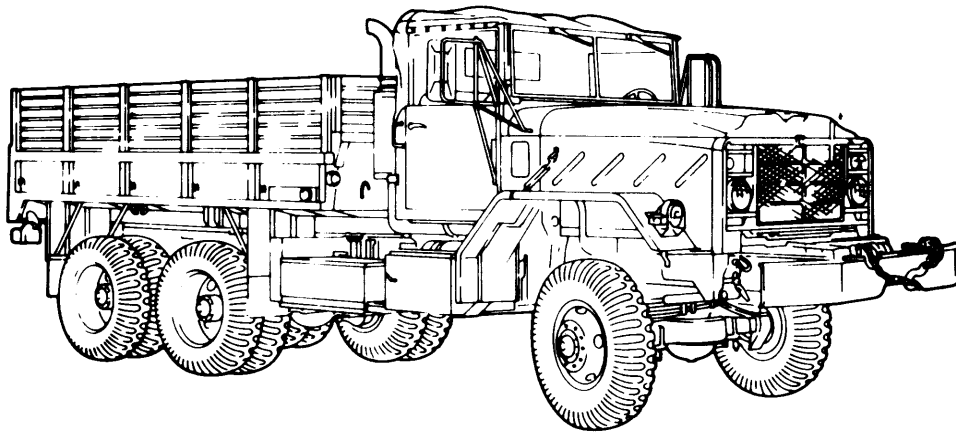


TECHNICAL MANUAL

**DIRECT SUPPORT AND
GENERAL SUPPORT MAINTENANCE**

**TRUCK 5-TON, 6X6, M939 AND
M939A1 SERIES (DIESEL)**



TRUCK, CARGO: 5-TON, 6X6, DROPSIDE,
M923 (2320-01-050-2084), M923A1 (2320-01-206-4087),
M925 (2320-01-047-8769), M925A1 (2320-01-206-4088);
TRUCK CARGO: 5-TON, 6X6,
M924 (2320-01-047-8773), M924A1 (2320-01-205-2692),
M926 (2320-01-047-8772), M926A1 (2320-01-205-2693);
TRUCK CARGO: 5 TON, 6X6, XLWB,
M927 (2320-01-047-8771), M927A1 (2320-01-206-4089),
M928 (2320-01-047-8770), M928A1 (2320-01-206-4090);
TRUCK DUMP : 5-TON, 6X6,
M929 (2320-01-047-8756), M929A1 (2320-01-206-4079),
M930 (2320-01-047-8755), M930A1 (2320-01-206-4080);
TRUCK TRACTOR: 5-TON, 6X6,
M931 (2320-01-047-8753), M931A1 (2320-01-206-4077),
M932 (2320-01-047-8752), M932A1 (2320-01-205-2684);
TRUCK/ VAN, EXPANSIBLE: 5-TON, 6X6,
M934 (2320-01-047-8750), M934A1 (2320-01-205-2682),
M935 (2320-01-047-8751), M935A1 (2320-01-205-2683);
TRUCK MEDIUM WRECKER 5-TON, 6X6,
M936 (2320-01-047-8754), M936A1 (2320-01-206-4078)

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MANUAL**

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MAINTENANCE**

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DEPARTMENT OF THE ARMY AND THE AIR FORCE

This copy is a reprint which includes current
pages from Changes 1 and 2.

JUNE 1986

CHANGE
NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
AND THE AIR FORCE
Washington D.C., 17August1991

TECHNICAL MANUAL
VOLUME 1 OF 2
DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE
TRUCK, 5-TON, 6X6, M939, M939A1 AND M939A2 SERIES
(DIESEL)

TRUCK, CARGO, DROPSIDE: 5-TON, 6X6

M923 (2320-01-050-2084), M923A1 (2320-01-206-4087), M923A2 (2320-01-230-0307),
M925 (2320-01-047-8769), M925A1 (2320-01-206-4088), M925A2 (2320-01-230-0308),

TRUCK, CARGO: 5-TON, 6X6,

M924 (2320-01-047-8773), M924A1 (2320-01-205-2692)
M926 (2320-01-047-8772), M926A1 (2320-01-205-2693)

TRUCK, CARGO, XLWB: 5-TON, 6X6,

M927(2320-01-047-8771), M927A1 (2320-01-206-4089), M927A2 (2320-01-230-0309),
M928 (2320-01-047-8770), M928A1 (2320-01-206-4090), M928A2 (2320-01-230-0310),

TRUCK, DUMP, 5-TON, 6X6

M929 (2320-01-047-8756), M929A1 (2320-01-206-4079), M929A2 (2320-01-230-0305),
M930 (2320-01-047-8755), M930A1 (2320-01-2064080), M930A2 (2320-01-230-0306),

TRUCK, TRACTOR: 5-TON, 6X6

M931 (2320-01-047-8753), M931A1 (2320-01-2064077), M931A2 (2320-01-230-0302),
M932 (2320-01-047-8752), M932A1 (2320-01-205-2684),M932A2 (2320-01-230-0303),

TRUCK, VAN, EXPANSIBLE: 5-TON,6X6,

M934 (2320-01-047-8750), M934A1 (2320-01-205-2682), M934A2 (2320-01-230-0300),
M935 (2320-01-047-8751), M935A1 (2320-01-205-2683), M935A2 (2320-01-230-0301),

TRUCK, MEDIUM WRECKER: 5-TON,6X6,

M936 (2320-01-047-8754), M936A1 (2320-01-206-4078), M936A2 (2320-01-230-0304),

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Brigadier General, United States Army
The Adjutant General

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

By Order of the Secretary of the Air Force;

Official;

CHARLES C. MCDONALD
General, United States Air Force
Commander, Air Force Logistics Command

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General, United States Air Force
Chief of Staff

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**CHANGE
NO. 1**

**TM 9-2320-272-34-1
TO 36A12-1C-452-1**

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
Washington D. C., 30 April 1990

TECHNICAL MANUAL

VOLUME 1 OF 2

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE TRUCK, 5-TON, 6X6, M939, M939A1 AND M939A2 SERIES (DIESEL)

TRUCK, CARGO, DROPSIDE: 5-TON, 6X6,
M923 (2320-01-050-2084), M923A1 (2320-01-206-4087), M923A2 (2320-01-230-0307),
M925 (2320-01-047-8769), M925A1 (2320-01-206-4088); M925A2 (2320-01-230-0308),
TRUCK, CARGO: 5-TON, 6X6,
M924 (2320-01-047-8773), M924A1 (2320-01-205-2692),
M926 (2320-01-047-8772), M926A1 (2320-01-205-2693);
TRUCK, CARGO, XLWB: 5-TON, 6X6,
M927 (2320-01-047-8771), M927A1 (2320-01-206-4089), M927A2 (2320-01-230-0309),
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M929 (2320-01-047-8756), M929A1 (2320-01-206-4079), M929A2 (2320-01-230-0305),
M930 (2320-01-047-8755), M930A1 (2320-01-206-4080); M930A2 (2320-01-230-0306),
TRUCK, TRACTOR: 5-TON, 6X6,
M931 (2320-01-047-8753), M931A1 (2320-01-206-4077), M931A2 (2320-01-230-0302),
M932 (2320-01-047-8752), M932A1 (2320-01-205-2684); M932A2 (2320-01-230-0303),
TRUCK, VAN, EXPANSIBLE: 5-TON, 6X6,
M934 (2320-01-047-8750), M934A1 (2320-01-205-2682), M934A2 (2320-01-230-0300),
M935 (2320-01-047-8751), M935A1 (2320-01-205-2683); M935A2 (2320-01-230-0301),
TRUCK, MEDIUM WRECKER: 5-TON, 6X6,
M936 (2320-01-047-8754), M936A1 (2320-01-206-4078) M936A2 (2320-01-230-0304),

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The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-38 (Block No. 0388),
Direct Support and general Support maintenance requirements for Truck, Diesel,
5-ton, 6x6, M939 and M939A1-Series.

WARNING

EXHAUST GASES CAN KILL

1. DO NOT operate your vehicle engine in enclosed area.
2. DO NOT idle vehicle engine with cab windows closed.
3. DO NOT drive vehicle with inspection plates or cover plates removed.
4. BE ALERT at all times for exhaust odors.
5. BE ALERT for exhaust poisoning symptoms, they are:
 - Headache
 - Dizziness
 - Sleepiness
 - Loss of muscular control
6. If YOU SEE another person with exhaust poisoning symptoms:
 - Remove person from area
 - Expose to open air
 - Keep person warm
 - Do not permit person to move
 - Administer artificial respiration, if necessary*

* For artificial respiration, refer to FM 21-11.

WARNING SUMMARY

- Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.
- Eyeshields must be worn when cleaning with a wire brush. Flying rust and metal particles may cause injury to personnel.
- All personnel must stand clear during hoisting operations. A snapped cable, shifting, or swinging load may cause injury to personnel.
- Do not use hands to free engine of "hangups". Use tanker or pry bars, or injury to personnel may result.
- Make sure engine compartment is free of all tools and working materials before starting engine. Failure to do this may result in injury to personnel.
- Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated areas. Failure to do this may result in injury to personnel.
- Do not remove filter when engine is hot. A removed filter may drip hot oil, causing injury to personnel.
- Do not handle hot pistons with bare hands, or injury to personnel may result.
- If task is being performed while engine is in vehicle, be sure fuel shutoff handle is pulled and battery ground cable is disconnected to prevent engine starting. Failure to do this may result in injury to personnel.
- Keep hands away from spray stream when fuel is forced from injector spray holes. Failure to do this may result in injury to personnel.
- The piston spring, located between the thrust cap and clutch facing, is under tension and may cause injury to personnel if screws are not removed as directed.

WARNING SUMMARY (Cont'd)

- Assistant must support hood during removal of wiring harness clamp, or injury to personnel may result.
- Torque converter must be removed with the transmission as an assembly, or injury to personnel may result.
- Keep rear of transmission tilted slightly downward to prevent converter from sliding off, or injury to personnel may result.
- Do not remove hoist chain from transmission until transmission is stable on holding fixture base, or injury to personnel may result.
- Regulator valve spring is under compression. Do not remove retaining snapping until spring compressor is in place, or valve spring may shoot out, causing injury to personnel.
- Piston return spring is under great compression. Do not remove snapping until pressure is applied to spring retainer, or return spring may fly out, causing injury to personnel.
- Make sure all personnel are clear of underside and front of vehicle before starting engine. Transmission slipping into gear may cause injury to personnel.
- Make sure transmission to propeller shaft has been removed before performing main and governor pressure test. If test is performed with propeller shaft installed, chocks may not prevent vehicle from rolling, causing injury to personnel.
- Do not disconnect air lines before draining air reservoirs. Small parts under pressure may shoot out with high velocity, causing injury to personnel.
- Weight of vehicle must remain supported on jack stands at all times. Do not attempt to support weight of vehicle on hydraulic jack. Injury to personnel may result if jack fails.
- Valve cover is under extreme tension. Do not remove all screws until limiting valve is positioned so vise will hold cover, or outer spring may fly out causing injury to personnel.
- Be careful when removing small retaining ring. Spring tension under "O" ring may release when retaining ring is removed, causing injury to personnel.
- Personnel must stand clear of vehicle when vehicle engine is running. Vehicle may suddenly move, causing injury to personnel.
- Adhesive material is flammable. Keep away from open flame, or injury to personnel may result.
- Use eyeshields when removing/installing door glass. Glass may shatter causing injury to personnel.
- Never work under dump body until safety braces are properly positioned. Injury to personnel may result if dump body suddenly lowers.
- Make sure dump control lever is in neutral and not moved. Injury to personnel may result if lift cylinder is operated when not secured.
- The elevating cylinder is heavy. Remove/install with the aid of assistant and a lifting device, or injury to personnel may result.
- Before hoisting outer boom away from/onto wrecker, make sure inner boom is properly fastened to outer boom, or injury to personnel may result.
- Inner boom must be supported at sheave to prevent tilting until hoist chain can be properly positioned around inner boom, or injury to personnel may result.
- Make sure all lines are fastened clear of the gondola to avoid snagging during removal or injury to personnel may result.
- Keep hydraulic oil reservoir away from open flame during inspection or repair. Failure to do this may result in injury to personnel.
- The front/rear winch is heavy. Use hoist during repair, or injury to personnel may result.

TECHNICAL MANUAL
NO. 9-2320-272 -34-1

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE

TECHNICAL ORDER
NO. 36A12-1C-452-1

WASHINGTON, D.C. 10 June 1986

TECHNICAL MANUAL

VOLUME 1 OF 2

DIRECT SUPPORT AND GENERAL SUPORT MAINTENANCE TRUCK, 5-TON, 6X6, M939, M939A1 AND M939A2 SERIES (DIESEL)

Model		NSN Without Winch	NSN With Winch
Truck, Cargo, Dropside	M923	2320-01-050-2084	
Truck, Cargo, Dropside	M923A1	2320-01-206-4087	
Truck, Cargo, Dropside	M923A2	2320-01-230-0307	
Truck, Cargo, Dropside	M925		2320-01-047-8769
Truck, Cargo, Dropside	M925A1		2320-01-206-4088
Truck, Cargo, Dropside	M925A2		2320-01-230-0308
Truck, Cargo	M924	2320-01-047-8773	
Truck, Cargo	M924A1	2320-01-205-2692	
Truck, Cargo	M926		2320-01-047-8772
Truck, Cargo	M926A1		2320-01-205-2693
Truck, Cargo, XLWB	M927	2320-01-047-8771	
Truck, Cargo, XLWB	M927A1	2320-01-206-4089	
Truck, Cargo, XLWB	M927A2	2320-01-230-0309	
Truck, Cargo, XLWB	M928		2320-01-247-8770
Truck, Cargo, XLWB	M928A1		2320-01-206-4090
Truck, Cargo, XLWB	M928A2		2320-01-230-0310
Truck, Dump	M929	2320-01-04708756	
Truck, Dump	M929A1	2320-01-206-4079	
Truck, Dump	M929A2	2320-01-230-0305	
Truck, Dump	M930		2320-01-047-8755
Truck, Dump	M930A1		2320-01-206-4080
Truck, Dump	M930A2		2320-01-230-0306
Truck, Tractor	M931	2320-01-047-8753	
Truck, Tractor	M931A1	2320-01-206-4077	
Truck, Tractor	M931A2	2320-01-230-0302	
Truck, Tractor	M932		2320-01-047-8752
Truck, Tractor	M932A1		2320-01-205-2684
Truck, Tractor	M932A2		2320-01-230-0303
Truck, Van, Expansibile	M934	2320-01 -047-8750	
Truck, Van, Expansibile	M934A1	2320-01 -205-2682	
Truck, Van, Expansibile	M934A2	2320-01 -230-0300	
Truck, Van, Expansibile, W/HLG	M935	2320-01 -047-8751	
Truck, Van, Expansibile, W/HLG	M935A1	2320-01 -205-2683	
Truck, Van, Expansibile, W/HLG	M935A2	2320-01 -230-0301	
Truck, Medium Wrecker	M936		2320-01-047-8754
Truck, Medium Wrecker	M936A1		2320-01-206-4078
Truck, Medium Wrecker	M936A2		2320-01-230-0304

This manual is published in two parts. TM 9-2320-272 -34-1 contains chapters 1 through 7, and TM 9-2320-272-34-2 contains chapters 8 through 21, appendices A, B, C, D, and E.

This manual contains a table of contents for both volumes 1 and 2. Volume 1 contains an alphabetized index for chapters 1 through 7 only. Volume 2 contains a table of contents and alphabetized index for chapters 8 through 21,

*This publication supersedes TM 9-2320 -272-34-1 dated 24 October 1982 and all changes.

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE TRUCK, 5-TON, 6X6, M939, M939A1 AND M939A2 SERIES (DIESEL)

REPORTING OF ERRORS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to: Commander, U.S. Army Tank-Automotive Command, ATTN: AMSTA-MB, Warren, Michigan 48397-5000. A reply will be furnished to you.

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HOW TO USE THIS MANUAL

ABOUT YOUR MANUAL

Spend some time looking through this manual. You'll find that it has a new look, different than most of the TMs you've been using.

New features added to improve the convenience of this manual and increase your efficiency are:

- a. **Accessing Information** — These include physical entry features such as the bleed-to-edge indicators on the cover and edge of the manual. Extensive troubleshooting guides for specific systems lead directly to step by step directions for problem solving and maintenance tasks.
- b. **Illustrations** — A variety of methods are used to make locating and fixing components much easier. Locator illustrations with keyed text, exploded views, and cut-away diagrams make the information in this manual easier to understand and follow.
- c. **Keying Text With Illustrations** — Instructions/text are located together with figures that illustrate the specific task you are working on. In most cases, the task steps and figures are located side by side. Continue reading for an example of modular text and figure layouts.

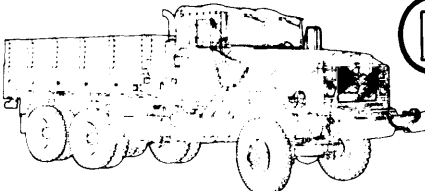
USING YOUR MANUAL: AN EXAMPLE

ARMY TM 9-2320-272-34-1
AIR FORCE TO 36A12-1C-452-1

TECHNICAL MANUAL

**DIRECT SUPPORT AND
GENERAL SUPPORT MAINTENANCE**

**TRUCK, 5-TON, 6X6, M939 SERIES
(DIESEL)**



**TRUCK, CARGO: 5-TON, 6X6, DROPSIDE,
M923 (2320-01-050-2084), M925 (2320-01-047-8769);
TRUCK, CARGO: 5-TON, 6X6,
M924 (2320-01-047-8773), M926 (2320-01-047-8772);
TRUCK, CARGO: 5-TON, 6X6, XLWB,
M927 (2320-01-047-8771), M928 (2320-01-047-8770);
TRUCK, DUMP: 5-TON, 6X6,
M929 (2320-01-047-8756), M930 (2320-01-047-8755);
TRUCK, TRACTOR: 5-TON, 6X6,
M931 (2320-01-047-8753), M932 (2320-01-047-8752);
TRUCK, VAN, EXPANSIBLE: 5-TON, 6X6,
M934 (2320-01-047-8750), M935 (2320-01-047-8751);
TRUCK, MEDIUM WRECKER: 5-TON, 6X6,
M936 (2320-01-047-8754)**

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

**HOW TO USE THIS
MANUAL** v

INTRODUCTION 1-1

**SERVICE AND
TROUBLESHOOTING
INSTRUCTIONS** 2-1

**ENGINE
MAINTENANCE** 3-1

**FUEL SYSTEM
MAINTENANCE** 4-1

**COOLING SYSTEM
MAINTENANCE** 5-1

**ELECTRICAL SYSTEM
MAINTENANCE** 6-1

**AUTOMATIC
TRANSMISSION
MAINTENANCE** 7-1

TASK: The organizational maintenance mechanic of an M939 series vehicle reports that the engine cranks, fails to start.

TROUBLESHOOTING STEPS:

1. Look at the cover of this manual. You'll see chapter titles listed from top to bottom on the right-hand side.
2. Look at the right edge of the manual. On some of the pages you'll see black bars (edge indicators) that are aligned with the chapter bars on the cover. These are the locations of the chapters in the text.
3. Look for "SERVICE AND) TROUBLESHOOTING INSTRUCTIONS in the chapter list on the cover.
4. Turn to those pages with the edge indicator matching the black bar for SERVICE AND TROUBLESHOOTING INSTRUCTIONS. Page numbers are also listed next to chapter titles.

MECHANICAL TROUBLESHOOTING SYMPTOM INDEX		
MALFUNCTION NO.	MALFUNCTION	TROUBLESHOOTING PROCEDURE PAGE
ENGINE		
1	Engine will not crank	2-9
2	Engine cranks, fails to start	2-9
3	Engine starter motor operates, does not engage flywheel ring gear	2-9
4	Engine stops	2-9
5	Engine knocks (mechanical noise)	2-10
6	Excessive oil consumption	2-10
7	Excessive engine vibration	2-10
8	Excessive gear noise	2-10
FUEL SYSTEM		
10	Engine idles rough/erratic	2-11
11	Excessive fuel consumption	2-11
12	Excessive exhaust smoke at idle and under load	2-11
13	Engine fails to stop	2-11
14	Engine misses	2-11
15	Low power, loss of power	2-12
16	Engine over speeds	2-12
17	Engine lubricating oil diluted by fuel	2-12
18	Engine fuel knocks	2-12
COOLING SYSTEM		
19	Engine overheats	2-12
20	Loss of coolant	2-12
TRANSMISSION		
21	Transmission shifts occur at too high a speed	2-13
22	Transmission shifts occur at too low a speed	2-13
23	Low main operating pressure at all shift ranges	2-13
24	Clutch slippage in all forward and/or reverse gears	2-13
25	Excessive vehicle creep (first and reverse)	2-13
26	Vehicle moves in neutral	2-13
27	No response to shift lever movement	2-13
28	Oil thrown out of filler tube	2-14
29	Oil leaking into converter housing	2-14
30	Rough shifting	2-14
31	Transmission overheating in all ranges	2-14
32	Transmission oil dirty, foamy and/or milky	2-14
33	Oil leak at output shaft	2-15
TRANSFER CASE		
34	Transfer case will not shift into gear	2-15
35	Transfer case will not stay in gear	2-15
36	Excessive noise during operation	2-15
37	Lubricant leaks	2-15

- One of the first pages having service and troubleshooting instructions edge indicators is the "MECHANICAL TROUBLESHOOTING SYMPTOM INDEX".
- Look down the list until you find "ENGINE". Beneath that heading you will find the symptoms noted by the maintenance mechanic: "Engine cranks, fails to start".
- Turn to the page indicated: 2-9.

- On page 2-9, steps/tests relating to resolving the problem of "Engine cranks, fails to start" are:

- You inspect the fuel pump shutoff valve and find that it is defective, and must be replaced. Paragraph 4-5 is referenced.
- The rest of the inspection shows no other cause for the problem.

Table 2-1. Mechanical Troubleshooting	
MALFUNCTION TEST OR INSPECTION	CORRECTIVE ACTION
ENGINE	
1. ENGINE WILL NOT CRANK	
Step 1. Check for mechanical or hydraulic seizure. Remove fuel injectors before attempting crank shaft rotation test (para. 4-27).	
a. Try to rotate crankshaft manually using engine barring tool.	
b. If crankshaft will not rotate, go to step 2.	
c. If crankshaft rotates and liquid is discharged, check if liquid is coolant or fuel.	
d. If liquid is coolant, replace cylinder heads (para. 3-20).	
e. If liquid is fuel, replace fuel injectors (para. 4-27).	
Step 2. Engine must be inspected for extent of internal damage.	
Replace engine (para. 3-24).	
END OF TESTING	
ENGINE CRANKS, FAILS TO START	
Step 1. Check for defective fuel pump shutoff valves.	
Remove, inspect, and replace if necessary with new fuel pump shutoff valves (para. 4-5).	
Step 2. Check for broken fuel supply pump drive shaft.	
a. Remove tachometer cable from fuel pump (TM 9-2320-272-20-1), crank engine, and observe if drive shaft end in pump housing is rotating.	
b. If drive shaft does not rotate, replace fuel pump (para. 4-4).	
Step 3. Check for defective fuel injectors and valve adjustment (para. 4-27).	
Step 4. Check for possible dirty or damaged fuel injectors.	
Remove, inspect, and replace if necessary with new fuel injectors (para. 4-27).	
Step 5. Adjust valve and injector clearances (para. 3-105 or 3-106).	
Step 6. Replace fuel pump (para. 4-4).	
END OF TESTING	
3. ENGINE STARTER MOTOR OPERATES, DOES NOT ENGAGE FLYWHEEL RING GEAR	
Step 1. Check for defective flywheel ring gear teeth.	
a. Remove starter motor (TM 9-2320-272-20-1).	
b. Using engine barring tool, turn engine and inspect flywheel ring gear teeth through starter motor opening in engine block.	
Step 2. Remove transmission (para. 7-11) and replace defective flywheel ring gear and plate (paras. 3-59 and 3-94).	
END OF TESTING	
4. ENGINE STOPS	
Step 1. If engine overheating is evident, go to malfunction 1. If engine has overheated, go to step 2.	
Step 2. Check cooling system.	
a. Check for defective radiator fan clutch drive (TM 9-2320-272-10).	
b. Install fan clutch overdrive bolt (TM 9-2320-272-10) and start engine.	

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Section II. FUEL PUMP REPAIR

4-3. FUEL PUMP REPAIR TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
4-4	Fuel Pump Replacement	4-4
4-5	Fuel Pump Shutoff Valves Replacement	4-14
4-6	Fuel Pump Shutoff Valve (M936) Replacement	4-16
4-7	Fuel Pump Mounting to Holding Fixture	4-19
4-8	Pulsation Damper Maintenance	4-20
4-9	Pressure Gear Pump Removal	4-22
4-10	Governor Spring Pack Maintenance	4-24
4-11	Fuel Pump Housing Disassembly	4-26
4-12	Throttle Cover and Shaft Disassembly	4-28
4-13	Governor Weight Removal	4-30
4-14	Front Drive Cover Disassembly	4-32
4-15	Tachometer Drive Disassembly	4-34

4-3

9. To locate paragraph 4-5, refer to the third page of chapter 4, section II (page 4-3). Find “Fuel Pump Shutoff Valves Replacement” in the ‘Fuel Pump Repair Task Summary’. You are directed to page 4-14.

10. Turn to paragraph 4-5 on page 4-14. Here you will find the detailed procedure for removing the old fuel pump shutoff valve and replacing it with a new one.

TM 9-2320-272-34-1

4-5. FUEL PUMP SHUTOFF VALVES REPLACEMENT

This task covers:
a. Manual Shutoff Valve Removal
b. Fuel Pump Shutoff Valve Removal
c. Fuel Pump Shutoff Valve Installation
d. Manual Shutoff Valve Installation

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All (except M936)	TM 9-2320-272-10 TM 9-2320-272-10	Boost raised and secured. Left splash shield removed.

Test Equipment
None

Special Tools
None

Materials/Parts
O-ring
Two lockwashers
Protective cap plugs (Appendix C, Item 5)

Personnel Required
Whichever is repairman M936/R

Manual References
TM 9-2320-272-10
TM 9-2320-272-10P

General Safety Instructions
None

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
a. Manual Shutoff Valve Removal				
1		Manual fuel shutoff valve (4)	Disconnect	
2		Fuel shutoff control cable (5)	Screw (15)	Loosen and remove clip (1) and pull cable (5) until free of shutoff lever (2)
3		Fuel shutoff valve (12)	Manual fuel shutoff valve (4)	Remove
b. Fuel Pump Shutoff Valve Removal				
4		Terminal (14)	Nut (10) and wires (9)	Remove
5		Two screws (16), lock washers (17) and washers (18)		Remove
6		Shutoff valve (12) and O-ring (13)		Plug openings in fuel pump (14). Discard O-ring (13).

4-14

TM 9-2320-272-34-1

4-5. FUEL PUMP SHUTOFF VALVES REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
c. Fuel Pump Shutoff Valve Installation				
7		New O-ring (13) and fuel shutoff valve (12)	Install on fuel pump (14) with two washers (18), new lockwashers (17) and screws (16)	
d. Manual Shutoff Valve Installation				
8		Wires (9) and nut (10)	Install to terminal (14)	
9		Manual fuel shutoff valve (4)	Install on fuel shutoff valve (12)	
10		Control cable (5), screw (15) and clip (1)	Install on shutoff lever (2)	Make sure shutoff lever (2) is in the forward position
11		Fuel line (6)	Connect to manual fuel shutoff valve (4)	

PART CALLOUT NUMBERS
EXPLODED PARTS DIAGRAM

END OF TASK

FOLLOW ON TASKS

- Start engine (TM 9-2320-272-10) and check fuel pump shutoff valves for proper operation.
- Install left splash shield (TM 9-2320-272-10).

4-15

DETAILED MAINTENANCE PROCEDURES:

11. Detailed procedures: Include everything you must do to accomplish a basic maintenance task.

- a. Before beginning the maintenance task, look through the procedure. You must familiarize yourself with the entire maintenance procedure before beginning the maintenance task. The entire procedure of paragraph 4-5: Fuel Pump Shutoff Valves Replacement includes:
 - a. Removal and
 - b. Installation.
- b. The nine basic headings listed under "INITIAL SETUP" outline the task conditions, materials, manpower requirements, and special conditions or tools. They are:
 - Applicable Models: Any models that require that particular maintenance task.
 - Test Equipment: Test equipment needed to complete a task.
 - Special Tools: Those special tools needed to finish a maintenance task. The use of common tools is not explained.
 - Materials/Parts: All parts or materials needed to complete a task.
 - Personnel Required: The number and type of personnel needed to accomplish a task.
NOTE: If you think that you need more help to correctly or safely complete a task (perhaps as the result of unusual conditions, etc.) alert your supervisor and ask for help.
 - Manual References: Those manuals needed to complete the task.
 - Equipment Condition: Notes the conditions that must exist before starting the task. For fuel pump shutoff valves replacement, the hood must be raised and secured, and the left splash shield must be removed.
 - Special Environmental Conditions: Outlines specific environmental conditions necessary to perform a task. For example: darkening an area when adjusting headlight beams.
 - General Safety Instructions: Summarizes all safety warnings for the maintenance task.
- c. A step by step maintenance procedure follows the Initial Setup. Five columns, "Step No.", "Location", "Item", "Action", and "Remarks" give detailed instructions for the procedure. They are:
 - Step No.: Gives the sequence of task steps.
 - Location: Indicates the general location of the part(s) you are working on in this step. Example: for Fuel Pump Shutoff Valves Replacement, a. Removal; the location of step no. 1 is "Manual fuel shutoff valve (4)". NOTE: The numbers in parentheses correspond to that part's callout number in the accompanying illustration.
 - Item: Lists the specific part(s) you are concerned with in this step. In our example, it is: "Fuel line (3)".
 - Action: Explains the action to be taken with those parts listed in the Item column. In our example you are directed to "Disconnect".
 - Remarks: Provides additional information.
- d. At the end of a procedure, "FOLLOW-ON TASKS" will list those additional tasks that must be performed to complete the procedure. The Follow-On Tasks for Fuel Pump Shutoff Valves Replacement are "Start engine (TM 9-2320-272- 10) and check fuel pump shutoff valves for proper operation" and "Install left splash shield (TM 9-2320-272-10)".

12. Refer to the example pages for para. 4-5, Fuel Pump Shutoff Valves Replacement as we review the following points:

- a. **Modular Text**: Both pages of text and illustrations are to be used together. This manual was designed so that the two pages would be visible at once, making part identification and procedure sequence easy to follow.
- b. **Initial Setup**: Outlines task conditions.
- c. **Illustrations**: A exploded diagram of the component, removed from the truck, shows part locations, attachments, and spatial relationships.

13. Refer to TM 9-2320-272-34P, Direct Support and General Support Maintenance Repair Parts and Special Tools List for Truck, 5-Ton, 6x6, M939 Series, when requisitioning parts, special tools, and equipment for direct support and general support maintenance.

14. Your manual is easier to use once you understand its design. We hope it will encourage you to use it more often.

CHAPTER 1

INTRODUCTION

Section I. GENERAL INFORMATION

1-1. SCOPE

a. This technical manual contains instructions for the Direct Support and General Support Maintenance levels for the 5-ton, 6x6, M939, M939A1 and M939A2 series vehicles.

Unique DS/GS M939A2 engine and central tire inflation system instructions are in TM 9-2320-358-24&P.

b. The vehicle model numbers and equipment names covered include:

M923, M923A1, M923A2 Cargo Truck, WO/W (Dropside)
 M924, M924A1, M924A2 Cargo Truck, WO/W
 M925, M925A1, M925A2 Cargo Truck, W/W (Dropside)
 M926, M926A1, M926A2 Cargo Truck, W/W
 M927, M927A1, M927A2 Cargo Truck, WO/W (XLWB)
 M928, M928A1, M928A2 Cargo Truck, W/W (XLWB)
 M929, M929A1, M929A2 Dump Truck, WO/W
 M930, M930A1, M930A2 Dump Truck, W/W
 M931, M931A1, M931A2 Tractor Truck, WO/W
 M932, M932A1, M932A2 Tractor Truck, W/W
 M934, M934A1, M934A2 Expansible Van, WO/W
 M935, M935A1, M935A2 Expansible Van, WO/W (W/HLG)
 M936, M936A1, M936A2 Medium Wrecker, W/W

1-2. MAINTENANCE FORMS AND RECORDS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, The Army Maintenance Management System (TAMMS).

1-3. DESTRUCTION OF ARMY EQUIPMENT TO PREVENT ENEMY USE

Procedures for destruction of Army equipment to prevent enemy use can be found in TM 750-244-6.

1-4. EQUIPMENT REQUIRING CALIBRATION

Calibration requirements in this manual cover the fuel pump and fuel injectors and can be found in chapter 4 of the manual.

1-5. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIRs)

If your 5-ton, M939 and M939A1 series vehicle 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 SF 368 (Quality Deficiency Report). Mail it to us at: Commander, U.S. Army Tank-Automotive Command, ATTN: AMSTA-MT, Warren, Michigan 48397-5000, We'll send you a reply.

The quarterly Equipment Improvement Report and Maintenance Digest, TB 43-0001-39 series, contains valuable field information on the equipment covered in this manual. The information in the TB 43-0001-39 series is compiled from some of the Equipment Improvement Reports that you prepared on the vehicles covered in this manual. Many of these articles resulted from comments, minor alterations, proposed Modification Work Orders (MWO'S), actions taken on some of your DA form 2028's (Recommended Changes to Publications), and advance information on proposed changes that may affect this manual. The information will help you in doing your job better and will help in keeping you advised of the latest changes to this manual.

1-6. WARRANTY INFORMATION

The 5-ton, 6x6, M939 series vehicle Cummins engine (model NHC 250), and Allison transmission (model MT654CR) are warranted in accordance with TB 9-2300-295-15/21. The warranty starts on the date, found in block 23, DA form 2408-9, in the logbook. Report all defects in material or workmanship to your supervisor, who will take appropriate action.

Section II. EQUIPMENT DESCRIPTION AND DATA

1-7. EQUIPMENT CAPABILITIES, CHARACTERISTICS, AND FEATURES

Detailed descriptions and data covering the 5-ton, 6x6, M939 series vehicles are described in TM 9-2320-272-10 and TM 9-2320-272-20-1. Equipment configurations with dimensions and weights (tabulated data) follow.

1-8. EQUIPMENT DATA

TM 9-2320-272-20-1 contains tabulated data for the M939 vehicles. Additional data applicable to the Direct Support and General Support levels can be found at the front of the applicable chapters of this manual.

CHAPTER 2

SERVICE AND TROUBLESHOOTING INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

2-1. COMMON TOOLS AND EQUIPMENT

Refer to Modified Table of Organization and Equipment (MTOE) for authorized common tools and equipment applicable to your unit.

2-2. SPECIAL TOOLS AND SUPPORT EQUIPMENT

Special tools and support equipment are listed and illustrated in TM 9-2320-272-34P-2.

2-3. TEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE)

Calibrate all measuring and test equipment used to determine equipment conformance in accordance with MIL-STD-120, MIL-C-45662, and MIL-L-45607.

2-4. FABRICATED TOOLS

Fabricated tools needed to maintain the equipment in this manual can be found in appendix D. These tools are not available for issue, but must be fabricated and applied by direct and general support personnel only.

2-5. REPAIR PARTS

Repair parts are listed and illustrated in TM 9-2320-272-34P-1 and TM 9-2320-272-34P-2.

Section II. GENERAL SERVICE INSTRUCTIONS

2-6. GENERAL MAINTENANCE INSTRUCTIONS TASK SUMMARY

Publications which provide additional information on general shop practice techniques, preservation, welding, sheet metal work, etc., are listed in appendix A of this manual. To find a particular general service instruction, use the instruction task summary below:

TASK PARA.	PROCEDURES	PAGE NO.
2-7.	Cleaning	2-2
2-8.	Inspection	2-3
2-9.	Repair	2-4
2-10.	Assembly — Precautionary Rules	2-6

2-7. CLEANING

a. General Instructions. Cleaning procedures will be the same for the majority of parts and components which make up the vehicle subassemblies. General cleaning procedures are detailed in “b” through “o”.

b. The Importance of Cleaning. Great care and effort are required in all cleaning operations. The presence of dirt and foreign material is a constant threat to satisfactory vehicle operation and maintenance. The following will apply to all cleaning operations:

- (1) Clean all parts before inspection, after repair, and before assembly.
- (2) Hands must be kept free of any accumulation of grease which can collect dust and grit.
- (3) After cleaning, all parts must be covered or wrapped in plastic or paper to protect them from dust and/or dirt.

WARNING

Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.

c. External Engine Cleaning. All electrical equipment and other parts that could be damaged by steam cleaning or moisture must be removed, and all openings covered before cleaning. Dry with compressed air.

d. Disassembled Parts Cleaning. Place all disassembled parts in wire baskets for cleaning.

- (1) Dry and cover all cleaned parts.
- (2) Place on or in “racks” and hold for inspection or repair.
- (3) All parts subject to rusting must be lightly oiled and wrapped.
- (4) Keep all related parts and components together. Do not mix parts.

WARNING

Improper cleaning methods and use of unauthorized cleaning solvents may injure personnel and damage equipment. Refer to TM 9-247 for correct information.

e. Castings.

- (1) Clean inner and outer surfaces of castings and all areas subject to grease and oil with cleaning solvents. Refer to TM 9-247.
- (2) Use a stiff brush to remove sludge and gum deposits.
- (3) Use compressed air to blow out all tapped screw holes and dry castings after cleaning.

f. Oil Passages. Particular attention must be given to all oil passages in castings and machined parts. Oil passages must be clean and free of any obstructions.

- (1) Clean passages with wire probes to break up any sludge or gum deposits.
- (2) Wash passages by flushing with solvents. Refer to TM 9-247.
- (3) Dry passages with compressed air.

CAUTION

Do not allow drycleaning solvents to come in contact with seals, cables, or flexible hoses. These cleaners cause leather, rubber, and synthetic materials to dry out, rot, and lose pliability, making them unserviceable.

g. Oil Seals, Electrical Cables, and Flexible Hoses. Clean with soap and water.

2-7. CLEANING (Cont'd)

h. Bearings.

(1) Bearings require special cleaning. After removing surface oil and gum deposits, place bearings in hot oil [140°F (60°C)] to loosen congealed oil and grease. Wipe bearings dry, do not use compressed air. After cleaning, coat bearings with oil, wrap in paper, and hold for inspection.

(2) Refer to TM 9-214 for information and care of bearings.

WARNING

Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

i. **Machine Tooled Parts.** Clean with drycleaning solvent and dry with compressed air.

j. **Machined Surfaces.** Clean with drycleaning solvent and dry with lint-free cloth.

WARNING

Eyeshields must be worn when cleaning with a wire brush. Flying rust and metal particles may cause injury to personnel.

k. **Mated Surfaces.** Remove old gasket and/or sealing compound using wire brush and drycleaning solvent.

NOTE

All parts subject to rusting must be lightly oiled and wrapped before being stored.

l. **Rusted Surfaces.** Clean all rusted surfaces using wire brush and crocus cloth.

m. **Oil Bathed Internal Parts.** Wipe clean with lint-free cloth.

n. **Air-Actuated Internal Parts.** Wipe clean with lint-free cloth.

o. **Externally Exposed Parts.** Wash with soap and water. Rinse thoroughly and air dry.

2-8. INSPECTION

a. **General Instructions.** Procedures for inspections will be the same for many parts and components which make up the vehicle subassemblies. General procedures are detailed in "b" through "q". Dimensional standards for parts have been fixed at extremely close tolerances, so use specification tables. Use specified inspection equipment for inspection where cracks and other damage cannot be spotted visually. Exercise extreme care in all phases of inspection.

b. Castings.

(1) Inspect all ferrous and nonferrous castings for cracks using a magnifying glass and strong light.

(2) Refer to MIL-I6866, Inspection, Liquid Penetrant Methods.

(3) particularly check areas around studs, pipe plugs, threaded inserts, and sharp corners. Replace all cracked castings.

(4) Inspect machined surfaces for nicks, burrs, or raised metal. Mark damaged areas for repair or replacement.

(5) Inspect all pipe plugs, pipe plug openings, screws, and screw openings for damaged or stripped threads.

(6) Check all gasket mating surfaces, flanges on housings, and supports for warpage with a straight-edge or surface plate. Inspect mating flanges for discolorations which may indicate persistent oil leakage.

(7) Check all castings for conformance to applicable repair standards.

c. **Bearings.** Refer to TM 9-214 for inspection of bearings. Check all bearings for conformance to applicable repair standards.

d. **Studs, Bolts, and Screws.** Replace if threads are damaged, bent, loose, or stretched.

2-8. INSPECTION (Cont'd)

e. Gears.

NOTE

When gear teeth wear limits are not established, good judgment is required to determine if gear replacement is necessary.

- (1) Inspect all gears for cracks, using a magnifying glass and strong light. No cracks allowed.
- (2) Inspect gear teeth for wear, sharp fins, burrs, and galled or pitted surfaces.
- (3) Check keyway slots for wear and/or damage.

f. Bearings, Engine.

CAUTION

Engine connecting rod and main bearings are serviced in sets. If one bearing fails, all bearings must be replaced. Refer to paragraphs 3-64 and 3-65 for engine bearing inspection.

g. Bushings and Bushing Type Bearings.

- (1) Check all bushings and bushing-type bearings for secure fit, evidence of overheating, wear, burrs, nicks, and out-of-round condition.
- (2) Check for dirt in lubrication holes or grooves. Holes and grooves must be clean and free from damage.

h. Oil Seals. Oil seals are mandatory replacement items.

i. Core Hole Expansion Plugs. Inspect for leakage. Replace plugs when leakage is present,

j. Machine Tooled Parts. Inspect for cracks, breaks, elongated holes, wear, and chips,

k. Machined Surfaces. Inspect for cracks, evidence of wear, galled or pitted surface, burrs, nicks, and scratches.

l. Mated Surfaces. Inspect for remains of old gasket, seal, secure fit, pitting, and evidence of leakage.

m. Rusted Surfaces. Inspect for pitting, holes, and severe damage.

n. Oil Bathed Internal Parts. Inspect for cracks, nicks, burrs, evidence of overheating, and wear.

o. Air-Actuated Internal Parts. Inspect for cracks, nicks, burrs, evidence of overheating, and wear.

p. Externally Exposed Parts. Inspect for breaks, cracks, rust damage, and wear.

q. Springs. Inspect for broken, collapsed, and twisted coils.

2-9. REPAIR

a. General Instructions. Repair of most parts and components is limited to general procedures outlined in applicable maintenance instructions and the following detailed procedures, "b" through "h".

CAUTION

Repaired items must be thoroughly cleaned to remove metal chips and abrasives to prevent them from entering working parts of vehicle.

b. Castings.

- (1) All cracked castings will be replaced.
- (2) Only minor repairs to machined surfaces, flanges, and gasket mating surfaces are permitted. Remove minor nicks, burrs, and/or scratches with:

2-9. REPAIR (Cont'd)

- (a) Fine mill file.
- (b) Crocus cloth dipped in cleaning solvent.
- (c) Lapping across a surface plate.

(3) Remachining of machined surfaces to repair damage, warpage, or uneven surfaces is not permitted. Replace castings.

(4) Repair damaged threaded pipe plug and/or screw threads with a tap. Repair oversize holes with threaded inserts.

c. Bearings. See TM 9-214.

d. Studs. Replace all bent and stretched studs. Repair minor thread damage with a thread die. Replace studs having stripped or damaged threads as outlined below:

(1) Remove using a stud remover. Back studs out slowly to avoid heat buildup and seizure which can cause stud to break off.

(2) If studs break off too short to use a stud remover, use a stud extractor to remove, or use "welding method".

CAUTION

Refer to TM 9-237, Welding Instructions, to avoid damage to castings if welding method is used.

(3) Broken studs can be removed by welding bar stock or a nut to stud and removing with wrench.

NOTE

Standard studs may have a coarse thread on one end and a fine thread on the other end. The coarse thread end is installed in the aluminum casting. Studs having coarse threads on both ends are used in some applications. The shorter threaded end goes into the casting. Refer to TM 9-2320-272 -34P-1 and TM 9-2320 -272-34P-2 for correct part numbers.

(4) Replacement studs have a special coating and must have a small amount of antiseize compound (MIL-A-907) applied on threads before stud is installed. Install replacement stud slowly to prevent heat buildup and snapping off.

e. Gears.

(1) Remove gears using pullers.

(2) Use the same methods described in paragraph 2-9b(2) for castings to remove minor nicks, burrs, or scratches on gear teeth.

(3) If keyways are worn or enlarged, replace gear.

f. Bushings and Bushing-Type Bearings. When bushings and bushing-type bearings seize to a shaft and spin in the bore, the associated part must also be replaced.

g. Oil Seals.

(1) Remove oil seals by pressing or prying out, being careful not to damage casting or adapter bore.

(2) Always install new seal in bore using proper seal replacing tool.

h. Cylinder Head — Cylinder Block. Repair of cylinder head and cylinder block is limited to procedures outlined in paragraphs 3-53, 3-54, 3-55, 3-56, 3-57, 3-64, and 3-66. Measurements outside the tolerance limits listed in tables 3-2, 3-3, 3-4, 3-7, 3-8, and 3-9 are cause for replacement of the item.

2-10 ASSEMBLY – PRECAUTIONARY RULES

- a. Cleanliness is essential in all component assembly operations. Dirt and dust, even in minute quantities, are abrasive. Parts must be cleaned as specified, and kept clean. Wrap or cover parts and components when assembly procedures are not immediately completed.
- b. Coat all bearings and contact surfaces with operating oil (axle oil for axle parts, transmission oil for transmission parts, etc.). to ensure lubrication of parts during initial operation after repair.
- c. Use new gaskets and preformed packings during assembly of all components.

Section III. TROUBLESHOOTING

2-11. GENERAL TROUBLESHOOTING INSTRUCTIONS

a. Troubleshooting procedures in this section cannot give all the answers or correct all vehicle malfunctions encountered. However, these procedures are an organized step by step approach to a problem that directs tests and inspections toward the source of a problem and successful solution.

Information in this section is for use by support maintenance personnel in conjunction with and as a supplement to the troubleshooting procedures in TM 9-2320-272-20-1.

CAUTION

Operation of a deadlined vehicle without preliminary inspection may cause further damage to a disabled component and possible injury to personnel.

- b. Do the easiest things first. Most problems are easily corrected. For example:
 - (1) Low power problems are generally caused by loose throttle linkage or dirty fuel filters.
 - (2) Excessive oil consumption is generally caused by leaky gaskets, or loose line connections.
 - (3) Always check the easiest and most obvious things first. This simple rule saves time and trouble.
- c. Doublecheck before disassembly. The source of most engine problems can be traced to more than one part in a system. For example:
 - (1) Excessive fuel consumption may not be caused by the fuel pump alone. Instead, the trouble could be a clogged air cleaner reducing air inflow, or a restricted exhaust passage, causing abnormally high back pressure.
 - (2) Engines very often are disassembled in search of a complaint and the real evidence of the problem is destroyed. Check again to be sure an easier solution to the problem has not been overlooked.
 - (3) Check all tags, service request forms, and vehicle logbook for repair history. This may help lead to source of problems.
- d. Before attempting to correct a problem, diagnose the cause of the problem. Do not allow the same failure to occur again.

MECHANICAL TROUBLESHOOTING SYMPTOM INDEX

MALFUNCTION NO.	MALFUNCTION	TROUBLESHOOTING PROCEDURE PAGE
ENGINE		
1.	Engine will not crank	2-9
2.	Engine cranks, fails to start	2-9
3.	Engine starter motor operates, does not engage flywheel ring gear	2-9
4.	Engine stops	2-9
5.	Low oil pressure	2-10
6.	Engine knocks (mechanical noise)	2-10
7.	Excessive oil consumption.. . . .	2-10
8.	Excessive engine vibration.. . . .	2-10
9.	Excessive gear noise	2-10
FUEL SYSTEM		
10.	Engine idle —rough, erratic.. . . .	2-11
11.	Excessive fuel consumption.	2-11
12.	Excessive exhaust smoke at idle, and under load	2-11
13.	Engine fails to stop	2-11
14.	Engine misses	2-11
15.	Low power —loss of power.	2-12
16.	Engine overspends	2-12
17.	Engine lubricating oil diluted by fuel	2-12
18.	Engine fuel knocks	2-12
COOLING SYSTEM		
19.	Engine overheats	2-12
20.	Loss of coolant	2-12
TRANSMISSION		
21.	Transmission shifts occur at too high a speed	2-13
22.	Transmission shifts occur at too low a speed	2-13
23.	Low main operating pressure, at all shift ranges	2-13
24.	Clutch slippage in all forward and/or reverse gears	2-13
25.	Excessive vehicle creep (first and reverse)	2-13
26.	Vehicle moves in neutral	2-13
27.	No response to shift lever movement	2-13
28.	Oil thrown out of filler tube	2-14
29.	Oil leaking into converter housing	2-14
30.	Rough shifting	2-14
31.	Transmission overheating in all ranges	2-14
32.	Transmission oil dirty, foamy, and/or milky	2-14
33.	Oil leak at output shaft	2-15
TRANSFER CASE		
34.	Transfer case will not shift into gear	2-15
35.	Transfer case will not stay in gear	2-15
36.	Excessive noise during operation	2-15
37.	Lubricant leaks	2-15

MECHANICAL TROUBLESHOOTING SYMPTOM INDEX (Cont'd)

MALFUNCTION NO.	MALFUNCTION	TROUBLESHOOTING PROCEDURE PAGE
AIR COMPRESSOR		
38.	Low air pressure (no air leaks, governor properly adjusted and operative)	2-15
39.	Air compressor passes excessive oil (excessive oil bled from air reservoirs)	2-16
40.	Air compressor does not unload (air governor adjusted and operative)	2-16
41.	Compressor head leaking water.	2-16
STEERING		
42.	Steering wheel hard to turn	2-16
43.	Excessive power steering pump noise	2-16
44.	Oil leaking from steering pump.	2-16
45.	Steering gear leaking oil	2-17
46.	Excessive play at steering wheel.	2-17
FRONT/REAR AXLES		
47.	Excessive play (backlash)	2-17
48.	Excessive noise	2-17
49.	Lubricant leaking	2-17
DUMP BODY (M929 AND M930)		
50.	Dump body raises to full dump position but does not power down	2-18
51.	Dump body does not hold in raised position	2-18
52.	Hoist assembly does not raise dump body	2-18
MEDIUM WRECKER CRANE (M936)		
53.	Crane boom fails to swing (other systems operate satisfactorily)	2-18
54.	Crane swings erratically (other systems operate satisfactorily)	2-18
55.	Boom fails to extend or retract (other systems operate satisfactorily).. . . .	2-19
56.	Boom extends or retracts sluggishly (other systems operate satisfactorily)	2-19
57.	Hoist winch drum fails to rotate, operates too slowly, or operates erratically (other systems operate satisfactorily)	2-19
58.	Boom fails to raise or raises and lowers sluggishly (other systems operate satisfactorily)	2-19
POWER TAKEOFF		
59.	Noisy power takeoff	2-19
60.	Power takeoff slips out of gear	2-20
61.	Lubricant leaking	2-20

Table 2-1. Mechanical Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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ENGINE**1. ENGINE WILL NOT CRANK**

- Step 1. Check for mechanical or hydraulic seizure. Remove fuel injectors before attempting crankshaft rotation test (para. 4-27).
- Try to rotate crankshaft manually using engine barring tool.
 - If crankshaft will not rotate, go to step 2.
 - If crankshaft rotates and liquid is discharged, check if liquid is coolant or fuel.
 - If liquid is coolant, replace cylinder heads (para. 3-20).
 - If liquid is fuel, replace fuel injectors (para. 4-27).
- Step 2. Engine must be inspected for extent of internal damage.
Replace engine (para. 3-24).

END OF TESTING!

2. ENGINE CRANKS, FAILS TO START

- Step 1. Check for defective fuel pump shutoff valves,
Remove, inspect, and replace if necessary with new fuel pump shutoff valves (para. 4-5).
- Step 2. Check for broken fuel supply pump drive shaft.
- Remove tachometer cable from fuel pump (TM 9-2320-272-20-1), crank engine, and observe if drive shaft end in pump housing is rotating.
 - If drive shaft does not rotate, replace fuel pump (para. 4-4).
- Step 3. Check for incorrect fuel injector and valve adjustments (para. 3-105 or 3-106).
- Step 4. Check for possible dirty or damaged fuel injectors.
Remove, inspect, and replace if necessary with new fuel injectors (para. 4-27).
- Step 5. Adjust valve and injector clearances (para. 3-105 or 3-106).
- Step 6. Replace fuel pump (para. 4-4).

END OF TESTING!

3. ENGINE STARTER MOTOR OPERATES, DOES NOT ENGAGE FLYWHEEL RING GEAR

- Step 1. Check for defective flywheel ring gear teeth.
- Remove starter motor (TM 9-2320-272-20-1).
 - Using engine barring tool, turn engine and inspect flywheel ring gear teeth through starter motor opening in engine block.
- Step 2. Remove transmission (para. 7-11) and replace defective flywheel ring gear and plate (paras. 3-59 and 3-94).

END OF TESTING!

4. ENGINE STOPS

- Step 1. If no engine overheating is evident, go to malfunction 1. If engine has overheated, go to step 2.
- Step 2. Check cooling system.
- Check for defective radiator fan clutch drive (TM 9-2320-272-10).
 - Install fan clutch override bolt (TM 9-2320-272-10) and start engine.

Table 2-1, Mechanical Troubleshooting (Cont'd)

MALFUNCTION	TEST OR INSPECTION	
		CORRECTIVE ACTION

- c. If engine starts and overheats, replace water pump (para. 5-7).
- d. If engine does not start, see malfunction 2.

END OF TESTING!

5. LOW OIL PRESSURE

Step 1, Check engine oil pressure with pressure gage.

- a. If pump pressure is low, replace oil pump (para. 3-44).
- b. If pump pressure is correct at oil pump, camshaft and crankshaft bearings are worn.

Step 2. Replace engine (para. 3-24).

END OF TESTING!

6. ENGINE KNOCKS (MECHANICAL NOISE)

Replace engine (para. 3-24).

END OF TESTING!

7. EXCESSIVE OIL CONSUMPTION

Step 1. Check for external oil leakage at:

- a. Oil pan.
- b. Oil pump.
- c. Engine oil cooler.
- d. Front gearcase cover.

If leakage is found, repair as necessary (para. 3-45).

Step 2. Replace engine (para. 3-24).

END OF TESTING!

8. EXCESSIVE ENGINE VIBRATION

Step 1. Check for loose vibration damper (para. 3-9).

Step 2. Check for loose flywheel (paras. 3-59 and 3-94).

Step 3. Check fuel injector operation and adjustment (para. 3-105 or 3-106).

END OF TESTING!

9. EXCESSIVE GEAR NOISE

Replace engine (para. 3-24).

END OF TESTING!

Table 2-1. Mechanical Troubleshooting(Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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FUEL SYSTEM**10. ENGINE IDLE – ROUGH, ERRATIC**

Check for incorrect injector and valve adjustments.

Adjust injectors and/or valves (para. 3-105 or 3- 106).

Replace injectors (para. 4-27).

If rough idle continues, replace fuel pump (para. 4-4).

END OF TESTING!

11. EXCESSIVE FUEL CONSUMPTION

Adjust fuel injectors (para. 3-105 or 3- 106).

Replace fuel injectors (para, 4-27).

END OF TESTING!

12. EXCESSIVE EXHAUST SMOKE AT IDLE, AND UNDER LOAD

Step 1. Check for incorrect fuel injector and valve adjustment.

Adjust if necessary (para. 3-105 or 3-106).

Step 2. Check for possible dirty or damaged fuel injectors. Remove, inspect, and replace, if necessary, with new fuel injectors (para. 4-27).

Step 3. Replace fuel pump (para. 4-4).

If malfunction is not corrected, go to step 4.

Step 4. Check cylinder heads.

a. Remove cylinder heads (para. 3-20) and check for:

1). Cylinder head warpage (para. 3-53).

2). Faulty gaskets (para. 3-53).

3). Burned valves (para. 3-53).

b. While cylinder heads are removed, check cylinder liners and pistons for:

1). Worn or scored cylinder liners.

2). Broken piston rings.

END OF TESTING!

13. ENGINE FAILS TO STOP

Step 1. Check fuel shutoff valve and solenoid.

Step 2. Replace defective fuel shutoff valve (para. 4-5).

END OF TESTING!

14. ENGINE MISSES

Step 1. Check fuel injectors (see malfunction 12).

If malfunction is not corrected, go to step 2.

Step 2. Check for improper valve seating, burned valves (para. 3-53).

END OF TESTING!

Table 2-1. Mechanical Troubleshooting (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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15. LOW POWER – LOSS OF POWER

- Step 1. Check for incorrect fuel injector and valve adjustments, adjust if necessary (para. 3-105 or 3-106).
- Step 2. Check fuel injectors (see malfunction 11).
If malfunction is not corrected, go to step 3.
- Step 3. Replace fuel pump with calibrated replacement unit (para. 4-4).
If malfunction is not corrected, go to step 4.
- Step 4. Check cylinder heads (see malfunction 12, step 4).
END OF TESTING!

16. ENGINE OVERSPEEDS

- Replace fuel pump with calibrated replacement unit (para. 4-4).
END OF TESTING!

17. ENGINE LUBRICATING OIL DILUTED BY FUEL

- See malfunction 11.
END OF TESTING!

18. ENGINE FUEL KNOCKS

- Step 1. Check valve and injector timing (para. 3-105 or 3-106).
- Step 2. See malfunction 11.
END OF TESTING!

COOLING SYSTEM

19. ENGINE OVERHEATS

- Step 1. Check cooling fan air drive actuator.
Replace air drive actuator (TM 9-2320-272-20-1).
- Step 2. Check water pump for wear or damage.
Replace water pump (para. 5-7).
END OF TESTING!

20. LOSS OF COOLANT

- Step 1. Check cylinder heads for defective gaskets and/or cracked heads.
- Step 2. Remove and replace cylinder heads (para. 3-53).
END OF TESTING!

Table 2-1. Mechanical Troubleshooting(Cont'd)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
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TRANSMISSION**21. TRANSMISSION SHIFTS OCCUR AT TOO HIGH A SPEED**

- Step 1. Check governor pressure (para. 7-62),
If malfunction not corrected, go to step 2.
- Step 2. Adjust modulator mechanical linkage (TM 9-2320-272-20-1).
If malfunction is not corrected, replace transmission (para. 7-11).
- END OF TESTING!

22. TRANSMISSION SHIFTS OCCUR AT TOO LOW A SPEED

- See malfunction 21, steps 1 and 2.
- END OF TESTING!

23. LOW MAIN OPERATING PRESSURE, AT ALL SHIFT RANGES

- Step 1. Check transmission oil level (TM 9-2320-272-10).
- Step 2. Check if oil filter element is clogged (TM 9-2320-272-20-1).
- Step 3. Perform transmission pressure tests (para. 7-62).
- Step 4. If pressure is still low, replace transmission (para. 7-11).
- END OF TESTING!

24. CLUTCH SLIPPAGE IN ALL FORWARD AND/OR REVERSE GEARS

- Replace transmission (para. 7-11).
- END OF TESTING!

25. EXCESSIVE VEHICLE CREEP (FIRST AND REVERSE)

- Check and adjust idle setting at throttle linkage (TM 9-2320-272-20-1).
- END OF TESTING!

26. VEHICLE MOVES IN NEUTRAL

- Check shift range selector (para. 7-3).
- Adjust shift selector linkage (para. 7-3).
 - Replace transmission (para. 7-11) if malfunction continues.
- END OF TESTING!

27. NO RESPONSE TO SHIFT LEVER MOVEMENT

- Check if shift linkage is disconnected or broken (para. 7-4).
- If linkage is normal, replace transmission (para. 7-11).
- END OF TESTING!

Table 2-1. Mechanical Troubleshooting (Cont'd)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

28. OIL THROWN OUT OF FILLER TUBE

- Step 1. Check filler cap (dipstick) fit, replace if necessary.
- Step 2. Check if transmission oil level is too high, Drain to proper level (LO 9-2320-272-12).
- Step 3. Check and clean breather vent (para. 7-36).

END OF TESTING!

29. OIL LEAKING INTO CONVERTER HOUSING

- Check if rear engine crankshaft seal is leaking (para. 3-61).
- If engine crankshaft seal is not leaking, replace transmission (para. 7-11).

END OF TESTING!

30. ROUGH SHIFTING

- Step 1. Check manual selector adjustment (para. 7-3).
- Step 2. Check if modulator is sticking (para. 7-63).
 - a. Replace modulator if necessary (TM 9-2320-272-20-1).
 - b. Check if modulator actuator cable is kinked or out of adjustment (TM 9-2320-272-20-1).

END OF TESTING!

31. TRANSMISSION OVERHEATING IN ALL RANGES

- Step 1. Check oil level (TM 9-2320-272-10).
 - a. If low, add oil to bring to proper level (LO 9-2320-272-12).
 - b. If high, drain oil to bring to proper level (LO 9-2320-272-12).
- Step 2. Check oil lines to oil cooler.

END OF TESTING!

32. TRANSMISSION OIL DIRTY, FOAMY, AND/OR MILKY

NOTE

Dirt/grit in transmission oil indicates oil needs changing (step 1).
Foaminess indicates contamination of oil by air (step 2). Milkyness indicates contamination of oil by coolant (step 3).

- Step 1. Inspect oil for dirt/grit.
 - a. Perform transmission oil service instructions (TM 9-2320-272-20-1).
 - b. Inspect all external transmission fittings for looseness.
 - c. Replace transmission (para. 7-11).
- Step 2. Inspect for excessive foaming.
 - a. Ensure transmission has proper oil level (LO 9-2320-272-12).
 - b. If foaming continues, remove and replace transmission oil filter (TM 9-2320-272-20-1).
- Step 3. Inspect for milkyiness in oil. Replace oil cooler (TM 9-2320-272-20-1).

END OF TESTING!

Table 2-1. Mechanical Troubleshooting (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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33. OIL LEAK AT OUTPUT SHAFT

Check oil seal at output shaft flange for wear or damage (para. 7-7).

Replace seal and output shaft flange if worn or damaged (para. 7-7).

END OF TESTING!

TRANSFER CASE**34. TRANSFER CASE WILL NOT SHIFT INTO GEAR**

Step 1. Check shift linkage adjustment (para. 8-10). Adjust if necessary (para. 8-10).

Step 2. Check for bent, broken, or disconnected mechanical shift linkage (para. 8-10).

Repair or replace linkage (para. 8-10).

Step 3. If malfunction continues replace transfer assembly (para. 8-18).

END OF TESTING!

35. TRANSFER CASE WILL NOT STAY IN GEAR

Step 1. Check linkage adjustment (para. 8-10).

Step 2. Check interlock air cylinder (para. 8-6).

Step 3. Check for worn or damaged internal components (para. 8-20).

Step 4. Replace transfer assembly (para. 8-18).

END OF TESTING!

36. EXCESSIVE NOISE DURING OPERATION

Replace transfer assembly (para. 8-18),

END OF TESTING!

37. LUBRICANT LEAKS

Step 1. Check for defective seals or gaskets (paras. 8-17 and 8-20).

Step 2. Check for cracked transfer case.

Step 3. Replace transfer assembly (para. 8-18).

END OF TESTING!

AIR COMPRESSOR**38. LOW AIR PRESSURE (NO AIR LEAKS, GOVERNOR PROPERLY ADJUSTED AND OPERATIVE)**

Step 1. Remove unloader valve and unloader valve spring from compressor and inspect for wear and damage (para. 10-4).

Step 2. Replace worn or damaged unloader valve spring (para. 10-4).

Step 3. If air pressure is still low, replace air compressor (para. 10-5).

END OF TESTING!

Table 2-1. Mechanical Troubleshooting (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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39. AIR COMPRESSOR PASSES EXCESSIVE OIL (EXCESSIVE OIL BLED FROM AIR RESERVOIRS)

Slowly bleed and check reservoirs for evidence of oil (TM 9-2320-272-10).

If air tanks bleed oil, replace compressor (para. 10-5).

END OF TESTING!

40. AIR COMPRESSOR DOES NOT UNLOAD (AIR GOVERNOR ADJUSTED AND OPERATIVE)

Step 1. Check unloader valve and unloader valve spring for wear and defects.

Step 2. Replace worn or damaged unloader valve or spring (para. 10-4).

END OF TESTING!

41. COMPRESSOR HEAD LEAKING WATER

Step 1. Make sure screws securing head are at proper torque.

a. Tighten screws to proper torque (para. 10-4).

b. If head is still leaking water, go to step 2.

Step 2. Check head and head cover for cracks.

a. Replace head or head cover if cracked (para. 10-4).

b. If head still leaks, go to step 3.

Step 3. Check to make sure head fittings are correctly installed.

Install fittings correctly (para. 10-4).

END OF TESTING!

STEERING**42. STEERING WHEEL HARD TO TURN**

Step 1. Check steering pump pressure with gage (para. 11-13).

If pump pressure is abnormal, replace pump (TM 9-2320-272-20-1).

Step 2. Check for broken piston or piston rings in power steering assist cylinder.

a. Replace broken piston or piston rings (para. 11-11).

b. If steering wheel is still hard to turn, go to step 3.

Step 3. Check front axle for security of mounting (para. 9-6).

END OF TESTING!

43. EXCESSIVE POWER STEERING PUMP NOISE

Replace defective pump (TM 9-2320-272-20- 1).

END OF TESTING!

44. OIL LEAKING FROM STEERING PUMP

Step 1. Check outlet fitting and reservoir "O" rings for defects (TM 9-2320-272-20-1).

Step 2. Replace defective seals (TM 9-2320-272-20-1).

END OF TESTING!

Table 2-1. Mechanical Troubleshooting (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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45. STEERING GEAR LEAKING OIL

Step 1. Check steering gear seals for wear (para. 11-10).

Step 2. Replace worn steering gear seals (para. 11-10).

END OF TESTING!

46. EXCESSIVE PLAY AT STEERING WHEEL

Step 1. Check steering gear for loose mounting.

a. Tighten loose mounting bolts.

b. If lost motion persists, go to step 2.

Step 2. Check steering gear adjustment.

a. Adjust gear (para. 11-14).

b. If excessive play persists, replace steering gear (para. 11-9).

END OF TESTING!

FRONT/REAR AXLES

47. EXCESSIVE PLAY (BACKLASH)

Replace differential carrier assembly (para. 9-7 or 9-12).

END OF TESTING!

48. EXCESSIVE NOISE

Replace differential carrier assembly (para. 9-7 or 9-1 2).

END OF TESTING!

49. LUBRICANT LEAKING

Step 1. Check for worn seals.

If worn, replace seals (para. 9-14 or 9-1 5).

Step 2. Check for cracked differential housing.

Replace differential assembly (para. 9-7 or 9- 12).

END OF TESTING!

Table 2-1. Mechanical Troubleshooting (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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DUMP BODY (M929 and M930)

50. DUMP BODY RAISES TO FULL DUMP POSITION BUT DOES NOT POWER DOWN

Step 1. Check control linkage adjustment.

- a. Adjust improperly adjusted linkage (para. 16-11).
- b. If linkage is not at fault, go to step 2,

Step 2. Check for hydraulic system leaks.

- a. Tighten. If leakage persists, replace gaskets (para. 16-6).
- b. If no leaks exist, replace control valve (para. 16-14).

END OF TESTING!

51. DUMP BODY DOES NOT HOLD IN RAISED POSITION

Step 1. Check for hydraulic system leaks.

- a. **Tighten.** Replace leaking components and gaskets (paras. 16-6, 16-10, 16-13 and 16-14).
- b. If no leaks exist, go to step 2.

Step 2. Check control linkage adjustment.

- a. Adjust improperly adjusted linkage (para. 16-11).
- b. When adjustment is satisfactory, replace control valve (para. 16-14).

END OF TESTING!

52. HOIST ASSEMBLY DOES NOT RAISE DUMP BODY

Inspect for leaks in hydraulic system.

Replace leaking components (paras. 16-6, 16-10, 16-13 and 16-14).

END OF TESTING!

MEDIUM WRECKER CRANE (M936)

53. CRANE BOOM FAILS TO SWING (OTHER SYSTEMS OPERATE SATISFACTORILY)

Perform pressure check (TM 9-2320-272-20-2).

- a. If pressure is not sufficient, replace control valve (para. 18-20).
- b. If pressure is sufficient, replace swing motor (para. 18-18).

END OF TESTING!

54. CRANE SWINGS ERRATICALLY (OTHER SYSTEMS OPERATE SATISFACTORILY)

Perform pressure check (TM 9-2320-272-20-2).

- a. If pressure is erratic, replace control valve (para. 18-20).
- b. If pressure is sufficient and constant, replace swing motor (para. 18-18).

END OF TESTING!

Table 2-1. Mechanical Troubleshooting (Cont'd)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

55. BOOM FAILS TO EXTEND OR RETRACT (OTHER SYSTEMS OPERATE SATISFACTORILY)

Perform pressure check (TM 9-2320-272-20-2).

- a. If pressure is sufficient, replace extension cylinder (para. 18-14).
- b. If pressure is not sufficient, replace control valve (para. 18-20).

END OF TESTING!

56. BOOM EXTENDS OR RETRACTS SLUGGISHLY (OTHER SYSTEMS OPERATE SATISFACTORILY)

Perform pressure check (TM9-2320-272-20-2).

- a. If pressure is sufficient, replace extension cylinder (para. 18-14).
- b. If pressure is not sufficient, replace crane control valve (para. 18-20).

END OF TESTING!

57. HOIST WINCH DRUM FAILS TO ROTATE, OPERATES TOO SLOWLY, OR OPERATES ERRATICALLY (OTHER SYSTEMS OPERATE SATISFACTORILY)

Perform pressure check (TM 9-2320-272-20-2).

- a. If pressure is low, replace control valve (para. 18-24).
- b. If pressure is sufficient, replace hoist motor (para. 18-7).

END OF TESTING!

58. BOOM FAILS TO RAISE OR RAISES AND LOWERS SLUGGISHLY (OTHER SYSTEMS OPERATE SATISFACTORILY)

Step 1. Perform pressure check (TM9-2320-272-20-2).

- a. If pressure is low, repair or replace control valve (para. 18-24).
- b. If pressure is sufficient, go to step 2.

Step 2. Determine if one or both elevating cylinders are defective by disconnecting elevating cylinders from boom (para. 18-10) and raising boom with suitable lifting device. Operate control valve and determine if one or both elevating cylinders are defective.

Replace defective elevating cylinders (para. 18-10).

END OF TESTING!

POWER TAKEOFF**59. NOISY POWER TAKEOFF**

Step 1. Replace defective gears or hearings.

- a. If transfer power takeoff (para. 20-7).
- b. If transmission power takeoff (para. 20-11).

Step 2. Replace worm shafts.

- a. If transfer power takeoff (para. 20-7).
- b. If transmission power takeoff (para. 20-11).

END OF TESTING!

Table 2-1. Mechanical Troubleshooting (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

60. POWER TAKEOFF SLIPS OUT OF GEAR

Step 1, Adjust shift linkage.

- a. If transfer power takeoff (paras. 20-4 and 20-5).
- b. If transmission power takeoff (para. 20-9).

Step 2. If malfunction continues, replace poppet springs.

- a. If transfer power takeoff (para. 20-7).
- b. If transmission power takeoff, replace power takeoff (para. 20-10).

END OF TESTING!

61. LUBRICANT LEAKING

Check for defective gaskets and seals.

Replace defective gaskets or seals.

- a. If transfer power takeoff (para. 20-7).
- b. If transmission power takeoff (para. 20-11).

END OF TESTING!

CHAPTER 3

ENGINE MAINTENANCE

NOTE

Refer to TM 9-2320-358-24&P for unique M939A2 maintenance procedures.

Section I. DESCRIPTION AND DATA

3-1. GENERAL

This section provides description and data for the Cummins NHC-250 diesel engine and its accessories. Description and data for the air compressor, fuel pump, starter, and alternator, which are engine components, can be found in separate chapters of this manual.

3-2. DESCRIPTION - ENGINE

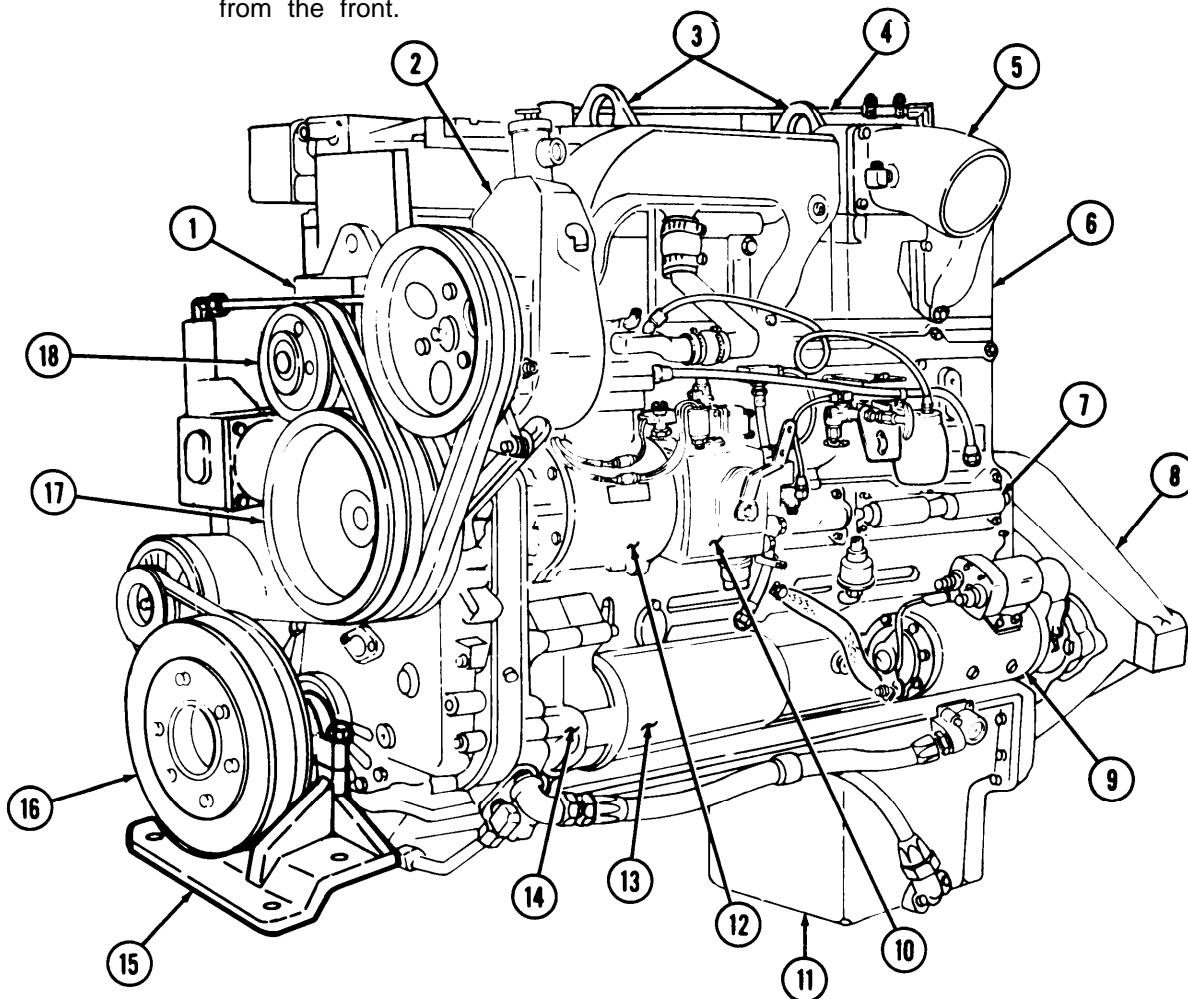
a. The Cummins NHC-250 diesel engine is used on all M939 series vehicles. It is a naturally-aspirated, liquid cooled, overhead valve, four-cycle engine of in-line six-cylinder design. The NHC-250 engine has a compression ratio of 15.8 to 1, and develops 240 horsepower at 2100 rpm. Peak torque is 685 lb-ft.

b. Both early, before serial number 1124663, and late model engines are covered in this chapter. The difference between the two is that the late model engine utilizes a new clean air configuration. The clean air configuration provides for controlled engine exhaust gas recirculation back to the air intake manifold. The engine also uses top-stop fuel injectors to direct fuel to cylinders. All other engine components remain the same.

Left and right views of the NHC-250 engine and its components are shown. Identification can be made from the engine identification plate located on the upper left side of the front engine cover. For additional engine data, see table 3-1.

NOTE

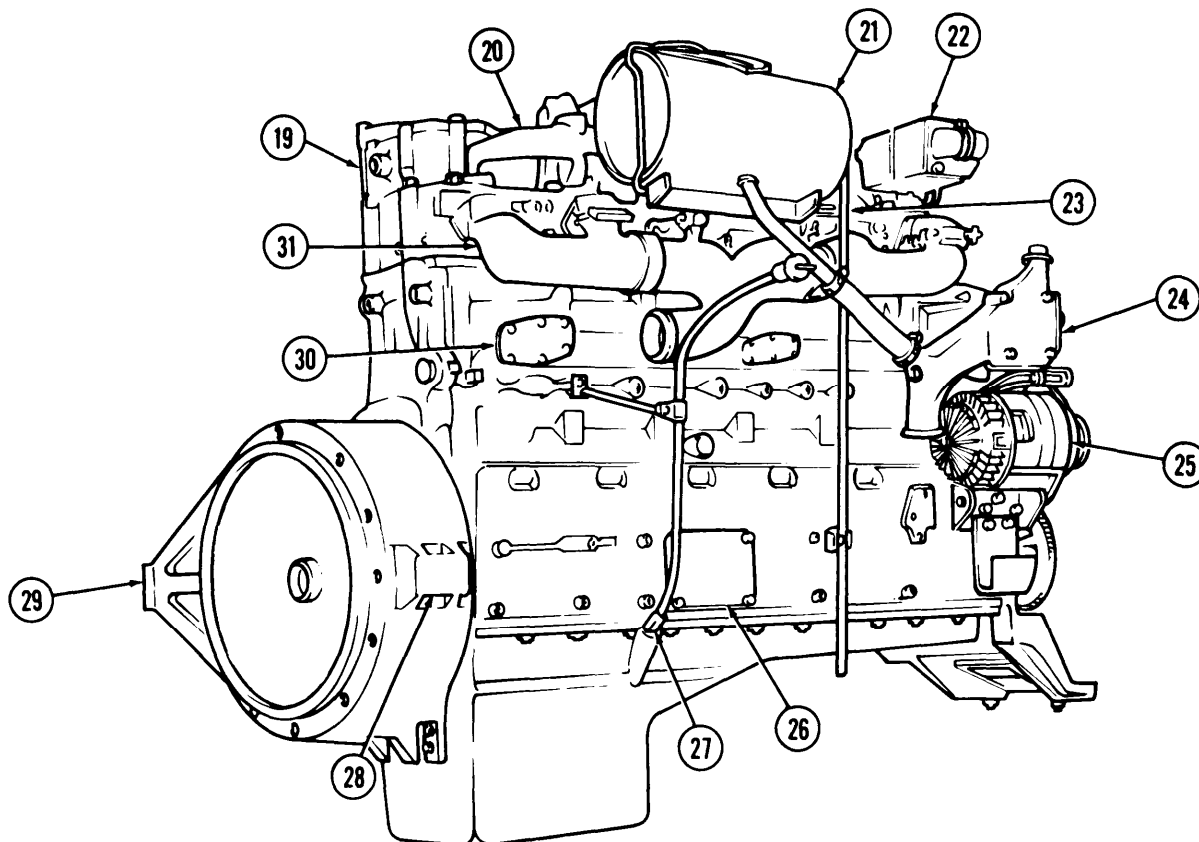
Engine exterior components and accessories are identified along with the word "front" and "flywheel" or "rear" as referred to in the manual. Below is a 3/4 view of the left side of the engine as viewed from the front.



- | | |
|---|----------------------------|
| 1. Water Pump | 10. Fuel Pump |
| 2. Power Steering Pump and Reservoir | 11. Oil Pan |
| 3. Engine Lift Eyes | 12. Air Compressor |
| 4. Crankcase Breather Tube
(Late Model Engine) | 13. Oil Filter |
| 5. Air Intake Manifold | 14. Oil Pump |
| 6. Cylinder Head | 15. Front Trunnion Mount |
| 7. Cam Follower Housing | 16. Vibration Damper |
| 8. Flywheel Housing | 17. Accessory Drive Pulley |
| 9. Starter Motor | 18. Fan Clutch |

NOTE

This is a 3/4 view of the right side of the engine as viewed from the "flywheel end" or "rear end".



- 19. Rocker Lever Housing
- 20. Water Manifold
- 21. Surge Tank
- 22. Thermostat Housing
- 23. Crankcase Breather Tube
(Early Model Engine)
- 24. Engine Oil Cooler

- 25. Alternator
- 26. Access Cover Plate
- 27. Oil Gage (Dipstick) and Tube
- 28. Right Rear Engine Mount
- 29. Left Rear Engine Mount
- 30. Water Header Cover Plate
- 31. Exhaust Manifold

Table 3-1. Engine Tabulated Data.

1. ENGINE

Make	Cummins
Model . . . . .	.NHC-250
Type	Four-cycle diesel, valve in-head, in-line, compression ignition
Weight (dry)	25101b(1139kg)
Number of cylinders	6
Type of cylinders	Wet (replaceable sleeve)

ENGINE (Cont'd)

Bore and stroke	5.5 x 6 in. (140 x 152 mm)
Displacement	855 cu. in. (14 l)
Maximum gross brake horsepower	240 @ 2100 rpm
Compression ratio	15.8 to 1
Number of pistons	6
Number of rings per piston	4 (3 compression, 1 oil)
Crankshaft rotation	Clockwise (viewed from front)
Firing order	1-5-3 -6-2-4
Normal oil pressure	15 - 70 psi (103 -483 kPa}
Normal oil temperature	180° - 225°F (82° - 107°C)
Normal coolant temperature	175° - 195°F (79° - 90°C)

2. VALVES

Number	
Intake	12
Exhaust	12
Type	Poppet
Type of guides	Removable

3. OIL PUMP

Make	Cummins
Type	Gear-type,double lubricated
Driven by	Crankshaft
Capacity	19 gpm (72 lpm) @ 2100 rpm (approx.)

4. WATER PUMP

Make	Cummins
Type	Gear type,twostage
Driven by	Crankshaft
Capacity	19 gpm (72 lpm) @ 2100 rpm (approx.)

5. CRANKCASE BREATHER

Make	Cummins
Type	Replaceable

6. OIL FILTER

Make	Cummins
Type	Replaceable element

Section II. GENERAL ENGINE MAINTENANCE

3-3. GENERAL MAINTENANCE INSTRUCTIONS

- a. Physically check all tags and forms attached to the equipment to determine the reason for its removal from service; check that all Technical Bulletins (TB) and Modification Work Orders (MWO) have been accomplished.
- b. Check the overall condition of the vehicle and/or engine before starting repairs.
- c. As components and accessories are removed, note clearances and fits. Record these to serve as a guide in the repair and replacement.
- d. Disassemble the equipment. Inspect and evaluate each defective component to determine extent of disassembly/repair needed to bring the equipment to the standards specified in this manual.
- e. Refer to paragraphs 2-7, 2-8, 2-9, and 2-10 for general cleaning, inspection, repair, and assembly instructions.

Section III. ENGINE (IN VEHICLE) MAINTENANCE

3-4. ENGINE (IN VEHICLE) MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
3-5.	Engine Access Cover Replacement	3-6
3-6.	Water Header Plates Replacement	3-8
3-7.	Exhaust Manifold Replacement	3-10
3-8.	Engine Oil Cooler Maintenance	3-14
3-9.	Vibration Damper Replacement	3-20
3-10.	Crankshaft Flange Replacement	3-24
3-11.	Engine Accessory Drive Pulley Replacement	3-28
3-12.	Engine Accessory Drive Maintenance	3-30
3-13.	Engine Intake Manifold Maintenance	3-38
3-14.	Engine Fuel Supply and Return Tubes Replacement	3-44
3-15.	Engine Lift Eyes Replacement	3-50
3-16.	Rocker Lever Housing Covers Replacement	3-52
3-17.	Rocker Lever Housings and Push Tubes Maintenance	3-56
3-18.	Valve Crossheads Replacement	3-68
3-19.	Fuel Crossover Connectors Replacement	3-72
3-20.	Engine Cylinder Heads Replacement	3-74
3-21.	Cam Follower Housing Maintenance	3-78
3-22.	Engine Oil Pan Maintenance	3-92

3-5. ENGINE ACCESS COVER REPLACEMENT

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10	Parking brake set.
	TM 9-2320-272-10	Right splash shield removed.
	LO 9-2320-272-12	Engine oil drained.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Engine access cover gasket		
Four lockwashers		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-34P		
LO 9-2320-272-12		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

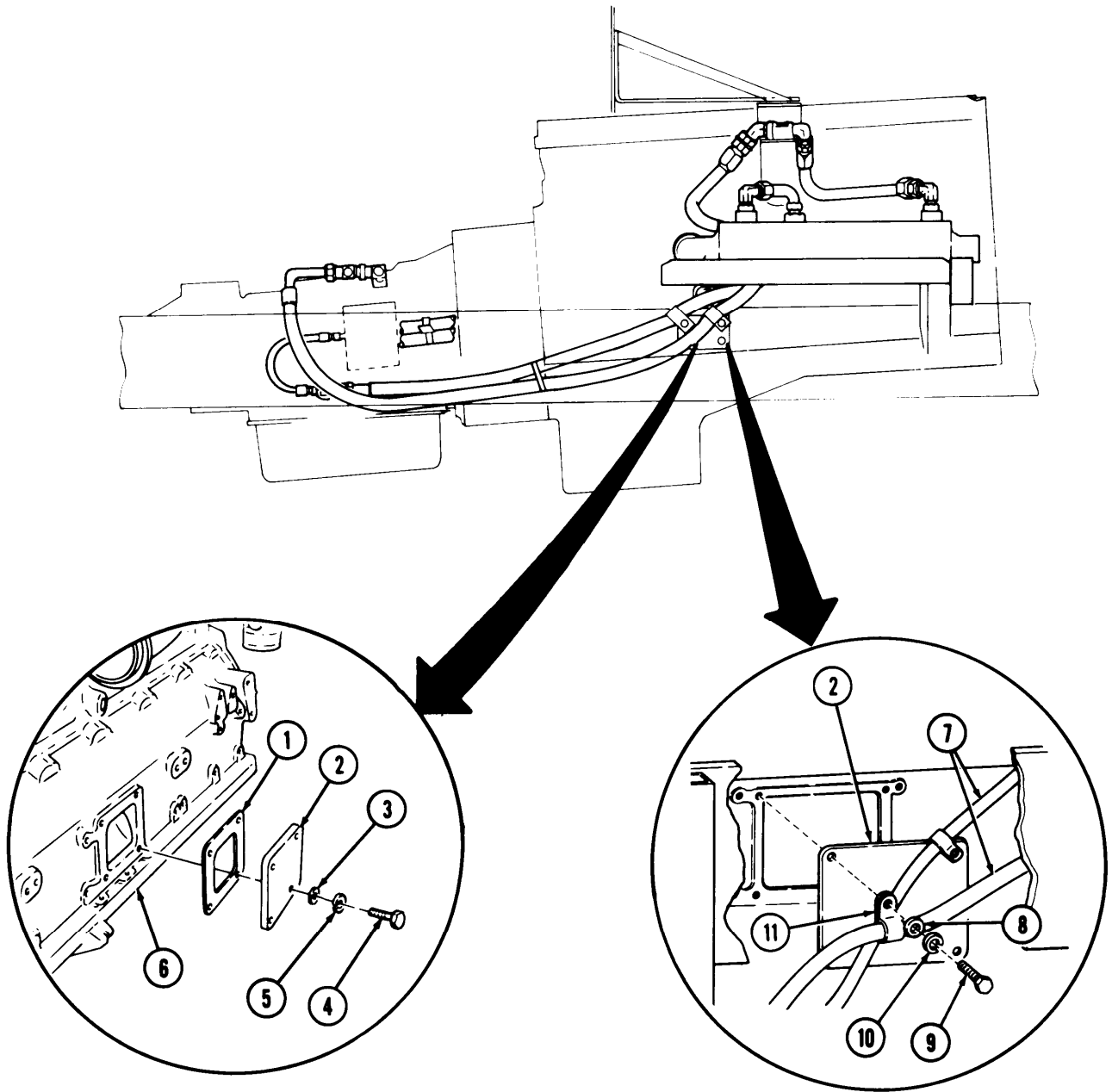
1. Engine access cover (2)	Two screws (9), lockwashers (10), washers (8), and clamps (11)	Remove and move transmission cooler lines (7) to one side.	Discard lockwashers (10).
2. Cylinder block (6)	Two screws (4), lockwashers (5), and washers (3), engine access cover (2), and gasket (1)	Remove.	Discard lockwashers (5) and gasket (1).

b. Installation

3.	New gasket (1) and engine access cover (2)	Install on cylinder block (6) with two washers (3), new lockwashers (5), and screws (4).	
4 .	Transmission cooler lines (7)	Install on access cover (2) with two clamps (11), washers (8), new lockwashers (10), and screws (9).	

3-5. ENGINE ACCESS COVER REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS:

- Install right splash shield (TM 9-2320-272-10).
- Fill engine to proper oil level (LO 9-2320-272-12).

3-6. WATER HEADER PLATES REPLACEMENT

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10 TM 9-2320-272 -20-1	Parking brake set. Cooling system drained.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Two gaskets Twelve lockwashers		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272 -20-1 TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Water header plates are mounted with screw-assembled lockwashers on late model engines.

a. Removal

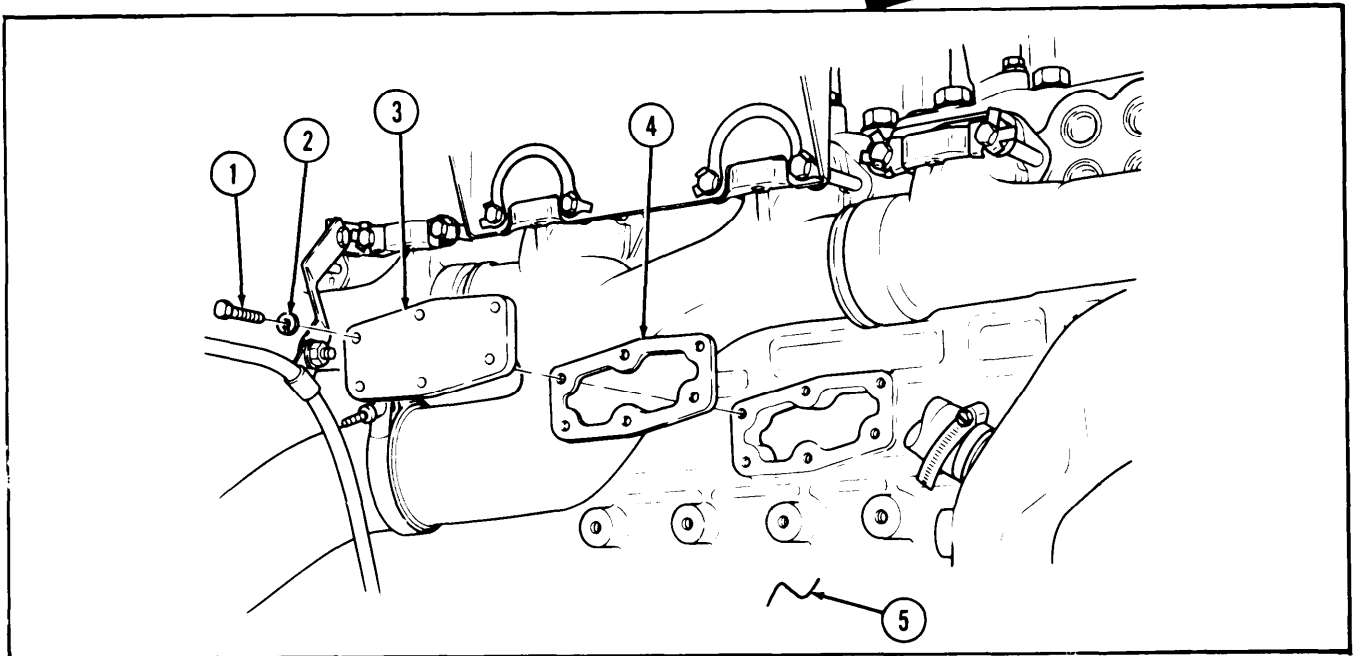
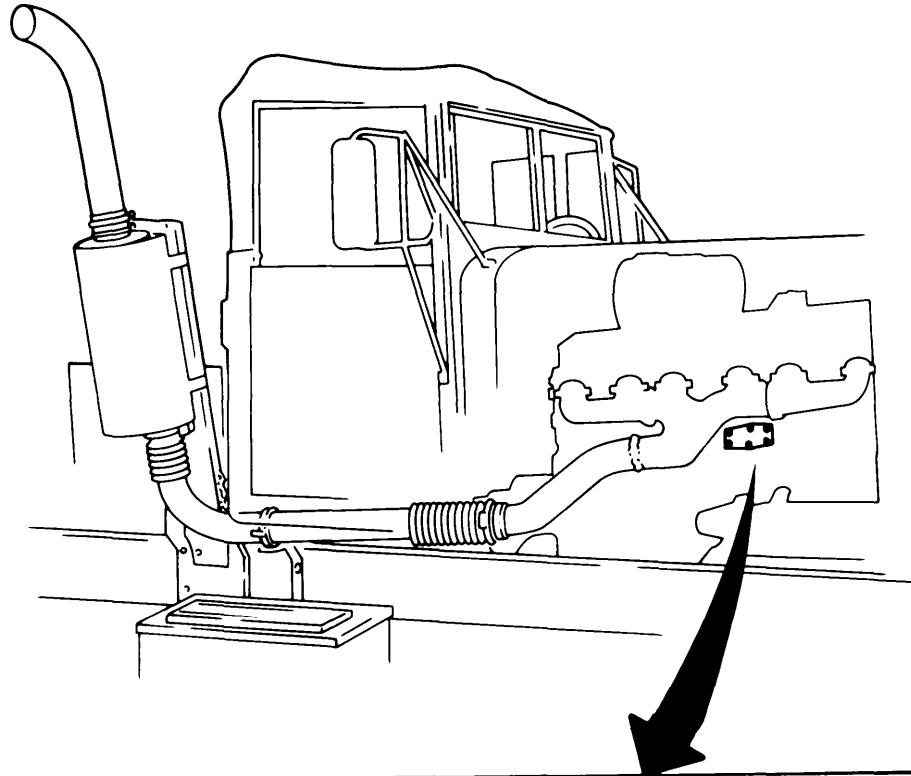
1. Cylinder block (5)	Twelve screws (1) and lockwashers (2), two water header plates (3) and gaskets (4)	Remove.	Discard gaskets (4) and lockwashers (2). Clean gasket remains from mating surfaces.
-----------------------	--	---------	---

b. Installation

2.	Two water header plates (3) and two new gaskets (4)	Install on cylinder block (5) with twelve new lockwashers (2) and screws (1).	
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3-6. WATER HEADER PLATES REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Fill cooling system to proper level (TM 9-2320-272-20-1).

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3-7. EXHAUST MANIFOLD REPLACEMENT

This task covers:

a. Removal

b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10 TM 9-2320-272 -20-1 TM 9-2320-272 -20-1	Parking brake set. Crankcase breather tube and mounting bracket removed. Surge tank removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Locknut Eight locktabs Seven gaskets		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272 -20-1 TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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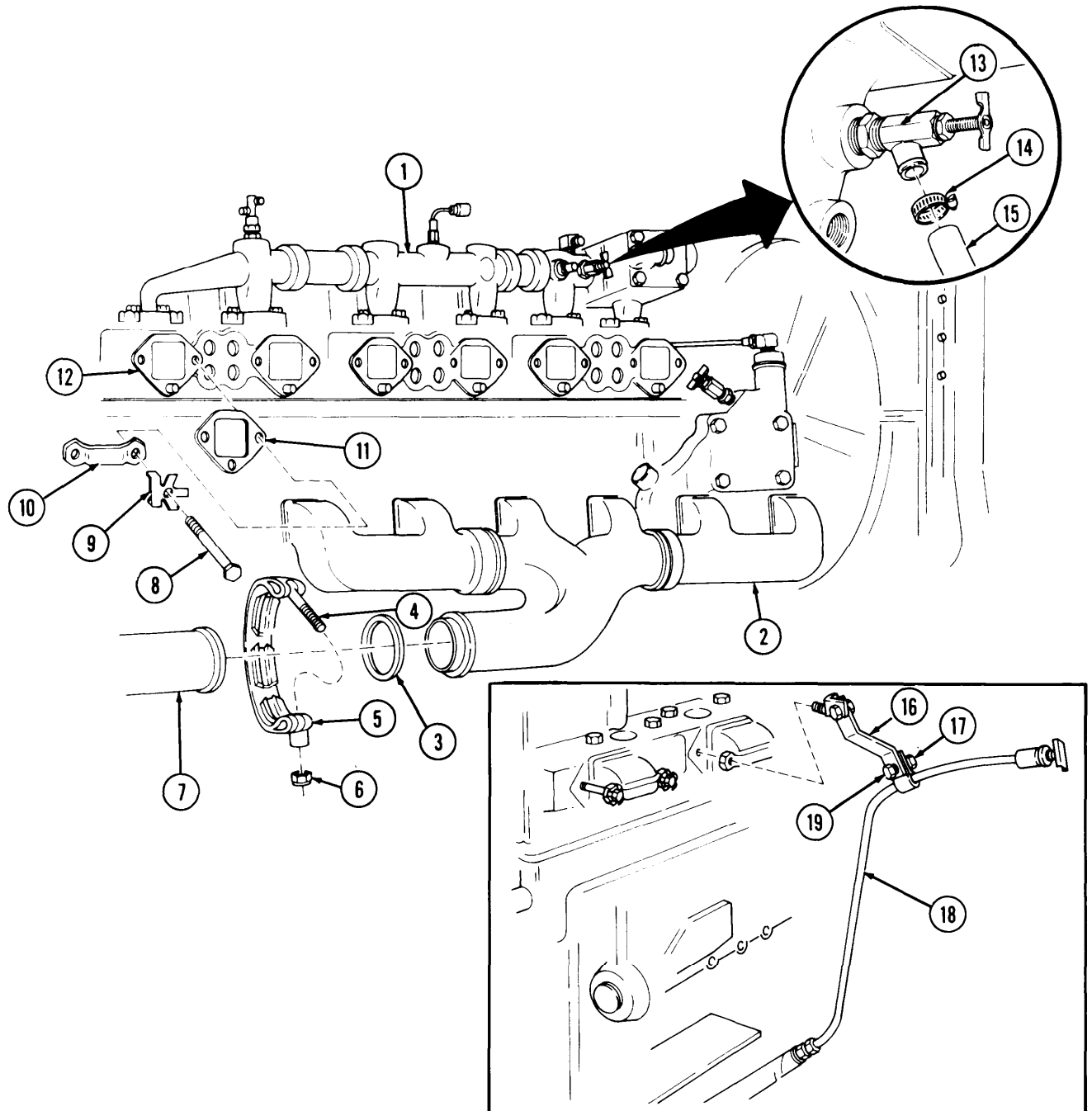
a. Removal

- | | | | | |
|----|------------------------|--|---|---|
| 1. | Front exhaust pipe (7) | Manifold coupling clamp (5), T-bolt (4), and locknut (6) | Remove. | Discard locknut (6) and tap clamp (5) apart with soft-faced hammer. |
| 2. | | Gasket (3) | Separate exhaust pipe (7) from exhaust manifold (2) and remove. | Discard gasket (3). |
| 3. | Dipstick tube (18) | Screw (19) and nut (17) | Loosen. | |
| 4. | Water manifold (1) | Heater inlet hose (15) and clamp (14) | Loosen hose clamp (14) and remove from manifold shutoff valve (13). | |
| 5. | Exhaust manifold (2) | Eight screws (8) and locktabs (9), and four clamps (10) | Remove. | Unlock locktabs (9) before removal.
Discard locktabs (9). |

3-7. EXHAUST MANIFOLD REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
----------	----------	------	--------	---------

- | | | | | |
|----|---------------------------|---|--------------------------|--|
| 6. | | Oil dipstick bracket (16) | Position out of the way. | |
| 7. | Three cylinder heads (12) | Exhaust manifold (2) and six gaskets (11) | Remove. | Discard gaskets (11).
Separate manifold (2) sections. |



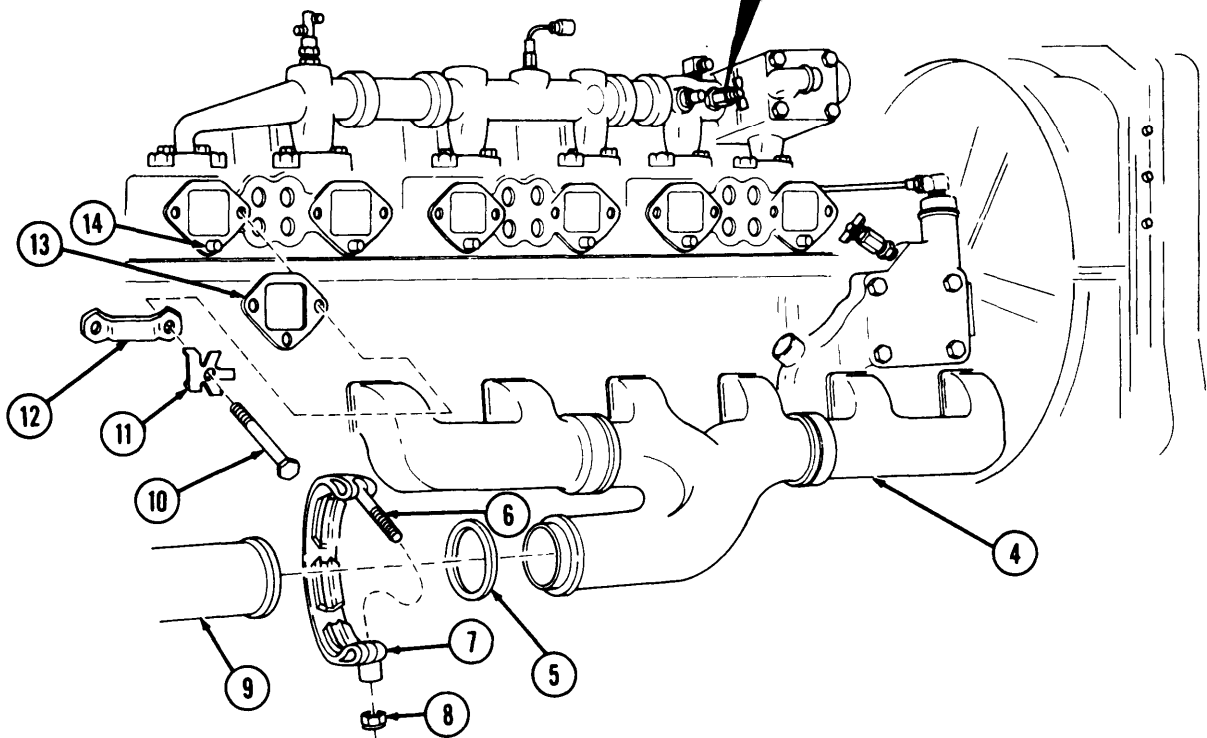
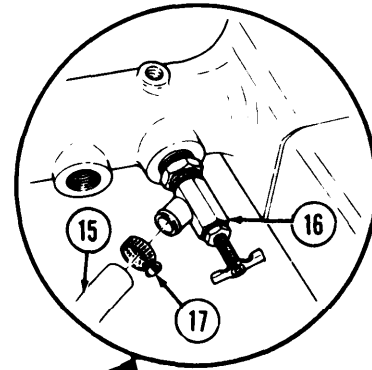
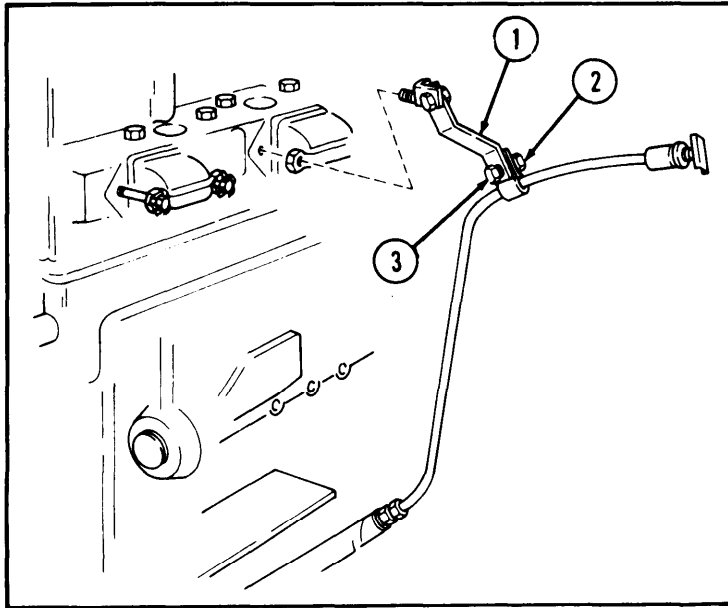
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3-7. EXHAUST MANIFOLD REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Installation				
8.		Six new gaskets (13) and exhaust manifold (4)	Position on dowels (14) for installation.	
9.		Four clamps (12), eight new locktabs (11), and screws (10), and bracket (1)	Install.	Reposition bracket (1) for installation.
10.		Heater inlet hose (15) and clamp (17)	Connect to manifold shutoff valve (16) and tighten clamp (17).	
11.		Screw (3) and nut (2)	Tighten.	
12.		New gasket (5)	Install.	Position between exhaust manifold (4) and front exhaust pipe (9).
13.		Manifold coupling, clamp (7), T-bolt (6), and new locknut (8)	Install.	

3-7. EXHAUST MANIFOLD REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS:
 • Install surge tank (TM 9-2320 -272-20-1).
 • Install crankcase breather tube and mounting bracket (TM 9-2320-272-20-1).

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3-8. ENGINE OIL COOLER MAINTENANCE

This task covers:

- | | |
|----------------------------|-----------------|
| a. Removal | d. Reassembly |
| b. Disassembly | e. Installation |
| c. Cleaning and Inspection | |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10 TM 9-2320-272-10 TM 9-2320-272 -20-1	Parking brake set. Right splash shield removed. Cooling system drained.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Packing sleeve		
Nine lockwashers		
Two gaskets		
Two "O" rings		
Two retaining rings		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
Sealing tape (Appendix C, Item 30)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		<ul style="list-style-type: none"> • Keep fire extinguisher nearby when using Drycleaning solvent. • Compressed air source will not exceed 30 psi (207 kPa). • Eyeshields must be worn when using compressed air.
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272 -20-1		
TM 9-2320-272-34P		

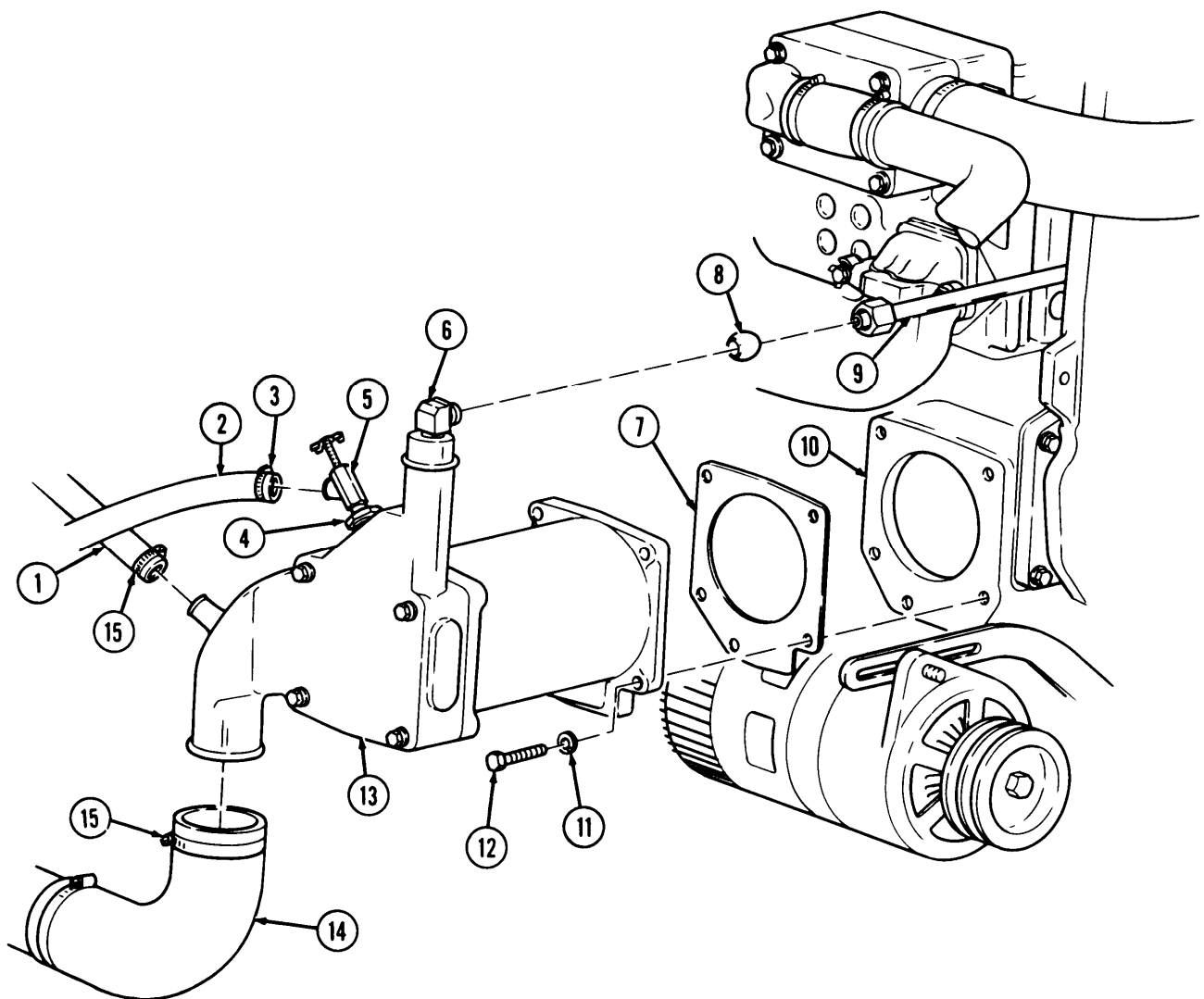
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1.	Shutoff valve (5)	Hose clamp (3)	Loosen and disconnect heater hose (2).	
2.	Oil cooler (13)	Shutoff valve (5) and adapter (4)	Remove.	
3.		Two hose clamps (15)	Loosen, and disconnect surge tank to oil cooler hose (1) and transmission cooler to oil cooler hose (14).	
4.	Oil cooler elbow (6)	Air compressor coolant line (9) and packing sleeve (8)	Disconnect.	Discard packing sleeve (8).

3-8. ENGINE OIL COOLER MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
5.	Cylinder block (10)	Five screws (12) and lockwashers (11), oil cooler (13), and gasket (7)	Remove.	Discard lockwashers (11) and gasket (7). Clean gasket remains from mating surfaces.



3-8. ENGINE OIL COOLER MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Disassembly				
6.	Oil cooler end cover (4)	Four screws (6) and lockwashers (7), cooler housing (10), and gasket (3)	Remove.	Discard lockwashers (7) and gasket (3). Clean gasket remains from mating surfaces,
7.		Pipe plug (9)	Remove.	
8.		Elbow (5)	Remove.	
9.		Two retaining rings (2) and "O" rings (1)	Remove.	Discard retaining rings (2), and "O" rings (1).
10.		Oil cooler element (8)	Remove.	

c. Cleaning and Inspection

WARNING

Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

NOTE

To prevent hardening and drying of foreign substances, clean cooler element as soon as possible after removal.

11.	Cooler housing (10)	a. Clean with drycleaning solvent. b. Inspect for cracks and stripped threads.	Replace housing (10) if cracked or threads are stripped.
12.	Oil cooler element (8)	a. Soak in drycleaning solvent. b. Flush with drycleaning solvent. c. Inspect for broken and cracked welds.	Replace cooler element (8) if broken or cracked.

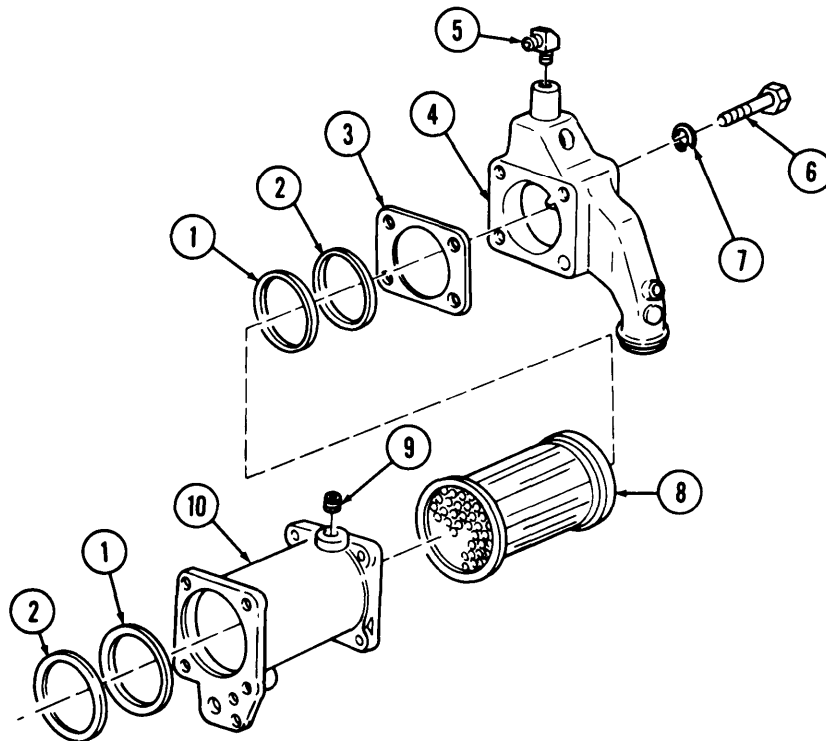
WARNING

Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.

d. Immerse in water and apply 30 psi (207 kPa) air pressure and plug opposite end.	If air bubbles are observed, replace oil cooler element (8).
--	--

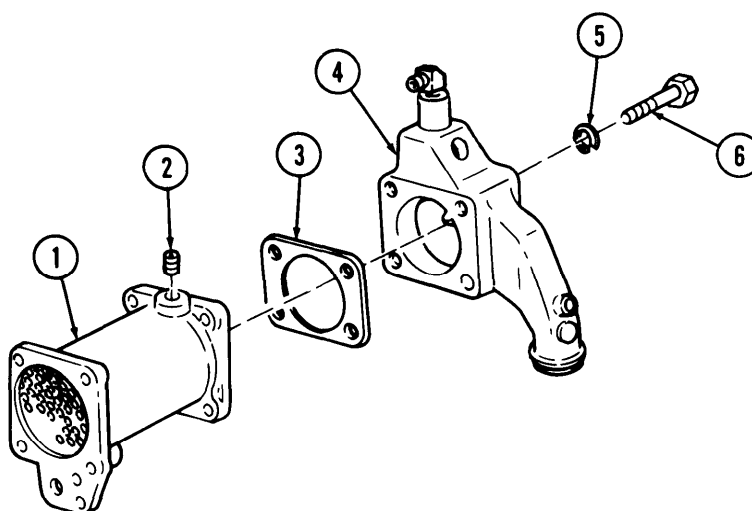
3-8. ENGINE OIL COOLER MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
d. Reassembly				
13.		Cooler element (8)	Align index marks and install in cooler housing (10).	
<p style="text-align: center;">NOTE</p> <p>Lubricate 'O' rings with engine oil before installation.</p>				
14.		Two new "O" rings (1) and new retaining rings (2)	Install one in each end of cooler housing (10).	
15.		Elbow (5)	Wrap end with sealing tape and install in end cover (4).	



3-8. ENGINE OIL COOLER MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
16.		Pipe plug (2)	Wrap with sealing tape and install in cooler housing (1).	
17.		New gasket (3) and end cover (4)	Install on cooler housing (1) with four new lockwashers (5) and screws (6).	Tighten 30-35 lb-ft (41-47 N·m).

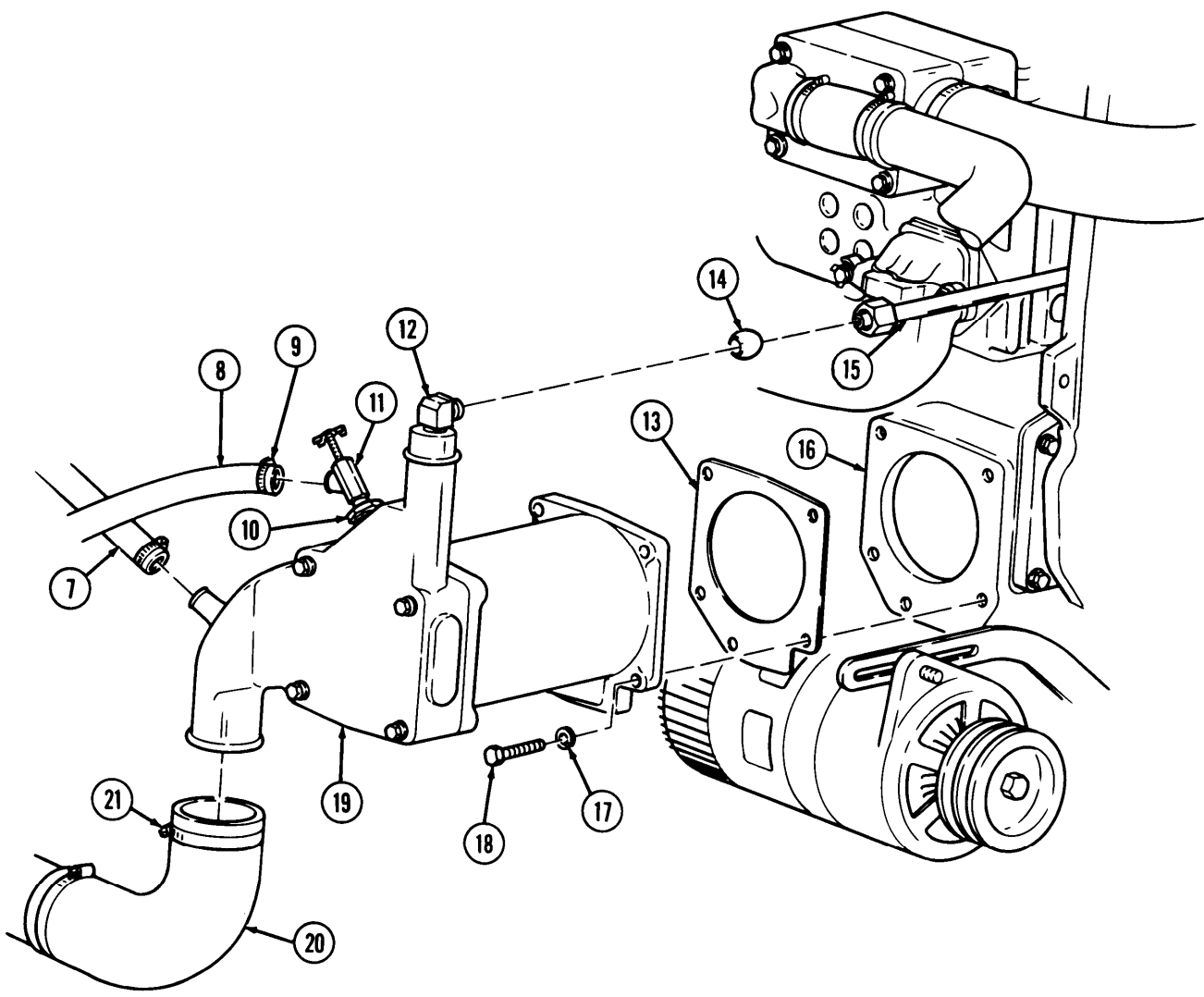
**e. Installation**

18.	New gasket (13) and oil cooler (19)	Install on cylinder block (16) with five new lockwashers (17) and screws (18).	Tighten :30-35 lb-ft (40-47 N·m),
19.	New packing sleeve (14) and air compressor coolant line (15)	Connect to oil cooler elbow (12).	
20.	Adapter (10) and shutoff valve (11)	Install on oil cooler (19).	
21.	Surge tank to oil cooler hose (7) and transmission cooler to oil cooler hose (20)	Connect to oil cooler (19) with two hose clamps (21).	
22.	Heater hose (8)	Connect to shutoff valve (11) with hose clamp (9).	

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3-8. ENGINE OIL COOLER MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS: • Fill cooling system to proper level (TM 9-2320-272-20-1).
• Install right splash shield (TM 9-2320-272-10).

3-9. VIBRATION DAMPER REPLACEMENT

This task covers:

- a. Check Runout and Wobble

b. Removal
- c. Inspection

d. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272 -20-1	Radiator fan shroud removed.
	TM 9-2320-272 -20-1	Radiator fan blade removed.
	TM 9-2320 -272-20-1	Alternator belts removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Barring tool ST-747		None
<u>Materials/Parts</u>		
Six lockwashers		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272 -20-1		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Check Runout and Wobble

1.

Vibration damper (1)

Check for runout as follows:

a. Mount dial indicator (3) with holding fixture (4) mounted to front gearcase cover (5).

b. Position dial arm (2) at surface (6) and zero dial indicator (3).

c. Rotate damper (1) and take reading,

Use barring tool ST-747.

If reading exceeds 0.025 in. (0.63 mm), replace damper (1).
2.

Vibration damper (1)

Check for wobble as follows:

3-9. VIBRATION DAMPER REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
----------	----------	------	--------	---------

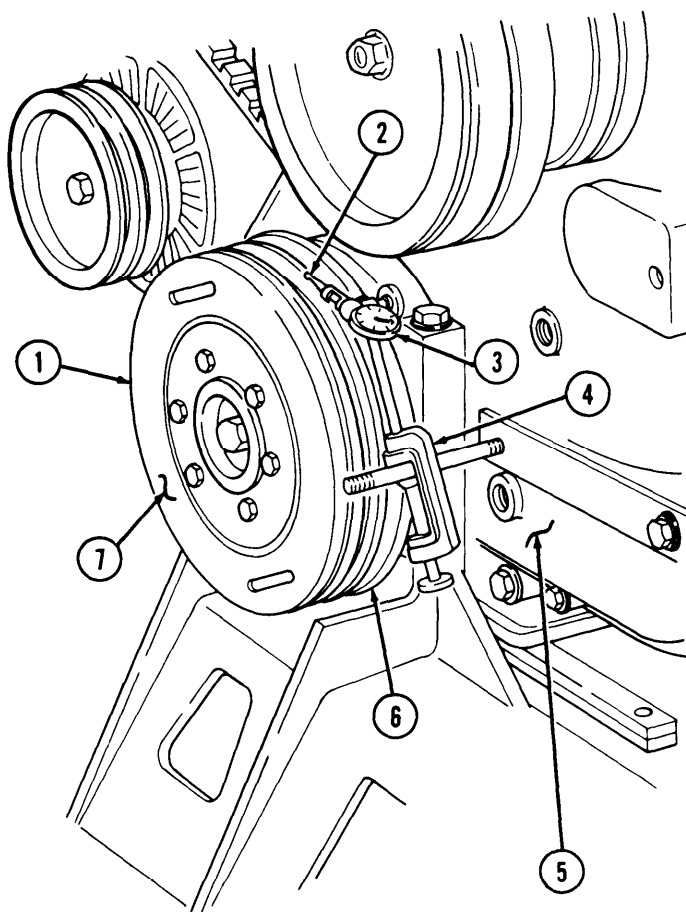
NOTE

Crankshaft must be kept at front or rear limit of thrust while checking damper for wobble.

- a. Using mounted dial indicator (3), position dial arm (2) at surface (7).
- b. Zero dial indicator (3).
- c. Rotate damper (1) and take reading.
- d. Remove dial indicator (3) and fixture (4).

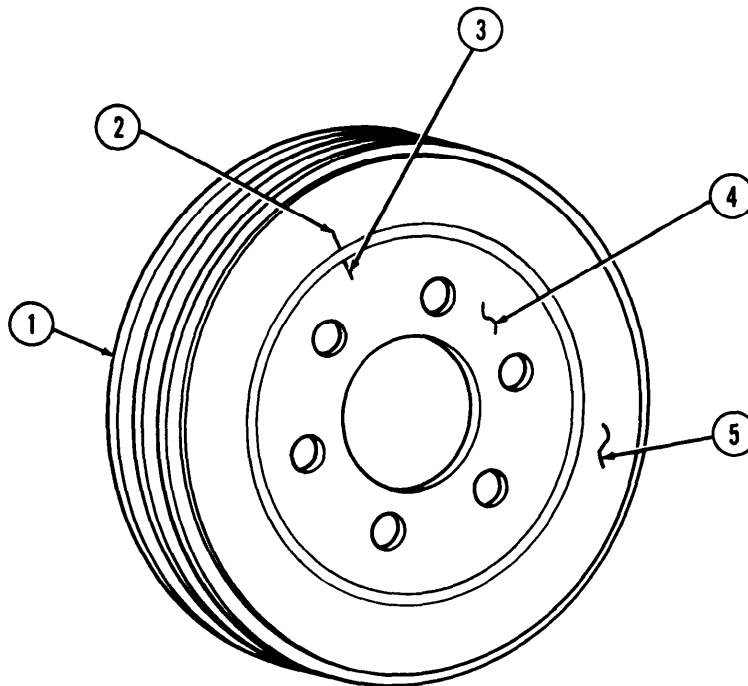
Use barring tool ST-747.

If reading exceeds 0.030 in. (.76 mm), replace damper (1).



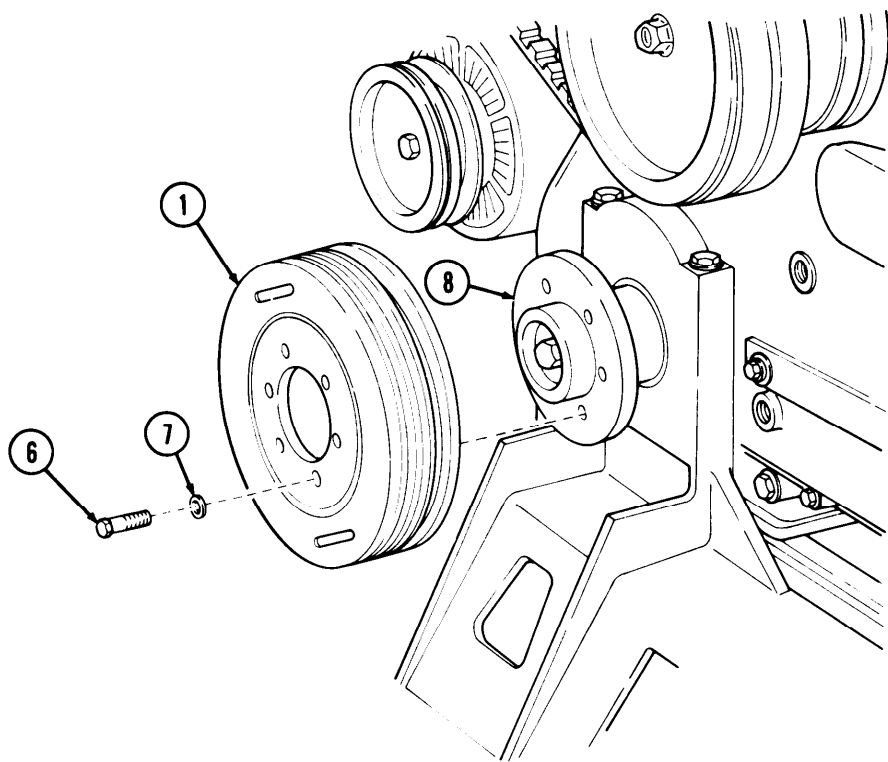
3-9. VIBRATION DAMPER REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Removal				
3.	Crankshaft flange (8)	Six screws (6) and lockwashers (7)	Remove.	Discard lockwashers (7).
4.		Vibration damper (1)	Remove.	Tap lightly to remove.
c. Inspection				
5.		Vibration damper (1)	Inspect hub (4) alignment mark (3) with member (5) alignment mark (2).	If alignment marks (2) and (3) are not within 0.062 in. (1.59 mm), replace damper (1).
d. Installation				
6.		Vibration damper (1)	Install on crankshaft flange (8) with six new lockwashers (7) and screws (6).	Tighten 55-60 lb-ft (75-81 N·m).



3-9. VIBRATION DAMPER REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS: Ž Install alternator belts (TM 9-2320-272-20-1).
• Install radiator fan blade (TM 9-2320-272-20-1).
Ž Install radiator fan shroud (TM 9-2320-272-20-1).

3-10. CRANKSHAFT FLANGE REPLACEMENT

This task covers:

- a. Check Runout and Wobble
- b. Removal
- c. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-9 TM 9-2320-272 -20-1	Vibration damper removed. Radiator removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Barring tool ST-747 Crankshaft flange puller ST-887		None
<u>Materials/Parts</u>		
Lubricating oil OE\HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-20-1 TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Check Runout and Wobble

- | | | | |
|----|-----------------------|---|--|
| 1. | Crankshaft flange (1) | Check runout and wobble as follows:
a. Mount dial indicator (3) with holding fixture (4) installed to front gearcase cover (5).
b. Position indicator arm (2) against flange hub face (6).
c. Zero dial indicator (3).
d. Rotate flange (1) and take reading. | Use barring tool ST-747.

If reading exceeds 0.004 in. (0,10 mm), replace crankshaft flange (1). |
| 2. | Crankshaft flange (1) | Check wobble as follows: | |

3-10. CRANKSHAFT FLANGE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Crankshaft must be kept at front or rear limit of thrust while checking flange wobble.

a. Using mounted dial indicator (3) and holding fixture (4) position indicator arm (2) on flange hub face (7).

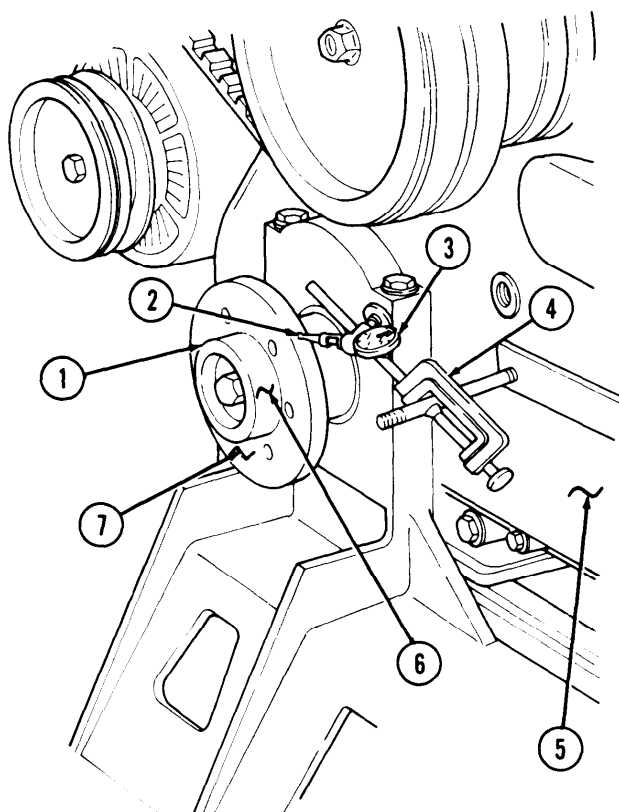
b. Zero dial indicator (3).

c. Rotate flange (1) and take reading.

Use barring tool ST-747.

If reading exceeds 0.004 in. (0.10 mm) after 360 degree crankshaft rotation, replace crankshaft flange (1).

d. Remove dial indicator (3) and holding fixture (4).



3-10. CRANKSHAFT FLANGE REPLACEMENT (Cont'd)

b. Removal

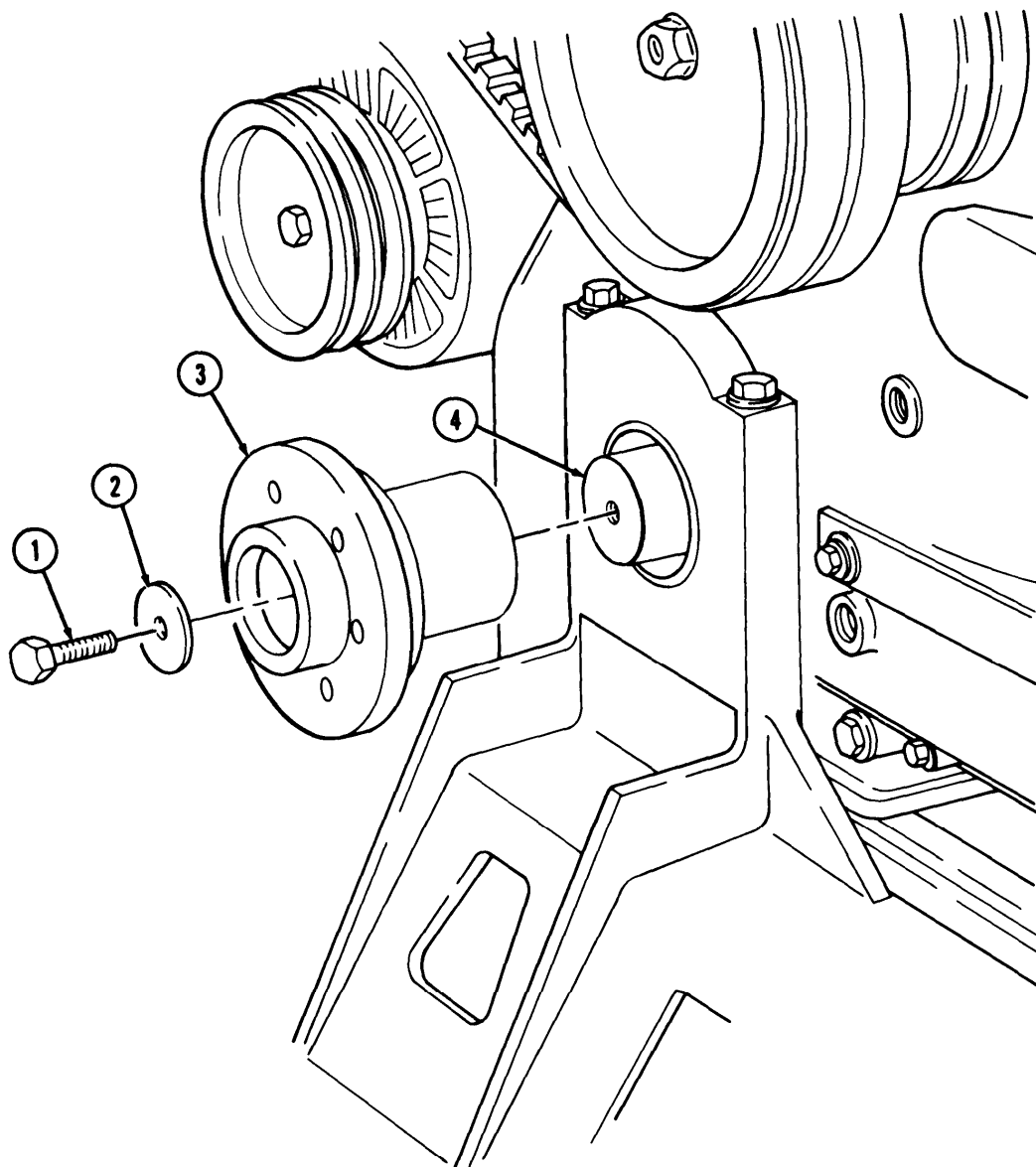
3.	Crankshaft flange (3)	Screw (1) and washer (2)	Remove.	
4.		Screw (1)	Install in crankshaft (4) three turns.	
5.	Crankshaft (4)	Crankshaft flange (3) Screw (1)	Remove. Remove.	Use ST-887 puller.

c. Installation

7.	Crankshaft flange (3)	a. Coat inside with oil.	Use lubricating oil.
		b. Install on crankshaft (4) with washer (2) and screw (1),	Tighten 180-200 lb-ft (244-271 N·m).

3-10. CRANKSHAFT FLANGE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS: \checkmark Install vibration damper (para. 3-9).
 • Install radiator (TM 9-2320-272-20-1).

3-11. ENGINE ACCESSORY DRIVE PULLEY REPLACEMENT

This task covers:

a. Removal

b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-20-2	Power steering belts removed.
<u>Test Equipment</u>	TM 9-2320-272-20-1	Radiator removed.
None	TM 9-2320-272-20-1	Water pump drivebelt removed.
<u>Special Tads</u>		<u>Special Environmental Conditions</u>
Mechanical puller kit GGG-P 781		None
<u>Materials/Parts</u>		<u>General Safety Instructions</u>
Gasket		None
GAA Grease (Appendix C, Item 11)		
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-20-1		
TM 9-2320-272-20-2		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

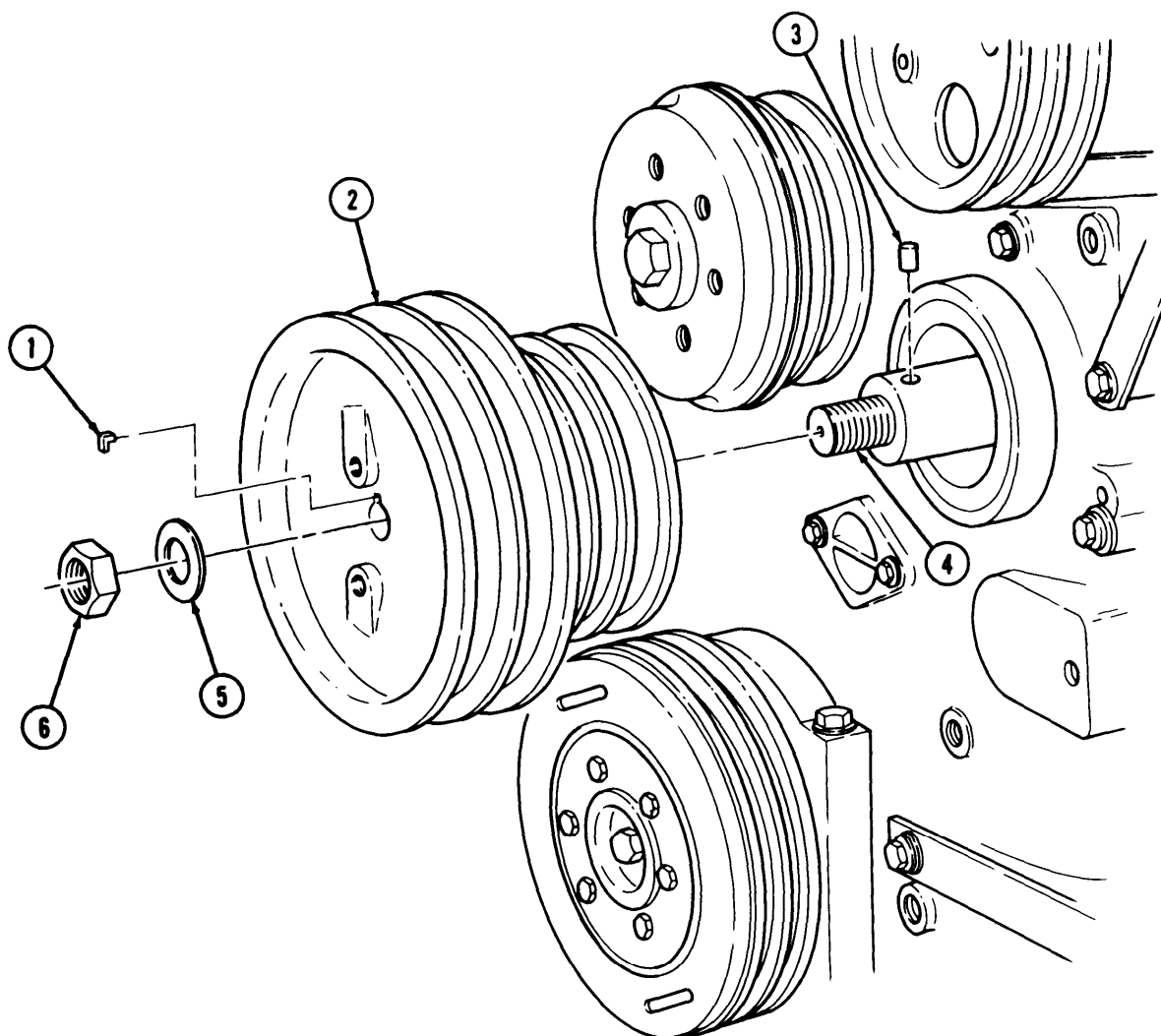
1. Accessory drive pulley (2)	Nut (6) and washer (5)	Remove.	
2. Accessory drive shaft (4)	Accessory drive pulley (2)	Remove.	Use puller.
2.1. Accessory drive pulley (2)	Gasket (1)	Remove.	Discard gasket (1).
NOTE Perform step 2.2 only if dowel pin is damaged.			
2.2 Accessory drive shaft (4)	Dowel pin (3)	Remove.	Discard dowel pin (3).

b. Installation

4.	Accessory drive shaft (4)	Apply a light coat of GAA grease.	
NOTE Perform step 5 if dowel pin was removed.			
5.	New dowel pin (3)	Install in accessory drive shaft (4)	
5.1.	New gasket (1)	Install in keyway of accessory drive pulley (2).	

3-11. ENGINE ACCESSORY DRIVE PULLEY REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
6.		Accessory drive pulley (2)	Aline with dowel pin (3) and install on accessory drive shaft (4).	Use soft-faced hammer.
7.		Washer (5) and nut (6)	Install on accessory drive shaft (4).	Tighten 300-310 lb-ft (407-420 N·m).



END OF TASK!

FOLLOW-ON TASKS:

- Install water pump drivebelt (TM 9-2320-272-20-1).
- Install radiator (TM 9-2320-272-20-1).
- Install power steering belts (TM 9-2320-272-20-2).

3-12. ENGINE ACCESSORY DRIVE MAINTENANCE

This task covers:

- | | |
|----------------------------|-----------------|
| a. Removal | d. Reassembly |
| b. Disassembly | e. Installation |
| c. Cleaning and Inspection | |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 10-6 Para. 3-11	Air compressor removed. Accessory drive pulley removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Five lockwashers Gasket		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		⚠ Keep fire extinguisher nearby when using drycleaning solvent. • Compressed air source will not exceed 30 psi (207 kPa) • Eyeshields must be worn when using compressed air.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

- | | | | | |
|----|----------------------------------|--|---------|--|
| 1. | Accessory drive front flange (6) | Five screws (5) and lockwashers (4) | Remove. | Discard lockwashers (4). |
| 2. | Engine block gearcase (1) | Accessory drive housing (3) and gasket (2) | Remove. | Discard gasket (2).
Clean gasket remains from mating surfaces.
Use soft-faced hammer to loosen from engine block gearcase (1). |

b. Disassembly

- | | | | | |
|----|-----------------------------|----------------------------|--|---|
| 3. | Accessory drive housing (3) | Drive shaft (9) | Measure end play with dial indicator gage. | Note end play measurement for reference. |
| 4. | Drive shaft (9) | Screw (17) and washer (16) | Remove. | |
| 5. | Coupling halfshaft (15) | Drive shaft (9) | Remove. | Press drive shaft (9) through coupling halfshaft (15) with arbor press and mandrel. |

3-12. ENGINE ACCESSORY DRIVE MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
6.	Accessory drive housing (3)	Drive shaft (9) and drive gear (7), thrust washers (11) and (13), and washer (14)	Remove.	Slide through bushing (12) in accessory drive housing (3).
7.	Drive shaft (9)	Drive gear (7)	Remove.	Press drive shaft (9) through drive gear (7) using arbor press and mandrel.

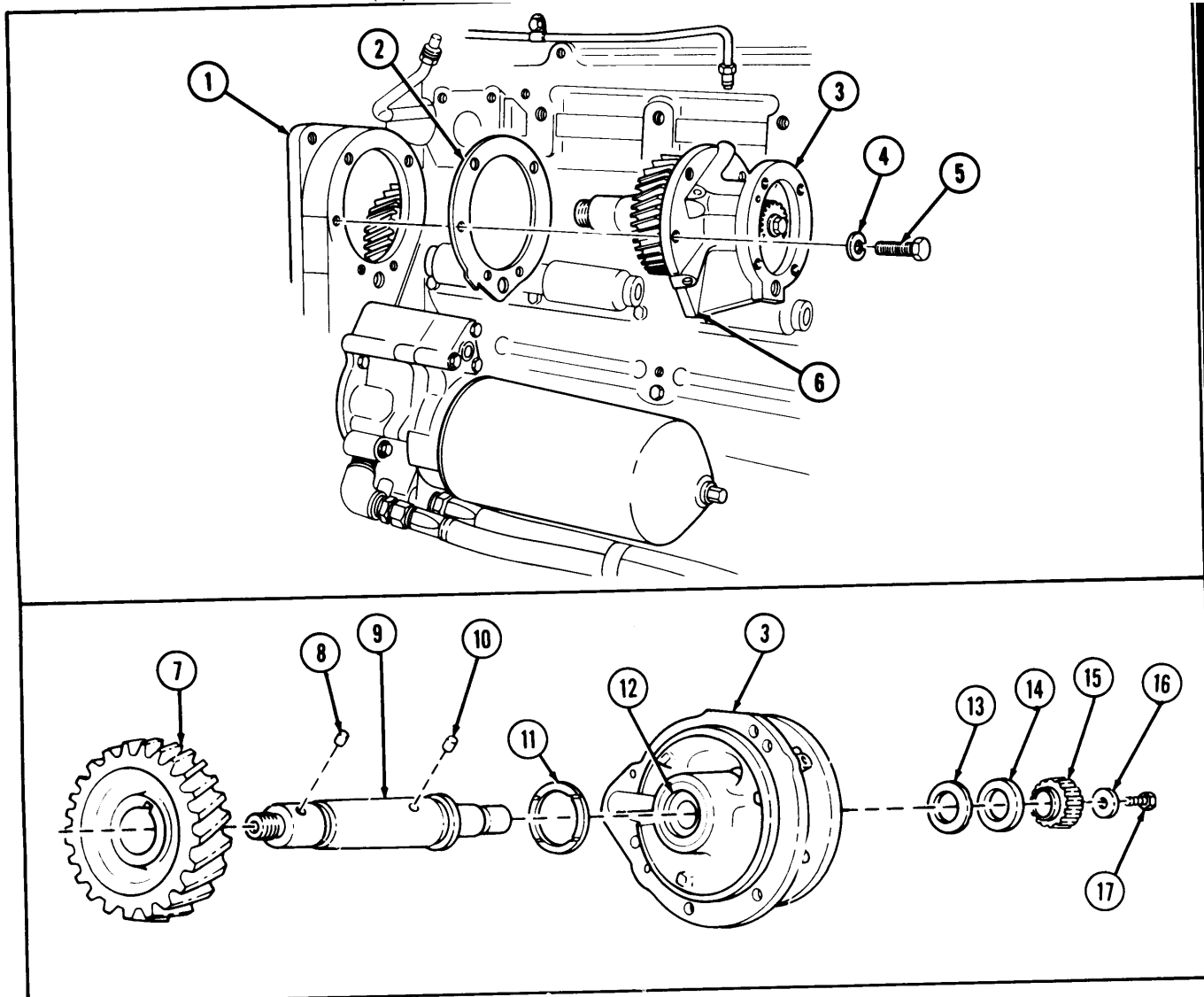
NOTE

Do not remove dowl pins unless damaged.

8.

Dowel pins (8) and (10)

Remove.



3-12. ENGINE ACCESSORY DRIVE MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Cleaning and Inspection

WARNING

- Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.
- Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.

9.		Accessory drive housing (5)	a. Wipe clean with dry-cleaning solvent. b. Blow out passages and bore with compressed air. c. Inspect for breaks and cracks.	If broken or cracked, replace housing.
10.	Accessory drive housing (5)	Bushing (6)	a. Inspect for pitting, galling, and cracks. b. Check inside diameter of bushing (6) at both ends.	Replace if pitted, galled, or cracked. Replace if either measurement is greater than 1.321 in. (33.6 mm).

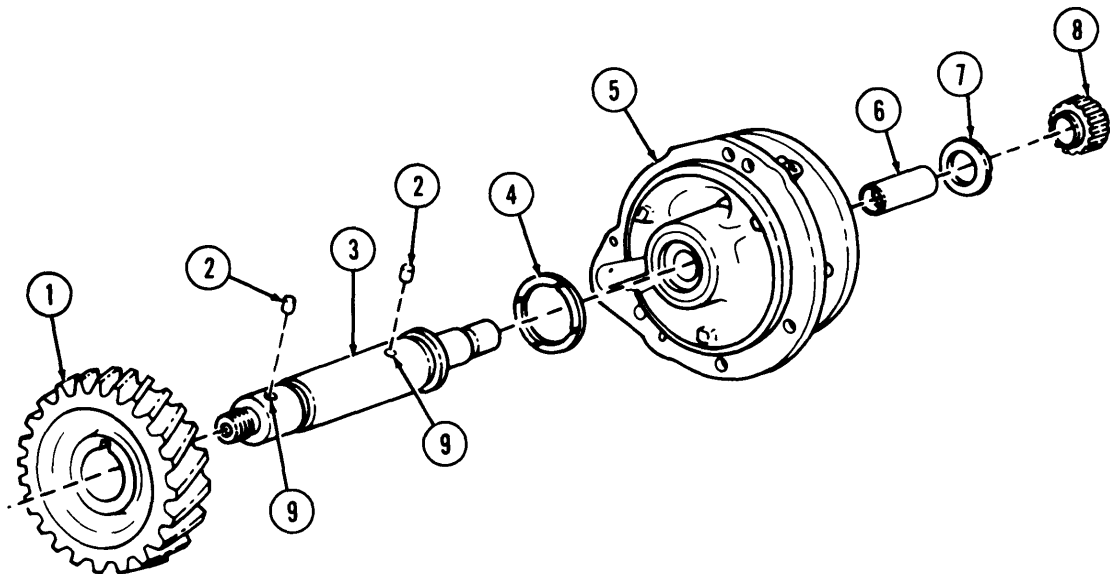
NOTE

Perform steps 10c and 11 only if bushing must be replaced.

			c. Remove.	Use arbor press and mandrel.
11.		New bushing (6)	Install in accessory drive housing (5) flush with face.	Use arbor press and mandrel.
12.		Drive shaft (3)	a. Wipe clean with dry-cleaning solvent. b. Inspect for breaks, cracks, and galling. c. Inspect for stripped or crossed threads. d. Check shaft (3) outside diameter at bushing (6) location. e. Inspect dowel pin holes (9).	Replace if broken, cracked, or galled. Repair or replace if threads are stripped or crossed. Refer to para. 2-9. If outside diameter is less than 1.310 in. (33.27 mm), replace drive shaft. If holes are enlarged, discard drive shaft.

3-12. ENGINE ACCESSORY DRIVE MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
13.		Drive gear (1) and coupling halfshaft (8)	a. Wipe clean with drycleaning solvent. b. Inspect for breaks, cracks, and galling in bore. c. Inspect for chipped and broken teeth.	Replace if cracked, broken, or bore shows galling. Replace if a tooth is broken or teeth are chipped.
14.		Thrust washers (4) and (7)	Inspect for cracks and scoring.	Replace if cracked, broken, or scored. If end play measured in step 3 is greater than 0.012 in. (0.3 mm), replace both thrust washers.
15.		Two dowel pins (2)	Inspect for burrs or cracks.	Replace if cracked or burred.

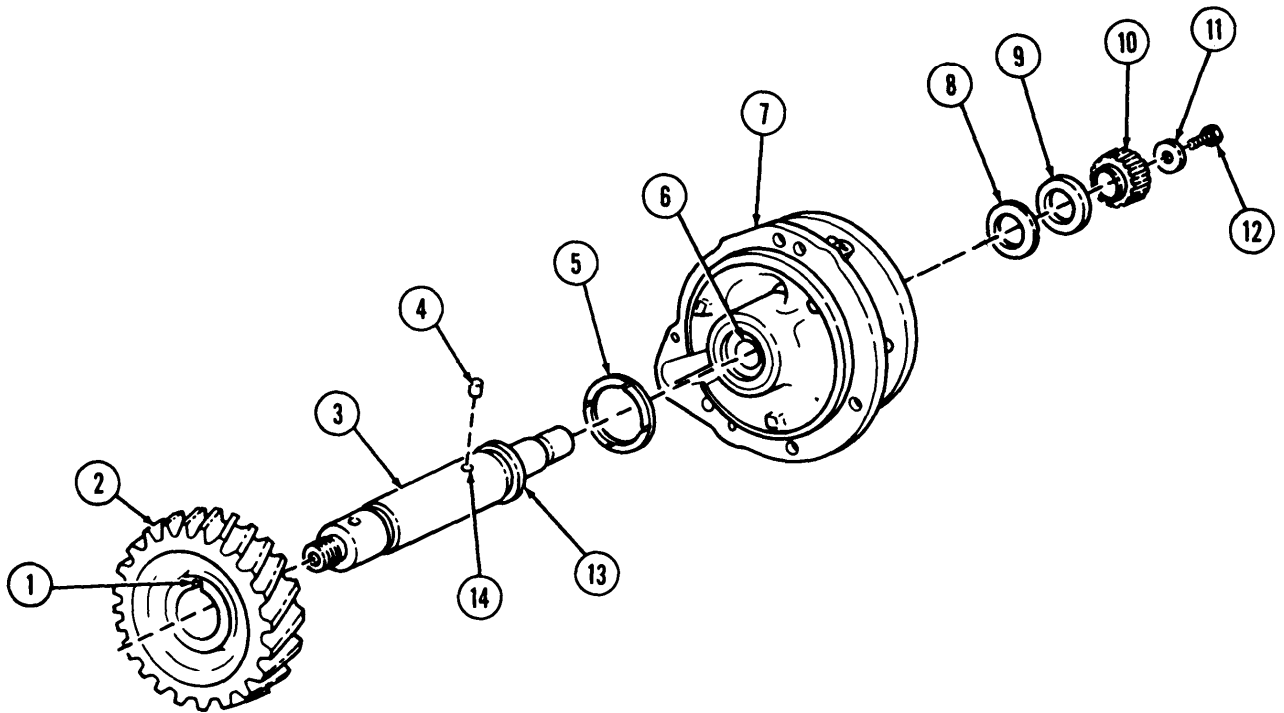


3-12. ENGINE ACCESSORY DRIVE MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
d. Reassembly				
16.		Drive gear (2) and dowel pin (4)	a. Install dowel pin (4) in hole (14) of drive shaft (3). b. Aline slot (1) in bore of drive gear (2) with dowel pin (4). c. Press drive gear (2) on drive shaft (3) over dowel pin (4).	Remaining dowel pin is installed with accessory drive pulley. Drive gear (2) must be seated on shoulder (13).
17.		Large thrust washer (5)	Install on front of accessory drive housing (7).	Grooved side faces away from housing.
18.		Drive shaft (3) and drive gear (2)	Install through thrust washer (5) and bushing (6) in accessory drive housing (7).	
19.		Thrust washer (8)	Install over drive shaft (3) and position in housing (7).	Grooved side faces away from accessory drive housing (7).
20.		Washer (9)	Install on drive shaft (3) against thrust washer (8).	
21.		Coupling halfshaft (10)	Press on drive shaft (3) until flush with end.	Flat end faces away from accessory drive housing (7).
22.		Drive shaft (3)	Measure end play.	End play should be 0.002 to 0.012 in. (0.05 to 0.26 mm). If not, press drive shaft (3) through coupling halfshaft (10) to obtain proper end play.
23.		Screw (12) and washer (11)	Install on drive shaft (3).	Tighten 30-35 lb-ft (41-47 N·m).

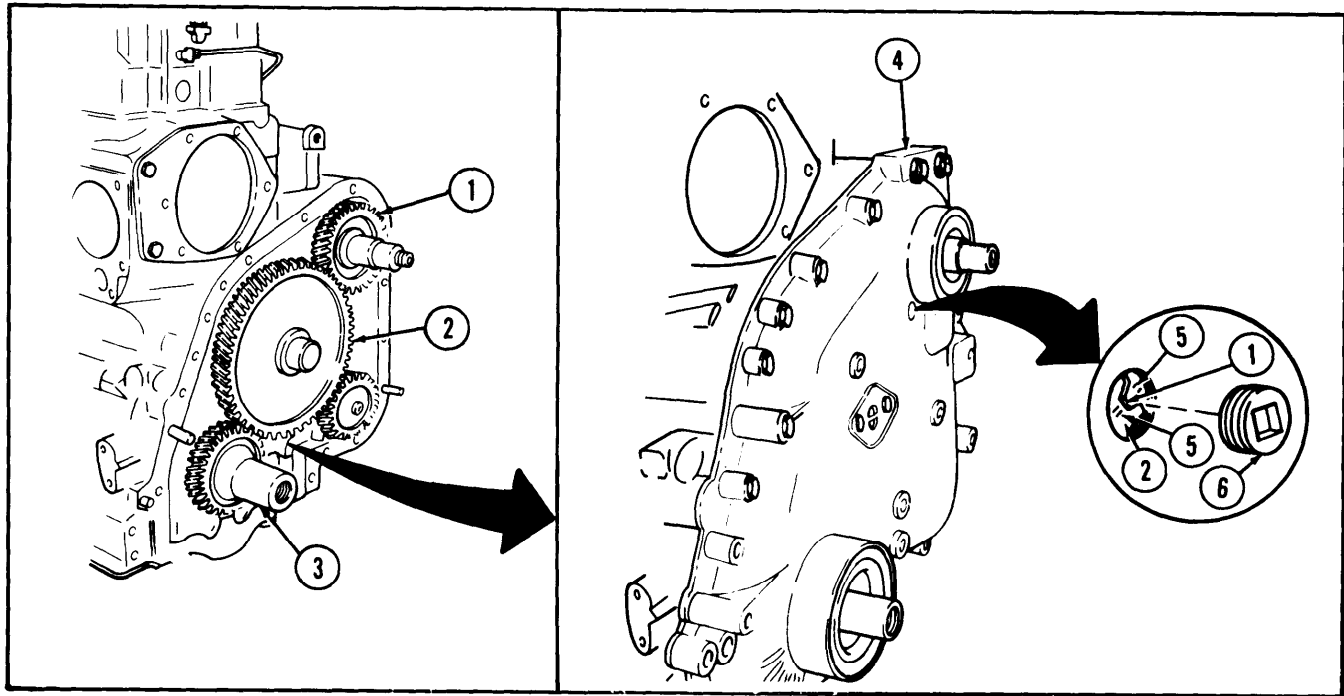
3-12. ENGINE ACCESSORY DRIVE MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-12. ENGINE ACCESSORY DRIVE MAINTENANCE (Cont'd)

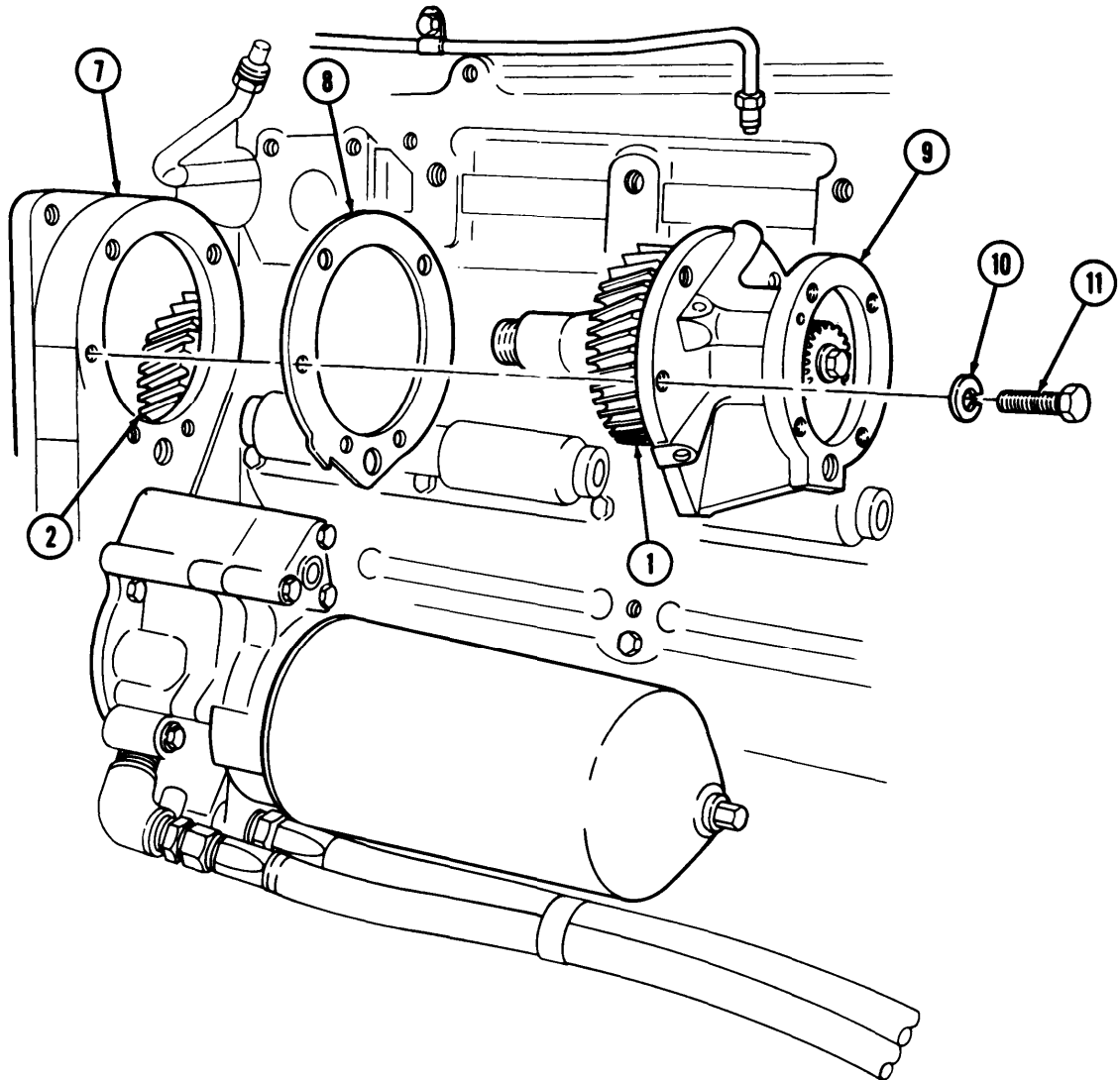
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
e. Installation				
NOTE				
If accessory drive gear and camshaft gear are not properly alined, valve, injector, and compressor timing will be incorrect.				
24.	Front gearcase cover (4)	Pipe plug (6)	Remove.	
25.		Crankshaft (3)	a. Rotate to number one piston top dead center firing stroke (TDC). b. Rotate crankshaft (3) 90 degrees past TDC.	
26.		Accessory drive housing (9) and new gasket (8)	Install on engine block gearcase (7) with five screws (11) and new lockwashers (10).	Timing marks (5) on accessory drive gear (1) and camshaft gear (2) must aline. Tighten 40-45 lb-ft (54-61 N·m).
27.		Pipe plug (6)	Install in front gearcase cover (4).	Wrap pipe plug threads with sealing tape before installation.



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3-12. ENGINE ACCESSORY DRIVE MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

- FOLLOW-ON TASKS:
- Install accessory drive pulley (para. 3-11).
 - Install air compressor (para. 10-6).

3-13. ENGINE INTAKE MANIFOLD MAINTENANCE

This task covers:

- | | |
|----------------------------|-----------------|
| a. Removal | d. Reassembly |
| b. Disassembly | e. Installation |
| c. Cleaning and Inspection | |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272 -20-1	Air intake pipe and hump hose removed.
<u>Test Equipment</u>	TM 9-2320-272 -20-2	Air compressor air intake tube removed.
None		Ether atomizer removed.
<u>Special Tools</u>	TM 9-2320-272 -20-1	Crankcase breather tube removed.
None	TM 9-2320-272 -20-1	
<u>Materials/Parts</u>		<u>Special Environmental Conditions</u>
Thirteen lockwashers		None
Four gaskets		
Protective cap-plugs (Appendix C, Item 5)		
Sealing tape (Appendix C, Item 30)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		<ul style="list-style-type: none"> Compressed air source will not exceed 30 psi (207 kPa). Eyeshields must be worn when cleaning with compressed air.
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-20-1		
TM 9-2320-272-20-2		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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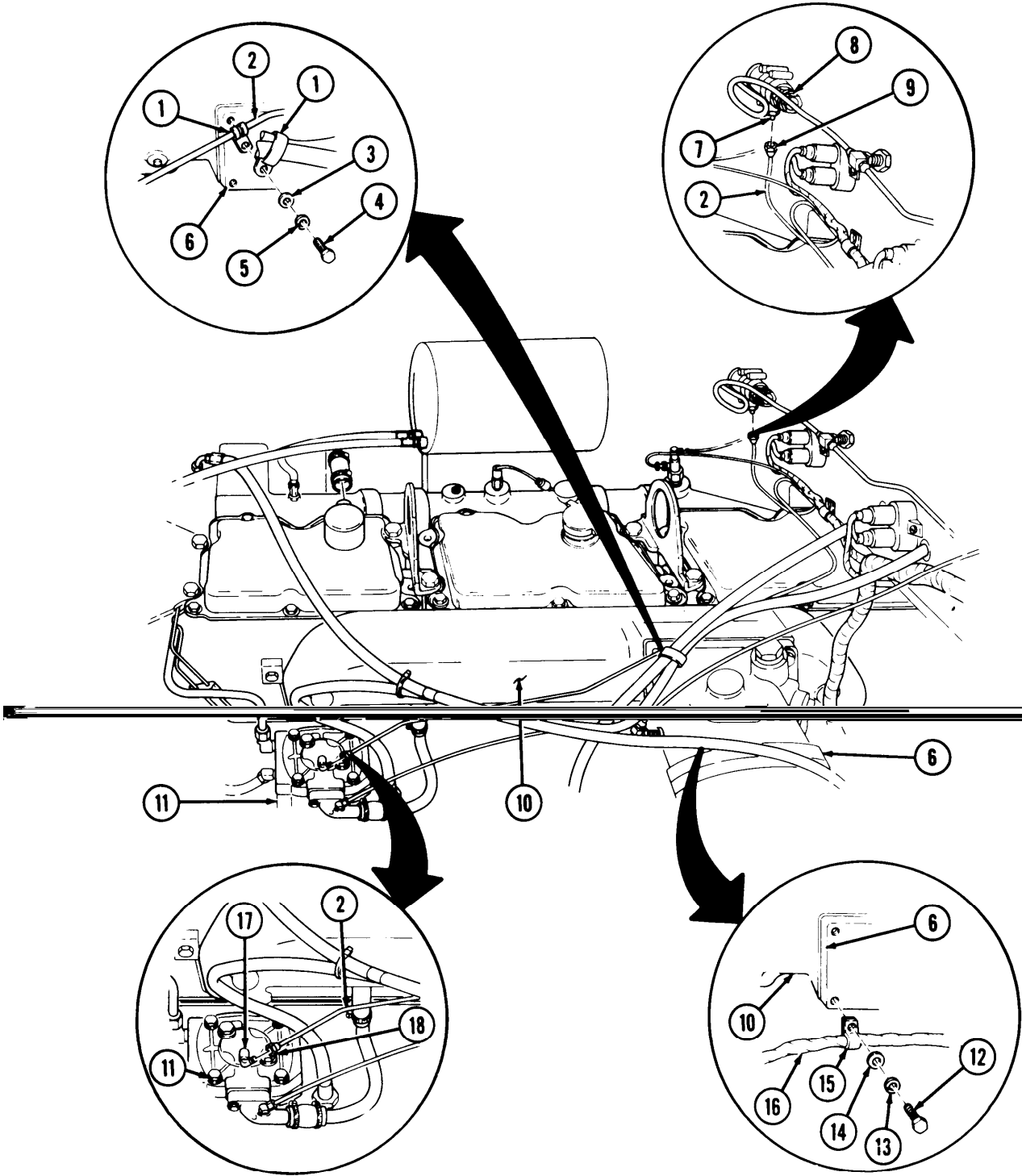
CAUTION

Cover or plug all openings to prevent dirt from entering and damaging engine components.

- | | | | | |
|----|--|--|-------------|--|
| 1. | Air compressor (11) and elbow (17) | Tubing nut (18) and air tube (2) | Disconnect. | |
| 2. | Air governor (8) and adapter (7) | Tubing nut (9) and air tube (2) | Disconnect. | |
| 3. | Air intake connector (6) | Screw (4), lockwasher (5), washer (3), two clamps (1), and air tube (2) | Remove. | Discard lockwasher (5). |
| 4. | Lower left side of air intake connector (6) and intake manifold (10) | Screw (12), lockwasher (13), washer (14), wire clamp (15), and wire harness (16) | Remove. | Discard lockwasher (13). Wire clamp (15) will remain on wire harness (16). |

3-13. ENGINE INTAKE MANIFOLD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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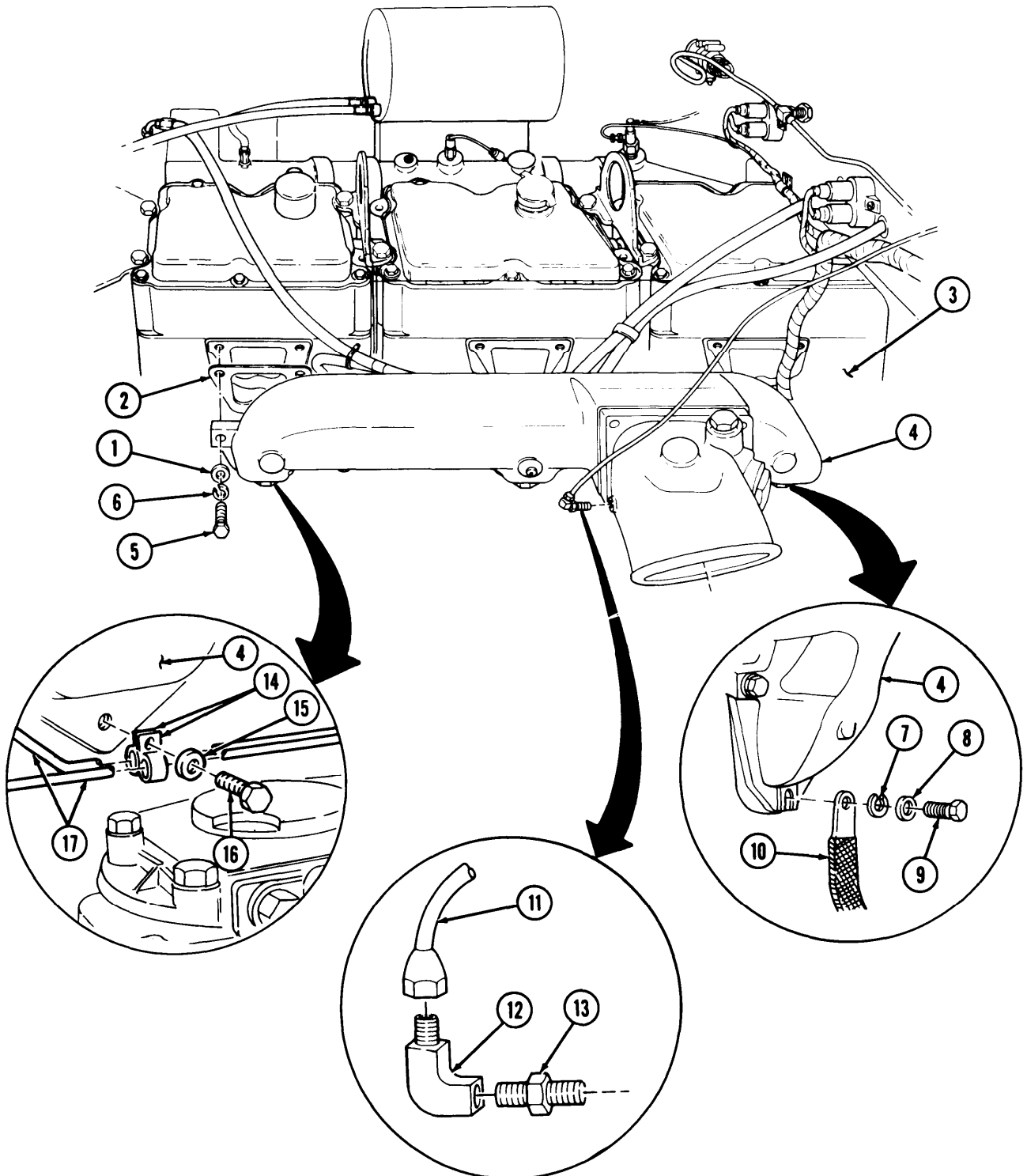


3-13. ENGINE INTAKE MANIFOLD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
5. Elbow (12)		Hose (11)	Disconnect.	
6.		Elbow (12) and air cleaner indicator filter (13)	Remove.	
7. Intake manifold (4)		Screw (9), lockwasher (8), washer (7), and cable ground strap (10)	Remove.	Tag cable ground strap (10) for installation. Discard lockwasher (8).
<p style="text-align: center;">NOTE</p> <ul style="list-style-type: none"> • Air intake manifold is mounted with screw-assembled washers on late model engine. • Perform step 7.1 only if clamps are on vehicle. 				
7.1.		Screw (16), washer (15), two clamps (14), and fuel tubes (17)	Remove.	
8. Cylinder heads (3)		Eight screws (5), lockwashers (6), and washers (1)	Remove.	Discard lockwashers (6).
9.		Intake manifold (4) and three gaskets (2)	Remove.	Discard gaskets (2). Clean gasket remains from mating surfaces.

3-13. ENGINE INTAKE MANIFOLD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-13. ENGINE INTAKE MANIFOLD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Disassembly

- | | | | | |
|-----|--------------------------|--------------------------|---------|--|
| 10. | Intake manifold (1) | Pipe plug (10) | Remove. | |
| 11. | Air intake connector (8) | Adapter (4) and plug (3) | Remove. | |

NOTE

- Air connector is mounted with screw-assembled washers on late model engine.
- Perform step 11.1 for late model engine.

- | | | | | |
|-------|--------------------------|---|---------|---|
| 11.1. | Air intake connector (8) | Elbow (2) | Remove. | |
| 12. | Intake manifold (1) | Two screws (6), lock-washers (7), and washers (5) | Remove. | Discard lockwashers (7). |
| 13. | | Air connector (8) and gasket (9) | Remove. | Discard gasket (9).
Clean gasket remains from mating surfaces. |

c. Cleaning and Inspection

WARNING

Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.

- | | | | |
|-----|--|--|--|
| 14. | Intake manifold (1) and air intake connector (8) | <p>a. Brush, clean, and inspect for breaks, cracks, and elongated holes.</p> <p>b. Clean internal passages with compressed air.</p> <p>c. Inspect threaded holes, screws, pipe plugs, and adapter for stripped or crossed threads.</p> | <p>Replace if broken, cracked, or if holes are elongated. Refer to para. 2-9.</p> <p>Repair or replace if threaded parts have stripped or crossed threads. Refer to para. 2-9.</p> |
|-----|--|--|--|

3-13. ENGINE INTAKE MANIFOLD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Reassembly**NOTE**

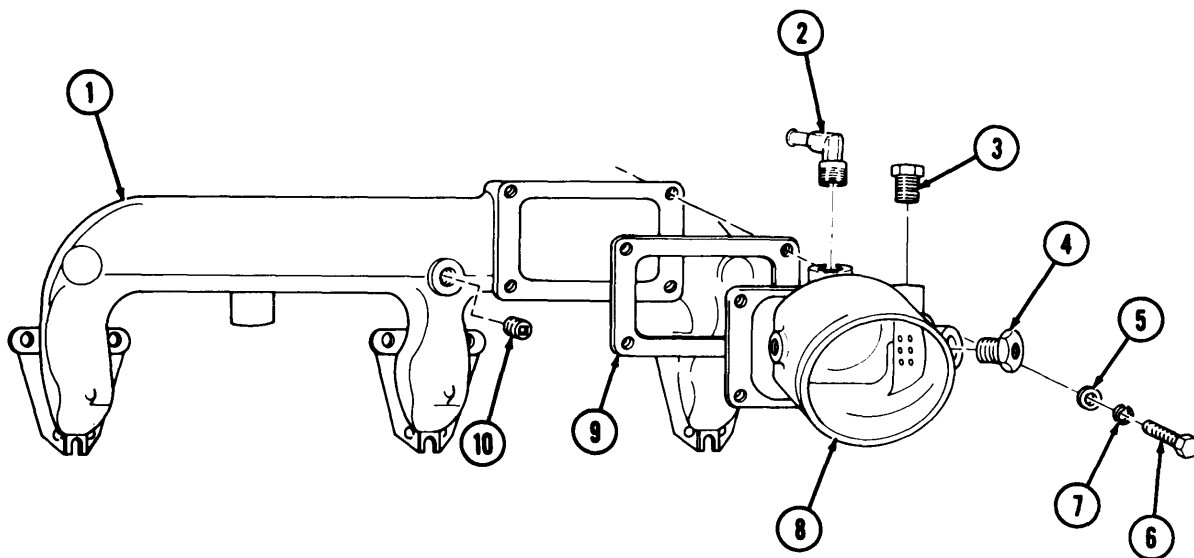
Male pipe threads must be wrapped with sealing tape before installation.

- | | | |
|-----|--------------------------|--------------------------------------|
| 15. | Adapter (4) and plug (3) | Install in air intake connector (8). |
| 16. | Pipe plug (10) | Install in intake manifold (1). |

NOTE

Perform step 16.1 for late model engine.

- | | | | |
|-------|--------------------------------------|---|----------------------------------|
| 16.1. | Elbow (2) | Install on air intake connector (8). | |
| 17. | Air connector (8) and new gasket (9) | Install on intake manifold (1) with two washers (5), new lockwashers (7), and screws (6). | Tighten 25-30 lb-ft (34-41 N-m). |



3-13. ENGINE INTAKE MANIFOLD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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e. Installation

NOTE

Male pipe threads must be wrapped with sealing tape before installation.

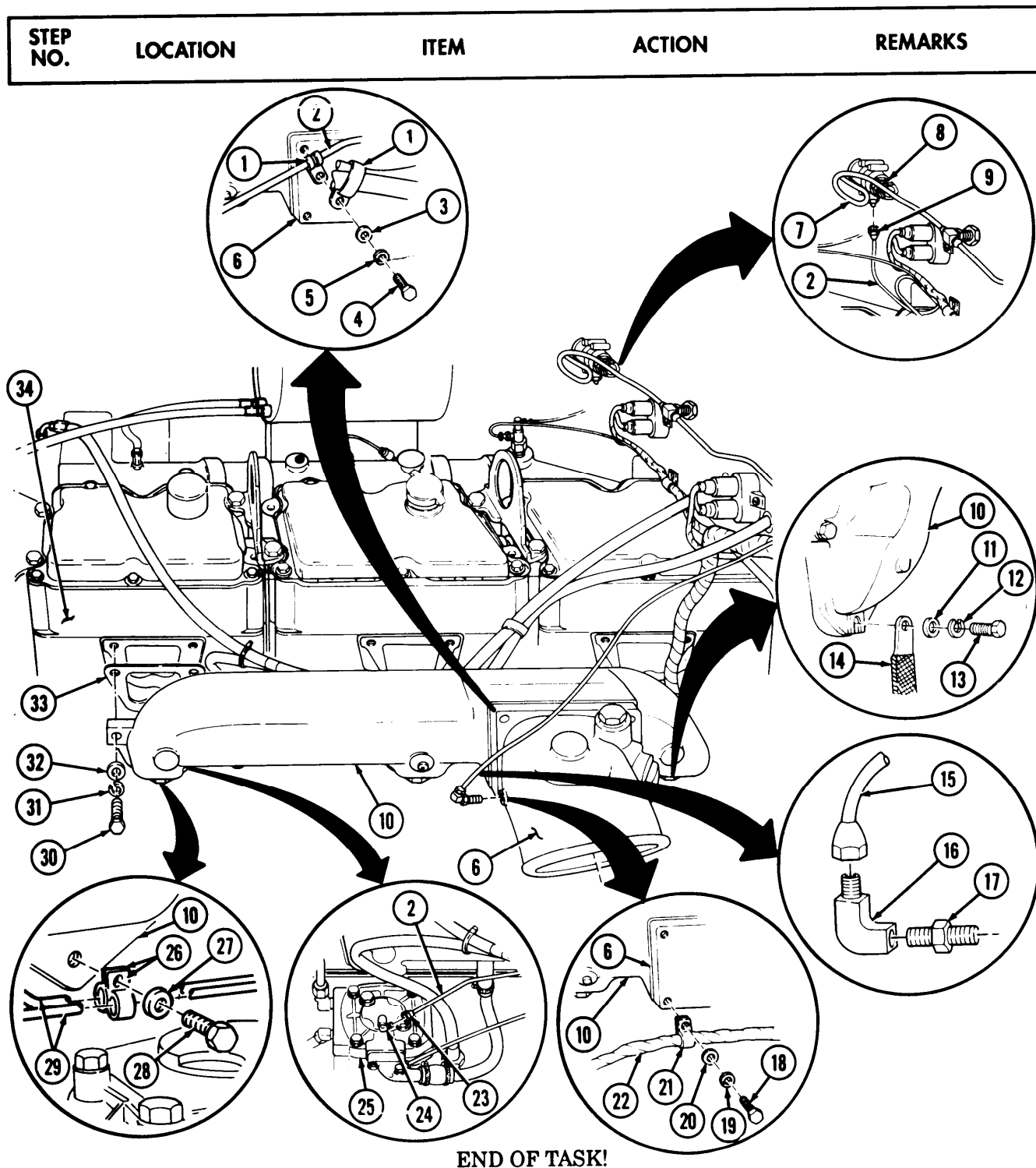
18.		Intake manifold (10) and three new gaskets (33)	Install on cylinder heads (34) with eight washers (32), new lock-washers (31), and screws (30).	Tighten 25-30 lb-ft (34-41 N·m).
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NOTE

Perform step 18.1 only if clamps were removed previously.

18.1.		Two clamps (26) and fuel tubes (29)	Install on intake manifold (10) with washer (27) and screw (28).	Tighten 20-25 lb-ft (27-34 N·m).
19.		Cable ground strap (14)	Install on intake manifold (10) with washer (11), new lockwasher (12), and screw (13).	Tighten 25-30 lb-ft (34-41 N·m).
20.		Wire harness (22) and clamp (21)	Install on lower left side of air intake connector (6) with washer (20), new lockwasher (19), and screw (18).	Tighten 25-30 lb-ft (34-41 N·m).
21.		Elbow (16) and air cleaner indicator filter (17)	Install on left side of air intake connector (6).	
22.		Hose (15)	Connect to elbow (16).	
23.		Air tube (2) and nut (9)	Connect to adapter (7) on air governor (8).	
24.		Air tube (2) and nut (23)	Connect to elbow (24) on air compressor (25).	
25.		Air tube (2) and two clamps (1)	a. Position two clamps (1) to screw hole in top left of air intake connector (6). b. Install with washer (3), new lockwasher (5), and screw (4).	Tighten 25-30 lb-ft (34-41 N·m).

3-13. ENGINE INTAKE MANIFOLD MAINTENANCE (Cont'd)



FOLLOW-ON TASKS:

- Install ether atomizer (TM 9-2320-272-20-1).
- Ž Install air compressor air intake tube (TM 9-2320-272-20-2).
- Install air intake pipe and hump hose (TM 9-2320-272-20-1).
- Ž Install crankcase breather tube (TM 9-2320-272-20-1).

3-14. ENGINE FUEL SUPPLY AND RETURN TUBES REPLACEMENT

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10 TM 9-2320-272-20-1	Parking brake set. Air compressor to engine oil coolant return tube removed. Water pump removed.
<u>Test Equipment</u>	Para. 5-7	
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Five lockwashers Sealing tape (Appendix C, Item 30)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272-20-1 TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

NOTE

Have drainage container ready to catch fuel.

- | | | | | |
|----|--|---|-------------|--------------------------|
| 1. | Fuel pump shutoff valve (16) | Fuel supply tube (17) | Disconnect. | |
| 2. | Fuel pump elbow (15) | Fuel return tube (6) | Disconnect. | |
| 3. | Left side engine block (1) and bracket (7) | Screw (12), lockwasher (11), washer (10), clamp (9), and spacer (8) | Remove. | Discard lockwasher (11). |
| 4. | | Screw (13), lockwasher (14), and bracket (7) | Remove. | Discard lockwasher (14). |

NOTE

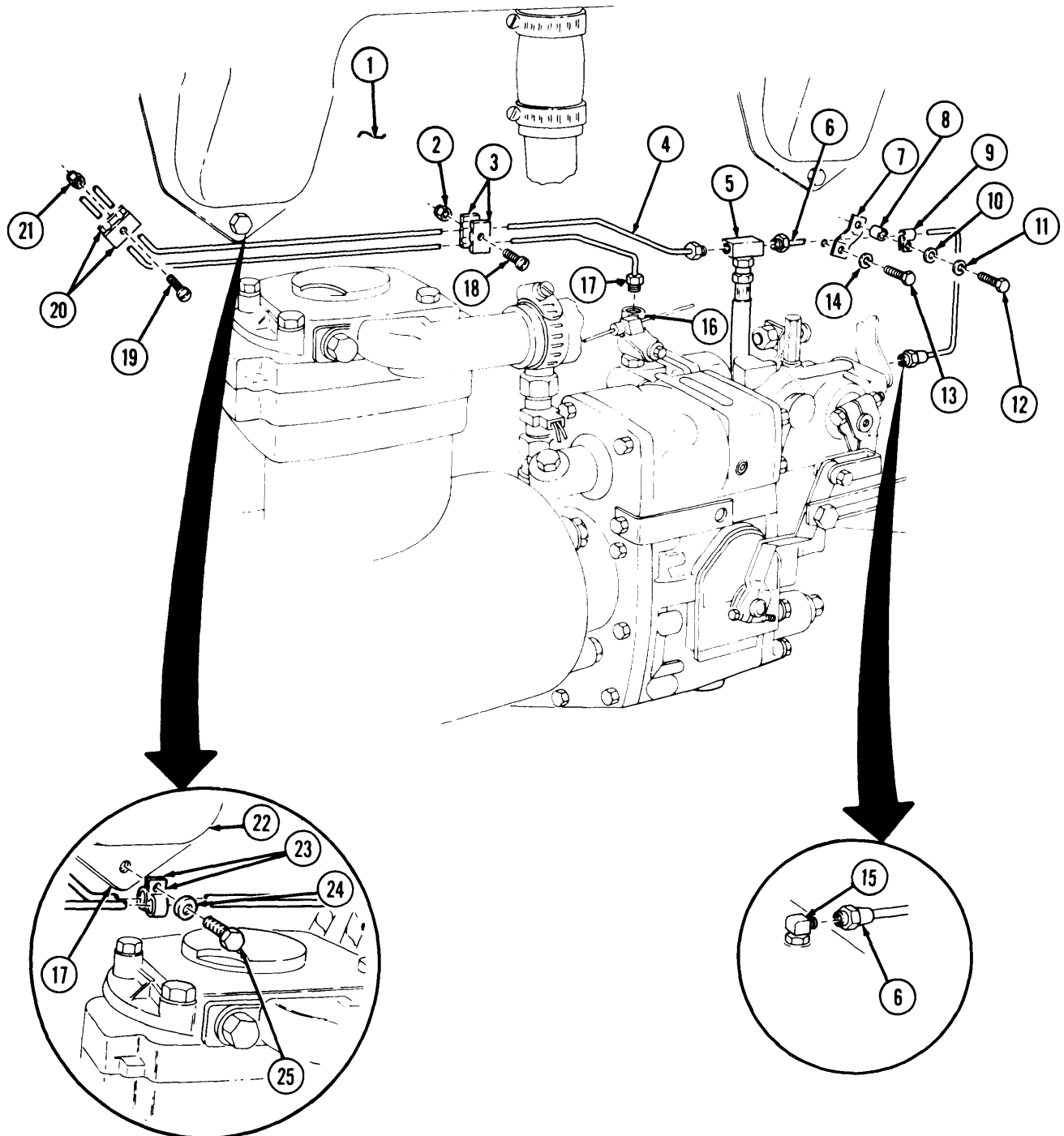
Step 5 may not be required on all vehicles.

- | | | | | |
|----|----------------------------|--|---------|--|
| 5. | Intake manifold (22) | Two clamps (23) and screw (25) and washer (24) | Remove, | |
| 6. | Left side engine block (1) | Screw (18), nut (2), and clamp (3) | Remove. | |
| 7. | | Screw (19), nut (21), and clamp (20) | Remove. | |

3-14. ENGINE FUEL SUPPLY AND RETURN TUBES REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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- | | | | | |
|----|-----------------|-------------------------------|-------------|--|
| 8. | Tee fitting (5) | Fuel return tubes (4) and (6) | Disconnect. | |
|----|-----------------|-------------------------------|-------------|--|



3-14. ENGINE FUEL SUPPLY AND RETURN TUBES REPLACEMENT (Contd)

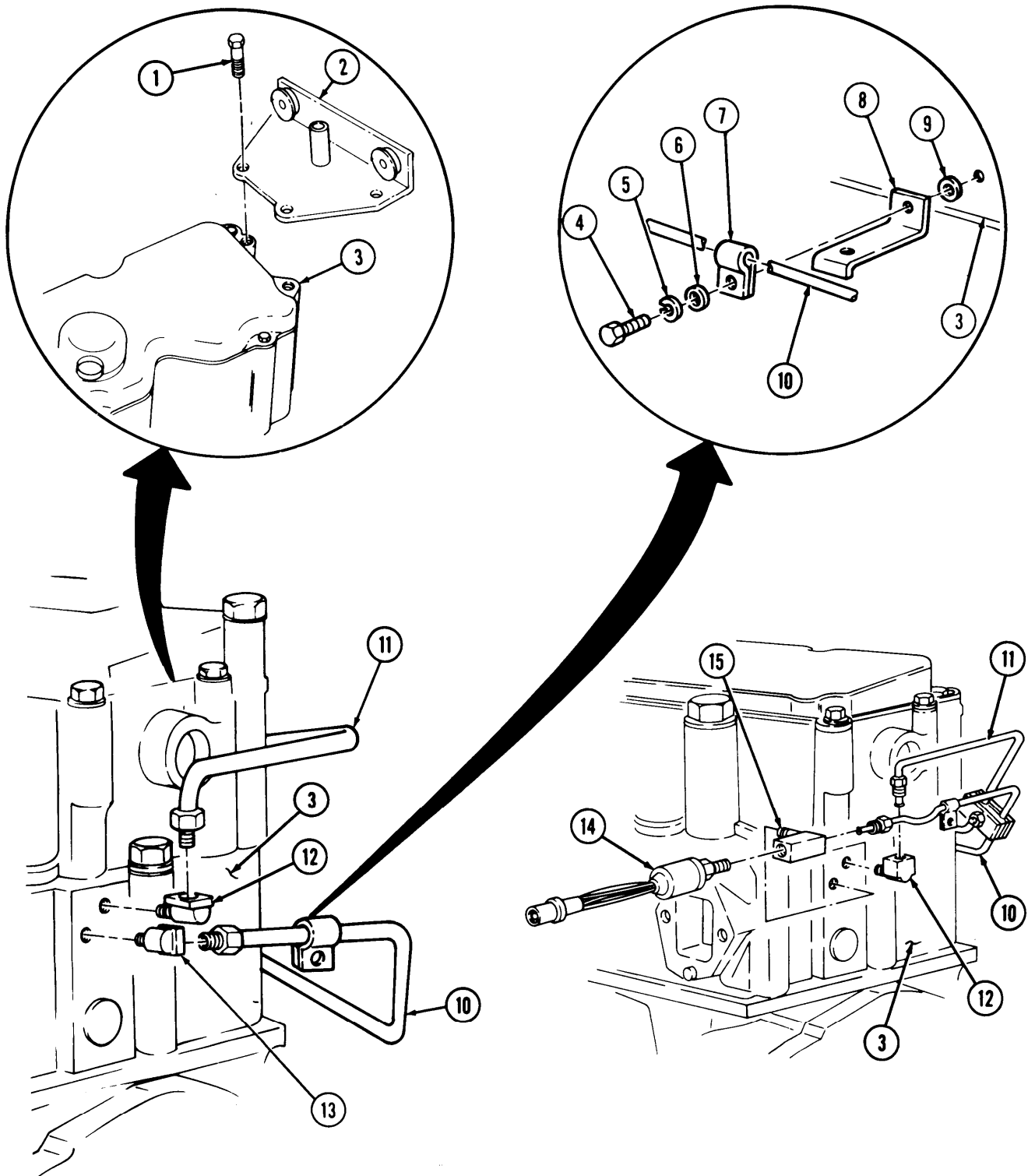
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
9.	Front of cylinder head (3)	Screw (4), lockwasher (5), washer (6), clamp (7), fuel supply tube (10), support bracket (8), and spacer (9)	Remove.	Discard lockwasher (5).
10.	Adapter fitting (13)	Fuel supply tube (10)	Remove.	
NOTE				
Perform step 10.1 for vehicles equipped with late model engine.				
10.1.	Tee (15)	Fuel supply tube (10) and fuel pressure transducer (14)	Remove.	
11.	Adapter fitting (12)	Fuel return tube (11)	Remove.	
12.	Front of cylinder head (3)	Two screws (1) and upper radiator support bracket (2)	Remove.	
13.		Two adapter fittings (12) and (13)	Remove.	Remove tee (15) for late model engine.

b. Installation

NOTE				
Wrap all male pipe threads with sealing tape before installation.				
14.		Two adapter fittings (12) and (13)	Install on front of cylinder head (3).	Tee (15) is used for late model engine.
15.		Upper radiator support bracket (2)	Install on front of cylinder head (3) with two screws (1).	Tighten 55-65 lb-ft (75-88 N·m).
16.		Fuel return tube (11)	Connect to adapter fitting (12).	
17.		Fuel supply tube (10)	Connect to adapter fitting (13).	
NOTE				
Perform step 17.1 for vehicles equipped with late model engine.				
17.1.		Fuel supply tube (10) and fuel pressure transducer (14)	Connect to tee (15).	
18.		Spacer (9), support bracket (8), clamp (7), fuel supply tube (10), washer (6), new lock-washer (5), and screw (4)	Install on front of cylinder head (3).	

3-14. ENGINE FUEL SUPPLY AND RETURN TUBES REPLACEMENT (Contd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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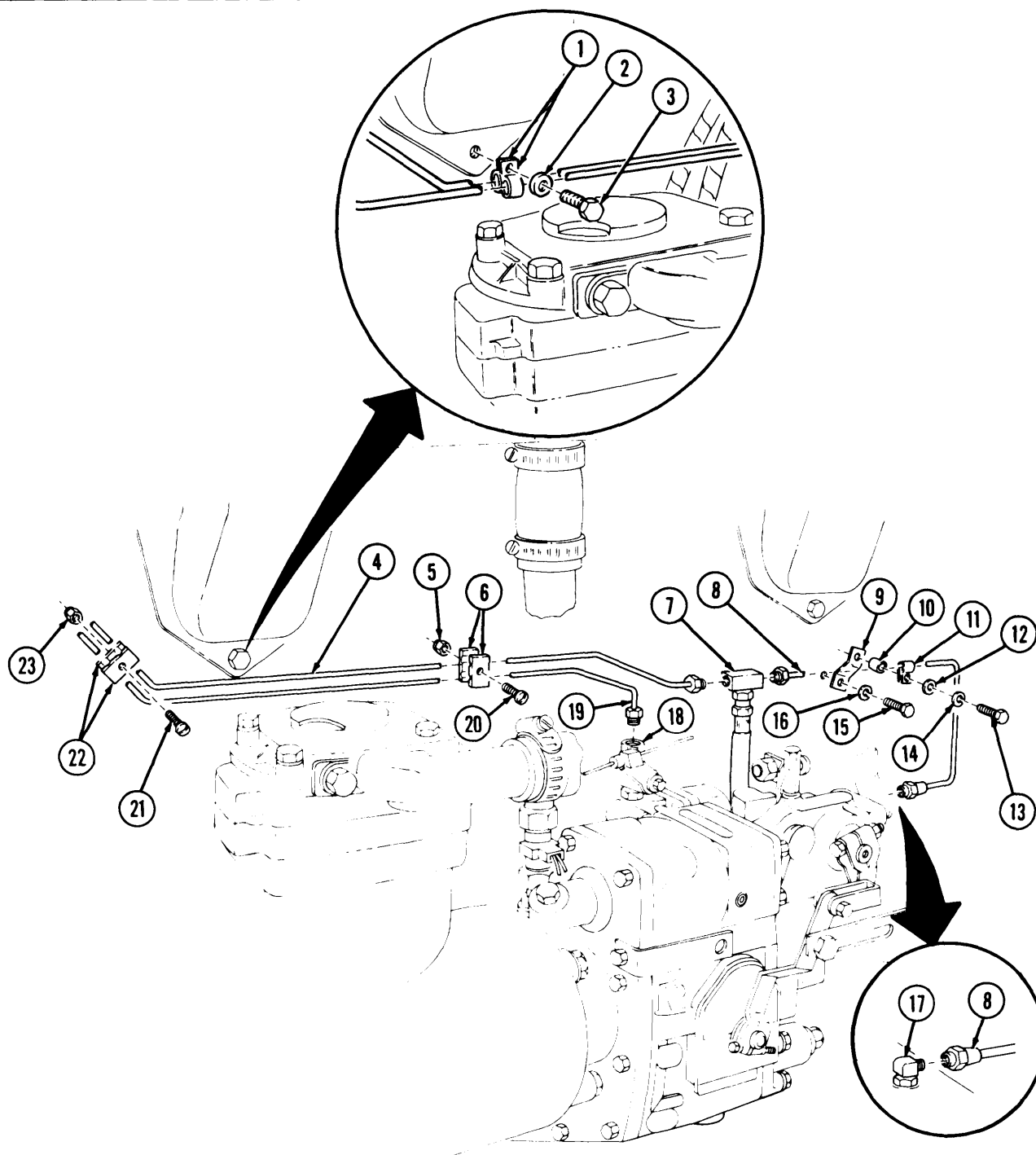


3-14. ENGINE FUEL SUPPLY AND RETURN TUBES REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
19.		Fuel return tubes (4) and (8)	Connect to tee fitting (7).	
20.		Screw (21), nut (23), and clamp (22)	Install,	
21.		Screw (20), nut (5), and clamp (6)	Install.	
NOTE				
Step 22 may not be required on all vehicles.				
22.		Two clamps (1), screw (3), and washer (2)	Install.	
23.		Screw (15), new lock-washer (16), and bracket (9)	Install.	
24.		Screw (13), new lock-washer (14), washer (12), clamp (11), and spacer (10)	Install,	
25.		Fuel return tube (8)	Connect to fuel pump elbow (17).	
26.		Fuel supply tube (19)	Connect to fuel shutoff valve (18).	

3-14. ENGINE FUEL SUPPLY AND RETURN TUBES REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

- FOLLOW-ON TASKS:
- Install air compressor to engine oil cooler coolant return tube (TM 9-2320-272-20-1).
 - Install water pump (para. 5-7).

TA 350072

3-15. ENGINE LIFT EYES REPLACEMENT

This task covers:

a. Removal

b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10 TM 9-2320-272-10	Parking brake set. Left and right splash shields removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Locknut		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

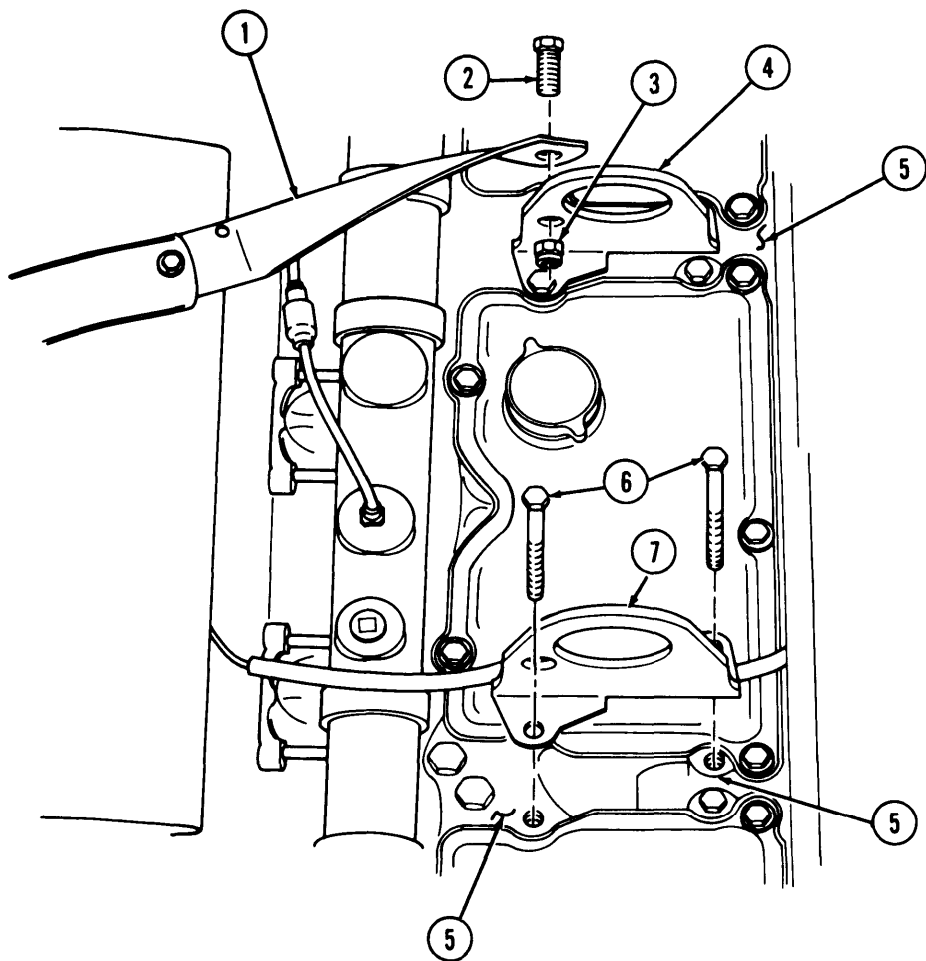
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|----|---|---|---------|----------------------|
| 1. | Rear lift eye (4) to surge tank support (1) | Screw (2) and locknut (3) | Remove. | Discard locknut (3). |
| 2. | Rocker lever housings (5) | Four screws (6) and two lift eyes (4) and (7) | Remove. | |

b. Installation

- | | | | |
|----|---------------------------|--|----------------------------------|
| 3. | Two lift eyes (4) and (7) | Install on rocker lever housings (5) with four screws (6). | Tighten 55-65 lb-ft (75-88 N-m). |
| 4. | Surge tank support (1) | Install on rear lift eye (4) with screw (2) and new locknut (3). | |

3-15. ENGINE LIFT EYES REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install left and right splash shields (TM 9-2320-272-10),

TA 350073

3-16. ROCKER LEVER HOUSING COVERS REPLACEMENT

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10	Parking brake set.
<u>Test Equipment</u>	Para. 3-15	Engine lift eyes removed.
None		
<u>Special Tool</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		<u>General Safety Instructions</u>
Two locknuts		None
Fifteen lockwashers		
Three rocker lever cover gaskets		
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W (2)		
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

NOTE

Perform steps 1 through 3 for removing rocker lever housing cover closest to firewall.

1. Air compressor elbow (18) and governor fitting (15)

Air line (16)

Remove.
2. Left and right cab "A" posts (1)

Two locknuts (5), washers (4), and rubber cushions (3)

Remove.

Discard locknuts (5).

NOTE

Assistant will help with step 3.

3.

Left and right screw jacks (6)

Turn to raise cab above frame (2) 4-5 in. (102-127 mm).

Turn both screws (6) at the same time.
4. Breather (8)

Hose clamps (10)

Loosen and remove hose (9).

NOTE

Perform step 4.1 for late model engine only.

- 4.1. Breather (8) and elbow (21)

Two clamps (19)

Loosen and remove breather tube (20).

3-16. ROCKER LEVER HOUSING COVERS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Rocker lever housings are mounted with screw-assembled lockwashers on late model engine.

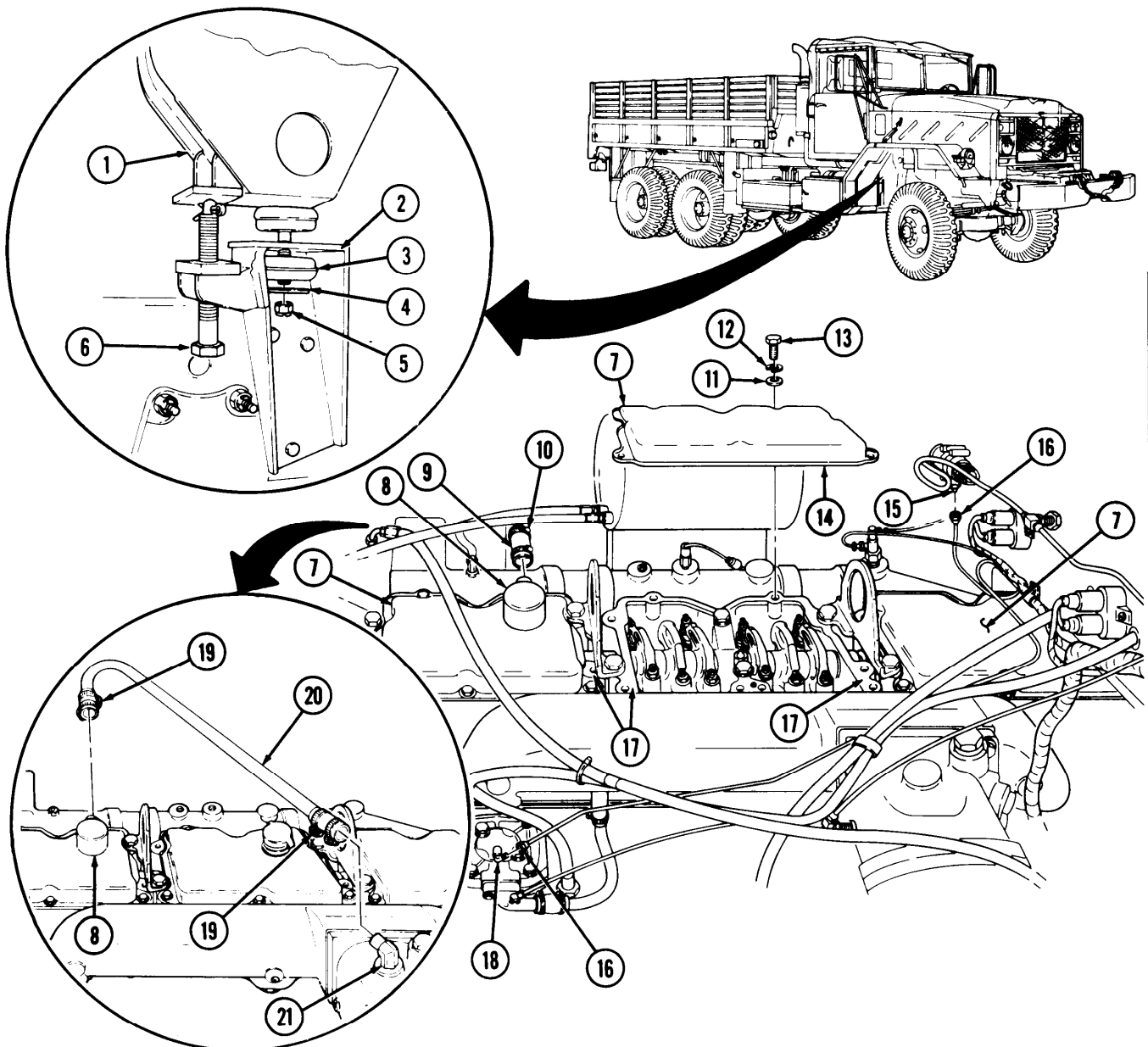
5. Three rocker lever housings (17)

Fifteen screws (13), lockwashers (12), washers (11), three rocker covers (7), and gaskets (14)

Remove.

Discard lockwashers (12) and gaskets (14).

Clean gasket remains from mating surfaces.



3-16. ROCKER LEVER HOUSING COVERS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Installation

6.		Three new gaskets (8) and rocker lever housing covers (1)	Install on three rocker lever housings (11) with fifteen washers (5), new lockwashers (6), and screws (7).	Tighten 10-15 lb-ft (14-20 N·m).
7.		Breather hose (3)	Connect to breather (2) with hose clamp (4).	

NOTE

Perform step 7.1 for late model engine only.

7.1.		Breather hose (20)	Connect to breather (2) and elbow (21) with two clamps (19).	
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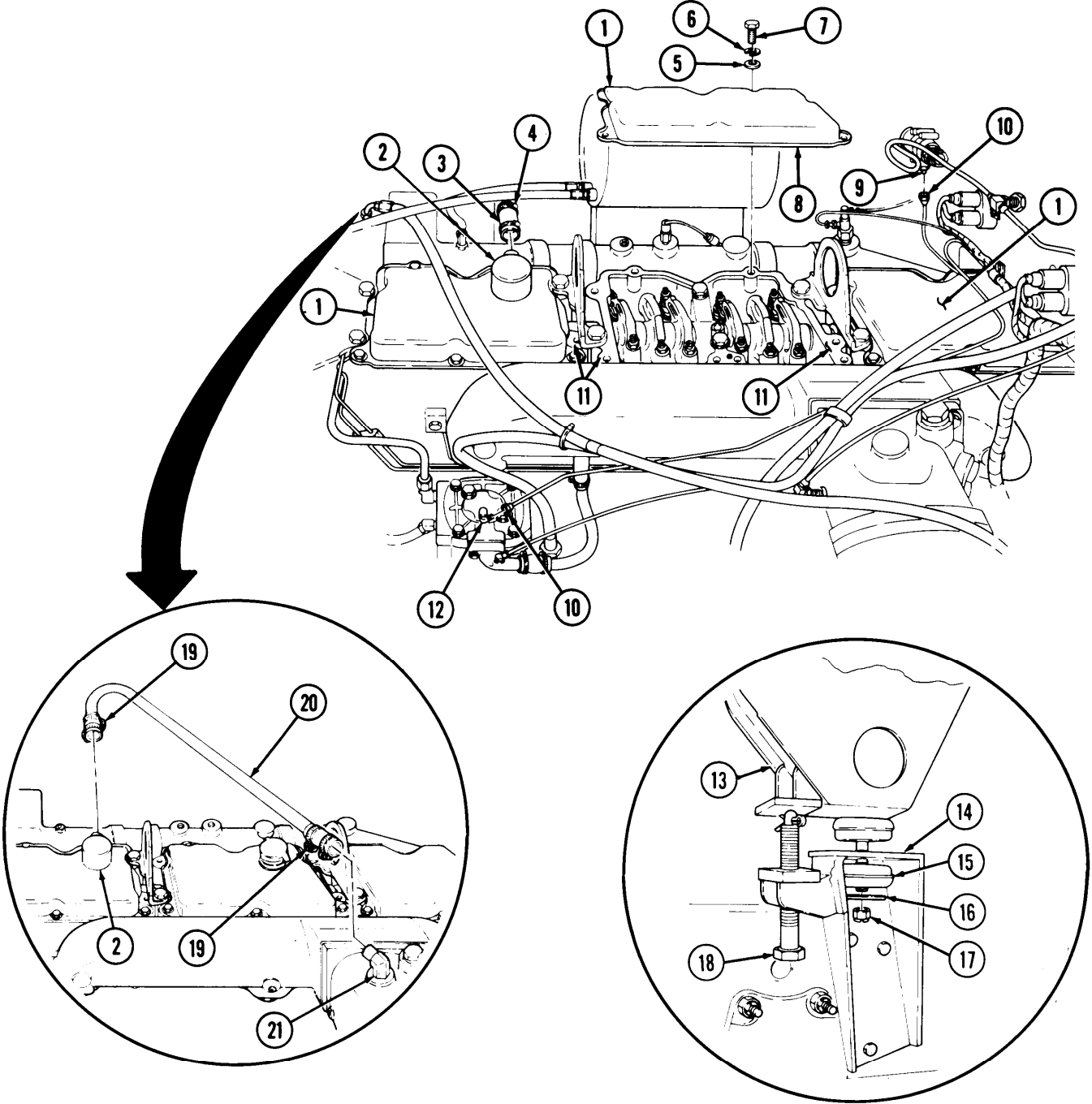
NOTE

- Perform steps 8 through 10 for number three rocker lever housing cover only.
- Assistant will help with step 8.

8.		Left and right screw jacks (18)	Turn to lower cab on frame (4).	Turn both screws (18) at the same time. Clearance between cab "A" post (13) and jack screw (18) should be 1-2 in. (25-50 mm).
9.		Two rubber cushions (15)	Install on left and right cab "A" posts (13) with two washers (16) and new locknuts (17).	
10.		Air line (10)	Connect to air compressor elbow (12) and governor fitting (9).	

3-16. ROCKER LEVER HOUSING COVERS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS: • Install splash shields (TM 9-2320-272-10).
Ž Install engine lift eyes (para. 3-15).

3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE

This task covers:

- a. Removal

b. Disassembly

c. Cleaning and Inspection
- d. Reassembly

e. Installation

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 3-13	Intake manifold removed.
	Para. 3-16	Rocker lever housing covers removed.
	Para. 14-6	Engine access cover (in cab) removed.
Test Equipment		
None		
Special Tools		Special Environmental Conditions
Rocker lever bushing block and mandrel ST-691		None
Materials/Parts		
Eighteen locknuts		
Six "O" rings		
Three gaskets		
Adhesive sealant (Appendix C, Item 2)		
Lubricating oil OE\HDO 30 (Appendix C, Item 17)		
Prussian blue (Appendix C, Item 20)		
Personnel Required		General Safety Instructions
Wheeled vehicle repairman MOS 63W (2)		Keep fire extinguisher nearby when using drycleaning solvent.
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

NOTE

Rocker lever housings are mounted with screw-assembled washers on late model engine.

1. Eighteen rocker levers (2)

Eighteen adjusting screw locknuts (7)

Loosen.
2.

Eighteen adjusting screws (8)

Loosen two turns.
3. Three cylinder heads (4)

Eighteen screws (1), twelve washers (10), upper radiator support bracket (9), three rocker lever housings (3), and gaskets (5)

Remove.

Tag housings (3) for installation.

Discard gaskets (5).

Clean gasket remains from mating surfaces.
4.

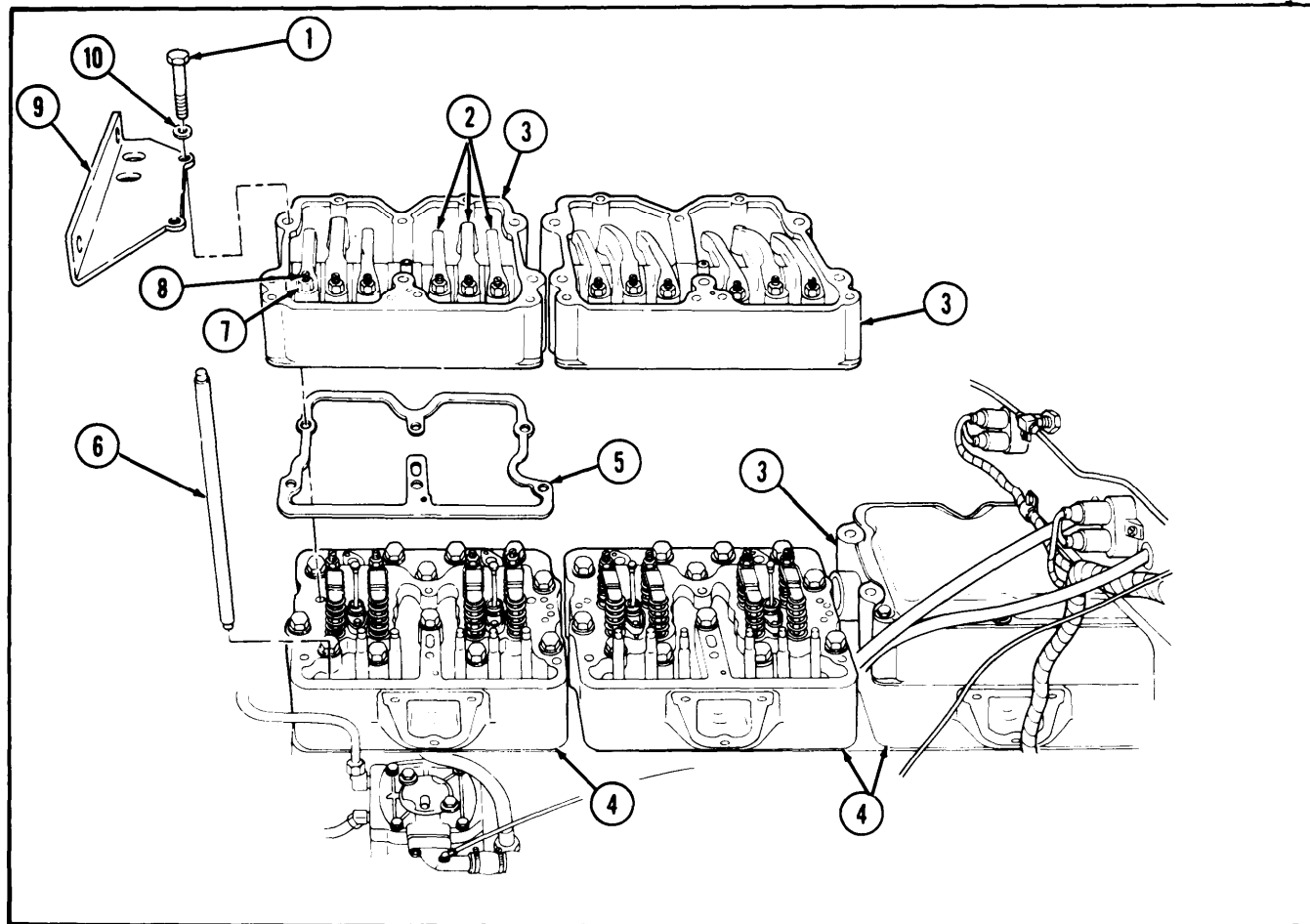
Eighteen push tubes (6)

Remove.

Tag push tubes (6) for installation.

3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Disassembly

- | | | | |
|----|--------------------------|-------------------------------|---------|
| 5. | Rocker lever housing (9) | Shaft retaining set-screw (6) | Remove. |
|----|--------------------------|-------------------------------|---------|

CAUTION

When removing rocker lever shaft, center the brass drift and lightly tap on shaft. Striking the housing or levers will cause damage.

NOTE

- Mark locations of rocker levers for proper installation during assembly.
- Mark direction of rocker lever shaft for proper installation during assembly.

- | | | | | |
|----|---------------------------------|---|---------|------------------------|
| 6. | Rocker lever housing (9) | Rocker lever shaft (7) | Remove. | Use brass drift. |
| 7. | Rocker lever shaft (7) | Two "O" rings (8) | Remove. | Discard "O" rings (8). |
| 8. | Rocker lever housing (9) | Two exhaust rocker levers (3), injector rocker levers (4), and intake rocker levers (5) | Remove. | |
| 9. | Rocker levers (3), (4), and (5) | Six rocker lever adjusting screws (2) and locknuts (1) | Remove. | Discard locknuts (1). |

c. Cleaning and Inspection

- | | | | |
|-----|----------------------------|---|--|
| 10. | Rocker lever bushings (11) | a. Wipe clean and inspect for cracks and pitting.
b. Measure inner diameter at several points. | Discard if cracked or pitted.

If inner diameter is more than 1.129 in. (28.66 mm), replace bushings (11). |
|-----|----------------------------|---|--|

NOTE

Steps 10c and 11 are performed only if bushings are to be replaced.

- | | |
|------------|--|
| c. Remove. | Use arbor press and ST-691 mandrel (13). |
|------------|--|

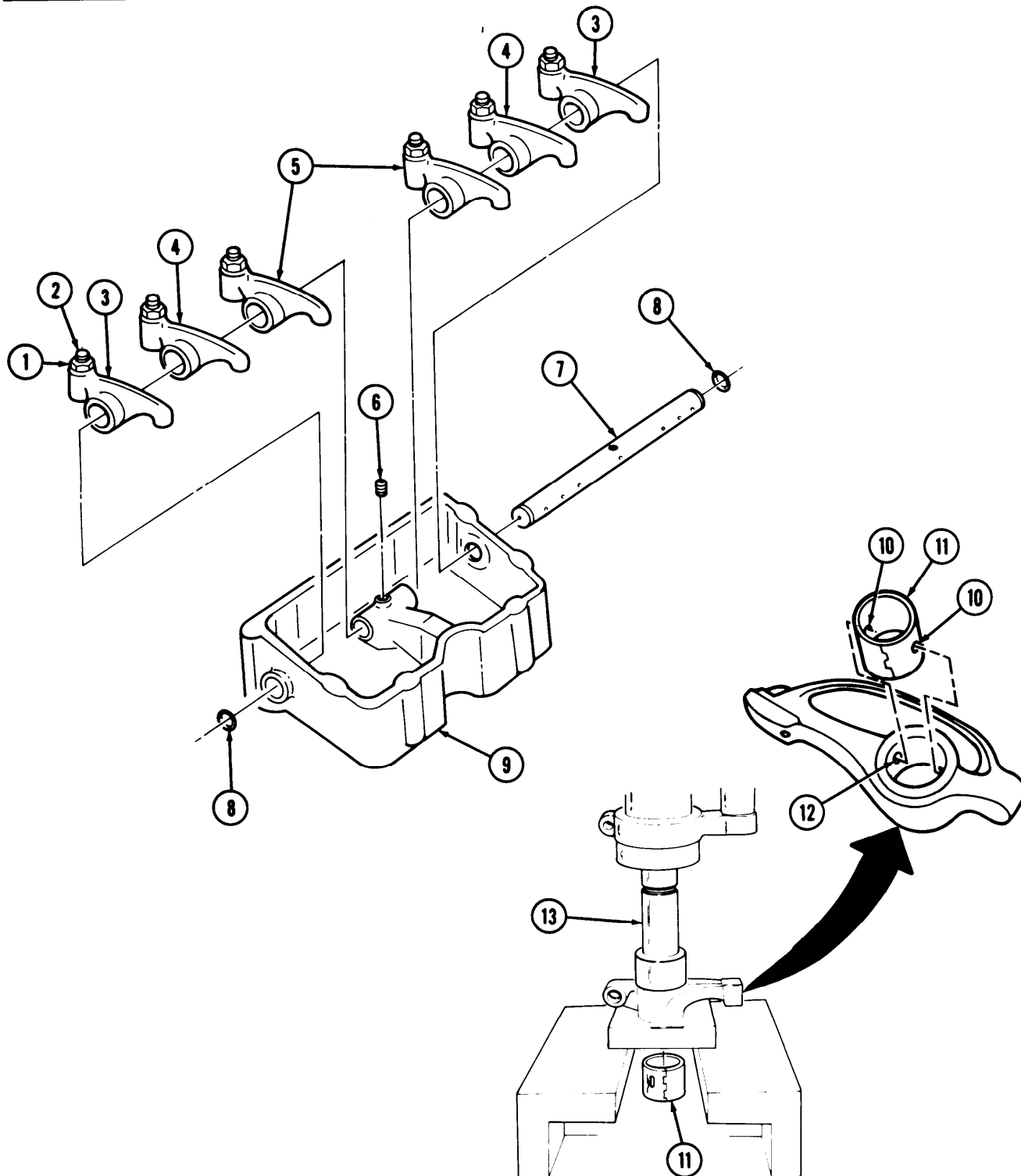
CAUTION

Make sure new bushing oil holes are properly aligned to oil passages in rocker levers. Failure to do so will cause lubrication failure and severe engine damage.

- | | | | |
|-----|-------------------|---|--|
| 11. | New bushings (11) | Install in rocker levers (3), (4), and (5) with oil holes (10) aligned with rocker lever oil passages (12). | Use arbor press and ST-691 mandrel (13). |
|-----|-------------------|---|--|

3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE (Cont'd)

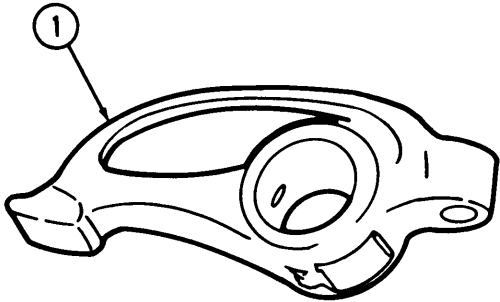
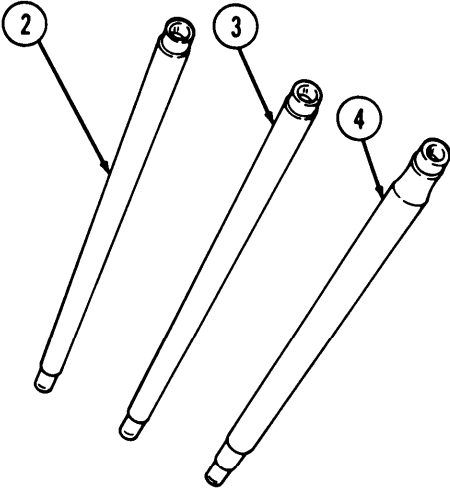
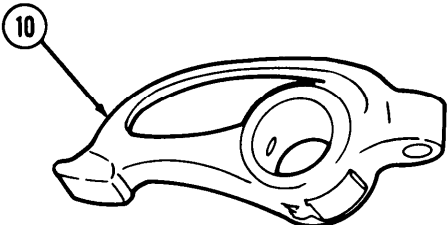
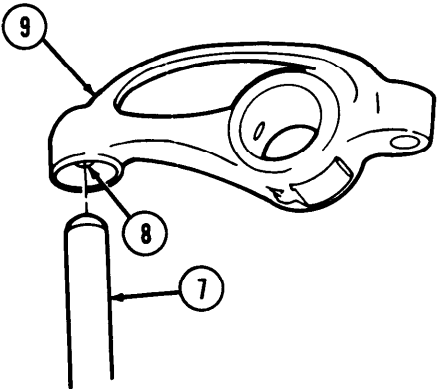
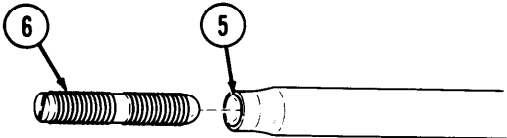
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
12.		Intake rocker lever (1), exhaust rocker lever (10), and injector rocker lever (9)	Wipe clean and inspect for breaks, cracks, and plugged oil passages.	If broken, cracked, or if oil passages are plugged, replace.
13.		Injector rocker lever (9)	Inspect socket seat (8) as follows: a. Coat new injector link (7) ball end with prussian blue. b. Place ball end of injector link (7) into socket seat (8) and rotate using hand pressure. c. Check seat (8) wear area.	If seat (8) wear area is not 80% blued, replace socket seat (8). If cracked or bent, replace.
14.		Intake push tube (2), exhaust push tube (3), and injector push tube (4)	a. wipe clean and inspect for cracks and bends. b. Coat ball end of new adjusting screw (6) with prussian blue. c. Place ball end of screw (6) into tube socket (5) and rotate using hand pressure. d. Check socket (5) wear area.	If socket (5) wear area is not 80% blued, replace.

3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				
				
				

3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
15.		Six valve adjusting screws (2)	a. Wipe clean and move new nut (1) full length of adjusting screw (2) by hand. b. Inspect ball end (3) for flat spots.	If new nut (1) binds on threads, replace adjusting screw (2). Use 114 in. (6.35 mm) radius gage. If flat spots are noted, discard screws (2).
16.		Rocker lever housing (8).	a. Wipe clean and inspect for cracks and breaks. b. Inspect shaft bore (9) for scratches, and measure inner diameter at several points for wear.	If cracked or broken, replace. Use bore gage. If bore (9) is scratched, or if inner diameter is more than 1.125 in. (28.56 mm), replace housing (8).

WARNING

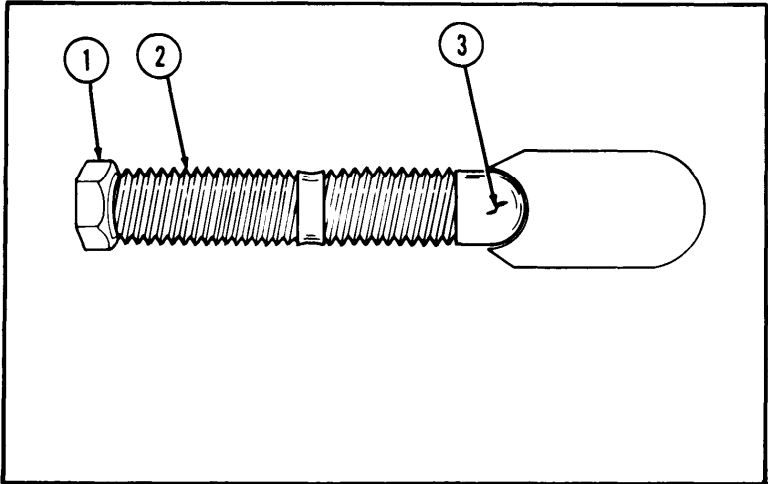
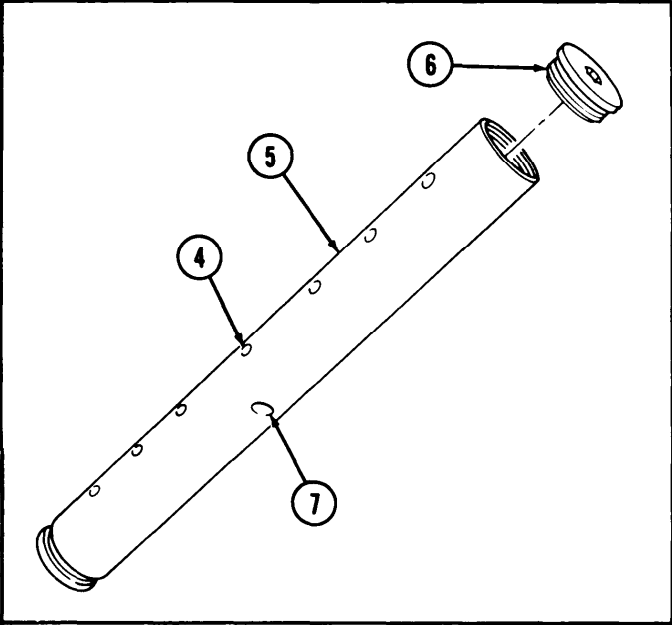
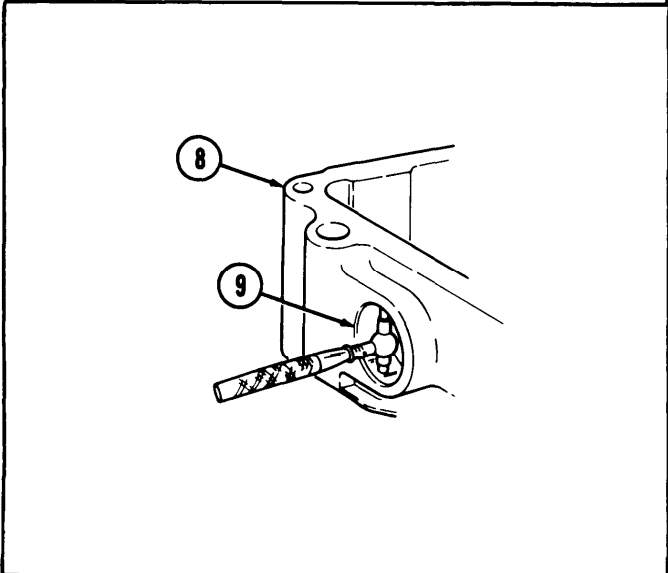
Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

NOTE

Perform step 16.1 if plugs are to be replaced.

16.1		Rocker lever plugs (6)	Remove.	Discard if cracked, pitted, or threads are damaged.
17.		Rocker lever shaft (5)	a. Clean oil passages (4). b. Inspect for scratches and measure outer diameter at several points for wear.	Use drycleaning solvent and brush. If scratched or outer diameter is less than 1.122 in. (28.50 mm), replace.
17.1		Rocker lever plugs (6)	a. Install on rocker lever shaft (5). b. Mark end of plug (6) to indicate set screw hole (7) position.	Tighten plugs (6) 50-70 lb-ft (68-95 N•m).

3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				
				

3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Reassembly

NOTE

Lightly oil all parts before reassembly.

- | | | |
|-----|--|--|
| 18. | Six rocker lever adjusting screws (2) and new locknuts (1) | Install one each in rocker levers (3), (4), and (5). |
|-----|--|--|

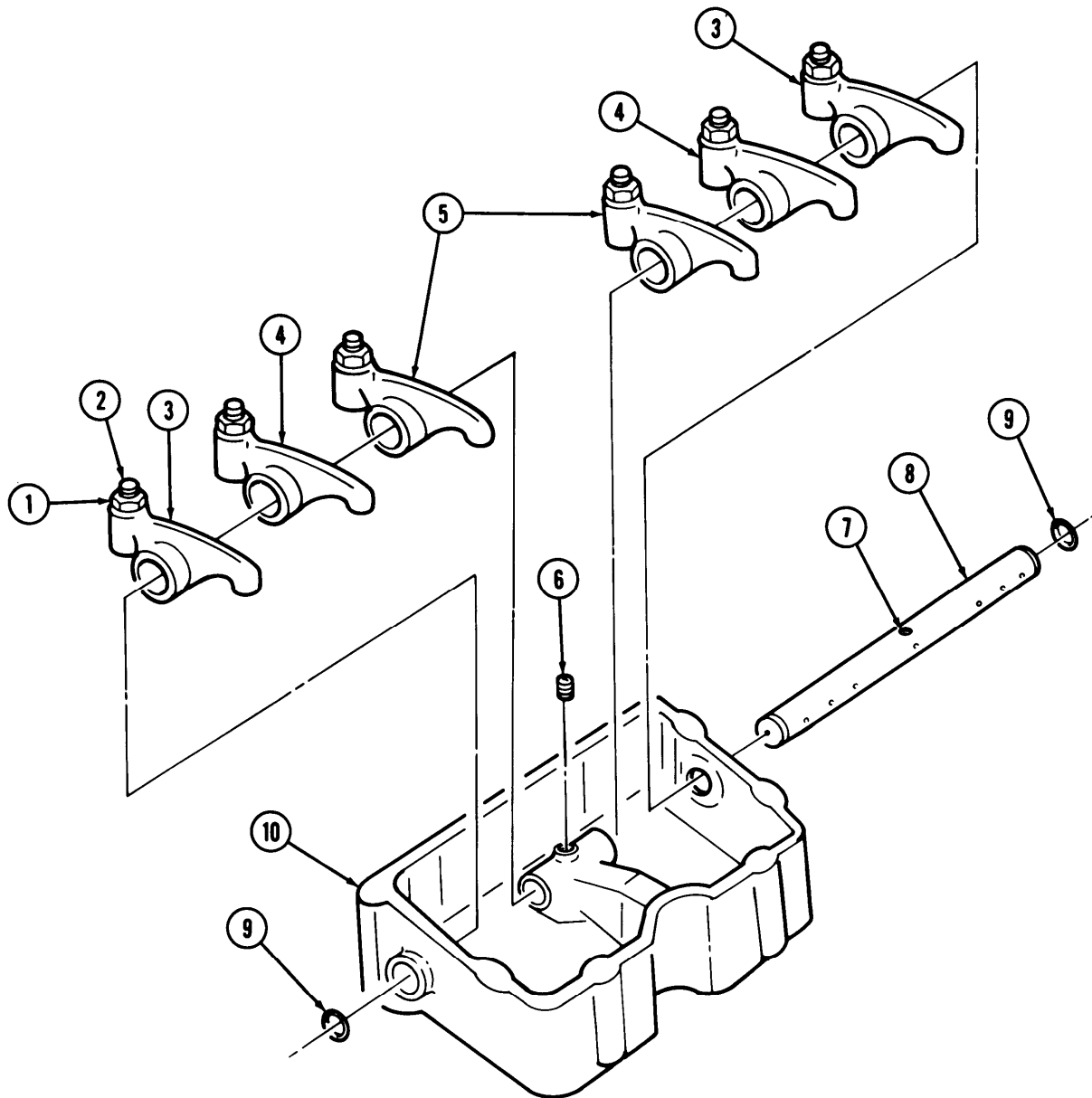
CAUTION

Make sure rocker lever shaft oil holes are properly aligned to oil passages in rocker lever housing. Failure to do this will cause lubrication failure and engine damage.

- | | | | |
|-----|---|---|---|
| 19. | Two exhaust rocker levers (3), intake rocker levers (5), and injector rocker levers (4) | <p>Install in rocker lever housing (10).</p> <p>a. Install rocker lever shaft (8) through one end of rocker lever housing (10).</p> <p>b. Install rocker lever shaft (8) through rocker levers (3), (4), and (5) and through center of rocker lever housing (10).</p> <p>c. Install first new "O" ring (9) and next set of rocker levers (3), (4), and (5).</p> <p>d. Install second new "O" ring (9) on rocker lever shaft (8).</p> <p>e. Complete installation of rocker lever shaft (8) through rocker lever housing (10).</p> | |
| 20. | Rocker lever shaft (8) | <p>Align hole (7) in rocker lever shaft (8) with hole in rocker lever housing (10) and install setscrew (6).</p> | <p>Apply adhesive sealant to threads of setscrew (6) before installation.</p> |

3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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e. Installation

NOTE

- Rocker lever housings are mounted with screw-assembled washers for late model engine.
- Do not mix push tubes during installation. The injector tube is the largest, and is positioned between the intake and exhaust push tubes. Intake and exhaust push tubes are identical.
- Make sure push tubes remain seated during rocker lever housing installation.

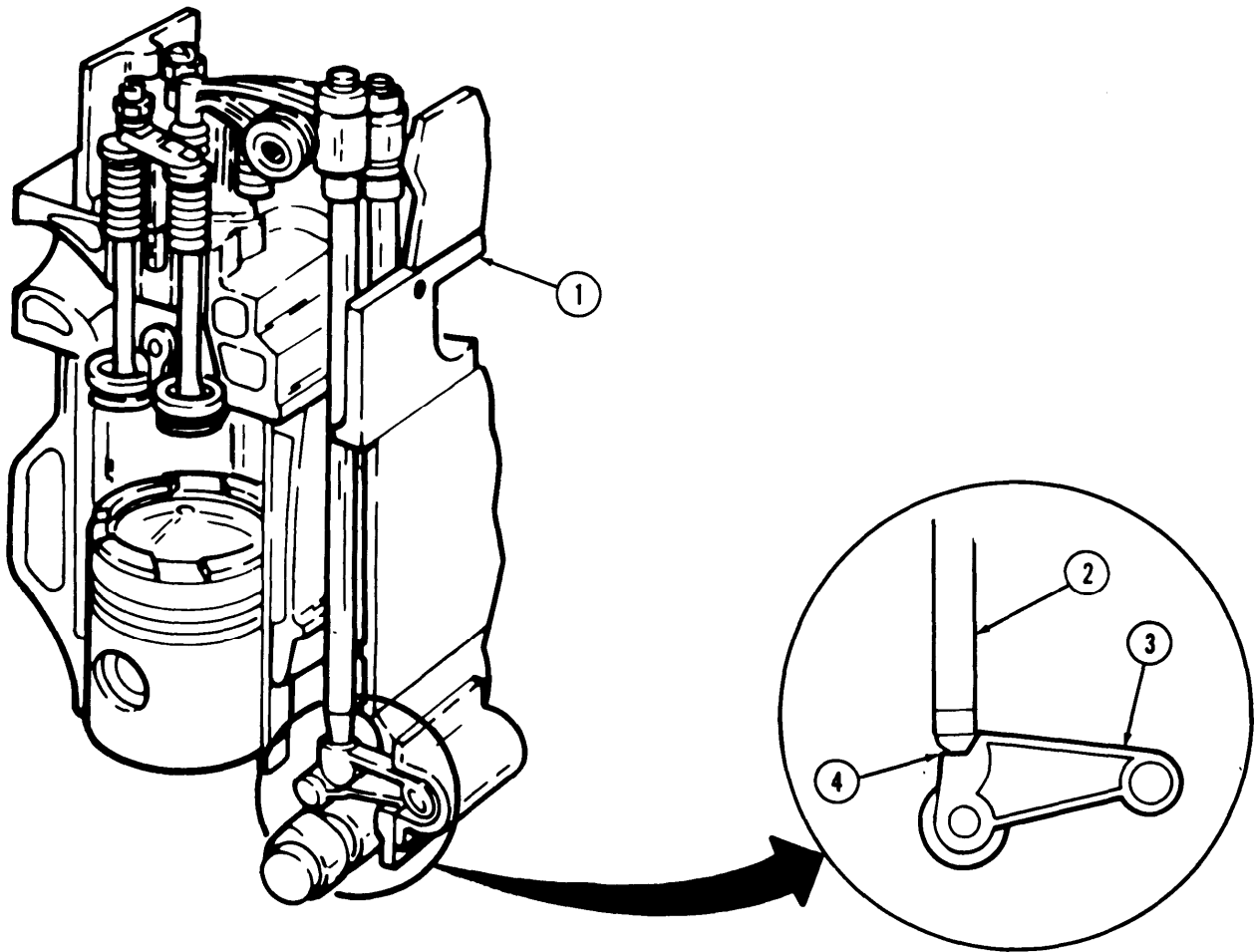
21.

Eighteen push tubes (2)

Install through cylinder head (1) and into socket seat (4) on cam follower (3).
22.

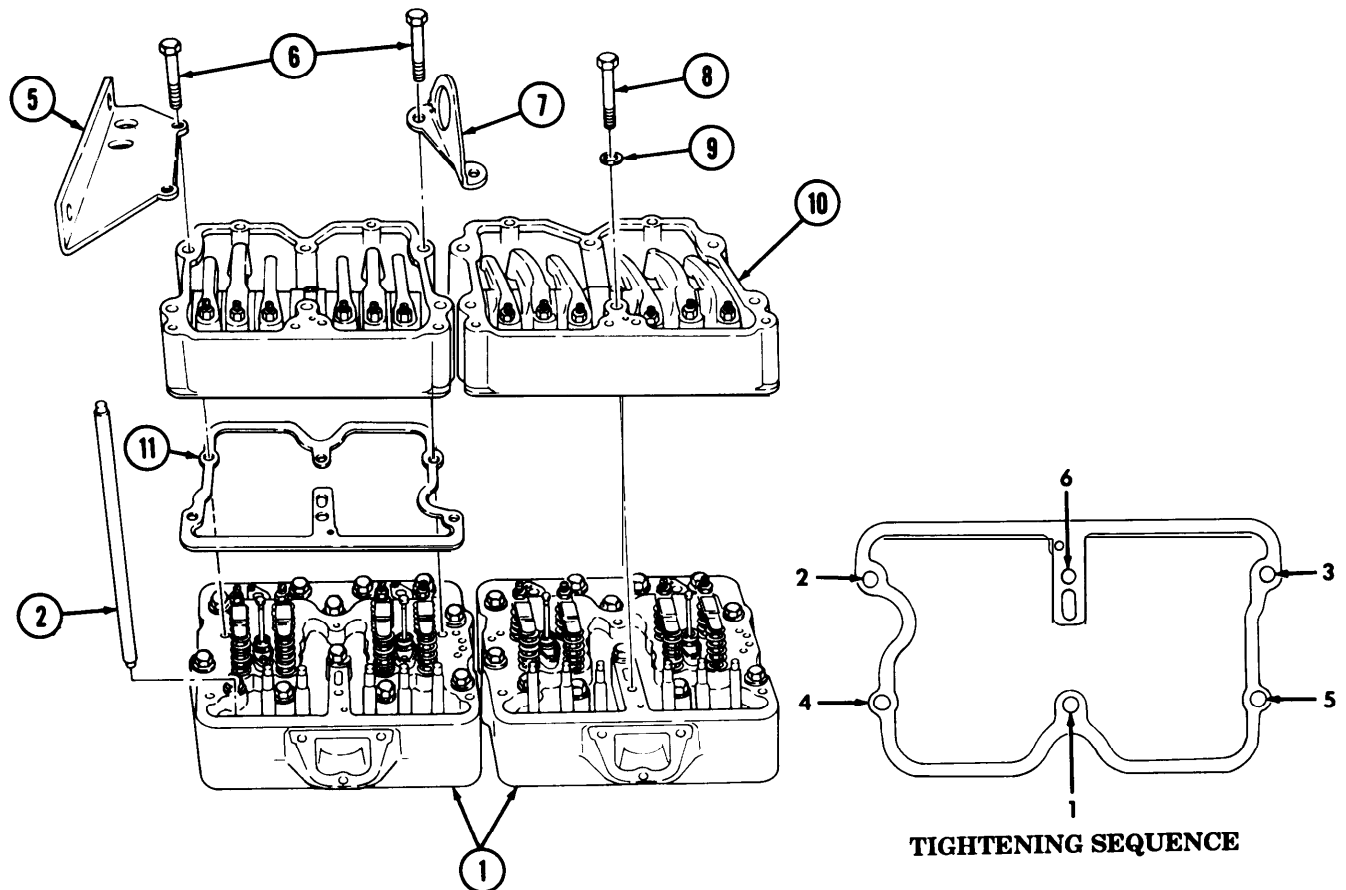
Three new gaskets (11) and rocker lever housings (10)

Install on cylinder heads (1) and align push tubes (2) with rocker levers.



3-17. ROCKER LEVER HOUSINGS AND PUSH TUBES MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
23.		Upper radiator support bracket (5) and two lifting eyes (7)	Install on rocker lever housings (10) with six screws (6).	Finger tighten screws (6).
<p style="text-align: center;">NOTE</p> <p>Rocker lever housings are mounted using screw-assembled lock-washers on late model engine.</p>				
24.		Twelve washers (9) and screws (8)	Install on rocker lever housings (10) and cylinder heads (1).	Tighten screws (6) and (8) 50-65 lb-ft (68-88 N•m) in sequence shown.



END OF TASK!

FOLLOW-ON TASKS:

- Adjust valve and injector (dial indicator method) (para. 3-105).
- Install rocker lever housing cover(s) (para. 3-16).
- Install engine access cover (in cab) (para. 14-6).
- Install intake manifold (para. 3-13).

3-18. VALVE CROSSHEADS REPLACEMENT

This task covers:

- a. Removal
- b. Inspection
- c. Installation and Adjustment

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-17	Rocker lever housings and push tubes removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1.

Twelve crossheads (1)

Twelve crosshead adjusting nuts (3)

Loosen.
2.

Cylinder heads (4)

Twelve crossheads (1)

Remove.

Tag for installation.

b. Inspection

3.

Valve crossheads (1)

Inspect for cracks, breaks, and scoring.

Replace crossheads (1) if cracked, broken, or scored.
4.

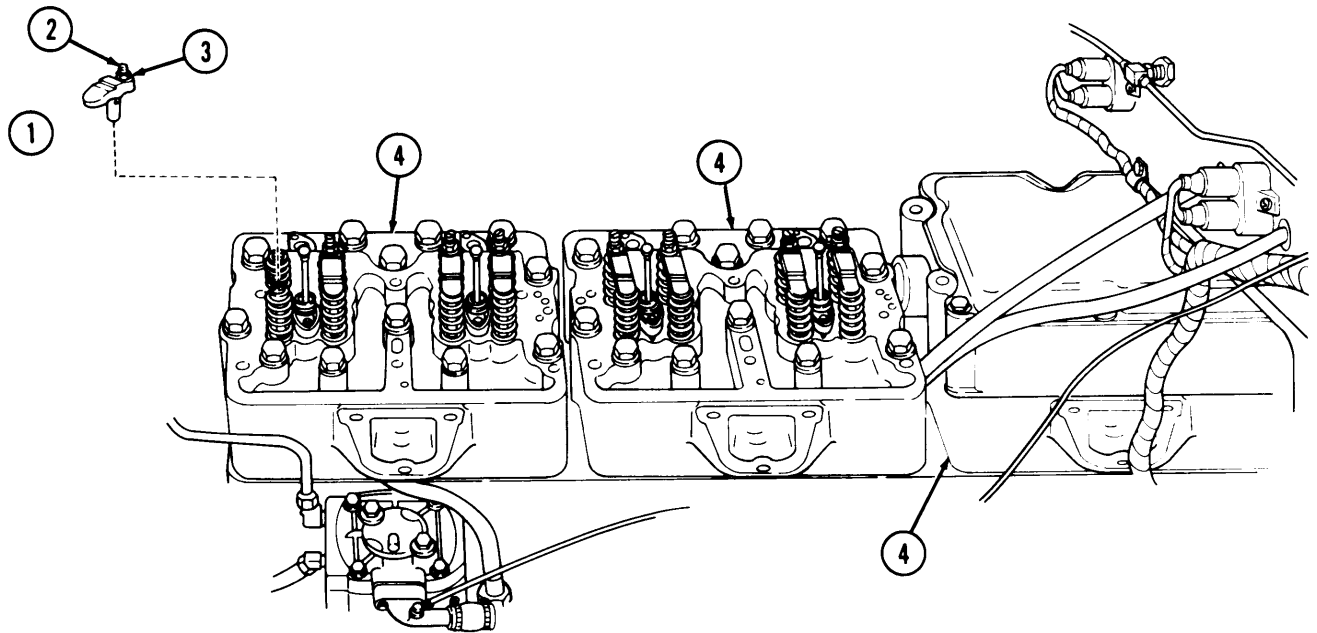
Adjusting screws (2)

Inspect for damaged threads.

Replace screws (2) if threads are damaged.

3-18. VALVE CROSSHEADS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-18. VALVE CROSSHEADS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Installation and Adjustment

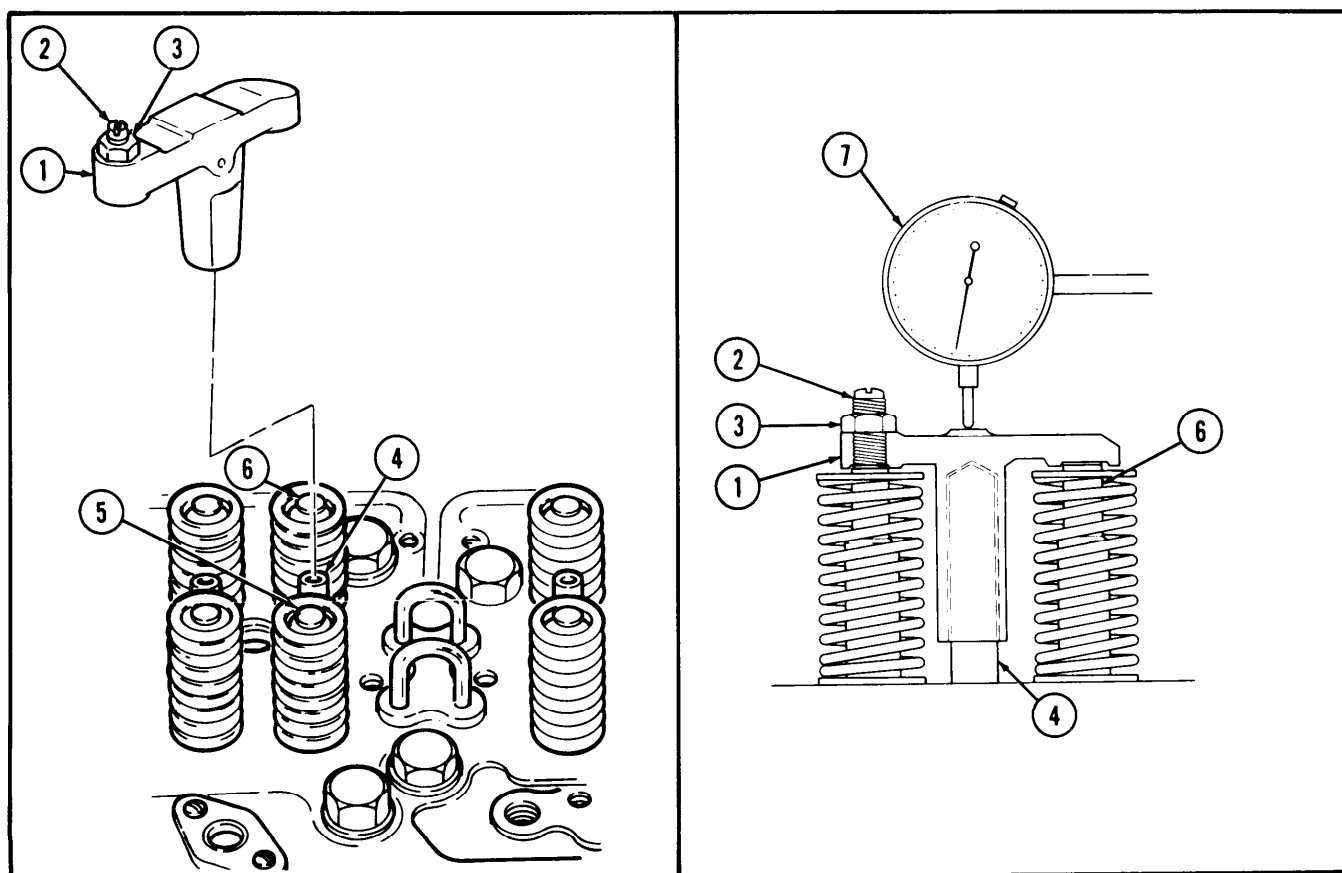
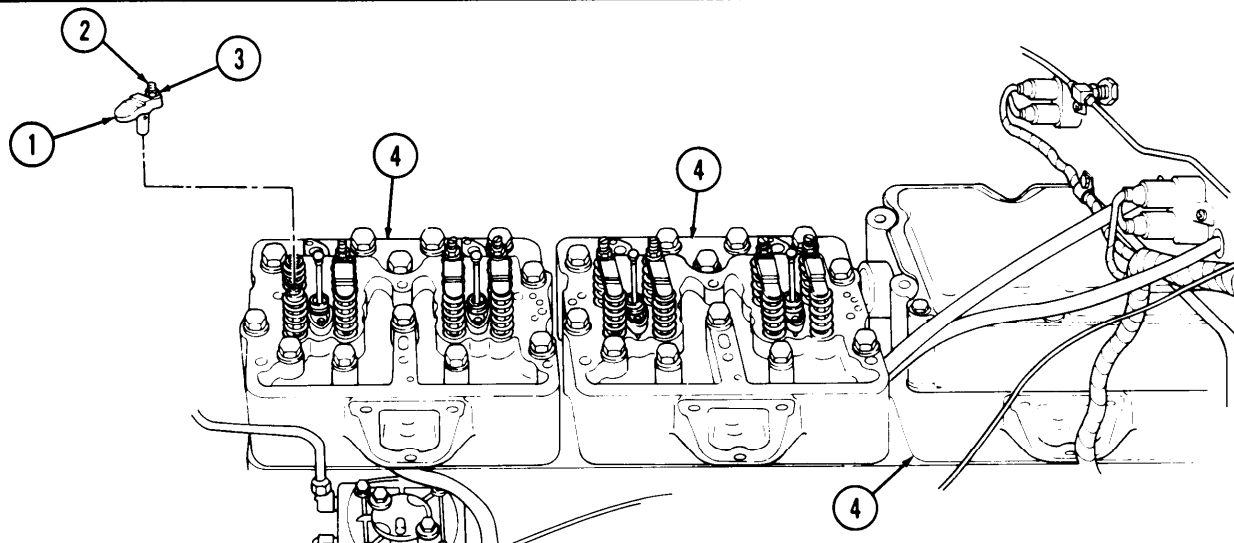
5.		Valve crosshead lock-nut (3)	Loosen and back out adjusting screw (2) one full turn.	
6.		Twelve crossheads (1)	Install and adjust as follows: a. Coat with light film of clean engine oil and install on cylinder head (4) guide. b. Hold crosshead (1) down so it contacts valve stem (6) on side opposite adjusting screw (2). c. Turn adjusting screw (2) down until it just touches valve stem (5).	Adjusting screw (2) faces toward exhaust manifold side of engine. Use finger pressure. It maybe necessary to loosen locknut (3).
<p>NOTE</p> <p>Make sure adjusting screw is just lightly seated.</p> <p>d. Setup dial indicator (7) over center of crosshead (1). e. Pressing down on crosshead (1), zero dial indicator (7). f. Holding crosshead (1) down lightly, turn adjusting screw (2) in until dial indicator reads between .025 -.040 in. (.64 -.80 mm).</p> <p>Minimum clearance must be 0.025 in. (0.64 mm). If not, see following note. Use torque wrench adapter and tighten locknuts (3) 22-26 lb-ft (30-35 N•m).</p>				

NOTE

If minimum clearance is not 0,025 in, (0.64 mm), advance adjusting screw 1/3 of one hex on new crossheads and guides or 1/2 hex on old crossheads and guides, retighten locknut, and check clearance.

