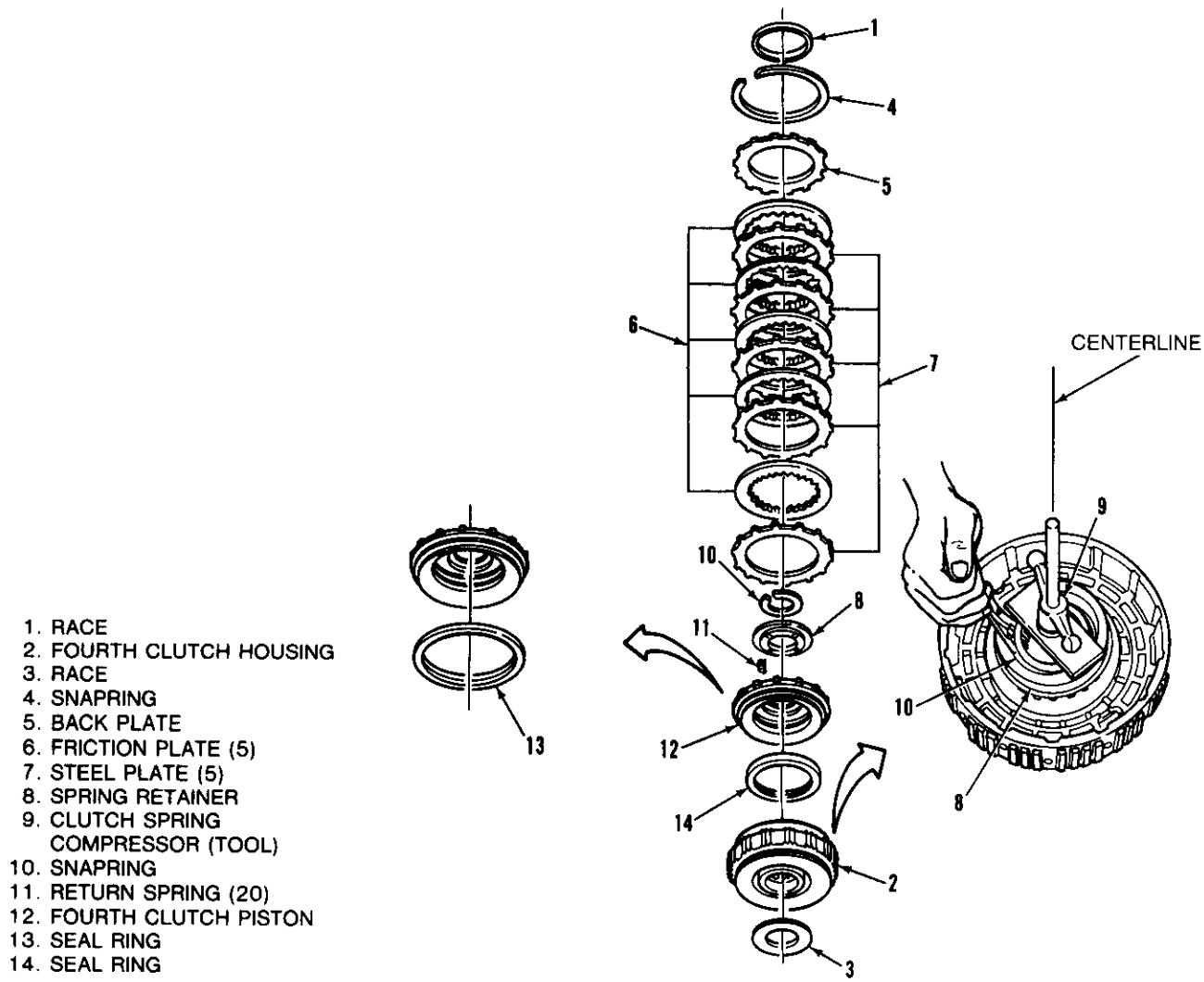
(20) Store the assembly in a clean, dry place until transmission is assembled.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 Install fourth clutch
TM 9-2320-297-34 (para 7-6).



1. RACE
2. FOURTH CLUTCH HOUSING
3. RACE
4. SNAPRING
5. BACK PLATE
6. FRICTION PLATE (5)
7. STEEL PLATE (5)
8. SPRING RETAINER
9. CLUTCH SPRING COMPRESSOR (TOOL)
10. SNAPRING
11. RETURN SPRING (20)
12. FOURTH CLUTCH PISTON
13. SEAL RING
14. SEAL RING

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CHAPTER 3

ENGINE

3-1. OVERVIEW

This chapter provides information authorized for Third and Fourth Echelon Maintenance level mechanics. General information, maintenance, replacement, disassembly, assembly, cleaning, inspection, repair, testing, and starting procedures for the vehicle's engine are covered in the following sections:

Section I. Description and Data

Section II. General Engine Maintenance

Section III. Power Pack Replacement Instructions

Section IV. Engine Disassembly into Subassemblies and Reassembly from Subassemblies

Section V. Engine Subassembly Cleaning, Inspection, and Repair

Section VI. Engine Testing and Adjustment

SECTION I. DESCRIPTION AND DATA

3-2. DESCRIPTION AND DATA

a. Principles of Operation. The Detroit Diesel engine is a two cycle (also called two stroke) engine. This means that one complete cycle (intake, compression, power, and exhaust) occurs every time the piston goes up and down - up being one stroke, and down being one stroke. This is possible because the air intake and exhaust functions are accomplished during the compression and power strokes. This is very different from four cycle (also called four stroke) engines - which use one extra stroke for air intake, and one extra stroke for exhaust. Thus, two cycle engines produce as much power as four cycle engines, using half the number of strokes.

The engine has a turbocharger and a blower to force air into the cylinders (called supercharging) for both the intake and the exhaust functions. When the piston is halfway down, the exhaust valves open. Shortly thereafter, the piston drops below a row of inlet ports in the cylinder liner wall. Supercharged air is then allowed to pass through the cylinder. During this process, all of the exhaust gases are removed (or scavenged) from the cylinder. When the exhaust valves close, during the piston's upward stroke, fresh air is trapped in the cylinder for compression.

Shortly before the piston reaches its highest point, the required amount of fuel is injected into the cylinder. The intense heat that is created by the high compression of the air immediately ignites the fine fuel spray. The combustion continues until the injected fuel has burned.

7-14. FOURTH CLUTCH REPAIR (Continued)

c. Assembly

(1) Look at bottom of fourth clutch piston (12) and note whether it is labeled 'T', 'S', or 'M'.

(2) Starting with steel plate (7) and alternating with friction plate (6), stack 10 clutch plates on a flat surface in a press.

(3) Place back plate (5) on clutch plates (6 and 7).

(4) Press evenly on back plate (5) with a pressure of 980-1020 pounds (444-462 kg).

(5) Measure distance from base of clutch pack (17) to top machined surface (18) of back plate (5). This is clutch pack thickness.

(a) If fourth clutch piston (12) is a 'T' piston, clutch pack thickness must be 1.362-1.388 inches (34.59-35.23 mm).

(b) If fourth clutch piston (12) is an 'S' piston, clutch pack thickness must be 1.388-1.415 inches (35.26 to 35.92 mm).

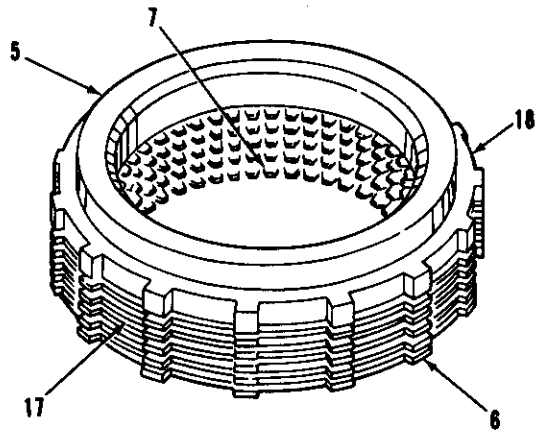
(c) If fourth clutch piston (12) is an 'M' piston, clutch pack thickness must be 1.415-1.442 inches (35.94 to 36.60 mm).

(6) Replace clutch plates (6 and 7) and recheck clutch pack thickness as needed to get proper clutch pack measurement.

(7) Remove clutch pack (17) and back plate (5) from press. Tie clutch pack (17) together.

(8) Coat new sealring (13) and outer rim of fourth clutch piston (12) with oil.

(9) Install new sealring (13) onto outer rim of fourch clutch piston (12) with sealring lip facing down.



5. BACK PLATE
6. FRICTION PLATE (5)
7. STEEL PLATE (5)
17. CLUTCH PACK
18. TOP MACHINED SURFACE

TA 298861

(10) Coat new sealring (14) and hub of fourth clutch housing (2) with oil.

(11) Install new sealring (14) on fourth clutch housing (2) with sealring lip pointing down.

(12) Install fourth clutch piston (12) in fourth clutch housing (2). Make sure piston is fully seated.

(13) Install 20 return springs (11) onto fourth clutch piston (12).

(14) Install spring retainer (8) onto return springs (11).

(15) Compress spring retainer (8) with clutch spring compressor (9). Install snapring (10).

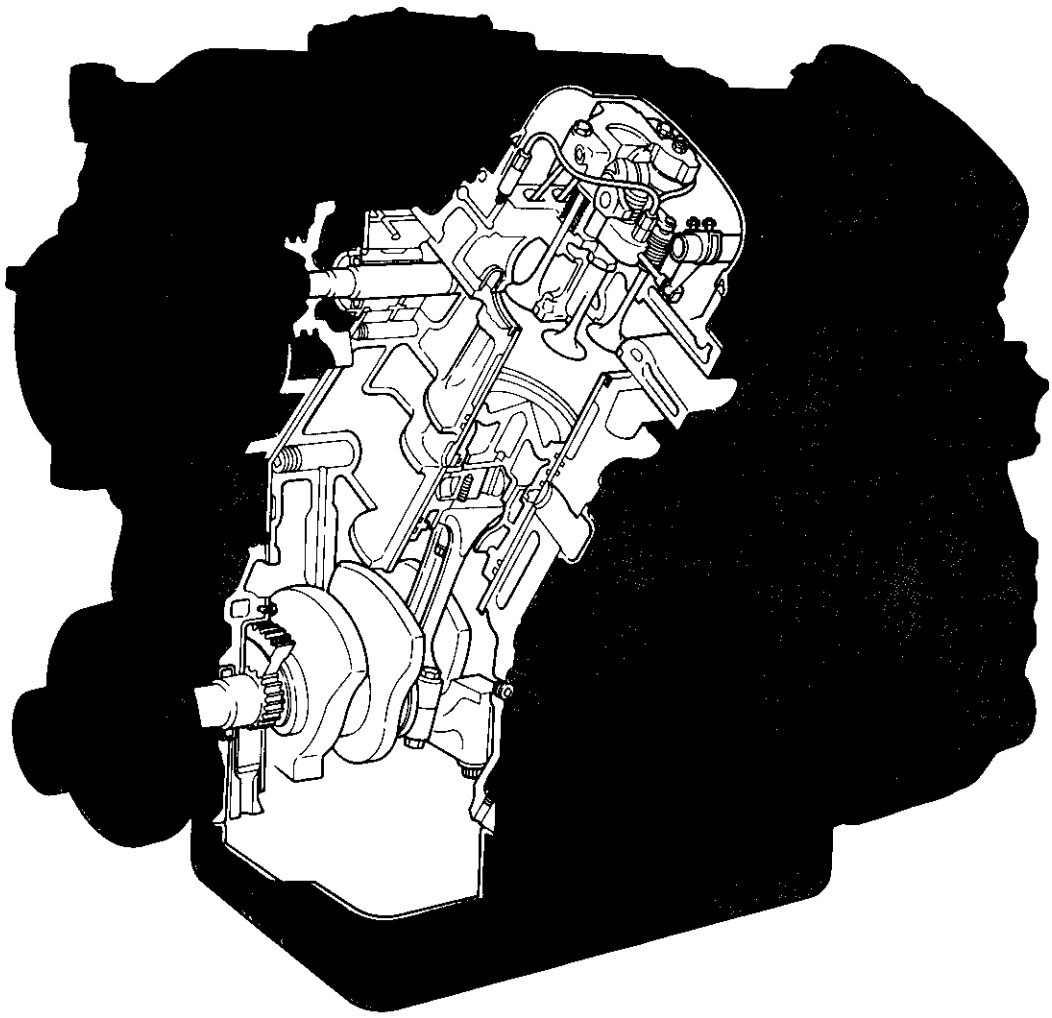
3-2. DESCRIPTION AND DATA (Continued)

a. Principles of Operation (Continued)

The resulting pressure forces the piston downward on its power-stroke. When the piston is about halfway down, the exhaust valves open. Shortly thereafter, the piston drops below the ports, and the cylinder is again swept with clean scavenging air. This entire combustion cycle is completed in each cylinder for each revolution of the crankshaft. In other words, one cycle is completed with every two strokes of the engine.

b. Detroit 8V92TA Diesel Engine. The Detroit 8V92TA diesel engine is a turbocharged, aftercooled, two cycle engine with eight cylinders in a V-type configuration. Each cylinder has 92 cubic inches for a total displacement of 736 cubic inches.

The following information describes engine characteristics and features that Organizational Maintenance is responsible for maintaining.



TA 298436

DETROIT 8V92TA DIESEL ENGINE

(5) Release pressure from spring retainer (8) and remove clutch spring compressor (9).

(6) Remove spring retainer (8).

(7) Remove 20 return springs (11) from fourth clutch piston (12).

(8) Remove fourth clutch piston (12) from fourth clutch housing (2).

(9) Remove outer seal ring (13) from fourth clutch piston (12). Discard seal ring (13).

(10) Remove inner seal ring (14) from hub of fourth clutch housing (2). Discard seal ring (14).

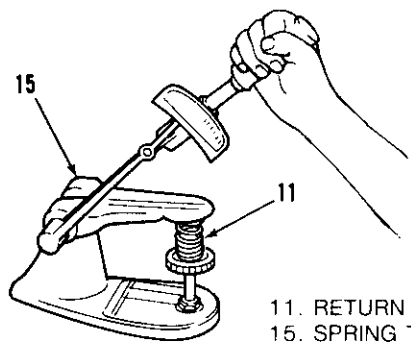
b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

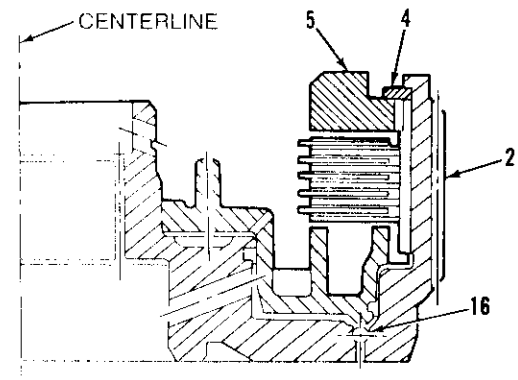
(2) Test return springs (11) using spring tester (15). Replace all return springs (11) if any three return springs do not meet the following load-height requirements:

(a) Length without load—must be at least 1.25 inch (31.78 mm).

(b) Length under load—must be at least 0.88 inch (22.35 mm) with load of 17.9-18.9 lb (8.13-8.58 kg).



11. RETURN SPRING (20)
15. SPRING TESTER



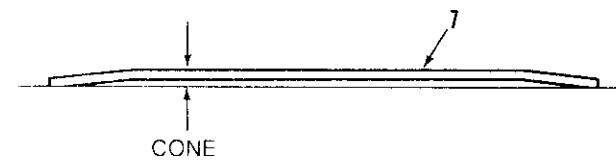
FOURTH CLUTCH CUTAWAY VIEW

2. FOURTH CLUTCH HOUSING
4. SNAPRING
5. BACK PLATE
16. BALL (8)

(3) Check balls (16) in fourth clutch housing (2) for free movement. Wipe clean and coat with lubricating oil.

(4) Measure back plate (5). Replace back plate (5) if less than 0.390 inch (9.91 mm) thick.

(5) Measure friction plates (6). Replace any friction plate (6) if less than 0.090 inch (2.29 mm) thick.



7. STEEL CLUTCH PLATE

TA 298860

(6) Measure steel plates (7). Replace any steel plate (7) if less than 0.0993 inch (2.522 mm) thick. Place steel plates (7) individually on a flat surface and measure for cone. Clutch plate cone must not exceed 0.010 inch (0.25 mm).

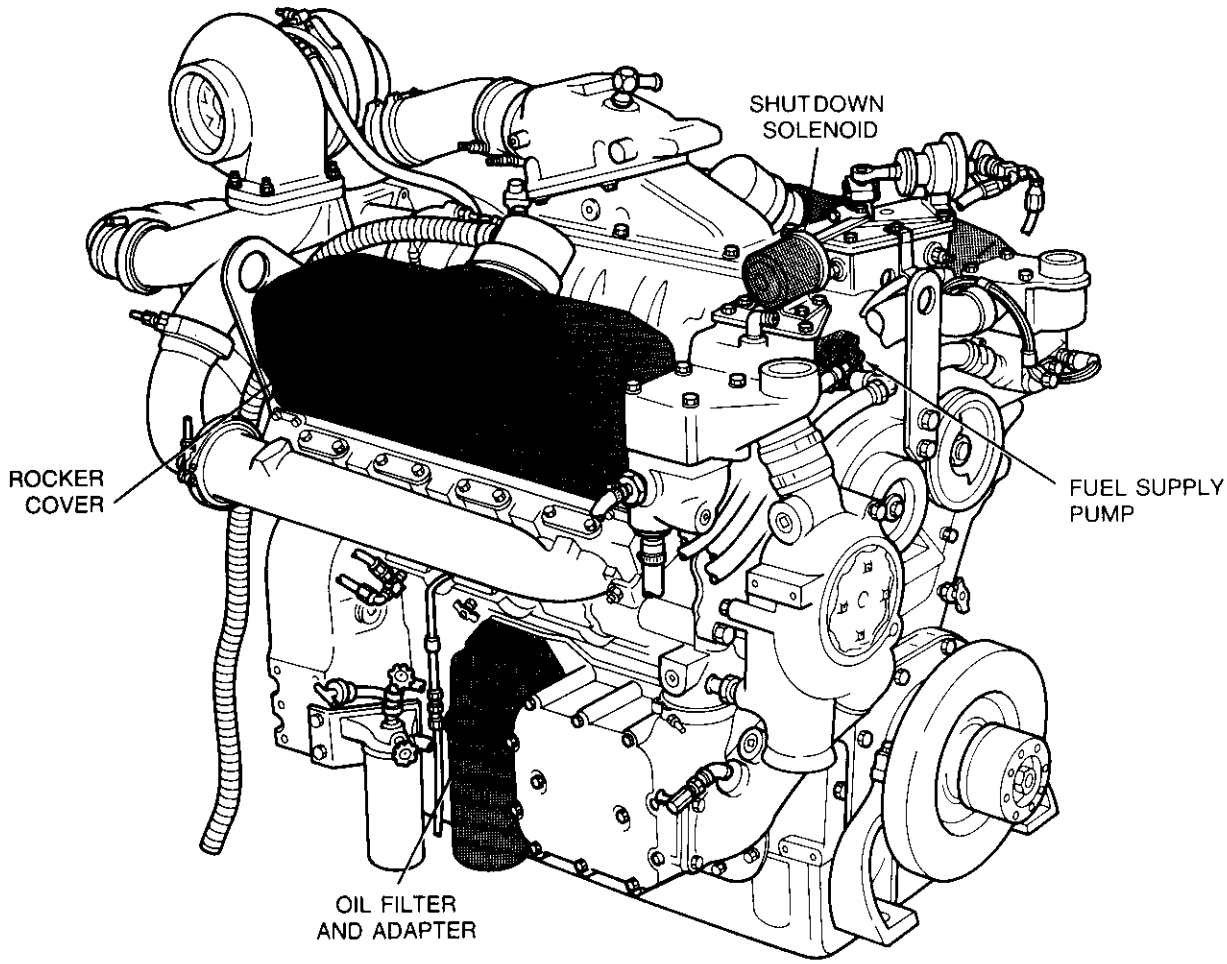
(7) Replace all parts failing inspection.

c. **Rocker Cover**. Encloses the valves, Jacobs brake, and fuel injector assemblies at the top of each cylinder head. The rocker covers also incorporate breather housings.

d. **Oil Filter and Adapter**. The oil filter is a spin-on type that attaches to the oil filter adapter. The adapter has a by-pass valve that opens at 18-21 psi (124-145 kPa). The by-pass valve will open if the oil filter becomes clogged.

e. **Fuel Supply Pump**. A positive gear-type fuel pump that transfers fuel from the fuel tanks through the filter to fuel the injectors. The fuel pump is attached to the governor housing. It is driven off the right-hand blower rotor by means of a drive coupling fork. It is not mandatory that the fuel pump be timed because the fuel injectors are self-timing.

f. **Shutdown Solenoid**. An electrically controlled solenoid used to shut down or stop the engine. The solenoid is attached to the stop lever on the governor. When activated, the shutdown solenoid pulls in the stop lever. The stop lever operates a series of internal fuel rods to shut off the fuel injectors.



TA 298437

7-14. FOURTH CLUTCH REPAIR

THIS TASK COVERS:
a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Special Tools
Clutch spring compressor (J 24204)
Spring tester (J 9666)
Micrometer set 0-6 inch outside (NSN 5120-00-554-7134)

Materials/Parts
Oil, OE/HDO-10 (item 44, Appendix C)
Sealring (P/N 6836799) item 13
Sealring (P/N 6833980) item 14

Equipment Condition

TM	Condition Description
TM 2320-34/13	Fourth clutch removed (para 7-5)
TM 9-2320-297-34	

Special Environmental Conditions
Work in a clean area free of blowing dust.

---

a. Disassembly

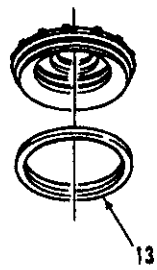
(1) Remove race (1) from front of fourth clutch housing (2). Remove race (3) from rear of fourth clutch housing (2).

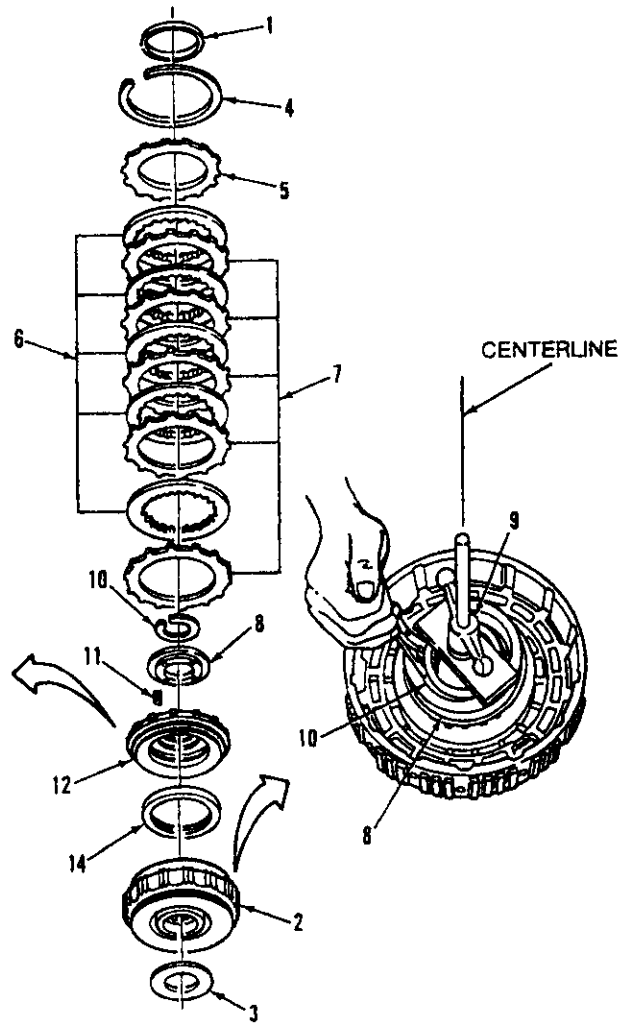
(2) Position fourth clutch housing (2) with front up and remove snapring (4) and back plate (5).

(3) Remove 10 clutch plates (6 and 7) from fourth clutch housing (2).

(4) Compress spring retainer (8) with clutch spring compressor (9). Remove snapring (10).

1. RACE
2. FOURTH CLUTCH HOUSING
3. RACE
4. SNAPRING
5. BACK PLATE
6. FRICTION PLATE (5)
7. STEEL PLATE (5)
8. SPRING RETAINER
9. CLUTCH SPRING COMPRESSOR (TOOL)
10. SNAPRING
11. RETURN SPRING (20)
12. FOURTH CLUTCH PISTON
13. SEALRING
14. SEALRING





3-2. DESCRIPTION AND DATA (Continued)

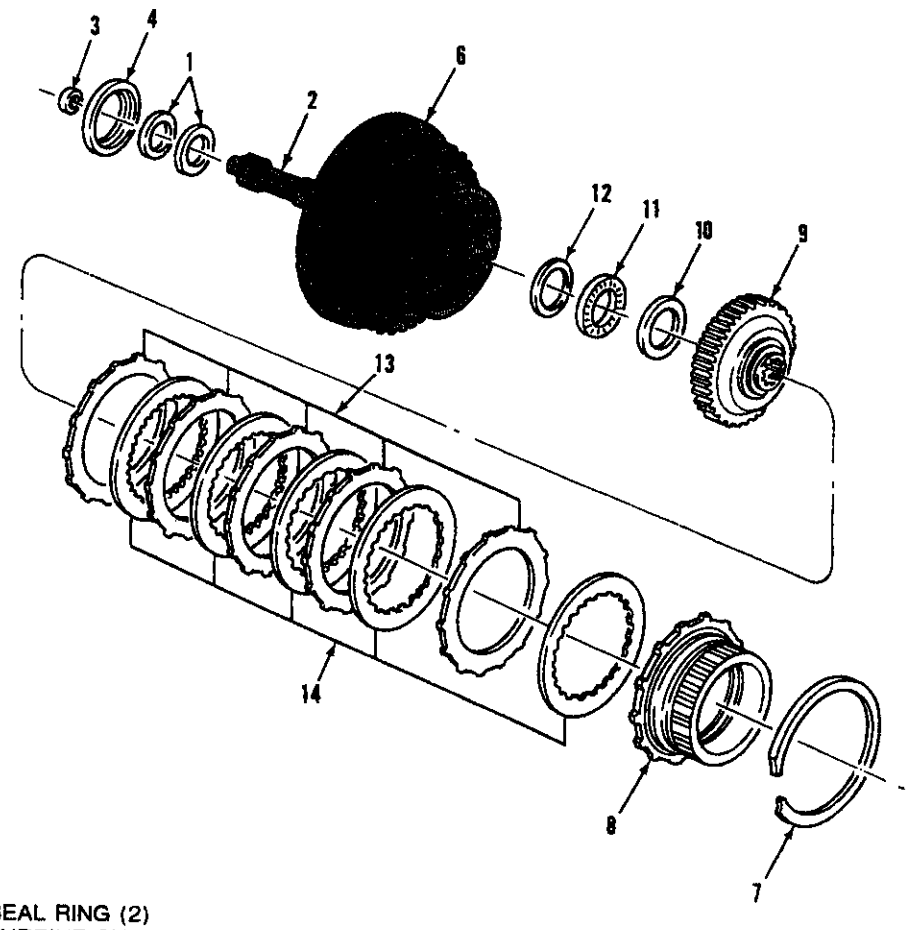
g. Throttle Cylinder. An air-actuated cylinder that is controlled by the throttle treadle valve. The throttle cylinder attaches to the speed control lever on the governor. When regulated air reaches the cylinder, a push rod moves the speed control lever. The control lever moves internal fuel rods and levers that regulate the amount of fuel in the injector.

h. Thermostats and Housing. Engine coolant temperature is controlled by two thermostats. Each thermostat is located in a housing attached to the water outlet end of each cylinder head. Thermostats are closed, letting coolant circulate within the engine, until coolant temperature reaches 160°F-197°F (71°C-91.6°C) when the thermostats open and allow coolant to pass into the radiator for cooling.

i. Alternator. A flange-mounted alternator that is driven by the blower drive gear by means of a drive coupling. The alternator has an integral regulator that regulates voltage, keeping it at approximately 24 volts. The regulator can be slightly adjusted to provide the desired output. Organizational Maintenance is responsible for replacement only.

j. Starter. The starter is an electric motor with a solenoid and drive gear. When the starter is activated, the drive moves outward and meshes with the flywheel ring gear. The starter is mounted on the left side of the flywheel housing. Organizational Maintenance is responsible for replacement only.

k. Exhaust Manifolds and Pipes. The exhaust manifolds and pipes are used to direct exhaust gases away from the engine.



1. SEAL RING (2)
2. TURBINE SHAFT
3. SEAL RING
4. BEARING RACE
6. FORWARD CLUTCH ASSEMBLY
7. SNAPRING
8. FOURTH CLUTCH DRIVING HUB
9. FORWARD CLUTCH HUB
10. INNER RACE
11. BEARING
12. OUTER RACE
13. STEEL PLATE (5)
14. FRICTION PLATE (5)

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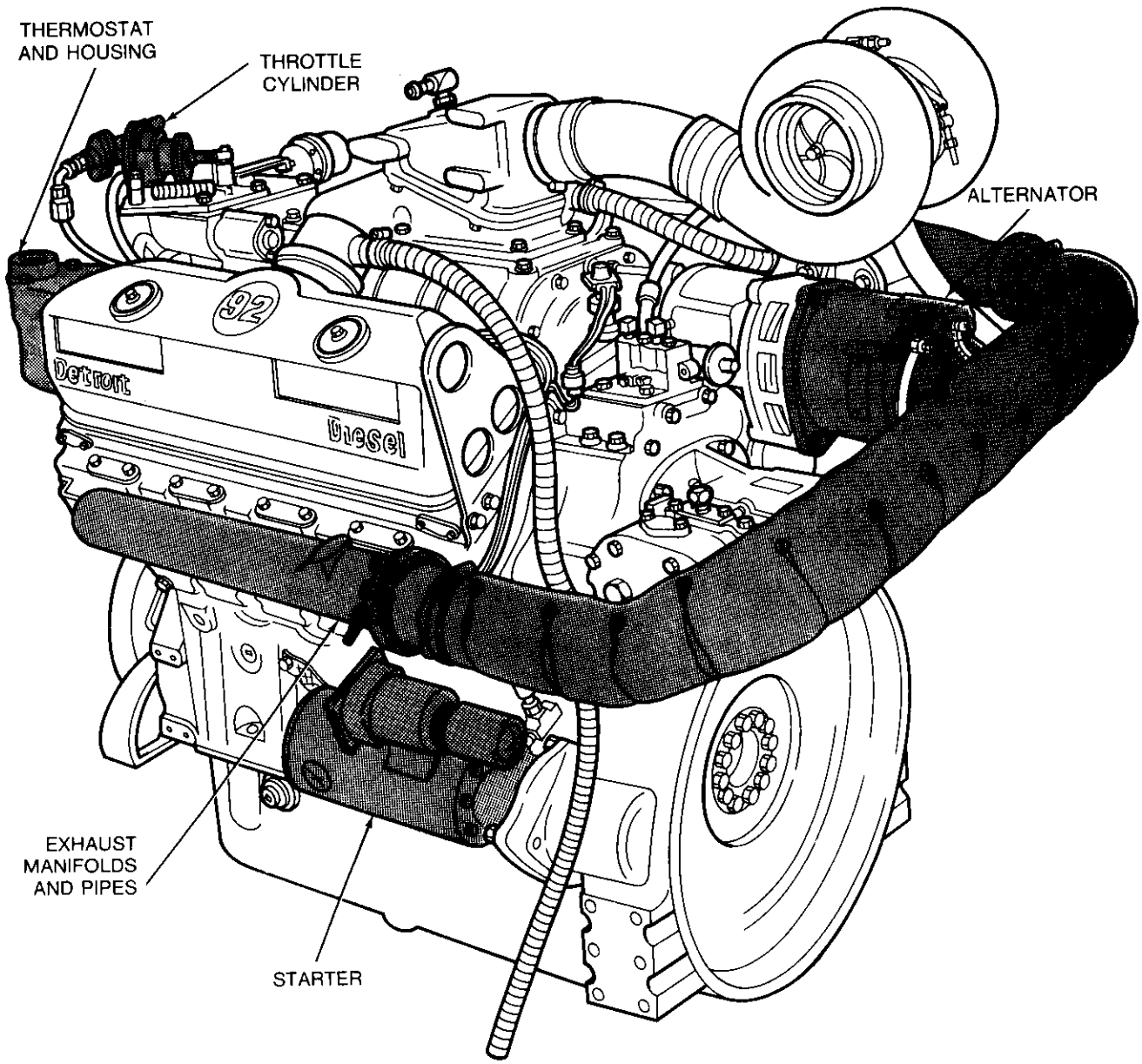

THERMOSTAT AND HOUSING
THROTTLE CYLINDER
ALTERNATOR
EXHAUST MANIFOLDS AND PIPES
STARTER
92
Detroit
Diesel

TA 298438

7-13. FORWARD CLUTCH REPAIR (Continued)

(34) Install outer race (12) onto small hub of forward clutch assembly (6), cupped side down.

(35) Install bearing (11) onto outer race (12).

(36) Coat inner race (10) with oil and install onto bearing (11).

(37) Install forward clutch hub (9) on top of forward clutch assembly (6).

(38) Soak five friction plates (14) in clean lubricating oil for two minutes.

(39) Starting with steel plate (13) and alternating with friction plate (14), install 10 clutch plates.

(40) Install fourth clutch driving hub (8) onto forward clutch assembly (6).

(41) Install snapring (7) to hold fourth clutch driving hub (8).

(42) Install two new sealrings (1) around turbine shaft (2).

(43) Install bearing race (4) and new sealring (3) on turbine shaft (2).

(44) Store the assembly in a clean, dry place until transmission is assembled.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13	Install forward
TM 9-2320-297-34	clutch (para 7-6).

3-2. DESCRIPTION AND DATA (Continued)

I. External Components.

(1) WATER PUMP. A centrifugal-type pump that circulates engine coolant through the cylinder block, cylinder heads, oil cooler, and radiator. The pump is mounted on the engine front cover and is driven off of the right front camshaft gear.

(2) OIL COOLER. Cools the engine oil by sending it through plates that are surrounded by engine coolant.

(3) GOVERNOR. Double weight limiting speed governor. The governor has the following two functions:

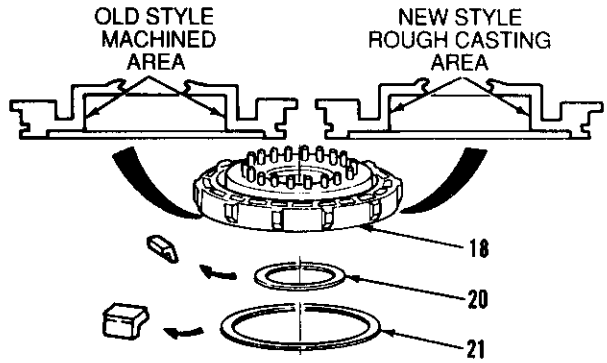
(a) Controls the engine idling speed.

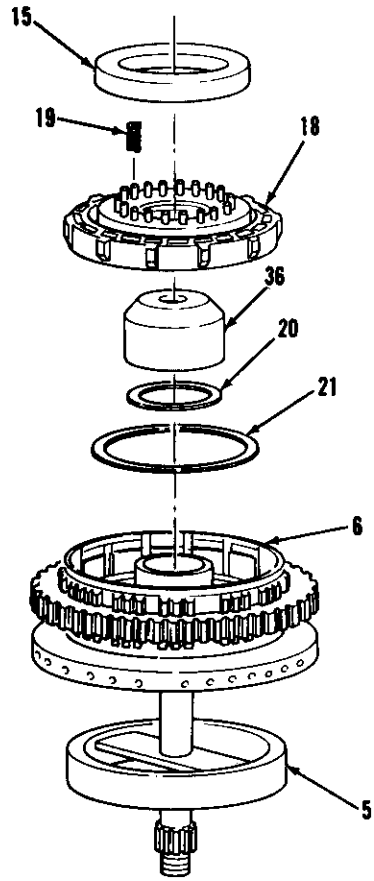
(b) Limits the maximum operating speed of the engine.

(4) BLOWER. Supplies fresh air needed for combustion and scavenging (to remove exhaust gas and replace with fresh air). The operation is similar to a gear pump. Two three-lobe rotors (spiral form) force air into the cylinders.

(5) TURBOCHARGER. A device that delivers pressurized air to the blower. It accomplishes this by using the engine's exhaust to turn a compressor wheel that draws in fresh air and compresses it.

(6) FLYWHEEL HOUSING. The flywheel housing is a one-piece casting that is mounted against the rear end plate, which is attached to the cylinder block. The flywheel housing provides a cover for the gear train and flywheel. It also serves as a support for the starter motor and transmission.





5. COLLECTOR RING INSTALLER (TOOL)
6. FORWARD CLUTCH ASSEMBLY
15. SPRING RETAINER
18. FORWARD CLUTCH PISTON
19. PISTON RETURN SPRING (20)
20. INNER SEAL RING
21. OUTER SEAL RING
22. DELETED
36. SEAL PROTECTOR (TOOL)

(26) Deleted

(27) Install seal protector (36) over inner hub of forward clutch assembly (6).

(28) Install forward clutch piston (18) over seal protector (36). Carefully tap forward clutch piston (18) down until it seats.

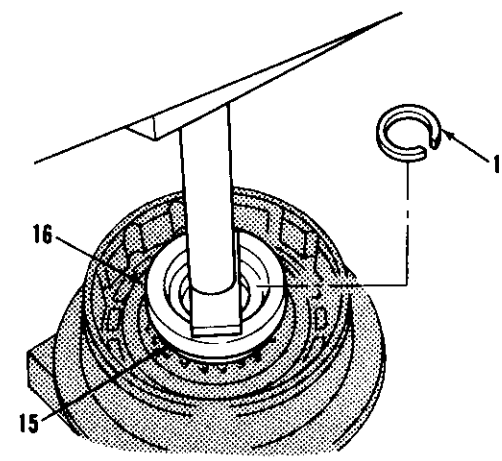
(29) Remove seal protector (36).

(30) Install 20 piston return springs (19) onto forward clutch piston (18).

(31) Install spring retainer (15) onto piston return springs (19).

(32) Compress spring retainer (15) with clutch spring compressor (16). Install snapring (17).

(33) Release pressure from spring retainer (15) and remove clutch spring compressor (16).



15. SPRING RETAINER
16. CLUTCH SPRING COMPRESSOR (TOOL)
17. SNAPRING

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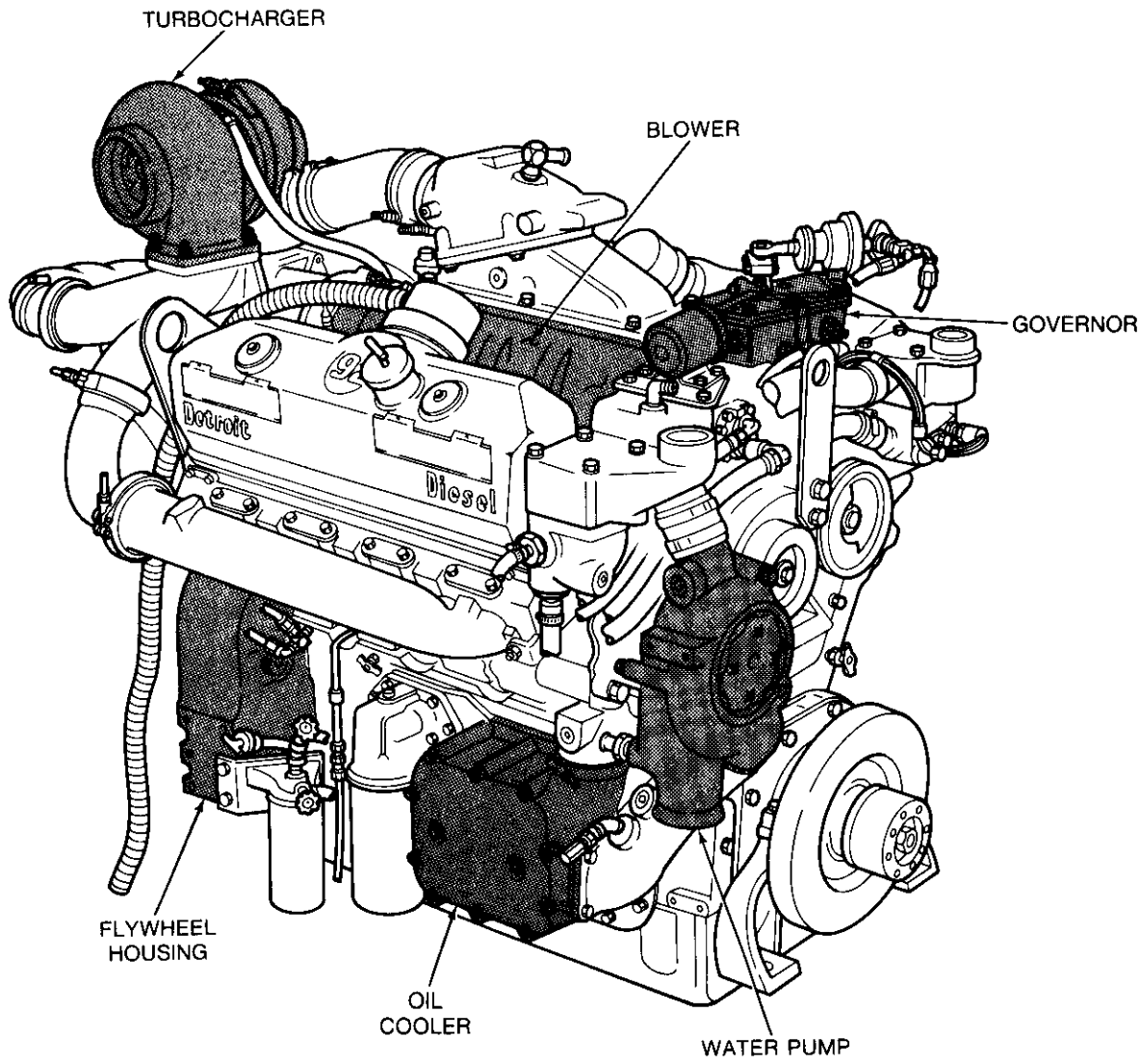

TURBOCHARGER
BLOWER
GOVERNOR
Detroit
Diesel
FLYWHEEL HOUSING
OIL COOLER
WATER PUMP

TA 298439

7-13. FORWARD CLUTCH REPAIR (Continued)

(14) Measure thickness of friction plates (14). Replace any plate if less than 0.090 inch (2.29 mm).

(15) Measure thickness of fourth clutch driving hub (8). Replace hub if less than 0.390 inch (9.91 mm).

(16) Look at bottom of forward clutch piston (18) and note whether it is labeled 'A', 'B', or 'C'.

(17) Starting with steel plate (13) and alternating with friction plate (14), stack 10 clutch plates on a flat surface in a press.

(18) Place fourth clutch driving hub (8) on clutch plates (13 and 14).

(19) Press evenly on fourth clutch driving hub (8) with a pressure of 980-1020 pounds (444-462 kg).

(20) Measure distance from base of clutch pack (35) to top machined surface of fourth clutch driving hub (8). This is clutch pack thickness.

(a) If forward clutch piston (18) is an 'A' piston, then clutch pack thickness must be 1.415 to 1.442 inches (35.94 to 36.60 mm).

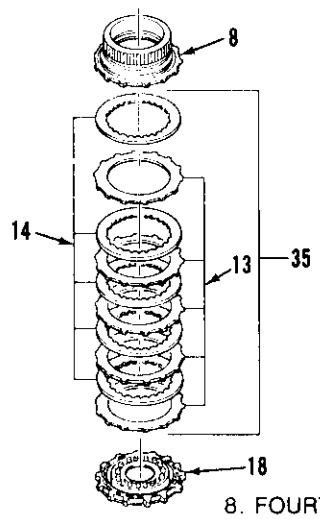
(b) If forward clutch piston (18) is a 'B' piston, then clutch pack thickness must be 1.388 to 1.415 inches (35.26 to 35.92 mm).

(c) If forward clutch piston (18) is a 'C' piston, then clutch pack thickness must be 1.362 to 1.388 inches (34.57 to 35.23 mm).

(21) Replace clutch plates (13 and 14) and recheck clutch pack thickness as needed to get proper clutch pack measurement.

(22) Remove clutch pack (35) and fourth clutch driving hub (8) from press. Tie clutch pack (35) together.

(23) Install forward clutch assembly (6) with shaft down through collector ring installer (5) and into hydraulic press.



8. FOURTH CLUTCH DRIVING HUB
13. STEEL PLATE (5)
14. FRICTION PLATE (5)
18. FORWARD CLUTCH PISTON
35. CLUTCH PACK

TA 298856

CAUTION

Do not mix old and new style pistons and housings. Equipment may be damaged.

NOTE

- There are two styles of clutch pistons and clutch assemblies. The old style clutch piston is machined smooth, new style is rough casting. The old style clutch assembly has a groove for installation of a seal ring, new style does not have a groove.
- If old or new housing is used, third seal ring is not used.

(24) Apply lubricating oil to two new seal rings (20 and 21).

(25) Install new inner seal ring (20), and outer seal ring (21), lips down, onto forward clutch piston (18).

3-2. DESCRIPTION AND DATA (Continued)

m. Internal Components.

(1) JACOBS BRAKE (Also known as ENGINE BRAKE). Converts the diesel engine into a power absorbing air compressor. Used to help slow the vehicle down by engine resistance.

(2) FUEL INJECTOR. A needle valve injector. The injector performs the following four functions:

(a) Creates high fuel pressure.

(b) Meters and injects the exact amount of fuel required to handle the load.

(c) Atomizes the fuel for mixing with air in the combustion chamber.

(d) Permits continuous fuel flow.

(3) THROTTLE DELAY. This device reduces the exhaust smoke during acceleration. It delays the action of the governor by hydraulically holding the control tube until the spring force moves the throttle-delay piston. The movement of the piston is restricted by the oil it must force out of the cylinder through a small orifice. This action slows the rotation of the control tube and thereby the movement of the fuel rack. As engine speed increases, the density of the exhaust smoke is gradually reduced.

(4) CYLINDER HEAD. The cylinder heads (one on each cylinder bank) are one-piece castings held securely to the cylinder block by special capscrews. The exhaust valves (four per cylinder), fuel injectors (one per cylinder), and the valve operating mechanism are located in the cylinder head.

Exhaust valve seat inserts pressed into the cylinder head permit accurate seating of valves under varying conditions of temperature. This significantly prolongs the life of the cylinder head.

The exhaust passages from the exhaust valves of each cylinder lead through a single port to the exhaust manifold. The exhaust passages and the injector tubes are surrounded by engine coolant.

In addition, cooling of the above areas are further ensured by the use of water nozzles pressed into the water inlet ports in the cylinder head. The nozzles direct the comparatively cool engine coolant at high velocity toward the sections of the cylinder head that are subjected to the greatest heat.

The fuel inlet and outlet manifolds are integral parts of the cylinder heads. Tapped holes are provided for connection of the fuel lines at various points along each manifold.

(5) Install PTO gear removal fixture (24) onto forward clutch assembly (6).

(6) Press PTO gear (27) onto forward clutch assembly (6) until snapring (26) expands into PTO gear (27).

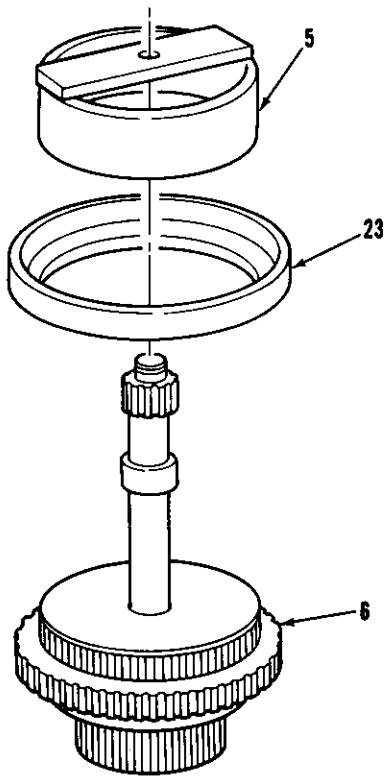
(7) Remove forward clutch assembly (6) and collector ring installer (32) from press.

(8) Coat pitot collector ring (23) collar with retaining compound.

(9) Place pitot collector ring (23) onto forward clutch assembly (6).

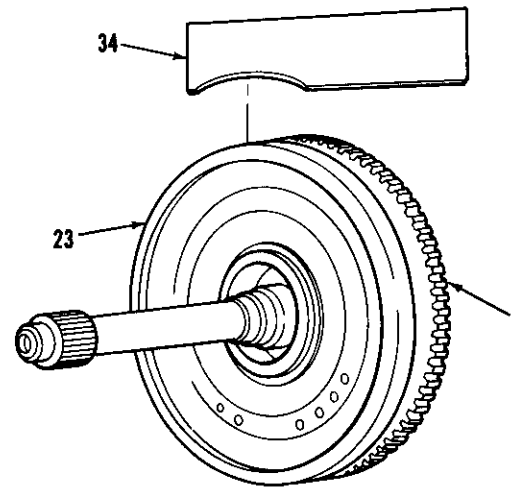
(10) Install collector ring installer (5) onto pitot collector ring (23) and install ring.

(11) Remove collector ring installer (5).



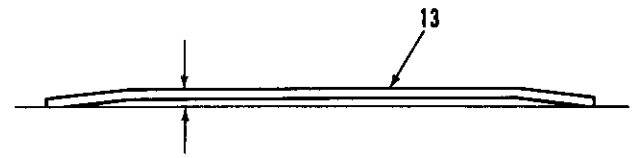
5. COLLECTOR RING INSTALLER (TOOL)
6. FORWARD CLUTCH ASSEMBLY
23. PITOT COLLECTOR RING

(12) Support forward clutch assembly (6) on edge. Make sure pitot collector ring (23) does not touch work surface. Using staking tool (34), bend edge of pitot collector ring (23) into groove in forward clutch assembly (6).



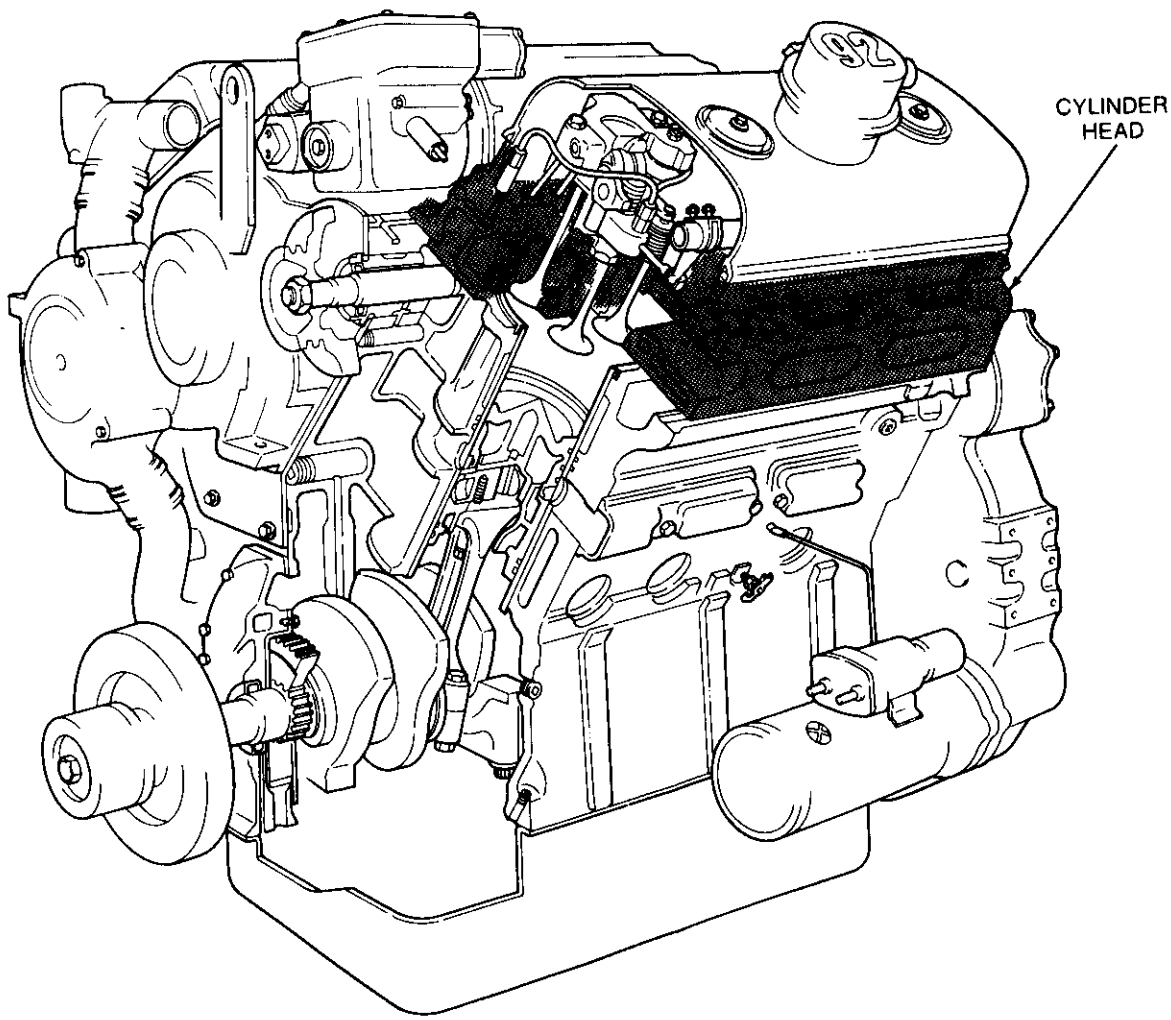
6. FORWARD CLUTCH ASSEMBLY
23. PITOT COLLECTOR RING
34. STAKING TOOL

(13) Measure thickness of steel clutch plates (13). Replace any plate if less than 0.099 inch (2.522 mm) thick. Place steel clutch plates (13) individually on a flat surface and measure for cone. Cone of steel plates must not exceed 0.010 inch (0.25 mm).



13. STEEL CLUTCH PLATE

TA 298855



DETROIT 8V92TA DIESEL ENGINE

TA 298440

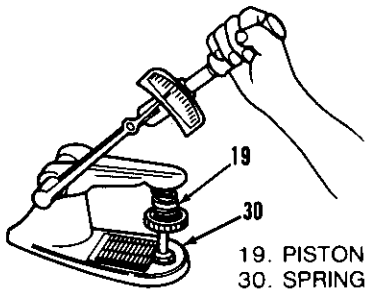
7-13. FORWARD CLUTCH REPAIR (Continued)

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect turbine shaft (2). Turbine shaft (2) is pressed into forward clutch housing (29) and must be tight.

(3) Test piston return springs (19) using spring tester (30). Replace all piston return springs (19) if any three springs do not meet the following load-height requirements:

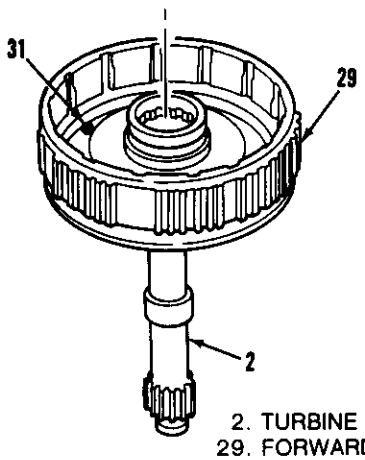


19. PISTON RETURN SPRING (20)
30. SPRING TESTER (TOOL)

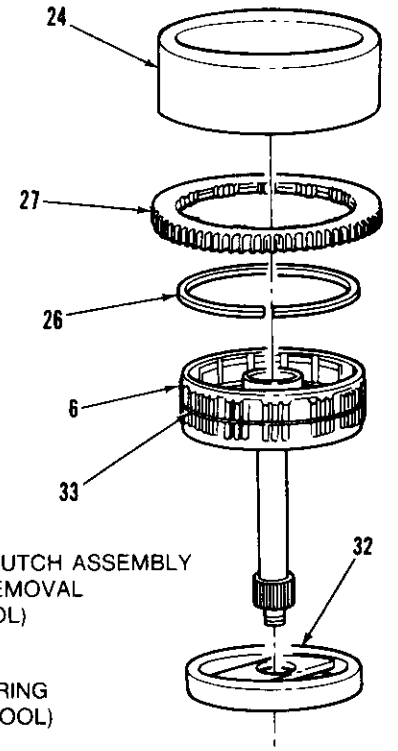
(a) Length without load must be 1.25 inch (31.8 mm).

(b) Length under load must be 0.88 inch (22.4 mm) with load of 17.9-18.9 lb. (8.13-8.58 kg).

(4) Check four balls (31) inside housing for free movement. Wipe clean and coat with lubricating oil.



2. TURBINE SHAFT
29. FORWARD CLUTCH HOUSING
31. BALL (4)



6. FORWARD CLUTCH ASSEMBLY
24. PTO GEAR REMOVAL FIXTURE (TOOL)
26. SNAPRING
27. PTO GEAR
32. COLLECTOR RING INSTALLER (TOOL)
33. GROOVE

TA 298854

c. Assembly

NOTE

PTO gear (27) is used in all transmissions even though a PTO may not be used on this vehicle.

(1) Place collector ring installer (32) in press.

(2) Install forward clutch assembly (6) on collector ring installer (32).

(3) Install snapring (26) into groove (33) on outside of forward clutch assembly (6).

(4) Carefully place PTO gear (27), beveled side of inner teeth down, onto forward clutch assembly (6).

3-2. DESCRIPTION AND DATA (Continued)

(5) PISTON AND CONNECTING ROD ASSEMBLY. The cross-head piston is a two-piece piston consisting of a crown, which has the compression ring grooves, and the skirt. The skirt has oil ring grooves. These are held together by the piston pin. A slipper bearing is locked in the upper half of the piston-pin bore. The connecting rod is bolted to the piston pin. With the cross-head piston design, the force of combustion from the piston crown goes directly onto the slipper bearing and piston pin. The skirt, being separate, is free from vertical load distortion. It is also free from thermal distortion, since the hotter crown expands during engine operation.

(6) CYLINDER LINER. The cylinder liner is of the replaceable wet type (water above ports) made of hardened alloy cast iron and is a slip fit in the cylinder block. The liner is inserted in the cylinder bore from the top of the cylinder block. The flange at the top of the liner fits into a counterbore in the cylinder block and rests on a replaceable cast iron insert that permits accurate alinement of the cylinder liner.

Two teflon-coated seal rings, recessed in the cylinder bore, are used between the liner and the block to prevent water leakage.

The upper half of the liner is directly cooled by the water surrounding the liner. At the air inlet ports, the liner is cooled by the air introduced into the cylinder through equally spaced ports around the liner. The lower half of the liner is cooled by water inside the cylinder block water jacket that surrounds the liner.

The air inlet ports in the liner are machined at an angle that makes the air move in a uniform swirling motion as it enters the cylinder. This motion persists throughout the compression stroke and helps scavenging and combustion.

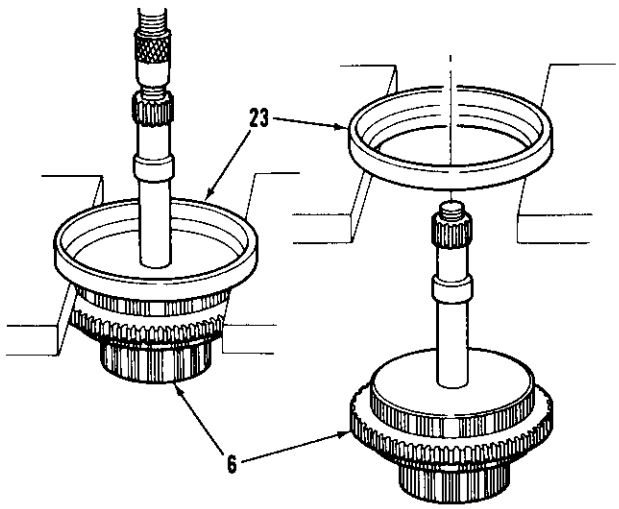
The wear on a liner or piston is directly related to the amount of abrasive dust and dirt introduced into the engine combustion chamber through the air intake. This dust, combined with lubricating oil on the cylinder wall, forms a lapping compound and will result in rapid wear. Therefore, to avoid pulling contaminated air into the cylinder, the air cleaners must be serviced regularly according to the surroundings in which the engine is operated.

(7) CAMSHAFT. Camshafts are made from special high-tensile-strength iron alloy. The bearing journals and cam lobes are heat-treated and precision-ground. The two counter-rotating camshafts are located just below the top of the cylinder block. A left cylinder bank and a right cylinder bank camshaft is provided to actuate the exhaust valve and injector operating mechanism. Camshafts have three lobes per cylinder. The two outside lobes actuate the exhaust valve mechanism and the middle one actuates the fuel injector mechanism.

NOTE

- PTO gear (27) is used in all transmissions even though a PTO may not be used on this vehicle.
- Pitot collector ring must be removed to allow removal of PTO gear.
- Perform steps (17) thru (25) only if pitot collector ring (23), PTO gear (27), or forward clutch assembly (6) must be replaced.

(17) Press pitot collector ring (23) loose from forward clutch assembly (6), if damaged.



6. FORWARD CLUTCH ASSEMBLY
23. PITOT COLLECTOR RING

(18) Place PTO gear removal fixture (24) in press.

(19) Install forward clutch assembly (6) onto PTO gear removal fixture (24).

(20) Install PTO removal tool (25) into forward clutch assembly (6).

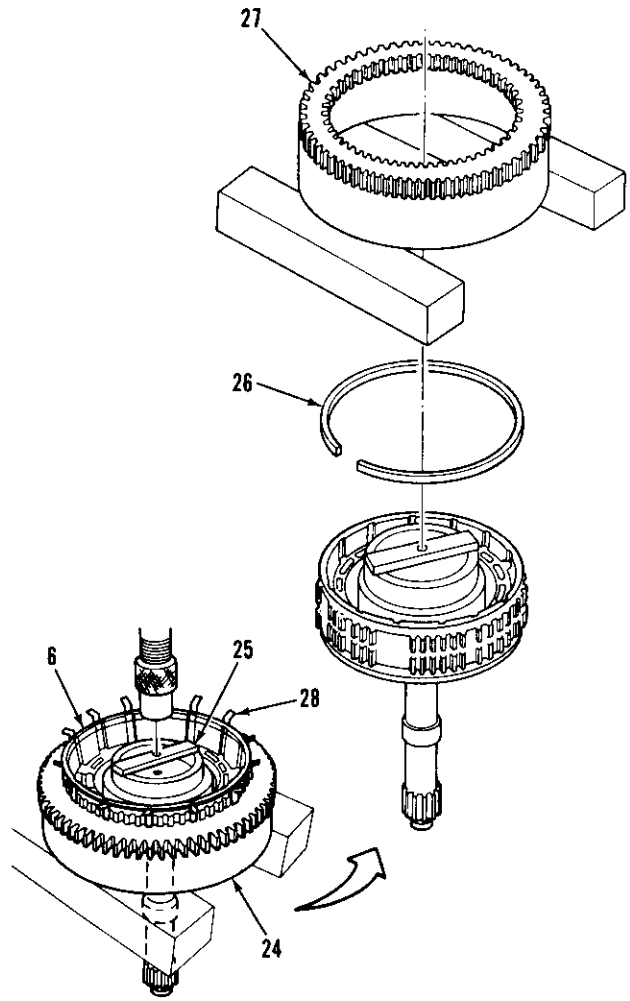
(21) Find gap in snapring (26) located around the inside diameter of PTO gear (27).

(22) Install shim stock (28) between snapring (26) and inside teeth of PTO gear (27). Push snapring (26) into forward clutch assembly (6).

(23) Put shim stock (28) every three inches around forward clutch assembly (6).

(24) Press forward clutch assembly (6) out of PTO gear (27).

(25) Remove PTO gear (27), forward clutch assembly (6), PTO removal tool (25), and PTO gear removal fixture (24) from press.



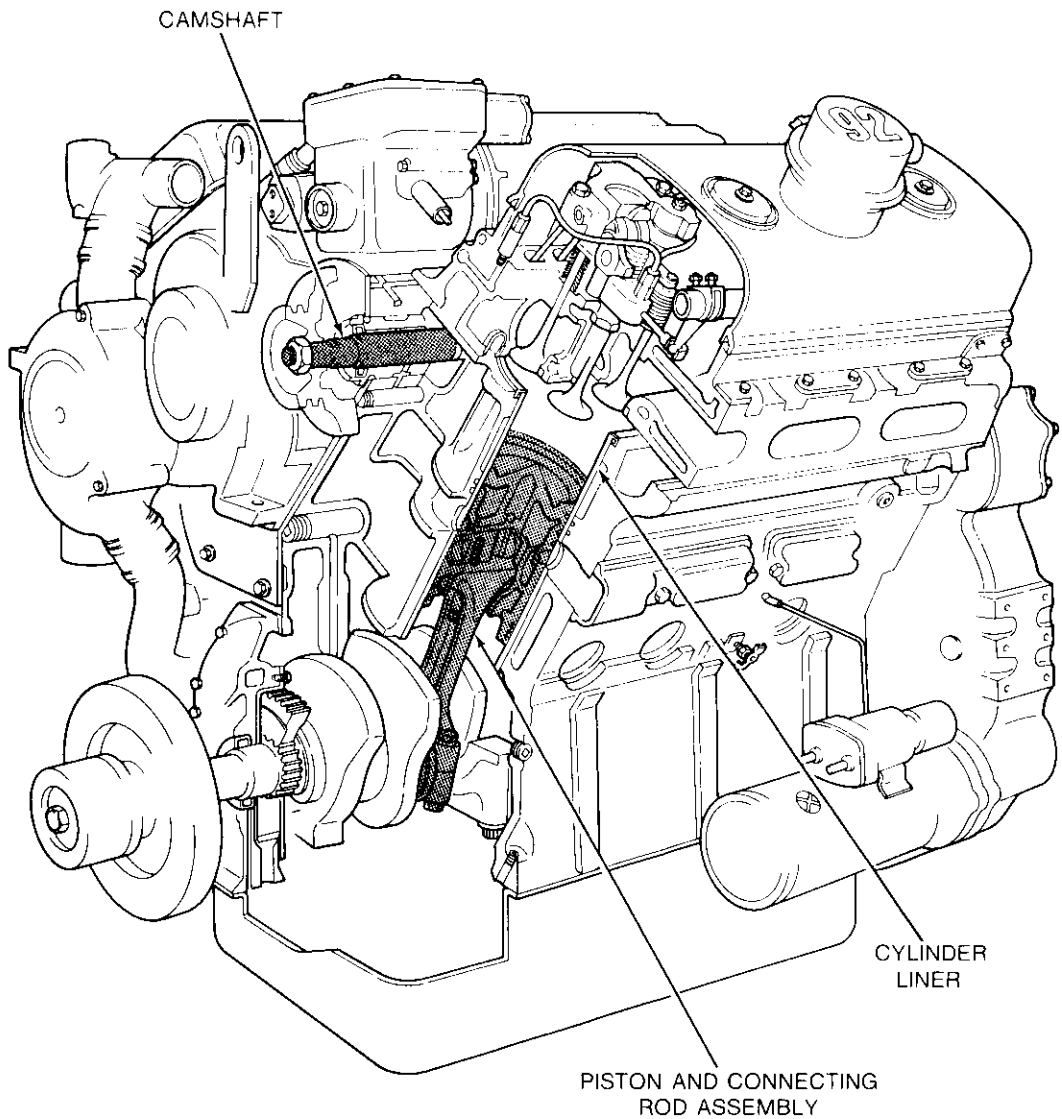
6. FORWARD CLUTCH ASSEMBLY
24. PTO GEAR REMOVAL FIXTURE (TOOL)
25. PTO REMOVAL TOOL
26. SNAPRING
27. PTO GEAR
28. SHIM STOCK A/R

TA 298853

Both ends of each camshaft are supported by a bearing assembly that consists of a flanged housing and two bushings. In addition, three intermediate, two-piece bearings support the camshafts at uniform intervals throughout their length. The intermediate bearings are secured to the camshaft by lock rings that permit them to be inserted in the cylinder block with the shafts. Each intermediate bearing is secured in place, after the camshafts are installed, with a lock screw that is threaded into a counterbored hole in the top of the cylinder block.

The camshaft gear thrust load is absorbed by four thrust washers - one at each end of both rear camshaft end bearings.

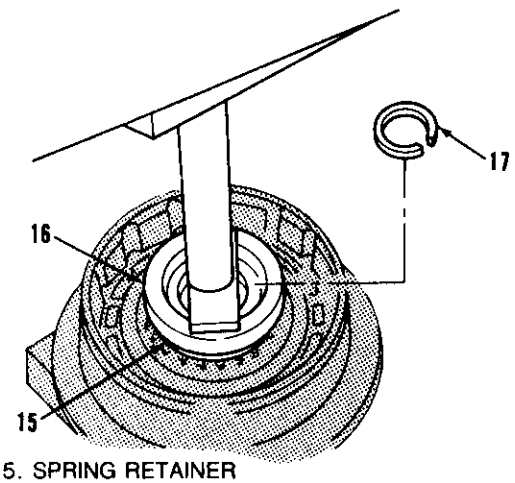
A camshaft front pulley (integral weight) is attached to the front end of the left bank camshaft, and a water pump drive gear (bolt-on weight) is attached to the front end of the right bank camshaft. A camshaft gear is attached to the rear end of each camshaft.



DETROIT 8V92TA DIESEL ENGINE

TA 298441

7-13. FORWARD CLUTCH REPAIR (Continued)



15. SPRING RETAINER
16. CLUTCH SPRING COMPRESSOR (TOOL)
17. SNAPRING

(9) Compress spring retainer (15) with clutch spring compressor (16). Remove snapring (17).

(10) Release pressure and remove clutch spring compressor (16).

(11) Remove spring retainer (15) from forward clutch piston (18).

(12) Remove 20 piston return springs (19) from forward clutch piston (18).

(13) Remove forward clutch piston (18) from forward clutch assembly (6).

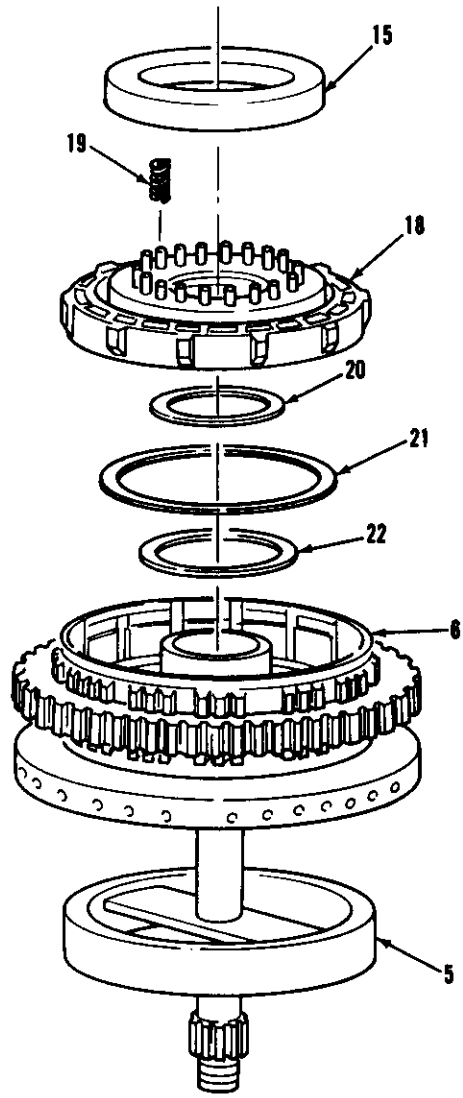
(14) Remove inner sealring (20) and outer sealring (21) from forward clutch piston (18). Discard sealrings (20 and 21).

NOTE

Some LVS transmissions utilize an additional sealring (22) in the forward clutch assembly (6). If present, this third sealring (22) must be discarded. A replacement sealring (22) must not be installed.

(15) Remove sealring (22) if present from inner hub in forward clutch assembly (6). Discard sealring (22).

(16) Remove forward clutch assembly (6) and collector ring installer (5) from press.



5. COLLECTOR RING INSTALLER (TOOL)
6. FORWARD CLUTCH ASSEMBLY
15. SPRING RETAINER
18. FORWARD CLUTCH PISTON
19. PISTON RETURN SPRING (20)
20. INNER SEAL RING
21. OUTER SEAL RING
22. SEALRING (SOME MODELS)

TA 298852

3-2. DESCRIPTION AND DATA (Continued)

(8) CAMSHAFT (Continued)

Lubricating oil is supplied under pressure to the bearings by way of drilled passages in the rear of the cylinder block that lead from the main oil gallery to each rear end bearing. From the rear end bearings, the oil passes through the drilled oil passages in the camshafts to the intermediate bearings and to the front end bearings.

The lower halves of the camshaft intermediate bearings are grooved along the horizontal surface that mates with the upper halves of the bearings. Oil from the passage in the camshaft is forced through the milled slots in the bearing and then out of the grooves to furnish additional oil to the cam follower rollers. This permits the cam pocket to fill rapidly to operating oil level immediately after the engine is started.

(9) VALVE OPERATING MECHANISM. Three rocker arms are provided for each cylinder. The two outer arms operate the exhaust valves, and the center arm operates the fuel injector.

Each set of three rocker arms pivots on a shaft supported by two brackets. A single bolt secures each bracket to the top of the cylinder head. Removal of the two bracket bolts permits the rocker arm assembly for one cylinder to be raised, providing easy access to the fuel injector and the exhaust valve springs.

The rocker arms are operated by a camshaft through cam followers and short push rods that extend through the cylinder head.

Each cam follower operates in a bore in the cylinder head. A guide for each set of three cam followers is attached to the bottom of the cylinder head to retain the cam followers in place and to aline the cam follower rollers with the camshaft lobes.

A coil spring, inside each cam follower, maintains a pre-determined load on the cam follower to insure contact of the cam roller on the camshaft lobe at all times.

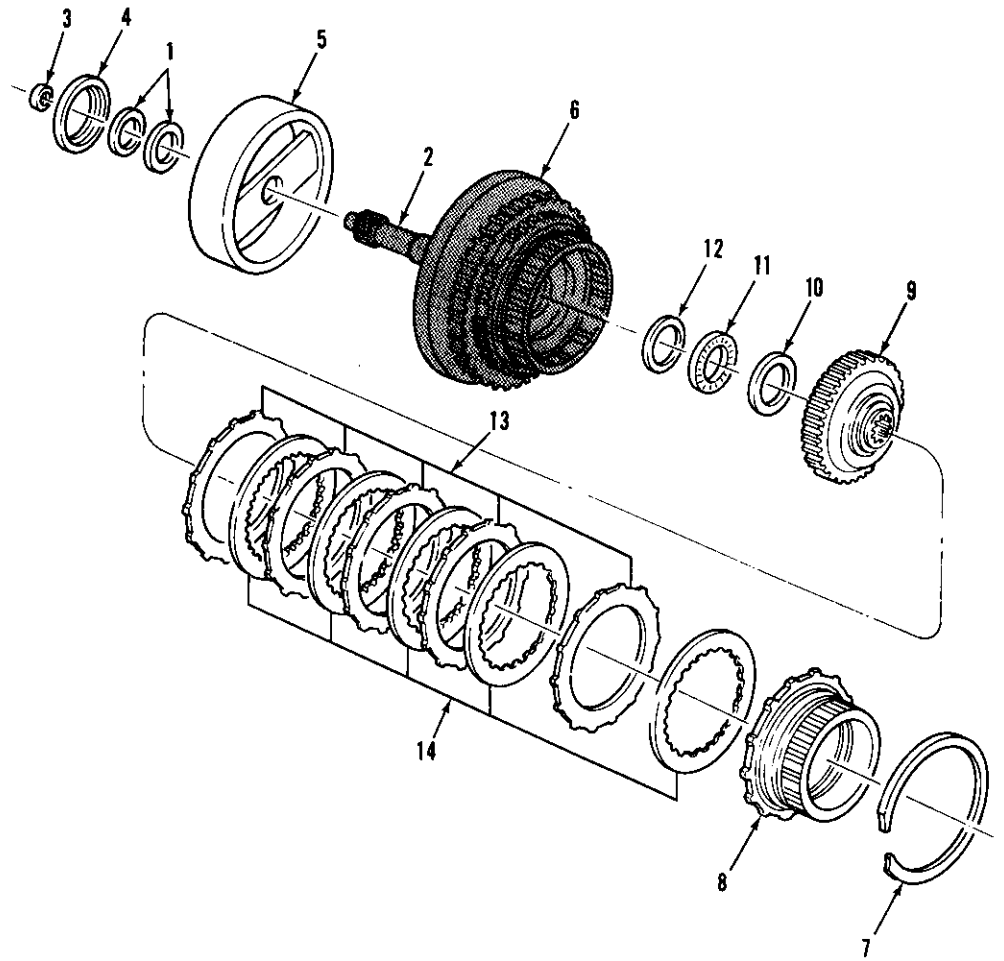
(10) CRANKSHAFT. The crankshaft is a one-piece steel forging, heat-treated to insure strength and durability. The main and connecting rod bearing journal surfaces and fillets on all crankshafts are induction hardened.

Complete static and dynamic balance of the crankshaft has been achieved by counterweights incorporated on the crankshaft.

The crankshaft end play is controlled by thrust washers located at the rear main bearing cap of the engine. Full pressure lubrication to all connecting rod and main bearings is provided by drilled passages within the crankshaft and cylinder block.

(11) CYLINDER BLOCK. The main structural part of the engine is a one-piece casting, made of cast-iron alloy.

The cylinder block is a wet type above the cylinder liner ports and a dry type below the cylinder liner ports. The water jacket and air box are sealed off by two sealrings compressed between the cylinder liner and the grooves in the block.



1. SEALRING (2)
2. TURBINE SHAFT
3. SEALRING
4. BEARING RACE
5. COLLECTOR RING INSTALLER (TOOL)
6. FORWARD CLUTCH ASSEMBLY
7. SNAPRING
8. FOURTH CLUTCH DRIVING HUB
9. FORWARD CLUTCH HUB
10. INNER RACE
11. BEARING
12. OUTER RACE
13. STEEL PLATE (5)
14. FRICTION PLATE (5)

TA 298851

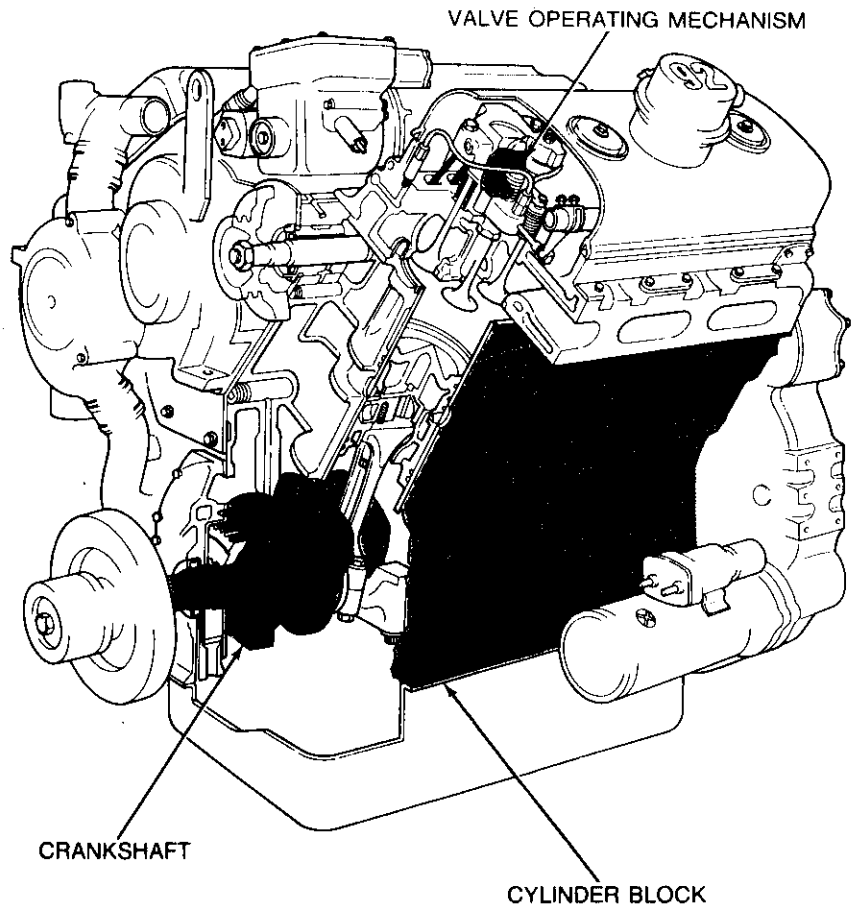
An air box between the cylinder banks and extending around the cylinders at the air inlet port belt conducts the air from the blower to the cylinders. Air box openings on each side of the block permit inspection of the pistons and compression rings through the air inlet ports in the cylinder liners. The air box openings in the cylinder block assembly are covered with cast covers.

The camshaft bores are located on the inner side of each cylinder bank near the top of the block.

The upper halves of the main bearing supports are cast into the block itself. The main bearing bores are line-bored with the bearing caps in place to insure longitudinal alinement. Drilled passages in the block carry the lubricating oil to all moving parts of the engine, eliminating the need for external piping.

The top surface of each cylinder bank is grooved to accommodate a block-to-head oil seal ring. Also, each water or oil hole is counterbored to provide for individual sealrings. The same size sealrings are used at all counterbored oil and water holes in the cylinder block.

Each cylinder liner is retained in the block by a flange at its upper end. The liner flange rests on an insert located in the counterbore in the block bore. An individual compression gasket is used at each cylinder.



TA 298442

7-13. FORWARD CLUTCH REPAIR

THIS TASK COVERS:
a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP

Special Tools
Clutch spring compressor set (J 24204)
Collector ring installer and staker set (J 24200)
Forward clutch piston inner seal protector (J 24216-01)
PTO gear removal tool (J 26899)
Spring tester (J 9666)
Micrometer set 0-6" outside (NSN 5120-00-554-7134)

Materials/Parts
Retaining compound (item 19, Appendix C)
Grease, oil soluble (item 32, Appendix C)
Oil, OE/HDO-10 (item 44, Appendix C)
Sealring (2) (NSN 5330-01-054-2242) item 1
Sealring (NSN 2520-00-374-4873) item 3
Sealring (NSN 5330-00-001-2008) item 20
Sealring (P/N 6836799) item 21

Personnel Required
1 MOS 3522
1 Assistant

Equipment

Condition	Condition
TM	Description
TM 2320-34/13	Forward clutch
TM 9-2320-297-34	removed (para 7-5)

Special Environmental Conditions
Work in a clean area free of blowing dust.

---

a. Disassembly

(1) Remove two sealrings (1) from turbine shaft (2). Discard sealrings (1).

(2) Remove sealring (3) and bearing race (4) from turbine shaft (2). Discard sealring (3).

(3) Place collector ring installer (5) on bed of press.

(4) Place forward clutch assembly (6) through collector ring installer (5) on press.

(5) Remove larger snapring (7).

(6) Remove fourth clutch driving hub (8) from forward clutch assembly (6).

(7) Remove forward clutch hub (9), inner race (10), bearing (11), and outer race (12).

(8) Remove five steel plates (13) and five friction plates (14) from forward clutch assembly (6).

SECTION II. GENERAL ENGINE MAINTENANCE

3-3. CYLINDER HEAD REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Lifting fixture (J 22062-01)
Fuel pipe socket (J 8932-01)
Cylinder head alinement studs (J 24748)

Materials/Parts

International Compound No. 2 (item 16, Appendix C)
Engine oil (item 46, Appendix C)
Capscrew (5) (NSN 5305-01-039-9660) item 1
Gasket (NSN 5330-00-735-4296) item 3
Cotter pin (2) (NSN 5315-00-234-1650) item 4
Lockwasher (2) (MS35338-47) items 14 and 18
Capscrew (NSN 5306-01-157-8909) item 17
Lockwasher (2) (MS35338-44) item 20
Shims (2) (NSN 5365-01-082-1972) item 30
Sealring (17) (NSN 5330-01-062-0943) item 31
Compression gaskets (4) (NSN 5330-01-054-2398) item 32
Sealring (NSN 5330-00-171-8763) item 33
Gasket (NSN 5330-00-892-1764) item 34

Personnel Required

1 MOS 3522
1 Assistant

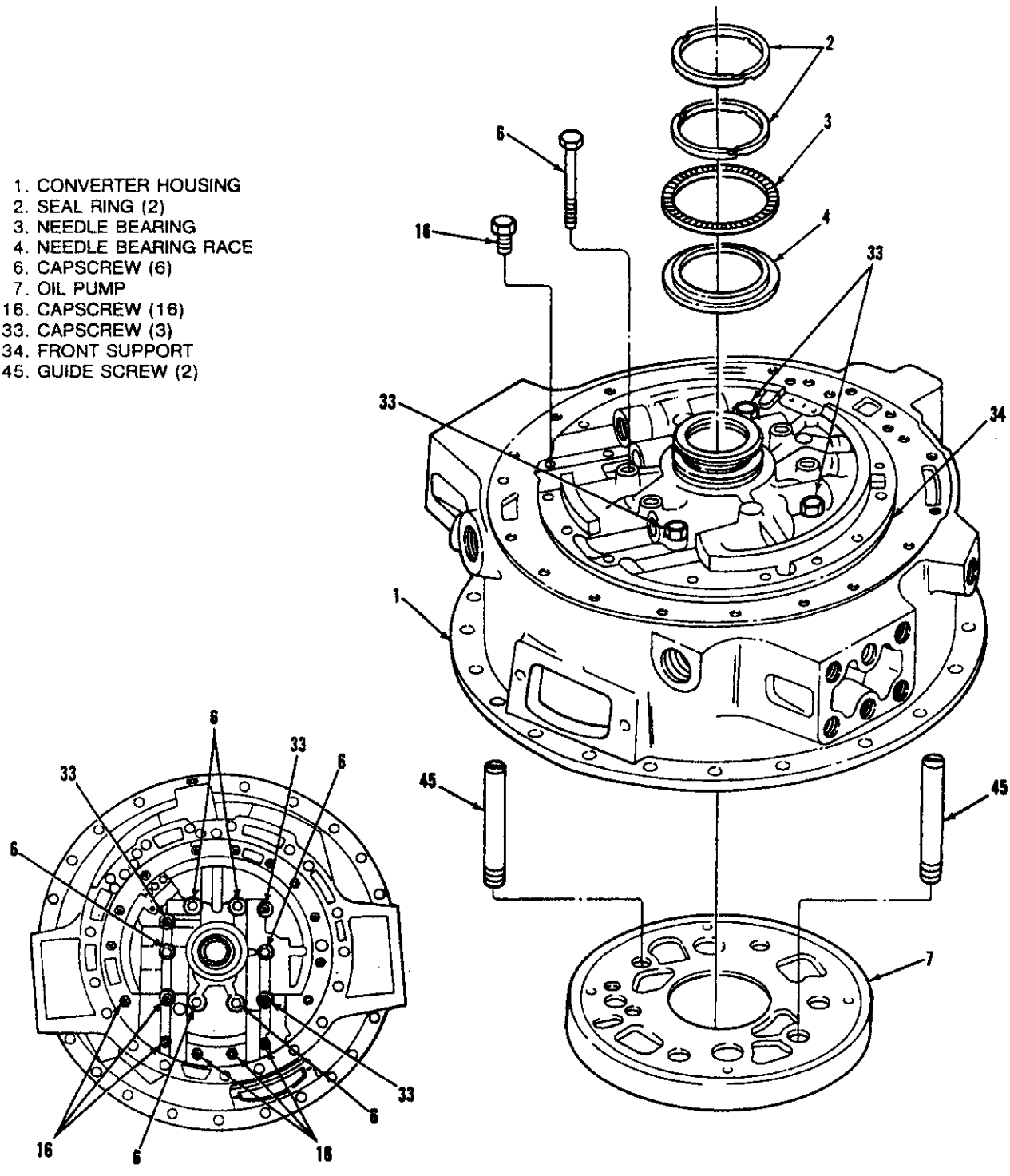
References

TM 2320-10/11
TM 9-2320-297-10

TM 2320-20/12
TM 9-2320-297-20

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Engine access door open (para 2-1).
TM 2320-20/12 TM 9-2320-297-20	Engine access panels removed (para 18-14).
	Throttle cylinder removed (para 4-15).
	Shutdown solenoid removed (para 4-13).
	Exhaust manifolds removed (para 3-7).
	Coolant drained (para 6-3).
	Thermostat housings removed (para 6-6).
	Fuel lines removed (para 4-12).
	Rocker covers removed (para 3-4).
TM 2320-34/13 TM 9-2320-297-34	Injector control tube removed (para 4-5).
	Air compressor coolant line removed (para 11-7).

1. CONVERTER HOUSING
2. SEAL RING (2)
3. NEEDLE BEARING
4. NEEDLE BEARING RACE
6. CAPSCREW (6)
7. OIL PUMP
16. CAPSCREW (16)
33. CAPSCREW (3)
34. FRONT SUPPORT
45. GUIDE SCREW (2)



TA 298850

a. Removal

NOTE

Capscrews (1) have captive lockwashers.

(1) Remove five capscrews (1) from governor cover (2). Discard capscrews (1).

(2) Remove governor cover (2) and gasket (3). Discard gasket (3).

CAUTION

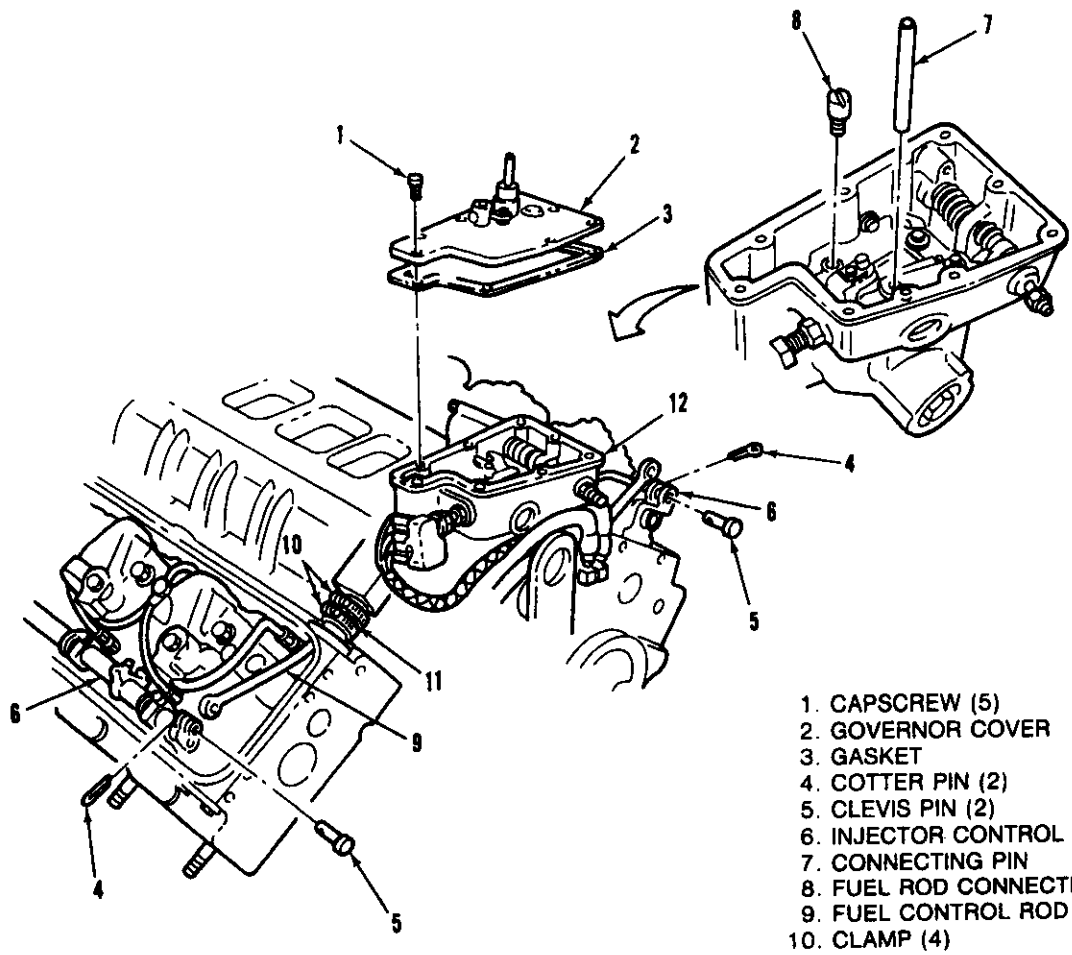
Oil drain holes in cylinder head must be covered to prevent cotter pins (4) and clevis pins (5) from falling into cylinder head.

(3) Remove two cotter pins (4) and clevis pin (5) from injector control tube (6) on each side of the engine. Discard cotter pins (4).

(4) Remove connecting pin (7) and fuel rod connecting pin (8).

(5) Tag and remove two fuel control rods (9) through cylinder head.

(6) Loosen four clamps (10) and slide hoses (11) clear of governor housing (12) on both sides of governor housing (12).



1. CAPSCREW (5)
2. GOVERNOR COVER
3. GASKET
4. COTTER PIN (2)
5. CLEVIS PIN (2)
6. INJECTOR CONTROL TUBE (2)
7. CONNECTING PIN
8. FUEL ROD CONNECTING PIN
9. FUEL CONTROL ROD (2)
10. CLAMP (4)
11. HOSE (2)
12. GOVERNOR HOUSING

TA 298443

7-12. CONVERTER HOUSING, FRONT SUPPORT, AND OIL PUMP REPAIR (Continued)

(16) Install 16 capscrews (16) into front support (34). Torque three capscrews (33) and 16 capscrews (16) evenly to 36-43 foot-pounds (49-58 N·m).

(17) Coat oil pump cavity in converter housing (1) with lubricating oil.

(18) Install two guide screws (45) into oil pump (7).

(19) Install oil pump (7) into converter housing (1). Install six capscrews (6) in remaining holes. Torque capscrews to 36-43 foot-pounds (49-58 N·m). Remove two guide screws (45).

(20) Coat needle bearing race (4) with lubricating oil and install on front support (34).

(21) Coat needle bearing (3) with lubricating oil and install on needle bearing race (4).

CAUTION

Prevent seal rings from being damaged by keeping them in sealed package until ready for use.

(22) Coat new seal rings (2) with lubricating oil.

(23) Roll seal rings (2) to 1/2 their length and hold for at least 10 seconds as shown.

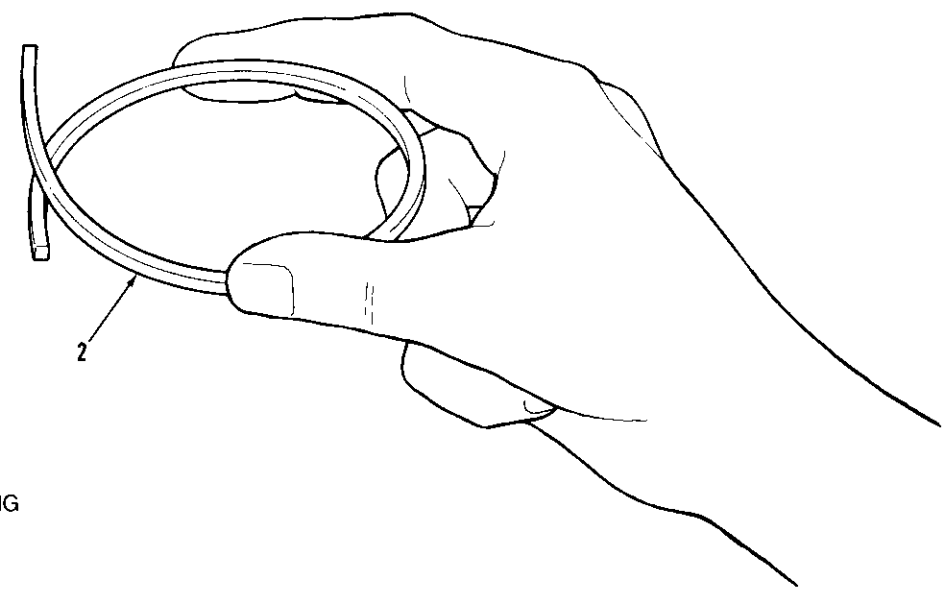
(24) Install seal rings (2) on front support (34).

END OF TASK

NOTE

Follow-On Maintenance

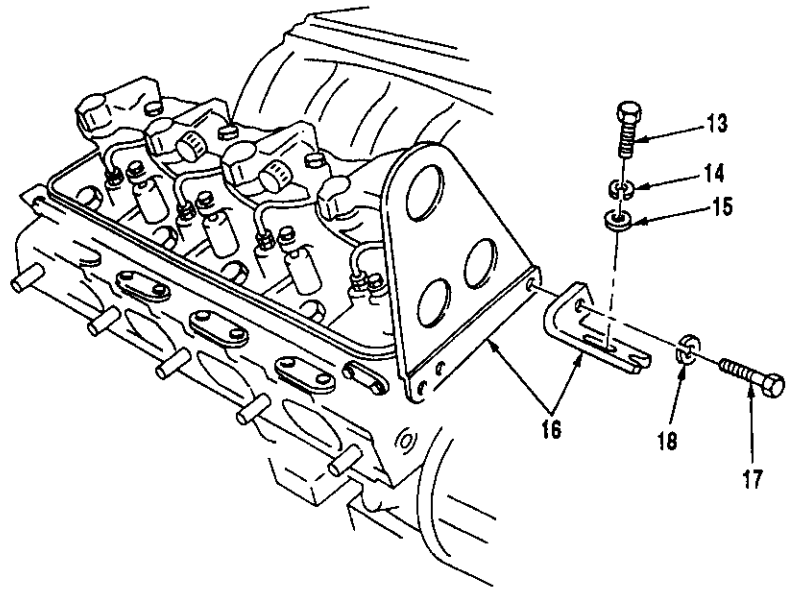
TM 2320-34/13 TM 9-2320-297-34	Install torque converter housing (para 7-6).



2. SEAL RING

TA 298849

3-3. CYLINDER HEAD REPLACEMENT (Continued)



13. CAPSCREW
14. LOCKWASHER
15. WASHER
16. BRACKET (2)
17. CAPSCREW
18. LOCKWASHER

(7) Remove capscrew (13), lockwasher (14), and washer (15) from brackets (16). Discard lockwasher (14).

(8) Remove capscrew (17), lockwasher (18), and brackets (16). Discard lockwasher (18) and capscrew (17).

(9) Remove two capscrews (19) and lockwashers (20) from breather pipe (21). Push and rotate breather pipe (21) away from cylinder head (29). Discard lockwashers (20).

(10) Cut Jacobs brake wire (22) about six inches away from cylinder head (29).

NOTE

- Fuel pipes for LVSA1 series vehicles have changed from flare style to O-ring style pipes and connectors. When repairing non-A1 vehicles, use new style pipes and connectors to replace old style pipes and connectors. Refer to TM 9-2320-297-24P for correct parts identification.
- Flare and O-ring style pipes and connectors are not interchangeable. When replacing one flare type pipe or connector, all pipes and connectors must be replaced with new O-ring style pipes and connectors.
- Tag locations of short (inlet) and long (return) fuel pipes to ensure proper installation.

(11) Remove four short (inlet) fuel pipes (23) and four long (return) fuel pipes (23.1) using a fuel pipe socket.

(12) Attach lifting fixture (24) with three nuts (25) and washers (26). Tighten nuts (25) securely. Connect lifting device.

(13) Remove 10 capscrews (27) and washers (28) from cylinder head (29).

WARNING

Stay clear of load during lifting and installation operation.

CAUTION

Do not allow excessive sealer to enter transmission. Transmission damage may result.

(10) Coat oil seal bore pump body (15) with non-hardening sealer. Install new oil seal (14) in oil pump body (15) with lip toward cover (10). Press oil seal (14) lightly until seal bottoms out in oil pump body (15).

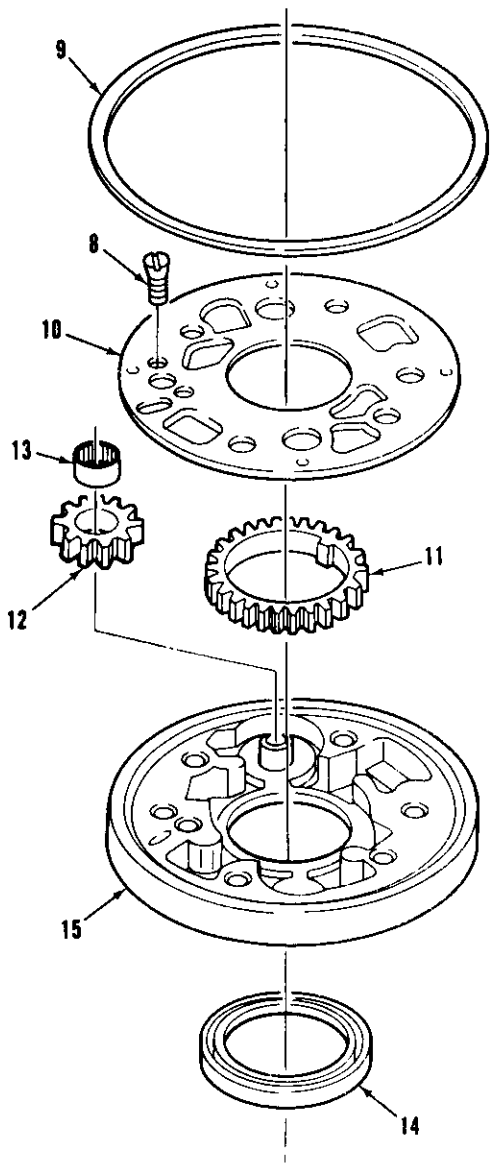
(11) If removed, install new bearing (13) in driven gear (12). Press on numbered side of bearing (13) only.

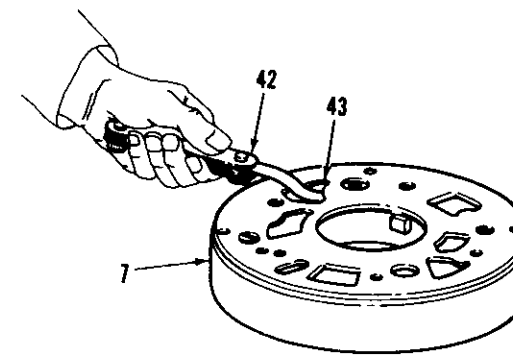
(12) Install driven gear (12) and drive gear (11) in oil pump body (15).

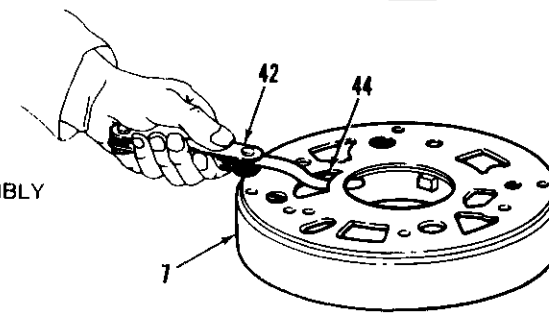
(13) Install pump cover (10) and screw (8) on oil pump body (15). Torque screw (8) to 9-11 foot-pounds (12-15 N·m).

(14) Check clearance with feeler gage (42) through driven gear opening (43). Check clearance with feeler gage (42) through drive gear opening (44). If either clearance exceeds 0.006 inch (0.152 mm), replace oil pump assembly (7).

(15) Coat new sealring (9) with oil and install on oil pump body (15).







7. OIL PUMP ASSEMBLY
8. SCREW
9. SEALRING
10. COVER
11. DRIVE GEAR
12. DRIVEN GEAR
13. BEARING
14. OIL SEAL
15. OIL PUMP BODY
42. FEELER GAGE (TOOL)
43. DRIVEN GEAR OPENING
44. DRIVE GEAR OPENING

TA 298848

CAUTION

Do not set cylinder head on cam followers.

(14) Lift and remove cylinder head (29).

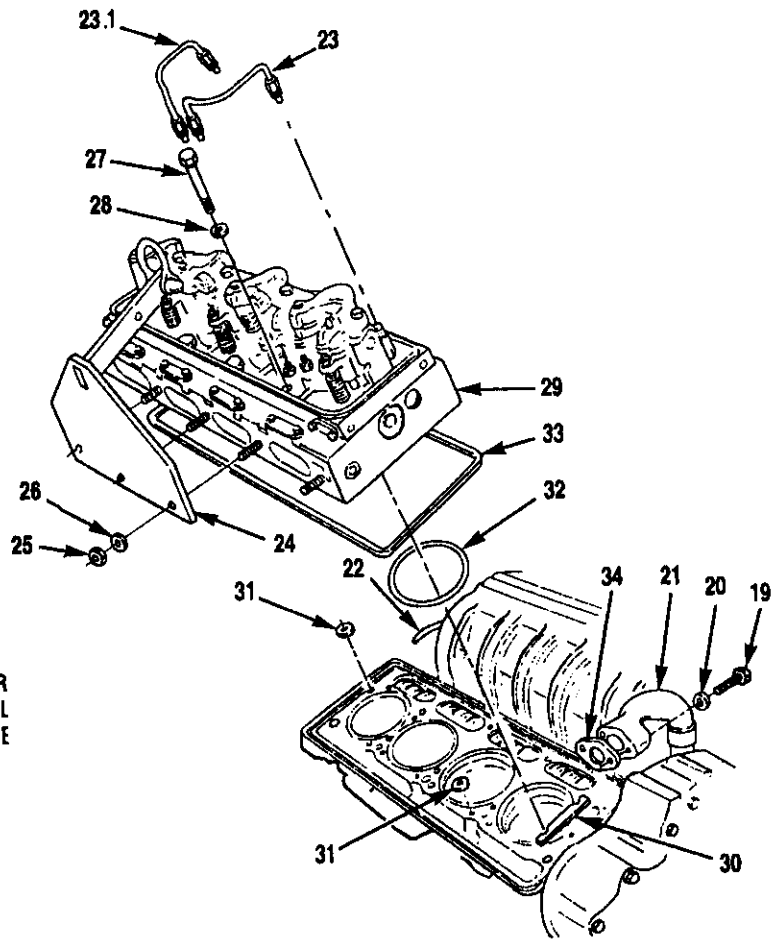
(15) Set cylinder head (29) on wooden blocks.

(16) Remove three nuts (25), washers (26), and lifting fixture (24).

(17) Remove two shims (30). Discard shims (30).

(18) Remove and discard 17 seal rings (31), four compression gaskets (32), seal ring (33), and gasket (34).

(19) Repeat steps (7) thru (18) for other cylinder head (29).



19. CAPSCREW (2)
20. LOCKWASHER (2)
21. BREATHER PIPE
22. JACOBS BRAKE WIR
23. SHORT (INLET) FUEL
23.1 LONG (RETURN) FUE
24. LIFTING FIXTURE
25. NUT (3)
26. WASHER (3)
27. CAPSCREW (10)
28. WASHER (10)
29. CYLINDER HEAD
30. SHIM (2)
31. SEAL RING (17)
32. COMPRESSION GASKET (4)
33. SEAL RING
34. GASKET

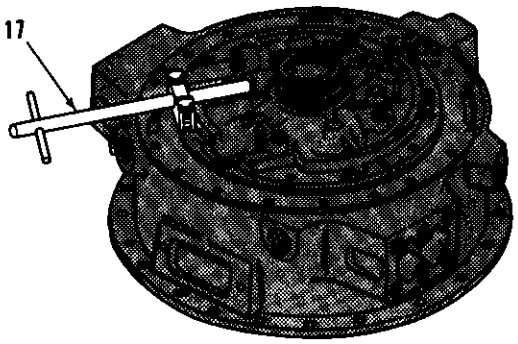
7-12. CONVERTER HOUSING, FRONT SUPPORT, AND OIL PUMP REPAIR (Continued)

(6) Install lockup shift valve (27) into bore in front support (34). Make sure lockup shift valve (27) slides freely in bore. Install valve spring (23), valve stop (26), and washer (25).

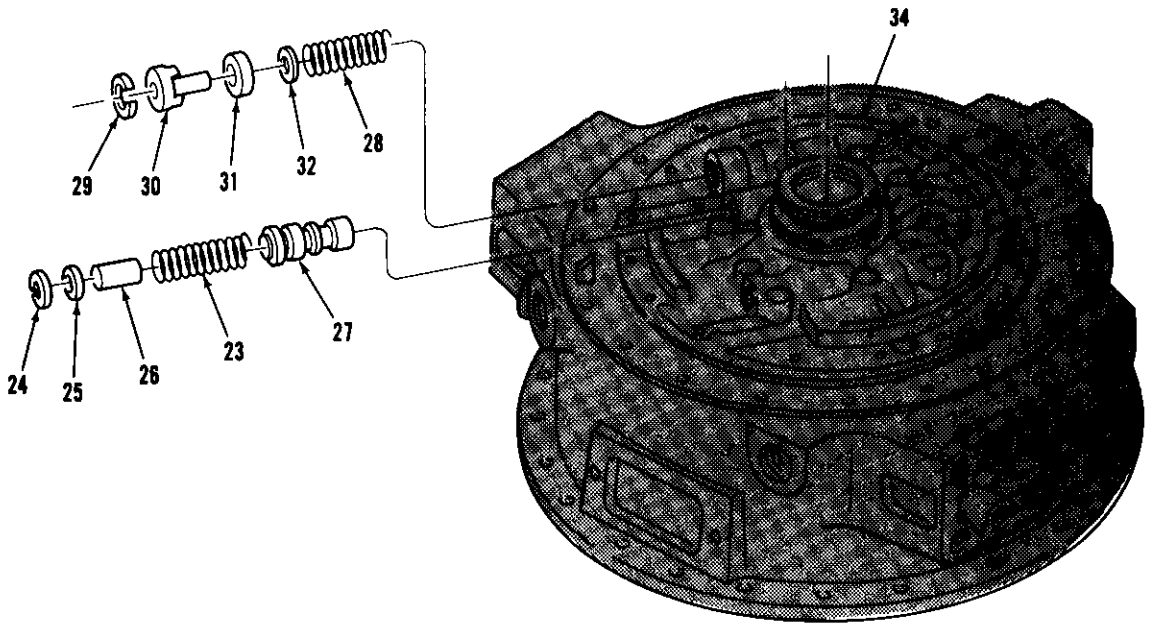
(7) Using spring compressor (17), compress valve spring (23) and install snapring (24). Release spring tension and remove spring compressor (17).

(8) Install valve spring (28), converter bypass valve (32), valve seat (31), and valve support assembly (30) into bore in front support (34). Make sure converter bypass valve (32) slides freely in bore.

(9) Compress valve spring (28) with a screwdriver and install snapring (29).



17. SPRING COMPRESSOR (TOOL)
23. VALVE SPRING
24. SNAPRING
25. WASHER
26. VALVE STOP
27. LOCKUP SHIFT VALVE
28. VALVE SPRING
29. SNAPRING
30. VALVE SUPPORT ASSEMBLY
31. VALVE SEAT
32. CONVERTER BYPASS VALVE
34. FRONT SUPPORT



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3-3. CYLINDER HEAD REPLACEMENT (Continued)

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

CAUTION

- Never install used cylinder head gaskets. Used gaskets can cause coolant leaks and poor engine performance.
- Make sure lip of compression gaskets (32) faces engine block.

(1) Install four new compression gaskets (32).

(2) Install 17 new seal rings (31).

(3) Install new seal ring (33) in groove so painted edges face away from cylinder bores.

NOTE

At rear of block, groove in shim must aline with oil supply hole.

(4) Remove adhesive paper from two new shims (30). Install two new shims (3), one at each end of block, with adhesive side down and grooves towards cylinder bores.

(5) Install two guide studs (35) in two opposite corner capscrew holes as shown.

(6) Attach lifting fixture (24) on cylinder head (29) with three nuts (25) and washers (26). Tighten nuts (25) securely.

WARNING

Stay clear of load during lifting and installation operation.

NOTE

Visually inspect all seal rings (31 and 33) and gaskets (34) to insure they are in place before lowering cylinder head (29).

(7) Lift cylinder head (29) and position over guide studs (35).

NOTE

- Breather pipe (21) may have to be held out of the way when lowering cylinder head (29).
- Make sure cylinder head (29) is clean and free of debris.

(8) Slowly lower cylinder head (29) on engine block (38).

(9) Apply International Compound No. 2 (or equivalent) to threads and underside of heads of capscrews (27).

(10) Install eight capscrews (27) and washers (28) through cylinder head (29) into engine block (38). Finger-tighten capscrews (27).

(11) Remove two guide studs (35) and lifting fixture (24).

(12) Install two capscrews (27) and washers (28) in guide studs holes.

(13) Tighten capscrews (27) in the sequence shown (37) until cylinder head (29) is seated on the compression seals and is parallel to the block face.

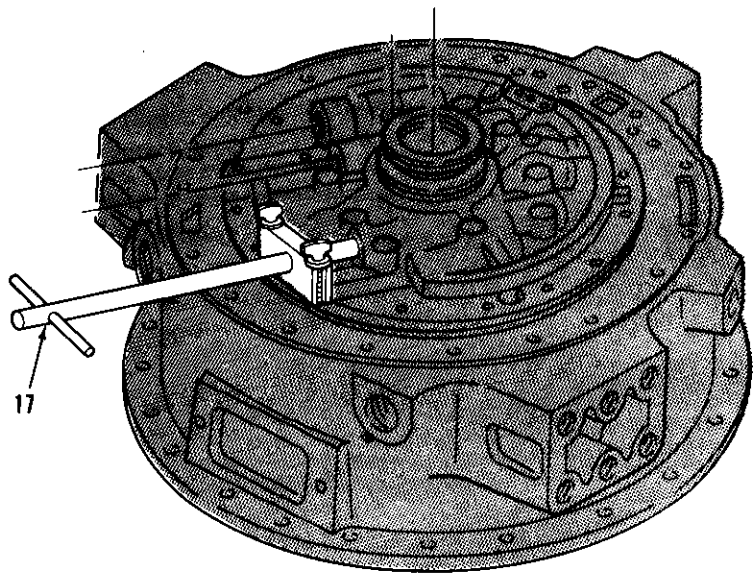
NOTE

It may be necessary to guide the main pressure regulator valve in from the back side of front support (34).

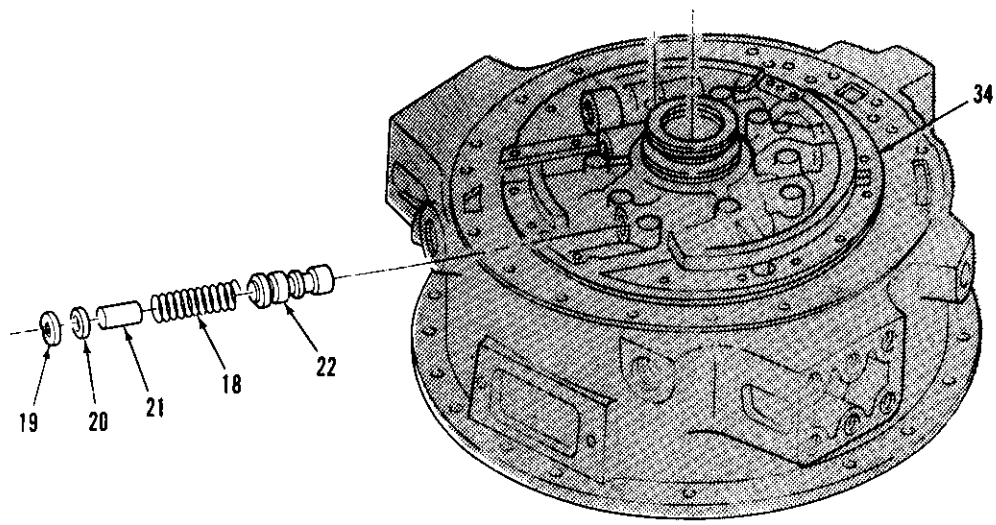
(3) Install main pressure regulator valve (22), small end first, in bore in front support (34). Make sure main pressure regulator valve (22) slides freely in bore. Install valve spring (18), valve stop (21), and washer (20).

(4) Install three longer capscrews (33) in front support (34) as shown.

(5) Using spring compressor (17), compress valve spring (18) and install snapring (19). Release spring tension and remove spring compressor (17).



17. SPRING COMPRESSOR (TOOL)
18. VALVE SPRING
19. SNAPRING
20. WASHER
21. VALVE STOP
22. MAIN PRESSURE REGULATOR VALVE
34. FRONT SUPPORT



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(14) Tighten all capscrews (27) to 150 foot-pounds (204 N·m) in the sequence shown (37). Hold the wrench at this torque for 2 to 3 seconds to allow bolts to turn while the compression seals yield to their crushed thickness.

CAUTION

In performing step (15), do not loosen more than one bolt at a time.

NOTE

For ease in carrying out the procedure below, it may be convenient to premark a socket with three marks 120 degrees apart (see inset A of the figure). At the start of each turn, mark the head with a grease pencil at one mark on the socket and turn to the next mark.

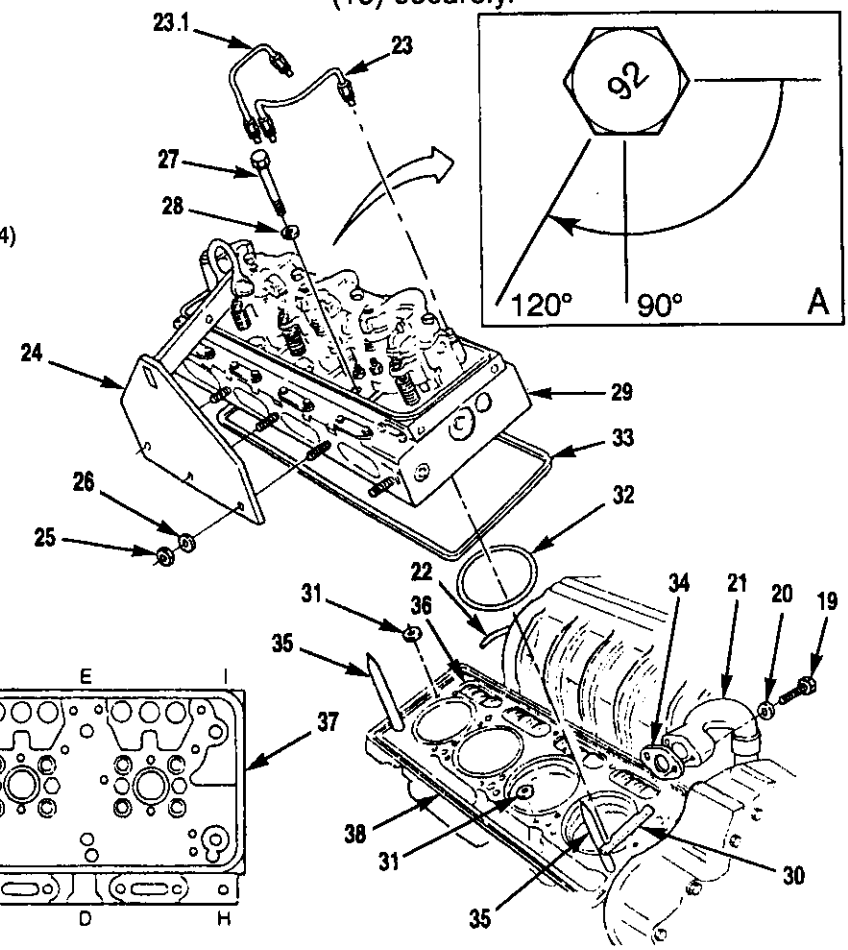
(15) After completing step (14) perform the following in the same sequence, beginning with capscrew A and continuing one capscrew at a time. Back off capscrew (27) until loose (at least one-half turn). Retighten to 100 foot-pounds (136 N·m), plus a turn of an additional 120 degrees. Then proceed with capscrew b, etc.

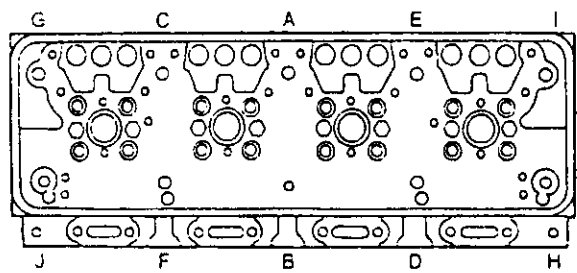
NOTE

Tightening a capscrew will not correct a leaking compression seal. The cylinder head must be removed and the damaged seal replaced.

(16) Install new gasket (34), two capscrews (19), and new lockwashers (20) on breather pipe (21). Tighten capscrews (19) securely.

19. CAPSCREW (2)
20. LOCKWASHER (2)
21. BREATHER PIPE
22. JACOBS BRAKE WIRE
23. SHORT (INLET) FUEL PIPE (4)
23.1 LONG (RETURN) FUEL PIPE (4)
24. LIFTING FIXTURE
25. NUT (3)
26. WASHER (3)
27. CAPSCREW (10)
28. WASHER (10)
29. CYLINDER HEAD
30. SHIM (2)
31. SEALRING (17)
32. COMPRESSION GASKET (4)
33. SEALRING
34. GASKET
35. GUIDE STUD (2)
36. CAMSHAFT
37. TORQUE SEQUENCE
38. ENGINE BLOCK





7-12. CONVERTER HOUSING, FRONT SUPPORT, AND OIL PUMP REPAIR (Continued)

NOTE

Torque converter ground sleeve vent holes have been eliminated in the new ground sleeve. The old ground sleeve, with holes, can be used until exhausted from the supply system.

(3) If the ground sleeve (39) is damaged or loose, replace the front support (34) and ground sleeve (39) as an assembly.

(4) Inspect three fittings (40). Replace if worn, damaged.

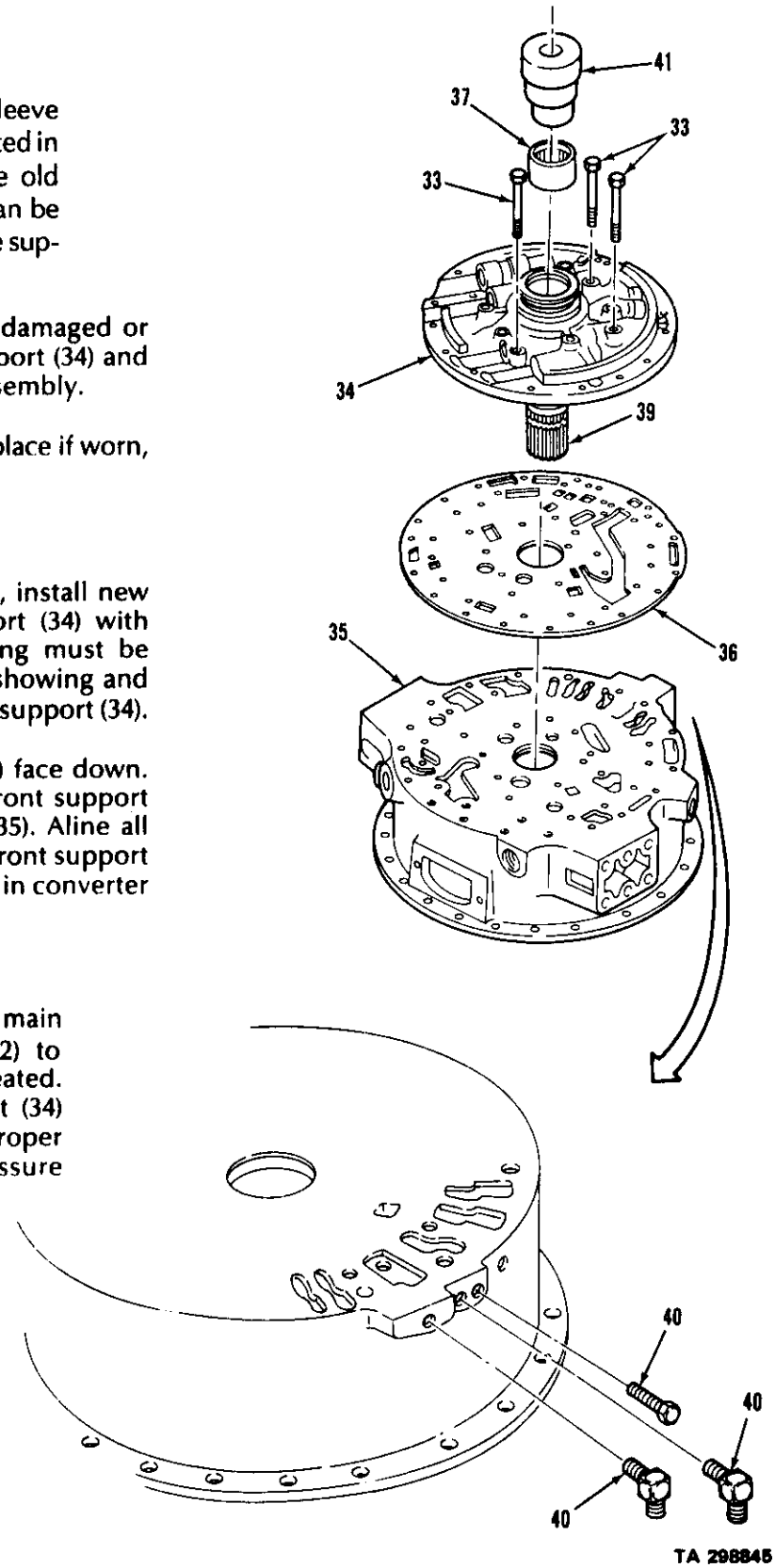
d. Assembly

(1) If bearing (37) was removed, install new bearing (37) in front support (34) with bearing installer (41). Bearing must be installed with part number showing and must be seated fully in front support (34).

(2) Place converter housing (35) face down. Place new gasket (36) and front support (34) on converter housing (35). Aline all openings in gasket (36) and front support (34) with matching openings in converter housing (35).

CAUTION

Be careful when installing main pressure regulator valve (22) to make certain it is properly seated. Ledges inside front support (34) valve bore may hinder proper seating of the main pressure regulator valve (22).



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33. CAPSCREW (3)
34. FRONT SUPPORT
35. CONVERTER HOUSING
36. GASKET
37. BEARING
39. GROUND SLEEVE
40. FITTING (3)
41. BEARING INSTALLER (TOOL)

3-3. CYLINDER HEAD REPLACEMENT (Continued)

CAUTION

Do not over torque fuel pipes (23).

NOTE

- Fuel pipes for LVSA1 series vehicles have changed from flare style to O-ring style pipes and connectors. When repairing non-A1 vehicles, use new style pipes and connectors to replace old style pipes and connectors. Refer to TM 9-2320-297-24P for parts identification.
- Flare and O-ring style pipes and connectors are not interchangeable. When replacing one flare type pipe or connector, all pipes and connectors must be replaced with new O-ring style pipes and connectors.

(17) Install short (inlet) (23) and long (return) (23.1) fuel pipes. Using fuel pipe socket, torque fuel pipes (23 and 23.1) to 160 lb-in (18 N·m).

(18) Install wire clamp (39).

(19) Connect Jacobs brake wire (22) from wire clamp (39) with Jacobs brake wire (22) on cylinder head (29).

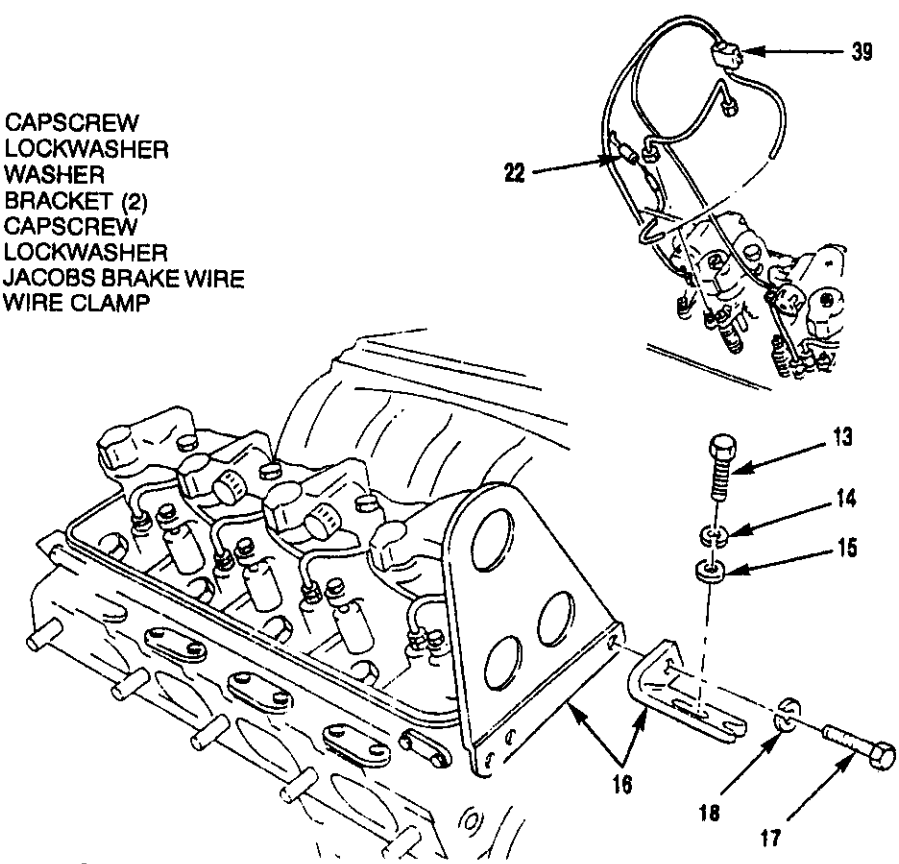
(20) Install two capscrews (13), new lockwashers (14), washer (15), and bracket (16).

(21) Install new capscrew (17) and new lockwasher (18). Tighten capscrew (13 and 17) securely.

(22) Repeat steps (1) thru (21) for other cylinder head.

(23) Install hoses (11) and two clamps (10) on both sides of governor housing (12).

13. CAPSCREW
14. LOCKWASHER
15. WASHER
16. BRACKET (2)
17. CAPSCREW
18. LOCKWASHER
22. JACOBS BRAKE WIRE
39. WIRE CLAMP



(22) Remove front support (34) and gasket (36). Discard gasket (36).

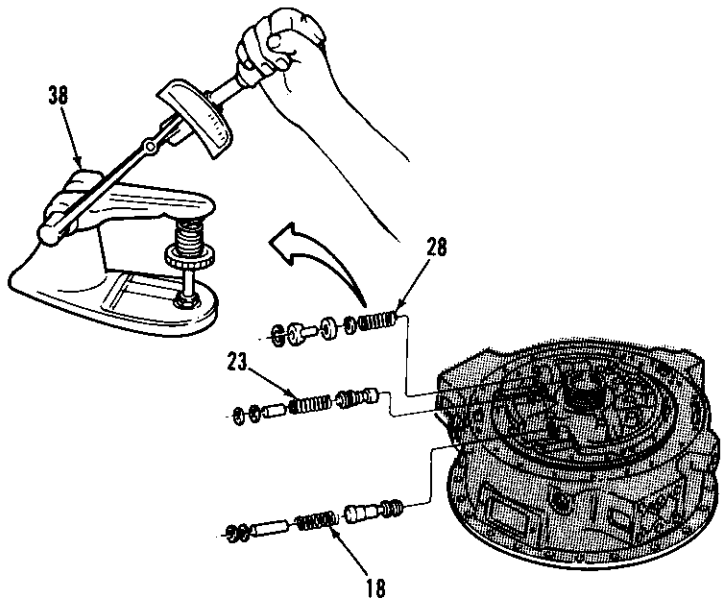
(23) If replacement is required, remove bearing (37) from front support (34).

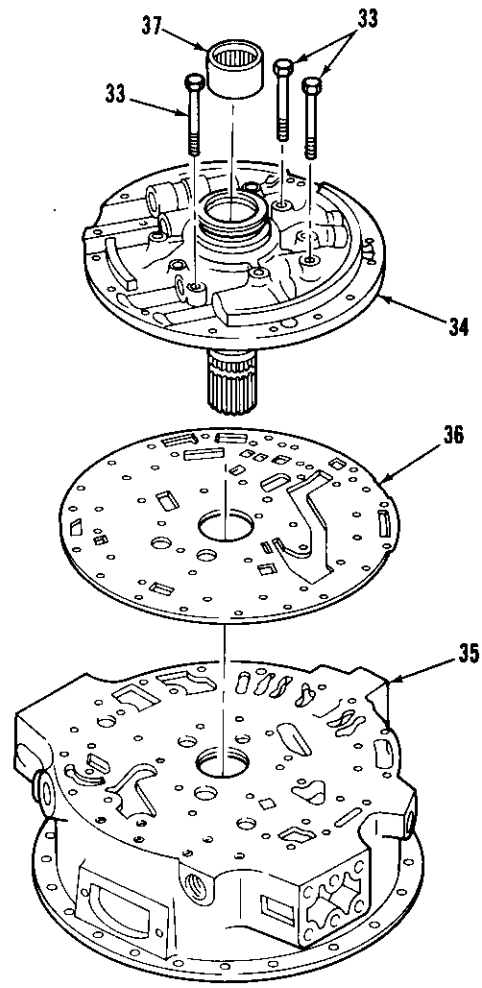
b. Cleaning Clean all parts. Refer to paragraph 2-6.

c. Inspection

(1) Inspect all parts. Refer to paragraph 2-7.

(2) Valve springs (18, 23, and 28) must be tested with spring tester (38) and replaced if they do not meet load-height specifications listed.





18. VALVE SPRING
23. VALVE SPRING
28. VALVE SPRING
33. CAPSCREW (3)
34. FRONT SUPPORT
35. CONVERTER HOUSING
36. GASKET
37. BEARING
38. SPRING TESTER (TOOL)

TA 298844

SPRING	LENGTH WITHOUT LOAD	LENGTH WITH LOAD	LOAD
Converter Bypass Valve Spring (28)	2.65 Inches	1.62 Inches	21-23 Pounds
Lockup Shift Valve Spring (23)	3.22 Inches	1.80 Inches	22-24 Pounds
Main Pressure Regulator Valve Spring (18)	3.94 Inches	2.64 Inches	82-87 Pounds

(24) Install two fuel control rods (9) through cylinder heads.

(25) Install connecting pin (7) and fuel rod connecting pin (8).

(26) Install two clevis pins (5) into levers of injector control tubes (6).

(27) Install two new cotter pins (4).

NOTE

When installing governor cover assembly, speed control shaft pin fits into differential lever fork.

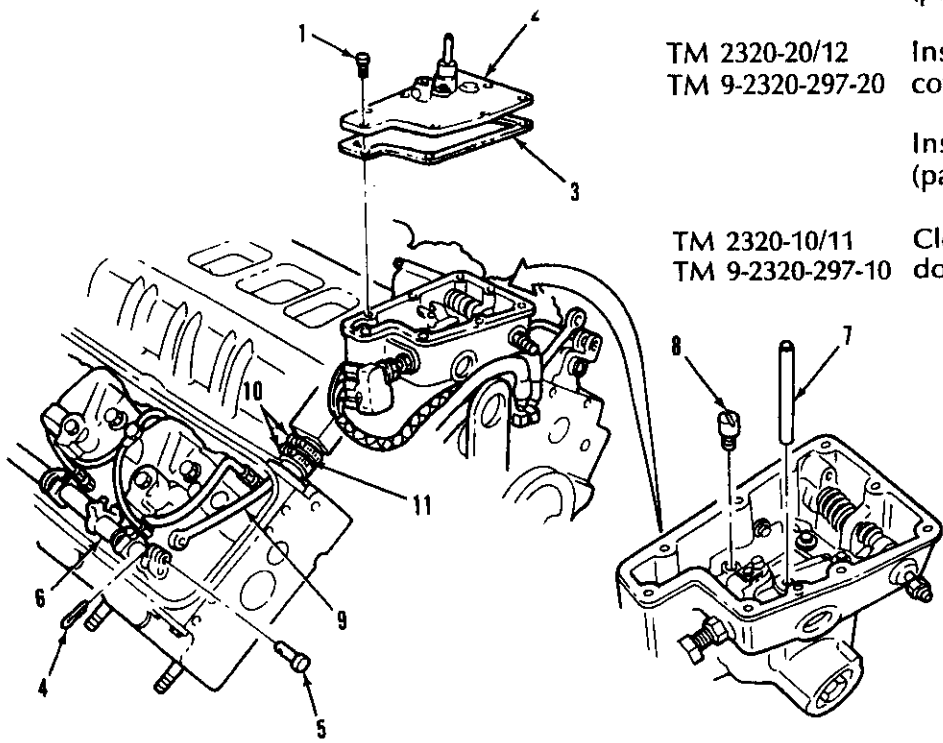
(28) Install governor cover (2), new gasket (3), and five new capscrews (1). Tighten capscrews (1) securely.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install fuel lines (para 4-12).
	Install thermostat housings (para 6-6).
	Install throttle cylinder (para 4-15).
	Install shutdown solenoid (para 4-13).
	Install exhaust manifolds (para 3-7).
	Fill radiator with coolant (para 6-3).
TM 2320-34/13 TM 9-2320-297-34	Install air compressor coolant line (para 11-7).
	Install injector control tube (para 4-5).
	Perform engine tune-up (para 3-29).
TM 2320-20/12 TM 9-2320-297-20	Install rocker covers (para 3-4).
	Install engine access panels (para 18-14).
TM 2320-10/11 TM 9-2320-297-10	Close engine access door (para 2-1).



1. CAPSCREW (5)
2. GOVERNOR COVER
3. GASKET
4. COTTER PIN (2)
5. CLEVIS PIN (2)
6. INJECTOR CONTROL TUBE (2)
7. CONNECTING PIN
8. FUEL ROD CONNECTING PIN
9. FUEL CONTROL ROD (2)
10. CLAMP (4)
11. HOSE (2)
12. GOVERNOR HOUSING

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7-12. CONVERTER HOUSING, FRONT SUPPORT, AND OIL PUMP REPAIR (Continued)

(15) Install spring compressor (17) as shown.

(16) Turn spring compressor (17) to compress valve spring (23).

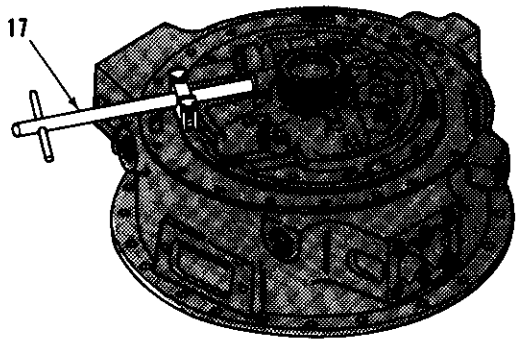
(17) Remove snapring (24). Slowly release spring pressure. Remove spring compressor (17).

(18) Remove washer (25), valve stop (26), valve spring (23), and lockup shift valve (27). Tag all parts.

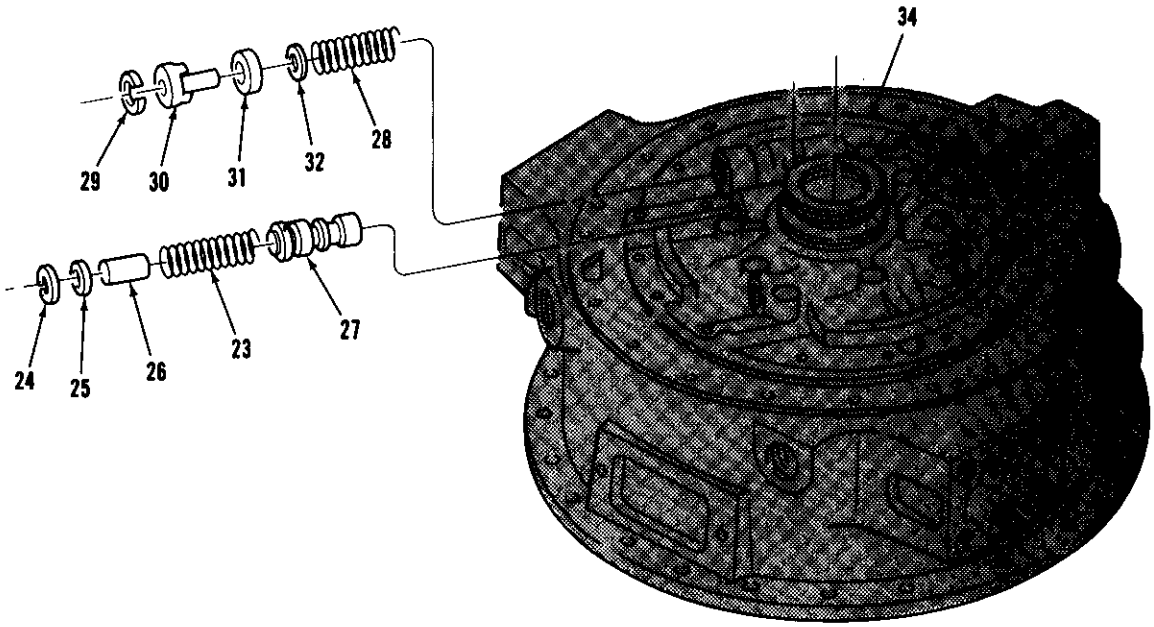
(19) Using a screwdriver, compress valve spring (28) and remove snapring (29). Slowly release spring pressure.

(20) Remove valve support assembly (30), valve seat (31), converter bypass valve (32), and valve spring (28). Tag all parts.

(21) Matchmark front support (34) and converter housing (35). Remove three capscrews (33) from front support (34).



17. SPRING COMPRESSOR (TOOL)
23. VALVE SPRING
24. SNAPRING
25. WASHER
26. VALVE STOP
27. LOCKUP SHIFT VALVE
28. VALVE SPRING
29. SNAPRING
30. VALVE SUPPORT ASSEMBLY
31. VALVE SEAT
32. CONVERTER BYPASS VALVE
34. FRONT SUPPORT



TA 298843

3-4. CYLINDER HEAD MAINTENANCE

THIS TASK COVERS:
a. Disassembly
b. Cleaning
c. Pressure Testing
d. Inspection
e. Assembly

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Valve seat insert remover set (J 23479-D)
Bridge guide installer (J 7482)
Injector tube tool set (J 22525-A)
Gage block (J 29091)
Valve spring compressor (J 7455)
Cylinder head test fixture (J 28454)
Valve guide remover (J 6569)
Spring tester (J 9666)
Bridge remover set (J 7091-01)
Valve seat insert installer (J 24357)
Water nozzle installer (J 24857-A)
Dial indicator (J 8165-2)
Valve guide installer (J 21520)

Materials/Parts
International compound No.2 (item 16, Appendix C)
Crocus cloth (item 20, Appendix C)
Fuel oil (item 38, Appendix C)
Prussian blue dye (item 55, Appendix C)
Pipe sealant (item 60, Appendix C)
Non-hardening sealant (item 62, Appendix C)
Gaskets (3) (NSN 5330-00-892-1764) item 4
Lockwasher (2) MS35338-47) item 6
Gasket (NSN 5330-00-725-2301) item 8
Lockwasher (6) (P/N 5152148) item 2
Gasket (4) (NSN 5330-00-364-3550) item 18
Washer (8) (17053) item 10

Equipment Condition
TM
TM 2320-34/13
TM 9-2320-297-34

Condition Description
Cylinder heads removed from engine (para 3-3).

Engine brake removed (para 3-15).

Valve operating mechanism removed (para 3-9).

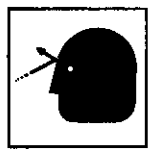
Injectors removed (para 4-3).

a. Disassembly

(1) Remove six capscrews (1), lockwashers (2), three plates (3), and three gaskets (4) from each cylinder head. Discard lockwashers (2) and gaskets (4).

(2) Remove two capscrews (5), lockwashers (6), lifting bracket (7), and gasket (8) from rear of each cylinder head. Discard lockwashers (6) and gasket (8).

WARNING

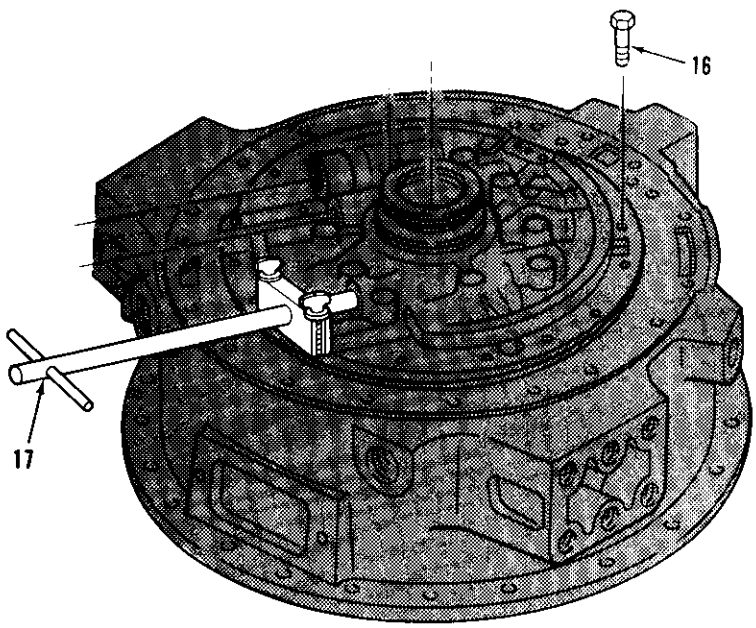


Parts are under spring tension. Release tension slowly to avoid personal injury.

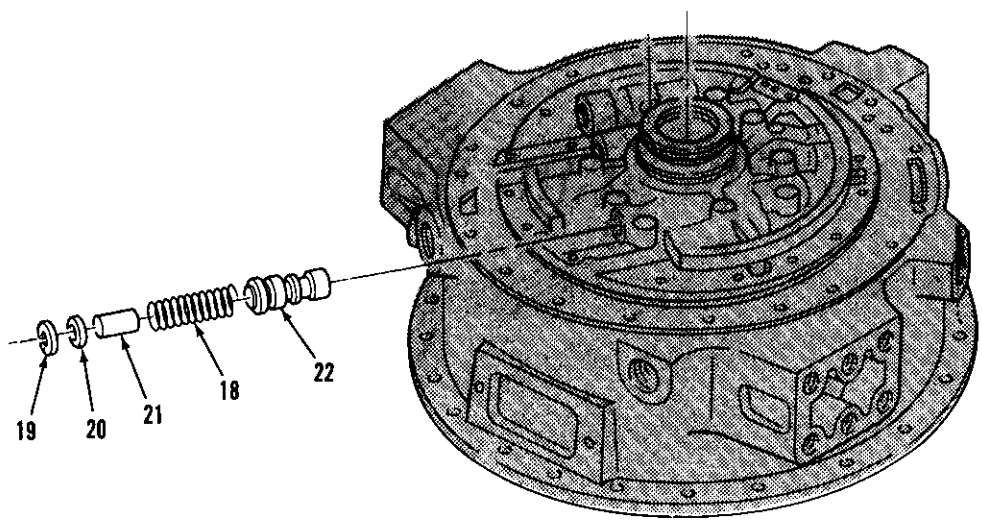
(12) Install spring compressor (17) as shown. Turn spring compressor (17) to compress valve spring (18).

(13) Remove snapring (19). Slowly release spring pressure. Remove spring compressor (17).

(14) Remove washer (20), valve stop (21), valve spring (18), and main pressure regulator valve (22). Tag all parts.



16. CAPSCREW (16)
17. SPRING COMPRESSOR (TOOL)
18. VALVE SPRING
19. SNAPRING
20. WASHER
21. VALVE STOP
22. MAIN PRESSURE REGULATOR VALVE



TA 298842

NOTE

- Fuel pipes for LVSA1 series vehicles have changed from flare style to O-ring style pipes and connectors. When repairing non-A1 vehicles, use new style pipes and connectors to replace old style pipes and connectors. Refer to TM 9-2320-297-24P for correct parts identification.
- Flare and O-ring style pipes and connectors are not interchangeable. When replacing one flare type pipe or connector, all pipes and connectors must be replaced with new O-ring style pipes and connectors.

(3) Remove eight fuel pipe connectors (9) and washers (10) from each cylinder head. Discard washers (10).

(4) Remove air compressor adapter (11) from left rear cylinder head.

(5) Remove two elbows (12) from left front cylinder head.

(6) Remove elbow (13) and connector (14) from right front cylinder head.

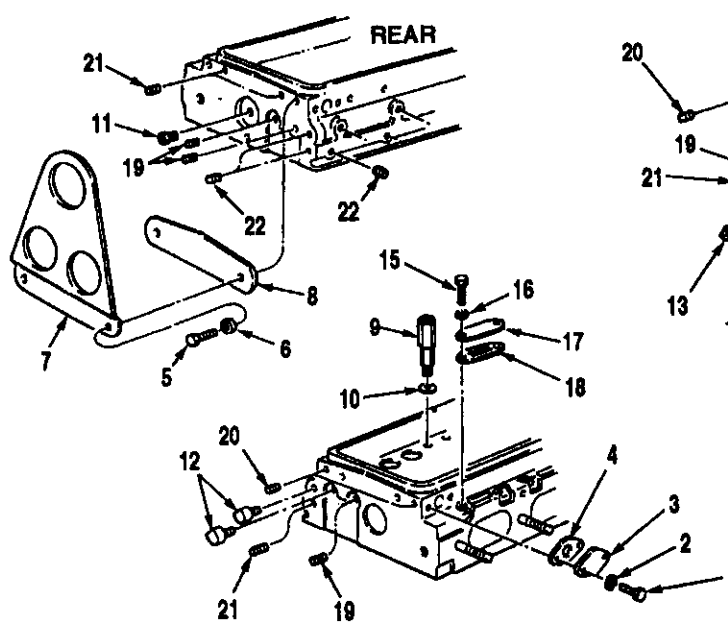
NOTE

Do not remove plugs and plates if cylinder head will be pressure tested.

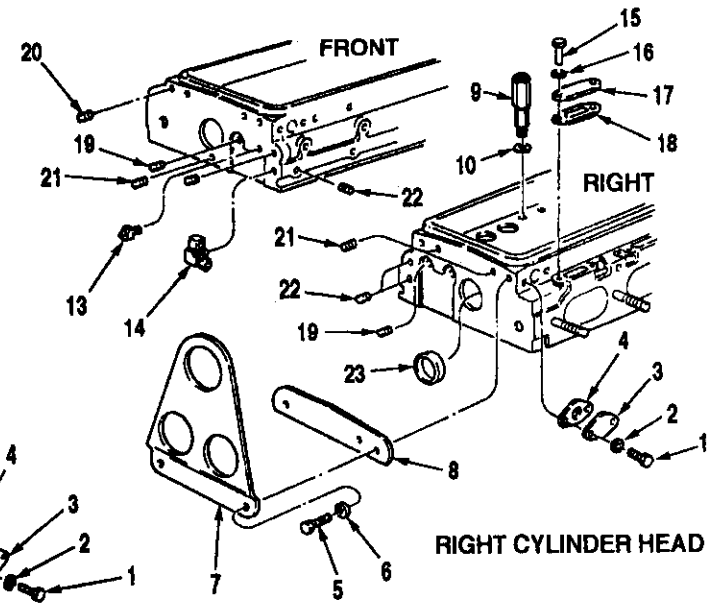
(7) Remove eight capscrews (15), washers (16), four plates (17), and gaskets (18) from each cylinder head. Discard gaskets (18).

(8) Remove and mark location of five plugs (19), three plugs (20), four plugs (21), and 25 plugs (22).

(9) Remove plug (23) from right rear cylinder head.



LEFT CYLINDER HEAD



RIGHT CYLINDER HEAD

1. CAPSCREW (6)
2. LOCKWASHER (6)
3. PLATE (3)
4. GASKET (3)
5. CAPSCREW (2)
6. LOCKWASHER (2)
7. LIFTING BRACKET
8. GASKET
9. FUEL PIPE CONNECTOR (8)
10. WASHER (8)
11. AIR COMPRESSOR ADAPTER
12. ELBOW (2)
13. ELBOW
14. CONNECTOR
16. WASHER (8)
17. PLATE (4)
18. GASKET (8)
19. PLUG (5)
20. PLUG (3)
21. PLUG (4)
22. PLUG (25)
23. PLUG

7-12. CONVERTER HOUSING, FRONT SUPPORT, AND OIL PUMP REPAIR (Continued)

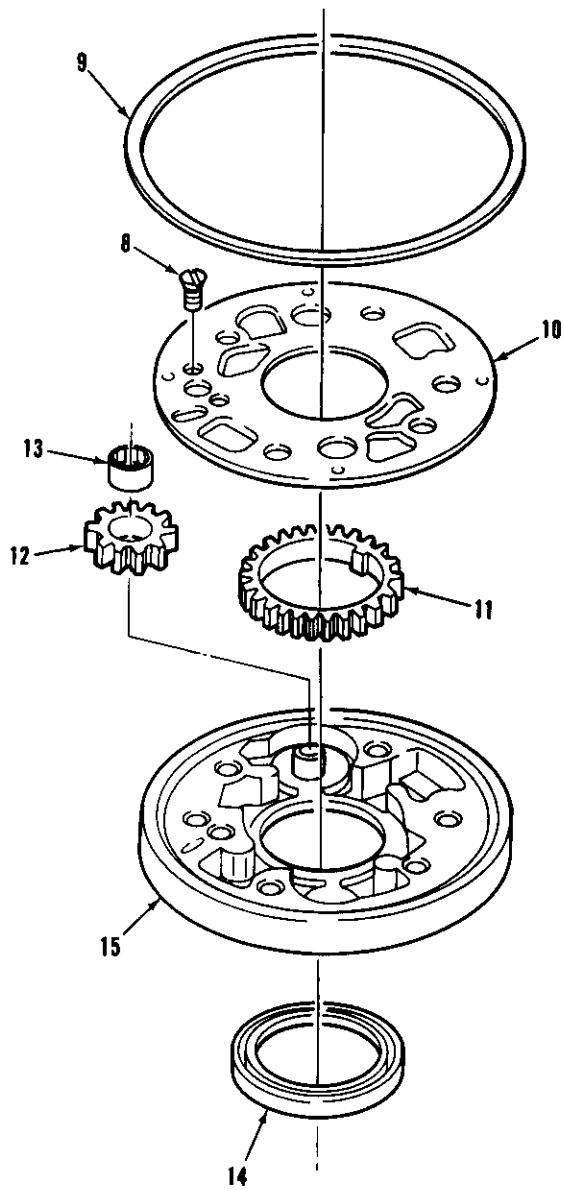
(7) Remove screw (8).

(8) Remove seal ring (9), cover (10), drive gear (11), and driven gear (12). Discard seal ring (9).

(9) Remove bearing (13) from driven gear (12), only if damaged.

(10) Remove oil seal (14) from oil pump body (15). Discard oil seal (14).

(11) Remove 16 capscrews (16).



8. SCREW
9. SEAL RING
10. COVER
11. DRIVE GEAR
12. DRIVEN GEAR
13. BEARING
14. OIL SEAL
15. OIL PUMP BODY

TA 298841

3-4. CYLINDER HEAD MAINTENANCE (Continued)

(10) Turn cylinder head so valve springs (24) are up. Place cylinder head (39) on a wooden block. Wooden block must cover all exhaust valves.

(11) Install valve spring compressor (tool) (25) in one of rocker arm bracket bolt holes.

(12) Compress spring (24) and remove two-piece valve lock (26).

(13) Slowly release pressure on spring (24). Remove spring cap (27), spring (24), and spring seat (28).

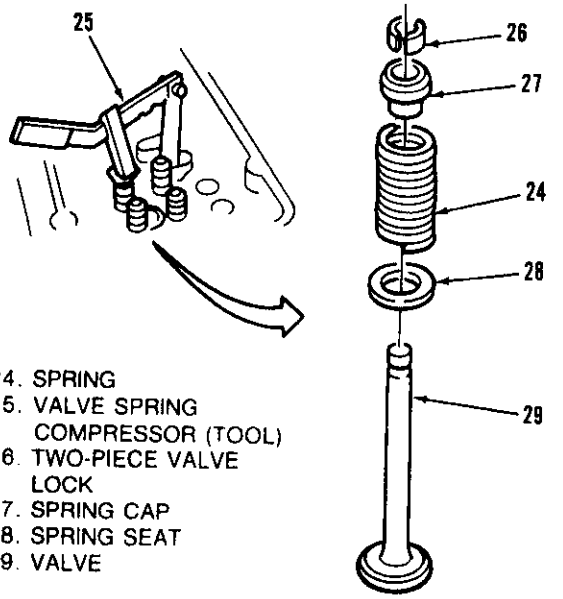
(14) Repeats steps (11) thru (13) for each spring (24).

(15) Tape valve stem prior to rotating cylinder head (39) to prevent valves from falling out of cylinder head (39). Slowly rotate cylinder head (39) on its side.

CAUTION

Exhaust valves must be tagged so they can be installed in their original position. Failure to do so could result in poor seating and loss of engine performance.

(16) Remove and tag all valves (29).



24. SPRING
25. VALVE SPRING COMPRESSOR (TOOL)
26. TWO-PIECE VALVE LOCK
27. SPRING CAP
28. SPRING SEAT
29. VALVE

TA 298450

b. Cleaning

(1) Remove carbon from valves (29).

CAUTION

Cylinder head must be thoroughly dried to prevent rust.

(2) Clean all parts. Refer to paragraph 2-6.

c. Pressure Testing

(1) Perform magnetic particle and fluorescent penetrant inspections before pressure testing. These inspections will locate exterior cracks. Replace cylinder head (39) if any cracks are detected.

(2) Install plug (30) into air compressor line hole (31) on rear of left cylinder head (39).

(3) Install cylinder head test fixture (32) on cylinder head (39).

CAUTION

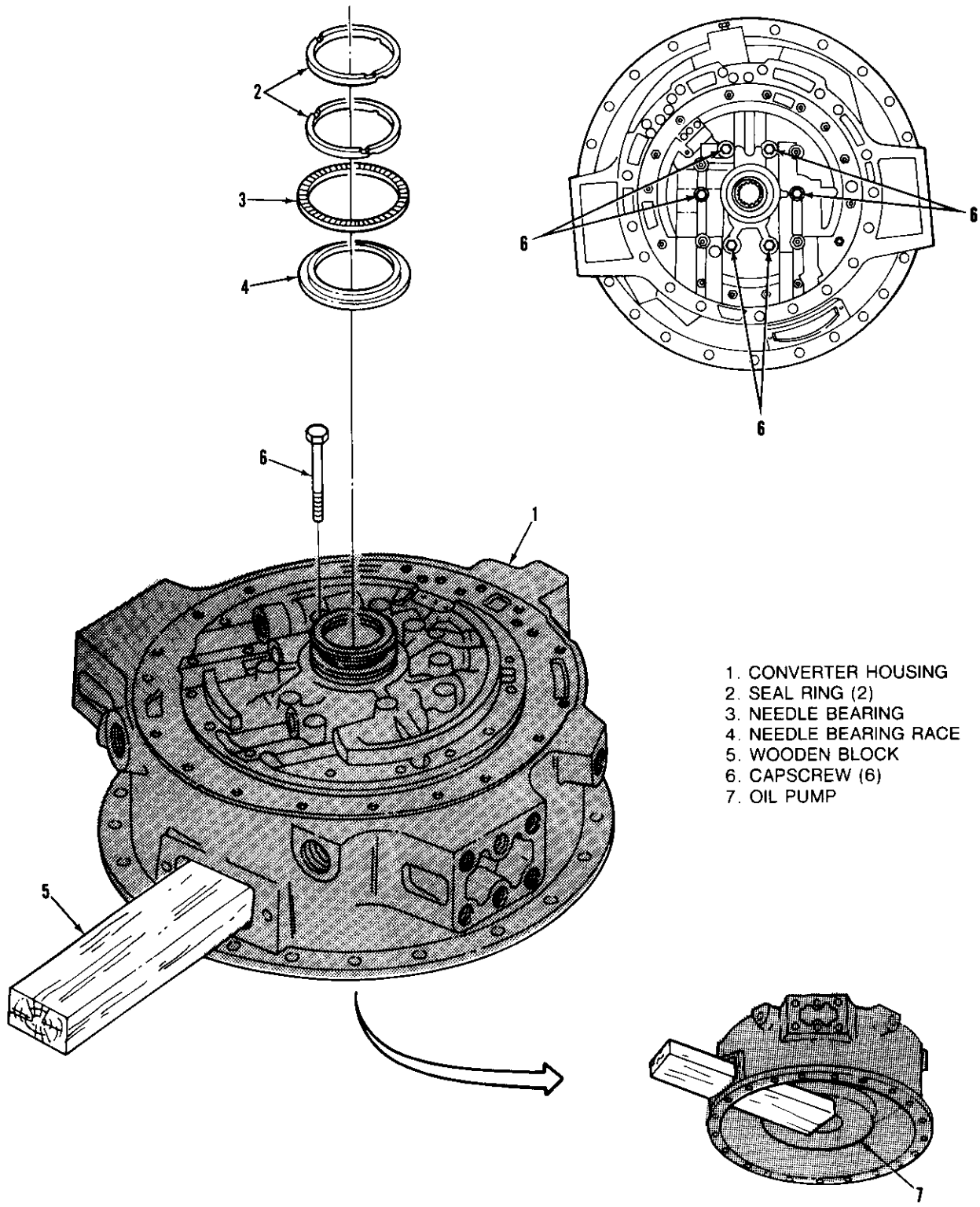
Do not overtighten hold-down capscrews. Rubber stopper could distort enough to seal off outer diameter of water nozzle. A leak would not be detected from outer diameter.

(4) Torque hold-down capscrews (33) to 4-5 foot-pounds (7-8 N·m).

(5) Install plate (34).

NOTE

Dummy injectors (35) may be made from old injector nuts and bodies. Injector spray tips are not necessary.



1. CONVERTER HOUSING
2. SEAL RING (2)
3. NEEDLE BEARING
4. NEEDLE BEARING RACE
5. WOODEN BLOCK
6. CAPSCREW (6)
7. OIL PUMP

TA 298840

(6) Install four dummy injectors (35) with clamp (36), capscrew (37), and washer (38). Torque capscrews (37) to 20-25 foot-pounds (27-34 N·m).

WARNING

When making this pressure test, make sure personnel are protected against pressurized water from a possible rupture or leak in a hose or fitting on cylinder head.

(7) Install air supply to plate (34) and apply 40 psi (276 kPa) of air pressure.

(8) Before immersing cylinder head (39) into water, check for air leaks around eight water nozzles (40) and fire deck (bottom) of cylinder head.

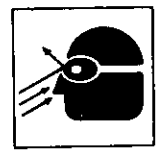
(9) Immerse cylinder head (39) into a tank of water heated to 180-200° F (82-93° C) for about 20 minutes.

(10) Check for leaks at top and bottom of injector tubes, oil galleys, exhaust ports, fuel manifolds, and at top and bottom of cylinder head (39).

(11) Remove cylinder head (39) from water tank and slowly relieve air pressure. Remove air supply.

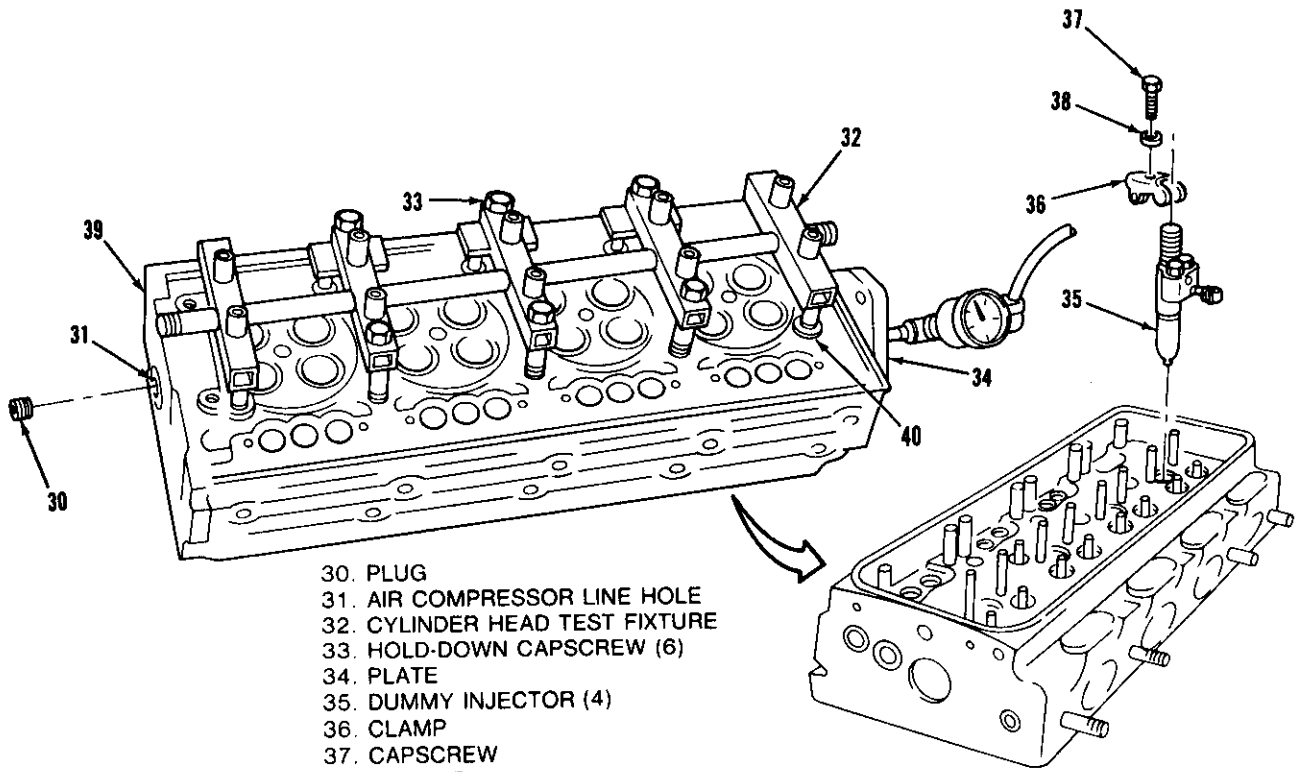
(12) Remove cylinder head test fixture (32), plate (34), dummy injectors (35), and plug (30).

WARNING



Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psi. Eye protection required.

(13) Completely dry cylinder head (39) with compressed air.



30. PLUG
31. AIR COMPRESSOR LINE HOLE
32. CYLINDER HEAD TEST FIXTURE
33. HOLD-DOWN CAPSCREW (6)
34. PLATE
35. DUMMY INJECTOR (4)
36. CLAMP
37. CAPSCREW
38. WASHER
39. CYLINDER HEAD
40. WATER NOZZLE (8)

TA 298451

7-12. CONVERTER HOUSING, FRONT SUPPORT, AND OIL PUMP REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP

Special Tools

Front support hub needle bearing installer (J 24197)
Spring Tester (J 9666)
Guide pin set (J 24315)
Spring compressor set (J 24219)

Materials/Parts

Oil, OE/HDO-10 (item 44, Appendix C)
Sealer non-hardening (item 62, Appendix C)
Sealring (2) (NSN 5330-01-087-6844) item 2
Sealring (NSN 5330-00-999-3754) item 9
Oil seal (NSN 2910-00-625-2975) item 14
Gasket (NSN 5330-01-088-5980) item 36

Personnel Required

1 MOS 3522
1 Assistant

Equipment

Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Torque converter housing removed (para 7-5).

Special Environmental Conditions

Work in a clean area free of blowing dust.

---

a. Disassembly

CAUTION

During disassembly all parts must be handled with care to avoid nicking, scratching or denting. Close fitting parts can bind if damaged or scratched.

(1) Place converter housing (1) face down.

(2) Remove two sealrings (2), needle bearing (3), and needle bearing race (4). Discard sealrings (2).

(3) Place 2 x 4 x 18 inch wooden block (5) through access opening.

(4) Remove four of six capscrews (6).

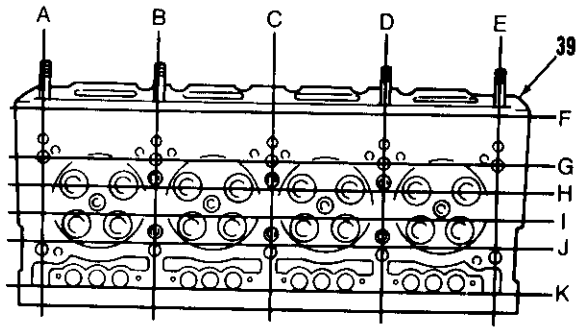
(5) Loosen remaining two capscrews (6). Tap remaining two capscrews with mallet while pressing on wooden block (5), to loosen oil pump (7).

(6) Remove remaining two capscrews (6) and allow oil pump (7) to separate from the converter housing (1). Oil pump (7) should rest on the wooden block (5). Carefully raise converter housing (1) and remove oil pump (7). Remove wooden block (5).

3-4. CYLINDER HEAD MAINTENANCE (Continued)

d. Inspection

(1) Inspect bottom of cylinder head (39) for flatness with an accurate straight edge and feeler gage.



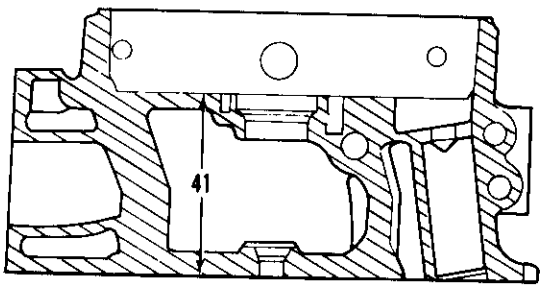
39. CYLINDER HEAD

(a) At points A thru E, maximum warpage is 0.004 inch (0.101 mm).

(b) At points F thru K, maximum warpage is 0.005 inch (0.127 mm).

(c) If excessively warped, cylinder head (39) must be replaced.

(2) Measure distance between top and bottom faces of cylinder head (39). Cylinder head (39) must have a minimum cylinder head height (41) of 3.535 inches (89.789 mm).



41. MINIMUM CYLINDER HEAD HEIGHT

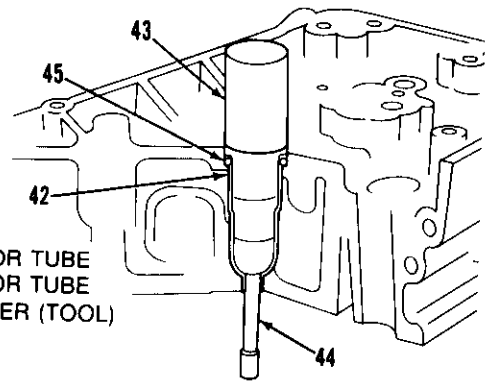
(3) Using injector removal tool, remove injector tube (42) if scored, cracked, or if leaks are detected.

(a) Install injector tube installer (tool) (43) in injector tube (42).

(b) Tap on pilot (44) to loosen injector tube (42).

(c) Once loose, remove injector tube installer (tool) (43), injector tube (42), and pilot (44), from cylinder head (39). Discard injector tube (42).

(d) Remove and discard O-ring (45).



42. INJECTOR TUBE
43. INJECTOR TUBE INSTALLER (TOOL)
44. PILOT
45. O-RING

TA 298452

(4) Inspect eight water nozzles (40) for looseness or damage. Remove water nozzles (40) that fail inspection or leak air during pressure testing.

(5) Inspect valve guides (46) for cracks, chipping, scoring or excessive wear.

(6) Measure inside diameter of valve guide (46).

(a) Inside diameter must be a minimum of 0.3125 inch (7.938 mm) and a maximum of 0.3140 inch (7.976 mm).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Assembly

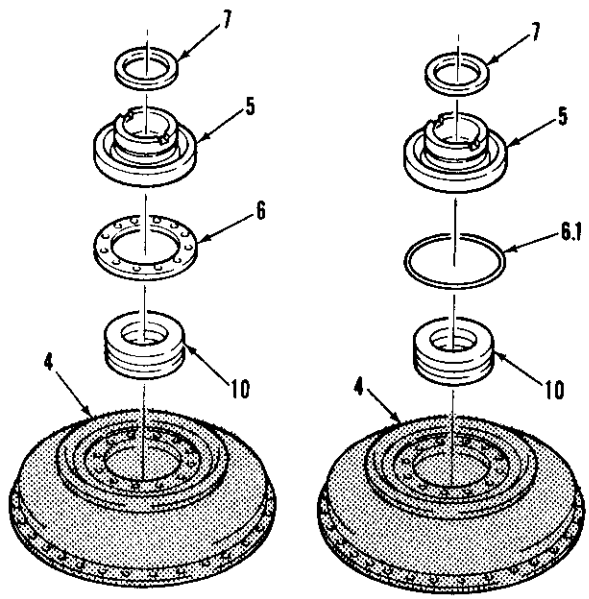
(1) If old design torque converter hub (5) is present, apply oil and install new gasket (6) onto torque converter hub (5).

(1.1) If new design torque converter hub (5) is present, apply oil and install new sealring (6.1) onto torque converter hub (5).

NOTE

Make sure three parts of bearing items (8, 9, and 10) have same serial number.

(2) Install inner race (10) on torque converter hub (5).



4. TORQUE CONVERTER PUMP
5. TORQUE CONVERTER HUB
6. GASKET
6.1. SEALRING
7. SEALRING
10. INNER RACE

(3) Using rubber hammer, install torque converter hub (5) onto torque converter pump (4).

(4) Install bearing (9) into inner race (10).

(5) Install outer race (8) over bearing (9). Tap outer race (8) until seated.

(6) Position two-piece bearing retainer (3), marked side up, into outer race (8).

(7) Install six new lockstrips (1) and 12 capscrews (2).

(8) Tighten 12 capscrews (2) to 35-40 foot-pounds (47-54 N·m.).

(9) Bend corners of lockstrips (1) against heads of capscrews (2).

(10) Install new sealring (11) on torque converter pump (4).

(11) Install new sealring (7) on torque converter hub (5).

(12) Store assembly in a clean, dry place until transmission is assembled.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install torque converter pump (para 7-6).

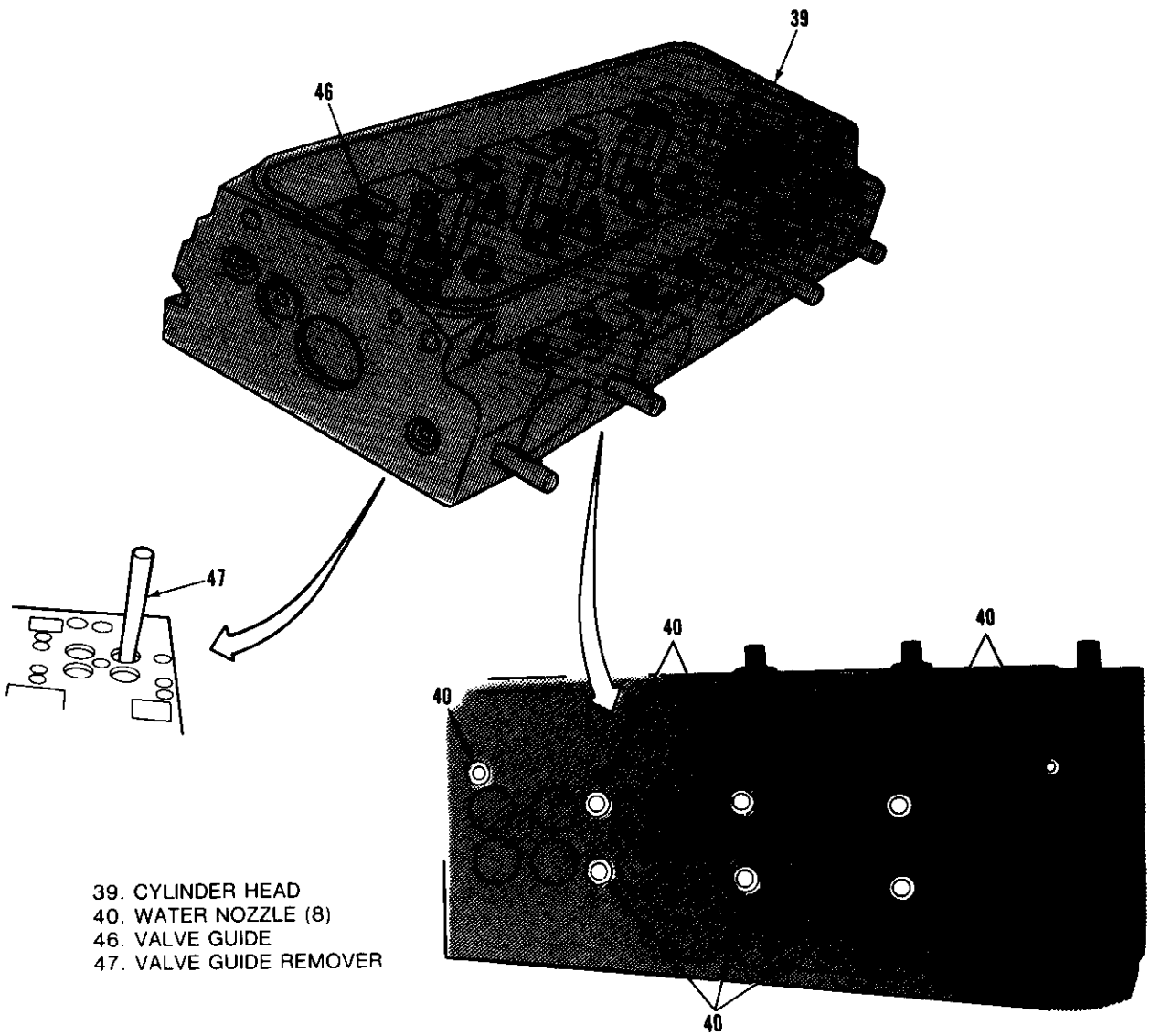
(b) Measure outside diameter of valve stem. Diameter must be between a minimum of 0.310 inch (7.874 mm) and a maximum of 0.309 inch (7.849 mm).

(c) To obtain valve-to-guide clearance, subtract valve stem diameter from valve guide (46) inside diameter measurement. Clearance should be between a minimum of 0.0017 inch (0.0432 mm) and a maximum of 0.0035 inch (0.089 mm), with a limit of 0.0050 inch (0.127 mm).

(d) If valve guide (46) has excessive clearance or inside diameter, replace valve guide (46).

(e) Support cylinder head (39), bottom side up, on two 3 inch high (7.62 cm) wooden blocks.

(f) Drive valve guide (46) from bottom cylinder head (39) with valve guide remover (47).



39. CYLINDER HEAD
40. WATER NOZZLE (8)
46. VALVE GUIDE
47. VALVE GUIDE REMOVER

TA 298453

7-11. TORQUE CONVERTER PUMP REPAIR

THIS TASK COVERS:
a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Materials/Parts
Oil, OE/HDO-10 (item 44, Appendix C)
Lockstrip (6) (NSN 5340-01-056-0037) item 1
Gasket (NSN 5330-00-911-9411) item 6
Sealring (NSN 5330-01-173-3413) item 7
Sealring (NSN 5330-01-141-9579) item 11
Sealring (NSN 5330-01-280-7491) item 6.1

Equipment Condition
TM
TM 2320-34/13
TM 9-2320-297-34

Condition Description
Torque converter pump removed (para 7-5)

Special Environmental Conditions
Work in a clean area free of blowing dust.

a. Disassembly

CAUTION

During disassembly all parts must be handled with care to avoid nicking, scratching, or denting. Close fitting parts can bind if damaged or scratched.

(1) Bend corners of six lockstrips (1) away from heads of 12 capscrews (2).

(2) Remove 12 capscrews (2) and six lockstrips (1). Discard lockstrips (1).

NOTE

Mark top of bearing retainers (3) before removal.

(3) Remove two-piece bearing retainer (3) from torque converter pump (4).

NOTE

Transmission might have either old or new design torque converter hub. To identify the new design hub, look for a sealring groove in bottom side of torque converter hub.

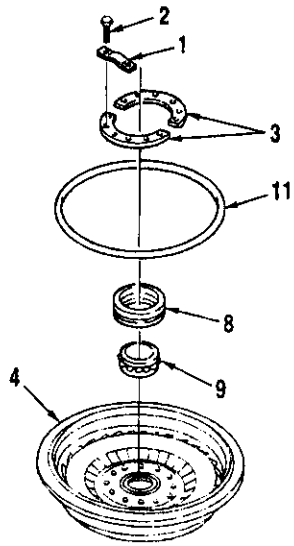
(4) Remove torque converter hub (5).

(5) Remove and discard gasket (6) and sealring (7) from torque converter hub (5).

(6) Using a brass drift, remove outer race (8) and bearing (9) by gently tapping bearing (9) from backside.

(7) Remove inner race (10).

(8) Remove sealing (11) from torque converter pump (4). Discard sealring (11).

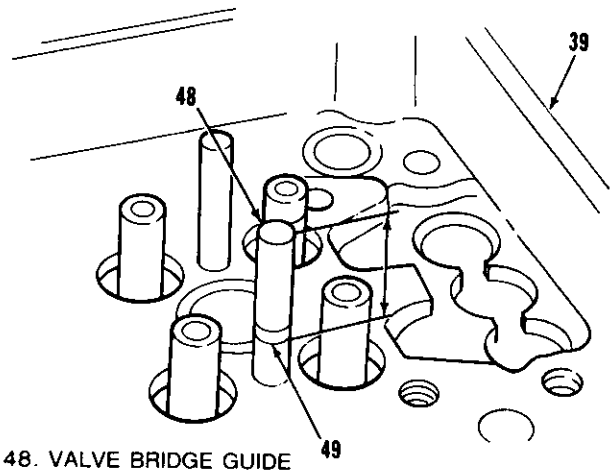


1. LOCKSTRIP (6)
2. CAPSCREW (12)
3. BEARING RETAINER
4. TORQUE CONVERTER PUMP
8. OUTER RACE
9. BEARING
11. SEALRING

3-4. CYLINDER HEAD MAINTENANCE (Continued)

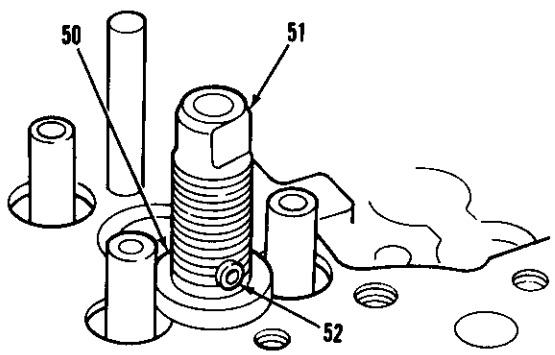
(7) Inspect valve bridge guides (48) for cracks, chipping, scoring, or excessive wear. If valve bridge guides (48) fail inspection, replace as follows:

(a) File two notches (49) 1/16 inch (1.588 mm) deep in opposite sides of valve bridge guide (48) approximately 1.25-1.50 inches (31.75-38.10 mm) from top of valve bridge guide (48).



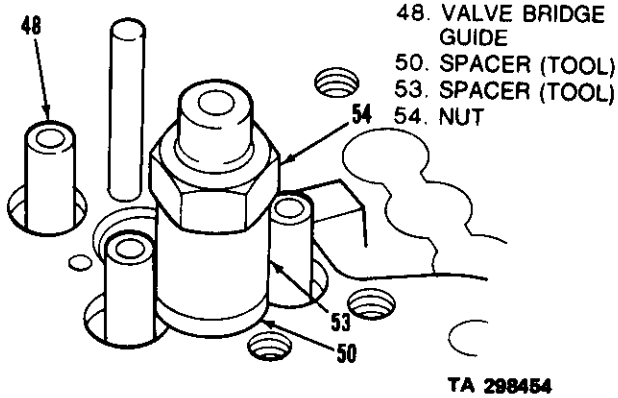
48. VALVE BRIDGE GUIDE
49. NOTCH

(b) Place spacer (tool) (50) over valve bridge guide (48). Then slide guide remover (51) over guide and aline setscrews (52) with notches (49) in guide. Tighten setscrews (52) to hold spacer (tool) (50) securely.



50. SPACER (TOOL)
51. GUIDE REMOVER
52. SET SCREW

(c) Place spacer (tool) (53) over guide remover (51). thread nut (54) on guide remover (51) and turn clockwise to remove valve bridge guide (48) from cylinder head (39).



48. VALVE BRIDGE GUIDE
50. SPACER (TOOL)
53. SPACER (TOOL)
54. NUT

TA 298454

(8) Visually inspect valve (29) for pitting, cracks, ridges on valve face, or bent valve stem. Reface valve face if pitted or if ridges are present. If valve head is warped or stem is bent, replace valve (29).

NOTE

Exhaust springs are color coded with a single or double yellow stripe or a single yellow and single blue stripe.

(9) Inspect spring (24) for pit marks or cracks. Replace a pitted or cracked spring (24). Test spring load as follows:

(a) Test spring load of spring (24) with a spring tester (55).

(b) Compress spring (24) to 1.80 inches (45.72 mm). If load is less than 25 pounds (11.35 kg), replace spring.

(10) Inspect spring seat (28), spring caps (27), and two-piece valve locks (26) for wear. If worn, replace parts.

(39) Slide separator plate (2) onto transfer plate (1).

(40) Hold separator plate (2) and transfer plate (1) together, turn over and place onto control valve body (5).

(41) Insert six guide capscrews (95) through transter plate (1), separator plate (2), and control valve body (5) to aline capscrew holes.

(42) Place modulator valve body (4) onto transfer plate (1) and install three capscrews (3).

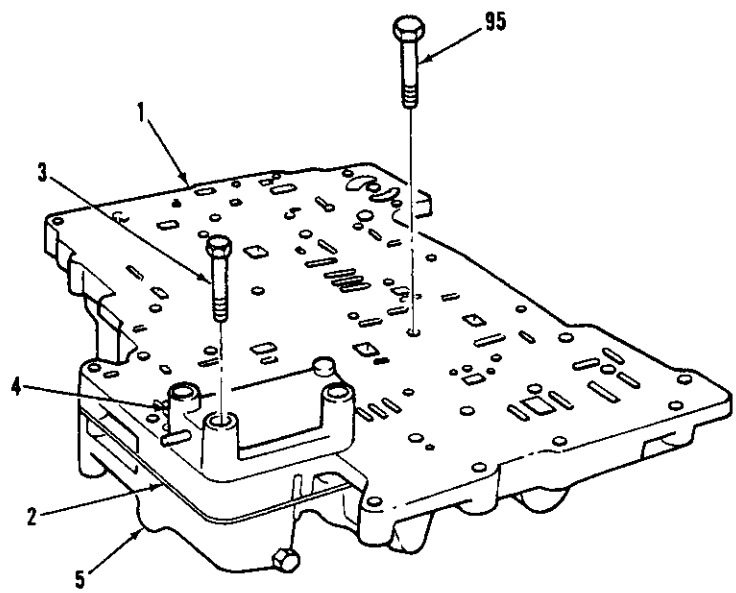
(43) Tighten capscrews (3) to 108-132 inch-pounds (12.2-14.9 N·m). Remove six guide capscrews (95).

END OF TASK

NOTE

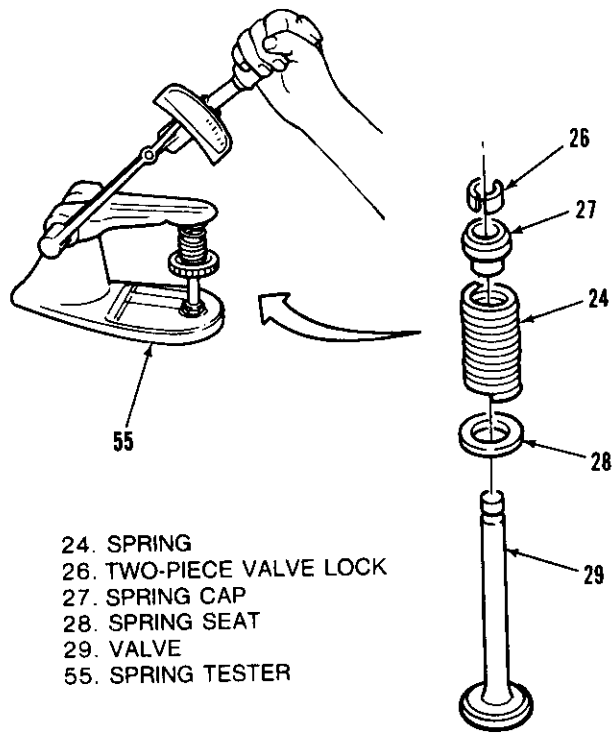
Follow-On Maintenance

TM 2320-34/13 Install control valve
TM 9-2320-297-34 (para 7-6).



1. TRANSFER PLATE
2. SEPARATOR PLATE
3. CAPSCREW (3)
4. MODULATOR VALVE BODY
5. CONTROL VALVE BODY
95. GUIDE CAPSCREW (6)

TA 298837



24. SPRING
26. TWO-PIECE VALVE LOCK
27. SPRING CAP
28. SPRING SEAT
29. VALVE
55. SPRING TESTER

(11) Inspect valve seat inserts (56) for excessive or uneven wear, pitting, or cracking. If valve seat insert (56) is unevenly worn or pitted, it can be refaced. Refer to section e, step (6). A cracked or damaged valve seat insert (56) must be replaced.

(a) Place valve seat insert (56) so bottom of collet (57) is flush with the bottom of valve seat insert (56).

(b) Press down on handle (58) and remove each valve seat insert (56) from cylinder head (39).

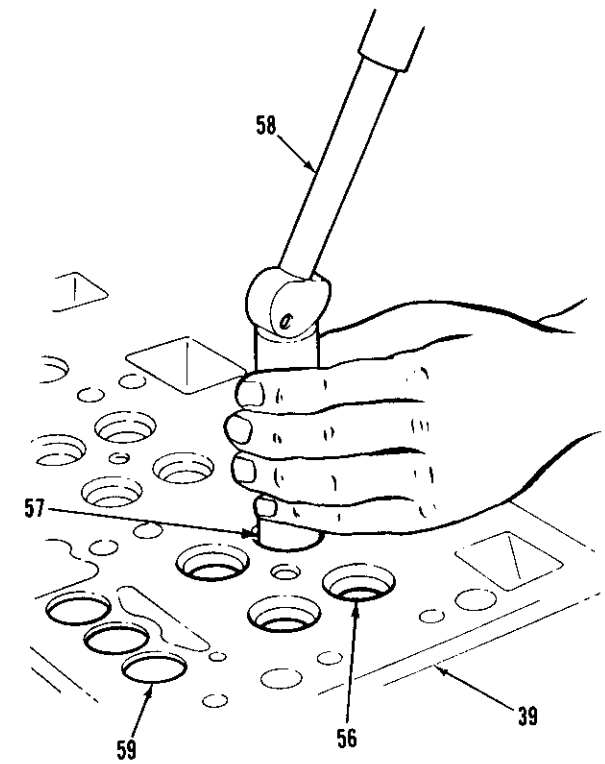
(12) Inspect cam follower bores (59) in cylinder head (39) for scoring or wear.

(a) Light score marks can be cleaned up with crocus cloth moistened with fuel oil.

(b) Measure inside diameter of cam follower bore (59). Diameter must be between minimum 1.062 inches (26.975 mm) and a maximum of 1.063 inches (27.000 mm), with a limit of 1.065 inches (27.051 mm) on used parts.

(c) If cam follower bores (59) are excessively worn or scored, replace cylinder head (39).

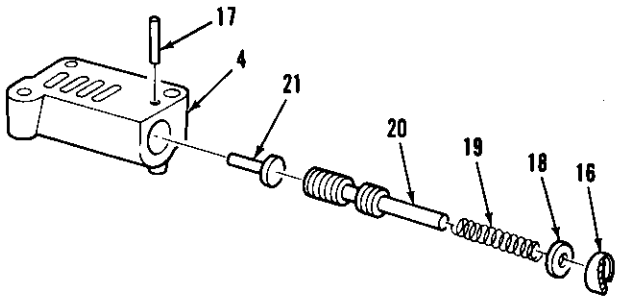
(13) Replace all other parts failing inspection.



39. CYLINDER HEAD
56. VALVE SEAT INSERT
57. COLLET
58. HANDLE
59. CAM FOLLOWER BORE

TA 298455

7-10. CONTROL VALVE REPAIR (Continued)



4. MODULATOR VALVE BODY
16. ADJUSTING RING
17. RETAINING PIN
18. WASHER
19. SPRING
20. MODULATOR VALVE
21. ACTUATOR

(34) Install actuator (21), modulator valve (20), spring (19), washer (18), and adjusting ring (16) in modulator valve body (4).

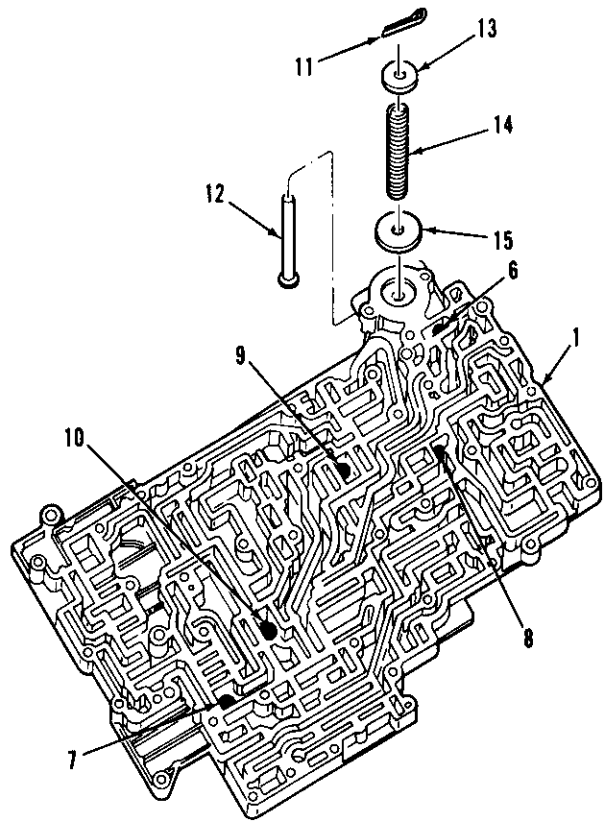
(35) Press on adjusting ring (16) and install retaining pin (17) in its original position.

(36) Install check valve pin (12), lubrication check valve (15), spring (14), and cup washer (13) onto oil transfer plate (1).

(37) Install retaining pin (11) while pushing down on cup washer (13).

(38) Install balls (6, 7, 8, 9, and 10) into oil transfer plate (1).

1. OIL TRANSFER PLATE
6. BALL (1/4")
7. BALL (1/4")
8. BALL (5/16")
9. BALL (1/4")
10. BALL (1/4")
11. RETAINING PIN
12. CHECK VALVE PIN
13. CUP WASHER
14. SPRING
15. LUBRICATION CHECK VALVE



TA 298836

3-4. CYLINDER HEAD MAINTENANCE (Continued)

e. Assembly

(1) Install new valve guides (46), if removed.

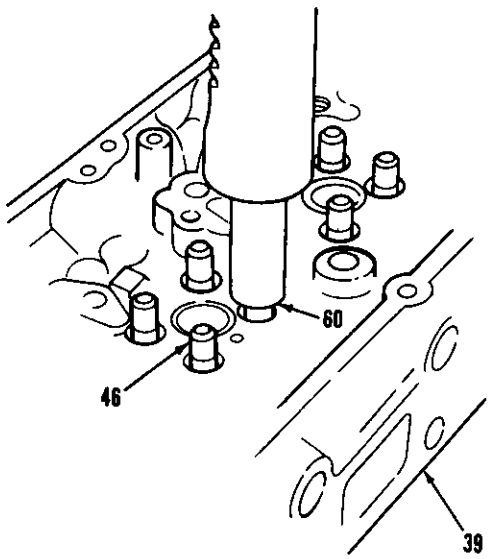
(a) Place cylinder head (39) on an arbor press bed so top of cylinder head (39) is towards press.

(b) Insert internally threaded end of valve guide (46) into guide installer (tool) (60).

(c) Position valve guide (46) squarely on guide bore.

(d) Press guide installer (tool) (60) gently to start valve guide (46) in straight.

(e) Press valve guide (46) until guide installer (tool) (60) contacts bottom of counterbore in cylinder head (39).



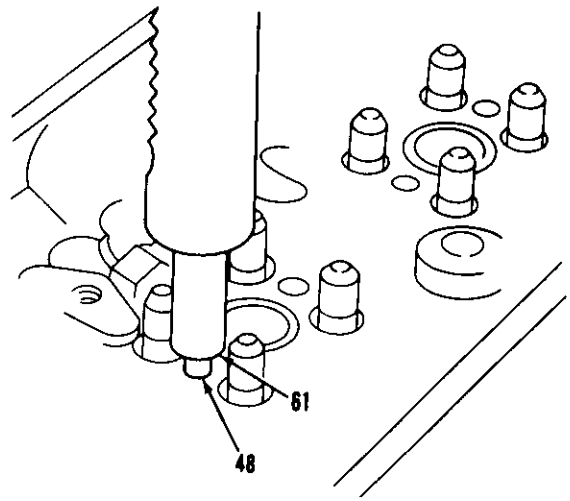
39. CYLINDER HEAD
46. VALVE GUIDE
60. GUIDE INSTALLER (TOOL)

(2) Install new valve bridge guide (48) if removed.

(a) Apply non-hardening sealant to undercut end of valve guide (46).

(b) Start undercut end of valve guide (46) into cylinder head (39).

(c) Place bridge guide installer (tool) (61) over valve bridge guide (48) and press guide until installer contacts cylinder head (39).



48. VALVE BRIDGE GUIDE
61. BRIDGE GUIDE INSTALLER (TOOL)

TA 298456

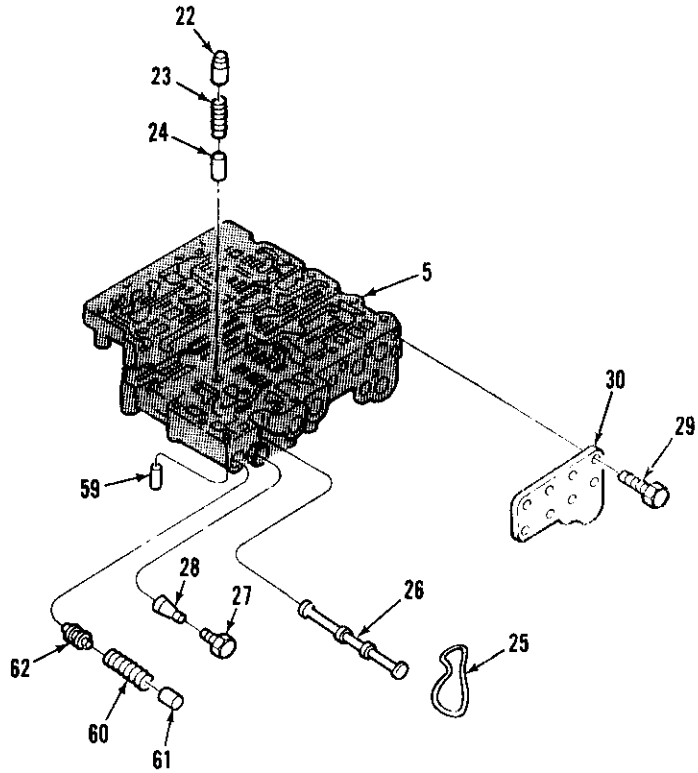
(3) If valve seat insert (56) was removed, measure diameter of valve seat insert (56) counterbore. Diameter must be between a minimum of 1.440 inches (36.576 mm) and a maximum of 1.441 inches (36.601 mm).

WARNING

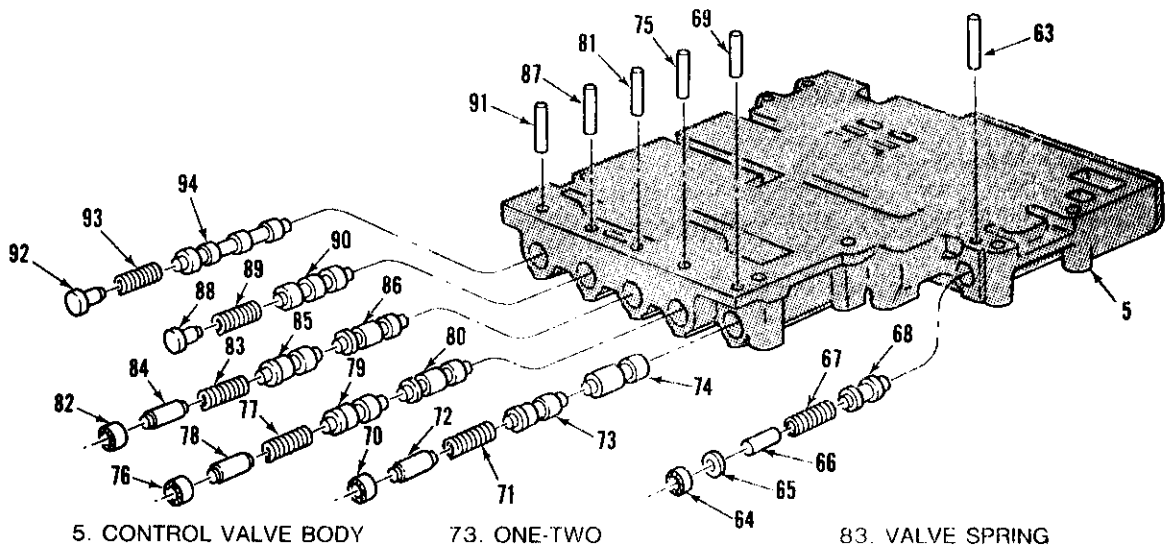
Hot water causes burns. Use care to prevent personal injury.

NOTE

Valve seat insert is available 0.010 inch oversize outside diameter.

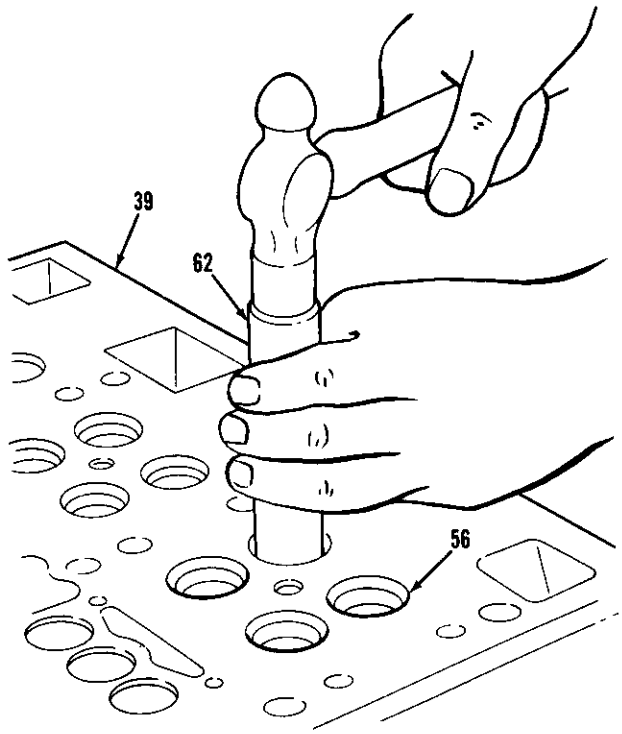


5. CONTROL VALVE BODY
22. PRIORITY VALVE
23. SPRING
24. VALVE STOP
25. RUBBER BAND
26. SELECTOR VALVE
27. PLUG
28. GOVERNOR SCREEN
29. CAPSCREW (8)
30. TRIMMER VALVE COVER
59. ROLL PIN
60. SPRING
61. VALVE STOP
62. ACCUMULATOR VALVE



5. CONTROL VALVE BODY
63. RETAINING PIN
64. ADJUSTING RING
65. WASHER
66. VALVE STOP
67. VALVE SPRING
68. HOLD REGULATOR VALVE
69. RETAINING PIN
70. ADJUSTING RING
71. VALVE SPRING
72. VALVE STOP
73. ONE-TWO MODULATOR VALVE
74. ONE-TWO SHIFT VALVE
75. RETAINING PIN
76. ADJUSTING RING
77. VALVE SPRING
78. VALVE STOP
79. TWO-THREE MODULATOR VALVE
80. TWO-THREE SHIFT VALVE
81. RETAINING PIN
82. ADJUSTING RING
83. VALVE SPRING
84. VALVE STOP
85. THREE-FOUR MODULATOR VALVE
86. THREE-FOUR SHIFT VALVE
87. RETAINING PIN
88. VALVE STOP
89. VALVE SPRING
90. THREE-FOUR RELAY VALVE
91. RETAINING PIN
92. VALVE STOP
93. VALVE SPRING
94. TRIMMER REGULATOR VALVE

TA 298835



39. CYLINDER HEAD
56. VALVE SEAT INSERT
62. VALVE INSERT INSTALLER (TOOL)

(4) Install new valve seat inserts (56), if removed.

(a) Immerse cylinder head (39) for at least 30 minutes in water heated to 180-200° F (82-93° C).

NOTE

Have insert installer and inserts ready to be installed. Inserts must be installed when cylinder head is still hot.

(b) Remove cylinder head (39) from hot water and place it on wooden blocks so bottom is facing up.

(c) Place valve seat insert (56) in bore.

(d) Drive valve seat insert (56) into bore with valve insert installer (tool) (62). Drive until valve seat insert (56) is seated against cylinder head (39) bore.

(e) New valve seat insert (56) must be refaced before installing valves (29).

NOTE

New valves (29) and new valve seat inserts (56) must be refaced before valve (29) installation. Original valves (29) and valve seat inserts (56) should be checked with Prussian blue dye to determine the contact surface (63) between the two parts.

(5) Check contact surface (63) between valve (29) and valve seat insert (56) using Prussian blue dye.

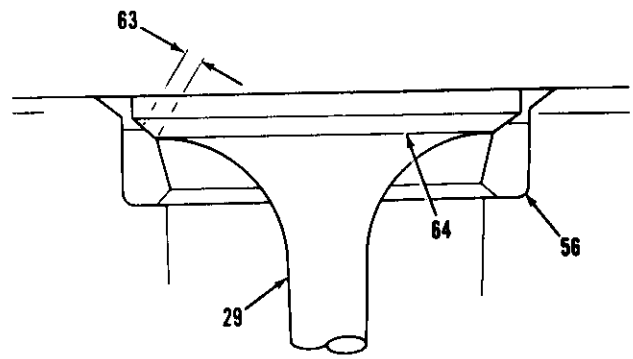
(a) Apply a light coat of Prussian blue dye to valve face (64).

(b) Lower valve stem into valve guide (46) and let valve (29) drop against valve seat insert (56).

NOTE

Do not rotate valve (29) when pushing valve (29) against valve seat insert (56).

(c) Push up on valve stem until valve face (64) is about one inch (2.54 cm) above valve seat insert (56).



29. VALVE
56. VALVE SEAT INSERT
63. CONTACT SURFACE
64. VALVE FACE

TA 298457

7-10. CONTROL VALVE REPAIR (Continued)

(11) Install trimmer valve cover (30) and install eight capscrews (29). Tighten capscrews (29) to 48-60 inch-pounds (5.4-6.8 N·m).

(12) Install governor screen (28) and plug (27) into control valve body (5). Tighten plug (27) to 50-60 inch-pounds (5.6-6. 8 N·m).

(13) Install accumulator valve (62), spring (60), and valve stop (61).

(14) Aline pin hole in valve stop (61) with pin holes in control valve body (5).

(15) Push in valve stop (61) and install new roll pin (59).

(16) Install valve stop (24), spring (23), and priority valve (22).

(17) Install selector valve (26). Temporarily secure in place with rubber band (25) or available wire.

(18) Install trimmer regulator valve (94), valve spring (93), and valve stop (92).

(19) Press valve stop (92), and install retaining pin (91).

(20) Install three-four relay valve (90), valve spring (89), and valve stop (88).

(21) Press valve stop (88) and install retaining pin (87).

(22) Install three-four shift valve (86), three-four modulator valve (85), valve spring (83), valve stop valve (84), and adjusting ring (82).

(23) Aline pin hole in valve stop (84) with pin holes in control valve body (5).

(24) Push in adjusting ring (82) and install retaining pin (81).

(25) Install two-three shift valve (80) and two-three modulator valve (79), valve spring (77), valve stop (78), and adjusting ring (76).

(26) Aline pin hole in valve stop (78) with pin holes in control valve body (5).

(27) Press on adjusting ring (76) and install retaining pin (75).

(28) Install one-two shift valve (74), one-two modulator valve (73), valve spring (71), valve stop (72), and adjusting ring (70).

(29) Aline pin hole in valve stop (72) with pin holes in control valve body (5).

(30) Press on adjusting ring (70) and install retaining pin (69) in control valve body (5).

(31) Install hold regulator valve (68), valve spring (67), valve stop (66), washer (65), and adjusting ring (64).

(32) Aline pin hole in valve stop (66) with pin holes in control valve body (5).

(33) Push in adjusting ring (64) and install retaining pin (63) in control valve body (5).

3-4. CYLINDER HEAD MAINTENANCE (Continued)

NOTE

Do not rotate valve (29).

(d) Release valve stem and, at the same time, apply pressure against valve (29) head until valve face (64) makes contact with valve seat insert (56). Repeat several times to get a good imprint in the Prussian blue dye.

(e) Being careful not to smear Prussian blue dye, remove valve (29).

(f) Imprint in Prussian blue dye should have an even seat mark all the way around the center of valve face (64).

(g) If imprint is uneven, valve (29) and valve seat insert (56) must be refaced.

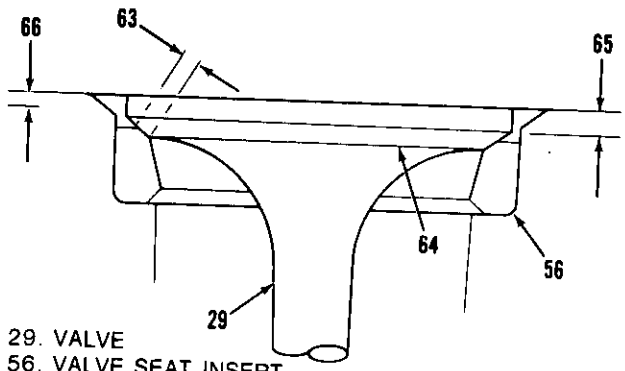
(6) Reface valves (29) and valve seat inserts (56) that are new or have uneven imprints.

(a) First, use 31 degree grinding wheel and grinder on valve seat insert (56).

(b) Use a 60 degree grinding wheel to open throat of valve seat insert (56).

(c) Grind contact surface (63) of valve seat insert (56) with a 15 degree grinding wheel to narrow width of seat from 5/64 inch (1.984 mm) to 3/64 inch (1.91 mm).

(d) Valve (29) must be refaced at a 30 degree angle. Valve head thickness (65) must be no less than 1/32 inch (0.794 mm).

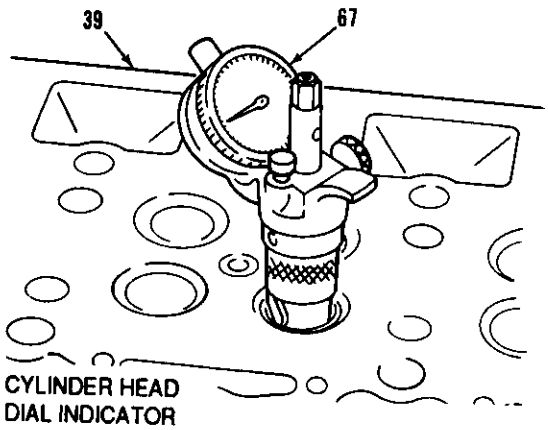


29. VALVE
56. VALVE SEAT INSERT
63. CONTACT SURFACE
64. VALVE FACE
65. VALVE HEAD THICKNESS
66. VALVE RECESS

(e) Measure valve recess (66) when valve (29) is seated against valve seat insert (56). Valve (29) must not protrude more than 0.006 inch (0.152 mm) above cylinder head (39) or be recessed more than 0.023 inch (0.584 mm). If beyond limit, a new valve seat insert (56) must be installed.

(f) Install gage block and dial indicator (67) in valve bore.

(g) Rotate dial indicator (67) to check that each valve seat insert (56) is directly centered with each valve guide. If runout exceeds 0.002 inch, check for a bent valve guide before regrinding valve seat insert (56).

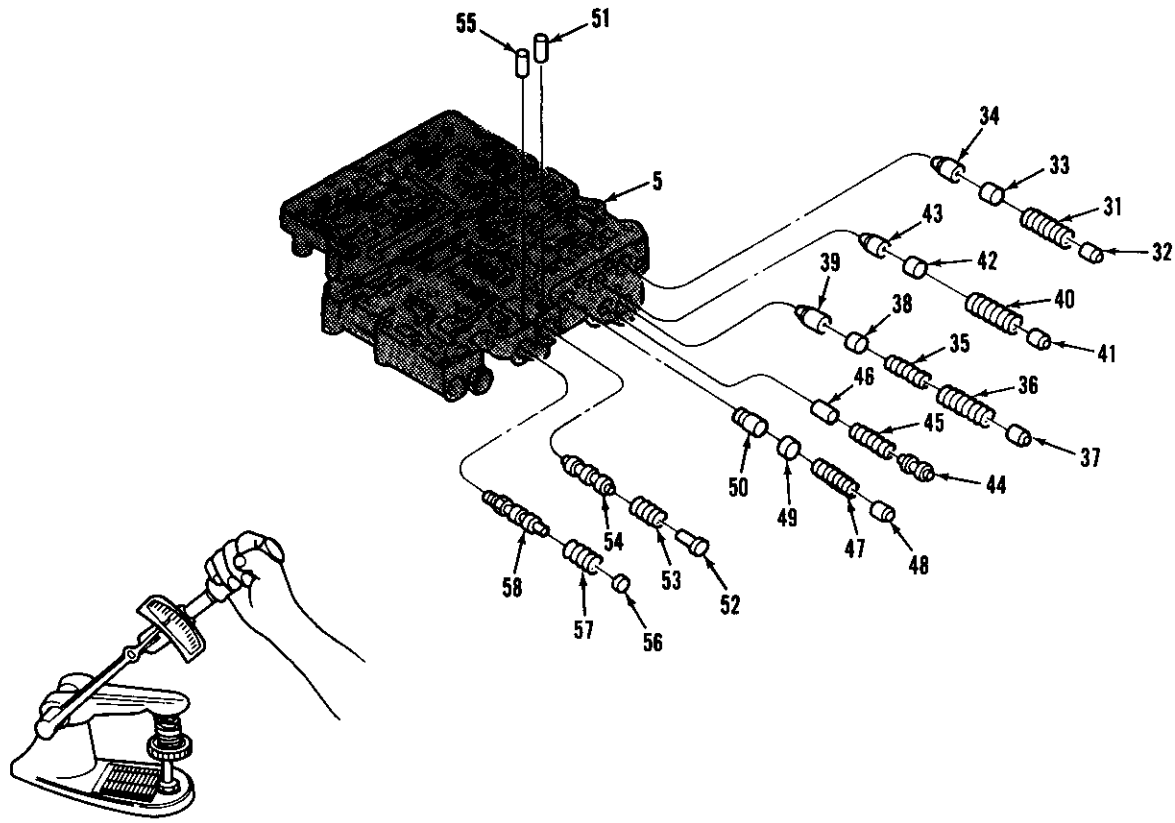


39. CYLINDER HEAD
67. DIAL INDICATOR

TA 298458

(9) Install first clutch trimmer valve (39), smaller end first, plug (38), secondary spring (35), primary spring (36), and valve stop (37) into control valve body (5).

(10) Install valve stop (46), spring (45), and accumulator valve (44) into control valve body (5).



5. CONTROL VALVE BODY
31. SPRING
32. VALVE STOP
33. TRIMMER PLUG
34. THIRD CLUTCH TRIMMER VALVE
35. SPRING
36. SPRING
37. VALVE STOP
38. PLUG
39. FIRST CLUTCH TRIMMER VALVE
40. SPRING
41. VALVE STOP
42. PLUG
43. SECOND CLUTCH TRIMMER VALVE
44. ACCUMULATOR VALVE
45. SPRING
46. VALVE STOP
47. SPRING
48. VALVE STOP
49. PLUG
50. FOURTH CLUTCH TRIMMER VALVE
51. RETAINER PIN
52. VALVE STOP
53. SPRING
54. TWO-THREE RELAY VALVE
55. RETAINER PIN
56. SPRING SPACER
57. SPRING
58. ONE-TWO RELAY VALVE

TA 298834

NOTE

Tag valves (29) so they may be installed with matched insert.

(h) Recheck contact surface (63) between valve face (64) and valve seat insert (56) with Prussian blue dye. Follow procedure step (5).

(i) Clean cylinder head (39) and valves (29) after valves (29) and valve seat inserts (56) have been ground. Refer to paragraph 2-6.

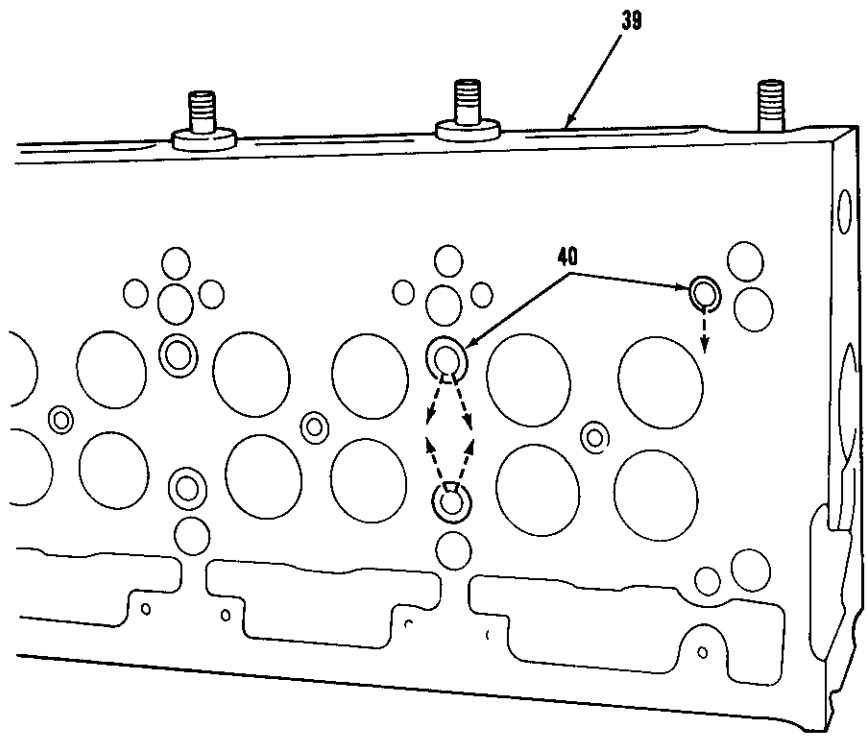
(7) Install new water nozzles (40), if removed.

(a) Place water nozzle (40) in opening.

(b) Position the nozzle orifices so they face in direction of arrows.

(c) Press water nozzle (40) flush to 0.004 inch (0.102 mm) below surface of cylinder head (39).

(d) Check to make sure water nozzle (40) fits tightly.



39. CYLINDER HEAD
40. WATER NOZZLE (8)

TA 298459

7-10. CONTROL VALVE REPAIR (Continued)

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all valves, valve stops, and plugs for damage. Replace damaged parts.

(3) Visually inspect bores and surfaces of control valve body for wear or damage.

(4) Inspect all springs. Replace springs that do not meet load length specifications listed in control valve body spring load table.

c. Assembly

(1) Place control valve body (5) flat side upward.

(2) Install one-two relay valve (58), spring (57), and spring spacer (56) into bore of control valve body (5).

(3) Press spring spacer (56) and install retainer pin (55) in control valve body (5).

(4) Install two-three relay valve (54), spring (53), and valve stop (52) into control valve body (5).

(5) Press valve stop (52) and install retainer pin (51) into control valve body (5).

(6) Install fourth clutch trimmer valve (50), smaller end first, plug (49), spring (47), and valve stop (48).

(7) Install second clutch trimmer valve (43), smaller end first, plug (42), spring (40), and valve stop (41) into control valve body (5).

(8) Install third clutch trimmer valve (34), smaller end first, trimmer plug (33), spring (31), and valve stop (32) into control valve body (5).

Spring	Length Without Load inch (mm)	Length Under Load inch (mm)	Load lbs (kg)	Item Number
Lubrication check valve spring	2.48 (63.0)	1.97 (50.0)	32.25 - 37.05 (14.6 - 16.8)	14
Modulator valve spring	1.47 (37.3)	0.80 (20.3)	11.9 - 13.1 (5.40 - 5.95)	19
Priority valve spring	1.17 (29.7)	0.94 (23.9)	8.15 - 9.25 (3.7 - 4.2)	23
Third clutch trimmer valve spring	2.18 (55.4)	1.94 (49.3)	6.2 - 7.4 (2.81 - 3.36)	31
First clutch trimmer valve spring	1.69 (42.9)	1.10 (27.9)	32.6 - 39.8 (14.80 - 18.07)	35
First clutch trimmer valve spring	2.96 (75.2)	1.10 (27.9)	8.30 - 10.30 (3.77 - 4.68)	36
Second clutch trimmer valve spring	2.56 (65.0)	1.94 (49.3)	20 - 22 (9.07 - 9.98)	40
Fourth clutch trimmer valve spring	2.27 (57.7)	1.94 (49.3)	9.4 - 11.4 (4.26 - 5.17)	45
Accumulator valve spring	2.77 (70.4)	1.49 (37.9)	11.6 - 12.8 (5.27 - 5.81)	47
1-2 Relay valve spring	1.52 (38.6)	1.10 (28.0)	7.2 - 8.8 (3.27 - 4.0)	53
2-3 Relay valve spring	2.18 (55.4)	1.20 (30.5)	16.2 - 19.8 (7.35 - 8.99)	57
3-4 Relay valve spring	2.18 (55.4)	1.20 (30.5)	16.2 - 19.8 (7.35 - 8.99)	60
Governor accumulator valve spring	1.84 (46.7)	0.7 (17.8)	9.6 - 10.6 (4.35 - 4.81)	67
Hold regulator valve spring	1.68 (42.7)	1.15 (29.2)	5.14 - 5.36 (2.33 - 2.43)	71
1-2 Shift valve spring	2.65 (67.3)	1.15 (29.2)	8.63 - 9.35 (3.98 - 4.25)	77
2-3 Shift valve spring	2.51 (63.8)	1.15 (29.2)	10.75 - 11.25 (4.88 - 5.11)	83
3-4 Shift valve spring	2.41 (61.2)	1.15 (29.2)	10.0 - 10.5 (4.54 - 4.76)	89
Trimmer regulator valve spring	1.37 (34.8)	0.89 (22.6)	2.43 - 2.69 (1.10 - 1.22)	93

TA 298833

3-4. CYLINDER HEAD MAINTENANCE (Continued)

(8) Install new injector tubes (42) if removed.

(a) Install new O-ring (45) in counterbore.

(b) Insert tube assembly into injector bore, using injector tube installer (tool) (43).

(c) Install pilot (44) into bottom of injector tube installer (tool) (43).

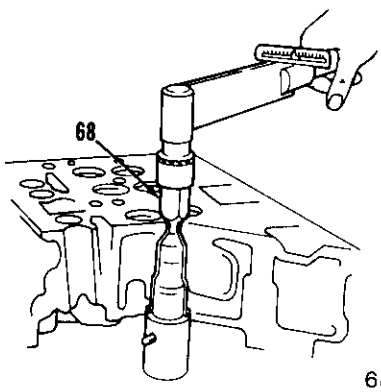
NOTE

It is allowable for tube flange at seal ring end to protrude 0.120 inches (3.048 mm) above the cylinder head casting without sealing being affected. Seal is formed when O-ring (45) is pressed between head counterbore and outside diameter of injector tube (42). Tube flange is merely used to retain sealring in head counterbore.

(d) Drive injector tube (42) into bore.

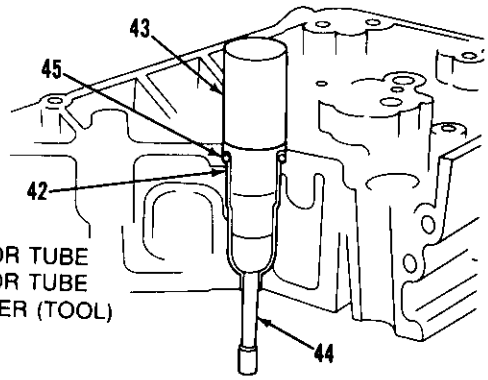
(e) Remove pilot (44) and install upsetting die (68) into injector tube installer (tool) (43).

(f) Torque upsetting die (68) to 30 foot-pounds (41 N·m) to flare the lower end of injector tube (42).



68. UPSETTING DIE

(g) Remove injector tube installer (tool) (43) and upsetting die (68). Injector tube (42) must be reamed to fit fuel injector.



42. INJECTOR TUBE
43. INJECTOR TUBE INSTALLER (TOOL)
44. PILOT
45. O-RING

TA 298460

(9) Ream injector tubes (42) if new ones were installed.

NOTE

Reamer (tool) (69) must be turned in a clockwise direction only, both when inserting and when withdrawing reamer (tool) (69). Movement in opposite direction will dull cutting edges.

(a) Place a few drops of cutting oil on reamer (tool) (69) cutting edge. Carefully insert reamer (tool) (69) into injector tube (42).

CAUTION

Make sure all metal chips and shavings are removed prior to each reaming operation.

(b) Slowly turn reamer (tool) (69) clockwise, withdrawing reamer (tool) (69) frequently to remove chips. Continued to cut injector tube (42) until shoulder of reamer cutting edge contacts injector tube (42).

(c) Clean out all metal chips.

(d) Install pilot (tool) (70) into reamer (tool) (69).

(24) Remove retainer pin (55), spring spacer (56), spring (57), and one-two relay valve (58).

(25) Remove roll pin (59), spring (60), valve stop (61), and governor accumulator valve (62). Discard roll pin (59).

NOTE

Record notches on adjusting rings before removal, for later installation.

(26) Remove retaining pin (63), adjusting ring (64), washer (65), valve stop (66), valve spring (67), and hold regulator valve (68) from control valve body (5).

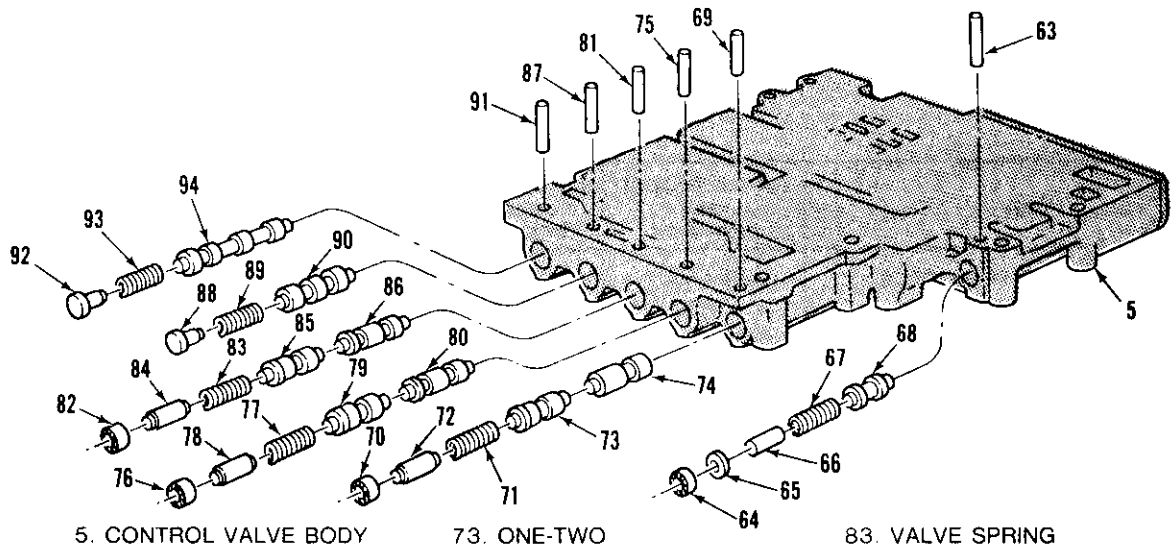
(27) Remove retaining pin (69), adjusting ring (70), valve spring (71), valve stop (72), one-two modulator valve (73), and one-two shift valve (74) from control valve body (5).

(28) Remove retaining pin (75), adjusting ring (76), valve spring (77), valve stop (78), two-three modulator valve (79), and two-three shift valve (80) from control valve body (5).

(29) Remove retaining pin (81), adjusting ring (82), valve spring (83), valve stop (84), three-four modulator valve (85), and three-four shift valve (86) from control valve body (5).

(30) Remove retaining pin (87), valve stop (88), valve spring (89), and three-four relay valve (90) from control valve body (5).

(31) Remove retaining pin (91), valve stop (92), valve spring (93), and trimmer regulator valve (94) from control valve body (5).



5. CONTROL VALVE BODY
63. RETAINING PIN
64. ADJUSTING RING
65. WASHER
66. VALVE STOP
67. VALVE SPRING
68. HOLD REGULATOR VALVE
69. RETAINING PIN
70. ADJUSTING RING
71. VALVE SPRING
72. VALVE STOP
73. ONE-TWO MODULATOR VALVE
74. ONE-TWO SHIFT VALVE
75. RETAINING PIN
76. ADJUSTING RING
77. VALVE SPRING
78. VALVE STOP
79. TWO-THREE MODULATOR VALVE
80. TWO-THREE SHIFT VALVE
81. RETAINING PIN
82. ADJUSTING RING
83. VALVE SPRING
84. VALVE STOP
85. THREE-FOUR MODULATOR VALVE
86. THREE-FOUR SHIFT VALVE
87. RETAINING PIN
88. VALVE STOP
89. VALVE SPRING
90. THREE-FOUR RELAY VALVE
91. RETAINING PIN
92. VALVE STOP
93. VALVE SPRING
94. TRIMMER REGULATOR VALVE

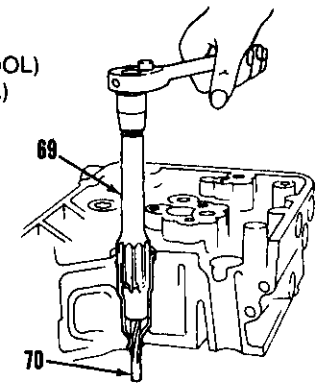
TA 298832

(e) Place a few drops of cutting oil on pilot tool (70).

(f) Turn reamer (tool) (69) until lower end of injector tube (42) is flush with or up to 0.005 inch (0.127 mm) below finished surface on bottom of cylinder head (39). Clean out all metal chips.

(g) Remove reamer (tool) (69) and pilot (tool) (70).

69. REAMER (TOOL)
70. PILOT (TOOL)



(h) Install injector gage (71) in injector tube (42).

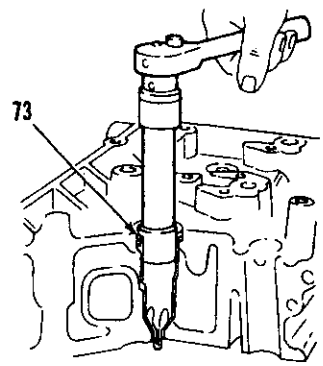
(i) Zero gage block (72) on finished surface of cylinder head (39).

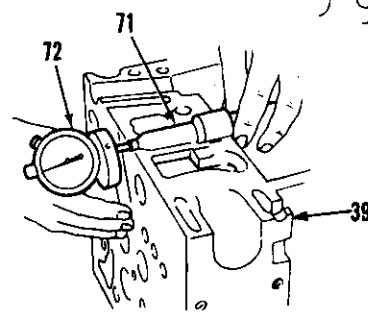
(j) Holding injector gage (71) in injector tube (42), move gage block (72) onto injector gage (71). Injector gage (71) must be flush with or up to 0.014 inch (0.356 mm) above or below finished surface of cylinder head (39).

(k) If not within specifications, use nut reamer (73) to remove excess stock. If gage reading shows that injector tube (42) is more than 0.014 inch above cylinder head (39) surface a new injector tube (42) must be installed.

(l) When using nut reamer (73), remove a little metal at a time and recheck measurement. Always clean out injector tube (42) before taking a reading.

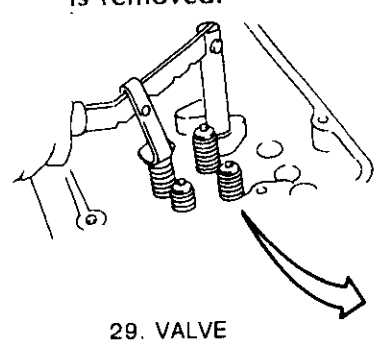
39. CYLINDER HEAD
71. INJECTOR GAGE
72. GAGE BLOCK
73. NUT REAMER

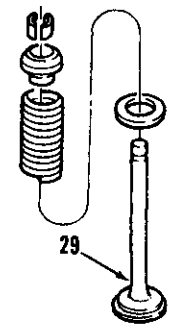




(10) Install valves (29) in their proper valve bores. Wrap a strip of tape around end of valve stem to keep valve (29) from falling out when cylinder head (39) is turned.

(11) Turn cylinder head (39) so valve stems are facing up. Place cylinder head (39) on wooden blocks. Blocks must cover valves (29) so valves (29) do not fall out when tape is removed.





29. VALVE

TA 298461

7-10. CONTROL VALVE REPAIR (Continued)

(13) Remove priority valve (22), spring (23), and valve stop (24) from control valve body (5).

(14) Remove rubber band (25) or wire holding selector valve (26) in place and remove selector valve (26).

(15) Remove plug (27) and governor screen (28) from control valve body (5).

NOTE

Remove last two capscrews (29) evenly while holding down trimmer valve cover (30).

(16) Remove capscrews (29).

(17) Remove trimmer valve cover (30).

(18) Remove spring (31), valve stop (32), trimmer plug (33), and third clutch trimmer valve (34) from control valve body (5).

(19) Remove springs (35 and 36), valve stop (37), plug (38), and first clutch trimmer valve (39) from control valve body (5).

(20) Remove spring (40), valve stop (41), plug (42), and second clutch trimmer valve (43) from control valve body (5).

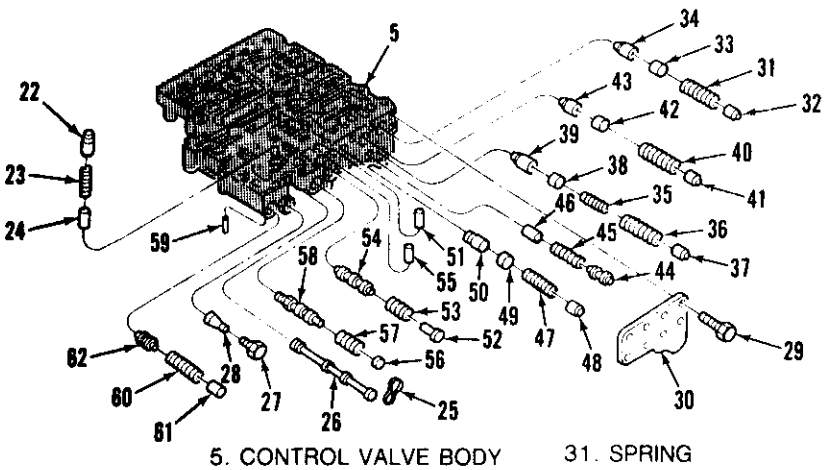
(21) Remove accumulator valve (44), spring (45), and valve stop (46).

(22) Remove spring (47), valve stop (48), plug (49), and fourth clutch trimmer valve (50) from control valve body (5).

NOTE

Use a drift pin to remove retaining pins from control valve body (5).

(23) Remove retainer pin (51), valve stop (52), spring (53), and two-three relay valve (54) from control valve body (5).



5. CONTROL VALVE BODY
22. PRIORITY VALVE
23. SPRING
24. VALVE STOP
25. RUBBER BAND
26. SELECTOR VALVE
27. PLUG
28. GOVERNOR SCREEN
29. CAPSCREW (8)
30. TRIMMER VALVE COVER
31. SPRING
32. VALVE STOP
33. TRIMMER PLUG
34. THIRD CLUTCH TRIMMER VALVE
35. SPRING
36. SPRING
37. VALVE STOP
38. PLUG
39. FIRST CLUTCH TRIMMER VALVE
40. SPRING
41. VALVE STOP
42. PLUG
43. SECOND CLUTCH TRIMMER VALVE
44. ACCUMULATOR VALVE
45. SPRING
46. VALVE STOP
47. SPRING
48. VALVE STOP
49. PLUG
50. FOURTH CLUTCH TRIMMER VALVE
51. RETAINER PIN
52. VALVE STOP
53. SPRING
54. TWO-THREE RELAY VALVE
55. RETAINER PIN
56. SPRING SPACER
57. SPRING
58. ONE-TWO RELAY VALVE
59. ROLL PIN
60. SPRING
61. VALVE STOP
62. GOVERNOR ACCUMULATOR VALVE

TA 298831

3-4. CYLINDER HEAD MAINTENANCE (Continued)

(12) Remove tape on end of valves (29).

(13) Install spring seat (28), spring (24), and spring cap (27).

(14) Install spring compressor (tool) (25) into rocker shaft bolt holes.

CAUTION

Compress spring (24) only enough to permit installation of the two-piece valve lock (26). Compressing the spring (24) too far may result in damage to oil seal.

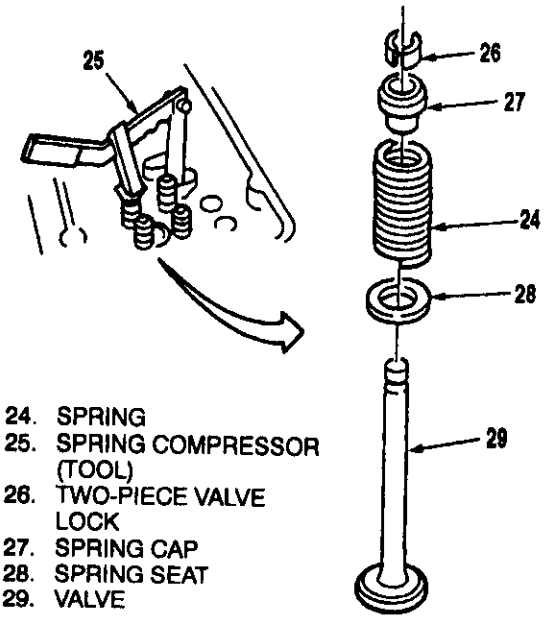
(15) Apply pressure on spring compressor (tools) (25) and compress spring (24).

(16) Install two-piece valve lock (26) in groove on valve stem.

(17) Slowly release pressure on spring (24), making sure two-piece valve lock (26) is in place.

(18) Turn cylinder head on its side once all valves (29) have been installed.

(19) Take a plastic hammer and tap each valve stem. This will help seat two-piece valve lock (26) and reduce the chance of failure.



24. SPRING
25. SPRING COMPRESSOR (TOOL)
26. TWO-PIECE VALVE LOCK
27. SPRING CAP
28. SPRING SEAT
29. VALVE

NOTE

Use pipe sealant on threads of plugs (19 thru 23), connector (14), and elbows (12 and 13).

(20) Install 25 plugs (22), four plugs (21), three plugs (20), five plugs (19), and plug (23).

(21) Install elbow (13) and connector (14) on front of right cylinder head.

(22) Install two elbows (12) on front of left cylinder head.

(23) Install air compressor adapter (11) on rear of left cylinder head.

NOTE

- Fuel pipes for LVSA1 series vehicles have changed from flare style to O-ring style pipes and connectors. When repairing non-A1 vehicles, use new style pipes and connectors to replace old style pipes and connectors. Refer to TM 9-2320-297-24P for correct parts identification.
- Flare and O-ring style pipes and connectors are not interchangeable. When replacing one flare type pipe or connector, all pipes and connectors must be replaced with new O-ring style pipes and connectors.

(24) Install eight fuel pipe connectors (9) and eight new washers (10) on each cylinder. Torque connectors to 40-45 ft-lb (54-61 N·m).

(25) Install eight capscrews (15), washers (16), four plates (17), and new gaskets (18) on each cylinder head. Tighten capscrews (15) securely.

(1) Hold oil transfer plate (1) and separator plate (2) together and remove three capscrews (3) from modulator valve body (4).

(2) Remove modulator valve body (4).

(3) Hold oil transfer plate (1) and separator plate (2) together and remove control valve body (5).

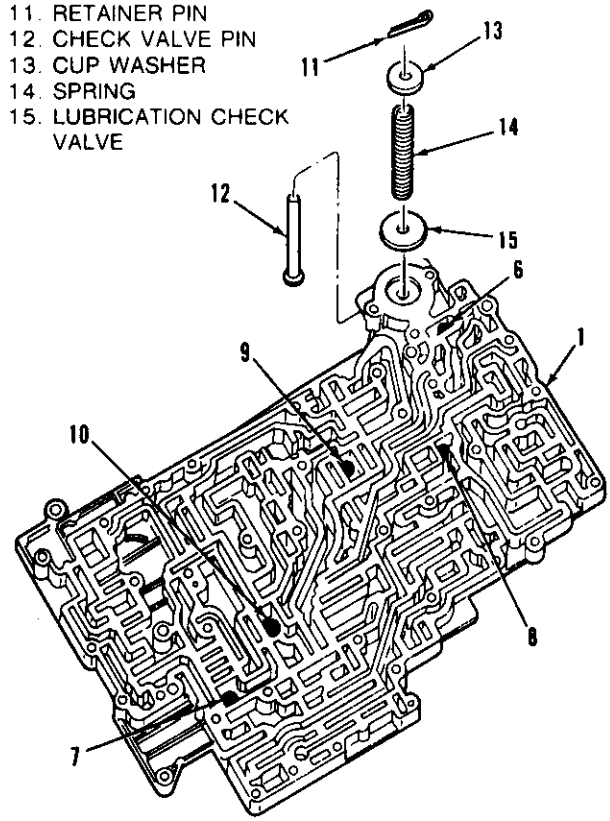
CAUTION

Do not allow oil transfer plate and separator plate to come apart until properly positioned. Check balls will fall out and may be lost or damaged.

(4) Turn oil transfer plate (1) and separator plate (2) over and place on bench.

(5) Remove separator plate (2) from oil transfer plate (1).

1. OIL TRANSFER PLATE
6. BALL (1/4")
7. BALL (1/4")
8. BALL (5/16")
9. BALL (1/4")
10. BALL (1/4")
11. RETAINER PIN
12. CHECK VALVE PIN
13. CUP WASHER
14. SPRING
15. LUBRICATION CHECK VALVE

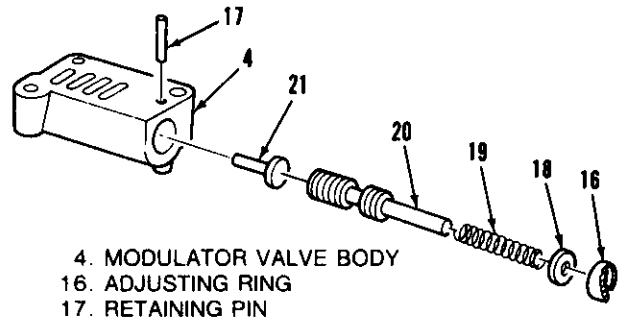


(6) Record and identify balls (6, 7, 8, 9, and 10) by size, color, and location for reassembly.

(7) Remove balls (6, 7, 8, 9, and 10) from oil transfer plate (1).

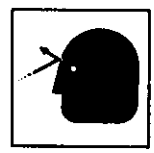
(8) Remove retainer pin (11) from check valve pin (12) while pushing down on cup washer (13).

(9) Remove cup washer (13), spring (14), lubrication check valve (15), and check valve pin (12) from oil transfer plate (1).



4. MODULATOR VALVE BODY
16. ADJUSTING RING
17. RETAINING PIN
18. WASHER
19. SPRING
20. MODULATOR VALVE
21. ACTUATOR

WARNING



All valves are under spring tension. Release springs slowly to avoid personal injury. Do not use magnets to remove valve bodies. Magnetized valve bodies may not work properly.

NOTE

Tag and mark all parts for later installation.

(10) Record notches on adjusting ring (16) so that retaining pin (17) can be installed in its original position.

(11) Press adjusting ring (16) inward and remove retaining pin (17) from modulator valve body (4).

(12) Remove adjusting ring (16), washer (18), spring (19), modulator valve (20), and actuator (21) from modulator valve body (4).

(26) Install six capscrews (1), new lockwashers (2), three plates (3), and three new gaskets (4) on each cylinder head. Tighten capscrews (1) securely.

(27) Install two capscrews (5), new lockwashers (6), new gasket (8), and lifting bracket (7) on rear of each cylinder head.

END OF TASK

NOTE

Follow-On Maintenance

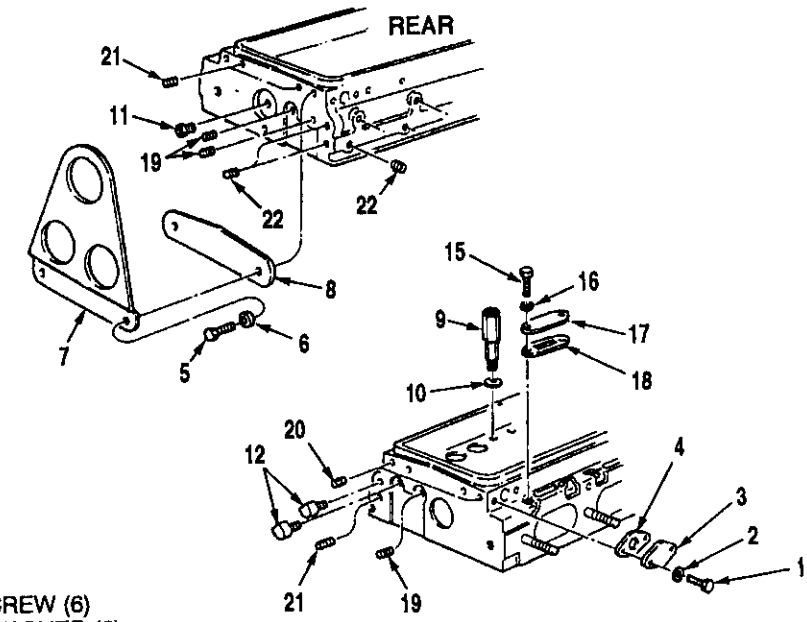
TM 2320-34/13
TM 9-2320-297-34

Install injectors (para 4-3).

Install valve operating mechanism (para 3-9).

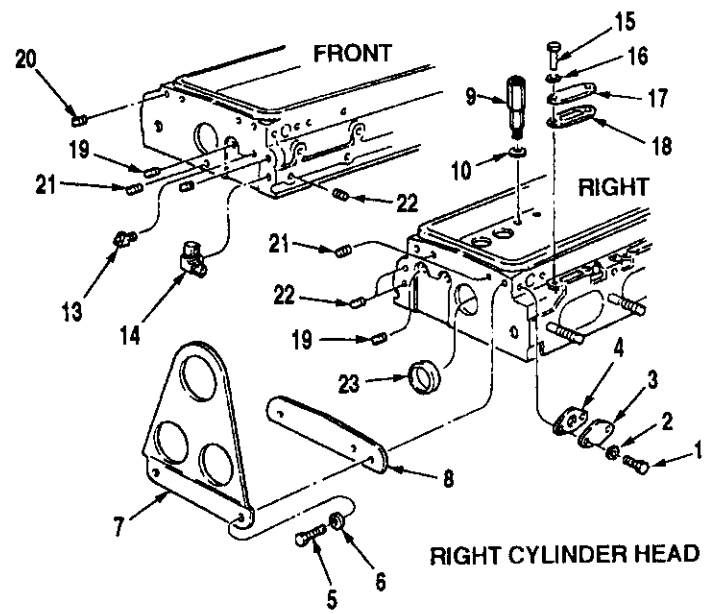
Install engine brake assemblies (para 3-15).

Install cylinder heads (para 3-3).



LEFT CYLINDER HEAD

1. CAPSCREW (6)
2. LOCKWASHER (6)
3. PLATE (3)
4. GASKET (3)
5. CAPSCREW (2)
6. LOCKWASHER (2)
7. LIFTING BRACKET
8. GASKET
9. FUEL PIPE CONNECTOR (8)
10. WASHER (8)
11. AIR COMPRESSOR ADAPTER
12. ELBOW (2)
13. ELBOW
14. CONNECTOR
15. CAPSCREW (8)
16. WASHER (8)
17. PLATE (4)
18. GASKET (8)
19. PLUG (5)
20. PLUG (3)
21. PLUG (4)
22. PLUG (25)
23. PLUG



RIGHT CYLINDER HEAD

7-10. CONTROL VALVE REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Special Tools

Spring tester (J 9666)

Materials/Parts

Solvent, dry cleaning (item 66, Appendix C)
Roll pin (MS16562-39) item 59

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Control valve body removed (para 7-5).

Special Environmental Conditions

Work in a clean area free of blowing dust.

---

a. Disassembly

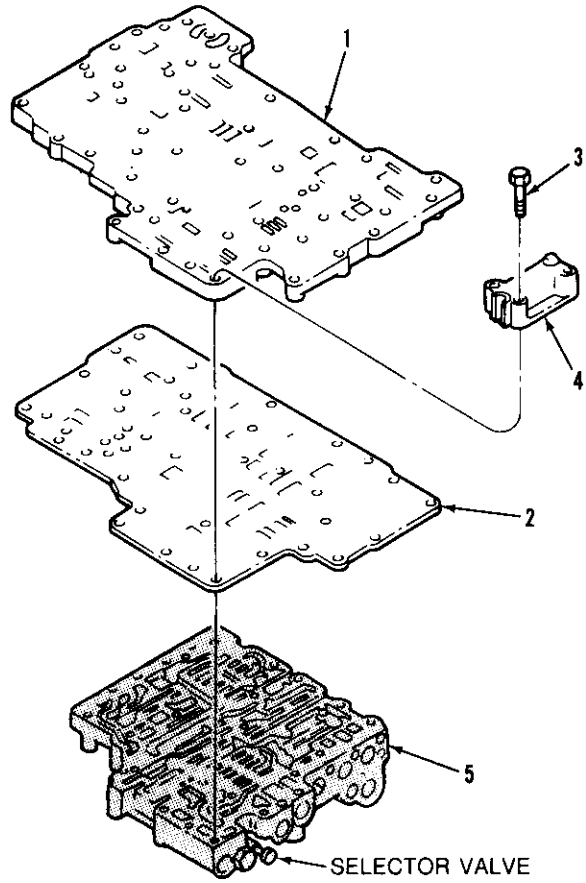
CAUTION

Do not let selector valve drop when removing control valve body or damage may result.

NOTE

- LVS transmissions might have one of two types of valve bodies. Differences in the valve bodies are slight, but differ enough to not allow interchangability of some parts. Locate the transmission serial number to identify the valve body style if replacement parts are needed. Serial numbers before and up to 2510086862 are considered an old style. Serial numbers after 2510086862 are considered a new style valve body. Refer to TM 2320-24P/14, TM 9-2320-297-24P for parts information.

- Repair procedures for either valve body style are the same.



1. OIL TRANSFER PLATE
2. SEPARATOR PLATE
3. CAPSCREW (3)
4. MODULATOR VALVE BODY
5. CONTROL VALVE BODY

TA 298829

3-5. VIBRATION DAMPER, FRONT COVER, AND OIL SEAL REPLACEMENT

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Oil seal installer (J9783)

Materials/Parts
Grease, GP (item 28, Appendix C)
Engine oil (item 46, Appendix C)
Lockwasher (6) (MS35338-45) item 4
Lockwasher (2) (MS35338-47) item 16
Lockwasher (8) (MS35338-48) items 21 and 26
Lockwasher (4) (MS35338-46) item 24
Gasket (NSN 5330-00745-7669) item 28
Oil seal (NSN 5330-00-154-8358) item 29

Personnel Required
1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Oil drained (para 3-3).
TM 2320-34/13 TM 9-2320-297-34	Power pack removed (para 3-17).
TM 2320-20/12 TM 9-2320-297-20	Oil pan removed (para 3-6).

a. Removal

(1) Remove capscrew (1). Secure crankshaft (2) so that it will not rotate.

(1.1) Remove washer (2.1).

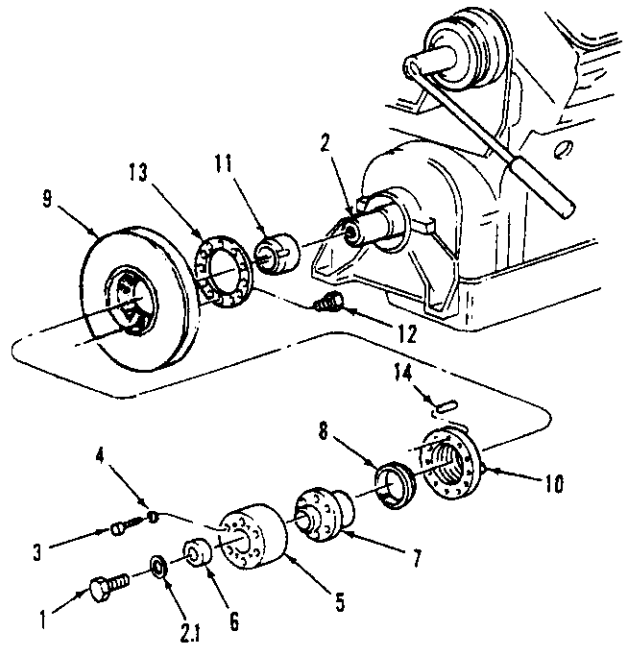
(2) Remove six Allen head capscrews (3) and lockwashers (4). Remove pump drive adapter (5). Discard lockwashers (4).

CAUTION

Use care when removing vibration damper (9). Pounding or prying can dent or damage vibration damper (9).

(3) Remove spacer (6) from pump drive adapter (5).

(4) Remove outer hub (7) and outer cone (8) from crankshaft (2). If needed, use a puller to remove outer hub (7).



1. CAPSCREW
2. CRANKSHAFT
2.1. WASHER
3. ALLEN HEAD CAPSCREW (6)
4. LOCKWASHER (6)
5. PUMP DRIVE ADAPTER
6. SPACER
7. OUTER HUB
8. OUTER CONE
9. VIBRATION DAMPER
10. INNER HUB
11. INNER CONE
12. CAPSCREW (8)
13. SCUFF PLATE
14. DOWEL PIN (2)

(4) Install first and second clutch lockup cutoff valve (8) and plug (7) into bore (9).

(5) Install pin (6) into valve body (2).

(6) Install second and third clutch lockup cutoff valve (4) and plug (3) into bore (5).

(7) Install pin (1) into valve body (2).

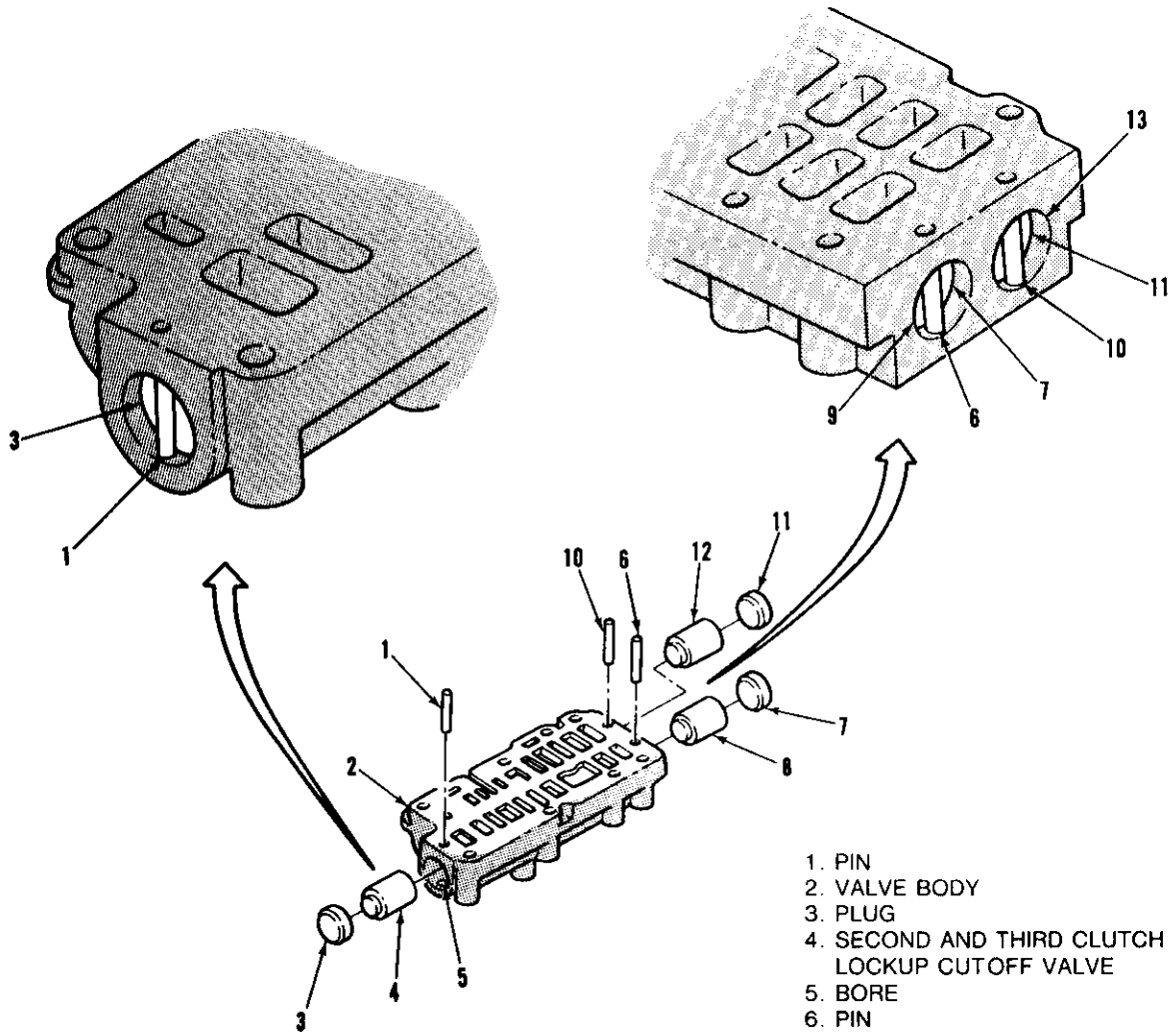
(8) Wrap valve body (2) in clean shop towels and set aside until transmission is assembled.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 Install lockup
TM 9-2320-297-34 cutoff valve (para 7-6).



1. PIN
2. VALVE BODY
3. PLUG
4. SECOND AND THIRD CLUTCH LOCKUP CUTOFF VALVE
5. BORE
6. PIN
7. PLUG
8. FIRST AND SECOND CLUTCH LOCKUP CUTOFF VALVE
9. BORE
10. PIN
11. PLUG
12. THIRD AND FOURTH CLUTCH LOCKUP CUTOFF VALVE
13. BORE

TA 298828

(5) Using a puller, remove vibration damper (9), inner hub (10), and inner cone (11) from end of crankshaft (2).

(6) Remove eight capscrews (12) and scuff plate (13).

(7) Separate vibration damper (9) from inner hub (10).

WARNING

Bottom support half (17) must be supported while removing capscrews (15).

(8) Remove two dowel pins (14) from inner hub (10), if damaged.

(9) Remove two capscrews (15) and lockwashers (16). Discard lockwashers (16).

(10) Remove two support halves (17) and ring (18) from trunnion plate (19).

(11) Remove four capscrews (20) and lockwashers (21). Discard lockwashers (21).

(12) Remove two capscrews (22), two capscrews (23), and four lockwashers (24). Discard lockwashers (24).

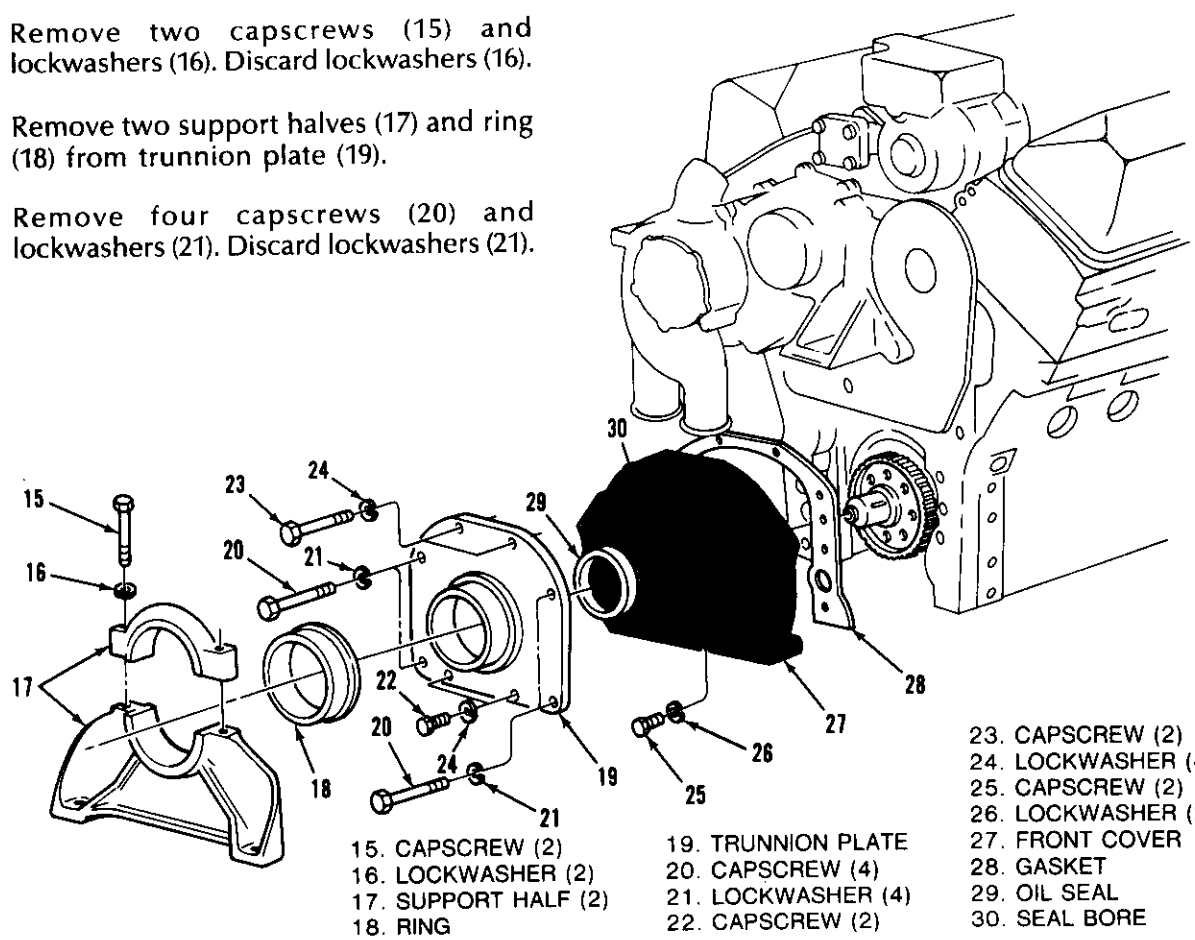
(13) Remove trunnion plate (19).

(14) Remove two capscrews (25) and lockwashers (26). Discard lockwashers (26).

(15) Remove front cover (27) and gasket (28). Discard gasket (28).

(16) Support front cover (27) on wooden blocks with oil seal (29) facing down.

(17) Drive oil seal (29) out of front cover (27). Discard oil seal (29).



15. CAPSCREW (2)
16. LOCKWASHER (2)
17. SUPPORT HALF (2)
18. RING
19. TRUNNION PLATE
20. CAPSCREW (4)
21. LOCKWASHER (4)
22. CAPSCREW (2)
23. CAPSCREW (2)
24. LOCKWASHER (4)
25. CAPSCREW (2)
26. LOCKWASHER (2)
27. FRONT COVER
28. GASKET
29. OIL SEAL
30. SEAL BORE

TA 298465

7-9. LOCKUP CUTOFF VALVE REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Crocus cloth (item 20, Appendix C)
Oil, OE/HDO-10 (item 44, Appendix C)

Equipment Condition TM

TM 2320-34/13
TM 9-2320-297-34

Condition Description

Lockup cutoff valve removed (para 7-5).

Special Environmental Conditions

Work in a clean area free of blowing dust.

---

a. Disassembly

CAUTION

When assembled, each valve must go into the same bore it was removed from. Tag and mark all parts for later installation.

(1) Using a 5/32 inch drift pin, remove pin (1) from valve body (2).

(2) Remove plug (3) and second and third clutch lockup cutoff valve (4) from bore (5).

(3) Remove pin (6) from valve body (2).

(4) Remove plug (7) and first and second clutch lockup cutoff valve (8) from bore (9).

(5) Remove pin (10) from valve body (2).

(6) Remove valve plug (11) and third and fourth clutch lockup cutoff valve (12) from bore (13).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect valve body and valves for nicks, burrs, or scratches. Remove defects with crocus cloth. If scratches are severe or part is cracked, replace part.

(3) Inspect pins (1, 6, and 10) for any damage caused during removal. Replace any damaged pin.

c. Assembly

NOTE

When dry, make sure each lockup cutoff valve moves freely in its bore. Apply lubricant oil to all parts.

(1) Apply oil to valve body (2).

(2) Install third and fourth clutch lockup cutoff valve (12) and plug (11) into bore (13).

(3) Install pin (10) into valve body (2).

3-5. VIBRATION DAMPER, FRONT COVER, AND OIL SEAL REPLACEMENT (Continued)

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Remove all traces of gasket material from front cover (27) and engine mating surface.

(3) Clean seal bore (30). Bore must be free of nicks and burrs.

(4) Inspect front cover (27) for cracks.

(5) Inspect two support halves (17), ring (18), and trunnion plate (19) for wear or damage.

(6) Inspect vibration damper (9) for nicks, dents, fluid leaks, or bulges in outer casing of damper.

(7) Inspect all other parts. Refer to paragraph 2-7 and replace all parts failing inspection.

c. Installation

NOTE

Do not remove lubricant or plastic coating from outer surface of new oil seal (29).

(1) Coat sealing lip of new oil seal (29) with grease.

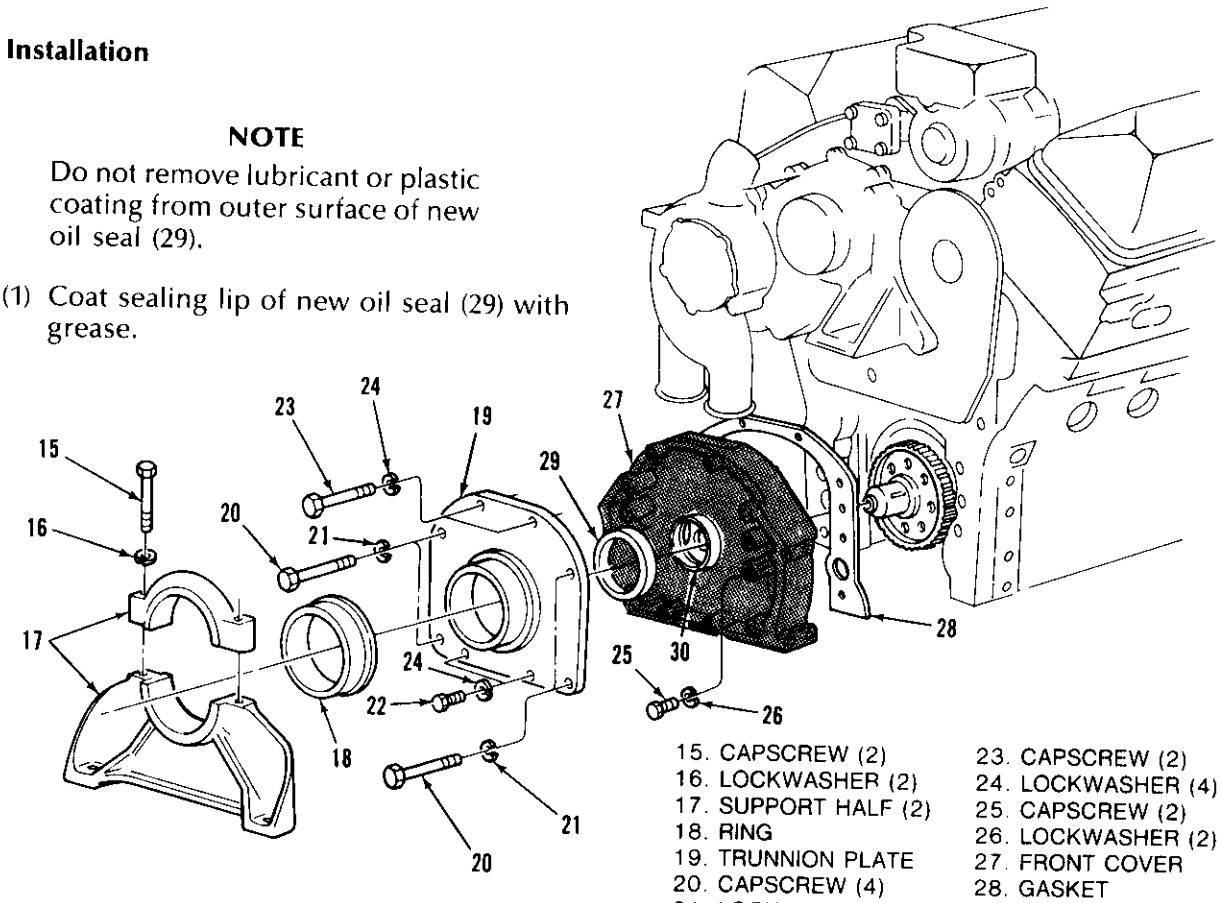
(2) Install new oil seal (29) into front cover (27).

(3) Install front cover (27) and new gasket (28) onto front of engine.

(4) Install two capscrews (25) and new lockwashers (26). Torque capscrews (25) to 80-90 foot-pounds (108-122 N·m).

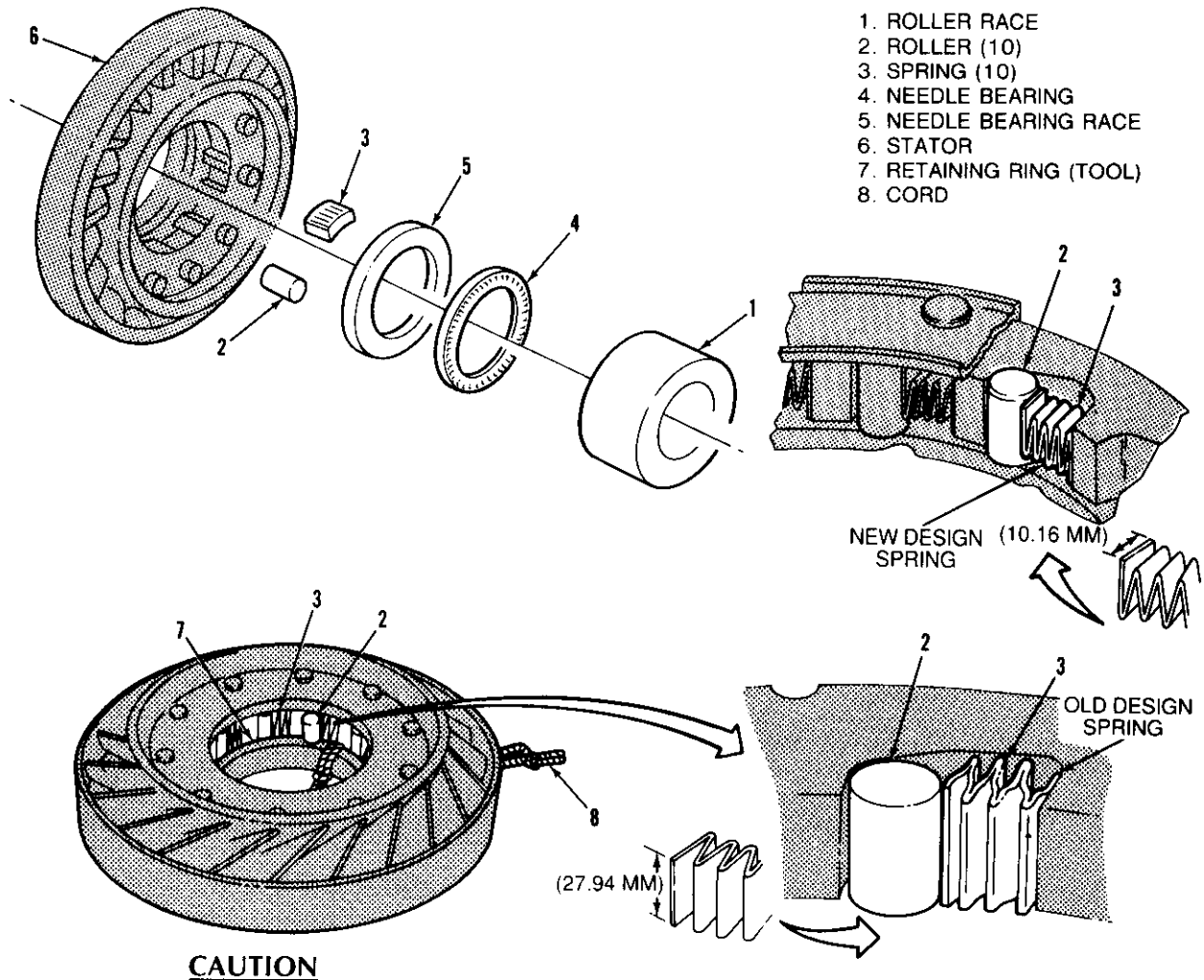
(5) Install trunnion plate (19) with capscrews (20, 22, and 23) and new lockwashers (21 and 24). Torque two capscrews (22) and capscrews (23) to 25-30 foot-pounds (33-40 N·m). Torque four capscrews (20) to 80-99 foot-pounds (108-122.04 N·m).

(6) Install ring (18) onto trunnion plate (19).



15. CAPSCREW (2)
16. LOCKWASHER (2)
17. SUPPORT HALF (2)
18. RING
19. TRUNNION PLATE
20. CAPSCREW (4)
21. LOCKWASHER (4)
22. CAPSCREW (2)
23. CAPSCREW (2)
24. LOCKWASHER (4)
25. CAPSCREW (2)
26. LOCKWASHER (2)
27. FRONT COVER
28. GASKET
29. OIL SEAL
30. SEAL BORE

TA 298466



CAUTION

If new springs are installed, do not mix old springs with new springs. Equipment damage could result.

NOTE

Stator might have either old design 1.10 in. (27.94 mm) high spring or new design .40 in. (10.16 mm) wide spring.

(4) Install 10 springs (3) into stator (6) cam pockets.

(5) Install 10 rollers (2).

(6) Place needle bearing (4) onto roller race (1). Install roller race (1) into stator (6) by turning clockwise. Stop near retaining ring (7).

(7) Remove retaining ring (7) from bottom by pulling cord (8).

(8) Seat roller race (1), then twist it counterclockwise to lock in place.

(9) Store stator (6) with roller race (1) up, in a clean, dry place until transmission is assembled.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install stator (para 7-6).

(7) Install two capscrews (15) and new lockwashers (16) into support halves (17).

(8) Install two support halves (17) onto ring (18). Tighten two capscrews (15) securely.

(9) Install two new dowel pins (14), if removed. Place vibration damper (9) on inner hub (10) and over dowel pins (14).

(10) Place scuff plate (13) over dowel pins (14) and against vibration damper (9).

(11) Install eight capscrews (12) and torque to 75-85 foot-pounds (102-115 N·m).

(12) Lubricate bore of inner cone (11) with clean engine oil.

(13) Install inner cone (11) on crankshaft (2) with split facing out.

(14) Slide vibration damper (9) and inner hub (10) on crankshaft (2).

(15) Install outer cone (8) and outer hub (7).

(16) Lubricate six Allen head capscrews (3) with clean engine oil. Install pump drive adapter (5) using six Allen head capscrews (3) and new lockwashers (4). Torque Allen head capscrews (3) to 13 foot-pounds (17.6 N·m).

■ (17) Install capscrew (1), washer (2.1), and cone (6).

(18) Torque capscrew (1) as follows:

(a) Torque capscrew (1) to 180 foot-pounds (244 N·m).

(b) Deliver a sharp blow to end of capscrew (1) with a two to three pound soft-faced hammer.

(c) Torque capscrew (1) to 300 foot-pounds (407 N·m) and strike capscrew (1) again.

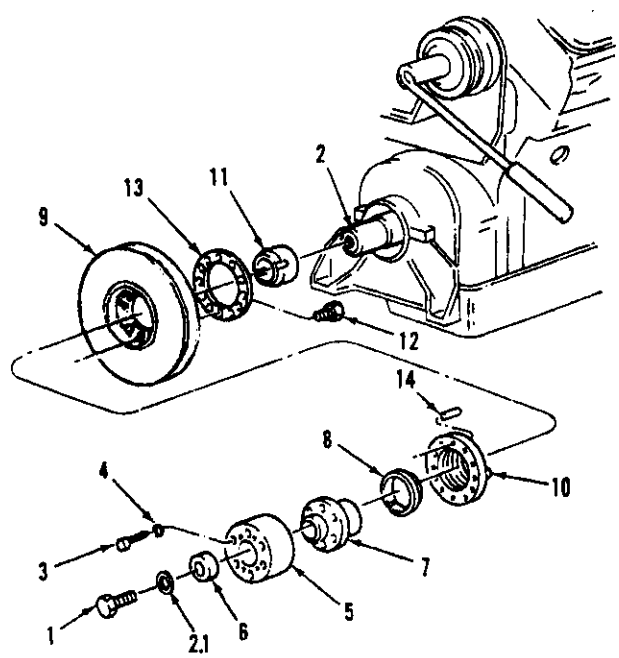
(d) Torque capscrew (1) to 290-310 foot-pounds (393-421 N·m).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install power pack (para 3-17).
TM 2320-20/12 TM 9-2320-297-20	Install oil pan (para 3-6).
	Fill engine with oil (para 3-3).



1. CAPSCREW
2. CRANKSHAFT
■ 2.1. WASHER
3. ALLEN HEAD CAPSCREW (6)
4. LOCKWASHER (6)
5. PUMP DRIVE ADAPTER
6. SPACER
7. OUTER HUB
8. OUTER CONE
9. VIBRATION DAMPER
10. INNER HUB
11. INNER CONE
12. CAPSCREW (8)
13. SCUFF PLATE
14. DOWEL PIN (2)

7-8. STATOR REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP

Special Tools

Stator cam spring and roller retainer ring (J 24218-2)
Micrometer set 0-6" outside (NSN 5120-00-554-7134)

Equipment Condition TM: TM 2320-34/13, TM 9-2320-297-34
Condition Description: Stator removed (para 7-5).

Special Environmental Conditions

Work in a clean area free of blowing dust.

a. Disassembly

CAUTION

During disassembly all parts must be handled with care to avoid nicking, scratching, or denting. Close fitting parts can bind if damaged or scratched.

NOTE

When roller race (1) is removed, rollers (2), and springs (3) will fall out.

(1) Rotate roller race (1) clockwise and remove.

(2) Collect 10 rollers (2) and springs (3).

(3) Remove needle bearing (4) and needle bearing race (5) from stator (6).

b. Cleaning Clean all parts. Refer to paragraph 2-6.

c. Inspection

(1) Inspect stator (6) for:

(a) Loose or broken vanes

(b) Loose rivets

(c) Cracks or burrs

(2) Measure needle bearing race (5). Replace if less than 0.029 inch (0.74 mm) thick.

(3) Measure outside diameter of roller race (1). Replace if diameter is less than 3.998 inches (10.155 cm).

(4) Visually inspect 10 rollers (2) and springs (3) for wear and weakness.

(5) Inspect all other parts. Refer to paragraph 2-7. Replace all parts failing inspection.

d. Assembly

(1) Place stator (6) rear side up.

(2) Install needle bearing race (5) into stator (6).

NOTE

Retaining ring (7) has a cord (8) attached to allow retaining ring (7) to be pulled from the bottom of stator (6).

(3) Install rubber retaining ring (7) into stator (6). Make sure cord (8) hangs out the bottom.

CAUTION

To insure proper operation, rollers and roller springs must be installed as shown.

3-6. REAR OIL SEAL REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Oil seal expander (J 4239)
Stud set (J 25002)
Flywheel housing seal installer (J 21112-B)

Materials/Parts

Engine oil (item 46, Appendix C
Metal screw (2) (MS51861-50) item 2
Flat washer (2) (MS27183-8) item 3
Oil seal (NSN 5330-01-129-9455) item 8

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Transmission removed (para 7-4). Flexplate removed (para 3-8).

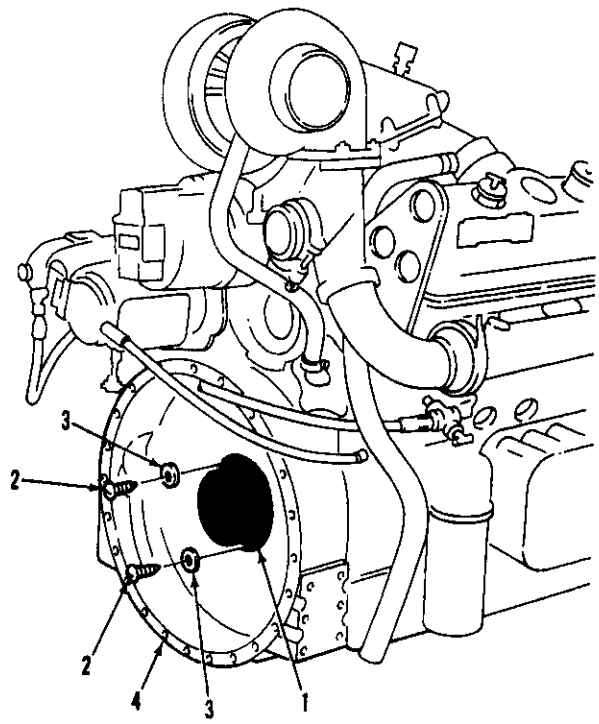
---

a. Removal

(1) Center punch two holes opposite each other in oil seal casing (1).

(2) Install two 10 x 1-1/4 metal screws (2) and flat washers (3).

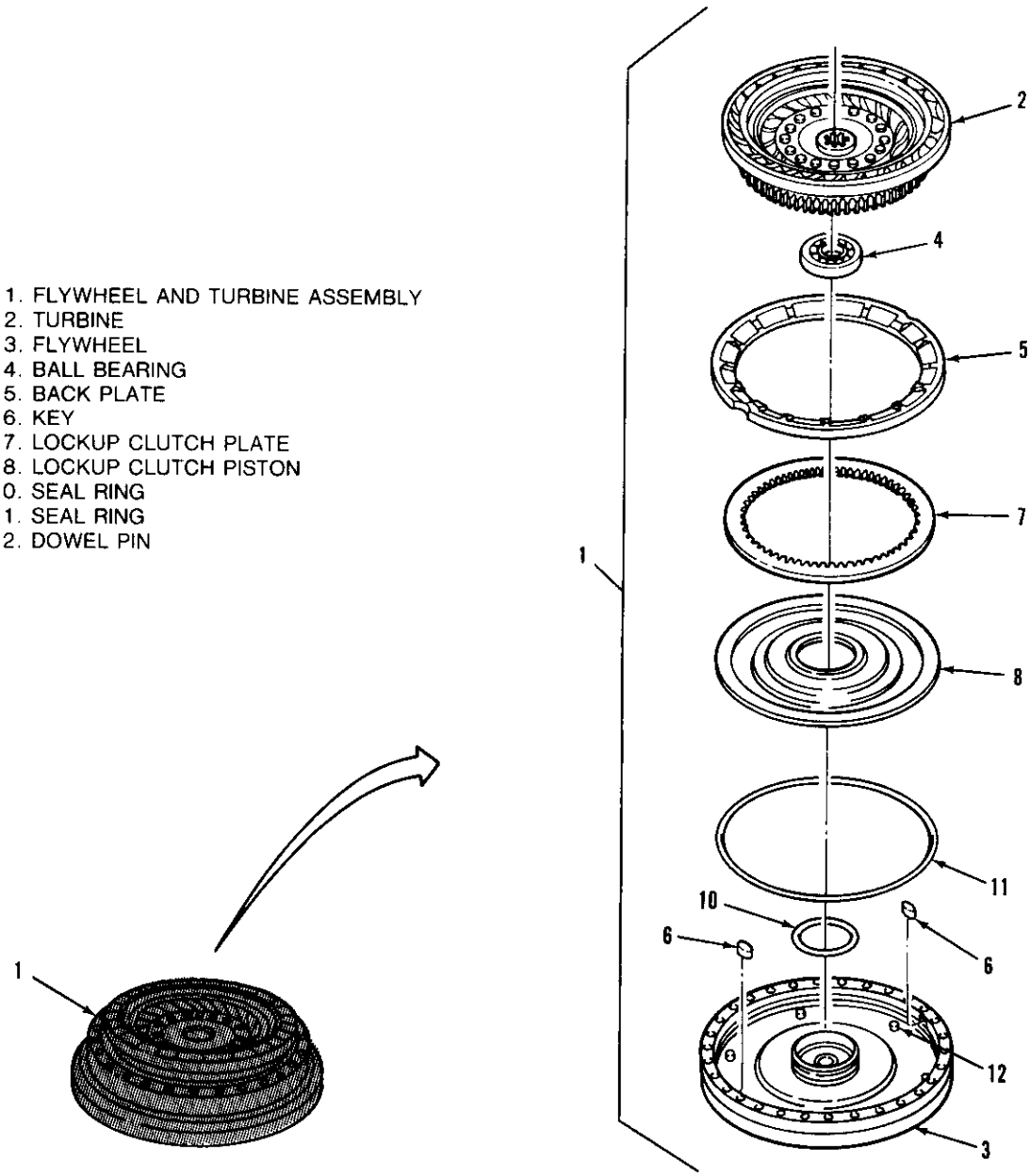
(3) Pry against flat washers (3) and remove oil seal (8) from flywheel housing (4). Remove two metal screws (2) and flat washers (3) from oil seal (8). Discard oil seal (8).



1. OIL SEAL CASING
2. METAL SCREW (2)
3. FLAT WASHER (2)
4. FLYWHEEL HOUSING

TA 298467

1. FLYWHEEL AND TURBINE ASSEMBLY
2. TURBINE
3. FLYWHEEL
4. BALL BEARING
5. BACK PLATE
6. KEY
7. LOCKUP CLUTCH PLATE
8. LOCKUP CLUTCH PISTON
10. SEAL RING
11. SEAL RING
12. DOWEL PIN



TA 298826

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Clean contact surfaces of crankshaft (5) and oil seal (8).

(3) Inspect crankshaft (5) for burrs or nicks.

(4) Replace all parts failing inspection.

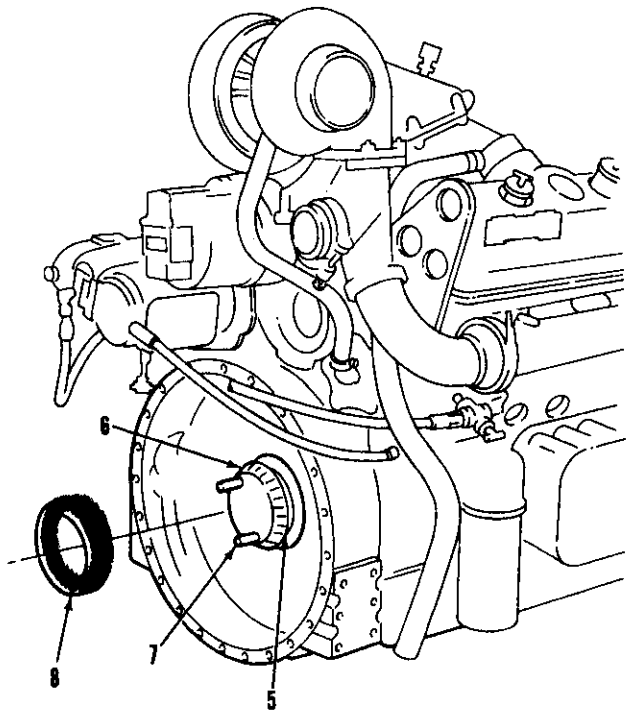
c. Installation

NOTE

If a wear sleeve is on crankshaft (5), an oversized oil seal (8) must be used.

(1) Install oil seal expander (6) and two guide studs (7) on crankshaft (5).

(2) Lubricate crankshaft (5), oil seal expander (6), and ID of oil seal (8) with clean engine oil.



5. CRANKSHAFT
6. OIL SEAL EXPANDER
7. GUIDE STUD (2)
8. OIL SEAL

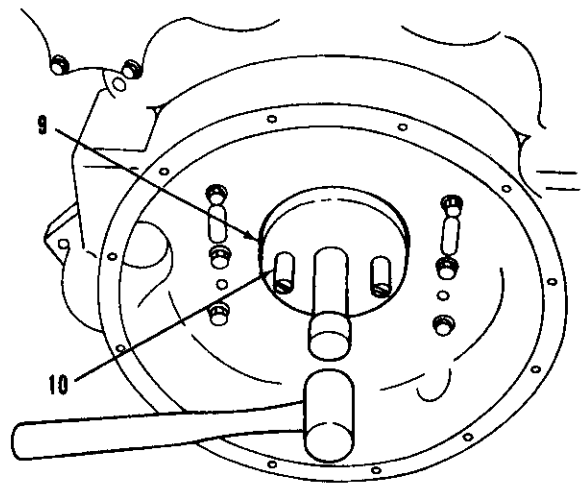
(3) With lip of new oil seal (8) facing towards crankshaft (5), install new oil seal (8) over oil seal expander (6) and onto crankshaft (5).

(4) Remove oil seal expander (6) and two guide studs (7).

(5) Install flywheel housing seal installer (9) and two guide assemblies (10).

(6) Drive oil seal (8) until flywheel housing seal installer (9) seats against crankshaft (5).

9. FLYWHEEL HOUSING SEAL INSTALLER
10. GUIDE ASSEMBLY (2)



TA 298468

(7) Remove flywheel housing seal installer (9) and two guide assemblies (10).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13
TM 9-2320-297-34

Install flexplate assembly (para 3-8).

Install transmission (para 7-4).

7-7. FLYWHEEL REPAIR (Continued)

d. Assembly

(1) Place flywheel (3) face down on bench.

(2) Coat new sealring (10) with lubricating oil and install on flywheel (3).

(3) Coat new sealring (11) with lubricating oil and install on lockup clutch piston (8).

(4) Put a pencil mark on edge of lockup clutch piston (8) opposite a dowel pin hole. Also place a pencil mark in the flywheel (3) bore opposite a dowel pin (12).

(5) Aline pencil marks on lockup clutch piston (8) and flywheel (3). Install lockup clutch piston (8) into flywheel (3). Make sure dowels in flywheel (3) engage recesses in lockup clutch piston (8).

(6) Install two keys (6) in flywheel (3).

(7) Soak lockup clutch plate (7) in lubricating oil for at least 2 minutes. Install lockup clutch plate (7).

(8) Line up back plate (5) with key (6) and install flat side first.

(9) Install ball bearing (4) on turbine (2), if removed.

(10) Center the lockup clutch plate (7) in flywheel (3).

(11) Install turbine (2). Make sure splines are engaged and that turbine is fully seated.

(12) Store flywheel and turbine assembly (1) in a clean, dry place until transmission is assembled.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 Install flywheel
TM 9-2320-297-34 (para 7-6).

3-7. FLYWHEEL HOUSING REPLACEMENT

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Stud set alinement (J 1927-01)

Materials/Parts
Adhesive, sealant silicone (item 7, Appendix C)
Engine oil (item 46, Appendix C)
Lockwasher (16) (MS35338-47) items 2, 6, 8, 12, 17, 31, 37
Capscrew (2) (NSN 5306-01-157-8909) items 5 and 11
Copper washer (NSN 5310-00-264-1939) item 19
Lockwasher (4) (MS35338-48) item 21
Lockwasher (AN960-716) item 23
Lockwasher (15) (MS35338-46) items 26, 48, 53, 69, 72, 75, 78
Capscrew (3) (P/N 189950) item 34
Gasket (3) (NSN 5330-01-109-6608) item 39
Capscrew (6) (MS90725-61) item 40
Lockwasher (2) (P/N 5137275) items 44 and 45
Capscrew (NSN 5306-01-084-4413) item 46
Gasket (P/N 23520287) item 55
Gasket (NSN 5330-01-088-5984) item 66
Gasket (P/N 5104506) item 24.1
Gasket (P/N 5104507) item 33.1

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Power pack removed (para 3-17).
	Engine mounted on stand (para 3-18).
TM 2320-20/12 TM 9-2320-297-20	Exhaust crossover tube removed (para 5-4).
	Alternator and adapter removed (para 7-4).
TM 2320-34/13 TM 9-2320-297-34	Turbocharger and adapter removed (para 4-10).
	Air compressor removed (para 11-7).
TM 2320-20/12 TM 9-2320-297-20	Starter removed (para 7-7).
	Oil pan removed (para 3-6).
TM 2320-34/13 TM 9-2320-297-34	Flexplates removed (para 3-8).
	Blower drive shaft removed (para 4-8).

a. Removal

(1) Remove two capscrews (1), lockwashers (2), and washers (3) from bracket (4). Discard lockwashers (2).

(2) Remove capscrew (5), lockwasher (6), and bracket (4). Discard capscrew (5) and lockwasher (6).

c. Inspection

(1) Inspect lockup clutch plate (7) for the following:

(a) Minimum thickness of 0.190 inch (4.82 mm).

(b) Minimum oil groove depth of 0.008 inch (0.203 mm)

NOTE

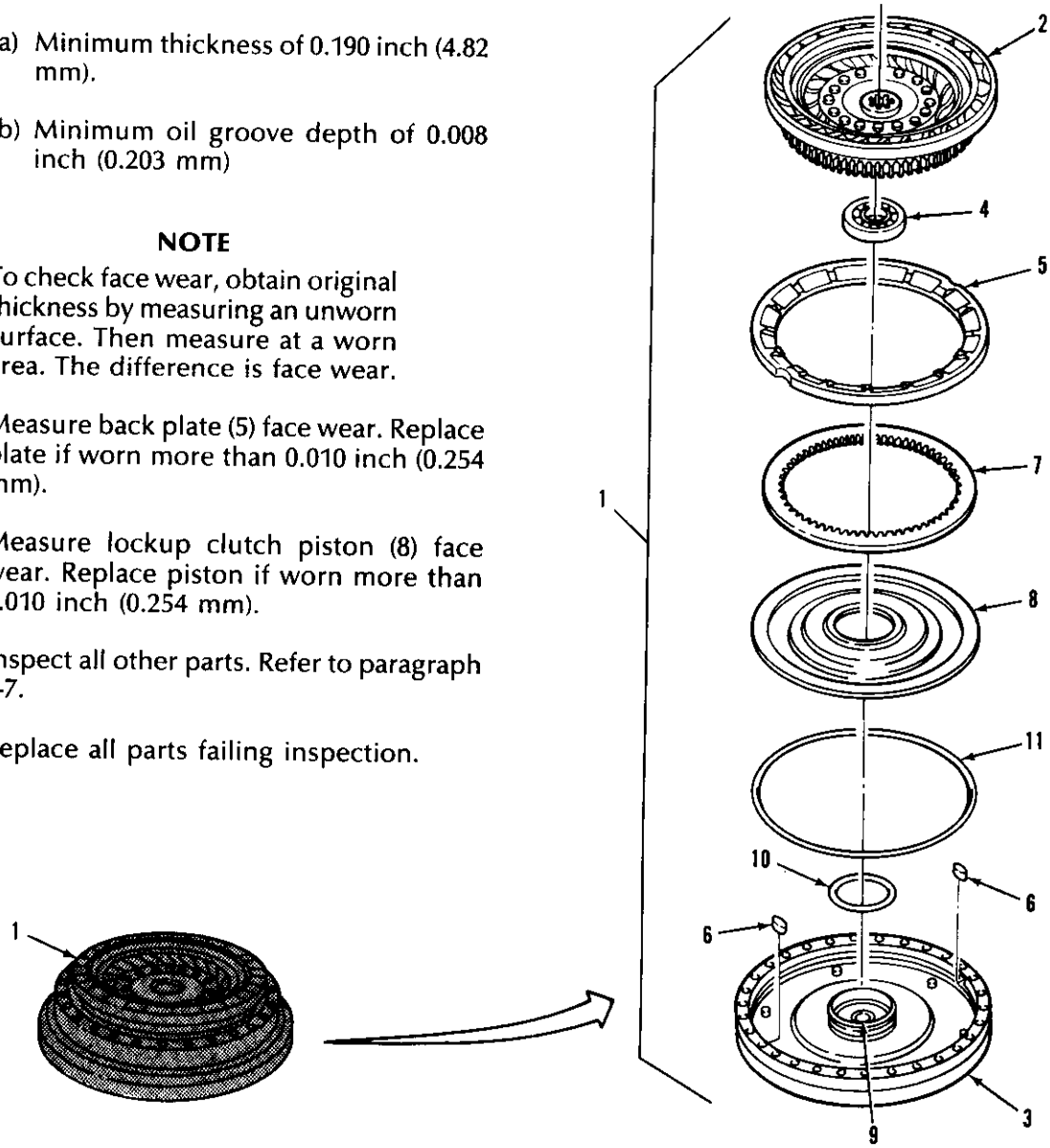
To check face wear, obtain original thickness by measuring an unworn surface. Then measure at a worn area. The difference is face wear.

(2) Measure back plate (5) face wear. Replace plate if worn more than 0.010 inch (0.254 mm).

(3) Measure lockup clutch piston (8) face wear. Replace piston if worn more than 0.010 inch (0.254 mm).

(4) Inspect all other parts. Refer to paragraph 2-7.

(5) Replace all parts failing inspection.



1. FLYWHEEL AND TURBINE ASSEMBLY
2. TURBINE
3. FLYWHEEL
4. BALL BEARING
5. BACK PLATE
6. KEY (2)
7. LOCKUP CLUTCH PLATE
8. LOCKUP CLUTCH PISTON
9. AIR HOLE
10. SEAL RING
11. SEAL RING

TA 298825

(3) Remove two capscrews (7), lockwashers (8), and washers (9) from bracket (10). Discard lockwashers (8).

(4) Remove capscrew (11), lockwasher (12), and bracket (10). Discard capscrew (11) and lockwashers (12).

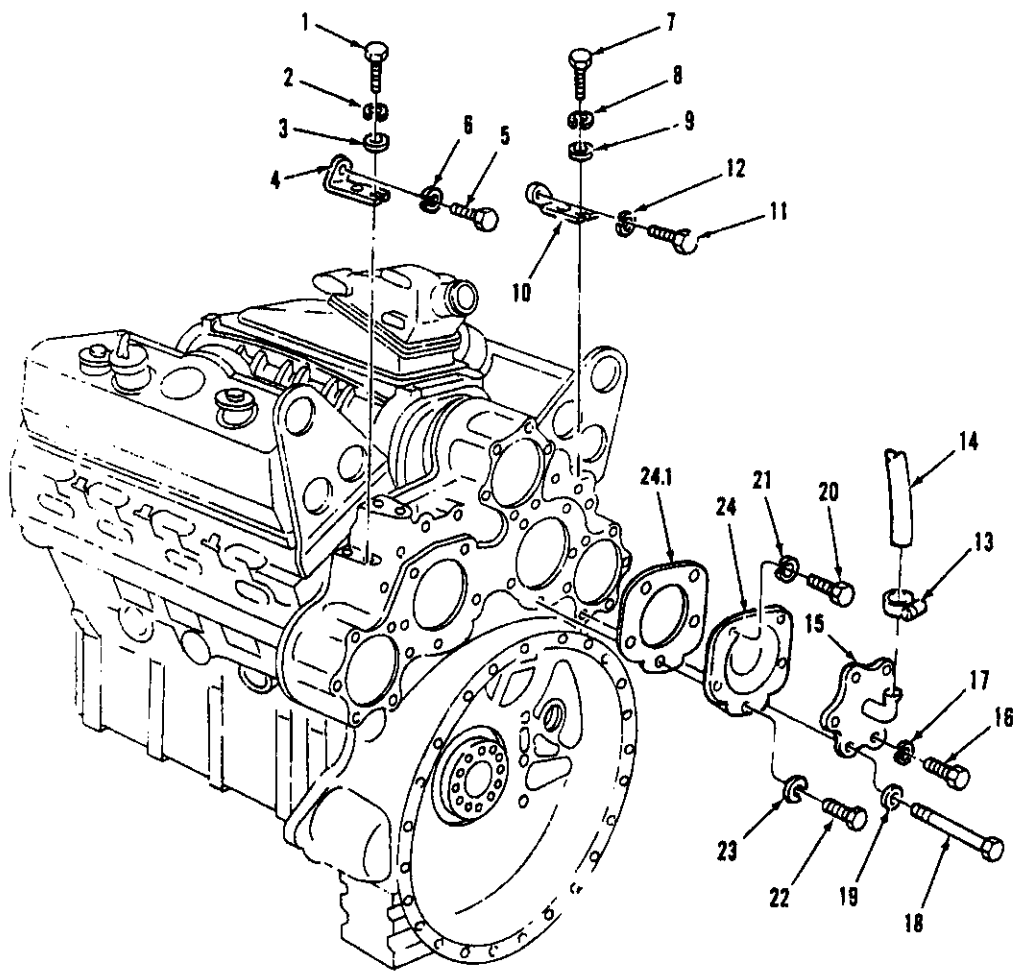
NOTE

When removing the flywheel housing capscrews, note the location of the various size capscrews, lockwashers, flat washers, and copper washers so they may be installed in their proper location.

(5) Loosen clamp (13) and remove turbocharger oil return hose (14) from cover (15).

(6) Remove five capscrews (16), lockwashers (17), capscrew (18), and copper washer (19) from cover (15). Discard copper washer (19) and lockwashers (17).

(7) Remove four capscrews (20), lockwashers (21), capscrew (22), lockwasher (23), gasket (24.1), and cover (24). Discard lockwashers (21), lockwasher (23), and gasket (24.1).



1. CAPSCREW (2)
2. LOCKWASHER (2)
3. WASHER (2)
4. BRACKET
5. CAPSCREW
6. LOCKWASHER
7. CAPSCREW (2)
8. LOCKWASHER (2)
9. WASHER (2)
10. BRACKET
11. CAPSCREW
12. LOCKWASHER
13. CLAMP
14. TURBOCHARGER OIL RETURN HOSE
15. COVER
16. CAPSCREW (5)
17. LOCKWASHER (5)
18. CAPSCREW
19. COPPER WASHER
20. CAPSCREW (4)
21. LOCKWASHER (4)
22. CAPSCREW
23. LOCKWASHER
24. COVER
24.1. GASKET

Section V. TRANSMISSION SUBASSEMBLY CLEANING, INSPECTION AND REPAIR

7-7. FLYWHEEL REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Micrometer set 0-6" outside (NSN 5120-00-554-7134)

Materials/Parts

Oil, OE/HDO-10 (item 44, Appendix C)
Sealring (NSN 5330-00-999-3760) item 10
Sealring (NSN 5330-00-582-0456) item 11

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Flywheel removed (para 7-5).

Special Environmental Conditions

Work in a clean area free of blowing dust.

---

a. Disassembly

WARNING

Torque converter turbine may fall free from flywheel when moving. Extra care must be taken when moving flywheel and turbine assembly to avoid serious injury to personnel.

CAUTION

During disassembly all parts must be handled with care to avoid nicking, scratching, or denting. Close fitting parts can bind if damaged or scratched.

(1) Place flywheel and turbine assembly (1) on bench with turbine (2) side up.

CAUTION

Torque converter turbine must be evenly pried up and off of flywheel. Use shop towels at two pry points to prevent scoring or other damage to turbine or flywheel.

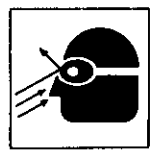
(2) Remove turbine (2) from flywheel (3).

(3) Remove ball bearing (4) from turbine (2) only if replacement is needed.

(4) Remove back plate (5) from flywheel (3). Remove two keys (6).

(5) Remove lockup clutch plate (7).

WARNING



Compressed air can create airborn particles that may enter the eyes. Pressure will not exceed 30 psi. Eye protection is required.

(6) Remove lockup clutch piston (8) by applying air pressure to air hole (9) in center of flywheel (3).

(7) Remove and discard sealrings (10 and 11).

b. Cleaning Clean all parts. Refer to paragraph 2-6.

3-7. FLYWHEEL HOUSING REPLACEMENT (Continued)

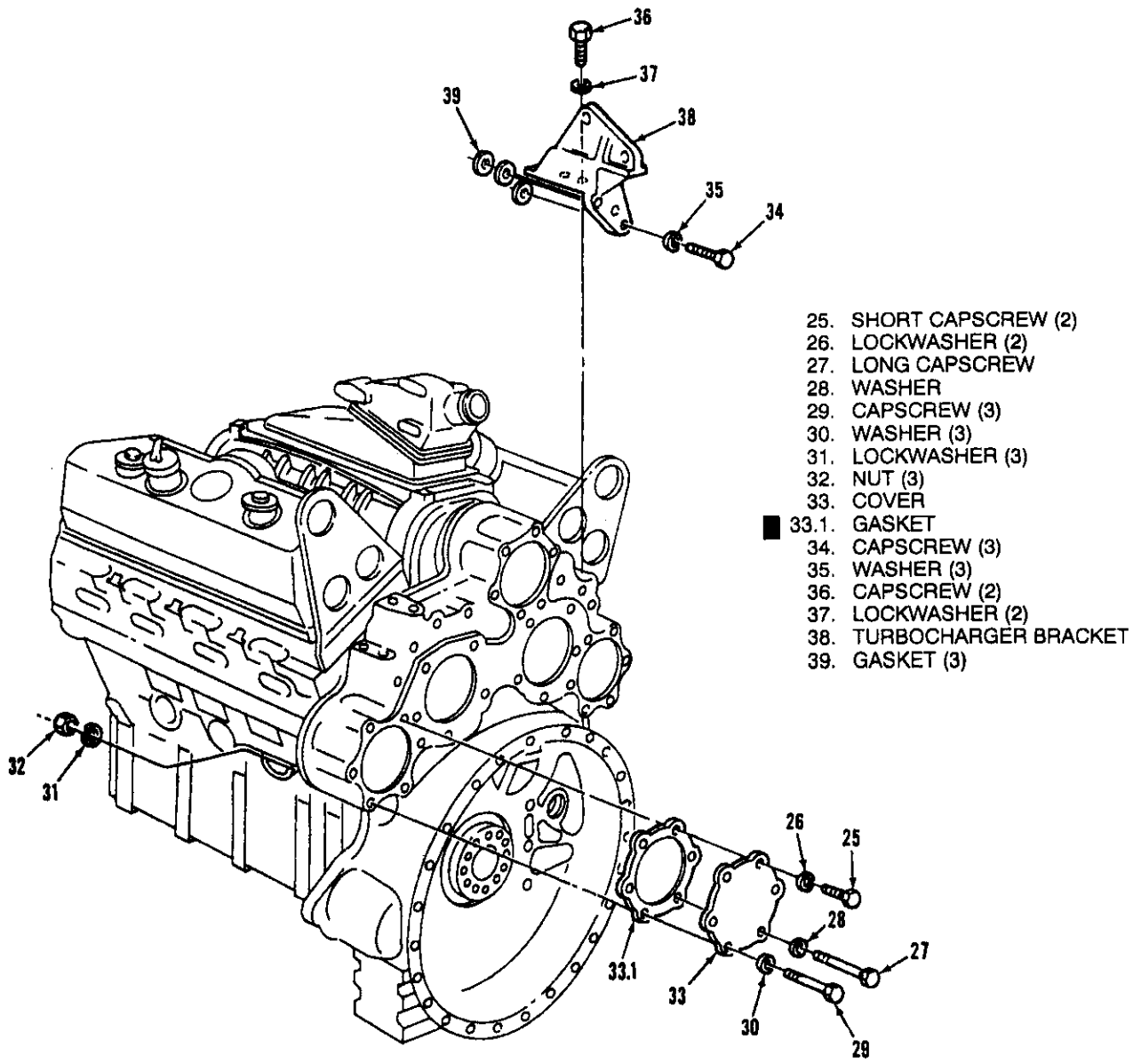
(8) Remove two short capscrews (25) and lockwashers (26). Discard lockwashers (26).

(9) Remove one long capscrew (27) and washer (28).

(10) Remove three remaining capscrews (29), washers (30), lockwashers (31), and nuts (32). Discard lockwashers (31).

(11) Remove cover (33) and gasket (33.1). Discard gasket (33.1).

(12) Remove three capscrews (34) and washers (35). Discard three capscrews (34). Remove two capscrews (36), lockwashers (37), turbocharger bracket (38), and three gaskets (39). Discard gaskets (39) and lockwashers (37).



25. SHORT CAPSCREW (2)
26. LOCKWASHER (2)
27. LONG CAPSCREW
28. WASHER
29. CAPSCREW (3)
30. WASHER (3)
31. LOCKWASHER (3)
32. NUT (3)
33. COVER
33.1. GASKET
34. CAPSCREW (3)
35. WASHER (3)
36. CAPSCREW (2)
37. LOCKWASHER (2)
38. TURBOCHARGER BRACKET
39. GASKET (3)

q. Final Assembly

(1) Remove transmission (1) from overhaul stand.

(2) If removed, install four new lockwashers (107) with capscrews (108).

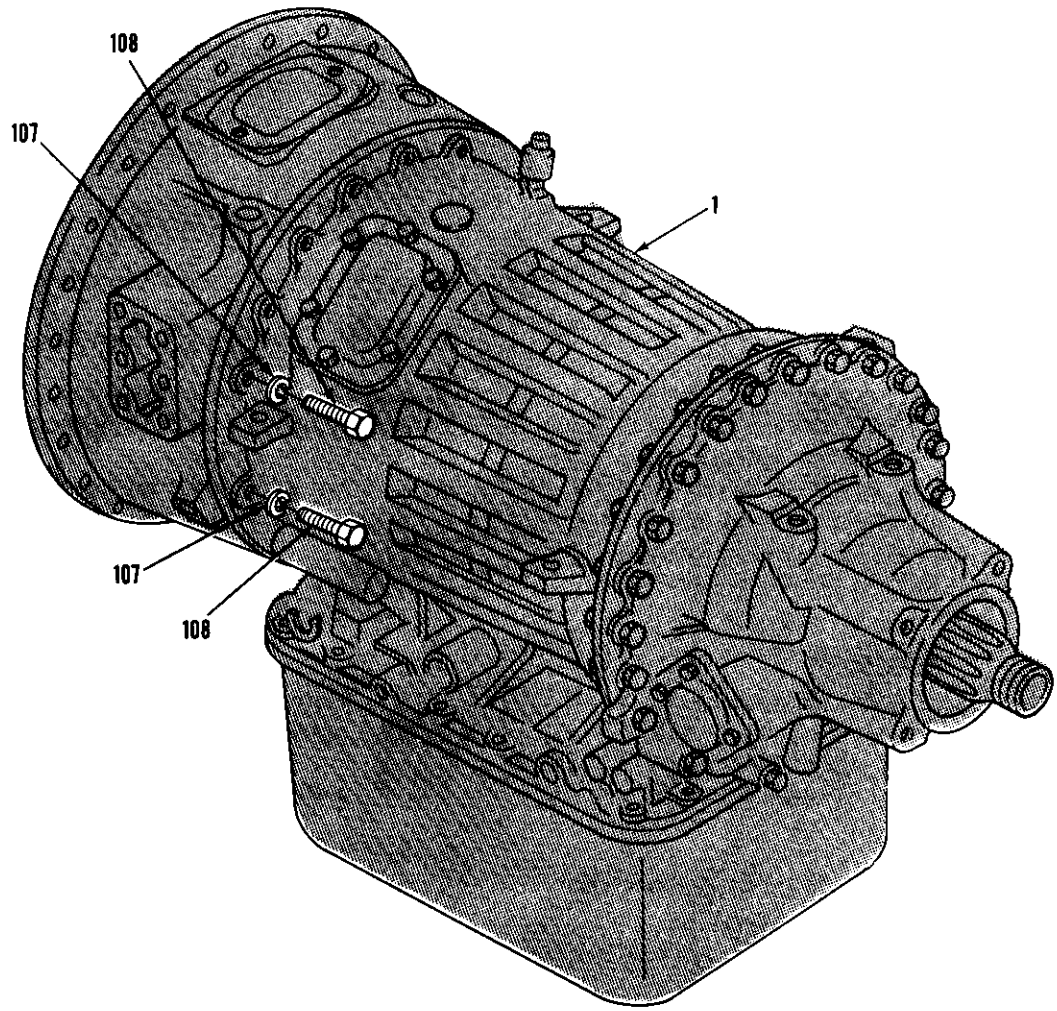
(3) Torque capscrews (108) to 70-80 foot-pounds (95-108 N·m).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install governor (para 8-9).
TM 2320-34/13 TM 9-2320-297-34	Install flange and nut (para 7-3).
	Install transmission (para 7-4).



1. TRANSMISSION
107. LOCKWASHER (4)
108. CAPSCREW (4)

TA 298824

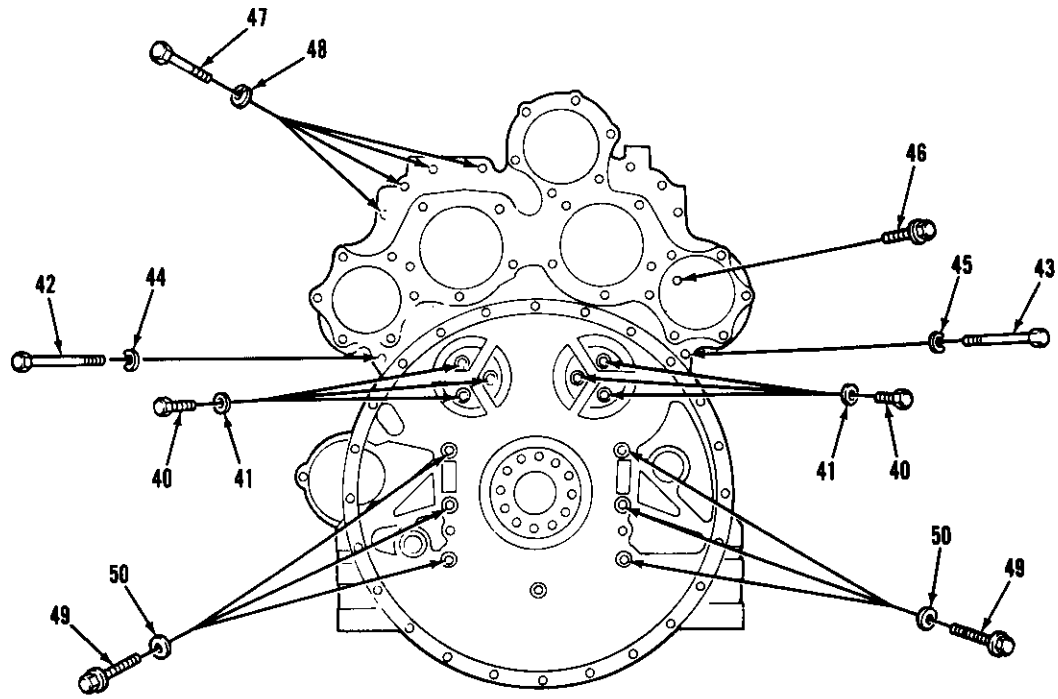
(13) Remove six capscrews (40) and washers (41). Discard six capscrews (40).

(14) Remove two capscrews (42 and 43) and lockwashers (44 and 45). Discard lockwashers (44 and 45).

(15) Remove and discard capscrew (46).

(16) Remove four capscrews (47) and lockwashers (48). Discard lockwashers (48).

(17) Remove six capscrews (49) and washers (50).



40. CAPSCREW (6)
41. WASHER (6)
42. CAPSCREW
43. CAPSCREW
44. LOCKWASHER
45. LOCKWASHER
46. CAPSCREW
47. CAPSCREW (4)
48. LOCKWASHER (4)
49. CAPSCREW (6)
50. WASHER (6)

TA 298471

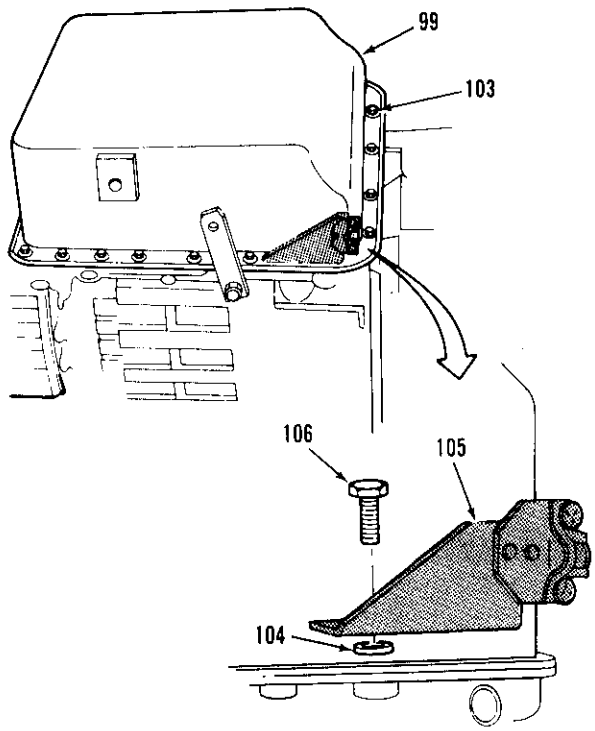
7-6. TRANSMISSION REASSEMBLY FROM SUBASSEMBLIES (Continued)

(5) Install two spacers (104), bracket (105), and two capscrews (106) in oil pan (99) as marked during disassembly.

CAUTION

To avoid parts damage, oil pan must be drawn evenly to the transmission.

(6) Starting with center capscrew on each side of oil pan (99), torque all 23 capscrews (103 and 106), working alternately toward ends of oil pan (99). Torque capscrews to 10-13 foot-pounds (13.6-17.6 N·m).



99. OIL PAN
103. CAPSCREW (21)
104. SPACER (2)
105. BRACKET
106. CAPSCREW (2)

TA 298823

3-7. FLYWHEEL HOUSING REPLACEMENT (Continued)

(18) Install four alining studs (51).

(19) Remove capscrew (52) and lockwasher (53) from both sides of flywheel housing (54). Discard lockwashers (53).

(20) Install lifting sling and remove flywheel housing (54) and gasket (55). Discard gasket (55).

(21) Remove four alining studs (51).

(22) Remove lifting sling.

(23) Remove pipe plugs (56, 57, and 58), if necessary.

(24) Remove and discard oil seal (59).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Clean all mating surfaces.

(3) Inspect flywheel housing (54) for cracks or other damage.

(4) Inspect crankshaft (60) for damage.

(5) Inspect all parts. Refer to paragraph 2-7.

(6) Replace all parts failing inspection.

c. Installation

NOTE

Apply pipe sealant to all pipe plugs.

(1) Install pipe plugs (56, 57, and 58). Tighten securely.

(2) DELETED

(3) Check capscrew (61) for installation and proper torque of 103-110 foot-pounds (140-149 N·m).

(4) Lubricate gear train (62) with clean engine oil.

(5) Install four alining studs (51).

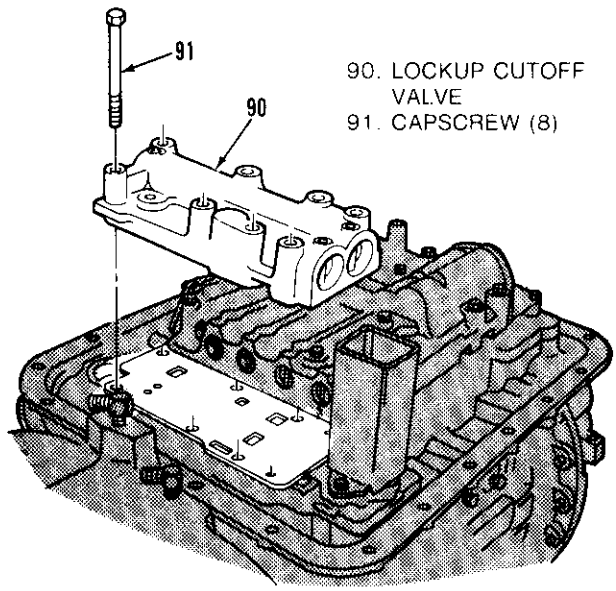
(6) Install flywheel housing sling.

(7) Apply silicone sealant to new gasket (55) and install gasket (55) on end plate (63).

(8) DELETED

(9) DELETED

(10) Position flywheel housing (54) on alining studs (51). Install flywheel housing (54).



90. LOCKUP CUTOFF VALVE
91. CAPSCREW (8)

n. Lockup Cutoff Valve

(1) Install lockup cutoff valve (90) with eight capscrews (91).

(2) Tighten eight capscrews (91) to 108-132 inch-pounds (12.2-14.9 N·m).

o. Oil Filter

(1) Coat new sealring (92) with oil. Install sealring (92) on filter (93).

(2) Install capscrew (94) with washer (95) through filter (93).

(3) Place two spacers (96) on capscrew (94).

(4) Install filter (93) on transmission (1).

(5) Tighten capscrew (94) to 10-15 foot-pounds (13.6-20.3 N·m).

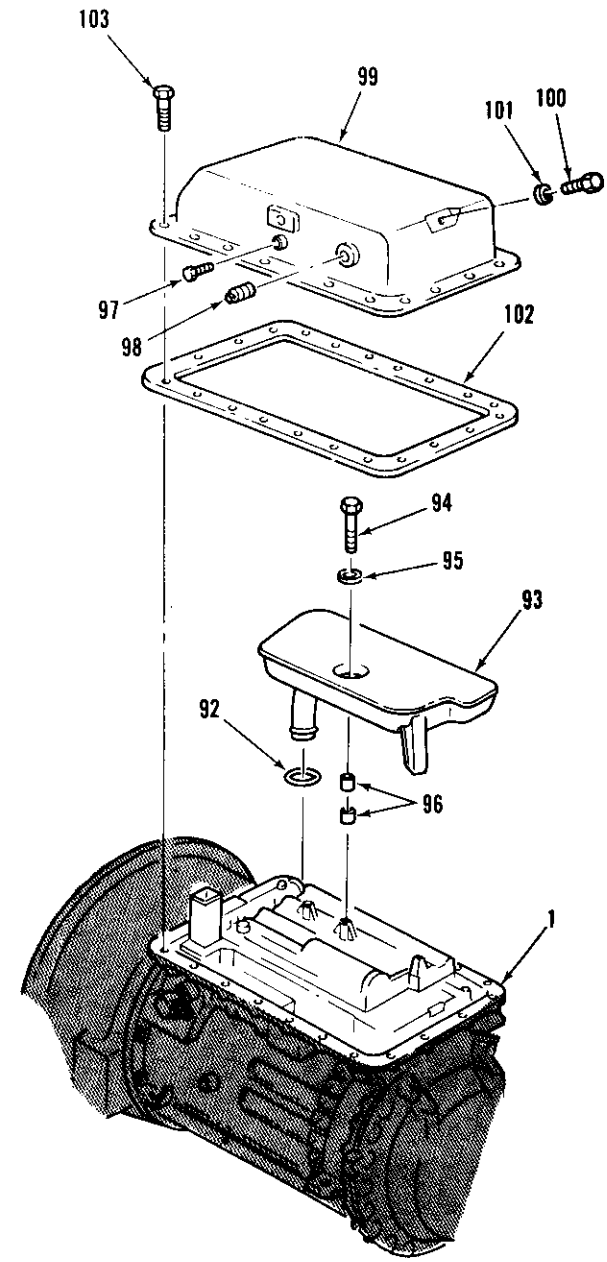
p. Oil Pan

(1) If removed, install plugs (97 and 98) into oil pan (99).

(2) Install plug (100) and washer (101) into oil pan (99).

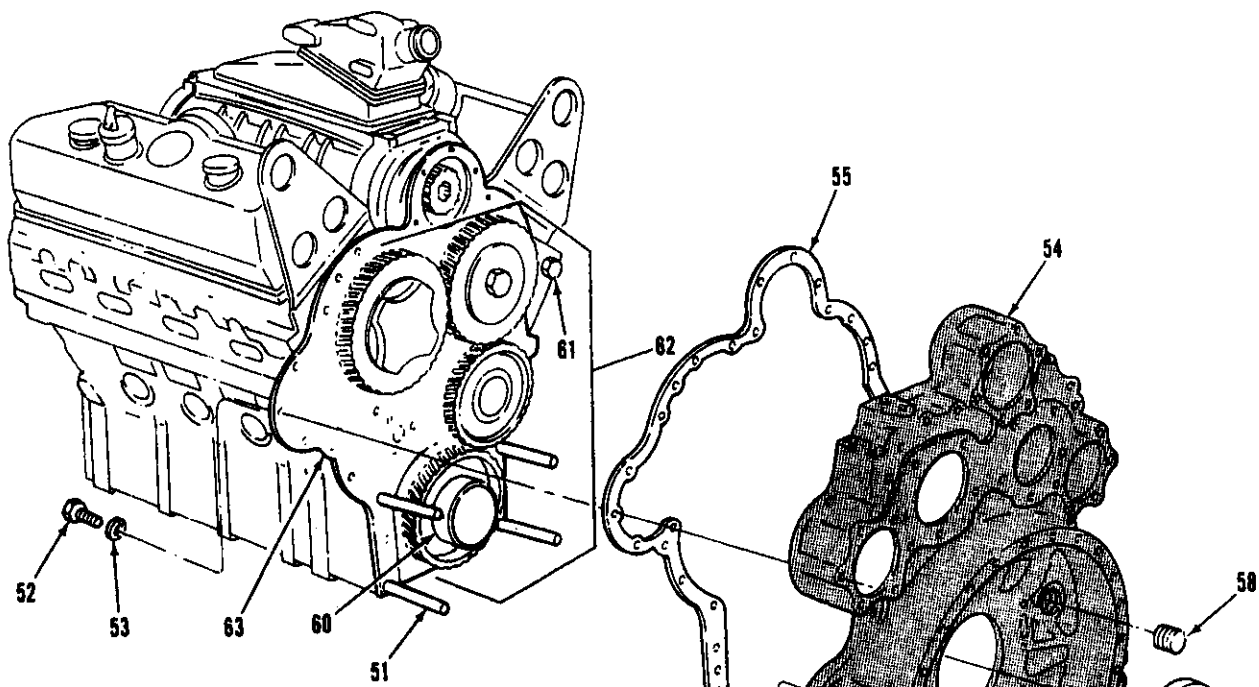
(3) Apply grease to oil pan (99) and install new gasket (102).

(4) Install oil pan (99) onto transmission (1) with 21 capscrews (103). Do not tighten capscrews (103).



1. TRANSMISSION
92. SEALRING
93. FILTER
94. CAPSCREW
95. WASHER
96. SPACER (2)
97. PLUG
98. PLUG
99. OIL PAN
100. PLUG
101. WASHER
102. GASKET
103. CAPSCREW (21)

TA 298822



51. ALINING STUD (4)
52. CAPSCREW (2)
53. LOCKWASHER (2)
54. FLYWHEEL HOUSING
55. GASKET
56. PIPE PLUG
57. PIPE PLUG
58. PIPE PLUG
59. OIL SEAL
60. CRANKSHAFT
61. CAPSCREW
62. GEAR TRAIN
63. END PLATE
64. DELETED
65. DELETED

TA 298472

7-6. TRANSMISSION REASSEMBLY FROM SUBASSEMBLIES (Continued)

m. Control Valve

(1) Turn transmission so oil pan surface faces up.

CAUTION

Remove rubber band or wire used to hold selector valve (80) before installing control valve (78). Do not allow selector valve (80) to drop from control valve (78).

(2) Install control valve (78), making sure shift rack pin (79) engages slot on selector valve (80).

(3) Install three longer capscrews (81).

(4) Install seven capscrews (82).

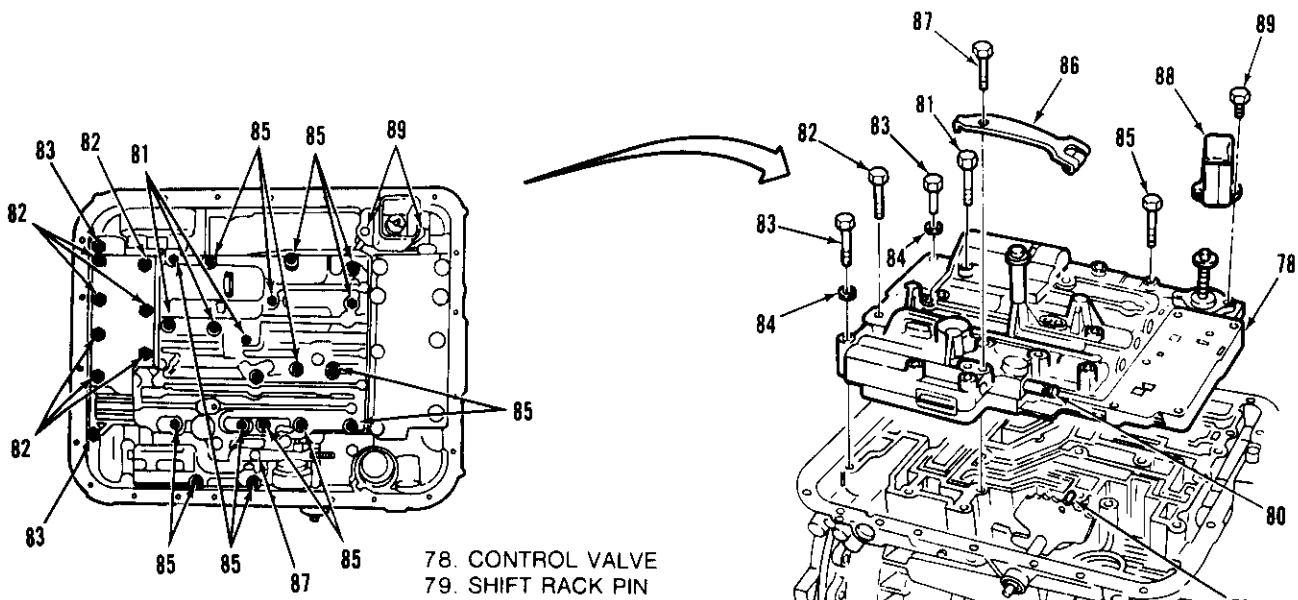
(5) Install two capscrews (83) and two washers (84).

(6) Install 15 capscrews (85) into control valve (78).

(7) Install manual detent lever (86) and capscrew (87) into control valve (78).

(8) Install oil baffle (88) and two capscrews (89).

(9) Torque all capscrews to 108-132 inch-pounds (12.2-14.9 N·m).



78. CONTROL VALVE
79. SHIFT RACK PIN
80. SELECTOR VALVE
81. CAPSCREW (3)
82. CAPSCREW (7)
83. CAPSCREW (2)
84. WASHER (2)
85. CAPSCREW (15)
86. MANUAL DETENT LEVER
87. CAPSCREW
88. OIL BAFFLE
89. CAPSCREW (2)

TA 298821

3-7. FLYWHEEL HOUSING REPLACEMENT (Continued)

(11) Install capscrews (42 and 43) and new lockwashers (44 and 45) fingertight.

(12) Install three new capscrews (34), washers (35), new gaskets (39), and turbocharger bracket (38) fingertight. Install two capscrews (36) and new lockwashers (37). Tighten capscrews (36) securely.

(13) Install four capscrews (47) and new lockwashers (48).

(14) Apply sealant around cover (33).

(15) Install capscrews (25, 27, and 29), new lockwashers (26 and 31), washers (28 and 30), nuts (32), new gasket (33.1), and cover (33) fingertight.

(16) Install new capscrew (46) fingertight.

(17) Install capscrew (52) and new lockwasher (53) on both sides of flywheel housing (54) fingertight.

(18) Remove four alining studs (51).

(19) Install six capscrews (49) and washers (50) fingertight.

(20) Install six new capscrews (40) and washers (41).

(21) DELETED

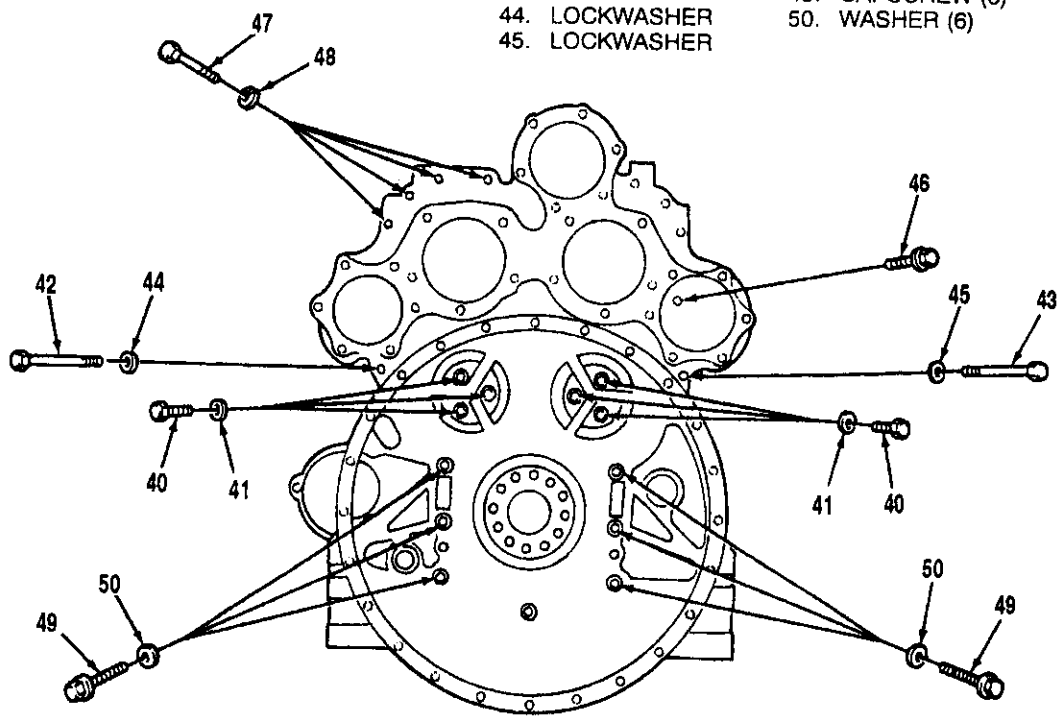
(22) Install new gasket (66) and adapter (67).

(23) Install two spacers (68), new lockwashers (69), and capscrews (70).

(24) Install three spacers (71), new lockwashers (72), and capscrews (73).

(25) Install spacer (74), new lockwasher (75), capscrew (76), bracket (77), new lockwasher (78), and nut (79).

40. CAPSCREW (6)
41. WASHER (6)
42. CAPSCREW
43. CAPSCREW
44. LOCKWASHER
45. LOCKWASHER
46. CAPSCREW
47. CAPSCREW (4)
48. LOCKWASHER (4)
49. CAPSCREW (6)
50. WASHER (6)



(6) Install one capscrew (73) with washer (74) through access hole into flywheel assembly (72). Tighten capscrew (73) until snug.

(7) Remove lifting device (71) from lifting bracket (67).

NOTE

Lifting bracket is used to turn flywheel for access to bolt holes inside converter housing.

(8) Install 29 capscrews (73) with washers (74) into flywheel assembly (72). Tighten capscrews until snug.

(9) Torque 30 capscrews (73) in the order shown to 41-49 foot-pounds (56-66 N·m).

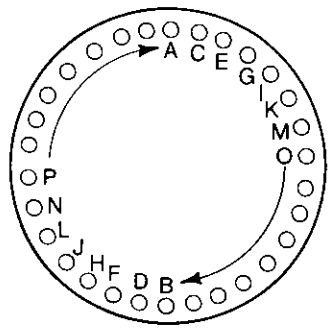
(10) Remove two capscrews (68).

(11) Remove lifting bracket (67).

(12) Install new gasket (75) and access cover (76).

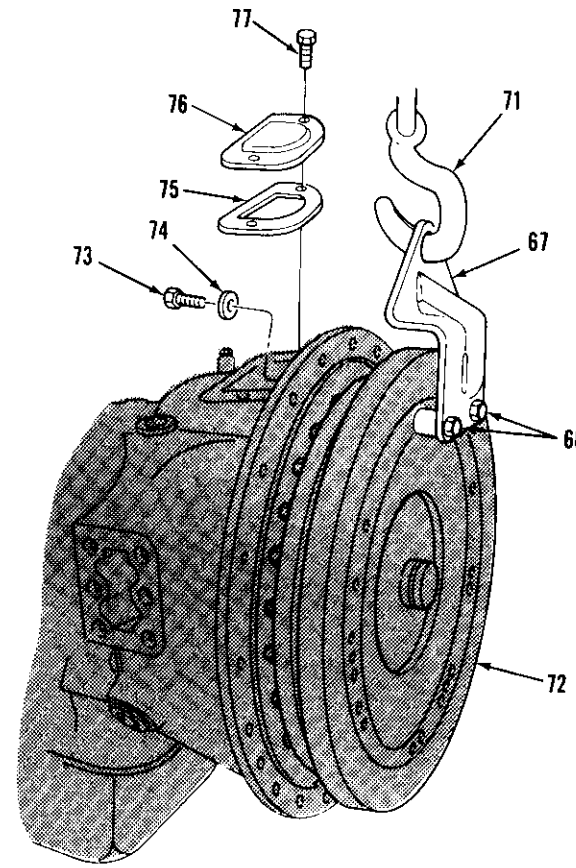
(13) Install two capscrews (77).

(14) Torque two capscrews (77) to 25-30 foot-pounds (34-41 N·m).

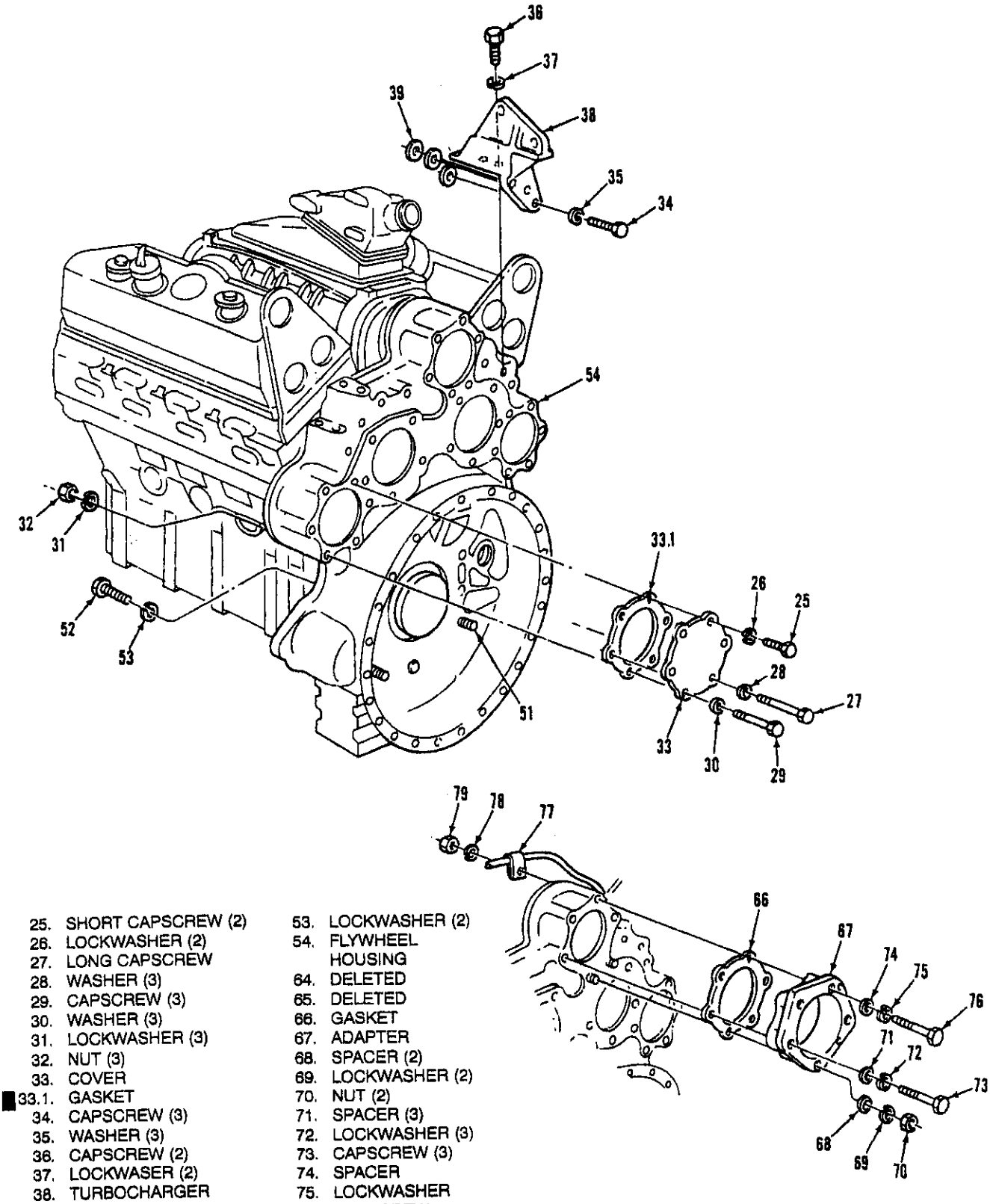


TORQUE PATTERN

67. LIFTING BRACKET (TOOL)
68. CAPSCREW (2)
71. LIFTING DEVICE
72. FLYWHEEL ASSEMBLY
73. CAPSCREW (30)
74. WASHER (30)
75. GASKET
76. ACCESS COVER
77. CAPSCREW (2)



TA 298820



25. SHORT CAPSCREW (2)
26. LOCKWASHER (2)
27. LONG CAPSCREW
28. WASHER (3)
29. CAPSCREW (3)
30. WASHER (3)
31. LOCKWASHER (3)
32. NUT (3)
33. COVER
■33.1. GASKET
34. CAPSCREW (3)
35. WASHER (3)
36. CAPSCREW (2)
37. LOCKWASER (2)
38. TURBOCHARGER BRACKET
39. GASKET (3)
51. ALINING STUD (4)
52. CAPSCREW (2)
53. LOCKWASHER (2)
54. FLYWHEEL HOUSING
64. DELETED
65. DELETED
66. GASKET
67. ADAPTER
68. SPACER (2)
69. LOCKWASHER (2)
70. NUT (2)
71. SPACER (3)
72. LOCKWASHER (3)
73. CAPSCREW (3)
74. SPACER
75. LOCKWASHER
76. CAPSCREW
77. BRACKET
78. LOCKWASHER
79. NUT

7-6. TRANSMISSION REASSEMBLY FROM SUBASSEMBLIES (Continued)

I. Flywheel

(1) Position transmission so that access hole in converter housing is up.

(2) Install lifting bracket (67) on flywheel assembly (72) with two capscrews (68).

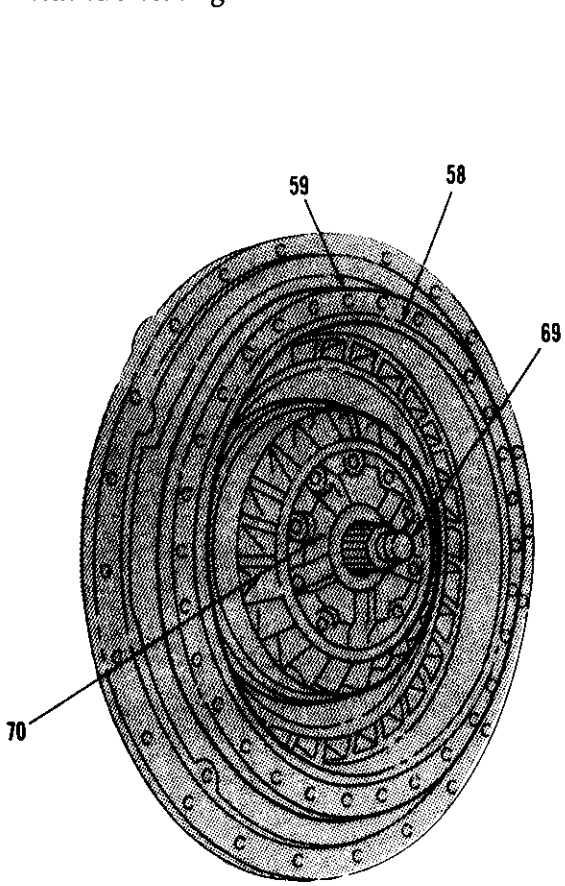
(3) Coat turbine shaft sealring (69) and converter sealring (58) with lubricating oil.

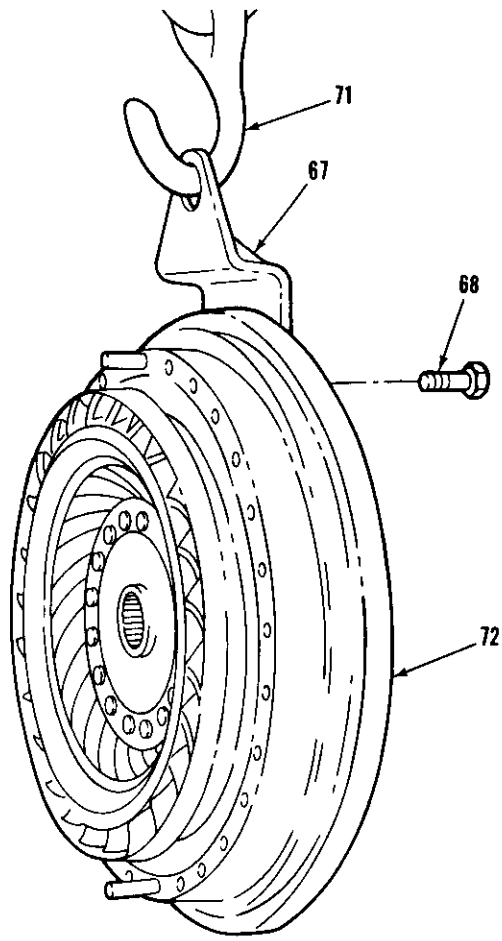
(4) Coat torque converter thrust pads (70) with lubricating oil.

WARNING

While installing flywheel assembly (72), the turbine may drop. Use care to prevent personal injury or parts damage.

(5) Using lifting device (71), aline flywheel assembly (72). Push flywheel assembly (72) straight onto torque converter pump (59).





58. SEALRING
59. TORQUE CONVERTER PUMP
67. LIFTING BRACKET (TOOL)
68. CAPSCREW (2)
69. SEALRING
70. THRUST PAD
71. LIFTING DEVICE (TOOL)
72. FLYWHEEL ASSEMBLY

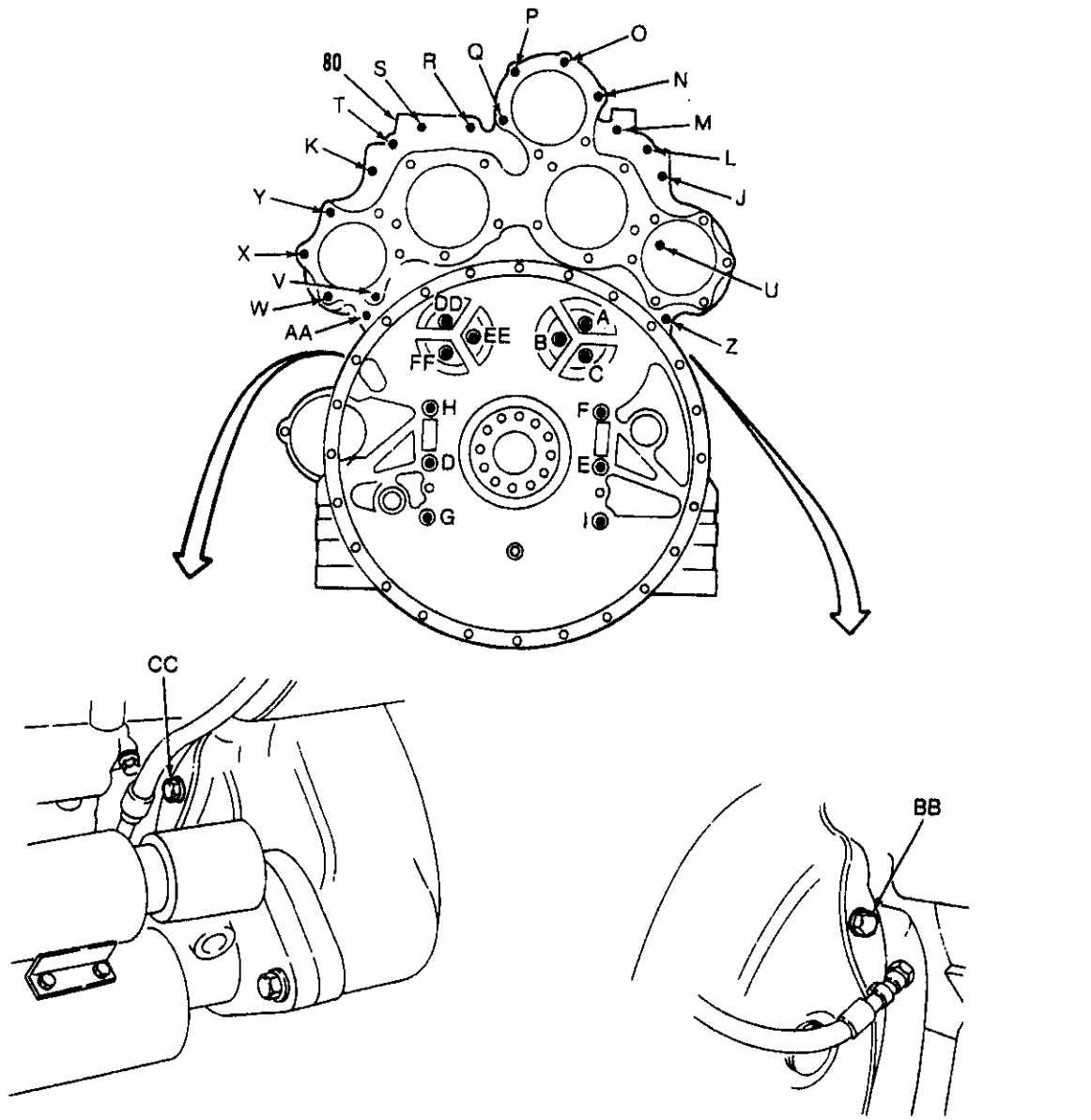
TA 298819

3-7. FLYWHEEL HOUSING REPLACEMENT (Continued)

CAUTION

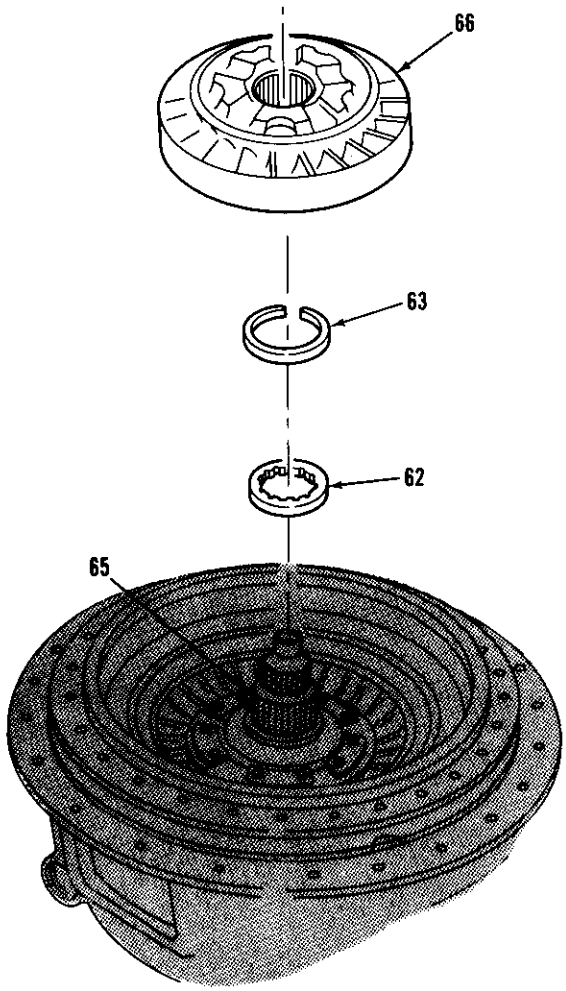
Rotate crankchaft for capscrews A, B, C, DD, EE, and FF during tightening pattern.

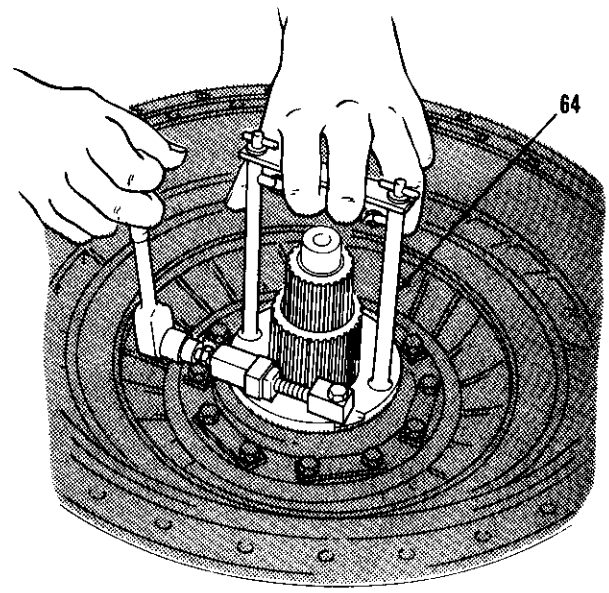
(26) Follow tightening pattern (80) and snug all capscrews.



80. TIGHTENING PATTERN

TA 288475





62. SPACER
63. SNAPRING
64. SNAPRING INSTALLER (TOOL)
65. HUB
66. STATOR

TA 298818

(27) Follow torque pattern (81) and torque all capscrews.

(28) Torque capscrews A thru F to 90-100 foot-pounds (122-136 N·m).

CAUTION

Rotate crankshaft (60) when torquing capscrews in locations G, H, I, J, K, and L to prevent bearing damage.

(29) Torque capscrews G thru L to 40-45 foot-pounds (54-61 N·m).

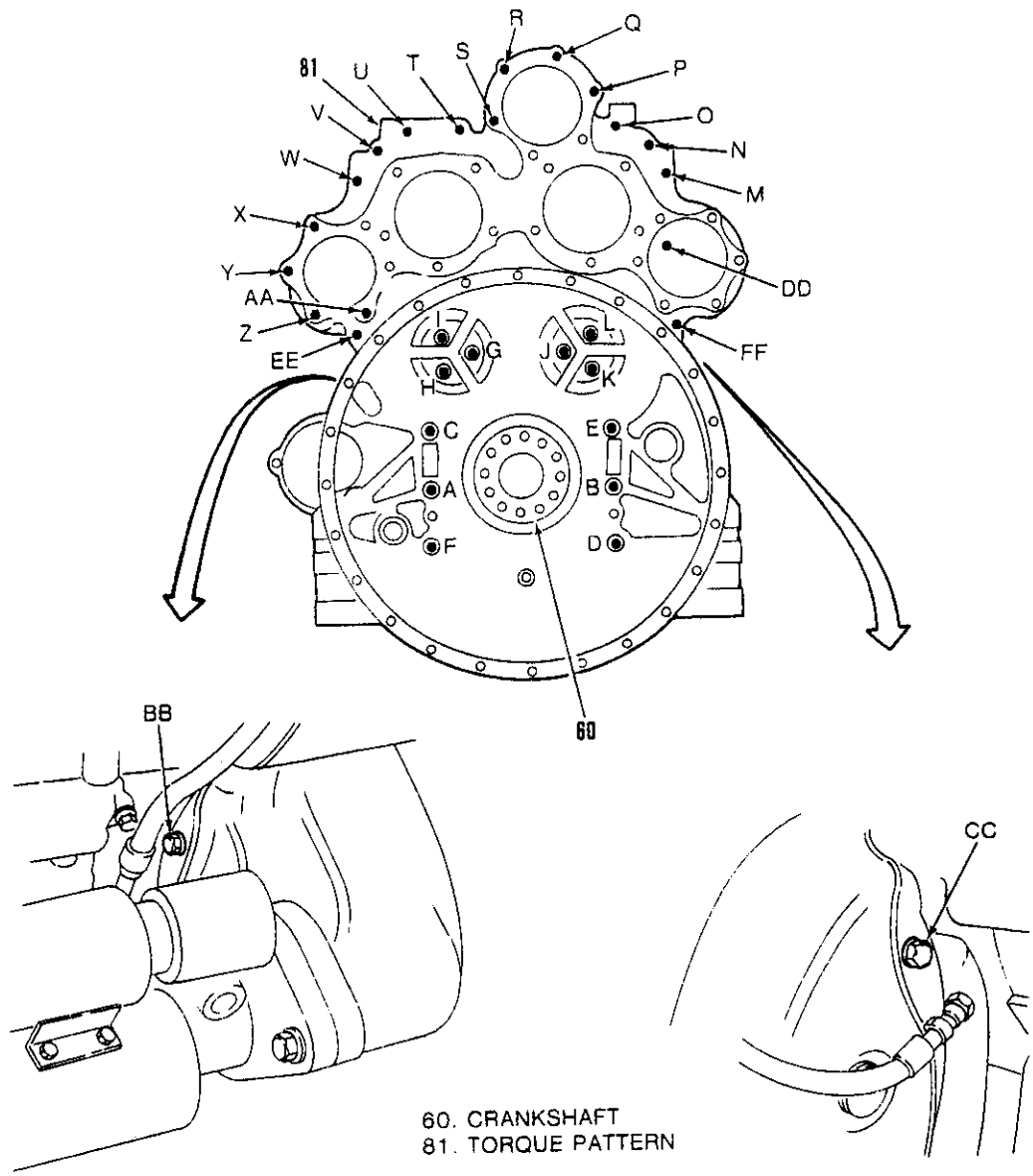
(30) Torque capscrews M thru W to 25-30 foot-pounds (34-41 N·m).

(31) Torque capscrews X thru AA to 30-35 foot-pounds (41-47 N·m).

(32) Torque capscrews BB thru CC to 40-45 foot-pounds (54-61 N·m).

(33) Torque capscrew DD to 30-35 foot-pounds (41-47 N·m).

(34) Torque capscrew EE thru FF to 137-147 foot-pounds (186-200 N·m).



60. CRANKSHAFT
81. TORQUE PATTERN

TA 298476

7-6. TRANSMISSION REASSEMBLY FROM SUBASSEMBLIES (Continued)

j. Torque Converter Pump

CAUTION

Make sure seal ring (58) has been installed on torque converter pump (59). Coat all seal rings on converter pump with lubricating oil to provide initial lubrication.

(1) Make sure seal ring (58) is on torque converter pump (59).

NOTE

Aline slots in torque converter pump with tangs in oil pump drive gear as torque converter pump is being installed.

(2) Aline and install torque converter pump (59) into torque converter housing (51).

(3) Place bearing installation tool (60) onto bearing race of torque converter pump (59).

(4) Place drive handle (61) over bearing installation tool (60).

(5) Use hammer to tap torque converter pump (59) down until seated. The sound will change when pump is seated.

(6) Remove bearing installation tools (60 and 61).

(7) Install spacer (62).

(8) Install snapring (63) using snapring installer tool (64).

k. Stator

(1) Coat hub (65) with lubricating oil.

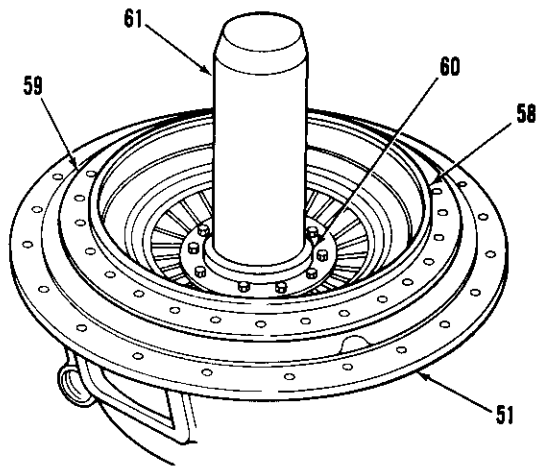
CAUTION

Keep outer face of stator down so that bearings and springs will not fall out.

(2) Install stator (66) onto hub (65) as shown.

CAUTION

Stator must turn freely in clockwise direction and lockup in counterclockwise direction to operate properly and prevent damage to equipment.



TA 298817

51. TORQUE CONVERTER HOUSING
58. SEAL RING
59. TORQUE CONVERTER PUMP
60. BEARING INSTALLATION (TOOL)
61. DRIVE HANDLE (TOOL)

3-7. FLYWHEEL HOUSING REPLACEMENT (Continued)

(35) Apply sealant around cover (15). Install cover (15) with its oil return tube (82) at the one o'clock position. Install new copper washer (19) and capscrew (18). Torque capscrew (18) 30-35 foot-pounds (41-47 N·m).

(36) Install five capscrews (16) and new lockwashers (17). Torque capscrews (16) 30-35 foot-pounds (41-47 N·m).

(37) Install clamp (13) and turbocharger oil return hose (14). Tighten clamp (13) securely.

(38) Apply sealant around cover (24). Install cover (24), new gasket (33.1), four capscrews (20), new lockwashers (21), capscrew (22), and lockwasher (23). Torque capscrews (20 and 22) to 30-35 foot-pounds (41-47 N·m).

(39) Install bracket (4), two capscrews (1), new lockwashers (2), and washers (3). Install new capscrew (5) and new lockwasher (6). Tighten capscrews (1 and 5) securely.

(40) Install bracket (10), two capscrews (7), new lockwashers (8), and washers (9). Install new capscrew (11) and new lockwasher (12). Tighten capscrews (7 and 11) securely.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install oil pan (para 3-6).
TM 2320-34/13 TM 9-2320-297-34	Install flexplates (para 3-8).
TM 2320-20/12 TM 9-2320-297-20	Install starter para (7-7).
TM 2320-34/13 TM 9-2320-297-34	Install air compressor (para 11-7).
TM 2320-20/12 TM 9-2320-297-20	Install alternator (para 7-4).
	Install exhaust crossover tube (para 5-4).
TM 2320-34/13 TM 9-2320-297-34	Install turbocharger and adapter (para 4-10).
	Install blower drive shaft (para 4-8).
	Remove engine from stand (para 3-21).
	Install power pack (para 3-17).
	Install rear oil seal (para 3-6).

(2) Position pitot block (48) onto forward clutch (44) with its tip under collector ring (49).

(3) Install lifting device (50) on converter housing (51).

NOTE

Guide screws may be used to help aline converter housing (51) with transmission (1).

(4) Position converter housing (51) over transmission (1).

(5) Aline two Pitot block guide screws (47) with two small holes in converter housing (51).

CAUTION

Take care not to damage Pitot block when installing converter housing (51). Do not turn converter housing (51) while installing it.

(6) Install converter housing (51) onto transmission (1).

(7) Remove lifting device (50).

NOTE

Move Pitot guide screws up and down to make sure Pitot block is free.

(8) Install seven capscrews (52) and new lockwashers (53). Tighten capscrews (52) to 70-80 foot-pounds (95-108 N·m).

WARNING

Adhesives and solvents burn easily and give off harmful vapors. To avoid injury, use in a well ventilated area and keep away from flame.

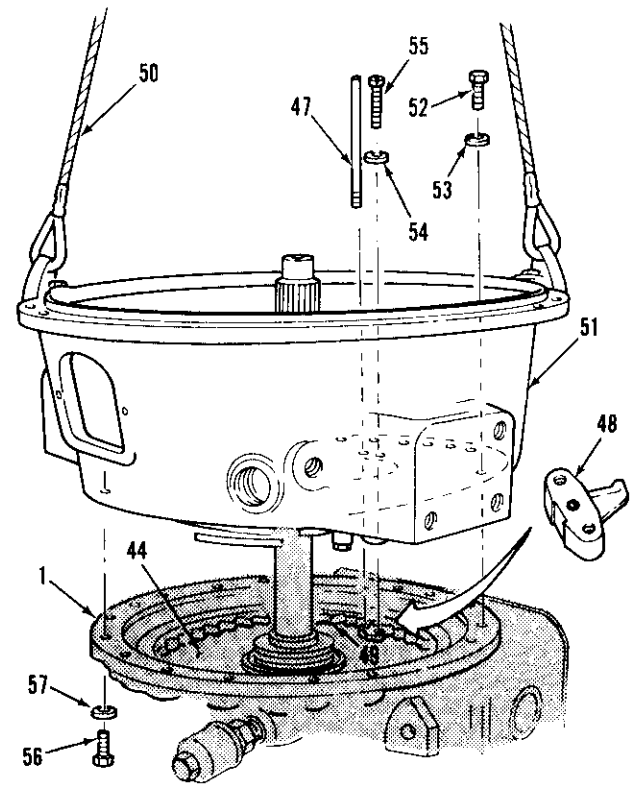
(9) Apply a small amount of silicone sealant to two washers (54).

(10) Remove one Pitot block guide screw (47) and install one screw (55) and washer (54).

(11) Remove other Pitot block guide screw (47) and install other screw (55) and washer (54).

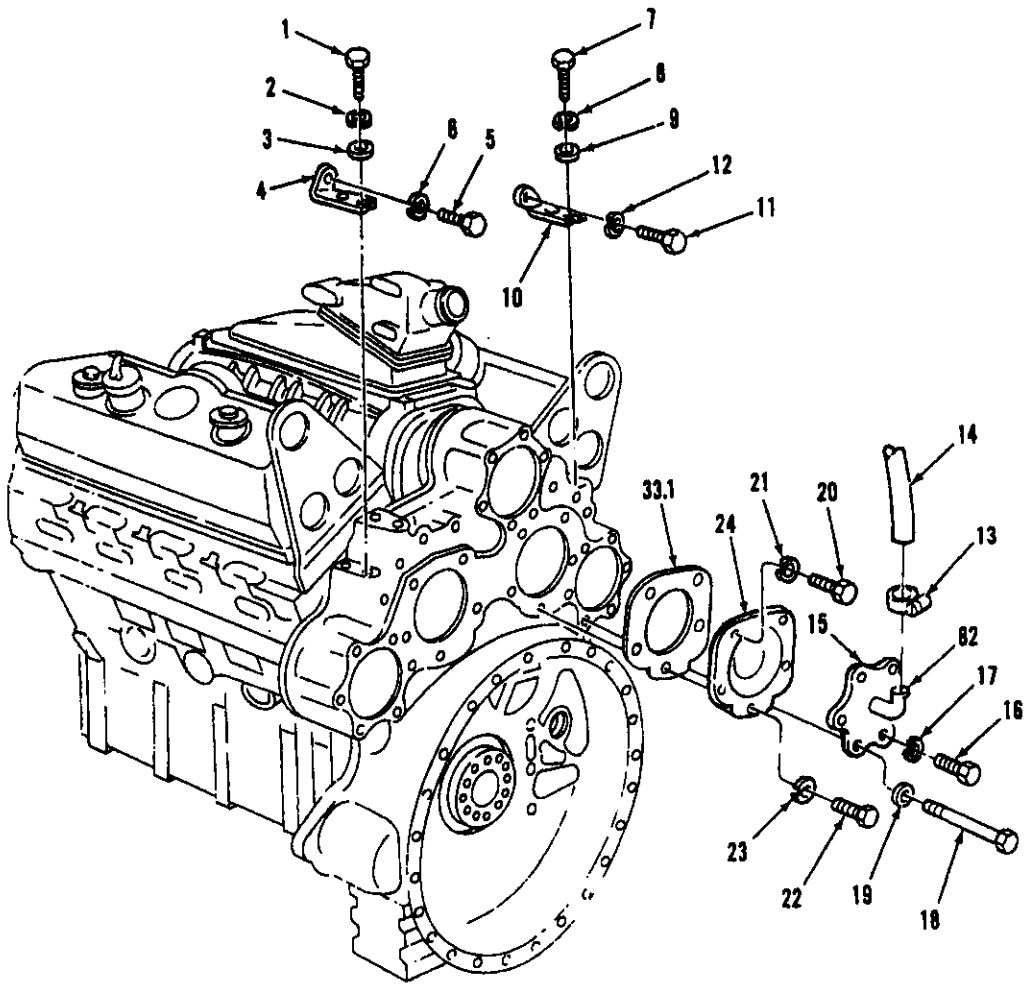
(12) Torque screws (55) to 30-48 inch-pounds (3.4-5.4 N·m).

(13) Install seven capscrews (56) and new lockwashers (57). Alternately torque capscrews (56) to 70-80 foot-pounds (95-108 N·m).



1. TRANSMISSION
44. FORWARD CLUTCH
47. GUIDE SCREW (2)
48. PITOT BLOCK
49. COLLECTOR RING
50. LIFTING DEVICE
51. CONVERTER HOUSING
52. CAPSCREW (7)
53. LOCKWASHER (7)
54. WASHER (2)
55. SCREW (2)
56. CAPSCREW (7)
57. LOCKWASHER (7)

TA 298816



1. CAPSCREW (2)
2. LOCKWASHER (2)
3. WASHER (2)
4. BRACKET
5. CAPSCREW
6. LOCKWASHER
7. CAPSCREW (2)
8. LOCKWASHER (2)
9. WASHER (2)
10. BRACKET
11. CAPSCREW
12. LOCKWASHER
13. CLAMP
14. TURBOCHARGER OIL RETURN HOSE
15. COVER
16. CAPSCREW (5)
17. LOCKWASHER (5)
18. CAPSCREW
19. COPPER WASHER
20. CAPSCREW (4)
21. LOCKWASHER (4)
22. CAPSCREW
23. LOCKWASHER
24. COVER
■ 33.1. GASKET
82. OIL RETURN TUBE

7-6. TRANSMISSION REASSEMBLY FROM SUBASSEMBLIES (Continued)

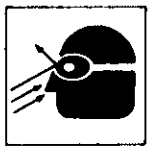
h. Forward Clutch

(1) Coat bearing (40) and race (41) with lubricating oil.

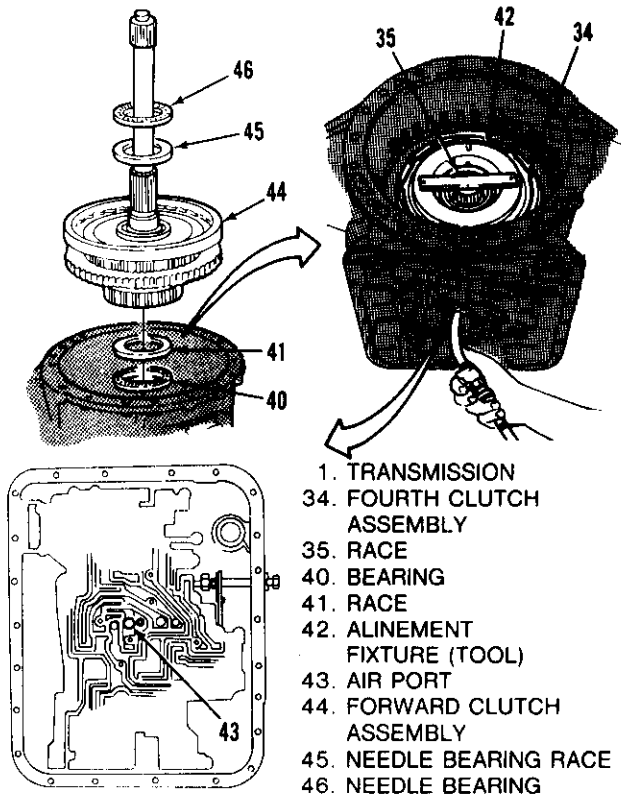
(2) Install bearing (40) and race (41) onto race (35) already on fourth clutch assembly (34).

(3) Install fourth clutch alinement fixture (42) onto fourth clutch assembly (34).

WARNING



Compressed air must not exceed 30 psi. Compressed air can cause injury to the eyes. Wear goggles or other eye protection when using compressed air. Do not point air handle at others.



1. TRANSMISSION
34. FOURTH CLUTCH ASSEMBLY
35. RACE
40. BEARING
41. RACE
42. ALINEMENT FIXTURE (TOOL)
43. AIR PORT
44. FORWARD CLUTCH ASSEMBLY
45. NEEDLE BEARING RACE
46. NEEDLE BEARING

TA 298815

(4) Lock up fourth clutch plates by applying air pressure to air port (43).

(5) Hold air pressure in fourth clutch assembly (34) and remove alinement fixture (42).

(6) Continue to apply air pressure while helper installs forward clutch assembly (44) into transmission (1).

NOTE

Forward clutch will fall slightly when air is released if the clutch is not fully seated.

(7) Stop applying air pressure and make sure that forward clutch assembly (44) is fully seated.

(8) Coat needle bearing race (45) and needle bearing (46) with oil and install on forward clutch assembly (44).

i. Torque Converter Housing

CAUTION

Make sure that a bearing and race are installed on the hub of the converter housing. A race must also be on the forward clutch hub.

NOTE

Guide screws are installed into side of pitot block with one hole in center.

(1) Install two guide screws (47) into pitot block (48).

3-8. FLEXPLATE ASSEMBLY REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

International compound No. 2 (item 16, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Transmission removed (para 7-4).

a. Removal

(1) Secure crankshaft (1) to prevent it from rotating. Remove 12 capscrews (2) and plate (3).

(2) Remove four discs (4) and flex disc (5) with spacers.

(3) Remove 12 capscrews (6), scuff plate (7), and hub (8).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

(1) Apply international compound to 12 capscrews (6).

(2) Install hub (8) with smooth, flat side away from crankshaft (1). Install scuff plate (7) and 12 capscrews (6). Torque capscrews (6) to 96-115 foot-pounds (130-156 N·m).

(3) Apply international compound to 12 capscrews (2).

NOTE

Flex disc (5) must be installed with spacers facing towards flywheel housing.

(4) Install flex disc (5), four discs (4), and plate (3).

(5) Aline the holes in plate (3) and discs (4 and 5) with holes in scuff plate (7). Install 12 capscrews (2). Torque capscrews (2) to 50 foot-pounds (68 N·m). Then torque capscrews (2) an additional 1/4 turn.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install transmission (para 7-4).

g. Third Clutch

(1) Soak four third clutch friction plates (36) in oil for two minutes.

NOTE

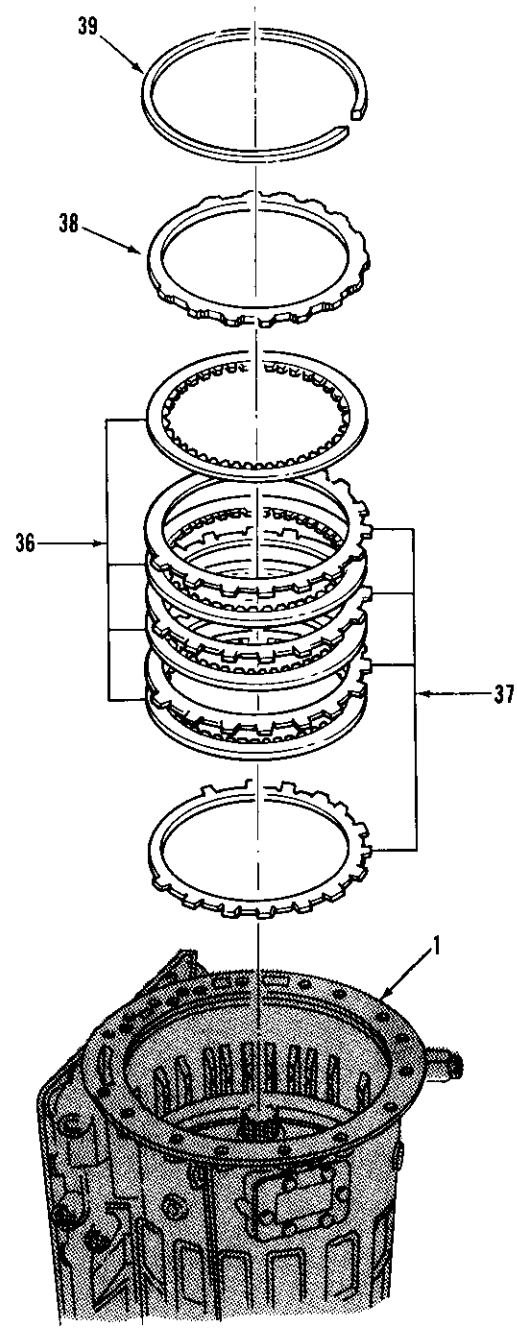
The thickest steel plate (37) must be installed on bottom of stack.

(2) Install one steel plate (37) with wide gap facing oil pan side of transmission (1).

(3) Starting with a friction plate (36) and alternating with steel plates (37), install seven additional clutch plates.

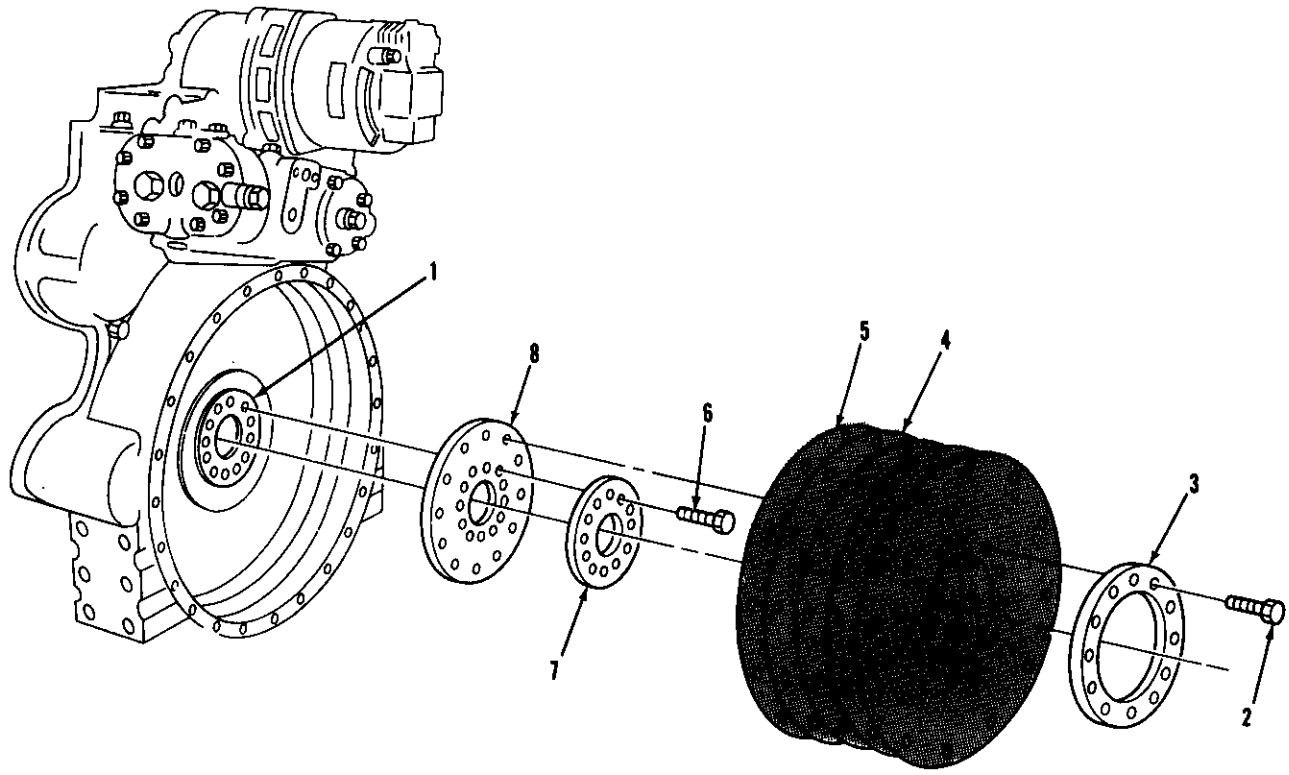
(4) Install backing plate (38).

(5) Install snapring (39), gap opposite oil pan side of transmission (1).



1. TRANSMISSION
36. FRICTION PLATE (4)
37. STEEL PLATE (4)
38. BACKING PLATE
39. SNAPRING

TA 298814



1. CRANKSHAFT
2. CAPSCREW (12)
3. PLATE
4. DISC (4)
5. FLEX DISC
6. CAPSCREW (12)
7. SCUFF PLATE
8. HUB

TA 298334

7-6. TRANSMISSION REASSEMBLY FROM SUBASSEMBLIES (Continued)

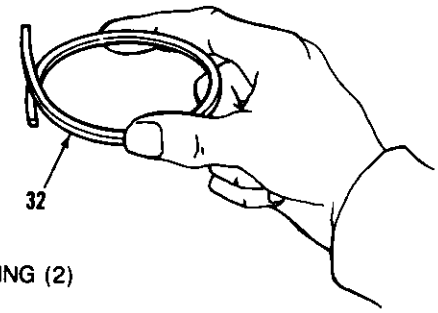
f. Fourth Clutch

(1) Apply lubricating oil to race (29) and bearing (30) and install on center support housing hub (31).

NOTE

Keep new sealrings sealed in their packages until they are to be used, to keep sealrings from being damaged.

(2) Roll sealrings (32) to one half their length and hold for at least ten seconds as shown.



32. SEALRING (2)

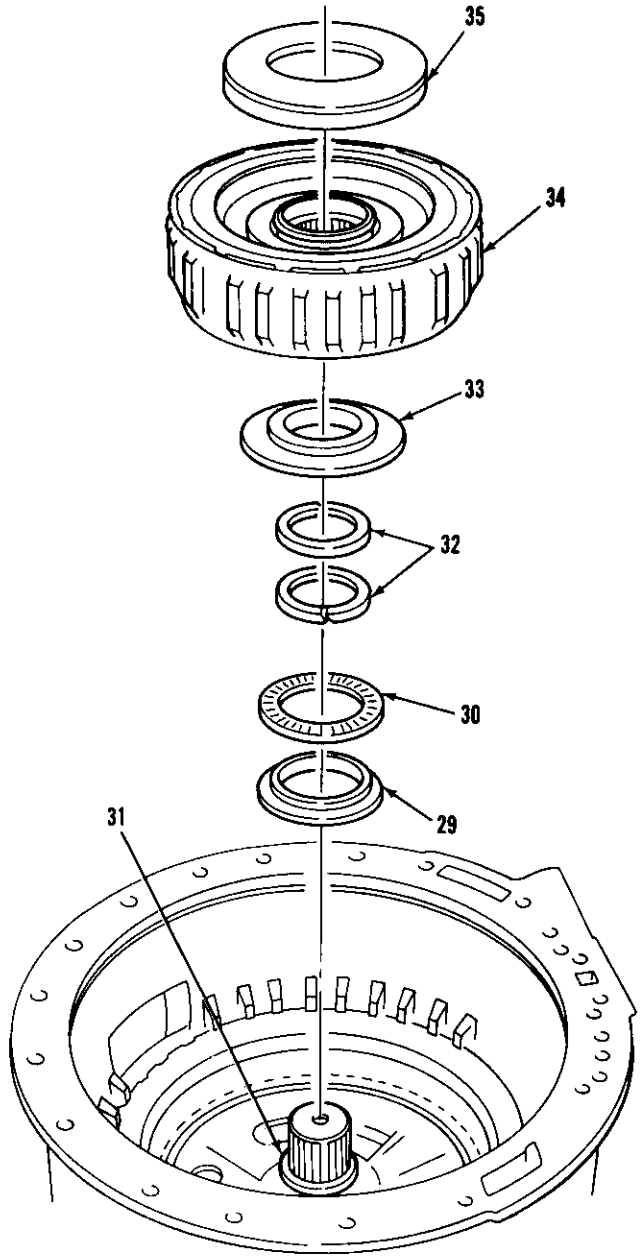
(3) Install one sealring (32) in lower groove on center support housing hub (31).

(4) Install other sealring (32) in upper groove on center support housing hub (31).

(5) Apply grease to race (33) and install it on bottom of fourth clutch assembly (34).

(6) Using fourth clutch lifting fixture, install fourth clutch assembly (34).

(7) Coat race (35) with oil and install on fourth clutch assembly (34).



29. RACE
30. BEARING
31. CENTER SUPPORT HOUSING HUB
32. SEALRING (2)
33. RACE
34. FOURTH CLUTCH ASSEMBLY
35. RACE

TA 298813

3-9. VALVE OPERATING MECHANISM MAINTENANCE

THIS TASK COVERS: a. Removal
b. Cleaning
c. Inspection
d. Disassembly
e. Assembly
f. Installation

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Spring tester (J 9666)
Cam follower service fixture (J 5840-01)

Materials/Parts

Cindol 1705 (item 12, Appendix C)
Engine oil (item 46, Appendix C)
Cleaning solvent (item 66, Appendix C)
Lockwasher (2) (MS35338-44) item 12

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Engine brake removed (para 3-15).
	Cylinder head removed (para 3-3).

a. Removal

NOTE

All parts must be tagged so they may be installed in their original position.

(1) Cover fuel line connections (1).

(2) Tag and remove two brackets (2).

(3) Remove rocker arm shaft (3) from rocker arms (4).

(4) Loosen three locknuts (5) and unscrew rocker arms (4) from push rods (6). Remove three rocker arms (4).

(5) Remove valve bridge (7) from bridge guides (8). Loosen locknut (9) and remove screw (10).

(6) Remove two capscrews (11), lockwashers (12), and cam follower guide (13) from bottom of cylinder head (31). Discard lockwashers (12).

(7) Pull cam follower (14) and push rod (6) from bottom of cylinder head (31).

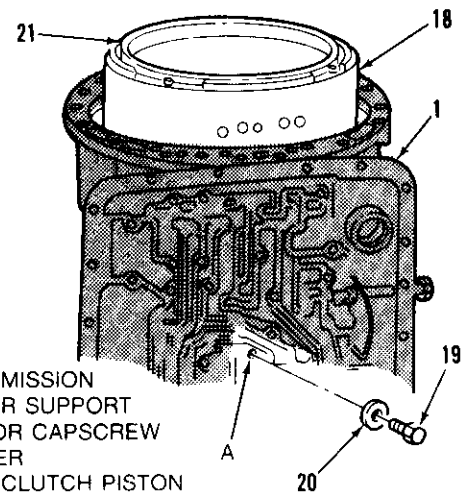
(8) If replacing cylinder head (31), remove spring retainer (15) from top of cylinder head (31).

(9) Repeat steps (1) thru (8) for remaining valve operating mechanisms.

(1) Lower center support (18) into transmission (1). Make sure tapped hole in center support (18) is alined with anchor capscrew hole in transmission (1).

(2) Install new anchor capscrew (19) and washer (20) in hole at location A. Tighten anchor capscrew (19) finger tight.

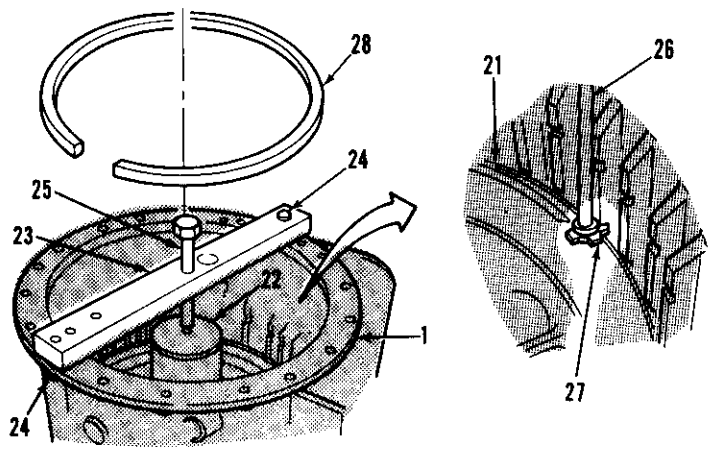
(3) Temporarily remove third clutch piston (21) from center support (18).



1. TRANSMISSION
18. CENTER SUPPORT
19. ANCHOR CAPSCREW
20. WASHER
21. THIRD CLUTCH PISTON

(4) Install compressor sleeve (22) on hub of center support (18). Install compressor bar (23) across transmission housing (1) with two capscrews (24).

(5) Tighten compressor center capscrew (25) to 5 foot-pounds (6.78 N·m) to compress center support (18).



(6) Place snapring selector gage (26) into snapring opening (27) and find which of the four colored lugs of the gage will fit most tightly.

NOTE

Blue color coded retaining ring is 0.148 to 0.150 inch (3.76 to 3.81 mm) thick, yellow color coded retaining ring is 0.152 to 0.154 inch (3.86 to 3.91 mm) thick, white color coded retaining ring is 0.155 to 0.157 inch (3.94 to 3.99 mm) thick, and red color coded retaining ring is 0.158 to 0.160 inch (4.01 to 4.06 mm) thick.

(7) Install snapring (28) that has same color code as lug of snapring selector gage (26). Snapring gap must be opposite oil pan side of transmission (1).

(8) Remove compressor bar (23) and compressor sleeve (22).

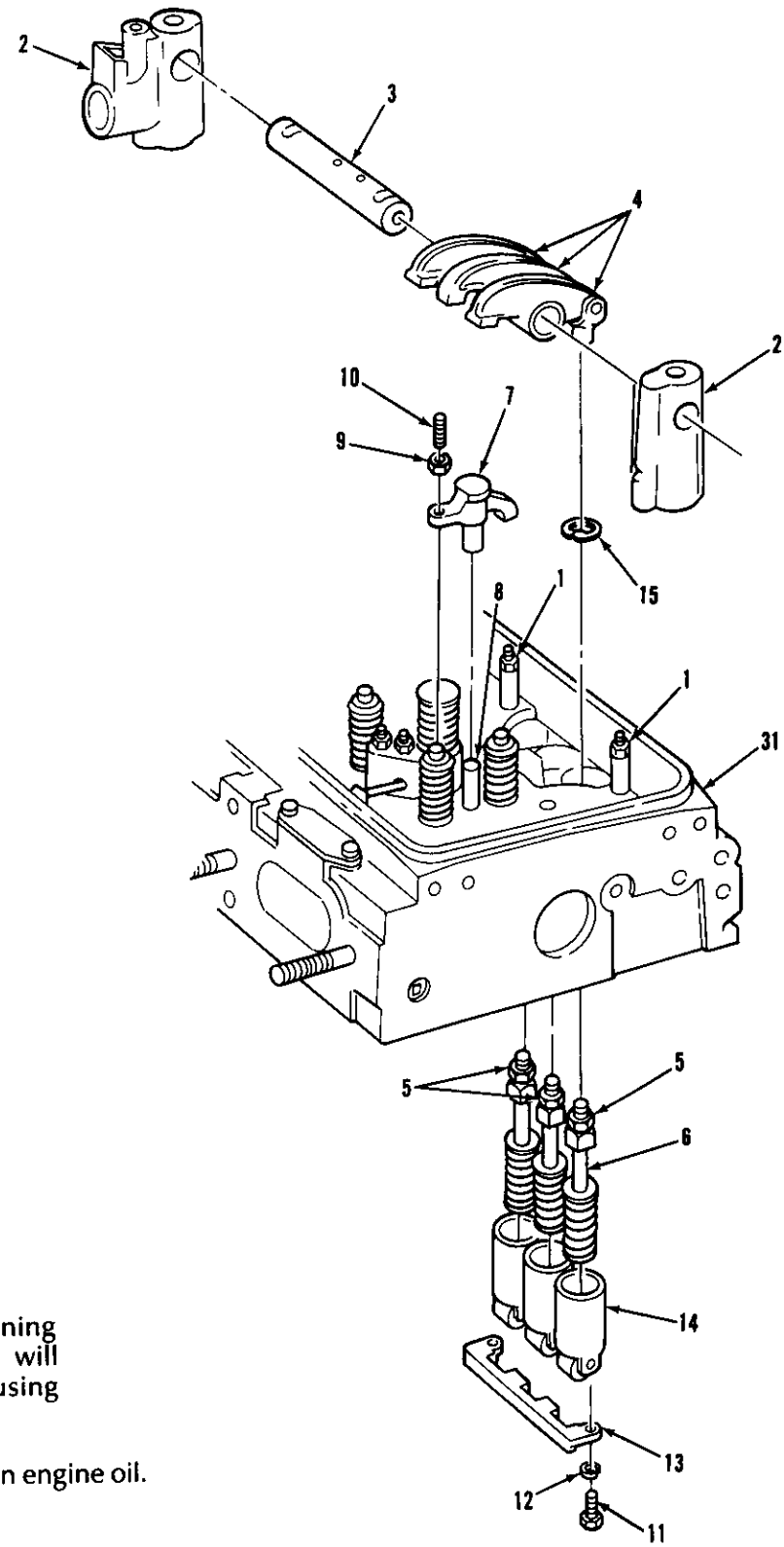
(9) Reinstall third clutch piston (21) into center support (18).

(10) Tighten center support anchor capscrew (19) to 45 foot-pounds (61 N·m).

1. TRANSMISSION
21. THIRD CLUTCH PISTON
22. COMPRESSOR SLEEVE
23. COMPRESSOR BAR
24. CAPSCREW (2)
25. CENTER CAPSCREW
26. SNAPRING SELECTOR GAGE
27. SNAPRING OPENING
28. SNAPRING

TA 298812

1. FUEL LINE CONNECTION
2. BRACKET (2)
3. ROCKER ARM SHAFT
4. ROCKER ARM (3)
5. LOCKNUT (3)
6. PUSH ROD (3)
7. VALVE BRIDGE
8. BRIDGE GUIDE
9. LOCKNUT
10. SCREW
11. CAPSCREW (2)
12. LOCKWASHER (2)
13. CAM FOLLOWER GUIDE
14. CAM FOLLOWER
15. SPRING RETAINER
31. CYLINDER HEAD



TA 298479

b. Cleaning

CAUTION

Do not use fuel oil when cleaning cam follower (14). Fuel oil will break down lubricants, causing damage during operation.

(1) Clean cam follower (14) in clean engine oil.

(2) Clean all other parts. Refer to paragraph 2-6.

7-6. TRANSMISSION REASSEMBLY FROM SUBASSEMBLIES (Continued)

c. Gear Unit

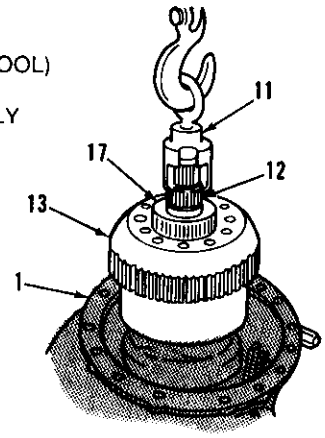
(1) Turn transmission (1) so front is up.

(2) Install lifting bracket (11) to main shaft (12) of gear unit assembly (13).

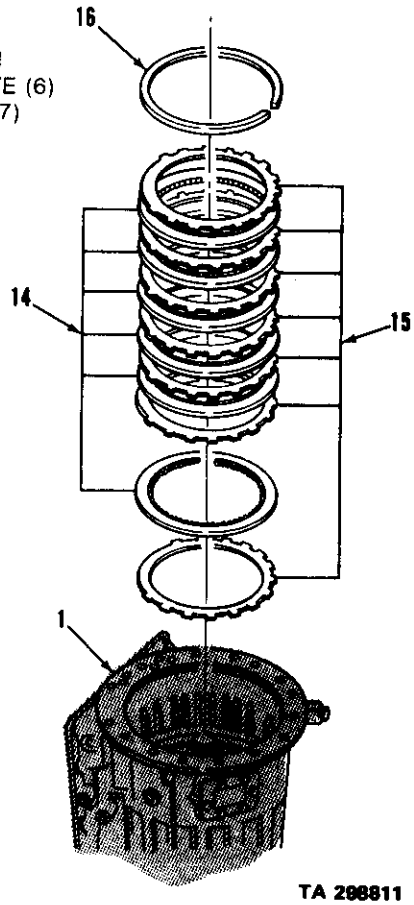
(3) Using suitable lifting device, lower gear unit assembly (13) into transmission (1).

(4) Remove lifting bracket (11).

1. TRANSMISSION
11. LIFTING BRACKET (TOOL)
12. MAIN SHAFT
13. GEAR UNIT ASSEMBLY
17. THRUST RACE



1. TRANSMISSION
14. FRICTION PLATE (6)
15. STEEL PLATE (7)
16. SNAPRING



TA 288811

d. Second Clutch

(1) Soak six friction plates (14) in oil for two minutes.

NOTE

The thickest steel plate (15) must be installed on top of stack.

(2) Install a steel plate (15) with wide gap toward oil pan side of transmission (1).

(3) Starting with friction plate (14) and alternating with steel plates (15), install 12 additional clutch plates.

(4) Install snapring (16), gap opposite oil pan side of transmission (1).

e. Center Support

CAUTION

- Make sure bronze thrust race (17) is on top of gear unit inside transmission.
- Make sure anchor capscrew (19) is removed before installing center support.
- Center support (18) is fitted to transmission housing with very little clearance and may bind if transmission housing is cold. Heat transmission housing with a heat lamp or warm current of air.

3-9. VALVE OPERATING MECHANISM MAINTENANCE (Continued)

c. Inspection

(1) Measure inside diameter of rocker arm bushing (16). Minimum clearance is 0.8750 inch (22.2250 mm). Maximum clearance is 0.8760 inch (22.2504 mm).

(2) Measure outside diameter of rocker arm shaft (3). Minimum diameter is 0.8735 inch (22.1742 mm). Maximum diameter is 0.874 inch (22.1996 mm).

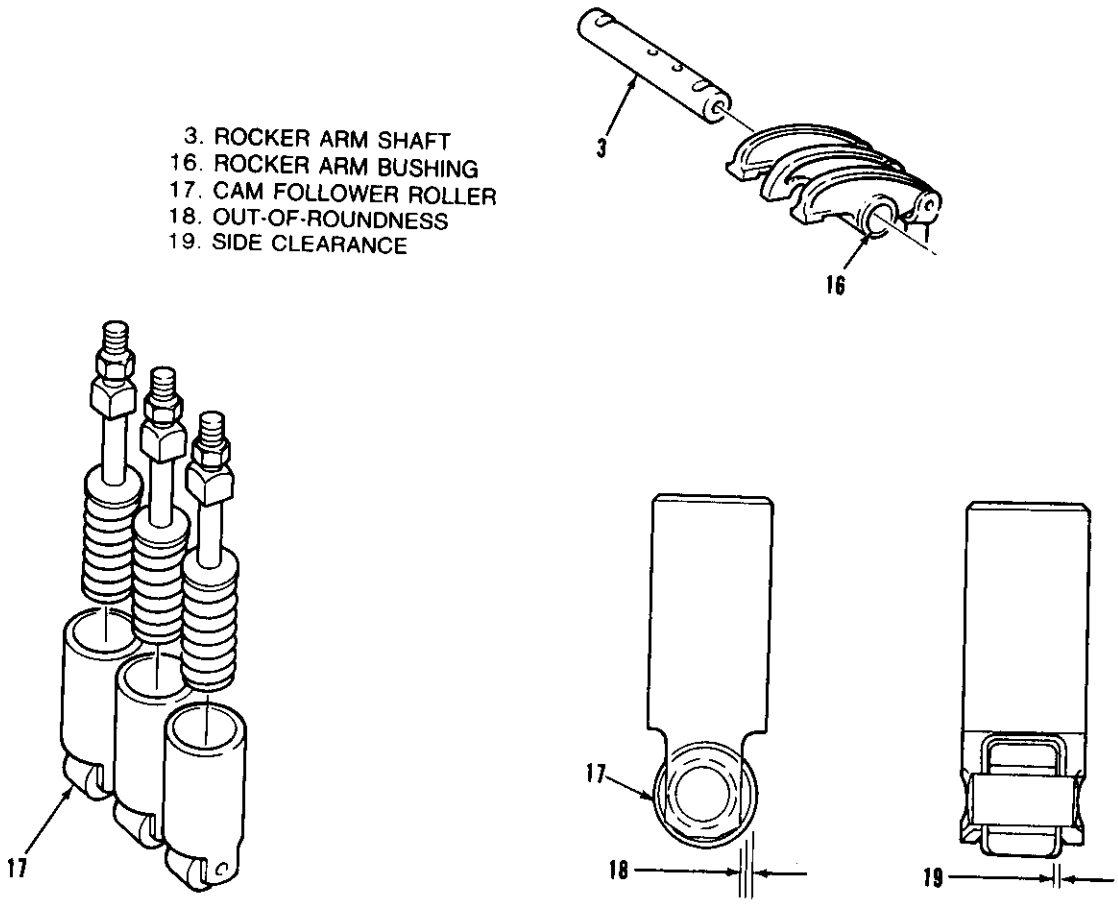
(3) Measure clearance between rocker arm shaft (3) and rocker arm bushing (16). Distance must not exceed 0.004 inch (0.10 mm).

(4) Check cam follower rollers (17) for scoring, pitting, or flat spots.

(5) Check cam follower roller (17) for out-of-roundness (18). The maximum out-of-roundness is 0.010 inch (0.2540 mm).

(6) Check the side clearance (19). The minimum clearance is 0.011 inch (0.2794 mm). The maximum is 0.023 inch (0.5842 mm).

3. ROCKER ARM SHAFT
16. ROCKER ARM BUSHING
17. CAM FOLLOWER ROLLER
18. OUT-OF-ROUNDNESS
19. SIDE CLEARANCE



TA 298480

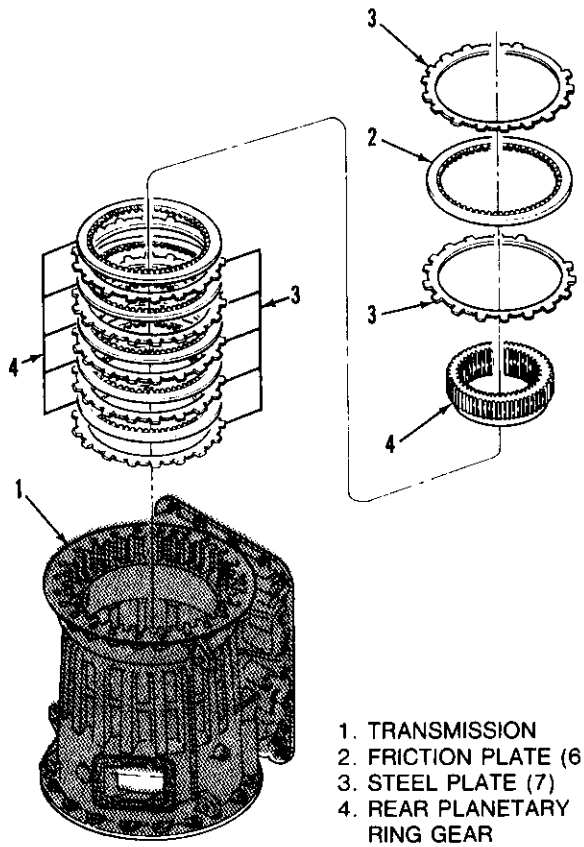
NOTE

Install thicker steel plate (3) last.

(3) Starting with a steel plate (3) and alternating with a friction plate (2), install 10 clutch plates.

(4) Install rear planetary ring gear (4), longer splines first.

(5) Starting with steel plate (3) and alternating with friction plate (2), install three clutch plates.

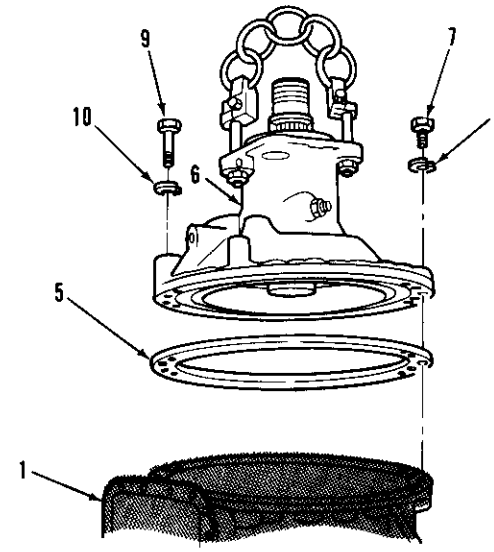


1. TRANSMISSION
2. FRICTION PLATE (6)
3. STEEL PLATE (7)
4. REAR PLANETARY RING GEAR

b. Rear Cover

(1) Lightly coat one side of new gasket (5) with grease.

(2) Set gasket (5) onto transmission (1), greased side of gasket down.



1. TRANSMISSION
5. GASKET
6. REAR COVER ASSEMBLY
7. CAPSCREW (21)
8. LOCKWASHER (21)
9. CAPSCREW (3)
10. LOCKWASHER (3)

TA 298810

(3) Aline holes in gasket (5) with holes in transmission (1). Notch in bottom of gasket must aline with notch in transmission.

(4) Install lifting device on rear cover assembly (6).

NOTE

Two different size dowel pins in rear cover will help aline cover and transmission.

(5) Aline screw holes and install rear cover assembly (6) onto transmission (1). Remove lifting device.

(6) Install 21 capscrews (7) with new lockwashers (8).

(7) Install three capscrews (9) with new lockwashers (10).

(8) Tighten capscrews (7 and 9) alternately to 70-80 foot-pounds (95-108 N·m).

(7) Measure the cam follower bore (20) in cylinder head (31). Minimum diameter is 1.0626 inches (26.9748 mm). Maximum diameter is 1.0636 inches (27.0002 mm).

(8) Measure the diameter of the cam follower (14). Minimum diameter is 1.060 inches (26.9240 mm). Maximum diameter is 1.061 inches (26.9494 mm).

(9) Check cam follower-to-cam follower bore (20) clearance by subtracting the measurement of cam follower (14) diamter from the cam follower bore (20). Minimum clearance is 0.0016 inch (0.04064 mm). Maximum clearance is 0.003 inch (0.07620 mm).

(10) Remove locknut (5), seat (21), spring (22), and seat (23) from push rod (6).

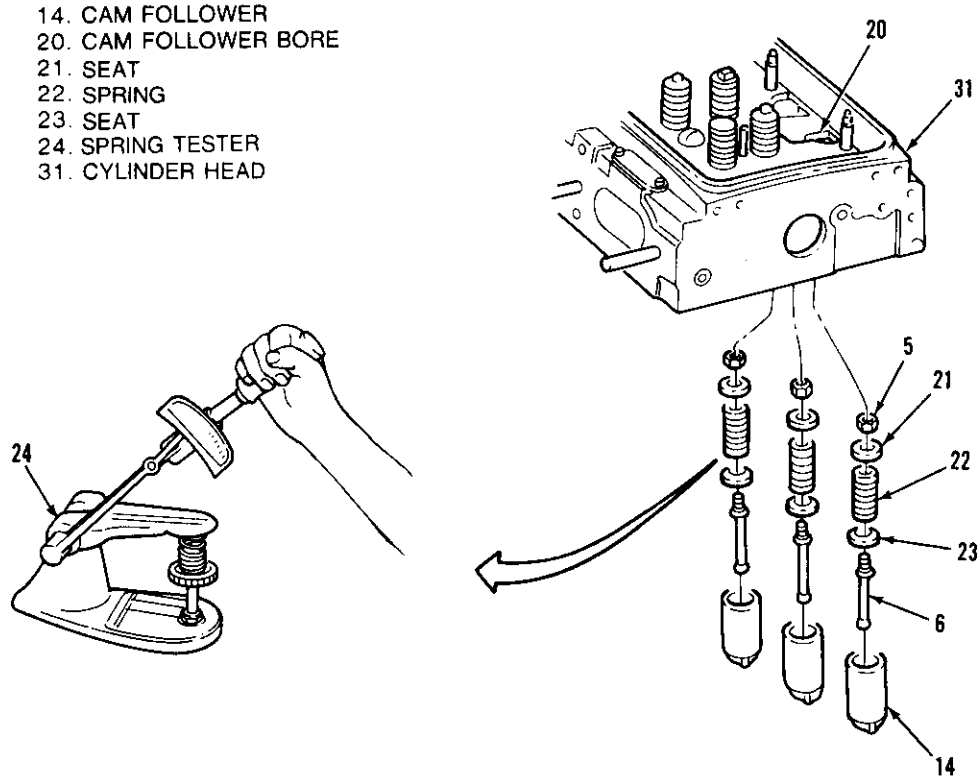
(11) Inspect push rods (6) and seats (21 and 23) for wear. Inspect for bent push rod (6).

(12) Inspect spring (22) for wear or damage.

(13) Use a spring tester (24) to check load on spring (22). Compress spring (22) to a length of 2.1406 inches (54.37124 mm). If load is less than 250 pounds (113 kg), replace spring (22).

(14) Inspect all other parts. Refer to paragraph 2-7 and replace all parts failing inspection.

5. LOCKNUT
6. PUSH ROD (3)
14. CAM FOLLOWER
20. CAM FOLLOWER BORE
21. SEAT
22. SPRING
23. SEAT
24. SPRING TESTER
31. CYLINDER HEAD



TA 298481

7-6. TRANSMISSION REASSEMBLY FROM SUBASSEMBLIES

THIS TASK COVERS:
a. First and Reverse Clutch
b. Rear Cover
c. Gear Unit
d. Second Clutch
e. Center Support
f. Fourth Clutch
g. Third Clutch
h. Forward Clutch
i. Torque Converter Housing
j. Torque Converter Pump
k. Stator
l. Flywheel
m. Control Valve
n. Lockup Cutoff Valve
o. Oil Filter
p. Oil Pan
q. Final Assembly

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Guide pin set (J 24315)
Lifting Bracket (J 24196)
Driver handle (J 24202-4)
Center support compressor set (J 24208C)
Fourth clutch alinement fixture (J 24221)
Flywheel lifting bracket (J 24365)
Rear bearing installer (J 24447)
Converter pump snapring installer (J 26598-A)
Fourth clutch lifting fixture (J 24209)

Materials/Parts

Adhesive, sealant silicone (item 7, Appendix C)
Grease, oil soluble (item 32, Appendix C)
Oil, OE/HDO-10 (item 44, Appendix C)
Overhaul kit (NSN 2520-01-092-5934)
Lockwasher (38) (MS35338-48) items 8, 10, 53, and 57
Filter (NSN 2520-01-096-1739) item 93

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Transmission disassembled into subassemblies (para 7-5).

Special Environmental Conditions

Work in a clean area free of blowing dust.

---

a. First and Reverse Clutch

(1) Position transmission (1) with rear facing up.

(2) Soak six friction plates (2) in clean lubricating oil for at least two minutes.

3-9. VALVE OPERATING MECHANISM MAINTENANCE (Continued)

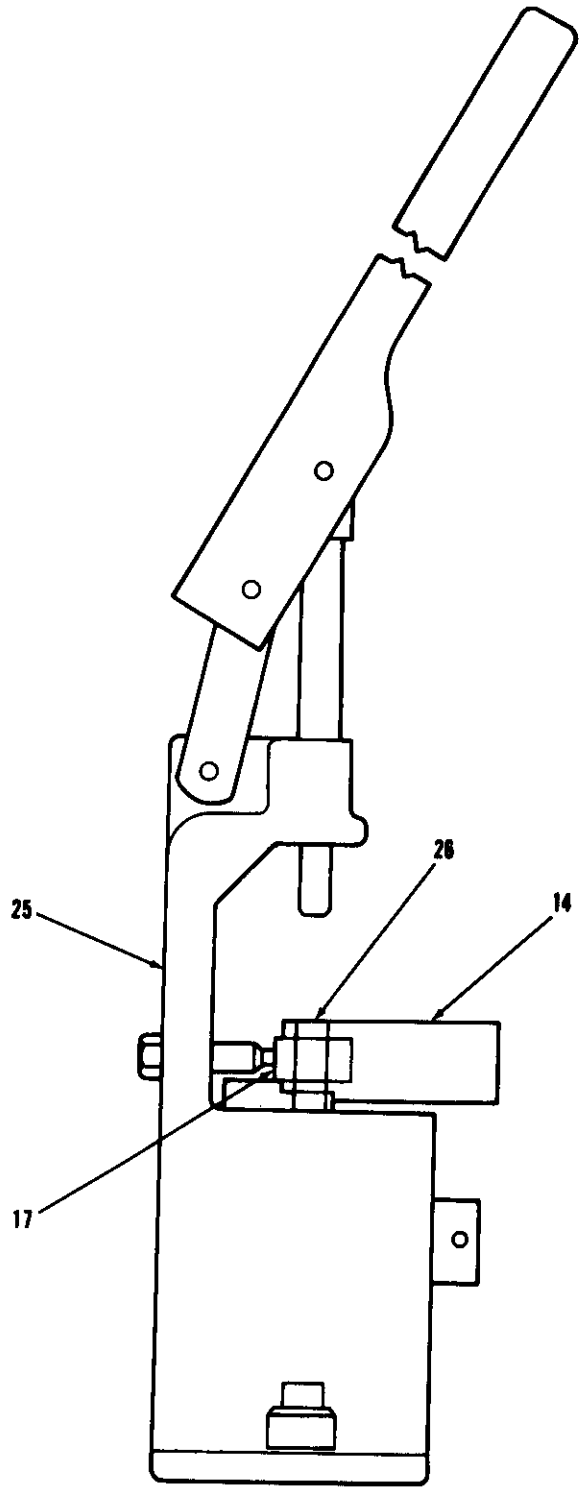
d. Disassembly

NOTE

Only remove cam roller and pin if not within specification or if cam follower (14) is damaged.

(1) Place cam follower (14) on fixture (25) per instructions on fixture.

(2) Remove cam follower pin (26) from cam follower roller (17) using fixture (25).



TA 298482

14. CAM FOLLOWER
17. CAM FOLLOWER ROLLER
25. FIXTURE
26. CAM FOLLOWER PIN

p. Rear Cover

(1) Position transmission (1) with output end facing up. Place a drain pan below transmission (1).

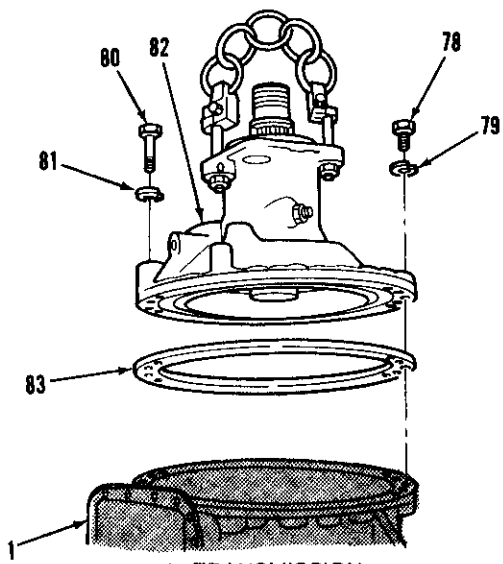
(2) Remove 21 capscrews (78) and lockwashers (79). Remove three capscrews (80) and lockwashers (81). Discard lockwashers (79 and 81).

NOTE

If necessary, loosen rear cover assembly (82) for removal by tapping several times with a rubber mallet.

(3) Attach lifting device and remove rear cover assembly (82) from transmission (1).

(4) Remove and discard gasket (83). Refer to paragraph 7-17 for rear cover maintenance.



1. TRANSMISSION
78. CAPSCREW (21)
79. LOCKWASHER (21)
80. CAPSCREW (3)
81. LOCKWASHER (3)
82. REAR COVER ASSEMBLY
83. GASKET

q. First and Reverse Clutch

(1) Remove two steel plates (84), one friction plate (85), and rear planetary ring gear (86) as an assembly.

(2) Separate two steel plates (84) and one friction plate (85) from rear planetary ring gear (86).

(3) Remove five remaining steel plates (84) and five remaining friction plates (85).

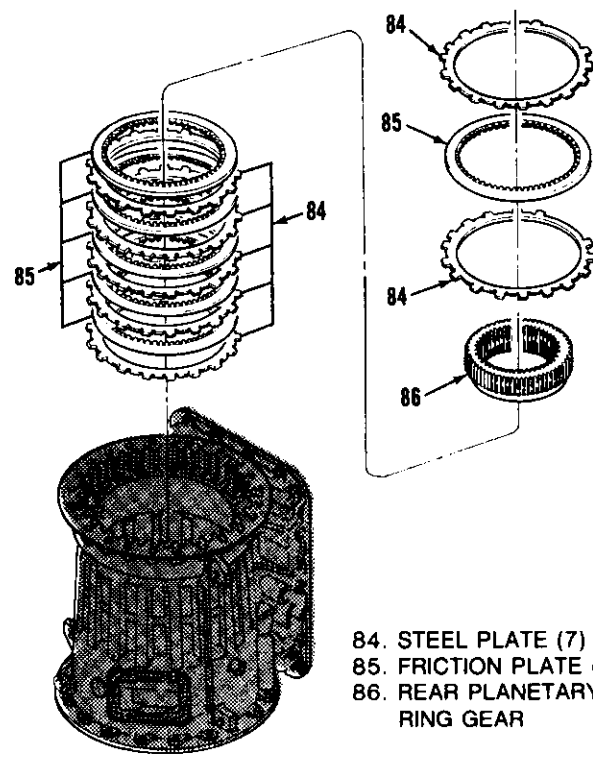
(4) Tie clutch plates together and label the pack. Refer to paragraph 7-17 for clutch maintenance. Refer to paragraph 7-18 for transmission housing repair.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 Reassemble transmission
TM 9-2320-297-34 (para 7-6).



84. STEEL PLATE (7)
85. FRICTION PLATE (6)
86. REAR PLANETARY RING GEAR

TA 298809

e. Assembly

CAUTION

Do not clean cam follower parts in diesel fuel oil.

(1) Before installing new cam follower rollers (17) and cam follower pin (26), remove preservative by washing parts in clean lubricating oil. Wipe the parts dry.

(2) Position the cam follower (14) and cam follower roller (17) on the fixture (25) per instructions on the fixture.

(3) Start new cam follower pin (26) in cam follower (14) and press in following instructions on the fixture.

(4) Recheck the side clearance.

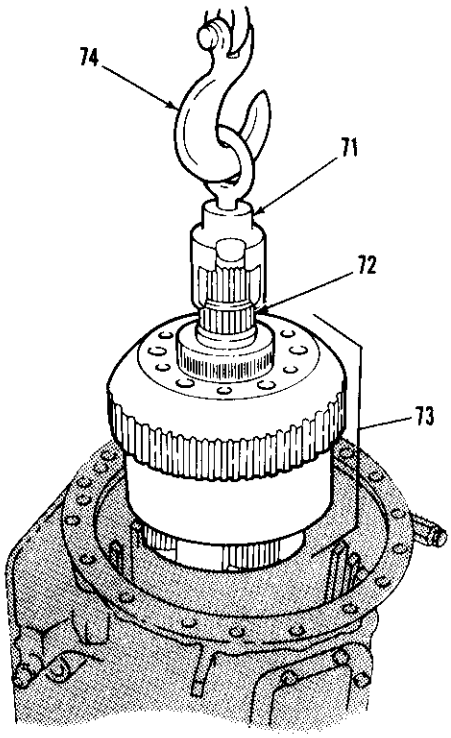
(5) Perform load cell test following instructions on fixture (25). Discard follower if not within specifications.

7-5. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (Continued)

n. Gear Unit

(1) Attach lifting bracket (71) to mainshaft (72) of gear unit assembly (73).

(2) Attach hoist (74) to lifting bracket (71). Remove gear unit assembly (73). Refer to paragraph 7-16 for gear unit repair.

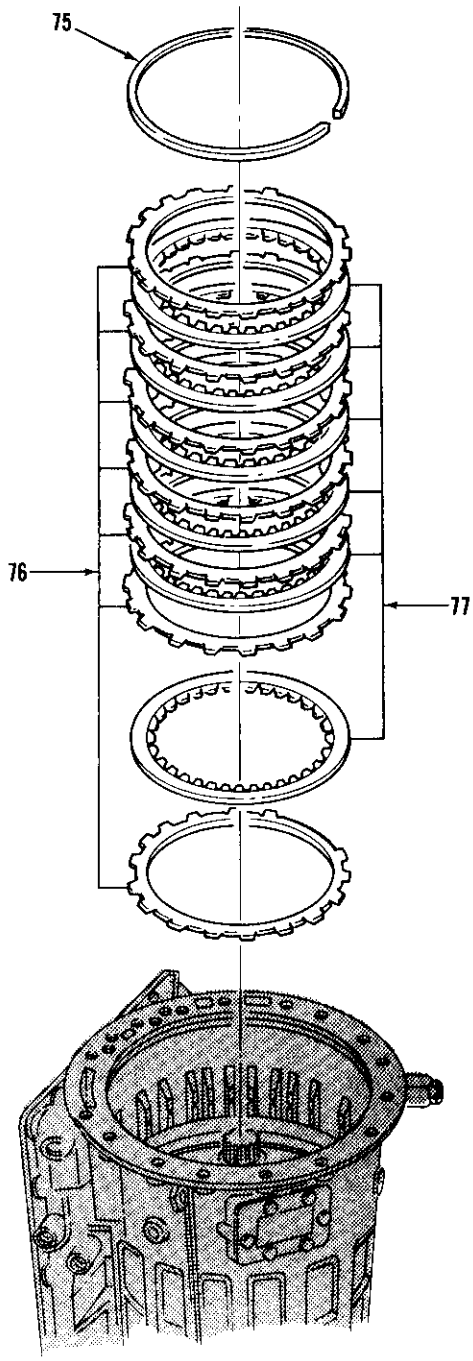


71. LIFTING BRACKET (TOOL)
72. MAINSHAFT
73. GEAR UNIT ASSEMBLY
74. HOIST (TOOL)

o. Second Clutch

(1) Remove snapring (75) holding 13 second clutch plates (76 and 77) together.

(2) Remove 13 clutch plates (76 and 77). Label pack for assembly. Refer to paragraph 7-15 for second clutch maintenance.



75. SNAPRING
76. STEEL PLATE (7)
77. FRICTION PLATE (6)

TA 298808

3-9. VALVE OPERATING MECHANISM MAINTENANCE (Continued)

f. Installation

WARNING

Hot items can burn you. Wear temperature resistant gloves.

(1) Before installing cam followers (14), immerse them in clean, heated Cindol 1705. Heat Cindol 1705 to 100-125° F (38-52°C). Leave cam followers (14) immersed for at least one hour.

(2) If removed, install spring retainers (15).

(3) Install seat (23), spring (22), seat (21), and locknut (5) on push rod (6).

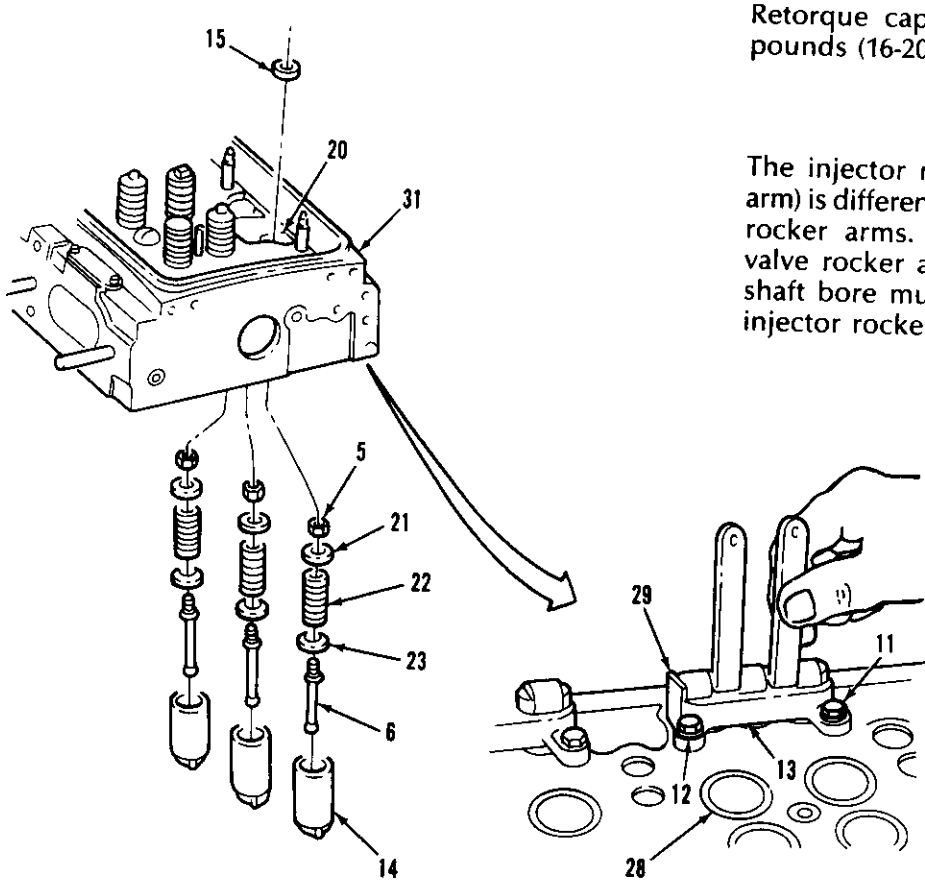
(4) Install push rod (6) assembly into proper cam follower (14). Install cam follower (14) assembly so oil hole in bottom of cam follower (14) faces away from exhaust valves (28). Parts were tagged for location during removal.

(5) After the three cam followers (14) have been installed, place cam follower guide (13) on cylinder head (31) and install two capscrews (11) and two new lockwashers (12). Torque capscrews to 12-15 foot-pounds (16-20 N·m).

(6) Check clearance between cam follower legs (29) and cam follower guide (13) with feeler gage. Clearance should be at least 0.005 inches. If less, loosen two capscrews (11) and move each corner of cam follower guide (13) away from cam followers (14). Retorque capscrews (11) to 12-15 foot-pounds (16-20 N·m). Recheck clearance.

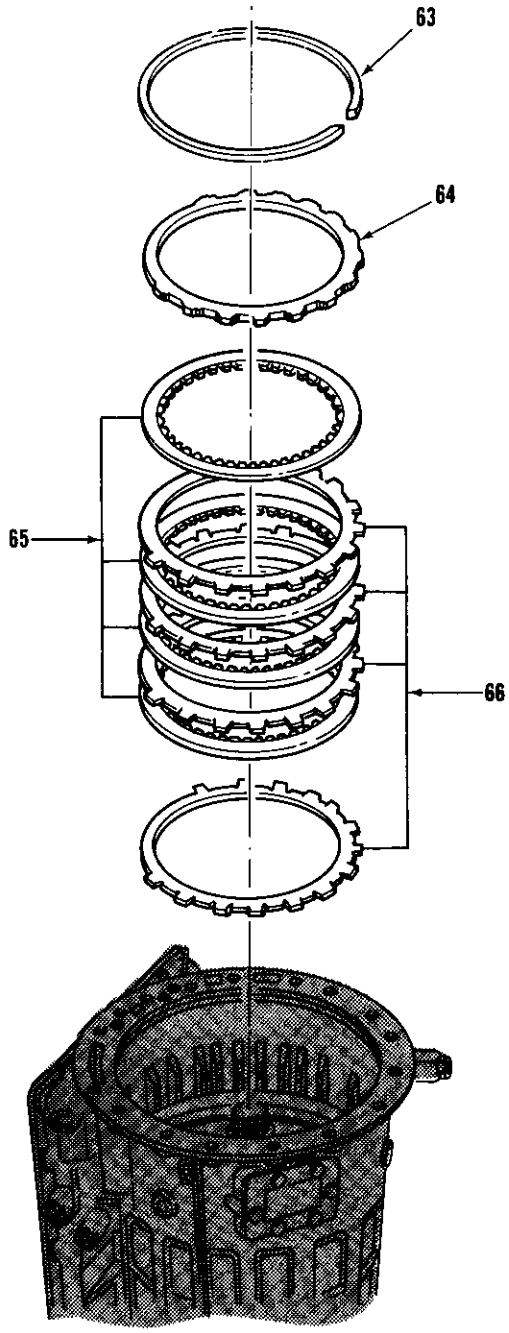
NOTE

The injector rocker arm (middle arm) is different from exhaust valve rocker arms. For right and left valve rocker arms, the extended shaft bore must face toward the injector rocker arm.



5. LOCKNUT
6. PUSH ROD (3)
11. CAPSCREW (2)
12. LOCKWASHER (2)
13. CAM FOLLOWER GUIDE
14. CAM FOLLOWER
15. SPRING RETAINER
20. CAM FOLLOWER BORE
21. SEAT
22. SPRING
23. SEAT
28. EXHAUST VALVES
29. CAM FOLLOWER LEGS
31. CYLINDER HEAD

TA 298484



63. SNAPRING
64. BACKING PLATE
65. FRICTION PLATE (4)
66. STEEL PLATE (4)

m. Center Support

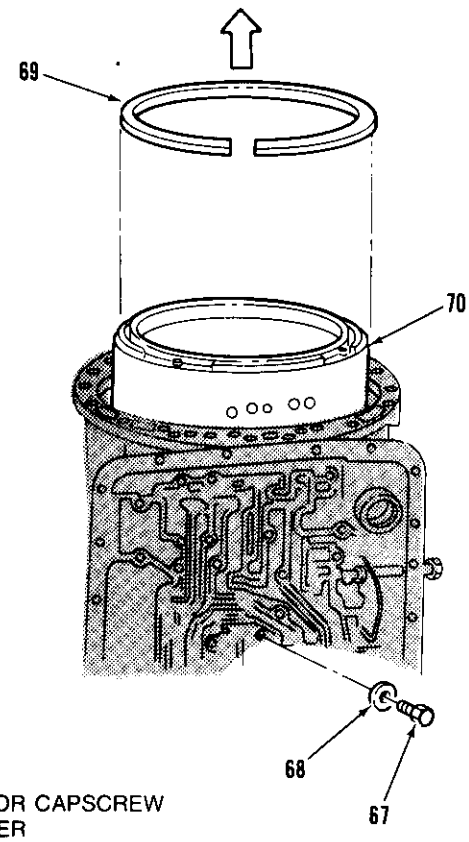
(1) Remove and discard center support anchor capscrew (67) and washer (68).

(2) Remove snapring (69).

CAUTION

Center support (70) is fitted to transmission housing with very little clearance and may bind if transmission housing is cold. Heat transmission housing with a heat lamp or warm current of air.

(3) Lift center support (70) straight up and remove. Refer to paragraph 7-15 for center support maintenance.



67. ANCHOR CAPSCREW
68. WASHER
69. SNAPRING
70. CENTER SUPPORT

TA 298807

(7) Install each rocker arm (4) on push rods (6) until flush with top of clevis (30).

(8) Install screw (10) and locknut (9) in valve bridge (7). Do not tighten.

(9) Install valve bridge (7) on bridge guide (8).

(10) While firmly pressing down on valve bridge (7), turn screw (10) clockwise until it just touches valve stem. Turn screw (10) an additional 1/8 to 1/4 turn clockwise.

(11) Tighten locknut (9) fingertight.

CAUTION

Valve bridge (7) must be placed in a soft jawed vise while torquing locknut (9) to prevent damage.

(12) Remove valve bridge (7) and place in a soft jawed vise. While holding screw (10), torque locknut (9) to 20-25 foot-pounds (27-34 N·m). Reinstall valve bridge (7) onto bridge guide (8).

(13) Place a 0.0015 feeler gage under each end of valve bridge (7). While pressing down on valve bridge (7), both feeler gages must be tight. If both feeler gages are not tight, repeat steps (9) thru (12).

(14) Install rocker arm shaft (3) into rocker arms (4).

NOTE

Brackets (2) must be installed in their original position.

(15) Install brackets (2) onto rocker arm shaft (3), one on each side of rocker arms (4).

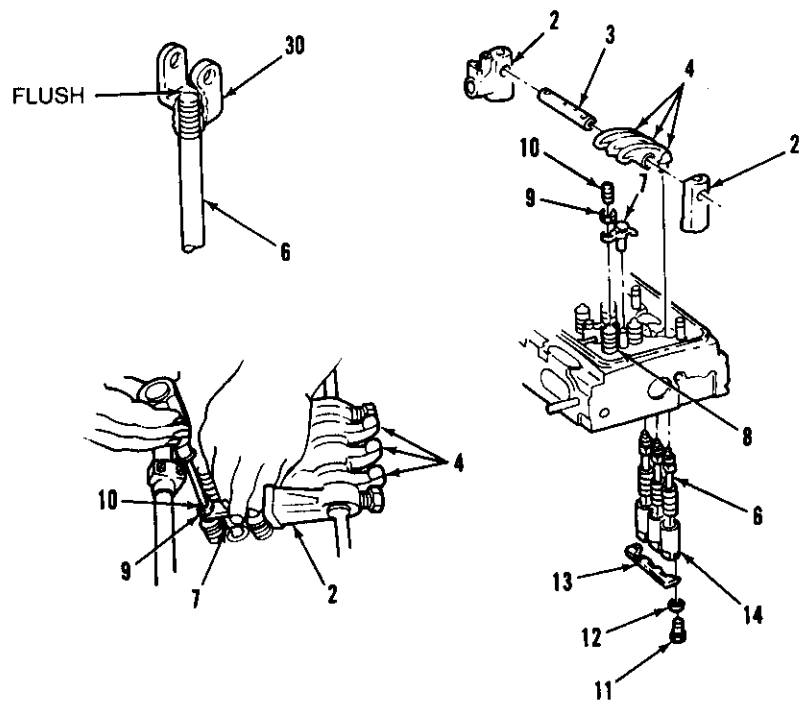
(16) Repeat steps (1) thru (15) for remaining valve operating mechanisms.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install cylinder head (para 3-3).
	Install engine brake (para 3-15).
	Adjust exhaust valves (para 3-29).



2. BRACKET (2)
3. ROCKER ARM SHAFT
4. ROCKER ARM (3)
6. PUSH ROD (3)
7. VALVE BRIDGE
8. BRIDGE GUIDE
9. LOCKNUT
10. SCREW
11. CAPSCREW
13. CAM FOLLOWER GUIDE
30. CLEVIS

TA 298485

7-5. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (Continued)

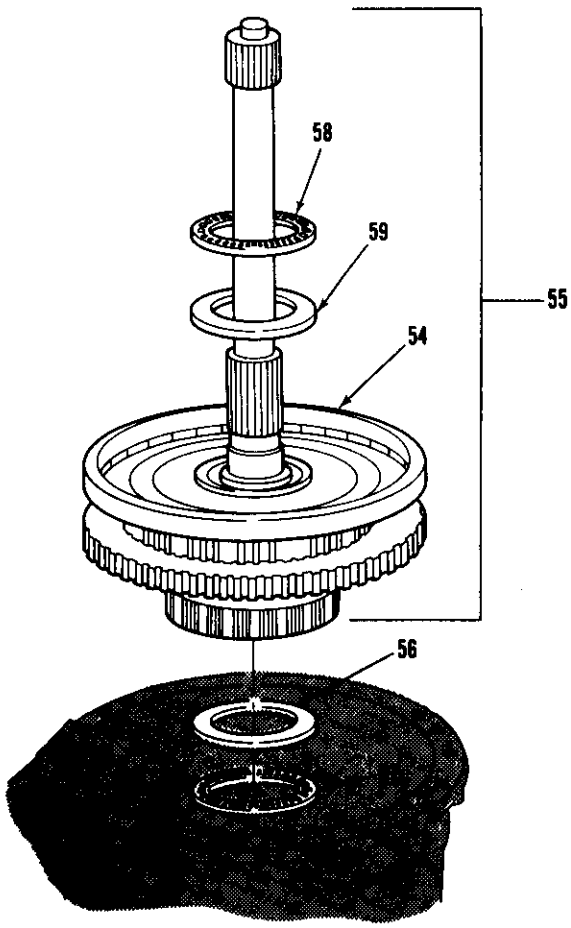
j. Forward Clutch

CAUTION

Do not let weight rest on oil collector ring (54). This may damage oil collector ring (54).

(1) Remove forward clutch assembly (55).

(2) Remove needle bearing race (56) and needle bearing (57).



54. OIL COLLECTOR RING
55. FORWARD CLUTCH ASSEMBLY
56. NEEDLE BEARING RACE
57. NEEDLE BEARING
58. NEEDLE BEARING
59. NEEDLE BEARING RACE

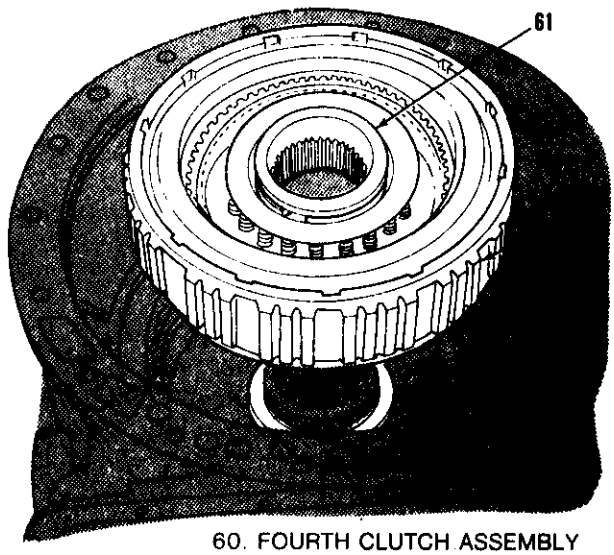
(3) Remove needle bearing (58) and needle bearing race (59). Keep all bearings and races with the forward clutch assembly (55).

(4) Refer to paragraph 7-13 for forward clutch and input shaft repair.

k. Fourth Clutch

(1) Using fourth clutch lifting fixture, remove fourth clutch assembly (60).

(2) Remove front bearing race (61) and rear bearing race (62). Keep races (61 and 62) with fourth clutch assembly (60). Refer to paragraph 7-14 for fourth clutch repair.



60. FOURTH CLUTCH ASSEMBLY
61. BEARING RACE (FRONT)
62. BEARING RACE (REAR)

TA 298806

l. Third Clutch

(1) Remove snapring (63) and backing plate (64).

(2) Remove eight clutch plates (65 and 66). Tie clutch plates together and identify pack for assembly. Refer to paragraph 7-15 for third clutch maintenance.

3-10. OIL COOLER AND HOUSING REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Adhesive (item 3, Appendix C)
Lockwasher (4) (MS35338-46) items 9, 23, 25, and 31
Gasket (NSN 5330-01-058-0586) item 10
Lockwasher (12) (MS35338-45) item 20
Gasket (NSN 5330-00-758-2863) item 21
Seal (NSN 5330-01-058-5220) item 26
Gasket (NSN 5330-00-745-7831) item 28
Gasket (NSN 5330-01-058-0587) item 29
Gasket (2) (P/N 8923512) item 33
Gasket (2) (NSN 5330-00-844-2907) item 41
Gasket (NSN 5310-00-231-3293) item 43

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Access panel removed (para 18-14).
	Engine coolant drained (para 6-3).
	Radiator coolant line removed (para 6-7).
	Oil filter adapter removed (3-5).

a. Removal

(1) Loosen two hose clamps (1). Slide hose (2) onto elbow (3).

(2) Loosen hose clamp (4). Remove hose (5). Remove two elbows (6 and 7).

(3) Remove four capscrews (8) and lockwashers (9). Remove elbow (3) and gasket (10). Discard gasket (10) and lockwashers (9).

(4) Loosen hose clamp (11). Remove hose (12). Remove tee fitting (13) and fitting (14).

(5) Make a mark across oil cooler housing (15) and oil cooler core (16) for proper installation.

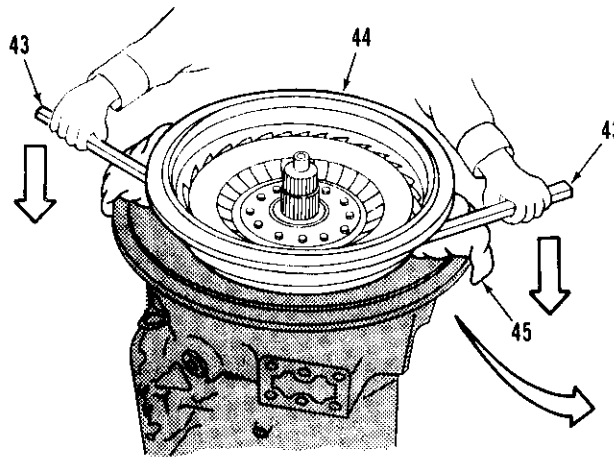
WARNING

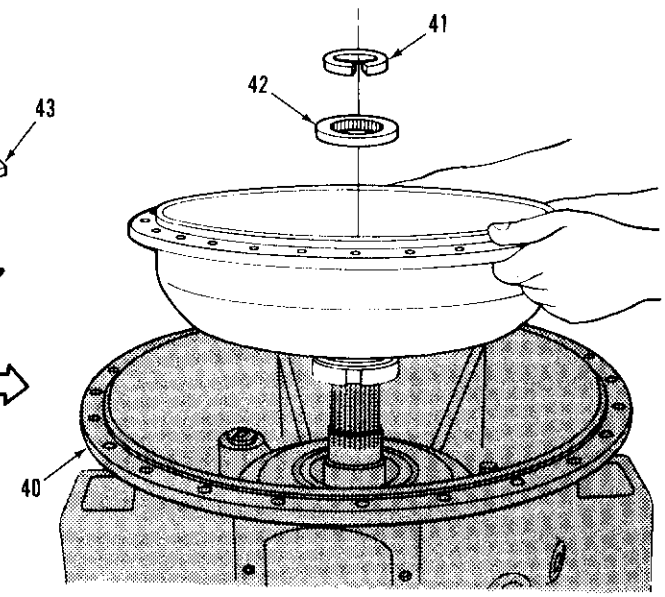
Oil cooler is extremely heavy (40 lbs). Oil cooler must be securely supported during removal of capscrews (17 and 18). Remove oil cooler carefully to avoid personal injury.

CAUTION

Oil cooler core (16) is loose in housing and can be damaged when removing oil cooler housing (15).

(6) Loosen 10 capscrews (17), and two capscrews (18). Loosen hose clamp (19).





40. TORQUE CONVERTER HOUSING
41. SNAPRING
42. SPACER
43. PRY BAR (2)
44. TORQUE CONVERTER PUMP
45. SHOP RAG (2)

i. Torque Converter Housing

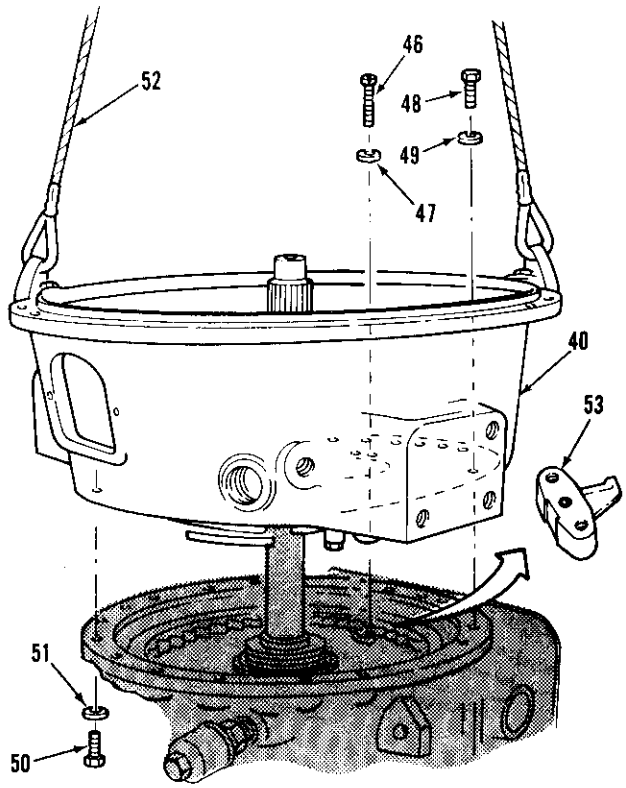
(1) Remove two screws (46) and washers (47) from inside torque converter housing (40).

(2) Remove seven capscrews (48) and lockwashers (49) from inside torque converter housing (40). Discard lockwashers (49).

(3) Remove nine capscrews (50) and lockwashers (51) from outside torque converter housing (40). Discard lockwashers (51).

(4) Remove torque converter housing (40) with a lifting sling (52).

(5) Remove pitot block (53). Refer to paragraph 7-12 for torque converter housing and front support repair.



40. TORQUE CONVERTER HOUSING
46. SCREW (2)
47. WASHER (2)
48. CAPSCREW (7)
49. LOCKWASHER (7)
50. CAPSCREW (9)
51. LOCKWASHER (9)
52. LIFTING SLING (TOOL)
53. PITOT BLOCK

TA 298805

(7) While supporting oil cooler housing (15), tag and remove 10 capscrews (17), two capscrews (18), and 12 lockwashers (20). Discard lockwashers (20).

(8) Remove oil cooler housing (15), gasket (21), and hose clamp (19). Discard gasket (21).

(9) Tag and remove two capscrews (22) and lockwashers (23). Remove two nuts (24) and lockwashers (25). Discard lockwashers (23 and 25).

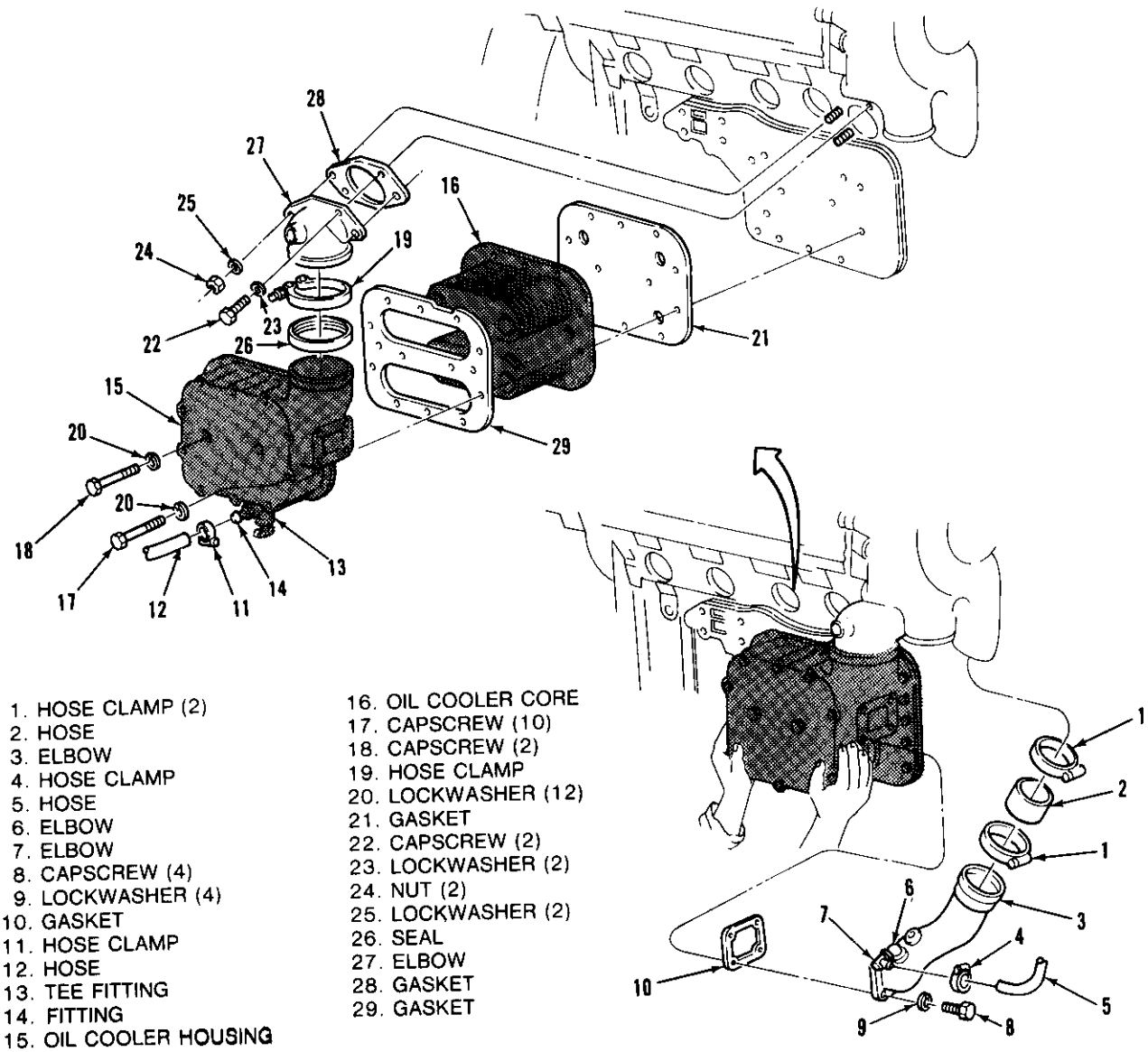
(10) If damaged, remove seal (26) from hose clamp (19) and discard.

NOTE

Remove elbow (27) only if damaged or engine is to be overhauled.

(11) Remove elbow (27) and gasket (28). Discard gasket (28).

(12) Separate oil cooler core (16) from oil cooler housing (15). Remove and discard gasket (29).



1. HOSE CLAMP (2)
2. HOSE
3. ELBOW
4. HOSE CLAMP
5. HOSE
6. ELBOW
7. ELBOW
8. CAPSCREW (4)
9. LOCKWASHER (4)
10. GASKET
11. HOSE CLAMP
12. HOSE
13. TEE FITTING
14. FITTING
15. OIL COOLER HOUSING
16. OIL COOLER CORE
17. CAPSCREW (10)
18. CAPSCREW (2)
19. HOSE CLAMP
20. LOCKWASHER (12)
21. GASKET
22. CAPSCREW (2)
23. LOCKWASHER (2)
24. NUT (2)
25. LOCKWASHER (2)
26. SEAL
27. ELBOW
28. GASKET
29. GASKET

TA 298486

7-5. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (Continued)

g. Control Valve

(1) Remove two capscrews (30) and baffle (31).

(2) Remove capscrew (32) and manual detent lever (33) from control valve (34).

(3) Remove seven capscrews (35) from control valve (34).

(4) Remove two capscrews (36) and washers (37) from corners of control valve (34).

(5) Remove 18 capscrews (38) from control valve (34).

CAUTION

Do not allow selector valve (39) to drop when control valve (34) is removed. Use rubber band or available wire to temporarily hold selector valve (39) in place.

(6) Remove control valve (34) while holding selector valve (39) in place. Refer to paragraph 7-10 for control valve repair.

h. Torque Converter Pump

(1) Position transmission so torque converter housing (40) faces up.

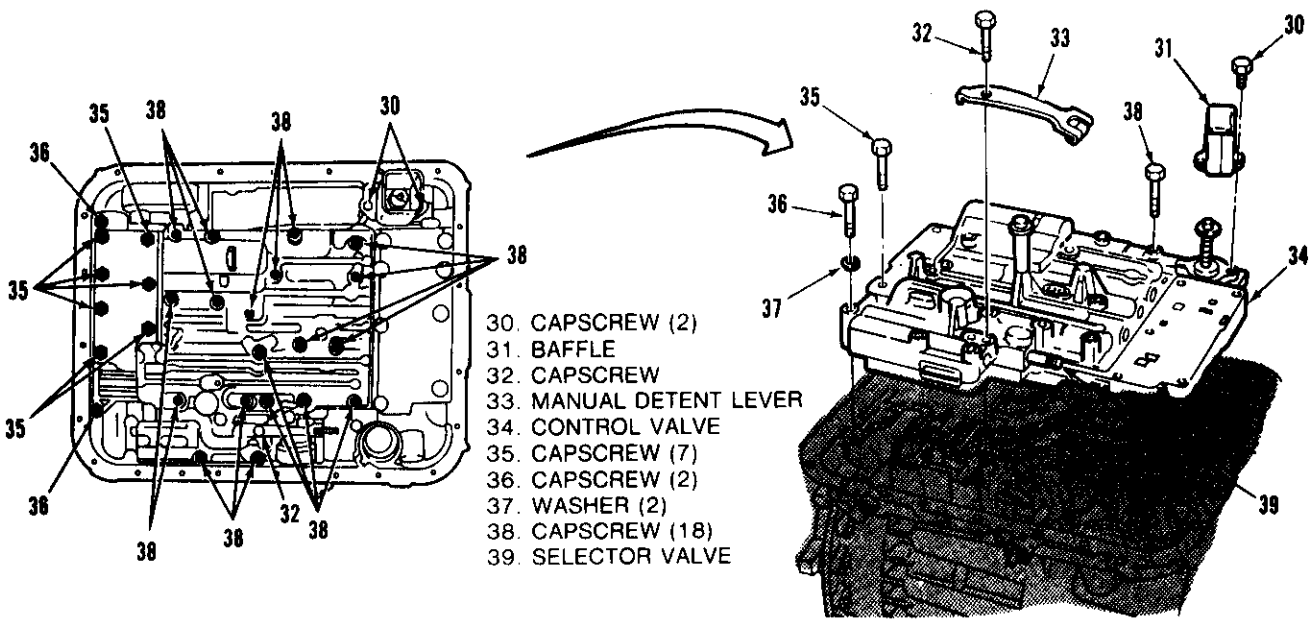
(2) Using converter pump snapring remover, remove snapring (41) and spacer (42).

(3) Place two pry bars (43) between torque converter pump (44) and torque converter housing (40). Use shop rags (45) to protect parts.

NOTE

Torque converter pump (44) is an extremely tight fit. It may be necessary to use an assistant. Evenly jiggle torque converter pump (44) upward until free.

(4) Press down on both pry bars (43) evenly and loosen torque converter pump (44). Remove torque converter pump (44). Refer to paragraph 7-11 for torque converter pump repair.



TA 298804

3-10. OIL COOLER AND HOUSING REPLACEMENT (Continued)

(13) Tag and remove eight capscrews (30) and lockwashers (31). Remove plate (32) and gasket (33). Discard gasket (33) and lockwashers (31).

(14) Tag and remove six capscrews (34, 35, and 36) and washers (37).

(15) Remove adapter (38), spacers (39 and 40), and gaskets (41). Discard gaskets (41).

(16) Remove plug (42), gasket (43), spring (44), and valve (45). Discard gasket (43).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Clean all gasket material from cylinder block and oil cooler parts.

(3) Inspect oil cooler housing (15) for cracks.

(4) Inspect all capscrews and threads for nicks and burrs.

(5) Inspect all other parts. Refer to paragraph 2-7 and replace all parts failing inspection.

c. Installation

(1) Install valve (45), spring (44), new gasket (43), and plug (42). Tighten plug (42) securely.

(2) Coat two capscrews (36) with adhesive.

(3) Install adapter (38), two spacers (39 and 40), and two new gaskets (41). Install six capscrews (34, 35, and 36), and washers (37). Torque capscrews (34, 35, and 36) to 30-35 foot-pounds (41-47 N·m).

(4) Install plate (32) and new gasket (33) with eight capscrews (30) and new lockwashers (31) at location A. Torque capscrews (30) to 13-17 foot-pounds (18-23 N·m).

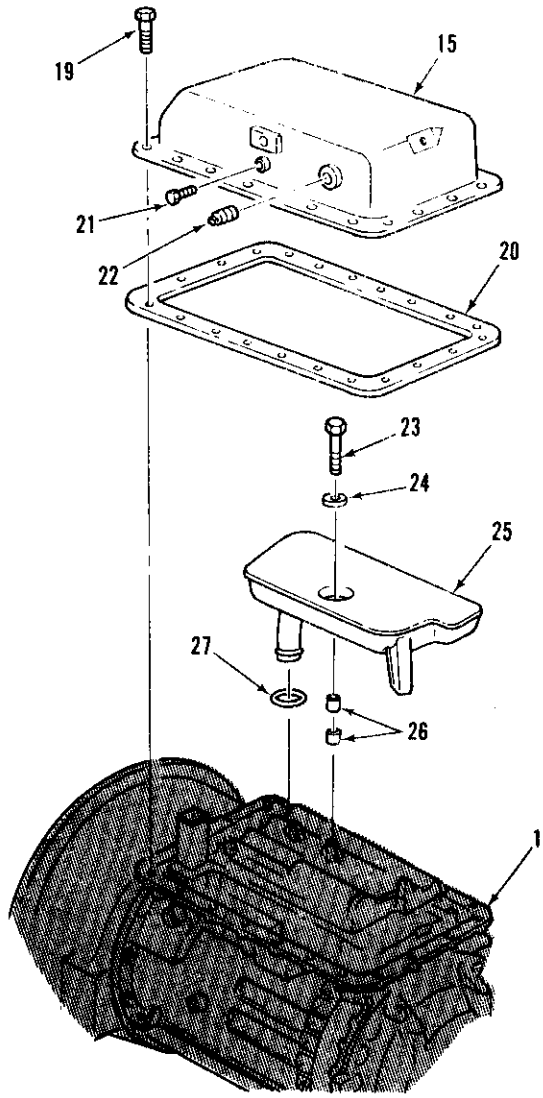
(3) Remove 21 capscrews (19) from oil pan (15).

(4) Remove oil pan (15) and gasket (20). Discard gasket (20).