3-18. VALVE CROSSHEADS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install rocker lever housings and push tubes (para. 3-17).

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3-19. FUEL CROSSOVER CONNECTORS REPLACEMENT

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10	Parking brake set.
	TM 9-2320-272-10	Left and right splash shields removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
None	None	
<u>Materials/Parts</u>		
Eight lockwashers		
Eight “0” rings		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W	None	
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Fuel crossover connectors are mounted using screw-assembled lockwashers on late model engine.

a. Removal

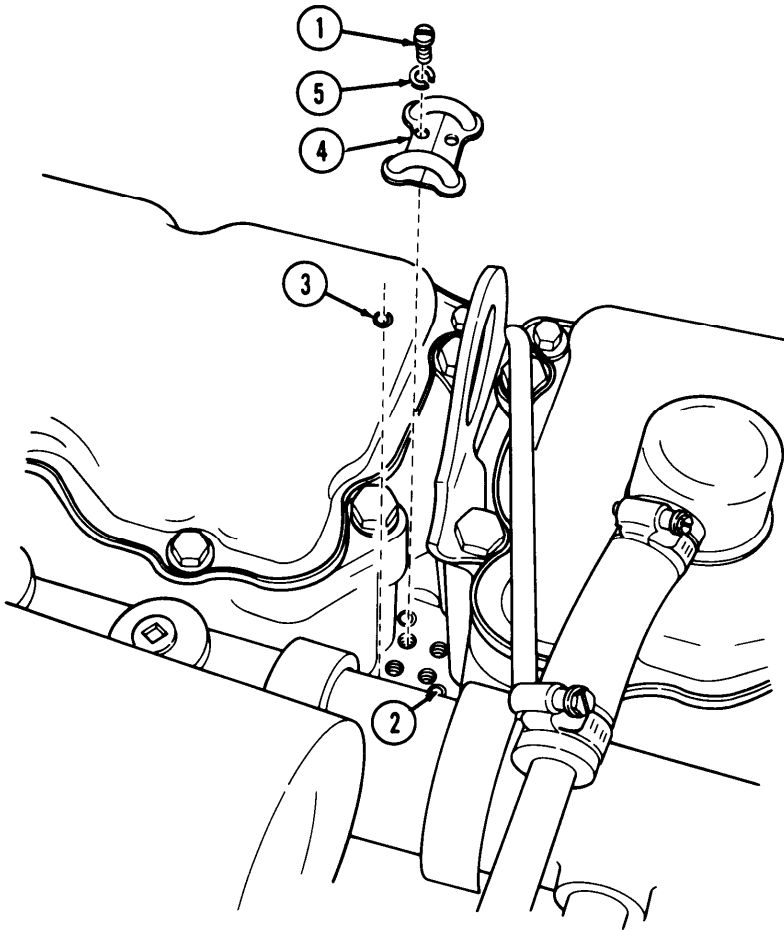
- | | | | | |
|----|--------------------|---|---------|--|
| 1. | Cylinder heads (2) | Eight screws (1) and lockwashers (5), two crossover connectors (4), and eight "O" rings (3) | Remove. | Discard "O" rings (3) and lockwashers (5). |
|----|--------------------|---|---------|--|

b. Installation

- | | | | | |
|----|--|------------------------------|--|-------------------------------------|
| 2. | | Eight new "O" rings (3) | Coat lightly with clean engine oil and insert in fuel crossover connector bores on cylinder heads (2). | |
| 3. | | Two crossover connectors (4) | Install on cylinder heads (2) with eight new lockwashers (5) and screws (1). | Tighten 34-38 lb-in. (3.8-4.3 N•m). |

3-19. FUEL CROSSOVER CONNECTORS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

3-20. ENGINE CYLINDER HEADS REPLACEMENT

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-14	Engine fuel supply and return tubes removed.
	Para. 3-18	Valve crossheads removed.
	Para. 3-19	Fuel crossover connectors removed.
	Para. 4-27	Fuel injectors removed.
	Para. 5-5	Water manifold removed.
	Para. 3-7	Exhaust manifold removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Three cylinder head gaskets		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		None
<u>Manual References</u>		
TM 9-2320-272-34P		

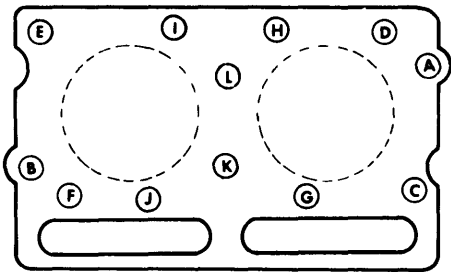
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

NOTE

Assistant will help with steps 1 and 2.

- | | | | | |
|----|---------------------------------------|---------------------------------------|---------|--|
| 1. | Three cylinder heads (2) | Thirty-six screws (1) and washers (6) | Remove. | Follow alphabetical loosening sequence. |
| 2. | Cylinder block (4) and dowel pins (3) | Three cylinder heads (2) | Remove. | Tag for installation. |
| 3. | | Three cylinder head gaskets (5) | Remove. | Discard gaskets (5).
Clean gasket remains from mating surfaces. |



LOOSENING SEQUENCE

3-20. ENGINE CYLINDER HEADS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Installation

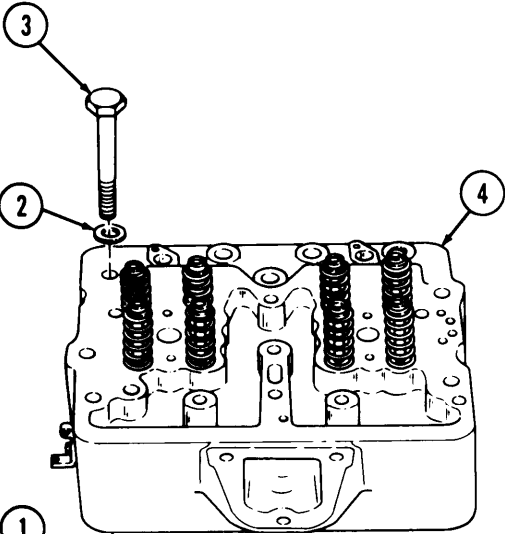
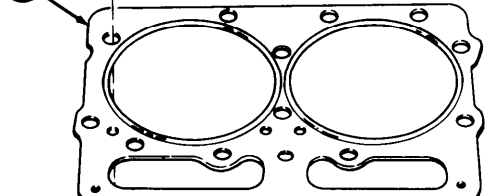
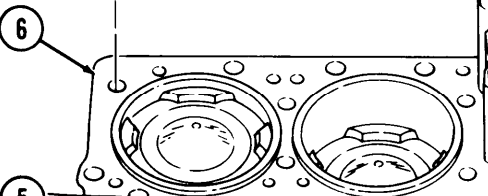
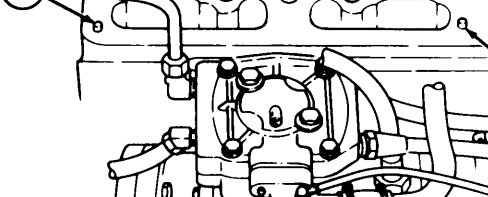
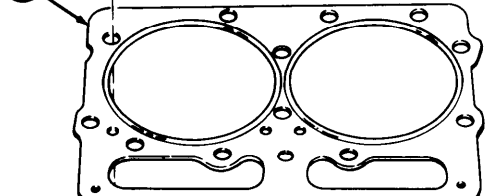
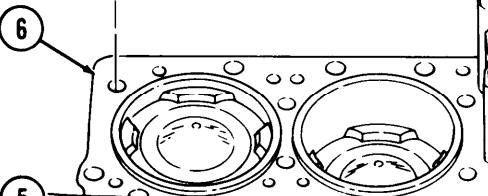
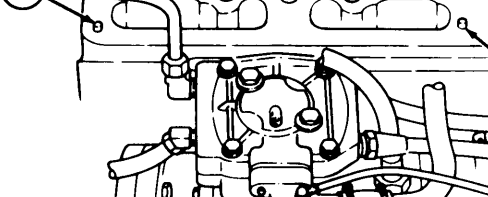

CAUTION

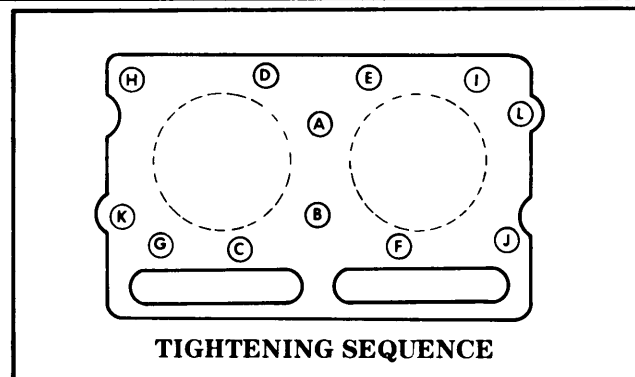
If old cylinder heads are being installed, make sure they are installed in the same location,

NOTE

Assistant will help with steps 4 and 5.				
4.		Three new cylinder head gaskets (1)	Install over dowels (5) on engine block (4).	Make sure the word "TOP" is facing up.
5.		Three cylinder heads (4)	a. Install over dowels (5) on engine block (6) with thirty-six screws (3), and washers (2). b. Tighten screws (3) in alphabetical sequence, 80-100 lb-ft (109 -136 N•m), c. Tighten screws (3) in alphabetical sequence, 180-200 lb-ft (244 -271 N•m). d. Tighten screws (3) in alphabetical sequence 280-300 lb-ft (380 -407 N•m).	Follow alphabetical tightening sequence and tighten 25 lb-ft (34 N•m).

3-20. ENGINE CYLINDER HEADS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
3				
4				



END OF TASK!

- FOLLOW-ON TASKS:
- Install water manifold (para. 5-5).
 - Install fuel injectors (para. 4-27).
 - Install fuel crossover connectors (para. 3-19).
 - Install valve crossheads (para. 3-18).
 - Install engine fuel supply and return tubes (para. 3-14).
 - Install exhaust manifold (para. 3-7).

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3-21. CAM FOLLOWER HOUSING MAINTENANCE

This task covers:

- | | |
|----------------------------|-----------------|
| a. Removal | d. Reassembly |
| b. Disassembly | e. Installation |
| c. Cleaning and Inspection | |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-4	Fuel pump removed (for cylinders 3 and 4).
	Para. 10-5	Air compressor removed (for cylinders 1 and 2).
	Para. 3-17	Rocker lever housings and push tubes removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Two cup plugs		
Six lockwashers		
Cam follower housing gaskets		
Lubricating oil OE/HDO 30		
(Appendix C, Item 17)		
Prussian blue (Appendix C, Item 20)		
No. 3 Permatex (Appendix C, Item 27)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		Keep fire extinguisher nearby when using drycleaning solvent.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

- Maintenance procedures for all three cam follower housings are the same.
- Cam follower housings are mounted with screw-assembled lockwashers on late model engine.

a. Removal

NOTE

Removal of fuel line bracket is only required for number 2-3 cam follower housing.

- | | | | | |
|----|--------------------------|---|---------|--------------------------|
| 1. | Cam follower housing (4) | Six screws (5) and lockwashers (6), and fuel line bracket (7) | Remove. | Discard lockwashers (6). |
|----|--------------------------|---|---------|--------------------------|

3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

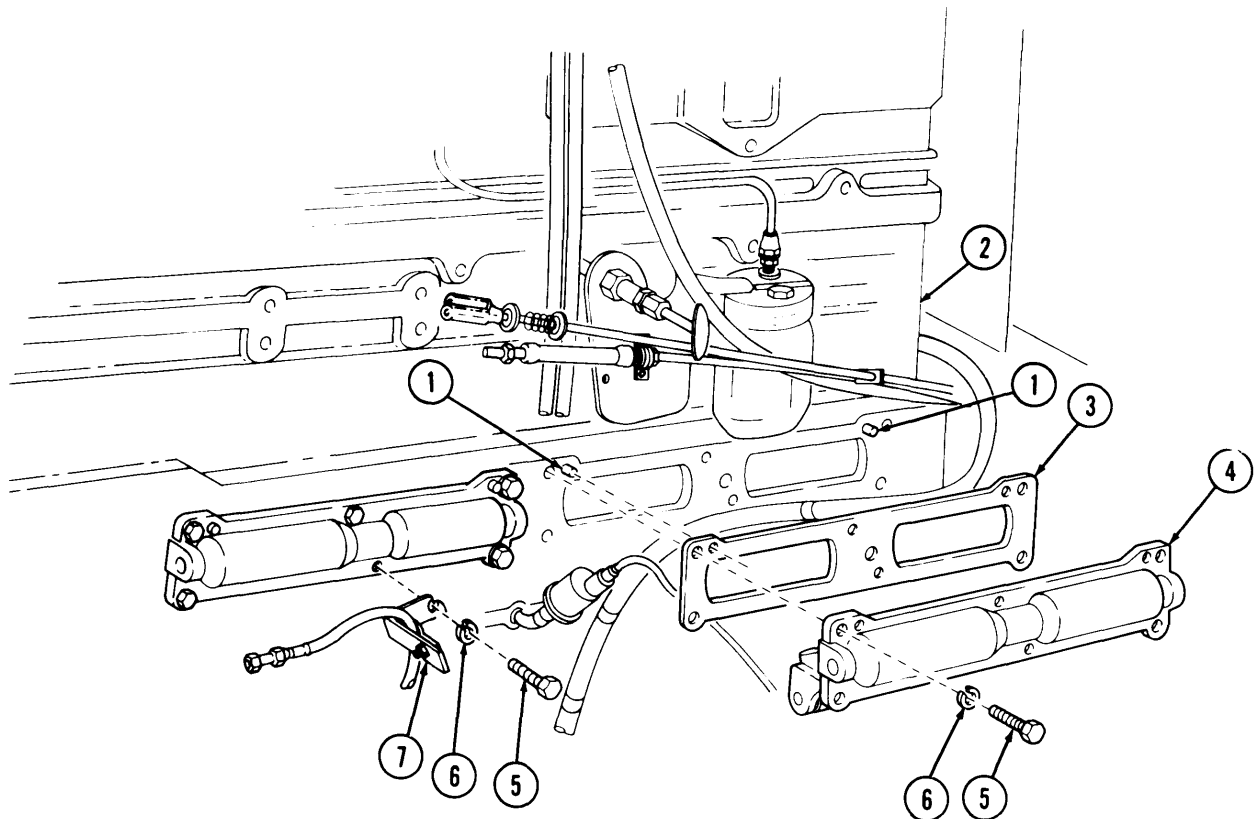
LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Do not discard cam follower housing gaskets before measuring total thickness of each gasket, Total thickness of all gaskets is critical for seating of cam followers on camshaft for correct injector and valve timing. Damage to engine will result if gasket spacing is not correct when installing cam followers.

- | | | | | |
|----|--------------------|--------------------------|---|---|
| 2. | Cylinder block (2) | Cam follower housing (4) | Carefully pry from dowel pins (1) and remove. | Tag for installation. |
| 3. | | Cam follower gaskets (3) | Remove and measure gasket (3) thicknesses using micrometer and record readings. | Discard gaskets (3) after readings are recorded.

Clean gasket remains from mating surface. |



3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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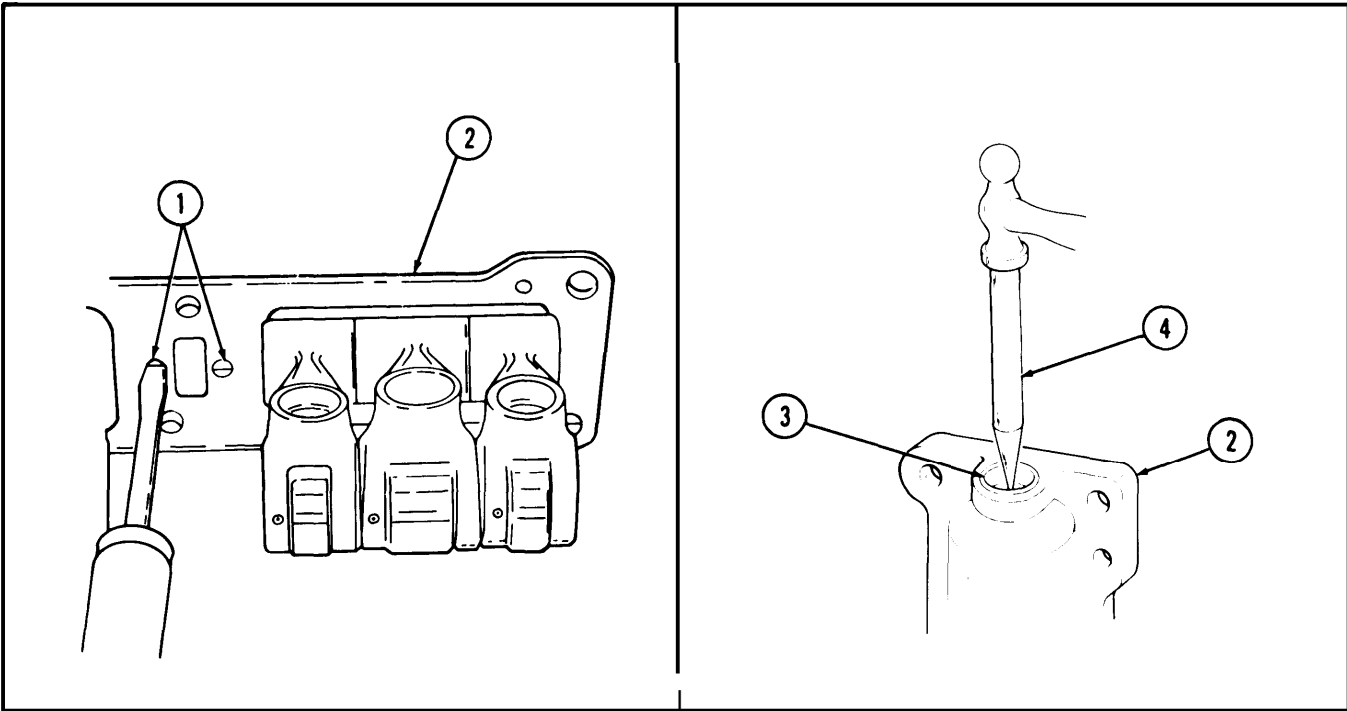
b. Disassembly

4.	Cam follower housing (2)	Two shaft lockscrews (1)	Remove.	
5.		cup plug (3)	Remove.	Use center punch (4). Discard cup plug (3).

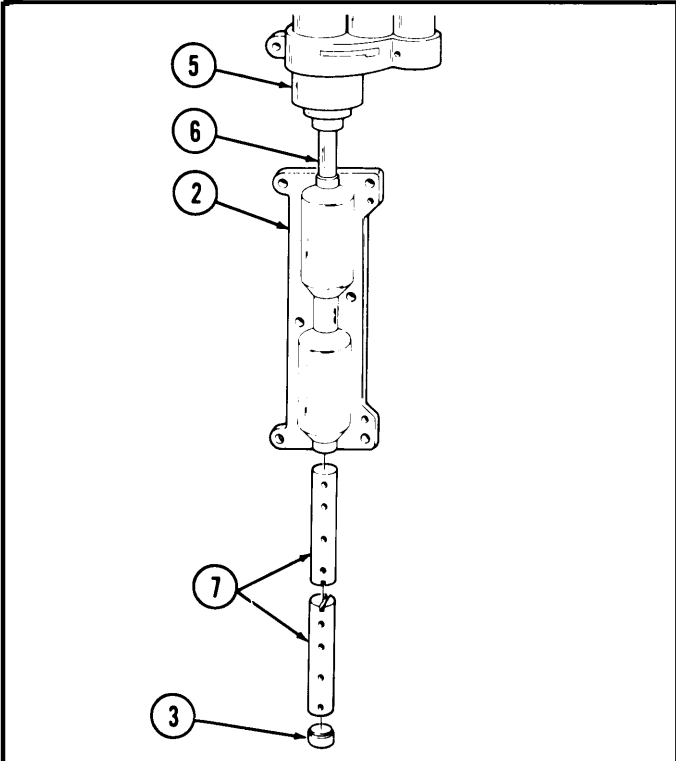
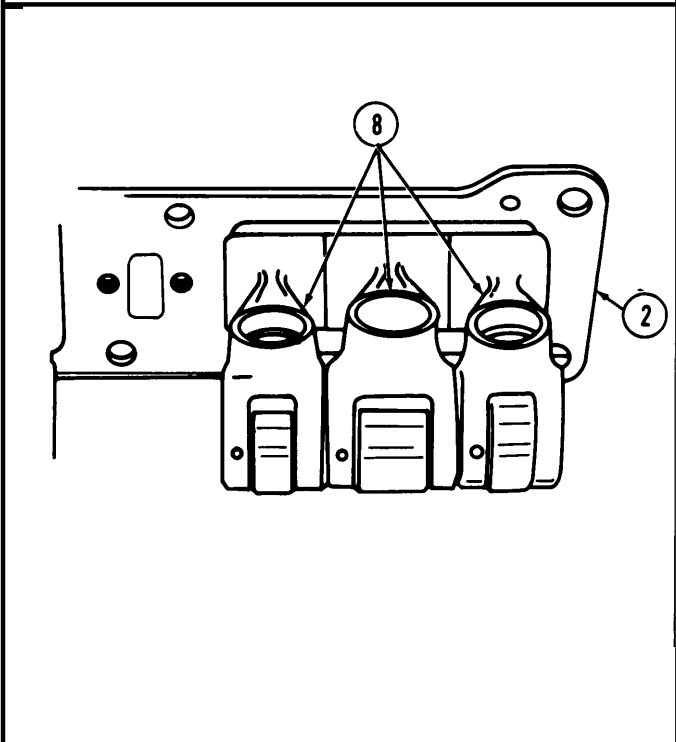
NOTE

Before performing step 6, mark each cam follower lever with its location for installation.

6.		Cup plug (3) and two lever shafts (7)	Remove.	Use arbor press (5) and mandrel (6).
7.		Six cam follower levers (8)	Remove.	

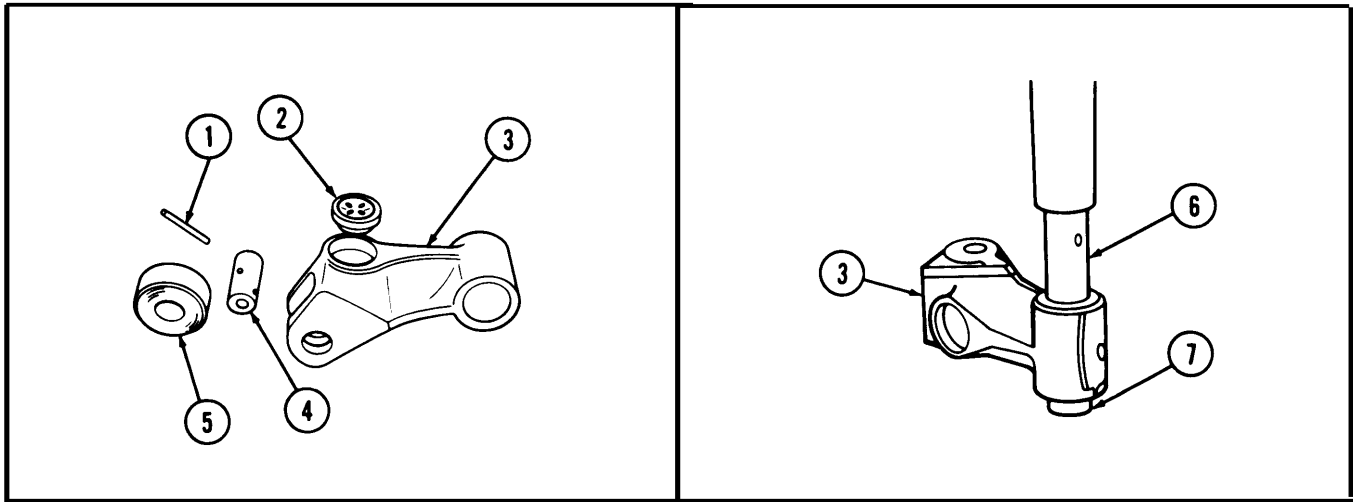


3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
		 <p>This diagram shows a vertical assembly of the cam follower housing. Callout 5 points to the top nut, 6 to the top pin, 2 to the main housing body, 7 to the lower guide pins, and 3 to the bottom pin.</p>		
		 <p>This diagram shows the cam follower housing installed in the engine block. Callout 8 points to the three cam followers, and callout 2 points to the housing body.</p>		

3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
8.	Cam follower lever (3)	Retainer pin (1), roller pin (4), and roller (5)	Remove.	Use drift to remove pin (1). Use arbor press and mandrel to remove roller (5).
<p>NOTE</p> <p>Before disassembling cam follower lever bushing and push tube insert, perform task c., "Cleaning and Inspection". If insert or bushing must be replaced, perform steps 9 and 10.</p>				
9.		Cam follower lever bushing (7)	Remove.	Use arbor press and mandrel (6).
10.		Push tube insert (2)	Remove from cam follower lever (3).	Use center punch.



c. Cleaning and Inspection

WARNING

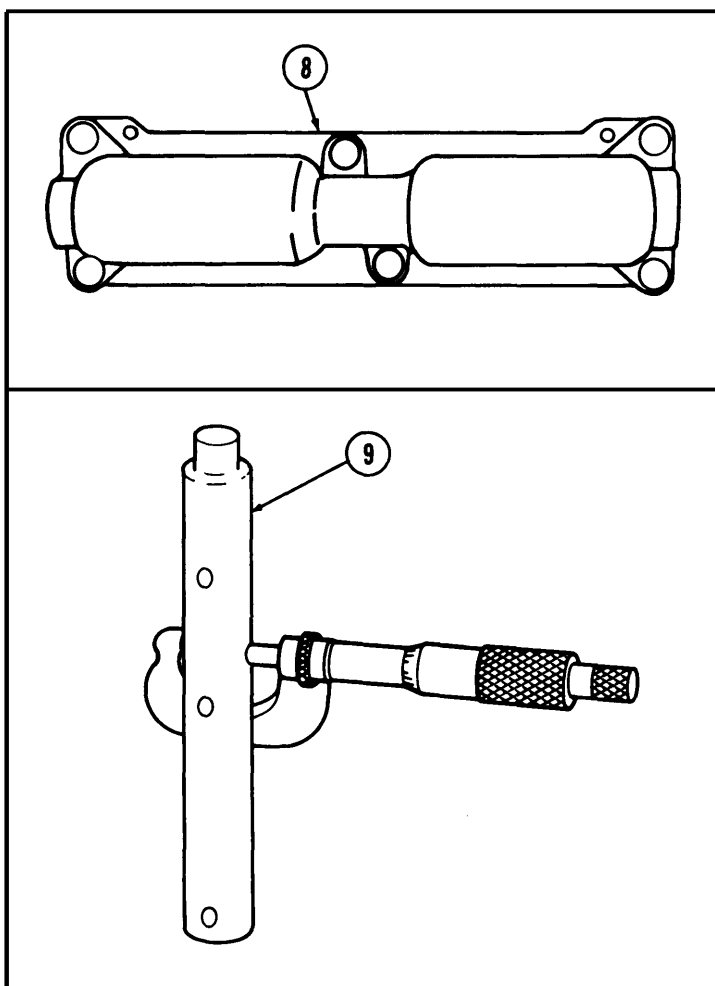
Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

11.	Cam follower housing (8)	a. Clean with drycleaning solvent. b. Inspect for breaks and cracks.	If housing (8) is broken or cracked, replace.
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3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
12,		Cam follower shaft (9)	a. Clean with drycleaning solvent. b. Inspect for breaks, cracks, or out-of-round condition. c. Measure all bearing surfaces with micrometer.	If shaft (9) is broken, cracked, or out-of-round, replace. Replace shaft (9) if outer diameter is less than 0.748 in. (19.02 mm).



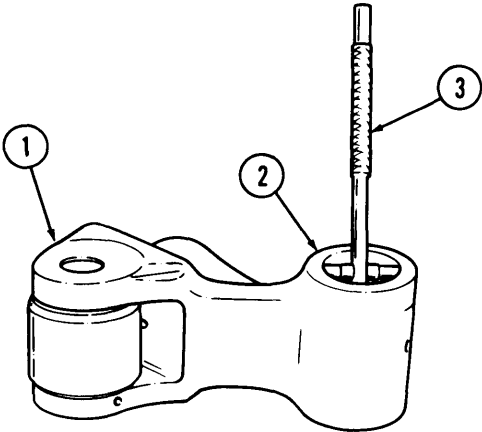
3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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WARNING

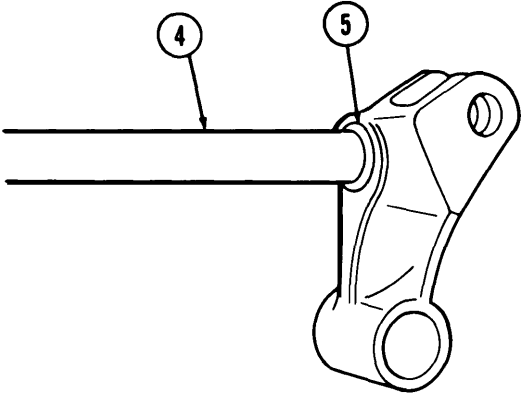
Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

13.		Cam follower lever (1)	a. Clean with drycleaning solvent. b. Inspect for breaks and cracks.	If broken or cracked, replace,
14.		Cam follower lever bushing (2)	a. Inspect for breaks, cracks, or out-of-round condition. b. Measure inner diameter with telescoping gage (3).	If broken, cracked, or out-of-round, replace. If inner diameter is more than 0.752 in. (19, 10 mm), replace.



15.		Push tube insert (5)	Check for wear as follows: a. Use a new push tube (4), and coat ball end with prussian blue. b. Place ball end of push tube (4) into push tube insert (5) and rotate.	If wear area is not 80% blued, replace insert (5).
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3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)				
STEP NO.	LOCATION	ITEM	ACTION	REMARKS



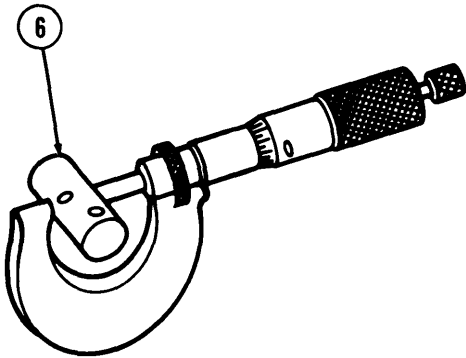
16.
- Cam follower roller pin (6)

a. Inspect for breaks, cracks, or out-of-round condition.

b. Measure outer diameter with micrometer.

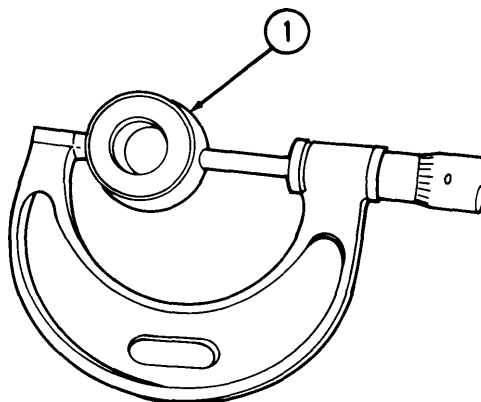
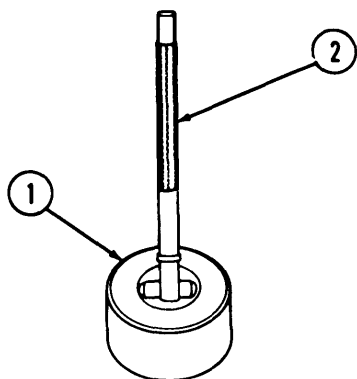
If broken, cracked, or out-of-round, replace.

Replace if outer diameter is less than 0.497 in. (12.62 mm).



3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
17.		Exhaust and intake valve cam rollers (1)	a. Inspect for breaks, cracks, or out-of-round condition. b. Set telescoping gage (2) to 0.503 in. (12.83 mm). c. Place gage (2) into inner diameter of roller (1). d. Measure outer diameter with micrometer.	If broken, cracked, or out-of-round, replace. If gage (2) slides into roller (1), it is worn beyond wear limit, replace. If outer diameter of roller (1) is less than 1.248 in. (31.71 mm), replace.
18.		Fuel injector cam rollers (1)	a. Inspect for breaks, cracks, or out-of-round condition. b. Set telescoping gage (2) to 0.505 in. (12.78 mm). c. Place gage (2) into inner diameter of roller (1). d. Measure outer diameter with micrometer.	If broken, cracked, or out-of-round, replace. If gage (2) slides into roller (1), it is worn beyond wear limit, replace. If outer diameter of roller (1) is less than 1.248 in. (31.71 mm), replace.



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3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

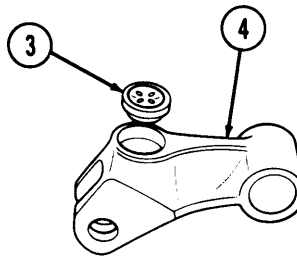
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Reassembly

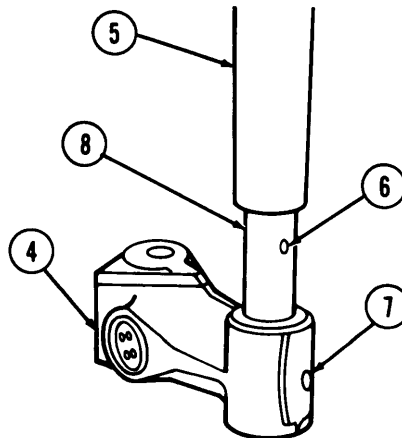
NOTE

- Lightly oil all parts before reassembly.
- If new push tube insert is being installed, a new push tube must also be used.

19.		Push tube insert (3)	Install into cam follower lever (4).	Make sure insert (3) is securely seated in lever (4).
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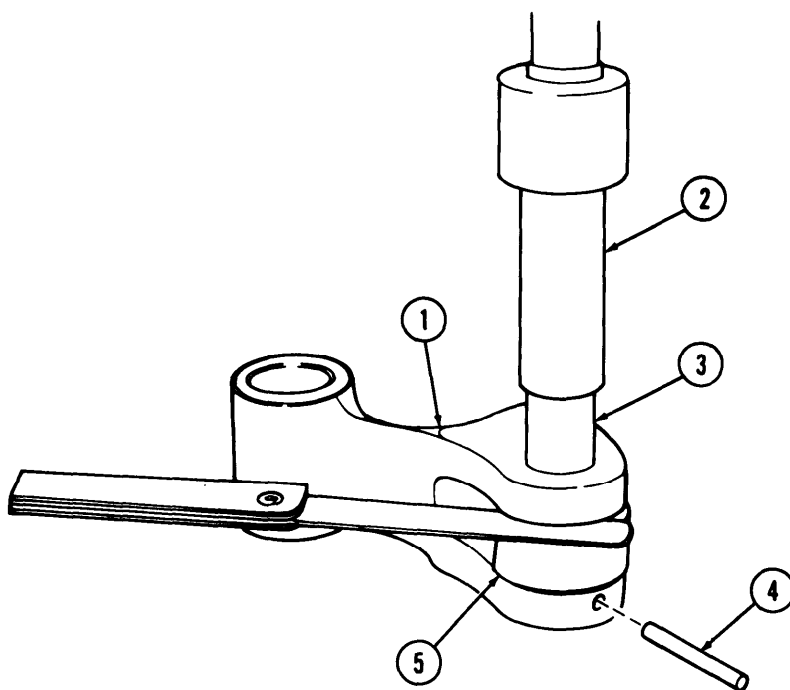


20.	Cam follower lever bushing (8)	<p>a. Install into cam follower lever (4), and align oil hole (6) in bushing (8) with oil hole (7) in lever (4).</p> <p>b. Chamfer each end with 60° angle cutter.</p>	<p>Use arbor press and mandrel (5).</p> <p>Clean all metal chips from bushing (8) surfaces.</p>
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3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

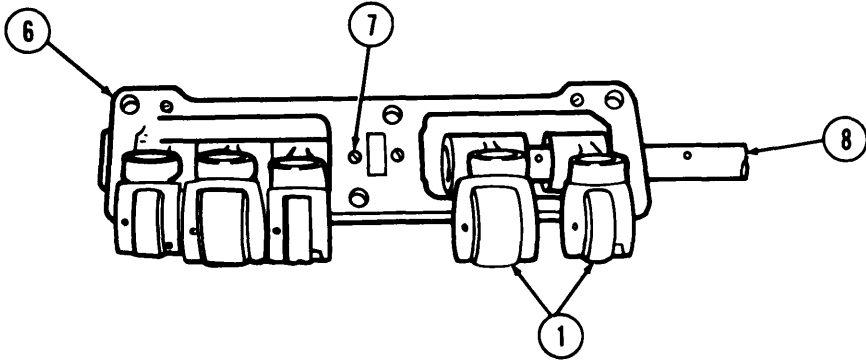
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
21.		Cam roller (5)	Place into cam follower lever (1) with 0.006 in. (O. 15 mm) feeler gage between lever (1) and roller (5).	
22.		Roller pin (3)	a. Install through cam follower (5), and align roller pin hole with hole in cam follower lever (1). b. Install on cam follower lever (1) with retainer pin (4).	Use arbor press and mandrel (2).

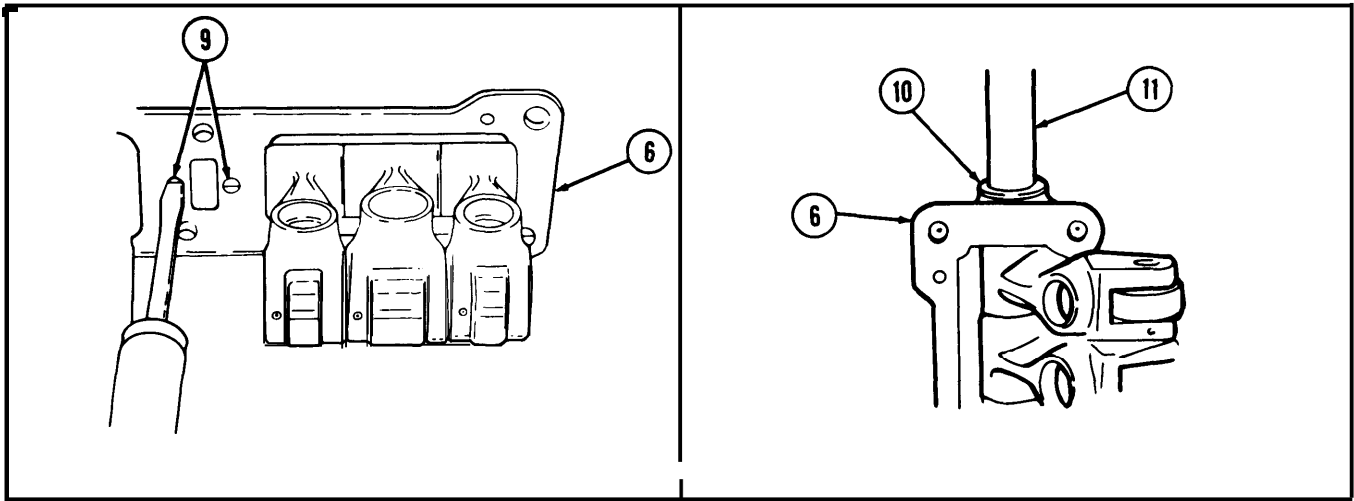


23. Six cam follower levers (1)
- a. Position into cam follower housing (6) in scribed locations, and slide cam follower shaft (8) through housing (6) and levers (1).

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3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			b. Aline screw hole in housing (6) with screw hole in shaft (8) with temporary dummy screw (7).	Using dummy screw (7) prevents lock screw (9) breakage when cup plugs (10) are installed.
				
			CAUTION	
			When pressing two cup plugs into housing, press in only until plugs are flush with cam follower housing to avoid lock screw breakage.	
24.		Two new cup plugs (10)	Coat with no. 3 Permatex, and press into housing (6).	Use arbor press and mandrel (11). Press only until flush with housing (6).
25.		Dummy screw (7)	Remove from housing (6).	
26.		Two shaft lock screws (9)	Install through cam follower housing (6) into cam follower shaft (8).	



3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
e. Installation				

CAUTION

- Before installation, make sure cam follower housing levers have been lubricated (para. 2-10b),
- If old cam follower housing assemblies are being installed, make sure they are installed in the same location from which they were removed.

NOTE

Cam follower housings are mounted with screw-assembled lock-washers on late model engine.

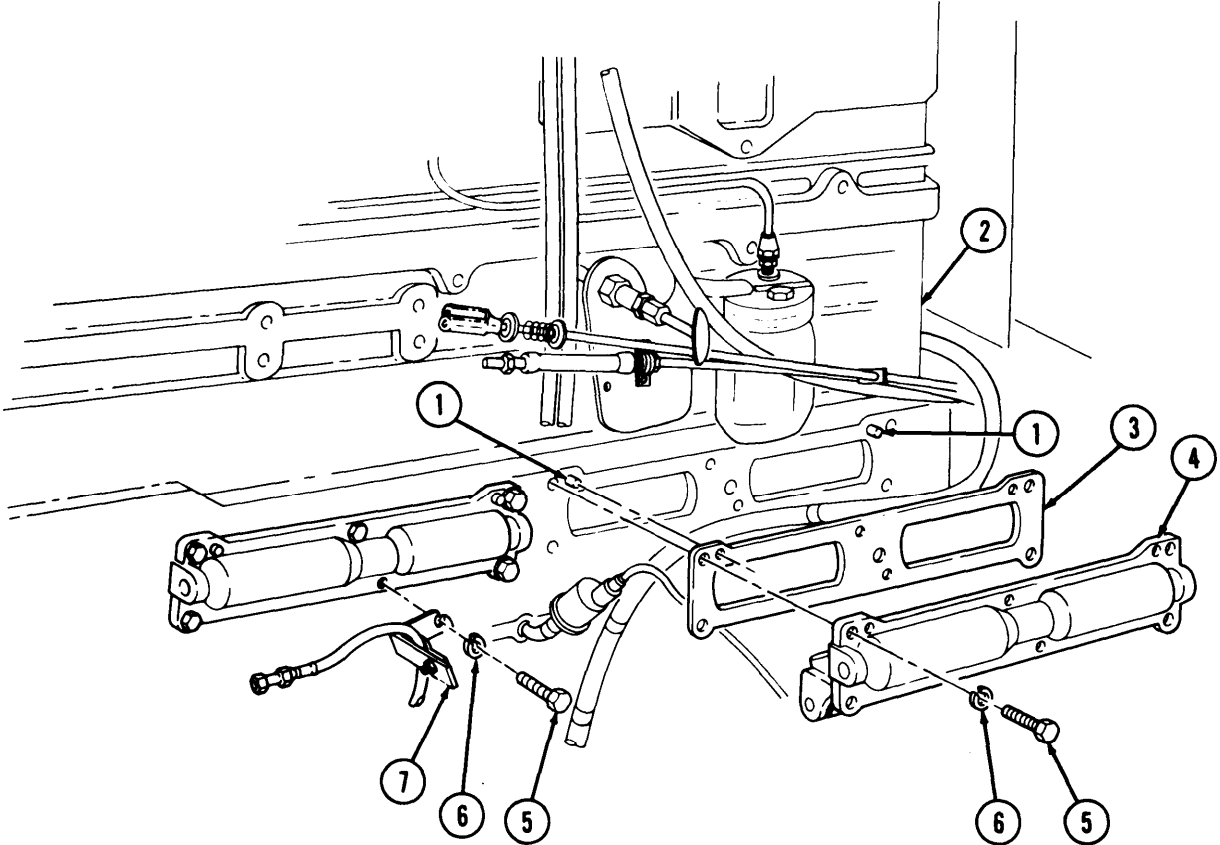
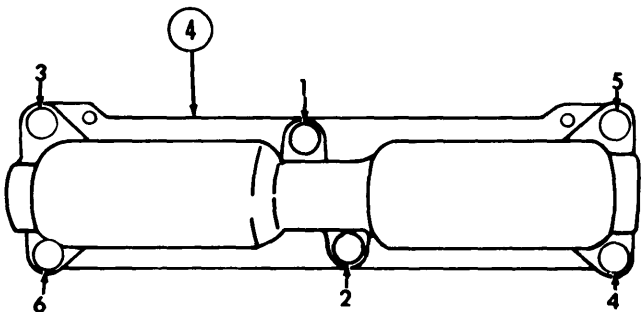
27.		New cam follower housing gasket (3)	Install as follows: a. Check recorded measurement of gaskets (3) removed. b. Measure new gaskets (3) being installed. c. Position gasket (3) with seals facing outward over dowels (1).	Gaskets (3) should measure 0.014-0.125 in. (0.36 -3.2 mm). New gaskets (3) must measure exact thickness of original gaskets (3).
28.		Cam follower assembly (4)	Install as follows: a. Position on gasket (3) over dowels (1), and seat against engine block (2).	Tap lightly with soft-faced hammer.

NOTE

Installation of fuel line bracket is only required for number 2-3 cam follower housing.

- b. Install fuel line bracket (7), six new lockwashers (6), and screws (5).
- c. Tighten screws (5) in sequence shown 15 lb-ft (20 N•m).
- d. Tighten screws (5) in sequence shown 30-35 lb-ft (41 - 48 N•m).

3-21. CAM FOLLOWER HOUSING MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
 <p style="text-align: center;">CAM FOLLOWER ASSEMBLY SCREW TIGHTENING SEQUENCE</p>				

END OF TASK!

FOLLOW-ON TASKS:

- Install rocker lever housings and push tubes (para. 3- 17).
- Install air compressor, if removed (para. 10-5).
- Install fuel pump, if removed (para. 4-4).

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3-22. ENGINE OIL PAN MAINTENANCE

This task covers:

- | | |
|----------------------------|-----------------|
| a. Removal | d. Reassembly |
| b. Disassembly | e. Installation |
| c. Cleaning and Inspection | |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-20-1 TM 9-2320-272-20-1 TM 9-2320-272-20-1	Front sump tube removed. Oil dipstick tube removed. Engine oil drained.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Eleven lockwashers Oil pan gasket Aerator gasket Drainplug gasket Suction flange gasket Sealing compound (Appendix C, Item 26)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle mechanic MOS 63W(2)		None
<u>Manual References</u>		
TM 9-2320-272-20-1 TM 9-2320-272-34P LO 9-2320-272-12		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

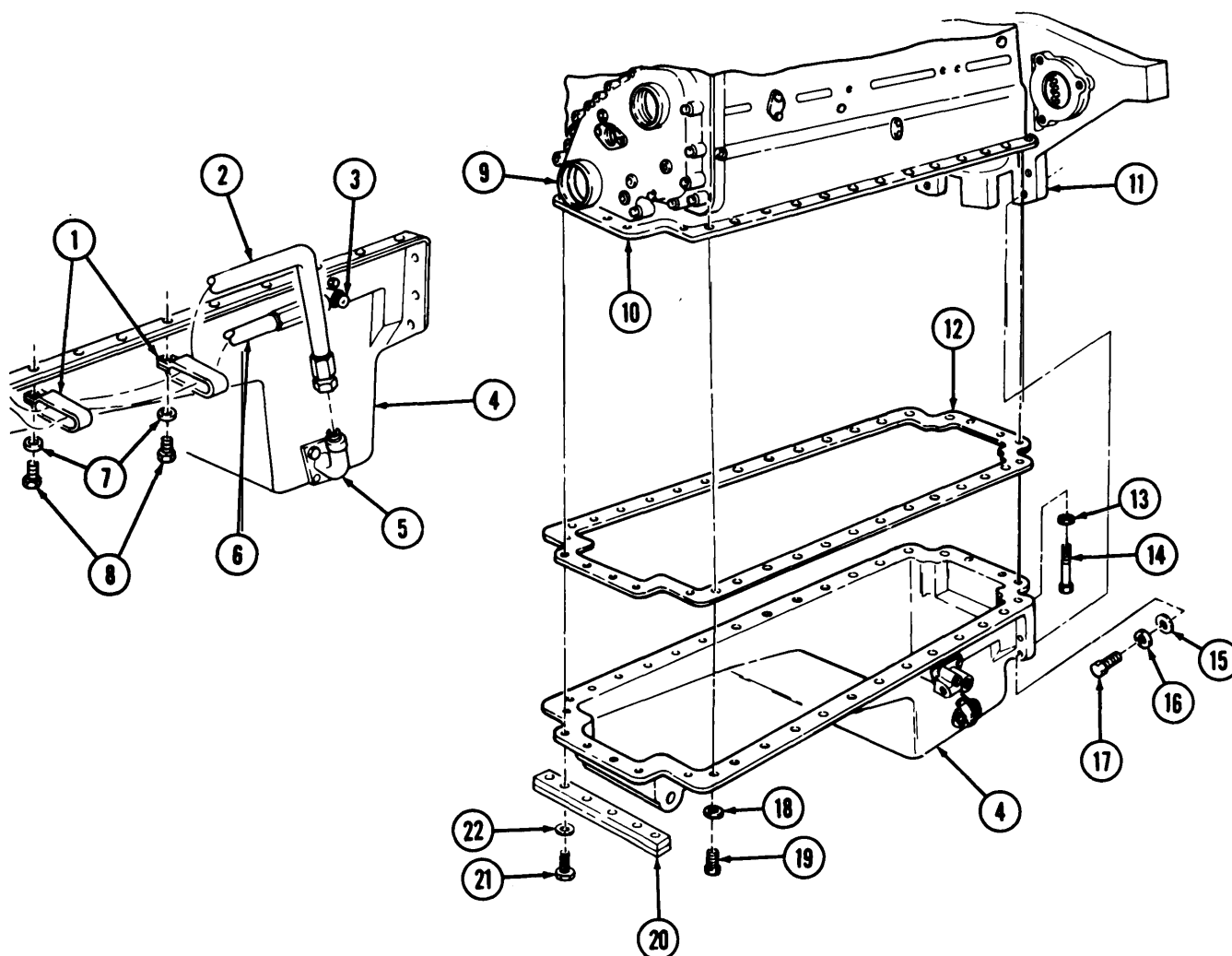
NOTE

Engine oil pan is mounted with screw-assembled washers on **late** model engine.

- | | | |
|------|--------------------|--|
| 1. | Vehicle frame | Raise above front axle to allow removal of oil pan (4). |
| 1.1. | Aerator(3) | Oil return hose (6) Disconnect. |
| 2. | Suction flange (5) | Oil pickup hose (2) Disconnect. |
| 2.1. | Oil pan (4) | Two screws (8), washers (7), clamps (1), and oil return (6) and pickup (2) hoses Remove. |

3-22. ENGINE OIL PAN MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
3.	Engine oil pan (4) and flywheel housing (11)	Six screws (17), lock-washers (16), and washers (15)	Remove.	Discard lockwashers (16).
4.	Rear of oil pan (4)	Four screws (14) and washers (13)	Remove.	
5.	Engine oil pan (4), engine block (10), and tint gearcase cover (9)	Thirty screws (19) and washers (18), four screws (21) and washers (22), brace (20), oil pan (4), and oil pan gasket (12)	Remove.	Discard oil pan gasket (12). Clean gasket remains from mating surfaces.

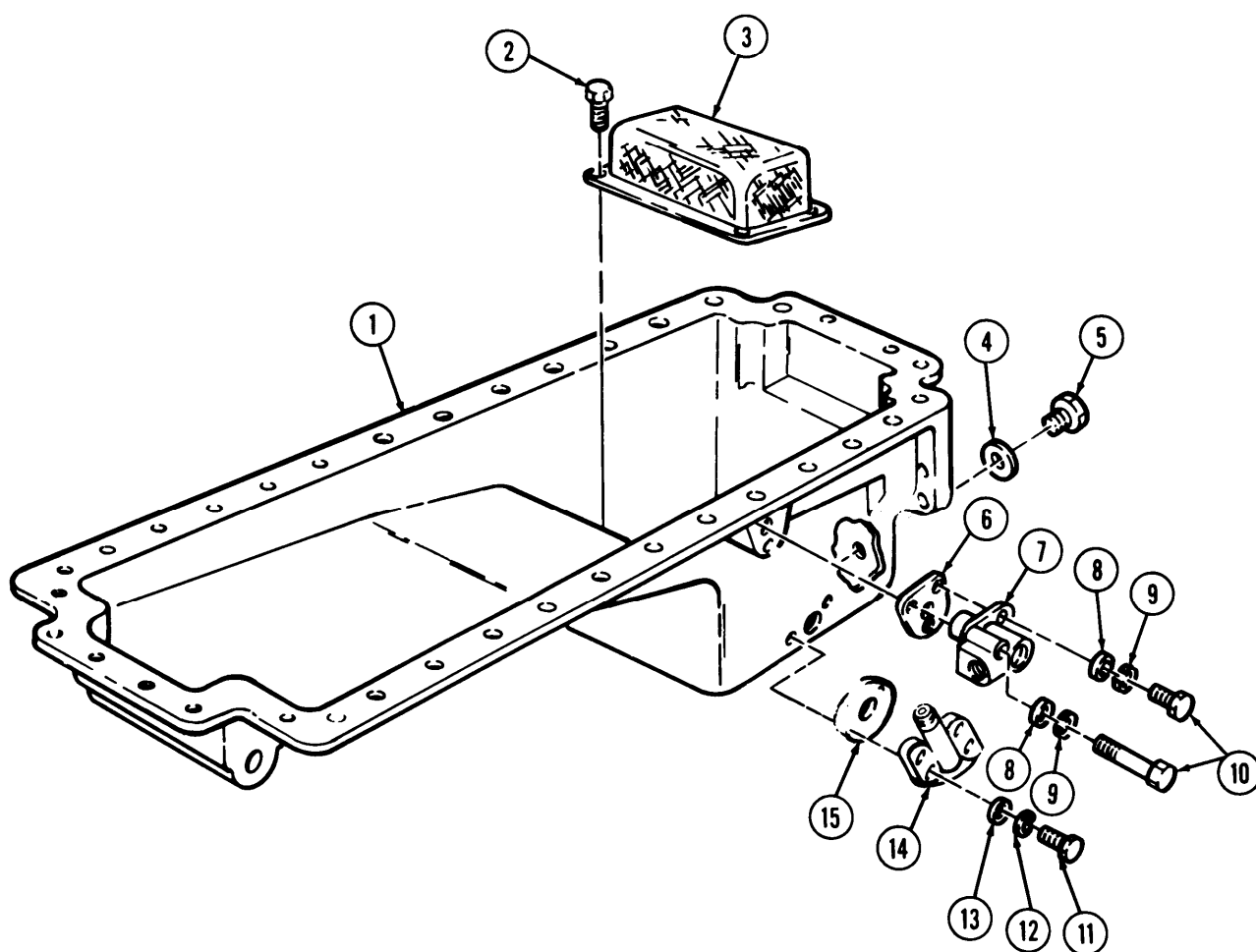


3-22. ENGINE OIL PAN MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Disassembly				
6.	Oil pan (1)	Four screws (2) and strainer screen (3)	Remove.	
7.		Drainplug (5) and gasket (4)	Remove.	Discard gasket (4).
8.		Three screws (10), lockwashers (9), and washers (8), aerator (7), and gasket (6)	Remove.	Discard lockwashers (9) and gasket (6). Clean gasket remains from mating surfaces,
9.		Two screws (11), lockwashers (12), and washers (13), suction flange (14), and gasket (15)	Remove.	Discard lockwasher (12) and gasket (15). Clean gasket remains from mating surfaces.
c. Cleaning and Inspection				
10.		Oil pan (1), aerator (7), drainplug (5), suction flange (14), and screen (3)	a. Clean in accordance with instructions in para. 2-7. b. Inspect in accordance with instructions in para. 2-8. c. Check for cracks in oil pan, damaged threads, uneven gasket mating surfaces, and damaged or torn screen.	If oil pan (1) is cracked or damaged, replace. If screen (3) is damaged or torn, replace. Repair damaged threads or replace oil pan.
d. Reassembly				
11.		Strainer screen (3)	Install on oil pan (1) with four screws (2).	
12.		New gasket (4) and drainplug (5)	Install in oil pan (1).	
13.		New aerator gasket (6)	Apply a thin coating of sealing compound.	
14.		Aerator gasket (6) and aerator (7)	Install on oil pan (1) with three washers (8), new lockwashers (9), and screws (10).	Tighten 10-12 lb-ft (14-16 N•m).
15.		New suction flange gasket (15)	Apply a thin coating of sealing compound.	

3-22. ENGINE OIL PAN MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
16.		Suction flange gasket (15) and suction flange (14)	Install on oil pan (1) with two washers (13), new lockwashers (12), and screws (11).	Tighten 19-22 lb-ft (26-30 N•m).

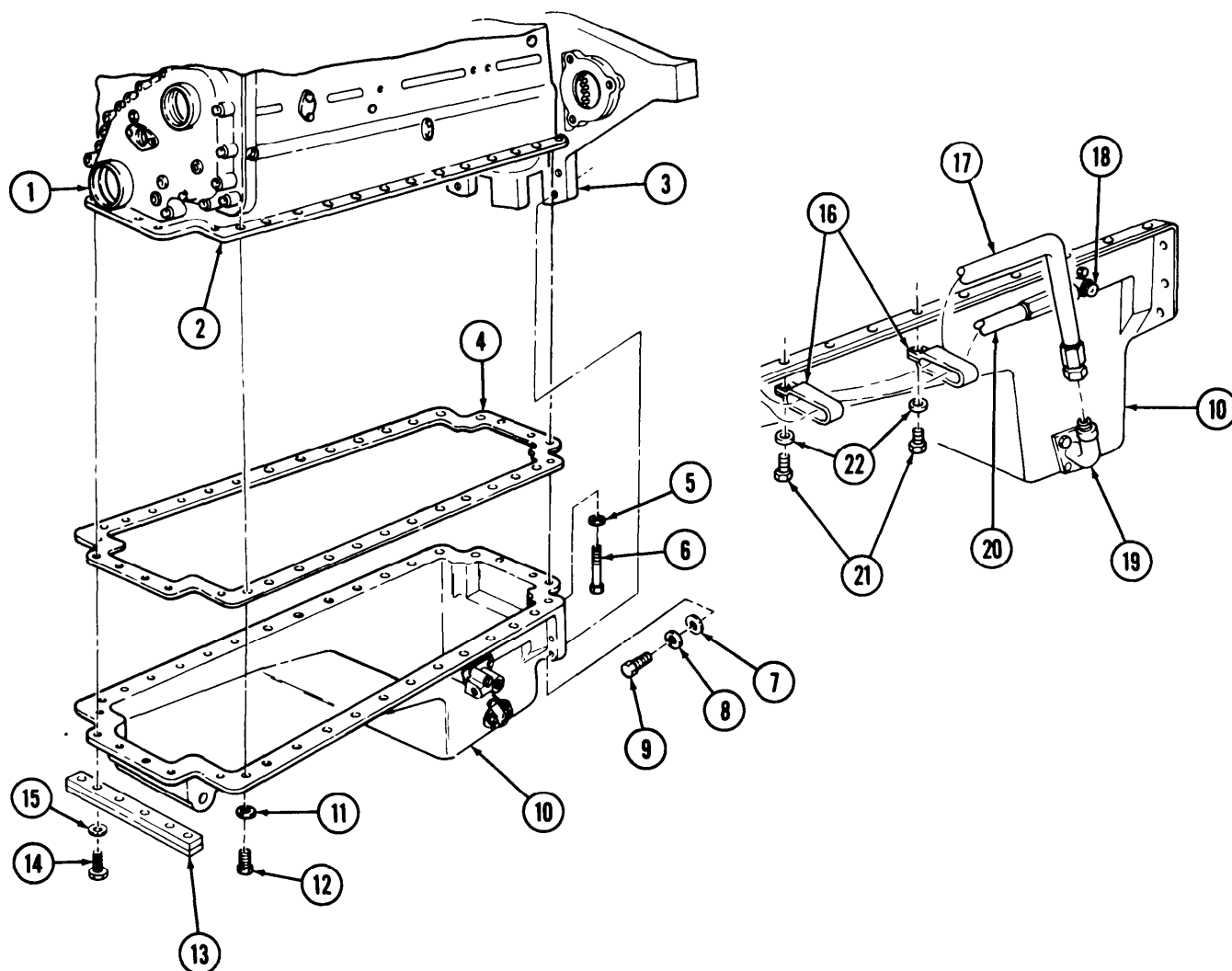


3-22. ENGINE OIL PAN MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p style="text-align: center;">NOTE</p> <p>Engine oil pan is mounted using screw-assembled washers on late model engine.</p>				
17.		New engine oil pan gasket (4) and oil pan (10)	<p>a. Install on cylinder block (2) and front gearcase cover (1) with brace (13), four washers (15) and screws (14), and thirty washers (11) and screws (12).</p> <p>b. Install rear of oil pan (10) with four washers (5) and screws (6).</p> <p>c. Install on flywheel housing (3) with six washers (7), new lockwashers (8), and screws (9).</p> <p>d. Alternately tighten screws (12) 35-40 lb-ft (48-54 N•m).</p> <p>e. Alternately tighten screws (12) 15-40 lb-ft (20-54 N•m).</p>	<p>Do not tighten.</p> <p>Do not tighten.</p> <p>Tighten alternately 70-80 lb-ft (95-109 N•m).</p>
18.		Oil pickup hose (17)	Connect to suction flange (19).	
18.1		Oil return hose (20)	Connect to aerator (18).	
18.2		Oil pickup (17) and return (20) hoses	Install on oil pan (10) with two clamps (16), washers (22), and screws (21).	Tighten 35-40 lb-ft (48-54 N•m).
19.		Vehicle frame	Lower.	

3-22. ENGINE OIL PAN MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS::

- Install front sump tube (TM 9-2320-272-20-1).
- Install oil dipstick tube (TM 9-2320-272-20-1).
- Refill engine oil (LO 9-2320-272-12).

Section IV. ENGINE REPLACEMENT INSTRUCTIONS

3-23. ENGINE REPLACEMENT TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
3-24.	Engine and Transmission Replacement	3-98
3-24.1.	Engine and Container Replacement	3-145.1
3-25.	Preparing Replacement Engine for Installation	3-146
3-26.	Starting Repaired or Replaced Engine	3-152

3-24. ENGINE AND TRANSMISSION REPLACEMENT

This task covers:

- ## a. Preliminary Disconnections c. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-20-1 TM 9-2320-272-10 LO 9-2320-272-12 LO 9-2320-272-12 TM 9-2320 -272-20-2 TM 9-2320-272-20-1 TM 9-2320-272-20-1 TM 9-2320-272-20-1 TM 9-2320-272-20-1 TM 9-2320-272-20-1	Battery ground cables disconnected. Air reservoirs drained. Engine oil drained. Transmission oil drained. Hood removed. Radiator drained and removed. Coolant hoses and tubes removed. Front exhaust pipe removed. Engine oil dipstick and tube removed. Air intake pipe and hump hoses removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		
None		
	TM 9-2320 -272-20-2	Transmission PTO to hydraulic pump drive shaft removed (if vehicle is so equipped).
	TM 9-2320-272-20-1	Transmission to transfer propeller shaft removed.
<u>Materials/Parts</u>		
Modulator "O" ring	TM 9-2320-272-20-1	Surge tank removed.
Two cotter pins	TM 9-2320-272-20-1	Engine fan Made assembly removed.
Twenty-two lockwashers		
Six locknuts		
Protective cap-plugs (Appendix C, Item 5)		
Adhesive sealant (Appendix C, Item 13)		
Tiedown strap (Appendix C, Item 21)		
Twine (Appendix C, Item 32)		
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W (2)		
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-20-1		
TM 9-2320-272 -20-2		
TM 9-2320-272-34P		
LO 9-2320-272-12		
		<u>General Safety Instructions</u>
		<ul style="list-style-type: none"> • Direct all personnel to stand clear during hoisting operations. • Do not use hands to free engine at transmission. Use tanker or pry bar. • Do not detach hoist chain from engine until all engine weight is evenly distributed and engine is stable on transport stand.

3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

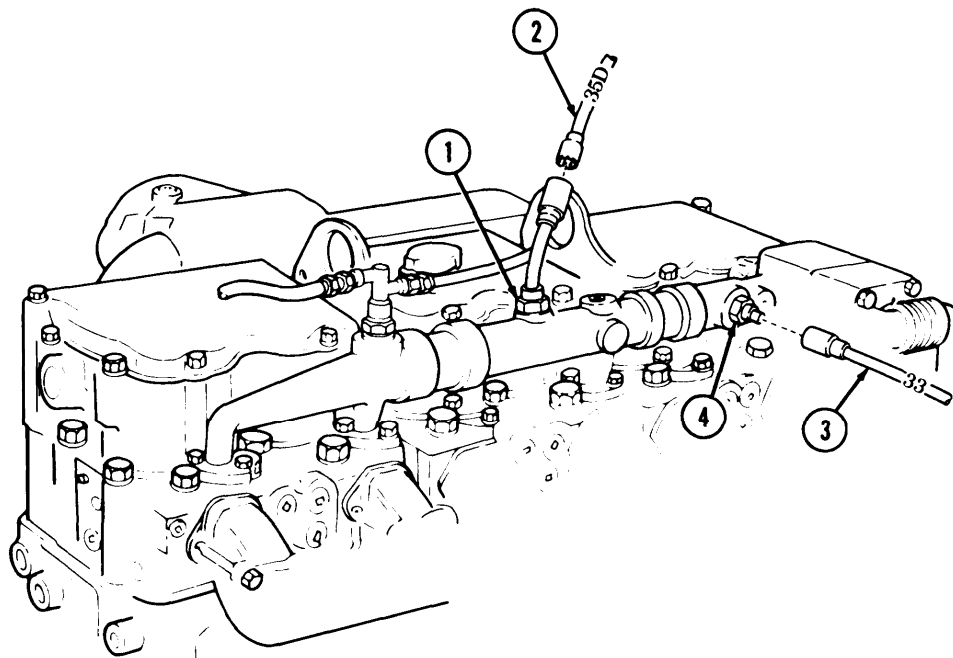
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Preliminary Disconnections

NOTE

If a special purpose kit is installed on vehicle, refer to chapter 21 and make necessary disconnections.

- | | | | |
|----|---|-------------------|-------------|
| 1. | Water temperature sending unit (4) and engine high temperature sending unit (1) | Wires (2) and (3) | Disconnect. |
|----|---|-------------------|-------------|

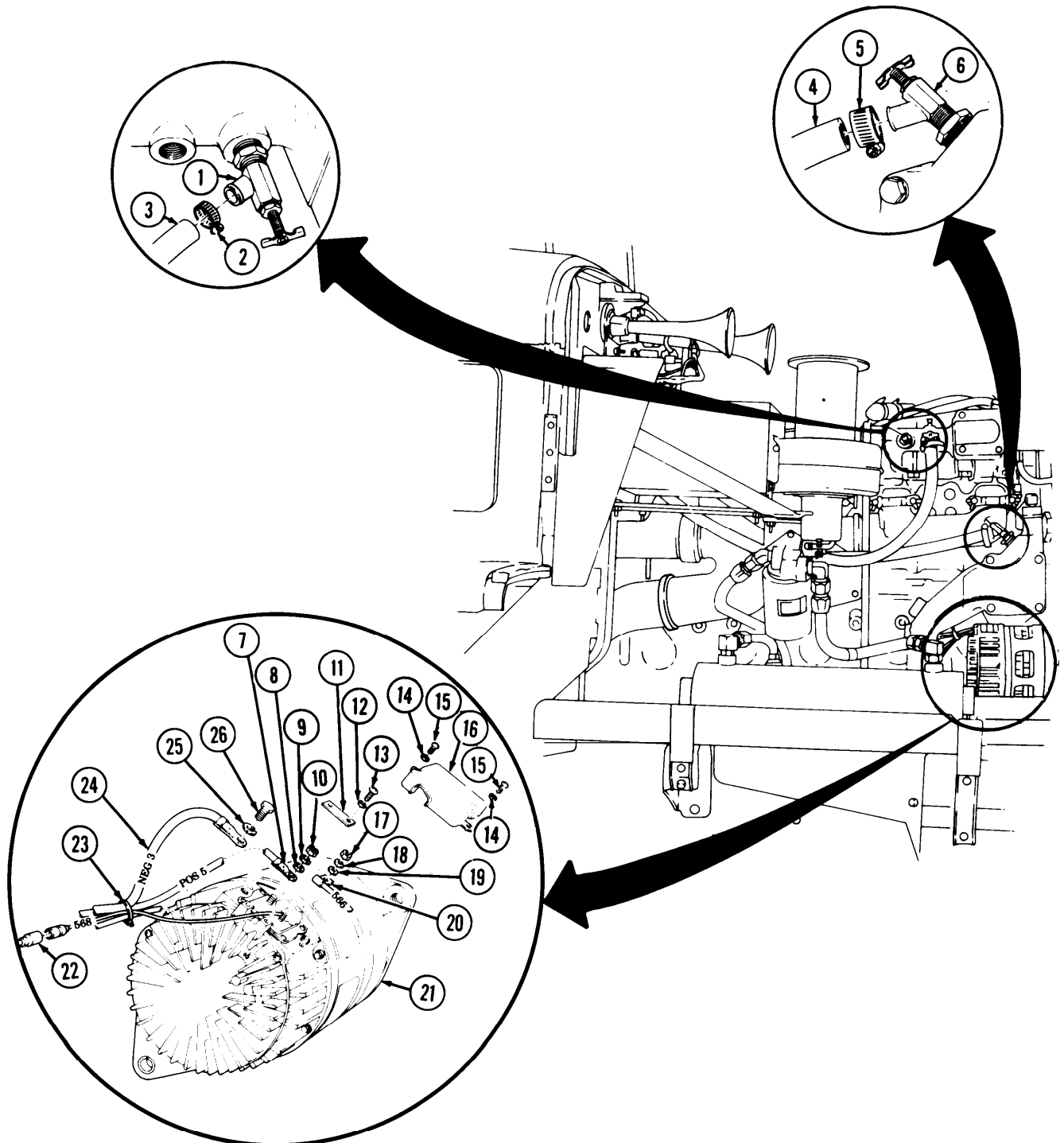


3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
2.	Water heater shutoff valve (1)	Hose clamp (2)	Loosen hose clamp (2) and disconnect hose (3).	Tie hose (3) clear of engine.
3.	Water heater shutoff valve (6)	Hose clamp (5)	Loosen hose clamp (5) and disconnect hose (4).	Tie hose (4) clear of engine.
4.	Alternator (21)	Two screws (15), lockwashers (14), and terminal cover (16)	Remove.	Discard lockwashers (14).
5.		Two screws (13), lockwashers (12), and wire retaining strap (11)	Remove.	Discard lockwashers (12).
6.		Screw (26), lockwasher (25), and wire (24)	Remove.	Discard lockwasher (25).
NOTE				
Sealant must be removed before removing wires.				
7.		Nut (10), lockwasher (9), washer (8), and wire (7)	Remove.	Discard lockwasher (9).
8.		Nut (17), lockwasher (18), washer (19), and wire (20)	Remove.	Discard lockwasher (18),
9.		Connector (22)	Disconnect.	
10.		Plastic tie (23)	cut.	Discard plastic tie (23).

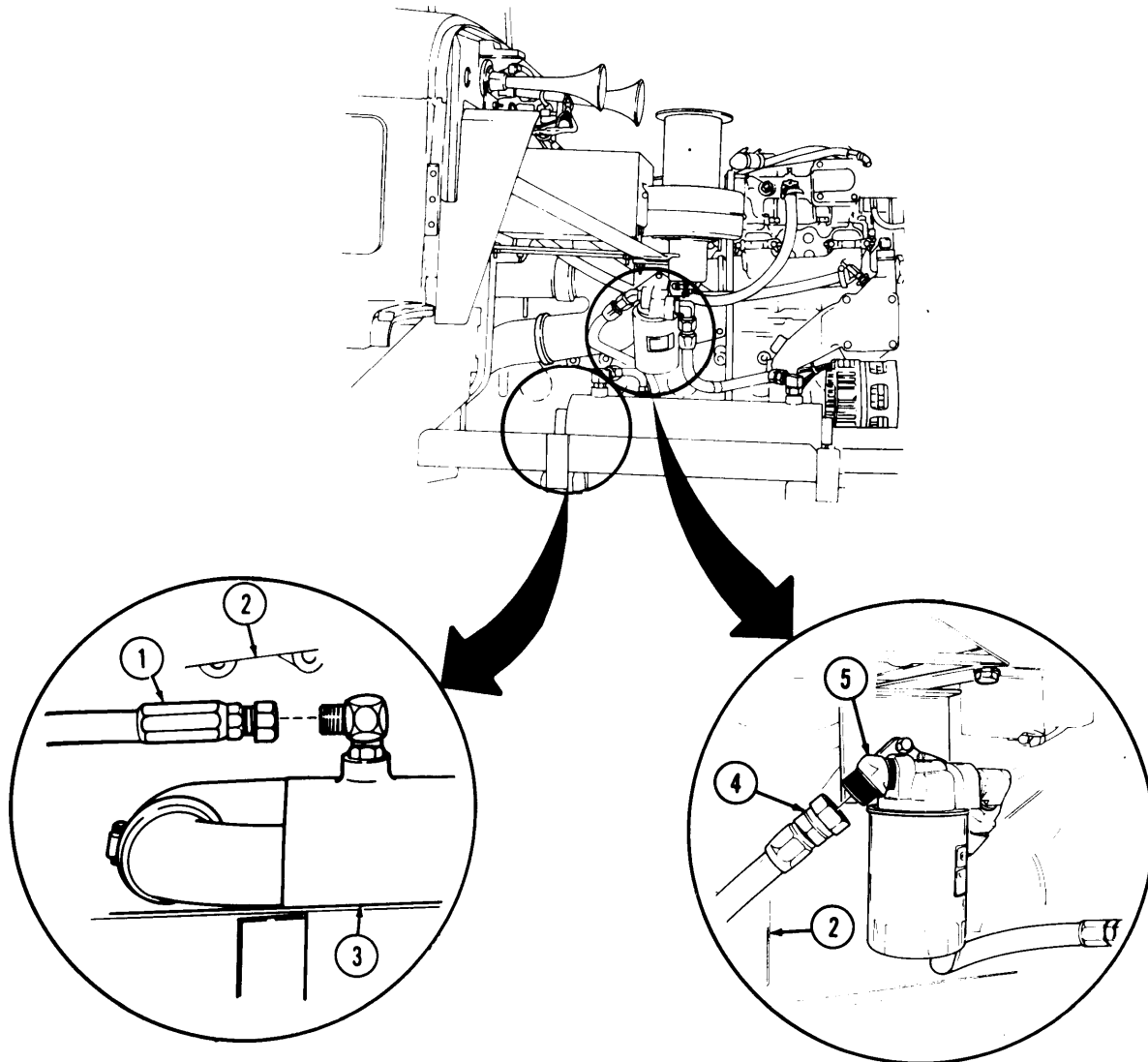
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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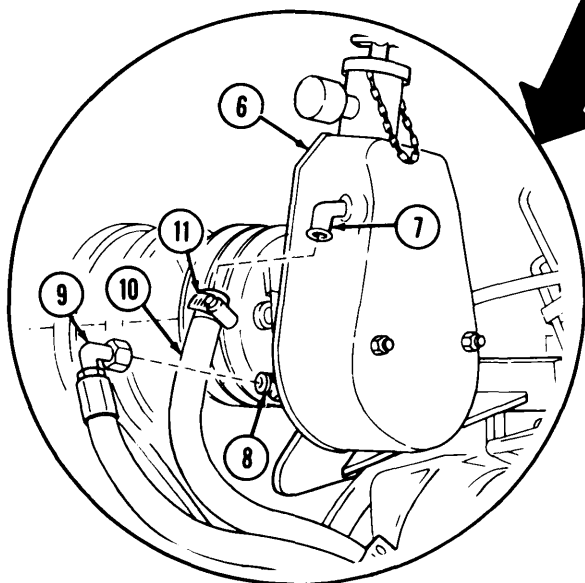
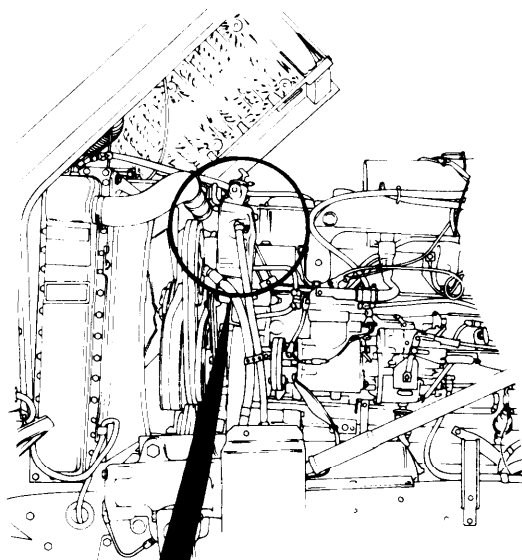
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
11.	Transmission oil filter adapter elbow (5)	Transmission to filter hose (4)	Disconnect and tie down to engine (2).	Plug openings and tag for installation.
12.	Transmission oil cooler (3)	Transmission oil cooler return hose (1)	Disconnect and tie down to engine (2).	Plug openings and tag for installation.
13.	Power steering pump and reservoir (6)	Oil pressure supply hose (9)	Disconnect from fitting (8) and drain oil into container.	Plug openings and tag for installation.
14.		Oil return hose (10)	Loosen clamp (11), disconnect from fitting (7), and drain oil into container.	Plug openings and tag for installation.



3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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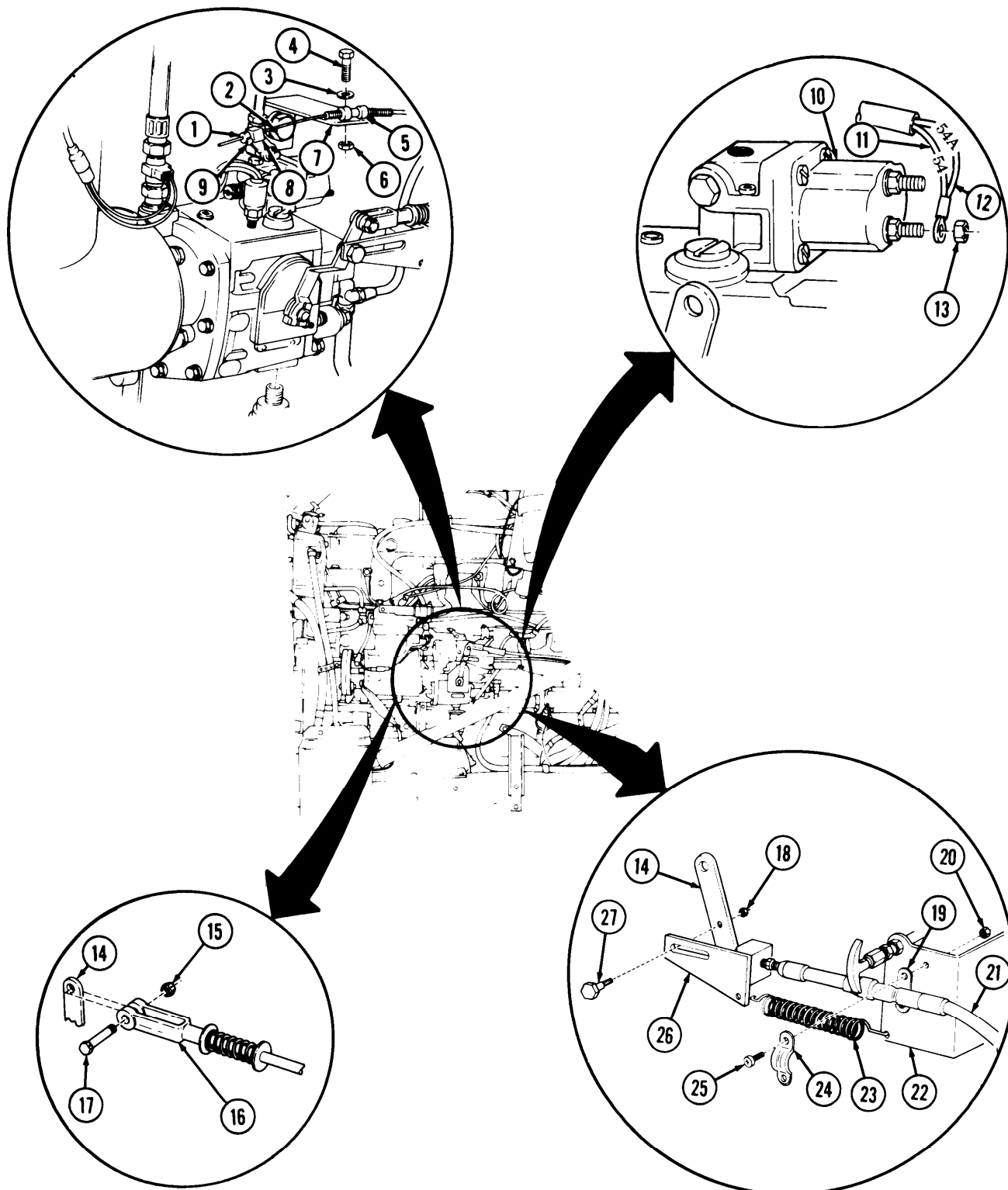


3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
15.	Emergency stop control cable (2)	Connector screw (9) and connector (1)	Remove.	
16.	Clamp bracket (7)	Screw (4), washer (3), nut (6), and clamp (5)	a. Remove. b. Pull control cable (2) through swivel block (8).	
17.		Connector screw (9) and connector (1)	Attach to cable (2).	
18.		Screw (4), washer (3), nut (6), and clamp (5)	Attach to cable (2).	Tie control cable (2) clear of engine. Tag for installation.
19.	Fuel shutoff solenoid (10)	Wires (11) and (12) and nut (13)	Remove.	
20.	Pump throttle lever (14)	Screw (17), locknut (15), and accelerator rod (16)	Remove.	Discard locknut (15). Tie accelerator rod (16) clear of engine.
21.		Screw (27), locknut (18), and link (26)	Remove.	Discard locknut (18).
22.	Fuel primer pump bracket (22)	Return spring (23), two screws (25) and nuts (20), cable clamp (24), and shim (19)	Remove.	
23.		Modulator cable (21)	Remove.	Tie modulator cable (21) clear of engine.

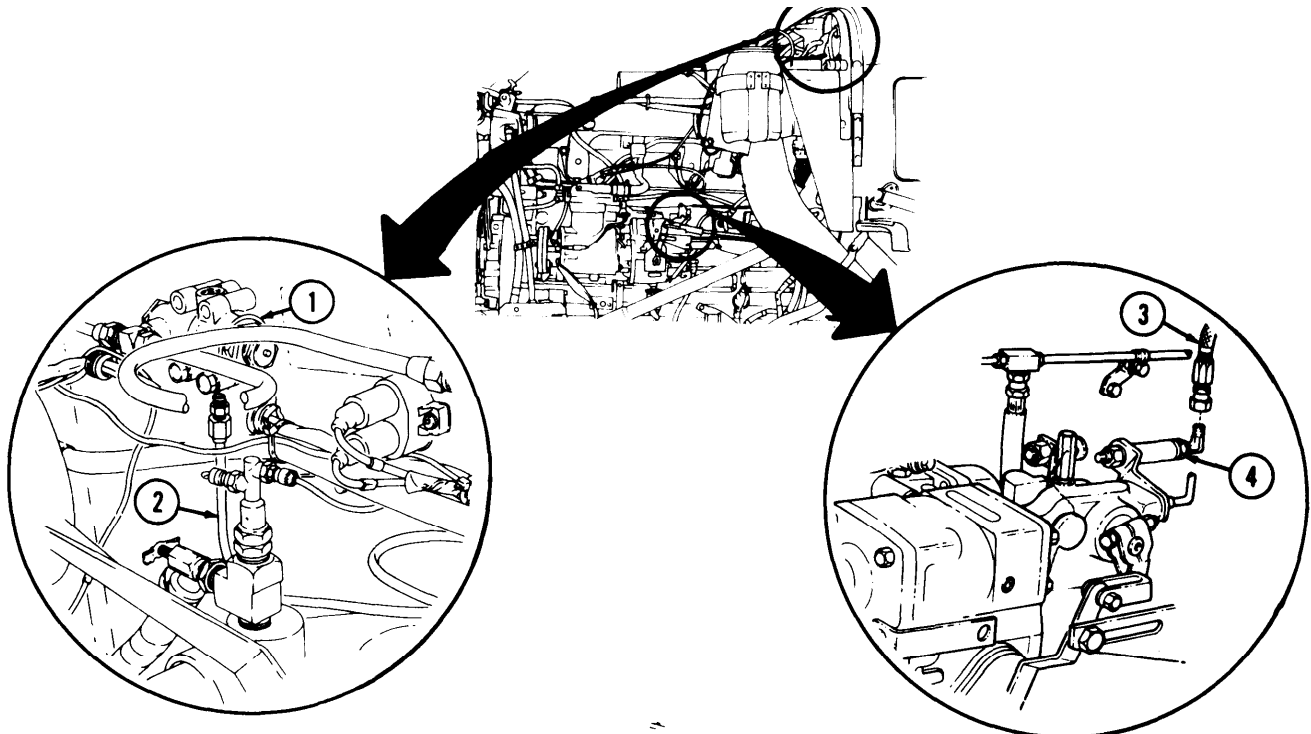
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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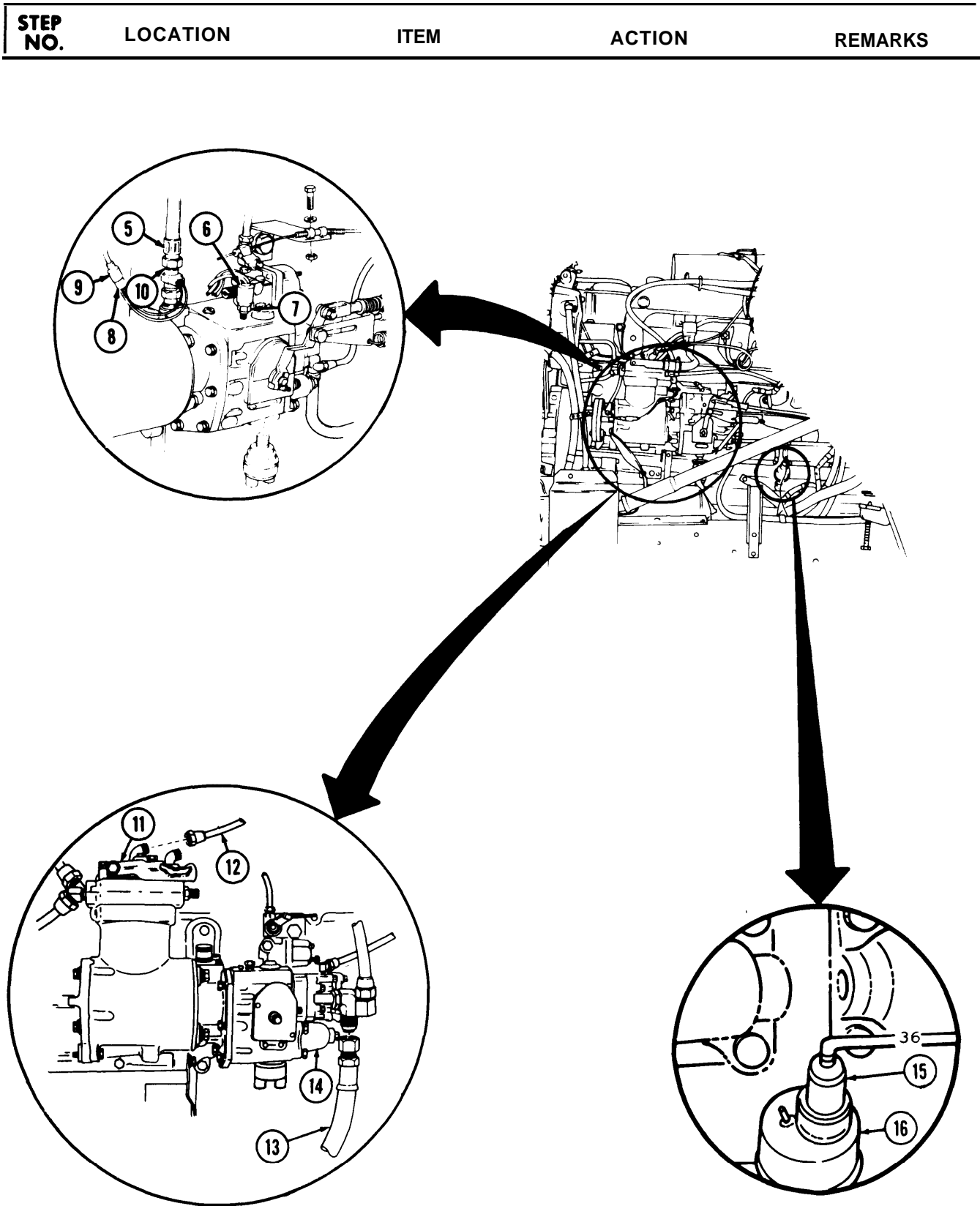
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
24.	Air governor (1)	Governor to compressor air line (2)	Disconnect.	Plug openings and tag for installation.
<p style="text-align: center;">NOTE</p> <p style="text-align: center;">Perform step 25 on M936 wrecker only.</p>				
25.	VS governor (4)	VS governor air line (3)	Disconnect.	Plug openings and tag for installation.
<p style="text-align: center;">NOTE</p> <p style="text-align: center;">Step 26 does not apply to M936 wrecker.</p>				
26.	Fuel pressure transducer harness socket (7)	Transducer connector (6)	Disconnect.	
27.	Rear of fuel pump (14)	Inlet fuel line (13)	Disconnect.	Plug openings and tag for installation.
28.	Air compressor (11)	Air governor to compressor air line (12)	Disconnect.	Plug openings and tag for installation.
29.	Oil pressure sending unit (16)	Wire connector (15)	Disconnect.	
30.	Tachometer pulse sender (10)	Tachometer drive cable (5)	Disconnect.	
31.	Pulse sender harness socket (8)	Pulse sender connector (9)	Disconnect.	



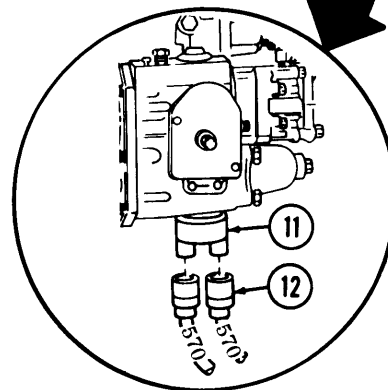
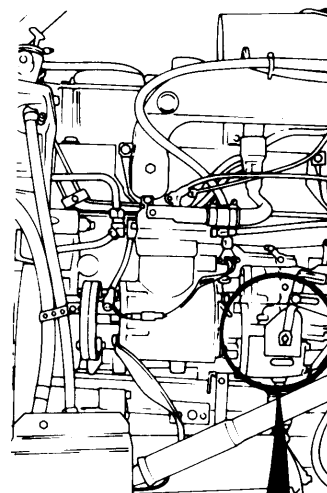
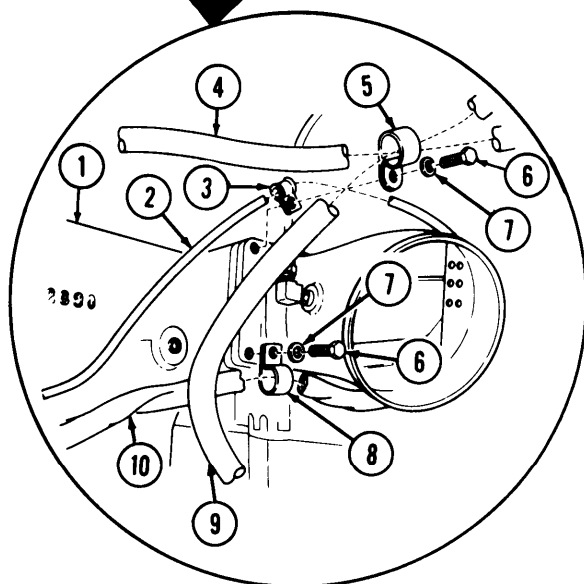
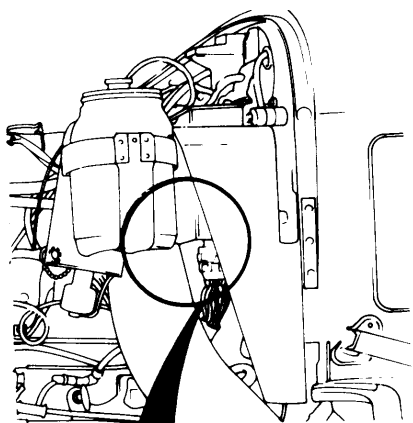
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3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)



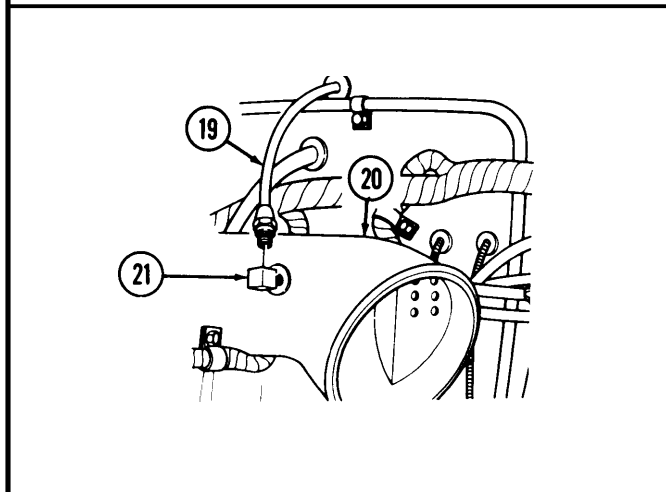
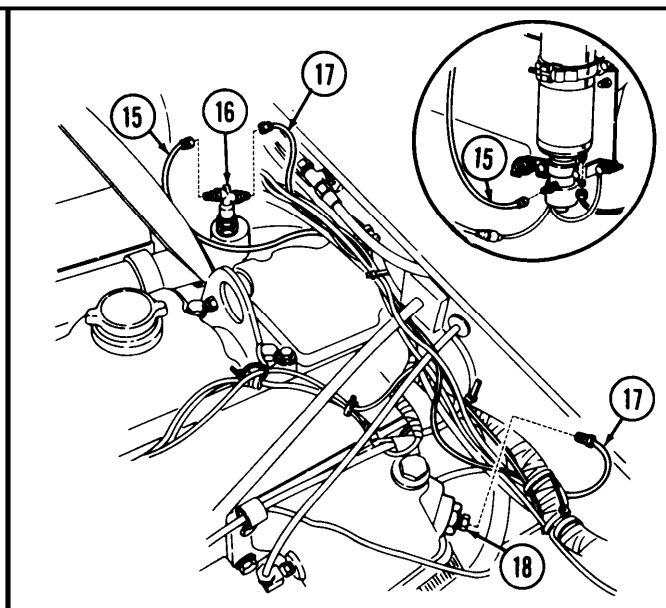
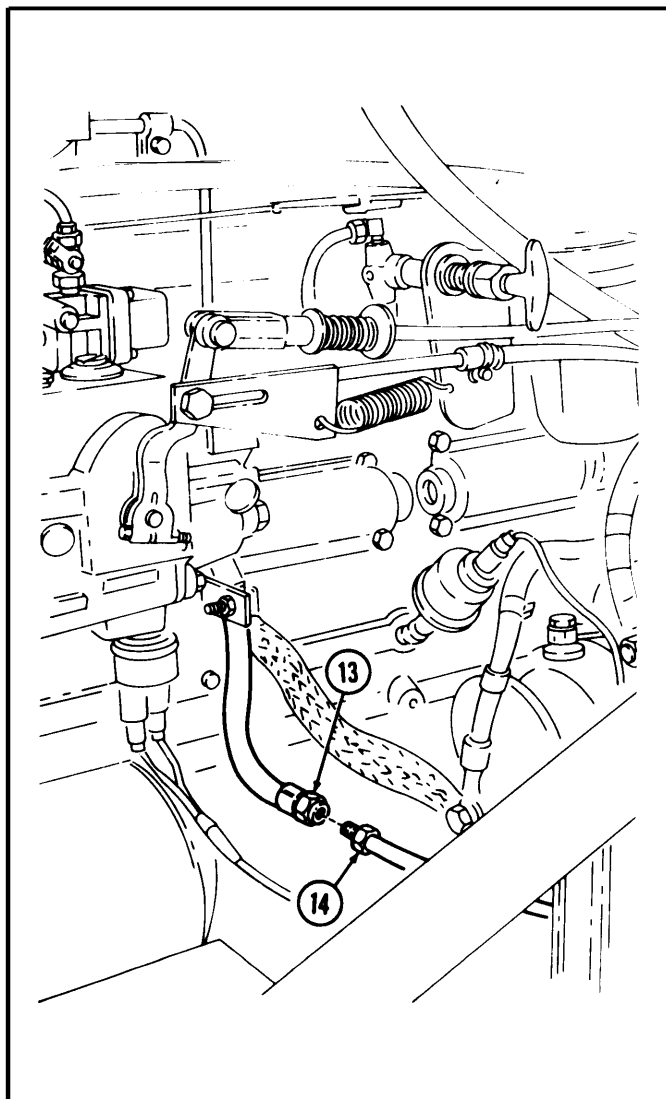
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
32.	Air intake manifold (1)	Two screws (6), washers (7), clamps (5), (3), and (8), and governor to compressor air line (2)	Remove.	
33.		Tachometer cable (4), speedometer cable (9), and electrical harness (10)	Remove.	Tie clear of engine.
34.	Ether start switch (11)	Two connectors (12)	Disconnect.	Tag for installation.



3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

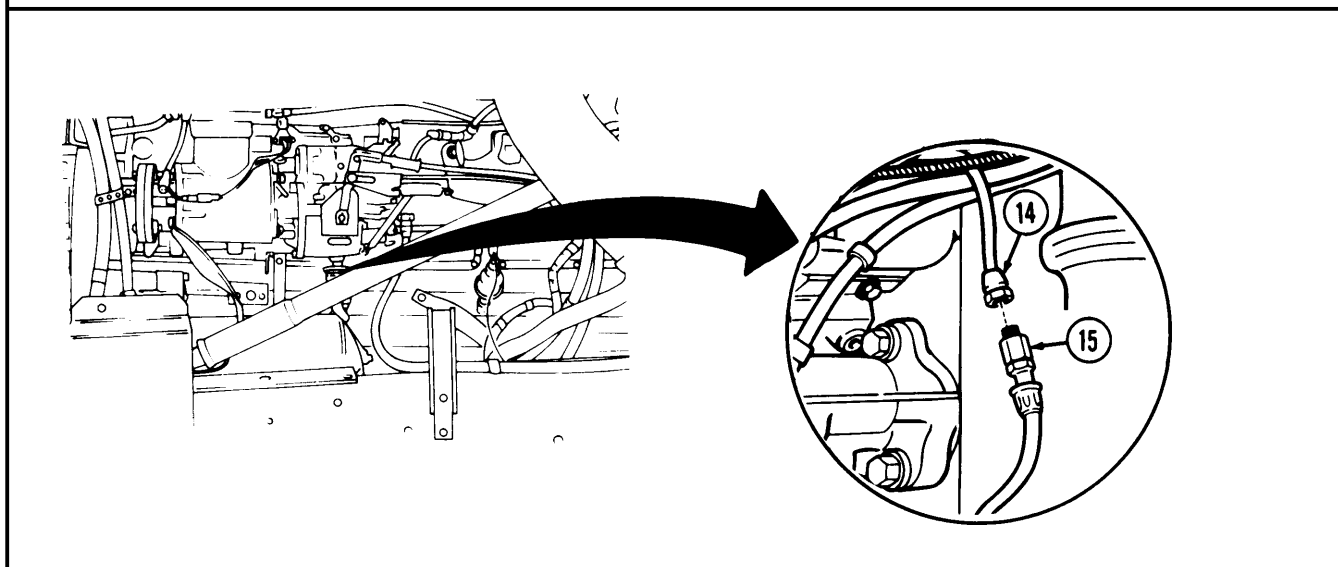
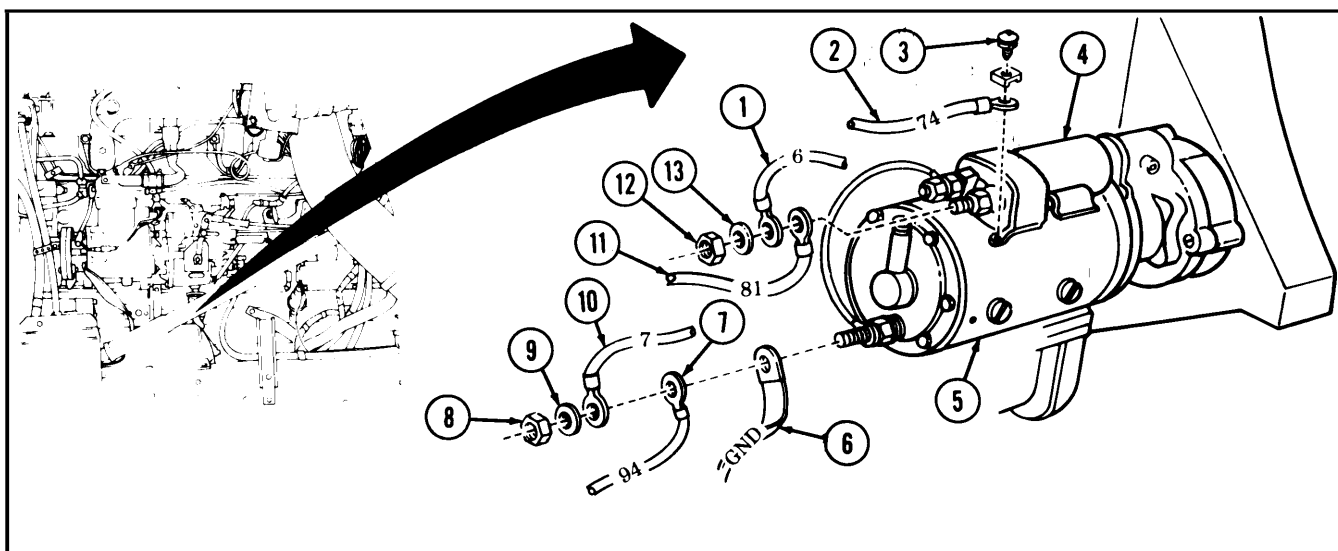
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
35. Fuel pump return hose (13)		Fuel return line (14)	Disconnect.	Tie clear of engine. Tag for installation.
36. Ether start safety valve (16)		Ether start safety valve to ether cylinder valve line (15) and safety valve to atomizer line (17)	Disconnect.	Tie clear of engine. Tag for installation.
37. Ether atomizer (18)		Safety valve to atomizer line (17)	Disconnect.	Tie clear of engine. Tag for installation.
38. Air intake manifold (20)		Air cleaner indicator tube (19)	Disconnect from fitting (21).	Tie clear of engine. Tag for installation.



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3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
39.	Starter solenoid (4)	Nut (12), washer (13), wires (1) and (11)	Remove.	Tiewires (1) and (11) clear of engine.
40.		Screw (3) and wire (2)	Remove.	Tie wire (2) clear of engine.
41.	Starter motor (5)	Nut (8), washer, (9), wires (10) and (7), and ground strap (6)	Remove.	Tie wires (10) and (7) clear of engine.
42.	Left rear of engine	Reservoir air supply line (14)	Disconnect from fitting (15).	Plug opening and tag for installation.



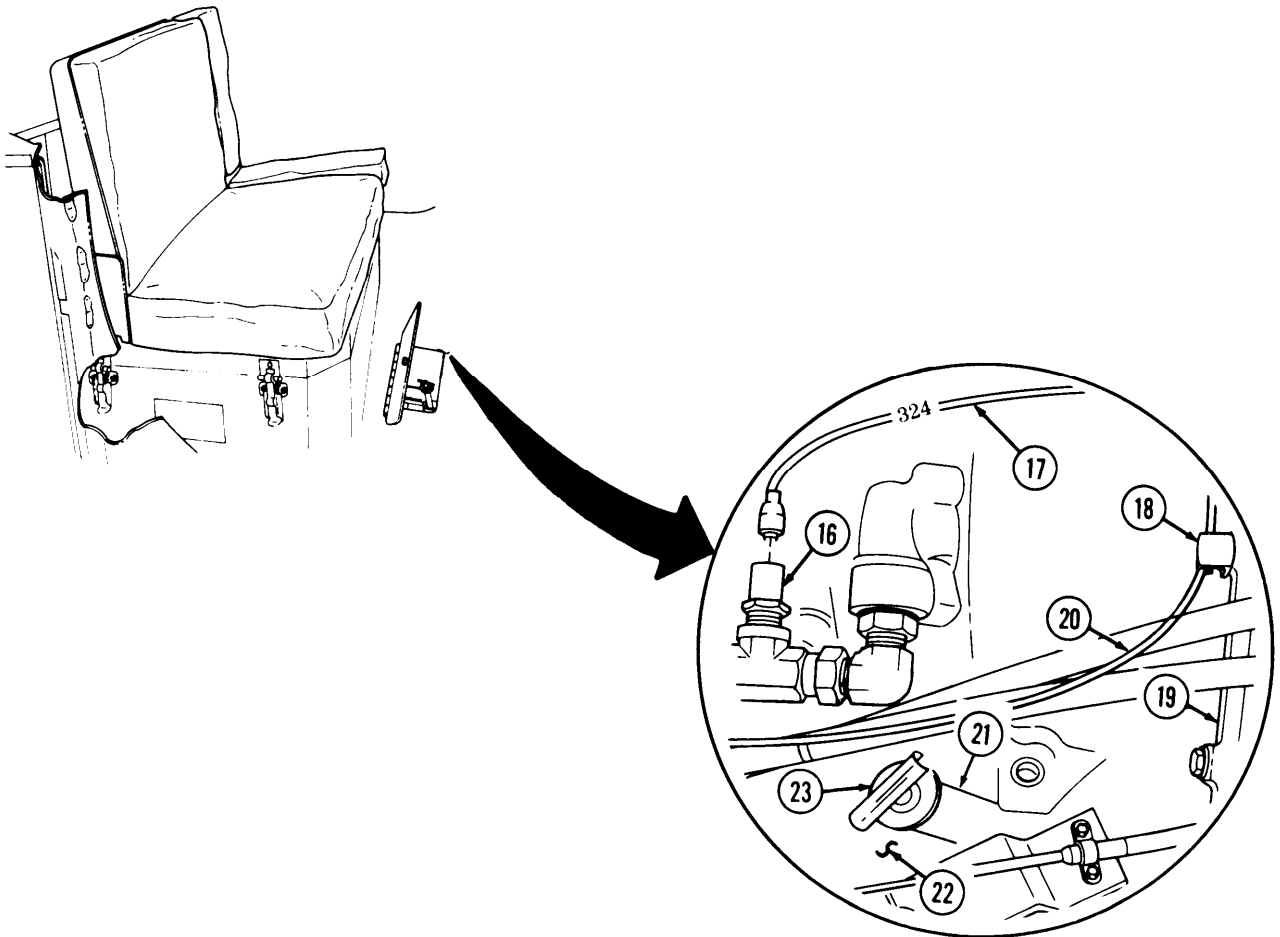
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Transmission preliminary disconnections listed in steps 43 through 45 can be made through access door in cab floor.

43.	Transmission oil temperature sending unit (16)	Wire (17)	Disconnect.	
44.	Transmission flange (19)	Wires (17) and (20)	Remove from two spring tension clips (18).	Tie clear of transmission (22).
45.	Top of transmission (22)	Transmission oil dipstick (23)	Remove.	Plug opening in tube (21).



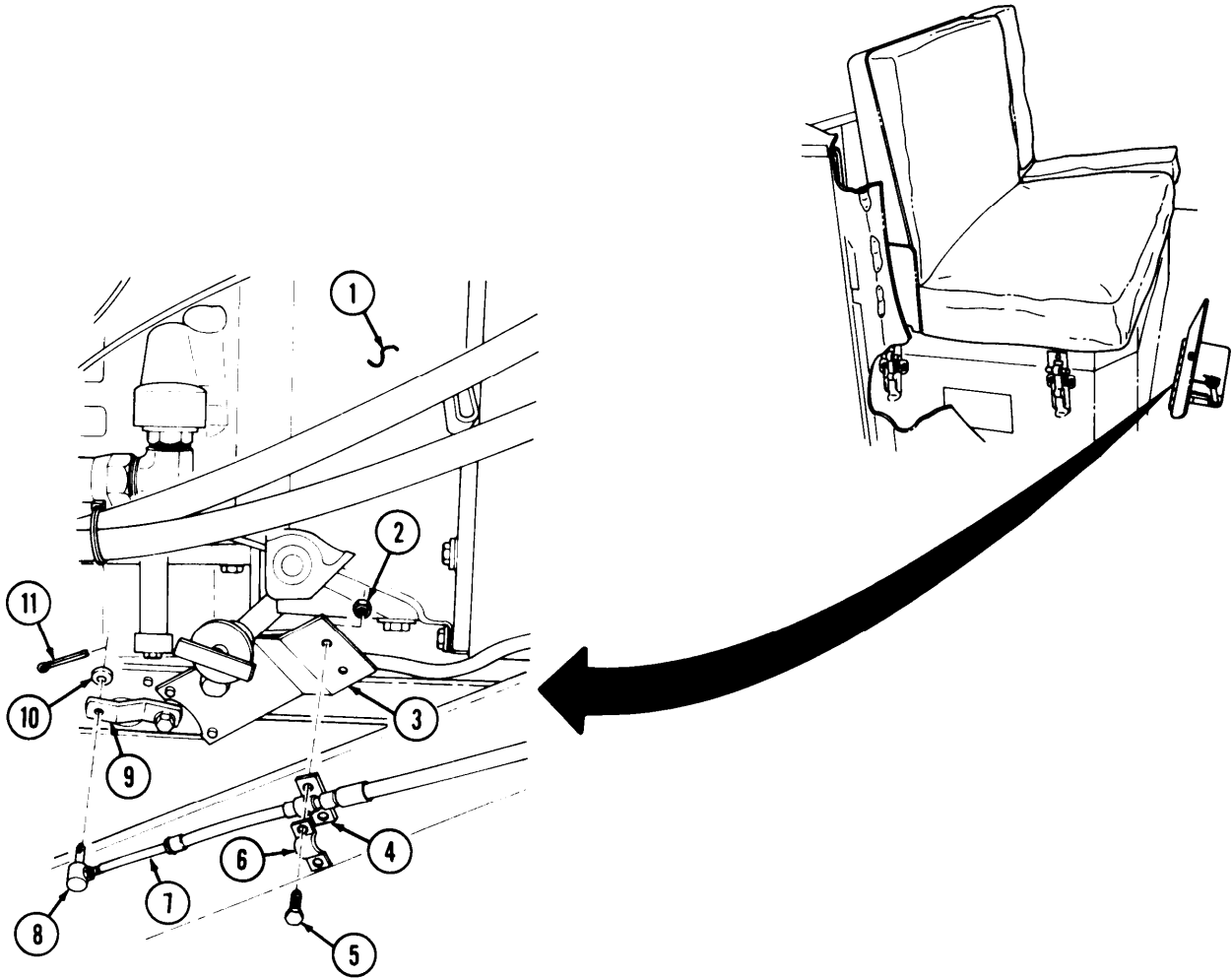
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

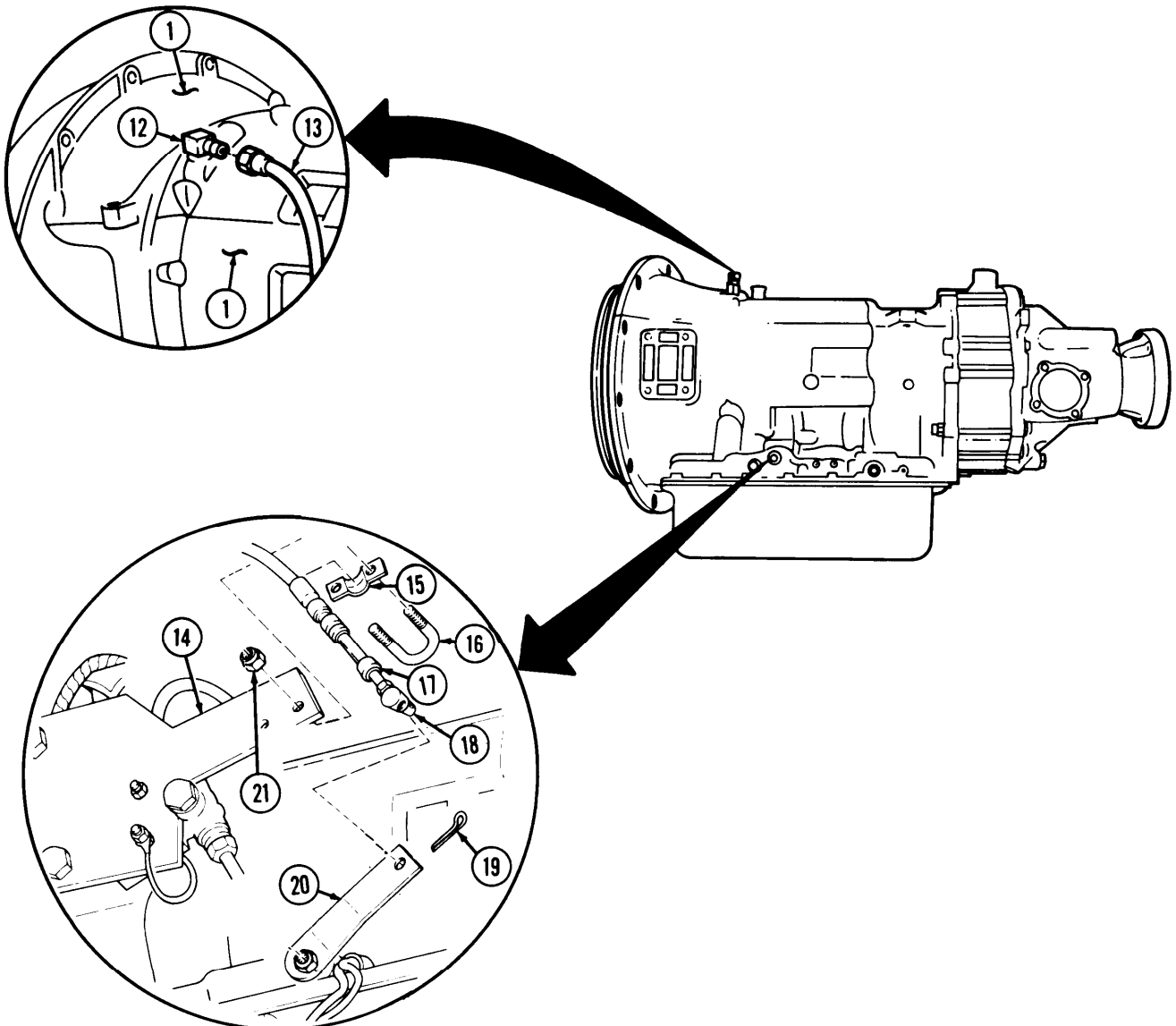
Perform steps 46 and 47 only on vehicles equipped with a transmission power takeoff (PTO).

46. PTO cable bracket (3)	Retaining strap (6), spacer plate (4), two screws (5), and two nuts (2)	Remove.		
47. PTO selector lever (9)	Cotter pin (11), washer (10), cable pin (8), and PTO cable (7)	Remove.		Discard cotter pin (11) and tie cable (7) clear of transmission (1).



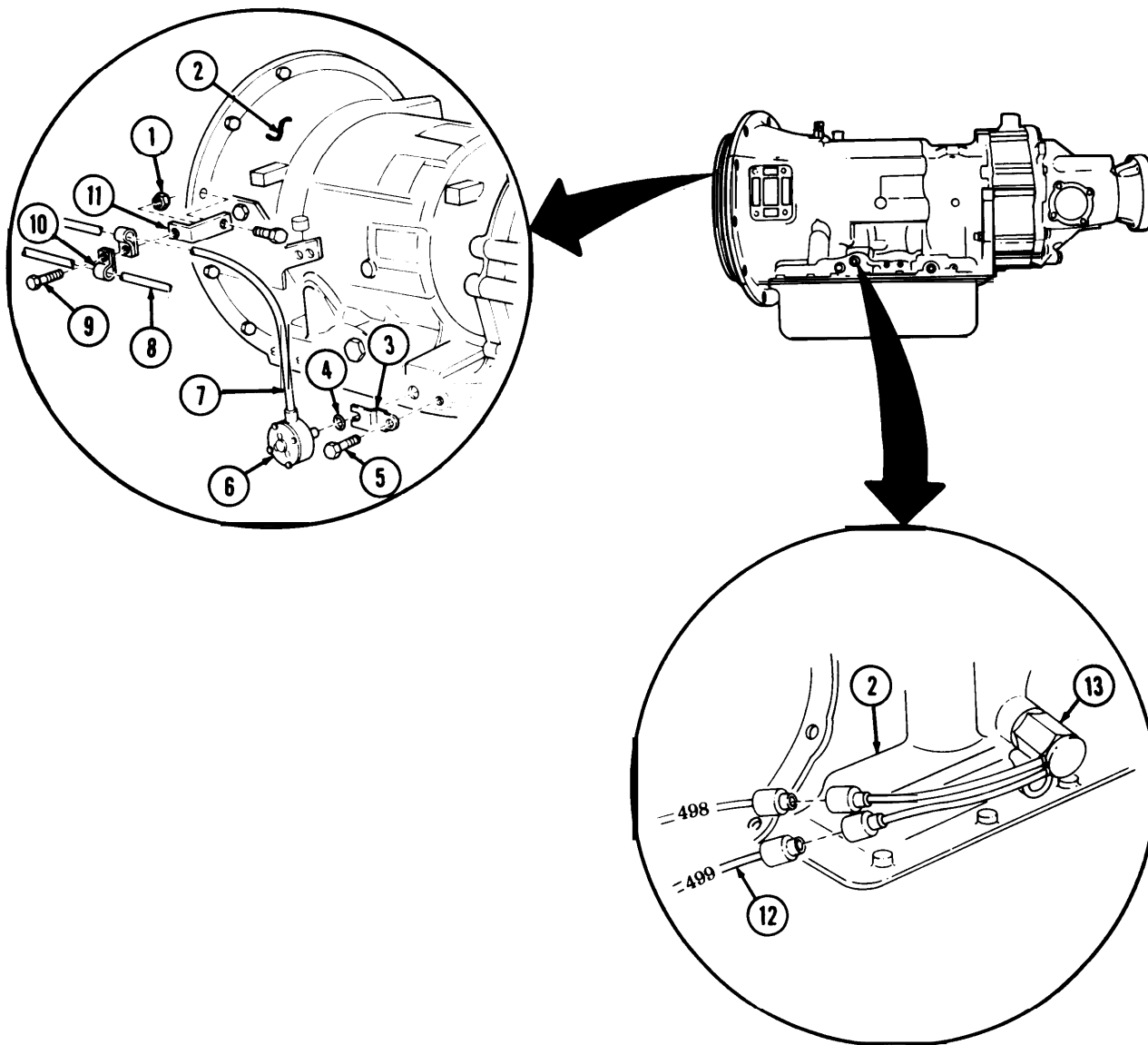
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
48.	Front of transmission (1)	Breather vent line (13)	Disconnect from transmission adapter elbow (12).	Tie clear of transmission. Tag for installation.
49.	Support bracket (14)	Two locknuts (21), U-bolt (16), and shim (15)	Remove.	Discard locknuts (21).
50.	Shift lever (20)	Cotter pin (19), cable pin (18), and transmission selector cable (17)	Remove and disconnect cable pin (18).	Discard cotter pin (19) and tie cable (17) clear of transmission (1).



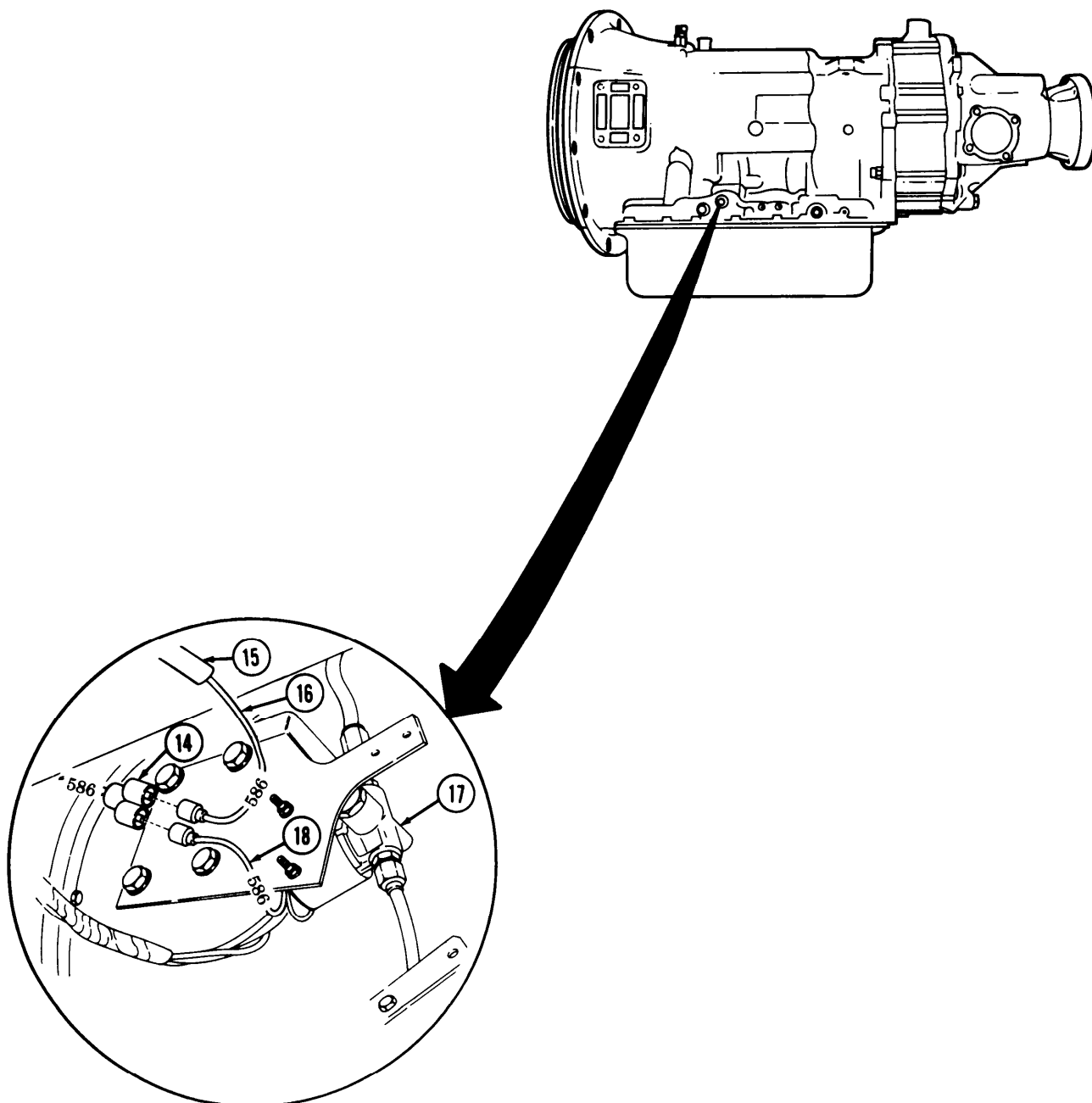
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
51.	Transmission bracket (11)	Screw (9), nut (1), and two cable clamps (10)	Remove.	Tie modulator cable (7) and speedometer cable (8) clear of transmission (2).
52.	Left side of transmission (2)	Screw (5), bracket (3), and modulator (6)	Remove.	Discard "O" ring (4).
53.	Neutral start switch (13)	Two wires (12)	Disconnect.	Tie clear of transmission (2). Tag for installation.



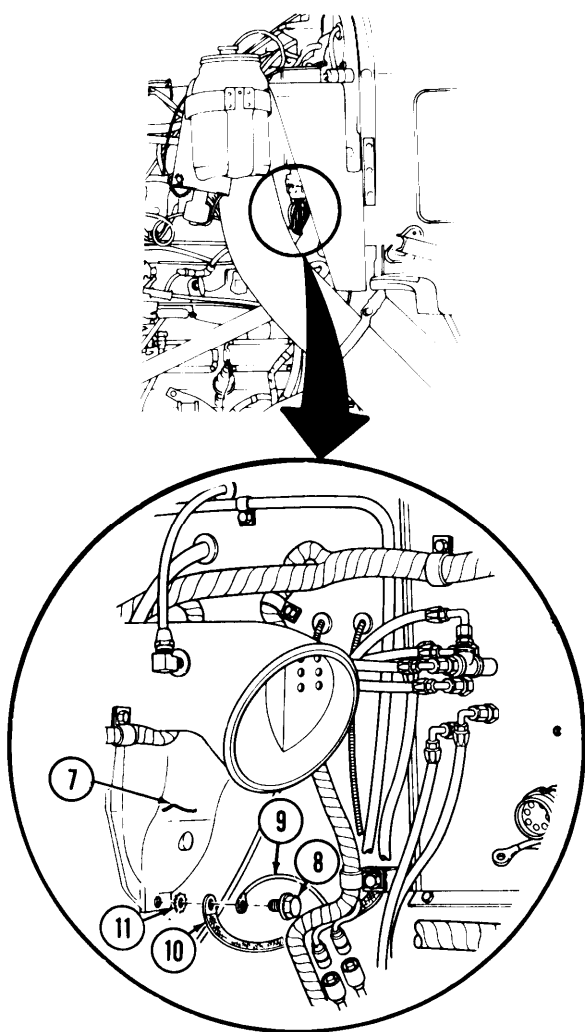
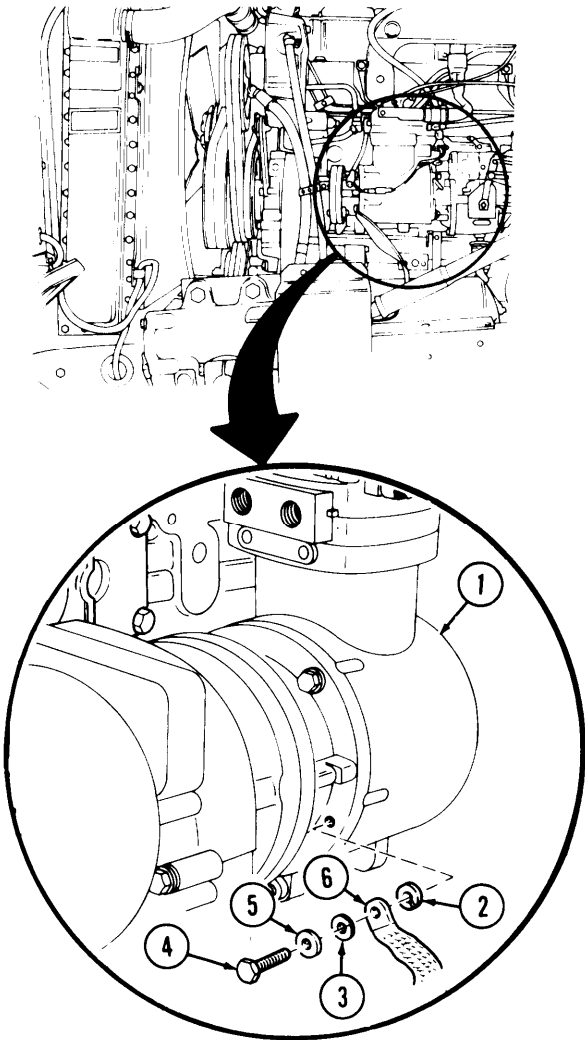
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
54.	Fifth gear lock-in solenoid (17)	Wire (18)	Disconnect from connector (14).	Tie to transmission.
55.	Transorb diode (15)	Wire (16)	Disconnect from connector (14).	



3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
56.	Air compressor (1)	Screw (4), lockwasher (5), washer (3), ground strap (6), and lock-washer (2)	Remove.	Discard lockwashers (5) and (2). Tie ground strap (6) clear of engine. Tag for installation. Discard lockwasher (2).
57.	Air intake manifold (7)	Screw-assembled washer (8), ground wire (9), ground strap (10), and lockwasher (11)	Remove,	Discard lockwasher (11). Tie ground strap (10) and ground wire (9) clear of engine. Tag for installation.



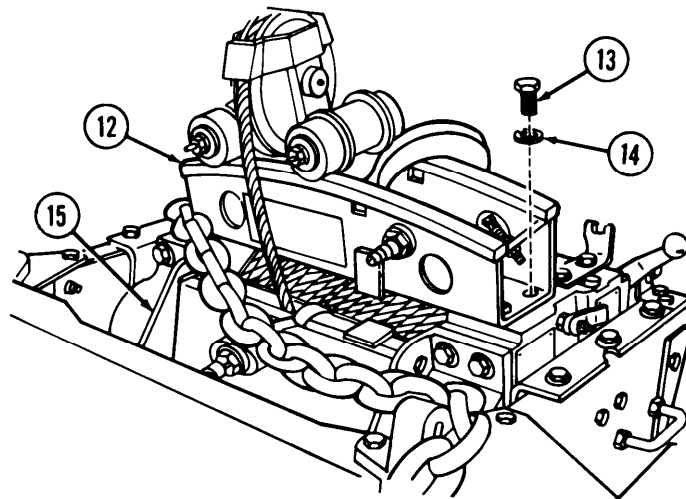
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

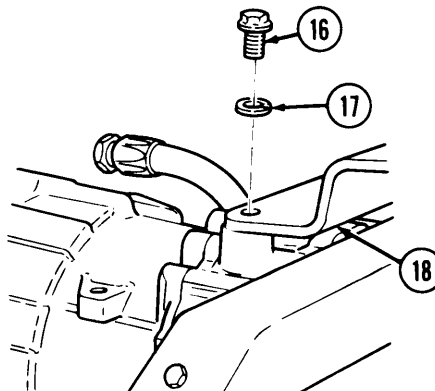
Step 58 is performed only on vehicles equipped with front winch with level wind.

58. Winch (15)		Four screws (13), lockwashers (14), and winch level wind (12)	Remove.	Discard lockwashers (14). Place winch level wind (12) clear of engine.
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b. Removal

59. Transmission rear support bracket (18)		Two screws (16) and lockwashers (17)	Remove.	Discard lockwashers (17).
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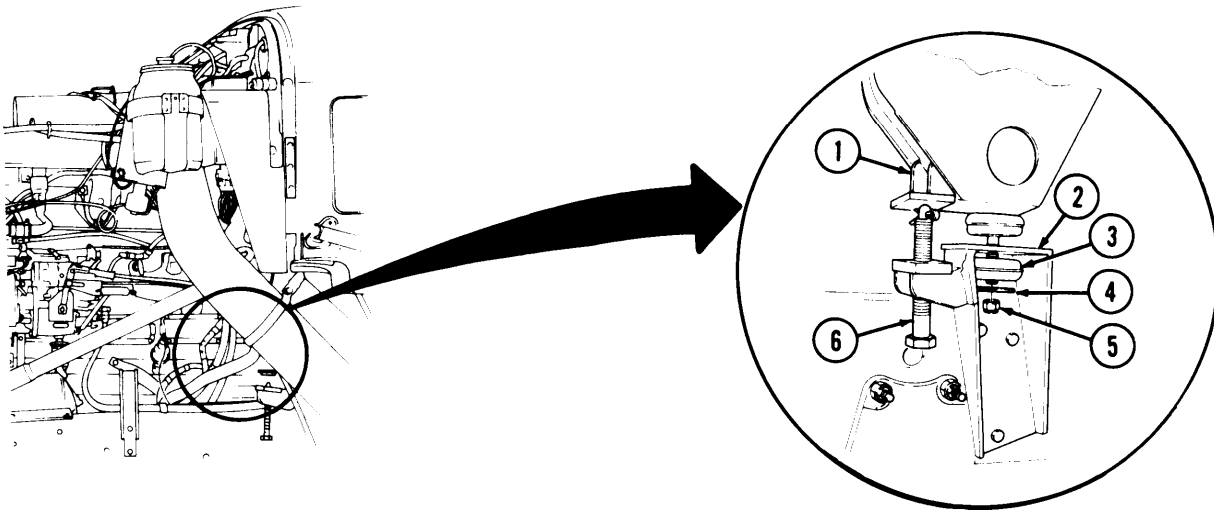
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

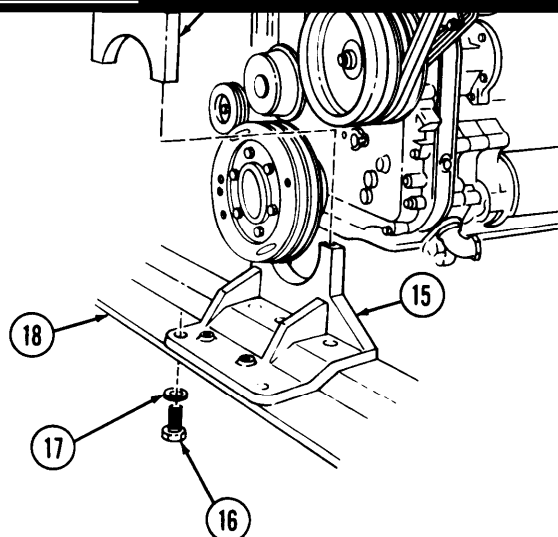
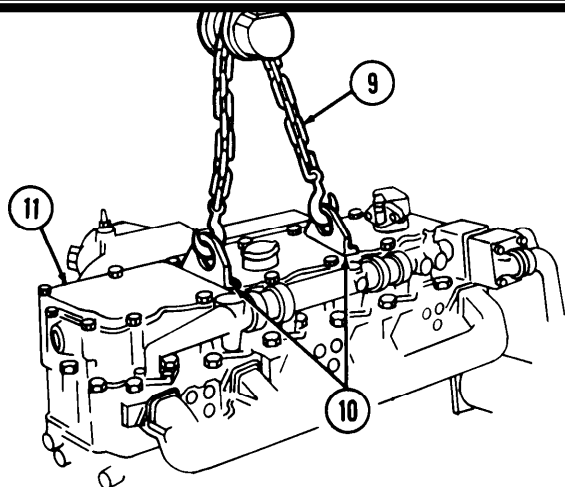
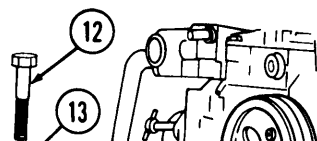
Front of cab must be raised 4 in. (102 mm) to permit engine oil pan sump to clear the front axle differential housing. Two permanently mounted jack screws under the left and right cab "A" posts permit raising front of cab.

- | | | | | |
|-----|------------------------------------|--|---|---|
| 60. | Cab "A" posts support brackets (2) | Two locknuts (5), washers (4), and rubber cushions (3) | Remove. | Discard locknuts (5). |
| 61. | Cab "A" posts (1) | Left and right jack screws (6) | Turn until "A" posts (1) are approximately 4 in. (102 mm) above support brackets (2). | Turn both jack screws (6) at same time. |



3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
62.		Adjustable hoist chain (9)	a. Attach adjustable end to hoist hook (8) and each chain hook to engine lift eyes (10). b. Raise hoist (7) until all slack is removed from chain (9).	Make sure hoist (7) does not support weight of engine (11).
63.	Front frame crossmember (18)	Two screws (12), lockwashers (13), five screws (16), lockwashers (17), trunnion cap (14), and trunnion mount (15)	Remove.	Discard lockwashers (13) and (17).



3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
64.	Engine flywheel housing (5)	Two nuts (7), lockwashers (8), screws (3), and washers (4)	Remove from left and right engine supports (6).	Discard lockwashers (8).

WARNING

- All personnel not participating in engine removal must stand clear during hoisting operations. A snapped cable, or swinging or shifting load may cause injury to personnel.
- Do not use hands to free engine of "hangups". Use tanker or pry bats to avoid injury to personnel.

CAUTION

Always remove engine slowly. Lift out of chassis in short lifts and closely observe all engine and transmission attachments during removal to prevent damage to equipment.

NOTE

During steps 65 through 67, mechanic will direct all hoisting operations while assistant operates hoist or assists mechanic.

NOTE

Hoist chain must be adjusted to lower rear of transmission downward so engine is suspended at approximately a 15° to 20° angle to clear front axle.

65.	Hoist chain adjustable ratchet (2)	Using socket wrench, adjust engine angle to 15° to 20°.
66.	Engine (1) and transmission (10)	Hoist slowly upward until clear of engine compartment and vehicle.

NOTE

Adjust hoist chain so that engine and transmission are level for placement on trestles,

67.	Engine (1) and transmission (10)	Hoist onto transport stand (12).	Make sure two trestles of transport stand (12) are positioned under each side of front gearcase cover (13) and two positioned under each end of bell-housing engine mount (11).
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WARNING

Do not detach hoist chain from engine until all engine weight is equally distributed and engine is stable on transport stand. An improperly supported engine may cause injury to personnel. Mounting engine on transport stand is solely temporary and is not intended as a supporting requirement for engine repair. When repairing engine, use repair stand.

3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
68.		Adjustable hoist chain (9)	Disconnect from engine lift eyes (14).	

NOTE

Remove replacement engine from container (para. 3-24.1).

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3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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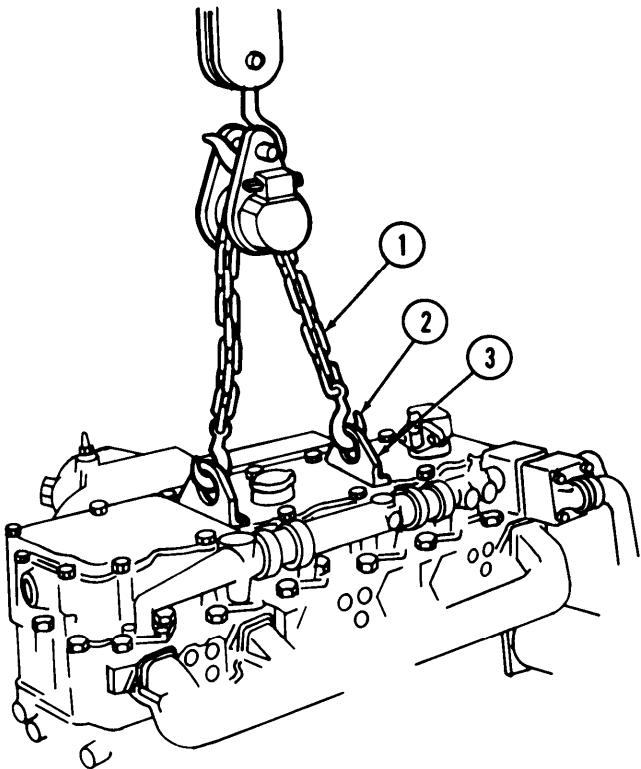
c. Installation

NOTE

When replacing engine, remove transmission and reinstall it on new engine as outlined in paragraph 7-12,

69. Hoist chain (1)
- a. Attach hooks (2) to engine lift eyes (3).

b. Raise hoist just enough to eliminate slack in chain (1).



WARNING

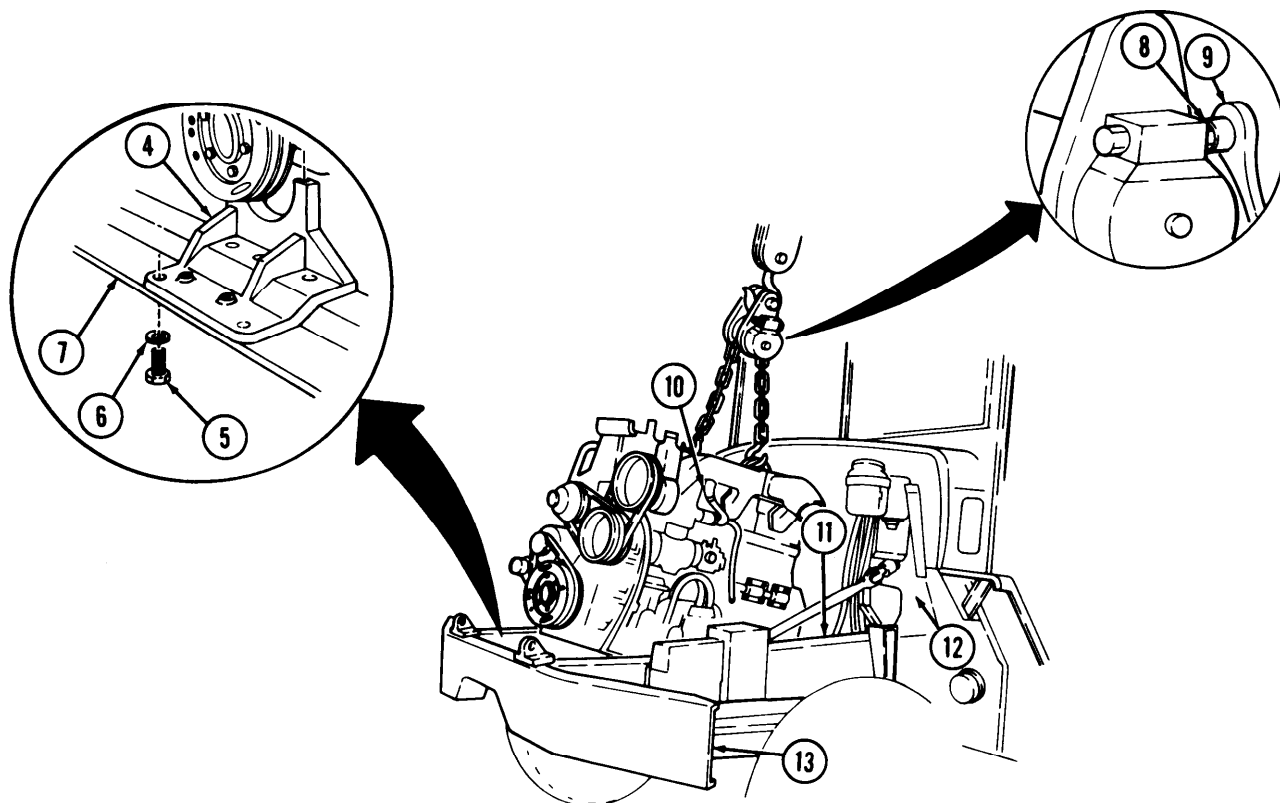
All personnel not participating in engine installations must stand clear during hoisting operations. A snapped cable, or swinging or shifting load may cause injury to personnel.

CAUTION

Lower engine into chassis carefully and closely observe all engine and transmission components to prevent equipment damage.

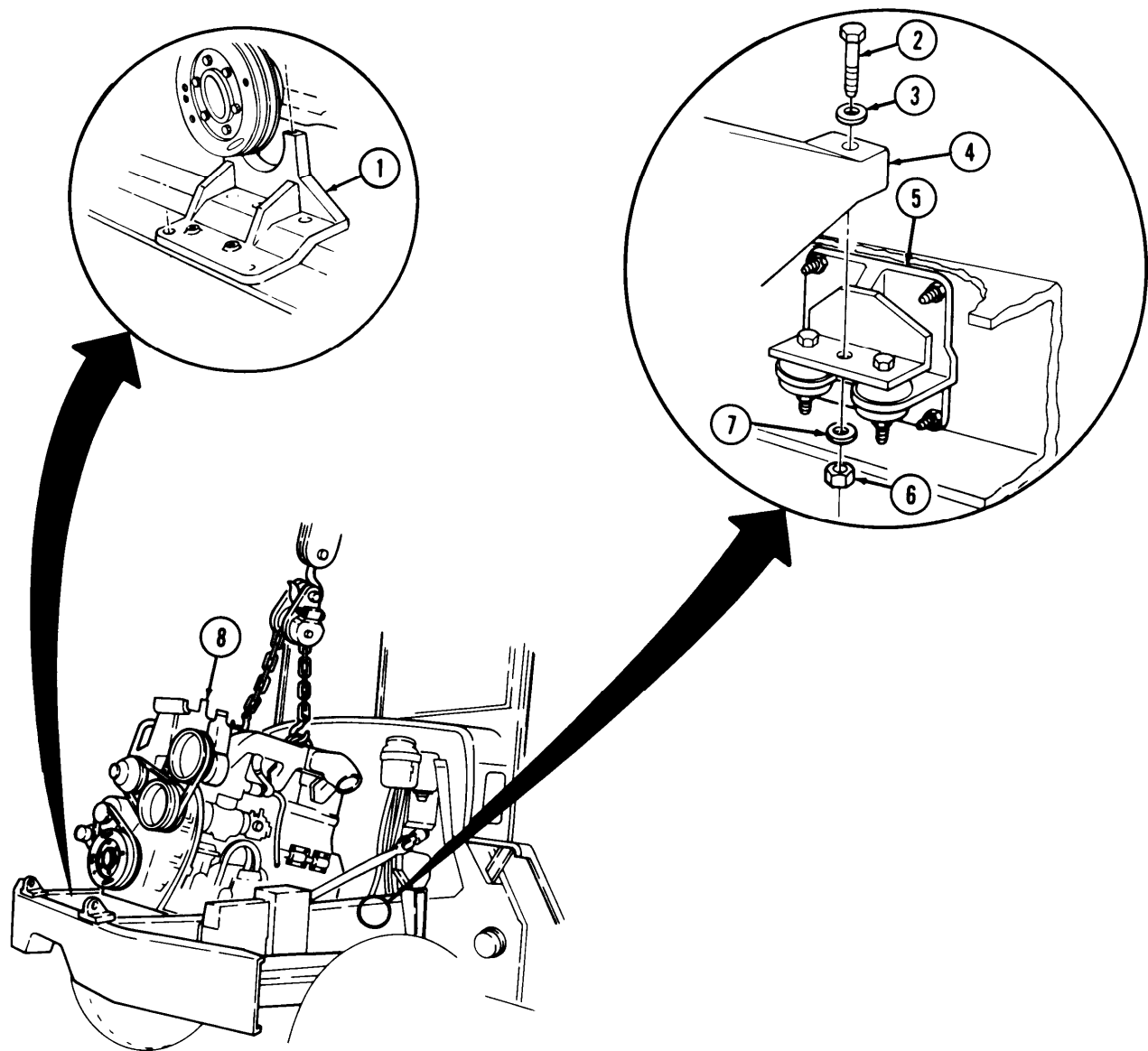
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p align="center">NOTE</p> <ul style="list-style-type: none"> •During steps 70 through 73, if engine is removed in the field, an additional assistant will be needed to operate the wrecker crane. Shop removal of engine requires a mechanic and one assistant if overhead hoist is available. •Hoist chain must be adjusted so transmission points downward at approximately a 15° to 20° angle for engine to clear front axle. 				
70.		Trunnion mount (4)	Install on front frame crossmember (7) with five screws (5) and new lockwashers (6).	Start screws (5) only
71.		Engine (10) and transmission (11)	Raise over front bumper (13) directly above engine compartment (12).	
72.		Hoist chain adjustable ratchet (8)	Using socket wrench (9), adjust engine angle to 15° to 20°.	
73.		Engine (10) and transmission (11)	Slowly lower into engine compartment (12).	Do not lower completely.



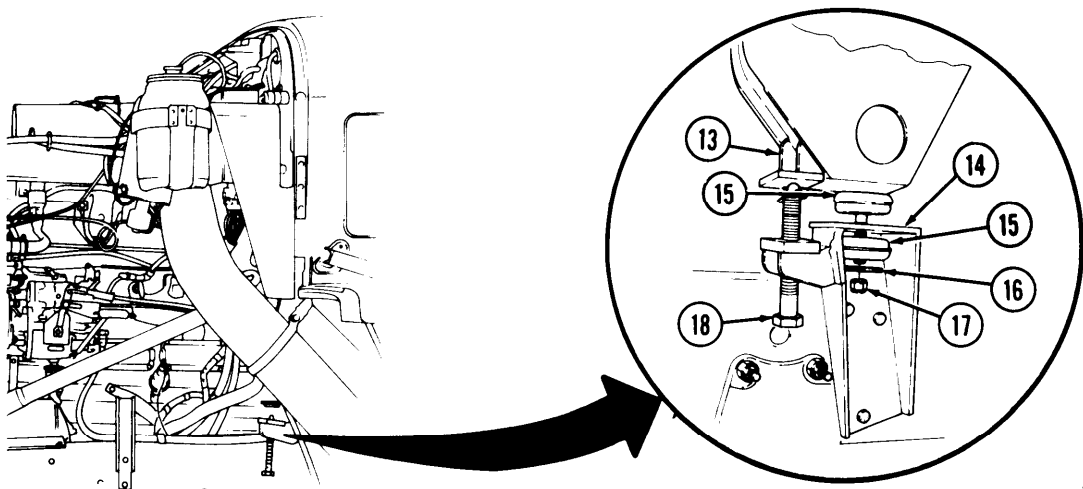
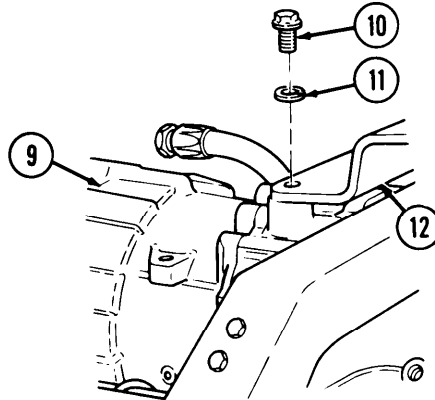
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
74.		Engine (8)	Lower until resting on trunnion mount (1) and rear engine supports (5).	
75.		Engine flywheel housing (4)	Install to rear engine supports (5) with two washers (3), screws (2), nuts (6), and new lockwashers (7).	Holes may have to be alined with long drift pin. Tighten 140-160 lb-ft (190-217 N-m).



3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

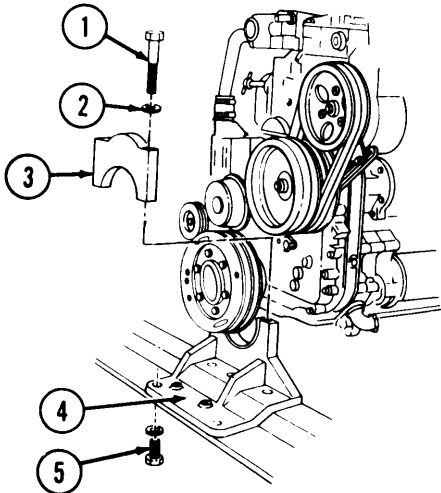
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
76.		Transmission (9)	Install on rear support bracket (12) with two screws (10) and new lockwashers (11).	Tighten 75-85 lb-ft (102-115 N.m).
77.		Left and right cab jack-screws (18)	Turn until cab "A" post (13) rubber cushion (15) rests on "A" post brackets (14).	Ensure jackscrews (18) are turned all the way down in "A" post brackets (14).
78.		Cab "A" posts (13)	Install on each "A" post bracket (14) with rubber cushion (15), washer (16), and new locknut (17).	



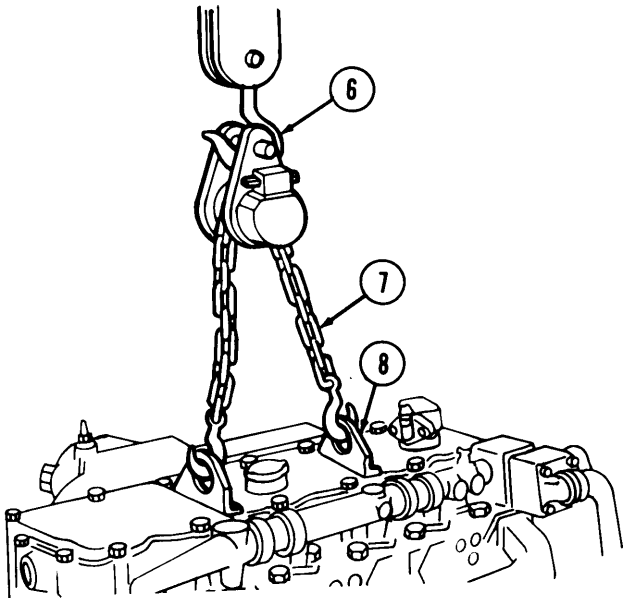
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3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
79.		Trunnion cap (3)	Install on trunnion mount (4) with two screws (1) and new lockwashers (2).	Tighten 150 lb-ft (203 N·m).
80.		Trunnion mount (4)	Tighten five screws (5).	Tighten 65-75 lb-ft (88-102 N·m).



81.		Adjustable hoist chain (7)	Disconnect from engine lift eyes (8) and hoist hook (6).	
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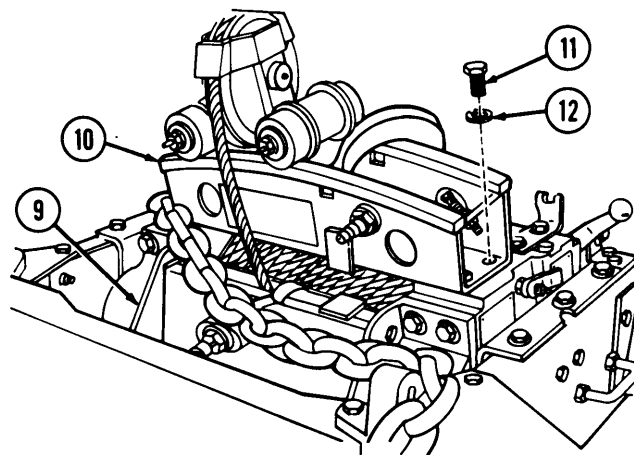
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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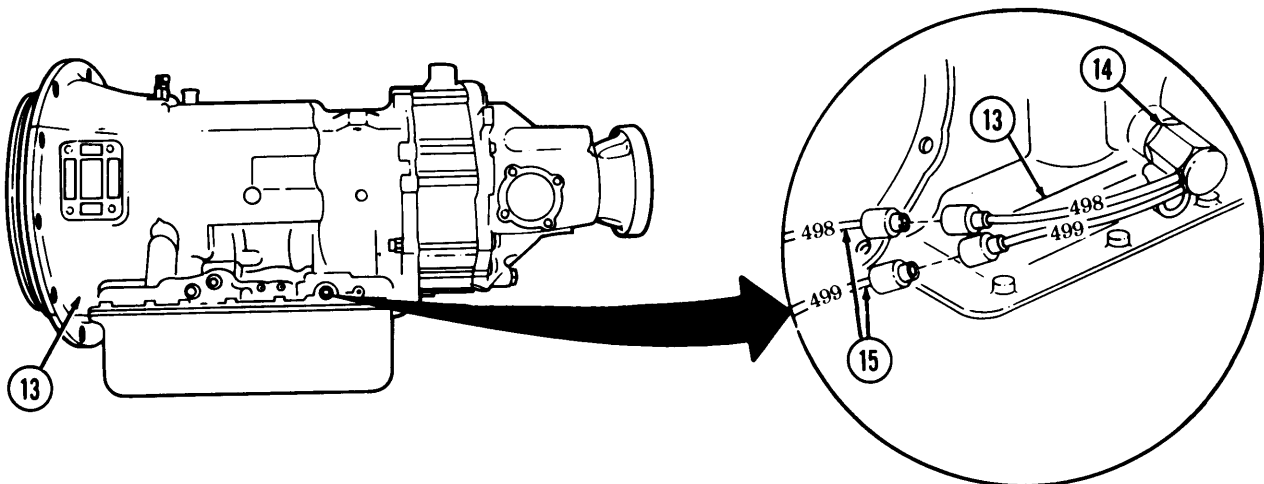
NOTE

Step 82 applies only to those vehicles equipped with a front winch with level wind.

82.	Winch level wind (10)	Install on winch (9) with four screws (11) and new lockwashers (12).	Tighten 70-90 lb-ft (95-122 N-m).
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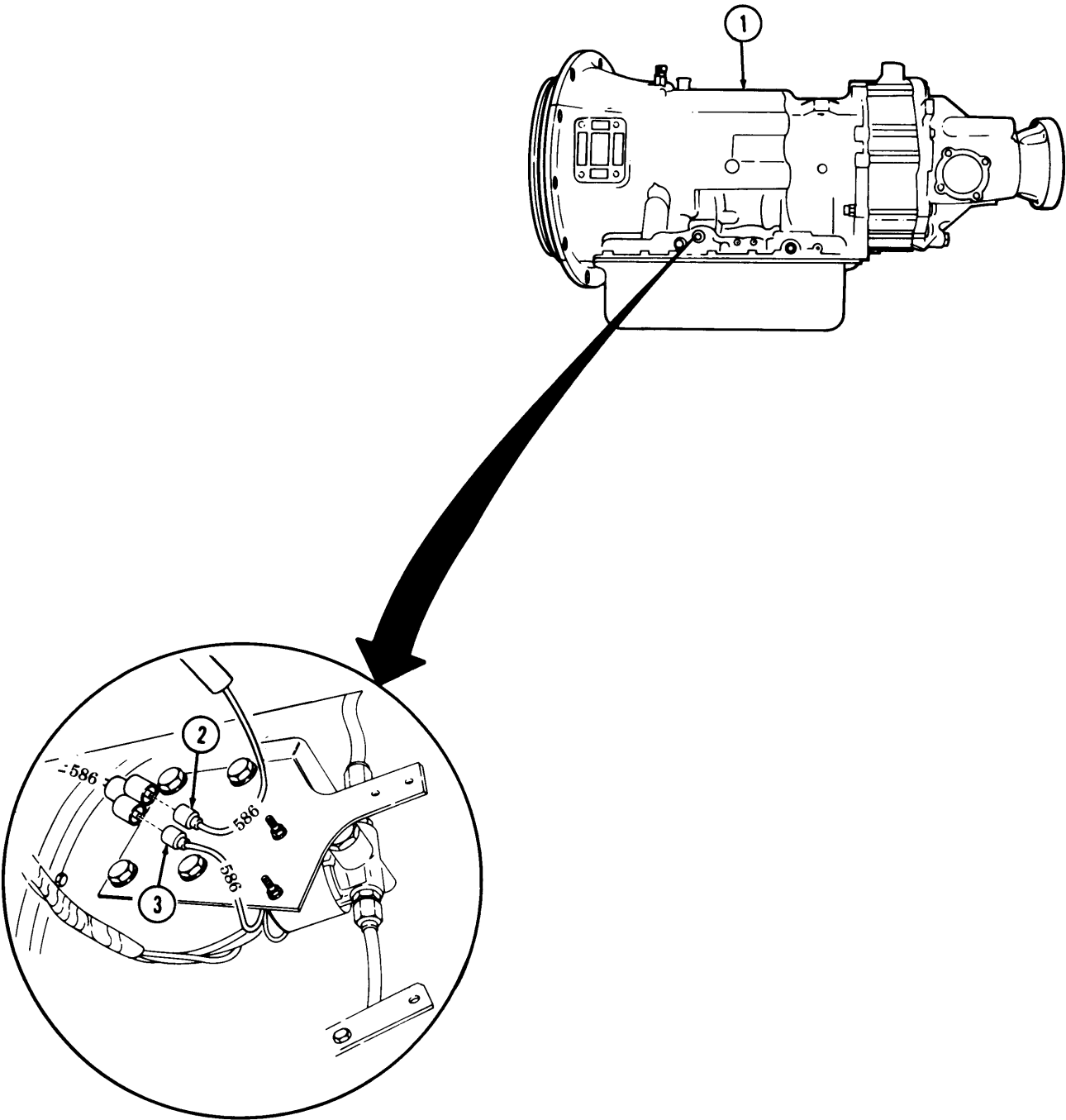
83.	Two wires (15)	Connect to transmission neutral start switch (14) on left side of transmission (13).
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3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

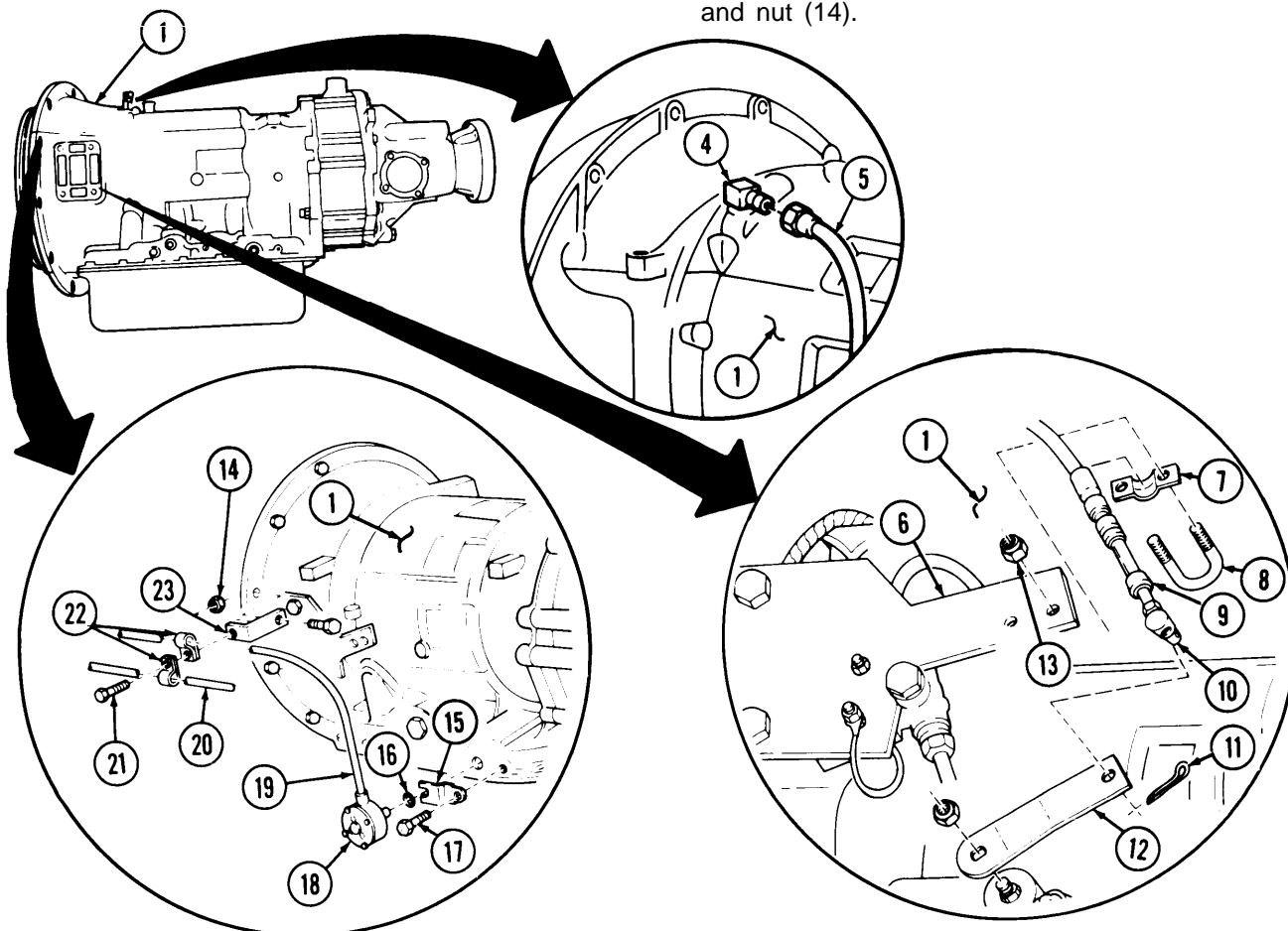
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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84.		Fifth gear lock-in connectors (2) and (3)	Connect.	
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3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
85.		Breather vent line (5)	Connect to transmission adapter elbow (4).	
86.		Transmission shift cable (9)	a. Install cable pin (10) to shift lever (12) with new cotter pin (11). b. Install on support bracket (6) with U-bolt (8), shim (7), and new locknuts (13).	
87.		Modulator (18)	Install on transmission (1) with screw (17), new "O" ring (16) and bracket (15).	
88.		Modulator cable (19) and speedometer cable (20)	Install on transmission bracket (23) with screw (21), clamps (22), and nut (14).	



3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

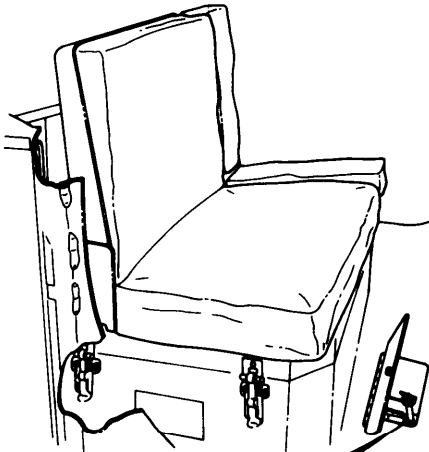
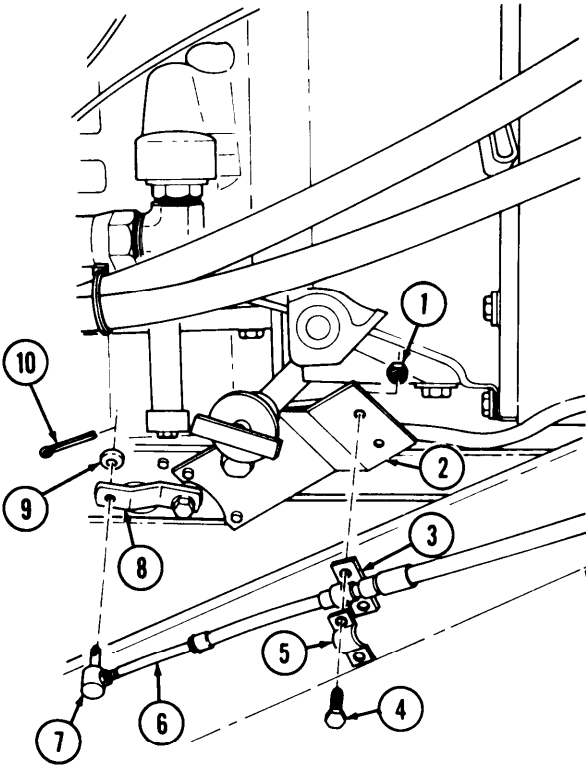
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

- Step 89 applies only to those vehicles equipped with a transmission power takeoff (PTO).
- Transmission connections listed in steps 89 through 92 can be made through access door in cab floor.

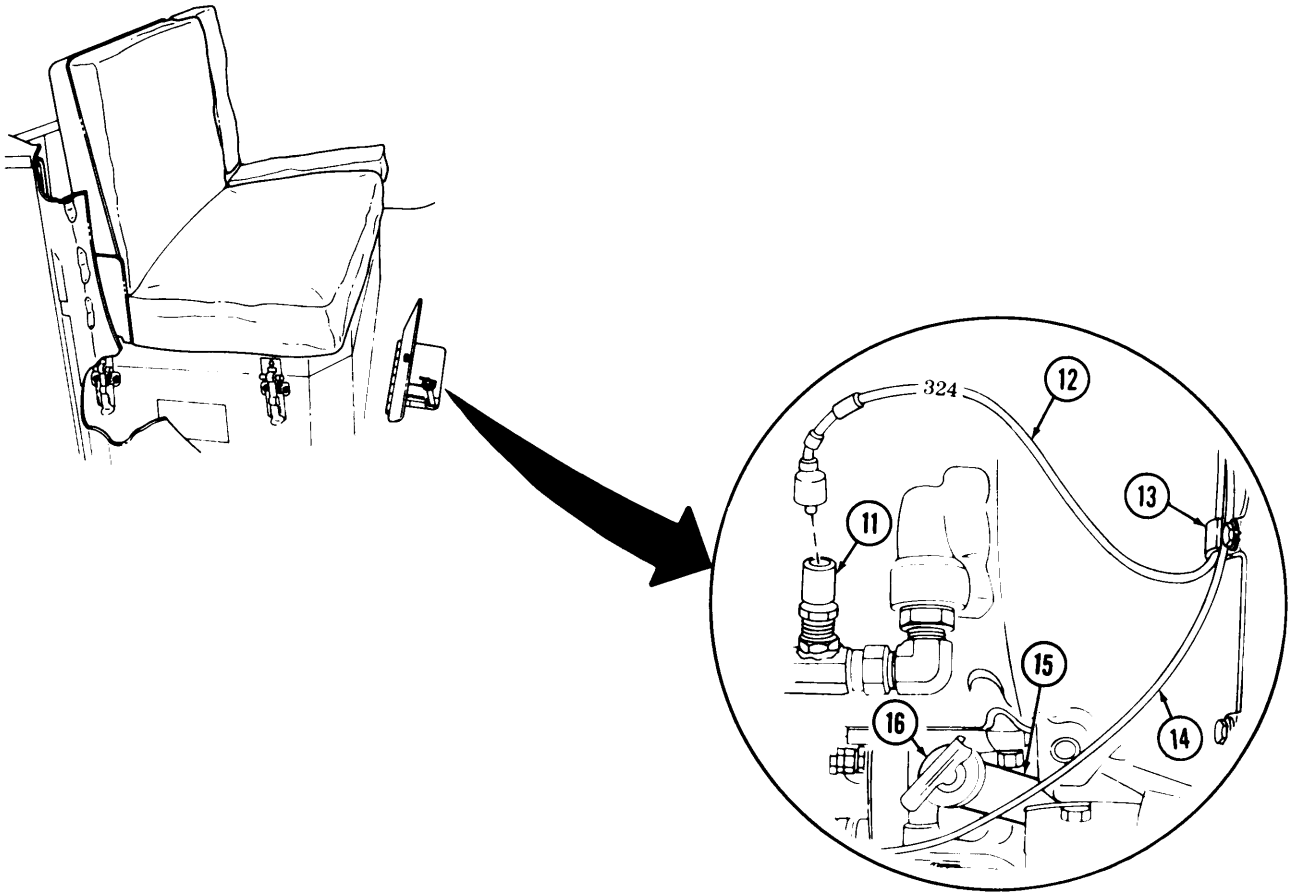
89.
- PTO control cable (6)
- a. Connect cable pin (7) to select lever (8) with washer (9) and new cotter pin (10).

b. Connect to bracket (2) with retainer strap (5), spacer plate (3), and two screws (4), and nuts (1).



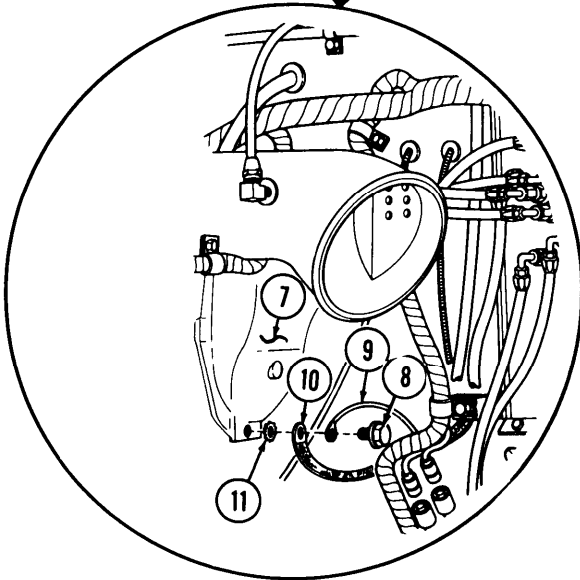
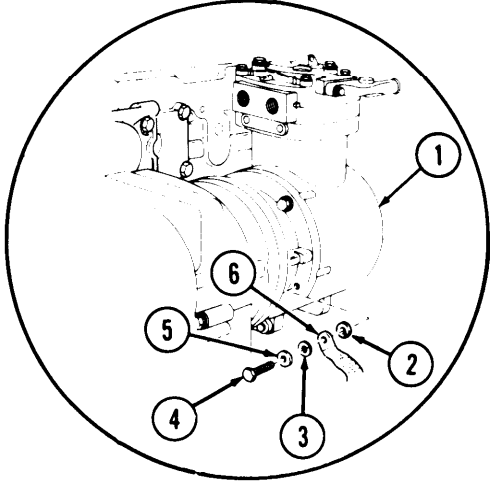
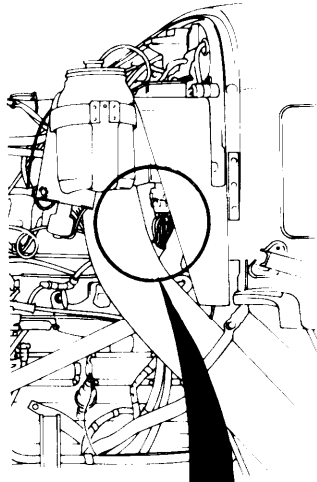
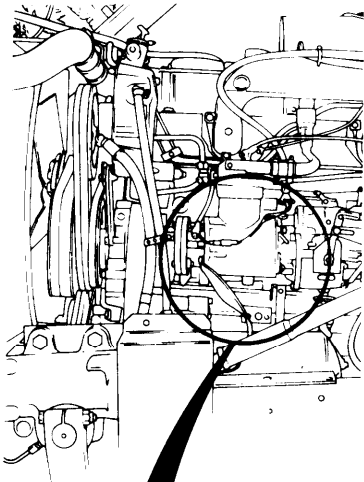
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
90.		Transmission oil dipstick (16)	Install in dipstick tube (15) and tighten.	
91.		Temperature sending unit wire (12) and low air pressure switch wire (14)	Install in two spring tension clips (13).	
92.		Wire (12)	Connect to transmission oil temperature sending unit (11).	



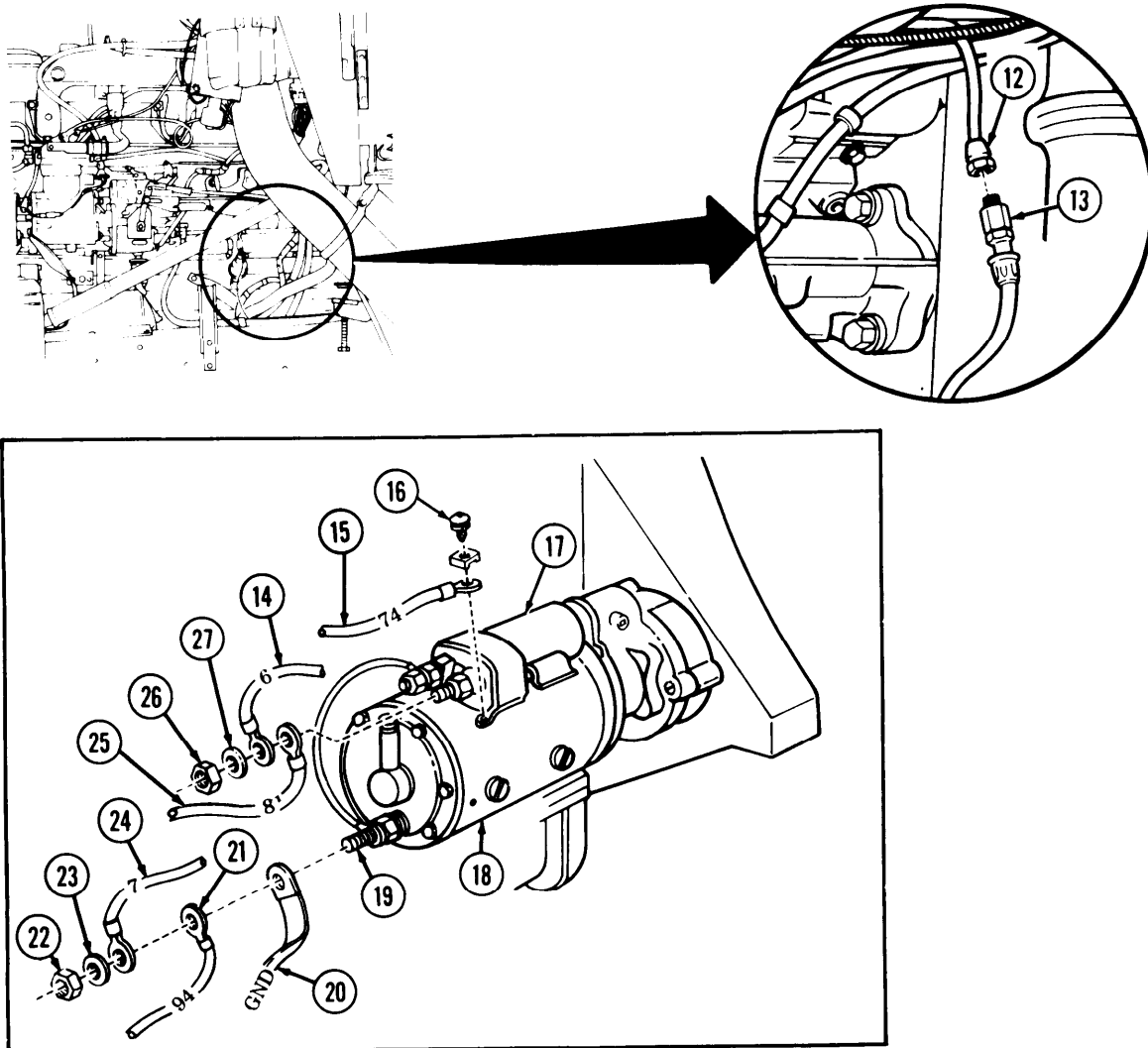
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
93.		Ground strap (6)	Install on air compressor (1) with screw (4), new lockwasher (5), washer (3), and new lockwasher (2).	
94.		Ground strap (10) and ground wire (9)	Install on air intake manifold (7) with screw-assembled washer (8) and new lockwasher (11).	



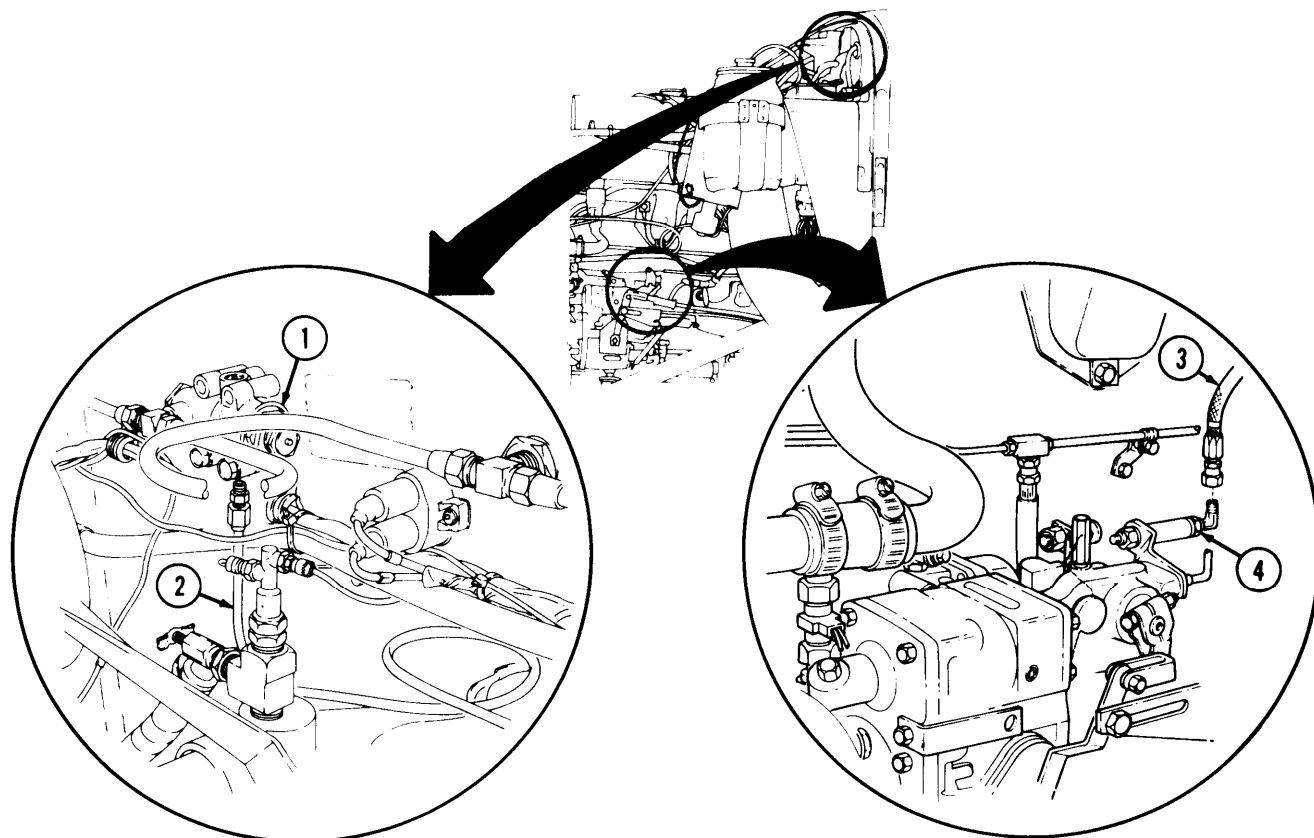
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
95.		Reservoir air supply line (12)	Connect to fitting (13).	
96.		Wires (24) and (21) and ground strap (20)	Install on terminal post (19) on starter motor (18) with washer (23) and nut (22).	
97.		Wires (14) and (25)	Install on starter solenoid (17) with washer (27) and nut (26).	
98.		Wire (15)	Install on starter solenoid (17) with screw (16).	



3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

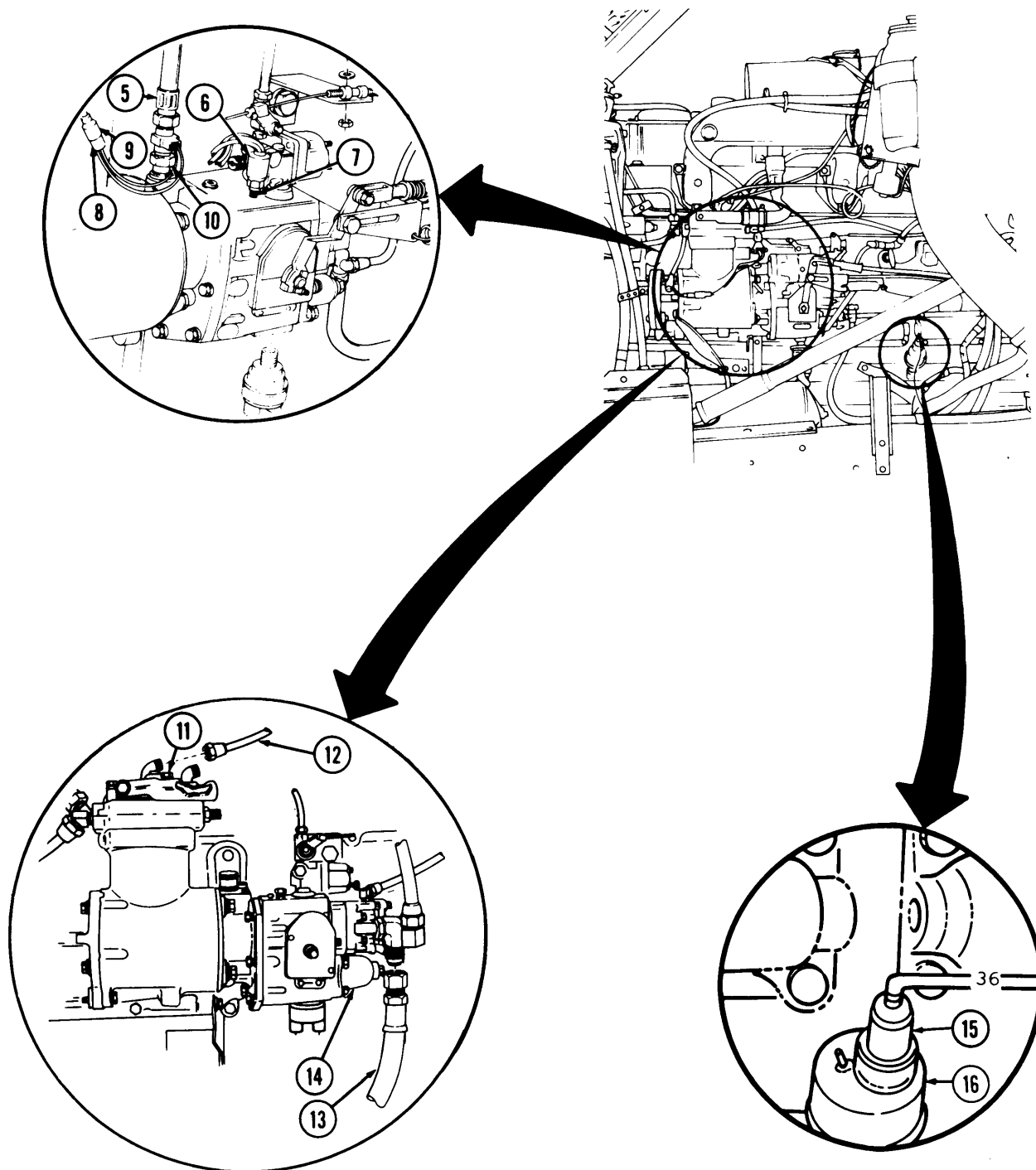
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
99.		Air governor to compressor air line (2)	Connect to air governor (1).	
<p style="text-align: center;">NOTE</p> <p>Perform step 100 on M936 wrecker only.</p>				
100.		VS governor air line (3)	Connect to VS governor (4).	
101.		Transducer connector (6)	Connect to fuel pressure transducer harness socket (7).	
102.		Inlet fuel line (13)	Connect to rear of fuel pump (14).	
103.		Governor to compressor air line (12)	Connect to air compressor (11).	
104.		Connector (15)	Connect to oil pressure sending unit (16).	
105.		Tachometer drive cable (5)	Connect to tachometer pulse sender (10).	
106.		Pulse sender connector (9)	Connect to pulse sender harness socket (8).	



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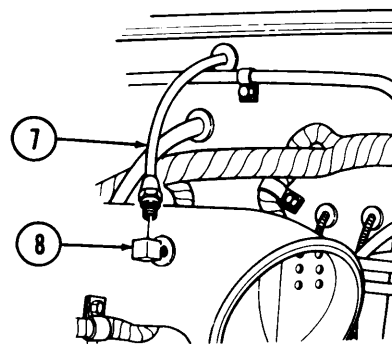
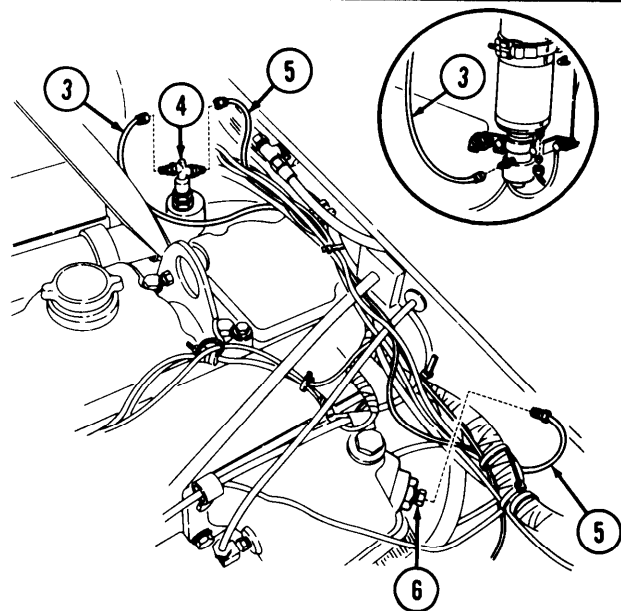
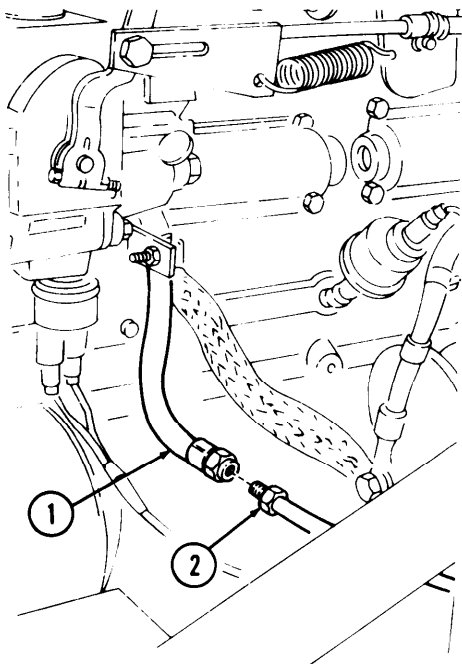
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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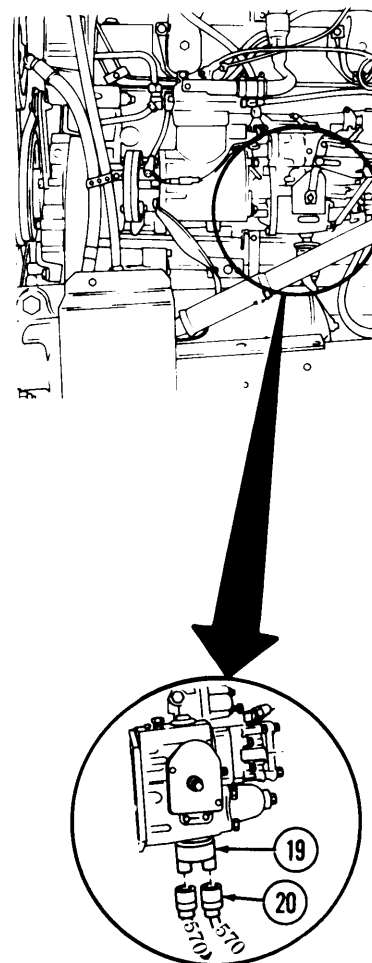
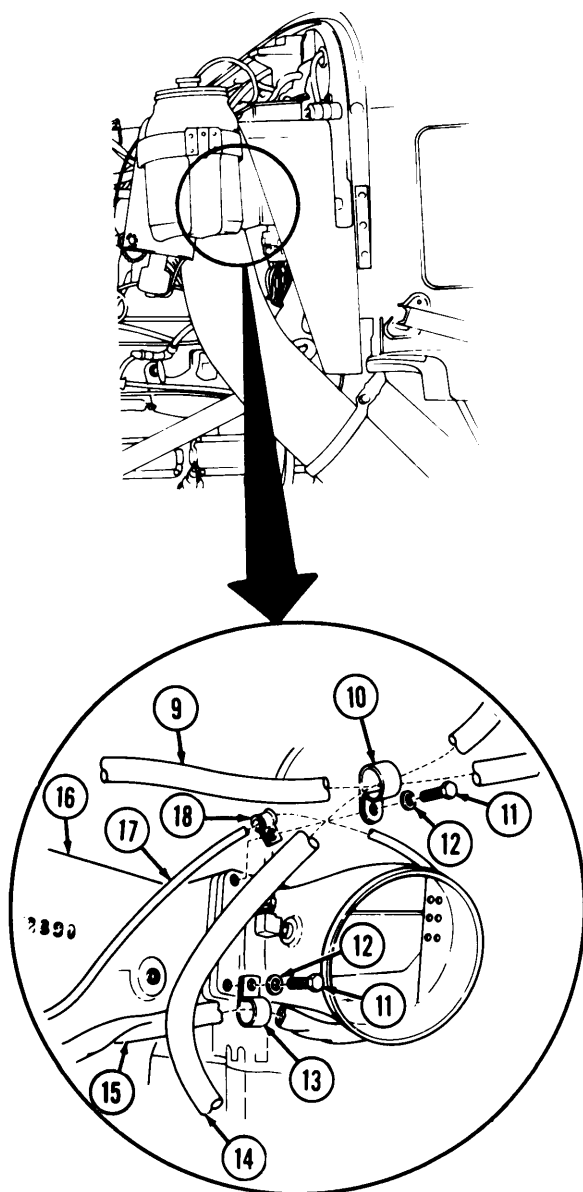
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
107.		Fuel return line (2)	Connect to fuel pump return hose (1).	
108.		Atomizer line (5)	Connect to ether start safety valve (4) and ether atomizer (6).	
109.		Ether cylinder valve line (3)	Connect to ether start safety valve (4).	
110.		Air cleaner indicator tube (7)	Connect to fitting (8).	



3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
111.		Two connectors (20)	Connect to ether start switch (19).	
112.		Air governor to compressor air line (17), tachometer cable (9), speedometer cable (14), and electrical harness (15)	Connect to manifold (16) with two screws (11), washers (12), clamp (10), clamp (18), and clamp (13).	



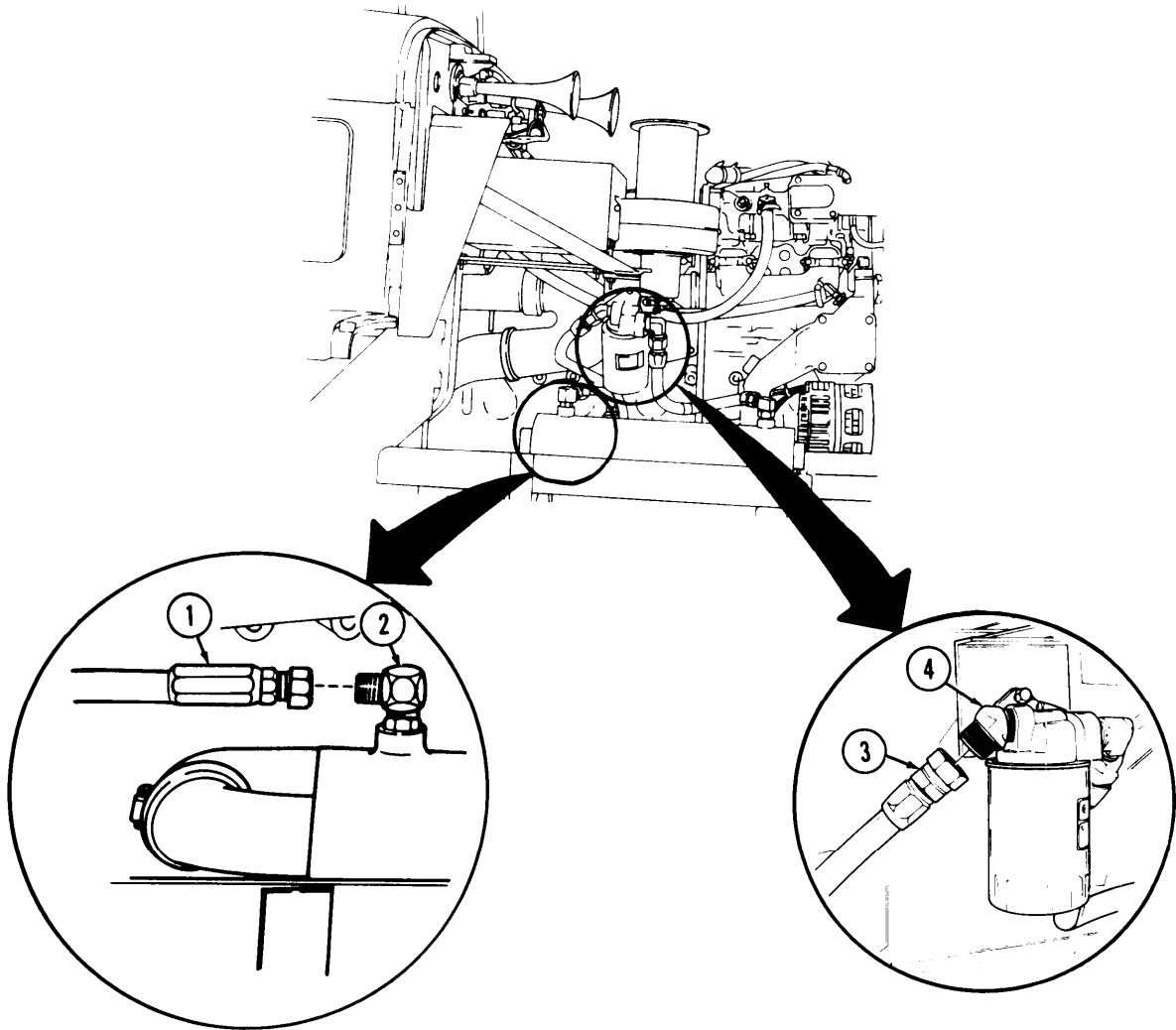
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)				
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
113.		Emergency stop control cable (2)	a. Install cable in swivel block (8). b. Install connector screw (9) and connector (1) on end of cable (2). c. Connect cable (2) to clamp bracket (7) with screw (4), washer (3), nut (6), and clamp (5).	
114.		Wires (11) and (12)	Connect to fuel shutoff solenoid (10) with nut (13).	
115.		Pump throttle lever (14)	a. Connect to accelerator rod (16) with screw (17), and new locknut (15). b. Connect to link (26) with screw (27) and new locknut (18).	
116.		Modulator cable (21)	a. Connect to fuel primer pump bracket (22) with screws (25), nuts (20), shim (19), and clamp (24). b. Connect return spring (23) to link (26) and fuel primer pump bracket (22),	

3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS

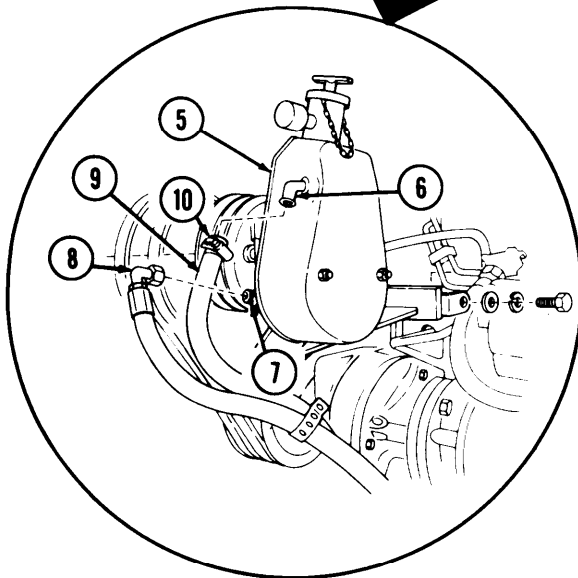
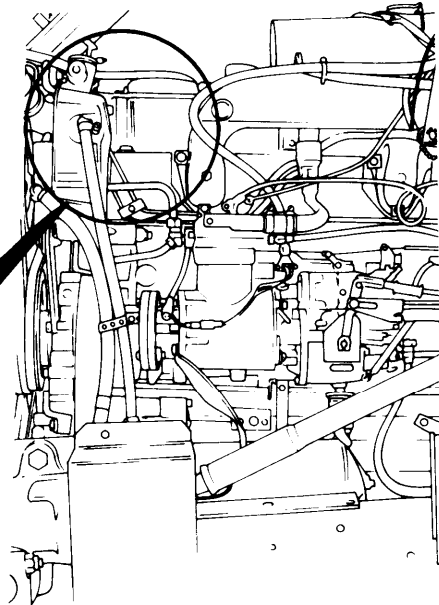
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
117.		Transmission to filter hose (3)	Connect to transmis- sion oil filter adapter elbow (4).	
118.		Transmission oil cooler return hose (1)	Connect to transmis- sion oil cooler connector (2).	
119.		Power steering oil pressure supply hose (8)	Connect to fitting (7) on power steering pump and reservoir (5).	
120.		Power steering oil return hose (9)	Connect to fitting (6) on power steering pump and reservoir (5) with clamp (10).	



3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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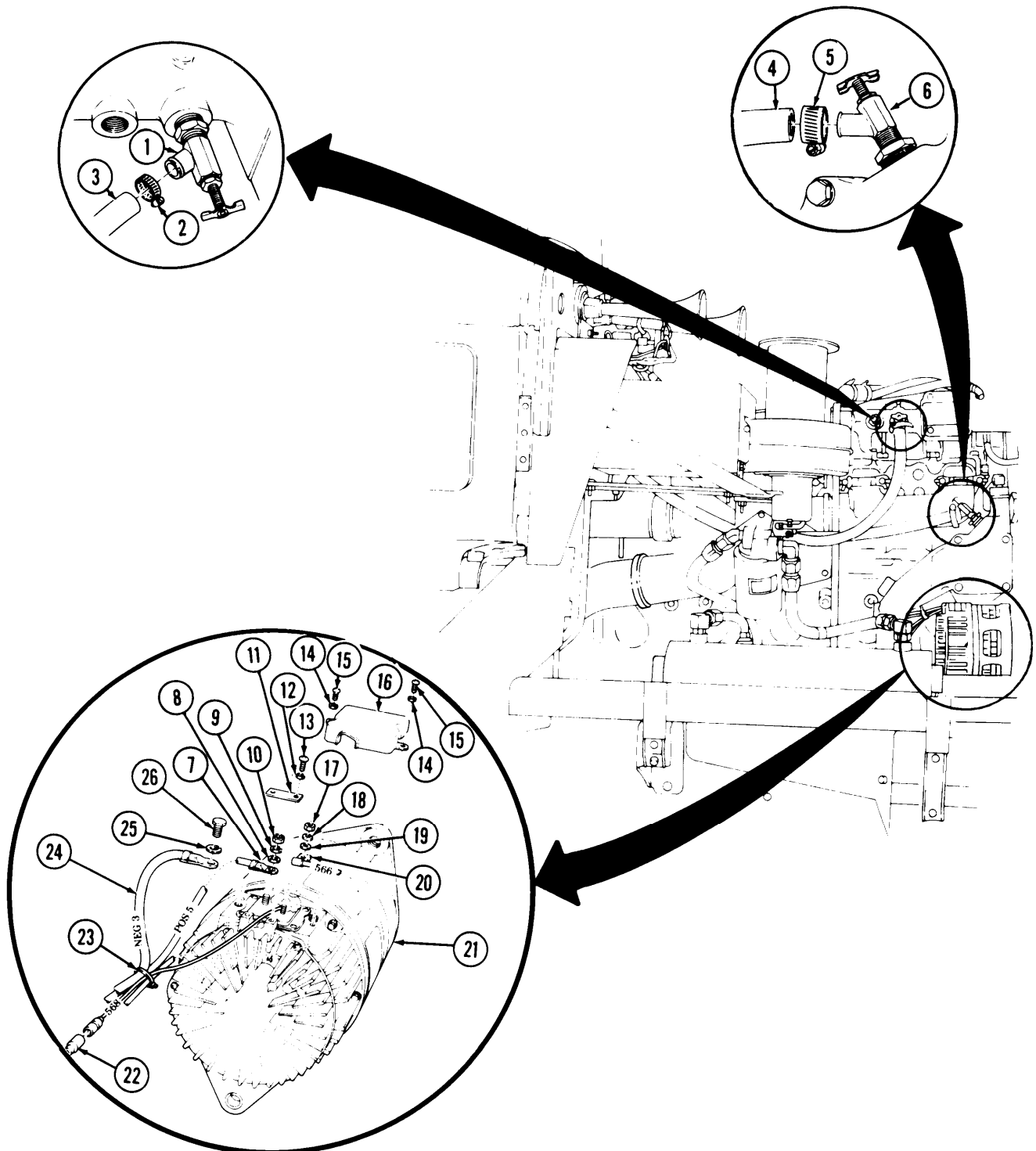


3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
121.		Water heater shutoff valve hose (3)	Connect to water heater shutoff valve (1) with hose clamp (2).	
122.		Water heater shutoff valve supply hose (4)	Connect to water heater shutoff valve (6) with hose clamp (5).	
123.		Wire (20)	Connect to alternator (21) with washer (19), new lockwasher (18), and nut (17).	
124.		Wire (7)	Connect to alternator (21) with washer (8), new lockwasher (9), and nut (10).	
125.		Wire (24)	Connect to alternator (21) with new lockwasher (25) and screw (26).	
126.		Wire retaining strap (11)	Install on alternator (21) with two new lockwashers (12) and screws (13).	
127.		Terminal cover (16)	a. Seal wire (20) and (7) connectors completely. b. Install with two new lockwashers (14) and screws (15).	Use adhesive sealant.
128.		Connector (22)	Connect.	
129.		Plastic tie (23)	Install around wires connected to alternator (21).	

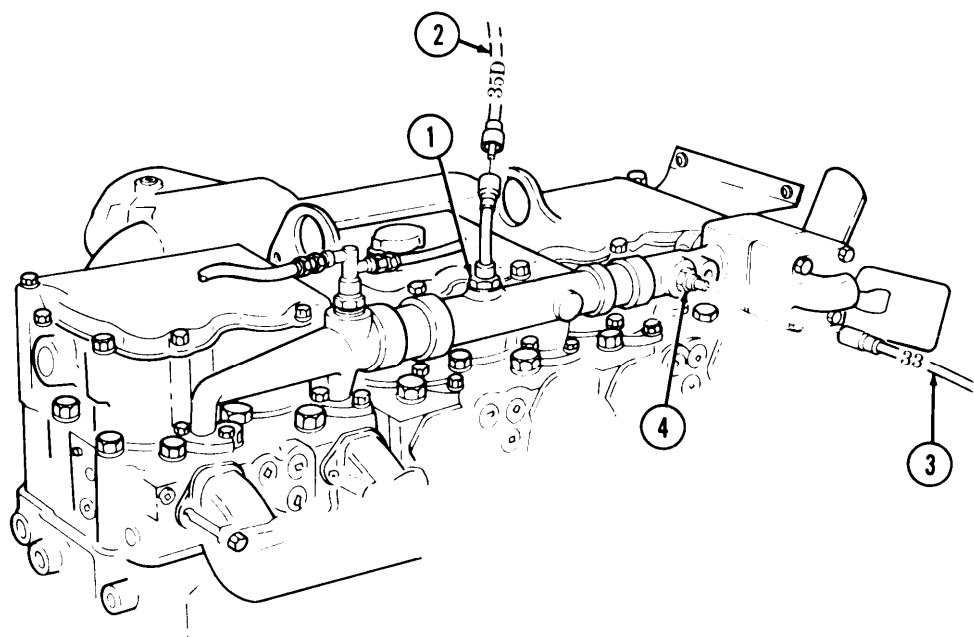
3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
130.		Wire (2)	Connect to engine high temperature sending unit (1).	
131.		Wire (3)	Connect to water temperature sending unit (4).	



3-24. ENGINE AND TRANSMISSION REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

- FOLLOW-ON TASKS:
- Install transmission to transfer propeller shaft (TM 9-2320-272-20-1).
 - Install transmission PTO to hydraulic pump drive shaft (TM 9-2320-272-20-2), if so equipped.
 - Install air intake pipe and hump hoses (TM 9-2320-272-20-1).
 - Install engine oil dipstick and tube (TM 9-2320-272-20-1).
 - Install front exhaust pipe (TM 9-2320-272-20-1).
 - Install fan blade assembly (TM 9-2320-272-20-1).
 - Install radiator (TM 9-2320-272-20-1).
 - Install surge tank (TM 9-2320-272-20-1).
 - Install coolant hoses (TM 9-2320-272-20-1).
 - Install hood assembly (TM 9-2320-272-20-2).
 - Fill steering system to proper oil level (LO 9-2320-272-12).
 - Fill cooling system to proper coolant level (LO 9-2320-272-12).
 - Fill engine crankcase to proper oil level (LO 9-2320-272-12).
 - Fill transmission to proper oil level (LO 9-2320-272-12).
 - Close air reservoir draincocks (TM 9-2320-272-10).
 - Reconnect battery ground cables (TM 9-2320-272-20-1).
 - Adjust modulator cable (TM 9-2320-272-20-1).
 - Adjust throttle control cable (TM 9-2320-272-20-1).
 - Adjust emergency stop control cable (TM 9-2320-272-20-1).
 - Adjust accelerator linkage (TM 9-2320-272-20-1).

CAUTION

Never start a new or repaired engine without performing run-in starting procedures provided in para. 3-26.

- Perform engine run-in starting procedures (para. 3-26).
- Start engine (TM 9-2320-272-10), allow air pressure to build up to normal operating range, and check for leaks. Road test vehicle.

3-24.1. ENGINE AND CONTAINER REPLACEMENT

This task covers:

a. Removal

b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Forty-four lockwashers		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		<ul style="list-style-type: none"> All personnel must stand clear during hoisting operations. Engine container pressure must be released before opening container.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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WARNING

Engine container is pressurized. Be sure pressure is released before opening container. Failure to do so may cause injury to personnel.

a. Removal

- | | | | |
|---|--|---------|---------------------------|
| 1. Lower container section (5) | Forty-two nuts (2), lockwashers (3), screws (4), and upper container section (1) | Remove. | Discard lockwashers (3). |
| 2. Front trunnion mount (8) and engine (6) | Two screws (7), washers (10), and trunnion cap (9) | Remove. | |
| 3. Rear trunnion mount (13) and flywheel housing (12) | Two screws (11), lockwashers (15), and washers (14) | Remove. | Discard lockwashers (15). |

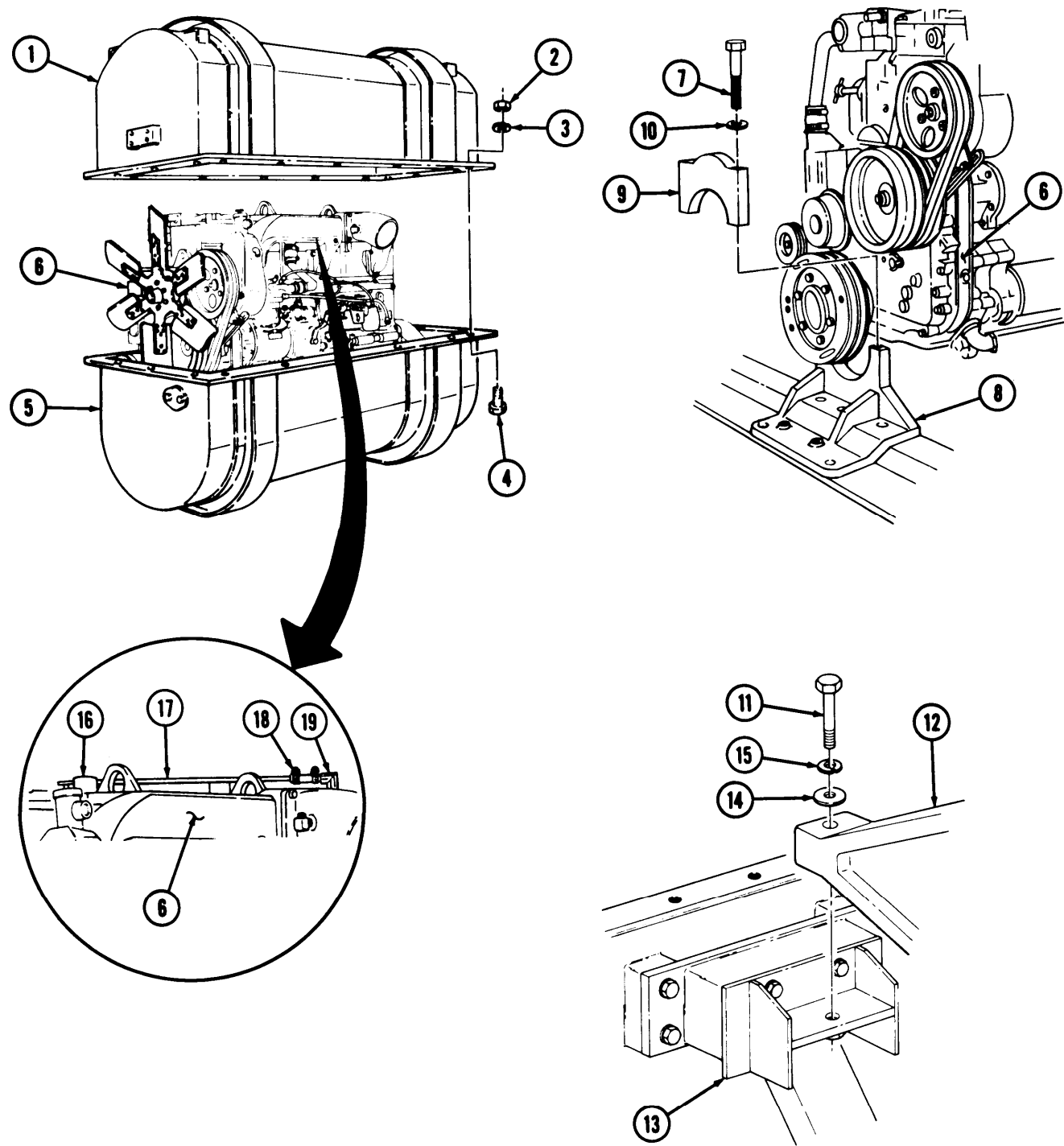
NOTE

Perform step 4 for late model engine.

- | | | |
|---------------------------------|----------------------|---------------------------------------|
| 4. Breather (16) and elbow (19) | Two hose clamps (18) | Loosen and remove breather tube (17). |
|---------------------------------|----------------------|---------------------------------------|

3-24.1 ENGINE AND CONTAINER REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-24.1. ENGINE AND CONTAINER REPLACEMENT (Contd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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- | | | | | |
|----|-------------------------|----------------------------------|----------|--|
| 5. | Engine lifting eyes (5) | Chain (2) and lifting device (1) | Install. | |
|----|-------------------------|----------------------------------|----------|--|

WARNING

All personnel must stand clear during hoisting operations. A snapped cable, swinging, or shifting load may cause injury to personnel.

NOTE

Assistant will help with steps 6 and 7.

- | | | | | |
|----|-----------------------------|----------------------------------|-----------------------------|--|
| 6. | Lower container section (4) | Engine (3) | Remove. | |
| 7. | | Engine (3) | Hoist onto transport stand. | |
| 8. | Engine lifting eyes (5) | Lifting device (1) and chain (2) | Remove. | |

NOTE

Prepare engine for installation (para. 3-25).

I b. Installation I

- | | | | | |
|----|--|----------------------------------|-------------------------------------|--|
| 9. | | Chain (2) and lifting device (1) | Install on engine lifting eyes (5). | |
|----|--|----------------------------------|-------------------------------------|--|

WARNING

All personnel must stand clear during hoisting operations. A snapped cable, swinging, or shifting load may cause injury to personnel.

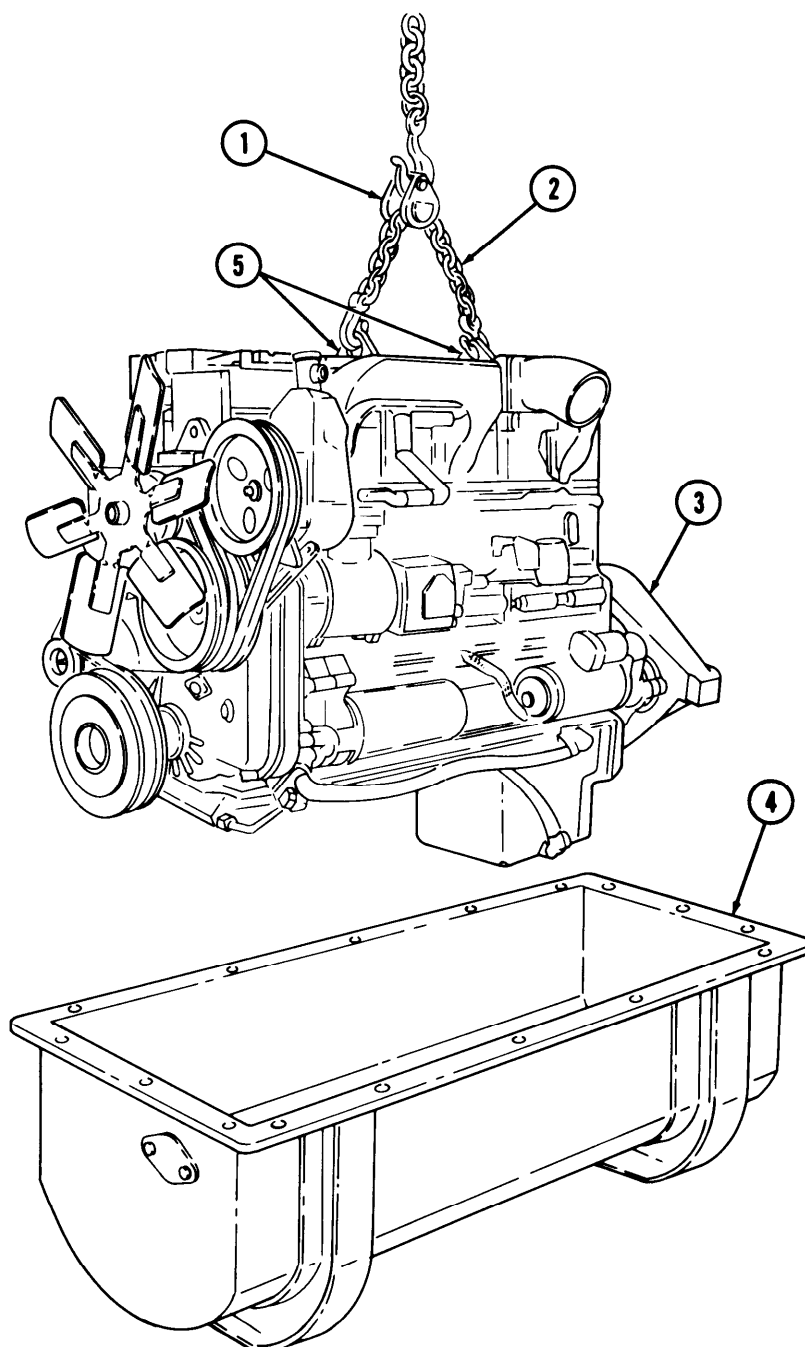
NOTE

Assistant will help with steps 10 and 11.

- | | | | |
|-----|----------------------------------|---|---|
| 10. | Engine (3) | Remove from transport stand and install in lower container section (4). | Be sure all mounting holes are aligned. |
| 11. | Lifting device (1) and chain (2) | Remove from engine lifting eyes (5). | |

3-24.1. ENGINE AND CONTAINER REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-24.1. ENGINE AND CONTAINER REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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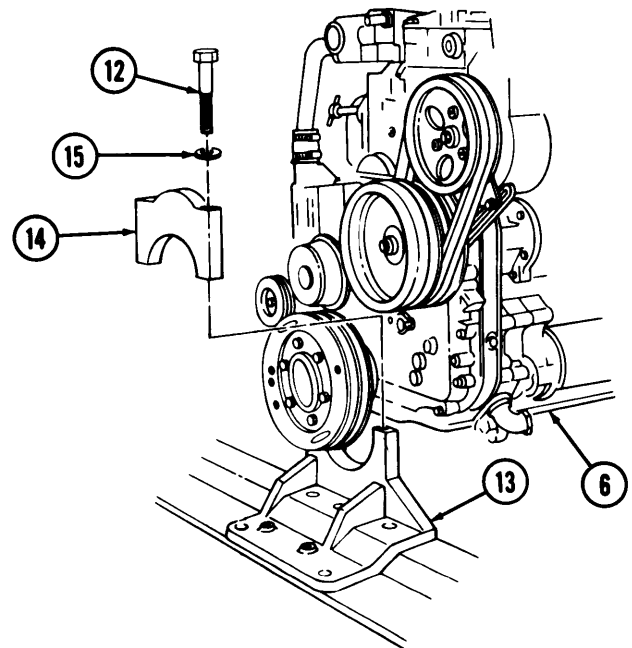
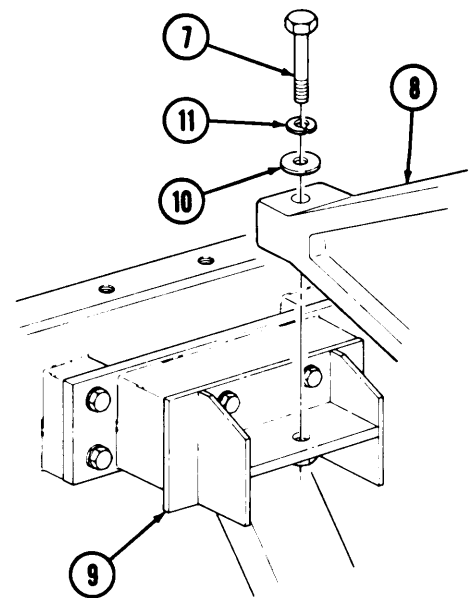
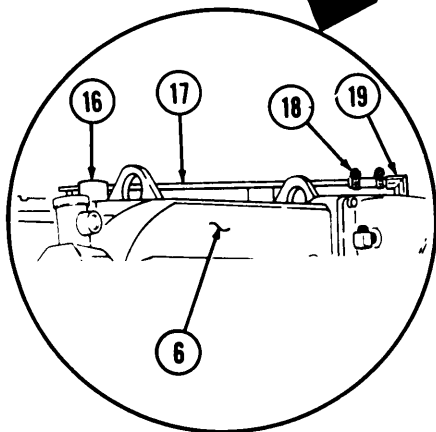
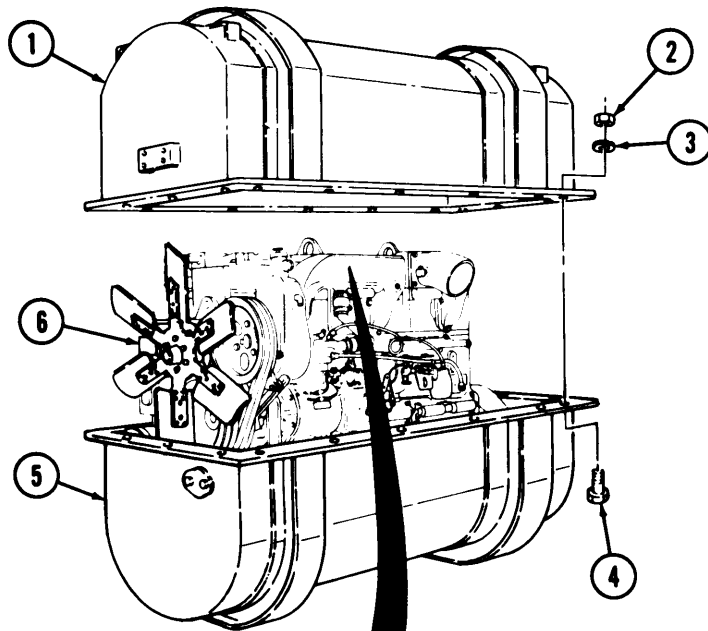
NOTE

Perform step 12 for late model engine.

12.		Breather tube (17)	Install on elbow (19) and breather (16) with two hose clamps (18).	
13.		Flywheel housing (8)	Install on rear trunnion mount (9) with two washers (10), new lock-washers (11), and screws (7).	
14.		Trunnion cap (14)	Install on engine (6) and front trunnion mount (13) with two washers (15) and screws (12).	
15.		Upper container section (1)	Install on lower container section (5) with forty-two screws (4), new lockwashers (3), and nuts (2).	Tighten 85-105 lb-ft (115-142 N-m).

3-24.1. ENGINE AND CONTAINER REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

3-25. PREPARING REPLACEMENT ENGINE FOR INSTALLATION

This task covers:

- a. Removal

b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-24	Engine removed from vehicle.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Six lockwashers		
Three locknuts		
Sealing tape (Appendix C, Item 30)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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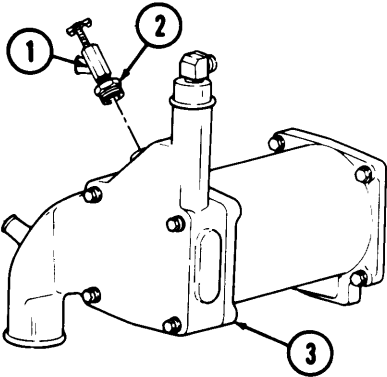
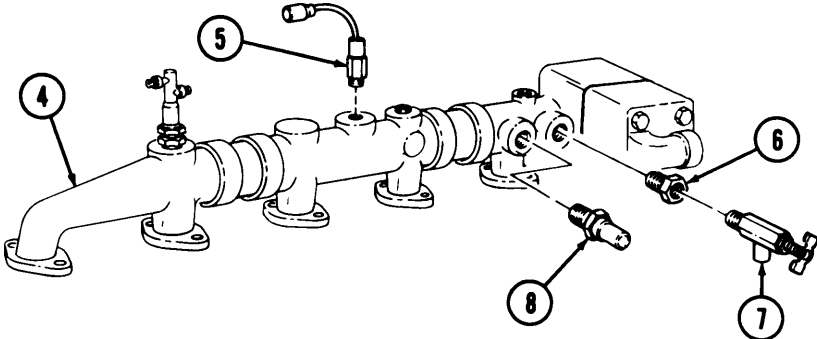
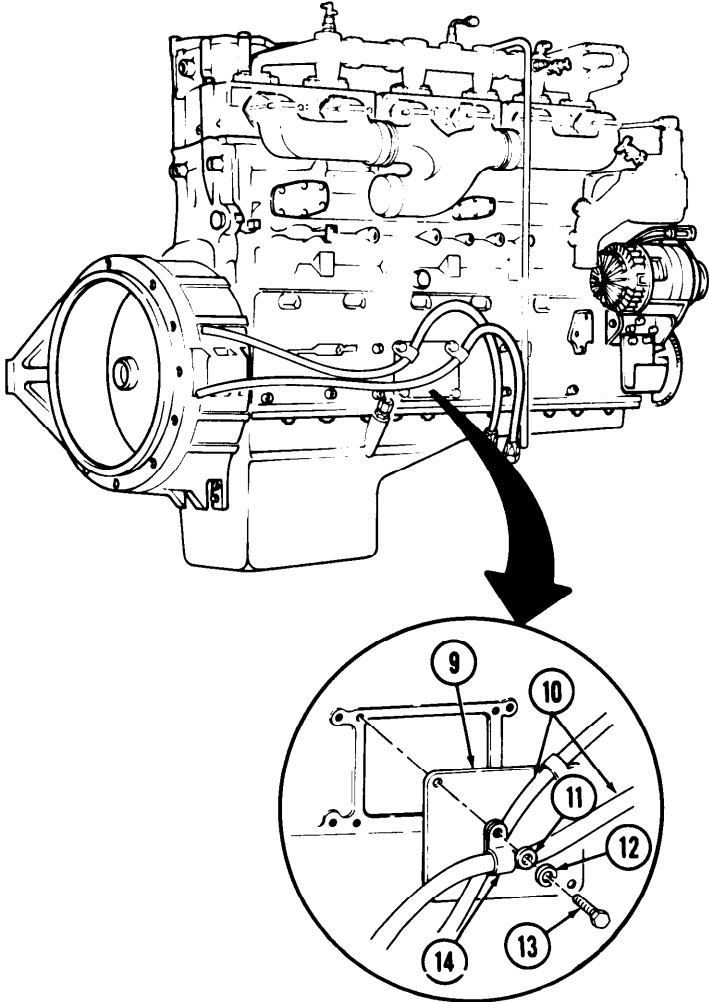
a. Removal

NOTE

- Perform this task when preparing removed engine for installation.
- Plug all open ports to prevent dirt or contamination from entering engine.

1. Engine oil cooler (3)	Shutoff valve (1) and adapter (2)	Remove.	
2. Water manifold (4)	Shutoff valve (7) and adapter (6)	Remove.	
3.	High temperature switch (5)	Remove.	
3.1.	Water temperature sending unit (8)	Remove.	
6. Access plate (9)	Two screws (13), lockwashers (12), washers (11), clamps (14), and transmission oil cooler lines (10)	Remove.	Tag lines for installation. Discard lockwashers (12).
6.1.	Two washers (11), new lockwashers (12), and screws (13)	Install on access plate (9).	

3-25. PREPARING REPLACEMENT ENGINE FOR INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				
				

3-25. PREPARING REPLACEMENT ENGINE FOR INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
9.	Evaporator bottle (9)	Air line (7)	Disconnect.	
10.	Primer pump bracket (6)	Three screws (8) and locknuts (10), evaporator bottle (9) and bracket (11)	Remove.	Discard locknuts (10).
11.	Air compressor (13)	Air line (3)	Disconnect.	
12.		Two elbows (12)	Remove.	
13.		Air line (7)	Disconnect.	
14.	Engine block (1)	Two screws (4), lockwashers (5), clamp (2) air line (3), and primer pump bracket (6)	Remove.	Discard lockwashers (5). Clamp (2) will remain on air line (3).

b. Installation

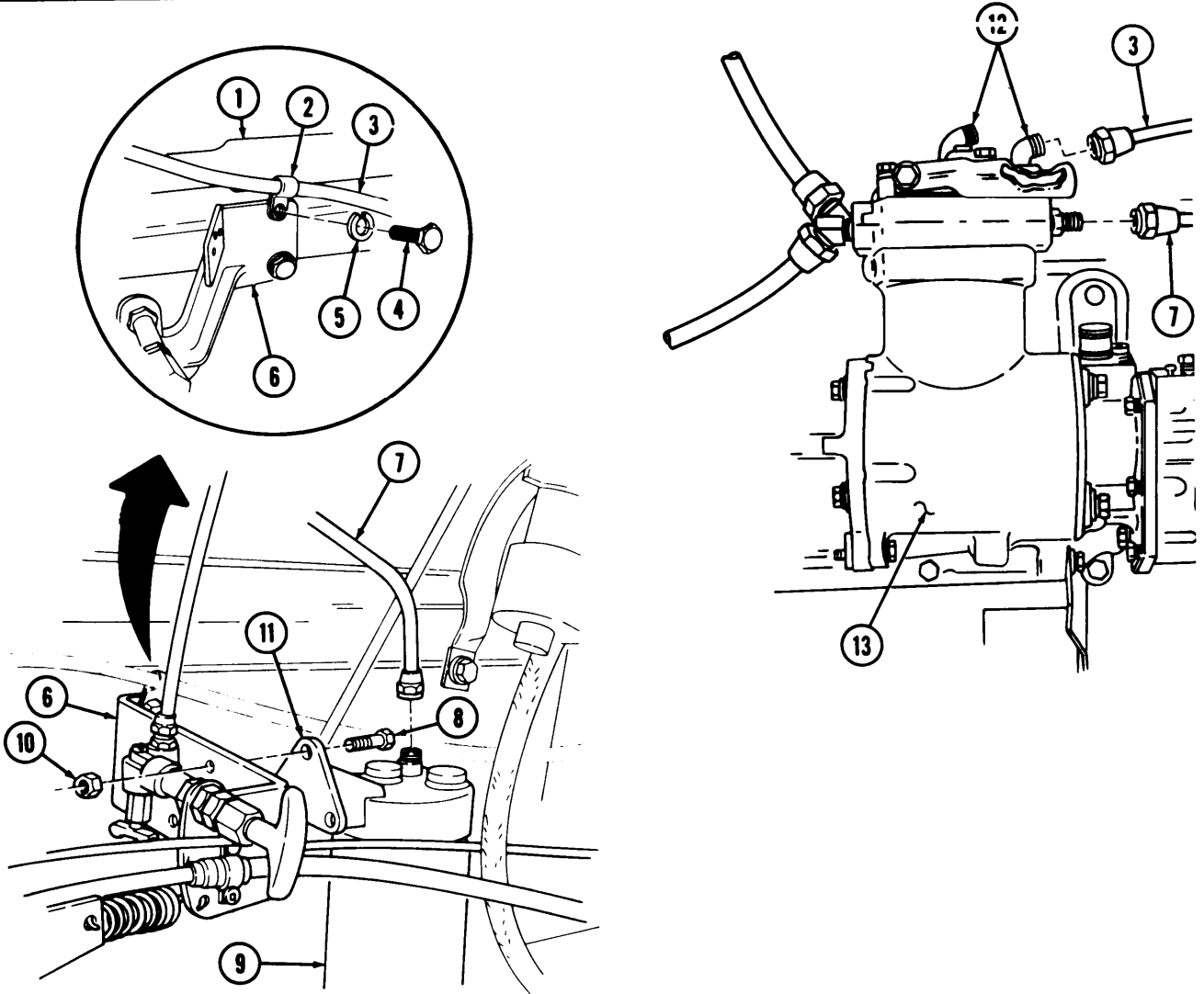
NOTE

Wrap all male pipe threads with sealing tape before installation.

15.	Primer pump bracket (6), clamp (2), and air line (3)	Install on engine block (1) with two new lockwashers (5) and screws (4).
16.	Air line (7)	Connect to air compressor (13).
17.	Two elbows (12)	Install on air compressor (13).
18.	Air line (3)	Connect to elbow (12).
19.	Evaporator bottle (9) and bracket (11)	Install on primer pump bracket (6) with three screws (8) and new locknuts (10).
20.	Air line (7)	Connect to evaporator bottle (9).

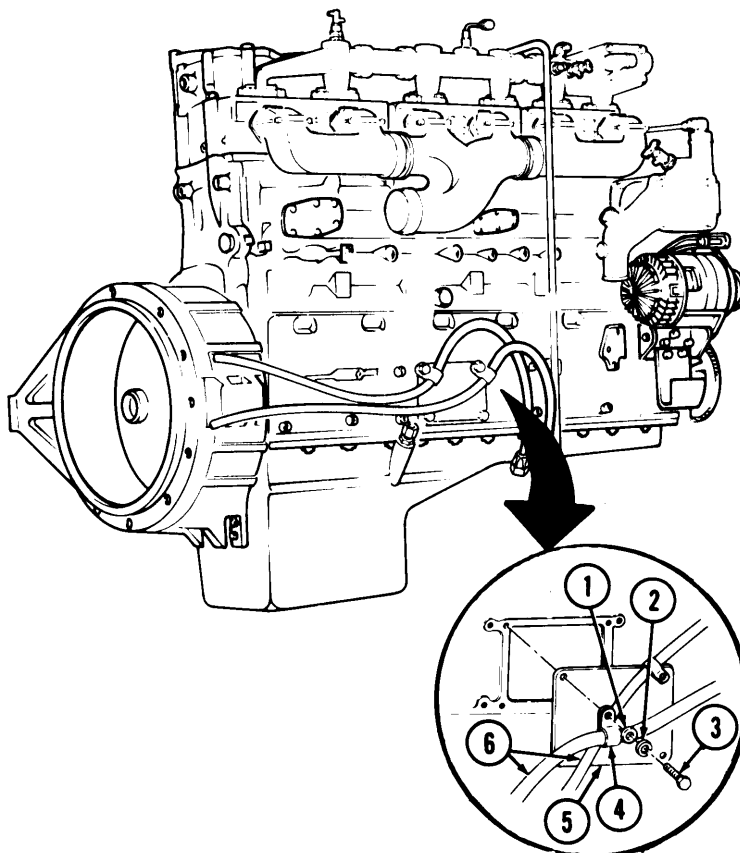
3-25. PREPARING REPLACEMENT ENGINE FOR INSTALLATION (Contd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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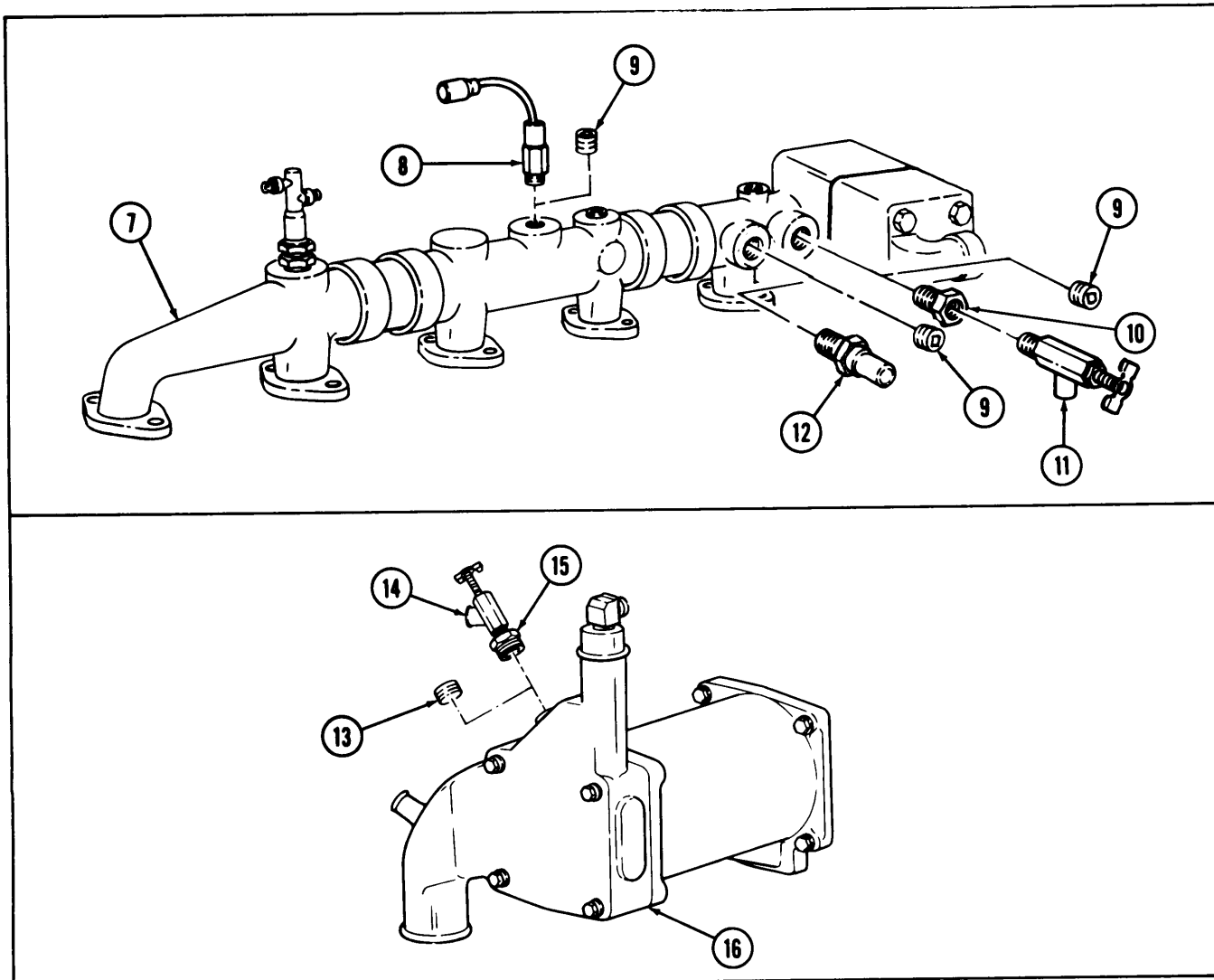
3-25. PREPARING REPLACEMENT ENGINE FOR INSTALLATION (Contd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
22.1.		Two screws (3), lock-washers (2), and washers (1)	Remove.	Discard lockwashers (2).
23.		Two transmission oil cooler lines (6)	Install on access cover (5) with two clamps (4), washers (1), new lock-washers (2), and screws (3).	
24.1.		Three plugs (9)	Remove.	
24.2.		Water temperature sending unit (12)	Install on water manifold (7).	
25.		High temperature switch (8)	Install on water manifold (7).	
26.		Shutoff valve (11) and adapter (10)	Install on water manifold (7).	
27.		Shutoff valve (14) and adapter (15)	Remove plug (13) and install on engine oil cooler (16).	



3-25. PREPARING REPLACEMENT ENGINE FOR INSTALLATION (Contd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK Install engine and transmission (para. 3-24).

3-26. STARTING REPAIRED OR REPLACED ENGINE

This task covers:

- a. Priming Lubrication System
- b. Out of Chassis Run-In

c. In-Chassis Run-In

INITIAL SETUP:

Applicable Models

All

Test Equipment

None

Special Tools

Priming pump
Spring pack adjusting tool ST-984

Materials/Parts

Special seal

Personnel Required

Wheeled vehicle repairman MOS 63W (2)

Manual References

TM 9-2320-272-34P

Equipment Condition Reference

Condition Description

None

Special Environmental Conditions

Well ventilated work area.

General Safety Instructions

Engine compartment clear of tools and work material before starting engine.

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
----------	----------	------	--------	---------

a. Priming lubrication System

CAUTION

Engine lubrication system cannot be primed through bypass filter. Insufficient lubrication will result, causing engine damage.

- | | | | |
|----|------------------|---|--|
| 1. | Oil priming pump | Connect and prime engine lubricating system as follows: <ul style="list-style-type: none"> a. Remove pipe plug (4) from gearcase cover flange (3), left side of engine block (2). b. Connect oil priming pump to orifice (1) in gearcase cover flange (3). c. Prime until 30 psi (206 kPa) pressure is obtained. | Use hand or motor driven priming pump. |
|----|------------------|---|--|

3-26. STARTING REPAIRED OR REPLACED ENGINE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Do not crank engine continuously for more than 30 seconds. Wait two to five minutes before repeating to prevent starter motor damage.

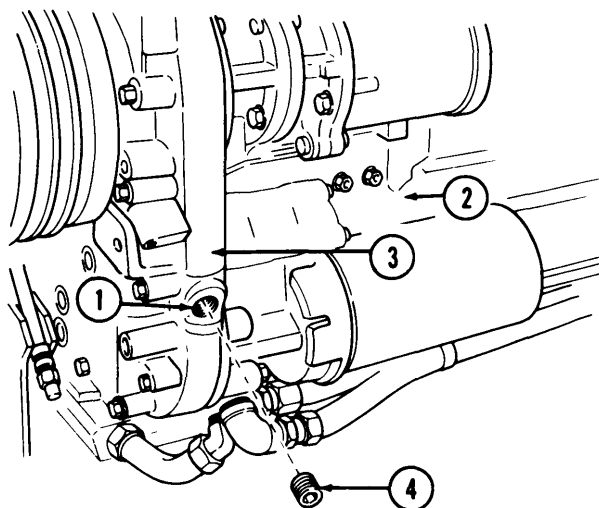
d. Close fuel shutoff valve and crank engine 15 seconds while maintaining 15 psi (103 kPa) pump pressure.

e. Disconnect oil priming pump and replace pipe plug (4) in gearcase cover flange (3).

Tighten 60-70 lb-ft (81-95 N·m).

f. Check oil level.

Refer to TM 9-2320-272-10.



3-26. STARTING REPAIRED OR REPLACED ENGINE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Out of Chassis Run-In

NOTE

If engine dynamometer is available, follow manufacturer's instructions for its use. Make sure dynamometer being used is torque rated at 685 lb-ft (929 N-m). If a dynamometer is not available, proceed to task c. of this paragraph.

2.
- Engine connected to dynamometer
- Start and run-in as follows:

CAUTION

- . If oil temperature rises sharply above 255°F (124°C), stop engine immediately and correct as necessary.
- . If any leak or abnormal noise is noted, stop engine immediately and correct as necessary.
- a. Start and run engine until oil temperature is 180°F (82°C).
- b. Stop engine and inspect oil level and check for leaks.

NOTE

Coolant should not exceed 195°F (90°C) or drop below 175°F (79°C) during engine load operation.

- c. Start and run engine at 1575 rpm, 125 hp for 15 minutes.
- d. Run engine at 2100 rpm, 188 hp for 15 minutes.
- e. Run engine at 2100 rpm, 213 hp for 15 minutes.
- f. Run engine at 2100 rpm, 225 hp for 15 minutes.
- g Run engine at 2100 rpm, 240 hp for 5 minutes,
- h Remove engine load and idle until tem-perature drops.
- i. Stop engine and inspect for leaks, and check oil level.
- j. Disconnect engine from dynamometer.

3-26. STARTING REPAIRED OR REPLACED ENGINE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. In-Chassis Run-In

- | | | | |
|----|-------------------|------------------------------------|----------------------------|
| 3. | Engine in vehicle | Begin run-in procedure as follows: | |
| | | a. Inspect oil and coolant levels. | Refer to TM 9-2320-272-10. |

WARNING

Make sure engine compartment is free of all tools and working material before starting engine. Failure to do so may cause injury to personnel.

CAUTION

If any leaks, abnormal noises, or sudden oil pressure drop is observed, stop engine immediately and correct as necessary.

- | | |
|---|--|
| b. Start and idle engine at 800-1000 rpm for 5-10 minutes, observing oil pressure. | Refer to TM 9-2320-272-10.
If oil pressure drops below 10 psi (68 kPa) or rises sharply above 30 psi (207 kPa), stop engine and correct as necessary. |
| c. Stop engine and inspect oil and coolant levels. | Refer to TM 9-2320-272-10. |
| d. Inspect for leaks. | If leaks are found, correct as necessary. |
| e. Start and run engine at 1/4 to 1/2 engine throttle until coolant temperature reaches 165°- 195°F (73°-90°C). | Refer to TM 9-2320-272-10.
It may be necessary to block air flows to radiator. |
| f. Stop engine and check oil and coolant levels. | Refer to TM 9-2320-272-10. |
| g. Inspect for leaks. | If leaks are found, correct as necessary. |
| h. Start and run engine at idle for 5-10 minutes. | |

3-26. STARTING REPAIRED OR REPLACED ENGINE (Cont'd)

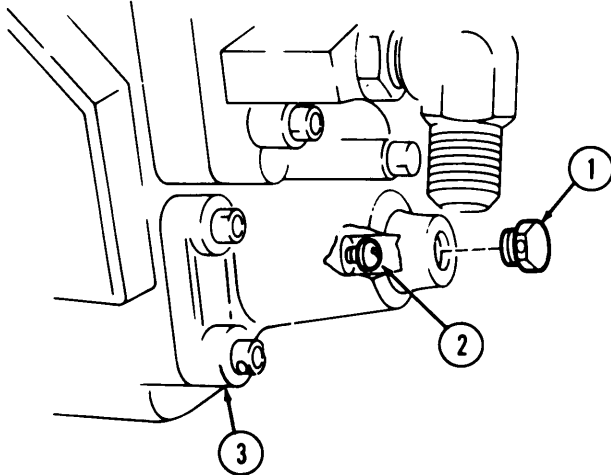
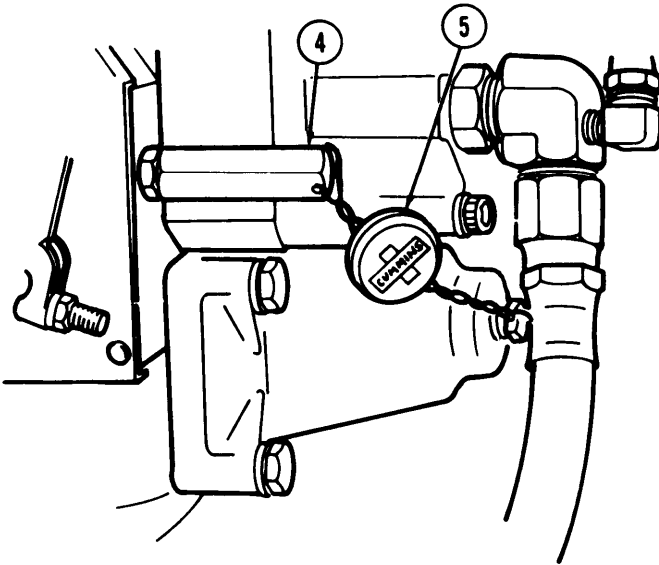
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Engine idle speed check and adjustment cannot be made on cold engine.

- | | |
|--|--|
| i. Check engine idle speed. | If idle speed is not 625 ± 25 rpm, perform step j. |
| j. Break special seal (5) and remove pipe plug (1) from governor spring pack cover (3). | Discard seal (5). |
| k. Turn adjusting screw (2) in to increase, or out to decrease idle speed. | Use spring pack adjusting tool.
Correct idle speed is 625 ± 25 rpm. |
| l. Install pipe plug (1) in spring pack cover (3). | |
| m. Thread new special seal (5) wire through pipe plug (1) and two hex head cover screws (4), and twist seal (5) wire until secure. | |
| n. Stop engine, and check oil and coolant levels. | Refer to TM 9-2320-272-10. |
| o. Inspect for leaks. | If leaks are found, correct as necessary. |

3-26. STARTING REPAIRED OR REPLACED ENGINE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
 <p>This diagram shows a close-up of engine components. Callout 1 points to a bolt on a vertical pipe. Callout 2 points to a bolt on a horizontal pipe. Callout 3 points to a bolt on a vertical pipe.</p>				
 <p>This diagram shows a different view of engine components. Callout 4 points to a bolt on a horizontal pipe. Callout 5 points to a bolt on a vertical pipe. A circular component with the word 'COMPRESSOR' is visible.</p>				

END OF TASK!

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Section V. ENGINE REPAIR

3-27. ENGINE REPAIR TASK SUMMARY

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3-29.	Water Header Plates Removal	3-168
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3-31.	Fan and Fan Drive Clutch Removal	3-172
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3-36.	Engine Accessory Drive Pulley Removal	3-179
3-37.	Fuel Pump Removal	3-180
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3-40.	Oil Pump Return Hose, Pickup Hose, and Sump Tube Removal	3-186
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3-47.	Rocker Lever Housing Covers Removal	3-220
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3-52.	Injectors Removal	3-226
3-53.	Cylinder Head Maintenance	3-228
3-54.	Refacing Intake and Exhaust Valves	3-254
3-55.	Valve Seat Inserts Replacement	3-258
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3-27. ENGINE REPAIR TASK SUMMARY (Cont'd)

TASK PARA.	PROCEDURES	PAGE NO.
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3-61.	Crankshaft Rear Cover Seal and Plate Removal	3-290
3-62.	Engine Oil Pan Removal	3-292
3-63.	Camshaft and Gear Maintenance	3-294
3-64.	Connecting Rod and Piston Maintenance	3-300
3-65.	Crankshaft and Main Bearings Removal	3-318
3-66.	Cylinder Liners and Cylinder Block Maintenance	3-324

3-28. ENGINE MOUNTING REPAIR STAND

This task covers:
Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-12	Transmission removed (engine and transmission removed from vehicle).
	Para. 2-7	Engine steam cleaned.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Engine repair stand 3375193		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		All personnel must stand clear during hoisting operations.
<u>Manual References</u>		
TM 9-2320-272-34P		

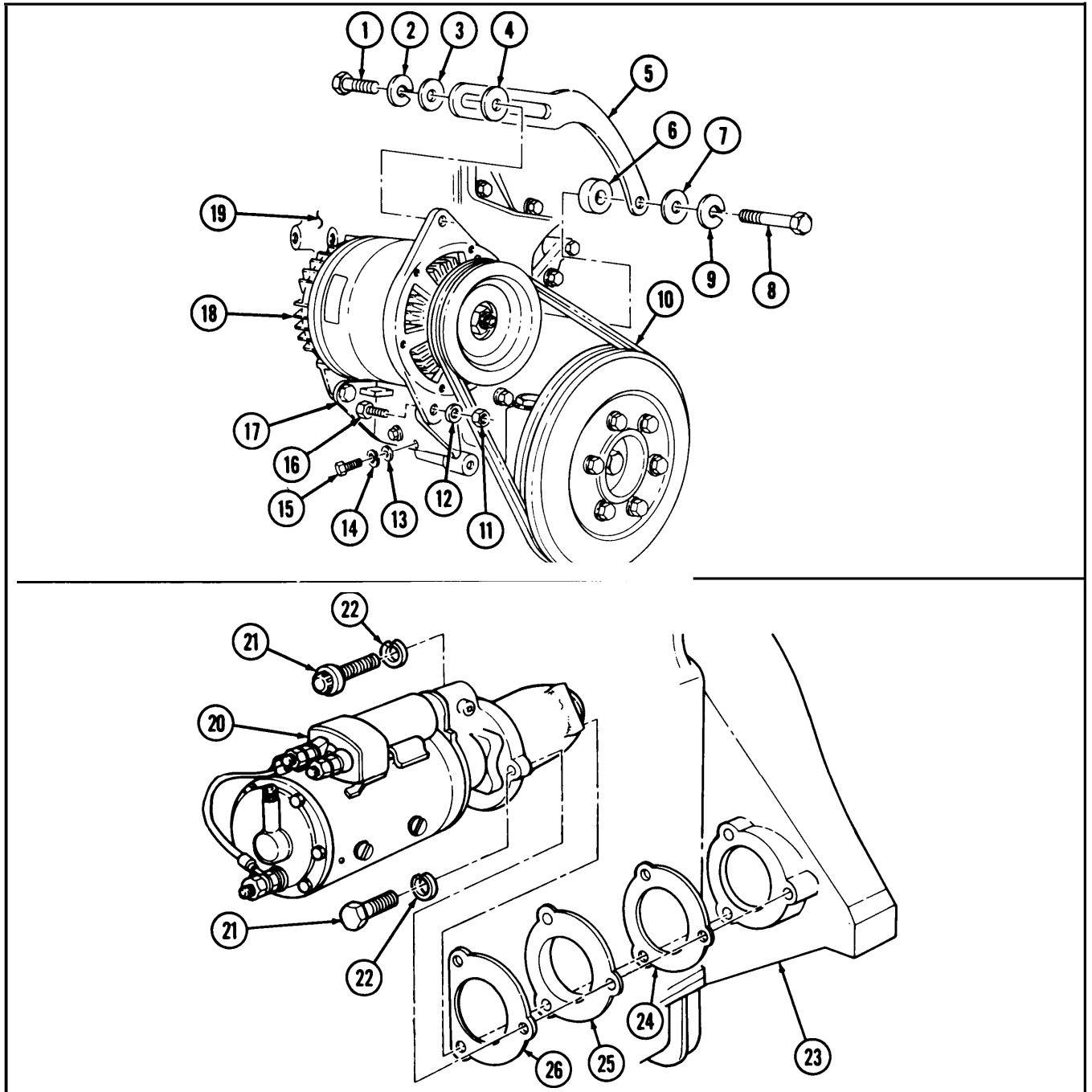
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.	Alternator (18)	Screw (1), lockwasher (2), washers (3) and (4), screw (8), lockwasher (9), washer (7), and adjusting link (5)	Remove.	Discard lockwashers (2) and (9).
Note Perform step 1.1 for late model engine.				
1.1.	Alternator (18) and engine (19)	Screw (1), lockwasher (2), washers (3) and (4), screw (8), lockwasher (9), washer (7), adjusting link (5), and spacer (6)	Remove.	Discard lockwashers (2) and (9).
2.	Mounting bracket (17)	TWO screws (16), washers (12), and locknuts (11), alternator belt (10), and alternator (18)	Remove.	Discard locknuts (11).
3.	Engine (19)	Four screws (15), lockwashers (14), washers (13), and mounting bracket (17)	Remove.	Discard lockwashers (14).
4.	Flywheel housing (23)	Three screws (21) and lockwashers (22) and starter (20).	Remove.	Discard lockwashers (22).

3-28. ENGINE MOUNTING ON REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
5.		Gasket (26), spacer (25), Remove. and gasket (24)		Discard gaskets (26) and (24). Clean gasket remains from mating surfaces.