(5) Remove plugs (21 and 22) if damaged.

e. Oil Filter

(1) Remove capscrew (23) and washer (24) from filter (25).



1. TRANSMISSION
15. OIL PAN
19. CAPSCREW (21)
20. GASKET
21. PLUG
22. PLUG
23. CAPSCREW
24. WASHER
25. FILTER
26. SPACER (2)
27. SEALRING

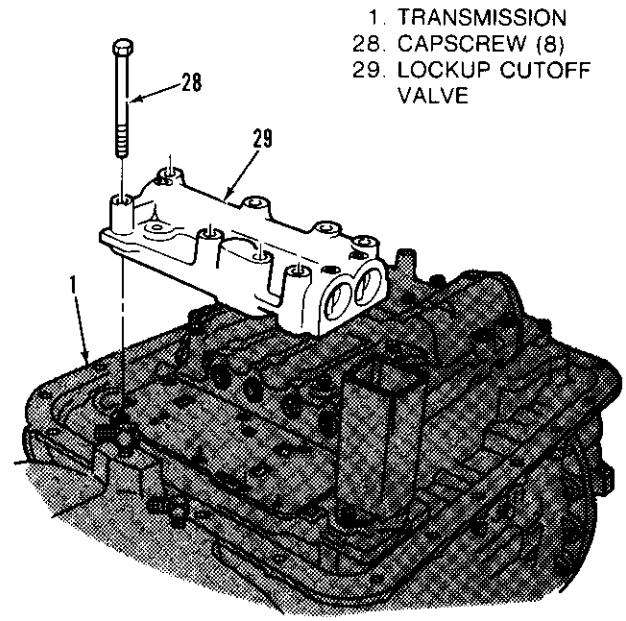
(2) Remove filter (25) and two spacers (26) from transmission (1).

(3) Remove sealring (27) from filter (25). Discard sealring (27).

f. Lockup Cutoff Valve

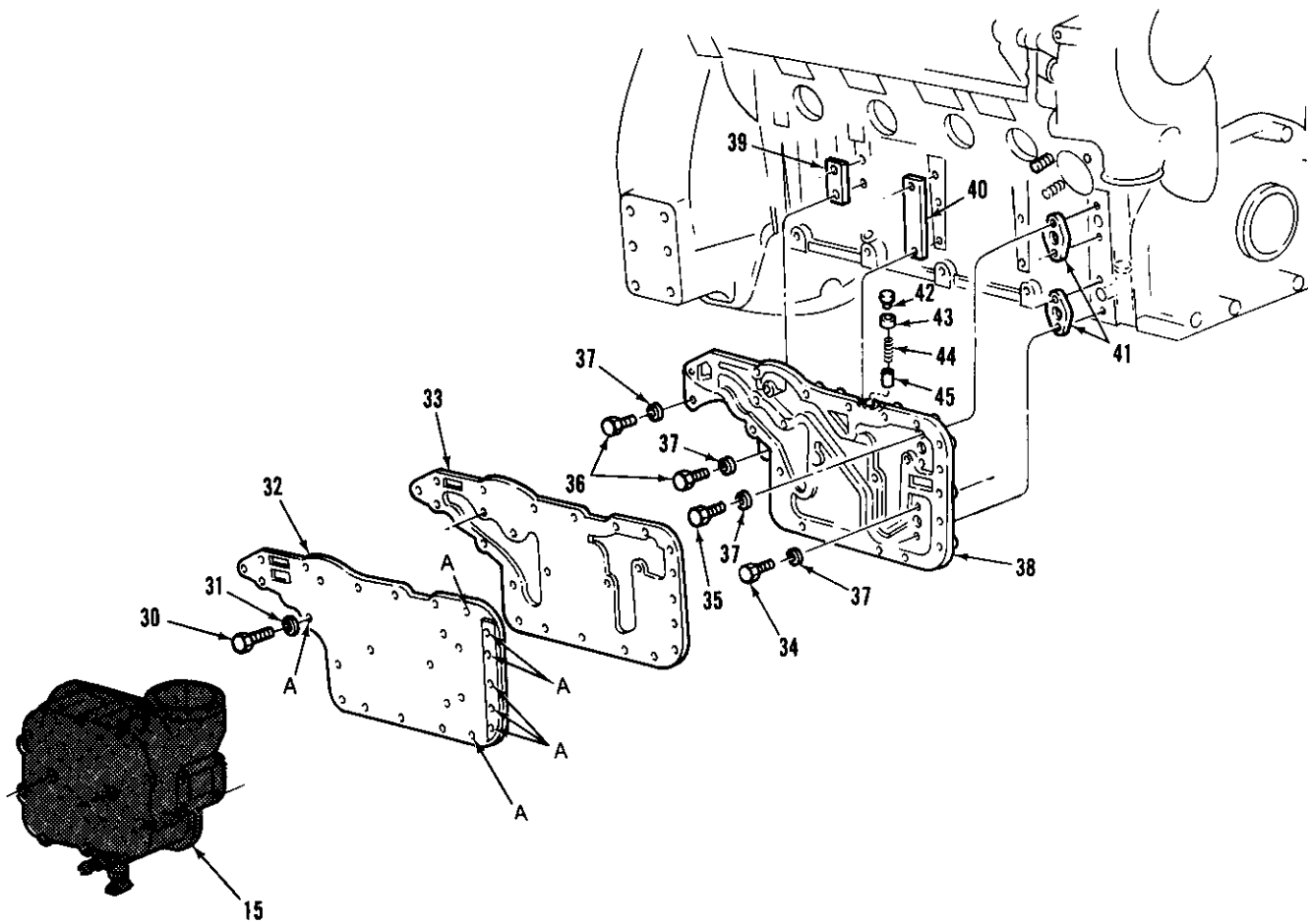
(1) Remove eight capscrews (28) from lockup cutoff valve (29).

(2) Remove lockup cutoff valve (29) from transmission (1). Refer to paragraph 7-9 for lockup cutoff valve repair.



1. TRANSMISSION
28. CAPSCREW (8)
29. LOCKUP CUTOFF VALVE

TA 298803



15. OIL COOLER HOUSING
30. CAPSCREW (8)
31. LOCKWASHER (8)
32. PLATE
33. GASKET
34. CAPSCREW (2) 3/8-16 X 1.13
35. CAPSCREW (2) 3/8-16 X 1.5
36. CAPSCREW (2) 3/8-16 X 1.5
37. WASHER (6)
38. ADAPTER
39. SPACER
40. SPACER
41. GASKET (2)
42. PLUG
43. GASKET
44. SPRING
45. VALVE

TA 298487

7-5. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES (Continued)

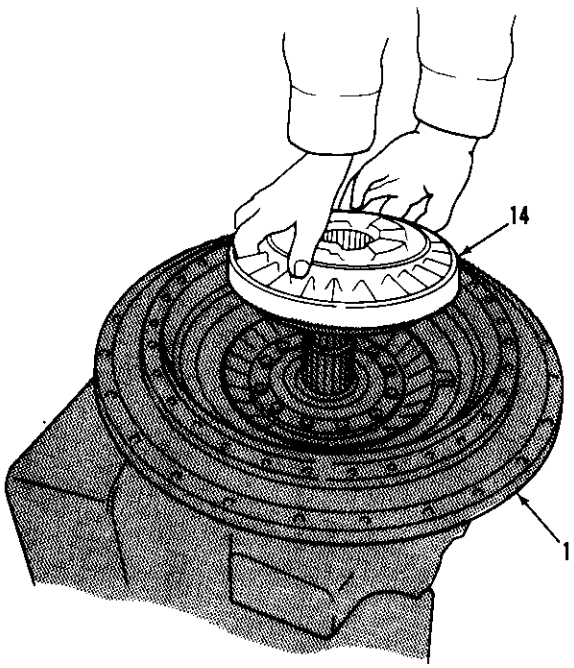
c. Stator

(1) Position transmission (1) with front up.

CAUTION

Remove stator as a unit. Stator may come apart during removal. Care must be taken during removal to prevent loss of parts.

(2) Grasp stator (14) and rotate counterclockwise to lock it together. Carefully lift stator (14) from transmission until you can place hands under stator (14). With hands under stator, lift to remove. Refer to paragraph 7-8 for stator repair.



1. TRANSMISSION
14. STATOR

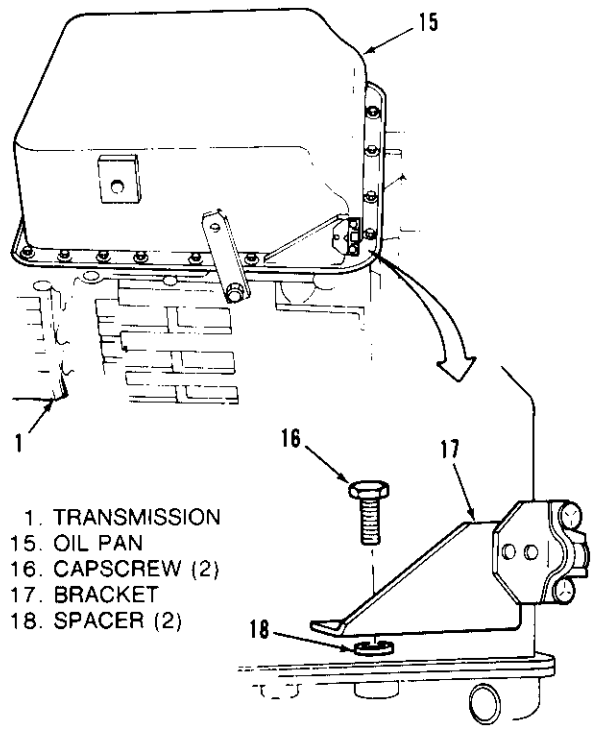
d. Oil Pan

(1) Position transmission (1) so oil pan (15) is on top.

NOTE

- Mark location of capscrews and bracket for proper assembly.
- Bracket (17) may have been removed during transmission replacement.

(2) Remove two capscrews (16), bracket (17), and two spacers (18) from transmission (1).



1. TRANSMISSION
15. OIL PAN
16. CAPSCREW (2)
17. BRACKET
18. SPACER (2)

TA 298802

3-10. OIL COOLER AND HOUSING REPLACEMENT (Continued)

(5) Install new gasket (28) and elbow (27) with two nuts (24), two capscrews (22), and four new lockwashers (23 and 25).

(6) Install new gasket (29) on oil cooler core (16).

(7) Aline installation marks made during removal, and install oil cooler core (16) into oil cooler housing (15).

(8) If removed, place new seal (26) on oil cooler housing (15).

WARNING

Oil cooler is extremely heavy (40 lbs). Oil cooler must be securely supported during installation.

(9) Using two capscrews (18) and new lockwasher (20) as guides, install oil cooler housing (15) and new gasket (21).

(10) Install 10 capscrews (17) and new lockwashers (20) into oil cooler housing (15). Tighten capscrews (17) securely.

(11) Install hose clamp (19) around seal (26). Tighten hose clamp (19) securely.

(12) Install elbow (3) and new gasket (10) with four capscrews (8) and new lockwashers (9). Torque capscrews (8) to 30-35 foot-pounds (41-47 N·m).

(13) Install hose (2). Tighten two hose clamps (1) securely.

(14) Install elbows (6 and 7).

(15) Install hose (5). Tighten hose clamp (4) securely.

(16) Install tee fitting (13) and fitting (14) into oil cooler housing (15).

(17) Install hose (12). Tighten hose clamp (11) securely.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install oil filter adapter (para 3-5).
	Install radiator coolant line (para 6-7).
	Fill engine coolant (para 6-3).
	Install access cover (para 18-14).
TM 2320-10/11 TM 9-2320-297-10	Start engine and check for leaks (para 2-13).

NOTE

- It may be necessary to remove capscrews (3) and washers (4) from each side of transmission to provide clearance for holding fixture.
- Position transmission with oil pan down.

(2) Attach suitable holding fixture to all four mounting locations (2) as shown.

b. Flywheel

(1) Remove two capscrews (5), cover (6), and gasket (7) from transmission (1). Discard gasket (7).

NOTE

Use lifting bracket to turn flywheel for access to capscrews inside.

(2) Install lifting bracket (8) to flywheel (9) with capscrews provided with tool.

WARNING

Leave last capscrew (10) centered at lifting bracket (8) to aid in proper removal of flywheel. It is important that steps (3) and (4) be accomplished before removing the final capscrew (10) to prevent personal injury.

(3) Remove 29 of 30 capscrews (10) and washers (11) from inside transmission (1).

(4) Connect lifting device (12) to lifting bracket (8). Raise lifting device until it supports weight of flywheel (9).

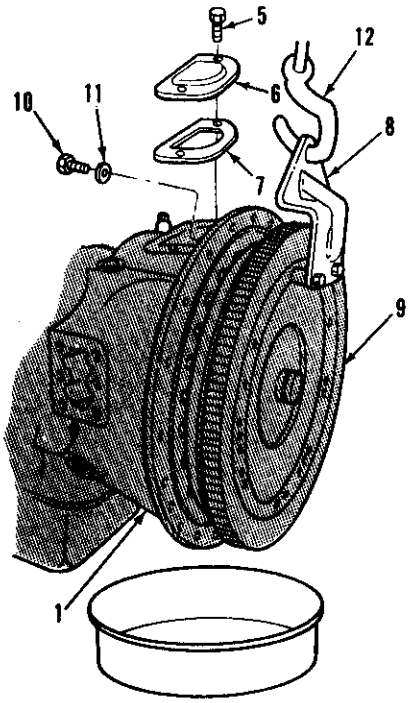
WARNING

While removing flywheel assembly, the turbine (13) may drop. Use care to prevent personal injury or parts damage.

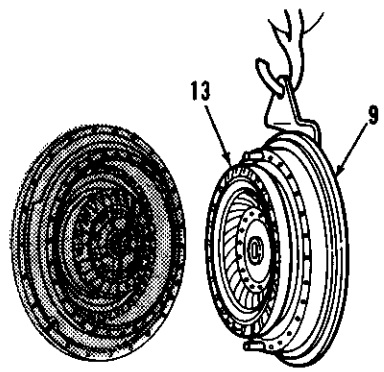
(5) Remove remaining capscrew (10) and washer (11) from transmission (1).

(6) Remove flywheel (9) with turbine (13) from transmission (1). Place on workbench. Remove lifting device (12).

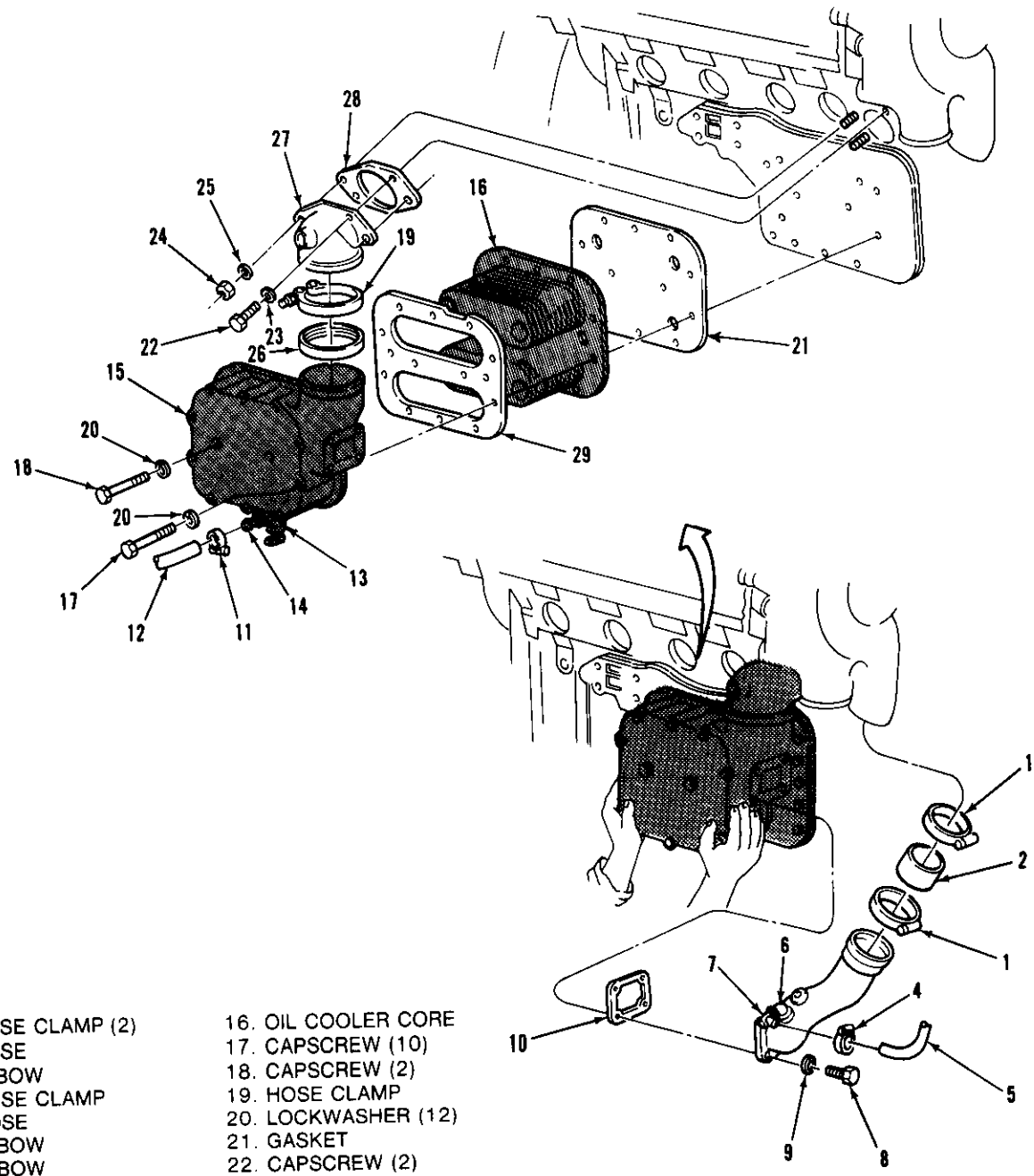
(7) Remove lifting bracket (8) from flywheel (9). Refer to paragraph 7-7 for flywheel repair.



1. TRANSMISSION
5. CAPSCREW (2)
6. COVER
7. GASKET
8. LIFTING BRACKET (TOOL)
9. FLYWHEEL
10. CAPSCREW (30)
11. WASHER (30)
12. LIFTING DEVICE (TOOL)
13. TURBINE



TA 298801



1. HOSE CLAMP (2)
2. HOSE
3. ELBOW
4. HOSE CLAMP
5. HOSE
6. ELBOW
7. ELBOW
8. CAPSCREW (4)
9. LOCKWASHER (4)
10. GASKET
11. HOSE CLAMP
12. HOSE
13. TEE FITTING
14. FITTING
15. OIL COOLER HOUSING
16. OIL COOLER CORE
17. CAPSCREW (10)
18. CAPSCREW (2)
19. HOSE CLAMP
20. LOCKWASHER (12)
21. GASKET
22. CAPSCREW (2)
23. LOCKWASHER (2)
24. NUT (2)
25. LOCKWASHER (2)
26. SEAL
27. ELBOW
28. GASKET
29. GASKET

TA 298488

SECTION IV. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES AND REASSEMBLY FROM SUBASSEMBLIES

7-5. TRANSMISSION DISASSEMBLY INTO SUBASSEMBLIES

THIS TASK COVERS:
a. Preparation for Disassembly
b. Flywheel
c. Stator
d. Oil Pan
e. Oil Filter
f. Lockup Cutoff Valve
g. Control Valve
h. Torque Converter Pump
i. Torque Converter Housing
j. Forward Clutch
k. Fourth Clutch
l. Third Clutch
m. Center Support
n. Gear Unit
o. Second Clutch
p. Rear Cover
q. First and Reverse Clutch

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Mainshaft Lifting Bracket, (J 24196)
Flywheel Lifting Bracket, (J 24365)
Converter Pump Snap Ring Remover/Installer, (J 26598-A)
Fourth Clutch Lifting Fixture (J 24209)

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Governor removed (para 8-9).
TM 2320-34/13 TM 9-2320-297-34	Flange and nut removed (para 7-3).
	Transmission removed (para 7-4).

Special Environmental Conditions

Work in a clean area away from blowing dust.

a. Preparation for Disassembly

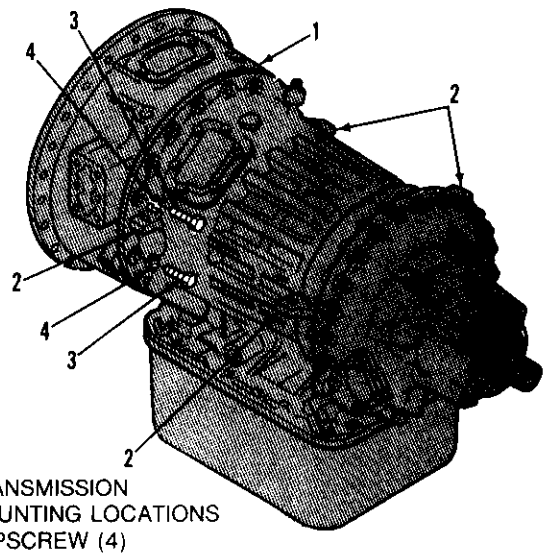
WARNING

The transmission is heavy. To prevent serious personal injury, use care when handling it.

CAUTION

During disassembly all parts must be handled with care to avoid nicking, scratching, or denting. Close fitting parts can bind if damaged or scratched.

(1) Clean transmission (1). Refer to paragraph 2-6.



1. TRANSMISSION
2. MOUNTING LOCATIONS
3. CAPSCREW (4)
4. WASHER (4)

TA 288800

3-11. OIL PUMP MAINTENANCE

THIS TASK COVERS: a. Removal
b. Disassembly
c. Cleaning/Inspection
d. Assembly
e. Installation

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Micrometer set 0-6 inch inside (NSN 5210-00-473 9350)
Micrometer set 0-6 inch outside (NSN 5210-00-554-7134)

Materials/Parts

Engine oil (item 46, Appendix C)
Capscrew and lockwasher (2) (NSN 5305-01-058-5319) item 1
Lockwasher (7) (MS35338-46) items 4, 19, and 29
Gasket (2) (NSN 5330-00-458-2324) items 6 and 8
Lockwasher (4) (MS35338-45) items 10 and 24
Gasket (NSN 5330-00-458-2325) item 12
Gasket (NSN 5330-00-054-8290) item 32
Lockwasher (4) (MS27183-14) item 26

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Oil pan removed (para 3-6).
TM 2320-34/13 TM 9-2320-297-34	Oil relief and regulator valves removed (para 3-12).

a. Removal

(1) Remove two capscrews with captive lockwashers (1) from bracket (2). Discard capscrews with captive lockwashers (1).

NOTE

Baffle (7) should be held during removal of items (3 thru 8). Baffle (7) will fall upon removal of capscrew (3).

(2) Remove two capscrews (3), lockwashers (4), scavenging inlet (5), gasket (6), baffle (7), and gasket (8). Discard gaskets (6 and 8) and lockwashers (4).

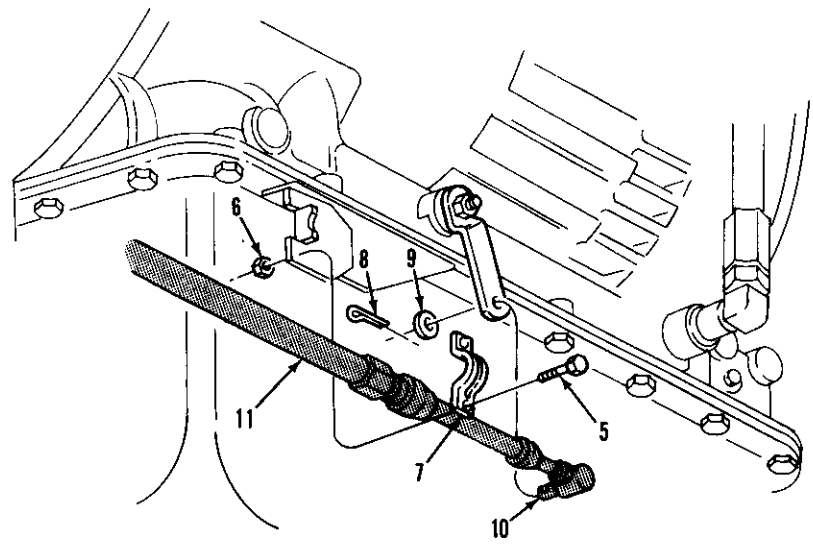
(3) Remove two capscrews (9), lockwashers (10), and oil pump inlet (11). Discard lockwashers (10).

(4) Remove and discard gasket (12).

NOTE

Remove inlet screens (15) if damaged or plugged.

(5) Remove four capscrews (13), washers (14), and inlet screens (15) from scavenging inlet pipe (16) and oil pump inlet pipe (17).



5. CAPSCREW (2)
6. LOCKNUT (2)
7. CLAMP
8. COTTER PIN
9. WASHER
10. CABLE ANCHOR
11. SHIFT CABLE

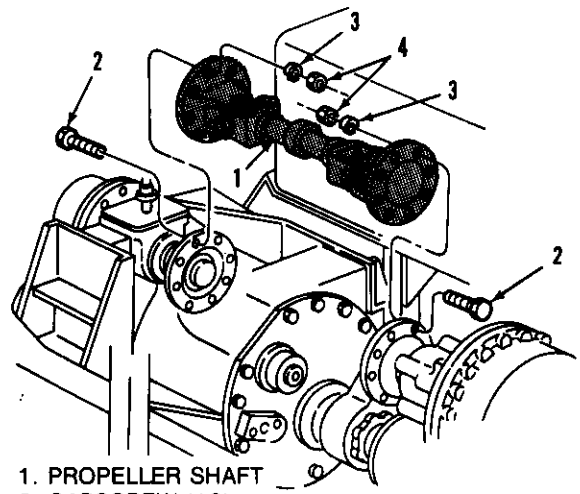
(34) Install shift cable (11). Install washer (9), and new cotter pin (8) onto cable anchor (10).

(35) Install two capscrews (5), new locknuts (6), and clamp (7). Tighten securely.

(36) Install retaining nut and output flange. Refer to paragraph 7-3, in this manual.

(37) Aline propeller shaft (1) and install eight capscrews (2), new lockwashers (3), and nuts (4) on each end of propeller shaft (1). Tighten capscrews (2) and nuts (4) securely.

END OF TASK



1. PROPELLER SHAFT
2. CAPSCREW (16)
3. LOCKWASHER (16)
4. NUT (16)

TA 298799

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install modulator (para 8-10).
	Install hi idle neutral switch (para 7-25).
	Install dipstick tube (para 8-12).
TM 2320-34/13 TM 9-2320-297-34	Install radiator and air reservoir (para 16-5).
TM 2320-20/12 TM 9-2320-297-20	Fill transmission with oil (para 8-3).
	Install front access panel (para 18-14).

WARNING

Pump assembly (20) is extremely heavy. Use care during removal of nuts (18). Use assistant to support pump assembly (20).

(6) Remove four nuts (18) and lockwashers (19). Pull pump assembly (20) off four studs (21). Discard lockwashers (19).

(7) Tag, mark, and remove shims (22).

(8) Remove four studs (21), if damaged.

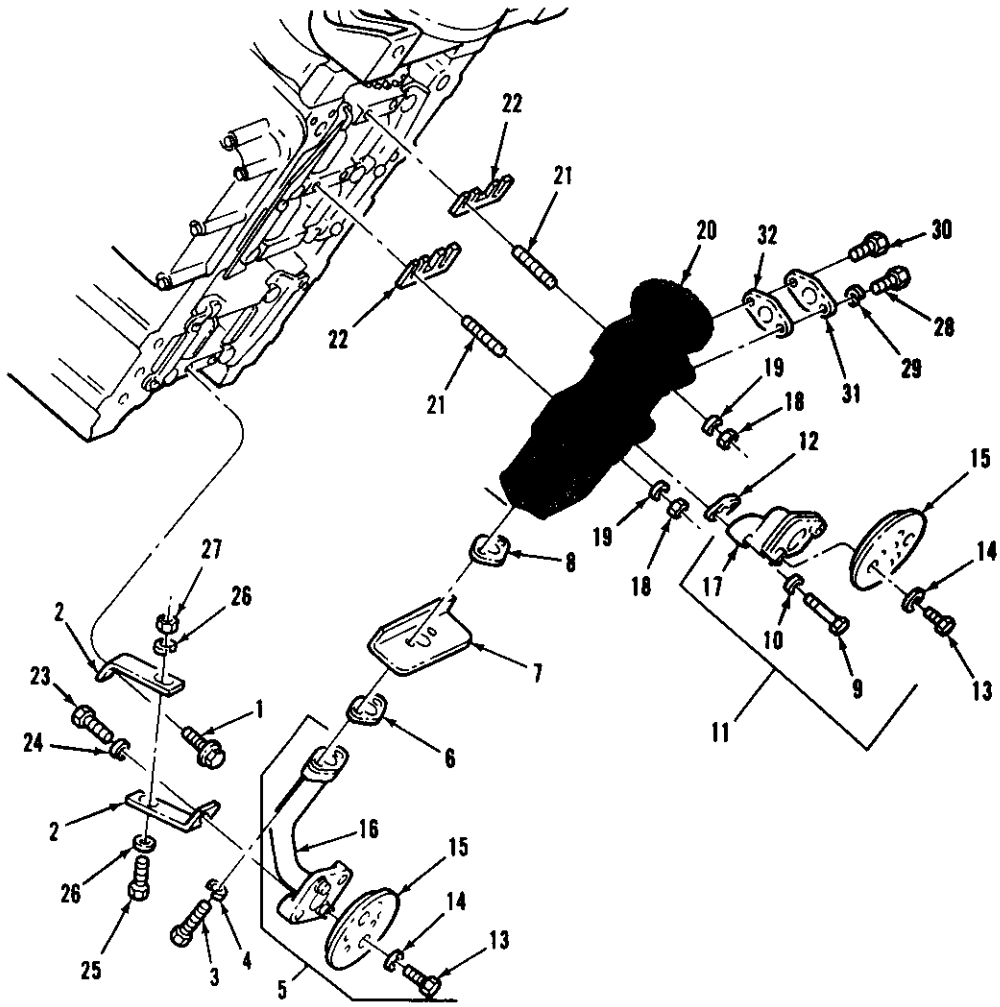
(9) Remove two capscrews (23), lockwashers (24), and bracket (2) from scavenging inlet (5). Discard lockwashers (24).

(10) Remove two capscrews (25), four lockwashers (26), and two nuts (27) to disassemble bracket (2). Discard lockwashers (26).

b. Disassembly

(1) Remove capscrew (28), lockwasher (29), screw (30), and cover (31). Discard lockwasher (29).

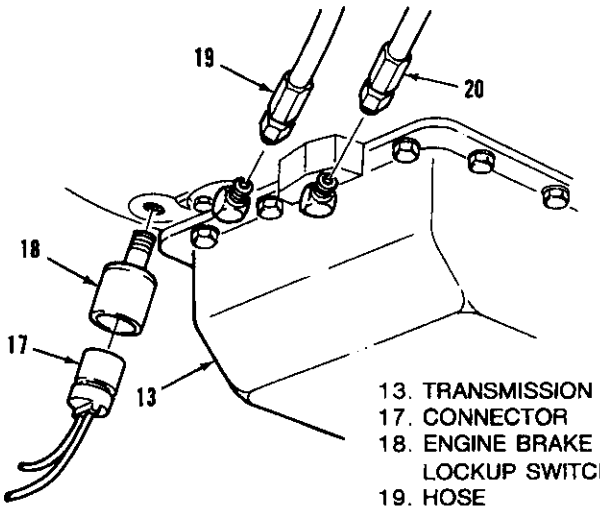
(2) Remove and discard gasket (32).



1. CAPSCREW WITH CAPTIVE LOCKWASHER (2)
2. BRACKET
3. CAPSCREW (2)
4. LOCKWASHER (2)
5. SCAVENGING INLET
6. GASKET
7. BAFFLE
8. GASKET
9. CAPSCREW (2)
10. LOCKWASHER (2)
11. OIL PUMP INLET
12. GASKET
13. CAPSCREW (4)
14. WASHER (4)
15. INLET SCREEN (2)
16. SCAVENGING INLET PIPE
17. OIL PUMP INLET PIPE
18. NUT (4)
19. LOCKWASHER (4)
20. PUMP ASSEMBLY
21. STUD (4)
22. SHIMS
23. CAPSCREW (2)
24. LOCKWASHER (2)
25. CAPSCREW (2)
26. LOCKWASHER (4)
27. NUT (2)
28. CAPSCREW
29. LOCKWASHER
30. SCREW
31. COVER
32. GASKET

TA 298469

7-4. TRANSMISSION REPLACEMENT (Continued)



13. TRANSMISSION
17. CONNECTOR
18. ENGINE BRAKE LOCKUP SWITCH
19. HOSE
20. HOSE

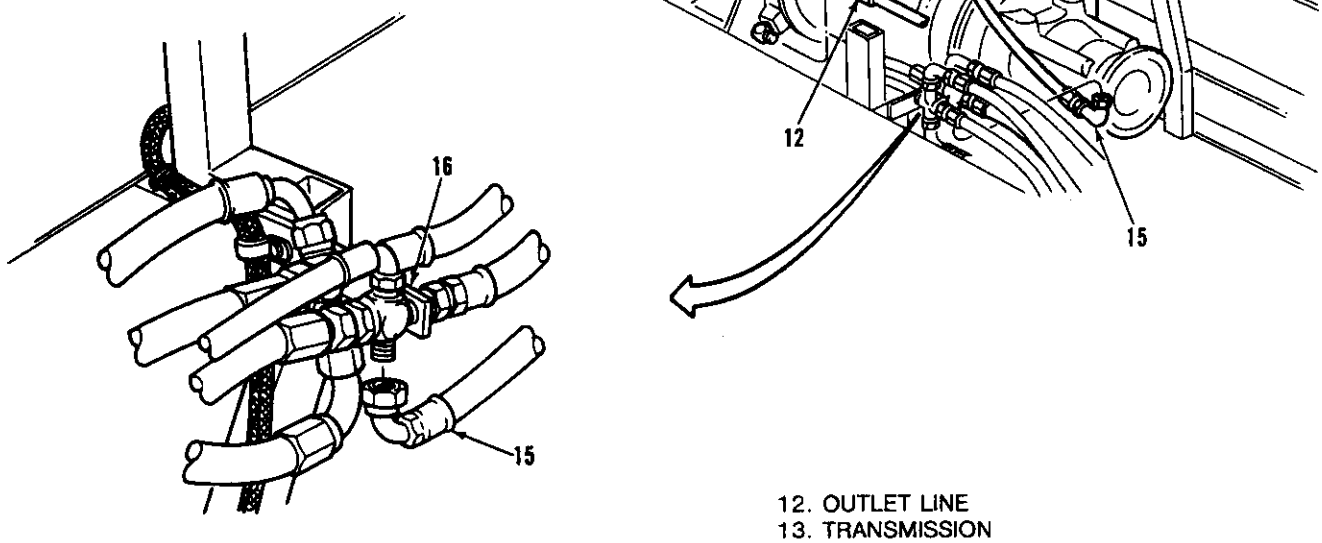
(29) Install hoses (19 and 20). Tighten securely.

(30) Install engine brake lockup switch (18) on bottom of transmission (13). Plug connector (17) to engine brake lockup switch (18).

(31) Install inlet line (14) at transmission (13). Tighten inlet line (14) securely.

(32) Install hydraulic hose (15) at steering valve bracket (16). Tighten hydraulic hose (15) securely.

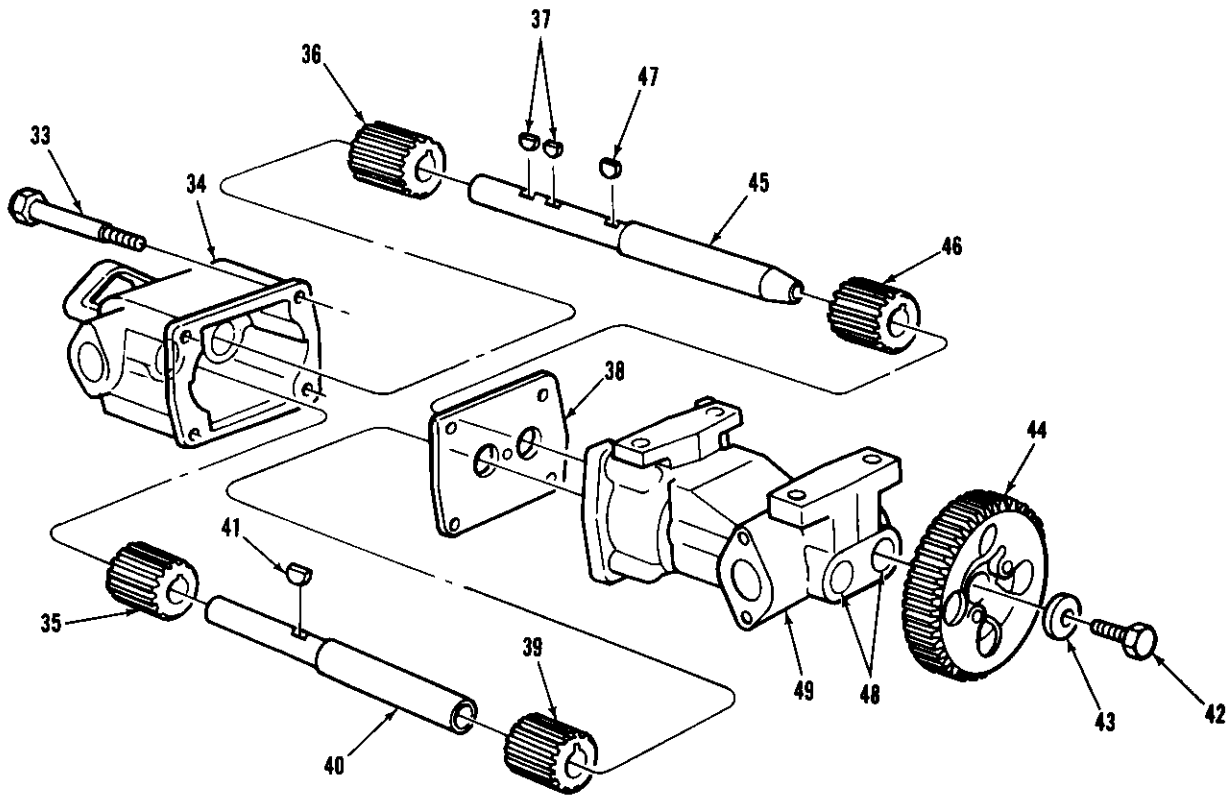
(33) Install transmission outlet line (12) at transmission (13). Tighten transmission outlet line (12) securely.



12. OUTLET LINE
13. TRANSMISSION
14. INLET LINE
15. HYDRAULIC HOSE
16. STEERING VALVE BRACKET

TA 298798

3-11. OIL PUMP MAINTENANCE (Continued)



33. CAPSCREW (4)
34. SCAVENGING PUMP BODY
35. GEAR
36. GEAR
37. KEY (2)
38. SPACER
39. GEAR
40. SHAFT
41. KEY
42. CAPSCREW
43. WASHER
44. OIL PUMP DRIVE GEAR
45. DRIVE SHAFT
46. GEAR
47. KEY
48. BUSHING BORE
49. OIL PUMP BODY

TA 298490

(19) Remove lifting tool (48), four capscrews (49), lockwashers (50), and nuts (51).

(20) Install capscrew (40), new lockwasher (41), and washer (42) to secure bracket (43) and oil pressure manifold (44) on transmission (13).

(21) Install temperature sending unit (39) on transmission (13).

(22) Install wire (38), washer (37), new lockwasher (36), and nut (35) on temperature sending unit 39).

(23) Install capscrew (33), washer (34), and throttle control solenoid (27).

(24) Install capscrew (30), washer (3), and wire (32).

NOTE

Perform step (24.1) on LVSA1 series vehicles only.

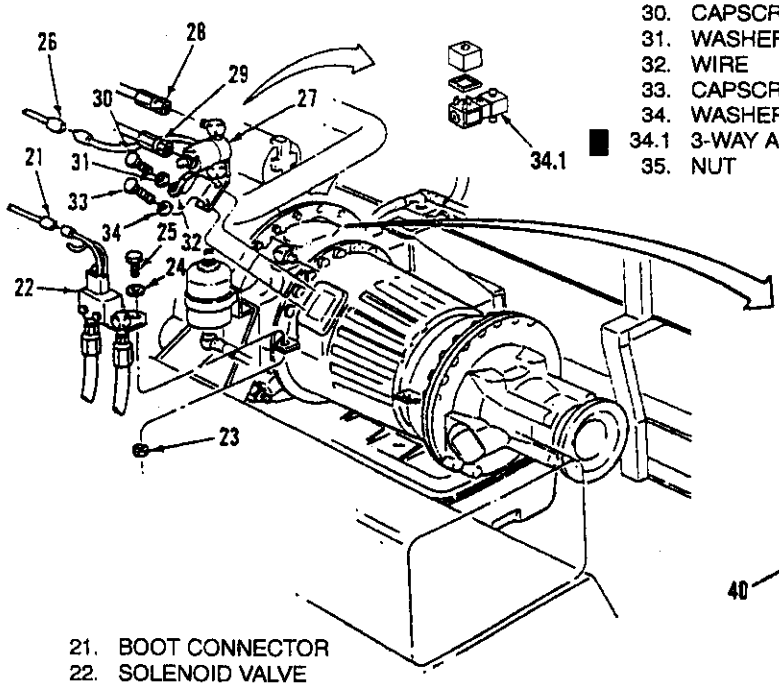
(24.1) Apply sealant to the threads of capscrews (33 and 30). Install 3-way air valve (34.1) using two washers (34 and 31) and capscrews (33 and 30). Tighten capscrews (33 and 30) securely.

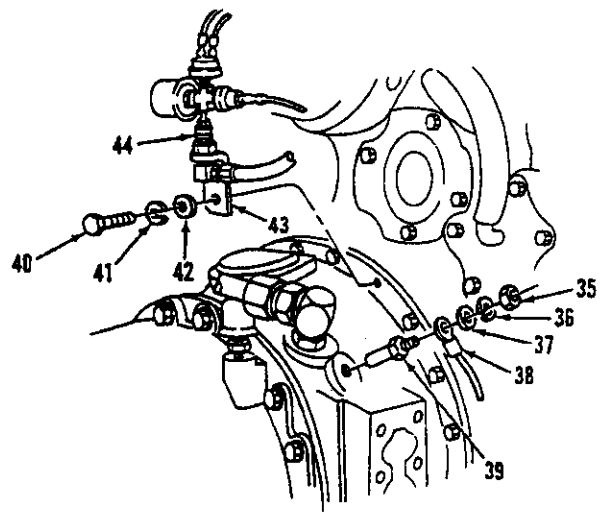
(25) Install two air lines (28 and 29) in their tagged locations.

(26) Connect plug (26).

(27) Install nut (23), washer (24), and capscrew (25) to secure solenoid valve (22) to transmission (13).

(28) Connect boot connector (21) to solenoid valve (22).





21. BOOT CONNECTOR
22. SOLENOID VALVE
23. NUT
24. WASHER
25. CAPSCREW
26. PLUG
27. THROTTLE CONTROL SOLENOID
28. AIR LINE
29. AIR LINE
30. CAPSCREW
31. WASHER
32. WIRE
33. CAPSCREW
34. WASHER
34.1 3-WAY AIR VALVE*
35. NUT
36. LOCKWASHER
37. WASHER
38. WIRE
39. TEMPERATURE SENDING UNIT
40. CAPSCREW
41. LOCKWASHER
42. WASHER
43. BRACKET
44. OIL PRESSURE MANIFOLD

* LVSA1 SERIES VEHICLES ONLY

(3) Remove four capscrews (33) and pull scavenging pump body (34) off.

NOTE

Mark location of all gears on shafts for proper installation.

(4) Tag and remove two gears (35 and 36).

(5) Remove two keys (37).

(6) Remove spacer (38).

(7) Remove gear (39) and shaft (40).

(8) Using a press, remove gear (39) from shaft (40).

(9) Remove key (41).

(10) Remove capscrew (42) and washer (43).

(11) Attach gear puller to oil pump drive gear (44). Protect end of drive shaft (45) by placing a spacer between drive shaft (45) and puller screw. Remove oil pump drive gear (44).

(12) Remove drive shaft (45) and gear (46) assembly.

(13) Using a press, remove gear (46) from drive shaft (45).

(14) Remove key (47).

c. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Check crankshaft drive gear for wear. If worn, replace. Refer to paragraph 3-26.

(3) Measure bushing bores (48) in pump body (49). Bore diameter must be a minimum of 1.0037 inches (24.493 mm) and a maximum of 1.0049 (25.524 mm). If not within limits, replace oil pump body (49) and scavenging pump body (34).

(4) Inspect all other parts. Refer to paragraph 2-7.

(5) Replace all parts failing inspection.

d. Assembly

(1) Install key (47) on drive shaft (45).

(2) Lubricate drive shaft (45) with clean engine oil and aline gear (46) notch with key (47). Install on a press and carefully press gear (46) on drive shaft (45) 7.57 inches (19.23 cm) from oil pump drive gear (44) end of drive shaft (45).

(3) Install key (41) on shaft (40).

(4) Lubricate shaft (40) with clean engine oil and press gear (39) 6.01 inches (15.27 cm) from end of shaft (40).

(5) Install drive shaft (45) and gear (46) assembly in oil pump body (49).

(6) Install gear (39) and shaft (40) assembly into oil pump body (49).

(7) Install spacer (38), two keys (37), and one key (41).

(8) Install two gears (35 and 36).

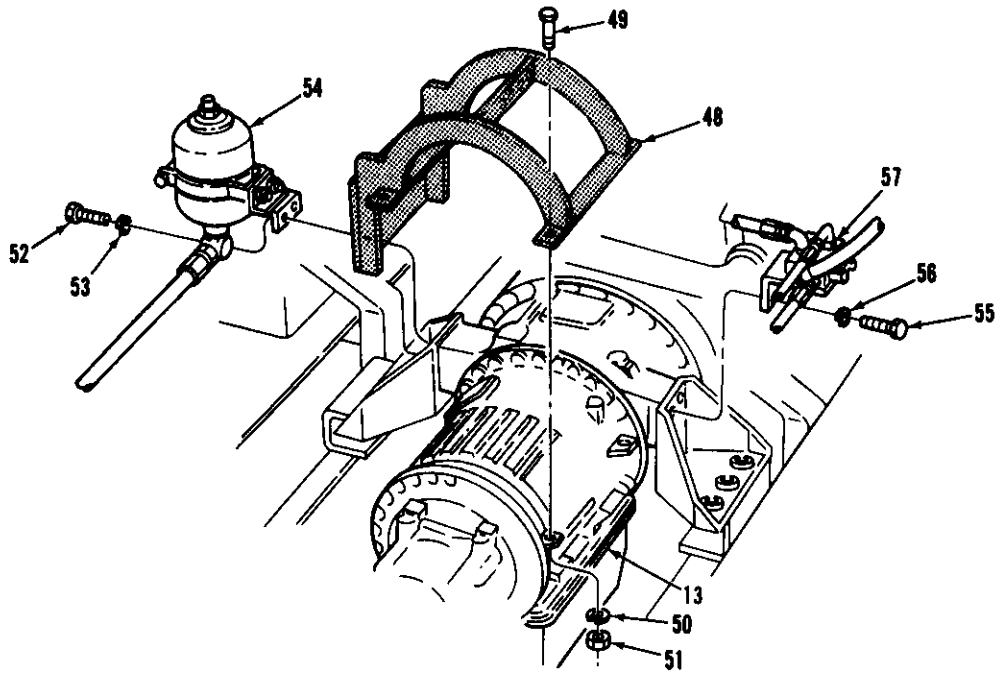
(9) Install scavenging pump body (34) with four capscrews (33). Tighten capscrews (33) securely.

(10) Install oil pump drive gear (44) on drive shaft (45).

(11) Install capscrew (42) and washer (43) on oil pump drive gear (44). Torque capscrew (42) to 60-65 foot-pounds (81-88 N·m).

(12) Rotate oil pump drive gear (44) by hand. Gears and shafts should turn freely. If gears bind, loosen the scavenging pump body capscrews (33) and tap them with a soft-faced hammer. Tighten capscrews (33) securely and check rotation of oil pump drive gear (44).

7-4. TRANSMISSION REPLACEMENT (Continued)



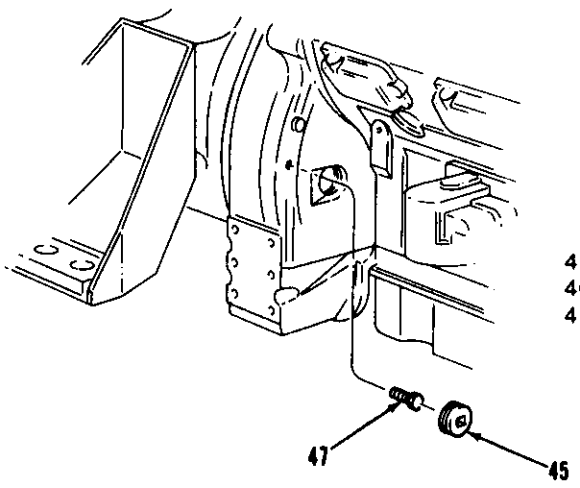
13. TRANSMISSION
48. LIFTING TOOL
49. CAPSCREW (4)
50. LOCKWASHER (4)
51. NUT (4)
52. CAPSCREW (2)
53. LOCKWASHER (2)
54. ACCUMULATOR
55. CAPSCREW (2)
56. LOCKWASHER (2)
57. FAN CONTROL VALVE

(13) Remove lifting sling.

NOTE

While turning engine over at camshaft pulley (46), use access hole to line up capscrews (47) for installation.

(14) Install 12 capscrews (47). Hand tighten only.



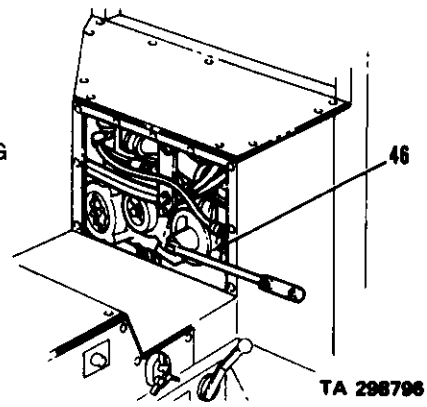
45. ACCESS HOLE PLUG
46. CAMSHAFT PULLEY
47. CAPSCREW (12)

(15) Torque capscrews (47) to 110 foot-pounds (149 N·m).

(16) Install access hole plug (45).

(17) Install top two transmission mount capscrews (55), new lockwashers (56), and fan control valve (57) on right side of transmission (13).

(18) Install top two transmission mount capscrews (52), new lockwashers (53), and accumulator (54) to left side of transmission (13). Torque capscrews (52 and 55) to 135 foot-pounds (183 N·m).



3-11. OIL PUMP MAINTENANCE (Continued)

e. Installation

(1) Install four studs (21), if removed, and tighten securely.

(2) Place shims (22) on studs (21) in their marked location.

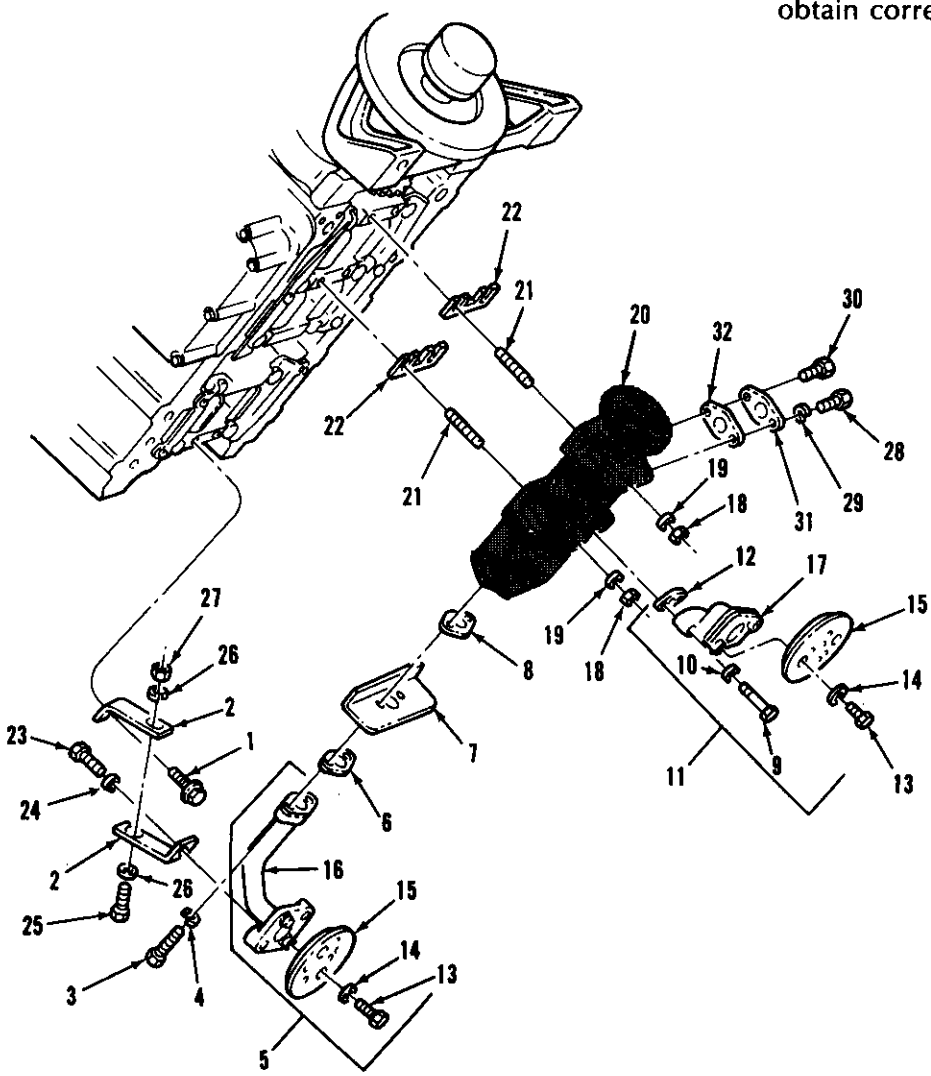
(3) Position pump assembly (20) on studs (21) and shims (22). Make sure gear teeth mesh.

(4) Install four nuts (18) and new lockwashers (19). Tighten nuts (18) securely.

NOTE

- Shims (22) are available in 0.005 0.010, and 0.015 inch.
- for each 0.005 inch shim (22), gear backlash will change 0.0035 inch (0.0889 mm).

(5) Using dial indicator, measure backlash between crankshaft gear (50) and oil pump drive gear (44). Backlash should be 0.006 inch (0.152 mm)to 0.012 inch (0.304 mm). Install or remove the same number and thickness of shims (22) under both mounting feet of pump assembly (20) to obtain correct backlash.



1. CAPSCREW WITH CAPTIVE LOCKWASHER (2)
2. BRACKET
3. CAPSCREW (2)
4. LOCKWASHER (2)
5. SCAVENGING INLET
6. GASKET
7. BAFFLE
8. GASKET
9. CAPSCREW (2)
10. LOCKWASHER (2)
11. OIL PUMP INLET
12. GASKET
13. CAPSCREW (4)
14. WASHER (4)
15. INLET SCREEN (2)
16. SCAVENGING INLET PIPE
17. OIL PUMP INLET PIPE
18. NUT (4)
19. LOCKWASHER (4)
20. PUMP ASSEMBLY
21. STUD (4)
22. SHIMS
23. CAPSCREW (2)
24. LOCKWASHER (2)
25. CAPSCREW (2)
26. LOCKWASHER (4)
27. NUT (2)
28. CAPSCREW
29. LOCKWASHER
30. SCREW
31. COVER
32. GASKET

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WARNING

Stay out from under transmission when being moved. If transmission falls, it could result in serious injury or death.

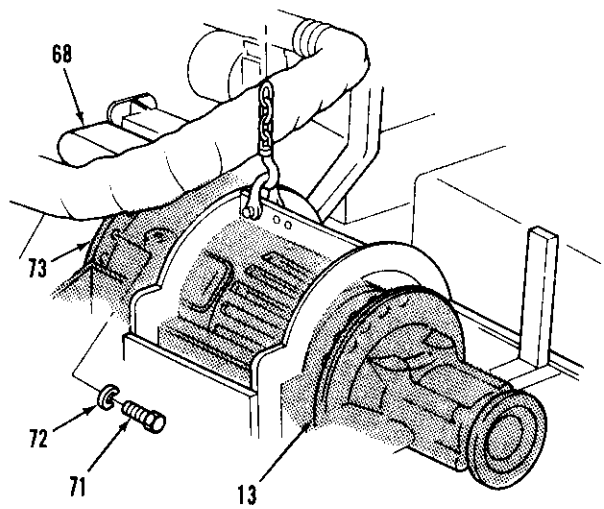
Avoid puncturing accumulator while installing transmission.

NOTE

Make sure lifting device is equally balanced on transmission (13).

(6) Lift transmission (13) and position it in vehicle.

(7) While assistant guides transmission (13), install 24 capscrews (71) and new lockwashers (72) on transmission bell housing (73). Lubricate and torque capscrews (71) to 35 foot-pounds (47.5 N·m).



13. TRANSMISSION
68. ENGINE
71. CAPSCREW (24)
72. LOCKWASHER (24)
73. TRANSMISSION BELL HOUSING

TA 298795

(8) Attach lifting sling to two rear engine lifting eyes (58) securely.

(9) Lift engine (68) up just enough to free support (69).

(10) Remove support (69) from under engine (68).

WARNING

Stay out from under heavy parts. Falling parts may cause serious injury or even death.

NOTE

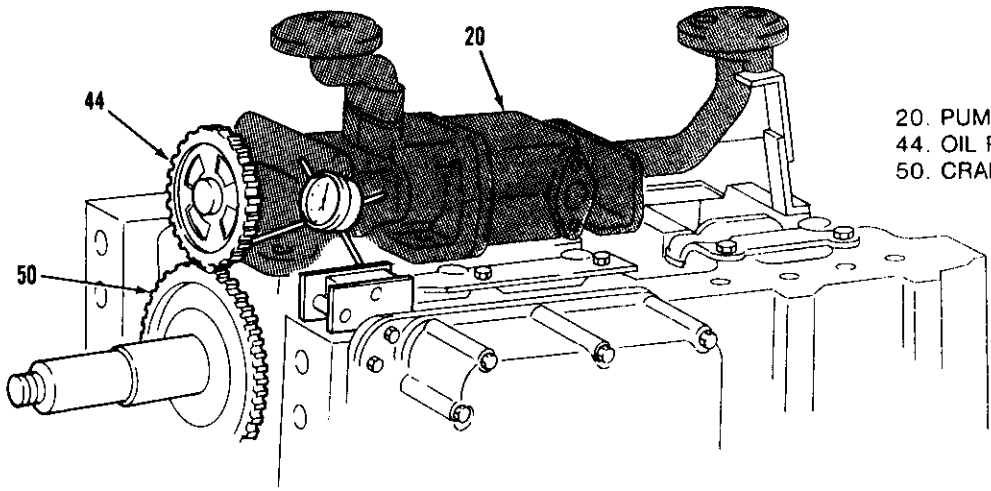
It may be necessary to use a pry bar to aline mount holes.

(11) While lowering engine (68) and transmission (13), have assistant aline transmission mounts (59 and 60) with mounting brackets (80 and 81).

NOTE

It may be necessary to use two washers (63) on capscrews (66) to insert cotter pins (61).

(12) Install three upper biscuits (65), biscuit plate (64), three washers (67), capscrews (66), washers (63), and castle nuts (62) on right and left transmission mounts (59 and 60). Tighten capscrews (66) and castle nuts (62) securely. Install six new cotter pins (61).



20. PUMP ASSEMBLY
44. OIL PUMP DRIVE GEAR
50. CRANKSHAFT GEAR

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(6) Tighten four nuts (18) securely.

(7) If removed, install inlet screens (15), two capscrews (13), and washers (14) to oil pump and scavenging inlet pipes (17 and 16).

(8) Install new gasket (8), baffle (7), new gasket (6), scavenging inlet (5), two capscrews (3), and new lockwashers (4). Tighten capscrews (3) securely.

(9) Install two capscrews (23), new lockwashers (24), and half of bracket (2). Tighten capscrews (23) securely.

(10) Install two new capscrews with captive lockwashers (1), and other half of bracket (2) fingertight.

(11) Aline halves of bracket (2) and install two capscrews (25), four new lockwashers (26), and two nuts (27). Tighten capscrews (25) and nuts (27) securely. Tighten two capscrews with captive lockwashers (1) securely.

(12) Install new gasket (12), oil pump inlet (11), two capscrews (9), and new lockwashers (10). Tighten capscrews (9) securely.

(13) Install new gasket (32), cover (31), screw (30), new lockwasher (29), and capscrew (28). Tighten capscrew (28) and screw (30) securely.

END OF TASK

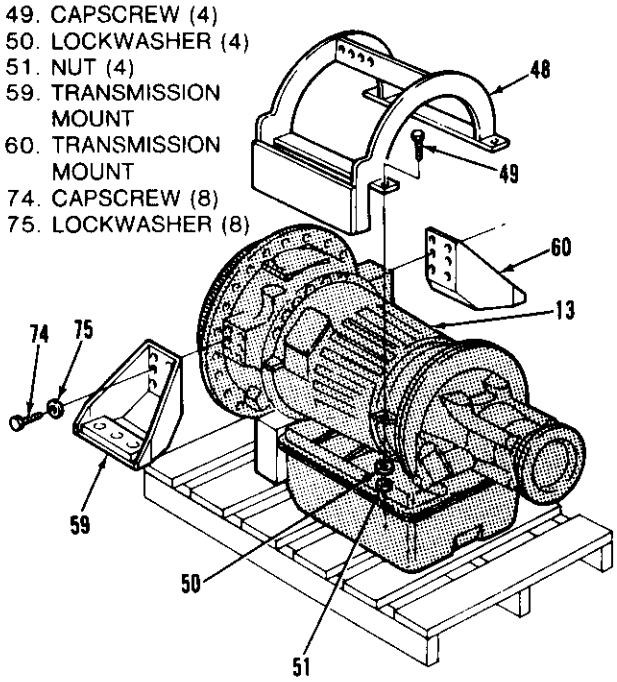
NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install pressure regulator and relief valves (para 3-12).
TM 2320-20/12 TM 9-2320-297-20	Install oil pan (para 3-6).
TM 2320-10/11 TM 9-2320-297-10	Start engine and check operation of pump (para 2-13).

7-4. TRANSMISSION REPLACEMENT (Continued)

13. TRANSMISSION
48. LIFTING TOOL
49. CAPSCREW (4)
50. LOCKWASHER (4)
51. NUT (4)
59. TRANSMISSION MOUNT
60. TRANSMISSION MOUNT
74. CAPSCREW (8)
75. LOCKWASHER (8)



NOTE

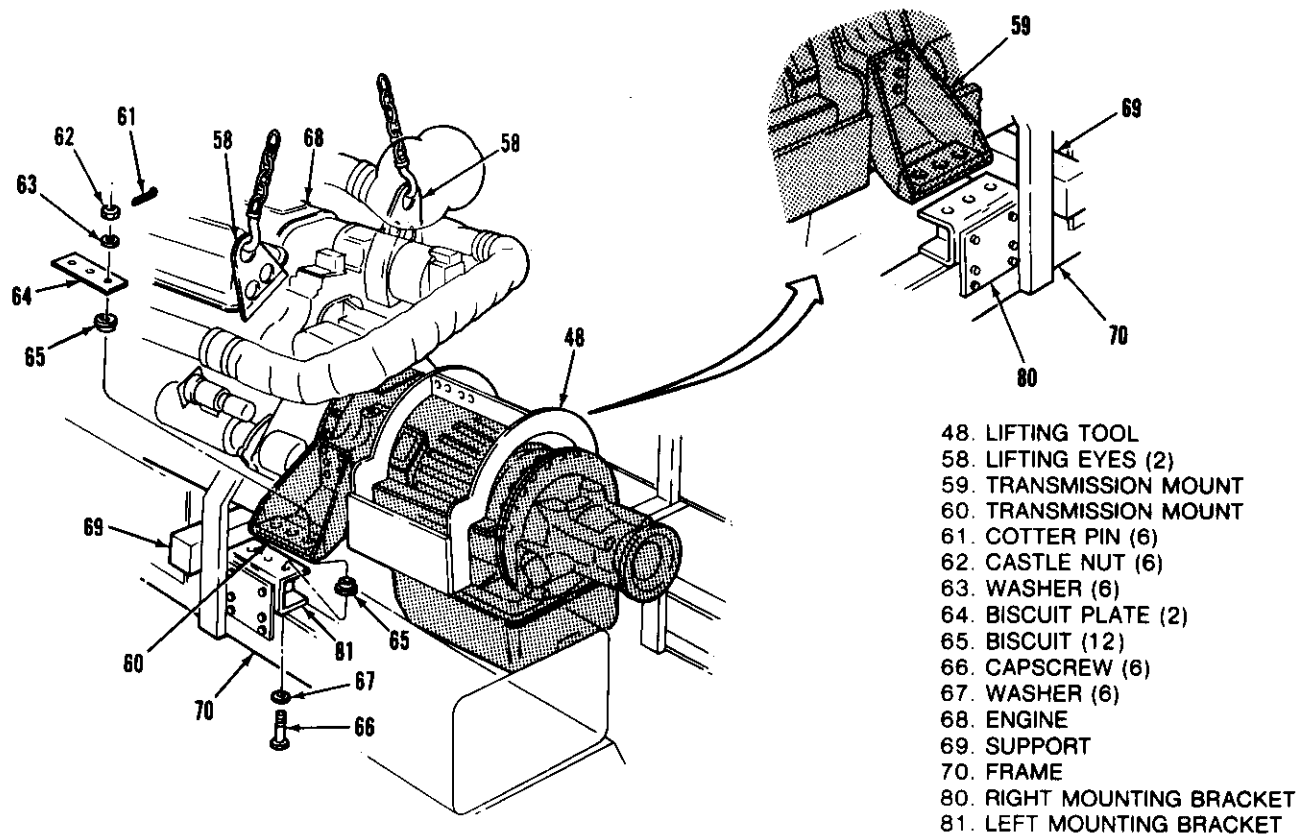
Use bottom four holes during installation of transmission mounts (59 and 60).

(2) Install right and left transmission mounts (59 and 60) on transmission (13) with eight capscrews (74) and new lockwashers (75). Torque to 135 foot-pounds (183 N·m).

(3) Install lifting tool (48) using four capscrews (49), lockwashers (50), and nuts (51).

(4) Install lifting sling to lifting tool (48).

(5) Install three lower biscuits (65) on left and right mounting brackets (80 and 81).



48. LIFTING TOOL
58. LIFTING EYES (2)
59. TRANSMISSION MOUNT
60. TRANSMISSION MOUNT
61. COTTER PIN (6)
62. CASTLE NUT (6)
63. WASHER (6)
64. BISCUIT PLATE (2)
65. BISCUIT (12)
66. CAPSCREW (6)
67. WASHER (6)
68. ENGINE
69. SUPPORT
70. FRAME
80. RIGHT MOUNTING BRACKET
81. LEFT MOUNTING BRACKET

TA 298794

3-12. OIL PRESSURE REGULATOR OR RELIEF VALVE MAINTENANCE

THIS TASK COVERS: a. Removal
b. Disassembly
c. Cleaning/Inspection
d. Assembly
e. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Engine oil (item 46, Appendix C)
Lockwasher (4) (MS35338-46) item 2
Gasket (2) (NSN 5330-00-735-4291) items 4 and 9
Gasket (NSN 5330-00-054-8290) item 5

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Oil pan removed (para 3-6).

a. Removal

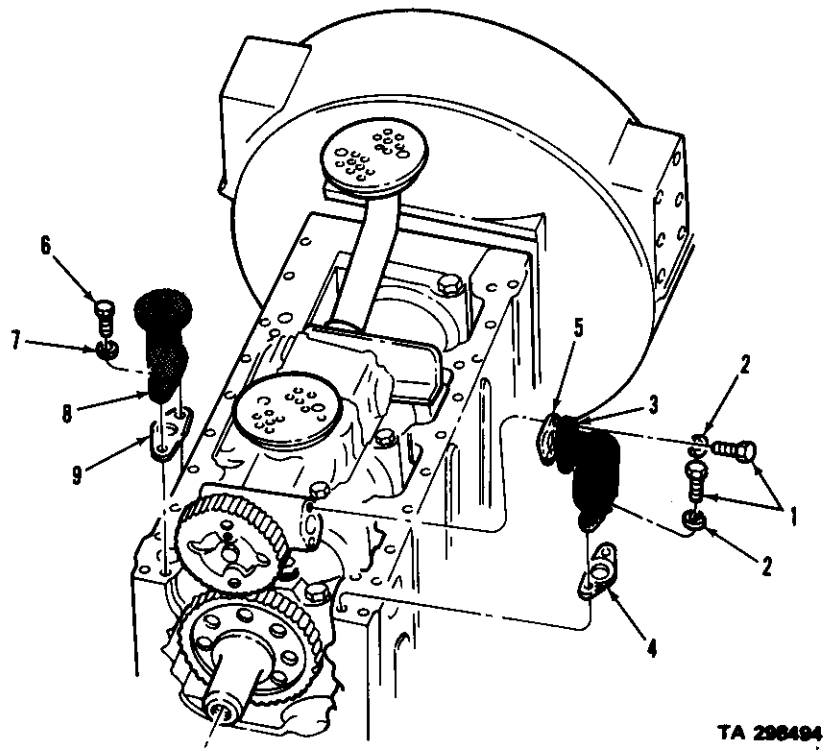
(1) Remove four capscrews (1) and lockwashers (2) holding pressure relief valve (3). Remove pressure relief valve (3). Discard lockwashers (2).

(2) Remove and discard gaskets (4 and 5).

(3) Remove two capscrews (6), washers (7), and pressure regulator valve (8).

(4) Remove and discard gasket (9).

1. CAPSCREW (4)
2. LOCKWASHER (4)
3. PRESSURE RELIEF VALVE
4. GASKET
5. GASKET
6. CAPSCREW (2)
7. WASHER (2)
8. PRESSURE REGULATOR VALVE
9. GASKET



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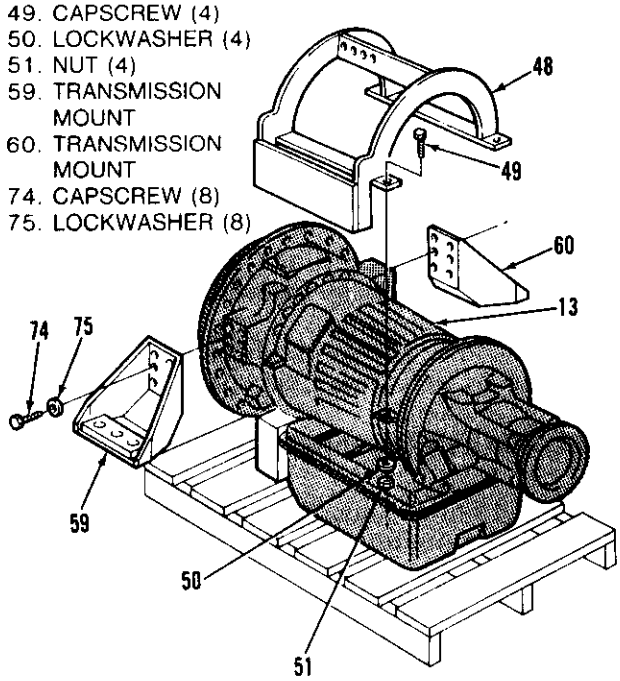
13. TRANSMISSION
48. LIFTING TOOL
49. CAPSCREW (4)
50. LOCKWASHER (4)
51. NUT (4)
59. TRANSMISSION MOUNT
60. TRANSMISSION MOUNT
74. CAPSCREW (8)
75. LOCKWASHER (8)



(32) Remove eight capscrews (74) and lockwashers (75) from left and right transmission mounts (59 and 60). Remove transmission mounts (59 and 60).

(33) Remove transmission cooling lines (76 and 77) and elbow fittings (78 and 79) from transmission (13).

(34) Remove retaining nut and output flange. Refer to paragraph 7-3, in this manual.

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

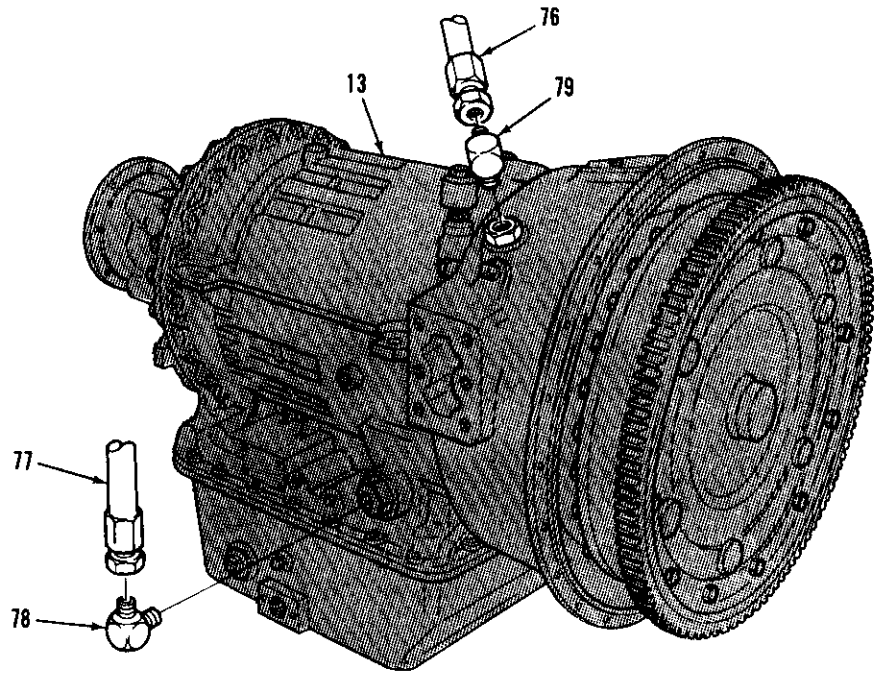
(3) Inspect all lines and hoses for cracks.

(4) Replace all parts failing inspection.

c. Installation

(1) Install elbow fittings (78 and 79) and cooling lines (76 and 77) on transmission (13).

13. TRANSMISSION
76. COOLING LINE
77. COOLING LINE
78. ELBOW FITTING
79. ELBOW FITTING



TA 298793

b. Disassembly

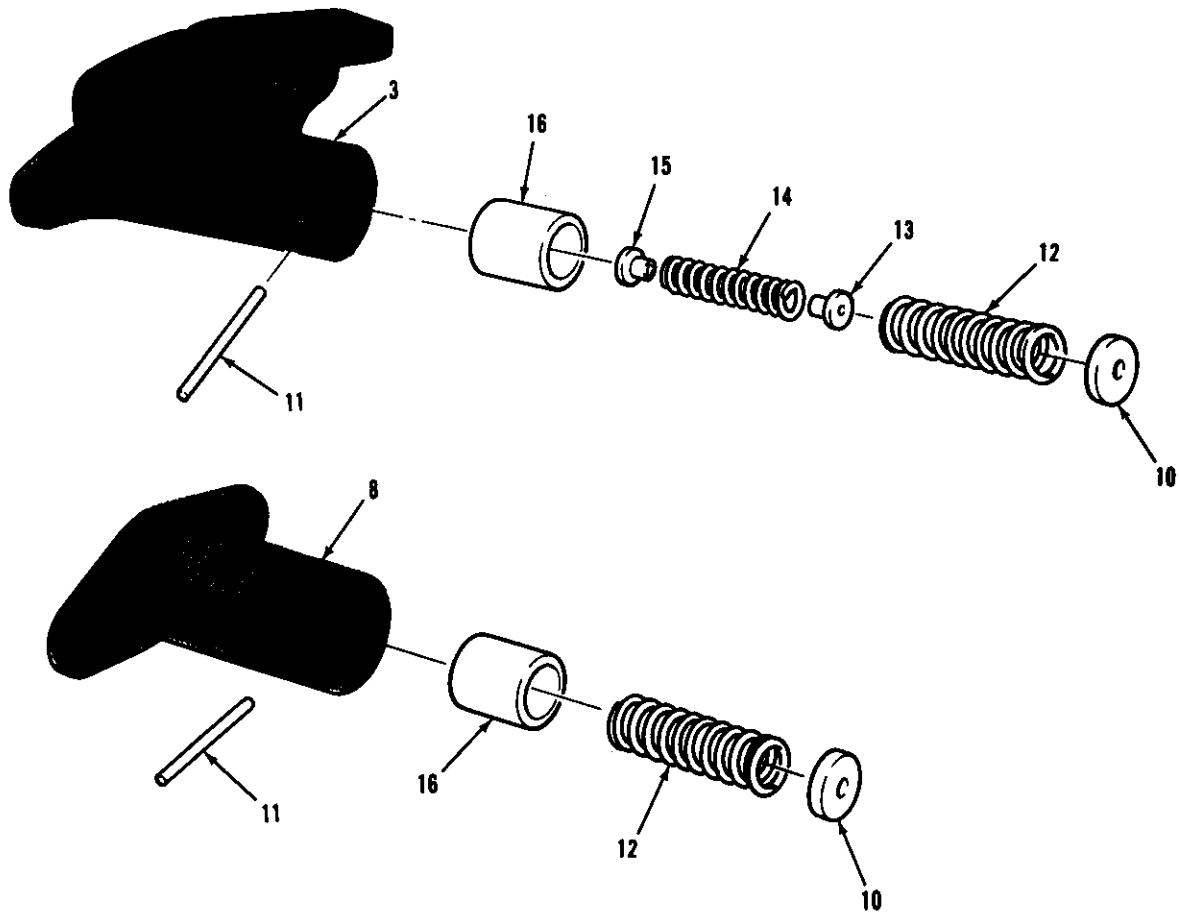
WARNING

A spring-loaded mechanism can cause injury if released in an uncontrolled manner.

(1) Press down on seat (10) and remove seat pin (11) from pressure relief valve (3) and presure regulator valve (8).

(2) Remove seat (10), large spring (12), spring seat (13), small spring (14), spring seat (15), and cup (16) from pressure relief valve (3).

(3) Remove seat (10), large spring (12), and cup (16) from pressure regulator valve (8).



3. PRESSURE RELIEF VALVE
8. PRESSURE REGULATOR VALVE
10. SEAT (2)
11. SEAT PIN (2)
12. LARGE SPRING (2)
13. SPRING SEAT
14. SMALL SPRING
15. SPRING SEAT
16. CUP (2)

TA 298495

7-4. TRANSMISSION REPLACEMENT (Continued)

WARNING

Stay out from under transmission (13) when being moved. If transmission (13) falls, it could result in serious injury or even death.

WARNING

Avoid puncturing accumulator while removing transmission.

NOTE

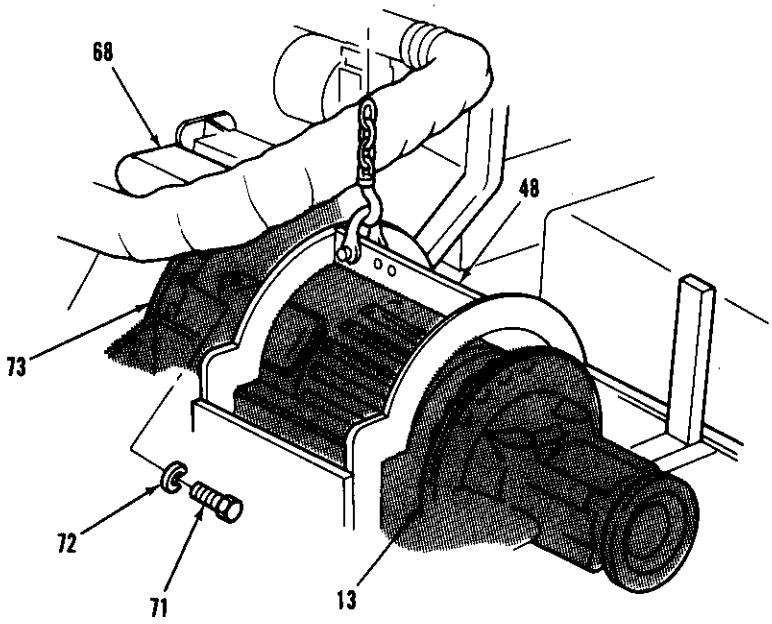
Make sure lifting device is equally balanced on transmission (13).

(28) Remove 24 capscrews (71) and lockwashers (72) from transmission bell housing (73). Discard lockwashers (72).

(29) While assistant guides transmission (13) away from engine (68), carefully remove transmission (13) from vehicle.

(30) Remove lifting sling.

(31) Remove four capscrews (49), lockwashers (50), nuts (51), and lifting tool (48).



13. TRANSMISSION
48. LIFTING TOOL
68. ENGINE
71. CAPSCREW (24)
72. LOCKWASHER (24)
73. TRANSMISSION BELL HOUSING

TA 298792

3-12. OIL PRESSURE REGULATOR OR RELIEF VALVE MAINTENANCE (Continued)

c. Cleaning/Inspection

(1) Clean all mating surfaces.

(2) Clean all other parts. Refer to paragraph 2-6.

(3) Inspect all parts. Refer to paragraph 2-7.

(4) Replace all parts failing inspection.

d. Assembly

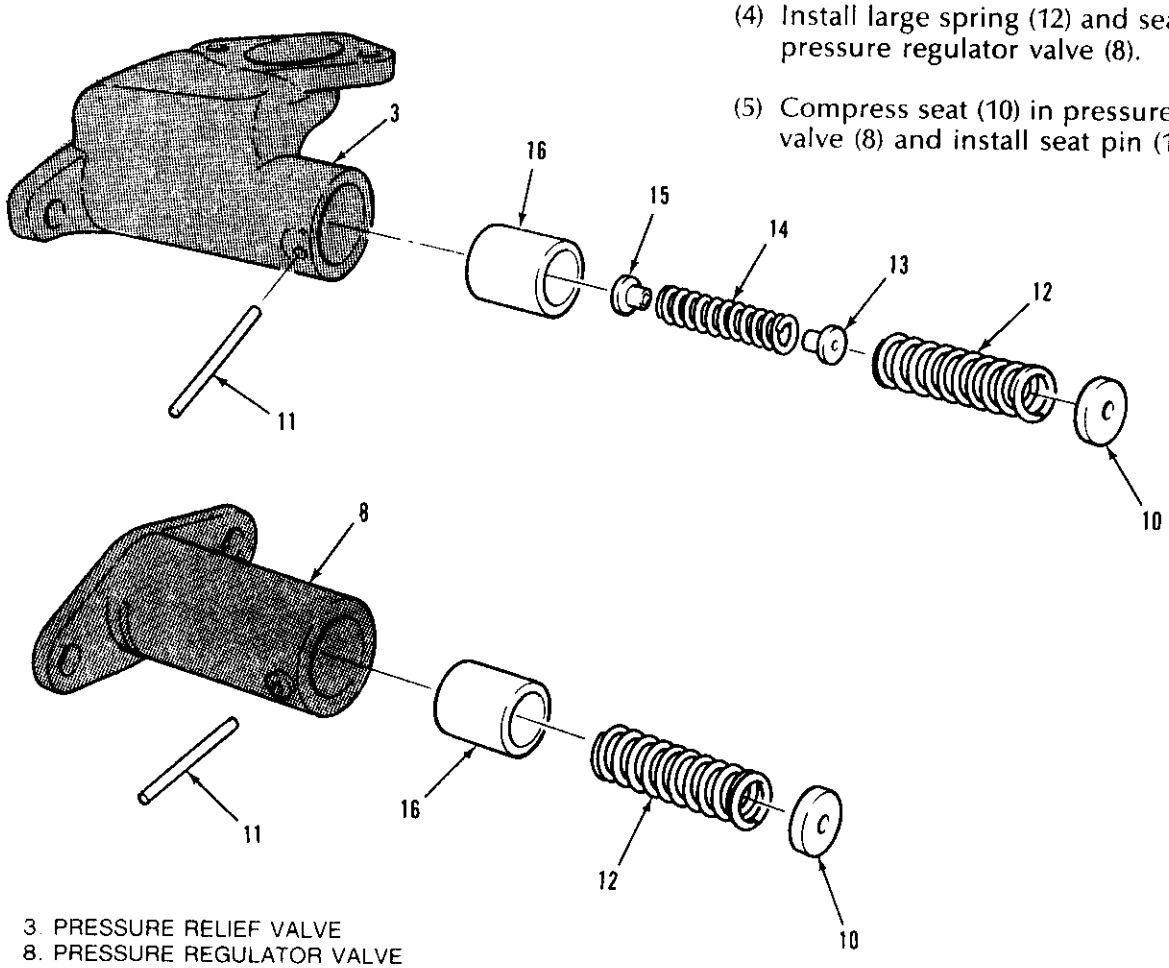
(1) Lubricate two cups (16) with clean engine oil. Install cups (16), closed end first, into valves (3 and 8).

(2) Place spring seats (13 and 15) on small spring (14) and install into pressure relief valve (3). Install large spring (12) and seat (10) into pressure relief valve (3).

(3) Compress seat (10) in pressure relief valve (3) and install seat pin (11).

(4) Install large spring (12) and seat (10) into pressure regulator valve (8).

(5) Compress seat (10) in pressure regulator valve (8) and install seat pin (11).



3. PRESSURE RELIEF VALVE
8. PRESSURE REGULATOR VALVE
10. SEAT (2)
11. SEAT PIN (2)
12. LARGE SPRING (2)
13. SPRING SEAT
14. SMALL SPRING
15. SPRING SEAT
16. CUP (2)

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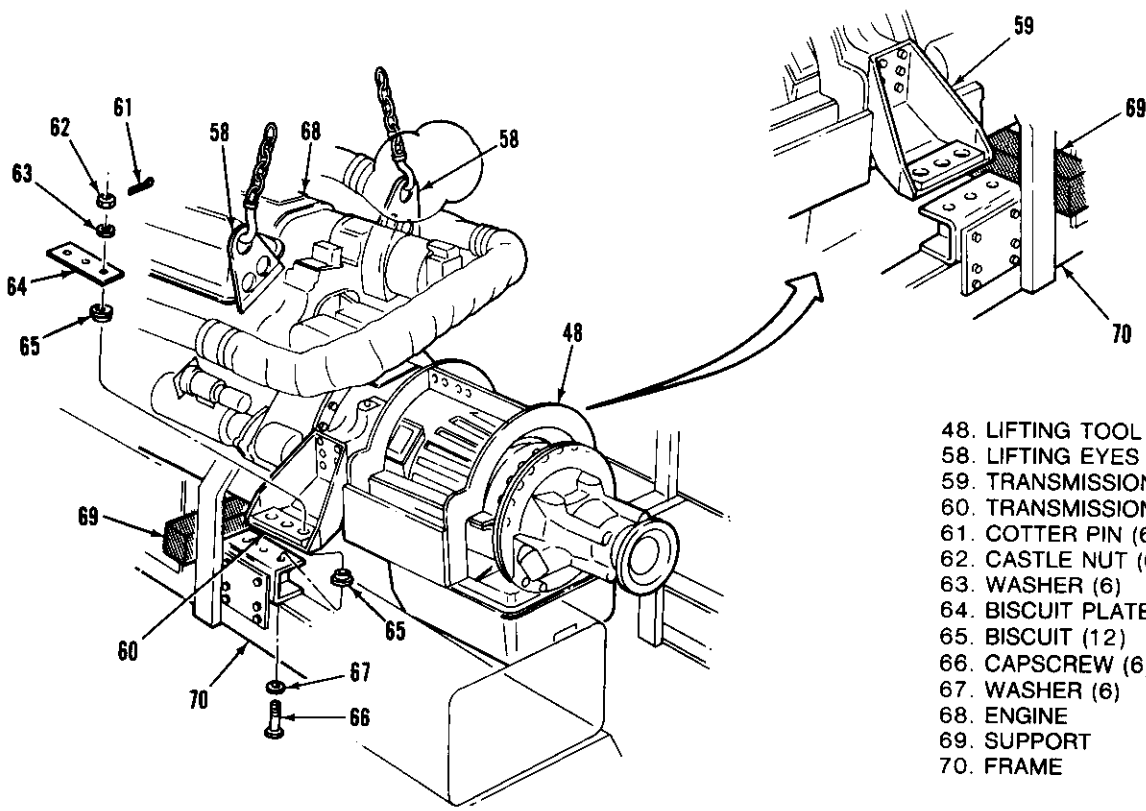
WARNING

Make sure support used to hold engine (68) is strong enough. Engine (68) weighs about 4,000 pounds (1,816 kg). If support holding engine (68) breaks, serious injury or death may result.

(25) While lifting engine (68), have assistant slide support (69) under engine (68) and across the frame (70).

(26) Lower engine (68) on support (69) and remove lifting sling from engine lifting eyes (58).

(27) Attach lifting sling to transmission lifting tool (48).



48. LIFTING TOOL
58. LIFTING EYES (2)
59. TRANSMISSION MOUNT
60. TRANSMISSION MOUNT
61. COTTER PIN (6)
62. CASTLE NUT (6)
63. WASHER (6)
64. BISCUIT PLATE (2)
65. BISCUIT (12)
66. CAPSCREW (6)
67. WASHER (6)
68. ENGINE
69. SUPPORT
70. FRAME

TA 298791

e. Installation

(1) Install new gasket (4) and pressure relief valve (3). Install two capscrews (1) and new lockwashers (2) fingertight. If needed they can be loosened for installation of second gasket (5).

(2) Place new gasket (5) between oil pump (17) and pressure relief valve (3). Install two capscrews (1) and new lockwashers (2). Tighten all capscrews securely.

(3) Install new gasket (9) and pressure regulator valve (8) so flat side of valve flange faces towards oil pump (17). Install two capscrews (6) and washers (7). Tighten capscrews (6) securely.

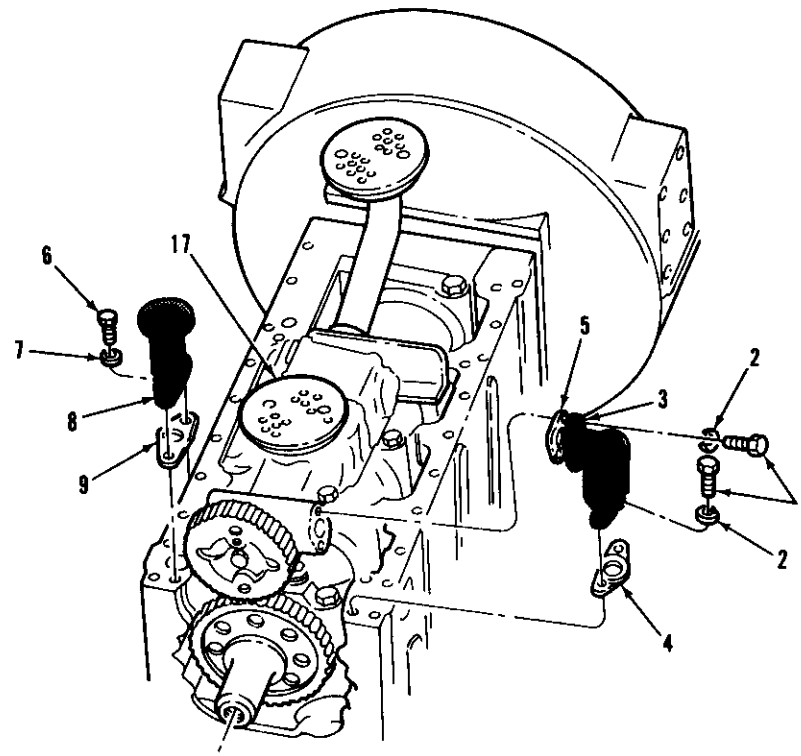
END OF TASK

NOTE

Follow-On Maintenance

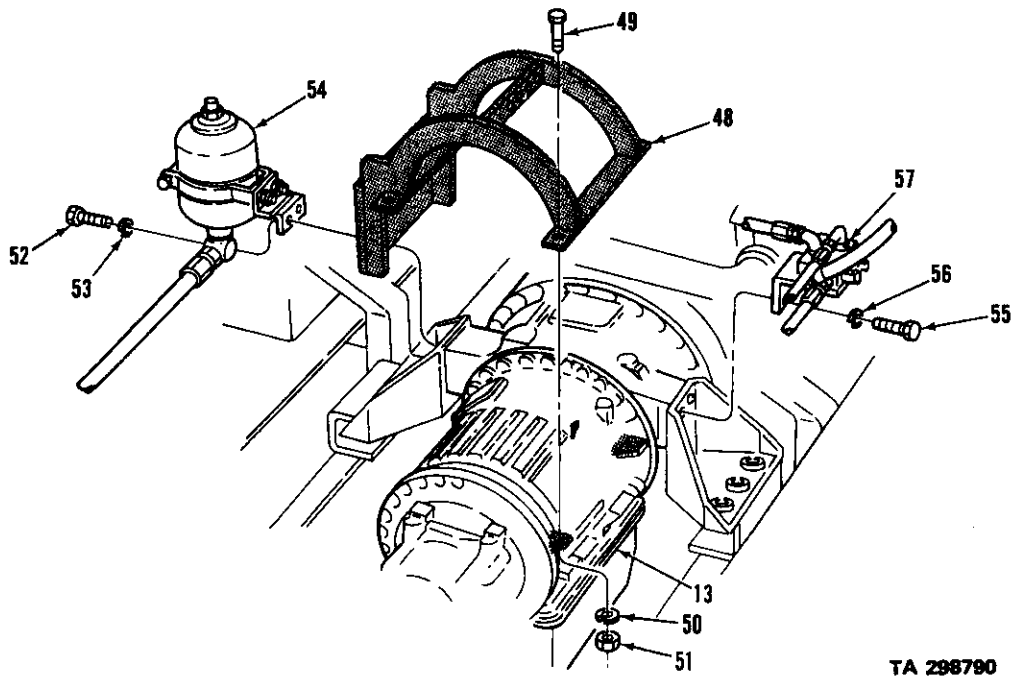
TM 2320-20/12
TM 9-2320-297-20 Install oil pan (para 3-6).

1. CAPSCREW (4)
2. LOCKWASHER (4)
3. PRESSURE RELIEF VALVE
4. GASKET
5. GASKET
6. CAPSCREW (2)
7. WASHER (2)
8. PRESSURE REGULATOR VALVE
9. GASKET
17. OIL PUMP



TA 298497

7-4. TRANSMISSION REPLACEMENT (Continued)



13. TRANSMISSION
48. LIFTING TOOL
49. CAPSCREW (4)
50. LOCKWASHER (4)
51. NUT (4)
52. CAPSCREW (2)
53. LOCKWASHER (2)
54. ACCUMULATOR
55. CAPSCREW (2)
56. LOCKWASHER (2)
57. FAN CONTROL VALVE

(19) Install lifting tool (48) to transmission (13) using four 5/8 x 11 x 2 capscrews (49), lockwashers (50), and nuts (51). Tighten capscrews (49) and nuts (51) securely.

WARNING

To prevent personal injury, avoid puncturing accumulator while removing from transmission mount.

(20) Tag and remove top two transmission mount capscrews (52), lockwashers (53), and accumulator (54) from left side of transmission (13). Discard lockwashers (53). Secure accumulator out of the way.

(21) Tag and remove top two transmission mount capscrews (55), lockwashers (56), and fan control valve (57) from right side of transmission (13). Discard lockwasher (56). Secure fan control valve out of the way.

(22) Attach a lifting sling to two rear engine lifting eyes (58).

WARNING

Keep lifting device taut while transmission mounts (59 and 60) are being removed. Keep fingers out of the way.

(23) Remove three cotter pins (61), castle nuts (62), washers (63), biscuit plate (64), and upper biscuits (65) from left and right side transmission mounts (59 and 60). Discard cotter pins (61).

(24) Remove three capscrews (66), washers (67), and lower biscuits (65) from bottom of left and right side transmission mounts (59 and 60).

3-13. IDLER GEAR MAINTENANCE

THIS TASK COVERS: a. Removal
b. Disassembly
c. Cleaning/Inspection
d. Assembly
e. Installation

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Bearing test fixture (2SK900)
Dial indicator (J 7872)

Materials/Parts
Engine oil (item 46, Appendix C)
Nylon patch capscrews (6) (5103534) item 4

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Power pack removed (para 3-17). Flywheel housing removed (para 3-7).

a. Removal

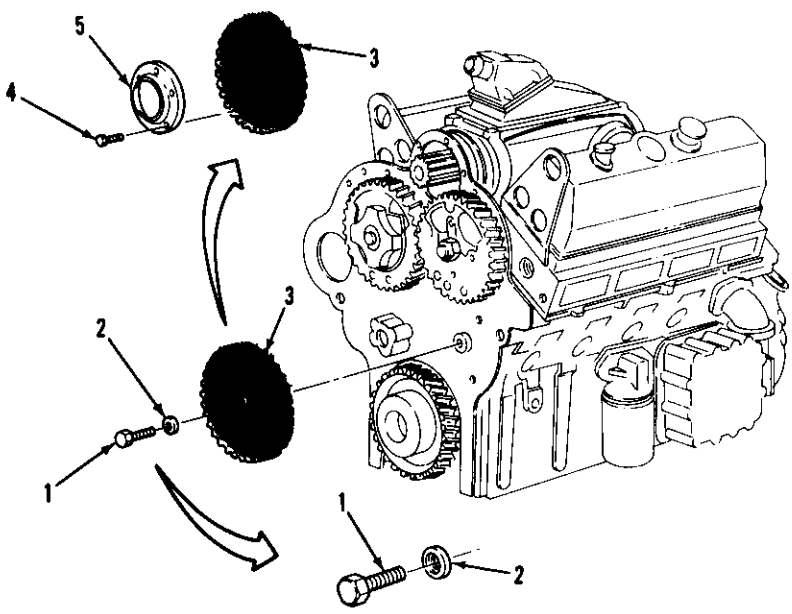
(1) Remove capscrew (1) and special washer (2).

(2) Remove idler gear assembly (3) from engine block.

b. Disassembly

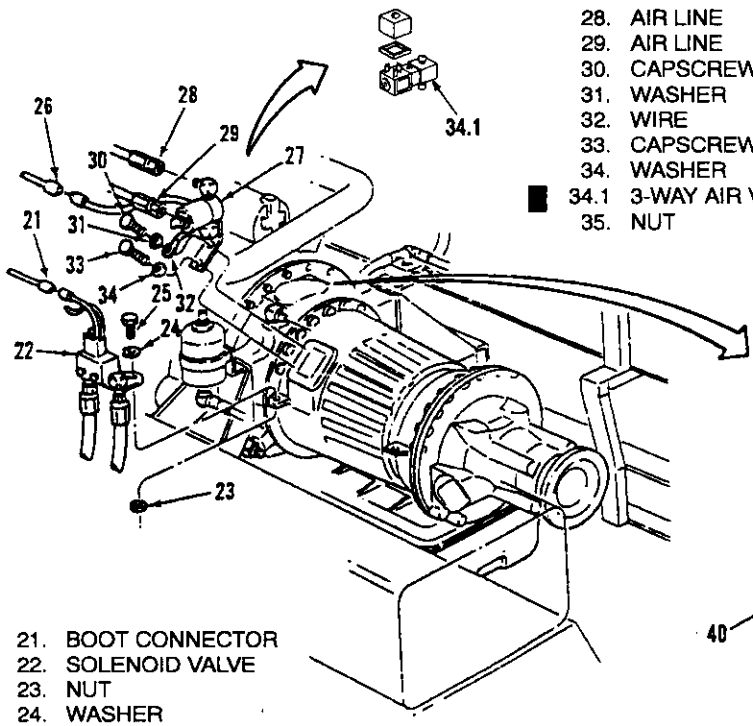
(1) Remove six nylon patch capscrews (4) from retainer (5). Discard six nylon patch capscrews (4).

(2) Remove retainer (5) from idler gear assembly (3).



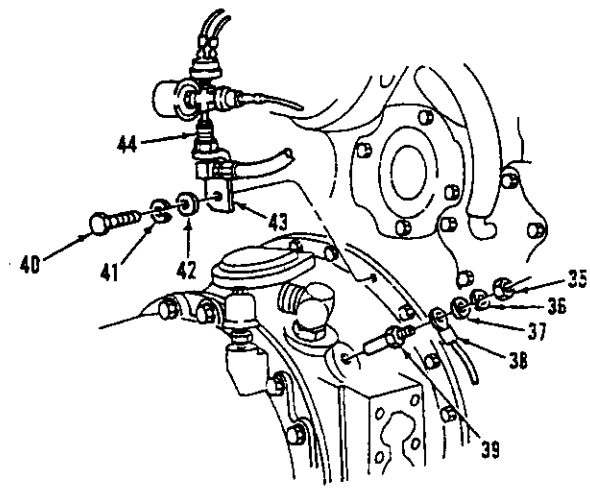
1. CAPSCREW
2. SPECIAL WASHER
3. IDLER GEAR ASSEMBLY
4. NYLON PATCH CAPSCREW (6)
5. RETAINER

TA 298498



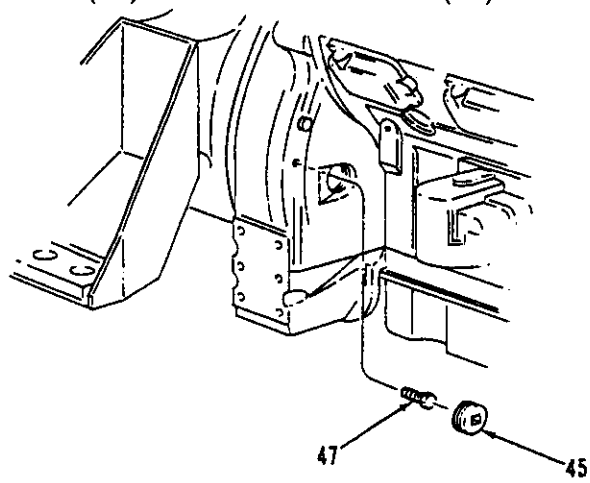
21. BOOT CONNECTOR
22. SOLENOID VALVE
23. NUT
24. WASHER
25. CAPSCREW
26. PLUG
27. THROTTLE CONTROL SOLENOID
28. AIR LINE
29. AIR LINE
30. CAPSCREW
31. WASHER
32. WIRE
33. CAPSCREW
34. WASHER
34.1 3-WAY AIR VALVE*
35. NUT
36. LOCKWASHER
37. WASHER
38. WIRE
39. TEMPERATURE SENDING UNIT
40. CAPSCREW
41. LOCKWASHER
42. WASHER
43. BRACKET
44. OIL PRESSURE MANIFOLD

* LVSA1 SERIES VEHICLES ONLY



(15) Remove nut (35), lockwasher (36), washer (37), and wire (38) from temperature sending unit (39). Remove temperature sending unit (39). Discard lockwasher (36).

(16) Remove capscrew (40), lockwasher (41), and washer (42) from bracket (43), and remove oil pressure manifold (44). Discard lockwasher (41).



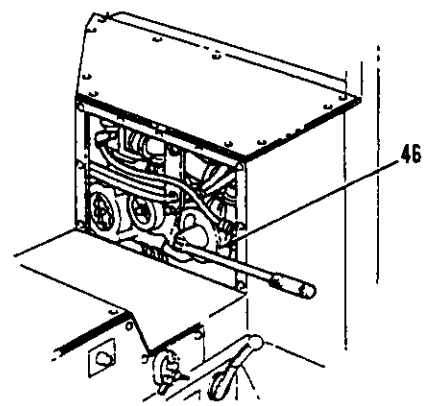
(17) Remove access hole plug (45).

NOTE

While turning engine over at camshaft pulley (46), use access hole to line up capscrews (47) for removal.

(18) Remove 12 capscrews(47).

45. ACCESS HOLE PLUG
46. CAMSHAFT PULLEY
47. CAPSCREW (12)



(3) Mark location of bearing cones (6 and 7) for proper installation.

(4) Place idler gear assembly (3) in press with inner bearing cone (6) supported on spacer.

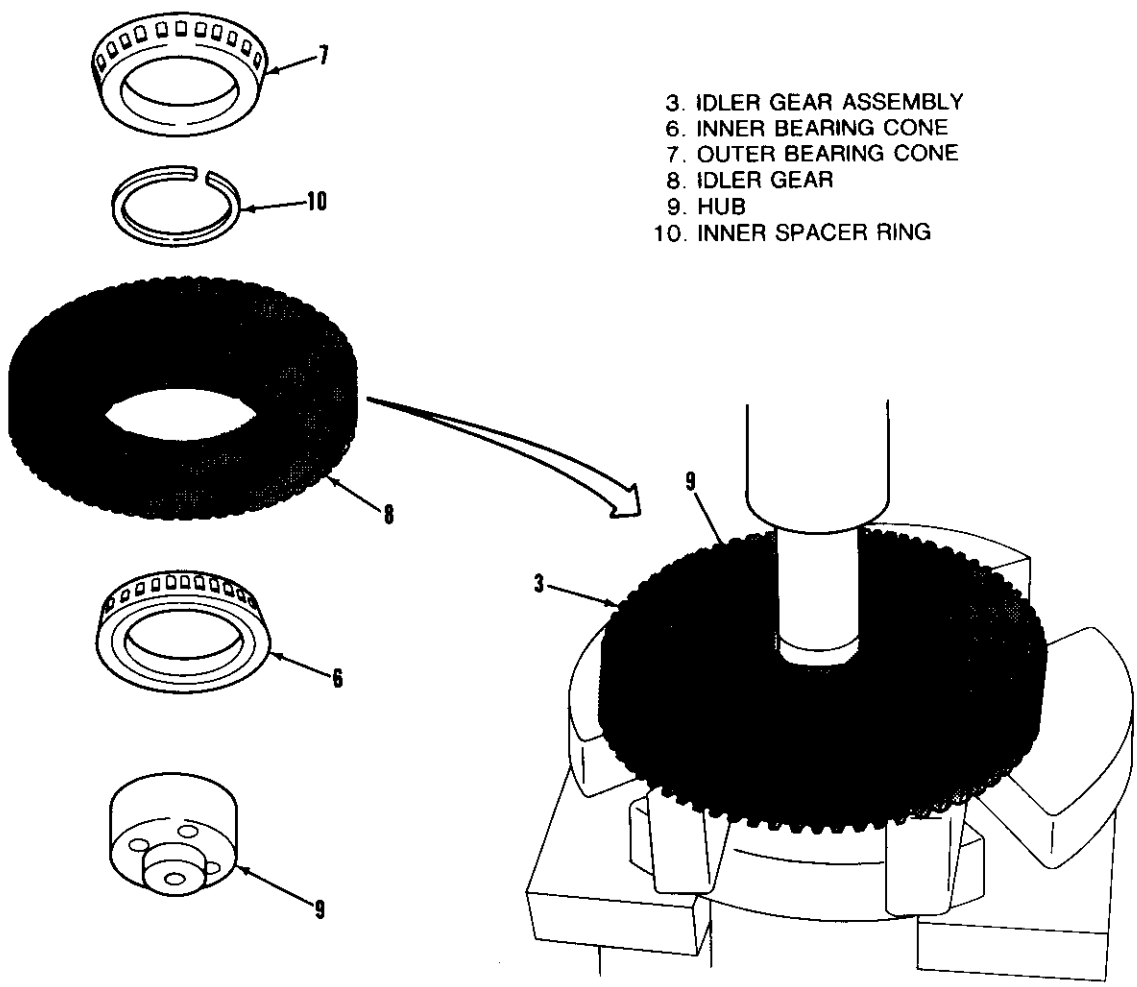
CAUTION

Idler gear (8) must be rotated during removal to prevent damage to bearing cones (6 and 7).

(5) While rotating idler gear (8), press hub (9) out of bearings (6 and 7).

(6) Remove idler gear assembly (3) as a unit from press.

(7) Remove outer bearing cone (7), inner spacer ring (10), and inner bearing cone (6) from idler gear (8).

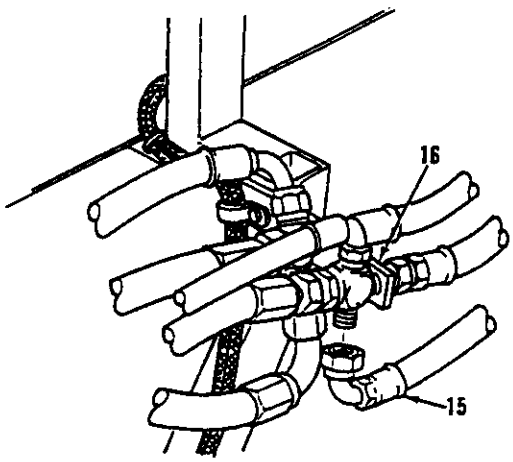


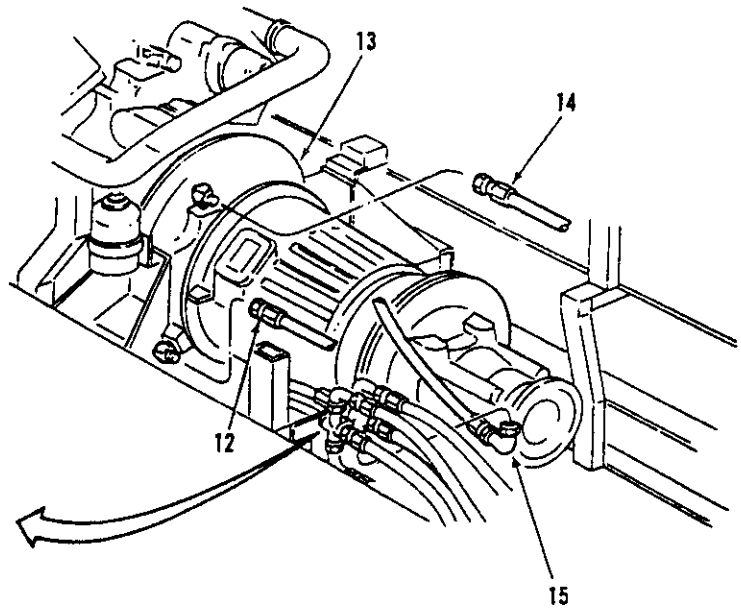
3. IDLER GEAR ASSEMBLY
6. INNER BEARING CONE
7. OUTER BEARING CONE
8. IDLER GEAR
9. HUB
10. INNER SPACER RING

TA 298499

7-4. TRANSMISSION REPLACEMENT (Continued)

12. OUTLET LINE
13. TRANSMISSION
14. INLET LINE
15. HYDRAULIC HOSE
16. STEERING VALVE BRACKET

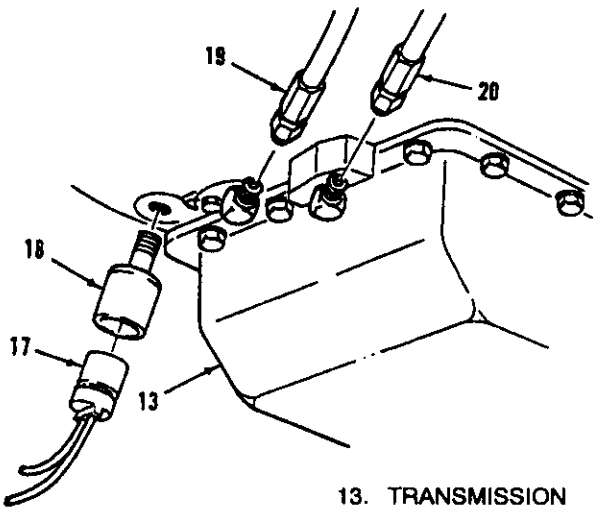




(5) tag and remove transmission outlet line (12) from transmission (13).

(6) Tag and remove transmission inlet line 14) from transmission (13).

(7) Tag and remove hydraulic hose (15) from steering valve bracket (16).



13. TRANSMISSION
17. CONNECTOR
18. ENGINE BRAKE LOCKUP SWITCH
19. HOSE
20. HOSE

(8) Unplug connector (17) from engine brake lockup switch (18) on bottom of transmission (13). Remove engine brake lockup switch (18).

(9) Tag and remove two hoses (19 and 20) from bottom of transmission (13).

(10) Unplug boot connector (21) from solenoid valve (22).

(11) Remove nut (23), washer (24), capscrew (25), and solenoid valve (22).

(12) Disconnect plug (26) from throttle control solenoid (27). Tag and remove two air lines (28 and 29).

(13) Remove capscrew (30), washer (31), and wire (32).

(14) Remove capscrew (33), washer (34), and throttle control solenoid (27).

NOTE

Perform step (14.1) on LVSA1 series vehicles only.

(14.1) Remove two capscrews (30 and 33), washers (31 and 34), and 3-way air valve (34.1).

3-13. IDLER GEAR MAINTENANCE (Continued)

NOTE

Do not remove bearing cups (11 and 12) unless damaged or loose.

(8) Mark and remove outer bearing cup (11), outer spacer ring (13), and inner bearing bearing cup (12) from idler gear (8).

c. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

NOTE

Bearing cup and cone must be replaced as an assembly.

(2) Inspect bearings for scoring, pitting, or flat spots on rollers or cones.

(3) Inspect gear teeth for scoring, pitting or chips.

(4) Inspect all other parts. Refer to paragraph 2-7.

(5) Replace all parts failing inspection.

(6) Coat all parts with clean engine oil.

d. Assembly

(1) Support idler gear (8), shoulder down, on bed of press.

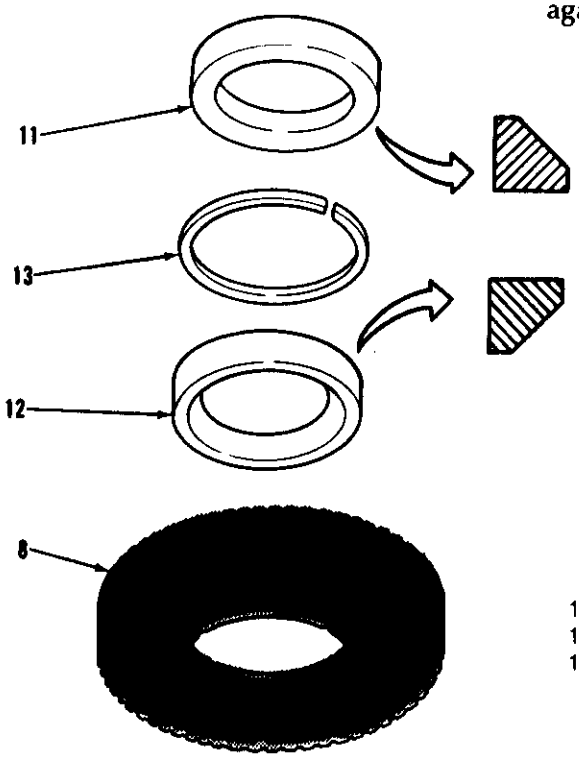
(2) Start inner bearing cup (12), numbered side up, into bore of idler gear (8).

(3) Press inner bearing cup (12) until it seats against shoulder of idler gear (8).

(4) Install outer spacer ring (13) on inner bearing cup (12) in idler gear (8).

(5) Start outer bearing cup (11), numbered side down, into bore of idler gear (8).

(6) Press outer bearing cup (11), until it seats against outer spacer ring (13).



8. IDLER GEAR
11. OUTER BEARING CUP
12. INNER BEARING CUP
13. OUTER SPACER RING

TA 298600

a. Removal

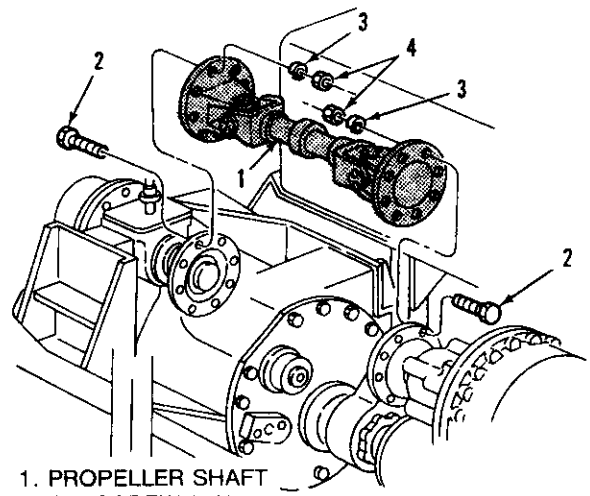
WARNING

Propeller shaft (1) is very heavy. Have assistants support it during removal.

NOTE

- Remove nylon ties as needed to remove hydraulic lines or electrical wiring. Note location and replace during installation.
- To aid in later installation, be sure to plug all lines as necessary, and tag all lines or wires and their connection points.

(1) Remove eight capscrews (2), lockwashers (3), and nuts (4) from each end of propeller shaft (1). Discard lockwashers (3).



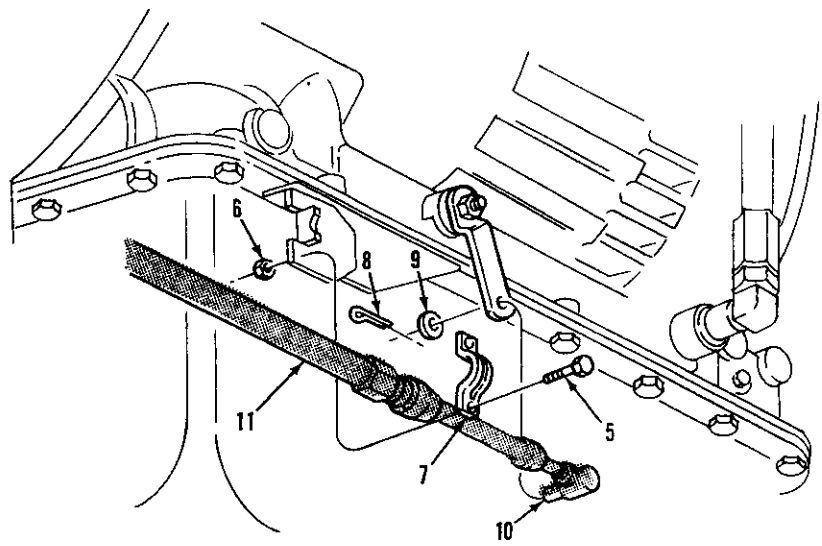
1. PROPELLER SHAFT
2. CAPSCREW (16)
3. LOCKWASHER (16)
4. NUT (16)

(2) Remove propeller shaft (1).

(3) Remove two capscrews (5) and locknuts (6) from clamp (7) at transmission end of shift cable. Discard locknuts (6).

(4) Remove cotter pin (8) and washer (9) from cable anchor (10), and remove shift cable (11). Keep anchor for installation. Discard cotter pin (8).

5. CAPSCREW (2)
6. LOCKNUT (2)
7. CLAMP
8. COTTER PIN
9. WASHER
10. CABLE ANCHOR
11. SHIFT CABLE



TA 298787

(7) Place outer bearing cone (7), numbered side down, on bed of press.

(8) Press hub (9) into outer bearing cone (7) until bottom of hub (9) is flush with bottom of outer bearing cone (7).

(9) Install inner spacer ring (10) on hub (9).

(10) Position gap in inner spacer ring (10) on side opposite oil hole (14) in hub (9).

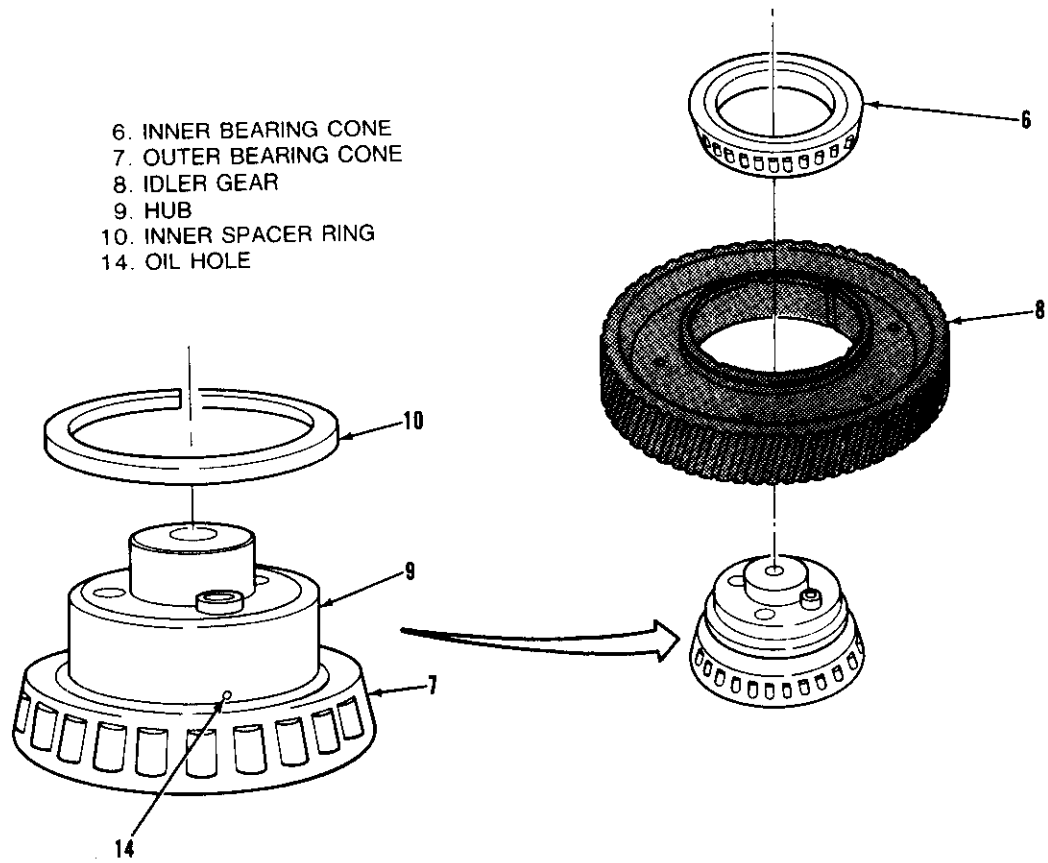
(11) Support outer bearing cone (7) and hub (9).

(12) Install idler gear (8) onto hub (9).

CAUTION

Turn idler gear (8) while installing inner bearing cone (6) on hub (9) to prevent damage.

(13) Turn idler gear (8) while pressing inner bearing cone (6) numbered side up, over hub (9).



TA 298501

SECTION I. TRANSMISSION REPLACEMENT INSTRUCTIONS

7-4. TRANSMISSION REPLACEMENT

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Transmission holding fixture (61373)

Materials/Parts
Oil, engine (item 46, Appendix C)
Lockwasher (16) (MS35338-46) item 3
Locknut (2) (MS51922-1) item 6
Cotter pin (MS24665-281) item 8
Lockwasher (MS35338-43) item 36
Lockwasher (25) (MS35338-47) items 41, and 72
Lockwasher (16) (MS35338-50) items 50, 53, 56, and 75
Cotter pin (6) (MS9245-49) item 61
Adhesive sealant (item 3, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Radiator and air reservoir removed (para 16-5).
TM 2320-20/12 TM 9-2320-297-20	Modulator removed from transmission (para 8-10).
	Hi idle neutral switch removed (para (7-25).
	Transmission oil drained (para 8-3).
	Dipstick tube removed (para 8-12).
	Coolant filter bracket removed (para 6-5).
	Front access panel removed (para 8-14).

General Safety Instructions
Block wheels of truck to prevent personal injury.

3-13. IDLER GEAR MAINTENANCE (Continued)

(14) Hold hub (9) and turn idler gear assembly (3) to see if binding occurs.

(15) Check bearing preload as follows:

(a) Mount idler gear assembly (3) in soft-jawed vise.

(b) Install test fixture plates (15 and 16) on idler gear assembly (3) with capscrew (17) and nut (18). Torque capscrew (17) to 80-90 foot-pounds (108-122 N·m).

(c) Install test fixture plate (19) on idler gear assembly (3) with three capscrews (20), lockwashers (21), and washers (22). Torque capscrews (20) to 25-40 foot-pounds (35-54 N·m).

(d) Place test fixture plate (16) in jaws of vise.

(e) Wrap cord several times around idler gear (8) and attach spring scale (23).

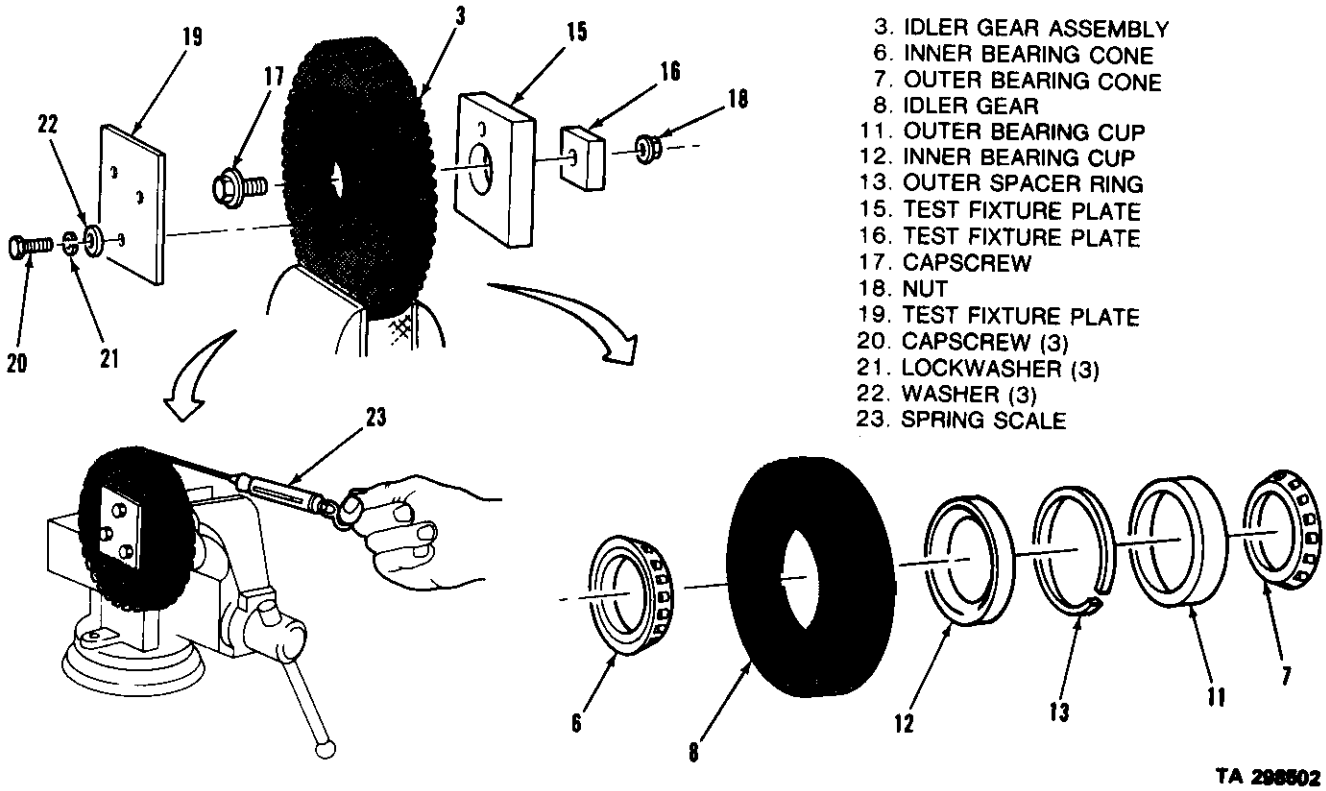
(f) Pull idler gear (8) several times. Record pull required to start gear moving. Pull must not be less than 0.5 pound (0.23 kg) or more than 4 pounds (1.8 kg), with a difference between pulls of 2 pounds 11 ounces (1.22 kg).

(g) If difference between pulls does not fall in correct range, replace bearing cones (6 and 7), bearing cups (11 and 12), and outer spacer ring (13).

(16) Place idler gear assembly (3) in soft-jawed vise.

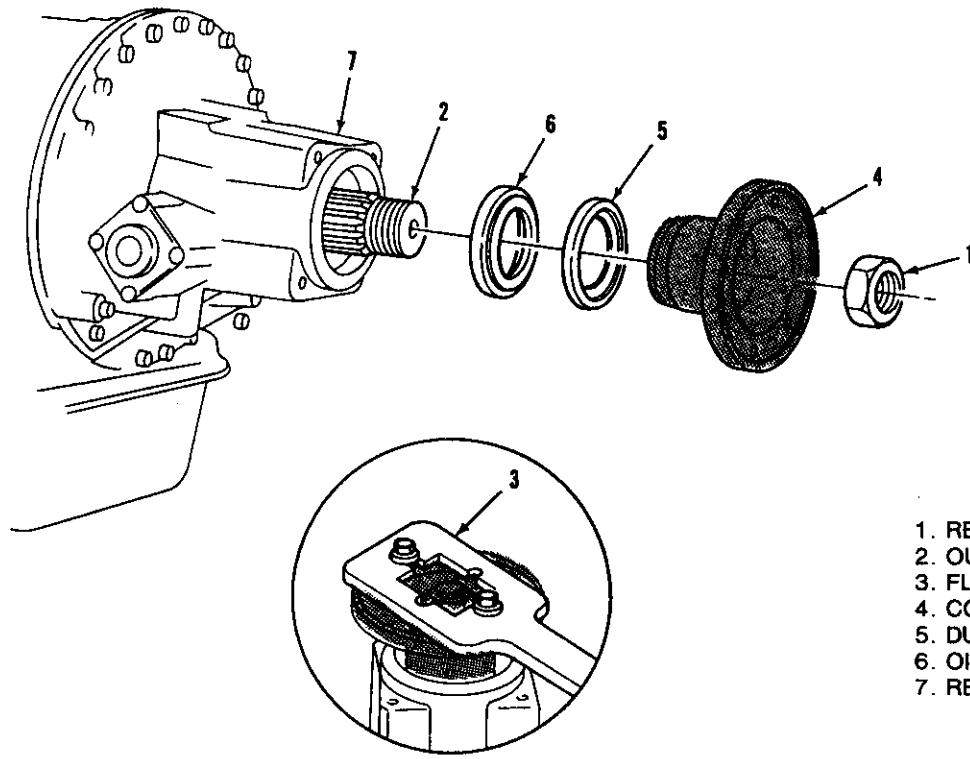
(17) Remove three capscrews (20), lockwashers (21), washers (22), and test fixture plate (19).

(18) Remove nut (18), capscrew (17), and two test fixture plates (15 and 16).



3. IDLER GEAR ASSEMBLY
6. INNER BEARING CONE
7. OUTER BEARING CONE
8. IDLER GEAR
11. OUTER BEARING CUP
12. INNER BEARING CUP
13. OUTER SPACER RING
15. TEST FIXTURE PLATE
16. TEST FIXTURE PLATE
17. CAPSCREW
18. NUT
19. TEST FIXTURE PLATE
20. CAPSCREW (3)
21. LOCKWASHER (3)
22. WASHER (3)
23. SPRING SCALE

TA 298502



1. RETAINING NUT
2. OUTPUT SHAFT
3. FLANGE YOKE HOLDING BAR
4. COMPANION FLANGE
5. DUST SHIELD
6. OIL SEAL
7. REAR COVER

TA 288786

(4) Use seal installer and seal driver handle to drive the rear of oil seal (6) 0.60-0.070 inch (15.2-17.8 mm) deep in rear cover (7).

(5) Coat outer circumference of dust shield (5) with non-hardening sealer.

(6) Drive dust shield (5), flat side first, into rear cover (7).

(7) Install companion flange (4) onto output shaft (2).

(8) Clean threads of output shaft (2) with a wire brush.

(9) Lubricate threads of output shaft (2) and retaining nut (1) with oil.

(10) Install new flange retaining nut (1) onto output shaft (2). Torque to 650-700 foot-pounds (814-1085 N·m) while holding companion flange (4) with flange yoke holding bar (3).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Connect propeller shaft to transmission output shaft (para 10-3).

(19) Remove idler gear assembly (3) from vise.

(20) Install retainer (5) and six new nylon patch capscrews (4) on idler gear assembly (3).

(21) Torque nylon patch capscrews (4) on idler gear assembly (3) to 24-29 foot-pounds (33-39 N·m).

e. Installation

(1) Aline timing marks (24) on camshaft gear (25). Aline crankshaft gear (26) with timing marks (24) on idler gear assembly (3).

(2) Mesh idler gear (3) with crankshaft gear (26) and camshaft gear (25)

(3) Rotate hub (9) so dowel in hub (9) alines with hole in end plate (27).

(4) Tap hub (9) until it seats against end plate (27).

(5) Install capscrew (1), and special washer (2) with indented side of special washer (2) facing head of capscrew (1).

(6) Torque capscrew (1) to 80-90 foot-pounds (108-122 N·m).

(7) Check gear backlash between gears (3 and 26). Minimum backlash is 0.0002 inch (0.05 mm). Maximum backlash is 0.008 inch (0.2 mm) for new gears and 0.010 inch (0.2540 mm) for used gears.

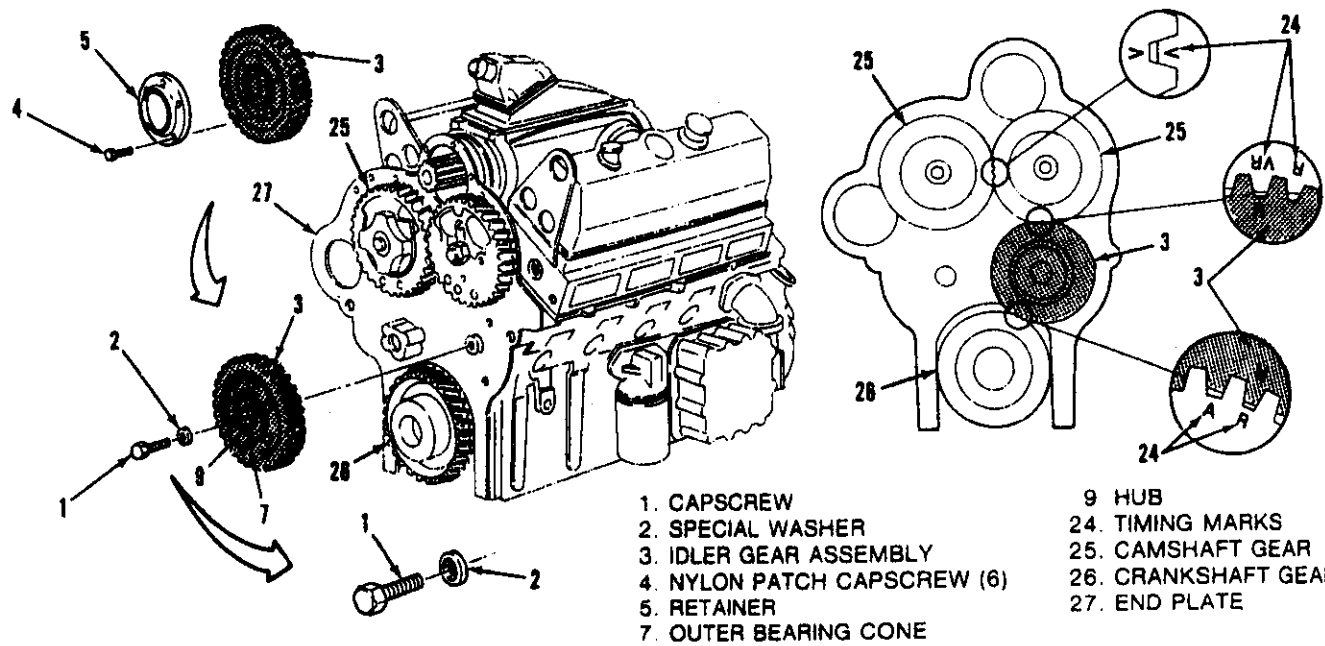
(8) Coat Outer bearing cone (7) and idler gear (3) with clean engine oil.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install flywheel housing (para 3-7).
	Install power pack (para 3-17).



TA 298503

SECTION II. GENERAL TRANSMISSION MAINTENANCE

7-3. OUTPUT FLANGE, DUST SHIELD, AND OIL SEAL REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Flange yoke holding bar (J 3453)
Seal & dust shield remover (J 24171)
Seal installer (J 24202-1A)
Seal driver handle (J 24202-4)

Materials/Parts

Grease, high temp, (item 29, Appendix C)
Oil, lubricating (item 44, Appendix C)
Non-hardening sealer (item 62, Appendix C)
Retaining nut (NSN 5310-00-478-0548) item 1
Oil seal (NSN 5330-00-999-3752) item 6

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Disconnect propeller shaft from transmission output shaft (para 10-3).

a. Removal

(1) Before removing retaining nut (1), clean threads of output shaft (2) to remove dirt.

(2) Install flange yoke holding bar (3) onto campanion flange (4).

(3) Remove retaining nut (1) while holding companion flange (4) with flange yoke holding bar (3). Discard retaining nut (1).

(4) Remove flange yoke holding bar (3).

(5) Using a puller, remove companion flange (4).

(6) Remove dust shield (5) and oil seal (6) with seal and dust shield remover tool. Discard oil seal (6).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

(1) Coat inside of new oil seal (6) with high temperature grease.

NOTE

The outer circumference of some oil seals are precoated with a dry sealant. The sealant is usually colored for easy identification. Precoated seals do not need additional sealant.

(2) Coat outer circumference of new oil seal (6) with non-hardening sealer.

(3) Install new oil seal (6) with spring loaded lip first.

3-14. WATER PUMP DRIVE GEAR REPLACEMENT

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Pulley remover (J 7932)

Materials/Parts
Grease, GP (item 28, Appendix C)
Lockwasher (10) (MS35338-48) items 3, 13, 19, 23, and 26
Lockwasher (MS35338-50) item 4
Lockwasher (MS35338-46) item 7
Gasket (NSN 5330-00-862-6934) item 28
Lockwasher (3) (MS35338-45) item 31
Star washer (2) (NSN 5310-00-209-1543) item 35
Locknut (P/N 23507006) item 18.1

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Access panel removed (para 18-14).
	Drain coolant system (para 6-3).
TM 2320-34/13 TM 9-2320-297-34	Water pump removed (para 5-5).
TM 2320-20/12 TM 9-2320-297-20	Shutdown solenoid and bracket removed (para 4-13).

a. Removal

(1) Remove capscrews (1 and 2), lockwashers (3 and 4), and lifting bracket (5). Discard lockwashers (3 and 4).

(2) Remove capscrew (6), lockwasher (7), and washer (8) from damper (9). Discard lockwasher (7).

CAUTION

Do not pry or hammer on damper (9). Damage to damper (9) will result.

(3) Install pulley remover (10) into camshaft seal hole.

NOTE

Not all shafts have a keyway, therefore the woodruff key is not required.

(4) Using a puller, remove damper (9) and woodruff key (11).

(5) Tag and remove capscrew (12), lockwasher (13), and washer (14) from balance weight cover (15) at location A. Discard lockwasher (13).

(6) Tag and remove two capscrews (16), and washers (17) at location B.

(7) Tag and remove four nuts (18), locknut (18.1), lockwashers (19), washers (20), and capscrews (21) at location C. Discard lockwashers (19) and locknut (18.1).

(8) Tag and remove two capscrews (22), lockwashers (23), and washers (24) at locations D. Discard lockwashers (23).

(9) Tag and remove capscrew (25), lockwasher (26), and washer (27) at location E. Discard lockwashers (26).

I. Specifications

Manufacturer: Detroit Diesel Allison

Model.....HT 740D

Net Weight.....840 lbs.

Rating:
- Input Torque.....1300 foot-pounds (1762 N·m) (MAX)
- Input Speed.....2800 rpm (MAX)
- Input horsepower.....425 (MAX)

Rotation: (view from input)
- Input ..... Clockwise
- Output (in forward ranges)...Clockwise

Torque Converter:
- Type.....Single-stage, poly-phase, 3 element
- Model TC-499

Clutches.....Oil cooled, hydraulically actuated, spring released, self-compensating for wear

Oil Type.....Above 0° F (0° C) Hydraulic transmission fluid (item 44, Appendix C)

Oil Pressure:
- Main pressure at 600 rpm in forward or reverse..... 110 psi (758 kPa)
- Main pressure at 1200 rpm in forward (stall).....140-175 psi (965-1206 kPa)
- Main pressure at 1500-2000 rpm in all forward ranges.....140-175 psi (965-1206 kPa)
- Lockup pressure.....Must be within 10 psi (69 kPa) at main pressure

Rear Governor Pressure.....83-91 psi (573-628 kPa)

Drive Range and Sequences....Reverse, neutral, 1-2-3-4, 1-2-3, 1-2, 1

(10) Remove balance weight cover (15), and gasket (28). Discard gasket (28).

(11) If damaged, remove seal (29) from balance weight cover (15).

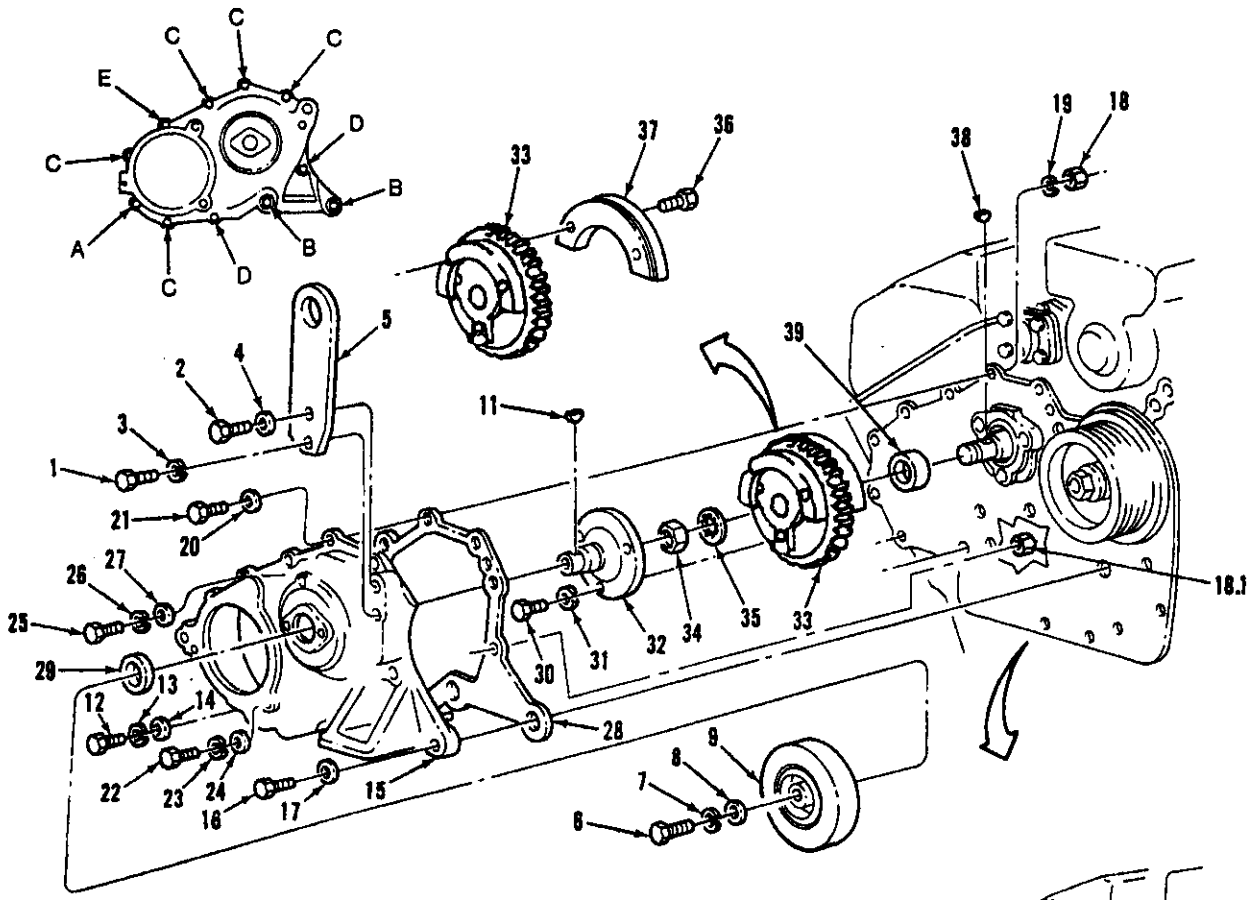
(12) Remove three capscrews (30), lockwashers (31), and hub (32) from drive gear (33). Discard lockwashers (31).

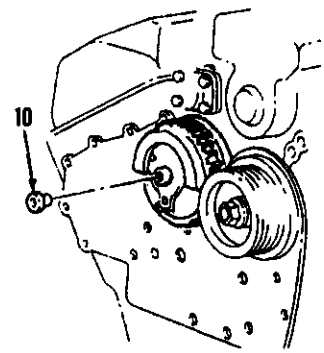
(13) Remove retaining nut (34) and star washer (35) from drive gear (33). Discard star washer (35).

(14) Install pulley remover (10) on drive gear (33). Using a puller, remove drive gear (33).

(15) Remove two capscrews (36) and balance weight (37) from drive gear (33).

(16) Remove key (38) and spacer (39).





1. CAPSCREW
2. CAPSCREW
3. LOCKWASHER
4. LOCKWASHER
5. LIFTING BRACKET
6. CAPSCREW
7. LOCKWASHER
8. WASHER
9. DAMPER
10. PULLEY REMOVER
11. WOODRUFF KEY
12. CAPSCREW
13. LOCKWASHER
14. WASHER
15. BALANCE WEIGHT COVER
16. CAPSCREW (2)
17. WASHER (2)
18. NUT (4)
18.1. LOCKNUT
19. LOCKWASHER (5)
20. WASHER (5)
21. CAPSCREW (5)
22. CAPSCREW (2)
23. LOCKWASHER (2)
24. WASHER (2)
25. CAPSCREW
26. LOCKWASHER
27. WASHER
28. GASKET
29. SEAL
30. CAPSCREW (3)
31. LOCKWASHER (3)
32. HUB
33. DRIVE GEAR
34. RETAINING NUT
35. STAR WASHER
36. CAPSCREW (2)
37. BALANCE WEIGHT
38. KEY
39. SPACER

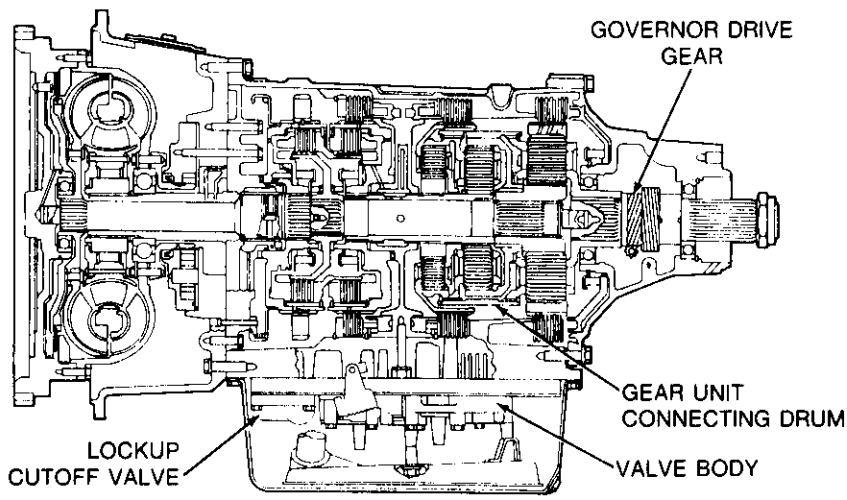
7-2. DESCRIPTION AND DATA (Continued)

h. Planetary Gearing. The HT 740D transmission contains three planetary carrier assemblies. Each assembly contains a sun gear and a ring gear, which are connected to the main transmission shaft and a drum. The front planetary unit, combined with the center planetary unit, provides second gear when the forward and second clutches are applied. The center planetary unit is active in second, third, fourth, and reverse gears. Two planetary units are required for second and reverse gears. The rear planetary carrier assembly is active in first and reverse gears. In fourth gear, all three planetary carrier assemblies rotate together as a unit, providing direct drive.

i. Governor. The governor is a centrifugal assembly, driven by a gear attached to the output shaft. Rotation of the governor causes the governor to move. When the valve moves left, governor pressure rises. When the valve moves right, governor pressure falls. Governor pressure is proportional to transmission output speed. Combined with modulator pressure, it regulates automatic shifting in the transmission.

j. Valve Body. The valve body assembly includes the various valves, springs, and other components that control the selection of ranges and the automatic shifting of gears. The valve body assembly is bolted to the bottom of the transmission case. The valve body is channeled to direct the flow of oil between the valve body, clutches, and other components.

k. Lockup Cutoff Valve. The low shift valve body contains a relay valve, a shift valve, springs, pins, and an adjusting ring. It is mounted at the back of the control valve body. When the selector valve is placed in the drive 1 position, hydraulic fluid is directed to the 1-2 shift signal valve and to the top of the 1-2 shift valve down until governor pressure charges the line. Hydraulic fluid forces the relay valve down against its spring allowing main pressure to apply the low clutch.



TA 298785

3-14. WATER PUMP DRIVE GEAR REPLACEMENT (Continued)

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Clean all gasket material from mating surfaces.

(3) Inspect drive gear (33) for nicks, pits, or wear.

(4) Inspect hub (32) for cracks or wear.

(5) Inspect balance weight cover (15) for dents and cracks.

(6) Inspect all threads for nicks and burrs.

(7) Inspect all other parts. Refer to paragraph 2-7.

(8) Replace all parts failing inspection.

c. Installation

(1) Install spacer (39) onto camshaft (41).

(2) Install key (38) into camshaft (41).

(3) Install balance weight (37) on drive gear (33) with two capscrews (36). Torque capscrews (36) to 15-18 foot-pounds (20-24 N·m).

(4) Install drive gear (33) onto camshaft (41).

(5) Install new star washer (35) and retaining nut (34). Torque retaining nut (34) to 300-325 foot-pounds (407-441 N·m).

(6) Install hub (32) with three capscrews (30) and new lockwashers (31). Torque capscrews (30) to 15-19 foot-pounds (20-26 N·m).

NOTE

Not all shafts have a keyway. The woodruff key is not used on these shafts.

(7) Install woodruff key (11) into keyway of hub (32).

(8) Install seal (29) in balance weight cover (15). Lip of seal (29) will point toward inner side of balance weight cover (15).

(9) Coat lip of seal (29) with grease.

(10) Place new gasket (28) over dowel pins (40) in balance weight cover (15).

CAUTION

Use care when installing balance weight cover (15) to prevent damage to seal (29).

(11) Aline balance weight cover dowel pins (40) and install balance cover (15).

(12) Install capscrew (12), new lockwasher (13), and washer (14) at location A.

(13) Install two capscrews (16) and washer (17) at location B.

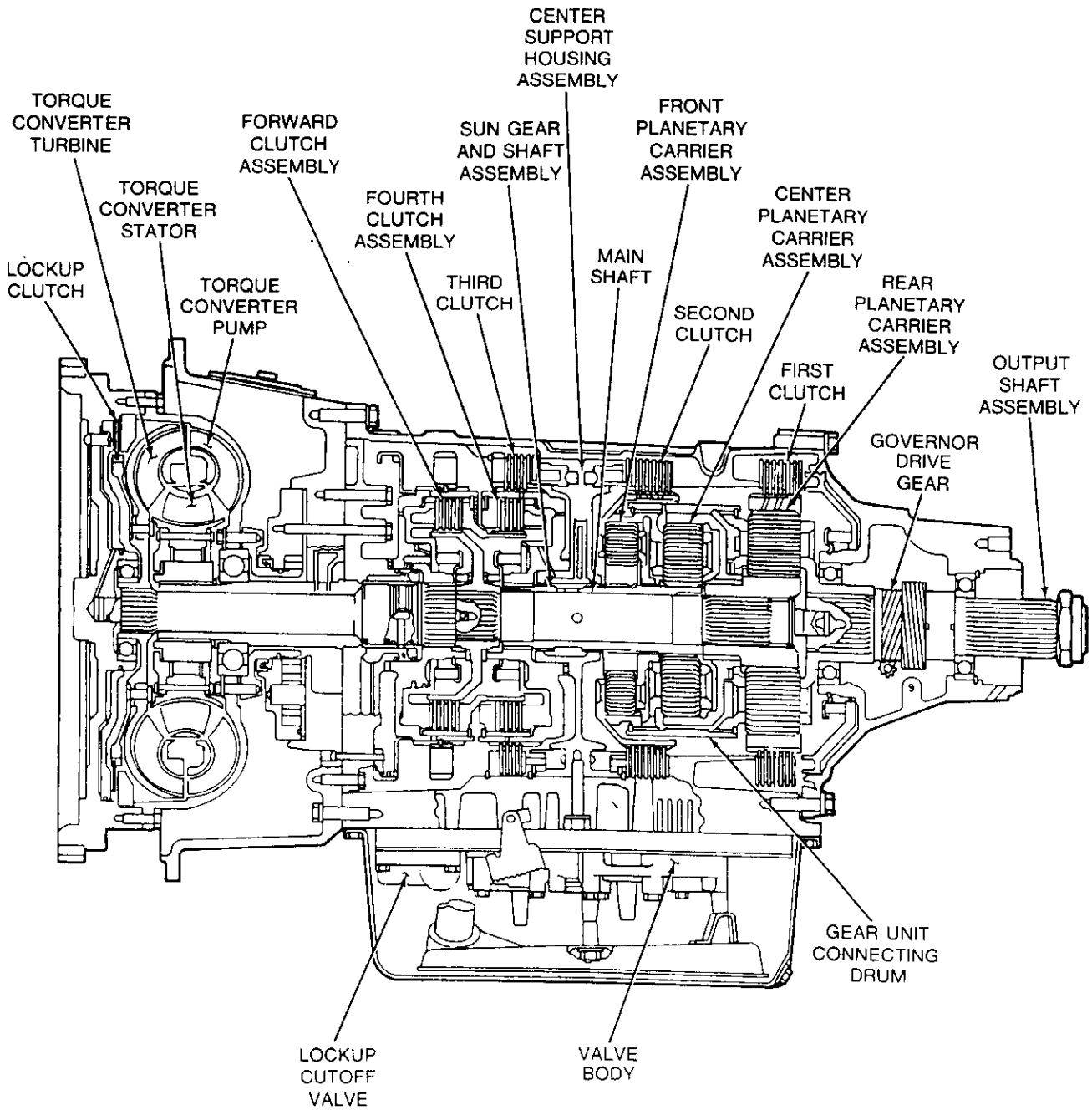
(14) Install five capscrews (21), washers (20), new lockwashers (19), nuts (18), and new locknut (18.1) at location C.

(15) Install two capscrews (22), new lockwashers (23), and washers (24) at location D.

(16) Install capscrew (25), new lockwasher (26), and washer (27) at location E.

(17) Torque capscrew (25) at location E to 30-35 foot-pounds (41-47 N·m), capscrew (12) at location A to 71-75 foot-pounds (96-102 N·m), capscrews (16) at location B to 137-147 foot-pounds (186-200 N·m), capscrews (21) at location C to 35-39 foot-pounds (47-53 N·m), and capscrews (22) at location D to 30-35 foot-pounds (41-47 N·m).

(18) Install damper (9).


CENTER SUPPORT HOUSING ASSEMBLY
TORQUE CONVERTER TURBINE
FORWARD CLUTCH ASSEMBLY
SUN GEAR AND SHAFT ASSEMBLY
FRONT PLANETARY CARRIER ASSEMBLY
TORQUE CONVERTER STATOR
FOURTH CLUTCH ASSEMBLY
CENTER PLANETARY CARRIER ASSEMBLY
LOCKUP CLUTCH
MAIN SHAFT
TORQUE CONVERTER PUMP
THIRD CLUTCH
SECOND CLUTCH
REAR PLANETARY CARRIER ASSEMBLY
FIRST CLUTCH
OUTPUT SHAFT ASSEMBLY
GOVERNOR DRIVE GEAR
GEAR UNIT CONNECTING DRUM
LOCKUP CUTOFF VALVE
VALVE BODY

TA 298784

(19) Install capscrew (6), new lockwasher (7), and washer (8).

(20) Torque capscrew (6) to 30-35 foot-pounds (41-47 N·m).

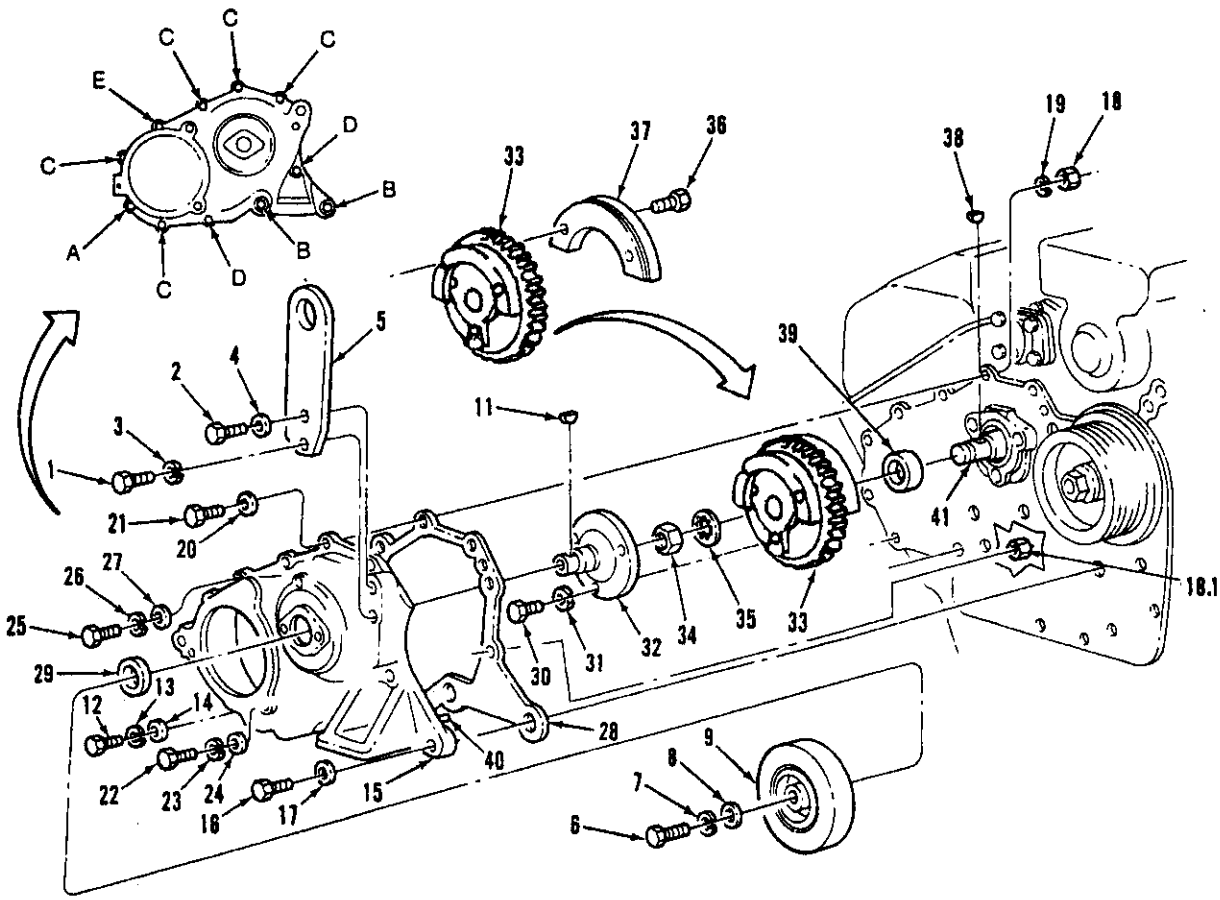
(21) Install lifting bracket (5) with capscrews (1 and 2) and new lockwashers (3 and 4). Torque capscrew (1) to 71-75 foot-pounds (96-102 N·m). Torque capscrew (2) to 137-147 foot-pounds (186-200 N·m).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install water pump (para 5-5).
TM 2320-20/12 TM 9-2320-297-20	Engine access panel installed (para 18-14).
	Fill coolant system (para 6-3).



1. CAPSCREW
2. CAPSCREW
3. LOCKWASHER
4. LOCKWASHER
5. LIFTING BRACKET
6. CAPSCREW
7. LOCKWASHER
8. WASHER
9. DAMPER
11. WOODRUFF KEY
12. CAPSCREW
13. LOCKWASHER
14. WASHER
15. BALANCE WEIGHT COVER
16. CAPSCREW (2)
17. WASHER (2)
18. NUT (4)
18.1. LOCKNUT
19. LOCKWASHER (5)
20. WASHER (5)
21. CAPSCREW (5)
22. CAPSCREW (2)
23. LOCKWASHER (2)
24. WASHER (2)
25 CAPSCREW
26. LOCKWASHER
27. WASHER
28. GASKET
29. SEAL
30. CAPSCREW (3)
31. LOCKWASHER (3)
32. HUB
33. DRIVE GEAR
34. RETAINING NUT
35. STAR WASHER
36. CAPSCREW (2)
37. BALANCE WEIGHT
38. KEY
39. SPACER
40. DOWEL PIN
41. CAMSHAFT

7-2. DESCRIPTION AND DATA (Continued)

d. Forward Clutch and Turbine Shaft. When the forward clutch is engaged with the first clutch, it provides first gear. When engaged with the second, third, or fourth clutches, it produces second, third or fourth gears, in that sequence. The forward clutch uses five internally splined clutch plates, five externally toothed clutch plates, and a piston. When hydraulic pressure is directed to the piston, the clutch plates are compressed together, locking the forward clutch hub to the forward clutch housing. Since the hub is splined to the transmission mainshaft, the shaft will rotate with the hub at input speed. The forward clutch is applied only in forward gears. When the convertor turbine rotates, and the forward clutch is applied, it drives the output shaft.

e. Fourth Clutch. The fourth clutch has a dual function. When engaged with the forward clutch, it produces fourth gear. When engaged with the first clutch, it provides reverse gear. The fourth clutch has 10 clutch plates, a clutch piston housing, and a piston. Five plates are internally splined and five are externally toothed. When hydraulic pressure is directed to the back side of the fourth clutch piston, the clutch plates are compressed. This locks the internally splined plates to the externally toothed plates. In turn, both plates are locked to the clutch housing. Since the center sun gear assembly is splined to the clutch housing, it will also rotate at input speed.

f. Center Support, Second and Third Clutches. The second and third clutches perform only one function apiece. When engaged with the forward clutch, the second clutch provides second gear and the third clutch provides third gear. The second and third clutches use a center support and two identical pistons. The second clutch uses 13 clutch plates. The third clutch uses eight clutch plates.

g. First Clutch. The first clutch has a dual function. When engaged with the forward clutch, it provides first gear, and when engaged with the fourth clutch, it provides reverse gear. The first clutch contains 13 clutch plates and a piston. Six are internally splined, and seven are externally toothed. The externally toothed plates are held stationary by the transmission housing. The internally splined plates are free to rotate.

When hydraulic pressure is directed to the back side of the piston, the clutch plates compress together. This locks rotating internally splined plates to stationary externally toothed plates, preventing the ring gears from rotating. When the forward or fourth clutch is applied with the first clutch, a reaction in the planetary gearing will produce either forward or reverse rotation of the output shaft.

3-15. ENGINE BRAKE MAINTENANCE

THIS TASK COVERS:
a. Removal
b. Disassembly
c. Cleaning/Inspection
d. Assembly
e. Installation

INITIAL SETUP

Applicable Configurations
MK48

Materials/Parts
Engine Oil (item 46, Appendix C)
Sealer, lubricating and wicking (item 63, Appendix C)
Lockwasher (MS35335-60) item 2
Sealring (NSN 5330-01-173-6825) item 10
Sealring (P/N 007117) item 17
Sealring (P/N 007118) item 18
Sealring (P/N 007119) item 19

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Engine access door opened (para 2-1).
TM 2320-20/12 TM 9-2320-297-20	Rocker covers removed (para 3-4).
	Shutdown solenoid removed (para 4-13.1 LVSA1 series vehicles only).

a. Removal

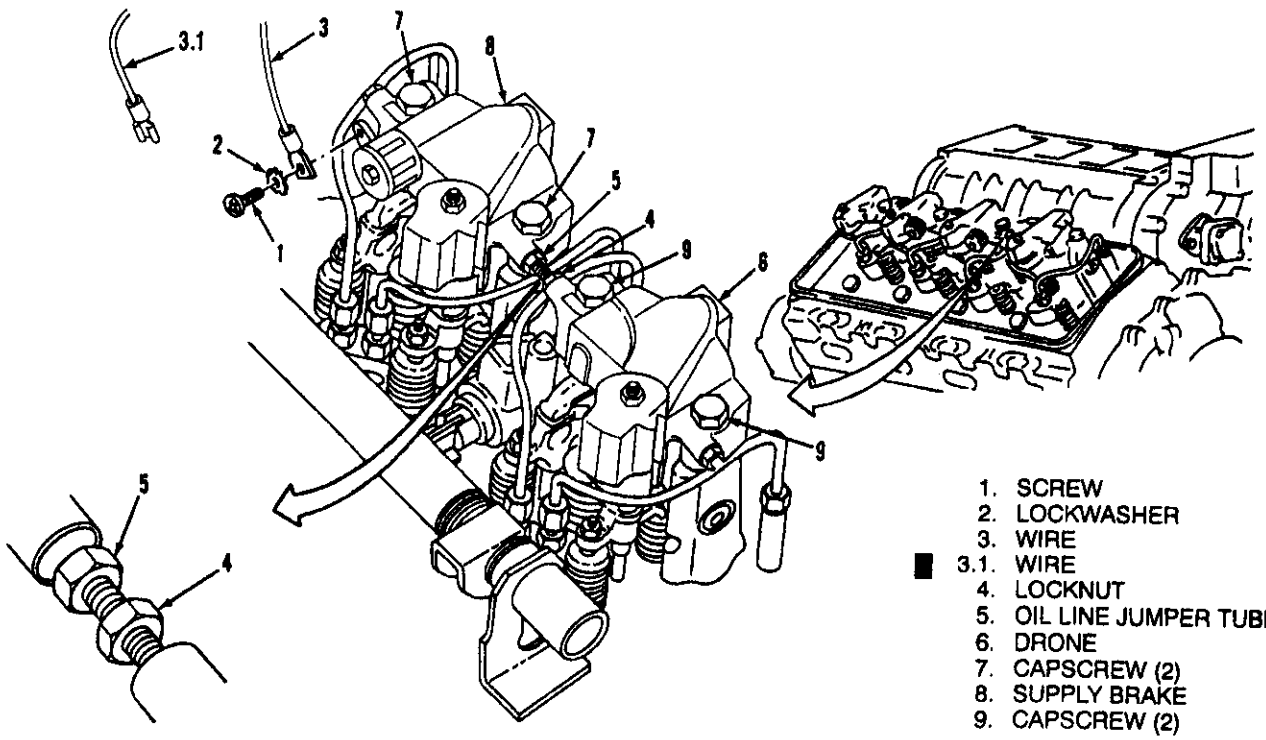
NOTE

Perform step (1) or step (1.1) depending on the configuration.

(1) Remove screw (1), lockwasher (2), and wire (3). Discard lockwasher (2).

(1.1) Remove wire (3.1).

(2) Loosen locknut (4). Screw oil line jumper tube (5) into drone (6) four to five turns.



1. SCREW
2. LOCKWASHER
3. WIRE
3.1. WIRE
4. LOCKNUT
5. OIL LINE JUMPER TUBE
6. DRONE
7. CAPSCREW (2)
8. SUPPLY BRAKE
9. CAPSCREW (2)

CHAPTER 7

TRANSMISSION

7-1. OVERVIEW

This chapter provides information authorized for Third and Fourth Echelon Maintenance level mechanics. General information, maintenance, replacement, disassembly, assembly, cleaning, inspection, repair, test, and adjustment procedures for the vehicle's transmission are covered in the following sections:

Section I. Description and Data

Section II. General Transmission Maintenance

Section III. Transmission Replacement Instructions

Section IV. Transmission Disassembly into Subassemblies and Reassembly from Subassemblies

Section V. Transmission Subassembly Cleaning, Inspection, and Repair

Section VI. Transmission Tests and Adjustments

SECTION I. DESCRIPTION AND DATA

7-2. DESCRIPTION AND DATA

a. **General.** This truck uses an HT 740D automatic transmission. This model has four forward speeds and one reverse speed. This transmission shifts automatically in all ranges. The name plate is located on right rear side of the transmission. The name plate displays the transmission serial number, part number, and the model number. Major components are described below.

b. **Torque Converter.** The torque converter is a three element assembly (pump, stator, and turbine). The first element, or input element, (pump) receives torque from the engine through the flex plate. The second element (stator) is a torque multiplying element. The third element (turbine) is the output element. When the pump is driven by the flex plate, it throws oil against the turbine vanes. The impact of oil against the turbine vanes rotates the turbine. The turbine transmits torque to the transmission gearing.

c. **Lockup Clutch.** This clutch automatically locks the turbine element of the torque convertor to the flex plate. When the turbine approaches the speed of the pump, hydraulic pressure applies the lockup clutch. With the lockup clutch applied, engine output is directed to the transmission gearing at a one to one gear ratio. A decrease in speed releases the lockup clutch.

(4) Tag and remove supply brake (8) and drone (6).

(5) Repeat steps (1) thru (4) and remove remaining supply brakes (8) and drones (6).

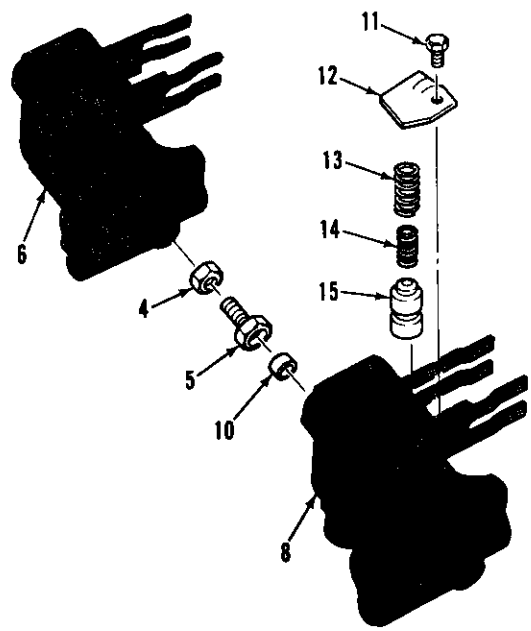
b. Disassembly

(1) Remove locknut (4) and oil line jumper tube (5) from drone (6).

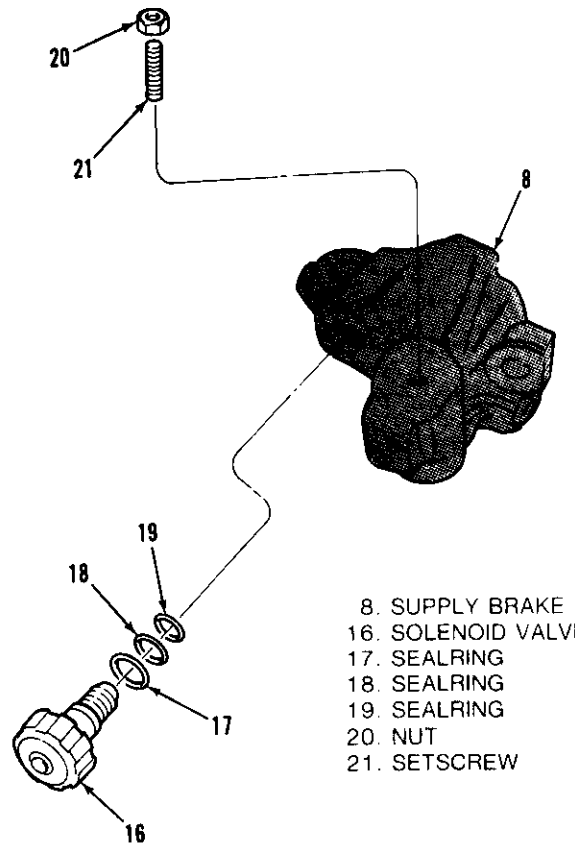
(2) Remove seal ring (10) from supply brake (8). Discard seal ring (10).

(3) Remove capscrew (11) and cover (12) from supply brake (8).

(4) Remove two springs (13 and 14) and control valve (15).



4. LOCKNUT
5. OIL LINE JUMPER TUBE
6. DRONE
8. SUPPLY BRAKE
10. SEALRING
11. CAPSCREW
12. COVER
13. SPRING
14. SPRING
15. CONTROL VALVE



8. SUPPLY BRAKE
16. SOLENOID VALVE
17. SEALRING
18. SEALRING
19. SEALRING
20. NUT
21. SETSCREW

TA 298506

NOTE

Solenoid valve (16) is on supply brake (8) only.

(5) Remove solenoid valve (16).

(6) Remove and discard two sealrings (17 and 18) from solenoid valve (16).

(7) Remove and discard sealring (19) from supply brake (8).

(8) Remove nut (20) and setscrew (21).

3-15. ENGINE BRAKE MAINTENANCE (Continued)

WARNING

Slave piston is retained by a spring under compression. Spring can be discharged and cause severe personal injury.

(9) Turn supply brake (8) over. Use a press to hold piston spring (22) and retainer (23).

(10) Remove snapring (24).

(11) Slowly release retainer (23) and piston spring (22).

(12) Remove retainer (23), piston spring (22), and piston (25).

(13) Remove screw (26), lockplate assembly (27), fork assembly (28), and master piston (29).

c. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

d. Assembly

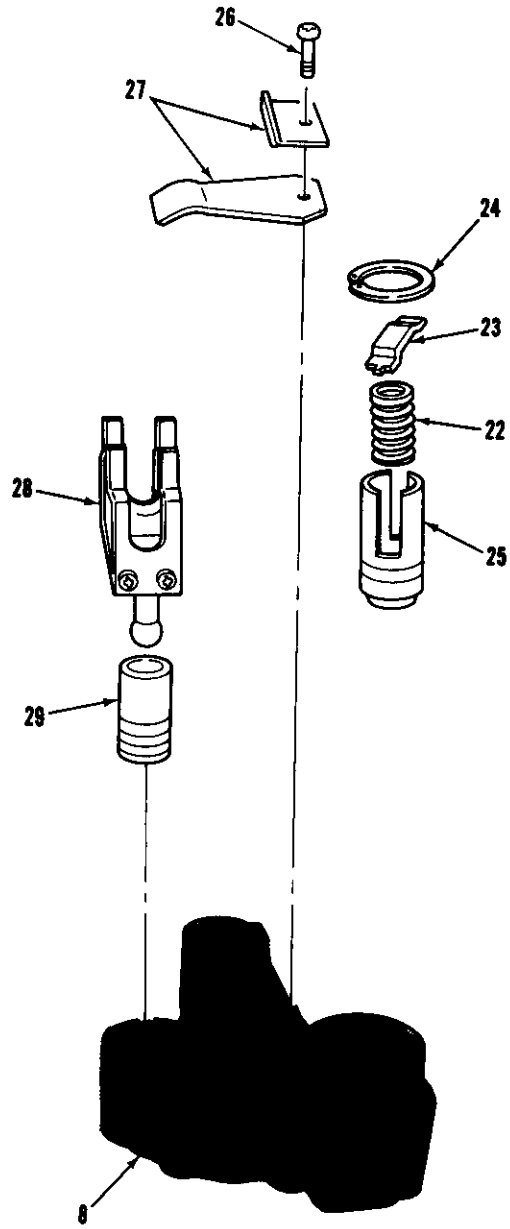
(1) Lubricate master piston (29) with clean engine oil.

(2) Install master piston (29) closed end first.

(3) Install fork assembly (28).

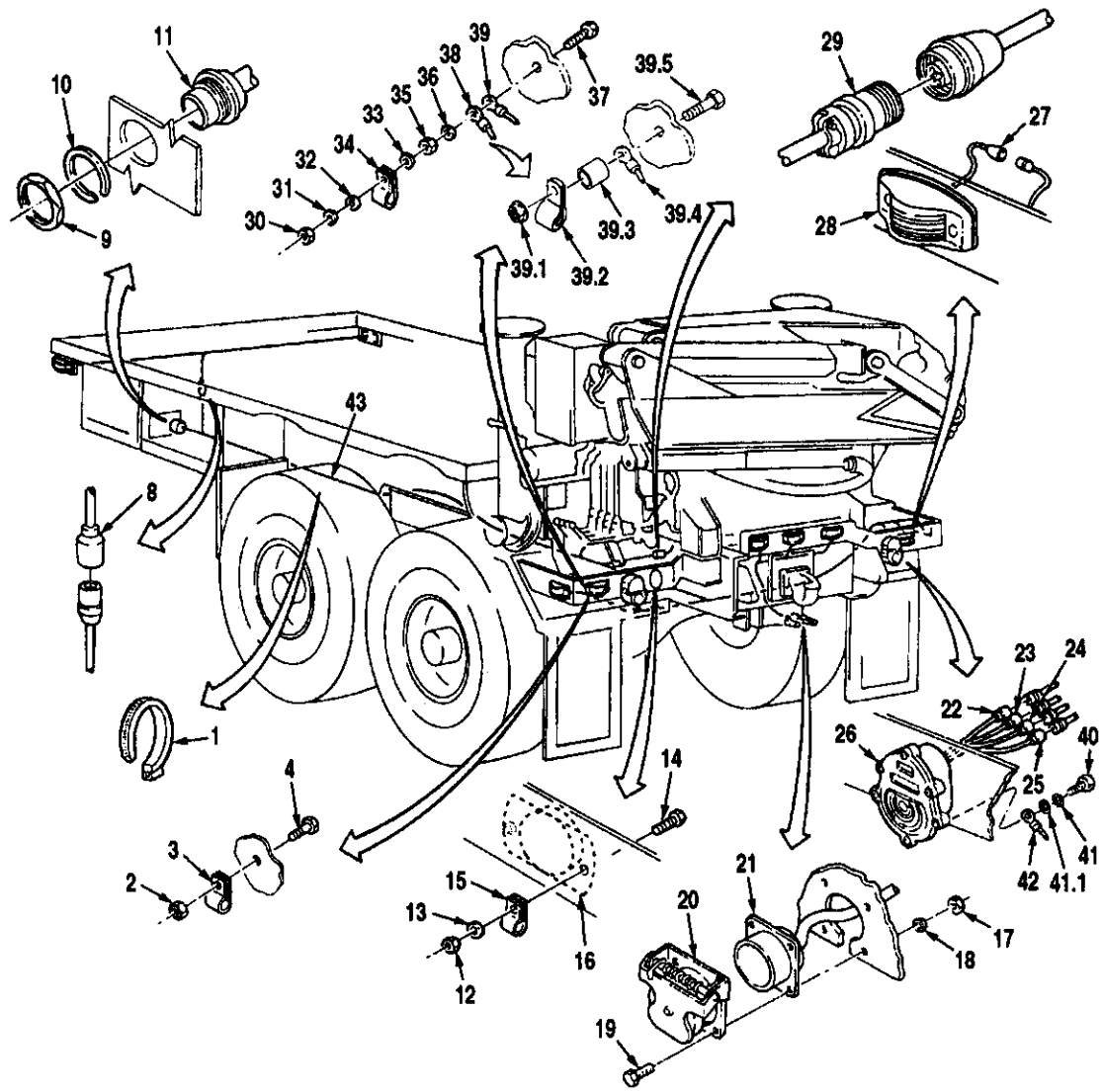
(4) Apply sealer to screw (26). Install lockplate assembly (27) and screw (26). Torque screw (26) to 50 inch-pounds (5.5 N·m).

(5) Lubricate piston (25) and piston spring (22) with clean engine oil.



8. SUPPLY BRAKE
22. PISTON SPRING
23. RETAINER
24. SNAPRING
25. PISTON
26. SCREW
27. LOCKPLATE ASSEMBLY
28. FORK ASSEMBLY
29. MASTER PISTON

TA 298607



1. NYLON TIE
2. LOCKNUT
3. CLAMP
4. CAPSCREW
5. DELETED
6. DELETED
7. DELETED
8. PLUG
9. NUT
10. LOCKRING
11. CONNECTOR
12. LOCKNUT
13. WASHER
14. CAPSCREW
15. CLAMP
16. REFLECTOR (2)
17. NUT (4)
18. LOCKWASHER (4)
19. CAPSCREW
20. COVER
21. CONNECTOR
22. PLUG
23. PLUG
24. PLUG
25. PLUG
26. COMPOSITE LIGHT (2)
27. PLUG
28. CLEARANCE LIGHT (5)
29. CONNECTOR
30. NUT
31. WASHER
32. WASHER
33. WASHER
34. CLAMP
35. NUT
36. WASHER
37. CAPSCREW
38. TERMINAL
39. TERMINAL
39.1. LOCKNUT*
39.2. CLAMP*
39.3. SPACER*
39.4. TERMINAL (1435)*
39.5. CAPSCREW*
40. CAPSCREW
41. LOCKWASHER
41.1. WASHER
42. TERMINAL
43. WIRING HARNESS

* LVSA1 SERIES VEHICLES ONLY

(6) Install piston (25) closed end first.

(7) Install piston spring (22).

(8) Aline retainer (23) with slot in supply brake (8).

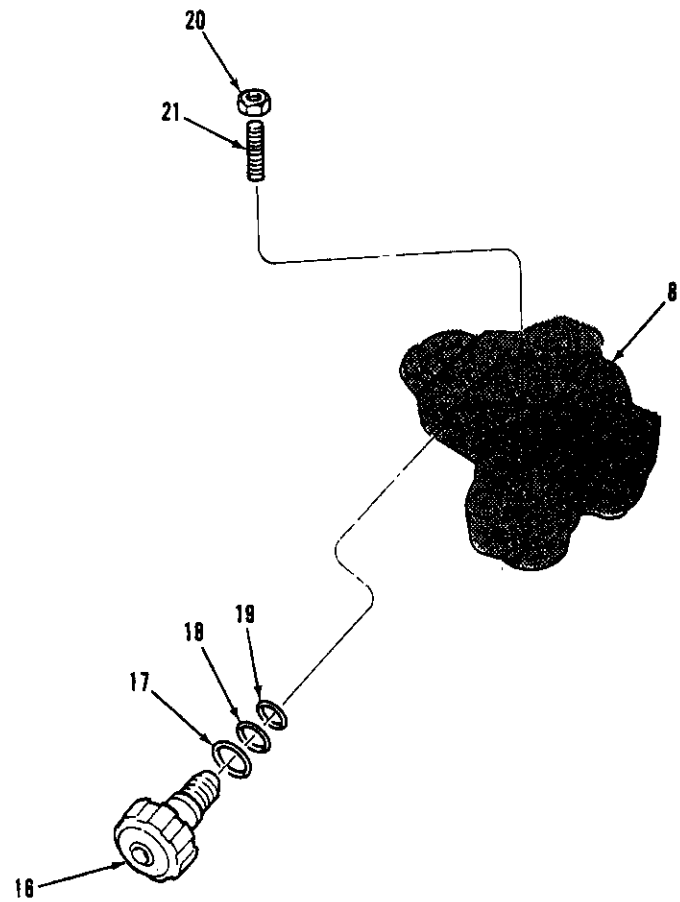
(9) Press down on piston spring (22) and retainer (23). Install snapring (24).

(10) Lubricate new sealring (19) with clean engine oil. Install sealring (19) into supply brake (8).

(11) Lubricate two new sealrings (17 and 18) with clean engine oil. Install sealrings (17 and 18) on solenoid valve (16).

(12) Install solenoid valve (16). Using a spanner wrench, tighten solenoid valve (16) securely.

(13) Install setscrew (21) and nut (20).



8. SUPPLY BRAKE
16. SOLENOID VALVE
17. SEALRING
18. SEALRING
19. SEALRING
20. NUT
21. SETSCREW

TA 298508

6-11. CHASSIS WIRING HARNESS REPLACEMENT (MK17) (Continued)

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

NOTE

- Match wire numbers on new harness to wire numbers remaining on vehicle.
- Install nylon ties (1) where removed.
- Install capscrew (4), clamp (3), and new locknut (2) where removed.

(1) Place wiring harness (43) in position.

(2) Install terminal (42) with washer (41.1), new lockwasher (41), and capscrew (40).

(2.1) Apply corrosion preventive compound to ground connection at washer (41.1).

(3) Plug connector (29) together.

(4) Install capscrew (37), terminals (38 and 39), washer (36), nut (35), washer (33), clamp (34), washers (31 and 32), and nut (30). Tighten nut (30) securely.

NOTE

Perform steps (4.1) and (4.2) on LVSA1 series vehicles only.

(4.1) Install capscrew (39.5), terminal (39.4), spacer (39.3), clamp (39.2), and new locknut (39.1).

(4.2) Apply corrosion preventive compound to ground connection at locknut (39.1).

(5) Connect plug (27) at five clearance lights (28).

(6) Connect four plugs (22 thru 25) at both composite lights (26).

(7) Install connector (21), cover (20), capscrews (19), new lockwashers (18), and nuts (17). Tighten nuts (17) securely.

(8) Install clamp (15) with capscrew (14), washer (13), and new locknut (12) on both reflectors (16). Tighten locknut (12) securely.

(9) Install connector (11) with new lockring (10) and nut (9). Tighten nut (9) securely.

(10) Connect plug (8).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install rear composite lights (para 7-34) (LVSA1 series vehicles only).
TM 2320-10/11 TM 9-2320-297-10	Connect Intervehicular connector (para 2-15).
	Check all lights for proper operation (para 2-14).

3-15. ENGINE BRAKE MAINTENANCE (Continued)

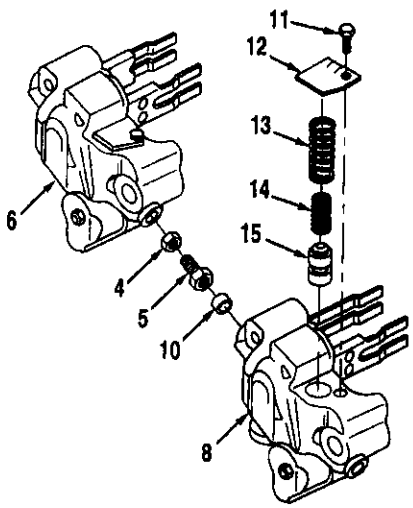
(14) Lubricate control valve (15) with clean engine oil.

(15) Install control valve (15) and two springs (13 and 14).

(16) Apply lubricating and wicking sealer to capscrew (11). Install cover (12) and capscrew (11). Torque capscrew (11) to 110 inch-pounds (12 N·m).

(17) Install new sealring (10) into supply brake (8).

(18) Install oil line jumper tube (5) and locknut (4) into drone (6). Turn oil line jumper tube (5) in four to five turns.



4. LOCKNUT
5. OIL LINE JUMPER TUBE
6. DRONE
8. SUPPLY BRAKE
10. SEALRING
11. CAPSCREW
12. COVER
13. SPRING
14. SPRING
15. CONTROL VALVE

e. Installation

(1) Install drone (6) and supply brake (8) in tagged location with fork assembly (28) over rocker arm clevis (30).

(2) Install two capscrews (7) in supply brake (8) and two capscrews (9) in drone (6).

(3) Torque capscrews (7 and 9) to 45 foot-pounds (61 N·m), then torque capscrews (7 and 9) to 88-92 foot-pounds (119-124 N·m).

(4) Move fork assembly (28) up and down to make sure it rides freely on rocker arm clevis (30).

(5) Turn oil line jumper tube (5) until it makes contact with supply brake (8). Then back off oil line jumper tube (5) 1/3 turn. Hold oil line jumper tube (5) while tightening locknut (4) securely.

NOTE

Perform step (6) or step (6.1) depending on the configuration.

(6) Install wire (3), new lockwasher (2) and screw (1). Tighten screw (1) securely.

(6.1) Install wire (3.1).

(7) Repeat steps (1) thru (6) and install remaining supply brakes (8) and drones (6).

END OF TASK

NOTE

Follow-On Maintenance

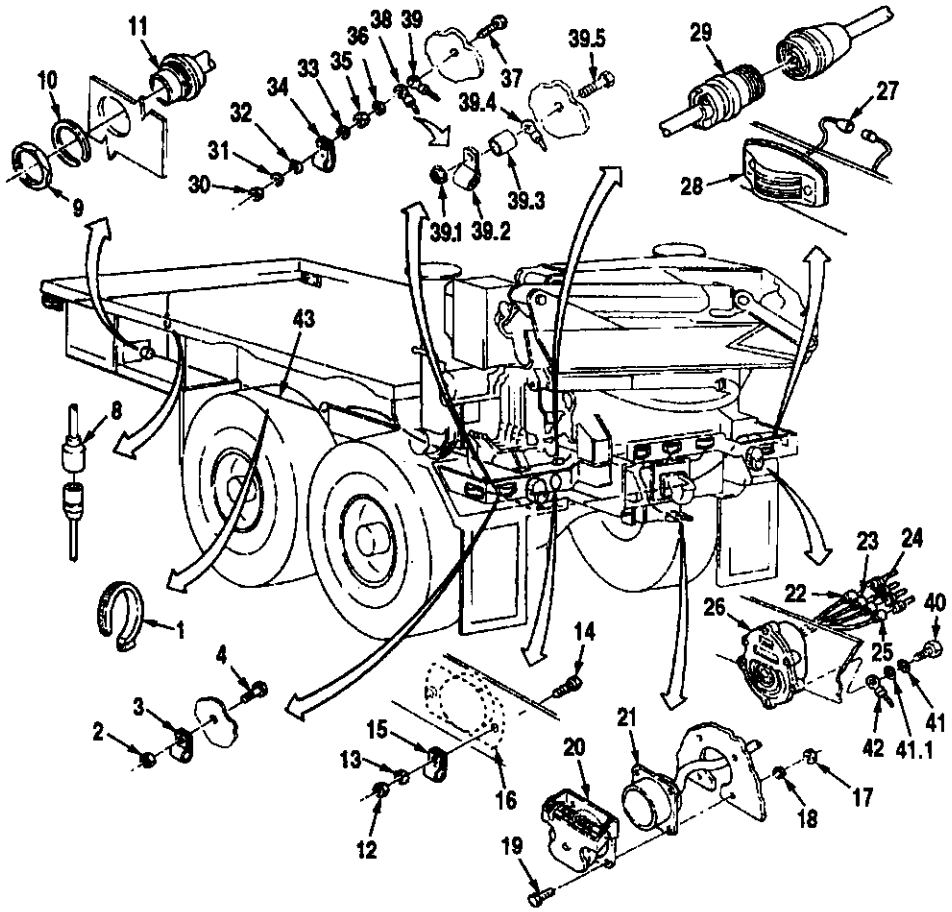
TM 2320-34/13 TM 2320-297-34	Adjust Jacobs brake (para 3-29).
TM 2320-20/12 TM 2320-297-20	Install rocker covers (para 3-4).
	Install shutdown solenoid (para 4-13.1 LVSA1 series vehicles only).
TM 2320-10/11 TM 2320-297-10	Close engine access door (para 2-1).

NOTE

Mounting hardware for LVSA1 composite light has changed from a capscrew and starwasher, to a capscrew, washer, and lockwasher. When repairing non-A1 vehicle, use the new style mounting hardware to replace the old style hardware. Refer to TM 9-2320-297-24P for correct parts identification.

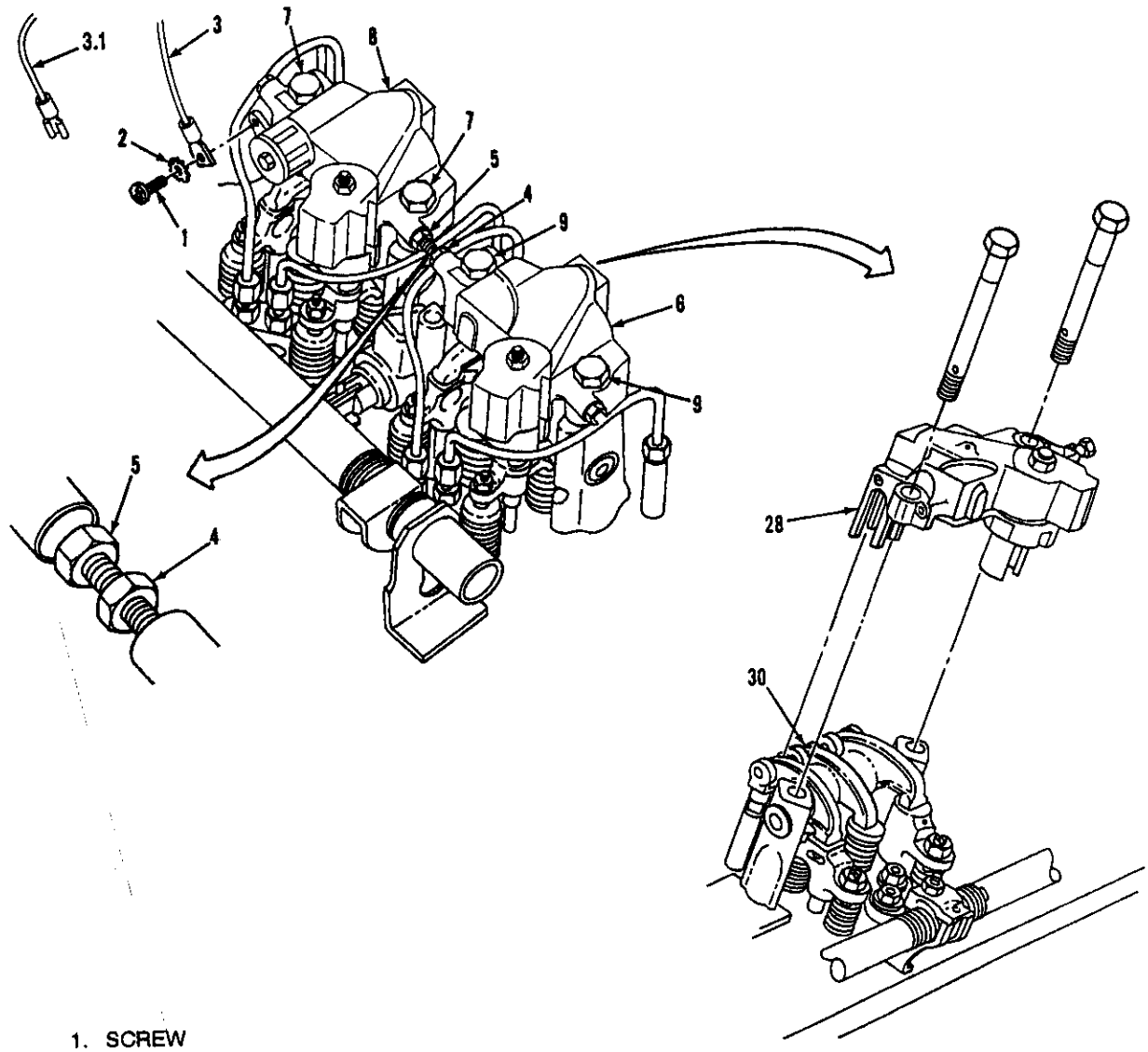
(9) Remove capscrew (40), lockwasher (41), washer (41.1), and terminal (42). Discard lockwasher (41).

(10) Remove wiring harness (43).



1. NYLON TIE
2. LOCKNUT
3. CLAMP
4. CAPSCREW
5. DELETED
6. DELETED
7. DELETED
8. PLUG
9. NUT
10. LOCKRING
11. CONNECTOR
12. LOCKNUT
13. WASHER
14. CAPSCREW
15. CLAMP
16. REFLECTOR (2)
17. NUT (4)
18. LOCKWASHER (4)
19. CAPSCREW
20. COVER
21. CONNECTOR
22. PLUG
23. PLUG
24. PLUG
25. PLUG
26. COMPOSITE LIGHT (2)
27. PLUG
28. CLEARANCE LIGHT (5)
29. CONNECTOR
30. NUT
31. WASHER
32. WASHER
33. WASHER
34. CLAMP
35. NUT
36. WASHER
37. CAPSCREW
38. TERMINAL
39. TERMINAL
39.1. LOCKNUT*
39.2. CLAMP*
39.3. SPACER*
39.4. TERMINAL (1435)*
39.5. CAPSCREW*
40. CAPSCREW
41. LOCKWASHER
41.1. WASHER
42. TERMINAL
43. WIRING HARNESS

* LVSA1 SERIES VEHICLES ONLY



1. SCREW
2. LOCKWASHER
3. WIRE
3.1. WIRE
4. LOCKNUT
5. OIL LINE JUMPER TUBE
6. DRONE
7. CAPSCREW (2)
8. SUPPLY BRAKE
9. CAPSCREW (2)
28. FORK ASSEMBLY
30. ROCKER ARM CLEVIS

6-11. CHASSIS WIRING HARNESS REPLACEMENT (MK17)

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK17

Materials/Parts
Nylon tie (AR) (MS3367-1-9) item 1
Lockring (NSN 5310-01-081-0799) item 10
Lockwasher (MS35333-44) item 18
Lockwasher (2) (351AX) item 41
Locknut (2) (1600460) items 2 and 39.1
Locknut (2) (66419AX) item 12
Compound, corrosion preventive (Item 14.1, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Intervehicular connector disconnected (para 2-15).
TM 2320-20/12 TM 9-2320-297-20	Rear composite lights removed (para 7-34) (LVSA1 series vehicles only).

a. Removal

NOTE

- Remove nylon ties (1) as needed. Note location for proper installation.
- Mounting hardware for LVSA1 clamps has changed from a nut, lockwasher, clamp, and capscrew to a locknut, washer, clamp, and capscrew. When repairing non-A1 vehicles, replace old style hardware with new style hardware. Refer to TM 9-2320-297-24P for correct parts identification.
- For LVSA1 vehicles, remove locknut (2), clamp (3), and capscrew (4) as needed. Note location for proper installation. Discard locknut (2).

(1) Disconnect plug (8).

(2) Remove nut (9), lockring (10), and connector (11). Discard lockring (10).

NOTE

Mounting hardware for LVSA1 reflector clamps has changed from a nut, washer, clamp, and capscrew to a locknut, washer, clamp, and capscrew. When repairing non-A1 vehicles, use new style hardware to replace old style hardware. Refer to TM 9-2320-297-24P for correct parts identification.

(3) Remove locknut (12), washer (13), capscrew (14), and clamp (15) from rear reflectors (16). Discard locknut (12).

(4) Remove four nuts (17), lockwashers (18), capscrews (19), cover (20), and connector (21). Discard lockwashers (18).

(5) Disconnect four plugs (22 thru 25) from both composite lights (26).

(6) Disconnect plug (27) at five clearance lights (28).

(7) Unplug connector (29).

(8) Remove nut (30), washers (31, 32, and 33), clamp (34), nut (35), capscrew (37), and terminals (38 and 39).

NOTE

Perform step (8.1) on LVSA1 series vehicles only.

(8.1) Remove locknut (39.1), clamp (39.2), spacer (39.3), terminal (39.4), and capscrew (39.5). Discard locknut (39.1).

3-16. ENGINE BRAKE MICROSWITCH MAINTENANCE

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation
d. Adjustment

INITIAL SETUP

Applicable Configurations
MK48

Materials/Parts
Lockwasher (MS35335-41) items 8 and 11

Equipment Condition
TM
TM 2320-20/12
TM 9-2320-297-20

Condition Description
Access cover removed (para 18-14), item 9.

Shutdown solenoid removed (para 4-13.1 LVSA1 series vehicles only).

a. Removal

NOTE

When removing microswitch (4) perform step (1).

(1) Tag and disconnect three wires (1, 2, and 3) from microswitch (4).

NOTE

When removing buffer switch (4.1 or 4.2) perform step (1.1).

(1.1) Tag and disconnect wires (1, 2, and 3) from buffer switch (4.1 or 4.2).

(2) Loosen nut (5). Remove bracket (6) and microswitch (4).

CAUTION

When removing buffer switch (4.1) do not use wrench on plastic case, damage to equipment could result.

NOTE

When removing buffer switch (4.1 or 4.2), perform step (2.1).

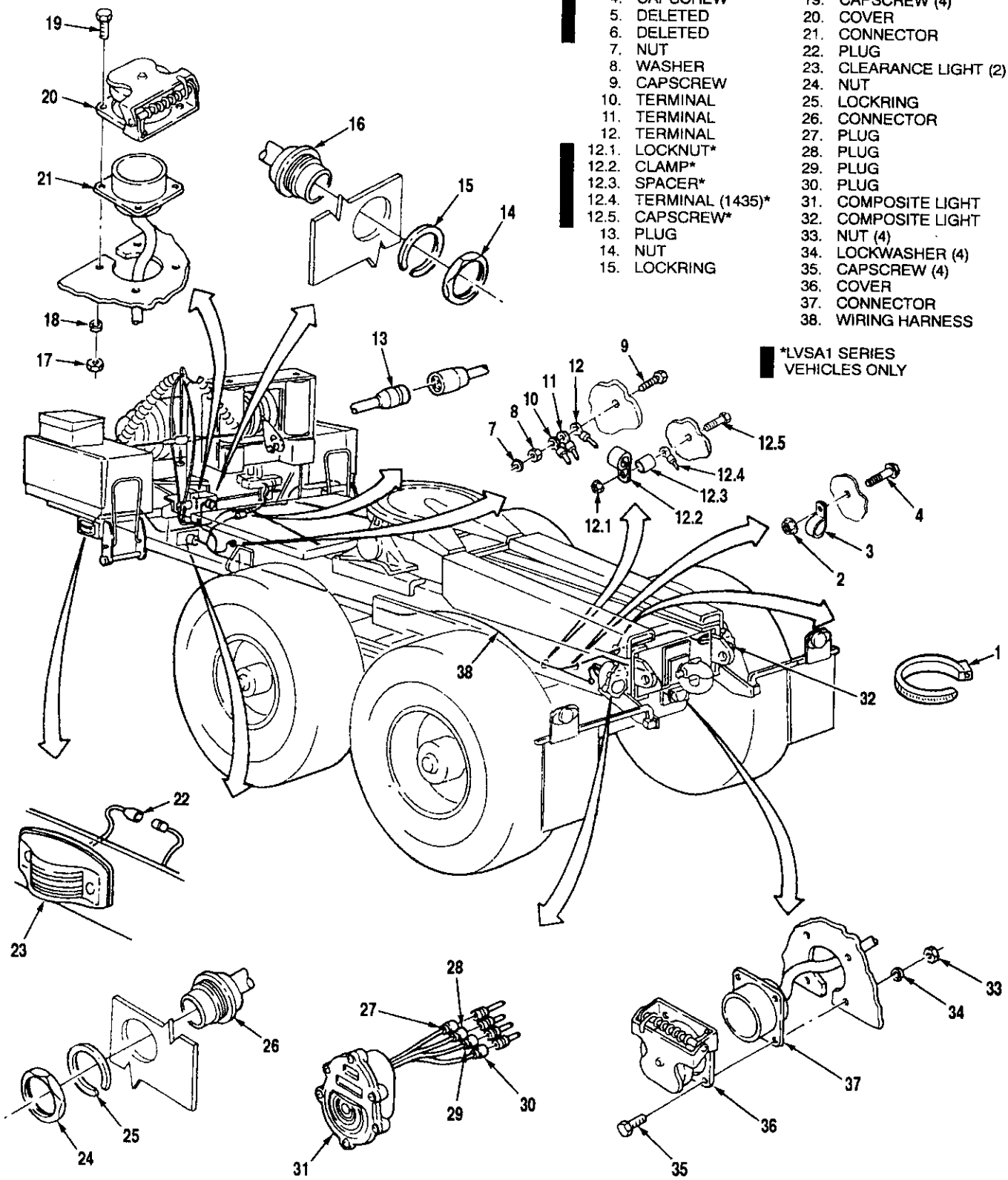
(2.1) Loosen nut (5.1) and remove buffer switch (4.1 or 4.2).

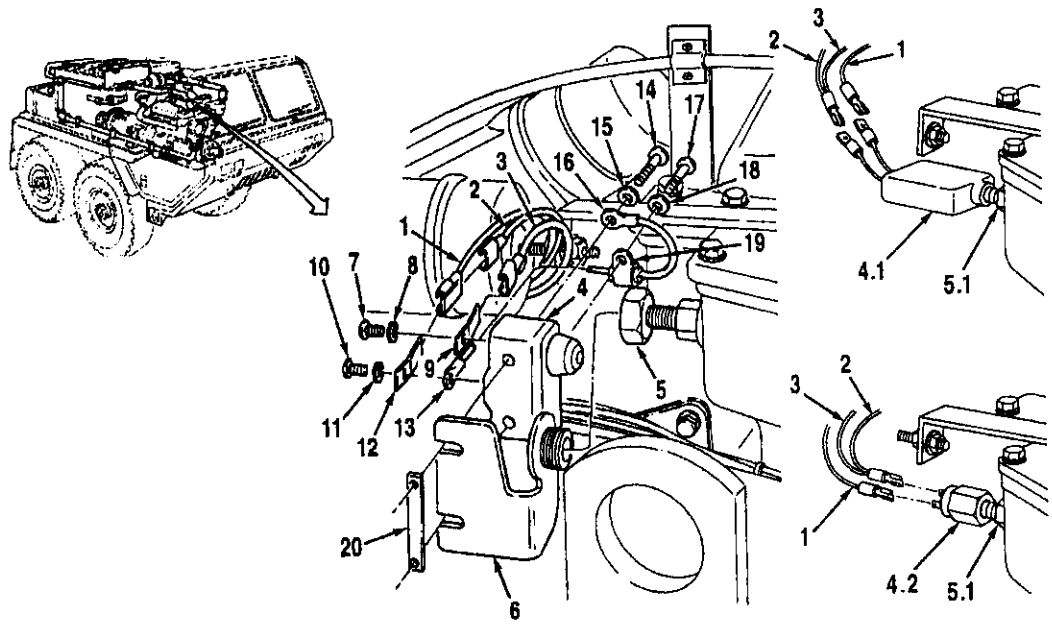
(3) Remove screw (7), lockwasher (8), and terminal (9). Discard lockwasher (8).

(4) Remove screw (10), lockwasher (11), terminal (12), and diode lead (13). Discard lockwasher (11).

(5) Remove screw (14), washer (15), and diode lead (16).

(6) Remove screw (17), washer (18), diode (19), clamp (20), and microswitch (4) from bracket (6).


1. NYLON TIE
2. LOCKNUT
3. CLAMP
4. CAPSCREW
5. DELETED
6. DELETED
7. NUT
8. WASHER
9. CAPSCREW
10. TERMINAL
11. TERMINAL
12. TERMINAL
12.1. LOCKNUT*
12.2. CLAMP*
12.3. SPACER*
12.4. TERMINAL (1435)*
12.5. CAPSCREW*
13. PLUG
14. NUT
15. LOCKRING
16. CONNECTOR
17. NUT (4)
18. LOCKWASHER (4)
19. CAPSCREW (4)
20. COVER
21. CONNECTOR
22. PLUG
23. CLEARANCE LIGHT (2)
24. NUT
25. LOCKRING
26. CONNECTOR
27. PLUG
28. PLUG
29. PLUG
30. PLUG
31. COMPOSITE LIGHT
32. COMPOSITE LIGHT
33. NUT (4)
34. LOCKWASHER (4)
35. CAPSCREW (4)
36. COVER
37. CONNECTOR
38. WIRING HARNESS
*LVSA1 SERIES VEHICLES ONLY



1. WIRE (NO. 839)
2. WIRE (NO. 714)
3. WIRE (NO. 713)
4. MICROSWITCH
4.1. BUFFER SWITCH
4.2. BUFFER SWITCH
5. NUT
5.1. NUT
6. BRACKET
7. SCREW
8. LOCKWASHER
9. TERMINAL
10. SCREW
11. LOCKWASHER
12. TERMINAL
13. DIODE LEAD
14. SCREW
15. WASHER
16. DIODE LEAD
17. SCREW
18. WASHER
19. DIODE
20. CLAMP

6-10. CHASSIS WIRING HARNESS REPLACEMENT (MK16) (Continued)

c. Installation

NOTE

- Match wire numbers on new harness to wire numbers remaining on vehicle.
- Install nylon ties (1) where removed.
- Install capscrew (4), clamp (3), and new locknut (2) where removed.

(1) Place wiring harness (38) in position.

(2) Install connector (37) with cover (36), four capscrews (35), new lockwashers (34), and nuts (33). Tighten nuts (33) securely.

(3) Connect plugs (27 thru 30) at both composite lights (31 and 32).

(4) Install connector (26) with new lockring (25) and nut (24). Tighten nut (24) securely.

(5) Connect plug (22) to clearance light (23) on both sides of the vehicle.

(6) Install connector (21) with cover (20), capscrews (19), new lockwashers (18), and nuts (17). Tighten nuts (17) securely.

(7) Install connector (16) with new lockring (15) and nut (14). Tighten nut (14) securely.

(8) Connect plug (13).

(9) Connect three terminals (10, 11, and 12) with capscrew (9), washer (8), and nut (7) in the two places shown.

NOTE

Perform steps (9.1) and (9.2) for LVSA1 series vehicles only.

(9.1) Install capscrew (12.5), terminal (12.4), spacer (12.3), clamp (12.2) and new locknut (12.1). Tighten locknut (12.1) securely.

(9.2) Apply corrosion preventive compound to ground connection at locknut (12.1).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install rear composite lights (para 7-34) (LVSA1 series vehicles only).
TM 2320-10/11 TM 9-2320-297-10	Connect Intervehicular connector (para 2-15).
	Check all lights for proper operation (para 2-14).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

NOTE

Installation procedure steps (1) thru (6) are for microswitch (4) only.

(1) Install microswitch (4), clamp (20), washer (18), and diode (19), and screw (17). Hand tighten screw (17).

(2) Install screw (14), washer (15), and diode lead (16). Hand tighten screw (14).

(3) Install screw (10), new lockwasher (11), terminal (12), and diode lead (13). Tighten screw (10) securely.

(4) Install screw (7), new lockwasher (8), and terminal (9). Tighten screw (7) securely.

(5) Install bracket (6). Tighten nut (5) securely.

(6) Install three wires (1, 2, and 3) in tagged locations.

NOTE

Steps (7) thru (8) are for buffer switch (4.1 and 4.2).

(7) Install buffer switch (4.1 or 4.2). Tighten nut (5.1) one turn.

(8) Install three wires (1, 2, and 3) on buffer switch (4.1 or 4.2) in tagged locations.

d. Adjustment

NOTE

Perform steps (1) thru (5) for microswitch (4) only.

(1) Place a .100 inch (.254 cm) feeler gage (21) between punger (22) and microswitch plunger (23).

(2) Slide microswitch (4) against feeler gage (21) until microswitch (4) clicks.

(3) Tighten two screws (14 and 17) securely.

(4) Check plunger (22) travel. Plunger (22) should move .090-.110 inch (.228-279 cm) before clicking microswitch (4).

(5) Remove feeler gage (21).

NOTE

Perform step (6) for buffer switch (4.1 or 4.2).

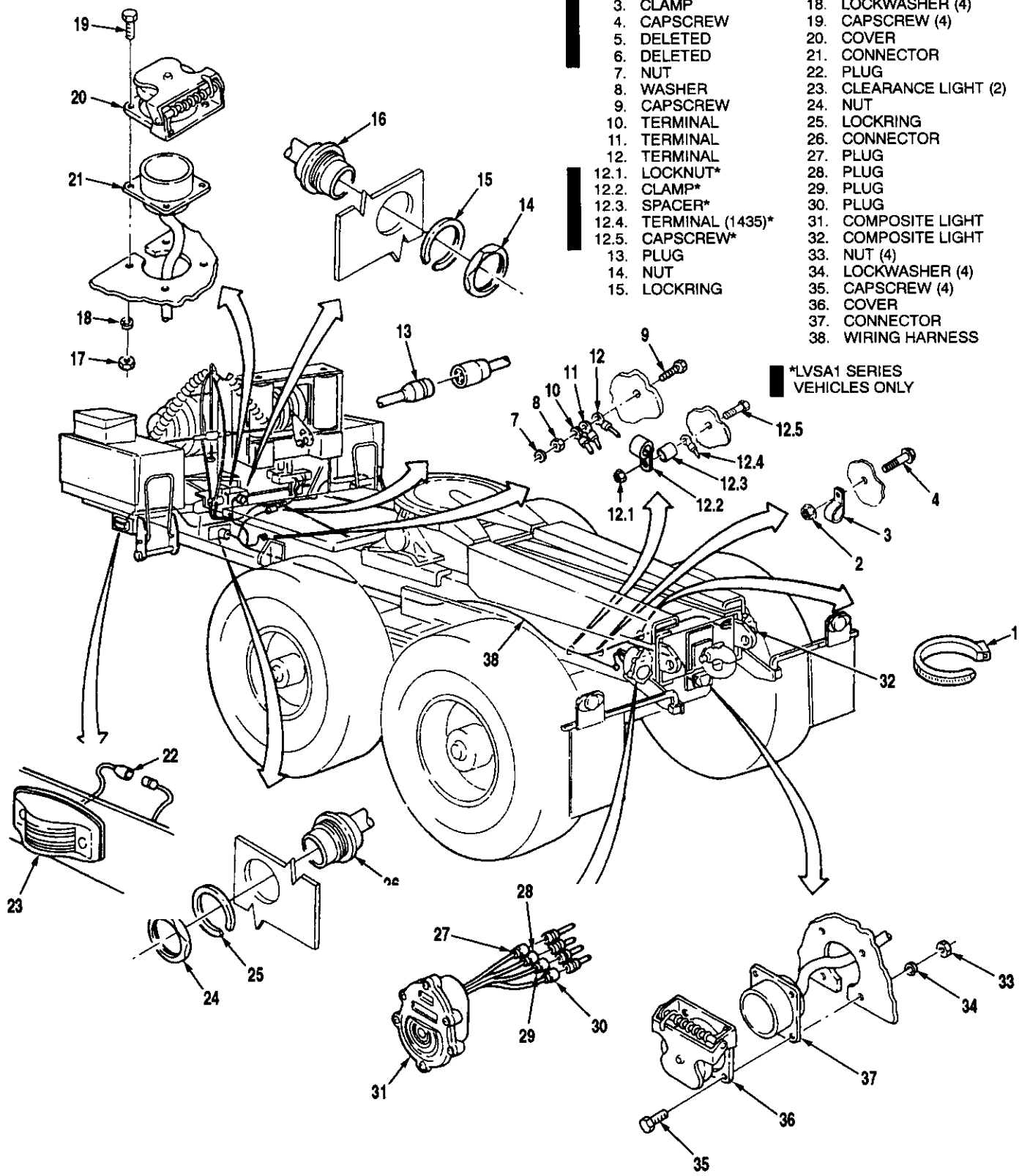
(6) For adjustment of buffer switch (4.1 or 4.2), refer to engine tune-up para 3-29 TM 9-2320-297-34.

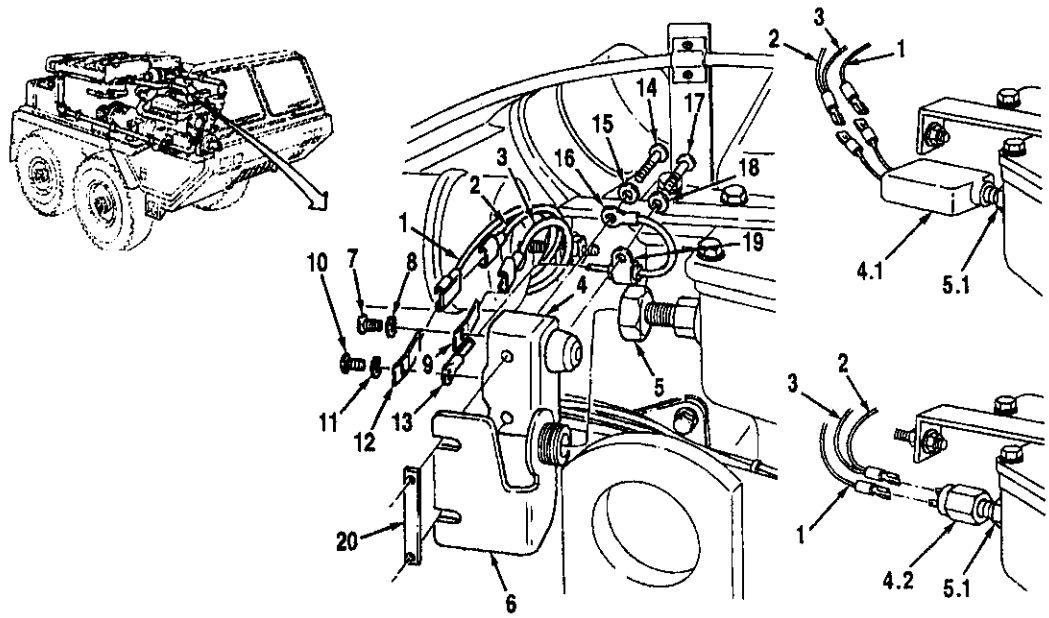
END OF TASK

NOTE

Follow-On Maintenance

TM 2320-12/12 TM 9-2320-297-20	Install access cover (para 18-14) item 9.
	Install shutdown solenoid (para 4-13.1 LVSA1 series vehicles only.)


1. NYLON TIE
2. LOCKNUT
3. CLAMP
4. CAPSCREW
5. DELETED
6. DELETED
7. NUT
8. WASHER
9. CAPSCREW
10. TERMINAL
11. TERMINAL
12. TERMINAL
12.1. LOCKNUT*
12.2. CLAMP*
12.3. SPACER*
12.4. TERMINAL (1435)*
12.5. CAPSCREW*
13. PLUG
14. NUT
15. LOCKRING
16. CONNECTOR
17. NUT (4)
18. LOCKWASHER (4)
19. CAPSCREW (4)
20. COVER
21. CONNECTOR
22. PLUG
23. CLEARANCE LIGHT (2)
24. NUT
25. LOCKRING
26. CONNECTOR
27. PLUG
28. PLUG
29. PLUG
30. PLUG
31. COMPOSITE LIGHT
32. COMPOSITE LIGHT
33. NUT (4)
34. LOCKWASHER (4)
35. CAPSCREW (4)
36. COVER
37. CONNECTOR
38. WIRING HARNESS
*LVSA1 SERIES VEHICLES ONLY



1. WIRE (NO. 839)
2. WIRE (NO. 714)
3. WIRE (NO. 713)
4. MICROSWITCH
4.1. BUFFER SWITCH
4.2. BUFFER SWITCH
5. NUT
5.1. NUT
6. BRACKET
7. SCREW
8. LOCKWASHER
9. TERMINAL
10. SCREW
11. LOCKWASHER
12. TERMINAL
13. DIODE LEAD
14. SCREW
15. WASHER
16. DIODE LEAD
17. SCREW
18. WASHER
19. DIODE
20. CLAMP

6-10. CHASSIS WIRING HARNESS REPLACEMENT (MK16)

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK16

Materials/Parts
Nylon tie (AR) (MS3367-1-9) item 1
Lockring (NSN 5310-01-081-0799) items 15 and 25
Lockwasher (4) (MS35338-44) items 18 and 34
Locknut (2) (1600460) items 2 and 12.1
Compound, corrosion preventive (Item 14.1, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Intervehicular connector disconnected (para 2-15).
TM 2320-20/12 TM 9-2320-297-20	Rear composite lights removed (para 7-34) (LVSA1 series vehicles only).

a. Removal

NOTE

- Remove nylon ties (1) as needed. Note location for proper installation.
- Attaching hardware for LVSA1 clamps has changed from a nut, washer, clamp, and capscrew to a locknut, clamp, and capscrew. When repairing non-A1 vehicles, use new style hardware to replace old style hardware. Refer to TM 9-2320-297-24P for correct parts identification.
- For LVSA1 vehicles, remove locknut (2), clamp (3), and capscrew (4) as needed. Note location for proper installation. Discard locknut (2).

(1) Remove nut (7), washer (8), capscrew (9), and three terminals (10, 11, and 12) from the two places shown.

NOTE

Perform step (1.1) for LVSA1 series vehicles only.

(1.1) Remove locknut (12.1), clamp (12.2), spacer (12.3), terminal (12.4), and capscrew (12.5). Discard locknut (12.1).

(2) Disconnect plug (13).

(3) Remove nut (14), lockring (15), and connector (16). Discard lockring (15).

(4) Remove four nuts (17), lockwashers (18), capscrews (19), cover (20), and connector (21). Discard lockwashers (18).

(5) Disconnect plug (22) from clearance light (23) on both sides of the vehicle.

(6) Remove nut (24), lockring (25), and connector (26). Discard lockring (25).

(7) Disconnect plugs (27 thru 30) at both composite lights (31 and 32).

(8) Remove four nuts (33), lockwashers (34), capscrews (35), cover (36), and connector (37). Discard lockwashers (34).

(9) Remove wiring harness (38).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

SECTION III. POWER PACK REPLACEMENT INSTRUCTIONS

3-17. POWER PACK REPLACEMENT

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Separation of Engine and Transmission
d. Installation of Transmission Onto Engine
e. Installation

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Lifting tool, 61373

Materials/Parts
Lockwasher (18) (MS35338-46) items 2 and 7
Lockwasher (16) (MS35338-45) items 20, 32 and 138
Lockwasher (2) (MS35338-42) item 37
Lockwasher (2) (MS35338-76) item 41
Lockwasher (20) (MS35338-50) items 66, 96, 112, and 151
Lockwasher (2) (MS35338-48) item 68
Cotter pin (2) (MS24665-287) item 88
Cotter pin (6) (MS9245-49) item 102
Lockwasher (25) (MS35338-47) items 143 and 154
Capscrew (4) (MS90725-164) item 150
Nut (4) (MS51967-20) item 152

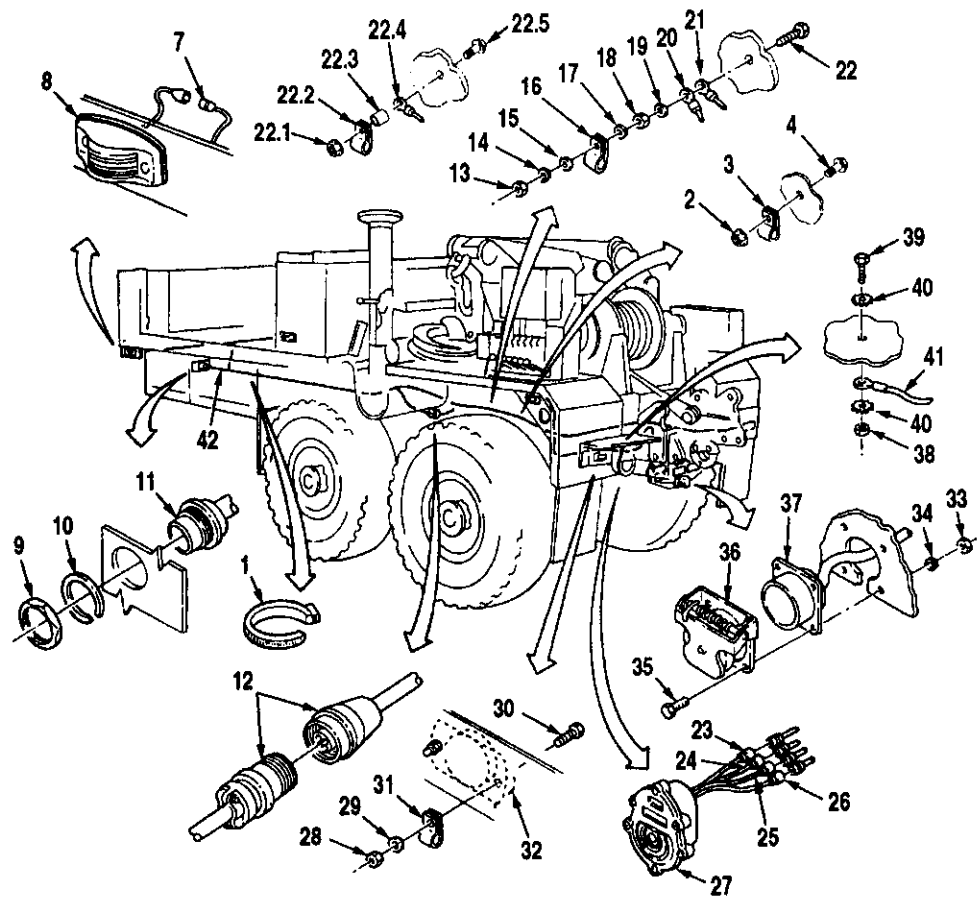
Personnel Required
1 MOS 3522
2 Assistants

References
TM 2320-20/12
TM 9-2320-297-20

Equipment Condition

TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Radiator and air reservoir assembly removed (para 16-5).
	Vehicle cab removed (para 16-3) (Note: To perform this task, removal of vehicle cab is optional and will be left to the discretion of the Motor Transport Chief (MTC).
TM 2320-20/12 TM 9-2320-297-20	Battery cables disconnected (para 7-43 or 7-43.1 on LVSA1 series vehicles only).
	Engine access panels removed (para 18-14).
	Engine oil drained (para 3-3).
	Engine oil sampling valve removed (para 3-7.1 step 3, LVSA1 series vehicles only).
	Intake ducting removed (para 14-9).
	Air cleaner assembly removed (para 4-6).
	Transmission shift cable removed (para 8-6).
	Throttle cylinder removed (para 4-15).
	Lower radiator hose and tube removed (para 6-7).
	Shutdown solenoid removed (para 4-13 or 4-13.1 on LVSA1 series vehicles only).

General Safety Instructions
Power pack components are heavy. Stay out from under components when being removed. If lifting device fails, serious injury or death could result.



1. NYLON TIE
2. LOCKNUT
3. CLAMP
4. CAPSCREW
5. DELETED
6. DELETED
7. PLUG
8. CLEARANCE LIGHT (9)
9. NUT
10. LOCKRING
11. CONNECTOR
12. PLUG
13. NUT
14. LOCKWASHER
15. WASHER
16. CLAMP
17. WASHER
18. NUT
19. WASHER
20. TERMINAL
21. TERMINAL
22. CAPSCREW
22.1. LOCKNUT*
22.2. CLAMP*
22.3. SPACER*
22.4. TERMINAL (1435)*
22.5. CAPSCREW*
23. PLUG
24. PLUG
25. PLUG
26. PLUG
27. COMPOSITE LIGHT (2)
28. LOCKNUT
29. WASHER
30. CAPSCREW
31. CLAMP
32. REFLECTOR (2)
33. NUT (4)
34. LOCKWASHER (4)
35. CAPSCREW (4)
36. COVER
37. CONNECTOR
38. NUT
39. CAPSCREW
40. STAR WASHER (2)
41. TERMINAL
42. WIRING HARNESS

*LVSA1 SERIES VEHICLES ONLY

a. Removal

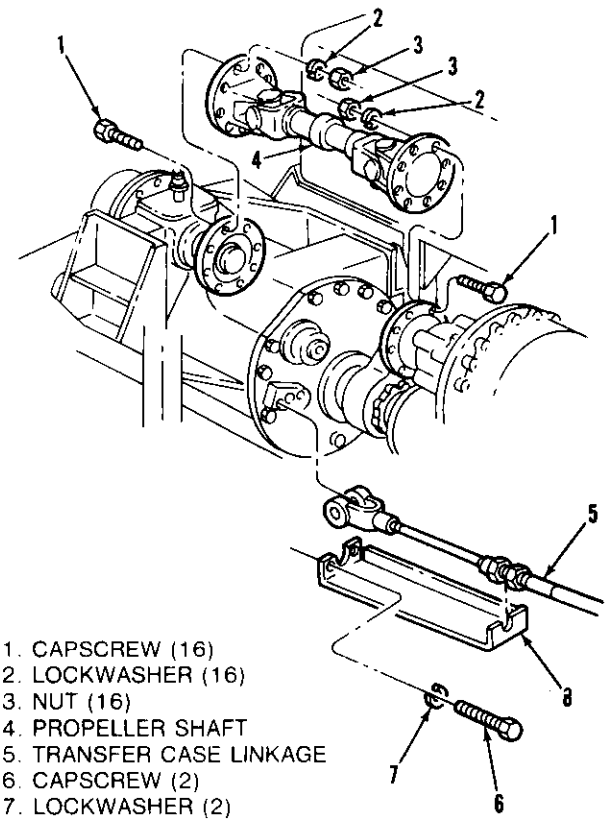
WARNING

Propeller shaft is heavy. Have assistant support propeller shaft during removal.

NOTE

- Remove nylon ties as needed to move hydraulic lines or electrical wiring. Note location and replace during installation.
- When disconnecting hydraulic lines, electrical wires, and/or air lines, plug ends and tag all lines and their connection points to aid in installation.

(1) Remove eight capscrews (1), lockwashers (2), and nuts (3) from each end of propeller shaft (4). Remove propeller shaft (4). Discard lockwashers (2).

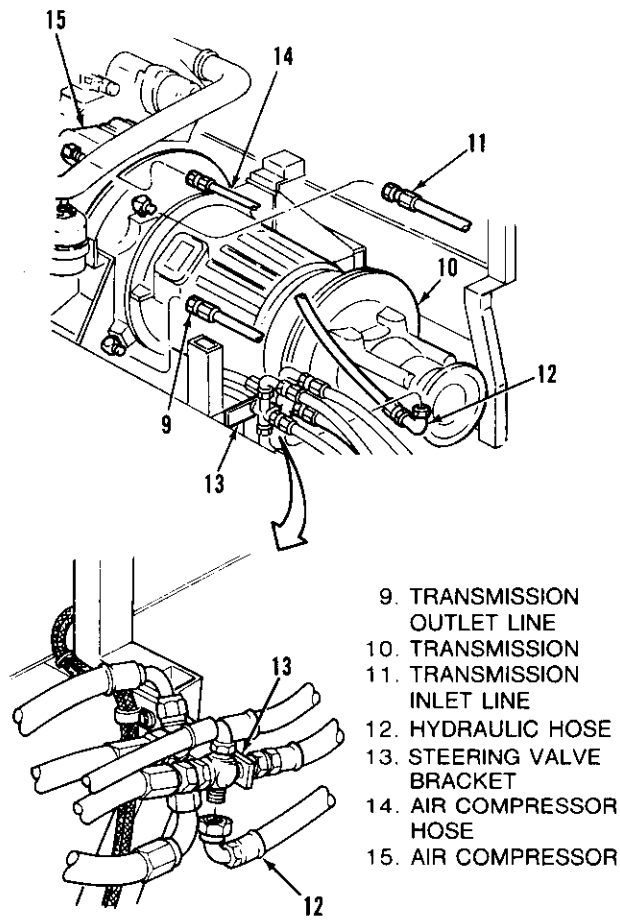


1. CAPSCREW (16)
2. LOCKWASHER (16)
3. NUT (16)
4. PROPELLER SHAFT
5. TRANSFER CASE LINKAGE
6. CAPSCREW (2)
7. LOCKWASHER (2)
8. BRACKET

(2) Remove transfer case linkage (5). Refer to paragraph 9-4 (TM 2320-20/12, TM 9-2320-297-20).

(3) Remove two capscrews (6), lockwashers (7), and bracket (8). Discard lockwashers (7).

(4) Tag and remove transmission outlet line (9) from transmission (10). Secure transmission outlet line (9) out of the way.



9. TRANSMISSION OUTLET LINE
10. TRANSMISSION
11. TRANSMISSION INLET LINE
12. HYDRAULIC HOSE
13. STEERING VALVE BRACKET
14. AIR COMPRESSOR HOSE
15. AIR COMPRESSOR

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(5) Tag and remove transmission inlet line (11) at the transmission (10). Secure transmission inlet line (11) out of the way.

(6) Tag and remove hydraulic hose (12) from steering valve bracket (13). Plug and secure hydraulic hose (12) out of the way.

(7) Tag and remove air compressor hose (14) from air compressor (15).

6-9. CHASSIS WIRING HARNESS REPLACEMENT (MK15) (Continued)

(8) Remove nut (38), capscrew (39), two star washers (40), and terminal (41). Discard star washers (40).

(9) Remove wiring harness (42).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

NOTE

- Match wire numbers on new harness to wire numbers remaining on vehicle.
- Install nylon ties (1) where removed.
- Install capscrew (4), clamp (3), and new locknut (2) where removed.

(1) Place wiring harness (42) in position.

(2) Install terminal (41) with two new star washers (40), capscrew (39), and nut (38). Tighten nut (38) securely.

(3) Install connector (37) with cover (36), four capscrews (35), new lockwashers (34), and nuts (33). Tighten nuts (33) securely.

(4) Install clamp (31) with capscrew (30), washer (29), and new locknut (28) at both rear reflectors (32). Tighten locknut (28) securely.

(5) Connect plugs (23 thru 26) at both composite lights (27).

(6) Install terminals (20 and 21) with capscrew (22), washer (19), and nut (18). Tighten nut (18) securely.

(7) Install washer (17), clamp (16), washer (15), new lockwasher (14), and nut (13). Tighten nut (13).

NOTE

Perform steps (7.1) and (7.2) for LVSA1 series vehicles only.

(7.1) Install capscrew (22.5), terminal (22.4), spacer (22.3), clamp (22.2), and new locknut (22.1). Tighten locknut (22.1) securely.

(7.2) Apply corrosion preventive compound to ground connection at locknut (22.1).

(8) Connect plug (12).

(9) Install connector (11) with new lockring (10) and nut (9). Tighten nut (9) securely.

(10) Connect plug (7) at nine clearance lights (8).

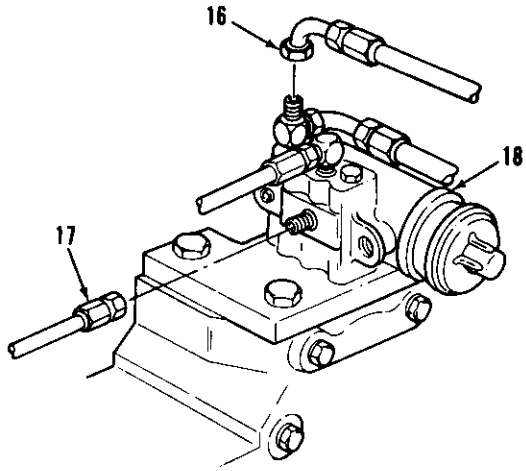
END OF TASK

NOTE

Follow-On Maintenance

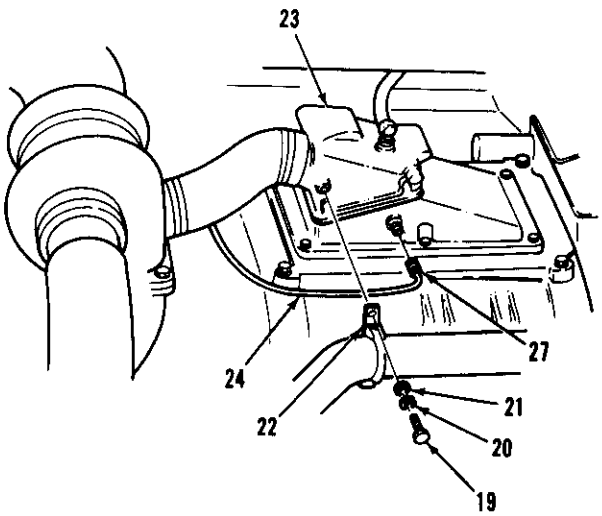
TM 2320-34/13	Winch remote control electrical connectors installed (para 17-17.1, steps 26, 27, and 28) (LVSA1series vehicles only).
TM 2320-20/12 TM 9-2320-297-20	Install rear composite lights (para 7-34) (LVSA1 series vehicles only).
TM 2320-10/11 TM 9-2320-297-10	Connect Intervehicular connector (para 2-15).
	Check all lights for proper operation (para 2-14).

3-17. POWER PACK REPLACEMENT (Continued)



16. AIR LINE
17. AIR LINE
18. AIR COMPRESSOR GOVERNOR

(8) Tag and remove two air lines (16 and 17) from air compressor governor (18).

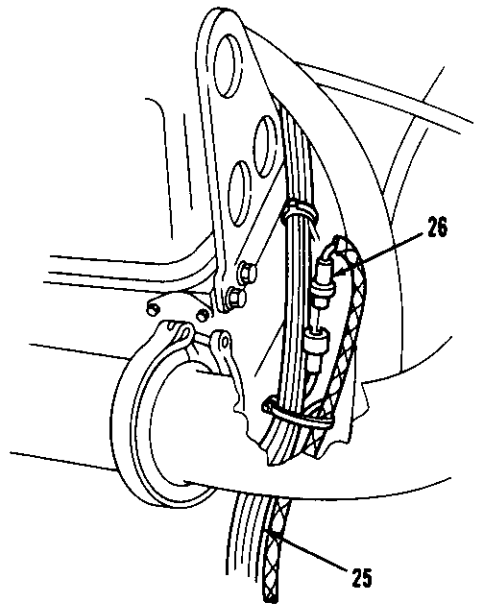


(9) Remove capscrew (19), lockwasher (20), washer (21), and bracket (22) from air inlet housing (23). Discard lockwasher (20).

NOTE

Remove nylon ties as needed to free electrical wires and tube (24) from wiring harness (25).

(10) Tag and unplug quick disconnect (26) from wiring harness (25). Remove tube (24) and fitting (27) from air inlet housing (23).



19. CAPSCREW
20. LOCKWASHER
21. WASHER
22. BRACKET
23. AIR INLET HOUSING
24. TUBE
25. WIRING HARNESS
26. QUICK DISCONNECT
27. FITTING

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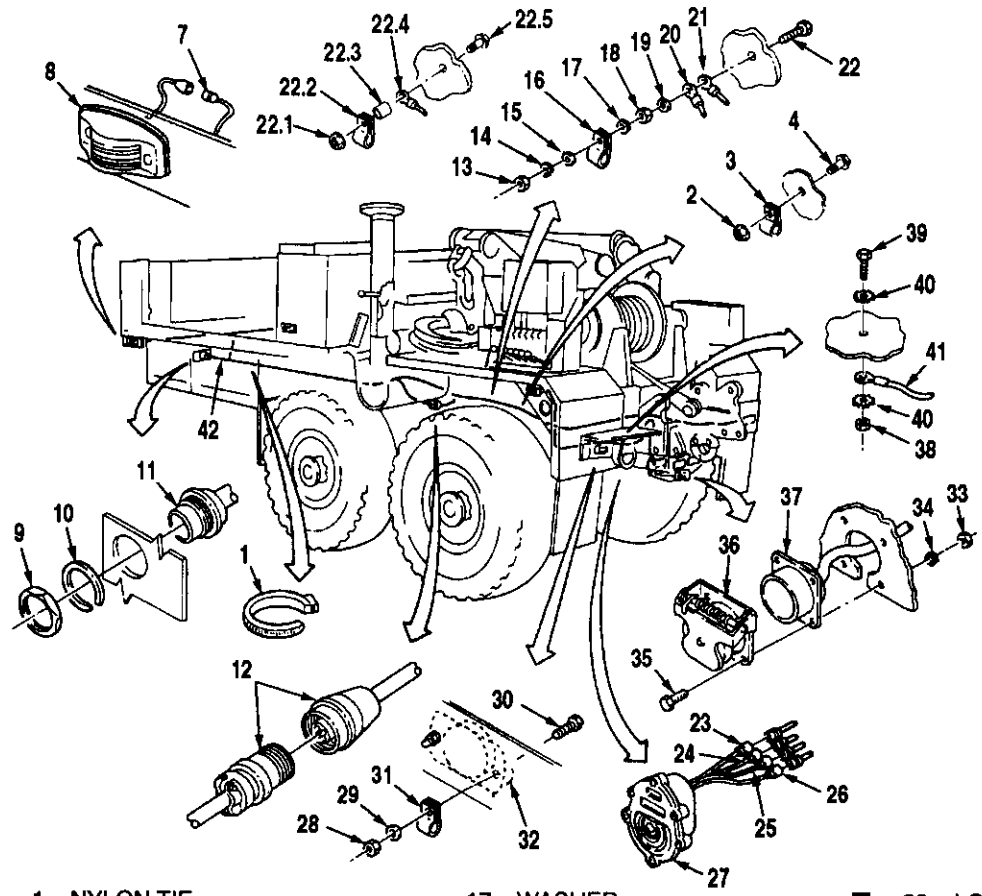
NOTE

Mounting hardware for LVSA1 rear reflectors has changed from a nut, washer, clamp, and capscrew to a locknut, washer, clamp, and capscrew. When repairing non-A1 vehicles, use new style hardware to replace old style hardware. Refer to TM 9-2320-297-24P for correct parts identification.

(6) Remove locknut (28), lockwasher (29), capscrew (30), and clamp (31) from both rear reflectors (32). Discard locknut (28) and lockwasher (29).

(7) Remove four nuts (33), lockwashers (34), capscrews (35), covers (36), and connector (37). Discard lockwashers (34).



1. NYLON TIE
2. LOCKNUT
3. CLAMP
4. CAPSCREW
5. DELETED
6. DELETED
7. PLUG
8. CLEARANCE LIGHT (9)
9. NUT
10. LOCKRING
11. CONNECTOR
12. PLUG
13. NUT
14. LOCKWASHER
15. WASHER
16. CLAMP
17. WASHER
18. NUT
19. WASHER
20. TERMINAL
21. TERMINAL
22. CAPSCREW
22.1. LOCKNUT*
22.2. CLAMP*
22.3. SPACER*
22.4. TERMINAL (1435)*
22.5. CAPSCREW*
23. PLUG
24. PLUG
25. PLUG
26. PLUG
27. COMPOSITE LIGHT (2)
28. LOCKNUT
29. WASHER
30. CAPSCREW
31. CLAMP
32. REFLECTOR (2)
33. NUT (4)
34. LOCKWASHER (4)
35. CAPSCREW (4)
36. COVER
37. CONNECTOR
38. NUT
39. CAPSCREW
40. STAR WASHER (2)
41. TERMINAL
42. WIRING HARNESS

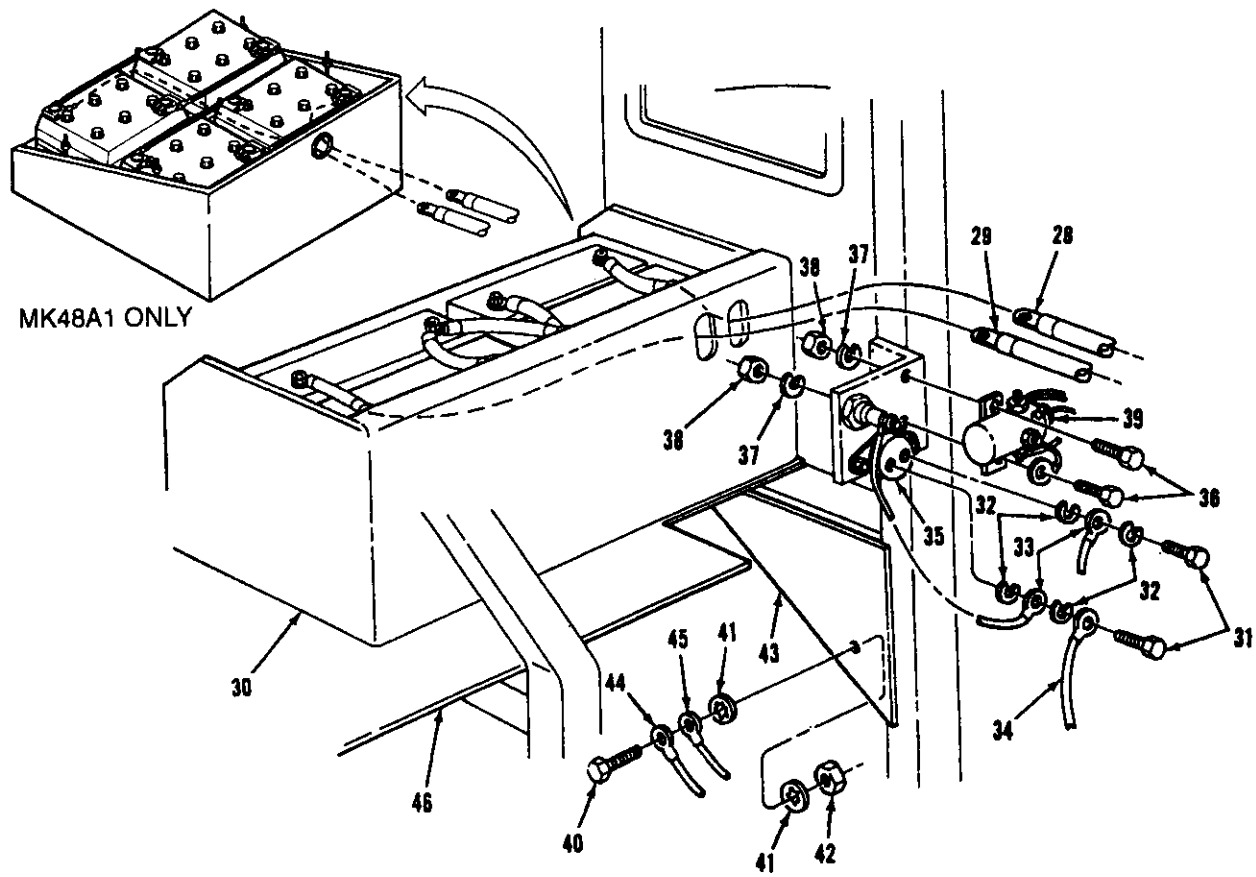
*LVSA1 SERIES VEHICLES ONLY

(11) Remove two battery cables (28 and 29) through slots in battery box (30).

(12) Remove two capscrews (31), four lockwashers (32), two wires (33), and wire (34) from circuit breaker (35). Discard lockwashers (32).

(13) Remove two capscrews (36), lockwashers (37), and nuts (38) from magnetic switch (39). Discard lockwashers (37).

(14) Remove capscrews (40), two star washers (41), nut (42) from bracket (43) and ground wires (44 and 45). Push ground wires (44 and 45) away from frame (46) and bracket (43). Discard star washers (41).



28. BATTERY CABLE
29. BATTERY CABLE
30. BATTERY BOX
31. CAPSCREW (2)
32. LOCKWASHER (4)
33. WIRE (2)
34. WIRE
35. CIRCUIT BREAKER
36. CAPSCREW (2)
37. LOCKWASHER (2)
38. NUT (2)
39. MAGNETIC SWITCH
40. CAPSCREW
41. STAR WASHER (2)
42. NUT
43. BRACKET
44. GROUND WIRE
45. GROUND WIRE
46. FRAME

6-9. CHASSIS WIRING HARNESS REPLACEMENT (MK15)

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK15

Materials/Parts
Nylon tie (AR) (MS3367-1-9) item 1
Lockring (NSN 5310-01-081-0799) item 10
Lockwasher (MS35333-74) item 13
Lockwasher (4) (MS35338-44) item 28
Locknut (2) (1600460) items 2 and 22.1
Locknut (2) (66419AX) item 28 (LVSA1 series vehicles only)
Compound, corrosion preventive (Item 14.1, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Intervehicular connector disconnected (para 2-15).
TM 2320-20/12 TM 9-2320-297-20	Rear composite light removed (para 7-34) (LVSA1 series vehicles only).
TM 2320-34/13 TM 9-2320-297-34	Winch remote control electrical connectors removed (para 17-17.1, steps 8, 9, and 10) (LVSA1 series vehicles only).

a. Removal

NOTE

- Remove nylon ties (1) as needed. Note location for proper installation.
- Attaching hardware for LVSA1 clamps has changed from a nut, lockwasher, clamp, and capscrew to a locknut, washer, clamp, and capscrew. When repairing non-A1 vehicles, replace old style hardware with new style hardware. Refer to TM 9-2320-297-24P for correct parts identification.
- For LVSA1 vehicles, remove locknuts (2), clamp (3), and capscrew (4) as necessary. Note location for proper installation. Discard locknut (2).

(1) Disconnect plug (7) at nine clearance lights (8).

(2) Remove nut (9), lockring (10), and connector (11). Discard lockring (10).

(3) Disconnect plug (12).

(4) Remove nut (13), lockwasher (14), washer (15), clamp (16), washer (17), nut (18), washer (19), terminals (20 and 21), and capscrew (22). Discard lockwashers (14).

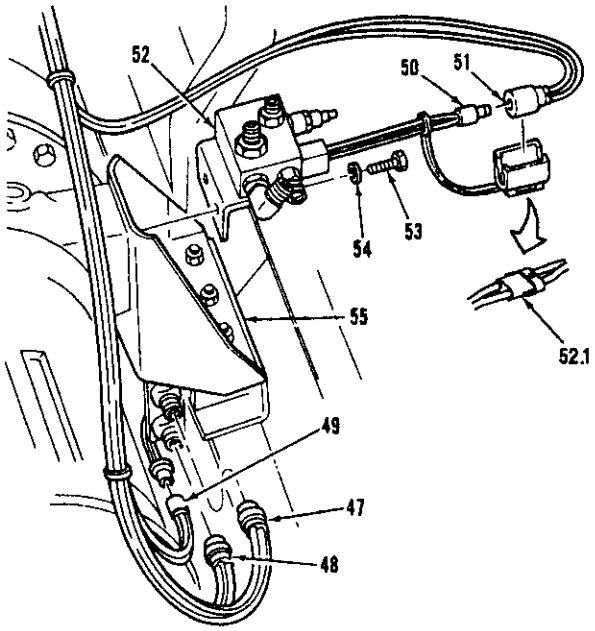
NOTE

Perform step (4.1) for LVSA1 series vehicles only.

(4.1) Remove locknut (22.1), clamp (22.2), spacer (22.3), terminal (22.4), and capscrew (22.5). Discard locknut (22.1).

(5) Disconnect plugs (23 thru 26) from both rear composite lights (27).

3-17. POWER PACK REPLACEMENT (Continued)



47. QUICK DISCONNECT
48. QUICK DISCONNECT
49. PLUG
50. PLUG
51. PLUG
52. FAN CONTROL VALVE
52.1. WEATHER PACK CONNECTOR*
53. CAPSCREW (2)
54. LOCKWASHER (2)
55. RIGHT TRANSMISSION MOUNT

* LVSA1 SERIES VEHICLES ONLY

(15) Tag and unplug two quick disconnects (47 and 48) and plug (49) from bottom right side of vehicle.

NOTE

MK48A1 has a new style fan control valve that is not interchangeable with a non-A1 series vehicle. Refer to TM 9-2320-297-24P for correct parts identification.

(16) Disconnect two plugs (50 and 51) from fan control valve (52).

NOTE

Perform step (16.1) on LVSA1 series vehicles only.

(16.1) Disconnect weather pack connector (52.1).

(17) Tag and remove top two capscrews (53), lockwashers (54), and fan control valve (52) from right transmission mount (55).

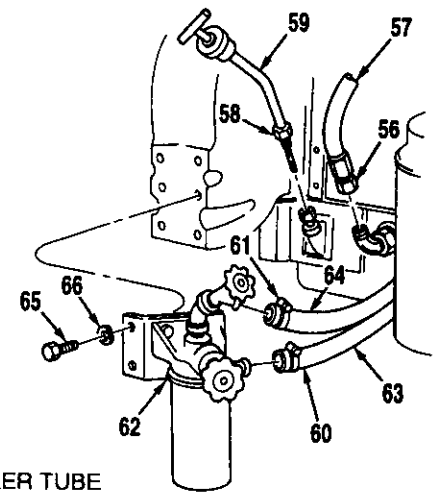
(18) Loosen nut (56) and remove oil filler tube (57).

(19) Loosen nut (58) and remove dipstick tube (59).

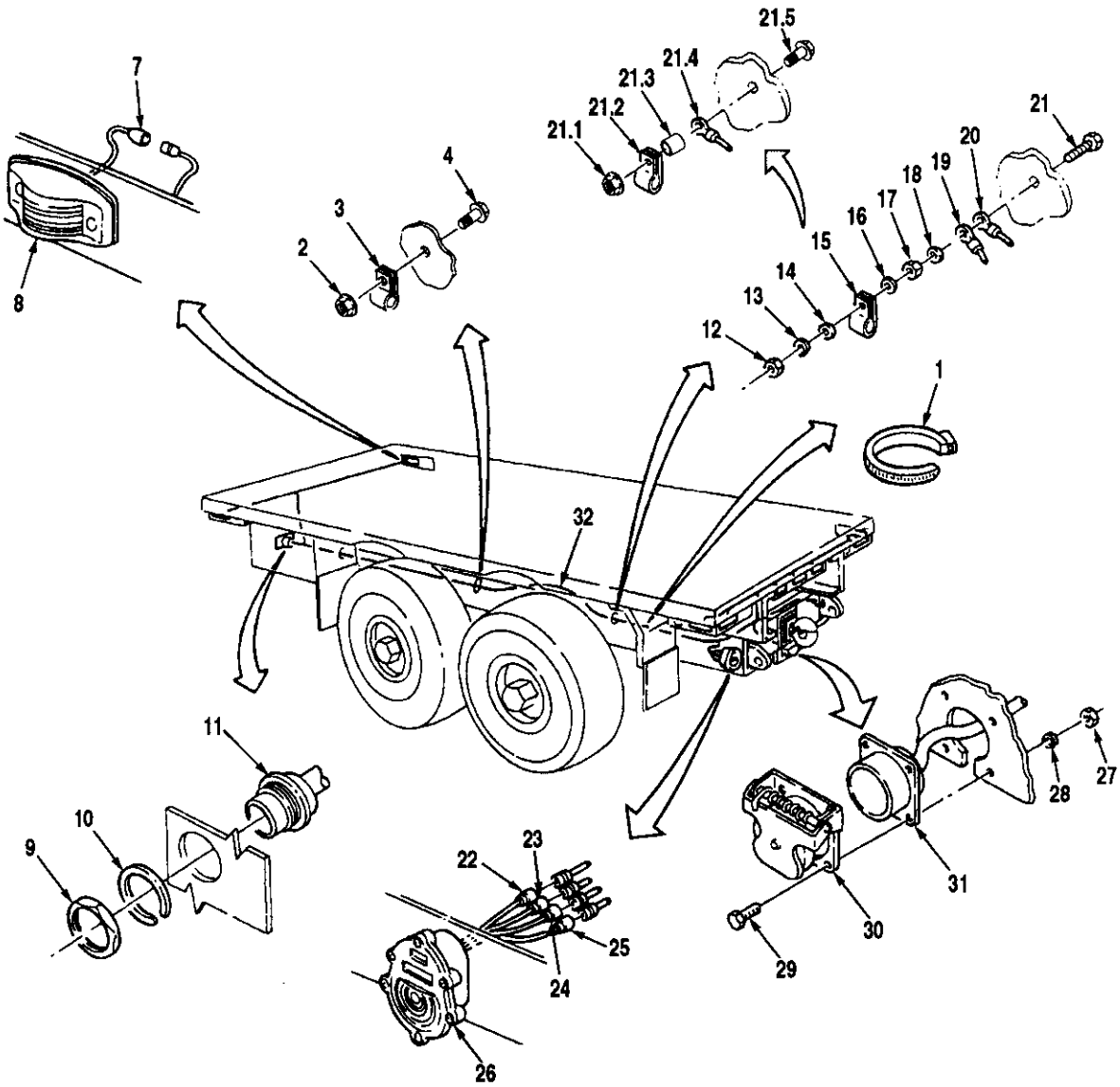
NOTE

Hose clamps (60 and 61) have changed from a worm type clamp to a constant torque "Breeze" type clamp. When repairing a non-A1 vehicle, use the new style constant torque clamp to replace the old style clamps. Refer to TM 9-2320-297-24P for correct parts identification.

(20) Loosen two clamps (60 and 61) from coolant filter adapter assembly (62). Tag and remove two hoses (63 and 64). Remove two capscrews (65), lockwashers (66), and coolant filter adapter assembly (62). Discard lockwashers (66).



56. NUT
57. OIL FILLER TUBE
58. NUT
59. DIPSTICK TUBE
60. CLAMP
61. CLAMP
62. COOLANT FILTER ADAPTER ASSEMBLY
63. HOSE
64. HOSE
65. CAPSCREW (2)
66. LOCKWASHER (2)



1. NYLON TIE
2. LOCKNUT
3. CLAMP
4. CAPSCREW
5. DELETED
6. DELETED
7. PLUG
8. CLEARANCE LIGHT (9)
9. NUT
10. LOCKRING
11. CONNECTOR
12. NUT
13. LOCKWASHER
14. WASHER
15. CLAMP
16. WASHER
17. NUT
18. WASHER
19. TERMINAL
20. TERMINAL
21. CAPSCREW
21.1. LOCKNUT*
21.2. CLAMP*
21.3. SPACER*
21.4. TERMINAL (1435)*
21.5. CAPSCREW*
23. PLUG
24. PLUG
25. PLUG
26. COMPOSITE LIGHT (2)
27. NUT (4)
28. LOCKWASHER (4)
29. CAPSCREW (4)
30. COVER
31. CONNECTOR
32. WIRING HARNESS

*LVSA1 SERIES VEHICLES ONLY

(21) Remove two capscrews (67), lockwashers (68), and lifting bracket (69).

NOTE

Hose clamps (70, 80, and 84) have changed from a worm type clamp to a constant torque "Breeze" type clamp. When repairing a non-A1 vehicle, use the new style constant torque clamp to replace the old style clamps. Refer to TM 9-2320-297-24P for correct parts identification.

(22) Loosen four clamps (70) and remove crossover tube (71).

(23) Tag and remove two fuel lines (72 and 73) from front of right cylinder head (74).

(24) Tag and remove one fuel line (75) from front of left cylinder head (76).

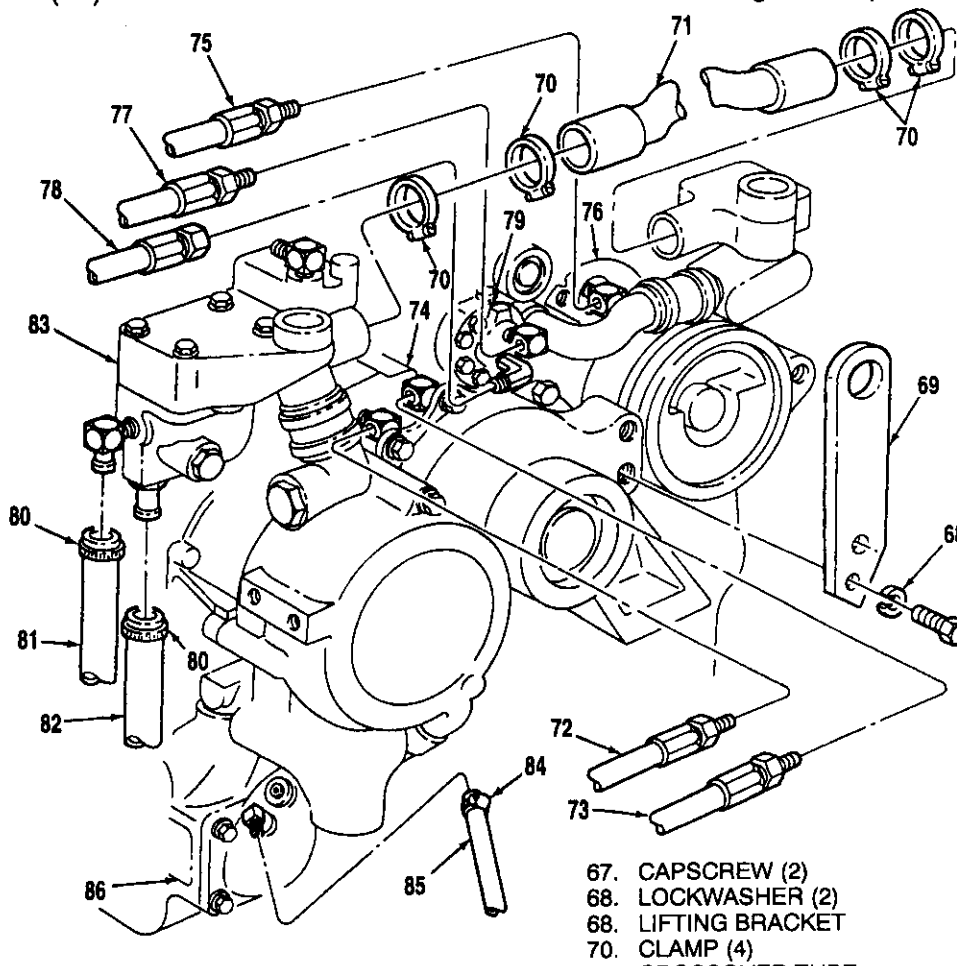
(25) Tag and remove two fuel lines (77 and 78) from fuel pump (79).

(26) Loosen two clamps (8). Tag and remove hoses (81 and 82) from bottom of right thermostat housing (83).

(27) Loosen clamp (84). Tag and remove hose (85) from engine oil cooler (86).

(28) Install crossover tube (71) and four clamps (70). Tighten clamps (70) securely.

(29) Install lifting bracket (69), two lockwashers (68), and capscrews (67). Tighten capscrews (67) securely.



67. CAPSCREW (2)
68. LOCKWASHER (2)
68. LIFTING BRACKET
70. CLAMP (4)
71. CROSSOVER TUBE
72. FUEL LINE
73. FUEL LINE
74. RIGHT CYLINDER HEAD
75. FUEL LINE
76. LEFT CYLINDER HEAD
77. FUEL LINE
78. FUEL LINE
79. FUEL PUMP
80. CLAMP (2)
81. HOSE
82. HOSE
83. RIGHT THERMOSTAT HOUSING
84. CLAMP
85. HOSE
86. ENGINE OIL COOLER

6-8. CHASSIS WIRING HARNESS REPLACEMENT (MK14) (Continued)

c. Installation

NOTE

- Match wire numbers on new harness to wire numbers remaining on vehicle.
- Install nylon ties (1) where removed.
- Install capscrew (4), clamp (3), and new locknut (2) where removed.

(1) Place wiring harness (32) in position.

(2) Install connector (31) with cover (30), four capscrews (29), new lockwashers (28), and nuts (27). Tighten nuts (27) securely.

(3) Install capscrew (21), terminals (19 and 20), washer (18), and nut (17). Tighten nut (17) securely.

(4) Install washer (16), clamp (15), washer (14), new lockwasher (13), and nut (12). Tighten nut (12) securely.

NOTE

Perform steps (4.1) and (4.2) for LVSA1 series vehicles only.

(4.1) Install capscrew (21.5), terminal (21.4), spacer (21.3), clamp (21.2), and new locknut (21.1). Tighten locknut (21.1) securely.

(4.2) Apply corrosion preventive compound to ground connection at locknut (21.1).

(5) Connect plugs (22 thru 25) at both composite lights (26).

(6) Install connector (11) with new lockring (10) and nut (9). Tighten nut (9) securely.

(7) Connect plugs (7) at nine clearance lights (8).

END OF TASK

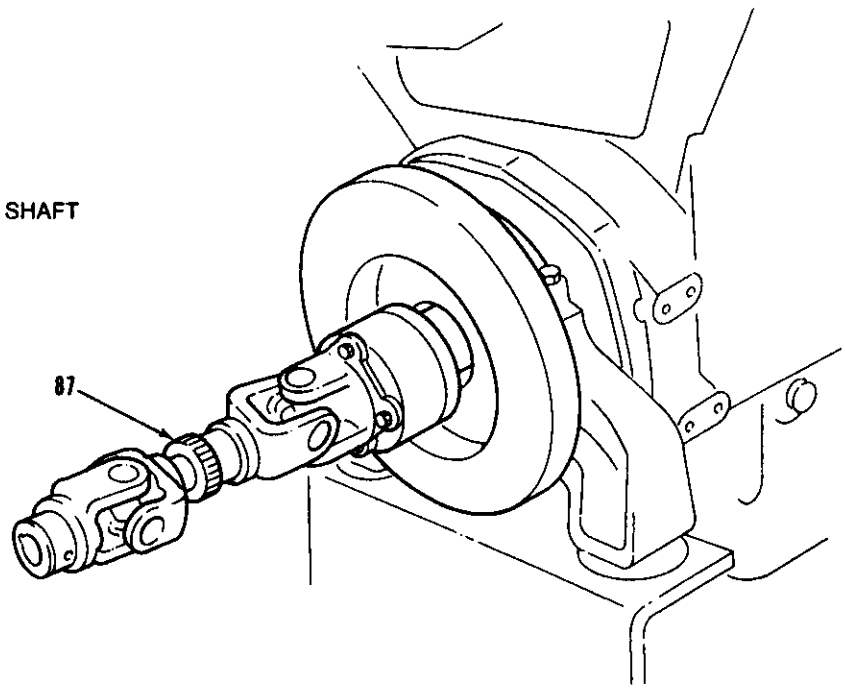
NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install rear composite lights (para 7-34) (LVSA1 series vehicles only).
TM 2320-10/11 TM 9-2320-297-10	Connect Intervehicular connector (para 2-15).
	Check all lights for proper operation (para 2-14).

3-17. POWER PACK REPLACEMENT (Continued)

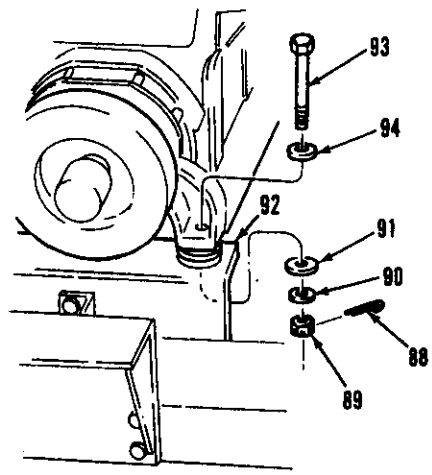
87. HYDRAULIC PUMP DRIVE SHAFT



(30) Remove hydraulic pump drive shaft (87). Refer to paragraph 19-22 of this manual.

(31) Remove two cotter pins (88), castle nuts (89), washers (90), and biscuit washers (91), from front motor mount (92). Discard cotter pins (88).

88. COTTER PIN (2)
89. CASTLE NUT (2)
90. WASHER (2)
91. BISCUIT WASHER (2)
92. FRONT MOTOR MOUNT
93. CAPSCREW (2)
94. WASHER (2)



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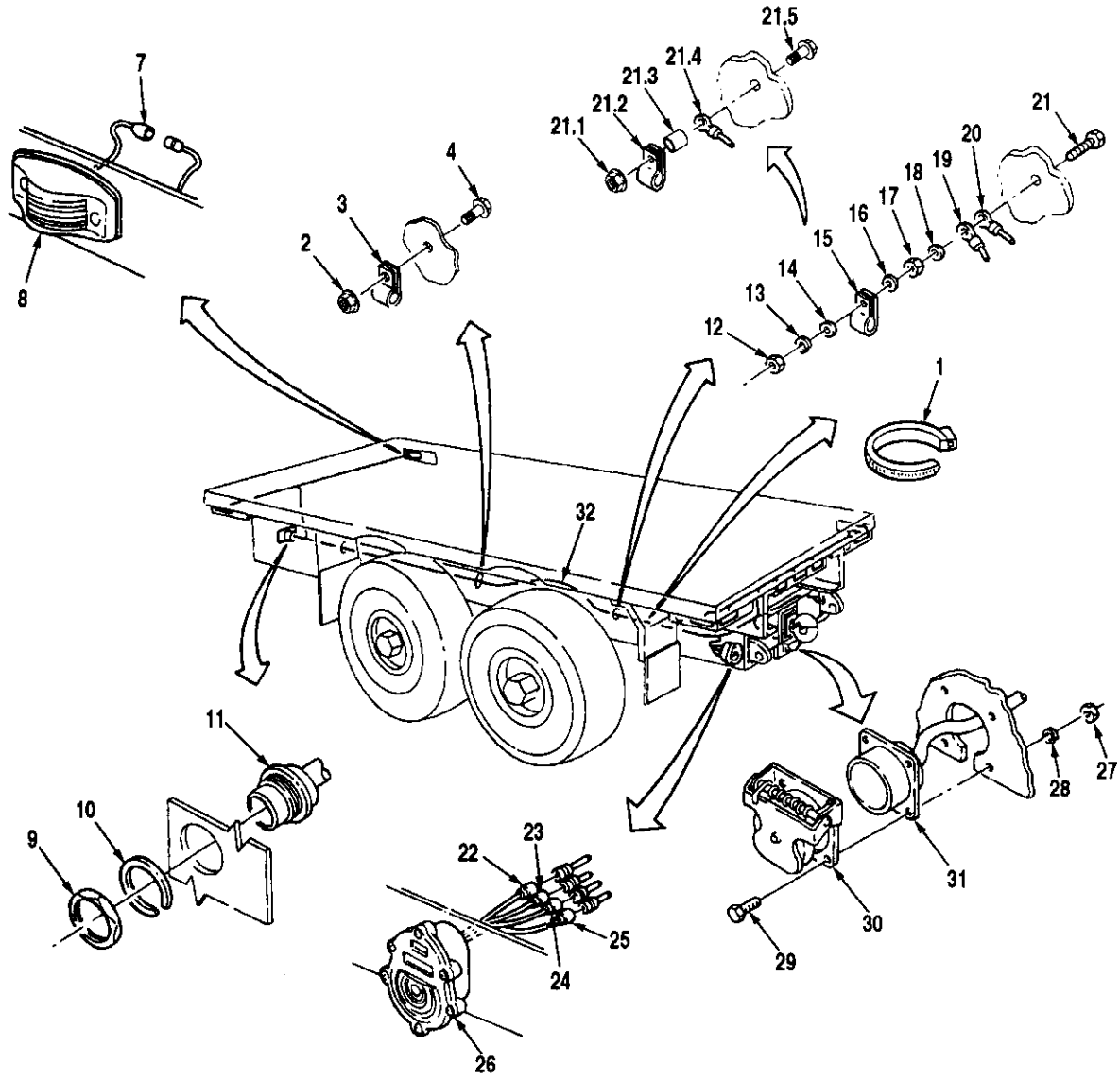


1. NYLON TIE
2. LOCKNUT
3. CLAMP
4. CAPSCREW
5. DELETED
6. DELETED
7. PLUG
8. CLEARANCE LIGHT (9)
9. NUT
10. LOCKRING
11. CONNECTOR
12. NUT
13. LOCKWASHER
14. WASHER
15. CLAMP
16. WASHER
17. NUT
18. WASHER
19. TERMINAL
20. TERMINAL
21. CAPSCREW
21.1. LOCKNUT*
21.2. CLAMP*
21.3. SPACER*
21.4. TERMINAL (1435)*
21.5. CAPSCREW*
23. PLUG
24. PLUG
25. PLUG
26. COMPOSITE LIGHT (2)
27. NUT (4)
28. LOCKWASHER (4)
29. CAPSCREW (4)
30. COVER
31. CONNECTOR
32. WIRING HARNESS

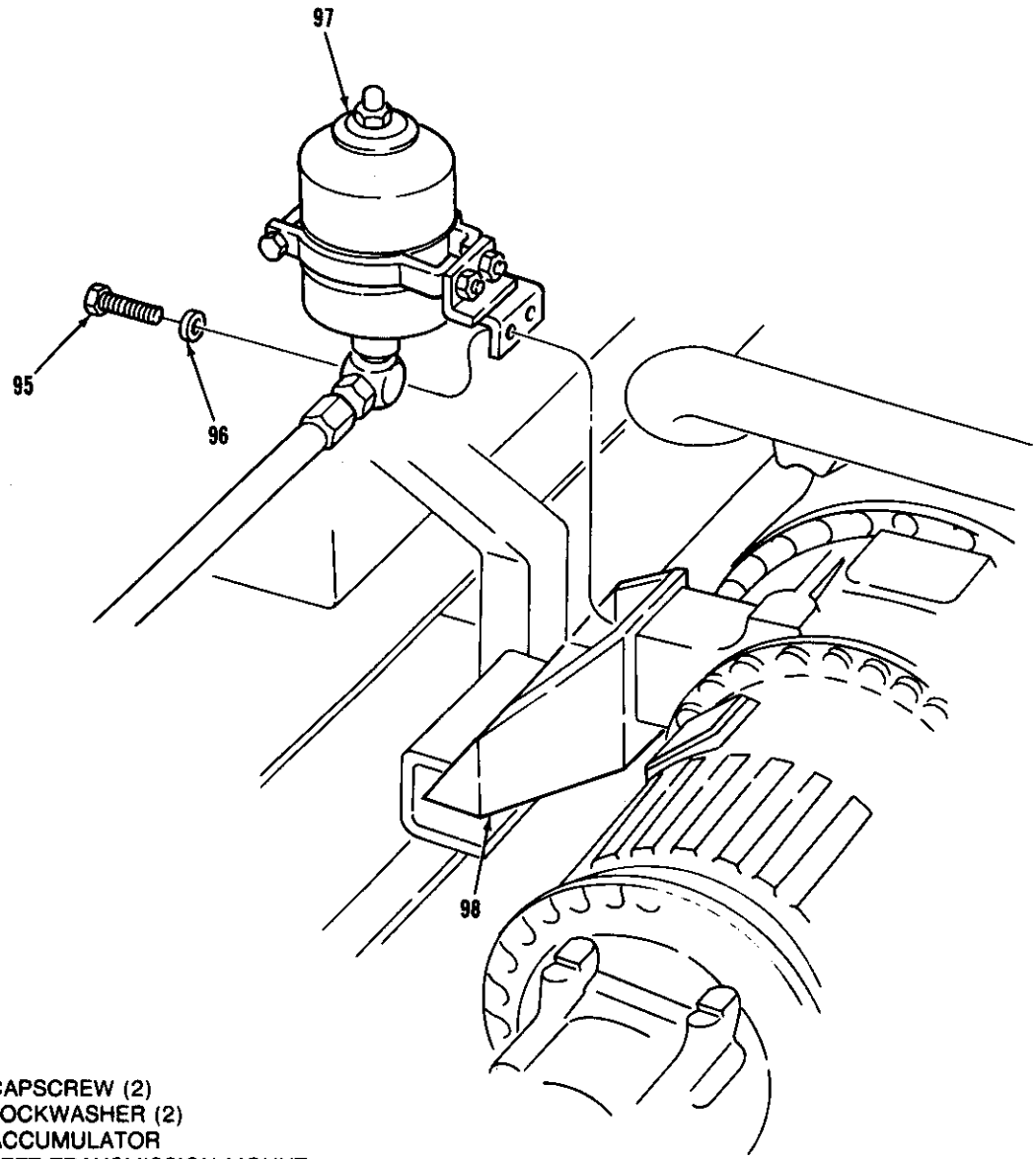
* LVSA1 SERIES VEHICLES ONLY

(32) Remove two capscrews (93) and washers (94) from front motor mount (92).

WARNING

Avoid puncturing accumulator while removing from transmission mount.

(33) Tag and remove top two capscrews (95), lockwashers (96), and accumulator (97) from left transmission mount (98). Discard lockwashers (96). Secure accumulator (97) out of the way.



95. CAPSCREW (2)
96. LOCKWASHER (2)
97. ACCUMULATOR
98. LEFT TRANSMISSION MOUNT

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6-8. CHASSIS WIRING HARNESS REPLACEMENT (MK14)

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK14

Materials/Parts
Nylon tie (AR) (MS3367-1-9) item 1
Lockring (NSN 5310-01-081-0799) item 10
Lockwasher (MS35333-74) item 13
Lockwasher (4) (MS35338-44) item 28
Locknut (2) (1600460) items 2 and 21.1
Compound, corrosion preventive (Item 14.1, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Intervehicular connector disconnected (para 2-15).
TM 2320-20/12 TM 9-2320-297-20	Rear composite light removed (para 7-34) (LVSA1 series vehicles only).

a. Removal

NOTE

- Remove nylon ties (1) as needed. Note location for proper installation.
- Attaching hardware for LVSA1 clamps has changed from a nut, lockwasher, clamp, and capscrew to a locknut, washer, clamp, and capscrew. When repairing non-A1 vehicles, replace old style hardware with new style hardware. Refer to TM 9-2320-297-24P for correct parts identification.
- For LVSA1 vehicles, remove locknuts (2), clamp (3), and capscrew (4) as necessary. Note location for proper installation.

(1) Disconnect plug (7) at nine clearance lights (8).

(2) Remove nut (9), lockring (10), and connector (11). Discard lockring (10).

(3) Remove nut (12), lockwasher (13), washer (14), clamp (15), washer (16), nut (17) washer (18), terminals (19 and 20), and capscrew (21). Discard lockwashers (13).

NOTE

Perform step (3.1) for LVSA1 series vehicles only.

(3.1) Remove locknut (21.1), clamp (21.2), spacer (21.3), terminal (21.4), and capscrew (21.5). Discard locknut (21.1).

(4) Disconnect plugs (22 thru 25) from both rear composite lights (26).

(5) Remove four nuts (27), lockwashers (28), capscrews (29), covers (30), and connector (31).

(6) Remove wiring harness (32).

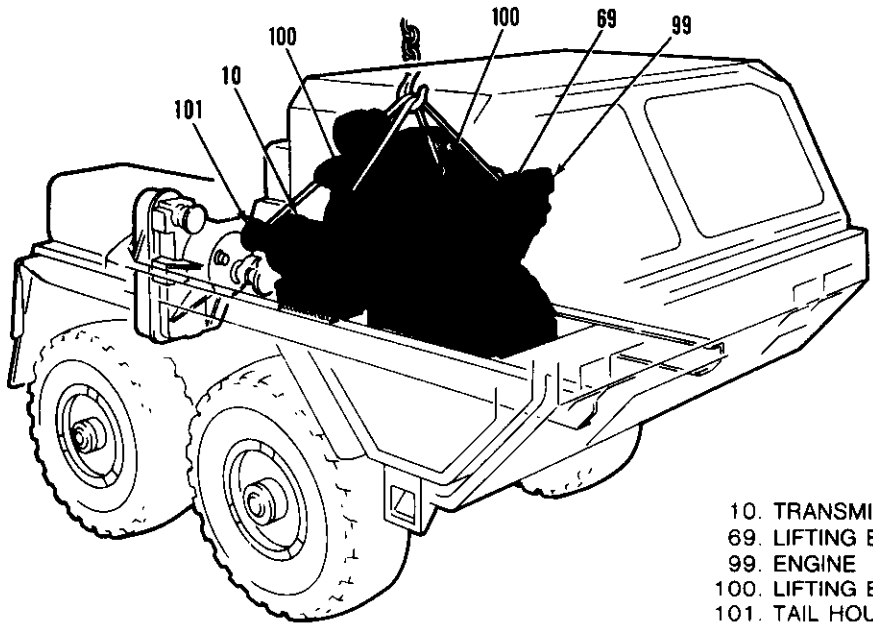
b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

3-17. POWER PACK REPLACEMENT (Continued)



10. TRANSMISSION
69. LIFTING BRACKET
99. ENGINE
100. LIFTING BRACKET (2)
101. TAIL HOUSING

(34) Attach a lifting sling capable of lifting engine (99) and transmission (10). Use the three lifting brackets (69 and 100) to secure engine (99). Use the tail housing (101) to secure transmission (10). Engine (99) and transmission (10) must be level and balanced when lifting.

WARNING

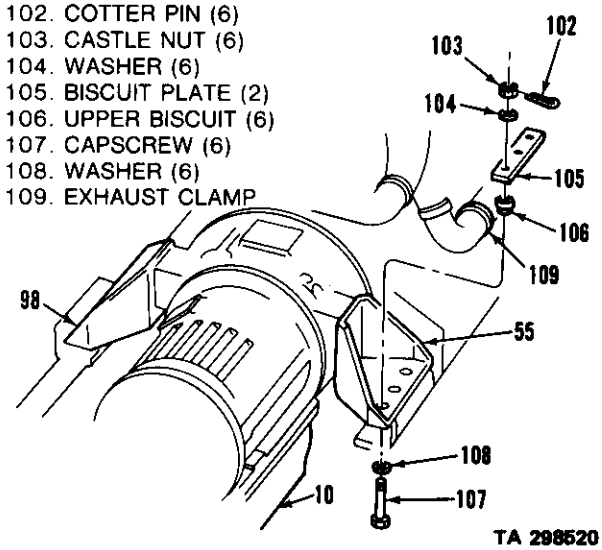
Keep lifting sling taut while transmission mounts (55 and 98) are being loosened. Keep fingers out of the way.

(35) Remove three cotter pins (102), castle nuts (103), washers (104, biscuit plates (105), and upper biscuits (106) from right transmission mount (55). Discard cotter pins (102).

(36) Remove three capscrews (107) and washers (108) from bottom of right transmission mount (55).

(37) Repeat steps (35) and (36) for left transmission mount (98).

10. TRANSMISSION
55. RIGHT TRANSMISSION MOUNT
98. LEFT TRANSMISSION MOUNT
102. COTTER PIN (6)
103. CASTLE NUT (6)
104. WASHER (6)
105. BISCUIT PLATE (2)
106. UPPER BISCUIT (6)
107. CAPSCREW (6)
108. WASHER (6)
109. EXHAUST CLAMP



TA 298520

(17) Plug in connectors (6 thru 9).

(18) Install connector (5) with four capscrews (4) and new locknuts (3). Tighten locknuts (3) securely.

(19) Install cap (2).

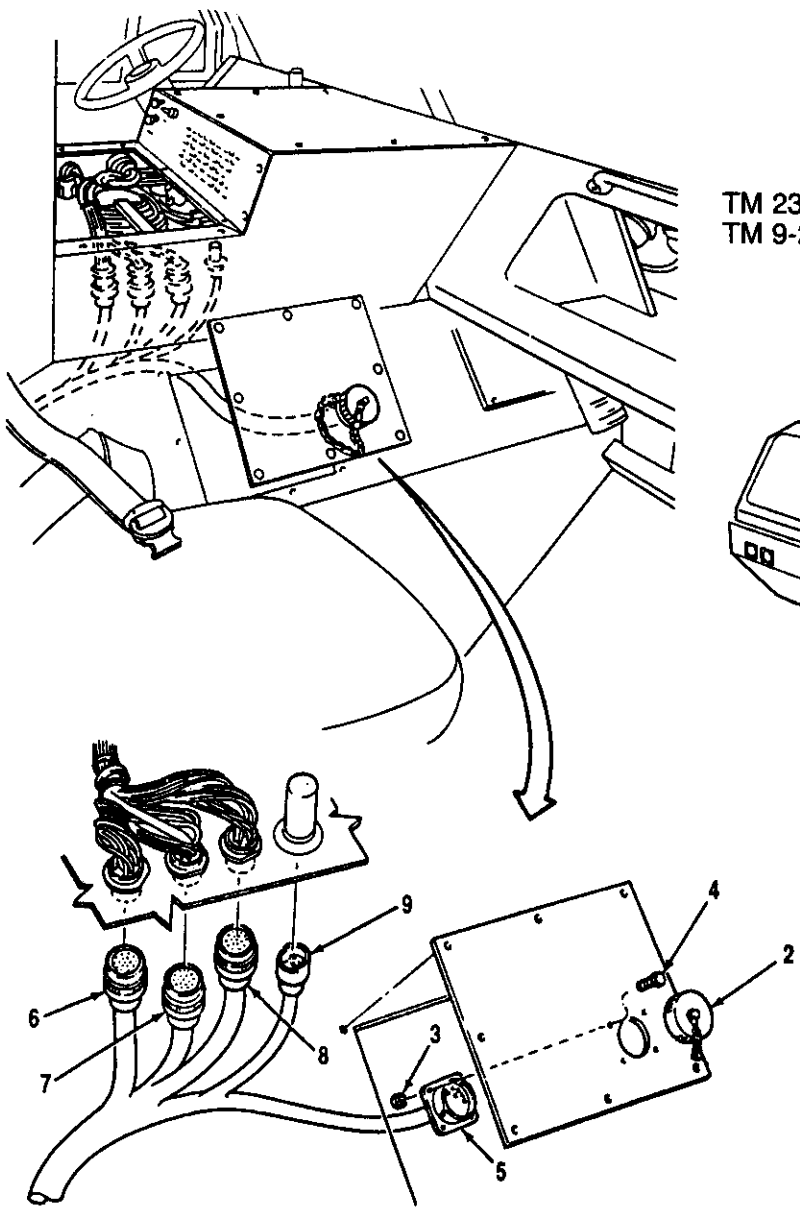
(20) Connect terminals (55, 57, and 58) using new locknuts (54 and 56). Refer to paragraph 7-43 (TM 2320-20/12, TM 9-2320-297-20).

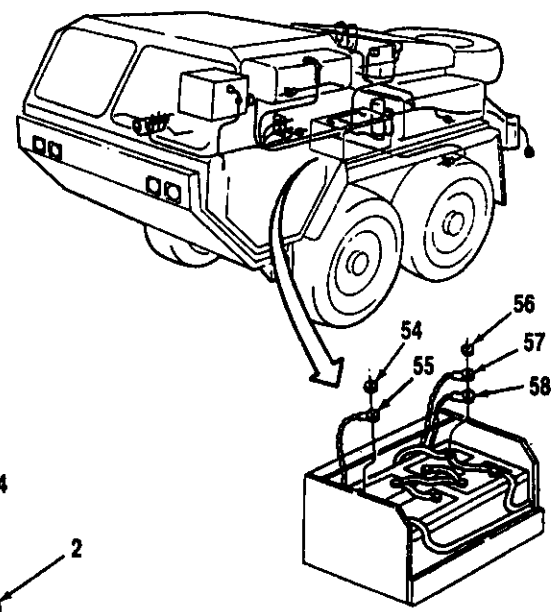
END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install STE/ICE panel (para 18-14).
	Connect batteries (para 7-43).
	Wires installed and batteries connected, (para 7-43.1, steps (5), (19), (23), and (24)) (LVSA1 series vehicles only).
	Install fuel/water separator (para 4-18, step a. (1.1)) (LVSA1 series vehicles only).
TM 2320-10/11 TM 9-2320-297-10	Connect Intervehicular connector (para 2-15).
	Check all lights for proper operation (para 2-14).





2. CAP
3. LOCKNUT (4)
4. CAPSCREW (4)
5. CONNECTOR
6. CONNECTOR
7. CONNECTOR
8. CONNECTOR
9. CONNECTOR
54. LOCKNUT
55. TERMINAL
56. LOCKNUT
57. TERMINAL
58. TERMINAL

WARNING

Keep out from under engine (99) and transmission (10) when lifting. If engine (99) and transmission (10) slips, sways, or falls, it may cause serious injury or death.

Avoid puncturing accumulator (97) while removing engine and transmission.

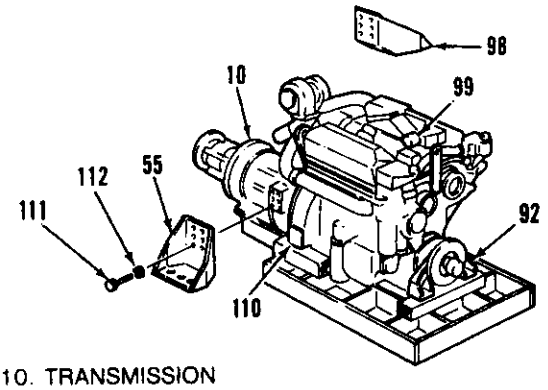
CAUTION

- Secure loose hoses and wires out of the way so they do not snag and cause damage when engine (99) and transmission (10) is lifted.
- Before lifting engine (99) and transmission (10) completely out of vehicle, lift slightly to see if balanced. If engine (99) and transmission (10) tilt, adjust chain lengths. Unbalanced engine (99) and transmission (10) may swing, causing damage.
- Exhaust clamp (109) might snag on the right side. If necessary, use a pry bar to help guide engine (99) and transmission (10).

(38) Remove engine (99) and transmission (10) from vehicle.

(39) Place engine (99) and transmission (10) on a flat, level surface. Place wooden blocks under front motor mount (92) and both sides of flywheel housing (110) to secure engine (99) and transmission (10).

(40) Remove four capscrews (111) and lockwashers (112) from both transmission mounts (55 and 98). Discard lockwashers (112).



10. TRANSMISSION
55. RIGHT TRANSMISSION MOUNT
92. FRONT MOTOR MOUNT
98. LEFT TRANSMISSION MOUNT
99. ENGINE
110. FLYWHEEL HOUSING
111. CAPSCREW (4)
112. LOCKWASHER (4)

b. Cleaning/Inspection

WARNING

Steam cleaning creates hazardous noise levels and severe burn potential. Eye, skin, and ear protection are required.

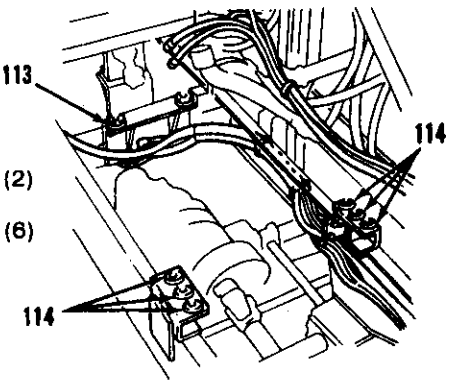
(1) Steam clean engine (99) and transmission (10).

(2) Clean all parts. Refer to paragraph 2-6.

NOTE

Rubber biscuits (113 and 114) in vehicle must be inspected.

(3) Inspect all rubber biscuits (106, 113, and 114) for dry rot and other damage.



113. RUBBER BISCUIT (2)
114. RUBBER BISCUIT (6)

TA 288521

6-7. CHASSIS WIRING HARNESS REPLACEMENT (MK48) (Continued)

(13) Install connectors (24 and 25) with new lockrings (23) and nuts (22). Tighten nuts (22) securely.

(14) Plug in connectors (20 and 21).

(15) Install capscrew (18), terminal (19), and nut (17). Tighten nut (17) securely. Connect plug (16).

(15.1) Install capscrew (19.3), terminal (19.2), and new locknut (19.1). Tighten locknut (19.1) securely.

(15.2) Apply corrosion preventive compound to terminal (19.2).

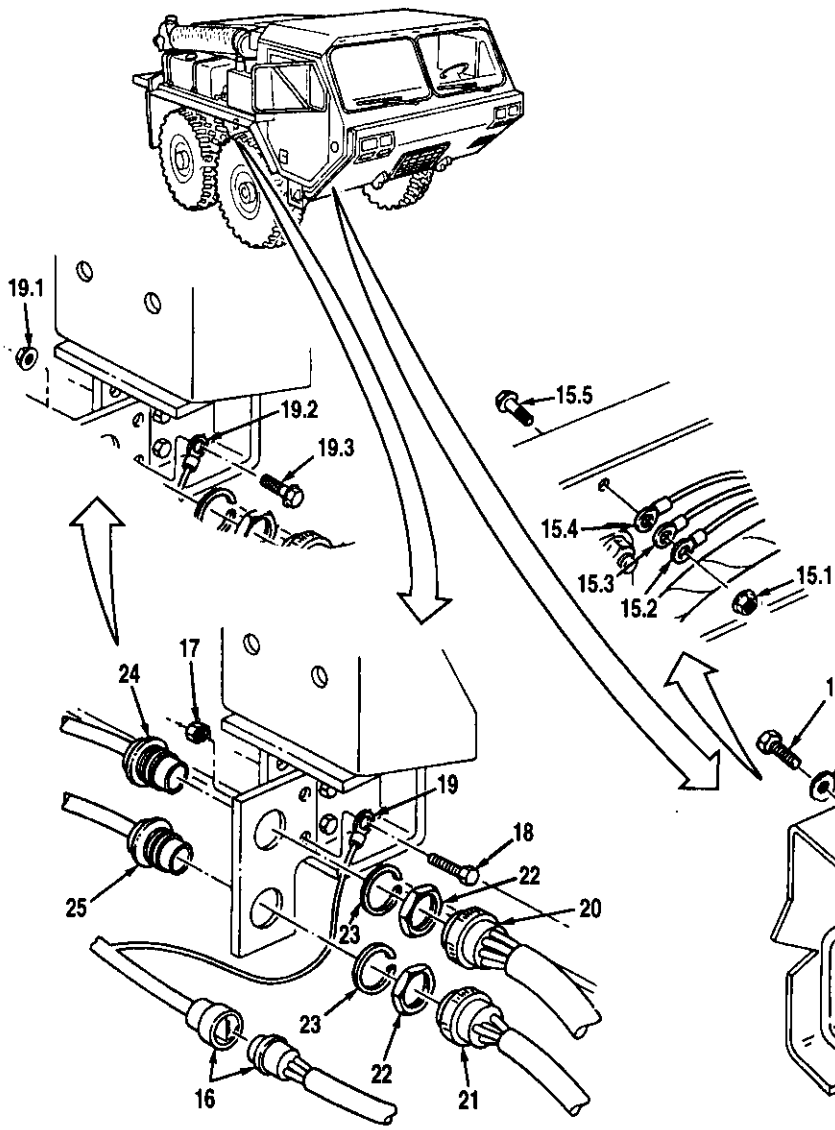
(16) Install capscrew (15), washer (14), three terminals (11, 12, and 13), and nut (10). Tighten nut (10) securely.

NOTE

Perform steps (16.1) and (16.2) on LVSA1 series vehicles only.

(16.1) Install capscrew (15.5), three terminals (15.4, 15.3, and 15.2), and new locknut (15.1). Tighten locknut (15.1) securely.

(16.2) Apply corrosion preventive compound to terminals (15.2, 15.3, and 15.4).



10. NUT
11. TERMINAL
12. TERMINAL
13. TERMINAL
14. WASHER
15. CAPSCREW
15.1. LOCKNUT*
15.2. TERMINAL (435)*
15.3. TERMINAL (435)*
15.4. TERMINAL (435)*
15.5. CAPSCREW*
16. PLUG
17. NUT
18. CAPSCREW
19. TERMINAL
19.1. LOCKNUT
19.2. TERMINAL (435)
19.3. CAPSCREW
20. CONNECTOR
21. CONNECTOR
22. NUT (2)
23. LOCKRING (2)
24. CONNECTOR
25. CONNECTOR

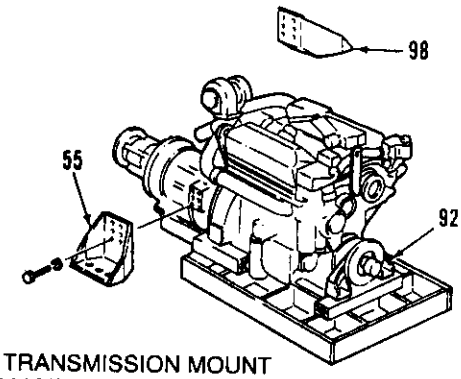
* LVSA1 SERIES VEHICLES ONLY

3-17. POWER PACK REPLCEMENT (Continued)

(4) Inspect all mounts (55, 92, and 98) for cracks or damage.

(4) Inspect all parts. Refer to paragraph 2-7.

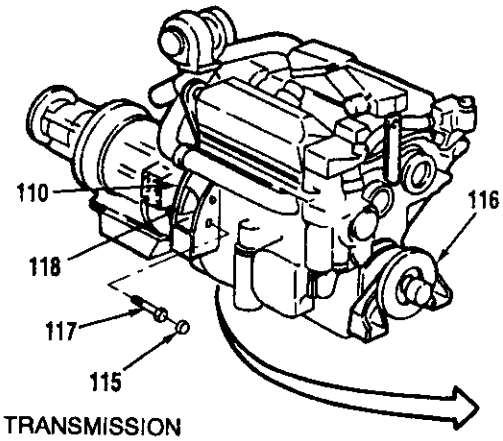
(6) Replace all parts failing inspection.



55. RIGHT TRANSMISSION MOUNT
92. FRONT MOTOR MOUNT
98. LEFT TRANSMISSION MOUNT

c. Separation of Engine and Transmission

(1) Remove access hole plug (115) from flywheel housing (110).



10. TRANSMISSION
110. FLYWHEEL HOUSING
115. ACCESS HOLE PLUG
116. CRANKSHAFT PULLEY
117. CAPSCREW (12)
118. FLEXPLATE

NOTE

While turning engine over at crankshaft pulley (116), use access hole to line up flexplate capscrews (117) for removal.

(2) Remove 12 capscrews (117) from flexplate (118).

(3) Unplug connector (119) from engine brake lockup switch (120) on bottom of transmission (10).

(4) Remove engine brake lockup switch (120).

(5) Tag and remove two hoses (121 and 122).

(6) Unplug boot connector (123) from solenoid valve (124).

NOTE

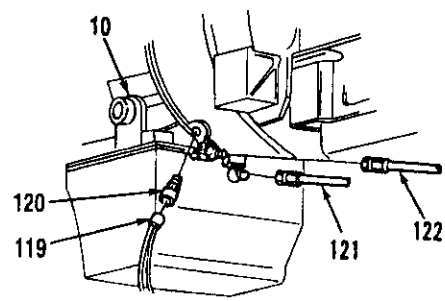
Perform step (6.1) on LVSA1 series vehicles only.

(6.1) Remove screw (124.1) and disconnect connector (124.2).

(7) Remove nut (125), washer (126), and capscrew (127) from solenoid valve (124). Remove solenoid valve (124).

(8) Unplug boot connector (128) from throttle control solenoid (129). Tag and remove two air lines.

(9) Remove capscrew (132), washer (133), and wire (134). Remove capscrew (135), washer (136), and throttle control solenoid (129).



119. CONNECTOR
120. ENGINE BRAKE LOCKUP SWITCH
121. HOSE
122. HOSE

(7) Install terminal (38) with new lockwasher (37) and nut (36). Tighten nut (36) securely.

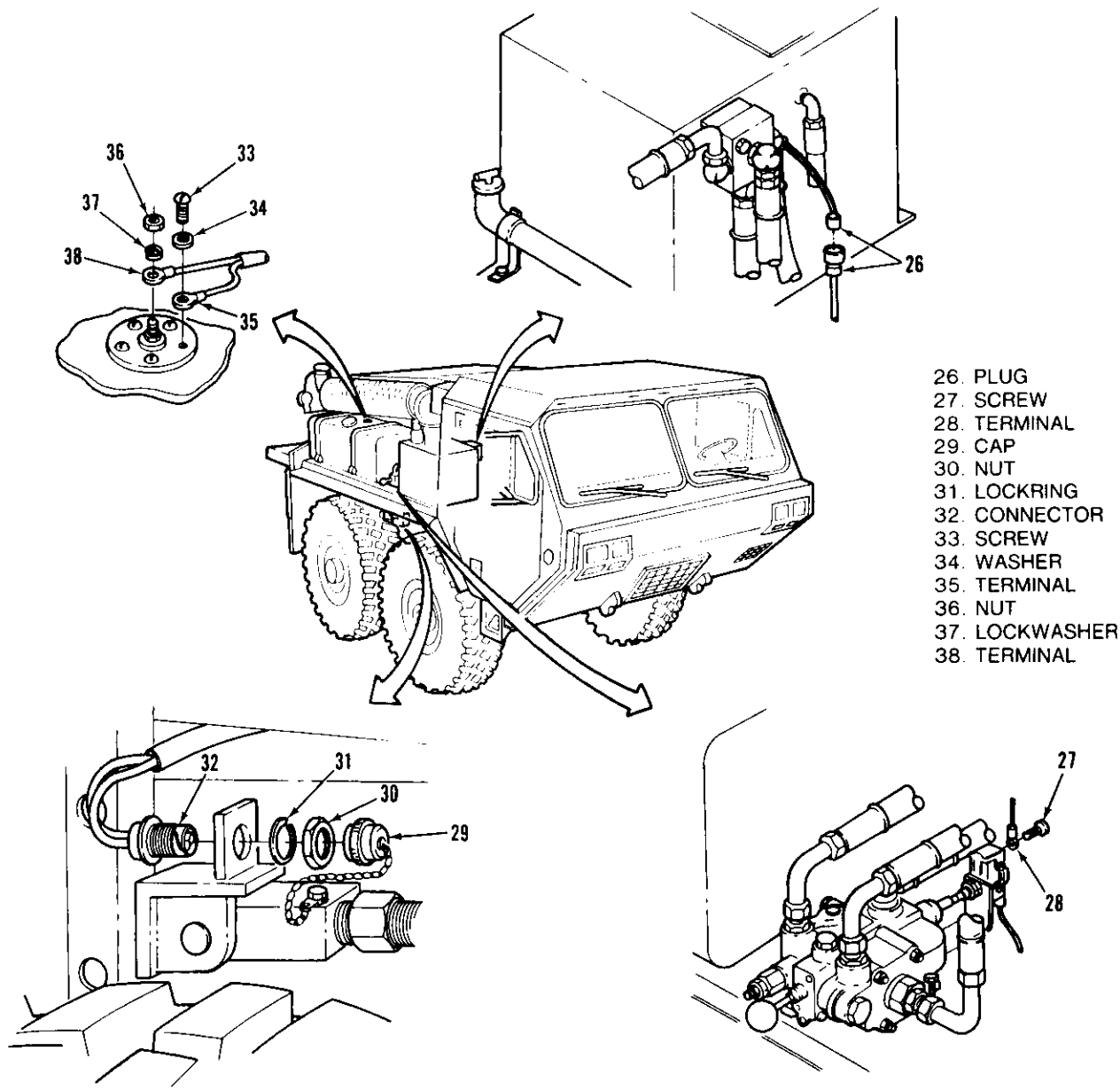
(8) Install terminal (35) with washer (34) and screw (33). Tighten screw (33) securely.

(9) Install connector (32) with new lockring (31) and nut (30). Tighten nut (30) securely.

(10) Install cap (29)

(11) Install terminal (28) with screw (27). Tighten screw (27) securely.

(12) Connect plug (26).



26. PLUG
27. SCREW
28. TERMINAL
29. CAP
30. NUT
31. LOCKRING
32. CONNECTOR
33. SCREW
34. WASHER
35. TERMINAL
36. NUT
37. LOCKWASHER
38. TERMINAL

TA 298773

(10) Remove nut (137), lockwasher (138), washer (139), wire (140), and temperature sending unit (141). Discard lockwasher (138).

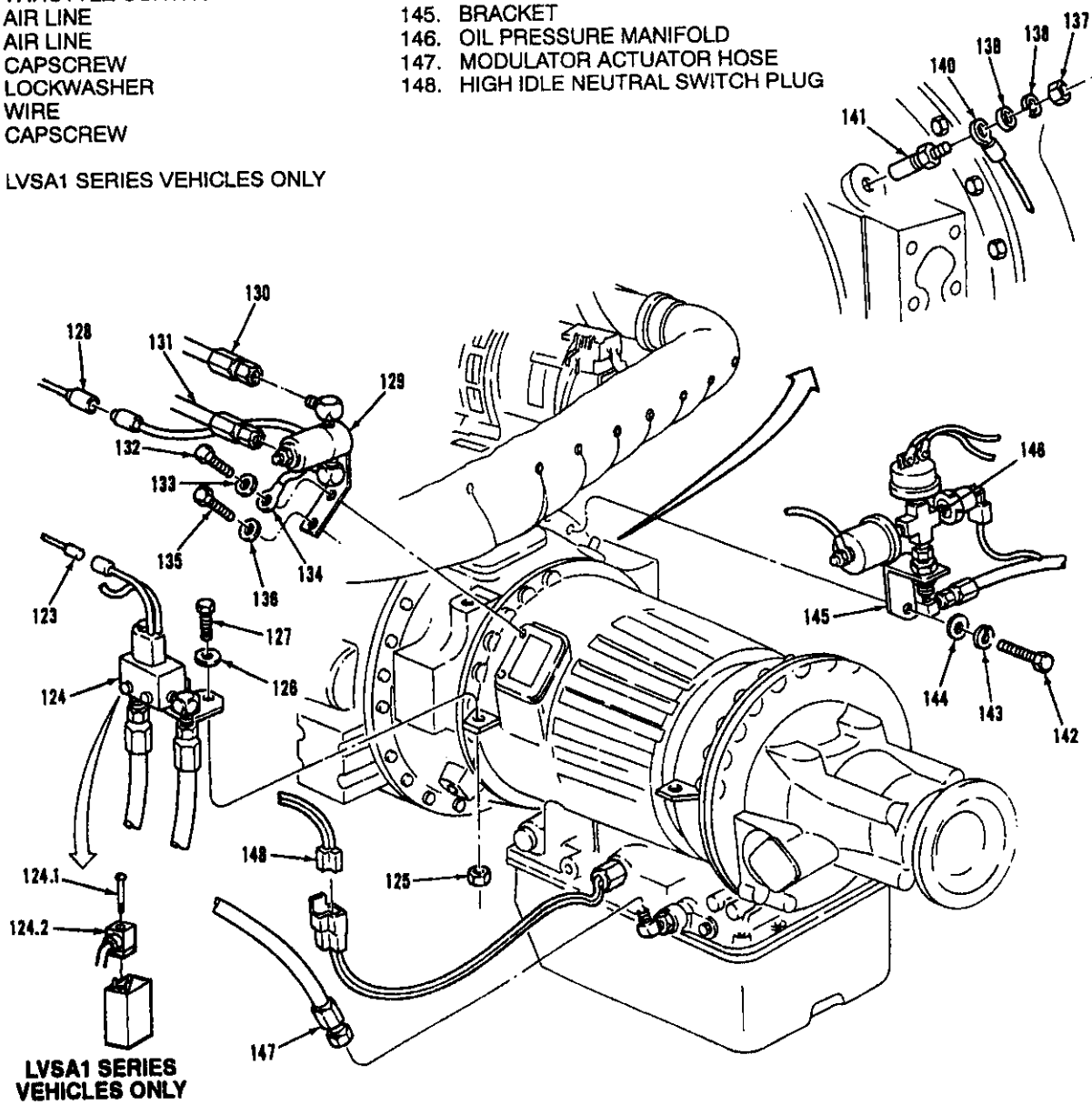
(11) Remove capscrew (142), lockwasher (143), and washer (144) from bracket (145), and remove oil pressure manifold (146). Discard lockwasher (143).

(12) Remove modulator actuator hose (147).

(13) Disconnect high idle neutral switch plug (148).

123. BOOT CONNECTOR
124. SOLENOID VALVE
124.1. SCREW*
124.2. CONNECTOR*
125. NUT
126. WASHER
127. CAPSCREW
128. BOOT CONNECTOR
129. THROTTLE CONTROL SOLENOID
130. AIR LINE
131. AIR LINE
132. CAPSCREW
133. LOCKWASHER
134. WIRE
135. CAPSCREW
136. WASHER
137. NUT
138. LOCKWASHER
138. WASHER
140. WIRE
141. TEMPERATUARE SENDING UNIT
142. CAPSCREW
143. LOCKWASHER
144. WASHER
145. BRACKET
146. OIL PRESSURE MANIFOLD
147. MODULATOR ACTUATOR HOSE
148. HIGH IDLE NEUTRAL SWITCH PLUG

* LVSA1 SERIES VEHICLES ONLY



LVSA1 SERIES VEHICLES ONLY

6-7. CHASSIS WIRING HARNESS REPLACEMENT (MK48) (Continued)

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

NOTE

- Match wire numbers on new harness to wire numbers remaining on the vehicle.
- Install nylon ties (1) where removed.

(1) Place wiring harness (59) in position.

(2) Install terminal (53) with washer (52) and nut (51). Tighten nut (51) securely.

(3) Install connector (50) with new lockring (49) and nut (48). Tighten nut (48) securely.

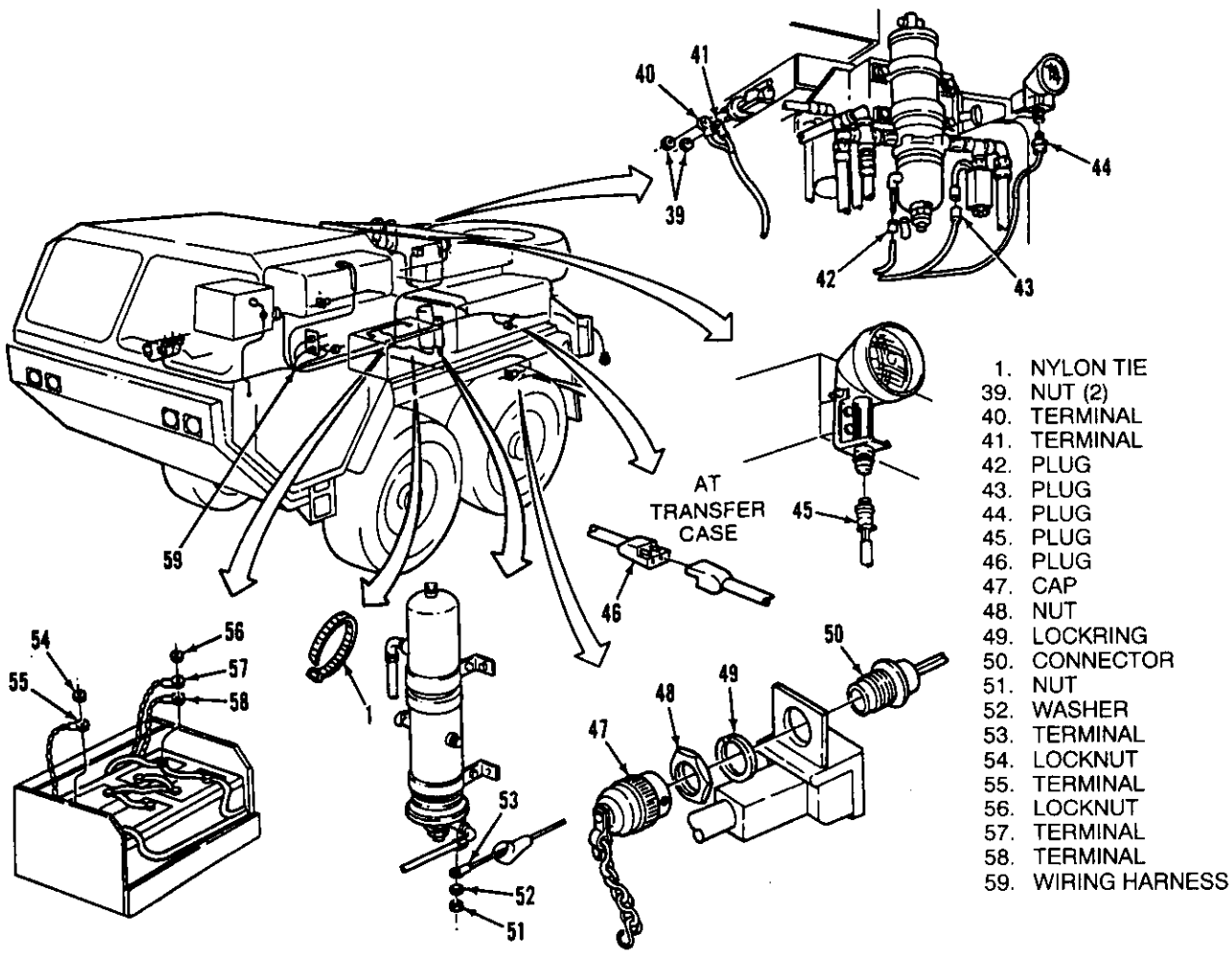
(4) Install cap (47).

NOTE

- Fill plug (46) with corrosion preventive compound before connecting.
- Installation of plug (42) not required on LVSA1 series vehicles.

(5) Connect plugs (46 thru 42)

(6) Install terminals (40 and 41) with nuts (39). Tighten nuts (39) securely.



1. NYLON TIE
39. NUT (2)
40. TERMINAL
41. TERMINAL
42. PLUG
43. PLUG
44. PLUG
45. PLUG
46. PLUG
47. CAP
48. NUT
49. LOCKRING
50. CONNECTOR
51. NUT
52. WASHER
53. TERMINAL
54. LOCKNUT
55. TERMINAL
56. LOCKNUT
57. TERMINAL
58. TERMINAL
59. WIRING HARNESS

3-17. POWER PACK REPLACEMENT (Continued)

(14) Install lifting tool (149) to transmission (10) using four 5/8 x 11 x 2 capscrews (150), lockwashers (151), and nuts (152).

(15) Install a lifting sling to lifting tool (149).

WARNING

Stay out from under transmission (10) when being moved. If transmission (10) falls, it could result in serious injury or death.

NOTE

Make sure lifting device is equally balanced on transmission.

(16) Remove 24 capscrews (153) and lockwashers (154) from transmission bell housing (155) and engine (99). Discard lockwashers (154).

(17) Carefully remove transmission (10) from engine (99).

d. Installation of Transmission onto Engine

(1) Install lifting tool (149) to transmission (10) with four 5/8 x 11 x 2 capscrews (150), lockwashers (151), and nuts (152).

(2) Install a lifting sling to lifting tool (149).

WARNING

Stay out from under transmission (10) when being moved. If transmission (10) falls it could result in serious injury or even death.

(3) Carefully install transmission (10) onto engine (99).

(4) Lubricate and install 24 capscrews (153) and new lockwashers (154) into transmission bell housing (155) and engine (99). Torque capscrews (153) to 35 foot-pounds (47 N·m).

(5) Remove lifting sling.

(6) Remove four nuts (152), lockwashers (151), capscrews (150), and lifting tool (149) from transmission (10).

(13) Remove two nuts (39) and terminals (40 and 41).

NOTE

Removal of plug (42) not required on LVSA1 series vehicles.

(14) Disconnect plugs (42 thru 46).

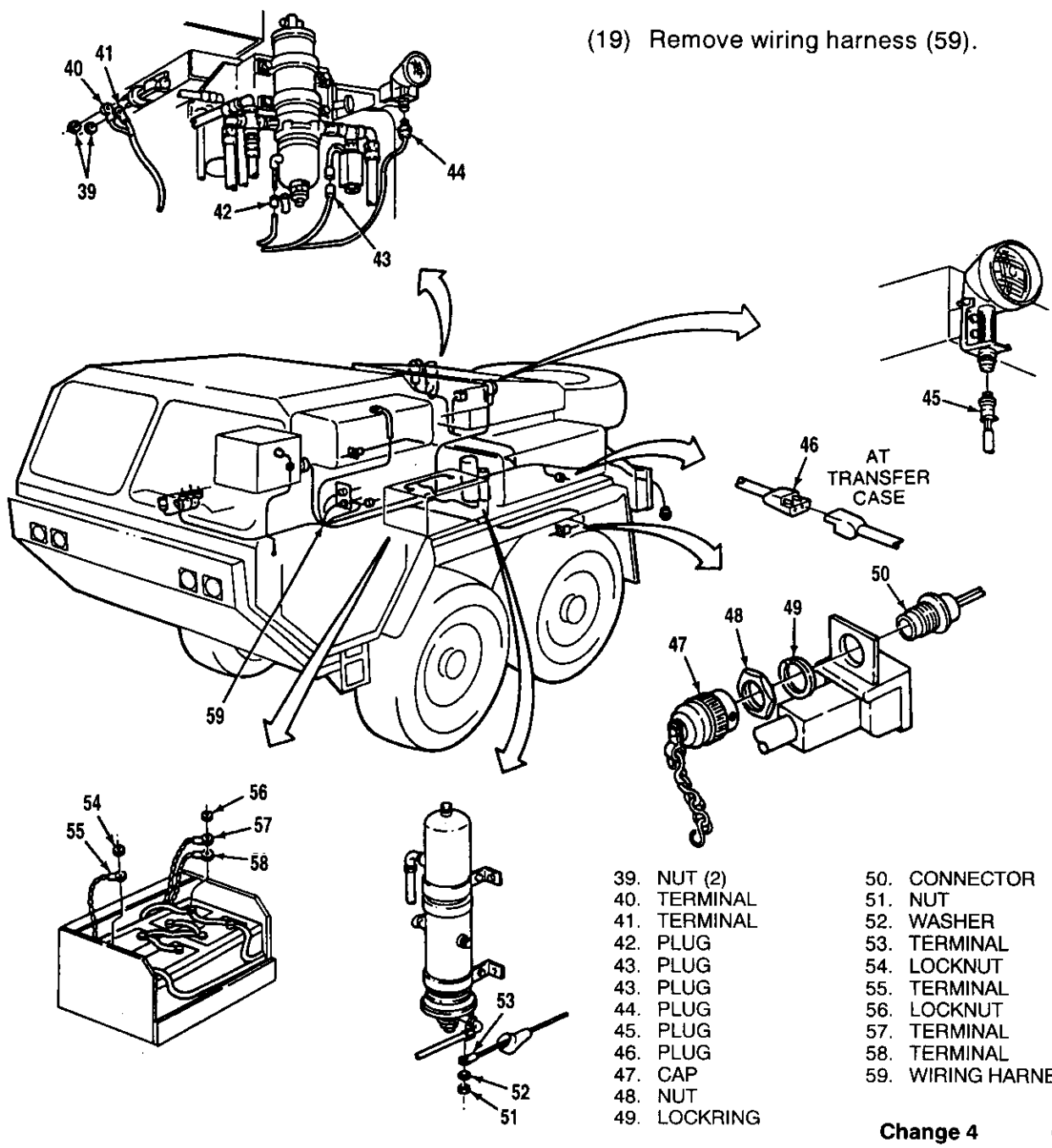
(15) Remove cap (47), nut (48), lockring (49), and connector (50). Discard lockring (49).

(16) Remove nut (51), washer (52), and terminal (53).

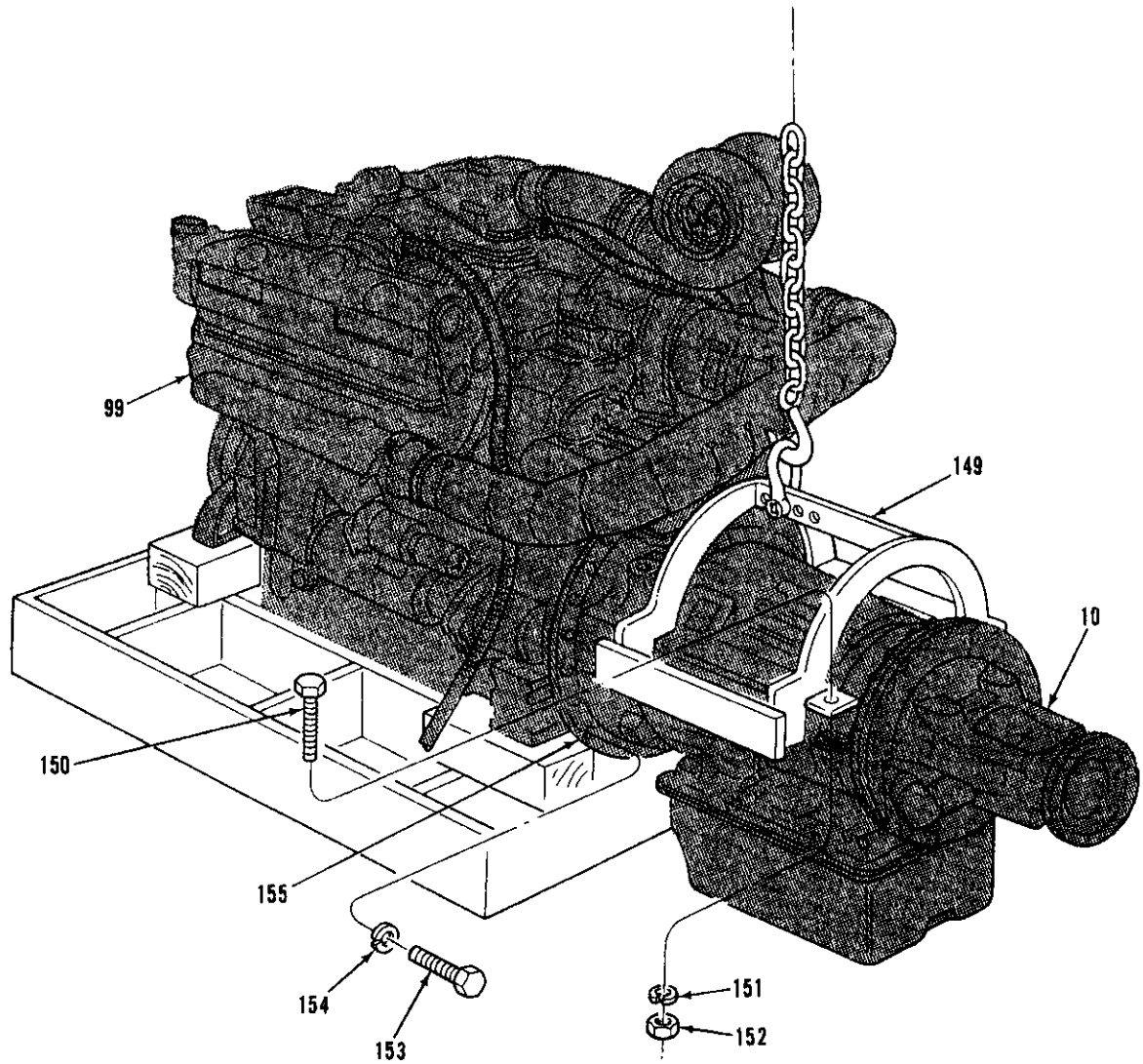
(17) Remove locknut (54) and terminal (55). Discard locknut (54).

(18) Remove locknut (56) and terminals (57 and 58). Discard locknut (56).

(19) Remove wiring harness (59).



39. NUT (2)
40. TERMINAL
41. TERMINAL
42. PLUG
43. PLUG
43. PLUG
44. PLUG
45. PLUG
46. PLUG
47. CAP
48. NUT
49. LOCKRING
50. CONNECTOR
51. NUT
52. WASHER
53. TERMINAL
54. LOCKNUT
55. TERMINAL
56. LOCKNUT
57. TERMINAL
58. TERMINAL
59. WIRING HARNESS



10. TRANSMISSION
99. ENGINE
149. LIFTING TOOL
150. CAPSCREW (4)
151. LOCKWASHER (4)
152. NUT (4)
153. CAPSCREW (24)
154. LOCKWASHER (24)
155. TRANSMISSION BELL HOUSING

TA 298524

6-7. CHASSIS WIRING HARNESS REPLACEMENT (MK48) (Continued)

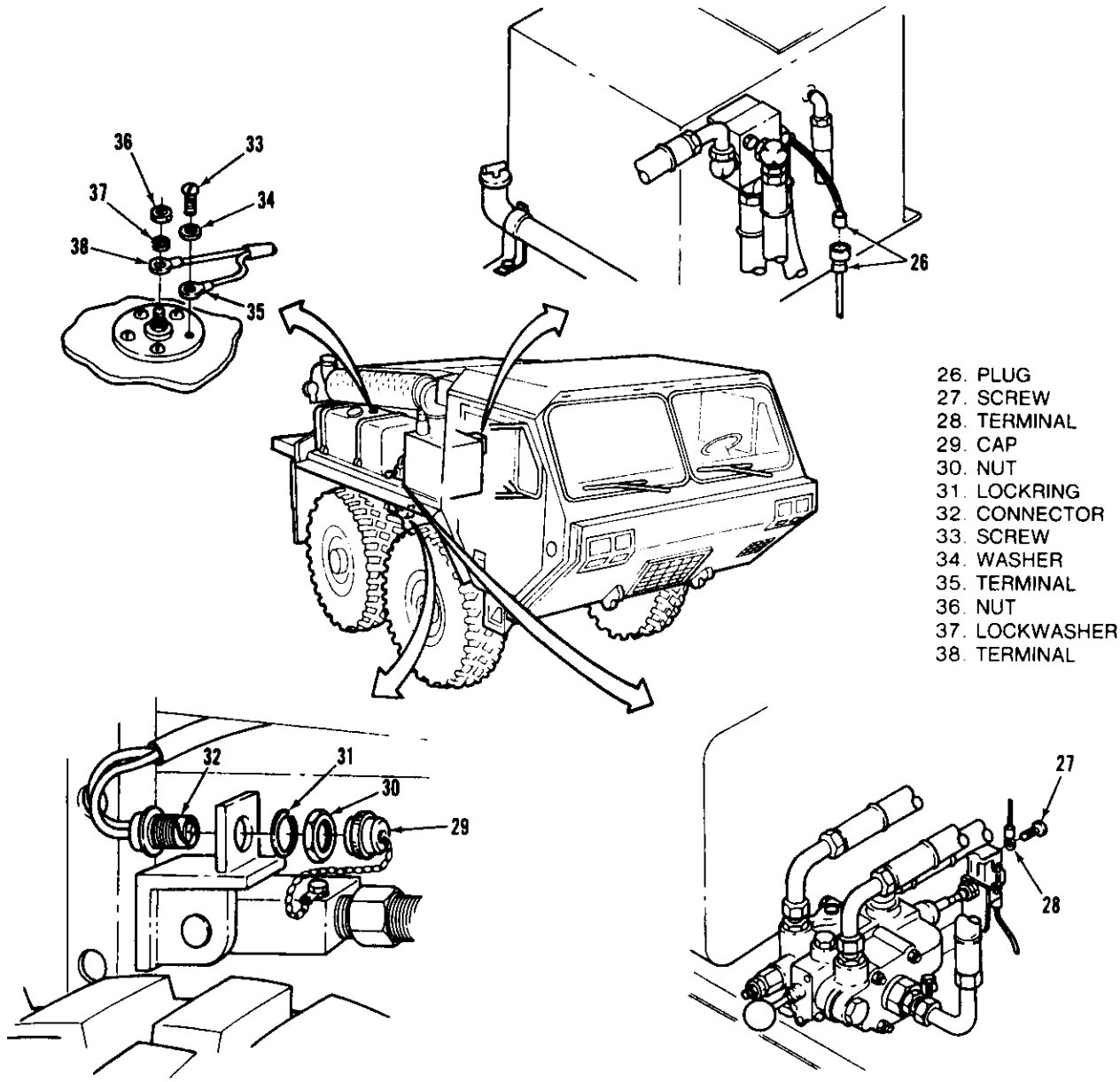
(8) Disconnect plug (26).

(9) Remove screw (27) and terminal (28).

(10) Remove cap (29), nut (30), lockring (31), and connector (32). Discard lockring (31).

(11) Remove screw (33), washer (34), and terminal (35).

(12) Remove nut (36), lockwasher (37), and terminal (38). Discard lockwasher (37).



26. PLUG
27. SCREW
28. TERMINAL
29. CAP
30. NUT
31. LOCKRING
32. CONNECTOR
33. SCREW
34. WASHER
35. TERMINAL
36. NUT
37. LOCKWASHER
38. TERMINAL

TA 298770

3-17. POWER PACK REPLACEMENT (Continued)

(7) Install capscrew (142), new lockwasher (143), and washer (144) to secure bracket (145) and oil pressure manifold (146) to transmission (10).

(8) Install temperature sending unit (141), wire (140), washer (139), new lockwasher (138), and nut (137). Tighten nut (137) securely.

(9) Install throttle control solenoid (129), capscrew (135), and washer (136). Install wire (134), washer (133), and capscrew (132). Tighten capscrews (132 and 135) securely.

(10) Install two air lines (130 and 131) and connect to boot connector (128) to throttle control solenoid (129).

(11) Install capscrew (127), washer (126), and nut (125) to secure solenoid valve (124).

(12) Install boot connector (123).

NOTE

Perform step (12.1) on LVSA1 series vehicles only.

(12.1) Connect connector (124.2) and install screw (124.1).

(13) Connect high idle neutral switch plug (148).

(14) Install modulator actuator hose (147). Tighten securely.

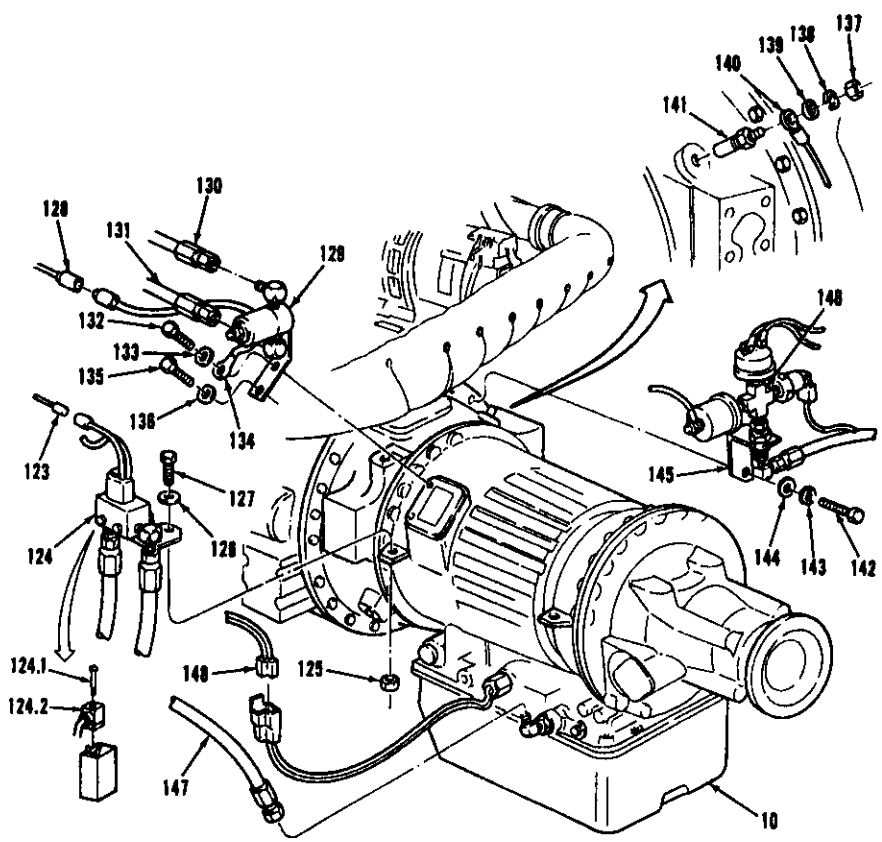
(15) Install engine brake lockup switch (120). Tighten securely.

(16) Install two hoses (121 and 122) Tighten securely.

(17) Plug connector (119) into engine brake lockup switch (120) on bottom of transmission (10).

10. TRANSMISSION
123. BOOT CONNECTOR
124. SOLENOID VALVE
124.1. SCREW*
124.2. CONNECTOR*
125. NUT
126. WASHER
127. CAPSCREW
128. BOOT CONNECTOR
129. THROTTLE CONTROL SOLENOID
130. AIR LINE
131. AIR LINE
132. CAPSCREW
133. LOCKWASHER
134. WIRE
135. CAPSCREW
136. WASHER
137. NUT
138. LOCKWASHER
139. WASHER
140. WIRE
141. TEMPERATURE SENDING UNIT
142. CAPSCREW
143. LOCKWASHER
144. WASHER
145. BRACKET
146. OIL PRESSURE MANIFOLD
147. MODULATOR ACTUATOR HOSE
148. HIGH IDLE NEUTRAL SWITCH PLUG

* LVSA1 SERIES VEHICLES ONLY



(3) Remove nut (10), three terminals (11, 12, and 13), and capscrew (15).

NOTE

Perform step (3.1) on LVSA1 series vehicles only.

(3.1) Remove locknut (15.1), three terminals (15.2, 15.3, and 15.4), and capscrew (15.5). Discard locknut (15.1).

(4) Disconnect plug (16).

(5) Remove nut (17), capscrew (18), and terminal (19).

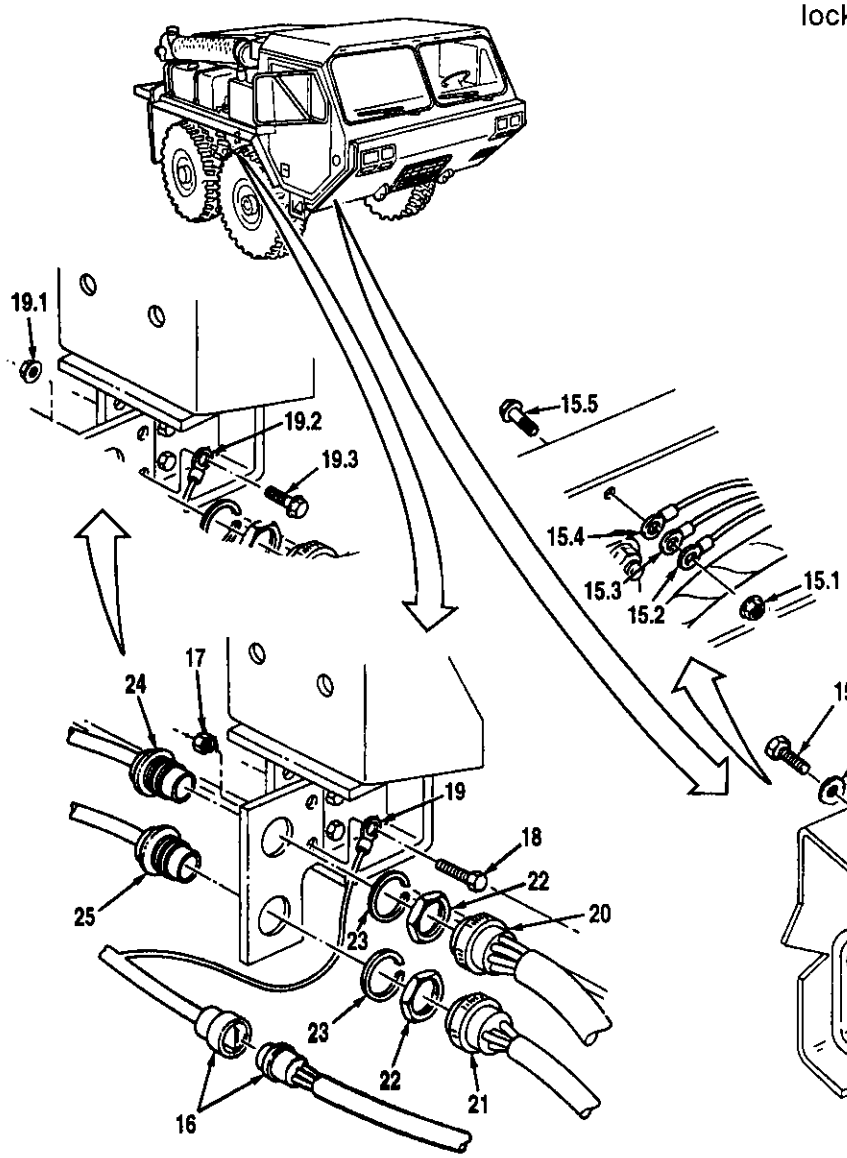
NOTE

Attaching hardware for LVSA1 terminals has been changed from nut, capscrew, and terminal to a locknut, capscrew, and terminal. When repairing non-A1 series vehicles, use new style hardware to replace old style hardware. Refer to TM 9-2320-297-24P for correct parts identification.

(5.1) Remove locknut (19.1), capscrew (19.2), and terminal (19.3). Discard locknut (19.1).

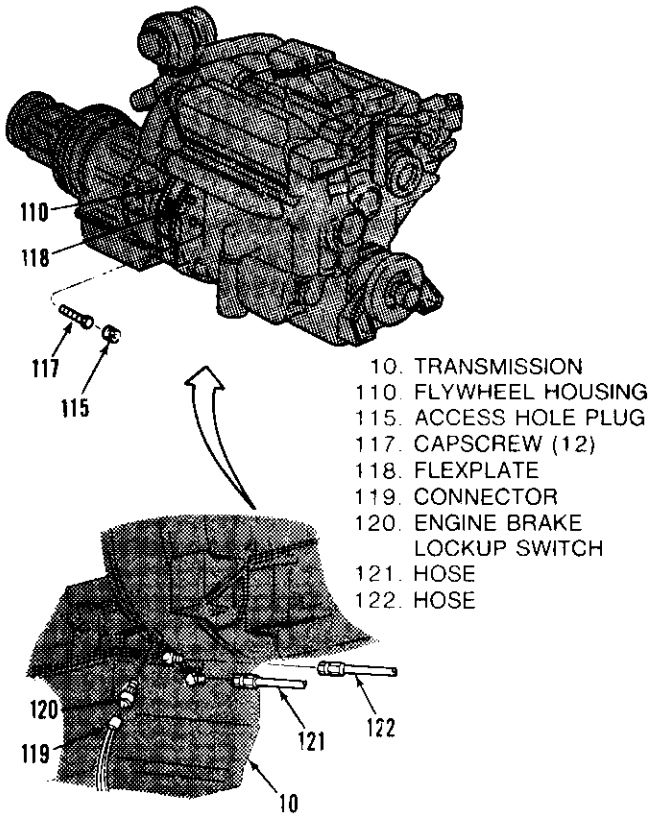
(6) Unplug connectors (20 and 21).

(7) Remove two nuts (22), lockrings (23), and connectors (24 and 25). Discard lockrings (23).



10. NUT
11. TERMINAL
12. TERMINAL
13. TERMINAL
14. WASHER
15. CAPSCREW
15.1. LOCKNUT*
15.2. TERMINAL (435)*
15.3. TERMINAL (435)*
15.4. TERMINAL (435)*
15.5. CAPSCREW*
16. PLUG
17. NUT
18. CAPSCREW
19. TERMINAL
19.1. LOCKNUT
19.2. CAPSCREW
19.3. TERMINAL (435)
20. CONNECTOR
21. CONNECTOR
22. NUT (2)
23. LOCKRING (2)
24. CONNECTOR
25. CONNECTOR

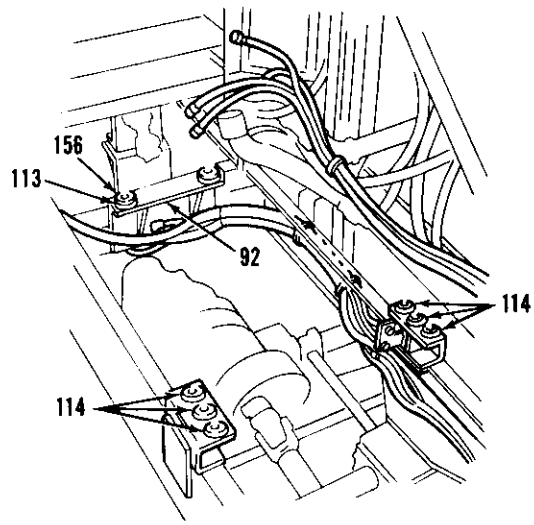
* LVSA1 SERIES VEHICLES ONLY



10. TRANSMISSION
110. FLYWHEEL HOUSING
115. ACCESS HOLE PLUG
117. CAPSCREW (12)
118. FLEXPLATE
119. CONNECTOR
120. ENGINE BRAKE LOCKUP SWITCH
121. HOSE
122. HOSE

(18) Install 12 capscrews (117) to flexplate (118). Torque capscrews (117) to 110 foot-pounds (149 N·m).

(19) Install access hole plug (115).



92. FRONT MOTOR MOUNT
113. RUBBER BISCUIT (2)
114. RUBBER BISCUIT (6)
156. UPPER WASHER (2)

e. Installation

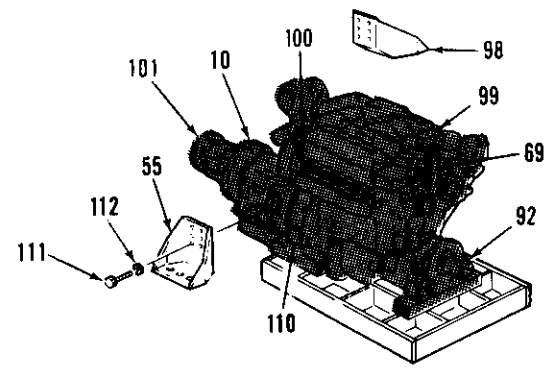
(1) If removed, install two rubber biscuits (113) and upper washers (156) in front motor mount (92). Make sure rubber biscuits (113) are installed and alined with upper washers (156). Attach lifting sling capable of lifting engine (99) and transmission (10). Use the three lifting brackets (69 and 100) to secure engine (99). Use the tail housing (101) to balance transmission (10). Engine (99) and transmission (10) must be level and balanced when lifting.

NOTE

Do not install capscrews in upper two holes of transmission mounts (55 and 98).

(2) Install two transmission mounts (55 and 98) using four capscrews (111) and new lockwashers (112) each as shown below. Torque capscrews (111) to 170 foot-pounds (230 N·m).

(3) If removed, install six rubber biscuits (114).



10. TRANSMISSION
55. RIGHT TRANSMISSION MOUNT
69. LIFTING BRACKET
92. FRONT MOTOR MOUNT
98. LEFT TRANSMISSION MOUNT
99. ENGINE
100. LIFTING BRACKET (2)
101. TAIL HOUSING
110. FLYWHEEL HOUSING
111. CAPSCREW (4)
112. LOCKWASHER (4)

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6-7. CHASSIS WIRING HARNESS REPLACEMENT (MK48)

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Materials/Parts
Corrosion preventive compound (item 14, Appendix C)
Nylon ties (AR) (MS3367-1-9) item 1
Locknut (4) (MS51858-4) item 3
Locknut (2) (1437220) items 15.1 and 19.1
Lockring (4) (NSN 5310-01-081-0799) items 23, 31, and 49
Lockwasher (MS35338-43) item 37
Locknut (2) (MS51922-7) items 54 and 56
Corrosion preventive compound (item 14.1, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Intervehicular connector disconnected (para 22-15).
TM 2320-20/12 TM 9-2320-297-20	Batteries disconnected (para 7-43).
	Batteries disconnected (para 7-43.1 steps (2), (3), and (7)) (LVSA1 series vehicles only).
	STE/ICE panel removed (para 18-14).
	Fuel/water separator removed (para 4-18, step a. (1.1)) (LVSA1 series vehicles only).

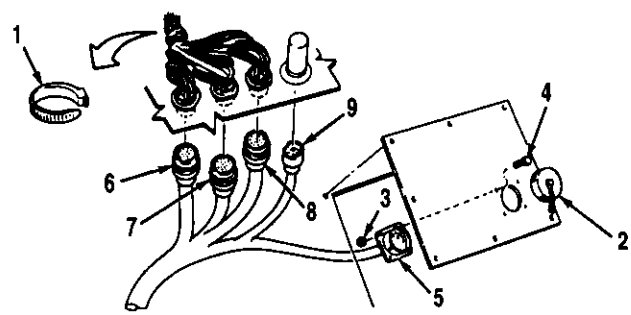
a. Removal

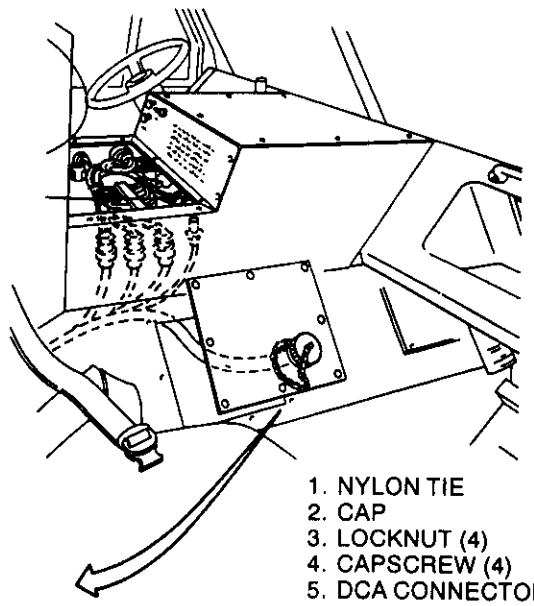
NOTE

Remove nylon ties (1) as needed. Note location for proper installation.

(1) Remove cap (2), four locknuts (3), capscrews (4), and DCA connector (5). Discard locknuts (3).

(2) Unplug four connectors (6 thru 9).





1. NYLON TIE
2. CAP
3. LOCKNUT (4)
4. CAPSCREW (4)
5. DCA CONNECTOR
6. CONNECTOR
7. CONNECTOR
8. CONNECTOR
9. CONNECTOR

3-17. POWER PACK REPLACEMENT (Continued)

WARNING

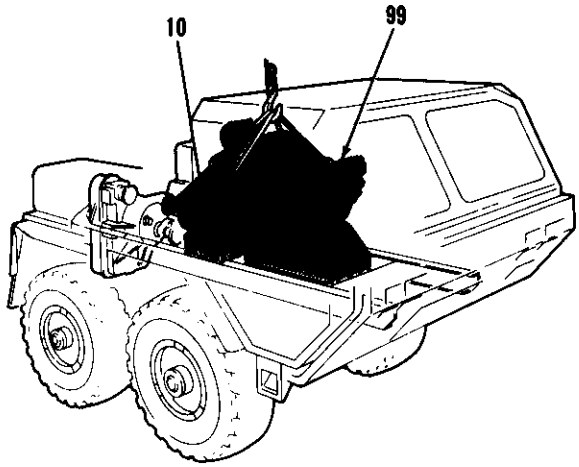
Keep out from under engine (99) and transmission (10) when lifting. If engine (99) and transmission (10) slips, sways, or falls, it may cause serious injury or death.

Avoid puncturing accumulator (97) while installing engine and transmission.

CAUTION

Secure loose hoses and wires out of the way so they do not snag and cause damage when engine (99) and transmission (10) is installed. Lift engine (99) slightly to see if balanced. If engine (99) and transmission (10) tilt, adjust chain lengths. Unbalanced engine (99) may swing, causing damage. To avoid damage, prevent engine (99) or any components from hitting anything while installing.

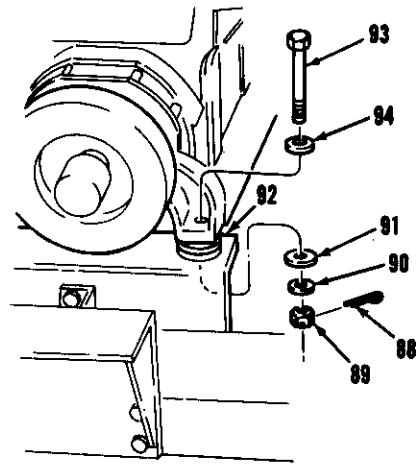
(4) Lift and position engine (99) and transmission (10) in vehicle.



10. TRANSMISSION
99. ENGINE

(5) Aline holes in front motor mount (92). Install two capscrews (93) and washers (94).

(6) Install two biscuit washers (91), washers (90), and castle nuts (89). Tighten capscrews (93) and castle nuts (89) four to five turns.



88. COTTER PIN (2)
89. CASTLE NUT (2)
90. WASHER (2)
91. BISCUIT WASHER (2)
92. FRONT MOTOR MOUNT
93. CAPSCREW (2)
94. WASHER (2)

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(7) Aline holes in bottom of right transmission mount (55).

NOTE

It may be necessary to use two washers (108) on capscrews (107) to insert cotter pins (102).

(8) Install three upper biscuits (106), biscuit plates (105), capscrews (107), washers (104 and 108), and castle nuts (103). Tighten capscrews (107) and castle nuts (103) four to five turns.

(22) Install wire (33) and capscrew (32).

(23) Install wires (29, 30, and 31) and nut (28).

(24) Install wires (26 and 27) and nut (25).

(25) Install wires (23 and 24) and nut (22).

(26) Install new lockwasher (21), wires (19 and 20), new lockwasher (18), and capscrew (17).

(27) Install new lockwasher (16), wire (15), new lockwasher (14), and capscrew (13).

(28) Install wire (12) and nut (11).

(29) Install wire (10) and nut (9).

(30) Install wires (7 and 8) and nut (6).

(31) If removed, install clamp (4) with capscrew (5), washer (3), and nut (2) where removed.

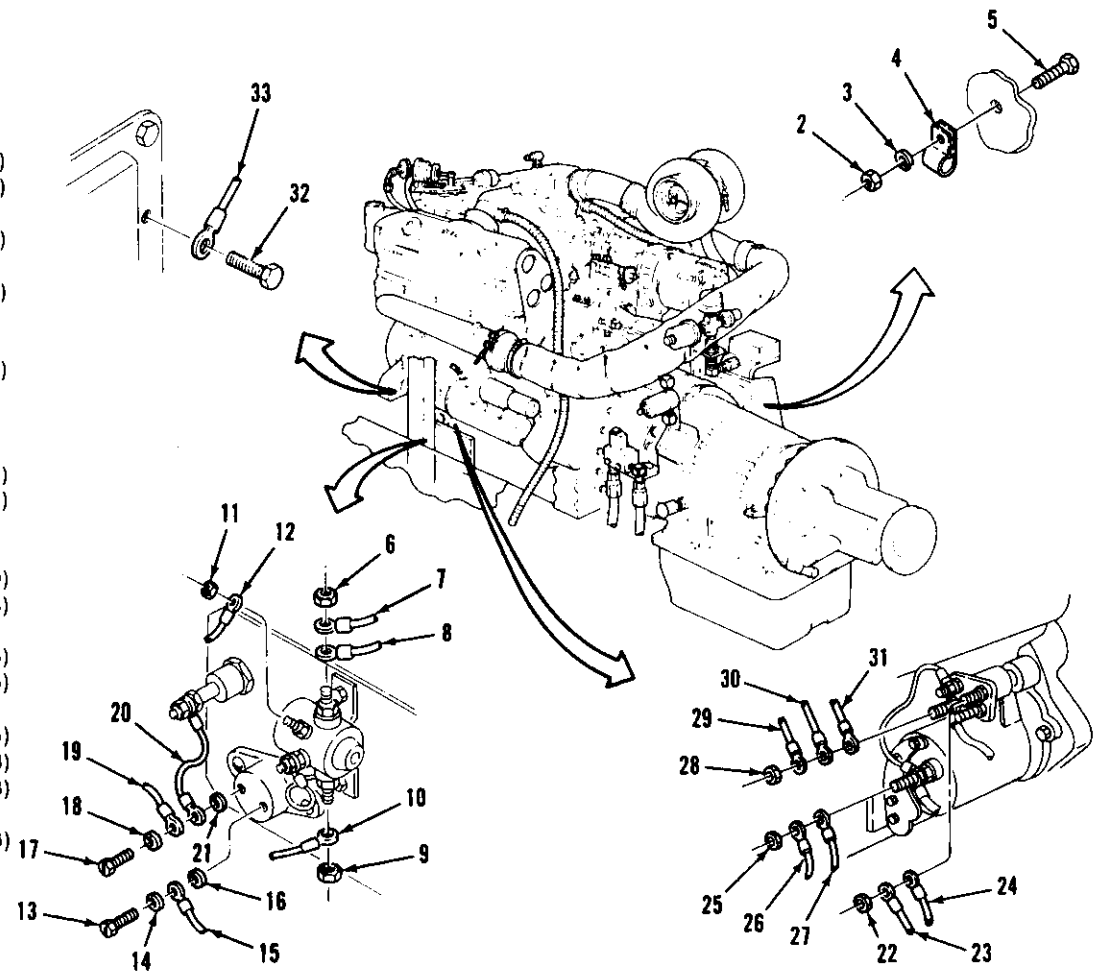
END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install access panels (para 18-14).
	Install air cleaner assembly (para 4-6).
	Connect batteries (para 7-43).
TM 2320-10/11 TM 9-2320-297-10	Start engine and check all gages for correct readings (para 2-13).

2. NUT
3. WASHER
4. CLAMP
5. CAPSCREW
6. NUT
7. WIRE (NO. 046)
8. WIRE (NO. 430)
9. NUT
10. WIRE (NO. 045)
11. NUT
12. WIRE (NO. 021)
13. CAPSCREW
14. LOCKWASHER
15. WIRE (NO. 833)
16. LOCKWASHER
17. CAPSCREW
18. LOCKWASHER
19. WIRE (NO. 278)
20. WIRE (NO. 278)
21. LOCKWASHER
22. NUT
23. WIRE (NO. 819)
24. WIRE (NO. 128)
25. NUT
26. WIRE (NO. 816)
27. WIRE (NO. 045)
28. NUT
29. WIRE (NO. 046)
30. WIRE (NO. 833)
31. WIRE (NO. 818)
32. CAPSCREW
33. WIRE (NO. 036)



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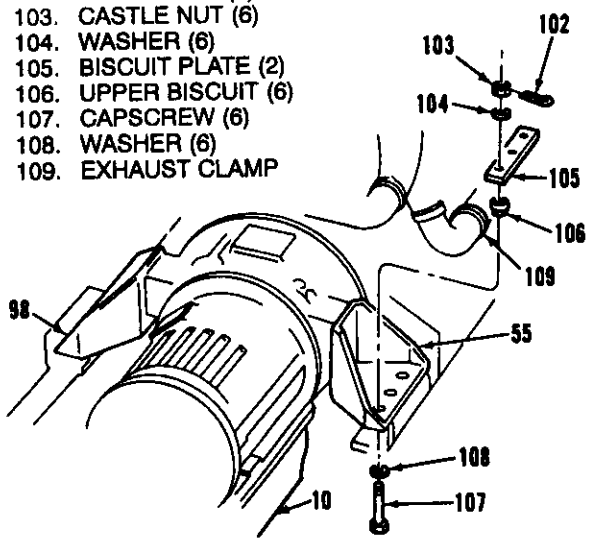
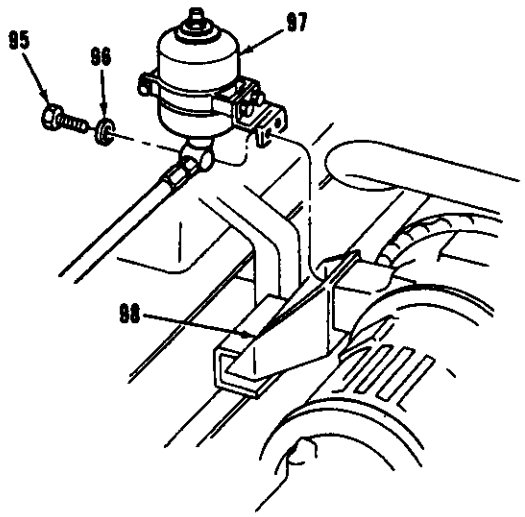
10. TRANSMISSION
55. RIGHT TRANSMISSION MOUNT
98. LEFT TRANSMISSION MOUNT
102. COTTER PIN (6)
103. CASTLE NUT (6)
104. WASHER (6)
105. BISCUIT PLATE (2)
106. UPPER BISCUIT (6)
107. CAPSCREW (6)
108. WASHER (6)
109. EXHAUST CLAMP

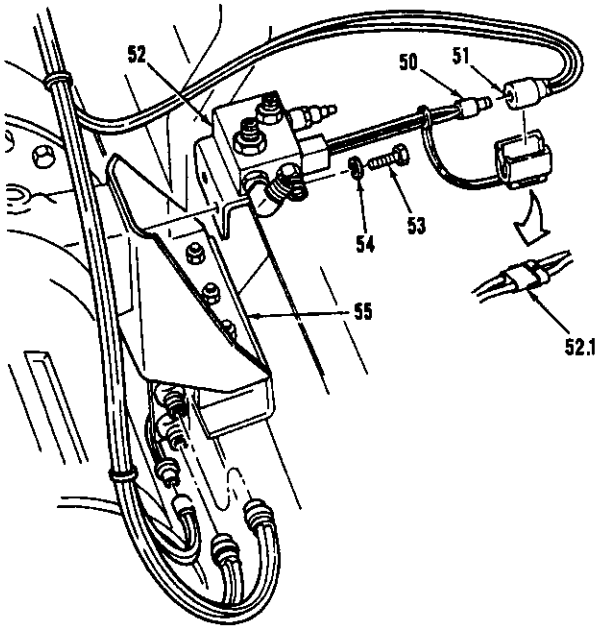


(9) Repeat step (8) for left transmission mount (98). Install accumulator (97), using two capscrews (95) and new lockwashers (96). Torque capscrews (95) to 170 foot-pounds (230 N·m).

95. CAPSCREW (2)
96. LOCKWASHER (2)
97. ACCUMULATOR
98. LEFT TRANSMISSION MOUNT



(10) Tighten two capscrews (93) and castle nuts (89) securely. Install two new cotter pins (88).



50. PLUG
51. PLUG
52. FAN CONTROL VALVE
■ 52.1. WEATHER PACK CONNECTOR*
53. CAPSCREW (2)
54. LOCKWASHER (2)
55. RIGHT TRANSMISSION MOUNT

■ * LVSA1 SERIES VEHICLES ONLY

(11) Tighten six capscrews (107) and castle nuts (103) securely. Install six new cotter pins (102).

(12) Install on right transmission mount (55) two capscrews (53), new lockwashers (54), and fan control valve (52). Torque capscrews (53) 170 foot-pounds (230 N·m).

(13) Connect two plugs (50 and 51) on fan control valve (52)

NOTE

Perform step (13.1) on LVSA1 series vehicles only.

(13.1) Connect weather pack connector (52.1).

(22) Install wire (33), new lockwasher (32.1), and capscrew (32).

(23) Install wires (29, 30, and 31) and nut (28).

(24) Install wires (26 and 27) and nut (25).

(25) Install wires (23 and 24) and nut (22).

(26) Install new lockwasher (21), wires (19 and 20), new lockwasher (18), and capscrew (17).

(27) Install new lockwasher (16), wire (15), new lockwasher (14), and capscrew (13).

(28) Install wire (12) and nut (11).

(29) Install wire (10) and nut (9).

(30) Install wires (7 and 8) and nut (6).

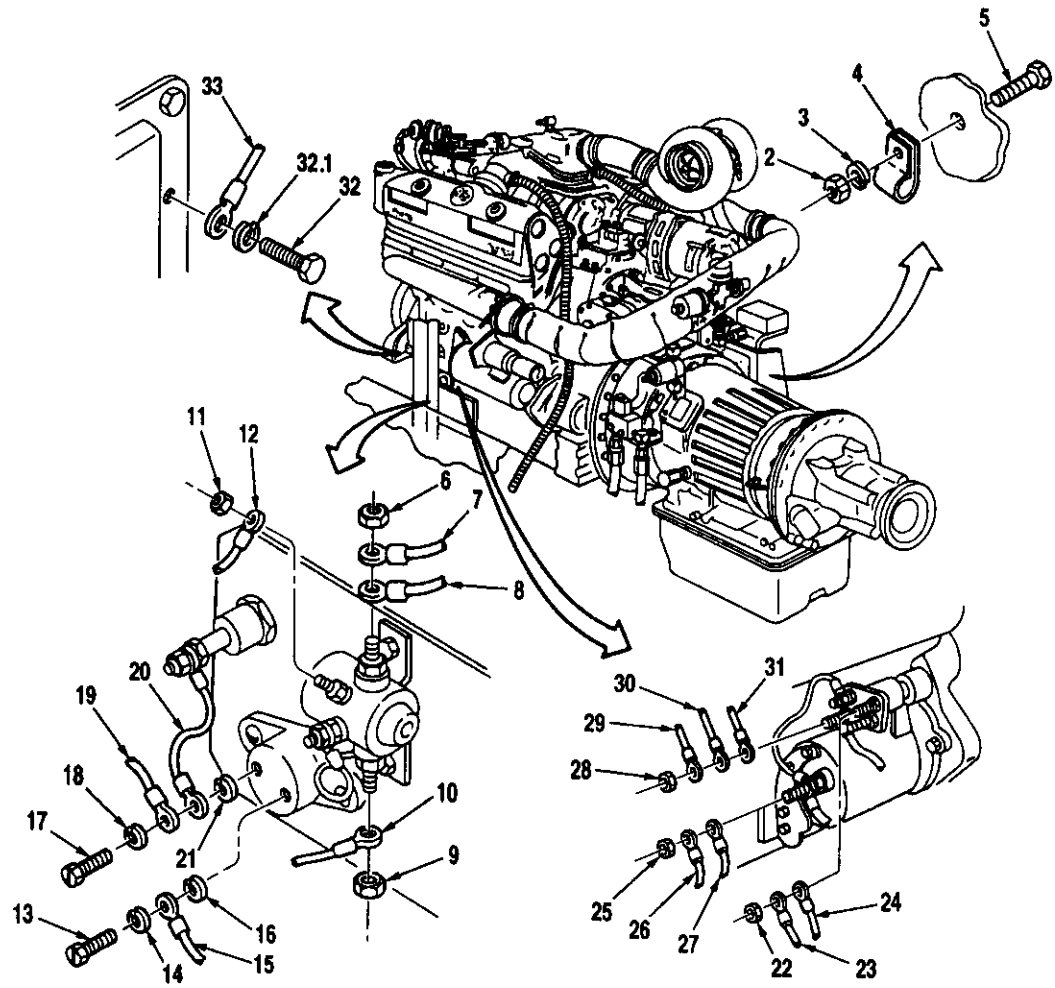
(31) If removed, install clamp (4) with capscrew (5), washer (3), and nut (2) where removed.

END OF TASK

NOTE

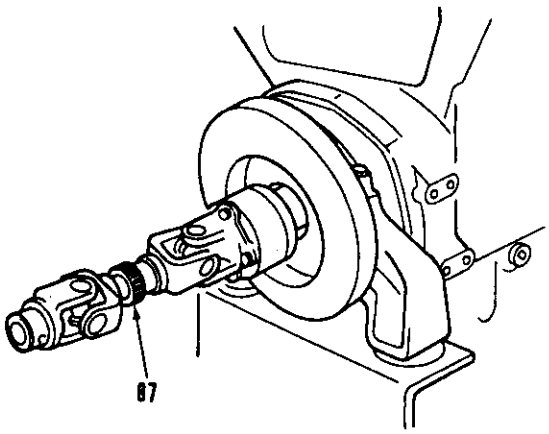
Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install access panels (para 18-14). Install air cleaner assembly (para 4-6). Connect batteries (para 7-43 or 7-43.1 on LVSA1 series vehicles only).
TM 2320-10/11 TM 9-2320-297-10	Start engine and check all gages for correct readings (para 2-13).



2. NUT
3. WASHER
4. CLAMP
5. CAPSCREW
6. NUT
7. WIRE (NO. 046)
8. WIRE (NO. 430)
9. NUT
10. WIRE (NO. 045)
11. NUT
12. WIRE (NO. 021)
13. CAPSCREW
14. LOCKWASHER
15. WIRE (NO. 833)
16. LOCKWASHER
17. CAPSCREW
18. LOCKWASHER
19. WIRE (NO. 278)
20. WIRE (NO. 279)
21. LOCKWASHER
22. NUT
23. WIRE (NO. 819)
24. WIRE (NO. 128)
25. NUT
26. WIRE (NO. 816)
27. WIRE (NO. 045)
28. NUT
29. WIRE (NO. 046)
30. WIRE (NO. 833)
31. WIRE (NO. 818)
32. CAPSCREW
32.1. LOCKWASHER
33. WIRE (NO. 036)

3-17. POWER PACK REPLACEMENT (Continued)



87. HYDRAULIC PUMP DRIVE SHAFT

(14) Install hydraulic pump drive shaft (87). Refer to paragraph 19-22 in this manual.

(15) Install hose (85) and clamp (84) onto engine oil cooler (86). Tighten clamp (84) to 40 inch-pounds (4.5 N·m).

(16) Install two hoses (81 and 82) and clamps (80) at tagged location on bottom of right thermostat housing (83). Tighten clamps (80) to 40 inch-pounds (4.5 N·m).

(17) Remove two capscrews (67), lockwashers (68), and lifting bracket (69). Discard lockwashers (68).

(18) Loosen four clamps (70) and remove crossover tube (71).

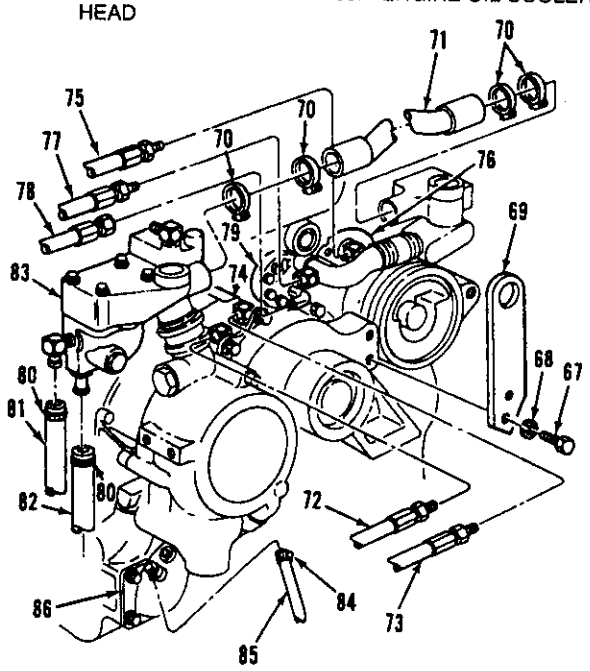
CAUTION

To prevent damage, fuel lines (72, 73, 75, 77 and 78) must be routed over motor mount.

(19) Install two fuel lines (77 and 78) at tagged location on fuel pump (79).

(20) Install one fuel line (75) at tagged location on left cylinder head (76). Install two fuel lines (72 and 73) at tagged location on right cylinder head (74).

67. CAPSCREW (2)
68. LOCKWASHER (2)
69. LIFTING BRACKET
70. CLAMP (4)
71. CROSSOVER TUBE
72. FUEL LINE
73. FUEL LINE
74. RIGHT CYLINDER HEAD
75. FUEL LINE
76. LEFT CYLINDER HEAD
77. FUEL LINE
78. FUEL LINE
79. FUEL PUMP
80. CLAMP (2)
81. HOSE
82. HOSE
83. RIGHT THERMOSTAT HOUSING
84. CLAMP (2)
85. HOSE
86. ENGINE OIL COOLER



(21) Install crossover tube (71) and four clamps (70). Tighten clamps (70) to 100 inch-pounds (11 N·m).

(22) Install lifting bracket (69), two new lockwashers (68), and capscrews (67). Tighten capscrews (67) securely.

(23) Install two capscrews (65) and new lockwashers (66) onto coolant filter adapter assembly (62). Install two hoses (63 and 64) and clamps (60 and 61) at tagged locations on coolant filter adapter assembly (62). Tighten clamps (60 and 61) to 40 inch-pounds (4.5 N·m).

(24) Install dipstick tube (59). Tighten nut (58) securely.

(8) Install wires (65 and 66) with new connector (64).

NOTE

Perform step (8.1) for LVSA1 series vehicles only.

(8.1) Connect connectors (66.1 and 66.2).

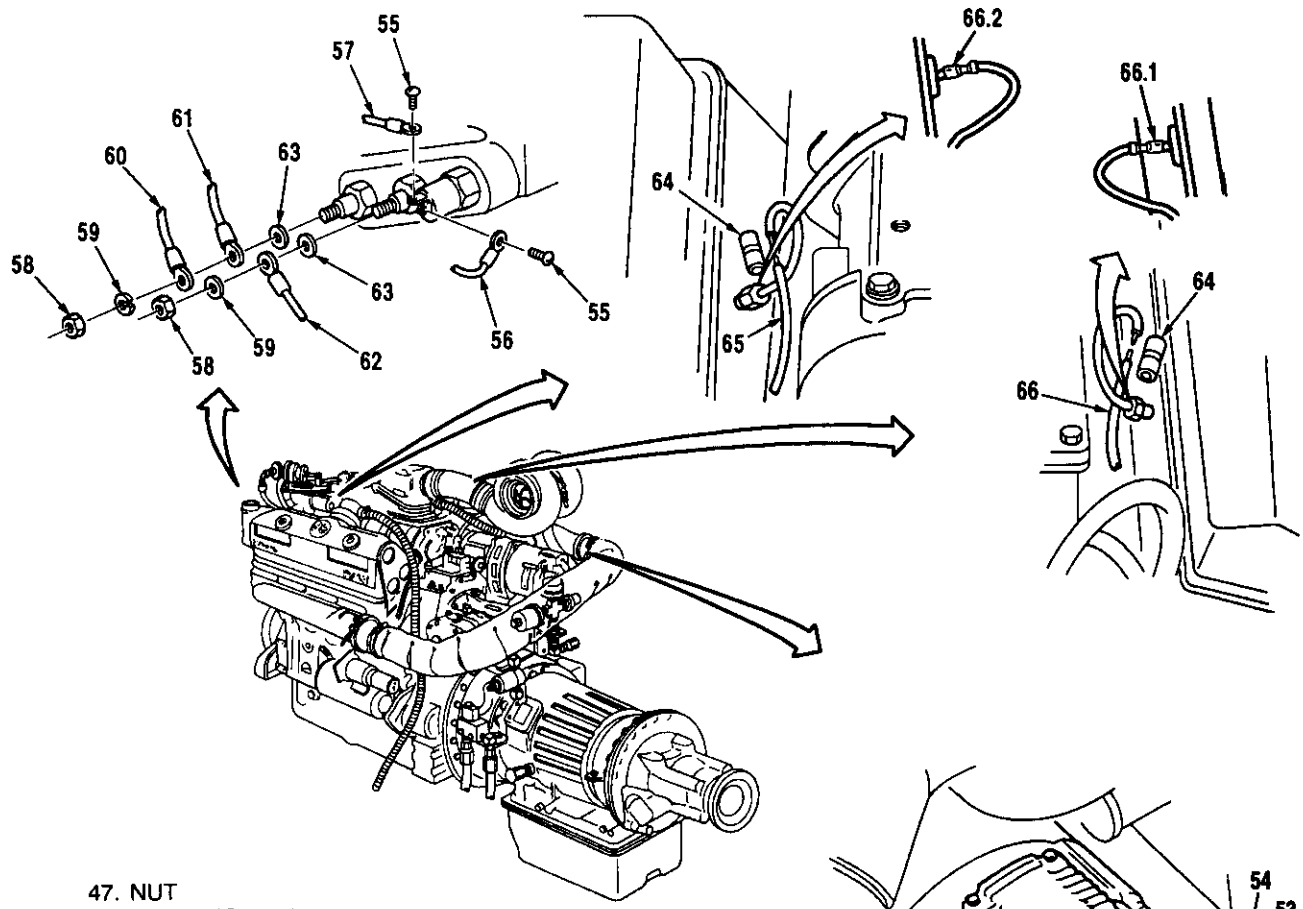
(9) Install washers (63), wires (60, 61, and 62), new lockwashers (59), and nuts (58).

(10) Install wires (56 and 57) and two screws (55).

(11) Install wires (53 and 54) and nut (52).

(12) Install wire (57) and nut (50).

(13) Install wires (48 and 49) and nut (47).



47. NUT
48. WIRE (NO. 815)
49. WIRE (NO. 128)
50. NUT
51. WIRE (NO. 831)
52. NUT
53. WIRE (NO. 820)
54. WIRE (NO. 278)
55. SCREW (2)
56. WIRE (NO. 718)
57. WIRE (NO. 718)
58. NUT (2)
60. WIRE (NO. 032)
61. WIRE (NO. 147)
62. WIRE (NO. 320)
63. WASHER (2)
64. CONNECTOR
65. WIRE (NO. 715)
66. WIRE (NO. 716)
66.1. CONNECTOR*
66.2. CONNECTOR*

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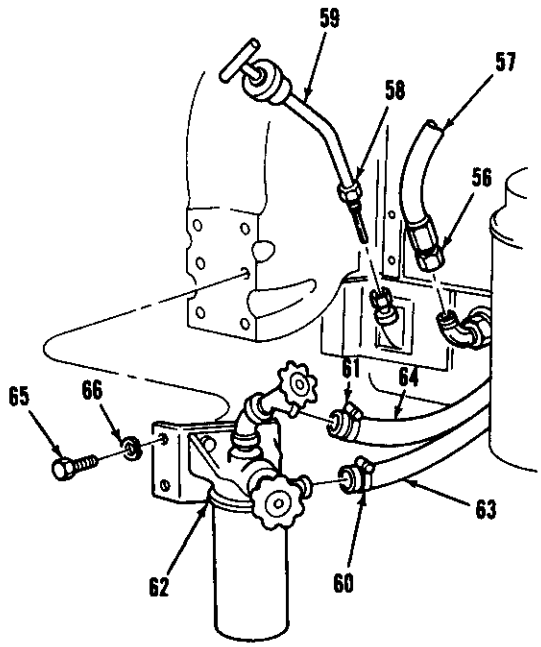
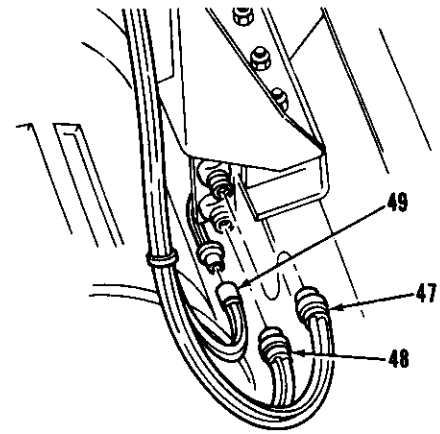


56. NUT
57. OIL FILLER TUBE
58. NUT
59. DIPSTICK TUBE
60. CLAMP
61. CLAMP
62. COOLANT FILTER ADAPTER ASSEMBLY
63. HOSE
64. HOSE
65. CAPSCREW
66. LOCKWASHER

(25) Install oil filler tube (57). Tighten nut (56) securely.

(26) Connect two quick disconnects (47 and 48) and one plug (49) at tagged locations on bottom right side of vehicle.

(27) Install two ground wires (44 and 45), capscrew (40), new star washers (41), and nut (42) onto bracket (43). Tighten capscrew (40) and nut (42) securely.

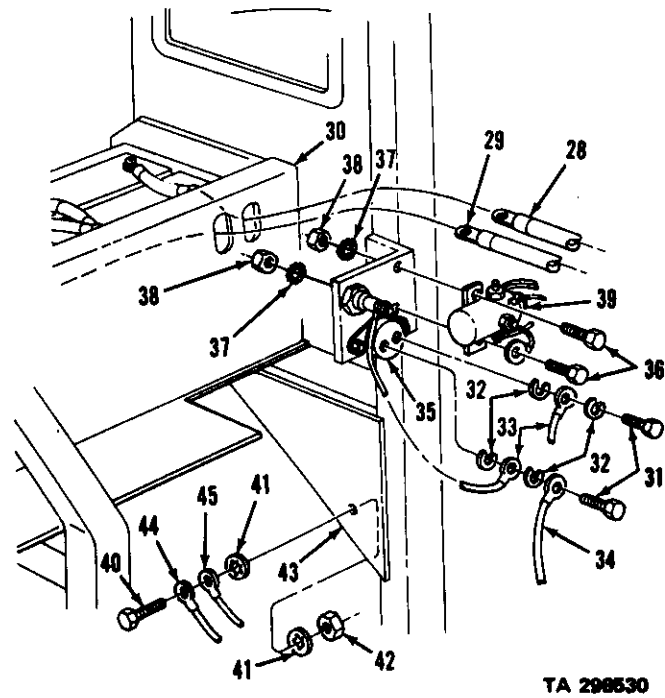


47. QUICK DISCONNECT
48. QUICK DISCONNECT
49. PLUG

(28) Install magnetic switch (39), two capscrews (36), new star washers (37), and nuts (38). Tighten capscrews (36) and nuts (38) securely.

(29) Install three wires (33 and 34), two capscrews (31), and new lockwashers (32) on circuit breaker (35). Tighten capscrews (31) securely.

(30) Install two battery cables (28 and 29) through slots in battery box (30).



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28. BATTERY CABLE
29. BATTERY CABLE
30. BATTERY BOX
31. CAPSCREW (2)
32. LOCKWASHER (4)
33. WIRE (2)
34. WIRE
35. CIRCUIT BREAKER
36. CAPSCREW (2)
37. STAR WASHER (2)
38. NUT (2)
39. MAGNETIC SWITCH
40. CAPSCREW
41. STAR WASHER (2)
42. NUT
43. BRACKET
44. GROUND WIRE
45. GROUND WIRE

6-6. ENGINE WIRING HARNESS REPLACEMENT (Continued)

c. Installation

NOTE

- Install nylon ties (1) where removed.
- Match wire numbers on new harness to wire numbers remaining on the vehicle.
- Tighten all hardware as it is installed.

(1) Place wiring harness (86) into position.

(2) Connect plug (85) and connectors (83 and 84).

NOTE

Perform step (2.1) for LVSA1 series vehicles only.

(2.1) Connect weather pack connector (82.1).

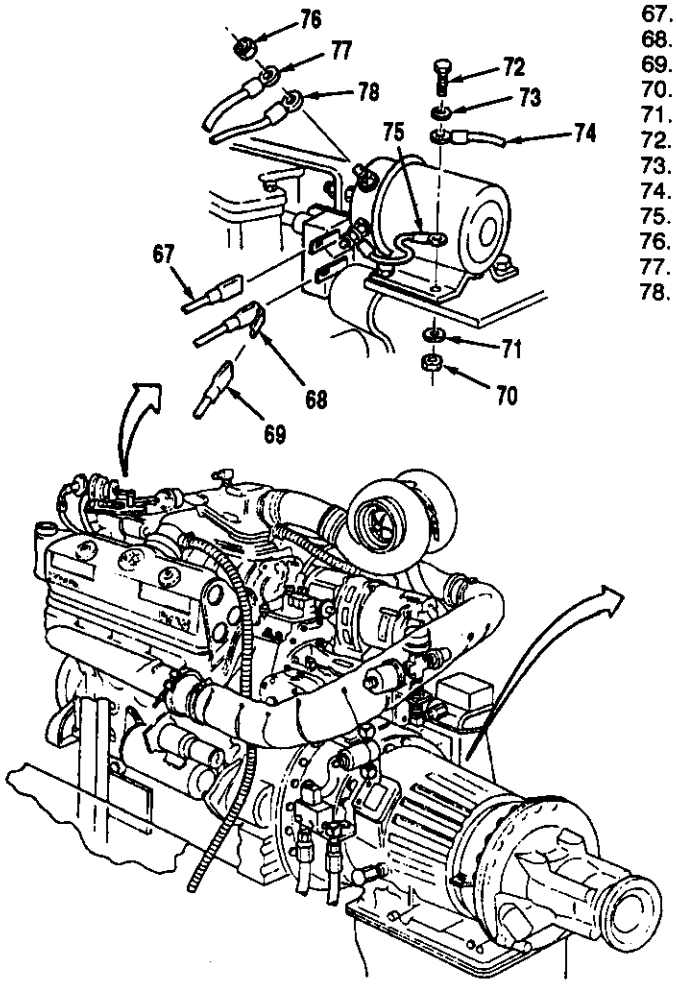
(3) Connect two plugs (81 and 82).

(4) Install insulator (80.2), washer (80.1), wire (80), new lockwasher (79.1), and nut (79). Tighten nut (79) to 20 inch-pounds (2.3 N·m) maximum.

(5) Install wires (77 and 78) and nut (76).

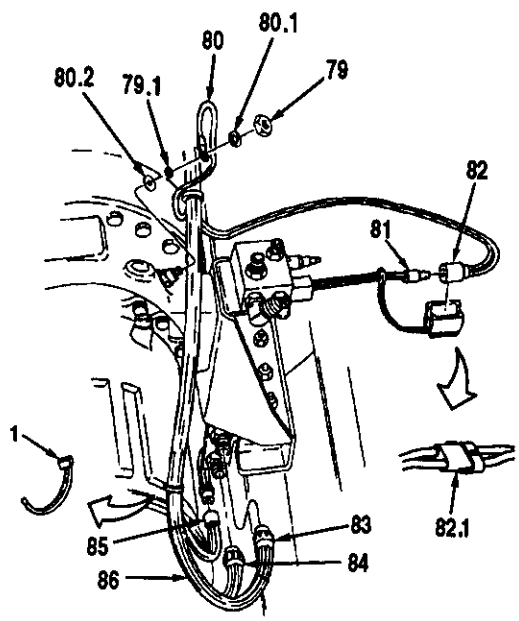
(6) Install wires (74 and 75), new lockwasher (73), capscrew (72), washer (71), and nut (70).

(7) Install wires (67, 68, and 69).



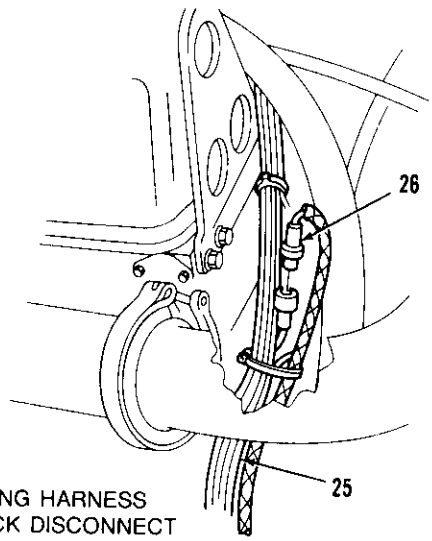
1. NYLON TIE
67. WIRE (NO. 713)
68. WIRE (NO. 839)
69. WIRE (NO. 714)
70. NUT
71. WASHER
72. CAPSCREW
73. LOCKWASHER
74. WIRE (NO. 019)
75. WIRE NO. 718)
76. NUT
77. WIRE (NO. 817)
78. WIRE (NO. 019)
79. NUT
79.1. LOCKWASHER*
80. WIRE (NO. 442)
80.1. WASHER*
80.2. INSULATOR*
81. PLUG
82. PLUG
82.1. WEATHER PACK CONNECTOR*
83. CONNECTOR
84. CONNECTOR
85. PLUG
86. WIRING HARNESS

*LVSA1 SERIES VEHICLES ONLY



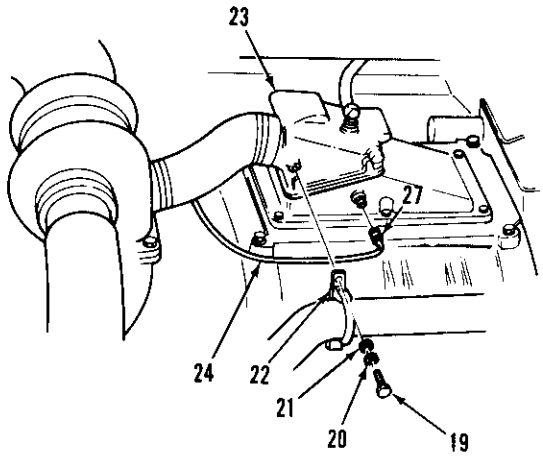
3-17. POWER PACK REPLACEMENT (Continued)

(31) Connect quick disconnect (26) in wiring harness (25). Install tube (24) and fitting (27) into air inlet housing (23). Tighten fitting (27) securely.



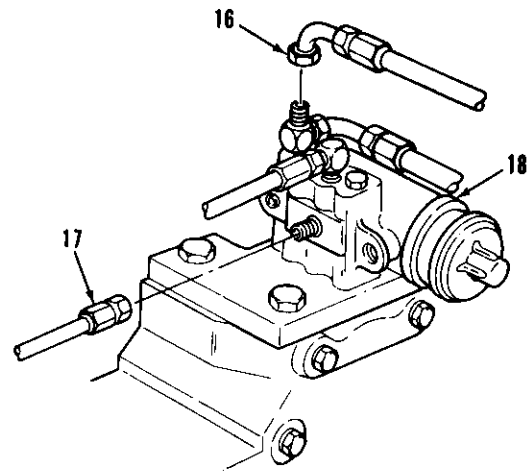
25. WIRING HARNESS
26. QUICK DISCONNECT

(32) Install bracket (22), capscrew (19), new lockwasher (20), and washer (21) on air inlet housing (23).



19. CAPSCREW
20. LOCKWASHER
21. WASHER
22. BRACKET
23. AIR INLET HOUSING
24. TUBE
27. FITTING

(33) Install two air lines (16 and 17) at tagged locations on air compressor governor (18).



16. AIR LINE
17. AIR LINE
18. AIR COMPRESSOR GOVERNOR

TA 298531

(34) Install air compressor hose (14) at tagged location on air compressor (15).

(35) Install transmission inlet line (11) at tagged location on transmission (10).

(36) Install hydraulic hose (12) at tagged location on steering valve bracket (13).

(37) Install transmission outlet line (9) at tagged location on transmission (10).

(38) Install transfer case linkage bracket (8), two capscrews (6), and new lockwashers (7). Tighten capscrews (6) securely.

(27) Remove nut (79), lockwasher (79.1), wire (80), washer (80.1), and insulator (80.2). Discard lockwasher (79.1).

(28) Disconnect two plugs (81 and 82).

NOTE

Perform step (28.1) for LVSA1 series vehicles only.

(28.1) Disconnect weather pack connector (82.1).

(29) Remove connectors (83 and 84) and plug (85).

(30) Remove wiring harness (86).

b. Cleaning/Inspection

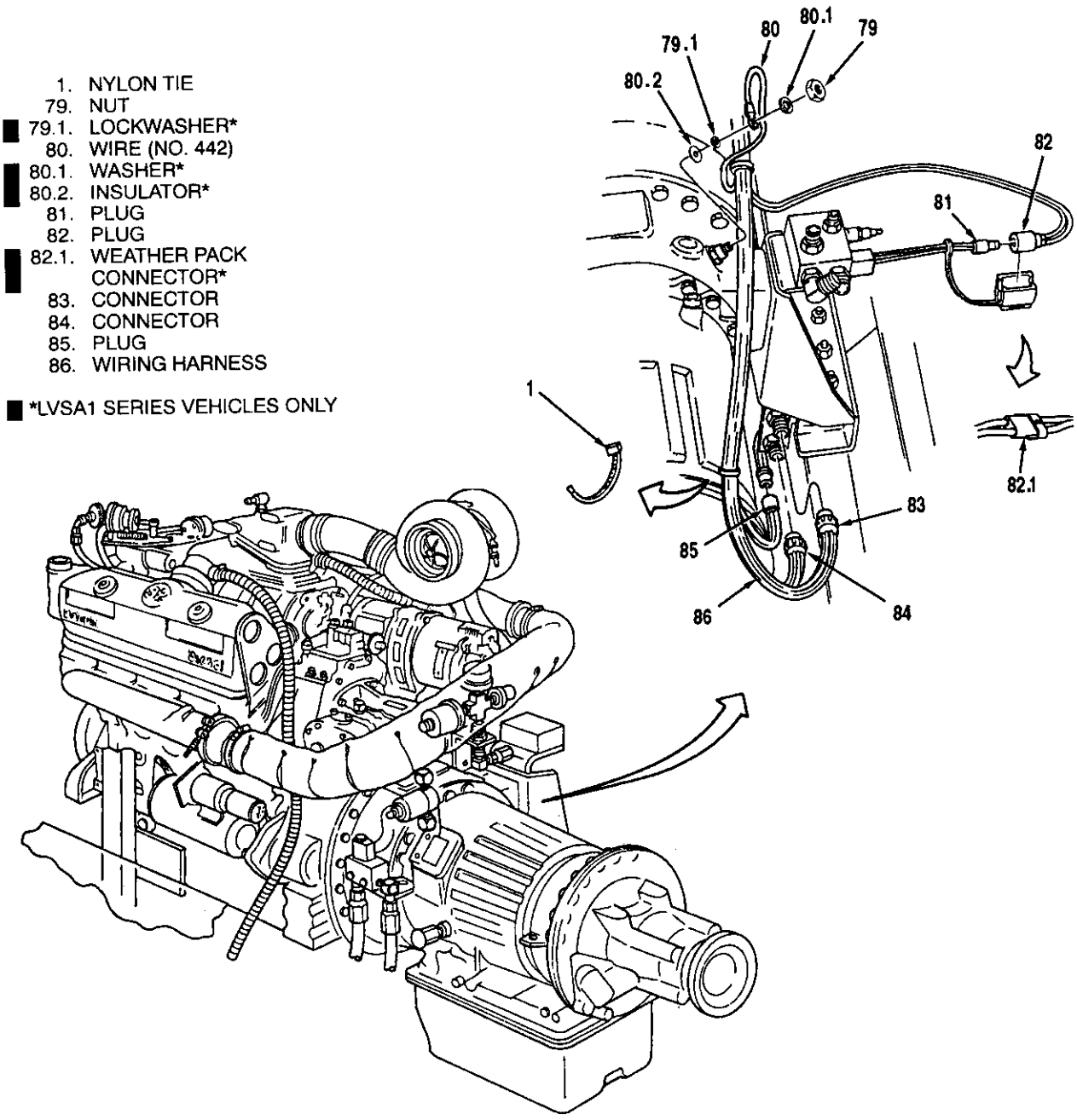
(1) Clean all parts. Refer to paragraph 2-6.

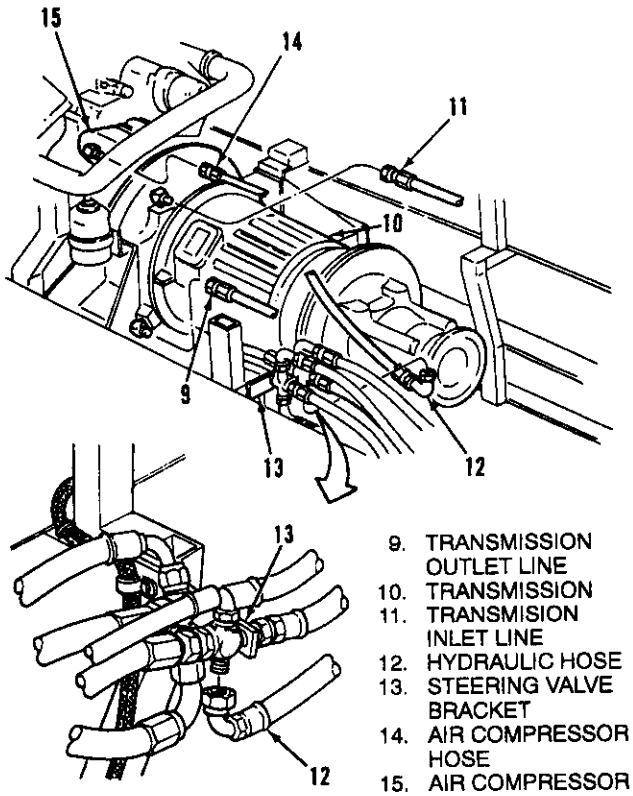
(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

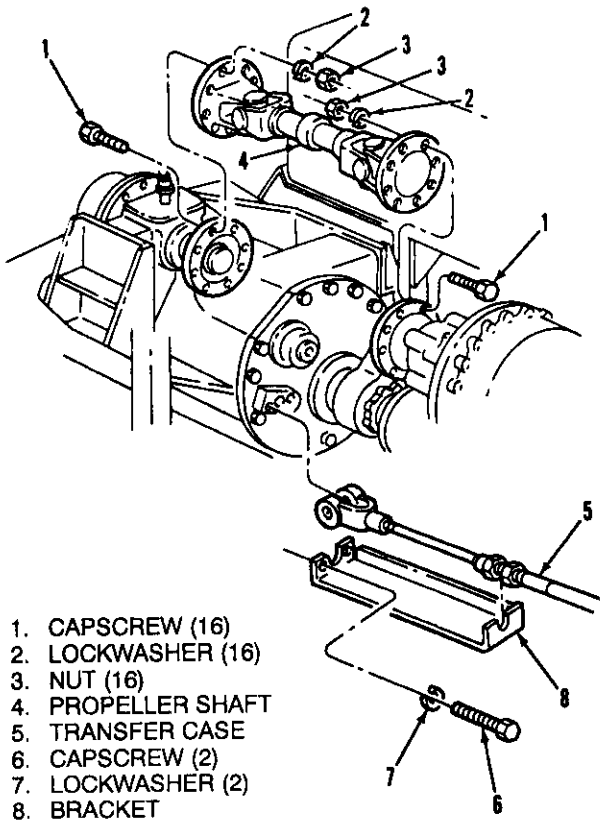
1. NYLON TIE
79. NUT
79.1. LOCKWASHER*
80. WIRE (NO. 442)
80.1. WASHER*
80.2. INSULATOR*
81. PLUG
82. PLUG
82.1. WEATHER PACK CONNECTOR*
83. CONNECTOR
84. CONNECTOR
85. PLUG
86. WIRING HARNESS

*LVSA1 SERIES VEHICLES ONLY





9. TRANSMISSION OUTLET LINE
10. TRANSMISSION
11. TRANSMISION INLET LINE
12. HYDRAULIC HOSE
13. STEERING VALVE BRACKET
14. AIR COMPRESSOR HOSE
15. AIR COMPRESSOR



1. CAPSCREW (16)
2. LOCKWASHER (16)
3. NUT (16)
4. PROPELLER SHAFT
5. TRANSFER CASE
6. CAPSCREW (2)
7. LOCKWASHER (2)
8. BRACKET

(39) Install transfer case linkage (5). Refer to paragraph 9-4 (TM 2320-20/12, TM 9-2320-297-20).

(40) Aline and install propeller shaft (4), 16 capscrews (1), new lockwashers (2), and nuts (3). Tigthen 16 capscrews (1) and nuts (3) securely.

END OF TASK

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install radiator and air reservoir assembly (para 16-5).
TM 2320-20/12 TM 9-2320-297-20	Install air cleaner assembly (para 4-6).
	Install intake ducting para (4-9).
	Fill engine with oil (para 3-3).
	Install engine oil sampling valve (para 3-7.1, step 3, LVSA1 series vehicles only).
	Install engine access panels (para 18-14).
	Install transmission shift cable (para 8-6).
	Install throttle cylinder (para 4-15).
	Connect battery cables (para 7-43 or 7-43.1 on LVSA1 series vehicles only).
	Install shutdown solenoid (para 4-13 or 4-13.1 on LVSA1 series vehicles only).
	Install lower radiator hose and tube (para 6-7).

6-6. ENGINE WIRING HARNESS REPLACEMENT (Continued)

(21) Remove two screws (55) and wires (56 and 57).

(22) Remove two nuts (58), lockwashers (59), wires (60, 61, and 62), and washers (63). Discard lockwashers (59).

(23) Remove connectors (64) and wires (65 and 66).

NOTE

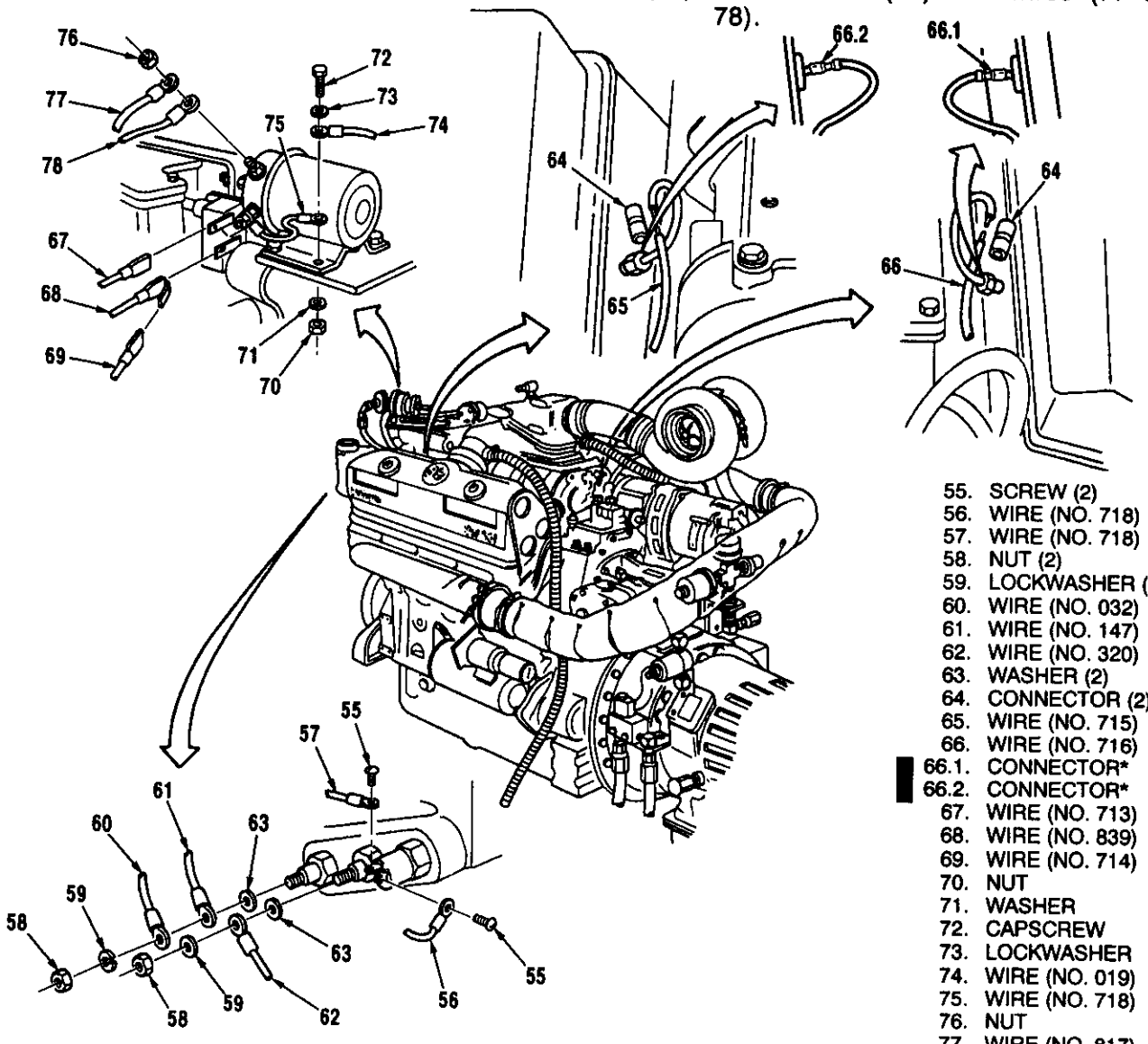
Perform step (23.1) for LVSA1 series vehicles only.

(23.1) Disconnect connectors (66.1 and 66.2).

(24) Remove wires (67, 68, and 69).

(25) Remove nut (70), washer (71), capscrew (72), lockwasher (73), and wires (74 and 75). Discard lockwasher (73).

(26) Remove nut (76) and wires (77 and 78).



55. SCREW (2)
56. WIRE (NO. 718)
57. WIRE (NO. 718)
58. NUT (2)
59. LOCKWASHER (2)
60. WIRE (NO. 032)
61. WIRE (NO. 147)
62. WIRE (NO. 320)
63. WASHER (2)
64. CONNECTOR (2)
65. WIRE (NO. 715)
66. WIRE (NO. 716)
66.1. CONNECTOR*
66.2. CONNECTOR*
67. WIRE (NO. 713)
68. WIRE (NO. 839)
69. WIRE (NO. 714)
70. NUT
71. WASHER
72. CAPSCREW
73. LOCKWASHER
74. WIRE (NO. 019)
75. WIRE (NO. 718)
76. NUT
77. WIRE (NO. 817)
78. WIRE (NO. 019)

* LVSA1 SERIES VEHICLES ONLY

SECTION IV. ENGINE DISASSEMBLY INTO SUBASSEMBLIES AND REASSEMBLY FROM SUBASSEMBLIES

3-18. MOUNTING ENGINE TO ENGINE STAND

THIS TASK COVERS: a. Lifting
b. Draining
c. Cleaning/Inspection
d. Component Removal
e. Mount to Stand

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Cleaning solvent (item 66, Appendix C)
Tape (item 71, Appendix C)

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition

TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Power pack removed (para 3-17).
TM 2320-20/12 TM 9-2320-297-20	Exhaust manifold removed (para 3-7).

a. Lifting

(1) Install a sling to the three engine lifting brackets (1).

NOTE

The lifting fixture should be adjusted so the lifting hooks are vertical. This prevents bending the lifting brackets (1).

(2) Using a hoist capable of lifting engine, lift engine for draining and cleaning.

b. Draining

(1) Remove oil drain plug (2). Drain oil into container.

(2) Install oil drain plug (2) once oil stops draining.

(3) Open drain cock (3). Drain oil into container.

(4) Open drain cocks (4, 5, and 6). Drain coolant into a container.

(5) Close all drain cocks (3, 4, 5, and 6) after fluids have been drained.

c. Cleaning/Inspection

(1) Tape the exhaust openings closed.

(2) Using water under pressure, wash the external parts of the engine.

(3) Remove oil and grease using a stiff brush and solvent.

CAUTION

Do not set engine on oil pan (7). Use wooden blocks under front engine mount (8) and flywheel housing (9) to prevent damage to engine parts.

(4) Place blocks under front engine mount (8) and flywheel housing (9).Set engine on blocks for inspection and component removal.

(14) Remove wire (41).

(15) Remove screw (42) and wire (43).

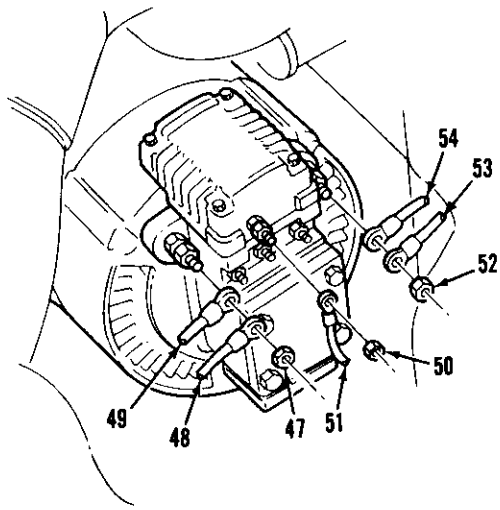
(16) Remove nut (44) and wire (45).

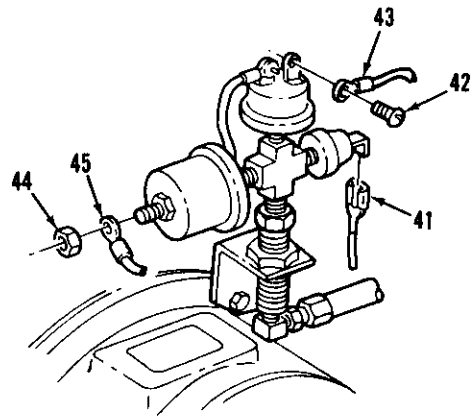
(17) Remove plug (46).

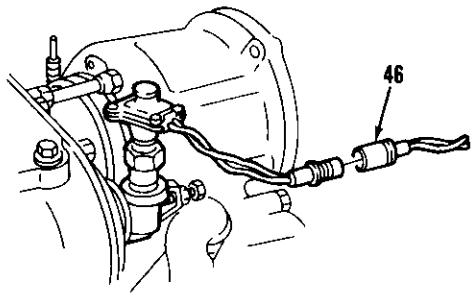
(18) Remove nut (47) and wires (48 and 49).

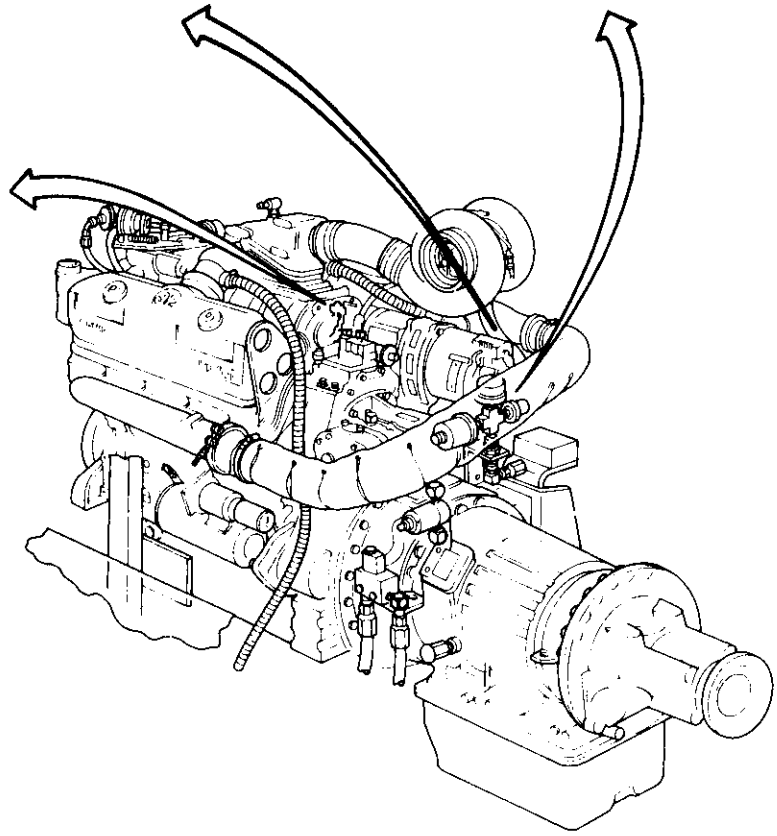
(19) Remove nut (50) and wire (51).

(20) Remove nut (52) and wires (53 and 54).









41. WIRE (NO. 147)
42. SCREW
43. WIRE (NO. 522)
44. NUT
45. WIRE (NO. 113)
46. PLUG
47. NUT
48. WIRE (NO. 815)
49. WIRE (NO. 128)
50. NUT
51. WIRE (NO. 831)
52. NUT
53. WIRE (NO. 820)
54. WIRE (NO. 278)

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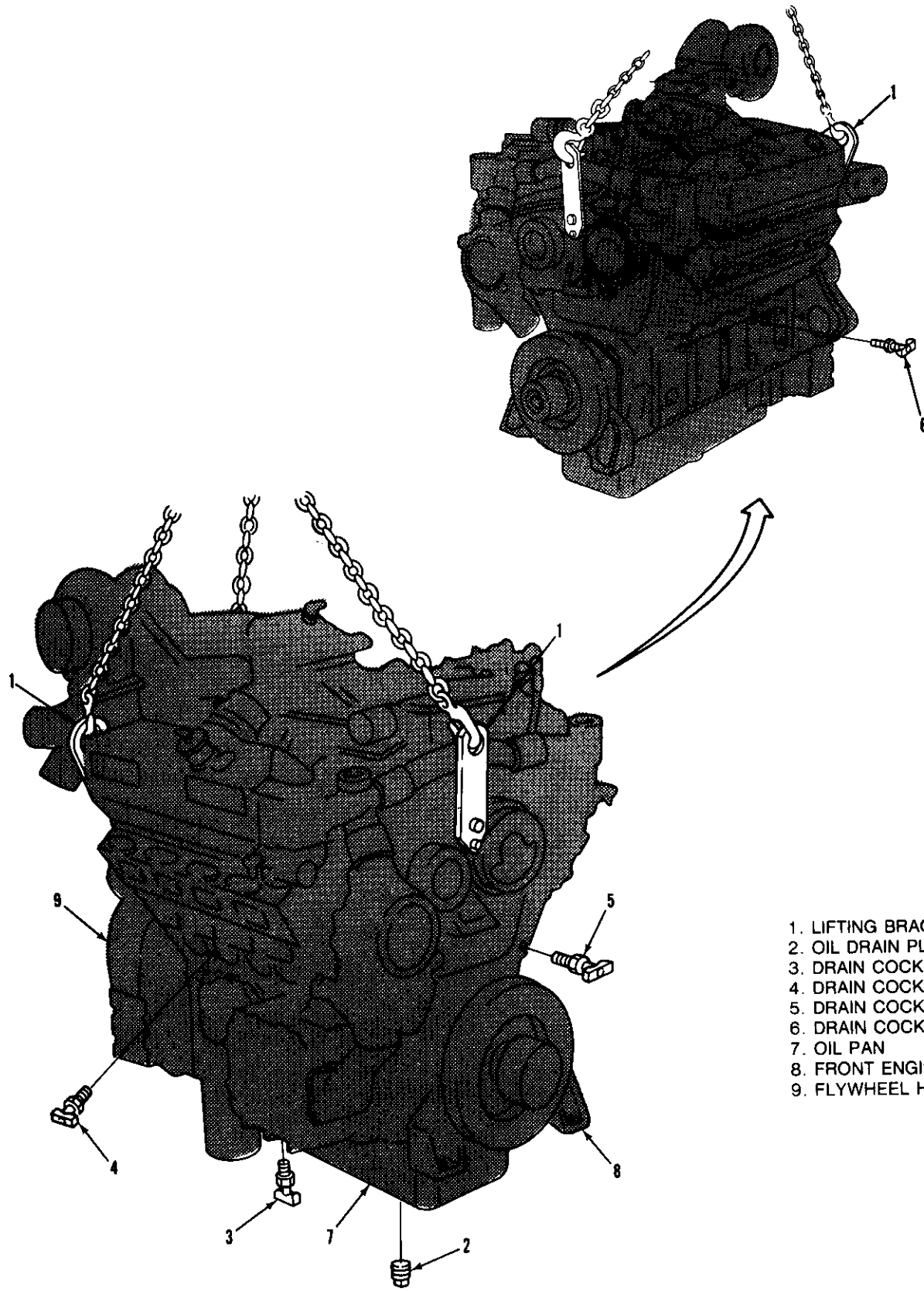


1. LIFTING BRACKET (3)
2. OIL DRAIN PLUG
3. DRAIN COCK
4. DRAIN COCK
5. DRAIN COCK
6. DRAIN COCK
7. OIL PAN
8. FRONT ENGINE MOUNT
9. FLYWHEEL HOUSING

TA 298533

6-6. ENGINE WIRING HARNESS REPLACEMENT (Continued)

(9) Remove capscrew (32), lockwasher (32.1), and wire (33). Discard lockwasher (32.1).

(10) Remove wires (34 and 35).

(11) Disconnect plug (36).

(12) Disconnect plugs (37 and 38).

(13) Disconnect plugs (39 and 40).

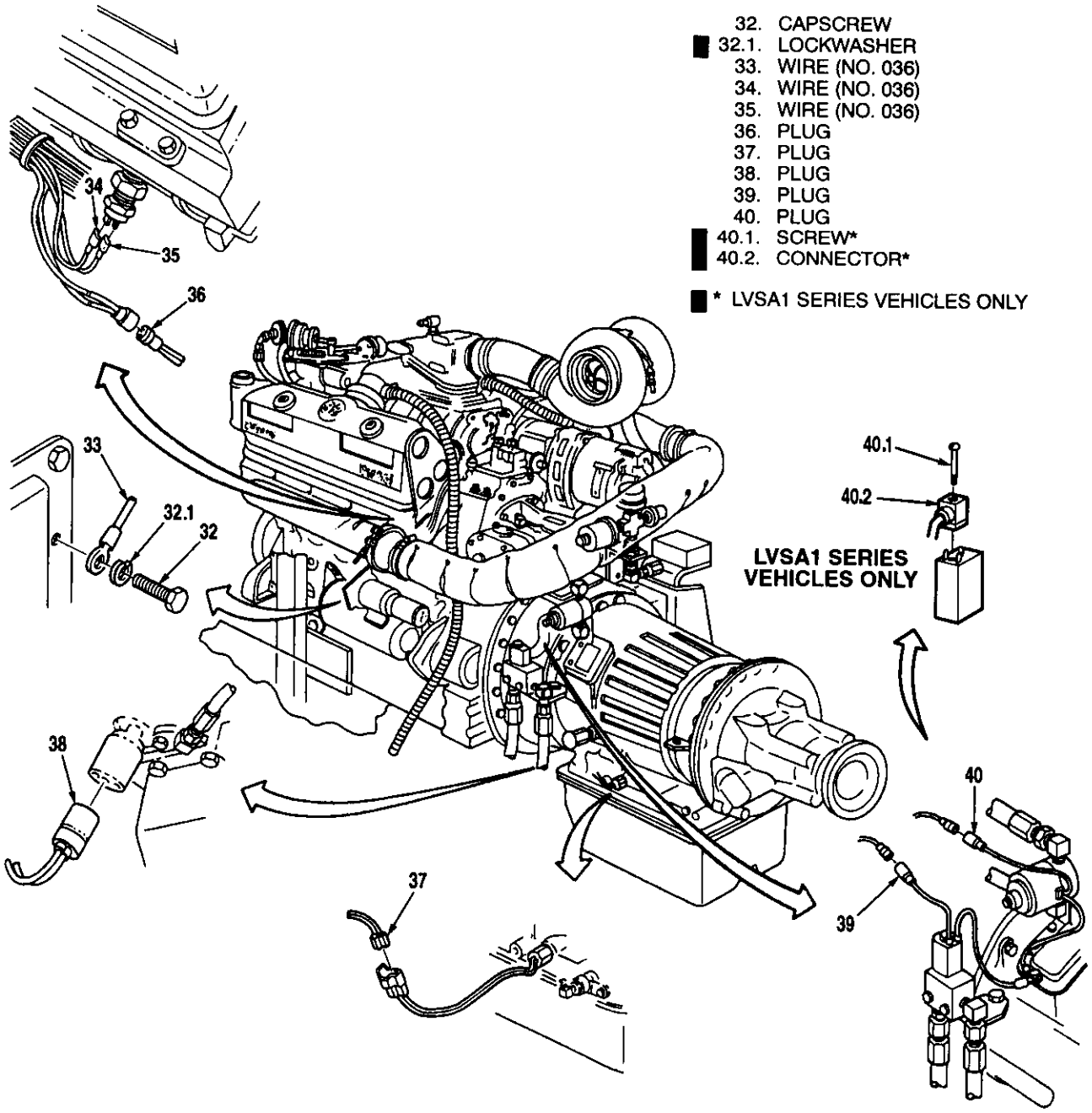
NOTE

Perform step (13.1) for LVSA1 series vehicles only.

(13.1) Remove screw (40.1) and disconnect connector (40.2).

32. CAPSCREW
32.1. LOCKWASHER
33. WIRE (NO. 036)
34. WIRE (NO. 036)
35. WIRE (NO. 036)
36. PLUG
37. PLUG
38. PLUG
39. PLUG
40. PLUG
40.1. SCREW*
40.2. CONNECTOR*

* LVSA1 SERIES VEHICLES ONLY



3-18. MOUNTING ENGINE TO ENGINE STAND (Continued)

(5) Inspect all external parts. Refer to paragraph 2-7.

(6) Mark all parts that fail inspection so that they may be repaired.

d. Component Removal

(1) Remove starter (10).Refer to paragraph 7-7 (TM 2320-20/12, TM 9-2320-297-20).

(2) Remove capscrews (11), washers (12), clamps (13), elbows (14), and air box drain tubes (15) on both sides of block.

(3) Remove turbocharger oil feed line (16) and elbow (17).

(4) Remove drain cock (6).

e. Mounting to Stand

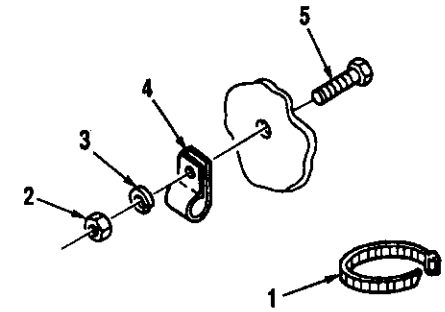
(1) Use seven capscrew holes (18) to secure engine to available engine stand.

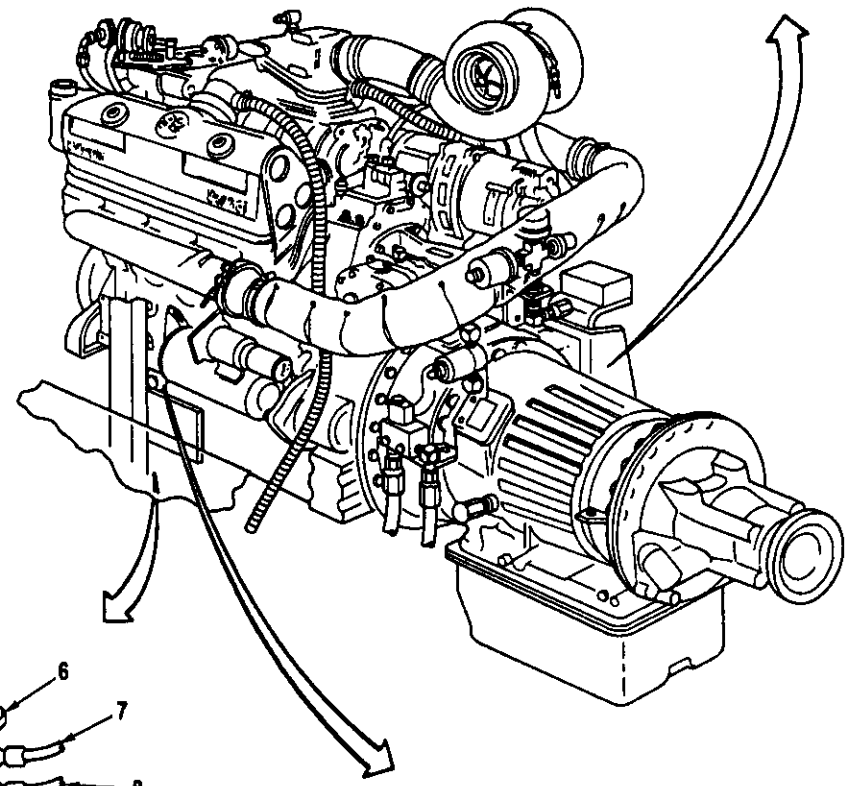
WARNING

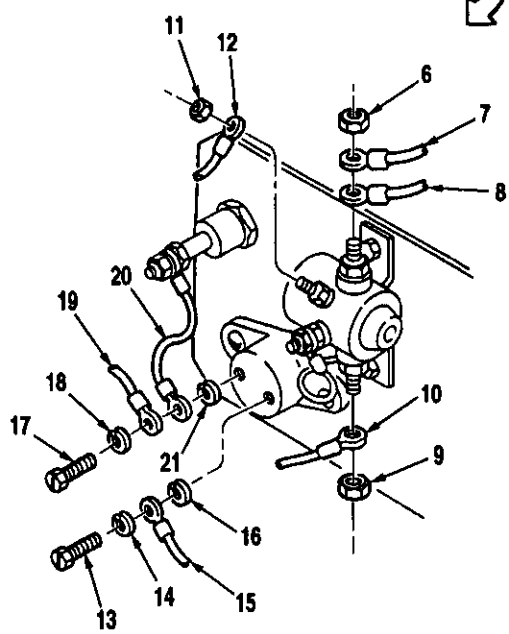
Release lifting sling slowly, making sure engine is securely mounted on stand. Severe personal injury or damage to engine could result if engine is not mounted properly.

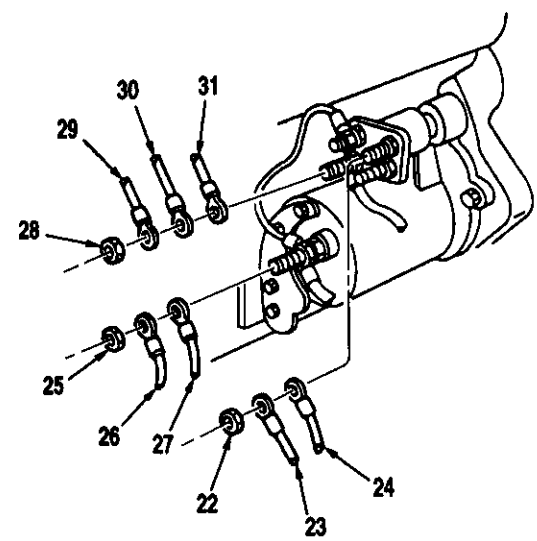
(2) Release and remove lifting sling.

1. NYLON TIE
2. NUT
3. WASHER
4. CLAMP
5. CAPSCREW
6. NUT
7. WIRE (NO. 046)
8. WIRE (NO. 430)
9. NUT
10. WIRE (NO. 045)
11. NUT
12. WIRE (NO. 021)
13. CAPSCREW
14. LOCKWASHER
15. WIRE (NO. 833)
16. LOCKWASHER
17. CAPSCREW
18. LOCKWASHER
19. WIRE (NO. 278)
20. WIRE (NO. 279)
21. LOCKWASHER
22. NUT
23. WIRE (NO. 819)
24. WIRE (NO. 128)
25. NUT
26. WIRE (NO. 816)
27. WIRE (NO. 045)
28. NUT
29. WIRE (NO. 045)
30. WIRE (NO. 833)
31. WIRE (NO. 818)

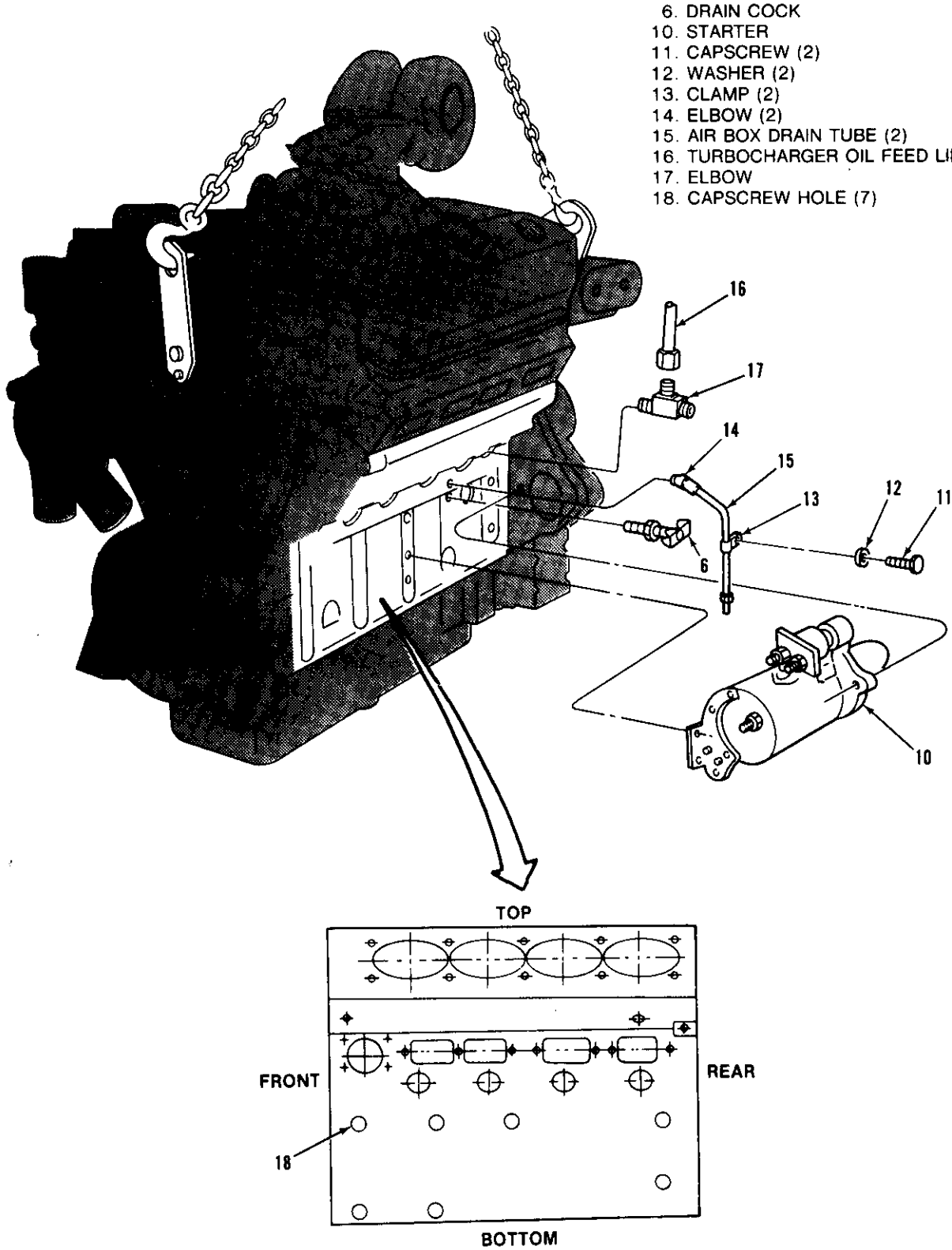








6. DRAIN COCK
10. STARTER
11. CAPSCREW (2)
12. WASHER (2)
13. CLAMP (2)
14. ELBOW (2)
15. AIR BOX DRAIN TUBE (2)
16. TURBOCHARGER OIL FEED LINE
17. ELBOW
18. CAPSCREW HOLE (7)



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END OF TASK

6-6. ENGINE WIRING HARNESS REPLACEMENT

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Materials/Parts
Nylon ties (AR) (MS3367-1-9) item 1
Lockwasher (6) (MS35338-45) items 14, 16, 18, 21, and 59
Connector (2) (NSN 5940-00-801-3535) item 64
Lockwasher (351AX) item 32.1
Lockwasher (MS35338-44) item 73
Lockwasher (238398) item 79.1

Equipment Condition
TM
TM 2320-20/12
TM 9-2320-297-20

Condition Description
Batteries disconnected (para 7-43 or 7-43.1 on LVSA1 series vehicles only).

Access panels removed (para 18-14).

Air cleaner assembly removed (para 4-6).

a. Removal

NOTE

- Remove nylon ties (1) as needed. Note location for proper installation.
- Remove nut (2), washer (3), clamp (4), and capscrew (5) as needed. Note location for proper installation.
- Tag terminals remaining on vehicle with wire numbers to aid installation.

(1) Remove nut (6) and wires (7 and 8).

(2) Remove nut (9) and wire (10).

(3) Remove nut (11) and wire (12).

(4) Remove capscrew (13), lockwasher (14), wire (15), and lockwasher (16). Discard lockwashers (14 and 16).

(5) Remove capscrew (17), lockwasher (18), wires (19 and 20), and lockwasher (21). Discard lockwashers (18 and 21).

(6) Remove nut (22) and wires (23 and 24).

(7) Remove nut (25) and wires (26 and 27).

(8) Remove nut (28) and wires (29, 30, and 31).

3-19. ENGINE DISASSEMBLY INTO SUBASSEMBLIES

THIS TASK COVERS: a. Camshaft Removal
b. Piston and Connecting Rod Removal
c. Crankshaft Removal
d. Cylinder Liner Removal

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Pulley remover (J 7932)
Cylinder liner remover (J 24563-A)

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Power pack removed (para 3-17).
TM 2320-20/12 TM 9-2320-297-20	Starter removed (para 7-7).
	Exhaust crossover tube removed (para 5-4).
	Exhaust manifold removed (para 3-7).
	Alternator removed (para 7-4).
TM 2320-34/13 TM 9-2320-297-34	Turbocharger removed (para 4-10).
	Air compressor removed (para 11-7).
	Air inlet housing removed (para 4-12).
	Mount engine to engine stand (para 3-18).
TM 2320-20/12 TM 9-2320-297-20	Rocker covers removed (para 3-4).
	Shutdown solenoid removed (para 4-13).
	Thermostat housings removed (para 6-6).
TM 2320-34/13 TM 9-2320-297-34	Water pump removed (para 5-5).
TM 2320-20/12 TM 9-2320-297-20	Oil filter adapter removed (para 3-5).
TM 2320-34/13 TM 9-2320-297-34	Oil cooler removed (para 3-10).
	Water pump drive gear removed (para 3-14).
TM 2320-20/12 TM 9-2320-297-20	Fuel pump removed (para 4-3).
TM 2320-34/13 TM 9-2320-297-34	Blower removed (para 4-6).
	Injector control tube removed (para 4-5).
	Cylinder head removed (para 3-3).
	Aftercooler removed (para 5-8).
TM 2320-20/12 TM 9-2320-297-20	Oil pan removed (para 3-6).

NOTE

Follow-On Maintenance

TM 2320-20/12
TM 9-2320-297-20

Install engine stop switch (para 7-14).

Install ignition switch (para 7-21).

Close instrument panel (para 7-27).

Install access panels (para 18-14).

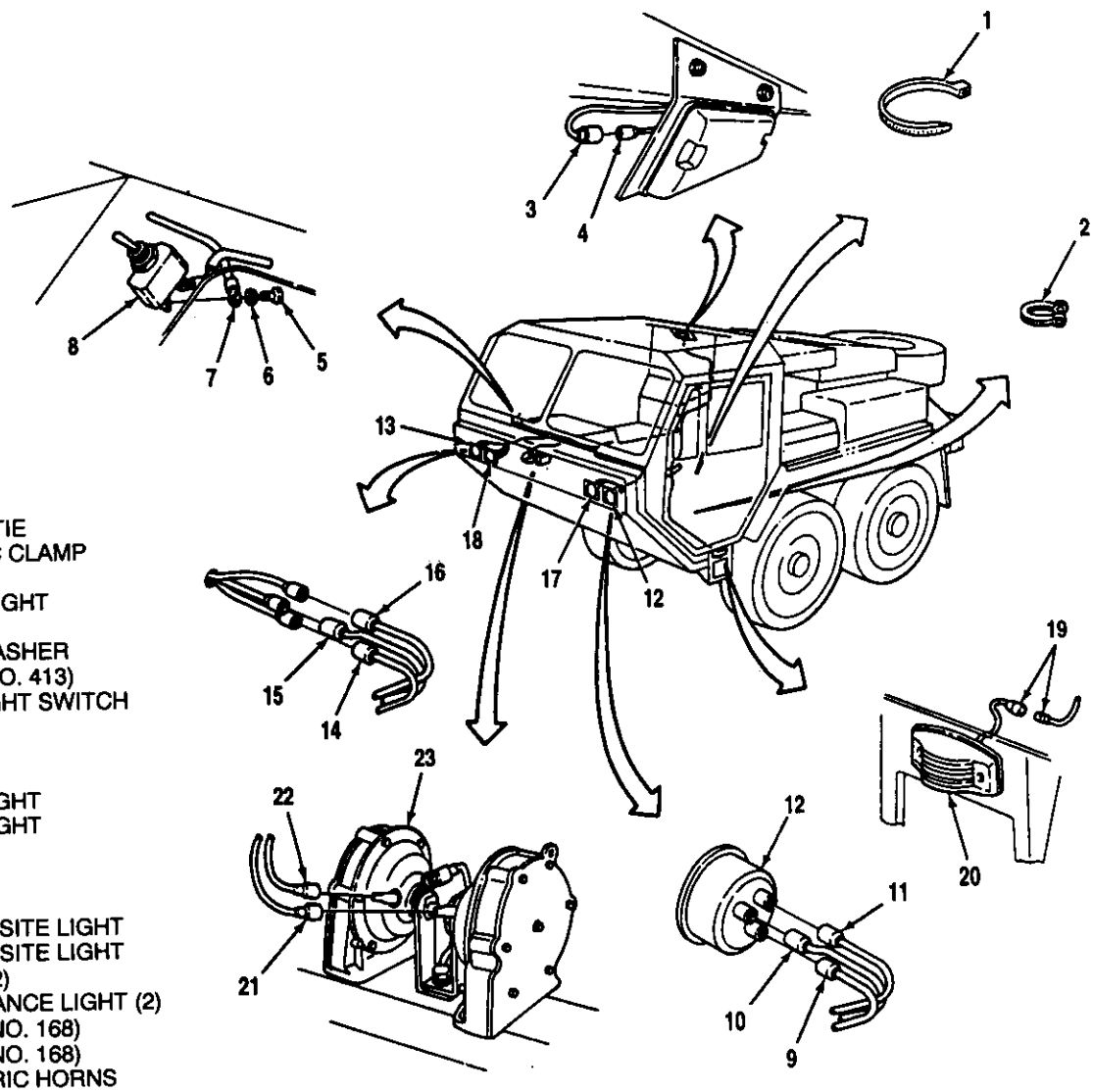
Install shield (para 7-28, task c, step (12), items 13 and 15).

Connect batteries (para 7-43 or 7-43.1 on LVSA1 series vehicles only).

Install skid plate grille (para 18-16).

TM 2320-10/11
TM 9-2320-297-10

Check all lights and accessories for proper operation (para 2-14).



1. NYLON TIE
2. PLASTIC CLAMP
3. PLUG
4. DOME LIGHT
5. SCREW
6. LOCKWASHER
7. WIRE (NO. 413)
8. MAP LIGHT SWITCH
9. PLUG
10. PLUG
11. PLUG
12. HEADLIGHT
13. HEADLIGHT
14. PLUG
15. PLUG
16. PLUG
17. COMPOSITE LIGHT
18. COMPOSITE LIGHT
19. PLUG (2)
20. CLEARANCE LIGHT (2)
21. WIRE (NO. 168)
22. WIRE (NO. 168)
23. ELECTRIC HORNS

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Oil pressure regulator/relief valve removed (para 3-12). Oil pump removed (para 3-11). Vibration damper and front cover removed (para 3-5).

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Flexplates removed (para 3-8). Blower drive gear removed (para 4-9). Flywheel housing removed (para 3-7). Idler gear removed (para 3-13).

a. Camshaft Removal

(1) Wedge a rag between two camshaft gears (1 and 2).

(2) Remove nut (3) and lockwasher (4) from front of pulley (5). Discard lockwasher (4).

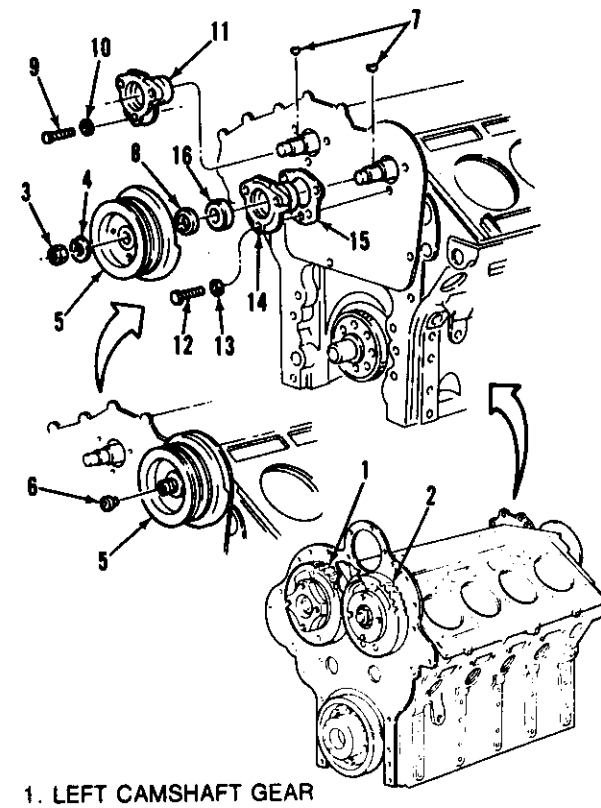
(3) Install pulley remover adapter (6) on pulley (5). Use puller to remove pulley (5).

(4) Remove two keys (7) and spacer (8).

(5) Remove three capscrews (9), lockwashers (10), and bearing (11).Discard lockwashers (10).

(6) Remove three capscrews (12), lockwashers (13), bearing (14), and gasket (15). Discard gasket (15) and lockwashers (13).

(7) Remove and discard seal (16).



1. LEFT CAMSHAFT GEAR
2. RIGHT CAMSHAFT GEAR
3. NUT
4. LOCKWASHER
5. PULLEY
6. PULLEY REMOVER ADAPTER
7. KEY (2)
8. SPACER
9. CAPSCREW (3)
10. LOCKWASHER (3)
11. BEARING
12. CAPSCREW (3)
13. LOCKWASHER (3)
14. BEARING
15. GASKET
16. SEAL

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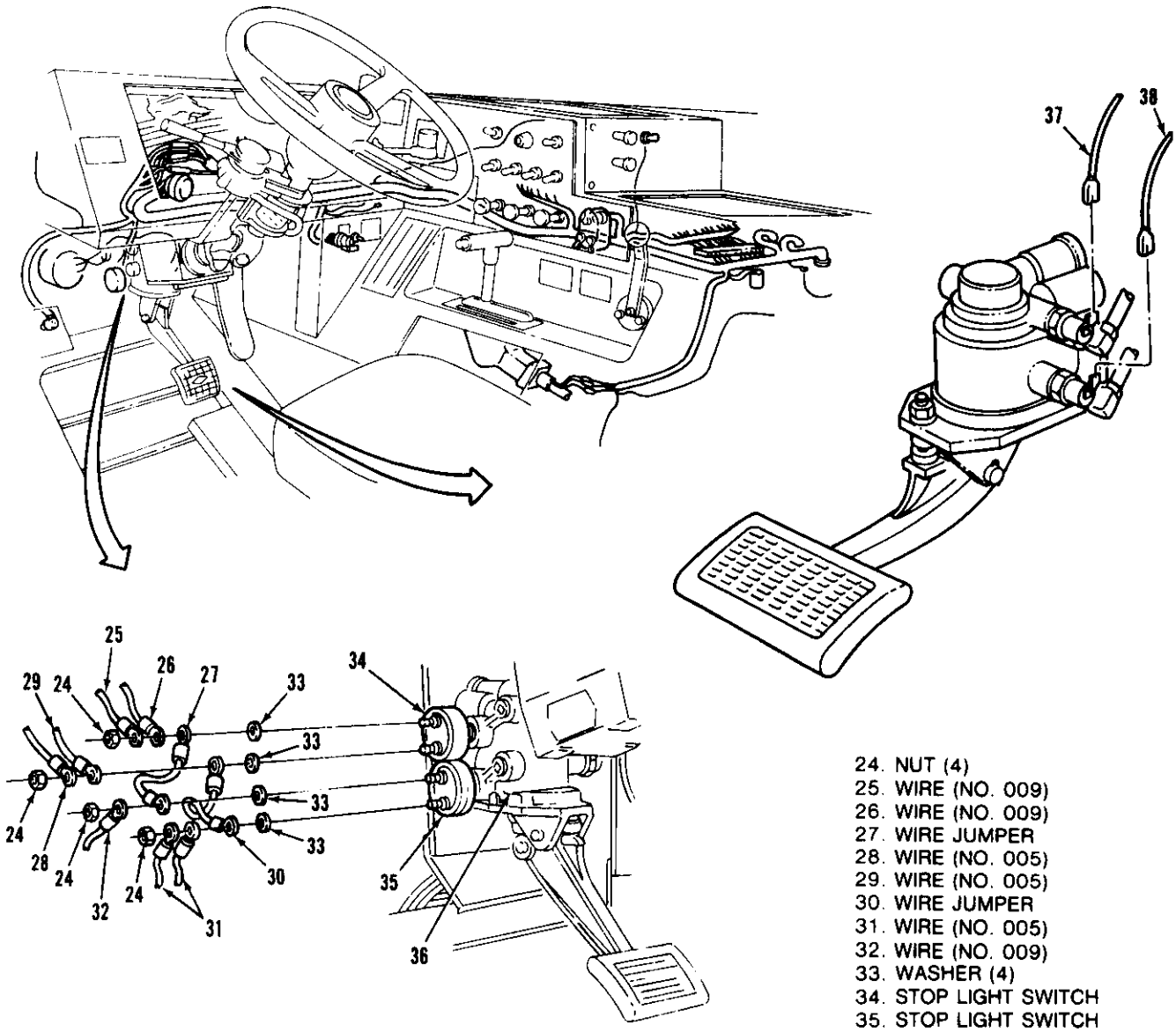
6-5. CAB WIRING HARNESS REPLACEMENT (Continued)



24. NUT (4)
25. WIRE (NO. 009)
26. WIRE (NO. 009)
27. WIRE JUMPER
28. WIRE (NO. 005)
29. WIRE (NO. 005)
30. WIRE JUMPER
31. WIRE (NO. 005)
32. WIRE (NO. 009)
33. WASHER (4)
34. STOP LIGHT SWITCH
35. STOP LIGHT SWITCH
36. BRAKE TREADLE VALVE
37. WIRE (NO. 120)
38. WIRE (NO. 120)

TA 298757

(37) Connect wires (37 and 38).

(38) Install four washers (33), wires (25 thru 32), and four nuts (24) on two stop light switches (34 and 35) at brake treadle valve (36).

(39) Connect wires (21 and 22) at electric horns (23).

(40) Connect plug (19) at clearance lights (20).

(41) Connect plugs (14, 15, and 16) at both composite lights (17 and 18).

(42) Connect plugs (9, 10, and 11) at both headlights (12 and 13).

(43) Connect wire (7), new lockwasher (6), and screw (5) to map light switch (8).

(44) Connect plug (3) at dome light (4).

END OF TASK

3-19. ENGINE DISASSEMBLY INTO SUBASSEMBLIES (Continued)

NOTE

Place a rag between camshaft gears (1 and 2) as needed to prevent turning of gears (1 and 2).

(8) Break the torque on four capscrews (17). Break the torque and remove four capscrews (18), adapter (19), and retainer (20).

(9) Remove four capscrews (17), lockwashers (21), and retainer (22). Discard lockwashers (21).

NOTE

Place a rag between camshaft gears (1 and 2) as needed to prevent turning of gears (1 and 2).

(10) Break the torque and remove nuts (23 and 24).

(11) Remove six setscrews (25).

(12) Remove rag and rotate camshaft gears (1 and 2) until capscrews (26 and 27) are exposed.

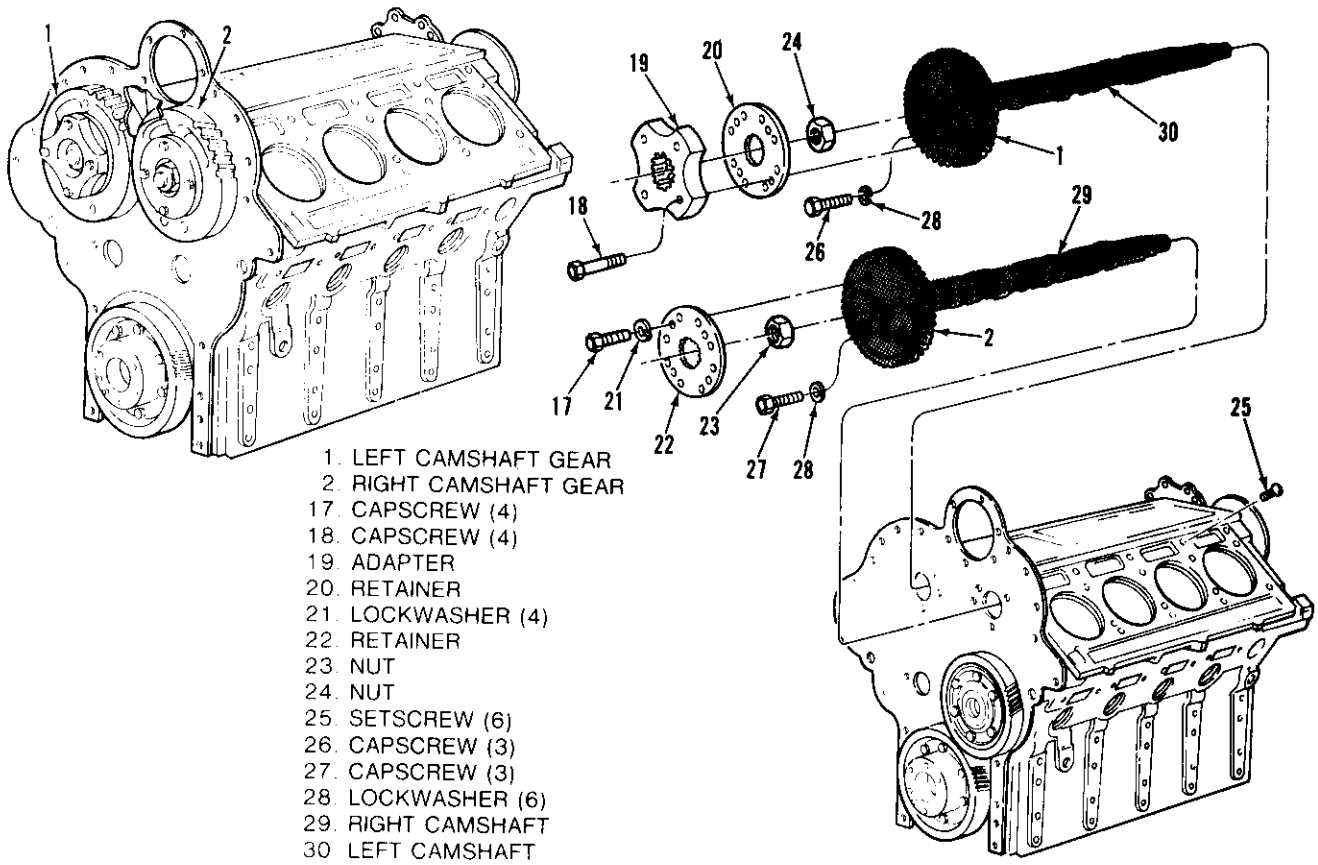
(13) Rotate gears and remove three capscrews (26), three capscrews (27), and lockwashers (28). Discard lockwashers (28).

CAUTION

Care must be taken when removing camshafts (29 and 30) to avoid damage to bearings.

(14) Tag and remove camshafts (29 and 30).

(15) Refer to paragraph 3-25 in this manual for camshaft repair.



1. LEFT CAMSHAFT GEAR
2. RIGHT CAMSHAFT GEAR
17. CAPSCREW (4)
18. CAPSCREW (4)
19. ADAPTER
20. RETAINER
21. LOCKWASHER (4)
22. RETAINER
23. NUT
24. NUT
25. SETSCREW (6)
26. CAPSCREW (3)
27. CAPSCREW (3)
28. LOCKWASHER (6)
29. RIGHT CAMSHAFT
30. LEFT CAMSHAFT

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(28) Connect wires (69 and 70) with two screws (68).

(29) Connect wires (66 and 67) with two screws (65).

(30) Install wire (64) in plug (62).

(31) Install plug (62) to flasher switch (63).

(32) Connect wires (51 thru 56).

NOTE

Perform step (32.1) on LVSA1 series vehicles only.

(32.1) Connect weather pack connector (56.1).

(33) Install clamp (60) on wiring harness (61).

(34) Install clamp (60) with capscrew (57), lockwasher (59), and nut (58). Tighten nut (58) securely.

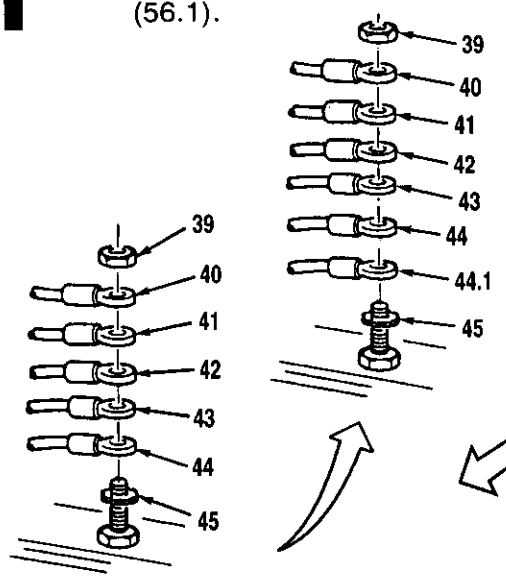
(35) Install two wires (46 and 47) onto terminals (48 and 49) at trailer supply valve (50).

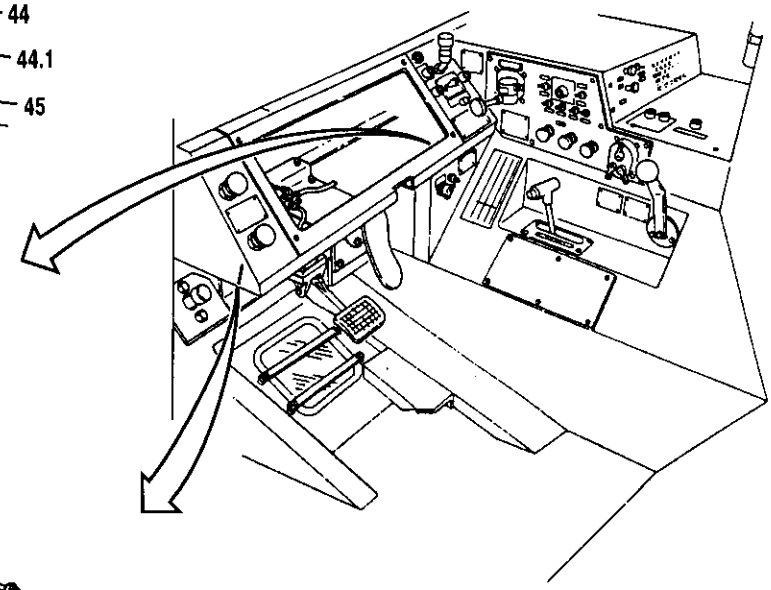
(36) Install new star washer (45), wires (40 thru 44), and nut (39).

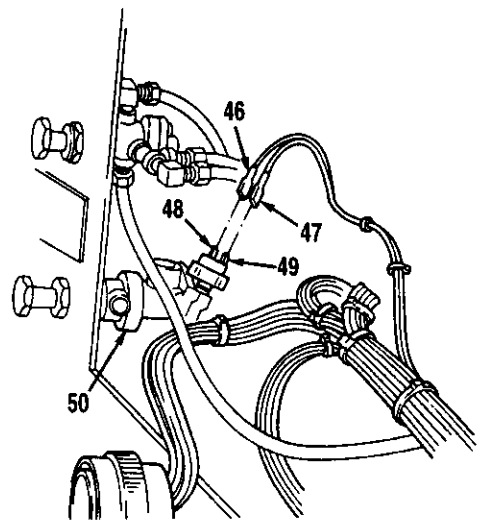
NOTE

Perform step (36.1) on LVSA1 series vehicles only.

(36.1) Install new star washer (45), wires (40 thru 44.1), and nut (39).







39. NUT
40. WIRE (NO 435)
41. GROUND WIRE
42. WIRE (NO. 091)
43. WIRE (NO. 091)
44. WIRE (NO. 435)
44.1. WIRE (NO. 435)*
45. STAR WASHER
46. WIRE (NO. 736B)
47. WIRE (NO. 615)
48. TERMINAL
49. TERMINAL
50. TRAILER SUPPLY VALVE

* LVSA1 SERIES VEHICLES ONLY

b. Piston and Connecting Rod Removal

(1) Rotate engine block (31) on engine stand until bell housing end faces downward.

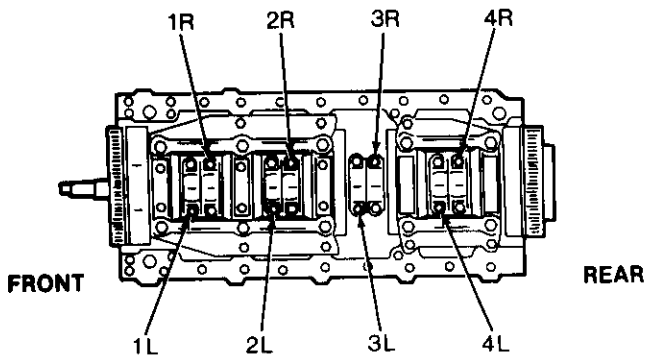
(2) Remove carbon deposits from upper inner surface of cylinder liner (32).

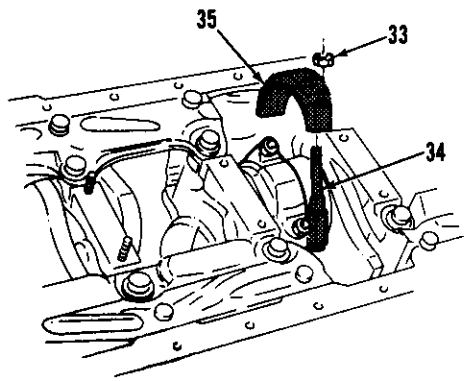
NOTE

Check bearing caps (35) and rods for matched markings. If rods have not been factory marked, mark them with a punch or number marking set. Have identification number face toward the outer edge of engine block (31). This is to insure that the rod cap and rod are matched during assembly.

(3) Remove two nuts (33) from connecting rod bolts (34).

(4) Tag and remove bearing cap (35).





(5) Using the handle of a rubber mallet, push piston and connecting rod assembly (36) out of cylinder liner (32).

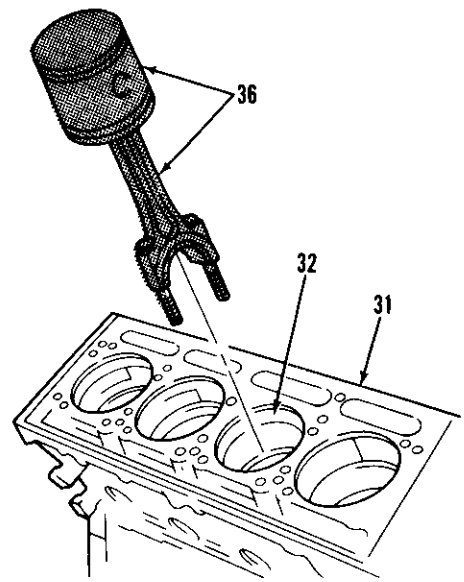
(6) For temporary storage, install bearing cap (35) and two nuts (33) on piston and connecting rod assembly (36). Install bearing cap (35) in same position as when removed.

NOTE

- Be sure to tag each piston and connecting rod assembly (36) to aid in installation.
- Matchmark piston and connecting rod assembly (36) and cylinder liner (32). Piston must be installed in liner facing the same direction as it was removed.

(7) Repeat steps (2) thru (6) for each piston an connecting rod assembly (36).

(8) Refer to paragraph 3-24 in this manual for piston and connecting rod repair.



31. ENGINE BLOCK
32. CYLINDER LINER (8)
33. NUT (16)
34. CONNECTING ROD BOLT
35. BEARING CAP (8)
36. PISTON AND CONNECTING ROD ASSEMBLY (8)

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6-5. CAB WIRING HARNESS REPLACEMENT (Continued)

NOTE

It may be necessary to remove switches for access to wire terminals. Refer to paragraph 7-14 (TM 2320-20/12, TM 9-2320-297-20).

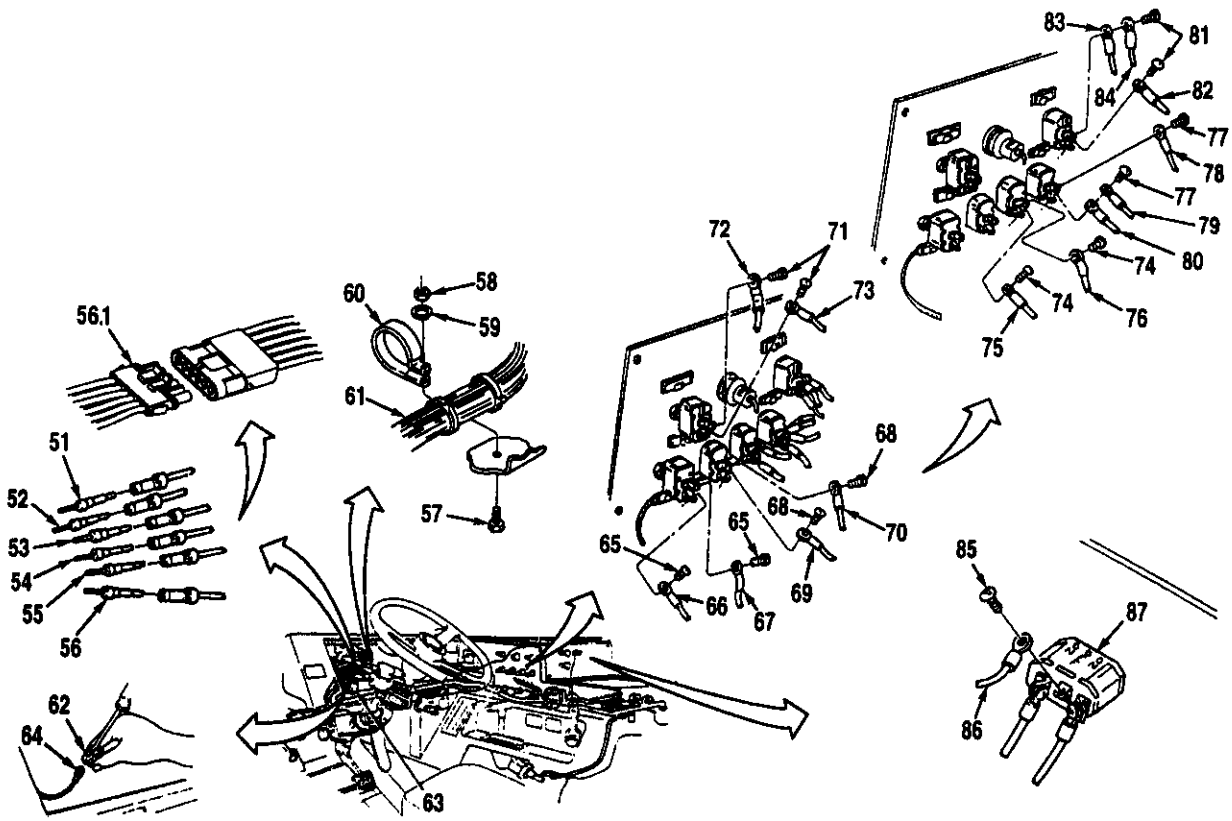
(23) Connect wire (86) to switch (87) with screw (85).

(24) Connect wires (82, 83, and 84) with two screws (81).

(25) Connect wires (78, 79, and 80) with two screws (77).

(26) Connect wires (75 and 76) with two screws (74).

(27) Connect wires (72 and 73) with two screws (71).



51. WIRE (NO. 002)
52. WIRE (NO. 004)
53. WIRE (NO. 001)
54. WIRE (NO. 294)
55. WIRE (NO. 003)
56. WIRE (NO. 016)
56.1. WEATHER PACK CONNECTOR*
57. SCREW
58. NUT
59. LOCKWASHER
60. CLAMP
61. WIRING HARNESS
62. PLUG
63. FLASHER SWITCH
64. WIRE (NO. 080)
65. SCREW (2)
66. WIRE (NO. 029)
67. WIRE (NO. 029)
68. SCREW (2)
69. WIRE (NO. 040)
70. WIRE (NO. 040)
71. SCREW (2)
72. WIRE (NOS. 714/716)
73. WIRE NO. 715
74. SCREW (2)
75. WIRE (NO. 153)
76. WIRE (NO. 027
77. SCREW
78. WIRE (NO. 012)
79. WIRE (NO. 012)
80. WIRE (NO. 060)
81. SCREW (2)
82. WIRE
83. WIRE (NO. 713)
84. WIRE (NO. 712)
85. SCREW
86. WIRE (NO. 082)
87. SWITCH

* LVSA1 SERIES VEHICLES ONLY

3-19. ENGINE DISASSEMBLY INTO SUBASSEMBLIES (Continued)

c. Crankshaft Removal

(1) Rotate engine block (31) on engine stand so that crankshaft (37) is on top.

(2) Remove seven capscrews (38) and seven washers (39).

(3) Remove 10 capscrews (40), washers (41), and four stabilizers (42, 43, 44, and 45) from engine block (31).