3-28. ENGINE MOUNTING ON REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
6.	Power steering pump bracket (4) to adjusting link (11)	Screw (13), washers (12) and (10), and locknut (9)	Remove.	Discard locknut (9).
7.	Power steering pump bracket (4)	Two screws (6), lockwashers (5), and washers (7)	Remove.	Discard lockwashers (5).
8.	Pulley (2)	Two drivebelts (1)	Remove.	
9.	Engine bracket (8)	Power steering pump bracket (4) and power steering pump (3)	Remove.	
10.	Engine block (19)	Four screws (16), lockwashers (17), washers (18), engine access cover (15), and gasket (14)	Remove.	Discard lockwashers (17) and gasket (14). Clean gasket remains from mating surfaces.
11.		Screw (26), lockwasher (25), and breather tube mounting bracket (24)	Remove.	Discard lockwasher (25).
12.	Breather (23)	Two hose clamps (21)	Loosen, and remove breather tube (20) and breather tube hose (22).	

NOTE

Perform step 12.1 for late model engine only.

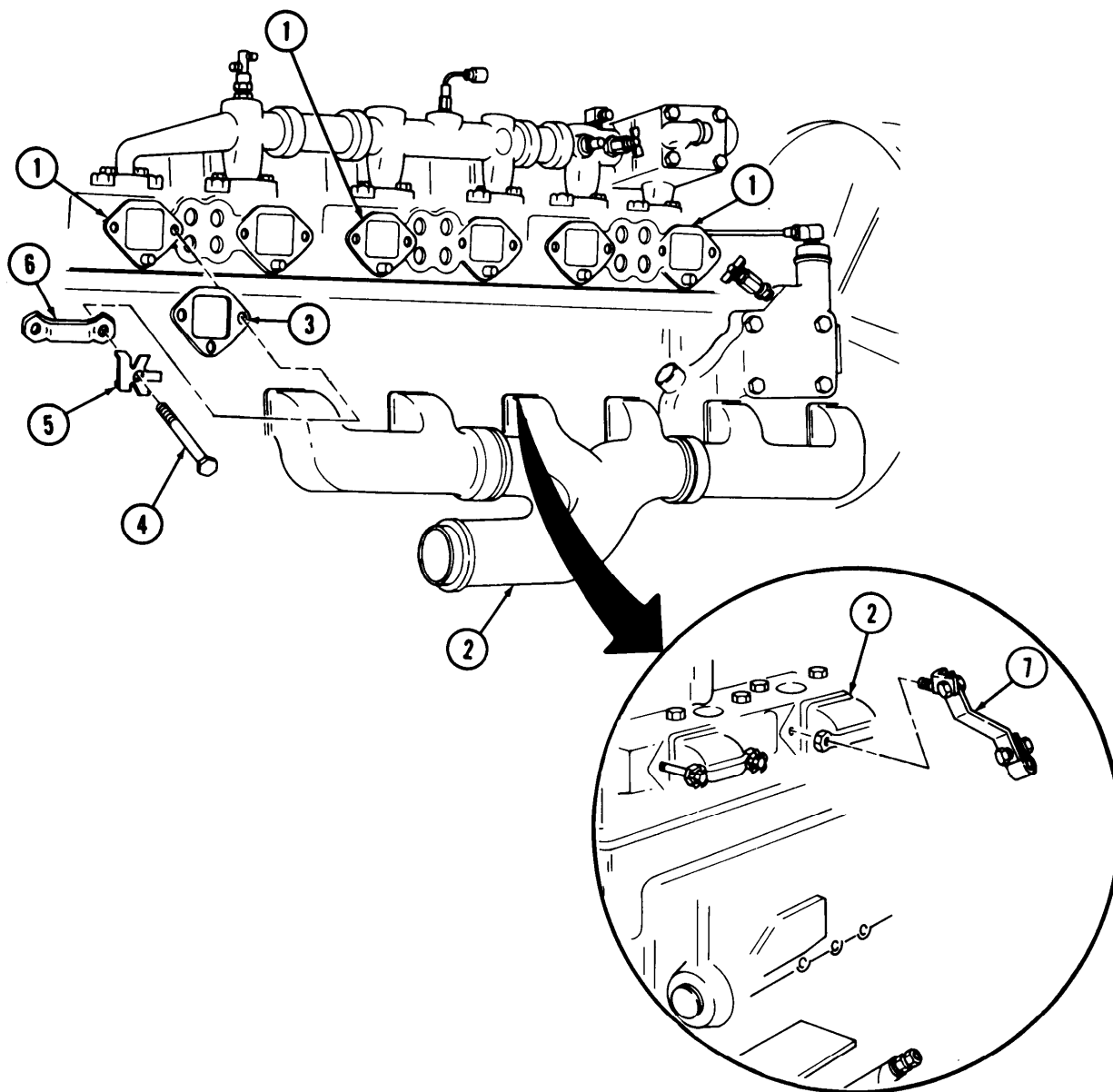
12.1.	Breather (23) and elbow (29)	1½" hose clamps (27)	Loosen, and remove breather tube (28).
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3-28. ENGINE MOUNTING ON REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS

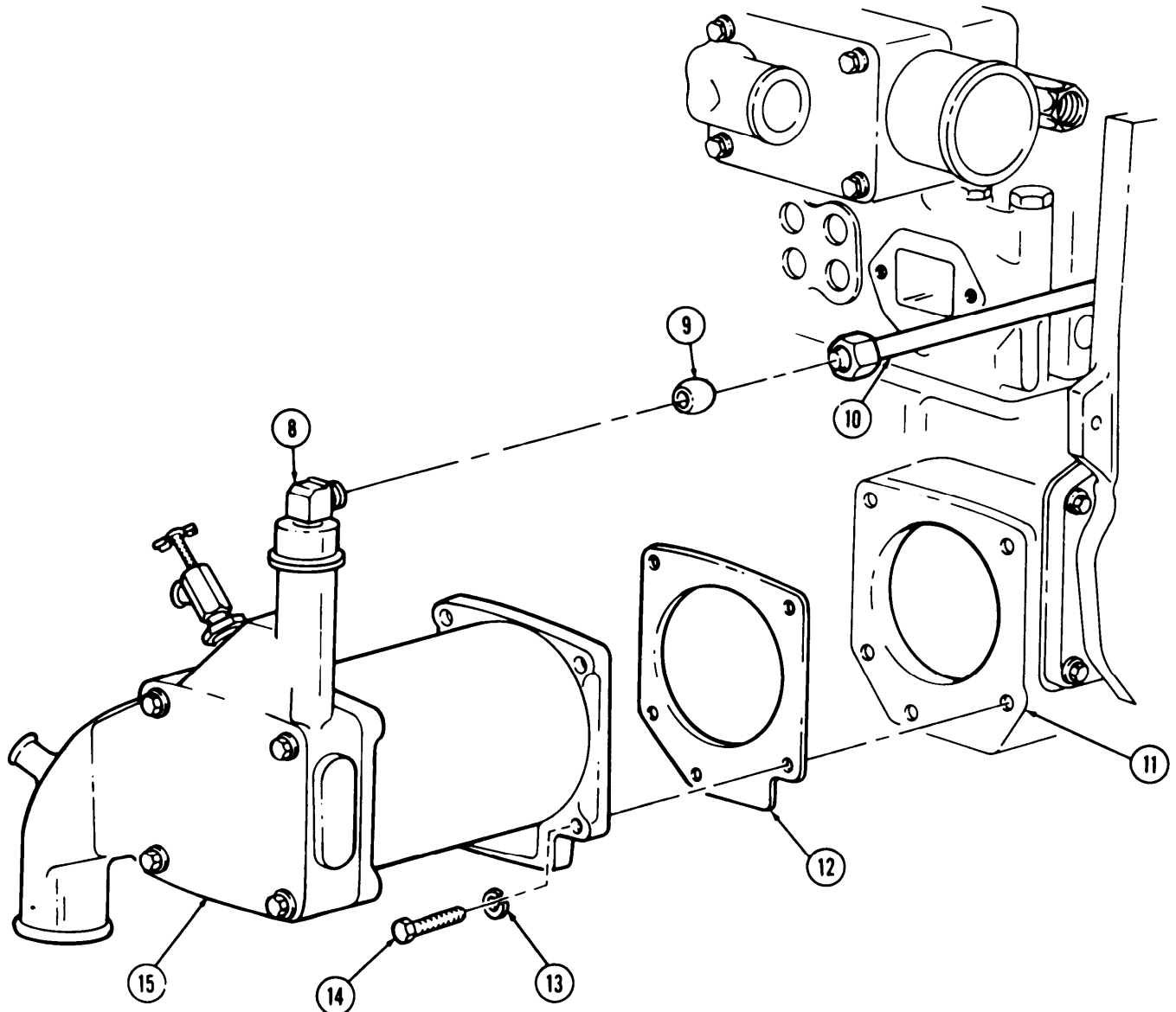
3-28. ENGINE MOUNTING ON REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
13.	Three cylinder heads (1)	Twelve locktabs (5) and screws (4), six clamps (6), dipstick tube bracket (7), exhaust manifold (2), and six gaskets (3)	Remove.	Discard locktabs (5) and gaskets (3). Mark location of dipstick tube bracket (7).



3-28. ENGINE MOUNTING ON REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
14.	Oil cooler elbow (8)	Air compressor coolant line (10) and packing sleeve (9)	Disconnect.	Discard packing sleeve (9).
15.	Cylinder block (11)	Five screws (14) and lockwashers (13), oil cooler (15), and gasket (12)	Remove.	Discard lockwashers (13) and gasket (12).



3-28. ENGINE MOUNTING ON REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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WARNING

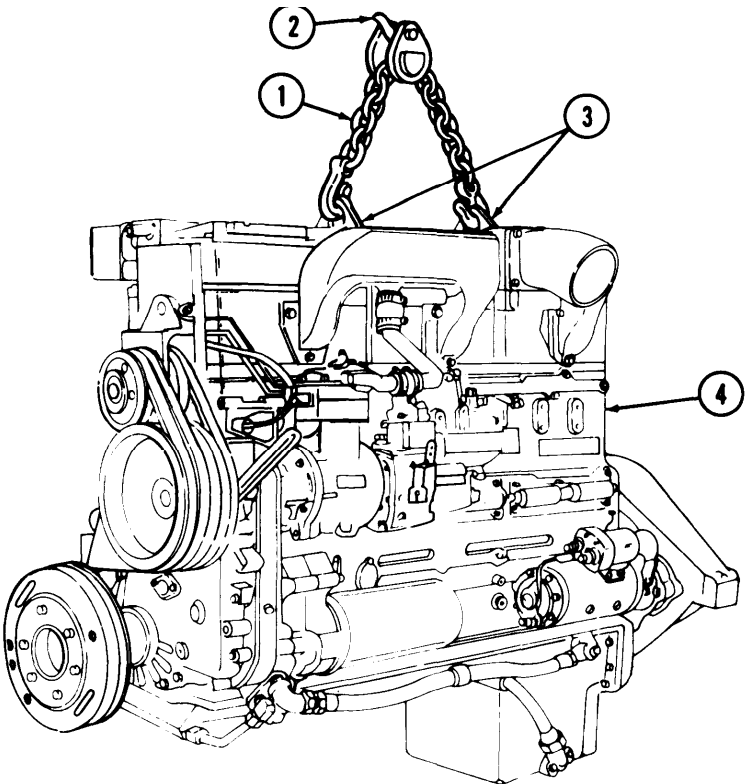
All personnel must stand clear during hoisting operations. A swinging, or shifting load may cause injury to personnel.

- | | | | |
|-----|----------------------|-------------------|------------------------------|
| 16. | Engine lift eyes (3) | Utility chain (1) | Attach to two lift eyes (3). |
| 17. | | Hoist hook (2) | Attach to utility chain (1). |

NOTE

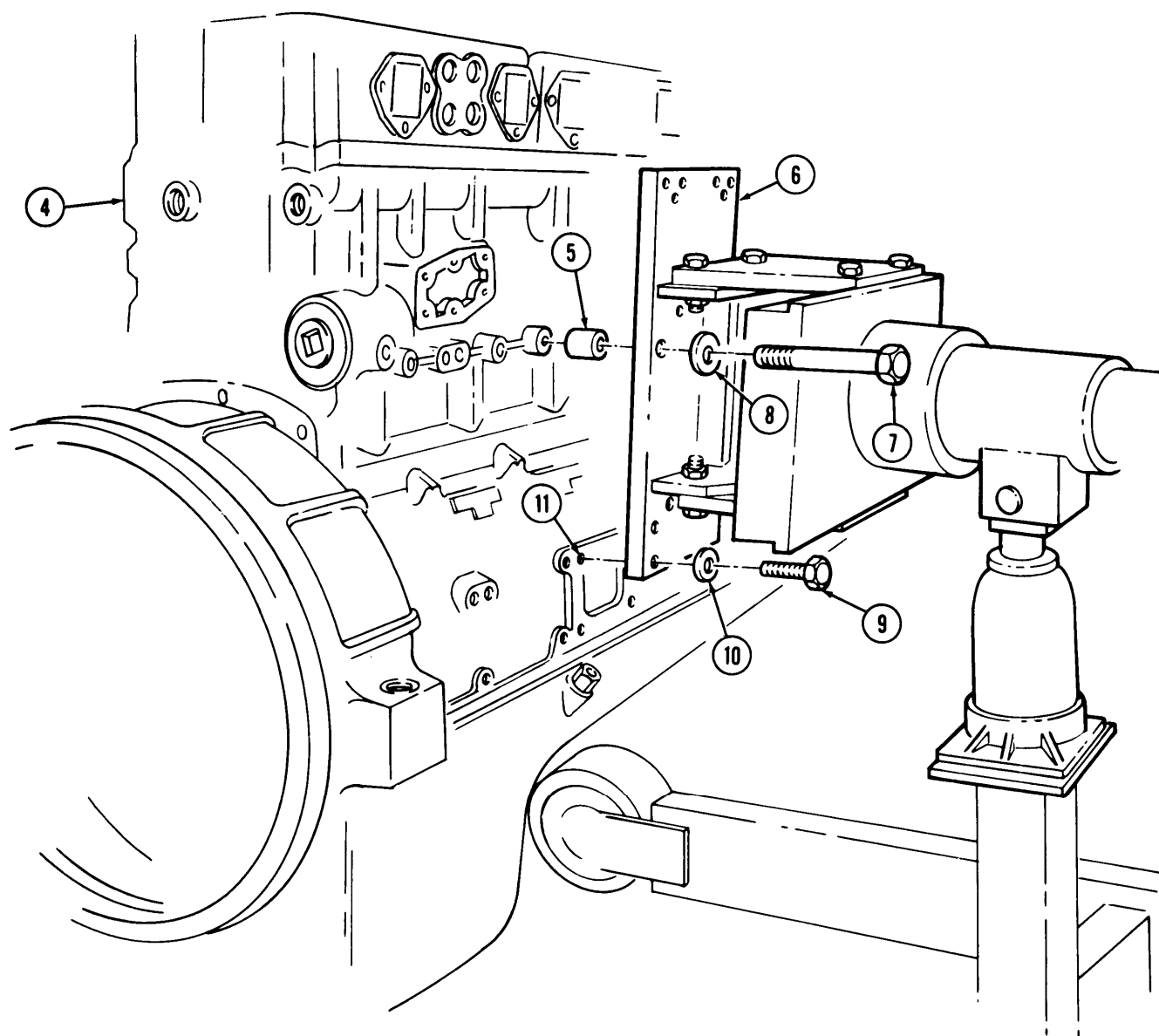
Assistant will help with step 18.

- | | | |
|-----|-------------------|---|
| 18. | Engine (4) | Position against engine stand brace (6) and install with two spacers (5), washers (8) and (10), and screws (7) and (9). Lower screws (9) are installed in engine access holes (11). |
| 19. | Utility chain (1) | Remove. |



3-28. ENGINE MOUNTING ON REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Ž For disassembly, cleaning, inspection, and reassembly of the oil cooler, refer to para. 3-8.

Ž For disassembly, cleaning, inspection, and reassembly of the power steering pump, refer to TM 9-2320-272-20-2.

END OF TASK!

TA 350156

3-29. WATER HEADER PLATES REMOVAL

This task covers:
Removal

INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-28	Engine installed on repair stand.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

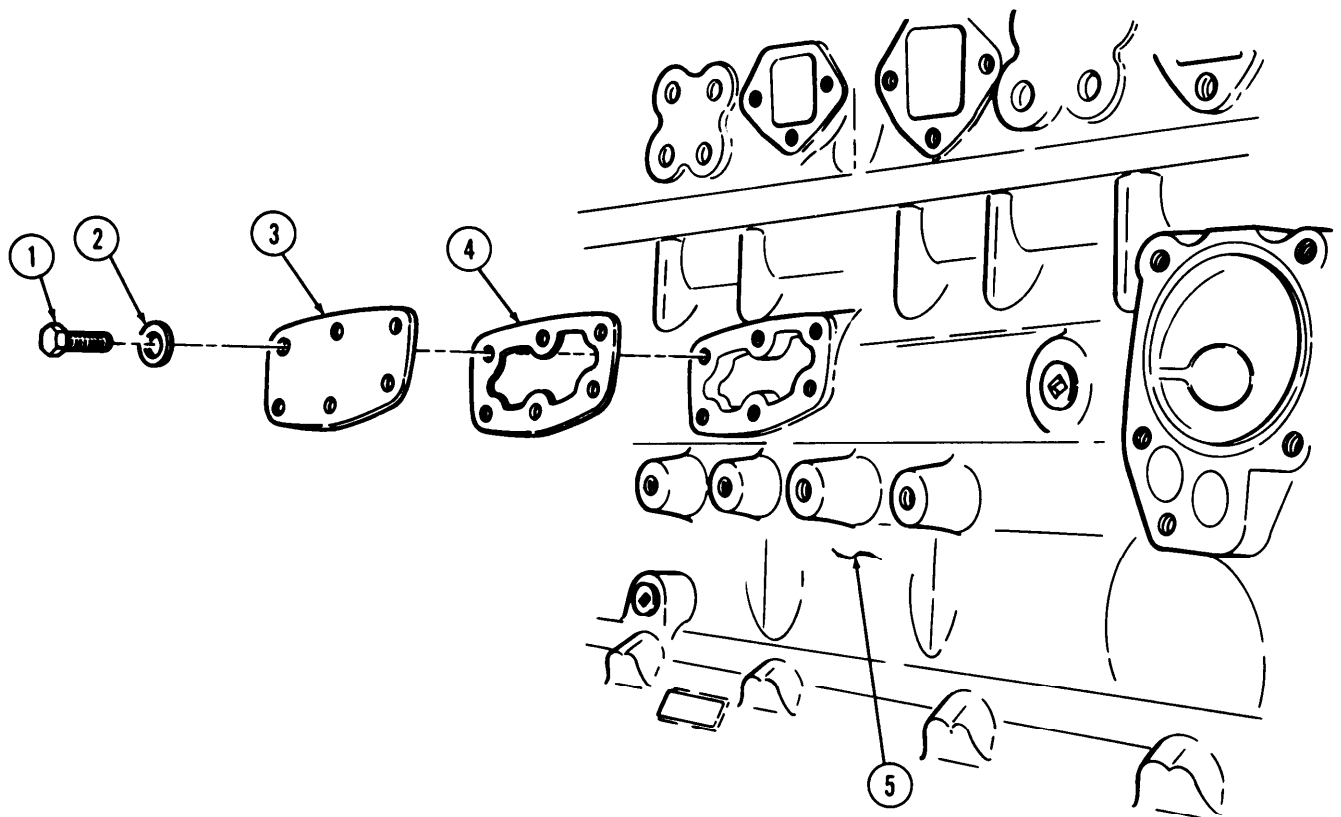
NOTE

Water header plates are mounted with screw-assembled lockwashers on late model engines.

1.	Cylinder block (5)	Twelve screws (1) and lockwashers (2), two water header plates (3) and gaskets (4)	Remove.	Discard gaskets (4) and lockwashers (2). Clean gasket remains from mating surfaces.
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3-29. WATER HEADER PLATES REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 350157

3-30. WATER MANIFOLD REMOVAL

This task covers:

Removal

INITIAL SETUP:

Equipment	
<u>Applicable Models</u>	<u>Reference</u>
All	Para. 3-28
<u>Test Equipment</u>	<u>Condition Description</u>
None	Engine installed on repair stand.
<u>Special Tools</u>	<u>Special Environmental Conditions</u>
None	None
<u>Materials/Parts</u>	<u>General Safety Instructions</u>
None	None
<u>Personnel Required</u>	
Wheeled vehicle repairman MOS 63W	
<u>Manual References</u>	
TM 9-2320-272-20-1	
TM 9-2320-272-34P	

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

NOTE

- Clean area around water manifold to prevent dirt or debris from entering cylinder head water ports as water manifold is removed.
- Ž Water manifold is mounted using screw-assembled lockwashers on late model engine.

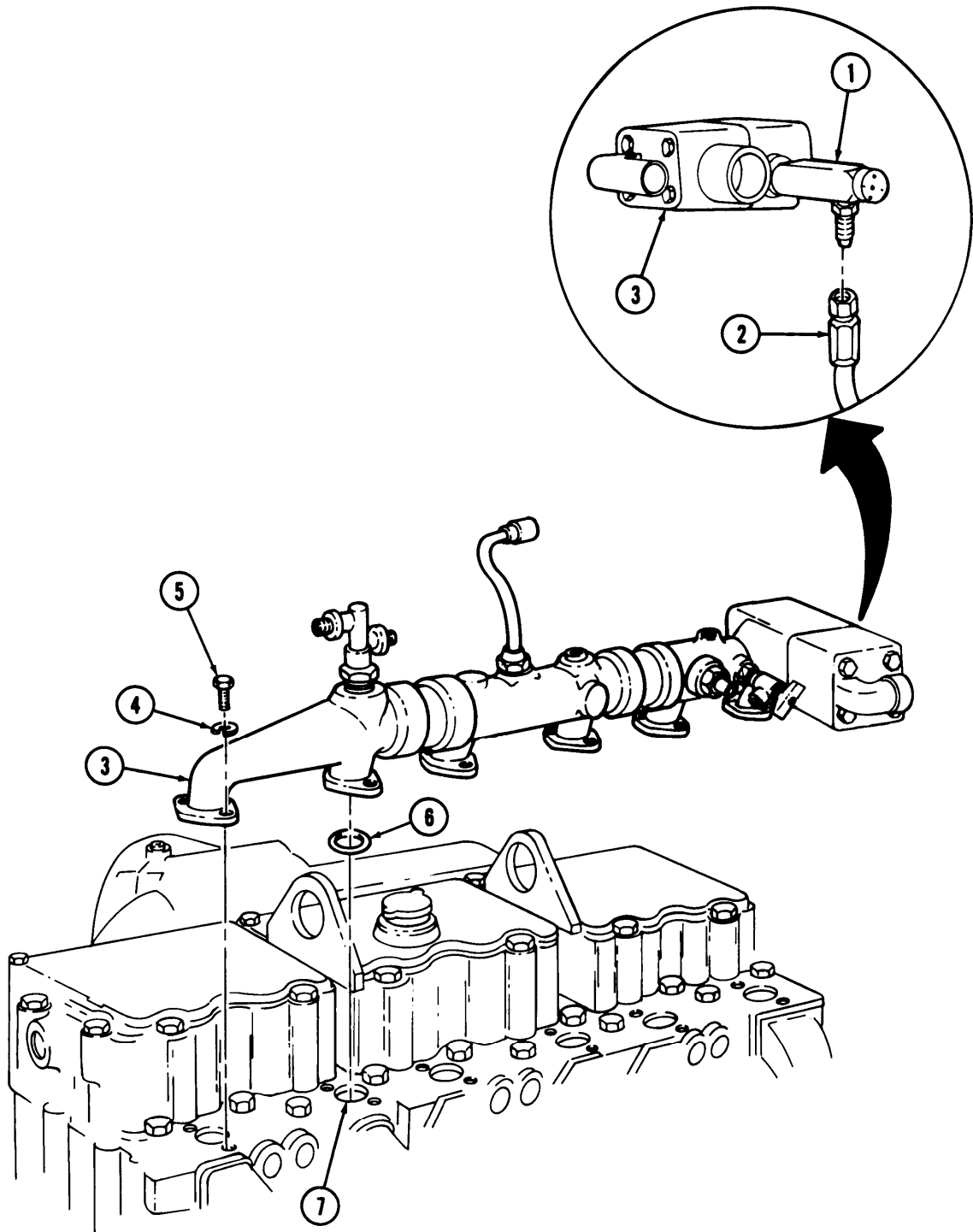
1.	Fan drive clutch actuator (1)	Hose (2)	Disconnect.	
2.	Water manifold (3)	Twelve screws (5) and lockwashers (4)	Remove.	Discard lockwashers (4).
3.		Water manifold (3) and six "O" rings (6)	Remove.	Discard "O" rings (6). Plug openings to prevent dirt from entering ports (7).

NOTE

For disassembly, cleaning, inspection, and reassembly, refer to para. 5-5.

3-30. WATER MANIFOLD REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-31. FAN AND FAN DRIVE CLUTCH REMOVAL

This task covers:
Removal

INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-28	Engine installed on repair stand.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		<u>General Safety Instructions</u>
None		None
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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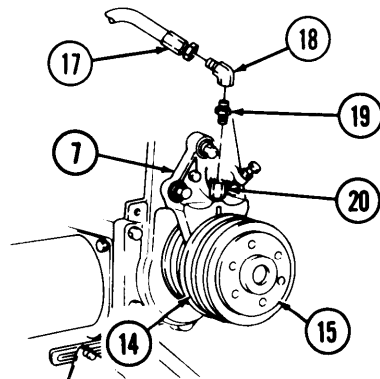
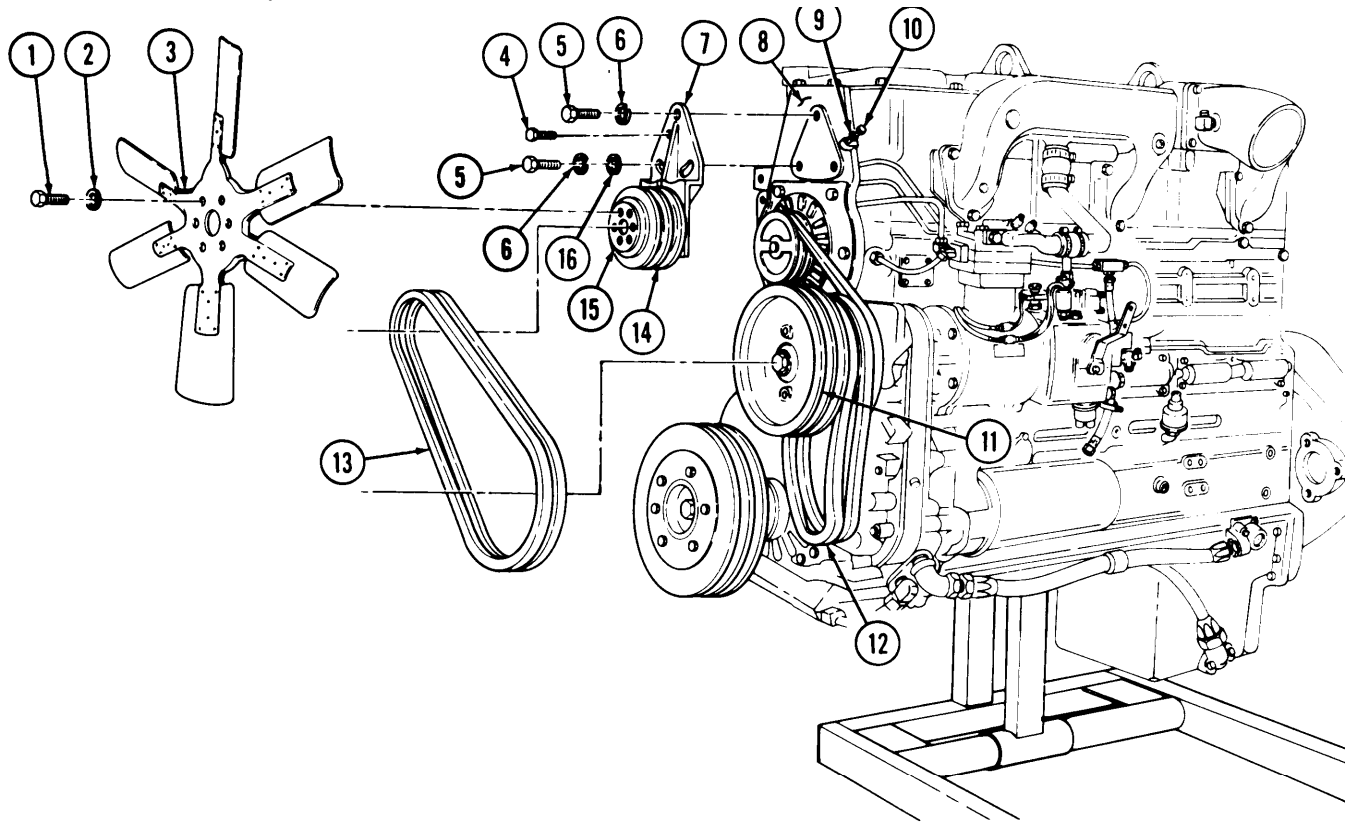
Removal I				
NOTE				
Perform steps 1 and 2 only if engine has been removed from container.				
1.	Fan drive clutch (15)	Six screws (1) and lockwashers (2)	Remove.	Discard lockwashers (2).
2.		Fan (3)	Remove.	
3.	Fan drive clutch bracket (7)	Three screws (5)	Loosen.	Loosen fan drive clutch bracket (7).
3.1.	Water pump support bracket (8)	Fan pulley adjusting screw (10)	Loosen locknut (9) and screw (10).	
4.	Fan drive pulley (14) and accessory drive pulley (11)	Two drivebelts (13)	Remove.	Tag for installation.
5.	Accessory drive pulley (11)	Two power steering drivebelts (12)	Remove.	
6.	Fan drive clutch bracket (7)	Hose nut (17), elbow (18), and adapter (19)	Remove.	Union (20) remains on fan drive clutch bracket (7).
7.		Two fan drive clutch lockup screws (4)	Remove.	
8.		Three screws (5), lockwashers (6), and two washers (16)	Remove.	Discard lockwashers (6).

3-31. FAN AND FAN DRIVE CLUTCH REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
10.	Water pump support	Fan drive clutch (15) and fan drive clutch bracket (7)	Remove.	

NOTE

For disassembly, cleaning and inspection, and reassembly, refer to para. 5-6.



END OF TASK!

3-32. WATER PUMP REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-31	Fan and fan drive clutch removed.
<u>Test Equipment</u>		<u>Special Environmental Conditions</u>
None		None
<u>Special Tool</u>		<u>General Safety Instructions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-20-1		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

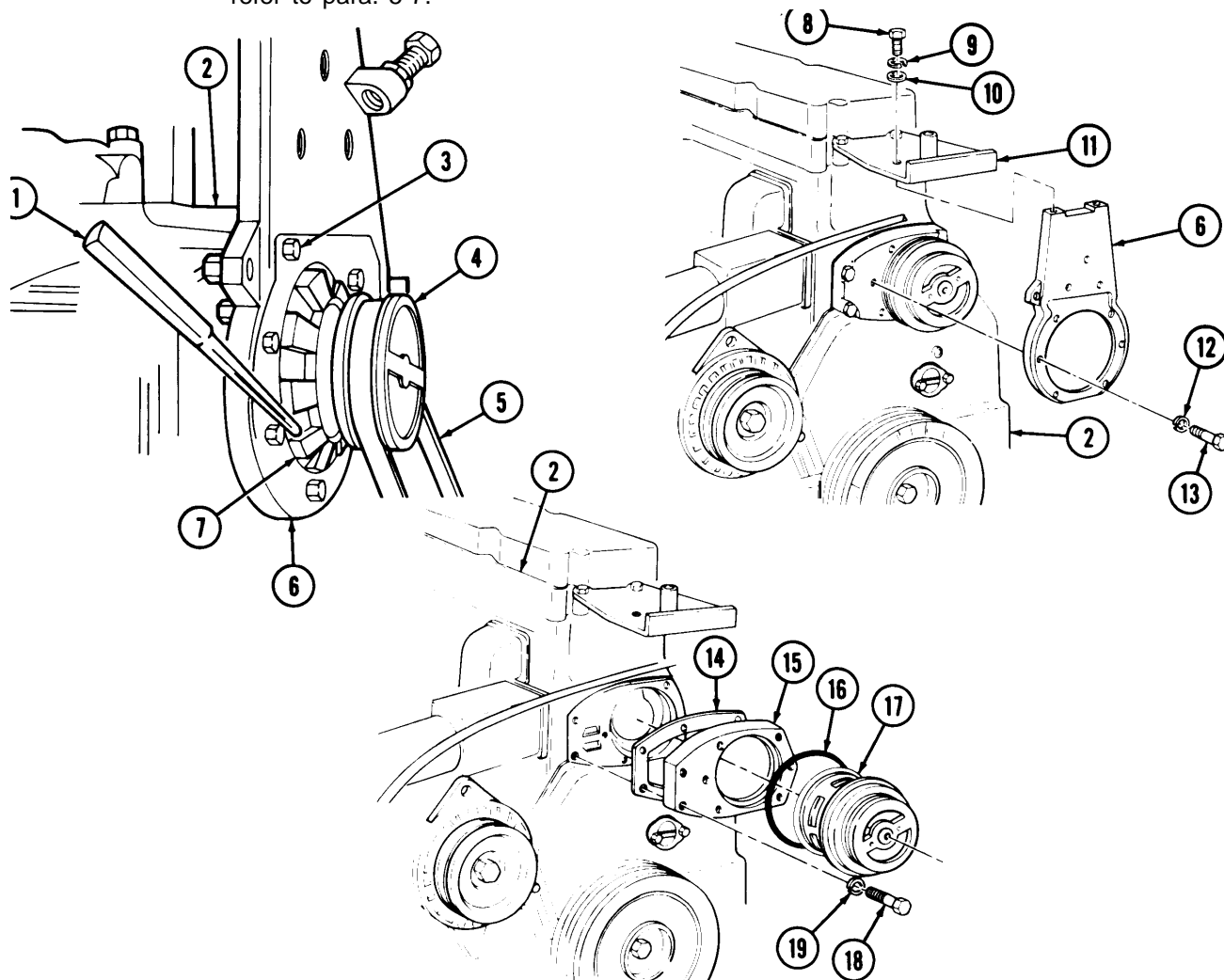
1.	Water pump support bracket (6) and engine (2)	Six screws (3)	Loosen.	Do not remove.
2.		Brass drift (1)	a. Place against water pump body rib (7). b. Punch counterclockwise until belt (5) can be removed.	
3.	Water pump pulley (4)	Water pump drivebelt (5)	Remove.	
4.	Upper radiator support bracket (11)	Two screws (8), lockwashers (9), and washers (10)	Remove.	Discard lockwashers (9).
5.	Engine (2)	Six screws (13), Lockwashers (12), and water pump support bracket (6)	Remove.	Discard lockwashers (12).

3-32. WATER PUMP REMOVAL (Cont'd)

STEP No.	LOCATION	ITEM	ACTION	REMARKS
6.	Water pump support (15)	Water pump body (17) and gasket (16)	Remove.	Discard gasket (16). Clean gasket remains from mating surfaces.
7.	Engine (2)	Two screws (18) and lockwashers (19)	Remove.	Discard lockwashers (19).
8.		Water pump support (15) and gasket (14)	Remove.	Use roll head pry bar. Discard gasket (14). Clean gasket remains from mating surfaces.

NOTE

For disassembly, cleaning and inspection, repair, and reassembly, refer to para. 5-7.



END OF TASK!

3-34. VIBRATION DAMPER REMOVAL

This task covers:
Removal

INITIAL SETUP:

Applicable Models

All

Test Equipment

None

Special Tools

None

Materials/Parts

None

Personnel Required

Wheeled vehicle repairman MOS 63W

Manual References

TM 9-2320-272-34P

Equipment
Condition
Reference

Para. 3-28

Condition Description

Engine mounted on repair stand.

Special Environmental Conditions

None

General Safety Instructions

None

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

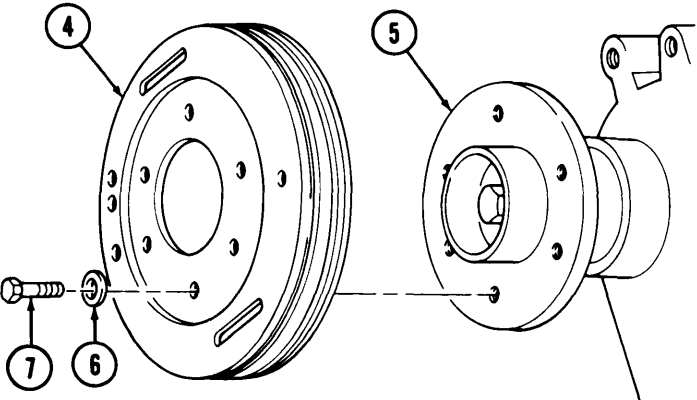
TO check runout and wobble, refer to para. 3-9.

Removal

NOTE

Before removing vibration damper screws, flywheel must be locked to stop crankshaft from turning.

- | | | | |
|--------------------------|------------------------------------|---------|--------------------------|
| 1. Crankshaft flange (5) | Six screws (7) and lockwashers (6) | Remove. | Discard lockwashers (6). |
| 2. | Vibration damper (4) | Remove. | Use soft-faced hammer. |



END OF TASK!

TA350162

3-35. CRANKSHAFT FLANGE REMOVAL

This task covers:
Removal

INITIAL SETUP:		Equipment Condition Reference	Condition Description
Applicable Models		Para. 3-34	Vibration damper removed.
Test Equipment			
Special Tools	Crankshaft flange puller ST-887		Special Environmental Conditions
Materials/Parts	None		None
Personnel Required	Wheeled vehicle repairman MOS 63W		General Safety Instructions
Manual References	TM 9-2320-272-34P		None

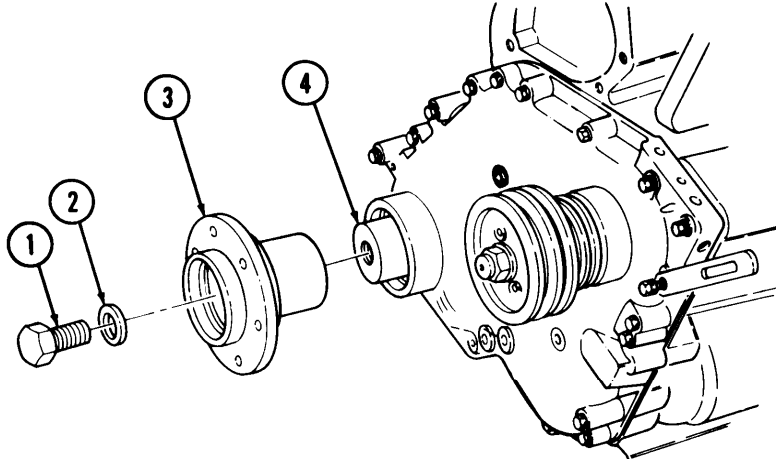
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

NOTE

To check runout and wobble, refer to para. 3-9.

- | | | | | |
|----|-----------------------|--------------------------|--|-------------|
| 1. | Crankshaft flange (3) | Screw (1) and washer (2) | Remove. | |
| 2. | | Screw (1) | Install in crankshaft (4) three turns. | |
| 3. | Crankshaft (4) | Crankshaft flange (3) | Remove. | Use puller. |
| 4. | | Screw (1) | Remove. | |



END OF TASK!

3-36. ENGINE ACCESSORY DRIVE PULLEY REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-28 TM 9-2320-272-20-1	Engine mounted on repair stand. Water pump drivebelt removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Accessory drive pulley puller ST-386		None
<u>Materials/Parts</u>		<u>General Safety Instructions</u>
None		None
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

LOCATION	ITEM	ACTION	REMARKS
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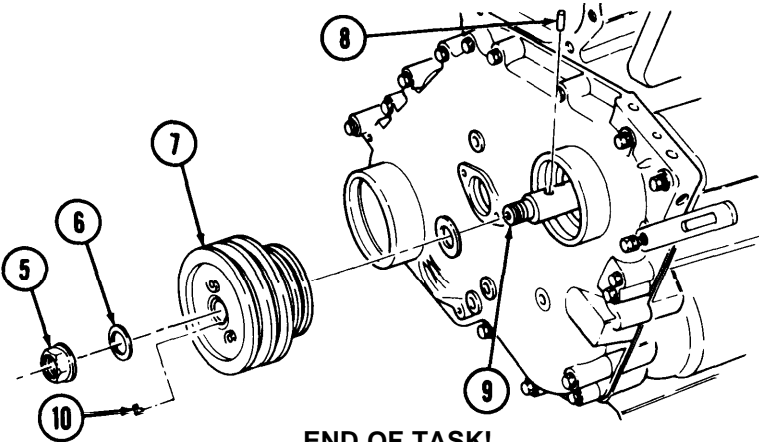
Removal

- | | | | |
|----|----------------------------|----------------------------|--|
| 1. | Accessory drive pulley (7) | Nut (5) and washer (6) | Remove. |
| 2. | Accessory drive shaft (9) | Accessory drive pulley (7) | Remove from accessory drive shaft (9). Use puller. |

NOTE

Perform step 3 only if dowel pin is damaged.

- | | | | | |
|----|----------------------------|---------------|---------|----------------------|
| 3. | | Dowel pin (8) | Remove. | |
| 4. | Accessory drive pulley (7) | Gasket (10) | Remove. | Discard gasket (10). |



END OF TASK!

3-37. FUEL PUMP REMOVAL

This task covers:
Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-28	Engine mounted on repair stand.
<u>Test Equipment</u>		<u>Special Environmental Conditions</u>
None		None
<u>Special Tools</u>		<u>General Safety Instructions</u>
None		None
<u>Materials/Parts</u>		
protective cap-plugs (Appendix C, Item 5)		
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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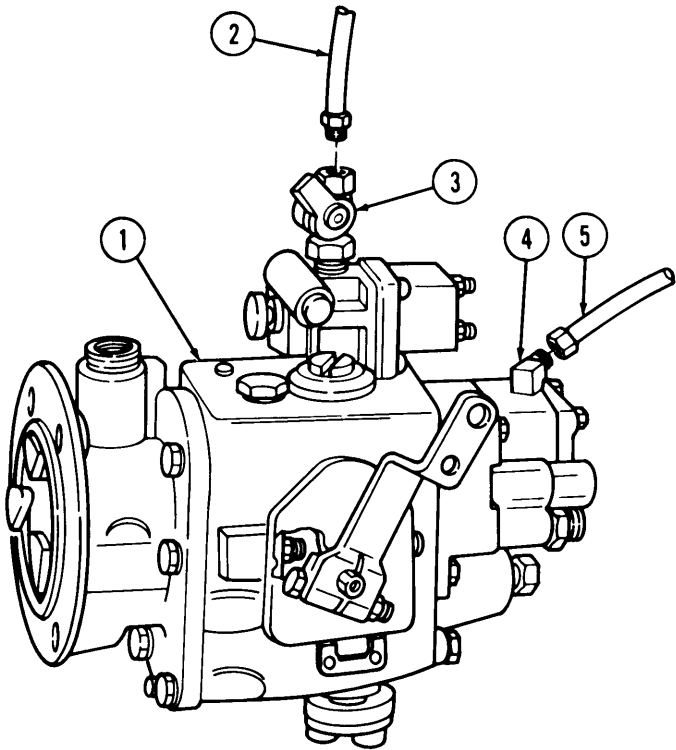
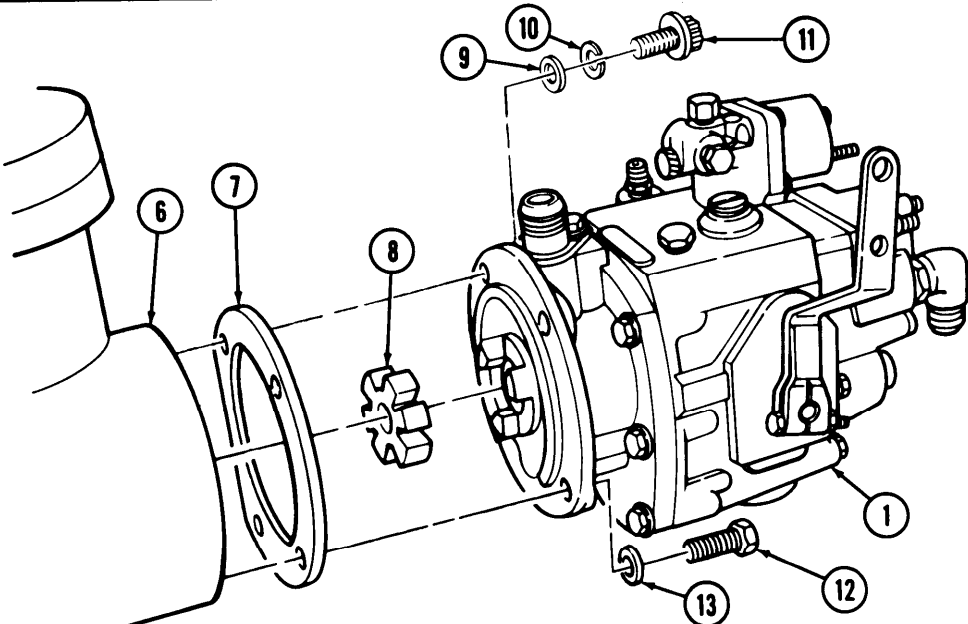
Removal

1. Fuel shutoff valve (3)	Fuel supply tube (2)	Disconnect.	
2. Fuel pump elbow (4)	Fuel return hose (5)	Disconnect.	
3. Air compressor (6)	Three screws (12) and washers (13), screw (11), lockwasher (10), washer (9), fuel pump (1), gasket (7), and drive coupling (8)	Remove.	Discard lockwasher (10) and gasket (7), and cover all pump openings. Clean gasket remains from mating surfaces.

NOTE

For disassembly, cleaning, inspection, repair, and reassembly, refer to chapter 4.

3-37. FUEL PUMP REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

END OF TASK!

3-38. AIR COMPRESSOR AIR INLET TUBE REMOVAL

This task covers:
Removal

INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-28	Engine mounted on repair stand.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

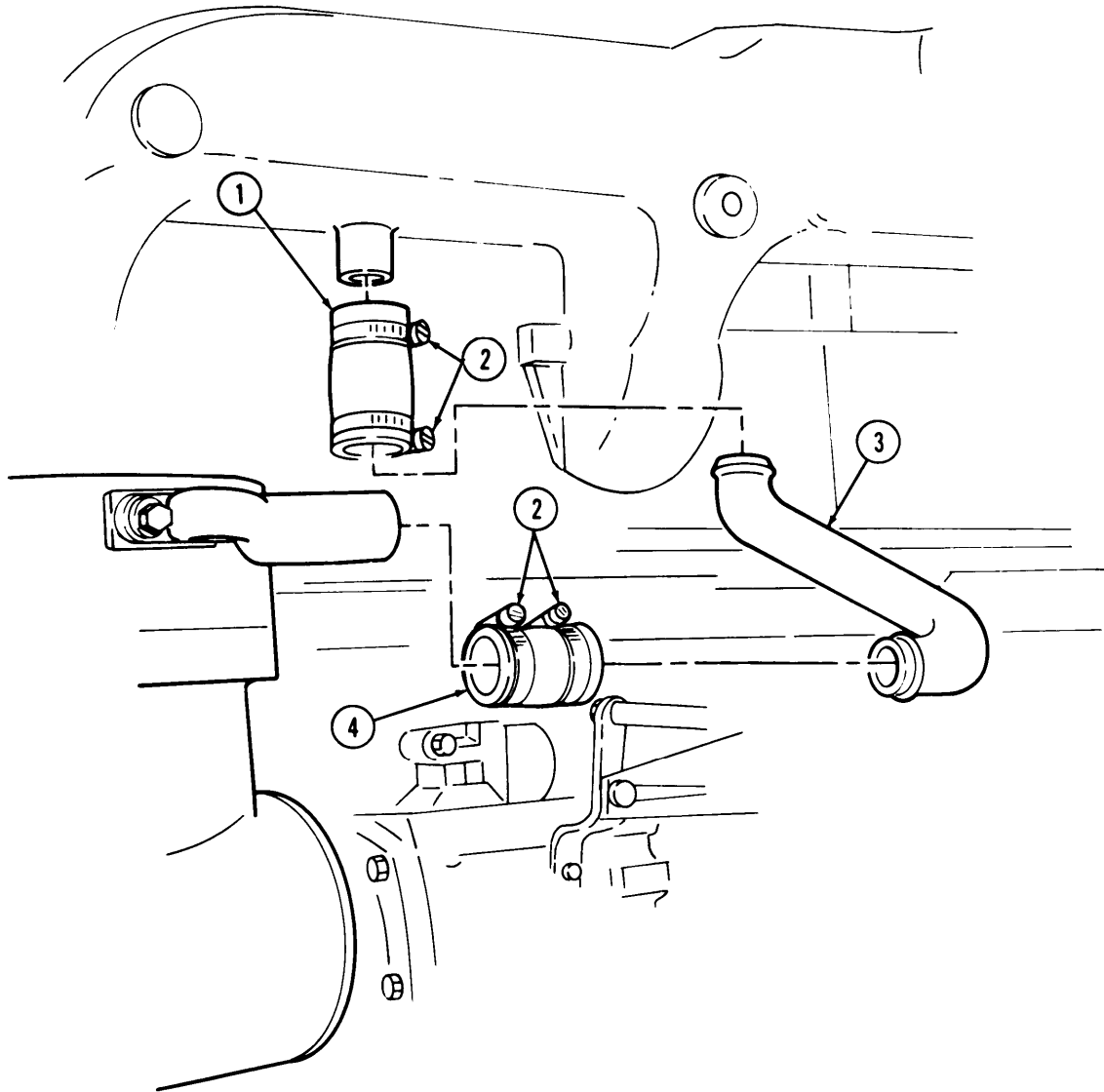
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

1.	Air compressor hose (4) and manifold hose (1)	Four hose clamps (2)	Loosen.	
2.		Air inlet tube (3)	Remove.	Tag for installation.
3.		Hoses (4) and (1) and four clamps (2)	Remove.	

3-38. AIR COMPRESSOR AIR INLET TUBE REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 350166

3-183

3-39. AIR COMPRESSOR REMOVAL

This task covers:

Removal

INITIAL SETUP:

Applicable Models

All

Test Equipment

None

Special Tool

None

Materials/Parts

None

Personnel Required

Wheeled vehicle repairman MOS 63W

Manual References

TM 9-2320-272-34P

Equipment Condition Reference

Para. 3-37
Para. 3-38

Condition Description

Fuel pump removed.
Air compressor inlet tube removed.

Special Environmental Conditions

None

General Safety Instructions

None

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

- | | | | | |
|----|-------------------------|--|-------------|-----------------------------|
| 1. | Compressor elbow (10) | Coolant outlet line (3) | Disconnect. | |
| 2. | Bracket (7) | Nut (6), lockwasher (5), washer (4), screw (1), washer (2), clamp (8), and coolant outlet line (3) | Remove. | Discard lockwasher (5). |
| 3. | Coolant outlet line (3) | Packing sleeve (9) | Remove. | Discard packing sleeve (9). |

NOTE

Power steering pump pivot bracket is mounted using screw-assembled lockwashers for late model engine.

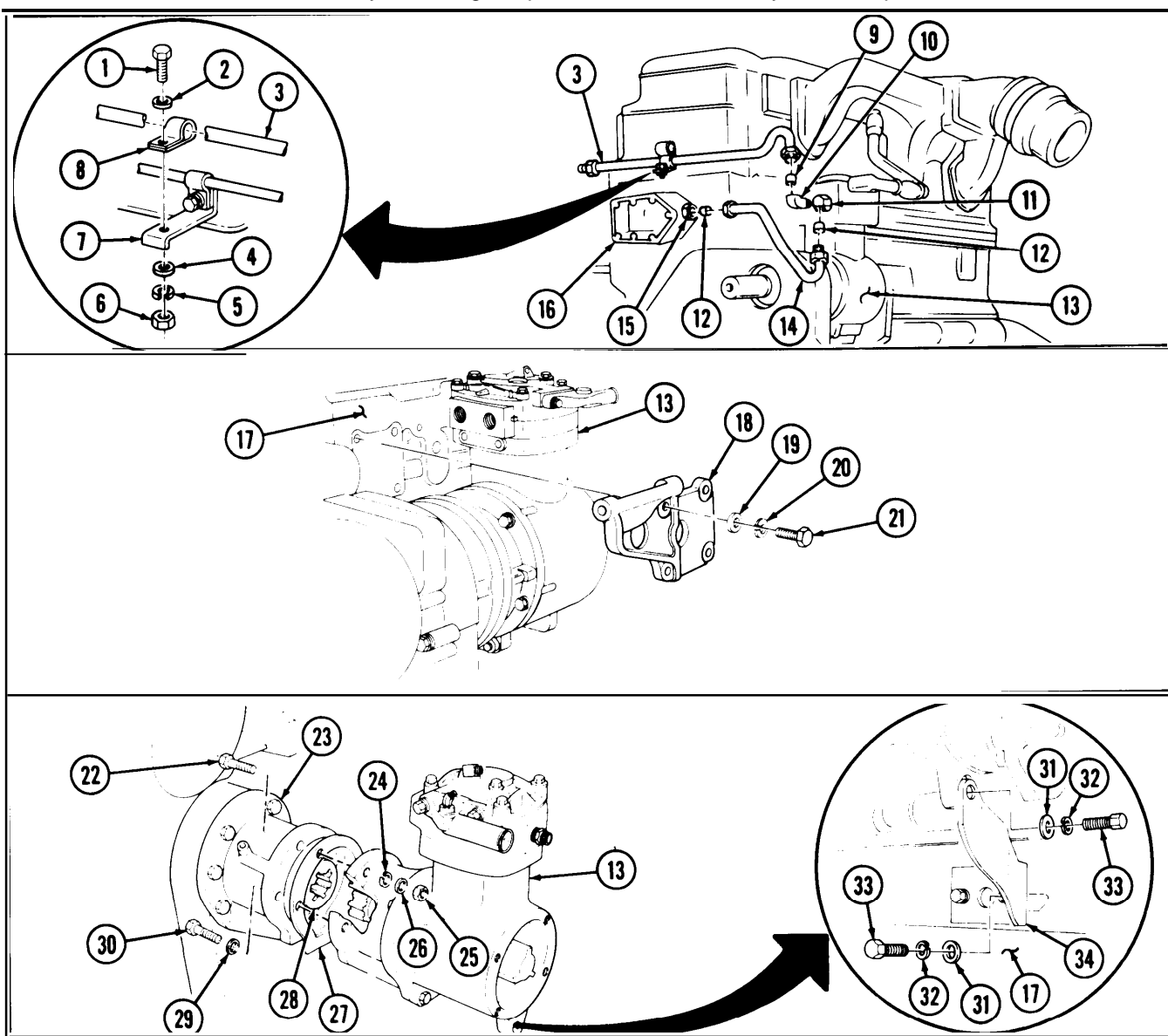
- | | | | | |
|----|--------------------------|--|-------------|-------------------------------|
| 4. | Cylinder block (17) | Four screws (21), lockwashers (20), washers (19), and power steering pump pivot bracket (18) | Remove. | Discard lockwashers (20). |
| 5. | Compressor elbow (11) | Coolant inlet line (14) | Disconnect. | |
| 6. | Water pump manifold (16) | Coolant inlet line (14) and adapter (15) | Remove. | |
| 7. | Coolant inlet line (14) | Two packing sleeves (12) | Remove. | Discard packing sleeves (12). |
| 8. | Bracket (34) | Two screws (33), lockwashers (32), and washers (31) | Remove. | Discard lockwashers (32). |

3-39. AIR COMPRESSOR REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
9.	Accessory drive housing	Two nuts (25), lockwashers (26), washers (24), and screws (22), two screws (30), lockwashers (29), air compressor (13) gasket (27), and coupling (28)	Remove.	Discard lockwashers (26) and (29). Discard gasket (27). Clean gasket remains from mating surfaces.

NOTE

For disassembly, cleaning, inspection, and reassembly, refer to para. 10-4.



3-40. OIL PUMP RETURN HOSE, PICKUP HOSE, AND SUMP TUBE REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-28	Engine mounted on repair stand.
<u>Test Equipment</u>		<u>Special Environmental Conditions</u>
None		None
<u>Special Tools</u>		<u>General Safety Instructions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Have drainage container ready to catch oil.

Removal

- | | | | | |
|----|---|----------------------|-------------|--|
| 1. | Oil pump fitting (10) and oil pan aerator (4) | Pump return hose (7) | Disconnect. | Disconnect at oil pump fitting (10) first. |
| 2. | Oil pan flange (6) and oil pump (1) | Pump pickup hose (2) | Disconnect. | Disconnect at oil pan flange (6) first. |

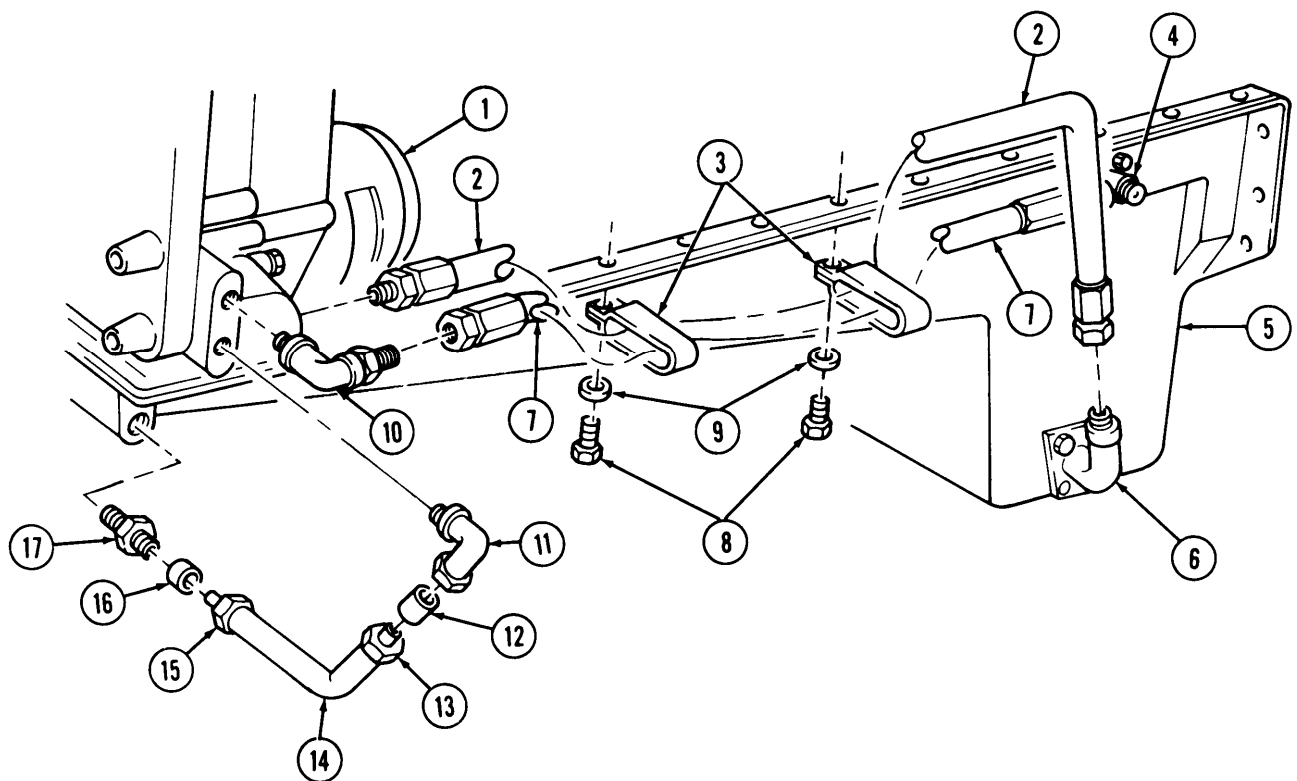
NOTE

Engine oil pan is mounted with screw-assembled washers for late model engine.

- | | | | | |
|----|-----------------------------------|---|--|--|
| 3. | Oil pan (5) | Two screws (8), washers (9), and clamps (3), pump return hose (7), and pump pickup hose (2) | Remove. | |
| 4. | Pump fitting (11) and pan adapted | Two sump tube nuts (13) and (15) | Remove, and disconnect front sump tube (14). | |
| 5. | Front of oil pump (1) | Fitting (11) | Remove. | |
| 6. | Front of oil pan (5) | Adapter (17) | Remove. | |
| 7. | Front sump tube (14) | Packing sleeves (12) and (16) | Remove. | |

3-40. OIL PUMP RETURN HOSE, PICKUP HOSE, AND SUMP TUBE REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 350168

3-41. ENGINE OIL FILTER REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-28	Engine mounted on repair stand.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		Do not remove filter when engine is hot.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

WARNING

Do not remove filter when engine is hot. A removed filter may drip hot oil, causing injury to personnel.

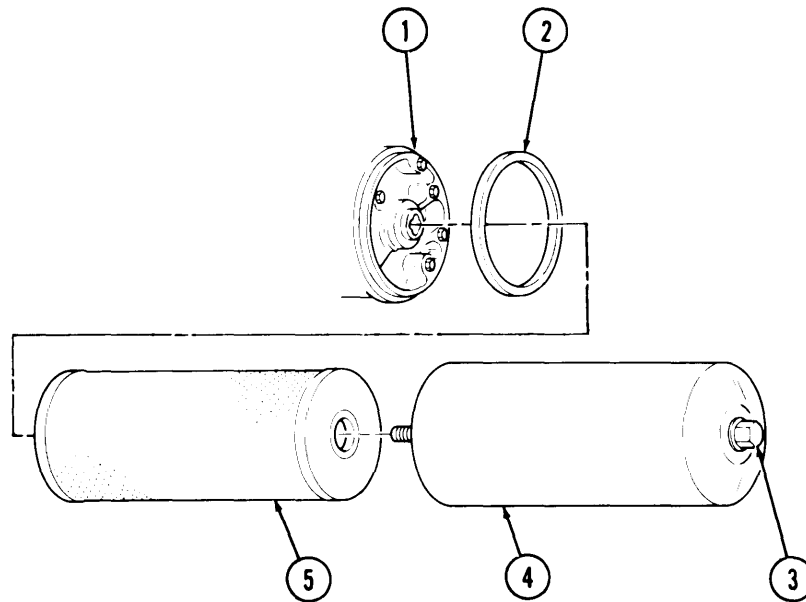
NOTE

Have drainage container ready to catch oil.

- | | | | | |
|----|------------------|-------------------------------------|---|-----------------------------------|
| 1. | Filter base (1) | Oil filter center bolt (3) | Loosen until filter shell (4) is free from filter base (1). | |
| 2. | Filter shell (4) | Filter element (5) and oil seal (2) | Remove. | Discard element (5) and seal (2). |
| 3. | | Filter base (1) | Remove old seal (2) remains. | |

3-41. ENGINE OIL FILTER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 350169

3-189

3-42. ENGINE FRONT GEARCASE COVER MAINTENANCE

This task covers:

- a. Removal
b. Disassembly

- c. Cleaning and Inspection
d. Reassembly

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment condition Reference</u>	<u>condition Description</u>
All	Para. 3-28	Engine mounted on repair stand.
<u>Test Equipment</u>	Para. 3-35	Crankshaft flange removed.
None	Para. 3-36	Engine accessory drive pulley removed.
<u>Special Tools</u>	Para. 3-32	Water pump removed.
None		
<u>Materials/Parts</u>	<u>Special Environmental Conditions</u>	
Two lockwashers	None	
Two oil seals		
Lubrication oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W	None	
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

- Gearcase mounting screws are of different lengths. Tag screws for installation.
- Front gearcase cover is mounted with screw-assembled washers for late model engine.

a. Removal

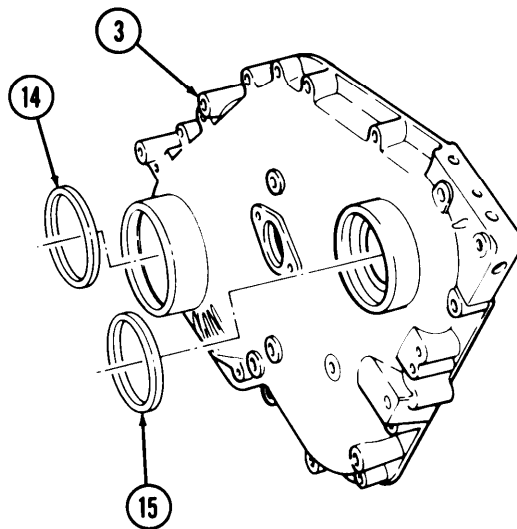
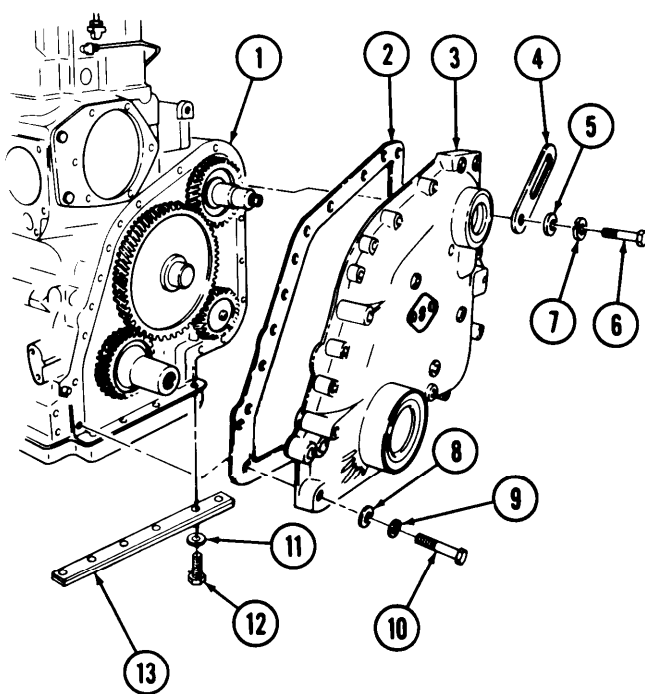
1. Front gearcase cover (3) and engine block (1)	Screw (6), lockwasher (7), washer (5), and power steering pump adjusting link (4)	Remove.	Discard lockwasher (7).
1.10	Four screws (12), washers (11), and brace (13)	Remove.	
2.	Fifteen screws (10), lockwashers (9), and washers (8)	Remove.	Discard lockwashers (9).
2.1. Engine block (1)	Front gearcase cover (3) and gasket (2)	Remove.	Discard gasket (2). Clean gasket remains from mating surfaces.

3-42. ENGINE FRONT GEARCASE COVER MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Disassembly

- | | | | | |
|----|--------------------------|---------------------------|---------|--------------------|
| 3. | Front gearcase cover (3) | Crankshaft seal (14) | Remove. | Discard seal (14). |
| 4. | | Accessory drive seal (15) | Remove. | Discard seal (15). |



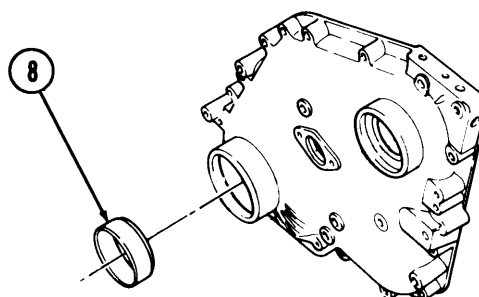
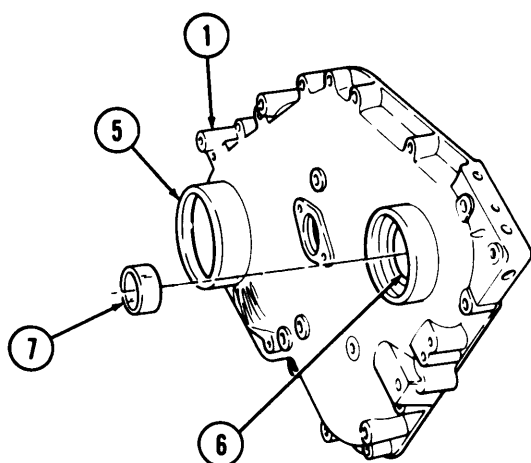
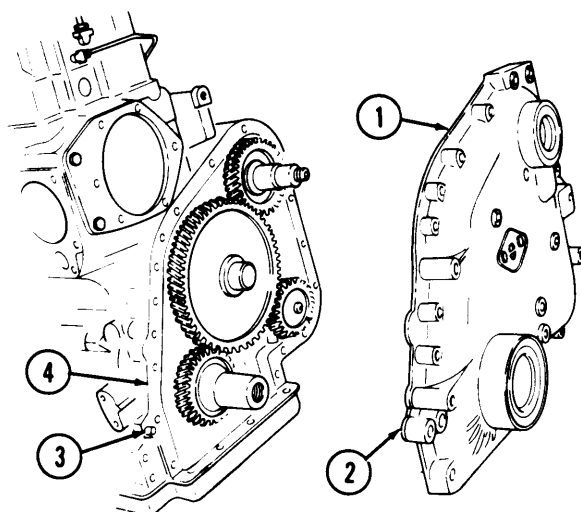
END OF TASK!

3-42. ENGINE FRONT GEARCASE COVER MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
c. Cleaning and Inspection				
7.		Gearcase cover (1)	a. Clean in accordance with instructions in paragraph 2-7. b. Remove all gasket material from mating surfaces on cover (1). c. Inspect in accordance with instructions in para. 2-8. d. Using a surface plate, lap gasket mating surfaces to remove high or low area to ensure flatness and good sealing.	Replace gearcase cover (1) if any defect is noted.
8.		Crankshaft seal bore (5) and accessory drive seal bore (6)	Check seal bores for nicks, burrs, and gouges.	Small nicks, burrs, and gouges can be smoothed out with crocus cloth.
9.	Accessory drive seal bore (6)	Bushing (7)	a. Check for scoring and pitting. b. Check for wear using inside micrometer. c. Measure outside diameter of accessory drive shaft.	Discard if scored or pitted. Discard if inside diameter is more than 1.571 in. (39.90 mm). Bushing to drive shaft clearance must be between 0.003 and 0.007 in. (0.08 and 0.18 mm), Can use under-size bushings to obtain proper clearance.
10.		Gearcase cover trunnion bushing (8)	a. Inspect for cracks or scoring. b. Measure outside diameter.	Replace if cracked or scored. If less than 4.745 in. (12.52 mm), replace trunnion bushing (8).
11.	Engine block (4)	Two dowel pins (3)	Inspect for cracks, breaks, or burrs.	Replace dowel pins if cracked or broken. Repair if burred (refer to para 2-9).

3-42. ENGINE FRONT GEARCASE COVER MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
12,	Gearcase cover (1)	Two dowel pin holes (2)	Inspect for elongated holes.	Replace front gearcase cover (1) if holes are elongated.



3-42. ENGINE FRONT GEARCASE COVER MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Reassembly

NOTE

Do not perform steps 13 and 14 unless new bushings are to be installed.

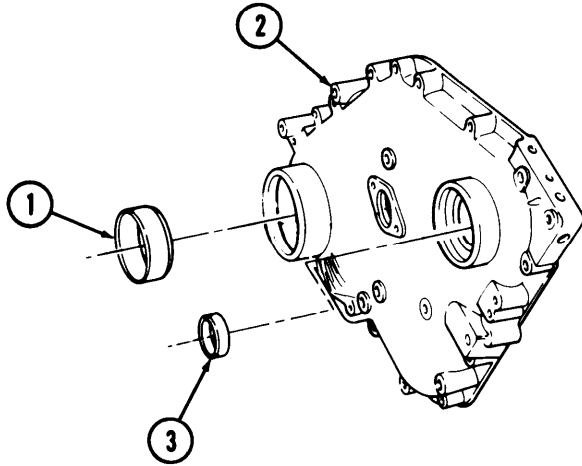
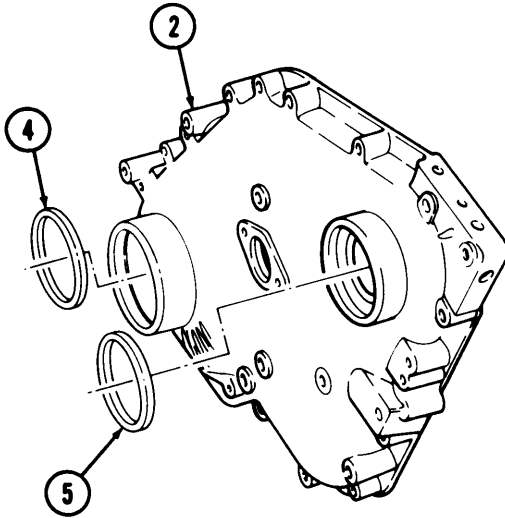
13.		Accessory drive bushing (3)	a. Remove. b. Install new accessory drive bushing (3) in gearcase cover (2).	Use arbor press and mandrel.
14.		Gearcase cover trunnion bushing (1)	a. Remove. b. Cut new bushing (1). c. Install new gearcase cover trunnion bushing (1) on gearcase cover (2).	Use puller. Outside diameter 4.747-4.750 in. (120.57-120.65 mm). Use arbor press and mandrel. Chamfer edge of bushing toward gearcase cover.

NOTE

- Do not install mandatory replacement oil seals until gearcase cover is to be reassembled to engine (para. 3-78). This prevents collection of dirt.
- Lightly coat all contacting parts of shafts, seals, and "O" ring with lubricating oil before installation.

15.		New crankshaft oil seal (4)	Install.	Use proper oil seal installation tool.
16.		New accessory drive oil seal (5)	Install.	Use proper oil seal installation tool.

3-42. ENGINE FRONT GEARCASE COVER MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

END OF TASK!

3-43. ENGINE ACCESSORY DRIVE REMOVAL

This task covers:

a. Gear Backlash Test	b. Removal
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INITIAL SETUP:											
	<table><tr><td>Equipment Condition Reference</td><td>Condition Description</td></tr><tr><td>Para. 3-42</td><td>Engine front gearcase cover removed.</td></tr><tr><td>Para. 3-39</td><td>Air compressor removed.</td></tr><tr><td></td><td>Special Environmental Conditions</td></tr><tr><td></td><td>None</td></tr></table>	Equipment Condition Reference	Condition Description	Para. 3-42	Engine front gearcase cover removed.	Para. 3-39	Air compressor removed.		Special Environmental Conditions		None
Equipment Condition Reference	Condition Description										
Para. 3-42	Engine front gearcase cover removed.										
Para. 3-39	Air compressor removed.										
	Special Environmental Conditions										
	None										
Special Tools											
None											
Materials/Parts											
None											
Personnel Required	General Safety Instructions										
Wheeled vehicle repairman MOS 63W	None										
Manual References											
TM 9-2320-272-34P											

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Gear Backlash Test 1

1.	Engine block flange (1) and accessory drive gear (3)	Dial indicator (2)	<div>a. Mount on engine block flange (1).</div> <div>b. Make sure anvil (5) is positioned flat against drive gear tooth (4).</div> <div>c. Turn gear (3) clockwise until tight.</div> <div>d. Zero dial indicator (2) index line.</div> <div>e. Turn drive gear (3) counterclockwise until tight.</div>	
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NOTE

Measure movement between gears only, not side to side movement

f. Note amount of movement of dial indicator hand (6).	Normal range is 0.004-0.016 in. (0.10-0.41 mm).
	If less than 0.002 in. (0.05 mm), replace drive gear (3).
	If greater than 0.018 in. (0.46 mm), replace drive gear (3).

3-43. ENGINE ACCESSORY DRIVE REMOVAL (Cont'd)

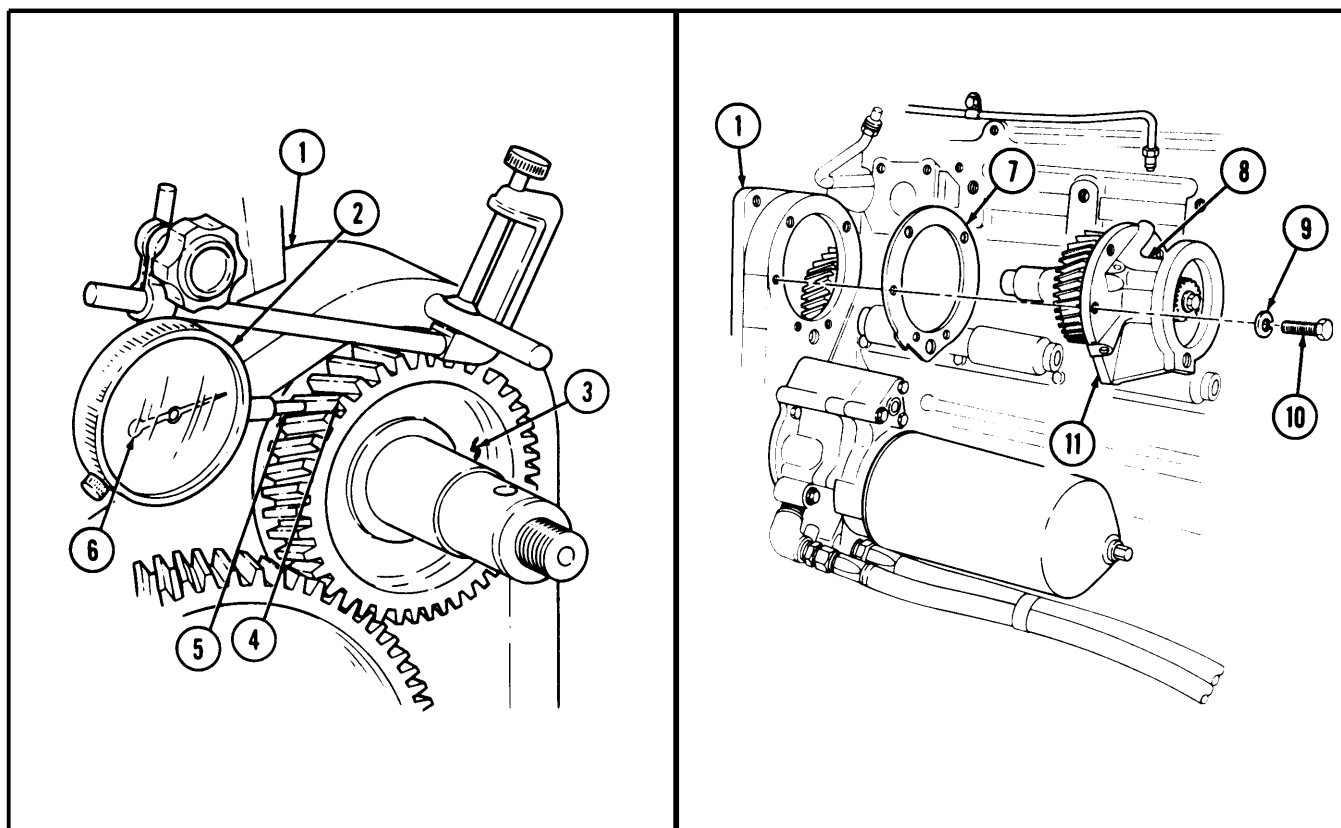
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Removal

2.	Accessory drive front flange (11)	Five screws (10) and lockwashers (9)	Remove.	Discard lockwashers (9).
3.	Engine block flange (1)	Accessory drive housing (8) and gasket (7)	Remove,	Discard gasket (7). Use soft-faced hammer to loosen accessory drive housing (8) from engine block flange (1). Clean gasket remains from mating surfaces.

NOTE

For disassembly, cleaning and inspection, and reassembly, refer to para. 3-12.



END OF TASK!

3-44. ENGINE OIL PUMP MAINTENANCE

- This task covers:
- a. Gear Backlash Test

b. Removal

c. Disassembly

d. Cleaning and Inspection

e. Repair

f. Reassembly

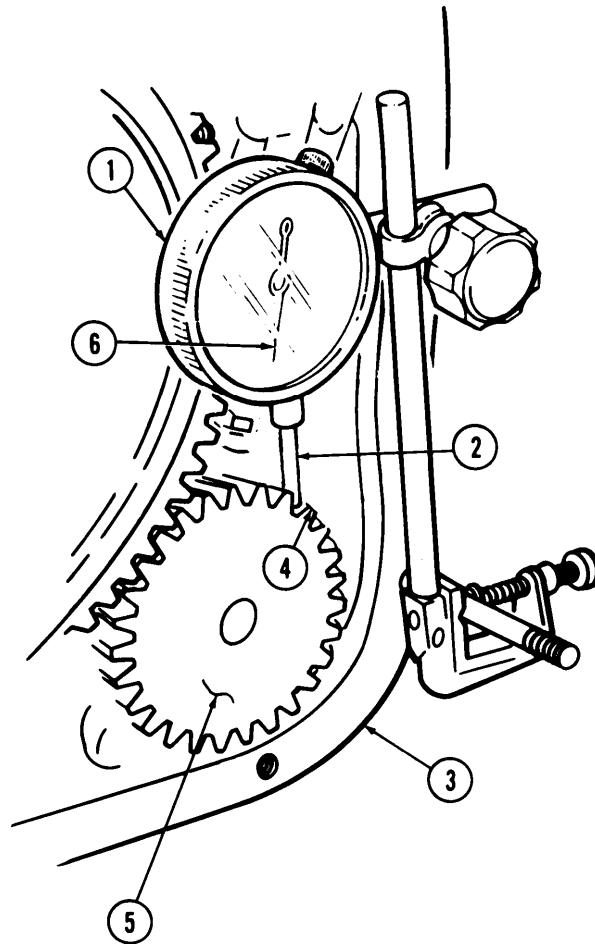
INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-41	Engine oil filter removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Bypass seat		
Bypass spring		
Disc		
Lockplate		
Oil pump flange gasket		
Two dowel pins		
Two body gaskets		
Fifteen lockwashers		
Regulator spring		
Lubricating oil OE/HDO 30		
(Appendix C, Item 17)		
Sealing tape (Appendix C, Item 30)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		<ul style="list-style-type: none">• Keep fire extinguisher nearby when using Drycleaning solvent.• Compressed air source will not exceed 30 psi (207 kPa).• Eyeshields must be worn when cleaning with compressed air,
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Gear Backlash Test				
1,	Engine block flange (3) and oil pump drive gear (5)	Dial indicator (1)	<div><div>a. Mount on flange (3) as shown.</div><div>b. Make sure anvil (2) is positioned against drive gear tooth (4).</div><div>c. Turn drive gear (5) clockwise until tight.</div><div>d. Zero dial indicator (2) index line.</div><div>e. Turn drive gear (5) counterclockwise until tight.</div></div>	

3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			f. Note amount of movement of dial indicator hand (6).	Normal range is 0.004-0.016 in. (0.10-0.40 mm). If less than 0.002 in. (0.05 mm), replace drive gear (5).



3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Removal

CAUTION

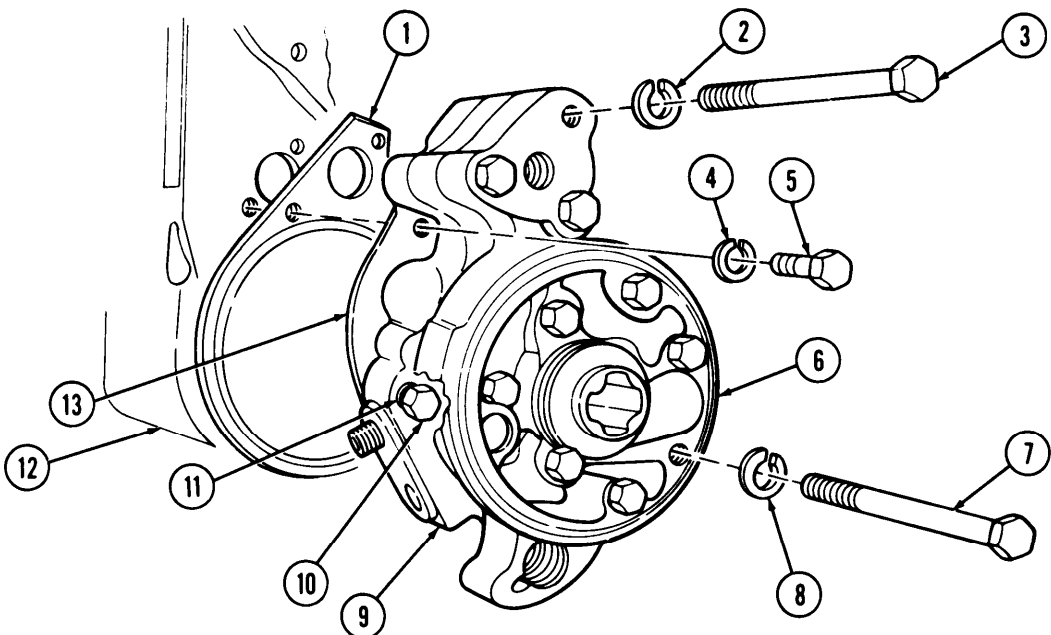
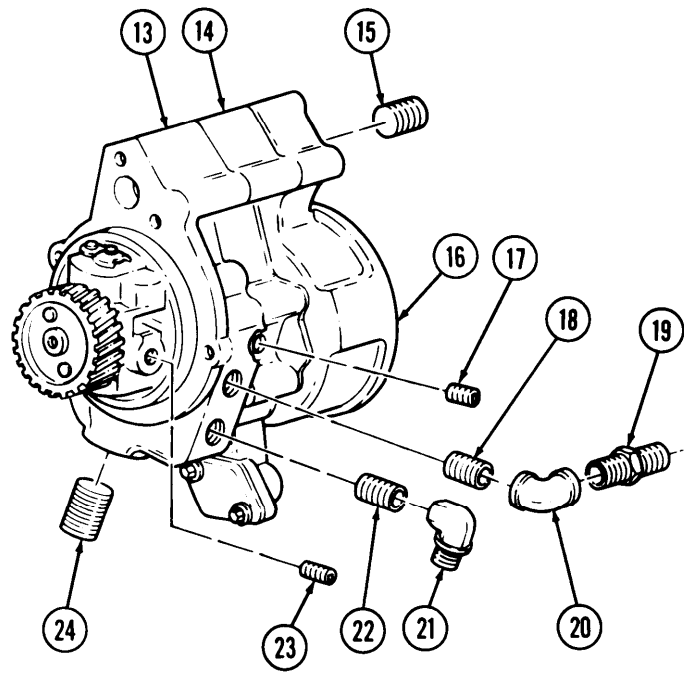
Mounting and assembly screws are of different sizes and lengths. Screws must be tagged for installation. Misplaced screws can damage parts.

2.	Oil pump body flange (13)	Two screws (5) and lockwashers (4)		Discard lockwashers (4).
3.		Screw (10) and lock-washer (11)	Loosen completely,	Screw (10) is removed during disassembly.
4.	Filter head (6)	Screws (3) and (7), and lockwashers (2) and (8)		Discard lockwashers (2) and (8).
5.	Front gearcase (12)	Oil pump (9) and gasket (1)		Discard gasket (1). Clean gasket remains from mating surfaces.

c. Disassembly

6.	Oil pump body flange (13)	Adapter (19), elbow (20), and nipple (18)
7.		Elbow (21) and nipple (22)
8.		Pipe plug (23)
9.		Pipe plug (24)
10.	Inner body (14)	Pipe plug (17)
11.	Filter head (16)	Pipe plug (15)

3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
	 <p>This diagram shows the front view of the engine oil pump assembly. Component 1 is the pump housing. Component 2 is a bolt. Component 3 is a long bolt. Component 4 is a washer. Component 5 is a nut. Component 6 is the pump cover. Component 7 is a long bolt. Component 8 is a washer. Component 9 is a nut. Component 10 is a bolt. Component 11 is a bolt. Component 12 is a bolt. Component 13 is a bolt.</p>			
	 <p>This diagram shows the rear view of the engine oil pump assembly. Component 13 is a bolt. Component 14 is a bolt. Component 15 is a bolt. Component 16 is a bolt. Component 17 is a bolt. Component 18 is a bolt. Component 19 is a bolt. Component 20 is a bolt. Component 21 is a bolt. Component 22 is a bolt. Component 23 is a bolt. Component 24 is a bolt.</p>			

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3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

step NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Flange plate is mounted with screw-assembled lockwashers on late model engine.

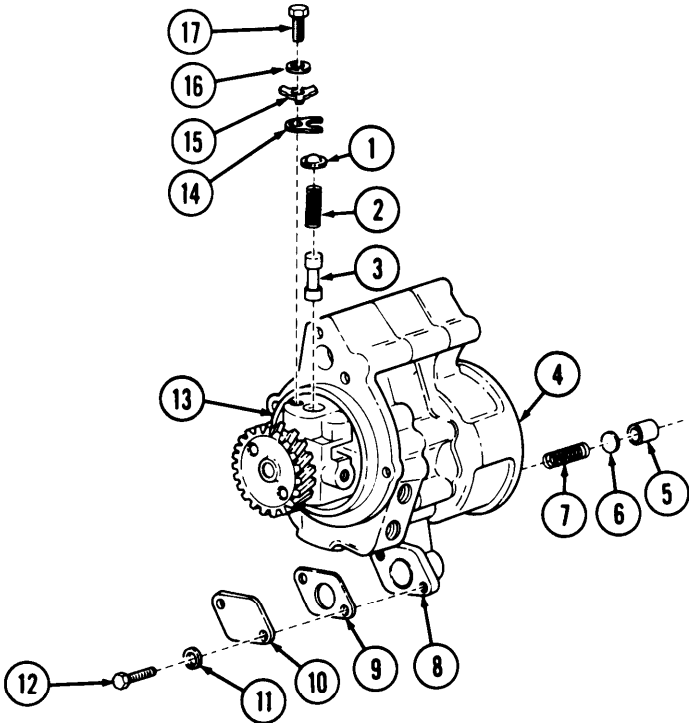
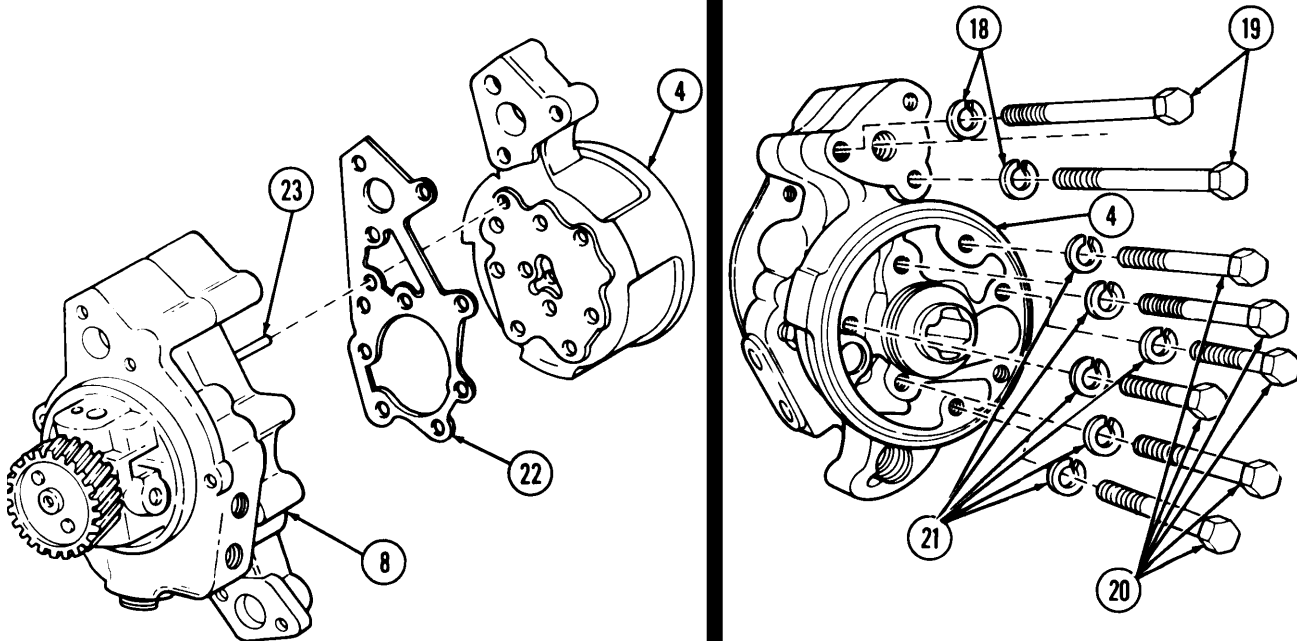
12. Inner body (8)	Two screws (12) lockwashers (11), flange plate (10), and gasket (9)	Remove.	Discard gasket (9) and lockwashers (11).
12.1. Screw (17)	Lockplate (15)	Bend tabs of lockplate (15) away from screw (17).	
13. Oil pump body (13)	Screw (17), lockwasher (16), lockplate (15), retainer (14), retainer cap (1), spring (2), and regulator plunger (3)	Remove.	Hold retainer (14) down while removing screw (17). Release slowly when removing parts. Discard lockwasher (16), lockplate (15), and spring (2).
14. Filter head (4)	Bypass seat (5), disc (6), and bypass spring (7)	Remove.	Discard bypass seat (5), disc (6), and bypass spring (7).

NOTE

Engine oil pump is assembled using screw-assembled lockwashers for late model engine.

15.	Two screws (19) and lockwashers (18)	Remove.	Discard lockwashers (18).
16.	Six screws (20) and lockwashers (21)	Remove.	Discard lockwashers (21).
17.	Filter head (4) and gasket (22)	Remove.	Tap filter head (4) with soft-faced hammer to separate from dowel pin (23) and inner body (8). Discard gasket (22). Clean gasket remains from mating surfaces.

3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP	LOCATION	ITEM	ACTION	REMARKS
				
				

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3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
18.	Idler shaft (9) and inner body (5)	Idler gear (8)	Remove.	
19.	Drive shaft (2)	Driven gear (7)	Remove.	Use arbor press to press drive shaft (2) through driven gear (7).
20.	Oil pump body (1)	Inner body (5) and gasket (4)	Remove.	Tap with soft-faced hammer to separate from dowel pin (3). Discard gasket (4). Clean gasket remains from mating surfaces.
21.	Idler shaft (9)	Idler gear (11)	Remove.	
22.	Drive shaft (2)	Driven gear (10)	Remove.	Use arbor press to press drive shaft (2) through driven gear (10).
23.		Drive gear (12)	Remove.	Use arbor press.
24.	Oil pump body (1)	Idler shaft (9)	Remove.	Use arbor press.
NOTE				
Perform steps 25 and 26 only if dowel pins are damaged.				
25.	Inner body (5)	Dowel pin (6)	Remove.	Discard dowel pin (6).
26.	Oil pump body (1)	Dowel pin (3)	Remove.	Discard dowel pin (3).

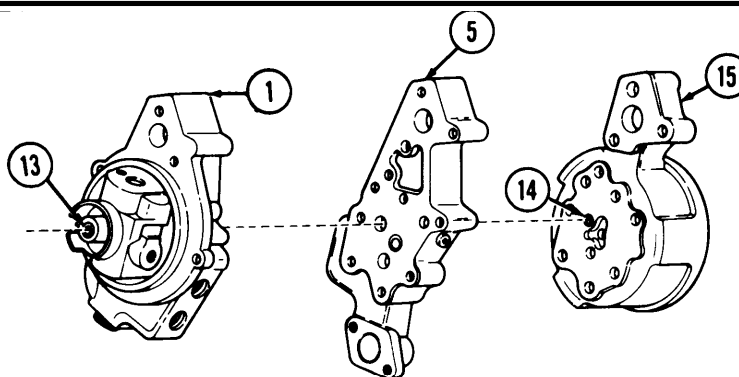
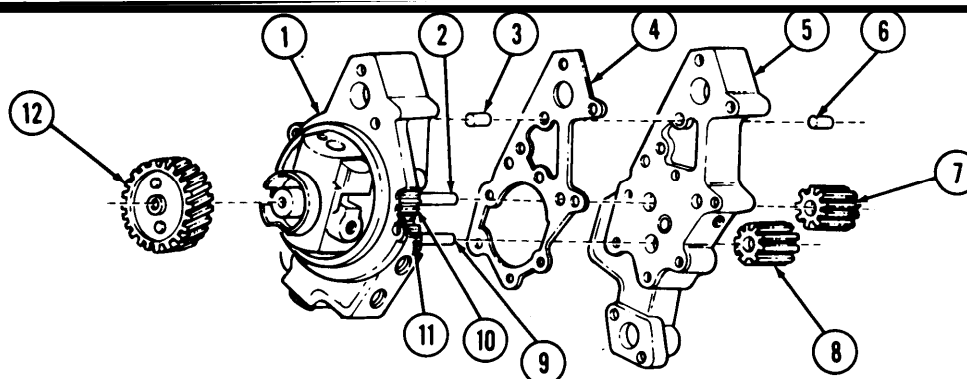
d. Cleaning and Inspection**WARNING**

- Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.
- Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.

27.	Pump body (1)	<ol style="list-style-type: none"> Wipe clean with Drycleaning solvent. Blow out oil passages with compressed air. Inspect for breaks and cracks. 	If broken or cracked, replace.
28.	Pump body (1)	Front and rear drive shaft bushings (13)	Using dial bore gage, check inside diameter. If inside diameter exceeds 0.6185 in. (15.710 mm), replace bushings.

3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
29.		Filter head (15)	a. Wipe clean with Dry-cleaning solvent. b. Blow out oil passages with compressed air. c. Inspect for breaks and cracks.	If broken or cracked, replace.
30.	Filter head (15)	Bushing (14)	Using dial bore gage, check inside diameter for wear.	If inner diameter exceeds 0.6185 in. (15.710 mm), replace bushing.
31.		Inner body (5)	a. Wipe clean with Dry-cleaning solvent. b. Blow out oil passages with compressed air. c. Inspect for breaks and cracks.	If broken or cracked, replace.



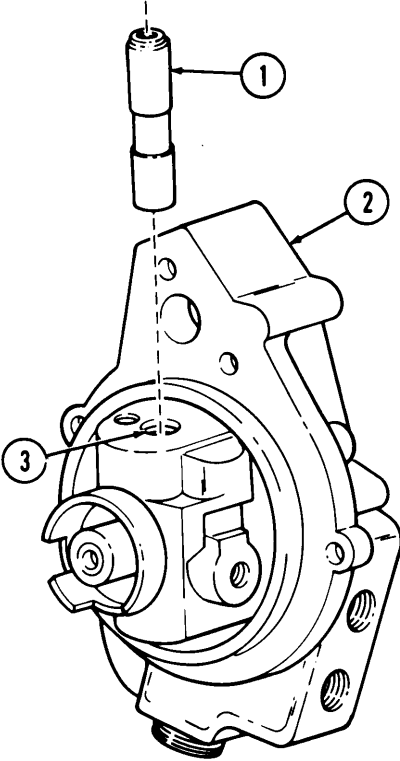
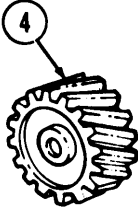
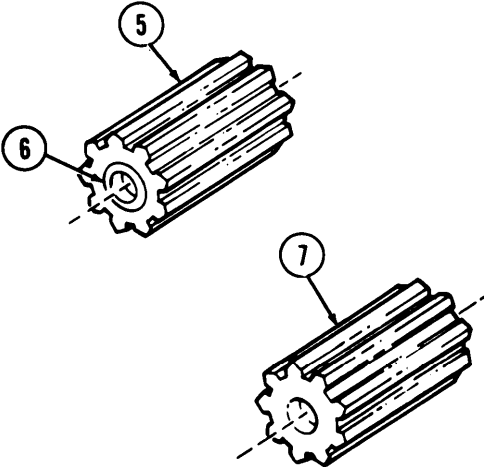
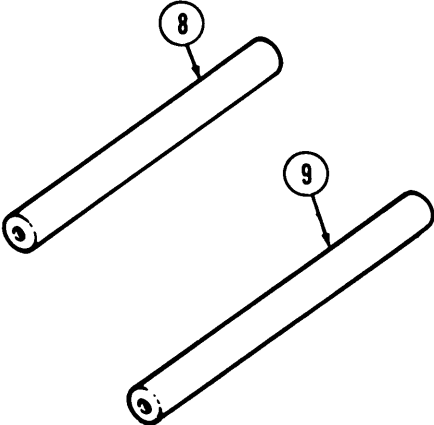
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3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
32,		Drive gear (4), two driven gears (7), and two idler gears (5)	Clean with Drycleaning solvent, and inspect for cracked, chipped, or broken teeth.	If gear (4), (5), and (7) teeth are cracked, chipped, or broken, replace gears. If gear teeth (4), (5), and (7) show pitting over more than 1/4 width of active tooth area, replace gears.
33,		Two idler gears (5) and four bushings (6)	Clean with Drycleaning solvent, and inspect as follows: Check inside diameter using bore gage.	Replace if inner diameter exceeds 0.6185 in. (15.71 mm).
34.		Pressure regulator plunger (1)	Inspect to ensure plunger does not bind in bore (3) of oil pump body (2).	Replace plunger (1) if bent or binds.
35.		Idler shaft (8) and drive shaft (9)	Clean with Drycleaning solvent, and inspect as follows: a. Inspect for breaks, cracks, and galling. b. Check shaft outside diameters using dial snap gage.	If broken, cracked, or galled, replace. If outside diameters are less than 0.6145 in. (15.608 mm), replace the shafts.

3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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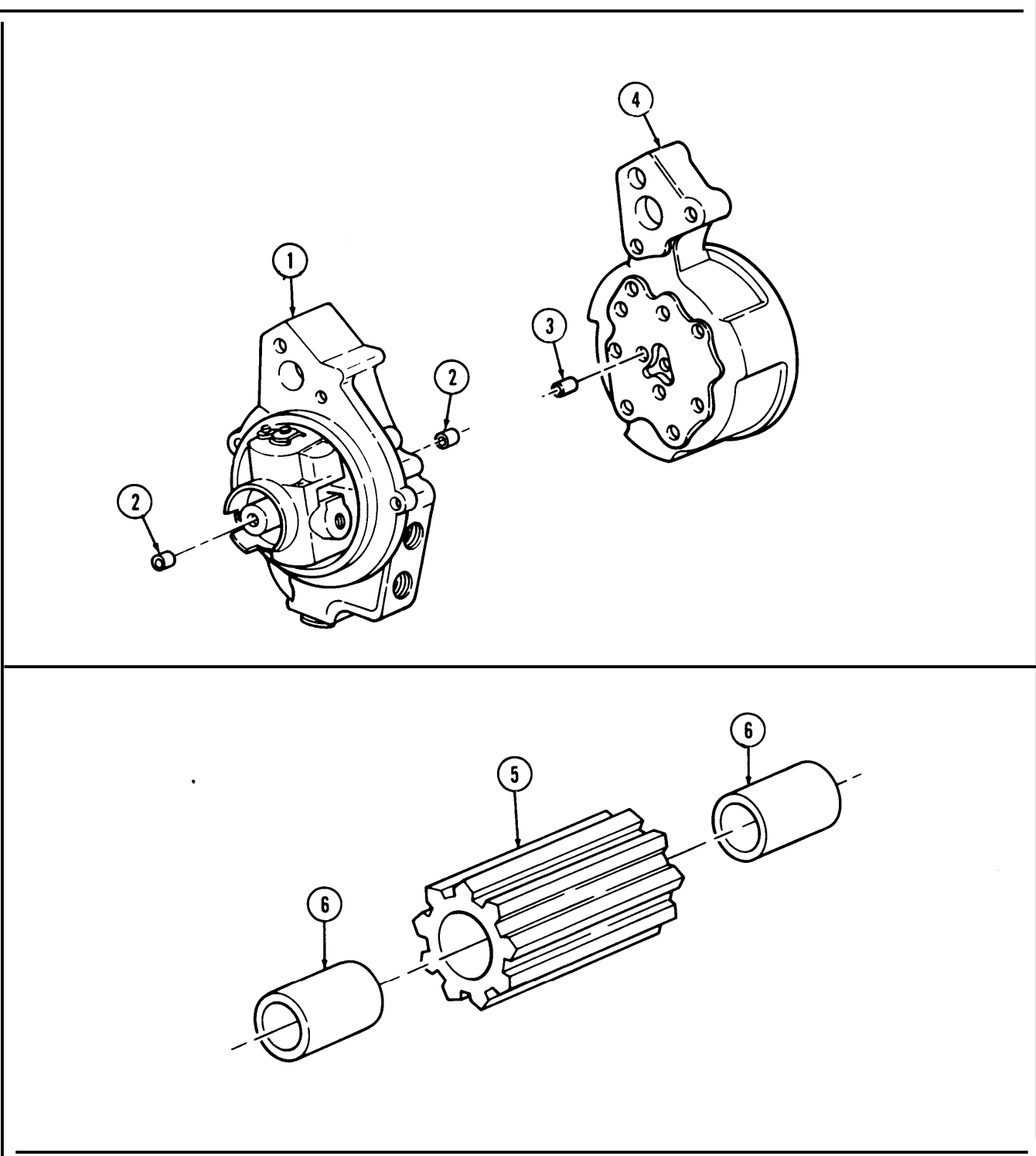
e. Repair**NOTE**

Steps 36 through 38 are performed to replace parts found defective during cleaning and inspection steps 28,30, and 33.

36. Oil pump body (1)	Front and rear drive shaft bushings (2)	a. Press out old bushings (2).	Bushings (2) must be replaced as a pair. Use arbor press and mandrel.
		b. Press new bushings (2) in pump body (1), flush to 0.030 in. (0.78 mm) below surfaces.	
		c. Bore new bushings (2) inner diameter to 0.6165-0.6175 in. (15.659-15.684 mm).	
37. Filter head (4)	New bushing (3)	a. Remove old bushing (3).	
		b. Press new bushing (3) in filter head (4) to 0.020 in. (0.51 mm) below front surface.	
		c. Bore new bushing (3) inner diameter to 0.6165-0.6175 in. (15.659-15.684 mm).	
38. Two idler gears (5)	Four bushings (6)	a. Press out old bushings (6).	Use arbor press and mandrel. Idler gear bushings (6) must be replaced as a pair.
		b. Press two new bushings (6) in each idler gear (5) flush to 0.20 in. (0.51 mm) below gear face.	
		c. Bore inner diameter to 0.6165-0.6175 in. (15.659-15.684 mm).	

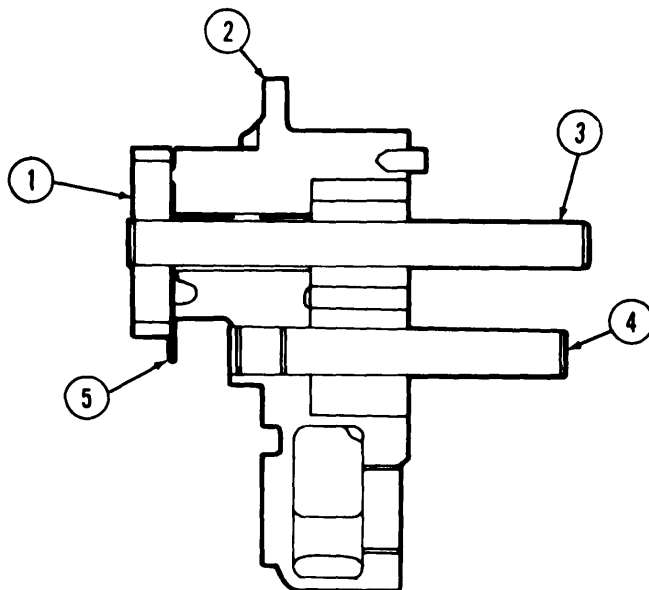
3-44 ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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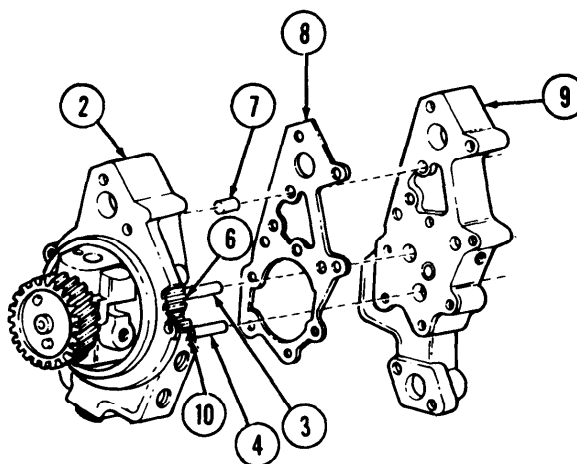
3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
f. Reassembly				
39.	Oil pump body (2)	Idler shaft (4)	Press drilled end into gear pocket side of pump body (2) until shaft (4) protrudes 2.600-2.620 in. (66.04-66.55 mm) above back of body.	Use arbor press and mandrel.
40.		Drive gear (1)	Press over drilled end of shaft (3) until shaft end protrudes 0.040-0.060 in. (1.02 -1.52 mm) above drive gear (1) face.	Use arbor press and mandrel.
41.		Drive shaft (3)	a. Lubricate with clean engine oil, and insert into pump body (2). b. Place 0.012 in. (0.30 mm) shim (5) between back side of drive gear (1) and front of body (2). c. Press gear (1) against shim (5) until snug, then remove shim (5).	



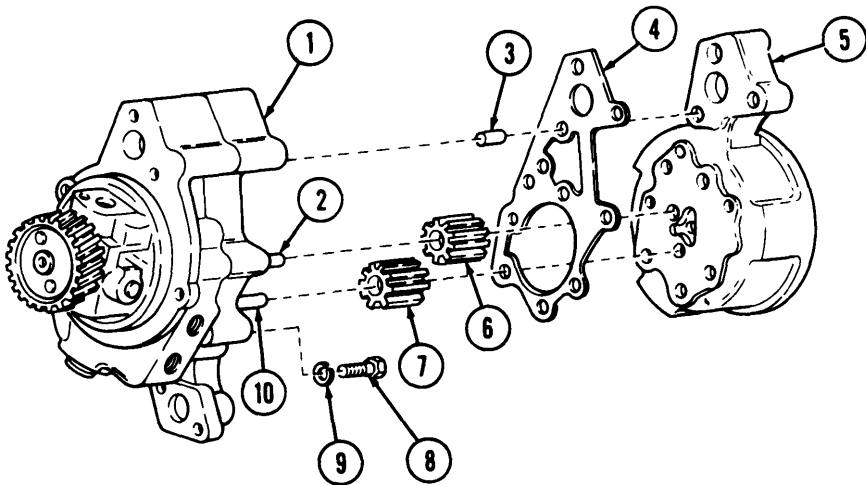
3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
42.		New dowel pin (7)	Install in pump body (2) to 0.990-1.010 in. (22.15-25.65 mm) above face.	If removed during disassembly procedure.
43.		Idler gear (10)	Install on idler shaft (4).	
44.		Driven gear (6)	Install as follows: a. Press gear (6) on shaft (3). b. Place a 0.012 in. (0.30 mm) shim (5) on rear surface of gear (6) facing inner body (9). c. Place inner body (9) over shafts (3) and (4) so it rests on the shim (5). d. Press inner body (9) to seat driven gear (6). e. Remove inner body (9) and shim (5). f. Lubricate gears (6) and (10), shafts (4) and (3), and gear pockets with clean engine oil.	Use arbor press and mandrel.
45.		Inner body (9) and new gasket (8)	Install on pump body (2).	Make sure screw holes are open. Use soft-faced hammer to seat inner body (9) on dowel pin (7).



3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
46.		New dowel pin (3)	Install in inner body (1) to 0.990-1.010 in. (25.15 to 25.65 mm) above face.	If removed during disassembly procedure.
47.		Driven gear (6)	Press on drive shaft (2) leaving 0.002-0,004 in, (0.05-0.10 mm) clearance between bottom of gear pocket and gear (6) surface.	Use arbor press and mandrel.
48.		Idler gear (7)	Install on idler shaft (10).	
49.		Gears (6) and (7), shafts (2) and (10), and gear pockets	Lubricate with clean engine oil.	
50.		Screw (8) and new lockwasher (9)	Position in oil pump body (1).	Screw (8) is an installation screw and cannot be tightened at this time.



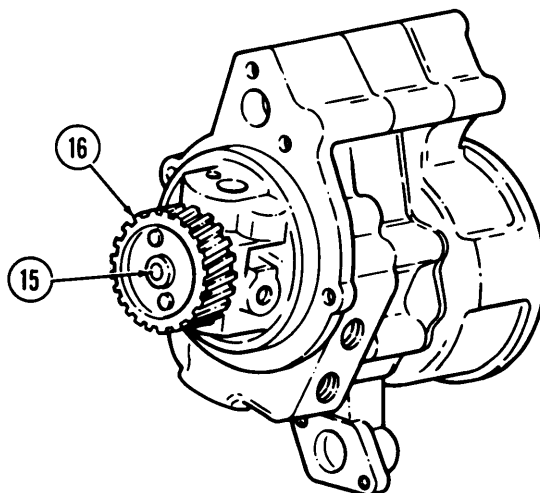
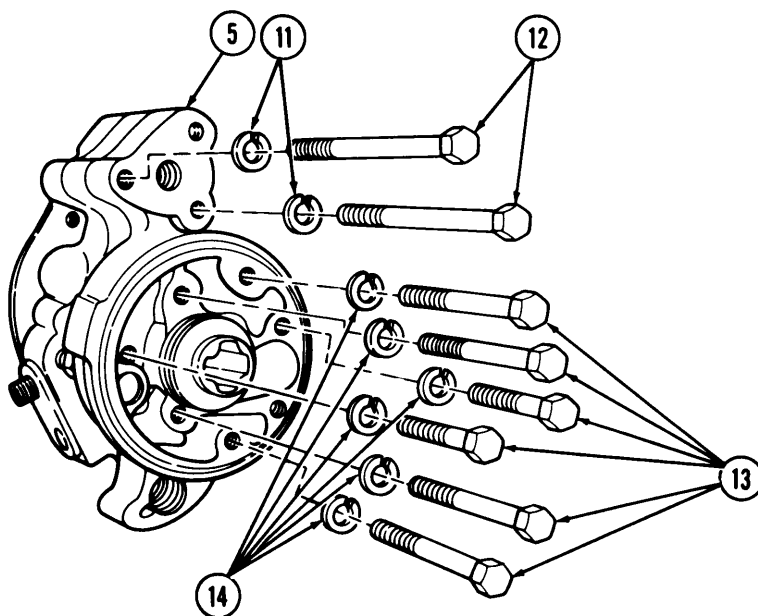
3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Engine oil pump is assembled with screw-assembled lockwashers on late model engine.

- | | | | | |
|-----|--|------------------------------------|---|---|
| 51. | | New gasket (4) and filter head (5) | Place on inner body (1) and install with two screws (12) and new lockwashers (11), six screws (13), and new lockwashers (14). | Use soft-faced hammer to seat filter head (5).
Tighten screws 30-35 lb-ft (41-47 N-m). |
| 52. | | Drive gear (16) | Rotate back and forth to make sure inner gears are free. | |
| 53. | | Drive shaft (15) | Check end play. | End play must be 0.004-0.007 in. (0.10-0.18 mm). |



TA 350183

Change 2

3-213

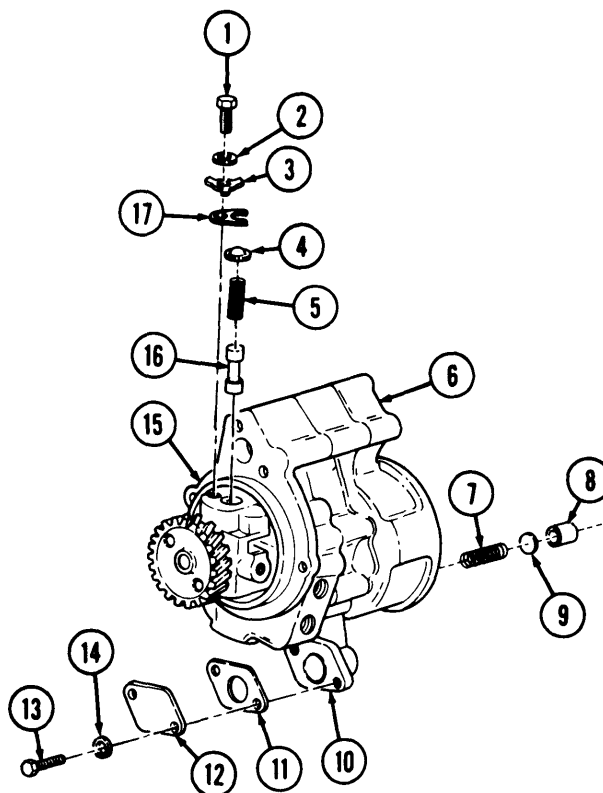
3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
54.		Pressure regulator plunger (16), new spring (5), and retainer cap (4)	Install in pump body (15) with retainer clamp (17), new lockplate (3), new lockwasher (2), and screw (1).	Tighten screw (1) 30-35 lb-ft (41-47 N.m). Bend tabs of lockplate (3) with hammer and drift punch.
55.		New bypass spring (7), disc (9), and new bypass seat (8)	Install in filter head assembly (6).	

NOTE

Flange plate is mounted with screw-assembled lockwashers on late model engine.

56.		New oil pump flange gasket (11) and flange (12)	Install to pump flange (10) with two new lockwashers (14) and screws (13).	
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END OF TASK!

TA 350184

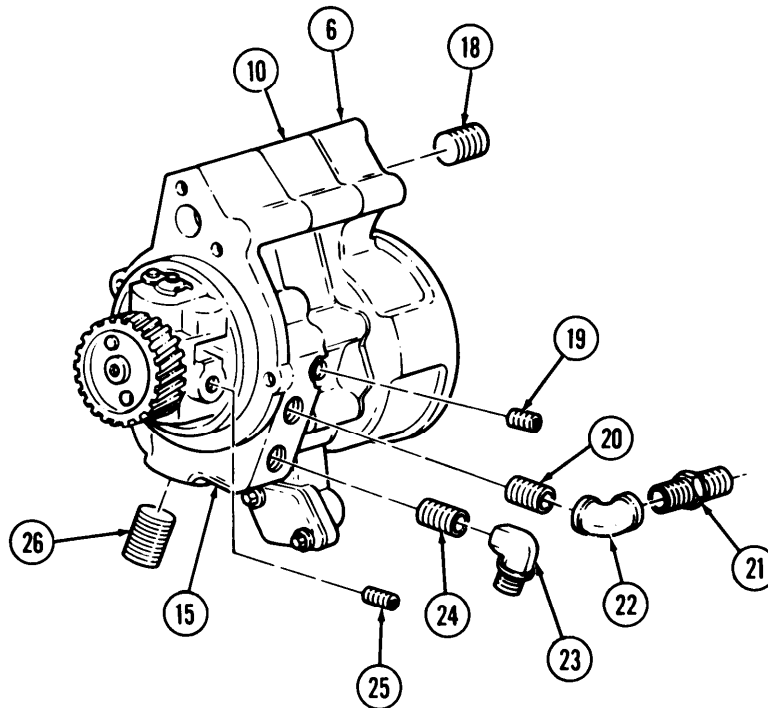
3-44. ENGINE OIL PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

All male pipe threads will be wrapped with sealing tape before installation.

57.		pipe plug (26)	Install in oil pump body (15).	Tighten 45-55 lb-ft (61-75 N-m).
58.		Pipe plug (25)	Install in oil pump body (15).	Tighten 20-30 lb-ft (27-41 N-m).
59.		Pipe plug (19)	Install in inner body (10).	Tighten 30-40 lb-ft (41-54 N-m).
60.		pipe plug (18)	Install in filter head (6).	Tighten 45-55 lb-ft (61-75 N-m).
61.		Pipe nipple (24) and elbow (23)	Install in oil pump body (15).	
62.		Pipe nipple (20), elbow (22), and adapter (21)	Install in oil pump body (15).	



END OF TASK!

TA 350185

3-45. INTAKE MANIFOLD REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-28	Engine mounted on repair stand.
<u>Test Equipment</u>		<u>Special Environmental Conditions</u>
None		None
<u>Special Tools</u>		<u>General Safety Instructions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

NOTE

Ž Intake manifold is mounted with screw-assembled washers on late model engine.

Ž Perform step 1 if clamps are on vehicle.

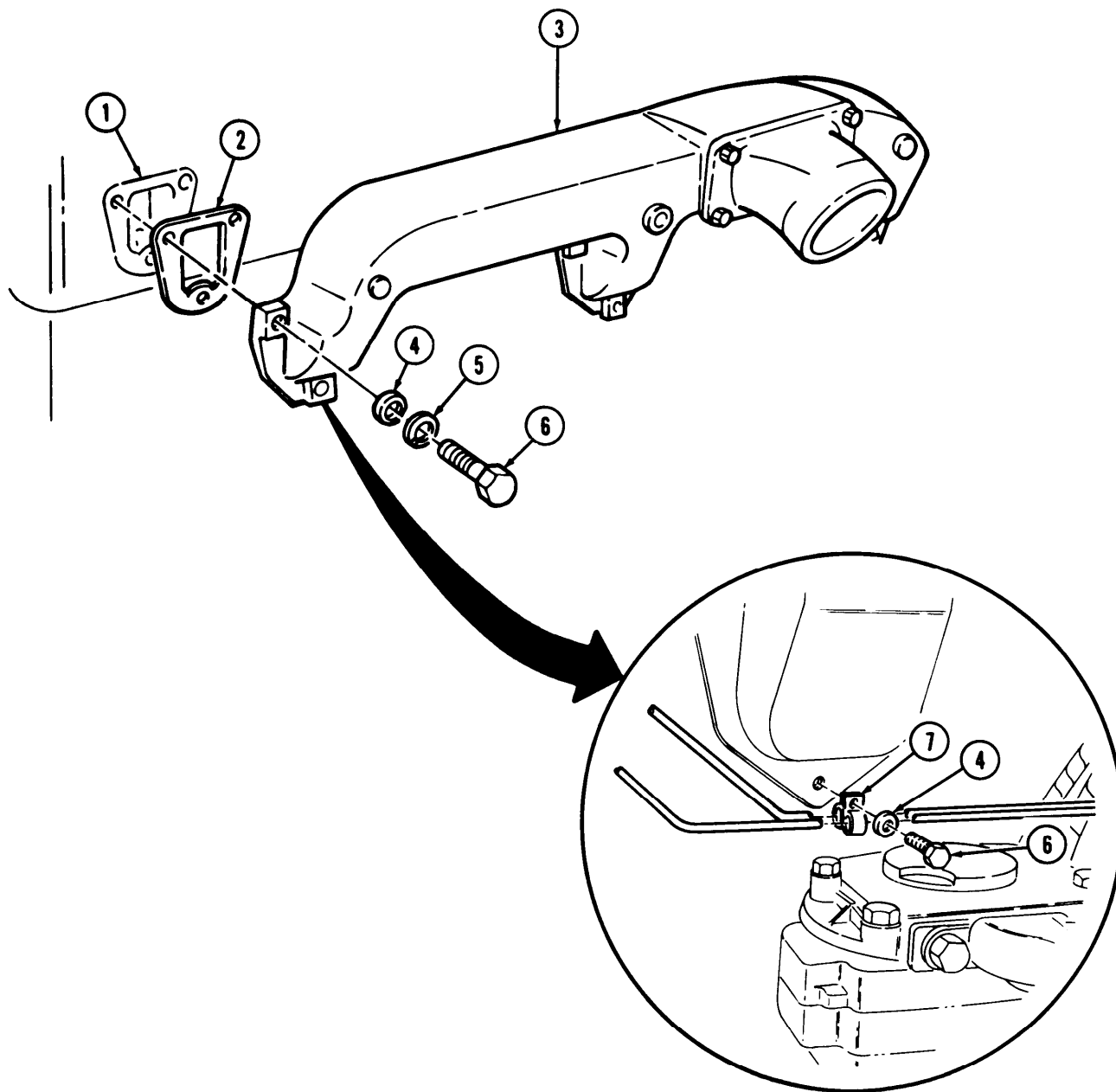
1. Intake manifold (3)	Two clamps (7), screw (6), lockwasher (5), and washer (4)	Remove.	Discard lockwasher (5).
2. Three cylinder head ports (1)	Eight screws (6), lockwashers (5), and washers (4)	Remove.	Discard lockwashers (5).
3.	Manifold (3) and three gaskets (2)	Remove.	Discard gaskets (2). Clean gasket remains from mating surfaces.

NOTE

For disassembly, cleaning, inspection, and reassembly, refer to para. 3-13.

3-45. INTAKE MANIFOLD REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 350186

3-217

3-46. ENGINE FUEL SUPPLY AND RETURN TUBES REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-20-1	Air compressor to engine oil coolant return tube removed. Water pump removed.
<u>Test Equipment</u>	Para. 3-32	<u>Special Environmental Conditions</u>
None		None
<u>Special tools</u>		<u>General Safety Instructions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

- | STEP NO. | LOCATION | ITEM | ACTION | REMARKS |
|----------|---------------------------------|---|---------|-------------------------|
| 1. | Front cylinder head (2) | Screw (6), lockwasher (7), washer (8), clamp (9) supply tube (4), bracket (10), and spacer (11) | Remove. | Discard lockwasher (7). |
| 3. | Adapter fitting (5) | Engine fuel supply tube (4) | Remove. | |
| 4. | Front cylinder head fitting (3) | Engine fuel return tube (1) | Remove. | |
| 5. | Front cylinder head (2) | Adapter fitting (5) and front cylinder head fitting (3) | Remove. | |

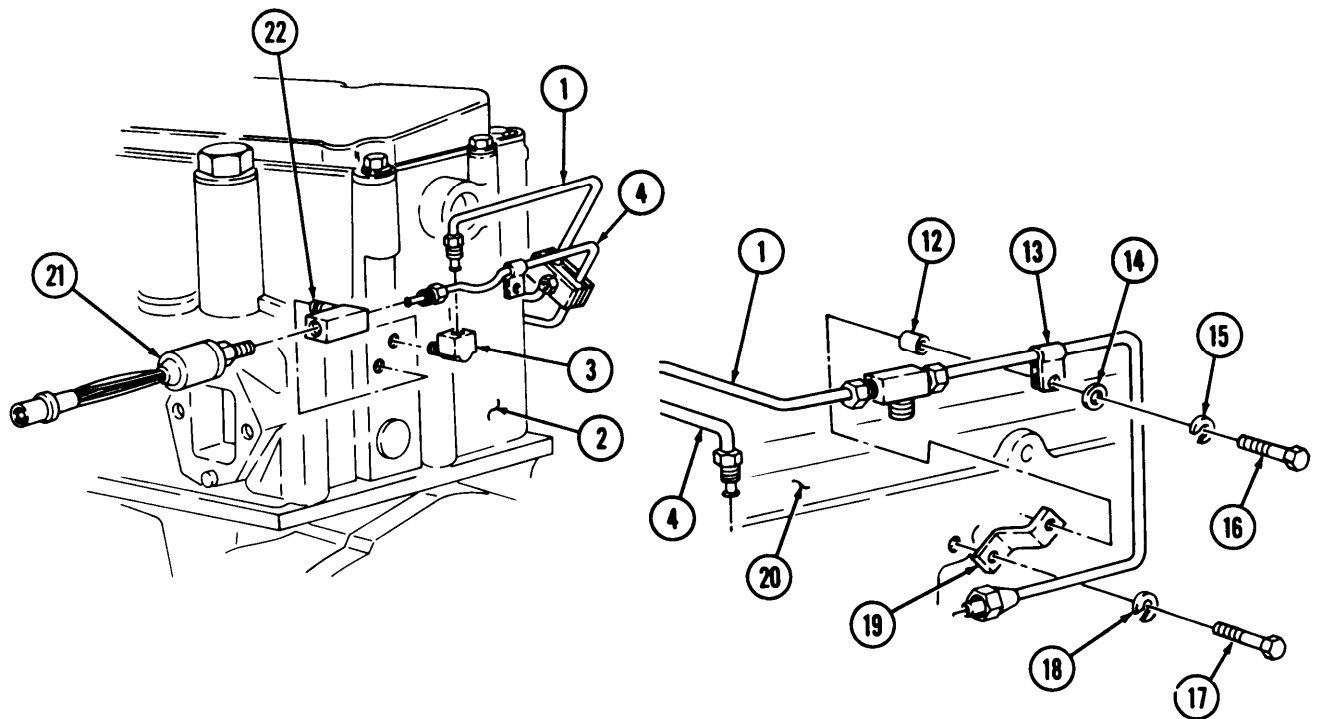
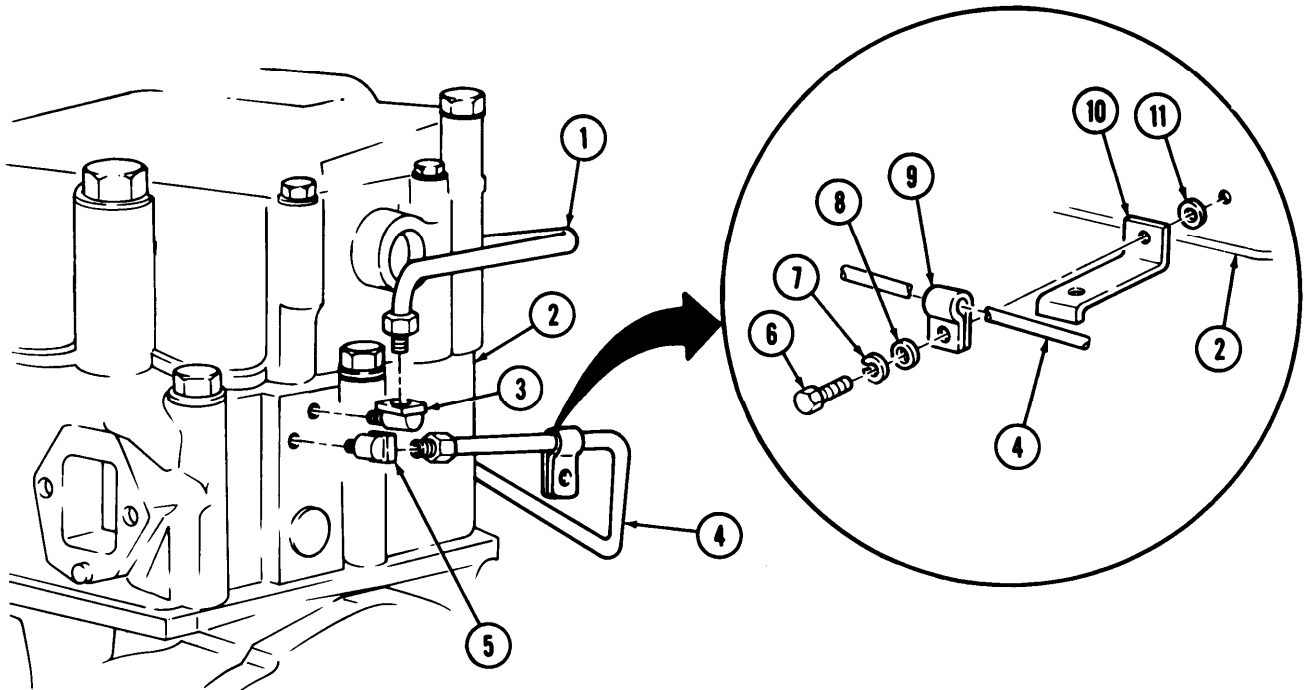
NOTE

Perform steps 6 and 7 for late model engine only.

- | | | | | |
|----|---|--|---------|--------------------------|
| 6. | Tee (22) | Fuel pressure transducer (21) and engine fuel supply tube (4) | Remove. | |
| 7. | Front cylinder head (2) | Tee (22) and cylinder head fitting (3) | Remove. | |
| 8. | Left side of engine block (20) and bracket (19) | Screw (16), lockwasher (15), washer (14), clamp (13), engine fuel return tube (1), and spacer (12) | Remove. | Discard lockwasher (15). |
| 9. | | Screw (17), lockwasher (18), and bracket (19) | Remove. | Discard lockwasher (18). |

3-46. ENGINE FUEL SUPPLY AND RETURN TUBES REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

3-47. ROCKER LEVER HOUSING COVERS REMOVAL

This task covers:
Removal

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 3-28	Engine mounted on repair stand.
Test Equipment		
None		
Special Tools		Special Environmental Conditions
None		None
Materials/Parts		
None		
Personnel Required		General Safety Instructions
Wheeled vehicle repairman MOS 63W		None
Manual References		
TM 9-2320-272-34P		

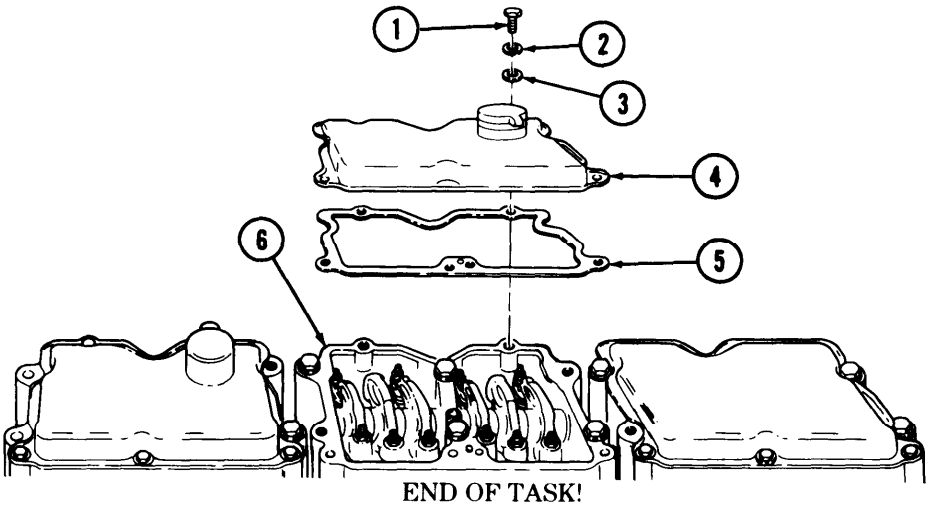
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

NOTE

- Rocker lever housing covers are mounted with screw-assembled lockwashers on late model engine.
- All rocker lever housing covers are removed the same way. This procedure covers the removal of center housing cover.

1.	Rocker lever housing (6)	Five screws (1), lockwashers (2), and washers (3), cover (4), and gasket (5)	Remove.	Discard gasket (5) and lockwashers (2). Clean gasket remains from mating surfaces.
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TA 350180

3-49. ROCKER LEVER HOUSINGS AND PUSH TUBES REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-47	Rocker lever housing covers removed.
<u>Test Equipment</u>		<u>Special Environmental Conditions</u>
None		None
<u>Special Tools</u>		<u>General Safety Instructions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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R e m o v a l

NOTE

Rocker lever housings are mounted with screw-assembled washers on late model engine.

- | | | | | |
|----|-------------------------------------|--|---------------------|--|
| 1. | Eighteen rocker levers (11) | Eighteen locknuts (9) | Loosen. | |
| 2. | | Eighteen adjusting screws (10) | Turn out two turns. | |
| 3. | Rocker lever housings (1) | Four screws (2) and two lifting eyes (3) | Remove. | |
| 4. | Upper radiator support bracket (12) | Two screws (13) | Remove. | |
| 5. | Cylinder heads (6) | Twelve screws (4), washers (5), three rocker lever housings (1), and gaskets (8) | Remove. | Tag housings (1) for installation.
Discard gaskets (8).
Clean gasket remains from mating surfaces. |

CAUTION

Each cylinder has an exhaust push tube, intake push tube, and injector push tube. The injector push tube is the largest and seats in the cam follower socket. It is important that each push tube be tagged so they can be reinstalled in the same location.

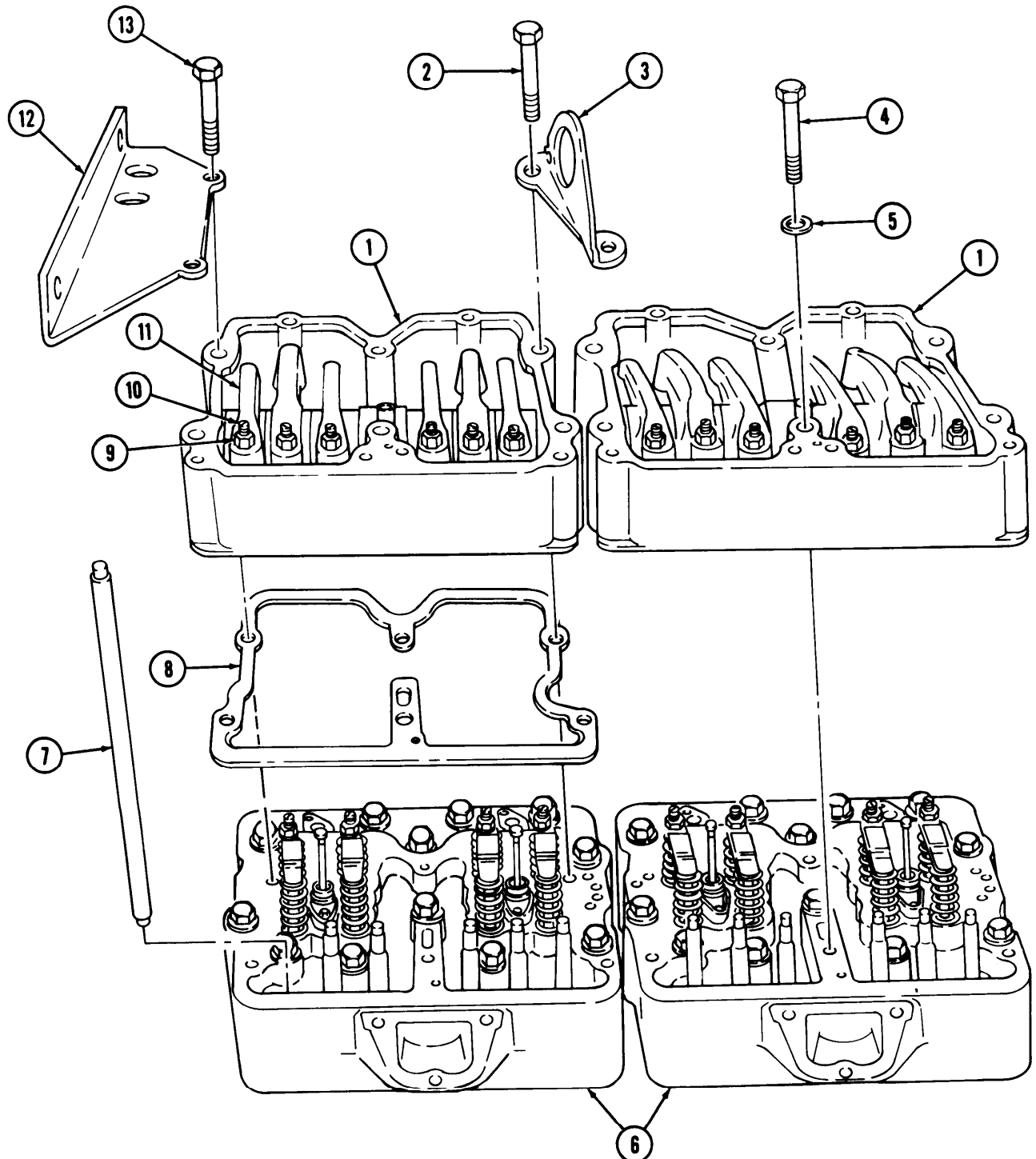
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|----|-------------------------|---------|
| 6. | Eighteen push tubes (7) | Remove. |
|----|-------------------------|---------|

NOTE

For disassembly, cleaning, inspection, and reassembly, refer to para. 3-17.

3-49. ROCKER LEVER HOUSINGS AND PUSH TUBES REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

3-50. VALVE CROSSHEADS REMOVAL

This task covers:

Removal

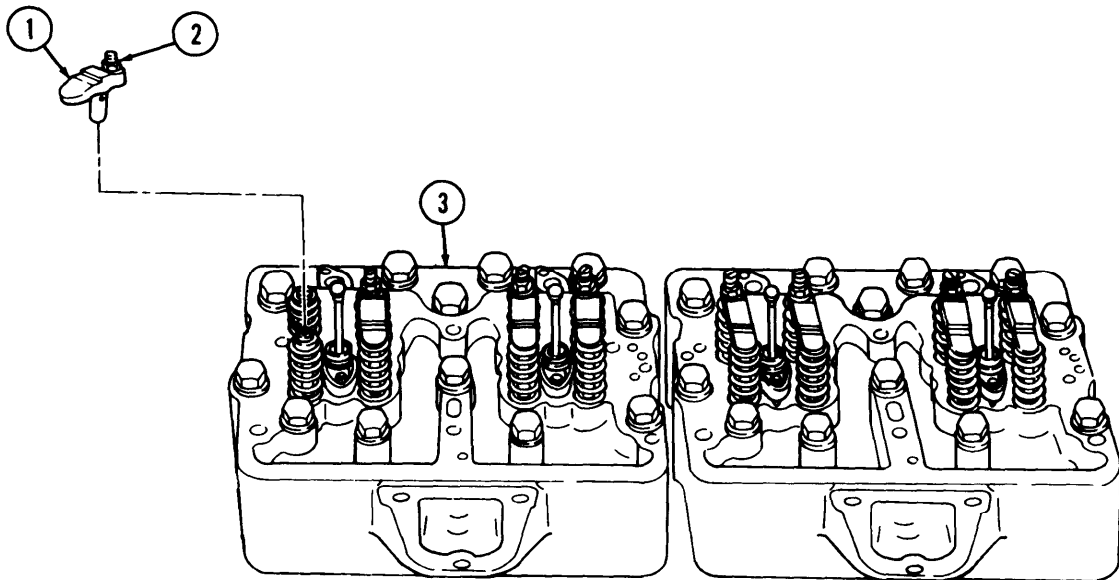
INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 3-49	Rocker lever housings and push tubes removed.
Test Equipment		
None		
Special Tools		Special Environmental Conditions
None		None
Materials/Parts		General Safety Instructions
None		None
Personnel Required		
Wheeled vehicle repairman MOS 63W		
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

- | | | | | |
|----|-----------------------|-------------------------------------|---------|-----------------------|
| 1. | Twelve crossheads (1) | Twelve crosshead adjusting nuts (2) | Loosen. | |
| 2. | Cylinder heads (3) | Twelve crossheads (1) | Remove. | Tag for installation. |



END OF TASK!

TA 350191

3-51. FUEL CROSSOVER CONNECTORS REMOVAL

This task covers:
Removal

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 3-49	Rocker lever housing and push tubes removed.
Test Equipment		
None		
Special Tools		Special Environmental Conditions
None		None
Materials/Parts		
None		
Personnel Required		General Safety Instructions
Wheeled vehicle repairman MOS 63W		None
Manual References		
TM 9-2320-272-34P		

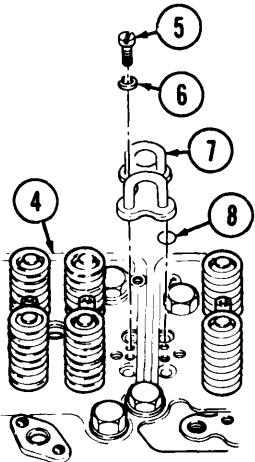
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

NOTE

Fuel crossover connectors are mounted with screw-assembled lockwashers on late model engine.

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|-----------------------------|---|---------|--------------------------|
| 1. Three cylinder heads (2) | Eight screws (5) and lockwashers (6) | Remove. | Discard lockwashers (6). |
| 2. | Two fuel crossover connectors (7) and eight "O" rings (8) | Remove. | Discard "O" rings (8). |



END OF TASK!

TA 35092

3-52. INJECTORS REMOVAL

This task covers:

Removal

INITIAL SETUP:

Applicable Models

All

Equipment Condition Reference

Para. 3-49

Condition Description

Rocker lever housing and push tubes removed.

Test Equipment

None

Special Tools

None

Special Environmental Conditions

None

Materials/Parts

None

Personnel Required

Wheeled vehicle repairman MOS 63W

General Safety Instructions

None

Manual References

TM 9-2320-272-34P

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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R e m o v a l

CAUTION

Do not turn injector upside down after removal. Plunger will fall out and be damaged.

NOTE

Top stop and non-top stop injectors are removed the same way.

- | | | |
|---------------------------------|----------------|---------|
| 1. Injector (3) | Link (1) | Remove. |
| 2. Injector retaining clamp (2) | Two screws (6) | Remove. |

CAUTION

Do not damage or bruise injector tip during handling. Be sure injectors and plungers are not intermixed. Always number injectors according to the cylinder head from which they were removed.

- | | | | |
|----------------------|---|---------|----------------------------------|
| 3. Cylinder head (4) | Retaining clamp (2), washer (5), and injector (3) | Remove. | Keep injector (3) in safe place. |
|----------------------|---|---------|----------------------------------|

3-52. INJECTORS REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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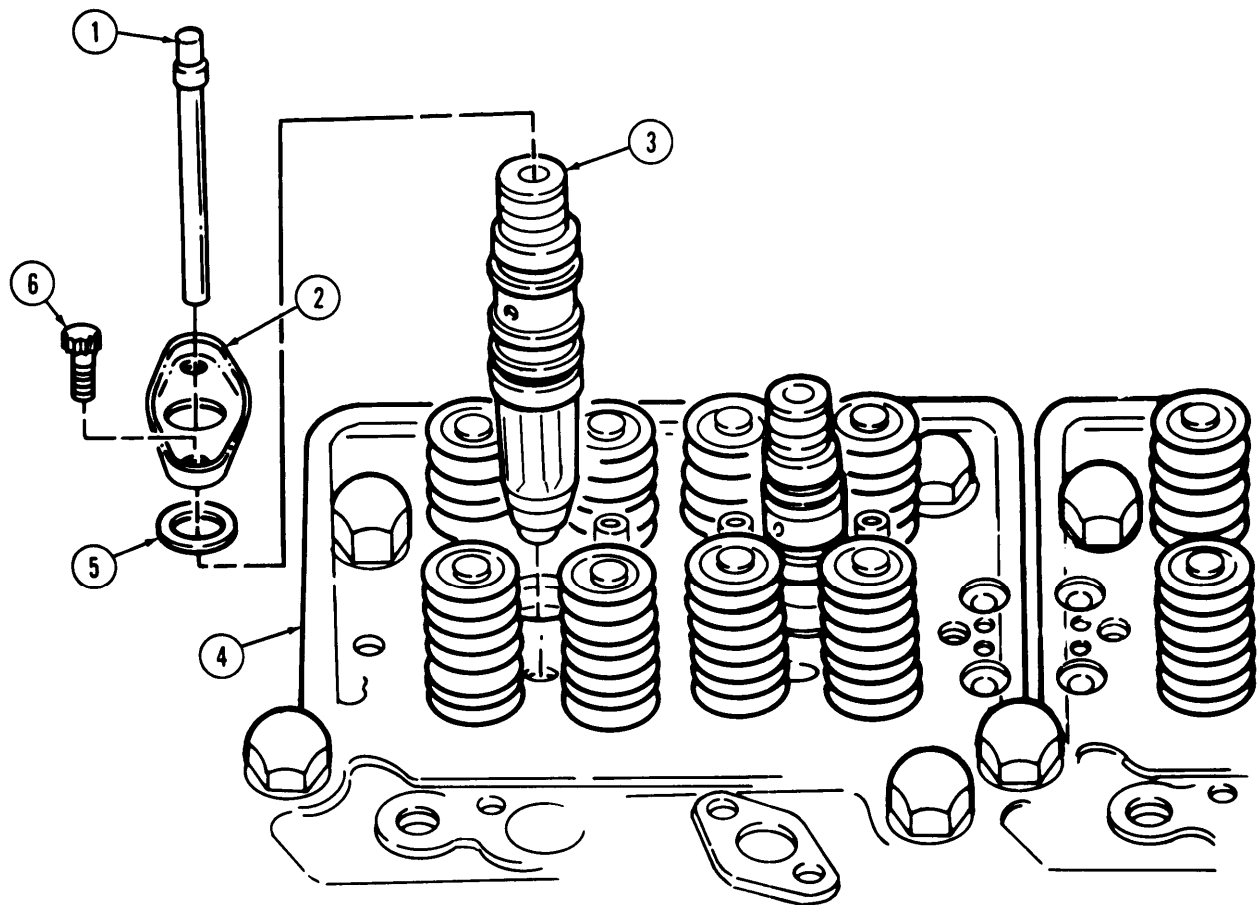
NOTE

Perform step 4 for removing top stop injectors found on late model engine.

4.	Cylinder head (4)	Retaining clamp (2) and injector (3)	Remove.	Keep injector (3) in safe place.
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NOTE

For disassembly, cleaning, inspection, and reassembly, refer to para. 4-28.



END OF TASK!

TA 350193

3-53. CYLINDER HEAD MAINTENANCE

This task covers:

- a. Removal
b. Disassembly
c. Cleaning
- d. Inspection
e. Reassembly

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 3-50	Valve crossheads removed.
Test Equipment	Para. 3-51	Fuel crossover connectors removed.
Portable magnetic tester	Para. 3-52	Injectors removed.
Vacuum tester		
Special Tools		Special Environmental Conditions
Head holding fixture 11600028		None
Cleaning brush ST-876		
Valve guide arbor ST-954		
Air pressure gage		
Gage block ST-547		
Crosshead guide puller ST-1134		
Crosshead guide spacer ST-633		
Materials/Parts		General Safety Instructions
Nine freeze plugs		Keep fire extinguisher nearby when using Drycleaning solvent.
Sixteen half-keepers		Compressed air source will not exceed 30 psi (207 kPa).
Two "O" rings		Eyeshields must be worn when cleaning with compressed air.
Cylinder head gasket		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
Prussian blue (Appendix C, Item 20)		
Sealing compound (Appendix C, Item 25)		
Sealing tape (Appendix C, Item 30)		
Personnel Required		
Wheeled vehicle repairman MOS 63W (2)		
Manual References		
TM 9-2320-272-34P		
TM 9-247		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

NOTE

All three cylinder heads are repaired the same way. Only one is covered in this paragraph.

1. Cylinder head (4)
- Twelve screws (2) and washers (3)
- Remove.
- Follow "outside-in" loosening sequence.

NOTE

Assistant will help with step 2.

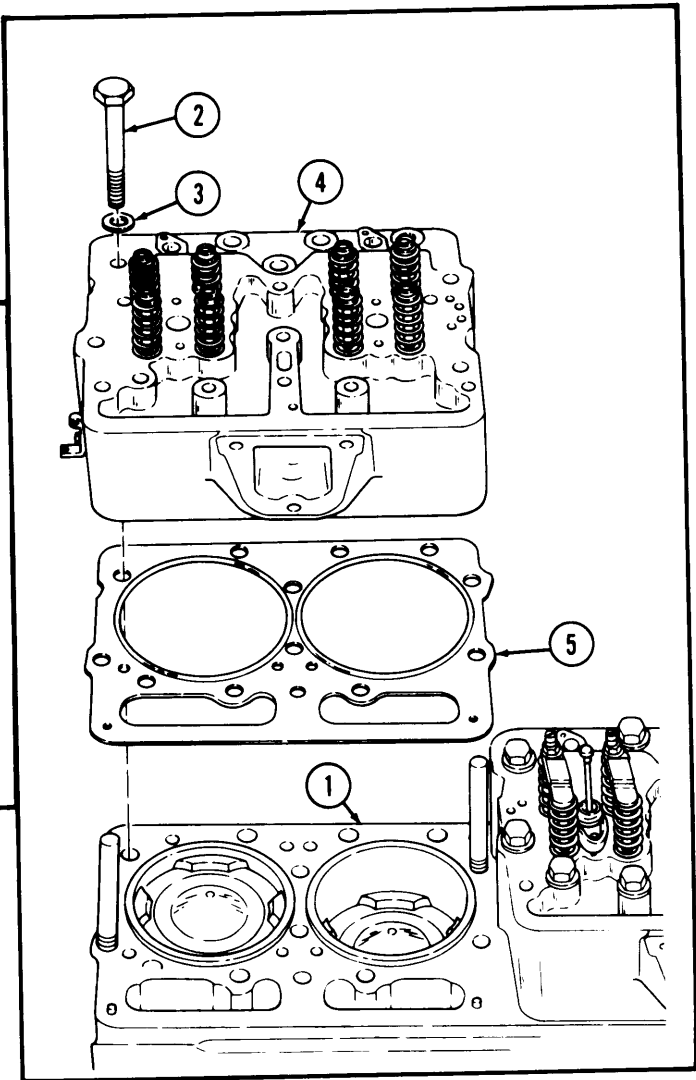
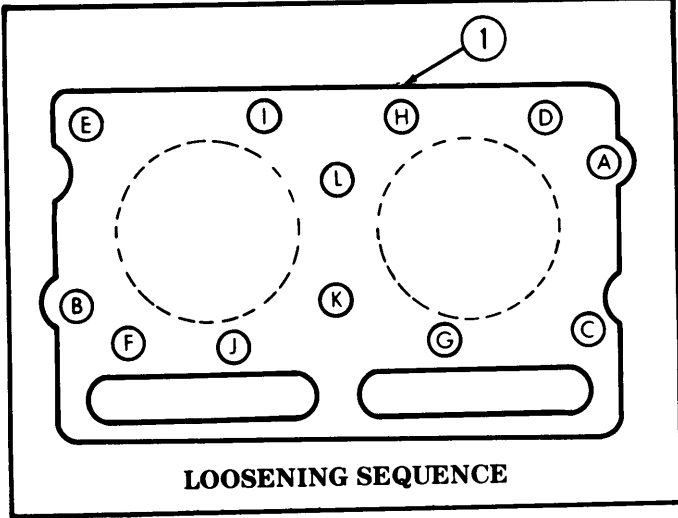
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
2.	Cylinder block (1)	Cylinder head (4)	Remove by lifting straight up.	Tag for installation.
3.		Cylinder head gasket (5)	Remove.	Discard gasket (5). Clean gasket remains from mating surfaces.

WARNING

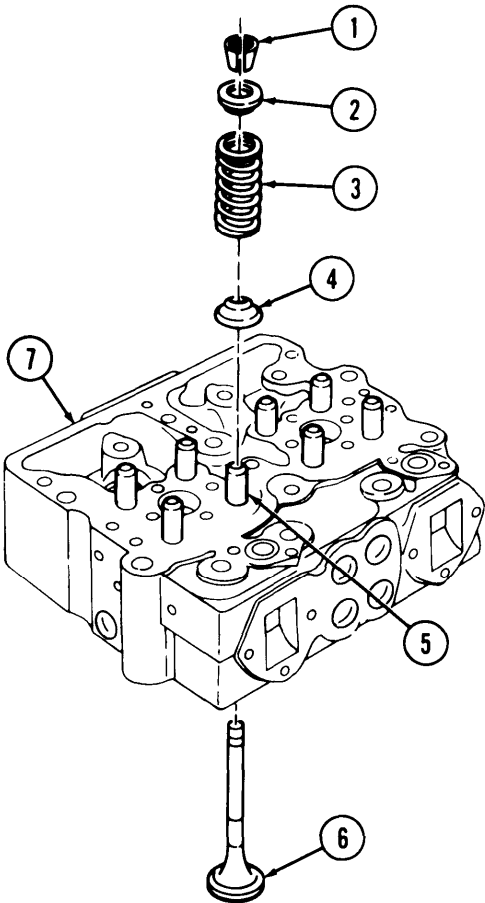
Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.

4.		Cylinder head (4)	Steam clean and dry with compressed air.	Place in cylinder head holding fixture.
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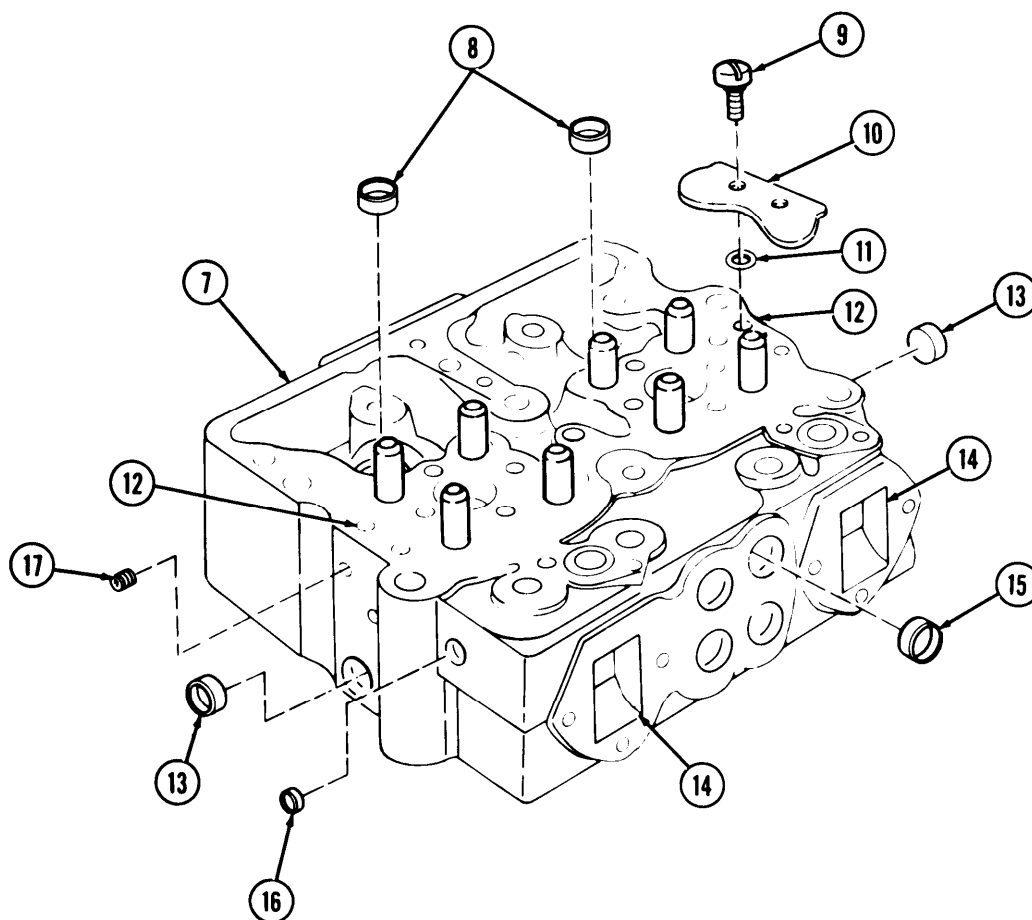
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION I	REMARKS
b. Disassembly				
5.	Valve springs (3) on cylinder head (7)	Sixteen half-keepers (1)	Remove.	Discard keepers (1).
6.	Valve guide (5) on cylinder head (7)	Eight upper spring guides (2), valve springs (3), and lower spring guides (4)	Remove.	Tag springs (3) for installation.
7.		Eight valves (6)	Tap valve (6) stems down lightly to loosen and remove from cylinder head (7).	Place on numbered valve board and hold for inspection.



3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
8.	Fuel crossover connection (12)	Two screw-assembled lockwashers (9), plate (10), and two "O" rings (11)	Remove from top of cylinder head (7).	Discard "O" rings (11).
9.	Front and rear face of cylinder head (7)	Four pipe plugs (17)	Remove.	Hold plugs (17) for installation.
10.	Between exhaust ports (14) on cylinder head (7)	Four freeze plugs (15)	Remove.	Discard freeze plugs (15).
11.	Front and rear face of cylinder head (7)	Two freeze plugs (13)	Remove.	Discard freeze plugs (13).
12.	Top of cylinder head (7)	two freeze plugs (8)	Remove.	Discard freeze plugs (8).
13.	Front face of cylinder head (7)	Freeze plug (16)	Remove.	Discard freeze plug (16).



3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Cleaning

- | | | | |
|-----|------------------------------|--------|--------------------|
| 14. | All cylinder head components | Clean. | Refer to TM 9-247. |
|-----|------------------------------|--------|--------------------|

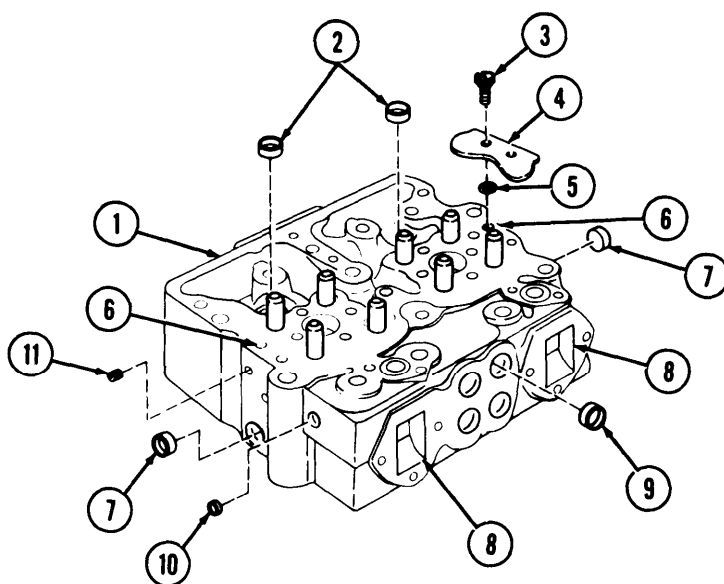
d. Inspection

- | | | |
|-----|----------------------|--|
| 15. | Four pipe plugs (11) | Install in front and rear face of cylinder head (1). |
|-----|----------------------|--|

NOTE

Apply sealing compound to outer diameter of freeze plugs before installation.

- | | | |
|-----|--|---|
| 16. | New freeze plug (10) | Install in front face of cylinder head (1). |
| 17. | Two new freeze plugs (2) | Install in top of cylinder head (1). |
| 18. | Two new freeze plugs (7) | Install in front and rear face of cylinder head (1). |
| 19. | Four new freeze plugs (9) | Install in between exhaust ports (8) on cylinder head (1). |
| 20. | Two new "O" rings (5), plate (4), and two screw-assembled lock-washers (3) | Install on fuel cross-over connection (6) in cylinder head (1). |



TA 350197

3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

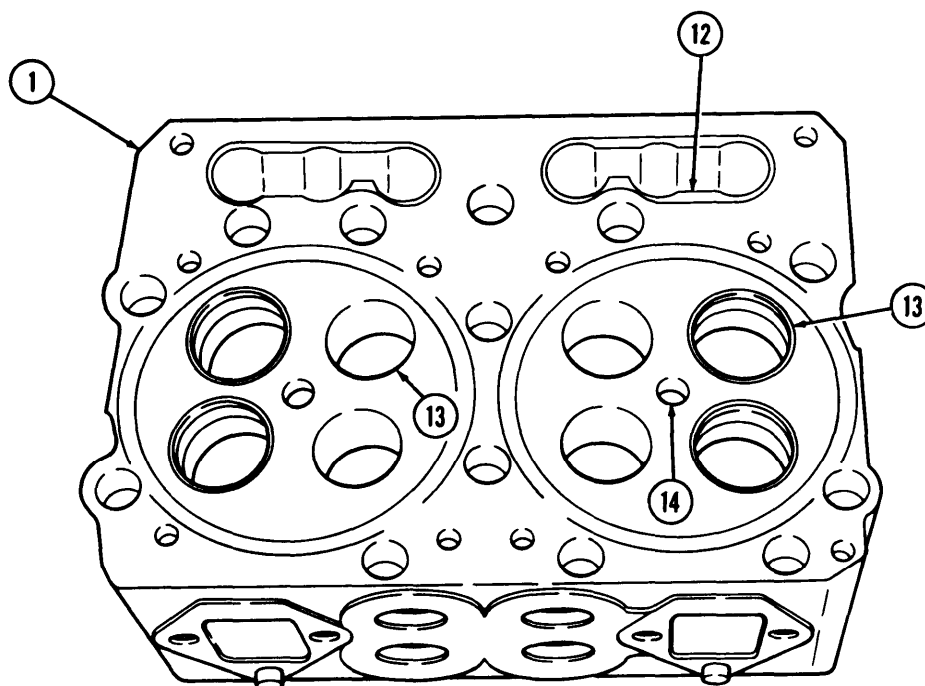
Do not use disc sander to polish cylinder heads. Serious damage to gasket sealing surfaces can result.

21.	Cylinder head (1)	a. Clean mating surfaces (12) lightly enough to remove all gasket remains and carbon deposits. b. Inspect in accordance with instructions in paragraph 2-8.	Use cleaning brush,
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NOTE

Instructions for use of portable magnetic tester are included with the tester.

22.	Cylinder head (1)	Valve seats (13) and injector ports (14)	Inspect for cracks.	Use portable magnetic tester. If cracks are found, replace cylinder head (1).
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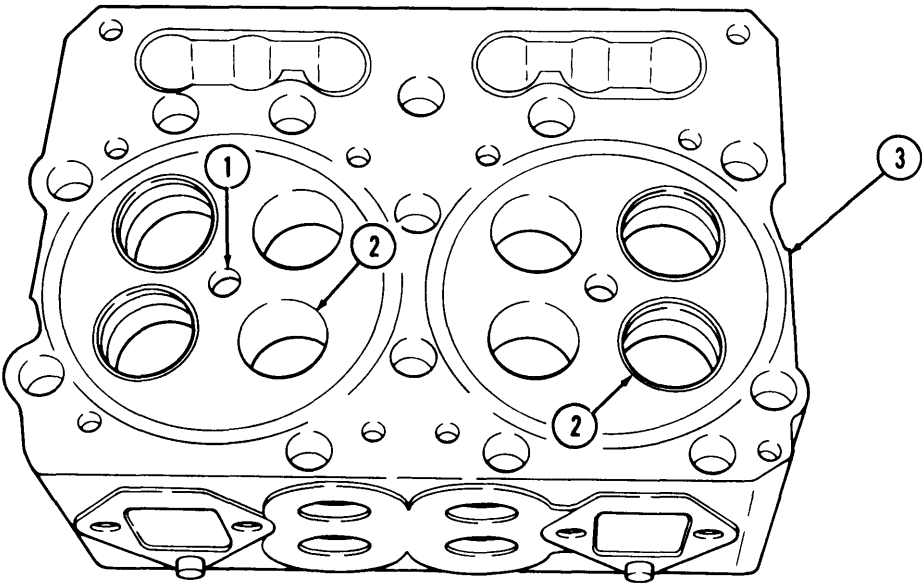
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

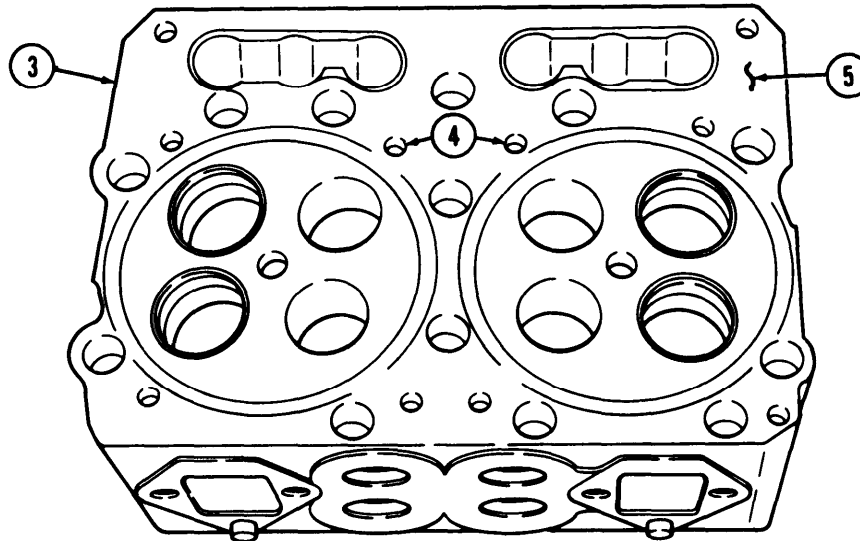
The following examples of cylinder head defects are provided as assistance in determining causes of failures.

23.	Cylinder head (3)	Valve seats (2) and injector port (1)	Check for hot spots and correct probable causes.	<p>If this condition exists, probable causes are overheating, loss of coolant, coolant flow stoppage, overfueling, tight injector hold-downs, incorrect injector sleeve installation, defective casting, hot shutdowns, and incorrect insert fittings.</p> <p>If hot spots are found, replace cylinder head (3).</p>
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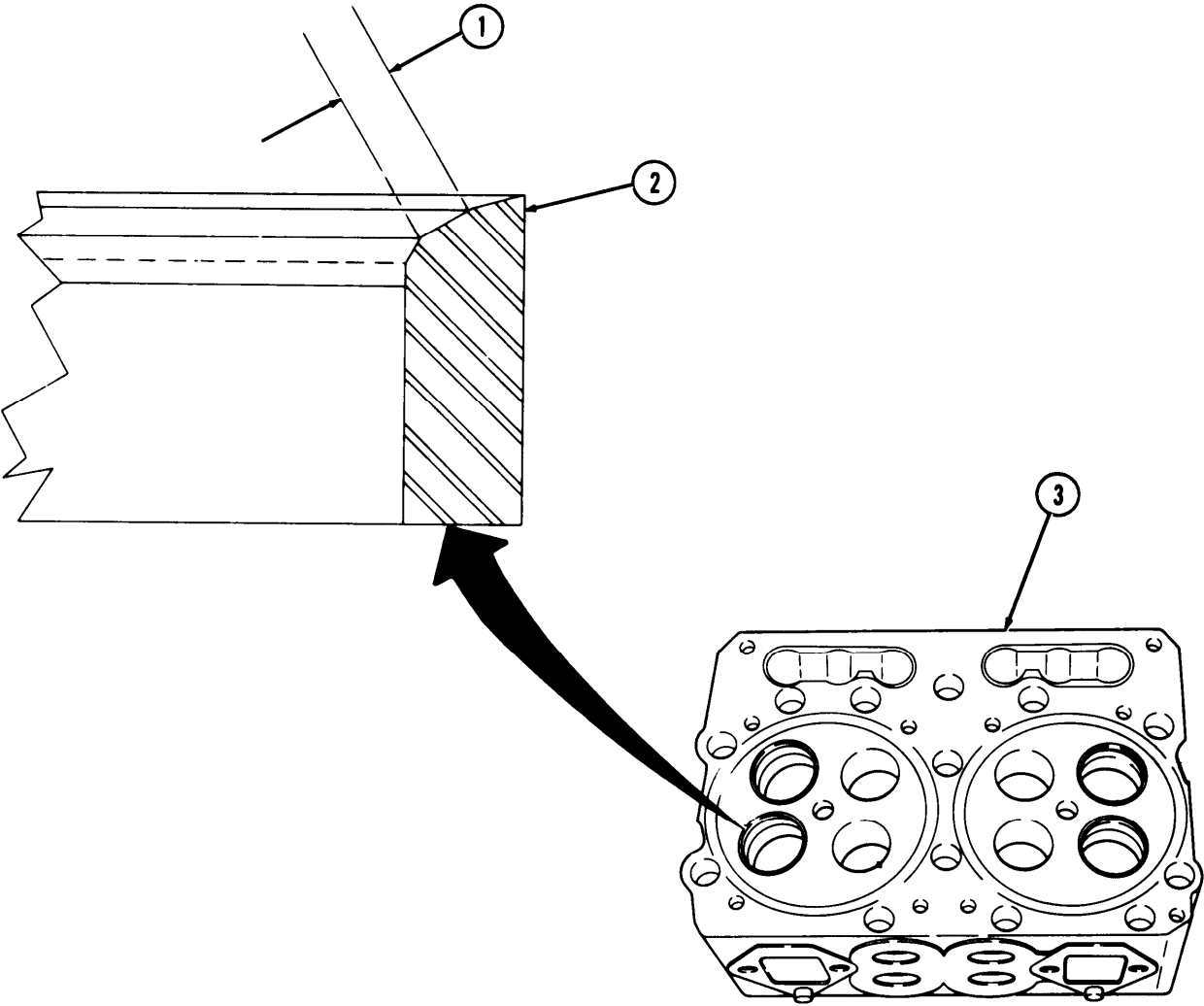
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
24.	Cylinder head (3)	Water passage holes (4)	Check surfaces around passage holes (4) for pits, and scratches.	<p>If pits and scratches are less than .003 in. (0.08 mm), remove with crocus cloth.</p> <p>If pits and scratches are more than 0.003 in. (0.08 mm) deep in the area 0.0625-0.156 in. (1.59-3.97 mm) from edge of water passage hole (4), replace cylinder head (3).</p>
25.		Cylinder head surfaces (5)	Check for warped surfaces.	If warped surface exceeds .002 in. (0.05 mm), replace cylinder head (3).



3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
26.	Cylinder head (3)	Valve seat insert (2)	Check for looseness by tapping surface around valve seat insert (2).	Replace valve seat inserts (2) that bounce when tapped (para. 3-55).
27.		Valve seat insert (2)	Measure width (1).	If width (1) exceeds 0.125 in. (3.18 mm) at any one point and cannot be narrowed during regrinding, mark seat inserts (2) for replacement (para. 3-55).



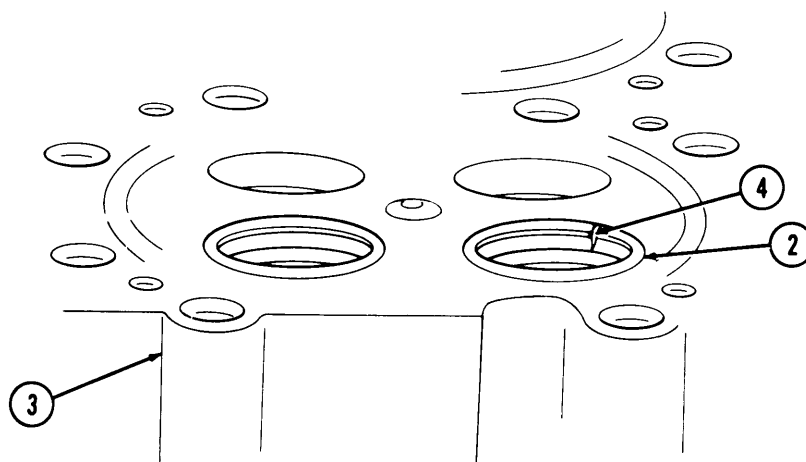
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

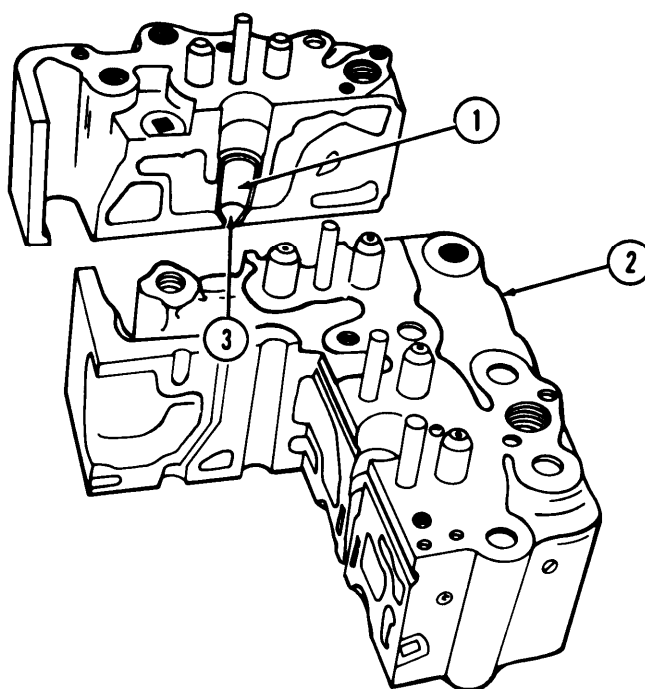
The following examples of valve seat insert defects are provided as an assistance in determining causes of failures.

- | | | | |
|-----------------------|-----------------------|--|---|
| 28. Cylinder head (3) | Valve seat insert (2) | <p>a. Inspect for cracks (4) and correct probable causes.</p> <p>b. Inspect for burns and correct probable causes.</p> | <p>If cracks exist, probable causes are improperly machined insert bore, improper fitting of insert in bore, foreign particle under insert, faulty installation, and overheating.</p> <p>If cracked, replace (para. 3-55).</p> <p>If burned, probable causes are carbon or foreign matter that prevents proper seating of valve.</p> <p>If burned, resurface or replace (para. 3-55).</p> |
|-----------------------|-----------------------|--|---|



3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

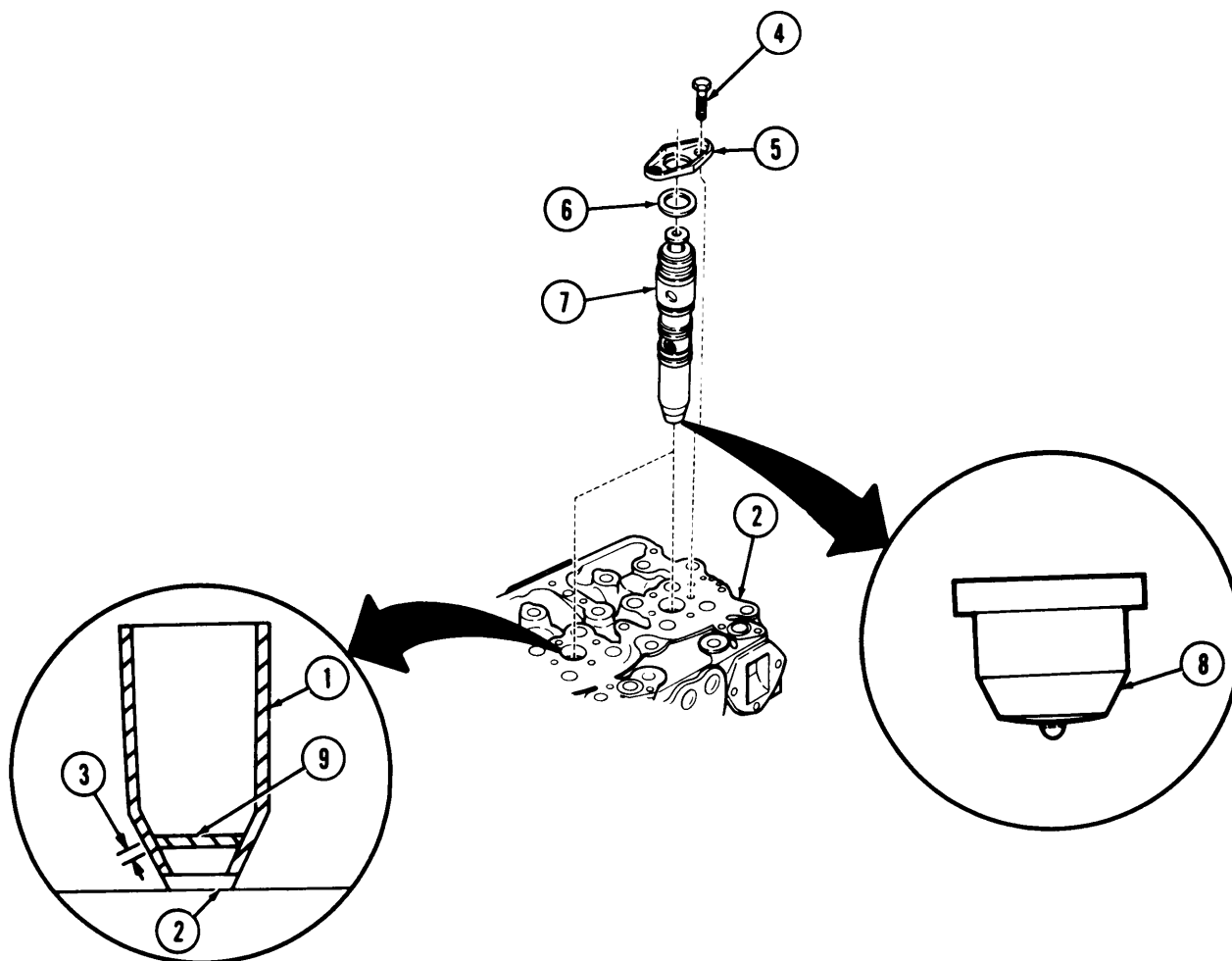
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
29.	Cylinder head (2)	Injector sleeves (1)	a. Inspect in accordance with instructions in paragraph 2-8. b. Check cup seat area (3) for scratches with a bright light.	See cut-away view below. If scratched, mark sleeve (1) for replacement (para. 3-57).



30.	Injector cup seating area (3)	Check seating pattern as follows: a. Lightly coat injector cup (8) with prussian blue. b. Install injector (7) into sleeve (1) with washer (6) and clamp (5), and two screws (4). c. Remove two screws (4), clamp (5), and washer (6), and injector (7).	Tighten alternately in 4 lb-ft (5.4 Nm) steps to 10-12 lb-ft (14-16 N-m).
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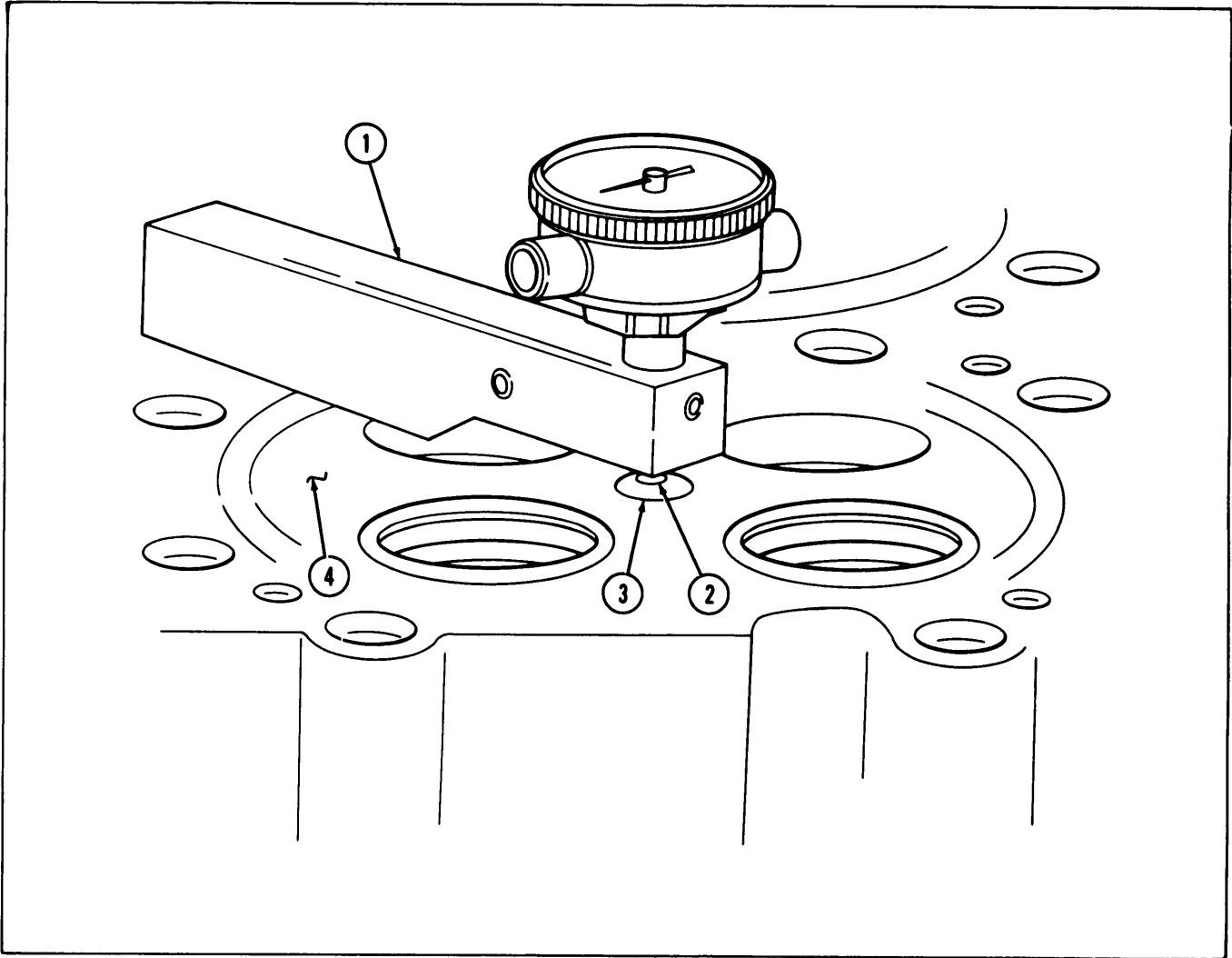
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			d. Check seat pattern in bottom of sleeve (1) and cup seating area (3).	
			e. Blued band (9) on sleeve (1) in sleeve seating area (3) must be 0.060 in. (1.52 mm) minimum width and be located approximately .469 in. (11.91 mm) from bottom of cylinder head (2) surface.	If seating pattern does not meet these specifications, mark sleeve (1) for replacement (para. 3-57).



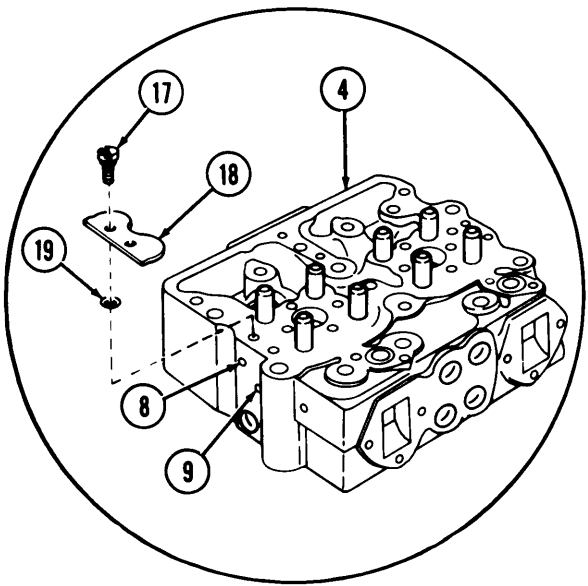
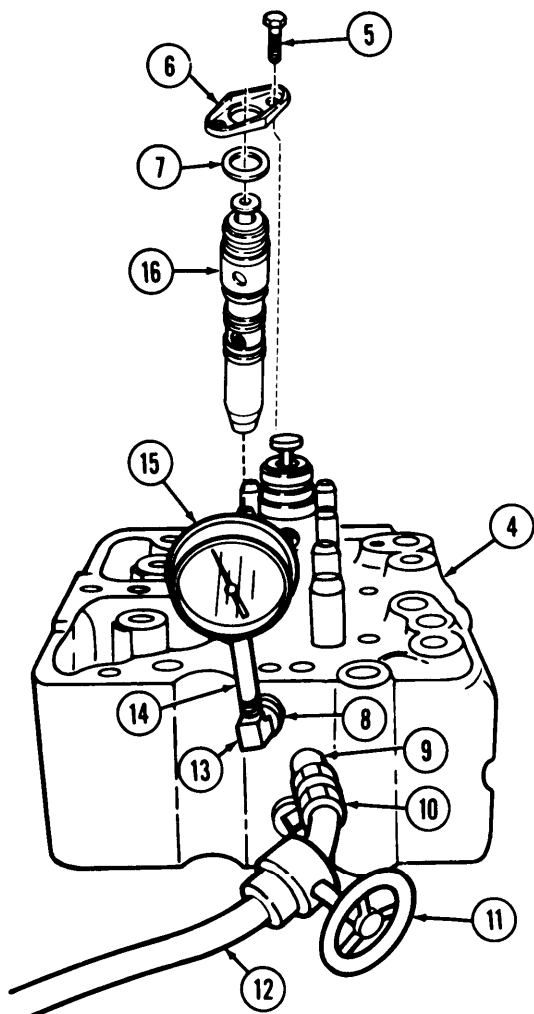
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
31.	Cylinder head (4)	Fuel injector assembly (16)	Install with washer (7), clamp (6), and two screws (5).	Tighten alternately in 4 lb-ft (5.4 N-m) steps to 10-12 lb-ft (14-16 N-m).
32.		Injector tip (2)	Measure protrusion with gage block (1).	Protrusion should be 0.060-0.070 in. (1.52-1.78 mm). If not, mark sleeve (3) for replacement (para 3-57).



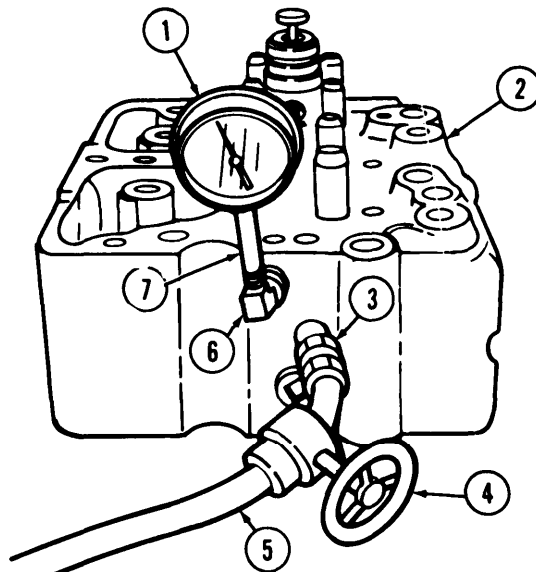
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
33.		Inlet fuel passage (9) and outlet fuel passage (8)	Air test for leakage or cracks as follows: a. Install plate (18), two "O" rings (19), and screw-assembled lockwashers (17). b. Install pipe adapter (13), pipe extension (14), and air pressure gage (15) into fuel outlet passage (8). c. Install air hose adapter (10), air pressure control valve (11), and air hose (12), into fuel inlet passage (9).	Opposite plate installed in step 20.



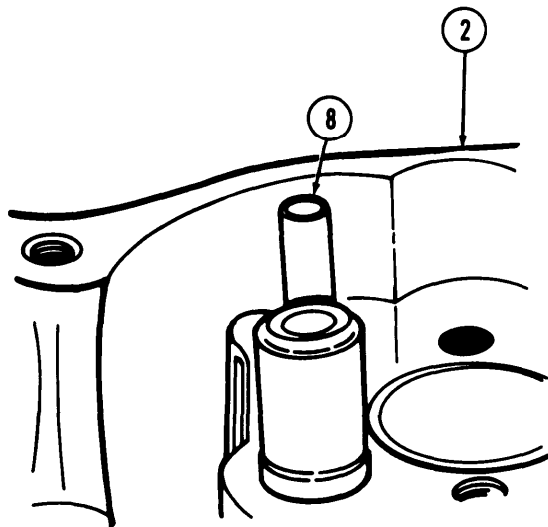
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			d. Open air pressure control valve (4) and apply air pressure until air pressure gage (1) reads between 80-100 psi (550 - 690 kPa), then close valve (4).	
			e. Observe air pressure gage (1). There must be no pressure drop for fifteen seconds.	If pressure drops before fifteen seconds pass, replace cylinder head (2).
			f. If air pressure holds for fifteen seconds, cylinder head (2) is serviceable.	
NOTE				
Make sure to replace pipe plugs in fuel passages of cylinder head after removal of test adapters.				
34.		Air pressure gage (1), extension pipe (7), and adapter (6)	Remove.	
35.		Air hose adapter (3), air pressure control valve (4), and air hose (5)	Remove.	



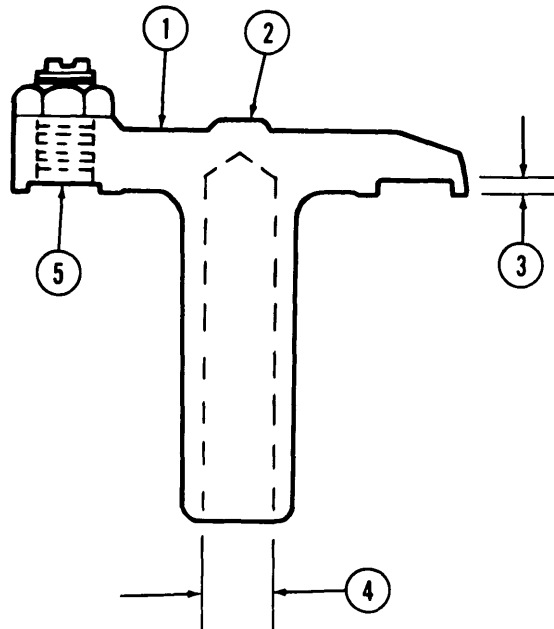
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
36.		Four crosshead guides (8)	<p>a. Inspect in accordance with instructions in paragraph 2-8.</p> <p>b. Check the outside diameter using micrometer or dial snap gage.</p> <p>c. Check for correct height.</p> <p>d. Check for straightness.</p>	<p>If outside diameter is less than .432 in. (10.97 mm), mark guide (8) for replacement.</p> <p>If height is not 1.860-1.880 in. (47.24-47.75 mm), mark guide (8) for replacement.</p> <p>If guide (8) is not straight, replace guide. Refer to step 42.</p>



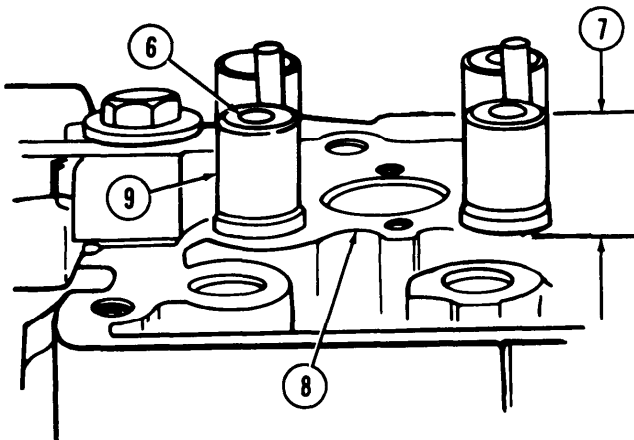
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
37.		Valve crossheads (1)	<p>a. Inspect in accordance with instructions in paragraph 2-8.</p> <p>b. Check for damaged adjusting screw threads (5) and excessive wear on rocker lever contact area (2).</p> <p>c. Set small bore gage at 0.4402 in. (11.181 mm).</p> <p>d. Attempt to insert gage into bore (4).</p> <p>e. Check for out-of-round bore (4) by gaging at several points 90° apart.</p> <p>f. Check valve stem counterbore depth (3).</p>	<p>Discard if defective.</p> <p>Discard if threads (5) are damaged or contact area is worn.</p> <p>Use micrometer.</p> <p>Discard crosshead (1) if bore gage goes into bore (4).</p> <p>Discard crosshead if bore (4) is out-of-round.</p> <p>Discard crosshead (1) if depth (3) is not 0.1200-0.1400 in. (3.048-3.556 mm).</p>



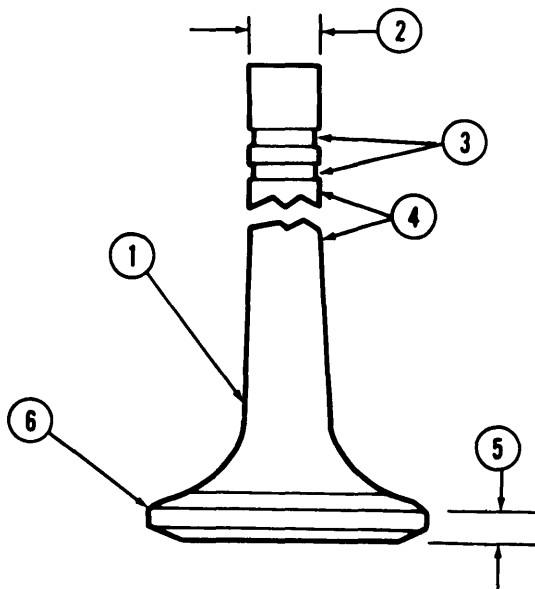
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
38.		Eight valve guides (9)	<p>a. Inspect in accordance with instructions in paragraph 2-8.</p> <p>b. Check for chips, cracks, burrs, or broken out sections.</p> <p>c. Check valve guide (9) protrusion (7).</p> <p>d. Set small bore gage at 0.4552 in. (11.562 mm).</p> <p>e. Attempt to insert gage into guide bore (6).</p>	<p>Mark for replacement if defective.</p> <p>Mark for replacement if chipped, cracked, broken, or burrs are found.</p> <p>If protrusion (7) is not 1.270-1.280 in. (32.26-32.51 mm), above cylinder head surface (8) mark guide (9) for replacement.</p> <p>Use micrometer.</p> <p>If gage goes into bore (6), mark guide (9) for replacement.</p>



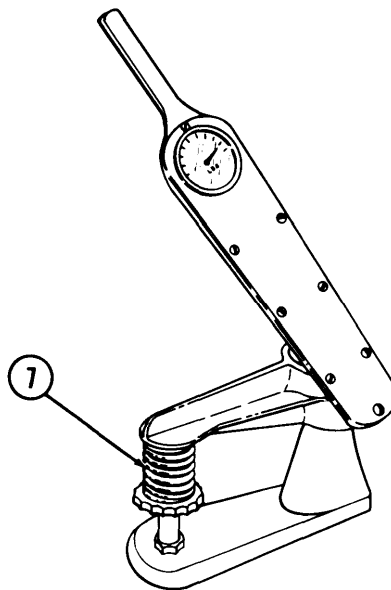
3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
39.		Intake and exhaust valves (1)	<p>a. Check valve head (6) for cracks, warping, pits, burns, or cupping.</p> <p>b. Check rim thickness (5).</p> <p>c. Check keeper grooves (3) for wear.</p> <p>d. Check valve stem (4) for cracks, scoring, and galling.</p> <p>e. Measure valve stem (2) outside diameter with micrometer.</p>	<p>Discard valve (1) if cracked or warped.</p> <p>If pitted, burned, or cupped, mark for refacing.</p> <p>Discard valve (1) if rim thickness (5) is less than 0.105 in. (2.67 mm),</p> <p>Use new keeper to check grooves (3). Discard valve (1) if new keepers fit loosely in grooves.</p> <p>Discard valve (1) if stem (4) is cracked, scored, or galled.</p> <p>Discard valve (1) if stem (2) outside diameter is less than 0.449 in. (11.41 mm).</p>



3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p style="text-align: center;">CAUTION</p> <p>Use care when selecting replacement valve springs. Intermixing of old and new valve springs and valve guides in any one cylinder head is permissible only if a specific crosshead has two of the same type or-equivalent guides and springs installed under it.</p>				
40.		Valve springs (7)	<p>a. Inspect in accordance with instructions in paragraph 2-8.</p> <p>b. Check for distortions, cracked, or collapsed coils.</p> <p>c. Check valve spring (6) free length.</p> <p>d. Using spring tester, inspect for serviceability by checking load when spring is compressed.</p>	<p>Discard if defective.</p> <p>Discard valve spring (6) if distorted, or if coils are cracked, or collapsed.</p> <p>No. 1 valve spring is 2.29 in. (58 mm) in length.</p> <p>No. 2 valve spring is 2.69 in. (68 mm) in length.</p> <p>Discard spring no. 1 if spring does not give load of at least 150 lb (667 N) when compressed to 1.77 in. (45 mm).</p> <p>Discard spring no. 2 if spring does not give load of at least 143 lb (636 N) when compressed to 1.72 in. (44 mm).</p>



3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

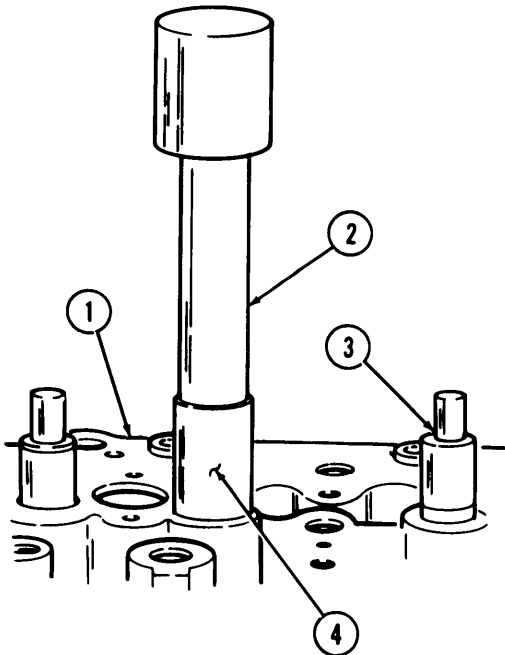
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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e. Reassembly

NOTE

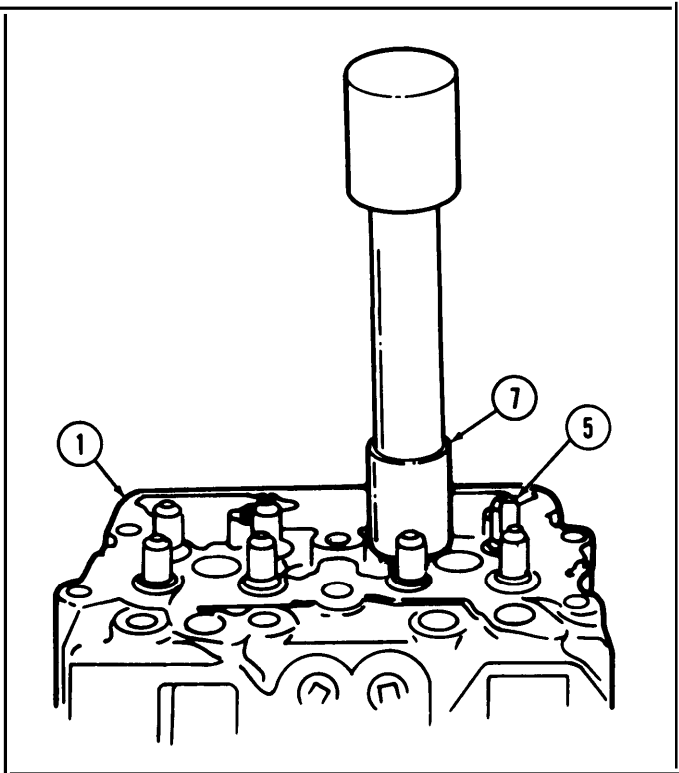
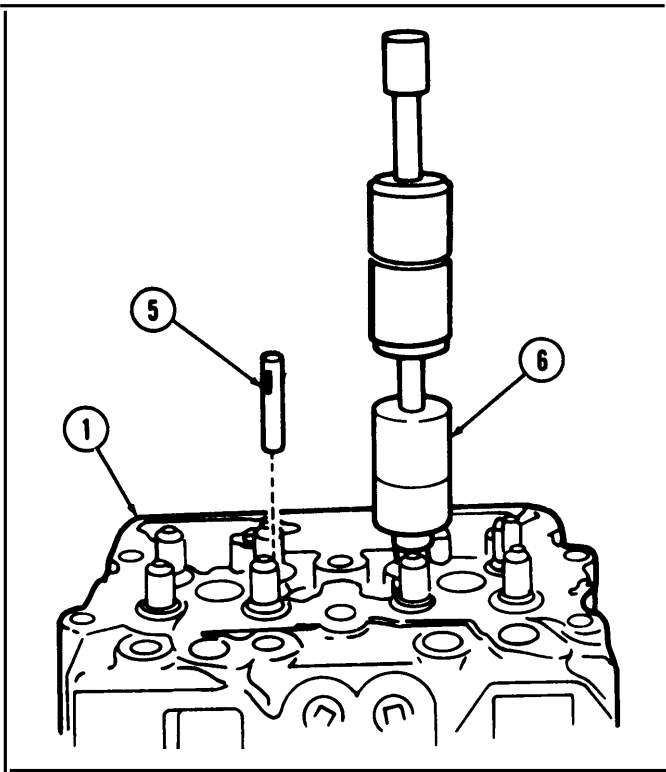
Use repaired and inspection-approved cylinder heads only.

41.	Valve guides (3)	a. Replace worn valve guides (3). Drive valve guides (3) from underside of cylinder head (1). b. Install new valve guides (3).	Use a hammer and punch. Use arbor press, mandrel (2), and valve guide arbor (4).
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3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
42.		Crosshead guides (5)	<p>a. Remove defective crosshead guides (5) from cylinder head (1) using crosshead guide puller (6).</p> <p>b. Clean crosshead guide (5) holes thoroughly.</p> <p>c. Install new cross-head guides (5) with crosshead guide spacer (7).</p> <p>d. Check crosshead guide (5) height.</p>	Assembled height must be 1.860-1.880 in. (47.24-47.75 mm).



3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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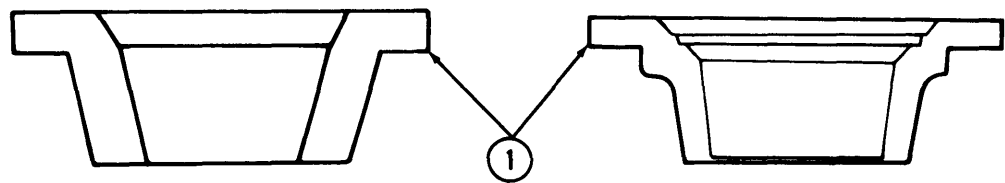
CAUTION

- To install intake and exhaust valves, position cylinder head on intake port face. Use wooden surface work bench or protective surface to prevent damage. Bench must be clean.
- Be sure to install valves in original locations as numbered in step 7.

43.		Eight valves (11)	a Make sure cylinder head (8) is clean. b Dip valve stems (5) in clean engine oil. c Install valve stems (5) through valve guides (6) from face side (7) of cylinder head (8). d Carefully position cylinder head (8) face down on work-bench after all valves are installed, so valve springs can be installed.	Use lubricating oil. Make sure valve heads, are correctly seated on valve seats (1).
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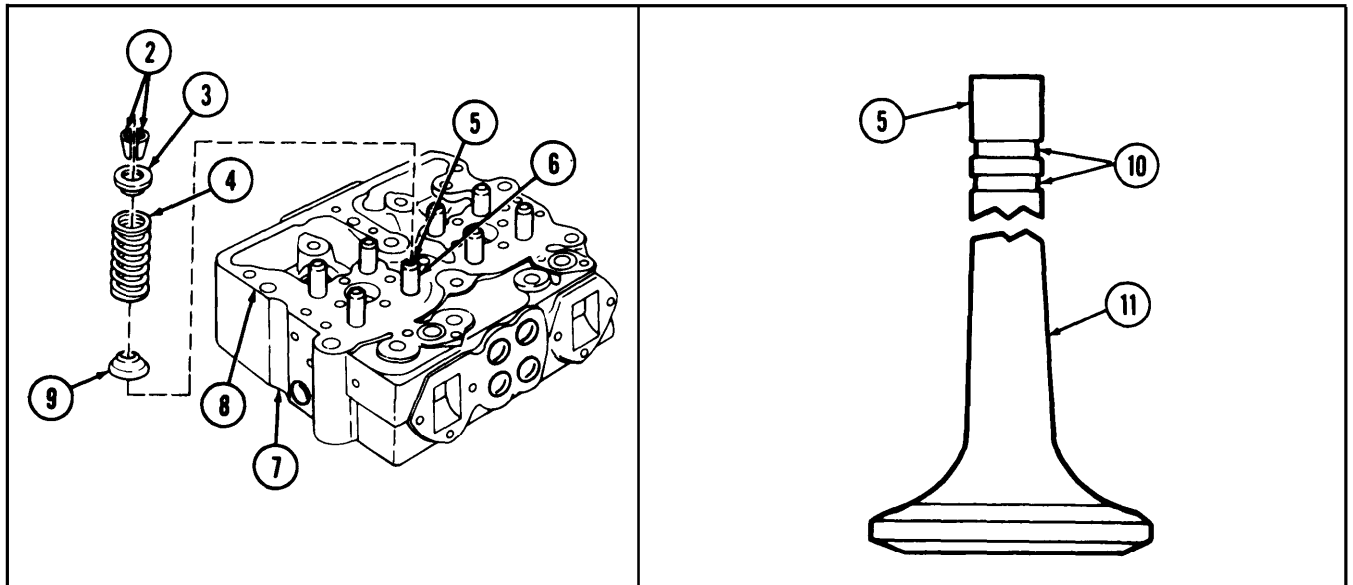
CAUTION

- Two differently-designed valve spring guides have been used in NHC-250 series engines. Part number 128879 spring guide cannot be used with 211999 valve spring. Number 170296 spring guide can be used with either valve spring.
- Reground valve heads seat deeper in cylinder head, causing valve stem to protrude further above valve guide. This allows valve spring to extend beyond length limits of 2,250 in. (57.150 mm), and causes weak spring action. Use spacers up to 0.0625 in. (15.875 mm) to reduce valve spring to proper height.



3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p style="text-align: center;">NOTE</p> <p>A maximum of two 0.03125 in. (0.794 mm) spacers may be used under lower valve spring guide when cylinder head has been resurfaced and valve seat insert has been refaced. Do not use spacers to compensate for weak springs.</p>				
44.		Eight lower spring guides (9)	Place over valve guides (6) and seat to cylinder head (8).	
45.		Eight valve springs (4)	Place on lower spring guide (9).	Do not mix intake and exhaust springs. Intake springs are taller.
46.		Eight upper spring guides (3)	Place on top of spring (4) and over stem end of valve (11).	
47.		Sixteen new half-keepers (2)	<p>a. Compress spring compressor until keeper grooves (10) on valve (11) are exposed.</p> <p>b. Install new keepers (2) into valve grooves (10) and slowly release spring compressor.</p>	Repeat step 46 until all valves (11) are locked by keepers (2).

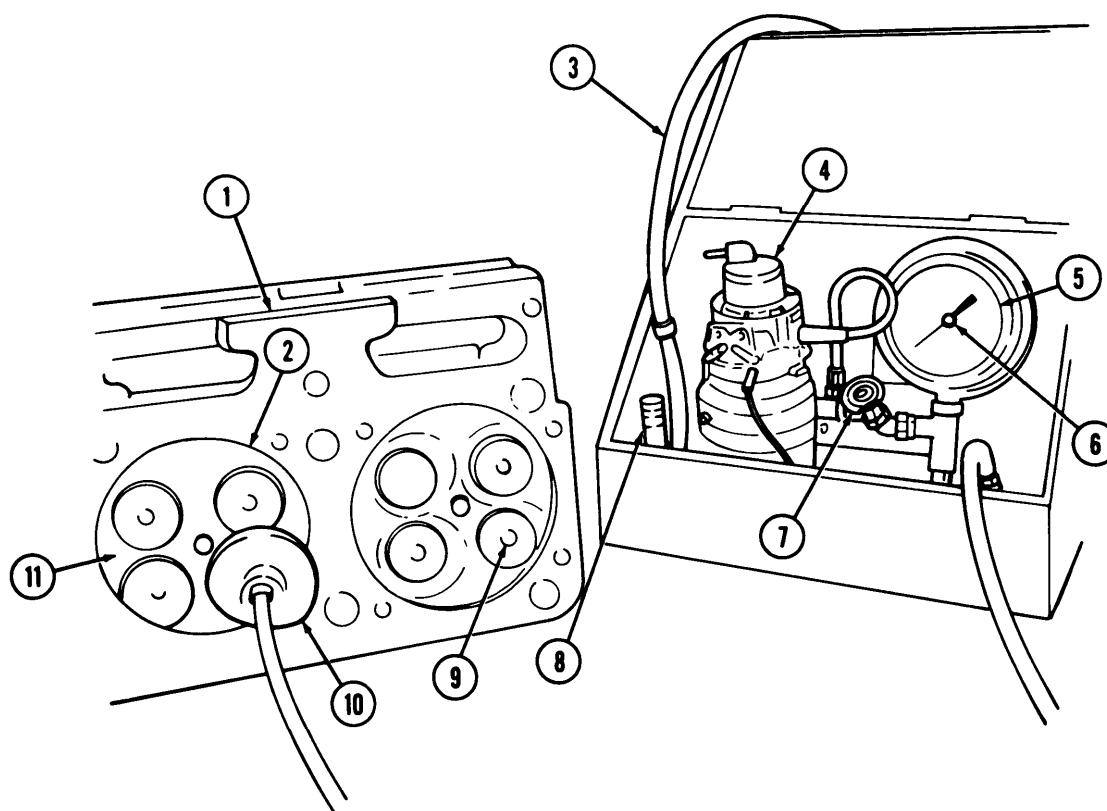


3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
48.		Intake and exhaust valves (9)	Vacuum test for proper valve seating.	Use vacuum tester (3). Operating instructions are provided with tester (3).
49.		Vacuum cup (10)	a. Select correct size for size of valves (9) to be tested. b. Hold vacuum cup (10) over head of valve (9), and seat flat on cylinder head surface (2) surrounding valve (9).	Valves (9) and valve seats (11) must be dry. Grease can be applied to "O" ring on vacuum cup (10) for better seal to cylinder head (1).
50.		Tester shutoff valve (7)	Turn to open position and hold push button (8) down to operate vacuum pump (4).	
51.		Vacuum pump (4)	Operate until indicator hand (6) on vacuum gage (5) stops climbing between 18 and 25 in. of mercury.	Close tester shutoff valve (7) and release push button (8).
52.		Indicator hand (6)	a. Begin timing as soon as hand (6) reaches 18 in. of mercury on gage (5). b. Stop timing when hand (6) reaches 8 in. of mercury.	If time is less than 10 seconds, valve (9) seating is not satisfactory.
53.		Valves (9)	Tap stem end with soft-faced hammer.	
54.		Tester (3)	a. Retest by repeating steps 49 through 52. b. Check for loose connections on tester (3). c. Operate vacuum pump (4) with suction cup (10) against a clear glass window. d. Check for indicator hand (6) movement.	If valve (9) seating is still unsatisfactory, proceed to 54b. If indicator hand (6) moves, there is leakage in the tester.

3-53. CYLINDER HEAD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
55.		Valves (9)	e. Tighten connections and retest valves (9). a. Repeat steps 49b through 54. b. If test fails, regrind valves before retesting.	Refer to para. 3-54.



END OF TASK!

TA 350217

3-54. REFACING INTAKE AND EXHAUST VALVES

This task covers:

- a. Valve Specifications
- b. Grinding or Refacing Valves
- c. Cleaning after Refacing

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-53	Cylinder head disassembled.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Well-ventilated work area.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		
TM 9-4910-484-10		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Valve Specifications

NOTE

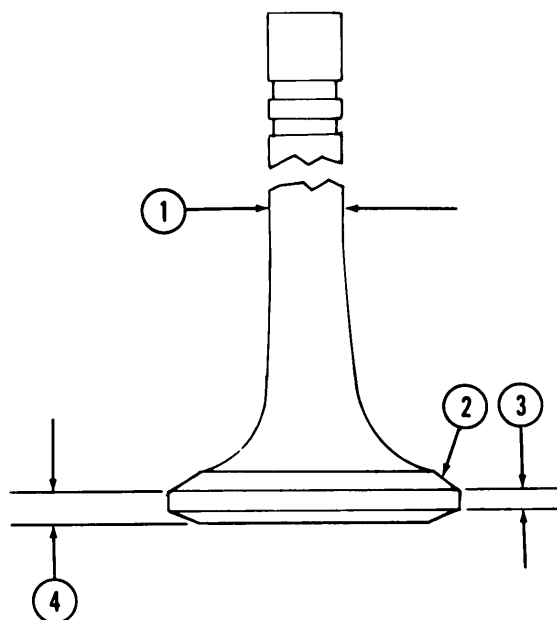
- ŽHard-faced exhaust valves are marked by letters “EX” or “HF” in recessed area of valve head. Intake valves are not marked.
- Use table 3-2 for solid valves.
 - Sodium filled valves are not used in Cummins engines.

3-54. REFACING INTAKE AND EXHAUST VALVES (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Table 3-2. Valve Specifications

Ref.	Intake and Exhaust Valves	New Minimum	New Maximum	Worn Limits
1.	Stem	0.4500 in. (11.4300 mm)	0.4510 in. (11.4554 mm)	0.4990 in. (12.4046 mm)
2.	Seat Angle	30°	30°	
3.	Refacing depth	0.0625 in. (1.59 mm)		0.0625 in. (1.59 mm)
4.	Valve head thickness	0.105 in. (2.67 mm)		0.105 in. (2.67 mm)



3-54. REFACING INTAKE AND EXHAUST VALVES (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Grinding or Refacing Valves				
<p style="text-align: center;">NOTE</p> <p>Mark on ground face of valve. Mark is used to determine head or stem warpage.</p>				
1.		Valve (3)	Install stem in chuck (2).	Refer to TM 9-4910-484-10 for operating instructions of valve refacer (8).
2.	Valve refacer (8)	Switch (5)	Turn 'ON' to start valve grinder electric motor.	
3.		Grind wheel (4)	a. Turn wheel handle (6) and very lightly touch valve (3) face with grind wheel (4). b. Move grind wheel (4) away from valve head and shut valve grinder electric motor off with switch (5).	An out-of-round condition of valve will be marked by a small bright spot on valve seating surface of valve head.
4.		Valve (3) seat surface	a. Indicate on ground face of valve (3) location of small bright spot. b. Rechuck valve (3) 180° from first position.	
5.		Switch (5)	Turn "ON" to start valve refacer (8) electric motor.	Mark new position on valve.
6.		Grinder wheel (4)	a. Turn wheel handle (6) and very lightly touch valve (3) face with grinder wheel (4).	

3-54. REFACING INTAKE AND EXHAUST VALVES (Cont'd)

- | | | | |
|----|------------------|---|--|
| | | b. Move grinder wheel (4) away from valve (3) head and shut grinder electric motor off with switch (5). | If bright spot is in the same position after both chucking operations, the valve (3) is warped. Replace valve (3). If bright spots occur in different positions, the chuck (2) is out of alignment or the valve (3) is being incorrectly chucked. Run-out should not exceed 0.001 in. (0.0254 mm). |
| 7. | Valves (3) | Wet grind to an exact 30° angle from horizontal. | Check valve (3) head rim thickness. Refer to table 3-2. |
| 8. | Wheel handle (1) | Use to control depth of grind. | |
| 9. | Handle (7) | Use for left and right motion of valve (3). | |

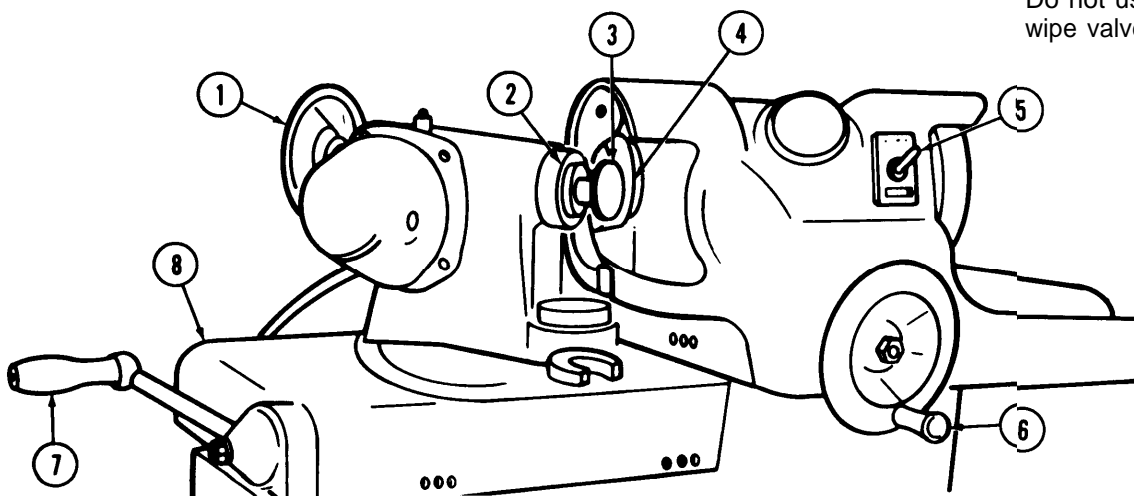
NOTE

Keep valves in order in a numbered valve stick or board.

c. Cleaning After Refacing

- | | | | |
|-----|--------------------|--------|---|
| 10. | Refaced valves (3) | Clean. | Refer to paragraph 2-7 for cleaning instructions.

Do not use cloth to wipe valves clean. |
|-----|--------------------|--------|---|



END OF TASK!

FOLLOW-ON TASK: Reassemble cylinder heads (para. 3-53).

TA 350219

3-257

3-55. VALVE SEAT INSERTS REPLACEMENT

This task covers:

- | | |
|------------------|-----------------|
| a. Removal | d. Cleaning |
| b. Gaging | e. Installation |
| c. Counterboring | |

INITIAL SETUP:**Applicable Models**

All

Equipment Condition Reference

Para. 3-53

Condition Description

Cylinder head disassembled.

Test Equipment

None

Special Tools

Valve seat insert tool ST-257
 Cutter seat ST-662
 Valve guide arbor (mandrel set) ST-663
 Tool driver ST- 1122
 Valve seat insert staking tool ST- 1124
 Valve seat insert extractor ST-1279

Special Environmental Conditions

None

Materials/Parts

Valve seat inserts (4 per cylinder head)

Personnel Required

Wheeled vehicle repairman MOS 63W (2)

General Safety Instructions

- Ž Always wear safety eyeshields when using compressed air.
- Keep fire extinguisher nearby when using drycleaning solvent.

Manual References

TM 9-2320-272-34P

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

- | | | | | |
|----|-------------------|-----------------------|---------------------|---|
| 1. | Cylinder head (1) | Valve seat insert (4) | Pull from bore (2). | Use valve seat insert extractor tool (3). |
|----|-------------------|-----------------------|---------------------|---|

b. Gaging**CAUTION**

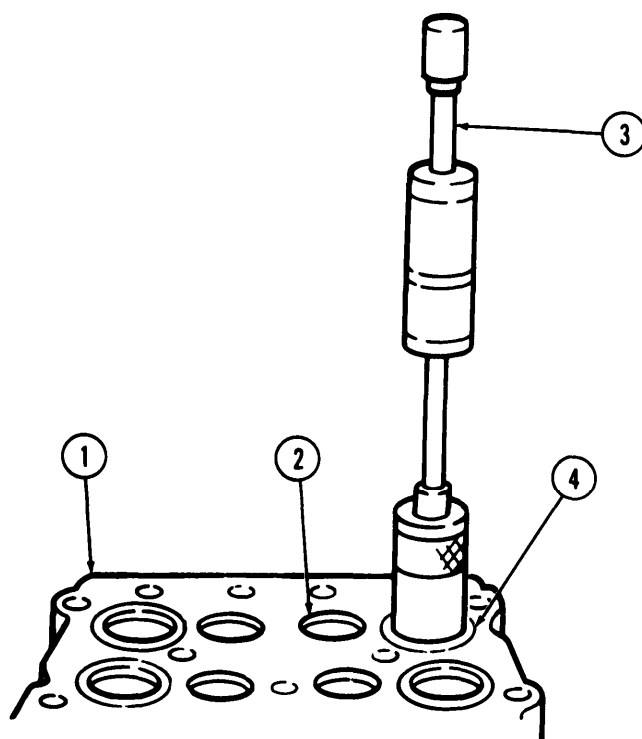
Each replacement valve seat insert outside diameter and thickness must be measured and compared to relating valve seat insert counterbore in the cylinder head before counterboring. These measurements will prevent over-boring and damage to the cylinder head.

- | | | | |
|----|-----------------------|--|--|
| 2. | Valve seat insert (4) | a. Measure outside diameter using micrometer,
b. Measure thickness. | Record reading and compare with specifications in table 3-3.

Record reading and compare with specifications in table 3-3. |
|----|-----------------------|--|--|

3-55. VALVE SEAT INSERTS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-55. VALVE SEAT INSERTS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
3.	Cylinder head (3)	Valve seat counterbore (8) depth (1)	Measure with depth micrometer (2).	Record reading and compare to specifications in table 3-3.
4.		Valve seat insert counterbore (8) inside diameter	Measure with inside micrometer (5).	Record reading and compare to specifications in table 3-3.

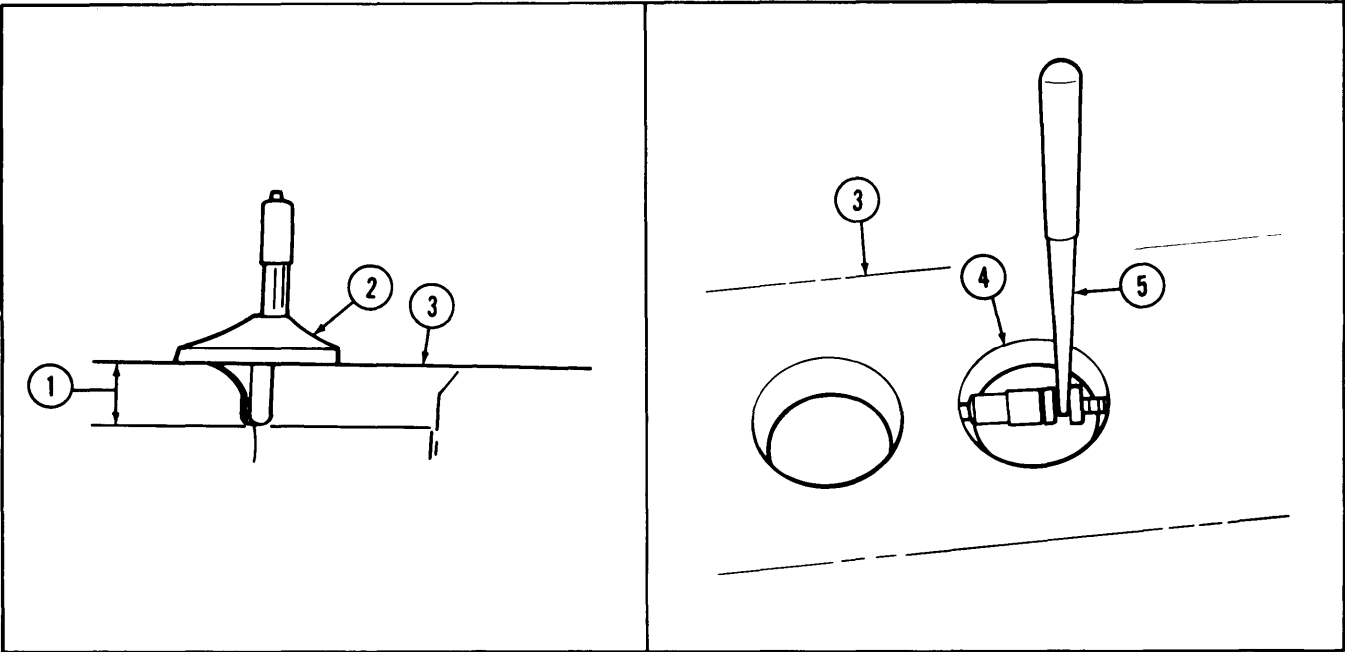
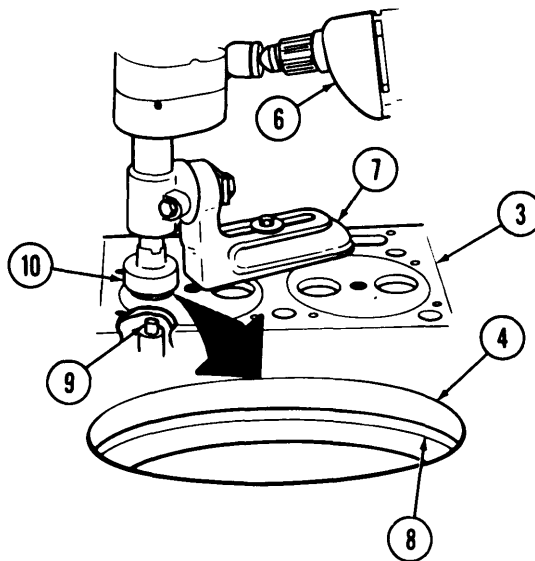


Table 3-3. Valve Seat Insert Specifications

Cylinder Head Valve Seat Counterbore Depth	Insert Outside Diameter	Cylinder Head Counterbore Inside Diameter	Insert Thickness
Standard	2.0025 - 2.0035 in. (50.864 - 50.889 mm)	1.9995 - 2.0005 in. (50.787 - 50.813 mm)	0.278 - 0.282 in. (7.0612 - 7.1629 mm)

3-55. VALVE SEAT INSERTS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
c. Counterboring				
5.		Counterbore cutter (10)	Clamp base (7) to cylinder head (3) near valve seat bore (4).	Be sure counterbore cutter (10) is securely clamped before starting electric drill motor (6).
<p style="text-align: center;">NOTE</p> <p>Allow cutter to turn several revolutions at exact moment the proper depth in cylinder head is reached to ensure a perfectly flat bottom of bore for valve seats to seat.</p>				
6.		Counterbore cutter (10)	<p>a. Center in valve seat insert bore (4) and valve guide mandrel (9).</p> <p>b. Cut counterbore (8) 0.006-0.010 in. (0.1524-0.2540 mm) deeper than insert thickness to allow staking (peening) of cylinder head (3) to secure insert.</p>	



3-55. VALVE SEAT INSERTS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Cleaning

WARNING

Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel,

7.
- Cylinder head (5)
- a. Blow out with compressed air,

WARNING

Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places, Failure to do this may result in injury to personnel.

- b. Clean opening and ports with brush and drycleaning solvent.
- c. Dry with compressed air.

e. Installation

CAUTION

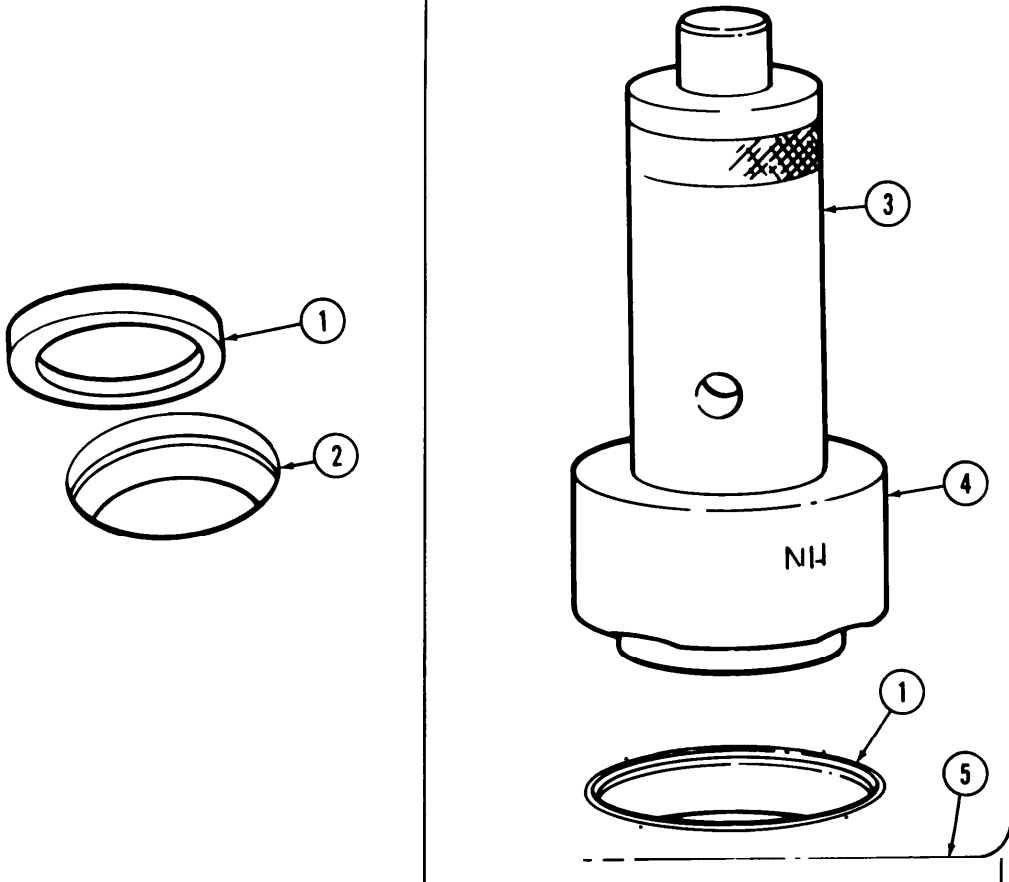
Valve seat inserts may be installed one time only. If valve seat insert is not properly installed the first time, a new valve seat insert must be installed.

NOTE

Keep valve seat inserts in cold storage until ready to install in cylinder head. Install valve seat insert very quickly so room temperature does not have a chance to expand insert making it difficult to install.

8.
- Valve seat insert (1)
- a. Drive into valve seat bore (2) until fully seated.
- b. Stake (peen) into cylinder head (5).
- Use valve seat insert tool.
- Use valve seat insert tool (3) with valve seat insert staking tool (4).

3-55. VALVE SEAT INSERTS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
		 <p>The diagram illustrates the replacement of valve seat inserts. On the left, two circular inserts are shown, labeled 1 and 2. On the right, a valve assembly is shown with a seat insert labeled 1. The assembly is labeled 3, 4, and 5. The seat insert is labeled 1 and 5.</p>		

END OF TASK!

FOLLOW-ON TASK: Grind valve seats (para. 3-54).

TA 350223

3-263

3-56. GRINDING VALVE SEATS

This task covers:

- | | |
|----------------------------|------------------------|
| a. Dressing Grinding Wheel | d. Cleaning |
| b. Pre-grinding Operation | e. Gaging Valve Seats |
| c. Valve Seat Grinding | f. Lapping Valve Seats |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-53 Para. 3-55	Cylinder head disassembled. New valve seat inserts installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Cylinder head holding fixture ST-583		Well-ventilated work area.
<u>Materials/Parts</u>		
Lint-free cloth (Appendix C, Item 7)		
Coarse lapping and grinding compound (Appendix C, Item 14)		
Fine lapping and grinding compound (Appendix C, Item 15)		
Lubricating oil OE/HDO 10 (Appendix C, Item 16)		
Prussian blue (Appendix C, Item 20)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		<ul style="list-style-type: none"> Eyeshields must be worn during all grinding operations and when cleaning with compressed air. Keep fire extinguisher nearby when using drycleaning solvent.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Dressing Grinding Wheel**CAUTION**

Intake and exhaust valve seating surface to cylinder head valve seat is critical. Accurate machining is required to provide for perfect sealing of combustion chambers.

- | | | | |
|----|---------------------|--|--|
| 1. | | Grinder driver (10) and grinding wheel stone (9) | Position on tool holder stand (8) with grinding wheel stone (9) facing down. |
| 2. | Angle quadrant (12) | Tool holder (4) | Position at 30° and lock screw (5). |

3-56. GRINDING VALVE SEATS (Cont'd)

- | | | | |
|----|---------------------|----------------------------|--|
| 3. | | Electric grinder motor (1) | Position directly above angle quadrant (12). |
| 4. | Grinder driver (10) | Electric grinder motor (1) | Position chuck (11) on driver (10). |

WARNING

Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.

- | | | | |
|----|----------------------------|--------------------|---|
| 5. | Electric grinder motor (1) | Switch (2) | Turn to "ON" position. |
| 6. | Tool holder (4) | Control handle (3) | Move slowly and draw tool bit (7) across face of grinding wheel stone (9) for test cut. |

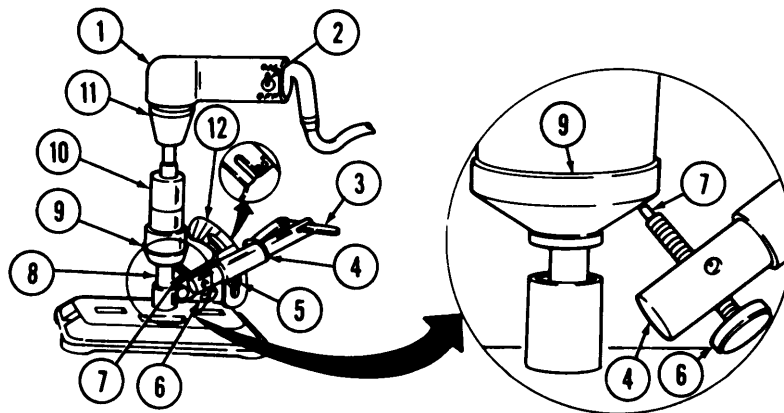
CAUTION

Do not try to remove a large quantity of grinder material at one time, take several cuts with dressing tool. Damage to dressing tool could result,

- | | | | | |
|----|--------------|------------------|---|---|
| 7. | Tool bit (7) | Knurled knob (6) | Turn clockwise slightly and just enough to remove a small amount on grinding wheel stone (9). | Move tool bit (7) back and forth across grinding wheel stone (9) face several times to ensure a full and clean dress cut has been made. |
|----|--------------|------------------|---|---|

CAUTION

Electric grinder motor switch must be turned to "OFF" position before making adjustments to diamond or carbide dressing tool bit and bit must be away from grinding wheel stone.



3-56. GRINDING VALVE SEATS (Cont'd)

b. Pre-Grinding Operation

- | | | | |
|-----|---|---|--|
| 8. | Cylinder head (5) | a. Position on head holding fixture or on work bench (10).
b. Use two boards to support cylinder head (5). | Position cylinder head (5) with valve seats (7) facing up.
This allows valve guides (9) to clear work bench (10). |
| 9. | Valve guide arbor (8) | Place in valve guide (9) from valve seat side of cylinder head (5). | |
| 10. | Valve seat grinder driver (3) and grinder wheel (4) | a. Position on valve guide arbor (8).
b. Position electric motor (1) on grinder driver (3) at chuck (6). | |

c. Valve Seat Grinding

CAUTION

Too much pressure on grinder driver may cause excessive wear on grinding stone, distorting the cut on valve seat, and removing too much material.

NOTE

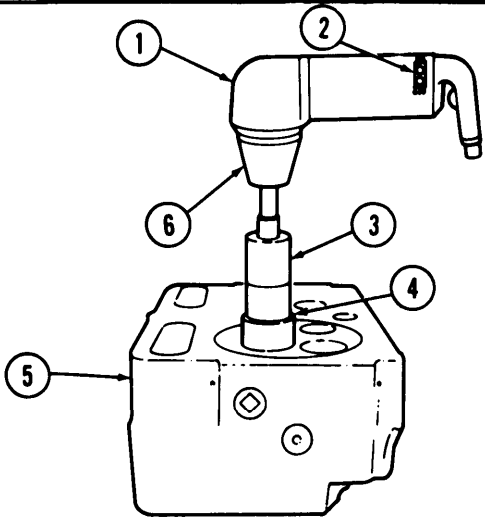
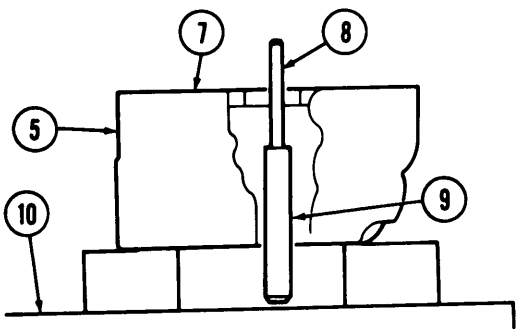
This procedure is for one valve seat. All other valve seats are done the same.

- | | | | |
|-----|----------------------------|---|--|
| 11. | Electric grinder motor (1) | a. Turn on with switch (2).
b. Apply light pressure on grinder driver (3) and grind valve seat (7).
c. Keep valve seat grinder driver (3) and grinder wheel (4) in a vertical position. | Take a very light cut from valve seat (7).
Do not apply side pressure to electric grinder motor (1). This action will cause the valve seat (7) to grind off-center. |
|-----|----------------------------|---|--|

NOTE

After each valve seat has been ground, redress, grinding stone to 30° angle, Stone wears with use.

3-56. GRINDING VALVE SEATS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

12.

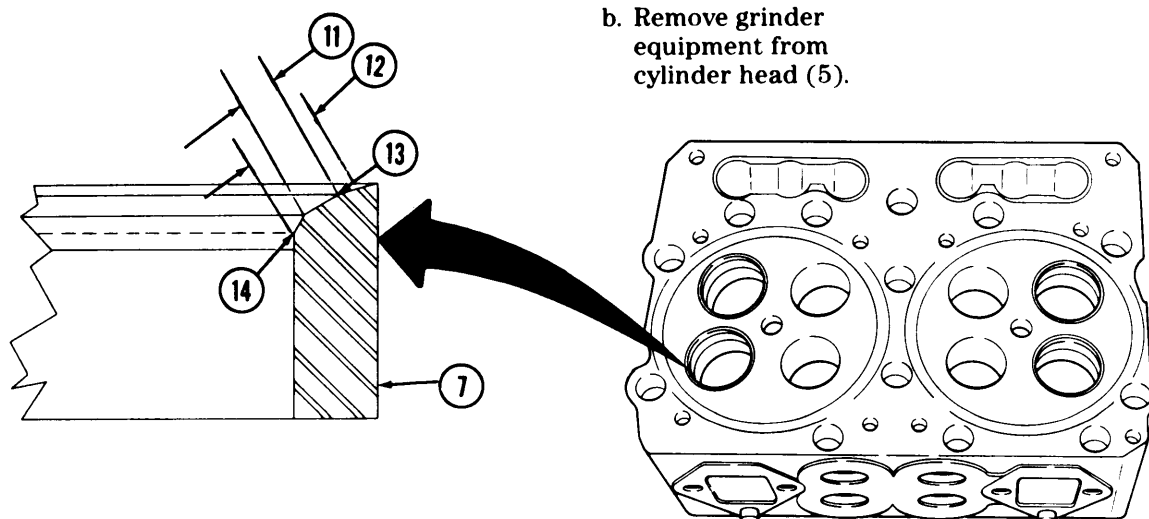
Valve seat (7)

a. Grind seat (7).

Seat area (11) is 0.0625-0.125 in. (1.5875-3.175 mm) maximum, seat (12) is 0.125 in. (3.175 mm) maximum.

If seating area (12) is wider than 0.125 in. (3.175 mm) maximum, stock can be removed from points (13) and (14), using a specially dressed valve seat grinding wheel stone.

b. Remove grinder equipment from cylinder head (5).



TA 350225

3-56. GRINDING VALVE SEATS (Cont'd)

d. Cleaning

WARNING

Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn, Failure to wear eyeshields may result in injury to personnel.

13.
- a. Air blow cylinder heads (7) clean of all dirt, debris, metal shavings, and grindings.

WARNING

Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

- b. Using a brush and solvent, clean all valve seats (5) and valve ports.

e. Gaging Valve Seats

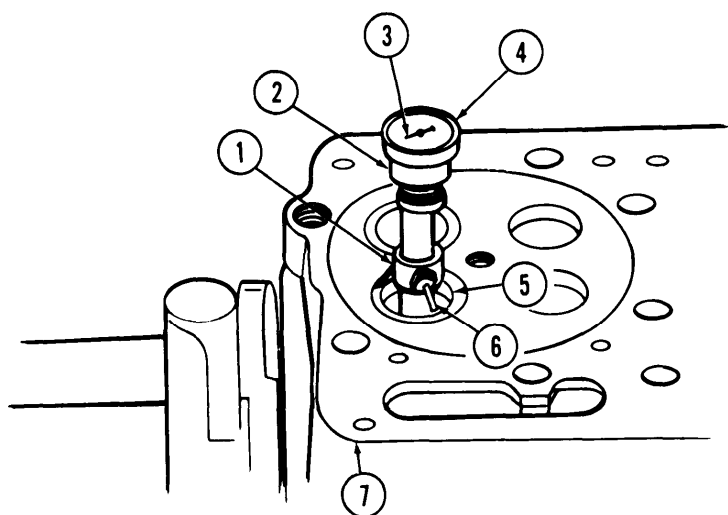
14. Valve seat (5)
- Dial indicator (2)
- a. Place on valve guide arbor (1).
- b. Position indicator finger (6) on valve seat (5).
- c. Zero dial indicator (2) by turning dial collar (4).
- d. Aline zero point with point of needle (3),

15.
- Dial indicator (2)
- a. Turn clockwise two or three turns and observe needle (3) for runout.
- b. Remove dial indicator (2) and valve guide arbor (1).

Total valve seat (5) runout must not exceed 0.002 in. (0.0508 mm).
If valve seat (5) runout exceeds .002 in. (.0508 mm), remove dial indicator and repeat steps 11 through 14a.

3-56. GRINDING VALVE SEATS (Cent'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-56. GRINDING VALVE SEATS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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f. Lapping Valve Seats

WARNING

Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

NOTE

This procedure is for one valve and valve seat. All other valves and valve seats are done the same.

16.	Valve (2)	a. Lightly oil valve stem (3). b. Apply coarse lapping compound to contact surface of valve (2). c. Insert valve (2) into cylinder head (1) and lap valve (2) and valve seat (4). d. Remove valve (2) and clean valve (2) and valve seat (4). e. Repeat steps a, b, and c using fine lapping compound.	Use OE/HDO 10 oil. Use 120 grit lapping compound. Keep lapping tool vertical at all times. Use lint-free cloth soaked in drycleaning solvent. Use 220 grit lapping compound.
17.	Valve (2) and valve seat (4)	Remove valve (2) and clean.	Use lint-free cloth soaked in drycleaning solvent.
18.	Valve (2)	a. Apply prussian blue to contact surface of valve seat (4). b. Install valve (2) in cylinder head (1). c. Press down on valve (2) and rotate back and forth. d. Remove valve (2). Check valve (2) and valve seat (4) for contact pattern,	 Examine for clear ring .0625-.125 in, (1.5875-3.175 mm).

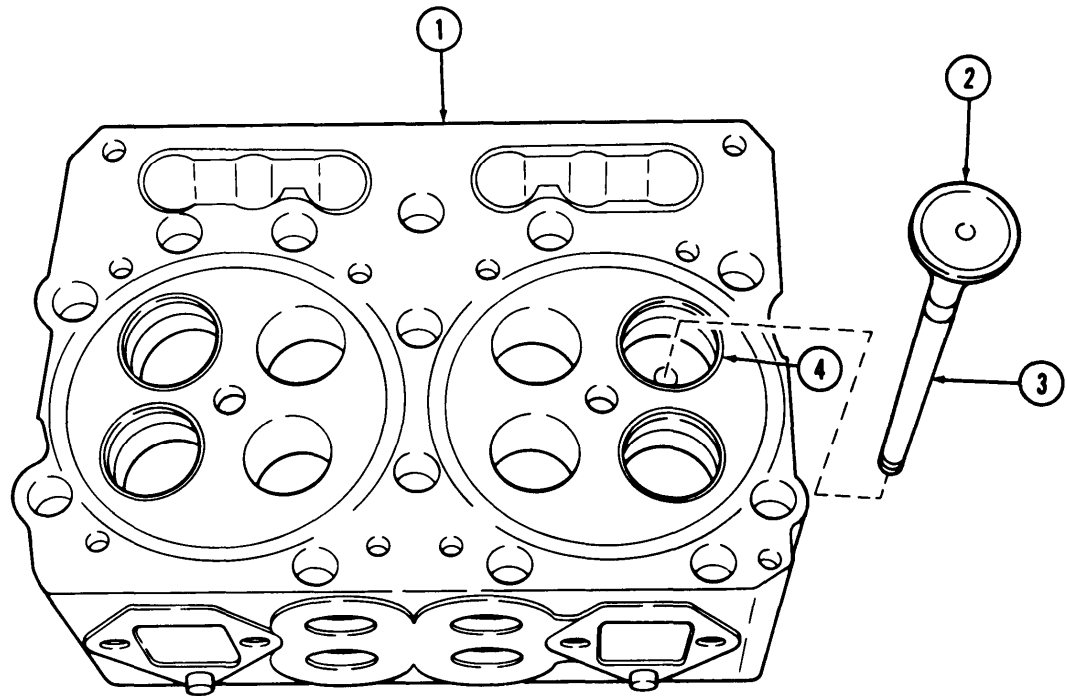
NOTE

Clean cylinder head (1) when all exhaust valves and valve seats have been lapped.

19.	Eight valves (2) and cylinder head (1)	Clean.	Repeat cleaning as in step 16d.
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3-56. GRINDING VALVE SEATS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Reassemble cylinder head(s) (para. 3-53).

TA 350227

3-271

3-57. INJECTOR SLEEVE REPLACEMENT

This task covers:

- a. Removal
- b. Bead Cutting
- c. Installation
- d. Fitting and Forming
- e. Check and Test

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-53	Cylinder head disassembled.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Bead cutting tool ST-788 Injector sleeve expander tool ST-880 Injector sleeve cutter ST-884 Injector protrusion 3376220 Injector sleeve holding tool ST-1 179 Injector sleeve installation mandrel ST-1 227 Extractor, injection sleeve ST- 1140		None
<u>Materials/Parts</u>		
Injector sleeve Injector sleeve "O" ring Cutting oil (Appendix C, Item 9) Lubricating oil OE/HDO 30 (Appendix C, Item 17) Prussian blue (Appendix C, Item 20)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

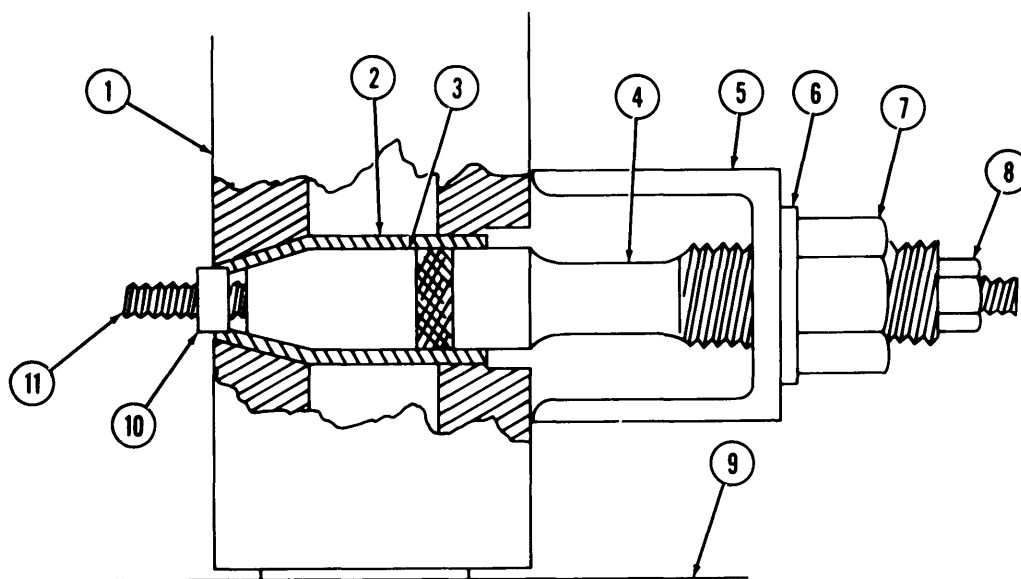
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

- | | | |
|----|-------------------------|--|
| 1. | Cylinder head (1) | Place on work bench (9) with exhaust manifold side down. |
| 2. | Lower puller collar (3) | Insert tapered end into injector sleeve (2). |
| 3. | Upper puller collar (4) | Insert on top of collar (3) with threaded end out. |

3-57. INJECTOR SLEEVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
4.		Support bridge (5)	Position over threaded end of collar (4) with one hand holding bridge (5) legs against cylinder head (1) and install washer (6) and nut (7).	Tighten nut (7) finger tight.
5.		Threaded rod (11)	While holding support bridge (5), insert rod (11) through holes in collars (3) and (4).	
6.		Hex nut (8) and extractor tip (10)	Install and tighten on rod(11).	Make sure extractor tip (10) is seated firmly against injector sleeve (2) bottom.



3-57. INJECTOR SLEEVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
7.		Nut (3)	Tighten to remove injector sleeve (1).	Discard injector sleeve (1).
8.		"O" ring (2)	Remove from injector sleeve bore (4).	Discard "O" ring (2).

b. Bead Cutting

9.	Cylinder head (5)	Cutter (8) and cutter pilot (7)	Insert into injector sleeve bore (4).
10.		Holder (6)	Position to cutter (8).
11.		Cylinder head (5)	Set on table of drill press.

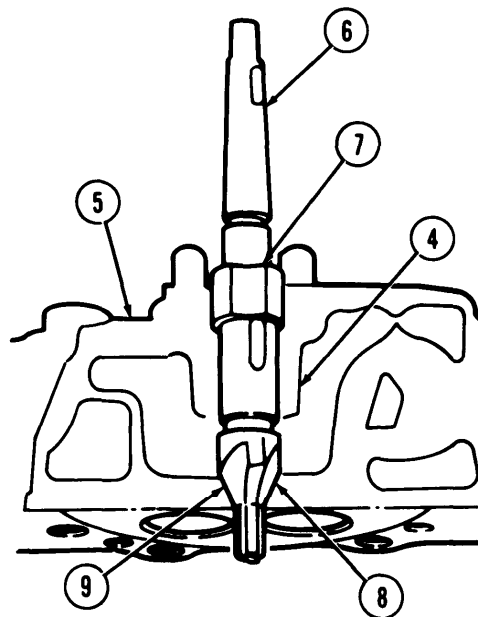
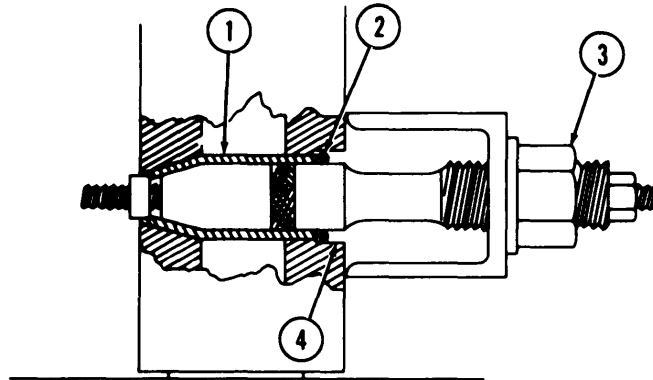
CAUTION

- Tool chatter may occur if drill speed is higher than 75 rpm, causing damage to cylinder head.
- Do not cut more than 0.010 in. (0.254 mm) deep into cylinder head (5).
- Cutter (8) must be sharp to prevent bead damage.

12.		Drill press	Set press speed no higher than 75 rpm.	Press may be turned by hand for light cuts or to prevent accidental removal of too much material.
13.		Holder (6), pilot (7), and cutter (8)	Lift enough to lubricate cutter (8).	Use cutting oil.
14.		Drill press motor	Turn on and take a very light cut.	When the proper cut depth has been reached, allow cutter (8) to dwell ten seconds to ensure a good seat and to clean the groove.
15.		Holder (6), pilot (7), and cutter (8)	Remove from injector sleeve bore (4).	
16.		New injector sleeve (1)	a. Coat seat end with blueing and insert in bore (4) until fully seated. b. Remove from bore (4).	Use prussian blue. Blueing must show a complete 360° band on both the injector sleeve (1) and seat (9).

3-57. INJECTOR SLEEVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-57. INJECTOR SLEEVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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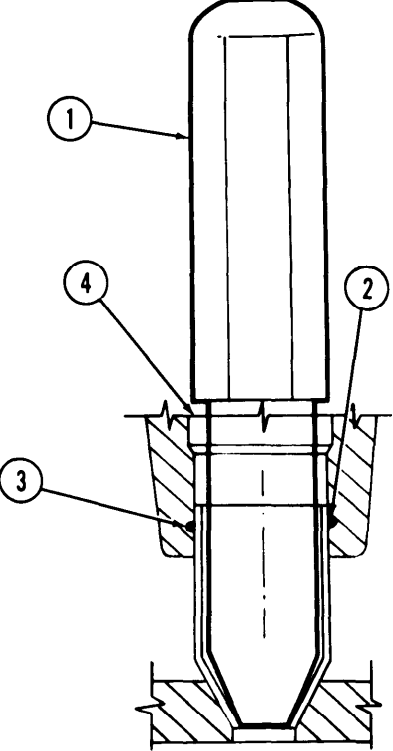
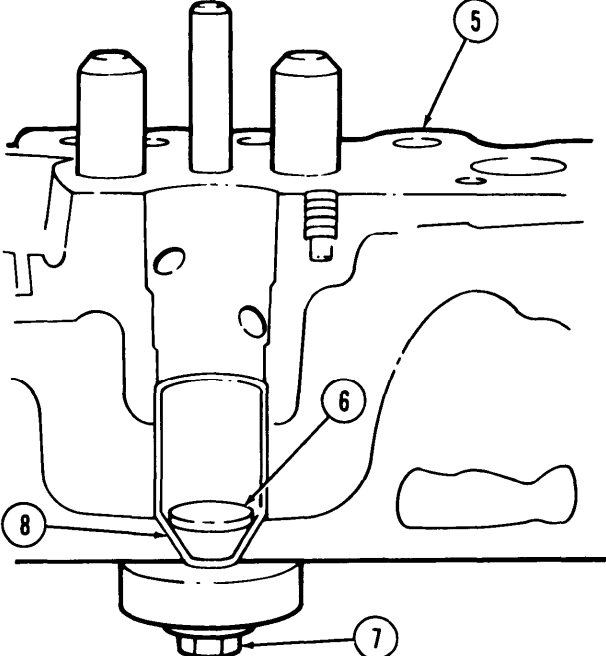
c. Installation

CAUTION

Make sure sleeve seat at bottom of injector bore is free from oil, carbon, or other foreign materials.

17.		New "O" ring (2)	a. Coat with clean engine oil. b. Install into groove (3) of injector sleeve bore (4).	Use lubricating oil.
18.		Injector sleeve mandrel (1)	a. Use to push the new injector sleeve (8) into injector sleeve bore (4) until it bottoms. b. Remove mandrel (1).	Do not strike mandrel (1) with a hammer during this operation.
19.		Injector sleeve holding tool (6)	Install in cylinder head (5).	Tighten nut (7) 35-40 lb-ft (48-54 N·m).
20.		Injector sleeve mandrel (1)	Insert into bore (4) and drive injector sleeve (8) in until seated.	Use a soft-faced hammer.
21.		Nut (7)	Retighten 35-40 lb-ft (48-54 N·m)	

3-57. INJECTOR SLEEVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM ,	ACTION	REMARKS
				
				

TA 350230

3-57. INJECTOR SLEEVE REPLACEMENT (Cont'd)

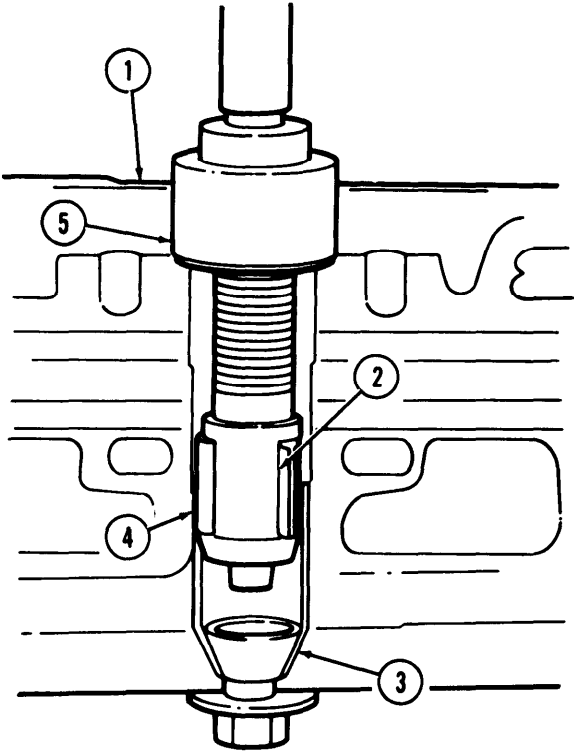
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Fitting and Forming

CAUTION

- Do not roll lower area of injector sleeve which will cause distortion of total sleeve.
- Overrolling of injector sleeve will cause deformation of sleeve into "O" ring groove.

22.		Injector sleeve expander tool (2)	Position into injector sleeve (3) in cylinder head (1).	
23.		Thrust nut (5)	Turn to adjust depth of expander tool (2) so that roller (4) extends 0.5 in. (12.7 mm) into sleeve (3).	Lock thrust nut (5) in place using an Allen wrench.
24.		Expander tool (2)	Push down, turn, and adjust until 75 lb-in. (8,5 N-m) maximum is reached.	

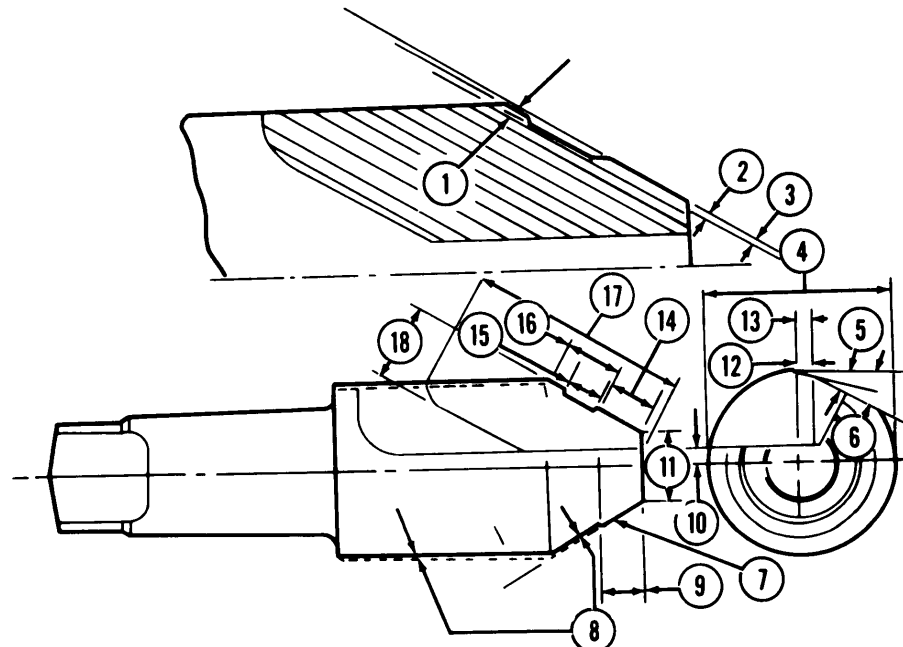


3-57. INJECTOR SLEEVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Table 3-4. Cutter Specifications

Item	In.	(MM)
1.	0.080	(2.0320)
	0.090	(2.2860)
2.	0.0015	(0.0381)
	0.0025	(0.0635)
3.	0.0077	(0.1955)
	0.0097	(0.2463)
4.	1.0615	(26.9621)
	1.0635	(27.0129)
5.	15 deg. angle relief	
6.	15 deg. angle relief	
7.	30 deg. 9' angle relief	
8.	0.375	(9.5250)
9.	0.312	(7.9375)
10.	0.125	(3.1750)
11.	0.375	(9.5250)
12.	0.010	(0.2540)
13.	0.0937	(2.3812)
14.	0.384	(9.7536)
	0.386	(9.8044)
15.	0.226	(5.7404)
	0.236	(5.9944)
16.	0.3425	(8.6995)
17.	1.250	(31.7500)
18.	0.375	(9.5250)



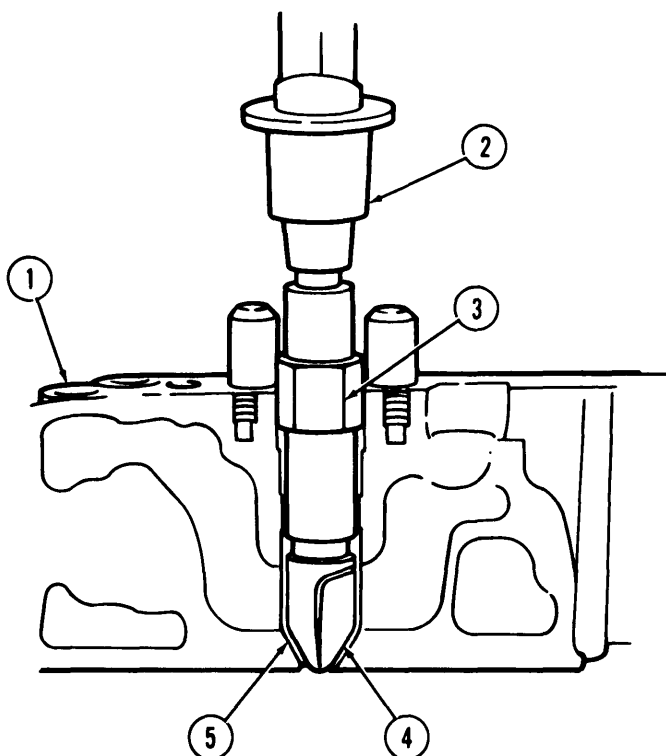
3-57. INJECTOR SLEEVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

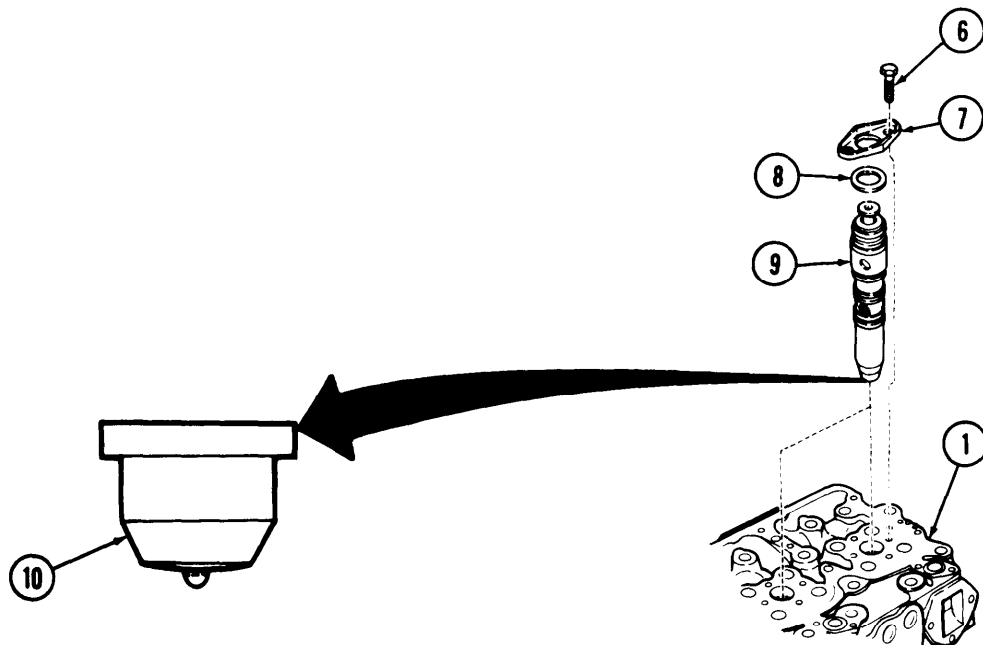
Form cutter per specifications in table 3-4.

- | | | | | |
|-----|--|---------------------------------|---|---|
| 25. | | Injector sleeve seat cutter (4) | Size, grind, and inspect cutter (4) and make sure it is ground to exact contours listed in table 3-4, | |
| 26. | | Injector sleeve seat cutter (4) | Install on head (1) and use in drill press (2) with pilot (3) to cut injector sleeve (5) just enough to provide for proper seating of injector and to maintain correct injector tip protrusion, | Use a solid stream of clean cutting oil to allow cutter (4) to cut freely without grabbing. Proper seating and protrusion are checked in step 29. |



3-57. INJECTOR SLEEVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
e. Check and Test				
27.	Injector (9)	Injector cup (10)	<p>Check seating pattern as follows:</p> <p>a. Lightly coat injector cup (10) with prussian blue.</p> <p>b. Install injector assembly (9) into cylinder head (1) and secure with washer (8), clamp (7), and two screws (6).</p> <p>c. Remove two screws (6), clamp (7), washer (8), and injector (9).</p>	<p>Tighten alternately in 4 lb-ft (5 N·m) steps to 10-12 lb-ft (14-16 N·m).</p>



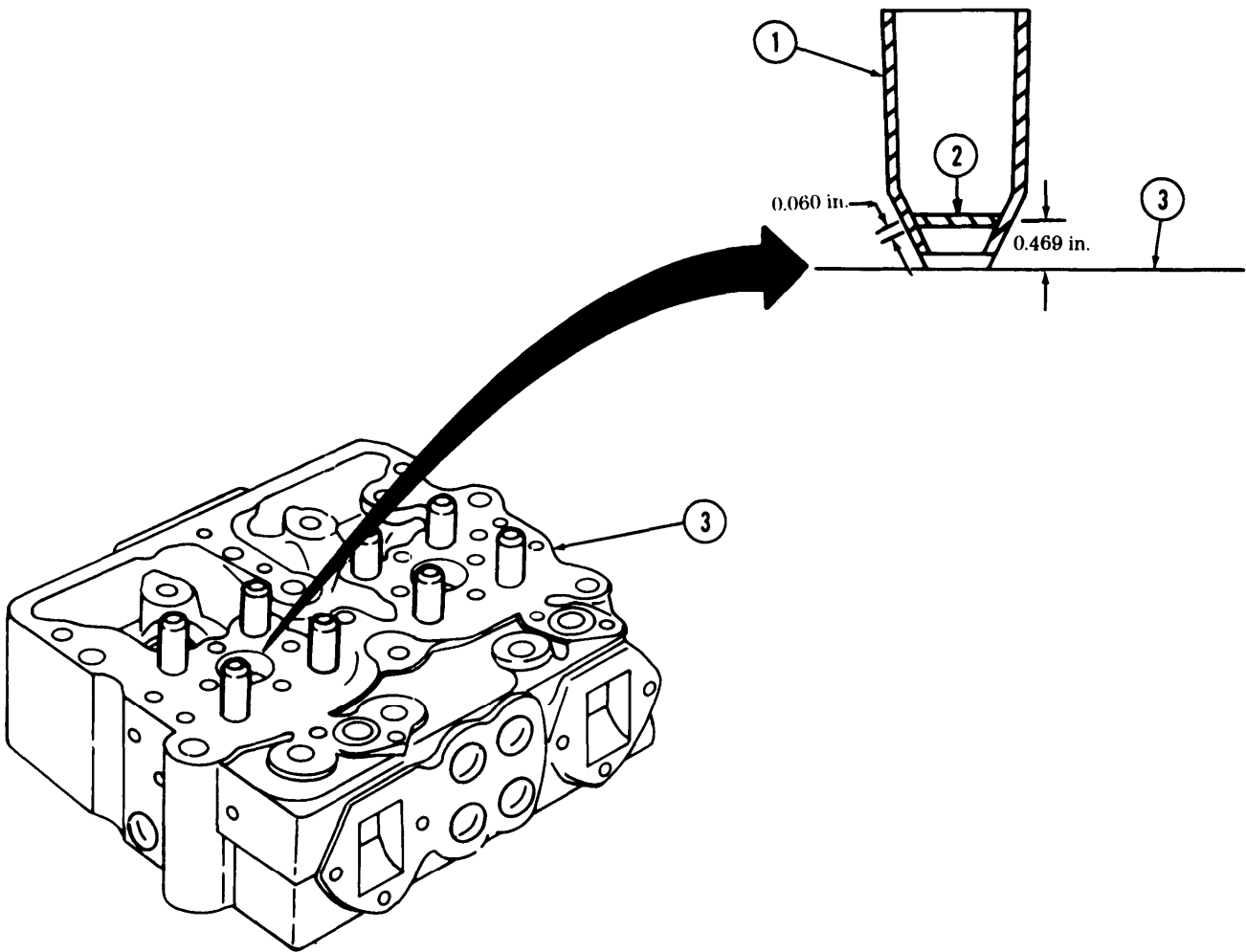
3-57. INJECTOR SLEEVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Check seat pattern in bottom of sleeve (1) cup seating area.

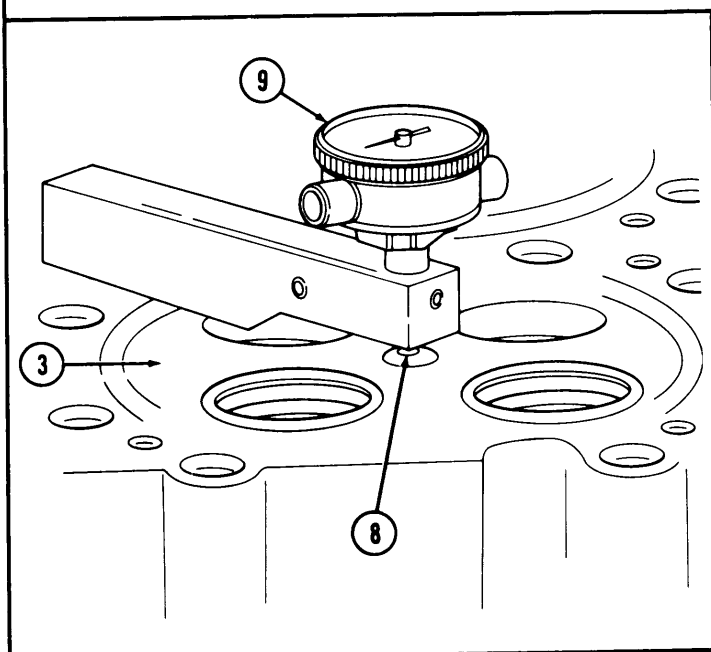
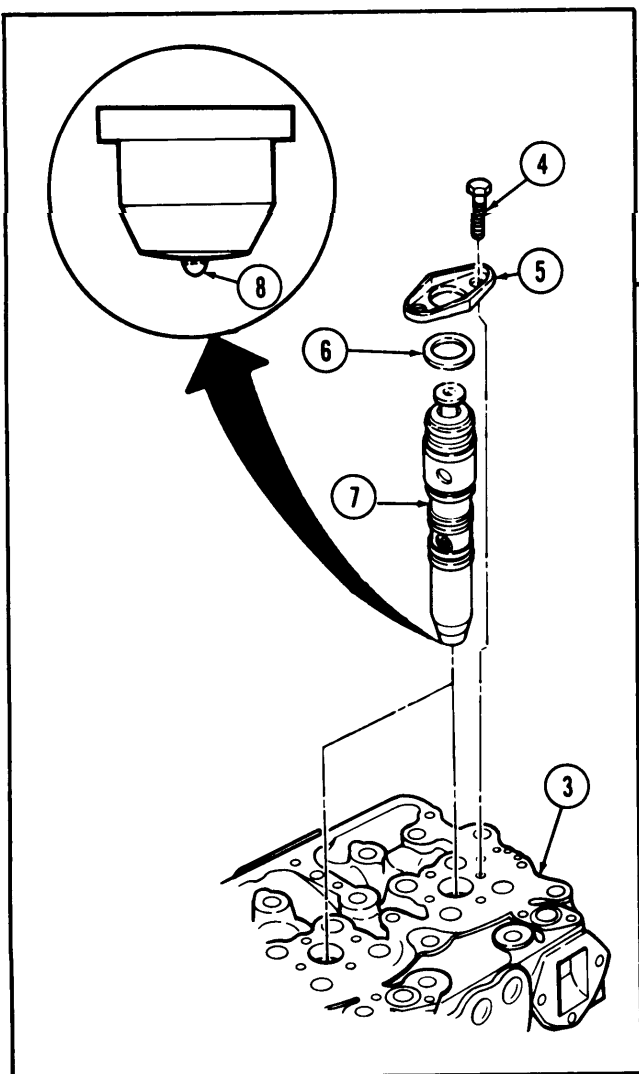
e. Blued band (2) on sleeve (1) in sleeve seating area must be 0.060 in. (1.52 mm) minimum width, and be located approximately 0.469 in. (11.91 mm) from bottom of cylinder head (3) surface.

If seating pattern does not meet these specifications, regrind sleeve (1) seating area as described in steps 25 and 26.



3-57. INJECTOR SLEEVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
28.		Injector assembly (7)	Install in injector sleeve (1) in head (3) with clamp (5), washer (6), and two screws (4).	Tighten alternately in 4 lb-ft (5 N·m) steps to 10-12 lb-ft (14-16 N·m).
29.		Injector tip (8)	Check protrusion, using dial gage (9).	<p>Tip (8) protrusion should be 0.060-0.070 in. (1.52-1.78 mm).</p> <p>If protrusion exceeds 0.070 in. (1.78 mm) install new sleeve.</p> <p>If protrusion is less than 0.060 in. (1.52 mm) regrind sleeve.</p>



END OF TASK!

FOLLOW-ON TASK: Reassemble cylinder head (para. 3-53).

TA 350236

3-58. CAM FOLLOWER HOUSING REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-53	Cylinder heads removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
None	None	
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W	None	
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal**NOTE**

Cam follower housings are mounted with screw-assembled lock-washers on late model engine.

Cam follower housing (4)	Six screws (5) and lock-washers (6)	Remove.	Discard lockwashers (6).
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CAUTION

Do not discard cam follower housing gaskets before measuring total thickness of each gasket first, Total thickness of gaskets spaces the cam follower to the camshaft for correct injector timing. Damage to the engine will result if gasket spacing is not correct when reinstalling cam followers.

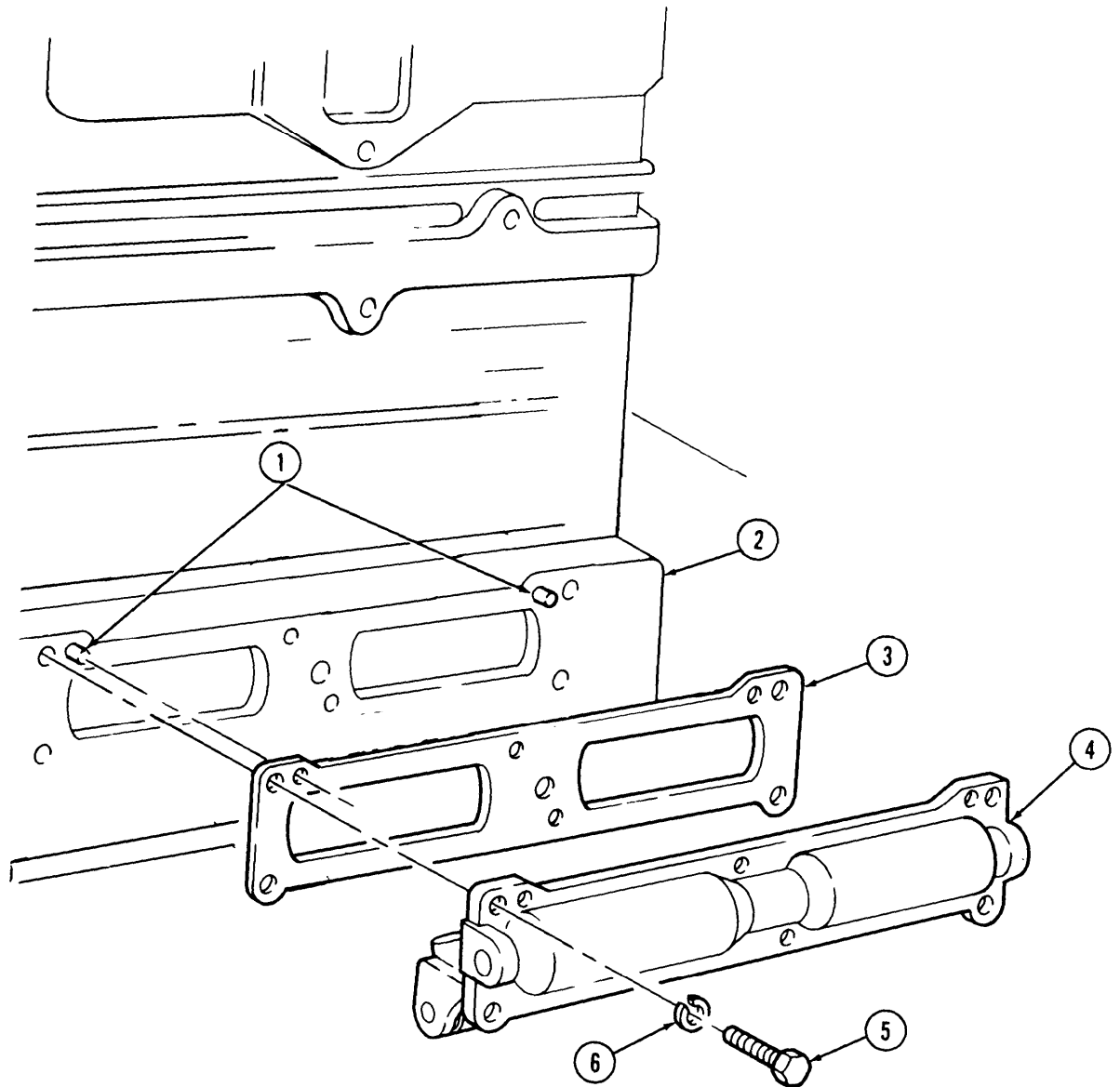
3.	Cylinder block (2)	Cam follower housing (4)	Carefully pry from dowel pins (1) and remove.	Remove remaining two cam follower housings (4) using the same procedure.
		Cam follower gaskets (3)	Remove and measure gasket (3) thickness. Record reading.	Discard gaskets (3) once readings are recorded. Clean gasket remains from mating surfaces.

NOTE

For disassembly, cleaning, inspection, and reassembly refer to para. 3-21.

3-58. CAM FOLLOWER HOUSING REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 350237

3-59. FLYWHEEL RING GEAR REMOVAL

This task covers:
Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-28	Engine mounted on repair stand.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

WARNING

Support ring gear when removing flywheel screws. Ring gear may fall if not supported, causing injury to personnel.

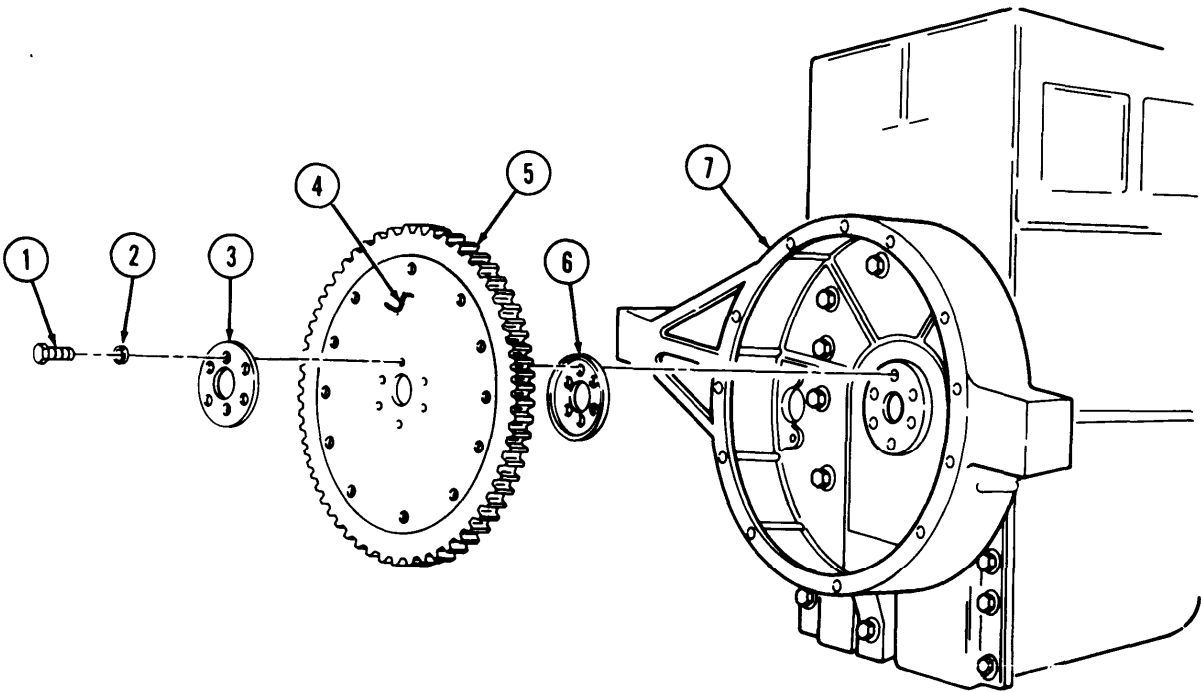
CAUTION

Lock ring gear to prevent crankshaft from turning before removing screws.

1.	Flywheel housing (7)	Six screws (1) and washers (2), clutch spacer (3), flex plate (4), ring gear (5), and adapter plate (6)	Remove.	Flex plate (4) and ring gear (5) will be an assembly.
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3-59. FLYWHEEL RING GEAR REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 350238

3-60. FLYWHEEL HOUSING REMOVAL

This task covers:

a. Removal

b. Cleaning and Inspection

INITIAL SETUP:**Applicable Models**

All

**Equipment
Condition
Reference**

Para. 3-59

Condition Description

Flywheel ring gear removed.

Test Equipment

None

Special Tools

None

Special Environmental Conditions

None

Materials/Parts

None

Personnel Required

Wheeled vehicle repairman MOS 63W

General Safety Instructions

None

Manual References

TM 9-2320-272-34P

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1.	Flywheel housing (1)	Nine screws (6), lockwashers (5), and washers (4)	Remove.	Discard lockwashers (5).
2.	Oil pan (7)	Six screws (9) and lockwashers (8)	Remove.	Discard lockwashers (8).
3.	Cylinder block (2)	Flywheel housing (1)	Tap around side with wood block and soft-faced hammer, and remove from dowel pins (3).	Remove camshaft bore cork gasket (10) from housing (1) and discard. Clean gasket remains from mating surfaces,

NOTE

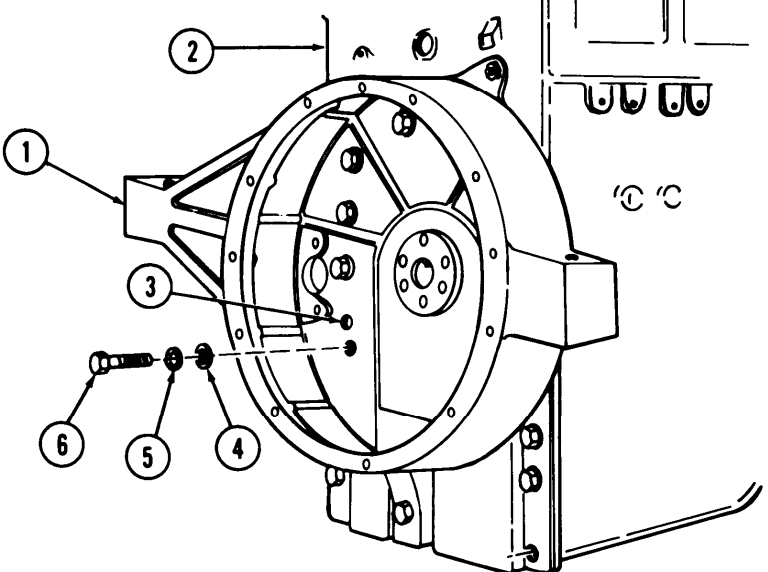
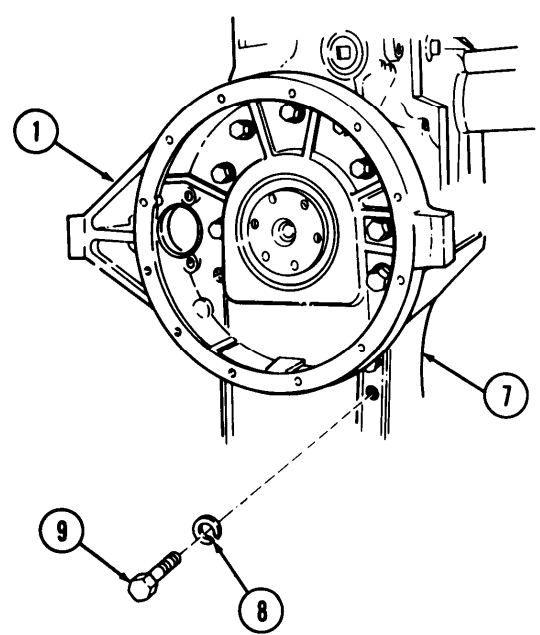
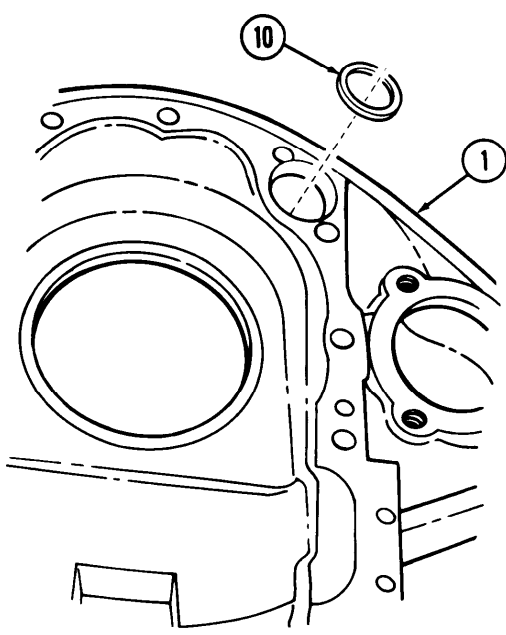
Perform step 3.1 if installing new flywheel housing.

3.1.	Dowel pins (3)	Remove.
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b. Cleaning and Inspection

4.	Flywheel housing (1)	a. Clean in accordance with instructions in paragraph 2-7. b. Inspect in accordance with instructions in paragraph 2-8.	Make sure gasket mating surfaces are clean. Discard if defective.
4.1.	Dowel pins (3)	Inspect for damage and wear.	Replace if damaged or outside diameter is worn less than 0.5005 in. (12.71 mm).

3-60. FLYWHEEL HOUSING REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				
				

END OF TASK!

TA 350239

3-61. CRANKSHAFT REAR COVER SEAL AND PLATE REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-60	Flywheel housing removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
None	None	
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W	None	
<u>Manual References</u>		
TM 9-2320-272-34P		

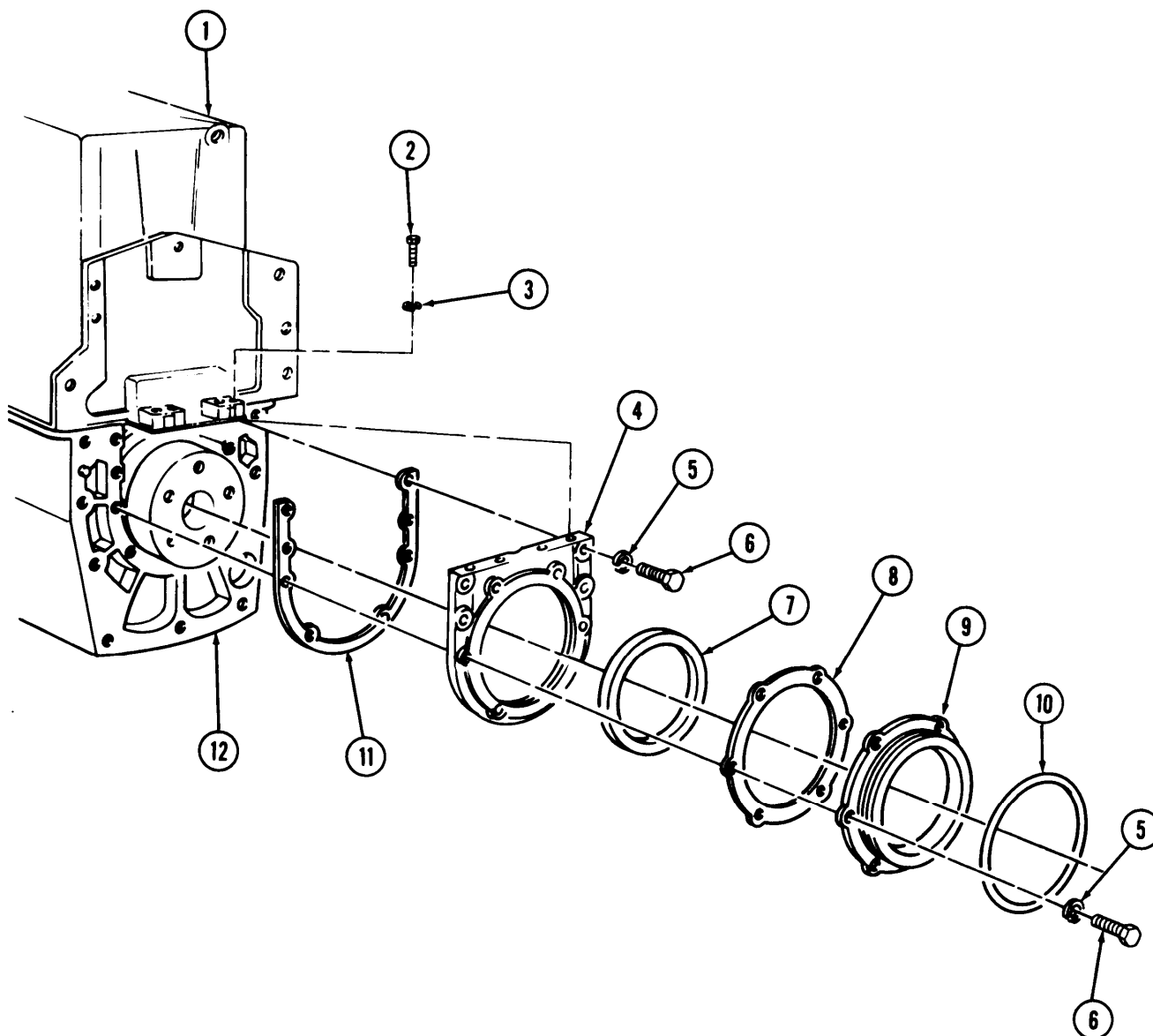
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

1.	Oil pan (1)	Four screws (2) and lockwashers (3)	Remove.	Discard lockwashers (3).
2.	Cylinder block (12)	Ten screws (6) and lockwashers (5), "O" ring retainer (9), re-tainer gasket (8), cover seal (7), cover plate (4), and cover plate gasket (11)	Remove.	Discard seal (7), "O" ring retainer gasket (8), plate gasket (11), and lockwashers (5).
3.	'O" ring retainer (9)	"O" ring (10)	Remove.	Discard "O" ring (10).

3-61. CRANKSHAFT REAR COVER SEAL AND PLATE REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 350240

3-62. ENGINE OIL PAN REMOVAL

This task covers:
Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-40	Oil pump return hose, pickup hose, and sump tube removed.
<u>Test Equipment</u>		
None		
<u>Special Tool</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		<u>General Safety Instructions</u>
None		None
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

- | | | |
|-------------------------|---------------------------------|---------|
| 1. Rear of oil pan (10) | Four screws (6) and washers (5) | Remove. |
|-------------------------|---------------------------------|---------|

NOTE

Engine oil pan is mounted with screw-assembled washers on late model engine.

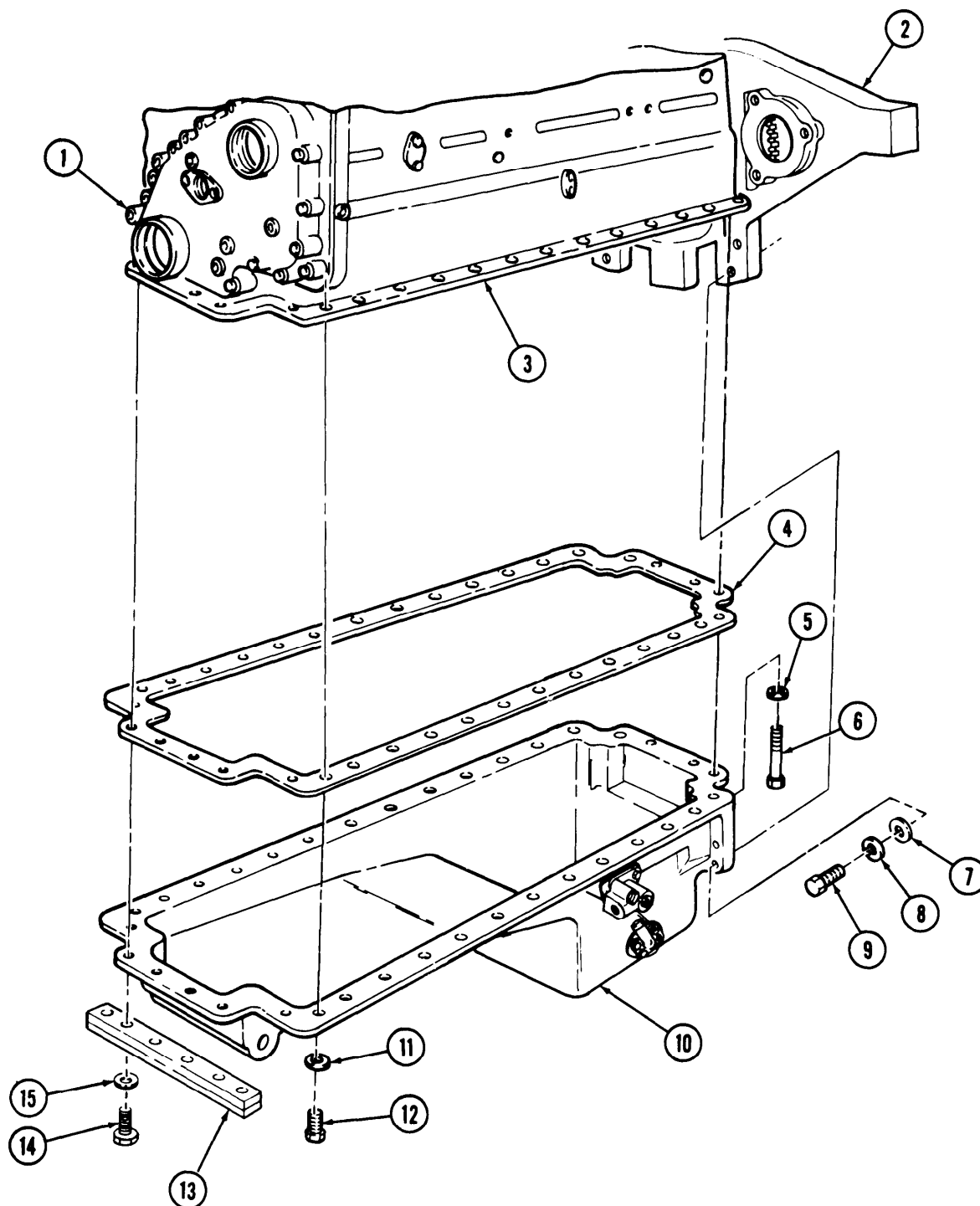
- | | | | |
|--|--|---------|---|
| 2. Both sides of oil pan (10) and engine block (3) | Thirty screws (12) and washers (11) | Remove. | |
| 3. Front of oil pan (10) and front of gearcase cover (1) | Four screws (14), washers (15), and brace (13) | Remove. | |
| 4. Engine oil pan (10) and flywheel housing (2) | Six screws (9), lockwashers (8), and washers (7) | Remove. | Discard lockwashers (8). |
| 5. Engine block (3) | Oil pan (10) and gasket (4) | Remove. | Discard gasket (4).
Clean gasket remains from mating surfaces. |

NOTE

For disassembly, cleaning, inspection, and reassembly, refer to para. 3-22.

3-62. ENGINE OIL PAN REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

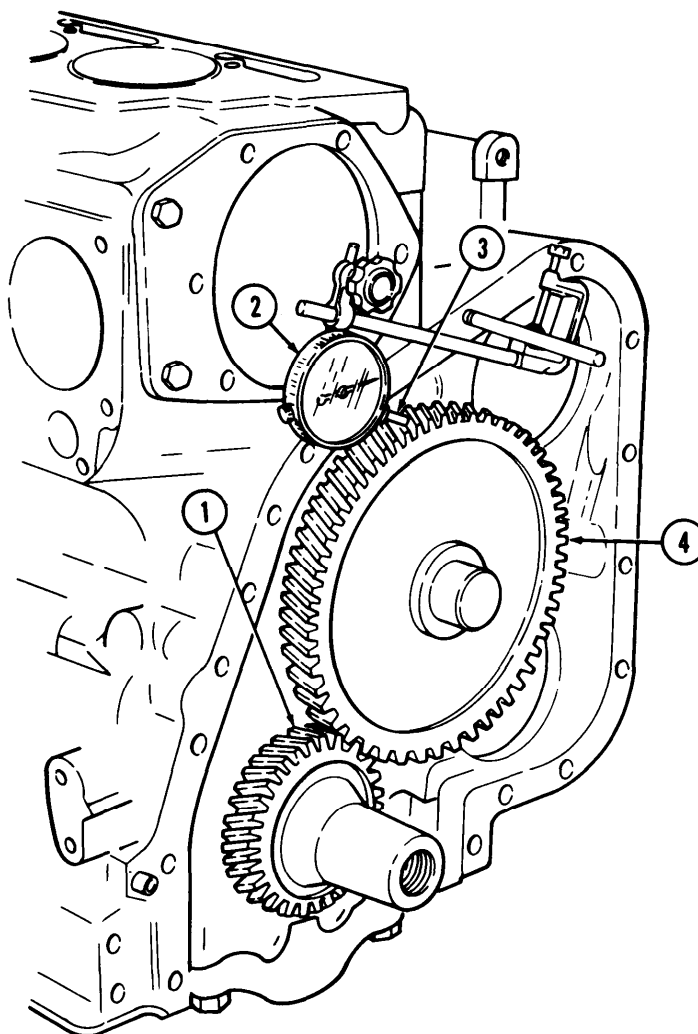
- a. Check Backlash
- b. Removal
- c. Disassembly
- d. Cleaning and Inspection
- e. Reassembly

Keep fire extinguisher nearby when using drycleaning solvent.

Change 2

3-63. CAMSHAFT AND GEAR MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-63. CAMSHAFT AND GEAR MAINTENANCE (Cont'd)

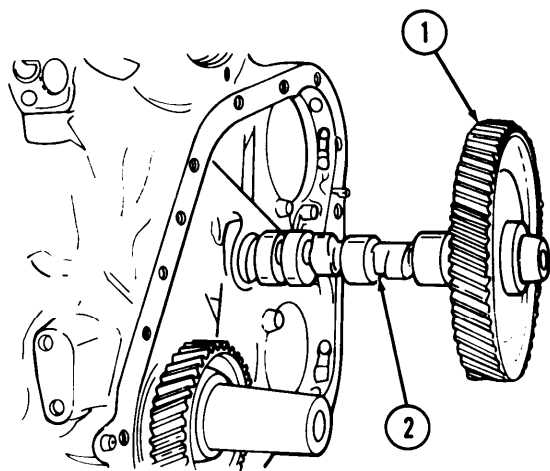
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Removal

2.		Camshaft gear (1) and camshaft (2)	Rotate slightly and remove.	
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CAUTION

Use care when removing camshaft to avoid damaging bearings.



c. Disassembly

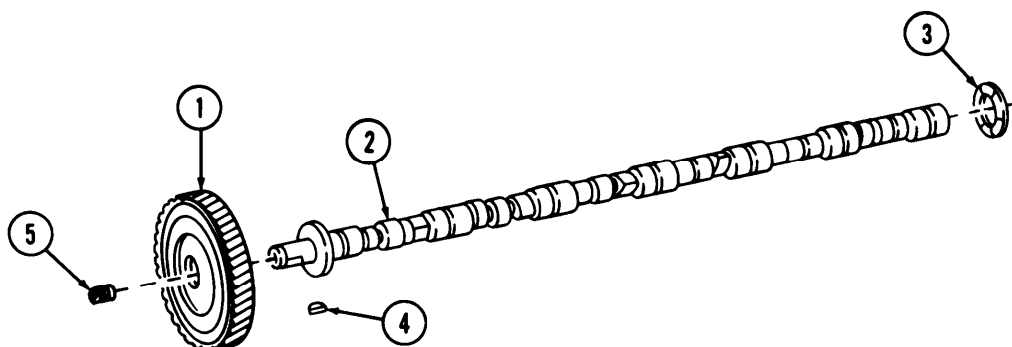
NOTE

Before disassembling camshaft gear from camshaft, perform task d of this procedure. If, as a result of inspection, camshaft gear must be disassembled from camshaft, perform steps 3 through 7.

3.		Camshaft (2)	Place between V-blocks.	V-blocks support camshaft (2).
4.	Camshaft (2)	Pipe plug (5)	Remove.	
5.		Camshaft gear (1)	Remove from camshaft (2).	Use puller.
6.		Woodruff key (4)	Remove from camshaft (2).	
7.		Thrust ring (3)	Remove from camshaft (2).	

3-63. CAMSHAFT AND GEAR MAINTENANCE (Cont'd)

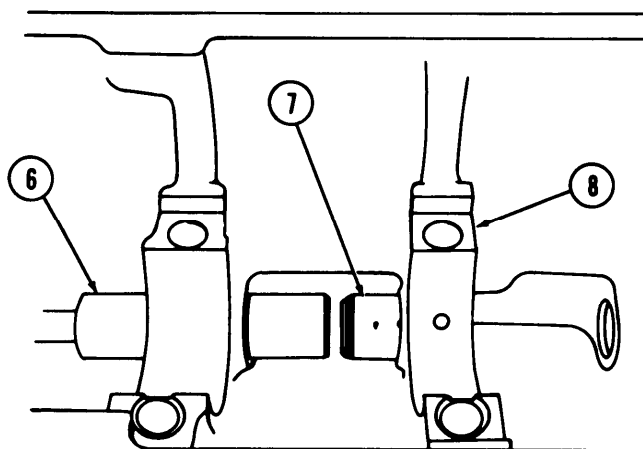
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Before removing camshaft bushings from engine block, perform task d of this procedure. If, as a result of inspection, bushings must be replaced, perform step a.

- | | | | | |
|----|--------------------|------------------------|---------|-------------------------------|
| 8. | Cylinder block (8) | Seven cam bushings (7) | Remove. | Use cam bushing replacer (6). |
|----|--------------------|------------------------|---------|-------------------------------|



3-63. CAMSHAFT AND GEAR MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Cleaning and Inspection

WARNING

Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

9.		Camshaft (2), camshaft gear (1), and thrust washer (3)	a. Clean with drycleaning solvent.	
			b. Inspect for cracks, breaks, or pits.	Discard if cracked, broken, or pitted.
10.		Camshaft (2) journals	Measure outside diameter using micrometer (6).	If outside diameter is less than 1.996 in. (50.70 mm) replace camshaft.
11.		Thrust ring (3)	Measure thickness,	Discard if thickness is less than 0.083 in. (2.11 mm).
12.		Seven camshaft bushings (7)	a. Clean with drycleaning solvent.	
			b. Inspect for breaks, cracks, or pits.	Discard if broken, cracked, or pitted.
			c. Measure inner diameter with bore gage (8).	Discard if inner diameter is more than 2.001 in. (50.83 mm).

e. Reassembly

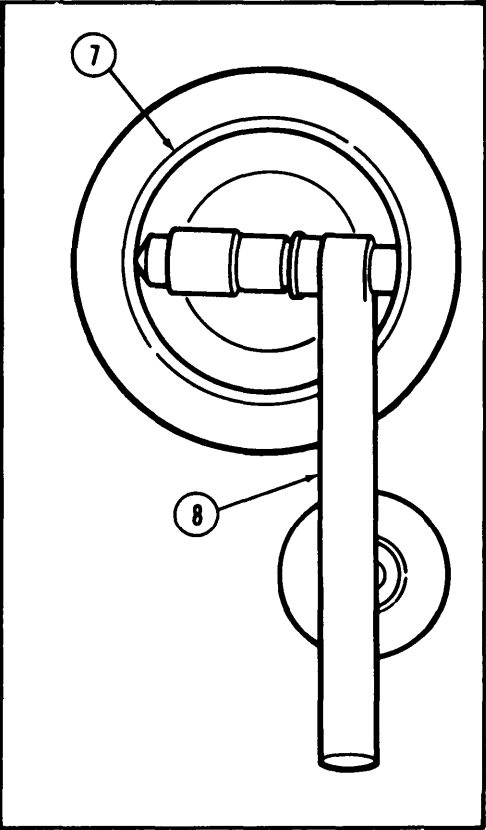
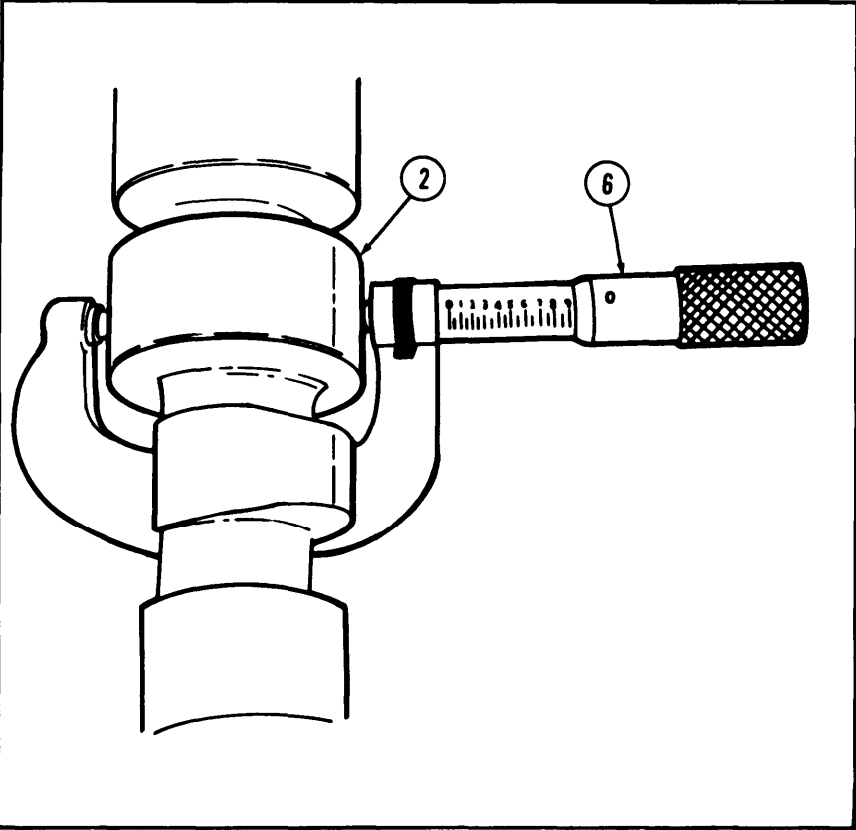
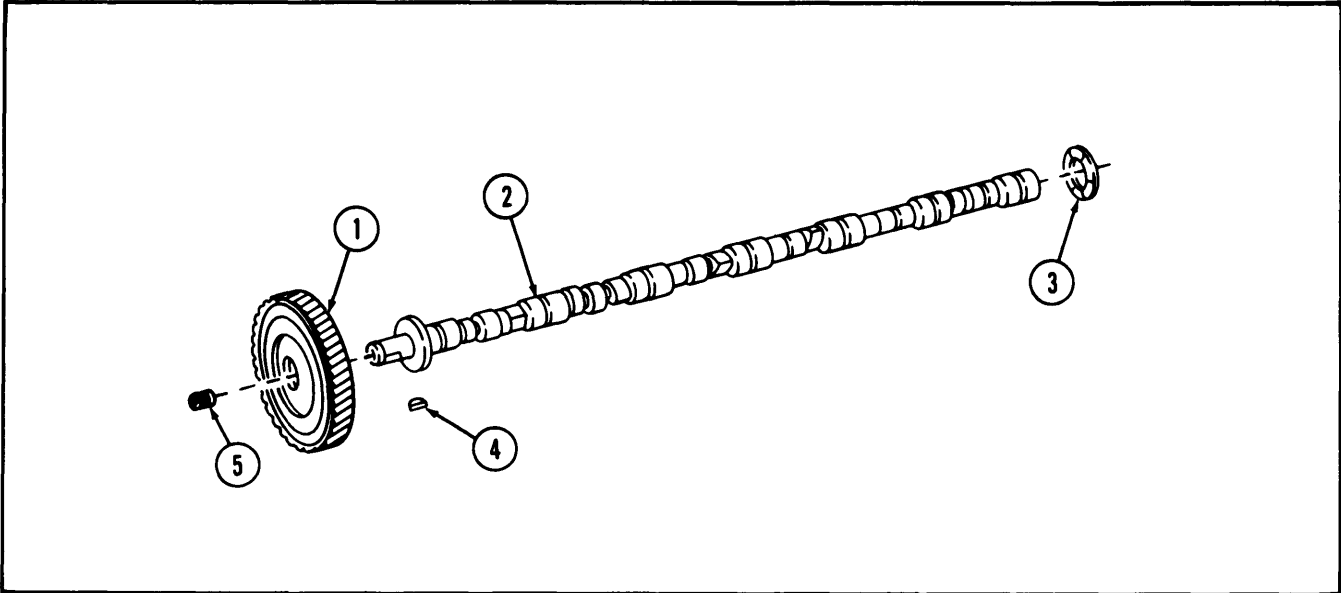
13.		Thrust ring (3)	Install on camshaft (2).
14.		Woodruff key (4)	Install in camshaft (2).
15.		Camshaft gear (1)	Install on camshaft (2).
16.		Pipe plug (5)	Install in camshaft (2).

NOTE

For reinstallation of camshaft bushings refer to para. 3-71.

3-63. CAMSHAFT AND GEAR MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 350245

3-64. CONNECTING ROD AND PISTON MAINTENANCE

This task covers:

- | | |
|--|----------------------------|
| a. Check Connecting Rod Side Clearance | d. Cleaning and Inspection |
| b. Removal | e. Reassembly |
| c. Disassembly | |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para, 3-63	Camshaft and gear removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Piston ring groove gage ST-560		None
<u>Materials/Parts</u>		
Twelve bearing shells		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		Gloves must be worn when handling hot pistons.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Check Connecting Rod Side Clearance**NOTE**

Connecting rod should have free movement at crank journal. Check with hand pressure first, Tap lightly with soft-faced hammer only if necessary.

1.	Connecting rod (3)	Move up and down on crank journal and measure clearance with feeler gage (2).	Clearance should be .0045-.013 in. (.11-.33 mm). Record clearance of all six connecting rods for reassembly,
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b. Removal

2.	Cylinder block (4)	a. Place in vertical position. b. Remove all carbon from upper inside wall of each cylinder liner.	Use ridge reamer as necessary.
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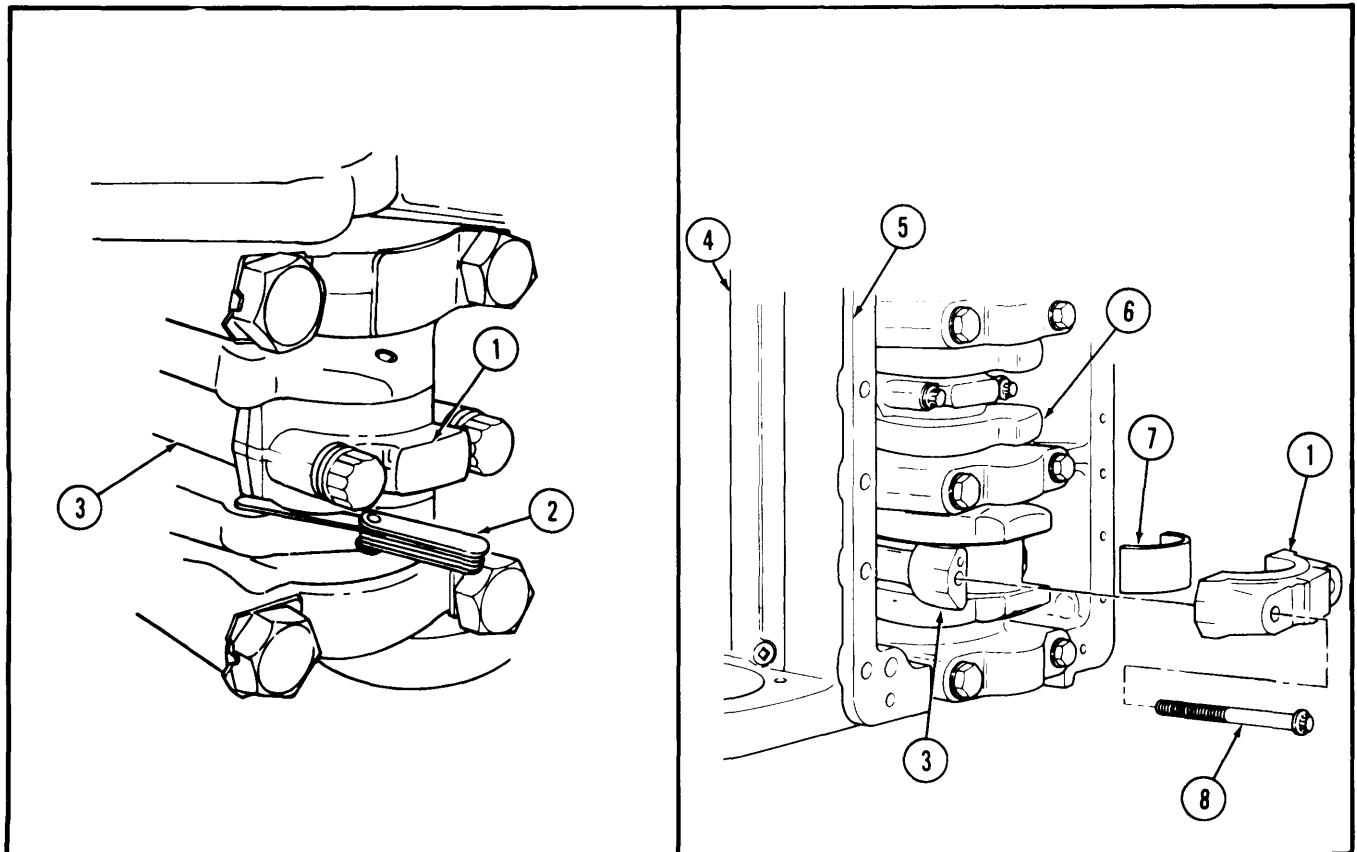
3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

All six connecting rod and bearing caps are removed the same way.
Steps 3 through 6 are for one connecting rod and bearing cap only.

3.		Crankshaft (6)	Rotate until rod bearing caps (1) are above edge of cylinder block flange (5).	
4.	Connecting rod bearing cap(1)	Two screws (8)	Loosen 3/8 in. (9.5 mm) and tap with soft-faced hammer.	Frees cap (1) from connecting rod (3).
5.	Connecting rod (3)	Two screws (8), bearing cap (1), and bearing shell (7)	Remove.	Tag and mark bearing cap (1) for installation. Do not mix caps (1).



3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Use a tape-protected tool to push piston from block. Failure to do this may result in damage to cylinder liners.

NOTE

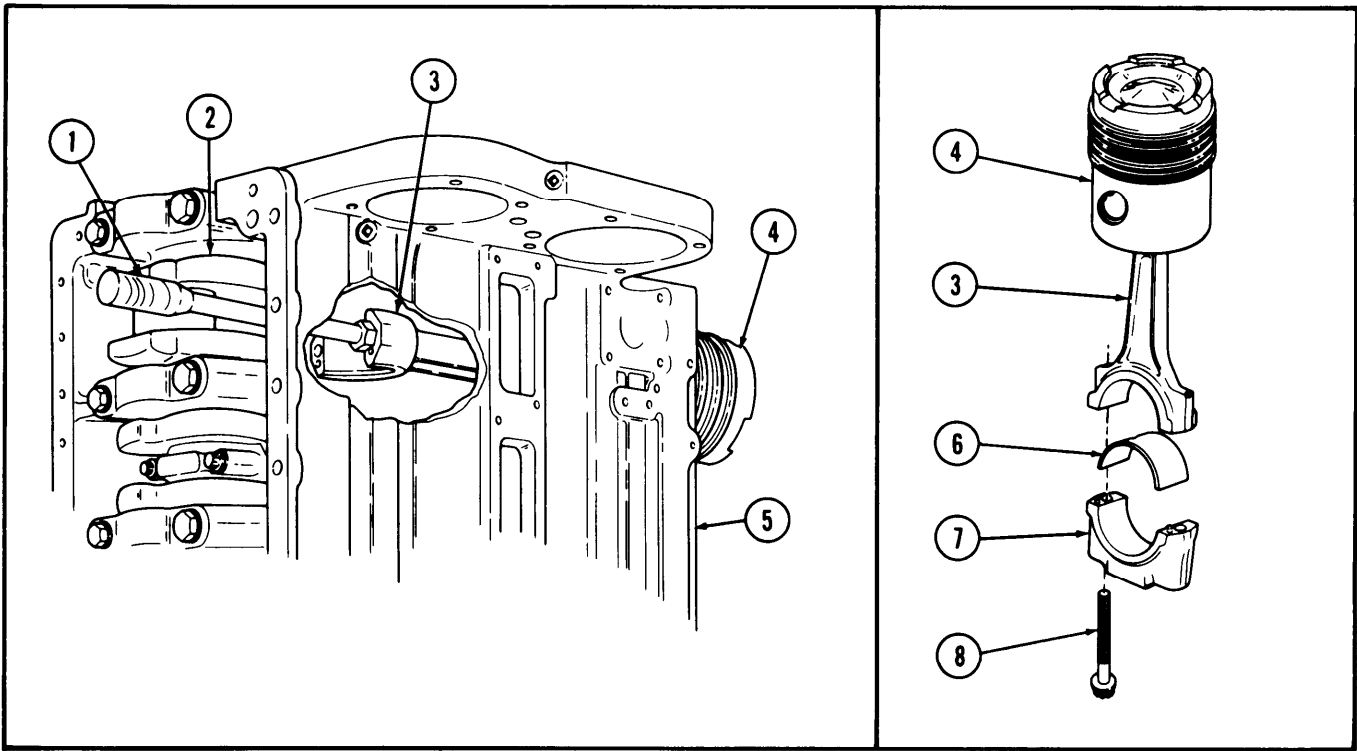
Assistant will help with step 6.

- | | | | |
|-----------------------|--|---|---|
| 6. Cylinder block (5) | Six connecting rods (3), pistons (4), and upper bearing shells (6) | a. Use a tape-protected tool (1). Push each out of block starting at crankshaft (2) side. | Mark location and position of all pistons (4) before removal from block. |
|-----------------------|--|---|---|

CAUTION

Bearing caps and connecting rods are stamped with the same number as the cylinder. Mixing piston assemblies may cause equipment damage.

- b. After each piston (4) and connecting rod (3) is removed, assemble bearing cap (7) to connecting rod (3) with two screws (8).



3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
----------	----------	------	--------	---------

c. Disassembly

- | | | | |
|----|----------------------|-----------------------|---------|
| 7. | Piston (4) | Four piston rings (9) | Remove. |
| 8. | Piston pin bore (12) | Two snaprings (10) | Remove. |

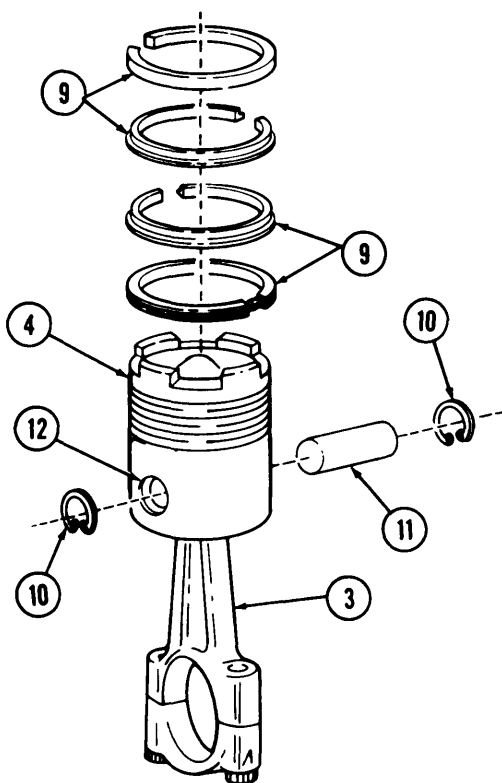
WARNING

Pistons must be heated in hot water to remove piston pins. Do not handle hot pistons with bare hands. Use protective gloves to avoid burning hands.

NOTE

Mark piston and connecting rod so it can be reassembled in same manner.

- | | | | |
|----|---|---|--|
| 9. | Pistons (4) and connecting rod (3) assemblies | <p>s. Submerge in container of hot water for fifteen minutes to allow pistons to expand,</p> <p>b. Remove and place in vise and push piston pin(n) out of piston pin bore (12).</p> <p>c. Place pistons (4), pistons pins (11), and connecting rods (3) on a numbered rack and hold for inspection.</p> | <p>Use tongs or hook to remove pistons from hot water. Do not drive pins (11) out with hammer.</p> |
|----|---|---|--|



3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Cleaning and Inspection

NOTE

Be sure to keep bearing caps assembled to mating connecting rods at all times to avoid mixing.

10.		Connecting rod assemblies (1)	a. Clean in accordance with instructions in paragraph 2-7. b. Inspect in accordance with instructions in paragraph 2-8. c. Visually check I-beam section (2) of connecting rod (3) for nicks, dents, and gouges. d. Check for cracks.	Replace connecting rod (3) if nicks, dents, and gouges are greater than .031 in. (.787 mm). Refer to paragraph 2-9 for further instructions.
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NOTE

To accurately measure all connecting rod bearing cap bores, the screws must be tightened to the operating torque specified in table 3-5.

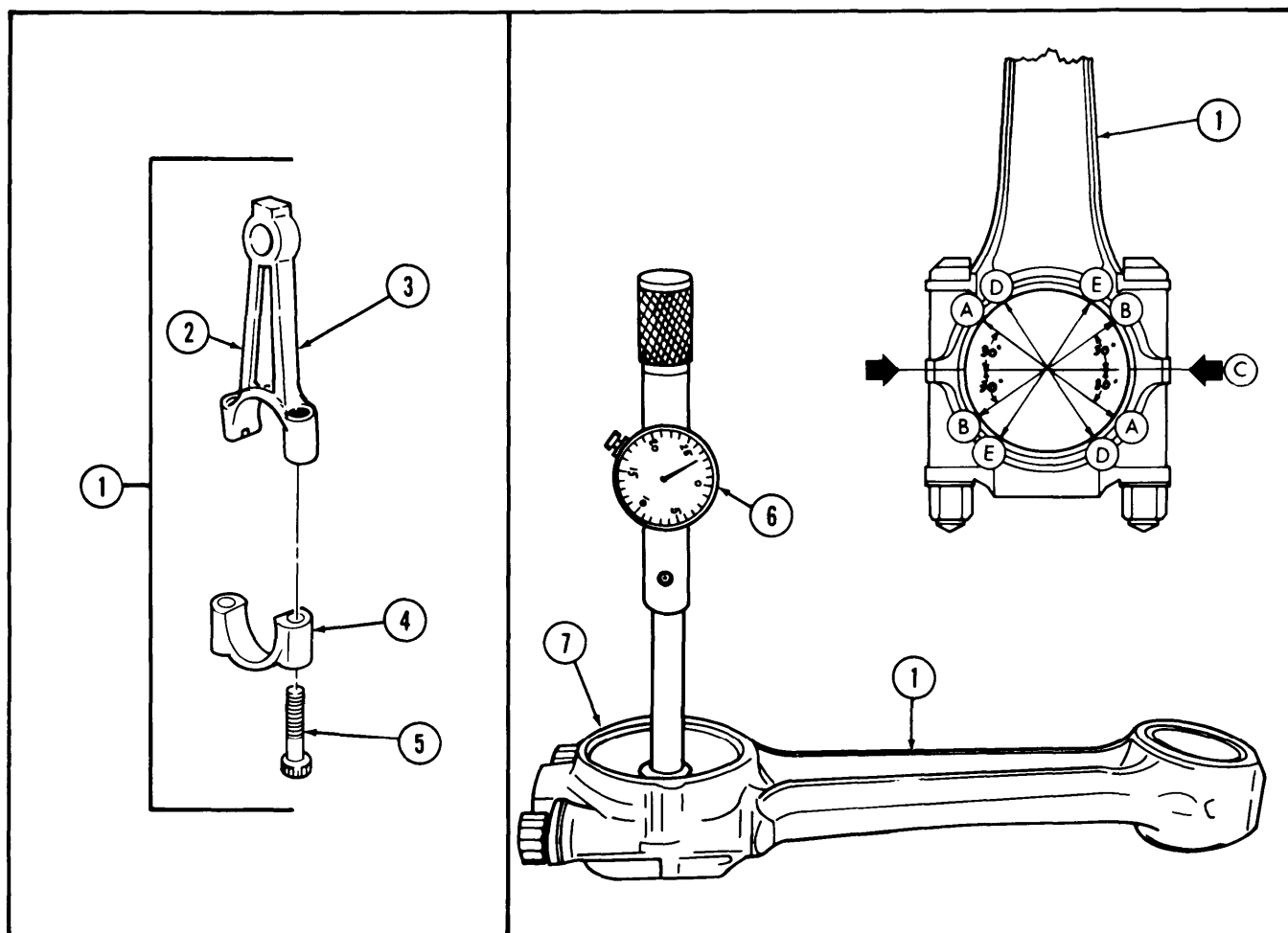
11.		Bearing caps (4)	a. Install to connecting rod (3) with screws (5). b. Alternately tighten in accordance with the sequence order in table 3-5.	Use torque wrench.
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Table 3-5. Connecting Rod Screw Tightening Sequence

Tighten Sequence	Torque Values	
	Lb-Ft	(N·m)
Step 1 — Tighten to	70-75	(95-102)
Step 2 — Tighten to	140-150	(190-203)
Step 3 — Loosen to	(0)	(0)
Step 4 — Tighten to	25-30	(34-41)
Step 5 — Advance to	70-75	(95-102)
Step 6 — Advance to	140-150	(190-203)

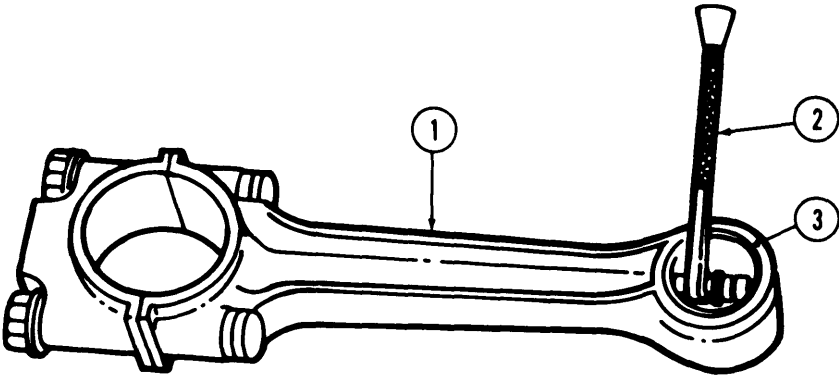
3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
12. Connecting rod (1)	Crankshaft journal bore (7)		<p>a. Using dial bore gage (6) measure inside diameter (I. D.) at points A-A and B-B, up to 30 degrees either side of parting line C, and record readings.</p> <p>b. Measure at points D-D and E-E; record readings.</p>	<p>Bore diameter must be 3.2722-3.2732 in. (83.114-83.139 mm).</p> <p>Bore diameter must be 3.2722-3.2732 in. (83.114-83.139 mm).</p> <p>Replace connecting rod (1) if the above specifications are not met.</p>



3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
13.	Connecting rod (1)	Piston pin bushing bore (3)	Check inside diameter using bore gage (2).	Pin bores are checked with bushings installed. If worn beyond 2.0022 in. (50.856 mm), mark bushings for replacement.



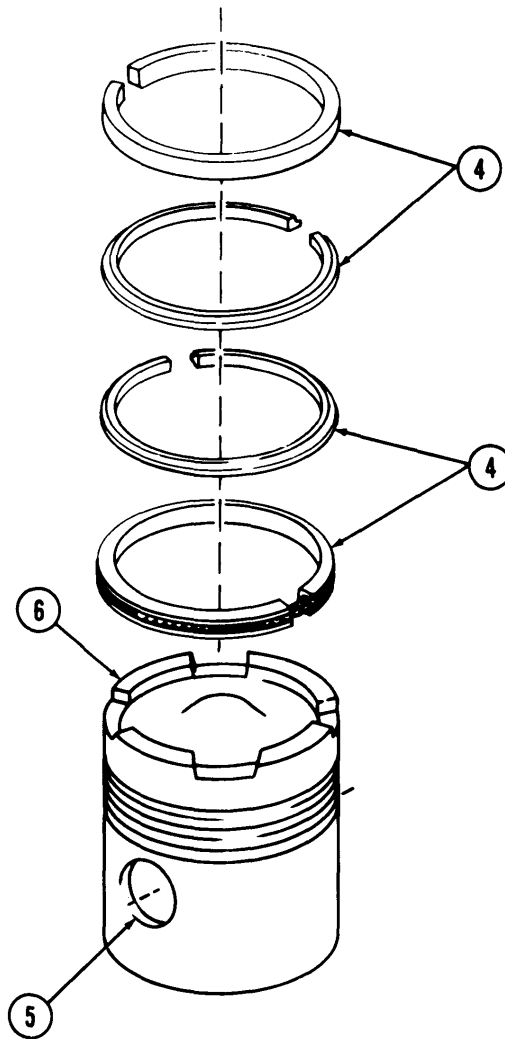
NOTE

- Pistons must be cleaned before inspection.
- Conditions of the pistons and piston rings should be carefully noted, as they indicate borderline conditions leading to engine failures.
- Pistons should be inspected at ambient temperatures of 70°-90°F (21°-32°C).

14.	Piston (6)	Check wear surface for scoring, scuffing, and cracks.	Replace if scored, scuffed, cracked.
15.	Piston rings (4)	a. Check for vertical scratching and discoloration of ring sealing surface. b. Check for broken rings (4). c. Check for formation of deposits which prevent outward movement of rings (4) to seal.	This is a major cause of oil consumption and piston and liner scoring. If scratched or discolored, replace. If broken, replace. If ring (4) sticks in piston grooves, replace.

3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
16, Piston (6)		Piston pin bore (5)	Check for fractures.	If fractured, replace piston (6).

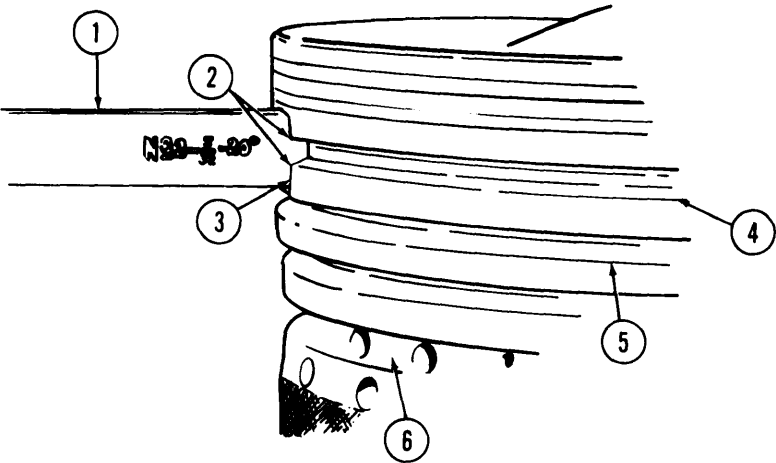


3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)				
STEP N O .	LOCATION	ITEM	ACTION	REMARKS

NOTE

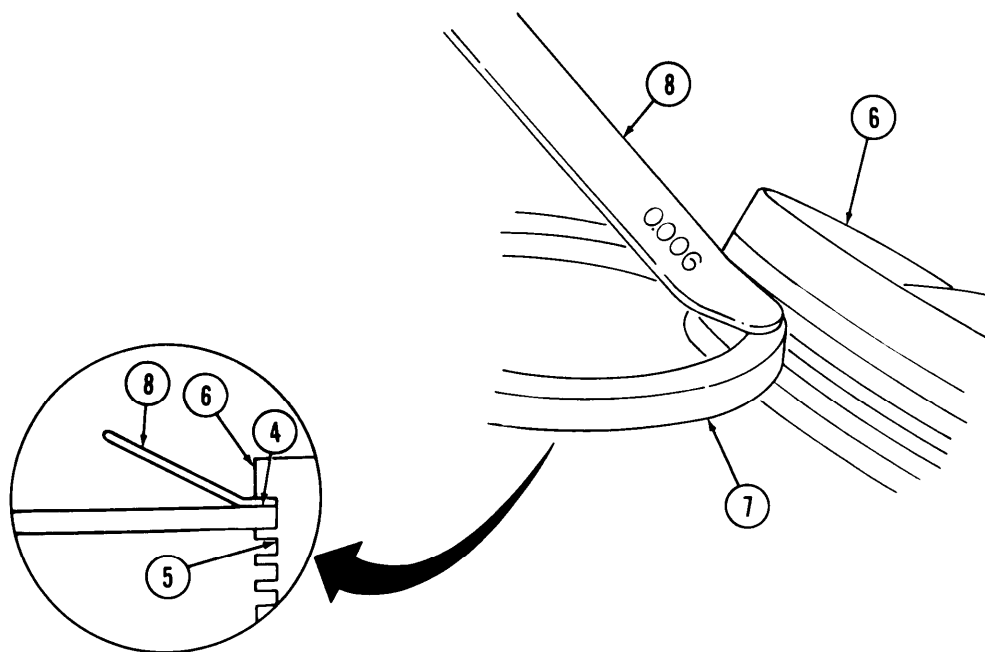
Pistons must be inspected at ambient temperatures of 70°-900F (21°-32°C) to obtain accurate measurement readings,

17.	Pistons (6)	Check for ring groove depth wear, as follows: a. Insert ring groove gage (1) into top ring groove (4). b. Shoulders (2) of gage (1) must not touch ring groove lands (3).	Use ring groove gage (2). Use same procedure to check second ring groove (5), If shoulders (2) touch either ring groove lands (3), pistons (6) are not serviceable and must be discarded.
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3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP N O .	LOCATION	ITEM	ACTION	REMARKS
18.		Pistons (6)	<p>Check ring groove widths for wear, as follows:</p> <p>a. Insert and hold new piston ring (7) in top ring groove (4).</p> <p>b. Try to insert 0.006 in, (0.15 mm) feeler gage (8) into ring groove (4) at top of piston ring (7).</p>	<p>Use new piston ring (7) and feeler gage (8).</p> <p>Use same procedure to check second ring groove (5).</p> <p>If feeler gage (8) enters either ring groove (4) or (5) without force, piston (6) is not serviceable and must be discarded.</p>



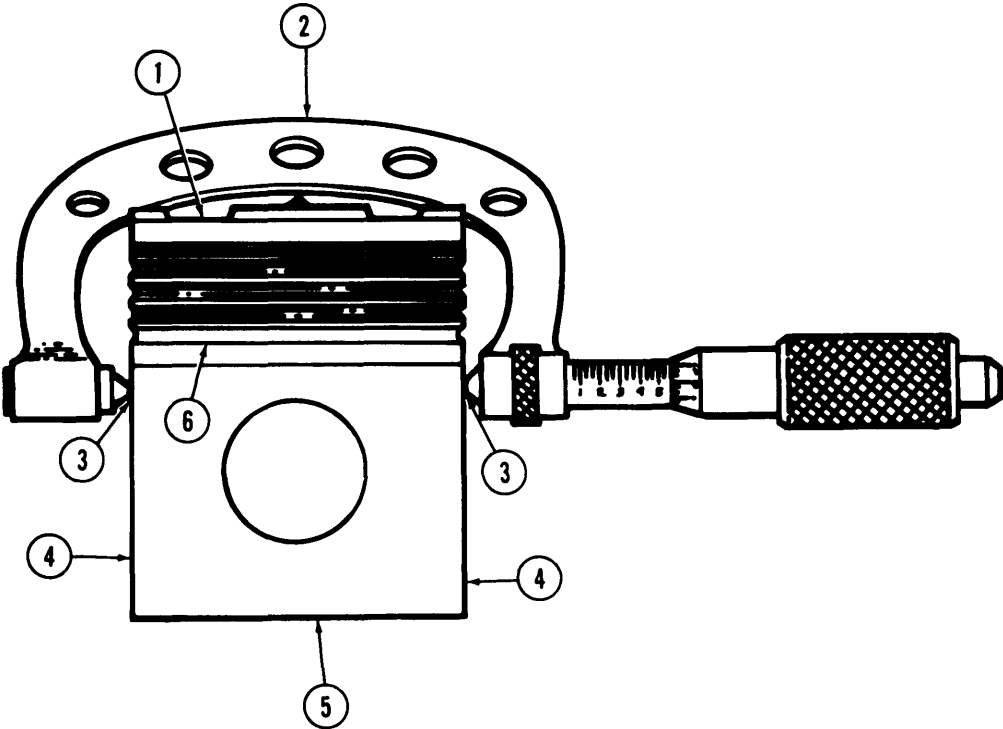
3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

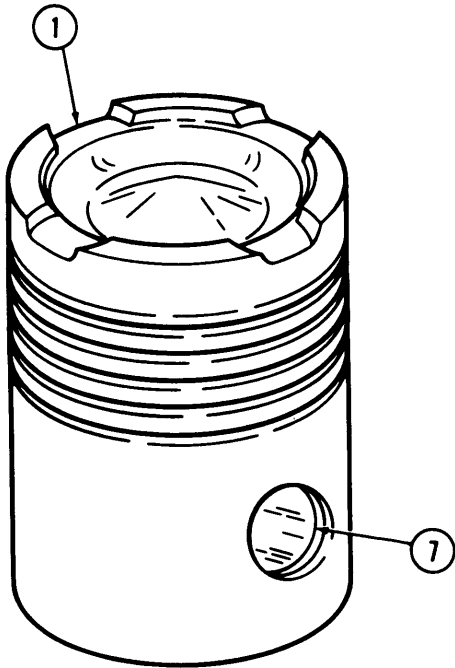
Measurements to check piston skirt outside diameters are taken at right angle to piston pin bore.

19.	Pistons (1)	Check skirt outside diameters. as follows:	Use 5.000-6.000 in. (127.0-152.4 mm) micrometer (2).
		a. Measure upper skirt outside diameter (3) approximately 1 in. (25.4 mm) below bottom ring groove (6).	Record reading.
		b. Measure bottom skirt outside diameter (4) approximately 1 in. (25.4 mm) above skirt bottom (5).	Discard piston (1) if outside diameters (3) and (4) measure less than 5.483 in. (139.27 mm).



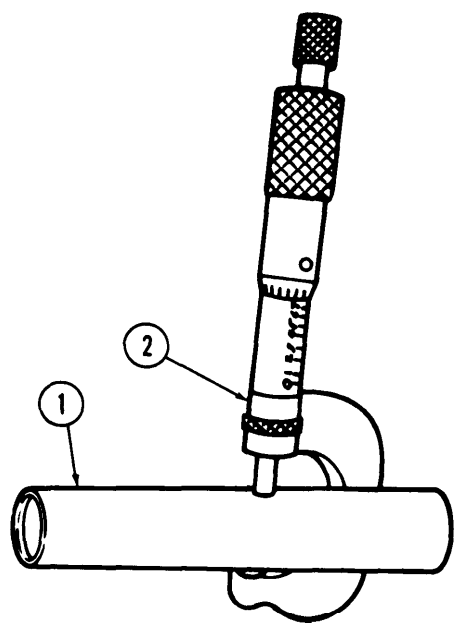
3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
20.		Piston (1)	Measure piston pin bore (7) inside diameter.	Discard piston (1) if piston pin bore (7) inside diameter exceeds 1.999 in. (50.775 mm) at 70°F (21°C). Add .0005 in. (0.13 mm) per each 10°F over 70°F (21°C) up to 90°F (32°C).



3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
21.		Piston pin (1)	Check outside diameter with micrometer (2).	Discard if worn out-of-round more than 0.001 in. (0,03 mm). Discard if diameter is smaller than 1.99885 in. (50.762 mm).



22.		Piston (10) part	Check all pistons (10) parts to be sure they are numbered the same.	Generally located on the inside of piston (10) skirt.
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NOTE

New piston rings must be checked in the cylinder liner in which they will be used to make sure ring gaps are correct.

23. Cylinder liner (3)	Piston rings (4), (7), (8), and (9)	a. Insert each in mating cylinder liner (3) bore. b. Use head (top) of piston (10) to position ring (4) so it seats squarely in ring (4) travel area. c. Measure ring gap (5) with feeler gage (6).	Ring gap (5) should meet specifications given in table 3-6.
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3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

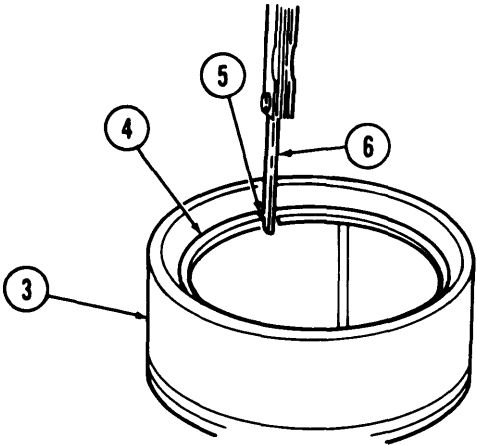
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Add 0.003 in. (0.08 mm) ring gap to new maximum for each 0.001 in. (0.03 mm) wear in cylinder liner wall. Measurement made in ring travel area of liner,

Table 3-6. Ring Gap

Number one compression ring (7) gap	0,023-0.033 in. (0.58-0.85 mm)
Number two and three compression ring (4) and (8) gap	0,019-0.029 in. (0.48-0.74 mm)
Number four oil ring (9) gap	0.010-0.025 in. (0.25-0.64 mm)

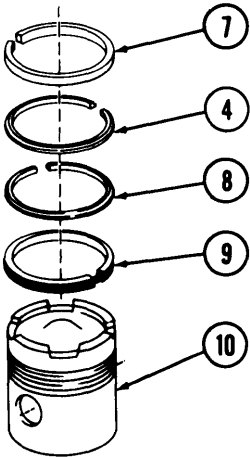


24. Piston (10)

Piston rings (7), (4), (8), and (9)

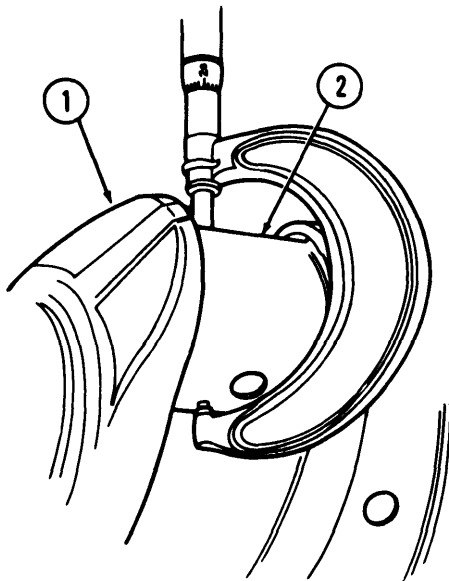
Install with word "top" toward top of piston (10).

Use piston ring expander.



3-64 CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
25.	Crankshaft assembly (1)	Connecting rod journals (2)	a. Check for scores and scratches. b. Using micrometer, check journals (2) for out-of-round wear.	If scored or scratched, replace crankshaft. If worn more than 0.002 in. (0.05 mm), replace crankshaft.



e. Reassembly

26.	Connecting rod (6)	Piston pin bushing (9)	Replace, using mandrel (3) and block (7) as follows: a. Remove bushing (9) using mandrel (3) removal tool (10) and arbor press. b. Install new standard size bushing (9) by assembling sleeve (4), bushing (9), and guide sleeve (8) on mandrel (3). c. Place connecting rod (6) on block (7), and support in horizontal position.	
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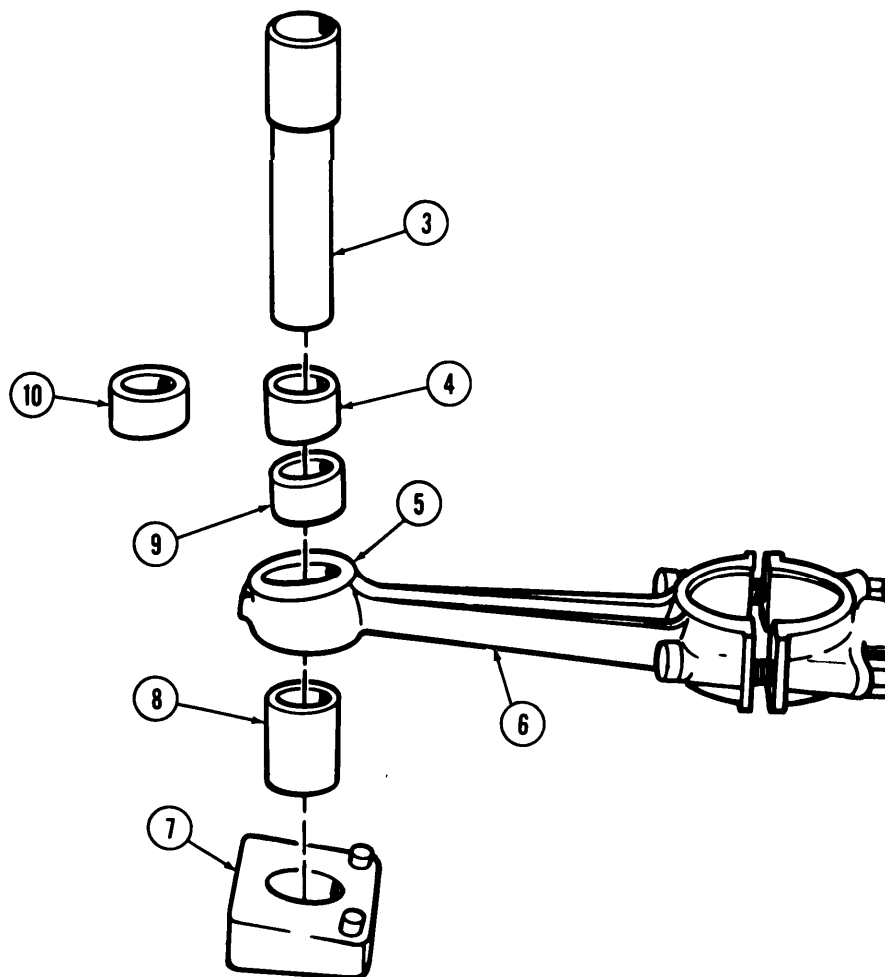
3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Line up mark on sleeve (8) with middle of boss on rod (6), making sure oil hole in bushing (9) and pin bore (5) are lined up.

e. Press bushing (9) into bore (5) until sleeve (8) contacts side of rod pin boss. Use arbor press.

f. Check inside diameter of new bushing (9). Replace if bushing (9) inside diameter is less than or greater than 2.001-2.0015 in. (50.83-50.838 mm).



3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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WARNING

Do not handle hot pistons with bare hands, or injury to personnel may result.

CAUTION

Never drive piston pins into pistons. Driving may cause distortion of piston and cause piston seizure in cylinder liner.

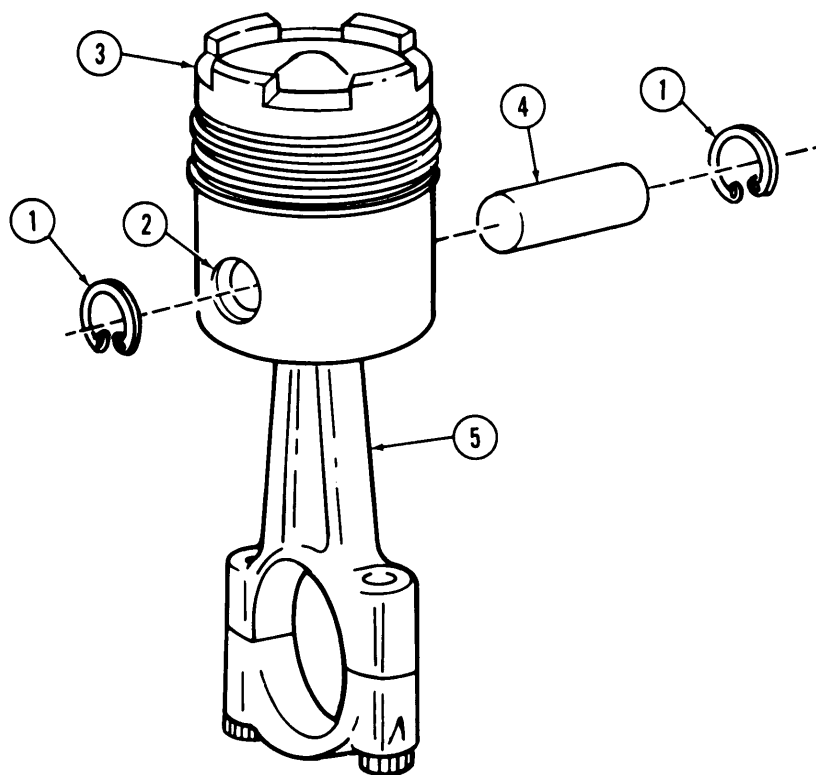
NOTE

- Be sure rod and bearing cap are stamped with the numbers of the cylinders they were removed from. All pistons must have same part number.
- Make sure pistons and connecting rods are assembled with orientation marks matching.

27. Connecting rods (5)	Pistons (3)	Assemble as follows: a. Install one piston pin snapping (1) in groove of piston pin bore (2). b. Heat pistons (3) in hot water, c. Install piston pin (4) through piston (3) and rod (5) pin bores before piston (3) cools. d. Secure pin (4) with second snapping (1) in piston pin groove at opposite end of pin bore (2).	Do not attempt to install pin (4) after piston (3) has cooled. Pin (4) will not fit.
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3-64. CONNECTING ROD AND PISTON MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA350260

3-317

3-65. CRANKSHAFT AND MAIN BEARINGS REMOVAL

This task covers:		
a. Removal	b. Cleaning and Inspection	
INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-64	Connecting rod and pistons removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Lint-free cloth (Appendix C, Item 7)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		Keep fire extinguisher nearby when using drycleaning solvent,
<u>Manual References</u>		
TM 9-2320-272-34P		

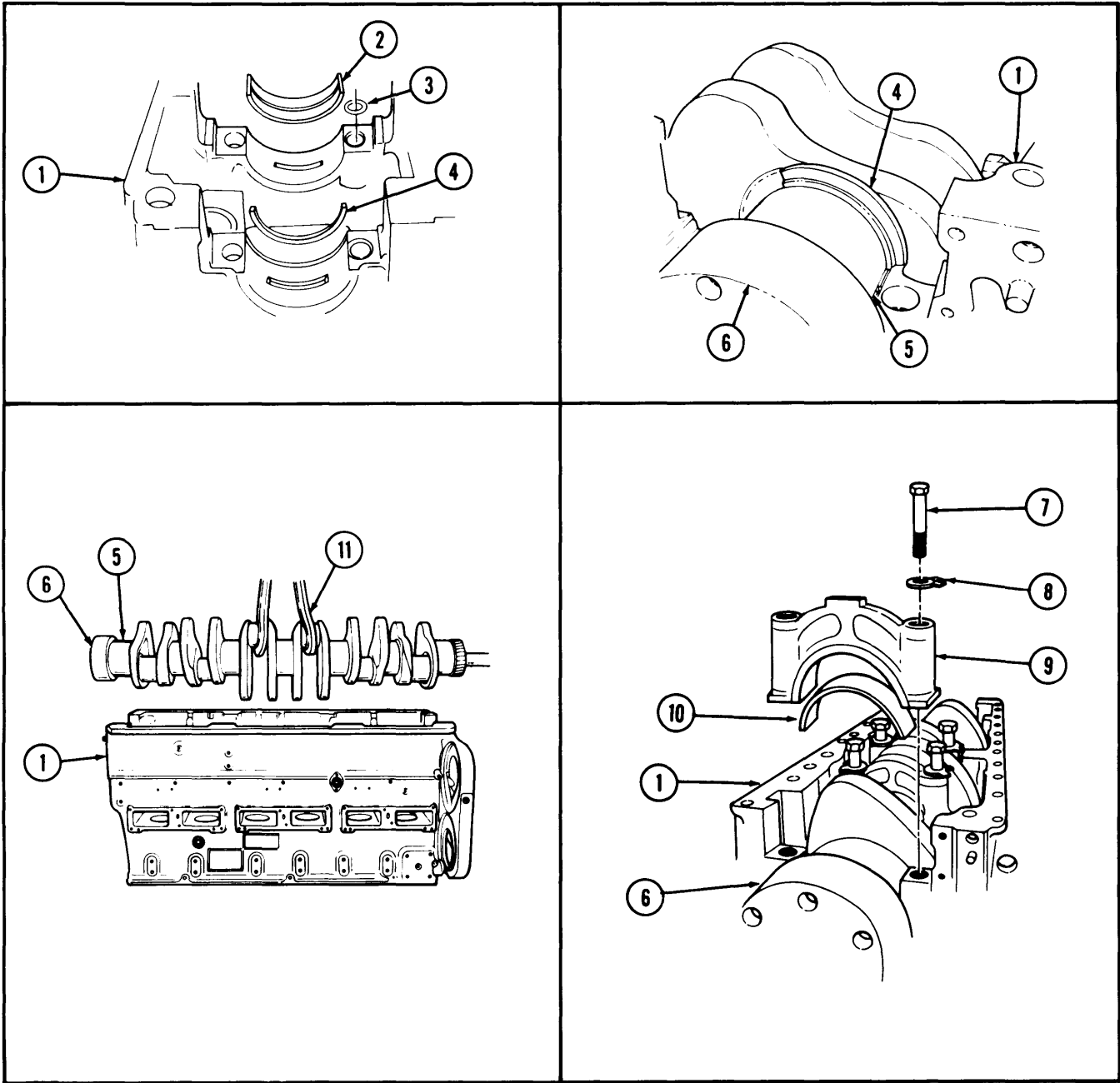
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1.		Cylinder block (1)	Turn upside down.	
2.	Main bearing caps (9)	Lockplates (8)	Bend down tab and remove two screws (7) from each bearing cap (9).	Discard lockplates (8).
NOTE Make sure all bearing caps and bearing shells are tagged for installation,				
3.		Main bearing caps (9)	Remove.	Use main bearing cap puller. Tag for installation.
4.	Main bearing caps (9)	Lower half bearing shell (10)	Remove.	Discard half bearing shell (10).
5.	Crankshaft rear journal (5)	Lower half of thrust ring (4)	Remove.	Discard thrust ring (4).
6.	Cylinder block (1)	Crankshaft (6)	a. Carefully remove, using hoist and rubber protected hooks (11). b. Place on clean, flat surface.	
7.	Cylinder block (1)	Upper half bearing shells (2)	Remove.	Discard half bearing shells (2).

3-65. CRANKSHAFT AND MAIN BEARINGS REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
8.		Seven dowel rings (3)	Remove.	Discard dowel rings (3).
9.		Upper half of thrust ring (4)	Remove.	Discard thrust ring (4).



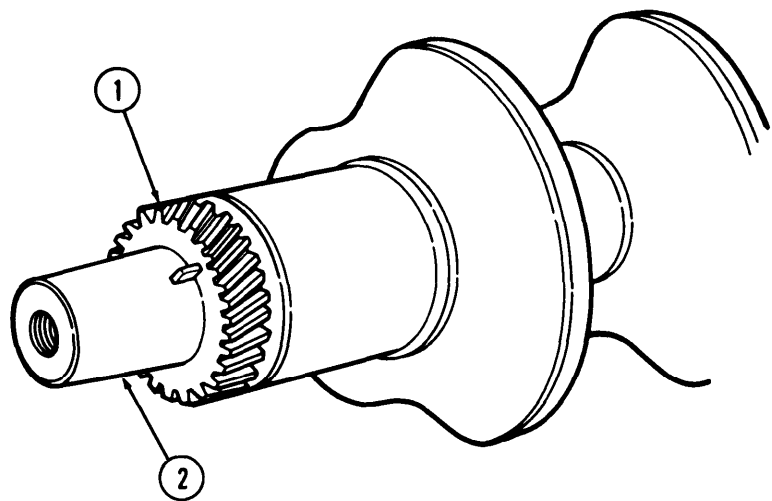
3-65. CRANKSHAFT AND MAIN BEARINGS REMOVAL (Cont'd)				
STEP NO.	LOCATION	ITEM	ACTION	REMARKS

b. Cleaning and Inspection

WARNING

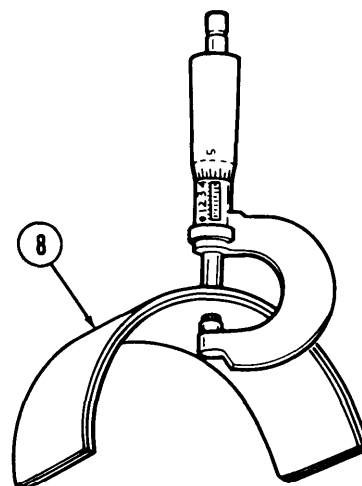
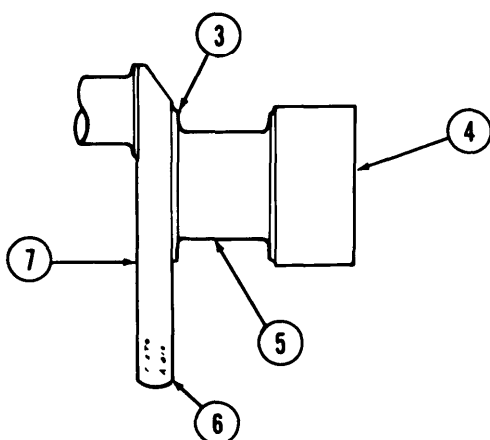
Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

10.		Crankshaft (2) and crankshaft gear (1)	Clean in accordance with instructions in paragraph 2-7.	
11.		Crankshaft gear (1)	Inspect for breaks, cracks, or chips.	If broken, cracked, or chipped, replace crankshaft assembly.
12.	Crankshaft (4)	Rear number seven main bearing journal thrust flange (3)	a. Wipe clean and check stamping (6) on shaft web (7). b. Inspect for scratches or scoring.	Stamped numbers show standard or oversize thrust rings both front and rear. If scratched or scored, regrind and stamp web (7) accordingly.



3-65. CRANKSHAFT AND MAIN BEARINGS REMOVAL (Cont'd)

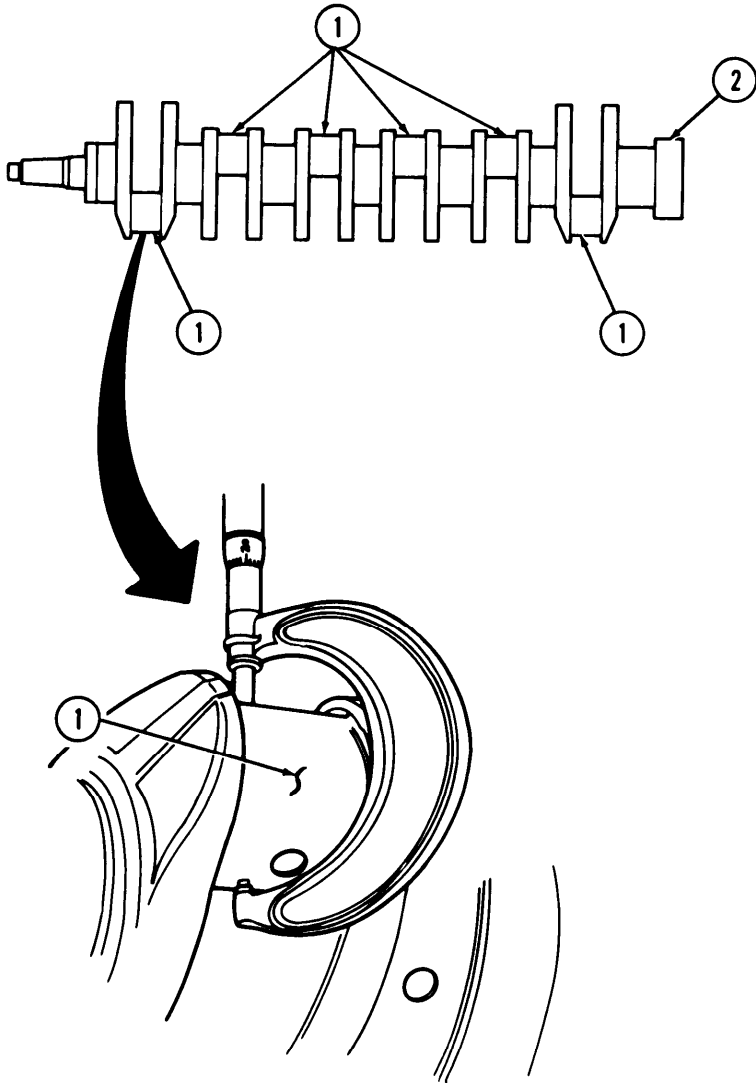
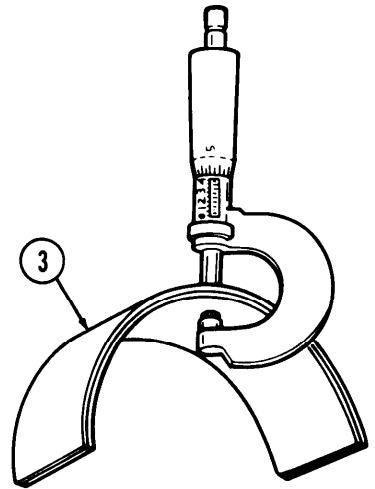
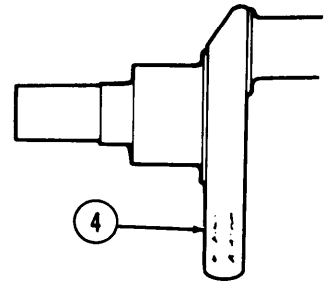
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p style="text-align: center;">CAUTION</p> <p>If any one bearing shell half is damaged, all bearing shells must be discarded. Not doing so will vary oil clearance limits when installed in engine and cause lubrication problems.</p>				
13.		Lower half main bearing shell and upper half main bearing shell (8)	<p>a. Wipe clean and inspect for pits, chips, and scratches.</p> <p>b. Measure shell thickness with micro-meter.</p>	<p>If pitted, chipped, or scratched, replace bearing set.</p> <p>If thickness is less than 0.1215 in. (3.086 mm), replace bearing set.</p>
14.		Crankshaft main bearing journals (5)	<p>a. Wipe clean with lint-free cloth and inspect for out-of-round condition.</p> <p>b. Measure outer diameter with micro-meter.</p>	<p>Measure with micro-meter and replace crankshaft if out-of-round more than 0.002 in. (0,05 mm).</p> <p>If outer diameter is less than 4.4975 in. (114.237 mm), repair and stamp on front counterweight (7) accordingly.</p>



3-65. CRANKSHAFT AND MAIN BEARINGS REMOVAL (Cont'd)
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STEP NO.	LOCATION	ITEM	ACTION	REMARKS
15.		Lower half rod bearing shell and upper half rod bearing shell (3)	a. Wipe clean and inspect for pits, chips, and scratches. b. Measure shell (3) thickness with micrometer.	If pitted, chipped, or scratched, replace bearing set. If thickness is less than 0.071 in. (1.80 mm), replace bearing set.
16.		Crankshaft rod journals (1)	Wipe clean with lint-free cloth and measure outer diameter with micrometer.	If outer diameter is less than 3.122 in. (79.30 mm), repair and stamp on front counterweight (4) accordingly.
17.		Rear counterweight seal flange (2)	Measure outer diameter with micrometer.	If outer diameter is under 5.997 in. (152.94 mm), replace crankshaft.

3-65. CRANKSHAFT AND MAIN BEARINGS REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				
				

END OF TASK!

TA350264

3-323.

3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning and Inspection

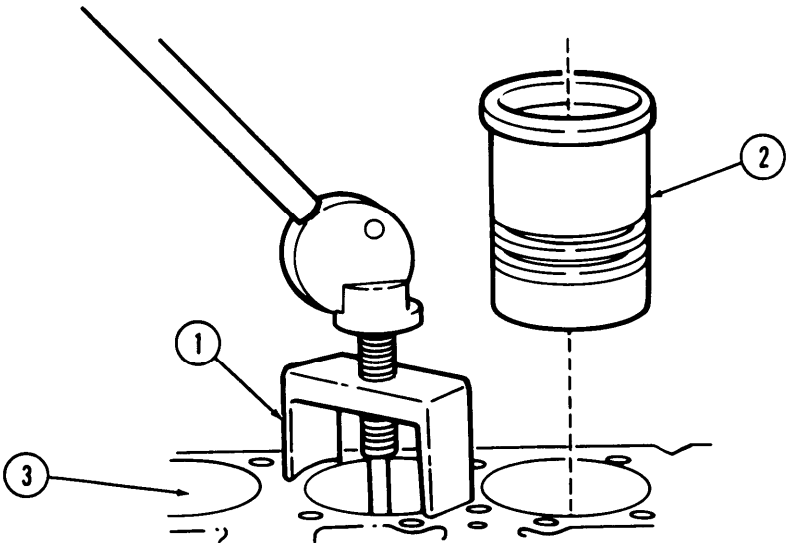
INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-65	Crankshaft and main bearings removed,
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Liner clamp set 3376669		Work area clean and free from blowing dust and dirt.
<u>Materials/Parts</u>		<u>General Safety Instructions</u>
Two lockwashers Suction flange plate gasket Sealing tape (Appendix C, Item 30)		<ul style="list-style-type: none">• Keep fire extinguisher nearby when using drycleaning solvent.• Compressed air source will not exceed 30 psi (207 kPa).• Eyeshields must be worn when cleaning with compressed air.
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1. Cylinder liner bores (3) Six cylinder liners (2) Remove,
- Use cylinder liner puller (1).
Tag cylinder liners (2) for installation.



3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

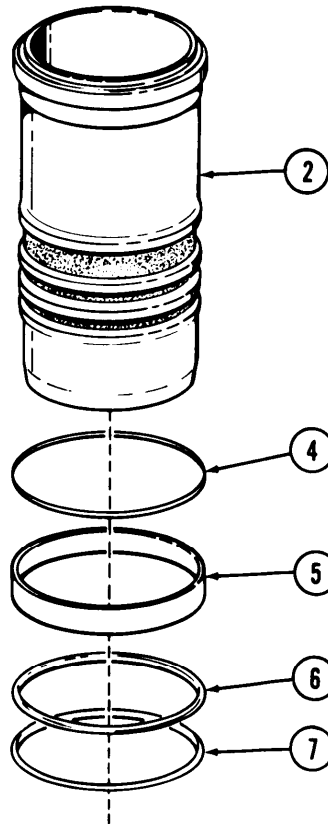
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Disassembly

NOTE

All six cylinder liners are repaired the same way. Only one is covered in this procedure,

2.	Cylinder liner (2)	Upper and lower "O" rings (6) and (7) and crevice seal (5)	Remove.	Discard "O" rings (6) and (7) and crevice seal (5).
3.		Shim pack (4)	a. Remove from liner (2) and measure thickness with micrometer. b. Tape together and tag with corresponding liner (2) number.	Record readings so same shim pack (4) thickness can be installed. Hold for reassembly.
4.		Cylinder liner (2)	Place on numbered rack.	Hold for cleaning and inspection.



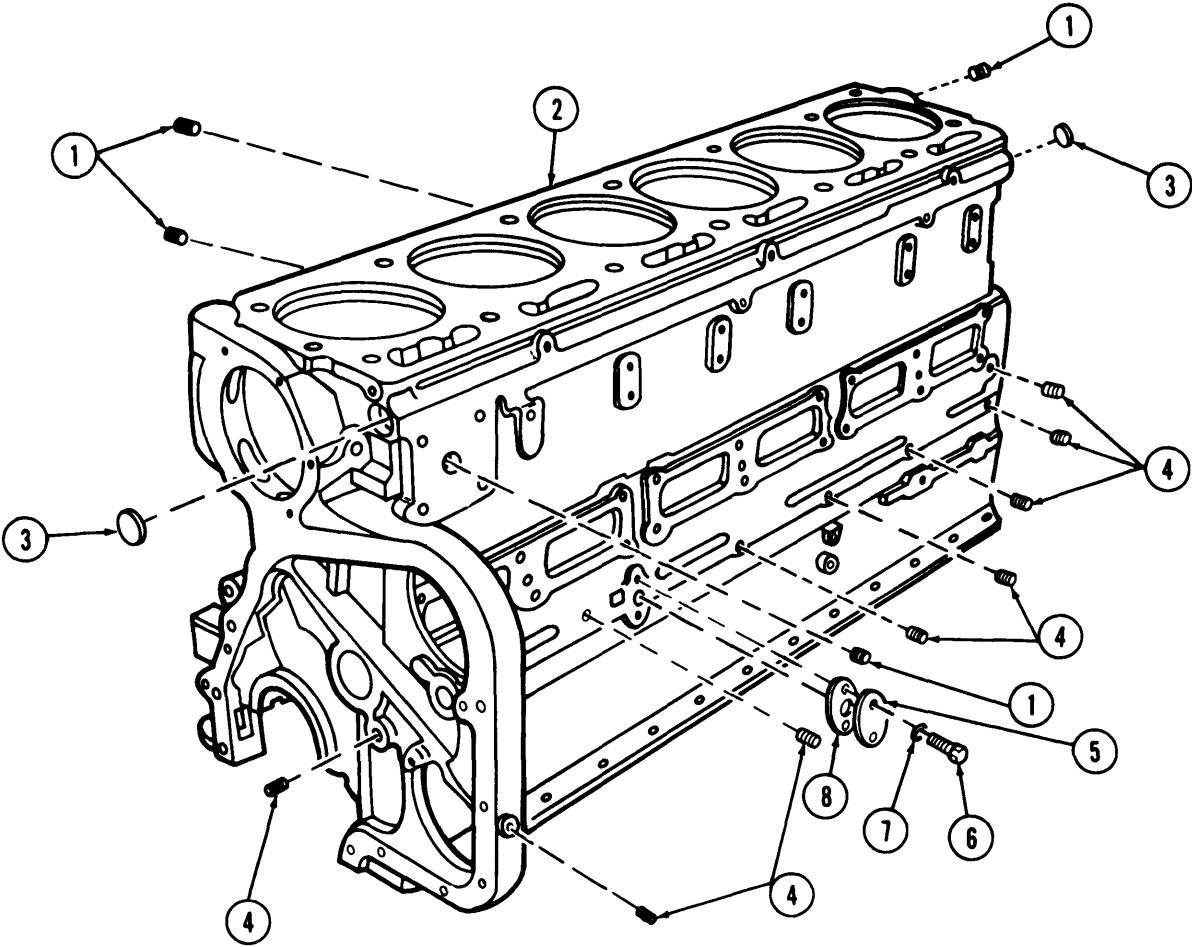
3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Note location of plug removal for installation.

- | | | | | |
|----|--------------------|------------------------------------|--|---|
| 5. | Cylinder block (2) | Water passageway pipe plugs (1) | Remove. | |
| 6. | | Oil passageway pipe plugs (4) | Remove. | |
| 7. | | Water passageway cup plugs (3) | Remove. | |
| 8. | | Two screws (6) and lockwashers (7) | Remove and detach suction flange plate (5) and gasket (8). | Discard lockwashers (7) and gasket (8).
Clean gasket remains from mating surfaces. |



TA350267

3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Cleaning and Inspection

WARNING

Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

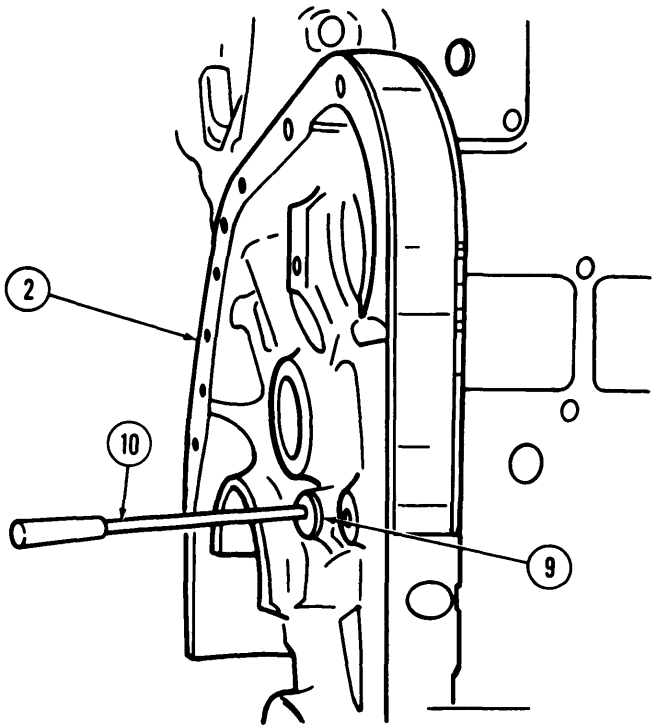
9. Cylinder block (2)
- a. Clean.

b. Run rods (10) with brushes through all oil passages (9).
- Refer to paragraph 2-7.

WARNING

Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.

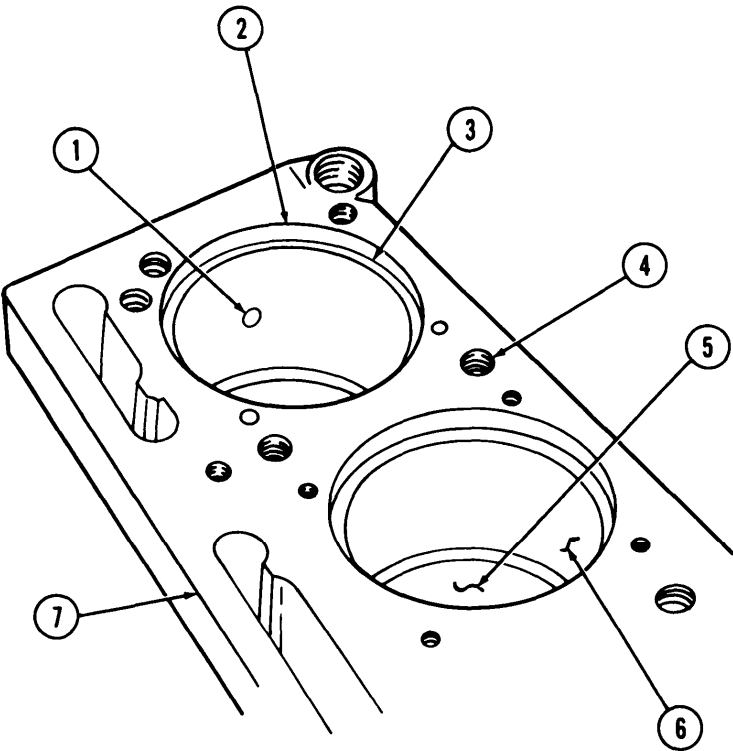
- c. Blow passages (9) clean with compressed air.



3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

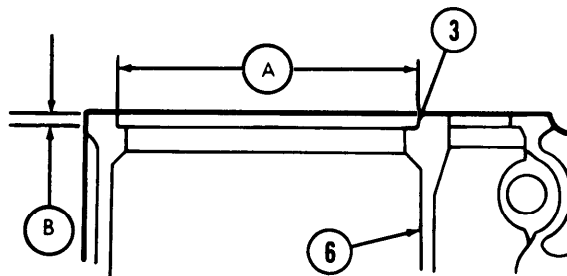
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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- d. Clean water pump air bleed hole (1) in number one cylinder bore (2) with compressed air.
- e. Blow all dirt and cleaning solvent from all screw holes (4).
- f. Remove scale from liner counterbore ledge (3).
- g. Clean carbon from lower liner bore (5)



3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
10.		Cylinder block (7)	Inspect in accordance with instructions in para. 2-8. Check for worn surfaces, pitting, corrosion, nicks, gouges, burrs, eroded water holes, damaged threads, distortion, and cracked areas.	Cylinder block must be on flat surface or work bench for inspection.
11.		Counterbore ledge (3) of cylinder liner counterbore (6)	<ol style="list-style-type: none"> The ledge must be 90 degrees to liner bore. Check at measuring point (A) and (B). Check counterbore diameter (A) and depth (B) to insure proper seating of cylinder liner and to determine if machining of counterbore ledge (3) depth (B) is necessary. 	



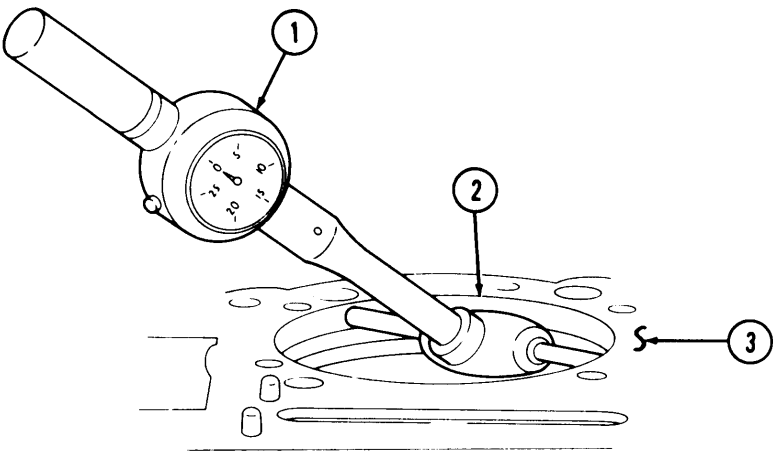
3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Refinish of the counterbore ledge will be required if counterbore depth varies more than 0.001 in. (0.03 mm) at several areas measured, if counterbore slants downward toward center of cylinder liner bore or if specification limits in table 3-7 are exceeded.

12.		Cylinder block (3)	<p>Check for possible counterbore (2) distortion using the following method:</p> <p>a. Position bore gage (1) and set dial to zero.</p> <p>b. Move gage around circumference of counterbore (2) taking readings at three intervals of 120 degrees.</p>	<p>The difference in the readings will indicate amount of distortion, Replace block if specifications in table 3-7 are exceeded.</p>
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3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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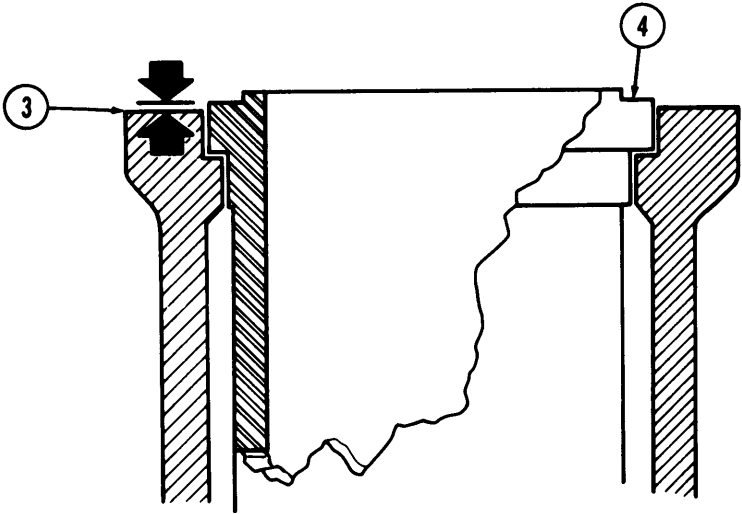
Table 3-7. Cylinder Liner Counterbore

	Inside Diameter	Depth
New minimum	6.5615 in. (166.662 mm)	0.350 in. (8.89 mm)
New maximum	6.5635 in. (166.713 mm)	0.352 in. (8.94 mm)
Wear limit		0.412 in. (10.46 mm)

c. Cylinder liners (4) must protrude 0.003-0.006 in. (0.08-0.15 mm) above the cylinder block (3) when they are properly installed,

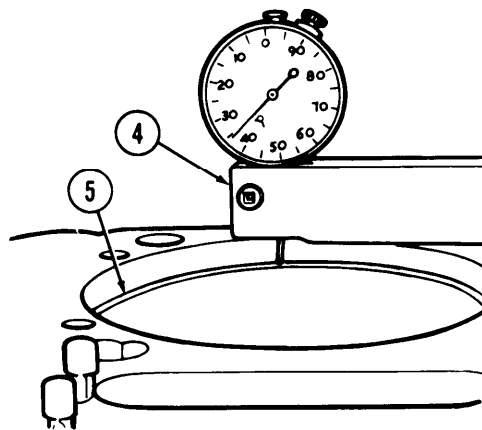
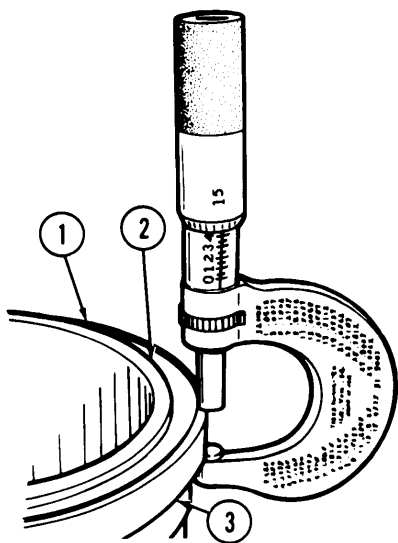
NOTE

Shims are used to compensate for counterbore depth wear.



3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
13.		Cylinder liner (1)	<p>Check for proper protrusion without installing a cylinder liner (1) as follows:</p> <p>a. Measure liner (1) outside flange (3) with micrometer, Do not include bead (2) when taking measurements.</p> <p>b. Measure counter-bore ledge (5) depth with gage block (4).</p> <p>c. Subtract counter-bore depth from liner (1) outside flange (3) depth to determine amount of shims or depth of counterbore cut to be made to obtain 0.003-0.006 in. (0.08-0.15 mm) liner protrusion.</p>	<p>Counterbore ledge must be smooth and not "cupped" more than 0.0014 in. (.036 mm). Depth must not vary more than 0.001 in. (.0254 mm).</p>



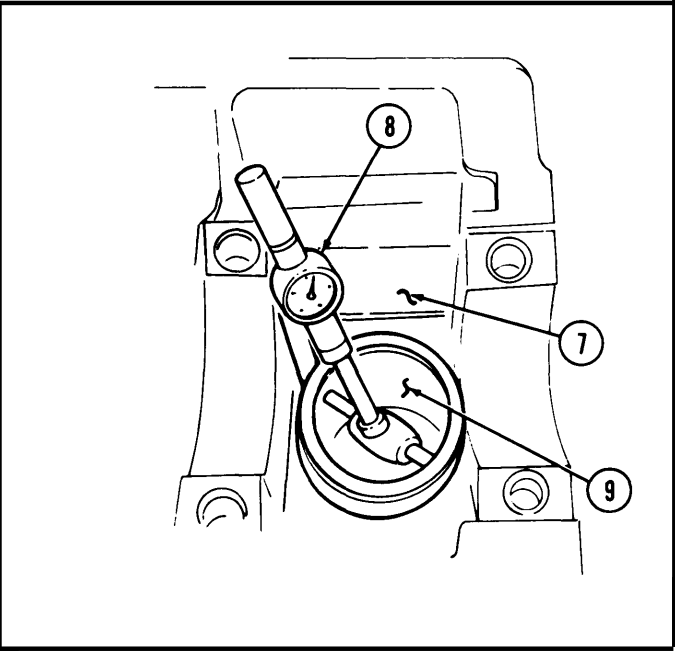
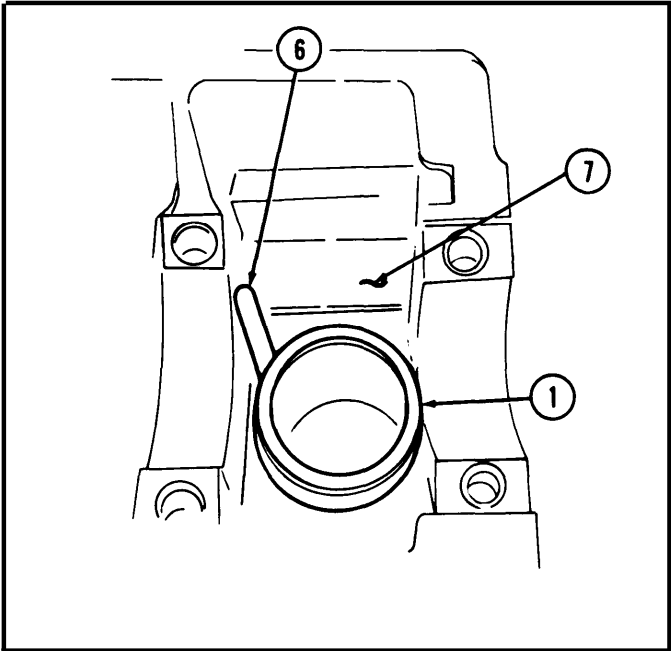
TA350273

3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP N O .	LOCATION	ITEM	ACTION	REMARKS
14.		Cylinder liner (1)	Install in block (7) without "O" rings or crevice seal.	Use clamps to hold liner in block. Make sure clamps are installed so there is equal pressure on liner. Tighten clamps 50 lb-ft (68 N•m).
15.		Feeler gage (6)	Use to check clearance between lower liner (1) and block (7).	Clearance should be within limits specified in table 3-8 below. If not, check lower "O" ring groove inside diameter in block (7).
16.		Cylinder liner (1)	Remove from block (7).	
17.		Bore gage (8)	Use to check lower liner bore (9) in block (7),	Bore should be within limits in table 3-8.

Table 3-8. Lower Linew Bore Inside Diameter and Block Clearance

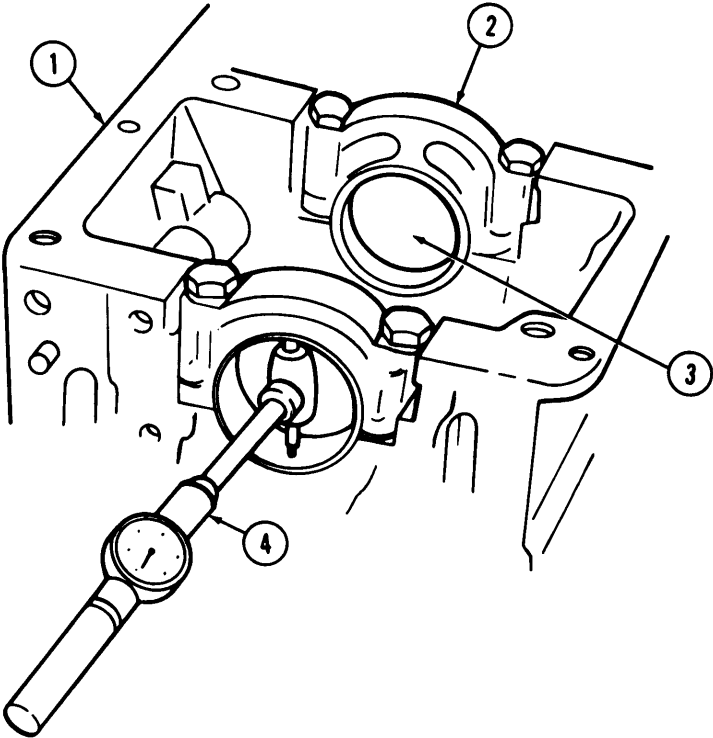
	<u>Minimum</u>	<u>Maximum</u>
Lower liner bore inside diameter	6.124 in. (155.55 mm)	6.126 in. (155.60 mm)
Lower liner to block clearance	0.002 in. (0.05 mm)	0.006 in. (0.15 mm)



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3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP N O .	LOCATION	ITEM	ACTION	REMARKS
18.		Main bearing caps (2)	Install in block(1)	Refer to para-
			without crank or bear-	graph 3-65.
			ing shells.	
19.		Main bearing bore	Measure horizontally,	Bore diameter must
		diameter (3)	vertically, and diagon-	not exceed 4.75 in.
			ally with bore gage (4).	(120-663 mm).
NOTE				
Pipe plugs, cup plugs, and suction flange plate are installed at this				
time to keep passages clean. Wrap pipe plug threads with sealing				
tape to prevent leakage.				
20.		cup plugs (6)	Install in block (1).	
21.		Pipe plugs (5)	Install in block (1).	Tighten according to
				table 3-9.
22.		Pipe plugs (7)	Install in block (1).	Tighten according to
				table 3-9.
23.		Suction flange plate	Position on cylinder	Tighten 10-15 lb-ft
		(10) and new gasket	block (1) and install	(14-20 N•m).
		(11)	with two new lock-	
			washers (9), and	
			screws (8).	



3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP N O .	LOCATION	ITEM	ACTION	REMARKS
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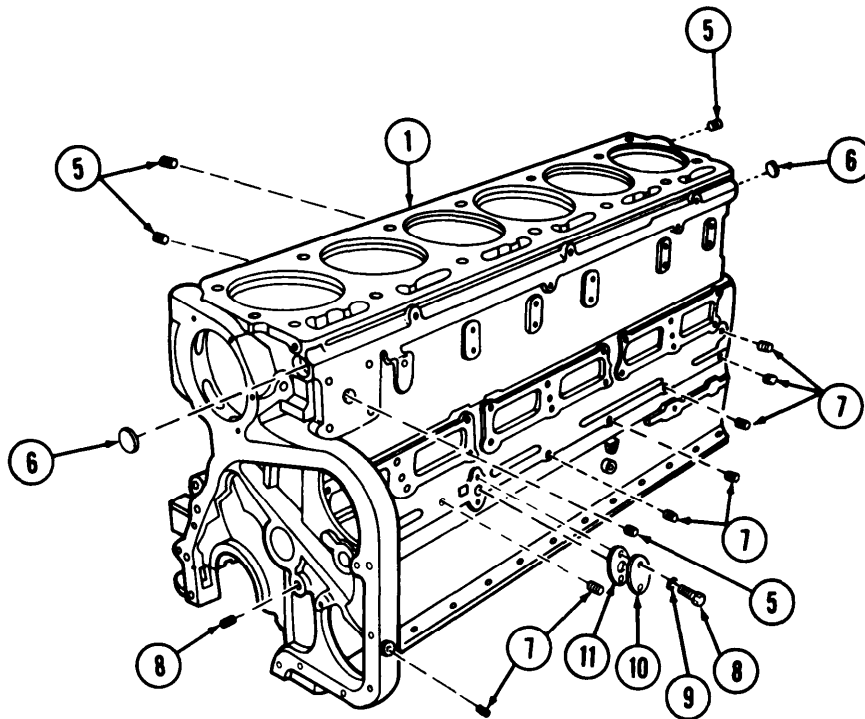
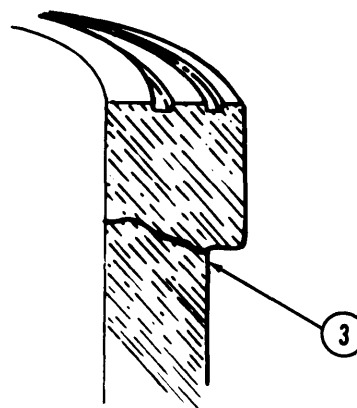
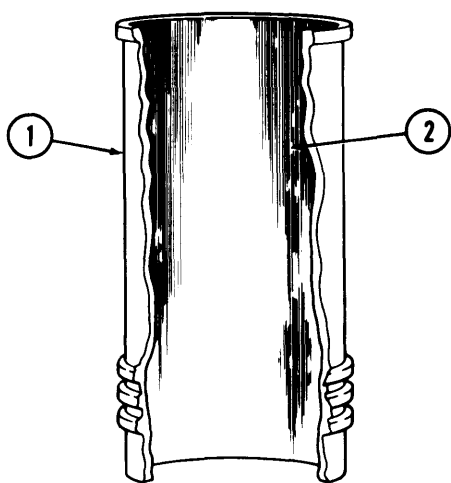


Table 3-9. Cylinder Block Pipe Plug Tightening Torque

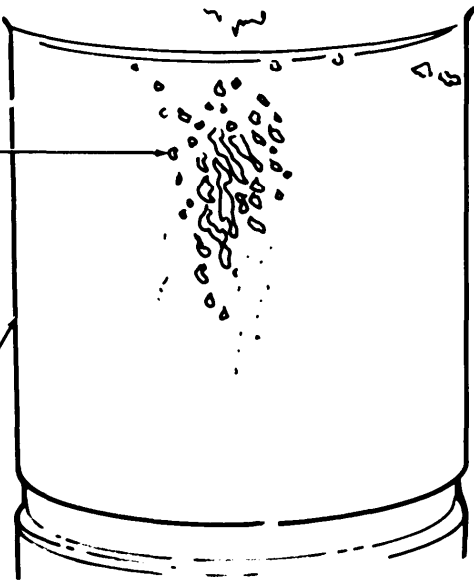
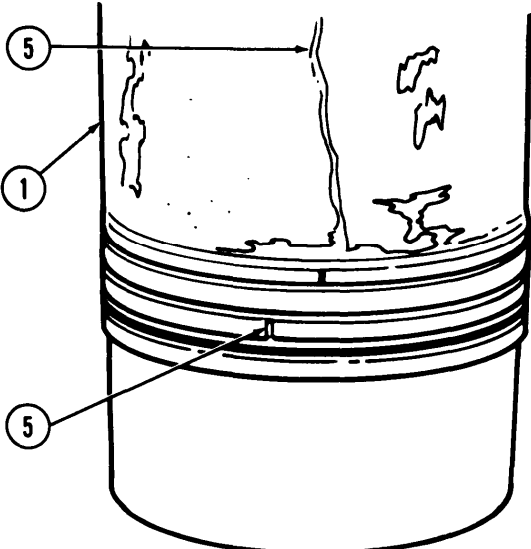
Pipe Plug Size	Minimum		Maximum	
	Lb-Ft	(N•m)	Lb-Ft	(N•m)
1/8 in.	15	(20)	20	(27)
1/4 in.	30	(41)	35	(47)
3/8 in.	35	(47)	45	(61)
1/2 in.	45	(61)	55	(75)
3/4 in.	60	(81)	70	(95)
1-1/4 in.	75	(102)	85	(115)
1-1/2 in.	90	(122)	100	(136)

3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p style="text-align: center;">NOTE</p> <ul style="list-style-type: none"> • Most attempts to hone or deglaze cylinder liners provide worse results than leaving them "as is". Experience and laboratory results indicate that liners do not need to be honed or deglazed to provide proper ring setting. • It is recommended that cylinder liners be inspected before cleaning so defects can be clearly noted. • Inspect cylinder liners closely for any of the metal conditions illustrated. If one liner has failed, then other liners in the same engine are likely to have early signs of the same type failure. 				
24.		Cylinder liner (1)	<p>a. Check for scoring or vertical grooving (2) on the inside diameter indicating heavy metal to metal contact of piston to liner (1).</p> <p>b. Check for cracks (3) indicated by magnetic detection.</p>	<p>Tag for replacement.</p> <p>Tag for replacement.</p>



3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			c. Check for a series of pit erosions (4) on the thrust or anti-trust or side of the liner (1) outside diameter.	Tag for replacement.
			d. Check for visible cracks. As a rule, liners are highly resistant to vertical cracks (5) or break-age.	Tag for replacement.

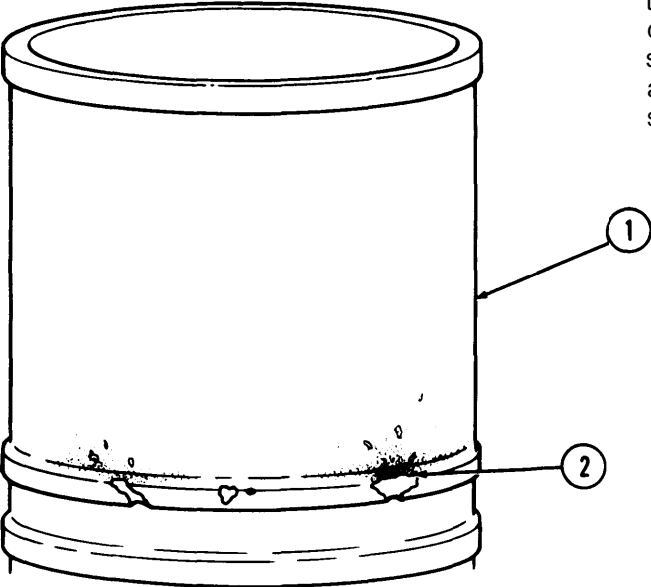
3-66. CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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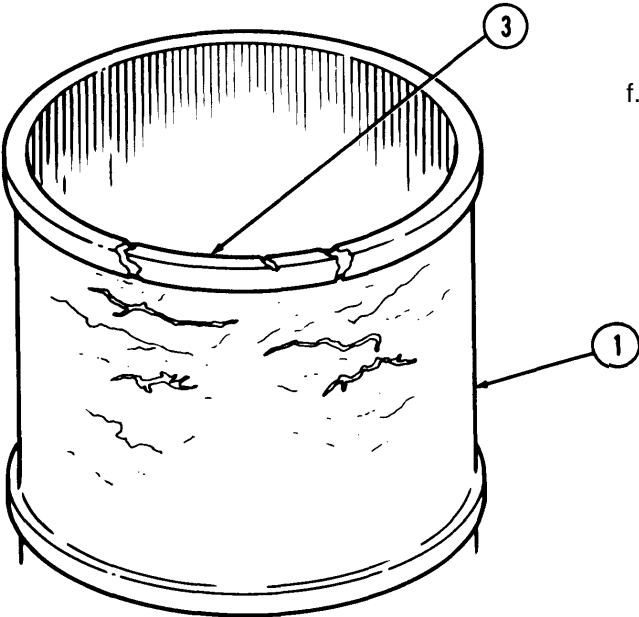
Cylinder liner (1)

e. Check for eroded surface (2), Moving coolant contacting the liner outside diameter erodes the surface away and attacks the crevice seal.

Tag for replacement.



The diagram shows a cross-section of a cylinder liner. A callout line labeled '1' points to the main body of the liner. Another callout line labeled '2' points to the bottom edge of the liner, where there is a visible eroded surface and a crack in the crevice seal.



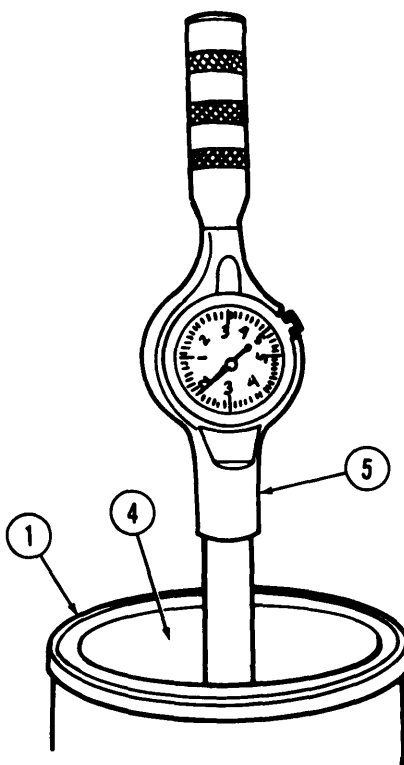
The diagram shows a cross-section of a cylinder liner. A callout line labeled '3' points to the top edge of the liner, where there is a visible fretted surface. Another callout line labeled '1' points to the main body of the liner.

f. Check for fretting of surfaces (3), and/or machined area. Top of liner bead has worn away on this liner.

Tag for replacement.

3-66, CYLINDER LINERS AND CYLINDER BLOCK MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
25.			a. Steam clean, or wash in hot water and detergent. b. Remove rust, scale, and corrosion.	Do not use wire brush. Replace liner if excessively rusted, scaled, or corroded.
<p style="text-align: center;">NOTE</p> <p>Cylinder liners must be checked at 60°-70°F (16°-21°C). New cylinder liners with lubrite finish maybe 0.0002-0.0006 in. (0.005-0.015 mm) smaller than indicated due to lubrite coating.</p>				
26.		Liner bore (4)	Check with bore gage (5).	If measurement exceeds 5.5050 in. (139.830 mm), tag liner (1) for replacement.



END OF TASK!

Section VI. ENGINE REASSEMBLY

3-67. ENGINE REASSEMBLY TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
3-68.	Cylinder Liners Installation	3-342
3-69.	Crankshaft and Main Bearings Installation	3-348
3-70.	Piston and Connecting Rod Installation	3-356
3-71.	Camshaft and Gear Installation	3-362
3-72.	Cylinder Head Installation	3-366
3-73.	Fuel Crossover Connectors Installation	3-368
3-74.	Cam Followers and Push Tubes Installation	3-370
3-75.	Injectors Installation	3-374
3-76.	Valve Crossheads Installation and Adjustment	3-376
3-77.	Engine Accessory Drive Installation	3-378
3-78.	Engine Front Gearcase Cover Installation	3-380
3-79.	Engine Accessory Drive Pulley Installation	3-382.2
3-80.	Rocker Lever Housings Installation	3-384
3-81.	Rocker Lever Housing Covers Installation	3-386
3-82.	Delete	3-387
3-83.	Air Compressor Installation	3-388
3-84.	Fuel Pump Installation	3-391
3-85.	Fuel Supply and Return Tubes Installation	3-392
3-86.	Engine Oil Pump Installation	3-394
3-87.	Engine Oil Filter Installation	3-397
3-88.	Air Intake Manifold Installation	3-398
3-89.	Air Compressor Air Inlet Tube Installation	3-399
3-90.	Crankshaft Rear Cover Seal and Plate Installation	3-400
3-91.	Flywheel Housing Installation	3-402
3-92.	Engine Oil Pan Installation	3-410
3-93.	Oil Pump Return Hose, Pickup Hose, and Sump Tube Installation	3-412
3-94.	Flywheel Ring Gear Installation	3-414
3-95.	Crankshaft Flange Installation	3-415
3-96.	Vibration Damper Installation	3-416
3-97.	Delete	3-417
3-98.	Water Pump Installation	3-418
3-99.	Fan and Fan Drive Clutch Installation	3-420

3-67. ENGINE REASSEMBLY TASK SUMMARY (Cont'd)

TASK PARA.	PROCEDURES	PAGE NO.
3-100.	Water Manifold Installation	3-422
3-101.	Water Header Plates Installation	3-423
3-102.	Engine Removal From Repair Stand	3-424

3-68. CYLINDER LINERS INSTALLATION

This task covers:

- a. Cleaning
- b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Liner clamp set 3376669 Liner driver ST-1229		None
<u>Materials/Parts</u>		
Red "O" ring Black "O" ring Crevice seal Lint-free cloth (Appendix C, Item 7) Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel, Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		<ul style="list-style-type: none">Compressed air source will not exceed 30 psi (207 kPa).Eyeshields must be worn when cleaning with compressed air.Keep fire extinguisher nearby when using drycleaning solvent.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Cleaning

NOTE

The following procedure is recommended for preparation of new or used liners before installation.

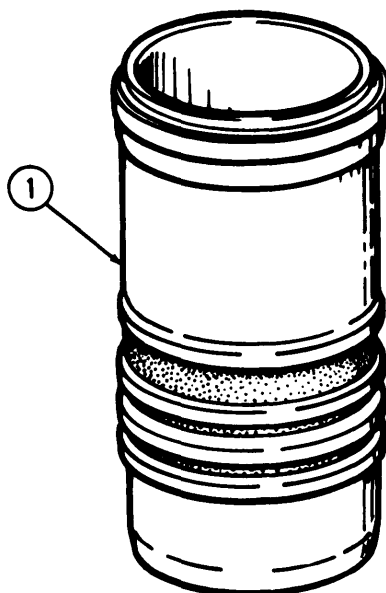
1. Cylinder liner (1)
- a. Wash with detergent soap and hot water. Scrub with bristle brush.

b. Rinse thoroughly in hot water, or steam clean.

Refer to para. 2-7.

3-68. CYLINDER LINERS INSTALLATION (Cont'd)

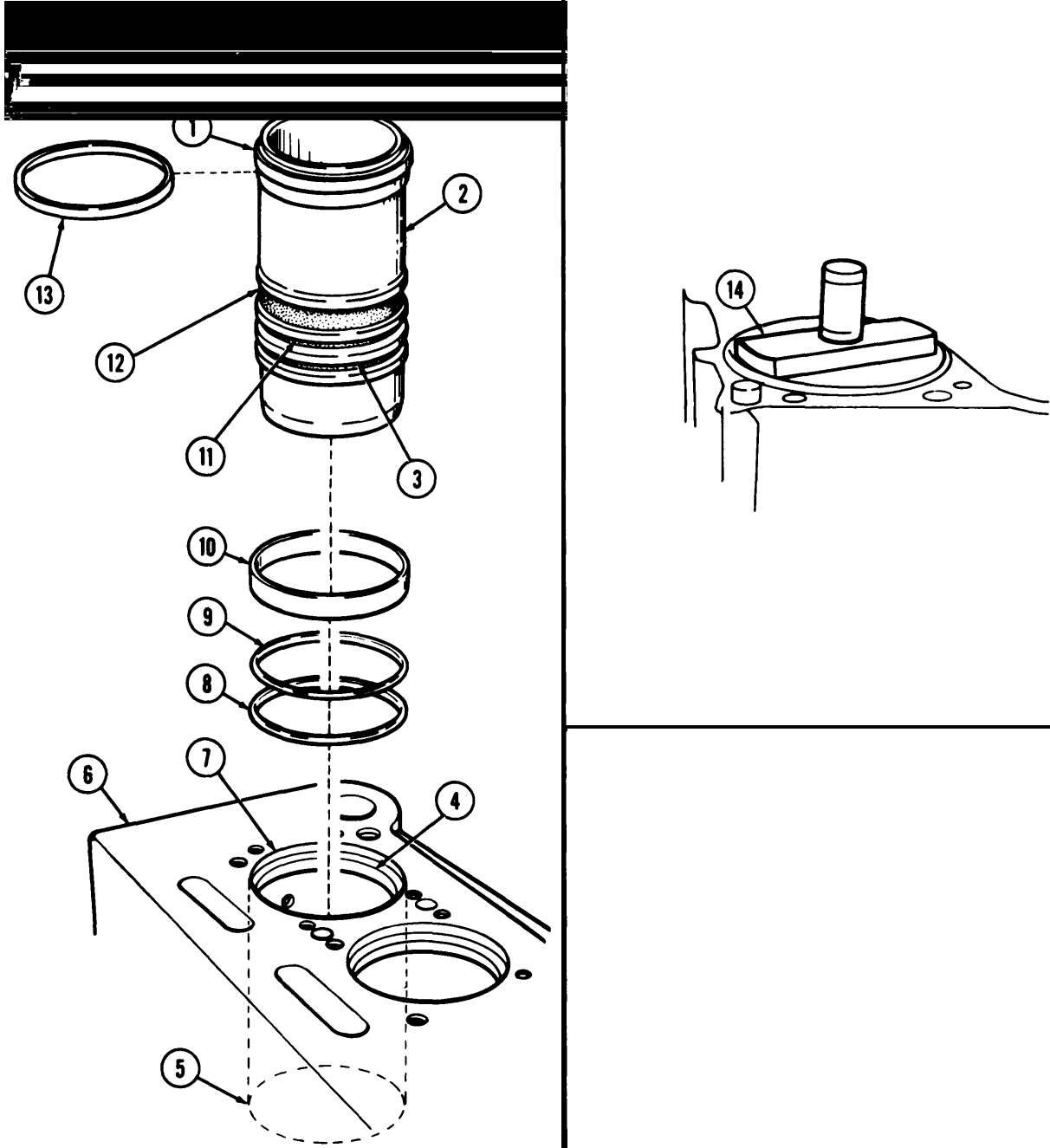
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<u>WARNING</u>				
		Compressed air source will not exceed 30 psi (207 kPa), When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.		
			c. Blow dry with compressed air.	
			d. Coat liner (1) generously with clean engine oil; let stand for 5 to 10 minutes.	
			e. Using heavy paper towel, wipe oil from liner bore.	Gray and black residue will appear on towels.
			f. Repeat application of oil and wiping until black or gray residue no longer appears on towel.	
			g. Lightly oil and wrap liners (1). Store in dry, clean location until installation.	



3-68. CYLINDER LINERS INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Installation				
2.		Cylinder liner flange (1), crevice seal groove (12), and "O" ring grooves (3) and (11)	Clean,	Use lint-free cloth.
3.		New crevice seal (10)	Install in crevice seal groove (12).	Make sure seal (10) is straight and not twisted.
4.		New black "O" ring (9)	Install in top "O" ring groove (11).	Use molding mark as guide, and make sure ring (9) is straight and not twisted.
5.		New red "O" ring (8)	Install in bottom "O" ring groove (3).	Make sure ring (8) is straight and not twisted.
6.		Cylinder bore (7), counterbore (4), and lower bore (5)	Clean and lubricate.	Use clean engine oil.
7.		Cylinder liner (2)	Install as follows: a. Apply light coat of clean engine oil to crevice seal (10) and "O" rings (9) and (8). b. Position in engine block (6) by hand, being careful not to dislodge "O" rings (8) and (9), and crevice seal (10). c. Press in place using hand pressure.	
NOTE				
Install liner without shims (13) until liner protrusion is checked in step 8. It may be necessary to remove liners and add shims.				
			d. Drive in until cylinder liner flange (1) is seated , and hold down with hold-down tool.	Use liner driver (14) and liner clamp.

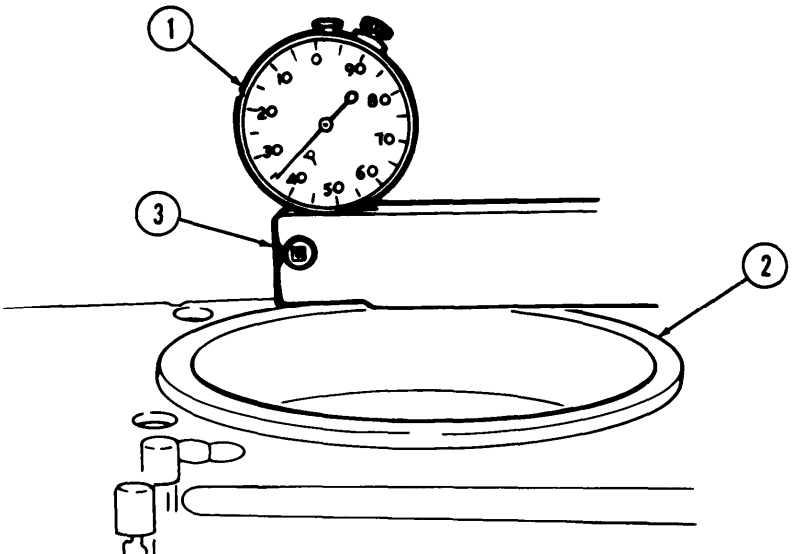
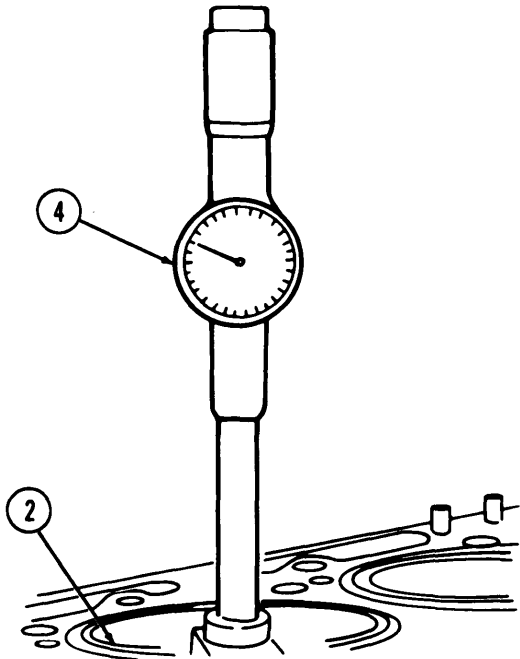
3-68. CYLINDER LINERS INSTALLATION (Cont'd)

STEP N O .	LOCATION	ITEM	ACTION	REMARKS
				

3-68. CYLINDER LINERS INSTALLATION (Cont'd)

STEP N O .	LOCATION	ITEM	ACTION	REMARKS
8.		Dial gage (1) and gage block (3)	Position on cylinder liner (2), and measure liner protrusion.	If protrusion is not 0.003-0.006 in. (0.08 - 0.15 mm), add or remove shims and repeat task b.
NOTE When performing step 9, if liner is more than 0.002 in. (0.05 mm) out-of-round in lower bore "O" ring area, remove liner and check for cause of distortion. It is permissible to have 0.003 in. (0.08 mm) out-of-round at the top 1 in. (25.4 mm) of liner bore.				
9.		Dial bore gage (4)	Position in cylinder liner (2) and measure at several points within range of piston travel for out-of-round condition.	If out-of-round, remove and reinstall. Refer to para. 3-66.

3-68. CYLINDER LINERS INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

END OF TASK!

FOLLOW-ON TASK: Install crankshaft and main bearings (para. 3-69).

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3-69. CRANKSHAFT AND MAIN BEARINGS INSTALLATION

This task covers:

- a. Installation
- b. End Play Clearance

INITIAL SETUP:

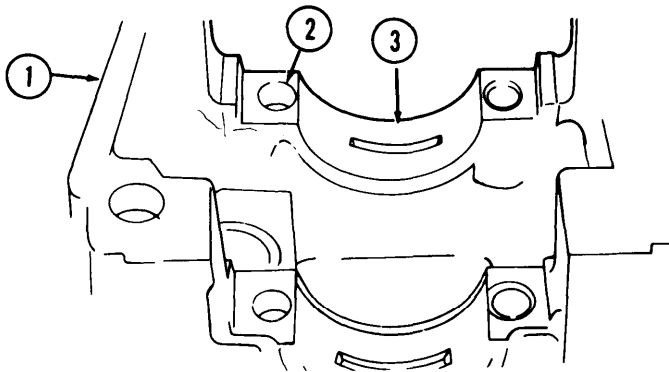
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Crankshaft bearing set		
Thrust ring set		
Fourteen lockplates		
Key		
Seven dowel rings		
Lint-free cloth (Appendix C, Item 7)		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		<ul style="list-style-type: none">Compressed air source will not exceed 30 psi (207 kPa).Eyeshields must be worn when cleaning with compressed air.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Installation

WARNING

Compressed air source will not exceed 30 psi (207 kPa). Eyeshields must be worn when cleaning with compressed air. Failure to wear eyeshields may result in injury to personnel.

1. Engine block (1)
- 
- a. Turn upside down so main bearing bores (3) face up.

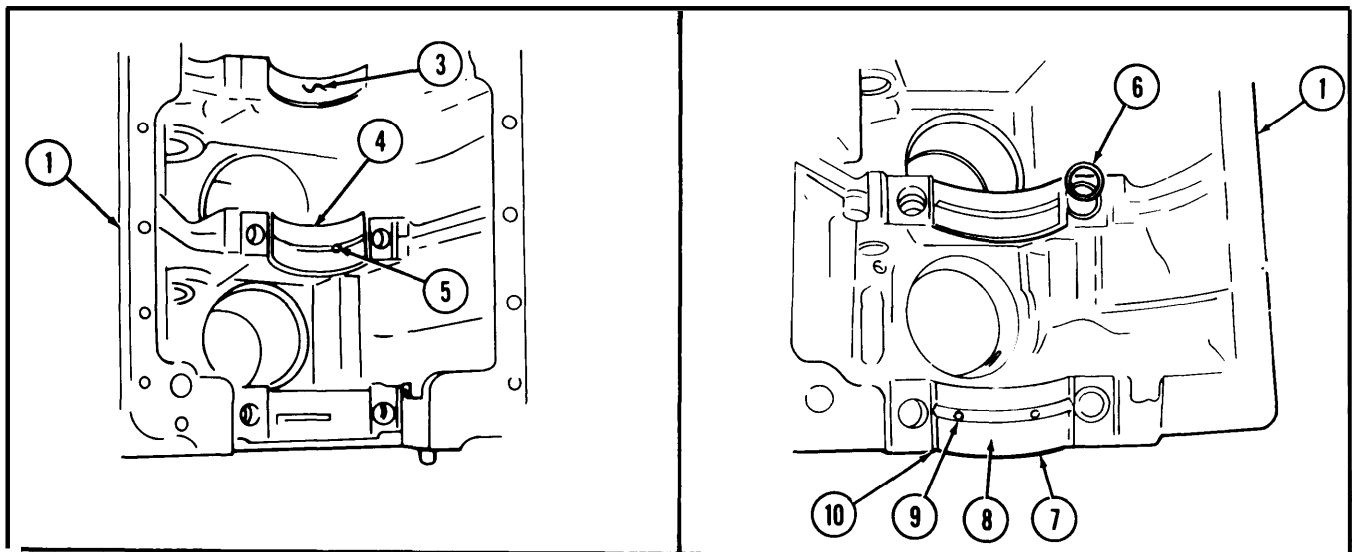
b. Clean all screw holes (2). Use compressed air.

c. Wipe all bearing bores (3) clean. Use lint-free cloth.

TA350284

3-69. CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Cont'd)

STEP N O .	LOCATION	ITEM	ACTION	REMARKS
<u>CAUTION</u>				
Touching bearing shell wear surface after shells have been cleaned will cause shell corrosion, resulting in engine damage.				
2.		New bearing upper shells numbers one, two, three, four, five, and six (4)	Install as follows: a. Wipe clean. b. Position in bearing bores (3) with oil holes (5) alined. c. Press in place, and coat with clean engine oil.	Count from front of engine block (1). Use lint-free cloth. Bearing shell (4) will project slightly above bore (3).
3.		New bearing upper shell number seven (7)	Install as follows: a. Install in bore (10) with wide portion (8) toward flywheel end of block (1). b. With oil holes (9) alined, press in place and coat with clean engine oil.	Wide portion is measured from oil groove to edge, Bearing shell (7) will project slightly above bore (10).
4.		Seven new dowel rings (6)	Install in engine block (1).	

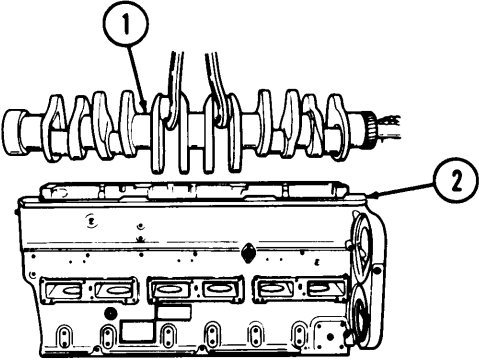
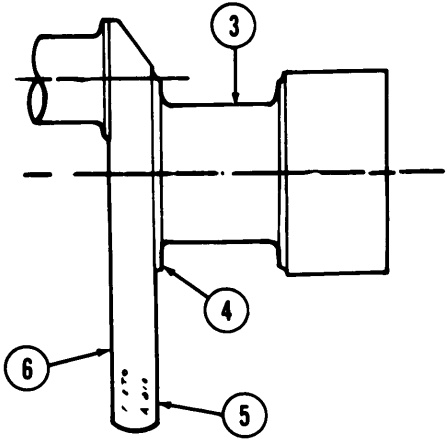
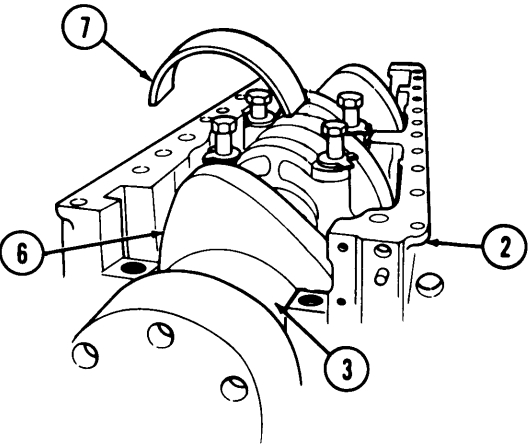
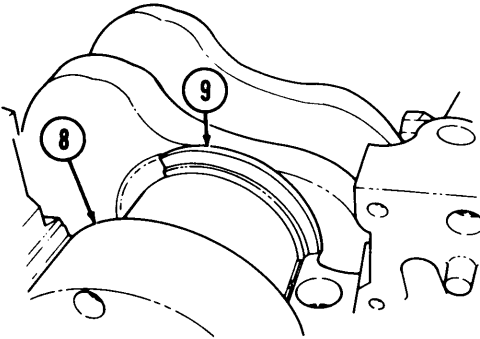


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3-69. CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Cont'd)

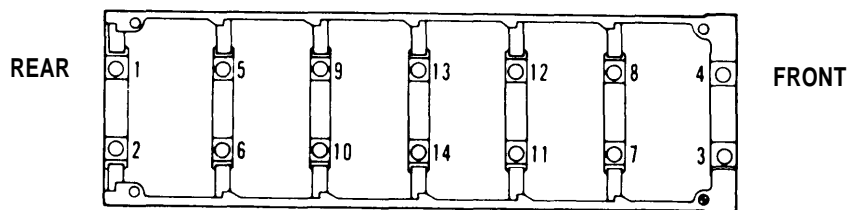
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
5.		Crankshaft (1)	Install as follows: a. Wipe wear surfaces clean, and coat with clean engine oil. b. Position in engine block (2), c. Rotate until rear crankshaft web (6) is visible,	Use lint-free cloth. Use hooks protected with rubber hose or rope sling at two crank throws.
<p style="text-align: center;">NOTE</p> <p>Upper thrust rings are not doweled to block. Lower halves are doweled to number seven bearing cap.</p>				
6.		New upper thrust ring (9)	Install as follows: a. Check markings (5) on rear crankshaft web (6). b. Coat with clean engine oil, and roll in place.	Markings will indicate what size thrust rings (8) and (9) are to be placed at front or rear of journal (3). Make sure babbit face or grooved side is next to crankshaft flange (4).
7.		New lower bearing shells (7)	Install as follows: a. Wipe clean, and coat with clean engine oil. b. Insert in place over crankshaft (1).	Use lint-free cloth.
<p style="text-align: center;">NOTE</p> <p>Lower thrust ring and number seven bearing cap are installed together. Lower thrust ring must be located-over dowel on bearing cap.</p>				
8.		New lower thrust ring (9)	Coat with clean engine oil and position on number seven main bearing cap.	Make sure babbit face or grooved side is next to crankshaft flange (4).

3-69. CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				
				
				

3-69. CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
9,		Main bearing caps (1)	a. Wipe wear surfaces clean, and coat with clean engine oil. b. Position in engine block (4) over new lower bearing shells (5).	Use lint-free cloth. Numbers on caps (1) correspond with numbers on engine block (4) at camshaft side.
CAUTION				
<ul style="list-style-type: none"> Do not tap main bearing caps to seat. Hammering will jar bearing shells out of position and cause engine damage. Main bearing screws must be tightened alternately and slowly to ensure proper seating of bearing caps. 				
10.		Fourteen screws (2) and new lockplates (3)	a. Lubricate screw (2) threads and lockplates (3). b. Install through caps (1) in engine block (4). c. Following sequence shown, tighten each screw (2) in three steps of 100 lb-ft (136 N•m) until 300-310 lb-ft (410-423 N•m) is reached. d. Loosen all screws (2) three turns. e. Repeat step c.	Use clean OE/HDO 30 oil,



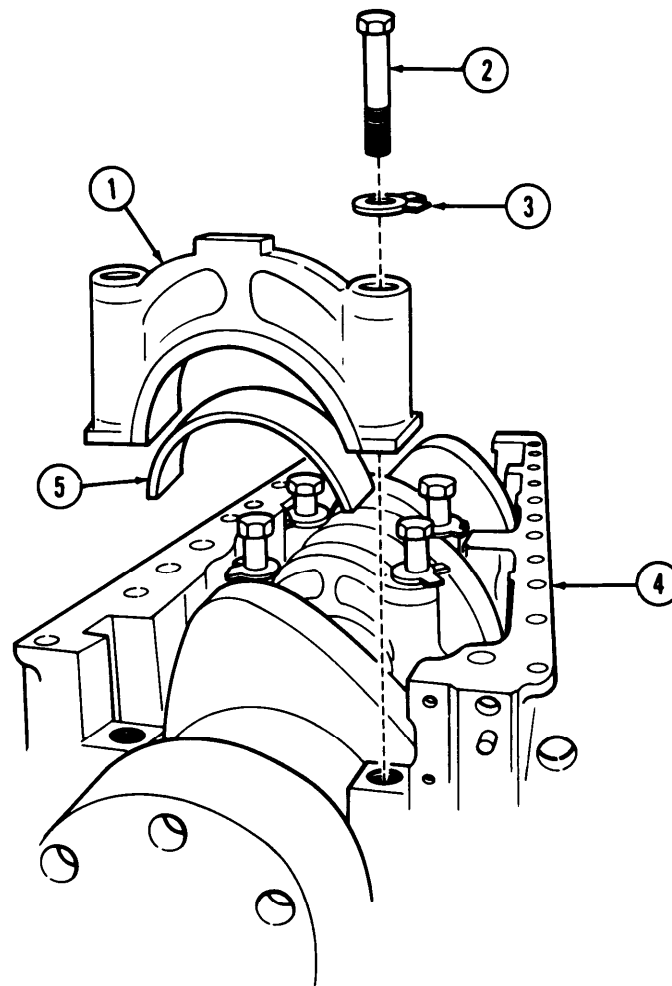
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3-69. CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Do not bend up tabs on lockplates until after crankshaft end clearance is checked.

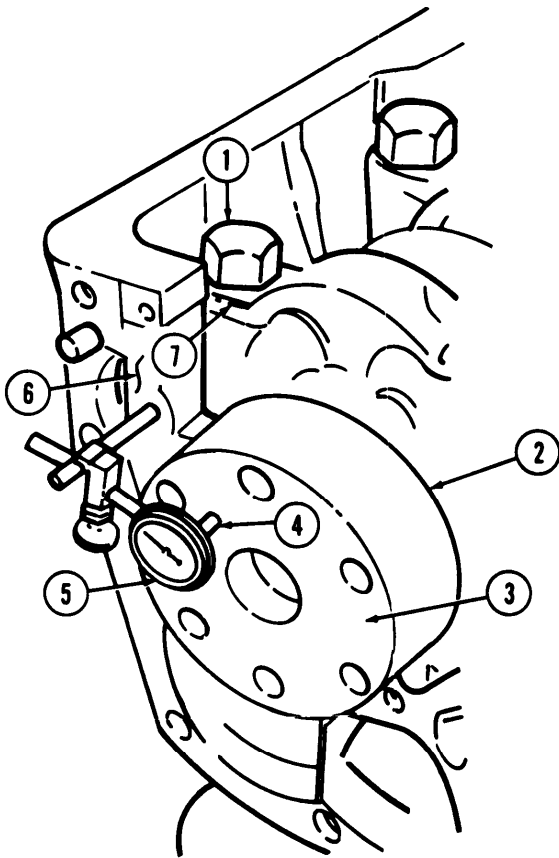


3-69. CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. End Play Clearance				
11.		Dial indicator (5)	a. Attach to rear of engine block (6) with contact point (4) resting on crankshaft end face (3). b. Push crankshaft end face (3) toward front of engine block (6) and set indicator (5) to zero. c. Push crankshaft end face (3) back toward rear of engine block (6) and check indicator (5).	
12.		Crankshaft (2)	If end clearance is less than 0.007 in. (0.18 mm), adjust as follows: a. Loosen main bearing screws (1) one turn. b. Push crankshaft (2) first toward front, and then toward rear of engine block (6). c. Tighten main bearing screws (1) and repeat step 11.	Refer to step 10 to tighten screws (1).
NOTE If end clearance is more than 0.22 in. (0.56 mm), crankshaft must be replaced or oversize thrust rings installed. Make sure markings on rear crankshaft counterbalance are correct. (Refer to step 6).				
13.		Fourteen lockplates (7)	Bend up tabs to hold screws (1).	

3-69. CRANKSHAFT AND MAIN BEARINGS INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

- FOLLOW-ON TASKS:
- Install pistons and connecting rods (para. 3-70).
 - Install camshaft and gear (para. 3-71).
 - Install cylinder heads (para. 3-72).

TA350289

3-70. PISTON AND CONNECTING ROD INSTALLATION

This task covers:

a. Installation

b. Check Connecting Rod Side Clearance

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Connecting rod bearing set Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Installation

NOTE

- Before installation, make sure all pistons have been properly assembled and lubricated (para. 3-64).
- If old pistons are being installed, make sure they are installed in same location from which they were removed.

- | | | | |
|----|--------------------|---|---|
| 1. | Connecting rod (2) | Two screws (5) and cap (4) | Remove. |
| 2. | | Piston (1), connecting rod (2), and upper bearing shell (3) | Install in engine block (9) as follows: <ul style="list-style-type: none"> a. Coat with clean engine oil. b. Position tang (6) on new bearing (3) to groove (7) in connecting rod (2), and snap into place. |

3-70. PISTON AND CONNECTING ROD INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Make sure piston ring gaps are staggered so they are not in line with each other or piston pin.

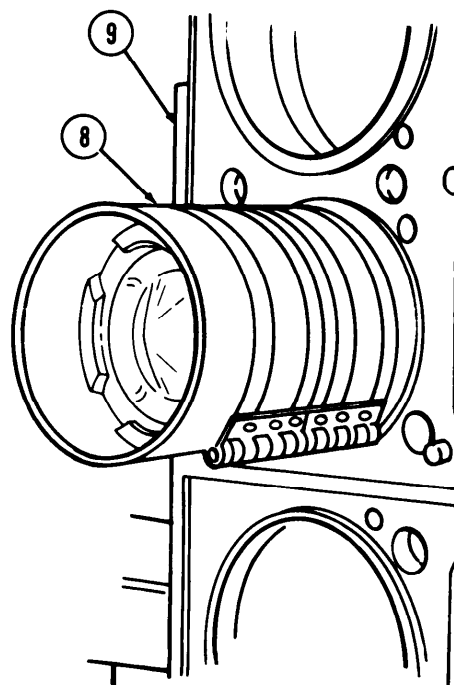
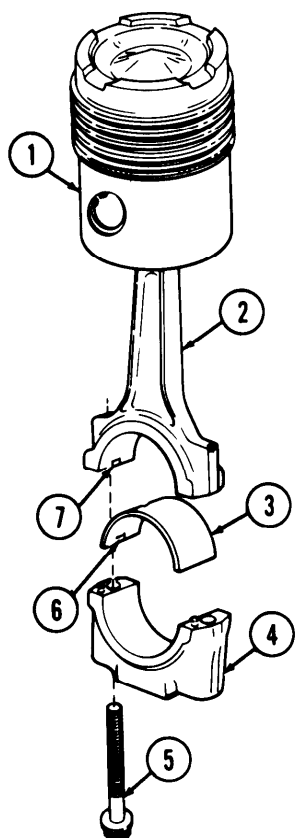
- c. Position ring compressor (8) over piston (1) and tighten. Use Allen wrench to close ring compressor (8).

CAUTION

Assistant must guide connecting rod through cylinder from oil pan side of block to avoid damaging liner.

NOTE

Make sure numbered side of connecting rod is toward the camshaft side of engine block.



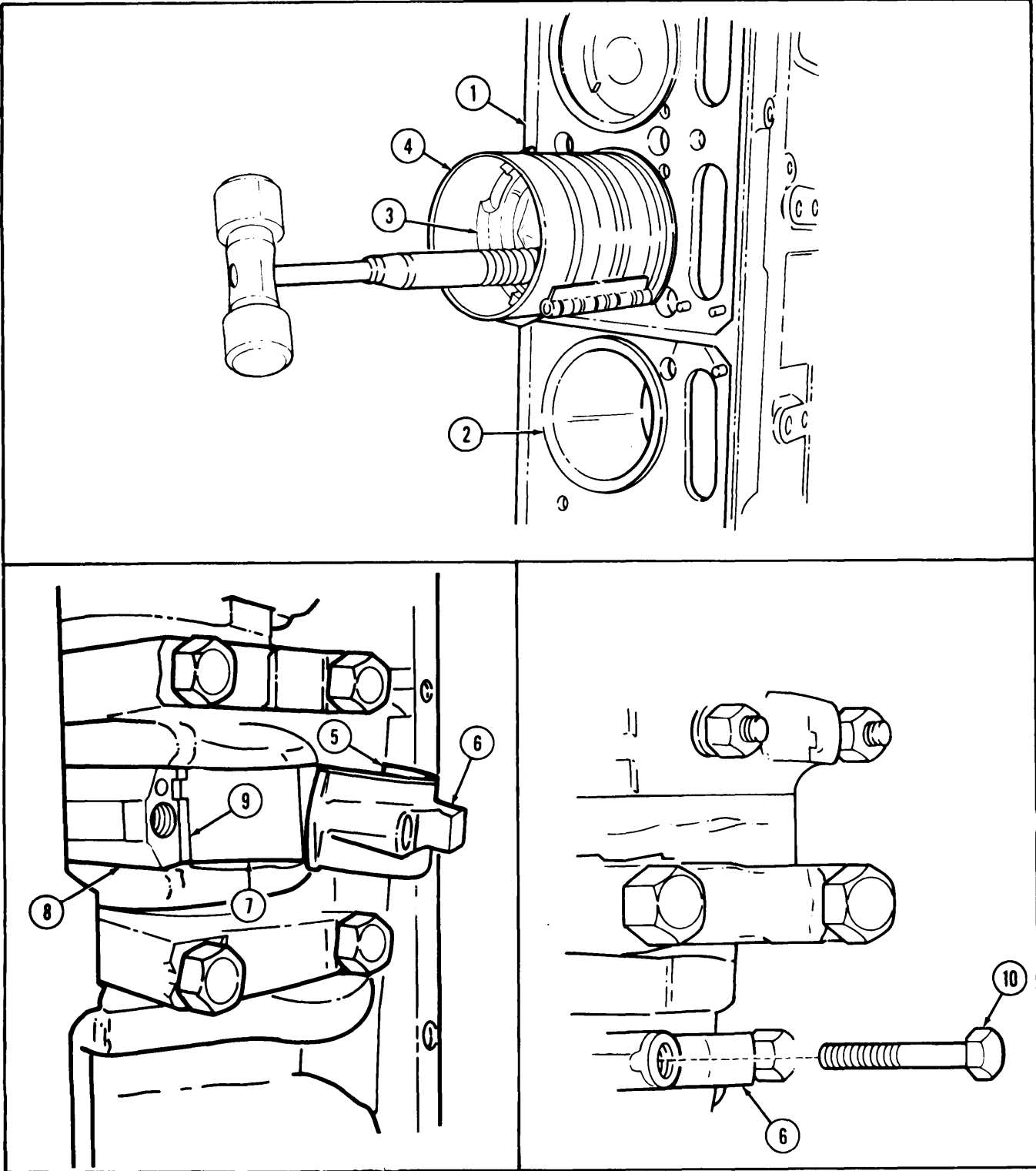
TA 350290

3-70. PISTON AND CONNECTING ROD INSTALLATION (Cont'd)

S T E P N O .	LOCATION	ITEM	ACTION	REMARKS
			d. Carefully insert connecting rod (8) in cylinder liner (2) and hold ring compressor (4) tight and firmly seated against engine block (1).	Crankshaft journal must be at bottom dead center.
<u>CAUTION</u>				
			<ul style="list-style-type: none"> • Ring compressor must be held firmly against engine block to prevent compressor from slipping and causing piston ring breakage when pushing piston into cylinder liner. • Do not force piston assembly into liner. If piston does not install "freely" in liner, remove and check for broken rings. 	
			e. Push piston (3) through ring compressor (4) until all piston rings are well into cylinder liner (2) in cylinder block (1).	Assistant will guide rod (8) onto crank journal (7) to prevent damage to journal (7) and liner (2).
			f. Drive piston (3) and rod (8) into liner (2) until upper rod bearing shell (9) seats on crankshaft journal (7).	Use rubber or wooden mallet handle.
			g. Lubricate lower connecting rod bearing shell (5) with clean engine oil.	
			h. Install new bearing shell (5) in rod cap (6), and install cap (6) so numbered side is matched to numbered side of rod (8).	Make sure tang on bearing shell (5) is aligned with groove in cap (6).
			i. Lubricate screw (10) threads with clean engine oil.	
			j. Install screws (10) through rod cap (6) and tighten.	Refer to table 3-5 in para. 3-64 for tightening sequence.

3-70. PISTON AND CONNECTING ROD INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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TA 35029T

3-70. PISTON AND CONNECTING ROD INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Check Connecting Rod Side Clearance

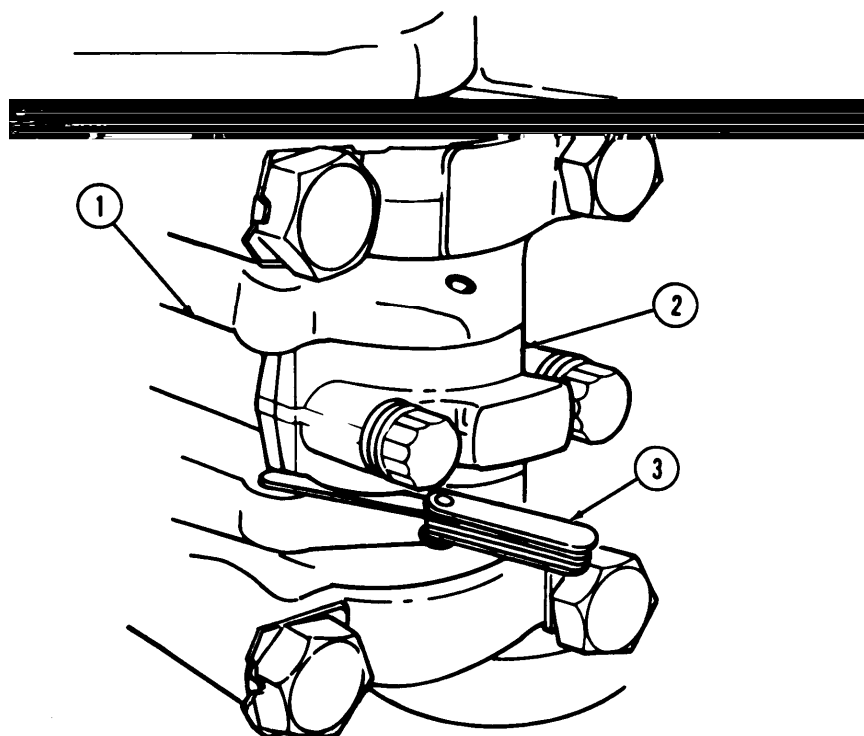
CAUTION

Connecting rod must have free movement at crank journal.

- | | | | |
|----|--------------------|---|--|
| 3. | Connecting rod (1) | <p>a. Move up and down on crank journal, and measure clearance with feeler gage (3).</p> <p>b. Remove cap (2), and check for improper bearing size, dirt, or burrs.</p> <p>c. Repeat steps 2b and 2e through 2j to install cap (2).</p> | <p>If clearance is not 0.0045-0.013 in. (0.11-0.33 mm), or rod will not move, continue with step 3b.</p> |
|----|--------------------|---|--|

3-70. PISTON AND CONNECTING ROD INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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**END OF TASK !**

FOLLOW-ON TASKS: • Install cylinder heads (para. 3-72).
• Install crankshaft rear cover seal and plate (para. 3-90).

TA 360292

3-71. CAMSHAFT AND GEAR INSTALLATION

This task covers:

- a. Installation
- b. Check Backlash

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Cam bushing replacement tool ST-782		None
<u>Materials/Parts</u>		
Seven cam bushings Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Installation

CAUTION

Positioning of new cam bushing in no. 7 bushing bore (rear of cylinder block) is critical. The new bushing must be pressed in leaving clearance between bushing and rear face of cylinder block to allow oil to drain from hole at rear of camshaft. Hydraulic lock will occur if oil drain passage is blocked.

NOTE

No. 1 cam bushing (gear end) is wider, all others are the same.

1. Seven cam bushings (2)
- a. Position on cam bushing replacer (1), alining oil hole (3) in bushing (2) to oil hole in main bearing bore.
- Use cam bushing replacement tool.

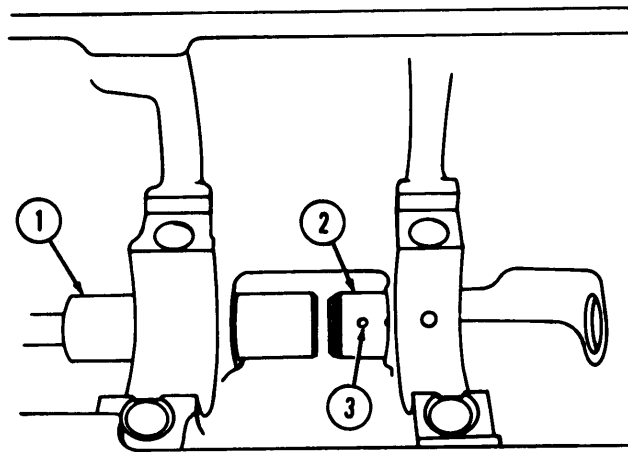
3-71. CAMSHAFT AND GEAR INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Press into position in cam bore.

c. Check oil hole (3) alinement with a brass rod through main bearing bore oil hole and bushing oil hole (3).

Brass rod must pass through with ease. If brass rod does not go through freely, reposition cam bushings (2).



3-71. CAMSHAFT AND GEAR INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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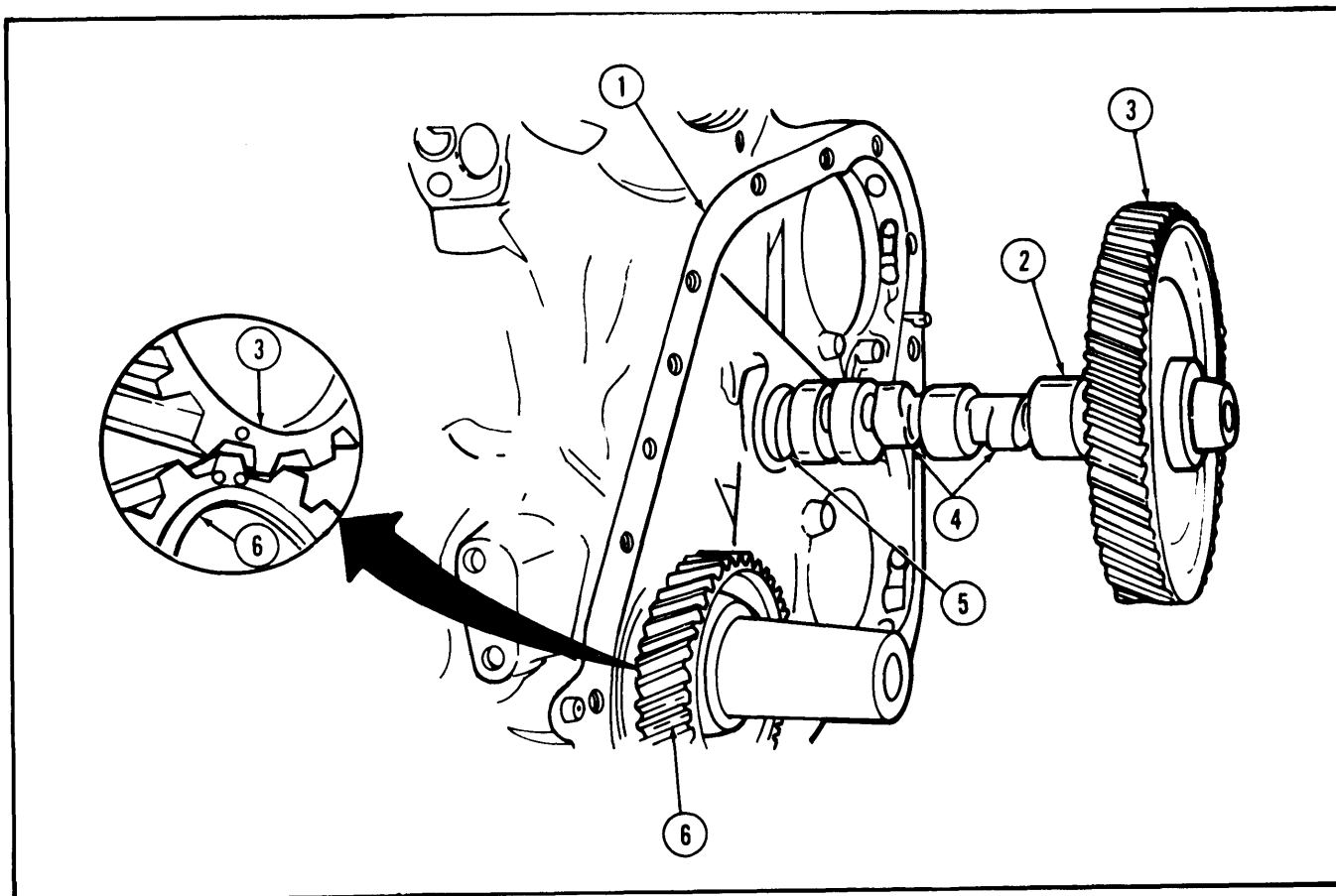
CAUTION

Use extreme care when installing camshaft to avoid damage to bearings and camshaft lobes.

NOTE

Assistant will help with step 2

- | | | | |
|----|---------------------------|--|--|
| 2. | Camshaft (2) and gear (3) | <p>a. Coat camshaft lobes (4) with clean engine oil.</p> <p>b. Position in engine block (1) by grasping gear (3) with both hands and gently sliding end into cam bore (5).</p> <p>c. Aline index mark on camshaft gear (3) with index mark on crankshaft gear (6).</p> | <p>With aid of assistant, carefully guide lobes (4) through bore (5) as camshaft (2) is installed.</p> |
|----|---------------------------|--|--|



TA 350294

3-71. CAMSHAFT AND GEAR INSTALLATION (Cont'd)

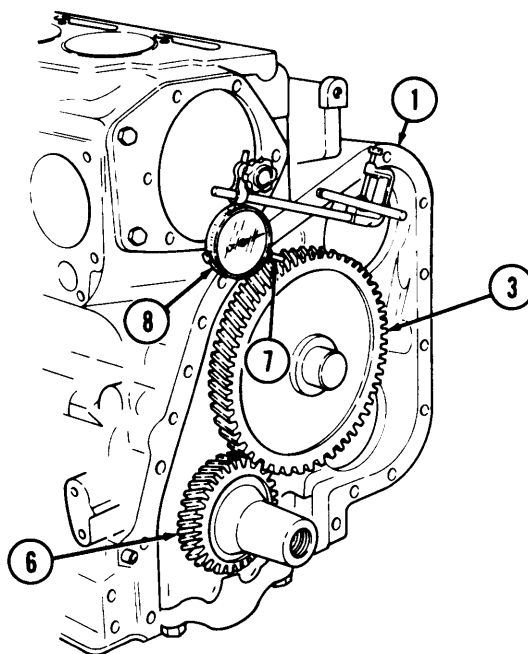
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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I b. Check Backlash I

3.		Camshaft gear (3)	<p>a. Attach dial indicator (8) to engine block (1).</p> <p>b. Rotate camshaft gear (3) as far as it will freely move and hold in place.</p> <p>c. Position plunger (7) to gear (3) tooth and set dial indicator (8) to zero.</p> <p>d. Rotate gear (3) in opposite direction and read backlash measurement as rotation stops.</p>	<p>Crankshaft gear (6) must not move.</p> <p>If backlash is more than 0.020 in. (0.51 mm), or less than 0.002 in. (0.05 mm), replace camshaft gear (para. 3-63).</p>
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NOTE

Normal backlash is 0.0045-0.0105 in. (0.114-0.267 mm) on new gear with a minimum of 0.002 in. (0.05 mm).



END OF TASK!

- FOLLOW-ON TASKS:
- Install engine accessory drive (para. 3-77).
 - Install engine oil pump (para. 3-86).
 - Install engine front gearcase cover (para. 3-78).

TA 350296

3-72. CYLINDER HEAD INSTALLATION

This task covers:

Installation

INITIAL SETUP:

Equipment Condition Reference		Condition Description
<u>Applicable Models</u>		None
All		
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Two guide screws		None
<u>Materials/Parts</u>		
Cylinder head gasket		
Lint-free cloth (Appendix C, Item 7)		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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I Installation I

NOTE

- Three cylinder heads are installed the same.
- If old heads are being installed, make sure they are installed in same location from which they were removed.

1.	Two dowels (7) and top of engine block (6)	Clean.	Use lint-free cloth.
2.	Two guide screws (5)	Install.	Screws (5) must be 4.5 in. (114.3 mm) long.
3.	New cylinder head gasket (4)	Position over guide screws (5), dowels (7), and seat on engine block (6).	Make sure the word "top" is facing up.

NOTE

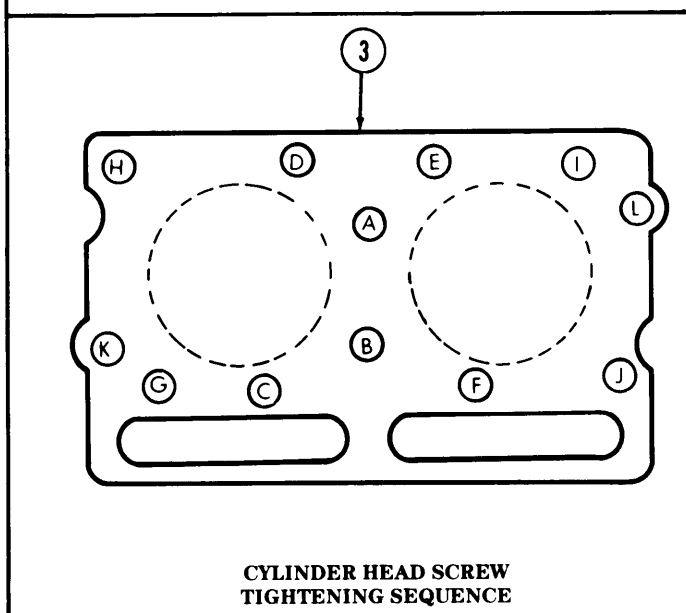
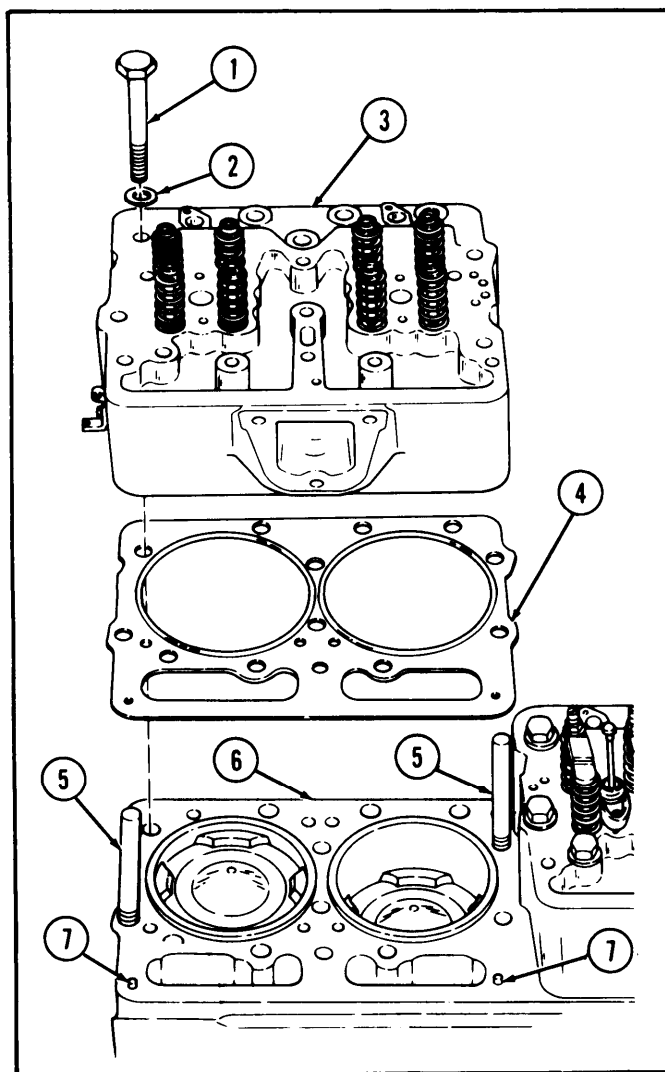
Assistant will help with steps 4 and 7.

4.	Cylinder head (3)	Install.	
5.	Two guide screws (5)	Remove.	
6.	Twelve screws (1)	Lubricate threaded ends with oil.	Allow excess oil to drip from screws (1) before installing.

3-72. CYLINDER HEAD INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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- | | | | | |
|----|--|-------------------|--|--|
| 7. | | Cylinder head (3) | <p>Install to engine block (6) with twelve washers (2) and screws (1) as follows:</p> <ol style="list-style-type: none"> Start each screw (1) by hand. Tighten in sequence shown below to 25 lb-ft (34 N-m). Tighten again in steps of 80-100 lb-ft (109-136 N-m) until screws (1) are tightened 280-300 lb-ft (380-407 N-m). | |
|----|--|-------------------|--|--|



END OF TASK!

- FOLLOW-ON TASKS:
- Install fuel injectors (para. 3-75).
 - Install and adjust valve crossheads (para. 3-76).
 - Install fuel crossover connectors (para. 3-73).

TA 350296

3-73. FUEL CROSSOVER CONNECTORS INSTALLATION

This task covers:
Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
None	None	
<u>Materials/Parts</u>		
Eight “O” rings Eight lockwashers Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W	None	
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION

1.		Eight new "O" rings (4)	Coat lightly with clean engine oil and insert in fuel crossover connector bores (5).	Make sure "O" rings (4) are properly seated.
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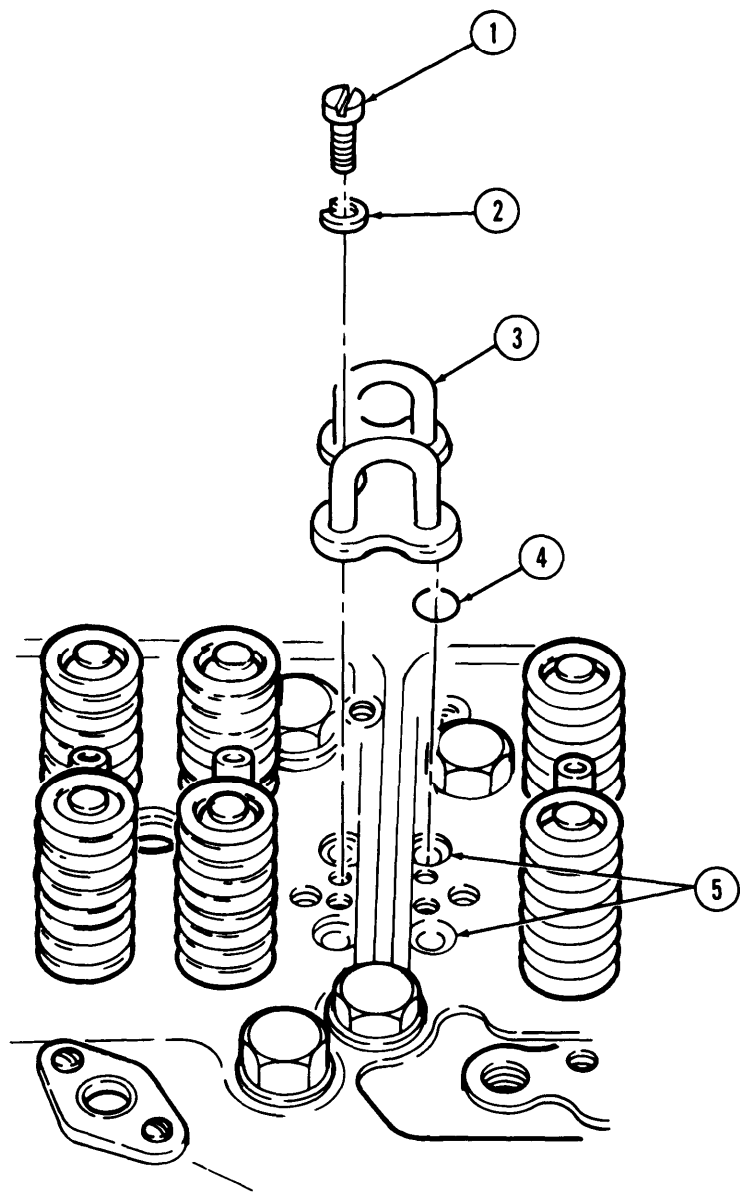
NOTE

Fuel crossover connectors are mounted with screw-assembled lockwashers on late model engine.

2.		Two fuel crossover connectors (3)	a. Carefully position over "O" rings (4) and fuel crossover connector bores (5). b. Install with eight new lockwashers (2) and slotted head screws (1).	Use screwdriver adapter on torque wrench and tighten 34-38 lb-in.(3.8-4.3 N-m).
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3-73. FUEL CROSSOVER CONNECTORS INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install rocker lever housings (para. 3-80).

3-74. CAM FOLLOWERS AND PUSH TUBES INSTALLATION

This task covers:
Installation

INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Gaskets Six lockwashers		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

CAUTION

- Before installation, make sure all cam follower housing assemblies have been properly assembled and lubricated (para. 3-21).
- If old cam follower housing assemblies are being installed, make sure they are installed in the same location from which they were removed.

1.	New cam follower housing gasket (3)	Install as follows:	
		a. Check recorded measurement of gaskets (3) removed.	Gaskets (3) should measure 0.014-0.125 in. (0.36-3.2 mm).
		b. Measure new gaskets (3) being installed.	New gaskets (3) must measure exact thickness of original gaskets (3).
		c. Position gasket (3) with seal facing outward over dowels (1).	

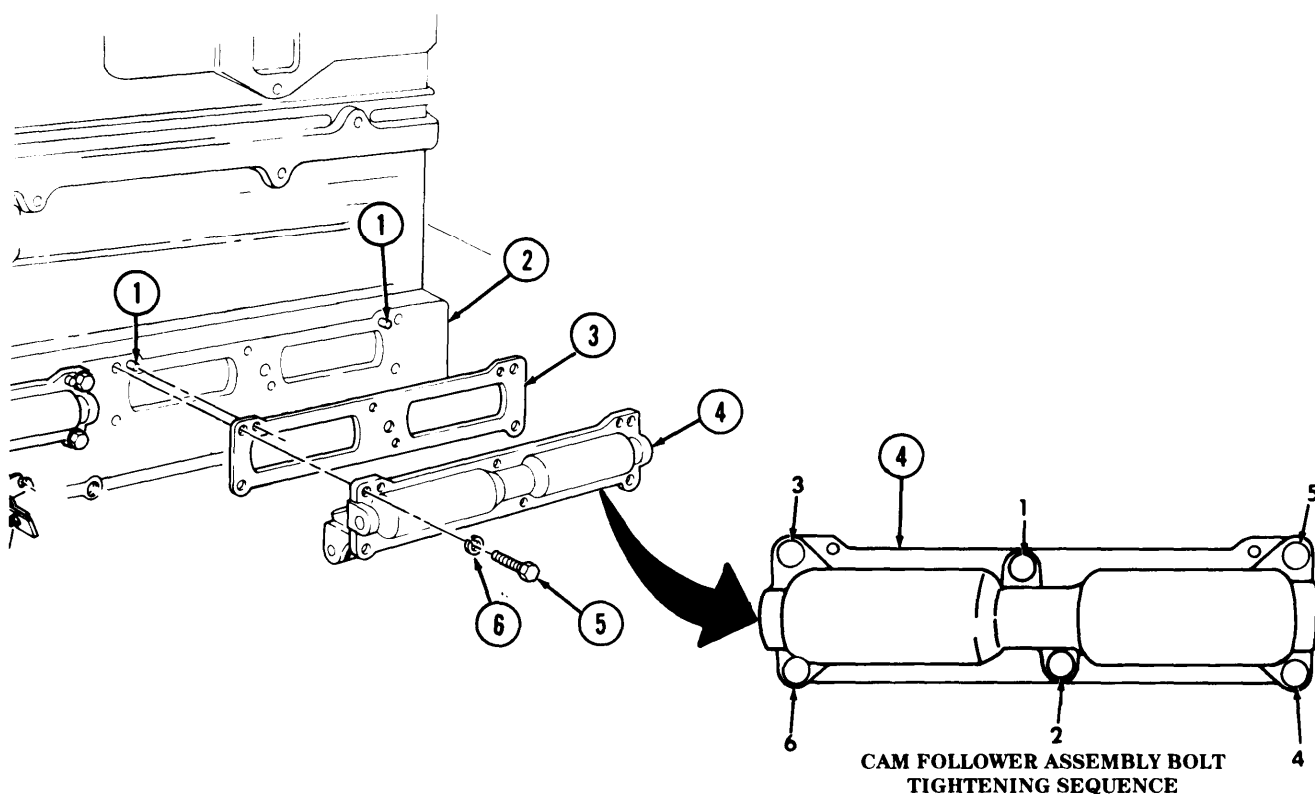
3-74. CAM FOLLOWERS AND PUSH TUBES INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Cam follower housings are mounted with screw-assembled lockwashers on late model engine.

- | | | | |
|----|--------------------------|---|-------------------------------------|
| 2. | Cam follower housing (4) | Install as follows: | |
| | | a. Position to gasket (3) over dowels (1), and seat against engine block (2). | Tap lightly with soft-faced hammer. |
| | | b. Install with six new lockwashers (6) and screws (5). | |
| | | c. Tighten screws (5) in sequence shown 15 lb-ft (20 N-m). | |
| | | d. Tighten screws (5) in sequence 30-35 lb-ft (41-47 N-m). | |



3-74. CAM FOLLOWERS AND PUSH TUBES INSTALLATION (Cont'd)

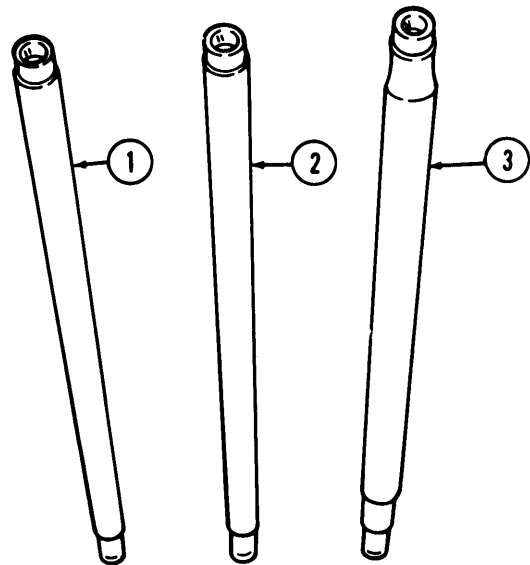
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

- Do not mix push tubes during installation. The injector tube is the largest, and is positioned between the intake and exhaust push tubes. Intake and exhaust push tubes are identical.
- Seating push tube lower ball ends into cam follower socket seats is critical. Several visual checks must be made during installation to ensure push tubes remain properly seated.

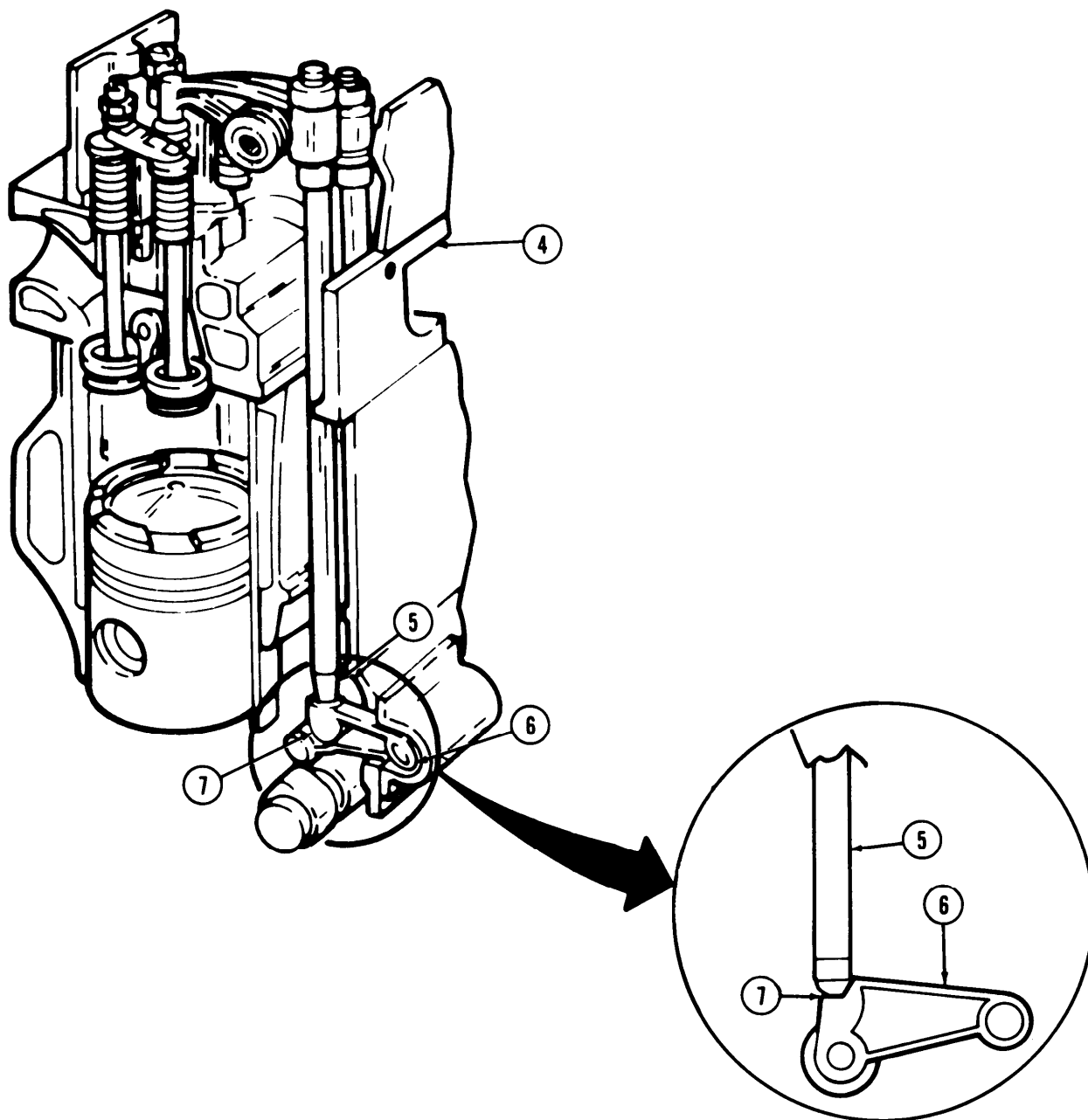
3.
- Two exhaust valve push tubes (1), injector push tubes (3), and intake valve push tubes (2)

Install each by passing ball end (5) down through opening in cylinder head (4) and into socket seat (7) on cam follower (6).



3-74. CAM FOLLOWERS AND PUSH TUBES INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK Install rocker lever housings (para. 3-80).

TA 350300

Change 2

3-373

3-75. INJECTORS INSTALLATION

This task covers:
Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
None	None	
<u>Materials/Parts</u>		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W	None	
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

CAUTION

Make sure no foreign objects have fallen into cylinder head through injector bore or damage to engine may result.

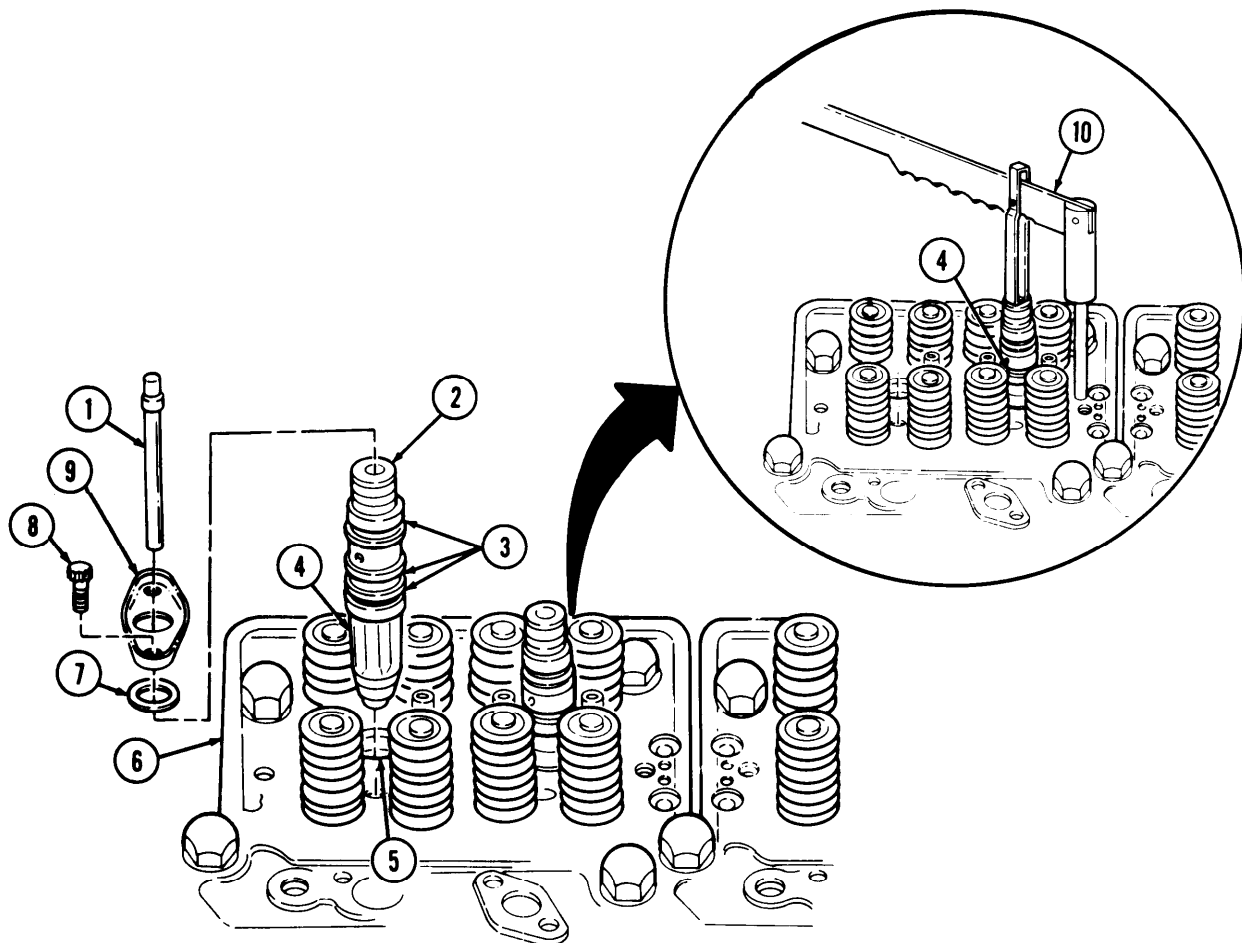
NOTE

- If injector condition is unknown, or has been disassembled, it must be calibrated before installation (para. 4-32).
- Top stop and non-top stop injectors are installed the same way. This procedure is for the non-top stop injector.

1.	Injector (4)	a. Lubricate three injector "O" rings (3) with clean engine oil. b. Start into injector bore (5).	Aline screen on fuel inlet hole with exhaust side of cylinder head (6).
2.	Spring compressor (1o)	a. Install on cylinder head (6), and place over injector plunger (2). b. Seat injector (4) by giving spring compressor (10) a quick push.	A click will be heard when injector (4) seats properly.

3-75. INJECTORS INSTALLATION (Cent'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
3.		Clamp plate (9) and retaining ring ('7)	Position over injector (4) and start two screws (8).	Do not tighten screws (8). Position clamp plate (9) with counterbore up.
4.		Injector link (1)	a. Carefully insert into injector plunger (2) and tighten screws (8). b. Raise link (1) 1/3 its length, and allow to fall back into injector plunger (2).	Tighten screws (8) 11-12 lb-ft (15-16 N•m) in 4 lb-ft (5 N•m) steps. (8). If link (1) binds or sticks, loosen screws (8) and retighten.



END OF TASK!

FOLLOW-ON TASKS:

- Install and adjust valve crossheads (para. 3-76).
- Install fuel crossover connectors (para. 3-73).
- Install rocker lever housings (para. 3-80).

TA 350301

Change 2

3-375

3-76. VALVE CROSSHEADS INSTALLATION AND ADJUSTMENT

This task covers:
Installation and Adjustment

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All		None
Test Equipment		
None		
Special Tools		Special Environmental Conditions
None		None
Materials/Parts		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
Personnel Required		General Safety Instructions
Wheeled vehicle repairman MOS 63W		None
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation and Adjustment

1.	Valve crosshead lock-nut (3)	Loosen, and back out adjusting screw (2) one full turn.	
2.	Twelve crossheads (1)	Install and adjust as follows: a. Coat with light film of clean engine oil and install on guides (4). b. Hold crosshead (1) down so it contacts valve stem (6) on side opposite adjusting screw (2). c. Turn adjusting screw (2) down until it just touches valve stem (5).	Adjusting screw (2) faces toward exhaust manifold side of engine. Use finger pressure. It maybe necessary to loosen locknut (3).

NOTE

Make sure adjusting screw is just lightly seated.

d. Set up dial indicator (7) over center of crosshead (1).

3-76. VALVE CROSSHEADS INSTALLATION AND ADJUSTMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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e. Pressing down on crosshead (1), zero dial indicator (7).

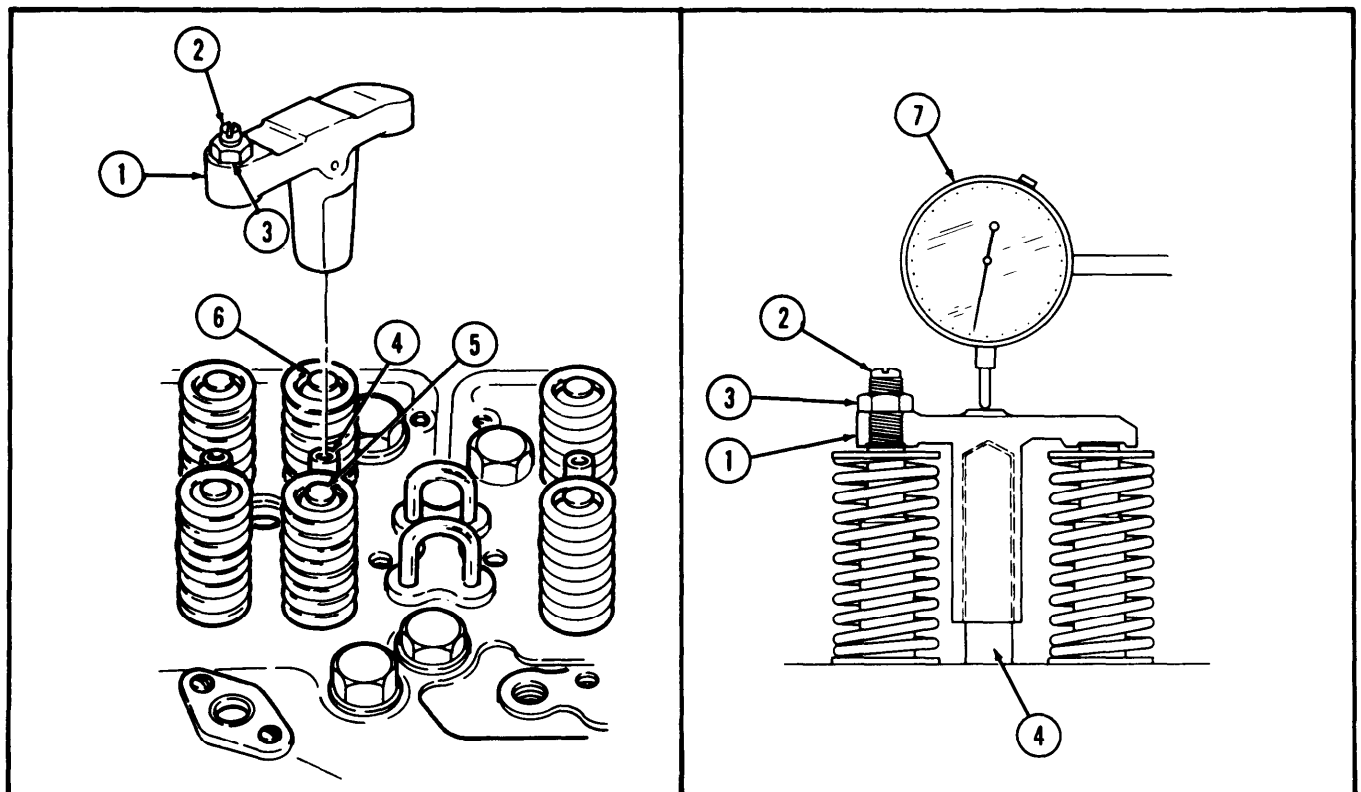
f. Holding crosshead (1) down lightly, turn adjusting screw (2) in until dial indicator reads 0.025-.040 in. (.65-.80 mm).

Minimum clearance must be 0.025 in. (0.64 mm). If not, see following note.

Use torque wrench adapter and tighten locknuts (3) 22-26 lb-ft (30-35 N·m).

NOTE

If minimum clearance is not 0.025 in. (0.64 mm), advance adjusting screw 1/3 of one hex on new crossheads and guides or 1/2 of one hex on old crossheads and guides, retighten locknut, and check clearance.



END OF TASK!

FOLLOW-ON TASK. Install rocker lever housings (para. 3-80).

TA 350302

Change 2

3-377

3-77. ENGINE ACCESSORY DRIVE INSTALLATION

This task covers:
Installation

INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Gasket Five lockwashers		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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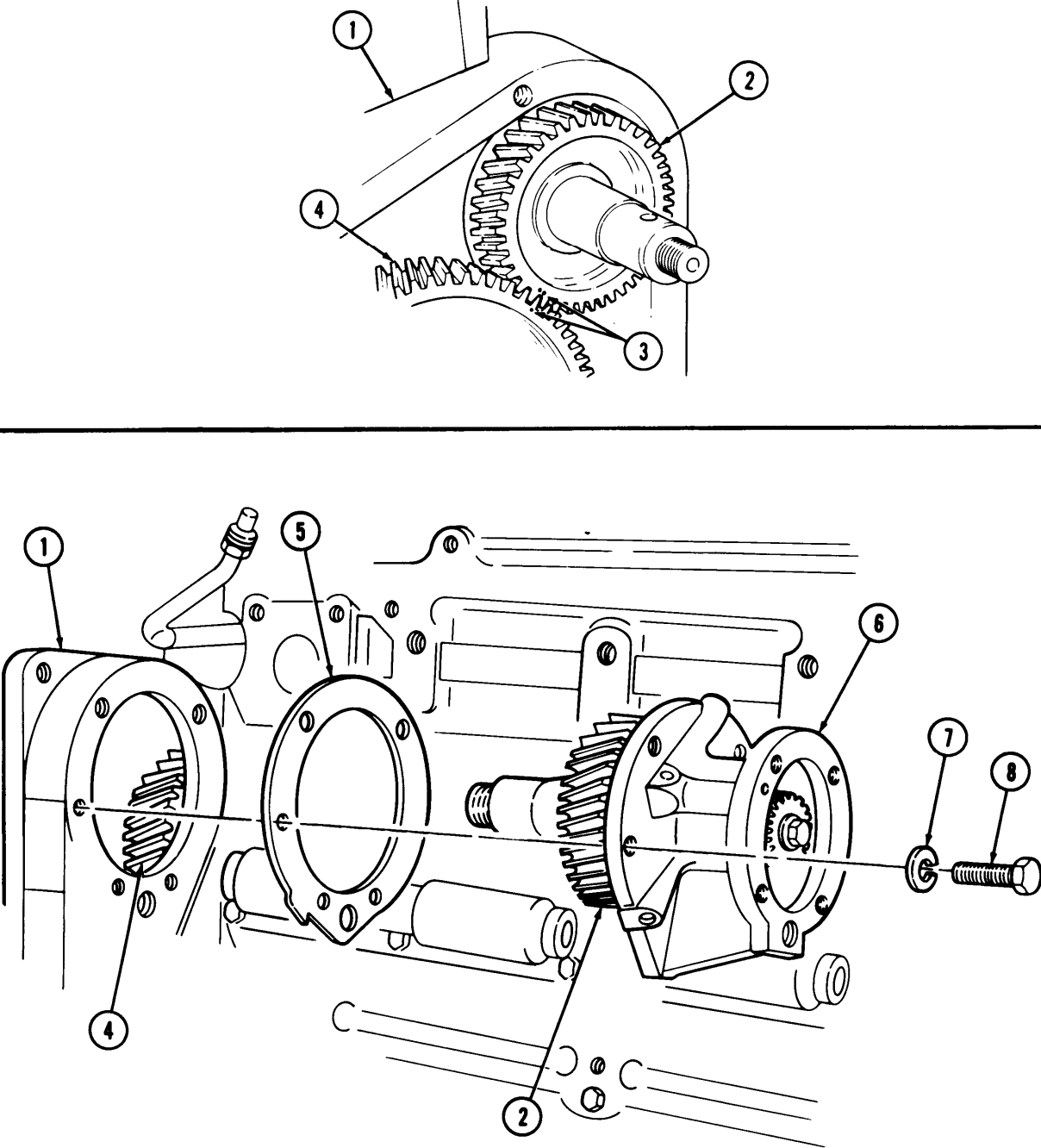
Installation

1.		Camshaft gear (4)	a. Rotate crankshaft to number one piston top dead center firing stroke (TDC). b. Rotate crankshaft 90 degrees past TDC.	
NOTE				
Alinement of accessory drive gear and camshaft gear is necessary. If not properly alined, valve, injector, and compressor timing will be incorrect,				
2.		Accessory drive housing (6) and new gasket (5)	Install on gearcase (1) with five screws (8) and new lockwashers (7).	Install gasket (5) with adhesive side towards gearcase (1). Timing marks (3) on accessory drive gear (2) and camshaft gear (4) must aline. Tighten 40-45 lb-ft (54-62 N.m).

NOTE

For accessory drive gear backlash test, refer to para. 3-43.

3-77. ENGINE ACCESSORY DRIVE INSTALLATION (Cent'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				

END OF TASK!

FOLLOW-ON TASKS:

- Install engine front gearcase cover (para. 3-78).
- Install air compressor (para. 3-83).
- Install fuel pump (para. 3-84).

3-78. ENGINE FRONT GEARCASE COVER INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Gasket		
Shims		
“O” ring		
Two seals		
Eighteen lockwashers		
Grease GAA (Appendix C, Item 11)		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

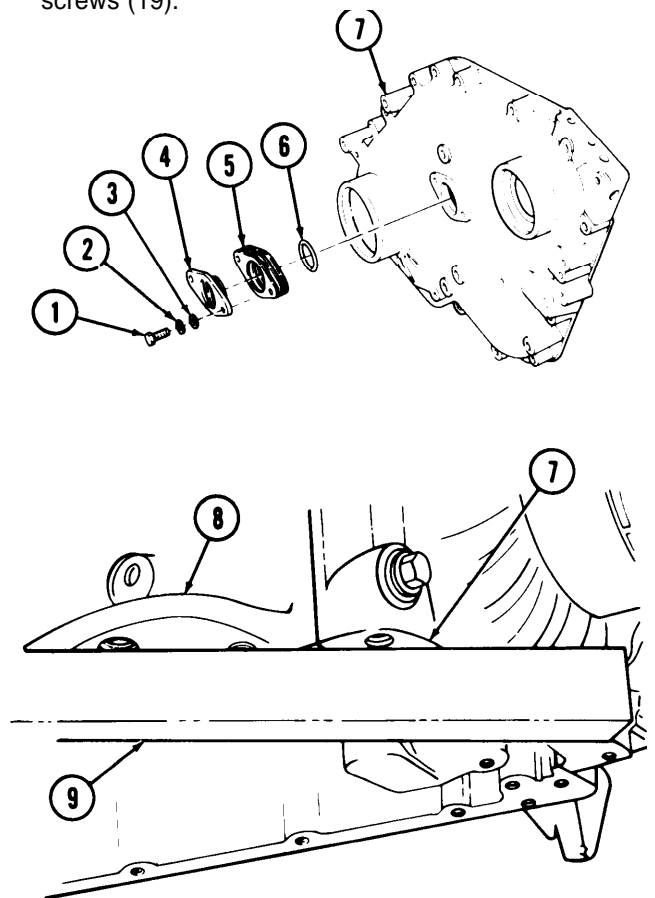
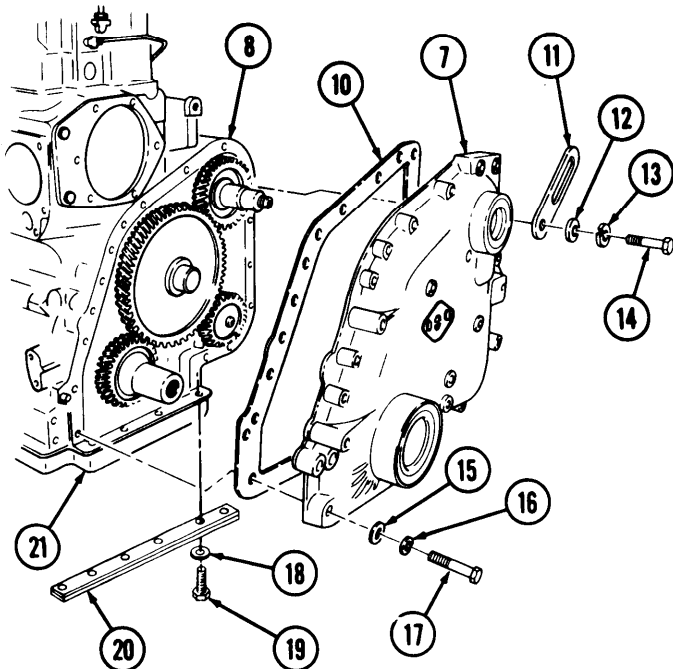
NOTE

Perform step 1 only if camshaft and gear have been removed.

1.	Front gearcase cover (7)	Two screws (1), lockwashers (2), and washers (3), camshaft thrust plate (4), shims (5), and “O” ring (6)	Remove.	
3.		New gasket (10)	Position on engine block (8).	Use GAA grease to hold gasket (10) in place.

3-78. ENGINE FRONT GEARCASE COVER INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
NOTE Front gearcase cover is mounted with screw-assembled washers for late model engine.				
4.		Front gearcase cover (7)	Install with fifteen washers (15), new lockwashers (16), and screws (17).	Check alinement at engine block (8) and gearcase cover (7) with straight edge (9). Tighten screws 45-50 lb-ft (61-68 N-m).
4.1.		Power steering pump adjusting link (11)	Install on front gearcase cover (7) with washer (12), new lockwasher (13), and screw (14).	
4.2.		Brace (20)	Install on oil pan (21) and front gearcase cover (7) with four washers (18) and screws (19).	Tighten screws (19) 35-40 lb-ft (48-54 N.m).

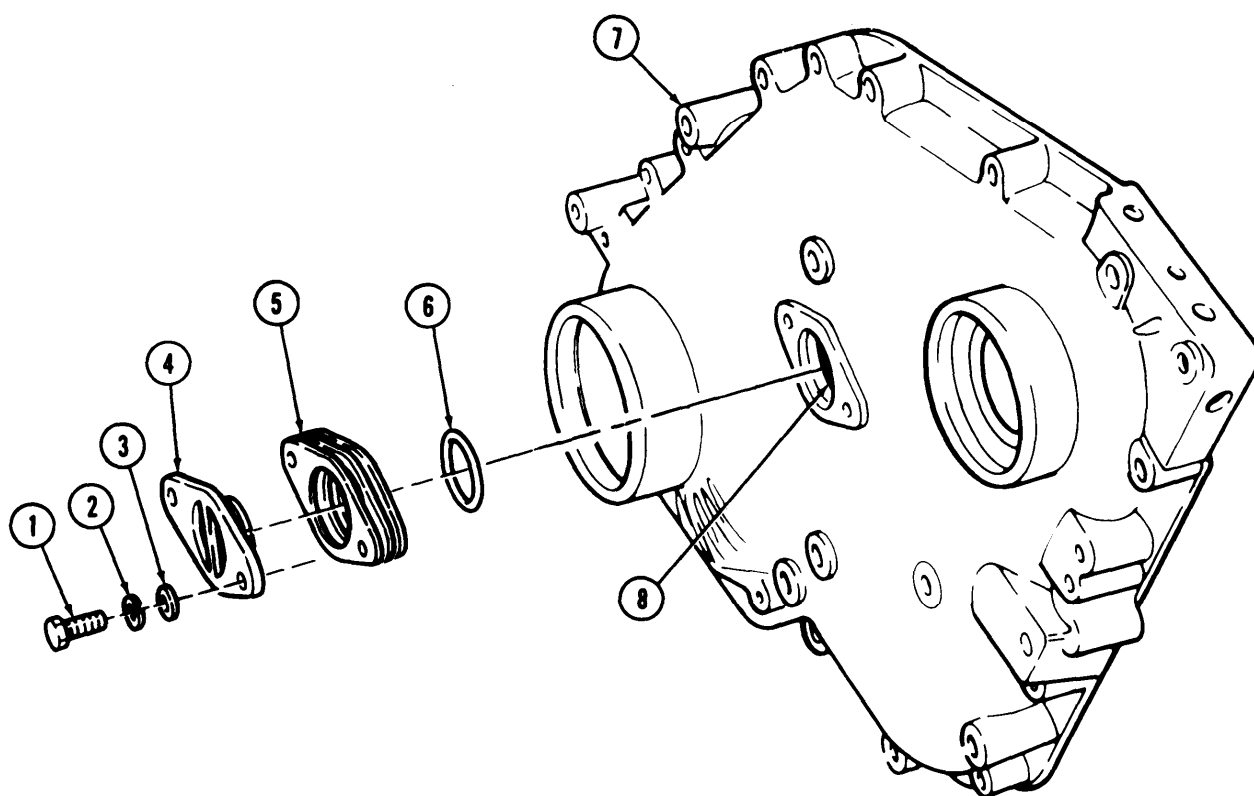


3-78. ENGINE FRONT GEARCASE COVER INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
5.		Camshaft thrust plate (4)	<p>Check as follows:</p> <p>a. Remove "O" ring (6) and shims (5).</p> <p>b. Push plate (4) against camshaft (8).</p> <p>c. Measure dimension between thrust plate (4) and gearcase cover (7) with feeler gage.</p> <p>d. Install plate (4), new shims (5), and new "O" ring (6) on front gearcase cover (7) with two washers (3), new lockwashers (2), and screws (1).</p>	<p>Install enough shims (5) to provide 0.001-0.005 in. (0.025-0.120 mm) end play.</p> <p>Tighten screws (1) 15-20 lb-ft (20-27 N.m).</p>

3-78. ENGINE FRONT GEARCASE COVER INSTALLATION (Cent'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS:

- Install engine accessory drive pulley (para. 3-79).
- Install crankshaft flange (para. 3-95).
- Install vibration damper (para. 3-96).
- Install water pump (para. 3-98).

TA 350305

3-79. ENGINE ACCESSORY DRIVE PULLEY INSTALLATION

This task covers:
Installation

INITIAL SETUP

Applicable Models	Equipment Condition Reference	Condition Description
All		None
Test Equipment		
None		
Special Tools		Special Environmental Conditions
Barring tool ST-747		None
Materials/Parts		General Safety Instructions
Gasket GAA Grease (Appendix C, Item 11)		None
Personnel Required		
Wheeled vehicle repairman MOS 63W		
Manual References		
TM 9-2320-272-34P		

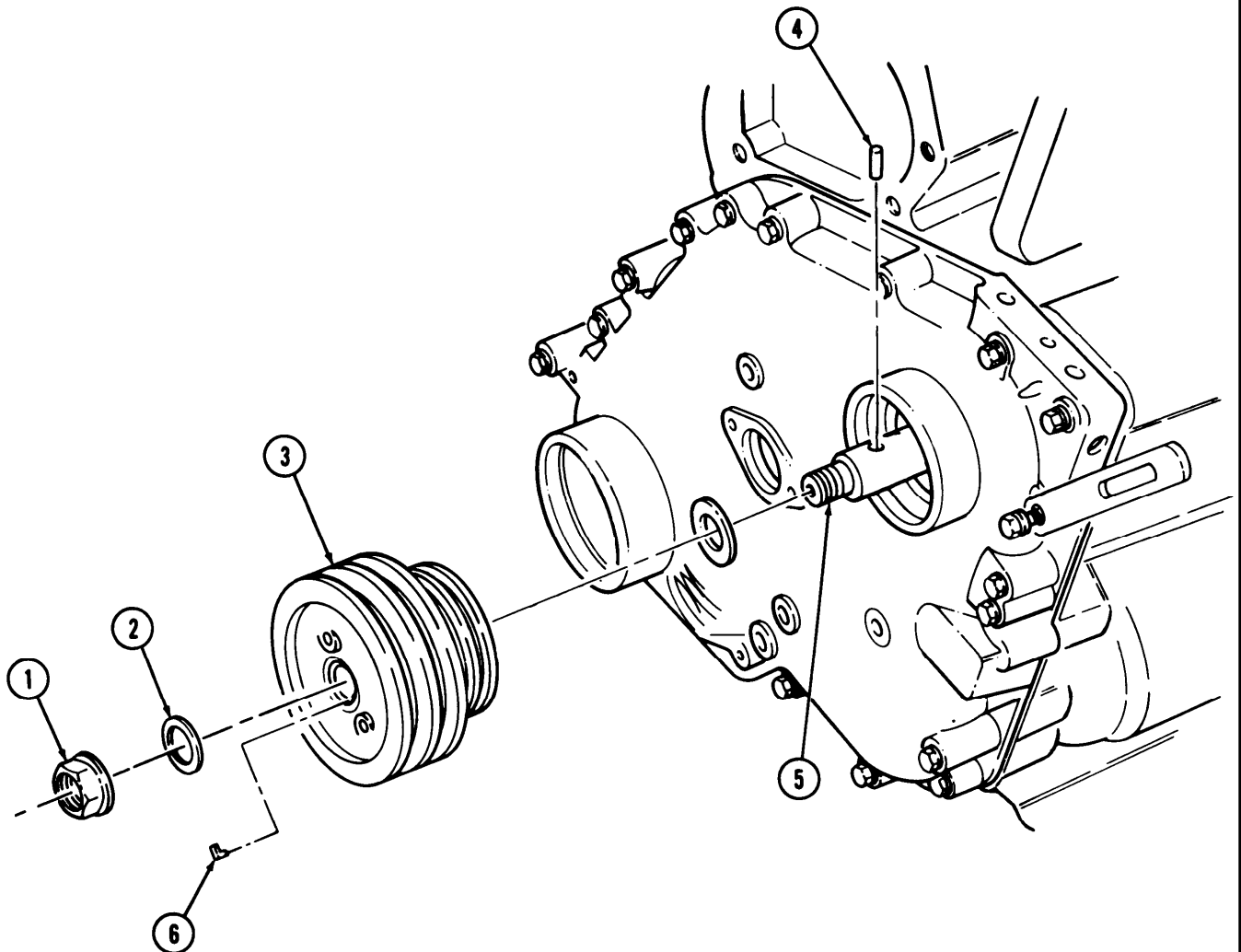
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.		Accessory drive shaft (5)	Apply alight coat of GAA grease.	
NOTE Perform step 2 only if damaged dowel pin was removed.				
2.		New dowel pin (4)	Install on shaft (5) if previously removed.	
2.1.		New gasket (6)	Install on keyway of accessory drive pulley (3).	
3.		Accessory drive pulley (3)	Aline keyway with dowel pin (4) and install on shaft (5) with washer (2) and flange nut (I).	Tighten 300-310 lb-ft (407-420 N.m). Use barring tool to prevent turning.

3-79. ENGINE ACCESSORY DRIVE PULLEY INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK Install engine oil pan (para. 3-92).

3-80. ROCKER LEVER HOUSINGS INSTALLATION

This task covers:
Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		<u>General Safety Instructions</u>
Three gaskets		None
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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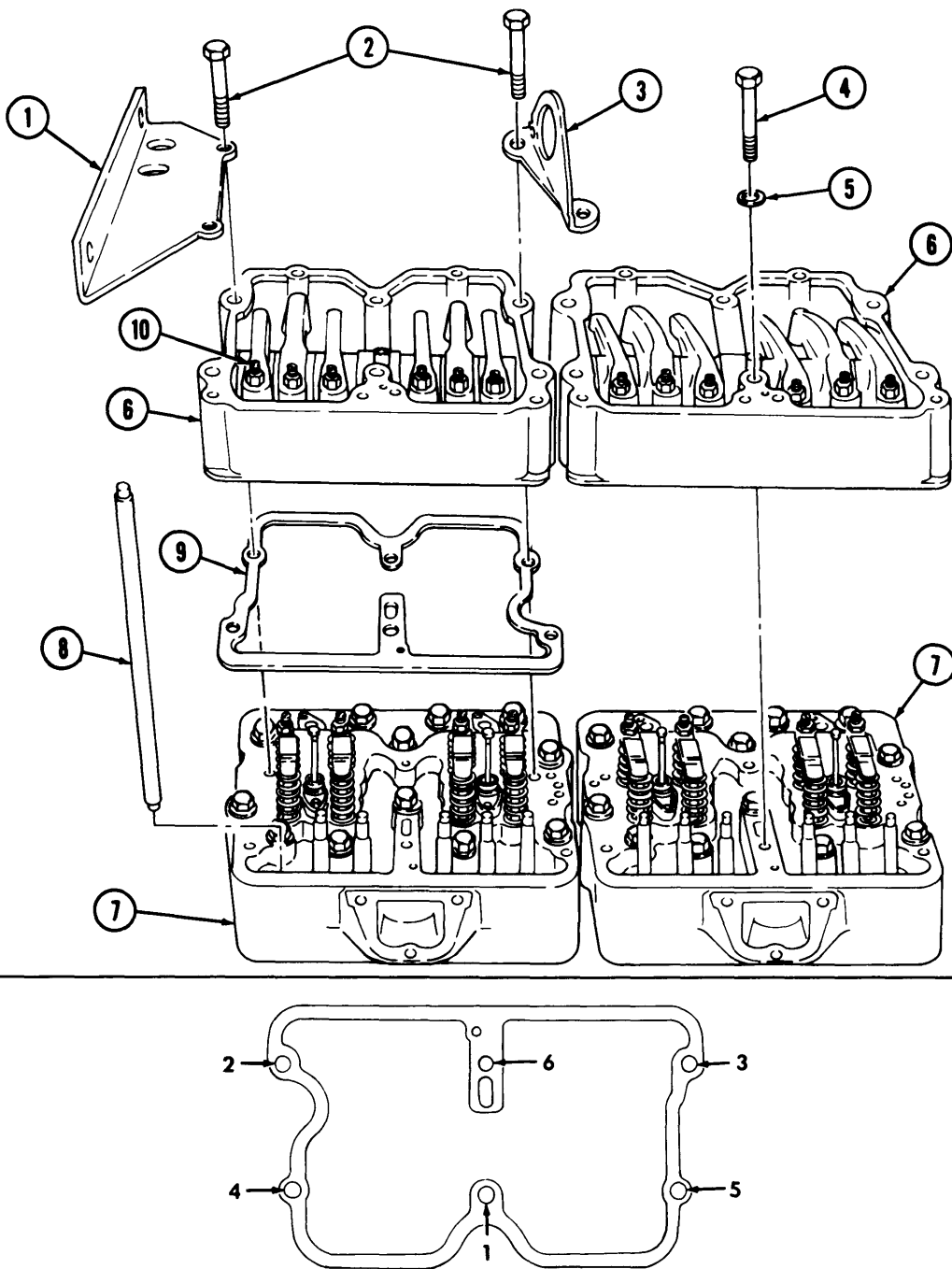
Installation

NOTE

- Rocker lever housings are mounted with screw-assembled washers on late model engines.
- Make sure push tubes remain seated during rocker lever housing installation.

1.	Rocker lever housing (6)	Eighteen screws (10)	Loosen.	
2.	Cylinder heads(7)	Twelve push tubes (8)	Install.	
3.		Three new rocker lever gaskets (9) and rocker lever housings (6)	Position on cylinder heads (7) and install with twelve washers (5) and screws (4).	Do not tighten screws (4). Ensure push tubes (8) are seated properly.
4.		Two lifting eyes (3) and upper radiator support bracket (1)	Install on rocker lever housings (6) with six screws (2).	Tighten screws (2) and (4) 55-65 lb-ft (75-88 N-m) in sequence shown.

3-80. ROCKER LEVER HOUSINGS INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
 <p style="text-align: center;">TIGHTENING SEQUENCE</p>				

END OF TASK!

FOLLOW-ON TASKS: • Adjust valves and injectors (dial indicator method) (para. 3-105).
 • Install rocker lever housing covers (para. 3-81).

3-81. ROCKER LEVER HOUSING COVERS INSTALLATION

This task covers:
Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
None	None	
<u>Materials/Parts</u>		
Gasket		
Five lockwashers		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W	None	
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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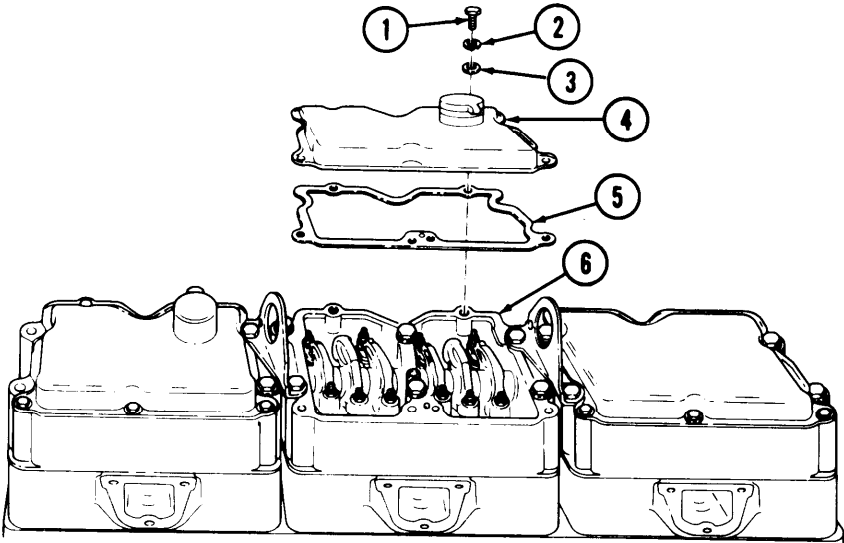
Installation

NOTE

lever housing covers are installed the same way. This covers center housing cover.

1.

Rocker lever housing cover (4) and new rocker lever housing cover gasket (5) Install on rocker lever housing (6) with five new lockwashers (2), washers (3), and screws (1).



END OF TASK!

3-83. AIR COMPRESSOR INSTALLATION

This task covers:
Installation

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All		None
Test Equipment		
None		
Special Tools		Special Environmental Conditions
Barring tool ST-747		None
Materials/Parts		General Safety Instructions
Ten lockwashers		None
Gasket		
Three packing sleeves		
Sealing tape (Appendix C, Item 30)		
Personnel Required		
Wheeled vehicle mechanic MOS 63W		
Manual References		
TM 9-2320-272-34P		

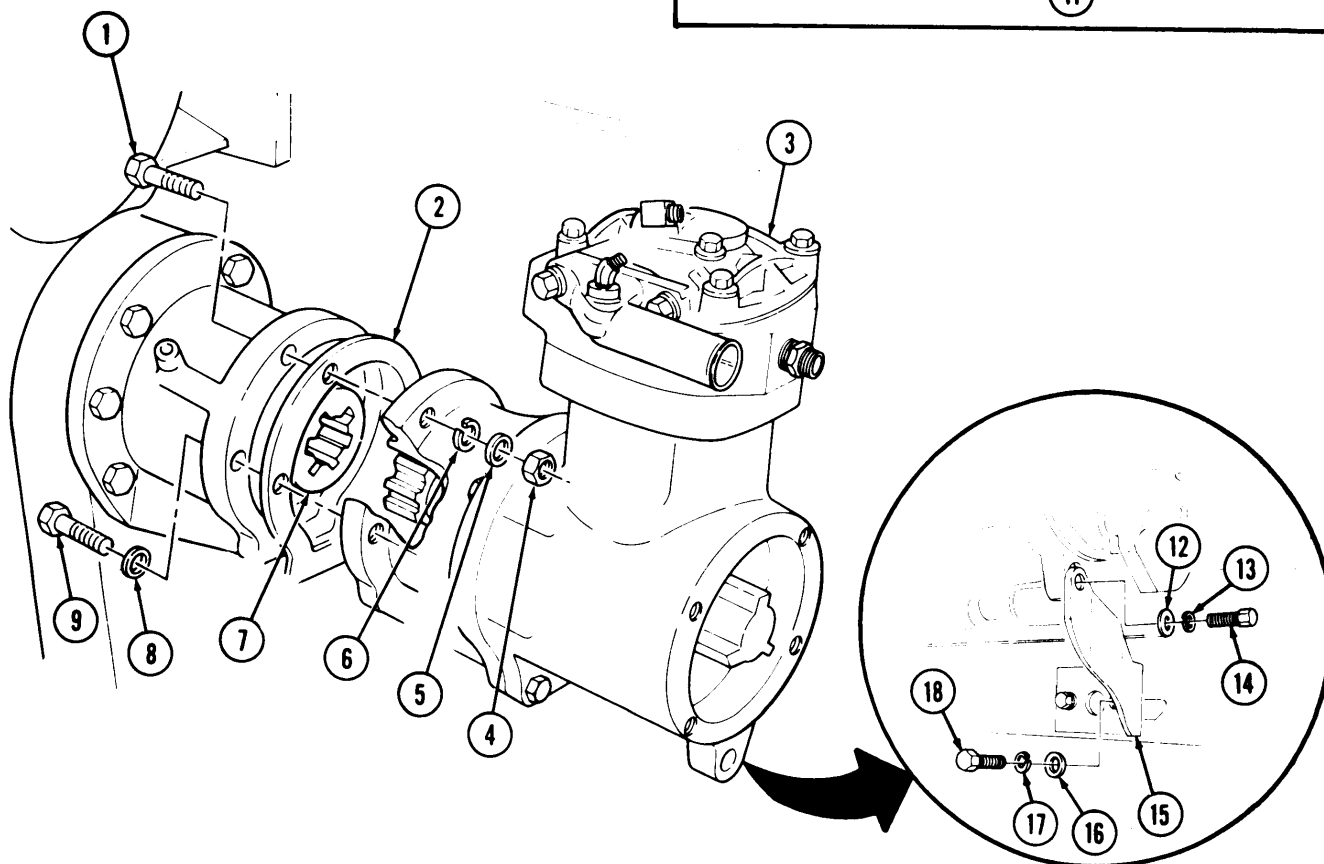
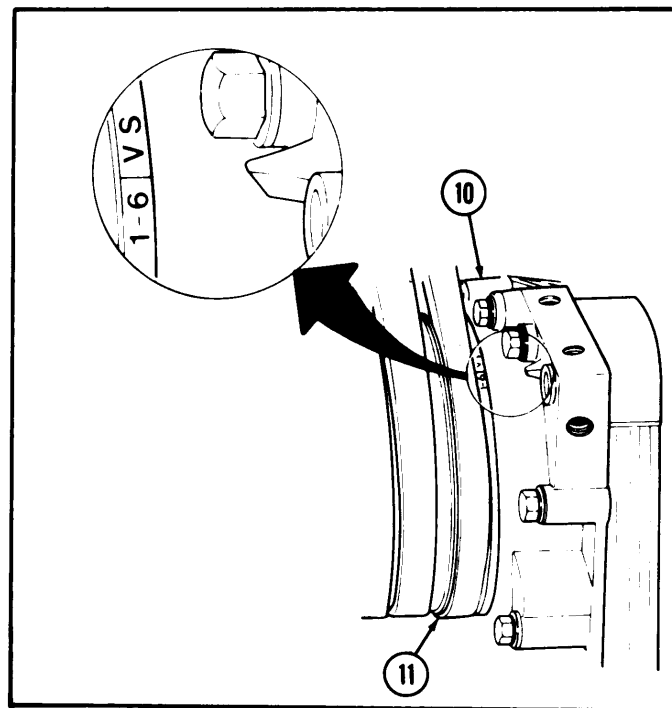
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.		Accessory drive pulley (11)	Bar engine to "1-6" valve set position and aline with marker on gearcase cover (10).	Use ST-747 barring tool.
2.		Air compressor (3)	Position air compressor crankshaft timing mark midway between 9:00 and 10:00 o'clock.	
3.		Coupling (7)	Install.	
4.		Air compressor (3) and new gasket (2)	Install with two new lockwashers (8), screws (9), screws (1), washers (6), new lockwashers (5), and nuts (4).	Tighten screws (9) and (1) 40-45 lb-ft (54-61 N·m).
5.		Bracket (15)	Install with washer (16), new lockwasher (17), screw (18), washer (12), new lockwasher (13), and screw (14).	Tighten screws (14) and (18) 30-35 lb-ft (41-47 N·m).