CAUTION

Use care during removal of rear main bearing cap (46) to prevent low thrust washers (48) from falling. Low thrust washers (48) are loosely installed and easily damaged.

NOTE

Check main bearing caps (46 and 47) for matched markings. If main bearing caps (46 and 47) are not factory marked, mark them with a punch or number marking set. This is to insure that the main bearing caps (46 and 47) are matched during assembly.

(4) Remove rear main bearing cap (46) with two lower thrust washers (48) and remove four main bearing caps (47).

(5) Remove two lower thrust washers (48) from rear main bearing cap (46).

CAUTION

Use care during removal of crankshaft (37) to make certain upper main bearings (49) and upper thrust washers (50) do not come out with crankshaft (37).

NOTE

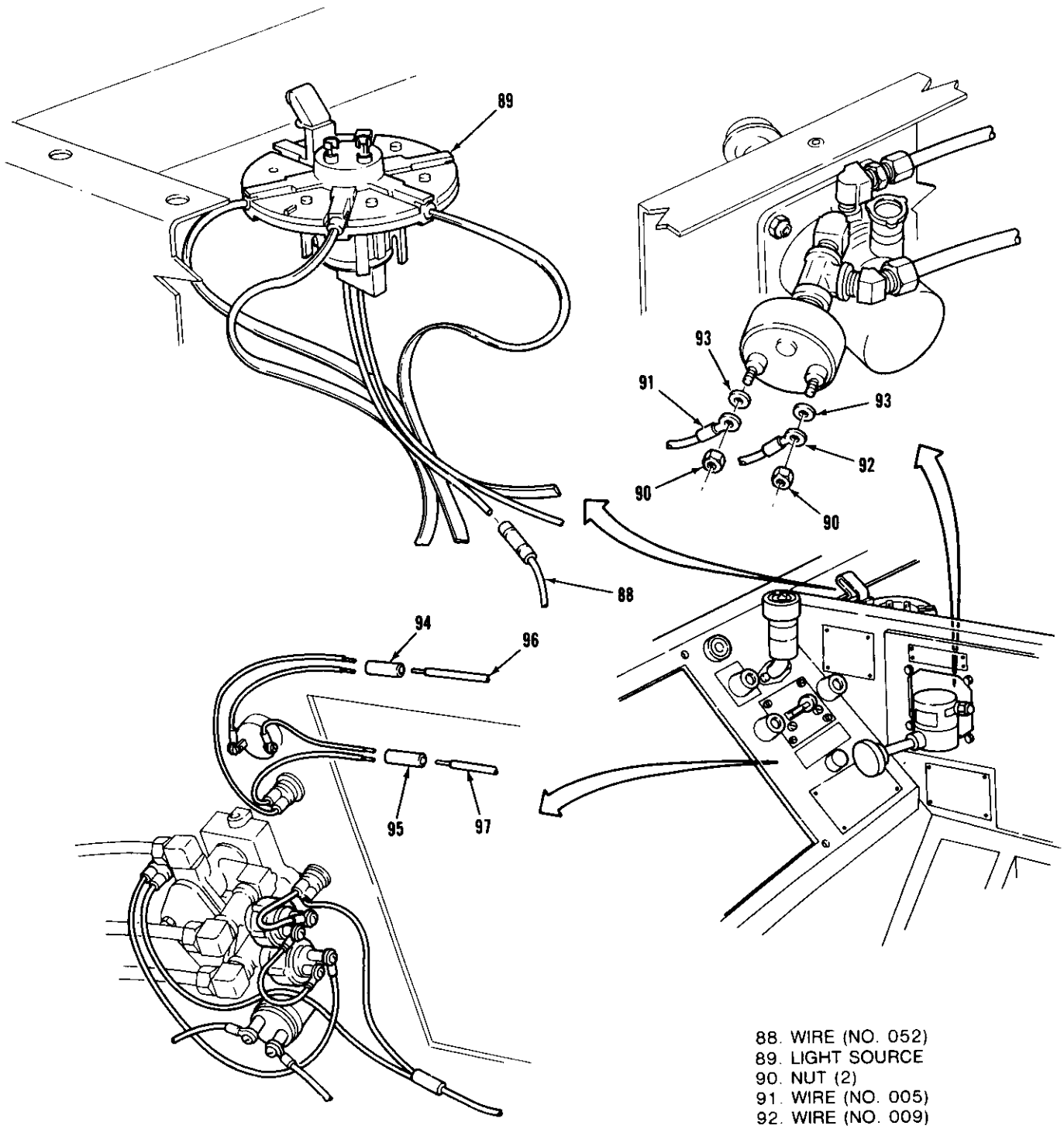
Crankshaft (37) must be positioned with front balance down and rear balance up (as shown) before removal of crankshaft (37).

(6) Using a sling, remove crankshaft (37). Set crankshaft (37) on wooden blocks to prevent damage.

(7) Remove remaining two upper thrust washers (50) from engine block (31).

(8) Remove and discard five upper main bearings (49). Remove and discard five lower main bearings (51) from main bearing caps (46 and 47).

(9) Refer to paragraph 3-26 for crankshaft repair.



88. WIRE (NO. 052)
89. LIGHT SOURCE
90. NUT (2)
91. WIRE (NO. 005)
92. WIRE (NO. 009)
93. WASHER (2)
94. CONNECTOR
95. CONNECTOR
96. WIRE (NO. 033)
97. WIRE (NO. 525)

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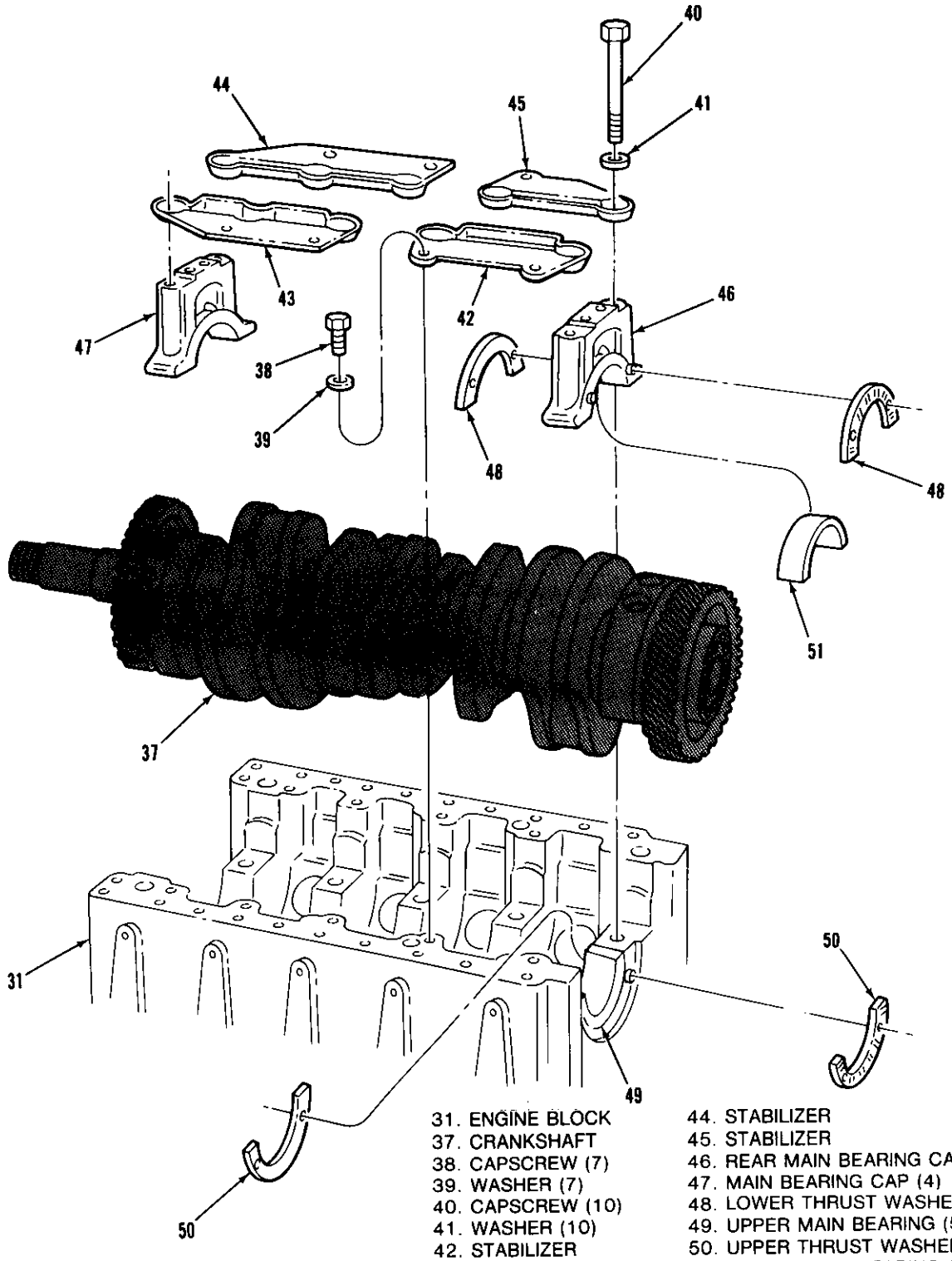
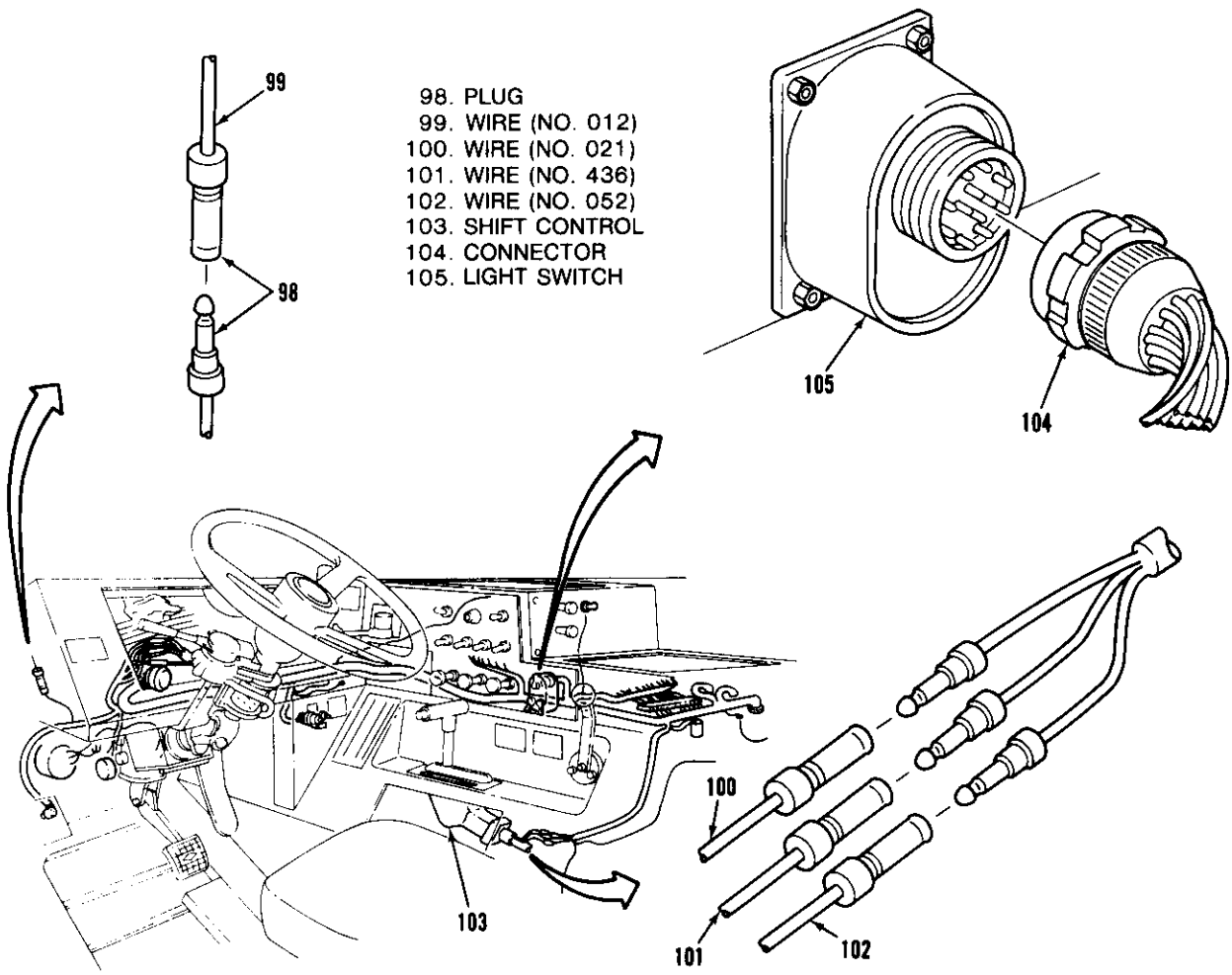


31. ENGINE BLOCK
37. CRANKSHAFT
38. CAPSCREW (7)
39. WASHER (7)
40. CAPSCREW (10)
41. WASHER (10)
42. STABILIZER
43. STABILIZER
44. STABILIZER
45. STABILIZER
46. REAR MAIN BEARING CAP
47. MAIN BEARING CAP (4)
48. LOWER THRUST WASHER (2)
49. UPPER MAIN BEARING (5)
50. UPPER THRUST WASHER (2)
51. LOWER MAIN BEARING (5)

TA 298538

6-5. CAB WIRING HARNESS REPLACEMENT (Continued)



TA 298753

(15) Install connector (104) into light switch (105).

(16) Connect three wires (100, 101, and 102) at shift control (103).

(17) Install dimmer switch. Refer to paragraph 7-49 (TM 2320-20/12, TM 9-2320-297-20).

(18) Connect plug (98) to wire (99).

(19) Connect wires (96 and 97) with new connectors (94 and 95).

(20) Install two wires to ether starting switch. Refer to paragraph 7-20, items 7 and 8 (TM 2320-20/12, TM 9-2320-297-20).

(21) Install two washers (93), wires (91 and 92), and two nuts (90). Tighten nuts (90) securely.

(22) Connect wire (88) to light source (89).

3-19. ENGINE DISASSEMBLY INTO SUBASSEMBLIES (Continued)

d. Cylinder Liner Removal

CAUTION

Never attempt to push or pry out cylinder liner (32) with metal tools. This may result in serious damage to parts.

NOTE

If liner remover tool (52) is unavalable, tap the cylinder liner (32) out with a wooden block and hammer.

(1) Rotate engine block (31) till top faces upward.

(2) Install liner remover tool (52) on cylinder liner (32).

(3) Turn capscrew (53) clockwise until cylinder liner (32) is loose in engine block (31).

(4) Remove cylinder liner (32) from engine block (31).

CAUTION

Care must be taken not to drop the cylinder liner (32) when removing liner remover tool (52). Cylinder liner (32) can crack very easily if not handled properly.

NOTE

Matchmark cylinder liners (32) and block (31) for proper installation.

(5) Remove liner remover tool (52) from cylinder liner (32). Tag each cylinder liner (32) for installation into the same cylinder bore.

(6) Remove and tag each insert (54) for installation into the same cylinder bore.

(7) Remove and discard two sealrings (55).

(8) Repeat steps (2) thru (7) to remove each cyinder liner (32).

(9) Refer to paragraph 3-23 for cylinder liner repair.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Repair cylinder block (para 3-22).
	Reassemble engine from subassemblies (para 3-20).

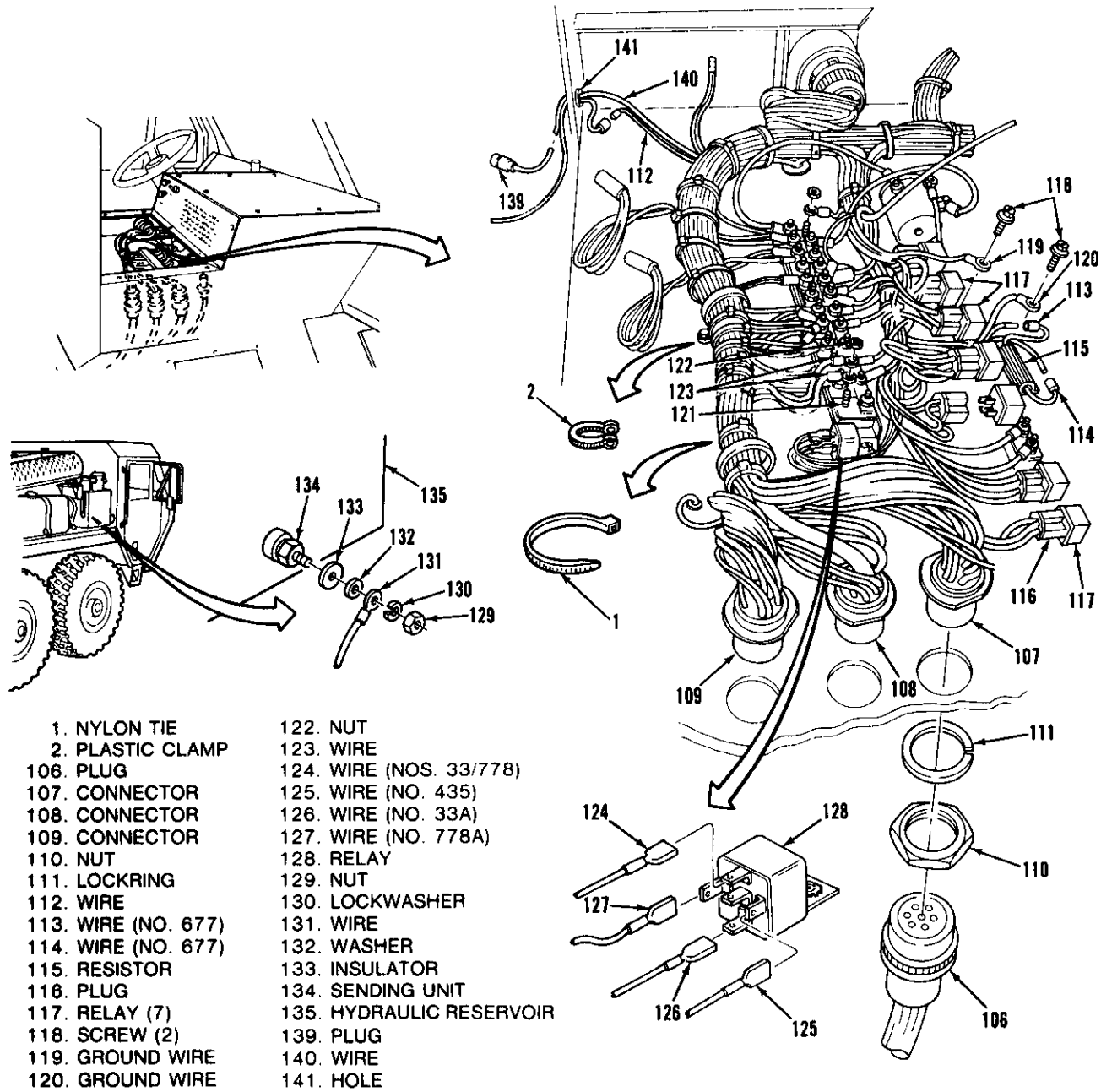
(10) Connect plugs (116) to relays (117).

(11) Connect wires (113 and 114) to resistor (115).

(12) Install wires (124, 125, 126, and 127) onto relay (128).

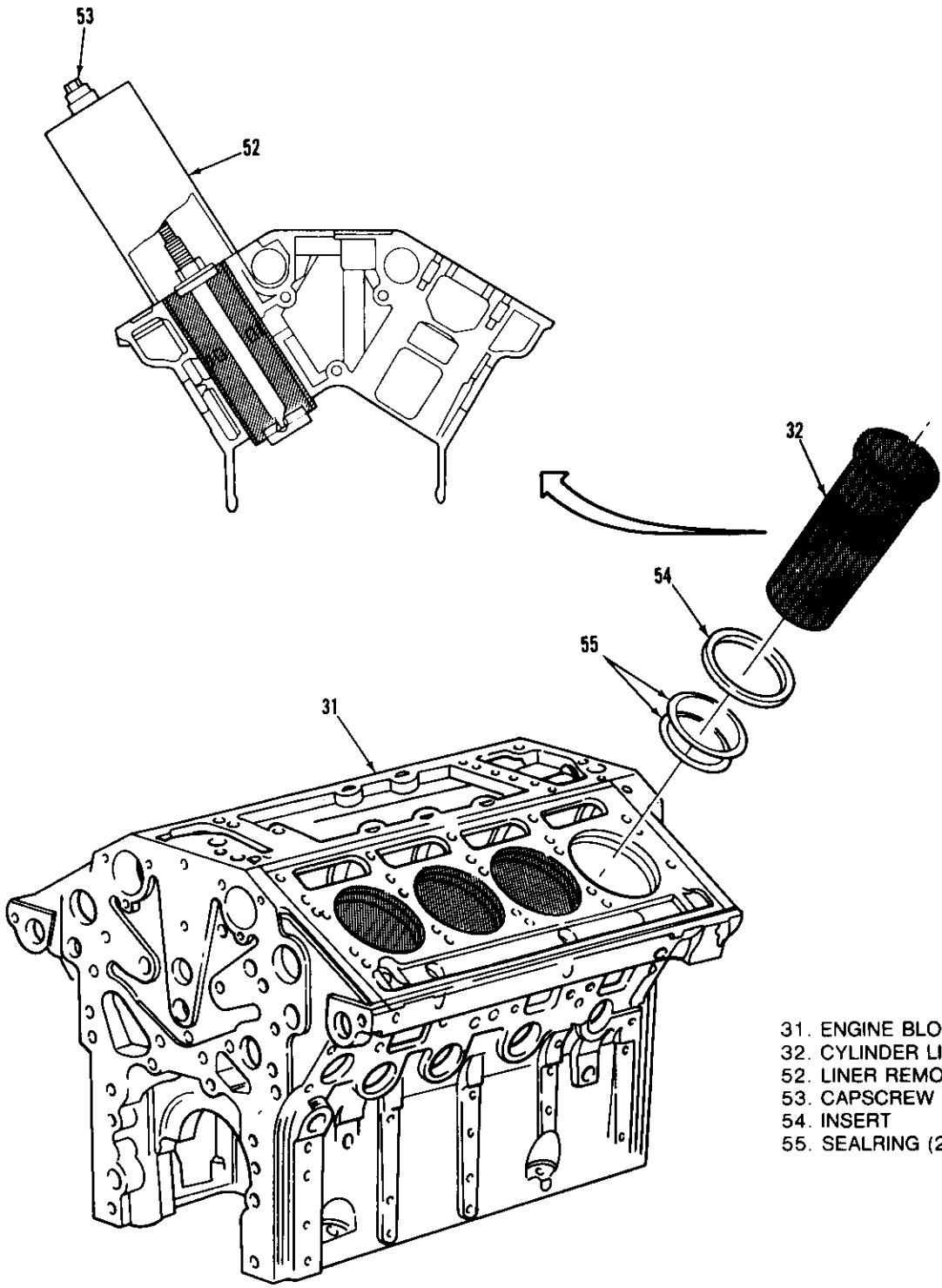
(13) Install connectors (107, 108, and 109) with new lockrings (111) and nuts (110). Tighten nuts (110) securely.

(14) Connect a plug (106) to each connector (107, 108, and 109).



1. NYLON TIE
2. PLASTIC CLAMP
106. PLUG
107. CONNECTOR
108. CONNECTOR
109. CONNECTOR
110. NUT
111. LOCKRING
112. WIRE
113. WIRE (NO. 677)
114. WIRE (NO. 677)
115. RESISTOR
116. PLUG
117. RELAY (7)
118. SCREW (2)
119. GROUND WIRE
120. GROUND WIRE
121. CIRCUIT BREAKER
122. NUT
123. WIRE
124. WIRE (NOS. 33/778)
125. WIRE (NO. 435)
126. WIRE (NO. 33A)
127. WIRE (NO. 778A)
128. RELAY
129. NUT
130. LOCKWASHER
131. WIRE
132. WASHER
133. INSULATOR
134. SENDING UNIT
135. HYDRAULIC RESERVOIR
139. PLUG
140. WIRE
141. HOLE

TA 298752



31. ENGINE BLOCK
32. CYLINDER LINER (8)
52. LINER REMOVER TOOL
53. CAPSCREW
54. INSERT
55. SEALRING (2)

TA 296539

3-20. ENGINE REASSEMBLY FROM SUBASSEMBLIES

THIS TASK COVERS: a. Crankshaft Installation
b. Piston and Liner Installation
c. Camshaft Installation

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Dial indicator (J 7872)
Cylinder liner hold down (J 24565-02)
Ring compressor (J 24227)

Materials/Parts

International compound No. 2 (item 16, Appendix C)
Engine oil (item 46, Appendix C)
Plastic strip (item 68, Appendix C)
Insert (8) (NSN 2815-01-058-0254) item 24
Sealring (16) (P/N 8927189) item 40
Lockwasher (16) (MS35338-46) items 51, 59, 62 and 71
Gasket (NSN 5330-00-735-4289) item 56
Lockwasher (MS35338-54) item 66

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition

TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Engine block repaired (para 3-22).
	Crankshaft repaired (para 3-26).
	Cylinder liner repaired (para 3-23).
	Piston and connecting rod repaired (para 3-24).
	Camshaft repaired (para 3-25).

a. Crankshaft Installation

CAUTION

Main bearings are a matched set and cannot be interchanged. Mixing of bearings will cause engine failure.

(1) Remove 10 capscrews (1), 10 washers (2), rear main bearing cap (3), and four main bearing caps (4).

(2) Remove oil and dirt from crankshaft (5) and main bearing caps (3 and 4) bearing surface.

(3) Carefully hoist crankshaft (5) and lower it into engine block (6).

CAUTION

The grooved side of thrust washers (7 and 8) must face away from rear main bearing journal for proper oil flow.

(4) Carefully insert two upper thrust washers (7) along engine block (6) at rear main bearing cap (3).

(5) Install two lower thrust washers (8) on rear main bearing cap (3).

(6) Place plastic strip (10) across main bearing journals (9) on crankshaft (5).

(7) Install insulator (133), washer (132), wire (131), new lockwasher (130), and nut (129) to sending unit (134) on hydraulic reservoir (135). Tighten nut (129) to 20 inch pounds (2.3 N·m) maximum.

(8) Connect wires (123) to circuit breakers (121) as marked. Install and tighten nuts (122) securely.

(9) Install two ground wires (119 and 120) and screws (118) in tagged location. Tighten securely.

(7) Install five main bearing caps (3 and 4), four stabilizers (11, 12, 13, and 14), 10 washers (2), and 10 capscrews (1).Torque capscrews (1) to 250-260 foot-pounds (339-352 N·m).

(8) Remove 10 capscrews (1), 10 washers (2), and four stabilizers (11, 12, 13, and 14).

(9) Remove five main bearing caps (3 and 4).

(10) Match plastic strip (10) width at widest point with plastic strip gage (15) provided.

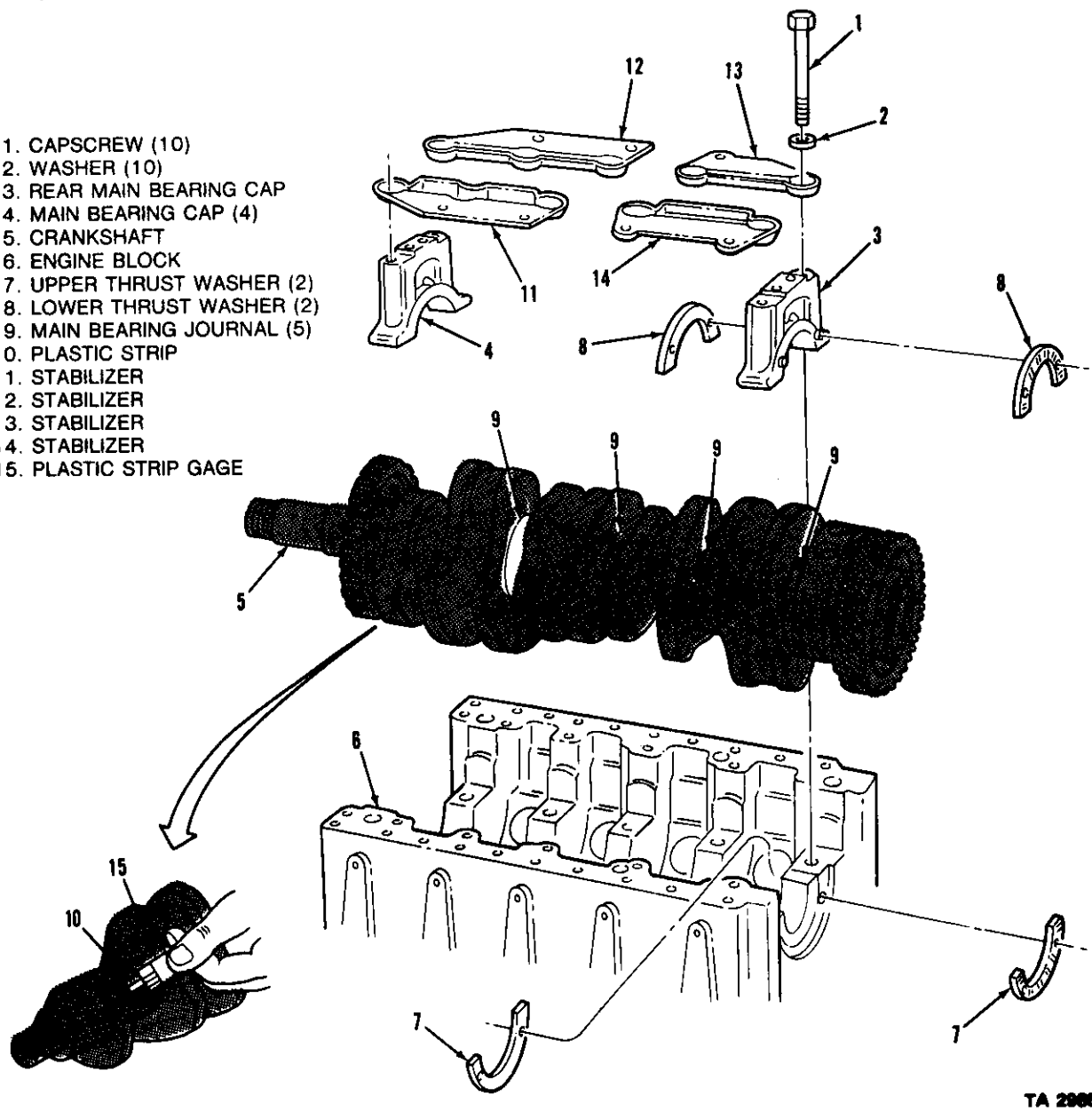
(11) Bearing-to-crankshaft journal clearance must be 0.0014-0.0055 inch (0.0355-0.1397 mm).

(12) If any bearing is not within specification, replace all main bearings.

(13) Remove all traces of plastic strip (10) from bearings and crankshaft (5).

(14) Coat all main bearing journals (9) with engine oil.

1. CAPSCREW (10)
2. WASHER (10)
3. REAR MAIN BEARING CAP
4. MAIN BEARING CAP (4)
5. CRANKSHAFT
6. ENGINE BLOCK
7. UPPER THRUST WASHER (2)
8. LOWER THRUST WASHER (2)
9. MAIN BEARING JOURNAL (5)
10. PLASTIC STRIP
11. STABILIZER
12. STABILIZER
13. STABILIZER
14. STABILIZER
15. PLASTIC STRIP GAGE



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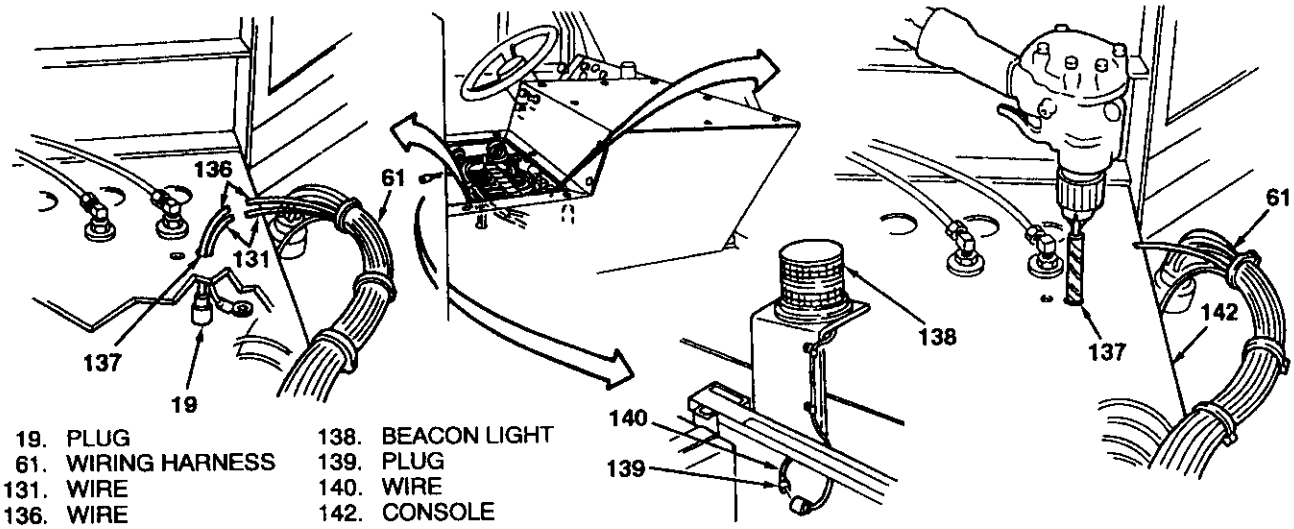
6-5. CAB WIRING HARNESS REPLACEMENT (Continued)



19. PLUG
61. WIRING HARNESS
131. WIRE
136. WIRE
137. HOLE
138. BEACON LIGHT
139. PLUG
140. WIRE
142. CONSOLE

(40) If necessary, tag and cut wire (136). Remove plug (19). Tag plug (19) for proper assembly.

(41) Pull wires (131 and 136) through hole (137).

(42) If beacon light (138) is used, disconnect plug (139).

(43) Pull wire (140) through hole (141) until plug (139) can be seen.

(44) Pull wire (140) through hole (141) until plug (139) can be seen.

(45) Tag and cut wire (140) and remove plug (139).

(46) Remove wiring harness (61).

NOTE

It may be necessary to enlarge hole (137) in bottom of console (142) for installation of a new wiring harness (61).

(47) Using a 9/16 inch drill bit, enlarge hole (137) in bottom of console (142).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

NOTE

- Install nylon ties (1) and plastic clamps (2) where removed.
- Match wire numbers on new harness to wire numbers remaining on the vehicle.
- Tighten all hardware as it is installed.

(1) Place wiring harness (61) into position.

(2) If necessary, splice plug (19) on wire (136). Refer to paragraph 7-45 (TM 2320-20/12, TM 9-2320-297-20). Route wires (131 and 136) through hole (137).

(3) Route wire (140) through hole (141).

(4) Splice plug (139) to wire (140). Refer to paragraph 7-45 (TM 2320-20/12, TM 9-2320-297-20).

(5) If used, route wire (140) to beacon light (138). Connect plug (139).

(6) Splice Wire (112). Refer to paragraph 7-45 (TM 2320-20/12, TM 9-2320-297 -20).

3-20. ENGINE REASSEMBLY FROM SUBASSEMBLIES (Continued)

CAUTION

After installation of each main bearing cap, rotate crankshaft 360 degrees and feel for binding.

NOTE

Apply International Compound No. 2 to threads and washers (2) of main bearing capscrews (1).

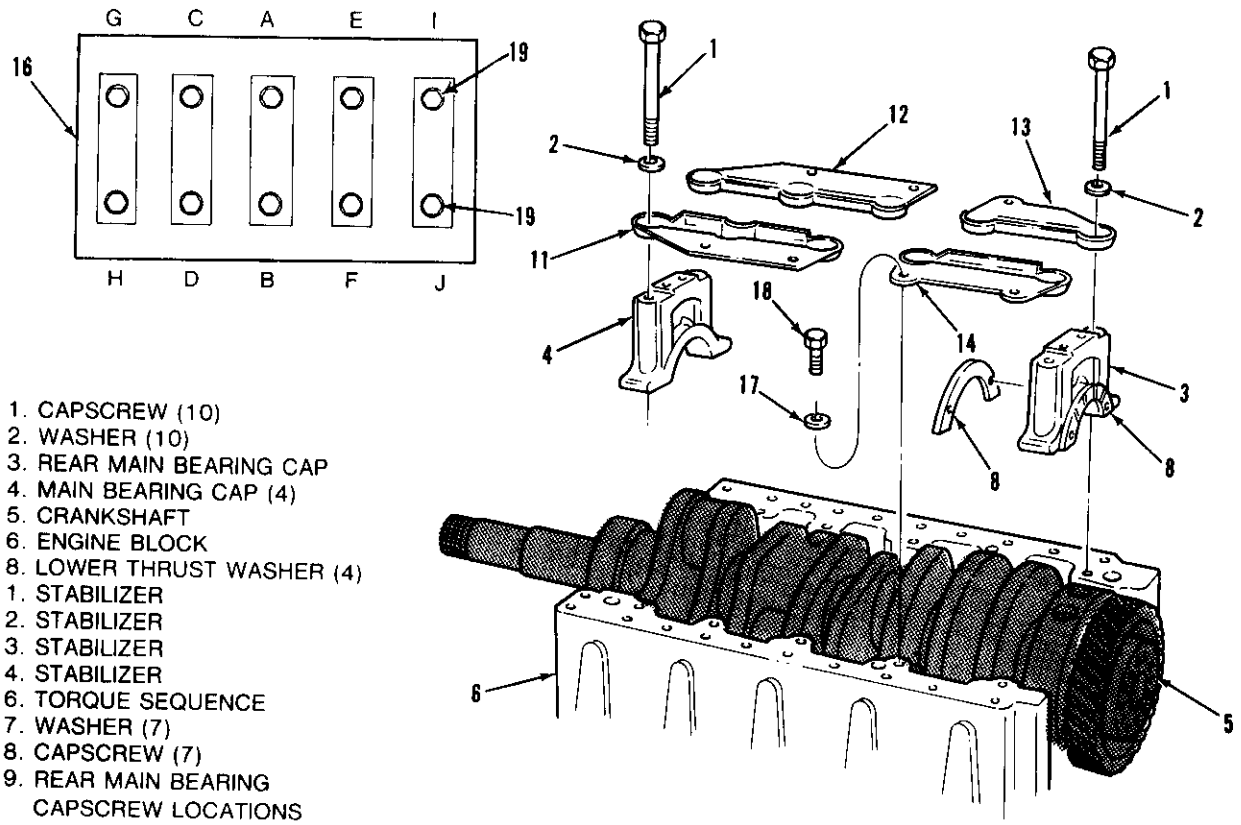
(15) Install rear main bearing cap (3) and four main bearing caps (4), four stabilizers (11, 12, 13, and 14), 10 washers (2), 10 capscrews (1), seven washers (17) and seven capscrews (18). Tighten 10 capscrews (1) and strike main bearing caps (4) sharply with a soft-faced hammer.

(16) Torque eight main bearing cap (4) capscrews (1) to 250-260 foot-pounds (339-352 N·m) in 50 foot-pounds (68 N·m) increments. Torque two rear main bearing cap (3) capscrews (1) at locations (19) to 40-50 foot-pounds (54-68 N·m). Torque capscrews (1) following torque sequence (16).

(17) Tap crankshaft (5) sharply at each end two or three times to firmly seat bearings and main bearing caps (3 and 4).

(18) Retorque all main bearing caps (3 and 4) capscrews (1) to 250-260 foot-pounds (339-352 N·m) by increments of 50 foot-pounds (68 N·m) following torque sequence (16).

(19) Torque capscrews (18) to 70-75 foot-pounds (95-102 N·m).



1. CAPSCREW (10)
2. WASHER (10)
3. REAR MAIN BEARING CAP
4. MAIN BEARING CAP (4)
5. CRANKSHAFT
6. ENGINE BLOCK
8. LOWER THRUST WASHER (4)
11. STABILIZER
12. STABILIZER
13. STABILIZER
14. STABILIZER
16. TORQUE SEQUENCE
17. WASHER (7)
18. CAPSCREW (7)
19. REAR MAIN BEARING CAPSCREW LOCATIONS

TA 298541

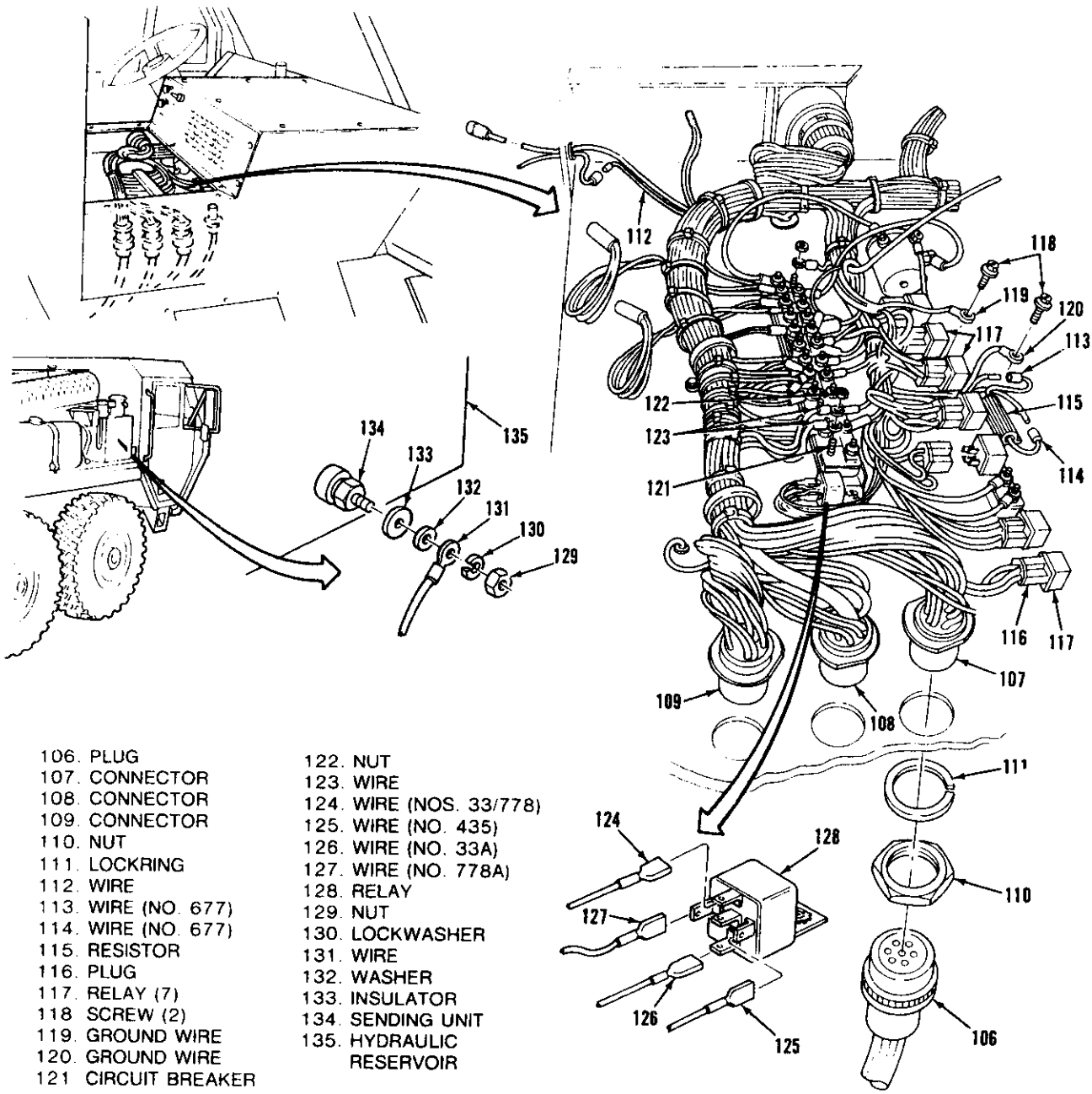
NOTE

Tag each terminal of circuit breaker (121) with the wire numbers attached to it.

(37) Remove nut (122) and wires (123) from each circuit breaker (121).

(38) Remove four wires (124, 125, 126, and 127) from relay (128).

(39) Remove nut (129), lockwasher (130), wire (131), washer (132) and insulator (133) from sending unit (134) on hydraulic reservoir (135). Pull wire (131) free.



106. PLUG
107. CONNECTOR
108. CONNECTOR
109. CONNECTOR
110. NUT
111. LOCKRING
112. WIRE
113. WIRE (NO. 677)
114. WIRE (NO. 677)
115. RESISTOR
116. PLUG
117. RELAY (7)
118. SCREW (2)
119. GROUND WIRE
120. GROUND WIRE
121. CIRCUIT BREAKER
122. NUT
123. WIRE
124. WIRE (NOS. 33/778)
125. WIRE (NO. 435)
126. WIRE (NO. 33A)
127. WIRE (NO. 778A)
128. RELAY
129. NUT
130. LOCKWASHER
131. WIRE
132. WASHER
133. INSULATOR
134. SENDING UNIT
135. HYDRAULIC RESERVOIR

TA 298750

(20) Install dial indicator (tool) (20) at flywheel housing end of crankshaft (5).

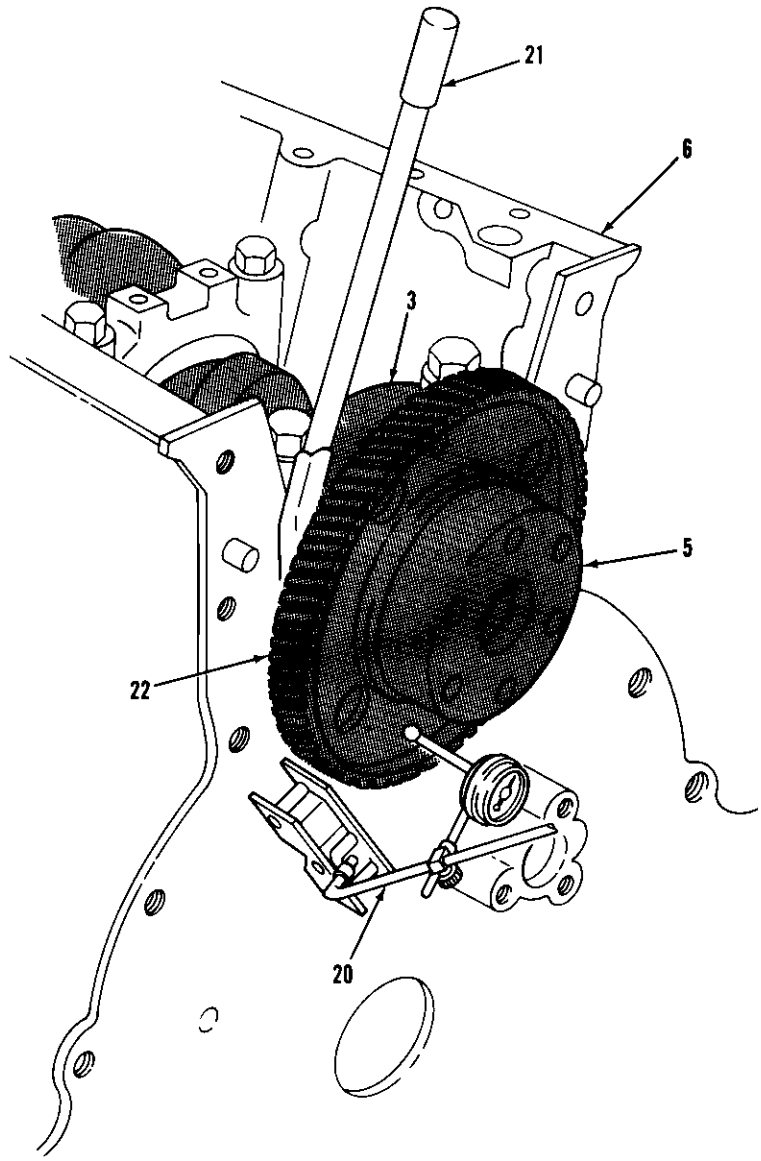
(21) Insert a pry bar (tool) (21) between engine block (6) and timing gear (22). Apply constant pressure and set dial indicator (tool) (20) to zero.

(22) Reposition pry bar (tool) (21) inside engine block (6) between block and crankshaft (5). Apply pressure on crankshaft (5) in opposite direction.

(23) Note amount of end play on dial indicator (tool) (20). End play must be a minimum of 0.0040 inch (0.1016 mm) and a maximum of 0.0110 inch (0.2794 mm), with a limit for used parts of 0.0180 inch (0.4572 mm).

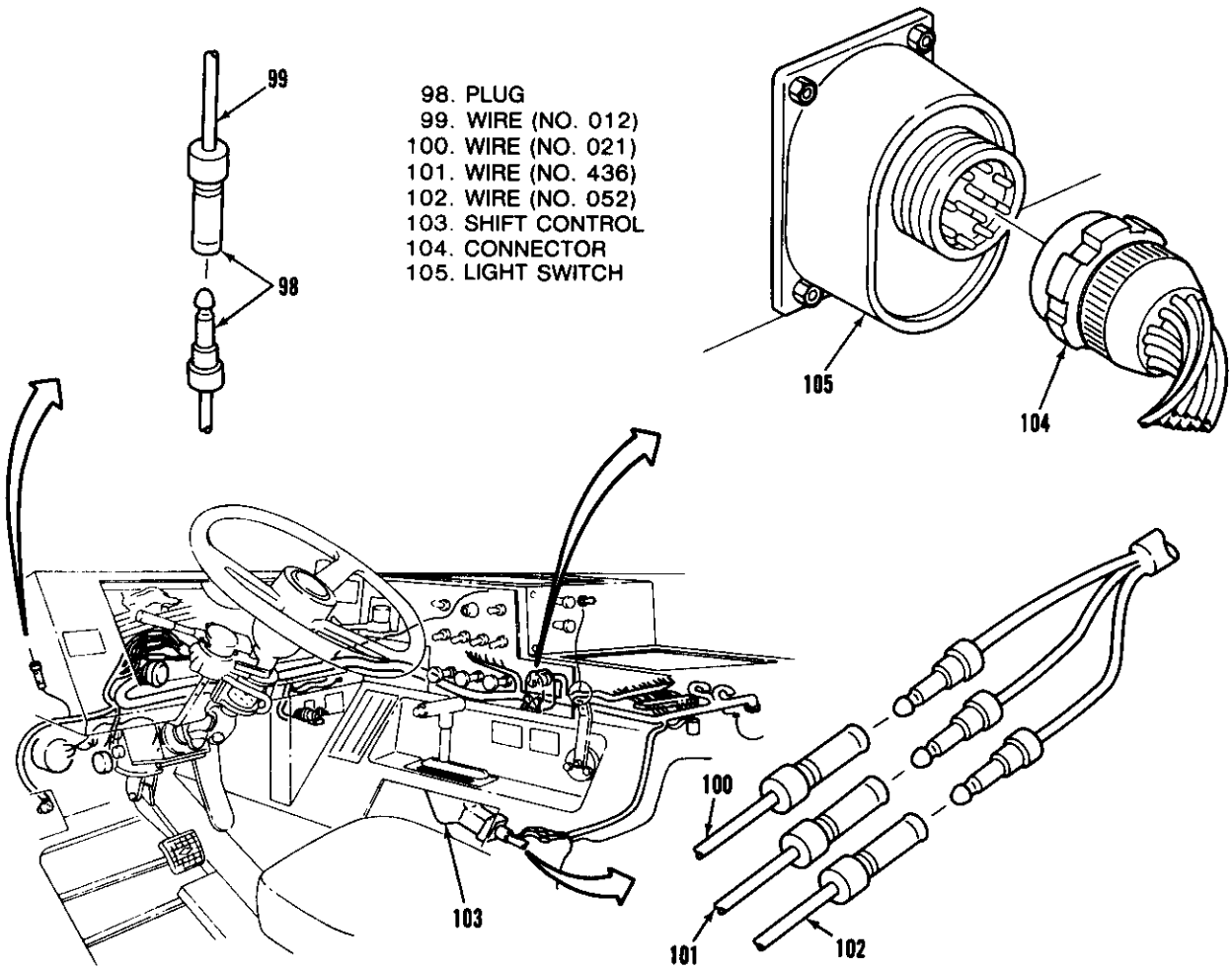
(24) If end play is not within specifications, check for misalined rear main bearing cap (3), dirt or burrs on thrust washer(8), or worn thrust washer (8).

3. REAR MAIN BEARING CAP
5. CRANKSHAFT
6. ENGINE BLOCK
20. DIAL INDICATOR (TOOL)
21. PRY BAR (TOOL)
22. TIMING GEAR



TA 298542

6-5. CAB WIRING HARNESS REPLACEMENT (Continued)



TA 298749

(27) Disconnect plug (98) from wire (99).

(28) Remove dimmer switch. Refer to paragraph 7-49 (TM 2320-20/12, TM 9-2320-297-20).

(29) Unplug three wires (100, 101, and 102) at shift control (103).

(30) Unplug connector (104) from light switch (105).

(31) Remove plug (106) from each connector (107, 108, and 109).

(32) Remove a nut (110) and a lockring (111) from each connector (107, 108, and 109). Discard lockring (111).

(33) Cut wire (112).

(34) Unplug wires (113 and 114) at resistor (115).

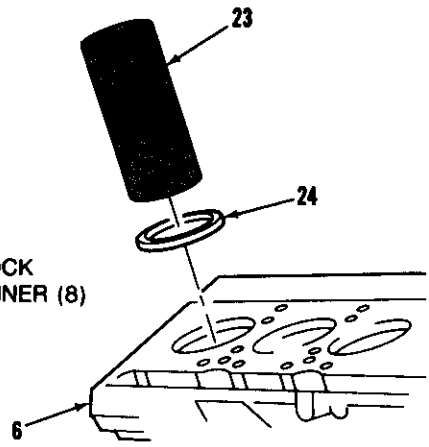
(35) Remove plugs (116) from all relays (117).

(36) Remove two screws (118) and ground wires (119 and 120) from two relays (117). Tag location of ground wires (119 and 120).

3-20. ENGINE REASSEMBLY FROM SUBASSEMBLIES (Continued)

b. Piston and Liner Installation

(1) Remove eight cylinder liners (23) and inserts (24) from engine block (6).



6. ENGINE BLOCK
23. CYLINDER LINER (8)
24. INSERT (8)

CAUTION

Make certain rings (25 thru 33) are all properly positioned, installed, and seated.

NOTE

Oil control ring (29) has an orange stripe and a chrome outside diameter. Oil control ring (30) has an orange stripe and a black outside diameter.

(2) Stagger gaps of rings (25 and 27) so they are 180 degrees from gap of compression ring (26).

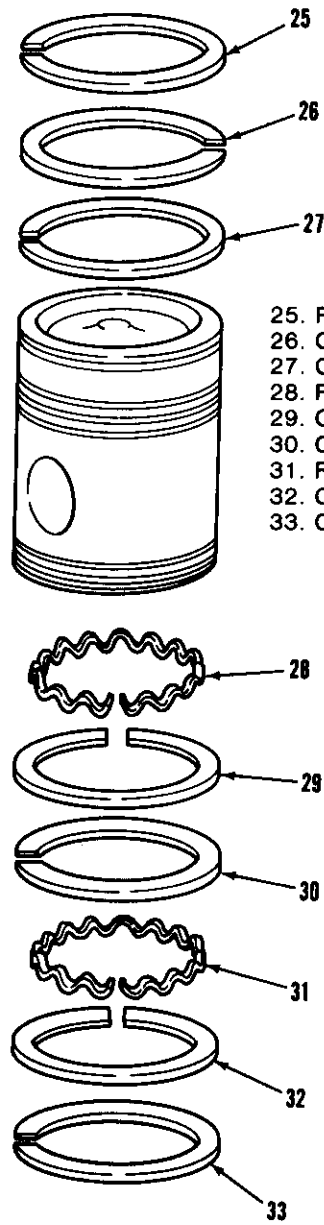
(3) Stagger gap of ring expander (28) 90 degrees from gap of compression ring (27).

(4) Stagger gap of oil control ring (29) 180 degrees from gap of ring expander (28).

(5) Stagger gap of oil control ring (30) 90 degrees from gap of oil control ring (29).

(6) Stagger gap of ring expander (31) 90 degrees from gap of oil control ring (30).

(7) Stagger gap of oil control ring (32) 180 degrees from gap of ring expander (31) and stagger gap of oil control ring (33) 90 degrees from gap of oil control ring (32).



25. FIRE RING
26. COMPRESSION RING
27. COMPRESSION RING
28. RING EXPANDER
29. OIL CONTROL RING
30. OIL CONTROL RING
31. RING EXPANDER
32. OIL CONTROL RING
33. OIL CONTROL RING

TA 298643

(18) Remove two screws (68) and wires (69 and 70).

(19) Remove two screws (71) and wires (72 and 73).

(20) Remove two screws (74) and wires (75 and 76).

(21) Remove two screws (77) and wires (78, 79, and 80).

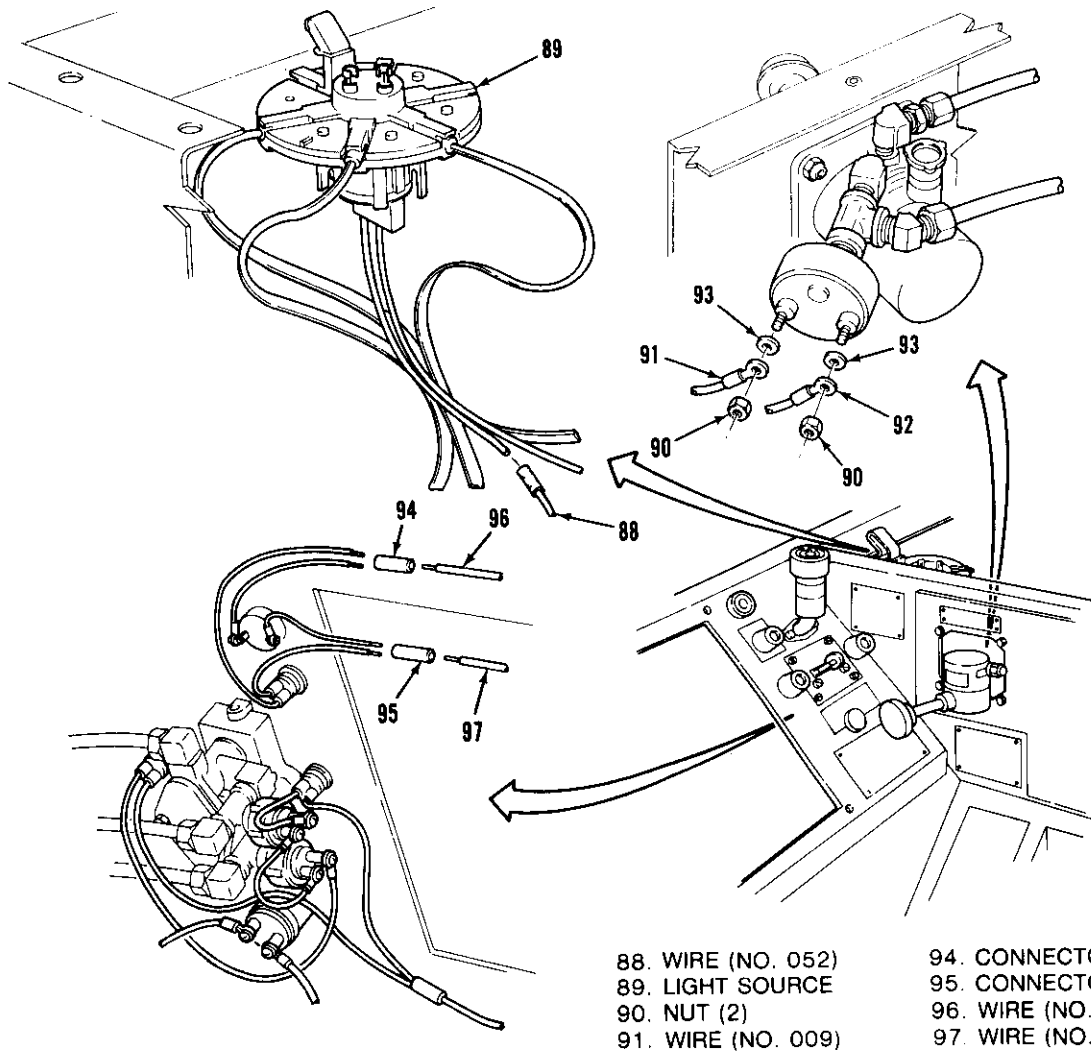
(22) Remove two screws (81) and wires (82, 83, and 84).

(23) Remove screw (85) and wire (86) from switch (87).

(24) Unplug wire (88) from light source (89).

(25) Remove two nuts (90), wires (91 and 92), and washers (93).

(26) Remove connectors (94 and 95) from wires (96 and 97). Discard connectors (94 and 95).



88. WIRE (NO. 052)
89. LIGHT SOURCE
90. NUT (2)
91. WIRE (NO. 009)
92. WIRE (NO. 005)
93. WASHER (2)
94. CONNECTOR
95. CONNECTOR
96. WIRE (NO. 033)
97. WIRE (NO. 525)

TA 298748

(8) Apply lubricating oil to rings (25 thru 33) and ring compressor (35) for each piston and connecting rod assembly (34).

CAUTION

- Make certain rings (25 thru 33) are all properly positioned, installed and seated before installing piston and connecting rod assembly (34) into ring compressor (35). Visually inspect expanders and rings to make sure they are not overlapped.
- Make certain piston and connecting rod assembly (34), ring compressor (35), and cylinder liner (23) are free of dust, dirt, and debris prior to installation.

(9) Install piston and connecting rod assembly (34) into ring compressor (35).

(10) Coat inside of cylinder liner (23) with lubricating oil.

(11) Place cylinder liner (23), with flange end down, on wooden block.

NOTE

Match the piston and connecting rod assembly (34) with the correct cylinder liner (23) and numbered cylinder hole in engine block (6).

(12) Place ring compressor (35) with piston and connecting rod assembly (34) on cylinder liner (23).

CAUTION

When installing piston and connecting rod assembly (34) into ring compressor (35) make certain piston is alined. Push piston straight down with one even push to avoid cocking piston to one side.

NOTE

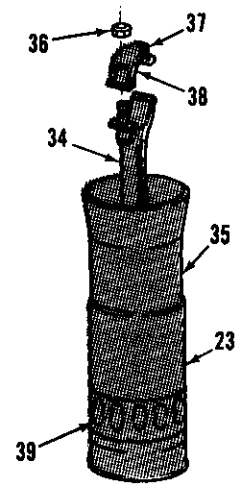
Piston must be installed in liner facing same direction as it was when removed.

(13) Push piston and connecting rod assembly (34) into cylinder liner (23) until piston is free from ring compressor (35).

(14) Push piston into cylinder liner (23) until rings (25, 26, and 27) pass cylinder liner ports (39). Remove ring compressor (35).

(15) Remove two nuts (36), connecting rod cap (37), and bearing (38) from piston and connecting rod assembly (34).

23. CYLINDER LINER (8)
34. PISTON AND CONNECTING ROD ASSEMBLY
35. RING COMPRESSOR
36. NUT (2)
37. CONNECTING ROD CAP
38. BEARING
39. CYLINDER LINER PORTS



TA 298544

6-5. CAB WIRING HARNESS REPLACEMENT (Continued)

(11) Remove two wires from ether starting switch. Refer to paragraph 7-20, items 7 and 8 (TM 2320-20/12, TM 9-2320-297-20).

NOTE

Perform step (12) on non-A1 series vehicles only.

(12) Disconnect wires (51 thru 56).

NOTE

Perform step (12.1) on LVSA1 series vehicles only.

(12.1) Disconnect weather pack connector (56.1).

NOTE

Attaching hardware for LVSA1 clamps has been changed from capscrew, star washer, and nut to a capscrew, lockwasher, and nut. When repairing non-A1 series vehicles, use new style hardware to replace old style hardware. Refer to TM 9-2320-297-24P for correct parts identification.

(13) Remove capscrew (57), nut (58), and lockwasher (59) from clamp (60).

(14) Remove clamp (60) from wiring harness (61).

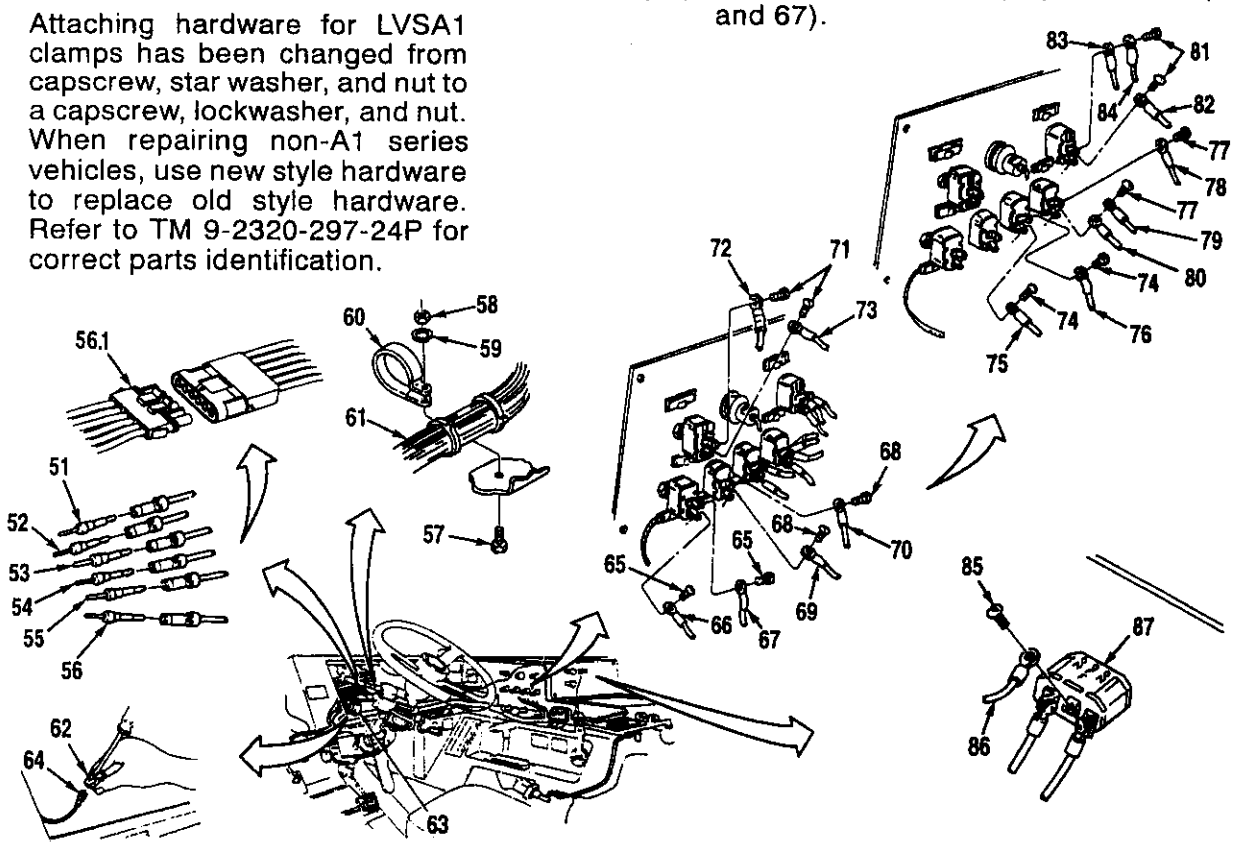
(15) Remove plug (62) from flasher switch (63).

(16) Using a screwdriver, remove wire (64) from plug (62).

NOTE

It may be necessary to remove switches for access to wire terminals. Refer to paragraph 7-14 (TM 2320-20/12, TM 9-2320-297-20).

(17) Remove two screws (65) and wires (66 and 67).



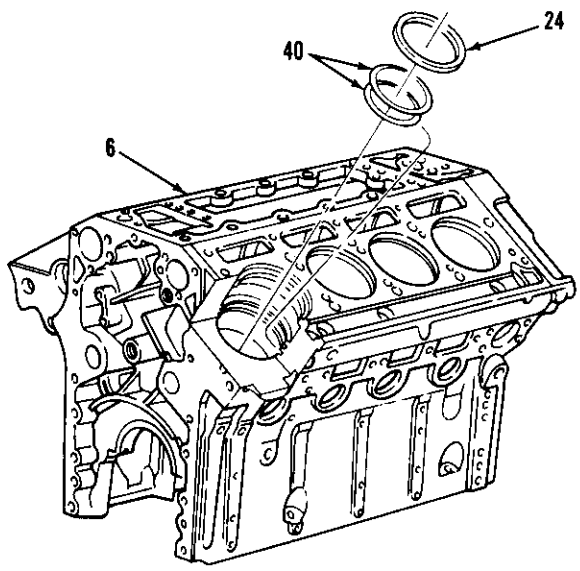
51. WIRE (NO. 002)
52. WIRE (NO. 004)
53. WIRE (NO. 001)
54. WIRE (NO. 294)
55. WIRE (NO. 003)
56. WIRE (NO. 016)
56.1. WEATHER PACK CONNECTOR*
57. SCREW
58. NUT
59. LOCKWASHER
60. CLAMP
61. WIRING HARNESS
62. PLUG
63. FLASHER SWITCH
64. WIRE (NO. 080)
65. SCREW (2)
66. WIRE (NO. 029)
67. WIRE (NO. 029)
68. SCREW (2)
69. WIRE (NO. 040)
70. WIRE (NO. 040)
71. SCREW (2)
72. WIRE (NOS. 714/716)
73. WIRE NO. 715
74. SCREW (2)
75. WIRE (NO. 153)
76. WIRE (NO. 027)
77. SCREW
78. WIRE (NO. 012)
79. WIRE (NO. 012)
80. WIRE (NO. 060)
81. SCREW (2)
82. WIRE
83. WIRE (NO. 713)
84. WIRE (NO. 712)
85. SCREW
86. WIRE (NO. 082)
87. SWITCH

* LVSA1 SERIES VEHICLES ONLY

3-20. ENGINE REASSEMBLY FROM SUBASSEMBLIES (Continued)

(16) Lubricate two new sealrings (40) with clean engine oil. Install new sealrings (40) and insert (24) into engine block (6).

6. ENGINE BLOCK
24. INSERT (8)
40. SEALRING (16)



TA 298545

CAUTION

When installing cylinder liner (23), care must be taken not to damage sealrings.

NOTE

Aline piston and liner assembly with cylinder. Have identification number on connecting rod (42) face toward the outer edge of engine block (6). Also aline marks on cylinder liner (23) and engine block (6). The marks were made during cylinder liner (23) repair.

(17) Install cylinder liner (23) into engine block (6). Rotate crankshaft (5) until crankshaft journal (41) lines up with connecting rod (42).

(18) Push piston and connecting rod assembly (34) down until bearing (38) is seated against crankshaft journal (41).

(19) Place a piece of plastic strip (10) along the full width of crankshaft journal (41).

(20) Install connecting rod cap (37) so rod cap notch (43) and connecting rod notch are on the same side.

(21) Install and torque two nuts (36) to 60-70 foot-pounds (81-95 N·m).

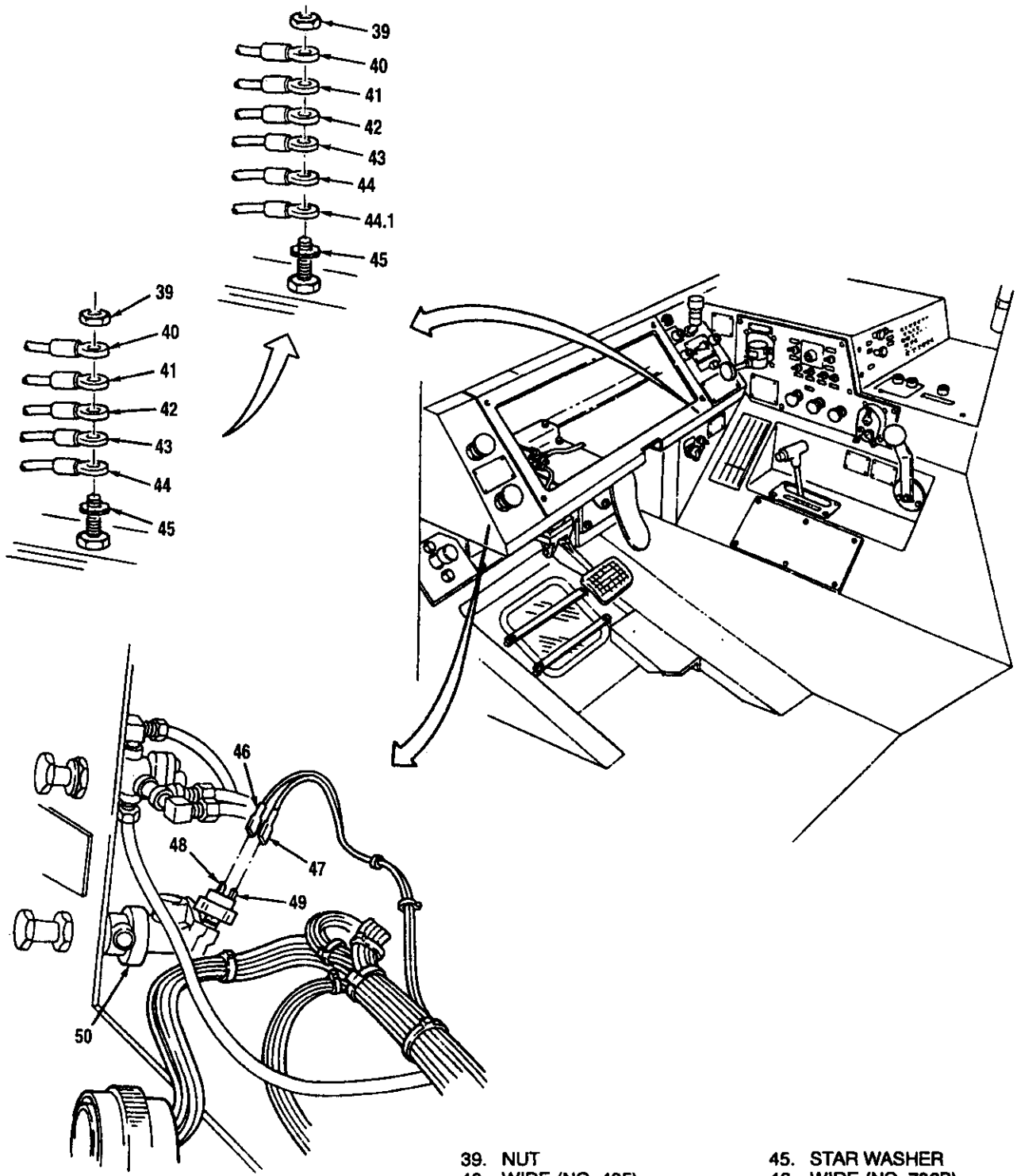
(22) Loosen and remove two nuts (36). Remove connecting rod cap (37) and compare the width of the flattened plastic strip (10) to the numbers on the plastic strip gage (15). The scale on the plastic strip gage (15) indicates bearing clearance in thousandths of an inch.

(23) Bearing clearance must be between 0.0008 and 0.0045 inch (0.4192-0.1145 mm). Replace all bearings (38) if clearance exceeds specification.

(24) Remove all traces of plastic strip (10) and lubricate bearing (38) with clean engine oil.

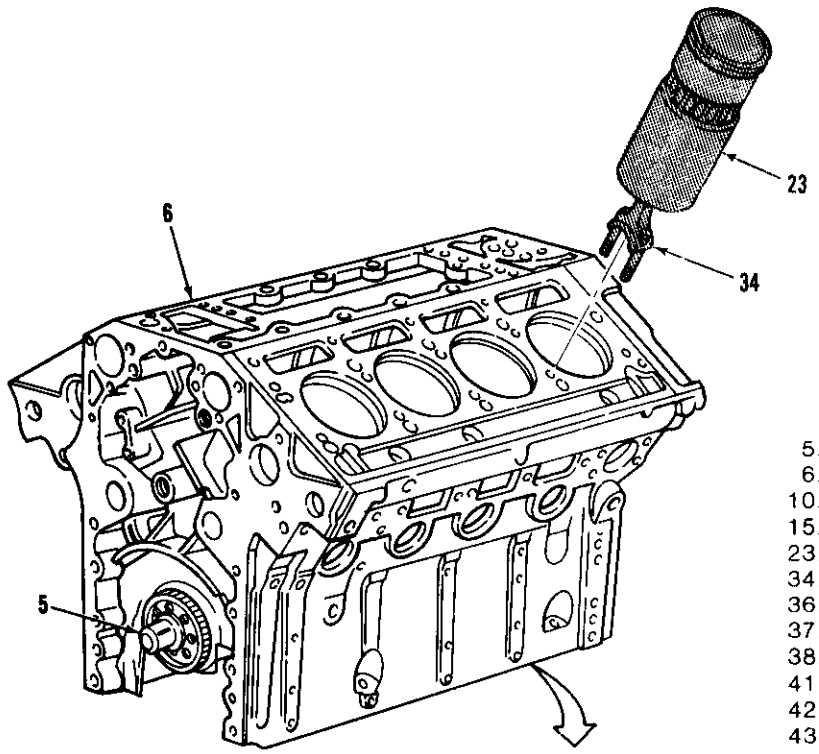
(25) Install connecting rod cap (37) so rod cap notch (43) and connecting rod (42) notch are on the same side.

(26) Install and torque two nuts (36) to 60-70 foot-pounds (81-95 N·m).

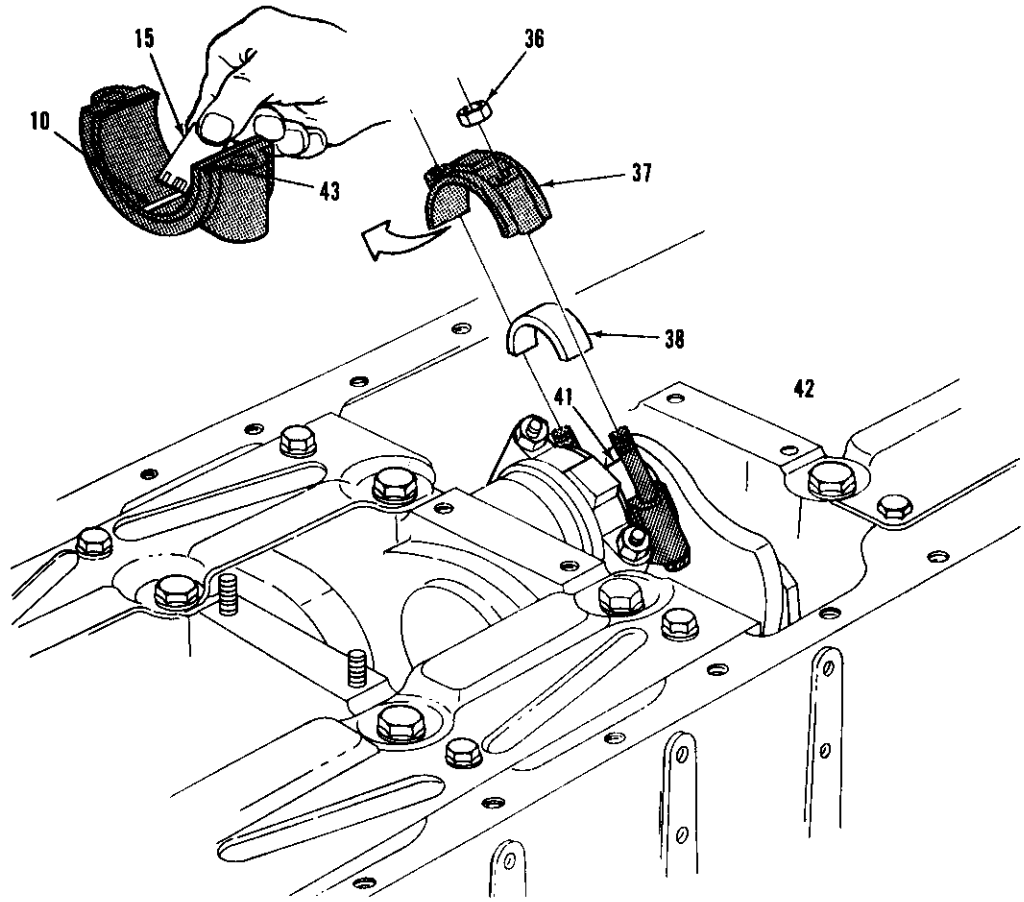


39. NUT
40. WIRE (NO. 435)
41. GROUND WIRE
42. WIRE (NO. 091)
43. WIRE (NO. 091)
44. WIRE (NO. 435)
44.1. WIRE (NO. 435)*
45. STAR WASHER
46. WIRE (NO. 736B)
47. WIRE (NO. 615)
48. TERMINAL
49. TERMINAL
50. TRAILER SUPPLY VALVE

* LVSA1 SERIES VEHICLES ONLY



5. CRANKSHAFT
6. ENGINE BLOCK
10. PLASTIC STRIP
15. PLASTIC STRIP GAGE
23. CYLNDER LINER (8)
34. PISTON AND CONNECTING ROD ASSEMBLY
36. NUT (2)
37. CONNECTING ROD CAP
38. BEARING
41. CRANKSHAFT JOURNAL
42. CONNECTING ROD
43. ROD CAP NOTCH



TA 298546

6-5. CAB WIRING HARNESS REPLACEMENT (Continued)

(7) Remove four nuts (24), wires (25 thru 32), and four washers (33) from two stop light switches (34 and 35) on brake treadle valve (36).

(8) Remove wires (37 and 38).

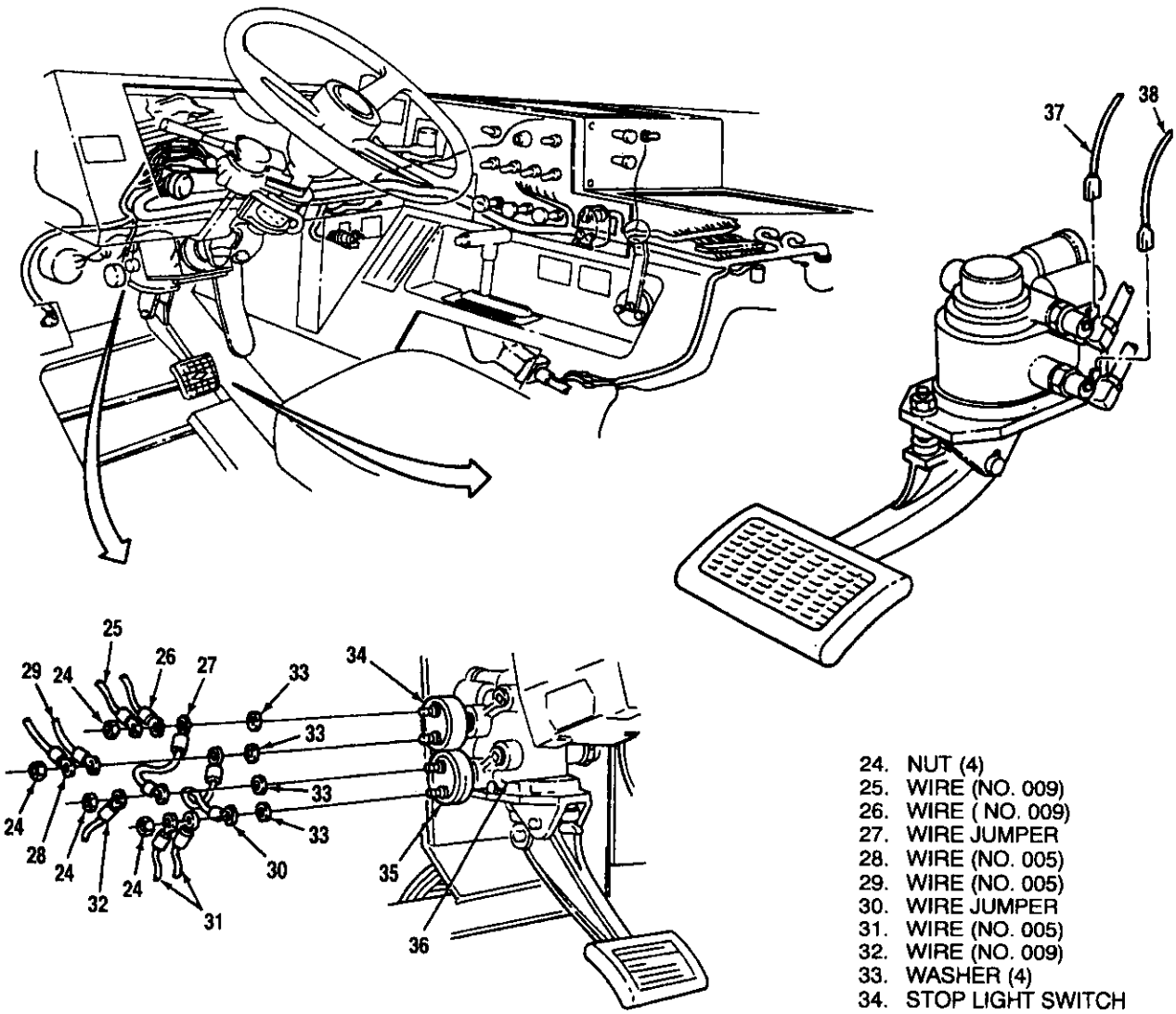
(9) Remove nut (39), wires (40 thru 44) and star washer (45). Discard star washer (45).

NOTE

Perform step (9.1) on LVSA1 series vehicles only.

(9.1) Remove nut (39), wires (40 thru 44.1) and star washer (45). Discard star washer (45).

(10) Remove two wires (46 and 47) from terminals (48 and 49) at trailer supply valve (50).



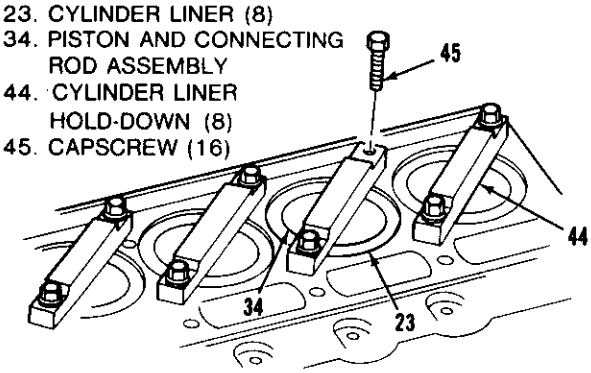
24. NUT (4)
25. WIRE (NO. 009)
26. WIRE (NO. 009)
27. WIRE JUMPER
28. WIRE (NO. 005)
29. WIRE (NO. 005)
30. WIRE JUMPER
31. WIRE (NO. 005)
32. WIRE (NO. 009)
33. WASHER (4)
34. STOP LIGHT SWITCH
35. STOP LIGHT SWITCH
36. BRAKE TREADLE VALVE
37. WIRE (NO. 120)
38. WIRE (NO. 120)

3-20. ENGINE REASSEMBLY FROM SUBASSEMBLIES (Continued)

(27) Install cylinder liner hold-down (44) with two capscrews (45). This is to prevent cylinder liner (23) from falling out when crankshaft is turned.

(28) After installation of each cylinder liner (23) and piston and connecting rod assembly (34), rotate crankshaft 360 degrees and feel for binding.

23. CYLINDER LINER (8)
34. PISTON AND CONNECTING ROD ASSEMBLY
44. CYLINDER LINER HOLD-DOWN (8)
45. CAPSCREW (16)

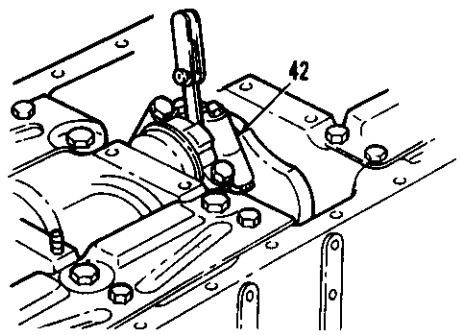


(29) Install remaining cylinder liners (23) and piston and connecting rod assemblies (34), repeating steps (2) thru (28).

(30) Check clearance between each connecting rod (42) attached to same crankshaft journal. Clearance must be a minimum of 0.008 inch and a maximum of 0.016 inch (0.203-0.406 mm).

(31) Once all piston and connecting rod assemblies (34) have been installed, remove cylinder liner hold-down (44) and capscrews (45).

42. CONNECTING ROD



c. Camshaft Installation

(1) Install idler gear (46). Refer to paragraph 3-13.

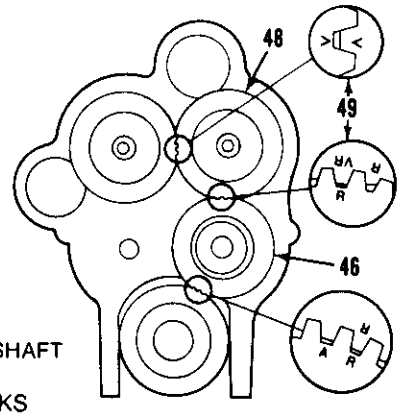
CAUTION

Care must be taken when inserting camshafts into cylinder block to prevent damage to camshaft lobes.

(2) Insert right camshaft (47) into opening on right bankside, until right camshaft gear (48) contacts idler gear (46).

(3) Aline timing marks (49) and slide right camshaft (47) into place.

46. IDLER GEAR
48. RIGHT CAMSHAFT GEAR
49. TIMING MARKS



TA 298547

(4) Install three capscrews (50) and new lockwashers (51) into rear bearing. Rotate right camshaft (47) to aline capscrew (50) holes in rear bearing.

(5) Torque capscrews (50) to 35-40 foot-pounds (47-54 N·m).

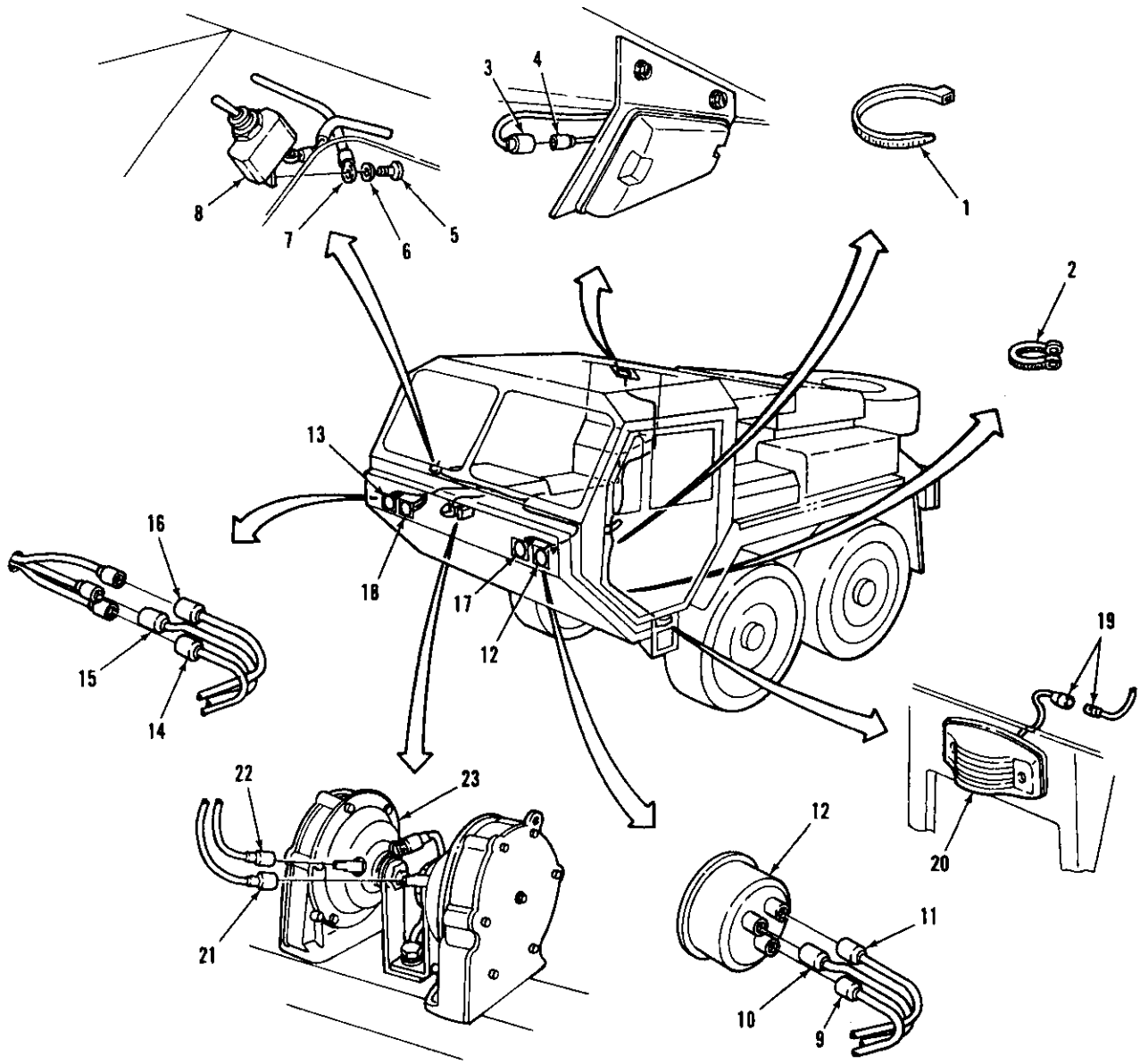
(6) Turn three camshaft bearings (52) until bearing holes aline with holes in cylinder block.

(7) Install three setscrews (53). Torque setscrews (53) to 15-20 foot-pounds (20-27 N·m).

(4) Disconnect plugs (14, 15, and 16) at both composite lights (17 and 18).

(5) Disconnect two plugs (19) from two clearance lights (20).

(6) Disconnect wires (21 and 22) at electric horns (23).



1. NYLON TIE
2. PLASTIC CLAMP
3. PLUG
4. DOME LIGHT
5. SCREW
6. LOCKWASHER
7. WIRE (NO. 413)
8. MAP LIGHT SWITCH
9. PLUG
10. PLUG
11. PLUG
12. HEADLIGHT
13. HEADLIGHT
14. PLUG
15. PLUG
16. PLUG
17. COMPOSITE LIGHT
18. COMPOSITE LIGHT
19. PLUG (2)
20. CLEARANCE LIGHT (2)
21. WIRE (NO. 168)
22. WIRE (NO. 168)
23. ELECTRIC HORNS

TA 298744

(8) Insert left camshaft (54) into opening on left bankside, until left camshaft gear (55) contacts right camshaft gear (48).

(9) Repeat steps (3) thru (7) to secure left camshaft bearings.

NOTE

Left bearing includes an oil seal.

(10) Install new gasket (56) and front bearing (57) on left camshaft (54).

(11) Install three capscrews (58) and lockwashers (59) on front bearing (57).

(12) Install bearing (60), three capscrews (61), and new lockwashers (62) on right camshaft (47).

(13) Torque capscrews (58 and 61) to 35-40 foot-pounds (47-54 N·m).

(14) Install spacer (63) and key (64) on left camshaft (54).

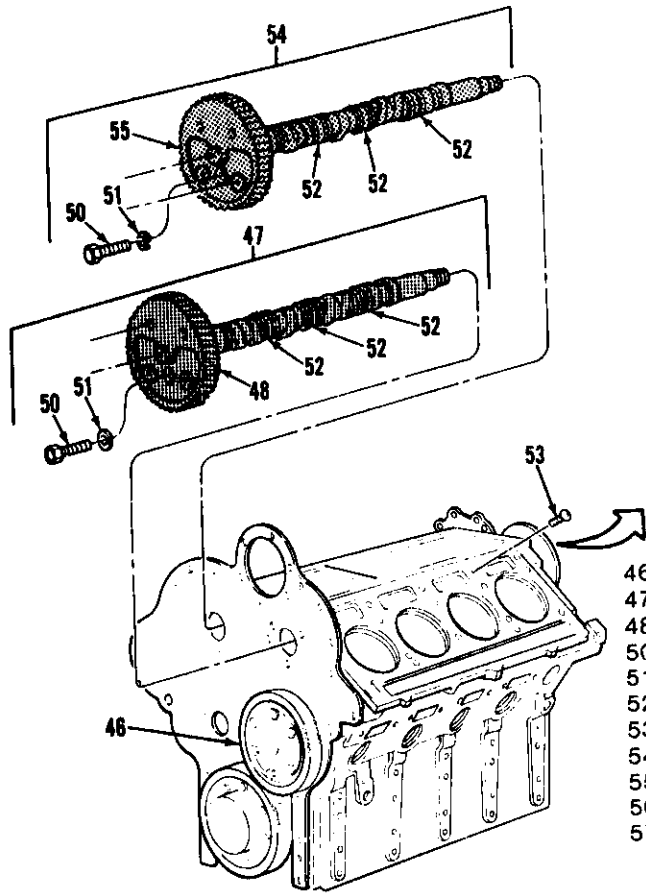
(15) Install pulley (65) on left camshaft (54).

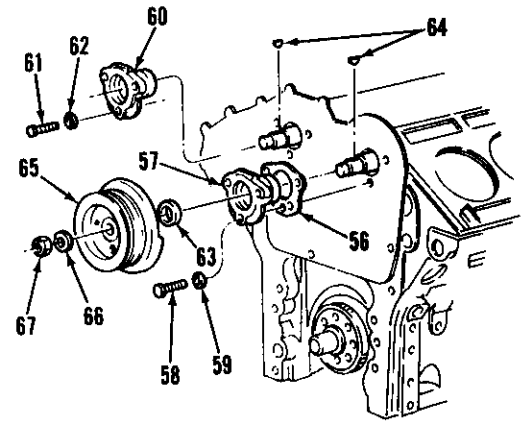
(16) Install new lockwasher (66) and nut (67).

(17) Wedge a rag between the two rear camshaft gears (48 and 55).

(18) Torque nut (67) to 300-325 foot-pounds (407-441 N·m).

(18.1) Check gear backlash between gears (48 and 55). Minimum backlash is 0.002 inch (0.05 mm). Maximum backlash is 0.008 inch (0.2 mm) for new gears and 0.010 (0.254 mm) for used gears.





46. IDLER GEAR
47. RIGHT CAMSHAFT
48. RIGHT CAMSHAFT GEAR
50. CAPSCREW (6)
51. LOCKWASHER (6)
52. CAMSHAFT BEARING (6)
53. SETSCREW (6)
54. LEFT CAMSHAFT
55. LEFT CAMSHAFT GEAR
56. GASKET
57. FRONT BEARING
58. CAPSCREW
59. LOCKWASHER (3)
60. BEARING
61. CAPSCREW (3)
62. LOCKWASHER (3)
63. SPACER
64. KEY
65. PULLEY
66. LOCKWASHER
67. NUT

6-5. CAB WIRING HARNESS REPLACEMENT

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Materials/Parts
Nylon ties (AR) (MS3367-1-9) item 1
Plastic clamp (AR) (NSN 5340-01-191-6461) item 2
Lockwasher (MS35338-42) item 6
Lockwasher (353AX) item 59
Lockring (3) (NSN 5310-01-081-0799) items 111 and 132
Connector (2) (NSN 5940-00-665-7317) items 113 and 114
Lockwasher (238398) item 130
Corrosion preventive compound (AR) (item 14.1, Appendix C)

Equipment Condition
TM
TM 2320-20/12
TM 9-2320-297-20

Condition Description
Batteries disconnected (para 7-43 or 7-43.1 LVSA1 series vehicles only).

Skid plate grille removed (para 18-16).

Access panels removed (para 18-14 items 2, 3, 4 14, 27, 28).

Shield removed (para 7-28, task a, steps (5) and (6), items 13 and 15).

Instrument panel opened (para 7-11).

Engine stop switch removed (para 7-14).

Ignition switch removed (para 7-21).

General Installation Instructions
Apply corrosion preventive compound to all ground terminals after installation

a. Removal

NOTE

- Remove nylon ties (1) and plastic clamps (2) as needed. Note location for proper installation.
- Tag terminals remaining on vehicle with wire numbers to aid installation.

(1) Disconnect plug (3) at dome light (4).

(2) Remove screw (5), lockwasher (6), and wire (7) from map light switch (8). Discard lockwasher (6).

(3) Disconnect plugs (9, 10, and 11) at both headlights (12 and 13).

3-20. ENGINE REASSEMBLY FROM SUBASSEMBLIES (Continued)

NOTE

Check alinement of capscrew holes in retainers (69 and 72) and gears (48 and 55) after two camshaft gear nuts (68) have been torqued.

(19) Install and torque two rear camshaft nuts (68) to 300-325 foot-pounds (407-441 N·m).

(20) Aline retainer capscrew holes and install retainer (69) on right camshaft gear (48).

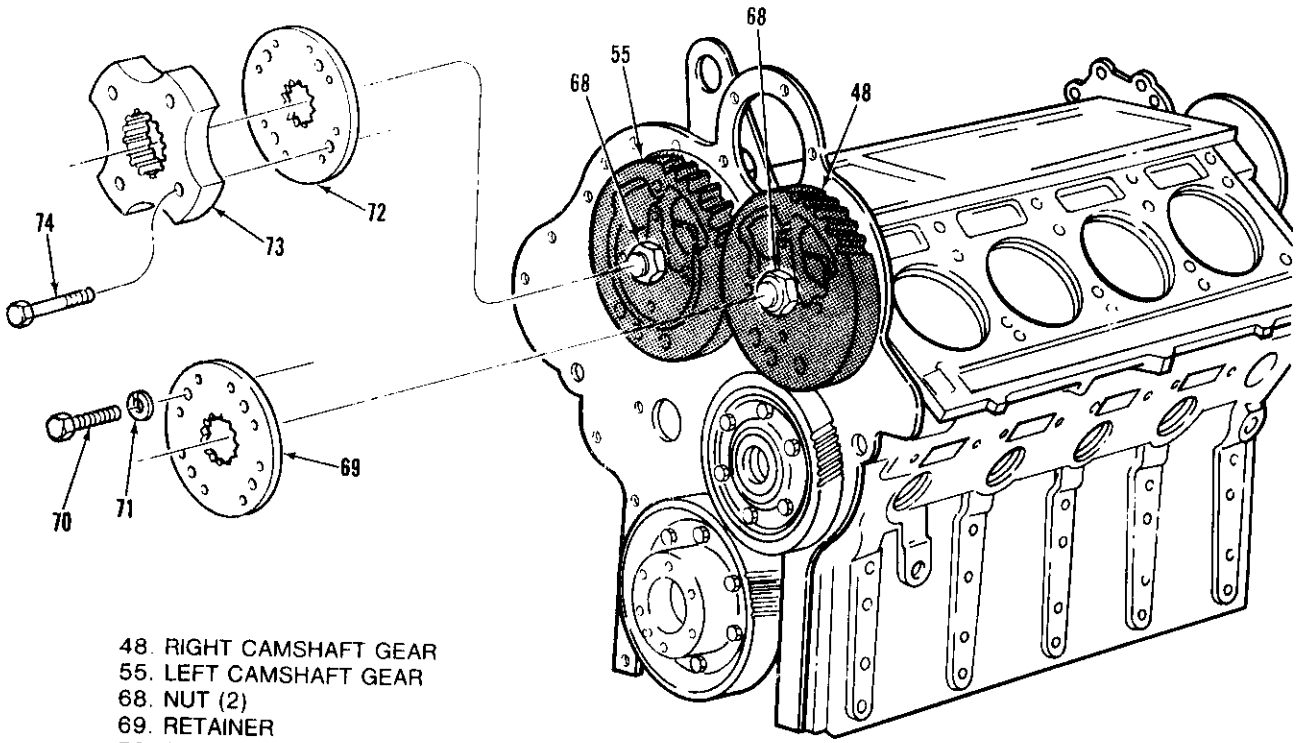
(21) Install four capscrews (70) and new lockwashers (71). Torque capscrews (70) to 35-39 foot-pounds (47-53 N·m).

(22) Aline retainer capscrew holes and install retainer (72) on left camshaft gear (55).

(23) Install adapter (73) and four capscrews (74) on left camshaft gear (55). Torque capscrews (74) to 40-50 foot-pounds (61-68 N·m).

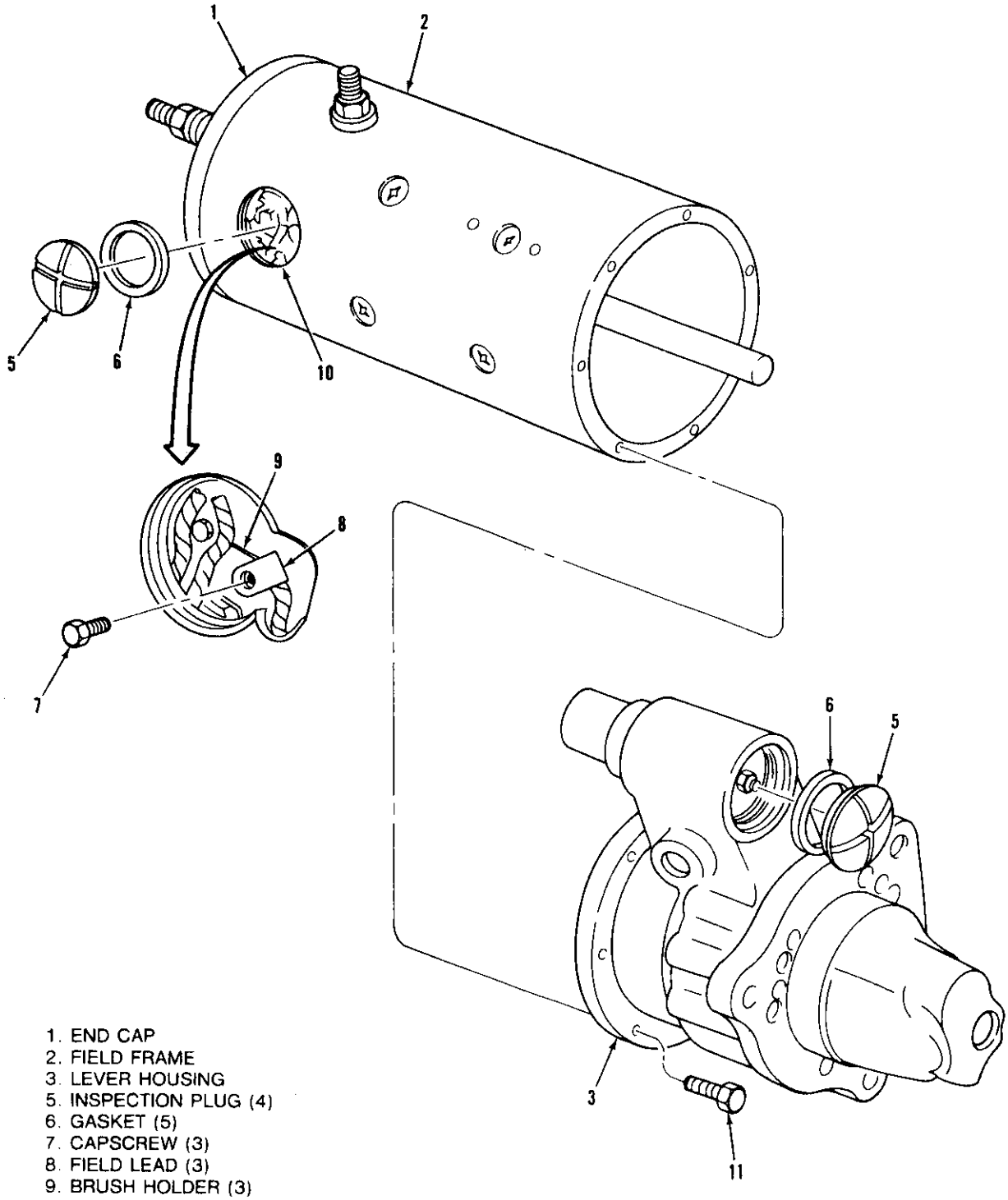
(24) Remove rag from camshaft gears (48 and 55).

END OF TASK



48. RIGHT CAMSHAFT GEAR
55. LEFT CAMSHAFT GEAR
68. NUT (2)
69. RETAINER
70. CAPSCREW (4)
71. LOCKWASHER (4)
72. RETAINER
73. ADAPTER
74. CAPSCREW (4)

TA 298549



1. END CAP
2. FIELD FRAME
3. LEVER HOUSING
5. INSPECTION PLUG (4)
6. GASKET (5)
7. CAPSCREW (3)
8. FIELD LEAD (3)
9. BRUSH HOLDER (3)
10. INSPECTION HOLE (3)
11. CAPSCREW (7)

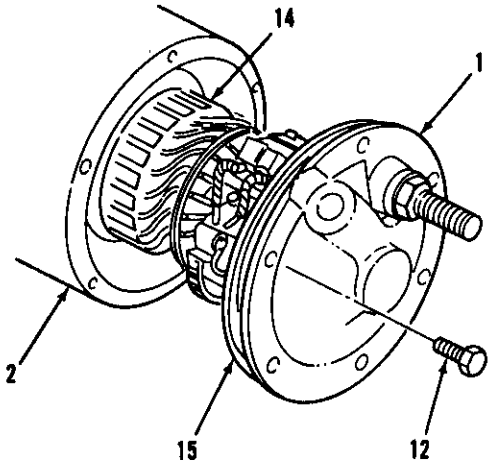
TA 298743

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install flywheel housing (para 3-7).
	Install flexplates (para 3-8).
	Install vibration damper and front cover (para 3-5).
	Install oil pump (para 3-11).
	Install oil pressure regulator/relief valve (para 3-12).
TM 2320-20/12 TM 9-2320-297-20	Install oil pan (para 3-6).
TM 2320-34/13 TM 9-2320-297-34	Install aftercooler (para 5-8).
	Install cylinder head (para 3-3).
	Install injector control tubes (para 4-5).
	Install blower drive gear (para 4-9).
	Install blower (para 4-6).
TM 2320-20/12 TM 9-2320-297-20	Install fuel pump (para 4-3).
TM 2320-34/13 TM 9-2320-297-34	Install water pump drive gear (para 3-14).
	Install oil cooler (para 3-10).
TM 2320-20/12 TM 9-2320-297-20	Install oil filter adapter (para 3-5).
TM 2320-34/13 TM 9-2320-297-34	Install water pump (para 5-5).
TM 2320-20/12 TM 9-2320-297-20	Install thermostat housings (para 6-6).
	Install shutdown solenoid (para 4-13).
TM 2320-34/13 TM 9-2320-297-34	Install turbocharger (para 4-10).
	Install air inlet housing (para 4-12).
	Install air compressor (para 11-7).
TM 2320-20/12 TM 9-2320-297-20	Install alternator (para 7-4).
TM 2320-34/13 TM 9-2320-297-34	Remove engine from engine stand (para 3-21).
TM 2320-20/12 TM 9-2320-297-20	Install exhaust manifold (para 3-7).
	Install starter (para 7-7).
TM 2320-34/13 TM 9-2320-297-34	Start overhauled engine (para 3-27).
	Perform engine tune-up (para 3-29).
TM 2320-20/12 TM 9-2320-297-20	Install rocker covers (para 3-4).
TM 2320-34/13 TM 9-2320-297-34	Perform dynamometer test (para 3-28).
	Install power pack (para 3-17).

6-4. STARTER REPAIR (Continued)



1. END CAP
2. FIELD FRAME
12. CAPSCREW (6)
14. ARMATURE
15. O-RING

(45) Install new O-ring (15) onto end cap (1).

(46) Install armature (14) and end cap (1) into field frame (2) with six capscrews (12).

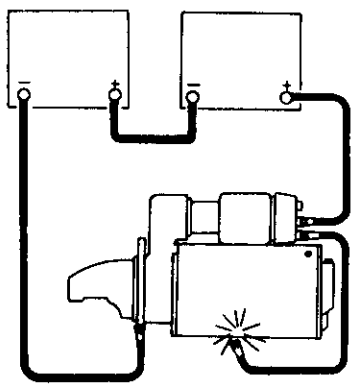
(47) Aline matchmarks and install lever housing (3) to field frame (2) with seven capscrews (11).

(48) Install three field leads (8) to brush holders (9) with three capscrews (7).

(49) Install four new gaskets (6), and inspection plugs (5) into inspection holes (10).

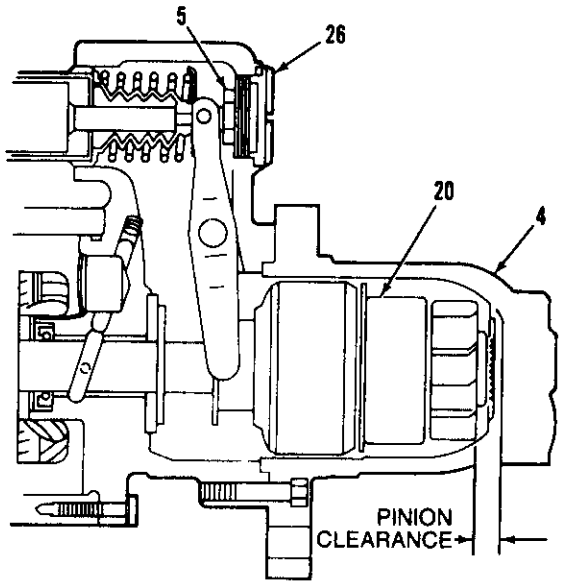
d. Pinion Clearance Adjustment

(1) Install starter solenoid. Refer to paragraph 7-6 in TM 2320-20/12, TM 9-2320-297-20.



(2) Make connections as shown.

(3) Temporarily flash a jumper lead as shown. The starter drive (20) will now shift into cranking position and remain there until batteries are disconnected.



4. DRIVE HOUSING
5. SELF LOCKING NUT
20. STARTER DRIVE
26. INSPECTION PLUG

TA 296742

(4) Push starter drive (20) back and measure the distance between starter drive (20) and drive housing (4).

(5) Pinion clearance should be 0.330-0.390 of an inch (8.3-9.9 mm).

(6) Adjust clearance by removing inspection plug (5) and turning self locking nut (26).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install starter (para 7-7).
TM 2320-10/11 TM 9-2320-297-10	Check operation of starter (para 2-13).

3-21. REMOVING ENGINE FROM ENGINE STAND

THIS TASK COVERS: a. Removal
b. Component Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Pipe sealant (item 60, Appendix C)

Personnel Required

1 MOS 3522
1 Assistant

References

TM 2320-20/12
TM 9-2320-297-20

General Safety Instructions

Engine components are heavy. To prevent personal injury, use extreme caution when removing engine from engine stand.

---

a. Removal

(1) Attach a sling to engine lifting brackets.

(2) Using a hoist capable of lifting engine, lift engine until sling has tension.

WARNING

Engine components are heavy. To prevent personal injury, use extreme caution when removing engine from engine stand.

(3) Remove engine from stand.

(4) Set engine on blocks.Place blocks under front engine mount (1) and flywheel housing (2).

b. Component Installation

(1) Apply pipe sealant to drain cock (3) threads. Install drain cock (3).

(2) Apply pipe sealant to two elbows (4).Install both elbows (4) into both sides of block.

(3) Install air box drain tube (5), clamp (6), washer (7), and capscrew (8) on both sides of block. Tighten capscrews (8) securely.

(4) Apply pipe sealant to threads of elbow (9). Install elbow (9) into block.

(5) Install turbocharger oil feed line (10) onto elbow (9).

(6) Install exhaust manifolds (11). Refer to paragraph 3-7 (TM 2320-20/12, TM 9-2320-297-20).

(7) Install starter (12). Refer to paragraph 7-7 (TM 2320-20/12, TM 9-2320-297-20).

(8) Release tension on sling. Remove sling from lifting brackets.

(38) Install new small O-ring (25) and new large O-ring (24) on shift lever shaft (23).

(39) Install shift lever shaft (23) through shift lever (28).

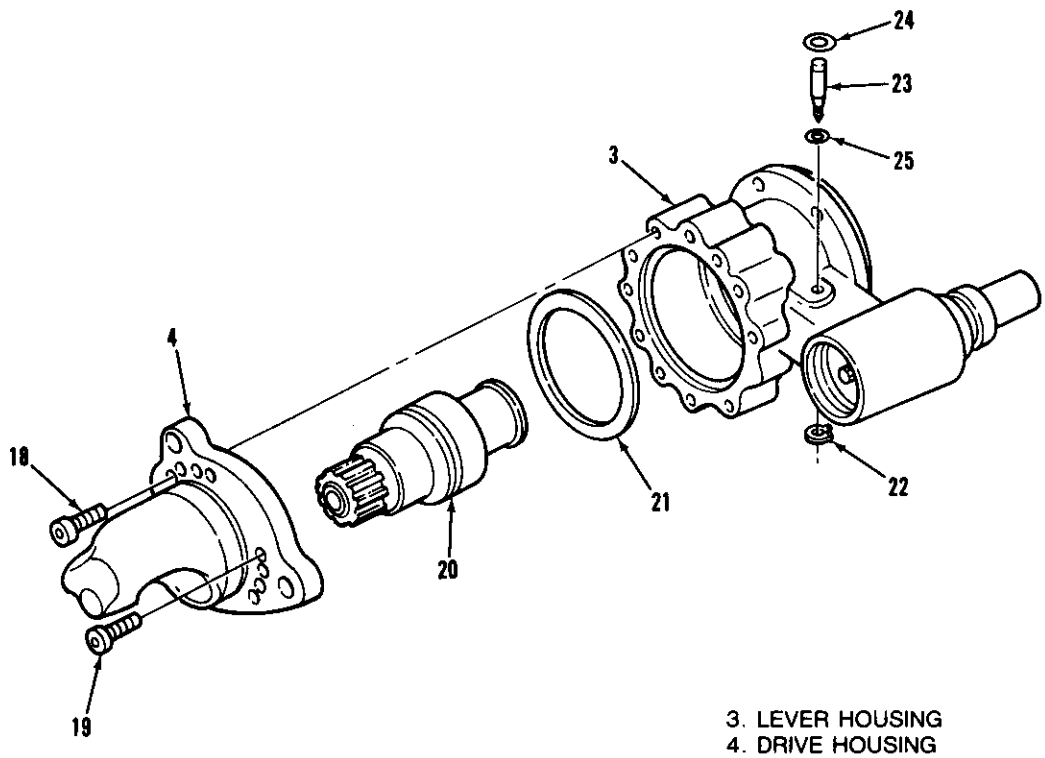
(40) Install retaining ring (22).

(41) Install new gasket (21) in lever housing (3).

(42) Install starter drive (20) into shift lever (28) in lever housing (3).

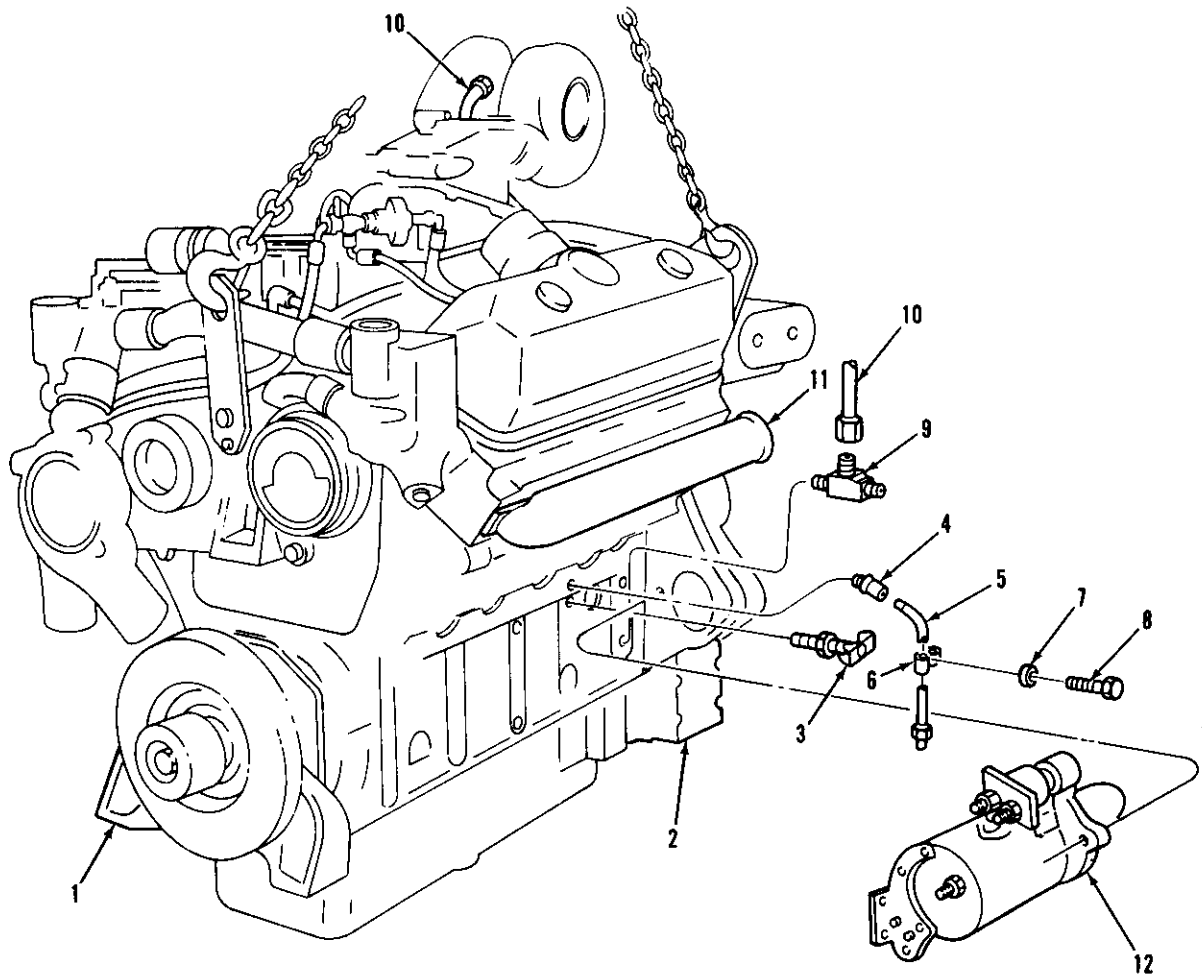
(43) Aline matchmarks and install drive housing (4) on lever housing (3) with five long screws (18) and one short screw (19).

(44) Tighten screws (18 and 19) to 15 foot-pounds (20 N·m).



3. LEVER HOUSING
4. DRIVE HOUSING
18. LONG SCREW (5)
19. SHORT SCREW
20. STARTER DRIVE
21. GASKET
22. RETAINING RING
23. SHIFT LEVER SHAFT
24. LARGE O-RING
25. SMALL O-RING

TA 298741



1. FRONT ENGINE MOUNT
2. FLYWHEEL HOUSING
3. DRAIN COCK
4. ELBOW (2)
5. AIR BOX DRAIN TUBE (2)
6. CLAMP (2)
7. WASHER (2)
8. CAPSCREW (2)
9. ELBOW
10. TURBOCHARGER OIL FEED LINE
11. EXHAUST MANIFOLD (2)
12. STARTER

TA 298550

END OF TASK

6-4. STARTER REPAIR (Continued)

(31) Press new oil seal (30) into lever housing (3).

(32) Install new O-ring (29).

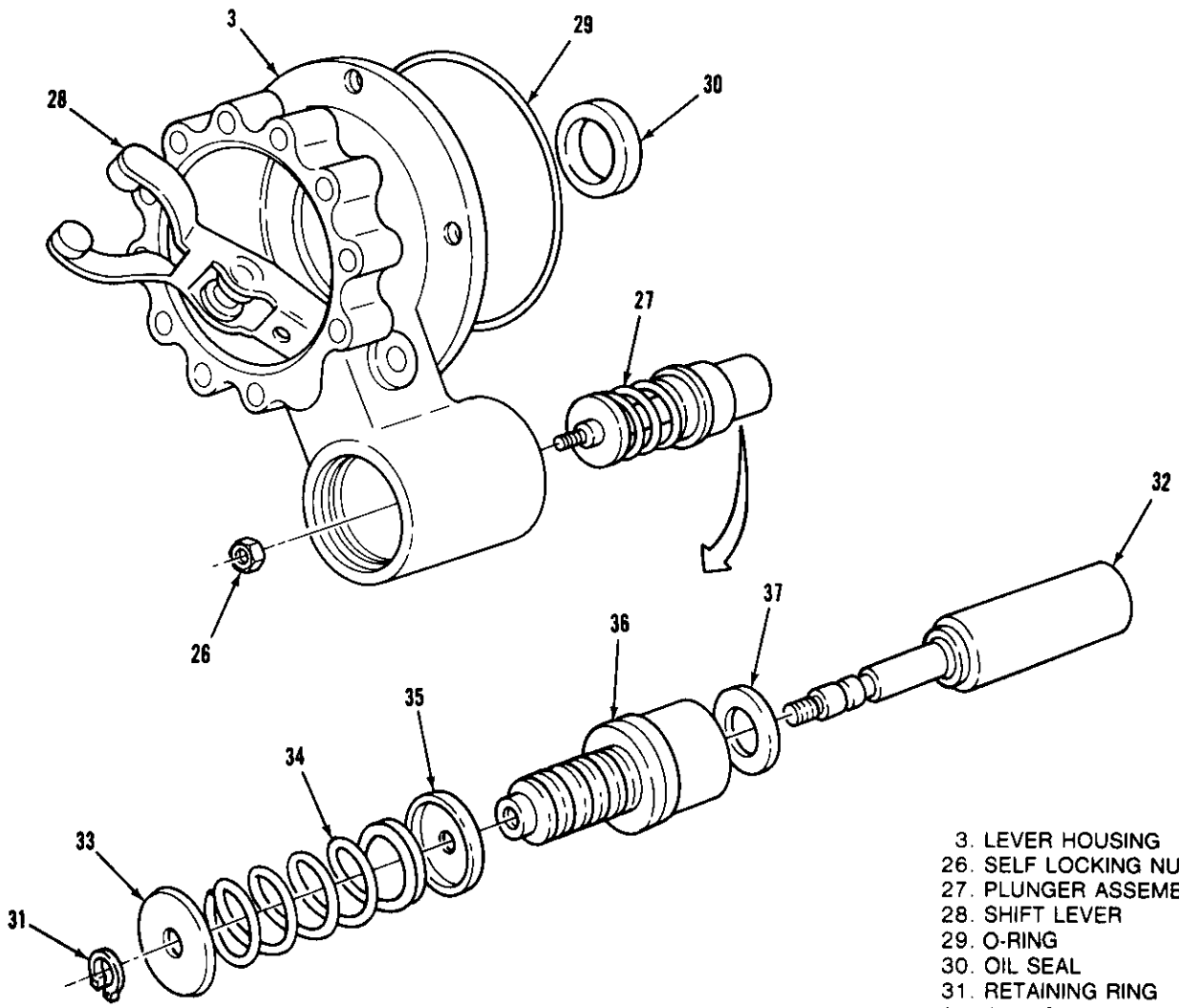
(33) Install washer (37) in boot (36).

(34) Install boot (36) on plunger (32). Push boot (36) down so collar on boot (36) fits in groove on plunger (32).

(35) Install retainer (35), helical spring (34), retainer (33), and retaining ring (31).

(36) Install shift lever (28) in lever housing (3).

(37) Install plunger assembly (27) through shift lever (28). Install new self-locking nut (26) using the same number of turns noted in removal.



3. LEVER HOUSING
26. SELF LOCKING NUT
27. PLUNGER ASSEMBLY
28. SHIFT LEVER
29. O-RING
30. OIL SEAL
31. RETAINING RING
32. PLUNGER
33. RETAINER
34. HELICAL SPRING
35. RETAINER
36. BOOT
37. WASHER

TA 298740

SECTION V. ENGINE SUBASSEMBLY CLEANING, INSPECTION, AND REPAIR

3-22. ENGINE BLOCK REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning
c. Pressure Testing
d. Inspection
e. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Aftercooler inlet adapter remover/installer (J 25275)
Block plug remover/installer (J 23019)
Cylinder block pressure kit (2SK737)
Ball attachment (J 4757) or (GGG-C-105)
Sled gauge (J 29091)
Micrometer set 0-6" inside (NSN 5210-00-473-9350)
Micrometer set 0-6" outside (NSN 5210-00-554-7134)

Materials/Parts

Adhesive (item 3, Appendix C)
International compound No. 2 (item 16, Appendix C)
Engine oil (item 46, Appendix C)
Non-hardening sealant (item 62, Appendix C)
Lockwasher (3) (MS35338-48) items 2 and 9
Lockwasher (20) (MS35338-46 items 4, 14, 24 and 36
Gasket (NSN 5330-00-847-4967) (Front) item 6
Gasket (NSN 5330-01-054-2399) (Front) item 7
Lockwasher (MS35338-50) item 12
Gasket (NSN 5330-01-054-2400) (Rear) item 16
Gasket (2) (P/N 8923792) item 20
Gasket (4) (NSN 5330-01-088-5982) item 21

Materials/Parts

Gasket (2) (NSN 5330-00-769-4882) item 32
(If pressure test is to be performed, 3 gaskets are required)
Gasket (NSN 5330-00-745-7776) item 38
Gasket (8) (NSN 5330-01-054-2398) item 60
Sealring (34) (NSN 5330-01-062-0943) item 61
Gasket (P/N 5138659) (for pressure testing only)
Pressure test plug (P/N 5138646) (for pressure testing only)

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Power pack removed (para 3-17). Engine disassembled into subassemblies (para 3-19).

---

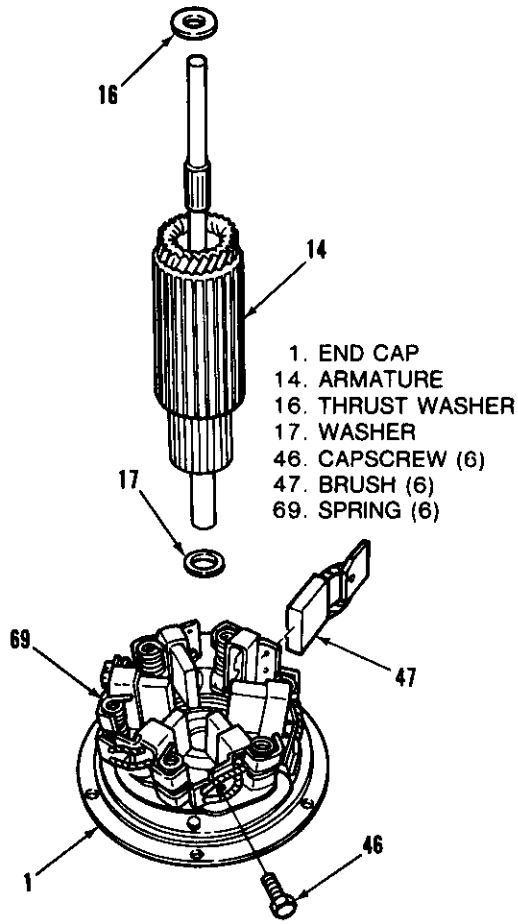
a. Disassembly

(1) Remove two capscrews (1) and lockwashers (2).Discard lockwashers (2).

(2) Remove five capscrews (3), lockwashers (4), front plate (5), gasket (6) and gasket (7). Discard gaskets (6 and 7) and lockwashers (4).

(19) Install washer (17) on shaft of armature (14).

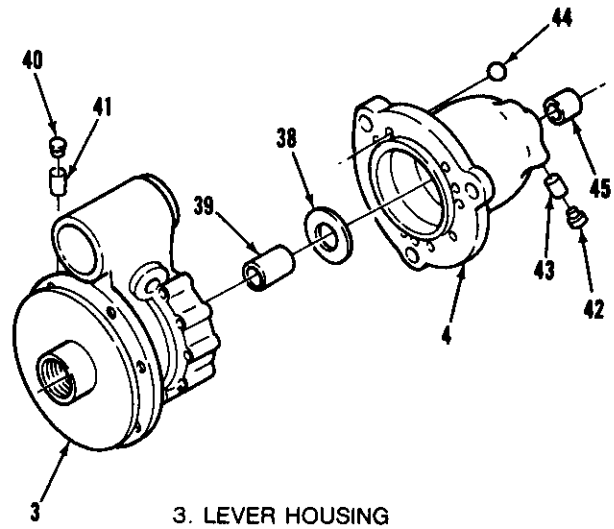
(20) Install armature (14) into end cap (1).



1. END CAP
14. ARMATURE
16. THRUST WASHER
17. WASHER
46. CAPSCREW (6)
47. BRUSH (6)
69. SPRING (6)

(21) Coat splines of armature (14) with a light film of lubricating oil.

(22) Install thrust washer (16) on long end of shaft on armature (14).



3. LEVER HOUSING
4. DRIVE HOUSING
38. NON-METALLIC WASHER
39. BUSHING
40. CUP PLUG
41. FELT WICK
42. CUP PLUG
43. FELT WICK
44. RUBBER BALL (6)
45. BUSHING

TA 298739

(23) If removed, aline hole in bushing (39) with hole in bushing boss and press new bushing into drive housing (4).

(24) Install non-metallic washer (38) in lever housing (3).

(25) Install felt wick (41) in lever housing (3) and fill with engine oil.

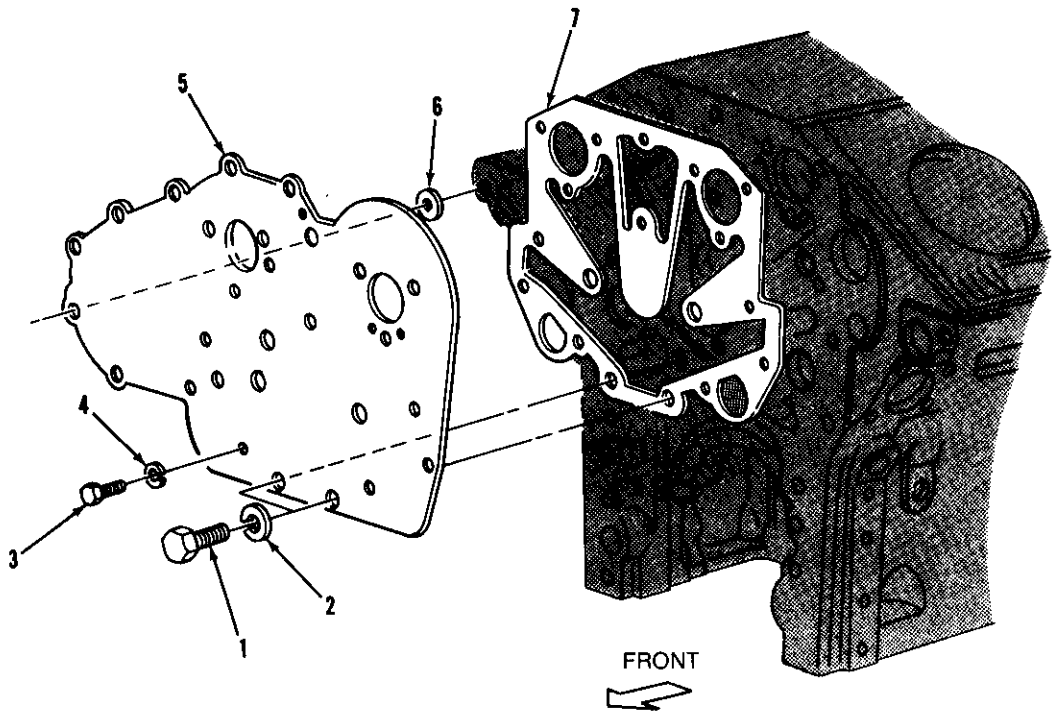
(26) Install cup plug (40).

(27) If removed, press new bushing (45) into drive housing (4).

(28) Install six rubber balls (44) into drive housing (4), if removed.

(29) Soak felt wick (43) with engine oil and install into drive housing (4).

(30) Install cup plug (42).



1. CAPSCREW (2)
2. LOCKWASHER (2)
3. CAPSCREW (5)
4. LOCKWASHER (5)
5. FRONT PLATE
6. GASKET
7. GASKET

TA 298551

6-4. STARTER REPAIR (Continued)

(10) If removed, press new bushing (59) into end cap (1) flush with top of bore.

(11) Install felt wick (58) in end cap (1) and fill with engine oil.

(12) Install cup plug (57).

(13) Install paper gasket (56), two insulating washers (55), and rubber bushing (54) on ground terminal (52) of brush holder assembly (13).

(14) Install brush holder assembly (13) to end cap (1) with three capscrews and captive washers (48).

(15) Install insulator (53), washer (51), new lockwasher (50), and nut (49) on ground terminal (52).

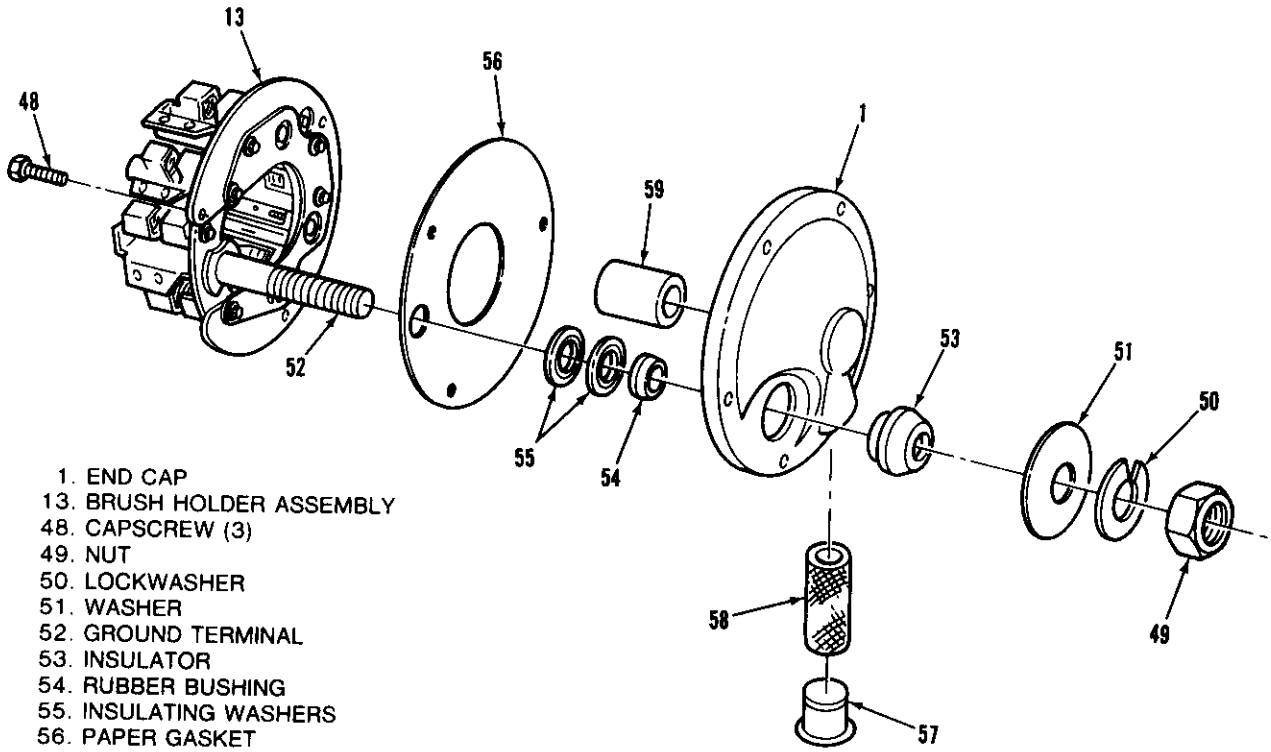
NOTE

Never reuse brushes. Always install new brushes when repairing starter.

(16) Hold six springs (69) and install six brushes (47) with six capscrews (46).

(17) Test armature (14) with multimeter. Place red (+) lead on end of shaft. Place black (−) lead on each strip around large part of armature (14). Multimeter needle must move to zero. If it does not move to zero, replace armature (14).

(18) Place red (+) lead on end of shaft. Place black (−) lead on each commutator strip. Multimeter needle must not move. If it does move, replace armature (14).



1. END CAP
13. BRUSH HOLDER ASSEMBLY
48. CAPSCREW (3)
49. NUT
50. LOCKWASHER
51. WASHER
52. GROUND TERMINAL
53. INSULATOR
54. RUBBER BUSHING
55. INSULATING WASHERS
56. PAPER GASKET
57. CUP PLUG
58. FELT WICK
59. BUSHING

TA 298738

3-22. ENGINE BLOCK REPAIR (Continued)

(3) Remove capscrew (8), lockwasher (9), and hub (10). Discard lockwasher (9).

(4) Remove capscrew (11) and lockwasher (12). Discard lockwasher (12).

(5) Remove four capscrews (13), lockwashers (14), rear plate (15), and gasket (16).Discard lockwasher (14), and gasket (16).

(6) Remove 14 capscrews (17), two large covers (18), four small covers (19), and gaskets (20 and 21). Discard gaskets (20 and 21).

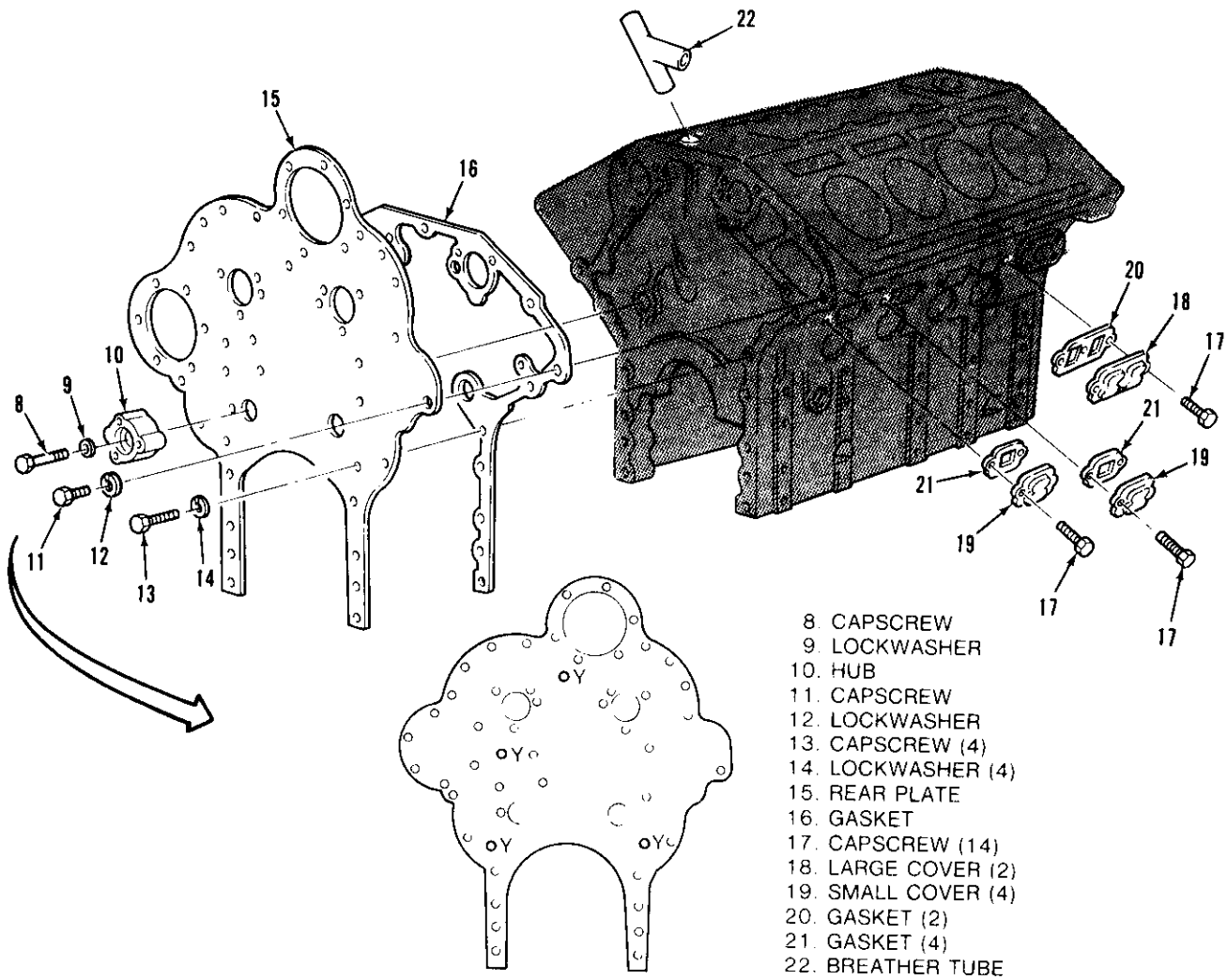
(7) Remove breather tube (22) from top of block, if damaged.

(8) Remove capscrew (23), lockwasher (24), and washer (25) from each drain tube (26). Discard lockwashers (24).

(9) Tag and remove two drain tubes (26) and elbows (27).

(10) Remove tee connector (28) and elbow (29).

(11) Remove oil connector (30).



8. CAPSCREW
9. LOCKWASHER
10. HUB
11. CAPSCREW
12. LOCKWASHER
13. CAPSCREW (4)
14. LOCKWASHER (4)
15. REAR PLATE
16. GASKET
17. CAPSCREW (14)
18. LARGE COVER (2)
19. SMALL COVER (4)
20. GASKET (2)
21. GASKET (4)
22. BREATHER TUBE

TA 298552

c. Assembly/Testing

(1) Install bushing insulator (67) on terminal stud (68).

(2) Install field coil (65) in field frame (2).

(3) Aline holes in plate insulator (66) with holes in field frame (2) and install around top of field coil (65).

NOTE

Screws (63) have built-in seals.

(4) Install six pole shoes (64) with 12 new screws (63).

(5) Install two insulators (62), washer (61), and nut (60).

(6) Check for proper installation of field coil with multimeter. Place red lead (+) on terminal stud (68). Place black (−) lead on field frame (2). Multimeter needle must not move. If needle moves, correct short between field coil (65) and field frame (2).

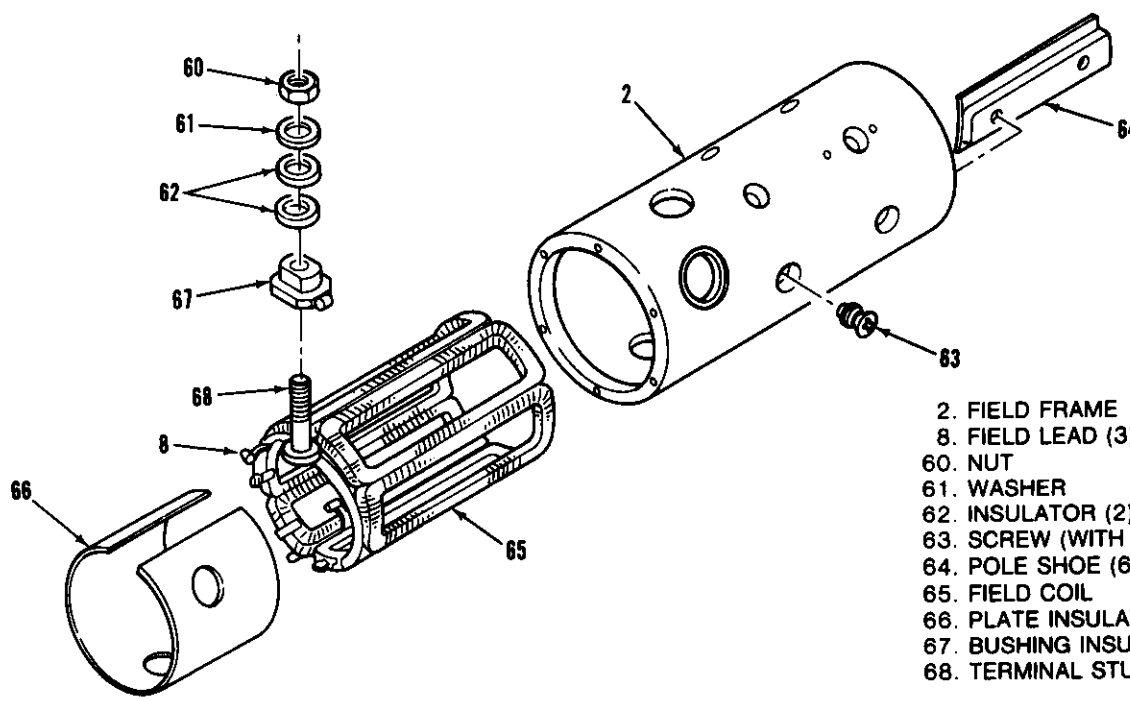
NOTE

If needle does not move in steps (7), (8), or (9), field coil (65) has an open circuit and must be replaced.

(7) Place red lead (+) on terminal stud (68). Place black lead (−) on one of field leads (8). Multimeter needle must move.

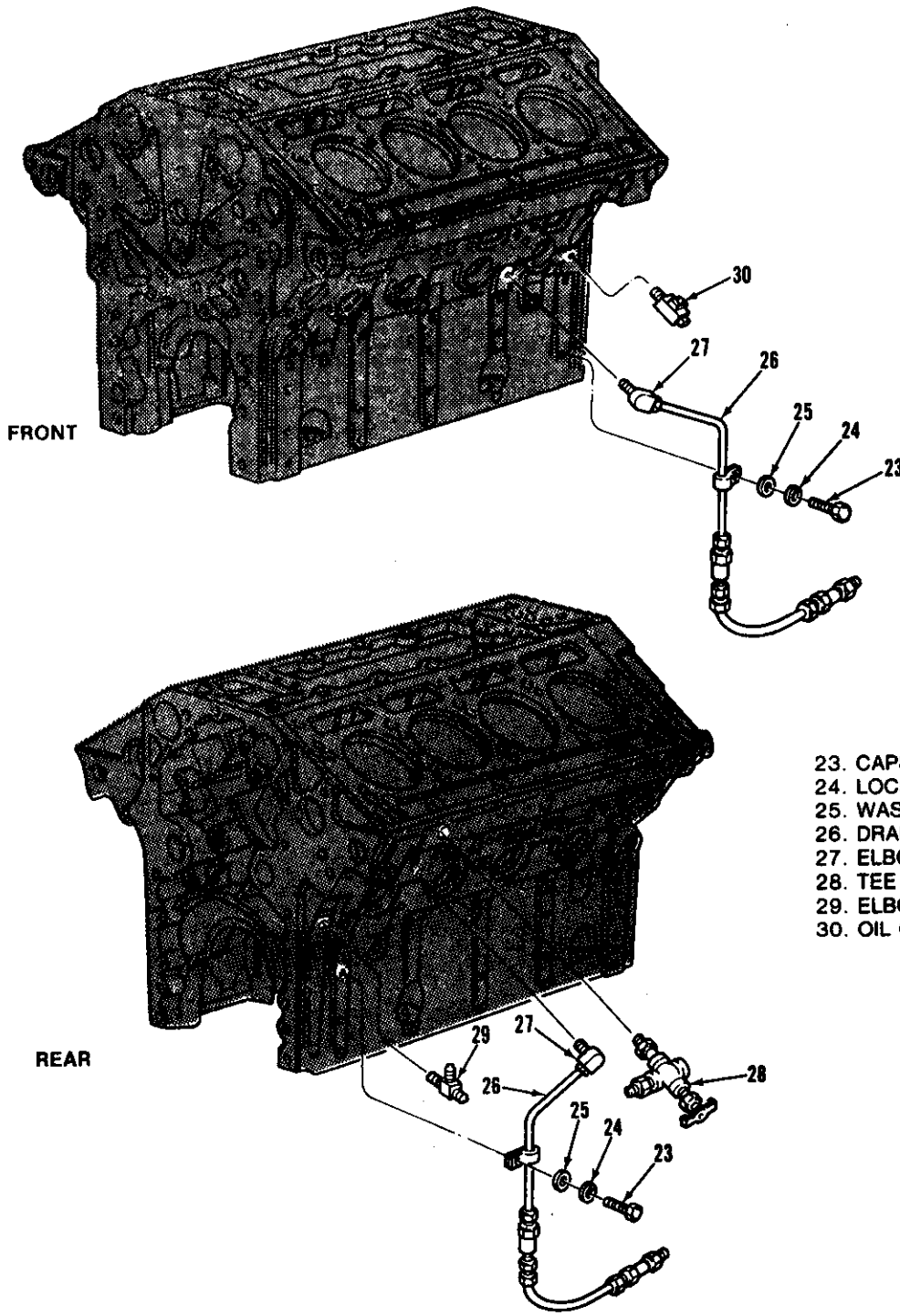
(8) Move black lead (−) to other field leads (8). Multimeter needle must move.

(9) Place red lead (+) on one field lead (8). Put black lead (−) on another field lead (8). Multimeter needle must move. Repeat for all leads (8).



2. FIELD FRAME
8. FIELD LEAD (3)
60. NUT
61. WASHER
62. INSULATOR (2)
63. SCREW (WITH SEAL) (12)
64. POLE SHOE (6)
65. FIELD COIL
66. PLATE INSULATOR
67. BUSHING INSULATOR
68. TERMINAL STUD

TA 298737



23. CAPSCREW (2)
24. LOCKWASHER (2)
25. WASHER (2)
26. DRAIN TUBE (2)
27. ELBOW (2)
28. TEE CONNECTOR
29. ELBOW
30. OIL CONNECTOR

TA 296553

6-4. STARTER REPAIR (Continued)

b. Cleaning/Inspection

(1) Clean all metal parts in dry cleaning solvent except armature, field coil, and starter drive.

(2) Clean starter drive (20) with clean, dry cloth.

(3) Inspect field frame (2) for cracks, breaks, or other obvious damage.

(4) Inspect brush contact surface of armature (14) for rough surface, pits, scoring, burns, hard carbon, oil coat, and out-of-roundness.

(a) Commutator diameter, when new, is 2.3125-2.3250 inches (5.8737-5.9055 cm).

(b) Used commutator diameter must be no less than 2.000 inches (5.08 cm).

(c) Commutator may be no more than 0.0020 inch (0.0050 cm) out-of-round.

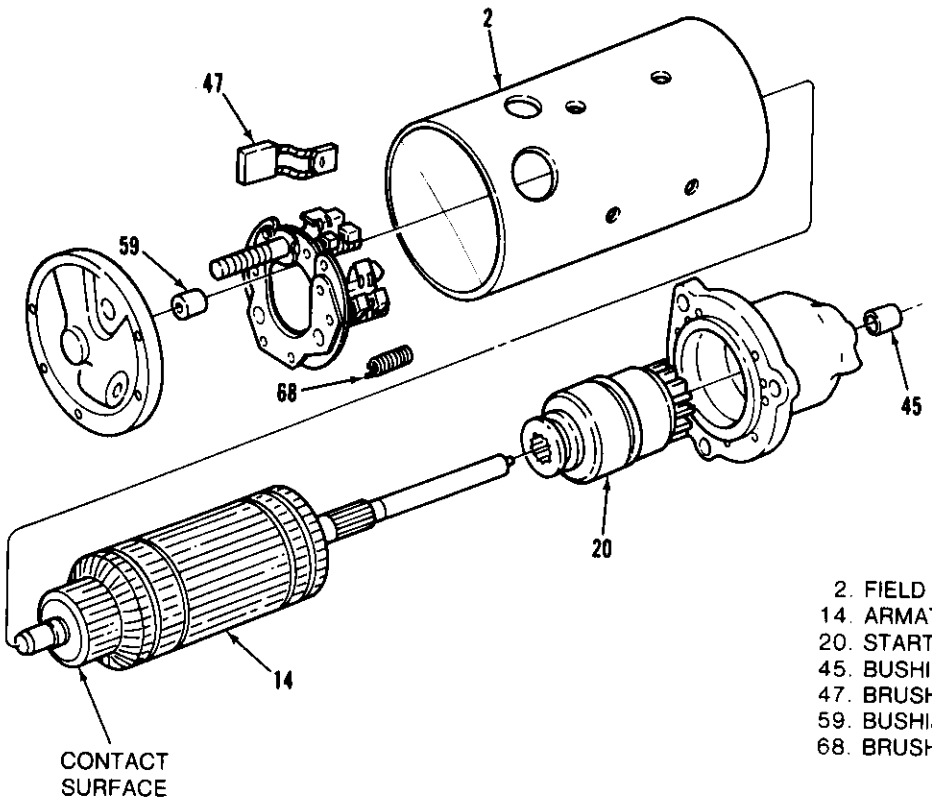
(5) Replace brushes (47) when repairing starter motor.

(6) Inspect brush springs (68) for distortion or discoloration.

(7) Inspect splines and gear teeth on starter drive (20) for damage.

(8) Check bushings (45 and 59) for damage or wear. If inside diameter of bushings is more than 0.005 inch (0.0127 cm) larger than shaft diameter, replace bushings.

(9) Replace all parts failing inspection.



2. FIELD FRAME
14. ARMATURE
20. STARTER DRIVE
45. BUSHING
47. BRUSH (6)
59. BUSHING
68. BRUSH SPRING (6)

TA 298736

3-22. ENGINE BLOCK REPAIR (Continued)

NOTE

Aftercooler water inlet adapter (31) may be extremely difficult to remove.

(12) Remove aftercooler water inlet adapter (31) and gasket (32) using inlet adapter remover. Discard gasket (32).

NOTE

If cylinder block will be pressure tested, go to section c, Pressure Testing.

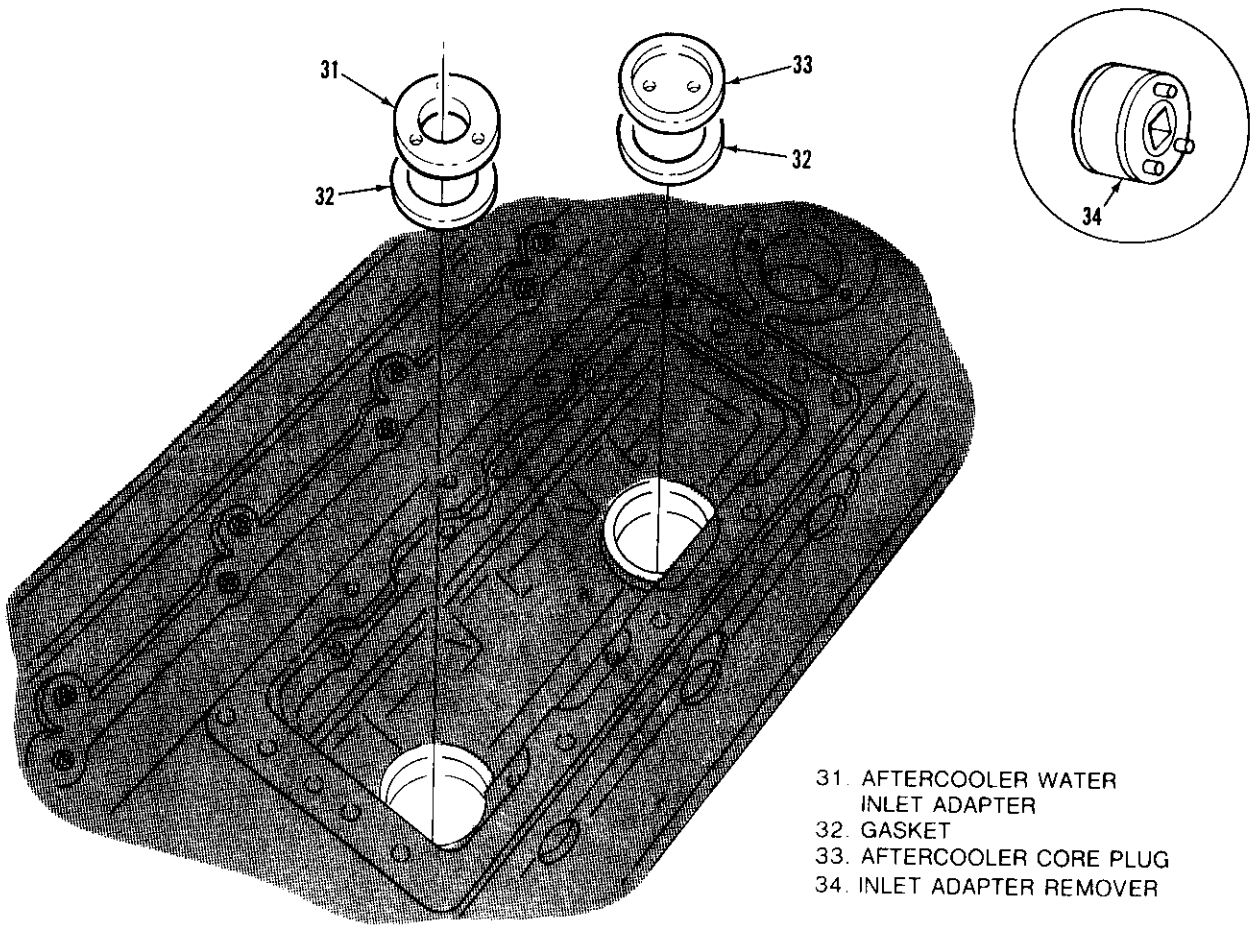
(13) Remove aftercooler core plug (33) and gasket (32) using a block plug remover. Discard gasket (32).

(14) Remove four capscrews (35), lockwashers (36), cover (37), and gasket (38). Discard gasket (38) and lockwashers (36).

(15) Remove two studs (39).

(16) Remove seven plugs (40), four plugs (41), eight plugs (42 thru 45), and plug (46).

(17) Remove reducer bushing (47) and three drain cocks (48).



31. AFTERCOOLER WATER INLET ADAPTER
32. GASKET
33. AFTERCOOLER CORE PLUG
34. INLET ADAPTER REMOVER

TA 298554

(33) Remove nut (60), washer (61), and two insulators (62).

NOTE

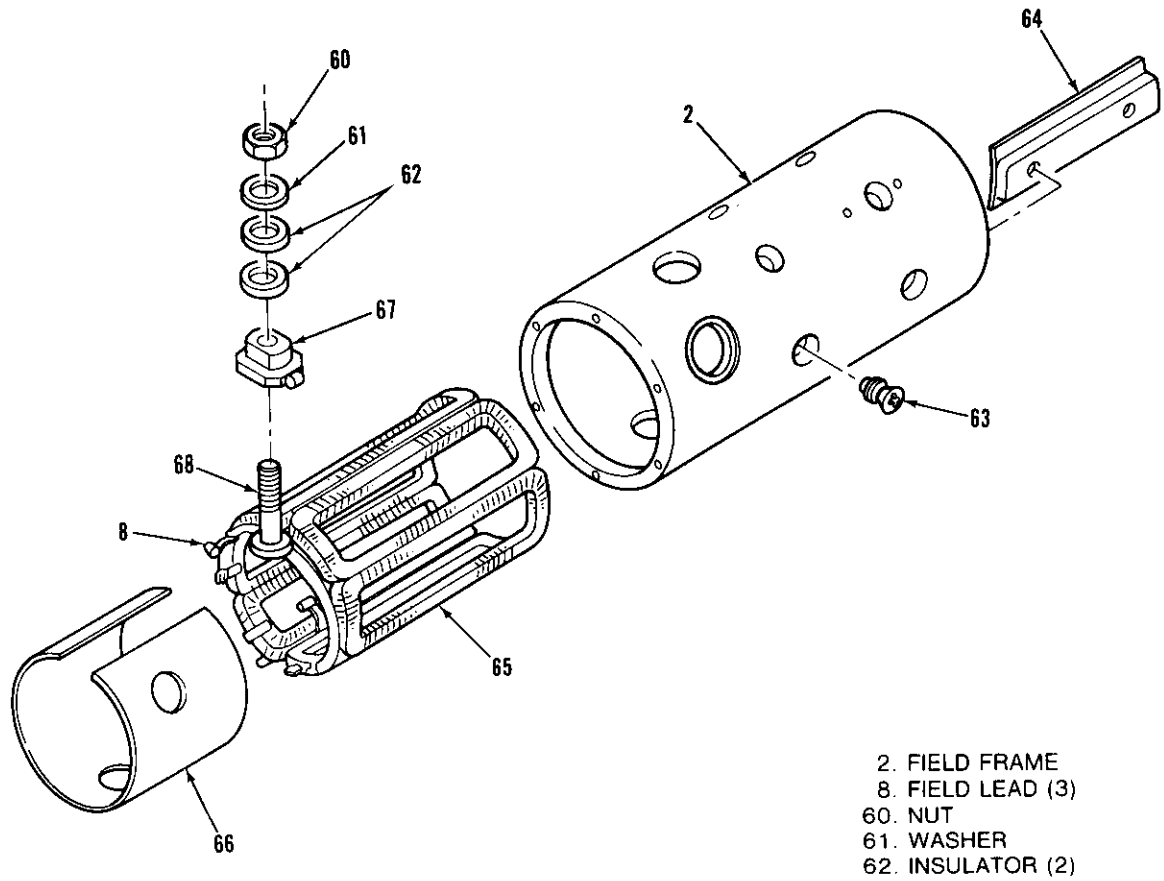
Screws (63) have built-in seals.

(34) Remove and discard 12 screws (63).

(35) Remove six pole shoes (64).

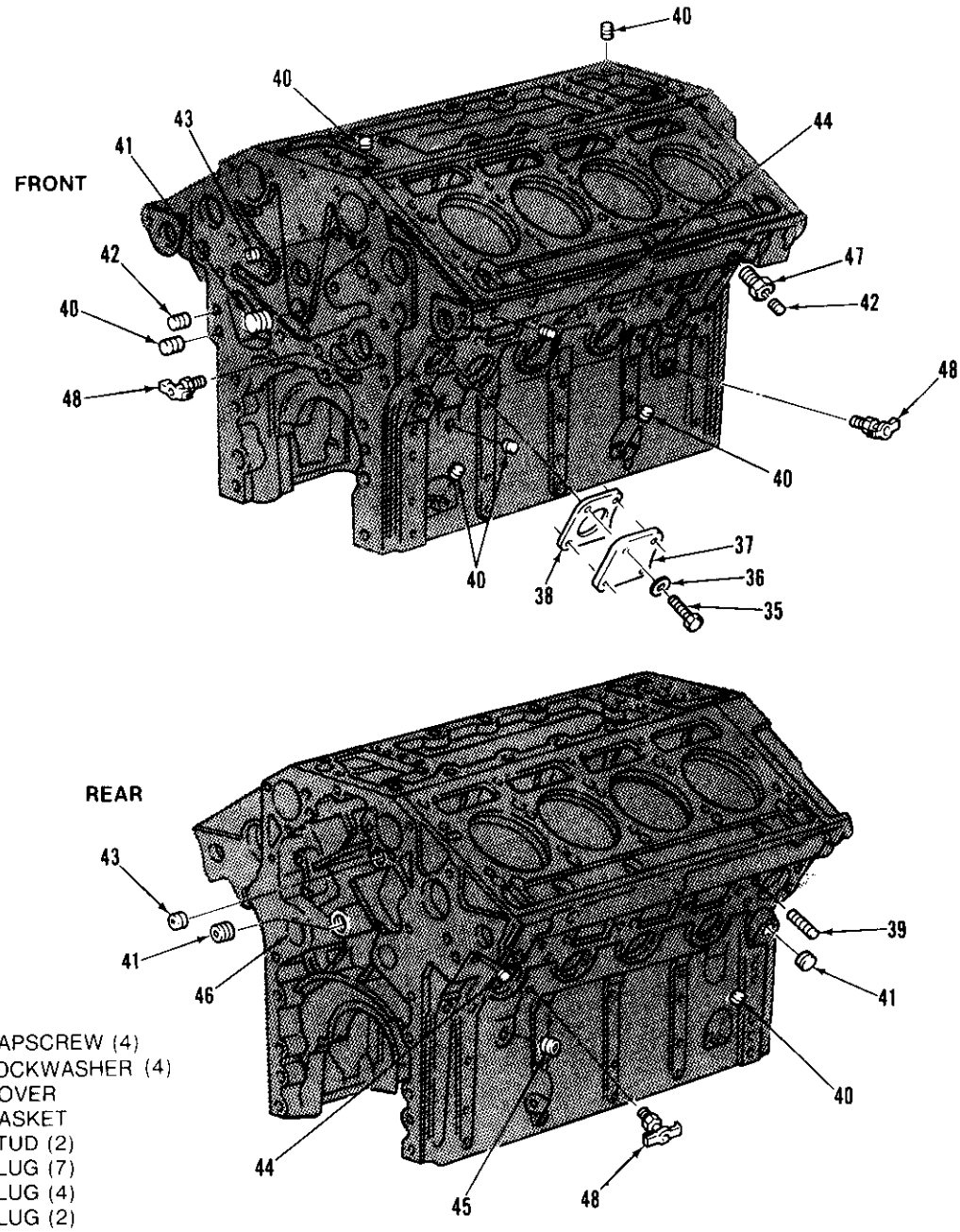
(36) Remove field coil (65) and plate insulator (66) from field frame (2).

(37) Remove bushing insulator (67) from terminal stud (68).



2. FIELD FRAME
8. FIELD LEAD (3)
60. NUT
61. WASHER
62. INSULATOR (2)
63. SCREW (WITH SEAL) (12)
64. POLE SHOE (6)
65. FIELD COIL
66. PLATE INSULATOR
67. BUSHING INSULATOR
68. TERMINAL STUD

TA 299703



35. CAPSCREW (4)
36. LOCKWASHER (4)
37. COVER
38. GASKET
39. STUD (2)
40. PLUG (7)
41. PLUG (4)
42. PLUG (2)
43. PLUG (2)
44. PLUG (2)
45. PLUG (2)
46. PLUG
47. REDUCER BUSHING
48. DRAIN COCK (3)

TA 298555

6-4. STARTER REPAIR (Continued)

(25) Remove six capscrews (46) and six brushes (47) from brush holder assembly (13).

(26) Remove three capscrews (with captive lockwashers) (48) from end cap (1).

(27) Remove nut (49), lockwasher (50), and washer (51) from ground terminal (52). Discard lockwasher (50).

(28) Remove insulator (53) from end cap (1).

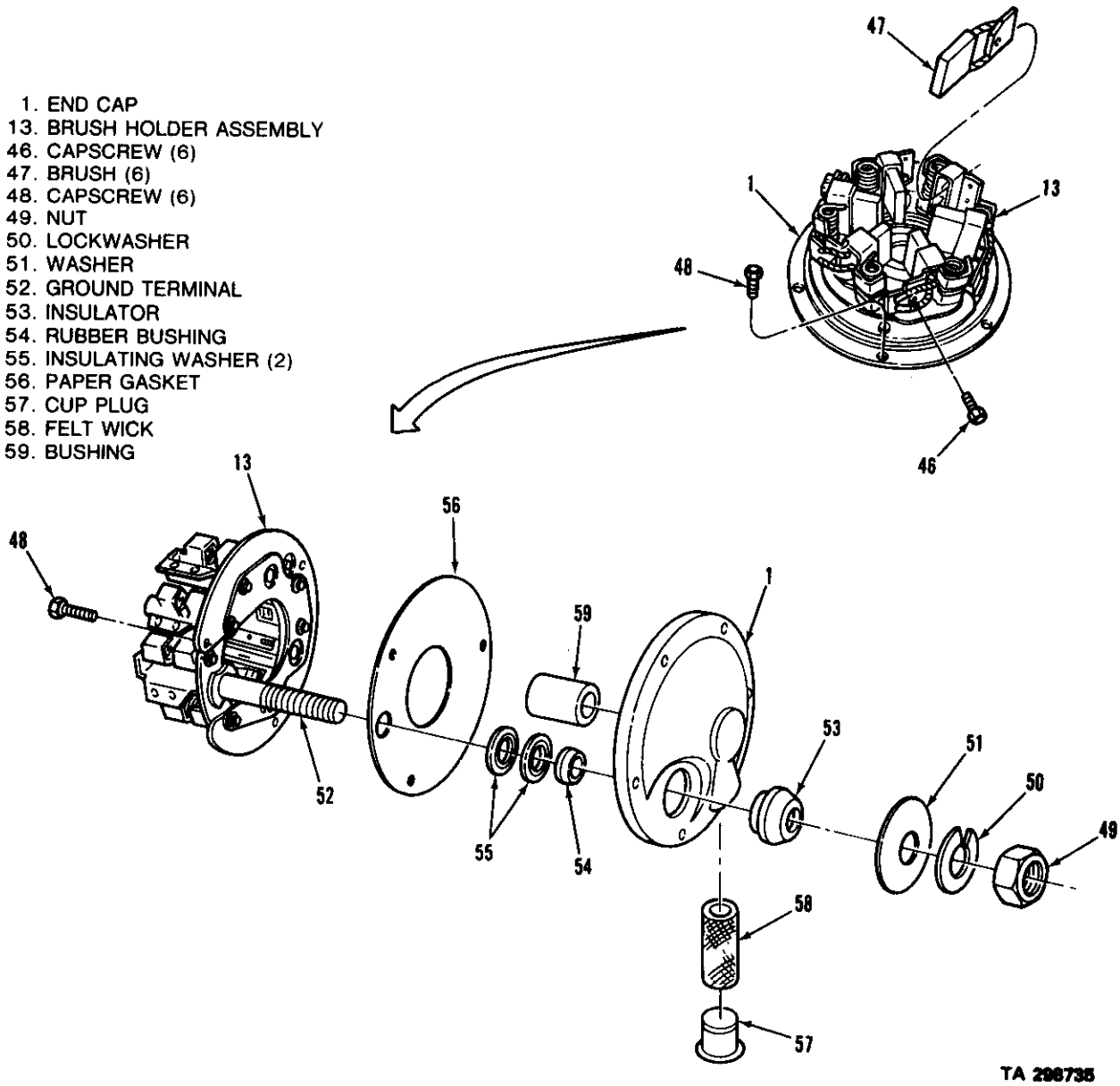
(29) Remove end cap (1) from brush holder assembly (13).

(30) Remove rubber bushing (54), two insulating washers (55), and paper gasket (56) from ground terminal (52).

(31) Remove cup plug (57) and felt wick (58).

(32) If damaged, remove bushing (59) from end cap (1) and discard.

1. END CAP
13. BRUSH HOLDER ASSEMBLY
46. CAPSCREW (6)
47. BRUSH (6)
48. CAPSCREW (6)
49. NUT
50. LOCKWASHER
51. WASHER
52. GROUND TERMINAL
53. INSULATOR
54. RUBBER BUSHING
55. INSULATING WASHER (2)
56. PAPER GASKET
57. CUP PLUG
58. FELT WICK
59. BUSHING



TA 298735

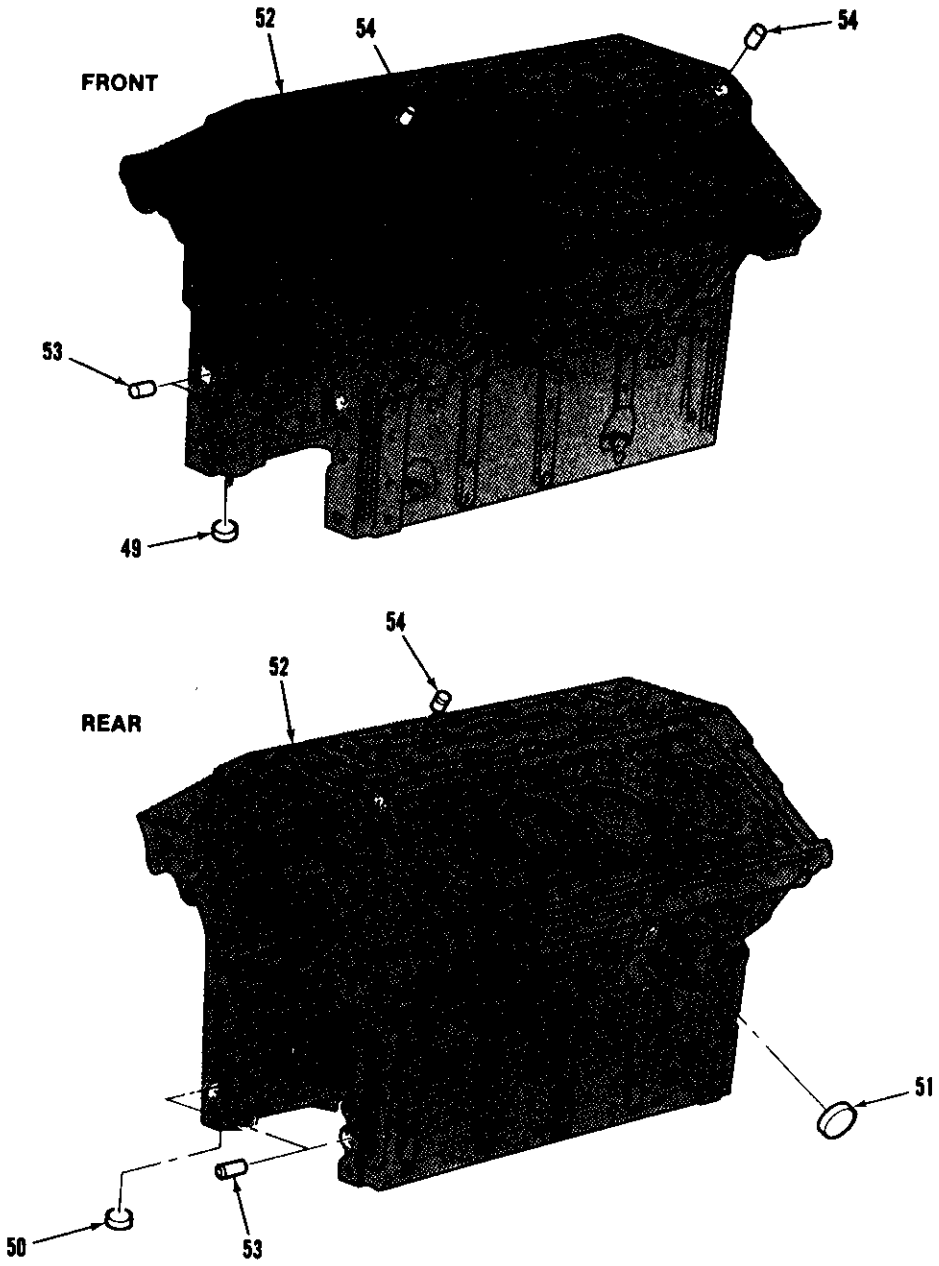
3-22. ENGINE BLOCK REPAIR (Continued)

NOTE

Only remove pins (53 and 54) and plugs (49, 50, and 51) if damaged.

(18) Remove plugs (49 and 50) and eight plugs (51) from block (52).

(19) Remove four pins (53) and three pins (54) from block (52).



49. PLUG
50. PLUG
51. PLUG (8)
52. BLOCK
53. PIN (4)
54. PIN (3)

TA 298556

(19) Remove non-metallic washer (38).

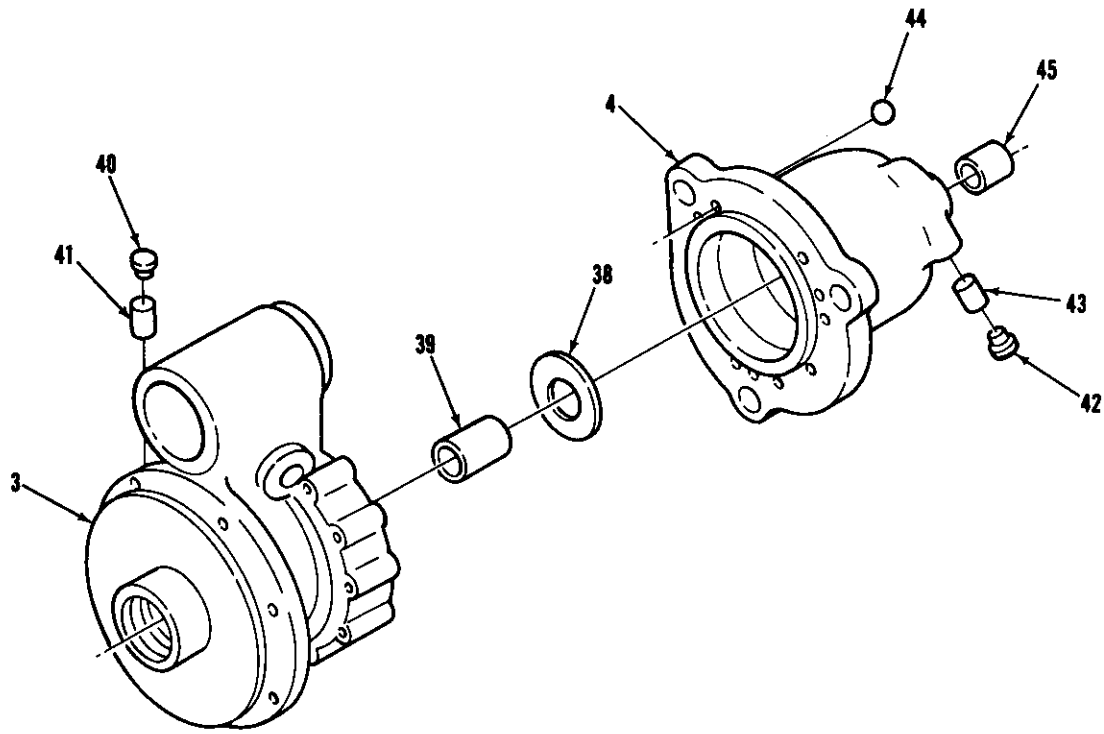
(20) Remove bushing (39) from lever housing (3).

(21) Remove cup plug (40) and felt wick (41).

(22) Remove cup plug (42) and felt wick (43) from drive housing (4).

(23) Mark holes and remove six rubber balls (44), if needed.

(24) Remove bushing (45).



3. LEVER HOUSING
4. DRIVE HOUSING
38. NON-METALLIC WASHER
39. BUSHING
40. CUP PLUG
41. FELT WICK
42. CUP PLUG
43. FELT WICK
44. RUBBER BALL (6)
45. BUSHING

TA 298734

b. Cleaning

(1) Remove all gasket material.

WARNING

Cleaning solvent is flammable and toxic to eyes, skin, and respiratory tract. Skin and eye protection is required. Avoid repeated or prolonged contact. Good general ventilation is required.

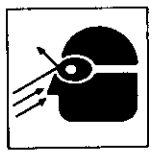
(2) Remove all grease and deposits by cleaning block (52) in a hot tank bath.

WARNING

Steam or vapor pressure cleaning creates hazardous noise levels and severe burn potential. Eye, skin, and ear protection required.

(3) Steam clean block (52) until all hot tank solution is removed.

WARNING



Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psi. Eye protection required.

(4) Dry block (52) with compressed air. Dry all oil passages and air box openings (55).

c. Pressure Testing

(1) Coat sealrings (56) with clean engine oil.

CAUTION

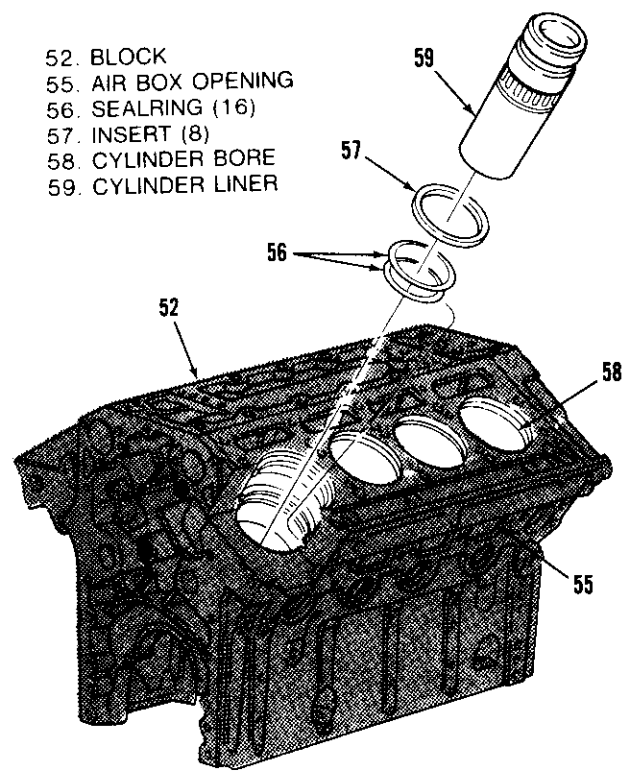
Make certain correct cylinder liners (59) and inserts (57) are installed in the same cylinder bore (58) from which they were removed.

(2) Install two sealrings (56) and insert (57) in each cylinder bore (58).

CAUTION

Care must be taken not to damage sealrings (56) when installing cylinder liners (59).

(3) Install eight cylinder liners (59).



TA 298567

6-4. STARTER REPAIR (Continued)

(13) Remove self-locking nut (26), noting number of turns. Discard self-locking nut (26).

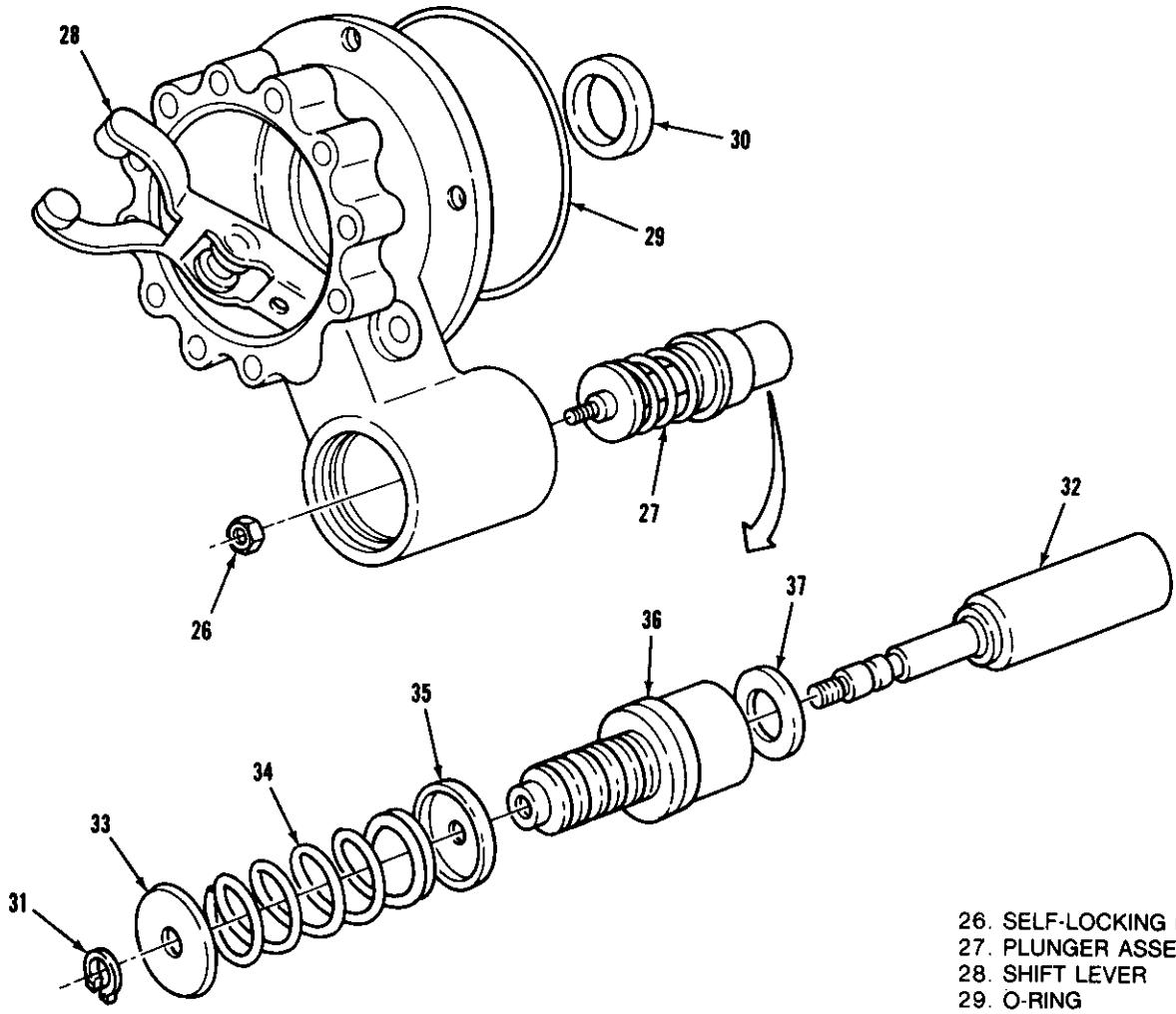
(14) Remove plunger assembly (27) and shift lever (28).

(15) Remove O-ring (29) and oil seal (30). Discard O-ring (29) and oil seal (30).

(16) Remove retaining ring (31) from plunger (32).

(17) Remove retainer (33), helical spring (34), retainer (35), and boot (36) from plunger (32).

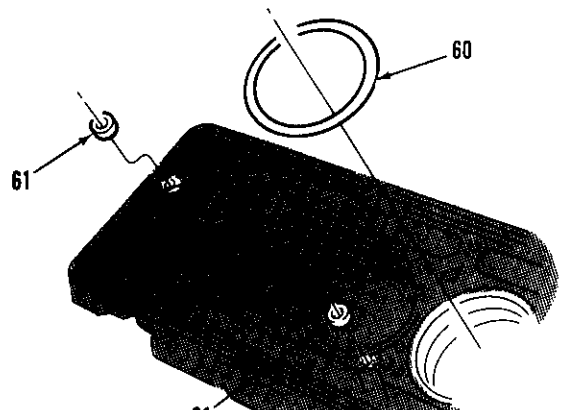
(18) Remove washer (37) from boot (36).



26. SELF-LOCKING NUT
27. PLUNGER ASSEMBLY
28. SHIFT LEVER
29. O-RING
30. OIL SEAL
31. RETAINING RING
32. PLUNGER
33. RETAINER
34. HELICAL SPRING
35. RETAINER
36. BOOT
37. WASHER

TA 298733

3-22. ENGINE BLOCK REPAIR (Continued)



60. COMPRESSION GASKET (8)
61. SEALRING (34)

(4) Install four compression gaskets (60) and 17 sealrings (61) for each side of block (52).

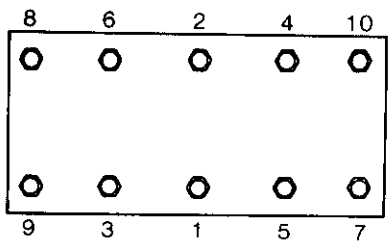
NOTE

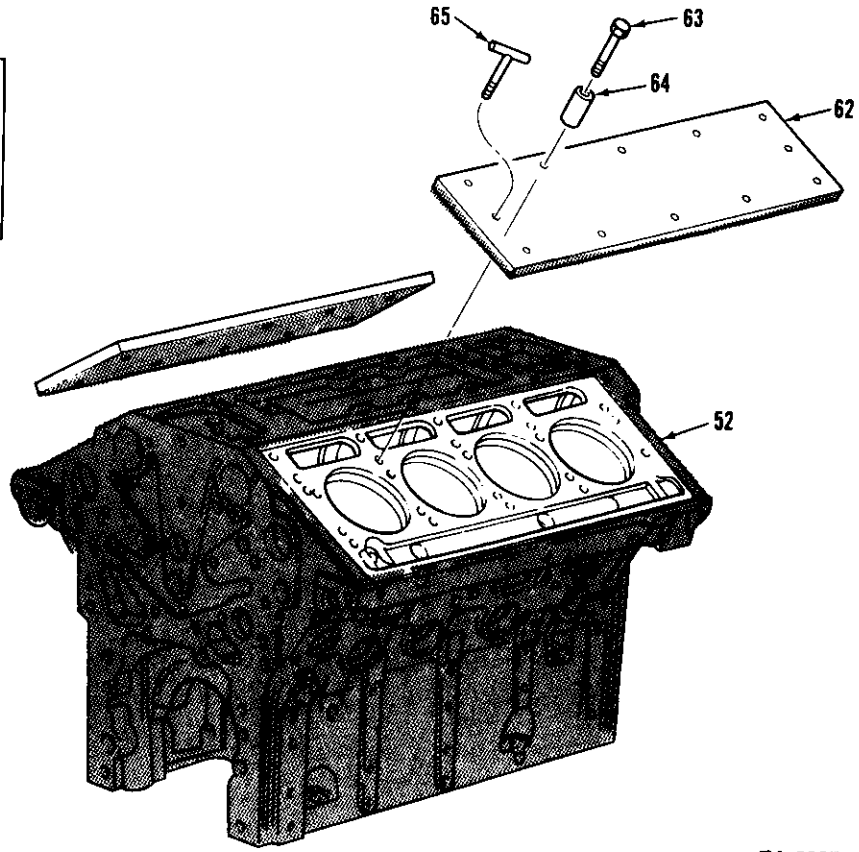
Plates (62), spacers (64), and T-handles (65) are parts of tool kit 2SK737. Reinstall cylinder head capscrews (63) during step (5) below.

(5) Install two special tool plates (62) on right and left cylinder banks of block (52) with 20 capscrews (63), spacers (64), and two T-handles (65).

(6) Torque all capscrews (63) to 50 foot-pounds (68 N·m). Continue torquing, in increments of 50 foot-pounds (68 N·m) until all capscrews (63) are torqued to 250-260 foot-pounds (339-353 N·m).

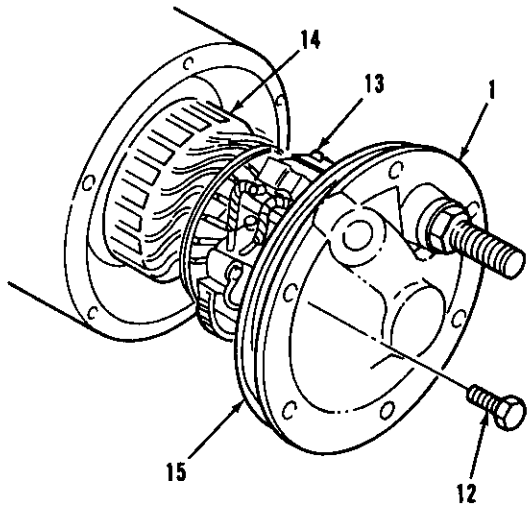
TORQUE SEQUENCE





52. BLOCK
62. PLATE (2)
63. CAPSCREW (20)
64. SPACER (20)
65. T-HANDLE (2)

TA 298558



1. END CAP
12. CAPSCREW (6)
13. BRUSHHOLDER ASSEMBLY
14. ARMATURE
15. O-RING

NOTE

Armature (14) may stay with end cap or in field frame.

(5) Remove six capscrews (12), end cap (1), and brush holder assembly (13).

(6) Remove armature (14).

(7) Remove O-ring (15) from end cap (1) and discard O-ring (15).

(8) Remove washer (17) and thrust washer (16) from armature (14).

NOTE

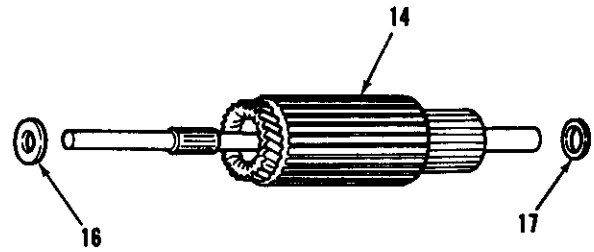
Mark location of short screw (19) to aid assembly.

(9) Remove five internal hex head long screws (18) and one short screw (19). Remove drive housing (4) from lever housing (3).

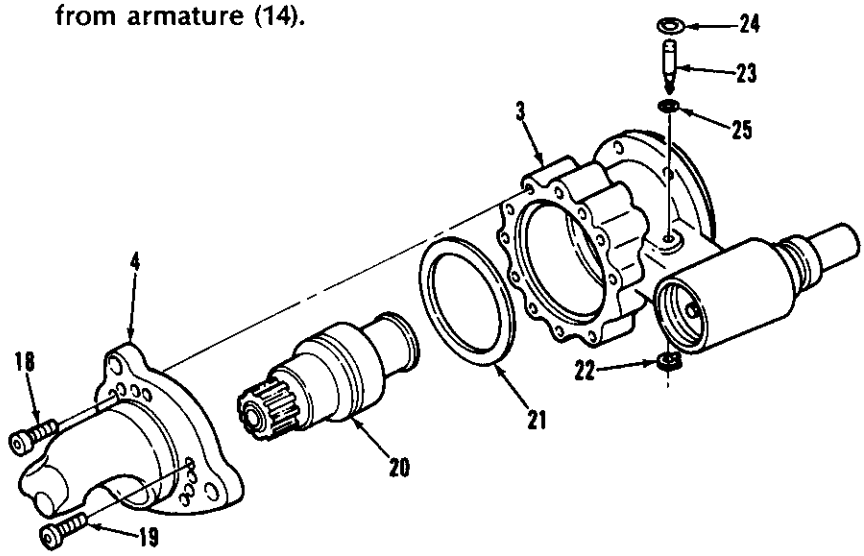
(10) Remove starter drive (20) and gasket (21). Discard gasket (21).

(11) Remove retaining ring (22) and shift lever shaft (23) from lever housing (3).

(12) Remove O-rings (24 and 25) from shift lever shaft (23). Discard O-rings (24 and 25).



14. ARMATURE
16. THRUST WASHER
17. WASHER



3. LEVER HOUSING
4. DRIVE HOUSING
18. LONG SCREW (5)
19. SHORT SCREW
20. STARTER DRIVE
21. GASKET
22. RETAINING RING
23. SHIFT LEVER SHAFT
24. LARGE O-RING
25. SMALL O-RING

TA 296732

(7) Install gasket (66) and cover (67) on right front side of block (52) with two capscrews (68), nuts (69), and four lockwashers (70). Tighten capscrews (68) and two nuts (69) securely.

(8) Install fitting (71) in right rear of block (52).

(9) Connect an air line to fitting (71). Route air line from above block (52) to prevent antifreeze solution from draining into hose.

(10) Pour a mixture of water and one gallon of antifreeze in water inlet adapter hole (72). Fill block (52) completely.

(11) Install core plug (73) and gasket (74) in aftercooler water inlet adapter hole (72) using core plug remover/installer. Torque core plug (73) 230-270 foot-pounds (312-366 N·m).

WARNING

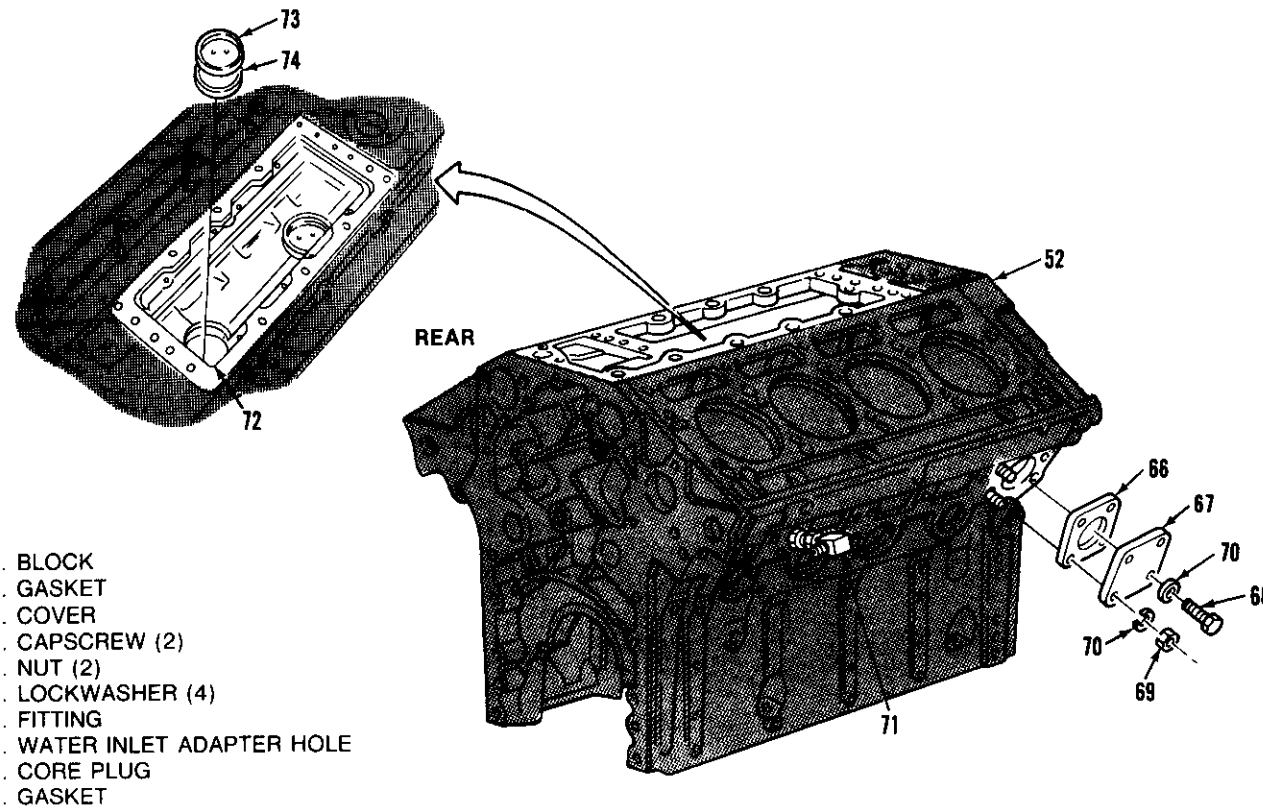
Be careful when using high air pressure. Make sure connections and seals are tight before applying pressure. High air pressure can blow out parts, hoses, or debris with force. Explosive force can damage equipment and cause injury.

(12) Apply 40 psi (276 kPa) pressure to block (52). Maintain this pressure for at least 2 hours.

(13) After test period, inspect block (52) for leaking antifreeze. If leaks are found, block (52) must be replaced.

(14) Slowly relieve 40 psi (276 kPa) pressure from block (52).

(15) Remove air line and fitting (71).



52. BLOCK
66. GASKET
67. COVER
68. CAPSCREW (2)
69. NUT (2)
70. LOCKWASHER (4)
71. FITTING
72. WATER INLET ADAPTER HOLE
73. CORE PLUG
74. GASKET

TA 298559

6-4. STARTER REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly/Testing
d. Pinion Clearance Adjustment

INITIAL SETUP

Applicable Configurations

MK48

Test Equipment

Multimeter

Special Tools

Micrometer set 0-6 inch inside (NSN 5120-00-473-9350)
Micrometer set 0-6 inch outside (NSN 5120-00-554-7134)

Materials/Parts

Engine oil (item 46, Appendix C)
Dry cleaning solvent (item 66, Appendix C)
Gasket (4) (NSN 5330-00-914-0703) item 6
O-ring (2) (NSN 5330-01-024-9686) items 15 and 29
Gasket (NSN 5330-00-976-4695) item 21
O-ring (NSN 5330-01-053-2907) item 24
O-ring (NSN 5330-01-053-7021) item 25
Self-locking nut (NSN 5310-00-965-6000) item 26
Oil seal (NSN 5330-00-285-9480) item 30
Brush (6) (P/N 1852888) item 47
Lockwasher (NSN 5310-01-129-7508) item 50
Screw (12) (NSN 5305-00-758-8117) item 63

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Starter removed (para 7-7). Starter solenoid removed (para 7-6).

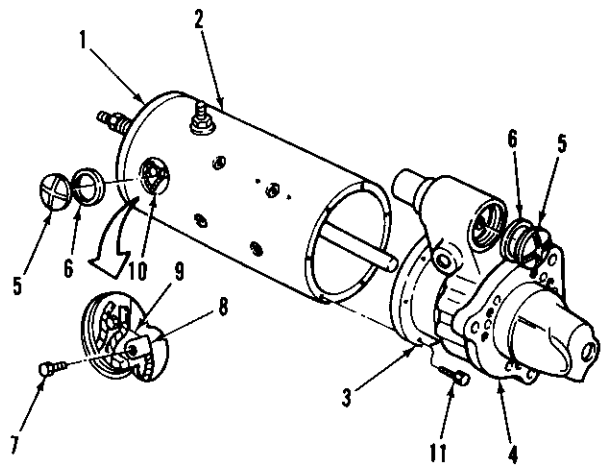
a. Disassembly

(1) Mark end cap (1), field frame (2), lever housing (3), and drive housing (4) to insure proper assembly.

(2) Remove four inspection plugs (5) and gaskets (6) from field frame (2) and lever housing (3). Discard gaskets (6).

(3) Remove three capscrews (7) to disconnect three field leads (8) from three brush holders (9). These are removed through the inspection holes (10) in the field frame (2).

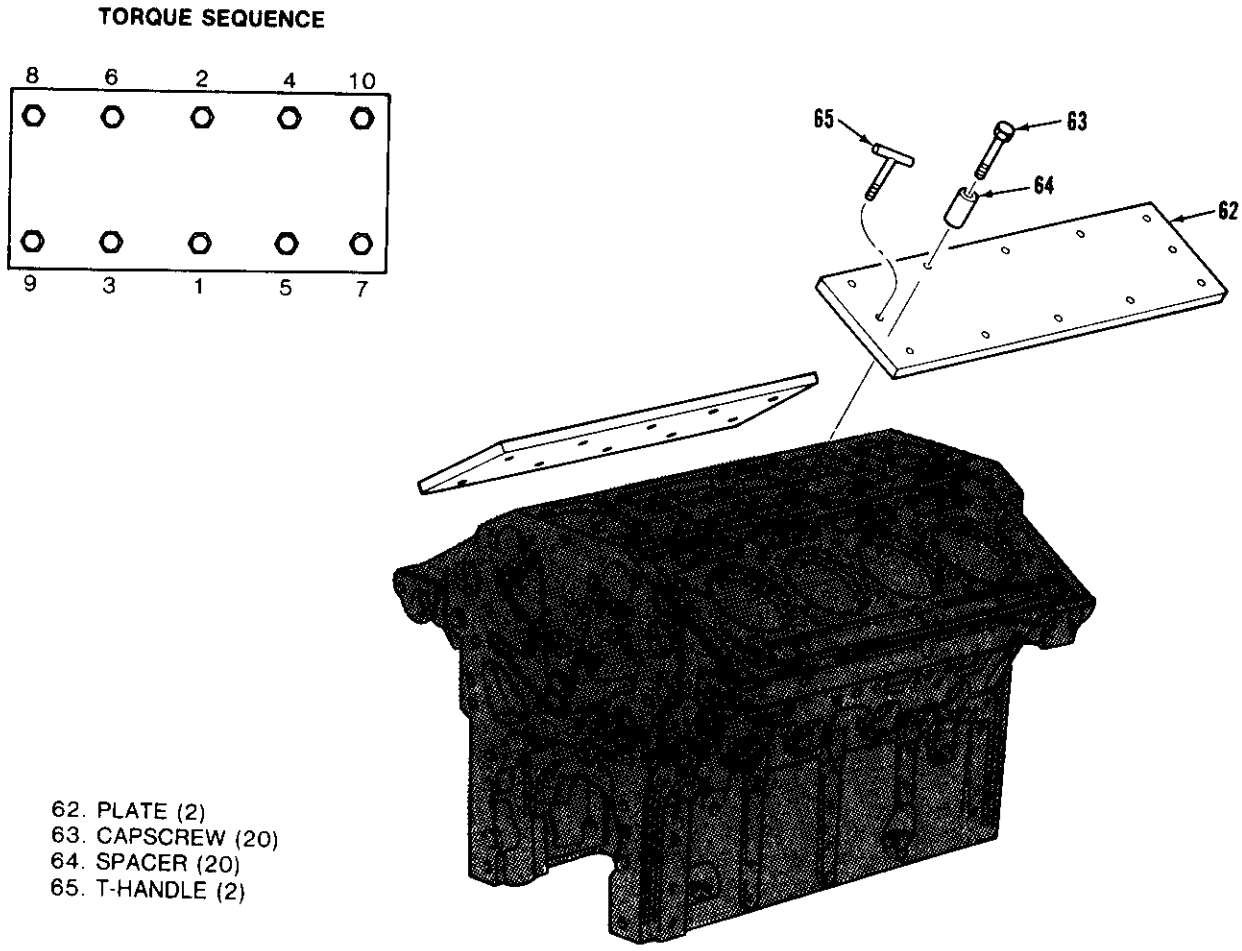
(4) Remove seven capscrews (11), lever housing (3), and drive housing (4).



1. END CAP
2. FIELD FRAME
3. LEVER HOUSING
4. DRIVE HOUSING
5. INSPECTION PLUG (4)
6. GASKET (4)
7. CAPSCREW (3)
8. FIELD LEAD (3)
9. BRUSH HOLDER (3)
10. INSPECTION HOLE (3)
11. CAPSCREW (7)

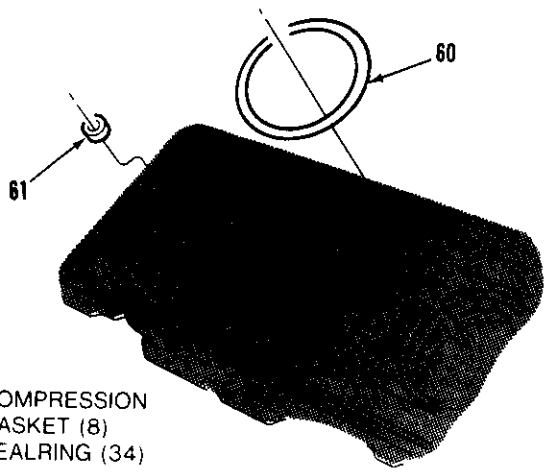
TA 298731

3-22. ENGINE BLOCK REPAIR (Continued)



62. PLATE (2)
63. CAPSCREW (20)
64. SPACER (20)
65. T-HANDLE (2)

(16) Remove 20 capscrews (63), spacers (64), two plates (62), and T-handles (65).



60 COMPRESSION GASKET (8)
61. SEALRING (34)

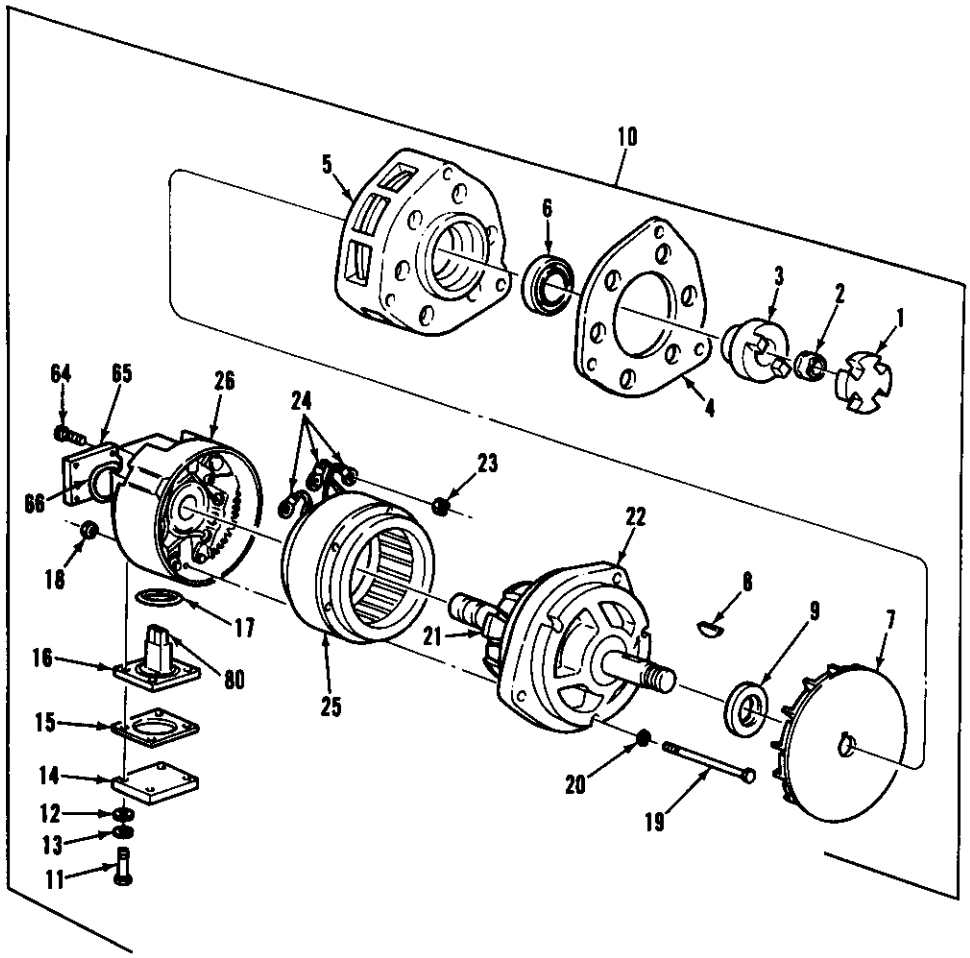
TA 298560

(17) Remove and discard sealrings (61) and four compression gaskets (60) from each side of block (52).

(18) Remove core plug (73) and gasket (74) from aftercooler water inlet adapter hole (72) using core plug remover.

(19) Remove two capscrews (68), nuts (69), four lockwashers (70), cover (67), and gasket (66).

(20) Remove cylinder liner (59), insert (57), and two sealrings (56) from each cylinder bore (58). Discard sealrings (56).



1. DRIVE COUPLING
2. LOCKNUT
3. DRIVE HUB
4. GASKET
5. FAN GUARD
6. OIL SEAL
7. FAN
8. KEY
9. FAN SPACER
10. ALTERNATOR ASSEMBLY
11. CAPSCREW (4)
12. WASHER (4)
13. LOCKWASHER (4)
14. BRUSH COVER
15. GASKET
16. BRUSH HOLDER
17. O-RING
18. LOCKNUT (3)
19. CAPSCREW (3)
20. D-WASHER (3)
21. ROTOR
22. DRIVE END HOUSING
23. LOCKNUT (3)
24. STATOR LEAD (3)
25. STATOR
26. SLIP RING END HOUSING
64. CAPSCREW (4)
65. COVER
66. SEAL RING
80. BRUSH (2)

TA 298730

(53) Install two brushes (80) into brush holder (16).

(54) Install gasket (15) and brush cover (14) onto brush holder (16).

(55) Install new O-ring (17) onto brush holder (16) and install assembly onto slip ring end housing (26).

(56) Install four washers (12), new lockwashers (13), and capscrews (11).

(57) Install new seal ring (66) and cover (65) onto slip ring end housing (26).

(58) Install four capscrews (64).

(59) Install fan spacer (9), key (8), and fan (7).

(60) Place fan guard (5) on housing (22). Install new oil seal (6) into fan guard (5).

(61) Install drive hub (3) onto rotor shaft. Make sure it engages key (8).

(62) Install new locknut (2). Torque to 70-80 foot-pounds (95-108 N·m).

(63) Place gasket (4) on fan guard (5).

(64) Place drive coupling (1) onto drive hub (3).

END OF TASK

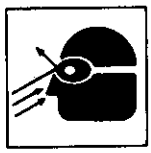
NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install voltage regulator (para 7-5).
	Install alternator (para 7-4).

(21) Completely drain block (52) of antifreeze.

WARNING



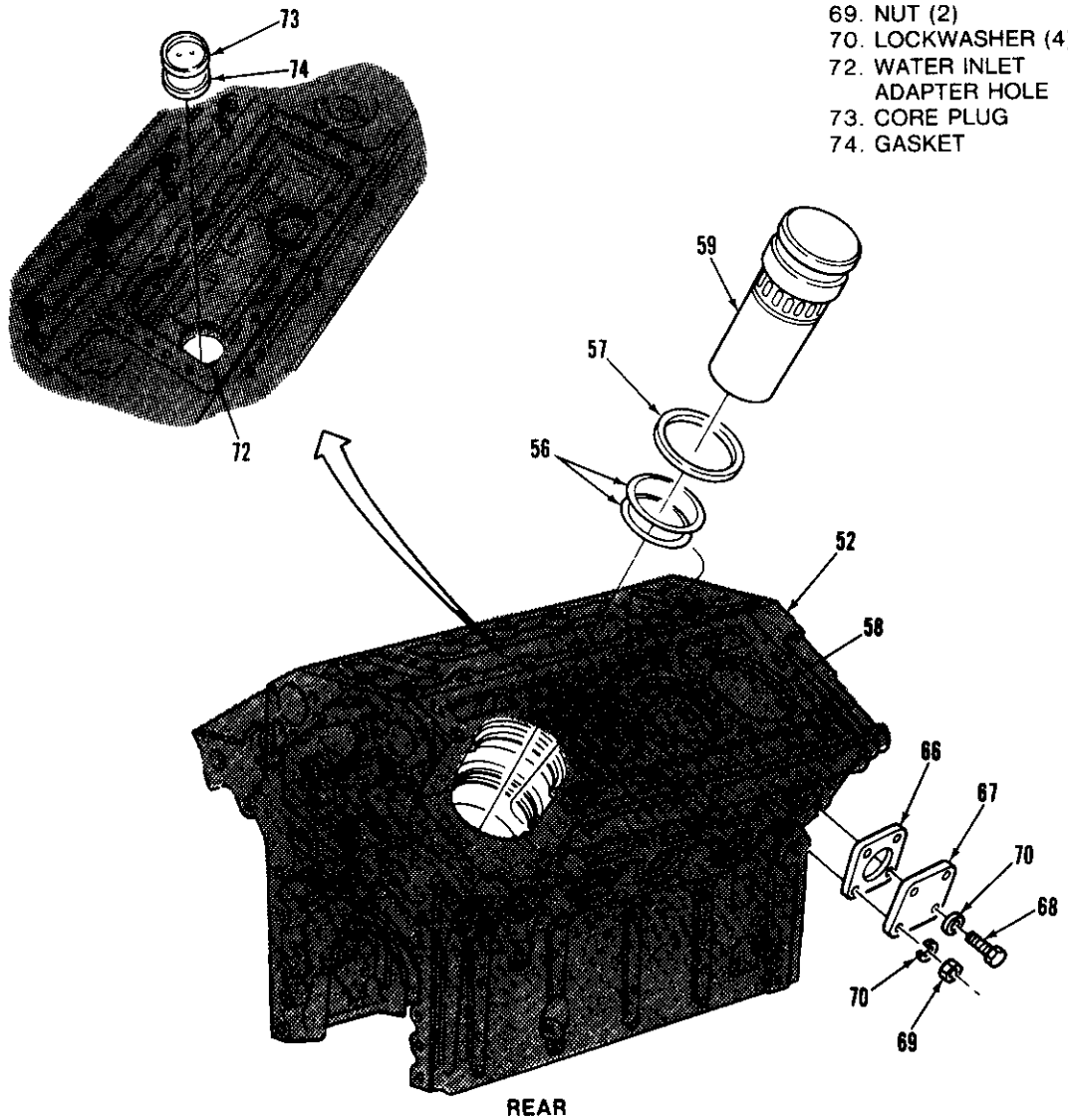
Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psi. Eye protection required.

(22) Dry block (52) with compressed air.

(23) Dry cylinder liners (59) and inserts (57) with compressed air.

(24) Coat cylinder liners (59) and inserts (57) with clean engine oil to prevent rust.

52. BLOCK
56. SEALRING (16)
57. INSERT (8)
58. CYLINDER BORE
59. CYLINDER LINER
66. GASKET
67. COVER
68. CAPSCREW (2)
69. NUT (2)
70. LOCKWASHER (4)
72. WATER INLET ADAPTER HOLE
73. CORE PLUG
74. GASKET



TA 298561

6-3. ALTERNATOR REPAIR (Continued)

(41) Install two red leads (28 and 29) onto positive rectifier (31), at locations shown, using two capscrews (27).

(42) Install black lead (30) onto negative rectifier (32), at location shown, using capscrew (27).

(43) Install three yellow leads (52) from regulator connector (51) onto terminal studs (46).

NOTE

If either positive or negative rectifier has been or is being replaced, leads from rectifiers will be separated. If original rectifiers are being reused, leads may be joined at eyelet connectors.

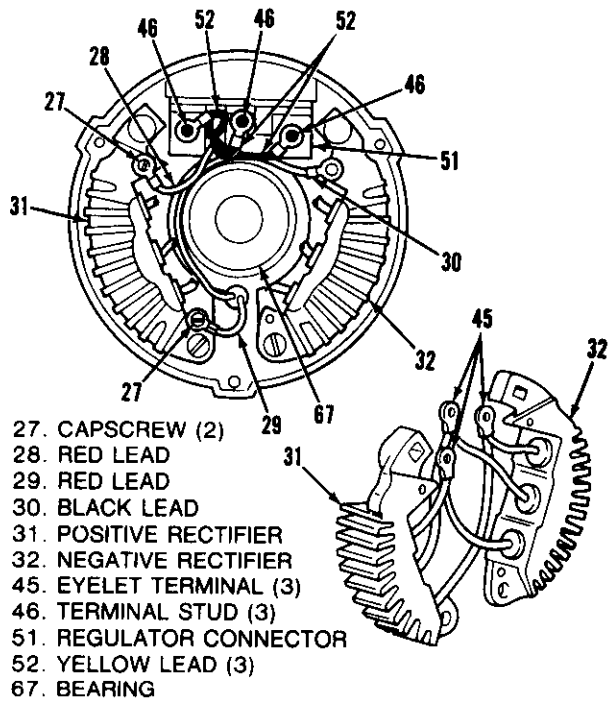
(44) Install eyelet terminal (45) from negative rectifier (32) to terminal studs (46). Install top eyelet terminal (45) to right stud (46), center eyelet terminal (45) to center stud (46), and route bottom eyelet terminal (45) under bearing (67) and connect to left stud (46).

(45) Install eyelet terminal (45) from positive rectifier (31) to terminal studs (46). Install top eyelet terminal (45) to left stud (46), center eyelet terminal (45) to center stud (46), and route bottom eyelet terminal (45) under bearing (67) and connect to right stud (46).

NOTE

Make sure that all eyelet terminals on terminal studs are installed with flat sides up.

(46) Install stator (25) onto slip ring end housing (26). Make sure stator leads (24) are on terminal studs (46).



27. CAPSCREW (2)
28. RED LEAD
29. RED LEAD
30. BLACK LEAD
31. POSITIVE RECTIFIER
32. NEGATIVE RECTIFIER
45. EYELET TERMINAL (3)
46. TERMINAL STUD (3)
51. REGULATOR CONNECTOR
52. YELLOW LEAD (3)
67. BEARING

TA 298729

(47) Install three new locknuts (23) onto terminal studs (46).

(48) Paint all internal terminals with red epoxy. Do not allow paint to get on oil seals (68) or bearing (67).

CAUTION

When installing rotor and drive end housing onto stator and slip ring housing, be very careful not to damage seals with slip rings on rotor.

(49) Carefully install rotor (21) and drive end housing (22) onto stator (25) and slip ring end housing (26).

(50) Aline drive end housing (22) with slip ring end housing (26) as shown.

(51) Install three D-washers (20) and capscrews (19) through drive end housing (22), stator (25), and slip ring end housing (26).

(52) Install three new nuts (18).

3-22. ENGINE BLOCK REPAIR (Continued)

d. Inspection

NOTE

If not on a stand, crankshaft side of block (52) should be flat on floor when measuring cylinder bores (58).

(1) Measure each cylinder bore (58) diameter with cylinder bore T-gage (75) at points A, B, C, and D. At each point take micrometer readings of T-gage (75) at X and W. At each point take out-of-round readings at points X and W.

(a) Point A should be a minimum diameter of 5.3595 inches (136.13 mm), a maximum of 5.3620 inches (136.19 mm) for new parts. A maximum limit of 5.3635 inches (136.23 mm) is acceptable on used parts.

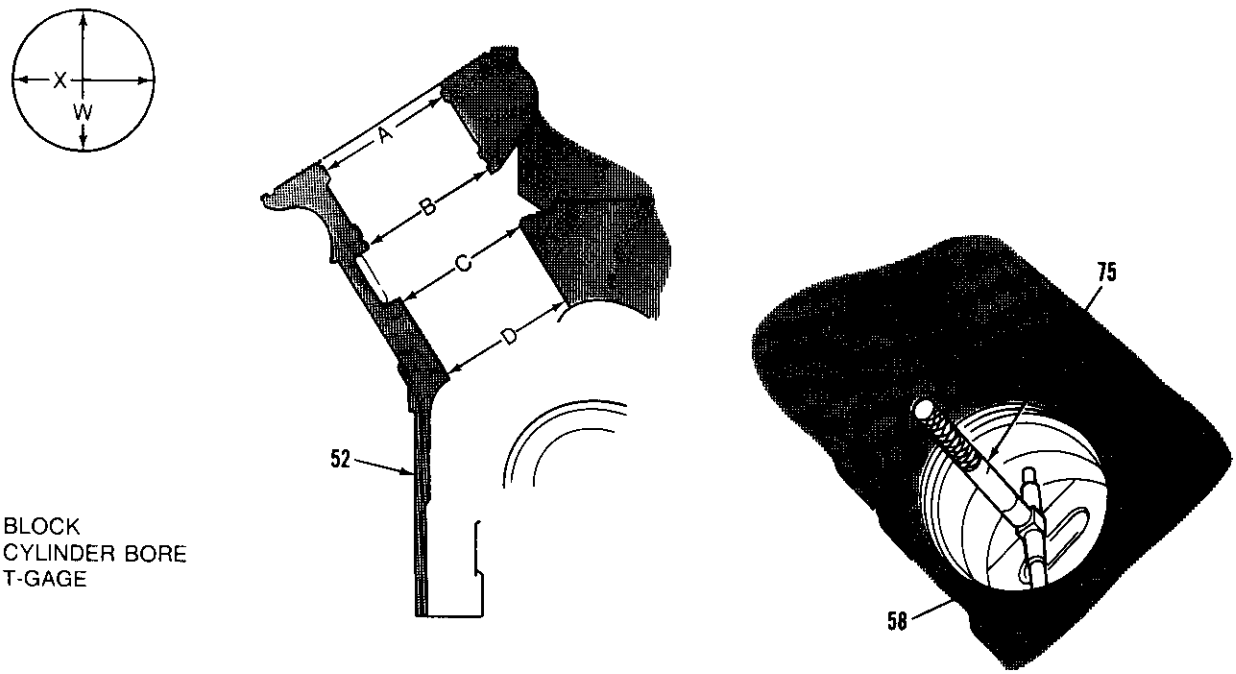
(b) Point B should be a minimum diameter of 5.3365 inches (135.55 mm), a maximum of 5.3385 inches (135.59 mm) for new parts. A maximum limit of 5.3395 inches (135.62 mm) is acceptable on used parts.

(c) Point C should be a minimum diameter of 5.2160 inches (132.48 mm), a maximum of 5.2175 inches (132.52 mm) for new parts. A maximum limit of 5.2185 inches (132.54 mm) is acceptable on used parts.

(d) Point D should be a minimum diameter of 5.2160 inches (132.48 mm), a maximum of 5.2180 inches (132.53 mm) for new parts. A maximum limit of 5.2185 inches (132.54 mm) is acceptable on used parts.

(e) Maximum out-of-roundness is 0.0010 inch (0.025 mm).

(f) Maximum taper is 0.0010 inch (0.025mm).



52. BLOCK
58. CYLINDER BORE
75. T-GAGE

TA 298562

(27) Apply electrical joint compound in and around square hole in negative rectifier (32). Install negative terminal (40) into hole.

(28) Tighten screw (41).

(29) Repeat steps (23) thru (28) for positive rectifier (31). Be sure to use proper size hardware (5/16 inch).

(30) Install insulators (48) onto rear of positive and negative terminals (36 and 40).

(31) Route regulator connector (51) leads through opening in slip ring end housing (26) and install holder (63) onto slip ring end housing (26).

(32) Install nut (35) onto positive terminal (36).

(33) Install nut (39) onto negative terminal (40).

(34) Install two new lockwashers (34 and 38) and nuts (33 and 37) onto terminals (36 and 40). Tighten finger tight.

(35) Route red (61) and brown (60) leads through access hole (82) in slip ring end housing (26).