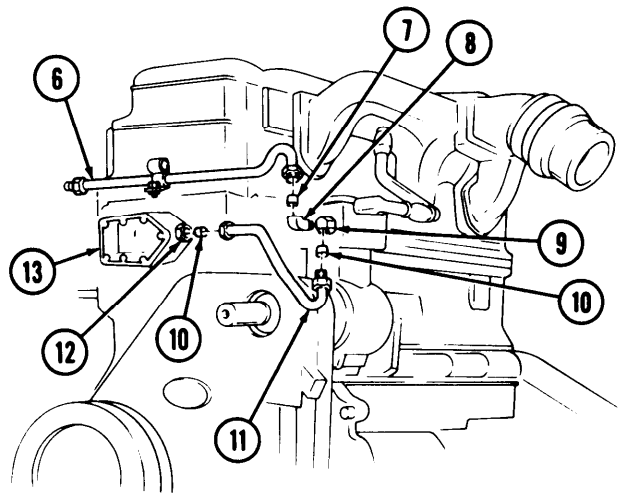
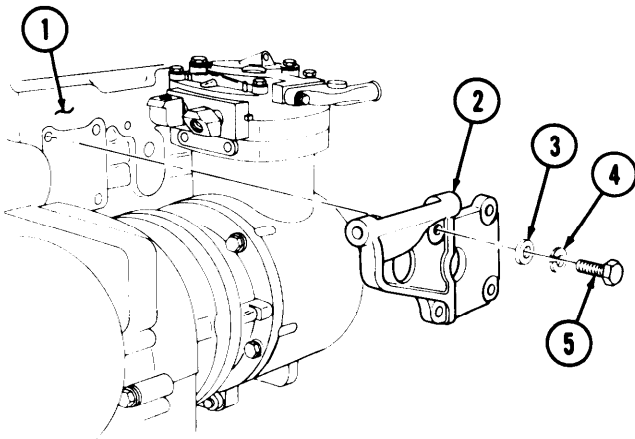
3-83. AIR COMPRESSOR INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-83. AIR COMPRESSOR INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
6.		Power steering pivot bracket (2)	Install on engine block (1) with four washers (3), new lockwashers (4), and screws (5).	
7.		Two new packing sleeves (10)	Install on coolant inlet line (11).	
NOTE Male pipe threads must be wrapped with sealing tape before installation.				
8.		Adapter (12) and coolant inlet tube (11)	Install on water pump manifold (13). b. Connect coolant inlet tube (11) to compressor elbow (9).	
9.		New packing sleeve (7)	Install on coolant outlet line (6).	
10.		Coolant outlet line (6)	Connect to compressor elbow (8).	



END OF TASK!

FOLLOW-ON TASKS:

- Install fuel pump (para. 3-84).
- Install air compressor air inlet tube (para. 3-89).

3-84. FUEL PUMP INSTALLATION

This task covers:

Installation

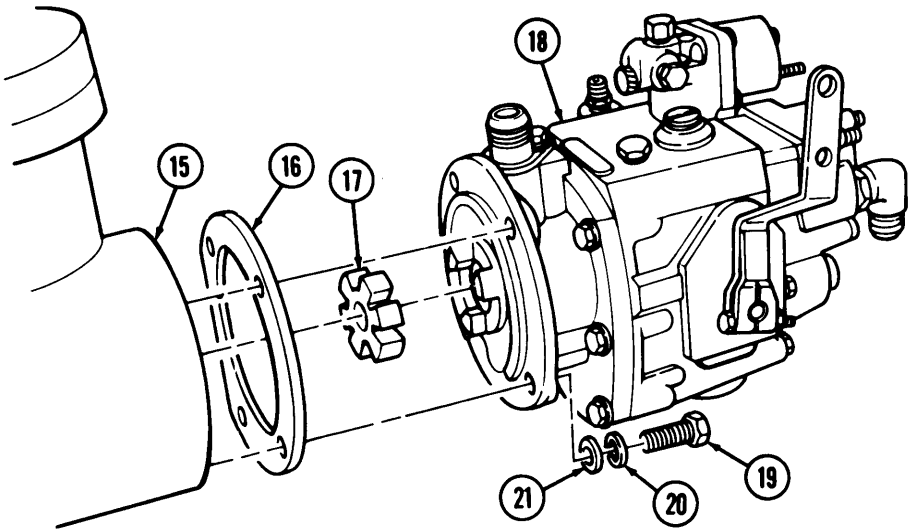
INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
None	None	
<u>Materials/Parts</u>		
Gasket		
Four lockwashers		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W	None	
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.
- Drive coupling (17), new fuel pump mounting gasket (16), and fuel pump (18)
- Install to air compressor (15) with four washers (21), new lockwashers (20), and screws (19).
- Tighten screws (19) 30-35 lb-ft (41-48 N.m).



END OF TASK!

FOLLOW-ON TASK: Install fuel supply and return tubes (para. 3-85).

3-85. ENGINE FUEL SUPPLY AND RETURN TUBES INSTALLATION

This task covers:

Installation

INITIAL SETUP:

Applicable Models

All

Test Equipment

None

Special Tool

None

Materials/Parts

Three lockwashers
Sealing tape (Appendix C, Item 30)

Personnel Required

Wheeled vehicle repairman MOS 63W

Manual References

TM 9-2320-272-34P

Equipment Condition Reference

Condition Description

None

Special Environmental Conditions

None

General Safety Instructions

None

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

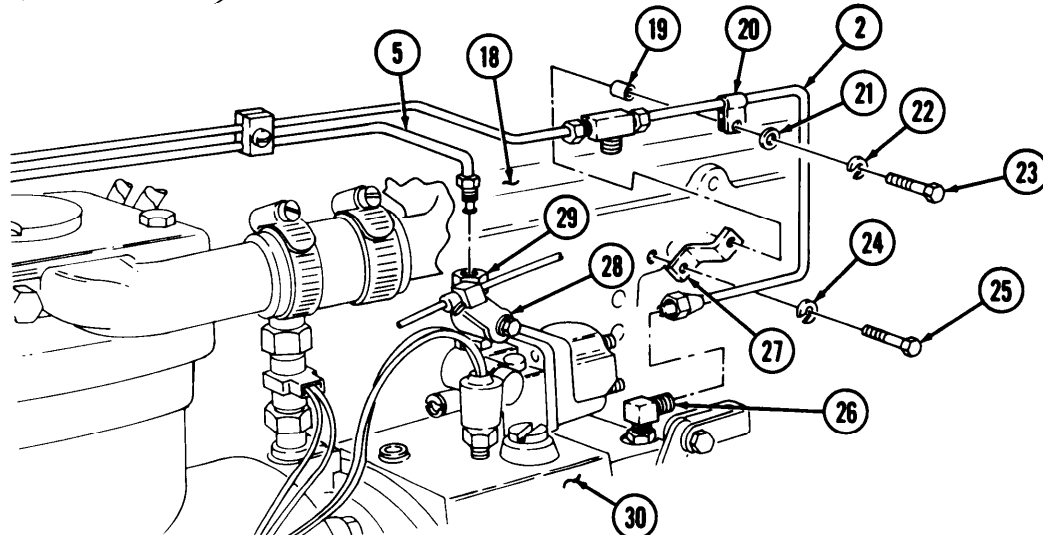
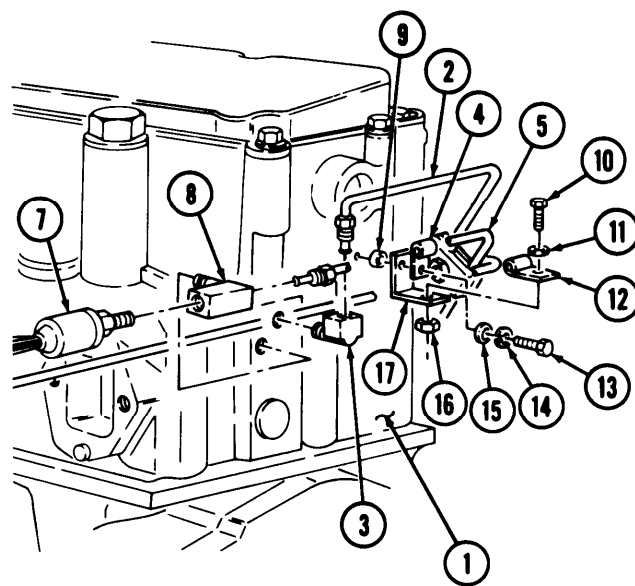
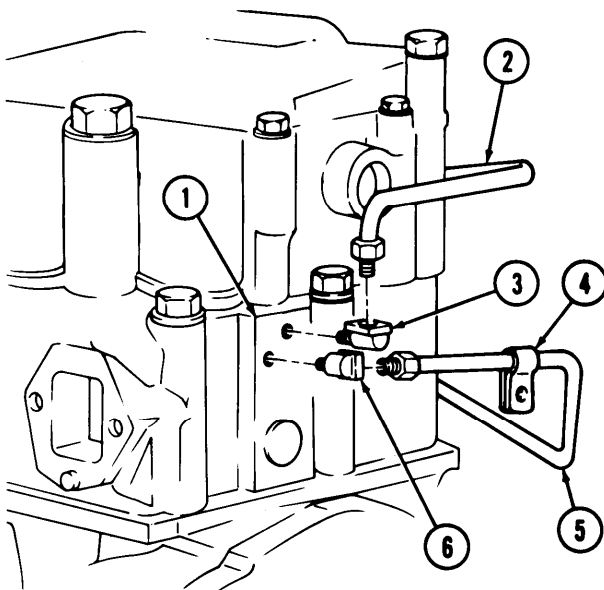
NOTE

- Male pipe threads must be wrapped with sealing tape before installation.
- Perform steps 1.1 and 1.2 for late model engine.

1.	Fittings (3) and (6)	Install on front of cylinder head (1).	
1.1.	Tee (8) and fitting (3)	Install on front of cylinder head (1).	
1.2.	Fuel pressure transducer (7)	Install on tee (8).	
2.	Engine fuel supply tube (5)	a. Connect to fitting (6) at front of cylinder head (1) and tighten. b. Connect other end to fitting (29) on to of shutdown valve (28) and tighten.	Connect to tee (8) on late model engine.
3.	Engine supply tube clamp (4) and bracket (17)	Install with spacer (9), washer (15), new lock-washer (14), and screw (13).	Tighten 10-12 lb-ft (14-16 N-m).
4.	Coolant outlet line clamp (12)	Install with washer (11), screw (10), and nut (16).	
5.	Engine fuel return tube (2)	a. Connect to fitting (3) at front of cylinder head (1) and tighten.	

3-85. ENGINE FUEL SUPPLY AND RETURN TUBES INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			b. Connect other end to elbow (26) on fuel pump (30).	
6.		Bracket (27)	Install on cylinder block (18) with new lockwasher (24) and screw (25).	
7.		Spacer (19), clamp (20), Install on bracket (27) and fuel return tube (2) with washer (21), new lockwasher (22), and screw (23).		



END OF TASK!

3-86. ENGINE OIL PUMP INSTALLATION

This task covers:

- a. Installation
- b. Gear Backlash Test

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 3-42	Engine front gearcase cover removed (task a. only).
Test Equipment		
None		
Special Tools		Special Environmental Conditions
None		None
Materials/Parts		General Safety Instructions
Five lockwashers Gasket		None
Personnel Required		
Wheeled vehicle repairman MOS 63W		
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Installation

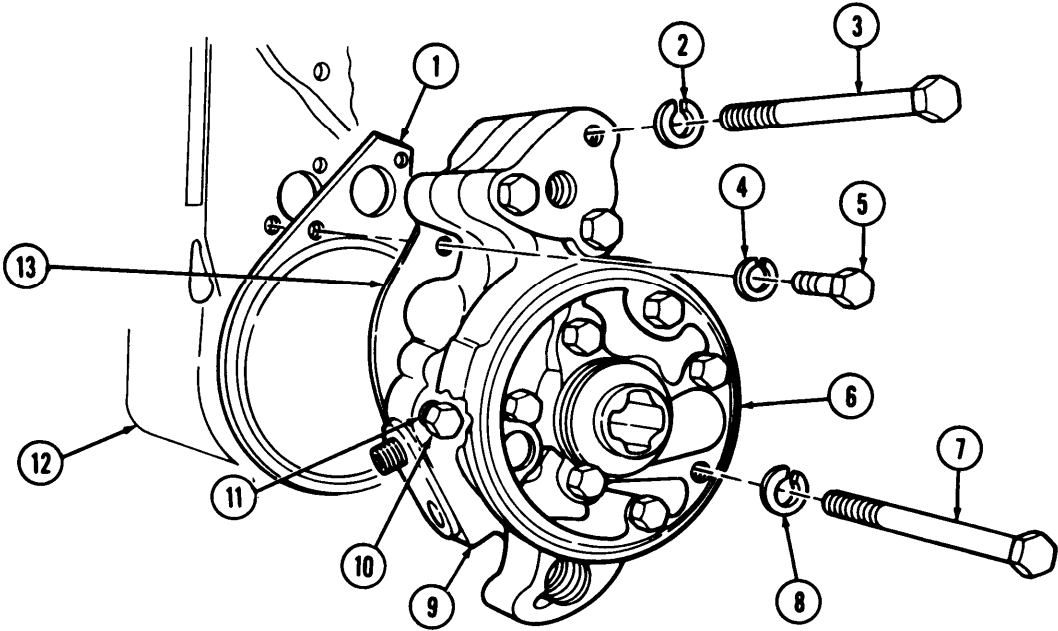
CAUTION

Mounting screws are of different sizes. Do not force screws to bottom. Misplaced screws can damage parts.

1.	Oil pump (9) and new gasket (1)	Install in gearcase (12) with two new lockwashers (2) and (8) and screws (3) and (7).	Screws (3) and (7) are inserted through oil filter head (6) and into gearcase (12).
2.	Three new lockwashers (4) and screws (5)	Install through oil pump flange (13) into gearcase (12).	
3. Oil pump (9)	Screw (10) and lock-washer (11)	Install through oil pump flange (13) into gearcase (12).	
4.	Screws (3), (7), and (10) and three screws (5)	Tighten.	Tighten to 35-46 lb-ft (48-62 N-m).

3-86. ENGINE OIL PUMP INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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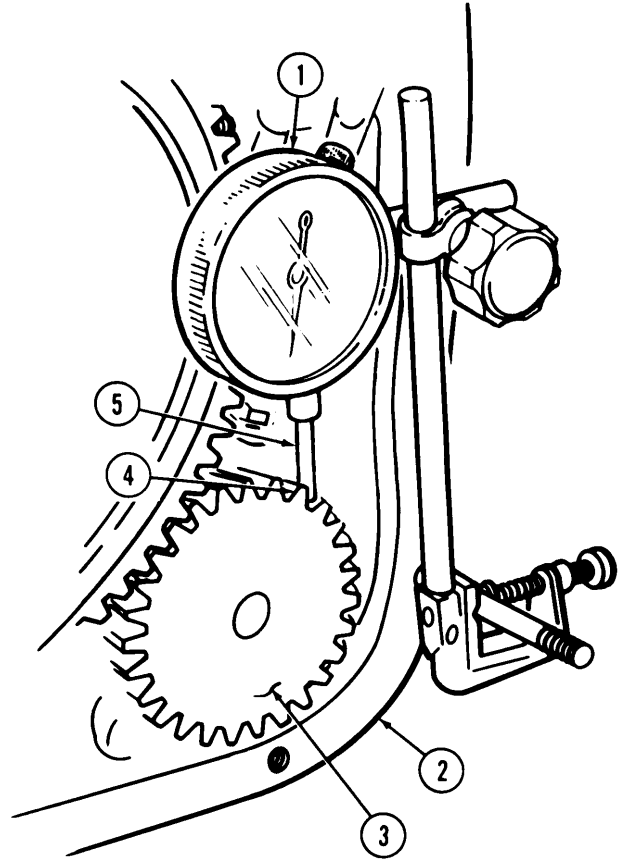


3-86. ENGINE OIL PUMP INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Gear Backlash Test

5. Engine block flange (2) and oil pump drive gear (3)	Dial indicator (1)	<div>a. Mount flange (2).</div> <div>b. Make sure plunger (5) is positioned flat against drive gear tooth (4).</div> <div>c. Turn drive gear (3) clockwise until tight.</div> <div>d. Zero dial indicator (1).</div> <div>e. Note amount of movement of dial indicator (1).</div>	Normal range is 0.004-0.016 in. (0.10-0.16 mm). If less than 0.002 in. (0.05 mm), replace drive gear (3). (Refer to para 3.12.)
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END OF TASK!

FOLLOW-ON TASK:
Install front gearcase cover (para. 3-78).

TA 350315

3-87. ENGINE OIL FILTER INSTALLATION

This task covers:

Installation

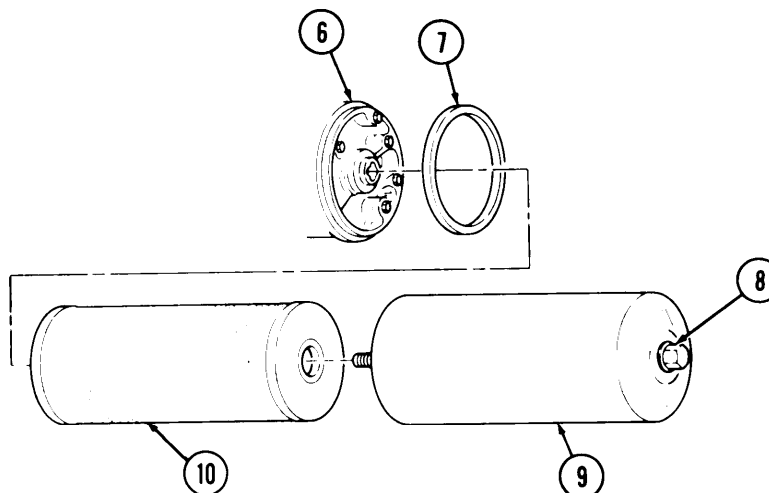
INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Oil filter seal		
Oil filter element		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

- | | | | |
|----|---|--|----------------------------------|
| 1. | New oil filter seal (7), new element (10), and oil filter shell (9) | Install on filter base (6) with center bolt (8). | Tighten 25-35 lb-ft (34-48 N·m). |
|----|---|--|----------------------------------|



END OF TASK!

FOLLOW-ON TASK: Install air intake manifold (para. 3-88).

TA 350316

3-88. AIR INTAKE MANIFOLD INSTALLATION

This task covers:
Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Three air intake manifold gaskets		
Nine lockwashers		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP	LOCATION	ITEM	ACTION	REMARKS
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Installation

NOTE

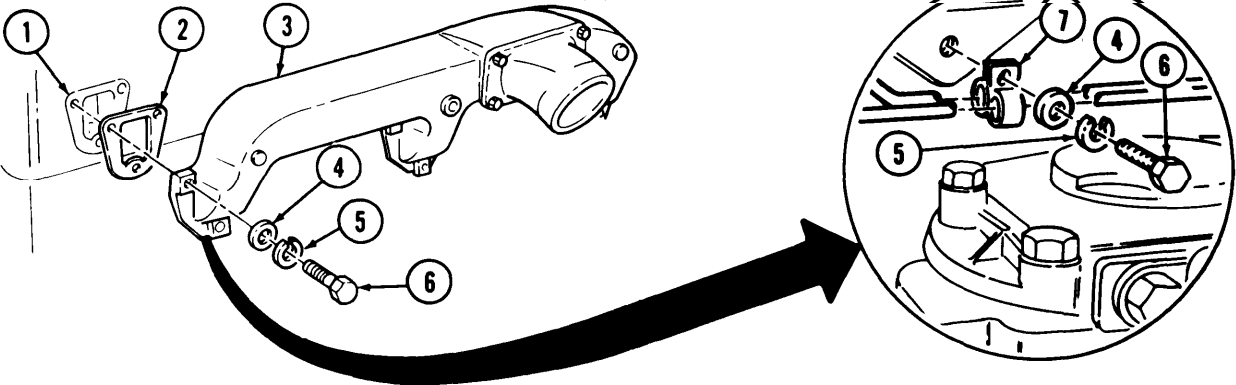
Air intake manifold is mounted with screw-assembled washers on late model engine.

1.
- Three new intake manifold gaskets (2) and intake manifold (3)
- Install on three cylinder heads (1) with eight washers (4), lockwashers (5), and screws (6).
- Tighten 20-25 lb-ft (27-34 N-m).

NOTE

Perform step 2 only if clamps were previously removed.

2.
- Two clamps (7), screws (6), lock-washers (5), and washers (4)
- Install on intake manifold (3).
- Tighten 20-25 lb-ft (27-34 N.m).



END OF TASK!

FOLLOW-ON TASK: Install air compressor air inlet tube (para. 3-89).

3-89. AIR COMPRESSOR AIR INLET TUBE INSTALLATION

This task covers:

Installation**INITIAL SETUP:****Applicable Models**

All

**Equipment
Condition
Reference****Condition Description**

None

Test Equipment

None

Special Tools

None

Special Environmental Conditions

None

Materials/Parts

None

Personnel Required

Wheeled vehicle repairman MOS 63W

General Safety Instructions

None

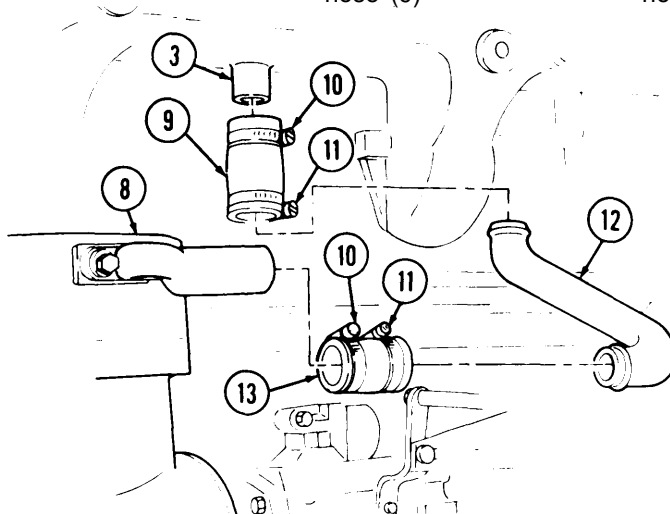
Manual References

TM 9-2320-272-34P

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1. Air compressor hose (13) and manifold hose (9)
Install each on end of compressor tube (12) with two hose clamps (11).
2. Compressor tube (12), air compressor hose (13), and manifold hose (9)
Install on air compressor (8) and manifold (3) with two hose clamps (10).



END OF TASK!

FOLLOW-ON TASK: Install crankshaft rear cover seal and plate (para. 3-90).

TA 350318

3-90. CRANKSHAFT REAR COVER SEAL AND PLATE INSTALLATION

This task covers:

Installation

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All		None
Test Equipment		
None		
Special Tools		Special Environmental Conditions
None		None
Materials/Parts		
"O" ring retainer		
"O" ring retainer gasket		
Rear cover plate gasket		
Rear cover plate seal		
"O" ring		
Ten lockwashers		
Personnel Required		General Safety Instructions.
Wheeled vehicle repairman MOS 63W		None
Manual References		
TM 9-2320-272-34P		

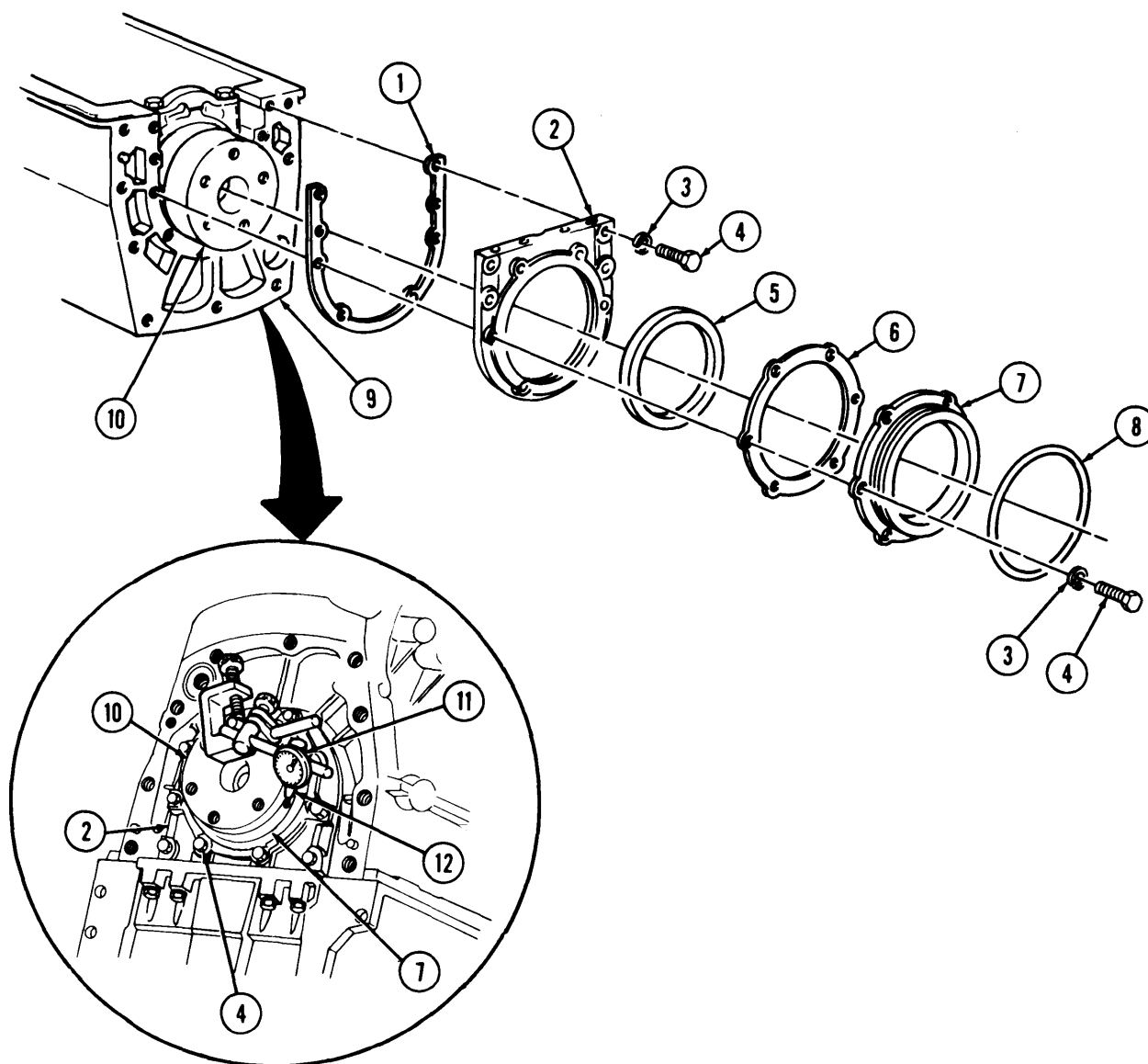
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.		New rear cover plate gasket (1) and rear cover plate (2)	Install on engine block (9) with four new lockwashers (3) and screws (4).	Do not tighten screws (4).
2.		New 'O" ring retainer (7) and new gasket (6)	a. Position over end of crankshaft (10). b. Install with six new lockwashers (3) and screws (4).	Do not tighten screws (4).
3.		Dial indicator (11)	Check cover plate (2) runout as follows: a. Position on end of crankshaft (10). b. Position indicator arm (12) to outside edge of "O" ring retainer (7). c. Rotate crankshaft (10) and read indicator (11) to aline rear covers (2).	Rear cover (2) must be alined within 0.005 in. (0.127 mm).

3-90. CRANKSHAFT REAR COVER SEAL AND PLATE INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
4.		Ten screws (4)	Tighten 24-29 lb-ft (33-39 N-m).	
5.		New rear cover plate seal (5)	Install into rear cover plate (2) over end of crankshaft (10).	
6.		New 'O' ring (8)	Install over new "O" ring retainer (7).	



END OF TASK!

FOLLOW-ON TASK: Install flywheel housing (para. 3-91).

TA 350319

3-91 I FLYWHEEL HOUSING INSTALLATION

This task covers:
Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
Dial indicator flywheel attachment ST-1325		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Nine lockwashers Camshaft bore cork gasket		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

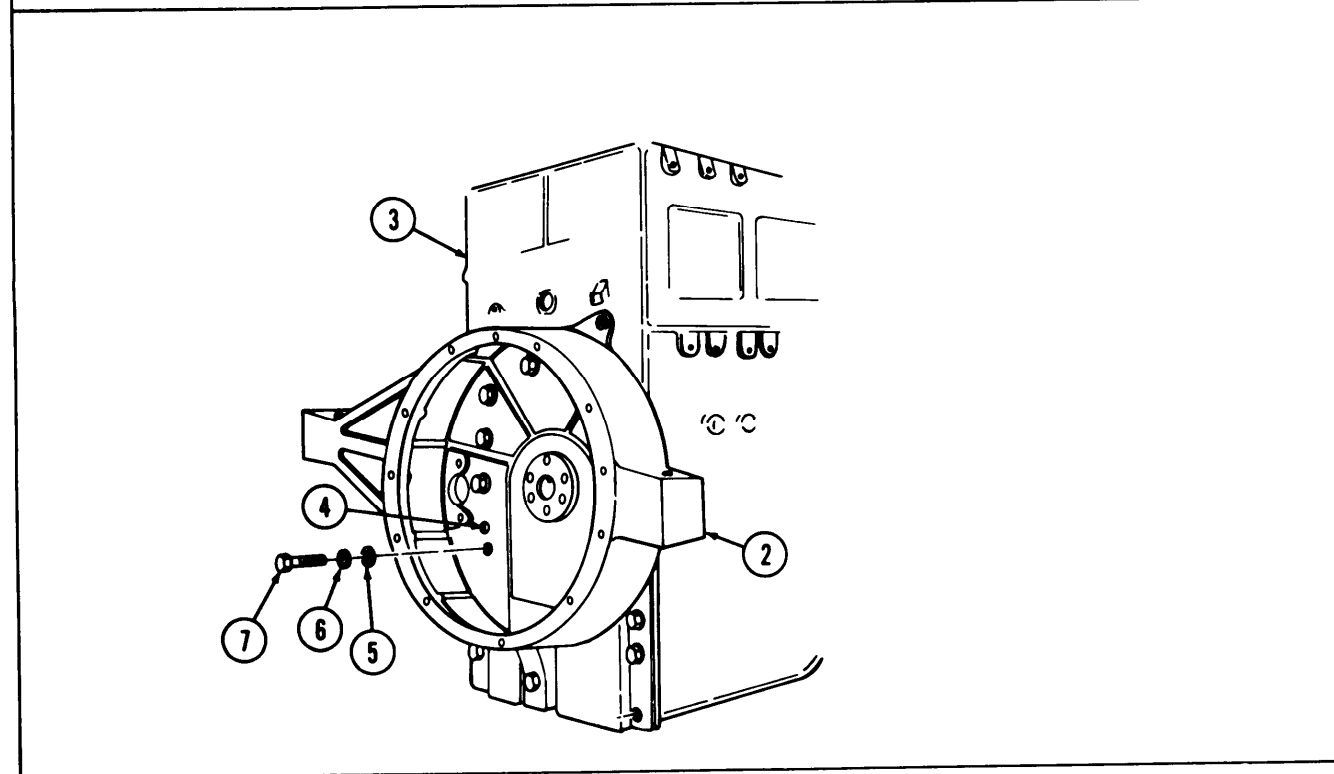
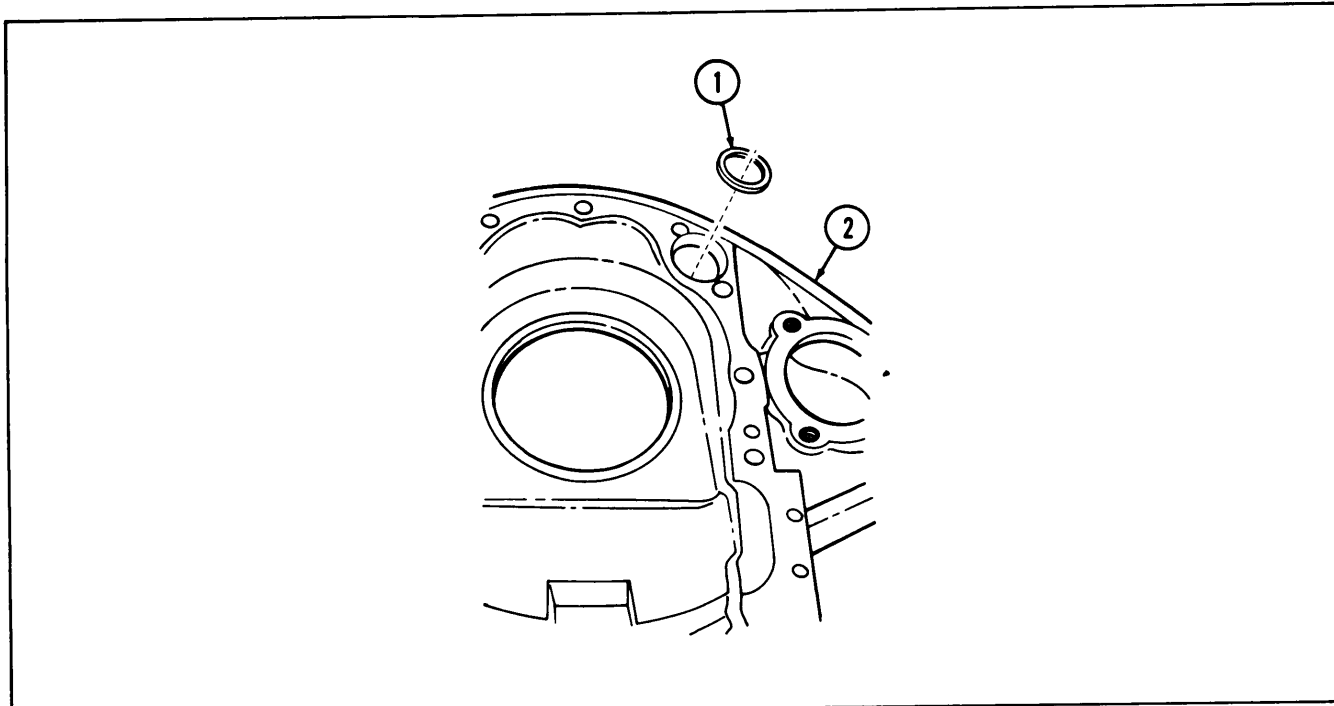
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.		New camshaft bore cork gasket (1)	Install into flywheel housing (2).	
NOTE Perform step 1.1 when installing new flywheel housing.				
1.1. Engine block (3)		Two dowel pins (4)	Install.	
2.		Flywheel housing (2)	Install over dowel pins (4) and seat against engine block (3).	
3.		Nine washers (5), new lockwashers (6), and screws (7)	Install finger tight.	Housing may have to be shifted during alignment.

3-91. FLYWHEEL HOUSING INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-91. FLYWHEEL HOUSING INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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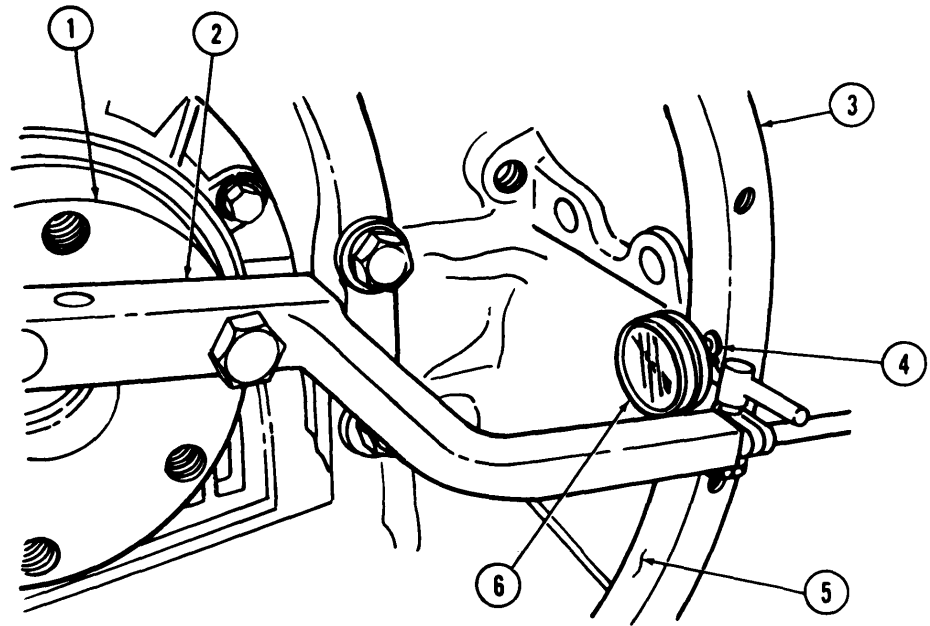
NOTE

The flywheel bore must be centered to crankshaft rotation. Follow steps 4 through 10, using a dial indicator with dial gage attachment.

4.		Dial indicator attachment (2)	Attach to crankshaft (1) flange and position dial indicator plunger (4) against bore face (5).	
5.		Flywheel housing (3)	Mark chalk marks at 12,3,6, and 9 o'clock positions.	
6.		Dial indicator plunger (4)	Position at 3 o'clock position by rotating crankshaft (1). Set dial indicator (6) to zero.	
7.		Flywheel housing (3)	Check vertical runout as follows: a. Rotate crankshaft (1) from 3 o'clock through 6 o'clock to 9 o'clock position. b. Rotate from 9 o'clock through 12 o'clock and back to 3 o'clock.	Record highest reading. Record highest reading. The highest reading recorded in steps a. and b. determines the up or down direction the housing (3) must be adjusted. Proceed to step 8.

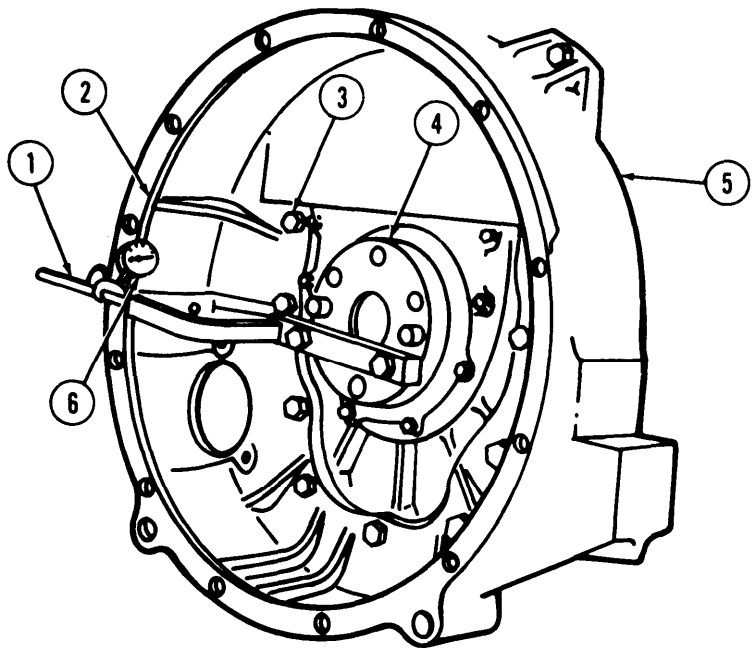
3-91. FLYWHEEL HOUSING INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-91. FLYWHEEL HOUSING INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
8.		Flywheel housing (5)	<p>Adjust vertical runout as follows:</p> <p>a. Rotate crankshaft (4) and indicator attachment (1) to point on bore (2) where highest reading was recorded.</p> <p>b. Set dial indicator (6) to read one-half of total highest reading.</p> <p>c. Loosen flywheel housing mounting screws (3) slightly.</p> <p>d. Using a soft-faced hammer, carefully tap housing (5) opposite the dial indicator (6) until dial indicator (6) reads zero.</p> <p>e. Once dial indicator (6) reads zero, tighten screws (3) finger tight.</p>	<p>Housing (5) is now centered vertically. Do not remove dial indicator (6).</p>



3-91. FLYWHEEL HOUSING INSTALLATION (Cont'd)

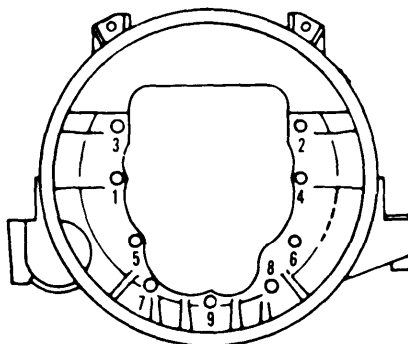
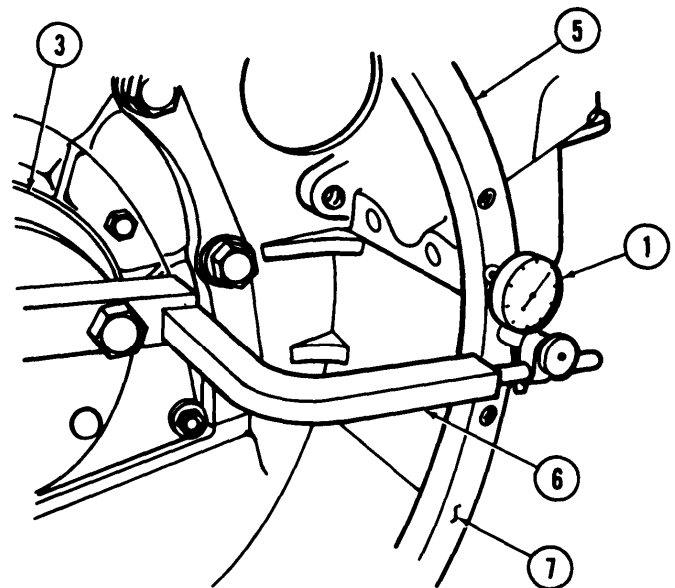
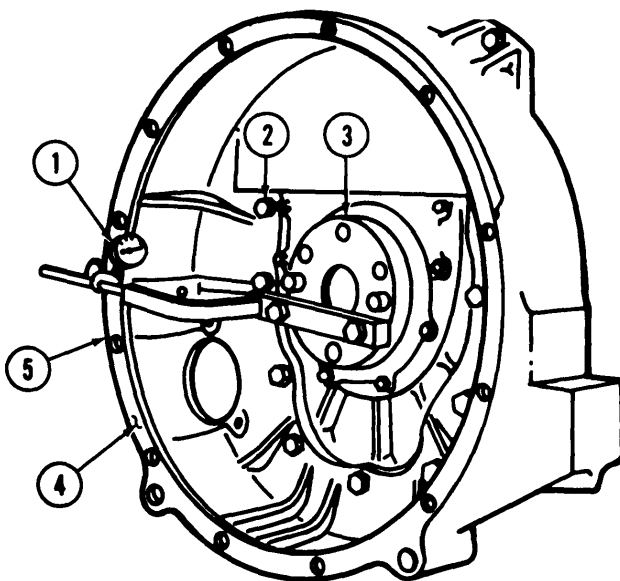
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
9.		Flywheel housing (5)	Check horizontal runout as follows: a. Rotate crankshaft (4) so dial indicator (6) is positioned at 12 o'clock. b. Rotate crankshaft (4) and check readings at 3 o'clock and 6 o'clock. c. Rotate crankshaft (4) and check reading at 9 o'clock and back to 12 o'clock position.	Set dial indicator (6) to zero. Record highest reading. Record highest reading. The highest reading recorded will indicate the direction the housing (5) must be moved to obtain correct alinement center. Proceed to step 10.

3-91. FLYWHEEL HOUSING INSTALLATION (Cont'd)

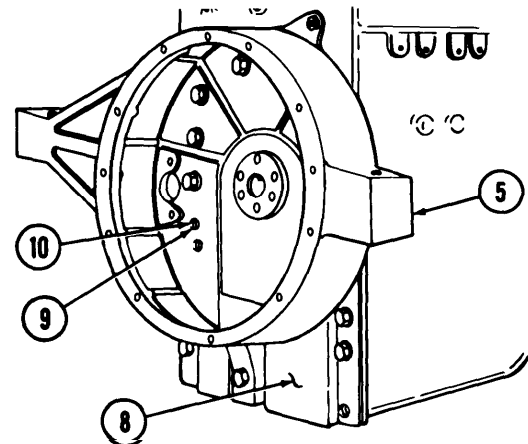
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
10.		Flywheel housing (5)	Adjust horizontal runout as follows: a. Rotate crankshaft (3) and set dial indicator (1) at point where highest reading was recorded on bore (4). b. Set dial indicator (1) to one-half of total highest reading. c. Loosen flywheel housing mounting screws (2) slightly. d. Tap housing (5) opposite dial indicator (1) with soft-faced hammer until dial indicator (1) reads zero.	
11.		Dial indicator (1)	e. Tighten nine flywheel housing mounting screws (2) in sequence shown. Reposition and set against housing face (7) to check total flywheel housing (5) runout as follows: a. Push crankshaft (3) forward to take up end play. b. Set dial indicator (1) to zero. c. Rotate crankshaft (3) and read total runout on dial indicator (1). d. Remove dial indicator (1) and attachment (6).	Tighten 140-160 lb-ft (190-217 N•m). Total runout must not exceed 0.008 in. (0.20 mm). If runout is within specifications, housing (5) is properly positioned.

3-91. FLYWHEEL HOUSING INSTALLATION (Contd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p align="center">NOTE</p> <p align="center">Perform steps 12 and 13 if dowel pins were removed.</p>				
12.		Dowel pin holes (9)	Ream holes (9) to next oversize.	Use drill and reaming future.
13.		Two new dowel pins (10) Install in flywheel housing (5) and engine block (8).		Ensure dowel pins (10) are even with or 0.010 in. (0.25 mm) below the flywheel housing (5).



**SCREW
TIGHTENING SEQUENCE**



END OF TASK!

FOLLOW-ON TASKS:

- Install engine oil pan (para. 3-92).
- Install flywheel ring gear (para. 3-94).

3-92. ENGINE OIL PAN INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Gasket Six lockwashers		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Engine oil pan is mounted with screw-assembled washers for late model engine.

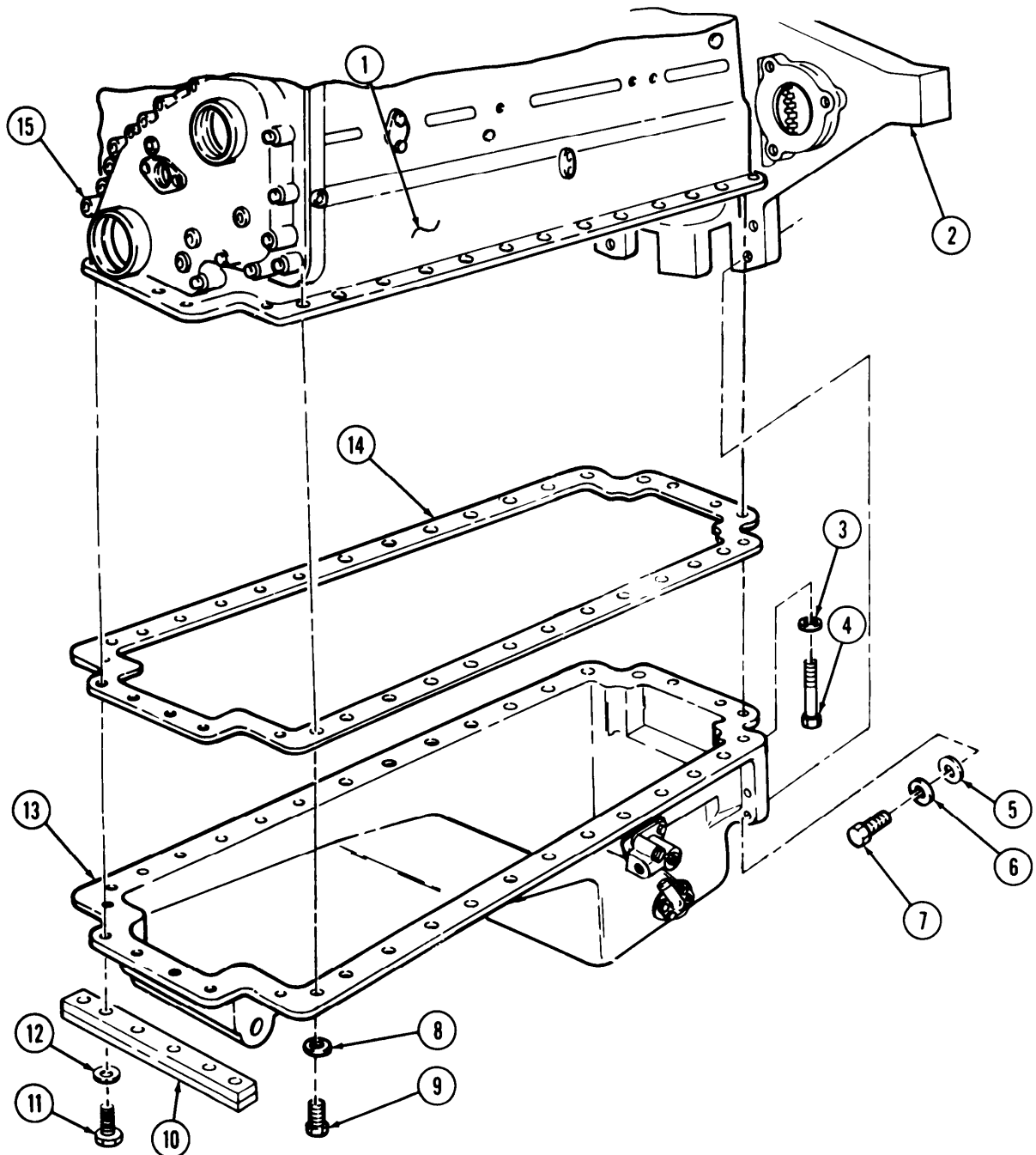
Installation

1.	New engine oil pan gasket (14) and oil pan (13)	a. Install on cylinder block (1) with twenty-eight washers (8) and screws (9). b. Install to front gearcase cover (15) with bar (10), four washers (12), and screws (1 1). c. Install rear of oil pan (13) with four washers (3) and screws (4). d. Install on flywheel housing (2) with six new washers (5), new lockwashers (6), and screws (7). e. Alternately tighten screws (9) and (11) 35-40 lb-ft (48-54 N•m).	Do not tighten screws (9). Do not tighten screws (11). Do not tighten screws (4). Tighten alternately 70-80 lb-ft (95-109 N•m).
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3-92. ENGINE OIL PAN INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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f. Alternately tighten screws (4) 15-20 lb-ft (20-27 N•m).



END OF TASK!

FOLLOW-ON TASK: Install oil pump return, pickup hoses and sump tubes (para. 3-93).

TA 350326

3-93. OIL PUMP RETURN HOSE, PICKUP HOSE, AND SUMP TUBE INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Two packing sleeves		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

- | | | |
|----|----------------------|--|
| 1. | Front sump tube (14) | a. Install adapter (17) to oil pan sump fitting (18), and pump fitting (11) to front of oil pump (1).
b. Install two new packing sleeves (16) and (12).
c. Connect nut (15) to adapter (17),
d. Connect nut (13) to oil pump fitting (11). |
| 2. | Pump return hose (7) | Install to oil pan aerator (4) and oil pump fitting (10). |
| 3. | Pump pickup hose (2) | Install to oil pan flange (6) and oil pump (1), |

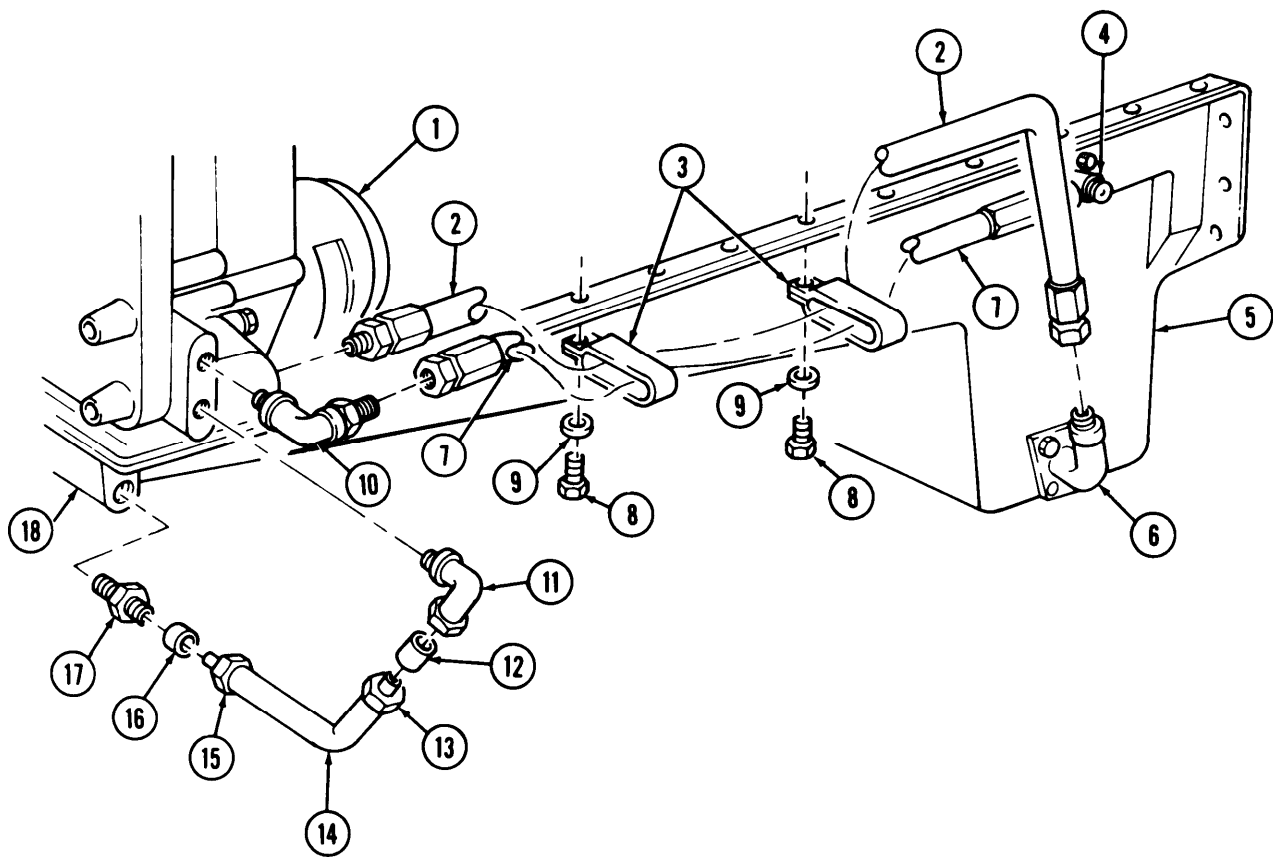
3-93. OIL PUMP RETURN HOSE, PICKUP HOSE, AND SUMP TUBE
INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Engine oil pan is mounted with screw-assembled washers on late model engine.

- | | | | | |
|----|--|--------------------------------|--|----------------------------------|
| 4. | | Two screws (8) and washers (9) | Remove from oil pan (5). | |
| 5. | | Two hose clamps (3) | a. Place around pickup hose (2) and return hose (7).
b. Install to oil pan (5) with two screws (8) and washers (9). | Tighten 35-40 lb-ft (47-54 N•m). |



END OF TASK!

3-94. FLYWHEEL RING GEAR INSTALLATION

This task covers:

Installation

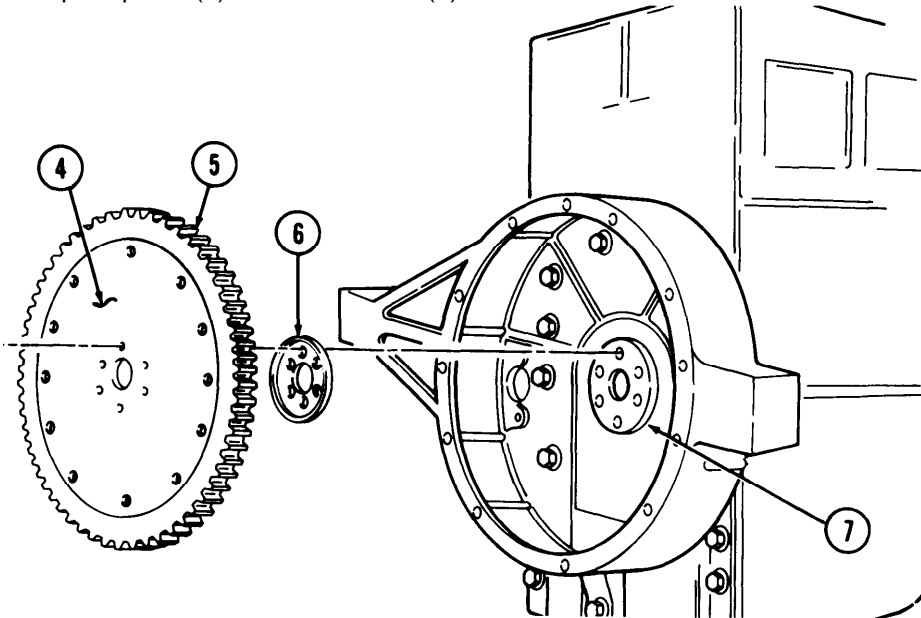
INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.
- Flywheel ring gear (5), flex plate (4), clutch spacer (3), and adapter plate (6)
- Install to crankshaft rear flange (7) with six washers (2) and screws (1).
- Tighten alternately 200-220 lb-ft (271-298 N•m).



END OF TASK!

3-95. CRANKSHAFT FLANGE INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

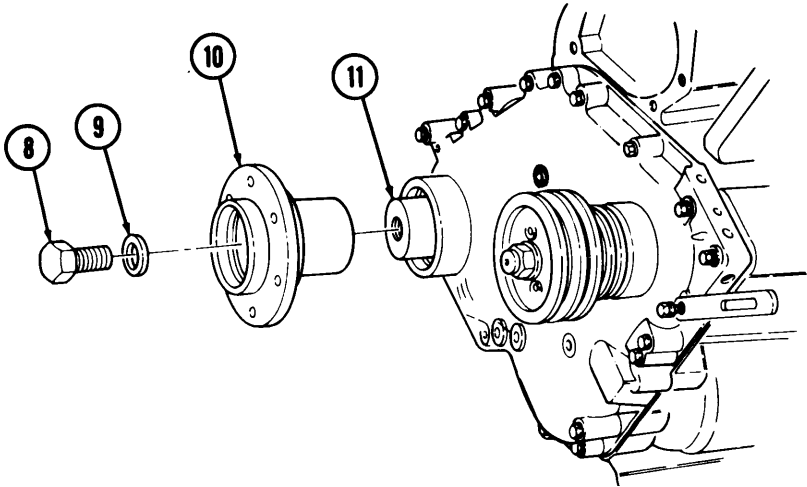
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

- | | | |
|----|------------------------|--|
| 1. | Crankshaft flange (10) | a. Coat inside with engine oil.
b. Install to crankshaft (11) with washer (9) and screw (8). Tighten 180-200 lb-ft (244-271 N•m). |
|----|------------------------|--|

NOTE

For checking eccentricity and wobble, refer to para. 3-10.



END OF TASK!

FOLLOW-ON TASK: Install vibration damper (para. 3-96).

3-96. VIBRATION DAMPER INSTALLATION

This task covers:

Installation

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All		None
Test Equipment		
None		
Special Tools	Special Environmental Conditions	
None	None	
Materials/Parts		
Six new lockwashers		
Personnel Required	General Safety Instructions	
Wheeled vehicle repairman MOS 63W	None	
Manual References		
TM 9-2320-272-341'		

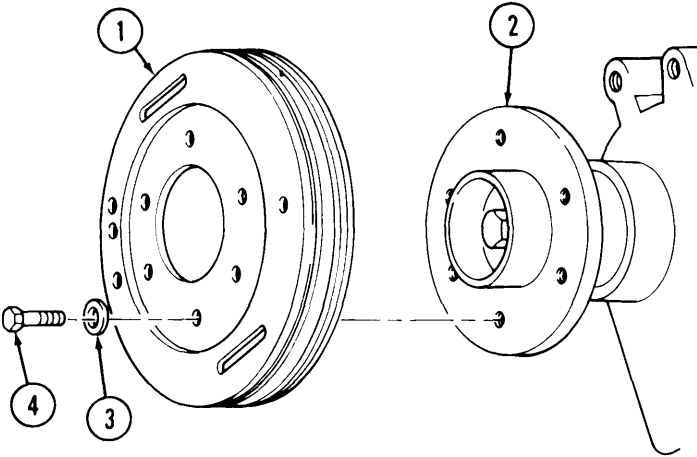
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.
- Vibration damper (1)
- Install on crankshaft flange (2) with six new lockwashers (3) and screws (4).
- Tighten 55-60 lb-ft (75-81 N•m).

NOTE

For checking runout, refer to para. 3-9.



END OF TASK!

FOLLOW-ON TASK: Install upper radiator support bracket (para. 3-97).

TA 350330

3-98. WATER PUMP INSTALLATION

This task covers:
Installation

INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Ten lockwashers		
Water pump body gasket		
Water pump support gasket		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-20		
TM 9-2320-272- 34P		

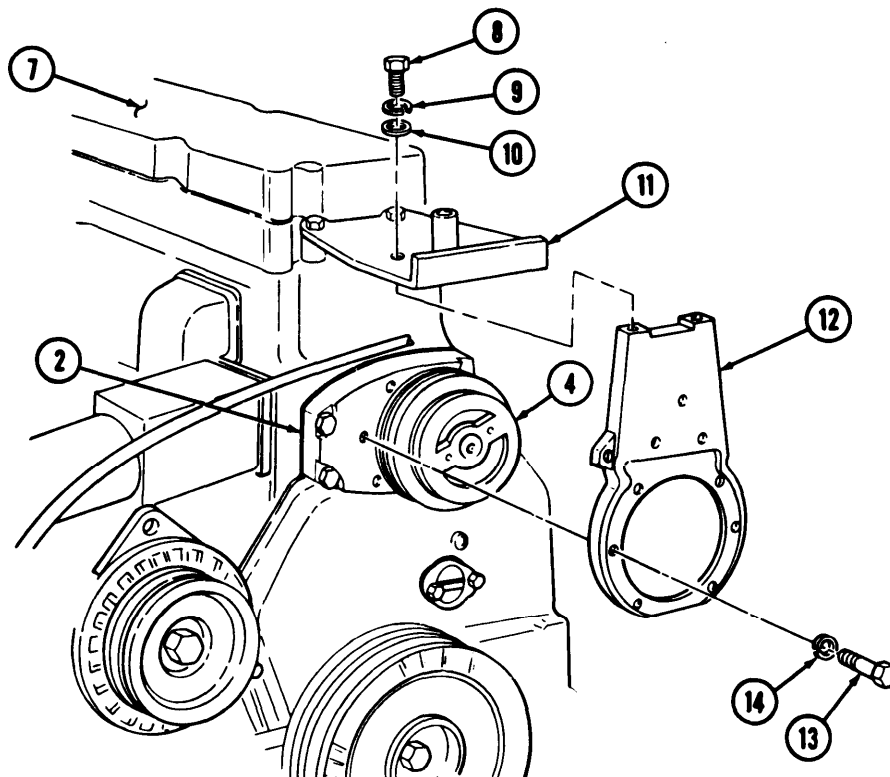
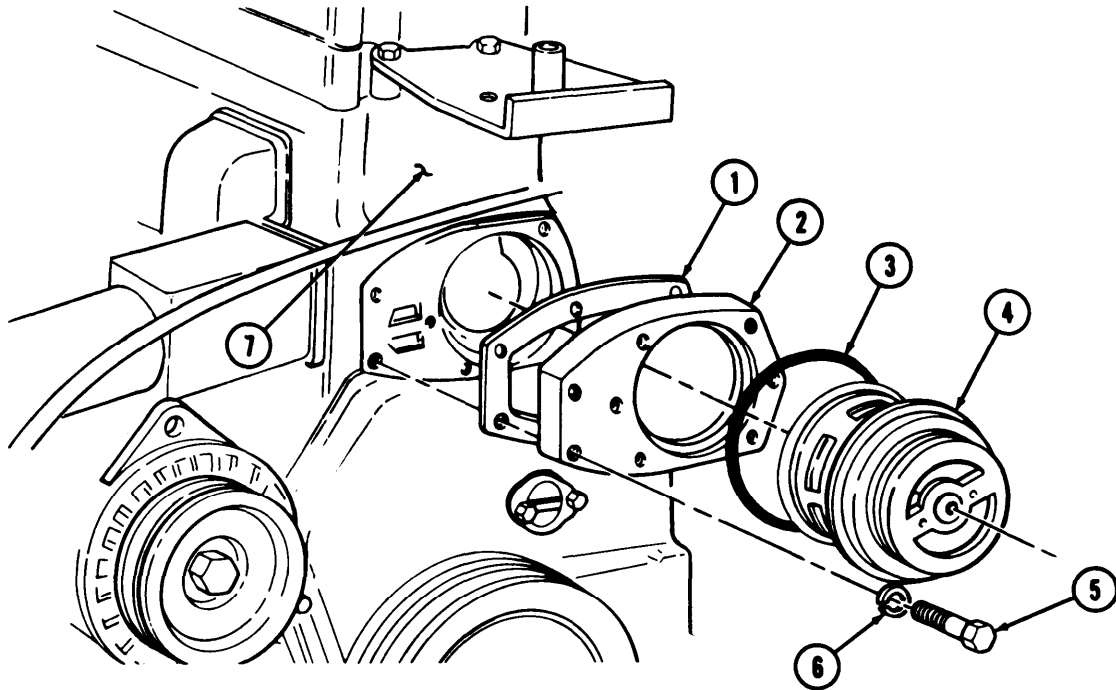
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION

1.		New water pump support gasket (1) and water pump support (2)	Install on engine (7) with two new lock-washers (6) and screws (5).	Tilghten 30 lb-ft (41 N•m).
2.		New water pump body gasket (3) and body (4)	Position into pump support (2).	
3.		Water pump support bracket (12)	a. Position over pump body (4) and install to pump support (2) with six new lock-washers (14) and screws (13). b. Install to upper radiator support bracket (11) with two washers (10), new lockwashers (9), and screws (8).	

3-98. WATER PUMP INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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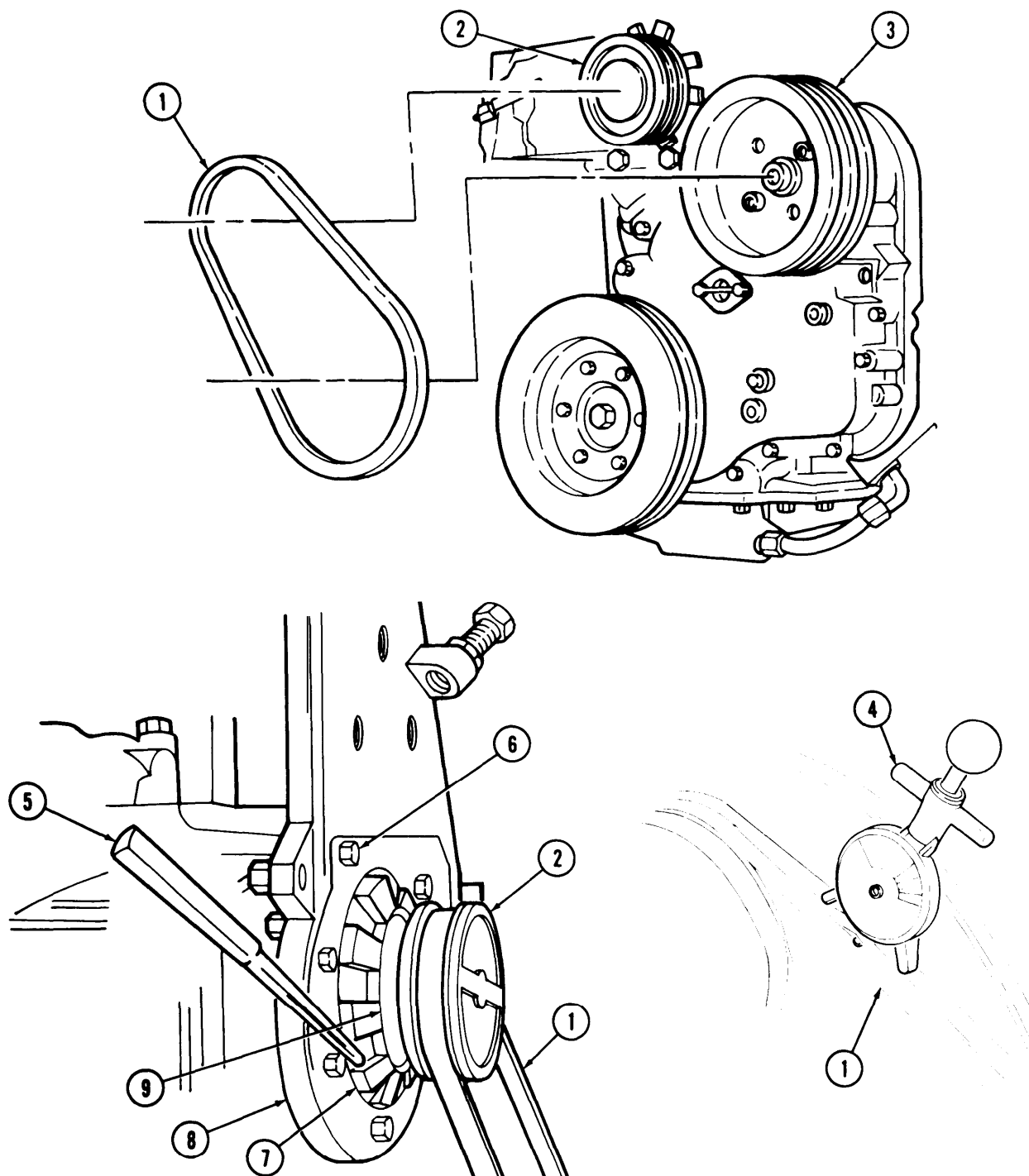


3-98. WATER PUMP INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
4.		Water pump drivebelt (1)	Install on pump pulley (2) and accessory drive pulley (3).	
5.		Brass drift (5)	a. Place against stud (7) on water pump housing (9). b. Punch stud (7) clockwise, facing pump housing (9), to tighten belt (1) tension. c. Punch stud (7) counterclockwise, facing pump housing (9), to loosen belt (1) tension.	
6.		Pump drivebelt (1)	Position belt tension gage (4) on drivebelt (1) between pump housing (9) and accessory drive pulley (3) and check for proper tension	New belt (1) tension should be 100 ± 5 pounds (445 ± 2 newtons). Used belt (1) tension should be 90 ± 5 pounds (400 ± 22 newtons). If belt (1) tension cannot be properly adjusted, replace belt (1).
7.	Water pump support bracket (8)	Six screws (6)	Tighten 30 lb-ft (41 N•m).	

3-98. WATER PUMP INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK. Install fan and fan drive clutch (para, 3-99).

3-99. FAN AND FAN DRIVE CLUTCH INSTALLATION

This task covers:

Installation

INITIAL SETUP:

ENGINE SERVICE		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-98	Water pump installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Nine lockwashers		
Adhesive sealant (Appendix C, Item 2)		
Sealing tape (Appendix C, Item 30)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
Installation				
1.		Fan drive clutch (13) and bracket (7)	Install on ring clamp (8) with new lockwasher (6) and screw (5).	Do not tighten screw (5).
2.		Two washers (14), new lockwashers (15), and screws (16)	Install through bracket (7) into ring clamp (8).	Do not tighten screws (16).
3.		Two screws (4)	Install in bracket (7) and tighten.	Use adhesive sealant on screw threads.
4.		Adapter (19), swivel elbow (18), and hose nut (17)	Install on union (20) on fan drive bracket (7).	Wrap all male pipe threads with sealing tape before installation.
5.		Two power steering belts (9)	Install on accessory drive pulley (10).	
6.		Two belts (11)	Mount on accessory drive pulley (10) and fan drive pulley (12).	Refer to TM 9-2320-272-20-1 to adjust drive belts (11).
7.		Fan (3)	Mount on fan drive clutch (13) with six new lockwashers (2) and screws (1).	

3-99. FAN AND FAN DRIVE CLUTCH INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p>The diagram illustrates the installation of the fan and fan drive clutch on the engine. The top part shows the fan assembly (1-3) and the fan drive clutch assembly (4-16) being installed on the engine (17-20). The bottom part shows the fan belt (11) being installed around the pulleys (12, 13, 14, 15, 16).</p>				

END OF TASK!

3-100. WATER MANIFOLD INSTALLATION

This task covers:
Installation

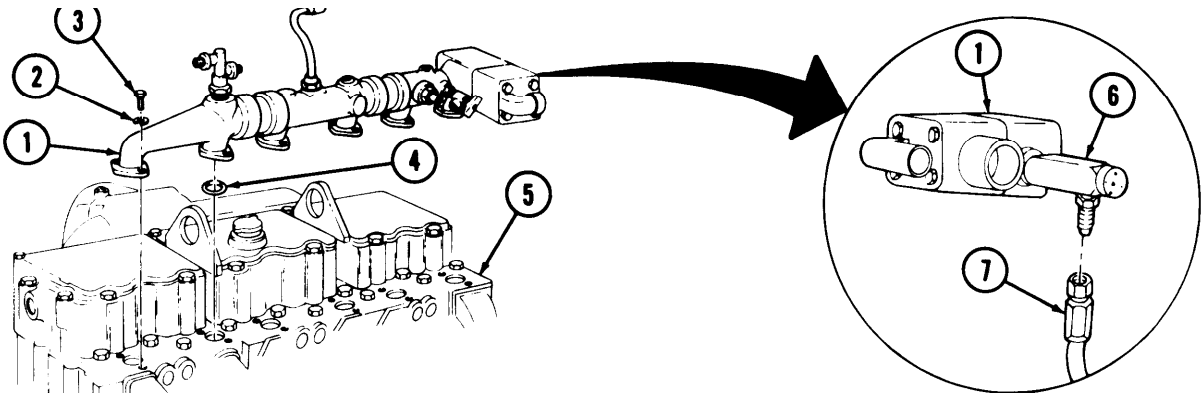
INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All		None
Test Equipment		
None		
Special Tools		Special Environmental Conditions
None		None
Materials/Parts		
Twelve lockwashers		
Six "O" rings		
Personnel Required		General Safety Instructions
Wheeled vehicle repairman MOS 63W		None
Manual References		
TM 9-2320-272 -20-1		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

- Six new "O" rings (4)
- Install on cylinder heads (5).
- NOTE
- Water manifold is mounted using screw-assembled lockwashers on late model engine.
2.
- Water manifold (1)
- Install on cylinder heads Tighten 30-35 lb-ft (5) with twelve new lockwashers (2) and screws (3).
3.
- Hose (7)
- Connect to fan clutch actuator (6).



END OF TASK!

TA 350334

3-101. WATER HEADER PLATES INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Two gaskets		
Twelve lockwashers		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

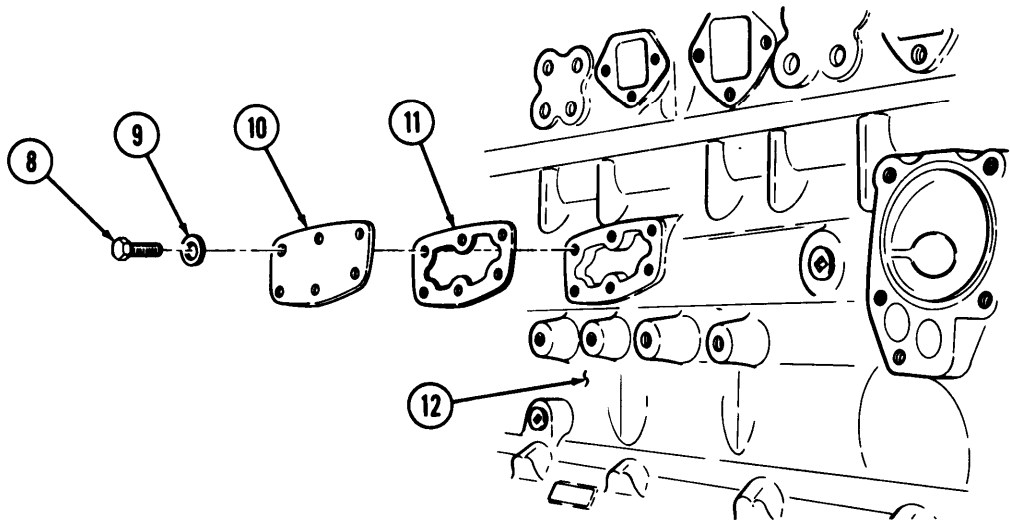
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

NOTE

Water header plates are mounted with screw-assembled lockwashers on late model engine.

1.
- Two new gaskets (11) and water header plates (10)
- Install on block (12) with twelve new lockwashers (9) and screws (8).



END OF TASK!

3-102. ENGINE REMOVAL FROM REPAIR STAND

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para, 3-28	Engine installed on repair stand,
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Oil cooler gasket		
Air compressor coolant line packing sleeve		
Six exhaust manifold gaskets		
Twenty-three lockwashers		
Three locknuts		
Two starter motor gaskets		
Engine access cover gasket		
Twelve exhaust manifold locktabs		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		All personnel must stand clear during hoisting operations.
<u>Manual References</u>		
TM 9-2320-272 -20-1		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

WARNING

All personnel must stand clear during hoisting operations. A snapped cable, swinging, or shifting load may cause injury to personnel.

- | | | |
|----|---------------------|--|
| 1. | Utility chain (1) | Attach to two lift eyes (3). |
| 2. | Hoist hook (2) | Attach to utility chain (1) and raise to support engine (4). |

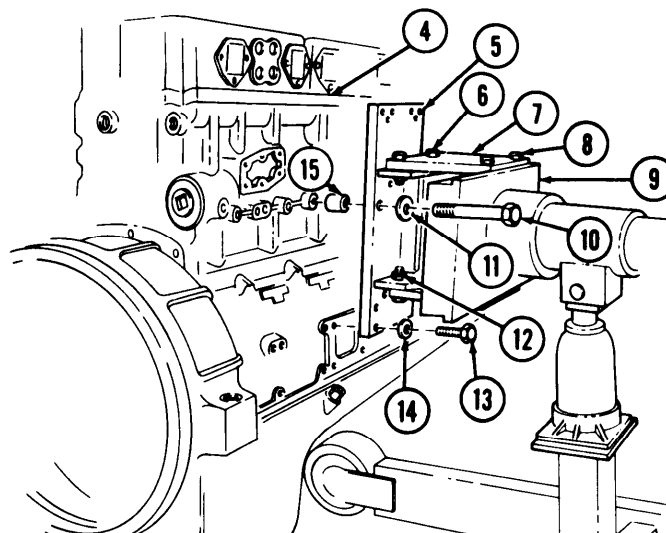
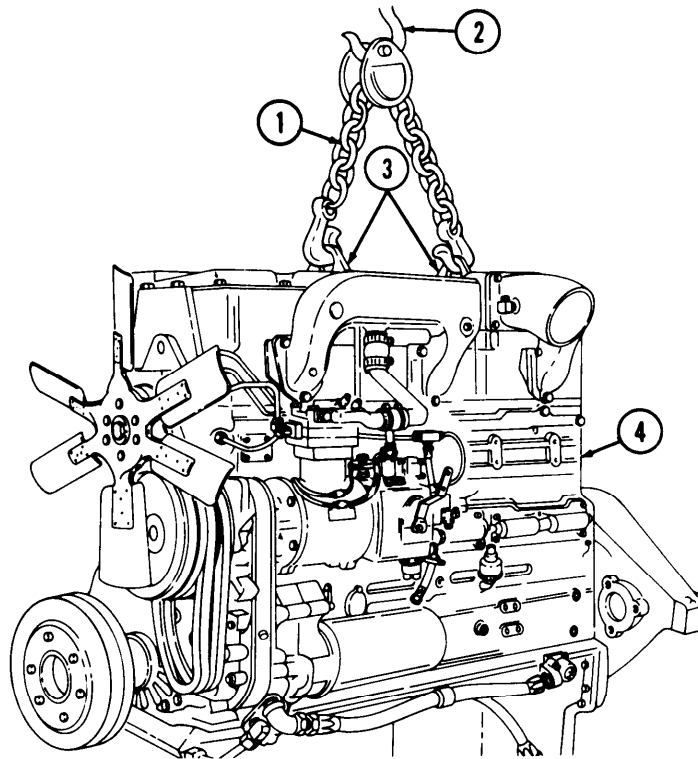
NOTE

Assistant will help with steps 3 and 4.

- | | | | |
|----|---------------------------|---|---------|
| 3. | Engine stand (9) | Two screws (8) | Loosen. |
| 4. | Engine stand supports (7) | Eight screws (6), nuts (12), and engine stand brace (5) | Remove. |

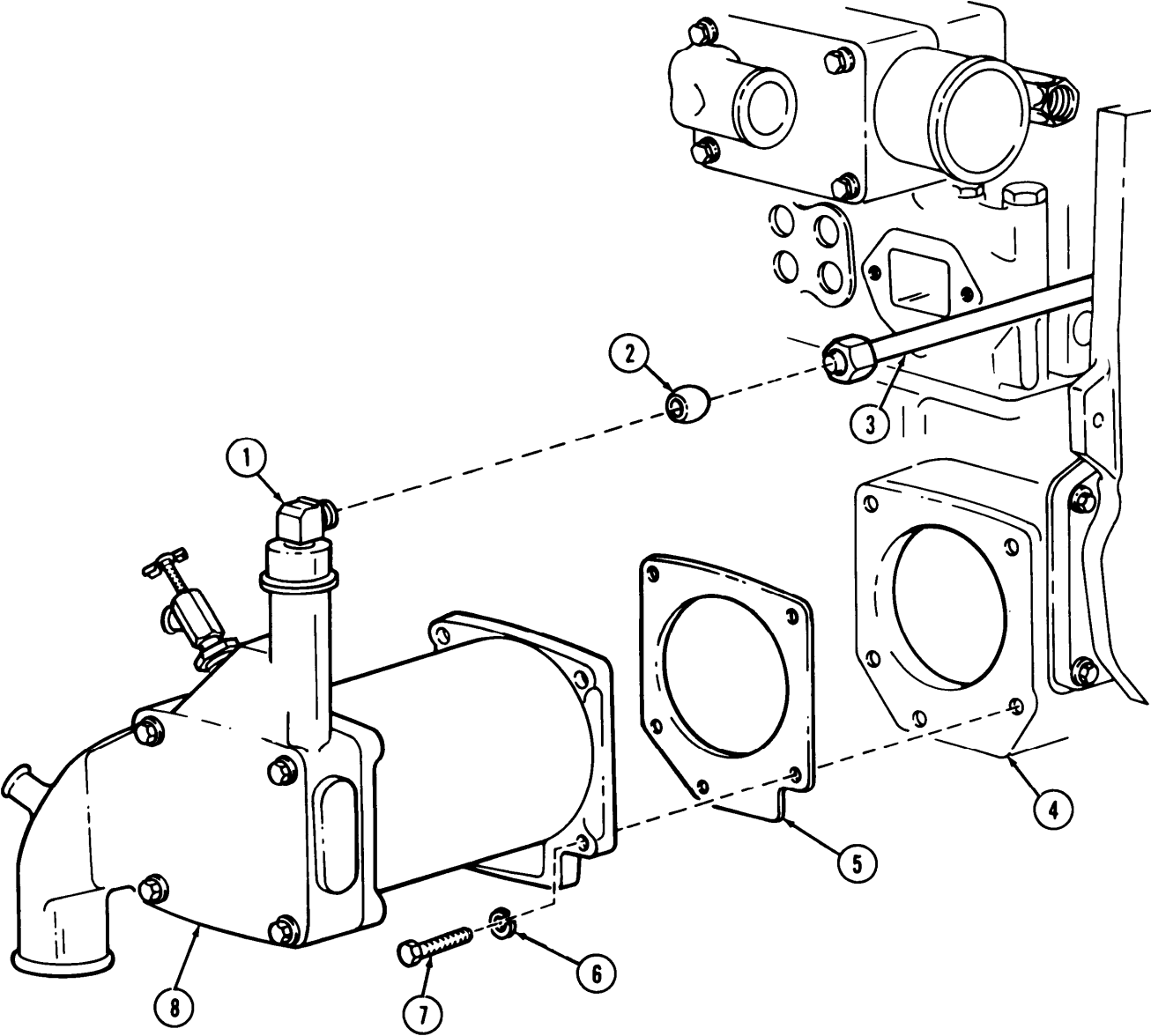
3-102. ENGINE REMOVAL FROM REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
5.	Engine (4)	Four screws (10) and (13), washers (11) and (14), engine stand brace (5), and two spacers (15)	Remove.	



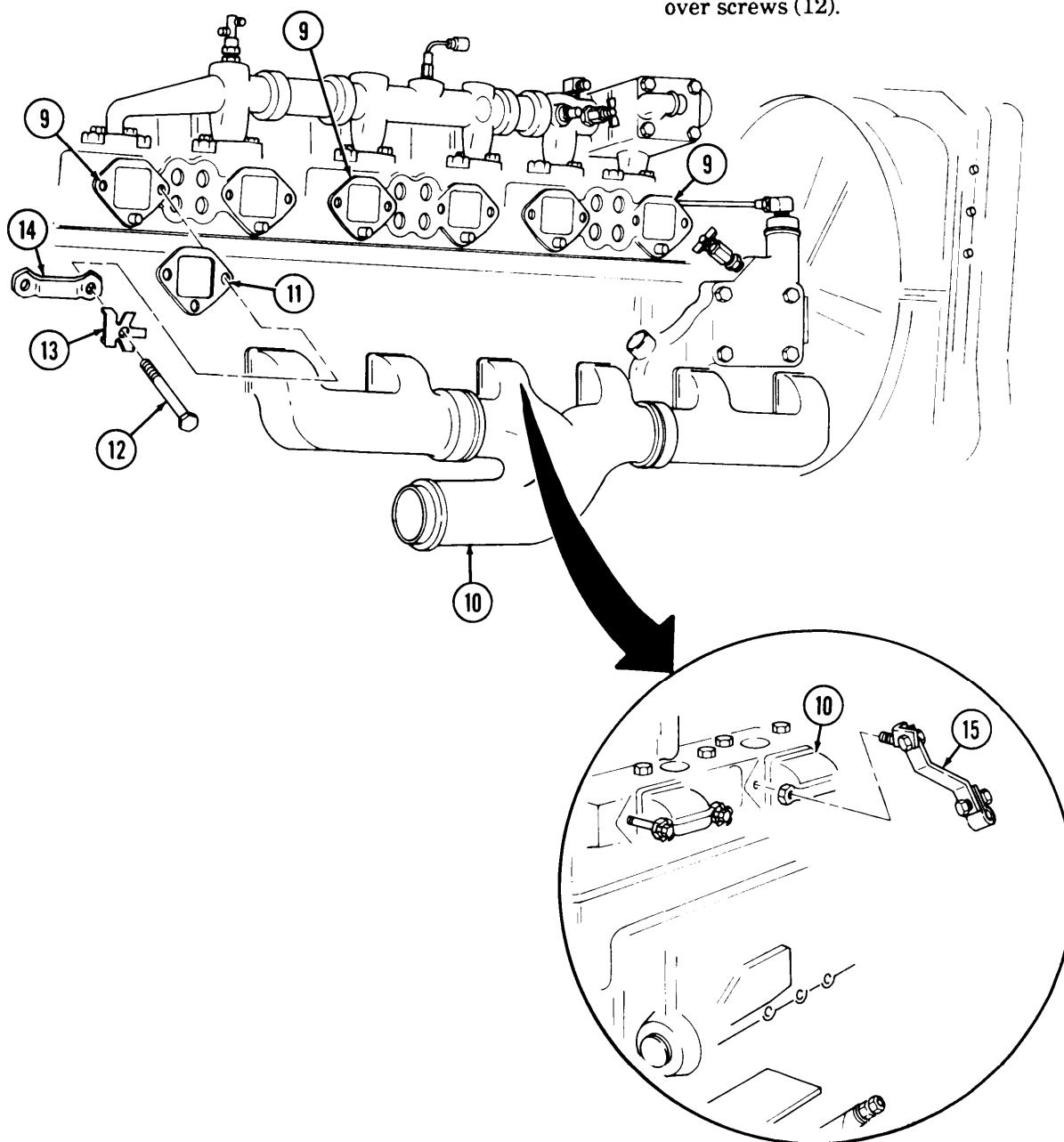
3-102. ENGINE REMOVAL FROM REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
6.		New gasket (5) and oil cooler (8)	Install on cylinder block (4) with five new lockwashers (6) and screws (7).	Tighten 30-35 lb-ft (41-48 N•m).
7.		New packing sleeve (2) and air compressor coolant line (3)	Connect to oil cooler elbow (1).	



3-102. ENGINE REMOVAL FROM REPAIR STAND (Cont'd)

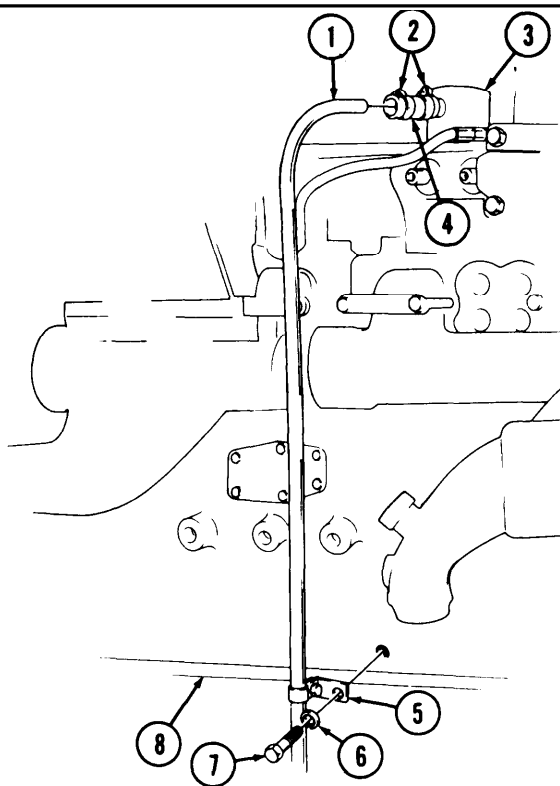
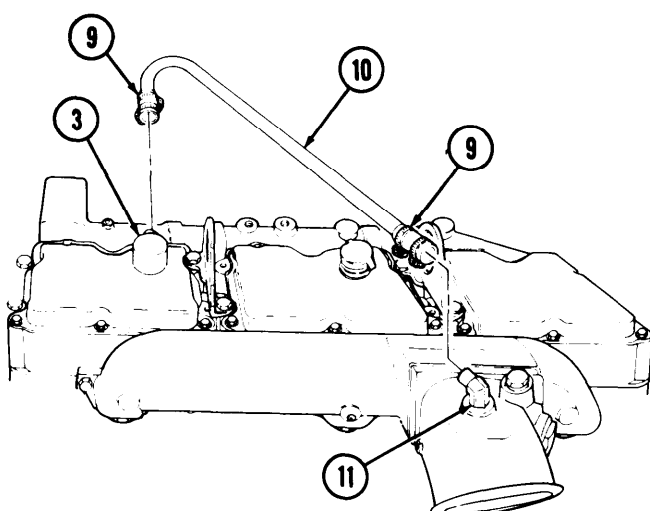
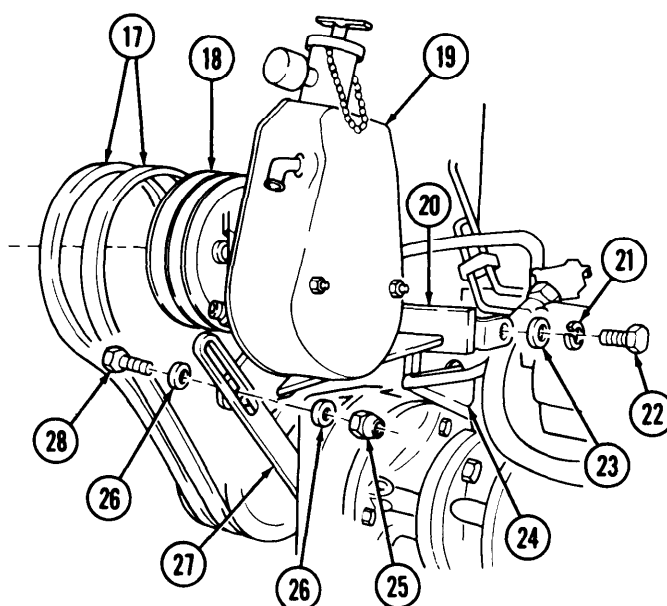
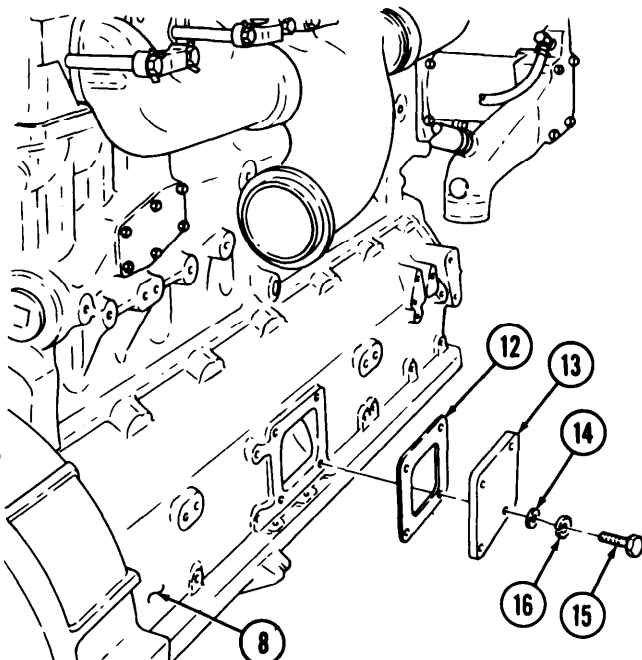
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
8.		Six new gaskets (11), exhaust manifold (10), and dipstick tube bracket (15)	<p>a. Install on three cylinder heads (9) with six clamps (14), twelve new locktabs (13), and screws (12).</p> <p>b. Bend locktabs (13) over screws (12).</p>	Tighten 15-20 lb-ft (20-27 N•m) then 40-45 lb-ft (54-61 N•m).



3-102. ENGINE REMOVAL FROM REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
9.		Breather hose (4) and breather tube (1)	Connect to breather (3) with two hose clamps (2).	
10.		Breather tube mounting bracket (5)	Install on cylinder block (8) with new lockwasher (6) and screw (7).	
NOTE				
Perform step 10.1 for late model engine.				
10.1.		Breather tube (10)	Install on elbow (11) and breather (3) with two hose clamps (9).	
11.		New gasket (12) and engine access cover (13)	Install on cylinder block (8) with four washers (14), new lockwashers (16), and screws (15).	
12.		Power steering pump bracket (20) and power steering pump (19)	Install on engine bracket (24) with two washers (23), new lockwashers (21), and screws (22).	Do not tighten.
13.		Power steering pump bracket (20)	Aline with adjusting link (27) and install with screw (28), two washers (26), and new locknut (25).	Do not tighten.
14.		Two power steering belts (17)	Install around pulley (18).	

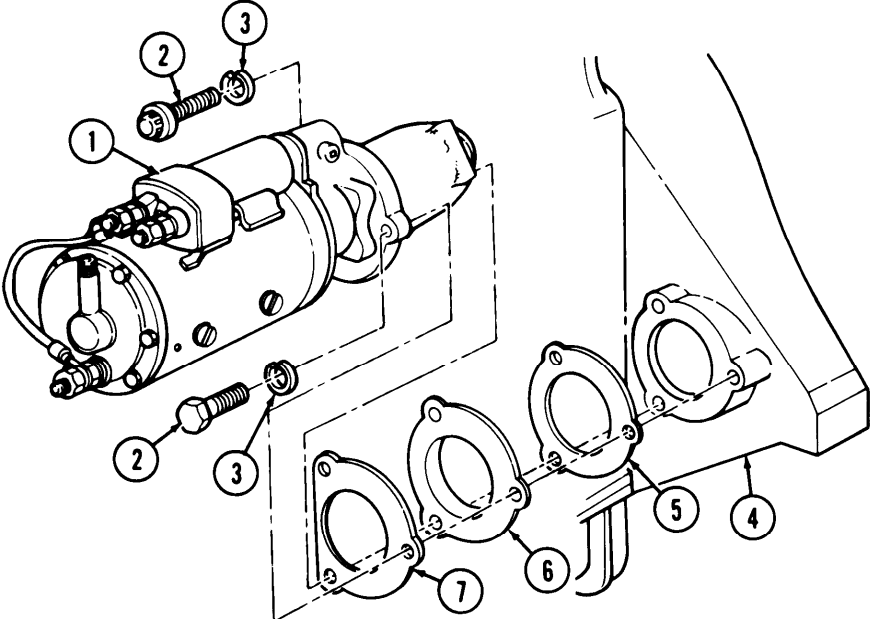
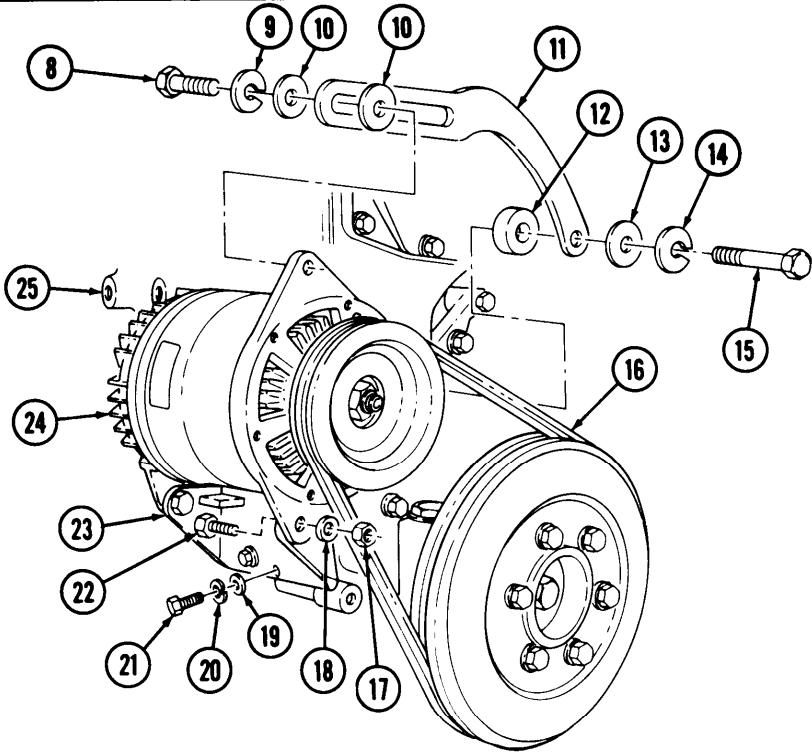
3-102. ENGINE REMOVAL FROM REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
	 			
	 			

3-102. ENGINE REMOVAL FROM REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
15.		New gasket (5), spacer (6), new gasket (7), and starter (1)	Install on flywheel housing (4) with three new lockwashers (3) and screws (2).	Tighten screws (2) 100-110 lb-ft (136-149 N•m).
16.		Mounting bracket (23)	Install on engine (25) with four washers (19), new lockwashers (20), and screws (21).	
17.		Alternator (24)	Install on mounting bracket (23) with two screws (22), washers (18), and new locknuts (17).	Do not tighten screws (22).
18.		Two alternator belts (16)	Install.	
19.		Adjusting link (11)	Install on engine (25) and alternator (24) with two washers (10), new lockwasher (9), screw(8), new lockwasher (14), and screw (15).	Do not tighten screws (15) and (8).
NOTE				
Perform step 20 on late model engine.				
20.		Spacer (12) and adjusting link (11)	a. Install on engine (25) with washer (13), new lockwasher (14), and screw (15). b. Install on alternator (24) with two washers (10), new lockwasher (9), and screw (8).	Do not tighten screw (15). Do not tighten screw (8).

3-102. ENGINE REMOVAL FROM REPAIR STAND (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

END OF TASK!

FOLLOW-ON TASKS: • Adjust power steering pump belts (TM 9-2320-272-20-1).
• Adjust alternator belts (TM 9-2320-272-20-1).

Section VII. ENGINE VALVE AND INJECTOR ADJUSTMENTS

3-103. ENGINE VALVE AND INJECTOR ADJUSTMENTS TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
3-104.	Engine Injector Timing Instructions	3-432
3-105.	Valve and Injector Adjustment (Dial Indicator Method)	3-452
3-106.	Injector Plunger and Valve Adjustments (Torque Method)	3-460

3-104. ENGINE INJECTOR TIMING INSTRUCTIONS

This task covers:

- | | |
|--|---|
| a. Deleted | h. Injector Timing |
| b. Rocker Lever Housing Covers Removal | i. Fuel Injectors Installation |
| c. Rocker Lever Housing and Push Tubes Removal | j. Valve Crossheads Installation and Adjustment |
| d. Valve Crossheads Removal | k. Rocker Lever Housing and Push Tubes Installation |
| e. Fuel Injectors Removal | 1. Deleted |
| f. General Instructions | m. Rocker Lever Housing Covers Installation |
| g. Timing Tool Setup | |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-28	Engine mounted on repair stand.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Injector timing fixture 3375522		None
<u>Materials/Parts</u>		
Four gaskets		
Five lockwashers		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

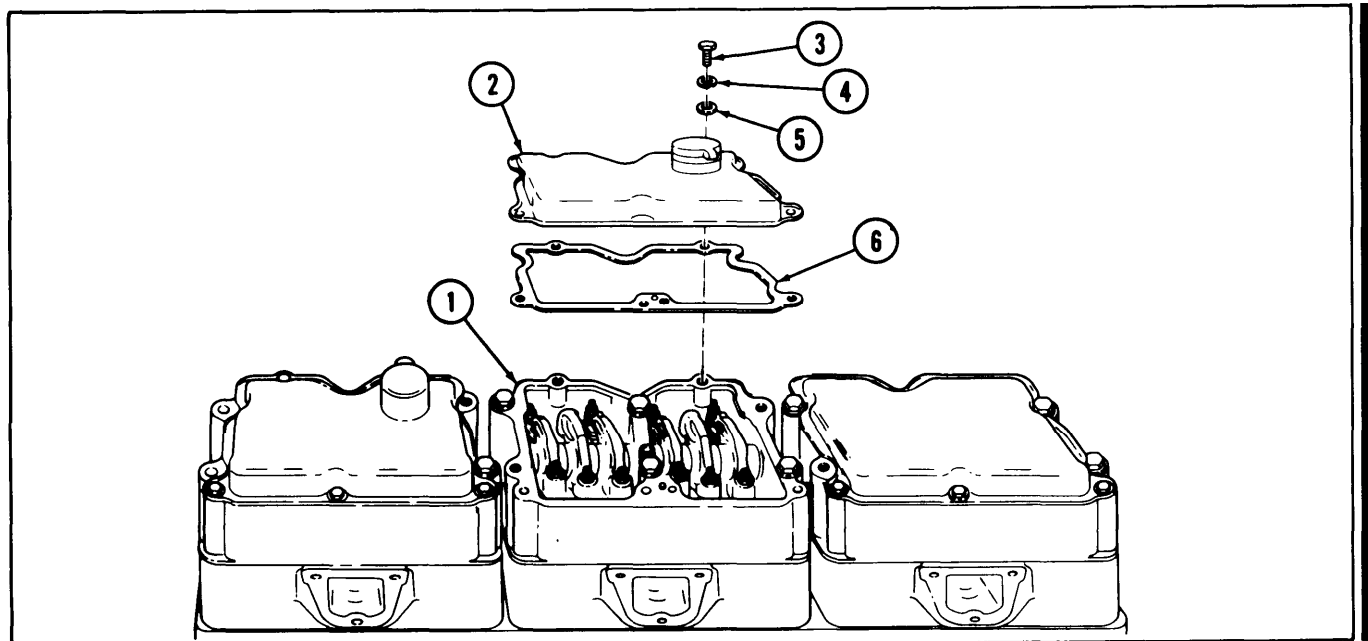
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Rocker Lever Housing Covers Removal

NOTE

- Rocker lever housing covers are mounted with screw-assembled washers on late model engine.
- All rocker lever housing covers are removed the same way. This task covers the removal of the center housing cover.

- | | | | |
|----|--|---------|--|
| 2. | Rocker lever housing (1) Five screws (3), lock-washers (4), washers (5), cover (2), and gasket (6) | Remove. | Discard gasket (6) and lockwashers (4).
Clean gasket remains from mating surfaces |
|----|--|---------|--|



3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Rocker Lever Housing and Push Tubes Removal

3.	Eighteen rocker levers (12)	Eighteen locknuts (10)	Loosen.	
4.		Eighteen adjusting screws (11)	Turn out two turns.	
4.1.	Rocker lever housings (6)	Six screws (2), two lifting eyes (3), and upper radiator support bracket (1)	Remove.	
NOTE Rocker lever housings are mounted with screw-assembled washers for late model engine.				
5.	Cylinder heads (7)	Twelve screws (4) and washers (5), three rocker lever housings (6), and gaskets (9)	Remove.	Tag housings (6) for installation. Discard gaskets (9). Clean gasket remains from mating surfaces.

CAUTION

Each cylinder has an exhaust push tube, intake push tube, and injector push tube. It is important that each push tube be tagged so, when reinstalled, they can be reinstalled in the same location.

6.		Eighteen push tubes (8)	Remove.	
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d. Valve Crossheads Removal

NOTE Valve crossheads are mounted with screw-assembled lockwashers on late model engine.				
7.	Twelve crossheads (13)	Twelve crosshead adjusting nuts (14)	Loosen.	
8.	Cylinder heads (7)	Twelve crossheads (13)	Remove.	Tag for installation.

3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p>The diagram illustrates the assembly of the engine injector timing components. It is divided into two main sections. The top section shows the assembly of the upper injector housing (6) with the lower injector housing (7). The bottom section shows the final assembly with the timing components (13, 14) being installed. Various parts are numbered 1 through 14.</p>				

3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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e. Fuel Injectors Removal

CAUTION

- Do not turn injector upside down after removal. Plunger will fall out and be damaged.
- Do not damage injector tip during handling. Be sure injectors and plungers are not intermixed. Always number injectors according to the cylinder head from which they were removed.

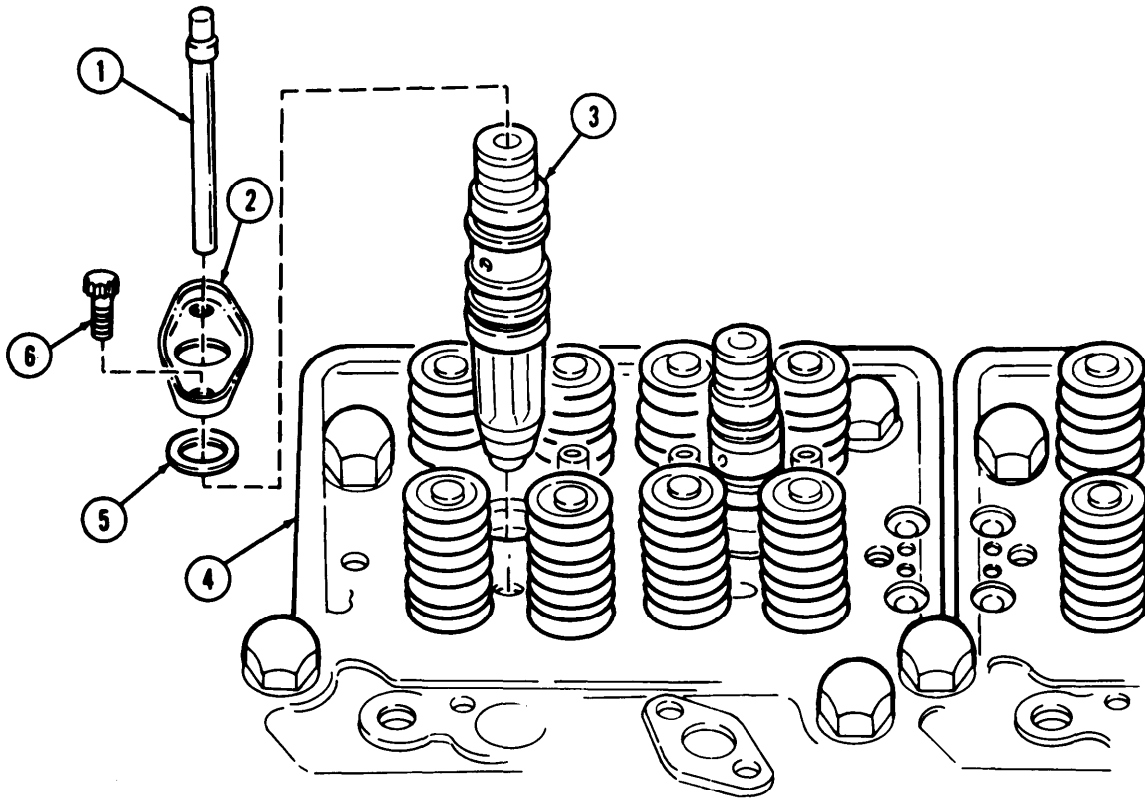
NOTE

Top stop and non-top stop injectors are removed the same way. This task covers non-top stop injectors.

9.	Injector (3)	Injector link (1)	Remove.	
10.	Injector retaining clamp (2)	Two screws (6)	Remove.	
11.	Cylinder head (4)	Retaining clamp (2), washer (5), and injector (3)	Remove.	Keep injector (3) in safe place.

3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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f. General Instructions

NOTE

- This timing procedure is for engines mounted on test stand only.
- The precise timing of the injector push tube travel with corresponding piston travel is accomplished by using injector timing fixture 3375522 to measure travel of these two parts.
- Adjustments to injection timing are made by altering the thickness of cam follower gaskets.
- The injection timing may be advanced or retarded by adding or removing cam follower gaskets.
- The timing operation is performed on only one cylinder on each head; cylinder #6 cannot be timed with engine in vehicle.
- Be sure camshaft is pushed back against rear of cylinder block for "O" (zero) endplay.

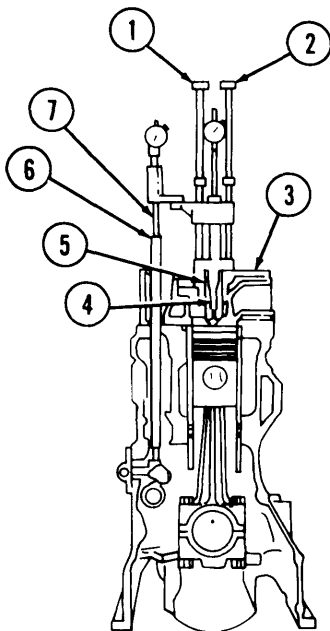
g. Timing Tool Setup

NOTE

Each of the two dial indicators used in timing the engine must have a total travel of at least 0.250 in. (6.35 mm).

12.

Timing tool fixture (4)



- a. Position in injector sleeve (5).
- b. Engage rod (7) of push tube indicator in injector push tube socket (6).
- c. Install fixture (4) by tightening knurled hold-downs (1) and (2) evenly by hand.
- d. Be sure fixture (4) is straight on cylinder head (3).

3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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h. Injector Timing

13. Timing tool fixture (4) Dial indicator supports (11) and (14) Loosen.

14. Engine (12) Crankshaft (13) Perform timing procedure 1 as follows:

a. Rotate crankshaft (13) in direction of engine rotation to TDC (top dead center).

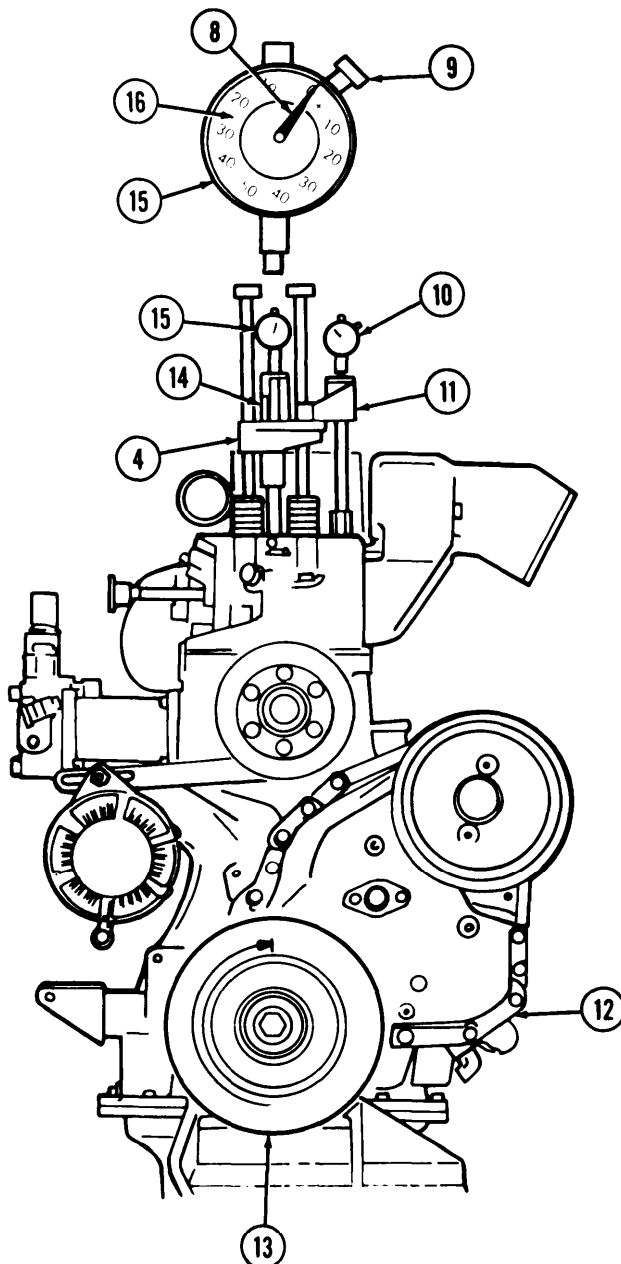
Piston travel plunger will be near full upward position.

b. Adjust both dial indicators (15) and (10) on fixture (4) to their fully compressed position. To prevent damage, raise both indicators (10) and (15) approximately 0.020 in. (0.5 mm), and lock in place with setscrew.

c. Rotate crankshaft (13) back and forth to make sure piston is precisely at TDC on compression stroke.

Both indicators (15) and (10) move in the same direction when piston is on compression stroke.

d. TDC is indicated by maximum clockwise position of the piston travel pointer (8). Turn the piston travel dial indicator face (16) to align zero with the pointer. Lock face (16) with thumbscrews (9).



3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

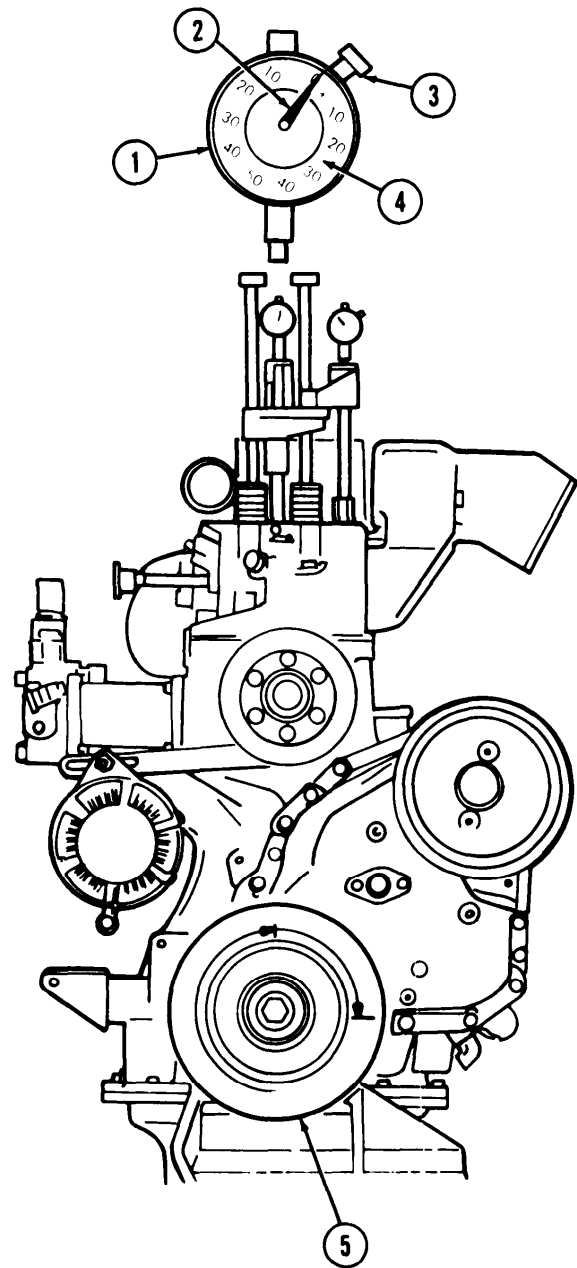
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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15. Crankshaft (5)

Perform timing procedure 2 as follows:

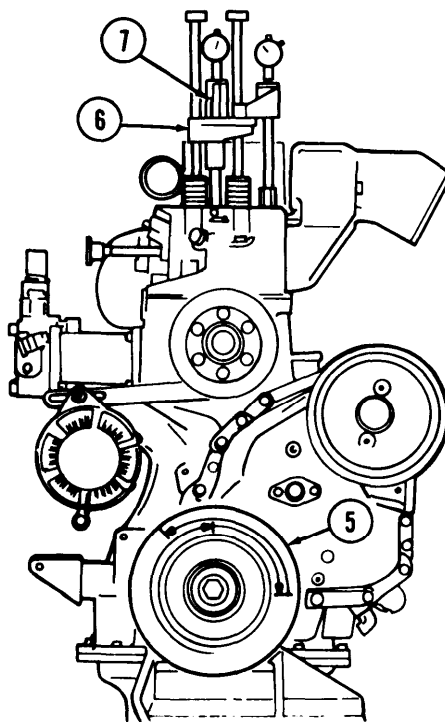
- a. Rotate crankshaft (5) in direction of engine rotation of 90° ATDC (after top dead center).
- b. Turn push tube travel dial indicator face (4) to align zero with pointer (2). Lock face (4) with thumbscrew (3).

Piston travel plunger will be near bottom of its travel.



3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
16.		Crankshaft (5)	<p>Perform timing procedure 3 as follows:</p> <p>Rotate crankshaft (5) in opposite direction of engine rotation through TDC to 45° BTDC (before top dead center).</p>	<p>This step is necessary to remove gear train lash.</p> <p>Turn crankshaft backwards through TDC, and then 45° further.</p>
17.		Timing fixture (6) and crankshaft (5)	<p>Perform timing procedure 4 as follows:</p> <p>a. Turn crankshaft (5) in direction of engine rotation until piston follower rod on fixture (6) is in contact with indicator stem (7).</p> <p>b. Very slowly, move crankshaft (5) until dial indicator (1) reads 0.0032 in. (.0812 mm) before zero.</p>	



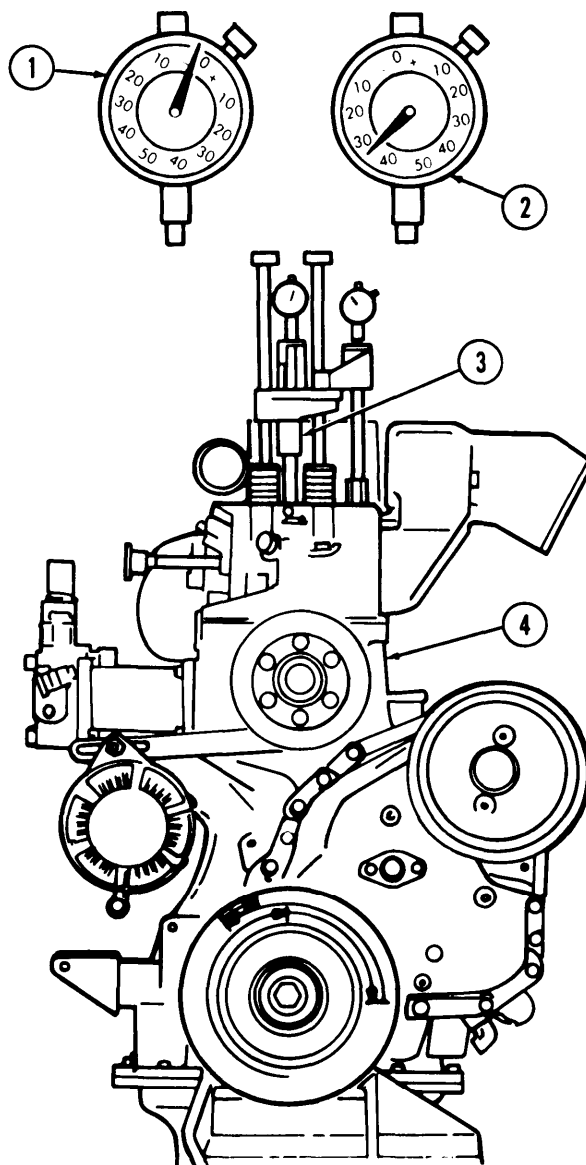
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3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			c. This position is actually 0.2032 in. (5.1612 mm) before "O" since the indicator (1) pointer has rotated twice (over 0.200 in.) (5,08 mm) as the crankshaft was moved to the 45° BTDC (procedure 3). d. The position of piston travel is now 19° BTDC. e. Read the push tube travel indicator (2).	Push tube travel should be 0.0290 in. (.74 mm). If not, continue to step 18.
<p style="text-align: center;">NOTE</p> <p>Perform the following steps before making changes in cam follower gaskets to correct injection timing.</p>				
18.		Cam follower housing	Make sure screws are tightened to specifications.	Refer to para. 3-74.
19.	Timing fixture (3)	Piston and push tube indicators (1) and (2)	a. Recheck indicator positioning. Be sure indicators (1) and (2) are not bottoming or binding. b. Carefully recheck top dead center (TDC).	Refer to step 14.
20.		Injector timing	a. If required, advance or retard by adding or removing cam follower gaskets. b. Remove gaskets to retard timing; add gaskets to advance timing.	Refer to para. 3-58 and 3-74.
21.	Engine (4)	Timing fixture (3)	Remove.	

3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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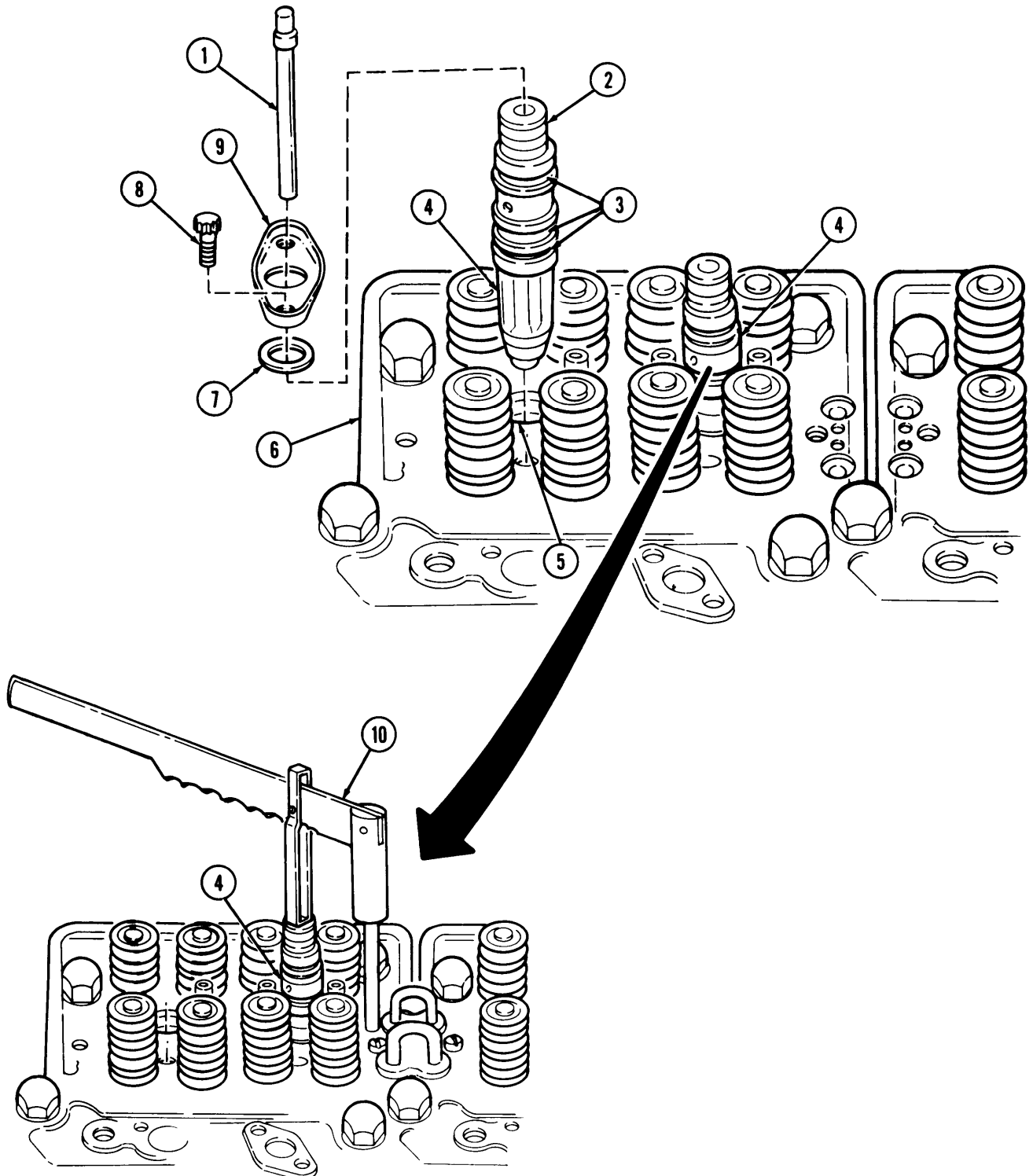


3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
i. Fuel Injectors Installation				
<p style="text-align: center;">CAUTION</p> <p>Make sure no foreign objects have fallen into cylinder head through injector bore.</p> <p style="text-align: center;">NOTE</p> <ul style="list-style-type: none"> If injector condition is unknown, or has been disassembled, it must be calibrated before installation (para. 4-32). Top stop and non-top stop injectors are installed the same way. This task covers non-top stop injectors. 				
22.		Injector (4)	a. Lubricate three injector "O" rings (3) with clean engine oil. b. Start into injector bore (5).	Aline screen on fuel inlet hole with exhaust side of cylinder head (6).
23.		Spring compressor (10)	a. Install cylinder head (6) and place over injector plunger (2). b. Seat injector (4) by giving spring compressor (10) a quick push.	A click will be heard when injector seats properly.
24.		Clamp plate (9) and retaining ring (7)	Position over injector (4) and start two screws (8).	Do not tighten screws (8). Position clamp plate (9) with counterbore up.
25.		Injector link (1)	a. Carefully insert into injector (4) and tighten screws (8). b. Raise link (1) 1/3 its length, and allow to fall back into injector (4). If link binds or sticks, loosen screws (8) and retighten.	Tighten screws (8) 11-12 lb-ft (15-16 N•m) in 4 lb-ft (5 N•m) steps.

3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
j. Valve Crossheads Installation and Adjustment				
26.		Valve crosshead lock-nut (3)	Loosen and back out adjusting screw (2) one full turn.	
27.		Twelve crossheads (1)	Install and adjust as follows: <ul style="list-style-type: none"> a. Coat with light film of clean engine oil and install on cylinder head (4) guide. b. Hold crosshead (1) down so it contacts valve stem (6) on side opposite adjusting screw (2), c. Turn adjusting screw (2) down until it just touches valve stem (5). d. Set up dial indicator (7) over center of crosshead (1). e. Pressing down on crosshead (1), zero dial indicator (7). f. Holding crosshead (1) down lightly, turn adjusting screw (2) in until dial indicator (7) reads between .025 -.040 in. (.64-80 mm). 	Adjusting screw (2) faces toward exhaust manifold side of engine. Use finger pressure. It maybe necessary to loosen locknut (3). Minimum clearance must be 0.025 in. (0,64 mm). If not, see following note. Use torque wrench adapter and tighten locknuts (3) 22-26 lb-ft (30-35 N•m).

NOTE

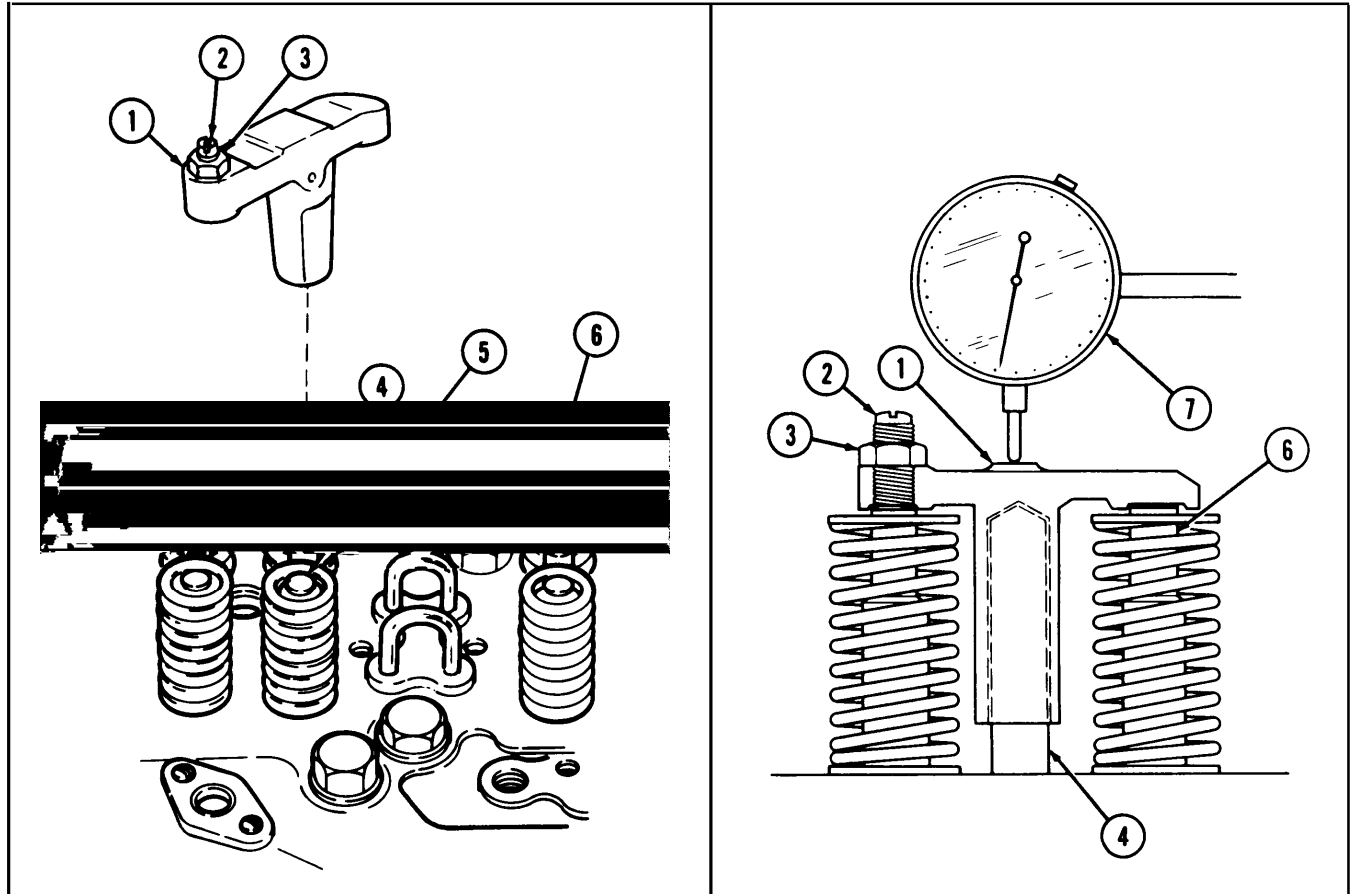
Make sure adjusting screw is just lightly seated.

3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

If minimum clearance is not 0.025 in. (0.64 mm), advance adjusting screw 1/3 of one hex on new crossheads and guides or 1/2 hex on old crossheads and guides, retighten locknut, and check clearance.



3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

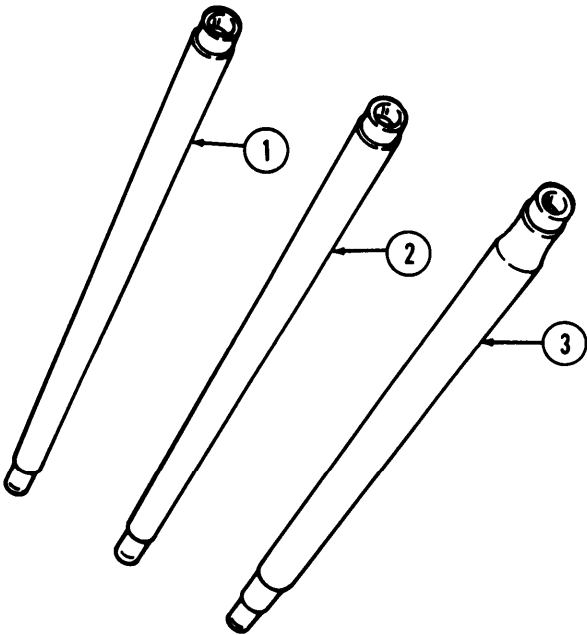
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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k. Rocker Lever Housing and Push Tubes Installation

CAUTION

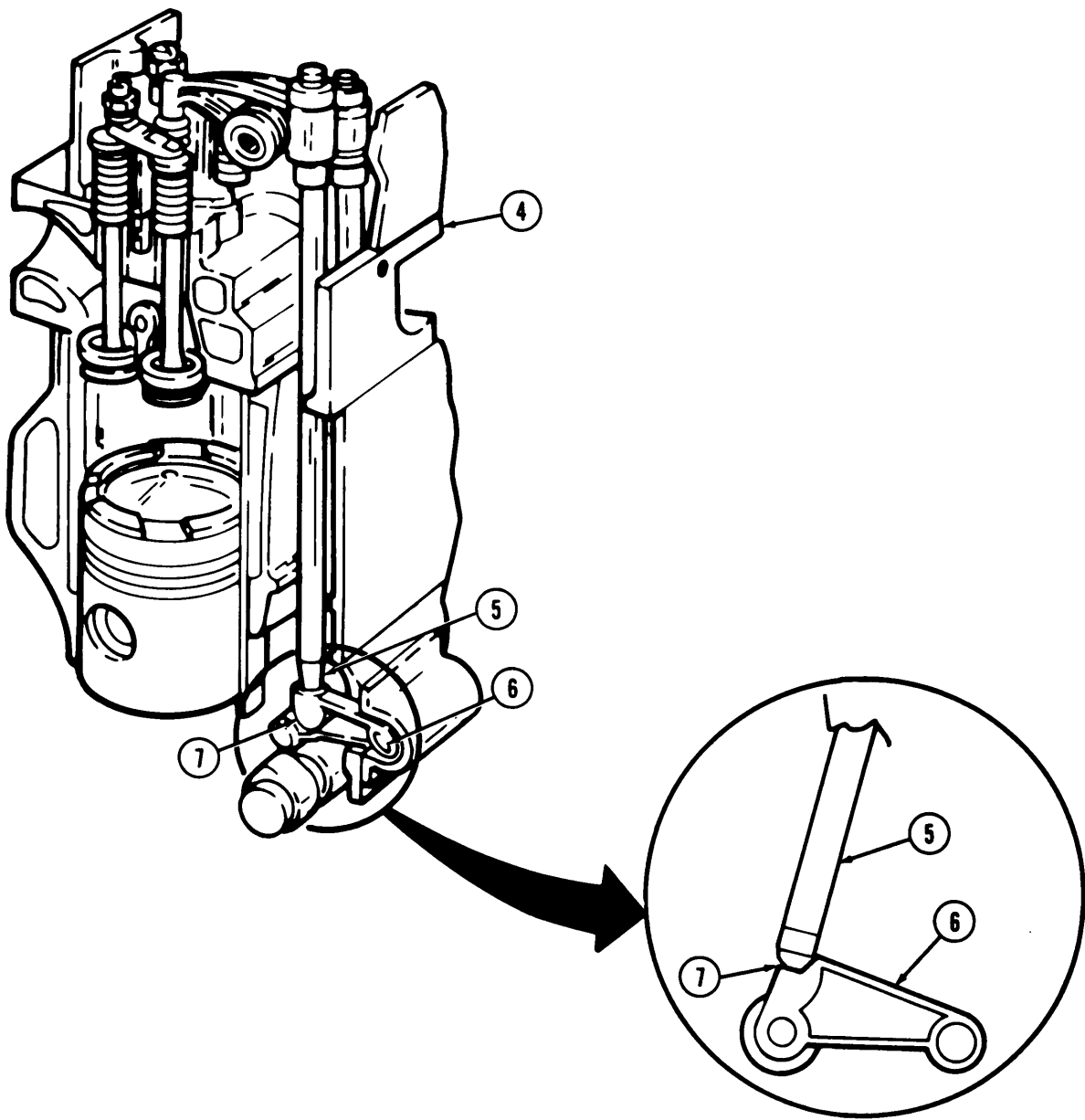
- Do not mix push tubes during installation, The injector tube is the largest, and is positioned between the intake and exhaust push tubes. Intake and exhaust push tubes are identical.
- Seating push tube lower ball ends into cam followers socket seats is critical. Several visual checks must be made during installation to ensure push tubes remain properly seated,

28.
- Two exhaust valve push tubes (1), injector push tubes (2), and intake valve push tubes (3)
- Install each by passing ball end (5) down through opening in cylinder head (4) and into socket seat (7) on cam follower (6).



3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

- Make sure push tubes remain seated during rocker lever housing installation.
- Rocker lever housings are mounted with screw-assembled washers on late model engine.

29. Three rocker lever housings (6) Eighteen screws (9) Loosen.

Three new gaskets (8) and rocker lever housings (6)

Position on cylinder heads (7) and install with twelve washers (5) and screws (4).

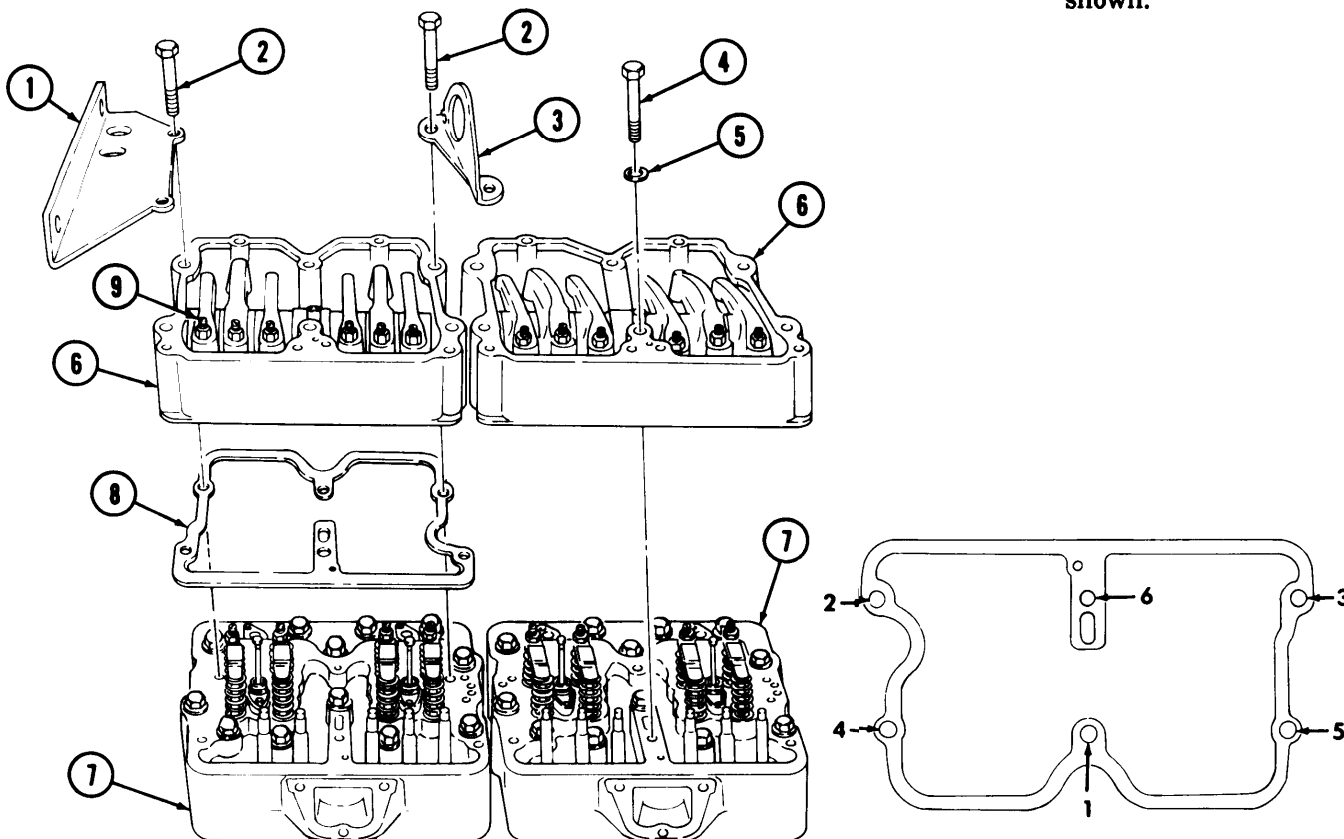
Do not **tighten screws (4)**.

29.1.

Two lifting eyes (3) and upper radiator support bracket (1)

Install on rocker lever housings (6) with six screws (2).

Tighten screws (2) and (4) 55-65 lb-ft (75-88 N•m) in sequence **shown**.



3-104. ENGINE INJECTOR TIMING INSTRUCTIONS (Cont'd)

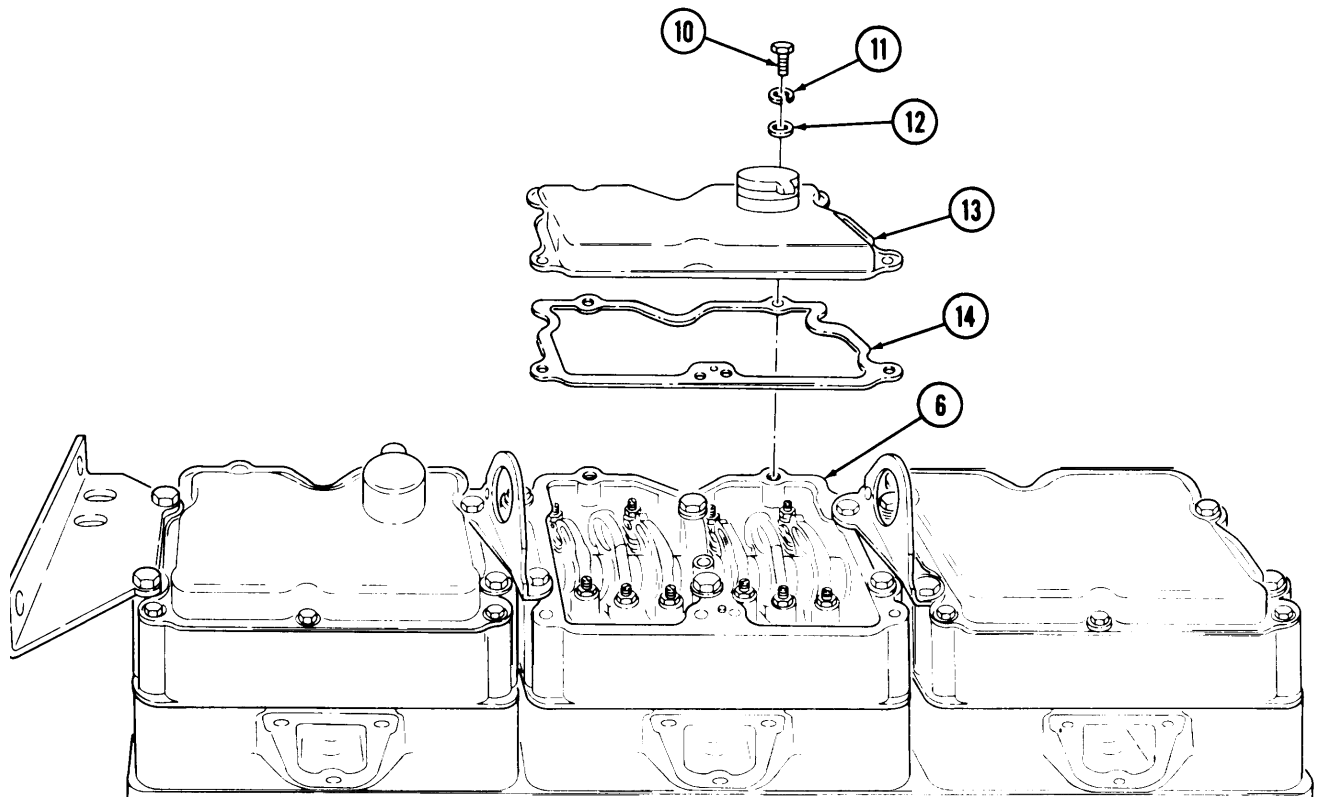
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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m. Rocker Lever Housing Covers Installation

NOTE

- Rocker lever housing covers are mounted with screw-assembled washers on late model engine.
- All rocker lever housing covers are installed the same way. This subtask covers the installation of the center housing cover.

- | | | |
|-----|---|--|
| 32. | Rocker lever housing cover (13) and new housing cover gasket (14) | Install on rocker lever housing (6) with five washers (12), new lockwashers (11), and screws (10). |
|-----|---|--|



END OF TASK!

FOLLOW-ON TASK: Remove engine from repair stand (para. 3-28).

3-105. VALVE AND INJECTOR ADJUSTMENT (DIAL INDICATOR METHOD)

This task covers:

- a. Checking Plunger Free Travel
- b. Injector and Valve Adjustments

INITIAL SETUP:		Equipment Condition Reference	Condition Description
Applicable Models			
All		Para. 3-47 Para. 3-76 Para. 3-16	Rocker lever housing covers removed. Valve crossheads adjusted. Rocker lever housing covers removed (in vehicle).
Test Equipment		TM 9-2320-272-10 TM 9-2320-272 -20-1	Fuel shutoff handle pulled (in vehicle). Battery ground cable disconnected.
Special Tools			Special Environmental Conditions
Injector and valve adjustment kit 3375842 Barring tool ST-747 Torque wrench adapter ST-669			None
Materials/Parts			General Safety Instructions
None			If task is being performed while engine is in vehicle, be sure fuel shutoff handle is pulled and battery ground cable is disconnected to prevent engine starting.
Personnel Required			
Wheeled vehicle repairman MOS 63W			
Manual References			
TM 9-2320-272-10 TM 9-2320-272-20 TM 9-2320-272-34P			

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Checking Plunger Free Travel

WARNING

If task is being performed while engine is in vehicle, be sure fuel shutoff handle is pulled and battery ground cable is disconnected to prevent engine starting. Failure to do this may result in injury to personnel.

CAUTION

This procedure is for non-top stop injectors. It is used to prevent excessive loading of the injector actuating systems and possible failure

1. Injector rocker levers (8)

Adjusting screw (6) and Loosen. locknut (7)
2.

Dial indicator (5), fixture (3), and extension arm (4)

a. Install on housing (1) at water manifold (2) side.

Use injector and valve adjustment kit.

3-105. VALVE AND INJECTOR ADJUSTMENT (DIAL INDICATOR METHOD) (Cont'd-

Step No.	LOCATION	ITEM	ACTION	REMARKS
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b. Position dial indicator (5) extension arm (4) on top of injector plunger (9) and set dial to zero.

c. Rotate engine and record the total amount of each plunger (9) travel.

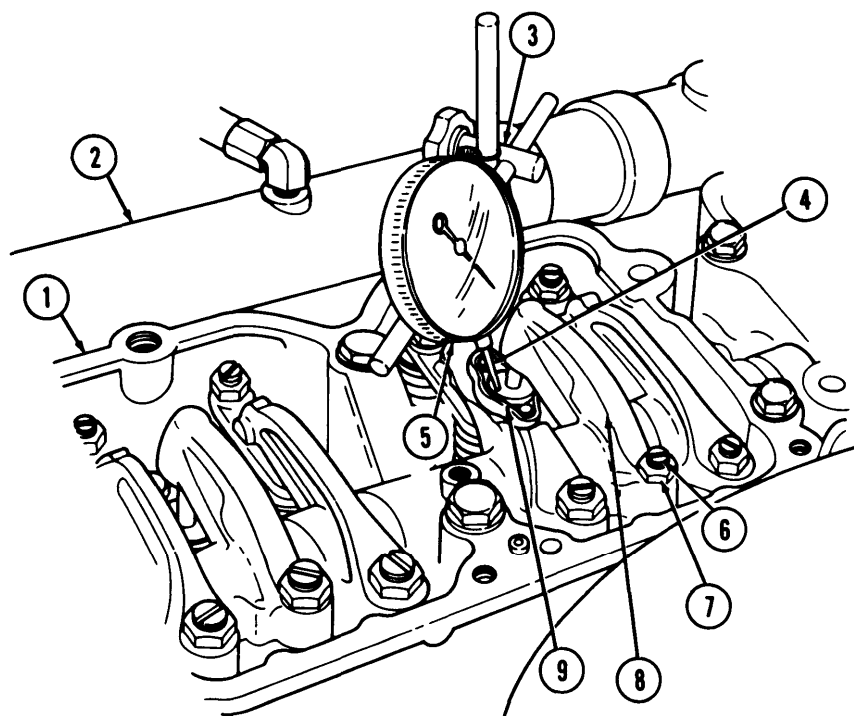
The plunger free travel must not exceed 0.206 in. (5.23 mm) on any cylinder.

Use engine barring tool to rotate crankshaft.

NOTE

If plunger free travel exceeds 0.206 in. (5.23 mm), the torque method of adjustment must be used. Refer to para. 3-106.

d. If free travel of all injector plungers checks within limits, reset dial indicator (5) on no. 3 cylinder.



3-105. VALVE AND INJECTOR ADJUSTMENT (DIAL INDICATOR METHOD) (Cont'd)

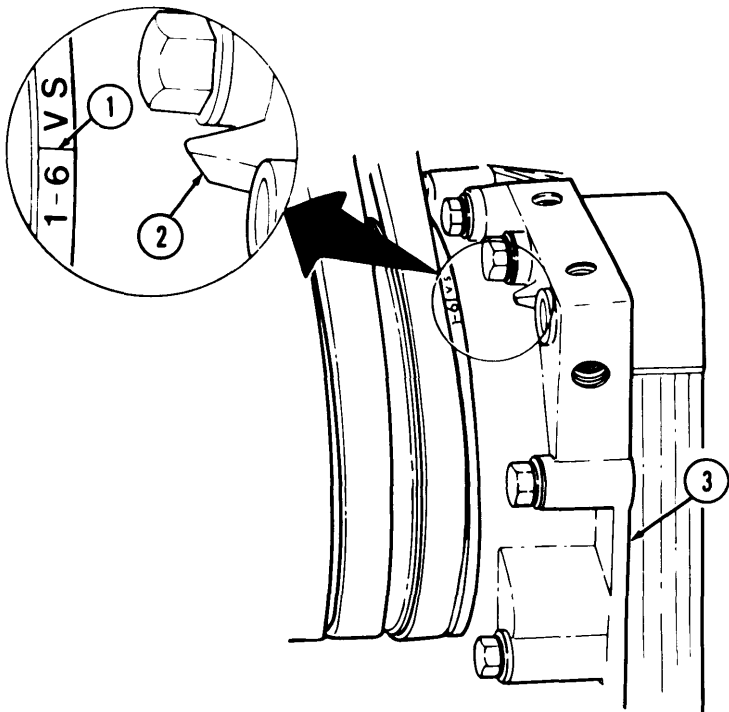
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Injector and Valve Adjustments

NOTE

- Before adjusting injectors and valves, check whether rocker housings are cast iron or aluminum, so correct clearance setting tolerances are used.
- During rebuild, injectors and valves are “cold set” with temperature of oil and components parts within 10°F (-12°C) of ambient air or room temperature. Final “hot set” adjustments must be made when engine is at operating temperature. When warming engine for hot adjust, make sure rocker cover is installed.
- The injector and valve adjusting procedures below and in the referenced “table of specifications” require that the injectors be adjusted before the valves.
- Perform this procedure for non-top stop injectors.

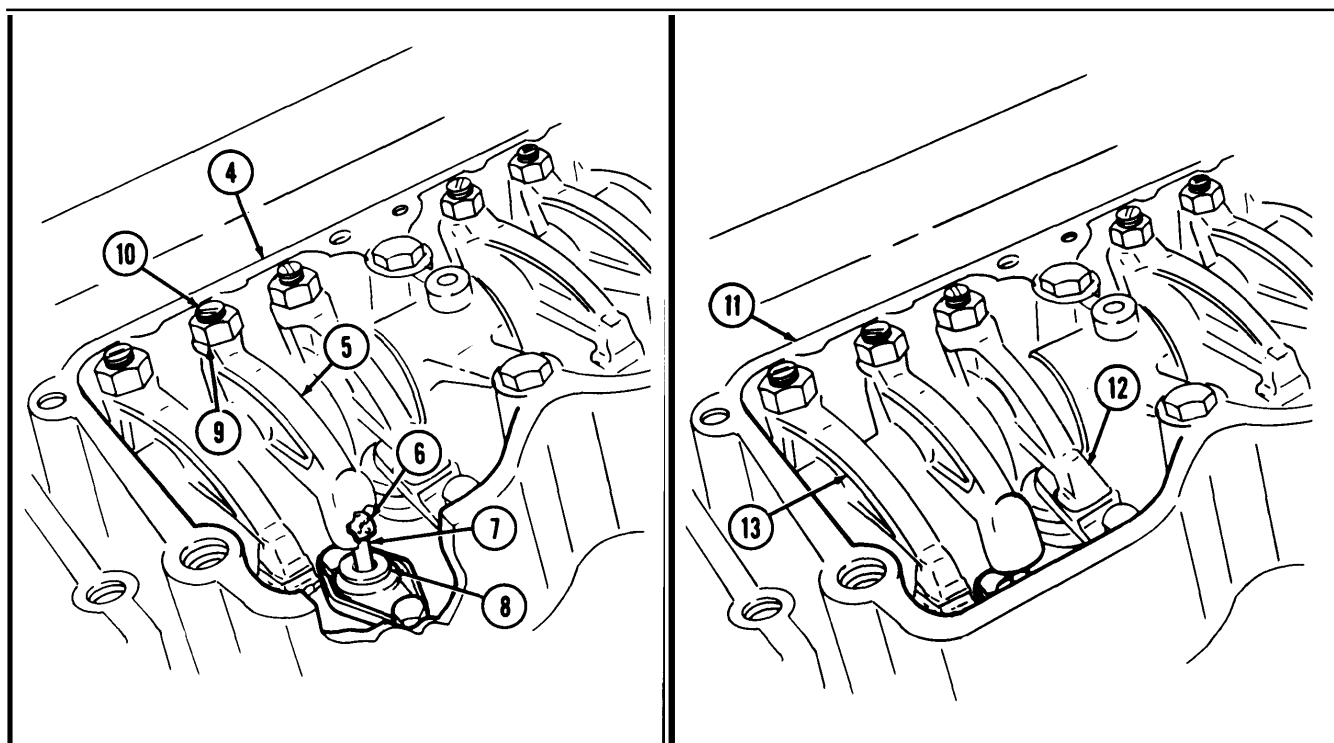
3.
- Timing mark (1) and pointer (2)
- Rotate crankshaft pulley until the mark 1-6 “VS” (1) is alined with pointer (2) on gearcase cover (3).
- Use engine bating tool to rotate crankshaft.



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3-105. VALVE AND INJECTOR ADJUSTMENT (DIAL INDICATOR METHOD) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p style="text-align: center;">NOTE</p> <p>Both valve rocker levers for cylinder no. 5 must be free (valves closed). Injector plunger for cylinder no. 3 must be at top of travel before beginning adjustments.</p>				
4.		No. 5 cylidner (11)	Both intake (12) and exhaust (13) rocker levers must be free (in closed position).	Check by shaking levers with hand. Valve springs must not be compressed.
5.		No. 3 cylinder (4)	Injector plunger (8) must be at top of travel.	If not at top of travel, rotate the crankshaft 360° and realine marks 1-6 "VS" with the pointer.
6.		Injector rocker lever (5)	Turn adjusting screw (10) down until plunger (8) link pin (7), contacts lever cup (6). Advance adjusting screw (10) 15° to squeeze oil from lever cup. Then loosen adjusting screw (10) several turns.	Use wrench to hold locknut (9).

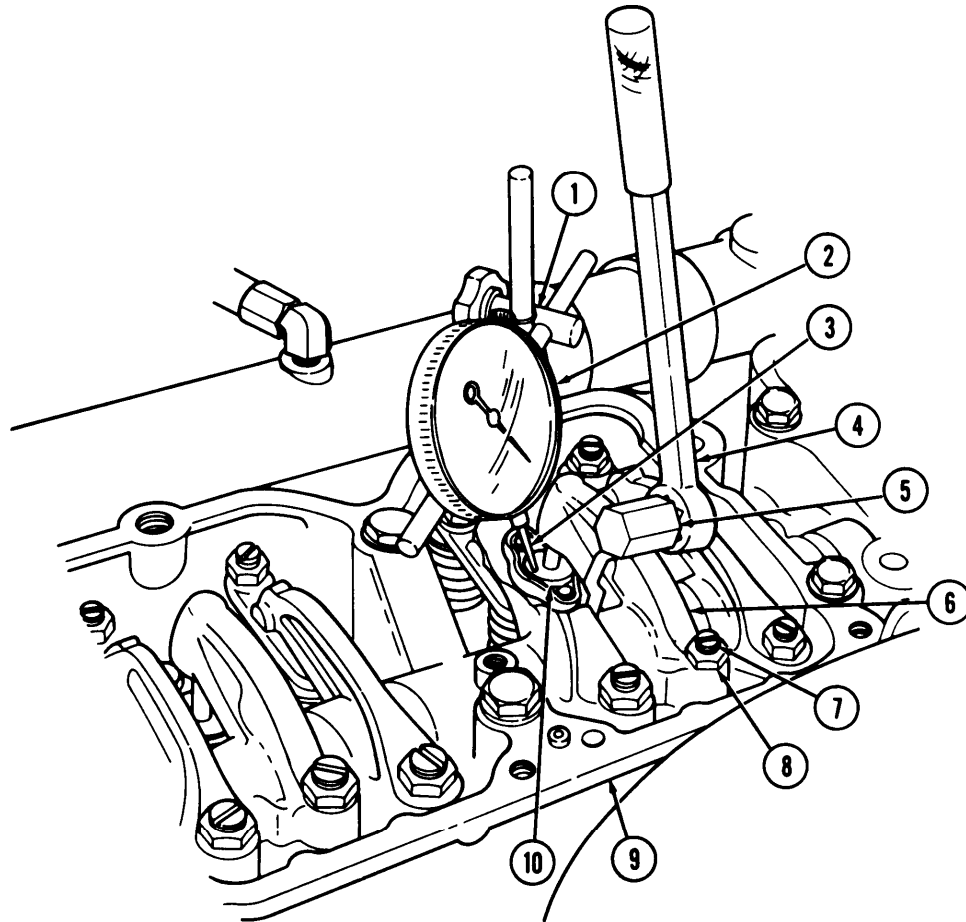


3-105. VALVE AND INJECTOR ADJUSTMENT (DIAL INDICATOR METHOD) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
7.	Cylinder (9)	Indicator fixture (1)	a. Position dial indicator (2) extension arm (3) on top of injector plunger (10). b. Using rocker lever actuator (5), press injector lever (6) down toward the fuel injector until injector plunger (10) is bottomed. c. Release lever (4) and allow plunger (10) to rise, then press to bottom again. d. Set dial indicator (2) to zero. e. Release injector plunger (1) and allow to rise. f. Turn adjusting screw (7) until dial indicator (2) reads 0.170 in. (4.32 mm) for aluminum housing.	Ensure injector plunger (10) is held bottomed. Dial must show travel of 0.169-0.171 in. (4.29-4.34 mm).
8.	Adjusting screw (7)	Locknut (8)	a. Tighten 40-45 lb-ft (54-61 N•m). b. Actuate (press) injector plunger (10) several times to check adjustment reading.	Use rocker lever actuator.

3-105. VALVE AND INJECTOR ADJUSTMENT (DIAL INDICATOR METHOD) (Cont'd~

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3-105. VALVE AND INJECTOR ADJUSTMENT (DIAL INDICATOR METHOD) (Cont'd-)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Table 9-10. Engine Firing Order

Right hand rotation 1-5-3-6-2-4

NOTE

Steps 3 through 8 cover injector adjustment for no. 3 cylinder.
Follow table 3-11 for the remaining five injectors.

Table 3-11. Injector and Valve Set Position

Rotation Direction	Pulley Position	A d u s t C y l i n d e r	
		Injector	Valve
Start	1-6 "VS"	3	5
Advance to	2-5 "VS"	6	3
Advance to	3-4 "VS"	2	6
Advance to	1-6 "VS"	4	2
Advance to	2-5 "VS"	1	4
Advance to	3-4 "VS"	5	1
NOTE: Two complete revolutions of the pulley are required to adjust all injectors and valves.			

Table 3-12. Uniform Plunger Travel Adjustment Limits

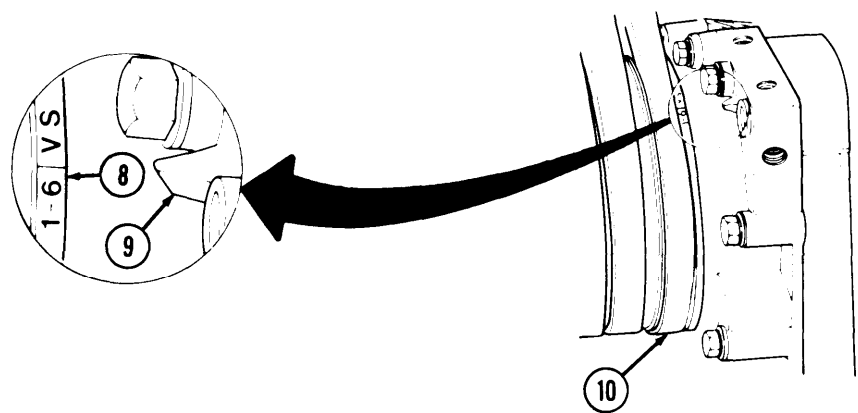
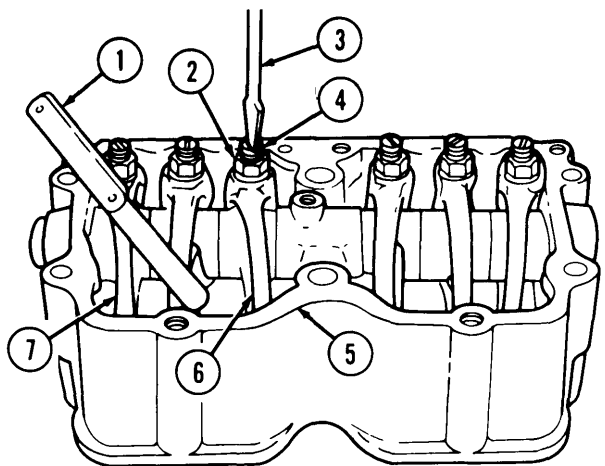
Oil Temp.	Injector Plunger Travel		Valve Clearance	
	Adjust Valve In. (mm)	Recheck Limit In. (mm)	Intake In. (mm)	Exhaust In. (mm)
	Aluminum Rocker Housing			
Cold	0.170 (4.32)	0.169-0.171 (4.29-4.34)	0.011 (0.28)	0.023 (0.58)

NOTE

With engine position at 1-6 "VS" mark, the no. 3 injector has been adjusted, and now valves in no. 5 cylinder must be adjusted.

3-105. VALVE AND INJECTOR ADJUSTMENT (DIAL INDICATOR METHOD) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
9.	No. 5 cylinder (5)	Intake rocker lever (6)	<p>a. Loosen locknut (2) and back out adjusting screw (4).</p> <p>b. Insert feeler gage (1) between rocker lever (6) nose and cross-head,</p> <p>c. Using screwdriver (3), slowly turn adjusting screw (4) down until lever (6) nose touches feeler gage (1).</p> <p>d. Hold adjusting screw (4) firmly in position and tighten locknut (2) 40-45 lb-ft (54-61 N•m).</p>	<p>Refer to table 3-12 for valve clearance settings.</p> <p>(Check clearance by removing and inserting feeler gage. There will be a slight drag on gage when clearance is correct.</p> <p>Use care to prevent moving of adjusting screw (4).</p>
10.		Exhaust rocker lever (7)	Perform the same adjustment procedures described in steps 9a through 9d.	Refer to table 3-12 for valve clearance settings.
11.		Timing mark (8) and pointer (9)	Advance pulley (10) to the next timing mark (8) and perform injector and valve adjustments indicated in tables 3-10 and 3-11.	After each set of injector and valve adjustments, advance pulley (10) to next timing mark (8) until all timing is completed.



END OF TASK!

- FOLLOW-ON TASKS:
- Install rocker lever housing covers (para. 3-81).
 - Install rocker lever housing covers (in vehicle) (para. 3-16).
 - Connect battery ground cable (in vehicle) (TM 9-2320 -272-20-1).
 - Fuel shutoff handle pushed in (in vehicle) (TM 9-2320-272-10).
 - Start engine (TM 9-2320-272-10), run until normal operating temperature is reached and check for leaks.
- TA 350359

3-106. INJECTOR PLUNGER AND VALVE ADJUSTMENTS (TORQUE METHOD)

This task covers:

a. Pre-adjustment Setup

b. Injector and Valve Adjustment

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 3-76 Para. 3-47 Para. 3-16 TM 9-2320-272-10 TM 9-2320-272 -20-1	Valve crossheads adjusted. Rocker lever housing covers removed. Rocker lever housing covers removed (in vehicle). Fuel shutoff handle pulled (in vehicle). Battery ground cable disconnected (in vehicle).

Test Equipment
None

Special Tools
Barring tool ST-747
Torque wrench adapter ST-669

Materials/Parts
None

Personnel Required
Wheeled vehicle repairman MOS 63W

Manual References
TM 9-2320-272-10
TM 9-2320-272 -20-1
TM 9-2320-272-34P

Special Environmental Conditions
None

General Safety Instructions
If task is being performed **while engine** is in vehicle, be sure fuel shutoff handle is pulled and battery ground cable is disconnected to prevent engine starting.

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Pre-Adjustment Setup

WARNING

If task is being performed while engine is in vehicle, be sure fuel shutoff handle is pulled and battery ground cable is disconnected to prevent engine starting. Failure to do this may result in injury to personnel.

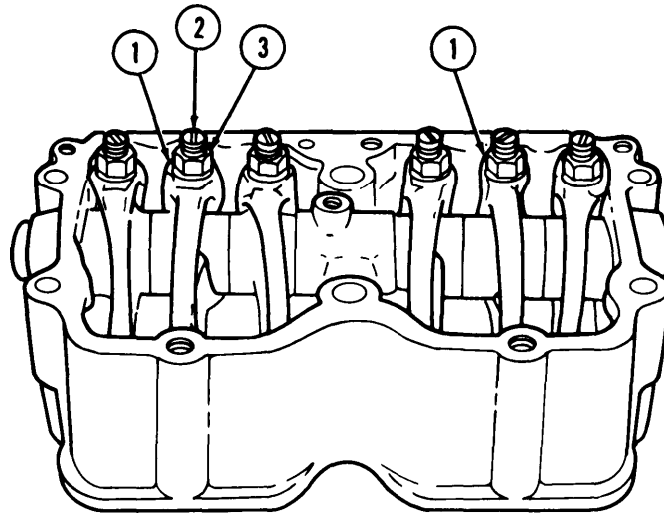
NOTE

- Injector plungers are adjusted before valves are adjusted.
- Loosening all injector rocker lever adjusting screws and locknuts will help indicate difference between cylinders that have been adjusted and those cylinders still needing adjustment.

1.	Six injector rocker levers (1)	Six locknuts (3) and adjusting screws (2)	Loosen each one a full turn, starting with locknuts (3).
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3-106. INJECTOR PLUNGER AND VALVE ADJUSTMENTS (TORQUE METHOD) (Cont'd)

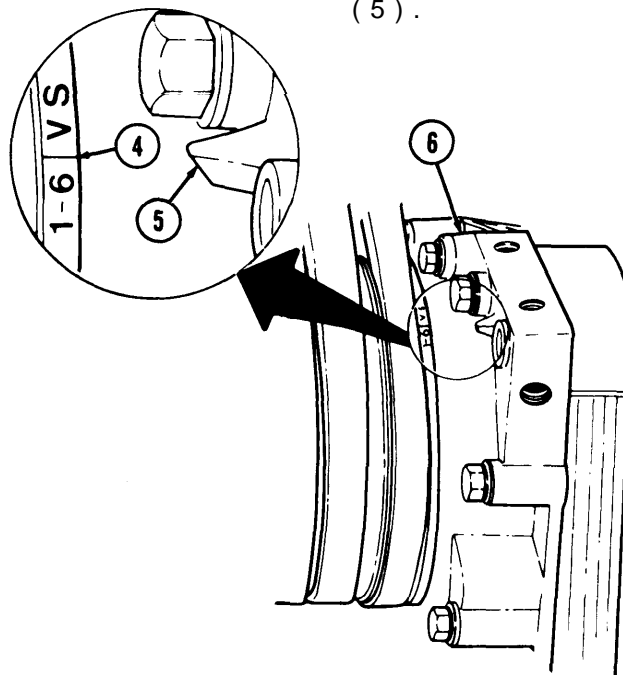
STEP:: NO.	LOCATION	ITEM	ACTION	REMARKS
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2. Gearcase (6)

Accessory drive pulley
(4)

Bar engine in direction
of operating rotation
until timing marks 1-6
"VS" aline with pointer
(5) .



3-106. INJECTOR PLUNGER AND VALVE ADJUSTMENTS (TORQUE METHOD] (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Injector and Valve Adjustment

NOTE

- Before adjusting injectors and valves, check if rocker housings are cast iron or aluminum, so that the correct clearance setting tolerances listed in table 3-13 are used.
- During rebuild, injectors and valves are “cold set” with oil and component parts temperature within 10° (-12°C) of ambient air or room temperature.
- The injector and valve adjusting procedures below and the referenced “table of specifications” require that the injectors be adjusted before the valves.

3. Cylinder	Injector rocker lever (3)	a. Loosen locknut (5). Turn adjusting screw (4) down until top of plunger(1) contacts cup (2). b. Advance screw (4) 15° to squeeze oil from cup (2). c. Back adjusting screw (4) out one full turn.	Use wrench to hold locknut (5). Ensure spring retainer (7) is against adjusting screw (8) of injector (6).
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NOTE

Use the ST-753-1 torque wrench to adjust iniectors. Set the torque wrench on value required and pull to "0". Break adjusting screw loose each time and pull to torque value shown in each tightening pass.

4.	Adjusting screw (4)	a. Tighten, making two or three passes with torque wrench, to values listed in table 3-13.
----	---------------------	--

NOTE

Perform step 4b for top stop injectors.

- b. Tighten adjusting screw (4) 5 to 6 lb-in. (0.6 to 0.7 N•m).

3-106. INJECTOR PLUNGER AND VALVE ADJUSTMENTS (TORQUE METHOD) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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4.1.		Locknut (5)	Tighten 40-45 lb-ft (54-61 N•m).	
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NOTE

The same engine position used in adjusting injectors is used for setting intake and exhaust valves.

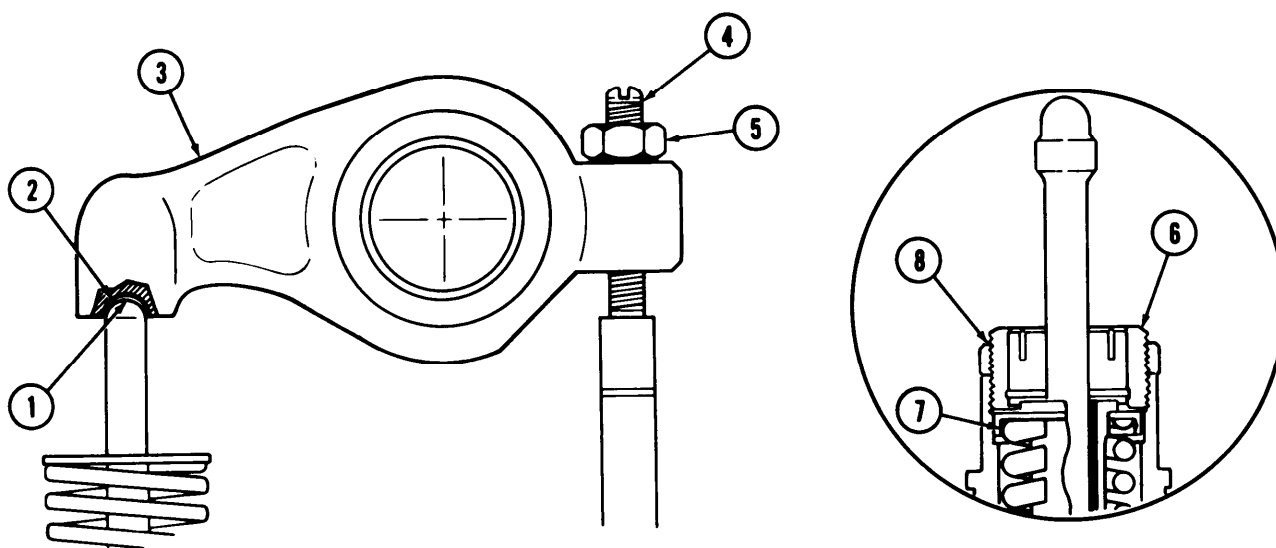


Table 3-13. Injector Adjustment

cold set
Aluminum Rocker Housing
72 lb-in. (8.1 N•m)

Table 3-14. Valve Clearance inch (mm) (Torque Method)

Intake Valves	Exhaust Valves
Cold Set	Cold Set
Aluminum Rocker Housing	
0.014 in. (0.36 mm)	0.027 in. (0.69 mm)

3-106. INJECTOR PLUNGER AND VALVE ADJUSTMENTS (TORQUE METHOD) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Before checking or setting valve clearances, be sure crossheads are adusted.

NOTE

Crossheads operate two valves with one rocker lever. Crosshead adjustments are necessary to ensure equal operation of each valve.

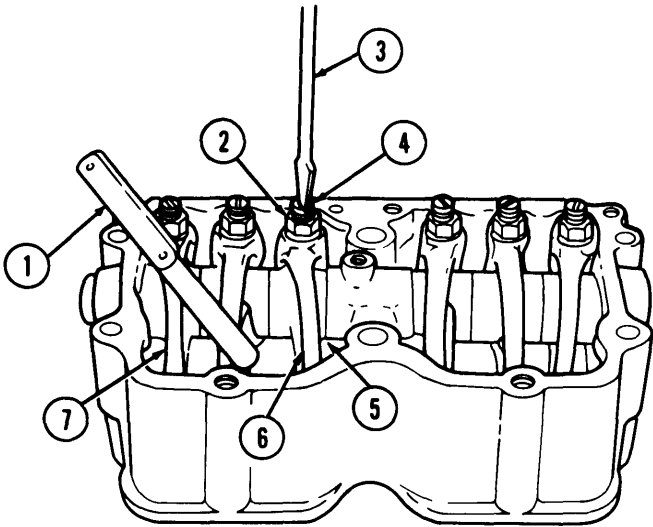
5.	Adjusting screw (3) on crosshead (1)	Locknut (2)	Loosen.	
6.		Adjusting screw (3)	Back out one turn.	
7.		Crosshead (1)	Use light finger pressure on rocker lever contact surface (4) to hold contact with valve stem (6).	Valve stem (6) is opposite the adjusting screw (3).
8.		Adjusting screw (3)	Turn down until it touches valve stem (7).	
9.		Locknut (2)	a. Tighten 22-26 lb-ft (30-35 N•m). b. Hold adjusting screw (3) with screwdriver and tighten locknuts (2) 25-30 lb-ft (34-41 N•m).	

3-106. INJECTOR PLUNGER AND VALVE ADJUSTMENTS (TORQUE METHOD) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
10.	crosshead (1)	Valve spring retainer (5)	Check clearance with wire gage.	There must be a minimum clearance at this point of 0.020 in. (0.51 mm).

3-106. INJECTOR PLUNGER AND VALVE ADJUSTMENTS (TORQUE METHOD) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
11.	Cylinder (5)	Intake rocker lever (6)	<p>a. Loosen locknut (2), and back out adjusting screw (4).</p> <p>b. Insert feeler gage (1) between rocker lever nose and crosshead.</p> <p>c. Using a screwdriver (3), slowly turn adjusting screw (4) down until lever (6) nose touches feeler gage (1).</p> <p>d. Hold adjusting screw (4) firmly in position and tighten locknut (2) 40-45 lb-ft (54-61 N•m).</p>	<p>Refer to table 3-14 for valve clearance settings.</p> <p>Check clearance by removing and inserting feeler gage. There will be a slight drag on feeler gage when clearance is correct.</p> <p>Use care to prevent moving of adjusting screw (4).</p>



3-106. INJECTOR PLUNGER AND VALVE ADJUSTMENTS (TORQUE METHOD) (Cont'd)

LOCATION	ITEM	ACTION	REMARKS
12.	Exhaust rocker lever (7)	Perform the same adjustment procedures described in steps 11a through 11d.	Refer to table 3-14 for valve clearance settings.
13.	Timing mark (8) and pointer (9)	Advance pulley (10) to next timing mark (8), and perform injector and valve adjustments as indicated in tables 3-10 and 3-11.	After each set of injector and valve adjustments, continue advancing engine rotations until all timing is completed.

END OF TASK!

- FOLLOW-ON TASKS:**
- Install battery ground cable (in vehicle) (TM 9-2320-272-20- 1).
 - Install rocker lever housing covers (para. 3-81).
 - Install rocker lever housing covers (in vehicle) (para. 3-16).
 - Fuel shutoff handle pushed in (in vehicle) (TM 9-2320-272-10).
 - Start engine (TM 9-2320-272- 10) and check for proper operation.

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CHAPTER 4

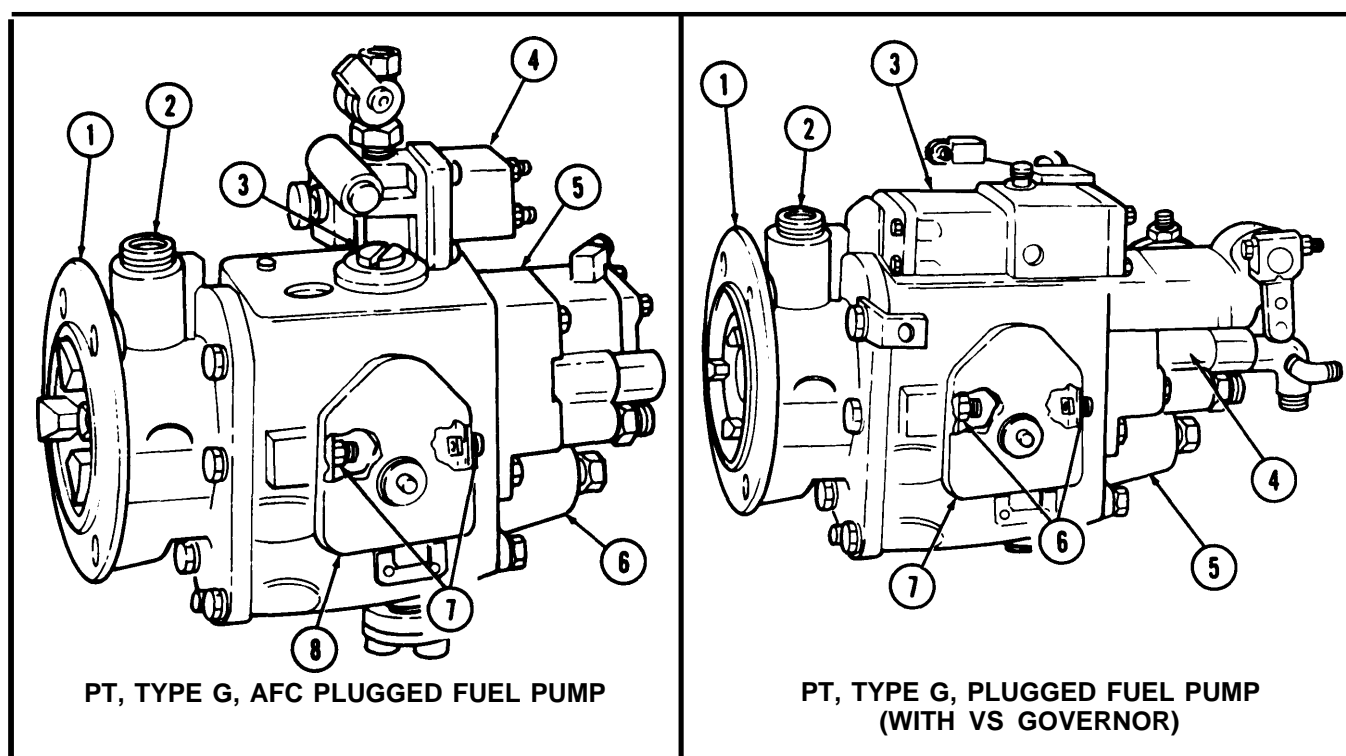
FUEL SYSTEM MAINTENANCE

Section I. DESCRIPTION AND DATA

4-1. DESCRIPTION - FUEL PUMP

a. M939 series vehicles use standard or variable speed pressure time (PT) air fuel controlled (AFC) plugged, type G fuel pumps. The variable speed (VS) fuel pump is used on the M936 (wrecker) only. The wrecker requires greater varying engine speed to operate the crane. This is accomplished by an additional governor located in the upper portion of the fuel pump housing.

b. Both pumps are shown and can be identified by information on throttle shaft covers on left side of each pump. For additional fuel pump data, see table 4-1.



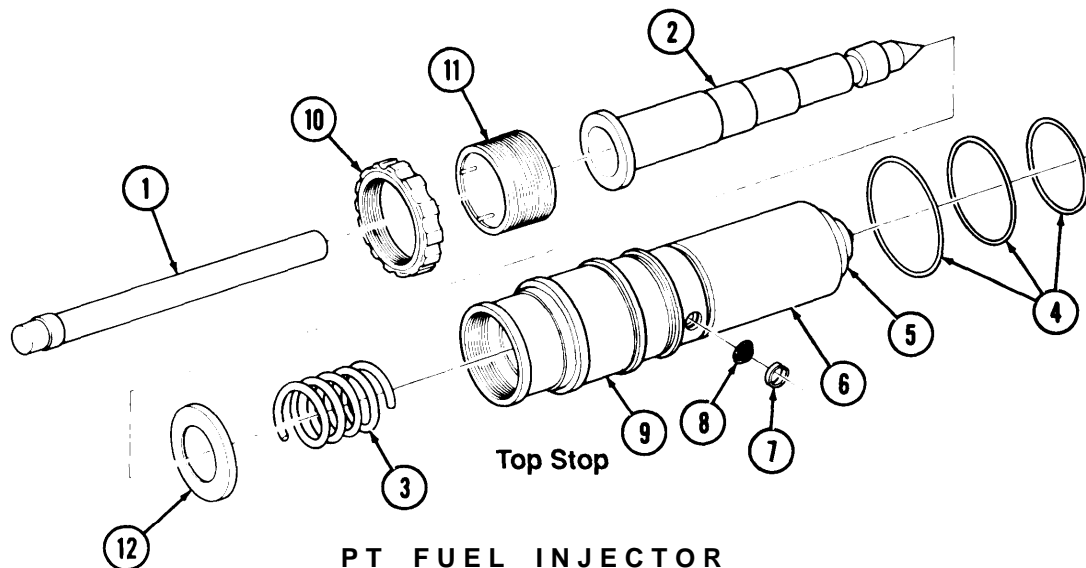
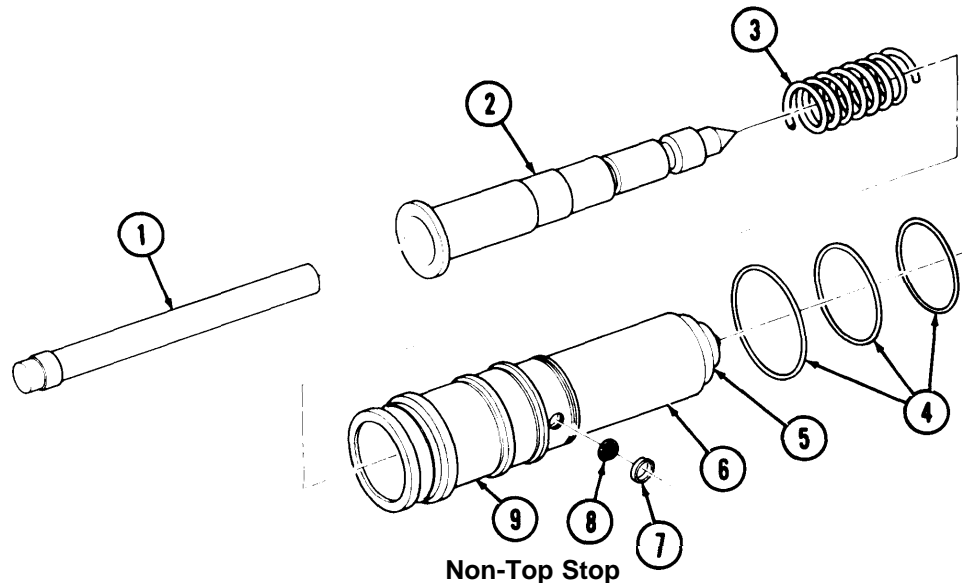
1. Front Drive Cover
2. Tachometer Drive Housing
3. Filter Cap
4. Fuel Pump Shutoff Valve
5. Gear Pump
6. Governor Spring Pack Cover
7. Throttle Adjusting Screws
8. Throttle Shaft Cover

1. Front Drive Cover
2. Tachometer Drive Housing
3. Variable Speed Governor
4. Gear Pump
5. Governor Spring Pack Cover
6. Throttle Adjusting Screws
7. Throttle Shaft Cover

c. Fuel tank(s) repair, which requires special safety precautions, is not contained in this manual. Refer to TM 9-237, Welding Theory and Application.

4-2. DESCRIPTION - FUEL INJECTORS

- a. The M939 and M939A1 vehicles use two types of injectors, a standard cylindrical PT (type-D) and a cylindrical PT (type-D) top stop injector. The standard injector (non-top stop) was used prior to engine serial number 11246663. The top stop injector is used with engine serial number after 11246663.
- b. The non-top stop fuel and top stop injectors are shown. For injector data, see table 4-1.



- | | |
|-----------------|-------------------------|
| 1. Link | 7. Screen Retainer Ring |
| 2. Plunger | 8. Inlet Fuel Screen |
| 3. Spring | 9. Adapter |
| 4. "O" Rings | 10. Locknut |
| 5. Cup | 11. Adjusting Screw |
| 6. Cup Retainer | 12. Spring Retainer |

4-2. DESCRIPTION - FUEL INJECTORS (Cont'd)

Table 4-1. Fuel System Tabulated Data.

1.	FUEL PUMP STANDARD AND VARIABLE SPEED	
	Make	Cummins
	Model	PT, AFC plugged
	Code (standard)	3892
	Type	G
	Location	Lefti side of engine
2.	FUEL INJECTOR	
	Make	Cummins
	Model	PT
	Type	D
	Number of cup holes	8
	Size of cup holes .....	.007 in. (.1178 mm)
	Degree of cup holes	17 degrees
	Orifice sizes .....	.018-.019 in. (0.48-0.49 mm)
	Number of injectors	6

Section II. FUEL PUMP REPAIR

4-3. FUEL PUMP REPAIR TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
4-4.	Fuel Pump Replacement	4-4
4-5.	Fuel Pump Shutoff Valves Replacement	4-14
4-6.	Fuel Pump Shutoff Valve (M936) Replacement	4-16
4-7.	Fuel Pump Mounting to Holding Fixture	4-19
4-8.	Pulsation Damper Maintenance	4-20
4-9.	Pressure Gear Pump Removal	4-22
4-10.	Governor Spring Pack Maintenance	4-24
4-11.	Fuel Pump Housing Disassembly	4-26
4-12.	Throttle Cover and Shaft Disassembly	4-28
4-13.	Governor Weight Removal	4-30
4-14.	Deleted	4-32
4-15.	Deleted	4-34

4-4. FUEL PUMP REPLACEMENT

This task covers:

- a. Removal
- b. Installation

c. On-Engine Adjustments

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10 TM 9-2320-272-10	Hood raised and secured. Left splash shield removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Two locknuts Gasket Three lockwashers Protective cap-plugs (Appendix C, Item 5) Lubricating oil-OE\HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

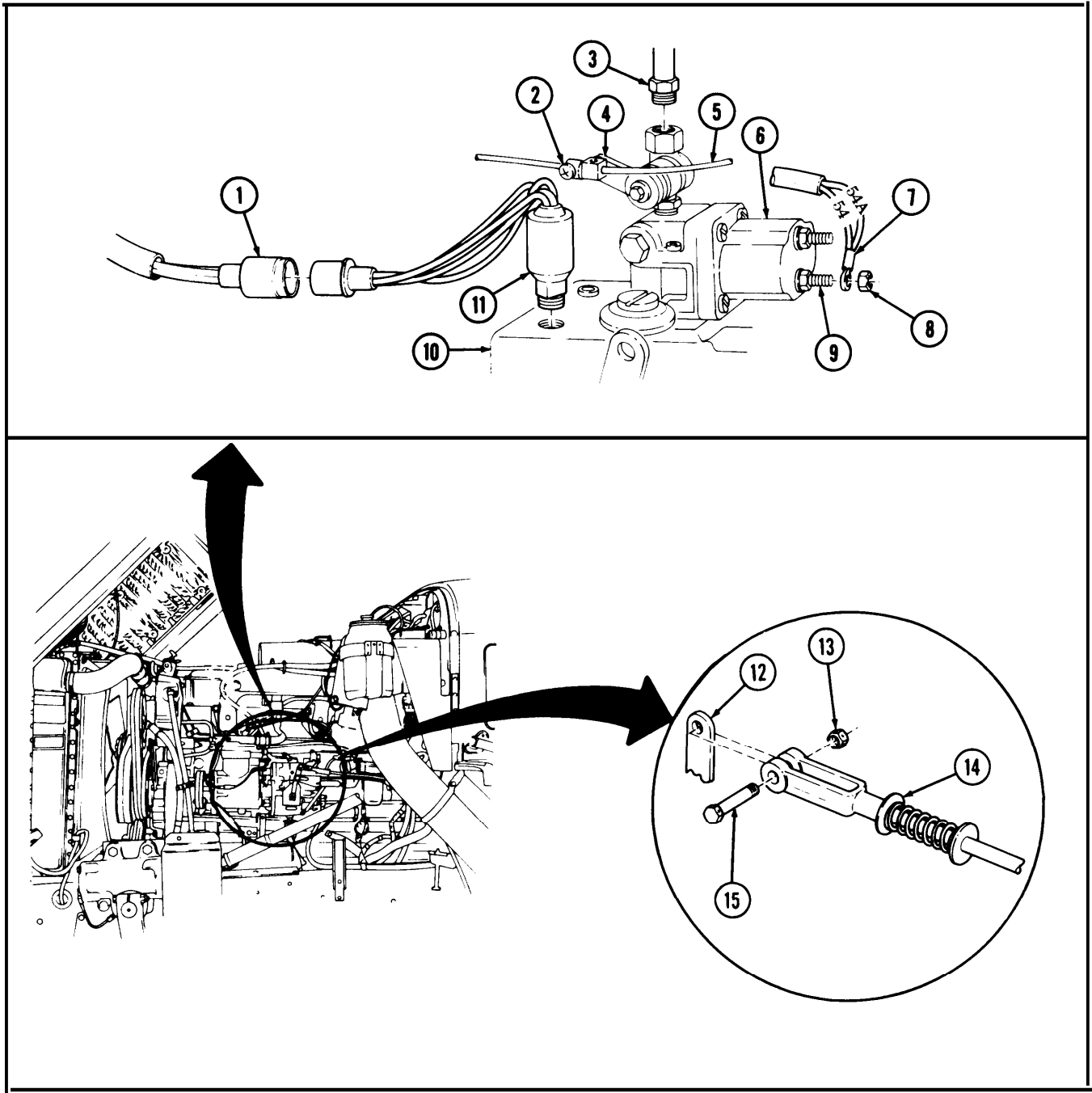
- Fuel pump body must be thoroughly cleaned before disconnecting any attaching components to prevent foreign particles from entering pump.
- When disconnecting lines, hoses, and fuel pump switch from pump, immediately plug all open ports to prevent possible damage to pump.

a. Removal

- | | | | | |
|----|--------------------------|-------------------------------|---|-----------------------|
| 1. | Fuel pump (10) | Fuel pressure transducer (11) | Disconnect lead (1) and remove. | |
| 2. | Fuel shutoff valve (6) | Fuel line (3) | Disconnect. | |
| 3. | Terminal (9) | Nut (8) and wires (7) | Remove. | |
| 4. | Fuel shutoff lever (4) | Screw (2) | Loosen, and pull cable (5) until free, | |
| 5. | Pump throttle lever (12) | Screw (15) and locknut (13) | Remove, and disconnect rod clevis (14). | Discard locknut (13). |

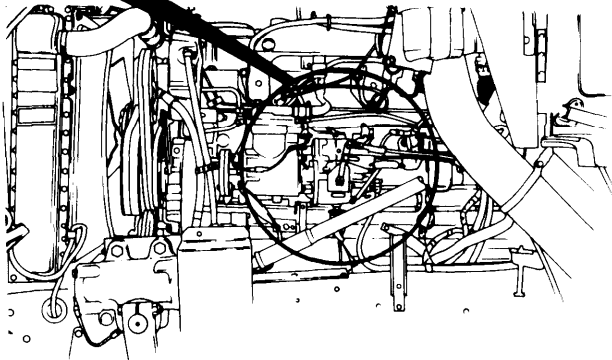
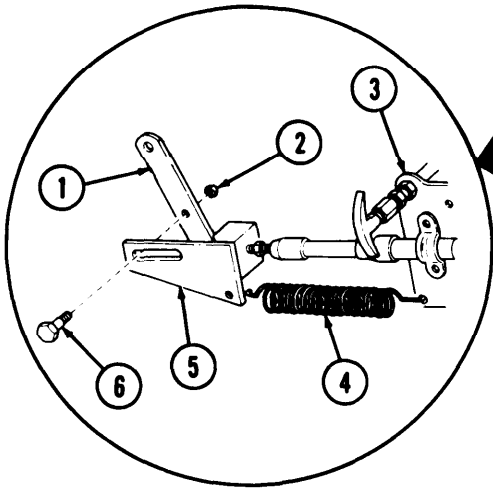
4-4. FUEL PUMP REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION
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4-4. FUEL PUMP REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
6.	Pump throttle lever (1)	Screw (6) and locknut (2)	Remove and disconnect link (5).	Discard locknut (2).
7.	Modulator control link (5) to modulator cable clamp bracket (3)	Return spring (4)	Remove.	



8.	Fuel pump (7)	Tachometer pulse sender (16)	Disconnect from tachometer drive housing (15).
9.	Inlet adapter elbow (12) and fuel outlet line fitting (8)	Primer pump fuel line (10), inlet fuel line (11), and fuel outlet line (9)	Disconnect.
10.	Ether start fuel pressure switch (14)	Two connectors (13)	Disconnect.
11.	Bottom of fuel pump (7)	Ether start fuel pressure switch (14)	Remove.

NOTE

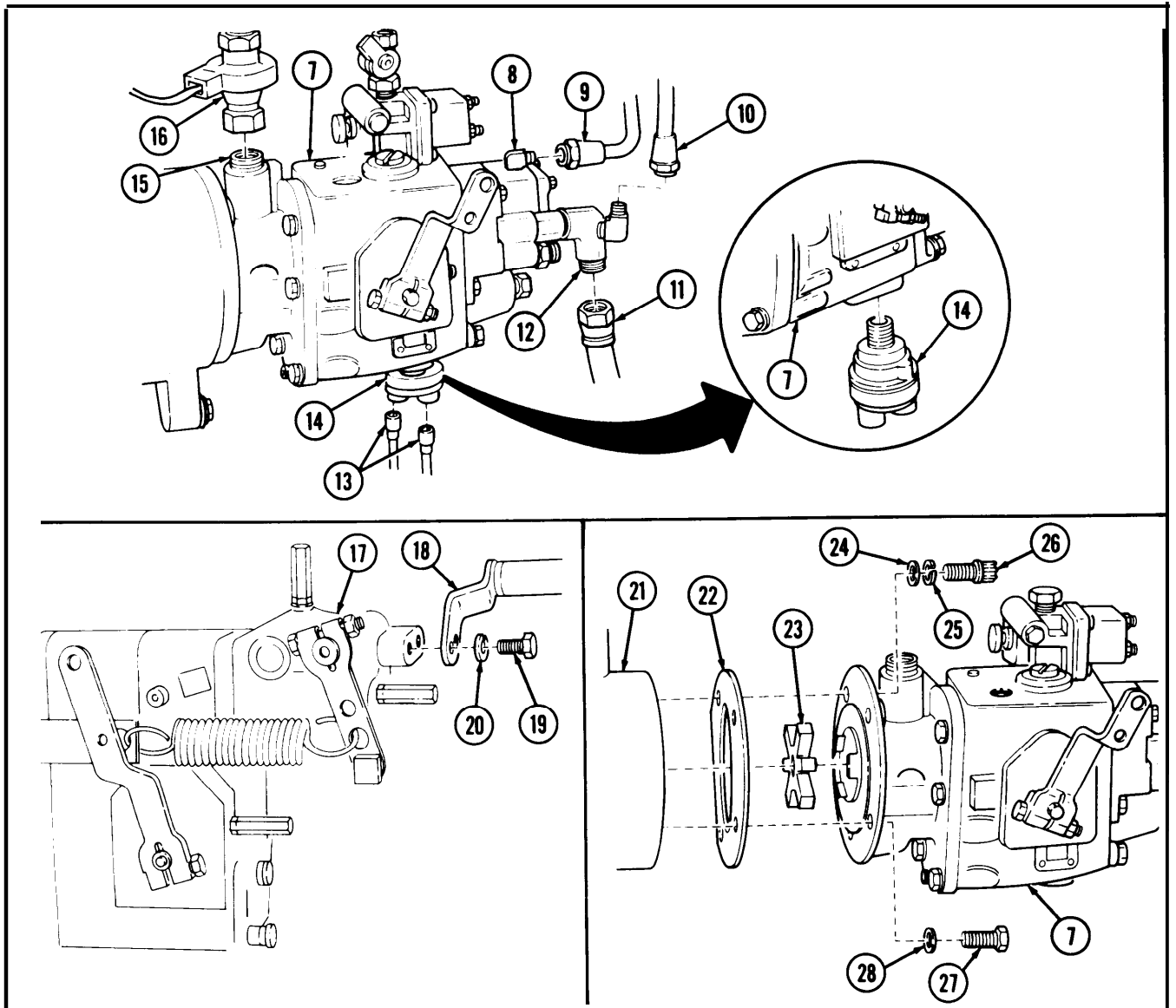
Step 12 applies to fuel pump with VS governor only.

12.	VS governor (17)	Two screws (19) and lockwashers (20), and air cylinder bracket (18)	Remove.	Discard lockwashers (20).
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4-4. FUEL PUMP REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
13.	Air compressor (21)	Three screws (27) and washers (28), screw (26), lockwasher (25), washer (24), and fuel pump (7)	Remove.	Discard lockwasher (25).
14.		Rubber spider coupling (23)	Remove.	
15.		Fuel pump gasket (22)	Remove.	Discard gasket (22). Clean gasket remains from mating surfaces.



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4-4. FUEL PUMP REPLACEMENT [Cont'd]

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Installation

16.

Rubber spider coupling (3)

Place on air compressor (1).
17.

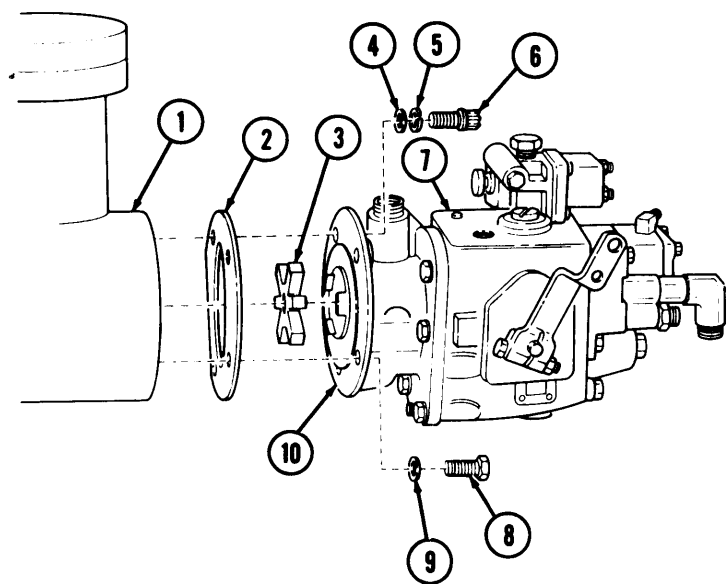
New gasket (2)

Place on air compressor (1).
18.

Fuel pump (7)

a. Aline fuel pump drive (10) with rubber spider coupling (3) on air compressor (1).

b. Install with three screws (8) and washers (9), screw (6), new lockwasher (5), and washer (4).



NOTE

Squirt clean oil into pump through inlet adapter elbow hole. This aids fuel pickup and provides pump lubrication on initial start.

19.

Tachometer pulse sender (13)

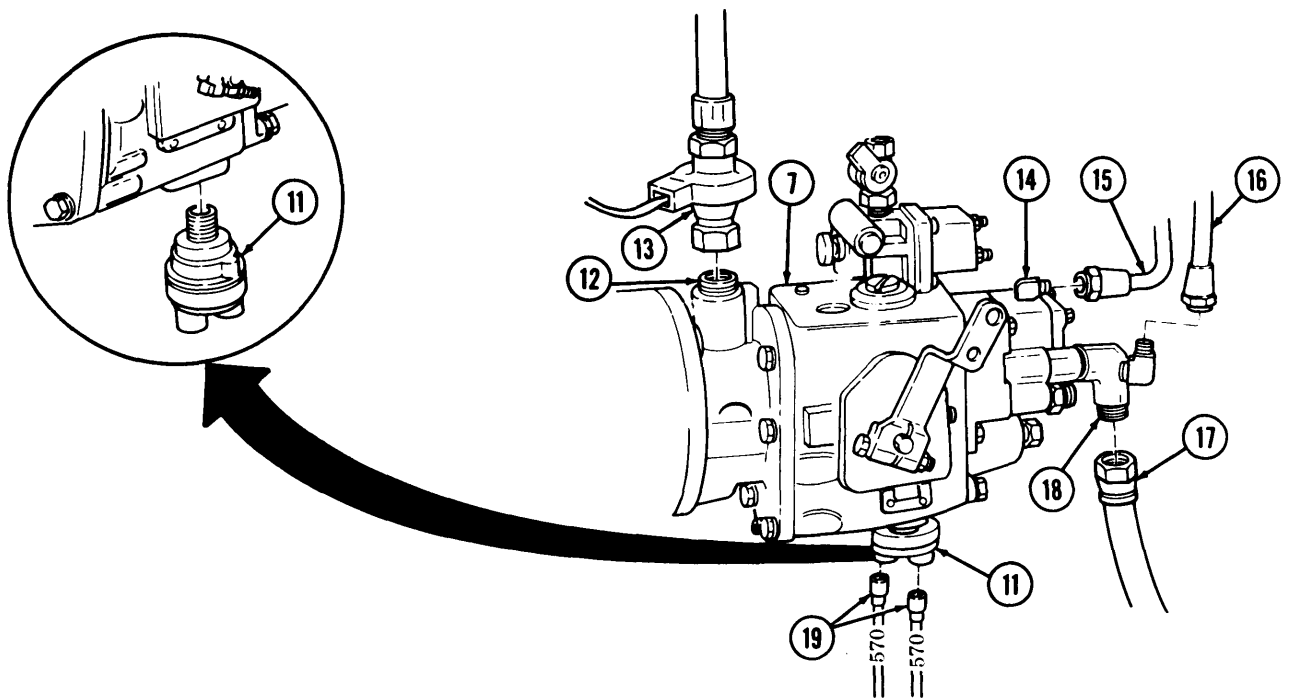
Connect to tachometer drive housing (12).
20.

Primer pump fuel line (16), inlet fuel line (17), and fuel outlet line (15)

Connect to inlet adapter elbow (18) and outlet line fitting (14).

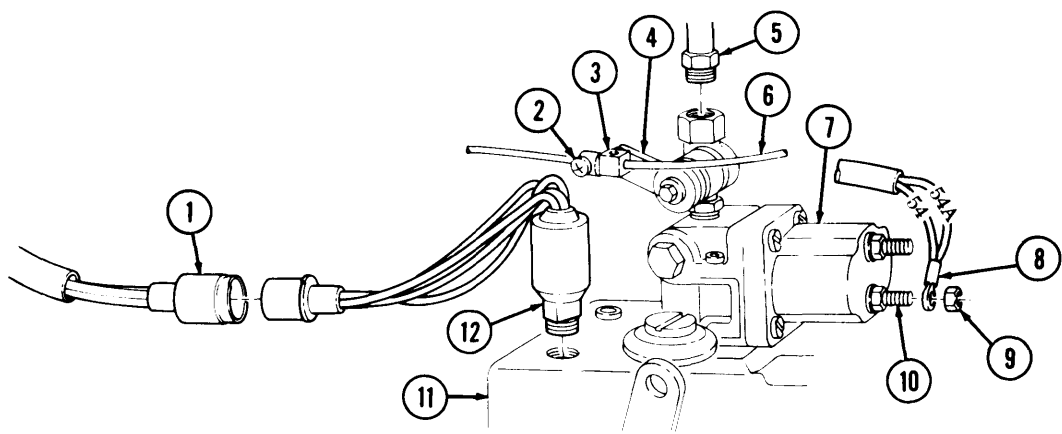
4-4. FUEL PUMP REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
21.		Ether start fuel pressure switch (11)	Install on fuel pump (7).	
22.		Two connectors (19)	Connect to ether start fuel pressure switch (11).	



4-4. FUEL PUMP REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
23.		Fuel shutoff control cable (6)	a. Place through hole in shutoff lever clamp (3), b. Tighten screw (2).	Make sure shutoff lever (4) is in the forward position.
24.		Fuel line (5)	Connect to fuel shutoff valve (7).	
25.		Two wires (8)	Connect to shutoff valve terminal (10) with nut (9).	
26.		Fuel pressure transducer (12)	Install in fuel pump (11) and connect lead (1).	



NOTE

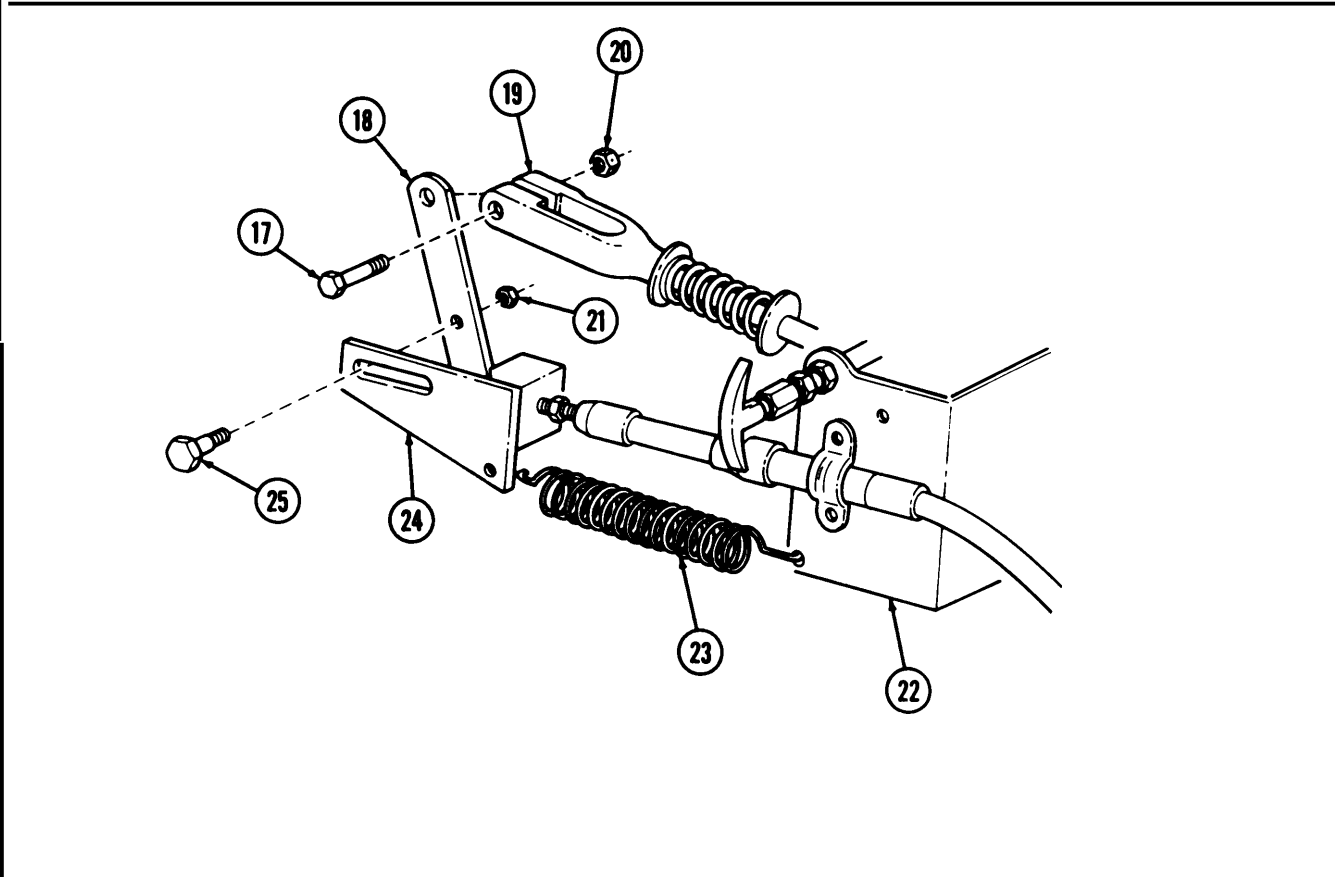
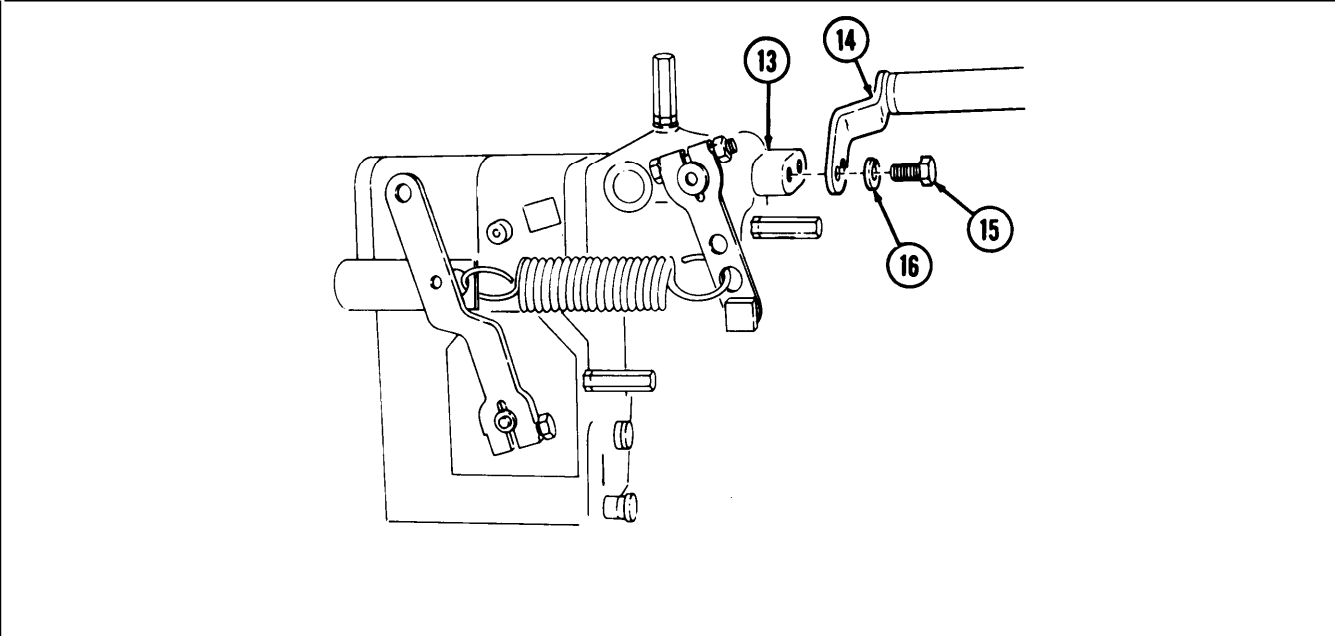
Step 27 applies to fuel pump with VS governor only.

27.	Air cylinder bracket (14)	Install on VS governor (13) with two screws (15) and new lock-washers (16).
28.	Rod clevis (19)	Connect to fuel pump throttle lever (18) with screw (17) and new locknut (20).
29.	Modulator link (24)	Connect to throttle lever (18) with screw (25) and new locknut (21).
30.	Modulator return spring (23)	Install to modulator link (24) and cable clamp bracket (22).

TA 349732

4-4. FUEL PUMP REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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4-4. FUEL PUMP REPLACEMENT (Cont'd)

STEP No.	LOCATION	ITEM	ACTION	REMARKS
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c. On-Engine Adjustments

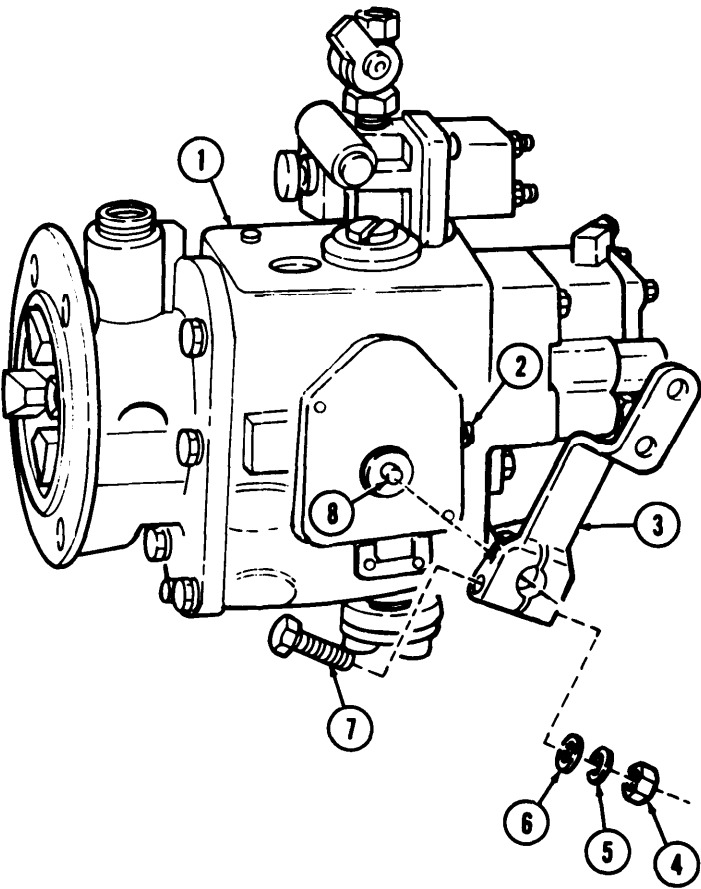
CAUTION

Do not change pump settings made during calibration.

31. Fuel pump (1)	Throttle lever (3)	Adjust as follows:	
		a. Remove screw (7), washer (6), lockwasher (5), and nut (4) from throttle lever (3).	Discard lockwasher (5).
		b. Slide lever (3) off splined throttle shaft (8).	
		c. Turn throttle shaft (8) clockwise until resting against idle adjusting screw (2).	
		d. Slide throttle lever (3) on throttle shaft (8), and install with screw (7), washer (6), new lockwasher (5), and nut (4).	Do not tighten.
		e. Prime fuel system and allow to warm up to operating temperature.	Refer to TM 9-2320-272-10.
		f. Check idle speed. It should be 600-650 rpm. If not, stop engine and check linkage adjustment.	
		g. When speed is correct, stop engine, tighten screw (7) and nut (4) at throttle lever (3).	

4-4. FUEL PUMP REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA349734

4-5. FUEL PUMP SHUTOFF VALVES REPLACEMENT

This task covers:

- | | |
|------------------------------------|---|
| a. Manual Shutoff Valve Removal | c. Fuel Pump Shutoff Valve Installation |
| b. Fuel Pump Shutoff Valve Removal | d. Manual Shutoff Valve Installation |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All (except M936)	TM 9-2320-272-10 TM 9-2320-272-10	Hood raised and secured. Left splash shield removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
"O" ring Two lockwashers Protective cap-plugs (Appendix C, Item 5)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Manual Shutoff Valve Removal

- | | | | | |
|----|--------------------------------|-------------------------------|---|--|
| 1. | Manual fuel shutoff valve (4) | Fuel line (3) | Disconnect. | |
| 2. | Fuel shutoff control cable (5) | Screw (15) | Loosen, and remove clip (1) and pull cable (5) until free of shutoff lever (2). | |
| 3. | Fuel shutoff valve (12) | Manual fuel shutoff valve (4) | Remove. | |

b. Fuel Pump Shutoff Valve Removal

- | | | | | |
|----|---------------|--|---------|--|
| 4. | Terminal (11) | Nut (10) and wires (9) | Remove. | |
| 5. | | Two screws (6), lockwashers (7), and washers (8) | Remove. | Discard lockwashers (7). |
| 6. | | Shutoff valve (12) and "O" ring (13) | Remove. | Plug openings in fuel pump (14).
Discard "O" ring (13). |

4-5. FUEL PUMP SHUTOFF VALVES REPLACEMENT (Cont'd)

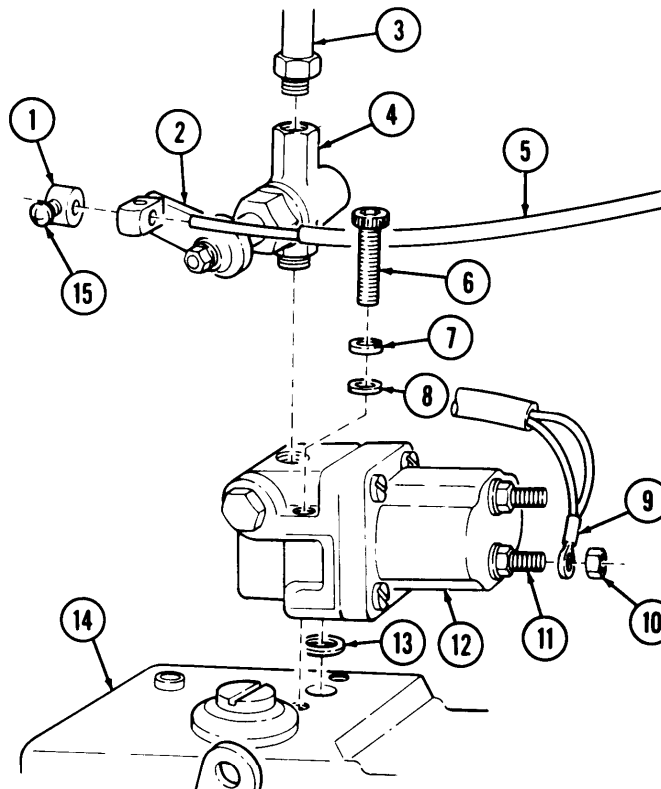
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Fuel Pump Shutoff Valve Installation

- | | | |
|----|--|---|
| 7. | New "O" ring (13) and fuel shutoff valve (12) | Install on fuel pump (14) with two washers (8), new lockwashers (7), and screws (6). |
|----|--|---|

d. Manual Shutoff Valve Installation

- | | | | |
|-----|--|---|---|
| 8. | Wires (9) and nut (10) | Install to terminal (11). | |
| 9. | Manual fuel shutoff valve (4) | Install in fuel shutoff valve (12). | |
| 10. | Control cable (5), screw (15), and clip (1) | Install on shutoff lever (2). | Make sure shutoff lever (2) is in the forward position. |
| 11. | Fuel line (3) | Connect to manual fuel shutoff valve (4). | |



END OF TASK!

- FOLLOW-ON TASKS:**
- Start engine (TM 9-2320-272-10) and check fuel pump shutoff valves for proper operation.
 - Install left splash shield (TM 9-2320-272-10).

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4-6. FUEL PUMP SHUTOFF VALVE (M936) REPLACEMENT

This task covers:

a. Removal

b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
M936	TM 9-2320-272-10 TM 9-2320-272-10	Hood raised and secured. Left splash shield removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
"O" ring Three lockwashers Protective cap-plugs (Appendix C, Item 5)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272-34P		

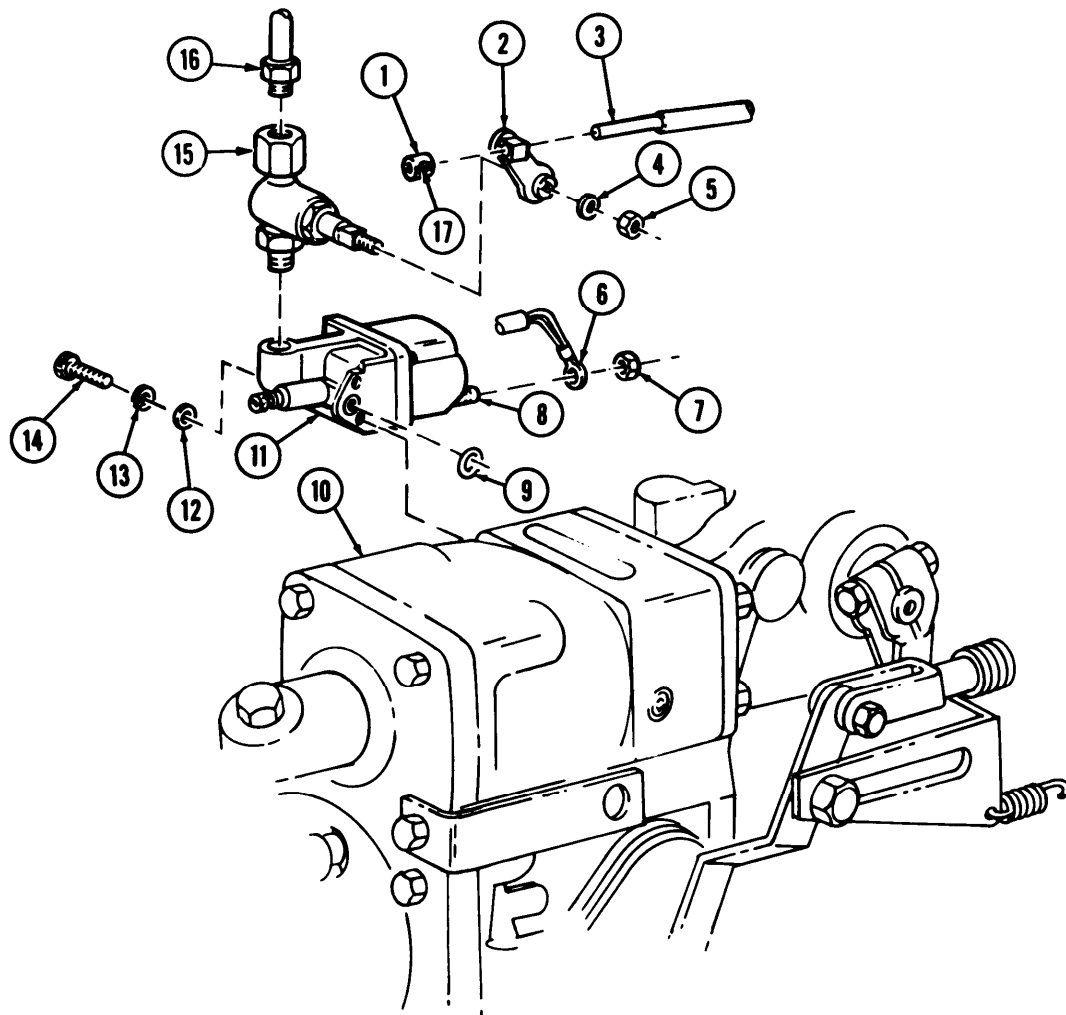
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

- | | | | | |
|----|--------------------------------|---|---|---|
| 1. | Manual fuel shutoff valve (15) | Fuel line (16) | Disconnect. | |
| 2. | Terminal (8) | Nut (7) and wires (6) | Remove. | |
| 3. | Fuel shutoff control cable (3) | Screw (17) | Loosen, and remove clip (1) and pull cable (3) until free of shutoff lever (2). | |
| 4. | Shutoff lever (2) | Nut (5) and lock-washer (4) | Remove. | Discard lockwasher (4). |
| 5. | | Shutoff lever (2) | Remove. | |
| 6. | Fuel shutoff valve (11) | Manual fuel shutoff valve (15) | Remove. | |
| 7. | Fuel pump (10) | Two screws (14), lock-washers (13), and washers (1,2), and fuel shutoff valve (11) | Remove. | Discard lockwashers (13). |
| 8, | | Fuel shutoff valve (11) and "O" ring (9) | Remove. | Plug openings in fuel pump (10).
Discard "O" ring (9). |

4-6. FUEL PUMP SHUTOFF VALVE (M936) REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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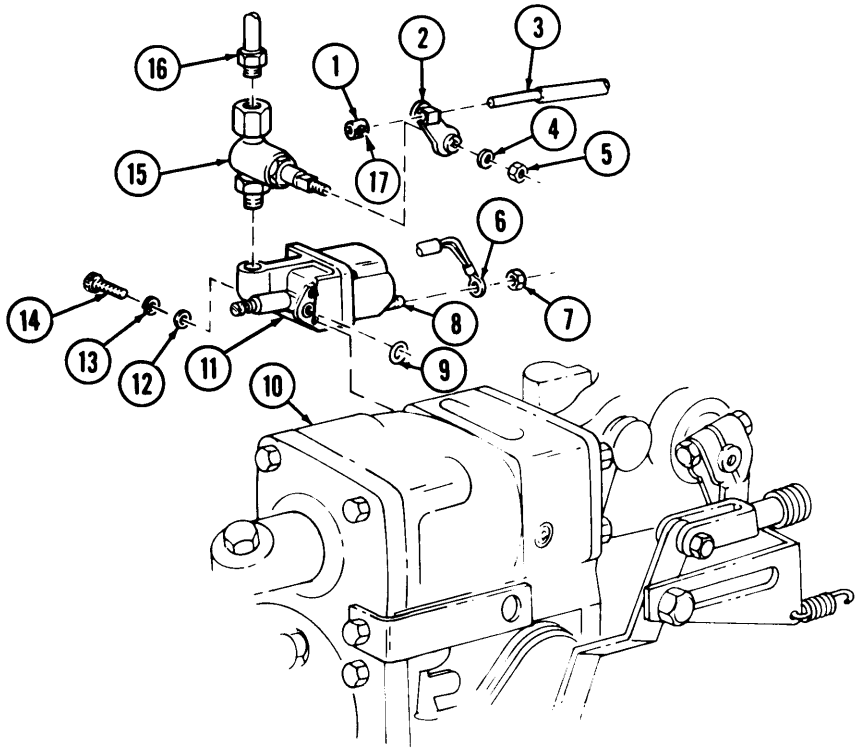


4-6. FUEL PUMP SHUTOFF VALVE (M936) REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Installation

9.		New "O" ring (9) and fuel shutoff valve (11)	Install on fuel pump (10) with two washers (12), new lockwashers (13), and screws (14).	
10.		Manual fuel shutoff valve (15)	Install in fuel shutoff valve (11).	
11.		Shutoff lever (2)	Install on manual fuel shutoff valve (15) with new lockwasher (4) and nut (5).	
12.		Control cable (3) and clip (1)	Install on shutoff lever (2) with screw (17).	Make sure shutoff lever (2) is in forward position.
13.		Wires (6) and nut (7)	Install to terminal (8).	
14.		Fuel line (16)	Connect to manual shutoff valve (15).	



END OF TASK!

FOLLOW-ON TASKS: • Start engine (TM 9-2320-272- 10) and check fuel pump shutoff valve for proper operation.
• Install left splash shield (TM 9-2320-272- 10),

TA 349737

4-7. FUEL PUMP MOUNTING TO HOLDING FIXTURE

This task covers:

Installation

INITIAL SETUP:

Applicable Models

All

Test Equipment

None

Special Tools

Mounting plate 11600040
Ball joint vise 11600028

Materials/Parts

None

Personnel Required

Fuel and electrical systems repairer MOS 63G

Manual References

TM 9-2320-272-34P

Equipment
Condition
Reference

Para. 4-4
Para. 4-5

Condition Description

Fuel pump removed from engine.
Fuel pump shutoff valve removed.

Special Environmental Conditions

None

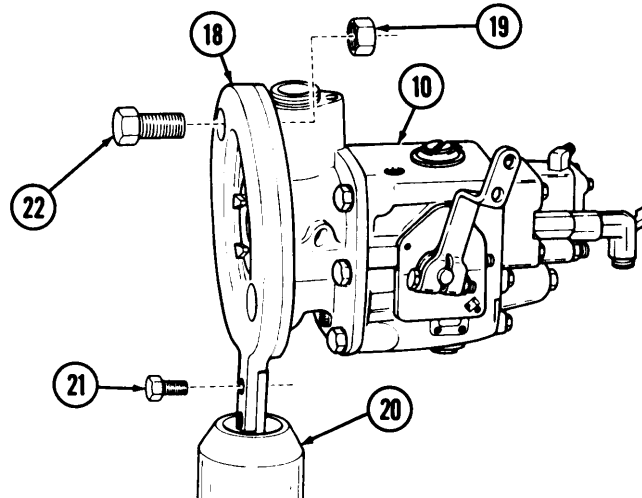
General Safety Instructions

None

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1. Mounting plate (18) Attach to ball-joint vise (20) and install two screws (21).
2. Fuel pump (10) Install with two screws (22) and nuts (19).



END OF TASK!

FOLLOW-ON TASK: Remove pulsation damper (para. 4-8).

TA 349738

4-8. PULSATION DAMPER MAINTENANCE

This task covers:

- a. Removal
- b. Disassembly
- c. Inspection

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-7	Fuel pump mounted to holding fixture.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

- | | | | | |
|----|----------------------|--|---------|--------------------------|
| 1. | Pulsation damper (1) | Two screws (4), lockwashers (3), and washers (2) | Remove. | Discard lockwashers (3). |
| 2. | | Pulsation damper (1) and seal (5) | Remove. | Discard seal (5). |

b. Disassembly

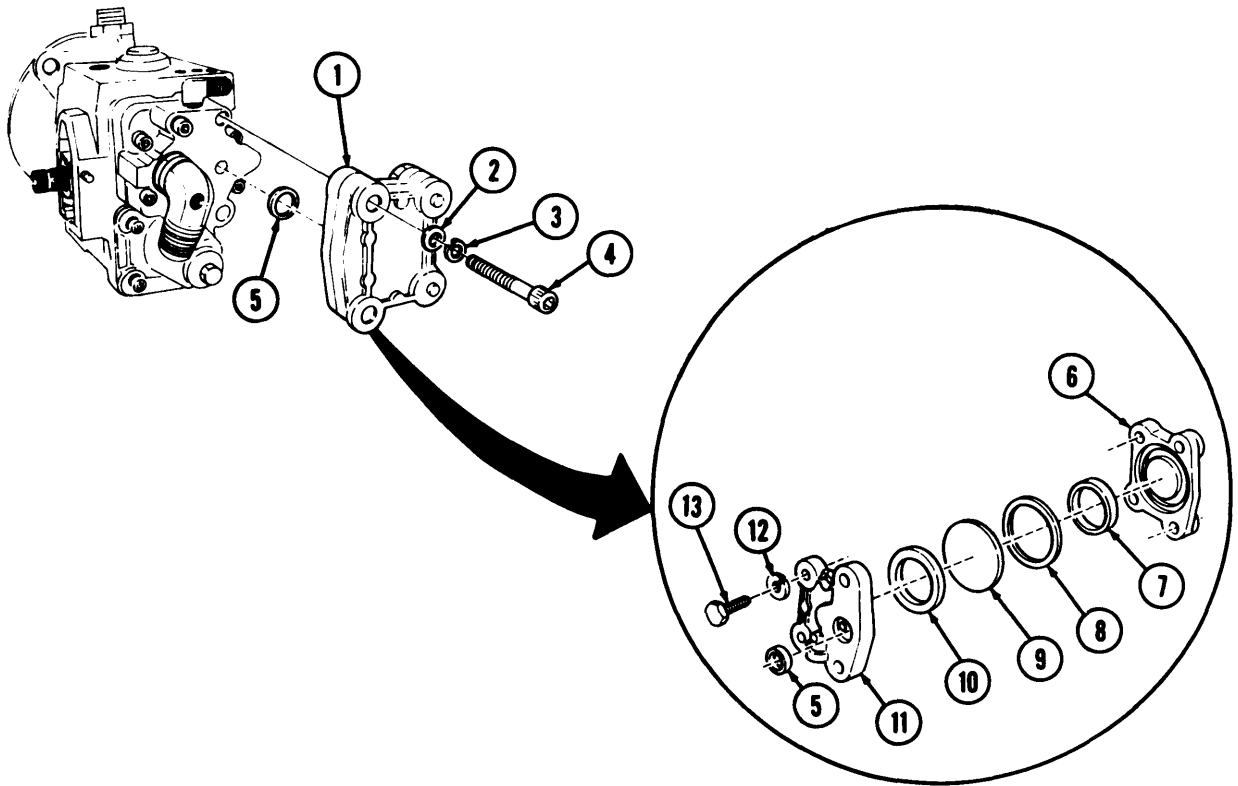
- | | | | | |
|----|----------------------|---|-----------|--|
| 3. | Pulsation damper (1) | Two screws (13) and lockwashers (12) | Remove. | Discard lockwashers (12). |
| 4. | | Body (11) and plate (6) | Separate. | |
| 5. | | Large "O" ring (10), and phragm (9), nylon washer (8), and small "O" ring (7) | Remove. | Discard nylon washer (8) and "O" rings (10) and (7) and diaphragm (9). |

c. Inspection

- | | | | | |
|--|--|-------------------------|-----------------------------------|---------------------------------|
| | | Body (11) and plate (6) | Inspect for corrosion and Cracks. | Replace if corroded or cracked. |
|--|--|-------------------------|-----------------------------------|---------------------------------|

4-8. PULSATION DAMPER MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 349739

4-9. PRESSURE GEAR PUMP REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-8	Pulsation damper removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

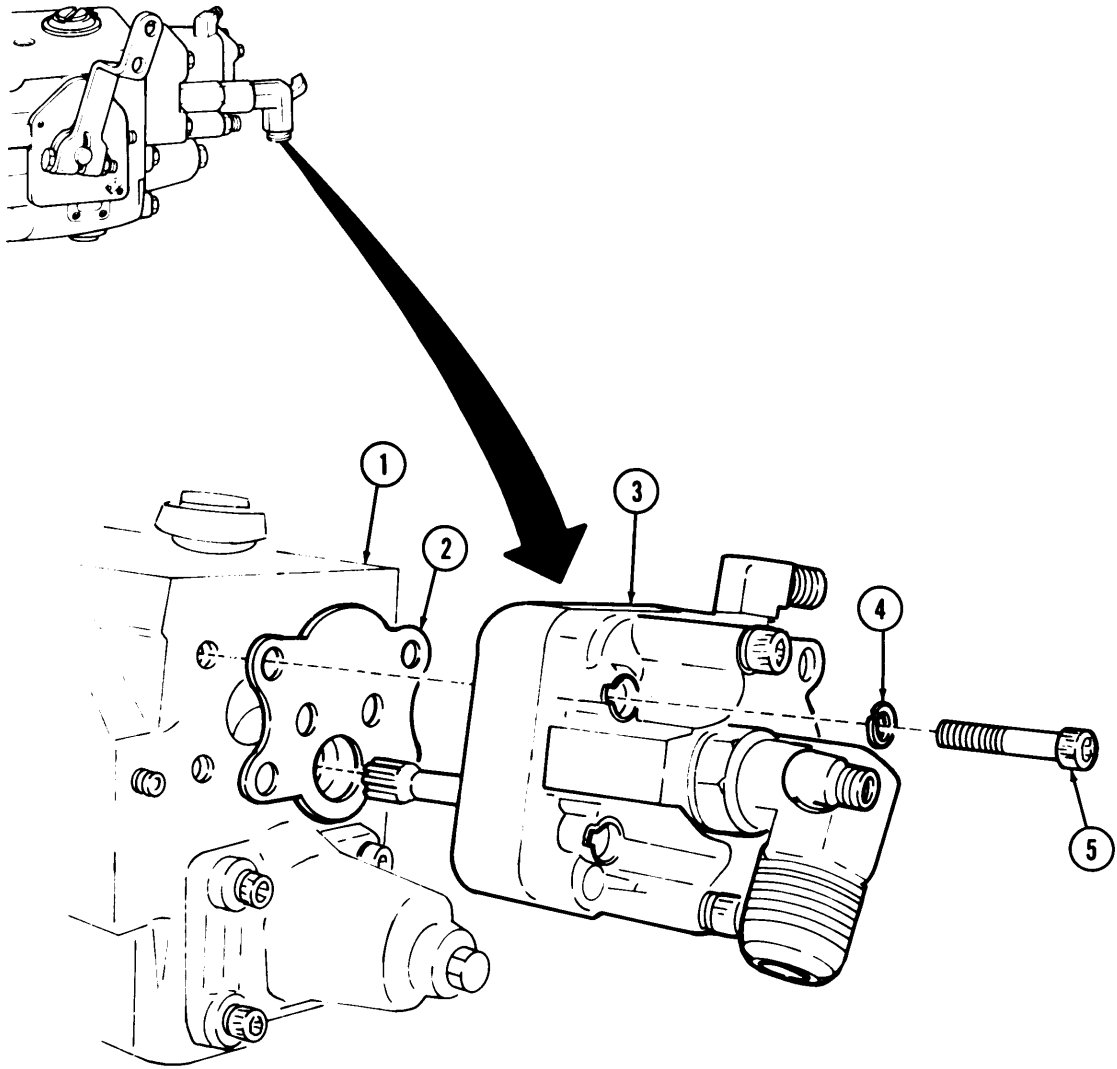
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

1.	Gear pump (3) to fuel pump housing (1)	Four screws (5) and lockwashers (4)	Remove.	Discard lockwashers (4).
2.		Gear pump (3)	Tap lightly and remove.	Use soft-faced hammer.
3.	Gear pump (3)	Gasket (2)	Remove.	Discard gasket (2). Clean gasket remains from mating surfaces.

4-9. PRESSURE GEAR PUMP REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Remove governor spring pack (para. 4-10).

TA 349740

4-10. GOVERNOR SPRING PACK MAINTENANCE

This task covers:

- a. Removal
b. Disassembly

- c. Inspection

INITIAL SETUP:

INITIAL SETUP.

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-9	Pressure gear pump removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM9-2320~272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
----------	----------	------	--------	---------

a. Removal

- | | | | | |
|----|----------------|--|--|--|
| 1. | Fuel pump (16) | Four screws (13), lockwashers (14), and washers (15) | Remove from governor spring pack cover (12). | Discard lockwashers (14). |
| 2. | | Governor spring pack cover (12) and gasket (11) | Remove. | Discard gasket (11).
Clean gasket remains from mating surfaces. |

b. Disassembly

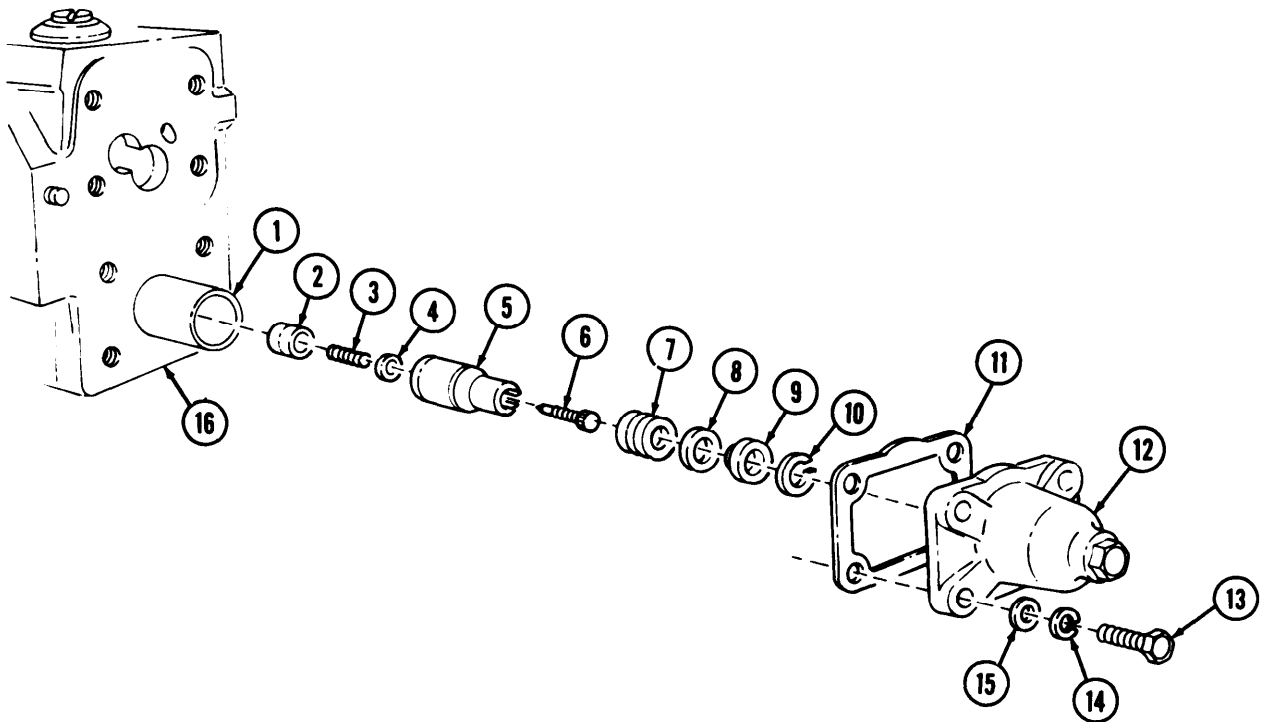
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|----|------------|--|-----------------------------------|--------------------------|
| 3. | Barrel (1) | Adjusting screw (6) | Turn counterclockwise until free. | Do not remove screw (6). |
| 4. | | Snapping (10) | Remove from barrel (1). | Use snapping pliers. |
| 5. | | Retainer (9), shim (8), and high-idle speed spring (7) | Slide out of guide (5). | |
| 6. | | Guide (5) | Remove. | |
| 7. | | Adjusting screw (6) plunger (2), washer (4), and idle speed spring (3) | Remove from guide (5). | |

4-10. GOVERNOR SPRING PACK MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Inspection

8.		Idle speed spring (3)	a. Inspect for broken or distorted coils. b. Inspect spring (3) tension with spring tester compressed to 1.0 in. (25.4 mm).	Free length is 1.025 to 1.050 in. (26.0-26.6 mm). Discard spring (3) if load is not within 0.69-0.85 lbs (.31-.54 kg).
9.		High-idle speed spring (7)	a. Inspect for broken or distorted coils. b. Inspect spring (7) tension with spring tester compressed to 1.025 (26.0 mm).	Free length is 1.405-1.430 in. (35.6-36.3 mm). Discard spring (7) if load is not within 16.02 -17.78 lbs (7.27-8.07 kg).



END OF TASK!

FOLLOW-ON TASK: Disassemble fuel pump housing (para. 4-11).

TA 349741

4-11. FUEL PUMP HOUSING DISASSEMBLY

This task covers:

a. Disassembly

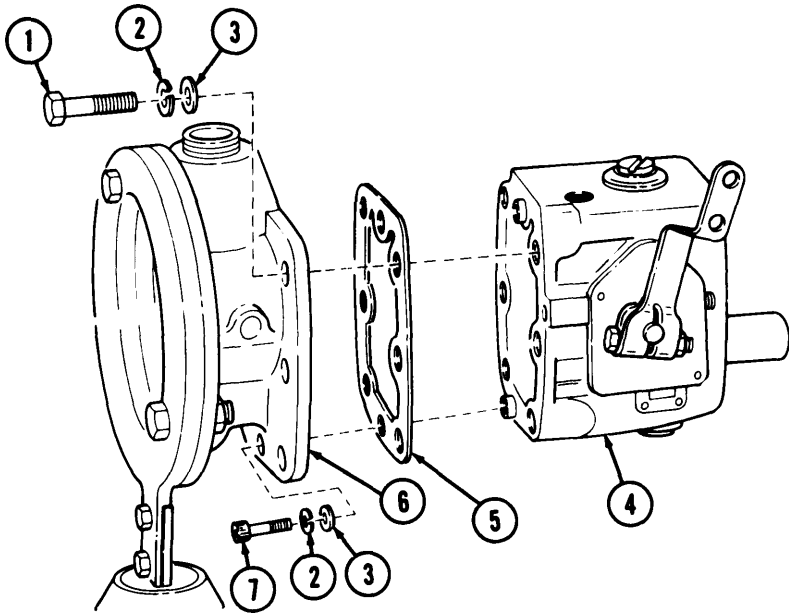
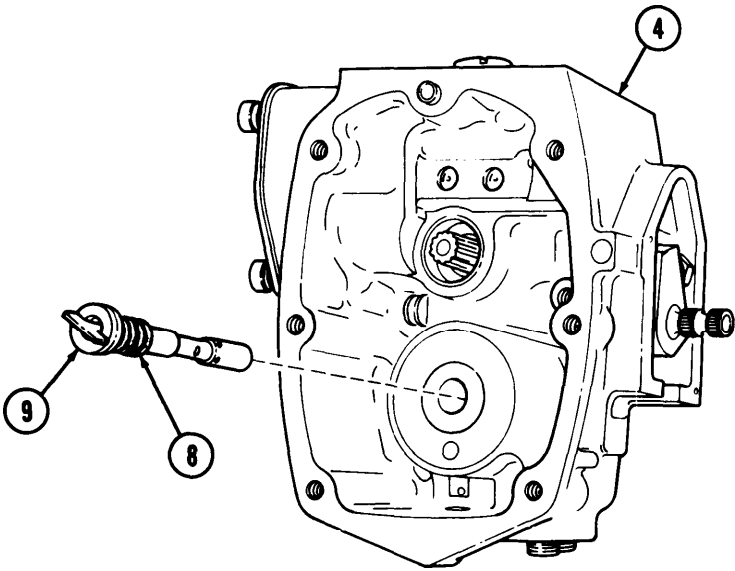
b. Inspection

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-10	Governor spring pack removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
a. Disassembly				
1.	Front drive cover (6) to fuel pump housing (4)	Screw (7), six screws (1), and seven lockwashers (2) and washers (3)	Remove,	Discard lockwashers (2). Tap edge lightly with soft-faced hammer to loosen.
2.	Front drive cover (6)	Fuel pump housing (4)	Remove.	Pull fuel pump housing (4) straight out to clear dowels.
3.		Gasket (5)	Remove.	Discard gasket (5). Clean gasket remains from mating surfaces.
4.	Fuel pump housing (4)	Governor plunger (9) and torque spring (8)	Remove.	
NOTE Do not use straight pull on governor plunger torque spring. To remove twist spring off shoulder.				
5.	Governor plunger (9)	Torque spring (8)	Remove.	
b. Inspection				
6.		Governor plunger (9)	Inspect for scoring, nicks, and scratches.	Replace if scored, nicked, or scratched.
7.		Torque spring (8)	Inspect for broken coils.	Replace if spring (8) coils are broken.

4-11. FUEL PUMP HOUSING DISASSEMBLY (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

END OF TASK!

FOLLOW-ON TASK: Disassemble throttle cover and shaft (para. 4-12).

TA 349742

4-12. THROTTLE COVER AND SHAFT DISASSEMBLY

This task covers:

a. Disassembly

b. Inspection

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-11	Fuel pump housing disassembled.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Disassembly

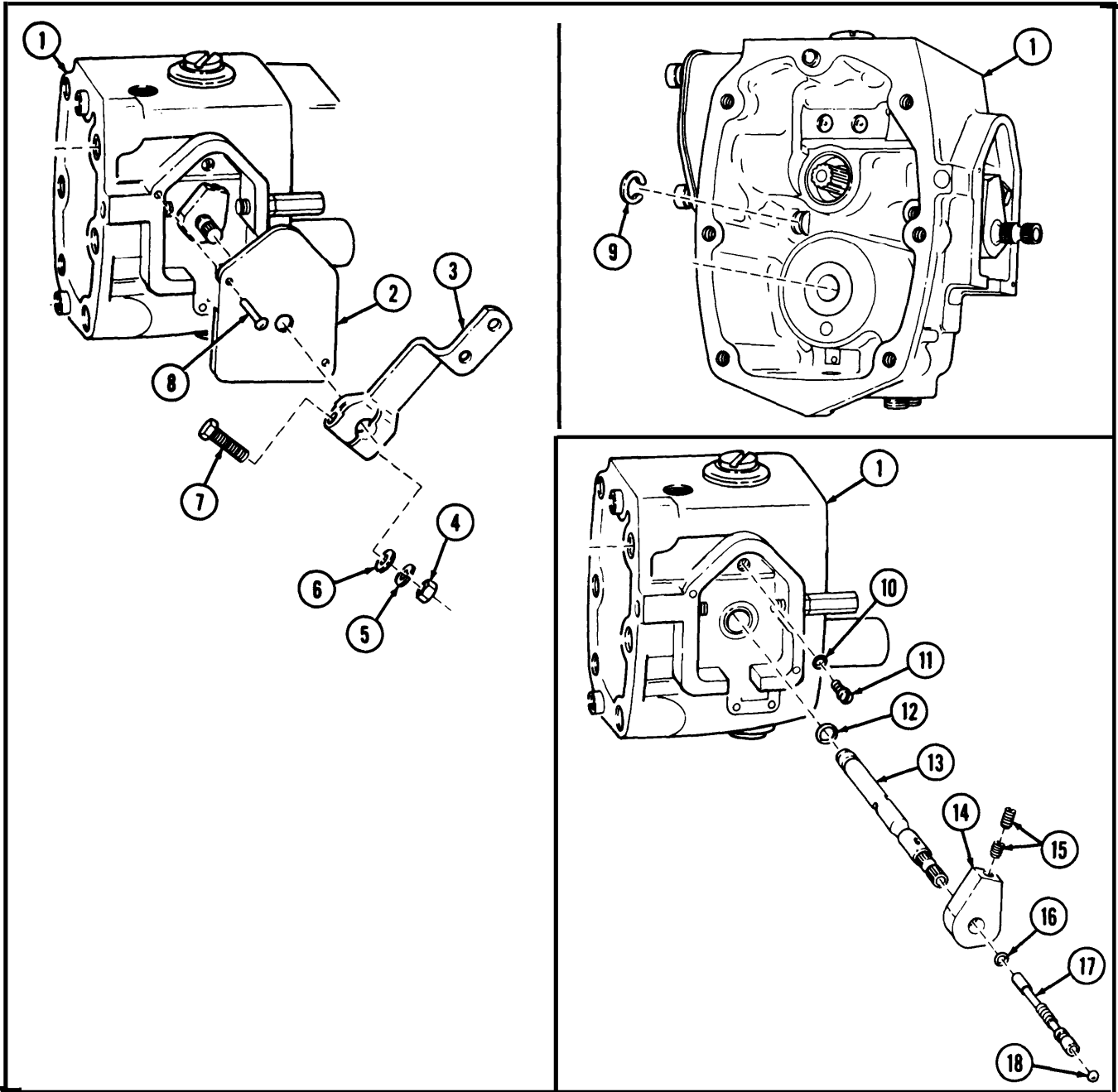
1.	Fuel pump housing (1)	Throttle shaft cover (2)	a. Center punch each of the two drive pins (8). b. Drill out two drive pins (8). c. Remove nut (4), lockwasher (5), washer (6), screw (7), and throttle lever (3). d. Remove throttle cover (2).	Discard drive pins (8). Discard lockwasher (5).
2.	Fuel pump housing (1)	Retaining ring (9) and throttle shaft (13)	Remove.	
3.	Throttle shaft (13)	Soft ball bearing (18)	Drill and remove.	Discard soft ball bearing (18).
4.		Two set screws (15) and throttle stop control (14)	Remove.	
5.		"O" rings (12) and (16)	Remove.	Discard "O" rings (12) and (16).
6.		Fuel adjust screw (17)	Remove.	
7.		Valve plug (11) and "O" ring (10)	Remove.	Discard "O" ring (10).

4-12. THROTTLE COVER AND SHAFT DISASSEMBLY (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Inspection

8.		Throttle shaft (13)	Inspect for scoring, nicks and scratches.	Replace if scored, nicked or scratched.
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END OF TASK!

FOLLOW-ON TASK: Remove governor weight (para. 4- 13).

TA 349743

4-13. GOVERNOR WEIGHT REMOVAL

This task covers:

a. Removal

b. Inspection

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-12	Throttle cover and shaft disassembled .
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

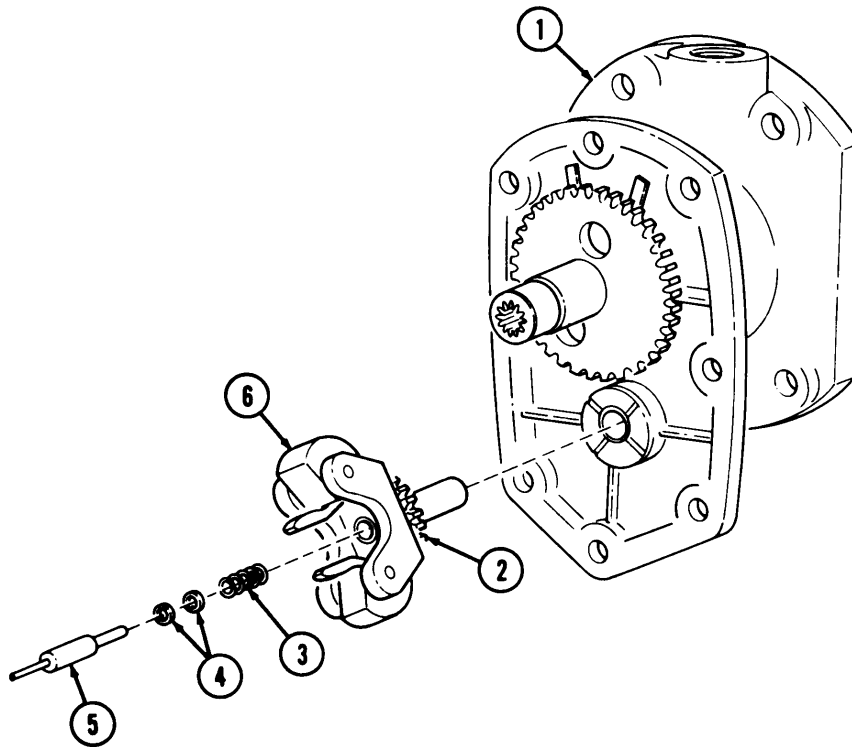
- | | | | |
|----|-----------------------|--|---------|
| 1. | Front drive cover (1) | Governor weight (6) and gear (2) | Remove. |
| 2. | Governor weight (6) | Weight assist plunger (5), spring (3), and shims (4) | Remove. |

b. Inspection

- | | | | | |
|----|---------------------------|--------------------------|---|---|
| 3. | Weight assist plunger (5) | Spring (3) | Inspect for bent or broken coils. | Replace if bent or broken. |
| 4. | | Governor weight (6) | Place in front drive cover (1). | |
| 5. | | Governor weight gear (2) | Inspect for cracked, broken, or pitted teeth. | If cracked, broken, or pitted, replace governor weight (6). |

4-13. GOVERNOR WEIGHT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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**END OF TASK!****FOLLOW-ON TASK:** Disassemble front drive cover (para. 4-14).

TA 349744

4-14. FRONT DRIVE COVER DISASSEMBLY

This task covers:

a. Disassembly

b. Inspection

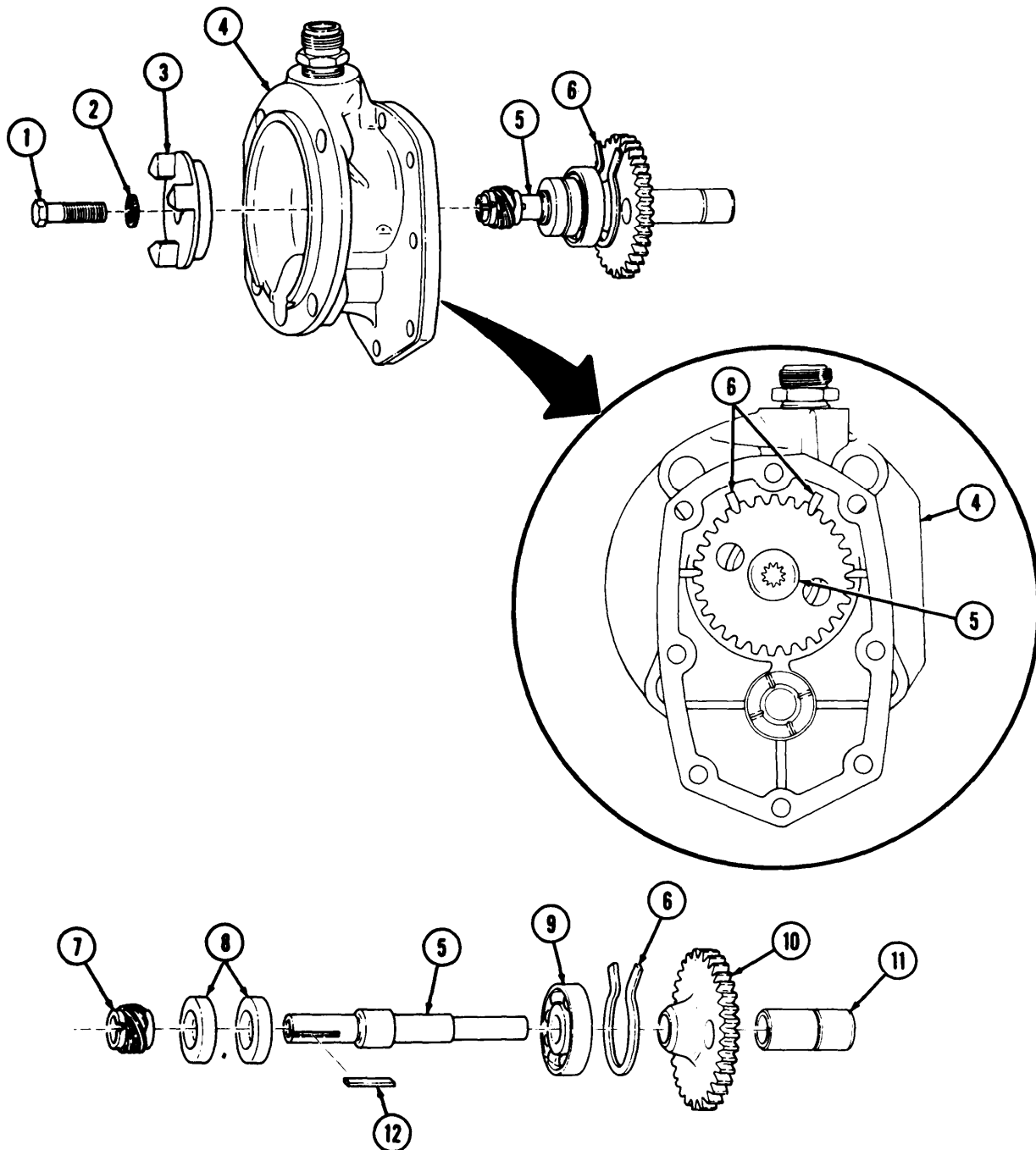
INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-13 Para. 4-24	Governor weight removed. Fuel pump removed from holding fixture.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
a. Disassembly				
1.	Front cover (4)	Screw (1), lockwasher (2), and drive coupling (3)	Remove.	Discard lockwasher (2).
2.	Front drive cover (4)	Retaining ring (6)	Remove from groove.	
3.		Shaft (5)	a. Press through front drive cover (4). b. Press out of rear drive coupling (11) and gear (10).	Use arbor press. Use arbor press.
4.	Shaft (5)	Retaining ring (6)	Remove.	
5.		Bearing (9)	Remove.	Use arbor press. Discard bearing (9).
6.		Tachometer drive gear (7)	Remove.	Use arbor press.
7.		Two seals (8) and key (12)	Remove.	Discard seals (8) and key (12).
b. Inspection				
8.		Drive gear (7) and gear (10)	Inspect for cracks, pitting, or chipped teeth.	Replace if teeth are cracked, chipped, or pitted.
9.		Shaft (5)	Inspect for scoring or scratches.	Replace if scored or scratched.

4-14. FRONT DRIVE COVER DISASSEMBLY (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Remove and disassemble tachometer drive (para. 4- 15).

TA 349745

4-15. TACHOMETER DRIVE DISASSEMBLY

This task covers:

- a. Removal
- b. Disassembly

- c. Inspection
- d. Reassembly

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-14	Front drive cover disassembled.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Tachometer drive remover ST 1032		None
<u>Materials/Parts</u>		
Bushings Two seals		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
----------	----------	------	--------	---------

a. Removal

- | | | | | |
|----|-----------------------|--|---------|-------------------------------|
| 1. | Front drive cover (7) | Drive adapter (1) | Remove. | |
| 2. | | Tachometer shaft (4), gear (6), bushing (5), and seals (2) and (3) | Remove. | Use tachometer drive remover. |

b. Disassembly

- | | | | | |
|----|----------------------|--|---------|--|
| 3. | Tachometer shaft (4) | Gear (6), bushing (5), and seals (2) and (3) | Remove. | Use arbor press.
Discard bushing (5) and seals (2) and (3). |
|----|----------------------|--|---------|--|

c. Inspection

- | | | | | |
|----|--|------------------------|--|---|
| 4. | | Gear (6) and shaft (4) | Inspect for scratches, chips or scoring. | If scratched, chipped or scored, discard. |
|----|--|------------------------|--|---|

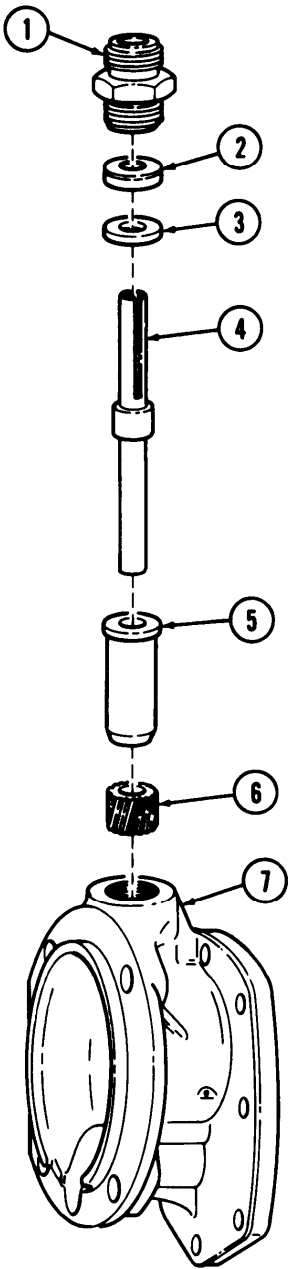
d. Reassembly

- | | | | | |
|----|--|---|-----------------------|---|
| 5. | | Gear (6), new bushing (5), new seals (3) and (2). | Install on shaft (4). | Use arbor press.
Maximum clearance between gear (6) and bushing (5) is 0.005 in. (.13 mm). |
|----|--|---|-----------------------|---|

4-15. TACHOMETER DRIVE DISASSEMBLY (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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6.
- Tachometer shaft (4)
and adapter (1)
- Install in front drive
cover (7).



Section III. FUEL PUMP REASSEMBLY

4-16. FUEL PUMP REASSEMBLY TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
4-17.	Front Drive Cover Reassembly	4-36
4-18.	Governor Weight Installation	4-40
4-19.	Throttle Shaft and Cover Installation	4-42
4-20	Fuel Pump Housing Installation	4-46
4-21.	Governor Spring Pack Installation	4-48
4-22.	Pressure Gear Pump Installation	4-50
4-23.	Pulsation Damper Installation	4-52
4-24.	Fuel Pump Removal From Holding Fixture	4-64
4-25.	Fuel Pump Setup and Calibration	4-56

4-17. FRONT DRIVE COVER REASSEMBLY

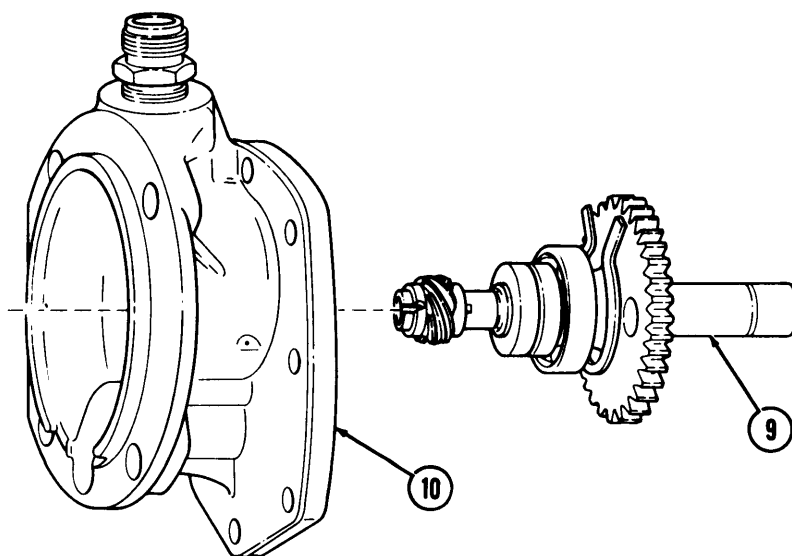
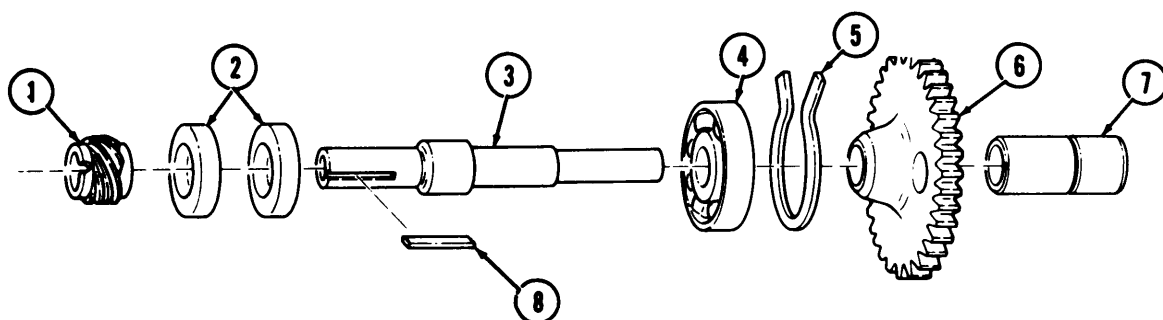
This task covers:

Reassembly**INITIAL SETUP:**

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-14	Front drive cover disassembled.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Lockwasher		
Two seals		
Bearing		
Key		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

4-17. FRONT DRIVE COVER REASSEMBLY (Cont'd)

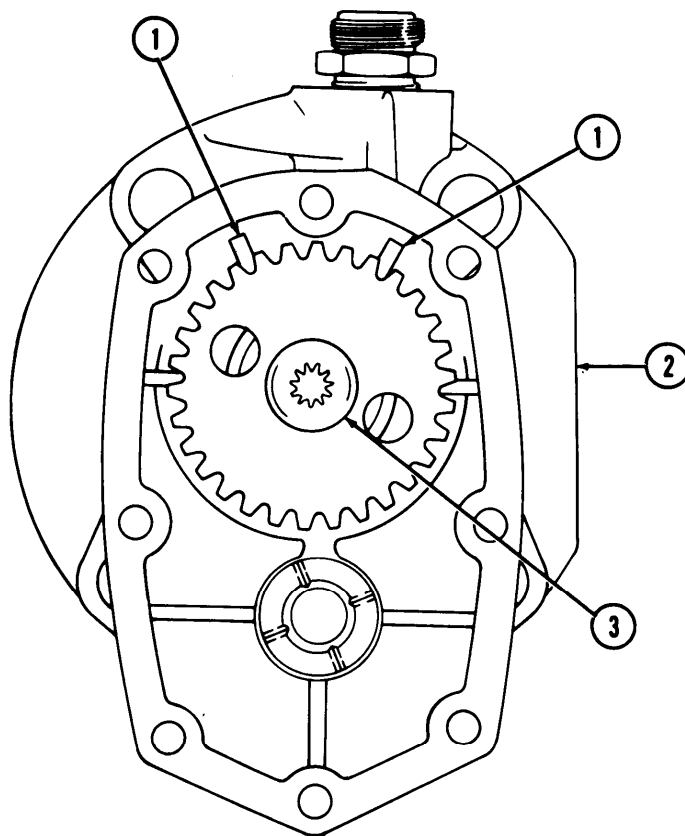
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
Reassembly				
1.		Two new seals (2) and new key (8)	Install on shaft (3).	
2.		Tachometer drive gear (1)	Press on shaft (3) over new key (8).	Use arbor press.
3.		New bearing (4), rear drive coupling (7), and gear (6)	Press on shaft (3).	Use arbor press.
4.		Retaining ring (5)	Install on shaft (3).	
5.		Shaft assembly (9)	Press in front drive cover (10).	Use arbor press.



TA 349790

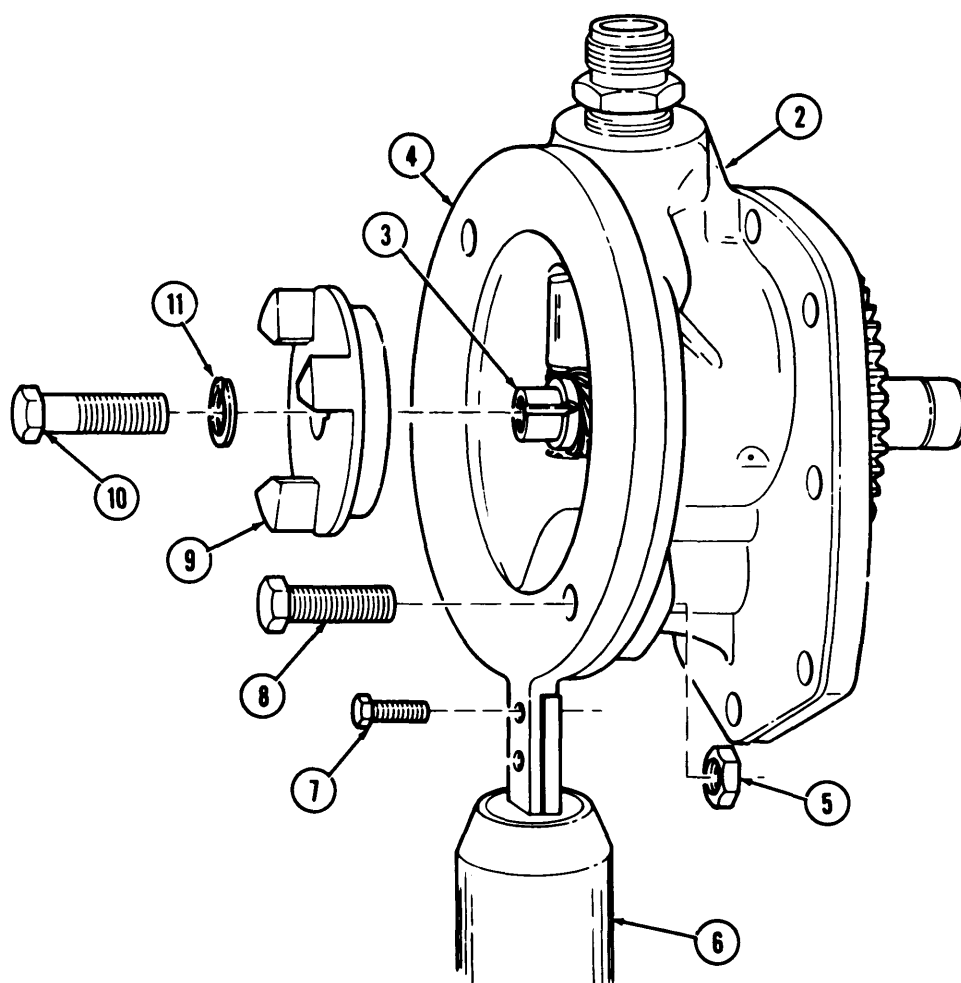
4-17. FRONT DRIVE COVER REASSEMBLY (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
6.		Retaining ring (1)	Install in groove in front cover (2).	
7.		Drive coupling (9), new lockwasher (11), and screw (10)	Install on shaft assembly (3).	
8.		Mounting plate (4)	Install on ball joint vise (6) with two screws (7).	
9.		Front cover (2)	Install on mounting plate (4) with two screws (8) and nuts (5).	



4-17. FRONT DRIVE COVER REASSEMBLY (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install governor weight (para. 4-18).

TA 349792

4-18. GOVERNOR WEIGHT INSTALLATION

This task covers

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-17	Front drive cover reassembled.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
None	None	
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Fuel and electrical systems repairer MOS 63G	None	
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

- | | | |
|----|--|-----------------------------------|
| 1. | Governor weight gear (2) and governor weight (6) | Install on front drive cover (1). |
|----|--|-----------------------------------|

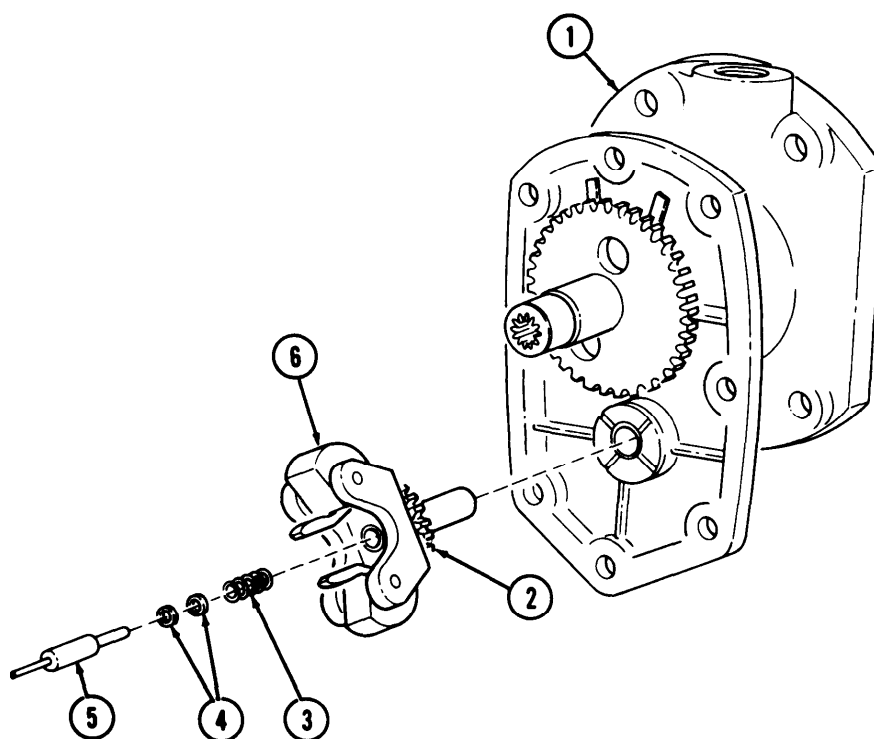
NOTE

Large end of assist plunger is installed first.

- | | | |
|----|--|---------------------------------|
| 2. | Shims (4), spring (3), and weight assist plunger (5) | Install in governor weight (6). |
|----|--|---------------------------------|

4-18. GOVERNOR WEIGHT INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install throttle shaft (para. 4-19).

TA 349793

4-19. THROTTLE SHAFT AND COVER INSTALLATION

This task covers:

a. Throttle Shaft Installation

b. Throttle Cover Installation

INITIAL SETUP:

APPLICABLE SEVERITY		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-18	Governor weight installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Two drive pins		
Three "O" rings		
Lockwasher		
Throttle shaft ball		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

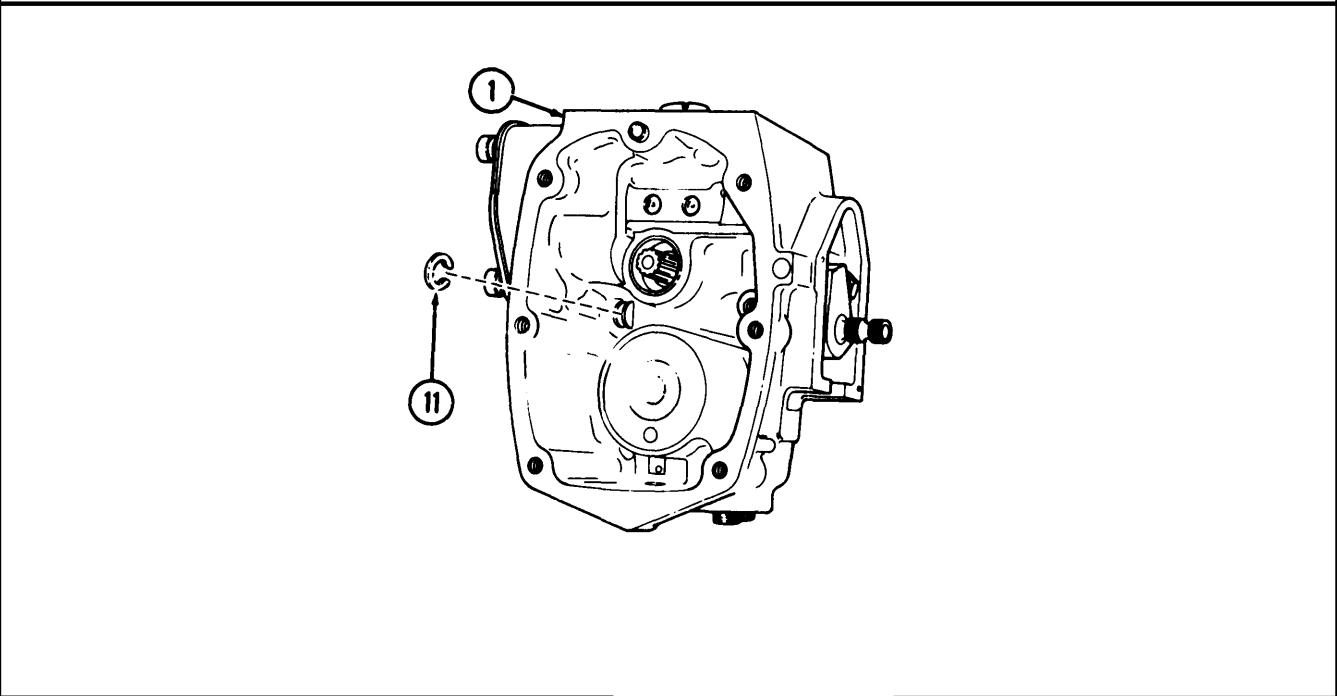
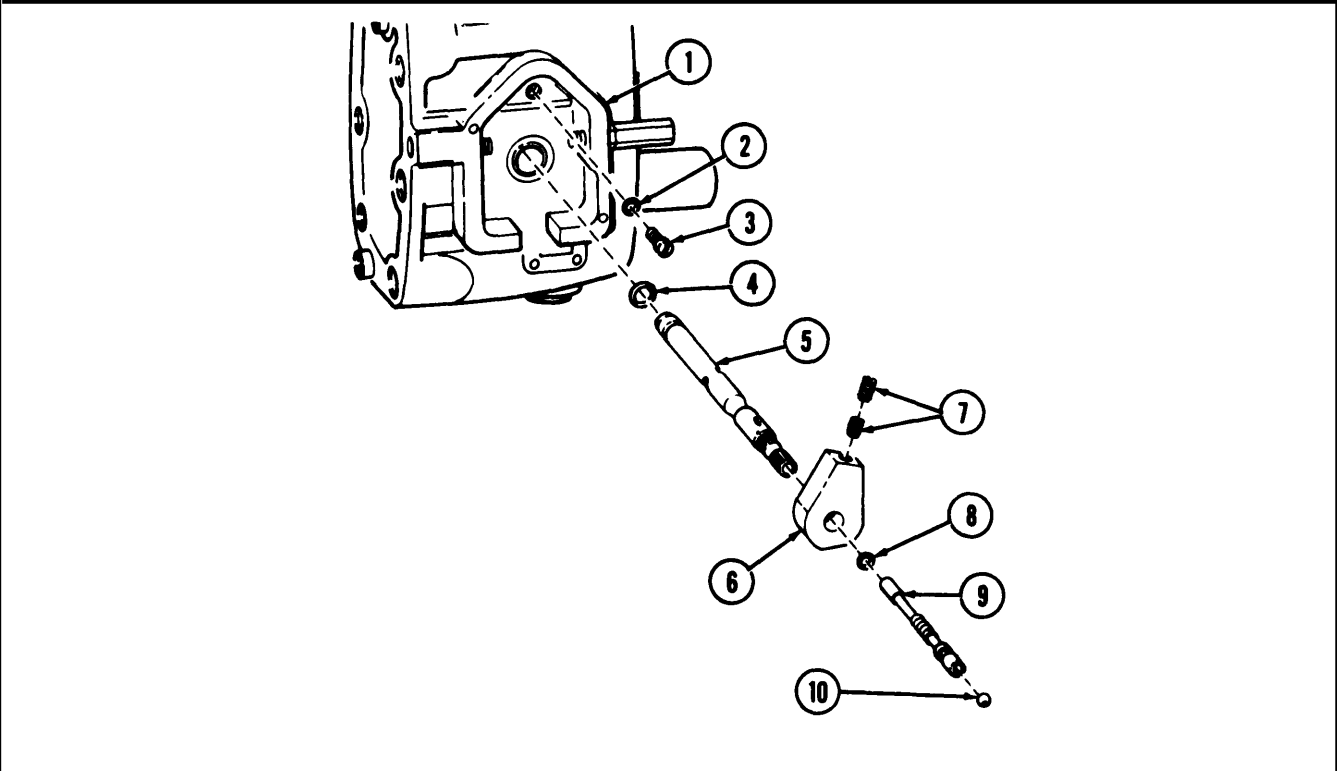
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Throttle Shaft Installation

- | | | |
|----|---|--|
| 1. | Valve plug (3) and new "O" ring (2) | Install in fuel pump housing (1). |
| 2. | Fuel adjusting screw (9) | Install in throttle shaft (5). |
| 3. | New "O" rings (4) and (8) | Install on throttle shaft (5). |
| 4. | Throttle stop control (6) and two setscrews (7) | Install on throttle shaft (5). |
| 5. | New throttle shaft ball (10) | Install in end of throttle shaft (5). |
| 6. | Throttle shaft (5) | Install in fuel pump housing (1) with retaining ring (11). |

4-19. THROTTLE SHAFT AND COVER INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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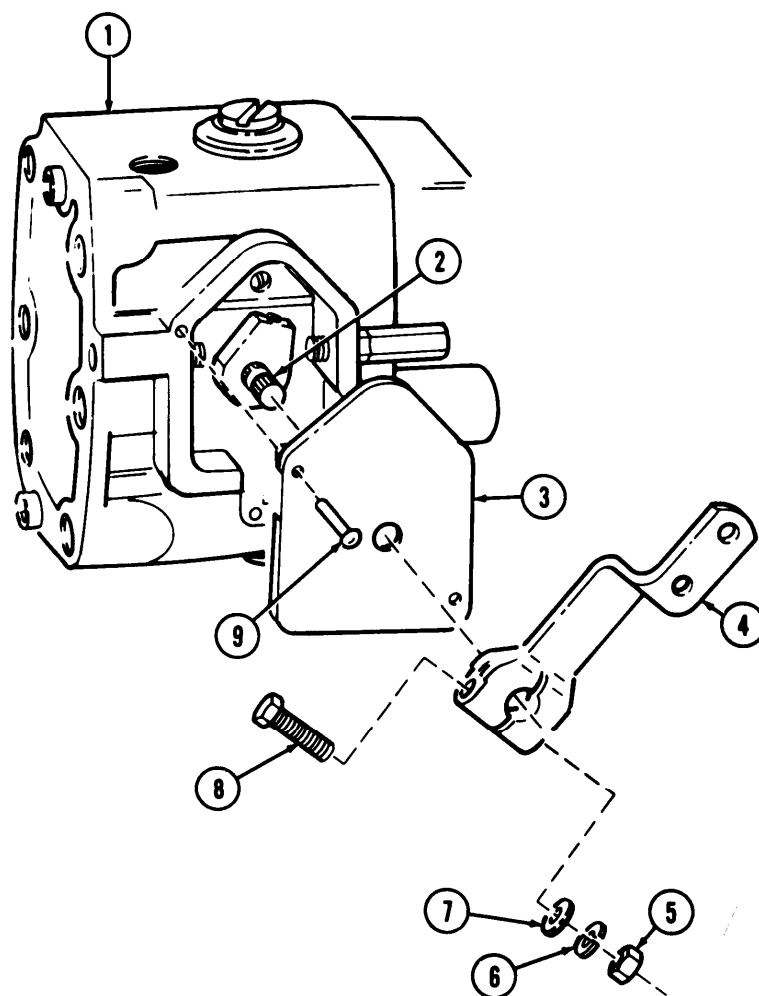


4-19. THROTTLE SHAFT AND COVER INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Throttle Cover Installation				
<p style="text-align: center;">NOTE</p> <p>Do not install throttle shaft cover until fuel pump has been calibrated.</p>				
7.		Throttle shaft cover (3)	a. Install with two new drive pins (9).	Gently tap new pins (9) through cover (3) into holes.
<p style="text-align: center;">NOTE</p> <p>Do not perform steps 7b through 7e unless pin holes are damaged beyond use.</p>				
<p style="text-align: center;">CAUTION</p> <p>Use care when drilling new holes for drive pins. The pump housing is made of cast aluminum and is easily damaged. Do not allow metal particles to enter pump housing.</p>				
			b. Position throttle shaft cover (3) on housing (1).	
			c. Center punch location of new holes on throttle shaft cover (3).	Holes should be opposite one another.
			d. Use care and drill through throttle shaft cover (3) and into throttle shaft cover flange with 1/16 in. drill bit NO MORE than 1/4 in, (6 mm).	
			e. Install with two new pins (9).	Gently tap new pins (9) through cover (3) into holes.
8.		Throttle lever (4)	Install on throttle shaft (2) with screw (8), washer (7), new lockwasher (6), and nut (5).	

4-19. THROTTLE SHAFT AND COVER INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install fuel pump housing (para, 4-20).

TA 349795

4-20. FUEL PUMP HOUSING INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-19	Throttle shaft installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Seven lockwashers Gasket		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

NOTE

Parts must be submerged in diesel fuel and hands wet with diesel fuel before steps 1 and 2 to prevent damage to close tolerance parts.

- | | | |
|----|--|--|
| 1. | Torque spring (2) | Install on governor plunger (3). |
| 2. | Governor plunger (3) | Install in fuel pump housing (1). |
| 3. | New gasket (7) and fuel pump housing (1) | Install on front cover (8) with seven washers (6) and new lock-washers (5), six screws (4), and screw (9). |

4-20. FUEL PUMP HOUSING INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS

END OF TASK!

FOLLOW-ON TASK: Install governor spring pack (para. 4-21).

4-21. GOVERNOR SPRING PACK INSTALLATION

This task covers:		
a. Reassembly	b. Installation	
<hr/>		
INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-20	Fuel pump housing installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Four lockwashers Gasket		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Reassembly

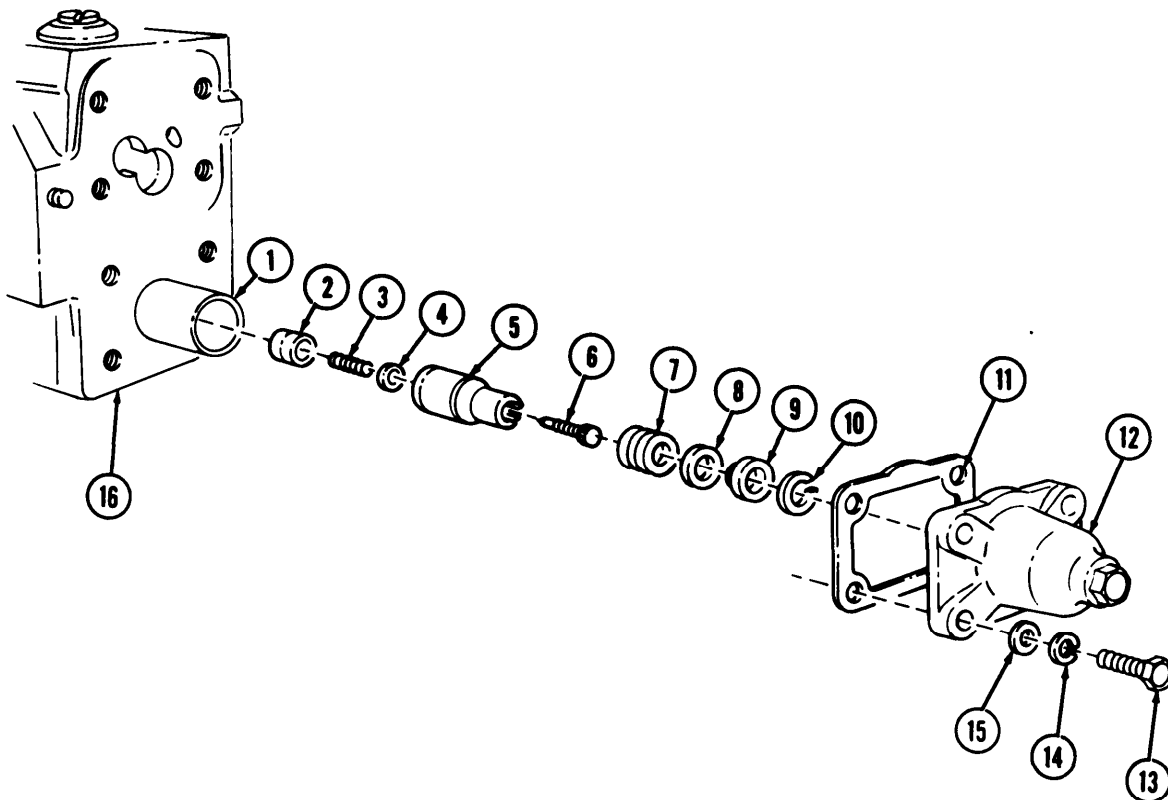
NOTE				
Parts must be submerged in diesel fuel and hands wet with diesel fuel before reassembly to prevent damage to close tolerance parts.				
1.		Adjusting screw (6)	Screw into guide (5).	
2.		Washer (4)	Place over adjusting screw (6) in guide (5).	
3.		Idle spring (3)	Slide in guide (5) over adjusting screw (6).	
4.		Plunger (2)	Place in guide (5) against idle spring (3).	
5.		High-speed spring (7), shim (8), and retainer (9)	Slide in guide (5).	The final number of shims is determined by calibration (para. 4-25),

b. Installation

6.		Guide (5)	Install in barrel (1), with snapping (10).	
7.		Adjusting screw (6)	Turn clockwise by hand until contact is made with seat.	Final adjustment is made by calibration (para. 4-25).

4-21. GOVERNOR SPRING PACK INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
8.		New gasket (11) and governor spring pack cover (12)	Install on fuel pump (16) with four washers (15), new lockwashers (14), and screws (13).	



END OF TASK!

FOLLOW-ON TASK: Install pressure gear pump (para. 4-22).

TA 349797

4-22. PRESSURE GEAR PUMP INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-21	Governor spring pack installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Gasket Four lockwashers		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

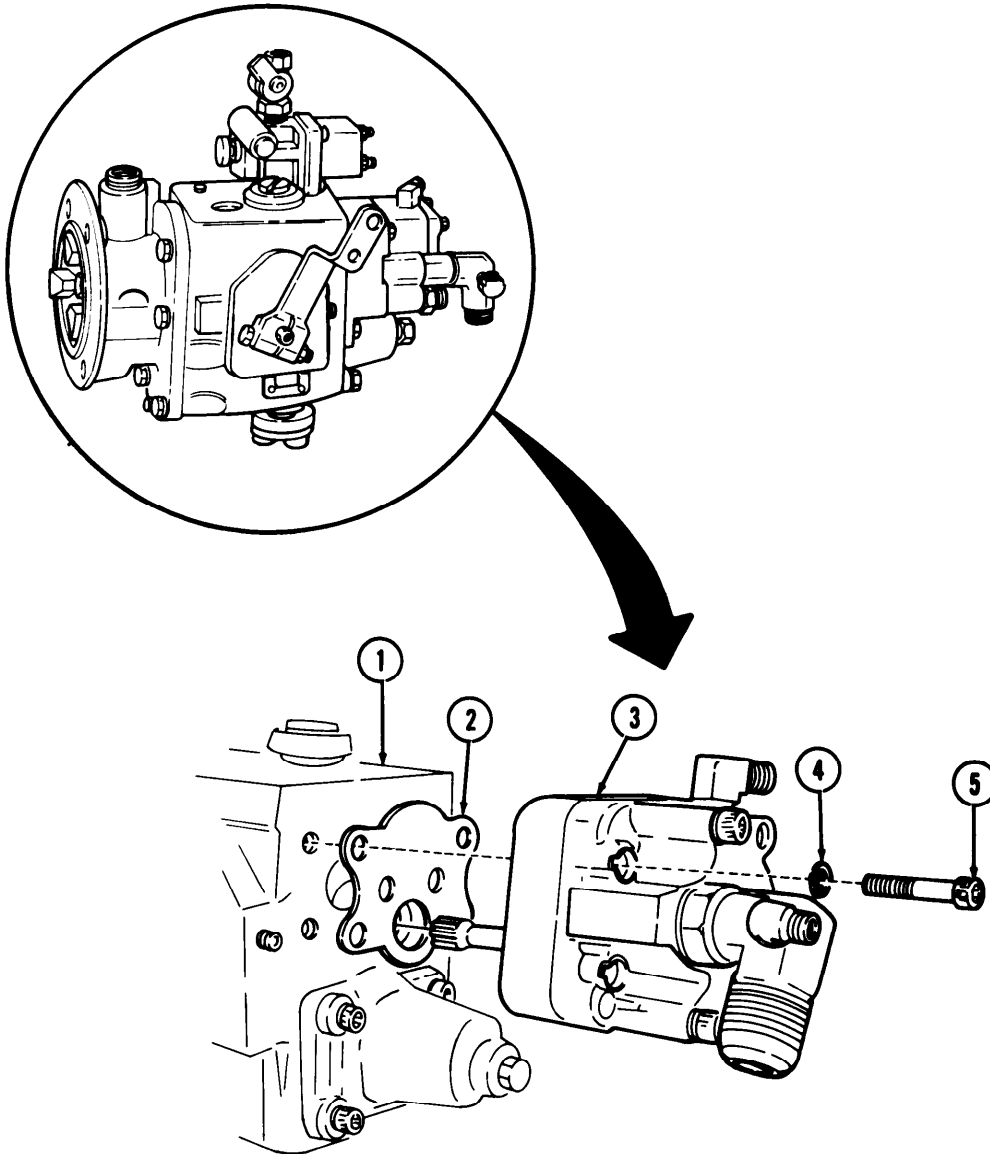
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

- | | | |
|----|----------------|---|
| 1. | New gasket (2) | Position on gear pump (3). |
| 2. | Gear pump (3) | a. Position on pump housing (1), and aline holes. |
- NOTE**
- Make sure gasket is in correct position and pump housing fuel holes aline with gear pump fuel holes.
- | | |
|---|----------------------------------|
| b. Install with four new lockwashers (4) and Allen-head screws (5). | Tighten 11-13 lb-ft (15-18 N-m). |
|---|----------------------------------|

4-22. PRESSURE GEAR PUMP INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install pulsation damper (para. 4-23).

TA 349798

4-23. PULSATION DAMPER INSTALLATION

This task covers:

- a. Assembly
- b. Installation

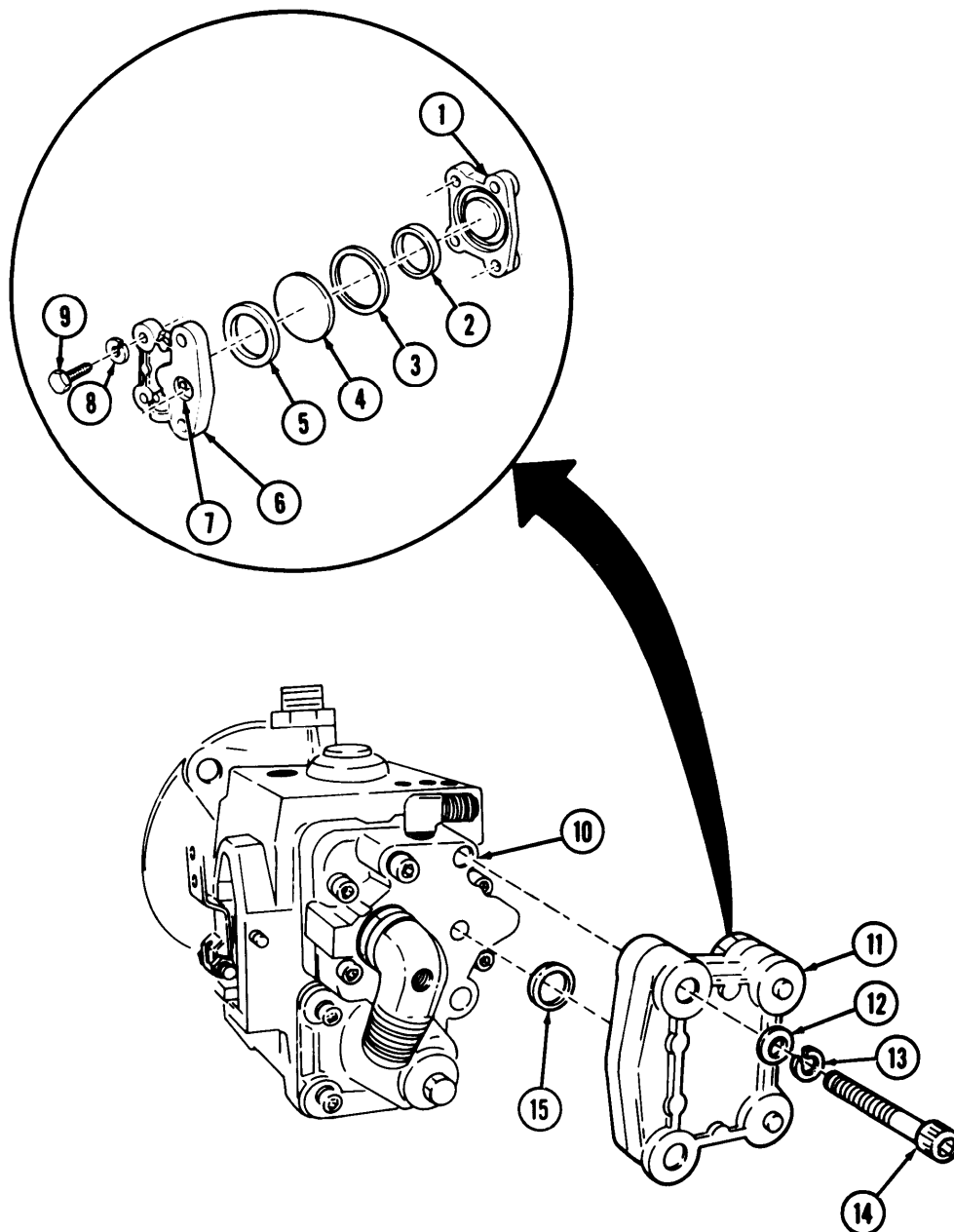
INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-22	Pressure gear pump installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
None	None	
<u>Materials/Parts</u>		
Four lockwashers		
Seal		
Two "O" rings		
Nylon washer		
Diaphragm		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Fuel and electrical systems repairer MOS 63G	None	
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
a. Assembly				
1.		New large "O" ring (5)	Place in body (6) groove.	
2.		New diaphragm (4) new small "O ring (2), and new nylon washer (3)	Install in plate (1) grooves,	
3.		Plate (1)	a. Position on body (6), and aline holes. b. Install with two new lockwashers (8) and screws (9).	Make sure diaphragm (4), "O" ring (2), and nylon washer (3) fit properly in plate (1) grooves. Tighten 11-13 lb-ft (15-18 N-m).
b. Installation				
4.		New seal (15)	Place in exterior body recess (7).	
5.		Pulsation damper assembly (11)	Install to gear pump (10) with two washers (12), new lockwashers (13), and Allen-head screws (14).	Tighten 11-13 lb-ft (15-18 N-m).

4-23. PULSATION DAMPER INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Remove fuel pump from holding fixture (para. 4-24).

TA 349799

4-24. FUEL PUMP REMOVAL FROM HOLDING FIXTURE

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-23	Pulsation damper installed. Fuel pump assembled.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
TM 9-2320-272-34P		

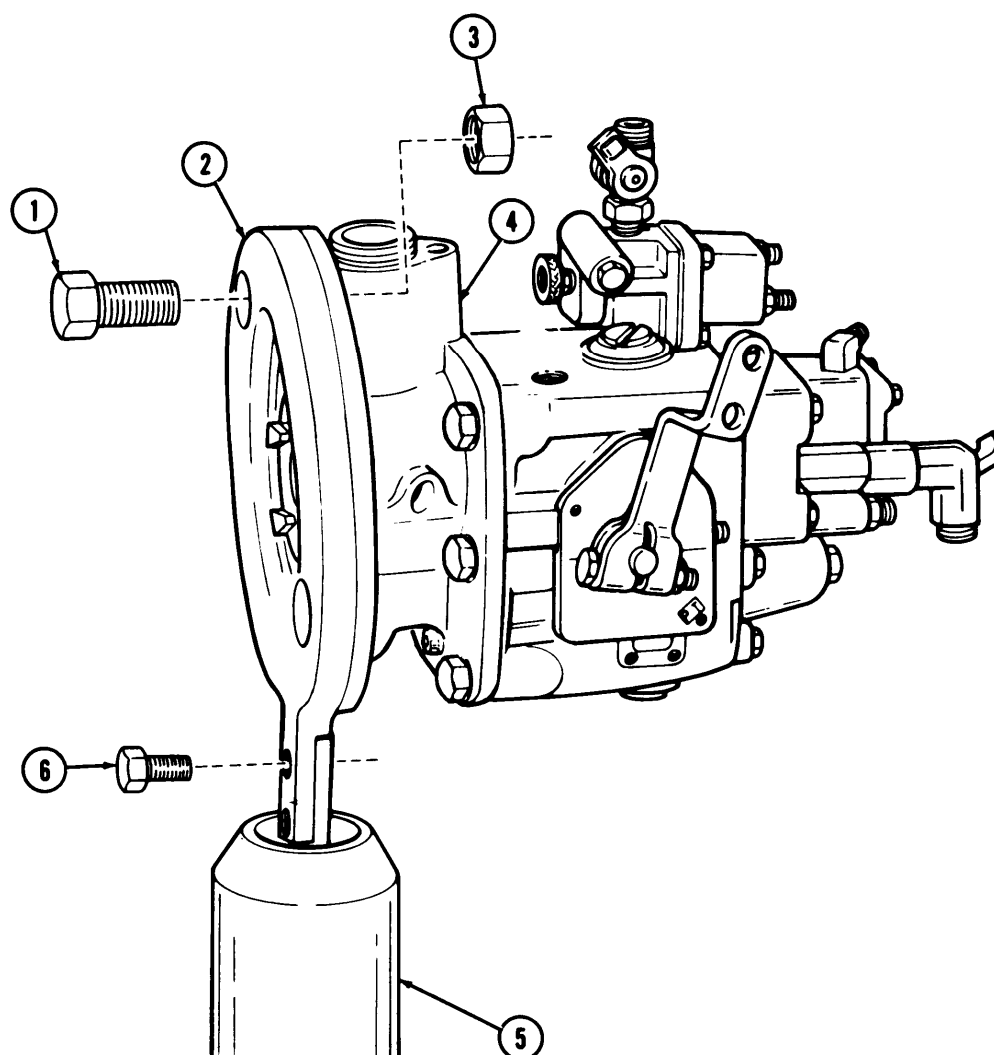
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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R e m o v a l

- | | | | |
|----|---------------------|---|---------|
| 1. | Ball joint vise (5) | Front drive cover mounting plate (2) and two screws (6) | Remove. |
| 2. | Front cover (4) | Mounting plate (2), two screws (1) and nuts (3) | Remove. |

4-24. FUEL PUMP REMOVAL FROM HOLDING FIXTURE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS ŽSet up and calibrate fuel pump (para. 4-25).
• Install fuel pump shutoff valve (para. 4-5).

TA 349800

4-25. FUEL PUMP SETUP AND CALIBRATION

This task covers:

- | | |
|---|--|
| <ul style="list-style-type: none"> a. Throttle Shaft Cover Removal b. Mounting Pump to Test Stand c. Fuel Pump Run-in d. Testing Pump Seals for Leaks e. Testing Governor Cutoff RPM f. Testing and Adjusting Throttle Leakage g. Testing and Adjusting Idle Speed | <ul style="list-style-type: none"> h. Checking and Adjusting Throttle Lever Travel i. Testing and Adjusting Pump Main Pressure j. Testing and Adjusting Fuel Pressure k. Testing and Adjusting Governor Fuel Pressure l. Checking and Adjusting Governor Weight Pressure m. Testing and Adjusting Idle Speed (VS Governor Only) n. Shutdown and Removal from Test Stand |
|---|--|

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-4 Para. 4-5	Fuel pump removed from vehicle. Manual fuel pump shutoff valve removed.
<u>Test Equipment</u>		
Fuel injection tester (test stand) 11020200		
<u>Special Tools</u>		
Spring pack adjusting tool ST-984 Travel template no. 3375355 Indicator, level and angle no. 3375855 Shaft installation tool no. 3375204 Gear pump block plate ST-844		
<u>Materials/Parts</u>		
Two drive pins Lockwasher Throttle shaft ball Grease, GAA (Appendix C, Item 11) Lubricating oil OE/HDO 30 (Appendix C, Item 17) 45A calibrating fluid (Appendix C, Item 4) Sealing tape (Appendix C, Item 30)		
<u>Personnel Required</u>		
Fuel and electrical systems repairer MOS 63B		
<u>Manual References</u>		
TM 9-2320-272-34P TM 9-4910-387-14 TM 9-4910-387-14P		
		<u>Special Environmental Conditions</u>
		None
		<u>General Safety Instructions</u>
		None

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Throttle Shaft Cover Removal

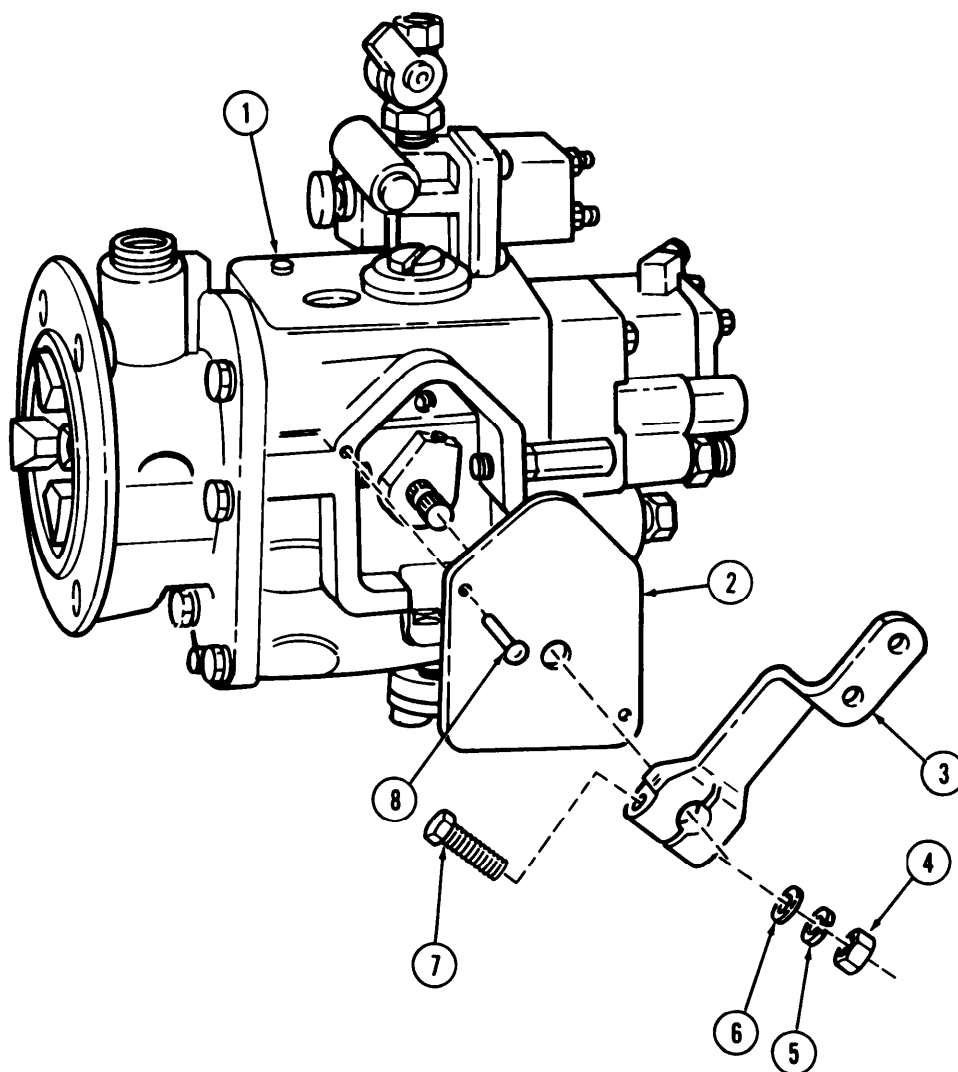
NOTE

Perform step 1 only if throttle shaft cover has not been removed.

- | | | | | |
|----|-----------------------|--------------------------|--|-------------------------|
| 1. | Fuel pump housing (1) | Throttle shaft cover (2) | <ul style="list-style-type: none"> a. Center punch on each of the two drive pins (8). b. Drill out two drive pins (8), | Discard drive pins (8). |
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4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

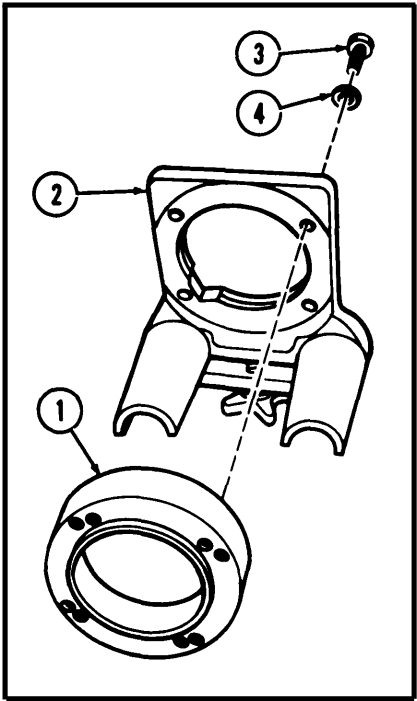
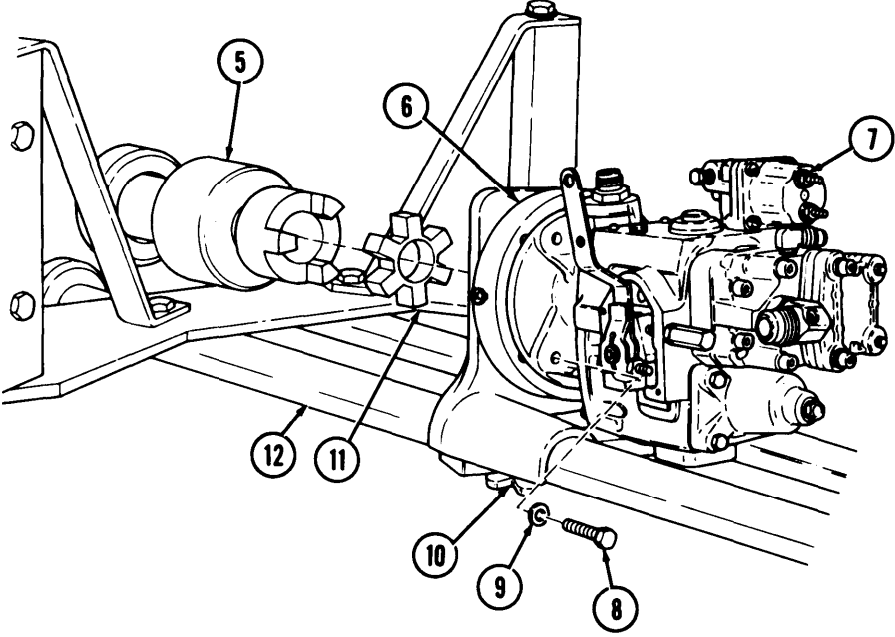
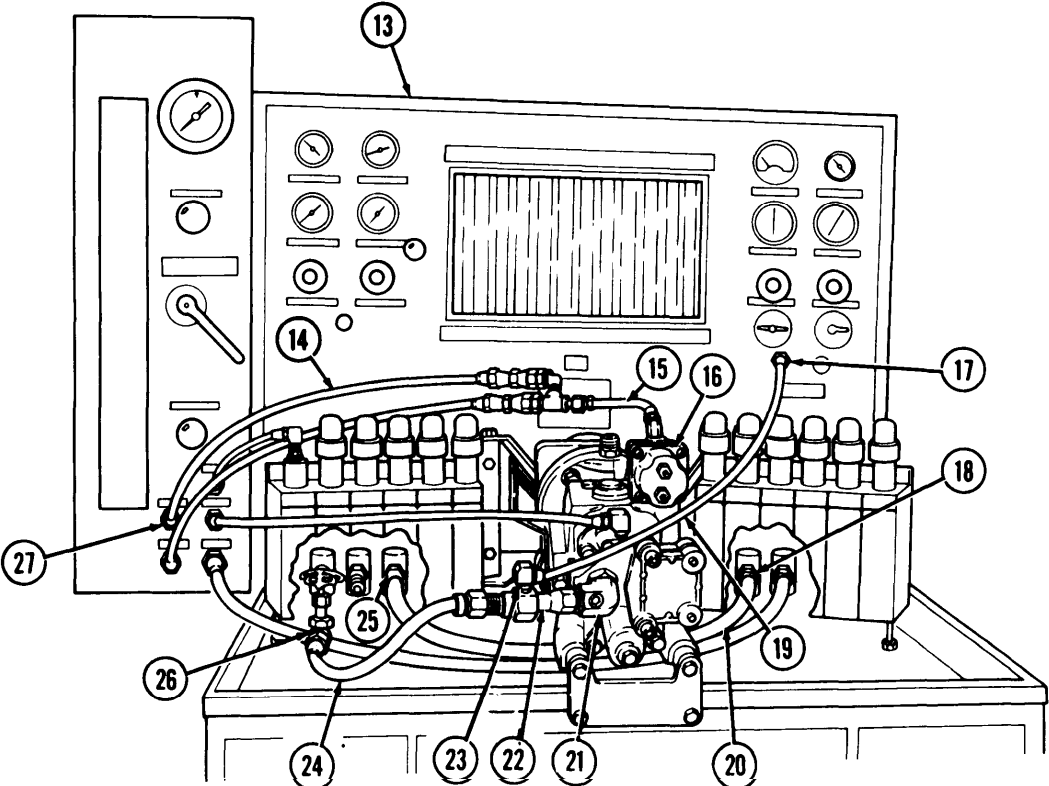
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			c. Remove nut (4), lockwasher (5), washer (6), screw (7), and throttle lever (3).	Discard lockwasher (5).
			d. Remove throttle shaft cover (2).	



4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Mounting Pump to Test Stand				
2.	Adapter bracket (2)	Adapter ring (1)	Install with four screws (3) and washers (4).	The word TOP or part number on adapter ring (1) must face up.
3.	Test stand (13)	Ring and adapter bracket (6)	Install on mounting rails (12) with clamp bar (10).	Tighten clamp bar (10) finger tight.
4.		Fuel pump (7)	Mount to ring and adapter bracket (6) with four screws (8) and washers (9).	
5.		Pump coupling insert (11)	Place into test stand drive coupling (5).	
6.		Ring and adapter (6)	Loosen bar clamp (10) and slide pump (7) and ring and adapter bracket (6) forward to engage drive shaft (5).	
NOTE				
Clean all male pipe threads and wrap with sealing tape before installation.				
7.		Inlet adapter (22)	Install on pump elbow (21).	
8.		1/2 in. (12.70 mm) flexible hose (24)	Connect from test stand fuel pressure control valve (26) to adapter (22).	
9.		1/4 in. (6.35 mm) manifold hose (19)	Connect from manifold vacuum adapter (23) to adapter (17).	
10.		Pump discharge fitting assembly (15)	Install in fuel pump shutoff solenoid valve (16).	
11.		Fuel pressure hose (14)	Install from test stand pressure gage outlet (27) to pump discharge fitting (15).	
12.		1/2 in. (12.70 mm) flexible hose (20)	Install from test stand lube pressure (25) to test stand lube return (18).	

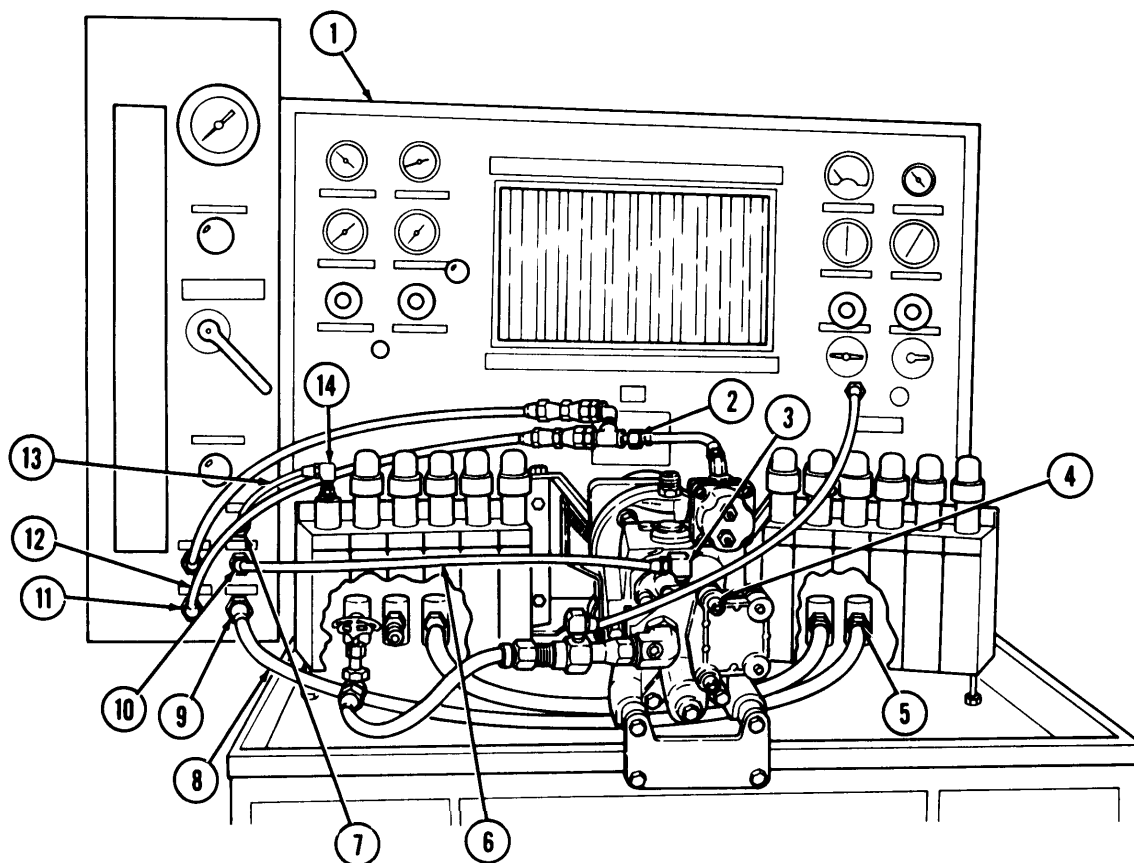
4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

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4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

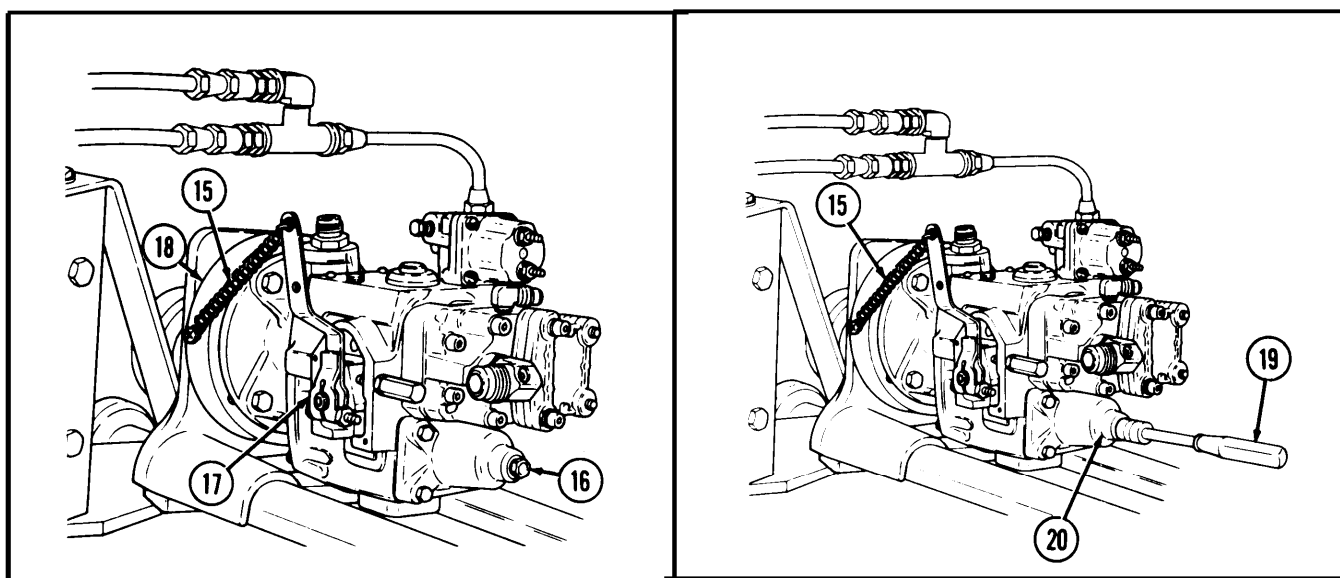
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
13.	Test stand (1)	Fuel input hose (12)	Install from test stand fuel input connector (11) to input discharge fitting (2).	
14.		Fuel outlet hose (8)	Install from test stand fuel outlet connector (9) to stand fuel return connector (5).	
15.		Leakage accumulator hose (13)	Install to no. 1 accumulator can (14) from test stand leak test connector (7),	
16.		1/4 in. (6.35 mm) flexible hose (6)	Connect to check valve fitting (3) on pump (4) and to auxiliary return connector (10).	
17.		Throttle lever position holding spring (15)	Install from top of throttle shaft lever (17) to ring and adapter bracket (18),	Spring (15) will hold throttle lever (17) to full fuel position.



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4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
18.		Governor spring pack housing pipe plug (16)	a. Remove. b. Install special spring pack adjusting tool ST-984 (19) into spring pack housing (20).	



4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Fuel Pump Run-In

NOTE

Seat all other test stand valves by opening one-quarter turn and reclosing to make sure they are in the CLOSED position to prevent leakage.

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| 19. Test stand (1) | Bypass valve (8), fuel pressure valve (7), and flow control valve (10) | Place in open position. |
| 20. Fuel pump (3) | Fuel shutoff valve manual override knob (11) | Open by turning knob (11) until seated. |

CAUTION

Check tachometer drive for clockwise rotation. If rotation is not clockwise, reverse rotation of drive coupling.

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|--------------------|---------------------------|------------------------------|---|
| 21. | Tachometer drive seal (2) | Lubricate. | Use lubricating oil. |
| 22. Test stand (1) | Power switch (6) | Place in ON position. | |
| 23. | Fuel heat switch (4) | Place in ON position. | Observe that fuel temperature gage reads between 90°-100°F (32°-38°C) for 45A calibrating oil and 80°-100°F (27°-38°C) for diesel fuel. |
| 24. | Selector valve (9) | Place in ROTAMETER position. | |
| 25. | Range crank (5) | Turn to HIGH range position. | |

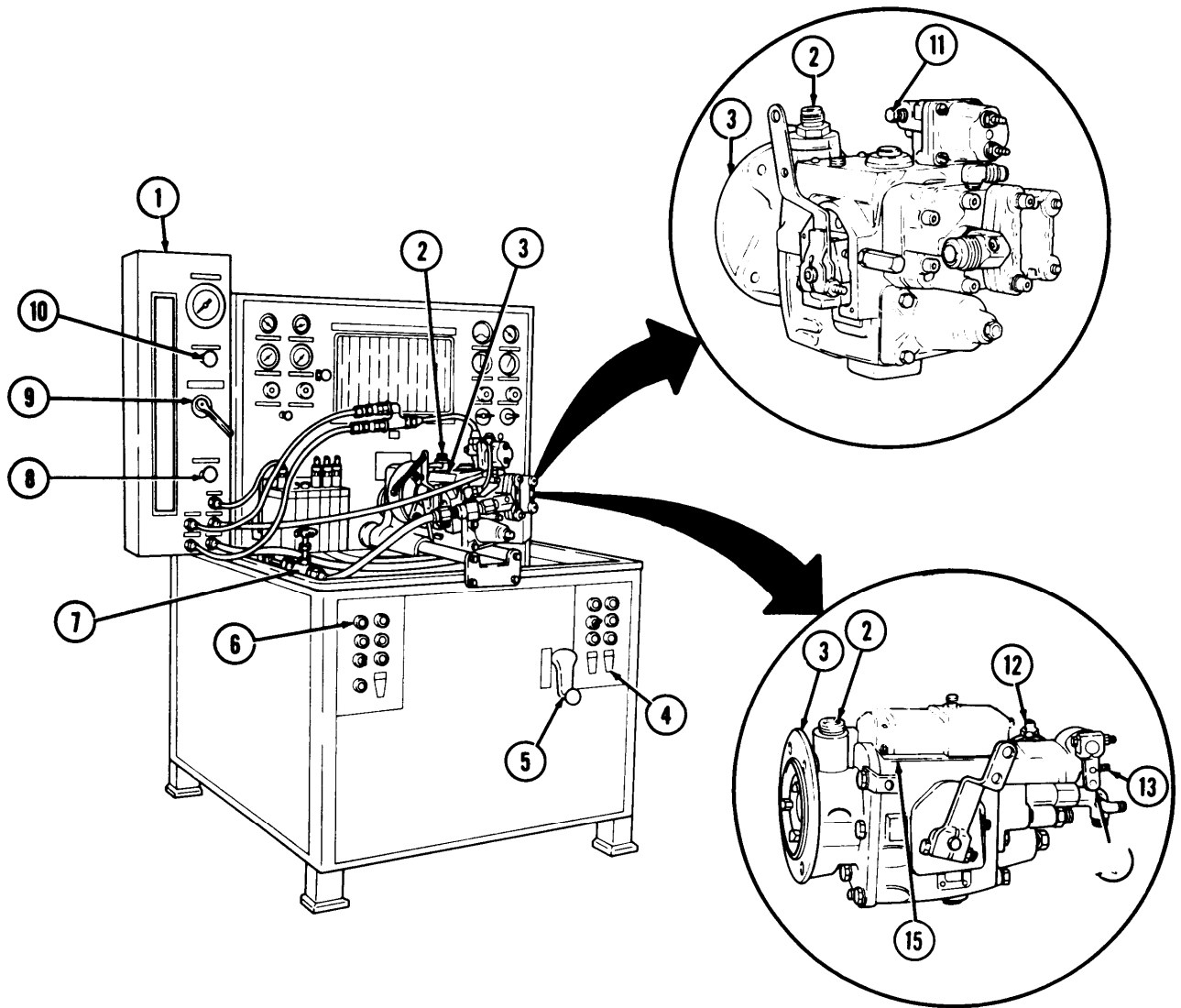
NOTE

Perform step 26 only on variable speed (VS) governor.

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| 26. VS governor (15) | High adjusting screw (12), low adjusting screw (13), and throttle lever (14) | Back out both adjusting screws four turns, and fasten VS governor throttle lever (14) in full fuel position. |
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4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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4-25. FUEL PUMP SETUP AND CALIBRATION (Coent'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
CAUTION				
Pump must pick up fuel at 500 rpm without priming. If no fluid pickup is indicated at ROTAMETER, check fuel filter for improper installation, motor switch for correct rotation, open suction valve and hose, and gear pump connections are tight.				
27. Test stand (1)		Speed control buttons (3) and (4)	Start test stand by depressing start button (5). Run test stand up to 500 rpm.	Depress and release FAST (3) or SLOW (4) button to maintain 500 rpm.

NOTE

- Check ROTAMETER for air in fuel flow. If air bubbles are present, work pump throttle from fuel full open to idle several times to relieve entrapped air in pump.
- If air bubbling persists, it is an indication of an air leak in the system. Turn test stand off and check the line for loose connections between tank and test stand pump, mating of gear pump housing, and full fuel supply tank (TM 9-4910-387-14).
- If pump is new or has been disassembled and reassembled, run pump at 500 rpm for 5 minutes to allow bearings and seals to seat, and to purge air from system.

d. Testing Pump Seals for Leaks

CAUTION

- Check tachometer drive for clockwise rotation. If rotation is not clockwise, reverse rotation of drive coupling.
- Do not leave fuel pressure valve closed more than five minutes because pump could overheat and be damaged.

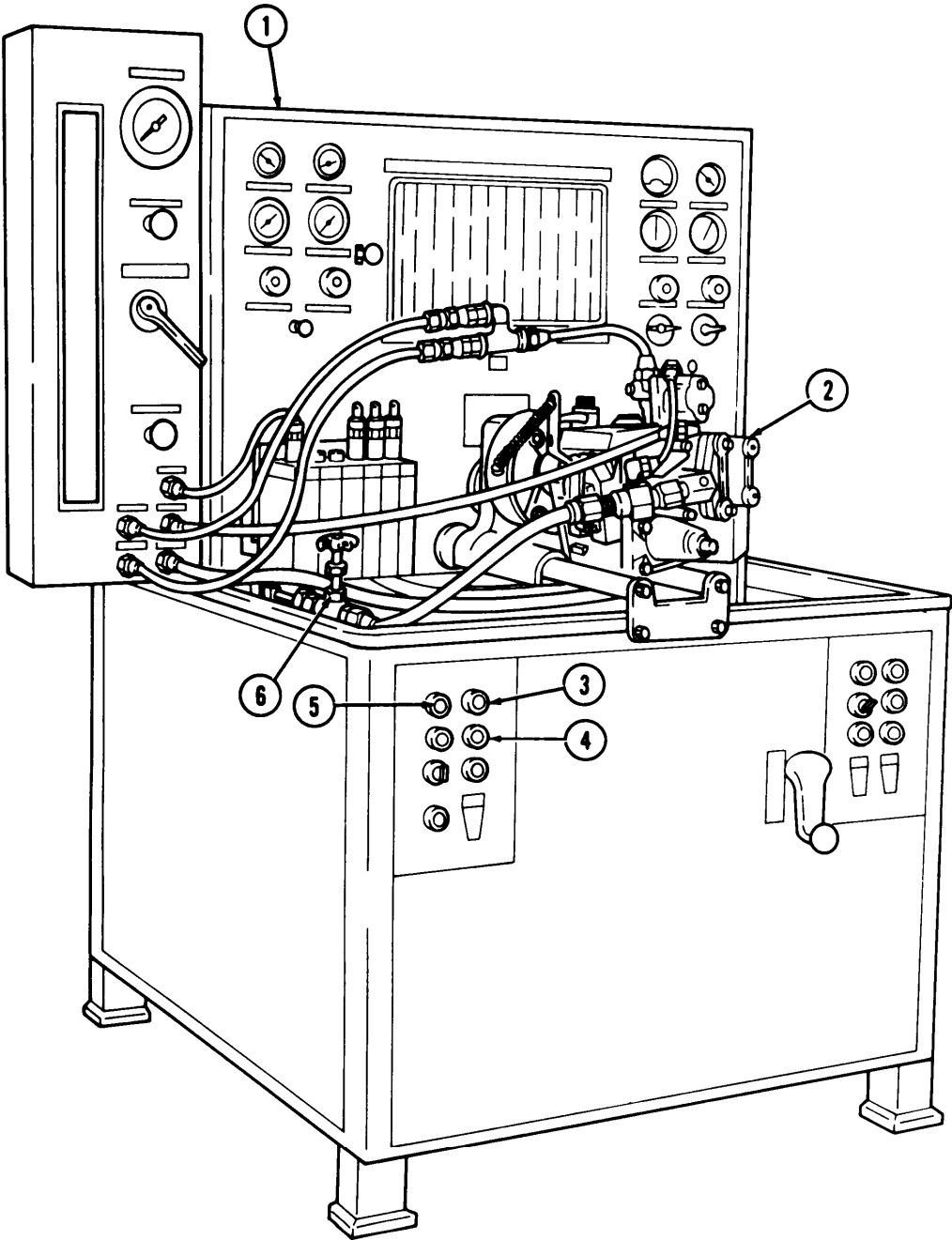
NOTE

All steps must be completed before pump is considered calibrated.

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| 28. Test stand (1) | Fuel pump (2) oil seals | a. With test stand (1) operating at 500 rpm close fuel pressure valve (6). |
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4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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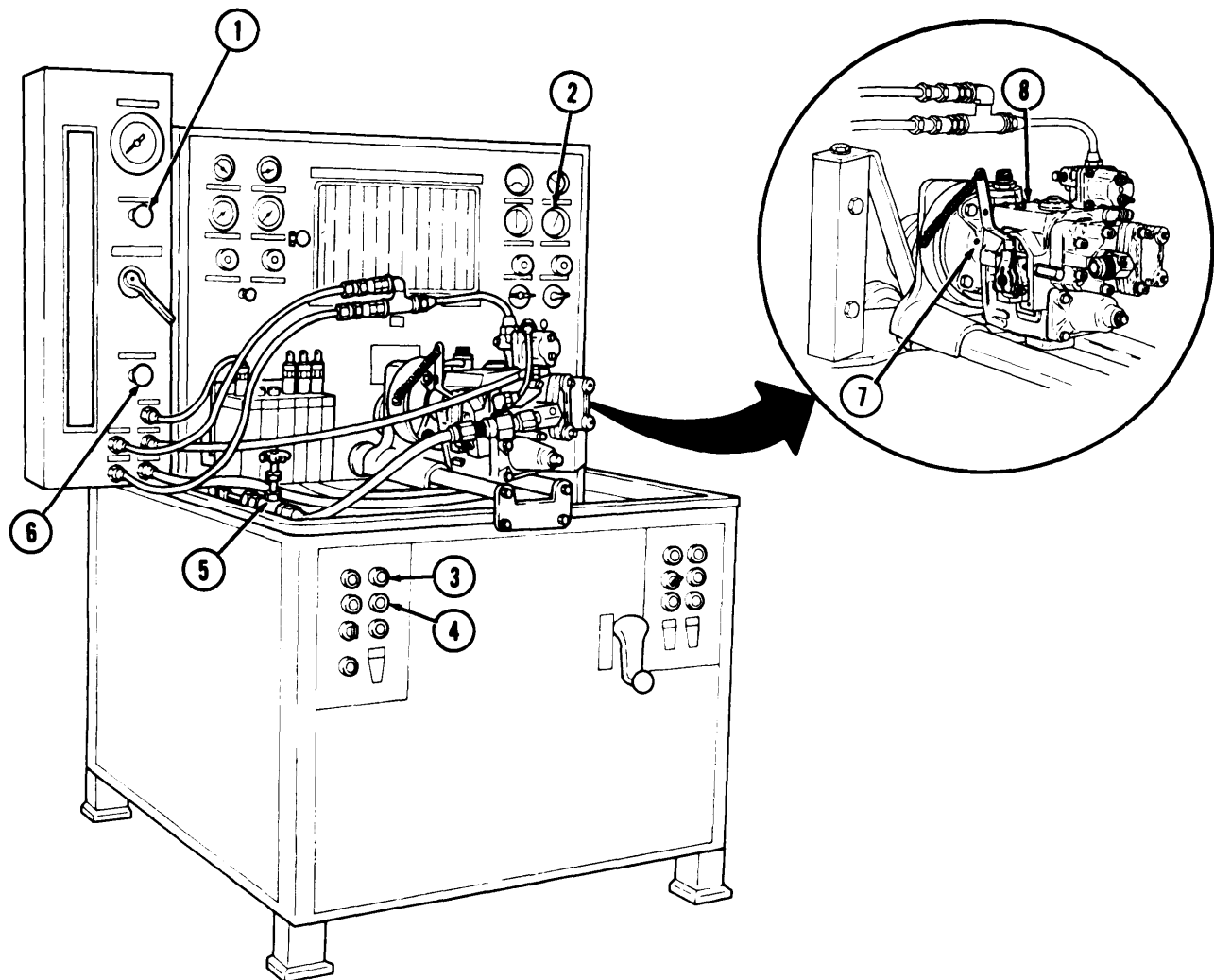


4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			b. Place test stand fuel flow control valve (1) to OPEN position.	If 25 in. vacuum is not obtained, check all test hose connections.
			c. Place bypass valve (6) in closed position.	
			d. Place a small amount of grease over vent of weep hole (7).	Use GAA grease.
			e. If grease is pulled into weep hole (7) at 25 in. vacuum, the seal is defective.	Replace fuel pump, Refer to para. 4-4.
			f. Open fuel pressure valve (5).	

4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
e. Testing Governor Cutoff RPM				
29.		Fuel pump (8)	<p>a. Open test stand fuel flow control valve (1) completely.</p> <p>b. Increase pump (8) speed to 2100 rpm.</p> <p>c. Adjust control valve (1) to obtain 8 in. mercury (HG) on vacuum gage (2).</p>	<p>Depress and release FAST (3) or SLOW (4) button to obtain 2100 rpm.</p>



4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p style="text-align: center;">NOTE</p> <p>Once 8 in. HG vacuum setting is obtained do not change setting. Readings will fluctuate during other tests. Just note the increases or decreases as they occur.</p>				
			d. Open the fuel flow control valve (1) and place the selector valve (6) in ROTAMETER position.	
			e. Increase pump speed until the fuel pressure drops. Stand tachometer (3) reading should be 2130-2150 rpm.	Depress and release FAST (4) or SLOW (5) button to increase or decrease rpm. The VS governor automotive governor portion is set 100 rpm higher.

CAUTION

Test stand must be shut off to change shims in spring pack.

NOTE

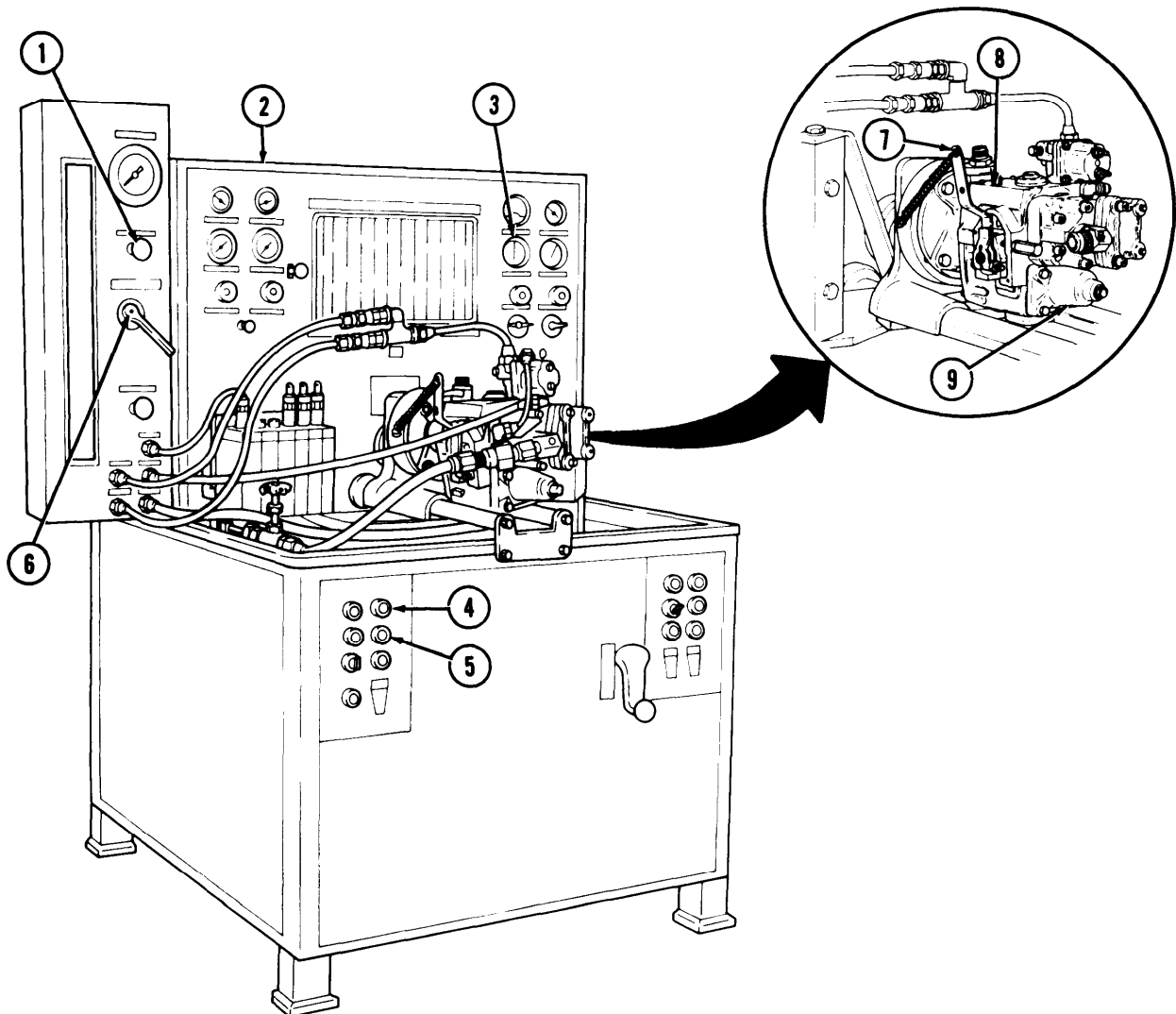
Perform steps 29g and 29h only if spring pack shims are changed.

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|---|---|
| g. If cutoff is too low, remove spring pack (9) and add shims. If cutoff is too high, remove shims (Refer to para 4-10). | Each .001 in. (0.25 mm) shim thickness will change speed approximately two rpm. Shims are available in .005, .010, and .020 in. (0.13, 0.25, and 0.51 mm) thickness.

If more than 0.015 in (0.381 mm) must be added, replace the spring (refer to para. 4-10). |
| h. Air must be purged from fuel pump (8). With fuel pump (8) at 500 rpm move throttle lever (7) back and forth until the ROTAMETER shows no air and recheck governor cutoff rpm, step 29. | |

4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
f. Testing and Adjusting Throttle Leakage				
30.	Test stand (2)	Fuel pump throttle lever (7)	<p>a. Increase pump (8) speed to 2100 rpm.</p> <p>b. Place selector valve (6) to ROTAMETER position,</p> <p>c. Set fuel flow control valve (1) for 315 pph reading.</p>	<p>This is to see if any air is in system.</p> <p>At 2100 rpm fuel flow ROTAMETER FLOAT should read 315 pph on the scale.</p>

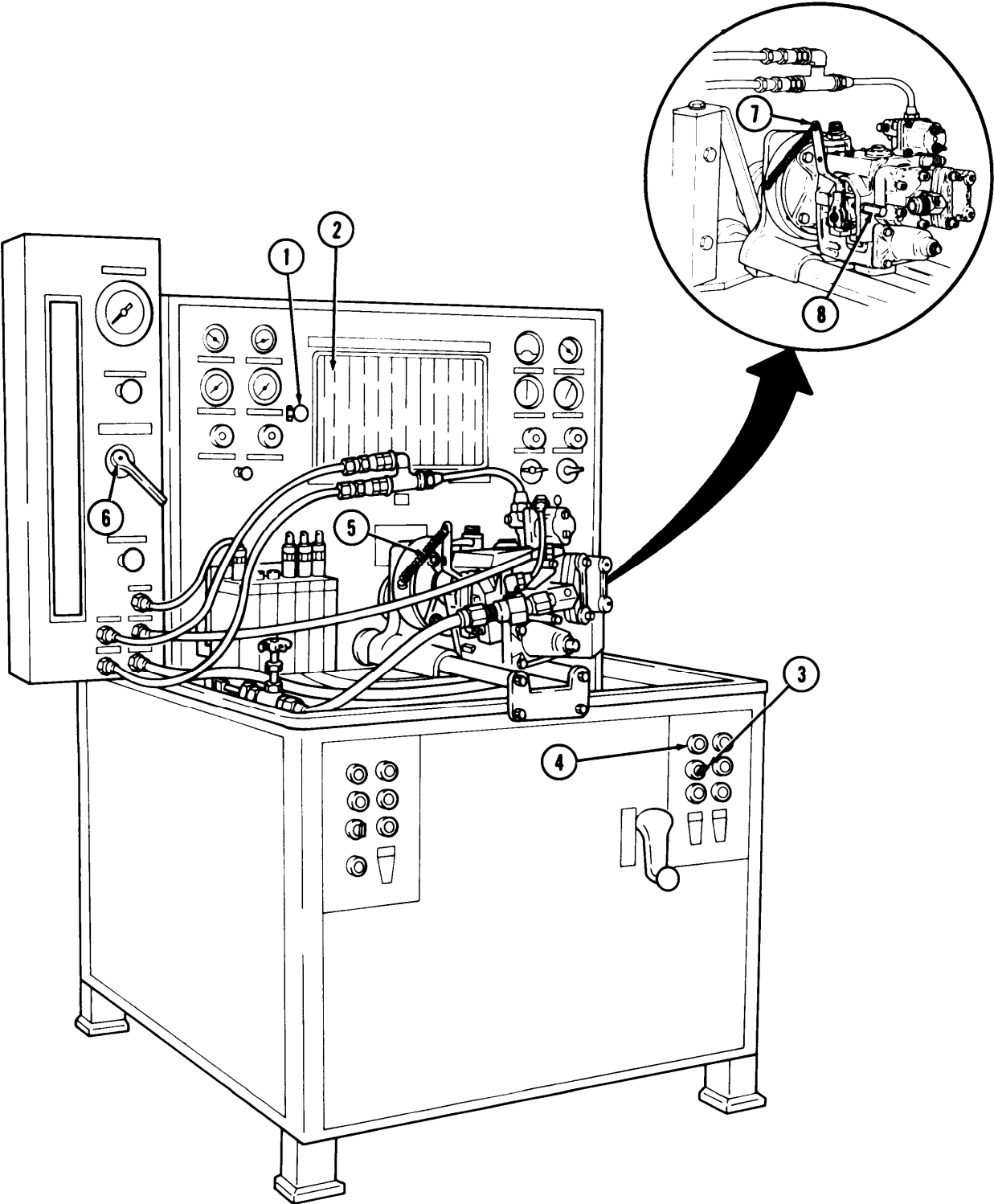


4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			d. Place selector valve (6) to LEAKAGE TEST position.	
			e. Place COUNT SELECTOR SWITCH (3) to the 1000 position.	
			f. Pull out dumping lever (1) to retain fuel in number one burrerie (2).	
<p style="text-align: center;"><u>CAUTION</u></p> <p>Do not hold throttle lever in idle position any longer than two minutes to complete test. Pump may overheat, since fuel flow is used to cool the pump.</p>				
			g. Remove throttle spring (5), and manually position throttle lever (7) to idle position.	
			h. Depress pulse counter button (4) to fill number one burrerie (2).	
			i. Push dumping lever (1) inward.	Burrerie (2) must be cleared of fuel to prevent overflow at this time.
<p style="text-align: center;"><u>NOTE</u></p> <p>A test cycle is one-half minute duration.</p>				
			j. At the end of a cycle, read the amount of fuel in number one burrerie (2) on the scale.	For one-half minute cycle fuel delivery is (40-70 cc).
			k. If throttle leakage is not as specified, then adjust rear throttle screw (8) in or out.	Backing screw (8) out will decrease leakage and moving screw (8) in will increase leakage.

4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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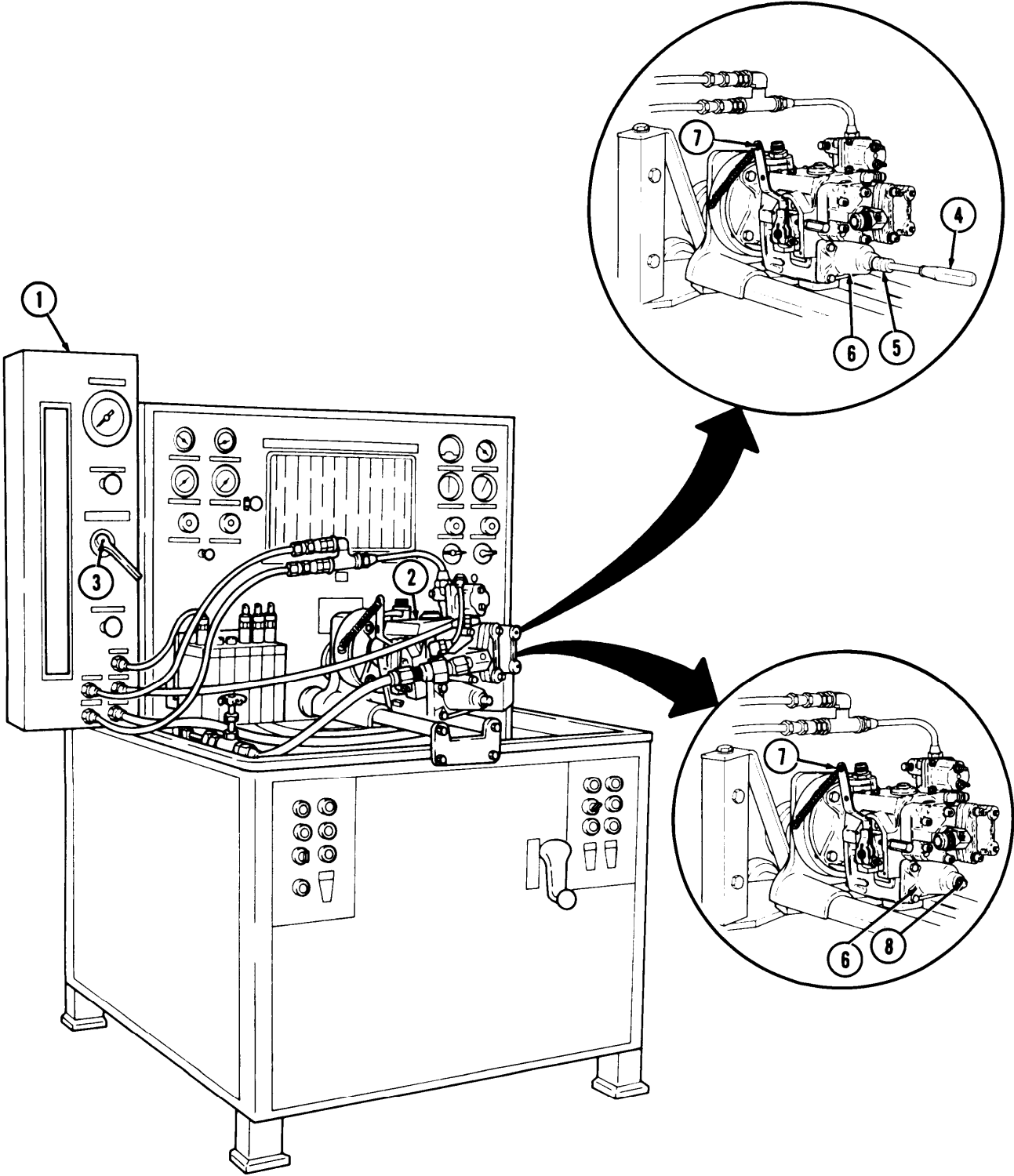


4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
g. Testing and Adjusting Idle Speed				
31.		Governor spring pack housing (6)	Test and adjust idle speed as follows: a. Place selector valve (3) to IDLE position. b. Increase pump (2) rpm to 500. c. Pull throttle lever (7) to idle position. d. If fuel pressure is not 26 psi (179.27 kPa) adjust idle screw (5), using adjust tool ST-984 (4).	Fuel pressure gage should read 26 psi (179.27 kPa). Turn screw (5) in to increase or out to decrease. If pressure is low and the adjusting screw bottoms, stop the test stand, add shims to the spring end of the adjusting screw (refer to para. 4-10), and retest cutoff rpm and throttle leakage steps 29 and 30.
NOTE Each time governor spring pack housing or adjusting tool is removed, run pump until purged of air.				
			e. After proper adjustment is made, stop the test stand (1) and remove adjusting tool ST-984 (4). f. Install 1/8 in. (3.17 mm) pipe plug (8). g. Purge the pump (2) of air.	Removed in step 18.

4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

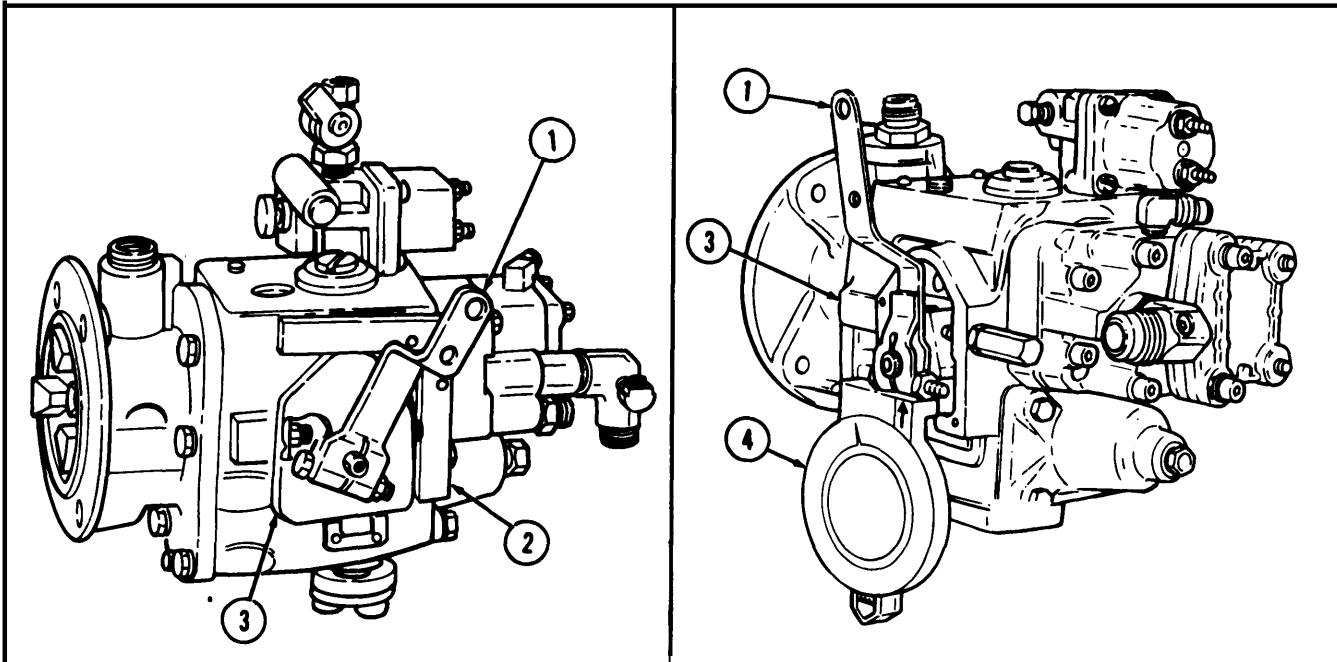
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
h. Checking and Adjusting Throttle Lever Travel				
<p style="text-align: center;">NOTE</p> <p>Travel template no. 3375355 or indicator, level and angle no. 3375855 will be used to set pump throttle lever for travel adjustment. Make sure the combination of the first and third or second and fourth holes on the template are used. Any other combination will result in an inaccurate reading. Correct travel is 27-29 degrees.</p>				
32.		Throttle lever (1)	a. Place template (2) against throttle housing so inside flats are even on top and bottom as shown.	
<p style="text-align: center;">CAUTION</p> <p>DO NOT adjust rear throttle screw from valve set under throttle leakage. The rear throttle screw has already been set to provide the proper deceleration time for the engine, and any changes at this point will require recalibration of throttle leakage.</p>				
			b. Move the throttle lever (1) to idle position.	
<p style="text-align: center;">NOTE</p> <p>The throttle lever may be repositioned on shaft as required to line up the lever and template holes.</p>				
			c. Line up template (2) idle hole with center of throttle lever (1). Use straight edge to aline.	
			d. Move the throttle lever (1) to full throttle position.	
			e. Aline template (2) holes with hole in throttle lever (1).	
33.		Throttle lever (1)	Using level and angle indicator (4), check travel adjustment as follows:	
			a. Place level and angle indicator (4) against the bottom of throttle lever (1).	

4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			<p>b. Move throttle lever (1) to idle position, note reading on scale of indicator (4),</p> <p>c. Move throttle lever (1) to full throttle position, note reading on scale of indicator (4).</p> <p>d. Add readings taken in steps 33 b and c. The correct throttle lever adjustment is 27-29 degrees.</p> <p>e. If throttle lever (1) travel is not correct, adjust front throttle step screw (3) to obtain correct travel.</p> <p>f. After proper adjustment, the throttle lever (1) may be repositioned to accommodate throttle linkage.</p>	
				

4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
i. Testing and Adjusting Pump Main Pressure				
34.		Test stand (2)	Test and adjust pump main pressure as follows: <ol style="list-style-type: none"> With vacuum set at 8 in. HG on vacuum gage (5) and throttle wide open, adjust speed to 2100 rpm. Place selector valve (4) to ROTAMETER position. Set fuel flow to 3.15 pph with fuel flow control valve (1). If 172-178 psi (1186-1227 kPa) fuel pressure is not read on pressure gage (3), adjust pressure. 	Fuel pressure should be 172-178 psi (1186-1227 kPa).

j. Testing and Adjusting Fuel Pressure

NOTE

Throttle shaft internal adjusting screw is covered by a throttle shaft ball in the end of throttle shaft.

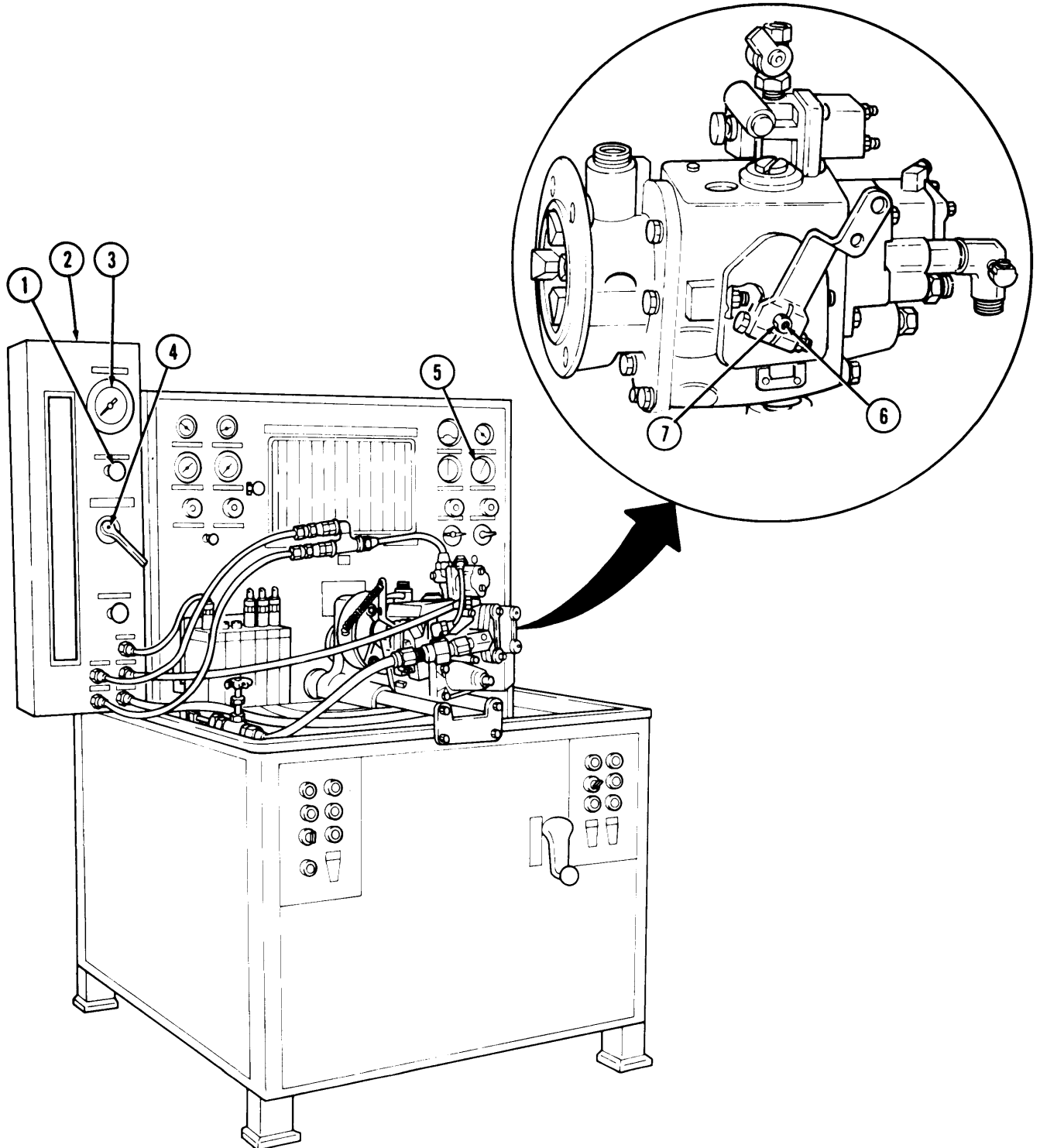
CAUTION

Be careful when drilling out ball not to damage bore of throttle shaft.

35.		Pump throttle shaft (7)	Test and adjust fuel pressure as follows: <ol style="list-style-type: none"> Center punch and drill out ball (6) with 1/4 in. drill bit. Set fuel pressure to 172-178 psi (1186-1227 kPa). After fuel pressure is adjusted, insert new throttle shaft ball (6). 	Screw internal fuel adjusting screw located in throttle shaft (7) inward to increase and outward to decrease. Use throttle shaft installation tool.
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4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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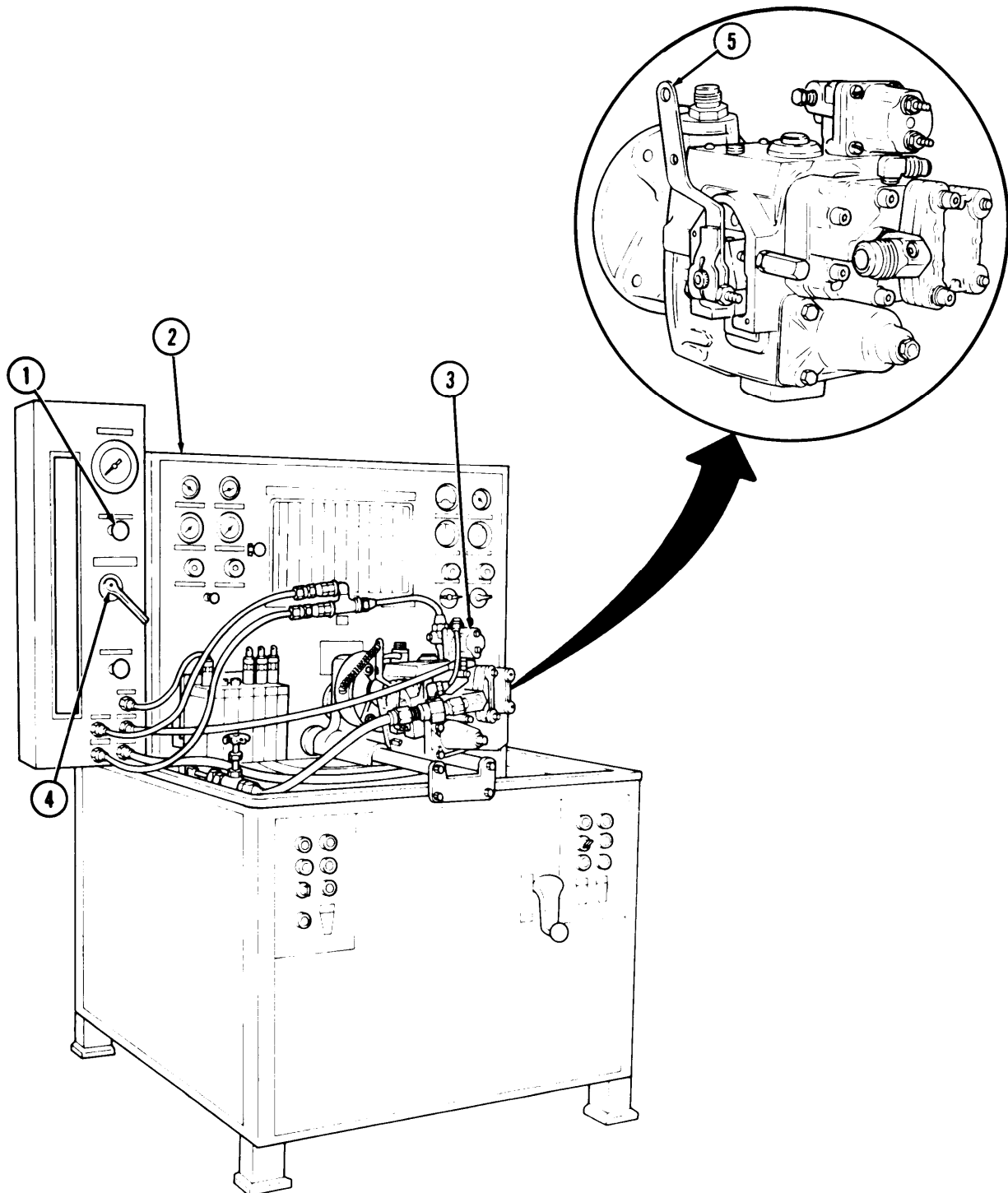


4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
k. Testing and Adjusting Governor Fuel Pressure				
36.	Test stand (2)	Fuel pump (3)	a. Adjust pump (3) speed to 1500 rpm. b. Place selector valve (4) in ROTAMETER position. c. Place fuel throttle lever (5) to wide open position. d. Set fuel flow to 2.30 pph with the fuel flow control valve (1). e. If fuel pressure is not 100-106 psi (689-730 kPa), check governor cut-off rpm. Refer to step 29.	Fuel pressure should be 100-106 psi (689-730 kPa).
l. Checking and Adjusting Governor Weight Setting				
37.	Test stand (2)	Fuel pump (3)	a. Adjust pump (3) speed to 1000 rpm. b. Place throttle lever (5) to wide open position. c. Place selector valve (4) in ROTAMETER position. d. Set fuel flow to 150 pph with fuel flow control valve (1).	Fuel pressure should be 50-58 psi (335-399 kPa).

4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Shims are available in 0.005 and 0.010 in. (0.13 and 0.25 mm) thickness. Do not change setting more than 0.020 in. (0.508 mm) from specification.

- e. If fuel pressure is not 50-58 psi (335-399 kPa), adjust.

To decrease pressure remove shims from behind weight plunger. To increase, add shims (refer to para. 4-13).

m. Testing and Adjusting Idle Speed (VS Governor Only)

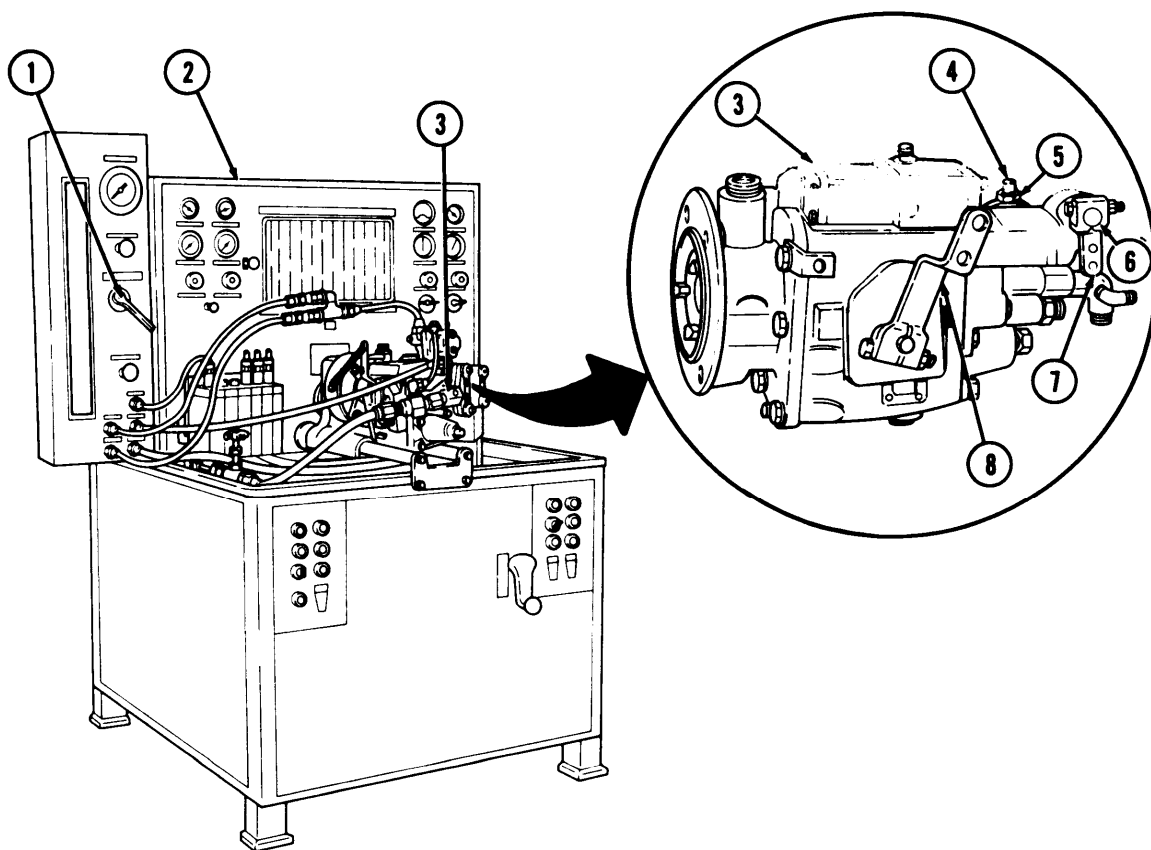
NOTE

To calibrate fuel pump equipped with variable speed (VS) governor, the preceding steps are followed. In addition, step 26 is to adjust the VS governor only.

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| 38. Test stand (2) | Fuel pump with VS governor (3) | <p>a. Place throttle lever (8) and VS governor lever (7) to full fuel position.</p> <p>b. Increase pump (3) speed to 2140 rpm.</p> <p>c. Loosen locknut (5), turn HI-IDLE (top screw) (4) in until fuel pressure starts to drop. Tighten locknut (5).</p> <p>d. Decrease pump (3) speed to 2100 rpm, and gradually increase until pressure starts to drop. Pump speed should be 2120-2140 rpm.</p> |
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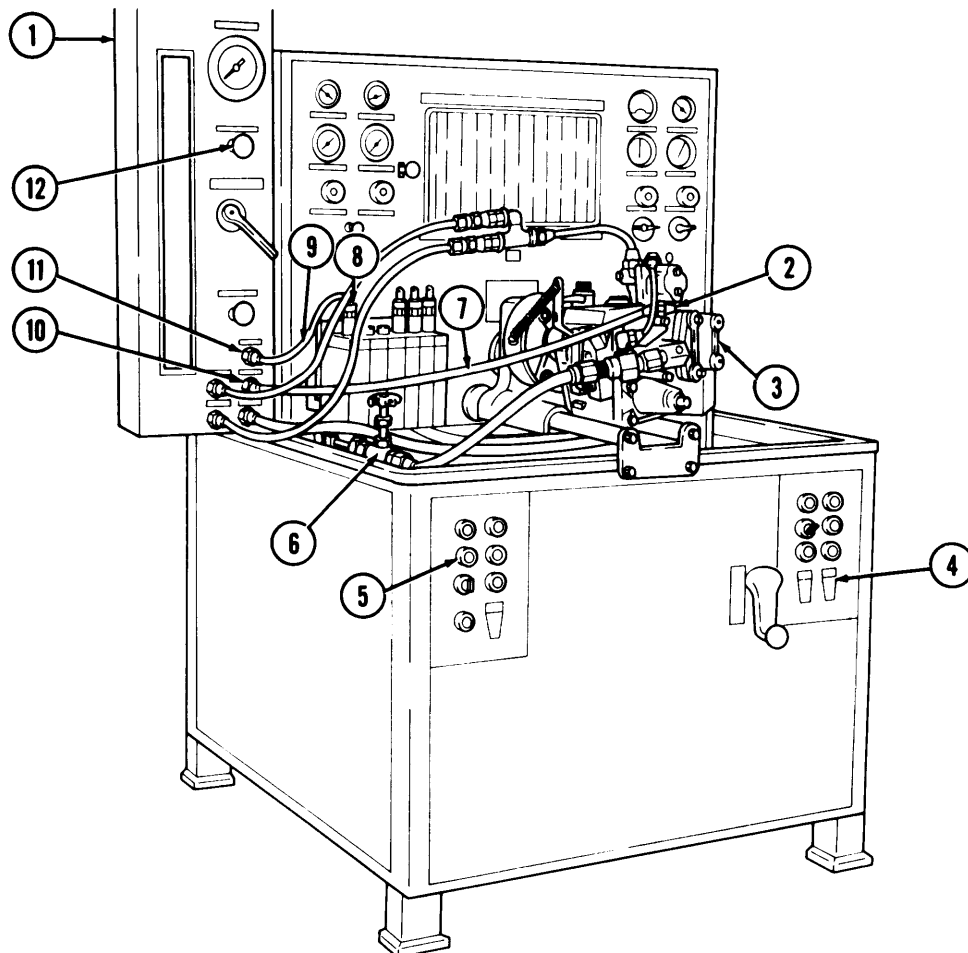
4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			e. If pump speed is NOT 2120-2140 rpm, adjust VS governor HI-IDLE screw (4) until rpm is 2120-2140 rpm.	The automotive governor cutoff must be set 100 rpm higher.
			f. Decrease pump (3) speed to 500 rpm.	
			g. Place VS governor lever (7) to IDLE position.	
			h. Place stand selector valve (1) to IDLE position.	
			i. adjust VS governor LO-IDLE screw (bottom) (6) to obtain 26 psi (179 kPa).	



4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

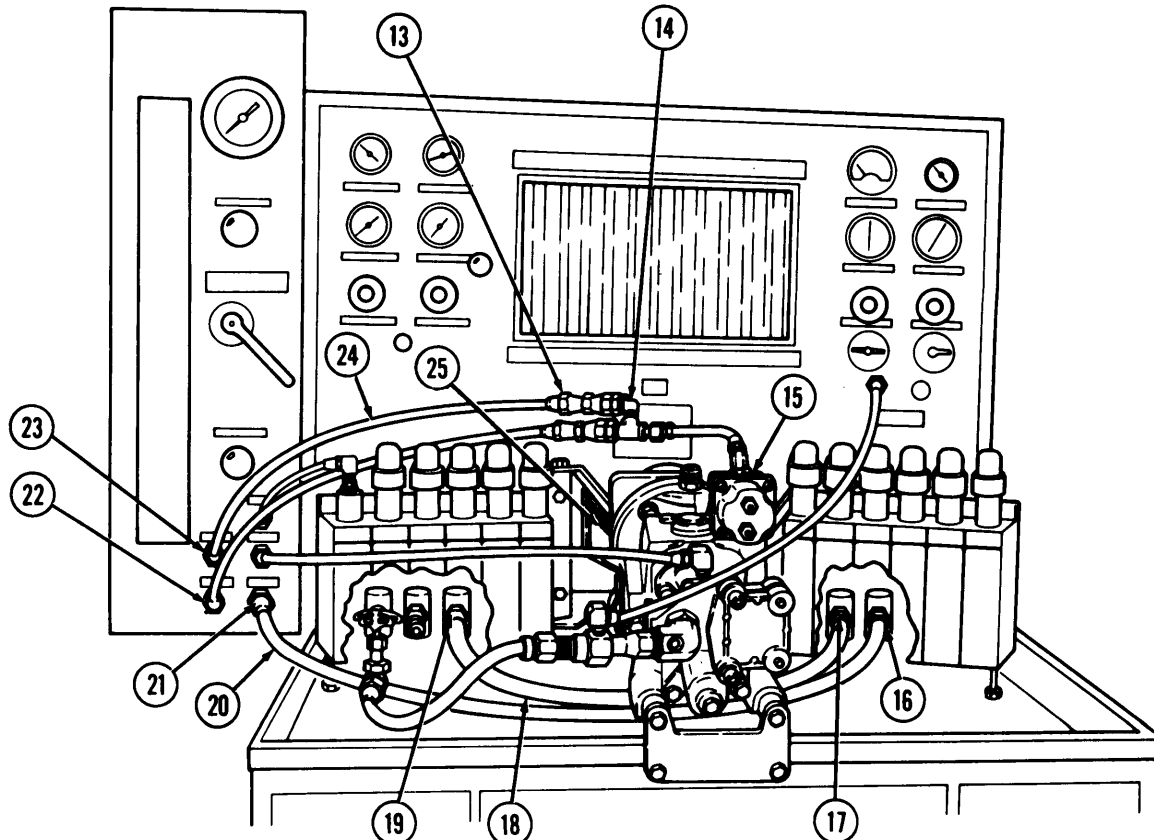
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
n. Shutdown and Removal from Test Stand				
39.	Test stand (1)	Stop button (5)	Depress.	
40.		Fuel heat switch (4)	Place in off position.	
41.		Fuel pressure control valve (6)	Close.	
42.		Fuel flow control valve (12)	Close.	
43.	Fuel pump (3)	1/4 in. (6.35 mm) flexible hose (7)	Remove from small fitting (2) on pump (3) and auxiliary return fitting (10) on test stand (1).	
44.		Leakage accumulator hose (9)	Remove from number one accumulator can (8) and stand leak test connector (11).	



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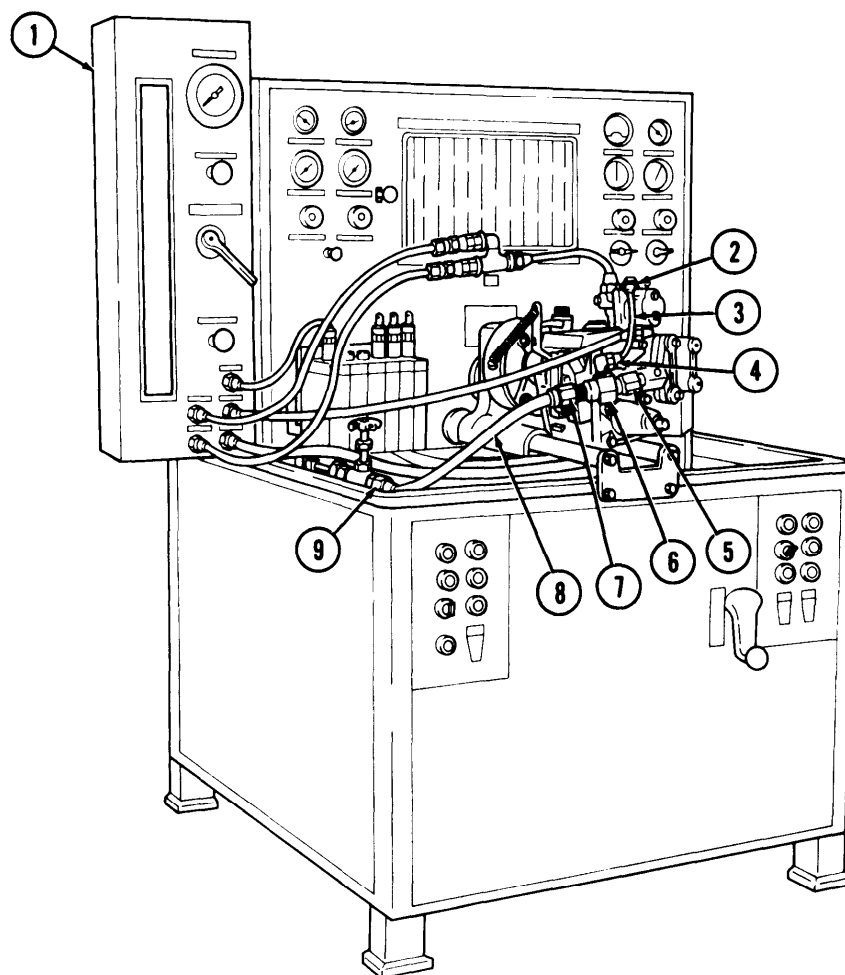
4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
45.		Fuel outlet hose (20)	Remove from test stand fuel input connector (21) and (16) fuel return connector.	
46.		1/2 in. (12.7 mm) flexible hose (18)	Remove from test stand lube pressure (19) and test stand lube return (17),	
47.		Fuel pressure hose (24)	Remove from test stand pressure gage outlet (23) and pump discharge fitting (13).	
48.		Pump discharge fitting assembly (14)	Remove from pump fuel shutoff valve (15) and test stand fuel input connector (22).	
49.		Throttle lever spring (25)	Remove.	



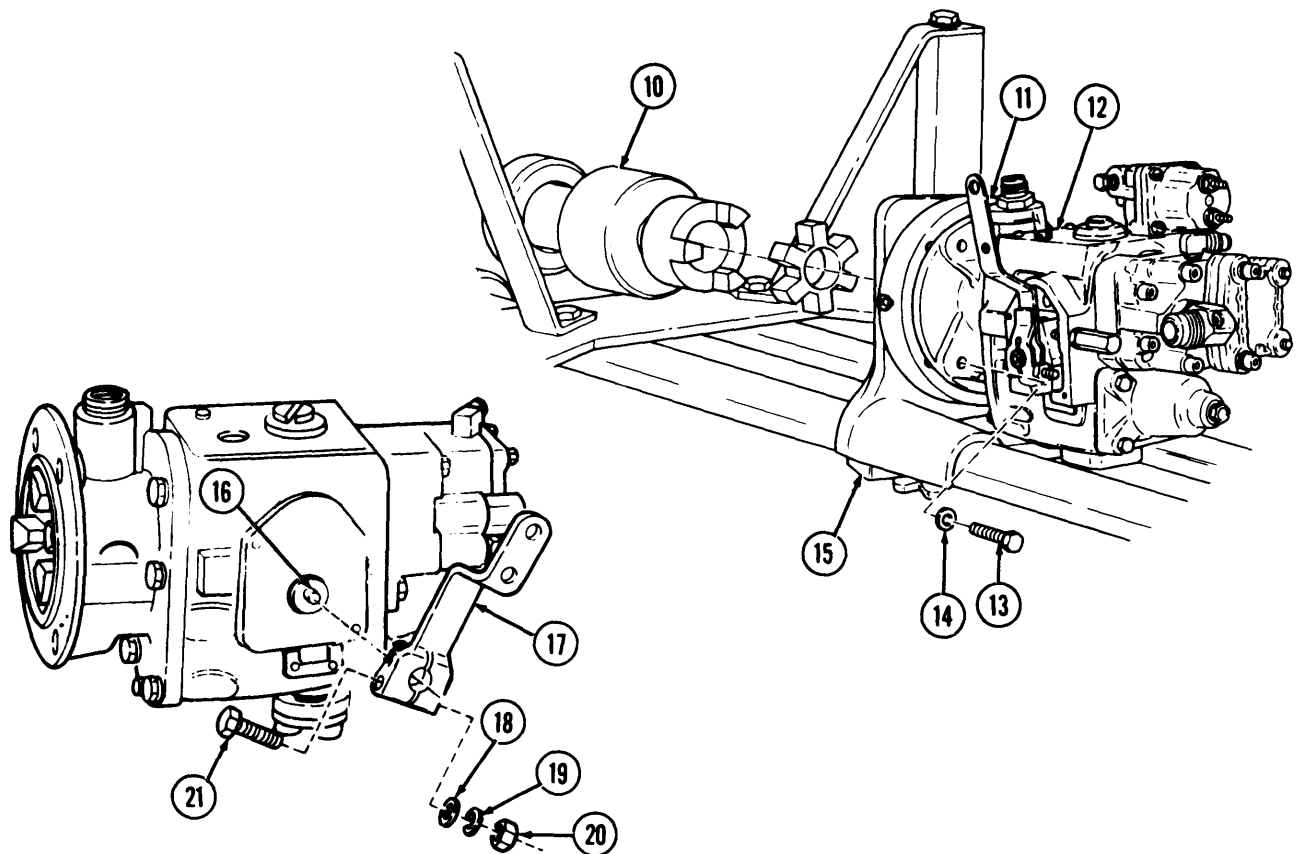
4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
50.	Test stand (1)	1/4 in. (6.35 mm) manifold hose (3)	Remove from test stand manifold vacuum gage (2) and 1/4 in. (6.35 mm) adapter on inlet adapter assembly (4).	
51.		1/2 in. (12.7 mm) I.D. flexible hose (8)	Remove from fuel pressure control valve (9) and adapter elbow on inlet adapter assembly (7).	
52.		Pump inlet adapter assembly (6)	Remove from pump inlet port (5).	



4-25. FUEL PUMP SETUP AND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
53.		Ring and adapter bracket (11)	Loosen bar clamp (15) and slide pump (12) and ring and adapter bracket (11) back from stand drive (10).	
54.		Fuel pump (12)	Remove pump from ring and adapter bracket (11) by removing four screws (13) and washers (14).	
55.	Throttle lever shaft (16)	Nut (20), lockwasher (19), washer (18), screw (21), and throttle lever (17)	Remove.	



END OF TASK!

FOLLOW-ON TASKS: ☒ Plug or cover all open ports or holes on pump and stand.
☒ Install throttle shaft cover (para. 4-19).
☒ Install manual fuel pump shutoff valve (para. 4-5).

TA 349818

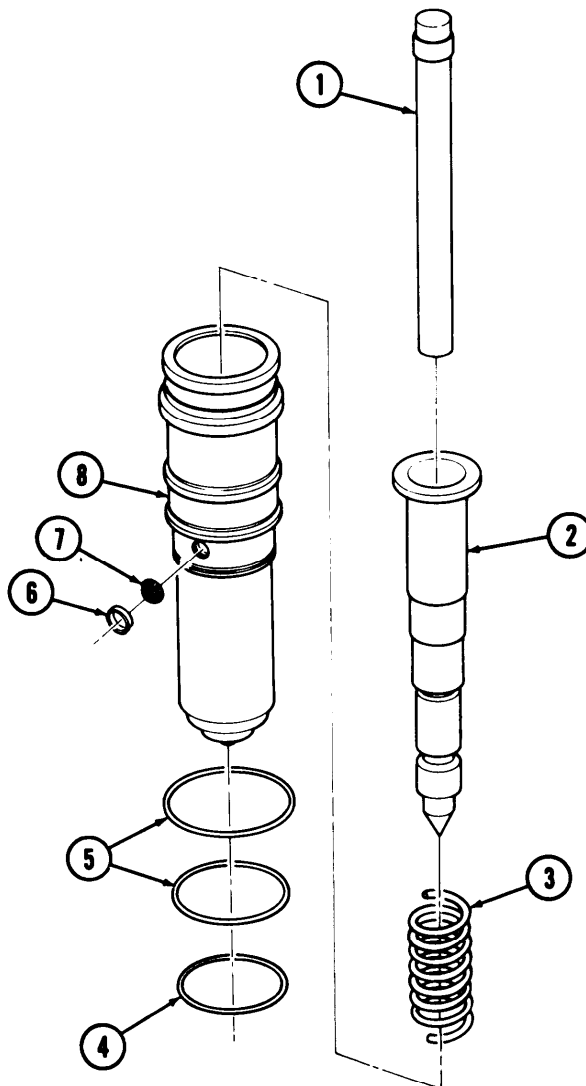
4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

LOCATION	ITEM	ACTION	REMARKS
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CAUTION

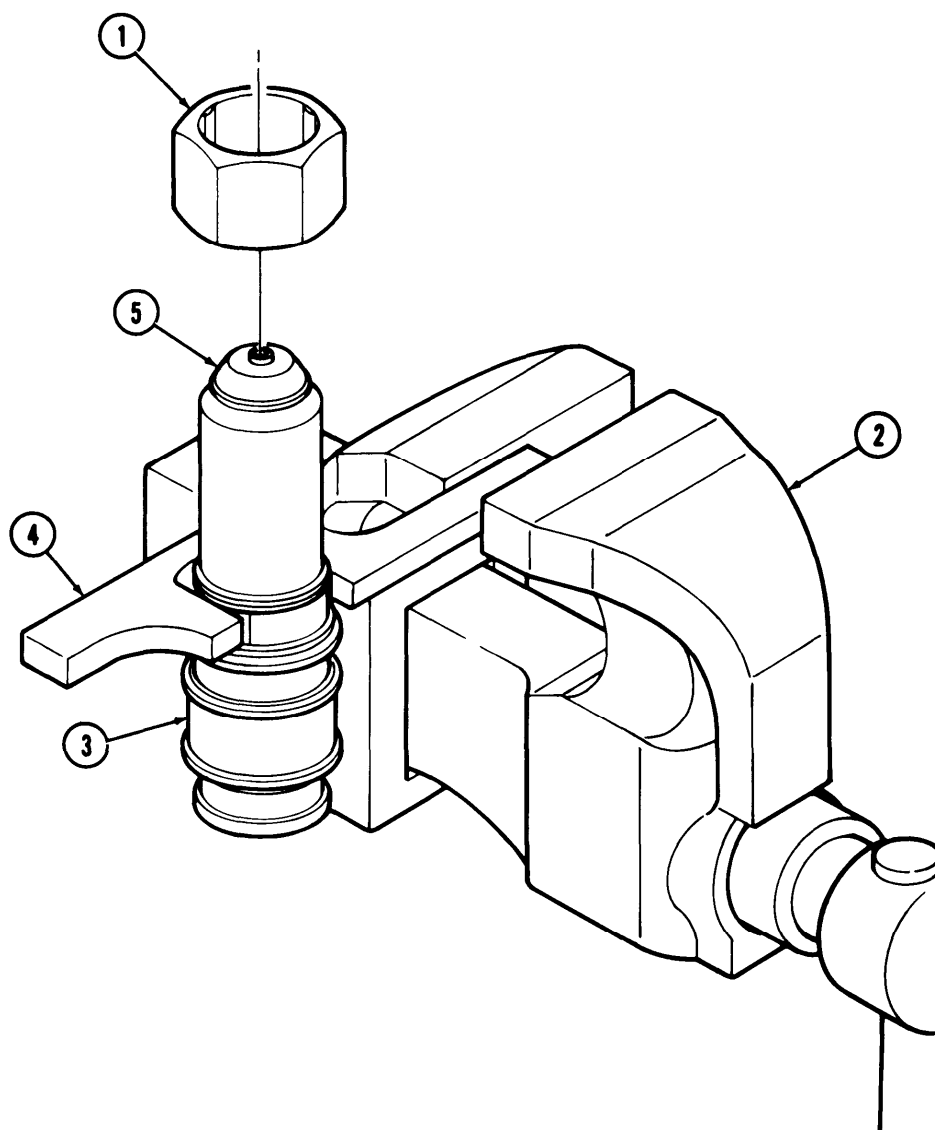
Injector barrel and plunger are a matched pair (class fit). Do not interchange. Do not touch internal parts unless hands are clean and moistened with diesel fuel.

- | | | | | |
|----|--------------|--|---------|--|
| 3. | Injector (8) | Plunger (2) and spring (3) | Remove. | Store plunger (2) by standing on end. |
| 4. | | Small "O" ring (4) and two large "O" rings (5) | Remove. | Discard "O" rings (4) and (5). |
| 5. | | Screen retaining ring (6) and screen (7) | Remove. | Discard retaining ring (6) and screen (7). |



4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
6.		Injector body wrench (4)	Install in vise (2).	
7.	Injector (3)	Flat machined areas of injector (3).	Slide into body wrench (4).	
8.		Cup retainer (5)	Loosen, using cup retainer wrench (1).	
9.		Injector (3) and body wrench (4)	Remove from vise (2).	



4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

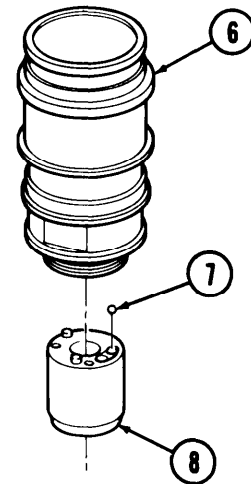
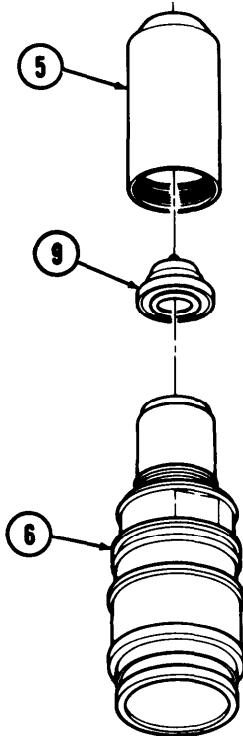
When handling injector, use care not to drop or lose any parts.

- | | | | |
|-----|----------------------|---|---------------------------|
| 10. | Injector adapter (6) | Set upright on flat surface and remove cup retainer (5) by lifting straight up. | |
| 11. | Injector cup (9) | Remove. | Discard injector cup (9). |

CAUTION

Injector barrel and plunger are a matched pair (class fit). Do not interchange. Do not touch internal parts unless hands are clean and moistened with diesel fuel.

- | | | | |
|-----|-------------------------------------|---|-------------------------|
| 12. | Injector barrel (8) and adapter (6) | a. Hold together and set injector barrel (8) end upright on clean cloth.
b. While holding injector barrel (8), lift adapter (6) straight up. | |
| 13. | Injector barrel (8) | Lift up and tilt over hand until check ball (7) falls out. | Discard check ball (7). |



4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cent'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Top Stop Injector Disassembly

WARNING

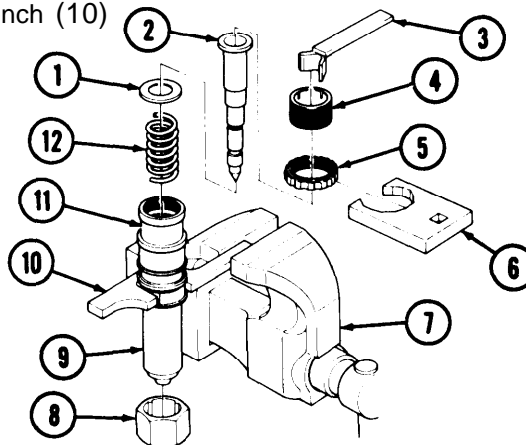
Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

CAUTION

Ž When handling injector, use care not to drop or lose parts.

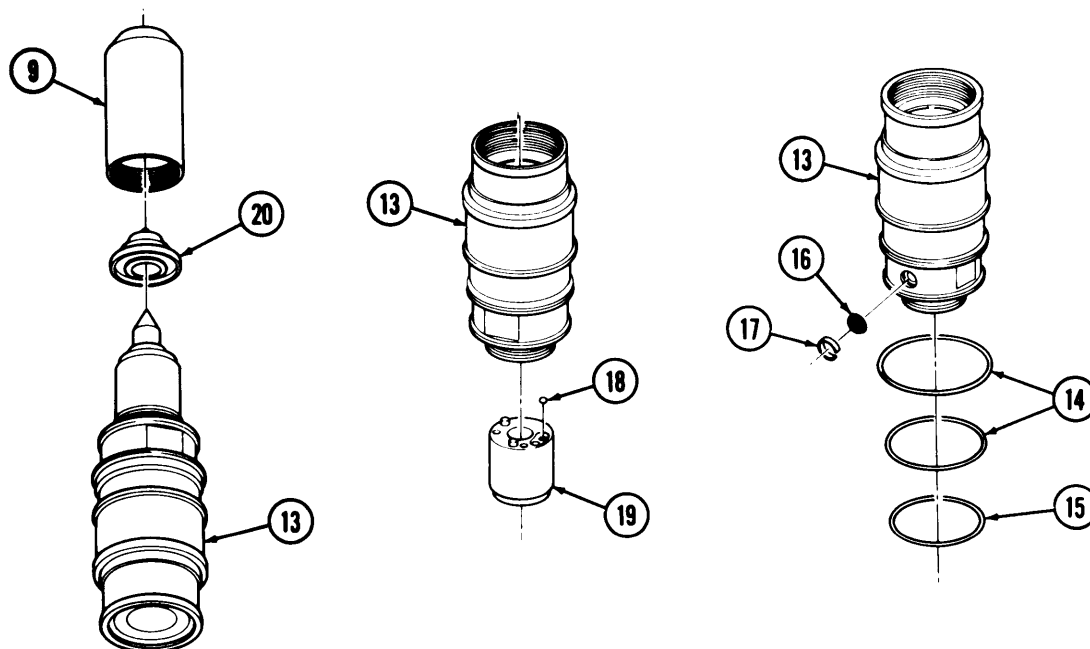
- Improper cleaning methods and use of unauthorized cleaning solvents can damage equipment.

14.		Exterior of injector (11)	Clean exterior with drycleaning solvent.	Refer to para. 2-7.
15.		Injector body wrench (10)	Install in vise (7).	
16.	Injector (11)	Flat machined areas of injector (11)	Slide into body wrench (10).	
17.		locknut (5)	Loosen locknut (5) using locknut wrench (6).	
18.		Adjusting screw (4)	Loosen adjusting screw (4) using adjusting wrench (3).	
19.		Adjusting screw (4) and locknut (5)	Remove.	
20.		Plunger (2)	Remove.	
21.		Spring retainer (1) and plunger spring (12)	Remove.	
22.		Cup retainer (9)	Loosen using cup retainer wrench (8)	
23.		Injector (11) and body wrench (10)	Remove from vise (7).	



4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

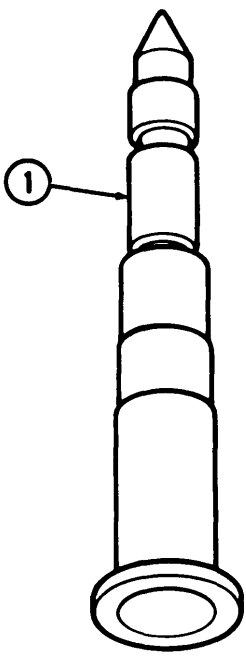
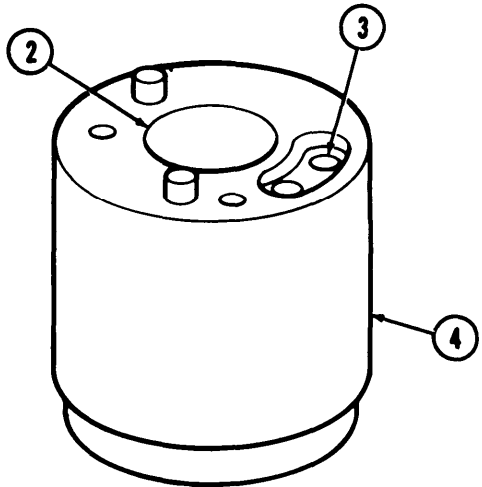
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
24.		Injector adapter (13)	Set upright on flat surface and remove cup retainer (9) by lifting straight up.	
25.		Injector cup (20)	Remove.	Discard injector cup (20).
<p style="text-align: center;"><u>CAUTION</u></p> <p>Injector barrel and plunger are a matched pair (class fit). Do not interchange. Do not touch internal parts unless hands are clean and moistened with diesel fuel.</p>				
26.		Injector barrel (19) and adapter (13)	<p>a. Hold together and set injector barrel (19) end upright on clean cloth.</p> <p>b. While holding injector barrel (19), lift adapter (13) straight up.</p>	
27.		Injector barrel (19)	Lift up and tilt over hand until check ball (18) falls out.	Discard check ball (18).
28.		Small "O" ring (15) and two large "O" rings (14)	Remove.	Discard "O" rings and (15)
29.		Screen retaining ring (17) and screen (16)	Remove.	Discard retaining (17) and screen (16)



4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
c. Inspection				
<p style="text-align: center;">NOTE</p> <p>Ž Bright spots or surface disruption at top of plunger machined area, on opposite side at bottom or midpoint, are normal results of rocker lever action.</p> <p>Ž Steps 13 and 14 pertain to the non-top stop and top stop injectors.</p>				
30.		Plunger (1)	Inspect machined surfaces for pitting, wear, cracks, and looseness.	<p>Narrow streaks running length of plunger (1) are normal. If pitted or worn, replace plunger (1) and injector barrel (4).</p> <p>Plunger (1) is one solid part. If cracks and looseness exist, replace plunger (1) and injector barrel (4).</p>
31.		Injector barrel (4)	<p>a. Inspect plunger bore (2) for scoring.</p> <p>b. Inspect surface at each end for burrs or scratches.</p> <p>c. Inspect check ball seat (3) for nicks or burrs.</p>	<p>Use strong magnifying glass. If scoring exists, replace injector barrel (4) and plunger (1).</p> <p>If burrs or scratches exist, replace injector barrel (4) and plunger (1).</p> <p>If nicks or burrs exist, replace injector barrel (4) and plunger (1).</p>

4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				

4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

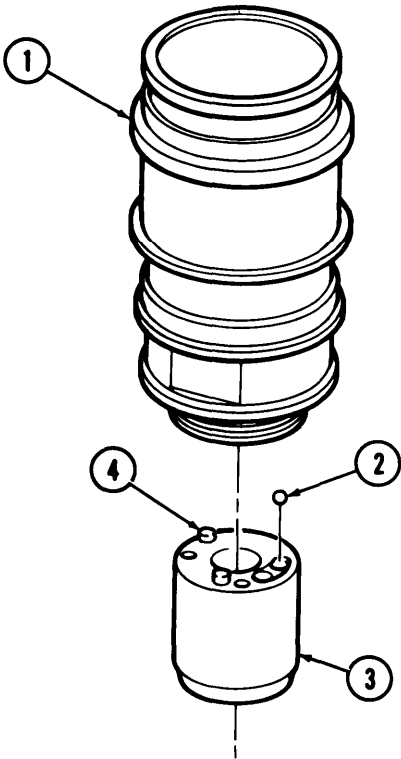
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Non-Top Stop Injector Assembly

CAUTION

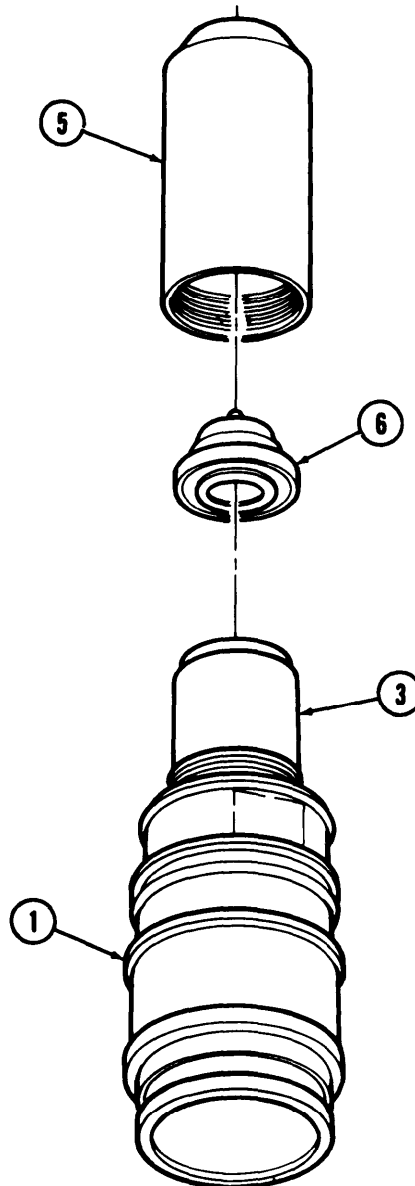
Lubricate parts only with clean diesel fuel before assembly. Do not use lubricating oil. Oil can crystallize under excessive heat, causing damage to injector components. Do not touch internal parts unless hands are clean and moistened with diesel fuel.

- | | | |
|-----|---------------------|---|
| 32. | New check ball (2) | a. Place in palm of hand.
b. Scoop up into injector barrel (3). |
| 33. | Injector barrel (3) | Place flat on clean cloth so mating surface faces upward. |
| 34. | | Aline spiral pins (4) with holes in adapter (1) and place adapter (1) on injector barrel (3). |



4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

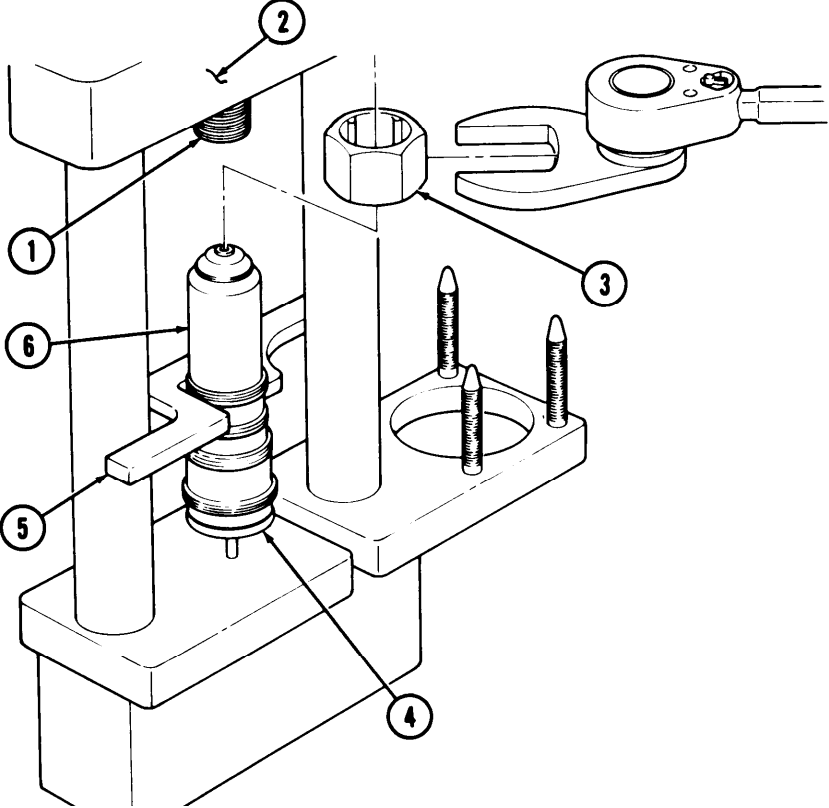
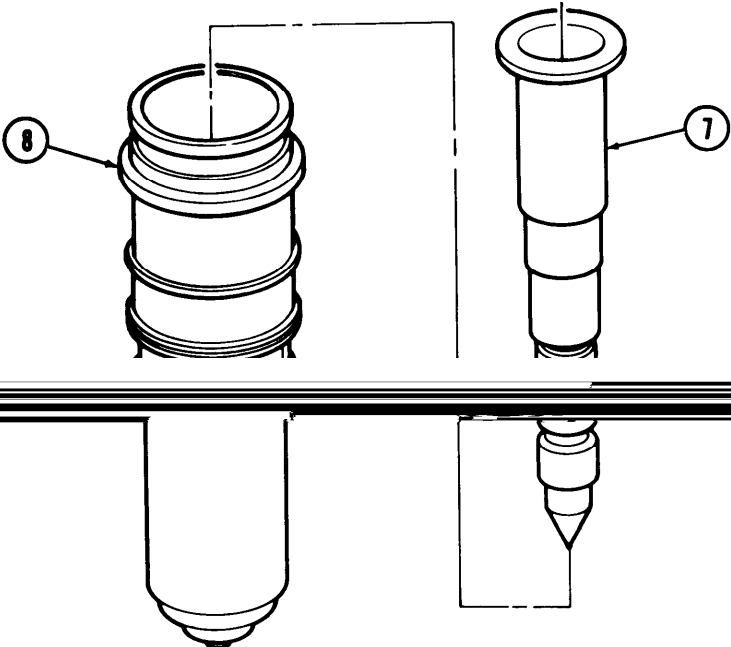
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
35.		Barrel (3) and adapter (1)	Hold together and set adapter (1) up-right on clean cloth.	
36.		New injector cup (6)	Position on top of injector barrel (3).	
37.		Cup retainer (5)	Screw onto adapter (1) and finger tighten, then back off 1/4 turn.	



4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
38.		Injector cup retainer wrench (3)	Place over cup retainer (6).	
<p style="text-align: center;"><u>CAUTION</u></p> <p>Injector barrel and plunger are a matched pair (class fit). Do not interchange. Do not touch internal parts unless hands are clean and moistened with diesel fuel.</p>				
39.		Plunger (7)	a. Coat with clean diesel fuel. b. Insert into adapter (8).	
40.		Injector (4)	Place in loading fixture (2) as follows: a. Remove loading fixture stud (1) from fixture (2) and slide body wrench (5) over injector (4) flats. b. Position cup retainer wrench (3) on cup retainer (6).	
41.		Loading fixture stud (1)	Install in fixture (2) and tighten to 110 lb-in. (12 N-m).	
42.		Cup retainer (6)	Tighten to 50 lb-ft (68 N-m).	Use torque wrench and crowfoot wrench.
43.		Injector (4)	Remove loading fixture stud (1) from fixture (2) and lift injector (4) out.	
44.		Plunger (7)	Remove from adapter (8).	

4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

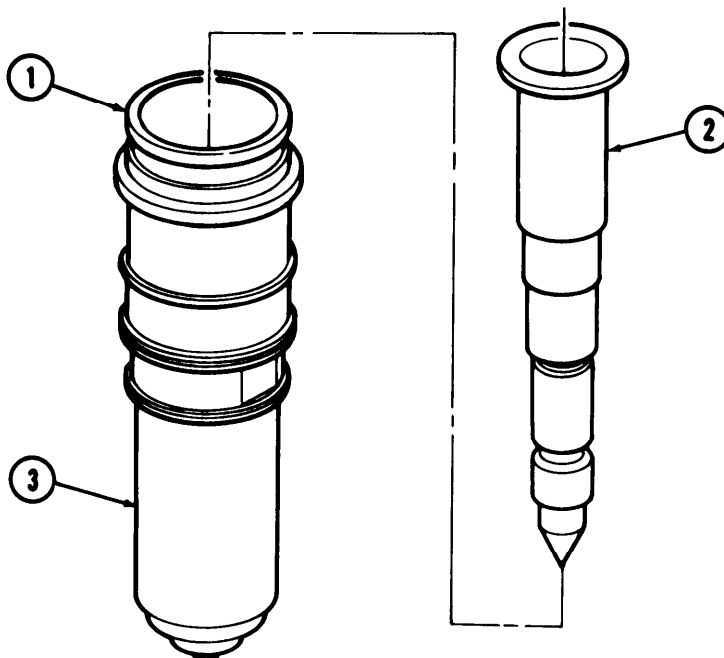
4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cent'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
45.		Plunger (2)	<p>Check cup retainer (3) to plunger (2) alignment as follows:</p> <ol style="list-style-type: none"> Coat plunger (2) with clean diesel fuel. Insert into injector barrel so plunger (2) remains .5 in. (12.7 mm) from edge of adapter (1). Using palm of hand, press plunger (2) into cup retainer (3). 	

CAUTION

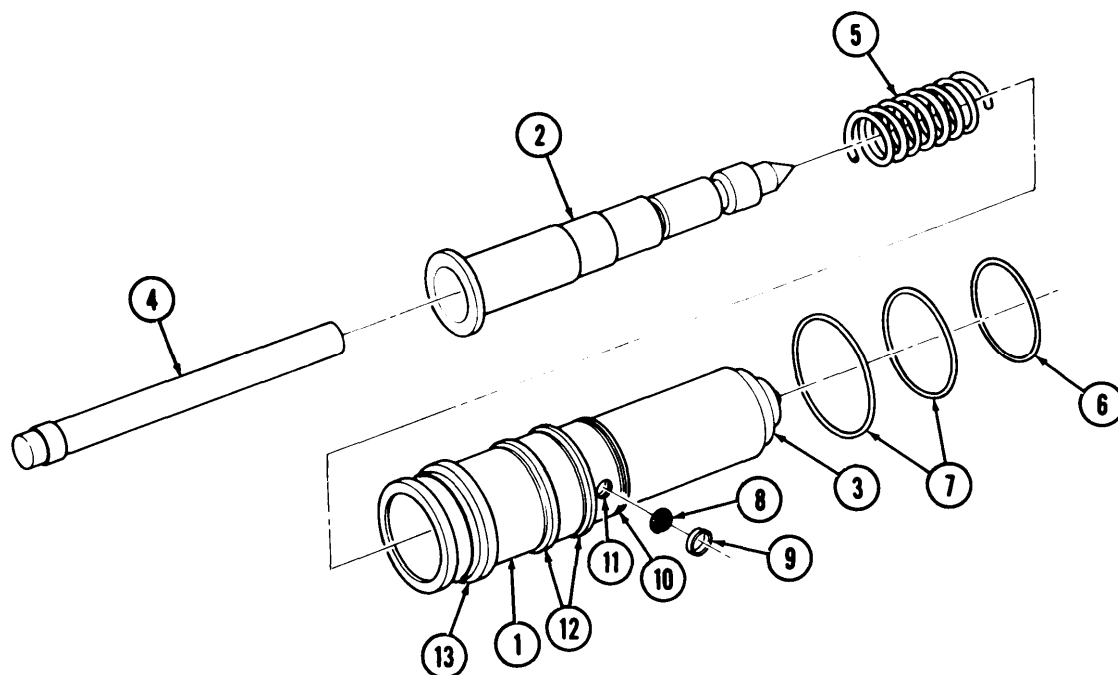
Do not allow plunger to fall out during step 29d.

- With one hand, turn cup retainer (3) and adapter (1) so cup retainer (3) faces upward. Plunger (2) should slide out immediately.
- If plunger (2) does not slide out immediately, the injector is not aligned and must be reassembled as outlined in steps 18 through 29.



4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
46.		Two new large "O" rings (7)	Starting at end of injector (13), slide into two upper grooves (12) on adapter (1).	
47.		New small "O" ring (6)	Starting at end of injector (13), slide onto lowest groove (10) on adapter (1).	
48.		New inlet fuel screen (8)	Place over adapter orifice (11) and install with new retainer ring (9).	
49.		Spring (5)	Place on plunger (2).	
50.		Plunger (2)	Slide into injector (13).	
51.		Injector link (4)	Install in plunger (2).	



4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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e. Top Stop Injector Assembly

CAUTION

Lubricate parts with clean diesel fuel before assembly. Do not use lubricating oil. Oil can crystallize under excessive heat, causing damage to injector. Do not touch internal parts unless hands are clean and moistened with diesel fuel.

52.

New check ball (6)

Place in injector barrel (4).
53.

Injector barrel (4)

Place flat on clean lint free cloth so mating surface faces upward.
54.

Adapter (5)

Place on barrel (4).
55.

Injector barrel (4) and adapter (5)

Hold together and set adapter (5) upright on clean lint free cloth.
56.

New injector cup (3)

Position on top of injector barrel (4).
57.

Cup retainer (2)

Screw onto adapter (5) and finger tighten, then back off 1/4 turn.

CAUTION

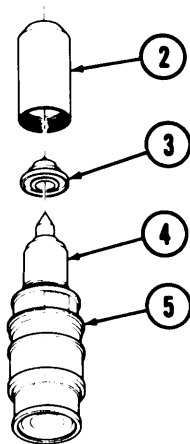
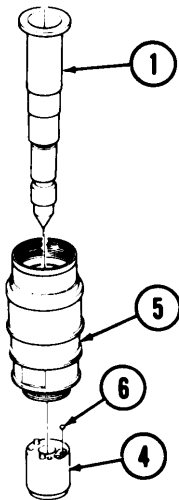
Injector barrel and plunger are a matched pair (class fit). Do not interchange. Do not touch internal parts unless hands are clean and moistened with diesel fuel. Failure to do so may result in damage to internal parts.

58.

Plunger (1)

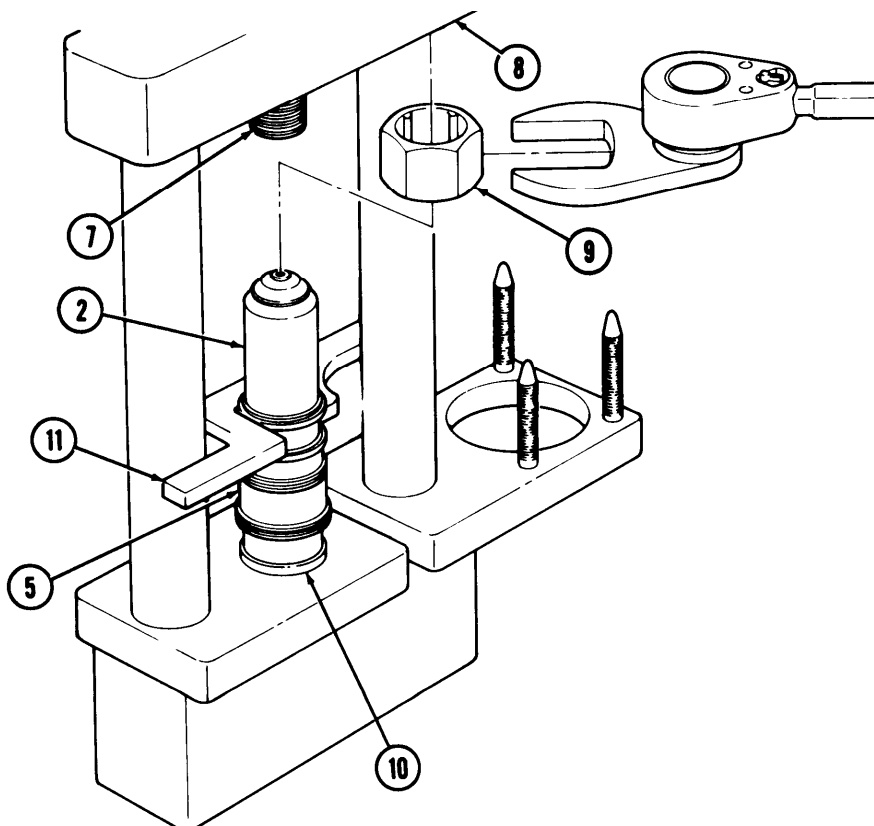
a. Coat with clean diesel fuel.

b. Insert into adapter (5).



4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
59.		Injector (10)	Place in loading fixture (8) as follows: a. Remove loading fixture stud (7) in holding fixture (8) and insert injector (10) into loading fixture (8). b. Slide body wrench (11) over flats on injector adapter (5). c. Position cup retainer wrench (9) on cup retainer (2).	
60.		Loading fixture stud (7)	Install in fixture (8) and tighten to 75 lb-in. (8 N·m).	
61.		Cup retainer (2)	Tighten to 50 lb-ft (68 N·m).	Use torque wrench and crowfoot wrench.
62.		Injector (10) and body wrench (11)	Remove from loading fixture (8).	



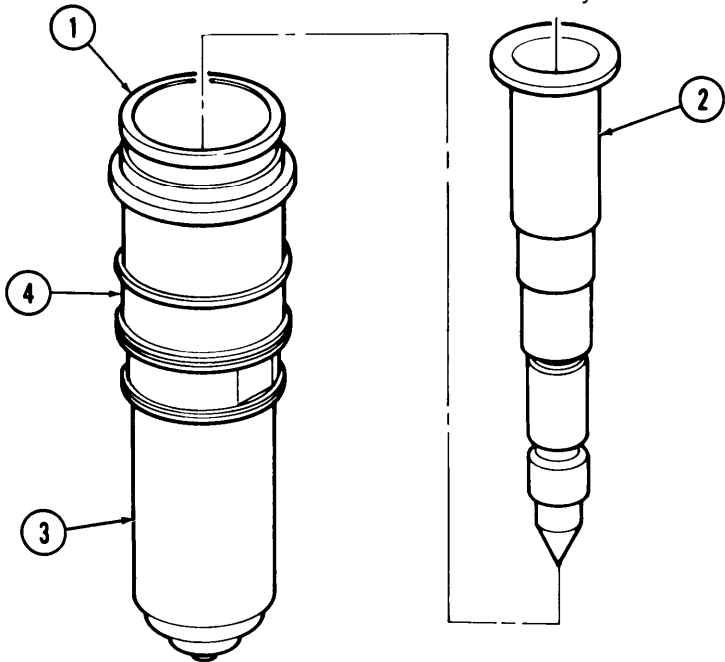
4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
63.		Plunger (2)	Remove from injector (4).	
64.			Check cup retainer (3) to plunger (2) alignment as follows: a. Coat plunger (2) with clean diesel fuel. b. Insert into injector (4) so plunger (2) remains .5 in. (12.7 mm) from edge of adapter (1). c. Using palm of hand, press plunger (2) into cup retainer (3).	

CAUTION

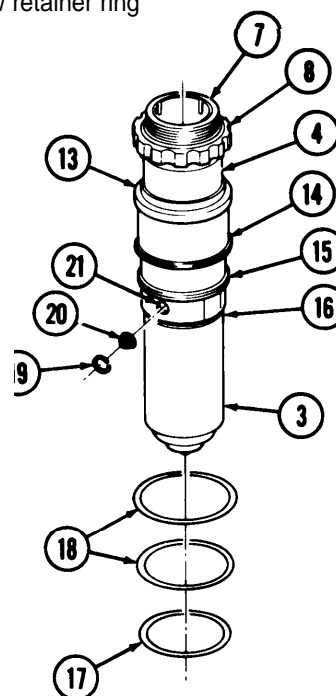
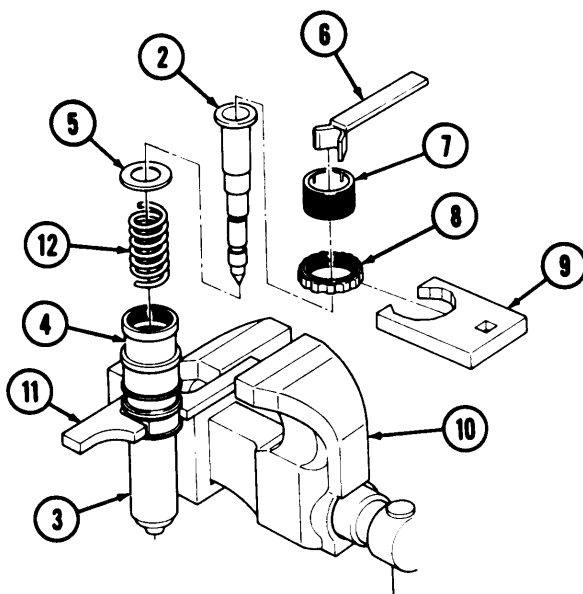
Do not allow plunger to fall out. Damage to plunger may result.

- d. With one hand, turn If plunger (2) does not slide out immediately, the injector (4) is not alined and must be reassembled as outlined in steps 35.3 through 35.13.



4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
65.		Body wrench (11)	Install in vise (10).	
66.		Injector (4)	Slide into body wrench (11).	
67.		Spring (12) and spring retainer (5)	Place in injector (4).	
68.		Plunger (2)	Slide into injector (4).	
69.		Locknut (8) and adjusting screw (7)	Thread into injector (4) until locknut (8) contacts 55 ft-lb. (75 N-m).	
70.	Body wrench (11)	Injector (4)	Remove.	
71.		Two new large "O" rings (18)	Starting at end of injector (4), slide into two upper grooves (14) and (15) of adapter (13).	
72.		New small "O" ring (17)	Starting at end of injector (4), slide into lowest groove (16) on adapter (13).	
73.		New inlet fuel screen (20)	Place over adapter orifice (21) and install with new retainer ring (19).	



END OF TASK!

FOLLOW-ON TASKS: Z Calibrate injector (para. 4-32).
Z Install injector (para. 4-27).

Section V. FUEL INJECTOR TESTS AND ADJUSTMENTS

4-29. FUEL INJECTOR TESTS AND ADJUSTMENTS TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
4-30.	Injector Leakage Test	4-102
4-31.	Injector Spray Pattern Test	4-110
4-32.	Injector Test Stand Calibration	4-114
4-33.	Injector Flow Test	4-122

4-30. INJECTOR LEAKAGE TEST

This task covers:

a. Setting Up Injector Leakage Tester**b. Testing Injector Plunger and Seat****INITIAL SETUP:**

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-27 Para. 4-28	Fuel injectors removed. Injectors cleaned.
<u>Test Equipment</u>		
Injector leakage tester		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		None
<u>Manual References</u>		
None		

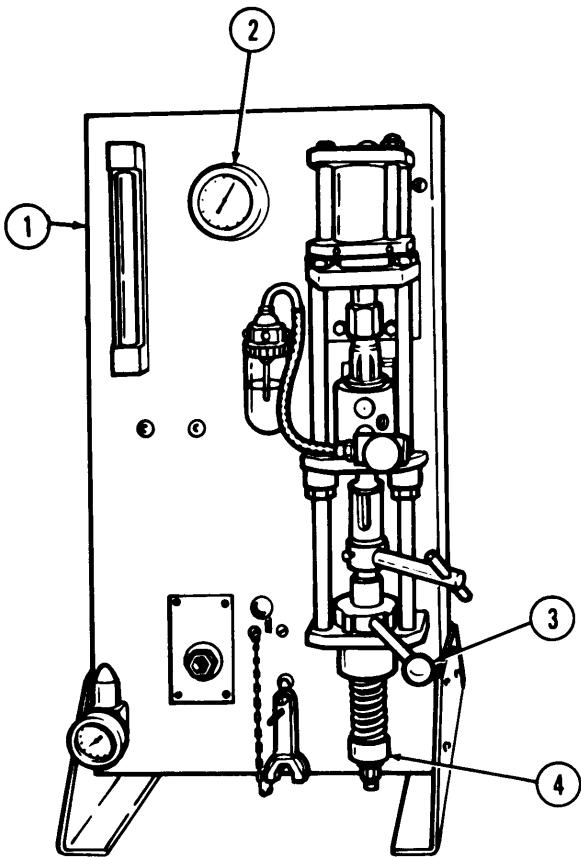
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Setting Up Injector Leakage Tester

1,	Leakage tester (1)	Pressure regulator (4)	Set at 60 psi (414 kPa).	Read pressure setting on gage (2).
2.		Cylinder actuation valve (3)	Operate three times, and reset pressure regulator gage (2) at precisely 60 psi (414 kPa).	Air pressure must be held at 60 psi (414 kPa) during all tests.

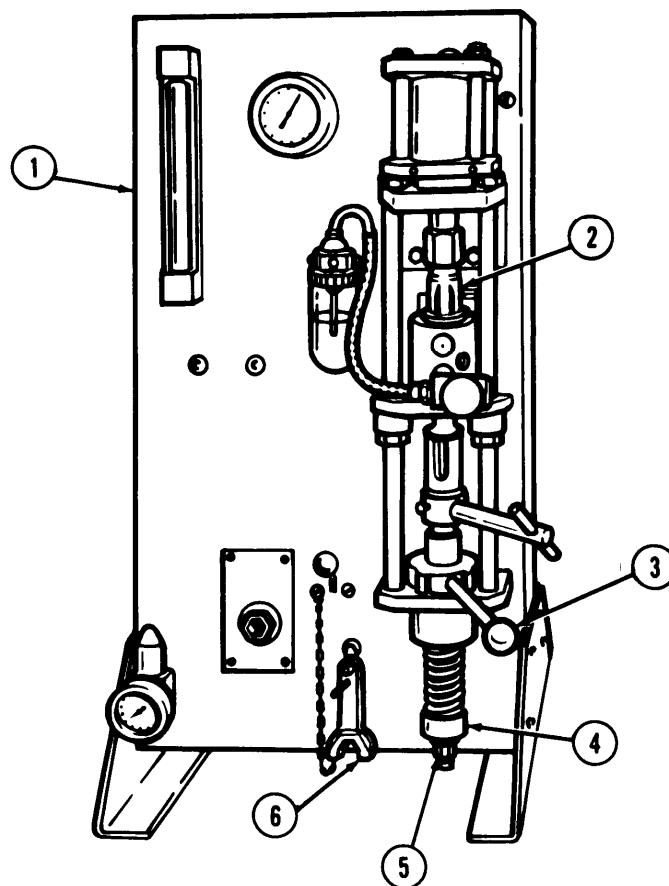
4-30. INJECTOR LEAKAGE TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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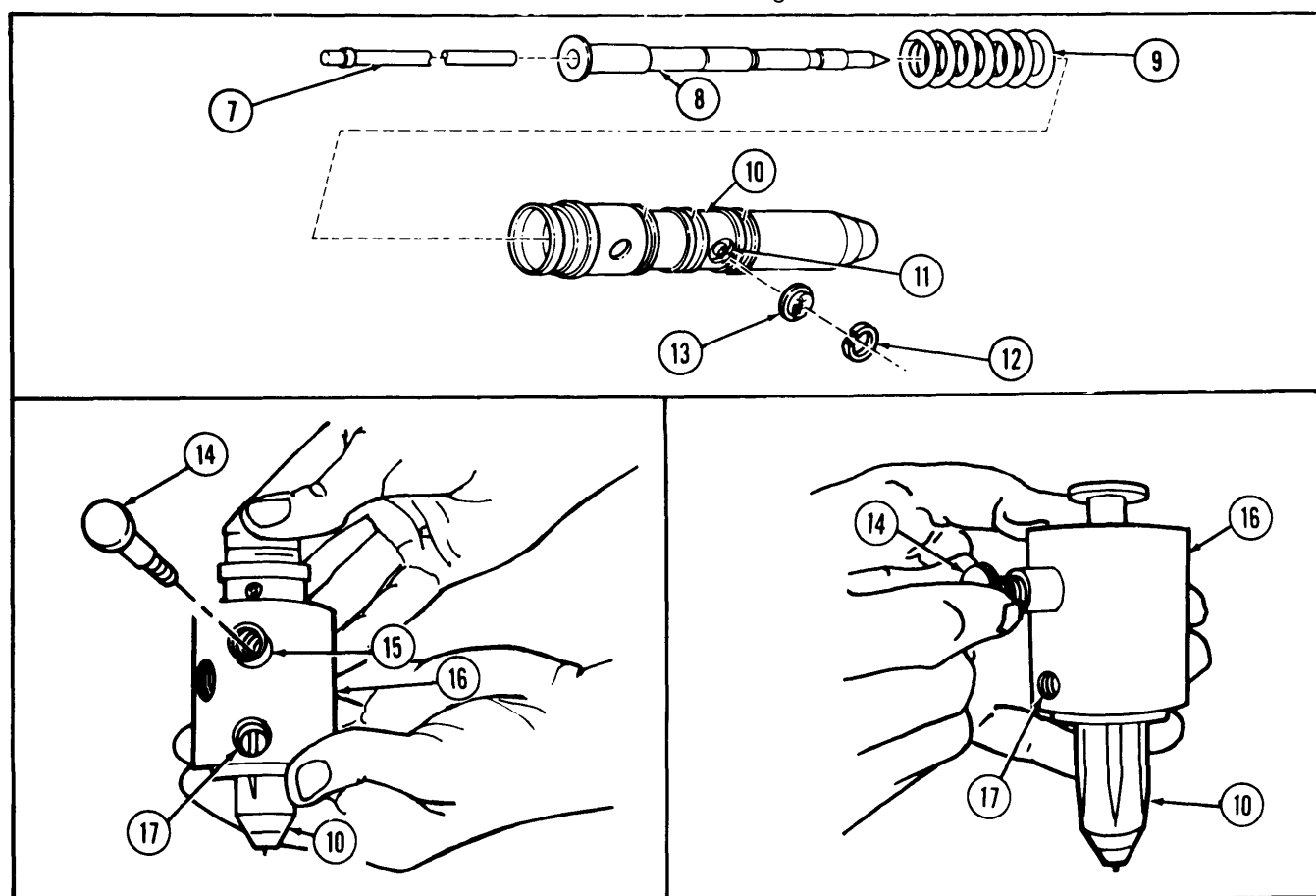
4-30. INJECTOR LEAKAGE TEST (Cont'd)

	LOCATION	ITEM	ACTION	REMARKS
3.	Leakage tester (1)	Retraction lever (3)	Place in position "A"	
4.		Load cell (2)	Position on leakage tester (1).	
5.	Load cell (2)	Knurled knob (4)	Adjust until load cell (2) reads 200 psi (1379 kPa).	
6.		Locknut (5)	a. Place feeler gage (6) between knurled knob (4) and locknut (5). b. Adjust.	Do not adjust locknut (5) unless load cell (2) is in use.
7.	Leakage tester (1)	Load cell (2)	Remove from leakage tester (1).	



4-30. INJECTOR LEAKAGE TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Testing Injector Plunger and Seat				
8.	Injector (10)	Plunger (8) and spring (9)	Remove.	
9.		Injector link (7)	Install injector link (7) in plunger (8) and place in injector (10).	
10.		Screen retainer (12) and screen (13)	Remove.	
11.		Burnishing tool adapter (16)	<p>a. Aline injector delivery orifice (11) with burnishing tool hole (17) on adapter (16).</p> <p>b. Insert locating screw (14) in locating screw hole (15) on adapter (16) and tighten.</p>	



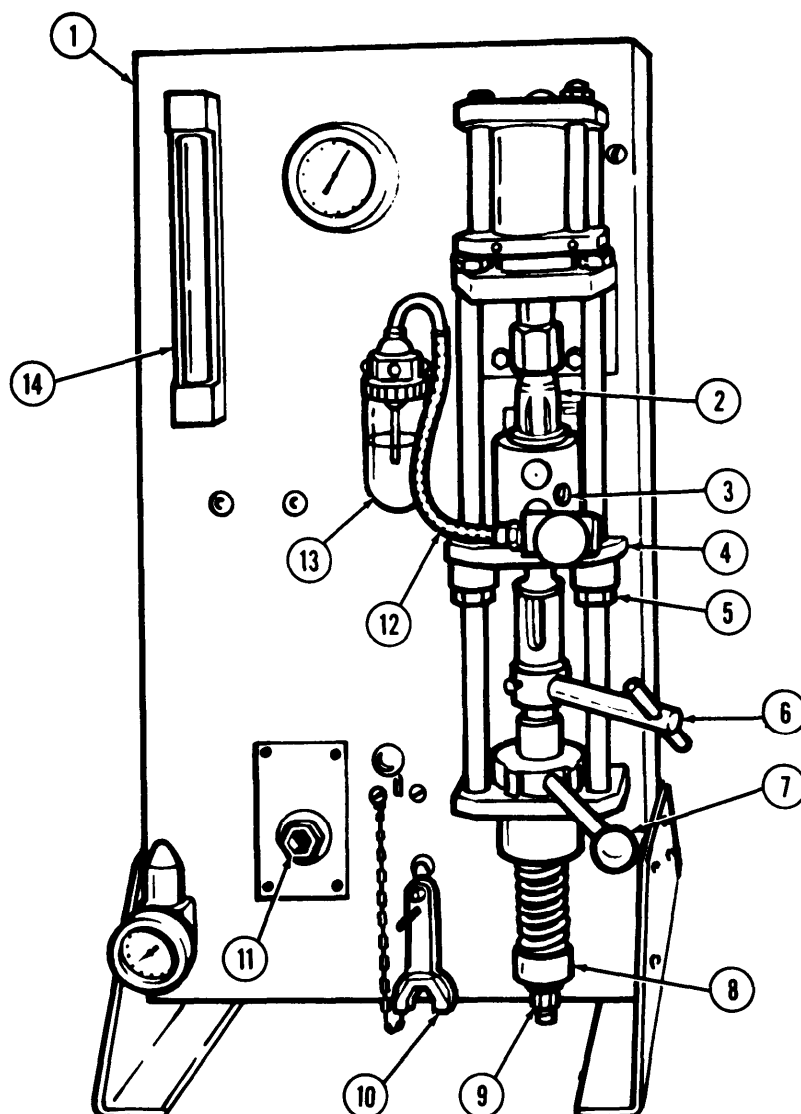
TA 349833

4-30. INJECTOR LEAKAGE TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
12.	Leakage tester (1)	Injector (2)	Position on support plate (4), and install in leakage tester (1).	Support plate (4) may be tilted.
13.		Feeler gage (10)	Place between knurled knob (8) and locknut (9).	Do not adjust locknut (9).
14.		Transfer line (12)	Install and tighten in injector adapter (3) drain port.	
15.		T-handle clamp (6)	Tighten.	
16.		Retraction lever (7)	Shift from position A to position B.	Make sure plunger (5) retracts.
17.		Plunger (5)	a. Rotate in clockwise direction a little at a time while reading air flow meter (14). b. Stop rotating plunger (5) when highest reading is obtained. c. Flow meter (14) should not indicate over 4.5 reading.	If reading is over 4.5, overhaul injector (2). Refer to para. 4-28.
18.		Retraction lever (7)	Shift from position B to position A.	
19.		T-handle clamp (6)	Loosen.	This will apply 200 lbs (91 kg) load to plunger (5).
20.			Check for injector cup leakage as follows: a. While observing checker (13), see if any bubbles appear during the first ten seconds of testing. No bubbles should appear. b. Once a bubble does appear, observe the time it takes for the next one to appear. No more than one bubble can appear every five seconds.	If bubbling is too high, overhaul injector (2). Refer to para. 4-28.

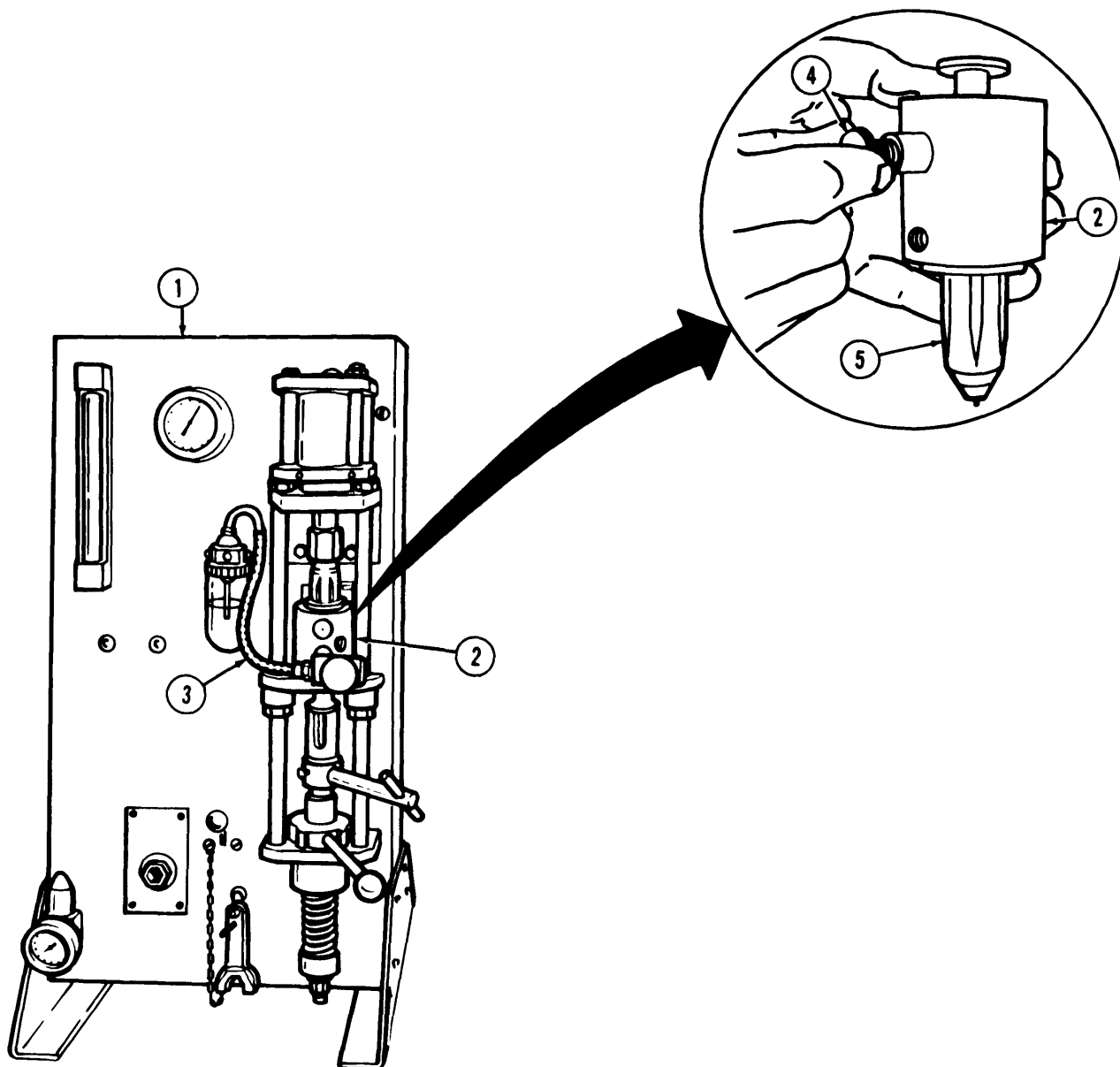
4-30. INJECTOR LEAKAGE TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
21.		Transfer line (12)	Remove from injector adapter (3) drain port.	
22.		Pressure regulator (11)	Release air pressure.	
23.		Adapter (3)	Remove from leakage tester (1).	



4-30. INJECTOR LEAKAGE TEST (Cont'd)

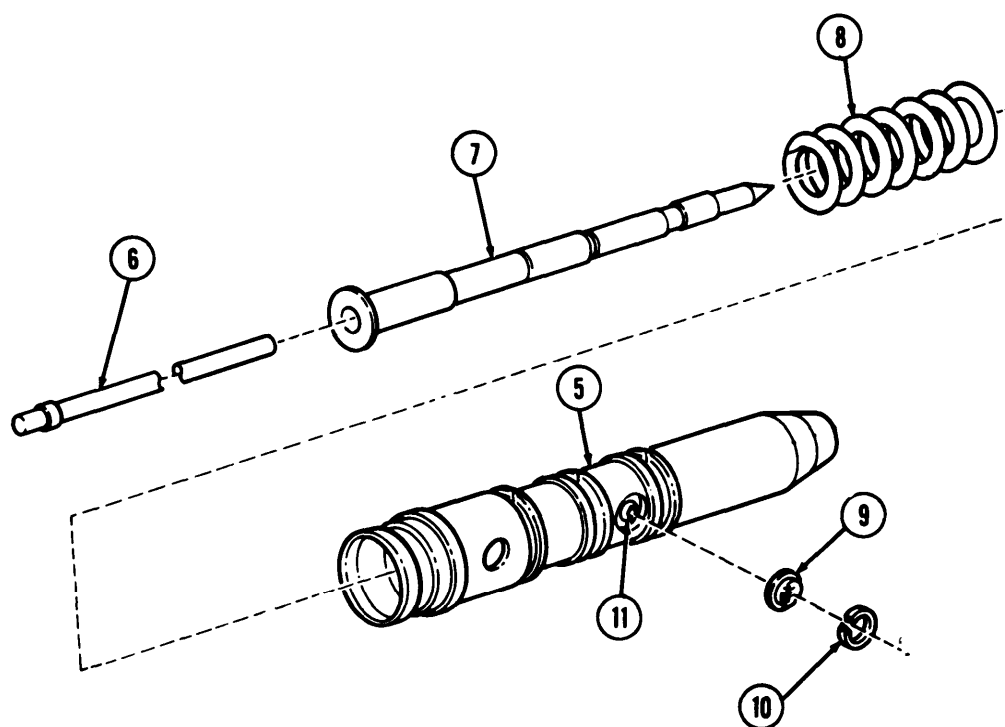
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
24.	Leakage tester (1)	Locating screw (4) and transfer line (3)	Remove from adapter (2).	
25.		Injector (5)	Remove from adapter (2).	



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4-30. INJECTOR LEAKAGE TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
26.		Inlet fuel screen (9)	Place over injector orifice (11), and install ring (10),	
27.		Plunger (7) and injector link (6)	Remove from injector (5).	
		Plunger (7) and spring (8)	Place in injector (5).	



END OF TASK!

TA 349836

4-31. INJECTOR SPRAY PATTERN TEST

This task covers:

a. Setting Up Spray Pattern Tester

b. Testing Spray Pattern

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 4-27 Para. 4-28	Fuel injectors removed. Injectors cleaned.
<u>Test Equipment</u>		
Injector test stand Spray pattern tester		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Fuel and electrical systems repairer MOS 63G		Whenever fuel is forced from injector spray holes keep hands away from spray stream.
<u>Manual References</u>		
None		

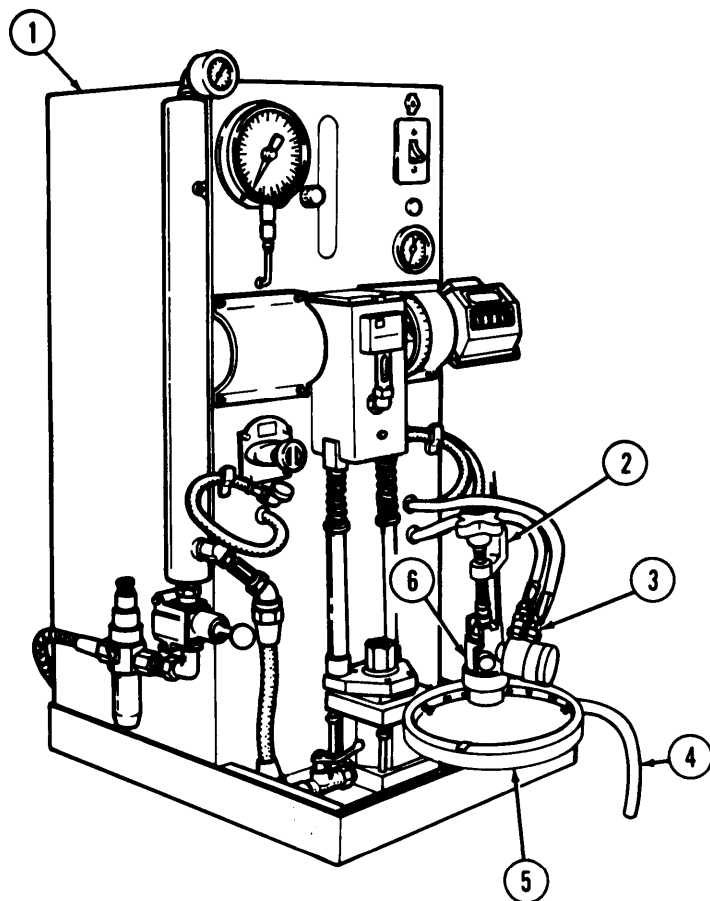
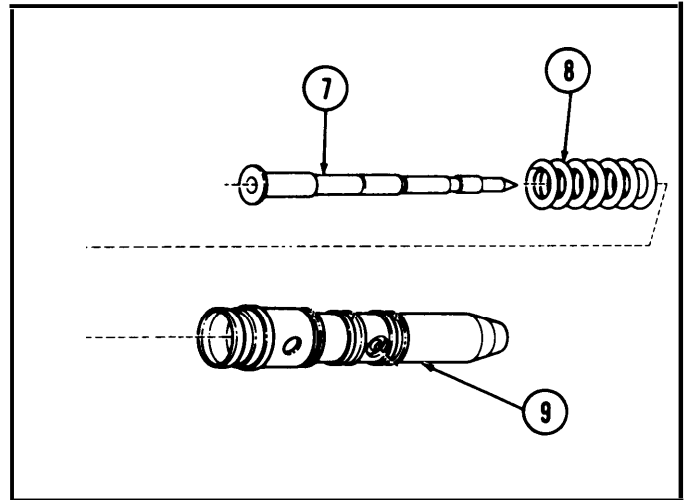
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Setting Up Spray Pattern Tester

1.	Injector test stand (1)	Spray pattern tester (2)	Locate near or on injector test stand (1).	Any source of 22 psi (152 kPa) constant fuel pressure will operate spray pattern tester (2).
2.		Inlet hose (3)	Attach to adapter (6) from injector test stand (1).	
3.		Drain hose (4)	Attach to adapter base (5), and place loose end in test stand (1) drain area.	
4.	Injector (9)	Plunger (7) and spring (8)	Remove.	Store in safe place.

4-31. INJECTOR SPRAY PATTERN TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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4-31. INJECTOR SPRAY PATTERN TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
5.	injector test stand (1)	Screen retainer (14) and inlet fuel screen (13)	Remove.	
6.		Adapter (7)	Place injector (11) in adapter (7).	
7.		Knurled plug (5)	Install in adapter (7) drain opening.	
8.		Injector (11)	Place in spray pattern tester (3), and tighten inlet hose connector (4).	
9.	Spray pattern tester (3)	Holddown bracket (8)	Install injector (11) to holddown bracket (8), with knurled knob (2).	
10.		Target ring (6)	Place target ring (6) on spray pattern tester (3).	Use target ring (6) marked "8-" .007 x 17".

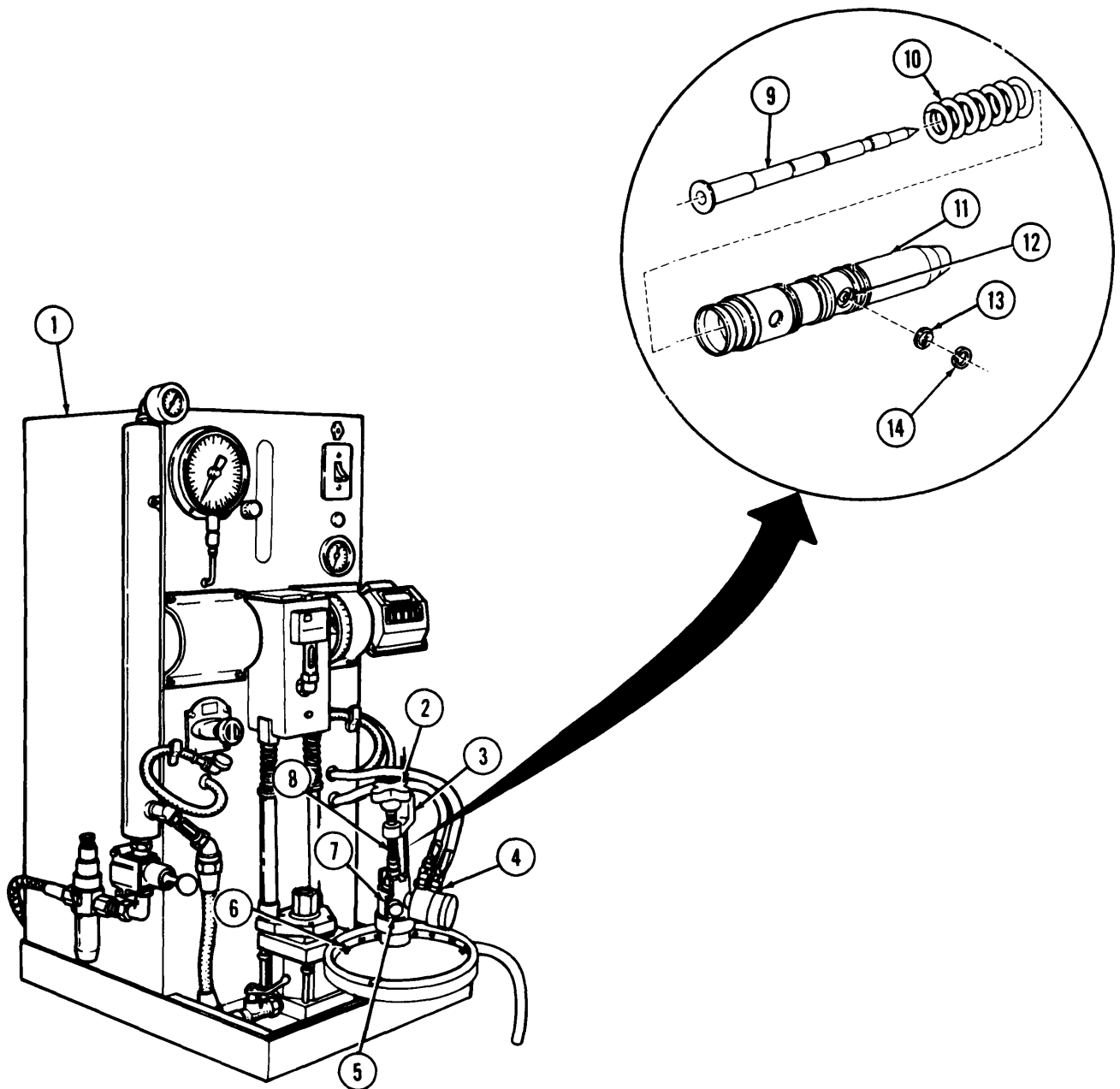
b. Testing Spray Pattern**WARNING**

Keep hands away from spray stream when fuel is forced from injector spray holes. Failure to do this may result in injury to personnel.

11.		Injector test stand (1)	Apply 22 psi (152 kPa) pressure.	
12.		Target ring (6)	a. Shift so one spray stream hits on no. 1 or index window. b. Each spray stream must hit a window in the target ring (6).	If spray stream is off 2° of window, replace the cup (para. 4-28).
13.	Spray pattern tester (3)	Holddown bracket (8)	Loosen knurled knob (2).	
14.		Injector (11)	Remove from spray pattern tester (3).	
15.		Knurled plug (5)	Remove from adapter (7).	
16.		Injector (11)	Remove from adapter (7).	
17.		Spring (10) and plunger (9)	Install in injector (11).	
18.		Inlet fuel screen (13)	Install over injector orifice (12) with screen retainer (14).	

4-31. INJECTOR SPRAY PATTERN TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 349838

4-113

4-32. INJECTOR TEST STAND CALIBRATION

This task covers:

a. Setting Up Test Stand

b. Test Stand Calibration

INITIAL SETUP:

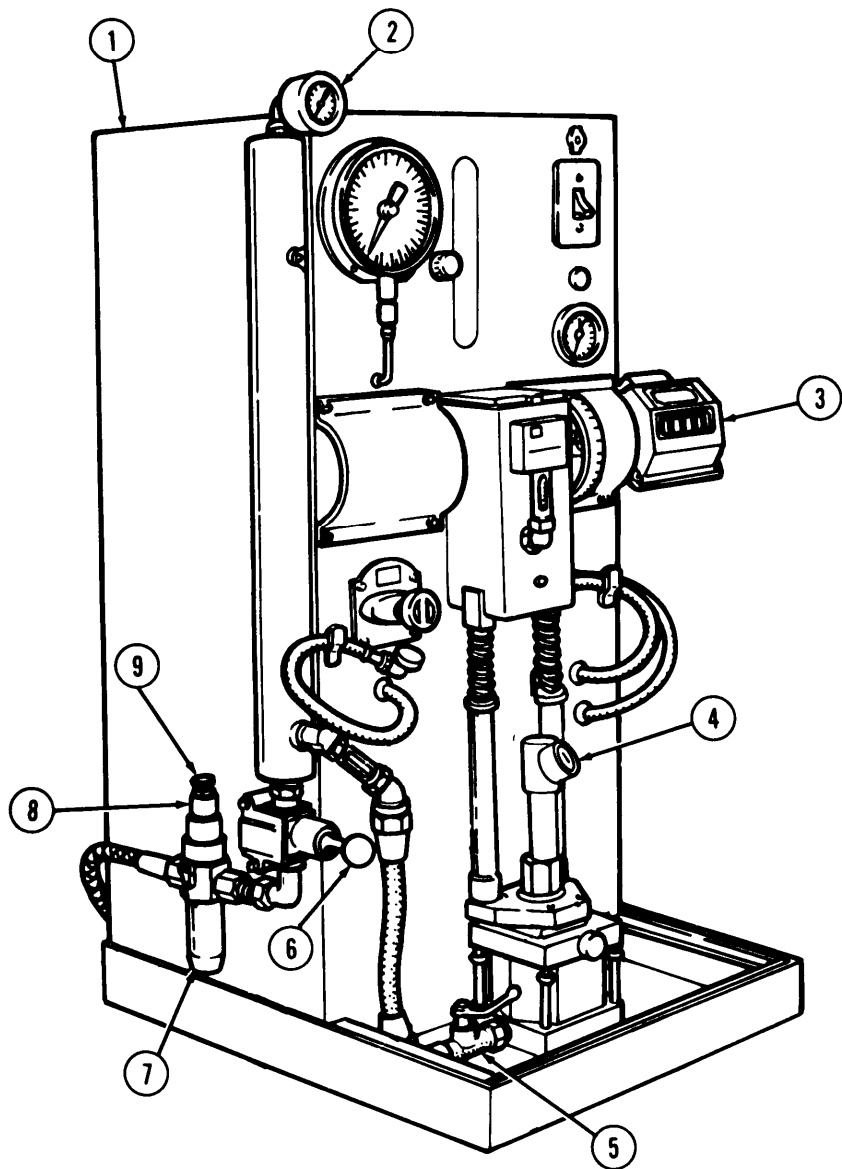
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
Injector test stand		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
Load cell tester	None	
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Fuel and electrical systems repairer MOS 63G	None	
<u>Manual References</u>		
None		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Setting Up Test Stand

1.	Injector test stand (1)	Counter wheel (3)	Rotate counter wheel (3) until wheel marks and pointer are aligned.	
2.		Hydraulic valve (5)	Open.	
<u>CAUTION</u>				
Never operate test stand with load cell in position.				
3.		Load cell tester (4)	Position on test stand (1), and secure by opening air valve (6).	
4.		Air regulator (7)	a. Adjust by turning knurled knob (9) until load cell tester (4) registers within coded range markings. b. Lock in place with locknut (8).	Record air gage (2) pressure reading.
5.		Load cell tester (4)	Remove as follows: a. Place air valve (6) to center position. b. Remove load cell tester (4).	

4-32. INJECTOR TEST STAND CALIBRATION (Cont'd)				
STEP NO.	LOCATION	ITEM	ACTION	REMARKS



4-32. INJECTOR TEST STAND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
6.	Injector test stand (1)	Cylinder (7)	When down, hydraulic fluid should show in sight bulb (11).	
7.		Air valve (9)	Open when cylinder (7) is at the top of its travel; no air should show in sight glass (10).	If air is indicated, tighten all line connections.

NOTE

The master injector is precalibrated and must never be tampered with.

Adapter (17)

Place on master injector (14).

Make sure wheel marks and pointer are alined. Refer to step 1.

NOTE

Make sure injector seat contains 0.020 in, (0.51 mm) restrictor orifice,

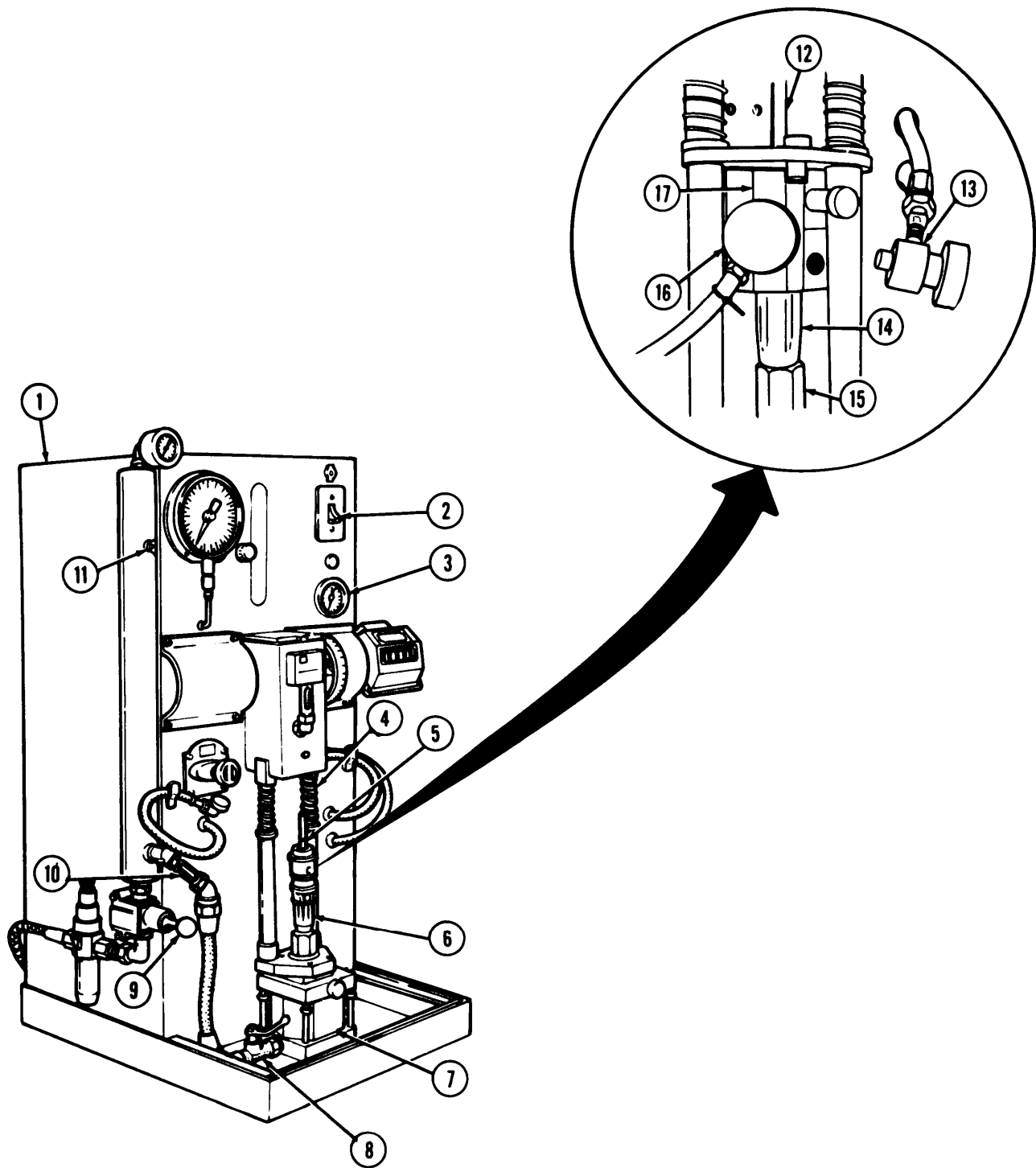
9.	Injector test stand (1)	Test stand link (12)	Position over injector link (5). Place master injector (6) in injector seat (15).	Tip back until test stand link (12) is below test stand push rod (4) and not rubbing.
10.		Air valve (9)	Open to clamp master injector (6) in place.	Make sure test stand link (12) is alined.
11.		Hydraulic valve (8)	Close to lock master injector (6) in place.	
12.		Test stand fuel drain connector (16)	Connect to adapter (17).	
13.		Test stand fuel inlet connector (13)	Connect to adapter (17).	

CAUTION

If temperature exceeds 13°F (57°C), drain and replace with new test oil.

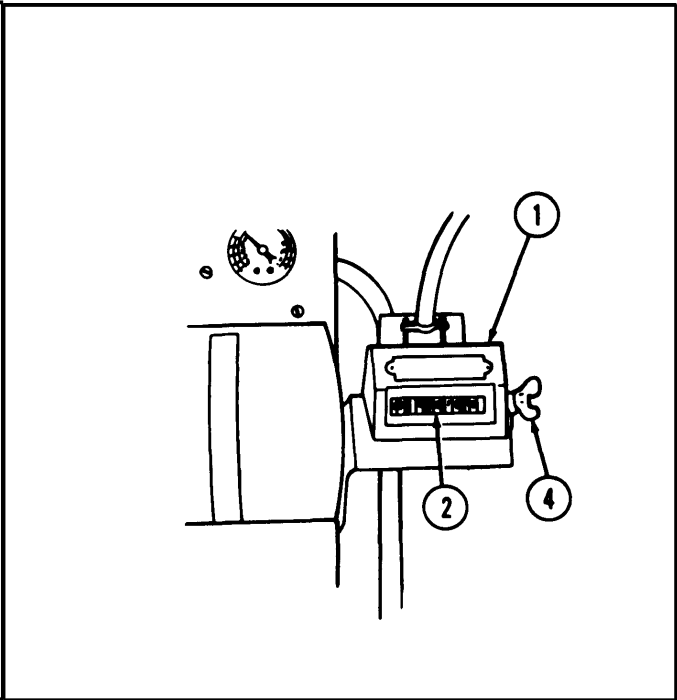
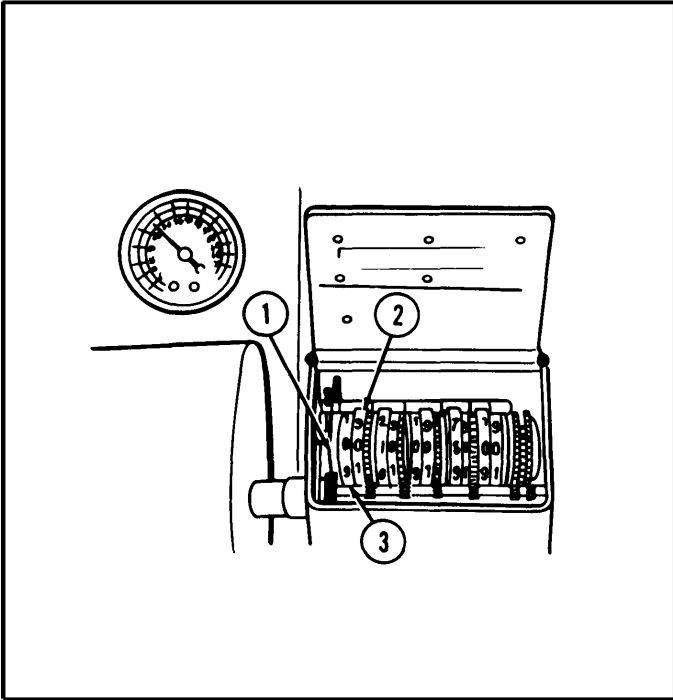
14.	Injector test stand (1)	Motor switch (2)	Place in START position.	Temperature gage (3) should read 90°-95°F (32°-35°C).
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4-32. INJECTOR TEST STAND CALIBRATION (Cont'd)				
STEP NO.	LOCATION	ITEM	ACTION	REMARKS



4-32. INJECTOR TEST STAND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
15.		Counter (1)	Set as follows: a. Shift the silver colored counter wheels (3) to the right. b. Rotate to indicate 1020 strokes, and release. c. Clear counter (1) by rotating thumb screw (4) one complete revolution.	All white-colored counter wheels (2) must read zero.
b. Test Stand Calibration				
16. Test stand (5)		Regulator knob (9)	Adjust by turning, until pressure gage (6) reads 120 psi (827 kPa).	Pressure must be maintained at 120 psi (827 kPa) during calibration.

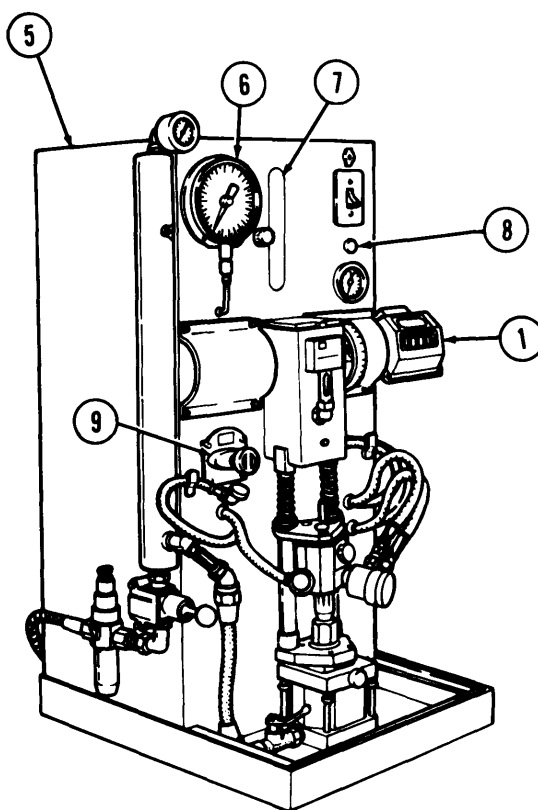


4-32. INJECTOR TEST STAND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
17.		Red flow start switch (8)	Press in and out until counter (1) reads 1020 count strokes.	
18.		Vial (7)	Look directly into vial (7) and observe reading.	Correct reading is 132 cc at 120 psi (827 kPa).

NOTE

Reading of 132 cc at 120 psi indicates test stand is in calibration. If reading is more than 132 cc, the test stand is not set up properly. Repeat setup steps. If reading is below 132 cc, continue.

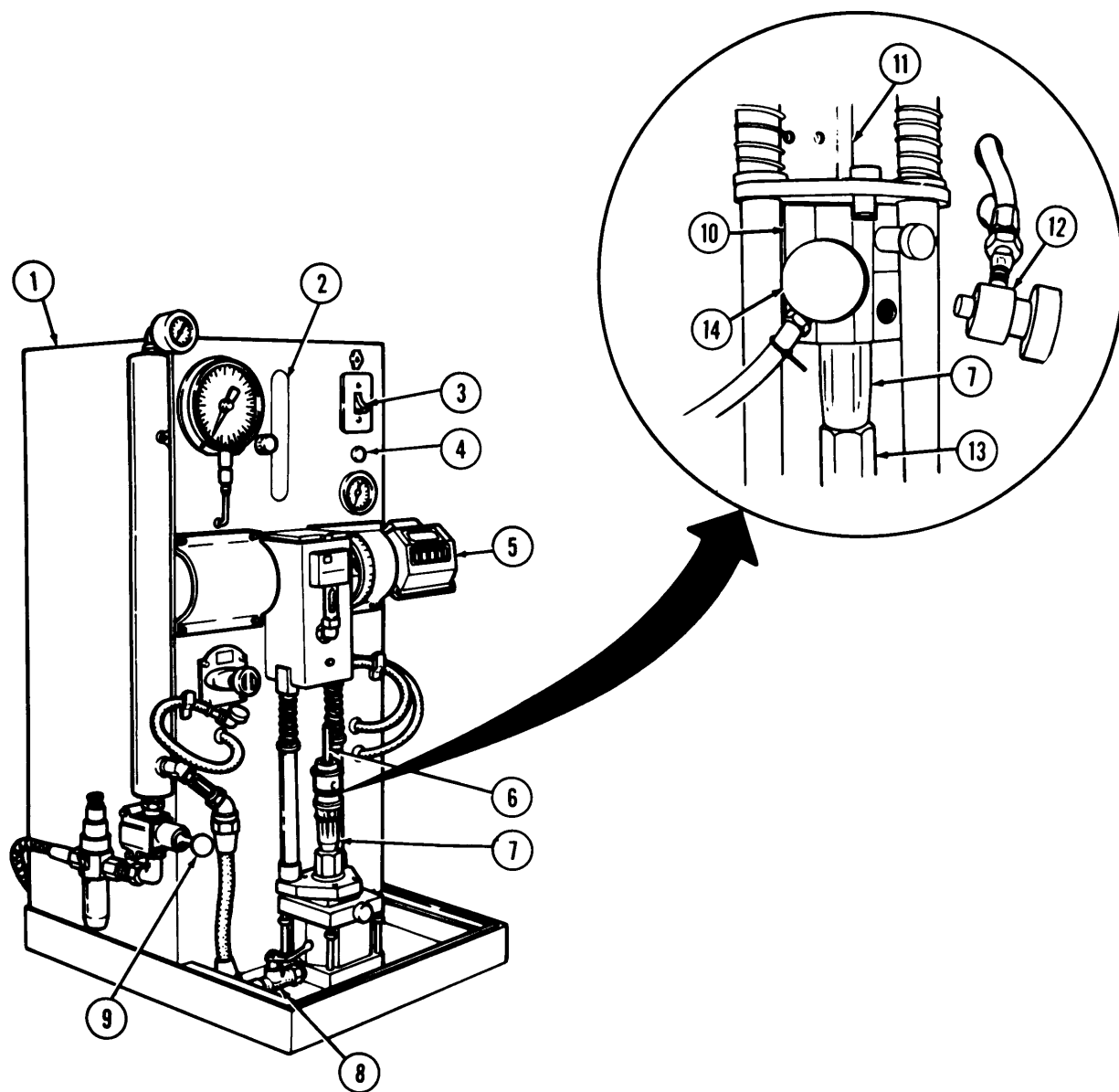


4-32. INJECTOR TEST STAND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
19.	Injector test stand (1)	Counter (5)	a. Reset to zero. b. Set counter (5) up 7 strokes for each cc less than 132 cc.	Refer to step 15.
20.		Vial (2)	Dump fuel.	
<p style="text-align: center;">NOTE</p> <p>If counter is set beyond 1050 strokes to obtain 132 cc, the test stand is not set up properly. Repeat setup steps. If counter reads 1050 or below, the test stand is in calibration.</p>				
21.		Red flow start switch (4)	Press in and out until counter (5) sets strokes to obtain 132 CC.	
22.	Injector test stand (1)	Motor switch (3)	Place in STOP position.	
23.		Test stand fuel drain connector (14)	Remove from adapter (10).	
24.		Hydraulic valve (8)	Open.	
25.		Air valve (9)	Close.	
26.		Master injector (7)	Remove from injector seat (13).	
27.		Test stand link (11)	Slide off injector plunger link (6).	
28.		Adapter (10)	a. Remove test stand fuel inlet connector (12), b. Remove adapter (10) from master injector (7).	

4-32. INJECTOR TEST STAND CALIBRATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 349843

4-33. INJECTOR FLOW TEST

This task covers:

- a. Setting Up Test Stand
- b. Testing Check Ball Seating
- c. Adjusting and Measuring Fuel Delivery

INITIAL SETUP:

Applicable Models

All

Equipment
Condition
Reference

Para. 4-27
Para. 4-28
Para. 4-32

Condition Description

Fuel injector removed,
Injector cleaned.
Injector test stand calibrated.

Test Equipment

Injector test stand

Special Tools

None

Special Environmental Conditions

Clean work area.

Materials/Parts

Gasket

Personnel Required

Fuel and electrical systems repairer MOS 63G

General Safety Instructions

None

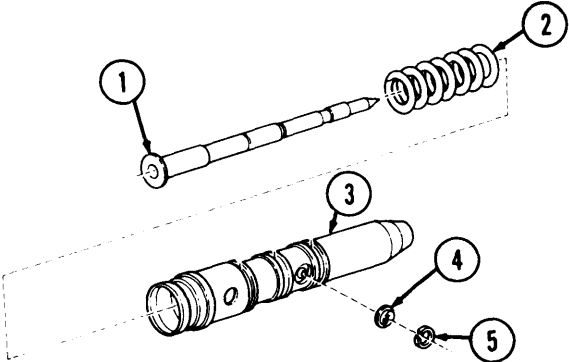
Manual References

TM 9-2320-272-34P

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Setting Up Test Stand

1. Injector (3)
Screen retainer ring (5) and inlet fuel screen (4)
Remove.
2. Plunger (1) and spring (2)
Remove from injector (3) and separate plunger (1) from spring (2).
3. Plunger (1)
Place in injector (3) without spring (2).



4-33. INJECTOR FLOW TEST (Cont'd)

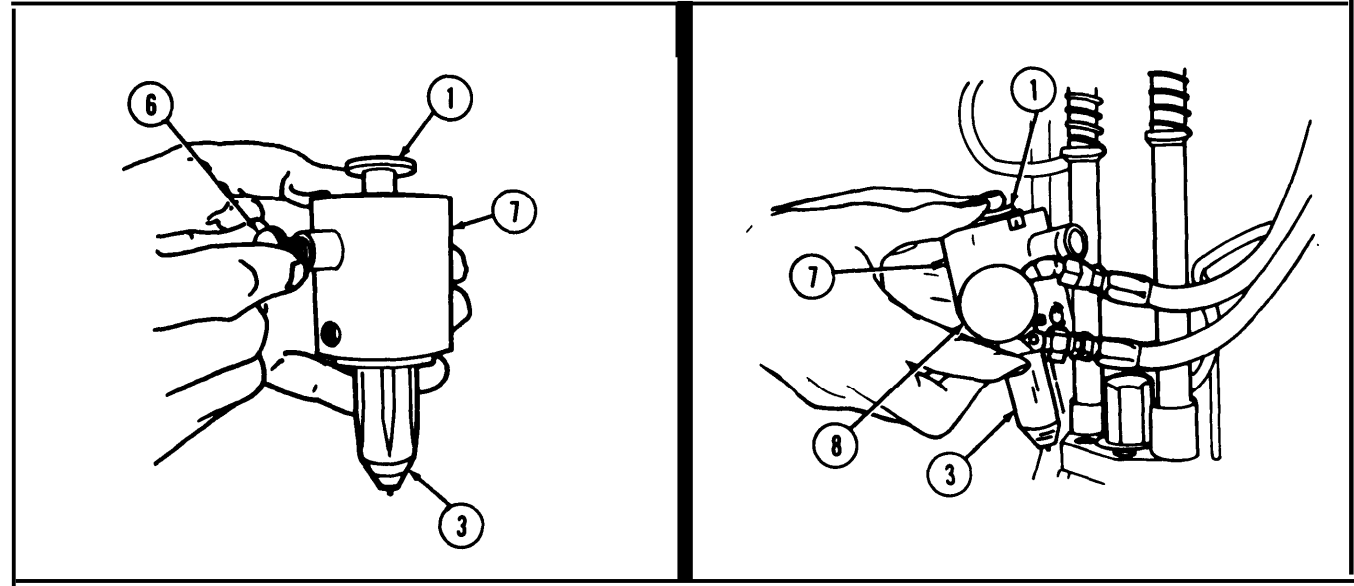
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
4.		Burnishing tool adapter (7)	Lubricate inside with diesel fuel.	
CAUTION Injector inlet port and burnishing tool adapter inlet hole must be alined to prevent damage to the burnishing tool points when installed later.				
		Injector (3)	a. Position in burnishing tool adapter (7) so injector (3) inlet port and adapter (7) inlet holes aline. b. Install by tightening locating screw (6) on burnishing tool adapter (7).	
6.		Test stand inlet pressure line adapter' (8)	Connect to burnishing tool adapter (7).	

b. Testing Check Ball Seating

NOTE

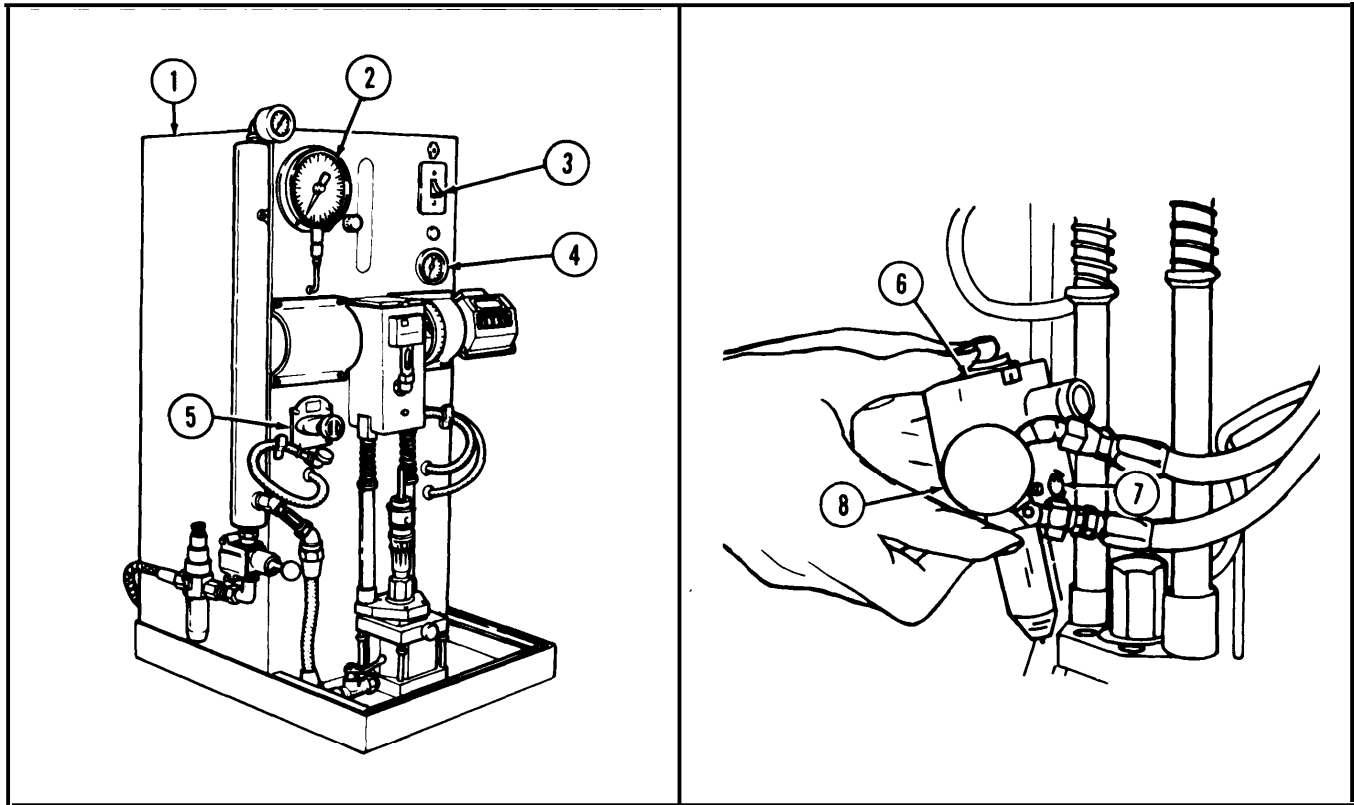
Hold injector in hand; do not place in test stand holding device.

7.	Injector (3)	Plunger (1)	Hold plunger (1) down in injector (3) as shown.
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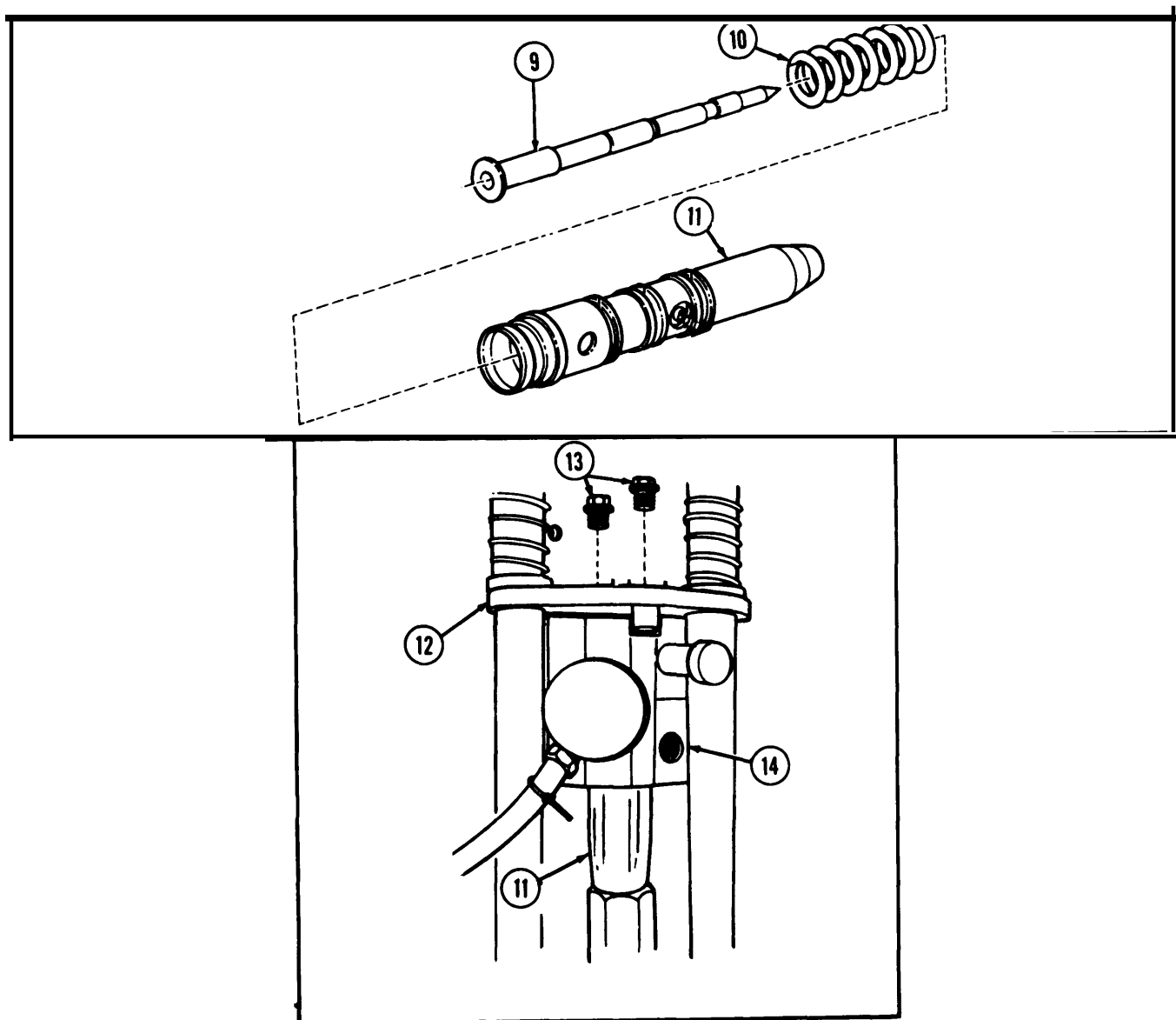
4-33. INJECTOR FLOW TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
8.	Injector test stand (1)	Motor switch (3)	Place in START position.	Temperature gage (4) should read 90°-95°F (32°-35°C).
If temperature exceeds 135°F (57°C), drain and replace with new test oil.				
9.		Regulator knob (5)	Adjust by turning until pressure gage (2) reads 150 psi (1034 kPa).	
10.		Burnishing tool adapter (6)	Check burnishing tool installation hole (7) for leaks.	A slight seepage is not harmful. If leakage is found, replace check ball. Refer to para. 4-28.
11.	Injector test stand(1)	Motor switch (3)	Place in STOP position.	
12.		Test stand inlet pressure line adapter (8)	Disconnect from burnishing tool adapter (6).	



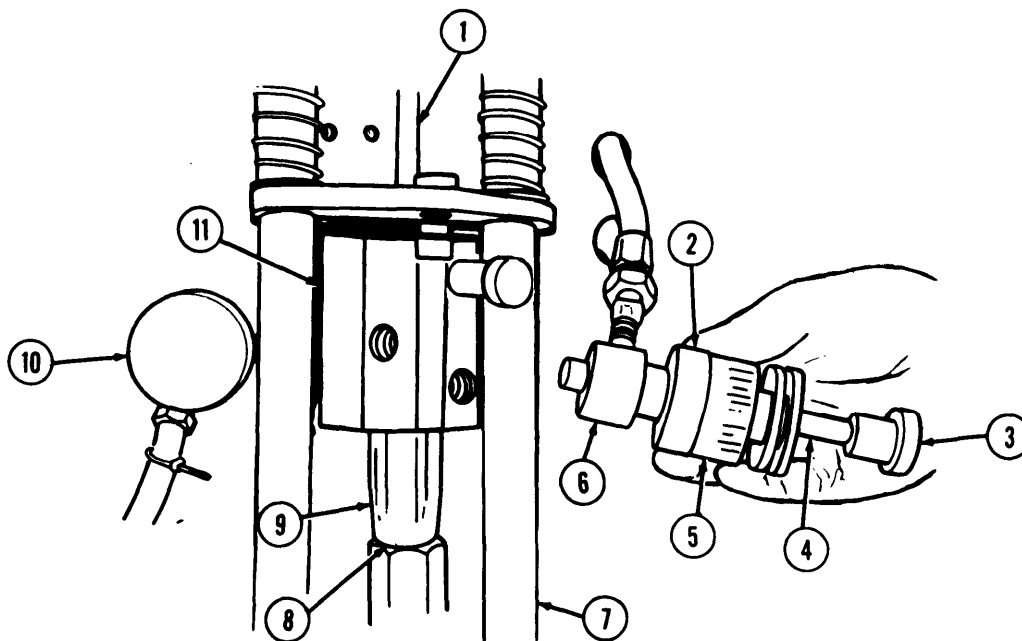
4-33. INJECTOR FLOW TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
c. Adjusting and Measuring Fuel Delivery				
13.	Injector test stand (1)	Plunger (9)	Remove from injector (11).	
14.		Spring (10) and plunger (9)	Slide spring (10) on plunger (9), and place in injector (11).	
15.		Retainer plate (12)	Place on burnishing tool adapter (14), and secure with pins (13).	



4-33. INJECTOR FLOW TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
16.	Injector teststand (7)	Test stand link (1)	Place in burnishing tool adapter (11).	Use test stand link (1) 6.5 in. (17 cm) long marked ST 790-331.
17.		Injector (9)	Place in test stand (7) so injector (9) is in injector seat (8).	Tip back until test stand link (1) is below test stand push rod (13), and is not rubbing.
18.		Burnishing tool (2)	Install in test stand inlet pressure line adapter (6).	
19.		Burnishing tool needle (4)	Retract by pulling small knob (3) out.	With needle (4) retracted, burnishing tool (2) may be left in adapter (11) during all test operations,
20.		Test stand inlet pressure line adapter (6)	Connect to burnishing tool adapter (11) inlet hole.	Connect by screwing in large knob (5).
21.		Drain connector (10)	Install in burnishing tool adapter (11).	

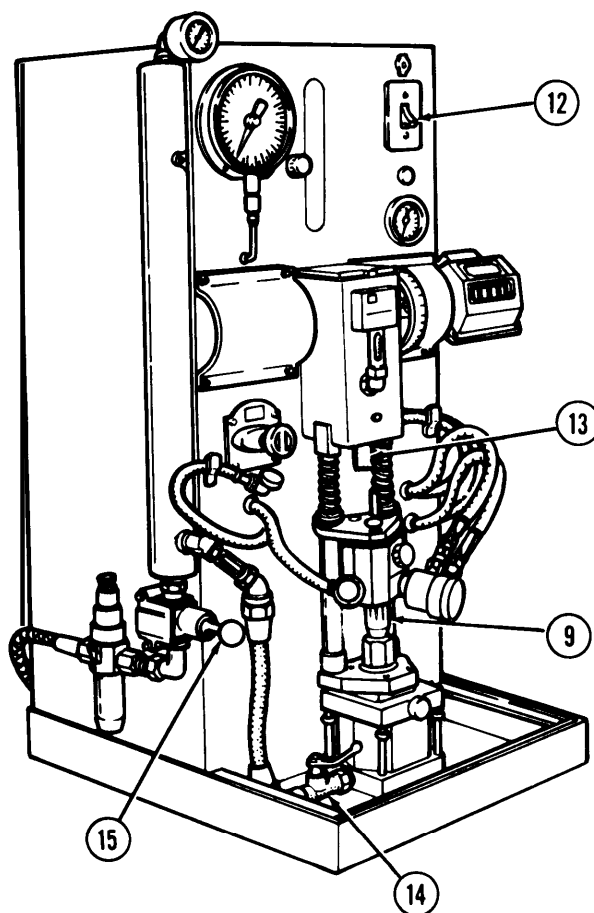


4-33. INJECTOR FLOW TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
22.		Air valve (15)	Clamp injector (9) in place by opening air valve (15).	Make sure test stand link (1) is aligned.
23.		Hydraulic valve (14)	Lock injector (9) in place by closing.	
24.		Motor switch (12)	Place in START position.	Temperature should read 90°-95°F (32°-35°C).

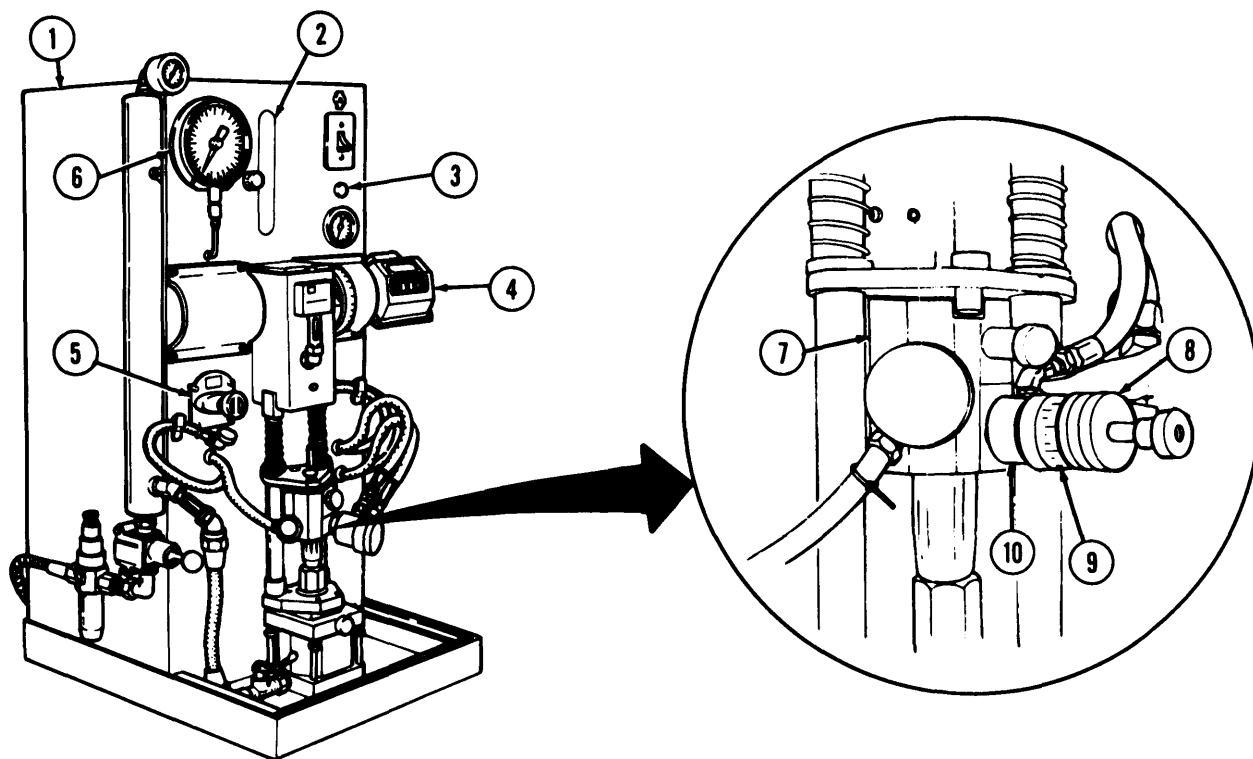
CAUTION

If temperature exceeds 135°F (57°C), drain and replace with new test oil.



4-33. INJECTOR FLOW TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
25.	Injector test stand (1)	Regulator knob (5)	Adjust by turning until pressures gage (6) reads 120 psi (827 kPa).	
26.		Red flow start switch (3)	Press in until counter (4) reads the same as master injector counter strokes.	
27.		Vial (2)	Observe reading.	Correct reading is 121-122 cc at 120 psi (827 kPa). If reading is higher, perform steps 29 through 31 to install new orifice plug (13). If lower, perform step 32 to set fuel flow.
28.		Test stand inlet pressure line adapter (10) and burnishing tool (8).	Remove from burnishing tool adapter (7) by turning large knob (9) out until assembly is free.	



TA 349850

4-28. FUEL INJECTOR OVERHAUL INSTRUCTIONS

This task covers:

- a. Non-Top Stop Injector Disassembly
- b. Top Stop Injector Disassembly
- c. Inspection

- d. Non-Top Stop Injector Assembly
- e. Top Stop Injector Assembly

INITIAL SETUP:

Applicable Models

All

Equipment Condition Reference

Para. 4-27

Condition Description

Fuel injectors removed.

Test Equipment

None

Special Tools

Cup retainer wrench ST-995
Crowfoot injector wrench ST-1072
Adjusting wrench 3375165
Locknut wrench 3375166
Injector body wrench ST-1298

Special Environmental Conditions

None

Materials/Parts

Injector overhaul kit AR-51522

General Safety Instructions

Keep fire extinguisher nearby when using drycleaning solvent.

Personnel Required

Fuel and electrical systems repairer MOS 63G

Manual References

TM 9-2320-272-34P

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Non-Top Stop Injector Disassembly

- | | | | |
|----|-------------------|---------------------------|------------------------------|
| 1. | Injector link (1) | Remove from injector (8). | Set aside to prevent damage. |
|----|-------------------|---------------------------|------------------------------|

WARNING

Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.

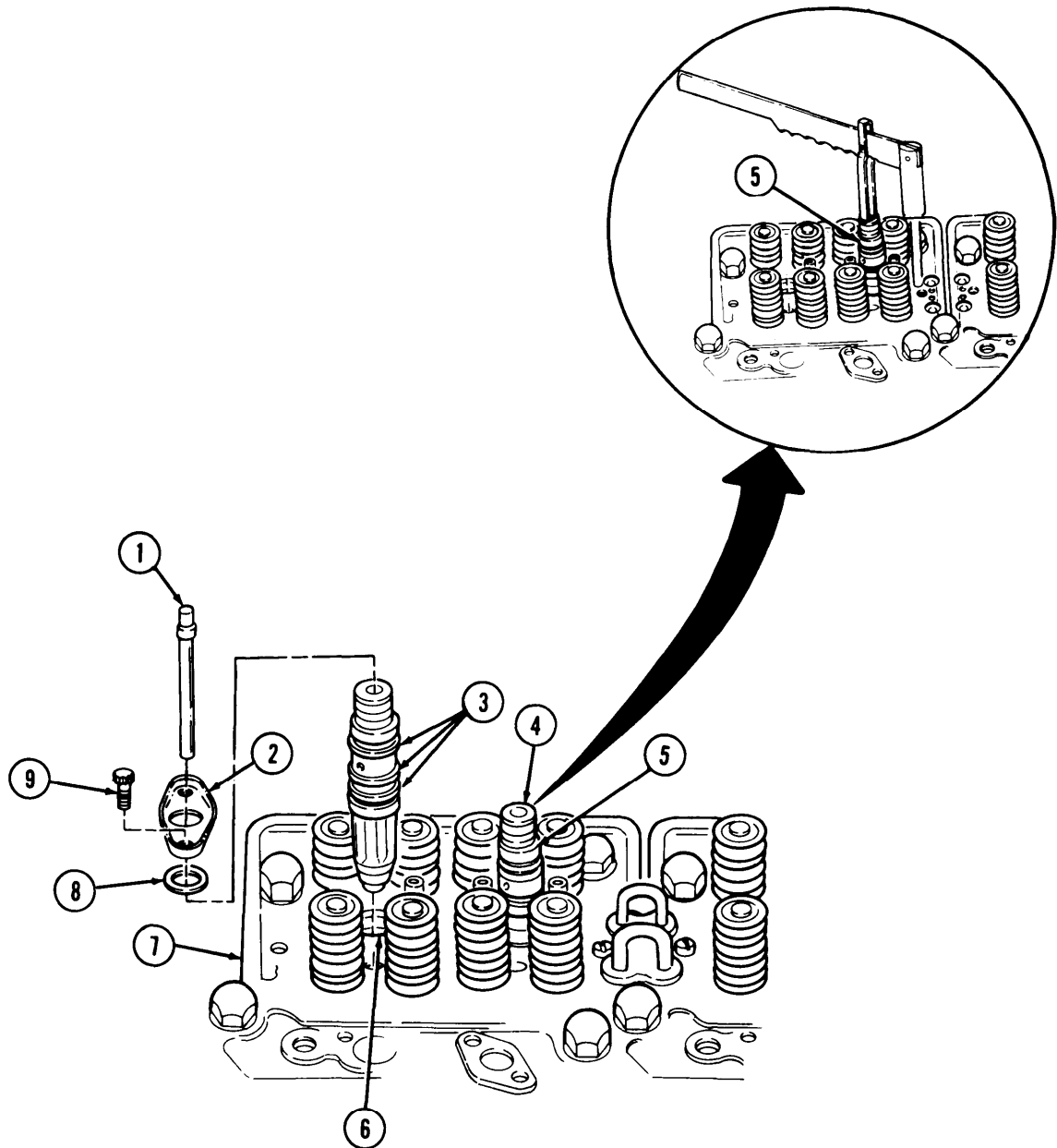
CAUTION

Improper cleaning methods and use of unauthorized cleaning solvents can damage equipment.

- | | | | |
|----|--------------------------|--|--------------------|
| 2. | Exterior of injector (8) | Clean exterior with drycleaning solvent. | Refer to para 2-7. |
|----|--------------------------|--|--------------------|

4-27. FUEL INJECTOR REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS:

- Install rocker lever housing(s) and push tubes (para. 3-1 7).
- Start engine (TM 9-2320-272-10) and check around cylinder head for leaks. Also check exhaust system for evidence of heavy black smoke, which indicates malfunction.

TA 349820

4-27. FUEL INJECTOR REPLACEMENT (Cent'd)

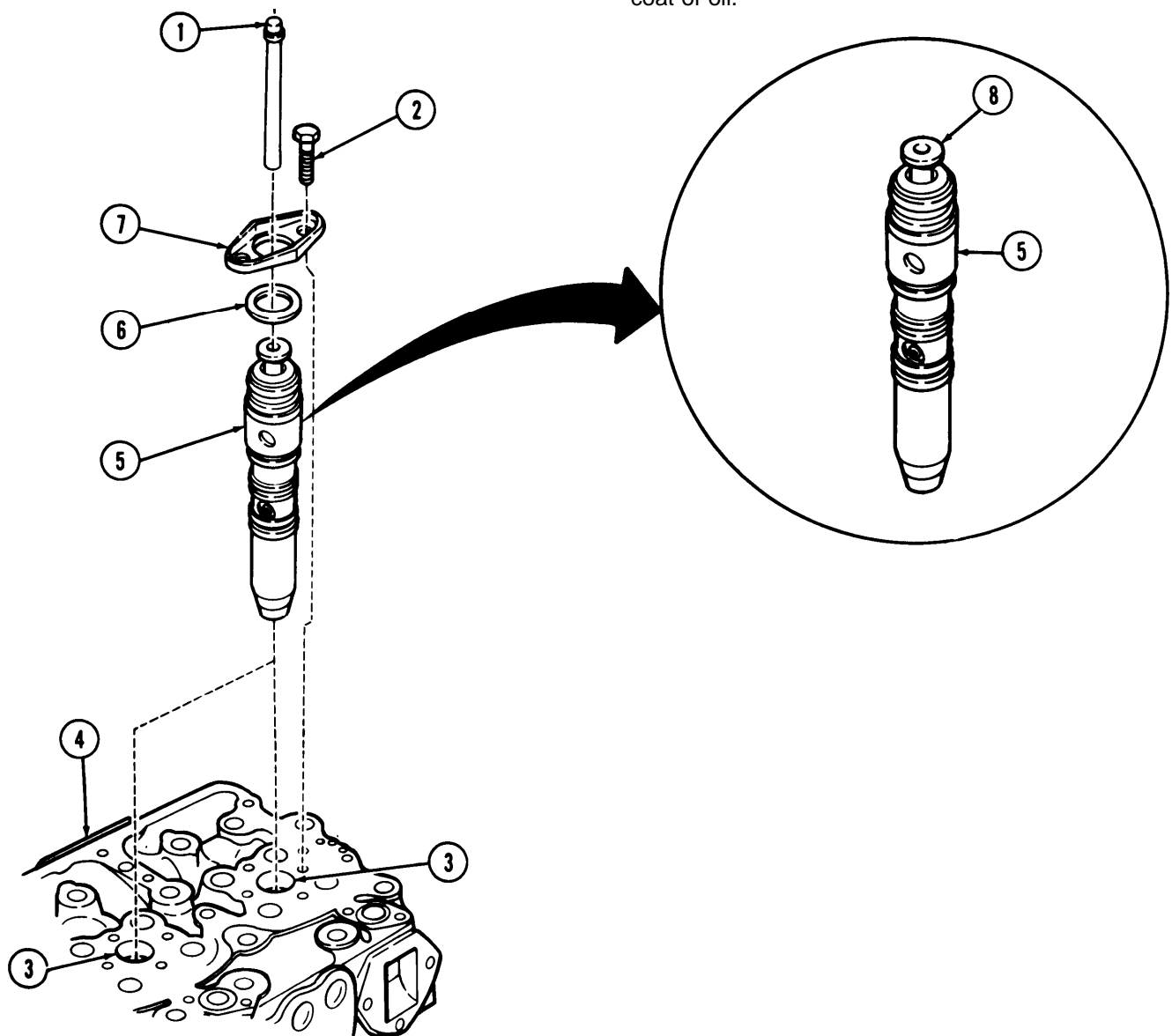
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Installation				
<p style="text-align: center;"><u>CAUTION</u></p> <p>Make sure no foreign objects have fallen into cylinder head through injector bore.</p> <p style="text-align: center;"><u>NOTE</u></p> <ul style="list-style-type: none"> • If injector condition is unknown, or has been disassembled, it must be calibrated before installation. Refer to para. 4-32. • Install injector from intake side of engine. 				
5.	Cylinder head (7)	Injector (5)	a. Lubricate injector "O" rings (3) with light coat of oil. b. Start injector (5) into injector bores (6). c. Place spring compressor on top of injector plunger (4) and seat injector (5) by giving a quick, hard push.	Aline screen on fuel inlet hole with exhaust side of cylinder head (7). A click should be heard when injector (5) seats properly.
6.		Washer (8), clamp plate (2), and two screws (9)	Place washer (8) and clamp plate (2) over injector (5) and start screws (9).	Do not tighten.
7.		Injector link (1)	a. Carefully insert into injector (5). b. Raise link (1) 1/3 its length, and allow to fall back. If link(1) binds or sticks, loosen screws (9), and retighten.	Tighten screws (9) 11-12 lb-ft (15-16 N•m) in 4 lb-ft (5 N•m) steps.

4-27. FUEL INJECTOR REPLACEMENT (Cent'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
3.	Cylinder head (4)	Injector (5) and plunger (8)	Remove.	Use roll head prybar. Place injector (5) in safe place. Tag for installation.

Plug all open bores. Not doing this can damage engine.

- | | | |
|----|-------------------|--|
| 4. | Injector bore (3) | Wipe with clean cloth, and lubricate with light coat of oil. |
|----|-------------------|--|



Section IV. FUEL INJECTOR MAINTENANCE

4-26. FUEL INJECTOR MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	Page NO.
4-27.	Fuel Injector Replacement	4-86
4-28.	Fuel Injector Overhaul Instructions	4-90

4-27. FUEL INJECTOR REPLACEMENT

This task covers:

- a. Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-17	Rocker lever housing(s) and push tubes removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		
None		
<u>Materials/Parts</u>		
Protective cap-plugs (Appendix C, Item 5)		
Lubricating oil OE/HDO 30 (Appendix C, Item 17)		
<u>Personnel Required</u>		
Fuel and electrical systems repairer MOS 63G		
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-34P		
<u>Special Environmental Conditions</u>		
None		
<u>General Safety Instructions</u>		
None		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
a.	Removal			

NOTE

This procedure applies to one or all injectors.

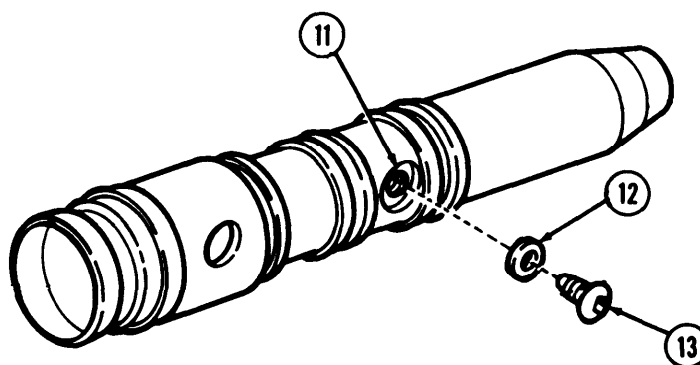
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|----|-------------------|---|---------|-----------------------|
| 1. | Injector (5) | Injector link (1) | Remove. | Tag for installation. |
| 2. | Cylinder head (4) | Two screws (2), clamp plate (7), and washer (6) | Remove. | |

CAUTION

Do not turn injector upside down after removal. Plunger will fall out.

4-33. INJECTOR FLOW TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
29.		Orifice plug (13) and gasket (12)	Remove from injector (11).	Remove orifice plug (13) and discard gasket (12).
<p style="text-align: center;">NOTE</p> <p>New orifice plug size .018-.019 in. (0.48-0.49 mm) is small enough so burnishing will increase fuel delivery.</p>				
30.		New gasket (12) and orifice plug (13)	Install in injector orifice (11) and tighten orifice plug (13) 8-10 lb-in. (0.9-1.1 N-m).	
31.		Test stand inlet pressure line adapter (10) and burnishing tool (8)	Install on burnishing tool adapter (7).	Screw large knob (9) into burnishing tool adapter (7) inlet hole until tight.



4-33. INJECTOR FLOW TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

When seating burnishing tool, use care not to push small knob in too hard or overtighten indicator knob. When slight contact is made, stop. Damage can be caused to injector. Test stand must be running while burnishing.

32. Injector test stand (1)	Burnishing tool (4)	Burnish as follows:	Burnishing cleans injector inlet orifice and sets fuel flow.
		<ul style="list-style-type: none"> a. Turn indicator knob (6) until spaced 3/8 in. (9.5 mm) from large knob (7), b. Slowly push small knob (5) in until slight contact is made with injector (8). c. Turn small knob (5) counterclockwise to lock large knob (7) and indicator knob (6). d. Slowly turn indicator knob (6) in until slightly seated in injector (8). e. Index indicator knob (6) with mark on large knob (7). f. Advance indicator knob (6) one mark, and back off until spaced 3/8 in. (9.5 mm). 	Do not overtighten.