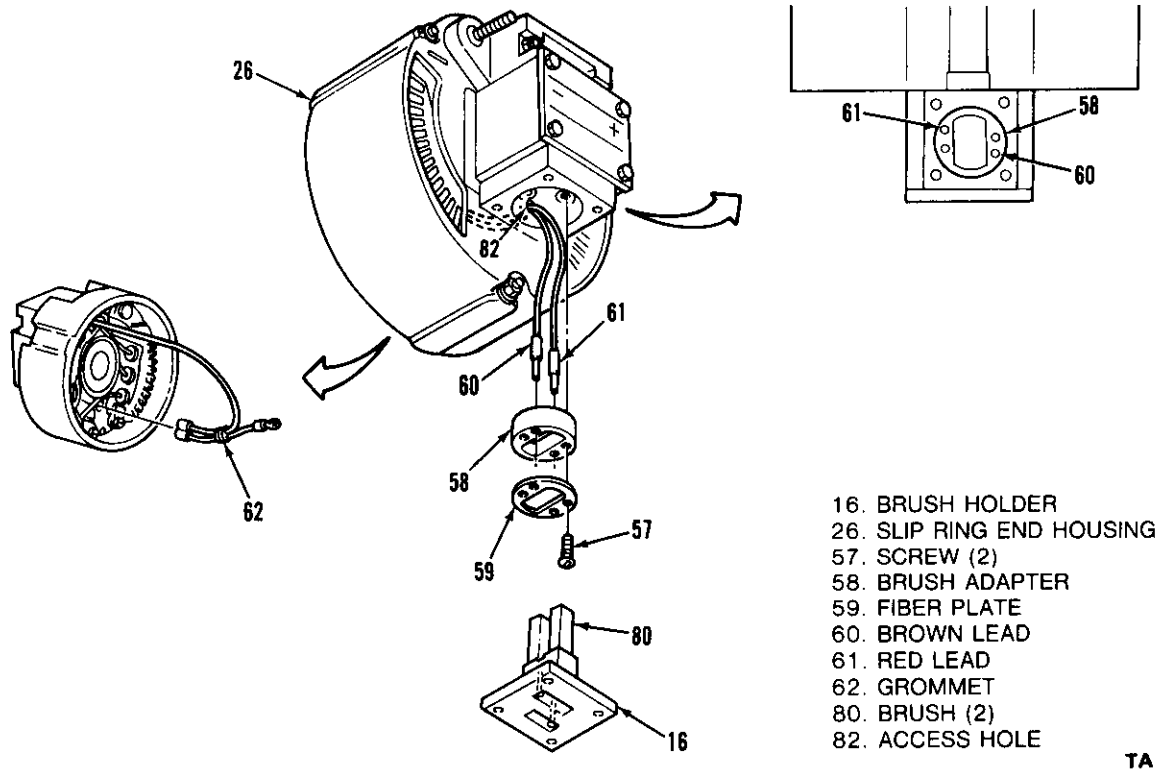
(36) Push connectors of red (61) and brown (60) leads into brush adapter (58). Make sure leads (60 and 61) are in locations shown.

(37) Install brush adapter (58) and fiber plate (59) into slip ring end housing (26) using two screws (57).

(38) Temporarily install brush holder (16) and brushes (80) onto slip ring end housing (26). Looking through hole in rear of slip ring end housing (26), make sure that only enough wire is left inside brush cavity to clear brushes (80).

(39) Remove brush holder (16) and brushes (80).

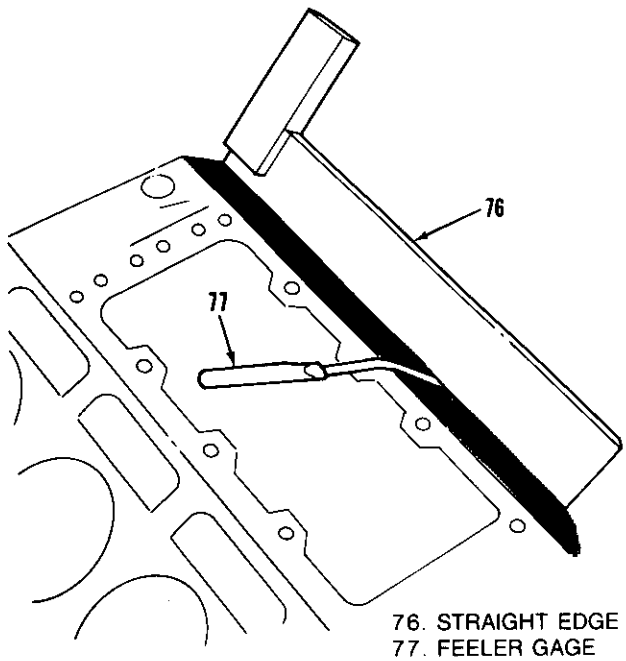
(40) Push grommet (62) into access hole (82) in slip ring end housing (26).



16. BRUSH HOLDER
26. SLIP RING END HOUSING
57. SCREW (2)
58. BRUSH ADAPTER
59. FIBER PLATE
60. BROWN LEAD
61. RED LEAD
62. GROMMET
80. BRUSH (2)
82. ACCESS HOLE

TA 298728

(2) Measure top of block (52) lengthwise and diagonally for flatness using a straight edge (76) and feeler gage (77). Lengthwise measurements must not exceed 0.007 inch (0.178 mm). Diagonal measurements must not exceed 0.003 (0.0762 mm).



76. STRAIGHT EDGE
77. FEELER GAGE

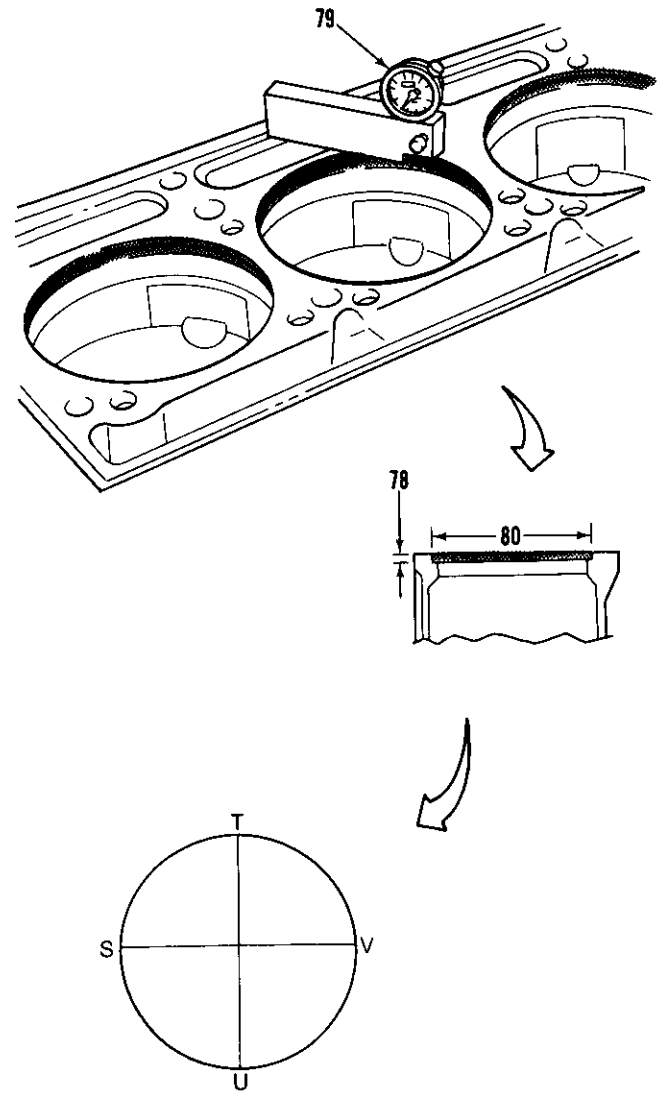
(3) Measure liner counterbore depth (78) with dial indicator (79) and gage block. Check depth at various points around the bore (S,T,U, and V).

(a) Depth must be a minimum of 0.4755 inch (12.077 mm) and a maximum of 0.4770 inch (12.116 mm).

(b) Depth must not vary more than 0.0015 (0.038 mm) inch throughout the bore.

(c) Between two adjacent cylinder counter bores the difference in depth readings must not exceed 0.0015 inch (0.038 mm).

(4) Measure counterbore diameter (80). Counterbore diameter (80) must be minimum of 5.5550 inches (141.097 mm) and a maximum of 5.5600 inches (141.224 mm).



78. LINER COUNTERBORE DEPTH
79. DIAL INDICATOR
80. COUNTERBORE DIAMETER

TA 298563

6-3. ALTERNATOR REPAIR (Continued)

(18) Install regulator connector (51) into holder (63) with yellow leads (52) toward rear of holder (63). Route leads through hole in rear of holder (63).

(19) Insert three terminal studs (46) into holder (63). Make sure that square part of stud is seated in holder (63).

(20) Install three washers (56) and nuts (55).

(21) Install three new lockwashers (54) and nuts (53) onto rear of terminal studs (46).

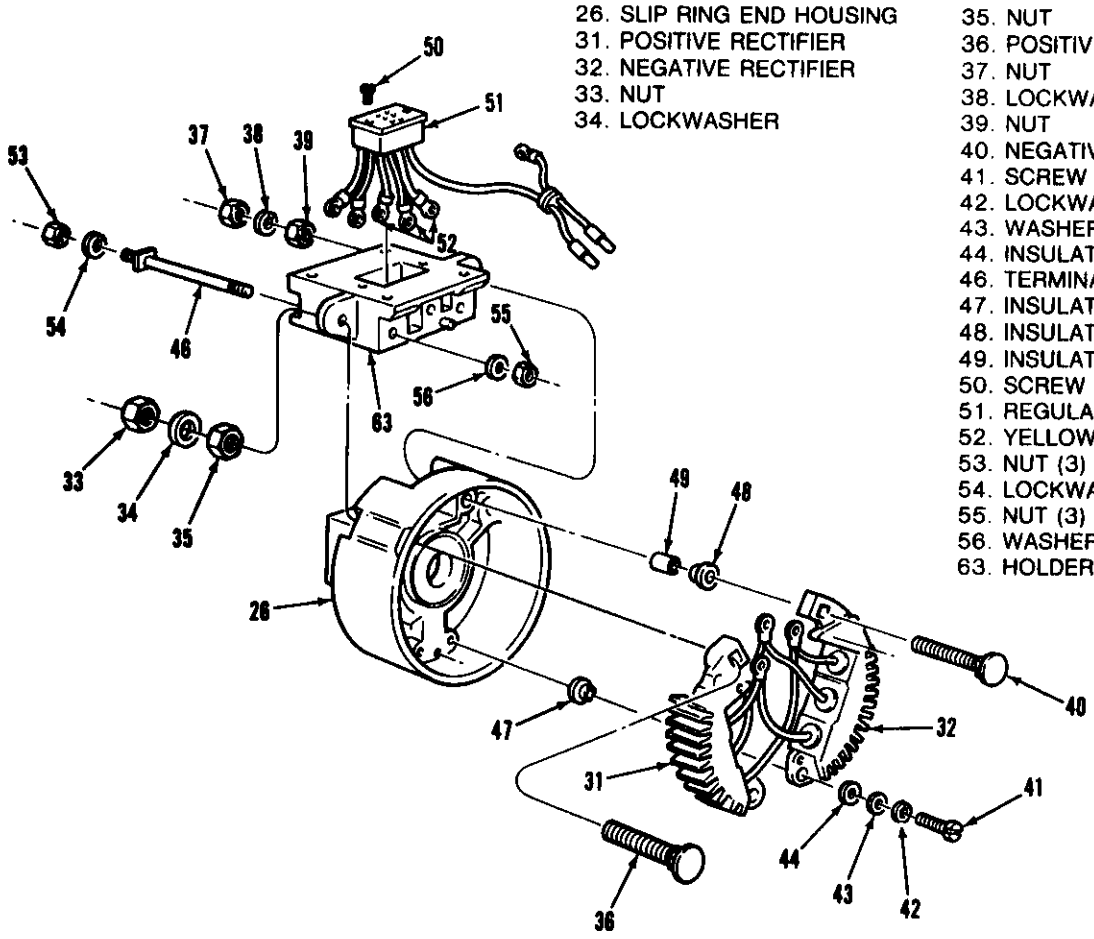
(22) Install two screws (50) to secure regulator connector (51) to holder (63).

(23) Install insulating bushings (49) into slip ring end housing (26). Make sure that 1/4 inch inside diameter bushing goes into negative hole and that 5/16 inch inside diameter bushing goes into positive hole.

(24) Install new lockwasher (42), flat washer (43), and insulator washer (44) onto screw (41).

(25) Install insulating bushing (47) into negative rectifier (32) from back side and install screw (41) assembly through insulating bushing (47) from front of negative rectifier (32).

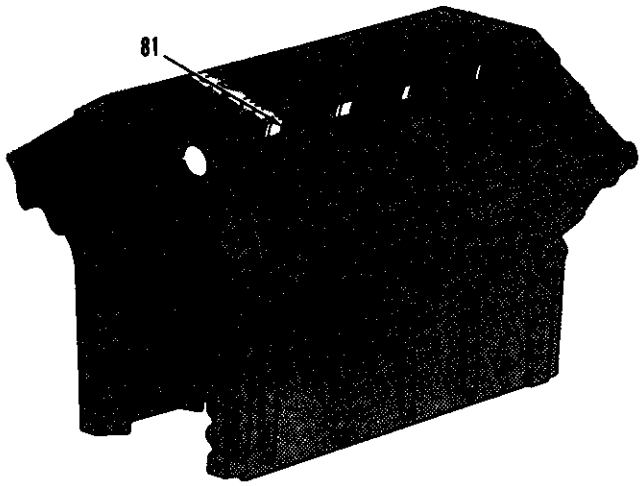
(26) Apply low viscosity adhesive to threads of screw (41) and install negative rectifier (32) into slip ring end housing (26). Do not tighten.



26. SLIP RING END HOUSING
31. POSITIVE RECTIFIER
32. NEGATIVE RECTIFIER
33. NUT
34. LOCKWASHER
35. NUT
36. POSITIVE TERMINAL
37. NUT
38. LOCKWASHER
39. NUT
40. NEGATIVE TERMINAL
41. SCREW (2)
42. LOCKWASHER (2)
43. WASHER (2)
44. INSULATING WASHER (2)
46. TERMINAL STUD (3)
47. INSULATING BUSHING (2)
48. INSULATOR (2)
49. INSULATING BUSHING (2)
50. SCREW (2)
51. REGULATOR CONNECTOR
52. YELLOW LEAD (3)
53. NUT (3)
54. LOCKWASHER (3)
55. NUT (3)
56. WASHER (3)
63. HOLDER

TA 298727

3-22. ENGINE BLOCK REPAIR (Continued)



81. CAMSHAFT BEARING BORE

(5) Measure inside diameter of camshaft bearing bores (81). Diameter must be a minimum of 2.1875 inches (55.562 mm) and a maximum of 2.1889 inches (55.598 mm).

(6) Turn block (52) upside down so top of block (52) is facing floor.

CAUTION

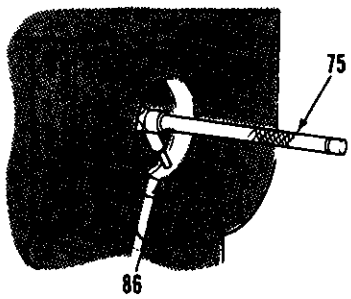
Extreme care must be taken to make certain rear and all main bearing retaining caps are installed in their exact locations and are position as originally installed.

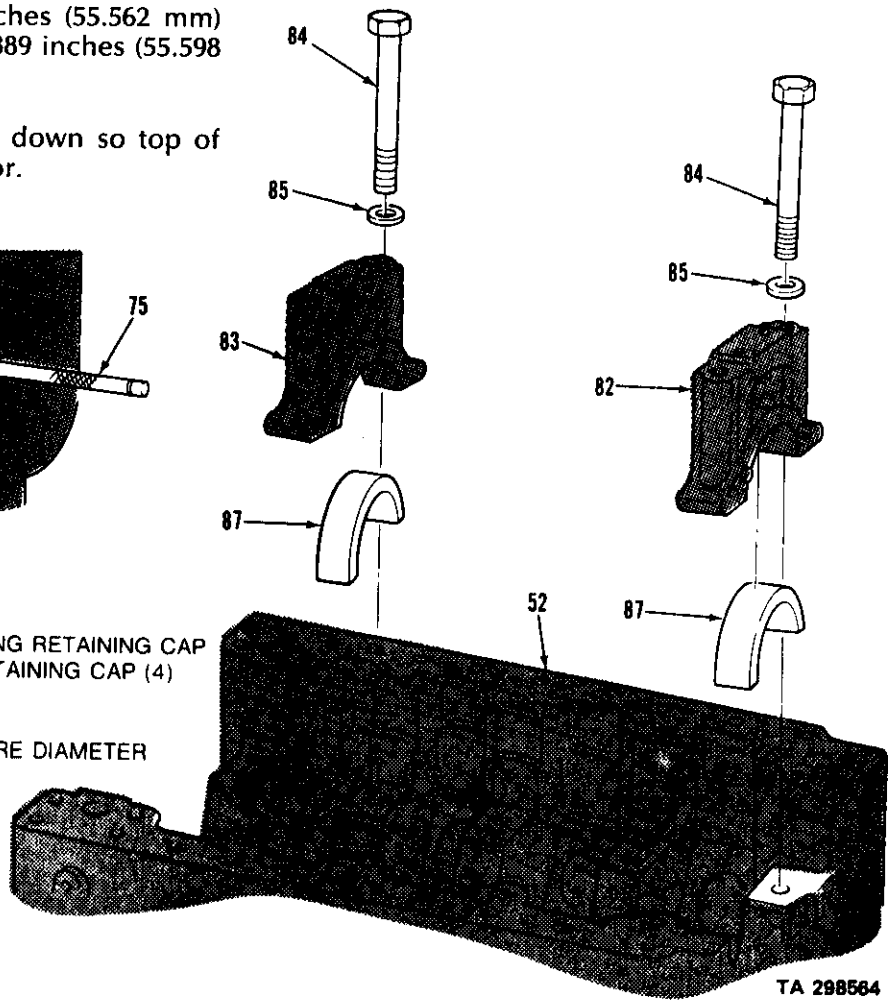
NOTE

If rear main bearing retaining cap (82) or any of the four main bearing retaining caps (83) need replacement, send engine to Depot Maintenance.

(7) Install rear main bearing retaining cap (82).

(8) Install four main bearing retaining caps (83) in their original positions.





52. BLOCK
75. T-GAGE
82. REAR MAIN BEARING RETAINING CAP
83. MAIN BEARING RETAINING CAP (4)
84. CAPSCREW (10)
85. WASHER (10)
86. MAIN BEARING BORE DIAMETER

TA 298564

(7) Apply high temperature adhesive to rotor (21) shaft and press on slip ring (73) assembly.

(8) Position rotor leads (76) as shown and solder to slip ring terminals (75).

(9) Cut off terminals (75) 1/8 inch (3.0 mm) from end of shaft.

(10) Place rotor (21) in press and install drive end housing (22) over drive end.

CAUTION

To avoid damage, press on inner race of bearing only.

(11) Pressing on inner race of bearing (72), press drive end housing (22) onto rotor (21).

(12) Install oil seal (68) into slip ring end housing (26). Position flat side towards outside of slip ring end housing (26).

(13) Fill cavity of oil seal (68) with lubricating grease.

(14) Place slip ring end housing (26) in press with open side up.

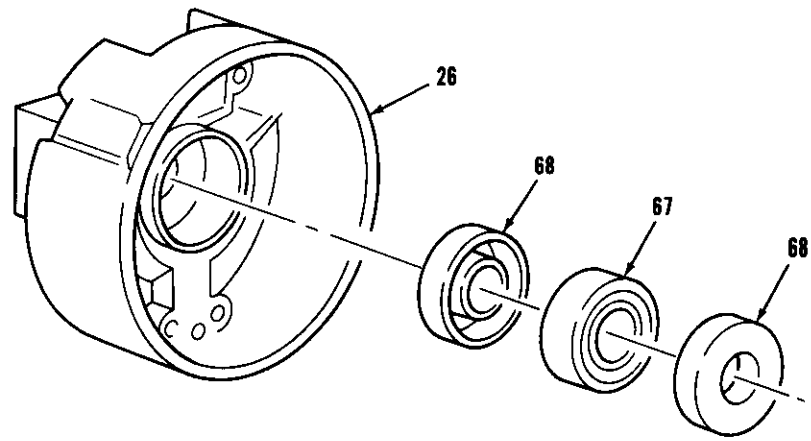
CAUTION

To avoid damage, press on outer race of bearing only.

(15) Press bearing (67) into slip ring end housing (26) until flush with inner edge.

(16) Pack bearing (67) with grease.

(17) Apply grease to new oil seal (68) and install into slip ring end housing (26) until flat side of oil seal (68) is flush with slip ring end housing (26).



26. SLIP RING END HOUSING
67. BEARING
68. OIL SEAL (2)

TA 298726

(9) Apply International compound No. 2 to the threads of capscrews (84). Install 10 capscrews (84) and washers (85) in main bearing caps (82 and 83).Torque capscrews (84) to 230-240 foot-pounds (312-325 N·m).

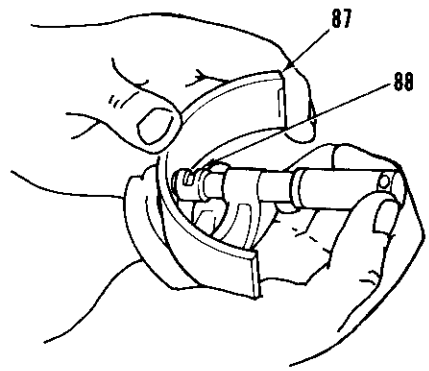
(10) Measure the main bearing bore diameter (86) with a T-gage (75). Diameter must be a minimum of 4.8120 inches (122.225 mm) and a maximum of 4.8130 inches (122.250 mm).

(11) Inspect the backs of the new bearings (87) for shiny spots, flaws, or damage. Replace any damaged bearings (87).

NOTE

Bearing (87) thickness equals the total thickness of the bearing (87) and ball attachment (88), minus the diameter of the ball.

(12) Measure thickness of halves of bearing (87) at outer edge using a micrometer and ball attachment (88).Measure at point A on both halves of bearing (87). Compare measurements with the table of limits.



87. BEARING
88. BALL ATTACHMENT

TABLE OF LIMITS

Bearing Size	Bearing Thickness	
	Min/Max	Limit
Standard	0.1545″ / 0.1552″ 3.924 mm / 3.942 mm	0.154″ 3.911 mm
.002 Undersize	0.1555″ / 0.1562″ 3.949 mm / 3.967 mm	0.155″ 3.937 mm
.010 Undersize	0.1595″ / 0.1602″ 4.051 mm / 4.069 mm	0.159″ 4.038 mm
.020 Undersize	0.1645″ / 0.1652″ 4.178 mm / 4.196 mm	0.164″ 4.165 mm
.030 Undersize	0.1695″ / 0.1702″ 4.305 mm / 4.323 mm	0.169″ 4.292 mm

TA 298565

6-3. ALTERNATOR REPAIR (Continued)

d. Assembly

CAUTION

To avoid damage, press on outer race of bearing only.

(1) Press bearing (72) into drive end housing (22) with open side of bearing (72) facing inside of drive end housing (22).

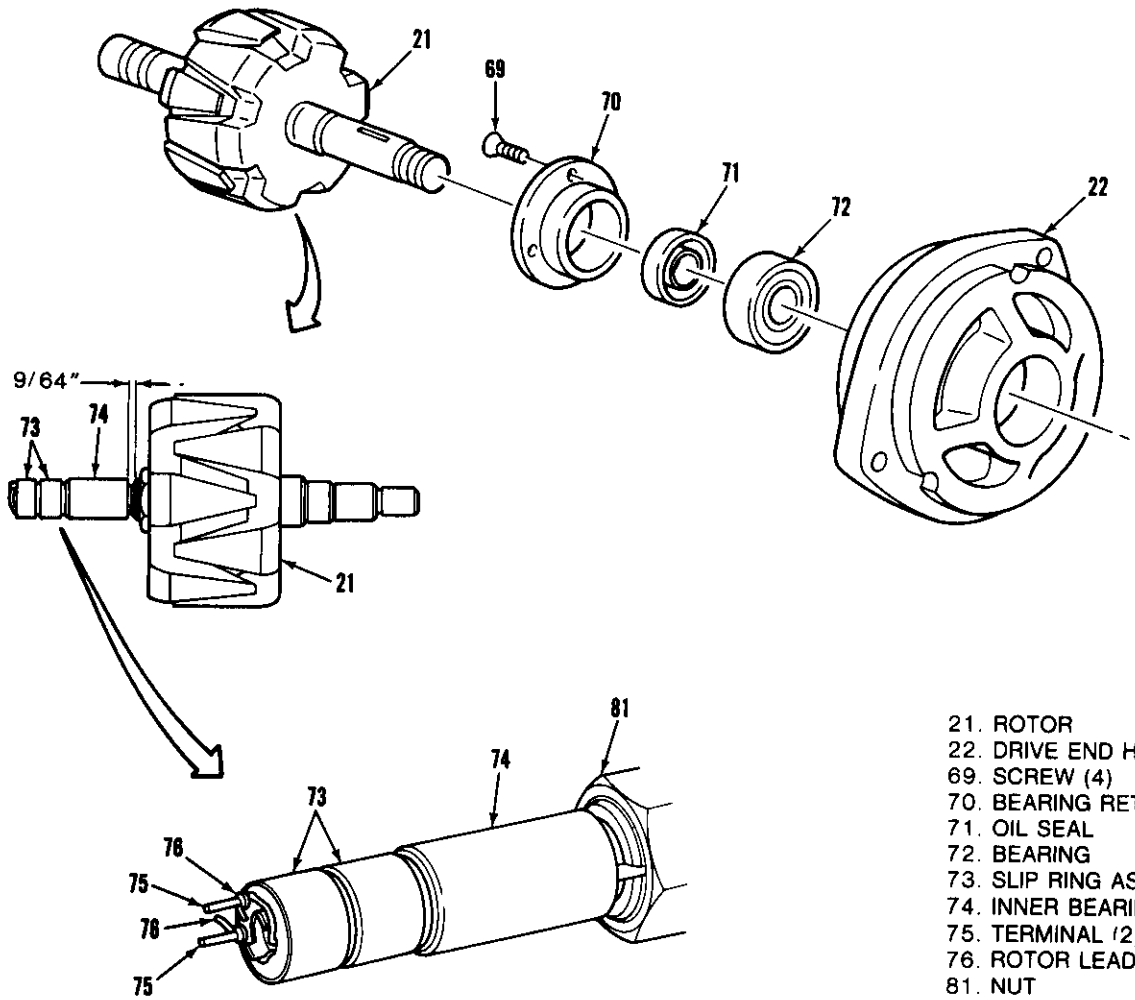
(2) Install oil seal (71) into bearing retainer (70) so that flat side of oil seal (71) fits flush with flat side of bearing retainer (70).

(3) Fill cavity of oil seal (71) with lubricating grease.

(4) Install bearing retainer (70) into drive end housing (22). Secure with four screws (69).

(5) Install rotor leads (76) into groove in rotor (21) shaft.

(6) Place rotor (21) in press and install inner bearing race (74), chamfered side toward end of shaft. Being careful not to damage rotor leads (76), press inner bearing race (74) onto shaft until it is 9/64 inch (3.571 mm) from nut (81).



21. ROTOR
22. DRIVE END HOUSING
69. SCREW (4)
70. BEARING RETAINER
71. OIL SEAL
72. BEARING
73. SLIP RING ASSEMBLY
74. INNER BEARING RACE
75. TERMINAL (2)
76. ROTOR LEAD (2)
81. NUT

TA 298725

3-22. ENGINE BLOCK REPAIR (Continued)

(13) Inspect dowel pins (89) on rear main bearing retainer cap (82) for looseness and extension. Dowel pins (89) must extend a minimum of 0.110 inch (2,794 mm) and a maximum of 0.120 inch (3.048 mm). If dowel pins (89) are loose, replace them with oversized pins.

(a) Remove old dowel pins (89) and drill dowel holes with a number 11 drill bit.

(b) Press in new dowel pins (89) to specified height.

(c) After pressing in dowel pins (89), remove all burrs from base of dowel pins (89) to permit proper seating of thrust washers (90).

(14) Measure the thickness of four thrust washers (90).

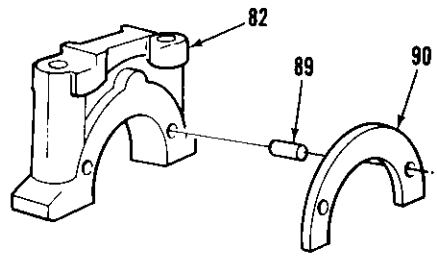
(a) Standard size thrust washer (90) has a minimum thickness of 0.1190 inch (3.022 mm) and a maximum of 0.1220 inch (3.098 mm).

(b) 0.005 oversize thrust washer (90) has a minimum thickness of 0.1240 inch (3.149 mm) and a maximum of 0.1270 inch (3.225 mm).

(c) 0.010 over size thrust washer (90) has a minimum thickness of 0.1290 inch (3.276 mm) and a maximum of 0.1320 inch (3.352 mm).

(15) Inspect all other parts. Refer to paragraph 2-7.

(16) Replace all parts failing inspection.



82. REAR MAIN BEARING RETAINER CAP
89. DOWEL PIN (4)
90. THRUST WASHER (4)

TA 298566

e. Assembly

(1) Install reducer bushing (47).

NOTE

Apply adhesive to all plugs, pins, and drain cocks.

(2) Install seven plugs (40), four plugs (41), eight plugs (42 thru 45), and plug (46).

(3) Install two studs (39) and three drain cocks (48).

(4) Drive four pins (53) into block (52) until pin (53) sticks out 0.880 inch (22.352 mm) to 0.980 inch (24.892 mm).

(5) Drive three pins (54) flush with surface of block (52).

(6) Install plug (49) and plug (50).

(7) Install eight plugs (51).

(8) Install tee connector (28) and elbow (29) and oil connector (30).

(9) Install two elbows (27) and two drain tubes (26) with capscrew (23), new lockwasher (24), and washer (25).

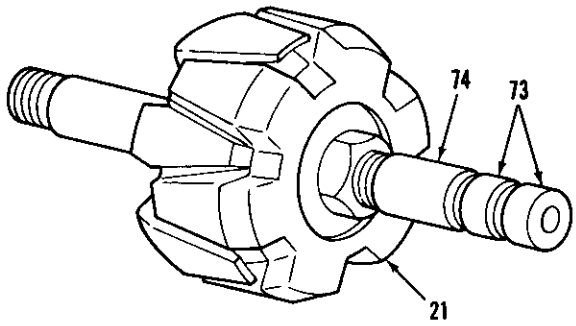
(10) Install new gasket (38) and cover (37) with four capscrews (35) and new lockwasher (36). Tighten capscrews (35) securely.

(c) Reading should be 12.5-13.5 ohms.

(d) If not, replace rotor (21).

(11) Measure two slip rings (73) on rotor (21). Minimum diameter is 0.767 inch (19.5 mm). Maximum run-out is 0.002 inch (0.05 mm).

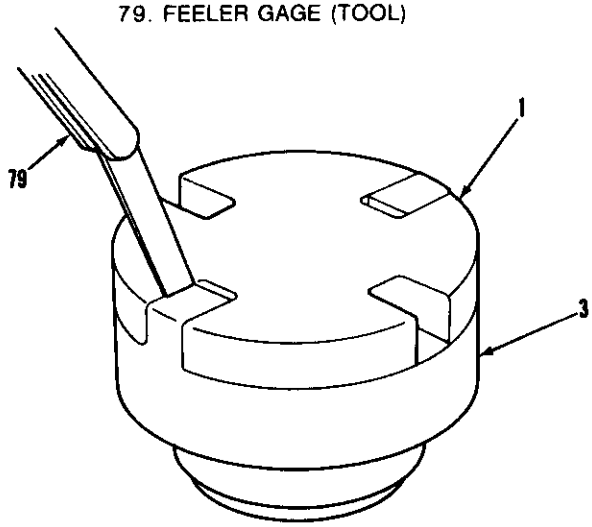
(12) Measure inner bearing race (74) on rotor (21). Minimum diameter is 0.8709 inch (22.1 mm).

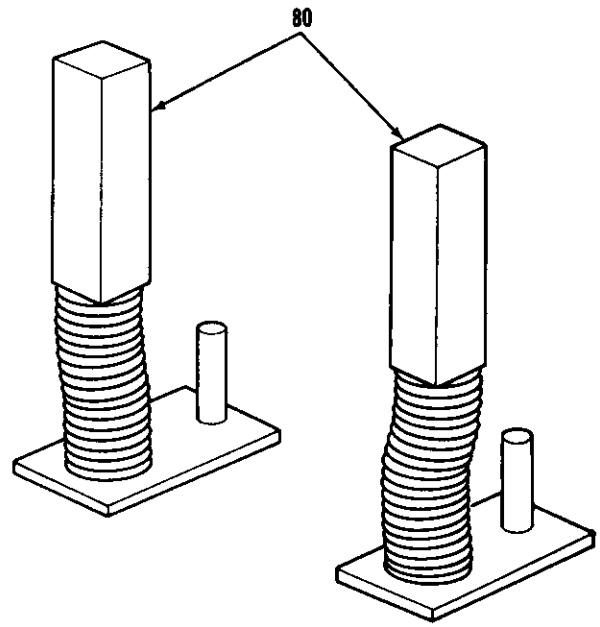


21. ROTOR
73. SLIP RING (2)
74. INNER BEARING RACE

(13) Check gap between drive hub (3) fingers and accessory drive coupling (1) slots with feeler gage (79). Maximum gap is 0.012 inch (0.30 mm).

1. ACCESSORY DRIVE COUPLING
3. DRIVE HUB
79. FEELER GAGE (TOOL)





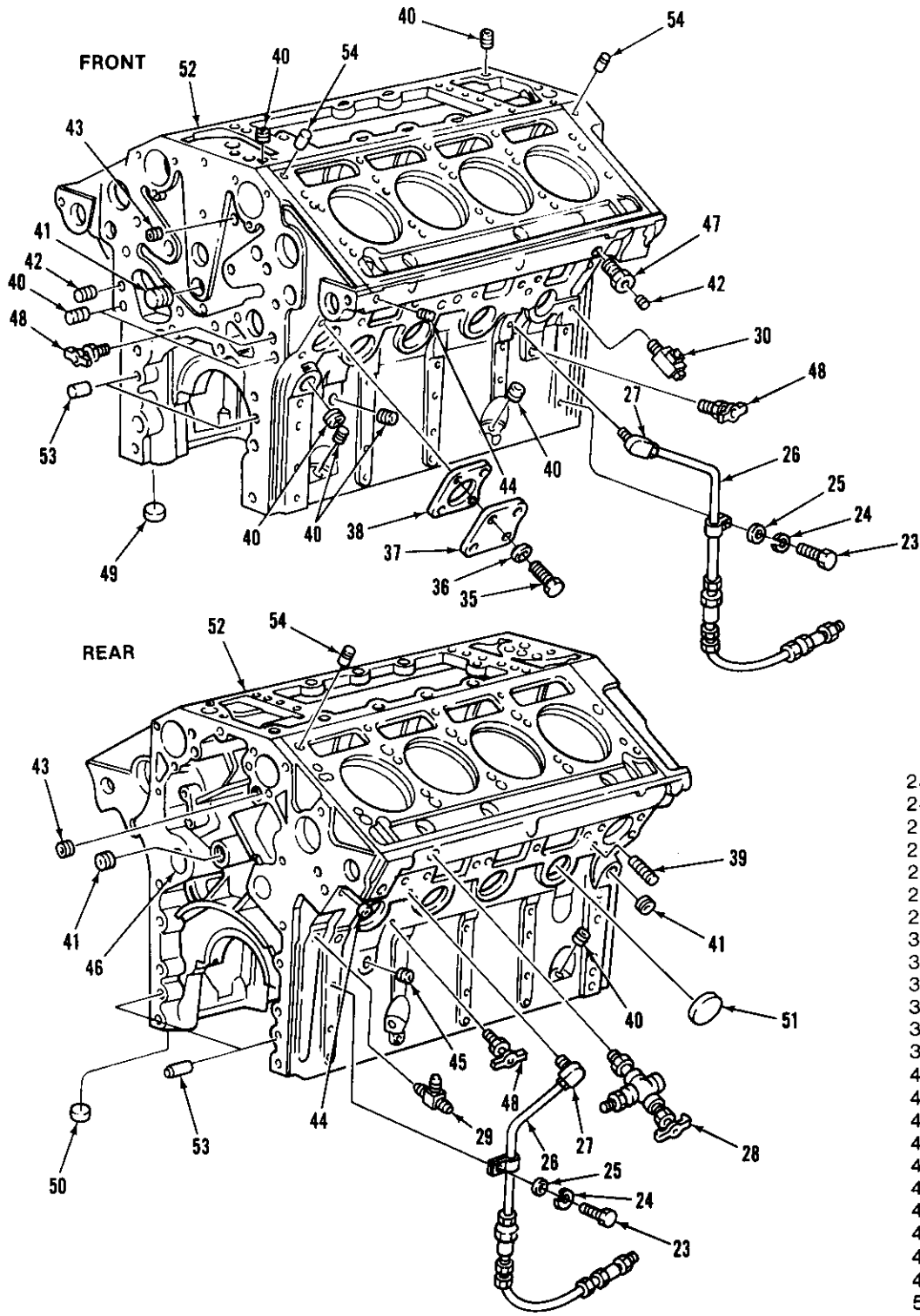
80. BRUSH (2)

TA 298724

(14) Inspect brushes (80), replace if burned, cracked, broken, or worn to less than 3/16 inch (4.8 mm).

(15) Inspect all parts for wear, damage, and signs of overheating.

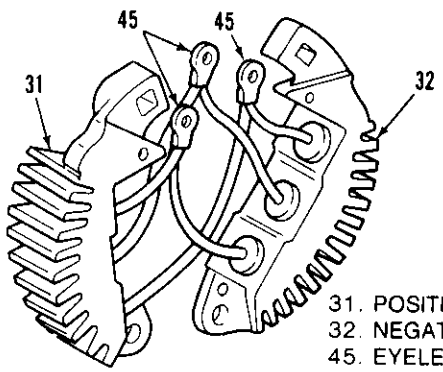
(16) Replace all parts failing inspection.



23. CAPSCREW (2)
24. LOCKWASHER (2)
25. WASHER (2)
26. DRAIN TUBE (2)
27. ELBOW (2)
28. TEE CONNECTOR
29. ELBOW
30. OIL CONNECTOR
35. CAPSCREW (4)
36. LOCKWASHER (4)
37. COVER
38. GASKET
39. STUD (2)
40. PLUG (7)
41. PLUG (4)
42. PLUG (2)
43. PLUG (2)
44. PLUG (2)
45. PLUG (2)
46. PLUG
47. REDUCER BUSHING
48. DRAIN COCK (3)
49. PLUG
50. PLUG
51. PLUG (8)
52. BLOCK
53. PIN (4)
54. PIN (3)

TA 298567

6-3. ALTERNATOR REPAIR (Continued)



31. POSITIVE RECTIFIER
32. NEGATIVE RECTIFIER
45. EYELET TERMINAL (3)

(b) Connect positive test lead to each of the three eyelet terminals (45).

(c) A low reading on any eyelet terminal (45) indicates shorted negative rectifier (32). Replace negative rectifier (32) if shorted.

(6) If either rectifier (31 or 32) has to be replaced, cut leads on rectifier being replaced as close to eyelet terminals as possible and discard bad part.

(7) Using an ohmmeter set at R x 10k range:

(a) Connect negative test lead to case of stator (25).

(b) Connect positive test lead to each of the three stator leads (24).

(c) High reading indicates good stator (25).

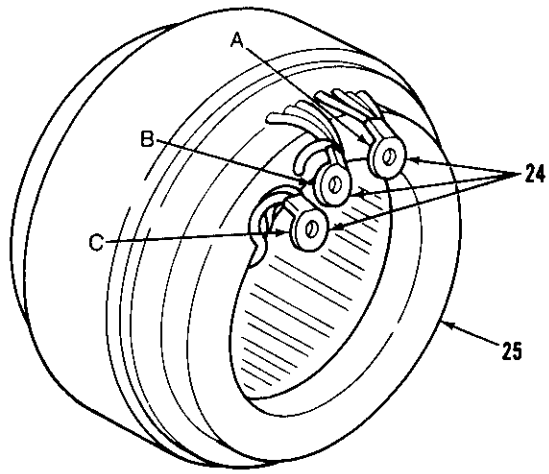
(d) Low reading indicates shorted stator (25). Replace stator (25) if shorted.

(8) Using digital ohmmeter capable of displaying 0.001 ohm reading:

(a) Connect test leads to stator leads (24) in the following order: (A-B), (B-C), (A-C).

(b) If all three readings are within 0.115-0.125 ohms, stator (25) is good.

(c) If any one reading varies more than 0.010 ohms over or under this range, stator (25) is bad.



24. STATOR LEADS (3)
25. STATOR

TA 298723

(9) Using an ohmmeter set to R x 10k setting:

(a) Connect one test lead to inner bearing race (74).

(b) Connect the other test lead to each of two slip rings (73).

(c) A low reading of either slip ring (73) indicates a grounded rotor (21). Replace rotor (21) if grounded.

(10) Using an ohmmeter set to R x 10k setting:

(a) Connect on test lead to inner slip ring (73).

(b) Connect the other test lead to outer slip ring (73).

3-22. ENGINE BLOCK REPAIR (Continued)

(11) Install a new gasket (32) and aftercooler core plug (33) with block plug installer. Torque aftercooler core plug (33) to 230-270 foot-pounds (312-366 N·m).

(12) Install new gasket (32) and aftercooler water inlet adapter (31) with inlet adapter installer. Torque aftercooler water inlet adapter (31) to 230-270 foot-pounds (312-366 N·m).

(13) If removed, install breather tube (22).

(14) Install new gaskets (20 and 21), two large covers (18), and four small covers (19) with 14 capscrews (17). Tighten capscrews (17) securely.

(15) Apply non-hardening sealant to new gasket (16). Install new gasket (16) at rear of block (52).

(16) Install rear plate (15), capscrew (11), and new lockwasher (12). Hand tighten capscrew (11).

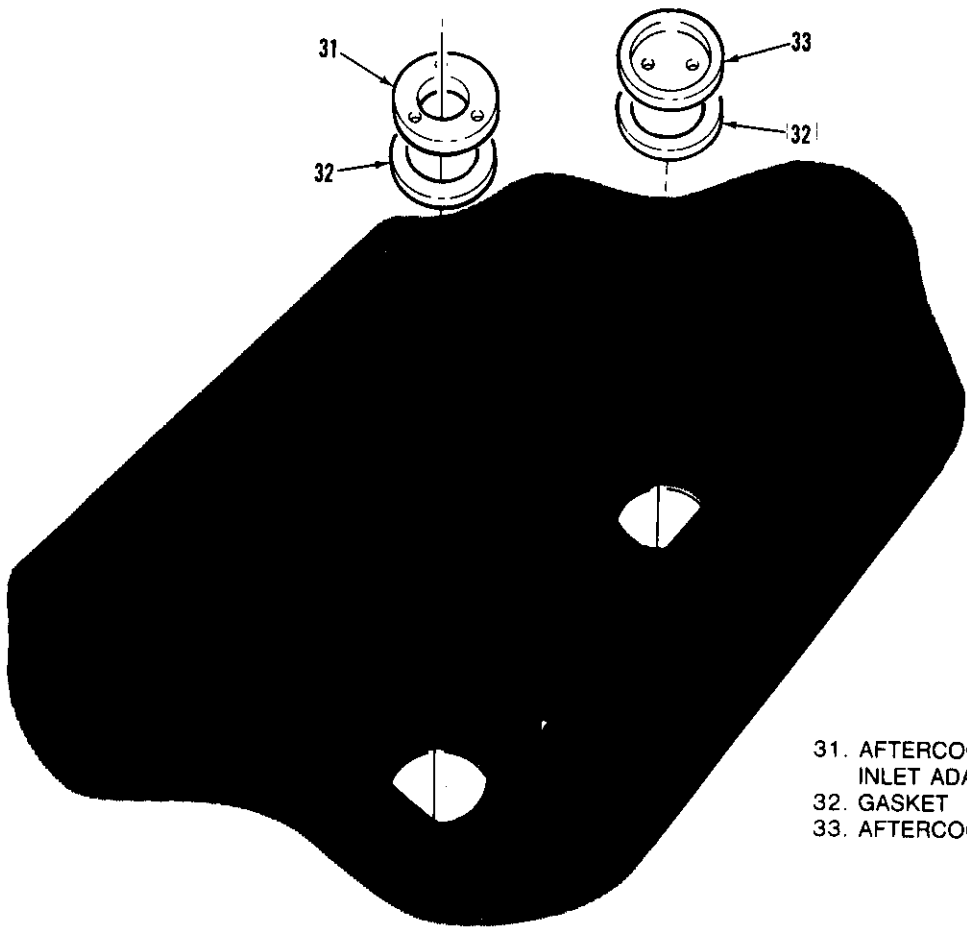
(17) Install four capscrews (13) and new lockwashers (14) at location Y. Hand tighten capscrews (13).

(18) Install camshaft bearing (91) to aline rear plate (15) with block (52).

(19) Torque four capscrews (13) to 30-35 foot-pounds (41-47 N·m). Torque capscrew (11) to 100-103 foot-pounds (140-149 N·m).

(20) Remove camshaft bearing (91).

(21) Install hub (10) on left side of rear plate (15). Install capscrew (8) and new lockwasher (9). Torque capscrew (8) to 80-90 foot-pounds (108-122 N·m).



31. AFTERCOOLER WATER INLET ADAPTER
32. GASKET
33. AFTERCOOLER CORE PLUG

TA 298568

(33) If needed, remove slip ring assembly (73) and/or inner bearing race (74) from rotor (21).

(a) Heat two terminals (75) with a soldering iron and unwrap rotor leads (76).

(b) Using a puller, remove slip ring assembly (73) from rotor (21).

(c) Using a puller, remove inner bearing race (74) from rotor (21).

b. Cleaning

CAUTION

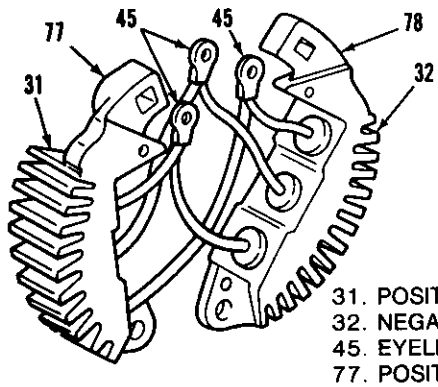
To prevent damage to parts, do not use solvent or paint thinner to clean parts.

(1) Clean all parts. Refer to paragraph 2-6.

(2) Dry parts with a clean cloth.

c. Inspection

(1) Using a ohmmeter set at R x 10k range, test both positive and negative rectifiers (31 and 32).



31. POSITIVE RECTIFIER
32. NEGATIVE RECTIFIER
45. EYELET TERMINAL (3)
77. POSITIVE OUTPUT TERMINAL
78. NEGATIVE OUTPUT TERMINAL

TA 298722

(2) For positive rectifier (31) perform open test:

(a) Connect negative test lead to positive output terminal (77).

(b) Connect positive test lead to each of the three eyelet terminals (45).

(c) A high reading on any eyelet terminal (45) indicates open positive rectifier (31). Replace positive rectifier (31) if open.

(3) For positive rectifier (31) perform short test:

(a) Connect positive test lead to positive output terminal (77).

(b) Connect negative test lead to each of the three eyelet terminals (45).

(c) A low reading on any eyelet terminal (45) indicates shorted positive rectifier (31). Replace positive rectifier (31) if shorted.

(4) For negative rectifier (32) perform open test:

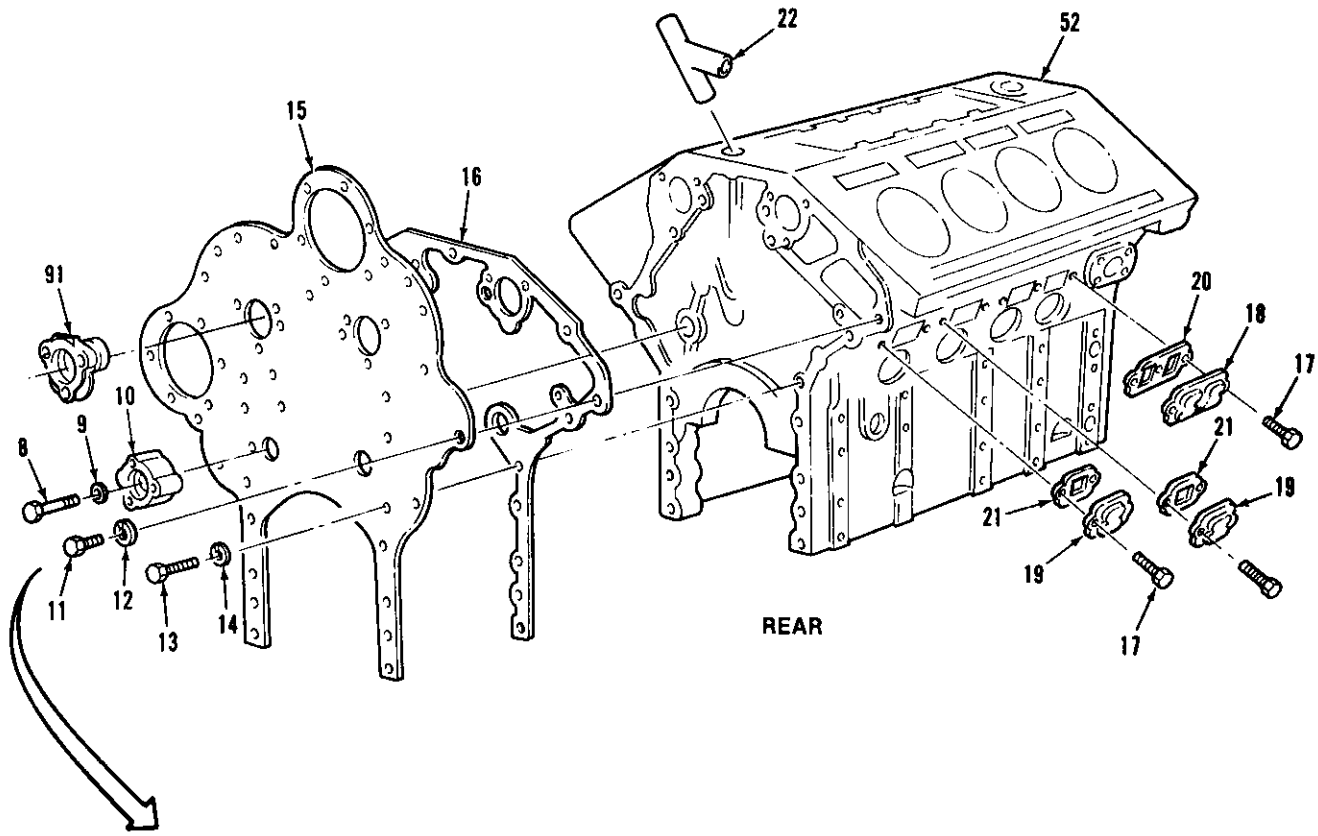
(a) Connect positive test lead to negative output terminal (78).

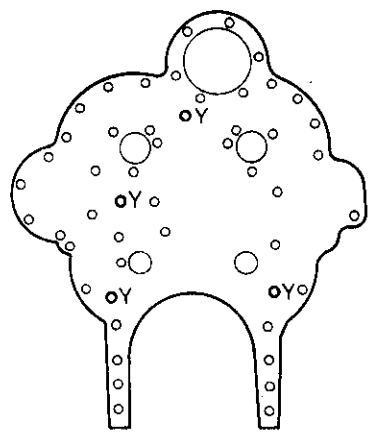
(b) Connect negative test lead to each of the three eyelet terminals (45).

(c) A high reading on any eyelet terminal (45) indicates open negative rectifier (32). Replace negative rectifier (32) if open.

(5) For negative rectifier (32) perform short test:

(a) Connect negative test lead to negative output terminal (78).

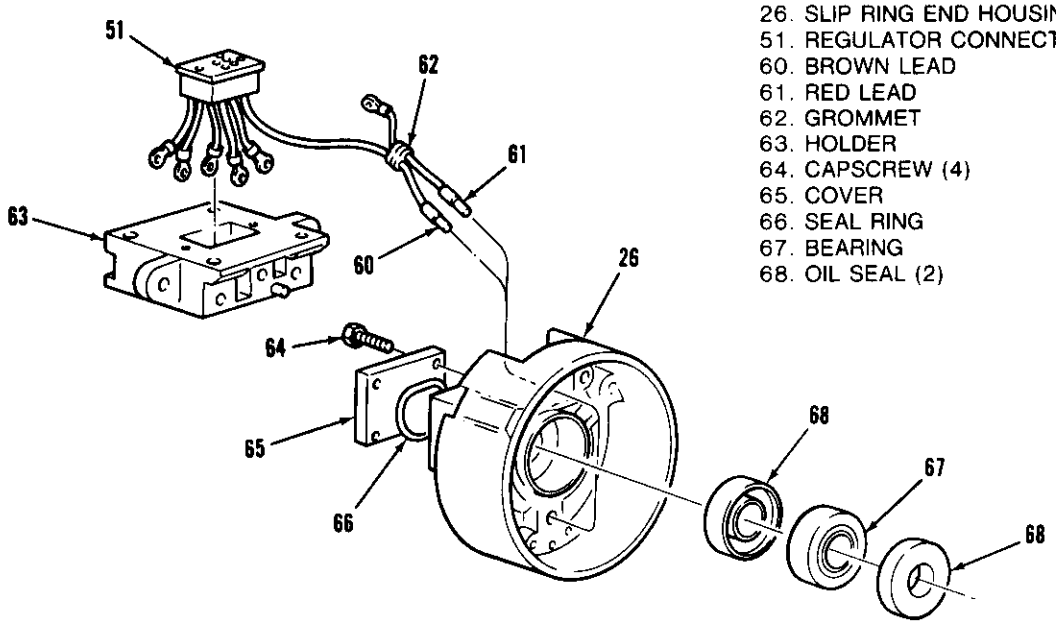




8. CAPSCREW
9. LOCKWASHER
10. HUB
11. CAPSCREW
12. LOCKWASHER
13. CAPSCREW (4)
14. LOCKWASHER (4)
15. REAR PLATE
16. GASKET
17. CAPSCREW (14)
18. LARGE COVER (2)
19. SMALL COVER (4)
20. GASKET (2)
21. GASKET (4)
22. BREATHER TUBE
52. BLOCK
91. CAMSHAFT BEARING

TA 298569

6-3. ALTERNATOR REPAIR (Continued)



26. SLIP RING END HOUSING
51. REGULATOR CONNECTOR
60. BROWN LEAD
61. RED LEAD
62. GROMMET
63. HOLDER
64. CAPSCREW (4)
65. COVER
66. SEAL RING
67. BEARING
68. OIL SEAL (2)

(26) Pull red (61) and brown (60) leads through hole and into slip ring end housing (26). Grommet (62) will come with leads.

(27) Remove regulator connector (51) and holder (63).

(28) Remove four capscrews (64), cover (65), and seal ring (66). Discard seal ring (66).

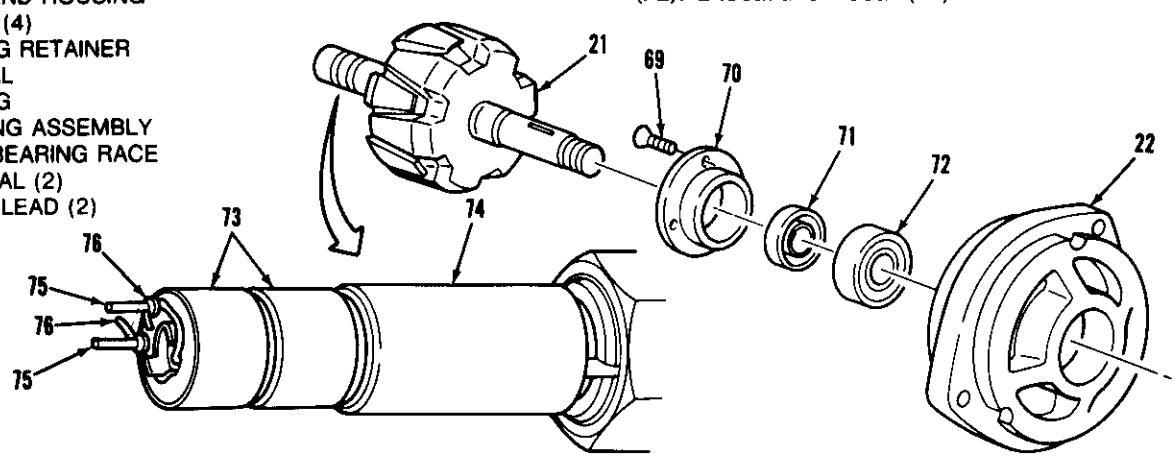
(29) Insert a punch through access holes and drive out bearing (67) and two oil seals (68). Discard oil seals (68).

(30) Place drive end housing (22) in press, rotor (21) side down, and press out rotor (21).

(31) Remove four screws (69) and bearing retainer (70).

(32) Remove oil seal (71) and press out bearing (72). Discard oil seal (71).

21. ROTOR
22. DRIVE END HOUSING
69. SCREW (4)
70. BEARING RETAINER
71. OIL SEAL
72. BEARING
73. SLIP RING ASSEMBLY
74. INNER BEARING RACE
75. TERMINAL (2)
76. ROTOR LEAD (2)



TA 298721

3-22. ENGINE BLOCK REPAIR (Continued)

(22) Apply non-hardending sealant to new gaskets (6 and 7). Install new gaskets (6 and 7).

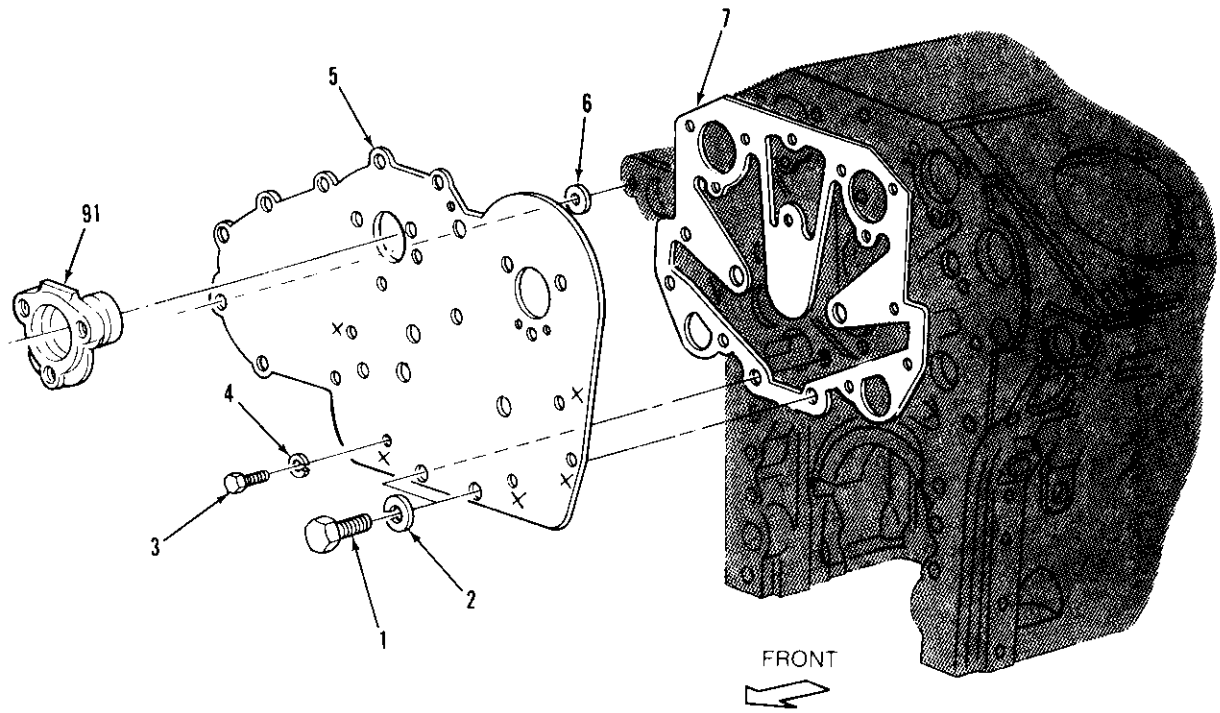
(23) Install five capscrews (3), new lockwashers (4), and front plate (5). Install capscrews (3) in location X. Hand tighten capscrews (3).

(24) Install two capscrews (1) and new lockwashers (2). Hand tighten capscrews (1).

(25) Install camshaft bearing (91) to accurately aline front plate (5) with block (52).

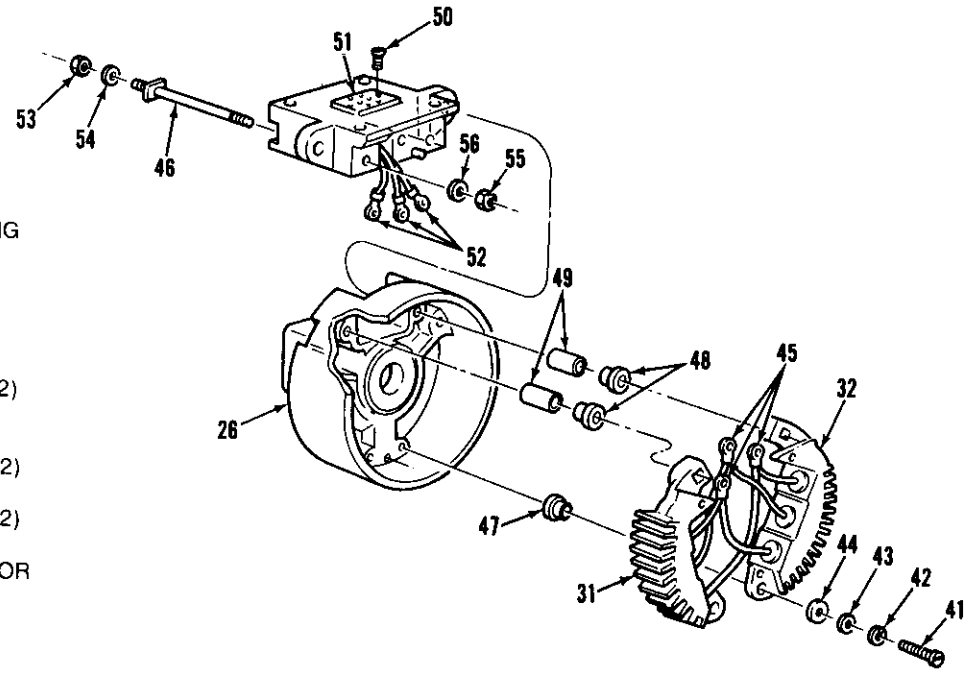
(26) Torque five capscrews (3) to 30-35 foot-pounds (41-47 N·m). Torque two capscrews (1) to 71-75 foot-pounds (96-102 N·m).

(27) Remove camshaft bearing (91) after front plate (5) is installed.



1. CAPSCREW (2)
2. LOCKWASHER (2)
3. CAPSCREW (5)
4. LOCKWASHER (5)
5. FRONT PLATE
6. GASKET
7. GASKET
91. CAMSHAFT BEARING

TA 298570



26. SLIP RING END HOUSING
31. POSITIVE RECTIFIER
32. NEGATIVE RECTIFIER
41. SCREW (2)
42. LOCKWASHER (2)
43. WASHER (2)
44. INSULATING WASHER (2)
45. EYELET TERMINAL (3)
46. TERMINAL STUD (3)
47. INSULATING BUSHING (2)
48. INSULATOR (2)
49. INSULATING BUSHING (2)
50. SCREW (2)
51. REGULATOR CONNECTOR
52. YELLOW LEAD (3)
53. NUT (3)
54. LOCKWASHER (3)
55. NUT (3)
56. WASHER (3)

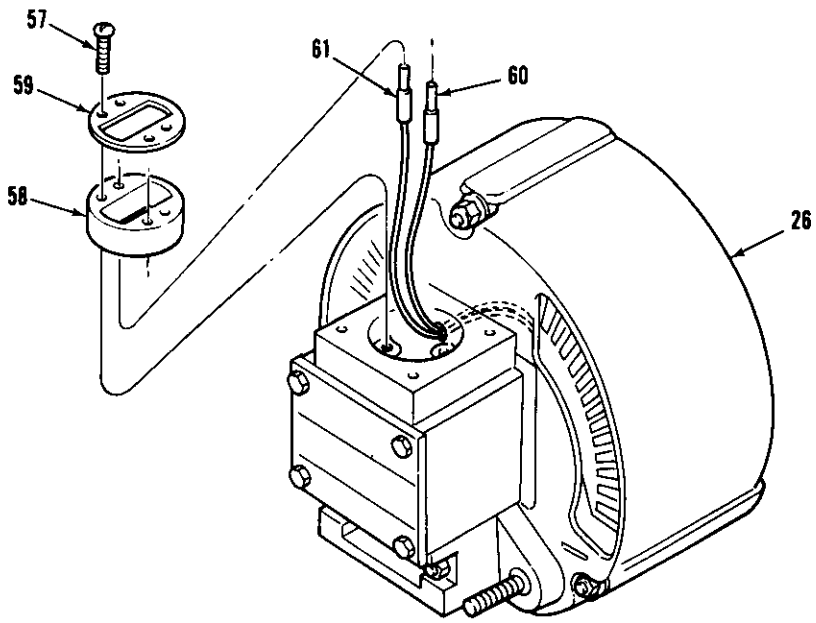
(21) Remove three nuts (53), and lockwashers (54) from terminal studs (46), outside of slip ring end housing (26). Discard lockwashers (54).

(22) Remove three nuts (55) and washers (56) from terminal studs (46), inside of slip ring end housing (26).

(23) Remove three terminal studs (46).

(24) Remove two screws (57) from brush adapter (58). Pull brush adapter (58) out of slip ring end housing (26) and fiber plate (59).

(25) Carefully remove connectors of brown (60) and red (61) leads from brush adapter (58).



26. SLIP RING END HOUSING
57. SCREW (2)
58. BRUSH ADAPTER
59. FIBER PLATE
60. BROWN LEAD
61. RED LEAD

TA 298720

NOTE

- Turn engine upside down to install main bearings.
- Coat each bearing (87) with clean engine oil before installing.

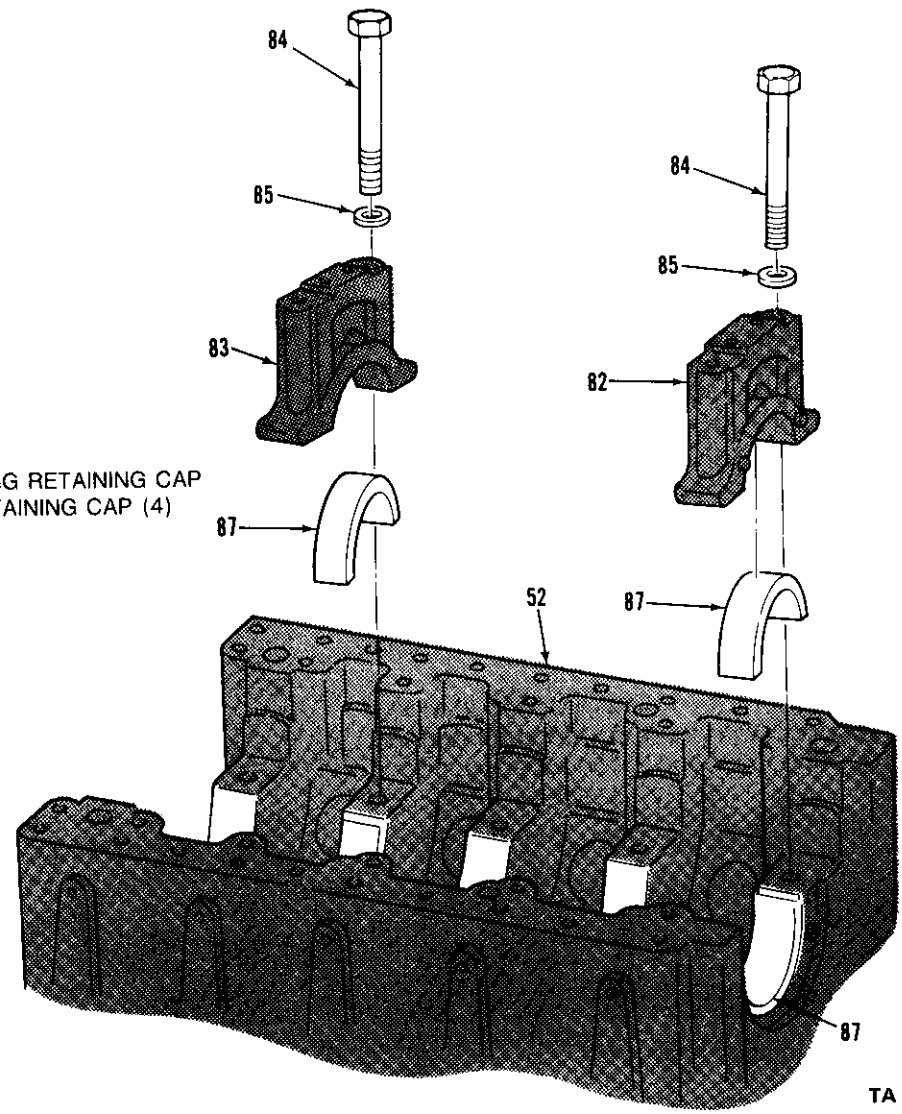
(28) Remove each of the five main bearing caps (82 and 83) in sequence. Install new bearings (87) on the block (52) and in each of the bearing caps (82 and 83). Secure main bearing caps (82 and 83) with 10 washers (85) and capscrews (84).

END OF TASK

NOTE

Follow-On Maintenance

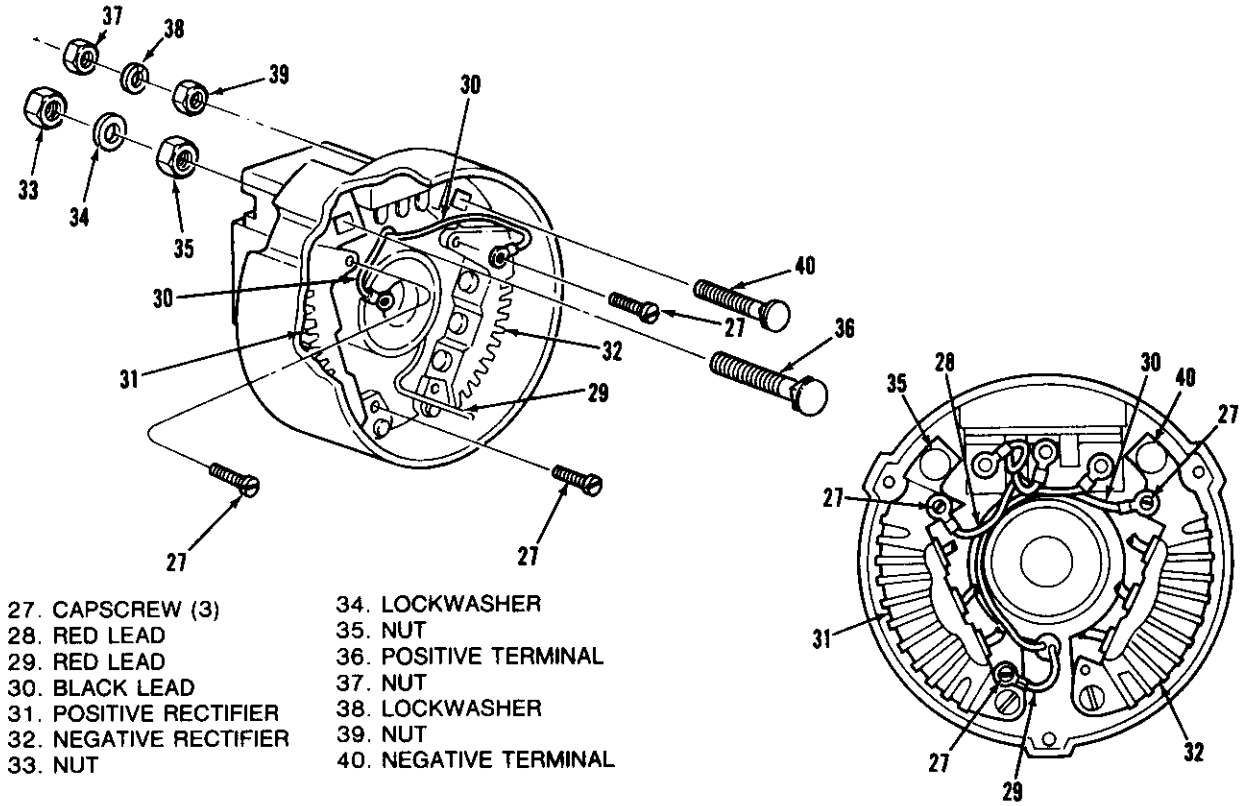
TM 2320-34/13 TM 9-2320-297-34	Reassemble engine from subassemblies (para 3-20). Install power pack (para 3-17).



52. BLOCK
82. REAR MAIN BEARING RETAINING CAP
83. MAIN BEARING RETAINING CAP (4)
84. CAPSCREW (10)
85. WASHER (10)
87. BEARING (10)

TA 298571

6-3. ALTERNATOR REPAIR (Continued)



27. CAPSCREW (3)
28. RED LEAD
29. RED LEAD
30. BLACK LEAD
31. POSITIVE RECTIFIER
32. NEGATIVE RECTIFIER
33. NUT
34. LOCKWASHER
35. NUT
36. POSITIVE TERMINAL
37. NUT
38. LOCKWASHER
39. NUT
40. NEGATIVE TERMINAL

TA 298719

(10) Remove three capscrews (27) and disconnect two red leads (28 and 29) and one black lead (30) from rectifiers (31 and 32).

(11) Remove nut (33), lockwasher (34) and nut (35) from positive terminal (36). Discard lockwashers (34).

(12) Remove nut (37), lockwasher (38), and nut (39) from negative terminal (40). Discard lockwasher (38).

(13) Remove both terminals (36 and 40) from rectifiers (31 and 32).

(14) Remove two screws (41), lockwashers (42), washers (43), and insulating washers (44). Discard lockwashers (42).

(15) Remove three eyelet terminals (45) from terminal studs (46).

(16) Remove both rectifiers (31 and 32).

(17) Remove two insulating bushings (47) from rectifiers (31 and 32).

(18) Remove two insulators (48) and insulating bushings (49) from slip ring end housing (26).

(19) Remove two screws (50) from regulator connector (51).

(20) Remove three yellow leads (52) from terminal studs (46).

3-23. CYLINDER LINER MAINTENANCE

THIS TASK COVERS: a. Cleaning
b. Inspection
c. Honing
d. Cylinder Liner Protrusion

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Cylinder liner depth gage (J 24898)
Hone (J 5902-1)
Cylinder liner hold down (J 24565-02)
Micrometer set 0-6" inside (NSN 5210-00-473-9350)
Micrometer set 0-6" outside (NSN 5210-00-554-7134)

Materials/Parts

Honing oil (item 43, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Cylinder block repaired (para 3-22).
	Cylinder liner removed (para 3-19).

---

a. Cleaning Clean all parts. Refer to paragraph 2-6.

b. Inspection

(1) Inspect cylinder liner (1) for cracks and scoring. A slightly scored cylinder liner (1) may be honed and reused. If cracked or excessively scored, replace cylinder liner (1).

(2) Inspect cylinder liner (1) area above port holes (2) for pitting.

(3) Inspect inside surface of cylinder liner (1) at top for ridge. If ridge is not excessive it may be honed.

(4) Before honing, measure inside diameter (5) of cylinder liner (1). Refer to step (8).

(5) If cylinder liner (1) is glazed it must be honed.

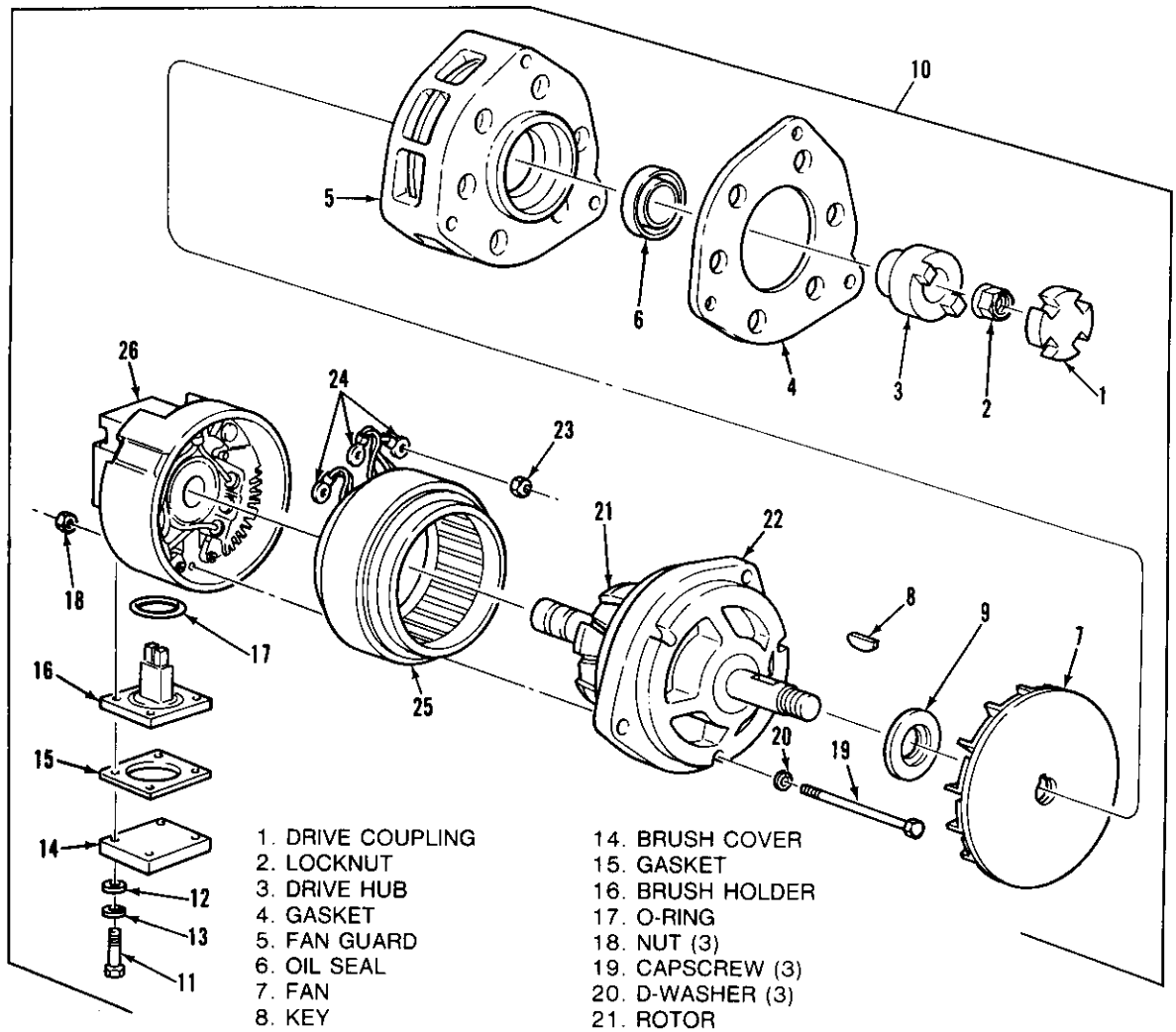
CAUTION

For individual cylinder liner (1) maintenance, the inside diameter (5) and roundness measurements of each affected cylinder bore (3) must also be inspected. Refer to paragraph 3-19, section d, step (1) for correct cylinder bore (3) measurements.

(6) Measure and record outside diameter of cylinder liner (1).

(a) The top diameter, just below the flange, should be a minimum of 5.3577 inches (13.608 cm) for new parts. A maximum of 5.3595 inches (13.613 cm) is acceptable.

(b) The middle diameter should be a minimum of 5.3347 inches (13.550 cm) and a maximum of 5.3365 inches (13.554 cm).



1. DRIVE COUPLING
2. LOCKNUT
3. DRIVE HUB
4. GASKET
5. FAN GUARD
6. OIL SEAL
7. FAN
8. KEY
9. FAN SPACER
10. ALTERNATOR ASSEMBLY
11. CAPSCREW (4)
12. WASHER (4)
13. LOCKWASHER (4)
14. BRUSH COVER
15. GASKET
16. BRUSH HOLDER
17. O-RING
18. NUT (3)
19. CAPSCREW (3)
20. D-WASHER (3)
21. ROTOR
22. DRIVE END HOUSING
23. LOCKNUT (3)
24. STATOR LEAD (3)
25. STATOR
26. SLIP RING END HOUSING

TA 298718

(5) Remove brush cover (14), gasket (15), and brush holder (16). Discard gasket (15).

(6) Remove O-ring (17) and discard.

(7) Remove three nuts (18), capscrews (19), and D-washers (20).

NOTE

Rotor (21) will stay with drive end housing (22).

(8) Remove drive end housing (22).

(9) Remove three locknuts (23) from stator leads (24) and remove stator (25) from slip ring end housing (26). Discard locknuts (23).

(c) The lower diameter must be a minimum of 5.2142 inches (13.244 cm) and a maximum of 5.2160 inches (13.248 cm).

CAUTION

- Cylinder liners (1) must be installed in their original bores.
- Do not drop cylinder liner (1) into cylinder bore (3). Damage to cylinder liner (1) will result.

(7) Check tags and install cylinder liners (1) and inserts (4) in the same cylinder bore (3) they were removed from. Cylinder liners (1) should have a push fit.

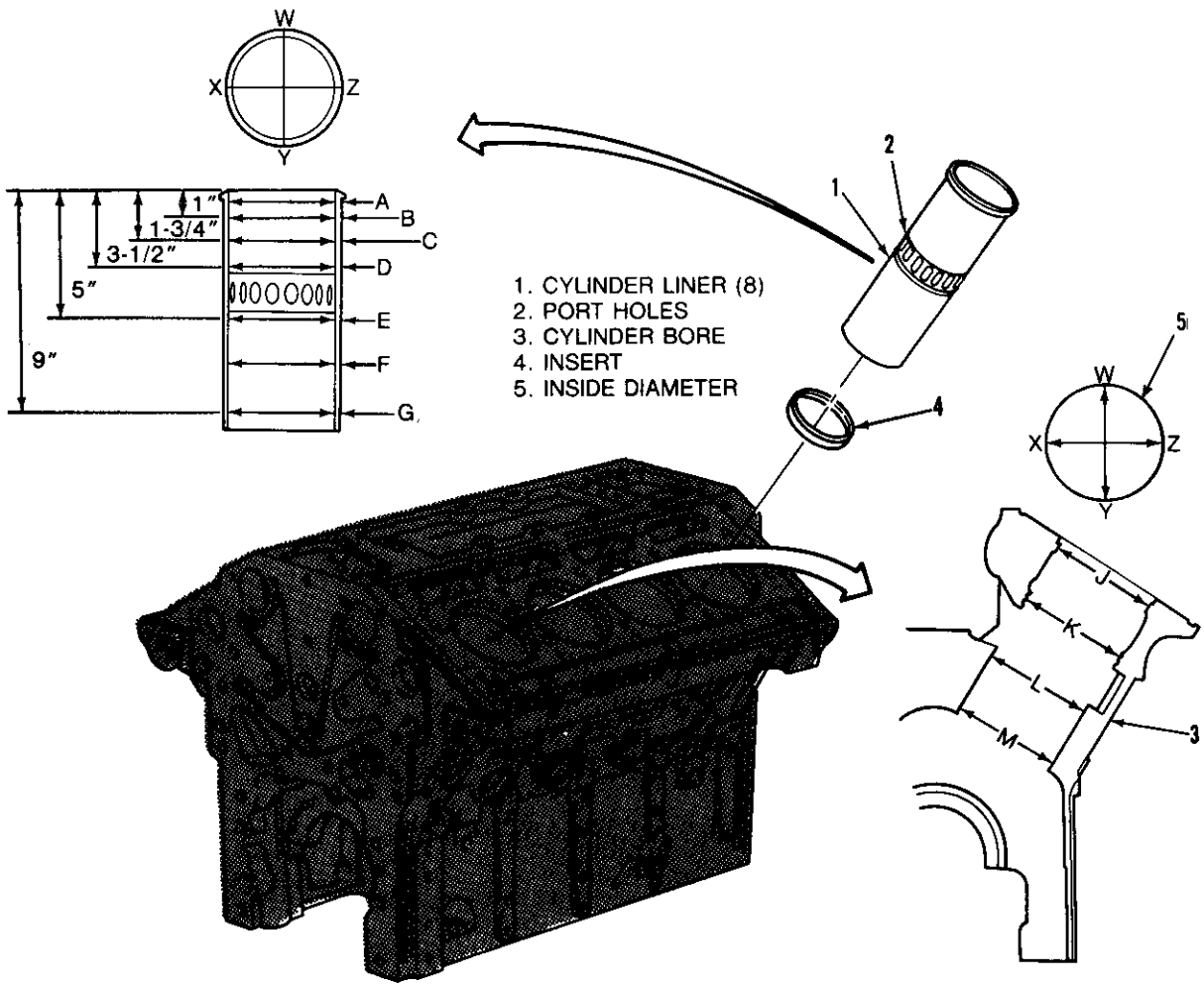
(8) Using a T-gage, measure and record the inside diameter (5) of cylinder liner (1). Measure points A thru G and make two measurements (XZ and WY) at each point.

(a) The inside diameter (5) must be a minimum of 4.8390 inches (12.291 cm),and a maximum of 4.8415 inches (12.297 cm).

(b) Cylinder liner (1) out-of-round may be a maximum 0.0020 inch (0.0508 mm) and a limit of 0.0025 inch (0.0635 mm).

(c) Cylinder liner (1) taper may be a maximum of 0.0015 (0.0381 mm) inch and a limit of 0.0025 inch (0.0635 mm).

(9) Repeat steps (1) thru (8) for each cylinder liner (1).



TA 298572

SECTION II. GENERAL ELECTRICAL SYSTEM MAINTENANCE

6-3. ALTERNATOR REPAIR

THIS TASK COVERS:
a. Disassembly
b. Cleaning/Inspection
c. Installation
d. Assembly

INITIAL SETUP

Applicable Configurations
MK48

Test Equipment
Multimeter

Special tools
Micrometer set 0-6 inch outside
(NSN 5120-00-665-7134)

Materials/Parts
Adhesive , high temperature (item 5, Appendix C)
Adhesive, low viscosity (item 6, Appendix C)
Electrical joint compound (item 15, Appendix C)
Red air dry epoxy (item 24, Appendix C)
Lubricating grease (item 25, Appendix C)
Solder (item 65, Appendix C)
Locknut (NSN 5310-00-432-3959) item 2
Gasket (P/N 101051) item 4
Seal (P/N 101054) item 6
Lockwasher (4) (MS35338-42) item 13
Gasket (NSN 5330-01-145-0724) item 15
O-ring (NSN 5330-01-145-5376) item 17
Locknut (3) (MS51858-6) item 23
Lockwasher (2) (MS35338-45) item 34
Lockwasher (3) (MS35338-44) items 38 and 54
Lockwasher (2) (MS35338-43) item 42
Seal ring (NSN 5330-01-145-0706) item 66
Seal (2) (NSN 5330-01-106-4329) item 68
Seal (NSN 5330-01-106-6101) item 71

Equipment Condition
TM
TM 2320-20/12
TM 9-2320-297-20

Condition Description
Alternator removed (para 7-4).

Voltage regulator removed (para 7-5).

---

a. Disassembly

NOTE

It may be necessary to use a puller to remove drive hub (3).

(1) Remove drive coupling (1), locknut (2), and drive hub (3). Discard locknut (2).

(2) Remove gasket (4), fan guard (5), and oil seal (6). Discard gasket (4) and seal (6).

(3) Remove fan (7), key (8), and fan spacer (9) from alternator assembly (10).

(4) Remove four capscrews (11), washers (12), and lockwashers (13). Discard lockwashers (13).

3-23. CYLINDER LINER MAINTENANCE (Continued)

c. Honing

CAUTION

Do not hone a new cylinder liner (1). New liners are factory finished and honing could affect seating of piston rings. A used liner may be honed if it is glazed, ridged, out-of-round, or tapered.

(1) Coat inside of cylinder liner (1) with honing oil.

(2) Install hone (6), equipped with 120-grit stones, into cylinder liner (1).

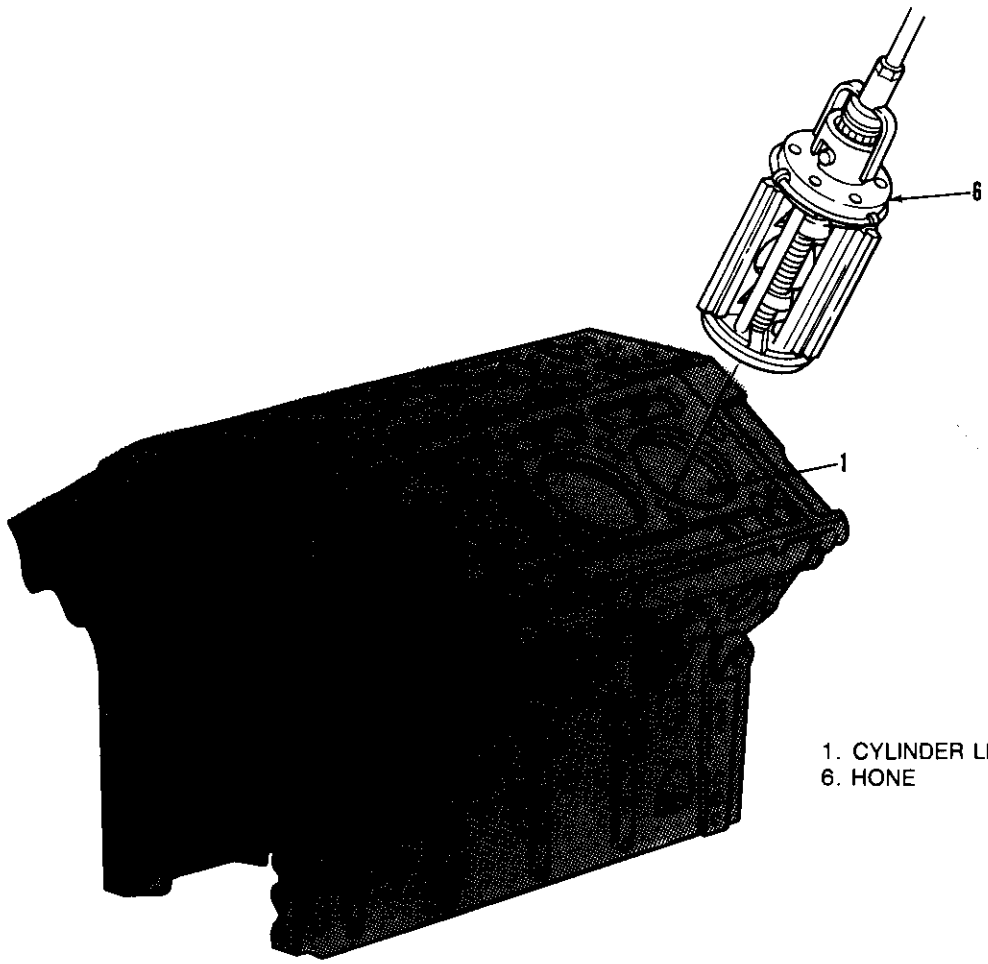
(3) Work hone (6) up and down in cylinder liner (1) at 300-400 rpm. Move the hone (6) the full length of cylinder liner (1) so hone (6) produces marks in criss-cross pattern at a 45 degree axis.

(4) Remove hone (6) after glaze has been removed from cylinder liner (1).

(5) Clean cylinder liner (1) and dry with compressed air (30 psi).

(6) Check cylinder liner (1) for burrs.

(7) Recheck cylinder liner (1) for taper and out-of-round.



1. CYLINDER LINER (8)
6. HONE

TA 298573

CHAPTER 6

ELECTRICAL SYSTEM

6-1. OVERVIEW

This chapter provides information authorized for Third and Fourth Echelon Maintenance level mechanics. General information, maintenance, and repair procedures for the vehicle's electrical system are covered in the following sections:

Section I. Description and Data

Section II. General Electrical System Maintenance

SECTION I. DESCRIPTION AND DATA

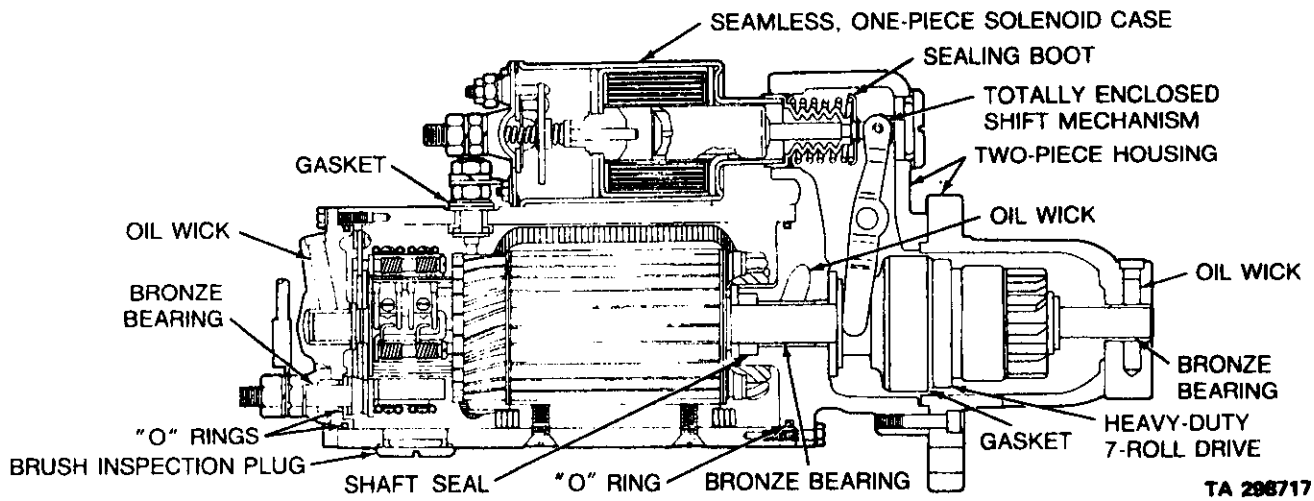
6-2. DESCRIPTION AND DATA

a. Alternator The vehicle uses a direct-driven, flange-mounted, 24 volt alternator. The alternator is designed for negative ground and has a plug-in type regulator mounted on top.

The alternator functions like other standard automotive alternators. A small amount of voltage is sent through the brushes to the rotor. As the rotor turns, it creates a low voltage in the stator. As the speed of the rotor increases, the voltage in the stator increases to one volt. At one volt the regulator allows full battery voltage to enter the rotor. This causes the output voltage of the stator to jump to rated output. This AC output is passed through the rectifier assemblies where it is converted to DC voltage.

b. Starter The vehicle uses a 24 volt starter with an enclosed shift lever and solenoid housing. A brush inspection plug is provided on the side of the starter.

The starter functions like other standard automotive starters. When the start switch is closed, voltage flows through the solenoid and pulls in the shift linkage. This causes the pinion to engage with the engine's flywheel and also closes the switch in the solenoid. The switch then allows battery voltage to operate the cranking motor. When the engine starts, the pinion protects the starter from damage by freewheeling until the next time that the start switch is opened.



d. Cylinder Liner Protrusion

NOTE

- Task below must be done when installing new cylinder liners (1). It is also a good idea to measure protrusion of cylinder liners (1) being reinstalled to make certain each cylinder liner (1) is correctly seated.
- Hold down clamps (7), capscrews (9), and washers (10) are part of special tool kit.

(1) Install eight hold down clamps (7) on engine block (8) and secure each in place with two capscrews (9) and washers (10). Torque capscrews (9) to 50 foot-pounds (68 N·m).

(2) Place depth gage (11) on engine block (8) and set to zero.

(3) Measure distance from the top of cylinder liner (1) to top of engine block (8) with depth gage (11). The depth of the flange below the engine block (8) must be a minimum of 0.0418 inch (1.061 mm) and a maximum of 0.0482 inch (1.224 mm).

(4) Once cylinder liners (1) are within specifications, mark cylinder liner (1) and engine block (8). This is to make sure cylinder liners (1) are installed in correct cylinder block bore.

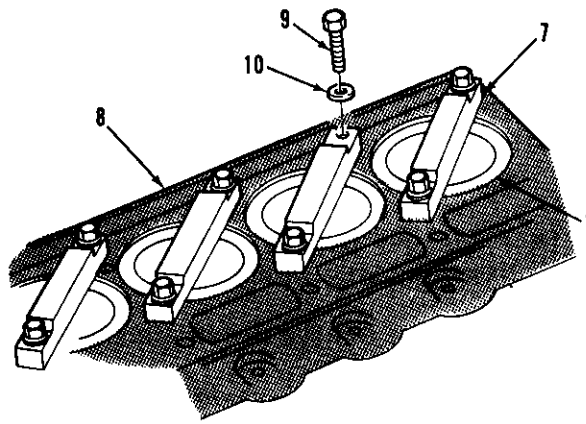
(5) Repeat steps (1) thru (4) for each cylinder liner (1).

END OF TASK

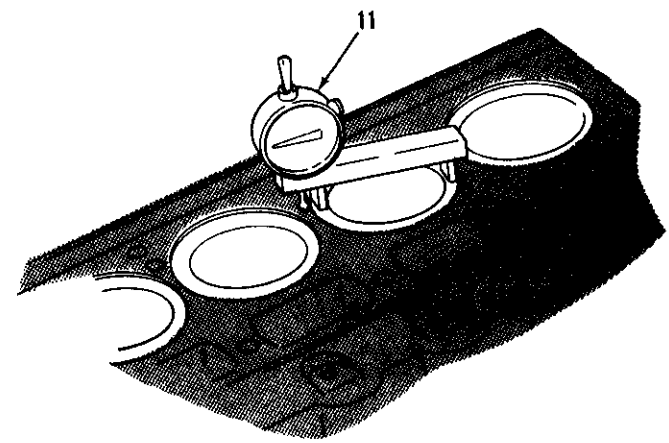
NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Repair piston and connecting rod (para 3-24).



1. CYLINDER LINER (8)
7. HOLD DOWN CLAMP (8)
8. ENGINE BLOCK
9. CAPSCREW (8)
10. WASHER (8)
11. DEPTH GAGE



TA 298574

3-24. PISTON AND CONNECTING ROD MAINTENANCE

THIS TASK COVERS: a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Pin retainer (J 23762)
Piston crown I.D. gage (J 25397)
Groove gage (J 24599)
Leak detector set (J 23987-01)
Ball attachment (J 4757) or (GGG-C-105)
Piston ring remover/installer (J 8128)
Piston to liner feeler gage (J 5438-01)
Micrometer set 0-6 inch inside (NSN 5210-00-473-9350)
Micrometer set 0-6 inch outside (NSN 5210-00-554-7134)

Materials/Parts

International compound No. 2 (item 16, Appendix C)
Engine oil (item 46, Appendix C)
Piston pin retainer (2) (NSN 2815-00-792-9020) item 11

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Piston removed (para 3-19). Cylinder liner repaired (para 3-23).

a. Disassembly

(1) Place connecting rod (1) in a soft-jawed vise.

(2) Remove fire ring (2), top compression ring (3), and bottom compression ring (4) using piston ring remover and installer. Remove two upper oil control rings (5 and 6) and two lower oil control rings (7 and 8).

(3) Remove oil ring expanders (9 and 10) from lower piston ring grooves.

(4) Punch hole in two piston pin retainers (11). Remove and discard both retainers (11).

(5) Loosen two capscrews (12).

(6) Remove connecting rod (1) and piston (13) from vise.

(7) Remove two capscrews (12) and two spacers (14).

(8) Mark and remove connecting rod (1) assembly from piston (13).

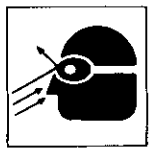
(9) Mark and remove piston pin (15).

(10) Mark and separate piston crown (16) from piston skirt (17).

(11) Remove metal seal ring (18) from piston crown (16).

(12) Mark and remove piston pin bearing (19).

WARNING



Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psi. Eye protection required.

(4) Blow out the inside and outside of aftercooler with compressed air. Be careful not to force debris into aftercooler (9) fins.

(5) Inspect core tubes and fins to make sure all debris has been removed. If necessary, repeat cleaning steps.

c. Installation

(1) Install two new seal rings (10 and 11) into grooves on water inlet tube (14).

(2) Install two new seal rings (12 and 13) into grooves on water outlet tube (15).

(3) Lightly coat new seal rings (10, 11, 12, and 13) with clean engine oil.

(4) Install aftercooler (9) and seal the water inlet tube (14) in the water inlet adaptor plug (16).

(5) Loosely install eight new capscrews (8).

(6) Aline and install a new gasket (7), water outlet elbow (4), two capscrews (5), and washers (6).

(7) Aline water outlet elbow (4) with thermostat housing (17) and install hose (3) and clamps (1 and 2). Tighten clamps (1 and 2) securely.

(8) Tighten two capscrews (5) securely.

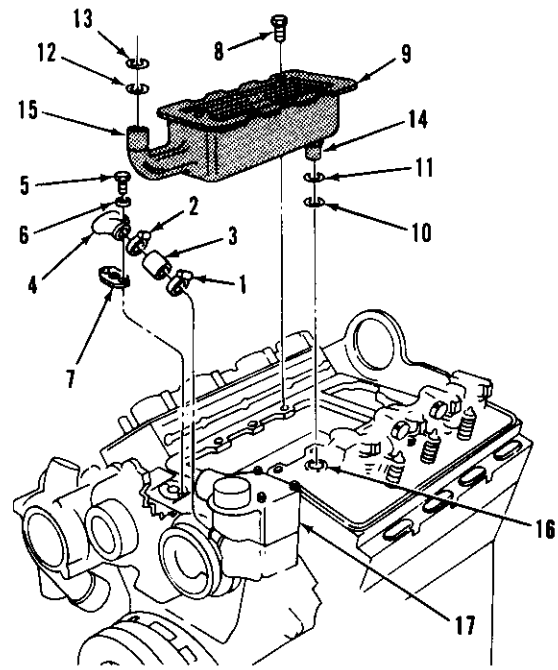
(9) Tighten eight capscrews (8) securely.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install blower (para 4-6).
	Install air inlet housing (para 4-12).
TM 2320-20/12 TM 9-2320-297-20	Fill coolant system (para 6-3).
	Install engine access panel (para 18-14).
TM 2320-10/11 TM 9-2320-297-10	Close engine access door (para 2-1).



TA 298716

1. CLAMP
2. CLAMP
3. HOSE
4. WATER OUTLET ELBOW
5. CAPSCREW (2)
6. WASHER (2)
7. GASKET
8. CAPSCREW (8)
9. AFTERCOOLER
10. SEAL RING
11. SEAL RING
12. SEAL RING
13. SEAL RING
14. WATER INLET TUBE
15. WATER OUTLET TUBE
16. WATER INLET ADAPTOR PLUG
17. THERMOSTAT HOUSING

b. Cleaning

CAUTION

Do not sandblast or use a wire brush to clean carbon deposits from piston skirt (17).

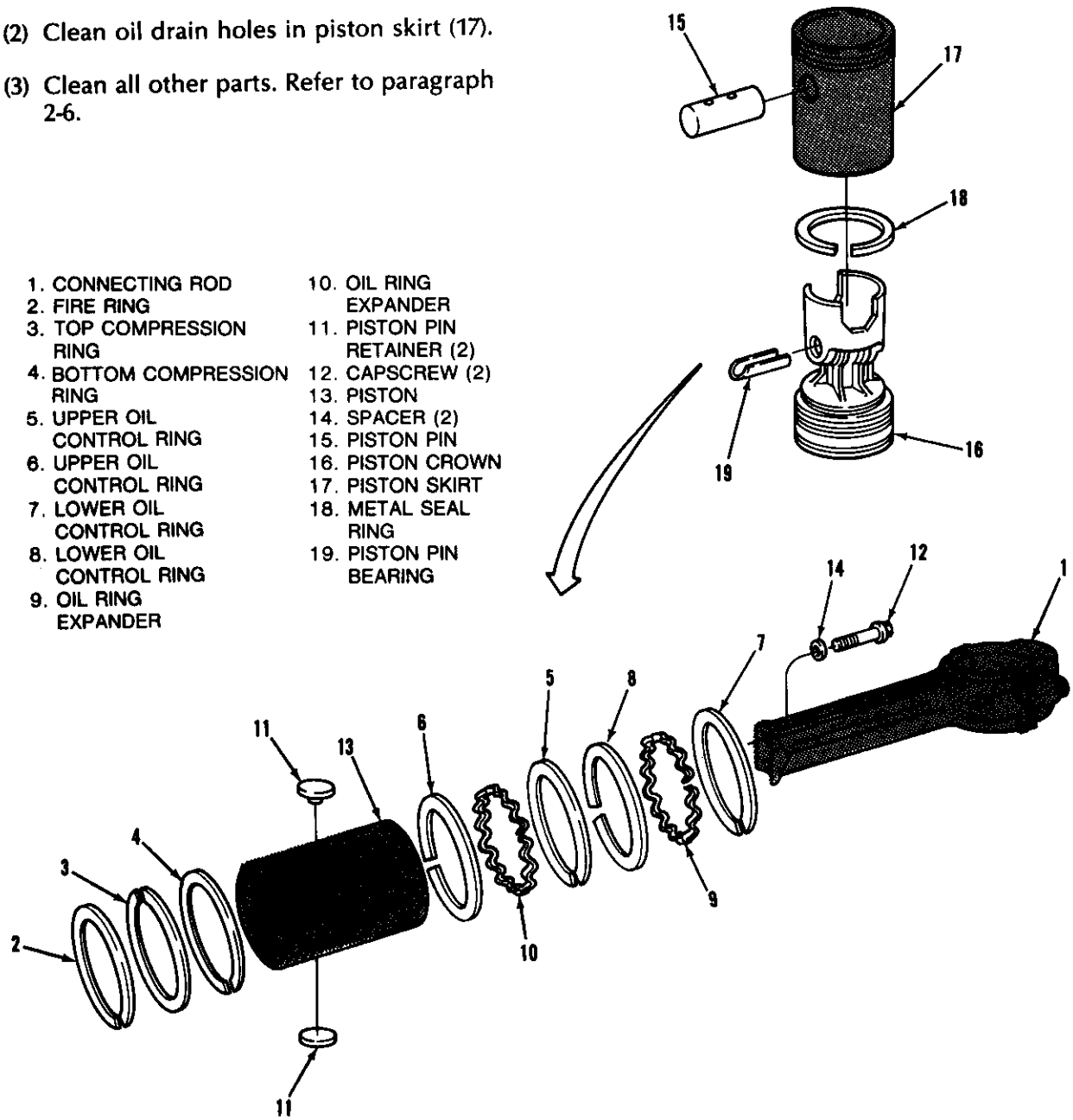
(1) Clean carbon deposits from all ring grooves.

(2) Clean oil drain holes in piston skirt (17).

(3) Clean all other parts. Refer to paragraph 2-6.

c. Inspection

(1) Inspect piston skirt (17) and piston crown (16) for score marks, cracks, or damaged ring grooves.



1. CONNECTING ROD
2. FIRE RING
3. TOP COMPRESSION RING
4. BOTTOM COMPRESSION RING
5. UPPER OIL CONTROL RING
6. UPPER OIL CONTROL RING
7. LOWER OIL CONTROL RING
8. LOWER OIL CONTROL RING
9. OIL RING EXPANDER
10. OIL RING EXPANDER
11. PISTON PIN RETAINER (2)
12. CAPSCREW (2)
13. PISTON
14. SPACER (2)
15. PISTON PIN
16. PISTON CROWN
17. PISTON SKIRT
18. METAL SEAL RING
19. PISTON PIN BEARING

TA 296575

5-8. ENGINE AFTERCOOLER REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Engine oil (item 46, Appendix C)
Dry cleaning solvent (item 66, Appendix C)
Gasket (NSN 5330-00-222-0801) item 7
Capscrew (8) (NSN 5306-01-120-3659) item 8
Seal ring (NSN 5330-01-062-0942) items 10, 11, 12, and 13

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Open engine access door (para 2-1).
TM 2320-20/12 TM 9-2320-297-20	Cooling system drained (para 6-3).
	Engine access panel removed (para 18-14).
TM 2320-34/13 TM 9-2320-297-34	Air inlet removed (para 4-12).
	Blower removed (para 4-6).

a. Removal

(1) Loosen hose clamps (1 and 2) and slide hose (3) off water outlet elbow (4).

(2) Remove two capscrews (5), washers (6), and water outlet elbow (4).

(3) Remove and discard gasket (7).

(4) Remove and discard eight capscrews (8).

CAUTION

Use care while removing aftercooler to avoid damaging cooler fin.

(5) Remove aftercooler (9).

(6) Remove and discard four seal rings (10, 11, 12 and 13).

b. Cleaning/Inspection

WARNING

Steam or vapor pressure cleaning creates hazardous noise levels and severe burn potential. Eye, skin, and ear protection required.

(1) Steam clean outside of aftercooler (9).

(2) Immerse aftercooler (9) in dry cleaning solvent and let soak.

(3) Remove aftercooler (9) from dry cleaning tank and steam clean.

3-24. PISTON AND CONNECTING ROD MAINTENANCE (Continued)

NOTE

Piston crown, bearing, pin, and retainers must be replaced as an assembly.

(2) Inspect fire ring groove (20) on piston crown (16) with piston groove gage (21).

(a) Insert 0.100 inch (2.54 mm) diameter wire of the piston groove gage (21) completely around fire ring groove (20). Wire must be flush or protrude slightly from fire ring groove (20).

(b) Insert the 0.106 inch (2.692 mm) diameter wire of the piston groove gage (21) completely around fire ring groove (20). If wire is below flush at any one point, the groove is too wide and the piston crown (16) must be replaced.

(3) Measure the following diameters of the piston crown (16):

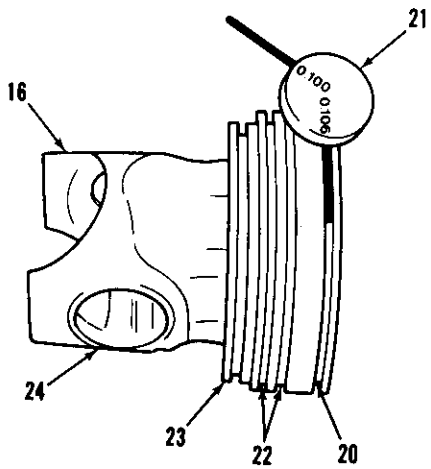
(a) Diameter above fire ring groove (20) must be between a minimum of 4.8104 inches and a maximum of 4.8134 inches (12.218-12.226 cm).

(b) Both compression ring diameters (22) must be between a minimum of 4.8273 inches and a maximum of 4.8303 inches (12.261-12.268 cm).

(c) Above and below sealring groove (23), diameter must be between a minimum of 4.4650 inches and a maximum of 4.4750 inches (11.341-11.366 cm).

(d) Above and below bearing bore (24) the diameter must be between a minimum of 3.2360 inches and a maximum of 3.2370 inches (8.219-8.221 cm).

16. PISTON CROWN
20. FIRE RING GROOVE
21. PISTON GROOVE GAGE
22. COMPRESSION RING DIAMETER
23. SEALRING GROOVE
24. BEARING BORE



TA 298576

(2) Install fan hub (7) onto fan motor shaft (10) with long side of fan hub (7) facing fan motor (8).

(3) Install fan (6) onto fan hub (7) using six capscrews (4) and new lockwashers (5). Torque capscrews (4) to 95 foot-pounds (128.14 N·m).

(4) Install washer (3) and nut (2). Tighten nut (2) securely.

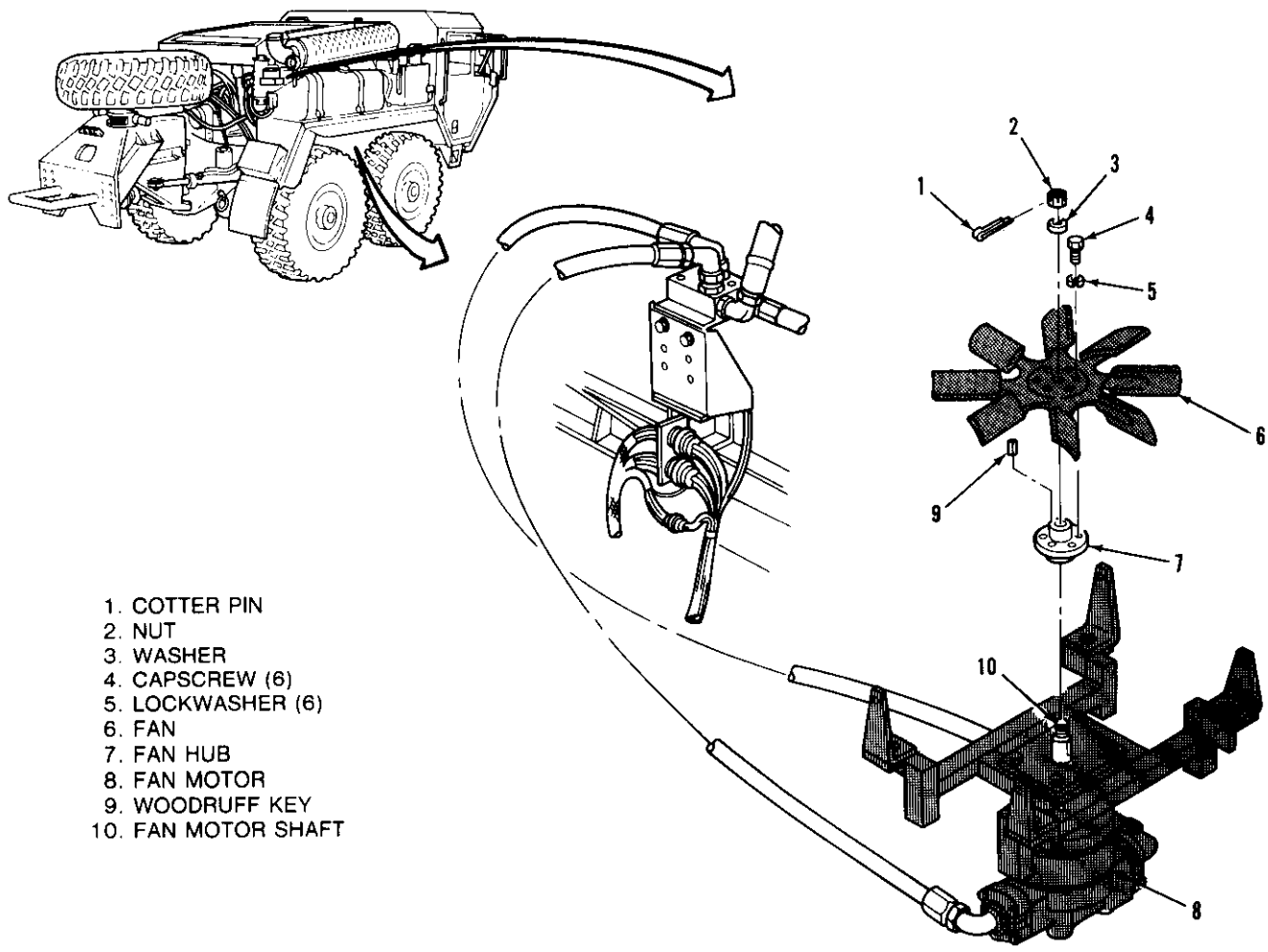
(5) Install new cotter pin (1).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install radiator (para 5-3).
TM 2320-20/12 TM 9-2320-297-20	Install transmission cooler (para 8-13).
	Install hydraulic oil cooler (para 22-10).
	Fill radiator (para 6-3).
TM 2320-10/11 TM 9-2320-297-10	Start engine. Check for leaks (para 2-13).



1. COTTER PIN
2. NUT
3. WASHER
4. CAPSCREW (6)
5. LOCKWASHER (6)
6. FAN
7. FAN HUB
8. FAN MOTOR
9. WOODRUFF KEY
10. FAN MOTOR SHAFT

TA 298715

(4) Use feeler gage (25) and measure ring-to-groove clearance in piston crown (16) and piston skirt (17).

(a) Fire ring groove (20) clearance must be between a minimum of 0.0010 inch and a maximum of 0.0070 inch (0.0254-0.1778 mm).

(b) Top compression groove (26) clearance must be between a minimum of 0.0100 inch and a maximum of 0.0220 inch.

(c) Bottom compression groove (27) clearance must be between a minimum of 0.0040 inch and a maximum of 0.0130 inch (0.1016-0.3302 mm).

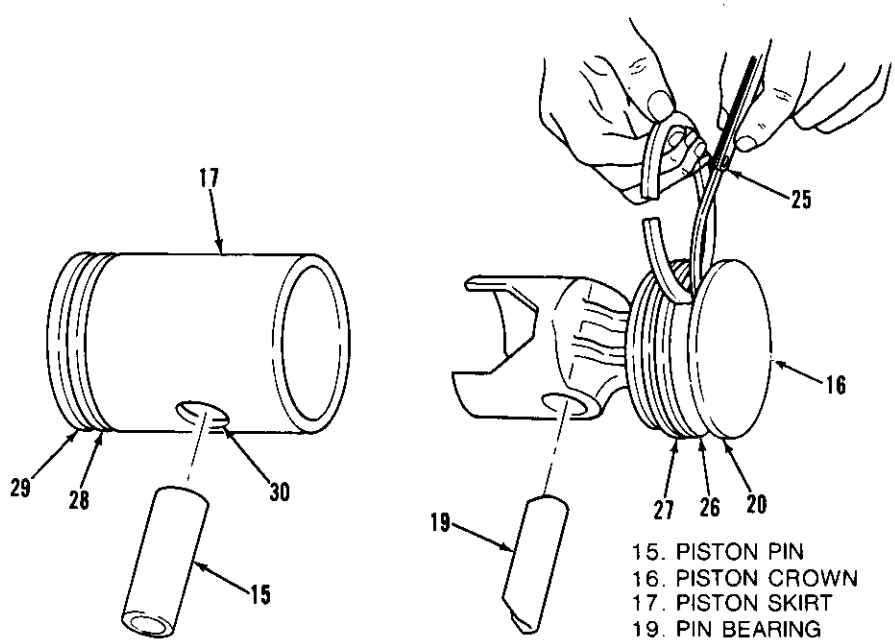
(d) Oil control grooves (28 and 29) clearance must be between a minimum of 0.0015 inch and a maximum of 0.0080 inch (0.0381-0.2032 mm).

(5) Measure diameter of piston skirt (17).Diameter must be a minimum of 4.8318 inches and a maximum of 4.8340 inches (12.2727-12.2783 cm).

(6) Using a T-gage and micrometer, measure piston pin bore (30) in piston skirt (17). Diameter must be between a minimum of 1.5025 inches and a maximum of 1.5040 inches (3.8163-3.8201 cm).

(7) Measure piston pin (15) diameter. Diameter must be between a minimum of 1.4980 inches and a maximum of 1.5000 inches (3.8049-3.810 cm).

(8) Inspect pin bearing (19) for scoring or wear. Bearing thickness must be between a minimum of 0.0860 inch and a maximum of 0.0880 inch (2.184-2.235 mm).



15. PISTON PIN
16. PISTON CROWN
17. PISTON SKIRT
19. PIN BEARING
20. FIRE RING GROOVE
25. FEELER GAGE
26. TOP COMPRESSION GROOVE
27. BOTTOM COMPRESSION GROOVE
28. OIL CONTROL GROOVE (UPPER)
29. OIL CONTROL GROOVE (LOWER)
30. PISTON PIN BORE

TA 298577

5-7. FAN ASSEMBLY REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Cotter pin (MS24665-360) item 1
Lockwasher (6) (MS35338-29) item 5

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Radiator drained (para 6-3).
	Hydraulic oil cooler removed (para 22-10).
	Transmission cooler removed (para 8-13).
TM 2320-34/13 TM 9-2320-297-34	Radiator removed (para 5-3).

---

a. Removal

(1) Remove cotter pin (1) from nut (2). Discard cotter pin (1).

(2) Remove nut (2) and washer (3).

(3) Remove six capscrews (4) and lockwashers (5). Discard lockwashers (5).

(4) Remove fan (6) from fan hub (7).

(5) Remove fan hub (7) from fan motor (8). Remove woodruff key (9).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

(1) Install woodruff key (9) into fan motor shaft (10).

3-24. PISTON AND CONNECTING ROD MAINTENANCE (Continued)

NOTE

Be sure to match piston to proper cylinder liner (31). Pistons being reinstalled were marked during removal. Match markings. Refer to paragraph 3-17.

(9) With cylinder liner (31) installed in engine block (32), hold piston skirt (17) upside down in cylinder liner (31). Attach spring scale to feeler gage set and check clearance in four places 90 degrees apart.

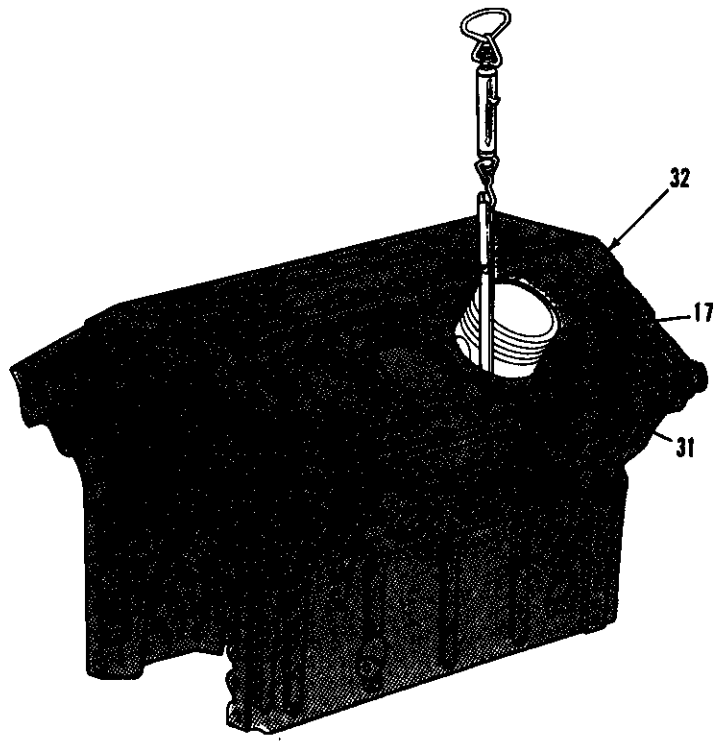
NOTE

Feeler gage must be down inside cylinder liner (31) approximately three inches (7.62 cm).

(a) Select feeler gage thickness requiring a pull of 6 pounds (2.7 kg). Clearance will be 0.001 inch (0.25 mm) greater than feeler gage thickness when it is withdrawn with pull of 6 pounds (2.7 kg).

(b) Clearance must be between a minimum of 0.0051 inch and a maximum of 0.0120 inch (0.1295-0.3048 mm).

17. PISTON SKIRT
31. CYLINDER LINER
32. ENGINE BLOCK



TA 298578

CAUTION

Use care when installing impeller to avoid damage to gear teeth.

(13) Install washer (7) and new locknut (6). Hold gear (1) in a soft-jawed vise while tightening locknut (6). Torque locknut (6) to 35-40 foot-pounds (47-54 N·m).

(14) Check slip torque between impeller (8), shaft (9), and gear (1) as follows:

(a) Scribe a line across gear (1) and shaft (9).

(b) Scribe a line across impeller (8), locknut (6), and shaft (9).

(c) Attach adapter to a torque wrench.

(d) With gear (1) secured, place adapter into impeller (8) puller-holes. Apply a torque of 80 foot-pounds (108 N·m). Check scribed marks to see if gear (1) or impeller (8) has turned. If marks don't line up, replace shaft (9) and gear (1), or shaft (9) and impeller (8) depending on which scribe mark is out of alinement.

(e) After replacement, test slip again.

(15) Insert a feeler gage through water outlet opening (16) and check clearance between impeller (8) and pump body (3). Clearance must be a minimum of 0.015 inch (0.381 mm). If clearance is less than this, disassemble water pump and check position of bearings (10 and 11).

(16) Install new O-ring (13), cover (5), and snapring (4).

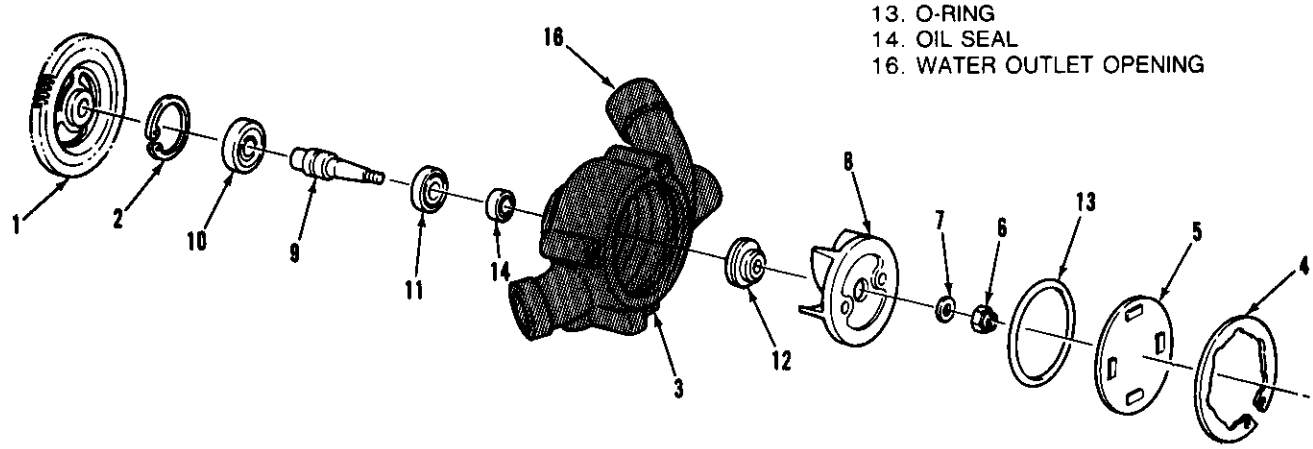
END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install water pump (para 5-5).
TM 2320-20/12 TM 9-2320-297-20	Fill coolant and check for leaks (para 6-3).

1. GEAR
2. SNAPRING
3. PUMP BODY
4. SNAPRING
5. PUMP COVER
6. LOCKNUT
7. WASHER
8. IMPELLER
9. SHAFT
10. LARGE BEARING
11. SMALL BEARING
12. WATER SEAL
13. O-RING
14. OIL SEAL
16. WATER OUTLET OPENING



TA 298714

NOTE

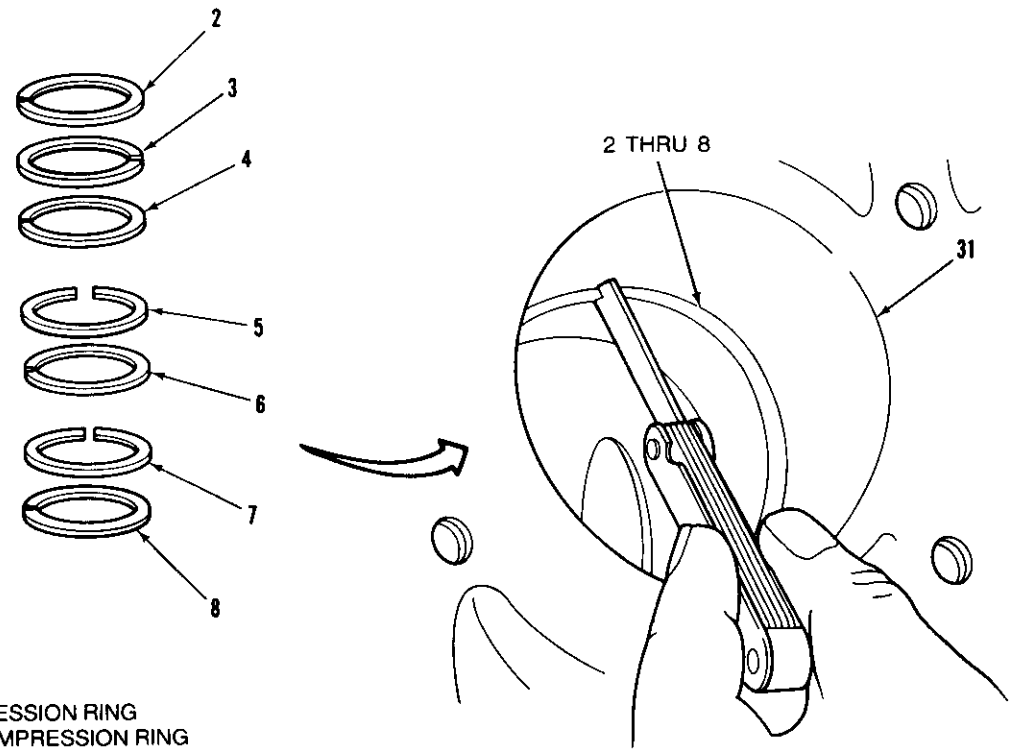
The fire ring (2) has two identification marks, top compression ring (3) has one identification mark, and bottom compression ring (4) has no marks. Upper oil control rings (5 and 6) have an orange stripe and lower oil control rings (7 and 8) are black rings.

(10) Insert and measure piston rings (2 thru 8), one at a time inside cylinder liner (31) far enough to be in area of ring travel 2 to 3 inches (5.0-7.6 cm) deep. Use piston skirt (17) to position ring parallel with top of cylinder liner (31).

(a) Top and bottom compression rings (3 and 4) and fire ring (2) must be between a minimum gap of 0.0250 inch and a maximum gap of 0.0600 inch (0.635-1.524 mm).

(b) Upper oil control rings (5 and 6) must have a gap between a minimum of 0.0070 inch and a maximum of 0.0350 inch (0.177-0.889 mm).

(c) Lower oil control rings (7 and 8) must have a gap between a minimum of 0.0100 inch and a maximum of 0.0430 inch (0.254-1.092 mm).



2. FIRE RING
3. TOP COMPRESSION RING
4. BOTTOM COMPRESSION RING
5. UPPER OIL CONTROL RING
6. UPPER OIL CONTROL RING
7. LOWER OIL CONTROL RING
8. LOWER OIL CONTROL RING
31. CYLINDER LINER

TA 298579

5-6. WATER PUMP REPAIR (Continued)

c. Assembly

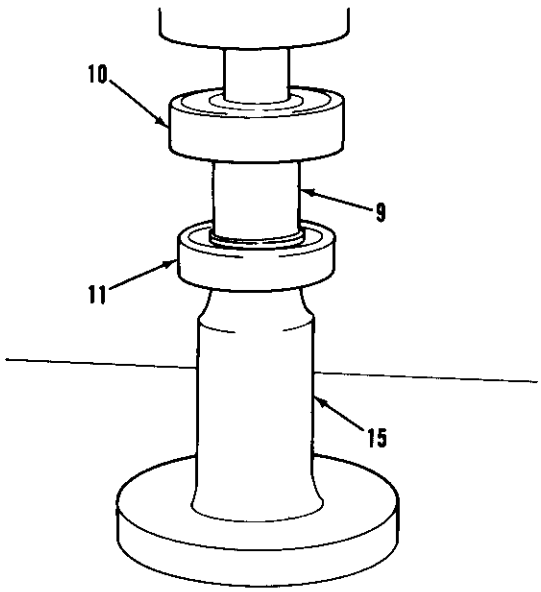
(1) Lubricate bearings (10 and 11) and shaft (9) with clean engine oil.

CAUTION

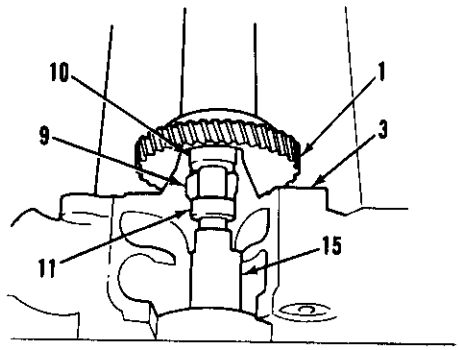
Use care to prevent damage to threads on shaft (9) while pressing shaft (9) into large bearing (10).

(2) Place large bearing (10) on installation tool (15). With threaded end of shaft (9) up, press shaft (9) into large bearing (10) bore until seated.

(3) Place threaded end of shaft (9) through bore of small bearing (11) and into water pump drive gear installer (15). Press shaft until small bearing (11) seats.



9. SHAFT
10. LARGE BEARING
11. SMALL BEARING
15. WATER PUMP DRIVE GEAR INSTALLER



1. GEAR
3. PUMP BODY
9. SHAFT
10. LARGE BEARING
11. SMALL BEARING
15. WATER PUMP DRIVE GEAR INSTALLER

TA 298713

(4) Place pump body (3), with pump cover (5) side down, on press. Install threaded end of shaft (9) into pump body (3). Press bearings (10 and 11) and shaft (9) assembly into place.

(5) Install snapring (2).

(6) Place water pump drive gear installer (15) under threaded end of shaft (9). Place gear (1) on shaft (9) and press on gear (1) until flush with shaft (9). Remove water pump drive gear installer (15) and pump body assembly (3).

(7) Apply a film of clean engine oil to sealing lip of new oil seal (14) and contact area of shaft (9).

(8) With lip of new oil seal (14) facing small bearing (11), install new oil seal (14). New oil seal (14) must be flush with counter bore in pump body (3).

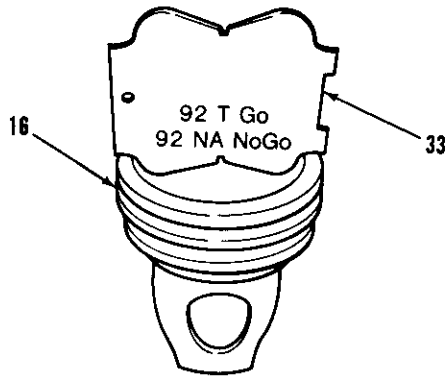
(9) Apply a light coat of silicone sealant to outside diameter of new water seal (12).

(10) Place pump body (3) on press and press in new water seal (12).

(11) Place impeller (8) on shaft (9).

(12) Apply international compound to shaft (9) threads.

3-24. PISTON AND CONNECTING ROD MAINTENANCE (Continued)



16. PISTON CROWN
33. CROWN I.D. GAGE

(11) Using edge of piston crown I.D. gage (33) marked "92T Go, 92 NA No Go," check piston crown (16) by setting piston crown I.D. gage (33) into top of piston crown (16). Gage rim must rest fully down on rim of piston crown (16) at all points while gage is fully rotated.

(12) Remove two nuts (34), bearing cap (35), and bearing halves (36 and 37).

(13) Remove two connecting rod bolts (38) from connecting rod (1) only if damaged.

(14) Inspect bearing halves (36 and 37) for scoring, pitting, flaking, etching, or signs of overheating. The upper bearing half (36) will normally show signs of wear before the lower half.

(15) Inspect the backs of the bearing halves (36 and 37) for shiny spots which indicate bearings have been shifting in cap and rod. If spots are present, replace bearing halves (36 and 37).

NOTE

Bearing shell thickness will be total thickness of steel ball in tool and bearing shell, less the diameter of the ball.

(16) Measure thickness of bearing halves (36 and 37) using a micrometer and ball attachment (39). Measure at point A on both bearing halves (36 and 37) at outside edges. Compare measurements with the table of limits.

(17) Replace all parts failing inspection.

TABLE OF LIMITS

Bearing Size	Bearing Thickness	
	Min/Max	Limit
Standard	0.1240" / 0.1245" 3.149 / 3.162 mm	0.1230" 3.124 mm
.002" Undersize	0.1250" / 0.1255" 3.175 / 3.187 mm	0.1240" 3.149 mm
.010" Undersize	0.1290" / 0.1295" 3.276 / 3.289 mm	0.1280" 3.251 mm
.020" Undersize	0.1340" / 0.1345" 3.403 / 3.416 mm	0.1330" 3.378 mm
.030" Undersize	0.1390" / 0.1395" 3.530 / 3.543 mm	0.1380" 3.505 mm

TA 298580

(4) Remove locknut (6) and washer (7). Using a puller, remove impeller (8). Discard locknut (6).

CAUTION

Use care to prevent damage to threads on shaft (9) while pressing shaft (9) from pump body (3).

(5) Using a press, press out shaft (9), bearings (10 and 11), and gear (1) as an assembly from pump body (3).

(6) Press shaft (9) out of gear (1).

(7) With threaded end down, press shaft (9) out of large bearing (10).

(8) With threaded end up, press shaft (9) out of small bearing (11).

(9) Lay pump body (3) flat on a bench. Drive out water seal (12). Discard water seal (12).

(10) Remove and discard O-ring (13).

(11) Push oil seal (14) out of pump body (3). Discard oil seal (14).

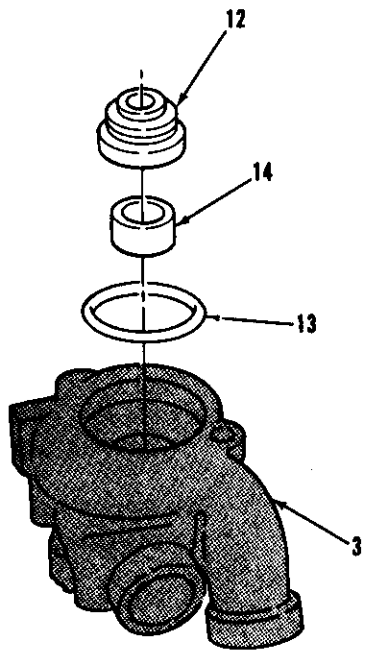
b. Cleaning/Inspection

(1) Clean all drilled passages in pump body (3).

(2) Clean all parts. Refer to paragraph 2-6.

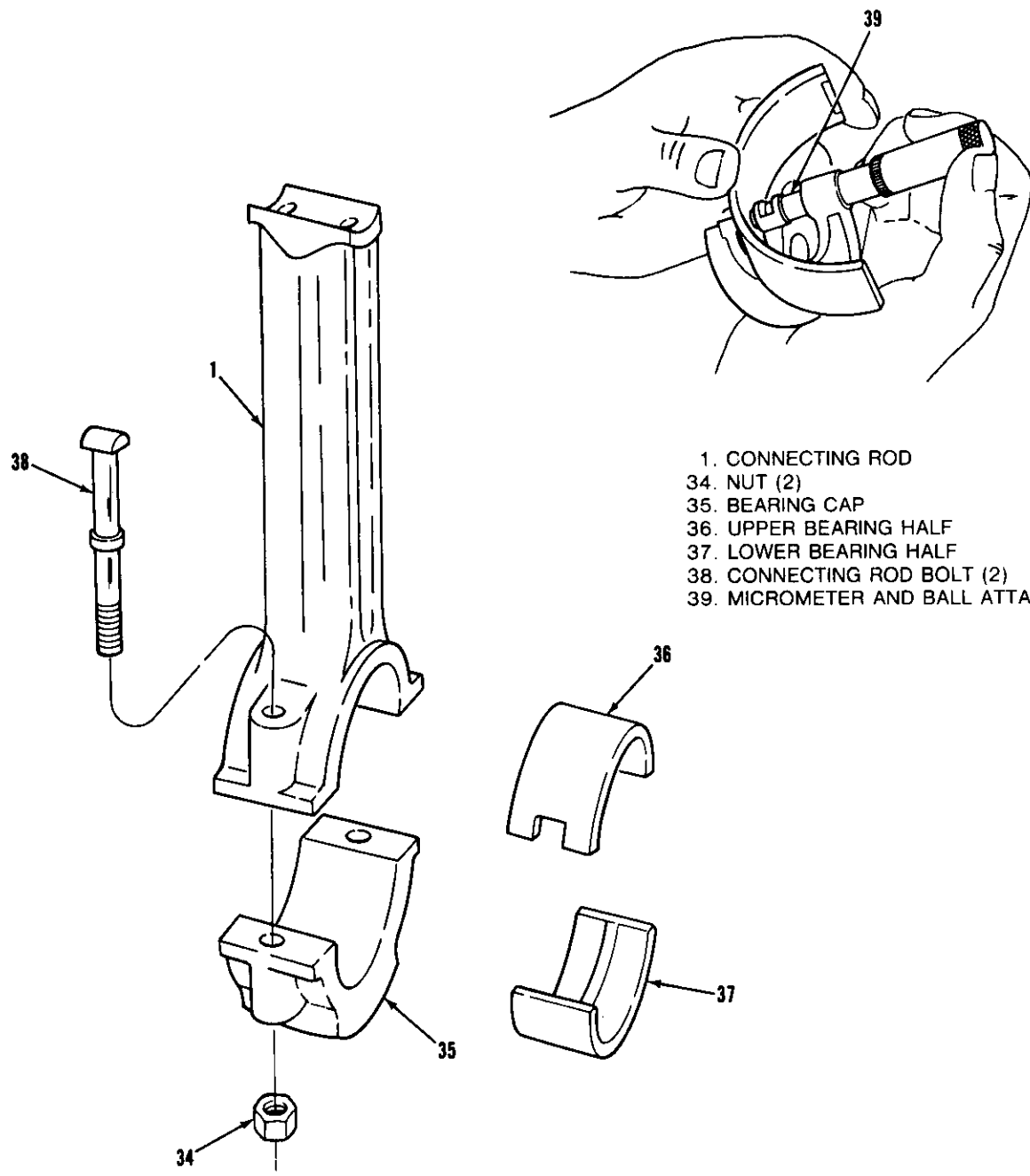
(3) Inspect all parts. Refer to paragraph 2-7.

(4) Replace all parts failing inspection.



3. PUMP BODY
12. WATER SEAL
13. O-RING
14. OIL SEAL

TA 208712



1. CONNECTING ROD
34. NUT (2)
35. BEARING CAP
36. UPPER BEARING HALF
37. LOWER BEARING HALF
38. CONNECTING ROD BOLT (2)
39. MICROMETER AND BALL ATTACHMENT

TA 298581

5-6. WATER PUMP REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Water pump drive gear installer (J 25257)

Materials/Parts

Adhesive, silicone sealant (item 7, Appendix C)
International Compound No. 2 (item 16, Appendix C)
Engine oil (item 46, Appendix C)
Locknut (NSN 5310-00-043-0427) item 6
Repair kit (NSN 2930-01-143-1352)

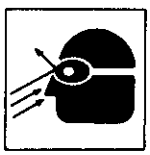
Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Coolant drained (para 6-3).
TM 2320-34/13 TM 9-2320-297-34	Water pump removed (para 5-5).

a. Disassembly

(1) Turn gear (1) until snapring (2) is visible through slots.

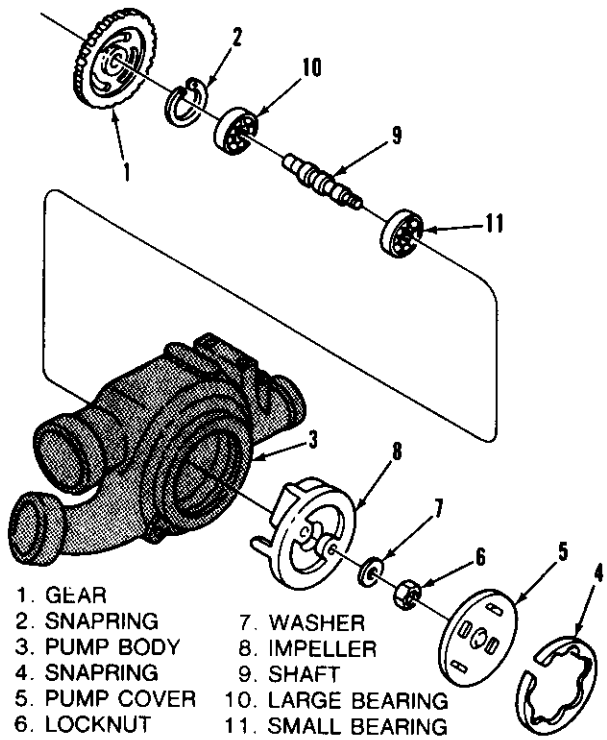
(2) Remove snapring (2).

WARNING



Snapring is under tension. Use proper size snapring pliers and wear eye protection.

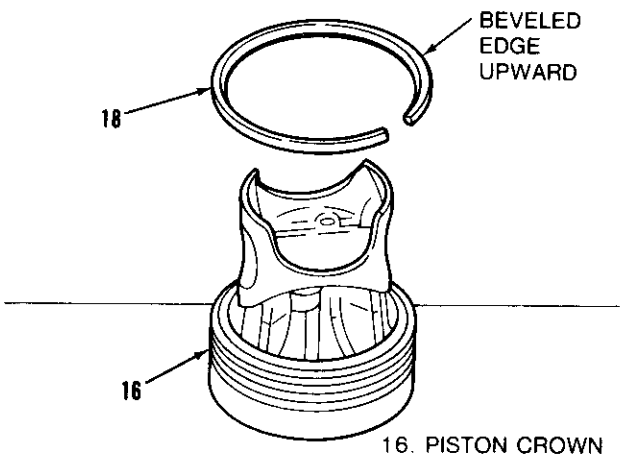
(3) Turn pump body (3) so gear (1) is down. Remove snapring (4) and pump cover (5).



1. GEAR
2. SNAPRING
3. PUMP BODY
4. SNAPRING
5. PUMP COVER
6. LOCKNUT
7. WASHER
8. IMPELLER
9. SHAFT
10. LARGE BEARING
11. SMALL BEARING

TA 298711

3-24. PISTON AND CONNECTING ROD MAINTENANCE (Continued)



16. PISTON CROWN
18. METAL SEALRING

(5) Rotate metal sealring (18) fully around piston crown (16) and be sure it turns freely with no sticking or binding.

(6) Compress metal sealring (18) and push piston skirt (17) down into position on piston crown (16).

(7) Hold piston crown (16) and turn piston skirt (17). Piston skirt (17) must turn freely with no binding.

d. Assembly

NOTE

Be sure to aline all marks.

(1) Place piston crown (16), top end down, on work bench.

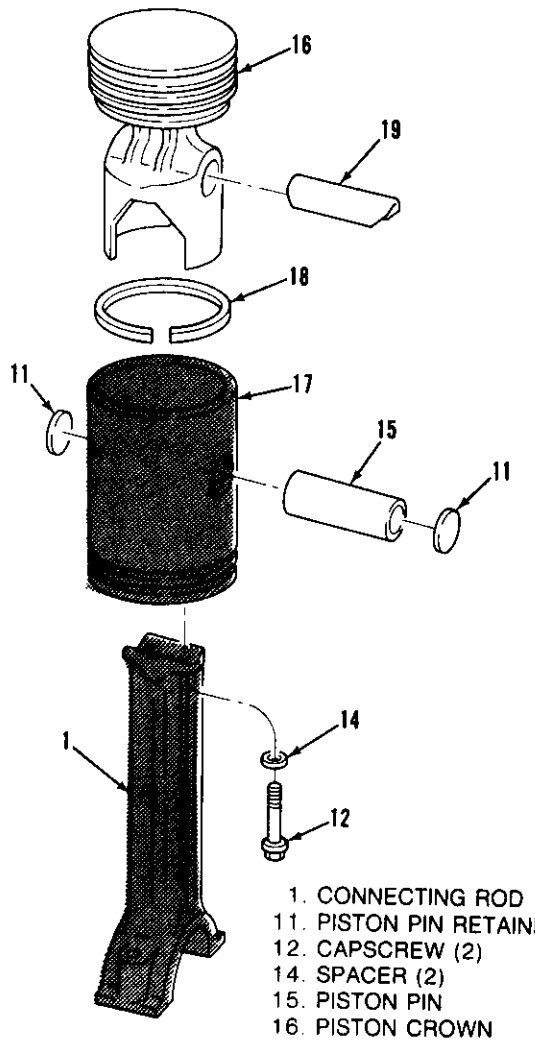
(2) Install piston pin bearing (19).

(3) Coat metal sealring (18) with lubricating oil.

CAUTION

If piston crown (16) is upside down on the workbench during installation of metal sealring (18), the beveled edge of sealring (18) will be upward. The word downward in step (4), below, refers to the installed position. Care must be taken to assure proper installation of metal sealring (18).

(4) Install metal sealring (18) on piston crown (16). Beveled side must face toward bottom of piston crown (16).



1. CONNECTING ROD
11. PISTON PIN RETAINER (2)
12. CAPSCREW (2)
14. SPACER (2)
15. PISTON PIN
16. PISTON CROWN
17. PISTON SKIRT
18. METAL SEALRING
19. PISTON PIN BEARING

TA 296582

(3) Place new seal ring (17) on pump (3).

(4) Install pump (3), alining gear teeth with drive gear.

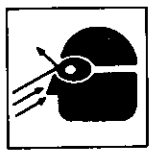
(5) Install two capscrews (11) and new lockwashers (12). Tighten two capscrews (11) securely.

(6) Install capscrew (13), new lockwasher (14), and washer (15). Tighten capscrew (13) securely.

(7) Install hoses (2, 5, 7, and 9) and hose clamps (1, 4, 6, and 8). Tighten hose clamps securely.

d. Gear Backlash Adjustment

WARNING



Snapring is under tension. Use proper size snapring pliers and wear eye protection.

(1) Remove snapring (18) and pump cover (19).

(2) Check gear backlash. Backlash setting should be between 0.001 and 0.006 inch (0.025-0.152 mm). If setting is not correct, loosen capscrews (11 and 13). Pivot pump (3) until proper backlash is obtained Tighten capscrews (11 and 13).

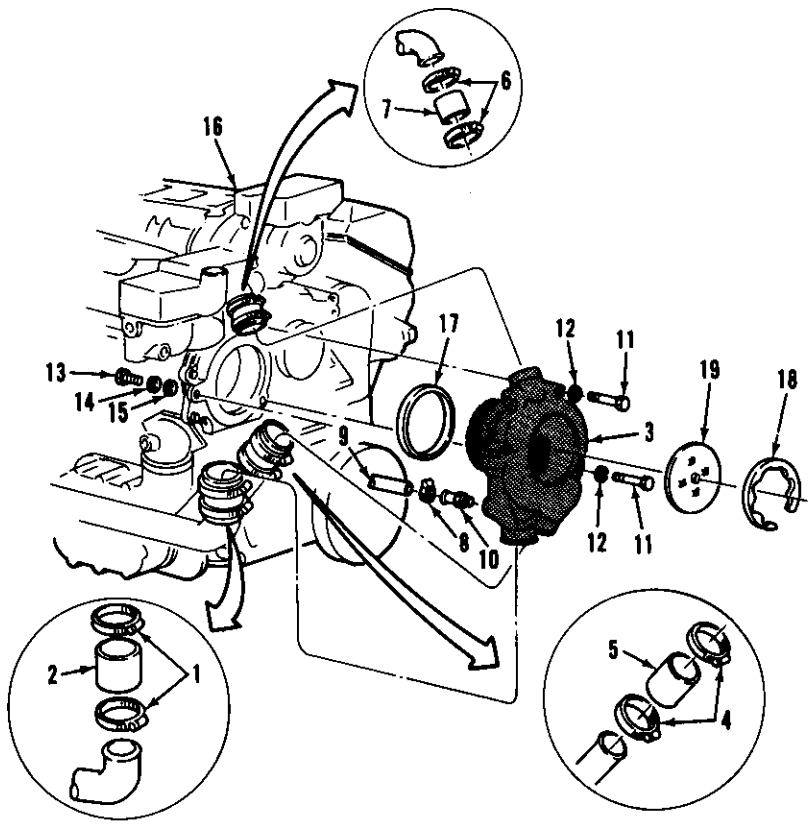
(3) Install pump cover (19) and snapring (18).

END OF TASK

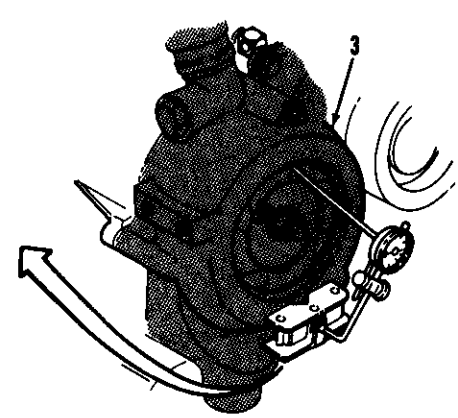
NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Fill cooling system (para 6-3).
	Install engine access panel (para 18-14).
TM 2320-10/11 TM 9-2320-297-10	Start engine and check for leaks (para 2-13).



1. CLAMP (2)
2. HOSE
3. PUMP
4. CLAMP (2)
5. HOSE
6. CLAMP (2)
7. HOSE
8. CLAMP
9. HOSE
10. FITTING
11. CAPSCREW (2)
12. LOCKWASHER (2)
13. CAPSCREW
14. LOCKWASHER
15. WASHER
16. ENGINE
17. SEAL RING
18. SNAPRING
19. PUMP COVER



TA 298710

(8) Coat piston pin (15) with lubricating oil.

(9) Line up hole in piston skirt (17) with hole in piston crown (16).

(10) Install piston pin (15) with threaded holes toward bottom of piston skirt (17).

(11) Install two spacers (14) on two capscrews (12) and apply international compound No. 2 to threads of capscrews (12).

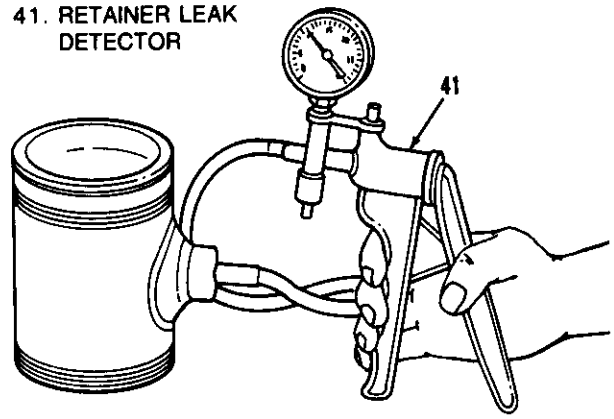
(12) Insert connecting rod (1) into piston skirt (17) and install two capscrews (12). Hand tighten capscrews (12).

(13) Clamp connecting rod (1) in soft-jawed vise and torque two capscrews (12) to 55-60 foot-pounds (75 to 81 N·m).

(14) Remove connecting rod (1) from vise.

(15) Install new piston pin retainers (11) into piston skirt (17) using pin retainer installer (40).

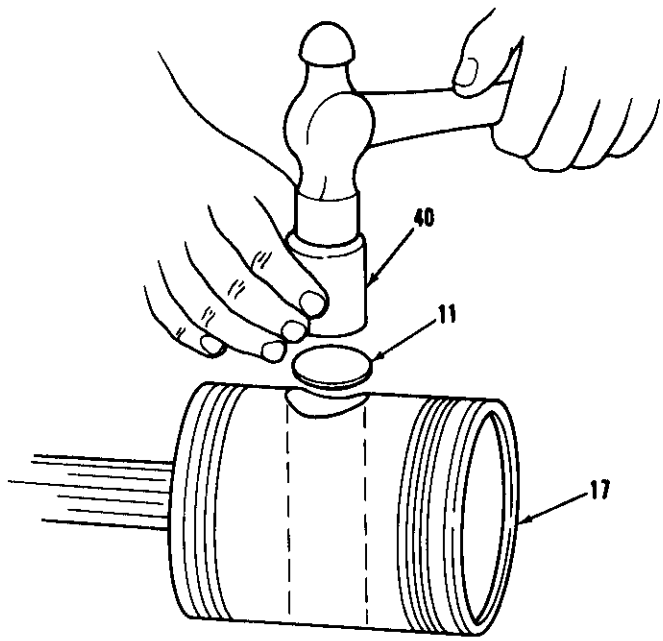
41. RETAINER LEAK DETECTOR



CAUTION

The piston pin retainer (11) prevents oil from reaching the cylinder walls. It is important that they are sealed properly to prevent leakage.

(16) Check each piston pin retainer (11) for proper sealing with a retainer leak detector (41). A vacuum reading of 10 inches on the gage is correct. A drop in the gage reading indicates leakage at the retainer. If retainer leaks, a new piston pin retainer (11) must be installed.



11. PISTON PIN RETAINER (2)
17. PISTON SKIRT
40. PIN RETAINER INSTALLER

TA 298583

5-5. WATER PUMP REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation
d. Gear Backlash Adjustment

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Pipe sealant (item 60, Appendix C)
Lockwasher (3) (MS35338-47) items 12 and 14
Seal ring (NSN 5330-01-088-6596) item 17

Special Tools

Dial indicator (J 7872)

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Cooling system drained. (para 6-3).
	Engine access panel removed (para 18-14).

General Safety Instructions

Use extreme care to avoid being burned when working on any part of the cooling system. Wear gloves to protect hands if you must work on a hot system.

---

a. Removal

(1) Loosen two hose clamps (1) and push hose (2) down, away from pump (3).

(2) Loosen two hose clamps (4) and push hose (5) down, away from pump (3).

(3) Loosen two hose clamps (6) and push hose (7) up, away from pump (3).

(4) Loosen clamp (8) and pull hose (9) away from hose fitting (10).

(5) Remove two capscrews (11) and lockwashers (12) from front of pump (3). Discard lockwashers (12).

CAUTION

Use care not to damage gear teeth during pump removal.

(6) Remove capscrew (13), lockwasher (14), washer (15), and pump (3) from engine (16). Discard lockwasher (14).

(7) Remove and discard seal ring (17).

(8) Remove hose fitting (10).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

(1) Clean all mating surfaces.

(2) Apply pipe sealant to threads of fitting (10) and install.

3-24. PISTON AND CONNECTING ROD MAINTENANCE (Continued)

CAUTION

To avoid breaking piston rings, do not spread rings any more than necessary to slip them over piston.

(17) Install bottom compression ring (4) in bottom compression groove (27), using ring expander tool.

NOTE

- Identification dots on rings face towards top of piston dome.
- The fire ring (2) has two identification marks. The top compression ring (3) has one identification mark, and the bottom compression ring (4) has no marks. Each of the upper oil control rings (5 and 6) have an orange stripe, and the bottom oil control rings (7 and 8) are colored black.

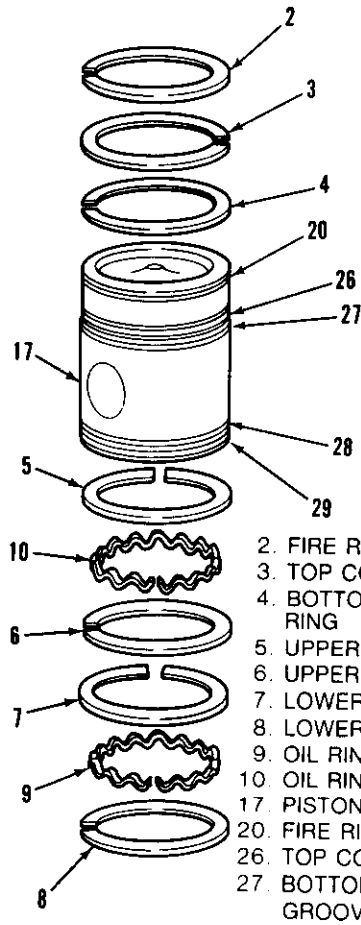
(18) Install top compression ring (3) in top compression groove (26).

(19) Install fire ring (2) in fire ring groove (20).

(20) Stagger gaps of rings (2 and 4) so they are 180 degrees from gap of top compression ring (3).

(21) Turn piston over and install oil ring expander (9) in upper oil control groove (28) so that end tips face towards top of piston.

(22) Install oil ring expander (10) in lower oil control groove (29) so that end tips face towards top of piston.



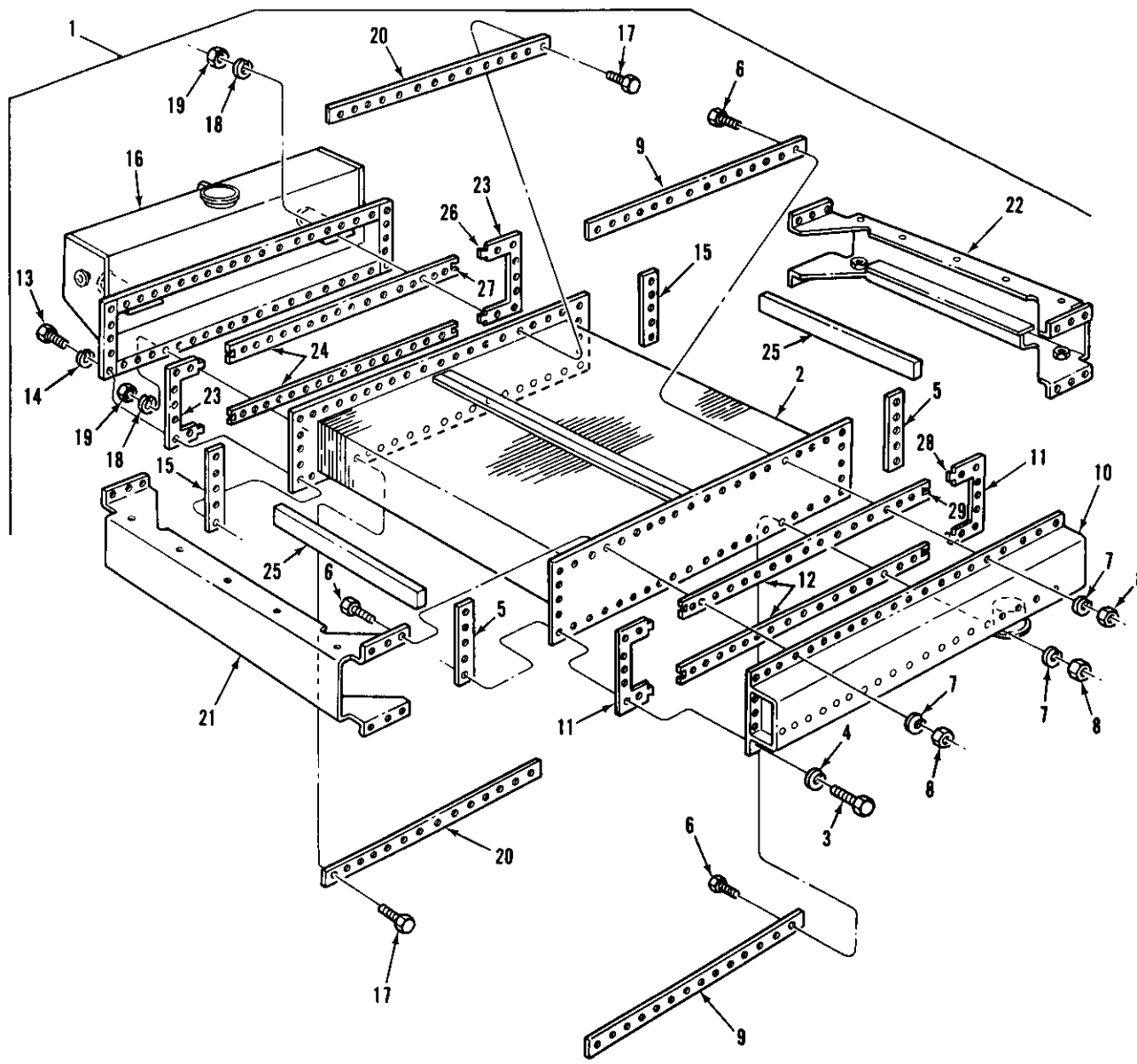
2. FIRE RING
3. TOP COMPRESSION RING
4. BOTTOM COMPRESSION RING
5. UPPER OIL CONTROL RING
6. UPPER OIL CONTROL RING
7. LOWER OIL CONTROL RING
8. LOWER OIL CONTROL RING
9. OIL RING EXPANDER
10. OIL RING EXPANDER
17. PISTON SKIRT
20. FIRE RING GROOVE
26. TOP COMPRESSION GROOVE
27. BOTTOM COMPRESSION GROOVE
28. OIL CONTROL GROOVE (UPPER)
29. OIL CONTROL GROOVE (LOWER)

TA 298584

(23) Stagger gaps of oil ring expanders (9 and 10) so they are 90 degrees from gap of bottom compression ring (4).

CAUTION

When installing oil control rings, use care to prevent overlapping of ring expander ends. An overlapped ring expander will cause the oil ring to protrude and break during piston installation.



1. RADIATOR
2. CORE
3. CAPSCREW (10)
4. LOCKWASHER (10)
5. END BAR (2)
6. CAPSCREW (50)
7. LOCKWASHER (50)
8. NUT (50)
9. END BAR (2)
10. OUTLET TANK
11. GASKET (2)
12. GASKET (2)
13. CAPSCREW (10)
14. LOCKWASHER (10)
15. END BAR (2)
16. INLET TANK
17. CAPSCREW (50)
18. LOCKWASHER (50)
19. NUT (50)
20. END BAR (2)
21. LEFT SIDE
22. RIGHT SIDE
23. GASKET (2)
24. GASKET (2)
25. NEOPRENE SPONGE (2)
26. TAB
27. SLOT
28. TAB
29. SLOT

TA 298709

NOTE

- Oil ring scraper edges must face towards bottom of piston.
- Upper oil control ring (5) has an orange stripe and a chrome outside diameter. Upper oil control ring (6) has an orange stripe and a flat black outside diameter.

(24) Install upper oil control rings (5 and 6) by hand in oil control groove (28).

(25) Install lower oil control rings (7 and 8) by hand in lower oil control groove (29).

(26) Stagger gap of upper oil control ring (5) 180 degrees from gap of oil ring expander (9).

(27) Stagger gap of upper oil control ring (6) 90 degrees from gap of upper oil control ring (5).

(28) Stagger gap of lower oil control ring (7) 180 degrees from gap of oil ring expander (10).

(29) Stagger gap of lower oil control ring (8) 90 degrees from gap of lower oil control ring (7).

(30) Install two connecting rod bolts (38) into connecting rod (1) if removed.

NOTE

Lower bearing half (37) has an oil groove.

(31) Install lower bearing half (37) into bearing cap (35).

(32) Install upper bearing half (36) into connecting rod (1).

(33) Install bearing cap (35) on connecting rod (1) so that notches on bearing halves (36 and 37) are on same side.

(34) Install two nuts (34). Hand tighten nuts.

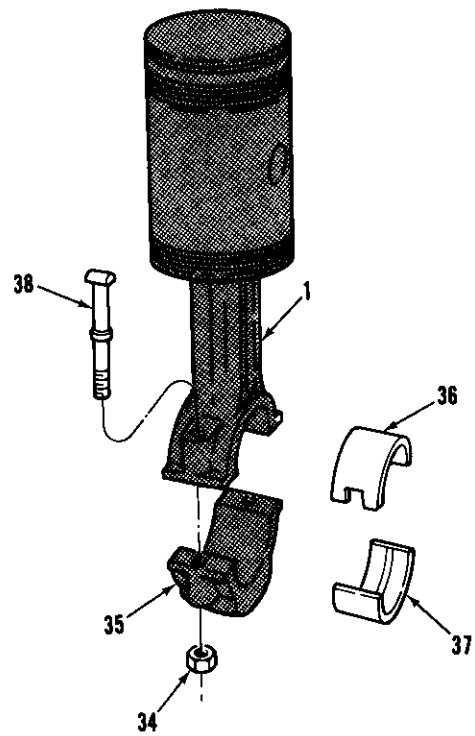
(35) Repeat all steps in this paragraph for each piston assembly.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13
TM 9-2320-297-34 Install piston assemblies (para 3-20).



1. CONNECTING ROD
34. NUT (2)
35. BEARING CAP
36. UPPER BEARING HALF
37. LOWER BEARING HALF
38. CONNECTING ROD BOLT (2)

TA 298585

5-4. RADIATOR REPAIR (Continued)

c. Assembly

(1) Install two neoprene sponges (25) into left and right sides (21 and 22).

(2) Position left and right sides (21 and 22) on core (2).

(3) Position four new gaskets (23 and 24) on core (2) so that tab (26) on gasket (23) fits into slot (27) on gasket (24).

(4) Install inlet tank (16) on core (2) using 50 capscrews (17), new lockwashers (18), two end bars (20) and 50 nuts (19).

(5) Torque nuts (19) to 22 foot-pounds (29.27 N·m).

(6) Install 10 capscrews (13), 10 new lockwashers (14) and two end bars (15). Torque capscrews (13) to 22 foot-pounds (29.27 N·m).

(7) Position four new gaskets (11 and 12) on core (2) so that tab (28) on gasket (11) fits into slot (29) on gasket (12).

(8) Install outlet tank (10) on core (2) using 50 capscrews (6), new lockwashers (7), two end bars (9), and 50 nuts (8).

(9) Torque nuts (8) to 22 foot-pounds (29.27 N·m).

(10) Install 10 capscrews (3), 10 new lockwashers (4), and two end bars (5). Torque capscrews (3) to 22 foot-pounds (29.27 N·m).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13
TM 9-2320-297-34 Install radiator (para 5-3).

3-25. CAMSHAFT MAINTENANCE

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. End Bearing Bushing Replacement
d. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Camshaft gear puller (J 1902-01)
Slide hammer (J 24171)
Micrometer set 0-6 inch inside (NSN 5210-00-473-9350)
Micrometer set 0-6 inch outside (NSN 5210-00-554-7134)

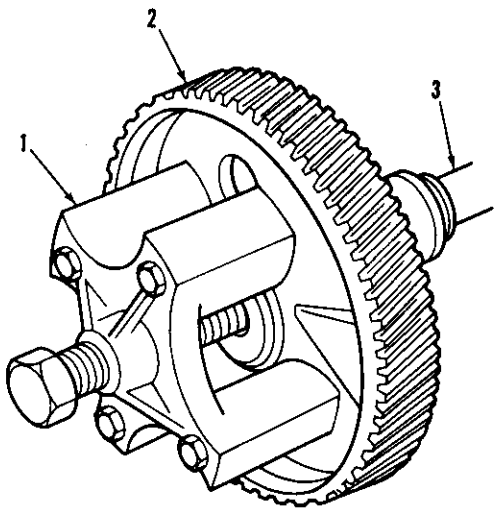
Materials/Parts

Engine oil (item 46, Appendix C)
Oil seal (NSN 5330-01-083-3980) item 10

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Camshaft removed (para 3-19).

a. Disassembly

(1) Attach gear puller (1) to gear (2). Remove gear (2) from camshaft (3).



1. GEAR PULLER
2. GEAR
3. CAMSHAFT

TA 298586

(2) Slide thrust washer (4), rear end bearing (5), and thrust washer (6) off camshaft (3).

(3) Mark six halves of three intermediate bearings (7). Remove six lock rings (8) and six bearing halves (7).

(4) Remove key (9).

(5) Repeat steps (1) thru (4) for other camshaft assembly.

NOTE

Oil seal (10) is only in left front bearing (11).

(6) Remove and discard oil seal (10) from front end bearing (11).

b. Cleaning/Inspection

(1) Clean all parts.Refer to paragraph 2-6.

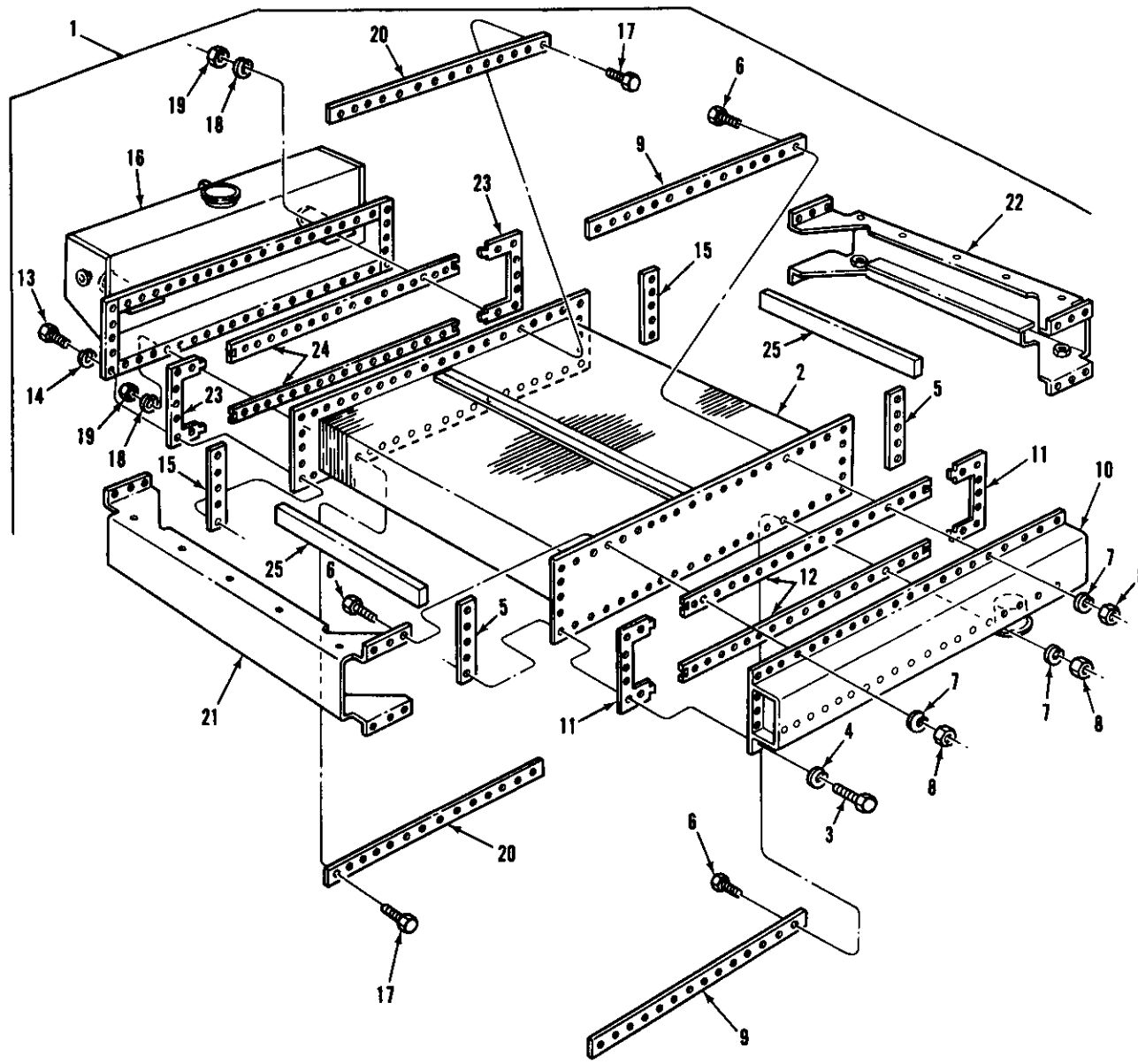
b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Inspect inlet and outlet tanks (10 and 16) for dents or cracks.

(4) Replace all parts failing inspection.



1. RADIATOR
2. CORE
3. CAPSCREW (10)
4. LOCKWASHER (10)
5. END BAR (2)
6. CAPSCREW (50)
7. LOCKWASHER (50)
8. NUT (50)
9. END BAR (2)
10. OUTLET TANK
11. GASKET (2)
12. GASKET (2)
13. CAPSCREW (10)
14. LOCKWASHER (10)
15. END BAR (2)
16. INLET TANK
17. CAPSCREW (50)
18. LOCKWASHER (50)
19. NUT (50)
20. END BAR (2)
21. LEFT SIDE
22. RIGHT SIDE
23. GASKET (2)
24. GASKET (2)
25. NEOPRENE SPONGE (2)

TA 298708

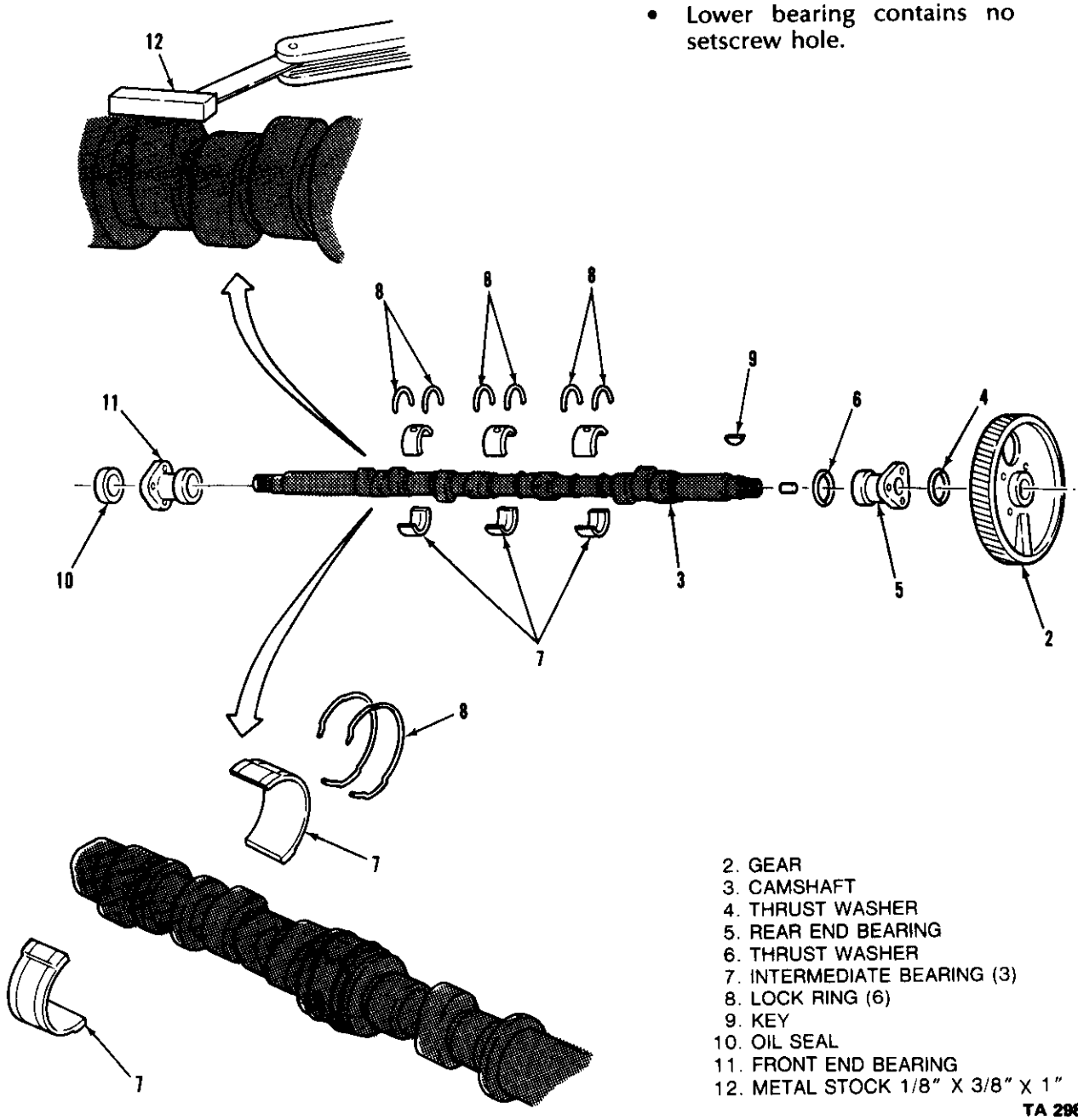
(2) Inspect gear (2) teeth for scoring, nicks, pitting, or wear.

(3) Measure thickness of thrust washers (4 and 6). Minimum thickness is 0.119 inch (3.02 mm) and maximum is 0.122 inch (3.10 mm).

(4) Measure flat on high side of cam lobe using a feeler gage and a 1/8 x 3/8 x 1 inch (3.17 x 9.52 x 25.4 mm) square metal stock (12). Flat clearance should measure less than 0.003 inch 0.0762 mm).

NOTE

- Both ends of lock ring (8) must cover split line of intermediate bearing (7).
- Lower bearing contains no setscrew hole.



2. GEAR
3. CAMSHAFT
4. THRUST WASHER
5. REAR END BEARING
6. THRUST WASHER
7. INTERMEDIATE BEARING (3)
8. LOCK RING (6)
9. KEY
10. OIL SEAL
11. FRONT END BEARING
12. METAL STOCK 1/8" X 3/8" X 1"

TA 298587

5-4. RADIATOR REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Lockwasher (120) (MS35338-45) items 4, 7, 14, and 18
Gasket (4) (OTC P/N 2CP296) items 11 and 23
Gasket (4) (OTC P/N 2CP295) items 12 and 24

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Radiator removed (para 5-3).

---

a. Disassembly

(1) Support radiator (1) on bench in a way that does not damage core (2).

(2) Remove 10 capscrews (3), lockwashers (4), and two end bars (5). Discard lockwashers (4).

(3) Remove 50 capscrews (6), lockwashers (7), nuts (8), and two end bars (9) from outlet tank (10). Discard lockwashers (7).

(4) Remove outlet tank (10) and four gaskets (11 and 12) from core (2). Discard gaskets (11 and 12).

(5) Remove 10 capscrews (13), lockwashers (14), and two end bars (15) from inlet tank (16). Discard lockwashers (14).

(6) Remove 50 capscrews (17), lockwashers (18), nuts (19), and two end bars (20) from inlet tank (16). Discard lockwashers (18).

(7) Remove left and rights sides (21 and 22) from core (2).

(8) Remove inlet tank (16) and four gaskets (23 and 24) from core (2). Discard gaskets (23 and 24).

(9) Remove neoprene sponges (25) from left and right sides (21) and 22).

3-25. CAMSHAFT MAINTENANCE (Continued)

(5) Put lower and upper half of three intermediate bearings (7) together. Secure each intermediate bearing (7) with two lock rings (8).

(6) Measure and note inside diameter of intermediate bearings (7). Diameter must be a minimum of 1.5010 inches (38.13 mm) and a maximum of 1.5030 inches (38.18 mm).

(7) Measure and note diameter of three intermediate bearing journals (13). Diameter must be a minimum of 1.4980 inches (38.049 mm) and a maximum of 1.4985 inches (38.06).

(8) Difference between bearing diameter and journal diameter is the bearing-to-shaft clearance. Clearance must be a minimum of 0.0025 inch (0.0635 mm), a maximum of 0.005 inch (0.127 mm) and must not exceed a limit of 0.009 inch (0.229 mm) for used parts.

(9) Measure and note inside diameter of front end bearing (11) and rear end bearing (5). Diameter must be minimum of 1.50 inches (38.10 mm) and a maximum of 1.501 inches (38.13 mm). Replace bushings (14) if not within specification. Refer to section d.

(10) Measure and note front and rear of end bearing journal (15). Diameter must be a minimum of 1.4960 inches (38.00 mm) and a maximum of 1.4965 inches (38.01 mm).

(11) Difference between bearing diameters and bearing journals is the bearing-to-shaft clearance. Clearance must be a minimum of 0.0035 inch (0.089 mm), a maximum of 0.0050 inch (0.127 mm), and must not exceed a limit of 0.0060 inch (0.152 mm) for used parts.

(12) Replace all parts failing inspection.

c. End Bearing Bushing Replacement

NOTE

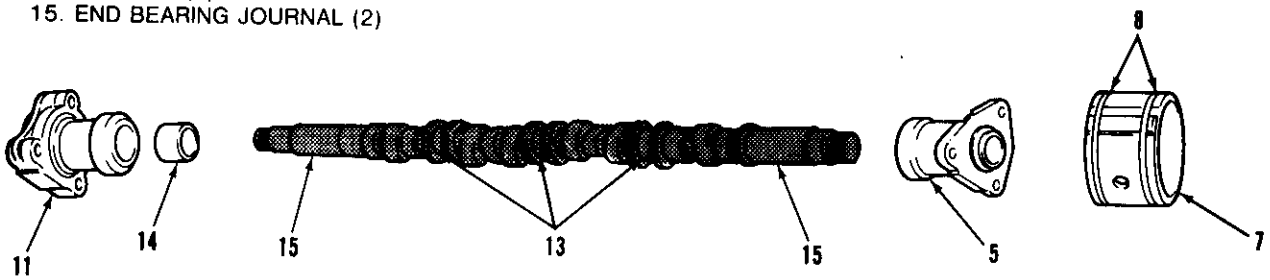
- Only replace bushings (14) if they failed inspection in step (9).
- If one bearing failed inspection, both front and rear bearing bushings (14) must be replaced.

(1) Press out bushings (14) from end bearings (5 and 11).

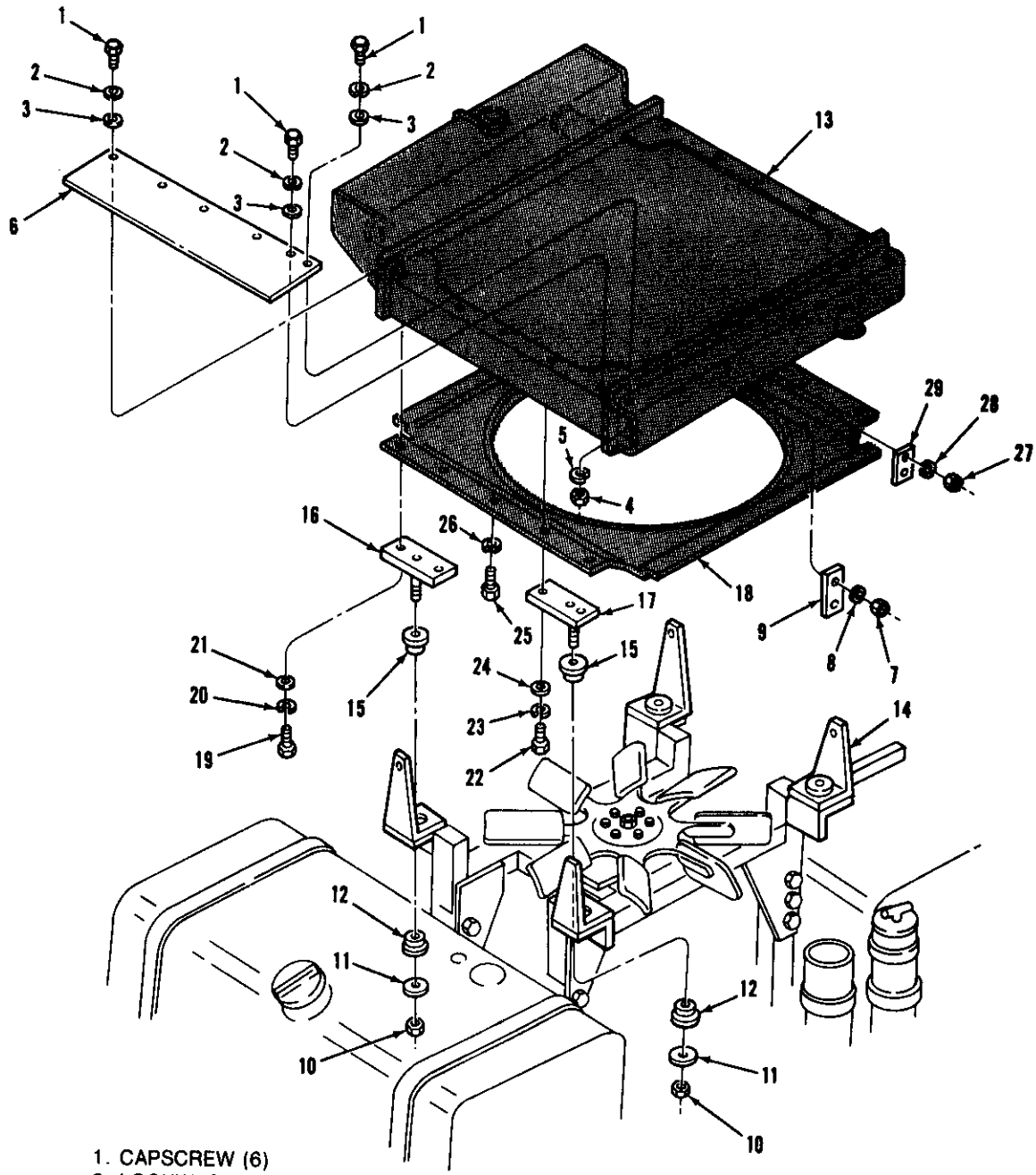
(2) Press new bushing (14) into front end bearing (11) until bushing is flush with bearing.

(3) Press new bushing (14) into rear end bearing (5) until bushing (14) protrudes 0.045-0.055 inch (1.14-1.40 mm).

5. REAR END BEARING
7. INTERMEDIATE BEARING (3)
8. LOCK RING (6)
11. FRONT END BEARING
13. INTERMEDIATE BEARING JOURNAL (3)
14. BUSHING (3)
15. END BEARING JOURNAL (2)



TA 298588



1. CAPSCREW (6)
2. LOCKWASHER (6)
3. FLATWASHER (6)
4. NUT (2)
5. LOCKWASHER (2)
6. RUBBER FLAP (2)
7. NUT
8. LOCKWASHER
9. BRACKET
10. LOCKNUT (4)
11. WASHER (4)
12. LOWER MOUNTING BISCUIT (4)
13. RADIATOR
14. RADIATOR SUPPORT
15. UPPER MOUNTING BISCUIT (4)
16. FRONT RADIATOR MOUNTING BRACKET
17. REAR RADIATOR MOUNTING BRACKET
18. FAN SHROUD
19. CAPSCREW (4)
20. LOCKWASHER (4)
21. WASHER (4)
22. CAPSCREW (4)
23. LOCKWASHER (4)
24. WASHER (4)
25. CAPSCREW (2)
26. LOCKWASHER (2)
27. NUT (6)
28. LOCKWASHER (6)
29. CLIP (6)

TA 298707

d. Assembly

(1) Install key (9).

NOTE

Steel face of thrust washers should face towards rear end bearing.

(2) Apply grease to steel face side of two thrust washers (4 and 5). Install thrust washers on rear end bearing (5).

(3) Lubricate rear camshaft journal with clean engine oil and slide rear end bearing (5) on camshaft (3). Flange of bearing should face toward gear (2) end of camshaft (3).

NOTE

Timing mark on gear faces away from camshaft (3).

(4) Support the camshaft (3) on a press. Aline the keyway in gear (2) with key (9) on camshaft (3). Start the gear (2) on key (9).

(5) Press gear (2) on camshaft (3).

(6) Measure clearance between thrust washers (4 and 6) and rear end bearing (5). Clearance must be a minimum of 0.004 inch (0.102 mm), a maximum of 0.012 inch (0.305 mm), and must not exceed a limit of 0.018 inch (0.457 mm) for used parts.

NOTE

Lower intermediate bearings (7) have an oil groove on mating edge and do not contain setscrew hole.

(7) Install upper and lower bearing halves of intermediate bearing (7) on camshaft journal.

(8) Install two lock rings (8) for each intermediate bearing (7).

(9) Install nut (16). Hand tighten only.

(10) Repeat steps (1) thru (10) for other camshaft (3).

(11) Install new oil seal (10) in front end bearing (11).

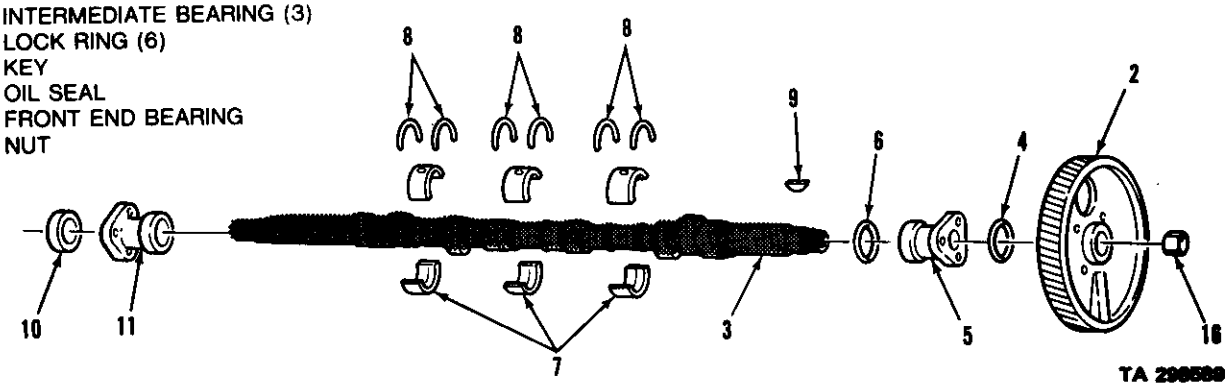
END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13
TM 9-2320-297-34 Install camshaft (para 3-20).

2. GEAR
3. CAMSHAFT
4. THRUST WASHER
5. REAR END BEARING
6. THRUST WASHER
7. INTERMEDIATE BEARING (3)
8. LOCK RING (6)
9. KEY
10. OIL SEAL
11. FRONT END BEARING
16. NUT



TA 298589

5-3. RADIATOR AND SHROUD REPLACEMENT (Continued)

c. Installation

(1) Support radiator (13) on wooden blocks with filler neck facing down.

(2) Install fan shroud (18) using six clips (29), nuts (27), new lockwashers (28), two capscrews (25), and new lockwashers (26). Tighten nuts (27) and capscrews (25) securely.

(3) Install two rear radiator mounting brackets (17) using four capscrews (22), new lockwashers (23), and washers (24).

(4) Install two front radiator mounting brackets (16) using four capscrews (19), new lockwashers (20), and washers (21).

(5) Install four upper mounting biscuits (15) on radiator mounting brackets (16 and 17).

(6) Using a lifting device, install radiator (13) on radiator support (14).

(7) Install four lower mounting biscuits (12), washers (11), and new locknuts (10).

(8) Torque locknuts (10) to 70 foot-pounds (94.92 N·m).

(9) Install two rubber flaps (6) using six capscrews (1), new lockwashers (2), washers (3), two nuts (4), and new lockwashers (5).

(10) Install bracket (9) using new lockwasher (8) and nut (7).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install radiator hoses (para 6-7).
	Install transmission cooler (para 8-13).
	Install hydraulic oil cooler (para 22-10).
	Install radiator grille (para 6-4).
	Fill radiator (para 6-3).
	Install right fuel tank straps (para 4-11).
	Tighten left fuel tank straps (para 4-11).
TM 2320-10/11 TM 9-2320-297-10	Start engine. Check for leaks (para 2-13).

3-26. CRANKSHAFT MAINTENANCE

THIS TASK COVERS: a. Disassembly
b. Cleaning
c. Inspection
d. Measurement
e. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Sleeve installer (J 21983)
Handle (J 8092)
Guide Studs (J 25002)
Dial Indicator (J 7872)
Micrometer set 0-6" inside (NSN 5210-00-473-4350)
Micrometer set 0-6" outisde (NSN 5210-00-354-7134)

Materials/Parts

Retaining compound (item 18, Appendix C)
Emery cloth (item 21, Appendix C)
Sealant shellac (item 61, Appendix C)

Equipment Condition

TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Crankshaft removed (para 3-19).

a. Disassembly

NOTE

If an oversized oil seal has been installed on flywheel housing, crankshaft (4) will have an oil seal sleeve (1).

(1) Remove oil seal sleeve (1), if used. To remove sleeve, peen the outside diameter of sleeve until it stretches enough so it can be removed.

(2) Remove six capscrews (2) from timing gear (3).

(3) Remove timing gear (3) from crankshaft (4).

NOTE

Locate engine serial number. Engines prior to serial number 8VF-097697 do not use roll pin (5).

(4) Remove roll pin (5) if damaged.

(5) Using a puller, remove oil pump gear (6), and spacer (7).

NOTE

Two types of keys (8 and 9) may be used. The old style key is completely interchangeable with the new style.

(6) Remove keys (8 and 9) from crankshaft (4). Discard damaged keys (8 and 9).

b. Cleaning

(1) Clean crankshaft oil passages using a stiff wire brush.

(2) Clean all other parts. Refer to paragraph 2-6.

c. Inspection

(1) Inspect crankshaft (4) for signs of overheating. Replace crankshaft (4) if journals (10 thru 15) have turned blue from heat.

(2) Inspect oil seal contact surfaces at rear of crankshaft (4) for roughness or grooves.

(a) Slight roughness may be repaired with emery cloth.

(b) If excessively worn or grooved, an oil seal sleeve (1) must be installed on the ridge or wear area when crankshaft (4) is assembled. If an oil seal sleeve (1) is installed, an oversized seal must be installed in the flywheel housing.

NOTE

Matchmark front and rear radiator mounting brackets (16 and 17) before removal.

(7) Remove four capscrews (19), lockwashers (20), washers (21), and front radiator mounting brackets (16). Discard lockwashers (20).

(8) Remove four capscrews (22), lockwashers (23), washers (24), and rear radiator mounting brackets (17). Discard lockwashers (23).

(9) Remove two capscrews (25), and lockwashers (26). Discard lockwashers (26).

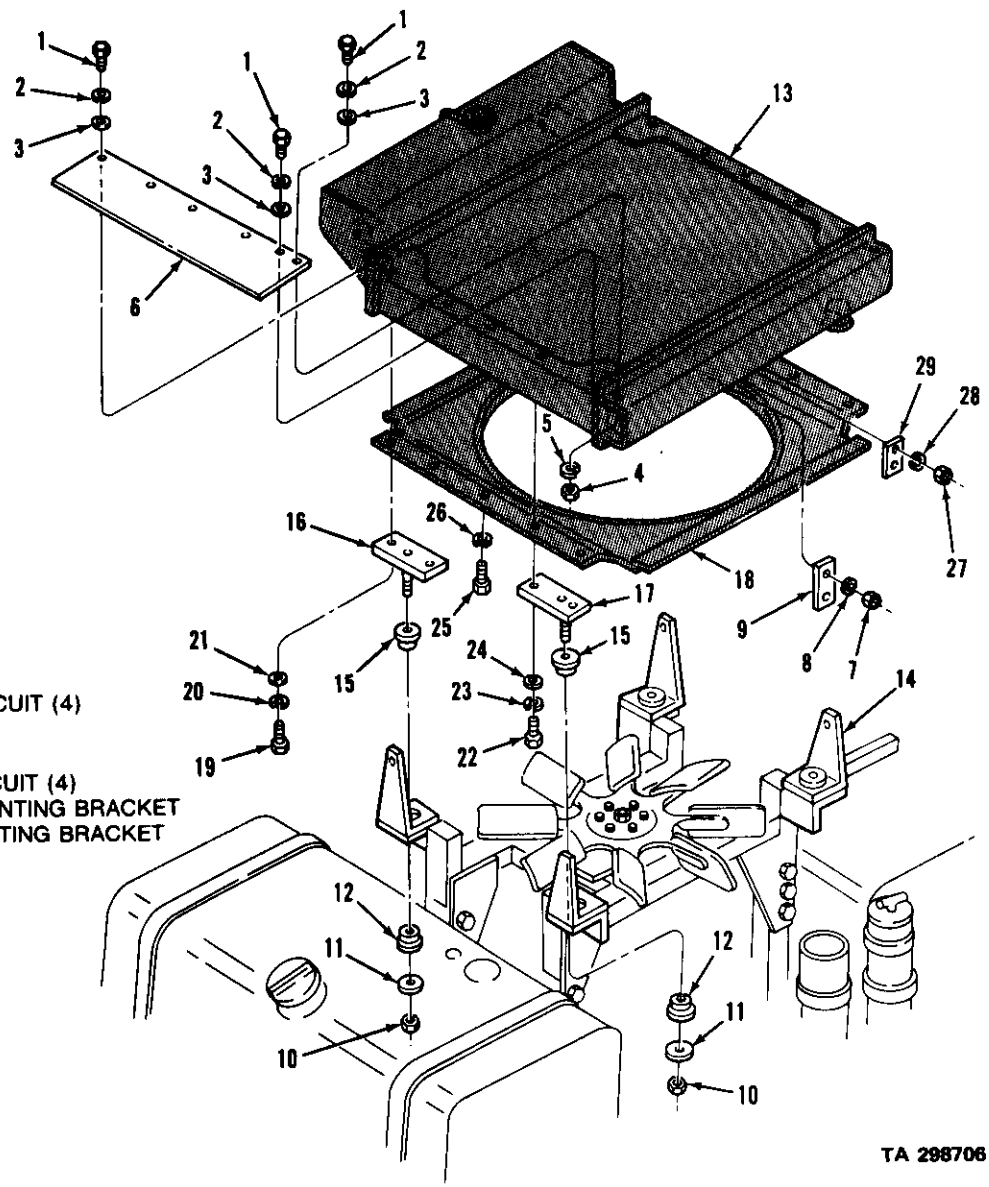
(10) Remove six nuts (27), lockwashers (28), and clips (29). Remove fan shroud (18). Discard lockwashers (28).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.



1. CAPSCREW (6)
2. LOCKWASHER (6)
3. FLATWASHER (6)
4. NUT (2)
5. LOCKWASHER (2)
6. RUBBER FLAP (2)
7. NUT
8. LOCKWASHER
9. BRACKET
10. LOCKNUT (4)
11. WASHER (4)
12. LOWER MOUNTING BISCUIT (4)
13. RADIATOR
14. RADIATOR SUPPORT
15. UPPER MOUNTING BISCUIT (4)
16. FRONT RADIATOR MOUNTING BRACKET
17. REAR RADIATOR MOUNTING BRACKET
18. FAN SHROUD
19. CAPSCREW (4)
20. LOCKWASHER (4)
21. WASHER (4)
22. CAPSCREW (4)
23. LOCKWASHER (4)
24. WASHER (4)
25. CAPSCREW (2)
26. LOCKWASHER (2)
27. NUT (6)
28. LOCKWASHER (6)
29. CLIP (6)

TA 298706

(3) Inspect oil pump gear (6) and timing gear (3) for wear or chipped teeth.

(4) Inspect crankshaft (4) for cracks using magnetic particle inspection and fluorescent penetrant methods. Refer to paragraph 2-7.

(5) Inspect journals (10 thru 15) for ridges (16).

(6) Replace all parts failing inspection.

d. Measurement

(1) Support crankshaft (4) on two machined V-blocks at the front main journal (10) and rear main journal (11).

(2) Using a dial indicator, measure journals (12, 13, and 14) for out-of-round. Rotate crankshaft (4) one complete turn. Record the readings and note where high spots of out-of-round are on journals (12, 13, and 14).

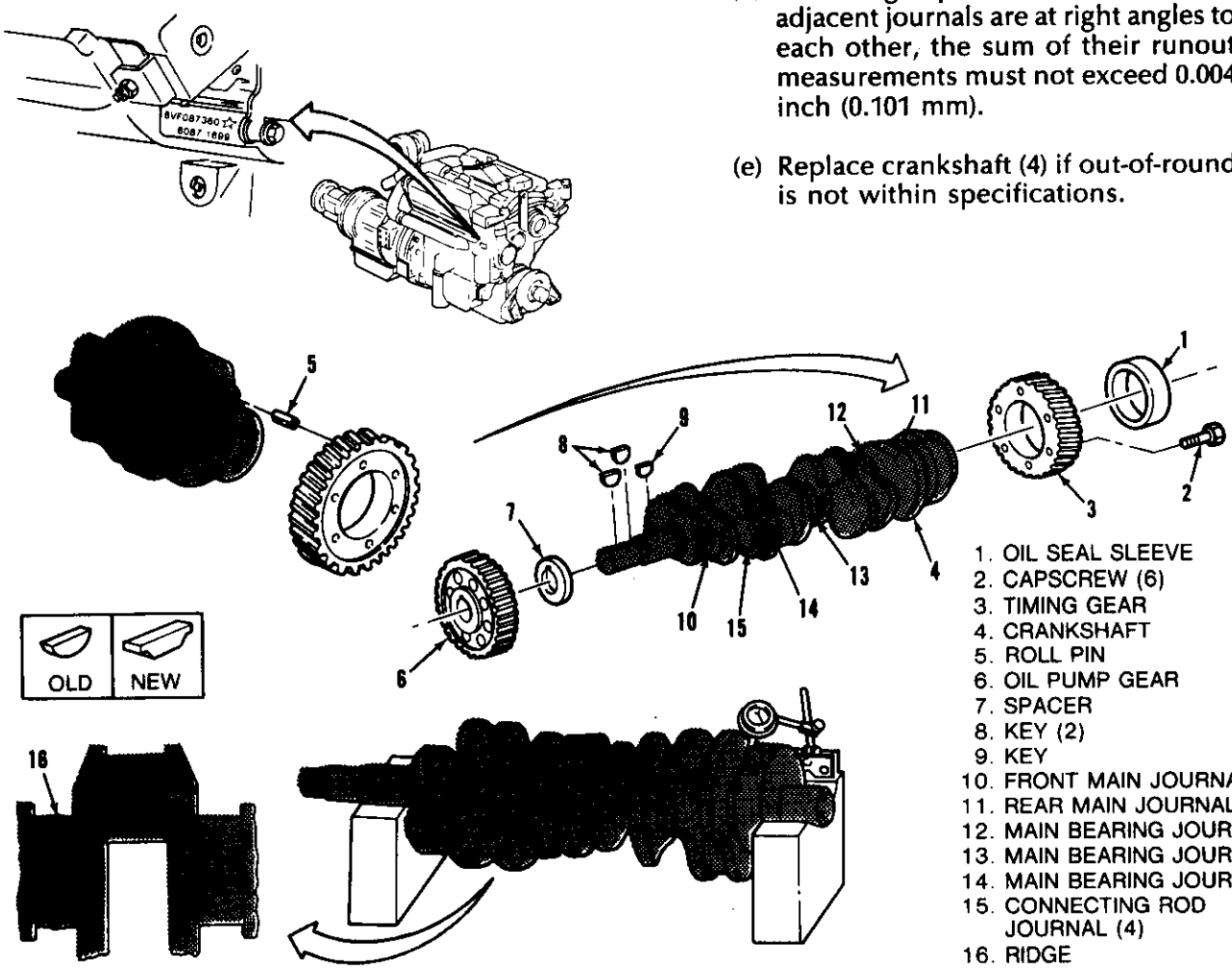
(a) Maximum out-of-round for journals (12 and 14) is 0.0020 inch (0.050 mm).

(b) Maximum out-of-round for main bearing journal (13) is 0.0040 inch (0.010 mm).

(c) The difference between out-of-round measurements for two adjacent journals must not exceed 0.003 inch (0.076 mm).

(d) When high spots of out-of-round on adjacent journals are at right angles to each other, the sum of their runout measurements must not exceed 0.004 inch (0.101 mm).

(e) Replace crankshaft (4) if out-of-round is not within specifications.



TA 298590

SECTION II. GENERAL COOLING SYSTEM MAINTENANCE

5-3. RADIATOR AND SHROUD REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Lockwasher (25) (MS35338-45) items 2, 5, 8, 20, 23, 26 and 28
Locknut (4) (MS51943-13) item 10

Personnel Required

1 MOS 3522
1 Assistant

References

TM 2320-10/11
TM 9-2320-297-10

TM 2320-20/12
TM 9-2320-297-20

Equipment Condition TM	Condition Description
TM 2320-20/12 TM9-2320-297-20	Radiator drained (para 6-3).
	Radiator grille removed (para 6-4).
	Hydraulic oil cooler removed (para 22-10).
	Transmission cooler removed (para 8-13).
	Right fuel tank removed (para 4-11).
	Left fuel tank straps loosened (para 4-11).
	Radiator hoses removed (para 6-7).

---

a. Removal

(1) Remove six capscrews (1), lockwashers (2), flat washers (3), two nuts (4), lockwashers (5) and two rubber flaps (6). Discard lockwashers (2 and 5).

(2) Remove nut (7), lockwasher (8), and bracket (9). Discard lockwasher (8).

(3) Remove four locknuts (10), washers (11), and lower mounting biscuits (12).

(4) Using a lifting device, remove radiator (13) from radiator support (14).

(5) Remove four upper mounting biscuits (15) from front and rear radiator mounting brackets (16 and 17).

(6) Support radiator (13) on wooden blocks, with fan shroud (18) facing up.

3-26. CRANKSHAFT MAINTENANCE (Continued)

(3) Install two more machined V-blocks under two journals (12 and 14) to support crankshaft (4).

(4) Measure crankshaft journals. At point A measure around the shaft at points C thru F. At point B measure around the shaft at points C thru F. Compare these measurements with the following limits:

(a) Diameter of main bearing journals (10 thru 14) must be a minimum of 4.4985 inches (11.426 cm) and a maximum of 4.5002 inches (11.430 cm).

(b) Connecting rod journals (15), diameter must be a minimum of 2.9985 inches (7.616 cm) and a maximum of 3.0002 inches (7.620 cm).

(c) Check main bearing journals (10 thru 14) and connecting rod journals (15) for out-of-round. Journal out-of-round must not exceed 0.0005 inch (0.0127 mm).

(d) Check main bearing journals for taper. Taper must not exceed 0.004 inch (0.1016 mm).

(e) Check connecting rod journals (15) for taper. Taper must not exceed 0.004 inch (0.1016 mm) (half width) and 0.008 inch (0.2032 mm) (full width).

(5) Measure crankshaft-to-timing gear clearance as follow:

(a) Measure timing gear (3) inside diameter. Inside diameter of timing gear (3) should be a minimum of 5.2490 (13.332 cm) and a maximum of 5.2510 inches (13.337 cm).

(b) Measure diameter of crankshaft (4) at timing gear surface (17). Record measurement.

(c) Crankshaft-to-timing gear clearance must not exceed 0.001 inch (0.0254 mm).

(d) Replace timing gear (3) if not within specification.

Bearing Size	Connecting Rod Journal Diameter	Main Bearing Journal Diameter
Standard	2.9985-3.0002 in. (7.6161-7.6205 cm)	4.4985-4.5002 in. (11.4261-11.4305 cm)
0.0020 (0.0508 mm)	2.9965-2.9982 in. (7.6111-7.6154 cm)	4.4965-4.4982 in. (11.4211-11.4254 cm)
0.0100 (0.254 mm)	2.9885-2.9902 in. (7.5907-7.5951 cm)	4.4885-4.4902 in. (11.4007-11.4051 cm)
0.0200 (0.508 mm)	2.9785-2.9802 in. (7.5653-7.5697 cm)	4.4785-4.4802 in. (11.3753-11.3797 cm)
0.0300 (0.762 mm)	2.9685-2.9702 in. (7.5399-7.5443 cm)	4.4685-4.4702 in. (11.3499-11.3543 cm)

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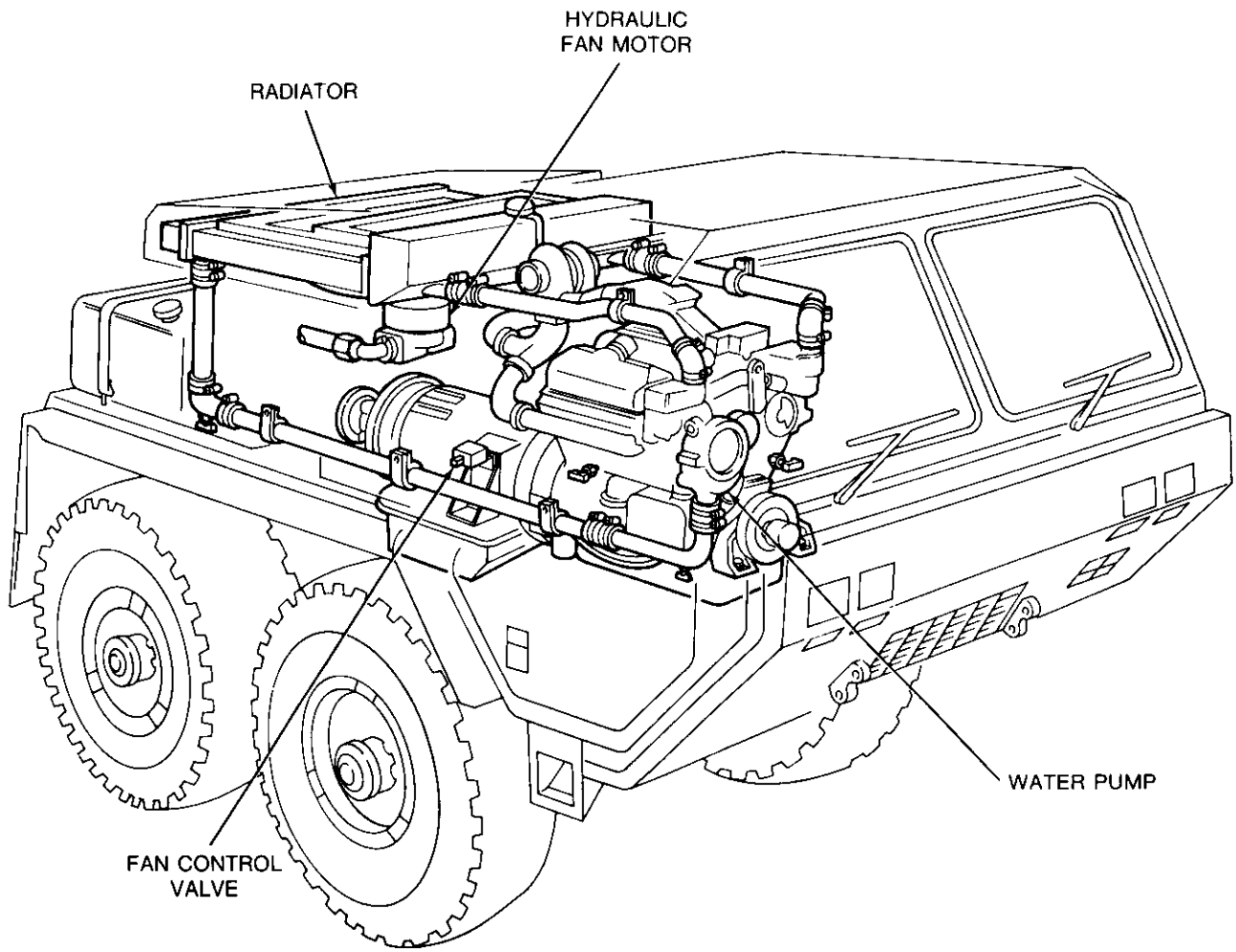


TA 298705

(6) Measure crankshaft thrust washer surface width (18 and 19).

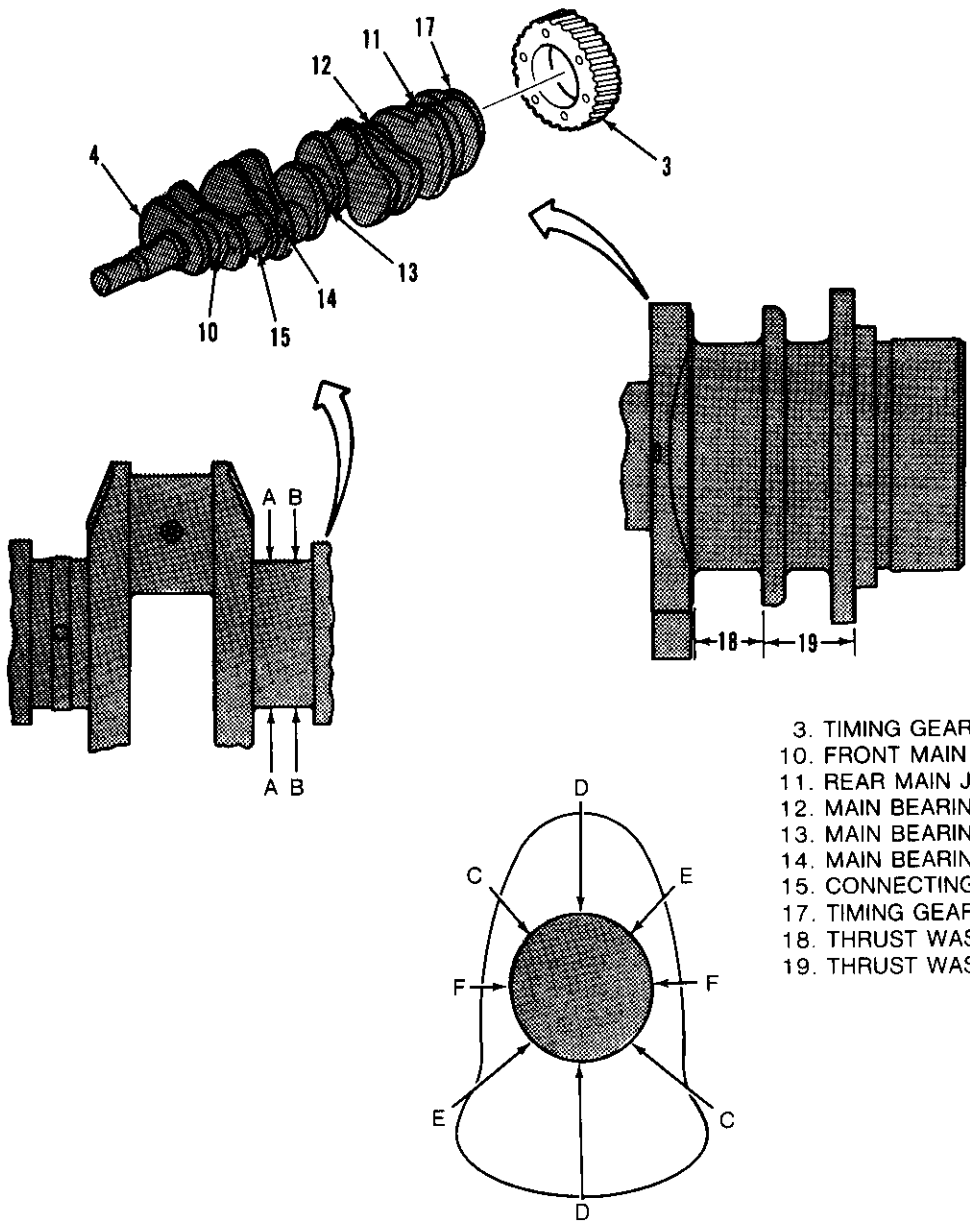
(a) Rear main thrust washer surface width (18) must be a minimum of 1.499 inches (3.807 cm) and a maximum of 1.501 inches (3.812 cm).

(b) Counter weight thrust washer surface width (19) must be a minimum of 1.915 inches (4.864 cm) and a maximum of 1.925 inches (4.889 cm).

NOTE

Main and connecting rod bearings are available in sizes 0.002, 0.010, 0.020, and 0.030 inch undersize. The 0.002 inch bearing is used only to compensate for slight wear on crankshaft.

(7) Replace all parts failing inspection.



3. TIMING GEAR
10. FRONT MAIN JOURNAL
11. REAR MAIN JOURNAL
12. MAIN BEARING JOURNAL
13. MAIN BEARING JOURNAL
14. MAIN BEARING JOURNAL
15. CONNECTING ROD JOURNAL (4)
17. TIMING GEAR SURFACE
18. THRUST WASHER SURFACE WIDTH
19. THRUST WASHER SURFACE WIDTH

TA 298592

5-2. DESCRIPTION AND DATA (Continued)

b. Radiator. The radiator consists of a front tank, a rear tank, a tube type radiator core, and a filler cap. The front tank (which has a right glass for checking coolant level) is a reservoir that holds coolant before it enters the radiator core section. The rear tank is a reservoir that holds coolant after it leaves the radiator core section. The radiator core section is a series of finned tubes that dissipate heat from the circulating coolant. The filler cap is a pressure cap that allows the radiator to be filled when removed, and seals the radiator when closed. The filler cap will only hold 7 psi (337.85). Beyond this, it allows pressurized coolant to pass through an overflow tube onto the ground.

c. Water Pump. The water pump, which is mounted on the front of the engine, is a gear-driven, centrifugal type pump. The water pump consists of a drive gear, a shaft with bearings, and a bronze impeller. The drive gear meshes with a gear on the camshaft. As the engine rotates, the water pump impeller also rotates. This causes the coolant to circulate throughout the cooling system.

d. Fan Control Valve. The fan control valve is an electrically controlled, hydraulic valve. When coolant temperature reaches 180 degrees (82.2°C), an electric solenoid is energized. This allows the fan control valve to open. When the hydraulic fan control valve opens, hydraulic oil is directed to the hydraulic fan motor.

e. Hydraulic Fan Motor. The fan motor is a hydraulically-driven motor. When coolant temperature reaches 180 degrees (82.2°C), hydraulic oil is directed to the fan motor. The fan motor turns the fan to draw air down through the radiator to increase the radiator's ability to dissipate heat.

f. Aftercooler. The aftercooler is mounted between the cylinders, in the opening in the engine block beneath the blower assembly. Hot air coming from the turbocharger and blower passes through the aftercooler before going to the engine. The aftercooler carries coolant from the cooling system through finned tubing. The hot air is cooled as it passed these fins. The coolant returns to the radiator through the left thermostat housing.

3-26. CRANKSHAFT MAINTENANCE (Continued)

e. Assembly

NOTE

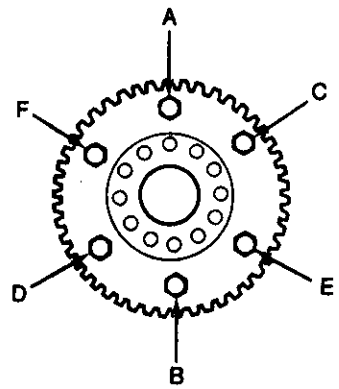
- Engines prior to serial number 8VF-097697 do not use roll pin (5).
- Do not use roll pin (5) when new timing gear (3) is used with old crankshaft (4) or when old timing gear (3) is used with new crankshaft (4).

(1) Install roll pin (5) if removed.

(2) Aline holes in timing gear (3) with rear of crankshaft (4) and roll pin (5).

(3) Slide timing gear (3) on crankshaft (4) and start six capscrews (2). Alternately tighten capscrews (2) until timing gear (3) is tight against shoulder of crankshaft (4).

(4) Torque capscrews (2) to 35-39 foot-pounds (47-53 N·m) in sequence shown below.



NOTE

Install oil seal sleeve only if the crankshaft previously had them or if during inspection it was determined they were needed.

(5) Lightly coat with sealant the area of the crankshaft (4) where oil seal sleeve (1) will be installed.

(6) Install oil seal sleeve (1) with sleeve installer. Install sleeve where flywheel housing oil seal contacts crankshaft (4).

(7) Wipe off excessive sealant from oil seal sleeve (1).

(8) Install two keys (8 and 9) and spacer (7). Beveled side of spacer (7) should face towards crankshaft (4).

(9) Coat inside surface of oil pump gear (6) with retaining compound.

(10) Aline key slot in oil pump gear (6) and press oil pump gear (6) on crankshaft (4). crankshaft (4).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13
TM 9-2320-297-34 Install crankshaft (para 3-20).

CHAPTER 5

COOLING SYSTEM

5-1. OVERVIEW

This chapter provides information authorized for Third and Fourth Echelon Maintenance level mechanics. General information, maintenance, replacement and repair procedures for the vehicle's cooling system are covered in the following sections:

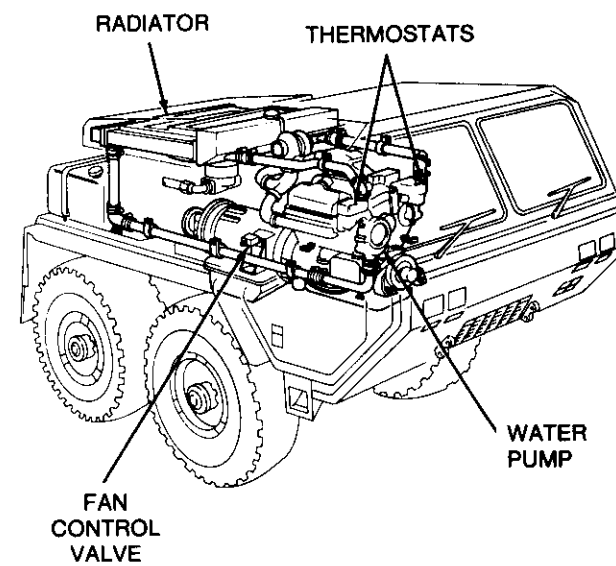
Section I. Description and Data

Section II. General Cooling System Maintenance

SECTION I. DESCRIPTION AND DATA

5-2. DESCRIPTION AND DATA

a. General. The cooling system consists of a horizontally mounted radiator, an engine-driven water pump, two thermostats, a hydraulically-driven fan, and an aftercooler. Coolant (ethylene-glycol and water) is drawn from the rear of the radiator by the water pump. The coolant passes through the water pump into passages in the engine block and aftercooler. The coolant circulates within the engine block and aftercooler until its temperature reaches 180 degrees (82.2°C). At this point, the two thermostats open and coolant is circulated into the front tank of the radiator. The fan control valve also opens, and hydraulic oil is directed to the fan motor. The fan draws air down through the radiator to dissipate heat from the coolant circulating through the radiator.



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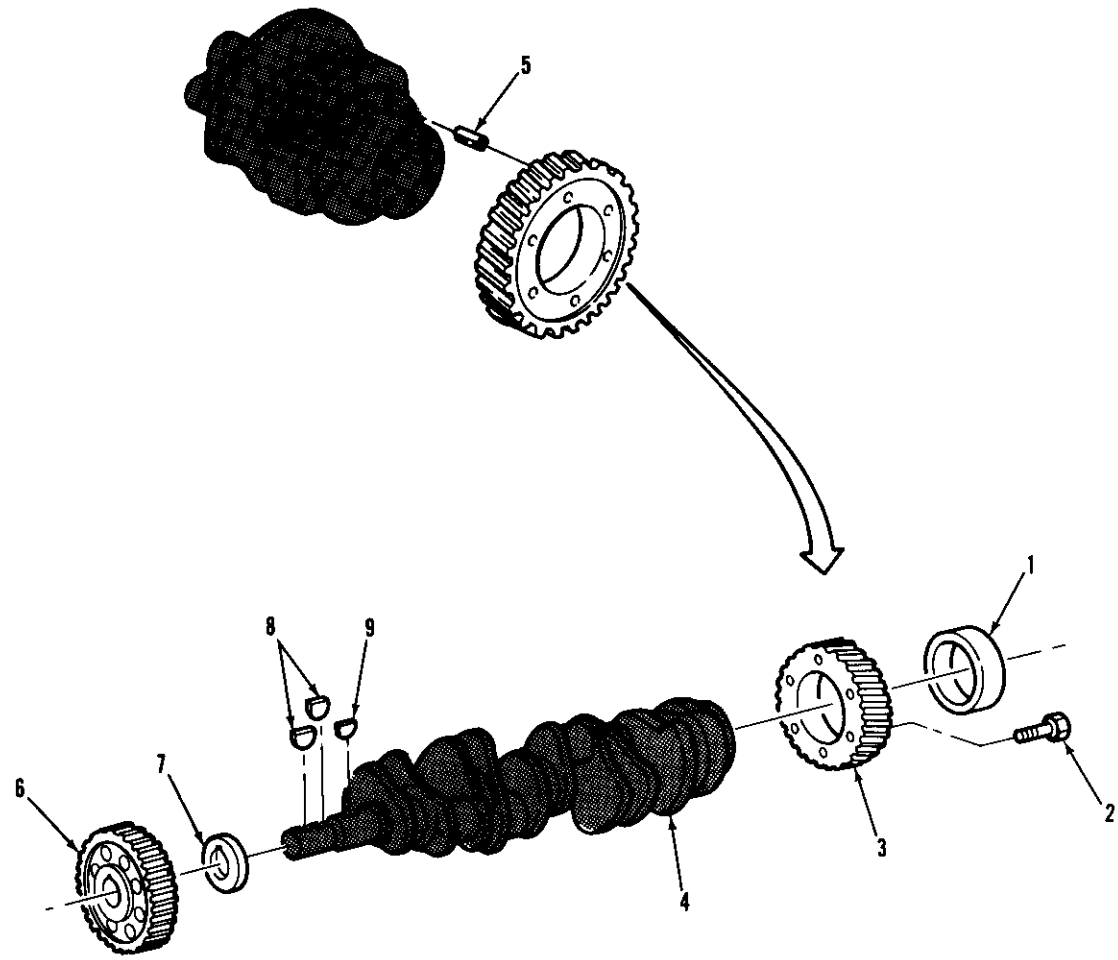


1. OIL SEAL SLEEVE
2. CAPSCREW (6)
3. TIMING GEAR
4. CRANKSHAFT
5. ROLL PIN
6. OIL PUMP GEAR
7. SPACER
8. KEY (2)
9. KEY

TA 208594

SECTION VI. ENGINE TESTING AND ADJUSTMENT

3-27. STARTING AN OVERHAULED ENGINE

THIS TASK COVERS: a. Preparation
b. Starting

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Coolant (item 10, Appendix C)
Engine oil (item 46, Appendix C)

Personnel Required

1 MOS 3522
1 Assistant

References

TM 2320-20/12
TM 9-2320-297-20

TM 2320-10/11
TM 9-2320-297-10

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Engine access door open (para 2-1).
TM 2320-20/12 TM 9-2320-297-20	Intake ducting removed (para 4-9).

a. Preparation

(1) Check coolant level.Fill the cooling system with a 50/50 mix of coolant and clean water.

(2) Check oil level. Refer to paragraph 3-3 (TM 2320-20/12, TM 9-2320-297-20).