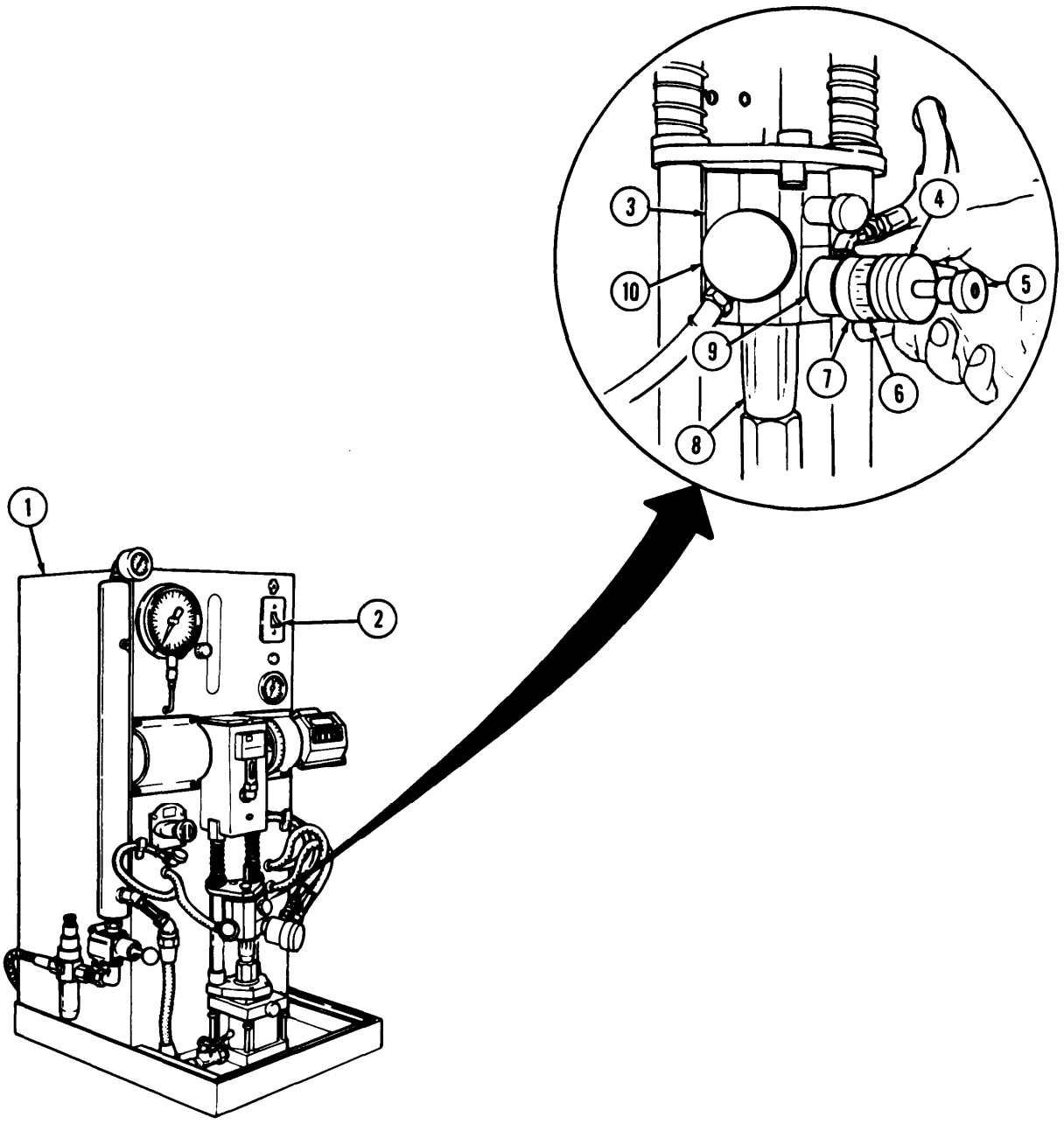
NOTE

Perform steps 24 through 27 and recheck fuel delivery. If delivery is lower than 121-122 cc, repeat step 32. If reading is higher, install new orifice plug (steps 29 through 31), and recheck fuel delivery.

33.	Injector test stand (1)	Motor switch (2)	Place in STOP position.	
34.		Drain connector (10)	Remove from burnishing tool adapter (3).	
35.		Test stand inlet pressure line adapter (9)	Remove from burnishing tool adapter (3).	Screw out large knob (7) on burnishing tool (4).
36.		Burnishing tool (4)	Remove from burnishing tool adapter (3).	Store in clean place.

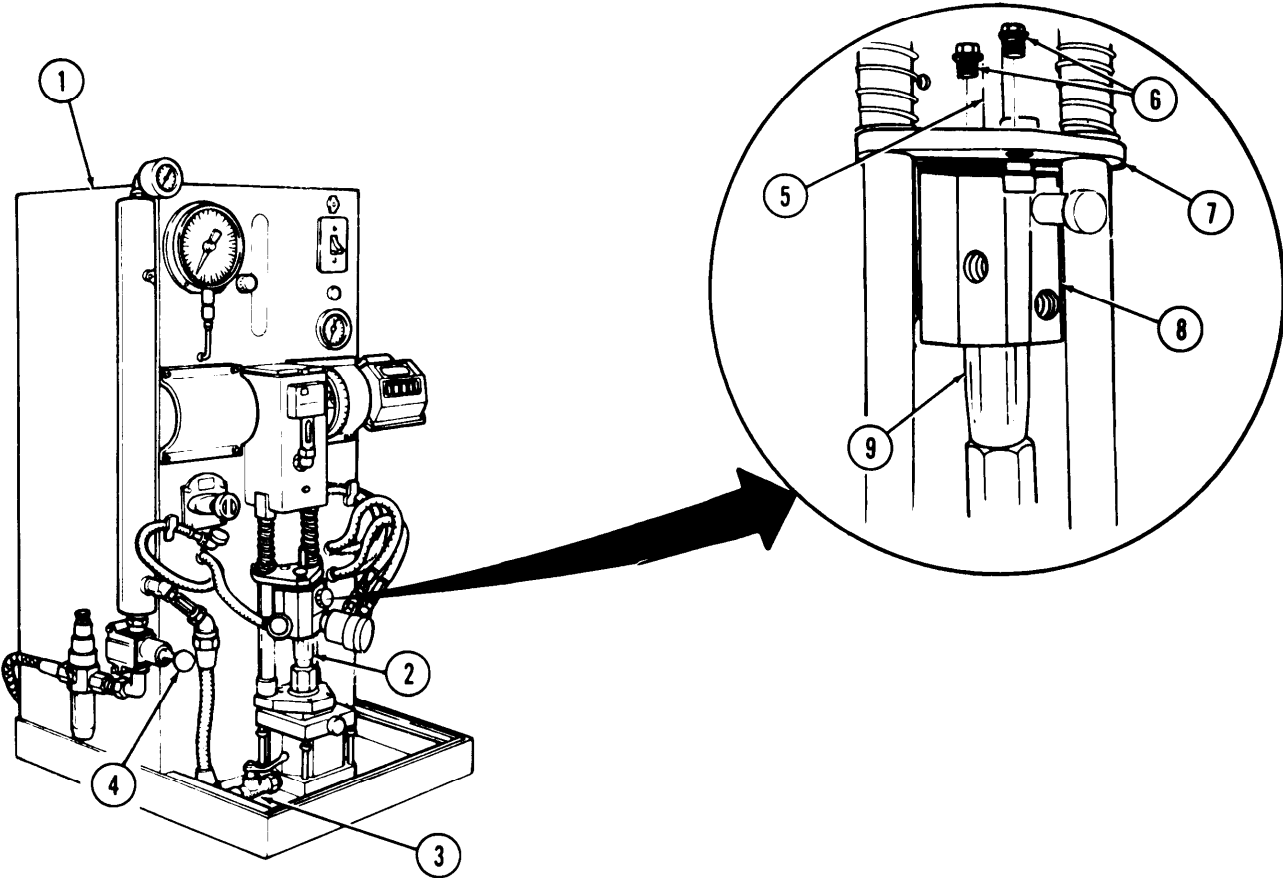
4-33. INJECTOR FLOW TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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4-33. INJECTOR FLOW TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
37.	Injector test stand (1)	Hydraulic valve (3)	Open.	
38.		Air valve (4)	close.	
39.		Injector (2)	Remove .	
40.		Test stand link (5)	Slide out of burnishing tool adapter (8).	
41.		Two pins (6) and retainer plate (7)	Remove from burnishing tool adapter (8).	
42.		Burnishing tool adapter (8)	Remove from injector (9).	

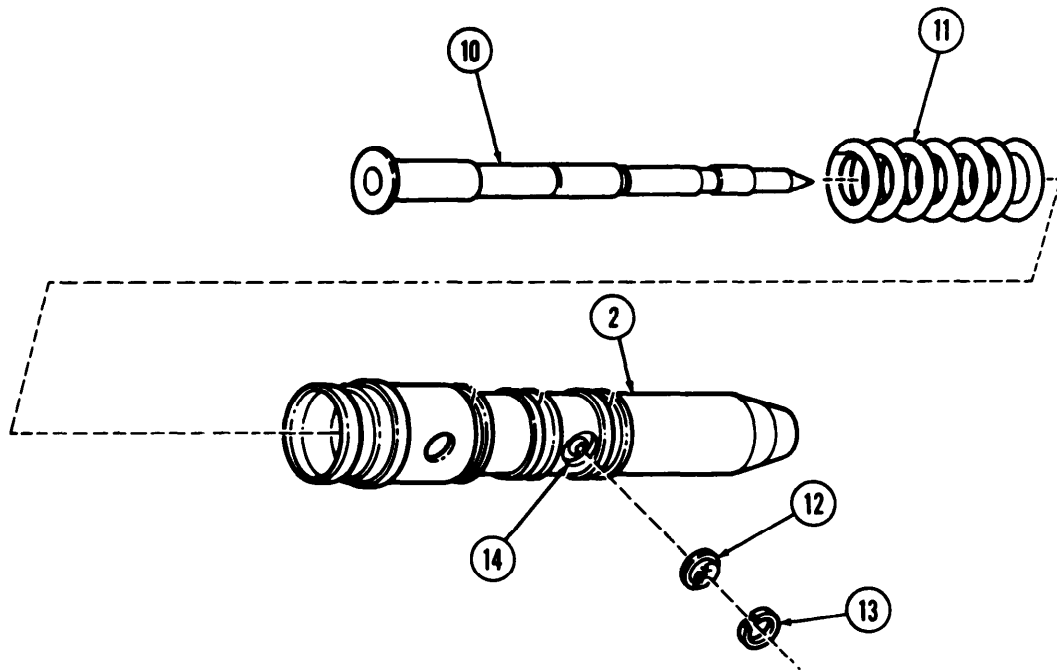


4-33. INJECTOR FLOW TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
43.		Plunger (10) and spring (11)	Remove from injector (2).	
44.		Screen (12)	Install in injector orifice (14) with screen retainer (13).	
45.		Spring (11) and plunger (10)	Place spring (11) on plunger (10) and slide in injector (2).	

NOTE

Store injectors in a clean place.



END OF TASK!

TA 349854

4-133 (4-134 blank)

CHAPTER 5

COOLING SYSTEM MAINTENANCE

Section I. DESCRIPTION AND DATA

5-1. GENERAL

Cooling system maintenance procedures not covered in this chapter can be found in TM 9-2320-272-20-1 and TM 750-254.

5-2. DESCRIPTION AND DATA

Refer to TM 9-2320-272 -20-1 for complete description and data regarding cooling system components.

Section II. COOLING SYSTEM MAINTENANCE

5-3. COOLING SYSTEM MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
5-4.	Radiator Maintenance	5-2
5-5.	Water Manifold Maintenance	5-8
5-6.	Fan Drive Clutch Maintenance	5-14
5-7.	Water Pump Maintenance	5-34

5-4. RADIATOR MAINTENANCE

This task covers:

- a. Disassembly
- b. Cleaning, Inspection, and Repair
- c. Reassembly

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-20-1 TM 9-2320-272-20-1	Radiator removed. Radiator fan shroud removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Two gaskets Eighty locknuts GAA grease (Appendix C, Item 11)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272 -20-1 TM 9-2320-272-34P		

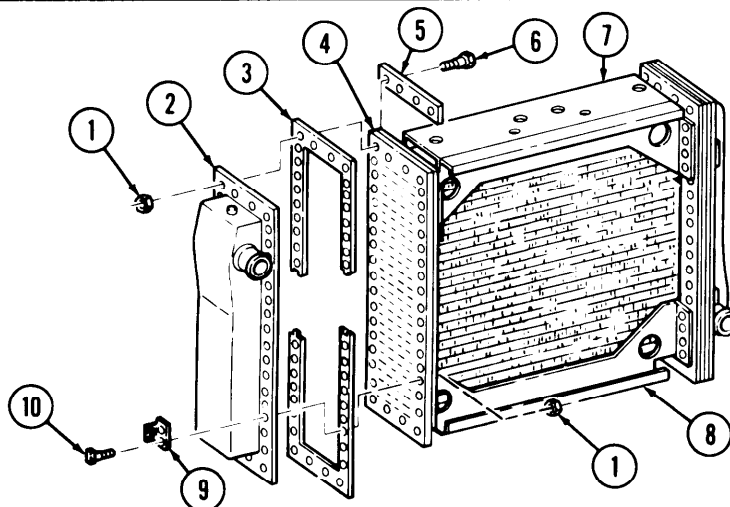
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Disassembly

- | | | | | |
|----|----------------------------|--|---------|--|
| 1. | Inlet tank (2) to core (4) | Forty locknuts (1), thirty-six screws (6), four screws (10), two clamping strips (5), and two shroud mounting brackets (9) | Remove. | Tag screws (10) for installation.
Discard locknuts (1). Mark position of two shroud mounting brackets (9) for reassembly. |
| 2. | | Inlet tank (2) and gasket (3) | Remove. | Discard gasket (3).
Clean gasket remains from mating surfaces. |

5-4. RADIATOR MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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3. Outlet tank (15) to core (4)

Forty locknuts (11), thirty-six screws (12), four screws (16), two shroud mounting brackets (17), two clamping strips (13), upper radiator side brace (7), lower radiator side brace (8), and four clamping strips (18)

Remove.

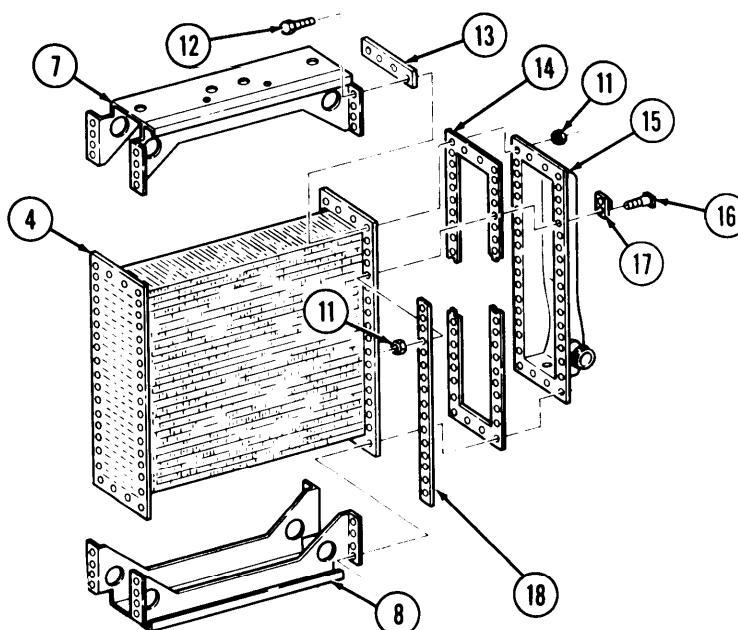
Tag radiator side brace (8) and screws (16) for installation. Mark position of shroud mounting brackets (17) for installation. Discard locknuts (11).

- 4.

Outlet tank (15) and gasket (14)

Remove.

Discard gasket (14). Clean gasket remains from mating surfaces.



TA 349747

5-4. RADIATOR MAINTENANCE (Cont'd)

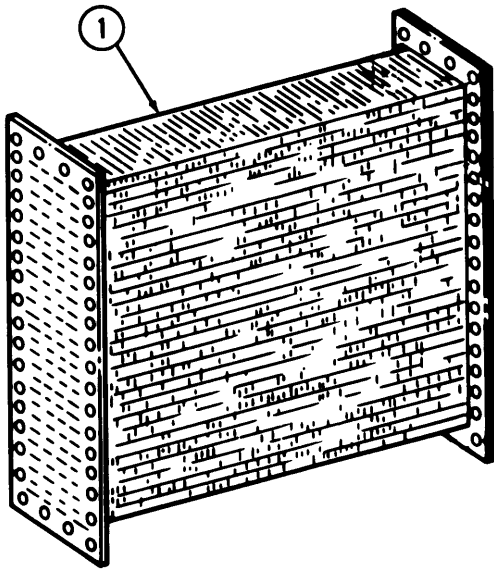
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Cleaning, Inspection, and Repair

5.		Radiator core (1)	Clean, inspect, and repair.	Refer to TM 750-254.
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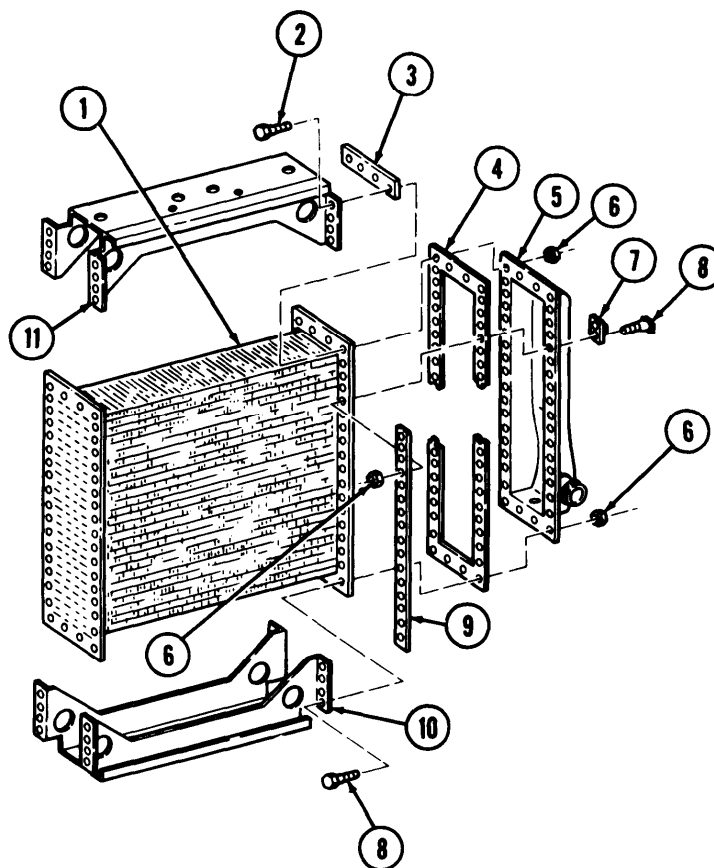
c. Reassembly

6.		Lower radiator side brace (10), upper radiator side brace (11), and two clamping strips (9)	Position to radiator core (1).	
7.		New gasket (4)	Interlock gasket (4) and aline to holes in radiator core (1).	Apply small amount of GAA grease between gasket (4) and radiator core (1) to hold gasket (4) in place.
8.		Outlet tank (5)	Aline to holes in gasket (4).	



5-4. RADIATOR MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
9.		Outlet tank (5), two clamping strips (3), and two shroud mounting brackets (7)	Install with four screws (8), thirty-six screws (2), and forty new locknuts (6).	Do not tighten locknuts (6).
10.		Forty new locknuts (6)	Tighten 19 lb-ft (26 N-m).	



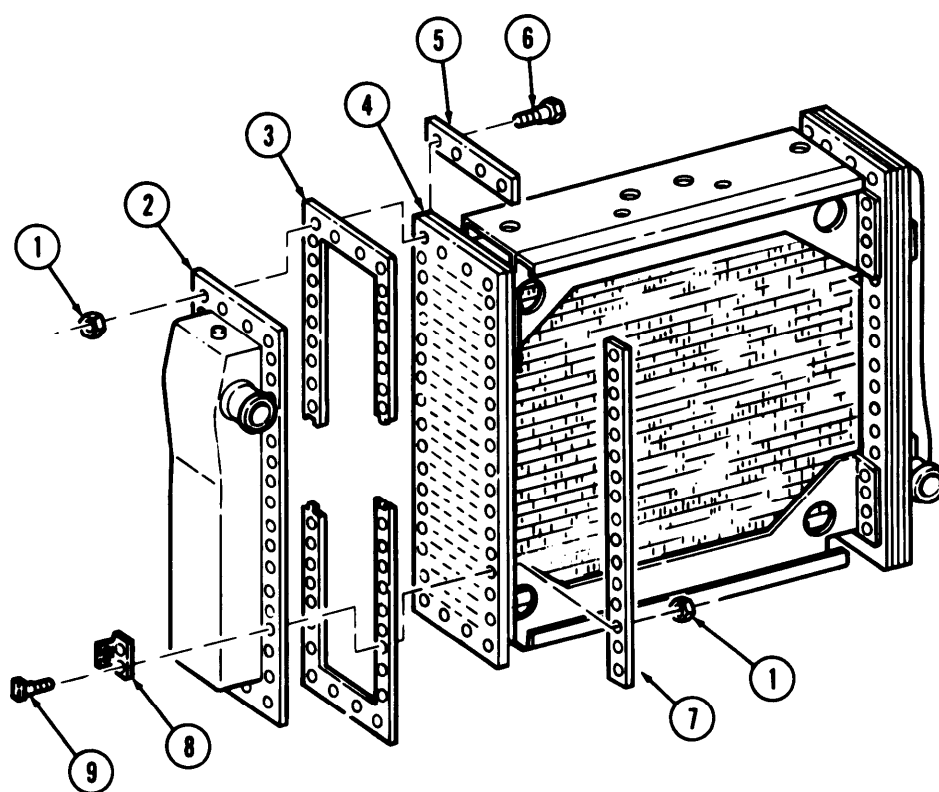
TA 349749

5-4. RADIATOR MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
11.		New gasket (3)	Align to holes in radiator core (4).	Apply small amount of GAA grease between gasket (3) and core (4) to hold gasket (3) in place.
12.		Inlet tank (2)	Align to holes in gasket (3).	
13.		Two clamping strips (7) and shroud mounting brackets (8), inlet tank (2), and two clamping strips (5)	Install with four screws (9), thirty-six screws (6), and forty new locknuts (1).	Do not tighten locknuts (1). Clamping strips (7) are inserted between core (4) and upper and lower radiator side braces.
14.		Forty new locknuts (1)	Tighten 19 lb-ft (26 N·m).	

5-4. RADIATOR MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS: Ž Install radiator fan shroud (TM 9-2320-272-20-1).

• Install radiator (TM 9-2320-272-20-1).

Ž Service cooling system (TM 9-2320-272-20-1).

• Start engine (TM 9-2320-272-10) and check for leaks.

TA 349750

5-5. WATER MANIFOLD MAINTENANCE

This task covers:

- | | |
|----------------------------|-----------------|
| a. Removal | d. Reassembly |
| b. Disassembly | e. Installation |
| c. Cleaning and Inspection | |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272 -20-1	Surge tank removed.
	TM 9-2320-272 -20-1	Engine crankcase breather draft tube removed.
	TM 9-2320-272 -20-1	Thermostat and housing removed.
	TM 9-2320-272 -20-1	Fan drive clutch actuator removed.

Test Equipment

None

Special Tools

None

Special Environmental Conditions

None

Materials/Parts

Ten "O" rings
Twelve lockwashers
Protective cap-plugs (Appendix C, Item 5)
GAA grease (Appendix C, Item 11)
Sealing tape (Appendix C, Item 30)

Personnel Required

Wheeled vehicle repairman MOS 63W

General Safety Instructions

Wear eyeshields during cleaning procedure.

Manual References

TM 9-2320-272-10
TM 9-2320-272 -20-1
TM 9-2320-272-34P

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

- | | | | | |
|----|--|---|----------------------------------|--|
| 1. | Personnel heater inlet hose (10) to water manifold shutoff petcock (8) | Hose clamp (9) | Loosen and disconnect hose (10). | Have container ready to catch coolant. |
| 2. | Water temperature sending unit (6) at water manifold (14) | Connector (7) | Disconnect. | |
| 3. | Engine temperature sensor (4) at water manifold (14) | Connector (5) | Disconnect. | |
| 4. | Ether start safety valve (2) | Ether cylinder to safety valve line (3) and safety valve to atomizer line (1) | Disconnect. | |

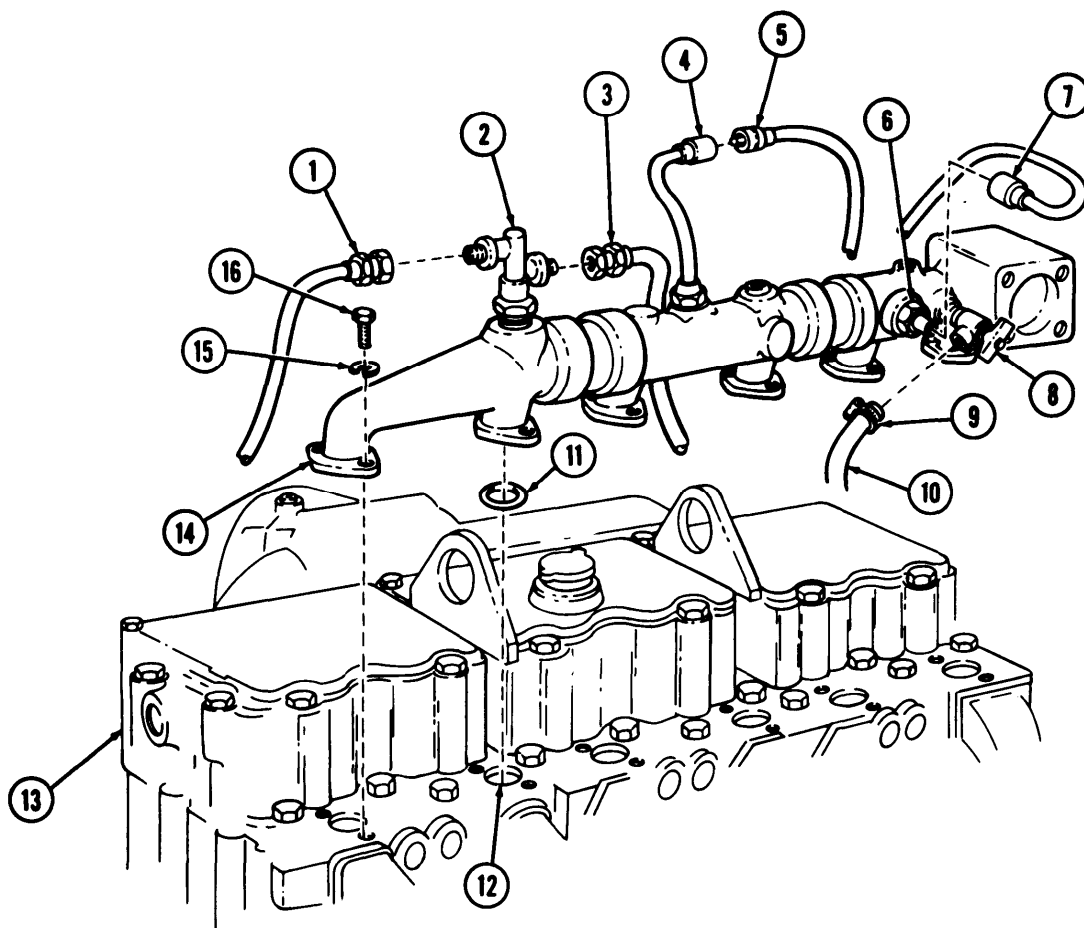
5-5. WATER MANIFOLD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Clean area water manifold to prevent dirt or debris from entering cylinder head water ports as water manifold is removed.

- | | | | | |
|----|--------------------------------|--|----------------|---|
| 5. | Cylinder heads (13) | Twelve screws (16) and lockwashers (15), and manifold (14) | Remove. | Discard lockwashers (15). |
| 6. | Cylinder head water ports (12) | Six "O" rings (11) | Remove. | Discard "O" rings (11). |
| 7. | | Six open water ports (12) | Plug openings. | To prevent dirt from entering ports (12). |



TA 349751

5-5. WATER MANIFOLD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Disassembly				
8.	Rear coupling (4)	Rear water manifold section (1) and 'O' ring (3)	Remove.	Discard "O" ring (3).
9.	Center water manifold section (6)	Rear coupling (4) and "O" ring (5)	Remove.	Discard "O" ring (5).
10.	Front coupling (9)	Center water manifold section (6) and "O" ring (8)	Remove.	Discard "O" ring (8).
11.	Front water manifold section (11)	Front coupling (9) and "O" ring (10)	Remove.	Discard "O" ring (10).
12.	Rear water manifold section (1)	Ether start safety valve (2)	Remove.	
13.	Center water manifold section (6)	Engine temperature sensor (7)	Remove.	
14.	Front water manifold section (11)	Water temperature sending unit (13) and heater shutoff petcock (12)	Remove.	

c. Cleaning and Inspection

WARNING

Eyeshields must be worn during cleaning procedure. Failure to wear eyeshields may result in injury to personnel.

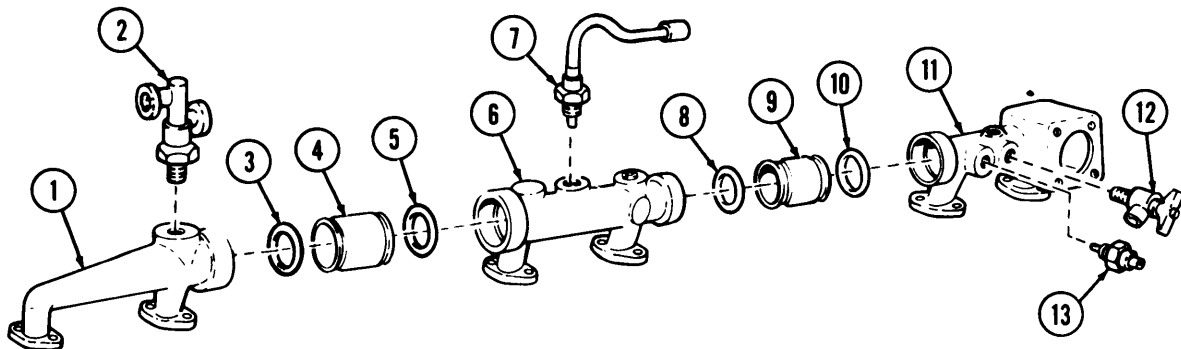
15.	Water manifold sections (1), (6), and (11), and couplings (4) and (9)	Brush clean, and inspect for breaks and cracks.	Use wire brush to clean, and replace if broken or cracked.
16.	Heater shutoff petcock (12)	Check for proper opening and closing.	Replace if defective.
17.	Water temperature sending unit (13) and engine temperature sensor (7)	Test.	Refer to TM 9-2320-272-20-1 for test procedure and replace if defective.

d. Reassembly

18.	Water temperature sending unit (13) and heater shutoff petcock (12)	Wrap male threaded ends of each with sealing tape and install in front water manifold section (11).
19.	New "O" ring (10)	Coat lightly with GM grease and install on front coupling (9).

5-5. WATER MANIFOLD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
20.		Front coupling (9)	Install one end in bore of front water manifold section (11) until "O" ring (10) is seated.	
21.		Engine temperature sensor (7)	Wrap male threaded ends with sealing tape and install in center water manifold section (6).	
22.		New "O" ring (8)	Coat lightly with GAA grease and install on front coupling (9).	
23.		Center water manifold section (6)	Install bore over end of coupling (9) until seated against "O" ring (8).	
24.		New "O" ring (5)	Coat lightly with GAA grease and install on rear coupling (4).	
25.		Rear coupling (4)	Install one end in bore of center water manifold section (6) until "O" ring (5) is seated.	
26.		Ether start safety valve (2)	Wrap male threaded end with sealing tape and install in rear water manifold section (1).	
27.		New "O" ring (3)	Coat lightly with GAA grease and install on rear coupling (4).	
28.		Rear water manifold section (1)	Install bore over end of rear coupling (4) until seated against "O" ring (3).	



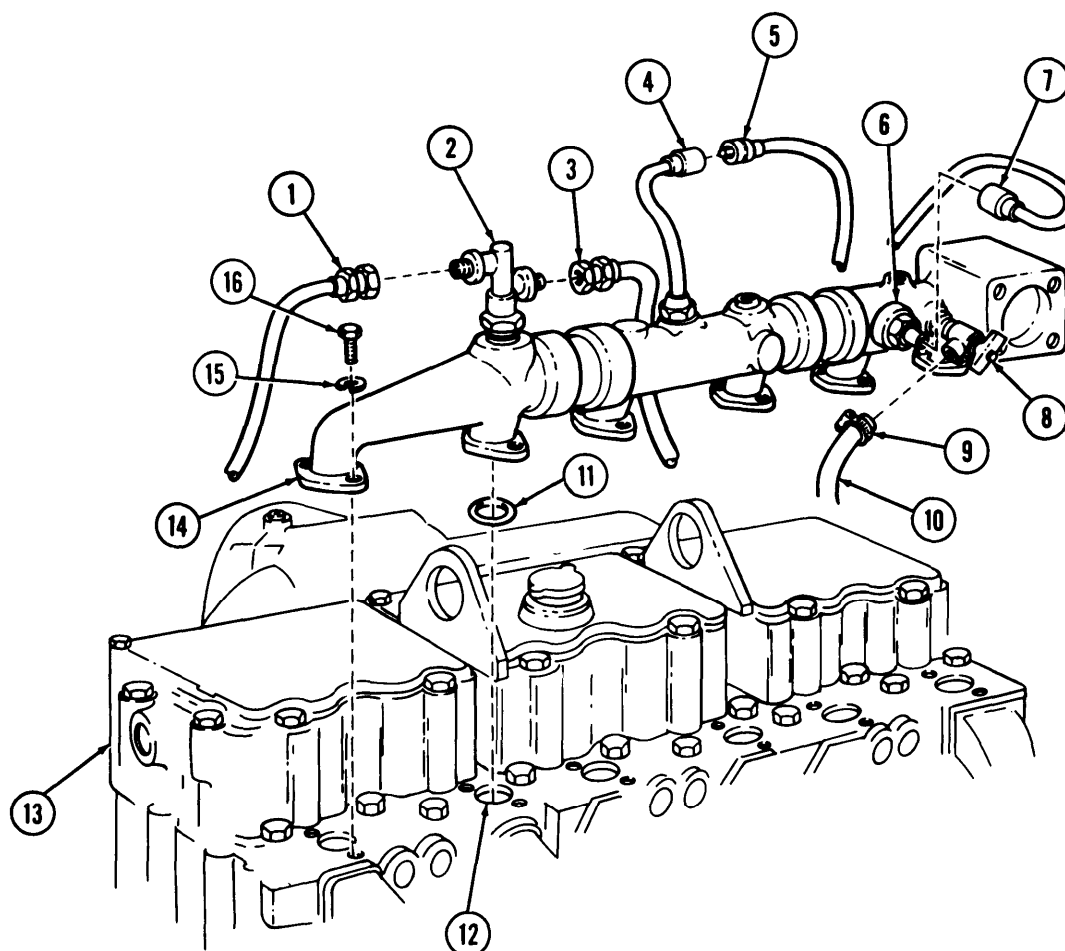
TA 349752

5-5. WATER MANIFOLD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
e. Installation				
29.		Six new "O" rings (11)	Coat each lightly with GAA grease, and install in each cylinder head water port (12).	Make sure all water ports (12) are unplugged.
30.		Water manifold (14)	Install to cylinder heads (13) with twelve new lockwashers (15) and screws (16).	Alternately tighten screws (16) 30-35 lb-ft (41-47 N·m) so manifold (14) seats properly.
31.		Either cylinder to safety valve line (3) and safety valve to atomizer line (1)	Install on ether start safety valve (2) at same points where disconnected.	
32.		Connector (5)	Connect to engine temperature sensor (4).	
33.		Connector (7)	Connect to water temperature sending unit (6).	
34.		Personnel heater inlet hose (10)	Connect to heater shutoff petcock (8), with hose clamp (9).	

5-5. WATER MANIFOLD MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

- FOLLOW-ON TASKS:
- Install fan drive clutch actuator (TM 9-2320-272-20-1).
 - Install thermostat and housing (TM 9-2320-272-20-1).
 - Install engine crankcase breather draft tube (TM 9-2320-272-20-1).
 - Install surge tank (TM 9-2320-272-20-1).
 - Fill cooling system to proper level (TM 9-2320-272-20-1).
 - Start engine (TM 9-2320-272-10) and check for leaks.

TA 349753

5-6. FAN DRIVE CLUTCH MAINTENANCE

This task covers:

- | | |
|----------------------------|-------------------------------------|
| a. Disassembly | c. Reassembly |
| b. Cleaning and Inspection | d. Fan Drive Clutch Operation Check |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272 -20-1	Fan drive clutch removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
Mandrel 11600059-1 Bearing replacer 7950082	None	
<u>Materials/Parts</u>		
Four "O" rings Locknut Snapring Three bearings GAA grease (Appendix C, Item 11)		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W (2)	<ul style="list-style-type: none">• Piston spring is under tension and may cause injury if not properly removed.• When using compressed air, eyeshields must be worn.	
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272 -20-1 TM 9-214 LO 9-2320-272-12 TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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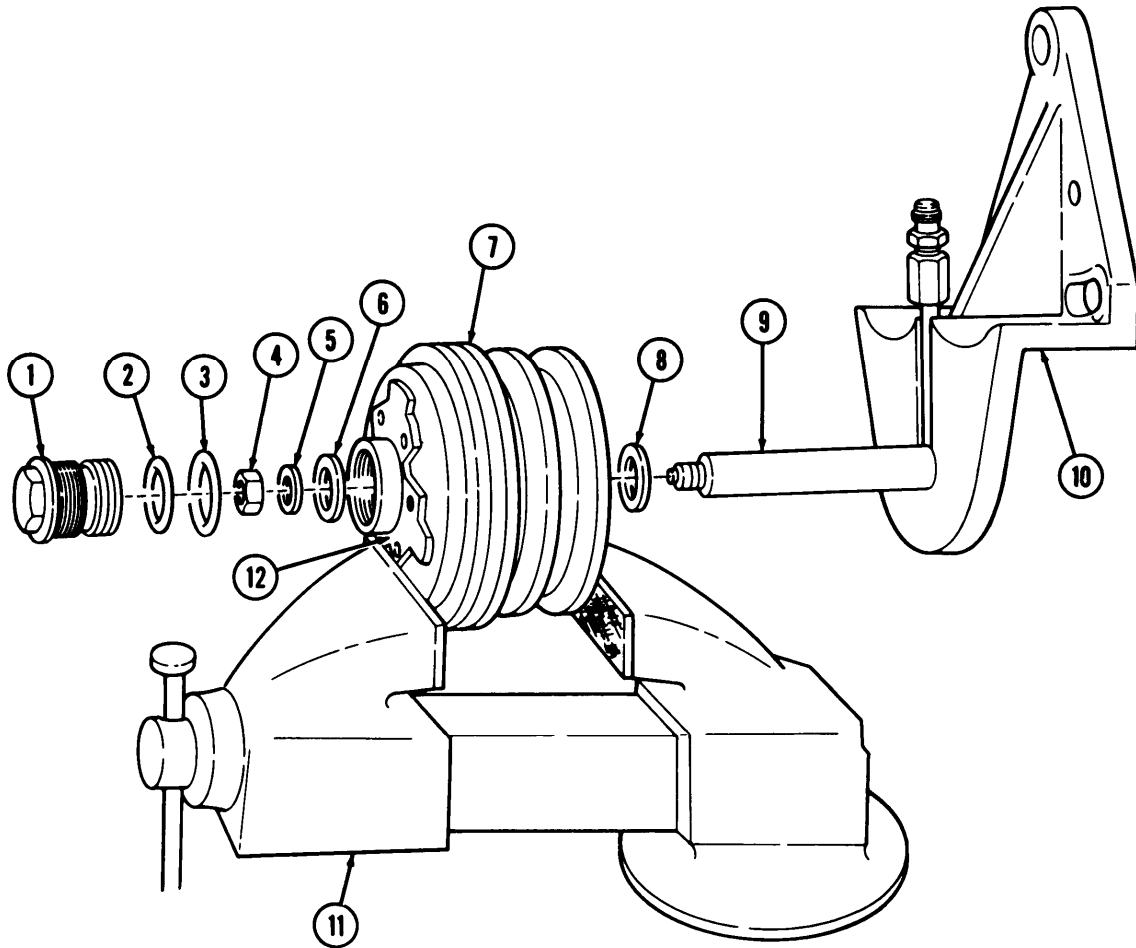
a. Disassembly**NOTE**

Clutch assembly must be put in soft-jawed vise.

- | | | | | |
|----|---------------------|---------------------------|---------|------------------------------------|
| 1. | Clutch assembly (7) | Seal plug (1) | Remove. | |
| 2. | Seal plug (1) | Two "O" rings (2) and (3) | Remove. | Discard two "O" rings (2) and (3). |
| 3. | Shaft (9) | Expansion locknut (4) | Remove. | Discard locknut (4). |

5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
4.		Washer (5) and spacer (6)	Remove.	
5.	Clutch assembly (7)	Clutch assembly bracket (10)	Remove.	
6.	Shaft (9)	Spacer (8)	Remove.	
7.	Vise (11)	Clutch assembly (7)	a. Remove. b. Place on workbench with thrust cap back-up plate (12) facing upward.	



TA 349754

5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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WARNING

The piston spring, located between the thrust cap and clutch facing, is under tension and may cause injury to personnel if screws are not removed as directed below.

NOTE

Assistant must help with completion of step 8.

8.	Thrust cap backup plate (2) to clutch assembly (3)	Eight screws (1)	a. Remove first six screws (1), leaving two screws installed opposite one another.	Assistant must slowly release hold on thrust cap backup plate (2).
			b. Remove last two screws (1) evenly.	

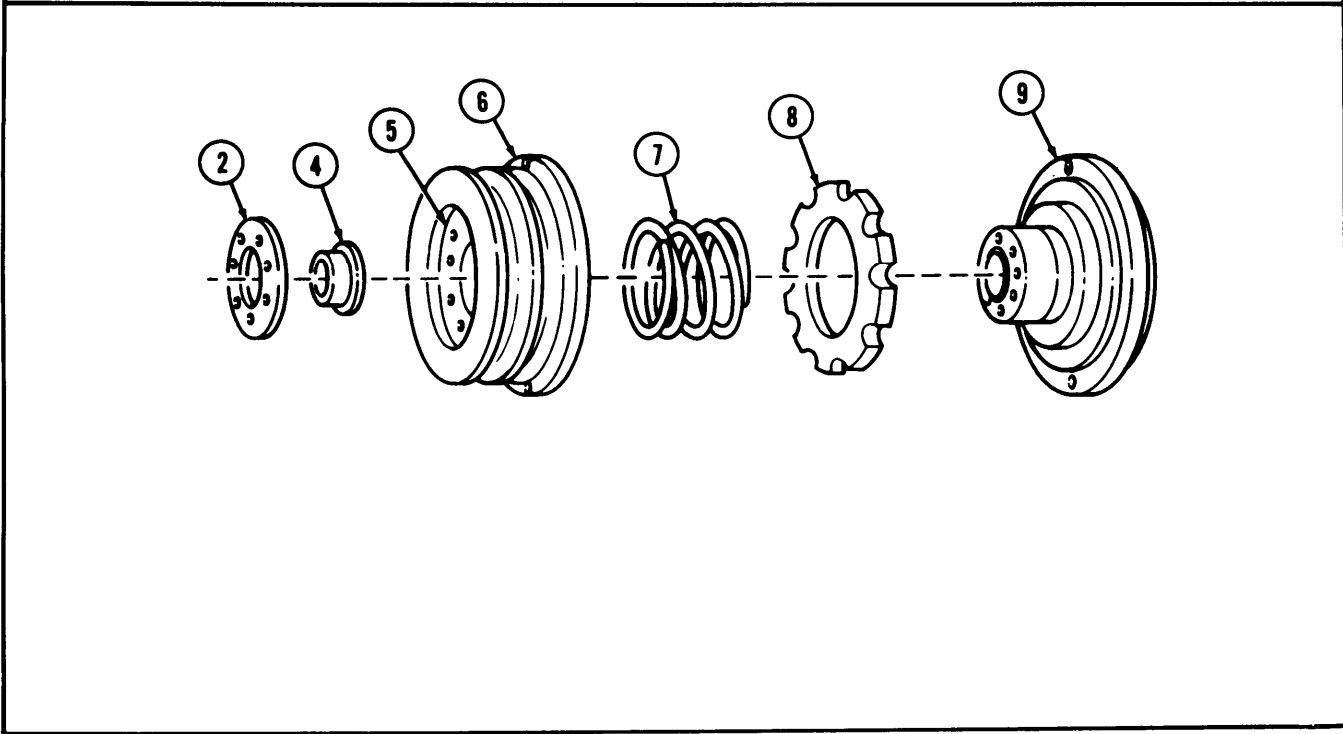
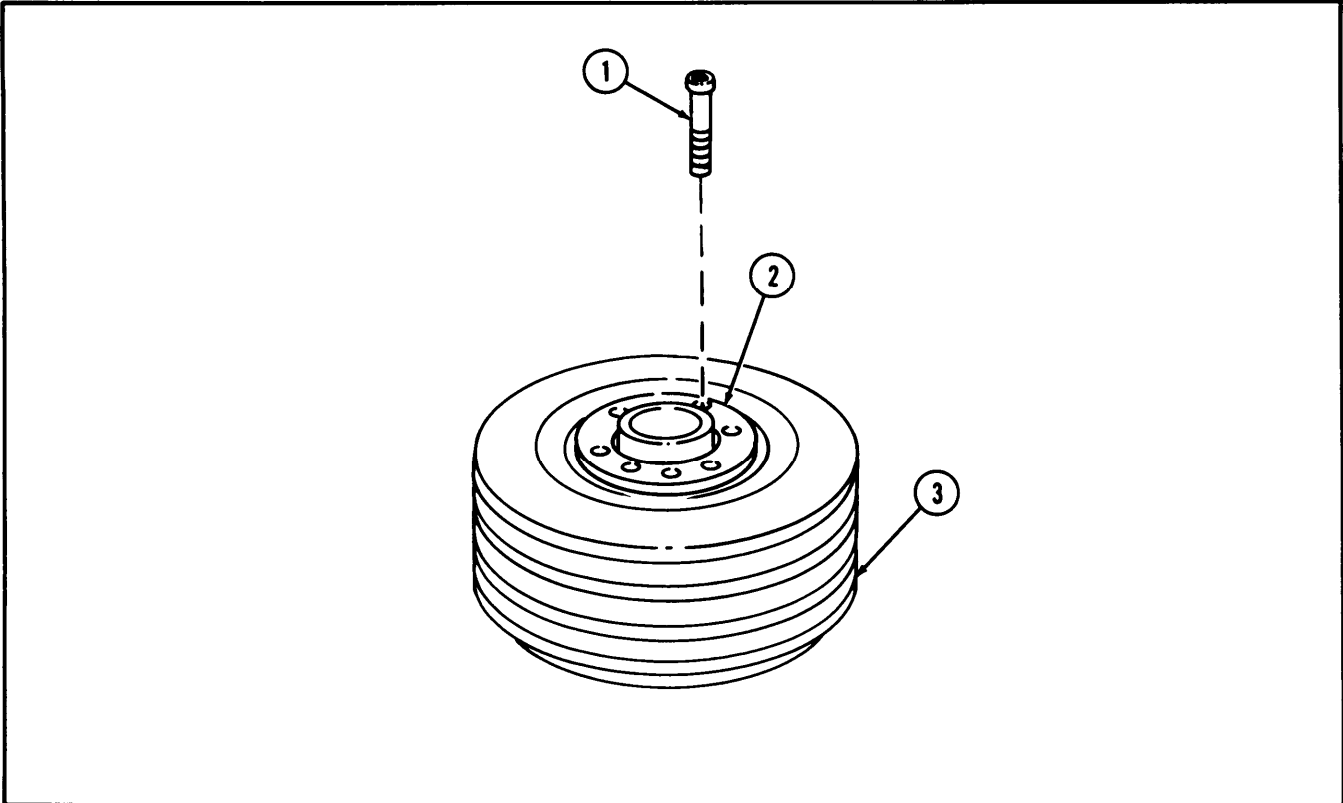
NOTE

Step 9 is required only if thrust cap backup plate fails to release.

9.	Two screws (1)	a. Install in opposite sides of thrust cap backup plate (2) and evenly unscrew each about halfway out.	Tap screws (1) gently until backup plate releases.
		b. Remove slowly while assistant holds on to thrust cap backup plate (2).	
10.	Thrust cap backup plate (2), spacer (4), clutch drive pulley (6), thrust cap (5), piston spring (7), and clutch facing (8)	Remove from clutch housing (9).	

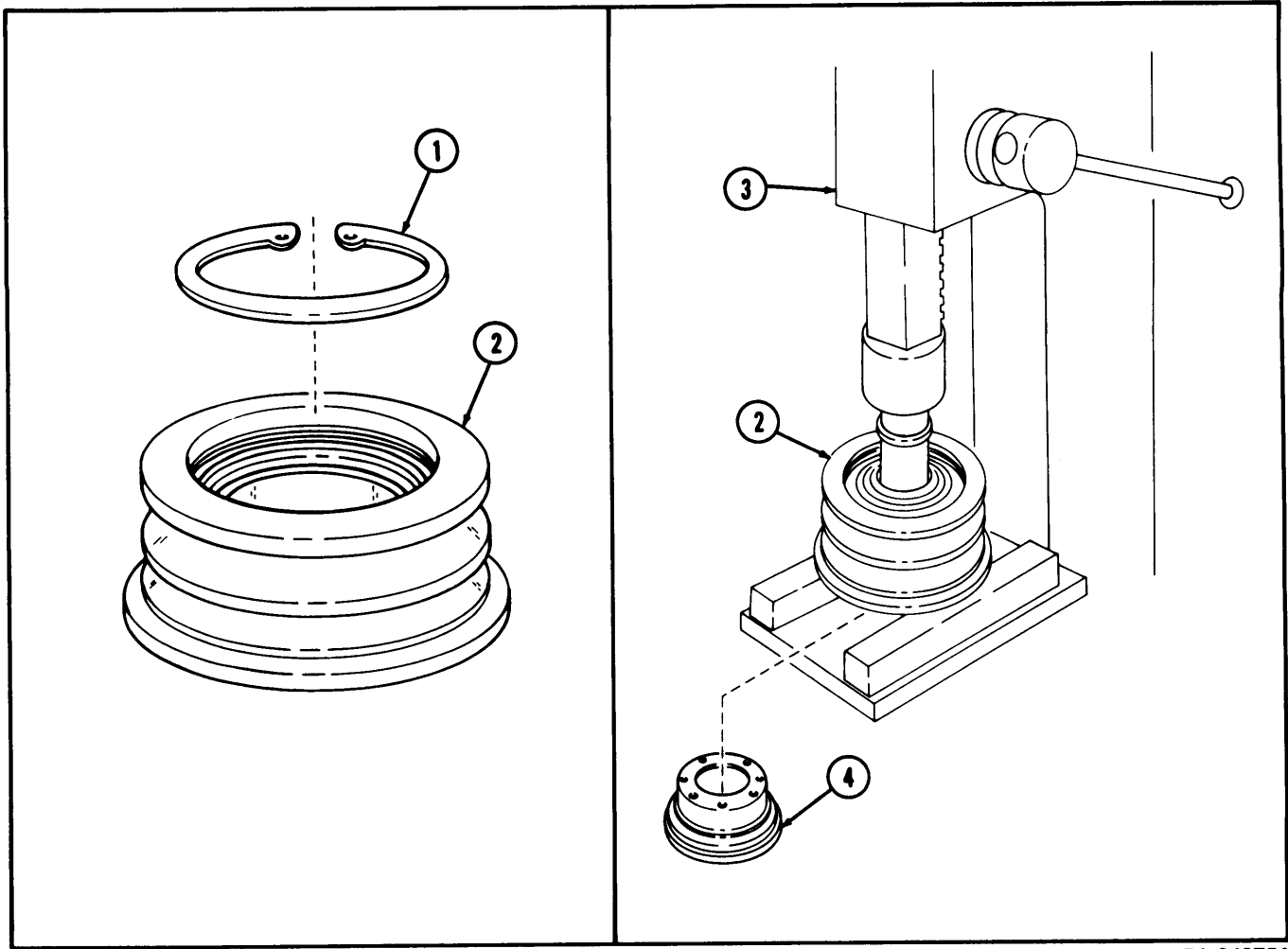
5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

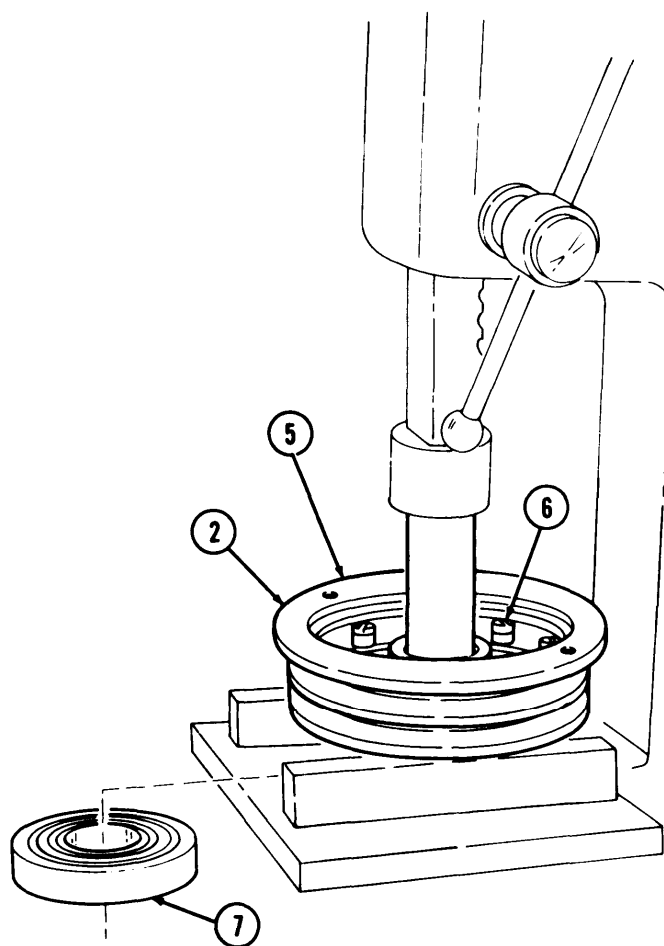
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
11.	Drive pulley (2)	Snapping (1)	Remove.	Use snapping pliers. Discard snapping (1).
CAUTION Do not attempt to remove drive pins from drive pulley. These pins are set by the manufacturer and must not be disturbed.				
12.	Drive pulley (2)		Place on arbor press (3) with drive pins (6), facing downward supported with two wood blocks.	Use bearing replacer.
13.	Thrust cap (4)		Press out of drive pulley (2).	



TA 349756

5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
14.		Drive pulley (2)	Turn pulley (2) over with drive pins (6) facing upward.	
15.		Drive pulley bearing (7)	Push bearing (7) downward in arbor press (3).	Use (5). Discard bearing (7).



TA 349757

5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

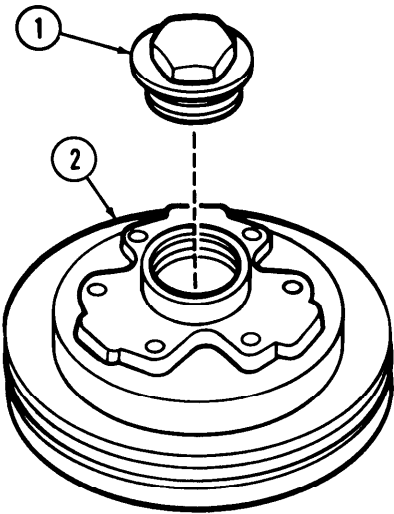
Before removing piston, first reinstall seal plug in the clutch housing and then apply compressed air to discharge piston.

- | | | | | |
|-----|--|---------------|--|--|
| 16. | | Seal plug (1) | Install in clutch housing (2) and tighten 40 lb-ft (54 N·m). | |
|-----|--|---------------|--|--|

WARNING

Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.

- | | | | | |
|-----|-------------------|-------------------------|--|---|
| 17. | Bracket shaft (4) | Air adapter fitting (5) | Install air adapter (6) and attach shop air supply hose (7). | Do not apply air pressure at this time. |
|-----|-------------------|-------------------------|--|---|



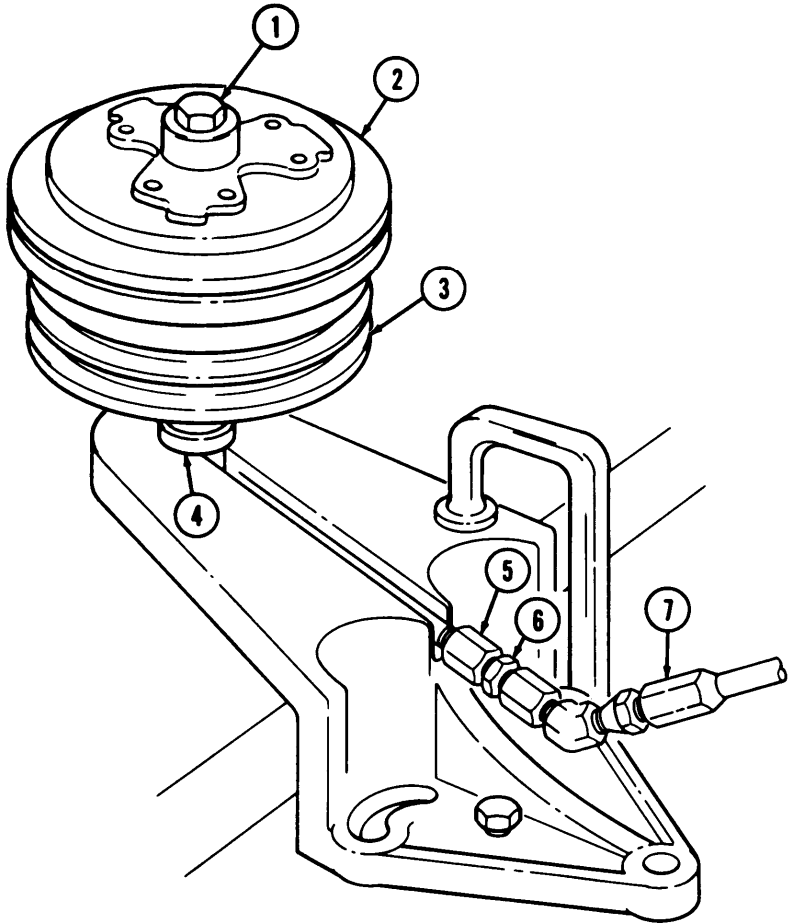
5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

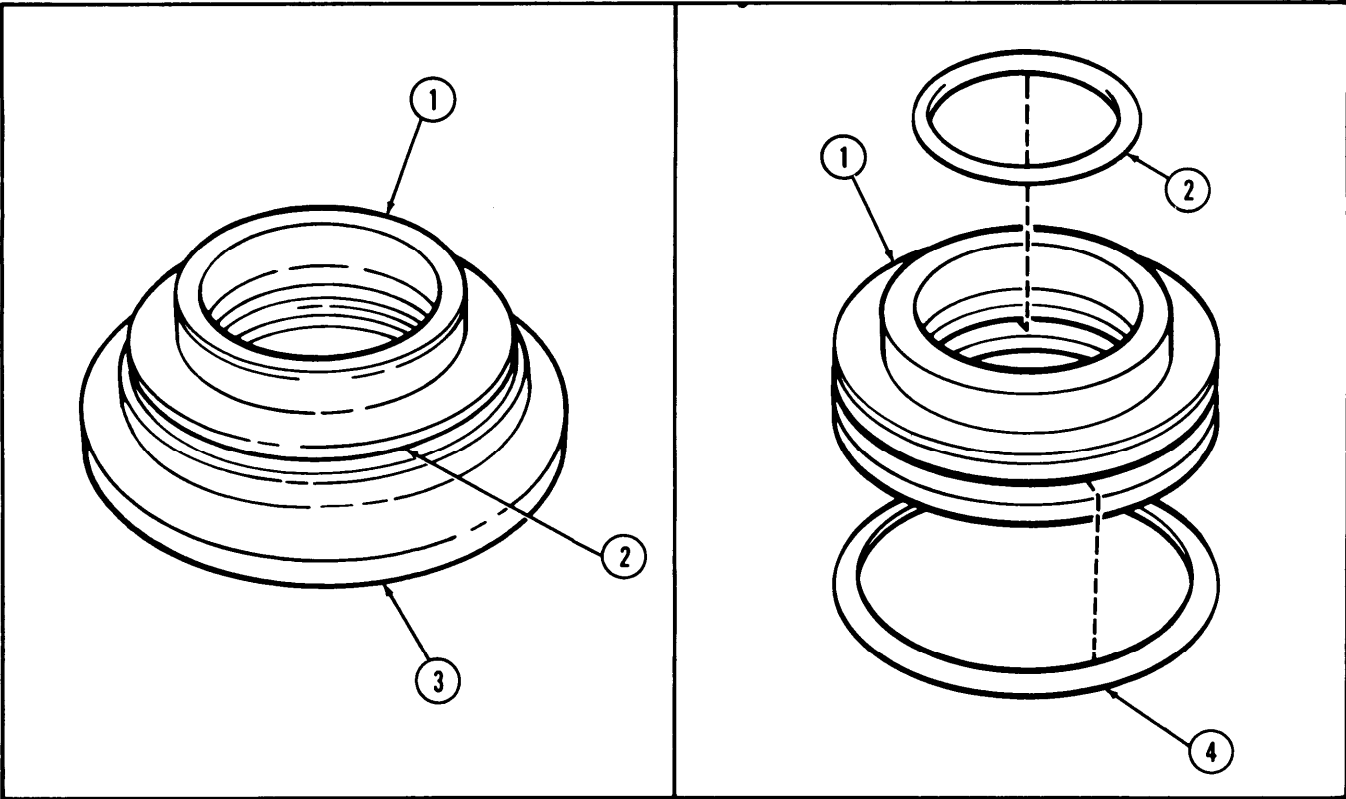
Assistant will help with completion of step 18.

18.		Clutch housing (2)	<p>a. Position on bracket shaft (4) with seal plug (1) facing upward.</p> <p>b. While assistant holds clutch housing (2) firmly in place, mechanic opens shop air supply to 60 psi (413.7 kPa) just long enough to partially discharge piston (3).</p>	<p>Make sure bracket shaft is firmly anchored to bench using C-clamp.</p> <p>Wrap shop cloth around shaft (4) to protect piston (3). Make sure piston (3) discharges evenly. If piston discharges unevenly, press piston (3) back into clutch housing (2) and repeat step b.</p>
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5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

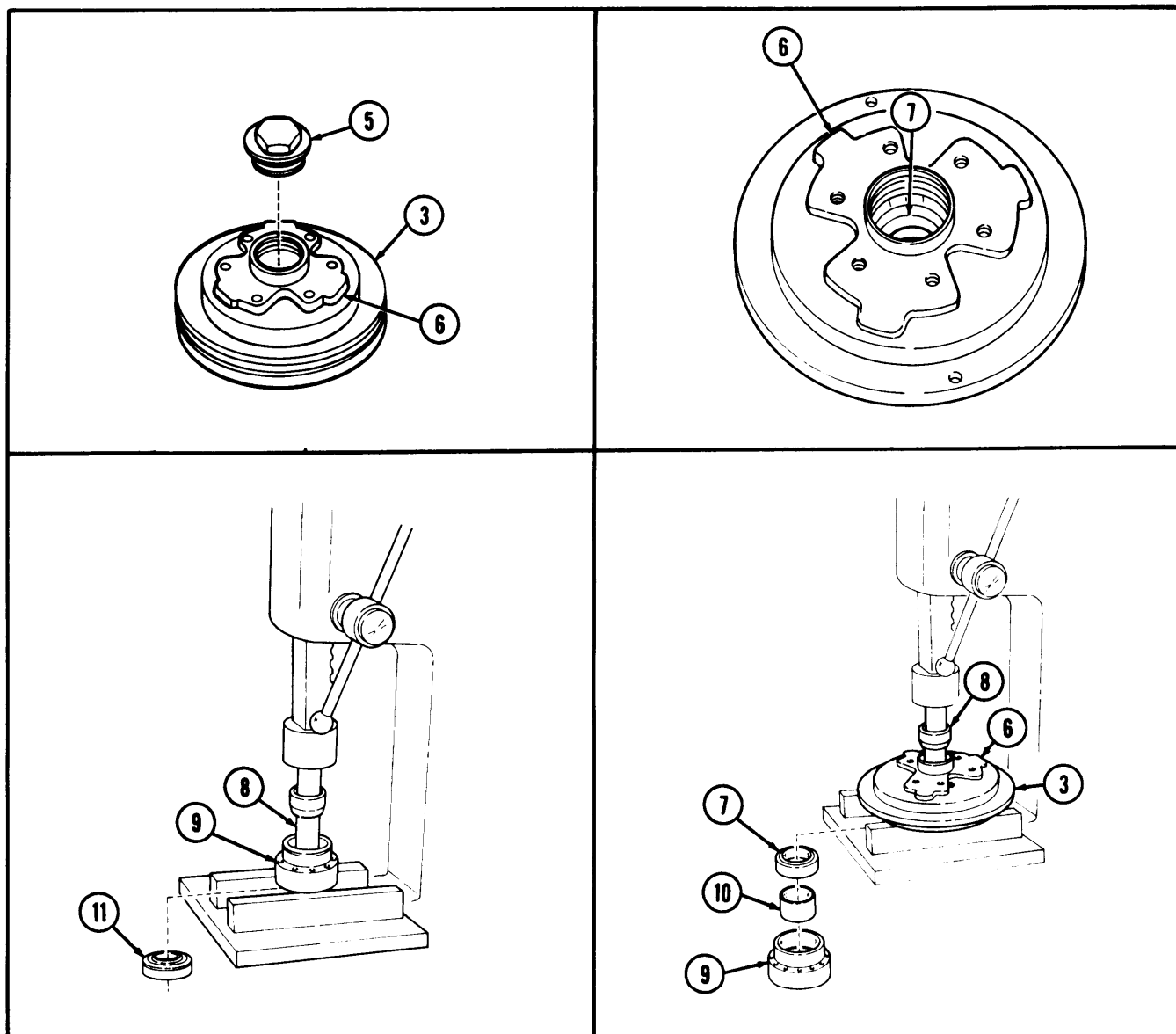
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p>CAUTION</p> <p>Extreme care must be used when removing the piston from the clutch housing to avoid damaging the piston. Do not use sharp tools, and do not pry or use force.</p>				
19.		Clutch housing (3)	Place on workbench with piston (1) side facing upward.	
<p>NOTE</p> <p>Assistant must help with step 20.</p>				
20.		Piston (1)	<p>a. Insert two thin blade screwdrivers under lip above "O" ring (2) opposite each other.</p> <p>b. Pull evenly at several points around the outside diameter and remove from clutch housing (3).</p>	
21.	Piston (1)	"O" rings (2) and (4)	Remove.	Discard "O" rings (2) and (4).



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5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
22.		Clutch housing (3)	Remove seal plug (5) and place on arbor press with fan hub (6) facing upward and supported with two wood blocks.	
23.	Clutch housing (3)	Spacer (9), spacer (10), and bearing (7)	Press out using mandrel (8).	Discard bearing (7).
24.	Spacer (9)	Fan clutch bearing (11)	Press out using mandrel (8),	Discard bearing (11).



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5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Cleaning and Inspection

- | | | | | |
|-----|--|--|---|--|
| 25. | | Clutch housing (1), drive pulley (10), bracket shaft (12), three spacers (3), (4), and (6), and thrust cap (9) | Clean in accordance with instructions in paragraph 2-7. | |
|-----|--|--|---|--|

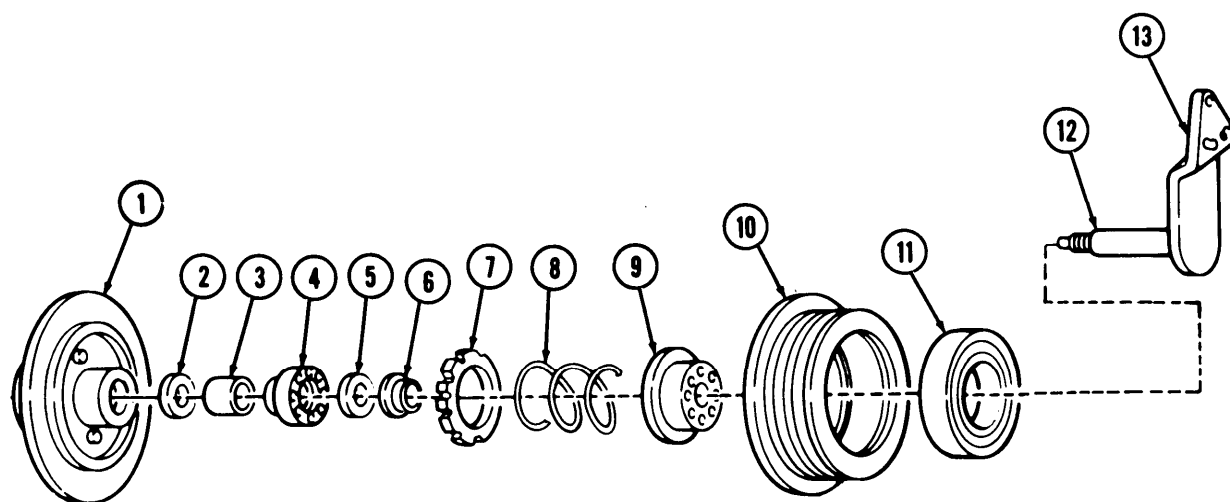
NOTE

All fan drive component parts must be inspected in accordance with the instructions in paragraph 2-8.

- | | | | | |
|-----|--|---|---|---|
| 26. | | Clutch housing (1), drive pulley (10), three spacers (3), (4), and (6), three bearings (2), (5) and (11), bracket (13), clutch facing (7), and thrust cap (9) | Inspect for chips, cracks, or breaks. | Replace if chipped, cracked, or broken. |
| 27. | | Clutch housing (1) and shaft (12) | Inspect for gouged or stripped threads. | If threads are damaged, discard housing or shaft. |
| 28. | | Return spring (8) | Inspect for cracks and weak coils. | Replace if defective. |

5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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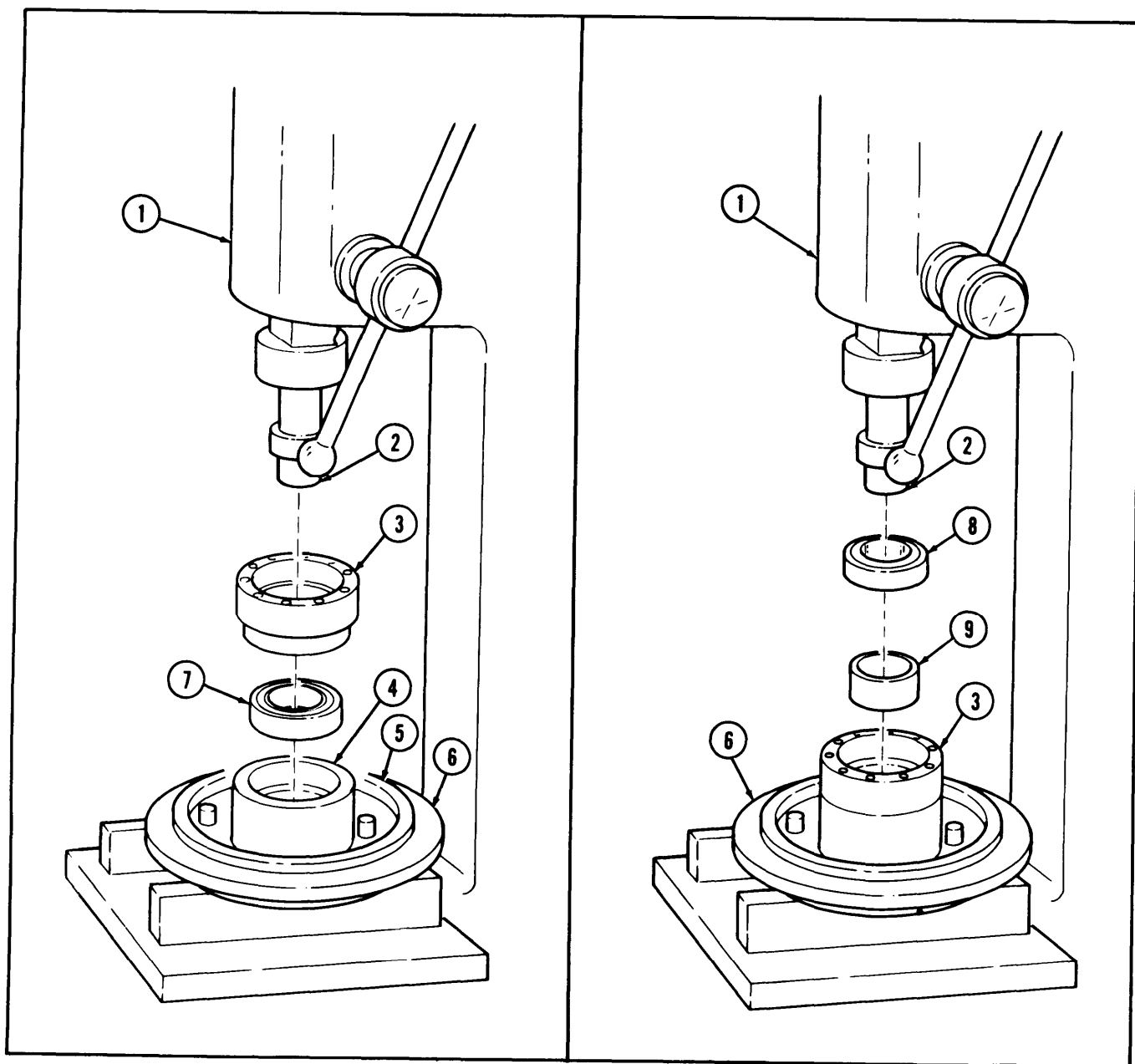
TA 349762

5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
c. Reassembly				
29.		Clutch housing bore (4)	Coat lightly with GAA grease.	
30.		Clutch housing (6)	Place on arbor press (1) with piston bore (5) facing up, supported with two wood blocks.	
31.		New bearing (7)	Install, using arbor press (1) and mandrel (2).	
32.		Bearing spacer (3)	Install using arbor press (1) and mandrel (2).	Aline holes in spacer (3) to holes in clutch housing (6). If holes do not aline, remove spacer using arbor press (1) and mandrel (2), then repeat step 32.
33.		Spacer (9) and new bearing (8)	Install, using arbor press (1) and mandrel (2).	
34.		Clutch housing (6)	Remove from arbor press (1) and place on workbench with piston bore (5) side facing up.	

5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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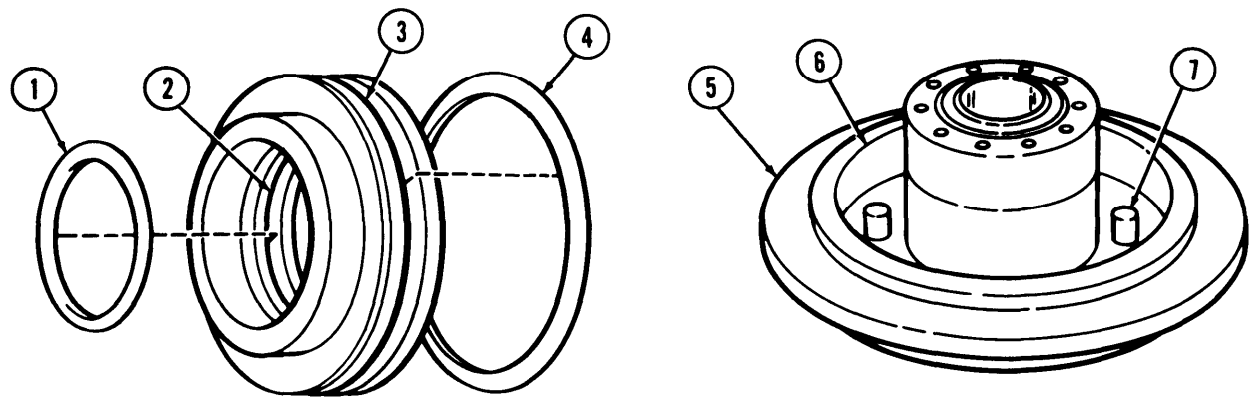


5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
35.		New "O" rings (1) and (4)	a. Install "O" ring (4) in outside groove in piston (3). b. Install "O" ring (1) in inside of piston bore (2).	Coat lightly with GAA grease. Coat lightly with GAA grease.

CAUTION

"O" rings must not be twisted after installation.

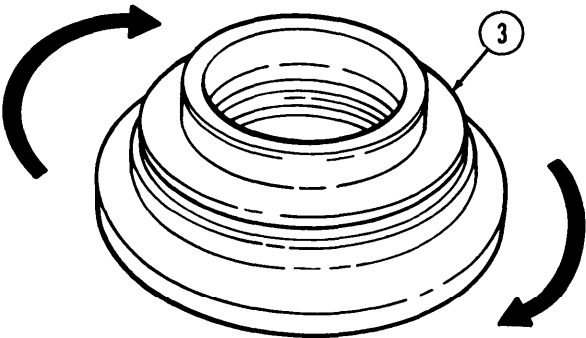


36.	Clutch housing (5)	a. Coat piston bore (6) lightly with GAA grease. b. Place with fan mounting hub facing downward, flat on workbench.
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CAUTION

When installing piston, use care not to cut or damage "O" rings.

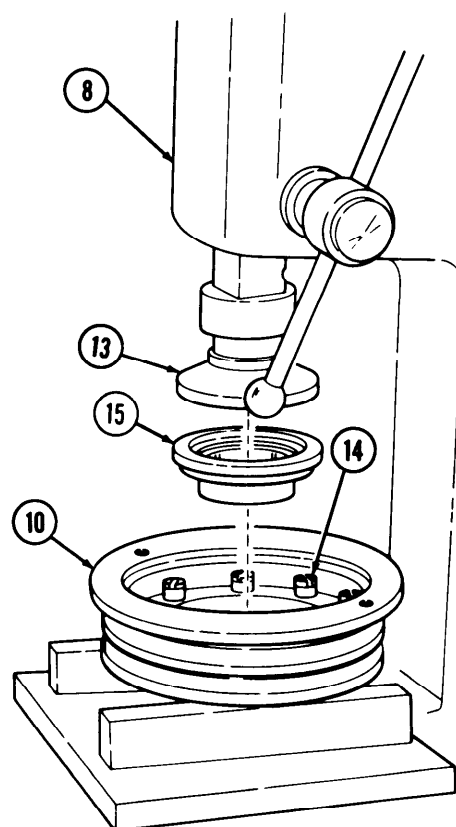
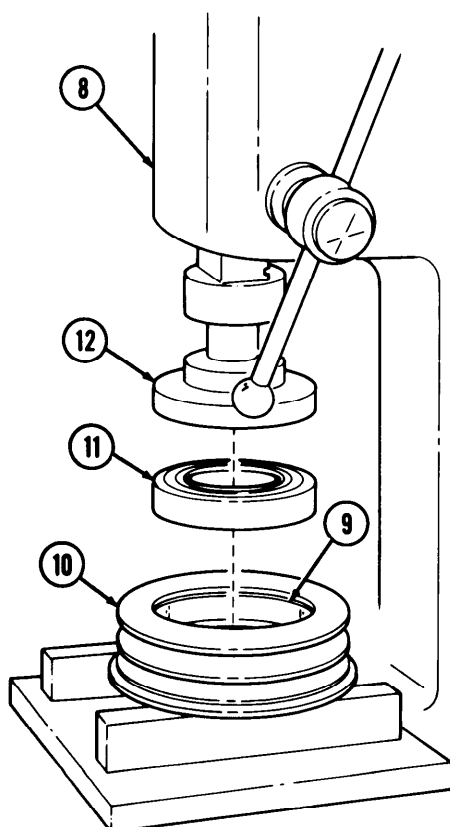
37.	Piston (3)	Using both hands, press downward and rotate clockwise until seated.	Piston has to seat over three hinge pins (7) of clutch housing (5).
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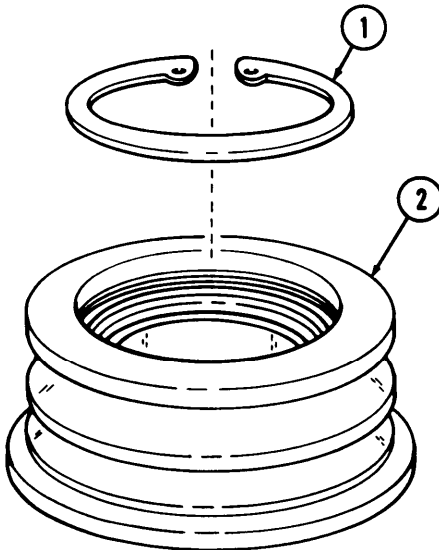
5-6. FAN DRIVE CLUTCH MAINTENANCE_ (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
38.		Drive pulley (10)	Place on arbor press (8) with drive pins (14) facing downward.	
39.		New bearing (11)	Install, using bearing replacer (12).	
40.		Drive pulley (10)	Place on arbor press (8) with drive pins (14) facing upward.	
41.		Thrust cap (15)	Install, using mandrel (13).	
42.		Drive pulley (10)	Turn pulley (10) over.	Make sure snapping groove (9) is fully exposed. If not, press bearing (11) until groove is fully exposed.



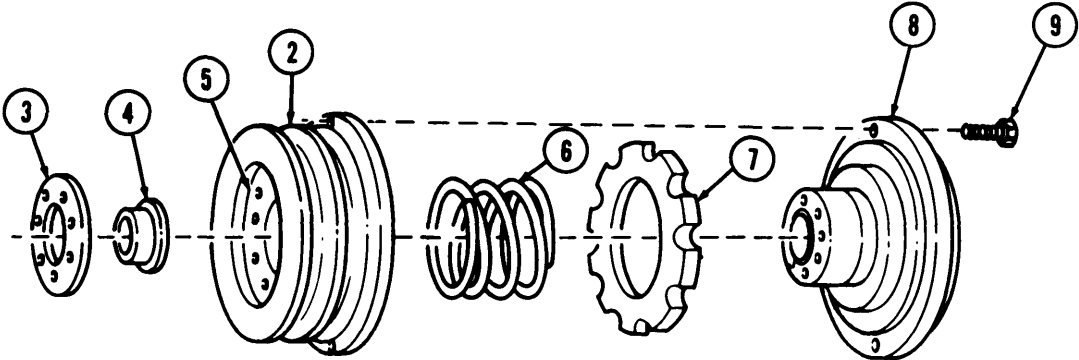
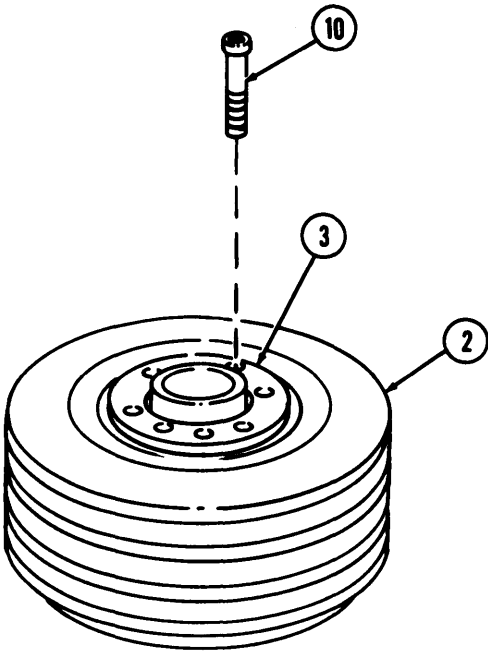
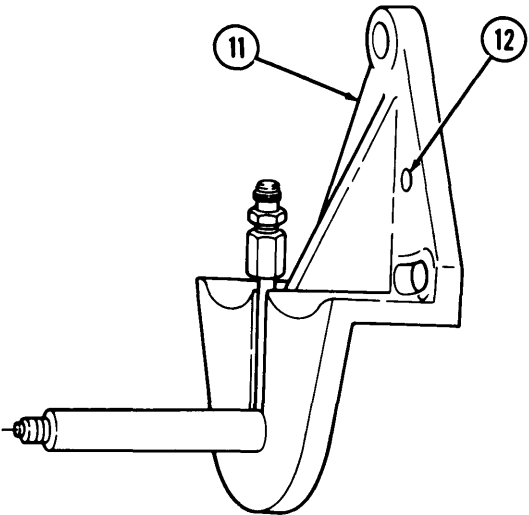
5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
43.		New snapping (1)	Install on drive pulley (2).	Use snapping pliers.
44.		Clutch facing (7), return spring (6), clutch housing (8), spacer (4), and thrust cap backup plate (3)	a. Install on drive pulley (2). b. Aline scribe marks on flanges of drive pulley (2) and clutch housing (8), then temporarily secure with two fan override lockup bolts (9).	Use fan override lockup bolts (9) stored in fan clutch assembly bracket (11).
NOTE Assistant will help with completion of step 45.				
45.		Thrust cap" (5) backup plate (3)	a. Aline screw holes to clutch housing (8). b. Assistant holds down backup plate (3) and drive pulley (2) as mechanic installs eight screws (10).	Tighten screws (10) 70 lb-in. (8 N·m).
46.	Drive pulley (2) and clutch housing (8)	Two fan override lockup bolts (9)	Remove and replace in storage holes (12) in fan clutch assembly bracket (11).	



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5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
	 			

5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Clutch assembly must be put in soft-jawed vise.

47.		Spacer (8)	Install on shaft (9).	
48.		Shaft (9)	Install in clutch assembly (7).	
49.		Spacer (6)	Position spacer (6) with cutout face toward clutch assembly (7) and install in clutch assembly (7) with flat washer (5) and new expansion locknut (4).	Tighten locknut (4) 65 lb-ft (88 N·m),

CAUTION

"O" rings must not be twisted after installation.

50.		Two new "O" rings (2) and (3)	Install on seal plug (1).	Coat lightly with GAA grease.
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CAUTION

When installing plug, use care not to cut or damage "O" rings.

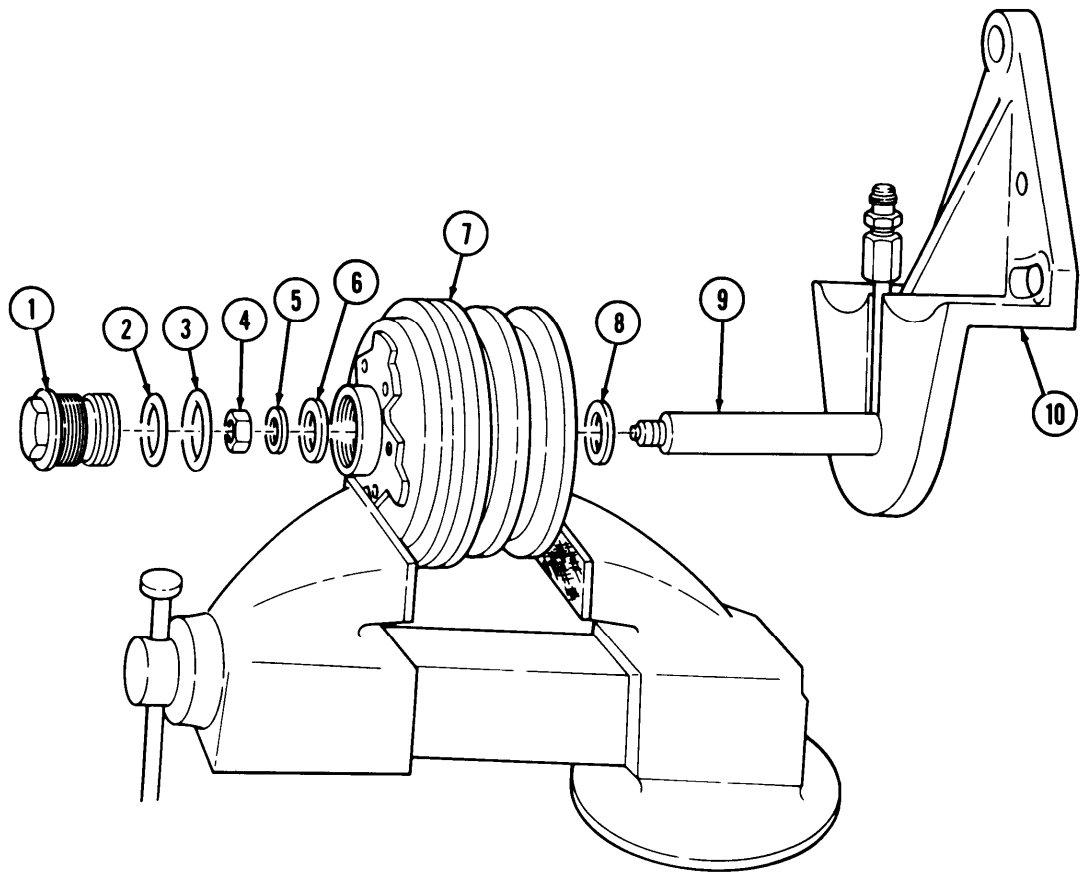
51.		Seal plug (1)	Install in clutch assembly (7).	Tighten plug (1) 40 lb-ft (54 N·m).
52.		Clutch assembly bracket (10) and clutch assembly (7)	Install on engine.	Refer to TM 9-2320-272-20-1.
53.		Engine	Start.	Refer to TM 9-2320-272-10.

d. Fan Drive Clutch Operation Check

54.		Engine	Run until coolant temperature reaches 175-195°F (79-91°C).	
55.		Cardboard	Place in front of radiator core until engine temperature reaches 200°F (93°C).	If fan does not engage when engine temperature reaches 200°F (93°C), refer to troubleshooting table 2-1.

5-6. FAN DRIVE CLUTCH MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

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5-7. WATER PUMP MAINTENANCE

This task covers:

- | | |
|----------------------------|-----------------|
| a. Removal | d. Reassembly |
| b. Disassembly | e. Installation |
| c. Cleaning and Inspection | |

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-20-1 TM 9-2320-272-20-1 TM 9-2320-272-20-1 TM 9-2320-272 -20-1	Cooling system drained. Fan drive clutch removed. Water pump drivebelt removed. Alternator adjusting link removed.

Test Equipment

None

Special Tools

None

Special Environmental Conditions

None

Materials/Parts

Ten lockwashers
Two gaskets
Water pump seal
Snapping
Seal
Relief fitting
Grease fitting
GAA grease (Appendix C, Item 11)
Liquid soap (Appendix C, Item 10)

Personnel Required

Wheeled vehicle repairman MOS 63W

General Safety Instructions

When using compressed air, eyeshields must be worn.

Manual References

TM 9-2320-272-10
TM 9-2320-272 -20-1
TM 9-2320-272-34P
TM 9-214

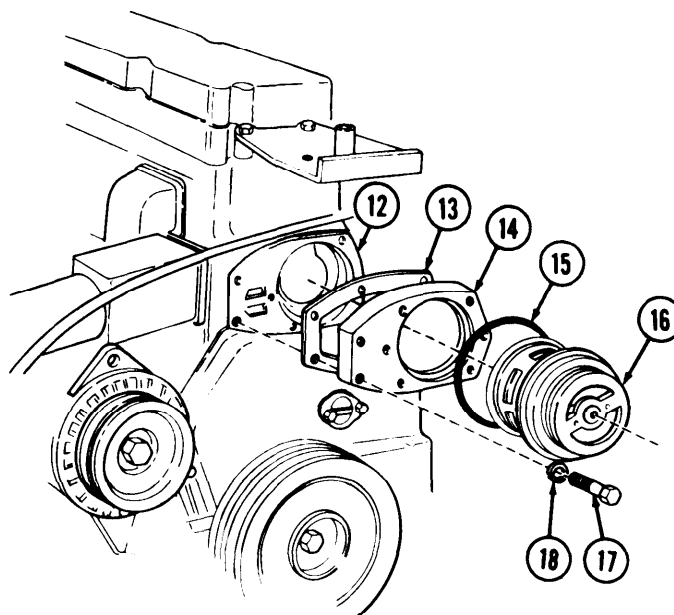
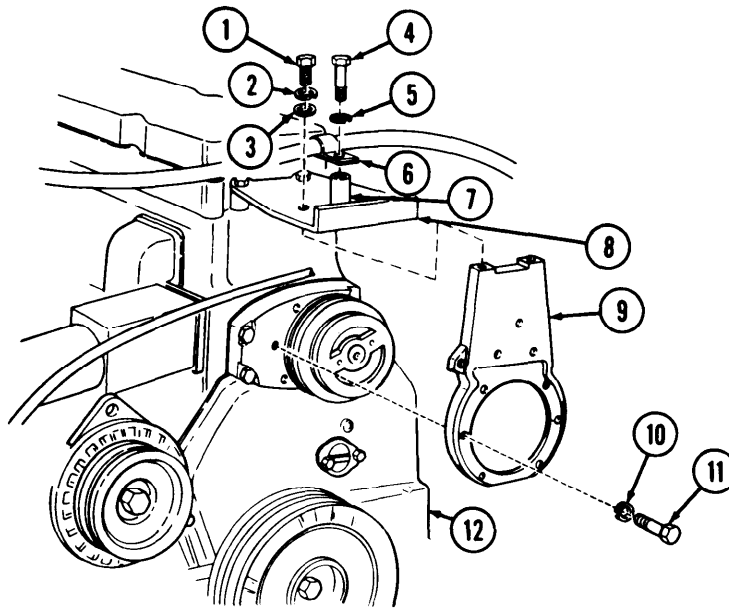
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1.	Engine bracket (8)	Screw (4), lockwasher (5), hose clamp (6), and spacer (7)	Remove.	Discard lockwasher (5).
2.		Screw (1), lockwasher (2), and washer (3)	Remove.	Discard lockwasher (2).
3.	Support bracket (9)	Six screws (11) and lockwashers (10)	Remove.	Discard lockwashers (10).
4.	Engine block (12)	Support bracket (9)	Remove.	

5-7. WATER PUMP MAINTENANCE (Cont'd)

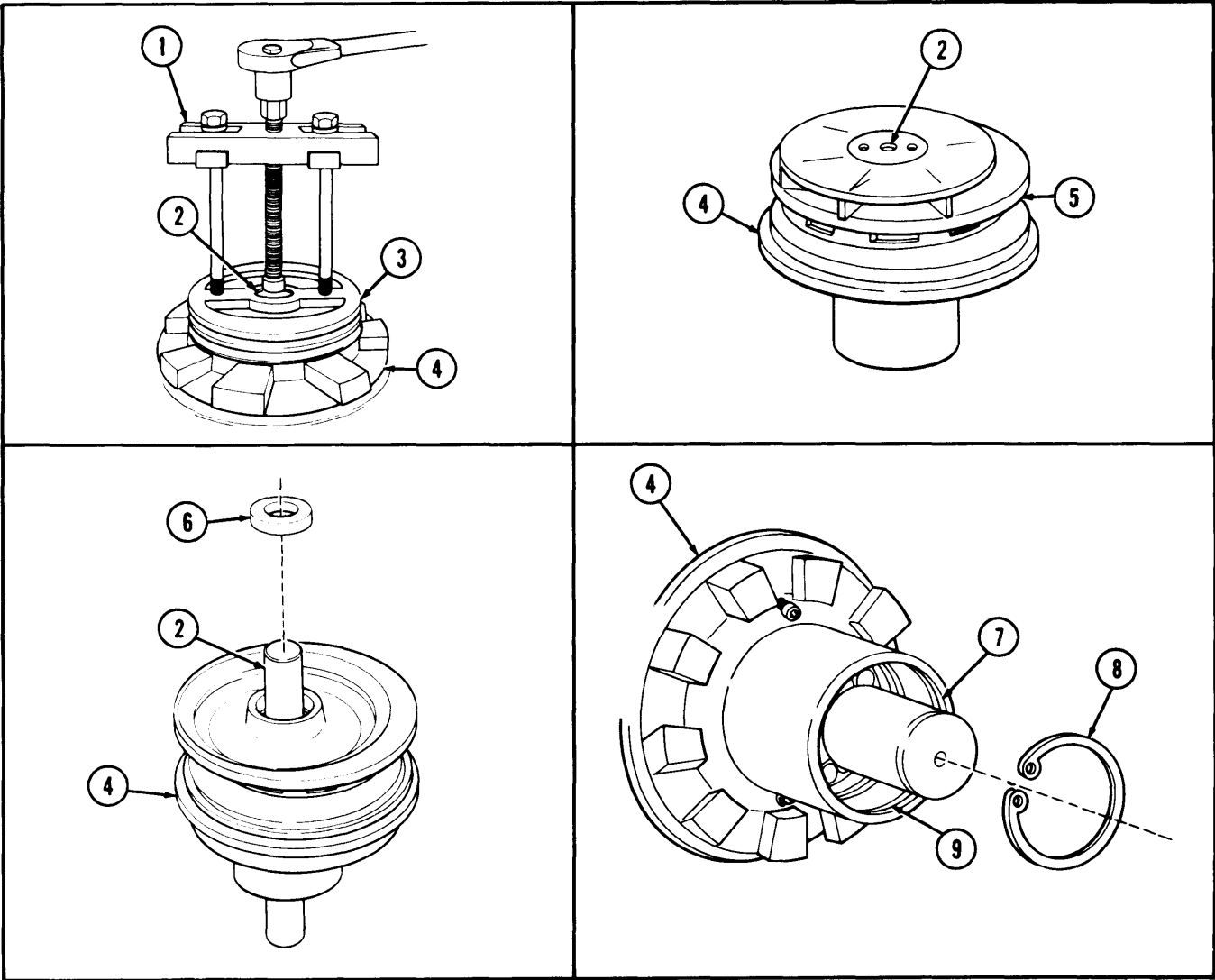
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
5.	Water pump support (14)	Water pump body (16) and gasket (15)	Remove.	Discard gasket (15).
6.	Engine block (12)	Two screws (17) and lockwashers (18)	Remove.	Discard lockwashers (18).
7.		Water pump support (14) and gasket (13)	Remove.	Discard gasket (13).



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5-7. WATER PUMP MAINTENANCE (Cont'd)

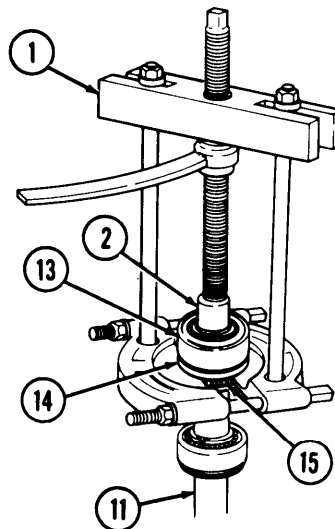
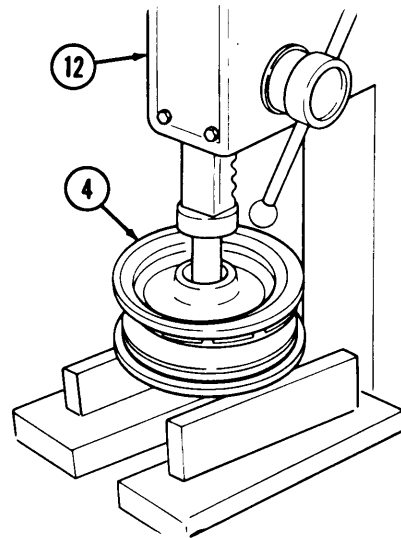
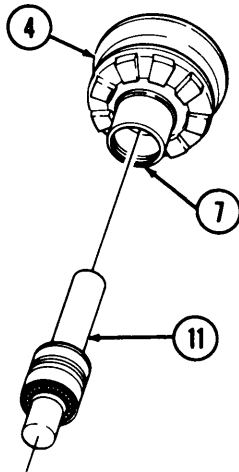
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Disassembly				
8.	Water pump body (4)	Drive pulley (3)	Remove from shaft (2).	Use puller.
9.	Shaft (2)	Water pump impeller (5)	Remove.	Use puller.
10.		Water pump seal (6)	Remove.	Discard seal (6).
11.	Water pump body (4)	Snapping (8)	Remove from ring groove (9) inside of bore (7).	Discard snapping (8).
12.		Water pump body (4)	Place on arbor press (12) with bore (8) facing downward.	Support water pump body (4) with two blocks of wood.



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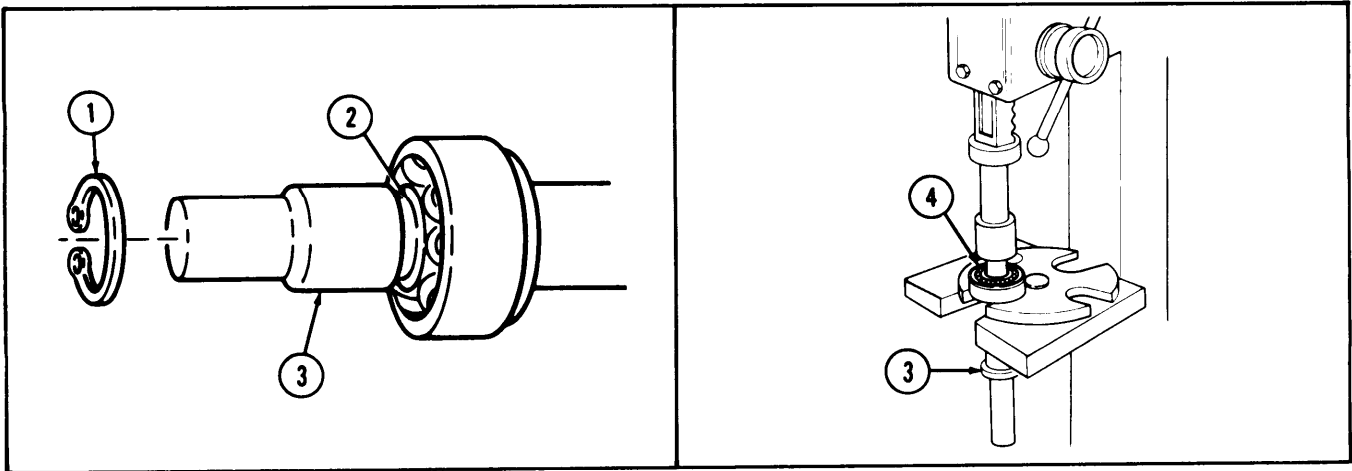
5-7. WATER PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
13.		Shaft assembly (11)	Remove by applying pressure on impeller end of shaft (11) and press shaft down and out of bore (7).	Bearing assemblies come out mounted on shaft (11).
14.		Bearing (13) and spacer (14)	Remove from shaft (11) using mechanical wedge puller (1) clamped between grease grooves (15) on spacer (14).	

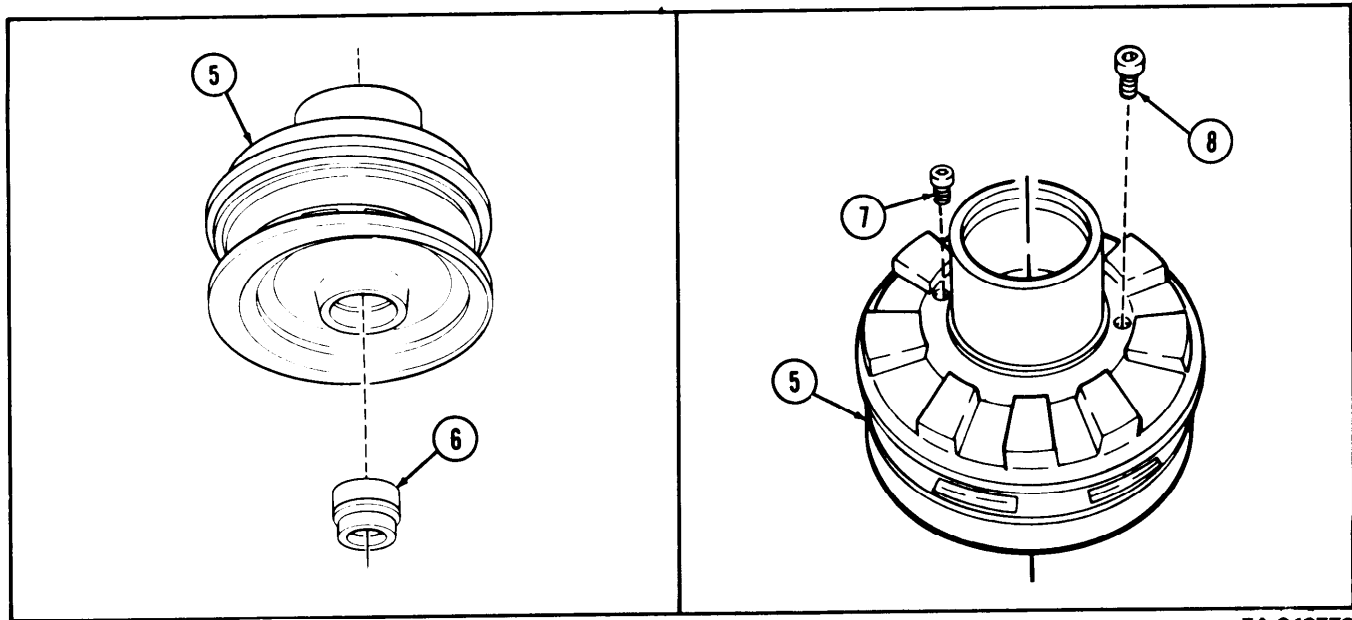


5-7. WATER PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
15.		Snapping (1)	Remove from snapping groove (2) on shaft (3).	
16.		Bearing (4)	Remove by pressing shaft (3) down through bearing (4).	
17.		Water pump seal (6)	Press out at impeller end of water pump body (5).	Discard seal (6).



18.		Plug (7)	Remove from water pump body (5).	Do not discard plug (7) unless damaged.
19.		Vent relief fitting (8)	Remove from water pump body (5).	Discard relief fitting (8).



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5-7. WATER PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Cleaning and Inspection

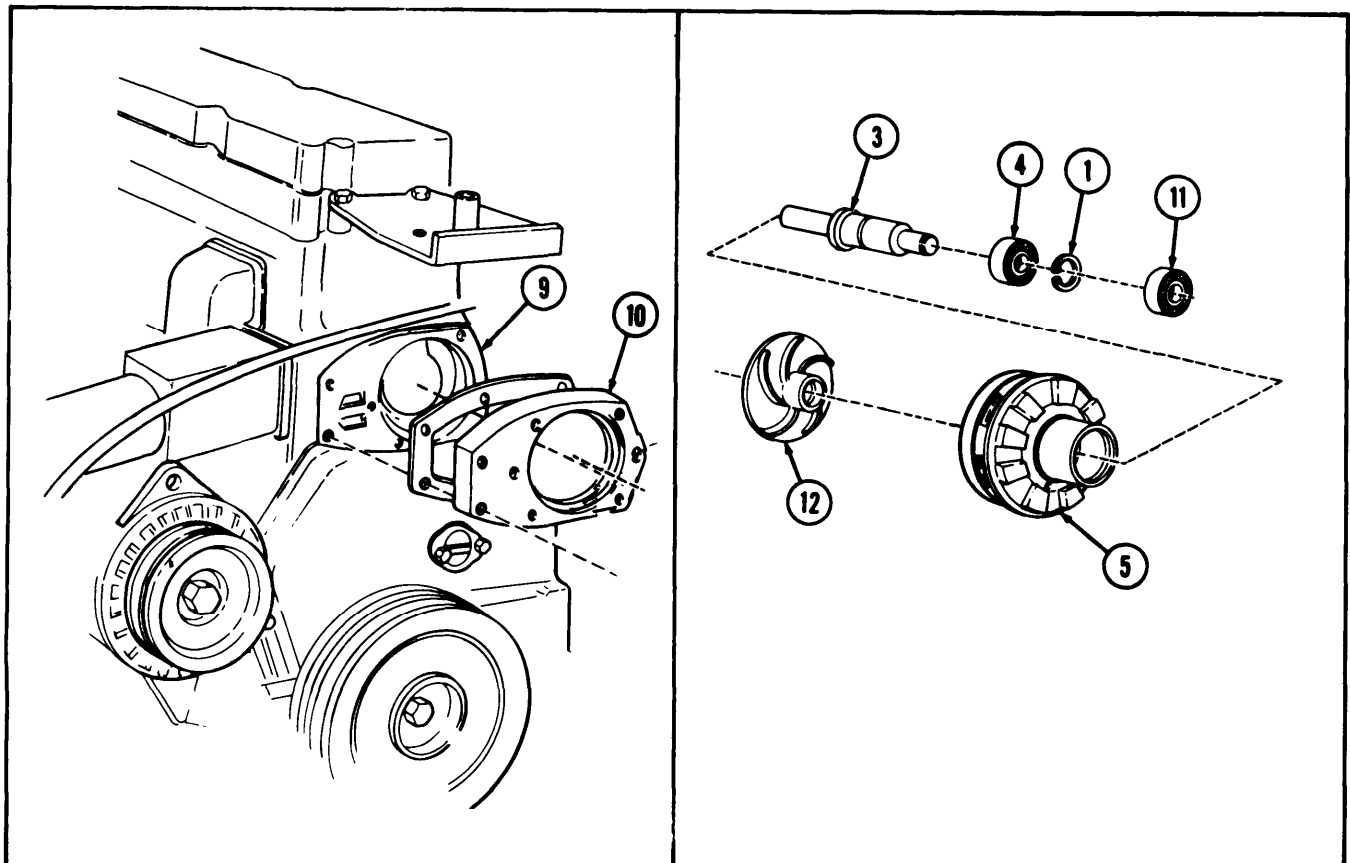
WARNING

Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.

CAUTION

Rotate bearings very slowly while cleaning. Do not spin bearing races with compressed air when drying bearings. Serious damage will result.

- | | | | |
|-----|---|--|---|
| 20. | Bearings (4) and (11), water pump body (5), shaft (3), and water pump impeller (12) | Clean in accordance with instructions in paragraph 2-7 and TM 9-214. | Do not service bearings (4) and (11) in dirty surroundings. |
| 21. | Water pump support (10) | Clean gasket remains from mating surfaces and engine block (9). | |

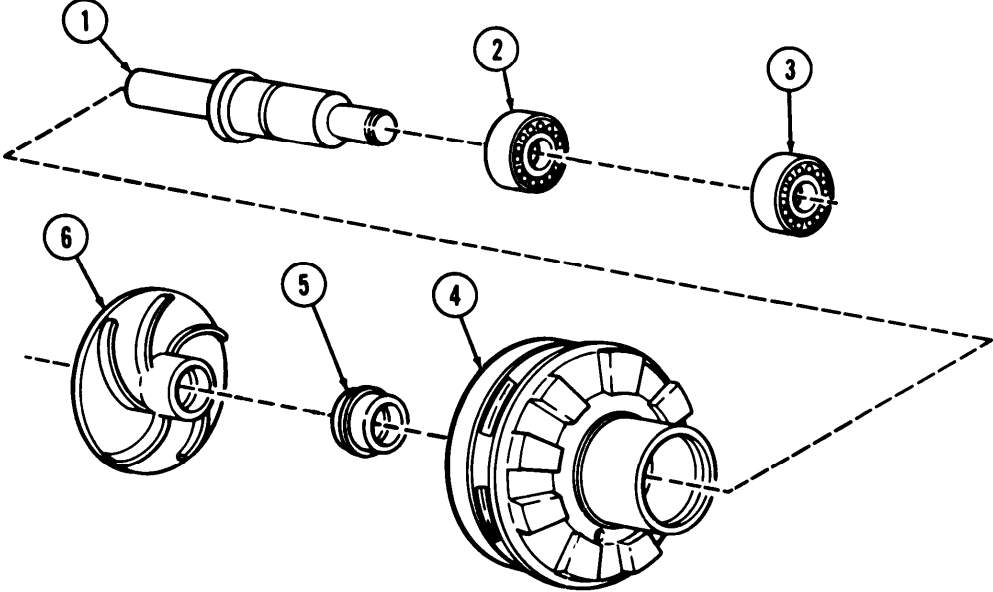
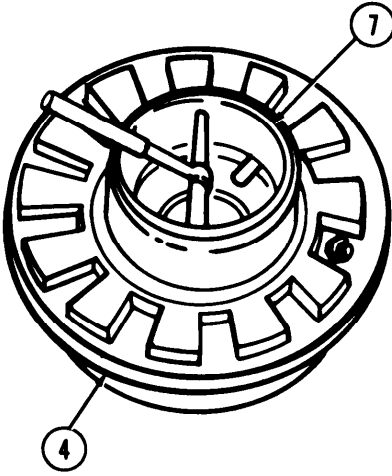


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5-7. WATER PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
22.		Bearing (2) and bearing (3)	a. Inspect in accordance with instructions in paragraph 2-8. b. Check for heat discoloration, pits, scored ball or rollers, breaks, cracks, splits, dents, rust, or corrosion.	Refer to TM 9-214 for additional inspection standards. Replace bearings (2) and/or (3) if any of these defects are noted.
23.		Spacer (5)	Inspect for cracks and galls.	Replace spacer (5) if either of these defects is noted.
24.		Water pump impeller (6)	Inspect for cracks and heavy corrosion.	Replace impeller (6) if cracked. If corroded, clean impeller (6) with wire brush.
25.		Shaft (1)	a. Inspect for cracks, scores, and galls. b. Check outside diameter (O. D.) using micrometer.	Replace shaft (1) if any of these defects are noted. Refer to table 5-1 for shaft (1) replacement wear limits.
26.		Water pump body (4)	a. Inspect for cracks, pits, and heavy corrosion. b. Check bore (7) inside diameter (I.D.) for wear, using a snap gage.	Replace water pump body (4) if cracked, pitted, or corroded. Refer to table 5-1 for bore (7) wear limits. Replace water pump body (4) if worn beyond limits.

5-7. WATER PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

5-7. WATER PUMP MAINTENANCE (Cont'd)

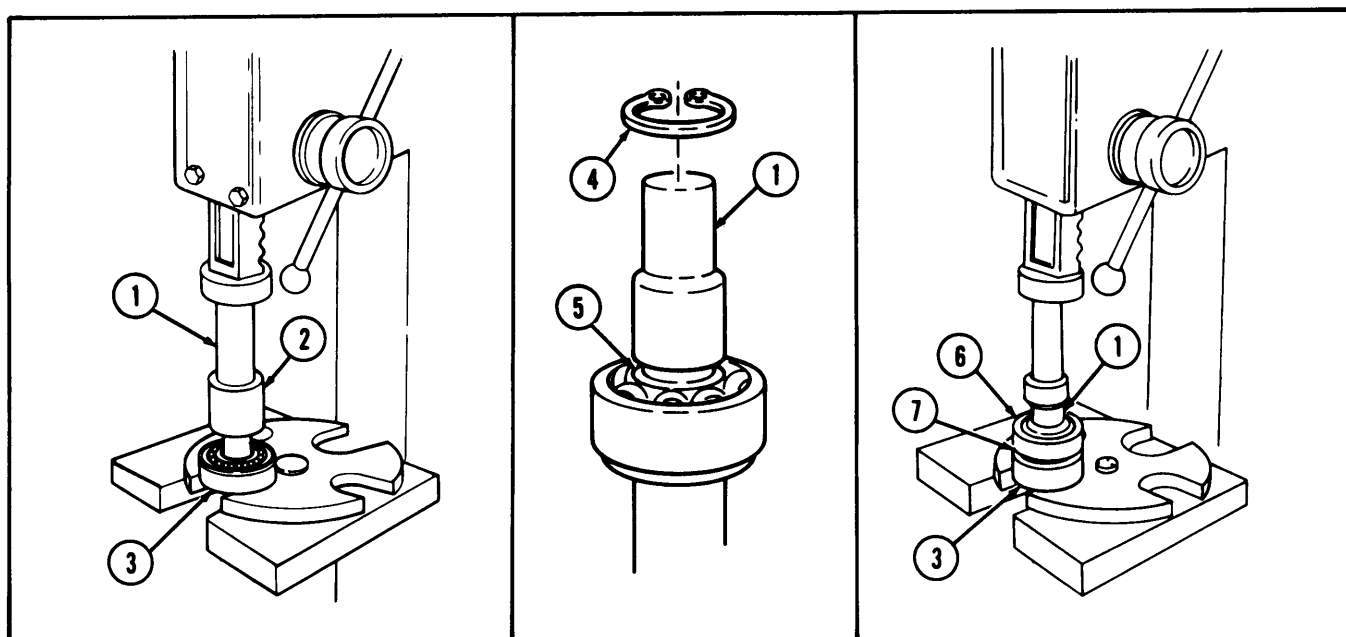
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Reassembly

NOTE

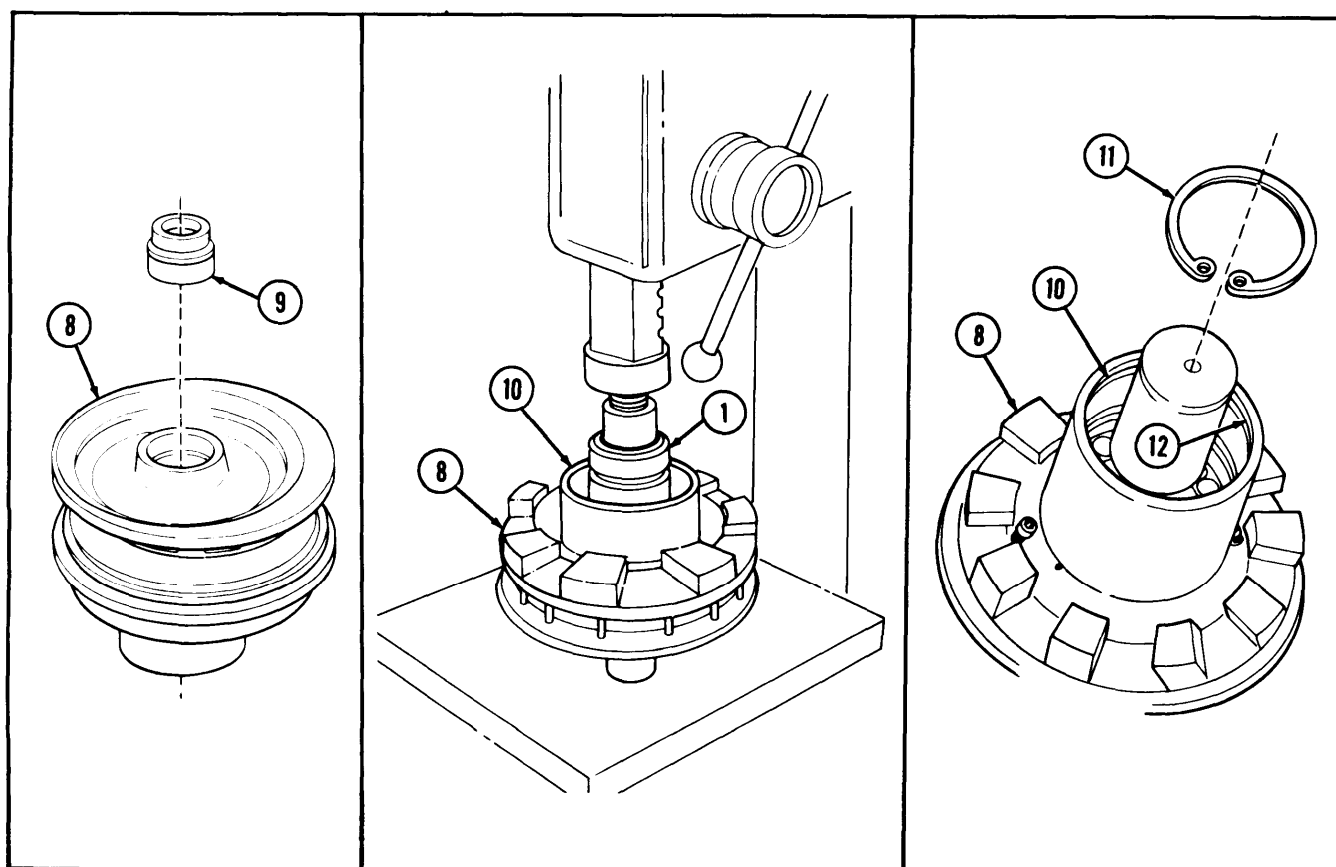
New replacement bearings are installed as they are removed from packages, without cleaning or repacking. Original bearings, approved by inspection for reuse, must be packed after cleaning and inspection.

27.		Shaft (1)	Coat lightly with clean GAA grease.	
28.		Bearing (3)	a. Pack with GAA grease. b. Press shaft (1) down until shoulder (2) bottoms on bearing (3).	Refer to TM 9-214, mandrel.
29.		Snapring (4)	Install in ring groove (5) on shaft (1).	
30.		Spacer (7)	Install on shaft (1), and seat against bearing (3).	
31.		Bearing (6)	Press bearing (6) over shaft (1) until seated against spacer (7).	Use arbor press and mandrel.



5-7. WATER PUMP MAINTENANCE (Cont'd)

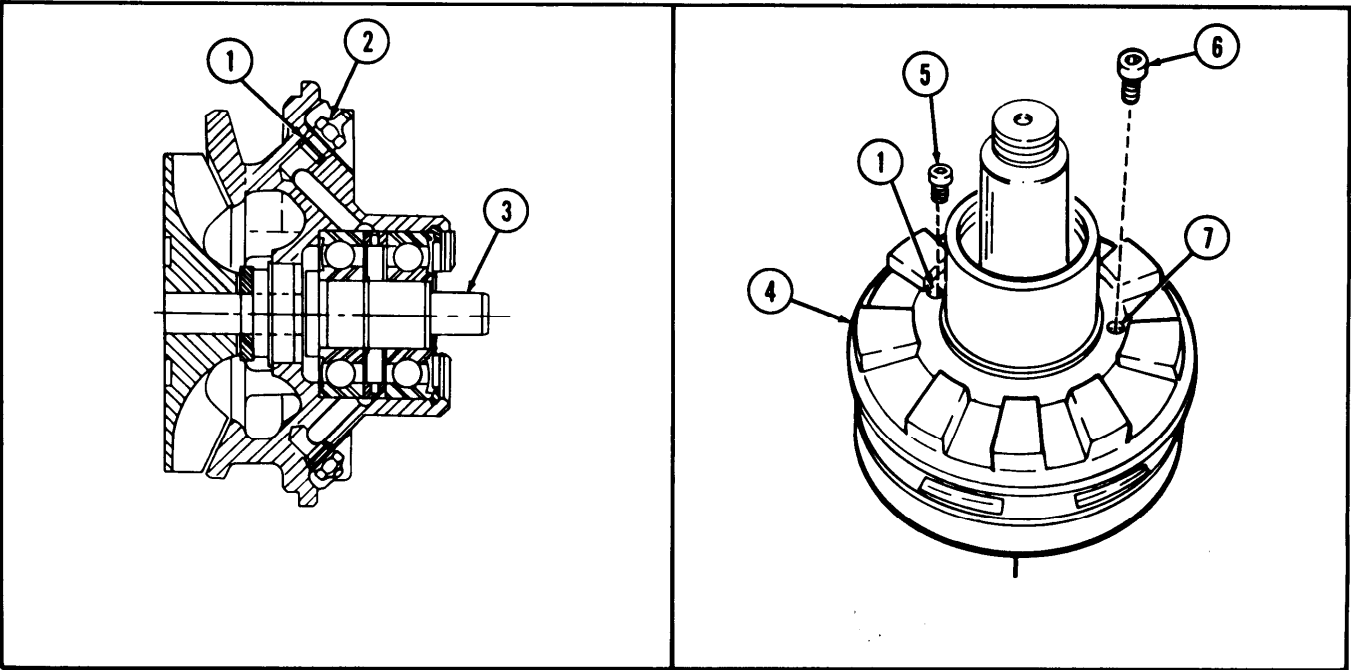
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
32.		New water pump seal (9)	Using mandrel, install in water pump body (8) at impeller end.	Coat seal (9) with liquid soap to ease installation. Keep carbon face on seal (9) free of grease.
33.		Water pump body (8)	Place on arbor press with bore (10) facing upward.	
34.		Shaft assembly (1)	a. Position in water pump body (8) and align straight with bore (10). b. Using mandrel, press shaft assembly (1) into water pump body (8).	Impeller end of shaft (1) must be facing downward.
35.		New snapring (11)	Install in snapring groove (12) in bore (10).	



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5-7. WATER PUMP MAINTENANCE (Cont'd)

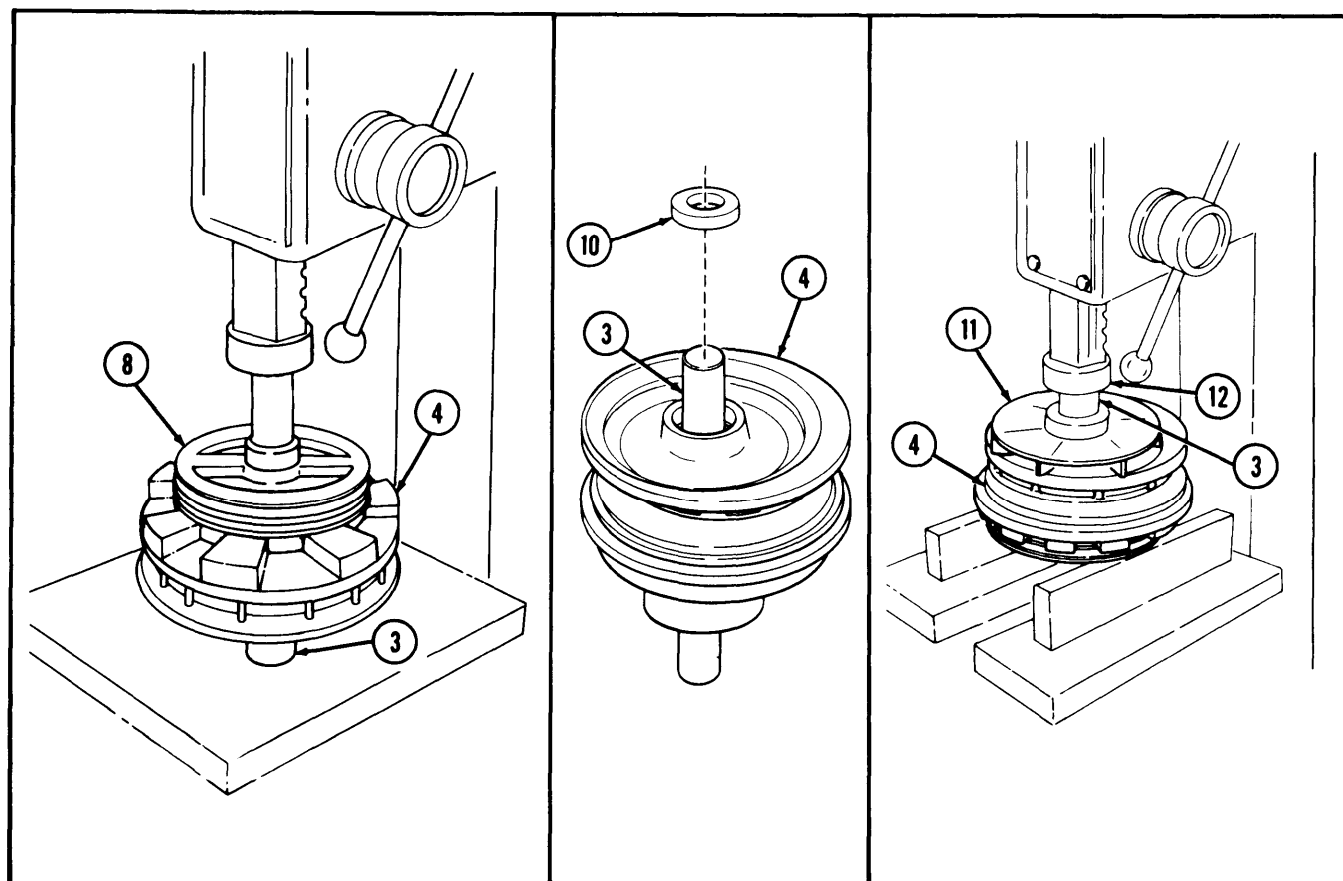
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
36.		New relief fitting (6)	Install in hole (7) on water pump body (4).	
<p>CAUTION</p> <p>Water pumps are lubricated only after rebuild. The lubrication passages are normally kept plugged to prevent overgreasing which can cause seal blowout and damage to water pump.</p> <p>NOTE</p> <p>. The following procedure must be maintained as described to prevent water pump damage.</p> <p>. Use care when lubricating water pump. Do not allow grease to come into contact with shaft (3).</p>				
37.		Water pump body (4)	a. Install a grease fitting (2) in passage (1). b. Fill water pump body (4) with .60-.70 cu. in. (.31-.37 oz) of GAA grease. c. Remove grease fitting (2).	Grease fitting (2) is installed temporarily to fill water pump cavity with lubricant. Discard.
38.		Plug (5)	Install in passage (1), and tighten securely.	



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5-7. WATER PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
39.		Drive pulley (8)	a. Support water pump body (4) directly on impeller end of shaft (3) on arbor press. b. Position drive pulley (8) on shaft (3), and press on until seated,	
40.		Water pump body (4)	Place on arbor press with pulley drive (8) face down.	
41.		Water pump seal (10)	Install on shaft (3) with stainless steel surface facing upward.	Apply coating of liquid soap to ease installation of seal (10).
42.		Water pump impeller (11)	Position and press on shaft (3) using mandrel driver (12).	Refer to table 5-1 for impeller (11) clearance specifications.



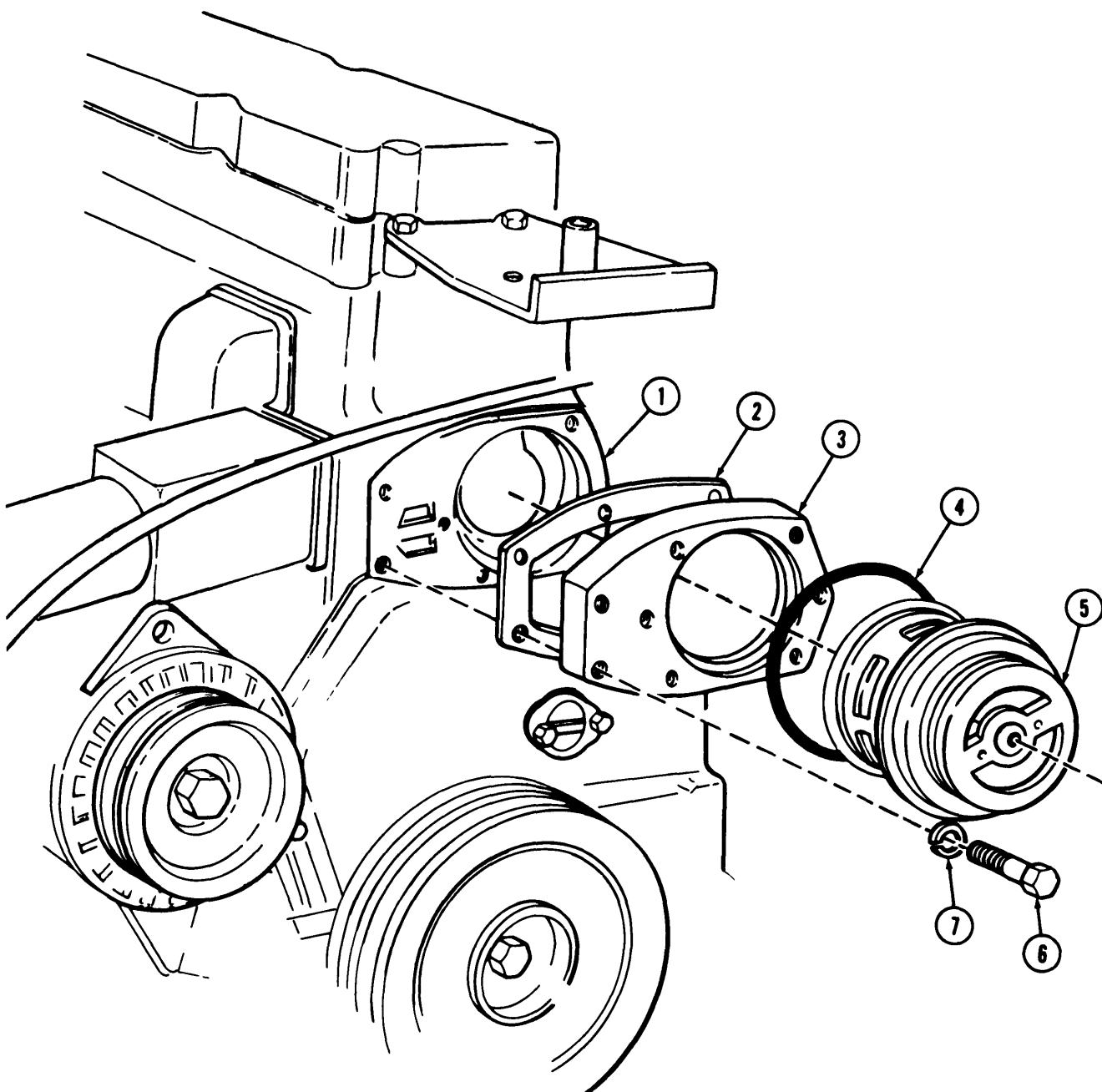
TA349778

5-7. WATER PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<hr/> e. Installation <hr/>				
43.		New gasket (2)	a. Coat both sides lightly with clean GAA grease. b. Position on water pump support (3) gasket mating surface, and aline to screw holes.	
44.		Water pump support (3)	Position on engine block (1), and aline to screw holes.	
45.		Two new lockwashers (7) and screws (6)	Install, securing water pump support (3) to engine block (1).	Do not tighten at this time.
46.		New gasket (4) and water pump body (5)	Install into water pump support (3).	
47,		Two screws (6)	Tighten 30 lb-ft (41 N·m).	

5-7. WATER PUMP MAINTENANCE [Cont'd]

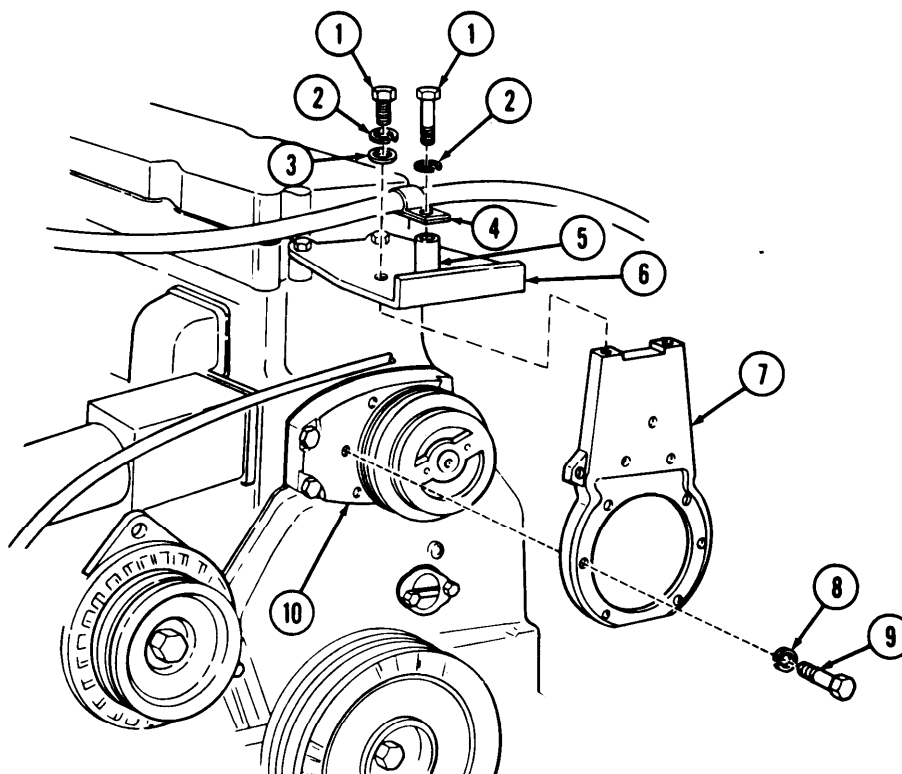
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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TA 349779

5-7. WATER PUMP MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
48.		Support bracket (7)	Install on pump support (10) with six new lockwashers (8), and screws (9).	Tighten screws (9) 30 lb-ft (41 N-m).
49.		Spacer (5), flat washer (3), two new lockwashers (2) and screws (1), and hose clamp (4)	Install and secure top of support bracket (7) to upper radiator support bracket (6), and tighten securely.	



END OF TASK!

- FOLLOW-ON TASKS:
- Install and adjust water pump drivebelt (TM 9-2320-272-20-1),
 - Install fan drive clutch (TM 9-2320-272-20-1).
 - Fill coolant system (TM 9-2320-272-20-1).
 - Install alternator adjusting link (TM 9-2320-272-20-1).
 - Start engine (TM 9-2320-272-10) and check for coolant leaks.

TA 349780

Section III. REPAIR AND REPLACEMENT STANDARDS – WATER PUMP

5-8. GENERAL

a. This section provides the minimum, maximum, and worn serviceability standards for the water pump assembly. The wear limits indicate point to which a part or parts may be worn before replacement is required.

b. An asterisk(*) in the “wear limits” column indicates that the part or parts must be replaced or repaired when worn beyond the dimensions specified in the “size and fit of new parts” column.

Table 5-1. Repair and Replacement Standards — Water Pump

REF. NO.	POINT OF MEASUREMENT	SIZE AND FIT OF NEW PARTS	WEAR LIMITS
	WATER PUMP BODY		
14	Housing bearing bore	2.4408-2.4414 in. (61.996-62.012 mm)	2.4494 in. (62.215 mm)

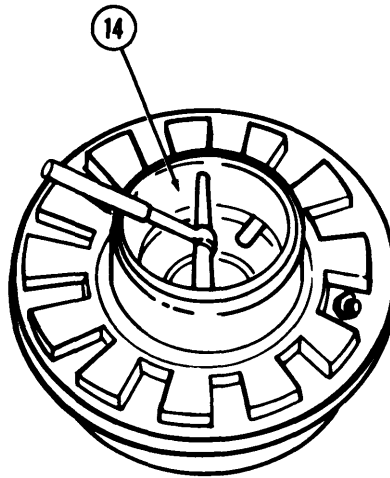


Table 5-1. Repair and Replacement Standards — Water Pump (Cont 'd)

REF. NO.	POINT OF MEASUREMENT	SIZE AND FIT OF NEW PARTS	WEAR LIMITS
SHAFT			
1	Shaft diameter (O.D.) Impeller end	0.6262-0.6267 in. (15.905-15.918 mm)	*
2	Shaft diameter (O.D.) Seal seat location	0.6262-0.6267 in. (15.905-15.918 mm)	*
3	Shaft diameter (O.D.) Inner bearing	0.9843-0.9847 in. (25.001-25.011 mm)	*
4	Shaft diameter (O.D.) Outer bearing	0.9843-0.9847 in. (25.001-25.011 mm)	*
5	Shaft diameter (O.D.) Pulley end	0.6693-0.6696 in. (17.002-17.007 mm)	*
IMPELLER			
6	Impeller bore inside diameter (I.D.)	0.624-0.625 in. (15.85-15.88 mm)	*

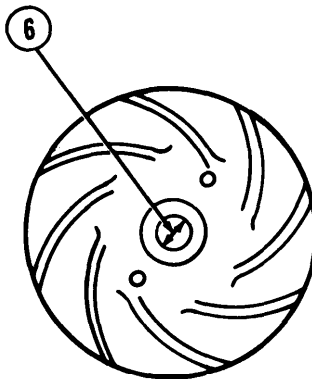
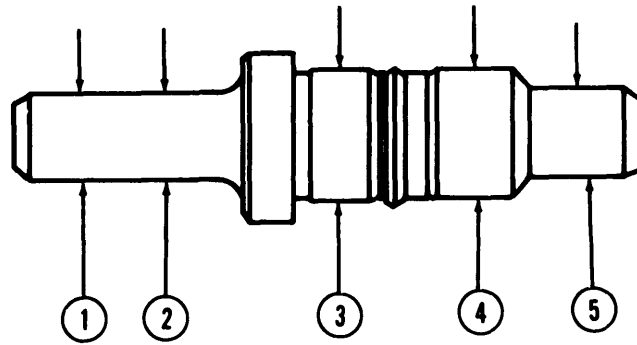


Table 5-1. Repair and Replacement Standard-s — Water Pump (Cont'd)

REF. NO.	POINT OF MEASUREMENT	SIZE AND FIT OF NEW PARTS	WEAR LIMITS
IMPELLER (Cont'd)			
7	Housing bore (impeller end) water pump body (I. D.)	1.5000-1.5200 in. (38.100-38.608 mm)	
	Minimum press fit between shaft and impeller	0.001 in. (0.03 mm)	
8	Drive pulley bore inside diameter (I.D.)	0.663-0.6673 in. (16.924-16.949 mm)	
	Minimum press fit between shaft and pulley	0.001 in. (0.03 mm)	

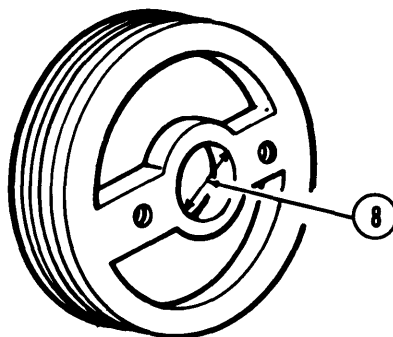
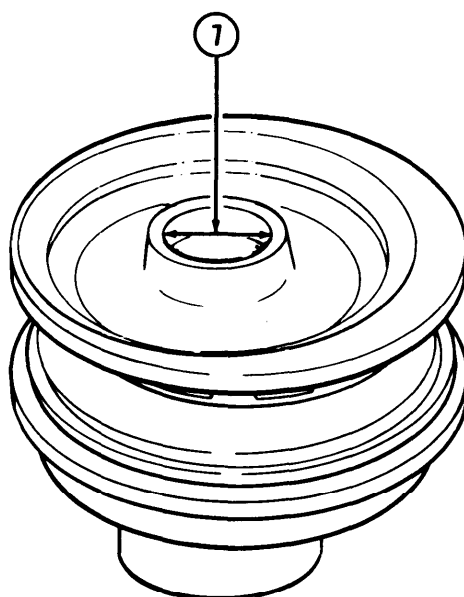


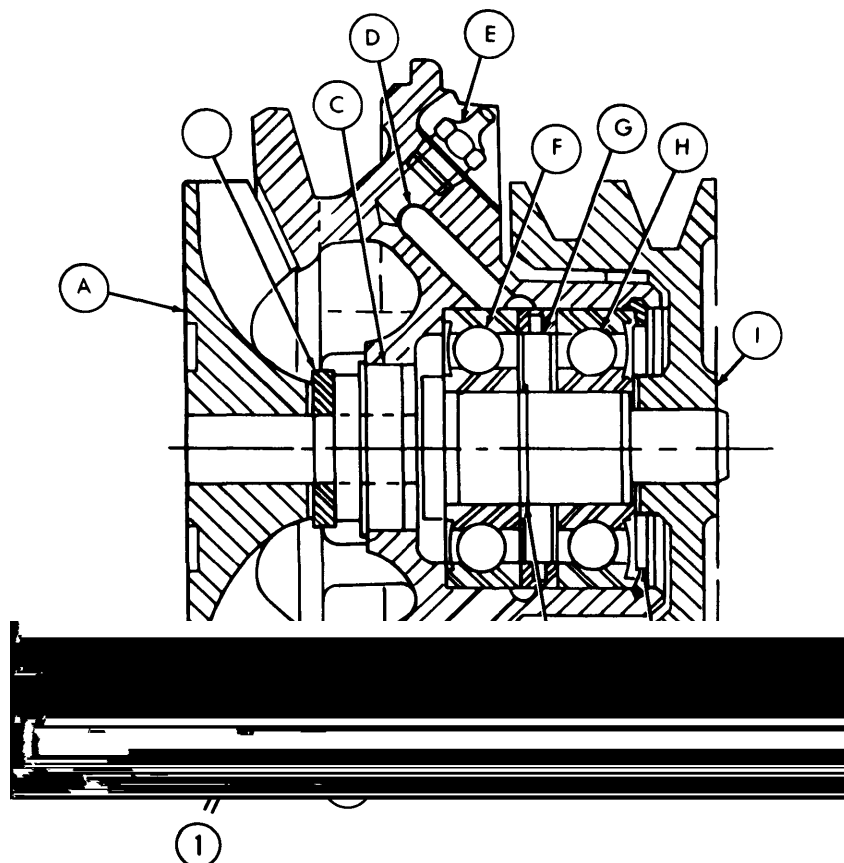
Table 5-1. Repair and Replacement Standards — Water Pump (Cont'd)

REF. NO.	POINT OF MEASUREMENT	SIZE AND FIT OF NEW PARTS	WEAR LIMITS
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IMPELLER (Cont'd)

1. Impeller vane to pump body clearance
(cast iron)

0.020-0.040 in.
(0.51-1.02 mm)



- A. Impeller
- B. Seat-Water Pump Seal
- c. Seal-Water Pump
- D. Lubricant Passage
- E. Grease Fitting
- F. Inner Bearing
- G. Spacer

- H. Outer Bearing
- I. Drive Pulley
- J. Snapring
- K. Snapring
- L. Relief Fitting
- M. Water Pump Body

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CHAPTER 6

ELECTRICAL SYSTEM MAINTENANCE

NOTE

Refer to TM 9-2320-358-24&P for unique M939A2 maintenance procedures.

Section 1. DESCRIPTION AND DATA

6-1. GENERAL

This section provides description and data for the alternator, starter motor, and solenoid.

6-2. DESCRIPTION - ALTERNATOR

The M939 series vehicles use an alternator with a voltage output of 28 volts and maximum output of 60 amperes. The alternator is air-cooled by a fan located on the drive end directly behind the pulley. The voltage regulator is built into the alternator and has an externally accessible voltage adjustment. The alternator components are enclosed in a sealed compartment, making it water resistant. Alternator maintenance, repair, and testing are covered in TM 9-2920-225-34.

6-3. DESCRIPTION - STARTER MOTOR AND SOLENOID

The M939 series vehicles use a 24-volt starter motor. The starter motor has a piggyback-mounted solenoid with the solenoid plunger and pinion shifting mechanism totally enclosed. The motor is completely sealed. The starter motor has a Positork Pinion Drive assembly which assures complete pinion drive engagement before the motor begins to rotate. This reduces pinion drive and flywheel ring gear wear.

Table 6-1. Electrical System Tabulated Data

NOTE

Two alternators are provided for M939 series vehicles.

1. ALTERNATOR

Make	.....	Leece-Neville
Model	.....	3002 AE
Make	.....	Prestolite
Model	.....	AMA 5104-UT

NOTE

Three starter motor are provided for M939 series vehicles.

2. STARTER MOTOR

Make	.....	Delco-Remy
Model	.....	1113847
Technical Manual	.....	TM 9-2920-242-35
Make	.....	Leece-Neville
Model	.....	M001-7260MA
Technical Manual	.....	TM 9-2920-243-34
Make	.....	Prestolite
Model	.....	MES-6401-CLT
Technical Manual	.....	TM 9-2920-248-35

Section II. ELECTRICAL SYSTEM MAINTENANCE

6-4. GENERAL

- a This section provides maintenance procedures assigned to the direct and general support level. To find a specific procedure, see the replacement task summary below.
- b. For maintenance instructions of electrical components not covered in this chapter, see TM 9-2320-272-20-1.
- c. Maintenance instructions for the fuel pump shutoff valve are described in paras. 4-5 and 4-6.

6-5. ELECTRICAL SYSTEM REPLACEMENT TASK SUMMARY

PARA. NO.	PROCEDURES	PAGE NO.
6-6.	Front Lights Cable Assembly Replacement	6-4
6-7.	Front Wiring Harness Replacement	6-12
6-8.	Rear Wiring Harness Replacement	6-50
6-9.	Alternator Adjustment	6-70

6-6. FRONT LIGHTS CABLE ASSEMBLY REPLACEMENT

This task covers:

a. Removal**b. Installation****INITIAL SETUP:**

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10 TM 9-2320-272-10 TM 9-2320 -272-20-1	Parking brake set. Splash shields removed. Battery ground cables disconnected.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Six lockwashers Twelve locknuts		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		Assistant must support hood during removal of wiring harness clamp.
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272 -20-1 TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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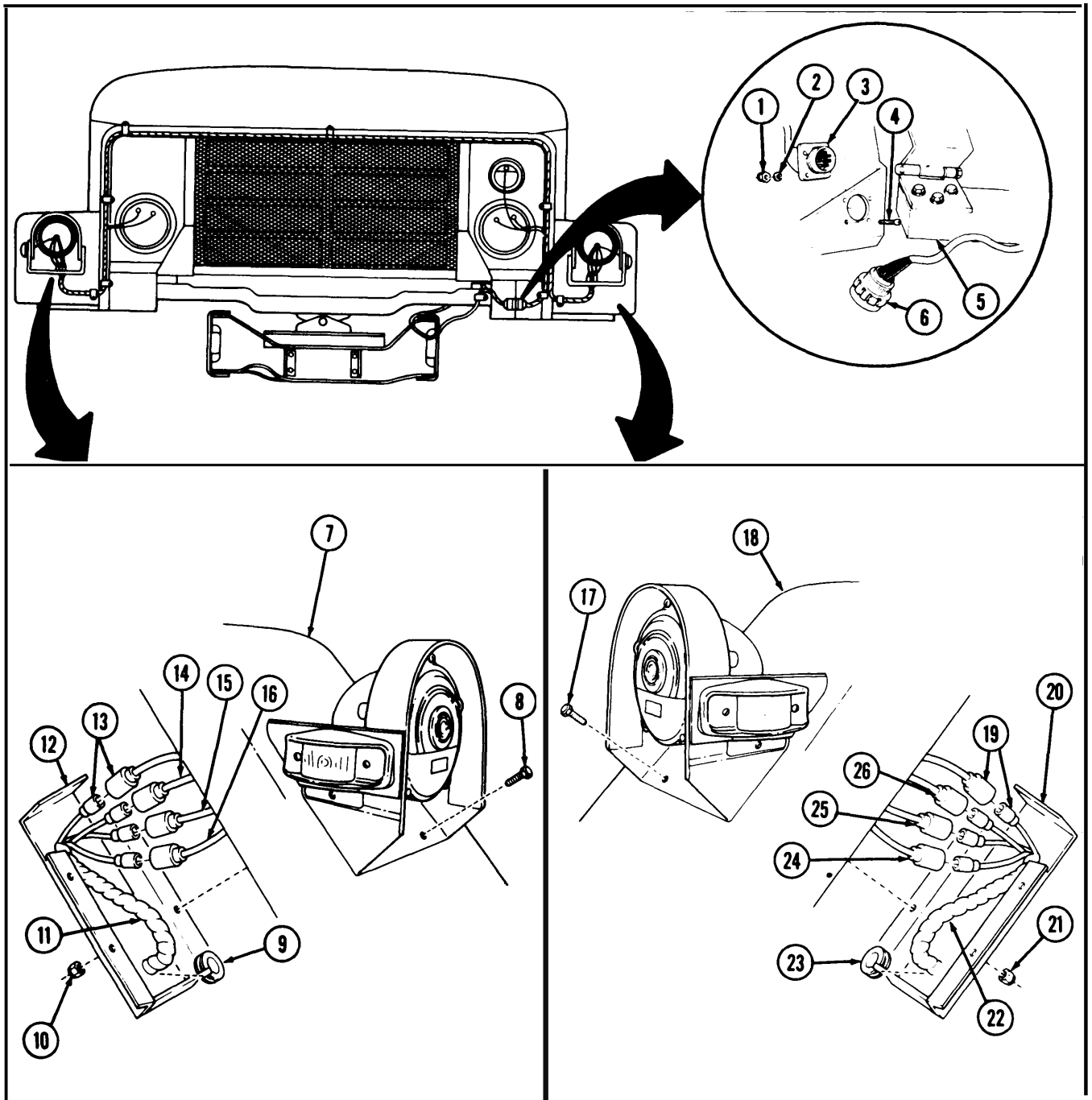
a. Removal**NOTE**

Tag wires and connectors for installation.

- | | | | | |
|----|---|--|--|---|
| 1. | Lower left engine hood (5) | Front light cable connector (6) | Disconnect from front harness connector (3). | |
| 2. | Front harness connector (3) to left fender (18) | Four locknuts (1), lockwashers (2), and screws (4) | Remove. | Discard lockwashers (2) and locknuts (1). |
| 3. | Left fender (18) | Four locknuts (21) and screws (17) | Remove. | Discard locknuts (21). |
| 4. | Wiring cover (20) | Grommet (23) | Remove. | |
| 5. | | Wires (19), (24), (25), and (26) | Disconnect. | |
| 6. | Cable assembly (22) | Wiring cover (20) | Remove. | |
| 7. | Right fender (7) | Four locknuts (10) and screws (8) | Remove. | Discard locknuts (10). |
| 8. | Wiring cover (12) | Grommet (9) | Remove. | |

6-6. FRONT LIGHTS CABLE ASSEMBLY REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
9.		Wires (13), (14), (15), and (16)	Disconnect,	
10.	Cable assembly (11)	Wiring cover (12)	Remove.	



6-6. FRONT LIGHTS CABLE ASSEMBLY REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
11.	Left hood lamp (24) and blackout lamp (9)	Connectors (23), (22), and (8)	Disconnect.	
12.	Left headlamp ground wire (20)	Connector (25)	Disconnect.	
13.		Screw (18), washer (19), ground wire (20), and lockwasher (21)	Remove.	Discard lockwasher (21).
14.	Right headlamp (10)	Connectors (11) and (12)	Disconnect.	
15.	Right headlamp ground wire (14)	Connector (17)	Disconnect.	
16.		Screw (16), washer (15), ground wire (14), and lockwasher (13)	Remove.	Discard lockwasher (13).
17.	Engine hood (4) and cable assembly (3)	Nine screws (1) and clamps (2)	Remove.	M936 model uses only eight screws (1) and clamps (2).

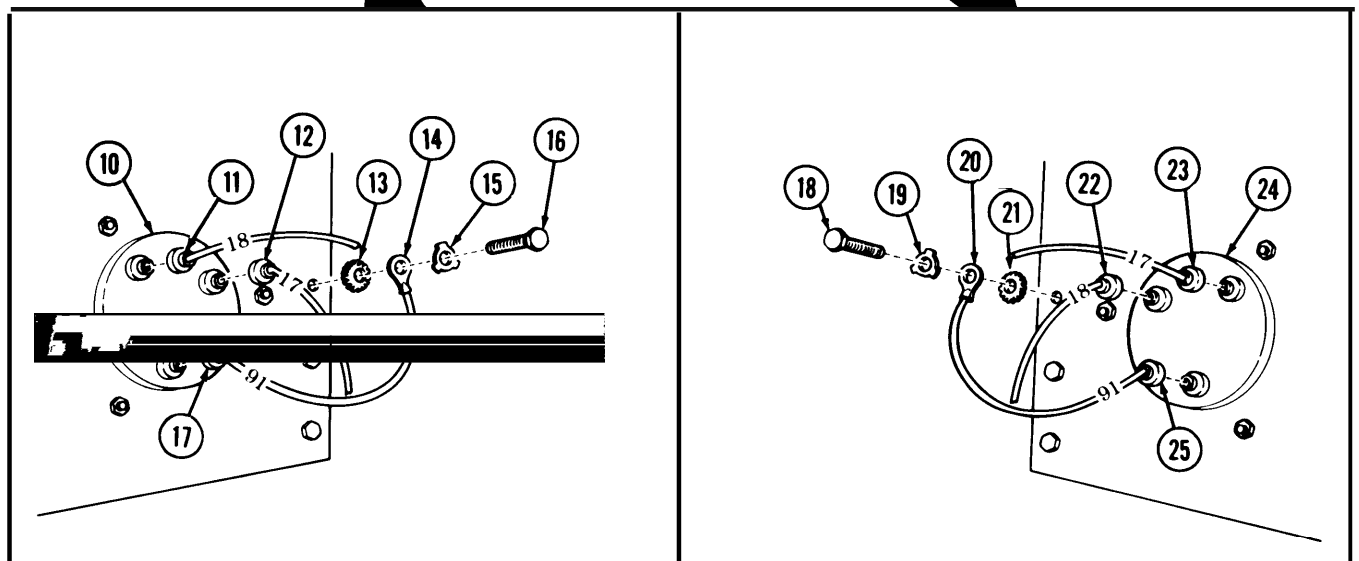
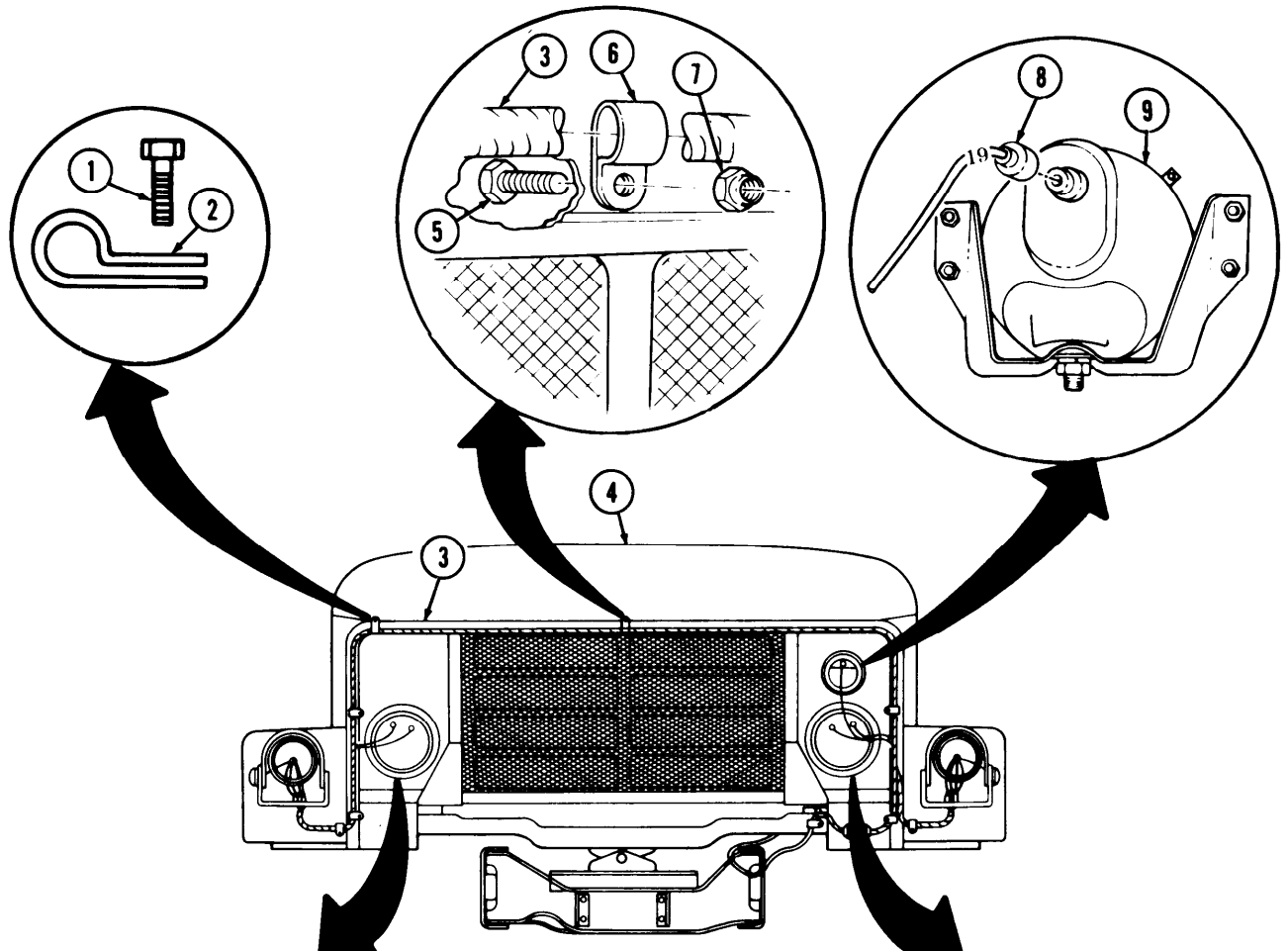
WARNING

Assistant must support hood during removal of wiring harness clamp, or injury to personnel may result.

18.	Hood retaining rod mounting bracket screw (5)	Locknut (7) and clamp (6)	Remove.	Discard locknut (7).
19.	Wiring harness (3)	Clamp (6)	Remove.	
20.	Engine hood (4)	Cable assembly (3)	Remove.	

6-6. FRONT LIGHTS CABLE ASSEMBLY REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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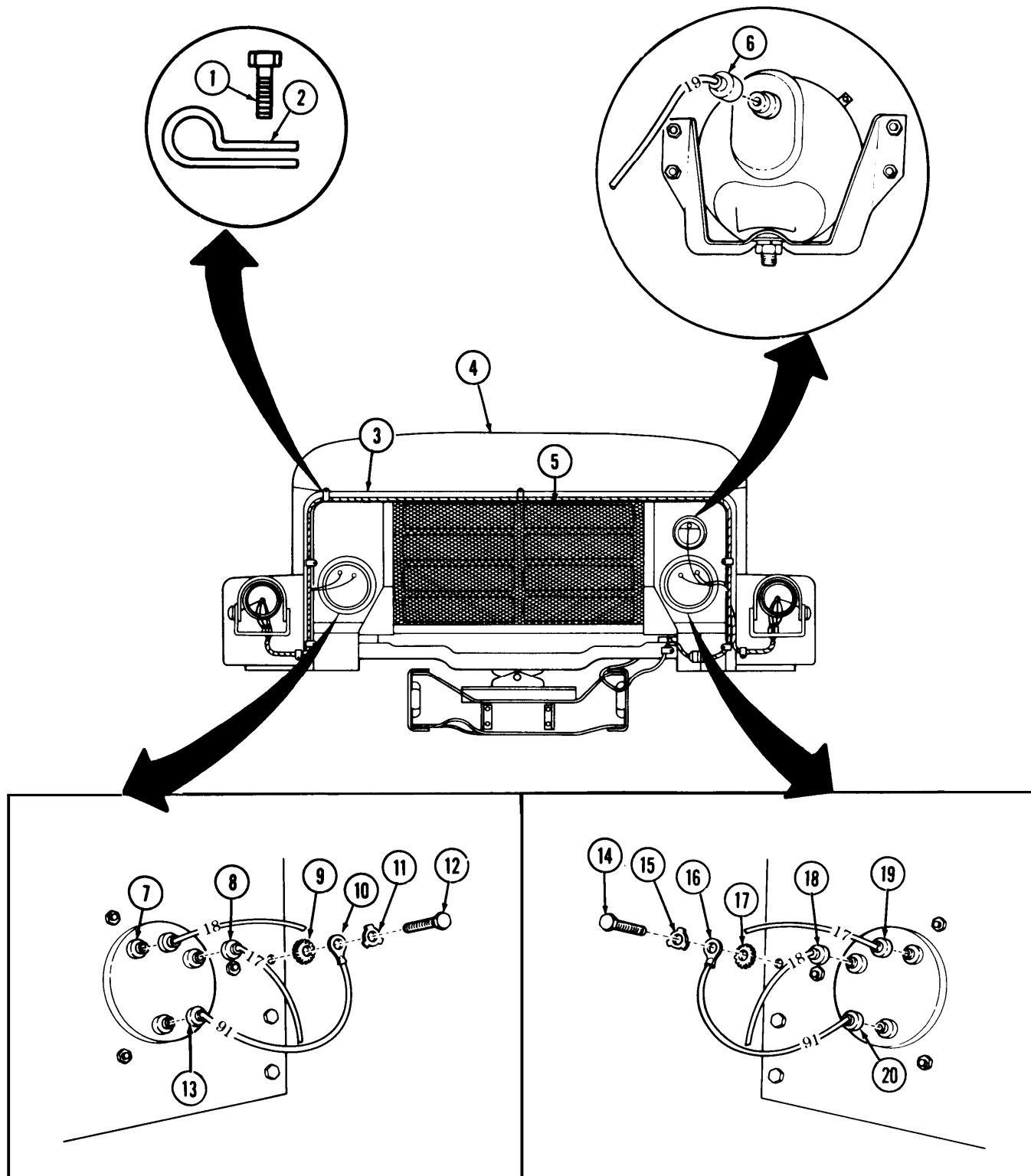
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6-6. FRONT LIGHTS CABLE ASSEMBLY REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Installation				
<p style="text-align: center;"><u>CAUTION</u></p> <p>Do not install wiring harness to hood retaining rod mounting bracket screw. Movement will cause clamp to cut harness.</p>				
21.		New cable (3)	Install with ten clamps (2) and screws (1)	Place cable assembly (3) inside of hood (4) and route along perimeter of grille (5). M936 model uses only eight screws (1) and clamps (2).
22,		Connectors (7) and (8)	Connect.	
23.		Right headlamp ground wire (10)	Install with new lock-washer (9), washer (11), and screw (12).	
24.		Connector (13)	Connect.	
25.		Connectors (19), (18), and (6)	Connect.	
26.		Left headlamp ground wire (16)	Install with new lock-washer (17), washer (15), and screw (14).	
27.		Connector (20)	Connect,	

6-6. FRONT LIGHTS CABLE ASSEMBLY REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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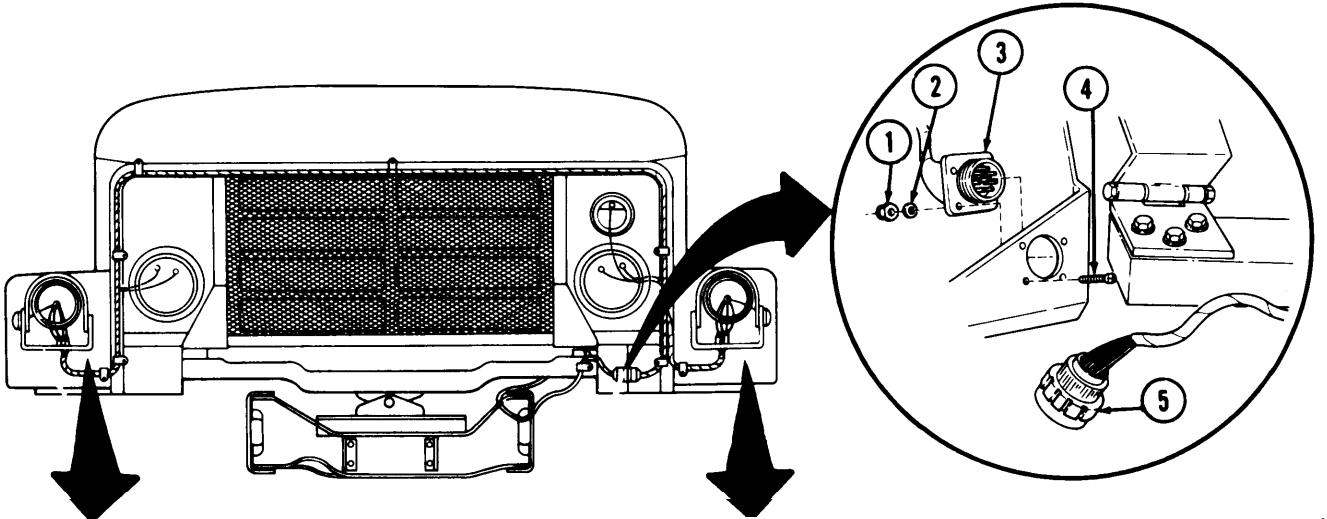
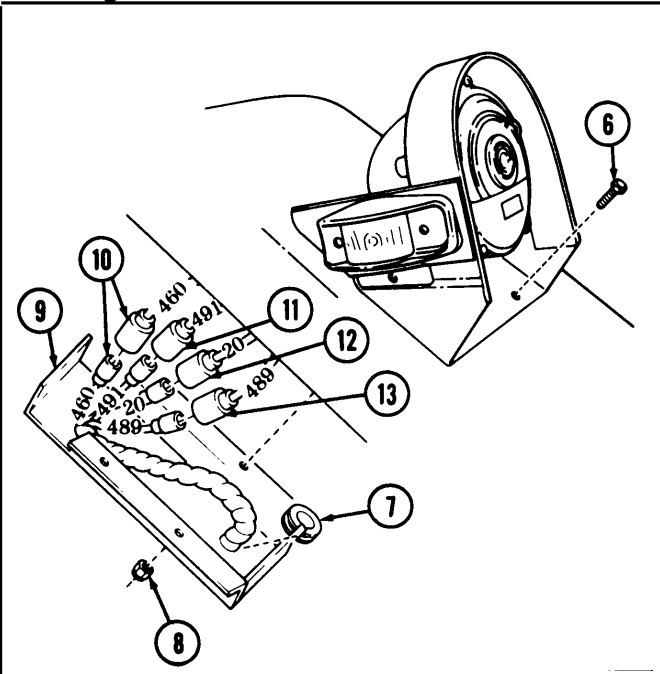
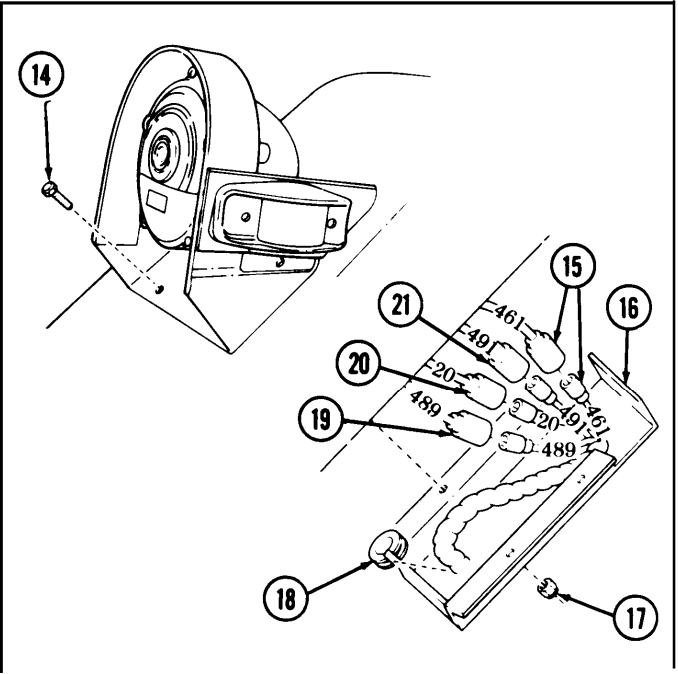


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6-6. FRONT LIGHTS CABLE ASSEMBLY REPLACEMENT [Cont'd]

LOCATION	ITEM	ACTION	REMARKS
28.	Wires (15), (19), (20), and (21)		
29.	Grommet (18)		
30.	Wiring cover (16)		
31.	Wires (10), (11), (12), and (13)		
32.	Grommet (7)		
33.	Wiring cover (9)		
34.	Front wiring harness connector (3)		
35.	Front lights cable connector (5)		

6-6. FRONT LIGHTS CABLE ASSEMBLY REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				
				

END OF TASK!

- FOLLOW-ON TASKS:
- Connect battery ground cables (TM 9-2320-272-20-1).
 - Check operation of all front lights (TM 9-2320-272-10).
 - Install splash shields (TM 9-2320-272-10).

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6-7. FRONT WIRING HARNESS REPLACEMENT

This task covers:

a. Removal

b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10	Parking brake set.
<u>Test Equipment</u>	TM 9-2320-272-10	Splash shields removed.
None	TM 9-2320 -272-20-1	Battery ground cables disconnected.
<u>Special Tools</u>	TM 9-2320 -272-20-1	Protective control box removed.
None	TM 9-2320 -272-20-1	Turn signal flasher removed.
<u>Materials/Parts</u>	TM 9-2320-272-20-1	Failsafe warning module removed.
Cotter pin	TM 9-2320-272-20-1	Main light switch removed.
Spring nut	TM 9-2320 -272-20-1	Air intake pipe removed.
Two locknuts		
Twenty-six lockwashers		
Seven tiedown straps (Appendix C, Item 21)		
Gasket sealant (Appendix C, Item 113)		
<u>Personnel Required</u>		<u>Special Environmental Conditions</u>
Wheeled vehicle repairman MOS 63W (2)		None
<u>Manual References</u>		<u>General Safety Instructions</u>
TM 9-2320-272-10		None
TM 9-2320-272 -20-1		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
a. Removal				

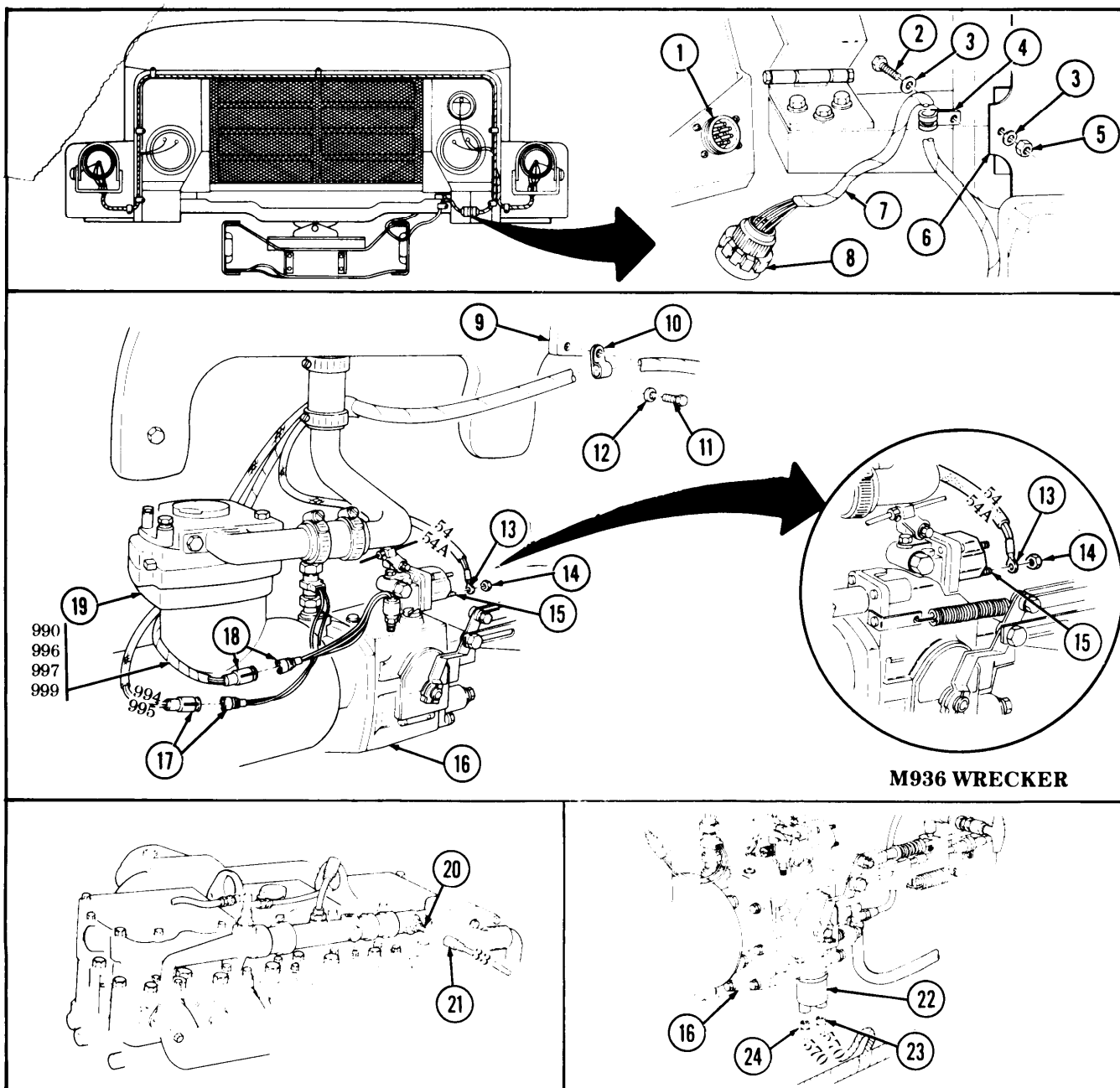
NOTE

Tag wires, connectors, and cables for installation.

1.	Front wiring harness (7) to front lights cable assembly (1)	Front wiring harness connector (8)	Disconnect.	
2.	Radiator (6)	Nut (5), two washers (3), cable clamp (4), and screw (2)	Remove.	
3.	Fuel pump (16)	Tachometer pulse sender connector (17)	Disconnect.	
4.		Fuel pressure transducer connector (18)	Disconnect.	All models except M936.
5.	Engine intake manifold (9)	Screw (11), washer (12), and cable clamp (10)	Remove.	
6.	Fuel pump shutoff valve solenoid terminal (15)	Nut (14) and two wires (13)	Remove.	

6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

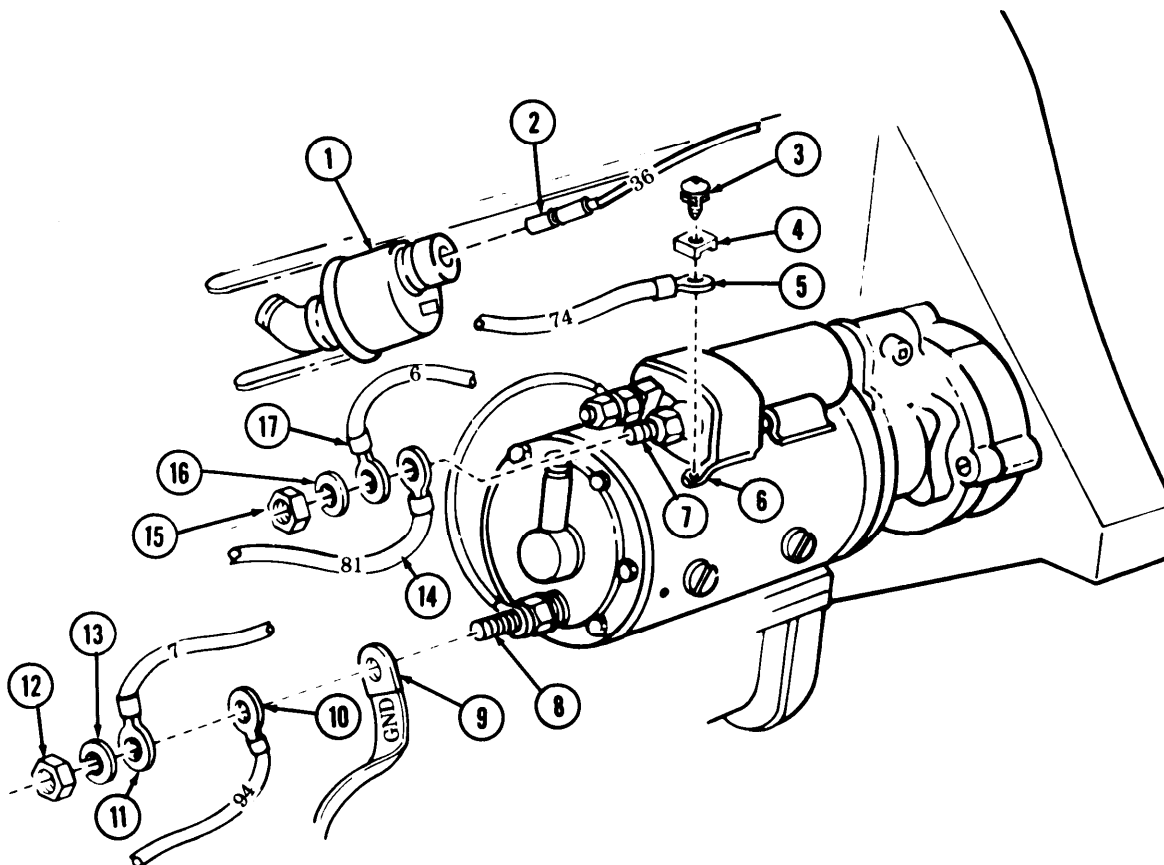
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
7.	Engine temperature sending unit (20)	Wire (21)	Disconnect and remove harness from behind air compressor (19) and intake manifold (9).	
8.	Ether start fuel pump pressure switch (22)	Wires (23) and (24)	Disconnect.	



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6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

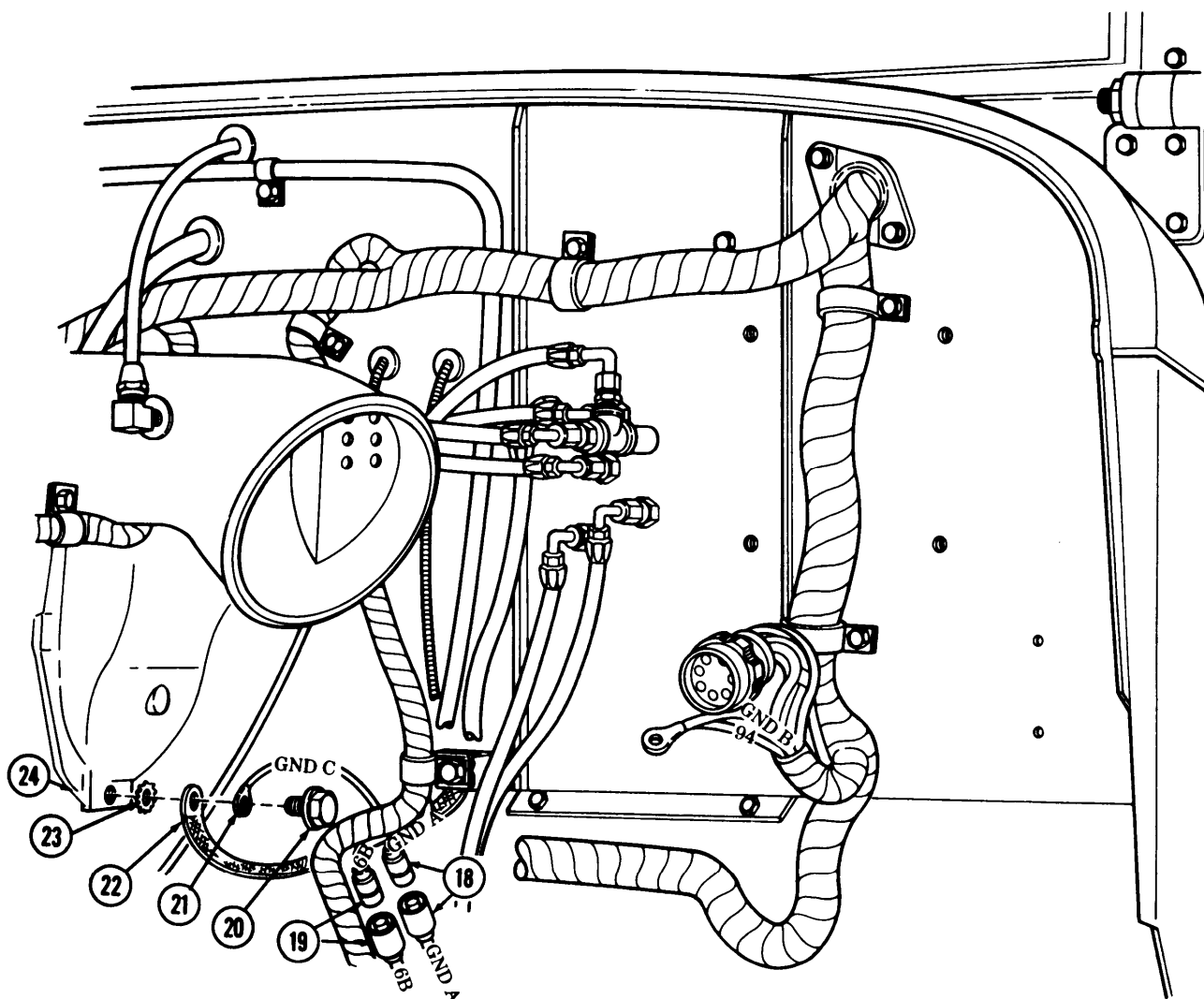
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
9.	Oil pressure sending unit (1)	Wire (2)	Disconnect.	
10.	Starter solenoid terminal (6)	Screw-assembled washer (3), washer (4), and wire (5)	Remove.	
11.	Solenoid terminal post (7)	Nut (15), lockwasher (16), wire (14), and wire (17)	Remove.	Discard lockwasher (16). Washer (16) not installed on M936. Keep wire (17) mounted on post (7) for installation.
12.	Starter motor terminal post (8)	Nut (12), lockwasher (13), wire (10), and wire (11)	Remove.	Discard lockwasher (13). Keep ground sleeving (9) and wire (11) mounted on post (8) for installation.



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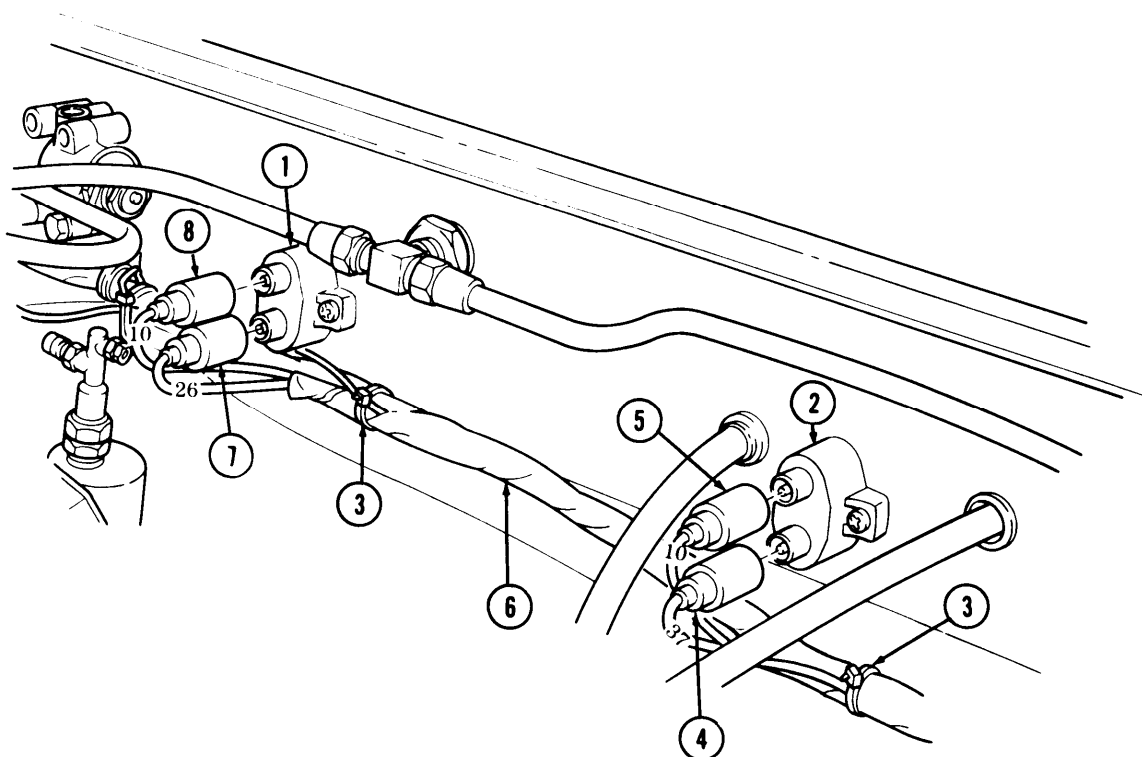
6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
13.	Intake manifold (24)	Screw-assembled washer (20), wire (21), ground strap (22), and lockwasher (23)	Remove.	Discard lockwasher (23).
14.		Wires (18) and (19)	Disconnect.	



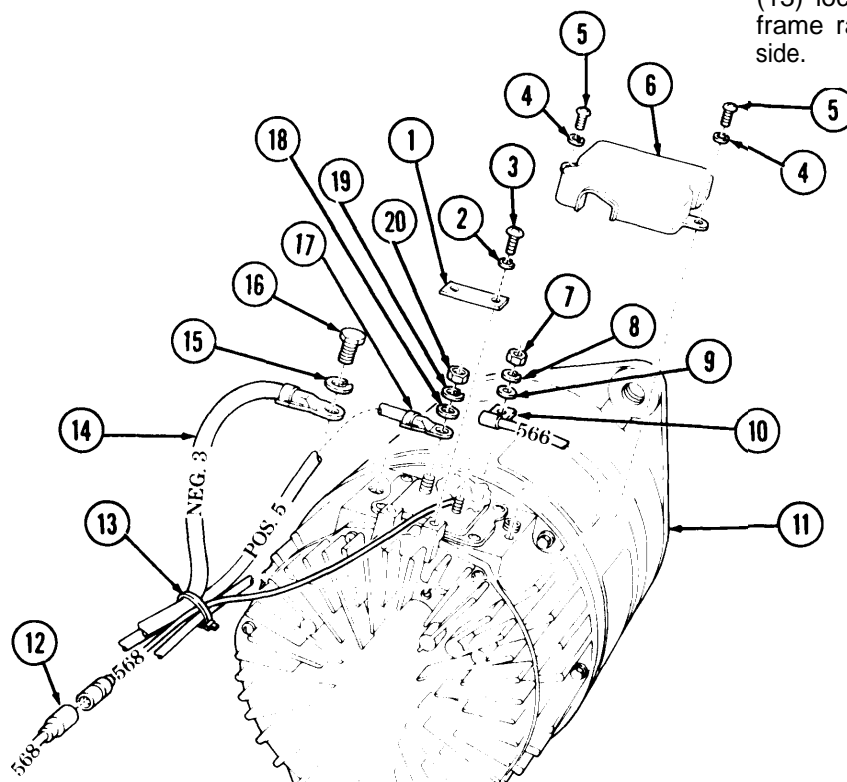
6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
15.	Horn circuit breaker (1)	Wires (7) and (8)	Disconnect.	
16.	Transmission control and spring brake circuit breaker (2)	Wires (4) and (5)	Disconnect.	
17.	Front wiring harness (6)	Two tiedown straps (3)	Cut.	Discard tiedown straps (3).
18.	Engine temperature switch wire (9)	Wire (10)	Disconnect.	
19.	Personnel hot water heater (11)	Wire (12)	Disconnect.	
20.	Horn solenoid (22)	Wires (20) and (21)	Disconnect.	
21.	Transorb diode coupling assembly wire (19)	Wire (18)	Disconnect.	Tag for installation.
22.	Front wiring harness cable (15)	Four tiedown straps (17)	cut.	Discard tiedown straps (17)
23.	Firewall (13)	Three screws (16) and cable clamps (14)	Remove.	Tag cable clamps for installation.



6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

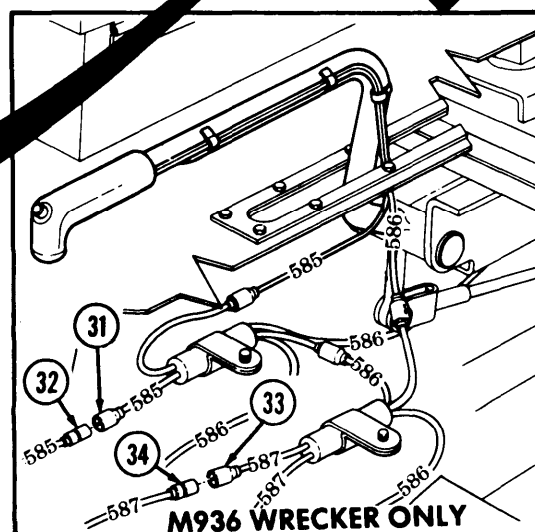
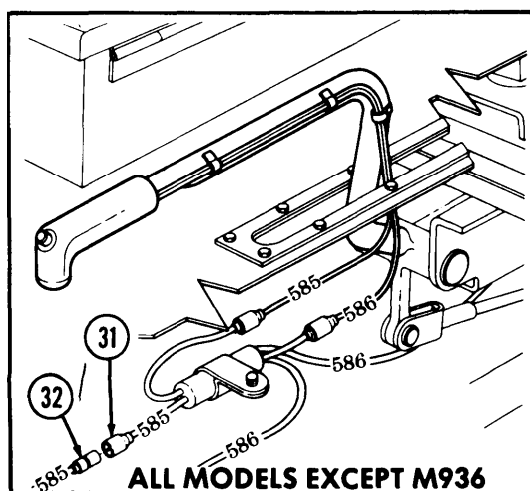
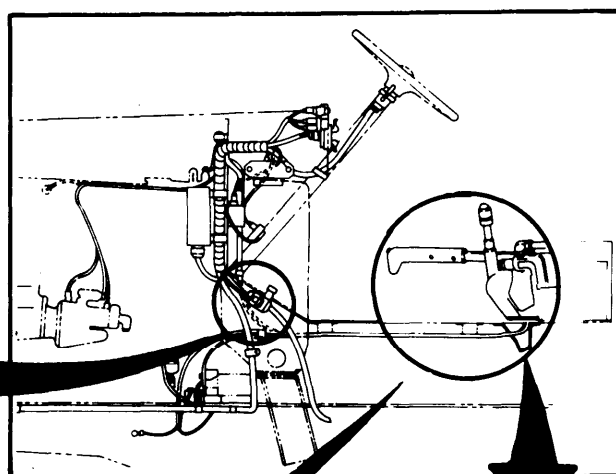
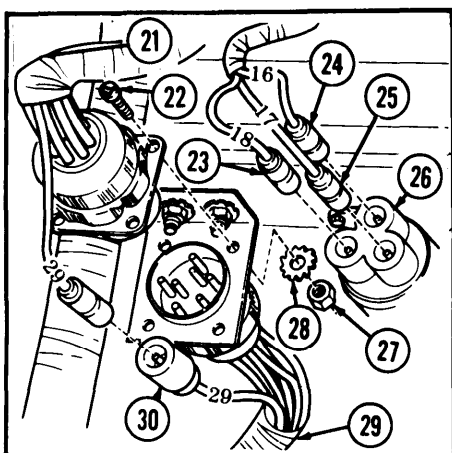
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
24.	Alternator (11)	Two screws (5), lockwashers (4), and terminal cover (6)	Remove.	Discard lockwashers (4).
25.		Two screws (3), lockwashers (2), and wire retaining strap (1)	Remove.	Discard lockwashers (2).
26.		Screw (16), lock-washer (15), and wire (14)	Remove.	Discard lockwasher (15).
NOTE				
Sealant must be removed before removing wires.				
27.		Nut (20), lockwasher (19), washer (18), and wire (17)	Remove.	Discard lockwasher (19).
28.		Nut (7), lockwasher (8), washer (9), and wire (10)	Remove.	Discard lockwasher (8).
29.		Connector (12)	Disconnect.	
30.		Three tiedown straps (13)	cut.	Discard tiedown straps (13). Two tiedown straps (13) located inside of frame rail on the right side.



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6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

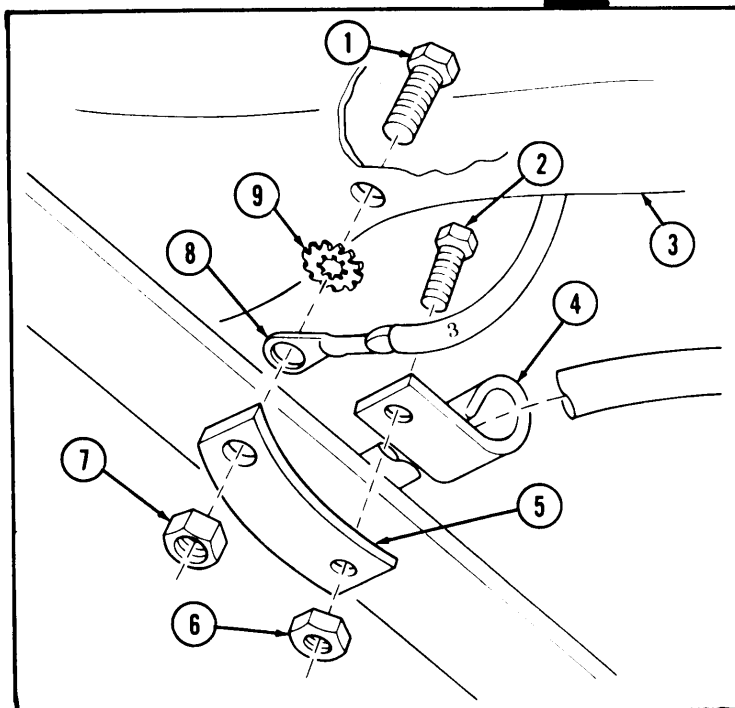
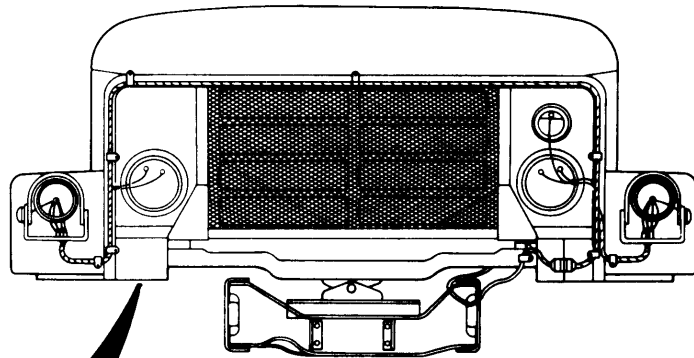
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
31.	Headlight beam selector switch (26)	Wires (23), (24), and (25)	Disconnect.	
32.	Rear wiring harness (29)	Four nuts (27), lockwashers (28), and screws (22), and connector (21)	Remove.	Discard lockwashers (28).
33.		Connector (30)	Disconnect.	Models M929, M930, M931, M932, and M936 only.
34.	Transfer case switch capacitor wire (31)	Wire (32)	Disconnect.	
35.	Fifth gear lockup capacitor wire (33)	Wire (34)	Disconnect.	Model M936 only.



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6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
36.	Frame crossmember (3)	Locknut (7), air line bracket (5), alternator ground wire (8), lockwasher (9), and screw (1)	Remove.	Discard locknut (7) and lockwasher (9).
37.	Air line bracket (5)	Locknut (6), air line clamp (4), and screw (2)	Remove.	Discard locknut (6).
38.	Parking brake switch wire(11)	Wire (10)	Disconnect.	



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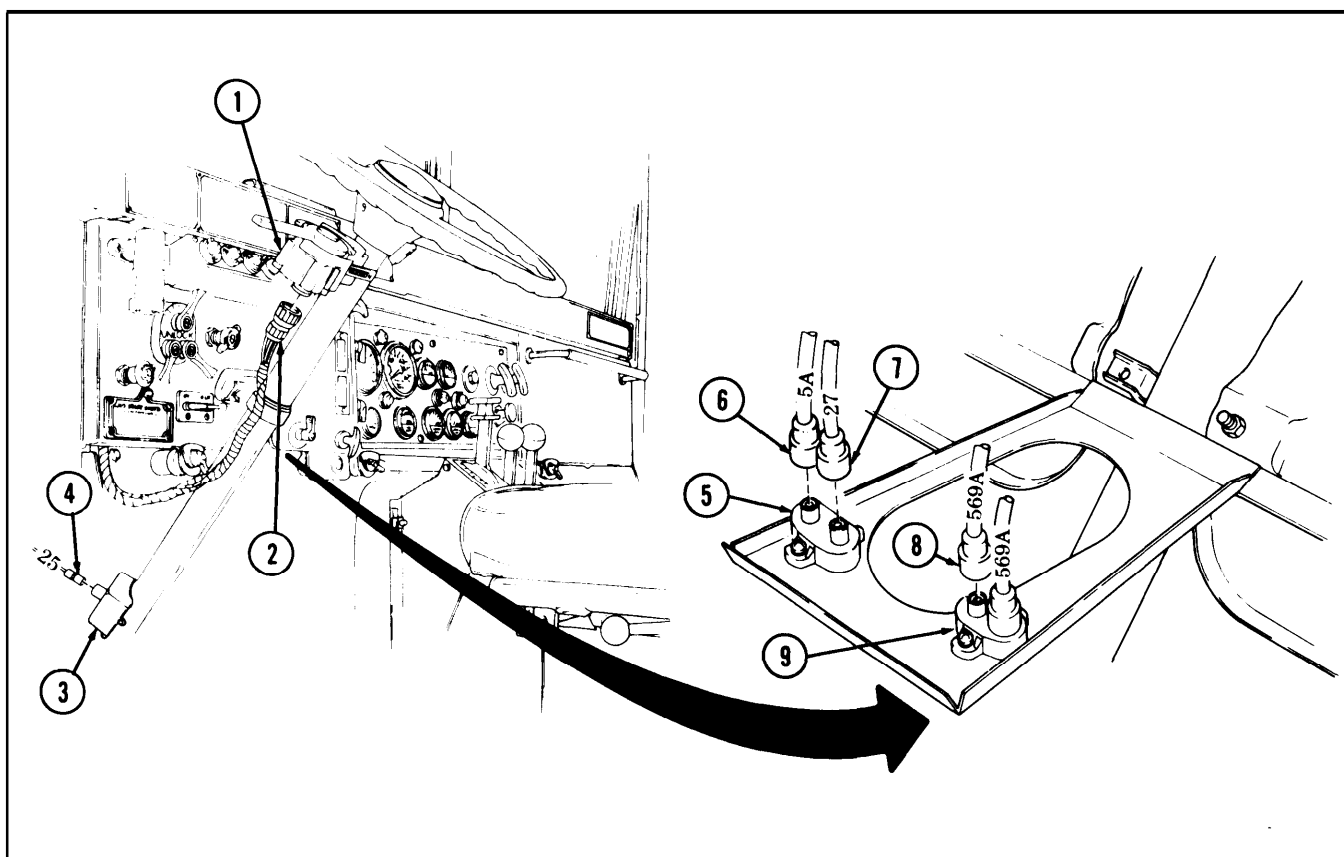
6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS

The diagram illustrates the front wiring harness replacement process. The top portion shows a side view of the vehicle chassis with the wiring harness being installed. A circular inset provides a close-up view of the harness being connected to a terminal block. A large arrow points down to a detailed view of the terminal block and the harness wires. The bottom part shows the harness wires connected to terminals 10 and 11, with the wire number 584 indicated.

6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
39.	Turn signal control (1)	Front harness connector (2)	Disconnect.	
40.	Horn switch (3)	Wire (4)	Disconnect.	
41.	Electrical gage circuit breaker (5)	Wires (6) and (7)	Disconnect.	
42.	Heater blower motor circuit breaker (9)	Wire (8)	Disconnect.	
43.	Fuel selector switch (10)	Wires (11), (12), and (13)	Disconnect.	Models M929, M930, M931, M932, and M936 only,
44.	Front wheel drive lock-in switch (15)	Connector (14)	Disconnect.	
45.	Ether start switch (18)	Wires (16) and (17)	Disconnect.	
46.	Heater blower motor switch (22)	Wires (19), (20), and (21)	Disconnect.	
47.	Warning signal lamp switch (23)	Wire (24)	Disconnect.	Model M936 only.



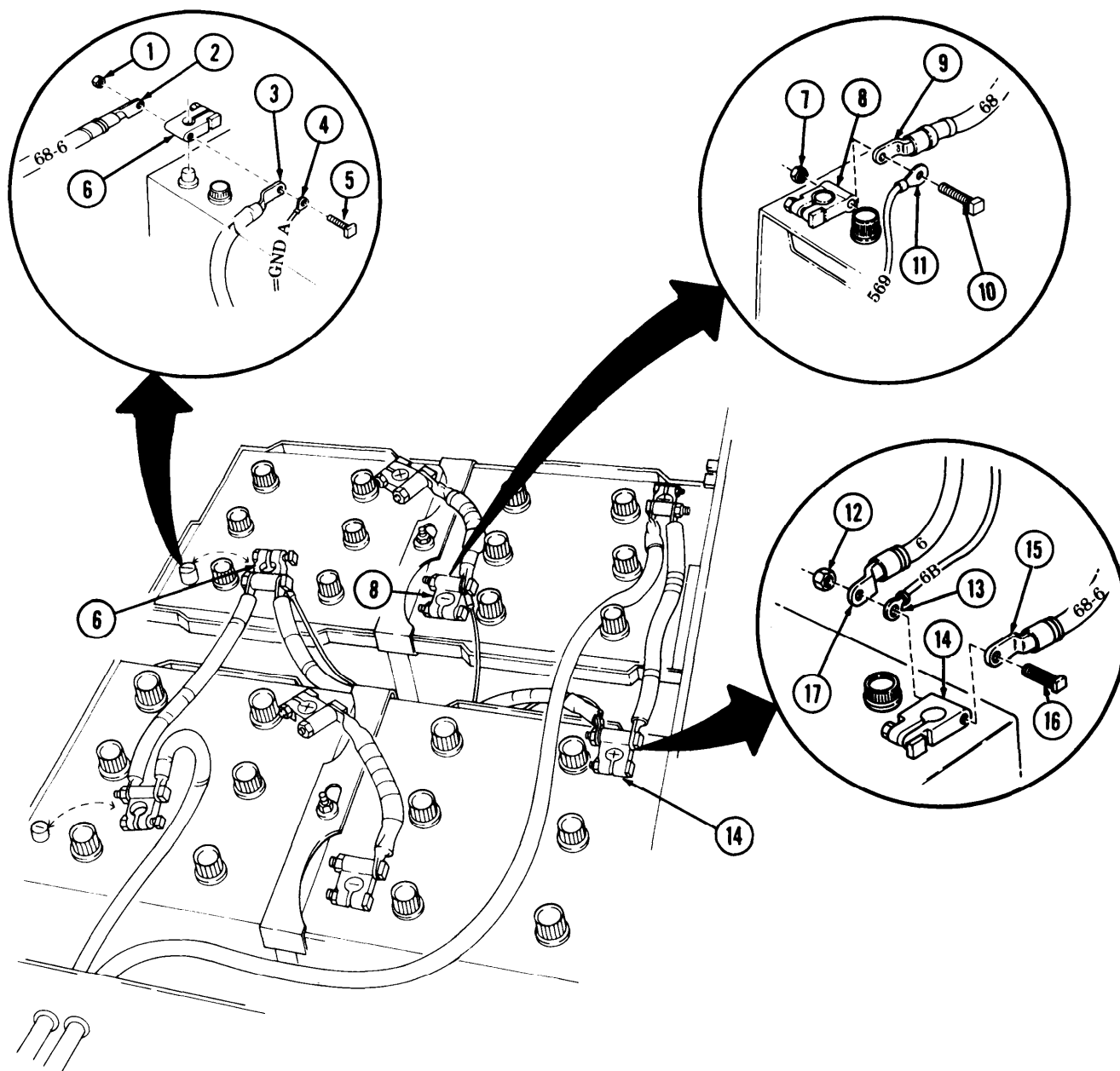
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6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS

6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

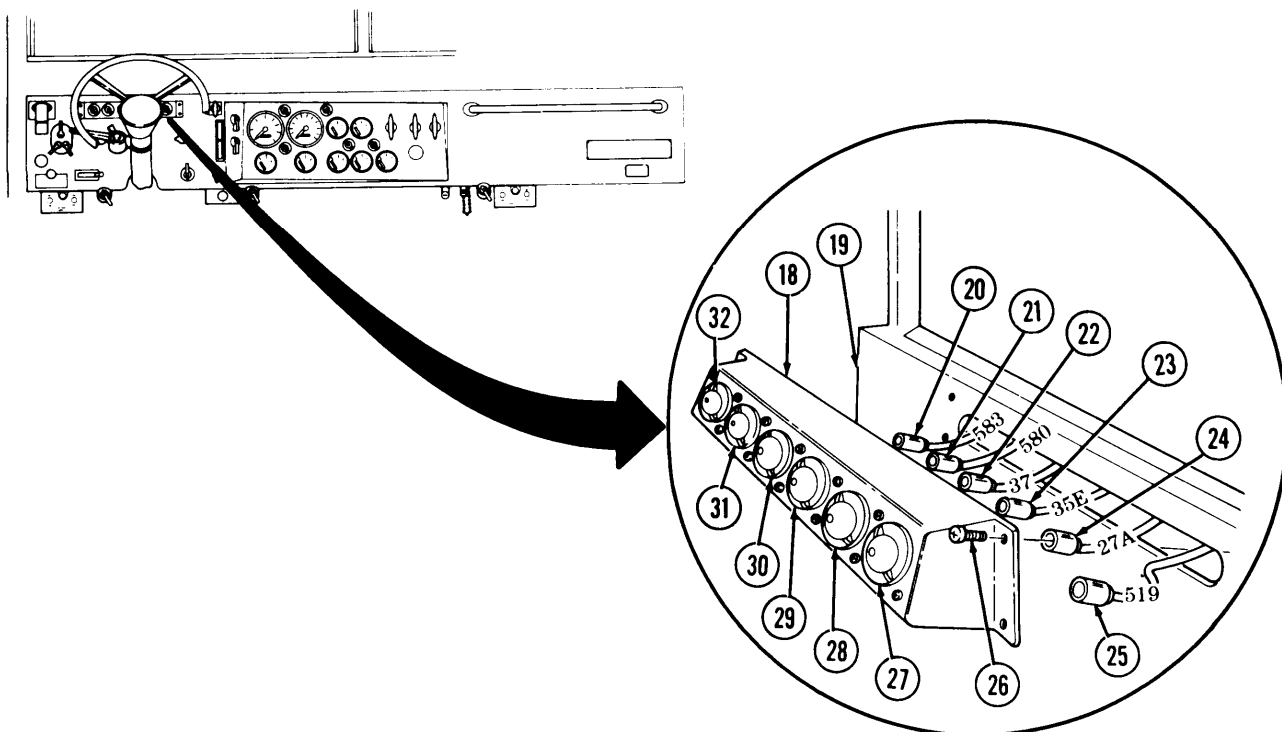
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
48.	Terminal adapter (6)	Nut (1), bolt (5), battery cables (2) and (3), and wire (4)	Remove.	Keep cables (2) and (3) mounted on terminal adapter (6) for installation.
49.	Terminal adapter (8)	Nut (7), bolt (10), battery cable (9), and wire (11)	Remove.	Keep cable (9) mounted on terminal adapter (8) for installation.



TA349870

6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

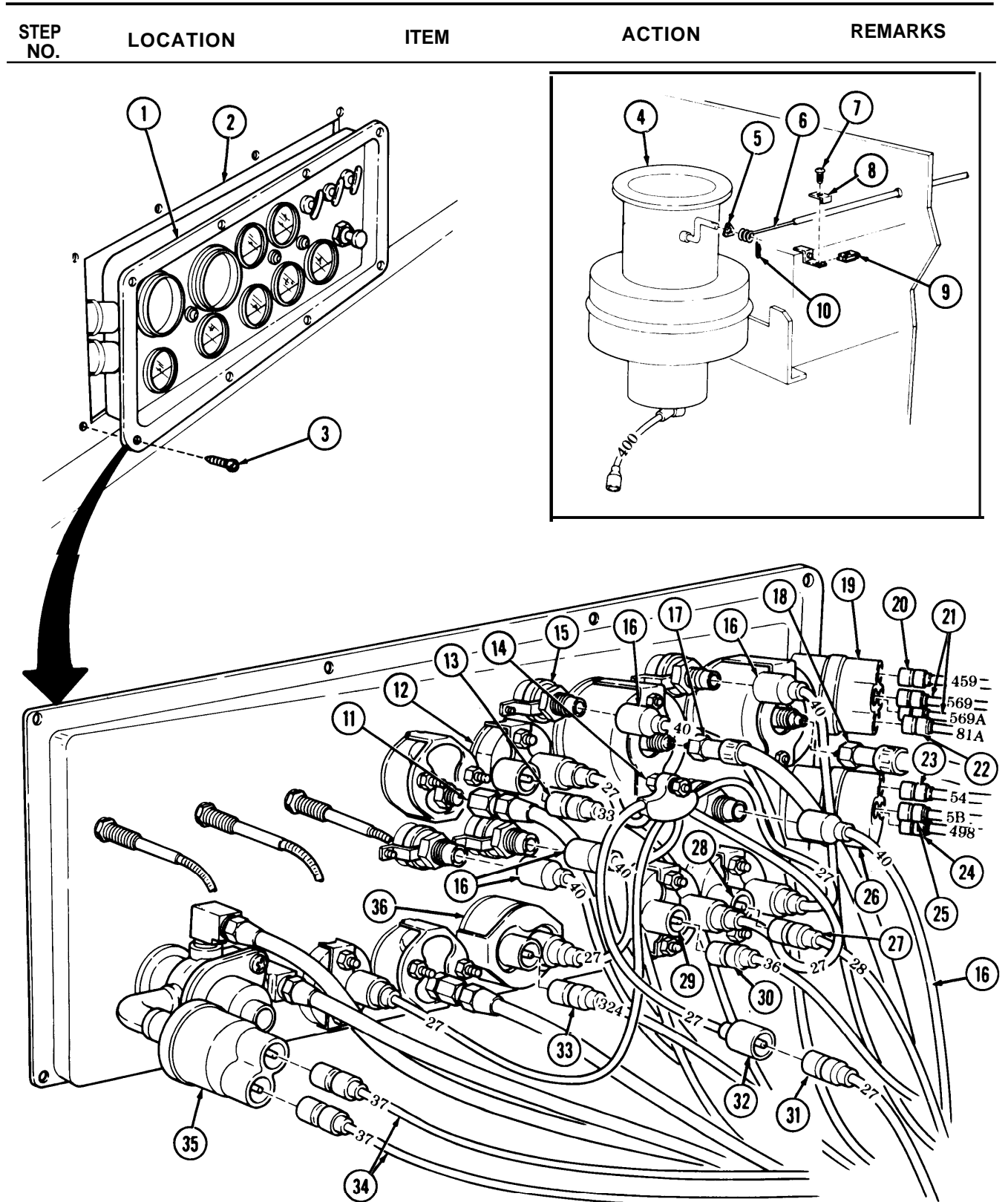
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
50.	Terminal adapter (14)	Nut (12), bolt (16), battery cables (15) and (17), and wire (13)	Remove.	Keep cables (15) and (17) mounted on terminal adapter (14) for installation. Push wires (4), (11), and (13) through hole in cab floor.
51.	Warning light panel (18)	Four screws (26)	Remove and pull warning light panel (18) away from instrument panel (19).	
52.	Parking brake indi- cator light (32)	Wire (20)	Disconnect.	
53.	Low air pressure indi- cator light (31)	Wire (21)	Disconnect.	
54.	Spring brake override indicator light (30)	Wire (22)	Disconnect.	
55.	Engine hot indicator light (29)	Wire (23)	Disconnect.	
56.	Axle lock-in indicator light (28)	Wire (24)	Disconnect.	
57.	Hi-beam indicator light (27)	Wire (25)	Disconnect.	



6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
58.	Instrument cluster (1)	Eight screws (3)	Remove and pull instrument cluster (1) away from instrument panel (2).	
59.	Heater assembly (4), right side engine compartment	Screw (7), retainer nut (9), and clamp (8)	Remove.	
60.		Cotter pin (10)	Remove.	Discard cotter pin (10).
61.		Fresh air control cable (6) and spring nut (5)	Remove.	Discard spring nut (5).
62.	Behind instrument cluster (1)	Tachometer drive shaft (18)	Disconnect.	
63.		Speedometer drive shaft (17)	Disconnect.	
64.		Air tube (11)	Disconnect.	
65.	Battery switch (19)	Wire (20), two wires (21), and wire (22)	Disconnect.	
66.	Starter switch (26)	Wires (23), (24), and (25)	Disconnect.	
67.	Instrument cluster wire assembly (14)	Wires (32) and (31)	Disconnect.	
68.	Five instrument cluster lights (15)	Five wires (16)	Disconnect.	
69.	Fuel gage (28)	Wire (27)	Disconnect.	
70.	Oil pressure gage (29)	Wire (30)	Disconnect.	
71.	Transmission oil temperature gage (36)	Wire (33)	Disconnect.	
72.	Engine temperature gage (12)	Wire (13)	Disconnect.	
73.	Spring brake pressure switch (35)	Two wires (34)	Disconnect.	

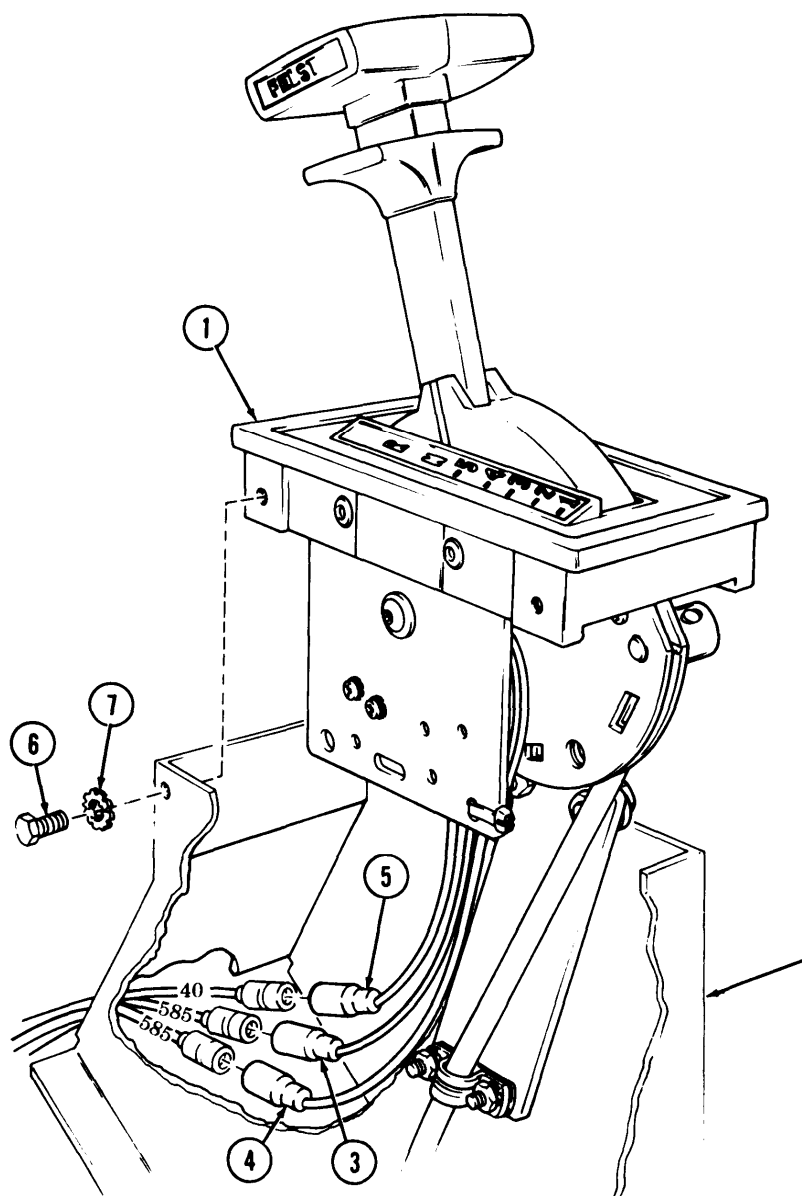
6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)



TA 349872

6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

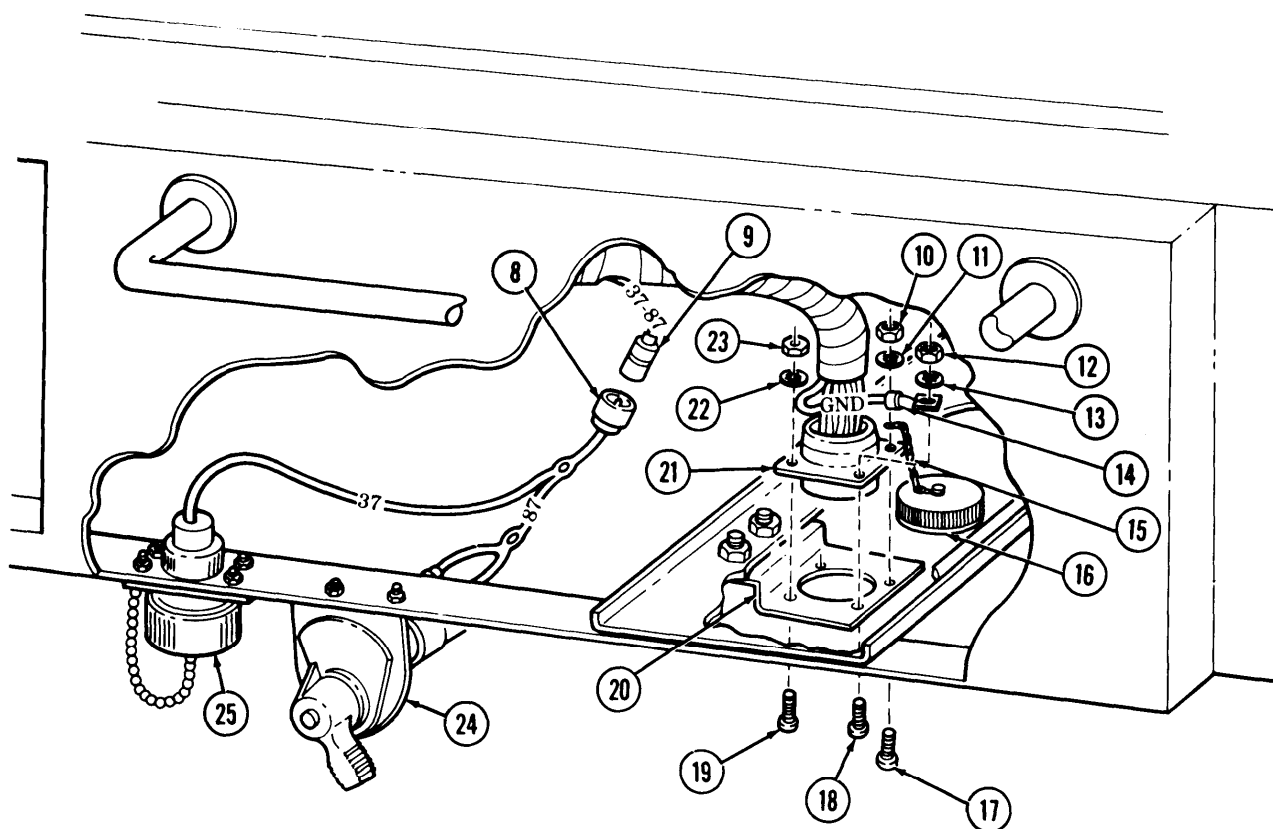
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
74.	Inside vehicle cab	Transmission selector assembly (1)	Place in "N" (neutral).	
75.	Console (2)	Four screws (6), lockwashers (7), and transmission selector assembly (1)	Remove.	Discard lockwashers (7).
76.	Inside of transmission selector console (2)	Wires (3), (4), and (5)	Disconnect.	



TA349873

6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
77.	Floodlight switch (24) and auxiliary receptacle (25)	Connectors (8) and (9)	Disconnect.	Model M936 only.
78.	Diagnostic connector (21)	Cap (16)	Remove.	
79.	Mounting bracket (20)	Nut (12), lockwasher (13), screw (18), and ground wire (14)	Remove.	Discard lockwasher (13).
80.		Nut (10), lockwasher (11), screw (17), and cap chain (15)	Remove.	Discard lockwasher (11).
81.		Two nuts (23), lockwashers (22), and screws (19) and diagnostic connector (21)	Remove.	Discard lockwashers (22).



6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
82.	Firewall (4)	Two screws (1), washers (2), and grommets (3)	Remove.	
83.	Harness (5)	Two nuts (9), three lockwashers (7), seven screws (6) and seven harness clamps (8)	Remove,	Tag clamps for installation. Discard lockwashers (7).
84.	Vehicle	Front wiring harness (5)	Remove.	
<hr/>				
b. Installation				
<hr/>				

NOTE

Assistant will help with step 85.

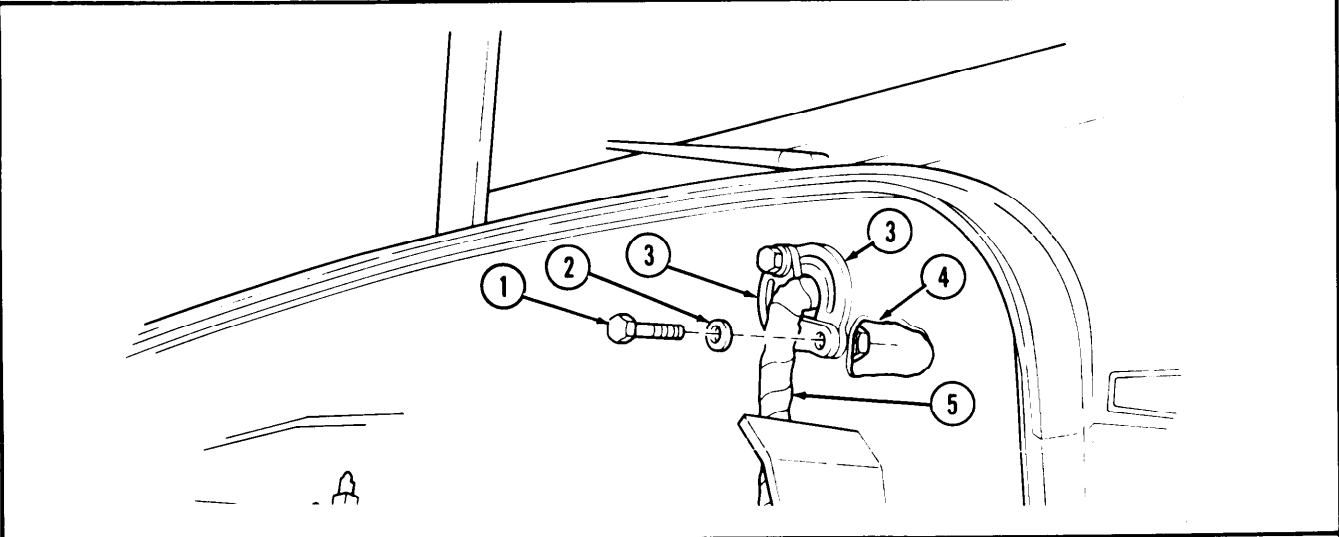
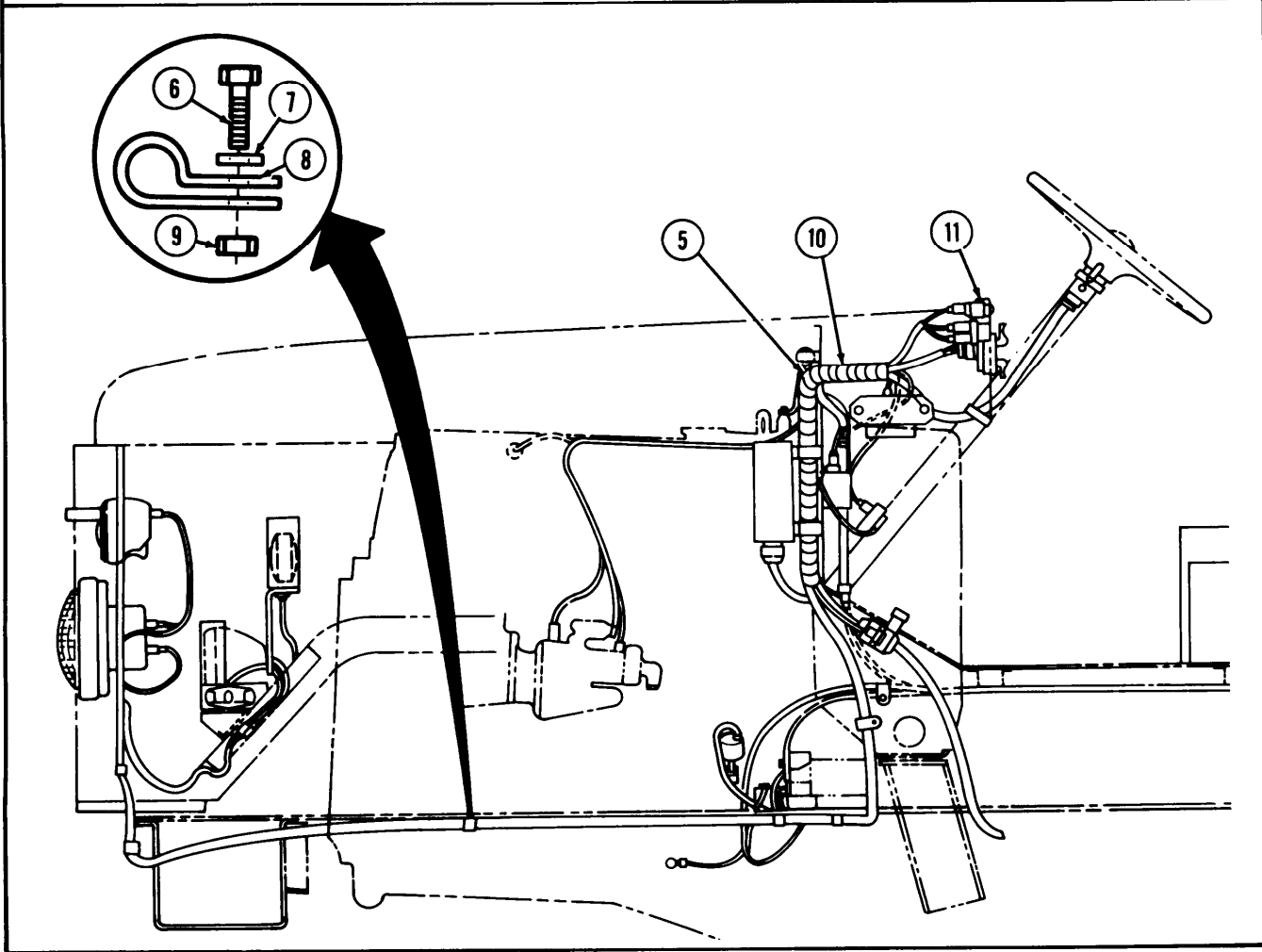
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| 85. | New front wiring harness (5) | Install on vehicle. |
|-----|------------------------------|---------------------|

CAUTION

Use care when routing harness. Snagging may result, and forceful pulling will cause damage to harness.

- | | | |
|-----|--|---|
| 86. | Instrument panel branch (10) of front wiring harness (5) | Insert through hole in firewall (4) and route as high as possible behind instrument panel (11). |
|-----|--|---|

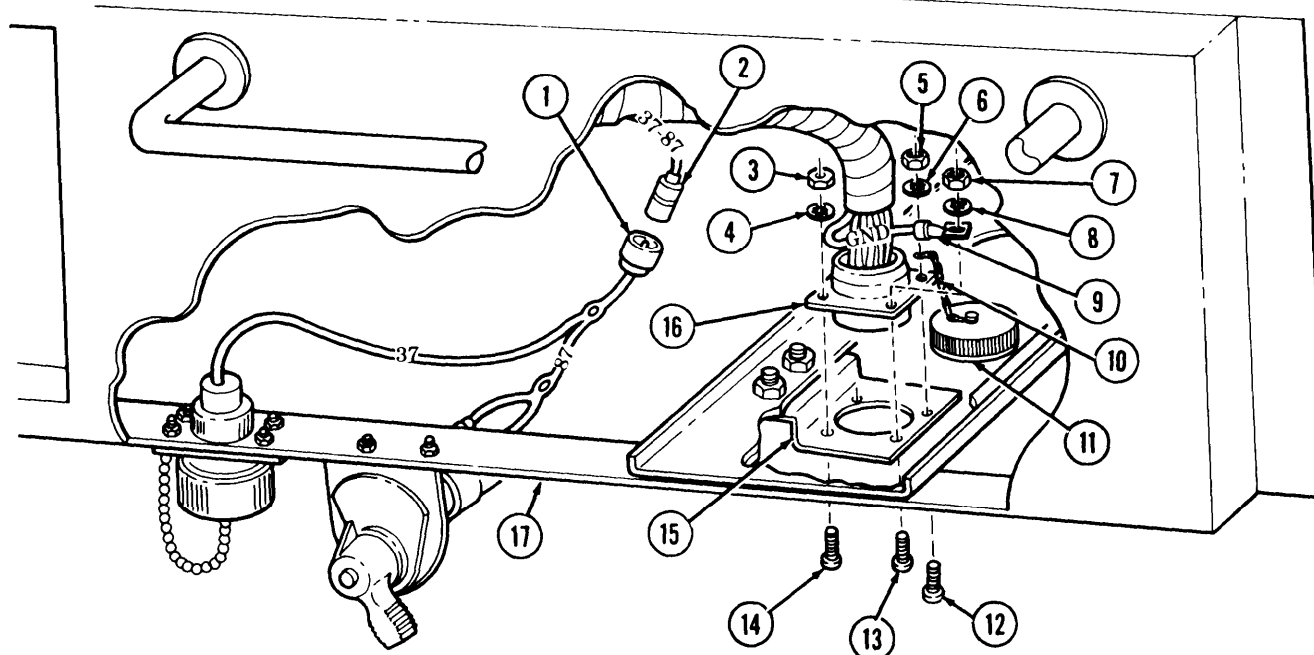
6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

TA 349875

6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

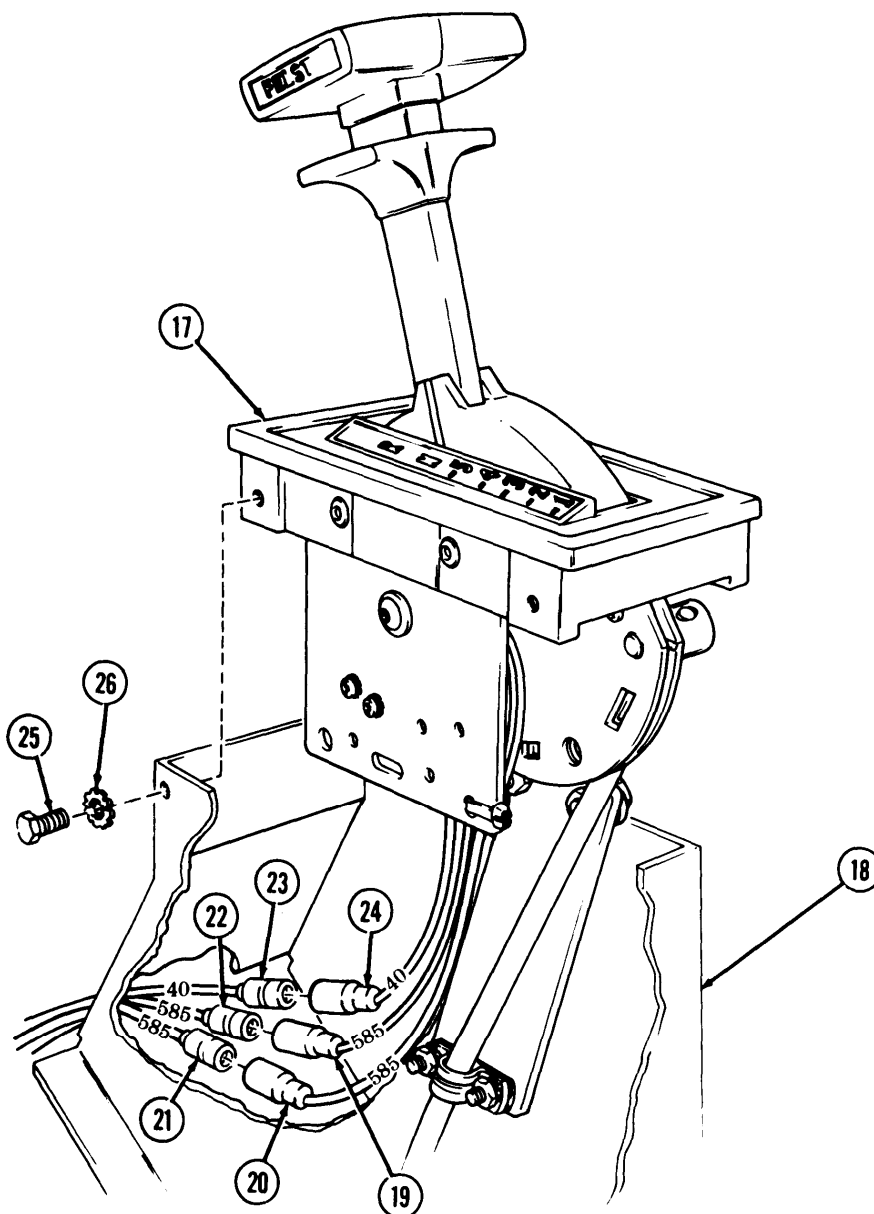
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
87.		Diagnostic connector (16)	<p>a. Install on top of mounting bracket (15) under right side of instrument panel (17) with two screws (14), new lockwashers (4), and nuts (3).</p> <p>b. Install cap chain (10) with screw (12), new lockwasher (6), and nut (5).</p> <p>c. Install ground wire (9) with screw (13), new lockwasher (8), and nut (7).</p> <p>d. Install cap (11).</p>	
88.		Connector (2)	Connect to floodlight switch and auxiliary receptacle connector (1).	Model M936 only.



TA 349876

6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
89.		Wires (21), (22), and (23)	Install in transmission selector console (18) and connect to selector assembly wires (20), (19), and (24).	
90.		Transmission selector assembly (17)	Install on console (18) with four screws (25) and new lockwashers (26).	



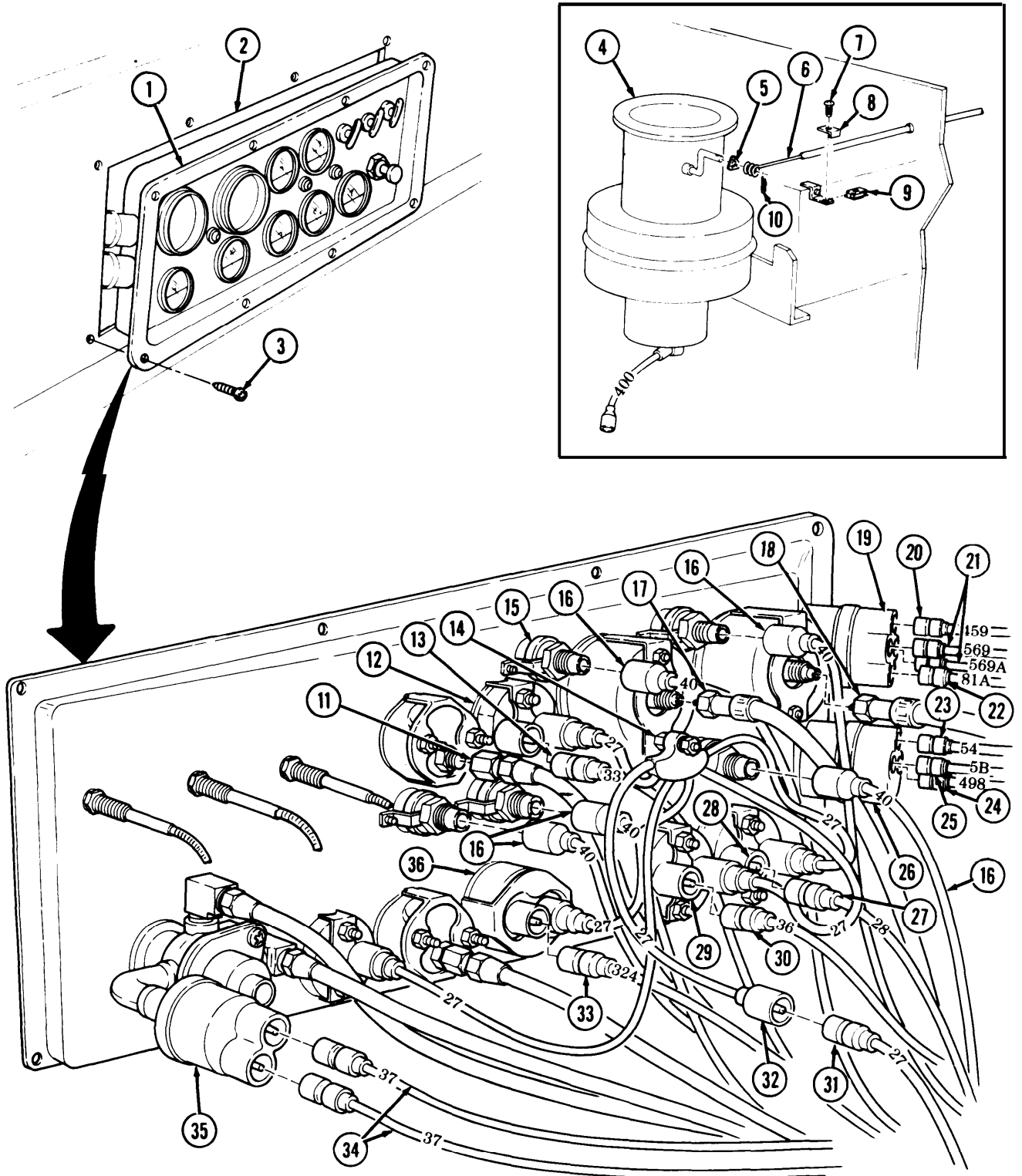
TA 349877

6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
91.		Two wires (34)	Connect to spring brake pressure switch (35).	
92.		Wire (13)	Connect to engine temperature gage (12).	
93.		Wire (33)	Connect to transmission oil temperature gage (36).	
94.		Wire (30)	Connect to oil pressure gage (29).	
95.		Wire (27)	Connect to fuel gage (28).	
96.		Five wires (16)	Connect to five instrument cluster lights (15).	
97.	Instrument cluster wire assembly (14)	Wire (32)	Connect to wire (31).	
98.		Wires (23), (24), and (25)	Connect to starter switch (26).	
99.		Wire (20), two wires (21) and wire (22)	Connect to battery switch (19).	
100.		Tachometer drive shaft (18)	Install.	
101.		Speedometer drive shaft (17)	Install.	
102.		Air tube(n)	Install.	
1030	Heater assembly (4), right side engine compartment	Fresh air control cable (6)	a. Install with new spring nut (5) and new cotter pin (10). b. Install with screw (7), clamp (8), and retainer nut (9).	
104.		Instrument cluster (1)	Install on instrument panel (2) with eight screws (3).	

6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

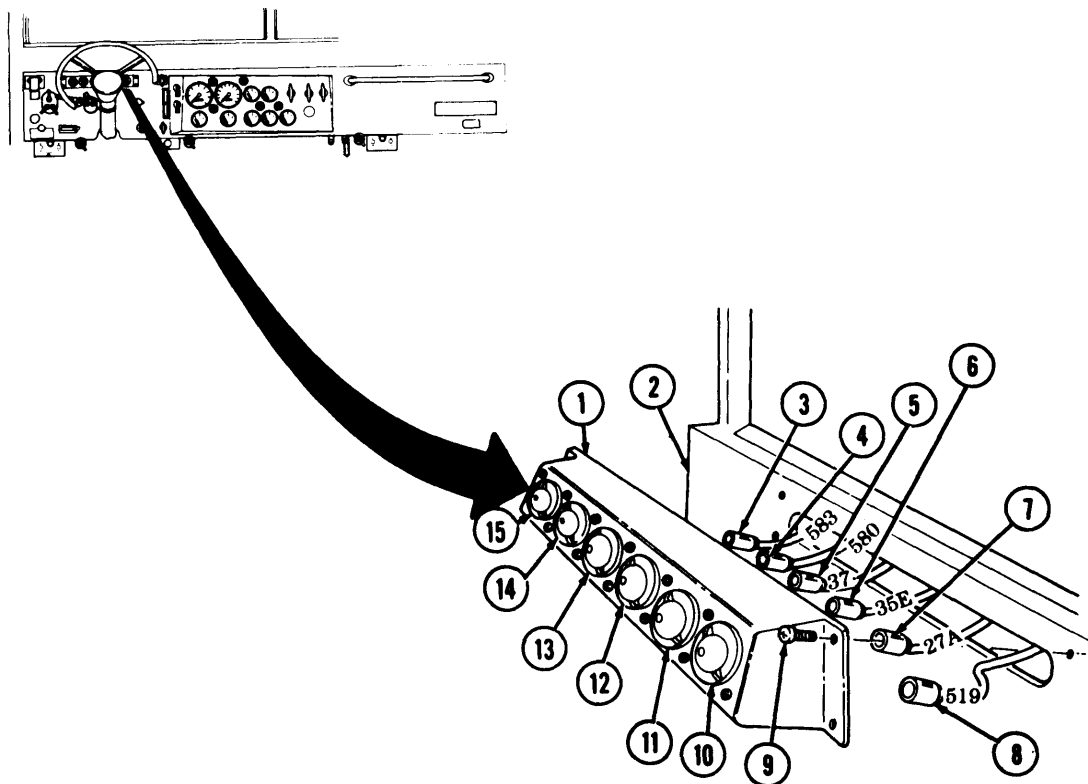
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

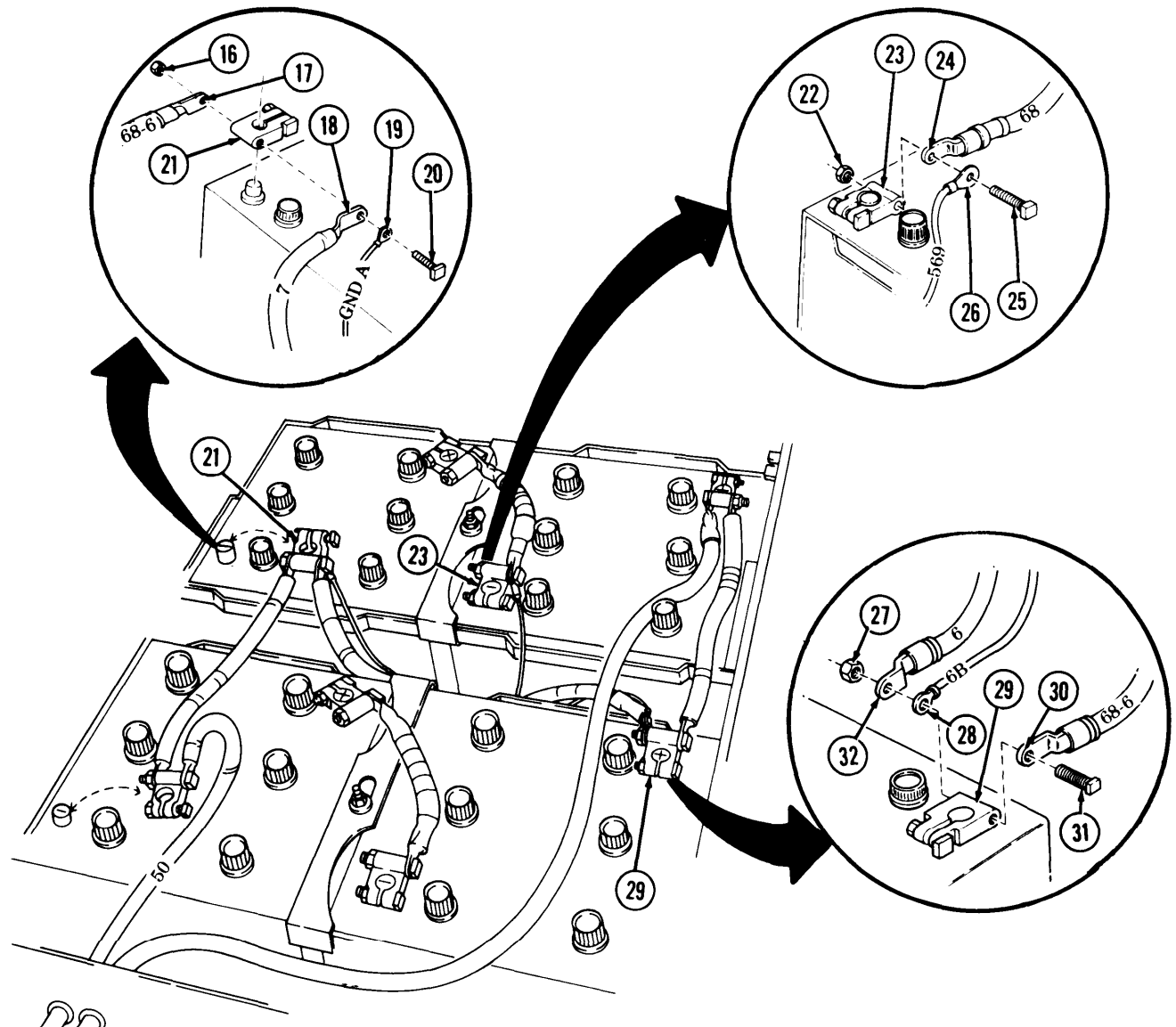
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
105.		Wire (8)	Connect to hi-beam indicator light (10).	
106.		Wire (7)	Connect to axle lock-in indicator light (11).	
107.		Wire (6)	Connect to engine hot indicator light (12).	
108.		Wire (6)	Connect to spring brake override indicator light (13).	
109.		Wire (4)	Connect to low air pressure indicator light (14).	
110.		Wire (3)	Connect to parking brake indicator light (15).	
111.		Warning light panel (1)	Install on instrument panel (2) with four screws (9).	
112.		Wires (19), (26), and (28)	Push wires through hole in cab floor.	



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6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

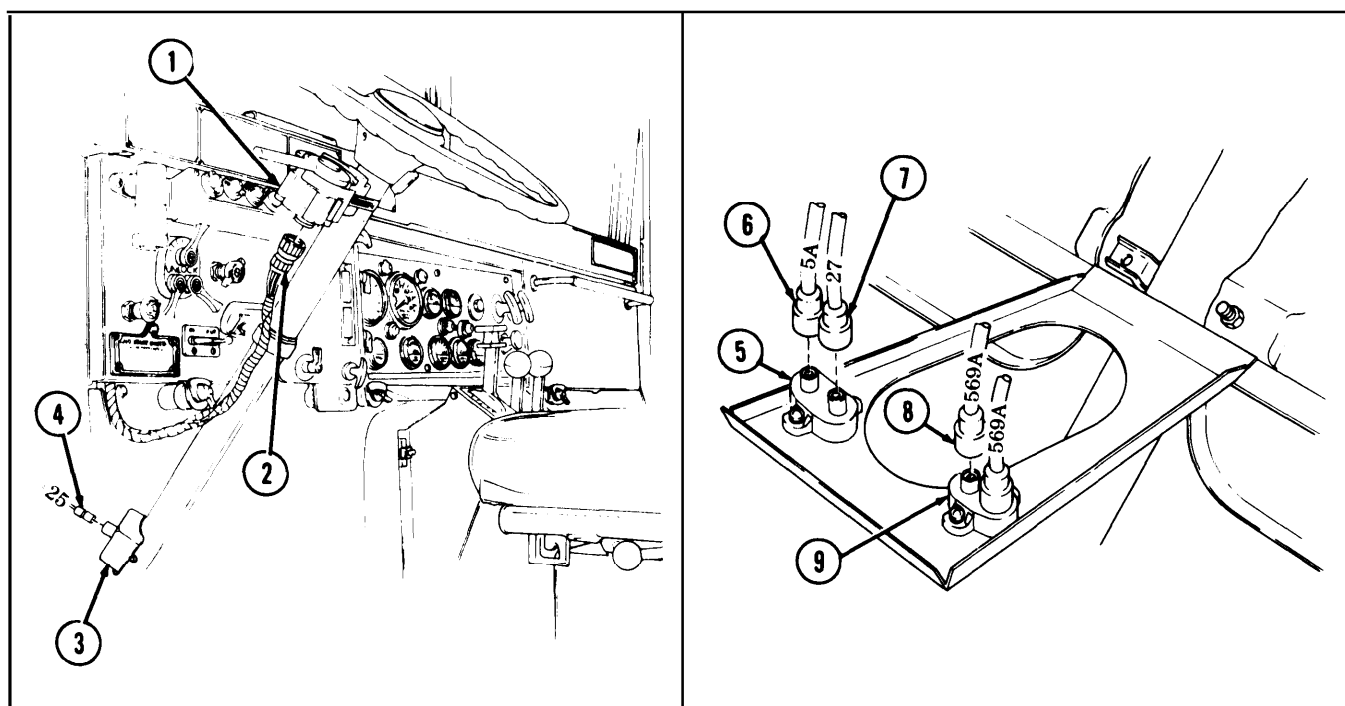
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
113.		Wire (28)	Install on terminal adapter (29) with bolt (31), wires (30) and (32), and nut (27).	
114.		Wire (26)	Install on terminal adapter (23) with bolt (25), wire (24), and nut (22).	
115.		Wire (19)	Install on terminal adapter (21) with bolt (20), wires (17) and (18), and nut (16).	



TA 349880

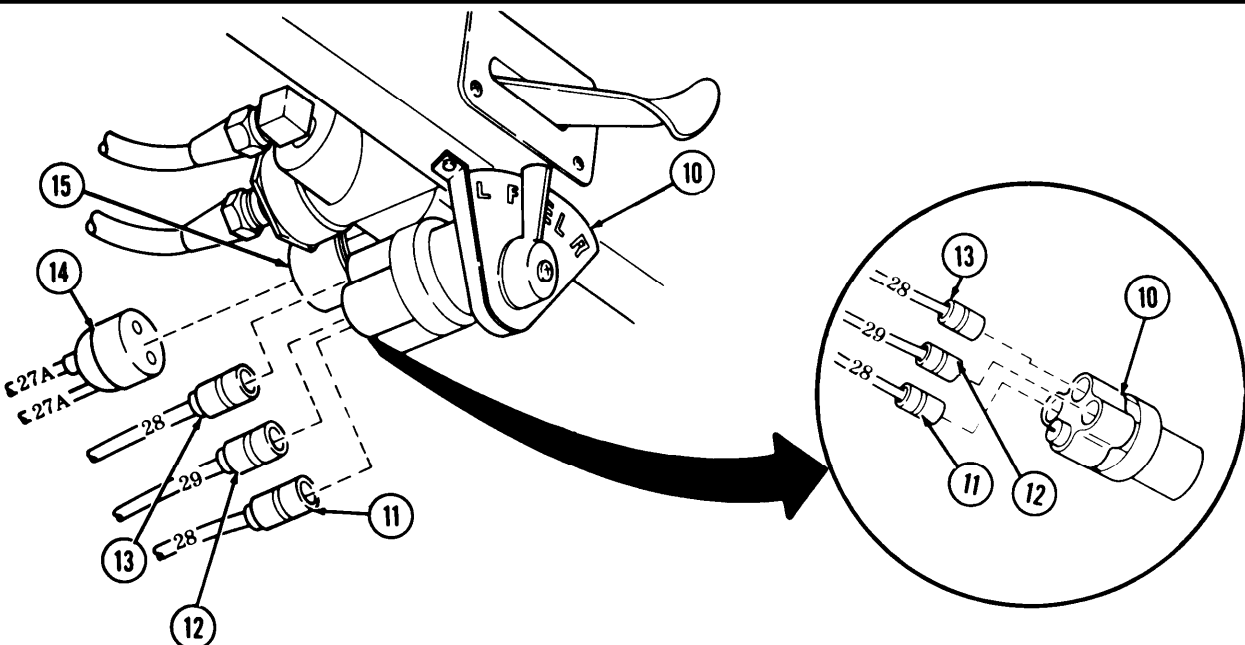
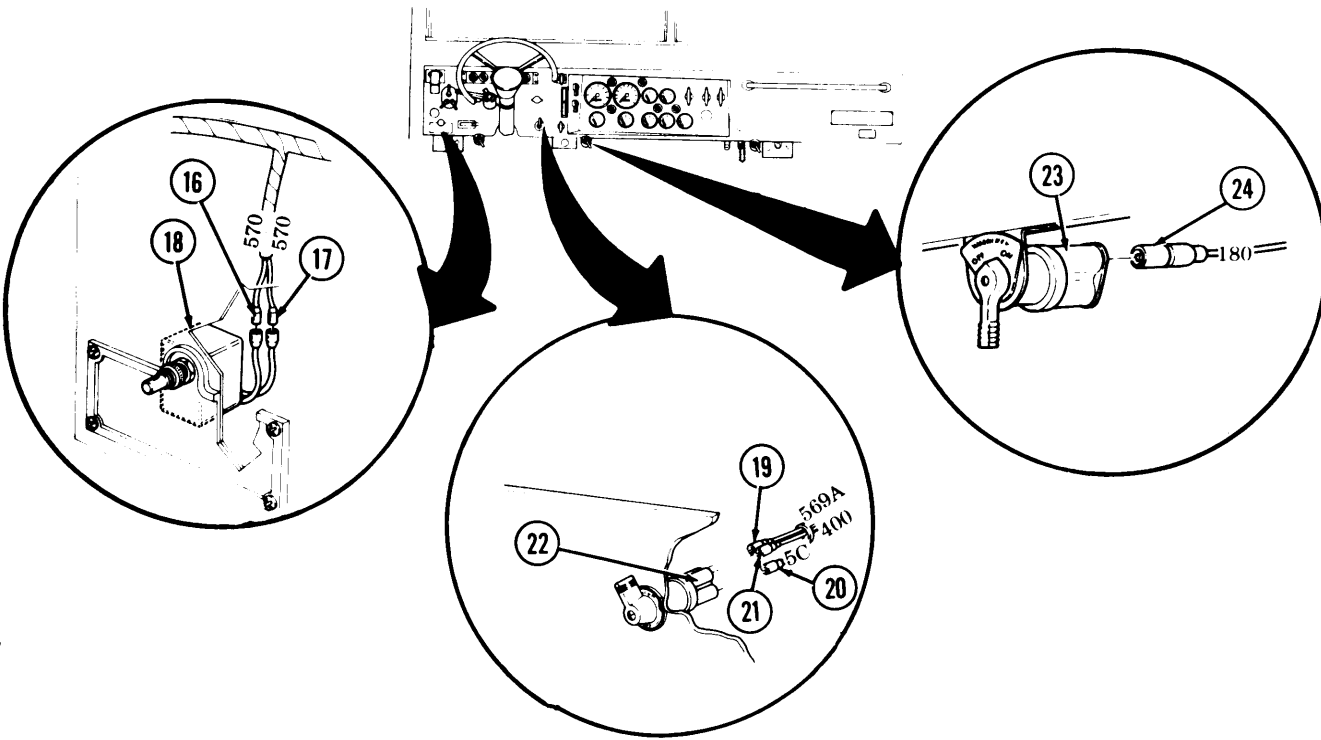
6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
116.		Wire (24)	Connect to warning signal lamp switch (23).	Model M936 only.
117,		Wires (19), (20), and (21)	Connect to heater blower motor switch (22).	
118.		Wires (16) and (17)	Connect to ether start switch (18).	
119,		Connector (14)	Connect to front wheel drive lock-in switch (15).	
120.		Wires (11), (12), and (13)	Connect to fuel selector switch (10).	Models M929, M930, M931, M932, and M936 only.
121.		Wire (8)	Connect to heater blower circuit breaker (9).	
122.		Wires (6) and (7)	Connect to electrical gage circuit breaker (5).	
123.		Wire (4)	Connect to horn switch (3).	
124,		Front harness connector (2)	Connect to turn signal control (1).	