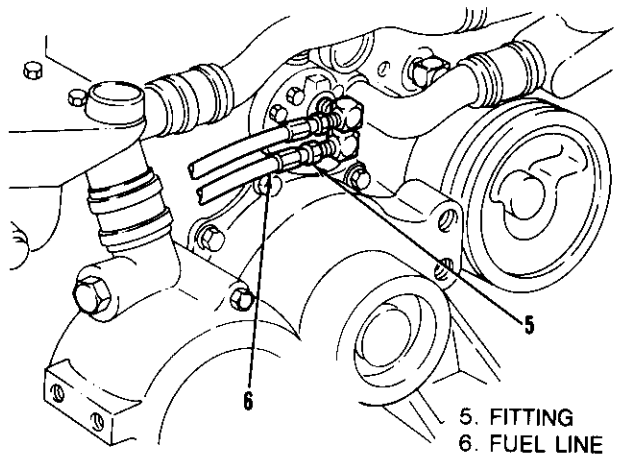
(3) Remove rocker covers. Refer to paragraph 3-4 (TM 2320-20/12, TM 9-2320-297-20).

(4) Lubricate rocker arms (1) with clean engine oil.

(5) Remove turbocharger oil inlet line (2) at turbocharger (3). Fill turbocharger (3) with clean engine oil. Turn impeller (4) to lubricate turbocharger (3). Add clean engine oil until turbocharger (3) is filled. Install turbocharger oil inlet line (2).

(6) Loosen fitting (5) on fuel line (6). Use priming pump to prime fuel system until fuel comes out of fitting (5). Tighten fitting (5) securely.

(7) Install rocker covers. Refer to paragraph 3-4 (TM 2320-20/12, TM 9-2320-297-20).



5. FITTING
6. FUEL LINE

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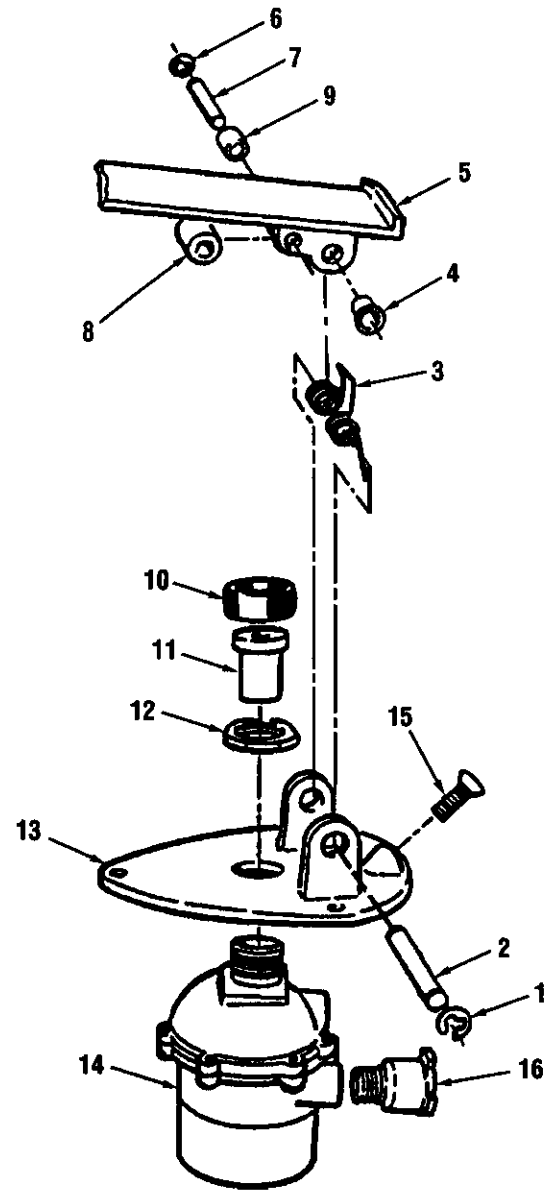


1. RETAINING RING (2)
2. PIN
3. SPRING
4. BUSHING (2)
5. PEDAL
6. RETAINING RING (2)
7. PIN
8. ROLLER
9. BUSHING (2)
10. DUST BOOT
11. PLUNGER
12. NUT
13. MOUNTING PLATE
14. CONTROL VALVE
15. SCREW
16. VENT

b. Starting

CAUTION

To prevent serious engine damage, oil pressure must show on oil pressure gage within 10-15 seconds after engine is started. If not, engine must be shut down immediately.

(1) Start and run engine at 690 rpm. Refer to paragraph 2-13 (TM 2320-10/11, TM 9-2320-297-10).

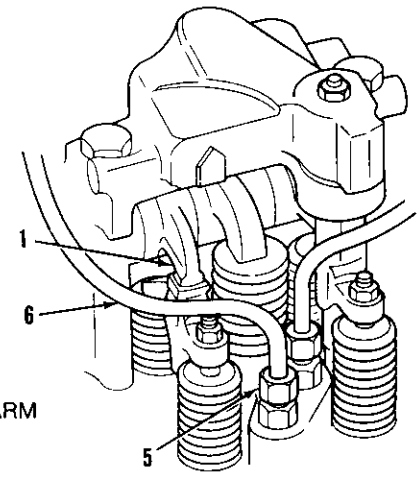
(2) Check oil pressure gage. If there is no oil pressure within 10 to 15 seconds, shut down engine and check lubrication system.

(3) Run engine at 690 rpm for one minute. Increase engine speed to 1,200 rpm, and allow engine to reach normal operating temperature.

(4) Check for coolant, fuel or oil leaks. Make any repairs needed.

(5) Shut down engine. Allow oil to drain back into oil pan. Check oil level. Fill if needed.

END OF TASK

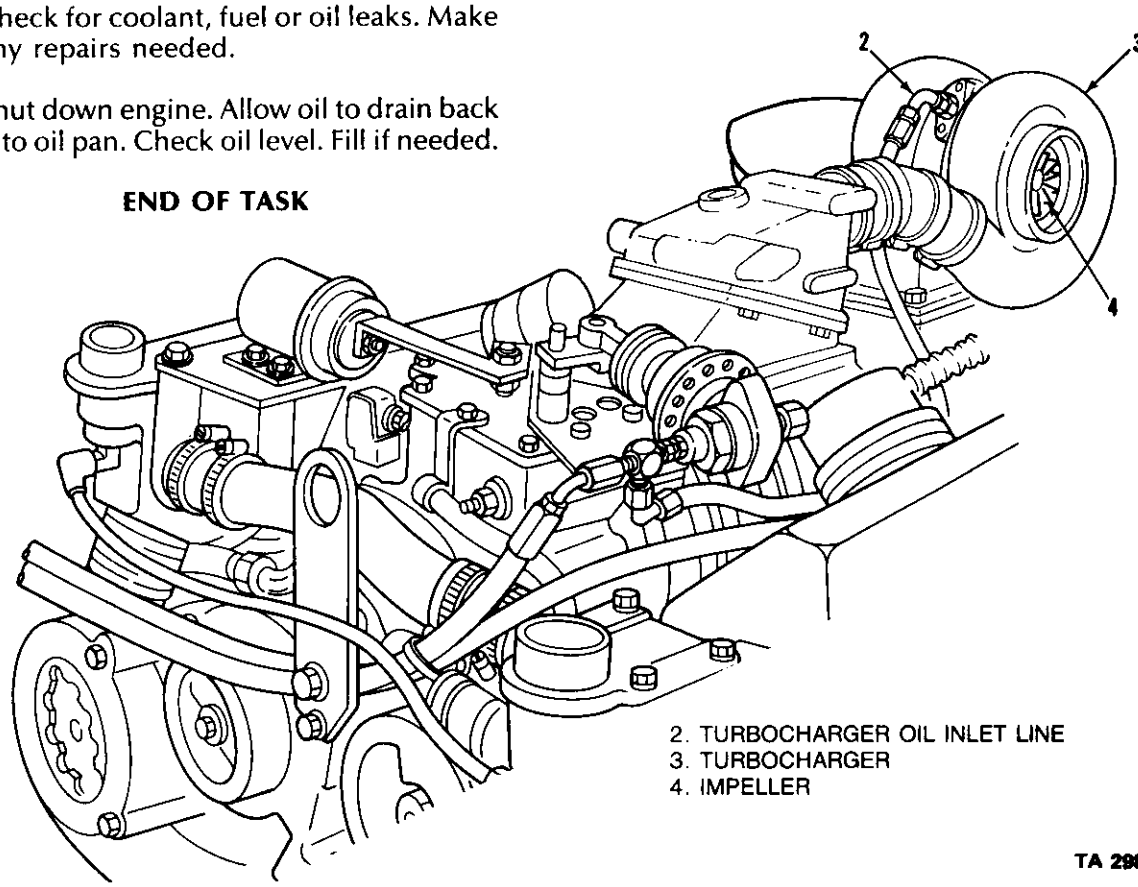


1. ROCKER ARM
5. FITTING
6. FUEL LINE

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install intake ducting (para 4-9).
TM 2320-10/11 TM 9-2320-297-10	Close engine access door (para 2-1).



2. TURBOCHARGER OIL INLET LINE
3. TURBOCHARGER
4. IMPELLER

TA 298595

4-16. THROTTLE TREADLE VALVE MAINTENANCE (LVSA1 VEHICLES ONLY)

THIS TASK COVERS:
a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations
MK48A1

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Throttle treadle valve removed (para 4-22).

---

a. Disassembly

(1) Remove two retaining rings (1), pin (2), spring (3), two bushings (4), and pedal (5).

(2) Remove two retaining rings (6), pin (7), roller (8) and two bushings (9).

(3) Remove dust boot (10) and plunger (11).

(4) Remove dust boot (10) from plunger (11).

NOTE

Matchmark mounting plate and control valve.

(5) Remove nut (12) and mounting plate (13) from control valve (14).

(6) Remove screw (15) from mounting plate (13).

(7) Remove vent (16).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Assembly

(1) Install vent (16).

(2) Install screw (15) in mounting plate (13).

(3) Aline matchmarks and install mounting plate (13) on control valve (14) with nut (12).

(4) Install dust boot (10) on plunger (11).

(5) Install plunger (11) and dust boot (10).

(6) Install two bushings (9), roller (8), pin (7), and two retaining rings (6) on pedal (5).

(7) Install pedal (5) with two bushings (4) and pin (2).

(8) Adjust screw (15) so roller (8) is just barely touching plunger (11).

(9) Remove pedal (5) and install spring (3).

(10) Install pedal (5) with pin (2) and two retaining rings (1).

END OF TASK

NOTE

Follow-On Maintenance	
TM 2320-20/12 TM 9-2320-297-20	Install throttle treadle valve (para 4-22).

3-28. DYNAMOMETER TESTING

THIS TASK COVERS: Testing

INITIAL SETUP

Applicable Configurations

MK48

References

TM 2320-20/12
TM 9-2320-297-20

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Engine tune up (para 3-29).
TM 2320-20/12 TM 9-2320-297-20	Rocker covers removed (para 3-4).

Testing

NOTE

Operator should be observant at all times. Any malfunction must be corrected.

(1) Lubricate engine and turbocharger. Refer to paragraph 3-27 in this manual.

(2) Install dynamometer.

(3) Start engine and run at 690 rpm. Apply a load of 5 foot-pounds (52 N·m) or 10-15 horsepower.

(4) Check oil pressure. Normal oil pressure is 32-70 psi (220-482 kPa).

(5) Follow basic run-in schedule (1). Make the following inspections during run-in:

(a) Inspect for oil flow at rocker arms.

(b) Inspect for oil leaks.

(c) Inspect for fuel leaks.

(d) Inspect for water leaks.

1. BASIC RUN-IN

RPM	BHP	RUN TIME
1200	72	10 MIN.
1800	300	30 MIN.
2100	387	30 MIN.

(8) Install barrier plate assembly (19) into piston (14).

(9) Install shim (16) and spring (15) into outlet body (11).

(10) Install piston (14) with barrier plate (19) into outlet body (11).

(11) Install outlet body (11) with all internal parts (14 thru 21) onto upper body (12) using six screws (10).

(12) Install bushing (8) into roller (9).

(13) Install bushing (8) and roller (9) onto front holes of pedal (4).

(14) Push pin (7) through pedal (4) holes, bushing (8) and roller (9). Install clips (6) on each end of pin (7).

(15) Install two bushings (3) into rear holes of pedal (4).

(16) Position spring (5) so it lines up with rear pedal (4) holes, and holes in pedal mounting plate (13).

(17) Push pin (2) through bushings (3), pedal (4), spring (5), and pedal mounting plate (13) holes. Install two clips (1) to lock pin (2) in place.

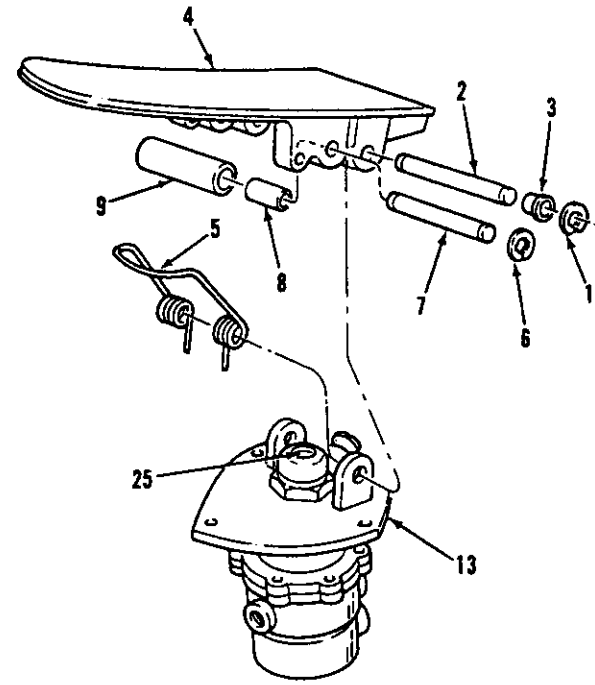
(18) Adjust stop screw (30) until roller (9) just contacts push rod (25).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 Install throttle
TM 9-2320-297-20 treadle valve (para 4-22).



1. CLIP (2)
2. PIN
3. BUSHING (2)
4. PEDAL
5. SPRING
6. CLIP (2)
7. PIN
8. BUSHING
9. ROLLER
13. PEDAL MOUNTING PLATE
25. PUSH ROD

(6) Remove load from dynamometer and slowly bring engine to 690 rpm. Shut down engine.

(7) Check and tighten all external capscrews.

(8) Torque cylinder head capscrews (2) and rocker shaft capscrews (3).Refer to paragraph 3-3 in this manual.

(9) Tune up engine.Refer to paragraph 3-29 in this manual.

(10) Start engine and run at 690 rpm until engine reaches normal operational temperature of 170-195° (76.6-90.5° C).

(11) Follow final run-in schedule (4).

4. FINAL RUN-IN

RPM	BHP	RUN TIME
2100	430	30 MIN.

(12) Shut down engine. Change oil filter. Refer to paragraph 3-3 (TM 2320-20/12, TM 9-2320-297-20).

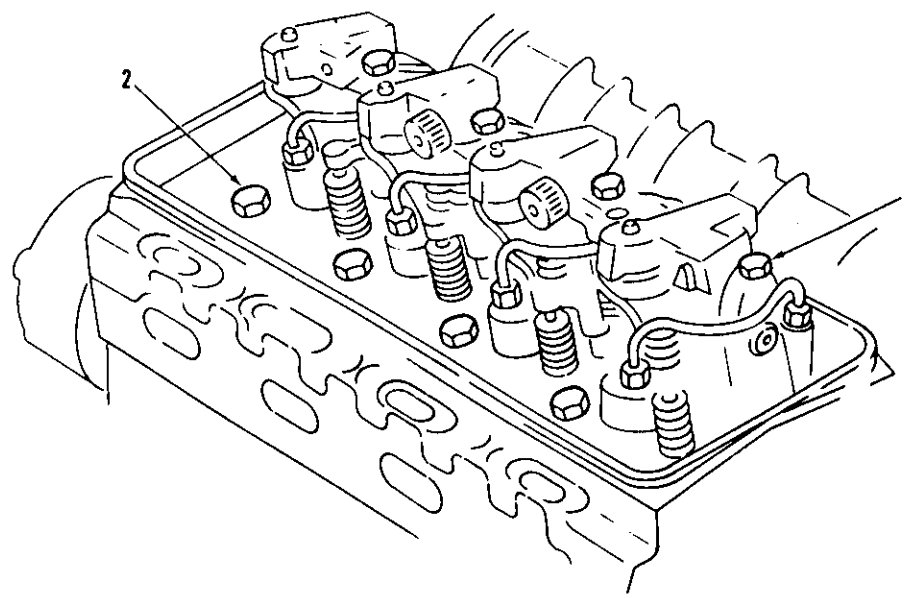
(13) Remove dynamometer.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 Install rocker covers
TM 9-2320-297-20 (para 3-4).



2. CYLINDER HEAD CAPSCREW (16)
3. ROCKER SHAFT CAPSCREW (16)

TA 298596

4-15. THROTTLE TREADLE VALVE MAINTENANCE (Continued)

c. Assembly

(1) Install stop screw (30) into pedal mounting plate (13).

(2) Install guide (27) onto upper body (12) by using four screws (28) and washers (29).

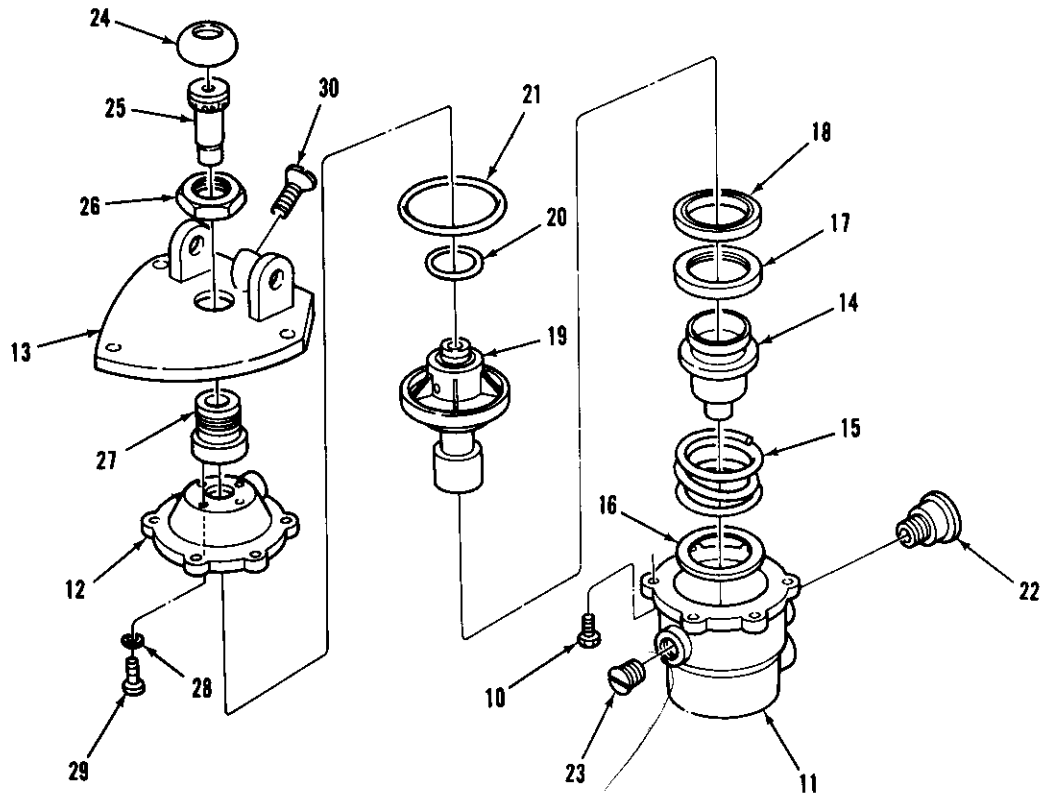
(3) Install pedal mounting plate (13) over guide (27). Install nut (26) onto guide (27) to retain pedal mounting plate (13).

(4) Install push rod (25) and boot (24) into guide (27).

(5) Install breather (22) and plug (23) into outlet body (11).

(6) Install two new O-rings (20 and 21) onto barrier plate assembly (19).

(7) Install seal (17) and thrust ring (18) onto piston (14).



10. SCREW (6)
11. OUTLET BODY
12. UPPER BODY
13. PEDAL MOUNTING PLATE
14. PISTON
15. SPRING
16. SHIM
17. SEAL
18. THRUST RING
19. BARRIER PLATE ASSEMBLY
20. O-RING
21. O-RING
22. BREATHER
23. PLUG
24. BOOT
25. PUSH ROD
26. NUT
27. GUIDE
28. SCREW (4)
29. WASHER (4)
30. STOP SCREW

TA 298702

3-29. ENGINE TUNE-UP

THIS TASK COVERS:
a. Exhaust Valve Clearance (Cold Engine)
b. Jacobs Brake Adjustment
c. Fuel Injector Timing
d. Governor Gap Adjustment
e. Injector Rack Control Lever Adjustment
f. Throttle Delay Adjustment
g. Maximum No-Load Engine Speed Adjustment
h. Idle Speed Adjustment
i. Buffer Screw Adjustment
j. Exhaust Valve Clearance (Hot Engine)

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Throttle delay pin gage (J 25558)
Throttle delay gage (J 25560)
Injector rack gage (J 23190)
Injector timing gage (J-34610)
Fuel line nut wrench (J 8932-01)

Materials/Parts

Cotter pin (P/N 103361) item 28
Lockwasher (P/N 7375429) item 16
Gasket (P/N 8922593) item 42

Personnel Required

1 MOS 3522
1 Assistant

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Engine access panel removed (para 18-14).
	Shutdown solenoid removed (para 4-13).
	Throttle cylinder removed (para 4-15).
	Rocker covers removed (para 3-4).

General Safety Instructions

Exhaust manifolds are hot. Use care to prevent personal injury.

Use care when working with a running engine. Avoid pullies and any moving parts to prevent personal injury.

Wear proper ear protection when working on engines without a muffler or exhaust system.

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a. Exhaust Valve Clearance (Cold Engine)

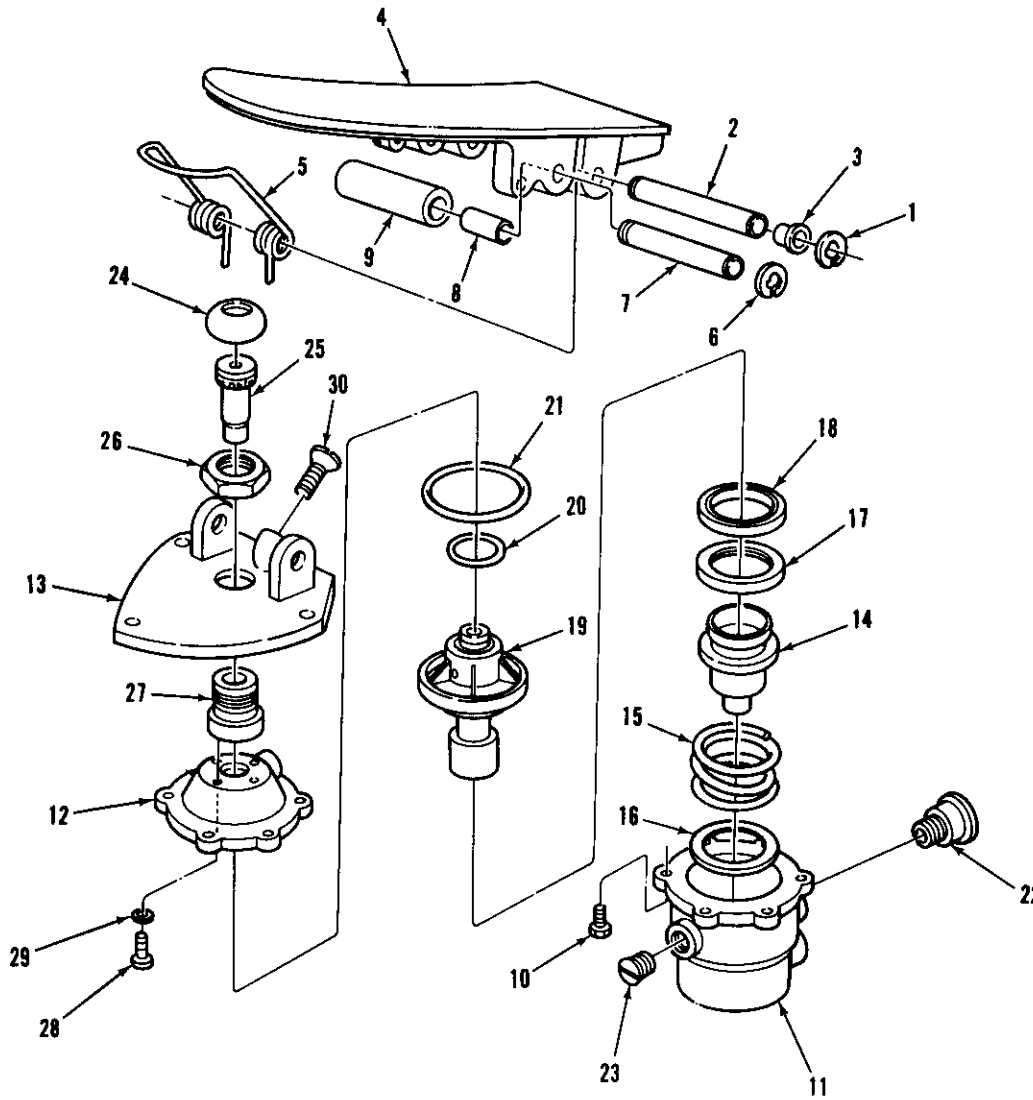
CAUTION

Perform all adjustments following the task coverage sequence. Engine overspeed could result if not properly followed.

(1) Install throttle lever (1).

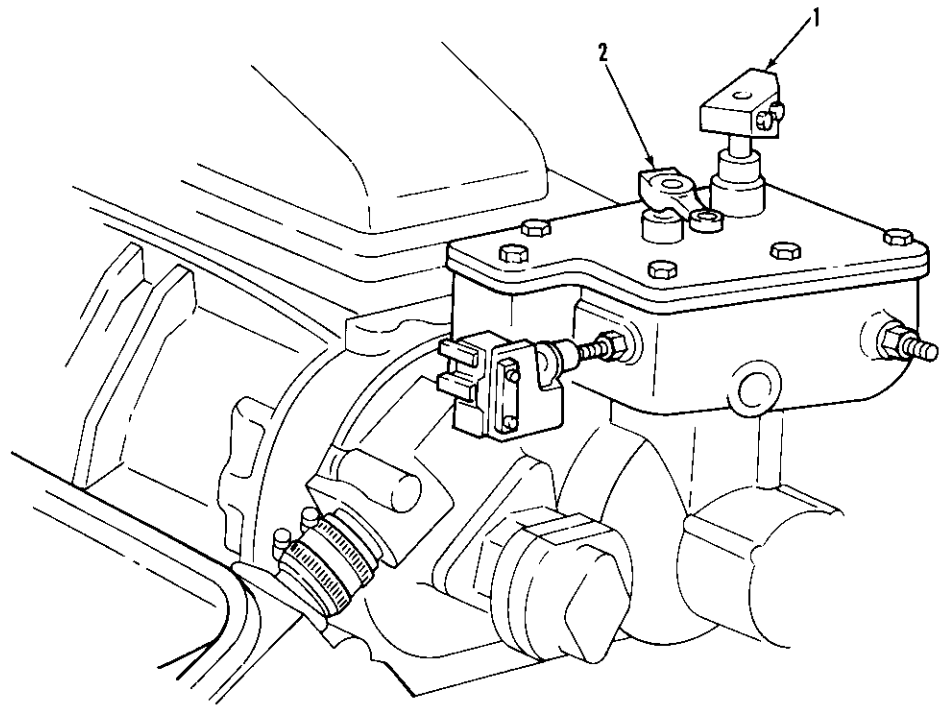
(2) Install shutdown lever (2).

(3) Place throttle lever (1) in IDLE position and secure stop lever (2) in STOP position



1. CLIP (2)
2. PIN
3. BUSHING (2)
4. PEDAL
5. SPRING
6. CLIP (2)
7. PIN
8. BUSHING
9. ROLLER
10. SCREW (6)
11. OUTLET BODY
12. UPPER BODY
13. PEDAL MOUNTING PLATE
14. PISTON
15. SPRING
16. SHIM
17. SEAL
18. THRUST RING
19. BARRIER PLATE ASSEMBLY
20. O-RING
21. O-RING
22. BREATHER
23. PLUG
24. BOOT
25. PUSH ROD
26. NUT
27. GUIDE
28. SCREW (4)
29. WASHER (4)
30. STOP SCREW

TA 298701



1. THROTTLE LEVER
2. SHUTDOWN LEVER

TA 298597

4-15. THROTTLE TREADLE VALVE MAINTENANCE

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Repair kit (NSN 2910-01-058-5118)
O-ring (P/N 116318) item 20
O-ring (P/N 118269) item 21

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Throttle treadle valve removed (para 4-22).

a. Disassembly

(1) Remove two clips (1), pin (2), and two bushings (3), to free pedal (4) and spring (5).

(2) Remove two clips (6), pin (7), bushing (8), and roller (9) from pedal (4).

(3) Remove six screws (10) to free outlet body (11) from upper body (12). Pedal mounting plate (13) is attached only to upper body (12).

(4) Tap outlet body (11) on flat surface to remove piston (14), spring (15), and shim (16).

(5) Remove seal (17) and thrust ring (18) from piston (14).

(6) Remove barrier plate assembly (19) from upper body (12).

(7) Remove O-rings (20 and 21) from barrier plate assembly (19). Discard O-rings (20 and 21).

(8) Remove breather (22) and plug (23) from outlet body (11).

(9) Remove boot (24) and push rod (25).

(10) Remove nut (26) from guide (27) to separate upper body (12) and pedal mounting plate (13).

(11) Remove guide (27) from upper body (12) by taking out four screws (28) and washers (29).

(12) Remove stop screw (30) from pedal mounting plate (13).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

3-29. ENGINE TUNE-UP (Continued)

NOTE

- Turn crankshaft clockwise when rotating. If crankshaft is turned counterclockwise, crankshaft capscrew can become loose.
- Jacobs brake can be adjusted at same time.

(4) Rotate crankshaft until injector follower (3) is fully depressed on the cylinder to be adjusted.

(5) Loosen locknut (4) on push rod (5).

(6) Place a 0.016 inch (0.406 mm) feeler gage between rocker arm (6) and valve bridge (7). Adjust push rod (5) to obtain a slight drag on feeler gage when pulled.

(7) Remove feeler gage. Holding push rod (5), tighten locknut (4) securely. Recheck clearance.

(8) Adjust all exhaust valves by following steps (3) thru (7).

b. Jacobs Brake Adjustment

NOTE

Turn crankshaft clockwise when rotating. If crankshaft is turned counterclockwise, crankshaft capscrew can become loose.

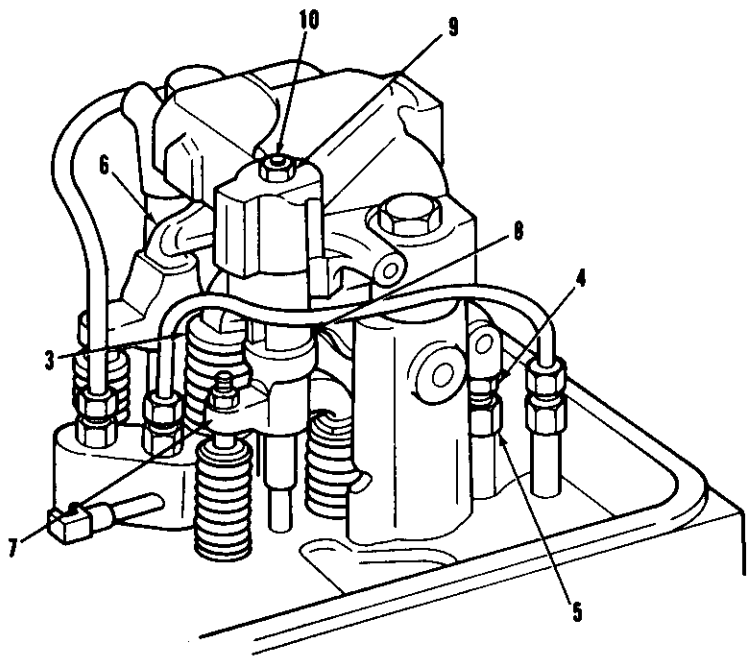
(1) Rotate crankshaft until injector follower (3) is fully depressed.

(2) Insert a 0.059 inch feeler gage between exhaust valve bridge (7) and slave piston (8).

(3) Loosen locknut (9) and adjust screw (10) until a light drag is felt on feeler gage.

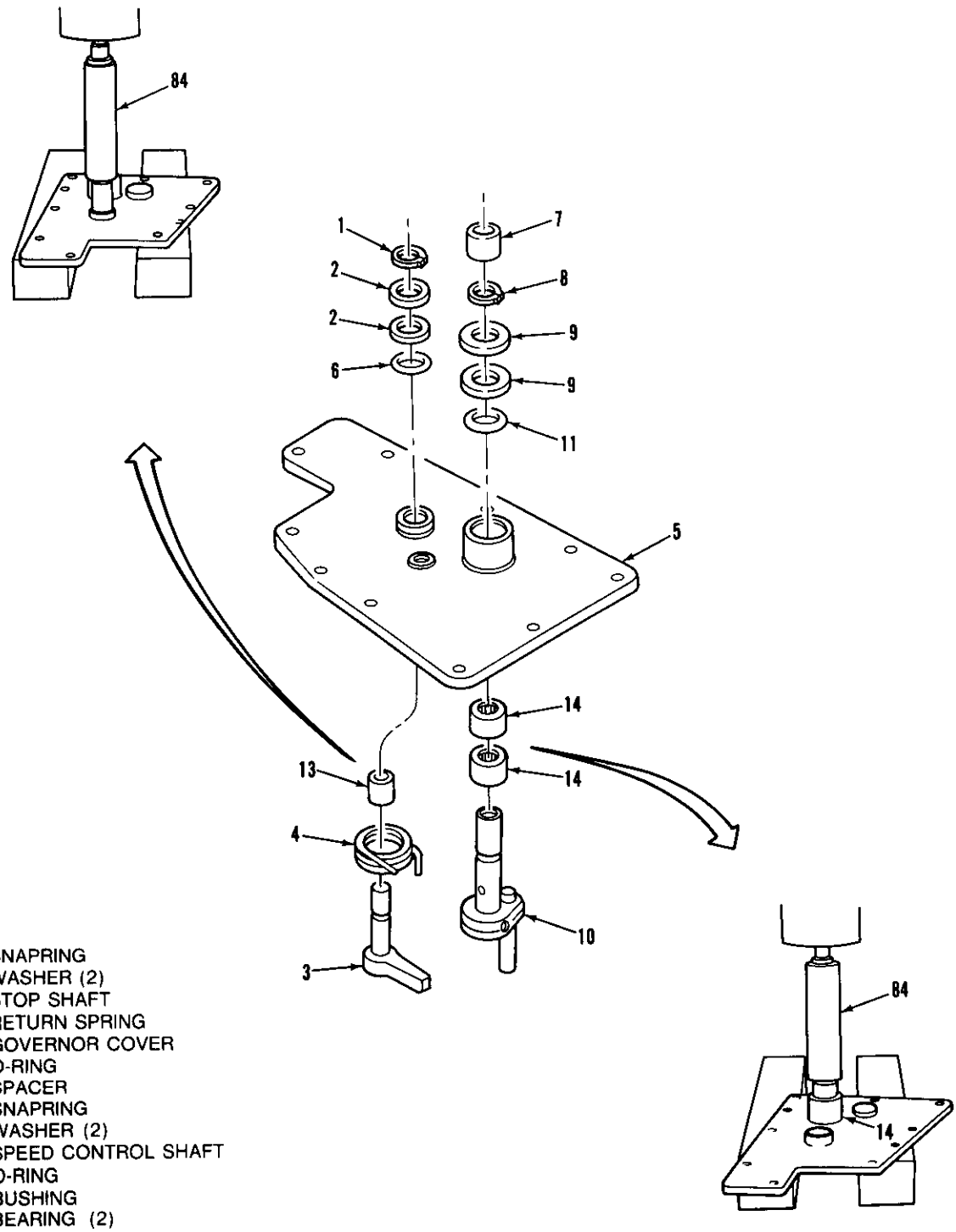
(4) Check on both sides of slave piston (8).

(5) Hold screw (10) and tighten locknut (9). Recheck clearance.



TA 296598

3. INJECTOR FOLLOWER
4. LOCKNUT
5. PUSH ROD
6. ROCKER ARM
7. VALVE BRIDGE
8. SLAVE PISTON
9. LOCKNUT
10. SCREW

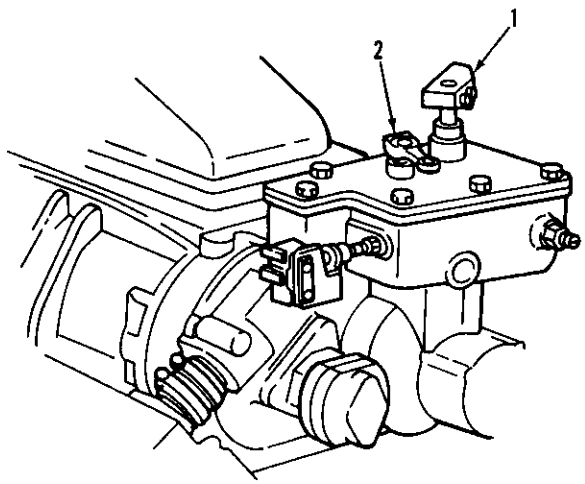


1. SNAPRING
2. WASHER (2)
3. STOP SHAFT
4. RETURN SPRING
5. GOVERNOR COVER
6. O-RING
7. SPACER
8. SNAPRING
9. WASHER (2)
10. SPEED CONTROL SHAFT
11. O-RING
13. BUSHING
14. BEARING (2)
84. COVER BEARING INSTALLER

TA 298700

c. Fuel Injector Timing

(1) Place throttle lever (1) in IDLE position and secure shutdown lever (2) in STOP position.



1. THROTTLE LEVER
2. SHUTDOWN LEVER

NOTE

Turn crankshaft clockwise when rotating. If crankshaft is turned counterclockwise, crankshaft capscrew can become loose.

(2) Rotate crankshaft until exhaust valve bridge (7) are fully depressed on the particular cylinder to be timed.

(3) Place small end of 1.458 timing gage (11) in hole at top of injector body.

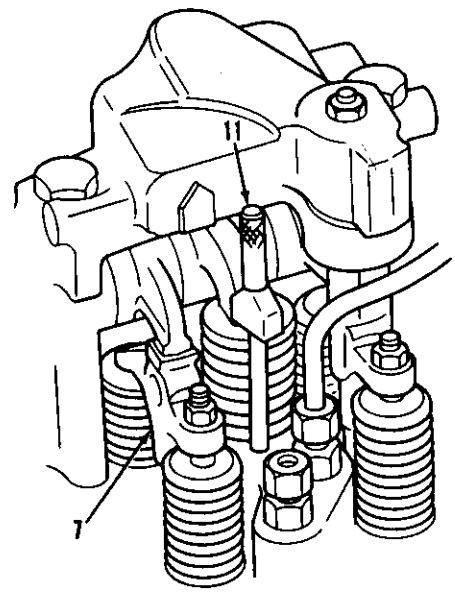
(4) Loosen locknut (4).

(5) Adjust push rod (5) until the flat extended part of timing tool has a slight drag over top of injector follower (3).

(6) Hold push rod (5) and tighten locknut (4).

(7) Check injector adjustment, and if necessary, readjust push rod (5).

(8) Time all injectors by following steps (1) thru (7).



7. EXHAUST VALVE BRIDGE
11. TIMING GAGE

TA 298599

4-14. GOVERNOR REPAIR (Continued)

(58) Place governor cover (5) in press, top facing up.

(59) Using cover bearing installer (84), press bearings (14), numbered side up, into governor cover (5).

(60) Turn governor cover (5) over in press, top facing down.

(61) Using cover bearing installer (84), press bushing (13) until flush with governor cover (5).

(62) Lubricate two bearings (14) and bushing (13) with grease.

NOTE

Spring arm goes behind stop pin (85). Spring tang goes over stop shaft (3).

(63) Install return spring (4) on governor cover (5).

(64) Install stop shaft (3) in return spring (4).

(65) Position stop shaft (3) against stop pin (85) on side opposite speed control shaft (10)

(66) Install new O-ring (6), two washers (2), and snapring (1) on stop shaft (3).

(67) Install speed control shaft (10) into governor cover (5) so guide pin (86) is between two pins (87) in governor cover (5).

(68) Install new O-ring (11), two washers (9), and snapring (8).

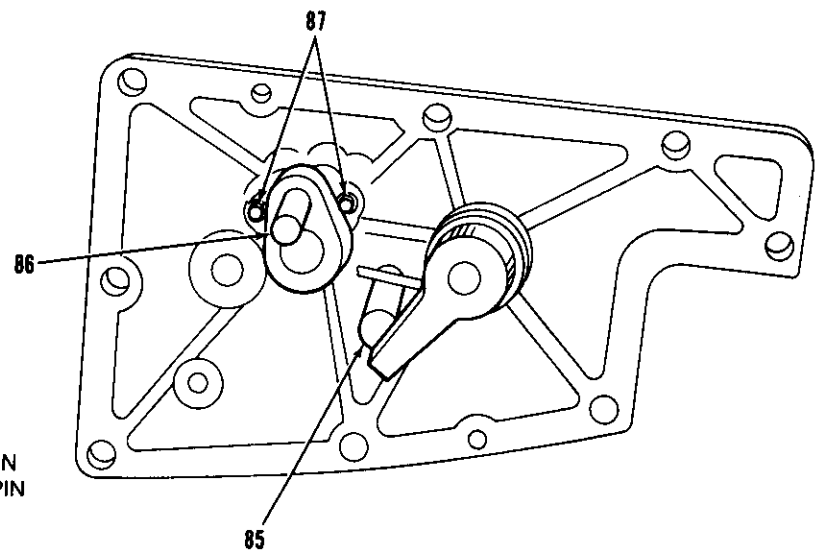
(69) Install spacer (7) on speed control shaft (10).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13	Install governor
TM 9-2320-297-34	(para 4-13).
	Install blower (para 4-6).



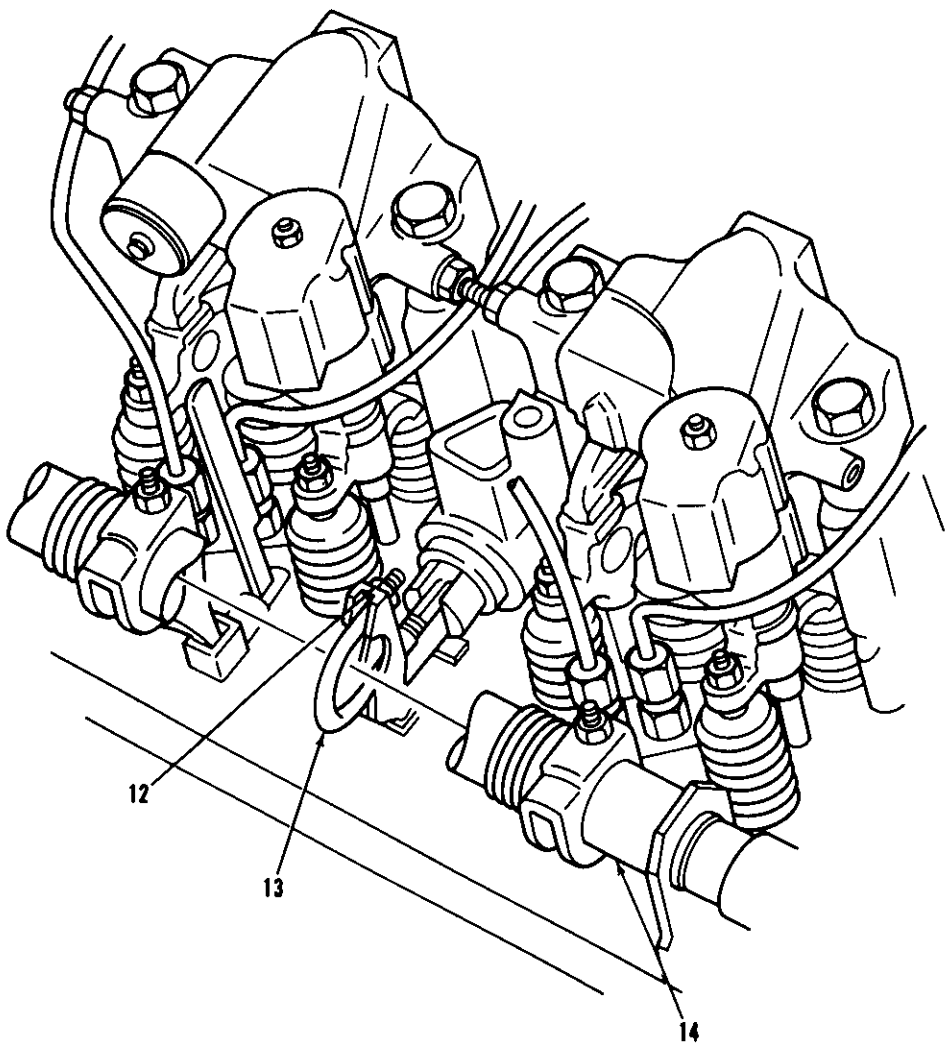
85. STOP PIN
86. GUIDE PIN
87. PIN (2)

TA 298699

3-29. ENGINE TUNE-UP (Continued)

d. Governor Gap Adjustment

(1) Loosen two U-bolt nuts (12) on throttle delay U-bolt (13) on right side injector control tube (14).



12. U-BOLT NUT (2)
13. U-BOLT
14. CONTROL TUBE

TA 298600

(47) Place high speed spring (26) on plunger (20), with loosely wound end of high speed spring (26) against shoulder of plunger (20).

(48) Insert adjusting pin (28), small end first, into plunger (20).

(49) Install plunger (20) assembly into high speed spring retainer (19).

(50) Thread adjusting screw (27) into threaded end of plunger (20) one half inch (12.7 mm).

(51) Install locknut (25) onto adjusting screw (27).

(52) Place low speed spring (23) into low speed spring cap (22).

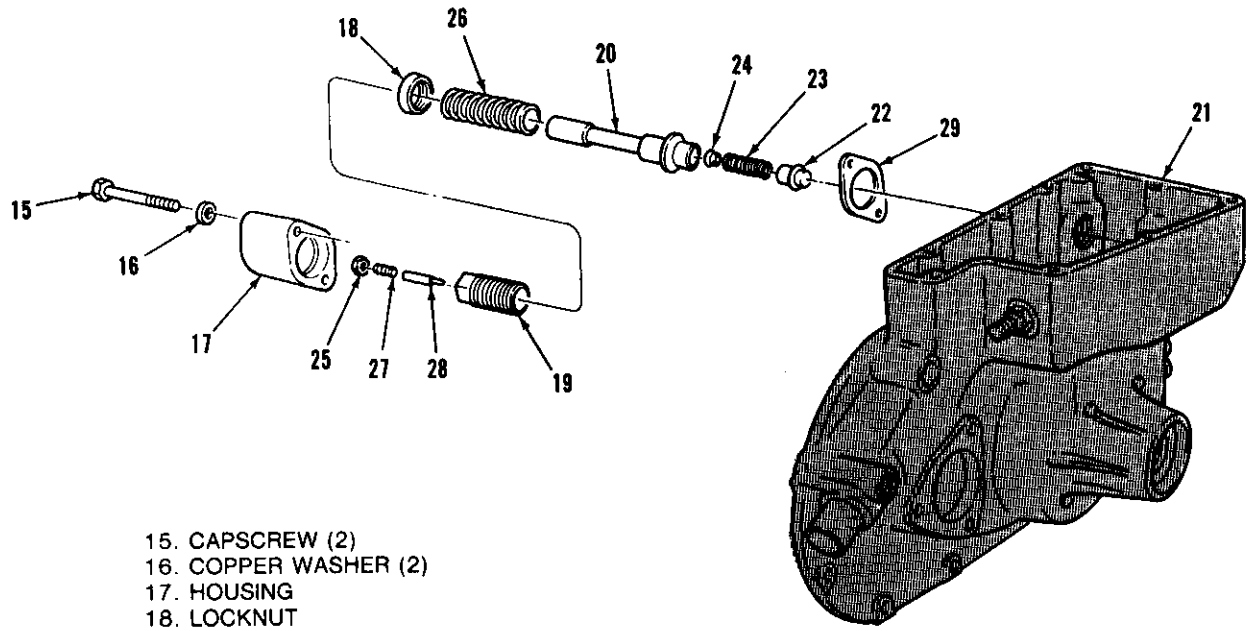
(53) Place small end of spring seat (24) into low speed spring (23).

(54) Install low speed spring (23), spring seat (24), and low speed spring cap (22) into plunger (20).

(55) Thread plunger (20) and high speed spring retainer (19) assembly into governor housing (21) one inch (25.4 mm).

(56) Tighten locknut (18).

(57) Install housing (17) and new gasket (29) with two capscrews (15) and two new copper washers (16). Hand tighten two capscrews (15).



15. CAPSCREW (2)
16. COPPER WASHER (2)
17. HOUSING
18. LOCKNUT
19. HIGH SPEED SPRING RETAINER
20. PLUNGER
21. GOVERNOR HOUSING
22. LOW SPEED SPRING CAP
23. LOW SPEED SPRING
24. SPRING SEAT
25. LOCKNUT
26. HIGH SPEED SPRING
27. ADJUSTING SCREW
28. ADJUSTING PIN
29. GASKET

TA 298698

(2) Remove two capscrews (15), lockwashers (16), and spring cover (17) from governor.

NOTE

Remove and discard any old gasket material.

(3) Back off buffer screw (18) until it extends 5/8 inch from locknut (19).

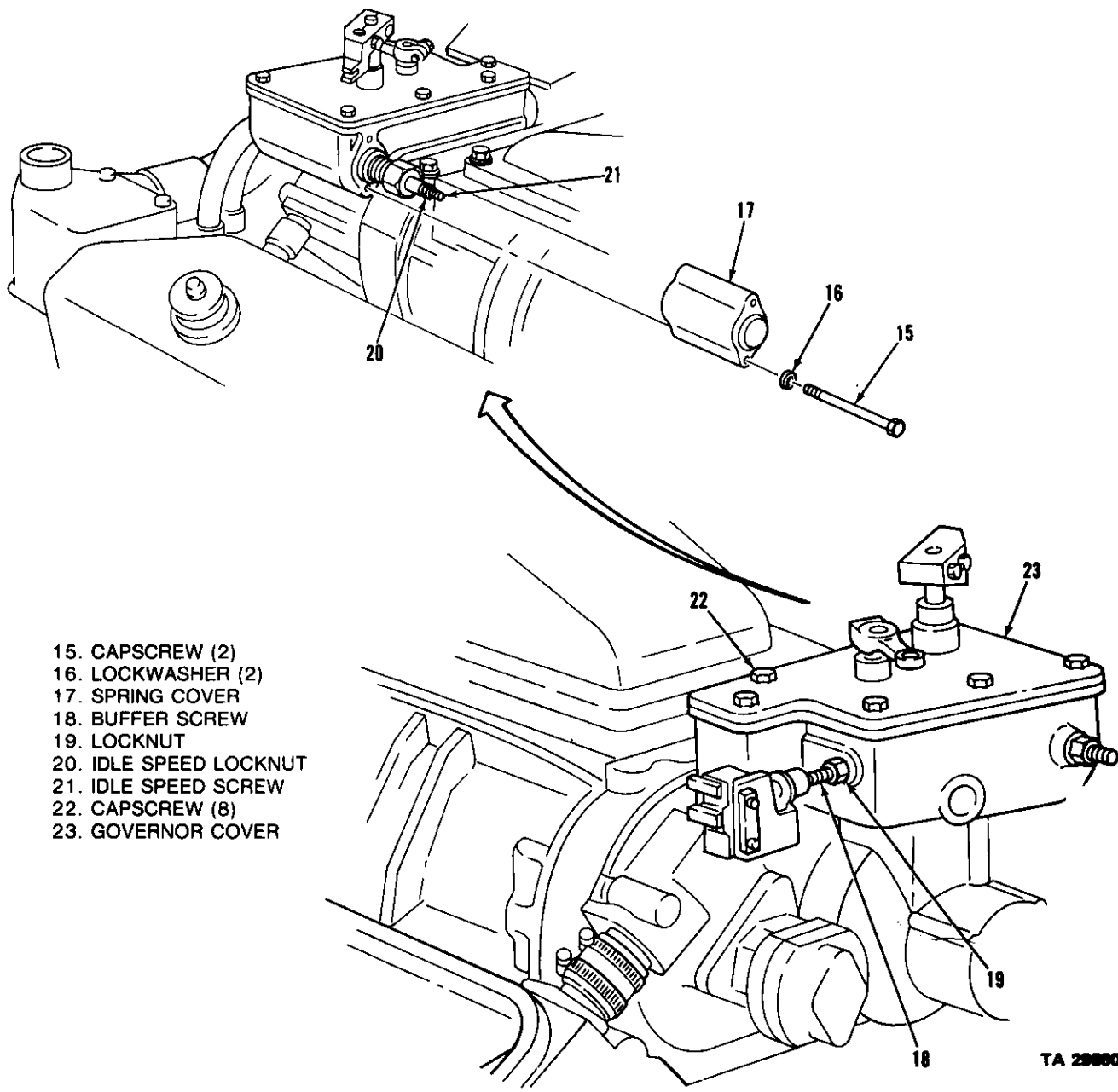
(4) Start engine and loosen idle speed locknut (20).

(5) Using an accurate tachometer, adjust idle speed screw (21) to obtain an idle speed of 690 rpm.

(6) Hold idle speed screw (21) and tighten idle speed locknut (20).

(7) Stop engine.

(8) Remove eight capscrews (22) and governor cover (23).



15. CAPSCREW (2)
16. LOCKWASHER (2)
17. SPRING COVER
18. BUFFER SCREW
19. LOCKNUT
20. IDLE SPEED LOCKNUT
21. IDLE SPEED SCREW
22. CAPSCREW (8)
23. GOVERNOR COVER

4-14. GOVERNOR REPAIR (Continued)

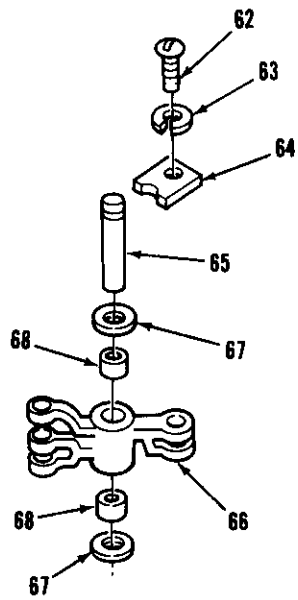
(42) If removed, lubricate two bearings (68) with grease. Press bearings (68), numbered side up, into control link operating lever (66) until flush with control link operating lever (66).

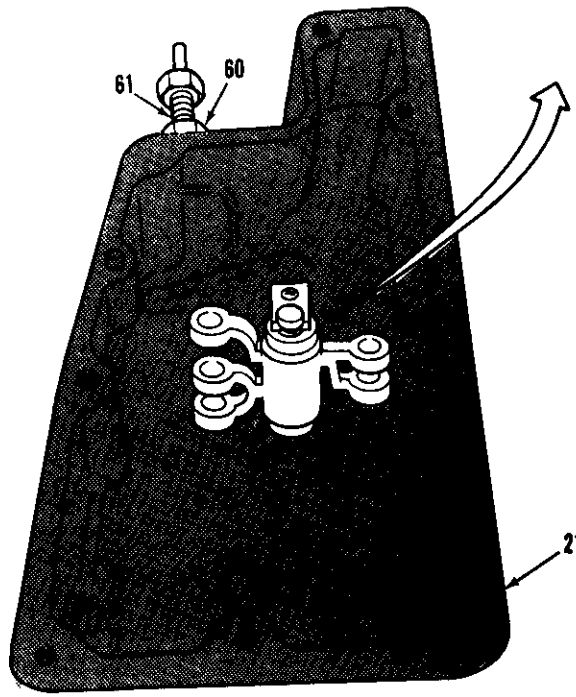
(43) Place control link operating lever (66) inside governor housing (21). Insert two washers (67), one on each side of control link operating lever (66).

(44) Install operating lever shaft (65) with slot up.

(45) Install locking clip (64), new lockwasher (63), and screw (62). Tighten screw (62) securely.

(46) Install buffer screw (61) and locknut (60).





21. GOVERNOR HOUSING
60. LOCKNUT
61. BUFFER SCREW
62. SCREW
63. LOCKWASHER
64. LOCKING CLIP
65. OPERATING LEVER SHAFT
66. CONTROL LINK OPERATING LEVER
67. WASHER (2)
68. BEARING (2)

TA 298697

3-29. ENGINE TUNE-UP (Continued)

CAUTION

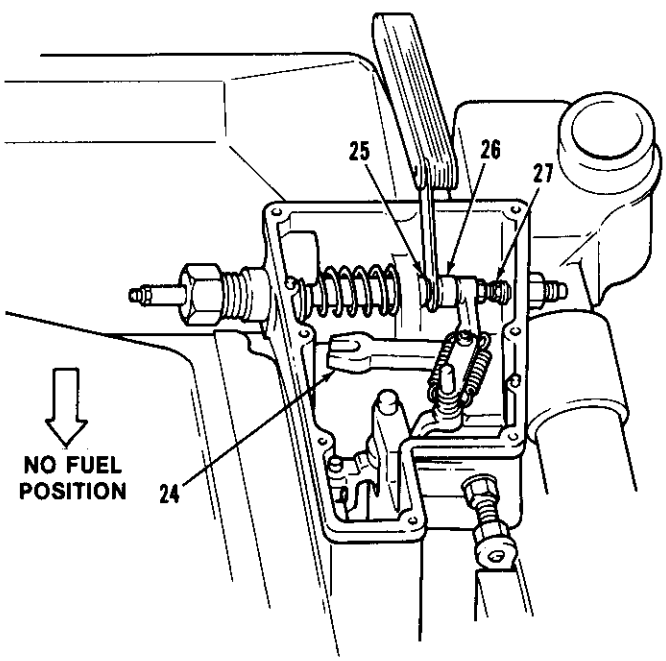
Governor is not controlling engine speed at this time. Make sure engine is not overspeeded.

(9) Start and run engine between 1100 and 1300 rpm by manual operation of differential lever (24).

(10) Check gap between spring plunger (25) and spring cap (26) with feeler gage. Gap should be between 0.002 and 0.004 inch.

(11) If gap is incorrect, adjust gap by adjusting screw (27) until correct gap is obtained.

(12) Stop engine by moving the differential lever (24), placing the governor in the NO FUEL position.



24. DIFFERENTIAL LEVER
25. SPRING PLUNGER
26. SPRING CAP
27. SCREW

TA 298602

(13) Aline shaft assemblies in governor cover (23) with levers inside governor housing. Install governor cover (23) on housing with eight capscrews (22).

e. Injector Rack Control Lever Adjustment

NOTE

Letters R or L will indicate injector location in the right or left cylinder bank, viewed from rear of engine. Cylinders will be numbered starting at front of engine on each cylinder bank.

(1) Turn idle speed screw (21) until it extends 1/2 inch (12.7 mm) beyond idle speed locknut (20).

(2) Back off buffer screw (18) about 5/8 inch (15.87 mm) beyond locknut (19).

CAUTION

Cover oil drain hole in cylinder head with a clean rag to prevent cotter pin (28) from falling into engine.

(3) Remove cotter pin (28) and pin (29) from right hand control tube lever. Discard cotter pin (28).

(4) Loosen all rack control lever locknuts (30) and adjusting screws (31). Control levers (32) should be loose on control tubes (14).

(5) Hold throttle lever (1) to maximum speed position.

(36) Place governor housing (21) in soft-jawed vise.

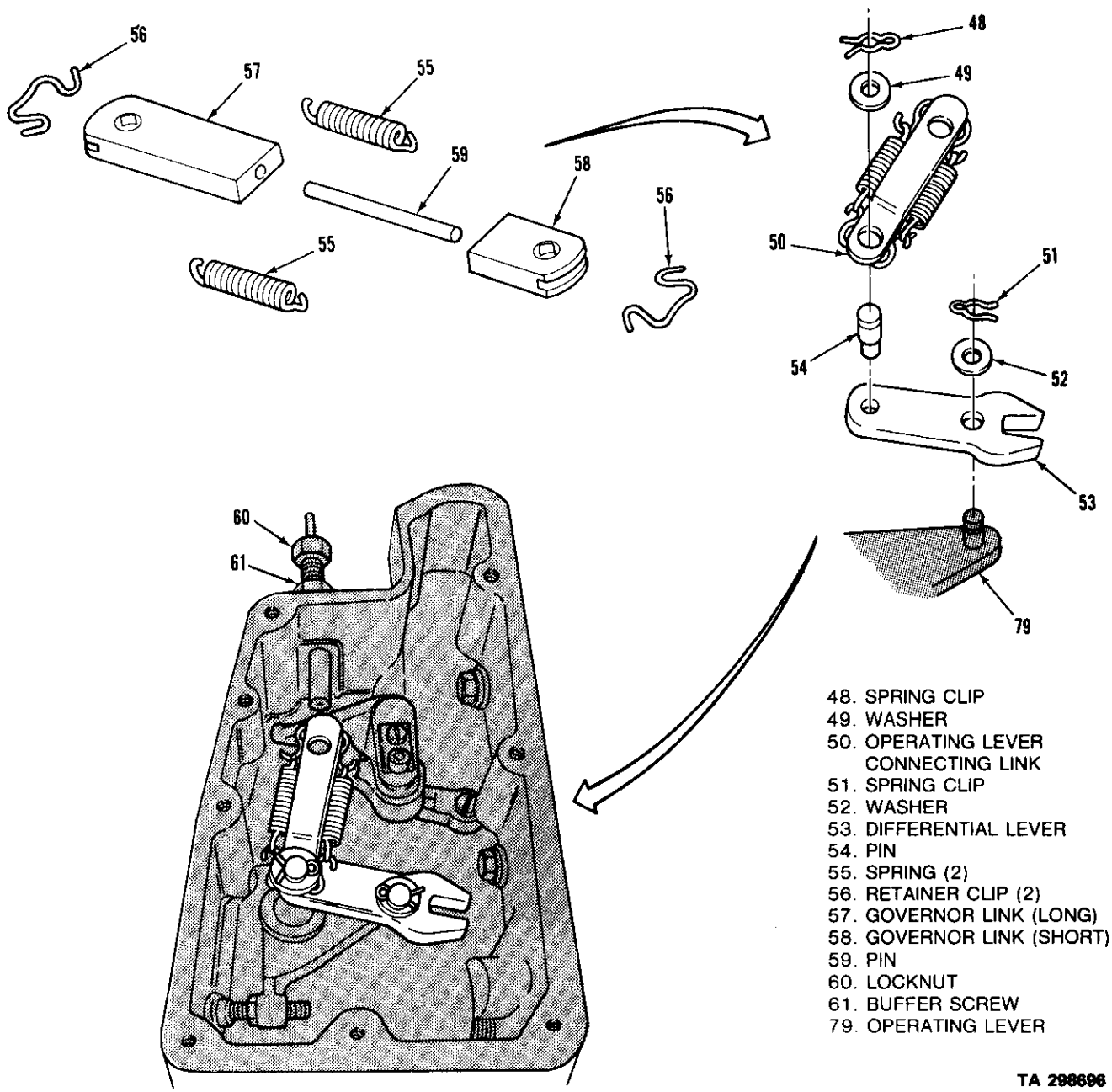
(37) Install pin (59) into governor link (57). Install governor link (58) onto pin (59).

(38) Install two retainer clips (56) and two springs (55).

(39) If removed, install pin (54) into differential lever (53).

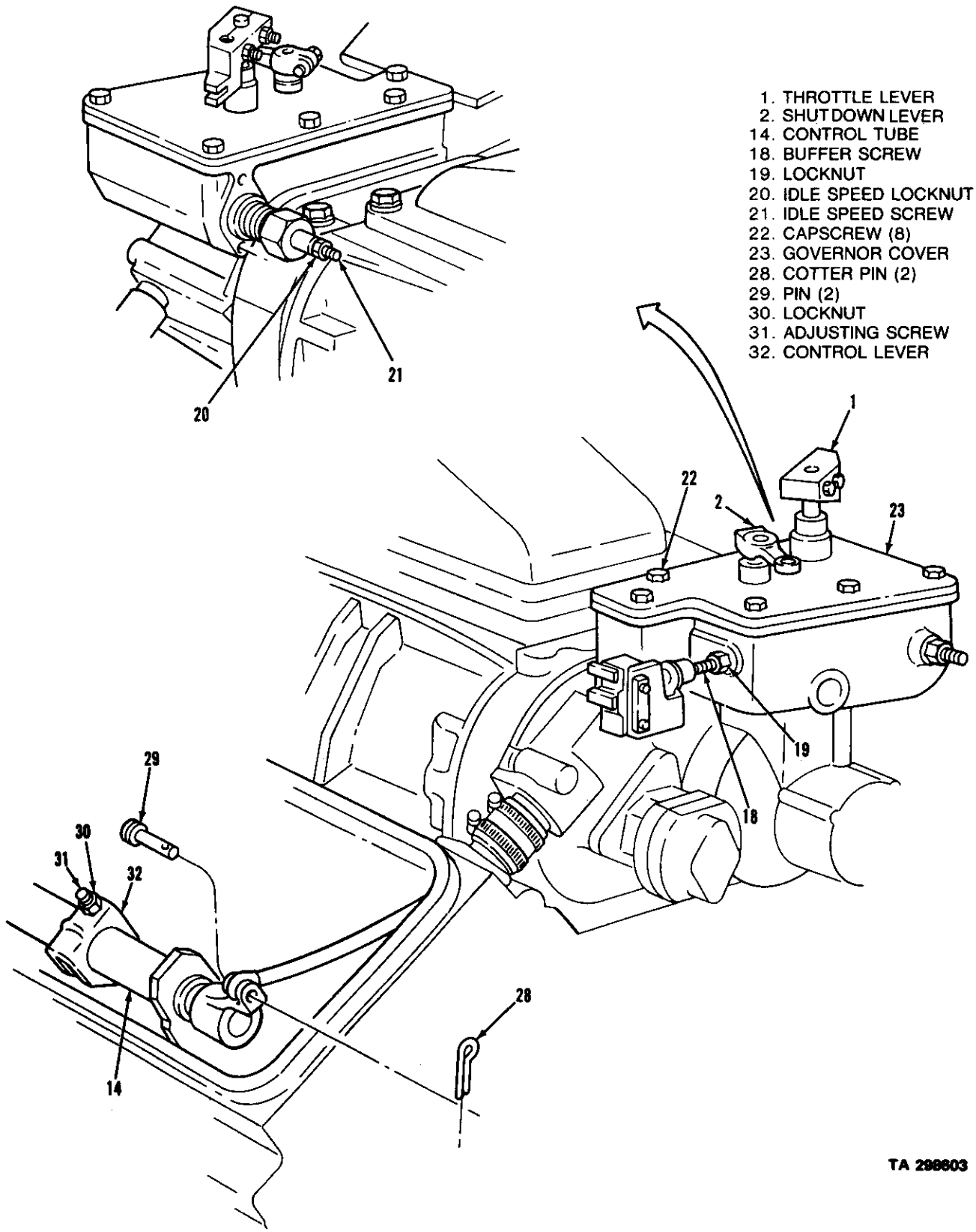
(40) Install differential lever (53), washer (52), and spring clip (51) on operating lever (79). Slot faces rear of governor housing (21).

(41) Install operating lever connecting link (50) on differential lever (53). Install washer (49) and spring clip (48).



48. SPRING CLIP
49. WASHER
50. OPERATING LEVER CONNECTING LINK
51. SPRING CLIP
52. WASHER
53. DIFFERENTIAL LEVER
54. PIN
55. SPRING (2)
56. RETAINER CLIP (2)
57. GOVERNOR LINK (LONG)
58. GOVERNOR LINK (SHORT)
59. PIN
60. LOCKNUT
61. BUFFER SCREW
79. OPERATING LEVER

TA 298696


1. THROTTLE LEVER
2. SHUTDOWN LEVER
14. CONTROL TUBE
18. BUFFER SCREW
19. LOCKNUT
20. IDLE SPEED LOCKNUT
21. IDLE SPEED SCREW
22. CAPSCREW (8)
23. GOVERNOR COVER
28. COTTER PIN (2)
29. PIN (2)
30. LOCKNUT
31. ADJUSTING SCREW
32. CONTROL LEVER
1
2
14
18
19
20
21
22
23
28
29
30
31
32
TA 298603

4-14. GOVERNOR REPAIR (Continued)

(23) Install bearing (38) into governor housing (21).

(24) Install riser (40) on weight shaft (37).

(25) Install riser bearing (39), smaller inside diameter first, against riser (40).

(26) Start weight shaft (37) into bearing (38).

(27) Place governor housing (21) in press. Support splined end of weight shaft (37).

(28) Press bearing (38) onto shaft until bearing (38) seats on shoulder of weight shaft (37).

(29) Clamp splined end of weight shaft (37) in soft-jawed vise.

(30) Position new lockwasher (32) with tab facing into governor housing (21).

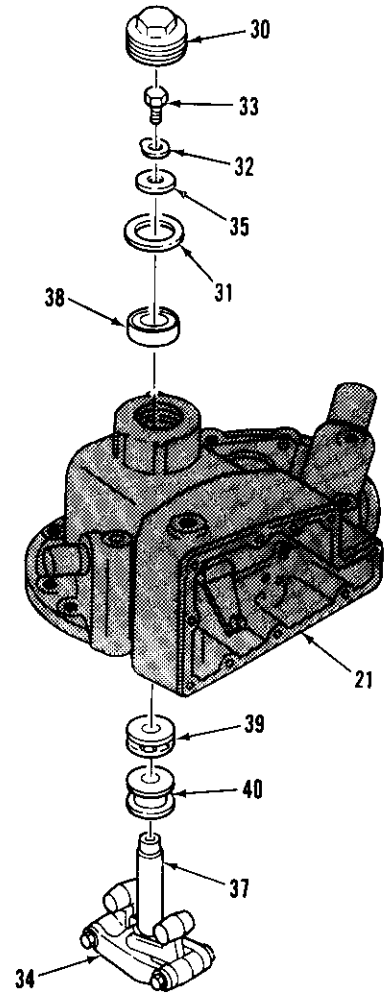
(31) Install retainer capscrew (33) and washer (35).

(32) Torque retainer capscrew (33) to 15-19 foot-pounds (20-26 N·m). Bend tang on new lockwasher (32) against head of retainer capscrew (33).

(33) Install new gasket (31) against bearing (38).

(34) Lightly coat threads of plug (30) with pipe sealant.

(35) Install plug (30) into governor housing (21). Torque plug (30) to 45 foot-pounds (61 N·m).



21. GOVERNOR HOUSING
30. PLUG
31. GASKET
32. LOCKWASHER
33. RETAINER CAPSCREW
34. WEIGHT CARRIER
35. WASHER
37. WEIGHT SHAFT
38. BEARING
39. RISER BEARING
40. RISER

TA 298695

3-29. ENGINE TUNE-UP (Continued)

NOTE

Letters R or L will indicate injector location in the right or left cylinder bank, viewed from rear of engine. Cylinders will be numbered starting at front of engine on each cylinder bank.

(6) Turn adjusting screw (31) on 1L injector rack control lever until injector control rack (33) rolls up on control lever (32). Turn adjusting screw (31) an additional 1/8 turn.

(7) Tighten locknut (30) on adjusting screw (31).

(8) To check proper rack lever adjustment, hold speed control lever (32) in maximum speed position.

(a) Using a screwdriver, press downward on control rack (33).

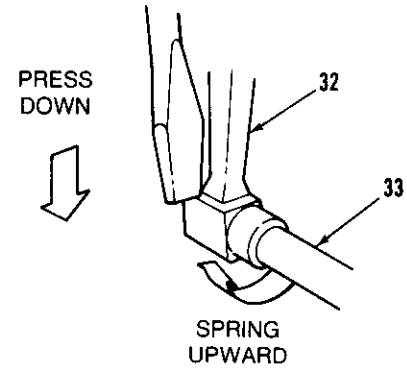
(b) Slide screwdriver off from control rack (33). Control rack (33) should spring back upward.

(c) If control rack (33) does not spring back, tighten adjusting screw (31) slightly and repeat steps a and b.

(d) All control racks (33) must have this spring action for proper adjustment.

(9) Install clevis pin (29) in right hand control tube lever and fuel rod (34.)

32. SPEED CONTROL LEVER
33. CONTROL RACK



TA 299702

(10) Remove cotter pin (28) and clevis pin (29) from left hand control tube (14). Discard cotter pin (28).

(11) Hold throttle lever (1) in maximum speed position.

(12) Adjust 1R speed control lever (32) until a spring action has been obtained at the injector control rack (33). Tighten locknut (30) on adjusting screw (31).

(13) Install clevis pin (29) in left hand control tube lever and fuel rod (34).

(14) Hold throttle lever (1) in maximum speed position and recheck 1R and 1L control rack (33) for spring action.

(15) Remove clevis pin (29) from the right and left hand control tubes (14).

NOTE

For the remaining control racks (33), injector control tube levers can be used to hold control rack (33) in full fuel position.

(16) Adjust the left hand cylinder bank starting with 2L speed control lever (32). Adjust 2L control rack (33) until spring action is obtained.

(19) Press weight shaft (37) into weight carrier (43) until shoulder of weight shaft (37) is seated in weight carrier (43).

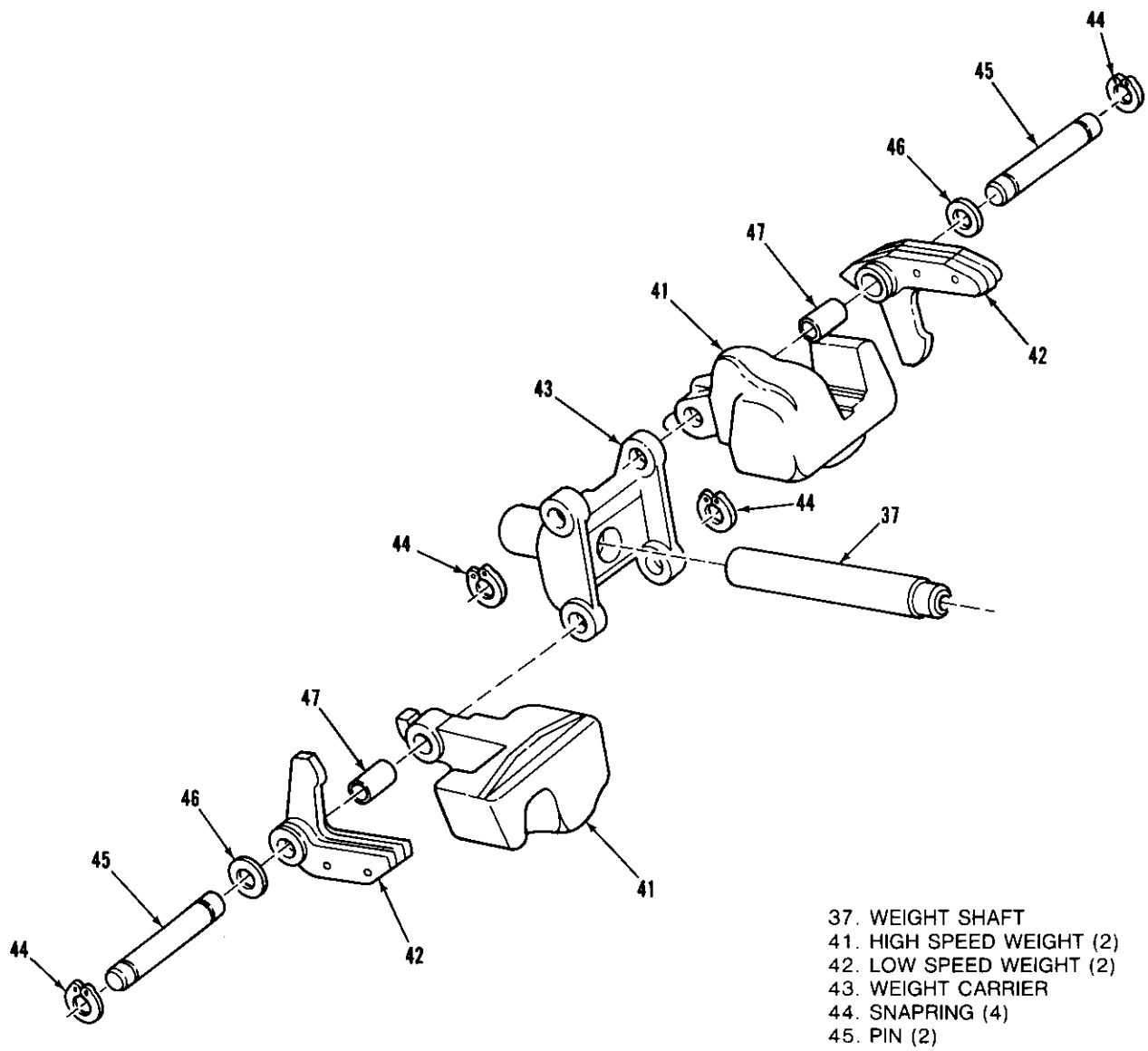
(20) If removed, press two bushings (47) into low speed weight (42).

NOTE

When installing weights, be sure matchmarks made at disassembly are alined.

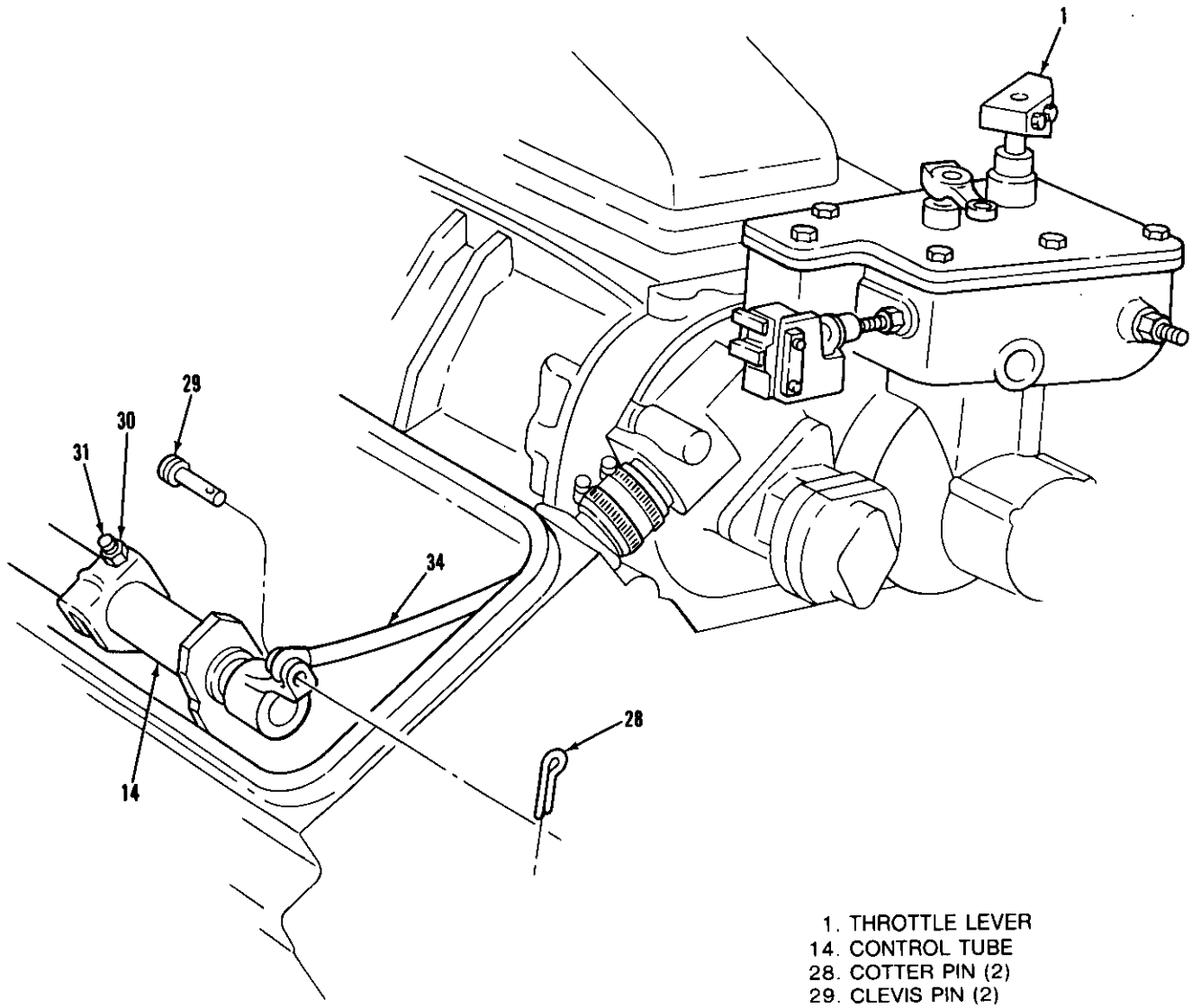
(21) Aline and install high speed weight (41), and low speed weight (42), pin (45), and two washers (46) into weight carrier (43). Install snapring (44).

(22) Repeat steps (20) and (21) for remaining weights (41 and 42).



37. WEIGHT SHAFT
41. HIGH SPEED WEIGHT (2)
42. LOW SPEED WEIGHT (2)
43. WEIGHT CARRIER
44. SNAPRING (4)
45. PIN (2)
46. WASHER (2)
47. BUSHING (2)

TA 298694



1. THROTTLE LEVER
14. CONTROL TUBE
28. COTTER PIN (2)
29. CLEVIS PIN (2)
30. LOCKNUT
31. ADJUSTING SCREW
34. FUEL ROD

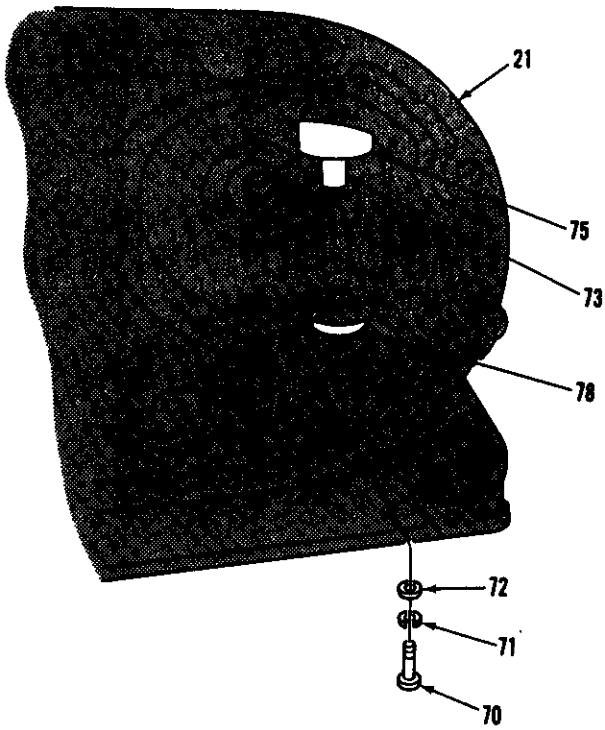
TA 298604

4-14 GOVERNOR REPAIR (Continued)

(11) Seat upper bearing (78) and install upper bearing retainer screw (70), new lockwasher (71), and washer (72).

(12) Lubricate lower bearing (75) with grease.

(13) Start lower bearing (75), shield side up, into governor housing (21) on operating shaft (73).



21. GOVERNOR HOUSING
69. EXPANSION PLUG
70. UPPER BEARING RETAINER SCREW
71. LOCKWASHER
72. WASHER
73. OPERATING SHAFT
75. LOWER BEARING
78. UPPER BEARING

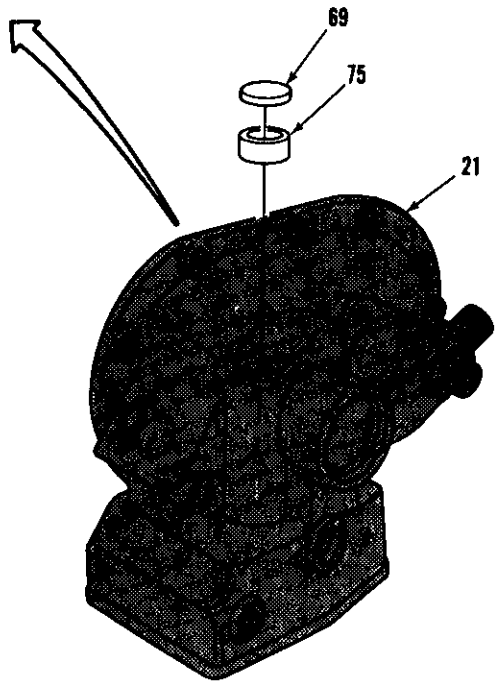
(14) Press lower bearing (75) on operating shaft (73) until bearing seats on shoulder in governor housing (21).

(15) Apply pipe sealant to edge of expansion plug (69).

(16) Install new expansion plug (69), curved side up, into governor housing (21).

(17) Tap center of expansion plug (69) to seat expansion plug (69).

(18) Place governor housing (21) in soft-jawed vise.



TA 298693

3-29. ENGINE TUNE-UP (Continued)

(17) Adjust 3L and 4L rack until spring action is obtained.

NOTE

Do not readjust 1R or 1L rack control levers. Adjustments should be made on remaining control lever.

(18) Recheck for spring action in all control racks on the left hand cylinder bank. All control racks must have the spring action when in full fuel position.

(19) Tighten locknuts (30) on all left hand cylinder bank adjusting screws (31).

(20) Adjust speed control levers (32) on the right hand cylinder bank. Start with 2R control rack.

(21) Once control racks have been adjusted to spring action, recheck all control racks (33) for proper adjustment.

(22) Tighten locknuts (30) on all right hand cylinder bank adjusting screws (31).

(23) Recheck all control racks (33) for spring action on cylinder banks.

(24) Install fuel rod (34), clevis pin (29), and new cotter pin (28) in control tube lever. Install clevis pin (29) on both cylinder banks.

(25) Turn idle speed adjusting screw (21) in until screw extends out 3/16 inch from idle speed locknut (20). This will enable engine to be started.

(26) Set shutdown lever (2) in RUN position and throttle lever (1) in IDLE position.

(27) Hold starting aid screw (35) and loosen locknut (36).

(28) Adjust starting aid screw (35) so .454 gage tool can be placed between 1R injector rack clevis shoulder (37) and injector body (38). Adjust starting aid screw (35) until clearance (39) between gage tool and injector body (38) is 0.0156 inch (0.397 mm).

(29) Hold starting aid screw (35) and tighten locknut (36).

NOTE

Movement of speed control lever (32) is to take up clearance in governor linkage.

(30) Position shutdown lever (2) in RUN position.

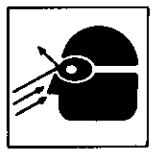
(31) Move throttle lever (1) from idle speed, to maximum speed, back to idle speed.

(32) Recheck clearance (39) of injector rack clevis-to-body, and adjust if necessary.

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

WARNING



Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psi. Eye protection is required.

(2) Dry parts with compressed air.

(3) Inspect bearings (75 and 78) for corrosion, pitting, and rough spots.

(4) Inspect governor housing (21) for cracks, warpage, and damaged threads.

(5) Remove old sealant from all mating surfaces.

(6) Inspect all other parts. Refer to paragraph 2-7.

(7) Replace all parts failing inspection.

c. Assembly

(1) Install adjusting screw (81) to length measured at disassembly.

(2) Tighten locknut (80) securely.

(3) If removed, install pin (82) into operating lever (79).

(4) Install upper bearing (78) on large end of operating shaft (73) with shield side of upper bearing (78) down.

(5) Press operating lever (79) with pin (82) facing up on operating shaft (73) until flush with operating shaft (73).

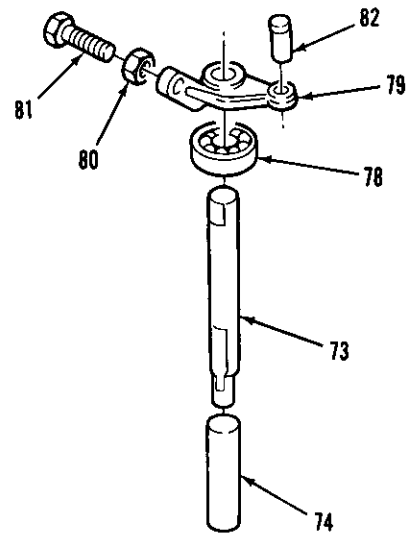
(6) Install spacer (74) onto operating shaft (73).

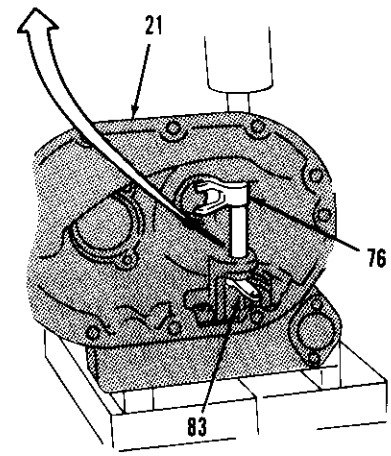
(7) Place operating shaft (73) into governor housing (21), positioning fork (76) with finished finger surface facing rear of governor housing (21).

(8) Place governor housing (21) in press with top facing down.

(9) Place a support (83) under operating shaft (73).

(10) Press fork (76) until spacer (74) does not move up or down.

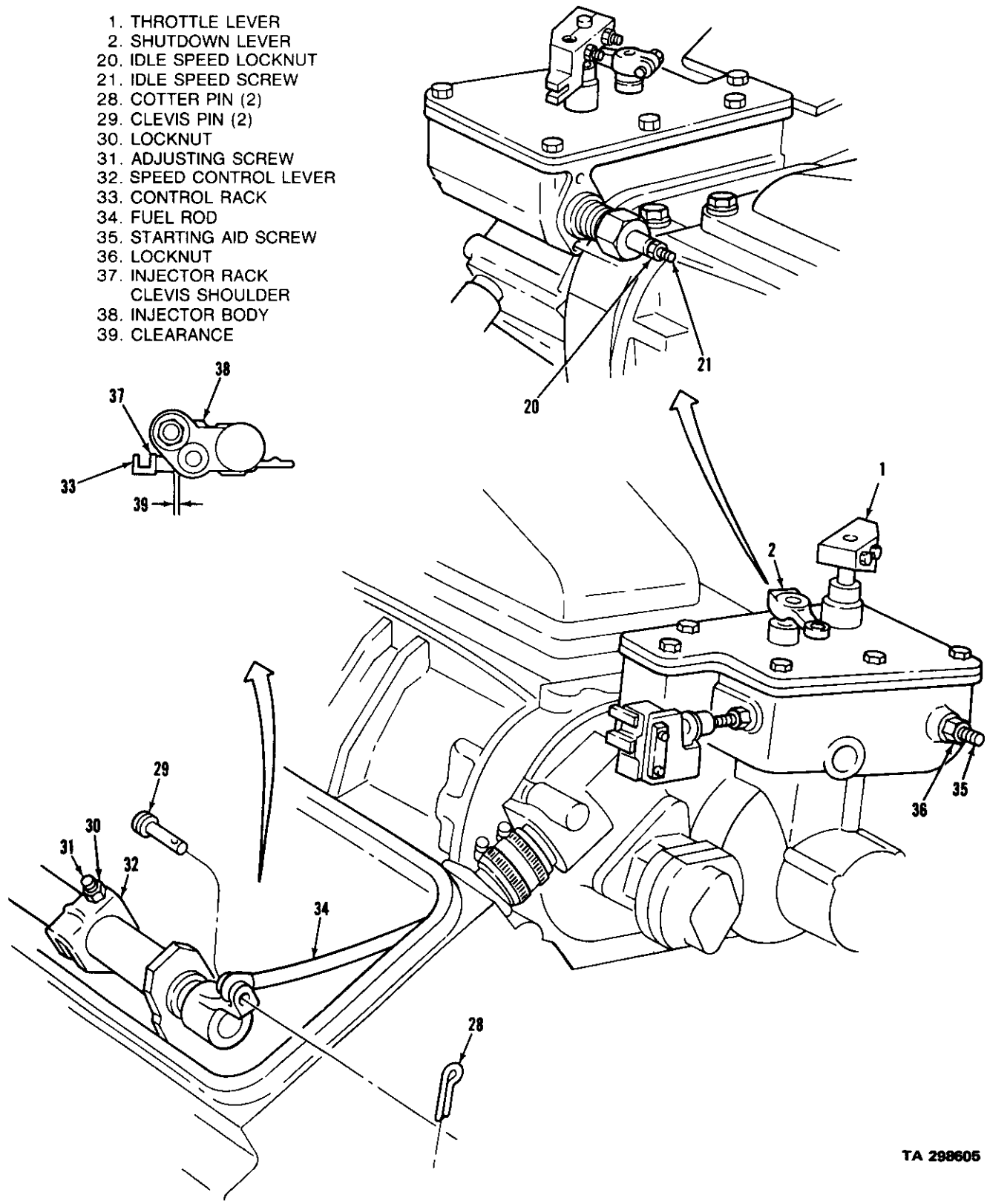




21. GOVERNOR HOUSING
73. OPERATING SHAFT
74. SPACER
76. FORK
78. UPPER BEARING
79. OPERATING LEVER
80. LOCKNUT
81. ADJUSTING SCREW
82. PIN
83. SUPPORT

TA 298692

1. THROTTLE LEVER
2. SHUTDOWN LEVER
20. IDLE SPEED LOCKNUT
21. IDLE SPEED SCREW
28. COTTER PIN (2)
29. CLEVIS PIN (2)
30. LOCKNUT
31. ADJUSTING SCREW
32. SPEED CONTROL LEVER
33. CONTROL RACK
34. FUEL ROD
35. STARTING AID SCREW
36. LOCKNUT
37. INJECTOR RACK CLEVIS SHOULDER
38. INJECTOR BODY
39. CLEARANCE



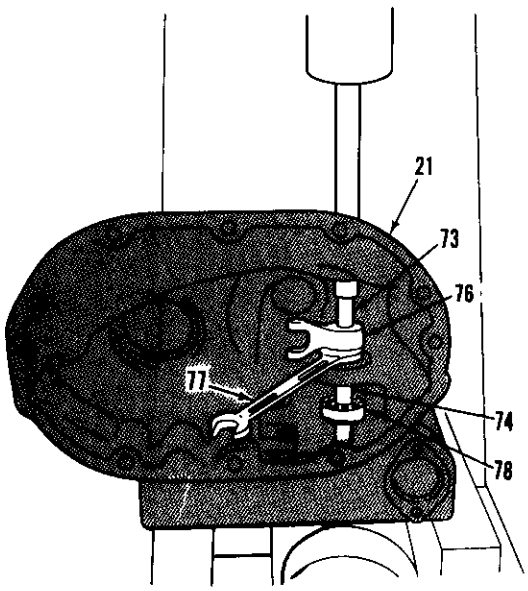
TA 298605

4-14. GOVERNOR REPAIR (Continued)

(51) Support fork (76) with wrench (77).

(52) Press operating shaft (73) from fork (76). Remove fork (76) and wrench (77).

(53) Remove spacer (74), operating shaft (73), upper bearing (78), and operating lever (79) from governor housing (21).



21. GOVERNOR HOUSING
73. OPERATING SHAFT
74. SPACER
76. FORK
77. WRENCH
78. UPPER BEARING

(54) Press operating shaft (73) from upper bearing (78) and operating lever (79).

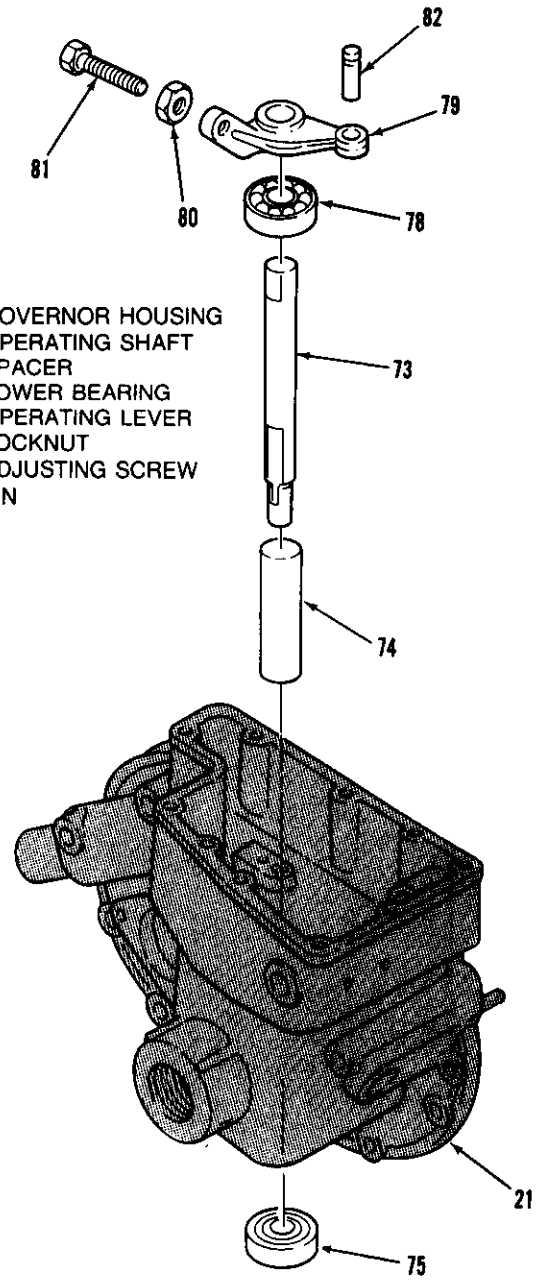
NOTE

Measure and note length of gap adjusting screw to aid in assembly.

(55) Loosen locknut (80) and remove adjusting screw (81).

(56) Remove pin (82) only if damaged.

(57) Press lower bearing (75) from governor housing (21).



21. GOVERNOR HOUSING
73. OPERATING SHAFT
74. SPACER
75. LOWER BEARING
79. OPERATING LEVER
80. LOCKNUT
81. ADJUSTING SCREW
82. PIN

TA 298691

3-29. ENGINE TUNE-UP (Continued)

f. Throttle Delay Adjustment

(1) Insert timing gage (43) between injector body (38) and injector rack clevis shoulder (37) nearest the throttle delay cylinder (44).

(2) Secure throttle lever (1) in maximum position. This will cause injector rack to move against timing gage (43).

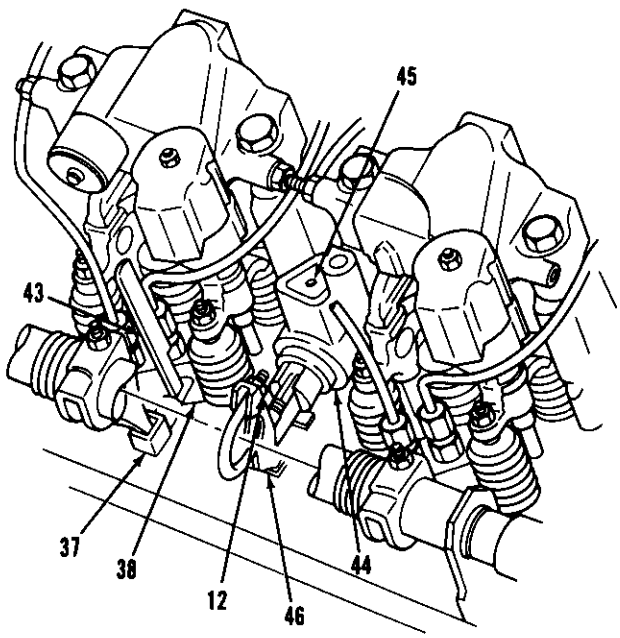
(3) Insert 0.069 inch end of pin gage into throttle delay cylinder fill hole (45).

(4) Push delay link (46) until piston contacts pin gage.

CAUTION

Do not overtighten two U-bolt nuts (12).

(5) Tighten two U-bolt nuts (12) while applying slight pressure on delay link (46) towards pin gage.



(6) Check the setting using the following steps:

(a) Remove pin gage.

NOTE

If 0.072 inch end of pin gage enters fill hole, tighten upper U-bolt nut (12). If 0.069 inch end will not enter fill hole without resistance, tighten lower U-bolt nut (12).

(b) Install 0.072 inch end of pin gage. It should not be able to fit back in cylinder fill hole (45).

(c) Reverse pin gage to 0.069 inch end and insert gage in cylinder fill hole (45). Gage should enter cylinder fill hole (45) without resistance.

(7) Release speed control lever and remove timing gage (43) and pin gage.

(8) Move throttle lever (1) from idle position to maximum speed position. There should be no bind in control tube assembly movement.

(9) Install two rocker covers. Refer to paragraph 3-4 (TM 2320-20/12, TM 9-2320-297-20).

12. U-BOLT NUTS
37. INJECTOR RACK CLEVIS SHOULDER
38. INJECTOR BODY
43. TIMING GAGE
44. THROTTLE DELAY CYLINDER
45. CYLINDER FILL HOLE
46. DELAY LINK

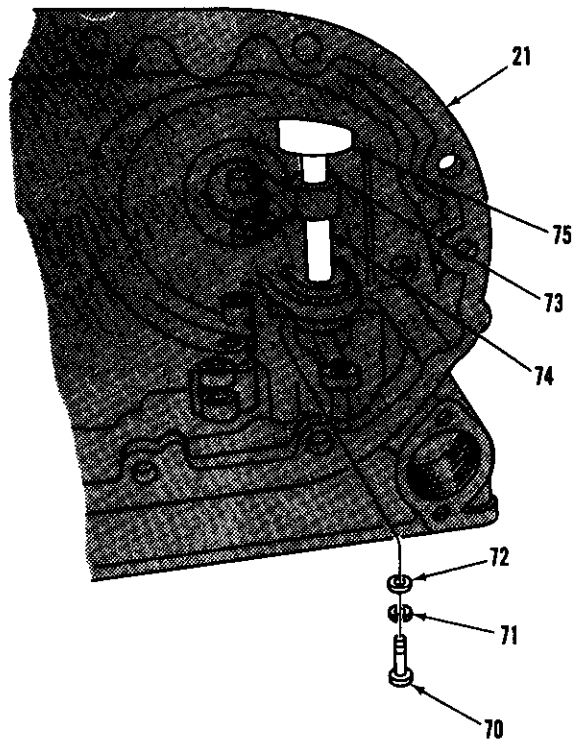
TA 298606

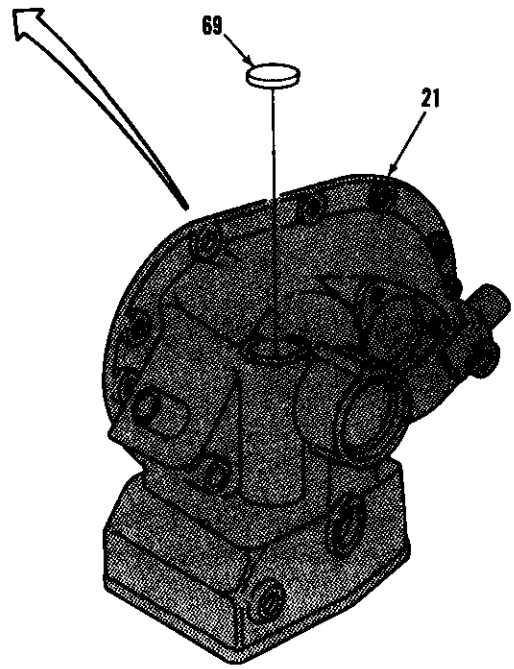
(47) Remove and discard expansion plug (69) from governor housing (21).

(48) Remove upper bearing retainer screw (70), lockwasher (71), and washer (72). Discard lockwasher (71).

(49) Place governor housing (21) in press, bottom side up.

(50) Press operating shaft (73) and spacer (74) from lower bearing (75).





21. GOVERNOR HOUSING
69. EXPANSION PLUG
70. UPPER BEARING RETAINER SCREW
71. LOCKWASHER
72. WASHER
73. OPERATING SHAFT
74. SPACER
75. LOWER BEARING

TA 298690

g. Maximum No-Load Engine Speed Adjustment

WARNING

Exhaust manifolds are hot. Use care to prevent personal injury. Use care when working with a running engine. Avoid pullies and any moving parts to prevent personal injury. Wear proper ear protection when working on engines without a muffler or exhaust system.

NOTE

Check to make sure buffer screw (18) extends out about 5/8 inch from locknut (19).

(1) Loosen locknut (40) and back off high speed retainer (41) about five turns.

(2) Start engine.

(3) Place throttle lever (1) in maximum speed position.

(4) Turn high speed retainer (41) until a no-load speed of 2,250 rpm.

(5) Hold high speed retainer (41) and tighten locknut (40).

(6) Position throttle lever (1) back to idle speed.

(7) Leave engine running so idle speed can be adjusted.

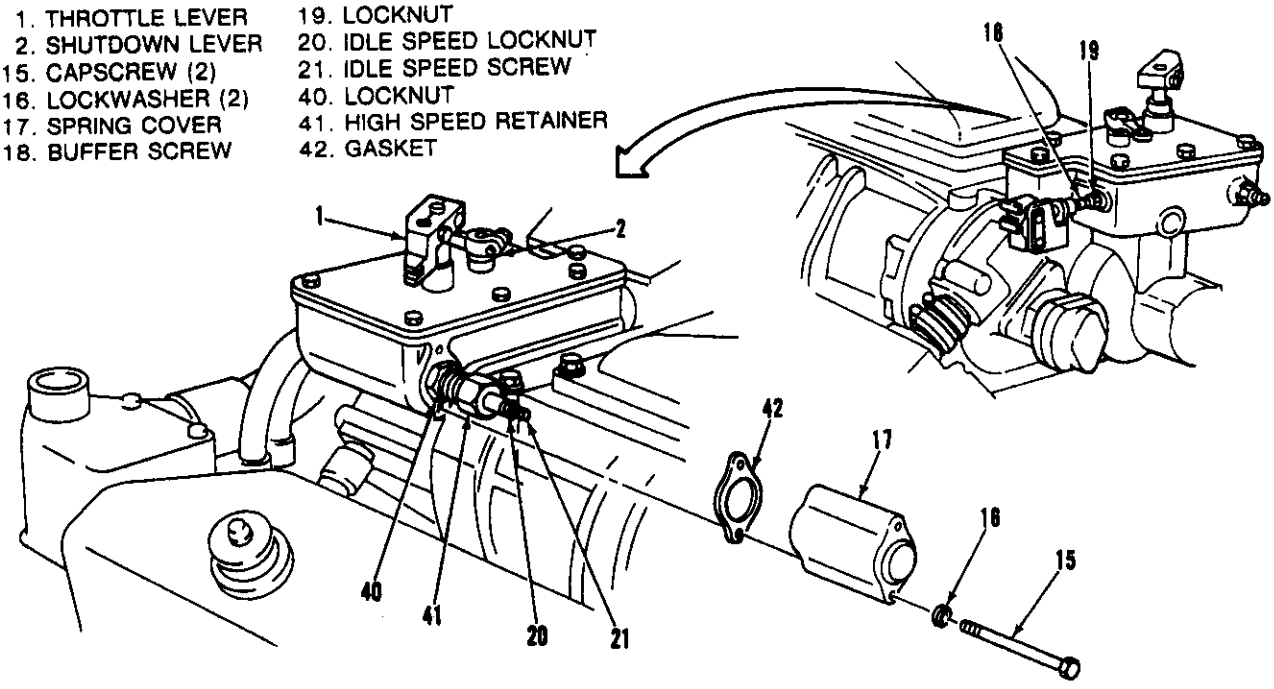
h. Idle Speed Adjustment

(1) Loosen idle speed locknut (20) and adjust idle speed screw (21) until engine is running 15 rpm below idle speed of 690 rpm.

(2) Hold idle speed screw (21) and tighten locknut (19).

(3) Install new gasket (42), spring cover (17), capscrews (15), and lockwashers (16). Tighten capscrews (15) securely.

1. THROTTLE LEVER
2. SHUTDOWN LEVER
15. CAPSCREW (2)
16. LOCKWASHER (2)
17. SPRING COVER
18. BUFFER SCREW
19. LOCKNUT
20. IDLE SPEED LOCKNUT
21. IDLE SPEED SCREW
40. LOCKNUT
41. HIGH SPEED RETAINER
42. GASKET



TA 298607

4-14. GOVERNOR REPAIR (Continued)

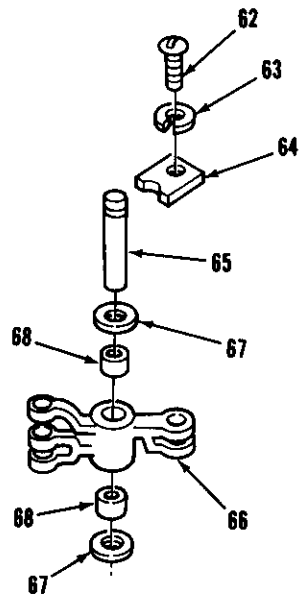
(44) Remove screw (62), lockwasher (63), and locking clip (64). Discard lockwasher (63).

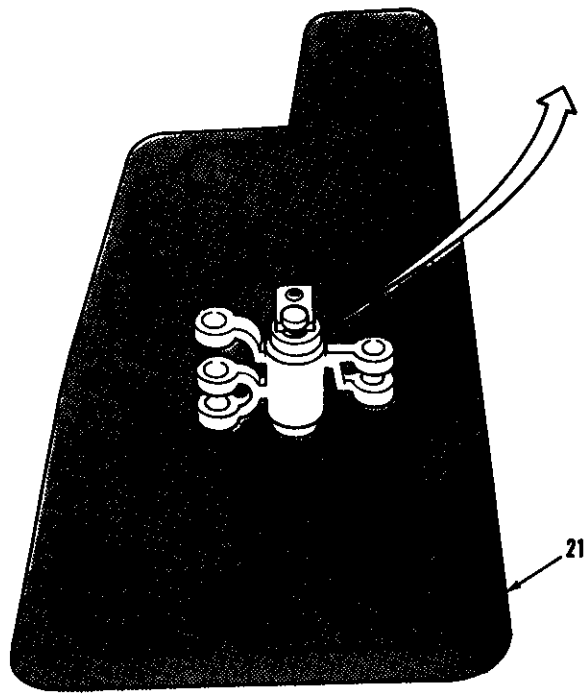
(45) Remove operating lever shaft (65), control link operating lever (66), and two washers (67).

NOTE

Remove bearings only if damaged.

(46) Press two bearings (68) from control link operating lever (66).





21. GOVERNOR HOUSING
62. SCREW
63. LOCKWASHER
64. LOCKING CLIP
65. OPERATING LEVER SHAFT
66. CONTROL LINK OPERATING LEVER
67. WASHER (2)
68. BEARING (2)

TA 298689

3-29. ENGINE TUNE-UP (Continued)

i. Buffer Screw Adjustment

CAUTION

Do not increase engine idle speed more that 15 rpm with buffer screw.

NOTE

Buffer screw adjustment procedures are similar for all types of switches.

(1) With engine running, adjust buffer screw (18) until it contacts differential lever and eliminates engine roll.

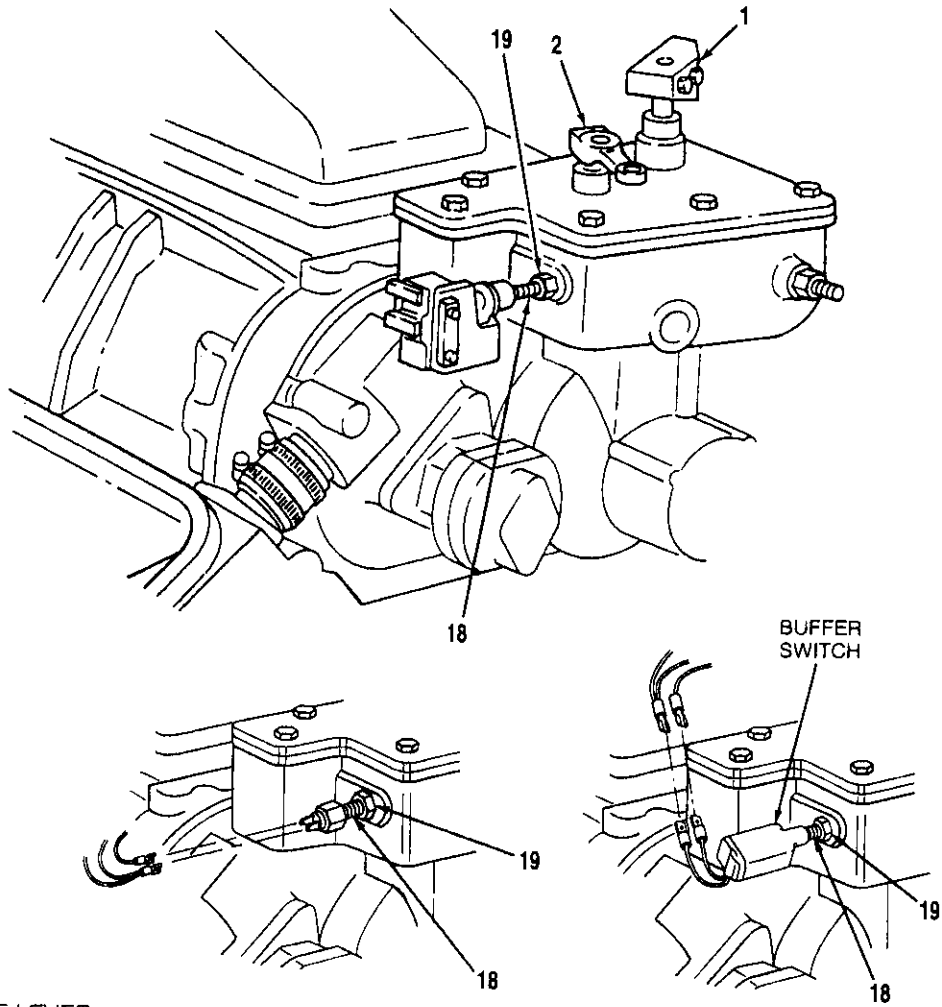
(2) Recheck maximum no-load speed. If it has increased more than 25 rpm, back off buffer screw (18) until the increase is less than 25 rpm.

CAUTION

Do not use wrench on plastic case of buffer switch, damage to equipment could result

(3) Hold buffer screw (18) and tighten locknut (19).

(4) Stop engine.



1. THROTTLE LEVER
2. SHUTDOWN LEVER
18. BUFFER SCREW
19. LOCKNUT

LVSA1 SERIES VEHICLES ONLY

(35) Remove spring clip (48) and washer (49) from operating lever connecting link (50).

(36) Remove operating lever connecting link (50).

(37) Remove spring clip (51) and washer (52) from differential lever (53).

(38) Remove differential lever (53) from operating lever (79).

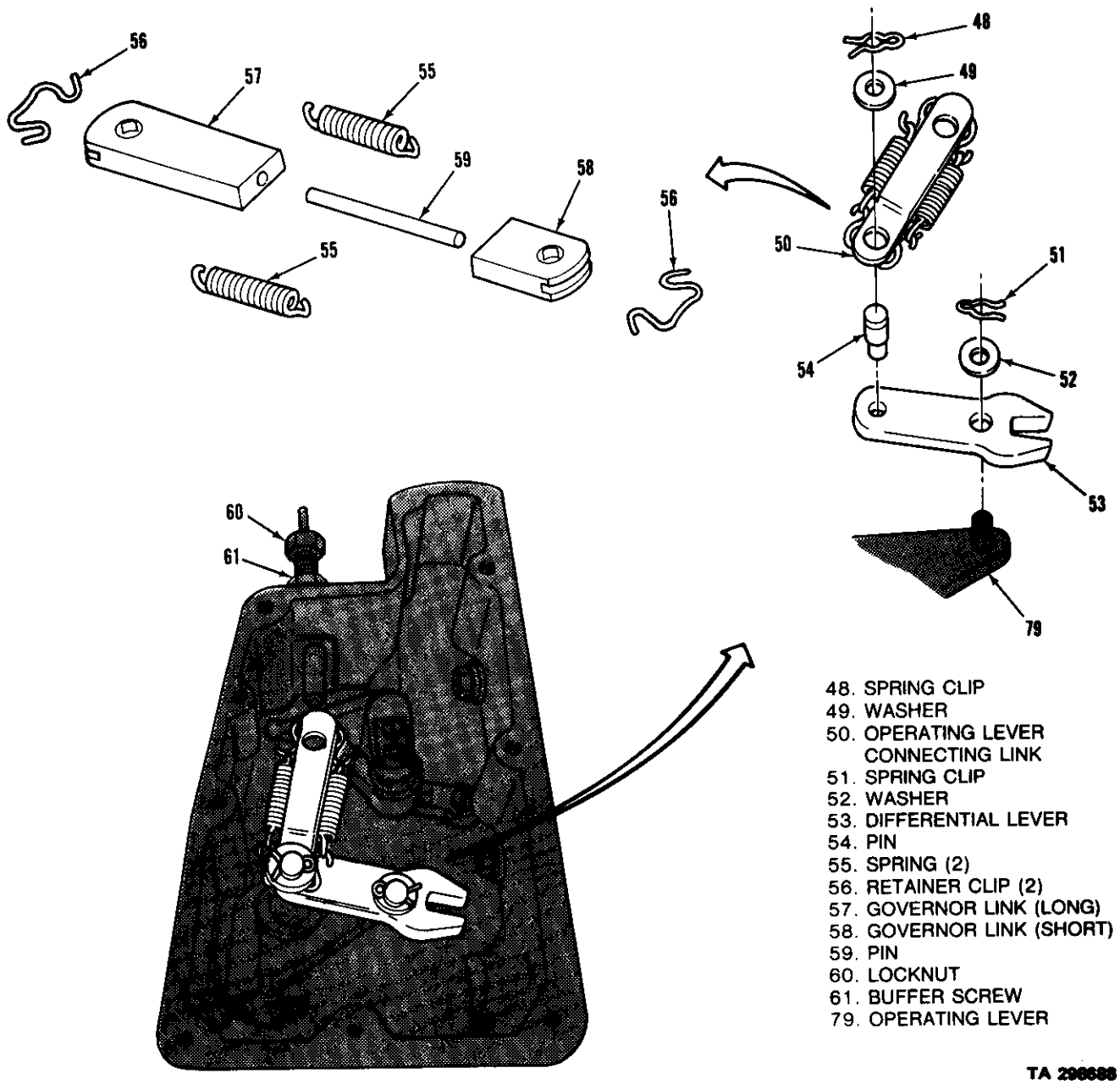
(39) Remove pin (54) from differential lever (53) only if damaged.

(40) Remove two springs (55) and retainer clips (56).

(41) Separate governor links (57 and 58).

(42) Remove pin (59) from governor link (57).

(43) Loosen locknut (60) and remove buffer screw (61).



48. SPRING CLIP
49. WASHER
50. OPERATING LEVER CONNECTING LINK
51. SPRING CLIP
52. WASHER
53. DIFFERENTIAL LEVER
54. PIN
55. SPRING (2)
56. RETAINER CLIP (2)
57. GOVERNOR LINK (LONG)
58. GOVERNOR LINK (SHORT)
59. PIN
60. LOCKNUT
61. BUFFER SCREW
79. OPERATING LEVER

TA 298688

j. Exhaust Valve Clearance (Hot Engine)

WARNING

Exhaust manifolds are hot. Use care to prevent personal injury.

NOTE

This procedure is only performed after a complete tune-up and after engine is allowed to reach normal operating temperature.

(1) Place throttle lever (1) in IDLE position and secure shutdown lever (2) in STOP position.

NOTE

Turn crankshaft clockwise when rotating. If crankshaft is turned counterclockwise, crankshaft capscrew can become loose.

(2) Rotate crankshaft until injector follower (3) is fully depressed on the cylinder to be adjusted.

(3) With engine at operating temperature of 170-195° F (77-91° C), check the exhaust valve clearance. If the clearance is correct, a 0.013 inch (0.332 mm) feeler gage will pass freely between rocker arm (6) and valve bridge (7).

(4) If clearance is incorrect in step (3), loosen locknut (4) on push rod (5) and readjust push rod (5) to hot engine specifications.

(5) Remove feeler gage. Holding push rod (5), tighten locknut (4) and recheck clearance.

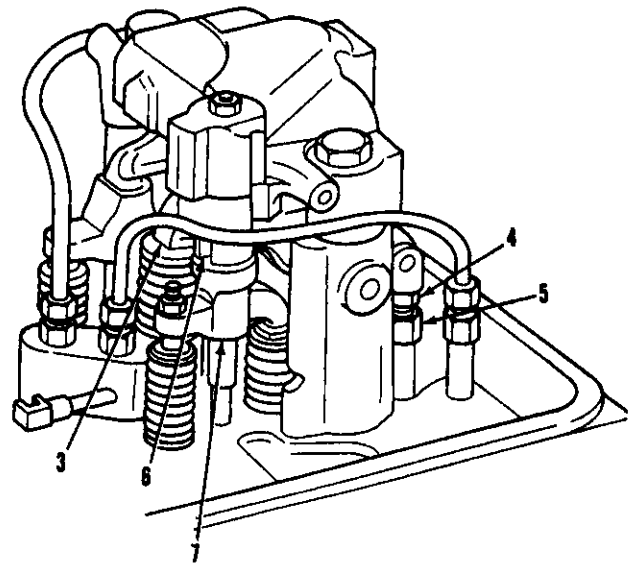
(6) Check all exhaust valves by following steps (1) thru (5).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install throttle cylinder (para 4-15).
	Install shutdown solenoid (para 4-13).
	Install rocker covers (para 3-4).
	Install engine access panel (para 18-14).



3. INJECTOR FOLLOWER
4. LOCKNUT
5. PUSH ROD
6. ROCKER ARM
7. VALVE BRIDGE

TA 298809

4-14. GOVERNOR REPAIR (Continued)

(30) Matchmark two high speed and two low speed weights (41 and 42) to weight carrier (43).

(31) Remove four snaprings (44).

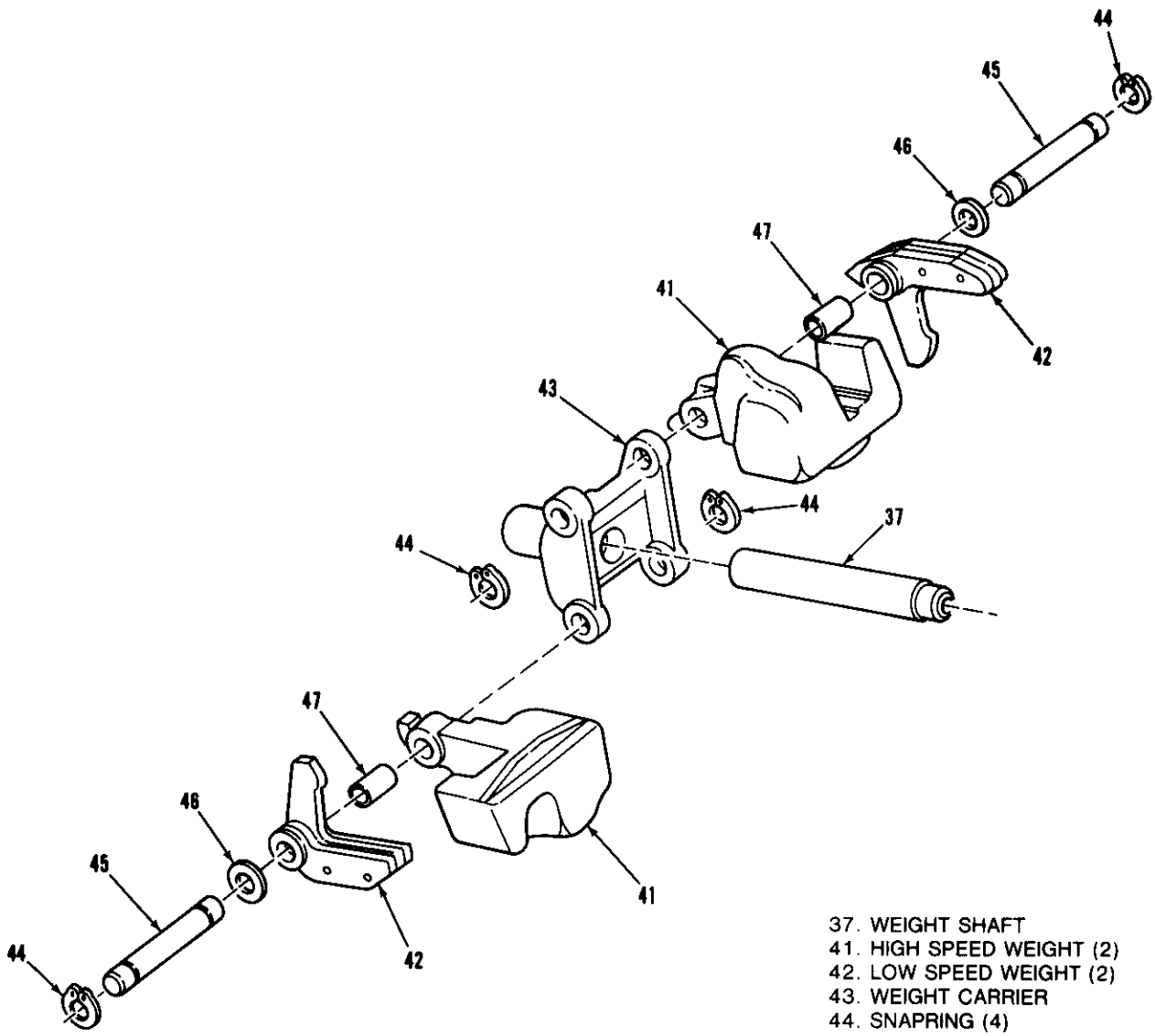
(32) Remove two pins (45), washers (46), high speed weights (41), and low speed weights (42).

NOTE

Bushings are removed from both weights in same manner. Remove only if damaged.

(33) Press two bushings (47) from low speed weight (42).

(34) Press weight shaft (37) from weight carrier (43).



37. WEIGHT SHAFT
41. HIGH SPEED WEIGHT (2)
42. LOW SPEED WEIGHT (2)
43. WEIGHT CARRIER
44. SNAPRING (4)
45. PIN (2)
46. WASHER (2)
47. BUSHING (2)

TA 298687

3-30. ENGINE TESTING

THIS TASK COVERS:
a. Compression Test
b. Fuel Flow Test
c. Misfiring Cylinder

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Compression gage and hose assembly (J 6692)
Compression gage adapter (J 7915-02)
Fuel pipe socket (J 8932-01)

Materials/Parts
Lockwasher (MS35338-41) item 7

References
TM 2320-10/11
TM 9-2320-297-10

TM 2320-20/12
TM 9-2320-297-20

Equipment Condition

TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Engine access door opened (para 2-1).

General Safety Instructions
Exhaust manifolds and engine parts are hot. Use care to prevent personal injury.

---

a. Compression Test

WARNING

Engine parts are hot. Use care to prevent personal injury.

(1) Start and run engine at 1,000 rpm until normal operating temperature is reached. Refer to paragraph 2-13 (TM 2320-10/11, TM 9-2320-297-10).

(2) Shut down engine and remove rocker cover. Refer to paragraph 3-4 (TM 2320-20/12, TM 9-2320-297-20).

NOTE

All parts must be tagged so they may be installed in their original position.

(3) Loosen four fuel line nuts (1). Tag and remove two fuel lines (2 and 3).

NOTE

Perform step (4) or step (4.1) depending on the configuration.

(4) If wire (4) is connected to Jacobs brake (5), remove screw (6), lockwasher (7), and wire (4). Discard lockwasher (7).

(4.1) Remove wire (7.1).

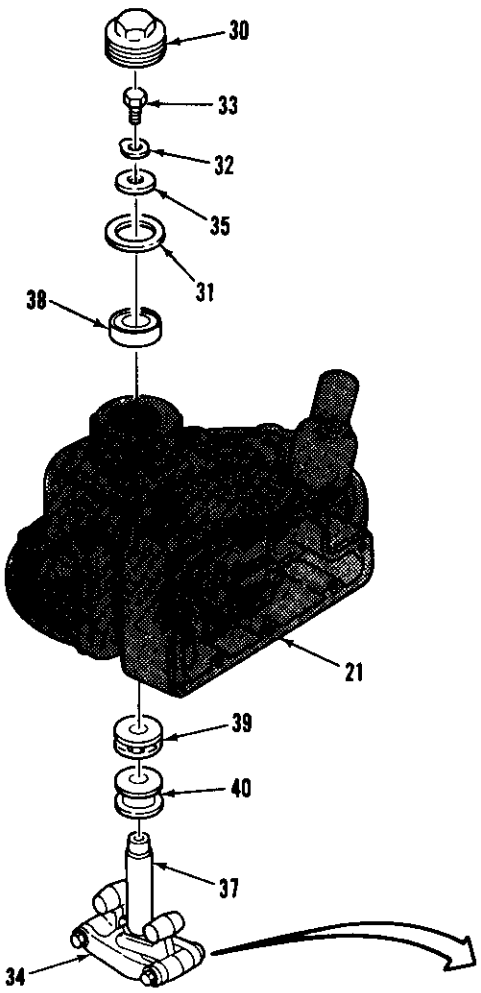
(5) Loosen locknut (8) and oil line jumper tube (9) four or five turns.

(6) Remove two capscrews (10) and Jacobs brake (5).

(7) Remove two brackets (11 and 12) from cylinder head.

(20) Place governor housing (21) in soft-jawed vise.

(21) Remove plug (30) and gasket (31). Discard gasket (31).



21. GOVERNOR HOUSING
30. PLUG
31. GASKET
32. LOCKWASHER
33. RETAINER CAPSCREW
34. WEIGHT CARRIER
35. WASHER
36. CAPSCREW
37. WEIGHT SHAFT
38. BEARING
39. RISER BEARING
40. RISER

(22) Bend tang of lockwasher (32) away from retainer capscrew (33).

(23) While holding weight carrier (34), remove retainer capscrew (33), washer (35), and lockwasher (32). Discard lockwasher (32).

(24) Thread a 5/16"-24 x 3" capscrew (36) into hole for retainer capscrew (33).

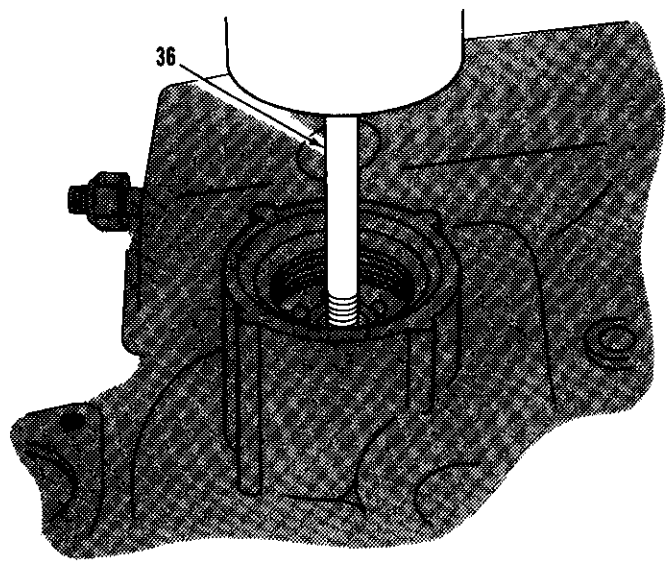
(25) Remove governor housing (21) from vise.

(26) Place governor housing (21) in press with capscrew (36) facing up.

(27) Press weight shaft (37) out of bearing (38).

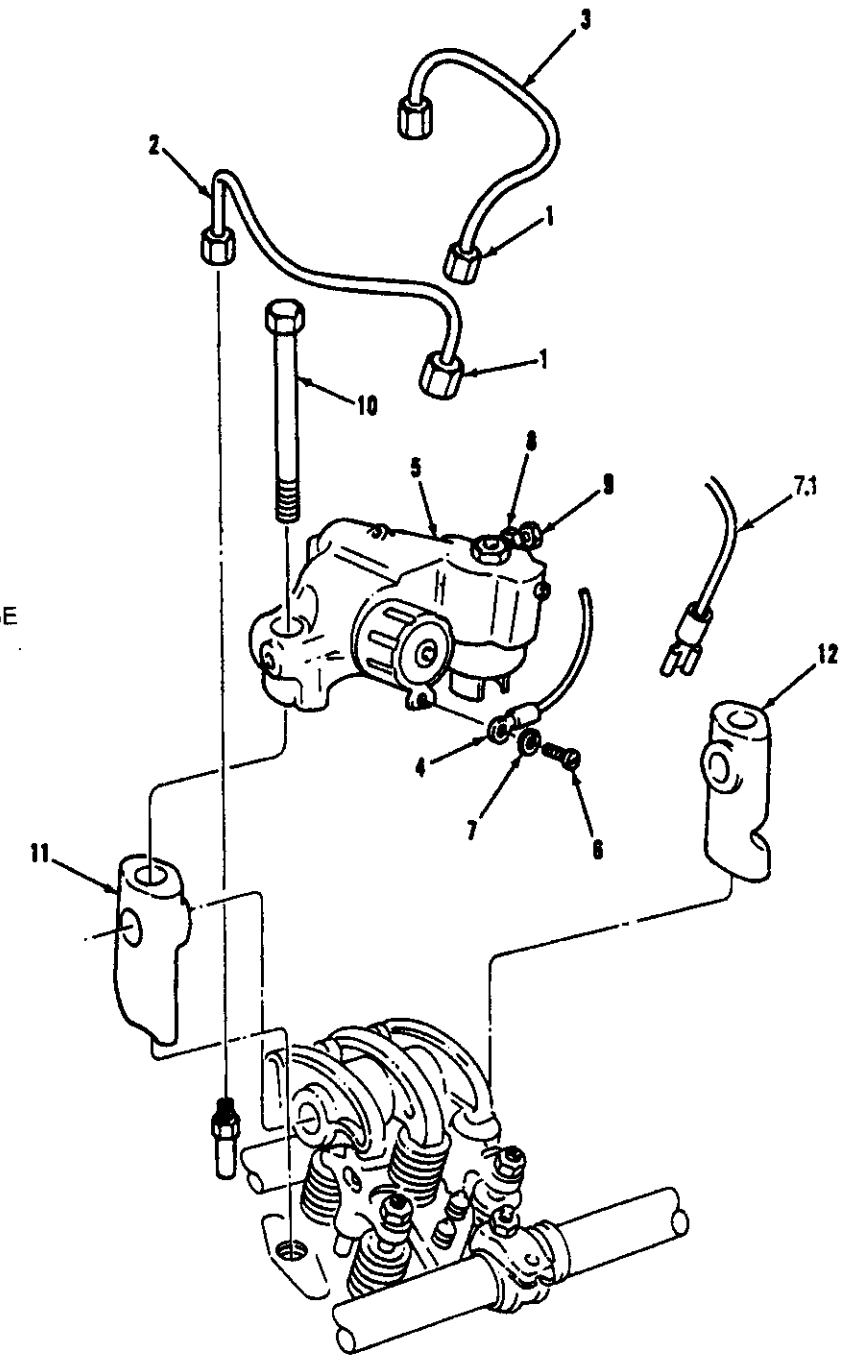
(28) Slide riser bearing (39) and riser (40) from weight shaft (37).

(29) Remove bearing (38) from governor housing (21).



TA 298686

1. FUEL LINE NUT (4)
2. FUEL LINE
3. FUEL LINE
4. WIRE
5. JACOBS BRAKE
6. SCREW
7. LOCKWASHER
7.1. WIRE
8. LOCKNUT
9. OIL LINE JUMPER TUBE
10. CAPSCREW (2)
11. BRACKET
12. BRACKET



4-14. GOVERNOR REPAIR (Continued)

(10) Remove two capscrews (15) and copper washers (16) from housing (17). Discard copper washers (16).

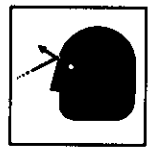
(11) Remove housing (17).

(12) Using a spanner wrench, loosen locknut (18).

(13) Remove high speed spring retainer (19) and plunger (20) assembly from governor housing (21).

(14) Remove low speed spring cap (22), low speed spring (23), and spring seat (24) from plunger (20).

WARNING



High speed spring (26) is under pressure and personal injury could occur if downward pressure is not applied to retainer.

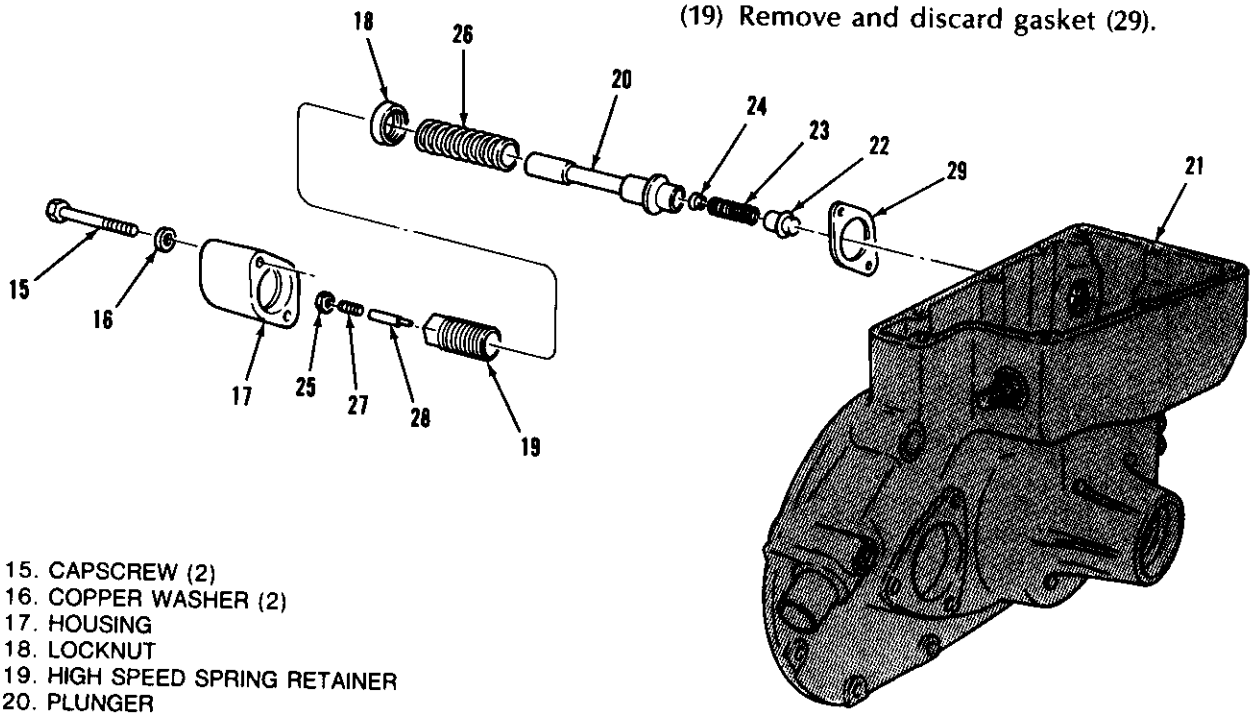
(15) Loosen locknut (25).

(16) While applying pressure to high speed spring (26), remove adjusting screw (27) and adjusting pin (28) slowly.

(17) Slowly release pressure on high speed spring (26).

(18) Remove plunger (20) and high speed spring (26) from high speed spring retainer (19).

(19) Remove and discard gasket (29).



15. CAPSCREW (2)
16. COPPER WASHER (2)
17. HOUSING
18. LOCKNUT
19. HIGH SPEED SPRING RETAINER
20. PLUNGER
21. GOVERNOR HOUSING
22. LOW SPEED SPRING CAP
23. LOW SPEED SPRING
24. SPRING SEAT
25. LOCKNUT
26. HIGH SPEED SPRING
27. ADJUSTING SCREW
28. ADJUSTING PIN
29. GASKET

TA 298685

3-30. ENGINE TESTING (Continued)

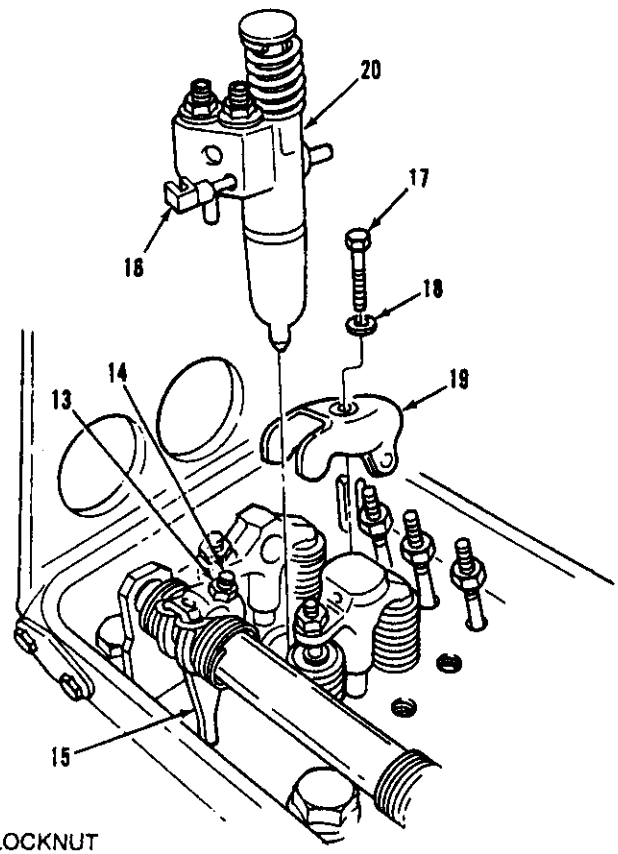
NOTE

Only loosen locknut (13) and setscrew (14) if injector control lever (15) cannot be removed from injector control rack (16).

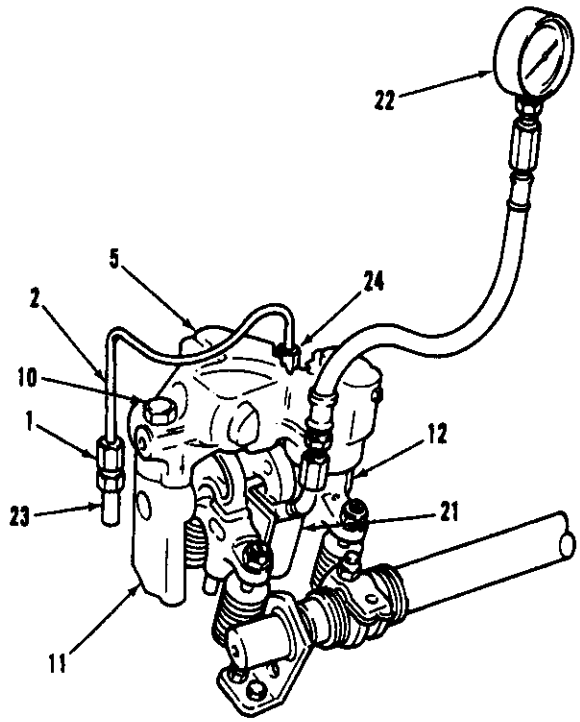
(8) Slide injector control lever (15) away from injector control rack (16)

(9) Remove capscrew (17), washer (18), and clamp (19).

(10) Remove injector (20).



13. LOCKNUT
14. SETSCREW
15. INJECTOR CONTROL LEVER
16. INJECTOR CONTROL RACK
17. CAPSCREW
18. WASHER
19. CLAMP
20. INJECTOR



1. FUEL LINE NUT
2. FUEL LINE
5. JACOBS BRAKE
10. CAPSCREW (2)
11. BRACKET
12. BRACKET
21. COMPRESSION GAGE ADAPTER
22. GAGE
23. INLET MANIFOLD
24. RETURN MANIFOLD

TA 290811

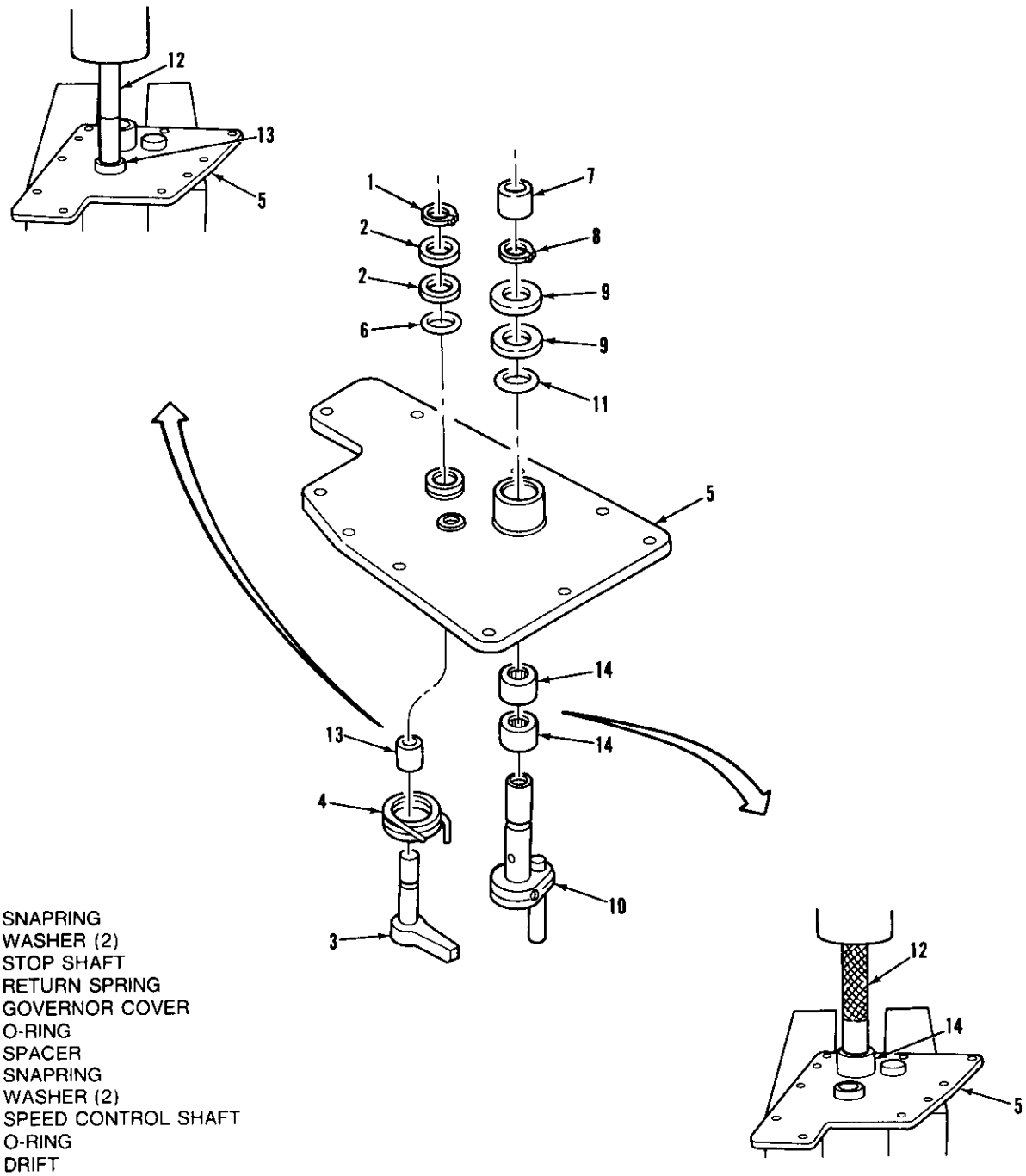
(11) Install compression gage adapter (21), gage (22), clamp (19), washer (18), and capscrew (17). Tighten capscrew (17) securely.

(12) Install brackets (11 and 12), Jacobs brake (5), and two capscrews (10).Tighten capscrews (10) securely.

(13) Install fuel line (2) between inlet manifold (23) and return manifold (24).

(14) Start engine and run at 690 rpm. Record pressure shown on gage (22).

(15) Turn off engine. Remove compression gage adapter (21), gage (22), and fuel line (2).



1. SNAPRING
2. WASHER (2)
3. STOP SHAFT
4. RETURN SPRING
5. GOVERNOR COVER
6. O-RING
7. SPACER
8. SNAPRING
9. WASHER (2)
10. SPEED CONTROL SHAFT
11. O-RING
12. DRIFT
13. BUSHING
14. BEARING (2)

TA 298685

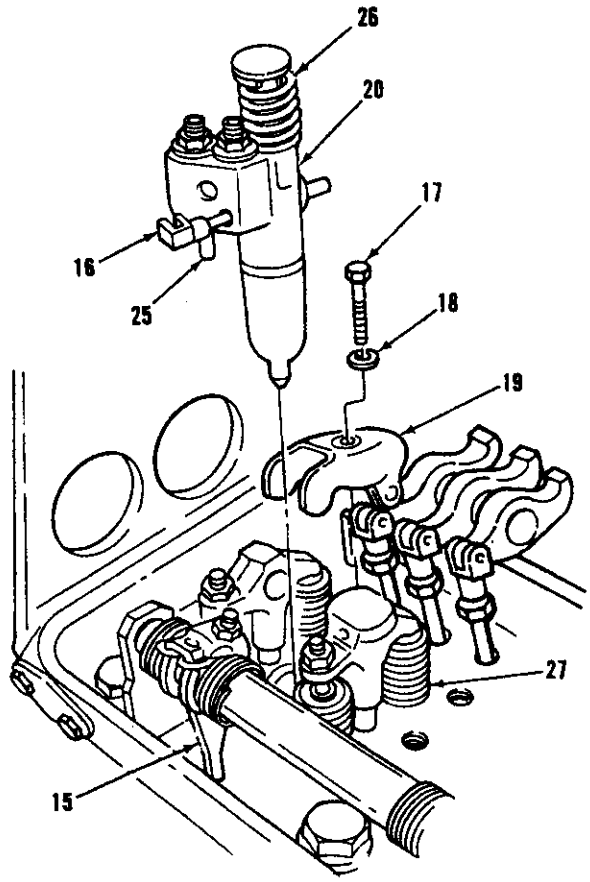
(16) Insert injector (20) into injector tube in cylinder head. Aline dowel pin (25) with locating hole in cylinder head.

(17) Slide injector control lever (15) into injector control rack (16).

(18) Install clamp (19), capscrew (17), and washer (18), with curved side of washer (18) facing clamp (19).

(19) Torque capscrew (17) to 20-25 foot-pounds (27-34 N·m).Make sure clamp (19) does not interfere with injector follower spring (26) or valve springs (27).

(20) Check injector control rack (16) for free movement. If injector control rack (16) binds, loosen capscrew (17). Retorque capscrew (17) to 20-25 foot-pounds (27-34 N·m).



15. INJECTOR CONTROL LEVER
16. INJECTOR CONTROL RACK
17. CAPSCREW
18. WASHER
19. CLAMP
20. INJECTOR
25. DOWEL PIN
26. INJECTOR FOLLOWER SPRING
27. VALVE SPRING

TA 298612

4-14. GOVERNOR REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Governor cover bearing installer (J 21068)

Materials/Parts

Grease (item 27, Appendix C)
Pipe sealant (item 60, Appendix C)
O-ring (NSN 5330-00-350-9013) item 6
O-ring (NSN 5330-01-105-6889) item 11
Copper washers (2) (NSN 5310-00-737-5429) item 16
Gasket (NSN 5330-01-186-7543) item 29
Gasket (NSN 5310-00-599-1616) item 31
Lockwasher (NSN 5310-00-274-9232) item 32
Lockwasher (NSN 5305-00-899-2109) item 63
Lockwasher (NSN 5305-00-899-2109) items 63 and 71
Expansion plug (NSN 5340-00-089-8037) item 69

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Governor removed from blower (para 4-13).

a. Disassembly

(1) Remove snapring (1) and two washers (2) from stop shaft (3).

(2) Remove stop shaft (3) and return spring (4) from governor cover (5).

(3) Remove O-ring (6) from governor cover (5). Discard O-ring (6).

(4) Remove spacer (7), snapring (8), and two washers (9) from speed control shaft (10).

(5) Remove speed control shaft (10) from governor cover (5).

(6) Remove O-ring (11) from governor cover (5). Discard O-ring (11).

(7) Support governor cover (5) on wooden blocks in a press, top facing down.

(8) Using drift (12), remove bushing (13) from governor cover (5).

(9) Using drift (12), remove two bearings (14) from governor cover (5).

3-30. ENGINE TESTING (Continued)

(21) Install brackets (11 and 12), Jacobs brake (5), and two capscrews (10). Torque two capscrews (10) to 45 foot-pounds (61 N·m).

(22) Retorque two capscrews (10) to 88-92 foot-pounds (119-124 N·m).

(23) Turn oil line jumper tube (9) until it makes contact between Jacobs brake (5). Then back off oil line jumper tube (9) 1/3 turn. Hold oil line jumper tube (9) while tightening locknut (8) securely.

NOTE

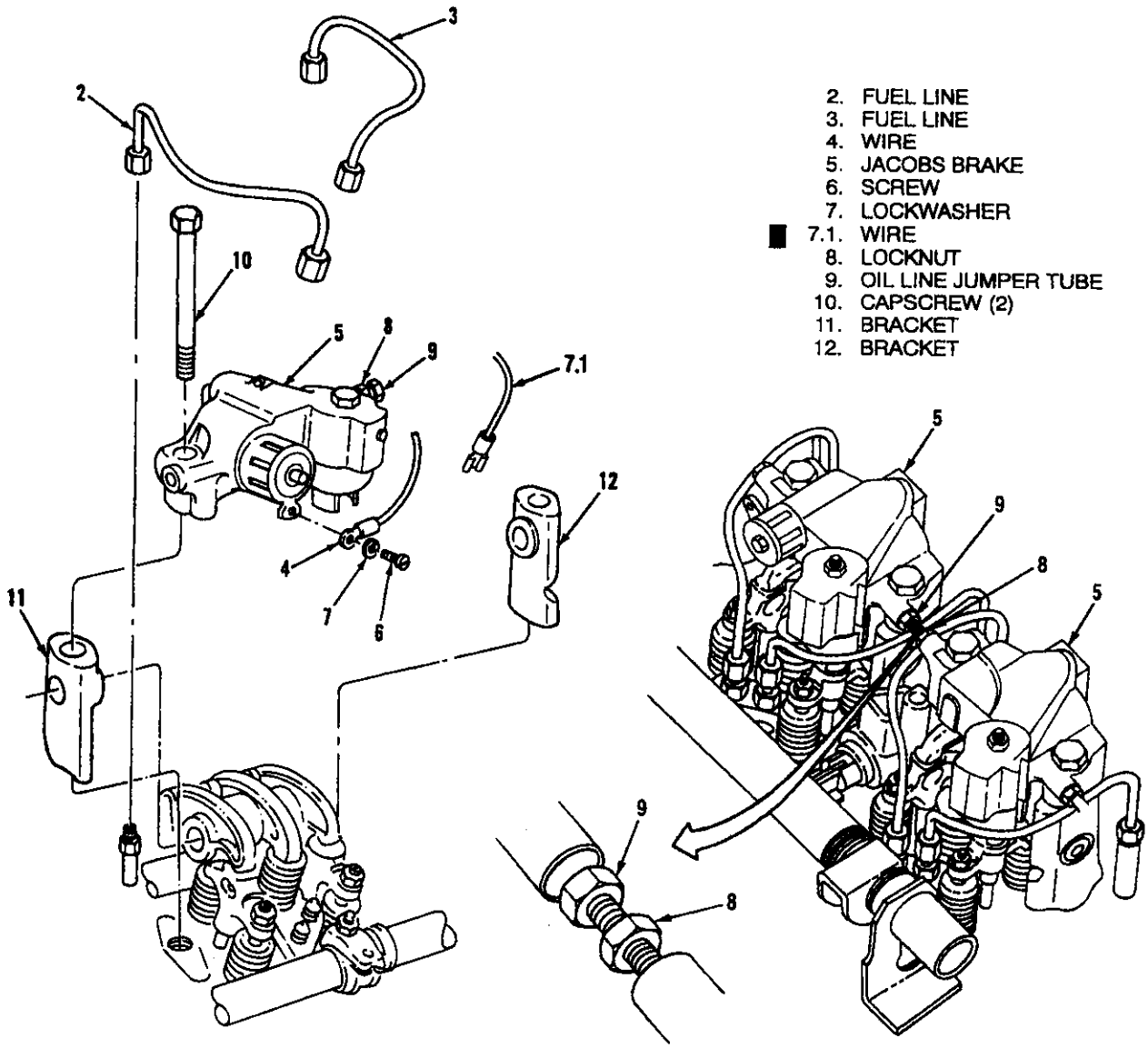
Perform step (24) or step (24.1) depending on the configuration.

(24) If removed, install wire (4), new lockwasher (7), and screw (6).

(24.1) Install wire (7.1).

(25) Install fuel lines (2 and 3). Using fuel pipe socket, torque fuel lines (2 and 3) to 160 lb-in (18 N·m).

(26) Repeat steps (3) thru (25) on remaining cylinders.



2. FUEL LINE
3. FUEL LINE
4. WIRE
5. JACOBS BRAKE
6. SCREW
7. LOCKWASHER
7.1. WIRE
8. LOCKNUT
9. OIL LINE JUMPER TUBE
10. CAPSCREW (2)
11. BRACKET
12. BRACKET

(5) Install eight capscrews (6), new lockwashers (7), and washers (8).

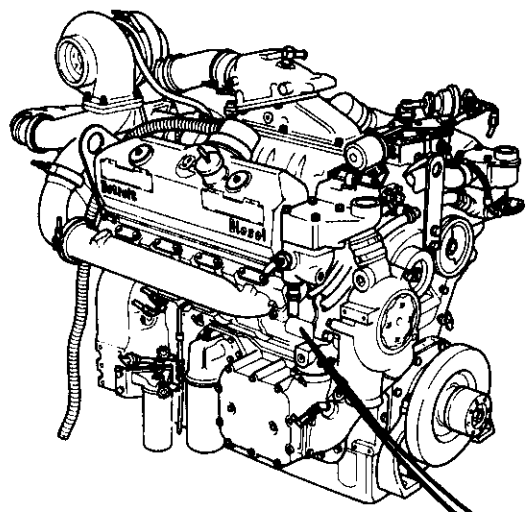
(6) Torque all capscrews (1, 4, and 6) to 13-17 foot-pounds (18-23 N·m).

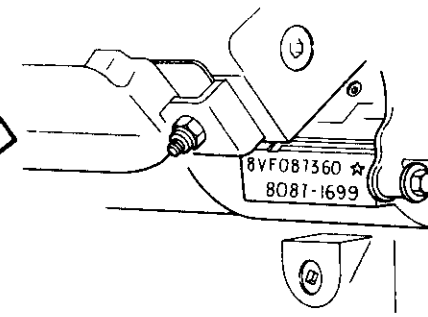
END OF TASK

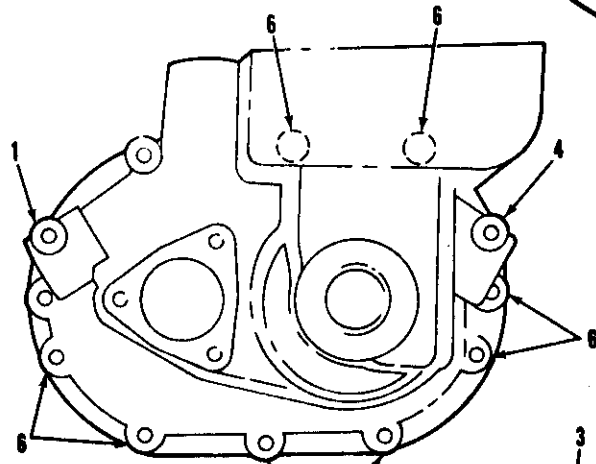
NOTE

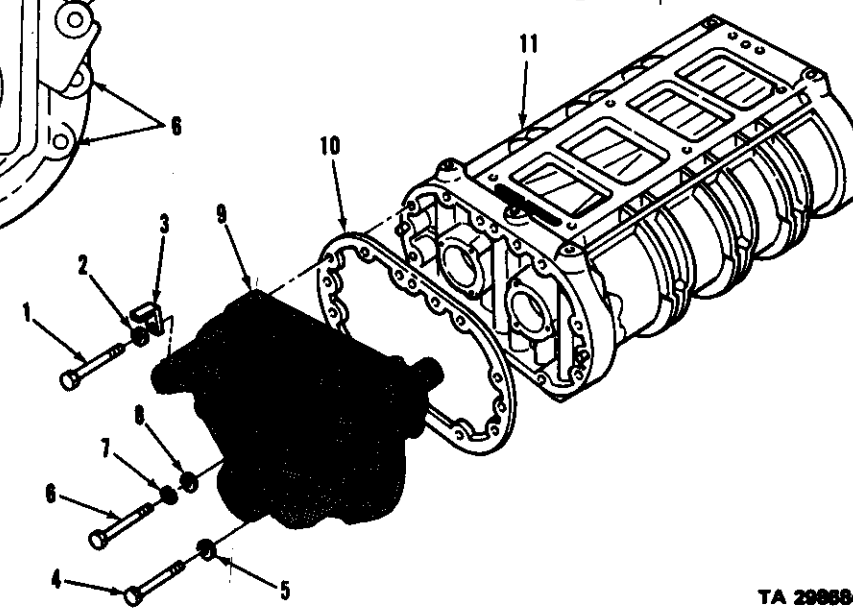
Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install fuel pump (para 4-3).
TM 2320-34/13 TM 9-2320-297-34	Install blower (para 4-6).
TM 2320-20/12 TM 9-2320-297-20	Install throttle cylinder (para 4-15).
	Install shutdown solenoid (para 4-13).
	Install rocker covers (para 3-4).
	Install engine access panels (para 18-14).
TM 2320-10/11 TM 9-2320-297-10	Close engine access door (para 2-1).









CAPSCREW LOCATIONS

1. CAPSCREW
2. COPPER WASHER
3. BRACKET
4. CAPSCREW
5. COPPER WASHER
6. CAPSCREW (8)
7. LOCKWASHER (8)
8. WASHER (8)
9. GOVERNOR HOUSING
10. GASKET
11. BLOWER HOUSING

TA 298884

(27) Compare compression pressures of cylinders with proper elevation above sea level on chart (A). Compression pressure between cylinders must not be more than 25 psi (172 kPa).

(28) Install rocker covers. Refer to paragraph 3-4 (TM 2320-20/12, TM 9-2320-297-20).

Minimum Compression Pressure at 690 RPM		Altitude Above Sea Level		Air Density*
psi	kPa	feet	meters	
450	3101	500	152	.0715
415	2859	2,500	762	.0663
385	2653	5,000	1,524	.0613
355	2446	7,500	2,286	.0567
330	2274	10,000	3,048	.0525

TA 290814

* Air density at 500 feet altitude based on 85°F (29.4°C) and 29.38 in. Hg (99.49 kPa) wet barometer.

4-13. GOVERNOR REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Copper washer (NSN 5310-00-737-5429) items 2 and 5
Lockwasher (8) (MS35338-45) item 7
Gasket (NSN 5330-00-736-0228) item 10

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Engine access door opened (para 2-1).
TM 2320-20/12 TM 9-2320-297-20	Engine access panels removed (para 18-14).
	Throttle cylinder removed (para 4-15).
	Shutdown solenoid removed (para 4-13).
	Rocker covers removed (para 3-4).
TM 2320-34/13 TM 9-2320-297-34	Blower removed (para 4-6).
TM 2320-20/12 TM 9-2320-297-20	Fuel pump removed (para 4-3).

a. Removal

NOTE

Locate engine serial number. Engines after serial number 8VF 98256 do not use bracket (3).

(1) Tag and remove capscrew (1), copper washer (2), and bracket (3). Discard copper washer (2).

(2) Tag and remove capscrew (4) and copper washer (5). Discard copper washer (5).

(3) Tag and remove eight capscrews (6), lockwashers (7), and washers (8). Discard lockwashers (7).

(4) Remove governor housing (9) and gasket (10) from blower housing (11). Discard gasket (10).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

(1) Install new gasket (10) onto blower housing (11).

(2) Install governor housing (9) onto blower housing (11).

(3) Install capscrew (1), new copper washer (2), and bracket (3).

(4) Install capscrew (4) and new copper washer (5).

3-30. ENGINE TESTING (Continued)

b. Fuel Flow Testing

(1) Close valve (28) on balance line (29) at left fuel tank (30).

NOTE

When fuel return line (31) is removed, fuel will flow. Be ready to plug elbow (32).

(2) Loosen fitting (33) and remove fuel return line (31). Plug elbow (32).

(3) Position open end of fuel return line (31) in a calibrated fuel container.

(4) Start and run engine at 1800 rpm for one minute. Refer to paragraph 2-13 (TM 2320-10/11, TM 9-2320-297-10).

(5) Shut down engine. Refer to paragraph 2-13 (TM 2320-10/11, TM 9-2320-297-10).

(6) Fuel flow must be 1.4 gallons per minute (5.29 liters per minute).

(7) Unplug elbow (32) and install fuel return line (31). Tighten fitting (33) securely.

(8) Open valve (28) on balance line (29) at left fuel tank (30).

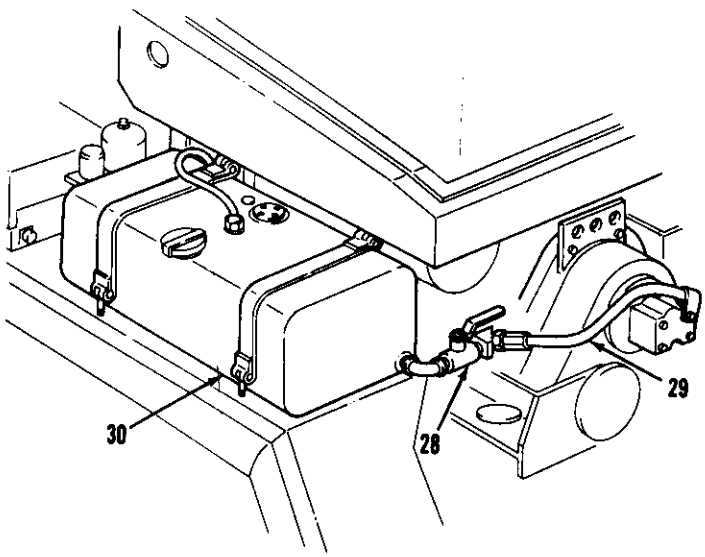
(9) If fuel flow is below specification:

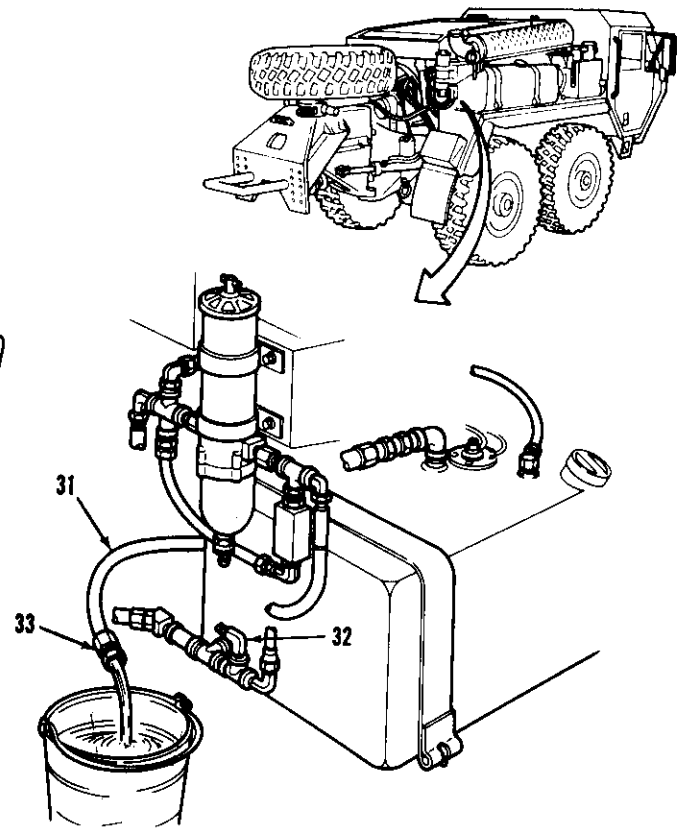
(a) Inspect for kinked or damaged fuel lines. Repair as necessary. If no damaged or kinked fuel lines, perform step b.

(b) Replace fuel filter. Refer to paragraph 4-20 (TM 2320-20/12, TM 9-2320-297-20). Check fuel flow. If below specification, perform step c.

(c) Replace fuel pump. Refer to paragraph 4-3 (TM 2320-20/12, TM 9-2320-297-20).

(10) If engine still runs poorly, check for misfiring cylinder. Refer to section C.





28. VALVE
29. BALANCE LINE
30. LEFT FUEL TANK
31. FUEL RETURN LINE
32. ELBOW
33. FITTING

TA 298615

(5) Install new gasket (22), inlet housing (21), four capscrews (18), new lockwashers (19), and washers (20). Tighten capscrews (18) securely.

(6) Aline inlet tube (17) on turbocharger (24) and tighten two clamps (4) securely.

(7) Use pipe sealant on threads of reducer (3.1) and fitting (3) and install reducer (3.1) and fitting (3). Tighten reducer (3.1) and fitting (3) securely.

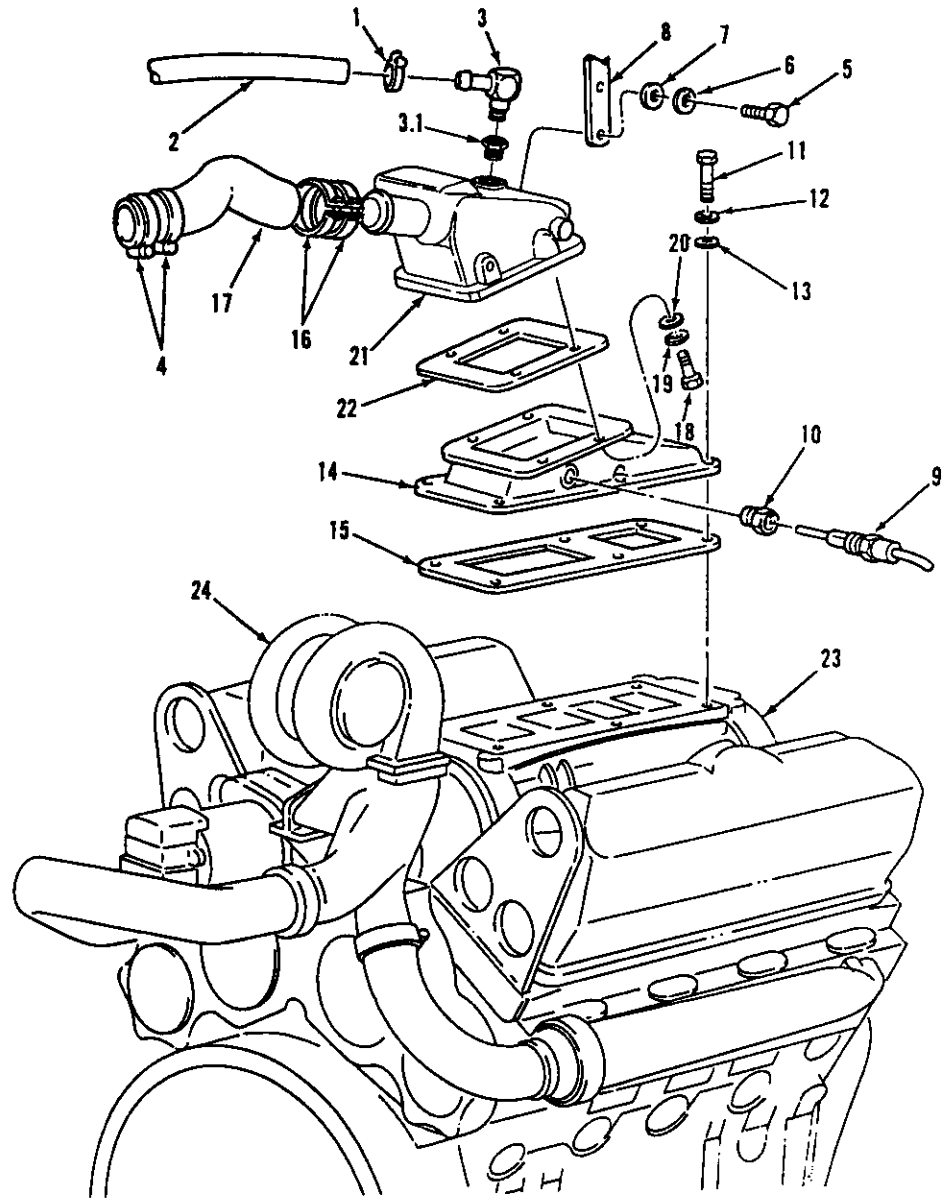
(8) Install hose (2) and clamp (1). Tighten clamp (1) securely.

(9) Use pipe sealant on threads of fitting (10) and atomizer (9), and install fitting (10) and atomizer (9). Tighten fitting (10) and atomizer (9) securely.

(10) Install capscrew (5), new lockwasher (6), washer (7) and bracket (8) into inlet housing (21). Tighten capscrew (5) securely.

END OF TASK

1. CLAMP
2. HOSE
3. FITTING
3.1. REDUCER
4. CLAMP (2)
5. CAPSCREW
6. LOCKWASHER
7. WASHER
8. BRACKET
9. ATOMIZER
10. FITTING
11. CAPSCREW (6)
12. LOCKWASHER (6)
13. WASHER (6)
14. INLET ADAPTER
15. GASKET
16. CLAMP (2)
17. INLET TUBE
18. CAPSCREW (4)
19. LOCKWASHER (4)
20. WASHER (4)
21. INLET HOUSING
22. GASKET
23. BLOWER
24. TURBOCHARGER



c. Misfiring Cylinder

(1) Start and run engine at 1,000 rpm until normal operating temperature is reached. Refer to paragraph 2-13 (TM 2320-10/11, TM 9-2320-297-10).

WARNING

Engine parts are hot. Use care to prevent personal injury.

(2) Shut down engine and remove rocker covers. Refer to paragraph 3-4 (TM 2323-20/12, TM 9-2320-297-20).

(3) Check valve clearances. Refer to paragraph 3-29 (TM 2320-34/13, TM 9-2320-297-34).

(4) Start and run engine at idle speed. Hold an injector follower (34) down with a screwdriver. If there is a change in sound and engine operation, cylinder is working properly. A misfiring cylinder will have no change in sound or engine operation.

(5) Repeat step (4) on all cylinders to locate misfiring cylinder or cylinders.

(6) If cylinder is misfiring,

(a) Check injector timing. Refer to paragraph 3-29. If engine still runs poorly, perform step b.

(b) Check compression pressure. Refer to Section a. If engine still runs poorly, perform step c, below.

(c) Replace injector (20). Refer to paragraph 4-3.

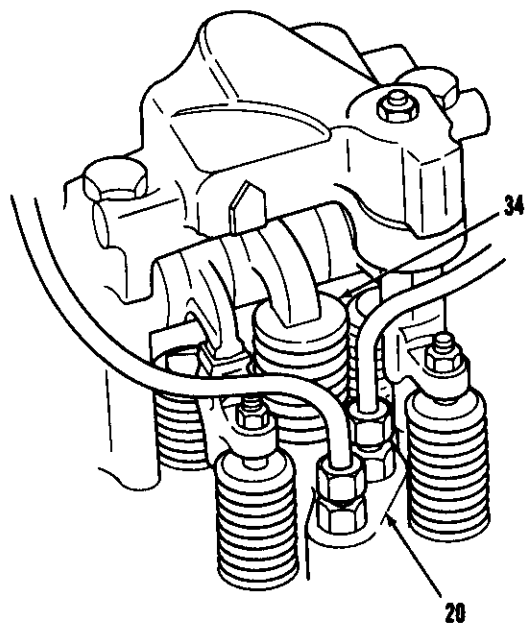
(7) Install rocker covers. Refer to paragraph 3-4 (TM 2320-20/12, TM 9-2320-297-20).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-10/11 TM 9-2320-297-10	Close engine access door (para 2-1).



20. INJECTOR
34. INJECTOR FOLLOWER

TA 288616

4-12. AIR INLET HOUSING REPLACEMENT

THIS TASK COVERS:
a. Removal
b. Cleaning
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Materials/Parts
Pipe sealant (item 60, Appendix C)
Lockwasher (11) (P/N 103321) items 6, 12, and 19
Gasket (P/N 5102062) item 15
Gasket (P/N 5134838) item 22

Equipment Condition

TM	Condition Description
TM 2320-10/11	Engine access door
TM 9-2320-297-10	open (para 2-1).

---

a. Removal

NOTE

Reducer (3.1) has changed from a steel type to a brass type. When repairing a non-A1 vehicle, use the new style brass reducer to replace the old style reducer. Refer to TM 9-2320-297-24P for correct part identification.

(1) Loosen clamp (1) and disconnect hose (2). Remove fitting (3) from reducer (3.1).

(1.1) Remove reducer (3.1) from inlet housing (21).

(2) Loosen two clamps (4).

(3) Remove capscrew (5), lockwasher (6), and washer (7) from bracket (8). Discard lockwasher (6).

(4) Remove atomizer (9) and fitting (10).

(5) Remove six capscrews (11), lockwashers (12), and washers (13). Discard lockwashers (12).

(6) Remove inlet adapter (14), and gasket (15). Discard gasket (15).

(7) Loosen two clamps (16) and remove inlet tube (17).

(8) Remove four capscrews (18), lockwashers (19), and washers (20). Discard lockwashers (19).

(9) Remove inlet housing (21), and gasket (22). Discard gasket (22).

(10) Cover blower (23) to prevent foreign objects from entering.

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

(1) Place new gasket (15) on blower (23).

(2) With opening facing turbocharger (24), aline holes of inlet adapter (14), and install on blower (23).

(3) Install six capscrews (11), new lockwashers (12), and washers (13). Tighten capscrews (11) securely.

(4) Install inlet tube (17) on inlet housing (21). Tighten two clamps (16) securely.

(30) Check the shaft radial movement on rotor assembly.

(a) Place magnetic base (31) with swivel adapter (32) on the flat surface of the turbine housing (3).

NOTE

Make sure the extension rod does not make contact with the sides of the center housing (2), otherwise it will be impossible to obtain an accurate reading.

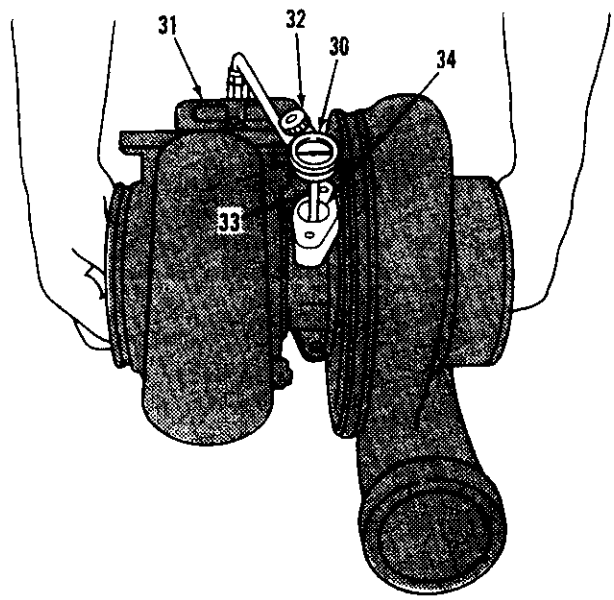
(b) Insert the extension rod (33) into the oil tube opening (34). The extension rod (33) must be against and perpendicular with the turbine wheel and shaft assembly (8).

(c) Grasp each end of the rotating assembly. Rotate turbine wheel and shaft assembly (8) one complete turn towards dial indicator (30). Then rotate shaft one complete turn away from dial indicator (30). The radial movement must be a minimum of 0.0030 inch (0.0762 mm) and a maximum of 0.0070 inch (0.1778 mm). If not within specifications, disassemble and repair or replace the rotating assembly.

(31) Install inlet shield covers on end of the compressor housing (1) for protection of impeller (11).

(32) If the turbocharger is to be stored, lubricate with clean engine oil, through the oil tube opening (34).

END OF TASK



30. DIAL INDICATOR
31. MAGNETIC BASE
32. SWIVEL ADAPTER
33. EXTENSION ROD
34. OIL TUBE OPENING

TA 296682

NOTE

Follow-On Maintenance

TM 2320-34/13	Install turbocharger
TM 9-2320-297-34	(para 4-10).

CHAPTER 4

FUEL SYSTEM

4-1. OVERVIEW

This chapter provides information authorized for Third and Fourth Echelon Maintenance level mechanics. General information, maintenance, replacement and repair procedures for the vehicle's fuel system are covered in the following sections:

Section I. Description and Data

Section II. General Fuel System Maintenance

SECTION I. DESCRIPTION AND DATA

4-2. DESCRIPTION AND DATA

a. Overview. With one 75 gallon fuel tank on each fender, the LVS has a total fuel capacity of 150 gallons. The fuel pump draws diesel fuel from the tanks through the fuel/water separator and a one way check valve. At the fuel pump, the fuel pressure is boosted to approximately 60 psi. After leaving the fuel pump, the diesel fuel goes through a secondary fuel filter. From the filter, it goes to each cylinder head by way of two separate fuel lines.

Fuel is then directed into the inlet manifold of each cylinder head. Fuel goes through the manifold and out to the injector inlet by way of fuel connector pipes. Fuel then flows through the injector where a certain amount, depending upon the engine load is metered to run the engine. The amount of fuel is mechanically determined by way of the injector control tubes and limited speed governor.

The remaining fuel circulates through the injector and helps to cool it. Fuel leaves the injector through the return fuel connector pipe and travels to the return manifold cast inside the cylinder head. Fuel flows out of the cylinder heads to a restricted tee. This restricted tee maintains manifold pressure within the cylinder heads. From the tee, fuel flows through a single fuel line back to the right fuel tank.

4-11. TURBOCHARGER REPAIR (Continued)

(24) Aline disassembly marks on turbine housing (3) with marks on center housing (2).

CAUTION

Failure to properly aline coupling can result in an exhaust leak or turbine wheel damage.

(25) Install and aline coupling (5) on turbine housing (3) and center housing (2). Alinement marks were made during disassembly.

CAUTION

Do not pull a misalined housing into alinement with the coupling (4 and 5). Parts must be alined and seated first.

(26) Tighten coupling (5) in the following sequence:

(a) Lubricate coupling threads with anti-seize compound.

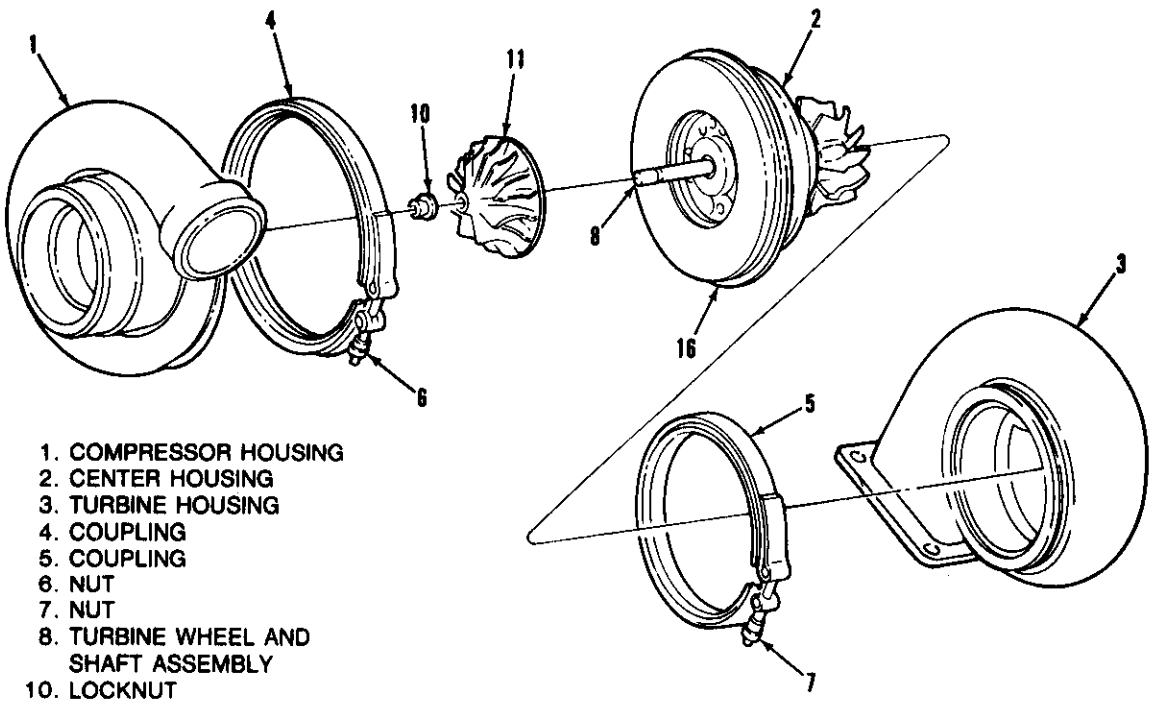
(b) Torque nut (7) on coupling (5) to 160 inch-pounds (18 N·m).

(c) Loosen nut (7) to about 50 inch-pounds (5.6 N·m), then retorque the nut to 152-168 inch-pounds (17-19 N·m).

(27) Aline the disassembly marks on the compressor housing (1) with the marks on the backplate (16).

(28) Install and aline the disassembly mark on coupling (4) with compressor housing (1) and backplate (16).

(29) With clean engine oil, lightly lubricate the thread on the coupling (4). Torque nut (6) to 110-130 inch-pounds (12-15 N·m).



1. COMPRESSOR HOUSING
2. CENTER HOUSING
3. TURBINE HOUSING
4. COUPLING
5. COUPLING
6. NUT
7. NUT
8. TURBINE WHEEL AND SHAFT ASSEMBLY
10. LOCKNUT
11. IMPELLER
16. BACKPLATE

TA 296681

4-2. DESCRIPTION AND DATA (Continued)

b. System Components

(1) FUEL TANKS. Two 75 gallon diesel fuel tanks. One fuel tank is mounted on each fender, above the No. 2 axle.

(2) FUEL/WATER SEPARATOR. Three stage device used to separate water from fuel and filter out solid particles. In the first stage, a centrifuge separates large solid particles and water from the fuel. The water and large particles sink to the bottom of the fuel bowl where they remain, until the fuel bowl is drained because they are heavier than fuel. In the second stage, water that is still in the system condenses on the separator shell. When droplets form, their weight causes them to fall to the bottom of the fuel bowl. In the third stage, a replaceable filter element traps solid particles still in the fuel.

(3) PRIMING PUMP. Hand pump used to prime fuel system when air has gotten into the fuel system (as when the vehicle has run out of fuel). After air has entered the system, the system must be primed before the engine will start.

(4) FUEL PUMP. A positive displacement, gear-type pump. The pump is attached to the governor housing. It is driven off the end of the right-hand helix blower rotor by means of a drive coupling. Incorporated in the fuel pump is a spring-loaded relief valve which normally remains closed. The pressure relief valve relieves discharge pressure by sending the fuel from the outlet side of the pump to the inlet side when the discharge pressure reaches about 65-75 psi (448-517 kPa).

(5) SECONDARY FILTER. Replaceable filter that traps extremely fine particles that have passed through previous filtration.

(6) FUEL MANIFOLD AND PIPES. Drilled passages within the cylinder head that route fuel to and from the injectors. Fuel pipes provide the means for direction of fuel from the cylinder head manifolds to the injectors.

(7) INJECTOR CONTROL TUBES. The two fuel injector control tube assemblies are mounted on the left and right bank cylinder heads of the engine. Each tube assembly consists of a control tube, injector rack control levers, a return spring, and injector control tube lever mounted in two bracket and bearing assemblies attached to each cylinder head.

The control tube is connected to the injector control racks and the governor. The control tubes keep the injectors balanced together and provide the mechanical means for the right amount of fuel to run the engine under varying loads and speeds.

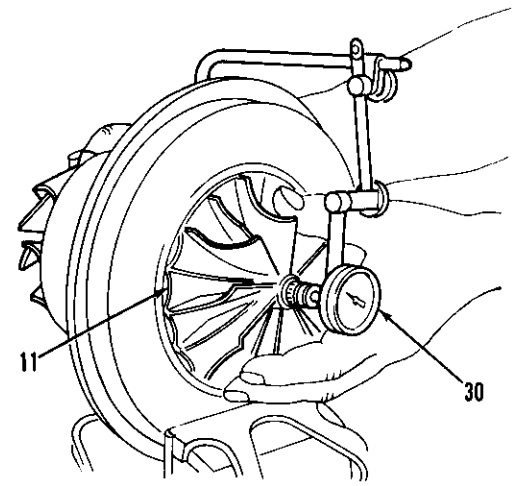
(18) Support turbine wheel and shaft assembly (8) with two wood blocks (9)

(19) Install locknut (10) on turbine wheel and shaft assembly (8). Torque locknut (10) to 125-150 inch-pounds (14-17 N·m) to seat the impeller (11) against spacer (18).

(20) Loosen locknut (10) and inspect locknut face and impeller (11) surface to be sure they are smooth and clean.

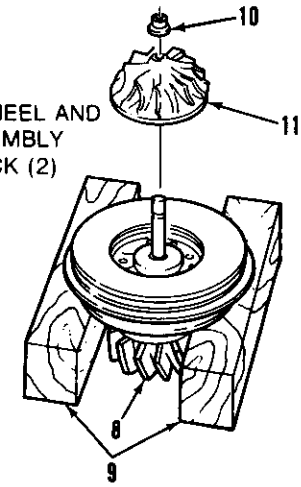
(21) Retorque locknut (10) to 35-55 inch-pounds (4-6 N·m). Turn locknut an additional 1/4 turn.

(22) Remove turbine wheel and shaft assembly (8) from wood blocks.



11. IMPELLER
30. DIAL INDICATOR

TA 298680



8. TURBINE WHEEL AND SHAFT ASSEMBLY
9. WOOD BLOCK (2)
10. LOCKNUT
11. IMPELLER

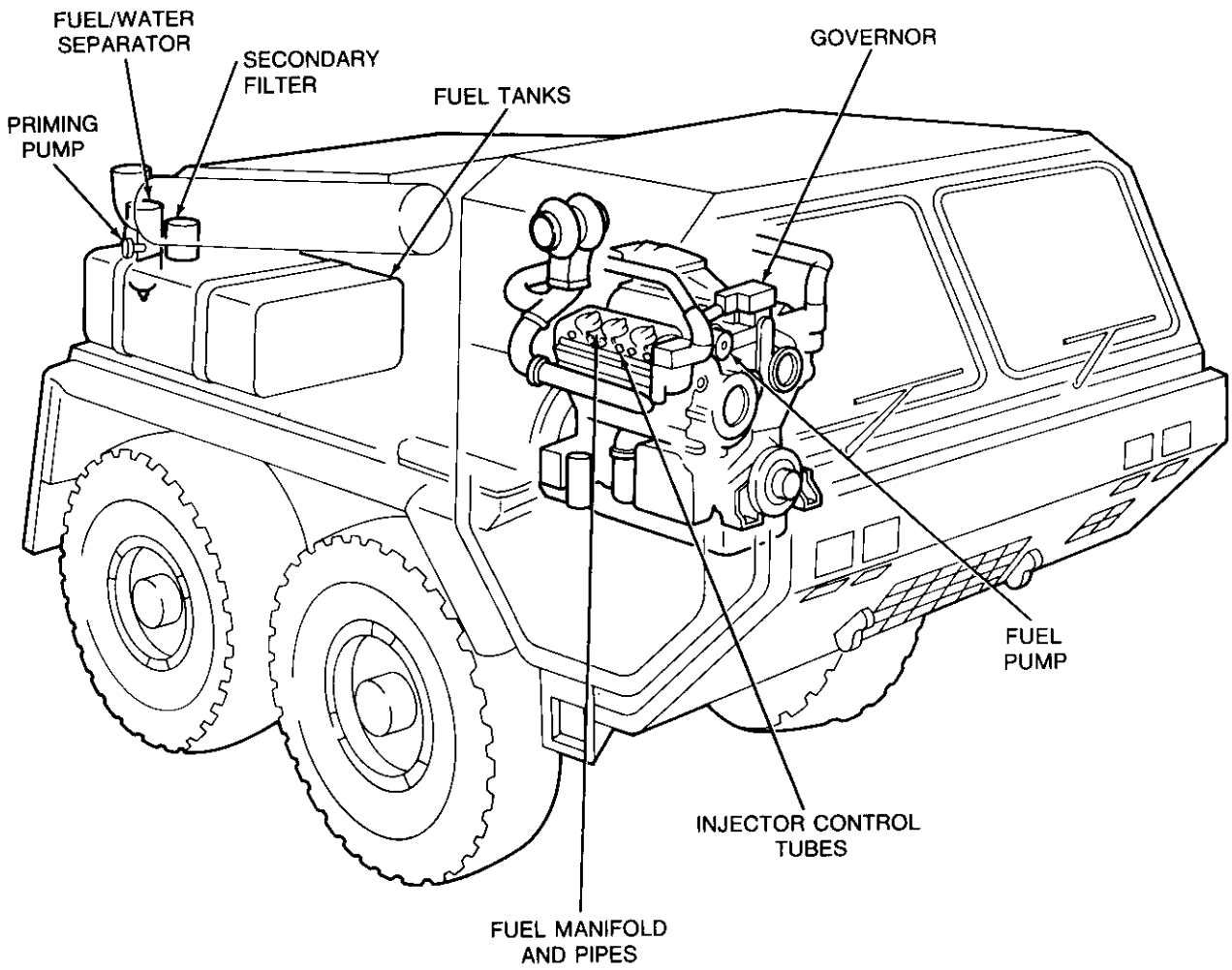
(23) Check bearing axial end play with a dial indicator (30).

(a) Clamp the center housing (2) and backplate (16) in a soft-jawed vise.

(b) Install dial indicator (30) so that indicator tip is positioned at the end of the turbine wheel and shaft assembly (8) on impeller (11) side.

(c) Move the turbine wheel and shaft assembly (8) in and out by hand. The total movement must be a minimum of 0.003 inch (0.0762 mm) and a maximum of 0.010 inch (0.254 mm).

(d) If readings are not within specifications, repair or replace the rotating assembly.


FUEL/WATER SEPARATOR
SECONDARY FILTER
FUEL TANKS
GOVERNOR
PRIMING PUMP
FUEL PUMP
INJECTOR CONTROL TUBES
FUEL MANIFOLD AND PIPES

TA 298617

4-11. TURBOCHARGER REPAIR (Continued)

(6) Install new seal ring (24), on center housing (2).

(7) Install new turbine seal ring (13) on turbine wheel and shaft assembly (8).

(8) Install shroud (12) on center housing (2).

(9) Install turbine wheel and shaft assembly (8) through shroud (12) and center housing (2).

(10) Place center housing (2) so turbine wheel and shaft assembly (8) faces up.

(11) Install thrust collar (17) on turbine wheel and shaft assembly (8). Open side of collar faces up.

(12) Install two new seal rings (19) on spacer (18).

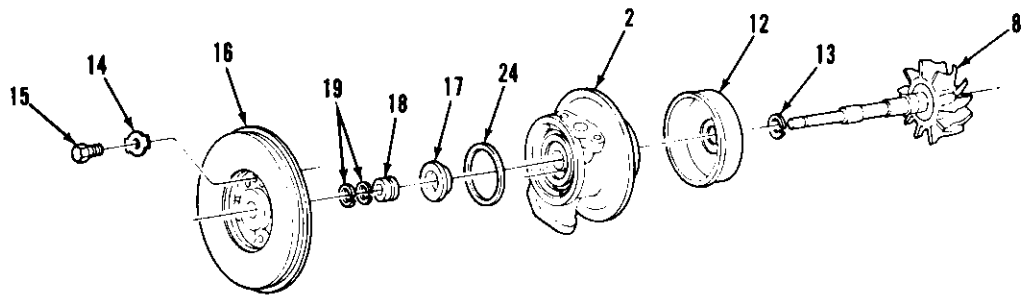
(13) Install spacer (18) in backplate (16). Compress seal rings (19) so spacer (18) will slide in bore of backplate (16). Bevel end of spacer (18) faces towards center housing side of backplate (16).

(14) Install backplate (16) on turbine wheel and shaft assembly (8).

(15) Aline capscrew holes in backplate (16) and center housing (2). Install four capscrews (15) and new lockplates (14). Torque capscrews to 80-100 inch-pounds (9-11 N·m). Bend lockplate tabs up against capscrew heads.

(16) Install impeller (11) on turbine wheel and shaft assembly (8).

(17) Using clean engine oil, lubricate the shaft threads and the impeller (11) surface that will be under locknut (10).



2. CENTER HOUSING
8. TURBINE WHEEL AND SHAFT ASSEMBLY
12. SHROUD
13. TURBINE SEAL RING
14. LOCKPLATE (4)
15. CAPSCREW (4)
16. BACKPLATE
17. THRUST COLLAR
18. SPACER
19. SEAL RING (2)
24. SEAL RING

TA 298679

4-2. DESCRIPTION AND DATA (Continued)

(8) GOVERNOR. When the engine is not operating, the force of the high-speed spring holds the high-speed plunger against its stop, and the low-speed spring holds the low-speed spring cap against the gap adjusting screw (which is located on the operating shaft lever). The expanded springs pivot the operating shaft lever, making the operating fork rest against the thrust bearing and the riser rest against the low-speed and high-speed weights.

The governor holds the injector racks in the advanced fuel position for starting when the speed control lever is in the idle position. Immediately after starting, the governor moves the injector racks to the position required for idling. To limit fuel input during engine start-up, when the speed control lever is in its idle position, the engine has a starting aid screw.

The centrifugal force of the revolving governor low-speed and high-speed weights is converted into linear motion that is transmitted through the riser and the operating shaft to the operating shaft lever. One end of this lever operates against the high-speed and low-speed springs through the spring cap, while the other end provides a moving fulcrum on which the differential lever pivots.

When the centrifugal force of the revolving governor weights balance out the tension on the high-speed or low-speed spring (depending on the speed range) the governor stabilizes the engine speed for a given setting of the speed control lever.

In the low-speed range, the combined centrifugal force of the low-speed and high-speed weights operates against the low-speed spring. As the engine speed increases, the centrifugal force of the low-speed and high-speed weights compresses the low-speed spring until the low-speed weights are against their stops, thus limiting their travel. At this time the low-speed spring is fully compressed.

The engine idle speed is determined by the force exerted by the governor low-speed spring. When the governor speed control lever is placed in the idle position, the engine will operate at the speed where the force exerted by the governor low-speed weights will equal the force exerted by the governor low-speed spring. Throughout the intermediate speed range, the operator has complete control of the engine because both the low-speed spring and the low-speed weights are against their stops, and the high-speed weights are not exerting enough force to overcome the high-speed spring.

As the speed increases, the centrifugal force of the high-speed weights increase until this force can overcome the high-speed spring. At this point the governor again takes control of the engine, limiting the maximum engine speed.

Fuel rods are connected to the differential lever and injector control tube levers through the control link operating lever and connecting link. This arrangement provides a means for the governor to change the fuel settings of the injector control racks.

Adjustment of the engine idle speed is accomplished by changing the force on the low-speed spring by means of the idle adjusting screw.

(6) Using a T-gage and micrometer, inspect the impeller (11) for signs of rubbing or damage from foreign material. The impeller inside diameter bore should be a minimum of 0.3736 inch (9.4894 mm), a maximum of 0.3739 inch (9.4971 mm) for new parts, and a limit of 0.3749 inch (9.5225 mm) for used parts.

(7) Inspect center housing (2) for signs of wear or damage from the rotating parts. Using a T-gage and micrometer, measure the inside diameter bearing bore. The diameter should be a minimum of 0.9827 inch (24.9606 mm), a maximum of 0.9832 inch (24.9733 mm) for new parts, and a limit of 0.9842 inch (24.9987 mm) for used parts.

(8) Inspect turbine wheel and shaft assembly (8) for signs of wear or damage from foreign material. Using a micrometer, measure the shaft journal diameter. The diameter must be a minimum of 0.6250 inch (15.875 mm), and a maximum of 0.6254 inch (15.8852 mm).

(9) Using a T-gage and micrometer, measure the bearings (21 and 27). The inside diameter must be a minimum of 0.6268 inch (15.9207 mm), and a maximum of 0.6272 (15.9309 mm).

(10) Inspect all other parts. Refer to paragraph 2-7.

(11) Replace all parts failing inspection.

d. Assembly

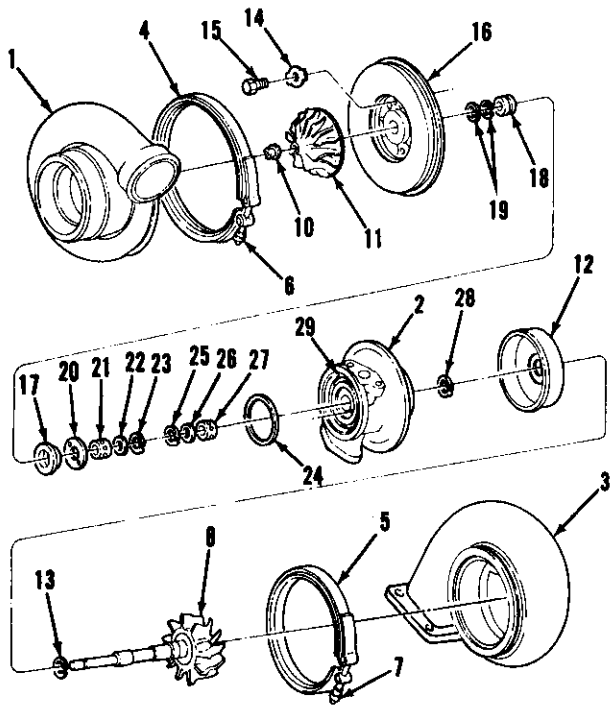
(1) Lubricate bearings (21 and 27) with clean engine oil.

(2) Install new snapring (28) in shaft assembly end of center housing (2).

(3) Install bearing (27), washer (26), and new snapring (25) through compressor side of center housing (2). Bearing (27), washer (26), and snapring (25) will be secured on turbine wheel and shaft assembly (8) side of center housing (2).

(4) Install new snapring (23), washer (22), and bearing (21) on compressor side of center housing (2).

(5) Install thrust bearing (20) on dowel pins (29) on center housing (2).



1. COMPRESSOR HOUSING
2. CENTER HOUSING
3. TURBINE HOUSING
4. COUPLING
5. COUPLING
6. NUT
7. NUT
8. TURBINE WHEEL AND SHAFT ASSEMBLY
10. NUT
11. IMPELLER
12. SHROUD
13. TURBINE SEAL RING
14. LOCKPLATE
15. CAPSCREW (4)
16. BACKPLATE
17. THRUST COLLAR
18. SPACER
19. SEAL RING (2)
20. THRUST BEARING
21. BEARING
22. WASHER
23. SNAPRING
24. SEAL RING
25. SNAPRING
26. WASHER
27. BEARING
28. SNAPRING
29. DOWEL PIN (2)

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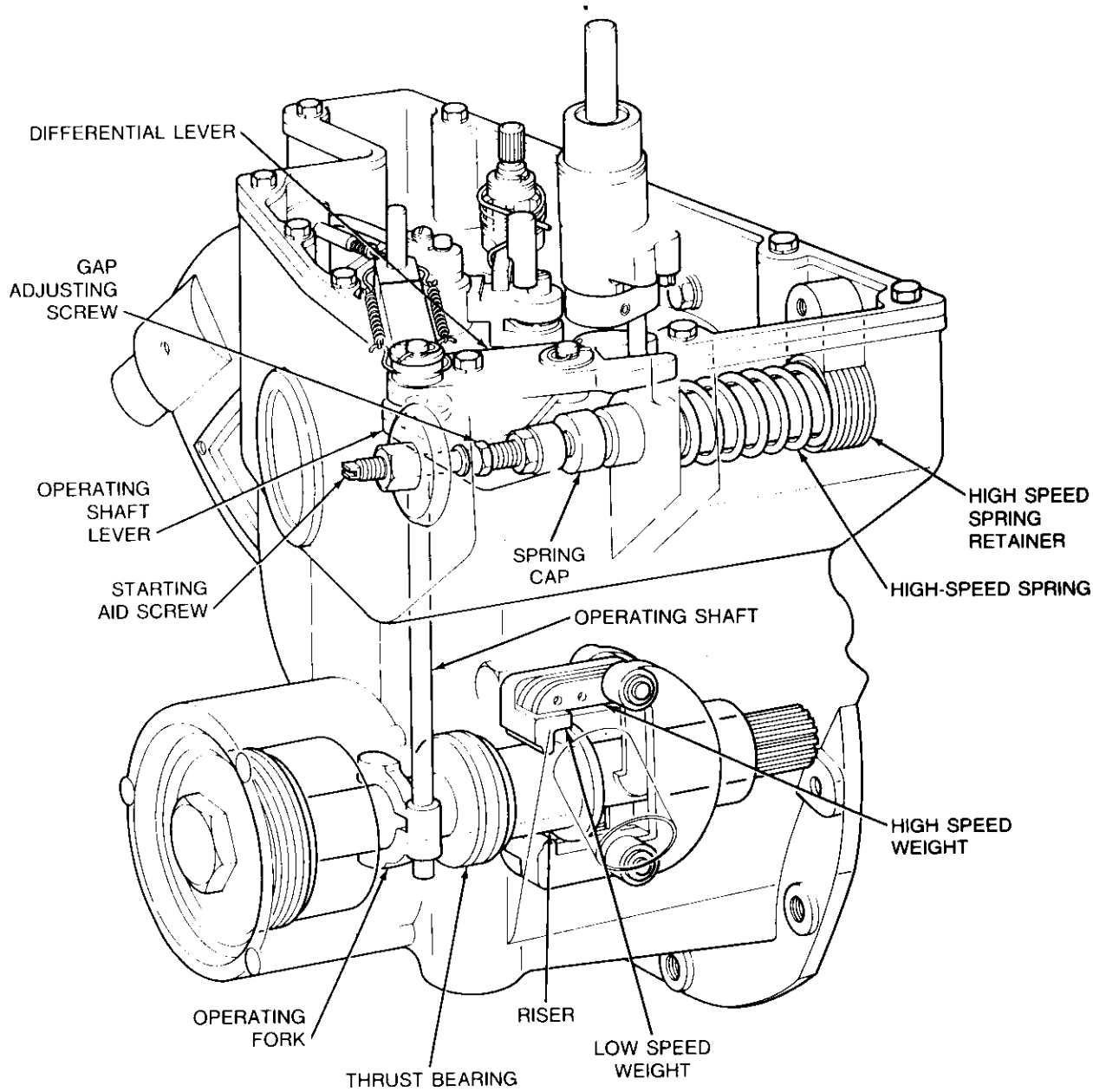
The engine maximum no-load speed is determined by the force exerted by the high-speed spring. When the governor speed control lever is placed in the maximum speed position, the engine will operate at a speed where the force exerted by the governor high-speed weights equals the force exerted by the governor high-speed spring.

Adjustment of the maximum no-load speed is accomplished by the high- speed spring retainer. Movement of the high-speed spring retainer will increase or decrease the tension on the high-speed spring.



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4-11. TURBOCHARGER REPAIR (Continued)

b. Cleaning

WARNING

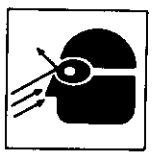
Never use corrosive cleaning solution for cleaning. This will damage certain parts. Use cleaning solution in an open or well ventilated area. Avoid breathing fumes to avoid possible toxic effect. Keep away from flames to avoid possibility of fire. Do not use a wire brush or a steel blade scraper to clean parts.

(1) Before cleaning, inspect parts for signs of burning, rubbing or other damage which might not be evident after cleaning.

(2) Soak all parts in a non-corrosive cleaning solvent for about 25 minutes. After soaking, use a stiff bristle brush and remove all dirt particles. Using a lint free cloth, dry all parts thoroughly.

(3) Thoroughly clean impeller (11), turbine wheel and shaft assembly (8). Any deposits left on the blade will affect the balance of the rotating assembly.

WARNING



Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psi. Eye protection required.

(4) Clean all internal cavities and oil passages in center housing (2). Thoroughly dry with compressed air.

(5) Clean all other parts. Refer to paragraph 2-6.

c. Inspection

(1) Visually inspect housings (1 and 3) for wear marks from rotating parts.

(2) Visually inspect the shroud (12) for wear marks.

(3) Using a T-gage and micrometer, inspect the backplate (16) for wear or damaged sleeve bore. The inside diameter should be a minimum of 0.6875 inch (17.4625 mm), a maximum of 0.6885 inch (17.4879 mm) for new parts and a limit of 0.6895 inch (17.5133 mm) for used parts.

(4) Using a micrometer, inspect spacer (18) for wear. The outside diameter should be a minimum of 0.6715 inch (17.0561 mm), a maximum of 0.6725 inch (17.0815 mm) for new parts, and a limit of 0.6705 inch (17.0307 mm) for used parts.

(5) Using a T-gage and micrometer, inspect the thrust collar (17) for wear.

(a) The thickness should be a minimum of 0.299 inch (7.5946 mm), a maximum of 0.300 inch (7.62 mm) for new parts, and a wear limit of 0.297 inch (7.5438 mm) for used parts.

(b) The inside diameter of the bore should be a minimum of 0.3754 inch (9.5352 mm), a maximum of 0.3758 inch (9.5453 mm) for new parts, and a limit of 0.3778 inch (9.5961 mm) for used parts.

4-2. DESCRIPTION AND DATA (Continued)

(9) FUEL INJECTOR

(a) *General.* The fuel injector performs four functions:

- Creates the high fuel pressure required for efficient injection.
- Meters and injects the exact amount of fuel required to handle the load.
- Atomizes the fuel for mixing with the air in the combustion chamber.
- Permits continuous fuel flow.

(b) *Identification.* The injector has three identification marks. They are a metal tag pressed into the injector body, a stamped number on the internal plunger, and a stamped number on the injector spray tip.

The metal tag identifies the model number of the injector. The model number for the LVS is 9A90.

The stamped number on the plunger is the model number that represents the size of the plunger. The LVS plunger number is F9.

The stamped number on the spray tip indicates the number of spray holes, hole size, and hole angle. The LVS number is 9-.0062-165A which means it has nine holes, a hole size of .0062 inch, and a hole angle of 165 degrees.

(c) *Injector Components*

Follower. Provides a place for the rocker arm to activate the injector plunger.

Stop Pin. Prevents the injector follower from being pushed out of the body by the follower spring.

Follower Spring. Returns the follower and the plunger that is connected to the follower to the raised position.

Plunger. Meters and pressurizes the fuel so that it can be injected into the engine.

Gear. Attached to the plunger and meshed into an injector control tube rack, it helps control the fuel output of the injector.

Gear Retainer. Holds the gear in place when installed in the injector.

Bushing. Closely fitted (lapped) to the plunger, the bushing (along with the plunger) controls the amount of fuel injected.

Spill Deflector. A stainless steel sleeve that prevents the high pressure, high velocity fuel from striking the injector body and eroding a hole in it.

Check Valve. A flat valve that prevents exhaust gases from flowing back into the injector if a small piece of carbon or dirt holds the needle valve open.

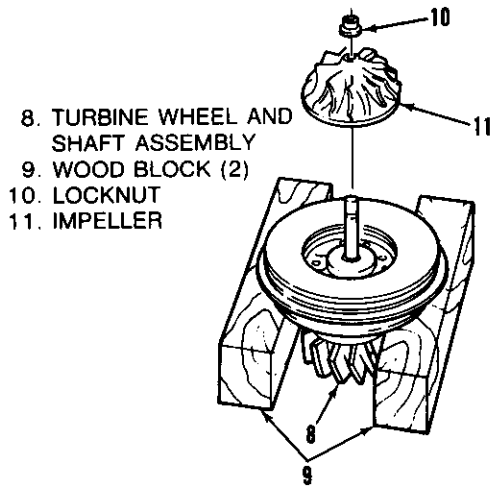
Check Valve Cage. It provides a place for the check valve to be installed.

Valve Spring. The spring holds the needle valve on its seat until pressure builds up to overcome the spring tension.

CAUTION

Care must be taken not to damage threads on turbine wheel and shaft assembly (8) when removing impeller (11).

(7) Press the impeller (11) from turbine wheel and shaft assembly (8).



8. TURBINE WHEEL AND SHAFT ASSEMBLY
9. WOOD BLOCK (2)
10. LOCKNUT
11. IMPELLER

TA 298677

NOTE

Shroud (12) may fall off when center housing is removed.

(8) Remove turbine wheel and shaft assembly (8) and shroud (12) from center housing (2).

(9) Slide shroud (12) from turbine wheel and shaft assembly (8).

(10) Remove and discard seal ring (13) from turbine wheel and shaft assembly (8).

(11) Bend down tabs on four lockplates (14). Remove four capscrews (15), lockplates (14), and backplate (16) from center housing (2). Discard lockplates (14).

(12) Remove thrust collar (17) from spacer (18).

(13) Remove spacer (18) from backplate (16). Remove and discard two seal rings (19) from spacer (18).

(14) Remove thrust bearing (20) from center housing (2).

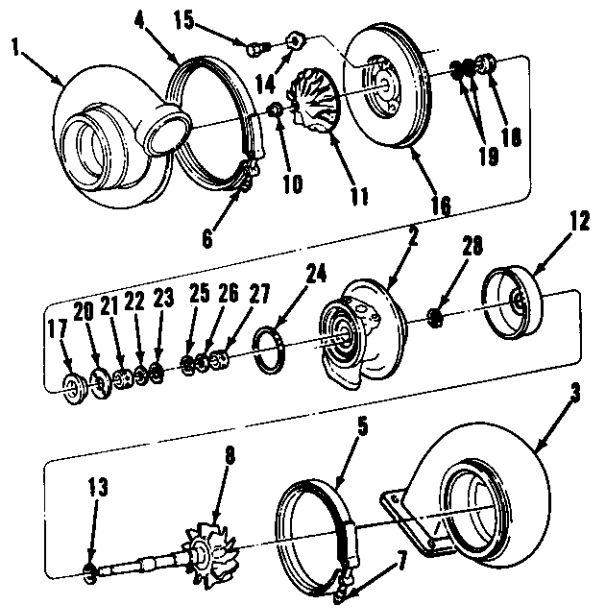
(15) Remove bearing (21) and washer (22).

(16) Remove and discard snapring (23).

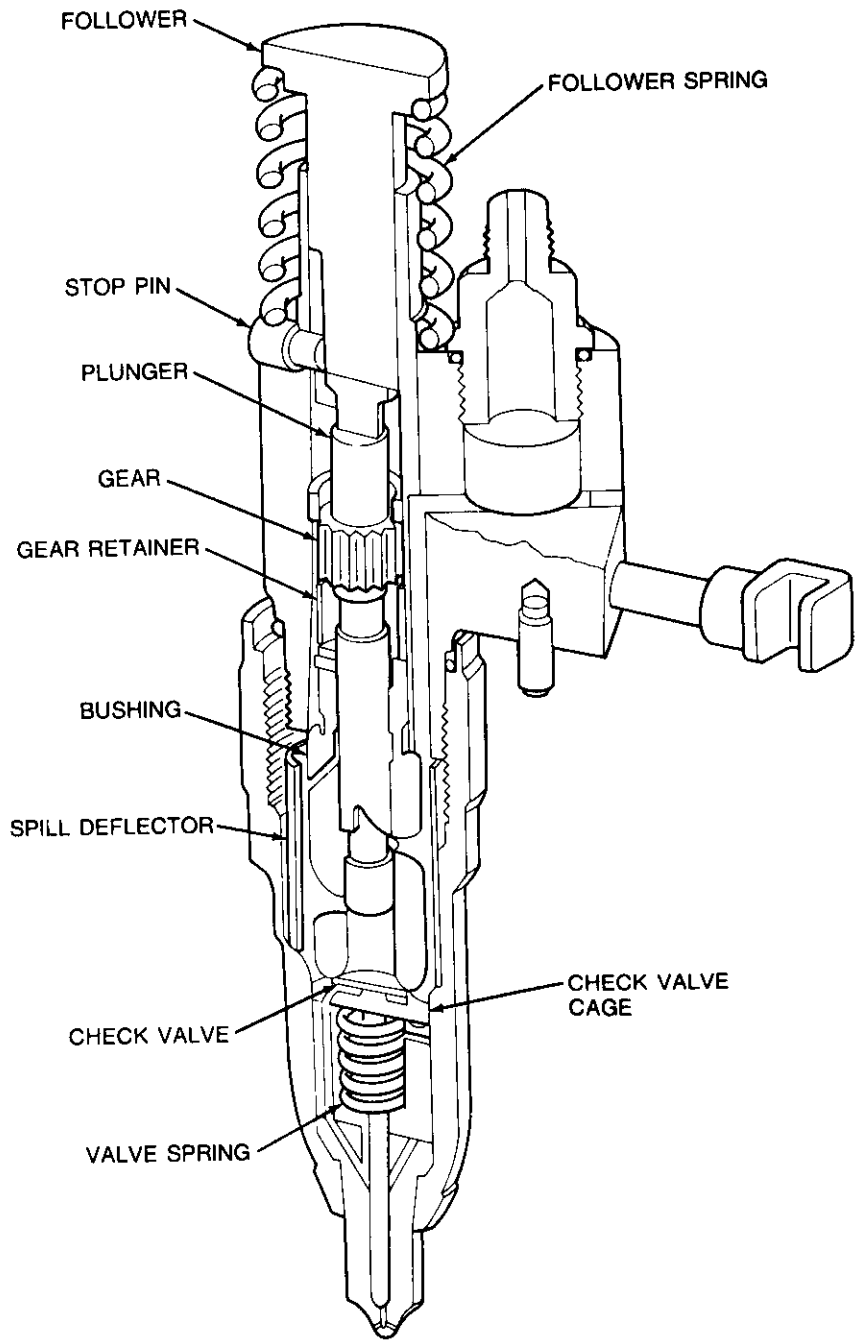
(17) Remove and discard seal ring (24) from center housing (2).

(18) Remove snapring (25), washer (26), and bearing (27) from compressor housing side of center housing (2). Discard snapring (25).

(19) Remove and discard snapring (28).



1. COMPRESSOR HOUSING
2. CENTER HOUSING
3. TURBINE HOUSING
4. COUPLING
5. COUPLING
6. NUT
7. NUT
8. TURBINE WHEEL AND SHAFT ASSEMBLY
10. LOCKNUT
11. IMPELLER
12. SHROUD
13. SEAL RING
14. LOCKPLATE (4)
15. CAPSCREW (4)
16. BACKPLATE
17. THRUST COLLAR
18. SPACER
19. SEAL RING (2)
20. THRUST BEARING
21. BEARING
22. WASHER
23. SNAPRING
24. SEAL RING
25. SNAPRING
26. WASHER
27. BEARING
28. SNAPRING


FOLLOWER
FOLLOWER SPRING
STOP PIN
PLUNGER
GEAR
GEAR RETAINER
BUSHING
SPILL DEFLECTOR
CHECK VALVE CAGE
CHECK VALVE
VALVE SPRING

TA 298619

4-11. TURBOCHARGER REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning
c. Inspection
d. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Dial indicator set (J 7872)
Micrometer set 0-6" inside (NSN 5120-00-473-9350)
Micrometer set 0-6" outside (NSN 5120-00-554-7134)

Materials/Parts

Antiseize compound (item 13, Appendix C)
Engine oil (item 46, Appendix C)
Locknut (MS51922-17) item 10
Turbine seal ring (NSN 2835-01-015-5414) item 13
Lockplate (4) (NSN 2835-01-015-5416) item 14
Seal ring (2) (NSN 2990-00-930-3254) item 19
Snapring (3) (NSN 5365-00-930-3257) items 23, 25 and 28
Seal ring (NSN 5330-01-016-0443) item 24

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Turbocharger removed (para 4-10).

a. Disassembly

CAUTION

Never use corrosive cleaning solution for cleaning. This will damage certain parts. Do not use a wire brush or a steel blade scraper to clean parts.

(1) Clean exterior of compressor housing (1), center housing (2), and turbine housing (3).

(2) Make a scribe mark across the compressor housing (1), center housing (2), turbine housing (3), and couplings (4 and 5). This is to insure proper positioning during assembly.

CAUTION

When removing compressor and turbine housings care must be taken to prevent damage to impeller and turbine wheel.

(3) Loosen nut (6) on coupling (4). Remove compressor housing (1) and coupling (4).

(4) Loosen nut (7) on coupling (5). Remove turbine housing (3) and coupling (5).

(5) Support turbine wheel and shaft assembly (8) with two blocks of wood (9).

(6) Hold center housing (2) upright and remove locknut (10). Discard locknut (10).

4-2. DESCRIPTION AND DATA (Continued)

Needle Valve. It opens and closes the tip. The valve is raised by fuel pressure and held shut by the valve spring.

Filter Cap Fitting. Holds the inlet filter in place and provides a place to connect the inlet and return jumpers.

Filter Cap Gasket. Seals the filter cap to the injector body.

Injector Body. Provides a place to mount all the other component parts of the injector.

Control Rack. Meshed with the gear on the pumping plunger, the control rack connects the injector to the control tube and the governor.

Seal. Provides the seal between the injector body and the injector tip nut.

Spring Cage. It provides a place for the needle valve spring and spring seat.

Nut. Retains the injector valve and tip on the body.

(d) *Fuel Injector Operation.* Fuel under pressure enters the injector at the inlet side through a filter cap and a filter. The inlet side is the filter cap that is located directly over the control rack. From the filter, the fuel passes through a drilled passage into the supply chamber. The supply chamber is the area between the bushing and spill deflector. Fuel also flows through the upper port of the bushing into the area below the plunger by way of a drilled passage. With the lower port open, the fuel continues to flow.

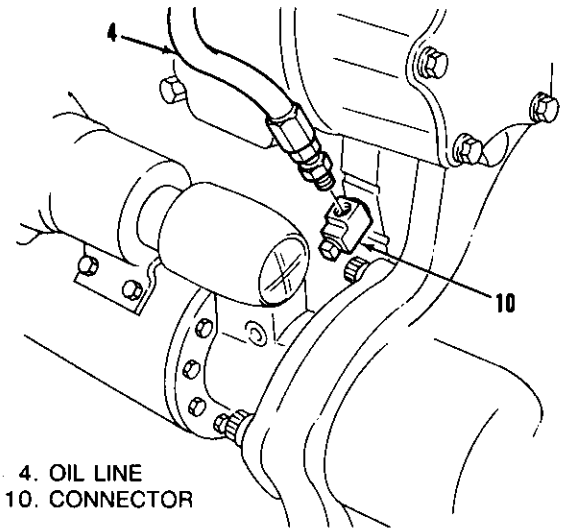
As the rocker arm pushes down on the cam follower, motion is transmitted through the follower to the plunger. The downward motion of the plunger closes off the upper and lower ports. With both ports closed, the fuel is trapped under the plunger. As the plunger continues downward, the fuel is then subjected to increased pressure.

When sufficient pressure is built up, it opens the flat, non-return check valve. The fuel in the check valve cage, spring cage, tip passages and tip fuel cavity is compressed until the pressure force acting upward on the needle valve is sufficient to open the valve against the downward force of the valve spring. As soon as the needle valve lifts off of its seat, the fuel is forced through the small orifices in the spray tip that inject atomized fuel into the combustion chamber.

When the lower land of the plunger uncovers the lower port in the bushing, the fuel pressure below the plunger is relieved and the valve spring closes the needle valve, ending injection.

A pressure relief passage has been provided in the spring cage to permit bleed-off of fuel leaking past the needle pilot in the tip assembly.

A check valve, directly below the bushing, prevents leakage from the combustion chamber into the fuel injector in case the valve is accidentally held open by a small particle of dirt. The injector plunger is then returned to its original position by the injector follower spring.



4. OIL LINE
10. CONNECTOR

(7) Install oil line (4) on connector (10) if removed.

(8) Install oil line (4) on turbocharger (2).

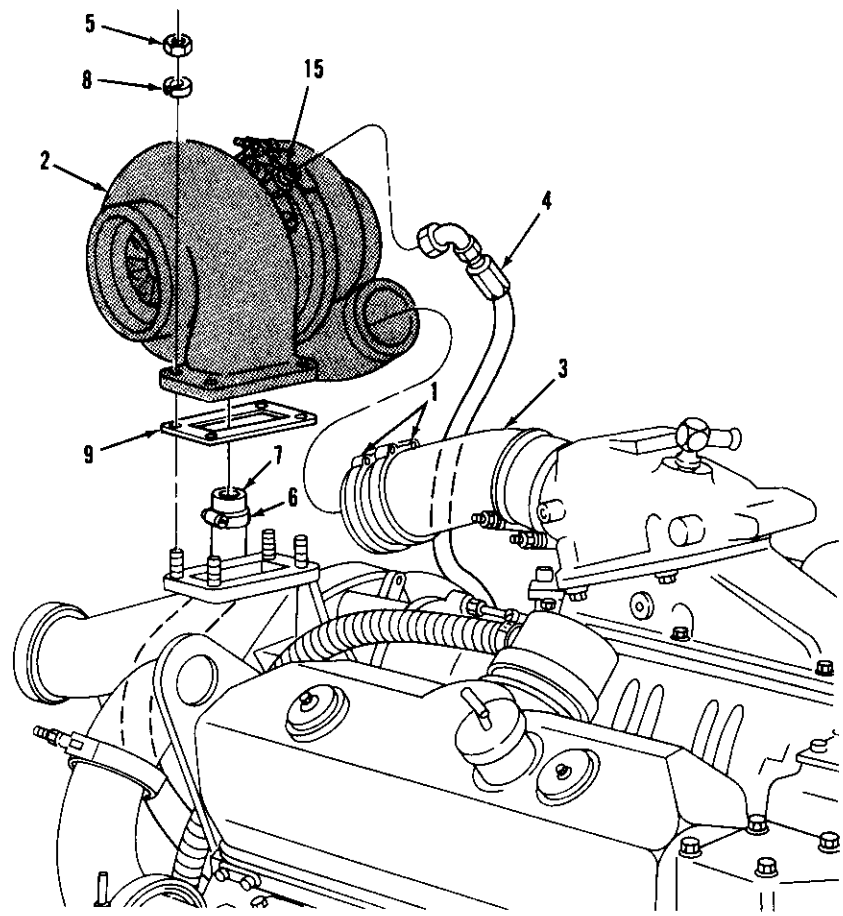
END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install intake ducting (para 4-9).
	Tighten exhaust tubing clamps (para 5-3).
TM 2320-10/11 TM 9-2320-297-10	Start engine and check for turbocharger operation (para 2-13).
	Close engine access door (para 2-1).

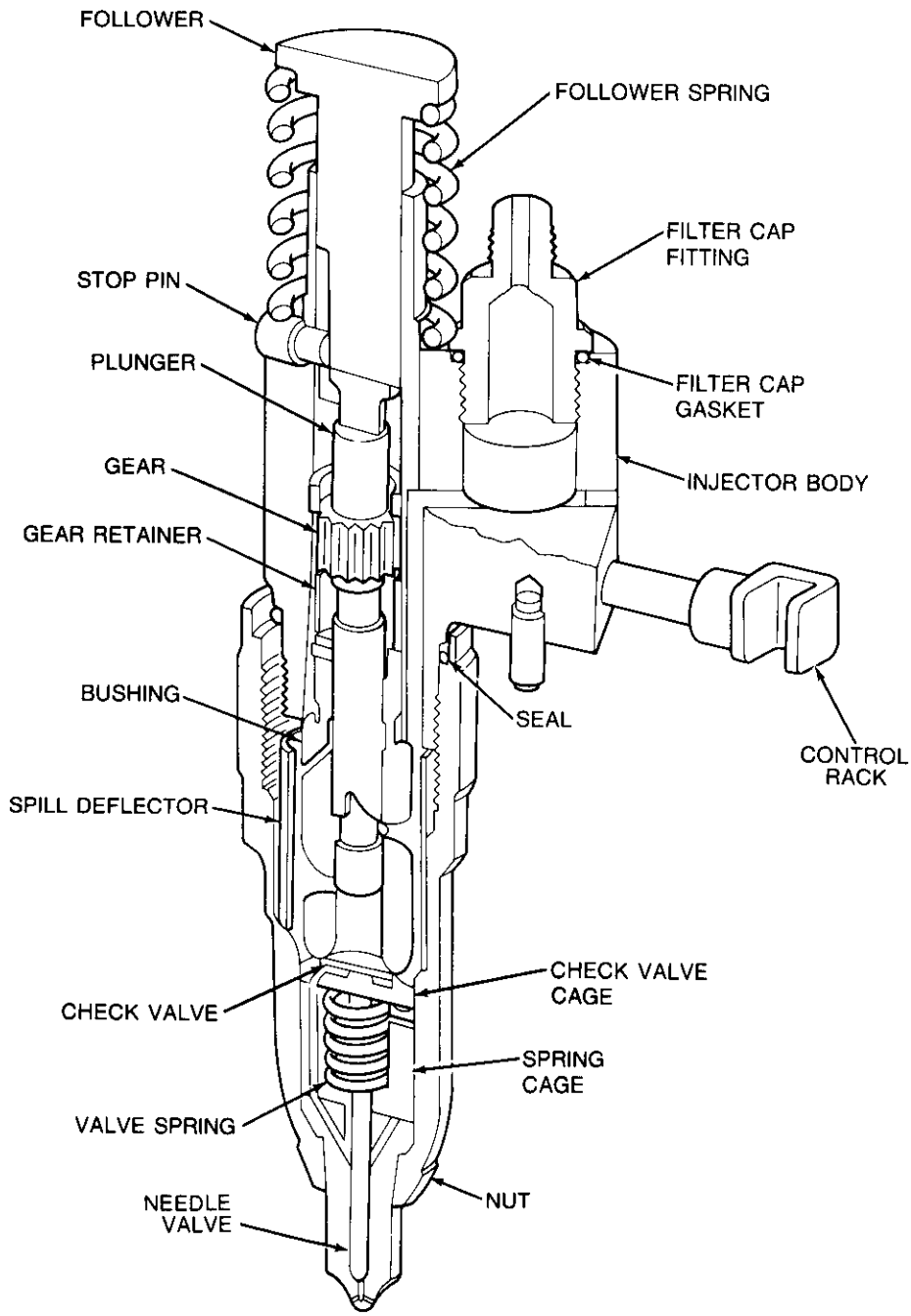
1. HOSE CLAMP (2)
2. TURBOCHARGER
3. HOSE
4. OIL LINE
5. LOCKNUT
6. HOSE CLAMP
7. HOSE
8. WASHER (4)
9. GASKET
15. OIL LINE FITTING



TA 298676

On the upward movement of the plunger, both ports allow fuel flow, permitting fuel to fill the cavity in the plunger. The constant circulation of fresh, cool fuel through the injector renews the fuel supply in the chamber, helps cool the injector, and also effectively removes all traces of air that might otherwise accumulate in the system and interfere with accurate metering of the fuel.

Excess fuel then returns through the fuel injector outlet opening, traveling back through the fuel pipes to the return manifold in the cylinder head.



TA 298620

4-10. TURBOCHARGER REPLACEMENT (Continued)

NOTE

Support turbocharger adapter (11) while removing three capscrews (12).

(8) Remove three capscrews (12), lockwashers (13), spacers (14), and turbocharger adapter (11). Discard lockwashers (13).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

(1) Install turbocharger adapter (11), three capscrews (12), new lockwashers (13), and spacers (14). Tighten capscrews (12) securely.

(2) Clean mating surfaces and install new gasket (9) on turbocharger adapter (11).

(3) Install turbocharger (2) with four washers (8) and new locknuts (5). Tighten locknuts (5) securely.

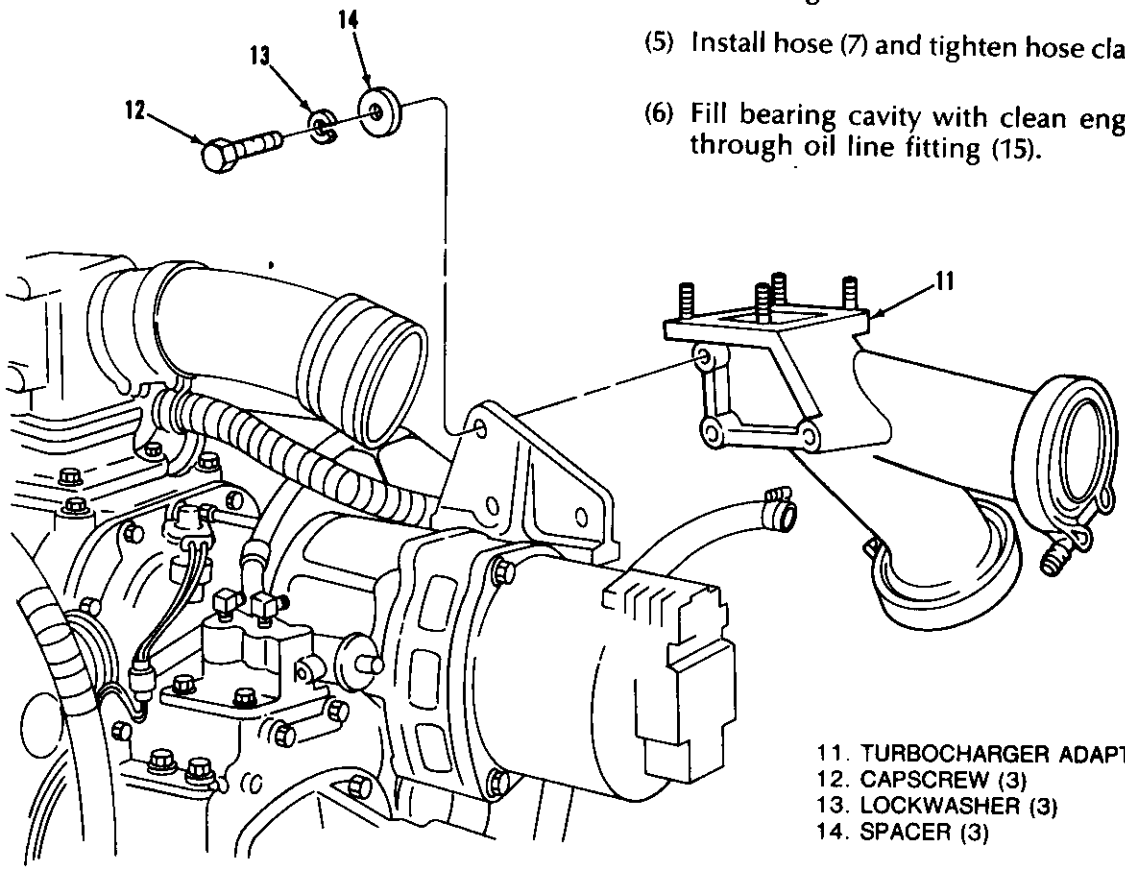
(4) Slide hose (3) onto turbocharger (2). Tighten two hose clamps (1) securely.

CAUTION

To prevent damage, turbocharger bearing cavity must be filled with clean engine oil.

(5) Install hose (7) and tighten hose clamp (6).

(6) Fill bearing cavity with clean engine oil through oil line fitting (15).



11. TURBOCHARGER ADAPTER
12. CAPSCREW (3)
13. LOCKWASHER (3)
14. SPACER (3)

TA 298675

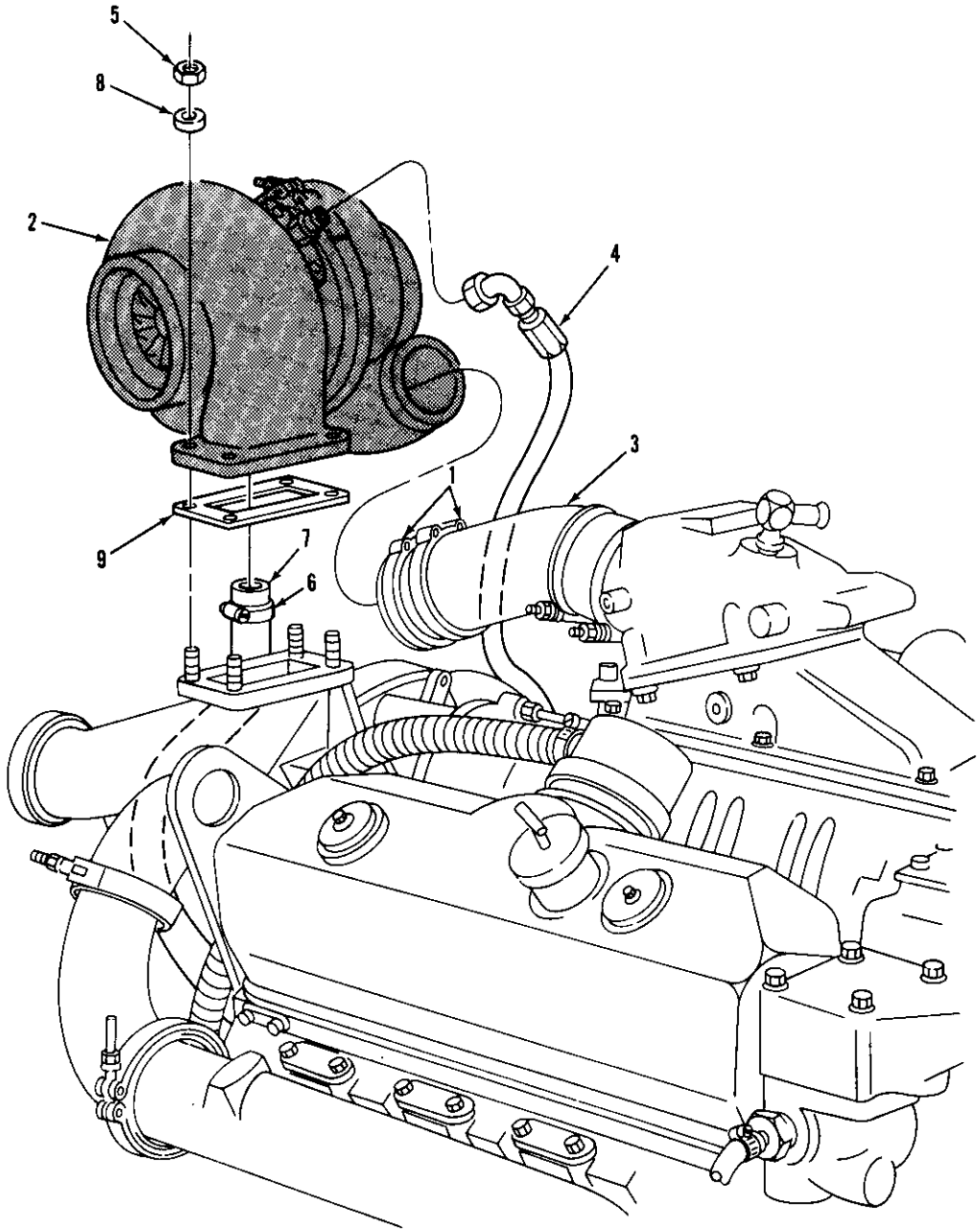
4-2. DESCRIPTION AND DATA (Continued)

(e) *Fuel Metering.* Fuel metering in the injectors is controlled by the position of the helix in relation to the ports in the bushing. The amount of fuel delivered to the engine is controlled by the position of the helix in relation to the upper and lower ports in the bushing. Turning the plunger causes the ports to close sooner or later, pumping more fuel into the engine cylinder. The turning of the plunger is controlled by the gear and control rack.

Changing the position of the helixes, by rotating the plunger, retards or advances the closing of the ports and the beginning and ending of the injection period. At the same time, it increases or decreases the amount of fuel injected into the cylinder. There are various plunger positions from no-load to full-load. With the control rack pulled out all the way (no injection), the upper port is not closed by the helix until after the lower port is uncovered. With the rack in this position, all of the fuel is forced back through the lower port before injection takes place.

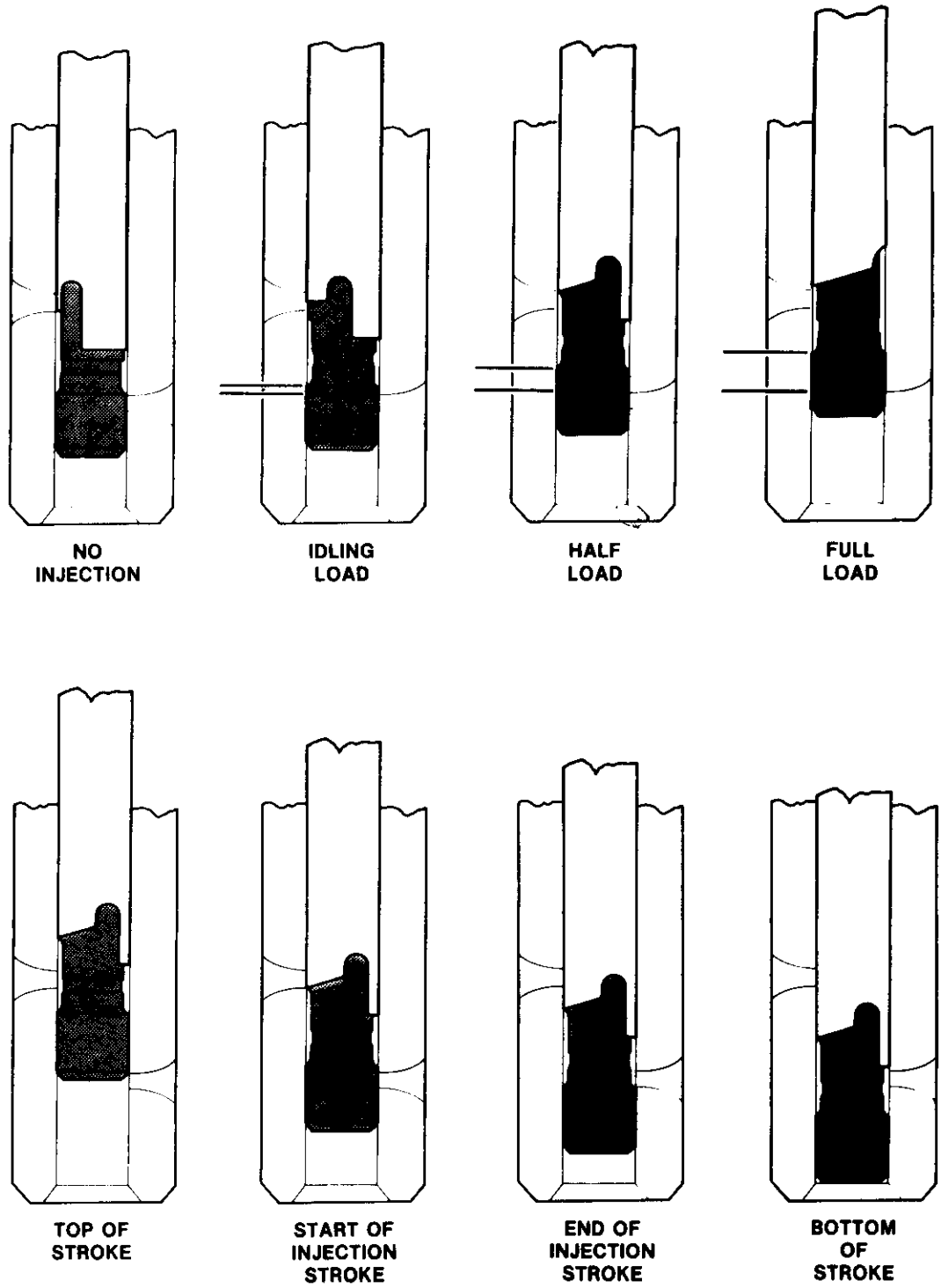
As the plunger is rotated, the angle of the upper helix changes. This change in angle creates a change in the effective stroke. Effective stroke is the distance that the plunger travels from the start of injection to the end of injection.

With the control rack pushed all the way in (full injection), the upper port is closed shortly after the lower port has been covered. This produces a maximum effective stroke and maximum injection. From this, no injection position to the full injection position (full rack movement), the angle of the upper helix advances the closing of the ports and the beginning of injection.



1. HOSE CLAMP (2)
2. TURBOCHARGER
3. HOSE
4. OIL LINE
5. LOCKNUT (4)
6. HOSE CLAMP
7. HOSE
8. WASHER (4)
9. GASKET

TA 298674


NO INJECTION
IDLING LOAD
HALF LOAD
FULL LOAD
TOP OF STROKE
START OF INJECTION STROKE
END OF INJECTION STROKE
BOTTOM OF STROKE

TA 290821

4-10. TURBOCHARGER REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Engine oil (item 46, Appendix C)
Locknut (4) (MS51922-17) item 5
Gasket (NSN 5330-01-037-4129) item 9
Lockwasher (3) (MS35338-46) item 13

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Engine access door open (para 2-1).
TM 2320-20/12 TM 9-2320-297-20	Intake ducting removed. (para 4-9).
	Loosen exhaust tubing clamps (para 5-3).

---

a. Removal

(1) Loosen two hose clamps (1) from hose (3).

(2) Free turbocharger (2) from hose (3).

(3) Disconnect oil line (4) at turbocharger (2).

(4) Loosen hose clamp (6). Disconnect hose (7) at turbocharger (2).

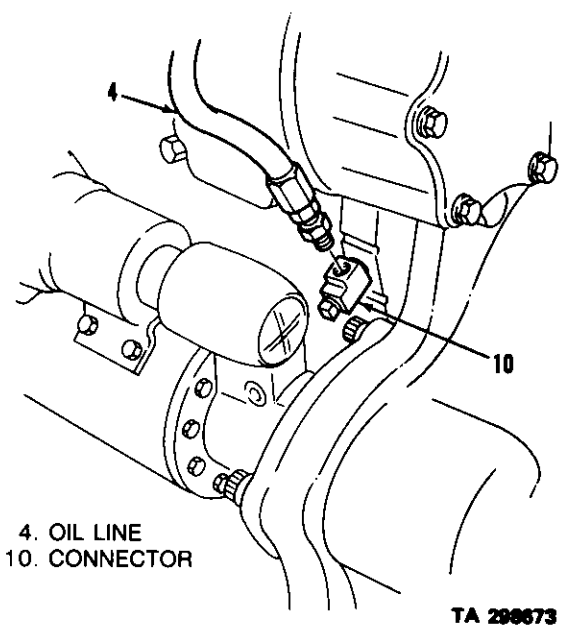
CAUTION

Take care when removing turbocharger (2). Turbocharger (2) can fall from mount during removal of locknuts (5). Remove inner two locknuts (5) first.

(5) Remove four locknuts (5) and washers (8). Discard locknuts (5).

(6) Remove turbocharger (2) and gasket (9). Discard gasket (9).

(7) Remove oil line (4) from connector (10), if necessary.



4. OIL LINE
10. CONNECTOR

TA 298673

SECTION II. GENERAL FUEL SYSTEM MAINTENANCE

4-3. INJECTOR REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

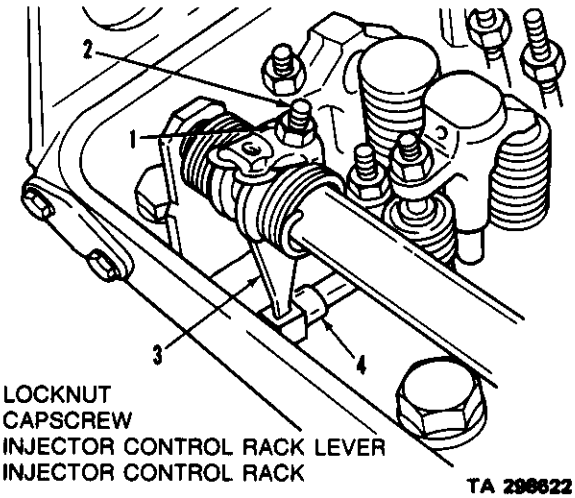
Diesel fuel (item 38, Appendix C)

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Engine access door open (para 2-1).
TM 2320-20/12 TM 9-2320-297-20	Rocker cover removed (para 3-4).
TM 2320-34/13 TM 9-2320-297-34	Engine brake removed (para 3-15).
	Rocker arm bracket and rocker arm shaft removed (para 3-9).
	Fuel pipes removed (para 3-3).

a. Removal

(1) Loosen locknut (1) and capscrew (2).

(2) Slide injector control rack lever (3) away from injector control rack (4).



1. LOCKNUT
2. CAPSCREW
3. INJECTOR CONTROL RACK LEVER
4. INJECTOR CONTROL RACK

TA 296622

(3) Remove capscrew (5), washer (6), and clamp (7).

CAUTION

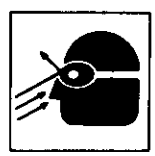
Injector tube hole in cylinder head must be covered to keep dirt out.

(4) Remove injector (8) and cover injector tube (9).

(5) Repeat steps (1) thru (4) to remove remaining seven injectors.

b. Cleaning/Inspection

WARNING



Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psi. Eye protection required.

(7) Torque four capscrews (7 and 10) and two nuts (4) to 35-40 foot-pounds (47-55 N·m).

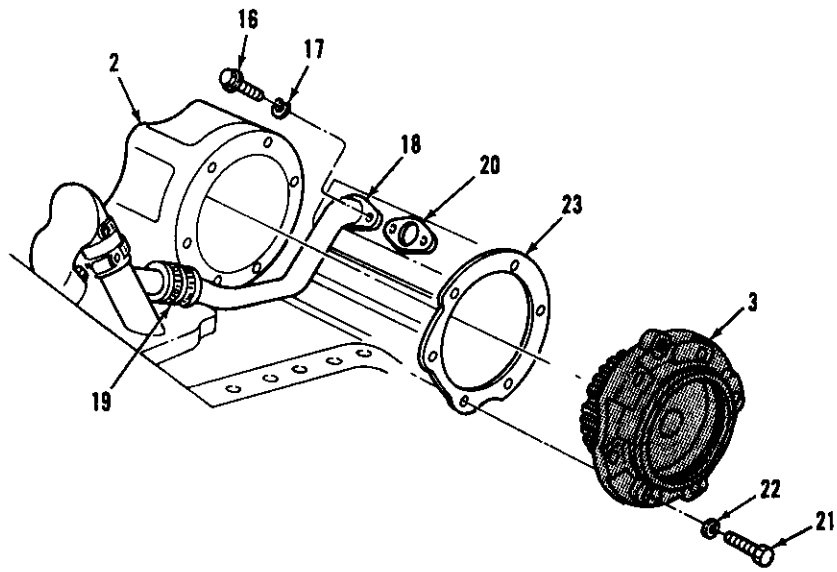
(8) Install breather tube (18) with new gasket (20), two new lockwashers (17) and two capscrews (16). Tighten capscrews (16) and clamp (19) securely.

END OF TASK

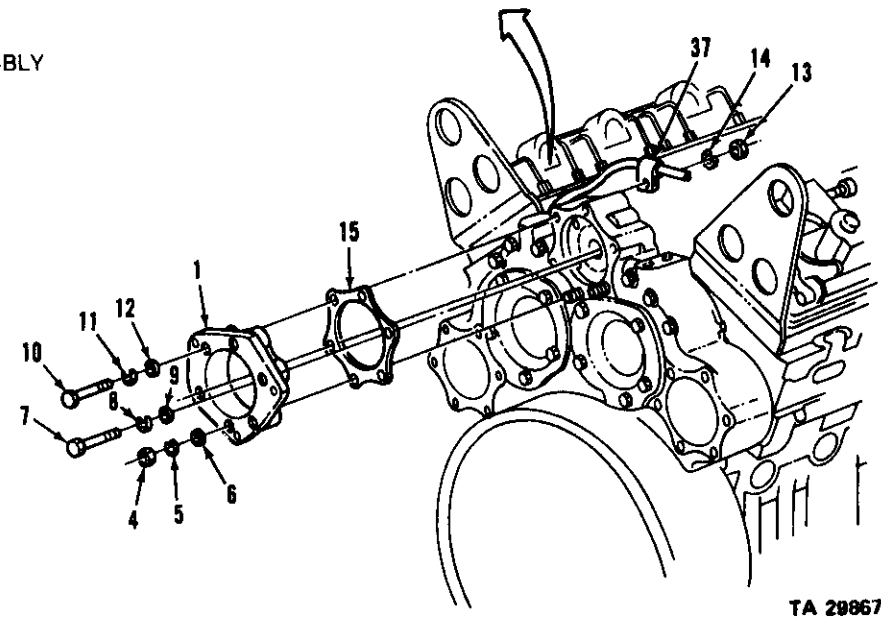
NOTE

Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install alternator (para 7-4).
TM 2320-34/13 TM 9-2320-297-34	Install blower (para 4-6).



1. ALTERNATOR ADAPTOR
2. FLYWHEEL HOUSING
3. BLOWER DRIVE GEAR ASSEMBLY
4. NUT (2)
5. LOCKWASHER (2)
6. WASHER (2)
7. CAPSCREW (3)
8. LOCKWASHER (3)
9. WASHER (3)
10. CAPSCREW
11. LOCKWASHER
12. WASHER
13. NUT
14. LOCKWASHER
15. GASKET
16. CAPSCREW (2)
17. LOCKWASHER (2)
18. BREATHER TUBE
19. CLAMP
20. GASKET
21. CAPSCREW (2)
22. COPPER WASHER (2)
23. GASKET
37. CLIP



TA 298672

(1) Clean exterior of each injector (8) with clean diesel fuel. Blow dry with compressed air.

(2) Clean injector tube (9) with clean diesel fuel.

(3) Clean all other parts. Refer to paragraph 2-6.

(4) Inspect all parts. Refer to paragraph 2-7.

(5) Replace all parts failing inspection.

c. Installation

(1) Uncover injector tube (9).

(2) Insert injector (8) into injector tube (9) in cylinder head. Aline dowel pin (10) with locating hole (11) in cylinder head.

(3) Slide injector control rack lever (3) into injector control rack (4).

(4) Install clamp (7), capscrew (5), and washer (6) with curved side of washer (6) facing clamp (7).

(5) Torque capscrew (5) to 20-25 foot-pounds (27-34 N·m). Make sure clamp (7) does not interfere with injector follower spring (12) or valve springs (13).

(6) Check injector control rack lever (3) for free movement. If injector control rack lever (3) binds, loosen capscrew (5). Retorque capscrew (5) to 20-25 foot-pounds (27-34 N·m).

(7) Repeat steps (1) thru (6) to install remaining seven injectors.

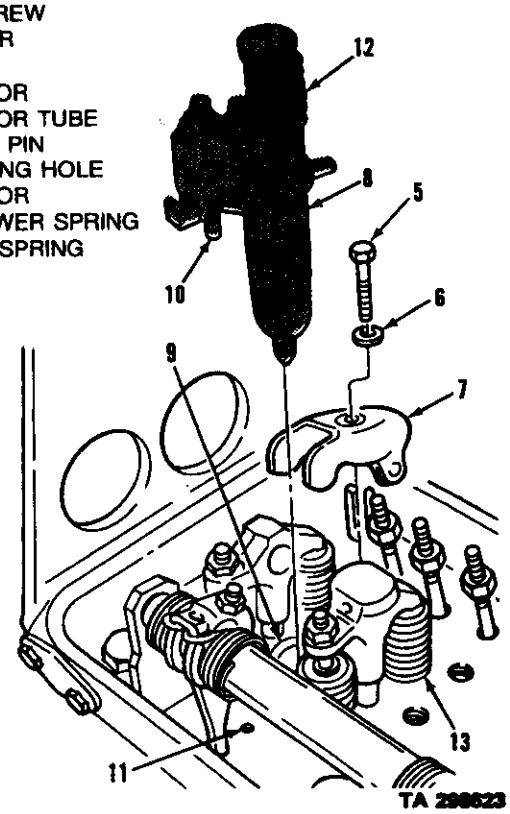
END OF TASK

NOTE

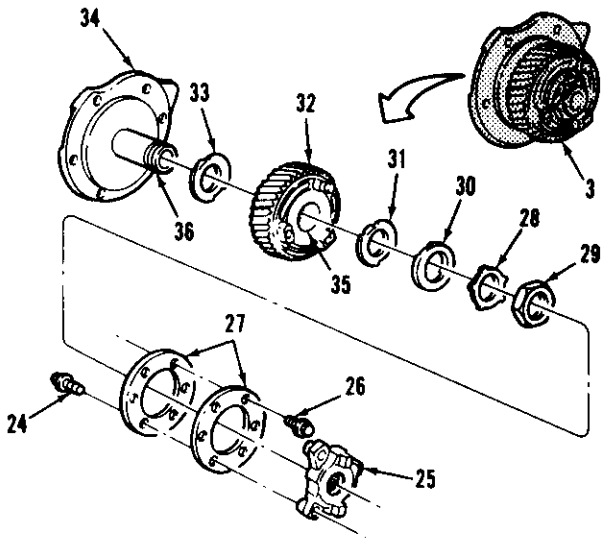
Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Install rocker arm bracket and rocker arm shaft (para 3-9).
	Install fuel pipes (para 3-3).
	Install engine brake (para 3-15).
	Adjust fuel injector timing (para 3-29).
	Adjust exhaust valves (para 3-29).
	Adjust injector rack control lever (para 3-29).
TM 2320-20/12 TM 9-2320-297-20	Install rocker arm cover (para 3-4).
TM 2320-10/11 TM 9-2320-297-10	Close engine access door (para 2-1).

5. CAPSCREW
6. WASHER
7. CLAMP
8. INJECTOR
9. INJECTOR TUBE
10. DOWEL PIN
11. LOCATING HOLE
12. INJECTOR FOLLOWER SPRING
13. VALVE SPRING



4-9. BLOWER DRIVE GEAR MAINTENANCE (Continued)



3. BLOWER DRIVE GEAR ASSEMBLY
24. CAPSCREW (3)
25. DRIVE HUB
26. CAPSCREW (3)
27. SPRING PLATE (2)
28. LOCKWASHER
29. NUT
30. THRUST WASHER
31. THRUST BEARING
32. DRIVE GEAR
33. THRUST BEARING
34. SUPPORT
35. BUSHING (2)
36. SUPPORT SHAFT

TA 298671

d. Assembly

(1) Install thrust bearing (33) on support (34) so tang alines with slot in support (34).

(2) Install drive gear (32) on support shaft (36) so flat side of gear is towards support.

(3) Install thrust bearing (31) so tangs are away from drive gear (32).

CAUTION

New style thrust washer (30) must be used to avoid interference and parts damage. Refer to parts manual for correct replacement part.

(4) Aline slots in thrust washer (30) with tangs on thrust bearing (31) and alining pin on support shaft (36). Place thrust washer (30) on thrust bearing (31).

CAUTION

New style lockwasher (28) must be used to avoid interference and parts damage. Refer to parts manual for correct replacement part.

(5) Aline lockwasher slot with shaft alining pin. Install new lockwasher (28) and nut (29). Torque nut (29) to 50-60 foot-pounds (68-81 N·m).

(6) Bend tangs on lockwasher (28) to secure nut (29).

(7) Check clearance between thrust washer (30) and thrust bearing (31). Clearance must be a minimum of 0.005 inch (0.127 mm), a maximum of 0.010 inch (0.254 mm) for new parts. Maximum limit on used parts is 0.012 inch (0.305 mm).

(8) Install blower drive gear assembly (3) into flywheel housing (2).

(9) Install two spring plates (27) with three capscrews (26). Torque capscrews to 35-39 foot-pounds (47-53 N·m).

(10) Install drive hub (25) on drive gear (32) with three capscrews (24). Torque capscrews to 35-39 foot-pounds (47-53 N·m).

e. Installation

(1) Aline marks made during removal. Install new gasket (23) and blower drive gear assembly (3) with two capscrews (21) and two new copper washers (22). Hand tighten capscrews (21) securely.

(2) Aline marks made during removal. Install new gasket (15) and alternator adaptor (1).

(3) Install two nuts (4), new lockwashers (5), and washers (6). Hand tighten two nuts (4).

(4) Install three capscrews (7), new lockwashers (8), and washers (9). Hand tighten capscrews (7).

(5) Install capscrew (10), new lockwasher (11), washer (12), clip (37), new lockwasher (14), and nut (13). Hand tighten nut (13).

(6) Torque two capscrews (21) to 25-30 foot-pounds (34-41 N·m).

4-4. INJECTOR REPAIR

THIS TASK COVERS:
a. Testing
b. Disassembly
c. Cleaning
d. Inspection
e. Lapping
f. Assembly

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Holding fixture (J 22396A)
Spring tester (J 9666)
Lapping block set (J 22090-A)
Seal protector (J 29197)
Tip runout and rack freeness gage (J 29584)
Needle valve lift gage (J 9462-02)
Injector service set (J 23435-02)
Brass wire brush (J 7944)
Injector body reamer (J 21089)
Injector test kit (J 23010-A)

Materials/Parts
Lapping compound (item 17, Appendix C)
Dry cleaning solvent (item 66, Appendix C)
Test oil (J 26400-55)
Service kit (NSN 2910-00-073-3010)
O-ring (P/N 5229167) item 48
Injector filter (P/N 17066) item 32
Gasket (P/N 17054) item 31

Equipment Condition

TM	Condition Description
TM 2320-34/13	Injector removed (para 4-3).
TM 9-2320-297-34	

Special Environmental Conditions
All injector repairs should be performed in a clean, well lit room, free from dust and dirt. Some fuel injector parts have very close tolerances and can be damaged by dirt or dust.

General Safety Instructions
The fuel spray from an injector can penetrate skin. Fuel oil which enters blood stream can cause a serious infection. Follow instructions and use proper equipment to test an injector.

a. Testing

WARNING

The fuel spray from an injector can penetrate skin. Fuel oil which enters blood stream can cause serious infection. Follow instructions and use proper equipment to test an injector.

NOTE

Perform all tests before disassembling injector. If injector fails test, injector must be disassembled and repaired.

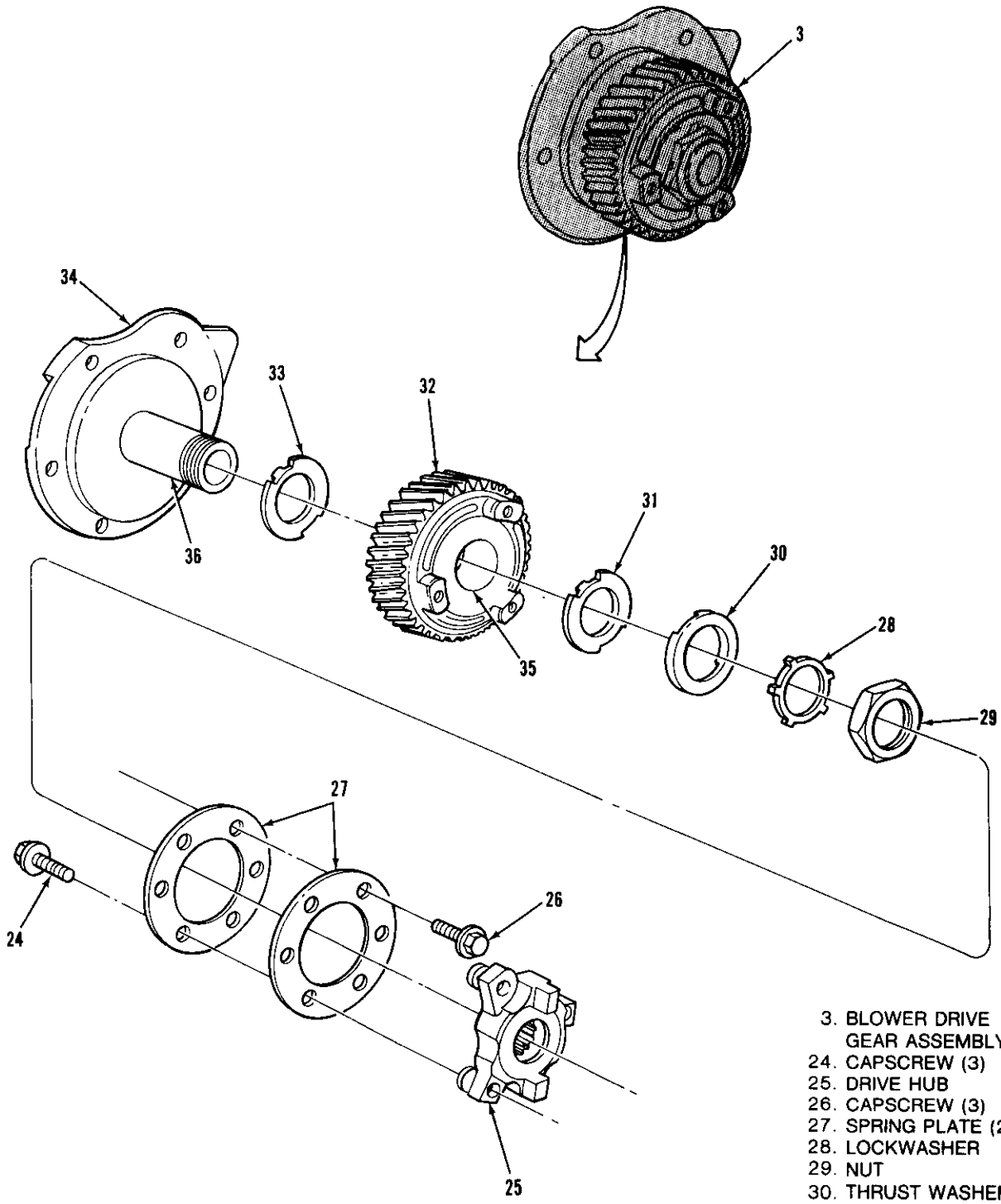
(1) To test control rack and plunger movement, perform the following steps:

a. Install injector (1) in gage (2).

b. Pull handle (3) over injector (1) until lobe (4) is centered on cam follower (5).

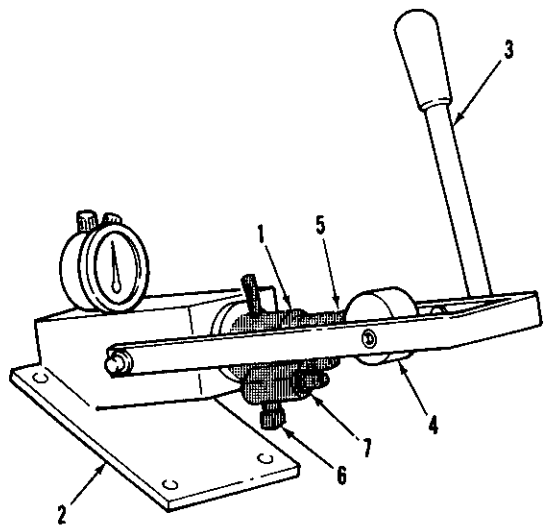
c. Push control rack (6) in a NO FUEL position with notch end away from injector body (7).

d. Push handle (3) down until cam follower (5) bottoms out.



3. BLOWER DRIVE GEAR ASSEMBLY
24. CAPSCREW (3)
25. DRIVE HUB
26. CAPSCREW (3)
27. SPRING PLATE (2)
28. LOCKWASHER
29. NUT
30. THRUST WASHER
31. THRUST BEARING
32. DRIVE GEAR
33. THRUST BEARING
34. SUPPORT
35. BUSHING (2)
36. SUPPORT SHAFT

TA 298670



1. INJECTOR
2. GAGE (TOOL)
3. HANDLE
4. LOBE
5. CAM FOLLOWER
6. CONTROL RACK
7. INJECTOR BODY

(e) Very slowly release pressure on handle (3) while moving control rack (6) up and down. Repeat this until no more pressure is on cam follower (5).

(f) Check for free movement of control rack (6). If control rack does not move freely, disassemble and overhaul injector (1).

(2) To install injector on test stand, perform the following steps:

(a) Install clamping head (8) onto post on test stand (9). Tighten thumb screw (10) on clamping head (8) in lower notch.

(b) Install delivery tube (11) on clamping head (8).

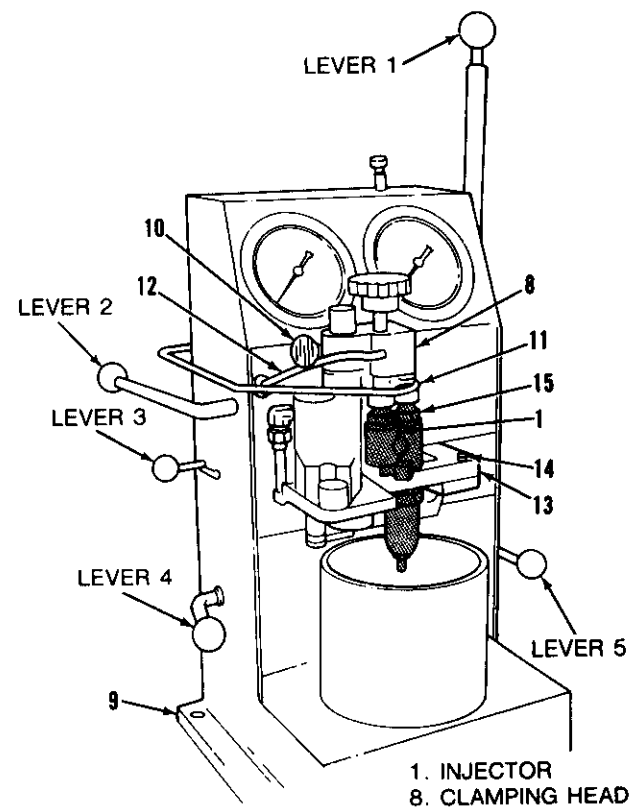
(c) Install clear discharge tube (12) on connector on side of clamping head (8).

(d) Aline correct hole in adapter plate (13) with dowel pin (14) on stand. Install plate over dowel pin. This allows plate to pivot on dowel pin.

(e) Swing adapter plate (13) out and insert injector (1). Aline dowel pin (14) with correct hole in adapter plate (13).

(f) Swing mounted injector in towards test stand (9) and position filter caps (15) under clamping head (8).

(g) Position lever 2 up and towards rear. Position lever 3 in rear detent and levers 4 and 5 up.



1. INJECTOR
8. CLAMPING HEAD
9. TEST STAND
10. THUMB SCREW
11. DELIVERY TUBE
12. DISCHARGE TUBE
13. ADAPTER PLATE
14. DOWEL PIN
15. FILTER CAP

TA 298624

4-9. BLOWER DRIVE GEAR MAINTENANCE (Continued)

b. Disassembly

(1) Remove three capscrews (24) and drive hub (25).

(2) Remove three capscrews (26) and two spring plates (27) from drive hub (25).

(3) Install blower drive gear assembly (3) in a soft-jawed vise.

(4) Straighten tangs on lockwasher (28) and remove nut (29).

(5) Remove lockwasher (28), thrust washer (30), thrust bearing , drive gear (32), and thrust bearing (33) from support (34). Discard lockwasher (28).

c. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Measure inside diameter of two bushings (35). Diameter must be a minimum of 1.6260 inches (41.300 mm) and a maximum of 1.6265 inches (41.313 mm). Replace bushings (35) if they fail inspection.

(3) Measure outside diameter of support shaft (36). Diameter must be a minimum of 1.6240 inches (41.250 mm) and a maximum of 1.6250 inches (41.275 mm).

(4) Clearance between support shaft (36) and bushing (35) must be a minimum of 0.0010 inch (0.0254 mm) and a maximum of 0.0025 inch (0.0635 mm). There is a limit of 0.0050 inch (0.127 mm) on used parts.

(5) Measure thickness of thrust washer (30). Thickness must be a minimum of 0.2350 inch (5.969 mm) and a maximum of 0.2450 inch (6.223 mm).

(6) Measure thickness of thrust bearings (31 and 33). Thickness must be a minimum of 0.0590 inch (1.499 mm) and a maximum of 0.0610 inch (1.549 mm).

(7) Inspect all other parts. Refer to paragraph 2-7.

(8) Replace all parts failing inspection.

4-4. INJECTOR REPAIR (Continued)

CAUTION

Excessive force on lever during clamping can damage seals in test stand valves.

NOTE

Thru-flow valve (16) should still turn freely. If not, turn valve counterclockwise until it rotates freely and reapply clamping pressure.

(h) Back off thru-flow valve (16) about halfway and operate lever 1 to move clamping head (8) down to seal filter cap (15) and delivery tube (11).

(i) Move lever 4 down and operate lever 1. Operate lever 1 until air bubbles no longer pass through clear discharge tube (12). The system is now free from air and test can be performed on stand.

(3) Perform valve opening and spray pattern test as follows:

WARNING

The fuel spray from an injector can penetrate skin. Fuel oil which enters blood stream can cause a serious infection. Follow instructions and use proper equipment to test an injector.

NOTE

This test determines uniformity of spray pattern and opening pressure at which fuel injection begins.

(a) Move lever 4 down.

(b) Position control rack (6) in FULL FUEL position (notch pushed in towards injector body).

(c) Position lever 1 straight up and lever 3 to forward detent.

(d) Operate lever 1 so cam follower (5) is between 40 and 80 strokes per minute.

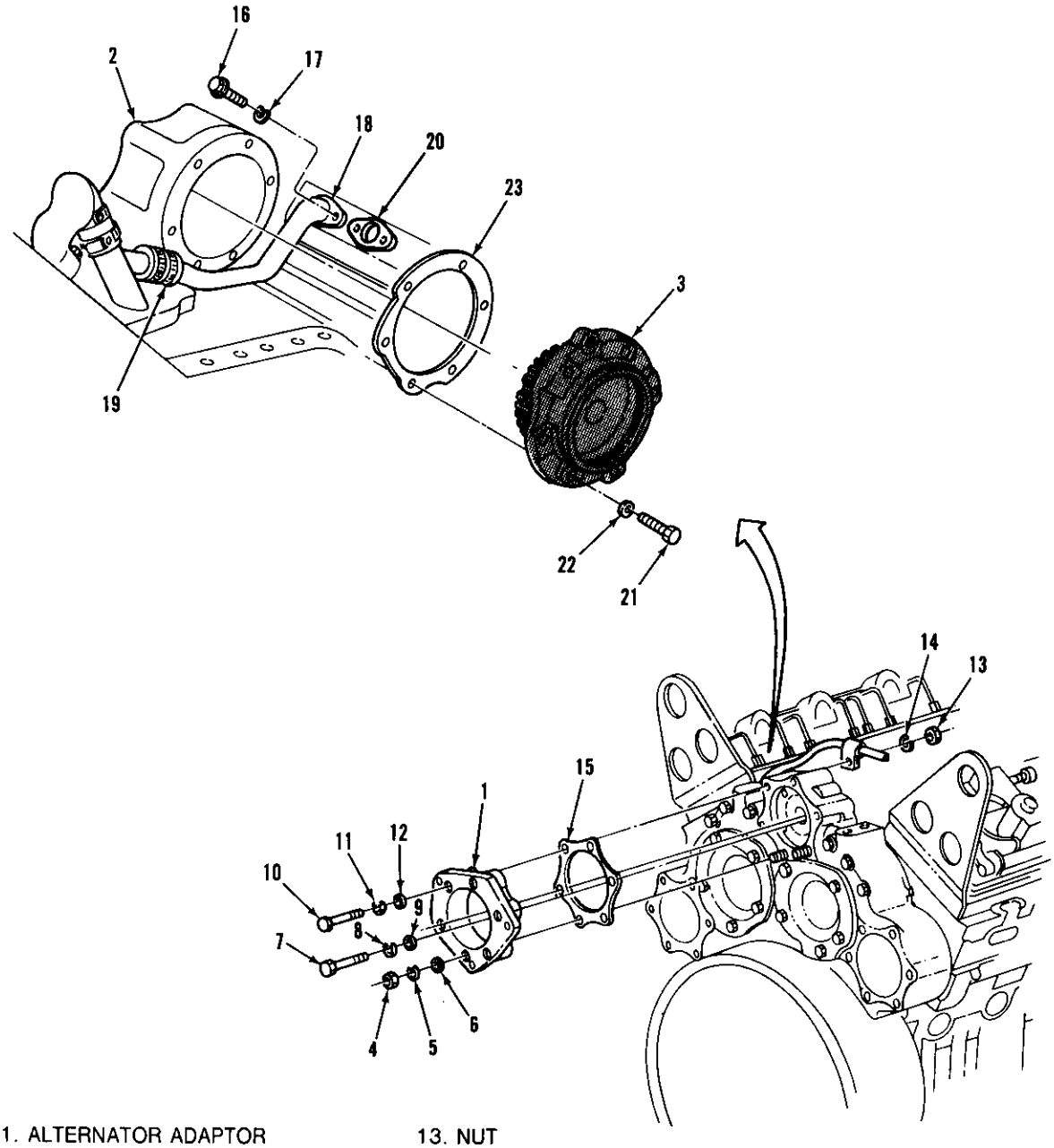
(e) Look at spray pattern to see if nine spray orifices (17) are open and dispersing fuel evenly. Spray patterns should be finely atomized with no drops at end of spray tip.

NOTE

Reading on gage is only used for troubleshooting before disassembly. Exact valve opening pressure is determined by needle valve tip test.

(f) Note the reading on gage 1. The pressure readings must be between 138 and 162 psi (951-1,116 kPa). The highest pressure reading will be reached just before injection ends.

(g) If injector failed test, needle valve and spray tip must be inspected and repaired or replaced.



1. ALTERNATOR ADAPTOR
2. FLYWHEEL HOUSING
3. BLOWER DRIVE GEAR ASSEMBLY
4. NUT (2)
5. LOCKWASHER (2)
6. WASHER (2)
7. CAPSCREW (3)
8. LOCKWASHER (3)
9. WASHER (3)
10. CAPSCREW
11. LOCKWASHER
12. WASHER
13. NUT
14. LOCKWASHER
15. GASKET
16. CAPSCREW (2)
17. LOCKWASHER (2)
18. BREATHER TUBE
19. CLAMP
20. GASKET
21. CAPSCREW (2)
22. COPPER WASHER (2)
23. GASKET

TA 298669

(4) Perform high pressure test as follows:

WARNING

The fuel spray from an injector can penetrate skin. Fuel oil which enters blood stream can cause a serious infection. Follow instructions and use proper equipment to test an injector.

NOTE

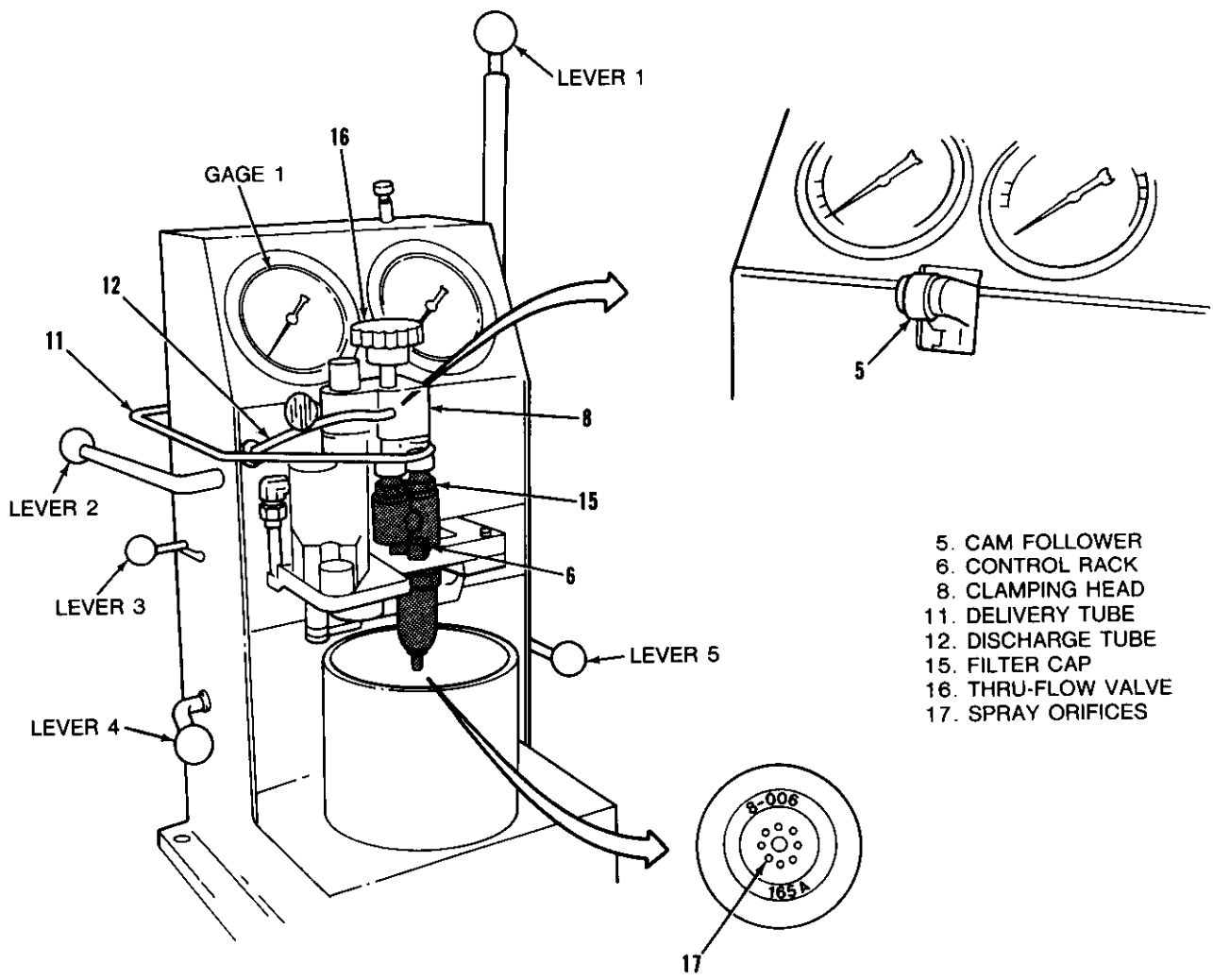
This test checks for leaks at filter cap gasket, injector body plugs, and injector nut seal.

(a) Close the thru-flow valve (16).

(b) Push lever 4 down.

(c) Operate lever 1 and build up pressure to 1600 to 2000 psi (11,024-13,780 kPa).

(d) Check for leakage on injector. If leakage occurs, note location so part can be inspected and either repaired or replaced.



5. CAM FOLLOWER
6. CONTROL RACK
8. CLAMPING HEAD
11. DELIVERY TUBE
12. DISCHARGE TUBE
15. FILTER CAP
16. THRU-FLOW VALVE
17. SPRAY ORIFICES

TA 298625

4-9. BLOWER DRIVE GEAR MAINTENANCE

THIS TASK COVERS: a. Removal
b. Disassembly
c. Cleaning/Inspection
d. Assembly
e. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Lockwasher (7) (MS35338-46) items 5, 8, 11, and 14
Gasket (NSN 5330-01-088-5984) item 15
Lockwasher (2) (MS35338-44) item 17
Gasket (NSN 5330-00-892-1764) item 20
Copper washer (2) (NSN 5330-00-264-1939) item 22
Gasket (NSN 5330-01-058-0585) item 23
Lockwasher (NSN 5310-00-276-1829) item 28

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Alternator removed (para 7-4).
TM 2320-34/13 TM 9-2320-297-34	Blower removed (para 4-6).

a. Removal

(1) Match mark alternator adaptor (1), flywheel housing (2), and blower drive gear assembly (3).

(2) Remove two nuts (4), lockwashers (5), and washers (6). Discard lockwashers (5).

(3) Remove three capscrews (7), lockwashers (8), and washers (9). Discard lockwashers (8).

(4) Remove capscrew (10), lockwasher (11), washer (12), nut (13), and lockwasher (14). Discard lockwashers (11 and 14).

(5) Remove alternator adaptor (1) and gasket (15). Discard gasket (15).

(6) Remove two capscrews (16) and lockwashers (17) from breather tube (18). Discard lockwashers (17).

(7) Loosen clamp (19) and remove breather tube (18) and gasket (20). Discard gasket (20).

(8) Remove two capscrews (21) and copper washers (22). Discard copper washers (22).

(9) Remove blower drive gear assembly (3) and gasket (23). Discard gasket (23).

4-4. INJECTOR REPAIR (Continued)

(5) Perform pressure holding test as follows:

WARNING

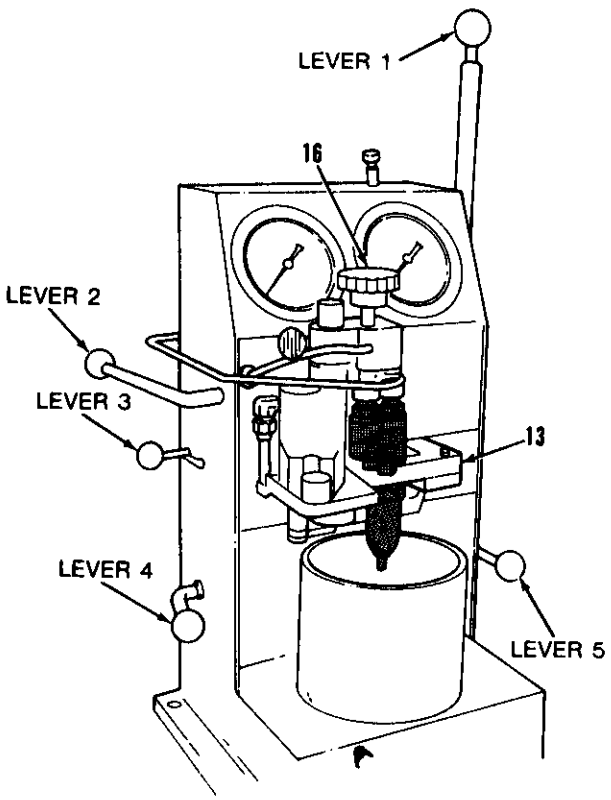
The fuel spray from an injector can penetrate skin. Fuel oil which enters blood stream can cause a serious infection. Follow instructions and use proper equipment to test an injector.

NOTE

This test checks sealing between body-to-bushing mating surfaces and plunger-to-bushing fit.

(a) Close thru-flow valve (16).

(b) Move lever 2 to rear of stand.



13. ADAPTER PLATE
16. THRU-FLOW VALVE

TA 298626

(c) Operate lever 1 until gage 1 reads about 700 psi (4,823 kPa).

(d) Move lever 4 to UP position. When pressure reaches 450 psi (3,089 kPa), time gage to see how long it takes for pressure to drop to 250 psi (1,723 kPa). If pressure drop (450-250 psi) occurs in less than 15 seconds, leakage is excessive.

(e) Open thru-flow valve (16) to release pressure.

(f) Move lever 5 down to release clamping pressure.

(g) Swing out adapter plate (13) and remove injector.

(h) Return lever 5 to UP position.

(6) Perform fuel output test as follows:

WARNING

The fuel spray from an injector can penetrate skin. Fuel oil which enters blood stream can cause a serious infection. Follow instructions and use proper equipment to test an injector.

NOTE

This test checks fuel output of each injector.

(a) Turn on heater switch (18) to preheat test oil on calibrator (19) to 95-105°F (35-40°C).

(b) Install adapter (20) on calibrator (19).

(c) Install injector (1) into adapter (20) and aline cradle (21) under injector (1).

CAUTION

When removing capscrews (5) care must be taken to prevent them from dropping down flywheel housing.

(3) Remove three capscrews (5) and drive hub assembly (6).

(4) Remove three capscrews (7) and two spring plates (8) from drive hub (9).

NOTE

Remove spring (4) only if damaged.

(5) Remove spring (4) from drive shaft (2).

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect all parts. Refer to paragraph 2-7.

(3) Replace all parts failing inspection.

c. Installation

(1) Install three capscrews (7) and two spring plates (8) on drive hub (9). Torque capscrews to 35-39 foot-pounds (47-53 N·m).

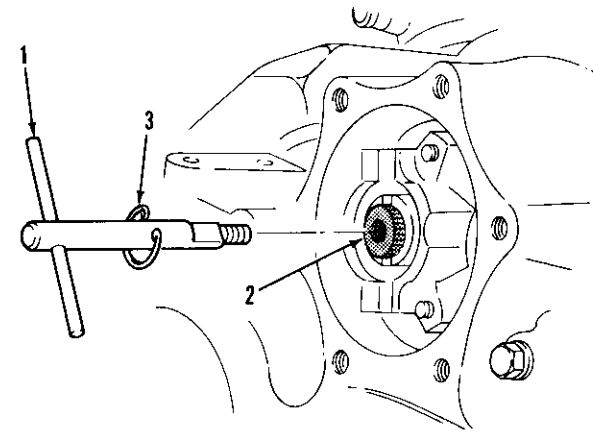
(2) Install drive hub assembly (6) with three capscrews (5). Hand tighten capscrews (5).

(3) If spring (4) was removed, press it on drive shaft (2).

(4) Install snapring (3) on blower shaft aliner (1).

(5) Install blower shaft aliner (1) on drive shaft (2).

(6) Aline shaft splines with hub splines and insert spring end of drive shaft (2) into drive hub (9). Insert drive shaft (2) until alinement tool end of shaft is secured into drive hub assembly (6).



1. BLOWER SHAFT ALINER
2. DRIVE SHAFT
3. SNAPRING

TA 298668

(7) Torque three capscrews (5) to 35-39 foot-pounds (47-53 N·m).

(8) Slide drive shaft (2) in and out about 1/2 inch to check for any binding.

(9) If drive shaft (2) is binding, loosen three capscrews (5). Then retorque capscrews to 35-39 foot-pounds (47-53 N·m). Check for binding.

(10) Push drive shaft (2) into drive hub assembly (6) until snapring groove is showing. Slide snapring (8) into groove.

(11) Remove blower shaft aliner (1) from drive shaft (2).

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-20/12	Install alternator
TM 9-2320-297-20	(para 7-4).

(d) Clamp injector (1) into position by operating clamp-up valve (22).

(e) Move injector switch (23) to notch marked 92.

(f) Set counter (24) to 500 strokes.

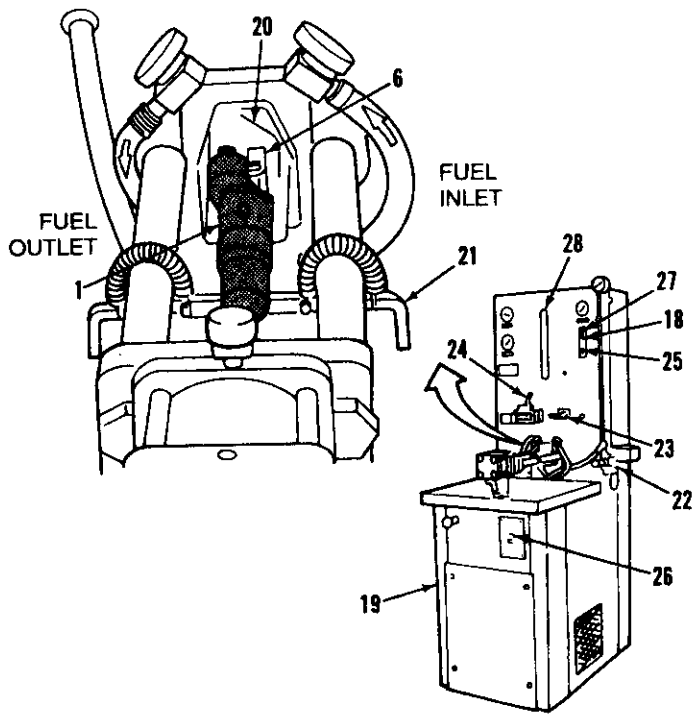
(g) Pull control rack (6) out to NO FUEL position (notch away from injector body).

(h) Turn main power control circuit switch (25) to ON position.

NOTE

Low oil pressure warning buzzer will sound briefly until lubricating oil reaches proper pressure. Buzzer will not continue during normal operation.

(i) Turn motor starter switch (26) to ON position.



(j) Push control rack (6) into FULL FUEL position (notch close to injector body). Allow injector (1) to operate about 30 seconds to purge air before starting fuel flow.

(k) Push fuel flow start button (27) to start fuel flow in measuring tube (28). Fuel flow will automatically stop after strokes have been completed.

(l) Reset counter (24) and wait 10 seconds after measuring tube (28) is empty. Repeat step (k) at least twice or until repeated readings are the same. Note final reading.

NOTE

Keep control rack in FULL FUEL position to quickly stop calibrator.

(m) Turn off motor starter switch (26).

(n) Note reading in measuring tube (28) and double it. Fuel output must be a minimum of 85 and maximum of 91 psi (588-627 kPa).

(o) An injector that fails any of these tests must be disassembled and repaired. All tests must then be performed again.

1. INJECTOR
6. CONTROL RACK
18. HEATER SWITCH
19. CALIBRATOR
20. ADAPTER
21. CRADLE
22. CLAMP-UP VALVE
23. INJECTOR SWITCH
24. COUNTER
25. MAIN POWER CONTROL CIRCUIT SWITCH
26. MOTOR STARTER SWITCH
27. FUEL FLOW START BUTTON
28. MEASURING TUBE

TA 288827

4-8. BLOWER DRIVE SHAFT AND HUB REPLACEMENT

THIS TASK COVERS: a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Blower shaft aliner (J 33001)

Equipment Condition TM	Condition Description
TM 2320-20/12 TM 9-2320-297-20	Alternator removed (para 7-4).

a. Removal

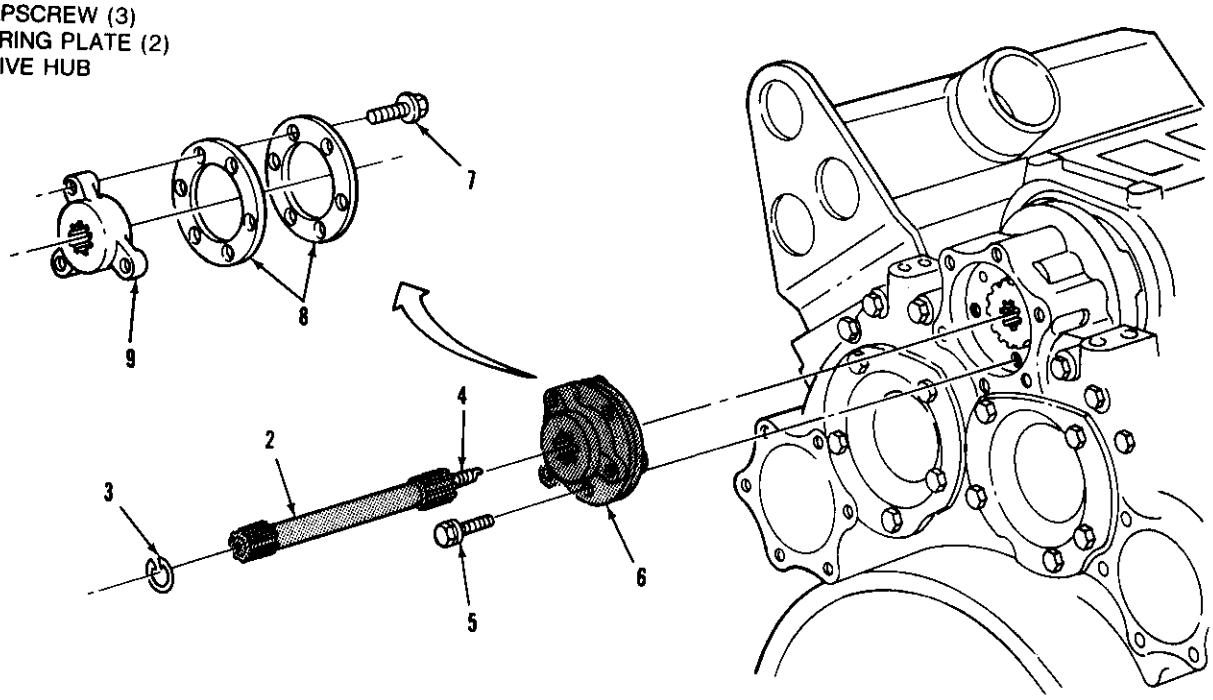
(1) Install blower shaft aliner (1). Push in on drive shaft (2) and remove snapring (3) from drive shaft (2).

CAUTION

Spring (4) may fall off when drive shaft (2) is removed.

(2) Remove drive shaft (2) and spring (4).

2. DRIVE SHAFT
3. SNAPRING
4. SPRING
5. CAPSCREW (3)
6. DRIVE HUB ASSEMBLY
7. CAPSCREW (3)
8. SPRING PLATE (2)
9. DRIVE HUB



TA 298667

4-4. INJECTOR REPAIR (Continued)

b. Disassembly

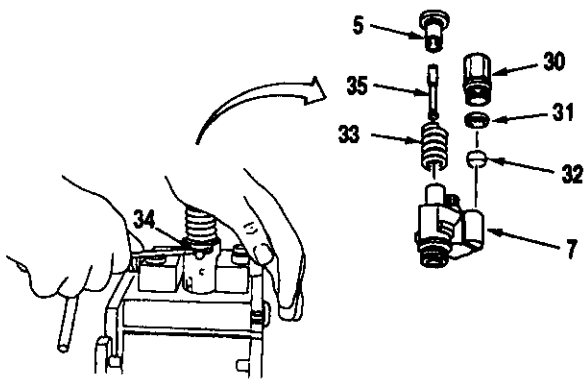
(1) Install injector in holding fixture (29).

NOTE

- Fuel filter caps for LVSA1 series vehicles have changed from flare style to O-ring style filter caps. When repairing non-A1 vehicles, use new style filter caps to replace old style filter caps. Refer to TM 9-2320-297-24P for correct parts identification.
- Flare and O-ring style filter caps are not interchangeable. When replacing one flare type filter cap, all filter caps must be replaced with new O-ring style filter caps.

(2) Remove two filter caps (30), gaskets (31), and filter (32). Discard two gaskets (31), filter caps (30), and fuel inlet filters (32).

(3) Compress cam follower spring (33) and raise lower end above stop pin (34) with a screwdriver. Remove stop pin (34) and slowly release tension on cam follower spring (33).



5. CAM FOLLOWER
7. INJECTOR BODY
29. HOLDING FIXTURE
30. FILTER CAP (2)
31. GASKET (2)
32. FILTER
33. CAM FOLLOWER SPRING
34. STOP PIN
35. PLUNGER

(4) Lift cam follower (5), plunger (35), and cam follower spring (33) as an assembly.

(5) Turn table of holding fixture (29) over so injector nut (36) is upward. Using injector nut socket, loosen injector nut (36) from injector body (7).

NOTE

Care must be taken when removing injector nut. Valve assembly parts are loose and easily lost.

(6) Lift injector nut (36) straight up.

(7) Remove check valve (37), cage (38), spring (39), seat (40), spring cage (41), needle valve (42), and spray tip (43). Spray tip (43) may stick in nut. Lay valve assembly on a clean, lint free cloth.

(8) If spray tip (43) is stuck in injector nut (36) push spray tip with fingers. If spray tip is still stuck, use tip remover and tap it through injector nut (36).

(9) Remove spill deflector (44) from bushing (45).

(10) Lift bushing (45) straight out of injector body (7).

(11) Remove injector body (7) from holding fixture (29). Turn injector body (7) upside down. Gear retainer (46) and gear (47) will fall out.

(12) Pull control rack (6) out of injector body (7).

(13) Remove O-ring (48) from injector body (7). Discard O-ring (48).

c. Cleaning

(1) Loosen carbon from spray tip (43) by soaking tip in dry cleaning solvent for about 15 minutes.

(2) Clean carbon from inside of spray tip (43) using tip cleaner tool (49).

(52) Install fuel pump drive capscrew (20), new lockwasher (20), disc (32), and spacer (33) in front end plate (1). Aline tabs on spacer (33) and disc (32).

(53) Bend two tabs on new lockwasher (20) over fuel pump drive capscrew (21). Tabs must clear slots in disc (32).

END OF TASK

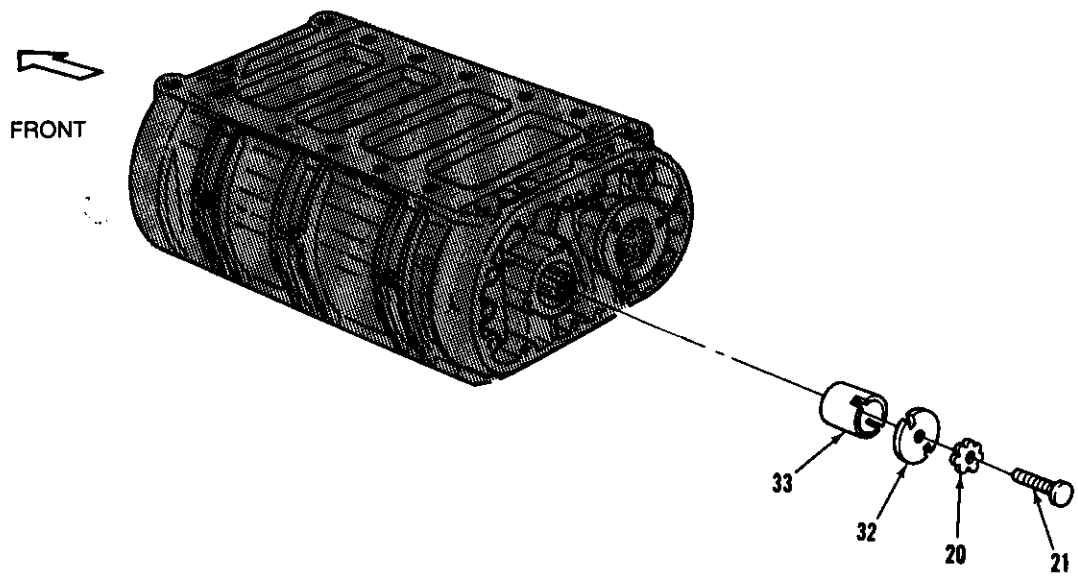
NOTE

Follow-On Maintenance

TM 2320-34/13
TM 9-2320-297-34

Install governor housing (para 4-13).

Install blower (para 4-6).



20. LOCKWASHER
21. FUEL PUMP DRIVE CAPSCREW
32. DISC
33. SPACER

TA 298866

(3) Clean outside surface of spray tip (43) with brass wire brush.

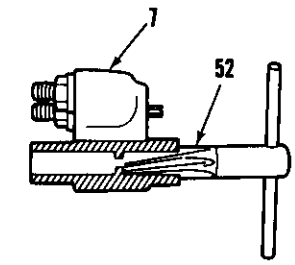
(4) Clean nine tip orifices with pin vise-tool (50) and cleaning wire (51). Wire must extend out of pin vise-tool (50) 1/8 inch (3.175 mm).

(5) Clean and brush all passages in injector body (7) using fuel hole brush and rack hole brush.

NOTE

Only turn frame clockwise and check injector body after every two turns.

(6) Clean inside injector body (7) using injector body reamer (52). Clean both bores.

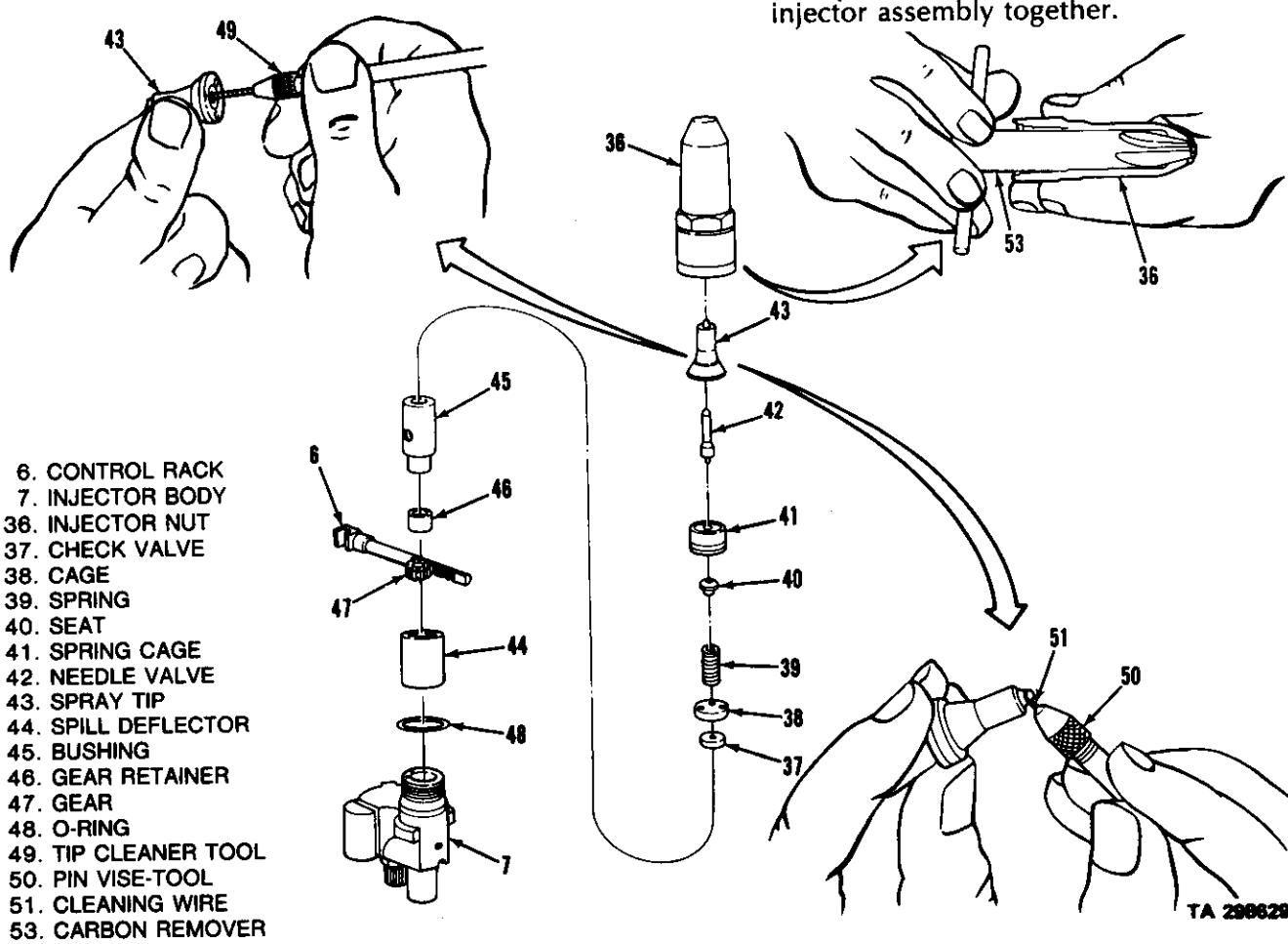


7. INJECTOR
52. INJECTOR BODY REAMER

(7) Clean carbon deposits from lower inside diameter taper of injector nut (36) with carbon remover (53). Use the seat carbon remover to remove deposits on flat spray tip seat of the injector nut (36).

(8) Clean all other parts. Refer to paragraph 2-6.

(9) After cleaning, put parts in a container with clean test oil. Keep parts of each injector assembly together.



6. CONTROL RACK
7. INJECTOR BODY
36. INJECTOR NUT
37. CHECK VALVE
38. CAGE
39. SPRING
40. SEAT
41. SPRING CAGE
42. NEEDLE VALVE
43. SPRAY TIP
44. SPILL DEFLECTOR
45. BUSHING
46. GEAR RETAINER
47. GEAR
48. O-RING
49. TIP CLEANER TOOL
50. PIN VISE-TOOL
51. CLEANING WIRE
53. CARBON REMOVER

4-7. BLOWER ASSEMBLY REPAIR (Continued)

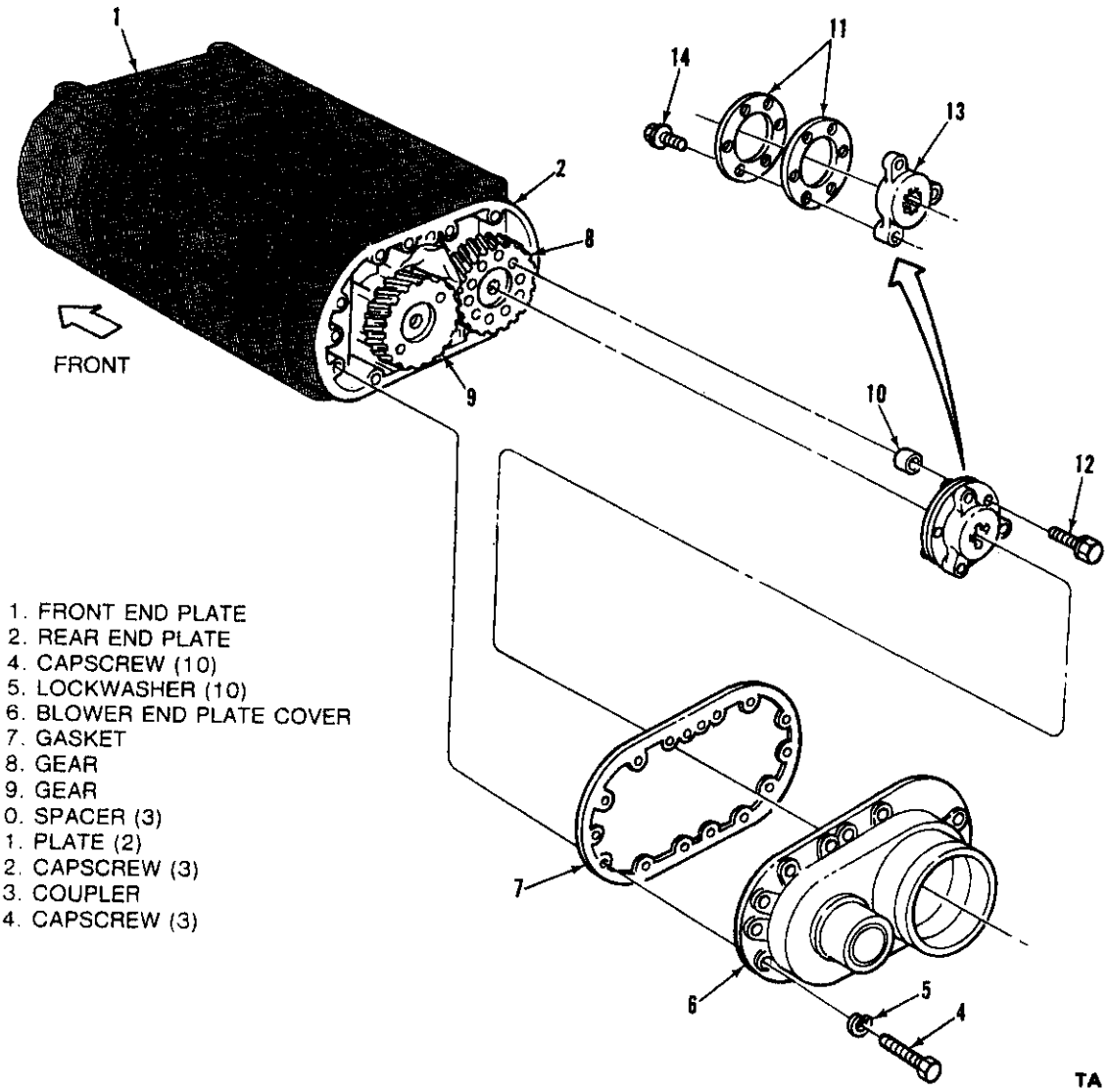
(47) Install three capscrews (14) and two plates (11) onto coupler (13). Torque capscrews (14) to 25-30 foot-pounds (34-41 N·m).

(48) Place a clean shop cloth between gears (8 and 9).

(49) Install three capscrews (12), spacers (10), plates (11), and coupler (13) onto gear (8). Torque capscrew to 25-30 foot-pounds (34-41 N·m).

(50) Remove four 5/16 x 18 x 1-7/8 capscrews from end plates (1 and 2).

(51) With opening in blower end plate cover (6) over coupler (13), install blower end plate cover (6) and new gasket (7) with 10 capscrews (4), and new lockwashers (5). Torque capscrews (4) to 13-17 foot-pounds (18-23 N·m).



1. FRONT END PLATE
2. REAR END PLATE
4. CAPSCREW (10)
5. LOCKWASHER (10)
6. BLOWER END PLATE COVER
7. GASKET
8. GEAR
9. GEAR
10. SPACER (3)
11. PLATE (2)
12. CAPSCREW (3)
13. COUPLER
14. CAPSCREW (3)

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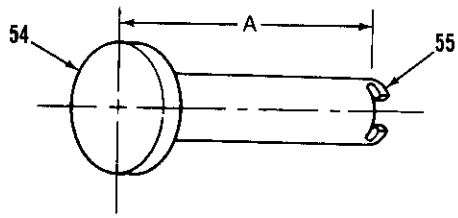
4-4. INJECTOR REPAIR (Continued)

d. Inspection

(1) Measure distance 'A' between cam follower face (54) and top of plunger slot (55). If distance is less than 1.645 inches (4.178 cm), replace cam follower.



54. CAM FOLLOWER FACE
55. PLUNGER SLOT

(2) Check spring tension using a spring tester. If a load of less than 70 pounds (31.78 kg) compresses cam follower spring (33) to 1.028 inches (2.61 cm) or less, replace cam follower spring (33).

(3) Carefully inspect plunger (35) and bushing (45) for erosion, chipping, wear, or score marks.

(4) Inspect port holes in the inner diameter of bushing (45) for cracks or chipping.

(5) Replace plunger (35) and bushing (45) as an assembly if they fail inspection.

(6) Inspect cage (38), check valve (37), and spring cage (41) for wear.

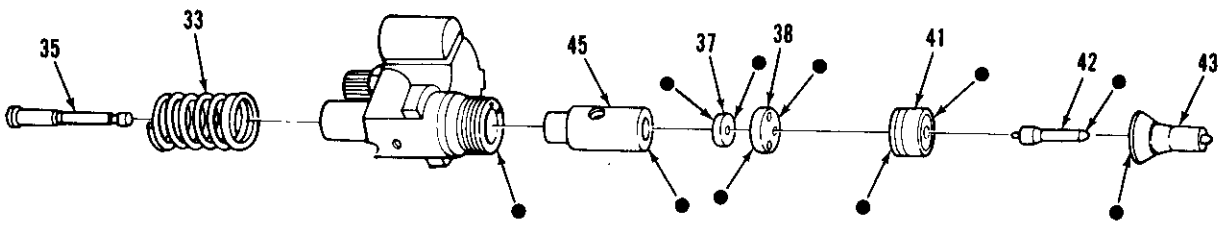
(a) Cage (38) must have a minimum thickness of 0.163 inch (4.140 mm).

(b) Check valve (37) must have a minimum thickness of 0.022 inch (0.559 mm).

(c) Spring cage (41) must have a minimum thickness of 0.602 inch (15.291 mm).

(7) Inspect 11 sealing surfaces on all internal parts for burrs, nicks, erosion, cracks, and chips. If sealing surfaces fail inspection, they must be lapped. Refer to section e.

(8) Inspect nut seating area on spray tip (43) for wear or damage. Replace needle valve (42) and spray tip (43) as an assembly if they fail inspection.



●SEALING SURFACES

33. CAM FOLLOWER SPRING
35. PLUNGER
37. CHECK VALVE
38. CAGE
41. SPRING CAGE
42. NEEDLE VALVE
43. SPRAY TIP
45. BUSHING

TA 298630

(43) Rotate rotor lobes 180 degrees and follow clearance diagram (B).

(a) Measure clearance at points (D). Minimum clearance is 0.010 inch (0.254 mm).

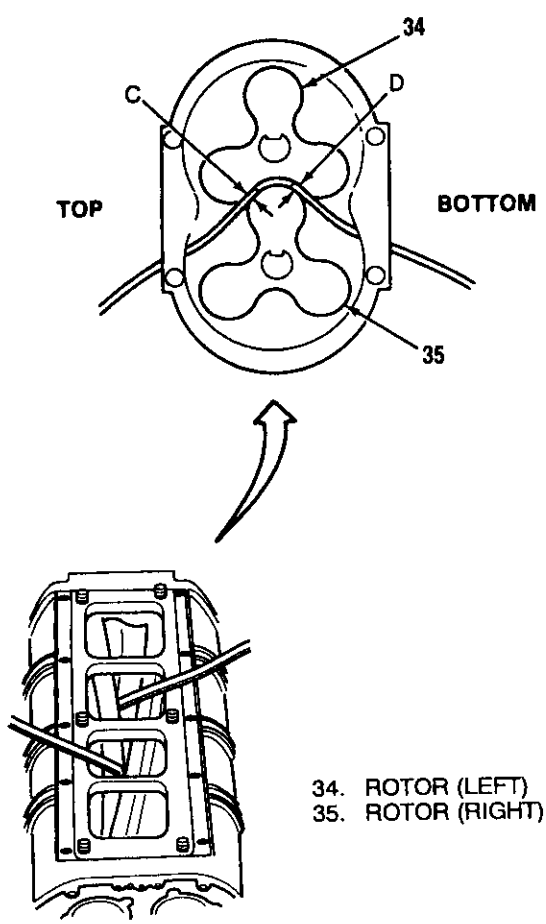
(b) Measure clearance at points (C). Minimum clearance is 0.004 inch to 0.008 inch (0.010 mm) to (0.0203 mm).

(c) Install or remove shims (23) to obtain proper clearance.

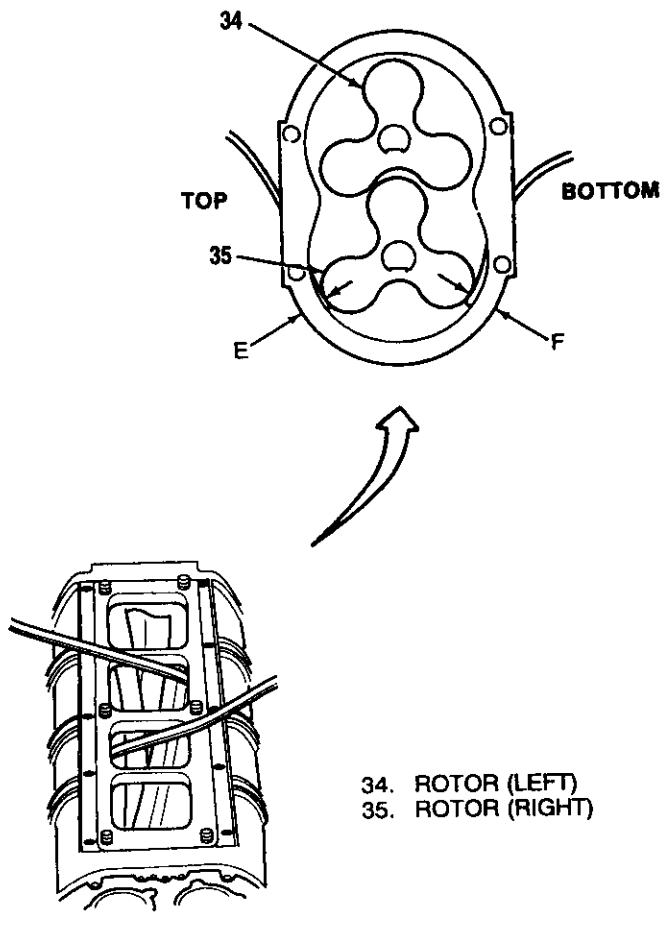
(44) Rotate rotors (34 and 35) to aline lobes with points (E). Measure clearance at points (E). Minimum clearance is 0.015 inch (0.381 mm).

(45) Measure clearance at points (F). Minimum clearance is 0.004 inch (0.101 mm).

(46) If clearance cannot be obtained, replace entire blower assembly.



CLEARANCE DIAGRAM "B"



CLEARANCE DIAGRAM "B"

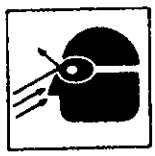
(9) Inspect spray tip seat area in injector nut (36) for dirt or carbon deposits.

(10) Inspect all other parts. Refer to paragraph 2-7.

(11) Replace all parts failing inspection.

e. Lapping

WARNING



Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psi. Eye protection required.

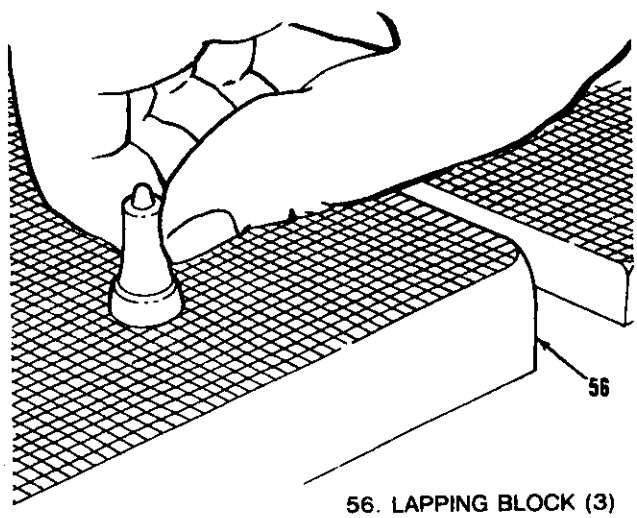
NOTE

Before assembling injector, all used sealing surface parts should be lapped.

(1) Clean lapping blocks (56) with compressed air. Do not use cloth.

(2) Apply lapping compound on number one lapping block (56).

(3) Place a sealing surface part flat on lapping block (56).



56. LAPPING BLOCK (3)

TA 298631

NOTE

Apply just enough pressure to keep part flat on lapping block.

(4) Using a figure eight motion, move part back and fourth across the block. Do four to five figure eight passes.

(5) Move part to number two lapping block (56) and repeat step (4).

(6) Clean compound from injector part with tissue laid on a flat surface.

(7) Inspect part for flatness. Repeat lapping if part is not flat. Do not exceed the minimum thickness of parts.

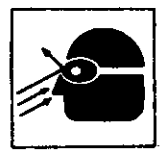
(8) When part is flat, clean with cleaning solvent and dry.

(9) Place part on dry number three lapping block (56). Do not use lapping compound on lapping block.

(10) Using a figure eight motion, lap part until a mirror finish can be seen.

(11) Repeat steps (1) thru (10) as required.

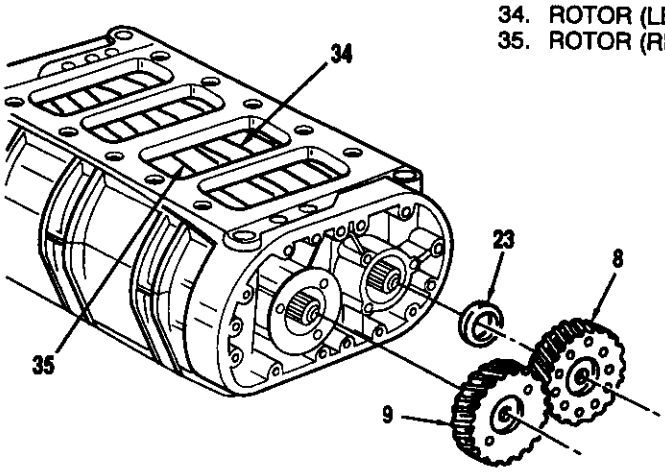
WARNING



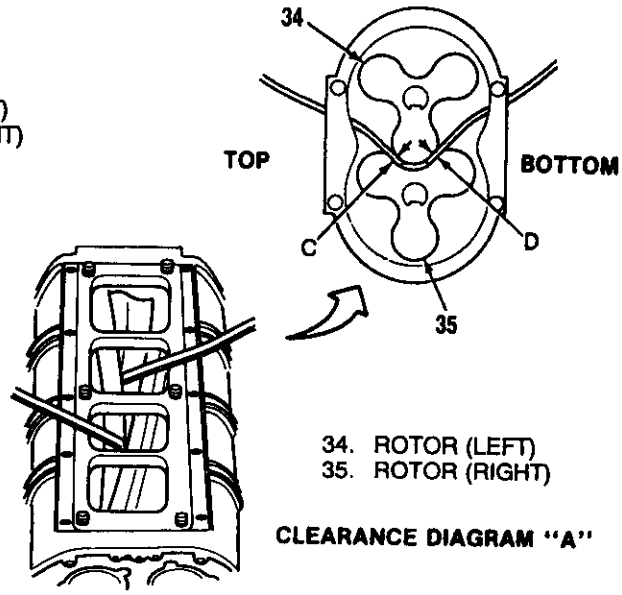
Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psi. Eye protection required.

(12) Wash all lapped parts in cleaning solvent and dry with compressed air.

4-7. BLOWER ASSEMBLY REPAIR (Continued)



8. GEAR
9. GEAR
23. SHIMS
34. ROTOR (LEFT)
35. ROTOR (RIGHT)



34. ROTOR (LEFT)
35. ROTOR (RIGHT)

CLEARANCE DIAGRAM "A"

NOTE

- To increase or decrease clearance between rotors (34 and 35), shims (23) must be added or removed from behind gears (8 and 9). Placing a 0.003 inch (0.076 mm) shim behind a gear (8 or 9) rotates rotor 0.001 inch (0.025 mm). Shims come in different thicknesses.
- Rotor to rotor measurements must be measured one inch (2.54 cm) from each end and at the center of blower.

(42) Following clearance diagram (A).

(a) Measure clearance between rotor lobes at points (D). Minimum clearance is 0.010 inch (0.254 mm).

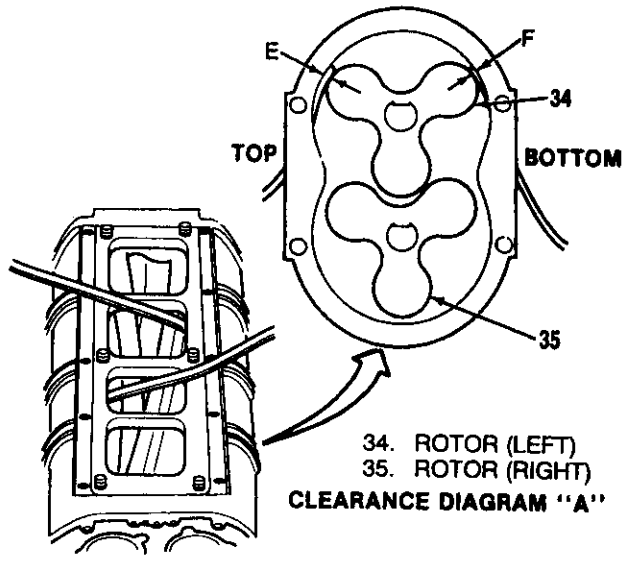
(b) Measure clearance at points (C). Minimum clearance is 0.004 inch (0.010 mm) to 0.008 inch (0.0203 mm).

(c) Rotate rotors (34 and 35) to aline lobes with points (E).

(d) Measure clearances at points (E). Minimum clearance is 0.015 inch (0.381 mm).

(e) Rotate rotors (34 and 35) to aline lobes with points (F).

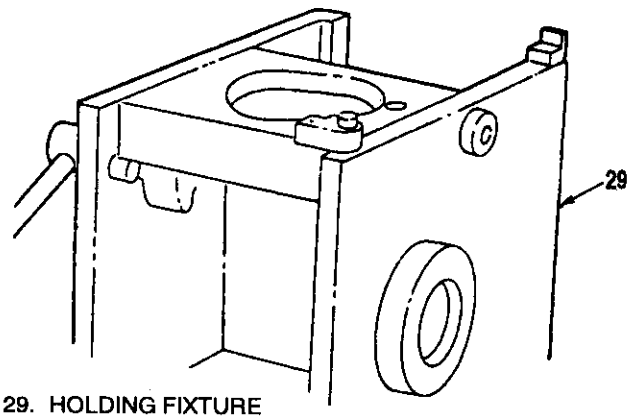
(f) Measure clearance at points (F). Minimum clearance is 0.004 inch (0.101 mm).



34. ROTOR (LEFT)
35. ROTOR (RIGHT)

CLEARANCE DIAGRAM "A"

4-4. INJECTOR REPAIR (Continued)



29. HOLDING FIXTURE

f. Assembly

(1) Install injector body (7) into holding fixture (29).

(2) Install new filter (32) in inlet side located over control rack (6) on injector body (7). Slotted end goes up.

(3) Install new gasket (31) on each filter cap (30). Install new filter (32) in injector body. Install two new filter caps (30). Torque filter caps (30) to 60-70 ft-lb (82-95 N m).

(4) Install shipping caps (57) on filter caps (30) to prevent dirt from entering injector.

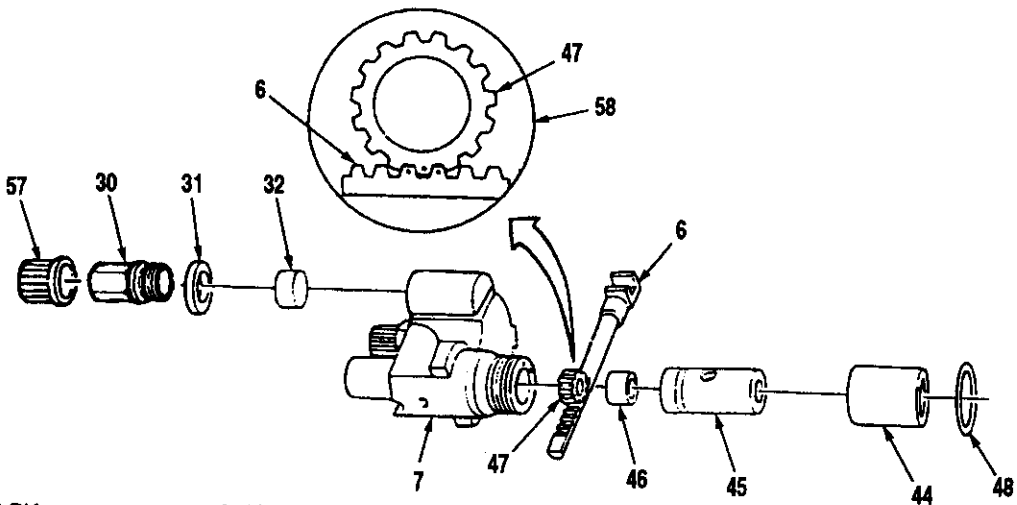
(5) Hold injector body (7) nut end up, and slide control rack (6) in from filter cap (30) side.

(6) Look in body bore and move control rack (6) until two alinement marks (58) can be seen. Hold control rack (6) in position.

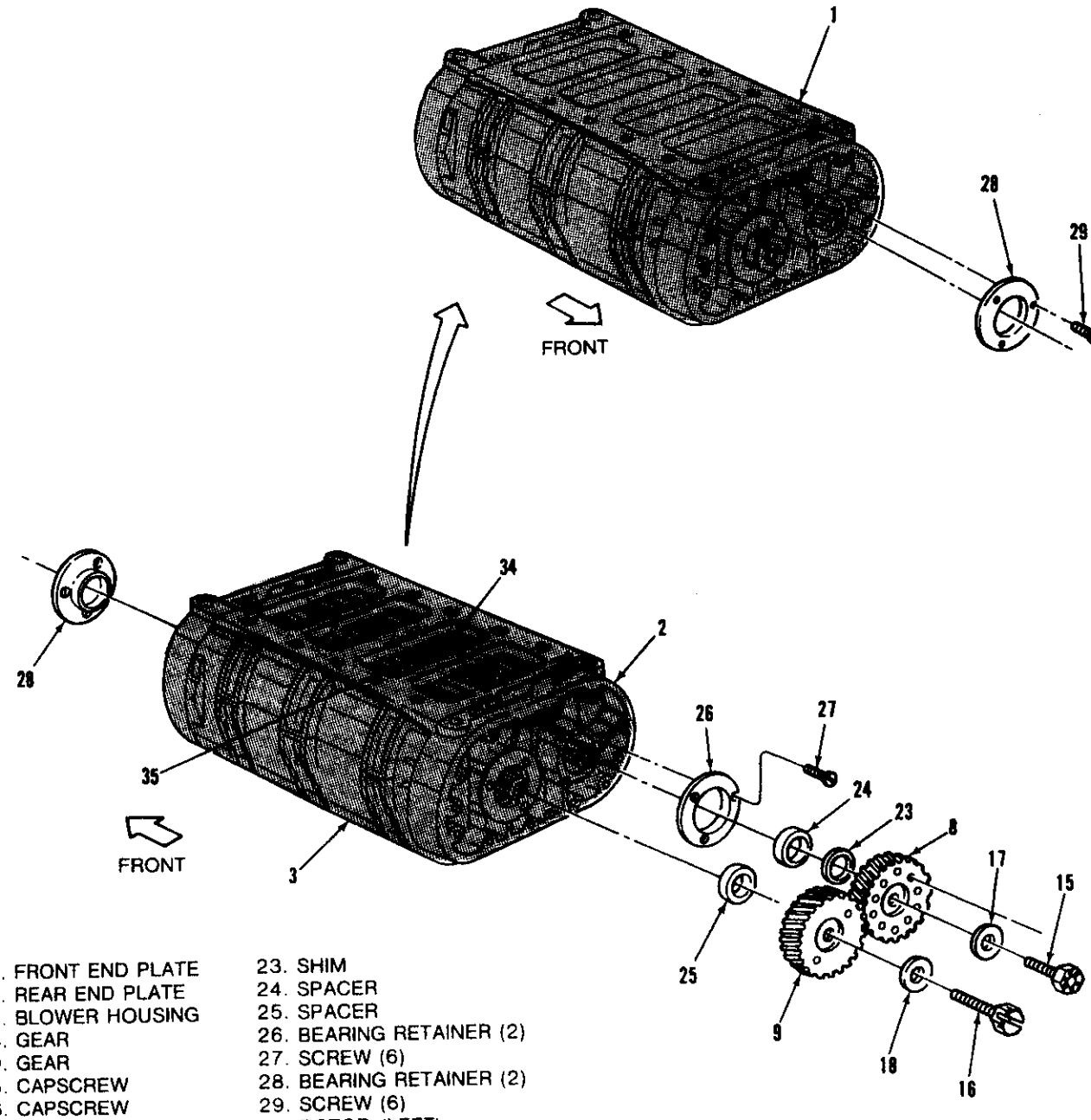
(7) Install gear (47) in body bore so mark on gear is between two alinement marks (58) on control rack (6).

(8) Install gear retainer (46) on top of gear (47).

(9) Install a new O-ring (48) on injector body (7).



6. CONTROL RACK
7. INJECTOR BODY
30. FILTER CAP (2)
31. GASKET (2)
32. FILTER
44. SPILL DEFLECTOR
45. BUSHING
46. GEAR RETAINER
47. GEAR
48. O-RING
57. SHIPPING CAP (2)
58. ALINEMENT MARKS



1. FRONT END PLATE
2. REAR END PLATE
3. BLOWER HOUSING
8. GEAR
9. GEAR
15. CAPSCREW
16. CAPSCREW
17. SLEEVE
18. SLEEVE
23. SHIM
24. SPACER
25. SPACER
26. BEARING RETAINER (2)
27. SCREW (6)
28. BEARING RETAINER (2)
29. SCREW (6)
34. ROTOR (LEFT)
35. ROTOR (RIGHT)

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(10) Aline dowel pin on bushing (45) with slot in body bore and slide bushing (45) into injector body (7).

(11) Install spill deflector (44) over bushing (45).

(12) Perform a needle valve tip test as follows:

NOTE

This test determines needle valve opening pressure.

(a) Install cage (38), spring (39), seat (40), spring cage (41), needle valve (42), and spray tip (43) on adapter (59).

(b) Carefully install injector nut (36) over spray tip (43) and valve parts (38 thru 42) onto adapter (59). Torque injector nut (36) to 75-85 foot-pounds (102-115 N·m).

(c) Install connecting pipe (60) from adapter (59) onto clamping post (61).

(d) Install clamping post (61) into clamping head (8).

(e) Place lever 4 in DOWN position.

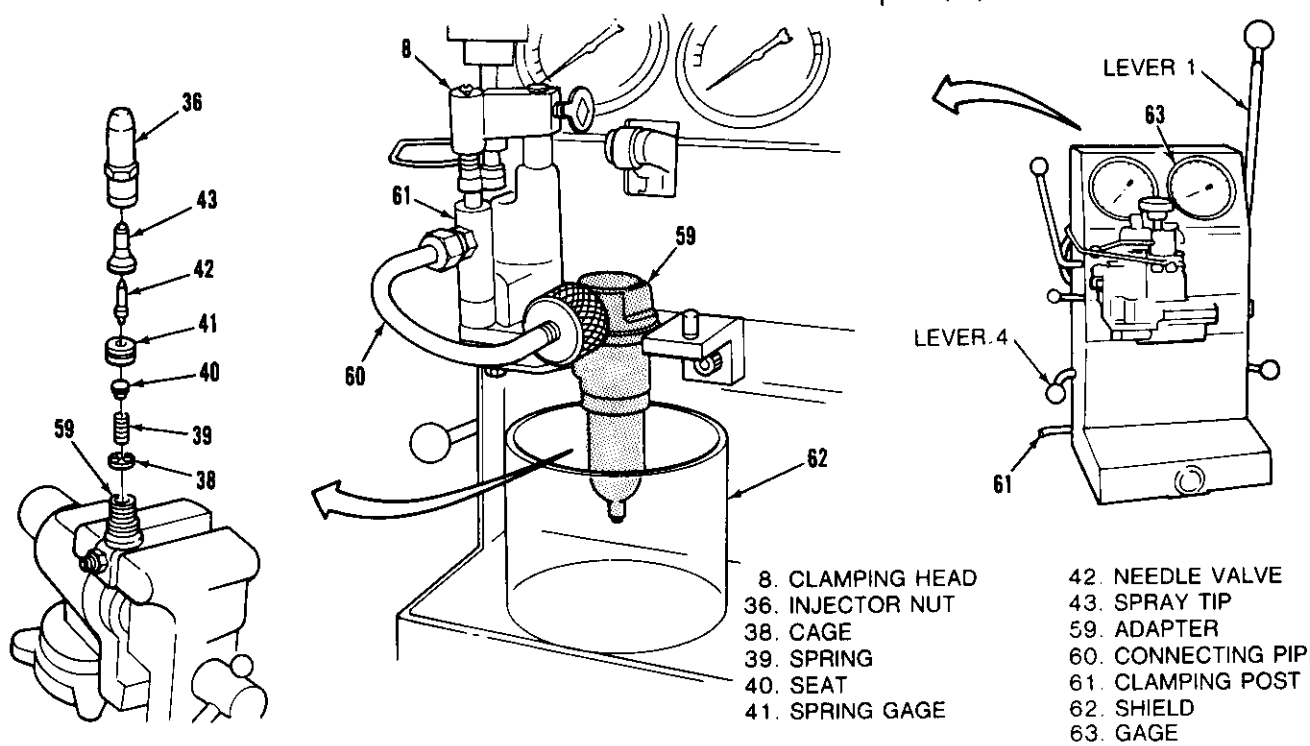
(f) Install shield (62) under injector nut assembly. Operate lever 1 for a couple of spray patterns to purge air from system.

(g) Operate lever 1 to produce about 40 strokes per minute. Note pressure on gage (63) at which test oil delivery occurs. Test oil delivery (valve opening) should occur between 2,200 psi and 3,200 psi (15,169 and 22,064 kPa).

(h) If valve opening pressure is below 2,200 psi (22,737 kPa), replace spring (39) and spray tip assembly (42 and 43).

(i) Operate lever 1 several times and hold pressure at 1500 psi (10,343 kPa) for 15 seconds and inspect for leakage. There should be no fuel drops at spray tip. Replace spray tip if droplets occur.

(j) Remove injector nut (36), spray tip (43), and valve parts (38 thru 42) from adapter (59).

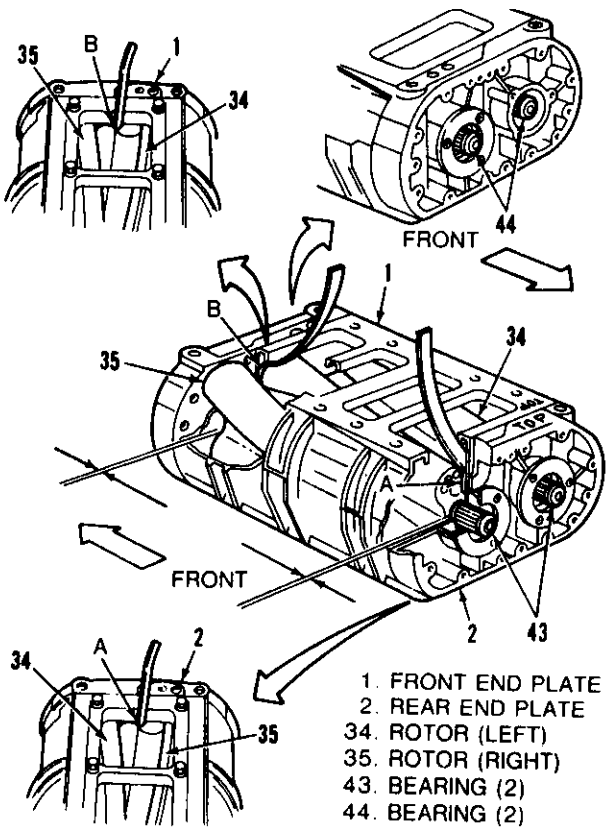


8. CLAMPING HEAD
36. INJECTOR NUT
38. CAGE
39. SPRING
40. SEAT
41. SPRING GAGE
42. NEEDLE VALVE
43. SPRAY TIP
59. ADAPTER
60. CONNECTING PIPE
61. CLAMPING POST
62. SHIELD
63. GAGE

TA 298633

4-7. BLOWER ASSEMBLY REPAIR (Continued)

(28) Check rotors (34 and 35) to end plates (1 and 2) clearance. Minimum clearance at point A is 0.007 inch (0.051 mm). Minimum clearance at point B is 0.014 inch (0.355 mm). If clearance is below minimum, tap bearings (43 and 44) using installation tool (46). Recheck clearances. If necessary, repeat this step and clearance checks, until proper clearances are obtained.



TA 298661

(29) Install bearing retainers (26 and 28) and 12 screws (27 and 29). Torque screws (26 and 28) 7-9 foot-pounds (9-12 N·m).

(30) Lay blower housing (3) flat on bench with rear end plate (2) towards you.

(31) Rotate rotors (34 and 35) and bring flat spots in rotor shaft splines into alinement facing to the left.

(32) Install spacers (24 and 25) and shims (23) in their tagged location.

(33) Lubricate splines on the shafts of rotors (34 and 35) with clean engine oil.

(34) Install gears (8 and 9) in tagged location with teeth meshed. Make sure flat spots inside gears (8 and 9) aline with flat spots on shafts of rotors (34 and 35). Mark flat spots of gears (8 and 9) onto face of gears (8 and 9).

(35) Thread capscrews (15 and 16) and sleeves (17 and 18) into their tagged locations.

(36) Place a clean, folded cloth between gears (8 and 9).

(37) Tighten capscrews (15 and 16), and draw gears (8 and 9) tight against spacers (24 and 25) and shims (23).

(38) Evenly torque capscrews (15 and 16) to 100-110 foot-pounds (136-150 N·m).

(39) Install four capscrews 5/16 x 18 x 1-7/8 and washers in front and rear end plates (1 and 2). Torque capscrews to 13-17 foot-pounds (18-32 N·m).

(40) Turn blower on its side, and support it with wooden blocks.

(41) Check clearances at points A and B, between lobes of rotors (34 and 35) and end plates (1 and 2). Each rotor lobe must be checked. Minimum clearance at point A is 0.007 inch (0.051 mm). Minimum clearance at point B is 0.014 inch (0.355 mm). If proper clearance is not obtained, refer to step (28).

4-4. INJECTOR REPAIR (Continued)

NOTE

If injector fails tip test, a needle valve lift test must be performed. Lift test will determine which part is damaged - spray tip assembly or spring.

(13) Needle valve lift test.

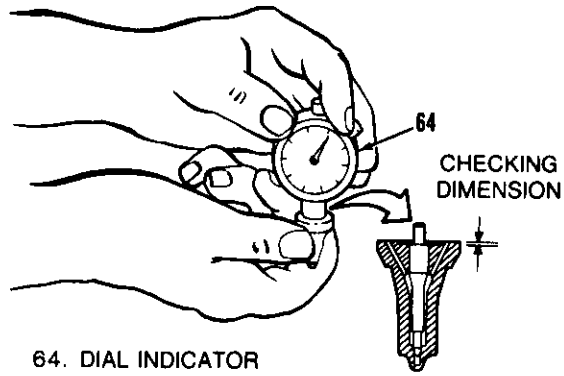
(a) Place needle valve lift gage assembly on a flat surface and zero dial indicator (64).

(b) Aline needle valve (42) with hole in plunger (35). Push spray tip (43) up against plunger (35).

(c) Note reading on dial indicator (64). The lift should be a minimum of 0.008 inch (0.203 mm), and a maximum of 0.018 inch (0.457 mm).

(d) If lift exceeds 0.018 inch (0.457 mm), spray tip (43) and needle valve (42) must be replaced as an assembly.

(e) If lift is less than 0.008 inch (0.203 mm), inspect for dirt between needle valve (42) and spray tip (43).



64. DIAL INDICATOR

(f) If needle valve lift is within limits, install a new spring (39) and seat (40). Perform needle valve tip test again. Refer to step (12).

(14) Place check valve (37) on top of bushing (45).

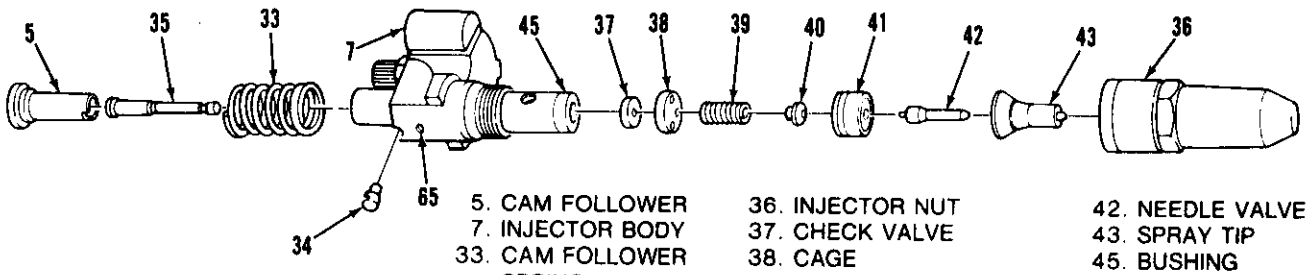
(15) Install cage (38) over check valve (37) and against bushing (45).

(16) Install seat (40) on spring (39) and insert spring (39) into spring cage (41), seat (40) first.

(17) Place spring cage (41) assembly on top of cage (38). The spring side must be against cage (38).

(18) Insert needle valve (42), tapered end down, inside spray tip (43).

(19) Place spray tip (43) on top of spring cage (41). Aline needle valve (42) with hole in spring cage (41).

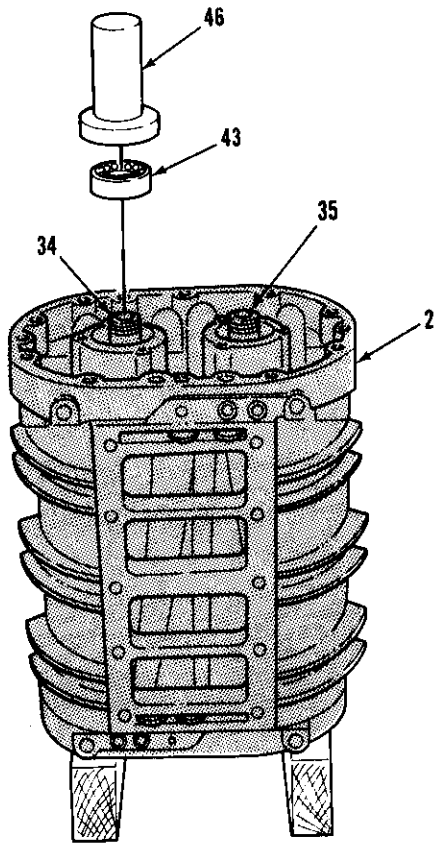


5. CAM FOLLOWER
7. INJECTOR BODY
33. CAM FOLLOWER SPRING
34. STOP PIN
35. PLUNGER
36. INJECTOR NUT
37. CHECK VALVE
38. CAGE
39. SPRING
40. SEAT
41. SPRING CAGE
42. NEEDLE VALVE
43. SPRAY TIP
45. BUSHING
65. BODY OIL HOLE

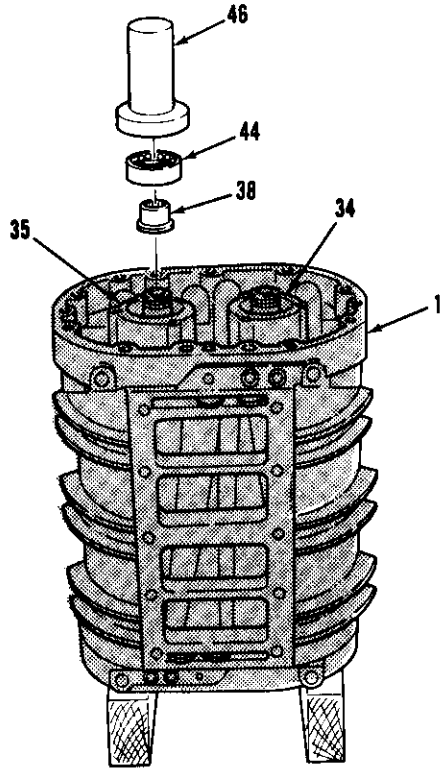
TA 298634

(23) Lubricate bearings (43) with clean engine oil. Install bearings (43) with numbered end up and in tagged location on rotors (34 and 35).

(24) Using installation tool (46), tap bearings (43) into the rear end plate (2) until fully seated.



2. REAR END PLATE
34. ROTOR (LEFT)
35. ROTOR (RIGHT)
43. BEARING (2)
46. INSTALLATION TOOL



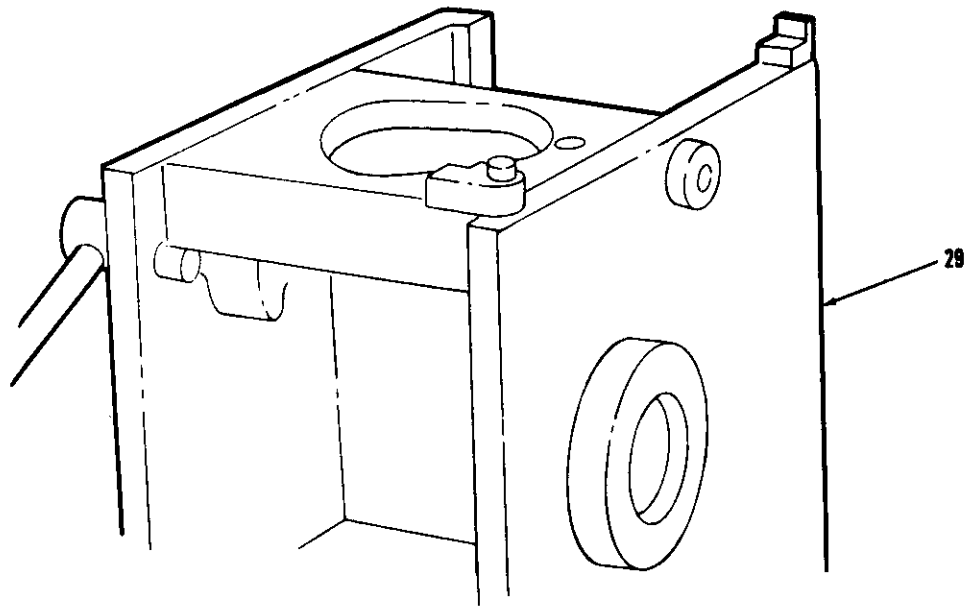
1. FRONT END PLATE
34. ROTOR (LEFT)
35. ROTOR (RIGHT)
38. INNER BEARING RACE (2)
44. BEARING (2)
46. INSTALLATION TOOL

TA 298860

(25) Turn blower over on wooden blocks so front end plate (1) faces up.

(26) Using installation tool, install inner bearing races (38) on shafts of rotors (34 and 35).

(27) Lubricate bearings (44) with clean engine oil. With shoulder side up, use installation tool (46) to install bearings (44) over shaft of rotors (34 and 35) and into front end plate (1).



29. HOLDING FIXTURE

NOTE

Before installing nut, check to make sure check valve (37) is seated in cage (38) and all other parts are centered on bushing (45).

(20) Lubricate injector nut (36) threads with test oil. Carefully install injector nut (36) over spray tip (43) and onto injector body (7). While turning injector nut (36), rotate spray tip (43) counterclockwise between your thumb and finger. Tighten injector nut (36) until spray tip (43) cannot be turned by fingers.

CAUTION

Some injector nuts (36) and injector bodies (7) could have a blued or non-blued finish. These parts are fully interchangeable, however. To avoid parts damage due to overtightening the correct torque values listed below must be used.

(a) Torque a non-blued injector nut (36) on a non-blued injector body (7) to 50foot-pounds (68 N·m).

(b) Torque a blued injector nut (36) on a blued injector body (7) to 80 foot-pounds (108 N·m).

(c) Torque a non-blued injector nut (36) on a blued injector body (7) or a blued injector nut (36) on a non-blued injector body (7) to 65 foot-pounds (88 N·m).

(21) Using injector nut socket, torque injector nut (36) to recommended torque.

(22) Turn table of holding fixture (29) over so filter caps (30) face up.

(23) Install cam follower spring (33) on injector body (7).

(24) Install stop pin (34) into side of injector body (7) until cam follower spring (33) rests on inner flange of stop pin (34).

(25) Install flat top of plunger (35) in groove at bottom of cam follower (5).

4-7. BLOWER ASSEMBLY REPAIR (Continued)

(19) Stand blower up on wooden blocks.

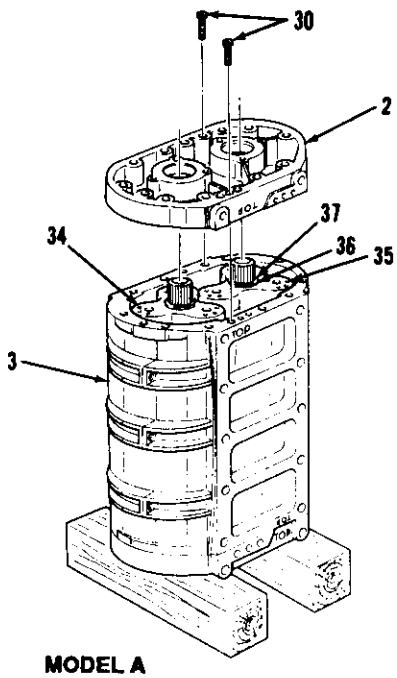
NOTE

If blower is Model A, perform steps (20) thru (22). If Model B, perform steps (22.1).

(20) Center oil seal ring (36) in oil seal ring carrier (37).

(21) Install rear end plate (2) so flat face of rear end plate (2) faces rotors (34 and 35) and installation marks are alined.

(22) Install two screws (30) to secure rear end plate (2) to blower housing (3). Torque screws (30) to 5-10 foot-pounds (7-14 N·m).



MODEL A

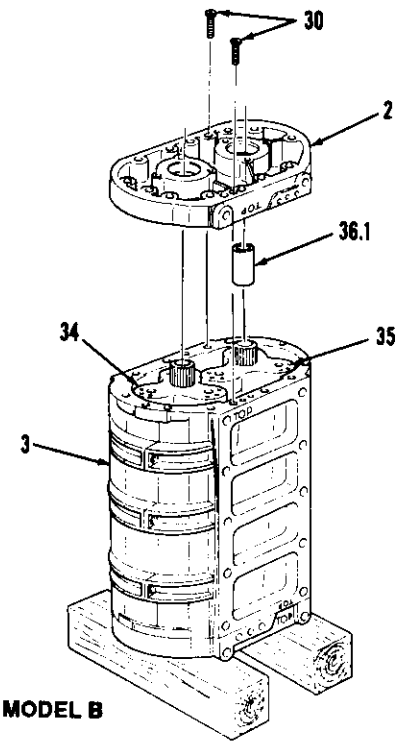
2. REAR END PLATE
3. BLOWER HOUSING
30. SCREW (2)
34. ROTOR (LEFT)
35. ROTOR (RIGHT)
36. OIL SEAL RING (4)
36.1. SEAL PROTECTORS
37. OIL SEAL RING CARRIER (4)

CAUTION

- Do not apply any oil to double lipped oil seals (42.1) or rotor (34 and 35) shafts. Oil will damage the Teflon coating on the seals.
- To prevent damage to the double lipped oil seals, (42.1) each rotor (34 and 35) shaft must have a plastic seal protector (36.1) installed before rear end plate (2) is installed.

(22.1) If blower is a Model B, install plastic seal protectors (36.1) over rotor (34 and 35) shaft ends. Install rear end plate (2) so flat face of rear end plate (2) faces rotors (34 and 35) and installation marks are alined.

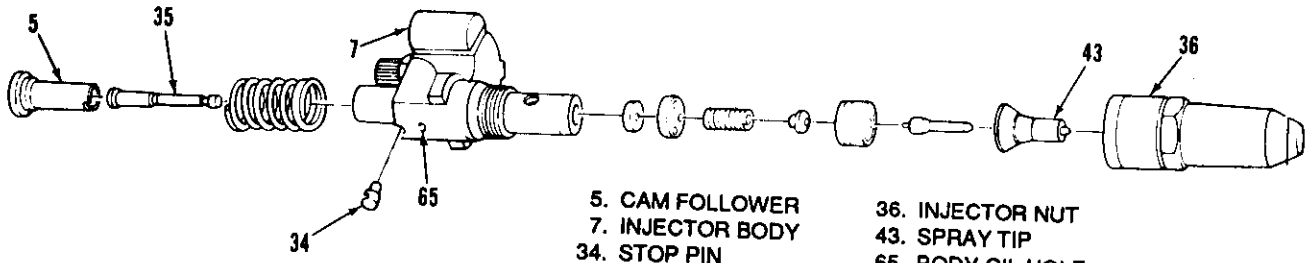
(22.2) Install two screws (30) to secure rear end plate (2) to blower housing (3). Torque screws (30) to 5-10 foot-pounds (7-14 N·m). Discard plastic seal protectors (36.1).



MODEL B

TA 298659

4-4. INJECTOR REPAIR (Continued)



5. CAM FOLLOWER
7. INJECTOR BODY
34. STOP PIN
35. PLUNGER
36. INJECTOR NUT
43. SPRAY TIP
65. BODY OIL HOLE

(26) Aline slot in cam follower (5) with the stop pin hole in injector body (7).

(27) Push control rack (6) to FULL FUEL position.

(28) Aline flat side of plunger (35) with body oil hole (65) on side of injector body (7).

(29) Insert plunger (35) into body core.

(30) Press down on cam follower (5) with hand. When follower is pressed down, press stop pin (34) until slot on cam follower (5) and stop pin (34) engage.

(31) Slowly release pressure on cam follower (5) making sure stop pin (34) is seated properly in cam follower (5).

(32) Place injector in gage (2). Adjust dial indicator (66) to zero.

(33) Rotate injector one full turn and then one full turn the other way. Note reading on dial indicator (66). Total runout must not exceed 0.08 inch (0.203 mm).

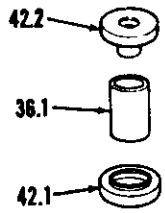
CAUTION

Some injector nuts (36) and injector bodies (7) could have a blued or non-blued finish. These parts are fully interchangeable, however. To avoid parts damage due to overtightening the correct torque values listed below must be used.

(a) Torque a non-blued injector nut (36) on a non-blued injector body (7) to 50foot-pounds (68 N·m).

(b) Torque a blued injector nut (36) on a blued injector body (7) to 80 foot-pounds (108 N·m).

(c) Torque a non-blued injector nut (36) on a blued injector body (7) or a blued injector nut (36) on a non-blued injector body (7) to 65 foot-pounds (88 N·m).



MODEL B

CAUTION

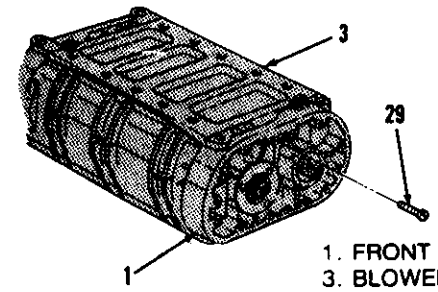
- Note installation marks made during disassembly step (25), and L/R installation marks made during disassembly steps (23) and (24). Make certain rotors (34 and 35) are alined during installation. Make certain 'L'-left rotor (34) is installed in the 'L'-left shaft hole of front end plate (1). Make certain 'R'-right rotor (35) is installed in the 'R'-right shaft hole of front end plate (1).
- To prevent double lipped oil seal (42.1) damage, do not apply oil to either the seals or the rotor (34 and 35) shafts.
- Installation of rotors (34 and 35) without using plastic seal protectors (36.1) could damage double lipped oil seals (42.1).

(14.1) If blower is Model B, reinstall plastic seal protectors (36.1) into double lipped oil seals (42.1), tapered edge facing out. Install rotor (34) in tagged shaft hole until rotor (34) contacts front end plate (1).

CAUTION

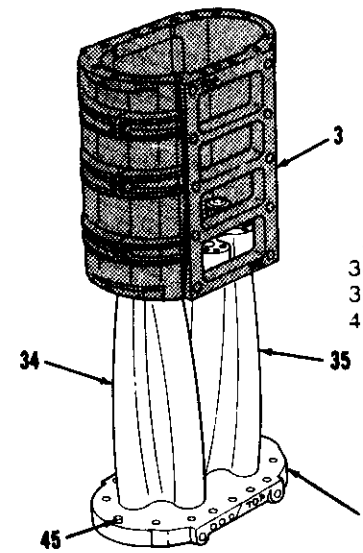
Installation marks must line up when both rotors (34 and 35) are installed.

(14.2) Install rotor (35) in tagged shaft hole. Installation marks must line up during installation. Work rotor (35) into position until rotor (35) contacts front end plate (1).



1. FRONT END PLATE
3. BLOWER HOUSING
29. SCREW (2)

(15) Position blower housing (3) over rotors (34 and 35) with top side of blower housing (3) and top side of front end plate (1) facing same direction. Lower blower housing (3) over rotors (34 and 35) until it contacts dowel pins (45) in front end plate (1).



1. FRONT END PLATE
3. BLOWER HOUSING
34. ROTOR (LEFT)
35. ROTOR (RIGHT)
45. DOWEL PIN

TA 298658

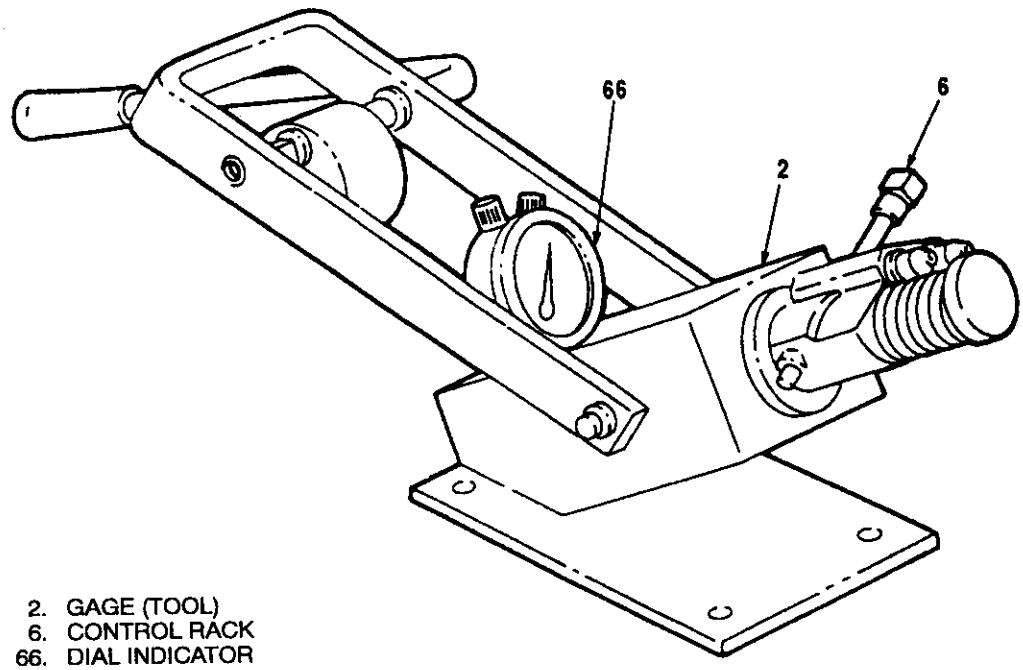
(16) Aline dowel pin holes in blower housing (3) with dowel pins (45) in front end plate (1). Push blower housing (3) tight against front end plate (1). If necessary, tap blower housing (3) with a soft-faced hammer.

CAUTION

Firmly hold front end plate (1) and blower housing (3) together to avoid damage.

(17) Carefully set blower housing (3) on workbench with top facing up.

(18) Install two screws (29) to secure front end plate (1) to blower housing (3). Torque screws (29) to 5-10 foot-pounds (7-14 N·m).



2. GAGE (TOOL)
6. CONTROL RACK
66. DIAL INDICATOR

(34) If runout exceeds 0.008 inch (0.203 mm) amount, loosen injector nut (36) and center spray tip (43). Torque injector nut (36) to recommended torque and recheck runout. If after several attempts runout is still not within limit, replace unit.

(35) Perform all tests on injector. Refer to section a.

END OF TASK

NOTE

Follow-On Maintenance

TM 2320-34/13	Install injector
TM 9-2320-297-34	(para 4-3).

4-7. BLOWER ASSEMBLY REPAIR (Continued)

NOTE

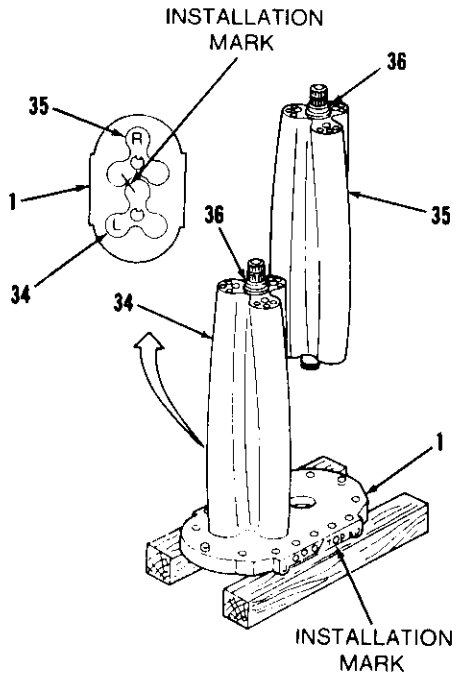
Installation mark "TOP" made at disassembly step (1) should face to your right.

(10) Support front end plate (1) with wooden blocks. The flat side should face up, and installation marks on the front end plate (1) should face your right.

NOTE

If blower is Model A, perform steps (11) thru (14). If Model B, perform steps (14.1) and (14.2).

(11) Lubricate oil seal rings (36) on both ends of rotor (34) with clean engine oil.



MODEL A

1. FRONT END PLATE
34. ROTOR (LEFT)
35. ROTOR (RIGHT)
36. OIL SEAL RING (4)
36.1. SEAL PROTECTORS

CAUTION

Note, installation marks made during disassembly step (25), and L/F installation marks made during disassembly steps (23) and (24). Make certain rotors (34 and 35) are alined during installation. Make certain 'L'-left rotor (34) is installed in the 'L'-left shaft hole of front end plate (1). Make certain 'R'-right rotor (35) is installed in the 'R'right shaft hole of front end plate (1).

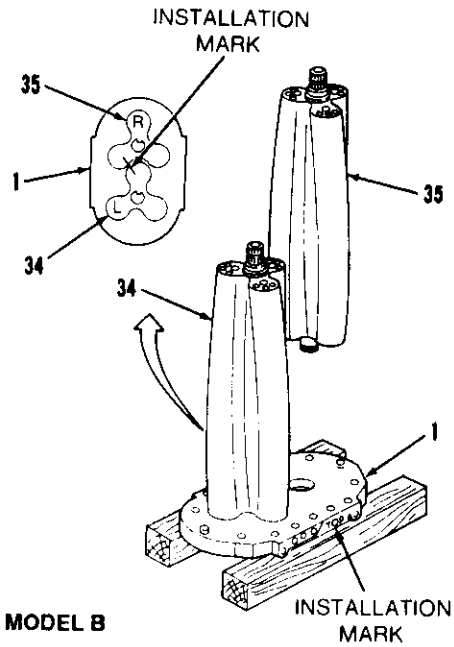
(12) Install rotor (34) in tagged shaft hole. Gently work rotor (34) until rotor contacts front end plate (1).

(13) Lubricate oil seal rings (36) on both ends of rotor (35) with clean engine oil.

CAUTION

Installation marks must line up when both rotors (34 and 35) are installed.

(14) Install rotor (35) in tagged shaft hole. Installation marks must line up during installation. Work rotor (35) into position until rotor (35) contacts front end plate (1).



MODEL B

4-5. INJECTOR CONTROL TUBE MAINTENANCE

THIS TASK COVERS: a. Removal
b. Disassembly
c. Cleaning/Inspection
d. Assembly
e. Installation

INITIAL SETUP

Applicable Configurations

MK48

Materials/Parts

Cotter pin (2) (P/N 103361) items 1 and 6
Lockwasher (2) (MS35338-44) item 8
Locknut (4) (NSN 5310-00-297-8836) item 14

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Engine access door open (para 2-1).
TM 2320-20/12 TM 9-2320-297-20	Rocker covers removed (para 3-4).

a. Removal

(1) Remove cotter pin (1) from left injector control tube clevis pin (2). Remove clevis pin (2). Discard cotter pin (1).

CAUTION

Oil drain holes in cylinder head must be covered to prevent 12 point capscrews (3) and nuts (4) from falling into cylinder head.

(2) Remove four 12 point capscrews (3). Remove left injector control tube assembly (5).

(3) Remove cotter pin (6) from right control tube clevis pin (7). Remove clevis pin (7). Discard cotter pin (6).

(4) Remove two nuts (4), lockwashers (8), and U-bolt (9) from right injector control tube assembly (10). Discard lockwashers (8).

NOTE

Throttle delay piston (12) will be removed with right injector control tube assembly (10).

(5) Remove four 12 point capscrews (11). Remove right injector control tube assembly (10).

(6) Support a blower end plate (1 or 2), inner face up, on a press with wooden blocks.

NOTE

Steps (7) thru (9) are for Model A only. Perform steps (9.1) and (9.2) for Model B.

(7) Lubricate the outside diameter of an oil seal collar (42) with clean engine oil.

(8) With chamfered outside diameter facing rear end plate (2), press oil seal collars (42) into rear end plate (2). Using bearing and seal tool (41), press oil seal collar (42) 0.002-0.008 inch (0.050-0.203 mm) below face of rear end plate (2).

(9) Install remaining three oil seal collars (42).

CAUTION

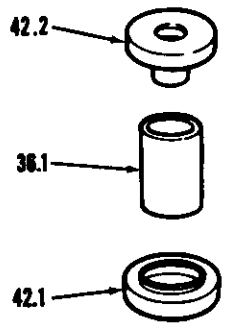
Double lipped oil seal (42.1) must be installed dry. Do not apply oil to inside or outside diameter of seal when installing. This seal is coated with Teflon, use of oil will damage the Teflon coating.

NOTE

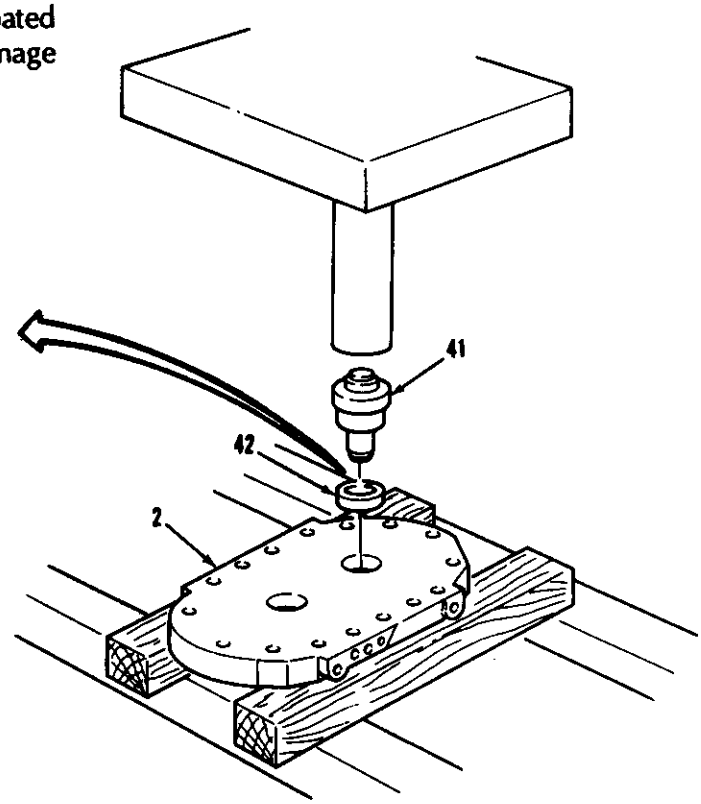
- Remove plastic seal protectors (36.1), set aside for use later.
- Install double lipped oil seal (42.1) with numbered side towards installation tool (42.2).
- Install double lipped oil seal (42.1) into rear end plate (2) until installation tool (42.2) contacts rear end plate (2).

(9.1) If blower is Model B, install new double lipped oil seal (42.1) into rear end plate (2) using installation tool (42.2).

(9.2) Install remaining three seals (42.1) following step (9.1).



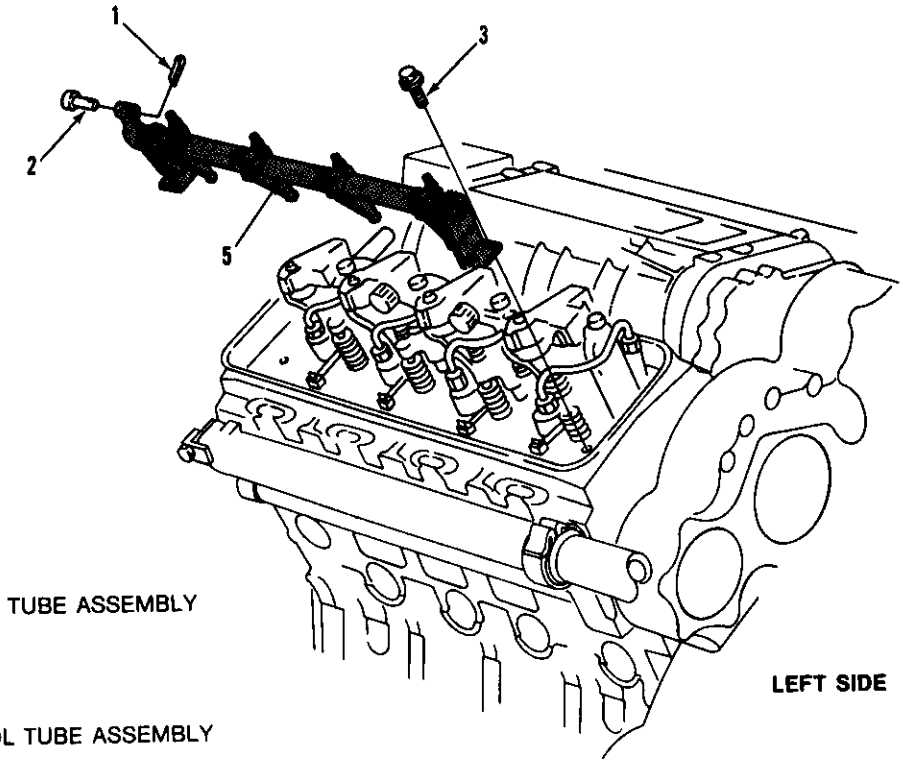
MODEL B



MODEL A

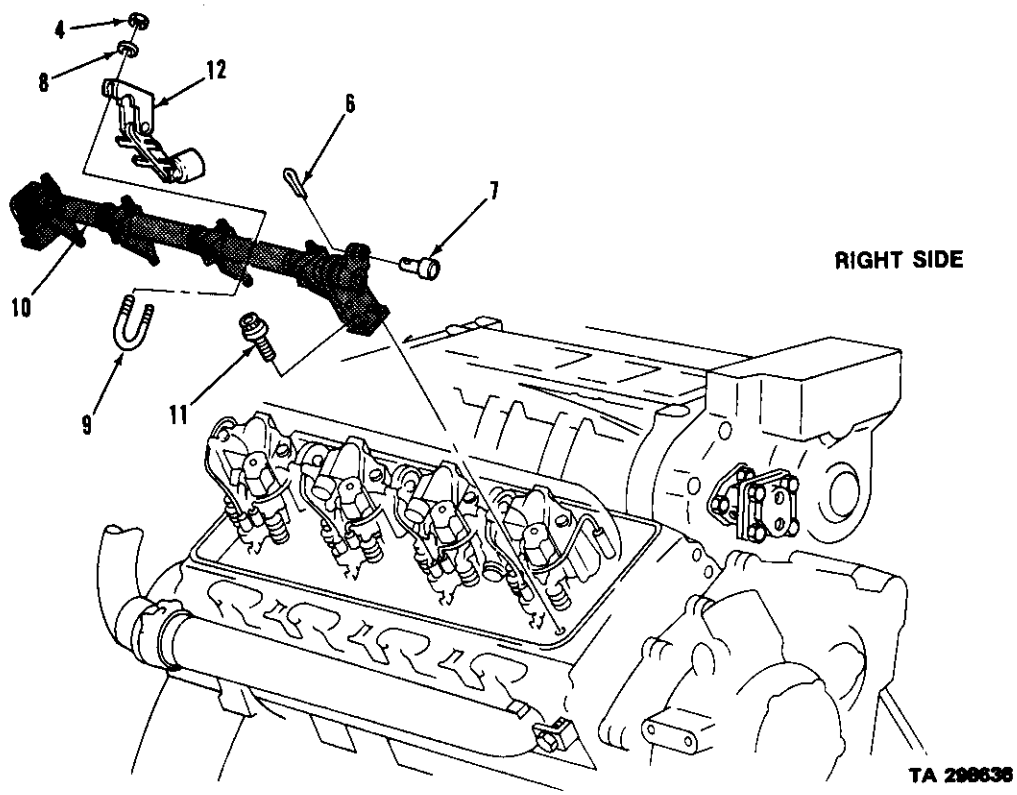
TA 298656

2. REAR END PLATE
36.1. PLASTIC SEAL PROTECTORS
41. BEARING AND SEAL TOOL
42. OIL SEAL COLLAR (4)
42.1. DOUBLE LIPPED OIL SEAL (4)
42.2. INSTALLATION TOOL



LEFT SIDE

1. COTTER PIN
2. CLEVIS PIN
3. 12 POINT CAPSCREW (4)
4. NUT (2)
5. LEFT INJECTOR CONTROL TUBE ASSEMBLY
6. COTTER PIN
7. CLEVIS PIN
8. LOCKWASHER (2)
9. U-BOLT
10. RIGHT INJECTOR CONTROL TUBE ASSEMBLY
11. 12 POINT CAPSCREW (4)
12. THROTTLE DELAY PISTON



RIGHT SIDE

TA 298636

4-7. BLOWER ASSEMBLY REPAIR (Continued)

c. Assembly

(1) Support rotor (34 or 35) with wooden blocks on a press.

NOTE

Steps (2) thru (5) are for Model A only. Perform steps (5.1) and (5.2) for Model B.

(2) Lubricate new oil seal ring carrier (37) with clean engine oil.

(3) With chamfered inside diameter facing rotors (34 and 35), press oil seal ring carrier (37) down tight against the rotor (34 or 35) with installation tool (46).

(4) Install the remaining three oil seal ring carriers (37), following steps (1) thru (3).

CAUTION

Do not spread oil seal rings (36) more than necessary or damage may result.

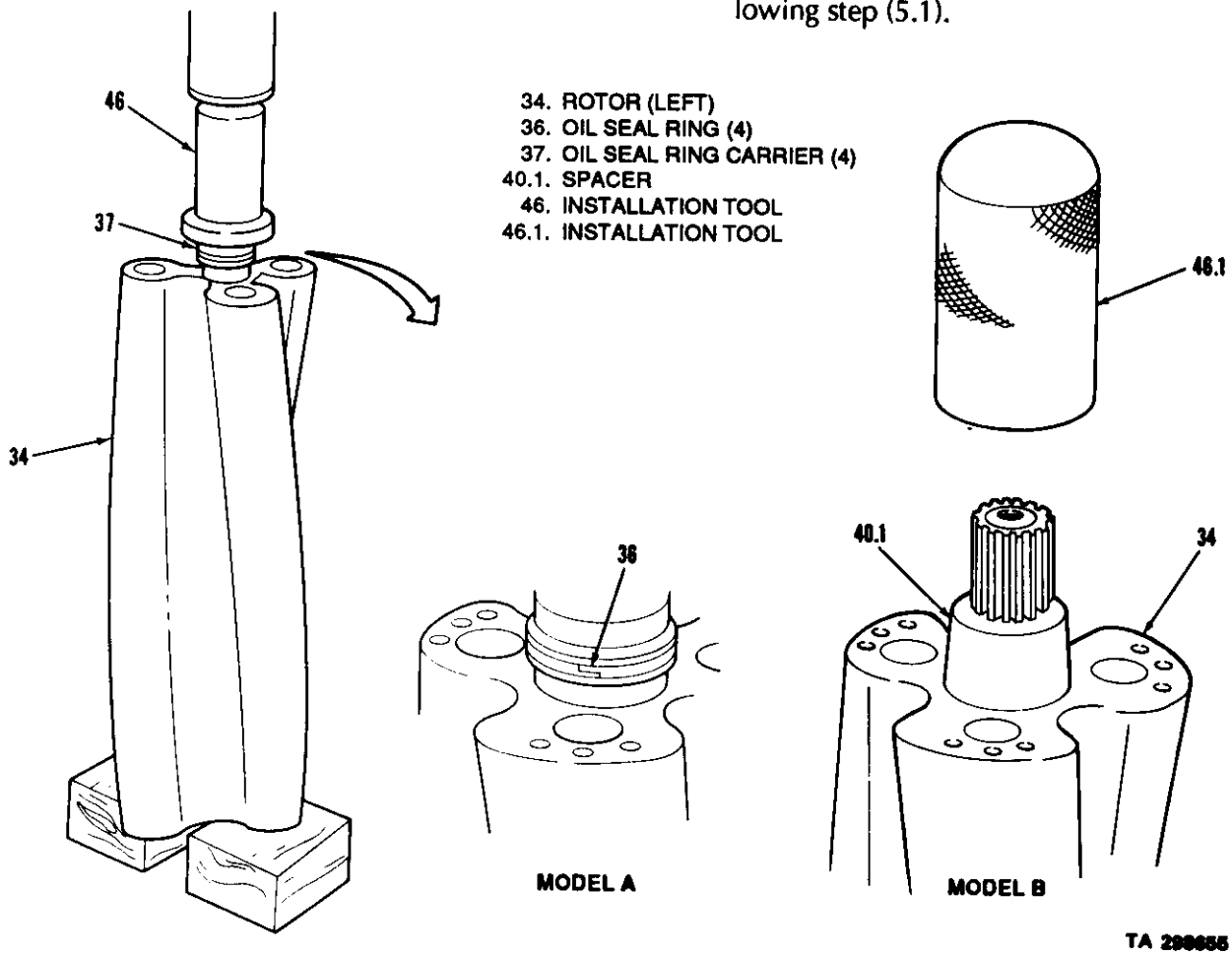
(5) Install a new oil seal ring (36) in the groove of each oil seal ring carrier (37).

NOTE

Press spacer (40.1) on rotor (34) shaft until either the shoulder of the tool or the spacer contacts the rotor (34).

(5.1) If blower is Model B, install new oil seal spacer (40.1) on rotor (34) shaft using installation tool (46.1).

(5.2) Install remaining three spacers (40.1) following step (5.1).



4-5. INJECTOR CONTROL TUBE MAINTENANCE (Continued)

b. Disassembly

(1) Remove bracket (13) from injector control tube assemblies (5 and 10).

(2) Remove locknuts (14) and adjusting screws (15) from control levers (16) at injector control tube assemblies (5 and 10). Discard locknuts (14).

(3) Tag and remove four levers (16), three springs (17), spring (18), and return spring (19) from each injector control tube assembly (5 and 10).

c. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

(2) Inspect injector control tube assemblies (5 and 10) for dents and cracks.

(3) Inspect springs (17, 18, and 19) for wear or cracks.

(4) Inspect all other parts. Refer to paragraph 2-7.

(5) Replace all parts failing inspection.

d. Assembly

NOTE

- Left injector control tube assembly has (green) return spring (19) at end of control lever (20).
- Right injector control tube assembly has (green) return spring (19) at end of bracket (13).
- Adjusting screws (15) must be in line with the control levers (20).

(1) Install return spring (19), spring (18), four levers (16) and three springs (17) in their tagged position.

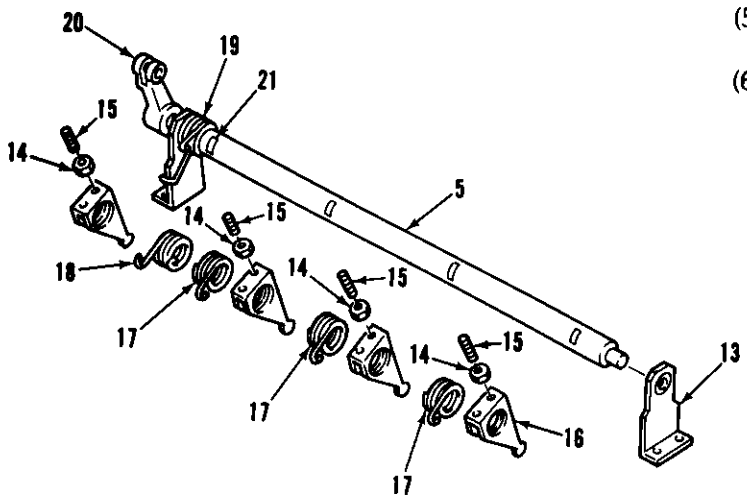
(2) Install curled end of spring (18) in slot (21) on injector control tube (5 or 10).

(3) Install four adjusting screws (15) and new locknuts (14) on levers (16). Aline adjusting screws (15) with end of slot (21) in injector control tube (5 or 10).

(4) Attach other curled end of springs (17 and 18) on levers (16).

(5) Install bracket (13).

(6) Repeat steps (1) thru (5) for other control tube assembly.



5. LEFT INJECTOR CONTROL TUBE ASSEMBLY
13. BRACKET
14. LOCKNUT (4)
15. ADJUSTING SCREW (4)
16. LEVER (4)
17. SPRING (3)
18. SPRING
19. RETURN SPRING
20. CONTROL LEVER
21. SLOT

LEFT BANK INJECTOR CONTROL TUBE

TA 290637

(4) Inspect oil seal collars (42) for scoring or damage.

(5) Inspect blower rotors (34 and 35) for burrs or scoring. If rotors (34 and 35) are slightly scored or burred, they may be cleaned with emery cloth.

(6) Inspect rotor shaft splines for burrs or peening.

(7) Inspect inner bearing races (38) for burrs or scoring.

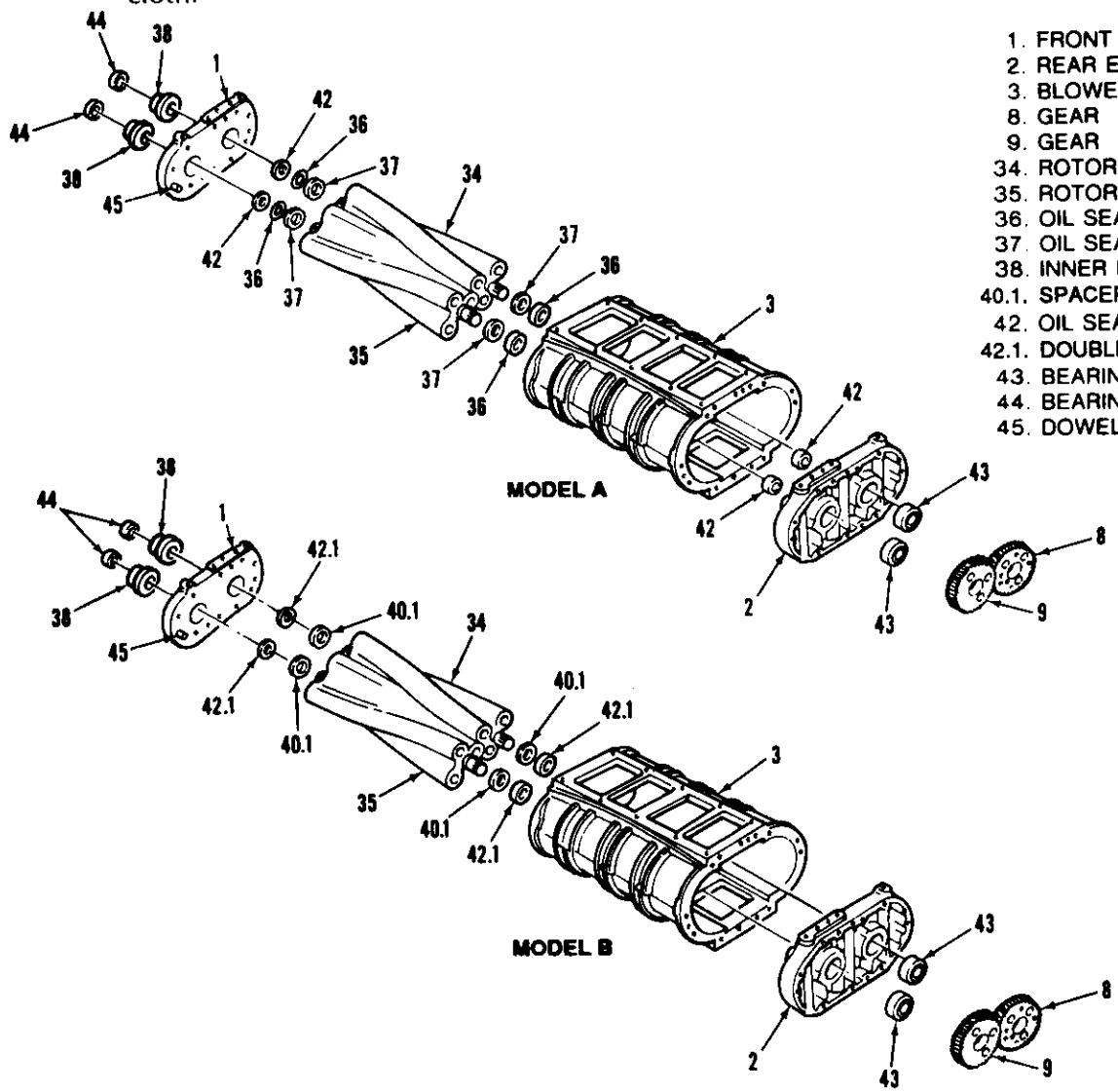
(8) Inspect inside surface of blower housing (3) for burrs or scoring. If burred or scored, it may be cleaned up with emery cloth.

(9) Check machined ends of blower housing (3) and end plates (1 and 2) for flatness and burrs. If end plates (1 and 2) are slightly scored or burred, they may be cleaned with emery cloth.

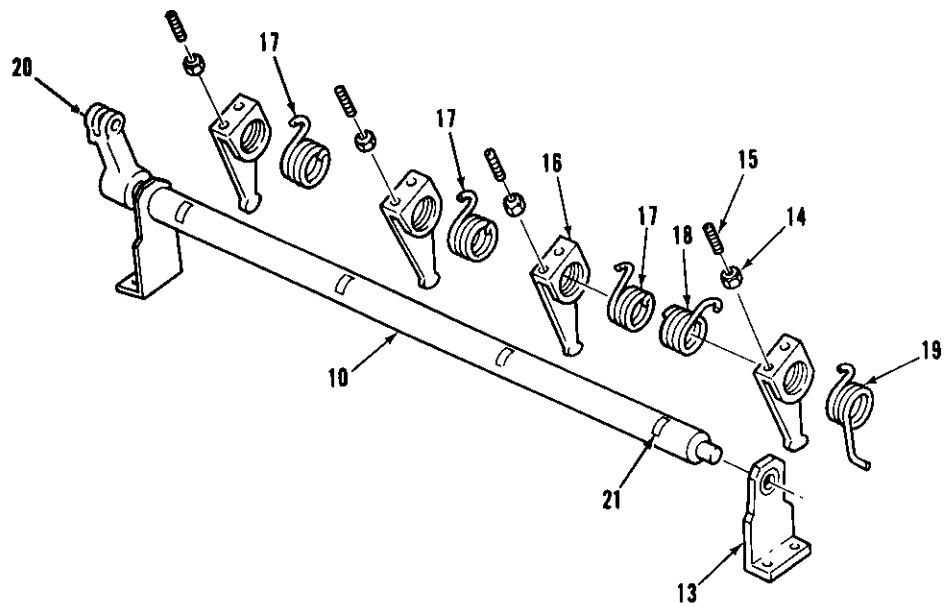
(10) Inspect blower gears (8 and 9) for peening and chips. If replacement of a gear (8 or 9) is needed, both gears must be replaced.

(11) Check dowel pins (45) in front and rear end plates. Dowel pins (45) must project 0.320 inch from the flat inner face of end plates (1 and 2).

(12) Replace all parts failing inspection.



1. FRONT END PLATE
2. REAR END PLATE
3. BLOWER HOUSING
8. GEAR
9. GEAR
34. ROTOR (LEFT)
35. ROTOR (RIGHT)
36. OIL SEAL RING (4)
37. OIL SEAL RING CARRIER (4)
38. INNER BEARING RACE (2)
40.1. SPACER (4)
42. OIL SEAL COLLAR (4)
42.1. DOUBLE LIPPED SEAL
43. BEARING (2)
44. BEARING (2)
45. DOWEL PIN (2)



RIGHT BANK INJECTOR CONTROL TUBE

10. RIGHT INJECTOR CONTROL TUBE ASSEMBLY
13. BRACKET
14. LOCKNUT (4)
15. ADJUSTING SCREW (4)
16. LEVER (4)
17. SPRING (3)
18. SPRING
19. RETURN SPRING
20. CONTROL LEVER
21. SLOT

TA 298638

4-7. BLOWER ASSEMBLY REPAIR (Continued)

(33) Support outer face of end plate (1 or 2) with wooden blocks on a press.

(34) Insert long end of bearing and seal tool (41) down through oil seal collar (42) or double lipped seal (42.1) and into bearing (43).

NOTE

Tag bearings (43 and 44) for proper installation.

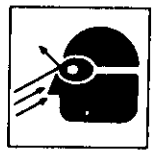
(35) Press out bearing (43) and oil seal collar (42) or double lipped seal (42.1). Discard seals.

(36) Repeat steps (33) thru (35) for remaining three bearings (43 and 44) and oil seal collars (42), or double lipped seals (42.1). Discard seals.

b. Cleaning/Inspection

(1) Clean all parts. Refer to paragraph 2-6.

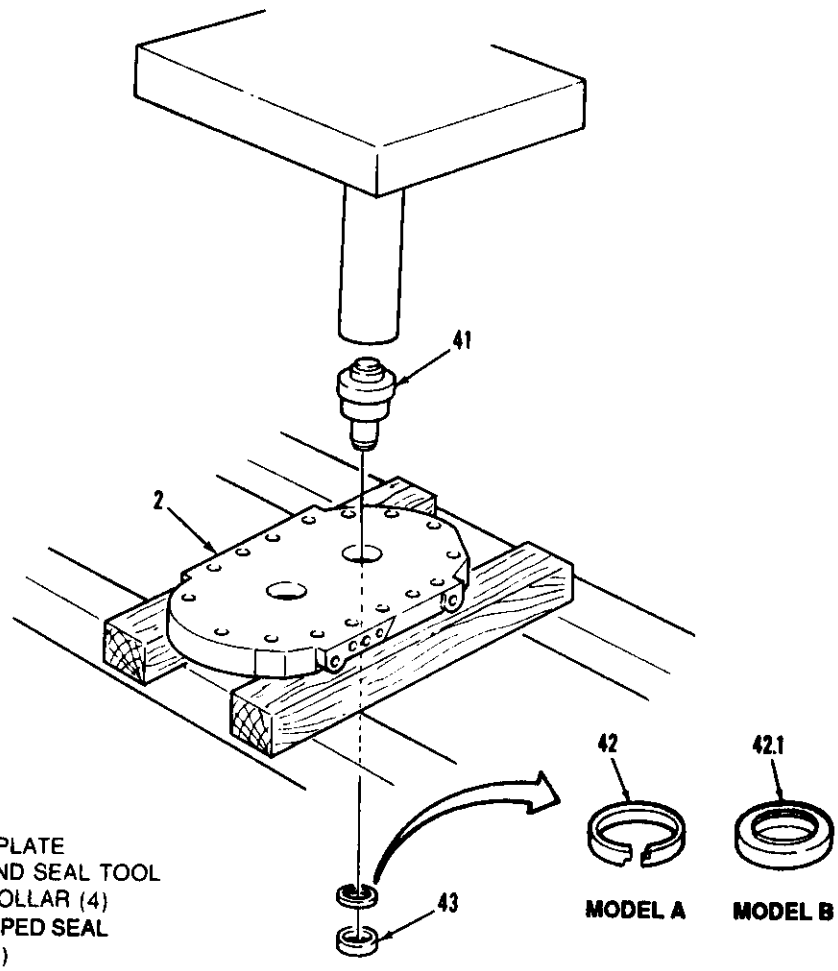
WARNING



Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psi (20.6 kPa). Eye protection required.

(2) Blow out oil passages with compressed air.

(3) Inspect bearings (43 and 44). Refer to paragraph 2-7.



2. REAR END PLATE
41. BEARING AND SEAL TOOL
42. OIL SEAL COLLAR (4)
42.1. DOUBLE LIPPED SEAL
43. BEARING (2)

TA 298653

4-5. INJECTOR CONTROL TUBE MAINTENANCE (Continued)

e. Installation

CAUTION

Oil drain holes in cylinder head must be covered to prevent 12 point capscrews (3) and U-bolt nuts (4) from falling into cylinder head.

(1) Install right injector control tube assembly (10) with four 12 point capscrews (11). Torque capscrews (11) to 10-12 foot-pounds (14-16 N·m).

(2) Repeat step (1) for left injector control tube assembly (5).

(3) Tap injector control tube assemblies (5 and 10) lightly to aline bearings in brackets (13).

(4) Install right fuel rod (22) to right control lever (20) with clevis pin (7) and new cotter pin (6).

(5) Install left fuel rod (23) to left control lever (20) with clevis pin (2) and new cotter pin (1).

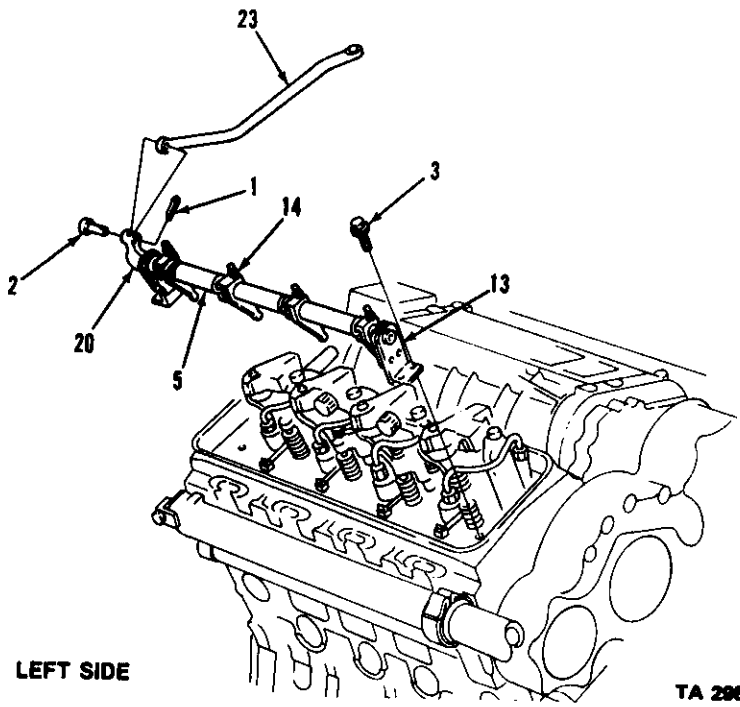
(6) Tighten eight new locknuts (14) securely.

NOTE

- Step (7) applies to right control tube only.
- Throttle delay piston (12) will be installed with right injector control tube assembly (10).

(7) Install U-bolt (9) two new lockwashers (8), and two nuts (4). Hand tighten nuts (4).

END OF TASK



1. COTTER PIN
2. CLEVIS PIN
3. 12 POINT CAPSCREW (4)
5. LEFT INJECTOR CONTROL TUBE ASSEMBLY
13. BRACKET
14. LOCKNUT (4)
20. CONTROL LEVER
23. LEFT FUEL ROD

LEFT SIDE

TA 298639

(27) Using snapring pliers, remove oil seal ring (36) from oil seal ring carrier (37). Discard oil seal ring (36).

NOTE

Front shafts of blower rotors (34 and 35) have inner bearing races (38) and oil seal ring carriers (37). Removal is the same for all oil seal ring carriers (37).

(28) Install carrier remover adapter (39) in groove of oil seal ring carrier (37).

(29) Aline two holes in gear pulling tool (19) with two holes in carrier remover adapter (39). Install two capscrews (40) and secure gear pulling tool (19) to carrier remover adapter (39).

(30) Remove and discard oil seal ring carrier (37). Inner bearing race (38) will come off with front end oil seal ring carriers (37).

(31) Remove carrier remover adapter (39) and gear pulling tool (19).

(32) Repeat steps (27) thru (31) for remaining three oil seal rings (36) and oil seal ring carriers (37).

NOTE

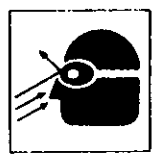
Some rotors utilize a spacers (40.1) to act as wear sleeves for the double lipped oil seals. To remove the spacers (40.1) from rotors (34) and (35), perform steps (32.1) thru (32.3).

CAUTION

Be careful not to damage rotors (34) and (35) when removing spacers (40.1).

(32.1) Place rotor (34) or (35) with spacer (40.1) flat on anvil portion of vise.

WARNING

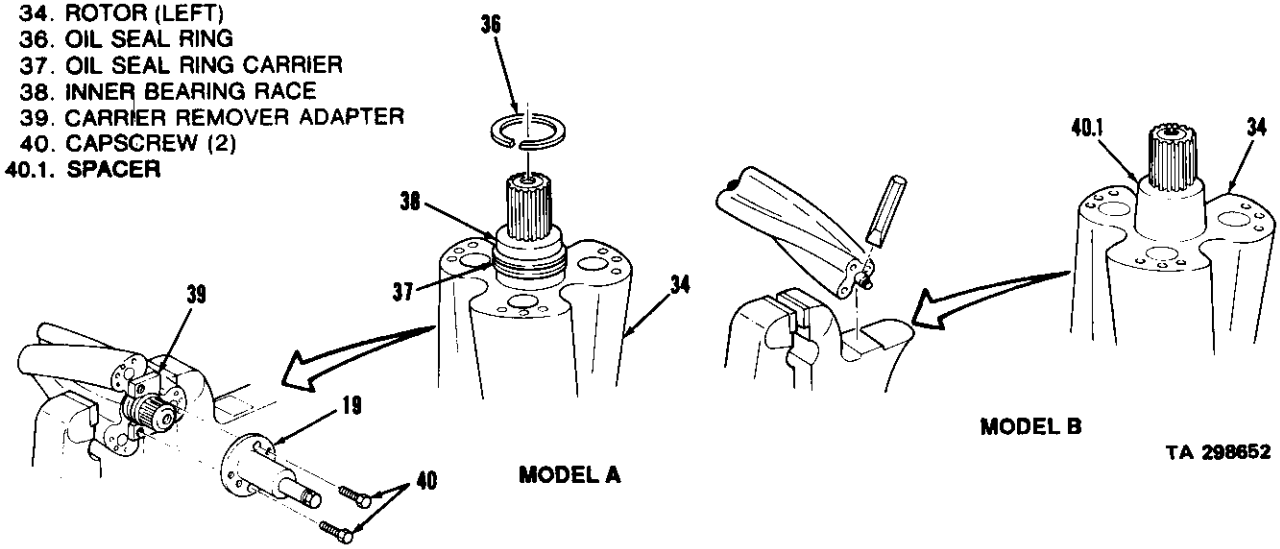


To prevent personal injury, wear a face shield when removing spacer (40.1). Pieces of spacer could cause severe eye injury if protection is not used.

(32.2) Using a sharp chisel, crack and remove spacer (40.1).

(32.3) Repeat steps (32.1) and (32.2) for remaining three spacers (40.1).

19. GEAR PULLING TOOL
34. ROTOR (LEFT)
36. OIL SEAL RING
37. OIL SEAL RING CARRIER
38. INNER BEARING RACE
39. CARRIER REMOVER ADAPTER
40. CAPSCREW (2)
40.1. SPACER

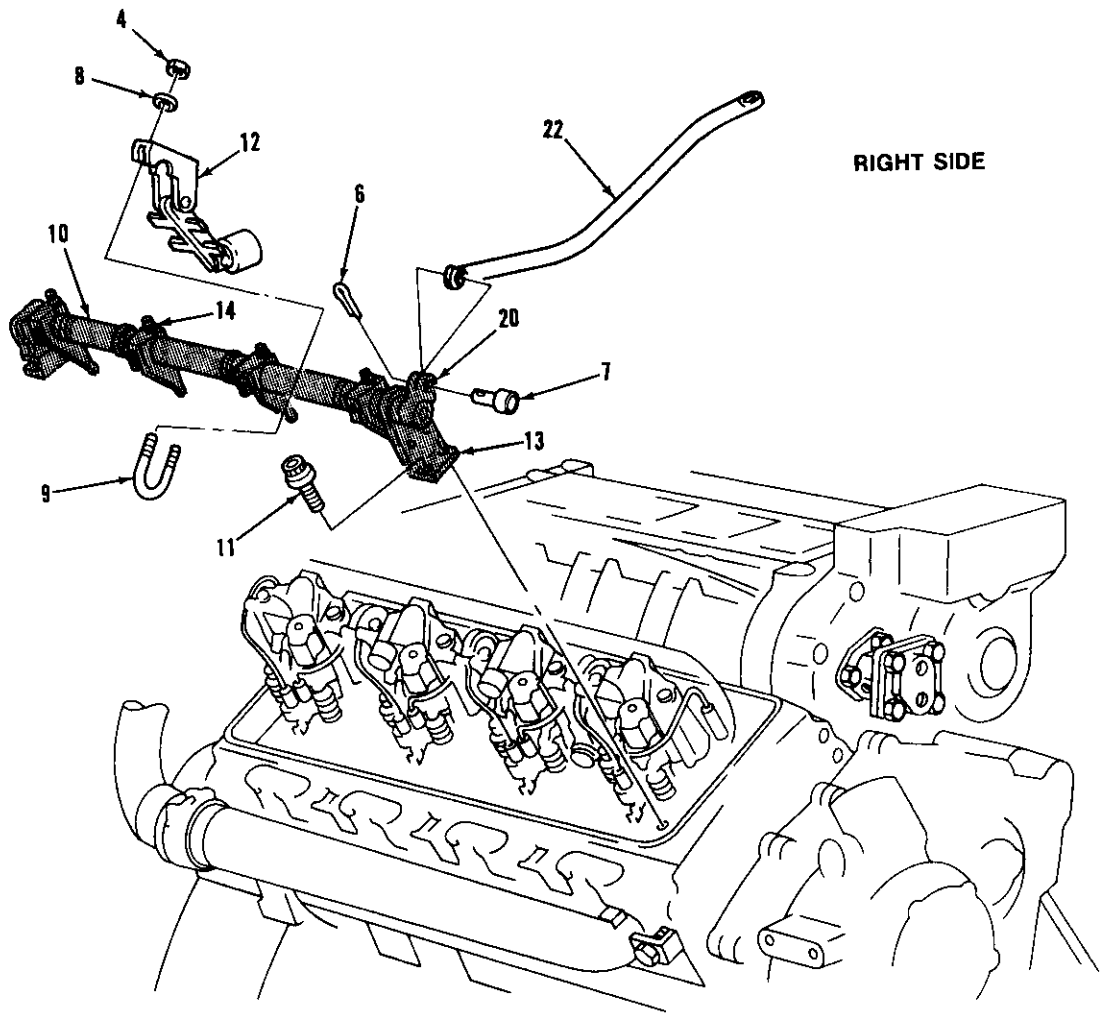


NOTE

Follow-On Maintenance

TM 2320-34/13 TM 9-2320-297-34	Adjust injector rack control lever and adjust throttle delay (para 3-29).
TM 2320-20/12 TM 9-2320-297-20	Install rocker cover (para 3-4).
TM 2320-10/11 TM 9-2320-297-10	Close engine access door (para 2-1).

4. NUT (2)
6. COTTER PIN
7. CLEVIS PIN
8. LOCKWASHER (2)
9. U-BOLT
10. RIGHT INJECTOR CONTROL TUBE ASSEMBLY
11. 12 POINT CAPSCREW (4)
12. THROTTLE DELAY PISTON
13. BRACKET
14. LOCKNUT (4)
20. CONTROL LEVER
22. RIGHT FUEL ROD



RIGHT SIDE

TA 298640

4-7. BLOWER ASSEMBLY REPAIR (Continued)

(21) Remove fuel pump drive capscrew (21), lockwasher (20), disc (32), and spacer (33) from front end plate (1). Discard lockwasher (20).

(22) Remove two screws (30) from front end plate (1).

(23) Tag and remove front end plate (1). Tag plate 'L'-left, 'R'-right as shown below.

(24) Tag and indicate top and bottom of blower housing (3). Tag rotors (34 and 35) and shaft holes of front end plate (1) for proper installation. Tag rotors 'L'-left, 'R'-right as shown below.

CAUTION

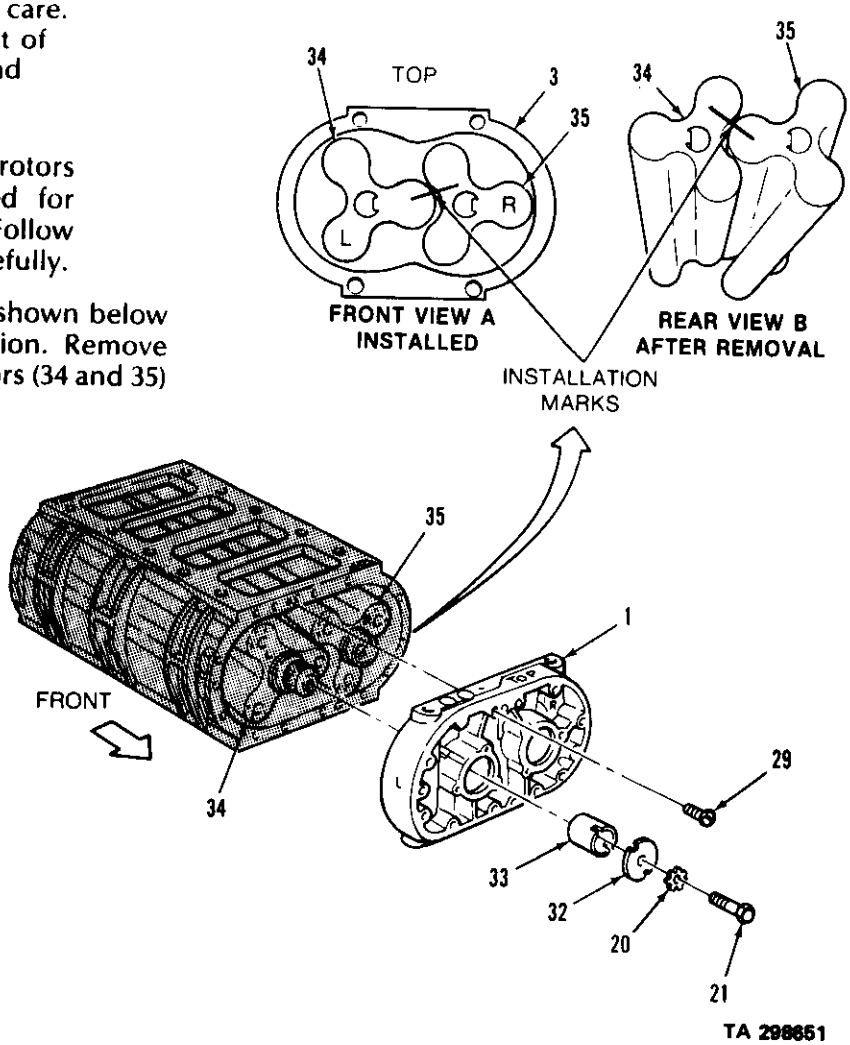
- To avoid damage, handle rotors (34 and 35) with care. Do not force rotors out of housing. Pull slowly and evenly.
- It is very important that rotors (34 and 35) be marked for proper reinstallation. Follow marking procedure carefully.

(25) Mark rotors (34 and 35) as shown below (View A) for later installation. Remove rotors (34 and 35). Hold rotors (34 and 35) in marked position, turn them upside down and mark opposite end (View B).

NOTE

Not all blower assemblies have oil seal ring carriers and oil seal rings. Some will have double lipped oil seals installed in each end plate. Blowers with carriers and seal rings will be called Model A in this task. Blowers using the double lipped seals will be called Model B.

(26) If blower is a Model A, clamp one lobe of rotor (34 or 35) in a soft-jawed vise. Tighten vise just enough to secure rotor (34 or 35).



TA 298651

4-6. BLOWER REPLACEMENT

THIS TASK COVERS:
a. Removal
b. Cleaning/Inspection
c. Installation

INITIAL SETUP

Applicable Configurations
MK48

Special Tools
Blower shaft aliner (J 33001)

Materials/Parts
Adhesive, silicone sealant (item 7, Appendix C)
Capscrew with captive lockwasher (5) (NSN 5305-01-039-9660) item 6
Gasket (NSN 5330-00-735-4296) item 8
Cotter pin (2) (P/N 103361) item 9
Gasket (NSN 5330-00-198-7953) item 29
Gasket (P/N 23520012) item 38
Blower drive seal (NSN 5330-00-764-1659) item 39

Equipment Condition TM	Condition Description
TM 2320-10/11 TM 9-2320-297-10	Engine access door open (para 2-1).
TM 2320-34/13 TM 9-2320-297-34	Air inlet housing removed (para 4-12).
TM 2320-20/12 TM 9-2320-297-20	Engine access panel removed (para 18-14).
	Throttle cylinder removed (para 4-15).
	Shutdown solenoid removed (para 4-13).
	Fuel pump removed (para 4-3).
	Rocker cover removed (para 3-4).
	Alternator removed (para 7-4).

a. Removal

(1) Tag and remove wire (1) from buffer switch (2).

(2) Tag and remove wire (3) and wire (4) from bottom terminals of buffer switch (2).

(3) Loosen nut (5) and remove buffer switch (2).

NOTE

Five capscrews (6) have captive lockwashers.

(4) Remove five capscrews (6) from governor cover (7). Discard capscrews (6).

(5) Remove governor cover (7) and gasket (8). Discard gasket (8).

NOTE

Place a rag over cylinder drain hole to prevent cotter pins (9) from falling into engine.

(6) Remove cotter pin (9) and clevis pin (10) from injector control tube lever (11) on both sides of engine. Discard cotter pins (9).

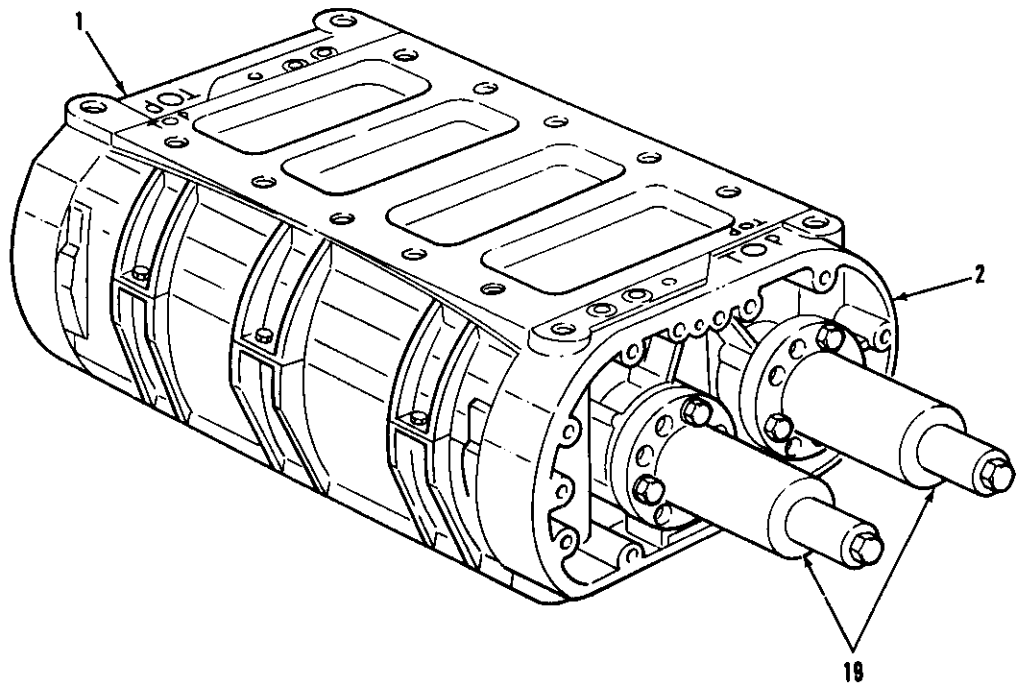
(17) Aline holes of two gear pulling tools (19) with tapped holes in rear end plate (2).

(18) Evenly install three 1/4 x 20 x 1-1/4 inch capscrews around each gear pulling tool (19). Tighten capscrews securely.

(19) Turn both screws clockwise. Remove rear end plate (2).

(20) Remove gear pulling tools (19).

1. FRONT END PLATE
2. REAR END PLATE
19. GEAR PULLING TOOL (2)



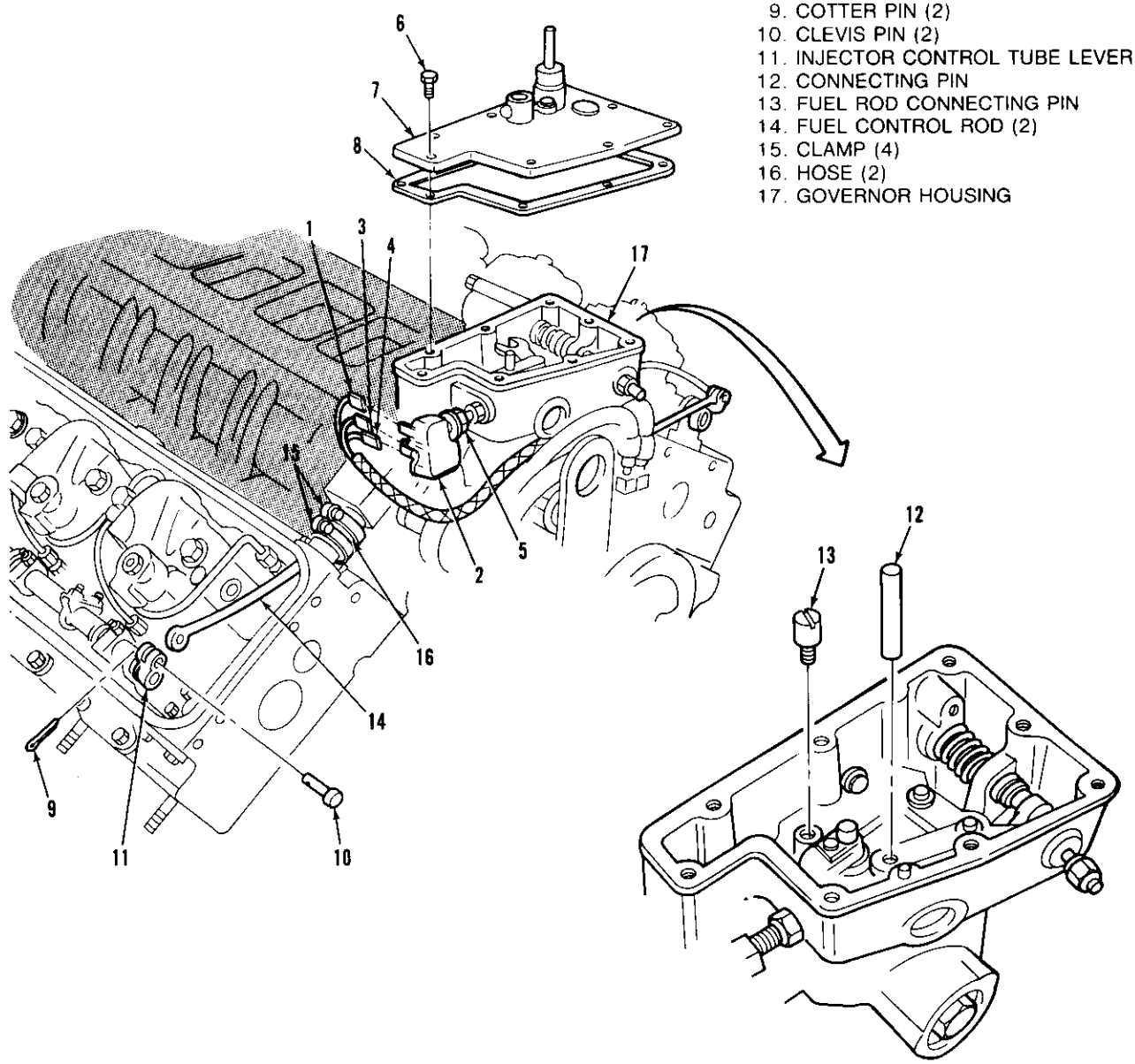
TA 298650

(7) Remove connecting pin (12) and fuel rod connecting pin (13).

(8) Tag and remove two fuel control rods (14) through cylinder head.

(9) Loosen two clamps (15) and slide hoses (16) clear of governor housing (17) on both sides of governor housing (17).

1. WIRE (NO. 713)
2. BUFFER SWITCH
3. WIRE (NO. 714)
4. WIRE (NO. 839)
5. NUT
6. CAPSCREW (5)
7. GOVERNOR COVER
8. GASKET
9. COTTER PIN (2)
10. CLEVIS PIN (2)
11. INJECTOR CONTROL TUBE LEVER (2)
12. CONNECTING PIN
13. FUEL ROD CONNECTING PIN
14. FUEL CONTROL ROD (2)
15. CLAMP (4)
16. HOSE (2)
17. GOVERNOR HOUSING



TA 298641

4-7. BLOWER ASSEMBLY REPAIR (Continued)

(8) Using five 5/16 x 24 x 1-1/2 inch capscrews, two on gear (9) and three capscrews on gear (8), install two gear pulling tools (19).

(9) Place a clean rag between gears (8 and 9). Bend back locking tabs on lockwasher (20) and break torque on fuel pump drive capscrew (21) located at the front of blower.

(10) Tag gears (8 and 9). Turn both capscrews (22) on gear pulling tools (19) at the same time and remove gears (8 and 9).

(11) Remove each gear pulling tool (19) from gears (8 and 9).

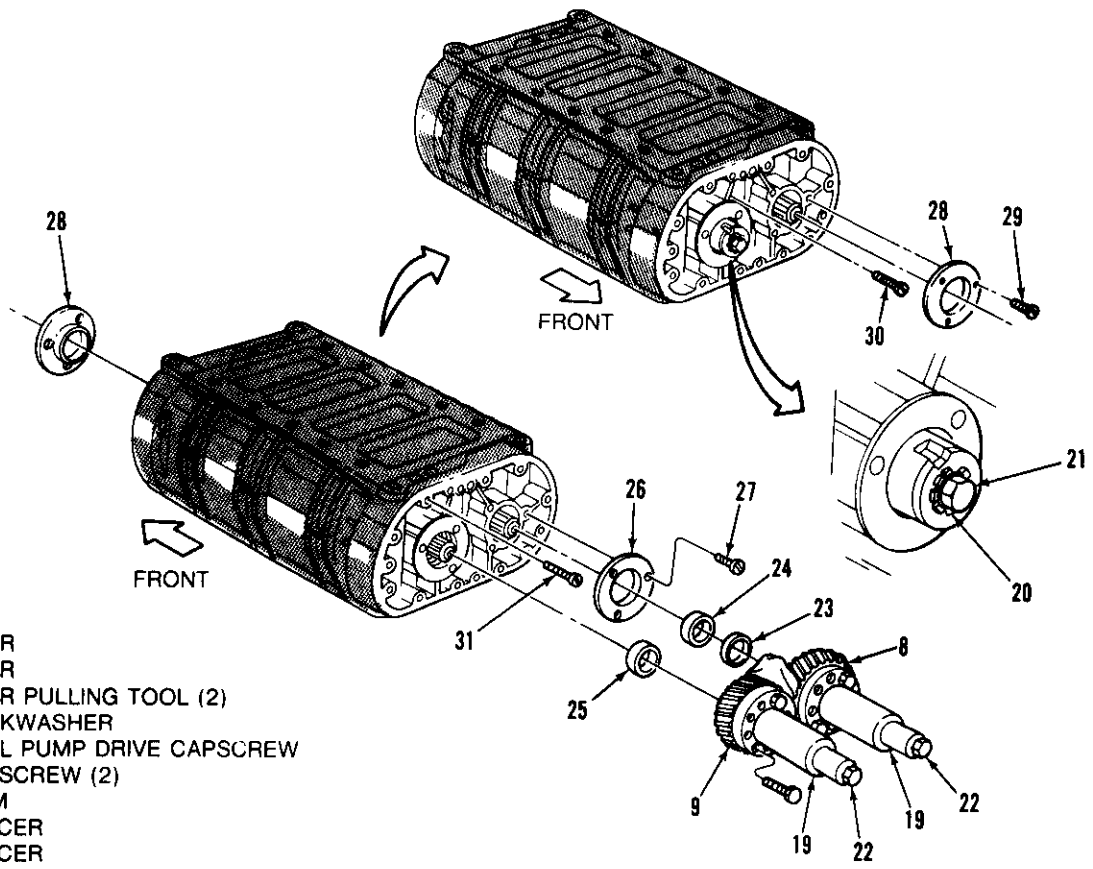
(12) Tag and remove shims (23) and spacers (24 and (25).

(13) Tag rear bearing retainers (26). Remove six screws (27) and rear bearing retainers (26).

(14) Tag front bearing retainers (28). Remove six screws (29) and bearing retainers (28).

(15) Loosen two screws (30) in front end plate (1) three complete turns until heads are flush with housing.

(16) Remove two screws (31) from rear end plate (2).



8. GEAR
9. GEAR
19. GEAR PULLING TOOL (2)
20. LOCKWASHER
21. FUEL PUMP DRIVE CAPSCREW
22. CAPSCREW (2)
23. SHIM
24. SPACER
25. SPACER
26. BEARING RETAINER (2)
27. SCREW (6)
28. BEARING RETAINER (2)
29. SCREW (6)
30. SCREW (2)
31. SCREW (2)

TA 298649

4-6. BLOWER REPLACEMENT (Continued)

(10) Loosen oil tube nuts (18 and 19) on oil tube (20). Slide oil tube (20) into blower (21).

(11) Loosen clamp (22) on blower drive support (23). Slide clamp (22) onto blower (21).

(12) Disconnect wire (24) from tachometer drive (25).

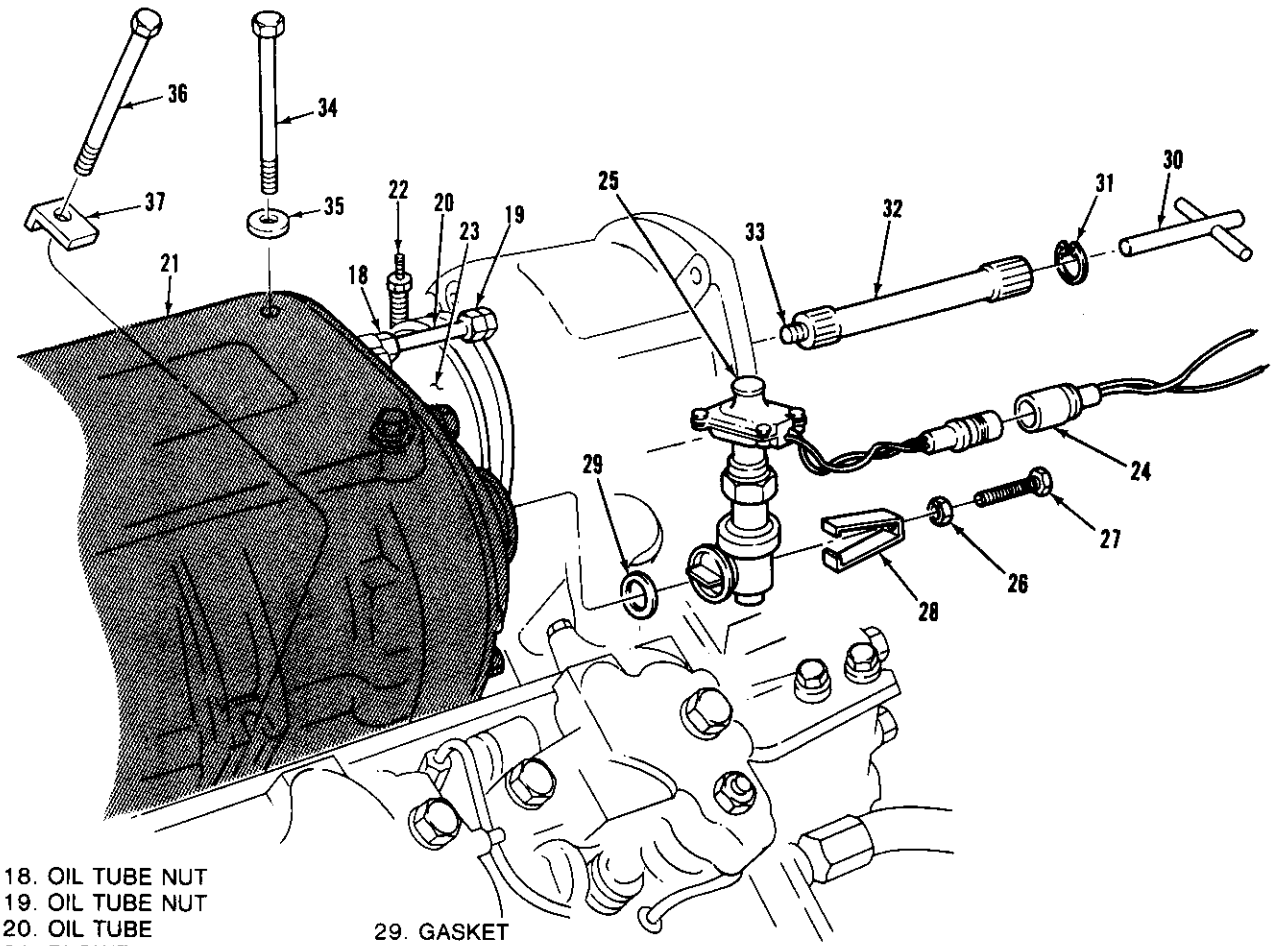
(13) Loosen locknut (26). Remove capscrew (27), clamp (28), tachometer drive (25), and gasket (29). Discard gasket (29).

(14) Install blower shaft aliner (30) and remove snapring (31). Remove blower drive shaft (32). Remove spring (33) only if damaged.

(15) Remove four capscrews (34) and washers (35).

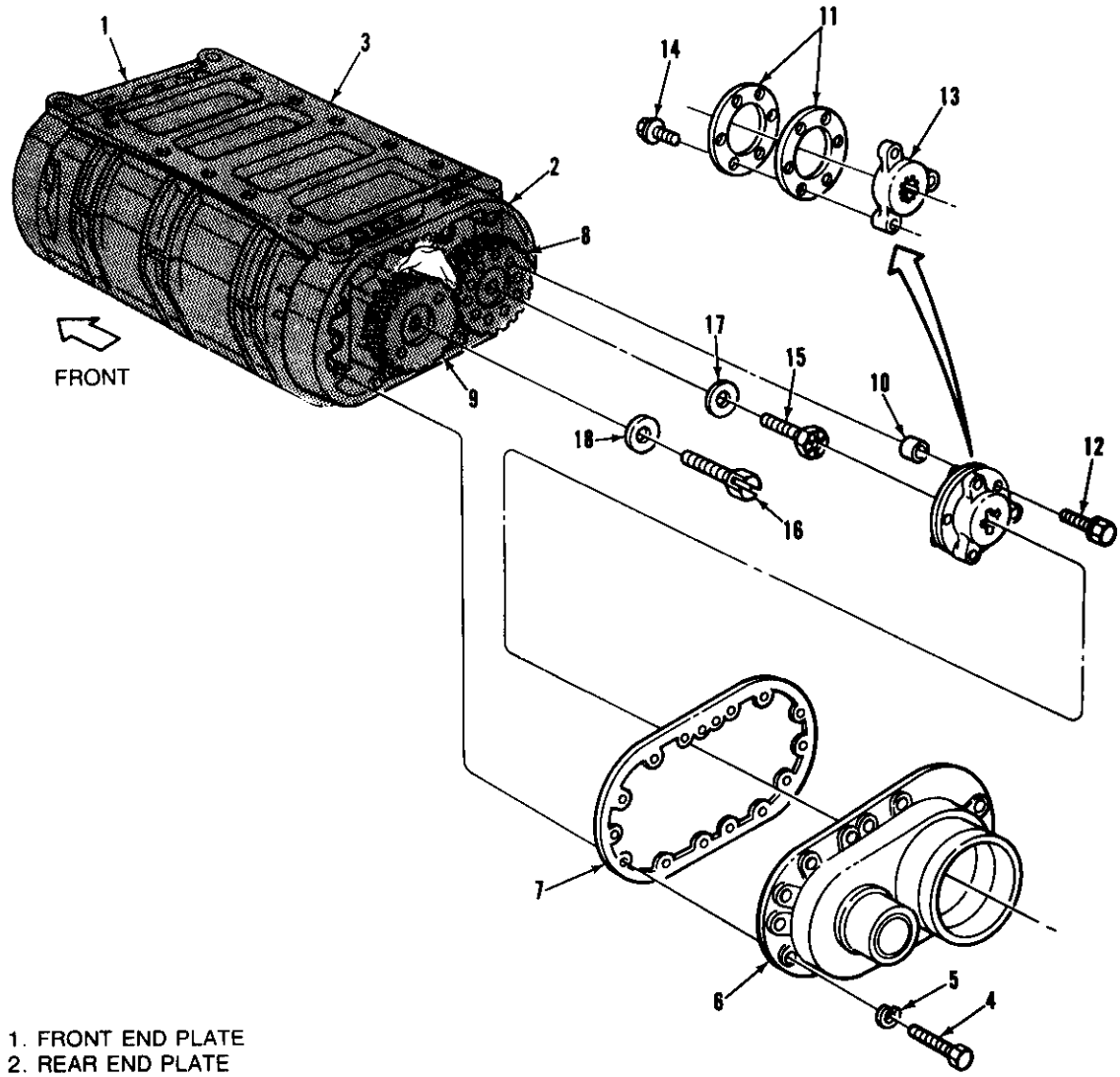
(16) Remove six capscrews (36) and retaining washers (37).

(17) Attach a sling to blower (21). Using a hoist, carefully remove blower (21).



18. OIL TUBE NUT
19. OIL TUBE NUT
20. OIL TUBE
21. BLOWER
22. CLAMP
23. BLOWER DRIVE SUPPORT
24. WIRE (QUICK DISCONNECT)
25. TACHOMETER DRIVE
26. LOCKNUT
27. CAPSCREW
28. CLAMP
29. GASKET
30. BLOWER SHAFT ALINER
31. SNAPRING
32. BLOWER DRIVE SHAFT
33. SPRING
34. CAPSCREW (4)
35. WASHER (4)
36. CAPSCREW (6)
37. RETAINING WASHER (6)

TA 298642



1. FRONT END PLATE
2. REAR END PLATE
3. BLOWER HOUSING
4. CAPSCREW (10)
5. LOCKWASHER (10)
6. BLOWER END PLATE COVER
7. GASKET
8. GEAR
9. GEAR
10. SPACER (3)
11. PLATE (2)
12. CAPSCREW (3)
13. COUPLER
14. CAPSCREW (3)
15. CAPSCREW
16. CAPSCREW
17. SLEEVE
18. SLEEVE

TA 298648

(18) Remove and discard gasket (38).

(19) Remove clamp (22) and blower drive seal (39) from flange (40). Discard blower drive seal (39).

(20) Remove oil tube fitting (41).

(21) Remove governor assembly, if necessary. Refer to paragraph 4-13.

b. Cleaning/Inspection

(1) Clean all mating surfaces.

(2) Clean all parts. Refer to paragraph 2-6.

(3) Inspect all parts. Refer to paragraph 2-7.

(4) Replace all parts failing inspection.

c. Installation

(1) Install governor assembly, if removed. Refer to paragraph 4-13.

(2) Apply adhesive silicone sealant to side of new gasket (38) facing block (42).

(3) Aline holes in new gasket (38) and block (42). Place new gasket (38) on block (42).

(4) Install blower drive seal (39) and clamp (22) into flange (40).

(5) Install oil tube fitting (41). Tighten securely.

(6) Slide oil tube (20) into oil tube fitting (41), about one inch.

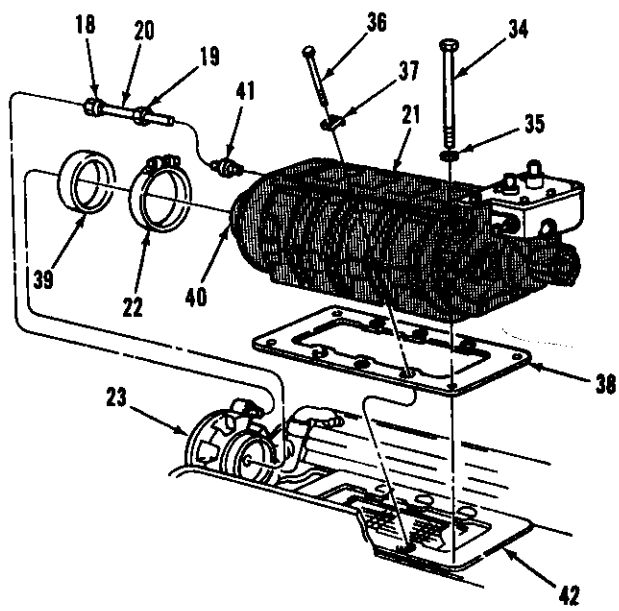
(7) Attach a sling to blower (21). Using a hoist, carefully lower so governor end of blower (21) is tilted first. Aline holes in blower (21) with holes in gasket (38) and block (42).

(8) Install four capscrews (34) and washers (35). Hand tighten only.

NOTE

The lip at the beveled end of the retaining washer (37) goes in the small recess in the blower housing.

(9) Install six capscrews (36) and retaining washers (37). Hand tighten only.



TA 298843

18. OIL TUBE NUT
19. OIL TUBE NUT
20. OIL TUBE
21. BLOWER
22. CLAMP
23. BLOWER DRIVE SUPPORT
34. CAPSCREW (4)
35. WASHER (4)
36. CAPSCREW (6)
37. RETAINING WASHER (6)
38. GASKET
39. BLOWER DRIVE SEAL
40. FLANGE
41. OIL TUBE FITTING
42. BLOCK

4-7. BLOWER ASSEMBLY REPAIR

THIS TASK COVERS: a. Disassembly
b. Cleaning/Inspection
c. Assembly

INITIAL SETUP

Applicable Configurations

MK48

Special Tools

Feeler gage (J 5438-01)
Blower service tool set (J 6270-G)

Materials/Parts

Emery cloth (item 21, Appendix C)
Clean engine oil (item 46, Appendix C)
Lockwasher (10) (MS35338-45) item 5
Lockwasher (MS35335-37) item 31
Blower overhaul kit (P/N 5108123)

Equipment Condition TM	Condition Description
TM 2320-34/13 TM 9-2320-297-34	Blower removed from engine (para 4-6).
	Governor housing removed from blower (para 4-13).

a. Disassembly

CAUTION

It is very important for later installation of blower assembly to mark the blower as indicated in step (1), below.

(1) Mark the top of front end plate (1) and rear end plate (2). Mark the word 'TOP' on both end plates (1 and 2) and the blower housing (3).

(2) Tag and remove 10 capscrews (4) and lockwashers (5) from blower end plate cover (6). Discard lockwashers (5).

(3) Remove blower end plate cover (6) and gasket (7). Discard gasket (7).

(4) Place a clean shop cloth between gears (8 and 9).

NOTE

Spacers (10) are behind plates (11) and will fall out when coupler plate capscrews (12) are removed.

(5) Remove three capscrews (12), spacers (10), and coupler (13) assembly from gears (8 and 9).

(6) Remove three capscrews (14). Remove two plates (11) from coupler (13).

(7) Tag and remove two capscrews (15 and 16) and sleeves (17 and 18) from gears (8 and 9).

4-6. BLOWER REPLACEMENT (Continued)

(10) Slide snapring (31) over notched end of blower shaft aliner (30) and thread drive shaft (32) onto blower shaft aliner (30).

(11) Install drive shaft (32) with spring facing blower (21).

(12) Pull drive shaft (32) in and out to check for binding. If binding, tap blower (21) with soft-faced hammer until no binding is felt on drive shaft (32).

(13) Remove blower shaft aliner (30) and drive shaft (32). Rotate lobes of blower (21) 90 degrees. Install drive shaft (32). Reposition blower (21) as necessary. Check alinement every 90 degrees of blower (21) rotation.

(14) With drive shaft (32) and blower shaft aliner (30) in place and blower (21) alined, torque four capscrews (34) to 40-45 foot-pounds (54-61 N·m).

(15) Torque six capscrews (36) in 5 foot-pounds (7 N·m) increments to 30-35 foot-pounds (41-47 N·m).

(16) Recheck four capscrews (34) for proper torque of 40-45 foot-pounds (54-61 N·m).

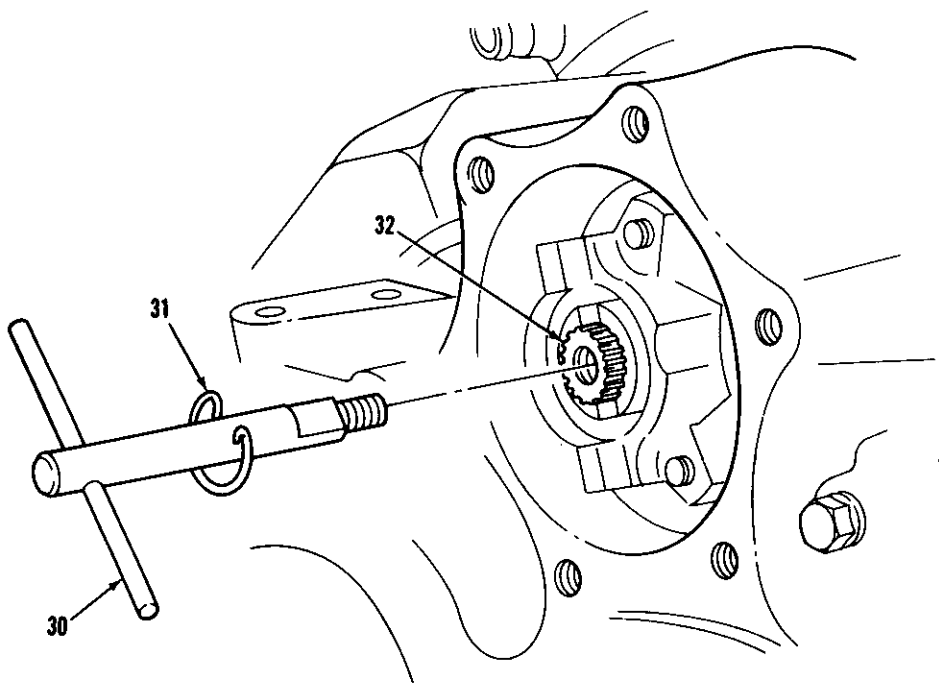
CAUTION

Do not over-tighten clamp (22). Damage to blower drive seal (39) may result.

(17) Position new blower drive seal (39) and clamp (22). Tighten clamp (22) until spring in the clamp (22) is completely compressed.

(18) Tighten oil tube nuts (18 and 19) securely.

(19) Recheck drive shaft (32) alinement. Adjust if necessary.



30. BLOWER SHAFT ALINER
31. SNAPRING
32. DRIVE SHAFT

TA 298644

(25) Install two hoses (16) and two clamps (15) on both sides of governor housing (17).

(26) Install two fuel control rods (14) through cylinder heads.

(27) Install connecting pin (12) and fuel rod connecting pin (13).

(28) Install two clevis pins (10) into injector control tube levers (11).

(29) Install two new cotter pins (9).

NOTE

When installing governor cover assembly, speed control shaft pin fits into differential lever fork.

(30) Install governor cover (7), new gasket (8), and five new capscrews (6). Tighten capscrews (6) securely.

(31) Install buffer switch (2). Tighten nut (5) securely.

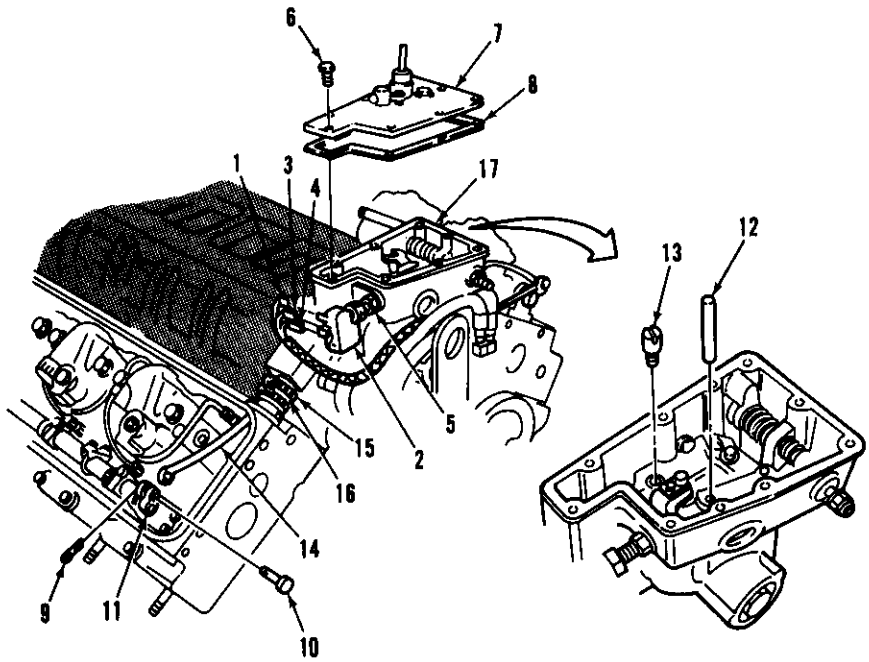
(32) Install three tagged wires (1, 3, and 4) to buffer switch (2).

END OF TASK

NOTE

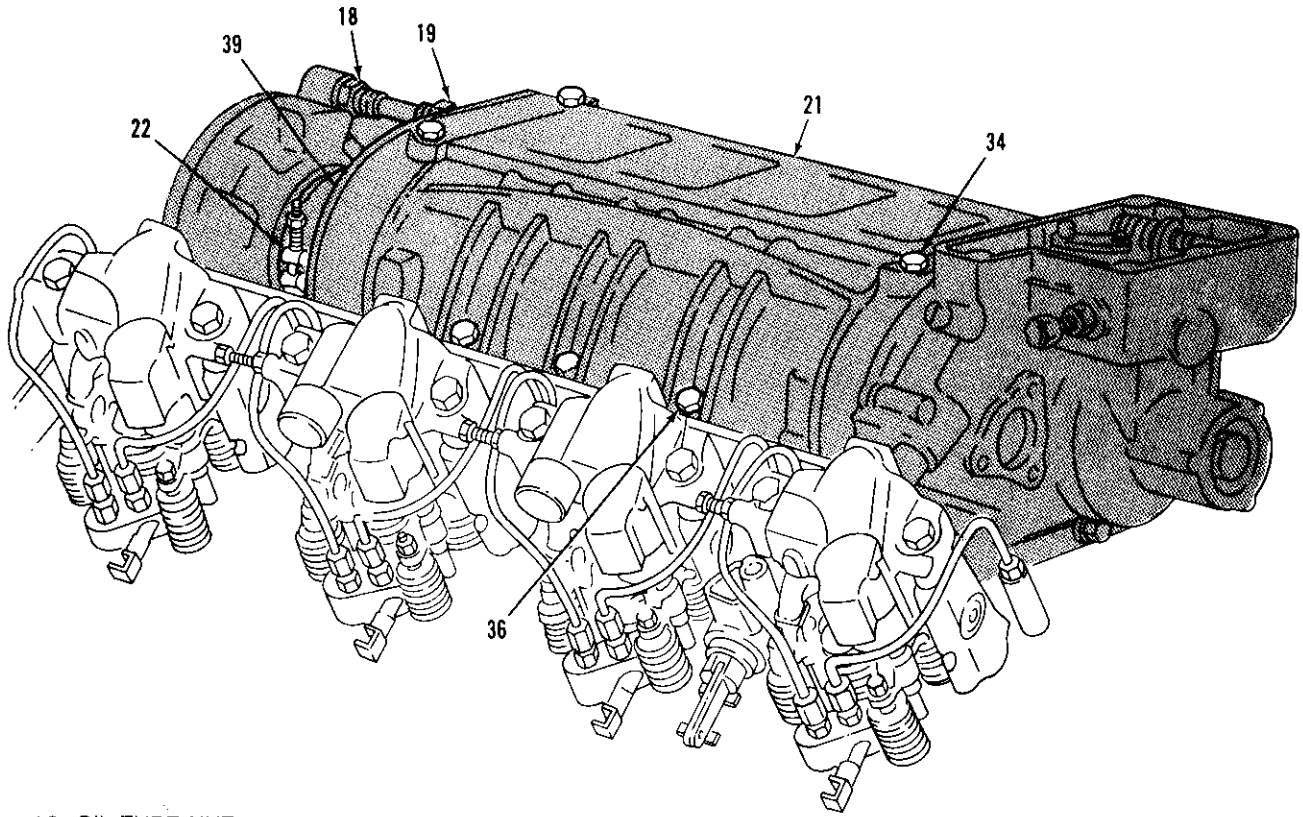
Follow-On Maintenance

TM 2320-20/12 TM 9-2320-297-20	Install alternator (para 7-4).
	Install rocker covers (para 3-4).
	Install engine shutdown solenoid (para 4-13).
	Install throttle cylinder (para 4-15).
	Install fuel pump (para 4-3).
	Install engine access covers (para 18-14).
TM 2320-34/13 TM 9-2320-297-34	Install air inlet housing (para 4-12).
TM 2320-10/11 TM 9-2320-297-10	Close engine access door (para 2-1).

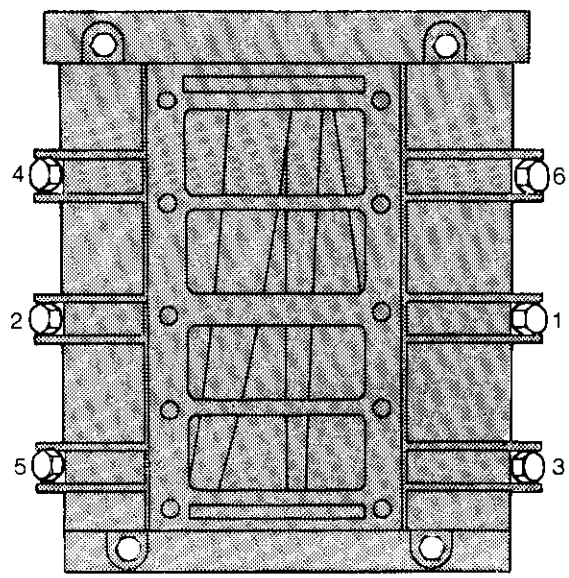


1. WIRE (NO. 713)
2. BUFFER SWITCH
3. WIRE (NO. 714)
4. WIRE (NO. 839)
5. NUT
6. CAPSCREW (5)
7. GOVERNOR COVER
8. GASKET
9. COTTER PIN (2)
10. CLEVIS PIN (2)
11. INJECTOR CONTROL TUBE LEVER (2)
12. CONNECTING PIN
13. FUEL ROD CONNECTING PIN
14. FUEL CONTROL ROD (2)
15. CLAMP (4)
16. HOSE (2)
17. GOVERNOR HOUSING

TA 298647



18. OIL TUBE NUT
19. OIL TUBE NUT
21. BLOWER
22. CLAMP
34. CAPSCREW (4)
36. CAPSCREW (6)
39. BLOWER DRIVE SEAL



TORQUE SEQUENCE

TA 298645

4-6. BLOWER REPLACEMENT (Continued)

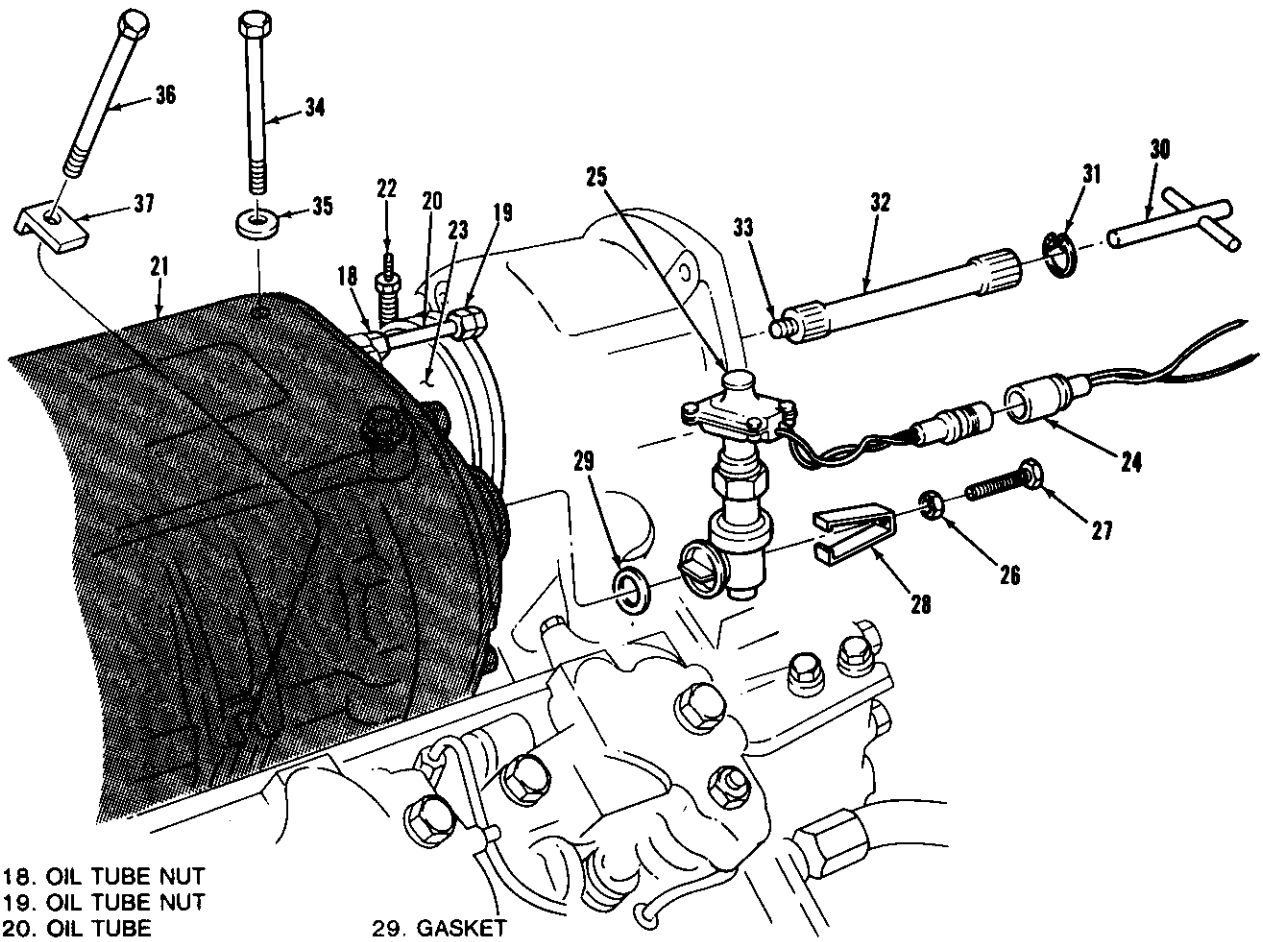
(20) Push in drive shaft (32) with spring (33). Install snapring (31).

(21) Remove blower shaft aliner (30) from drive shaft (32).

(22) Install tachometer drive (25) with new gasket (29), clamp (28), capscrew (27), and locknut (26).

(23) Tighten capscrew (27) and locknut (26) securely.

(24) Connect wire (24) to tachometer drive (25).



18. OIL TUBE NUT
19. OIL TUBE NUT
20. OIL TUBE
21. BLOWER
22. CLAMP
23. BLOWER DRIVE SUPPORT
24. WIRE (QUICK DISCONNECT)
25. TACHOMETER DRIVE
26. LOCKNUT
27. CAPSCREW
28. CLAMP
29. GASKET
30. BLOWER SHAFT ALINER
31. SNAPRING
32. BLOWER DRIVE SHAFT
33. SPRING
34. CAPSCREW (4)
35. WASHER (4)
36. CAPSCREW (6)
37. RETAINING WASHER (6)

TA 298846