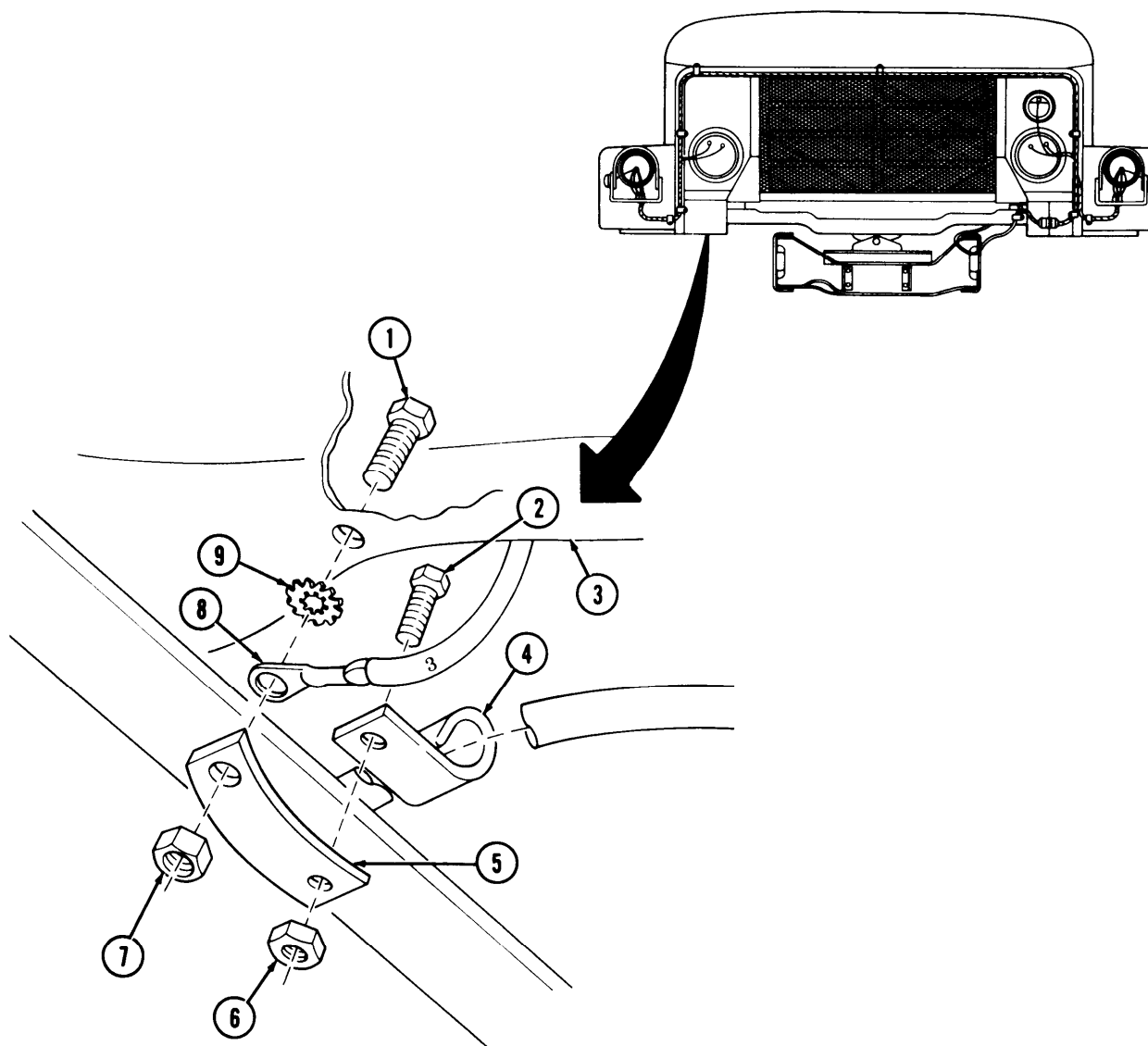
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6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

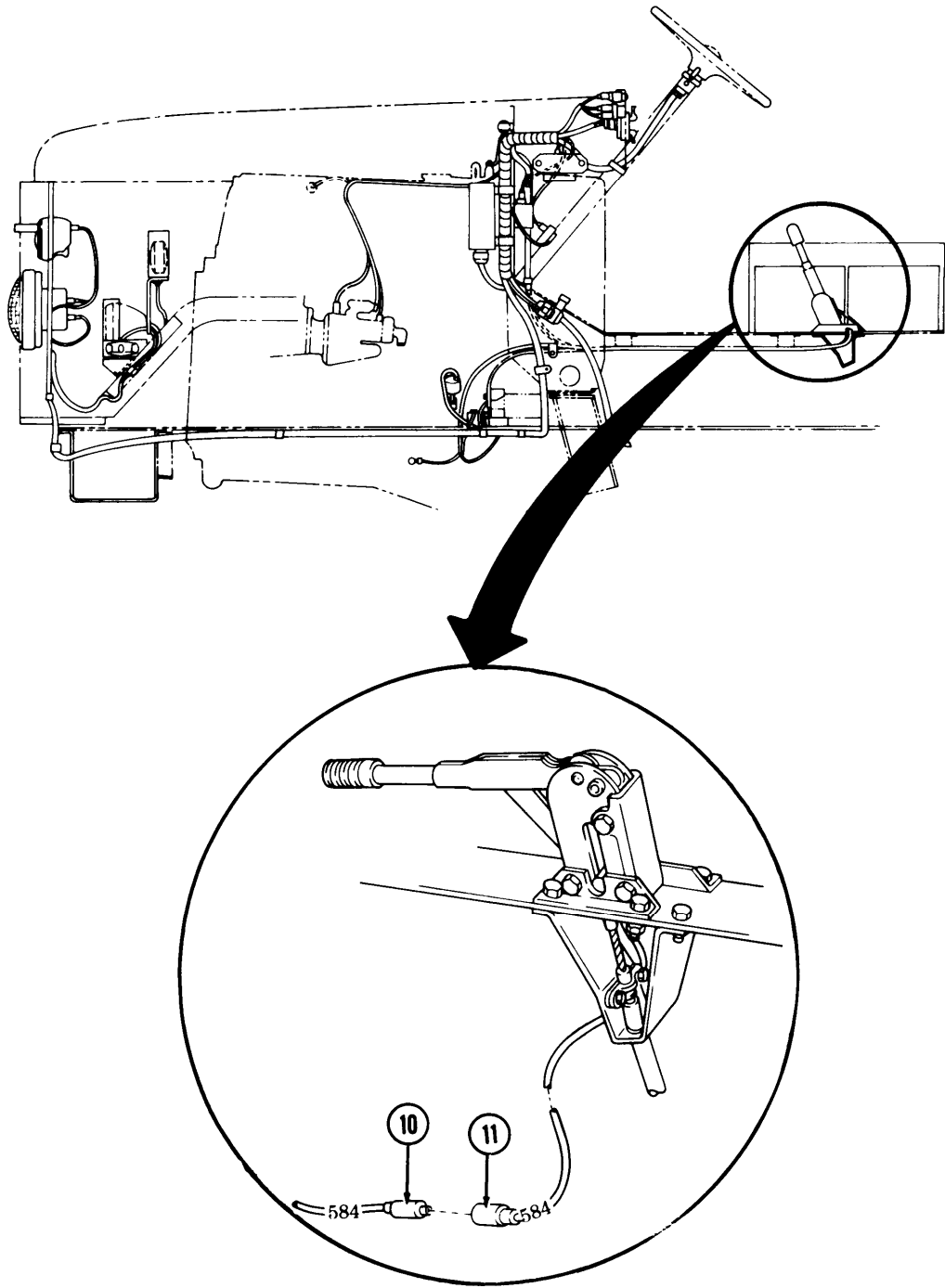
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
125.		Wire (10)	Connect to parking brake switch lead (11).	
126.		Air line clamp (4)	Install on air line bracket (5) with screw (2) and new locknut (6).	
127.		Alternator ground wire (8)	Install on frame crossmember (3) with screw (1), new lock-washer (9), air line bracket (5), and new locknut (7).	



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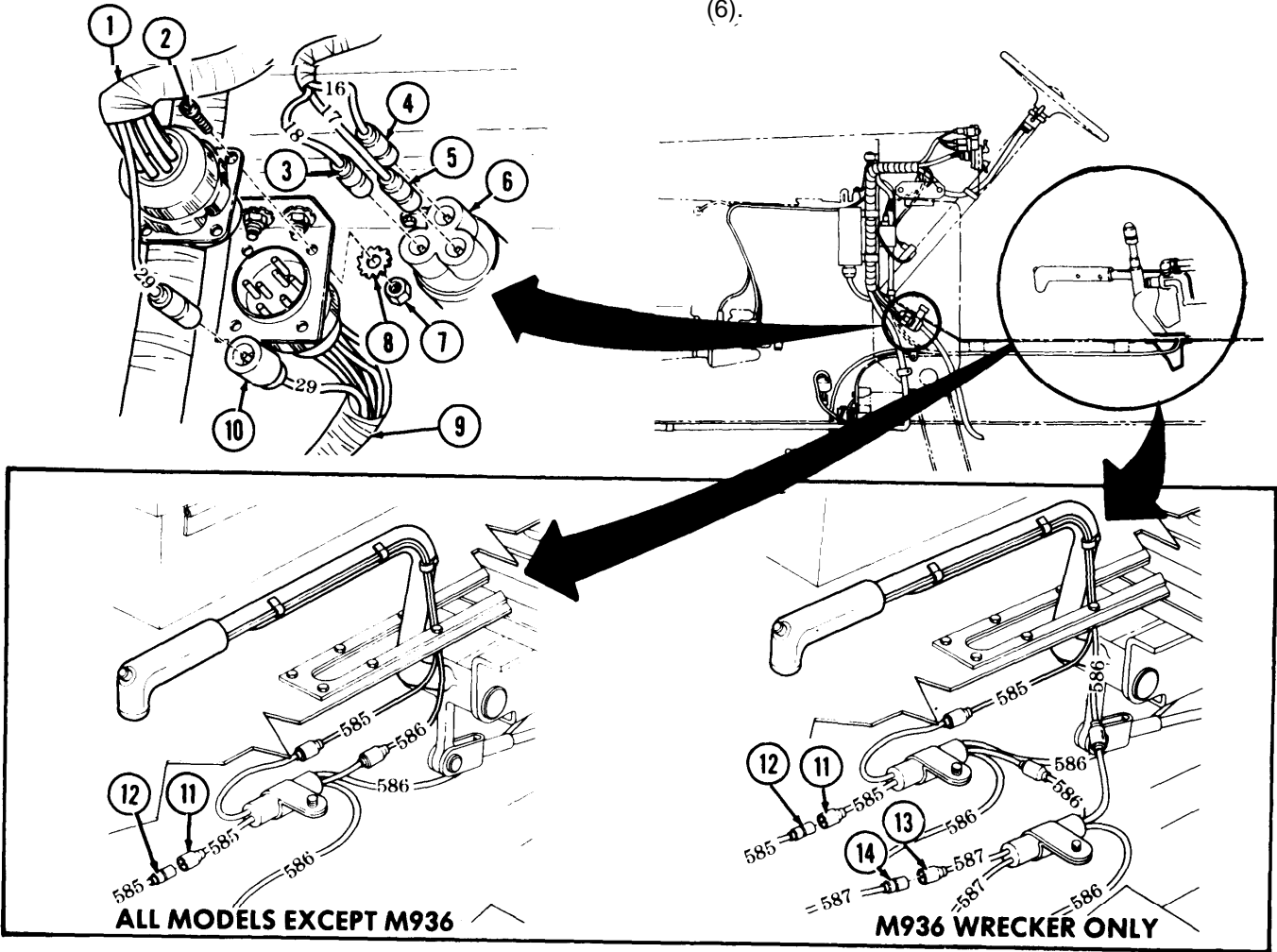
6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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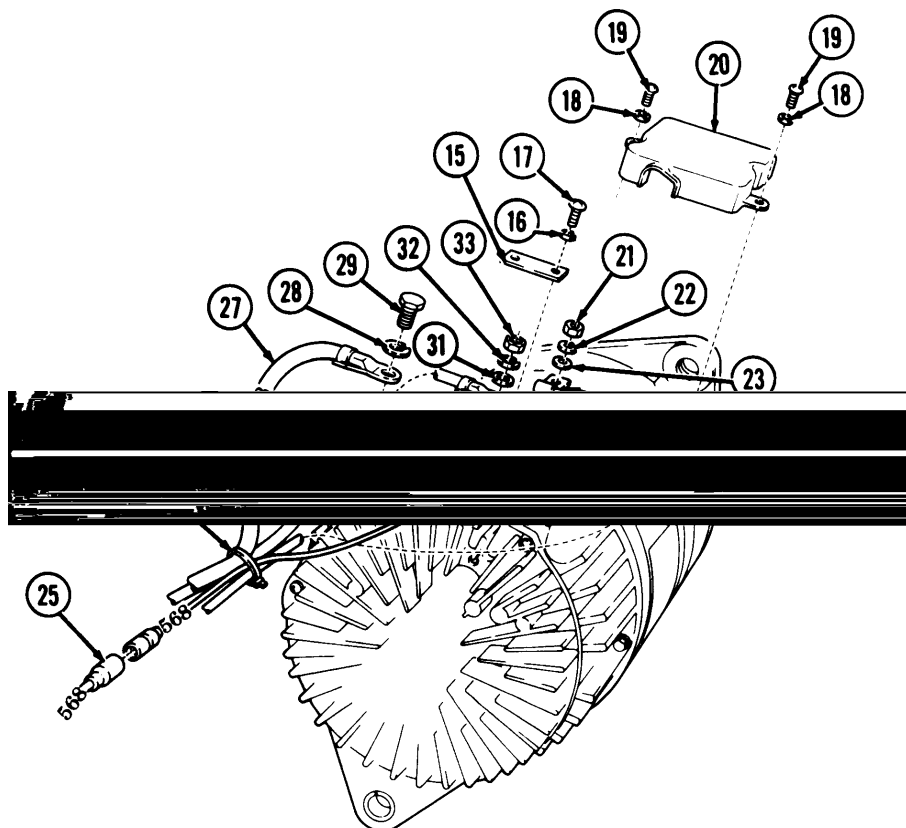
6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP N O .	LOCATION	ITEM	ACTION	REMARKS
128.		Wire (14)	Connect to fifth gear lockup capacitor wire (13).	Model M936 only,
129.		Wire (12)	Connect to transfer case switch capacitor wire (11).	
130.		Connector (1)	Connect to rear wiring harness (9) with four screws (2), new lock-washers (8), and nuts (7).	
131.		Connector (10)	Connect.	Models M929, M930, M931, M932, and M936 only.
132.		Wires (3), (4), and (5)	Connect to headlight beam selector switch (6).	



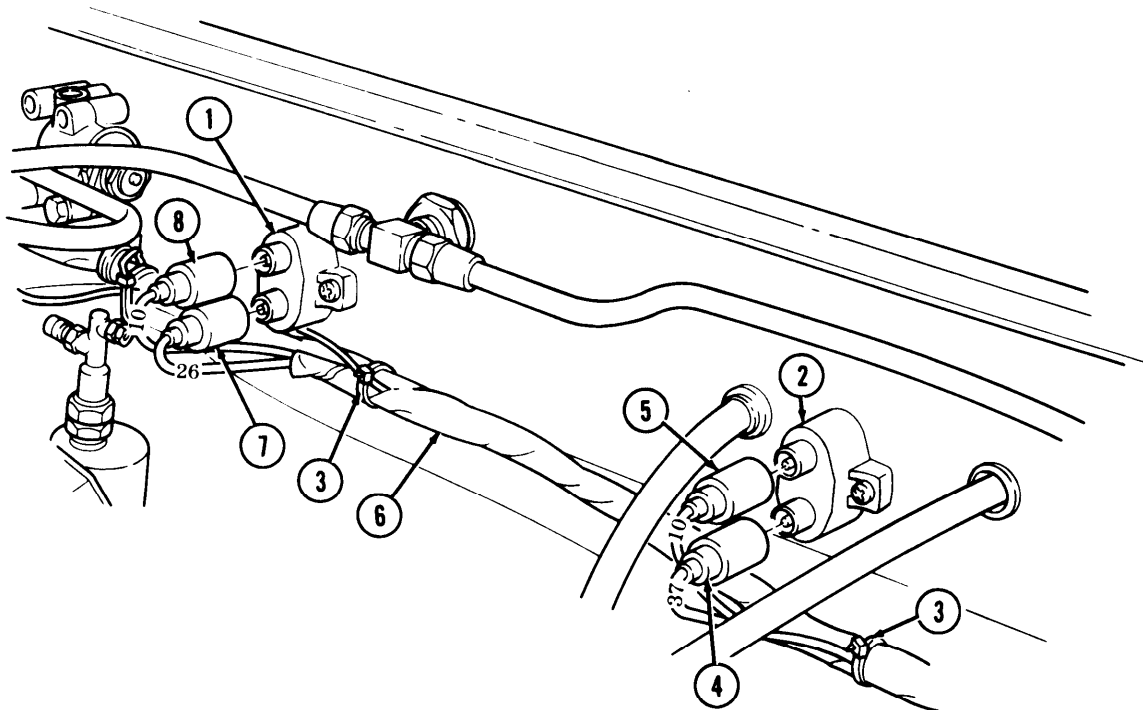
6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
133.		Connector (25)	Connect.	
134.		Wire (24)	Install with washer (23), new lockwasher (22), and nut (21).	Tighten 20-25 lb-in. (2-3 N•m).
135.		Wire (30)	Install with washer (31), new lockwasher (32), and nut (33).	Tighten 45-55 lb-in. (5-6 N•m).
136.		Wire retaining strap (15)	Install with new lockwashers (16) and screws (17).	Wires (30), (24), and (25) are held in place with strap (15).
137.		Wire (27)	Install with new lockwasher (28) and screw (29).	Tighten 82-102 lb-in. (9-12 N•m).
138.		Terminal cover (20)	a. Seal wires (24) and (30) connectors completely. b. Install with two new lockwashers (18) and screws (19).	Use gasket sealant.
139.		Three tiedown straps (26)	Install,	Two tiedown straps (26) are located inside of frame rail on right side.



6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
140.		Wire (18)	Connect to transorb diode coupling assembly wire (17).	
141.		Wires (19) and (20)	Connect to horn solenoid (21).	
142.		Wire (12)	Connect to personnel hot water heater (11).	
143.		Four tiedown straps (16)	Install.	
144.		Three cable clamps (14)	Install on firewall (13) with three screws (15),	
145.		Wire (10)	Connect to engine temperature switch wire (9).	
146.		Wires (4) and (5)	Connect to transmission control and spring brake circuit breaker (2).	
147.		Wires (7) and (8)	Connect to horn circuit breaker (1).	
148.		Two tiedown straps (3)	Install on cable (6).	



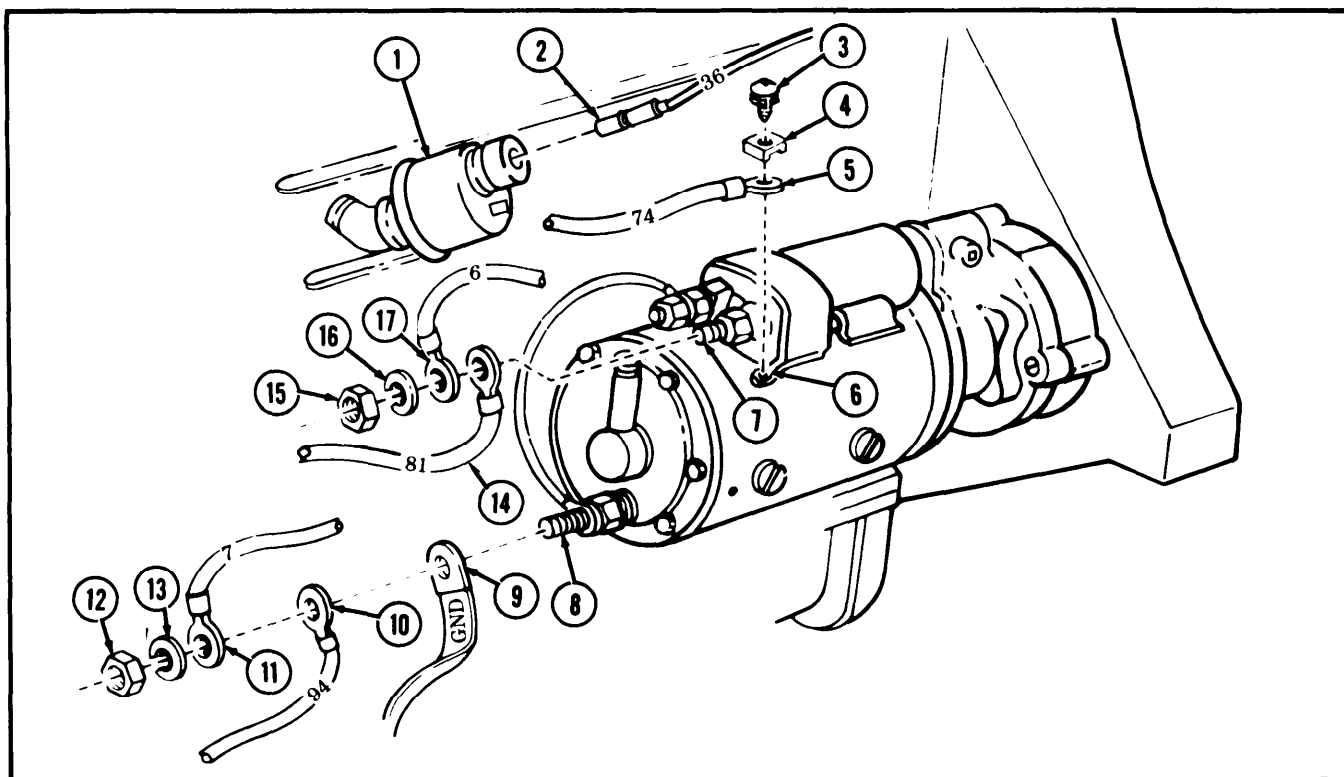
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6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

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6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

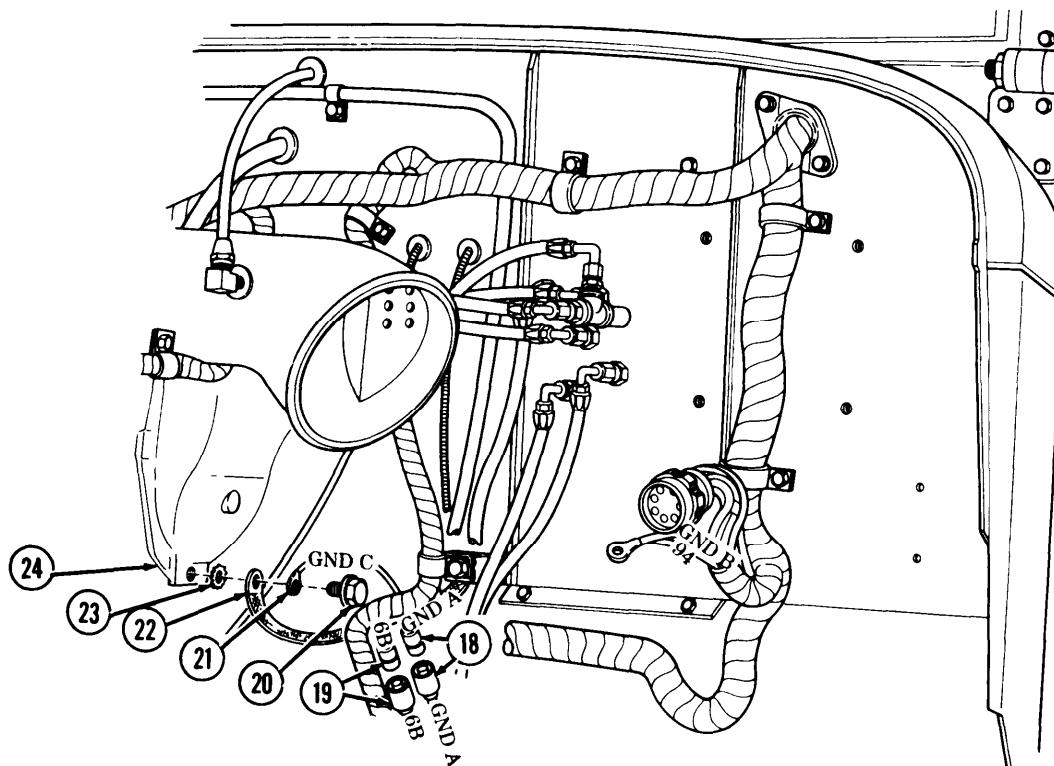
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
149.		Wire (10)	Install on post (8) with ground sleeving (9), wire (11), new lock-washer (13), and nut (12).	
150.		Wire (14)	Install on post (7) with wire (17), new lock-washer (16), and nut (15).	
151.		Wire (5)	Install on solenoid terminal (6) with washer (4) and screw-assembled washer (3).	
152.		Wire (2)	Connect to oil pressure sending unit (1).	
153.		Wires (18) and (19)	Connect.	
154.		Ground wire (21)	Install on intake manifold (24) with new lockwasher (23), ground sleeving (22), and screw-assembled washer (20).	



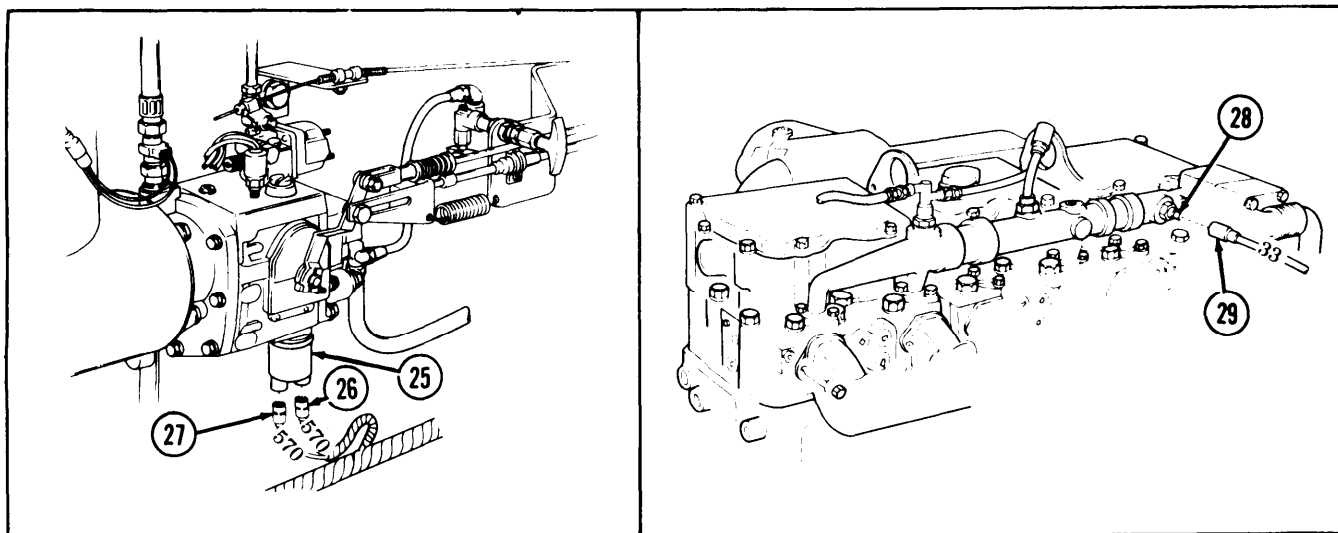
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6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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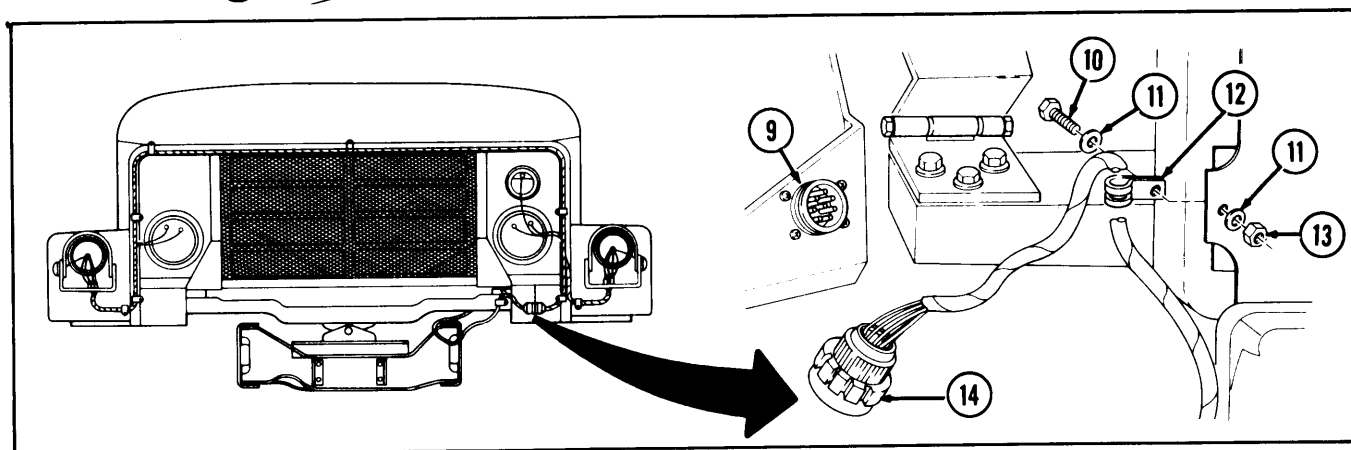
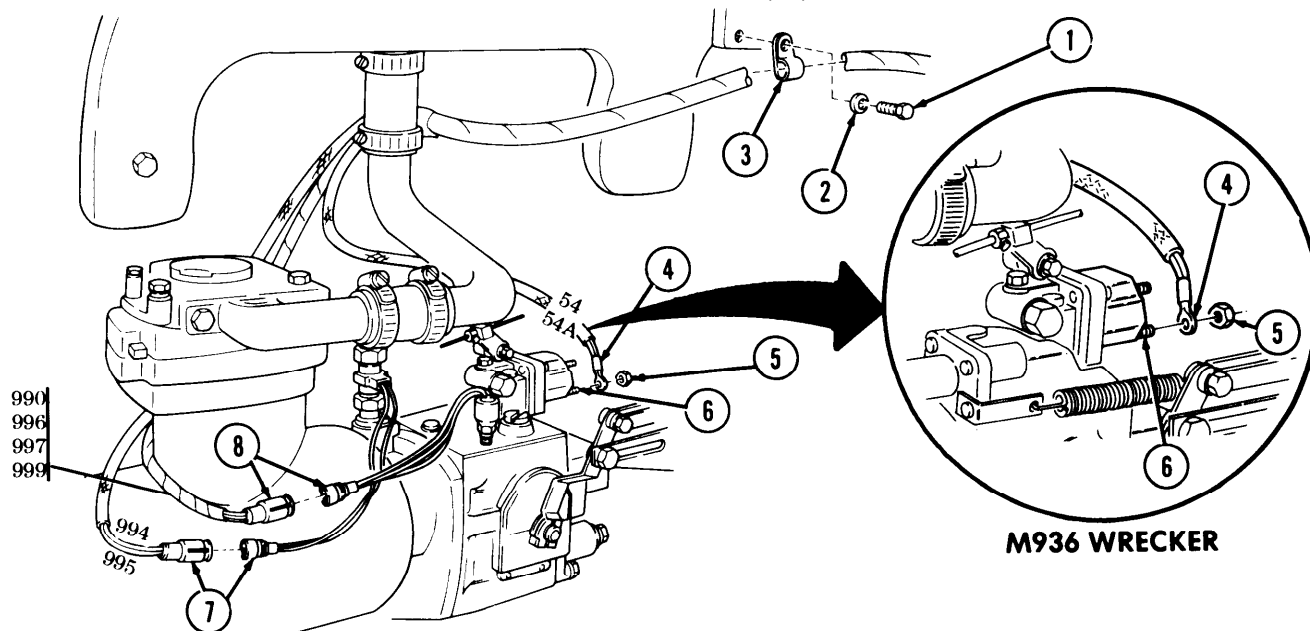


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|------|---------------------|--|
| 155, | Wires (26) and (27) | Connect to ether start fuel pump pressure switch (25). |
| 156. | Wire (29) | Connect to engine temperature sending unit (28). |



6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

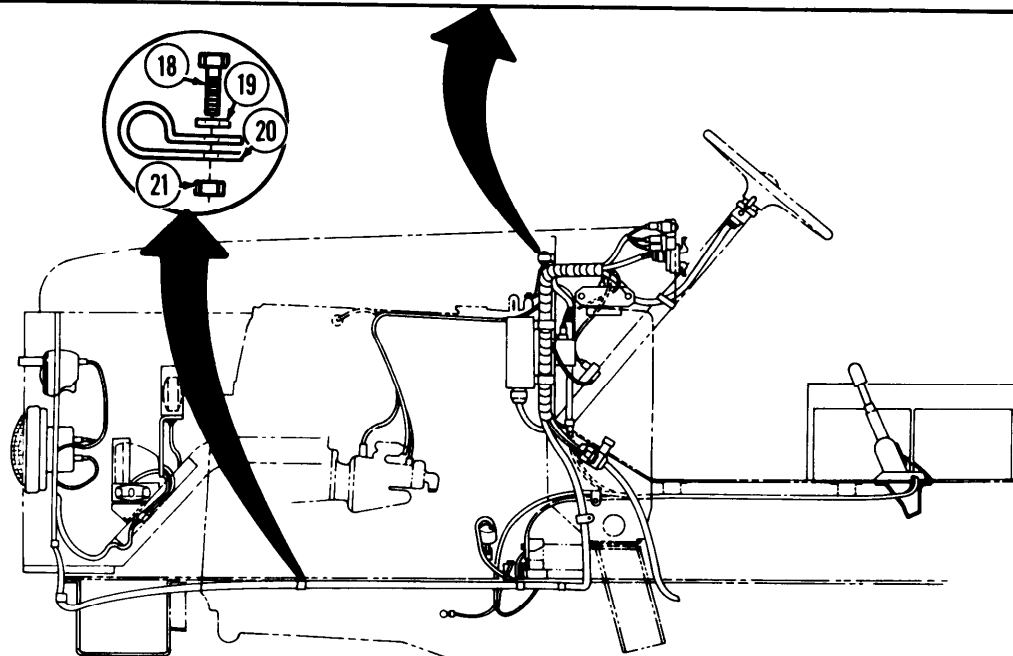
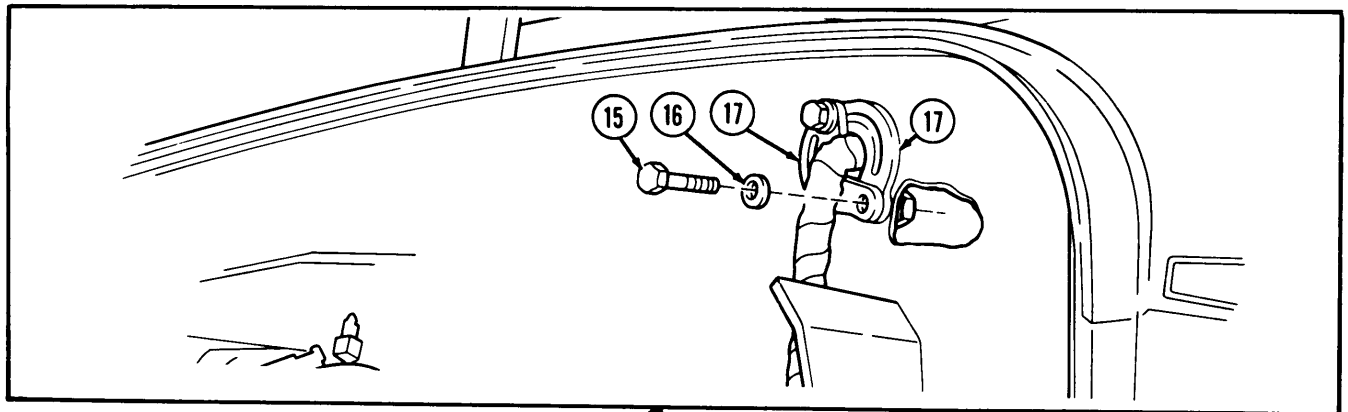
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
157.		Wire (4)	Install on fuel pump solenoid terminal (6) with nut (5).	
158.		Fuel pressure transducer connector (8)	Connect.	All models except M936.
159.		Tachometer pulse sender connector ('i')	Connect.	
160.		Cable clamp (3)	Install with washer (2) and screw (1).	
161.		Front wiring harness connector (14)	Connect to front lights cable assembly (9).	
162.		Cable clamp (12)	Install with screw (10), two washers (11), and nut (13).	



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6-7. FRONT WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
163.		Two grommets (17)	Install with two washers (16) and screws (15).	
164.		Seven harness clamps (20)	Install with seven screws (18), three new lockwashers (19), and two nuts (21).	



END OF TASK!

- FOLLOW-ON TASKS:**
- Install main light switch (TM 9-2320-272-20-1).
 - Install failsafe warning module (TM 9-2320-272-20-1).
 - Install turn signal flasher (TM 9-2320-272-20-1).
 - Install protective control box (TM 9-2320-272-20-1).
 - Install battery ground cables (TM 9-2320-272-20-1).
 - Install splash shields (TM 9-2320-272-10).
 - Install air intake pipe (TM 9-2320-272-20-1).

6-80 REAR WIRING HARNESS REPLACEMENT

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	TM 9-2320-272-10 TM 9-2320-272-20-1 TM 9-2320-272-10	Parking brake set. Battery ground cables disconnected. Hood raised and secured.
Test Equipment		
None		
Special Tools		Special Environmental Conditions
None		None
Materials/Parts		
Seven locknuts Three lockwashers		
Personnel Required		General Safety Instructions
Wheeled vehicle repairman MOS 63W (2)		None
Manual References		
TM 9-2320-272-10 TM 9-2320-272-20-1 TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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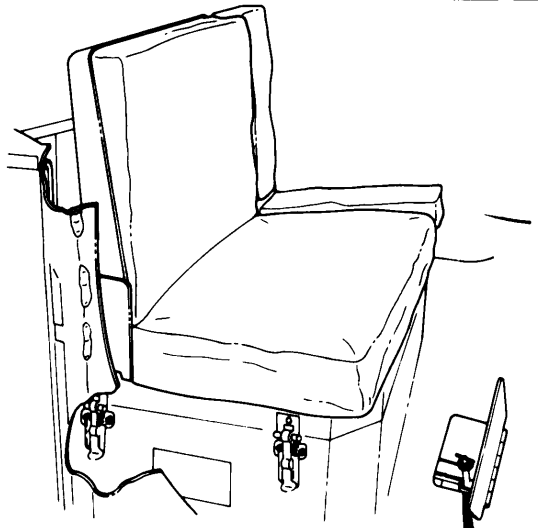
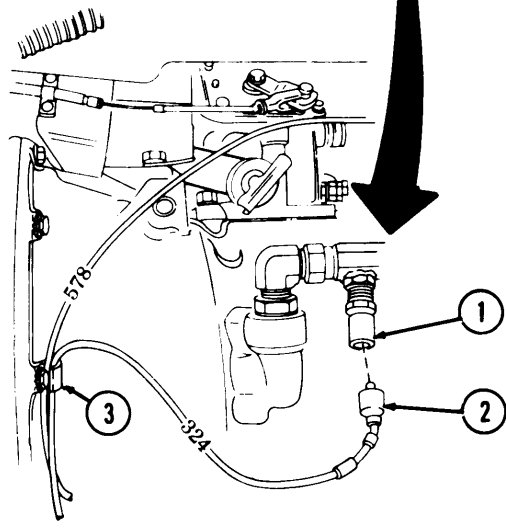
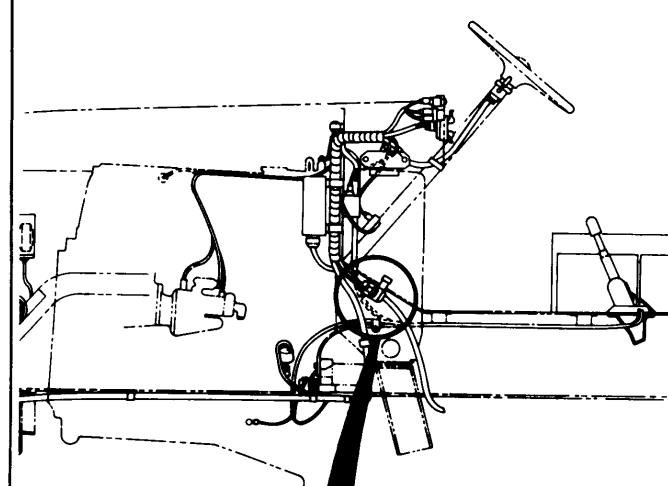
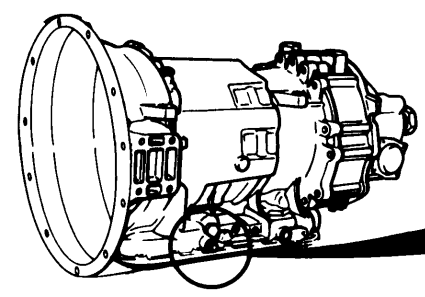
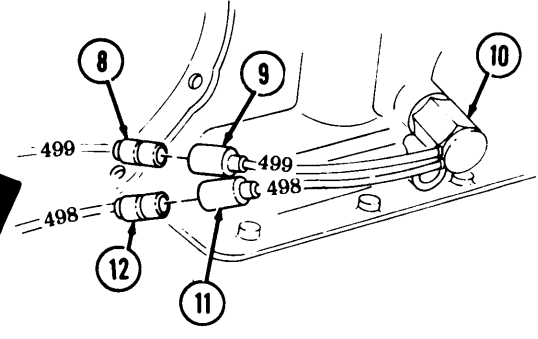
a. Removal

NOTE

Tag wires, connectors, and cables for installation.

- | | | | | |
|----|--|-----------------------------------|---|---|
| 1. | Transmission temperature transmitter (1) | Wire (2) | Disconnect and open spring tension tab (3). | |
| 2. | Front wiring harness (4) | Rear wiring harness connector (5) | Disconnect. | |
| 3. | | Wire (6) | Disconnect from wire (7). | Models M929, M930, M931, M932, and M936 only. |
| 4. | Transmission neutral start switch (10) | Wires (8) and (12) | Disconnect from wires (9) and (11). | |

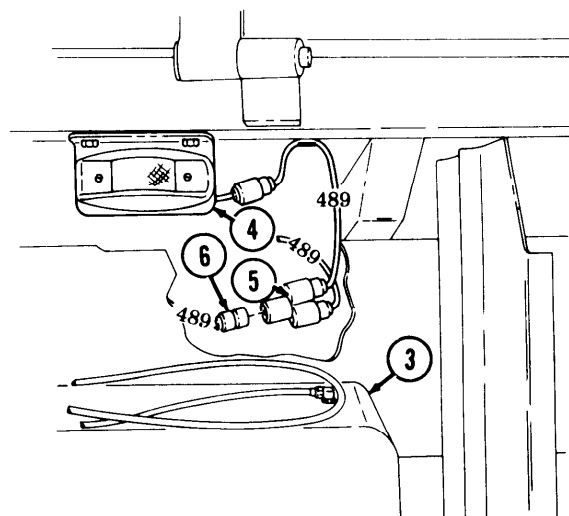
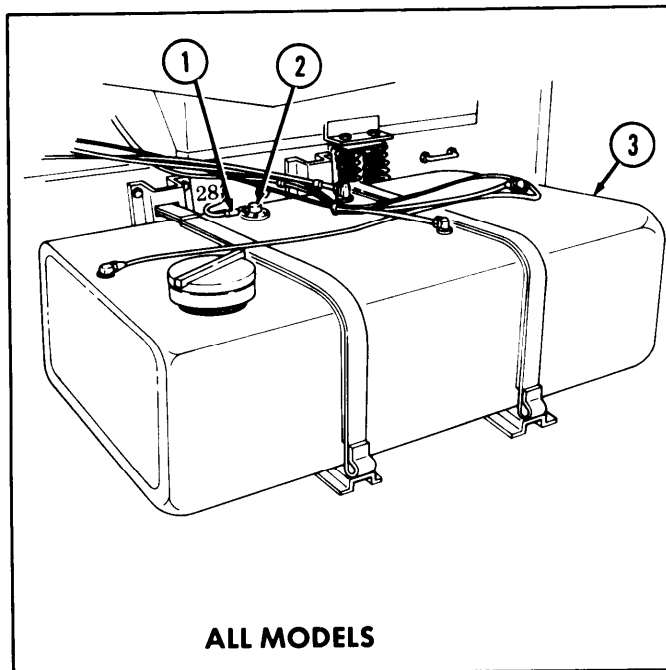
6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

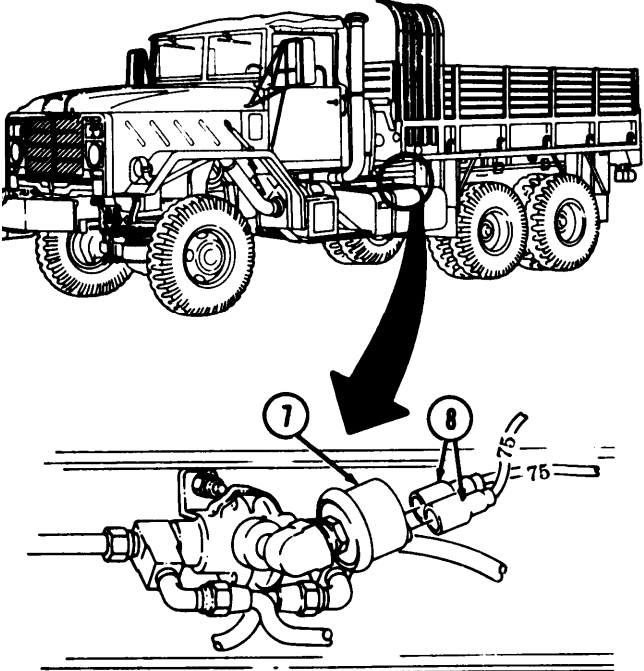
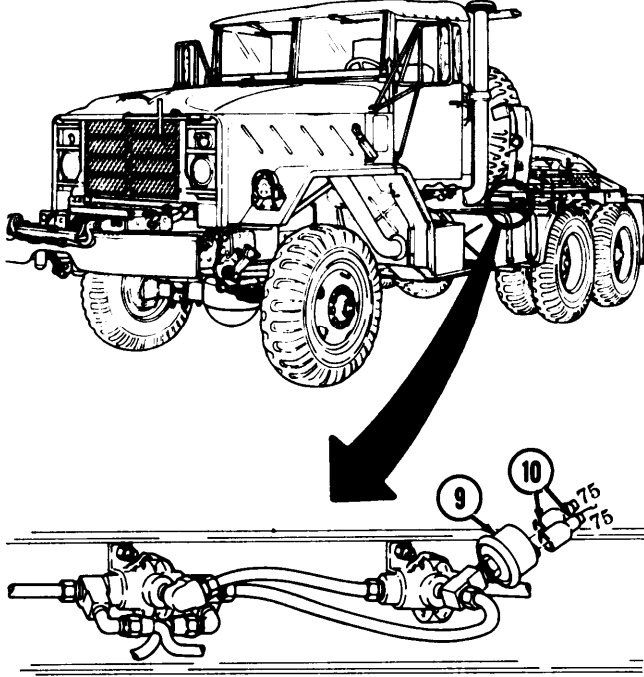
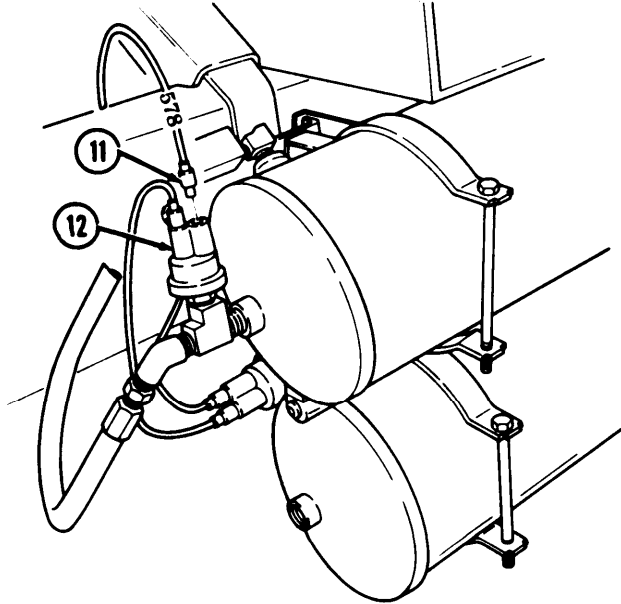
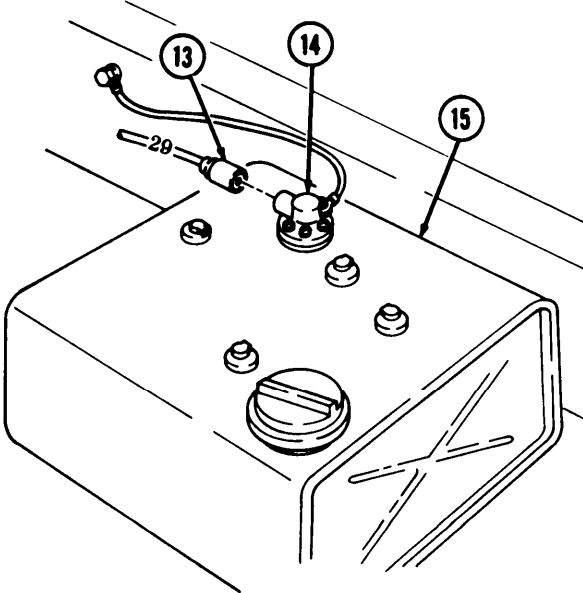
TA 349893

6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
5.	Fuel level sending unit (2) on left-hand fuel tank (3)	Wire (1)	Disconnect.	
6.	Left side and right side marker lights (4)	Wire (6)	Disconnect from connector (5).	Models M923, M924, M925, M926, M927, and M928 only.
7.	Stoplight switch (7)	Two wires (8)	Disconnect.	All models except M931 and M932.
8.	Stoplight switch (9)	Two wires (10)	Disconnect.	Models M931 and M932 only.
9.	Primary low air pressure switch (12)	Wire(11)	Disconnect.	
10.	Fuel level sending unit (14) on right-hand fuel tank (15)	Wire (13)	Disconnect.	Models M929, M930, M931, M932, and M936 only.



6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				ALL MODELS EXCEPT M931, M932
				
				MODELS M931, M932
				
				ALL MODELS
				
				MODELS M929, M930, M931, M932, M936

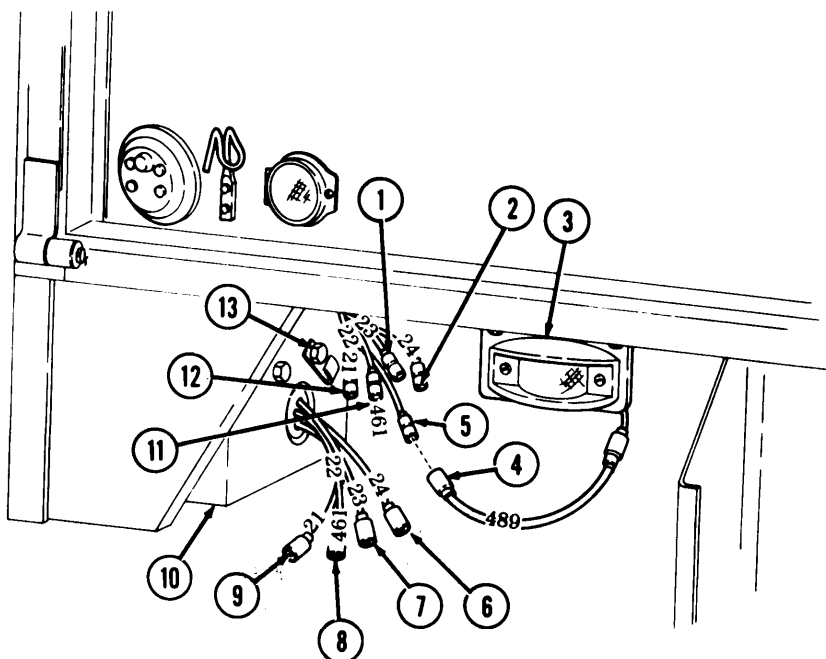
6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
11.	Right rear and left rear side marker light (3)	Wires (4) and (5)	Disconnect.	Models M923, M925, M924, M926, M927, and M928 only.
12.	Right rear and left rear composite light (10)	Spring tension tab (13)	Open and remove wires (6), (7), (8), and (9).	Models M923 and M925 only.
13.	Right rear composite light (10)	Wires (6), (7), (8), and (9)	Disconnect from wires (2), (l), (n), and (12).	
14.	Left rear composite light (22)	Wires (21), (23), (24), and (25)	Disconnect from wires (20), (28), (27), and (26).	
15.	Left side and right side marker lights (18) and (19)	Wire (29)	Disconnect from connector (30).	Models M929, M930, and M936 only.
16.	Left side frame rail (14)	Locknut (17), screw (15), and wood block (16)	Remove.	Model M936 only. Discard locknut (17).

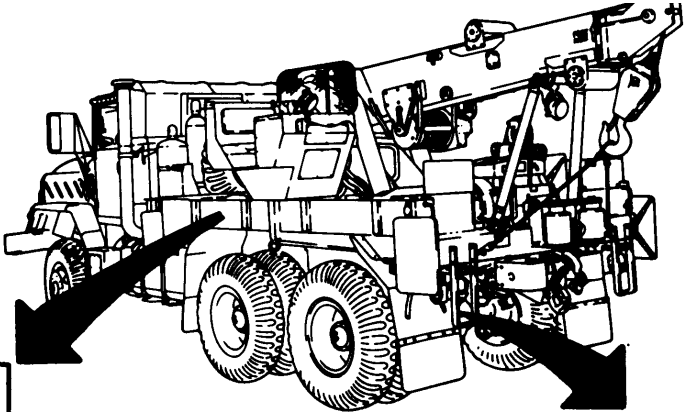
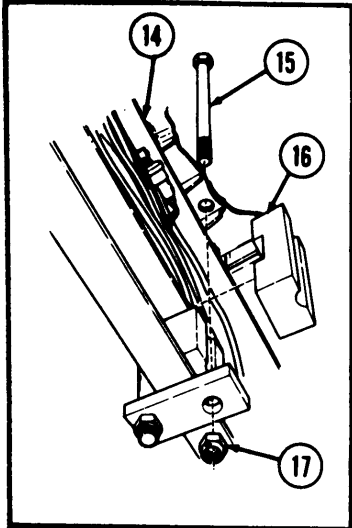
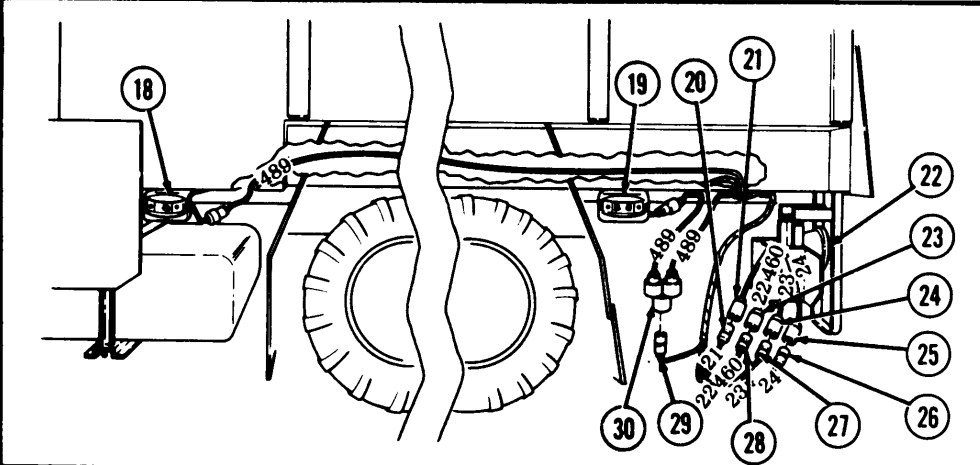
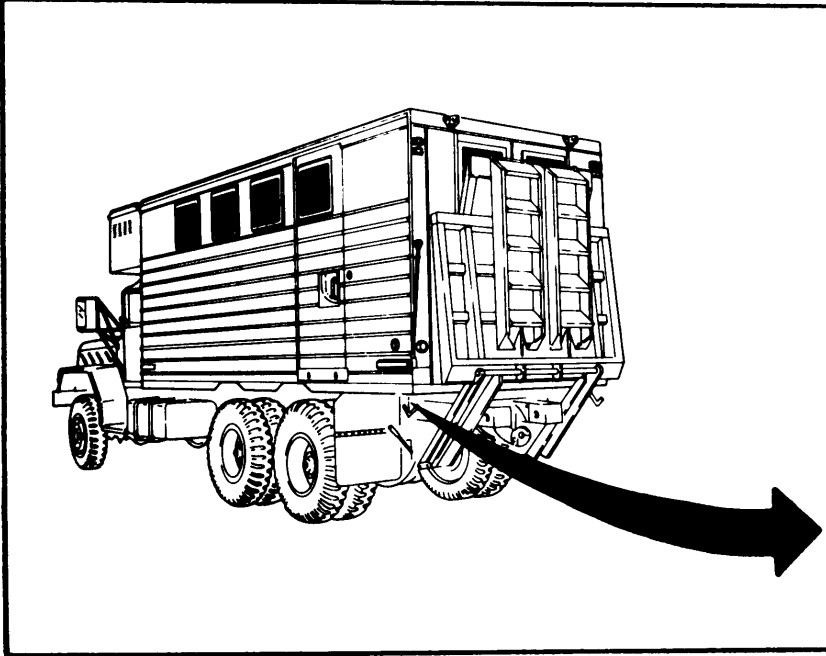
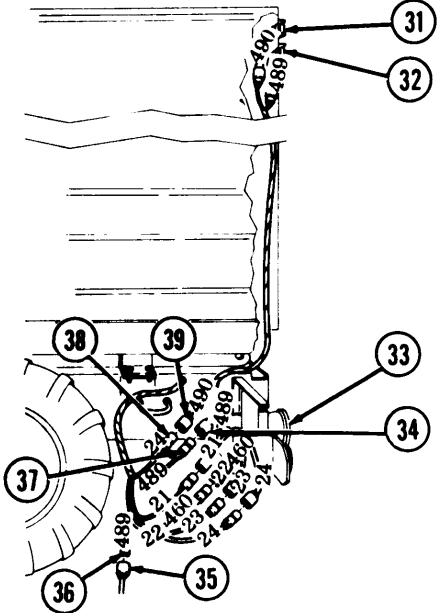
NOTE

Steps 17 through 19 apply to models M934 and M935 only.

17.	Left rear composite light (33)	Wire (36) and wire plug (35)	Disconnect.	
18.	Clearance light (32)	Wires (34) and (37)	Disconnect.	Disconnect wire found on left rear only.
19.	Blackout clearance light (31)	Wires (38) and (39)	Disconnect.	Disconnect wire found on left rear only.



6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				
				
				
				

6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

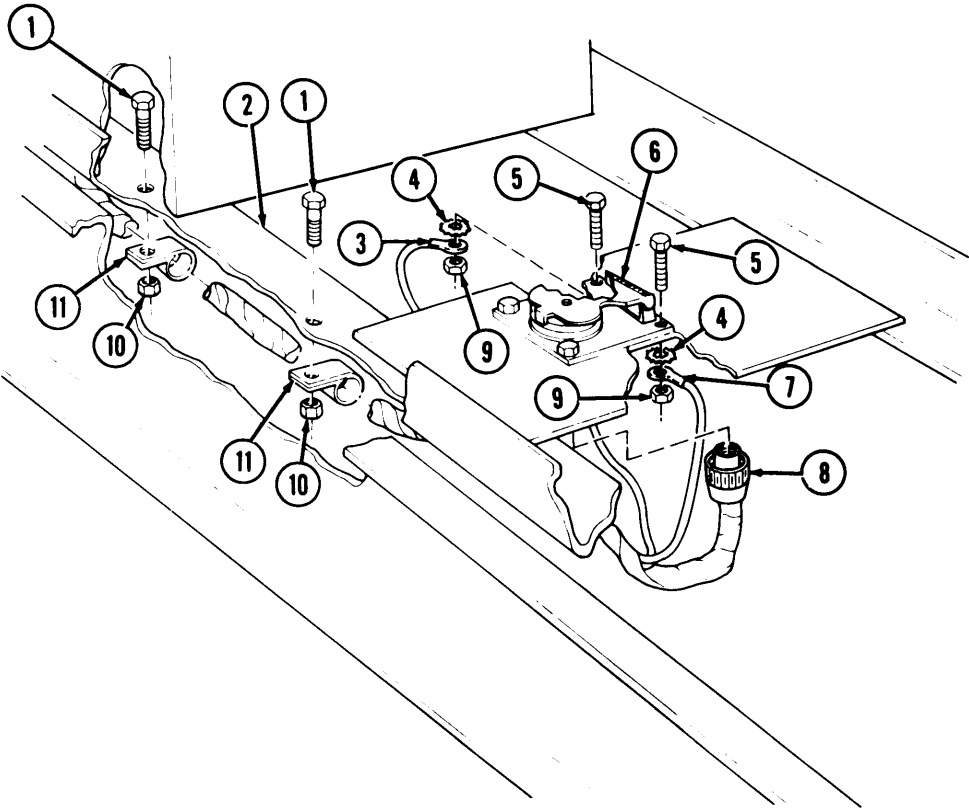
Steps 20 through 22 apply to models M931 and M932 only.

20.	Frame rail (2)	Two nuts (10), screws (1), and clamps (11)	Remove.	
21.	Semitrailer receptacle (6)	Harness connector (8)	Disconnect.	
22.		Two nuts (9), ground wires (3) and (7), two lockwashers (4), and two screws (5)	Remove.	Discard lockwashers (4).

NOTE

- Tag all clamps for installation.
- Refer to table 6-2 for number of harness clamps installed on each vehicle.

23.	Rear wiring harness (12)	Nut (15), screw (13), and harness clamp (14)	Remove.	
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MODELS M931, M932

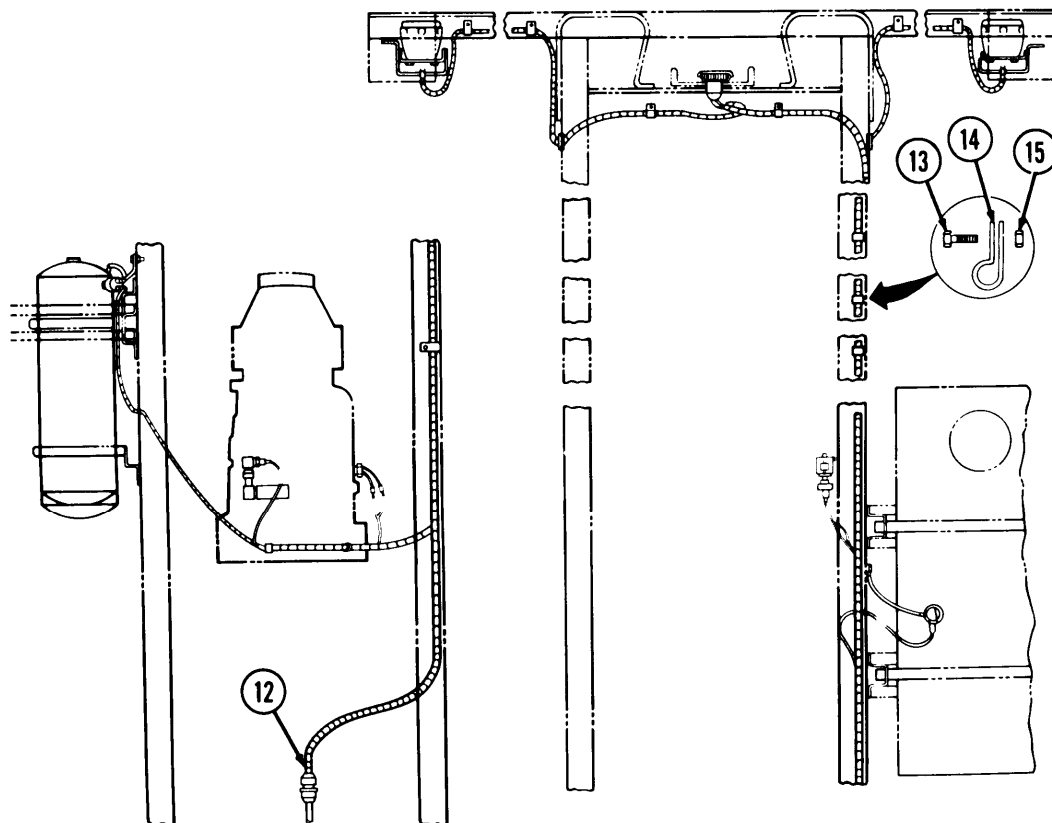
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6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Table 6-2. Rear Wiring Harness Clamp Quantity

MODEL	NUMBER OF CLAMPS
M923, M924, M925, M926, M927, M928	Eighteen
M929, M930	Ten
M931, M932	Eleven
M934, M935	Twelve
M936	Ten



6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)
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STEP NO.	LOCATION	ITEM	ACTION	REMARKS
24.	Rear frame rail (1)	Locknut (4), screw (2), spring clamp (3), two ground wires (6), and lockwasher (5)	Remove.	Discard locknut (4) and lockwasher (5). Models M931 and M932 only,
25.	Rear frame rail (8)	Locknut (11), screw (7), two ground wires (10), and lockwasher (9)	Remove.	Discard locknut (11) and lockwasher (9). All models except M931 and M932.
NOTE				
Receptacle cover must be lifted and held open to remove top two screws.				
26.	Rear frame rail (8)	Four locknuts (15) and screws (17), receptacle cover (12) and trailer cable receptacle (13)	Remove.	Discard locknuts (15).
27.		Rear wiring harness (16)	Pull through hole (14) in rear frame rail (8) to remove from vehicle.	

b. Installation

CAUTION

Use care when routing harness. Snagging may occur and forceful pulling will result in damage to harness.

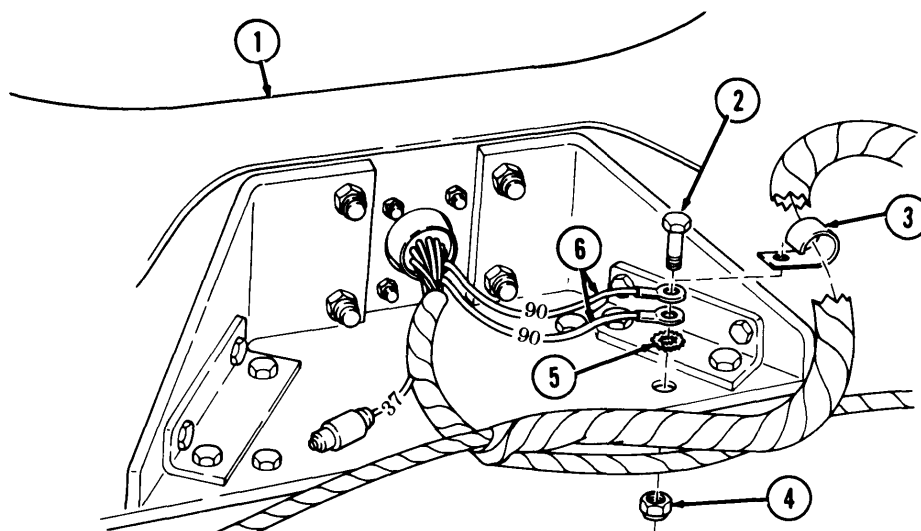
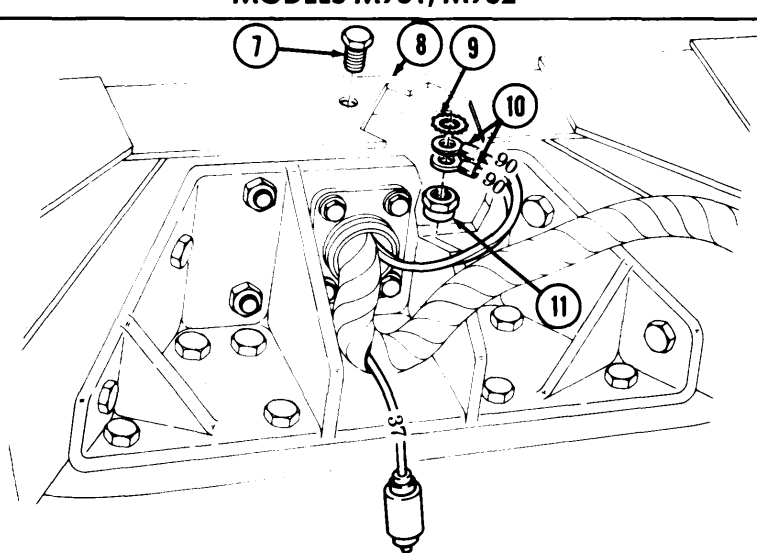
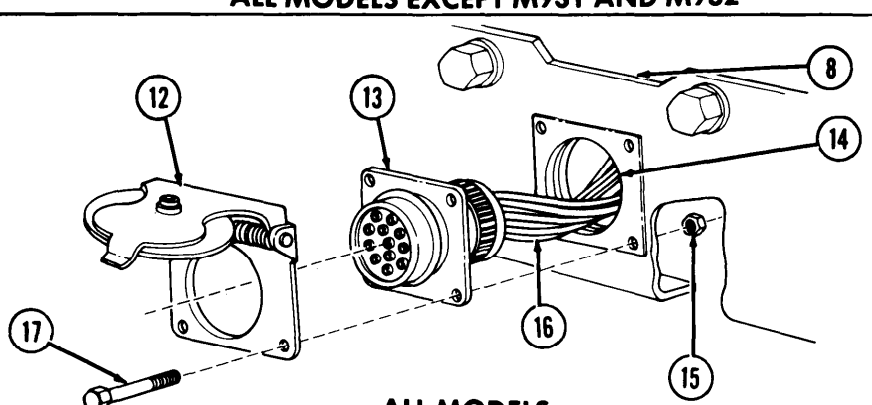
28.	Rear wiring harness (16)	Route through hole (14) and place in approximate position.
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NOTE

Receptacle cover must be lifted and held open to install top two screws,

29.	Trailer cable receptacle (13) and receptacle cover (12)	Install with four screws (17) and new locknuts (15).
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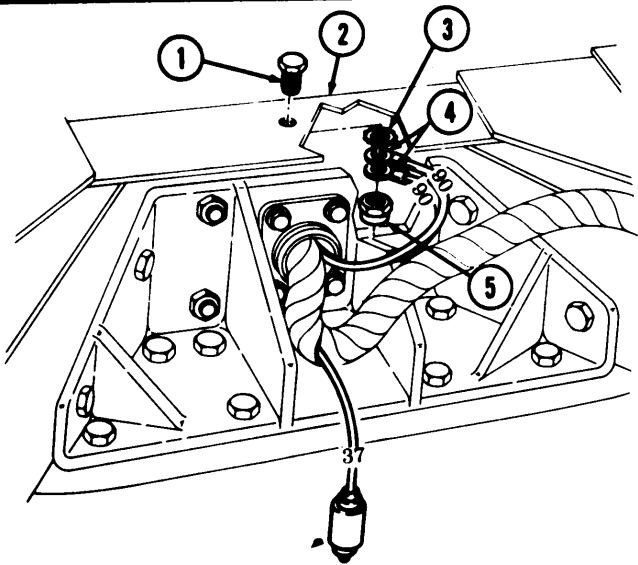
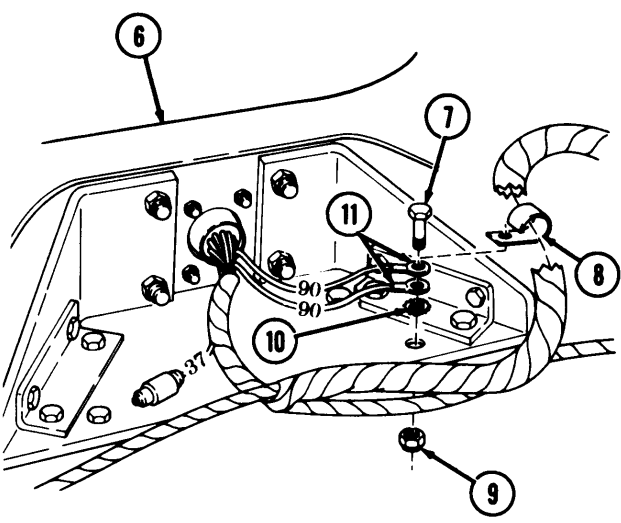
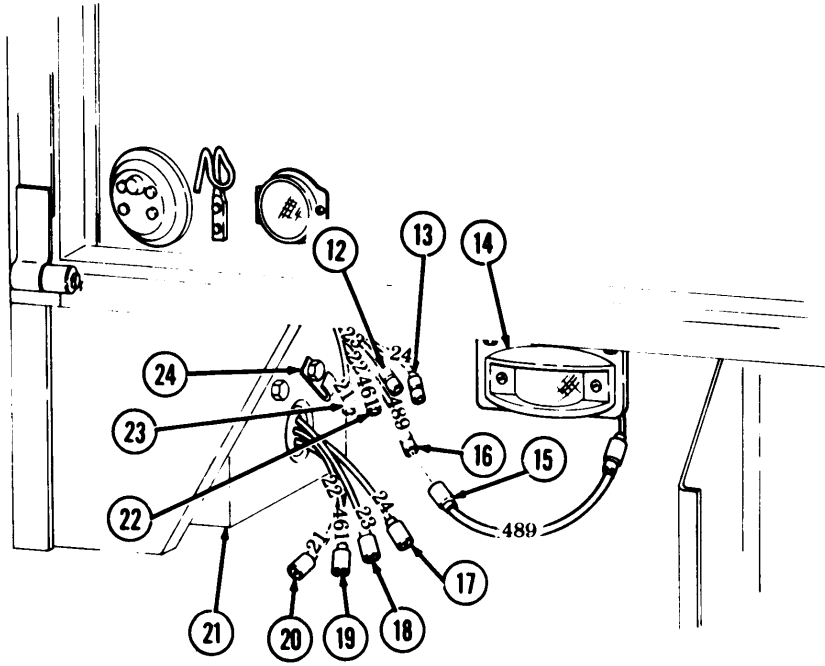
6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
		MODELS M931, M932		
				
		ALL MODELS EXCEPT M931 AND M932		
				
		ALL MODELS		

6-8. REAR WRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
30.		Two ground wires (4)	Install on frame rail (2) with screw (1), new lockwasher (3), and new locknut (5).	All models except M931 and M932.
31.		Two ground wires (11)	Install on frame rail (6) with screw (7), spring tension tab (8), new lockwasher (10), and new locknut (9).	Models M931 and M932 only.
32.	Right side and left side marker lights (14)	Wire (15)	Connect to wire (16).	Models M923, M924, M925, M926, M927, and M928 only.
33.	Right rear composite light (21)	Wires (17), (18), (19), and (20)	Connect to wires (13), (12), (22), and (23).	
34.	Right and left rear composite lights (21)	Spring tension tab (24)	Close around wires (17), (18), (19), and (20).	Models M923 and M925 only.

6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				ALL MODELS EXCEPT M931, M932
				MODELS M931, M932
				MODELS M923, M924, M925, M926, M927, M928

6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
35.	Left side frame rail (1)	Wood block (3), screw (2), and new locknut (4)	Install.	Model M936 only,
36.	Left rear composite light (9)	Wires (8), (10), (11), and (12)	Connect to wires (7), (15), (14), and (13).	
37.	Left side and right side marker lights (5) and (6)	Connector (17)	Connect to wire (16).	Models M929, M930, and M936 only.

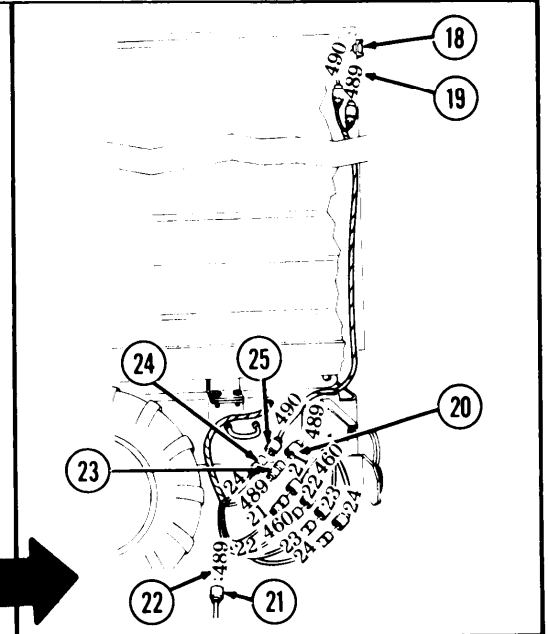
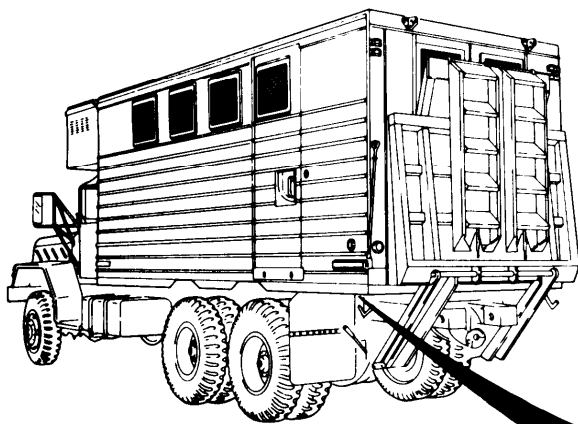
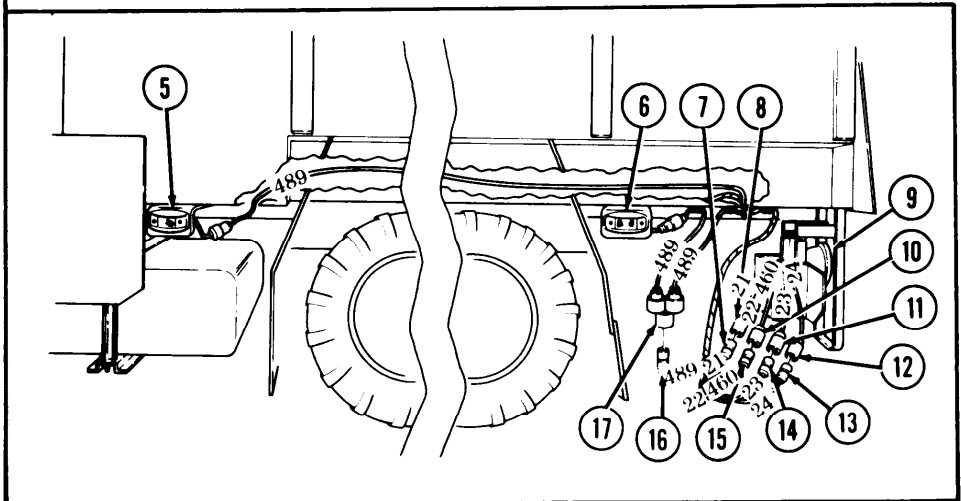
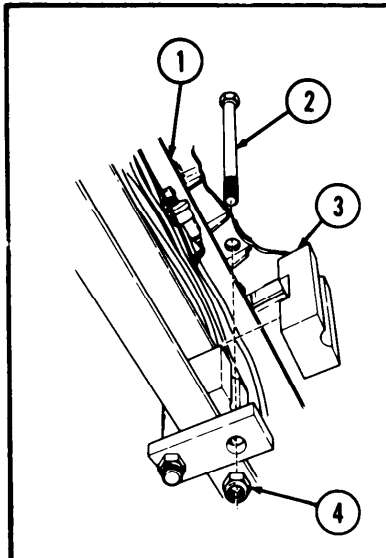
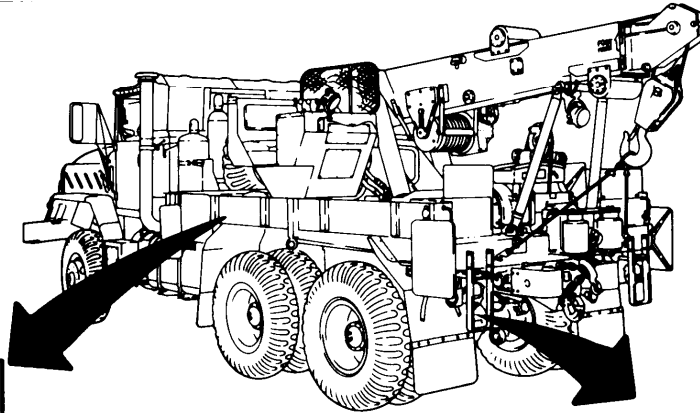
NOTE

- Steps 38 through 40 apply to models M934 and M935 only,
- Perform these steps in front of left rear composite light only.

38.	Blackout clearance light (18)	Wire (25)	Connect to wire (24).
39.	Clearance light (19)	Wire (20)	Connect to wire (23).
40.		Wire (22)	Install wire plug (21).

6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

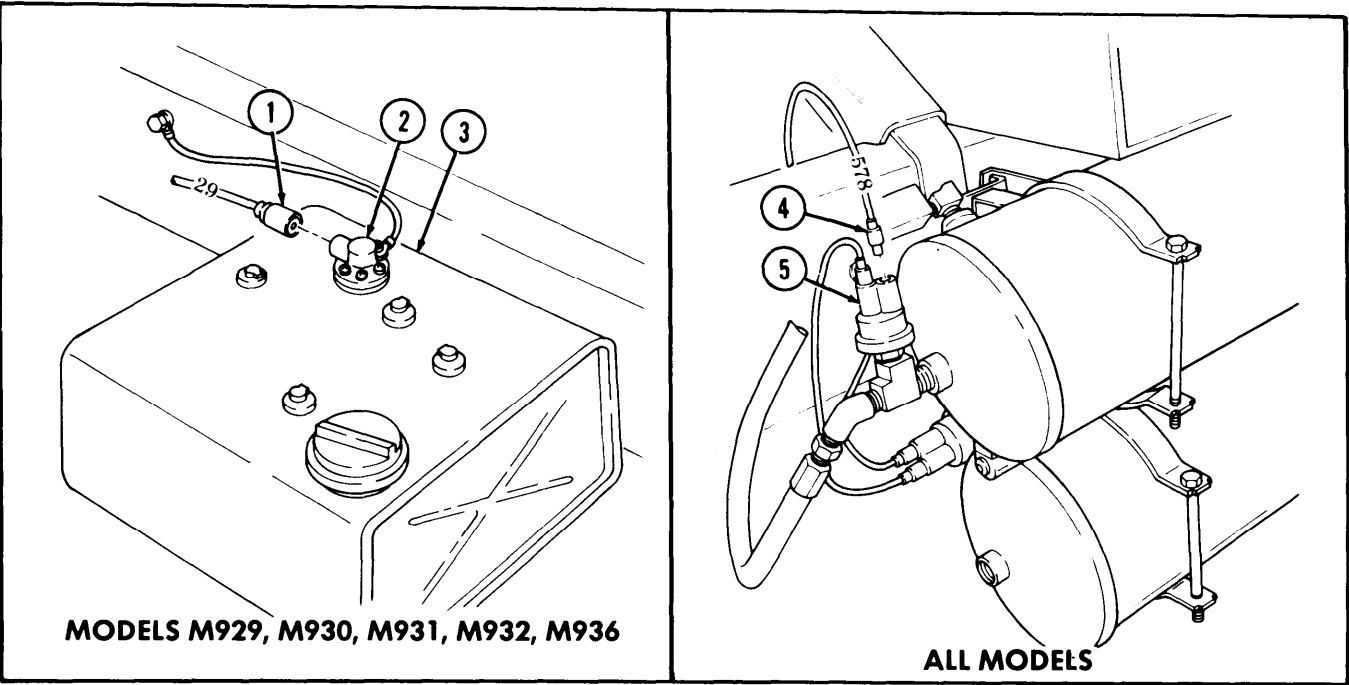
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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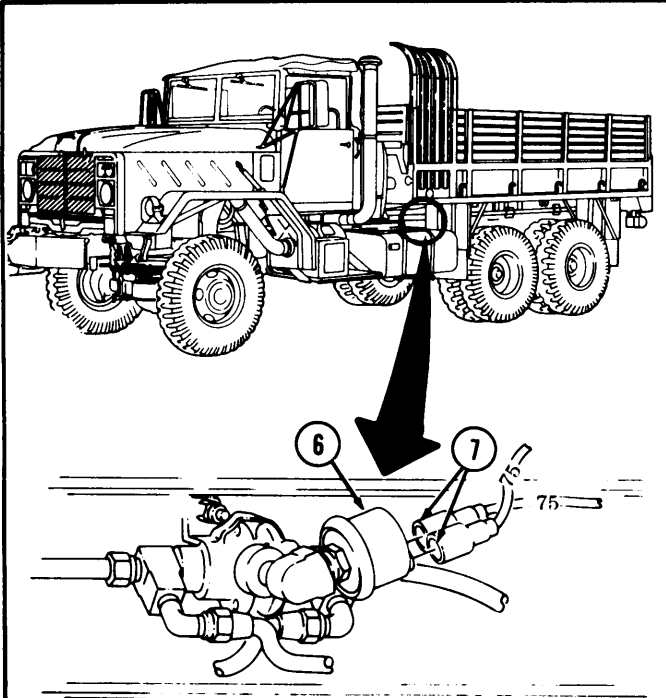
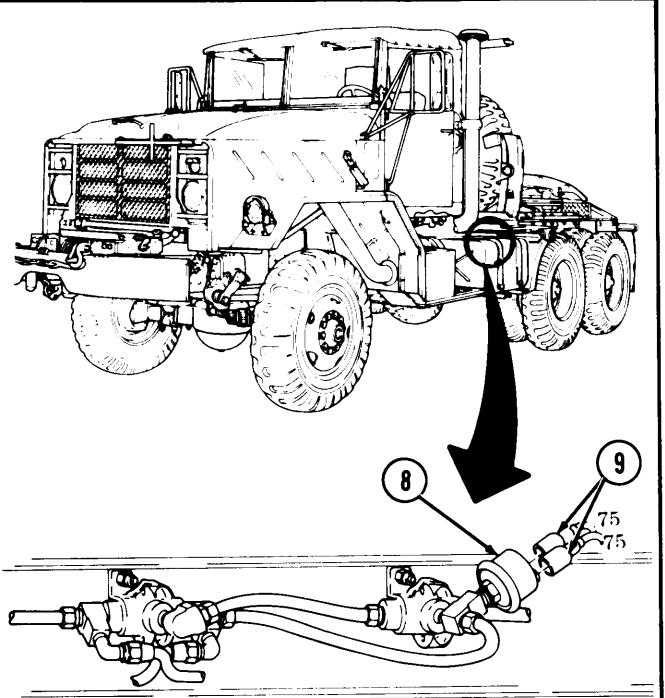
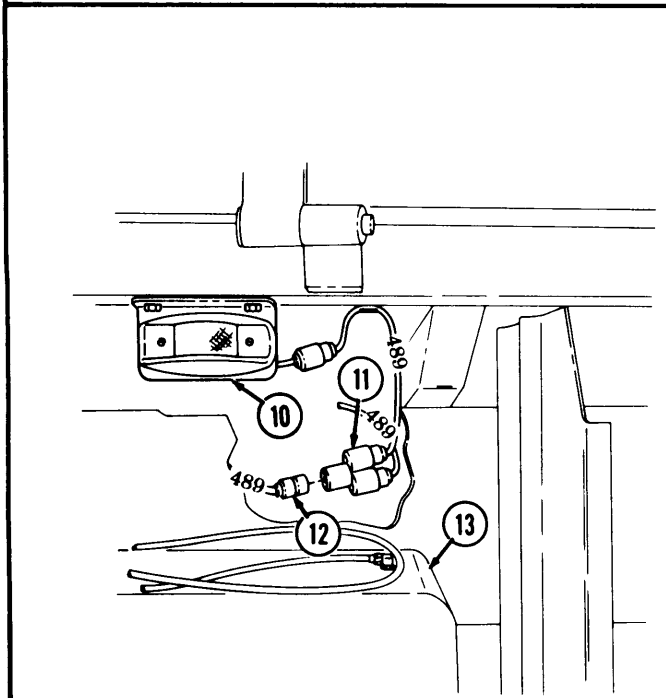
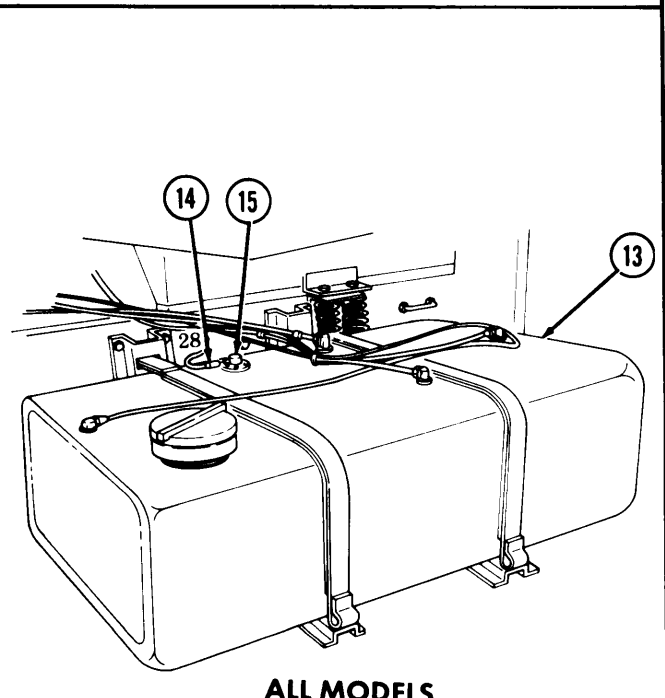
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6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
41.		Wire (1)	Connect to fuel level sending unit (2) on right-hand fuel tank (3).	
42.		Wire (4)	Connect to primary low air pressure switch (5).	
43.		Two wires (7)	Connect to stoplight switch (6).	All models except M931 and M932.
44.		Two wires (9)	Connect to stoplight switch (8).	Models M931 and M932 only.
45.	Left and right side marker lights (10)	Connector (11)	Connect to wire (12).	Models M923, M924, M925, M926, M927, and M928.
46.		Wire (14)	Connect to fuel level sending unit (15) on left-hand fuel tank (13).	



6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				
				
				

ALL MODELS EXCEPT M931, M932

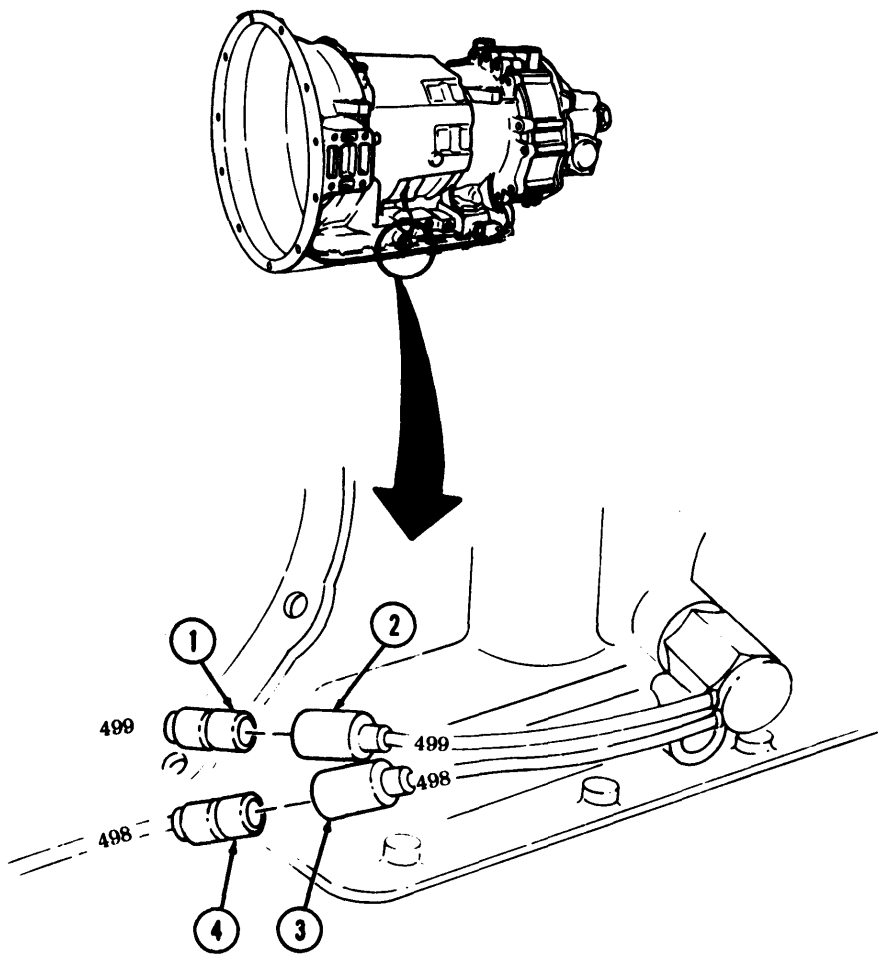
MODELS M931, M932

MODELS M923, M924, M925, M926, M927, M928

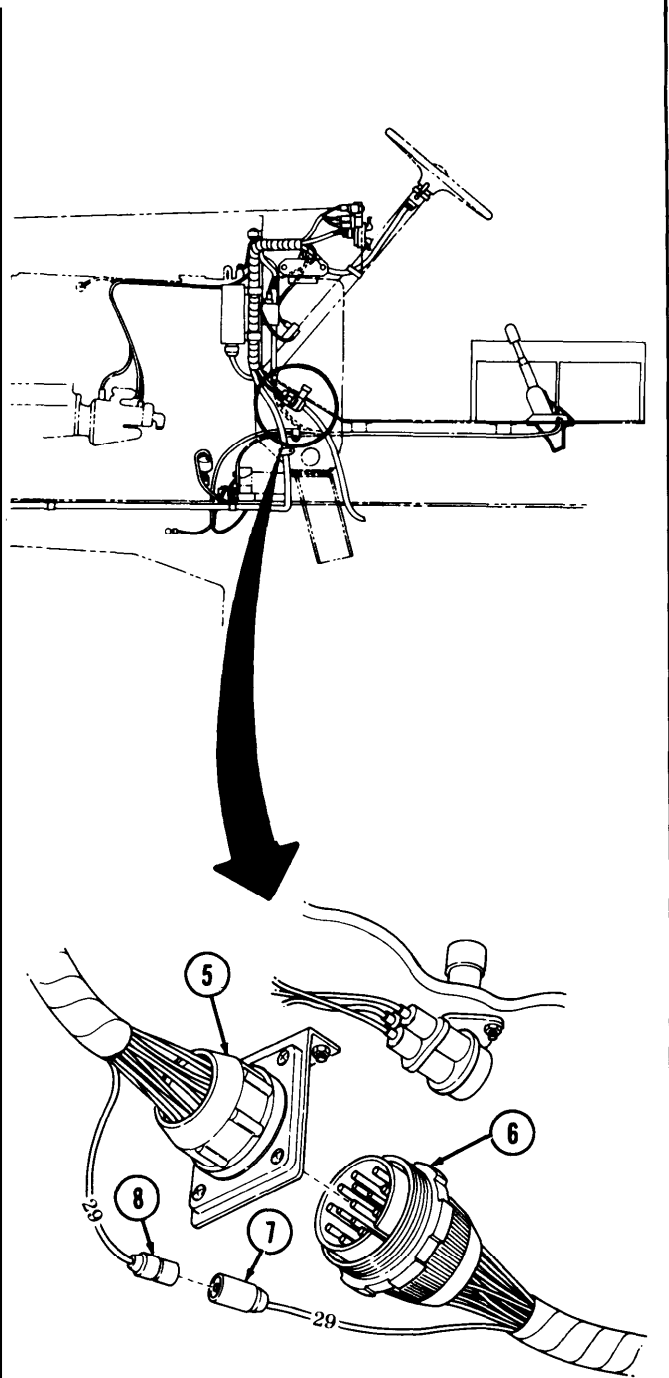
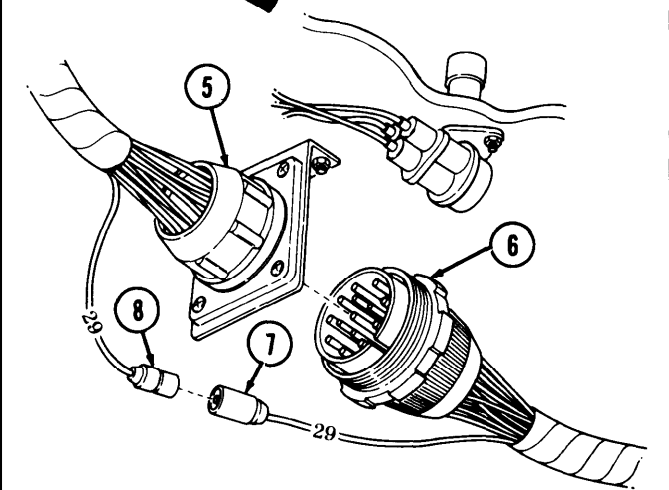
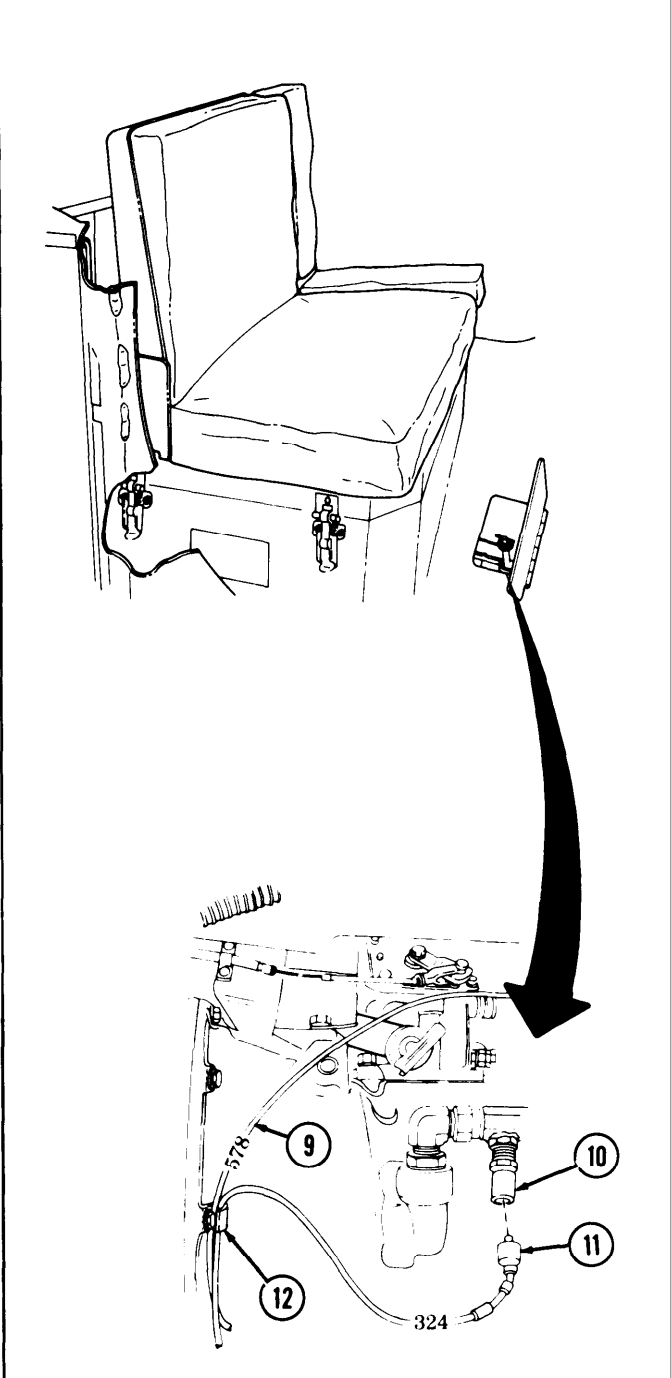
ALL MODELS

6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
47.		Wires (1) and (4)	Connect to wires (2) and (3).	
48.		Rear wiring harness connector (6)	Connect to front wiring harness (5).	
49.		Wires (7) and (8)	Connect.	Models M929, M930, M931, M932, and M936 only.
50.		Wire (11)	Connect to transmission temperature transmitter (10).	
51.		Spring tension tab (12)	Close around wires (9) and (11).	



6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				

6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

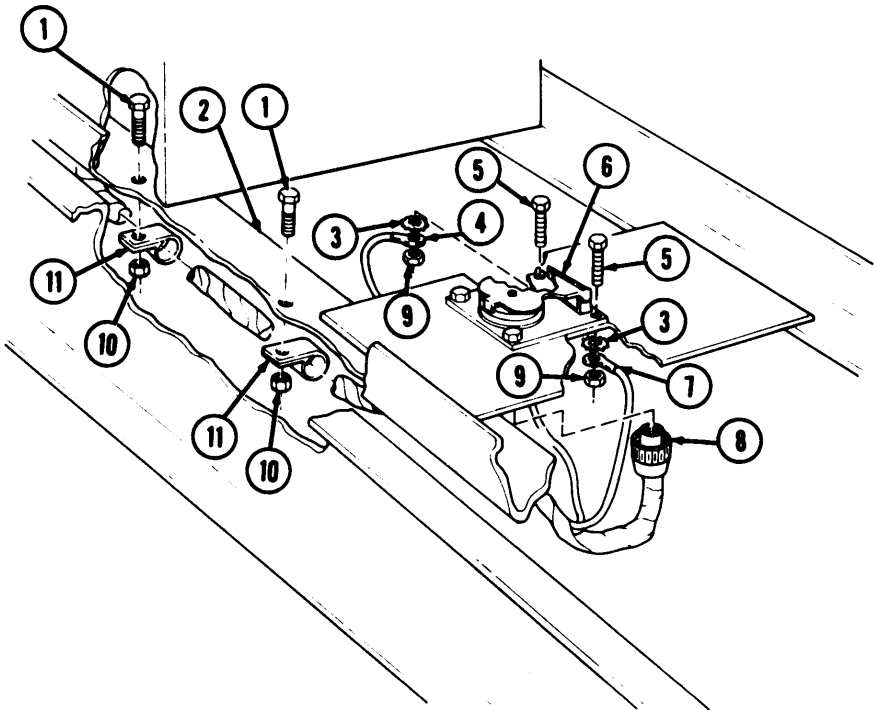
Steps 52 through 54 apply to models M931 and M932 only.

- | | | | |
|-----|--|--------------------------|---|
| 52. | | Harness connector (8) | Connect to semitrailer receptacle (6). |
| 53. | | Ground wires (4) and (7) | Install with two screws (5), new lockwashers (3), and nuts (9). |
| 54. | | Two clamps (11) | Install to frame rail (2) with two screws (1) and nuts (10). |

NOTE

Refer to table 6-2 for number of harness clamps installed on each vehicle.

- | | | | |
|-----|--|---------------------|--|
| 55. | | Harness clamps (14) | a. Install on rear wiring harness (12).
b. Install each with screw (13) and nut (15). |
|-----|--|---------------------|--|



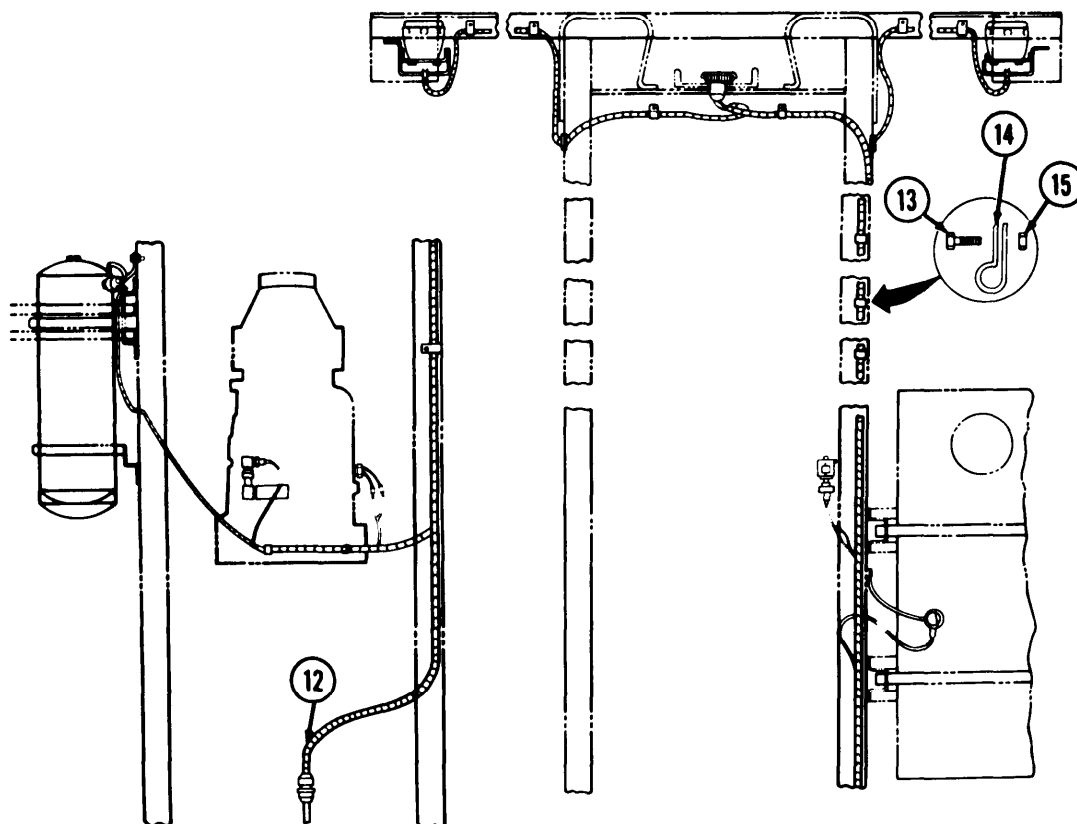
MODELS M931, M932

6-8. REAR WIRING HARNESS REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Table 64?. Rear Wiring Harness Clamp Quantity

MODEL	NUMBER OF CLAMPS
M923, M924, M925, M926, M927, M928	Eighteen
M929, M930	Ten
M931, M932	Eleven
M934, M935	Twelve
M936	Ten



END OF TASK!

- FOLLOW-ON TASKS:
- Connect battery ground cables (TM 9-2320-272-20-1)
 - Start vehicle (TM 9-2320-272-10) and check operation of all rear lights, fuel selector switch, fuel gage, low air pressure warning lights and gages, and transmission temperature gage.

TA 349900

6-9. ALTERNATOR ADJUSTMENT

This task covers:		
Adjustment		
INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10	Parking brake set.
	TM 9-2320-272-10	Hood raised and secured.
<u>Test Equipment</u>		
Multimeter		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Two lockwashers		
Gasket sealant (Appendix C, Item 13)		
Sealing compound (Appendix C, Item 20)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Adjustment

CAUTION

Never operate alternator with the positive terminal disconnected.
 Damage to alternator will result.

1.	Terminal cover (1) on alternator (5)	Two screws (3) and lockwashers (2)	Remove.	Discard lock- washers (2).
2.		Terminal cover (1)	Pry from alternator (5).	
NOTE				
Remove all sealant from wires prior to testing.				
3.			Start engine and set engine speed at 1200 rpm.	
			Turn headlights on to place a load on alternator (5). I	
4.		Alternator (5)	Attach black lead of multimeter to negative wire (7) and red lead to positive wire (6).	Alternator output volt- age should read 28.0 ± 0.2 Vdc.

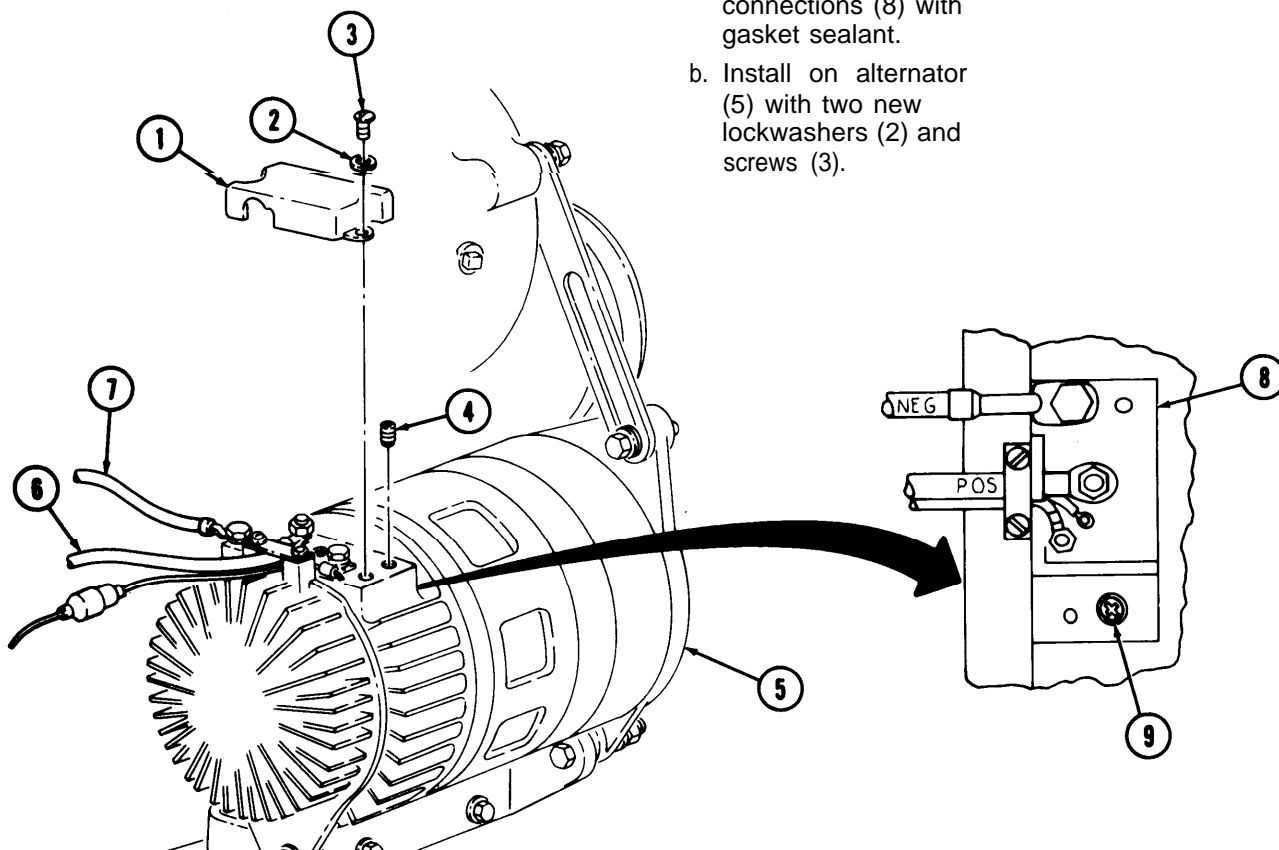
6-9. ALTERNATOR ADJUSTMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

- If output voltage is correct, proceed to step 8.
- If output voltage is incorrect, continue with step 5.

5.	Alternator (5)	Pipe plug (4)	Remove.	
6.		Adjusting screw (9)	Turn clockwise to decrease voltage, or counterclockwise to increase voltage, until output voltage is 28.0 ± 0.2 vdc.	
7.		Pipe plug (4)	Apply sealing compound to threads and install on alternator (5).	Tighten to 30-40 lb-in. (3-4 N•m).
8.		Terminal cover (1)	a. Coat inside of terminal cover (1) and terminal connections (8) with gasket sealant. b. Install on alternator (5) with two new lockwashers (2) and screws (3).	



END OF TASK!

CHAPTER 7

AUTOMATIC TRANSMISSION MAINTENANCE

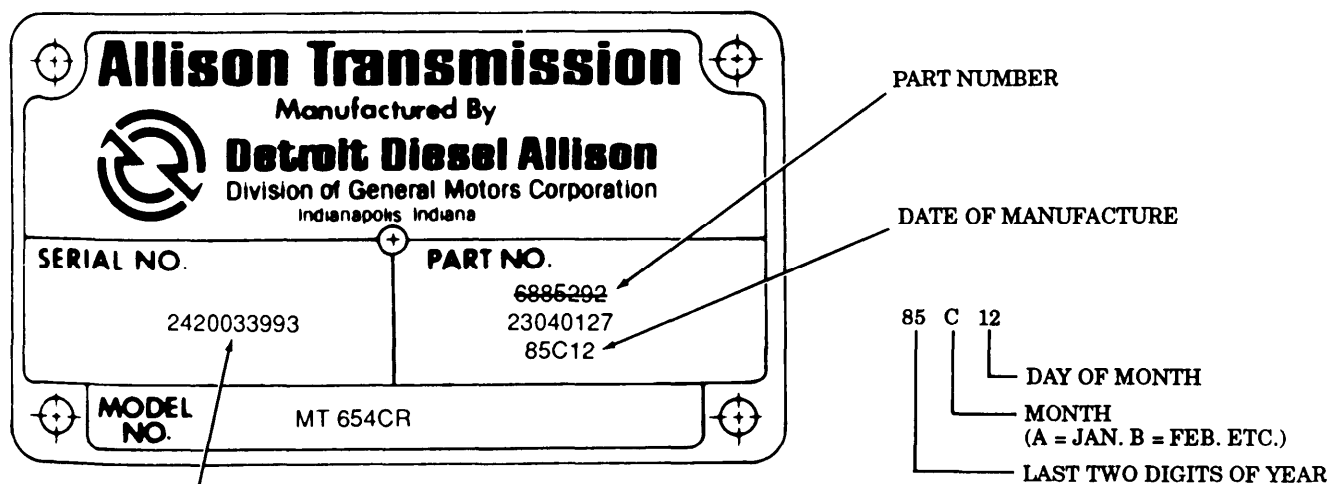
NOTE

Refer to TM 9-2320-358-248&P for unique M939A2 maintenance procedures.

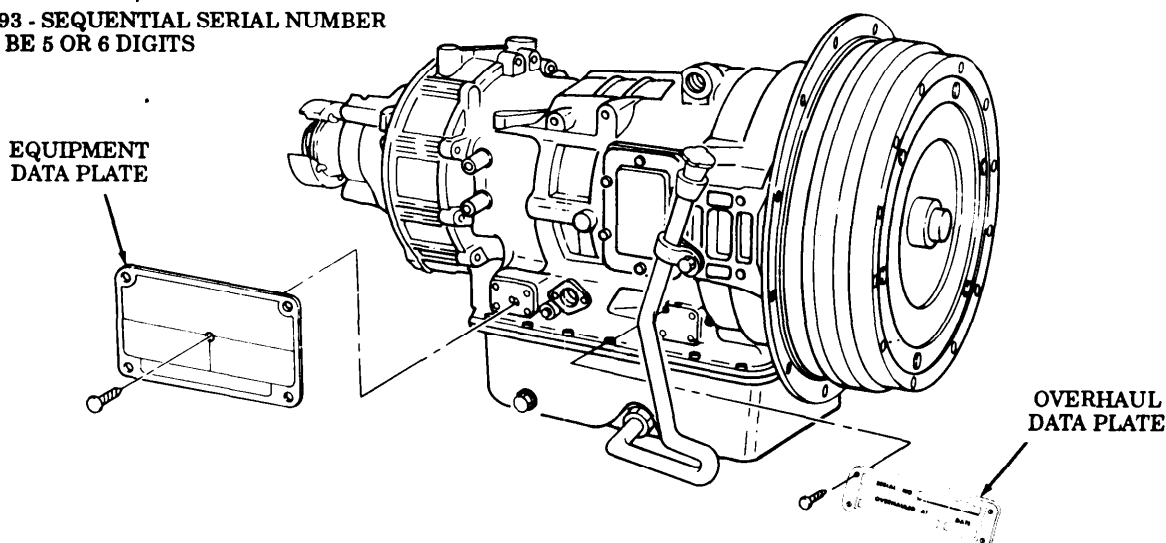
Section 1. DESCRIPTION AND DATA

7-1 GENERAL

a. The M939 and M939A1 series trucks are equipped with either of two models of MT 654CR automatic transmission. The models are identified by part number on the equipment data plate which is located on the lower right rear of the transmission housing. The early model number is 6885292 and the late model number is 23040127. The major difference between models is the use of a larger oil pump and a different converter hub in the late model. Both models are installed the same way and are interchangeable on M939 and M939A1 series vehicles. Some internal parts are not interchangeable and are noted in the procedures.



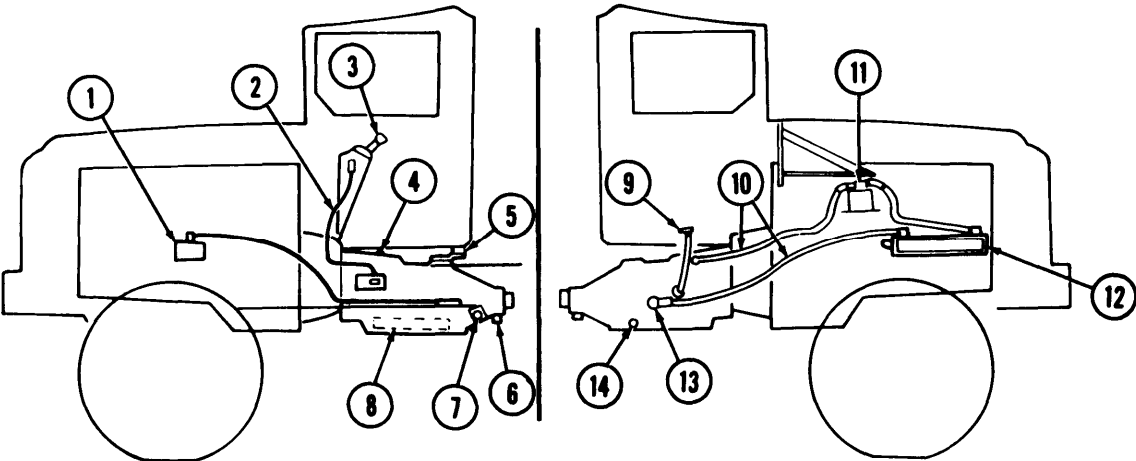
033993 - SEQUENTIAL SERIAL NUMBER
MAY BE 5 OR 6 DIGITS



b. The MT 654CR automatic transmission is an oil-cooled, hydraulically actuated transmission with five forward drive ranges. Upshifting and downshifting occurs automatically during vehicle operation. The transmission housing is cast aluminum. The transmission can be adapted for a power takeoff, which can be mounted on the right side.

Locations of major components of the MT 654CR automatic transmission authorized for service by direct support follow. Refer to table 7-1 for specifications and performance data.

MT 654CR AUTOMATIC TRANSMISSION
LOCATION OF MAJOR DIRECT SUPPORT SERVICED COMPONENTS



- | | |
|-------------------------------|--------------------------------|
| 1. Modulator Adjustment Point | 8. Transmission Oil Pan Filter |
| 2. Shift Cable | 9. Oil Dipstick Tube |
| 3. Selector Lever Assembly | 10. Oil Cooler Lines |
| 4. Breather | 11. Oil Cooler Filter |
| 5. Rear Mount Bushing | 12. Oil Cooler |
| 6. Governor Filter | 13. Lubrication Valve |
| 7. Governor | 14. Oil Drain |

Table 7-1. MT 654CR Automatic Transmission Specifications and Performance Chart.

1.	RATING	
	Input Torque	9501b-ft (1287 NŻm)
	Input Speed	3,000 rpm (maximum)
	Input Horsepower	300 (maximum)
2.	MOUNTING	
	Engine	Bell housing
	Vehicle	Top mount to frame rail crossmember
3.	TORQUE CONVERTER	
	Type	Direct drive, 3 element
	Model	TC 4915
	Torque multiplication	2.21.1
	Lockup clutch	Automatic in selected range
	Weight (less oil)	.85 lb (39 kg)
4.	CLUTCHES	Hydraulically-actuated, self-compensating for wear
5.	OIL CAPACITY (LESS EXTERNAL LINES AND FILTER)	
	W/O PTO	23 qt (22 l)
	W/PTO	25 qt (24 l)
6.	OIL TYPE	OE HDO 10
7.	OIL DRAIN AND REFILL	
	W/O PTO	17qt (16 l)
	W/PTO	19 qt (18 l)
	W/Dry torque converter	24-1/2 qt (23.2 l)

Table 7-1. MT 654CR Automatic Transmission Specifications and Performance Chart (Cont'd).

8.	OIL COOLER FILTER	
	Type	Full flow spin on
	Capacity	1.6Pt (0.771)
9.	OIL TEMPERATURE	
	From converter to cooler	300°F (maximum) (149°C)
	From cooler to sump	250°F (maximum) (121°C)
10.	OIL PRESSURE	
	At engine idle (625 ± 25 rpm)	125 psi (minimum) (862 kPa)
	At stall (1200 rpm)	18-205 psi (1241-1413 kPa)
	Converter out (1650 rpm)	30-50 psi (207-345 kPa)
	Governor pressure (engine rpm at maximum)	82-91 (565-627 kPa)
11.	POWER TAKEOFF	
	Type	Converter driven
	Gear	6 pitch, 64 teeth, 20° pressure angle
12.	WEIGHT (less oil/less PTO) .....	.640 lb(290kg)

Section II. GENERAL TRANSMISSION MAINTENANCE

7-2. GENERAL TRANSMISSION REPLACEMENT TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
7-3.	Deleted	7-4
7-4.	Transmission Shift Cable Replacement	7-8
7-5.	Transmission Selector Shaft Oil Seal Replacement	7-12
7-6.	Transmission Mount Bushing Replacement	7-16
7-7.	Transmission Output Shaft Oil Seal Replacement	7-18
7-8.	Transmission Lubrication Valve Replacement	7-22
7-9.	Transmission 5th Gear Lock-In Solenoid Valve and Bracket Replacement	7-26

7-4. TRANSMISSION SHIFT CABLE REPLACEMENT

This task covers:

- a. Removal
b. Installation

c. Adjustment

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10	Parking brake set.
<u>Test Equipment</u>	TM 9-2320-272-10	Left splash shield removed.
None	Para. 7-3	Transmission selector lever assembly removed.
<u>Special Tools</u>		
None		
<u>Materials/Parts</u>		<u>Special Environmental Conditions</u>
Two locknuts		None
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		None
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
----------	----------	------	--------	---------

a. Removal

- | | | | | |
|----|---|---|---------|-----------------------|
| 1. | Transmission lock-in solenoid bracket (9) | Two locknuts (1), U-bolt (4), and cable clamp (3) | Remove. | Discard locknuts (1). |
|----|---|---|---------|-----------------------|

NOTE

Step 2 applies to M929 and M934 models only.

- | | | | | |
|----|--------------------------------|---|---------|-----------------------|
| 2. | | Two locknuts (1) and screws (10), and cable clamp (3) | Remove. | Discard locknuts (1). |
| 3. | Manual control linkage arm (8) | Spring clip (7) and cable trunnion (6) | Remove. | |
| 4. | Transmission shift cable (2) | Cable trunnion (6) and jamnut (5) | Remove. | |

NOTE

Assistant will help with step 5.

- | | | | | |
|----|-------------------------------------|-------------------------------------|-------------------------|--|
| 5. | Control console (11) in vehicle cab | Cable trunnion (12) and jamnut (13) | Remove. | |
| 6. | | Transmission shift cable (2) | Remove. | |
| 7. | Engine cover (14) | Rubber grommet (15) | Remove horn under hood. | |

7-4. TRANSMISSION SHIFT CABLE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9
10	10	10	10	10
11	11	11	11	11
12	12	12	12	12
13	13	13	13	13
14	14	14	14	14
15	15	15	15	15

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7-4. TRANSMISSION SHIFT CABLE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Installation

8. Rubber grommet (15) Install.

NOTE

Assistant will help with step 9.

9. Transmission shift cable (2) Feed from control console (12) through rubber grommet (15) back to transmission.

10. Jamnut (14) and cable trunnion (13) Install. Make sure cable (2) end is even with cable trunnion (13) before tightening jamnut (14).

11. Transmission shift cable (2) a. Install on lock-in solenoid bracket (9) with U-bolt (4), clamp (3), and two new locknuts (1). Make sure cable clamp (3) seats in groove (11) of cable (2) housing.

NOTE

Step 11 b. applies to M929 and M934 models only.

- b. Install on lock-in solenoid bracket (9) with cable clamp (3), two screws (10), and new locknuts (1). Make sure cable clamp (3) seats in groove (11) of cable (2) housing.

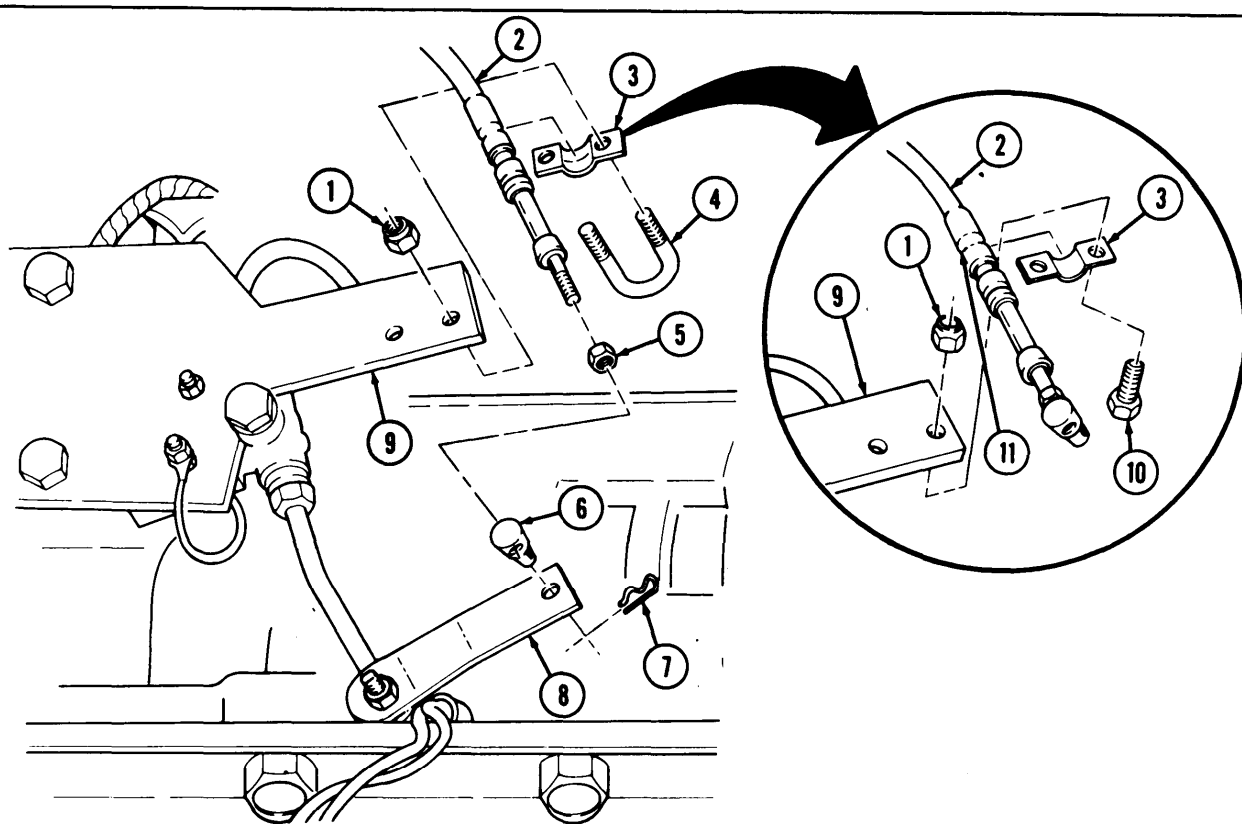
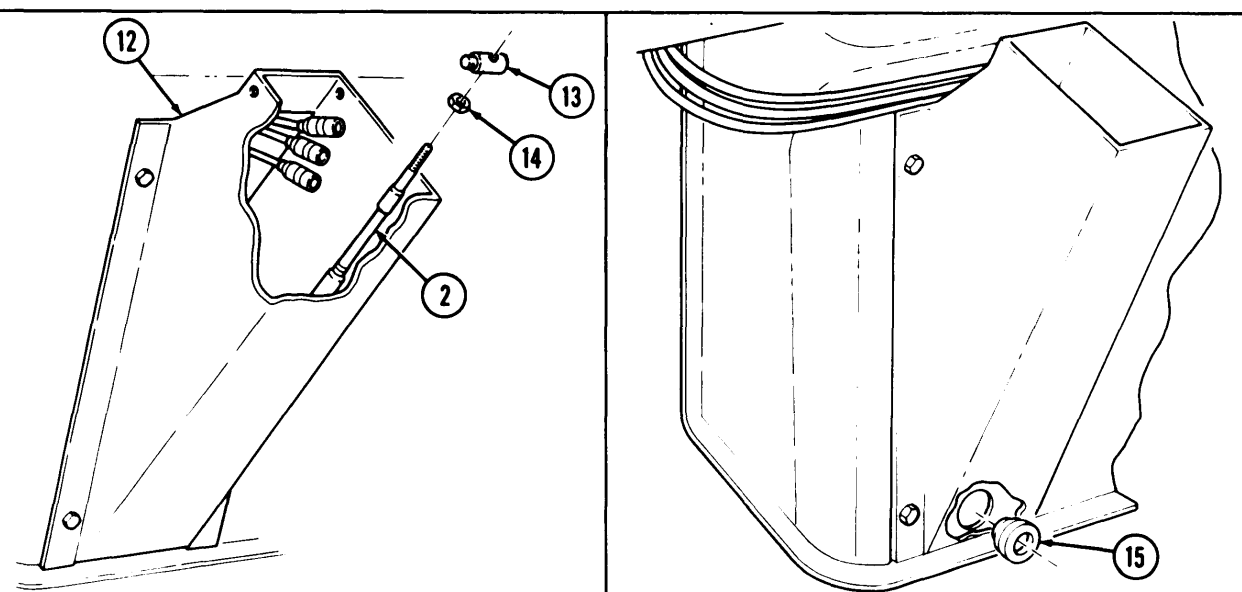
c. Adjustment

CAUTION

If manual control linkage arm is not in the proper detent for each transmission selector lever position, transmission will be damaged

12. Manual control linkage arm (8) Pull down in "I" (first) gear position.
13. Jamnut (5) and cable trunnion (6) a. Insert on end of transmission shift cable (2). Do not tighten jamnut (5).
b. Aline with hole in manual control linkage arm (8). Cable trunnion (6) is turned clockwise to shorten and counter-clockwise to lengthen.
c. Insert trunnion (6) into manual control linkage (8) and install with spring clip (7). Tighten jamnut (5).

7-4. TRANSMISSION SHIFT CABLE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

END OF TASK!

FOLLOW-ON TASKS:

- Install left splash shield (TM 9-2320-272-1()).
- Install transmission selector lever assembly (para. 7-3),
- Start engine (TM 9-2320-272-10) and road test vehicle.

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7-5. TRANSMISSION SELECTOR SHAFT OIL SEAL REPLACEMENT

This task covers:

a. Removalb. Installation

INITIAL SETUP:

Applicable Models

All

Test Equipment

None

Special Tools

Seal remover J-26401
Seal installer J-26282

Materials/Parts

Oil seal
Metric locknut
Lint-free cloth (Appendix C, Item 7)
Lubricating oil OE\HDO 10
(Appendix C, Item 16)
Sealing compound (Appendix C, Item 26)

Personnel Required

Wheeled vehicle repairman MOS 63W

Manual References

TM 9-2320-272-10
TM 9-2320-272-34P
LO 9-2320-272-12

Equipment Condition Reference

TM 9-2320-272-10
Para. 7-4

Condition Description

Parking brake set.
Transmission shift cable disconnected.

Special Environmental Conditions

Work area clean and free from blowing dirt and dust.

General Safety Instructions

None

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
----------	----------	------	--------	---------

a. Removal

CAUTION

Clean around seal area to prevent entry of dirt. Damage will occur if dirt or dust enters transmission.

NOTE

Manual selector shaft locknut has metric thread.

1.

Transmission manual selector shaft (1)

Metric locknut (2)

Remove.

Discard locknut (2).

2.

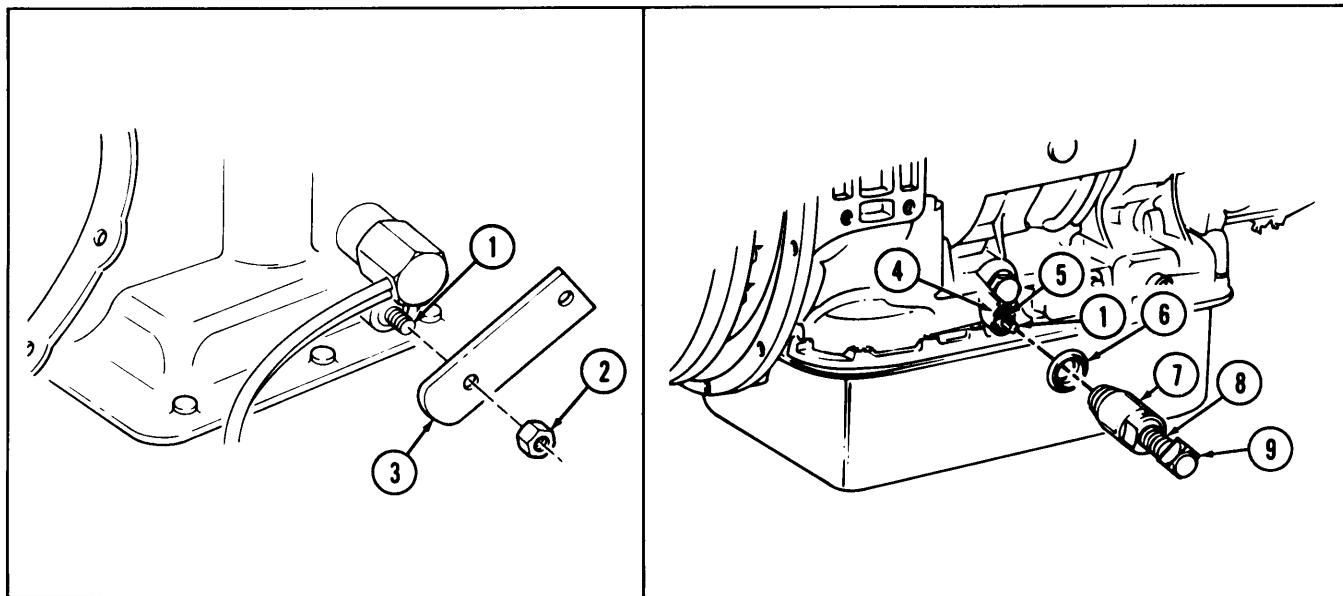
Manual control linkage arm (3)

Remove.

7-12Change 2

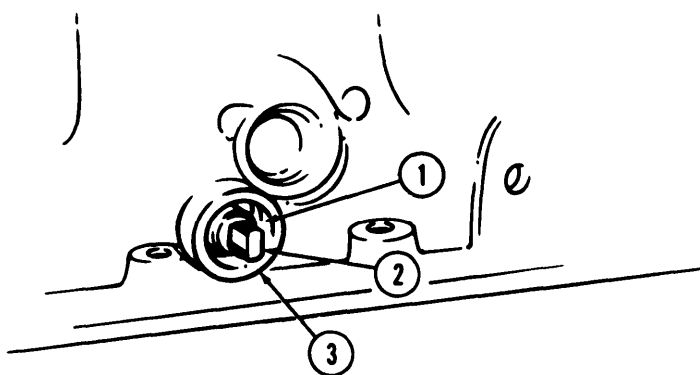
7-5. TRANSMISSION SHAFT OIL SEAL REPLACE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
3.		Seal remover tool (7)	a. Position over selector shaft (1). b. Turn tool (7) clockwise and thread tapered end into seal (6). c. Finger tighten threaded bolt (8) until it cannot be turned by hand. d. Turn squarehead (9) of threaded bolt (8) clockwise until seal (6) slides from bore (5) of housing (4).	At this point, the threaded bolt (8) contacts the selector shaft (1). Have drainage container ready to catch oil.
4.		Oil seal (6)	Remove from end of tool (7).	Discard seal (6).



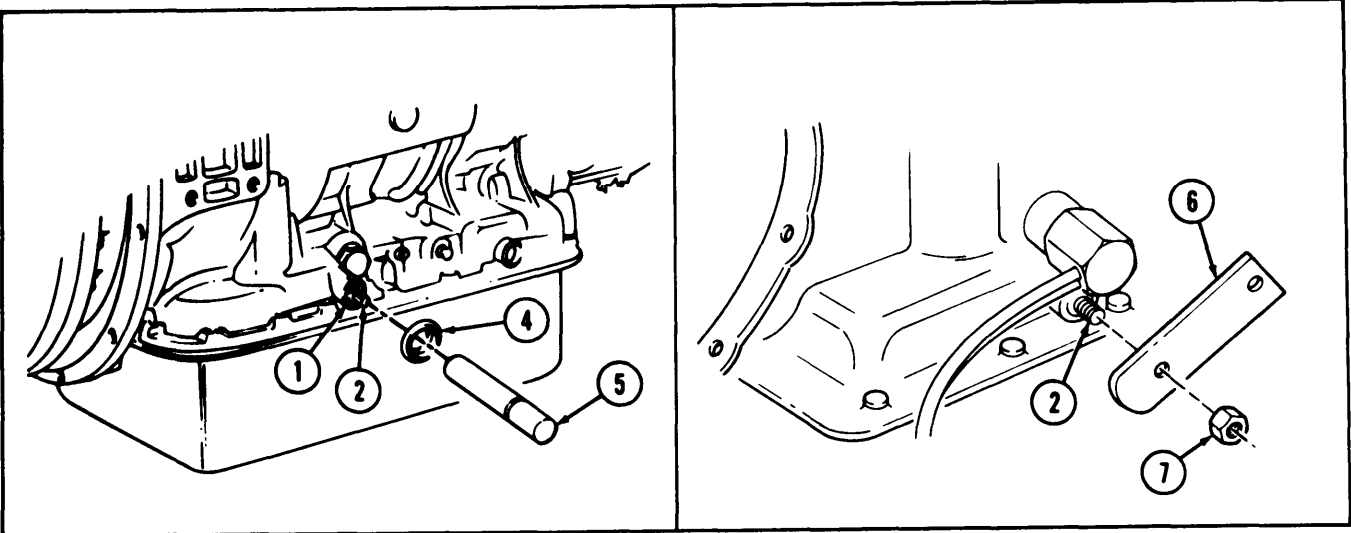
7-5. TRANSMISSION SELECTOR SHAFT OIL SEAL REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Installation				
5.		Oil seal bore (1)	Lubricate with clean transmission oil.	
6.		Selector shaft (2)	Lubricate with clean transmission oil.	
7.		New oil seal (4)	a. Coat outer edge with a small amount of sealing compound. b. Place on installing tool (5), with seal (4) lip facing away from tool (5). c. Drive seal (4) into bore (1) of housing (3).	Use care and do not cut seal (4) lip on selector shaft (2). Seal (4) will "seat" at counterbore position of bore (1).



7-5. TRANSMISSION SELECTOR SHAFT OIL SEAL REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
8.		Manual control linkage arm (6)	Install with arem (6) facing toward rear of vehicle.	
<p style="text-align: center;">CAUTION</p> <p>When installing transmission selector shaft linkage, a metric threaded locknut must be used. Failure to do so will damage selector shaft.</p>				
9.		New metric locknut (7)	Install on selector shaft (2).	Tighten 22-30 lb-ft (30-41 N•m).



END OF TASK!

FOLLOW-ON TASKS:

- Fill transmission to proper oil level (LO 9-2320-272-12).
- Connect transmission shift cable (para. 7-4).

7-6. TRANSMISSION MOUNT BUSHING REPLACEMENT

This task covers:

a. Removal

b. Installation

INITIAL SETUP:

GENERAL INFORMATION		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10	Parking brake set.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
Four lockwashers		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

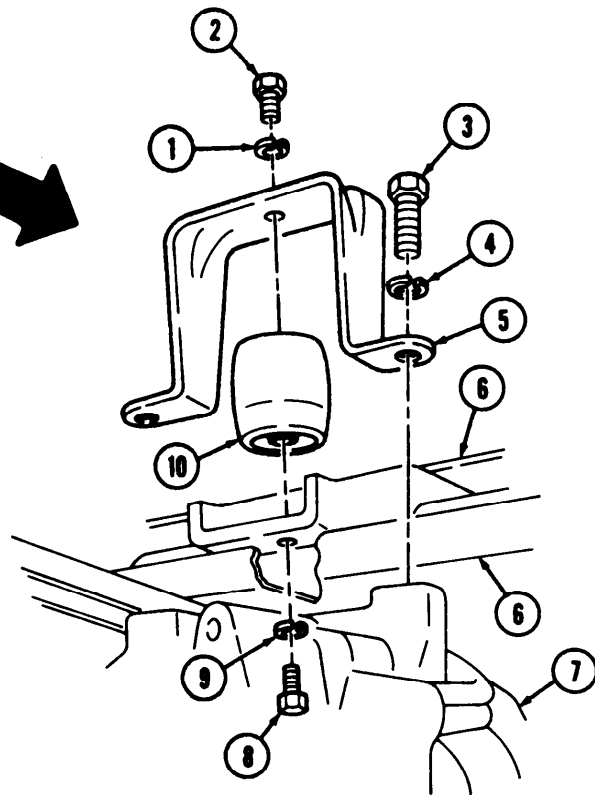
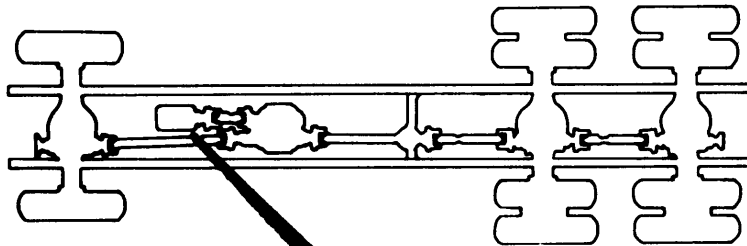
- | | | | | |
|----|-------------------------------|------------------------------------|---------|--------------------------|
| 1. | Bracket (5) | Screw (2) and lock-washer (1) | Remove. | Discard lockwasher (1). |
| 2. | | Two screws (3) and lockwashers (4) | Remove. | Discard lockwashers (4). |
| 3. | Transmission (7) | Bracket (5) | Remove. | |
| 4. | Underside of cross-member (6) | Screw (8) and lock-washer (9) | Remove. | Discard lockwasher (9). |
| 5. | Top of crossmember (6) | Rubber mount bushing (10) | Remove. | |

b. Installation

- | | | | | |
|----|--|-------------------------------|--|---|
| 6. | | Rubber mount bushing (10) | Install to bracket (5) with screw (2) and new lockwasher (1). | Tighten screw (2) 75-83 lb-ft (102-113 NŹm). |
| 7. | | Bracket (5) and bushing (10) | Install with screw (8) and new lockwasher (9) from underside of crossmember (6). | Tighten screw (8) 75-83 lb-ft (102-113 NŹm). |
| 8. | | Bracket (5) | Install to top of transmission (7) with two screws (3) and new lockwashers (4). | Tighten screws (3) 75-83 lb-ft (102-113 NŹm). |

7-6. TRANSMISSION MOUNT BUSHING REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

7-7. TRANSMISSION OUTPUT SHAFT OIL SEAL REPLACEMENT

This task covers:

a. Removal

b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10 TM 9-2320-272 -20-1	Parking brake set. Propeller shaft removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Remover, output shaft seal and dust shield J-24171 Dust shield installer J-24198 Oil seal installer J-24620 Driver handle J-24202-4 Torque multiplier		Work area clean and free from blowing dust and dirt.
<u>Materials/Parts</u>		
Locknut Oil seal Lubricating oil OE/HDO-10 (Appendix C, Item 16)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272 -20-1 TM 9-2320-272-34P LO 9-2320-272-12		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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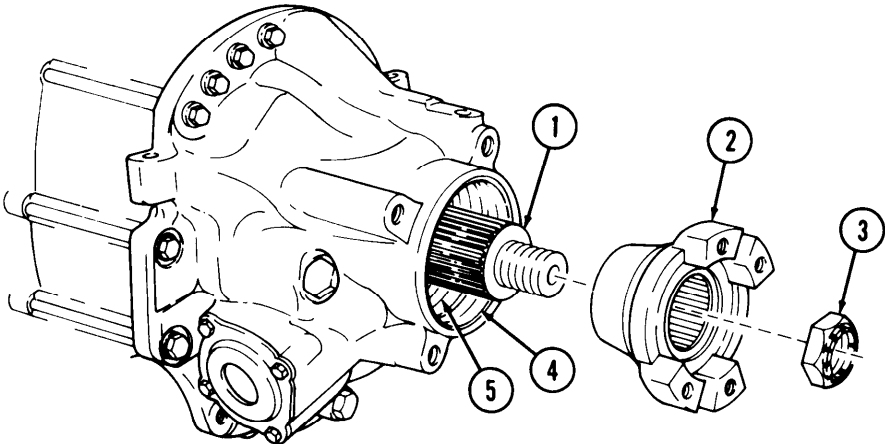
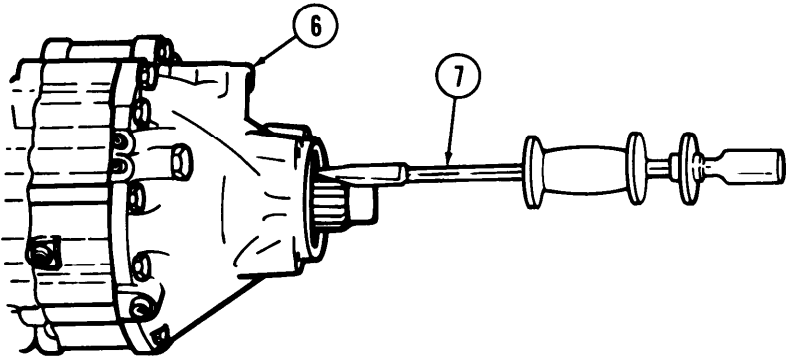
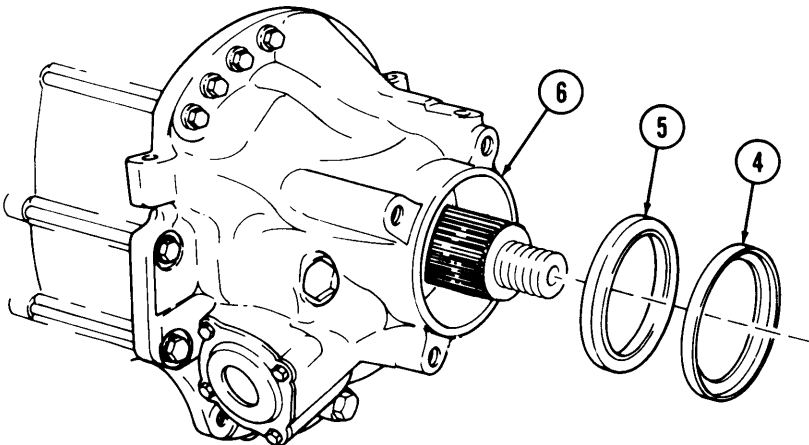
a. Removal

- | | | | | |
|----|-----------------------------|--------------------------------------|---------|----------------------|
| 1. | Output shaft (1) | Locknut (3) and companion flange (2) | Remove. | Discard locknut (3). |
| 2. | Transmission rear cover (6) | Dust shield (4) | Remove. | Use remover (7). |

NOTE

- | | | | | |
|----|--|---|---------|---|
| | | Have drainage container ready to catch oil. | | |
| 3. | | Oil seal (5) | Remove. | Use remover (7),
Discard oil seal (5). |

7-7. TRANSMISSION OUTPUT SHAFT OIL SEAL REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				
				

7-7. TRANSMISSION OUTPUT SHAFT OIL SEAL REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
----------	----------	------	--------	---------

b. Installation

4.		New oil seal (2)	a. Install with rubber lip facing inside of rear cover (3). b Coat inside diameter with transmission oil.	Use driver handle and oil seal installer tool (1).
5.		Dust shield (5)	a. Install with cupped side facing out. b. Drive until installer tool (4) seats on face (6) of rear cover (3).	Use driver handle and dust shield installer tool (4).
6.		Companion flange (8)	Slide on output shaft (7) and install with new locknut (9).	Tighten locknut (9) 600-800 lb-ft (814-1085 N•m). Use torque multiplier.

7-7. TRANSMISSION OUTPUT SHAFT OIL SEAL REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS

7-8. TRANSMISSION LUBRICATION VALVE REPLACEMENT

This task covers:		
a. Removal	b. Installation	
INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10	Parking brake set.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Remover, output shaft seal and dust shield J-29355		None
<u>Materials/Parts</u>		
Locknut		
“O” ring		
Gasket		
Lubrication valve		
Spring guide		
Valve spring		
Sealing tape (Appendix C, Item 30)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-34P		
LO 9-2320-272-12		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Clean around lubrication valve area before removal procedure to prevent entry of dirt. Damage will occur if dirt or dust enters transmission.

a. Removal

NOTE

Step 1 is required only when vehicle is equipped with front winch.

- | | | | | |
|----|------------------|---------------------------|---------|--|
| 1. | Hanger strap (4) | Locknut (1) and screw (6) | Remove. | Move winch hydraulic hoses (3) and (5) and two clamps (2) aside.
Discard locknut (1). |
|----|------------------|---------------------------|---------|--|

NOTE

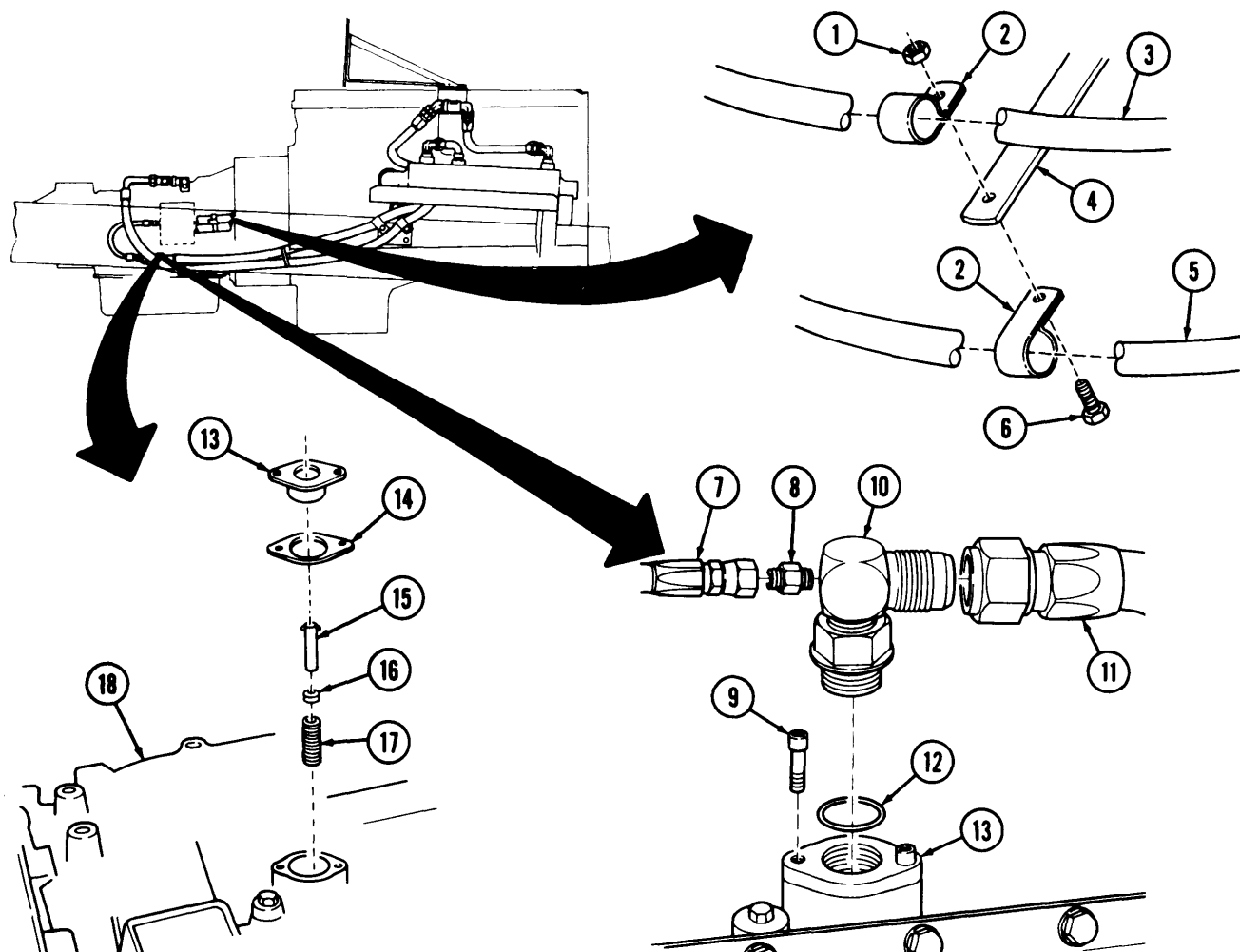
Steps 2 and 3 are required only when vehicle is equipped with transmission power takeoff (PTO).

Have drainage container ready to catch oil.

- | | | | |
|----|--|-------------------------------------|-------------|
| 2. | Transmission lubrication valve elbow assembly (10) | Transmission to PTO supply hose (7) | Disconnect. |
|----|--|-------------------------------------|-------------|

7-8. TRANSMISSION LUBRICATION VALVE REPLACEMENT (Cont'd)

STEP NO.1	LOCATION	ITEM	ACTION	REMARKS
3.		Adapter (8)	Remove.	
4.		Transmission oil filter to transmission supply hose(11)	Disconnect.	
5.	Transmission lubrication valve housing (13)	Elbow assembly (10) and "O" ring (12)	Remove.	Discard 'O" ring (12).
6.		Two screws (9)	Remove.	
7.	Transmission (18)	Lubrication valve housing (13), gasket (14), spring guide (15), lubrication valve (16), and valve spring (17)	Remove.	Use output shaft seal and dust shield remover. Discard gasket (14), spring guide (15), lubrication valve (16) and valve spring (17).



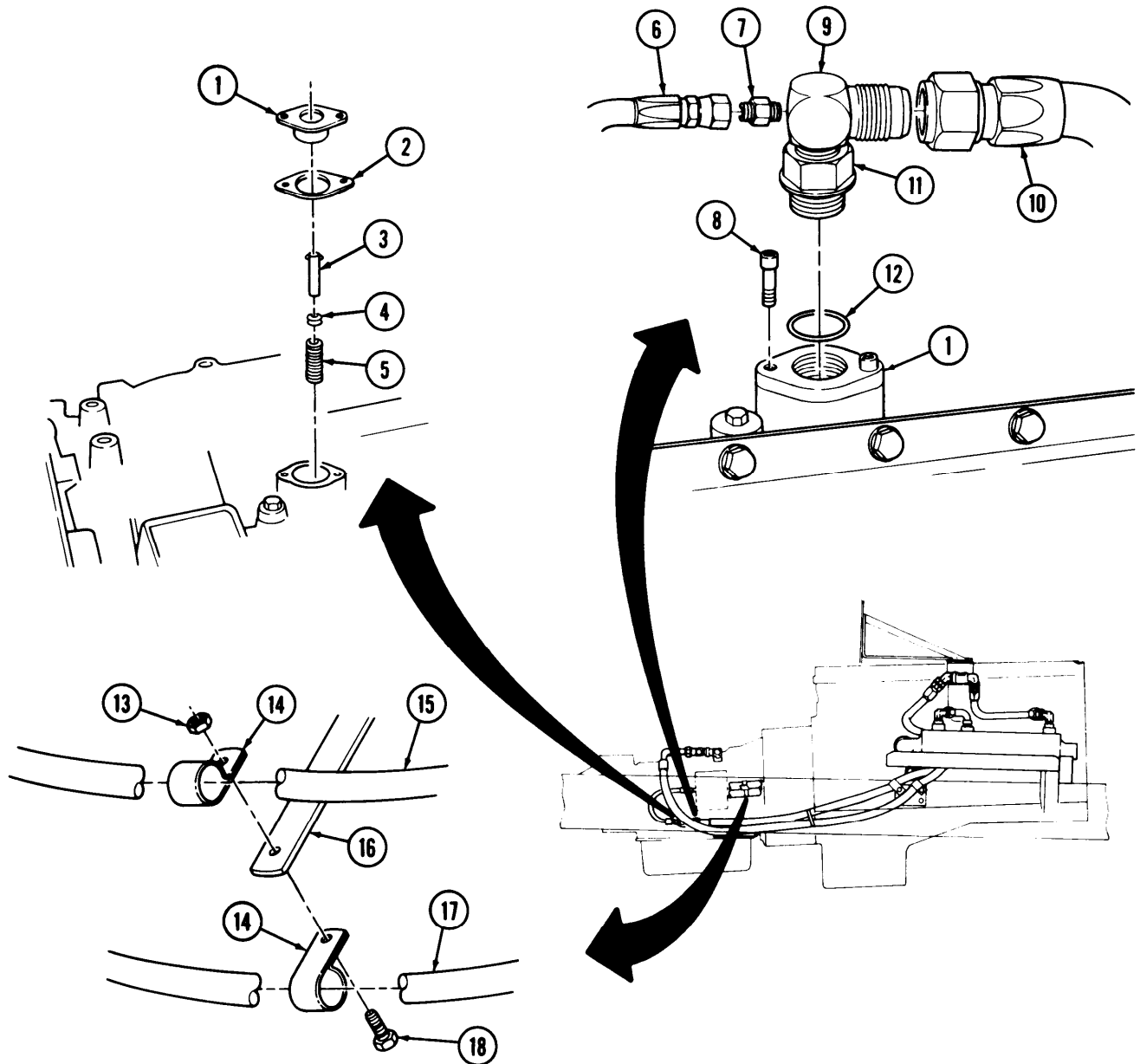
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7-8. TRANSMISSION LUBRICATION VALVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Installation				
8.		New lubrication valve (4) and new valve spring (5)	Install on new spring guide (3) with raised side of valve (4) facing outward.	
9.		New spring guide (3)	Install.	
10.		New gasket (2)	Install on lubrication valve housing (1).	
11.		Lubrication valve housing (1)	Install with two screws (8).	Tighten 9-11 lb-ft (12-15 N•m).
12.		New "O" ring (12) and elbow assembly (9)	a. Install new "O" ring (12) on elbow assembly (9). b. Install elbow assembly (9) until aligned and jamnut (11) seats. c. Tighten jamnut (11) until new "O" ring (12) is seated.	
13.		Transmission oil filter to transmission supply hose (10)	Connect.	
NOTE				
<ul style="list-style-type: none"> Male pipe threads must be wrapped with sealing tape before installation. Steps 14 and 15 are required only when vehicle is equipped with transmission power takeoff (PTO). 				
14.		Adapter (7)	Install.	
15.		Transmission to PTO supply hose (6)	Connect.	
NOTE				
Step 16 is required only when vehicle is equipped with front winch.				
16.		Winch hydraulic hose (15), hydraulic hose (17), and two hose clamps (14)	a. Position hoses (15) and (17) to align clamps (14) with hole in hanger strap (16). b. Install with screw (18) and new lock-nut (13).	

7-8. TRANSMISSION LUBRICATION VALVE REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS: . Fill transmission to proper oil level (LO 9-2320-272-12),
 . Start engine (TM 9-2320-272-10) and road test vehicle.

7-9. TRANSMISSION 5th GEAR LOCK-IN SOLENOID VALVE AND BRACKET REPLACEMENT

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10 Para. 7-4	Parking brake set. Transmission shift cable removed,
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
Two locknuts Protective cap-plugs (Appendix C, Item 5) Tiedown strap (Appendix C, Item 21) Sealing tape (Appendix C, Item 30)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272-34P LO 9-2320-272-12		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
----------	----------	------	--------	---------

a. Removal

CAUTION

Clean surrounding surfaces before disconnecting transmission pressure lines and plug open ports to prevent dirt and debris from entering transmission. Failure to do so will cause damage to transmission.

NOTE

Have drainage container ready to catch oil.

- | | | | | |
|----|---------------------------------------|----------------------------|-------------|------------------|
| 1. | Adapter (5) | Main pressure line (4) | Disconnect. | |
| 2. | Adapter (15) | Main pressure line (4) | Disconnect. | |
| 3. | Transmission main pressure port (16) | Adapter (15) | Remove. | Plug port (16). |
| 4. | Adapter (7) | Governor pressure line (8) | Disconnect. | |
| 5. | Adapter (19) | Governor pressure line (8) | Disconnect. | |

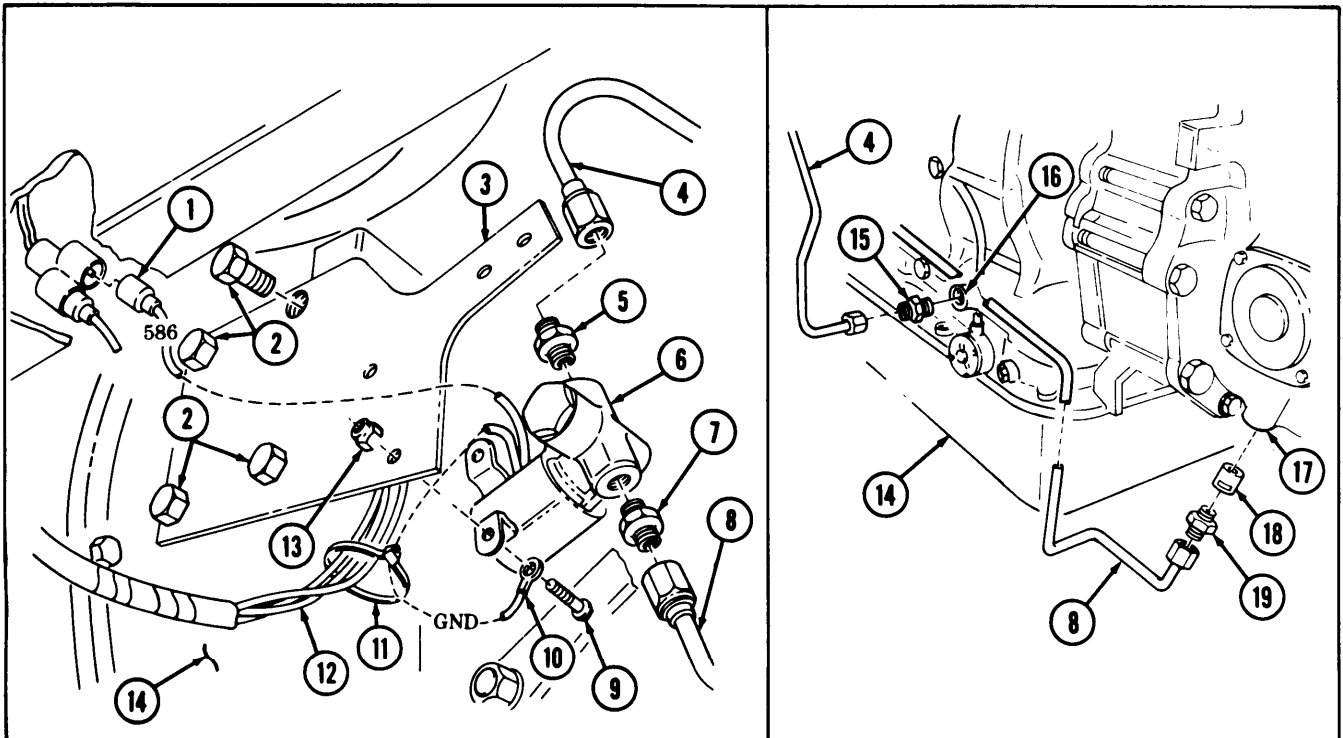
7-9. TRANSMISSION 5th GEAR LOCK-IN SOLENOID VALVE AND BRACKET REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Only M936 vehicles are equipped with check valve.

6.	Transmission governor pressure port (17)	Adapter (19) and check valve (18)	Remove.	Mark position of check valve (18) for installation. Plug port (17).
7.	Transmission 5th gear lock-in solenoid valve (6)	Connector (1)	Disconnect	
8.	Wires (12)	Tiedown strap(11)	Remove.	Discard.
9.	Transmission 5th gear lock-in solenoid support bracket (3)	Two locknuts (13), transmission lock-in solenoid valve (6), wire (10) and two screws (9)	Remove.	Discard locknuts (13).
10.	Transmission (14)	Four screws (2) and 5th gear lock-in solenoid support (3)	Remove.	
11.	Transmission 5th gear lock-in solenoid valve (6)	Adapter (5) and adapter (7)	Remove.	



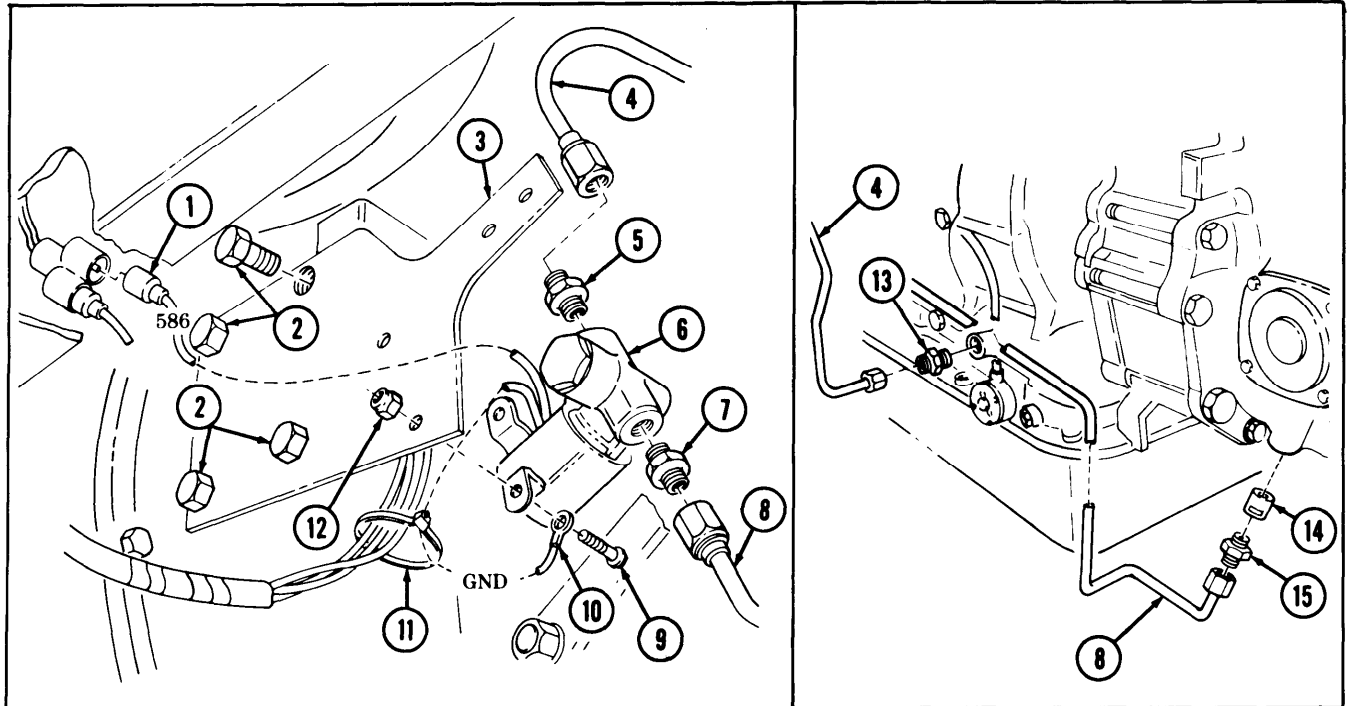
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7-9. TRANSMISSION 5th GEAR LOCK-IN SOLENOID VALVE AND BUCKET REPLACEMENT (Cont'd)
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STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Installation				
<p style="text-align: center;">NOTE</p> <ul style="list-style-type: none"> When new solenoid valve is being installed, use attaching parts and fittings from old valve. Fittings must be cleaned and inspected for cracks or stripped thread. Male pipe threads must be wrapped with sealing tape before installation. 				
12.		Adapter (5) and adapter (7)	Install to transmission 5th gear lock-in solenoid valve (6).	
13.		Transmission 5th gear lock-in solenoid valve bracket (3)	Install with four screws (2).	
14.		Transmission 5th gear lock-in solenoid valve (6) and wire (10)	Install to bracket (3) with two screws (9) and new locknuts (12).	
15.		Connector (1)	Connect.	
16.		Tiedown strap(11)	Install.	
<p style="text-align: center;">NOTE</p> <p>Only M936 vehicles are equipped with check valve.</p>				
17.		Check valve (14) and adapter (15)	Install.	
18.		Adapter (13)	Install.	
19.		Governor pressure line (8)	Connect to adapter (7) and (15).	
20.		Main pressure line (4)	Connect to adapter (5) and (13).	

7-9. TRANSMISSION 5th GEAR LOCK-IN SOLENOID VALVE AND BRACKET REPLACEMENT (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

- FOLLOW-ON TASKS:
- Install transmission shift cable (para. 7-4).
 - Fill transmission to proper oil level (LO 9-2320-272-12),
 - Start engine (TM 9-2320-272-10), check for leaks and road test vehicle.

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Section III. TRANSMISSION REPLACEMENT INSTRUCTIONS**7-10. TRANSMISSION REPLACEMENT TASK SUMMARY**

TASK PARA.	PROCEDURES	PAGE NO.
7-11.	Transmission Replacement (from Vehicle)	7-32
7-12.	Transmission Replacement (Engine and Transmission Removed from Vehicle)	7-50

7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE)

This task covers:

a. Removal**b. Installation****INITIAL SETUP:**

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-20-1 TM 9-2320-272-20-1	Transmission oil drained. Transmission to transfer case propeller shaft removed,
	TM 9-2320-272-20-1	Transmission oil dipstick removed.
	TM 9-2320-272-20-1	Transmission breather removed.
	TM 9-2320-272-20-1	Transmission modulator removed.
	Para. 7-9	Transmission 5th gear lock-in solenoid valve and bracket removed.
<u>Test Equipment</u>	TM 9-2320-272-20-1	Transmission neutral start switch removed.
None	Para. 19-10	Winch control valve removed (if so equipped).
<u>Special Tools</u>		Transmission power takeoff removed (if so equipped).
Barring tool ST-747	Para. 20-10	
<u>Materials/Parts</u>		
Shipping bracket (retaining strap)		
Tubing or shim stock 3 x 6 x 0.030 in.		
Three gaskets		
Seventeen lockwashers		
Eight locknuts		
Cotter pin		
Protective cap-plugs (Appendix C, Item 5)		
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W (2)		
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-20-1		
TM 9-2320-272-34P		
LO 9-2320-272-12		

Special Environmental Conditions

None

General Safety Instructions

- Torque converter must be removed with transmission.
- Keep rear of transmission tilted slightly downward.

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal**WARNING**

Torque converter must be removed with the transmission as an assembly to prevent injury to personnel and damage to the converter.

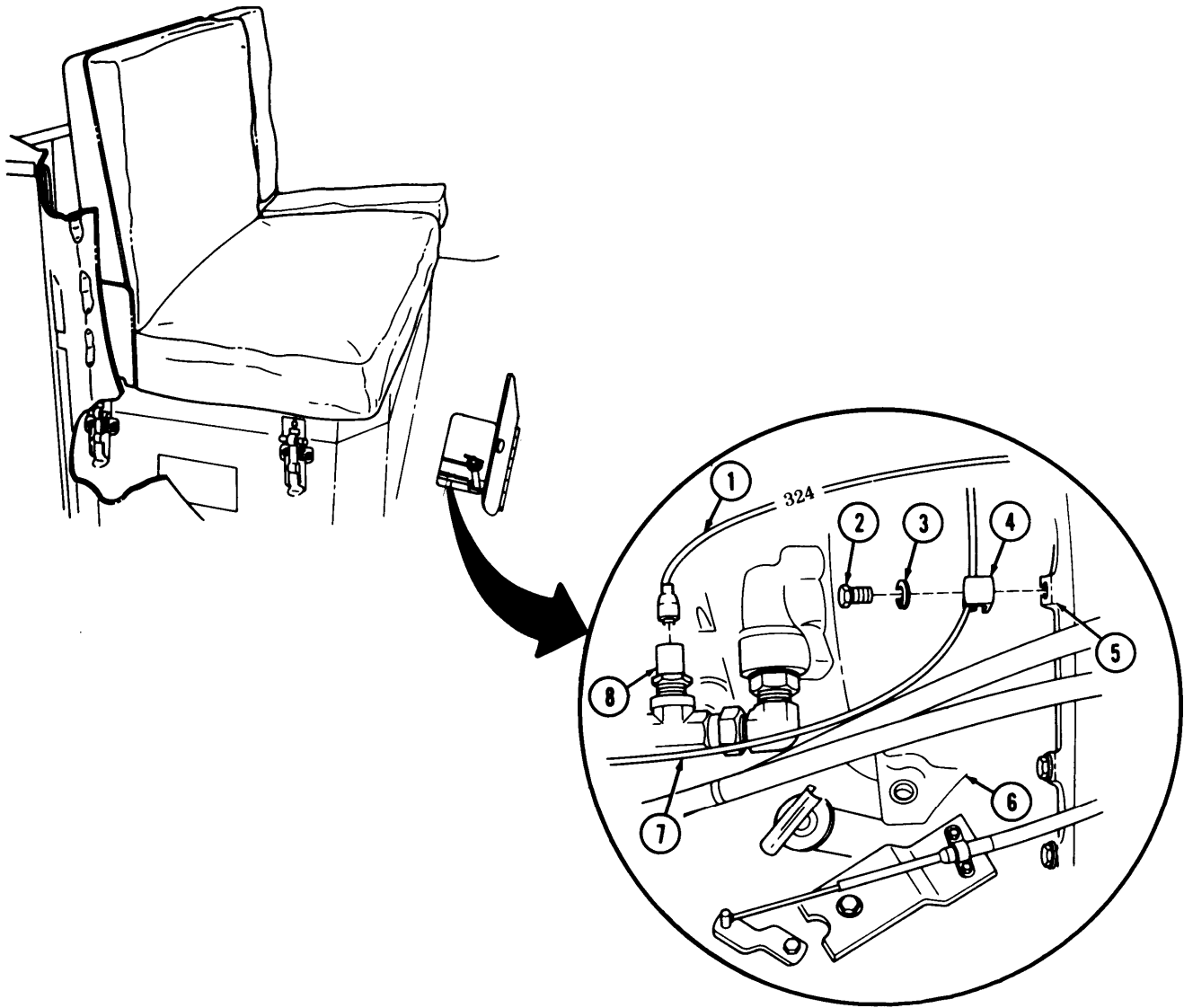
CAUTION

Plug all openings to prevent dirt from entering transmission. Damage will occur if dirt or dust enters the transmission.

- | | | | |
|----|--|-----------|-------------|
| 1. | Transmission oil temperature transmitter (8) | Wire (1) | Disconnect. |
|----|--|-----------|-------------|

7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
2.	Transmission flange (5)	Screw (2), lockwasher (3) and clamp (4)	Remove from wire (7).	Discard lockwasher (3).
3.		Wire (1) and wire (7)	Tie back clear of transmission (6).	



7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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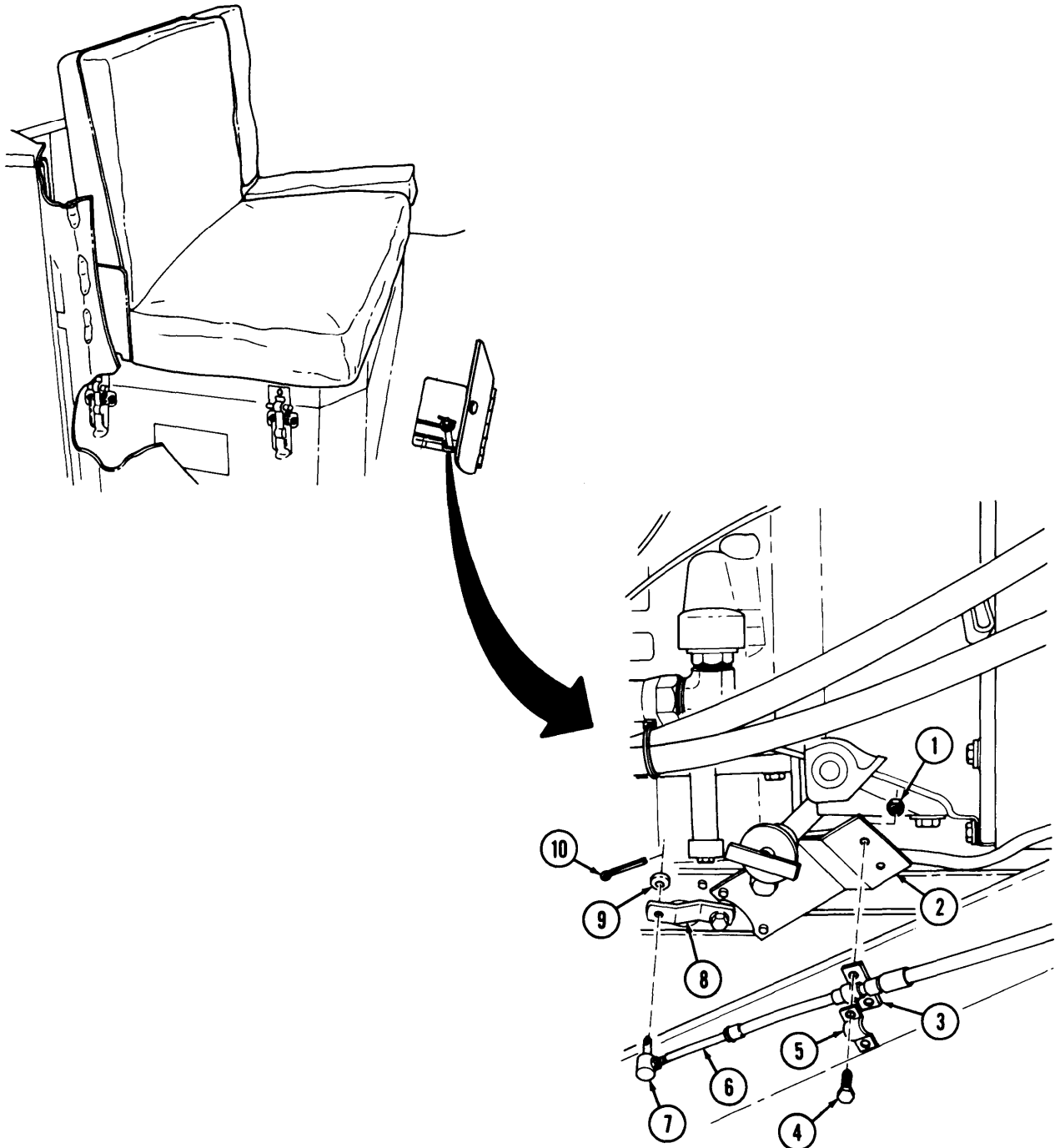
NOTE

Steps 4, 5, and 6 apply to vehicles equipped with a transmission power takeoff (PTO).

4.	PTO cable bracket (2)	Retainer strap (5), spacer plate (3), and two screws (4), and nuts (1)	Remove.	
5.	PTO cable pin (7)	Cotter pin (10) and washer (9)	Remove and lift PTO cable pin (7) free of select lever (8).	Discard cotter pin (10).
6.	PTO cable (6)	PTO cable pin (7)	Remove.	

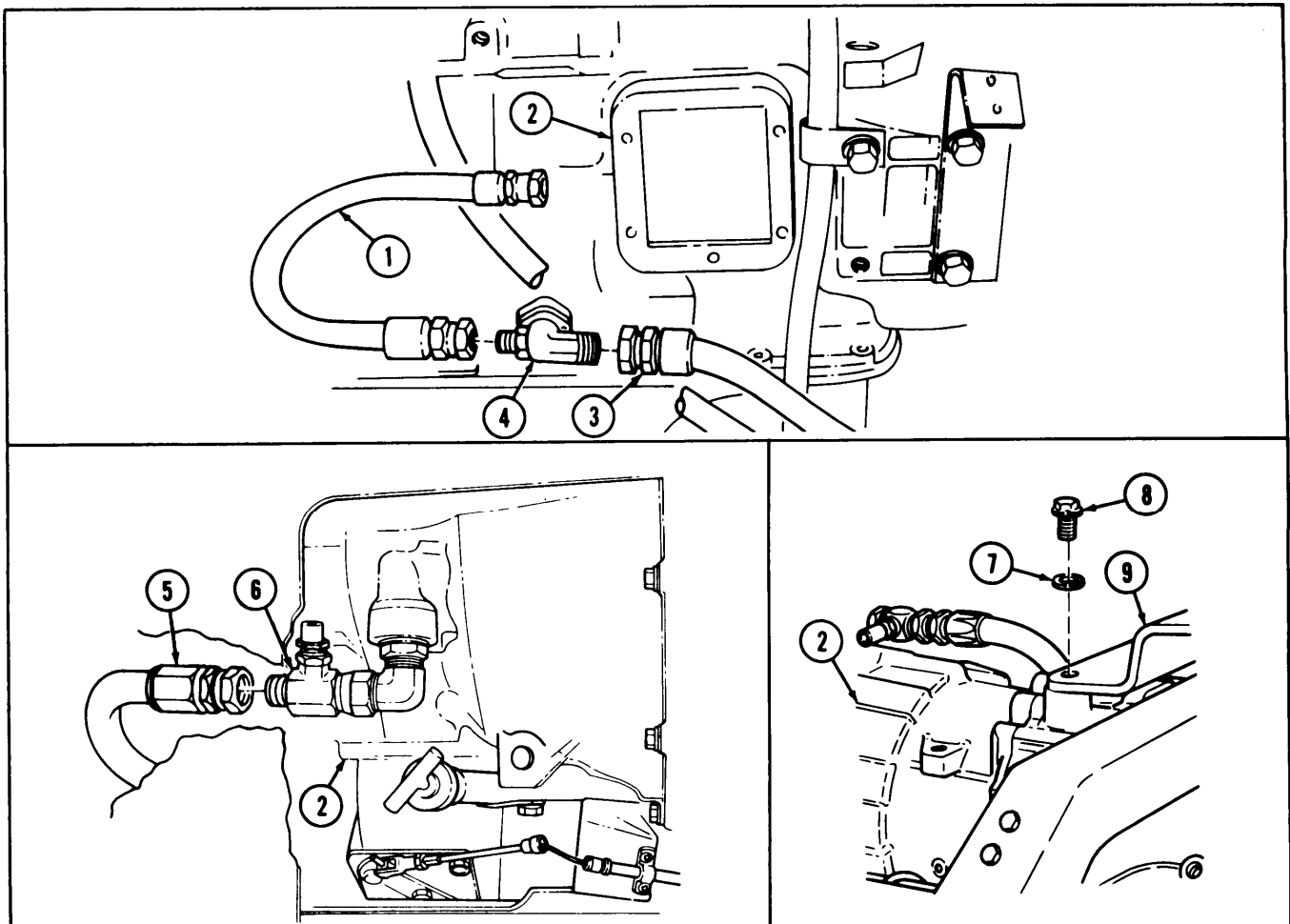
7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

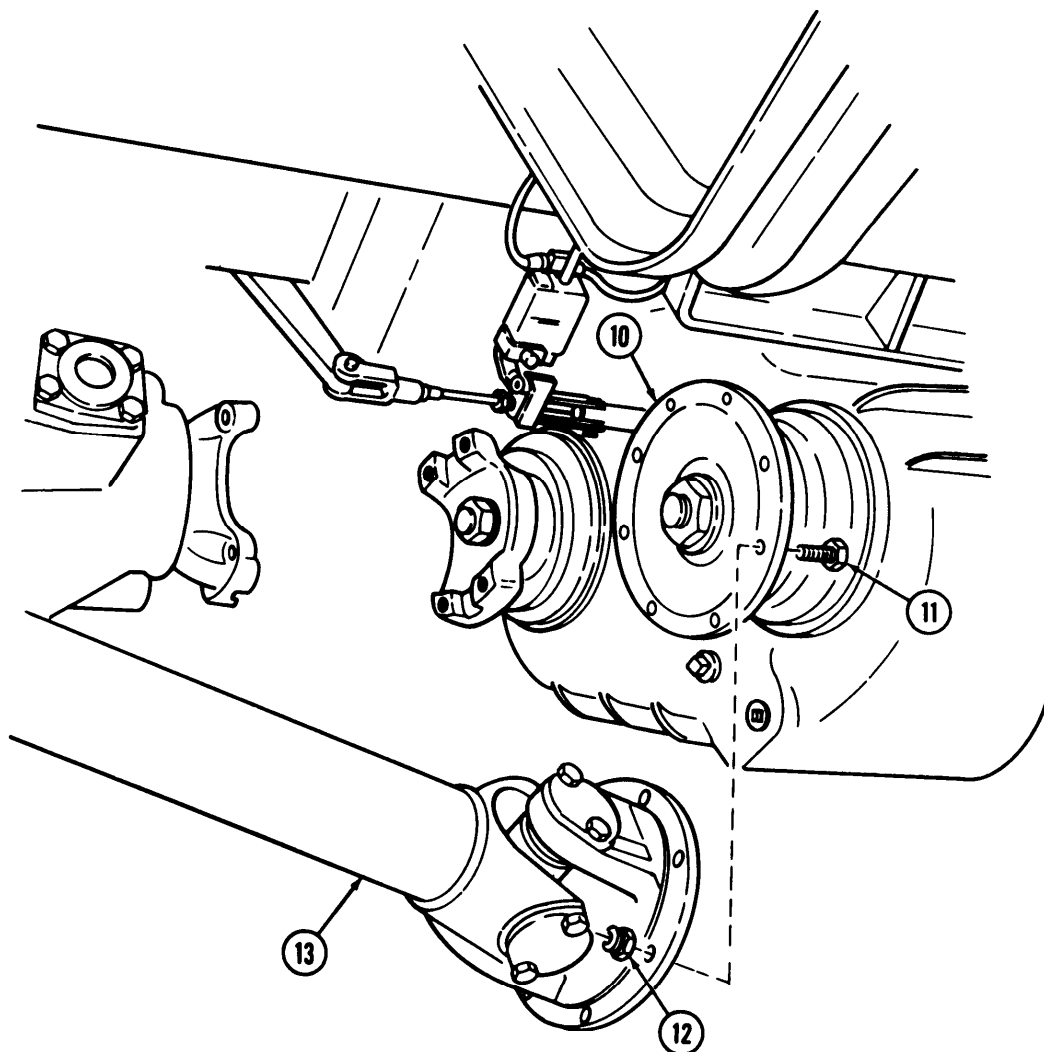
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
7.	Temperature trans-mitter adapter (6)	Transmission to oil cooler return hose (5)	Disconnect.	Cover opening in adapter (6).
8.	Lubrication valve adapter (4)	Oil cooler filter to transmission supply hose (3)	Disconnect.	Cover opening in adapter (4).
NOTE Step 9 applies to vehicles equipped with a transmission power takeoff (PTO).				
9.		PTO oil return hose (1)	Remove.	Cover opening in adapter (4).
10.	Rear support bracket (9) and transmission (2)	Two screws (8) and lockwashers (7)	Remove.	Discard lockwashers (7).



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7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
11.	Transfer case flange (10)	Eight screws (11) and locknuts (12)	Remove.	Discard locknuts (12).
12.		Front axle propeller shaft (13)	Tie clear to provide clearance for transmission (2) removal from vehicle.	

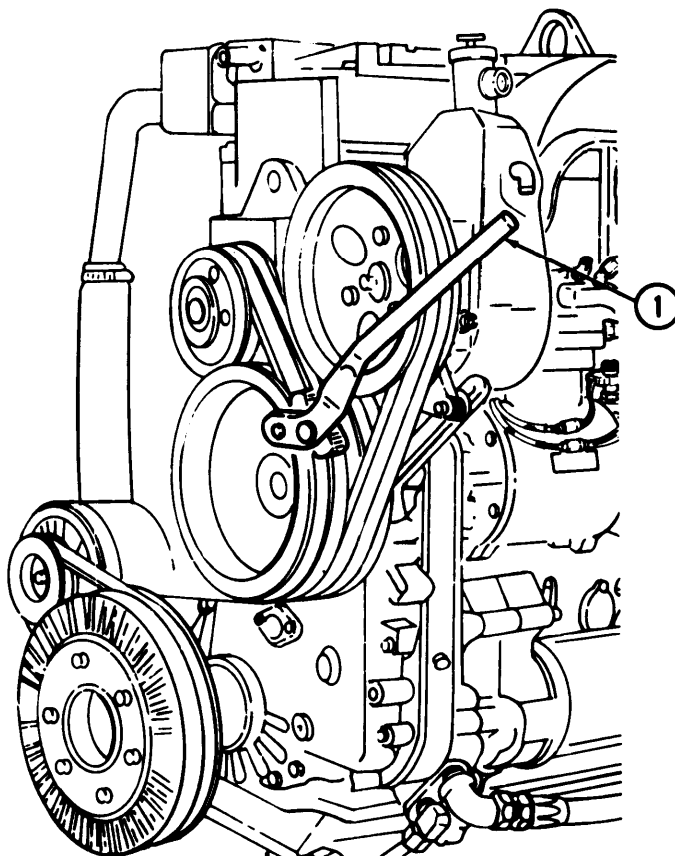


7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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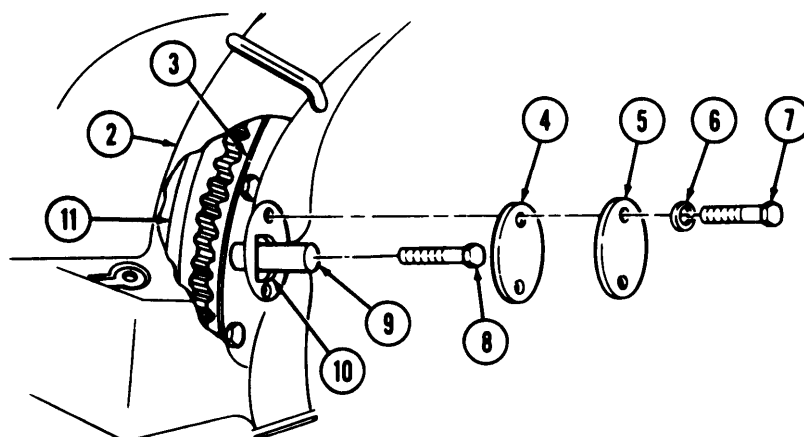
NOTE

The use of shim stock tube in the torque converter access hole prevents the converter screws from falling down behind flex plate. A loose screw may "lock" the flex plate, preventing crankshaft rotation required to remove remaining screws. Engine crankshaft may be turned using barring tool (1).



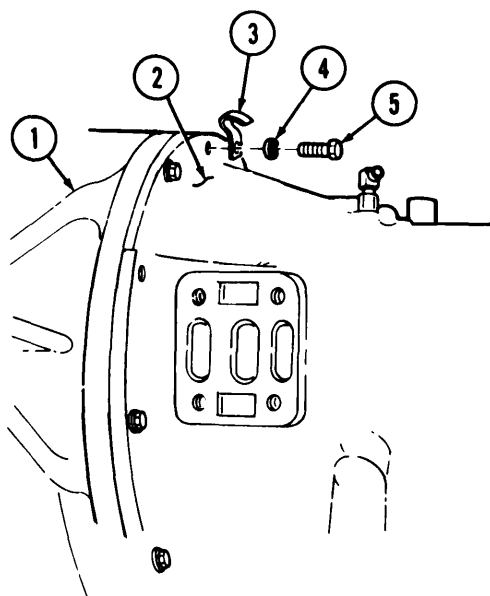
7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
13.	Bell housing (2)	Two screws (7) and lockwashers (6), and access plate (5) Access cover plate gasket (4)	Remove. Remove.	Discard lockwashers (6). Discard gasket (4). Clean gasket remains from mating surfaces.
14.	Flex plate (3) to converter (11)	Twelve screws (8)	Remove using the following method: a. Roll shim stock (9) into tube form and size to fit diameter of access hole (10). b. Rotate flex plate (3) until screw (8) is visible in access hole (10). c. Insert end of shim stock tube (9) into access hole (10) and position over screw (8) against flex plate (3). d. Remove screw (8). e. Remove remaining screws (8) in the same manner.	This procedure prevents screw (8) from falling down into the bottom of the bell housing (2) causing an engine lock-up condition, and making it difficult to remove the transmission. Flex plate (3) can be rotated by barring engine with barring tool (1)



7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
15.	Bell housing (1) and transmission (2)	Four screws (5) and lockwashers (4), and one of two clamps (3)	Remove screws (5) and lockwashers (4) from 9, 11, 1, and 3 o'clock positions.	Discard lockwashers (4).



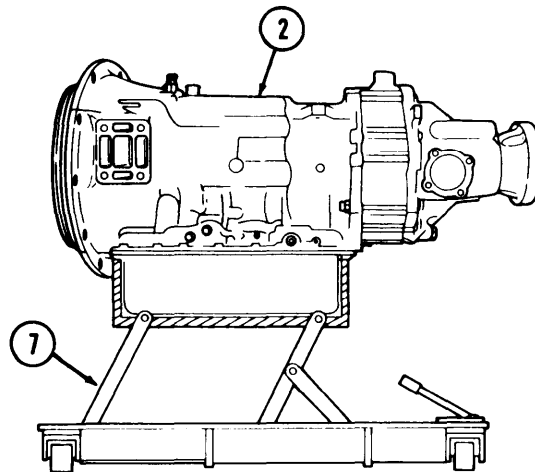
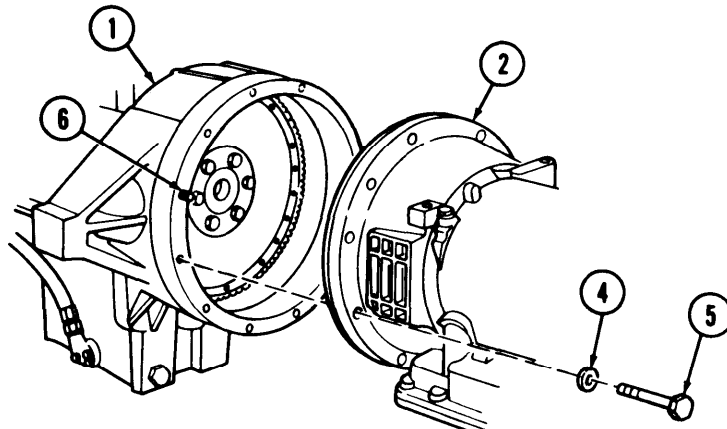
NOTE

Guide or alinement screws can be made from extra screws that are longer and of the same thread size, by cutting off heads and cutting a screwdriver slot in one end for ease of removal and installation.

16.		Four guide screws (6)	Install in bell housing(1)at 9, 11, 1, and 3 o'clock positions.	
17.	Underside of transmission (2)	Transmission jack (7)	Position to transmission (2) and raise until transmission (2) weight is supported.	
18.	Bell housing (1) and transmission (2)	Remaining eight screws (5) and lockwashers (4), and clamp (3)	Remove.	Discard lockwashers (4).

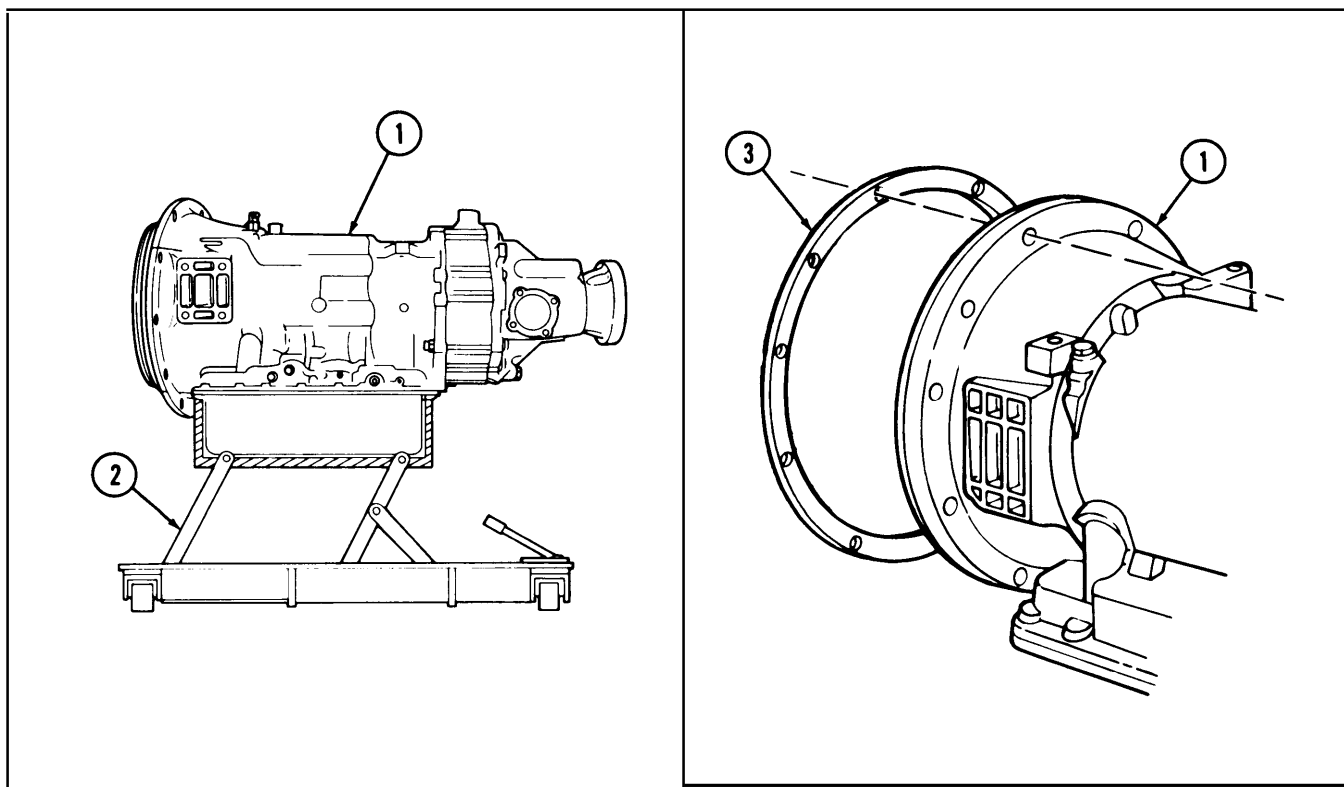
7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
19.		Transmission (2)	<p>a. Separate from engine bell housing (1).</p> <p>b. Keep transmission (2) level until clear of guide screws (6). After separation from engine, slightly tilt rear of transmission (2) downward to prevent torque converter separation from transmission (2).</p> <p>c. Remove four guide screws (6) from bell housing (1).</p>	Retain guide screws (6) for installation.



7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
20.		Front of vehicle	Raise until clearance is provided for removal of transmission (1) from beneath vehicle.	
21.		Transmission (1) on transmission jack (2)	Roll away from vehicle.	
22.	Transmission (1)	Gasket (3)	Remove.	Discard gasket (3). Clean gasket remains from mating surfaces.



7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

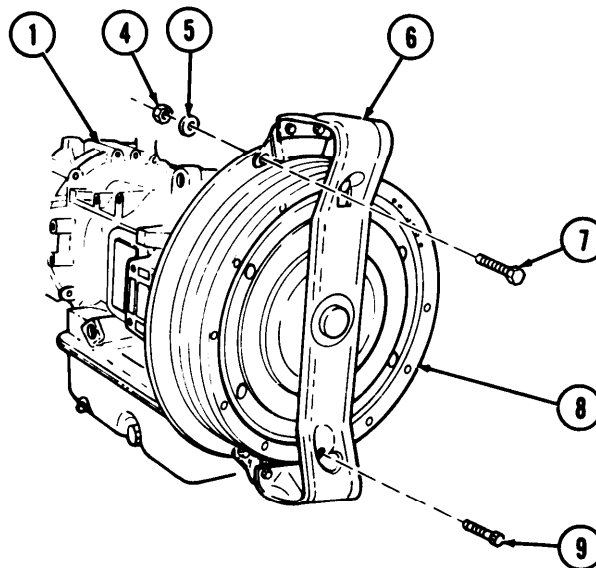
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
23.		Converter retaining strap (6)	a. Install on converter (8) with two screws (9). b. Install on flange of transmission (1) with four screws (7), washers (5), and nuts (4).	

b. Installation

WARNING

Keep rear of transmission tilted slightly downward to prevent converter from sliding off and causing injury to personnel or damage to converter.

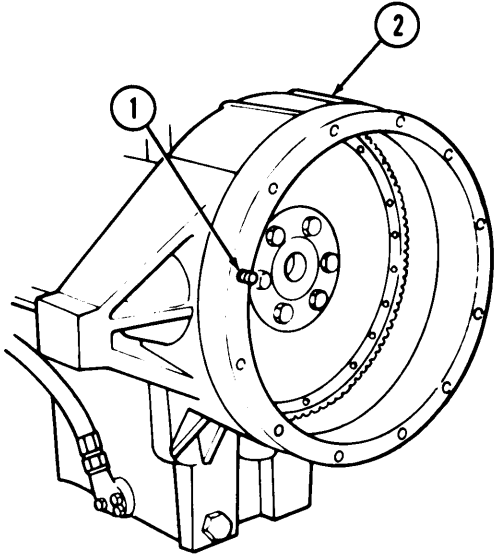
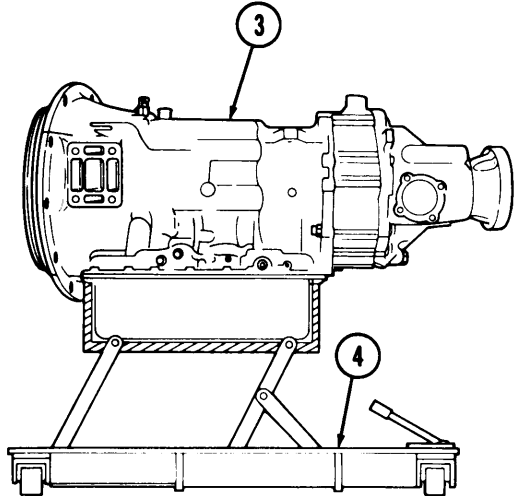
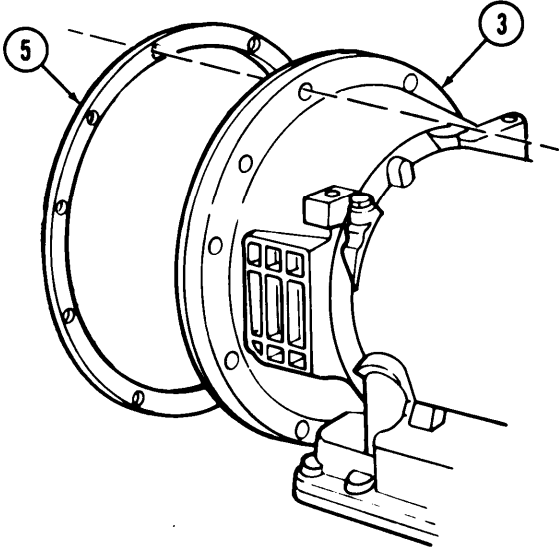
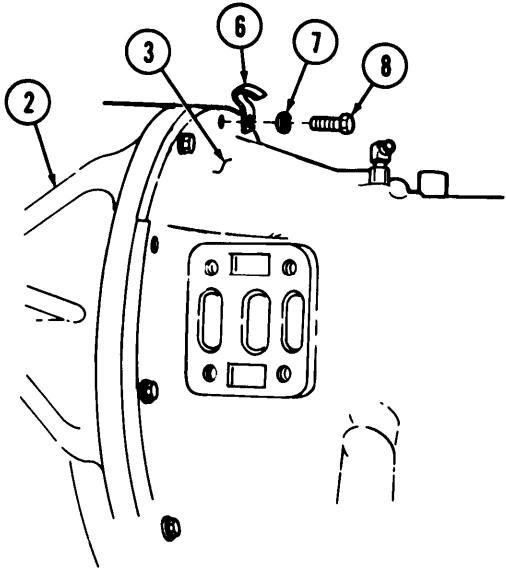
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|--------------------------|--|---------|
| 24. Converter strap (6) | Four screws (7), washers (5), and nuts (4) | Remove. |
| 25. Torque converter (8) | Two screws (9) and converter strap (6) | Remove. |



7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
26.		New gasket (5)	Position on transmission (3).	
27.		Four guide screws (1)	Install in bell housing (2) at 9, 11, 1, and 3 o'clock positions.	
28.	Front of vehicle		Raise until clearance is provided for installation of transmission (3) from beneath vehicle.	
<p style="text-align: center;">CAUTION</p> <p>Maintain transmission alinement to engine bell housing during installation to prevent damage to the converter.</p>				
29.		Transmission (3)	a. Position on transmission jack (4). b. Position under vehicle and raise until transmission (3) and gasket (5) are in alinement with guide screws (1). c. Position on guide screws (1) until seated against bell housing (2).	
30.		Transmission (3) and clamp (6)	a. Install on bell housing (2) with eight new lockwashers (7) and screws (8). b. Remove guide screws (1) and install remaining four new lockwashers (7) and screws(8).	Tighten 25-31lb-ft (34-42 N•m). Tighten 25-31 lb-ft (34-42 N•m).

7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				
				
				

7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

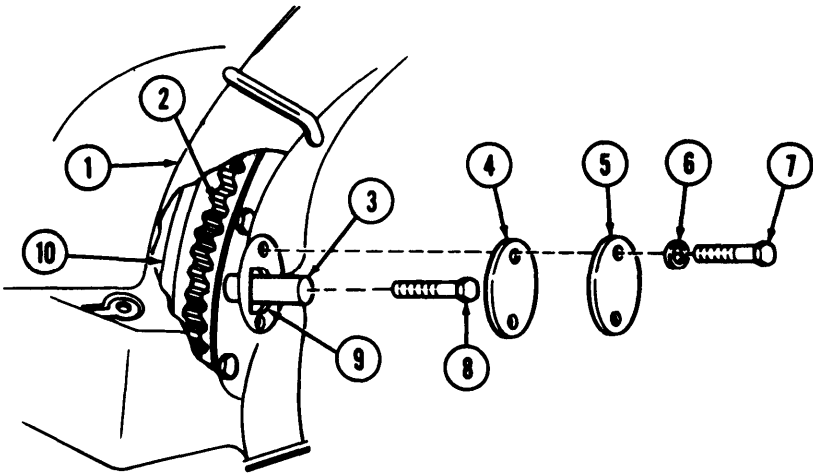
To aline flex plate to converter screw holes, engine crankshaft may be turned using barring tool ST-747.

31.		Converter (10) and flex plate (2) screw holes	Aline to access hole (9).	
32.		Tubing (3) or rolled up shim stock	Insert through access hole (9) in bell housing (1).	This procedure prevents the screw (8) from falling into bottom of bell housing (1).
33.		Twelve screws (8)	Install.	Tighten 41-49 l b-ft (56-66 N•m).
34.		Tubing (3) or rolled up shim stock	Remove.	
35.		New gasket (4) and cover plate (5)	Position to bell housing access hole (9) and install with two new lockwashers (6) and screws (7).	Tighten 5-8 lb-ft (7-11 N•om).
36.		Oil cooler filter to transmission supply hose (12)	Install on lubrication valve adapter (13).	

NOTE

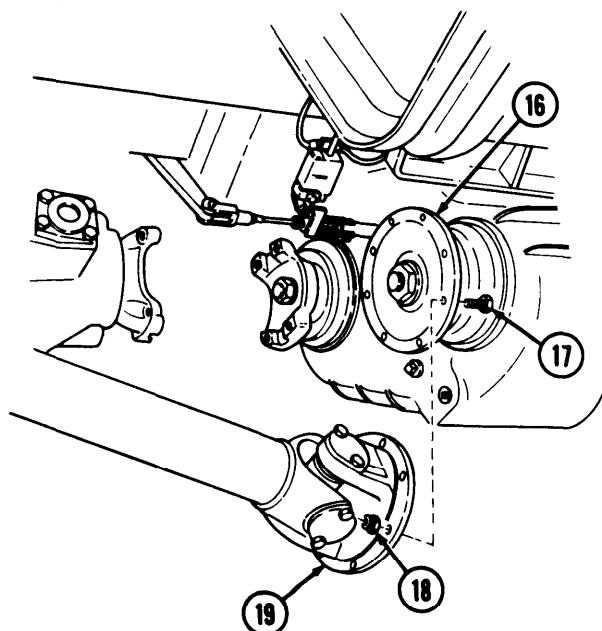
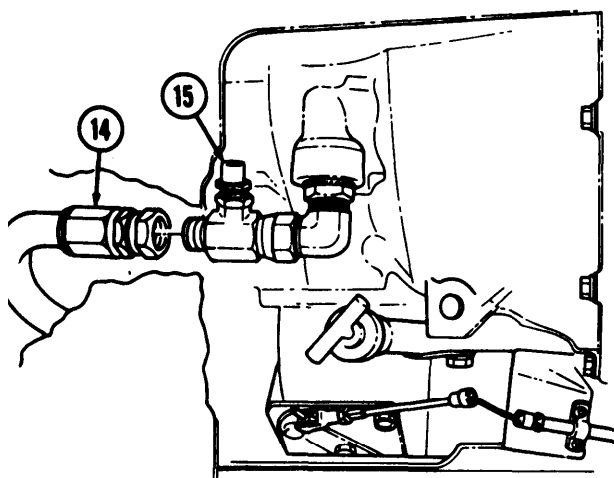
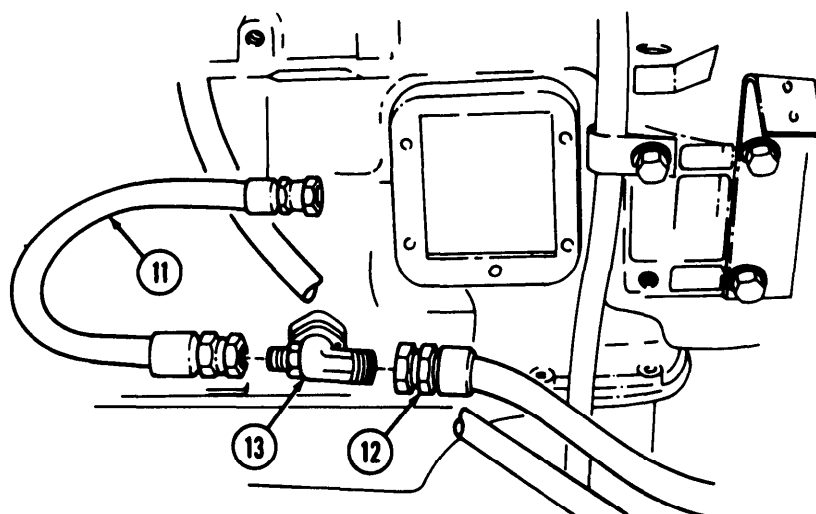
Step 37 applies to vehicles equipped with transmission PTO.

37.		PTO oil return hose (11)	Install.	
38.		Transmission to oil cooler return hose(14)	Install on temperature transmitter adapter (15).	



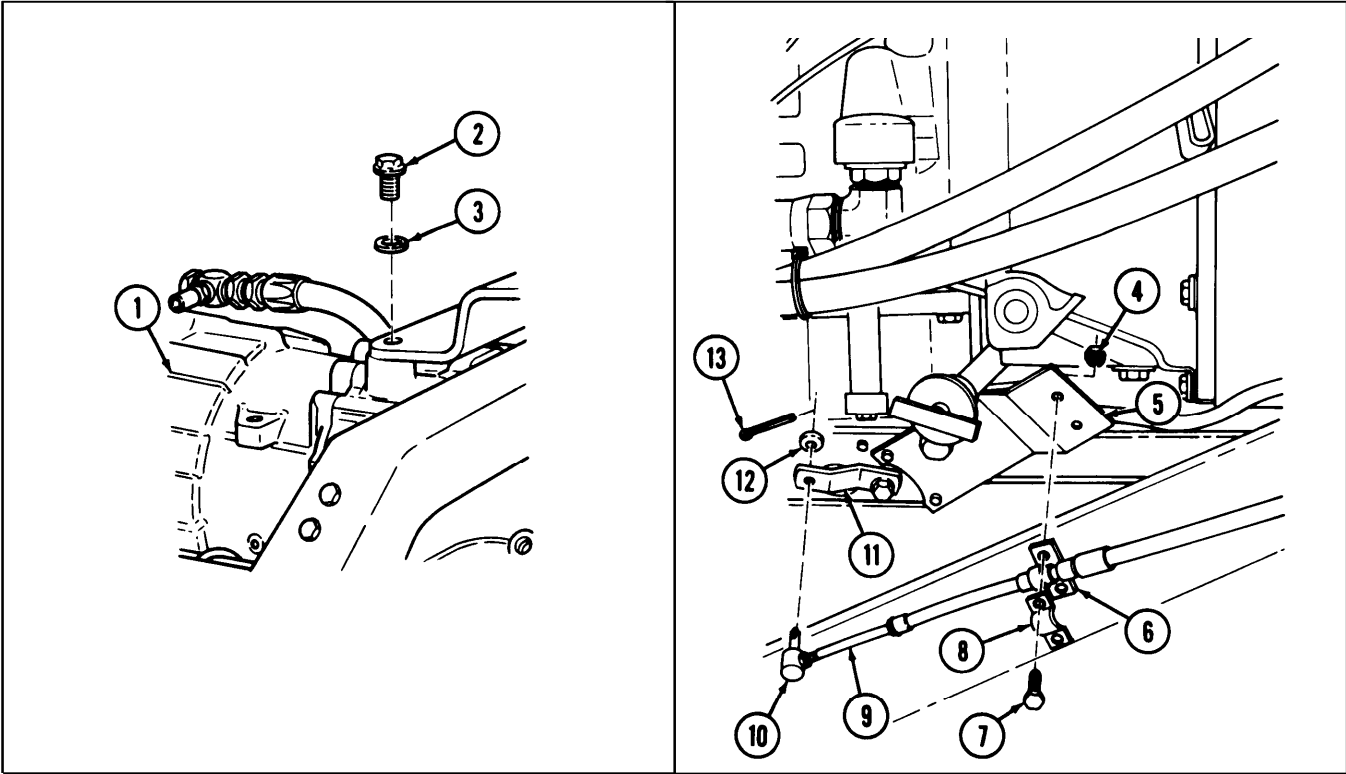
7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
39.		Front axle propeller shaft flange (19)	Untie and install to transfer case flange (16) with eight new locknuts (18) and screws (17).	Tighten 32-40 lb-ft (43-54 N•m).



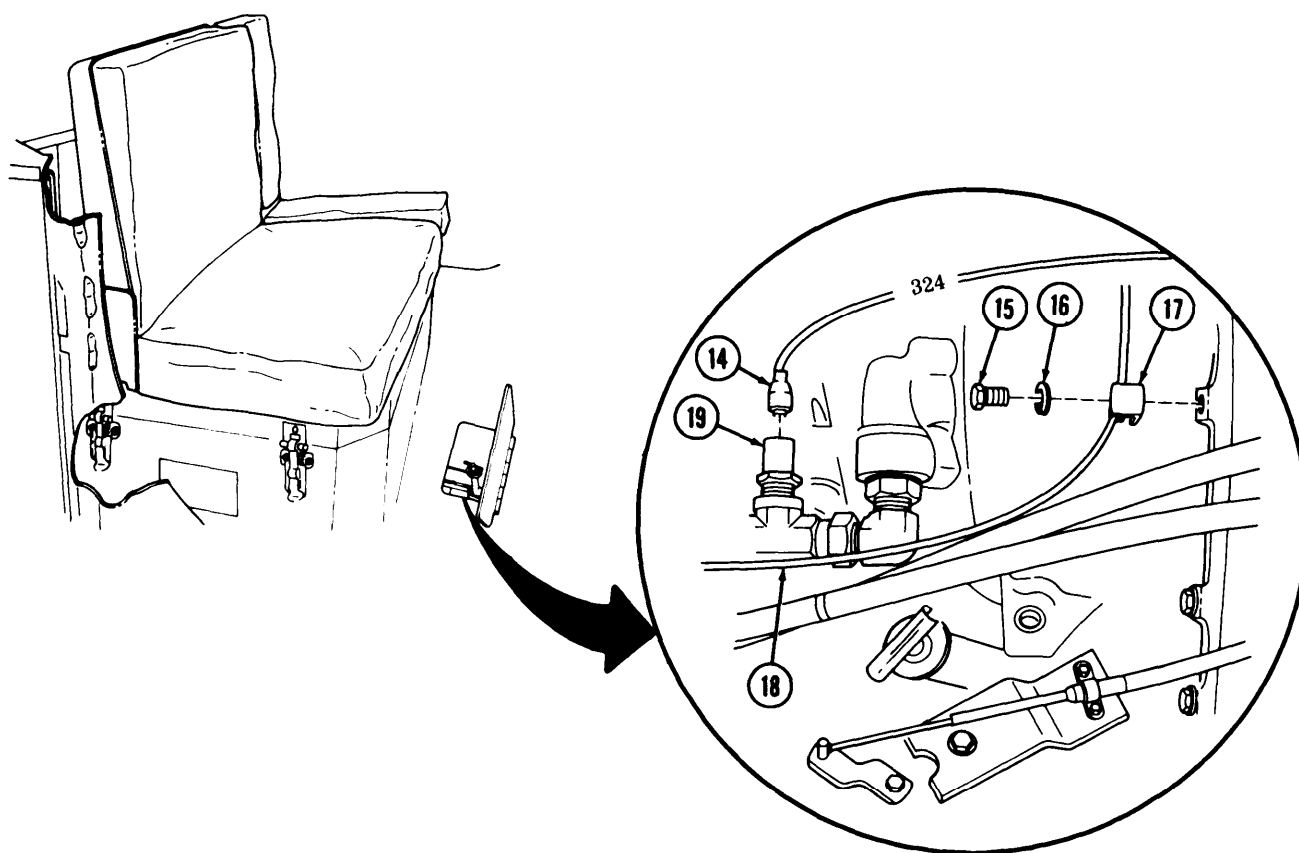
7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
40.		Transmission (1)	Install with two new lockwashers (3) and screws (2).	Tighten 65-85 lb-ft (88-115 N•m).
NOTE Steps 41, 42, and 43 apply to vehicles equipped with transmission power takeoff (PTO).				
41,		PTO control cable (9)	Install PTO cable pin (10) on end of PTO control cable (9).	
42.		PTO cable pin (10)	Connect to PTO select lever (11) with washer (12) and new cotter pin (13).	
43.		PTO control cable (9)	Attach to PTO cable bracket (5) with retainer strap (8), spacer plate (6), and two screws (7) and nuts (4).	



7-11. TRANSMISSION REPLACEMENT (FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
44.		Wire (14)	Connect to transmission oil temperature sending unit (19).	
45.		Wire (18) and clamp (17)	Install with screw (15) and new lockwasher (16).	



END OF TASK!

- FOLLOW-ON TASKS:
- Install transmission power takeoff (if so equipped) (para. 20-10).
 - Install winch control valve (if so equipped) (para. 19-10).
 - Install transmission neutral start switch (TM 9-2320-272-20-1).
 - Install transmission 5th gear lock-in solenoid valve and bracket (para. 7-9).
 - Install transmission modulator (TM 9-2320-272-20-1).
 - Install transmission breather (TM 9-2320-272-20-1).
 - Install transmission oil dipstick (TM 9-2320-272-20-1).
 - Install transmission to transfer case propeller shaft (TM 9-2320-272-20-1).
 - Fill transmission to proper oil level (LO 9-2320-272-12).
 - Start engine (TM 9-2320-272-10) and road test vehicle,

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7-12. TRANSMISSION REPLACEMENT (ENGINE AND TRANSMISSION REMOVED FROM VEHICLE)

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 3-24	Engine and transmission removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Barring tool ST-747		None
<u>Materials/Parts</u>		
Tubing or shim stock 3 x 6 x 0.030 in.		
Two gaskets		
Fourteen lockwashers		
Protective cap-plugs (Appendix C, Item 5)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		<ul style="list-style-type: none">• Converter must be removed with transmission.• Keep rear of transmission tilted slightly downward.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

WARNING

Keep rear of transmission tilted slightly downward to prevent converter from sliding off and causing injury to personnel or damage to equipment.

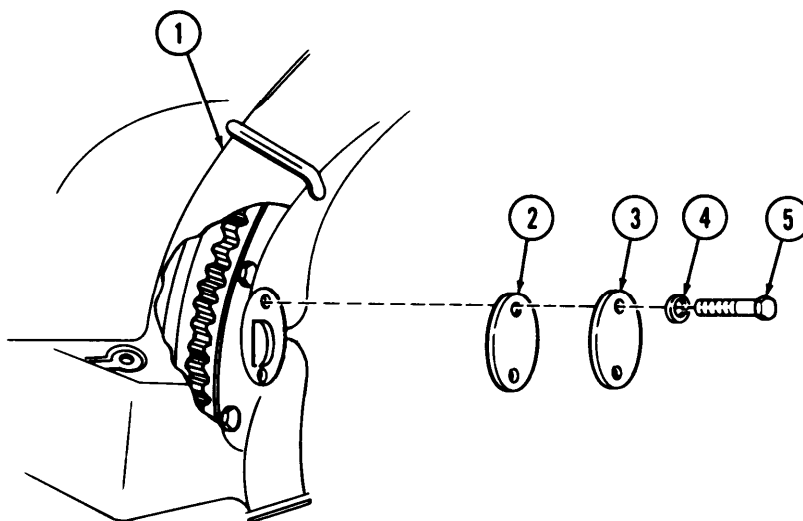
7-12. TRANSMISSION REPLACEMENT (ENGINE AND TRANSMISSION REMOVED FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Plug all openings to prevent dirt from entering transmission.
Damage will occur if dirt or dust enters transmission.

- | | | | | |
|----|------------------|---|---------|---|
| 1. | Bell housing (1) | Two screws (5) and lockwashers (4) and access plate (3) | Remove. | Discard lockwashers (4). |
| 2. | | Gasket (2) | Remove. | Discard gasket (2).
Clean gasket remains from mating surfaces, |



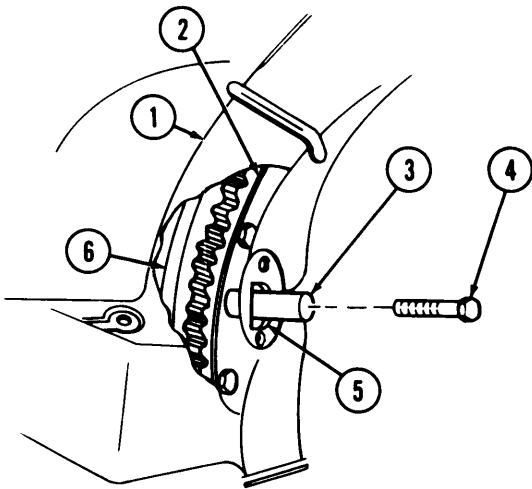
7-12. TRANSMISSION REPLACEMENT (ENGINE AND TRANSMISSION REMOVED FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

The use of shim stock tube in the torque converter access hole prevents converter screws from falling down behind flex plate. A loose screw may "lock flex plate, preventing crankshaft rotation required to remove remaining screws. Engine crankshaft maybe turned using barring tool ST-747.

3.	Flex plate (2) to converter (6)	Twelve screws (4)	<p>Remove, using the following method:</p> <p>a. Roll shim stock (3) into tube form and size to fit diameter of access hole (5).</p> <p>b. Rotate flex plate (2) until screw (4) is visible in access hole (5).</p> <p>c. Insert end of shim stock tube (3) into access hole (5), and position over screw (4) and flat against flex plate (2).</p> <p>d. Remove screw (4).</p> <p>e. Remove remaining screws (4) in the same manner.</p>	<p>This procedure prevents screw (4) from falling down into the bottom of the engine bell housing (1), causing an engine lock-up condition, and making it difficult to remove the transmission.</p> <p>Flex plate (2) can be rotated by turning engine crankshaft (8) with barring tool ST-747 (7).</p>
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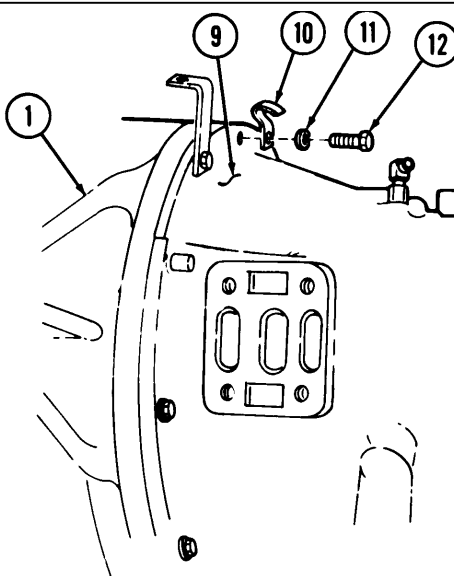
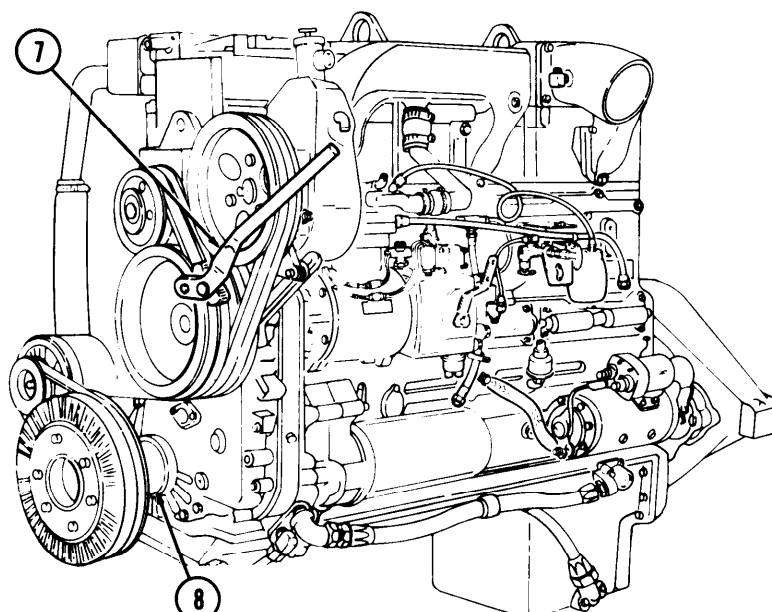
7-12. TRANSMISSION REPLACEMENT (ENGINE AND TRANSMISSION REMOVED FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Maintain transmission alignment to engine bell housing during removal to prevent damage to converter.

- | | | | | |
|----|---------------------------------------|--|---|---------------------------|
| 4. | Bell housing (1) and transmission (9) | Four screws (12) and lockwashers (11) and clamp (10) | Remove screw (12) and lockwasher (11) at 9, 11, 1, and 3 o'clock positions. | Discard lockwashers (11). |
|----|---------------------------------------|--|---|---------------------------|



7-12. TRANSMISSION REPLACEMENT (ENGINE AND TRANSMISSION REMOVED FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Plug all openings to prevent dirt from entering transmission.
Damage will occur if dirt or dust enters the transmission.

- | | | | | |
|----|--------------------------------|--|---|---------------------------------|
| 5. | Top of transmission (4) | Transmission to oil cooler return hose (10) | Disconnect from temperature transmitter adapter (11). | Cover opening in adapter (11). |
| 6. | Right side of transmission (4) | Oil cooler filter to transmission supply hose (13) | Disconnect from lubrication valve adapter (12). | Cover opening in adapter (12). |

NOTE

Guide or alinement studs can be made from extra screws that are longer and of the same thread size by cutting off heads and cutting a screwdriver slot in one end for ease of removal and installation.

- | | | | | |
|-----|--|--|---|--|
| 7. | | Four guide screws (1) | Install in bell housing (2) at 9,11,1, and 3 o'clock positions. | |
| 8. | Underside of transmission (4) | Transmission jack (8) | Position to transmission (4) and raise until transmission (4) weight is supported. | |
| 9. | Engine bell housing (2) and transmission (4) | Remaining eight screws (6), lockwashers (5), and bracket (7) | Remove. | Discard lockwashers (5). |
| 10. | Bell housing (2) | Transmission (4) and gasket (3) | a. Separate from engine bell housing (2).

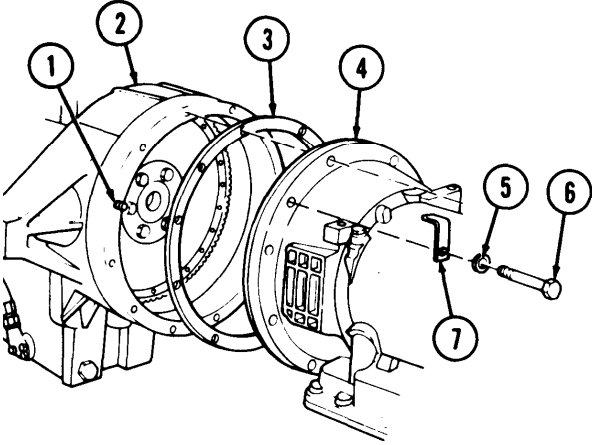
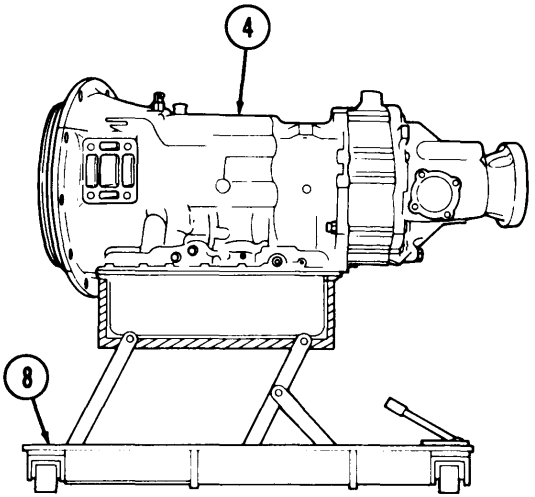
b. Keep transmission (4) level until clear of guide screws (1). After separation from engine, slightly tilt rear of transmission (4) downward to prevent torque converter separation from transmission (4).

c. Remove four guide screws (1) from bell housing(2). | Discard gasket (3).

Clean gasket remains from mating surfaces.

Retain guide screws (1) for installation. |

7-12. TRANSMISSION REPLACEMENT (ENGINE AND TRANSMISSION REMOVED FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
	<div style="display: flex; justify-content: space-around;">   </div>			

7-12. TRANSMISSION REPLACEMENT (ENGINE AND TRANSMISSION REMOVED FROM VEHICLE) (Cont'd)

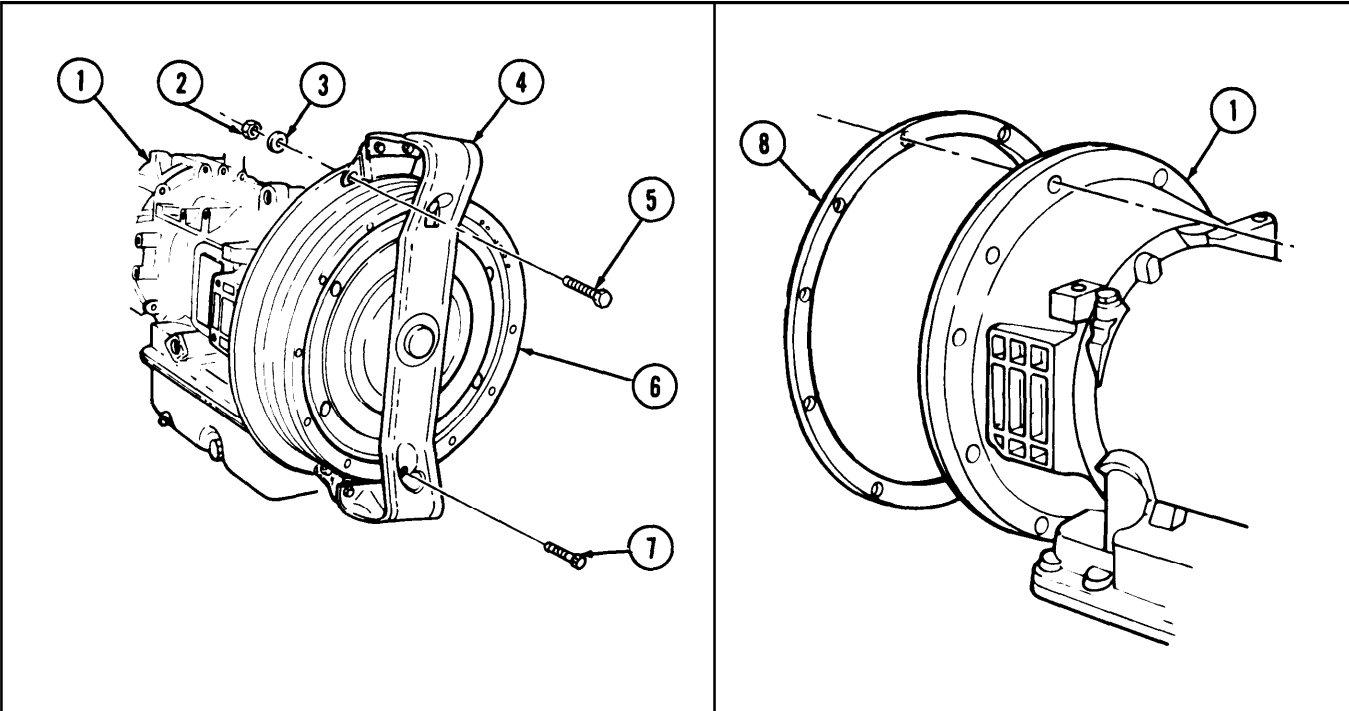
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
11.		Converter retaining strap (4)	a. Install on converter (6) with two screws (7). b. Install on flange of transmission (1) with four screws (5), washers (3), and nuts (2).	Converter strap (4) retains converter (6) to transmission (1) until repair is performed.

b. Installation I

WARNING

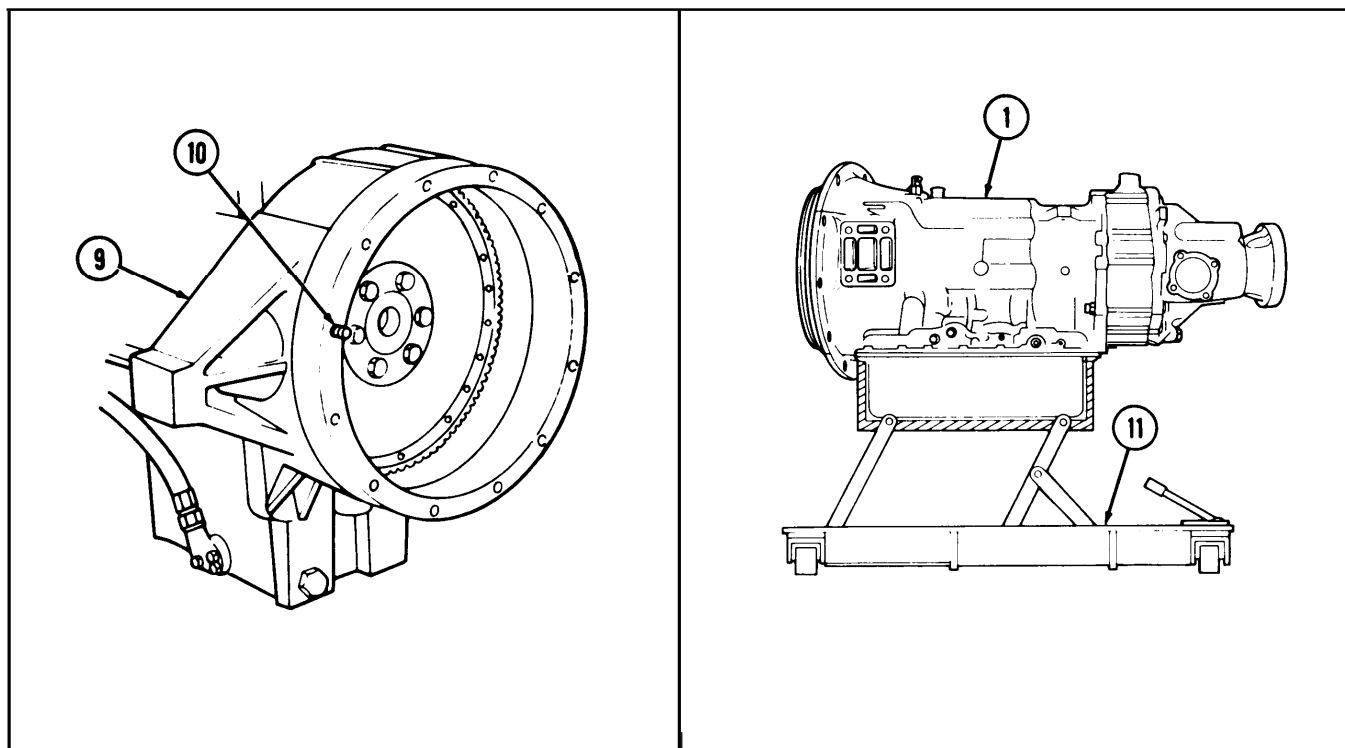
Keep rear of transmission tilted slightly downward to prevent converter from sliding off and causing injury to personnel or damage to equipment.

12. Converter strap (4)	Four screws (5), washers (3), and nuts (2)	Remove.
13. Torque converter (6)	Two screws (7) and converter strap (4)	Remove.
14.	New gasket (8)	Install on transmission (1).



7-12. TRANSMISSION REPLACEMENT (ENGINE AND TRANSMISSION REMOVED FROM VEHICLE) (Cont'd)

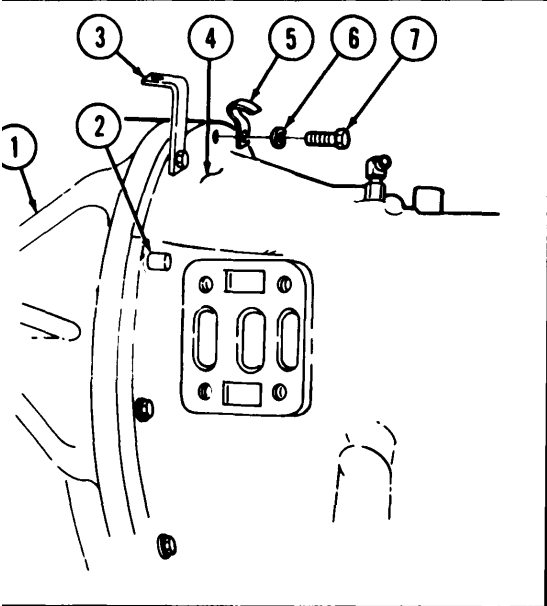
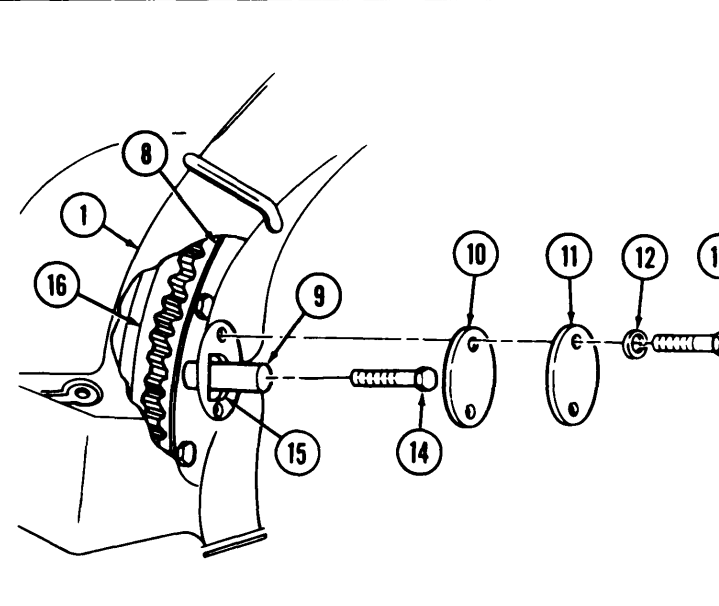
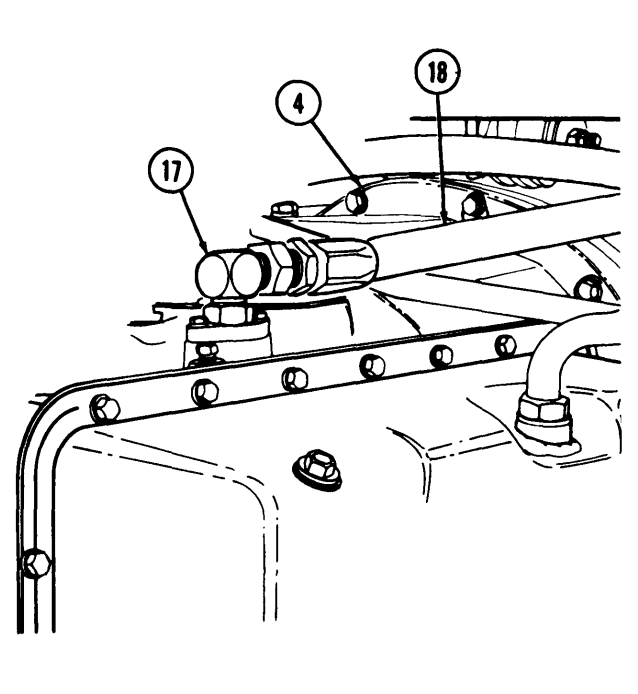
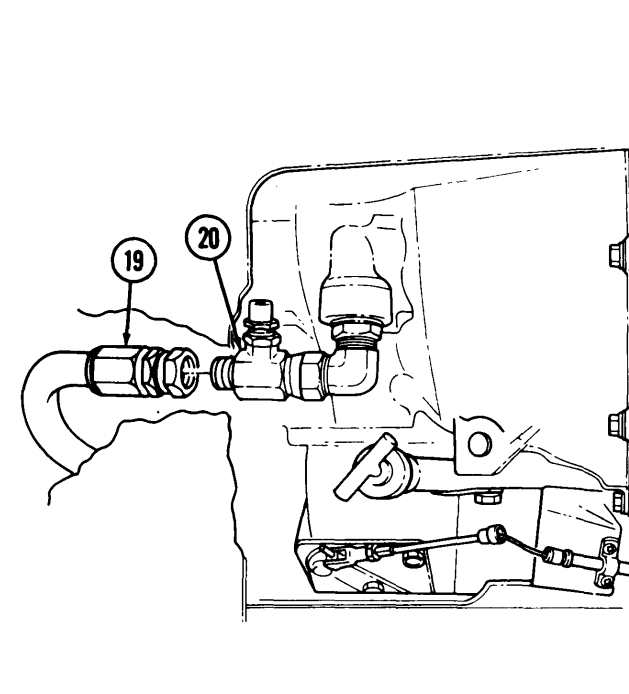
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
15.		Four guide screws (10)	Install in bell housing (9) at 9, 11, 1, and 3 o'clock positions.	
<p style="text-align: center;">CAUTION</p> <p>Maintain transmission alignment to engine bell housing during installation to prevent damage to converter.</p>				
16.		Transmission (1)	<ul style="list-style-type: none"> a. Position on transmission jack (11). b. Position until transmission (1) and gasket (8) are in alignment with guide screws (10). c. Position on guide screws (10) until seated against bell housing (9). 	



7-12. TRANSMISSION REPLACEMENT (ENGINE AND TRANSMISSION REMOVED FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
17.		Transmission (4), clamp (5), and bracket (3)	a. Install on bell housing (1) with eight new lockwashers (6) and screws (7). b. Remove guide screws (2) and install remaining new lockwashers (6) and four screws (7).	Tighten 25-31 lb-ft (34-42 N•m). Tighten 25-31 lb-ft (34-42 N•m).
18.		Transmission jack	Remove,	
NOTE To aline flex plate to converter screw holes, bar engine using barring tool ST-747.				
19.		Converter (16) and flex plate (8) screw holes	Aline to access hole (15).	
20.		Tubing (9) or rolled up shim stock	Insert through access hole (15) in bell housing (1).	This procedure prevents screw (14) from falling into bottom of bell housing (1).
21.		Twelve screws (14)	Install,	Tighten 41-49 lb-ft (56-66 N•m).
22.		Tubing (9) or rolled up shim stock	Remove.	
23.		New gasket (10) and cover plate (11)	Position to bell housing access hole (15) and install with two new lockwashers (12) and screws (13).	Tighten 5-8 lb-ft (7-11 N•m).
24.		Oil cooler filter to transmission supply hose (18)	Install on lubrication valve adapter (17).	
25.		Transmission to oil cooler return hose (19)	Install on transmission temperature transmitter adapter (20),	

7-12. TRANSMISSION REPLACEMENT (ENGINE AND TRANSMISSION REMOVED FROM VEHICLE) (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

END OF TASK!

FOLLOW-ON TASK: Install engine and transmission (para. 3-24).

Section IV. TRANSMISSION REPAIR

7-13. GENERAL MAINTENANCE INSTRUCTIONS

WARNING

- Drycleaning solvent is flammable and will not be used near open flame. Use only in well-ventilated places. Failure to do this may result in injury to personnel.
- Compressed air source will not exceed 30 psi (207 kPa). When cleaning with compressed air, eyeshields must be worn. Failure to wear eyeshields may result in injury to personnel.

CAUTION

- When converter pump hub, front support (including ground sleeve), or oil pump is defective, install wide oil pump kit. This kit converts an early model transmission (P/N 6885292) into a late model transmission (P/N 23040127). Failure to simultaneously install all parts of kit may cause damage to transmission during assembly or may cause transmission malfunction.

NOTE

- Refer to para. 2-7 for cleaning all transmission components.
- Make sure location markings are not removed when cleaning.
- All transmission parts must be lubricated with clean transmission oil before assembly.

7-14. TRANSMISSION DISASSEMBLY TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
7-15.	Transmission Mounting to Holding Fixture	7-62
7-16.	Transmission Torque Converter Removal	7-64
7-17.	Transmission Oil Pan Removal	7-78
7-18.	Transmission Oil Filter Removal	7-80
7-19.	Modulated Lockup Valve Removal	7-82
7-20.	Low Trimmer Valve Removal	7-84
7-21.	Low Shift Valve Removal	7-86
7-22.	Transmission Control Valve Removal	7-88
7-23.	Transmission Manual Selector Shaft Removal	7-90
7-24.	Transmission Oil Pump and Front Support Removal	7-92
7-25.	Turbine Shaft Removal	7-104
7-26.	Fourth Clutch Removal	7-120
7-27.	Third Clutch Removal	7-128
7-28.	Center Support Removal	7-130
7-29.	Gear Unit and Main Shaft Removal	7-136
7-30.	Second Clutch Removal	7-144
7-31.	First Clutch Removal	7-146
7-32.	Transmission Governor Removal	7-148
7-33.	Rear Cover and Low Planetary Carrier Removal	7-150
7-34.	Low Clutch Removal	7-160
7-35.	Adapter Housing and First Clutch Piston Removal	7-162
7-36.	Transmission Housing Repair	7-166

7-15. TRANSMISSION MOUNTING TO HOLDING FIXTURE

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-11	Transmission removed from vehicle.
	Para.- 12	Transmission removed from engine.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Holding fixture adapter set J-24462		Work area clean and free from blowing dirt and dust.
Holding fixture J-23642		
Holding fixture base J-3289-20		
<u>Materials/Parts</u>		
None		<u>General Safety Instructions</u>
<u>Personnel Required</u>		All personnel must stand clear during hoisting operations.
Wheeled vehicle repairman MOS 63W (2)		
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation I

1. Transmission (1) right side	Six screws (4), power takeoff cover (3), and gasket (2)	Remove.	Discard gasket (2). Clean gasket remains from mating surfaces.
2.	Holding plate (6) and holding fixture (5)	Install with six screws (8) and washers (7).	

NOTE

Transmission may be mounted on any overhaul stand or holding fixture. However, the front, rear, and bottom of transmission must be freely accessible for removal and installation of components.

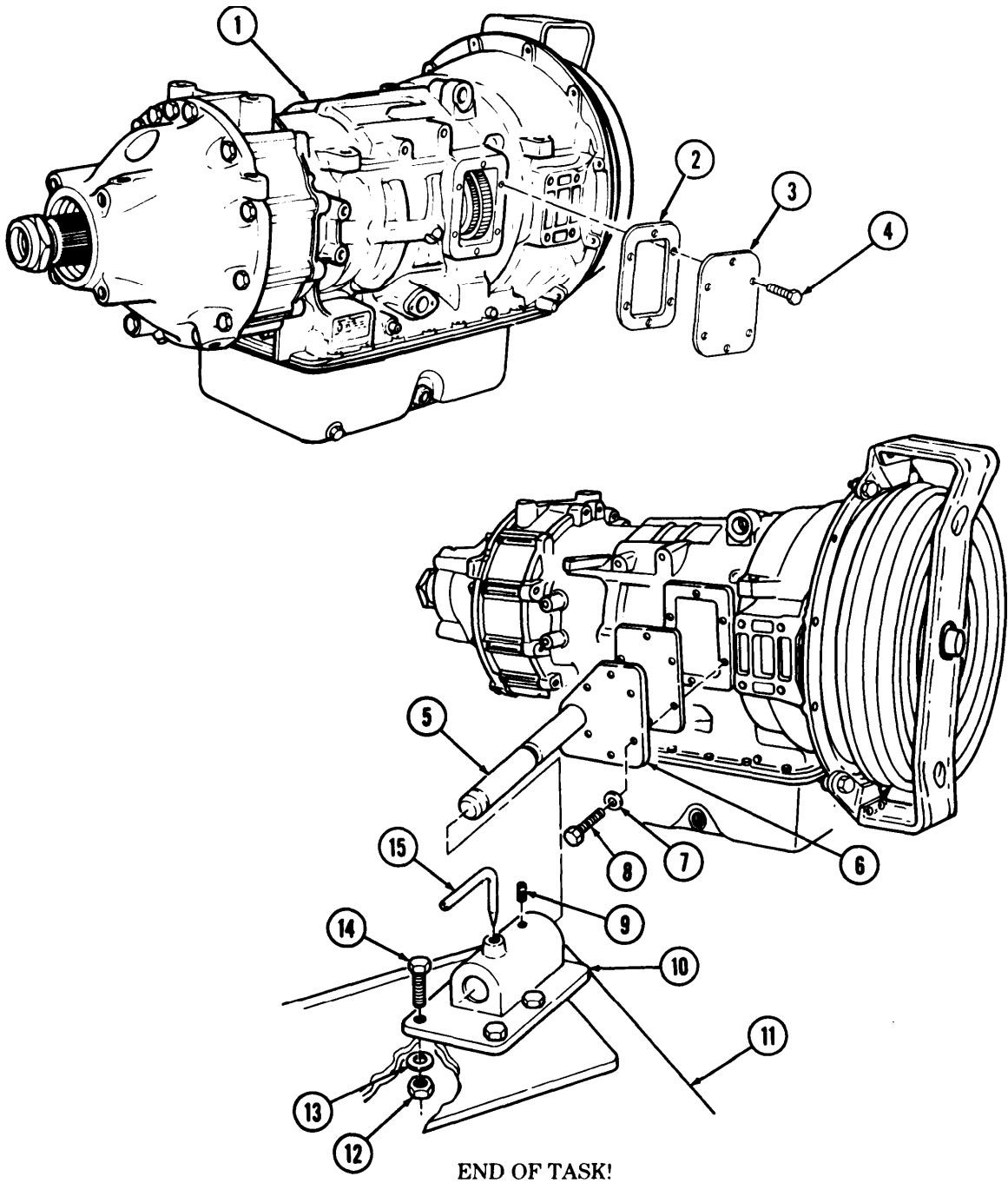
3.	Holding fixture base (10)	Install to overhaul stand (11) with four screws (14), washers (13), and nuts (12).	
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WARNING

- All personnel must stand clear during hoisting operations. A snapped cable, heavy, or swinging load may cause injury to personnel.
- Do not remove hoist chain from transmission until transmission is stable on holding fixture base or injury to personnel may result.

7-15. TRANSMISSION MOUNTING TO HOLDING FIXTURE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
4.		Transmission (1) and holding fixture (5)	Lift into position and install in-holding fixture base (10) with pin (15) and setscrew (9).	Use hoist and chain to lift transmission (1).



7-16. TRANSMISSION TORQUE CONVERTER REMOVAL

This task covers:

- a. Removal
- b. Disassembly
- c. Inspection
- d. Reassembly

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
None	Para. 7-15	Transmission mounted to holding fixture.
Test Equipment		
None		
Special Tools		Special Environmental Conditions
Bearing puller set J-26956 Drive handle J-8092 Bearing remover/installer J-28435 Bearing installer J-36376		None
Materials/Parts		General Safety Instructions
Converter pump seal ring Flywheel seal ring Hook-type seal ring Piston seal ring Pump hub gasket Six jockstraps Thirty self-locking screws Lubricating oil OE/HDO-10 (Appendix C, Item 16) Oil-soluble grease (Appendix C, Item 19)		<ul style="list-style-type: none">Keep fire extinguisher nearby when using drycleaning solvent.Do not use more than 30 psi (207 kPa) when cleaning with air.Always wear safety eye shields when using compressed air.
Personnel Required		
Wheeled vehicle repairman MOS 63W (2)		
Manual References		
TM9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

NOTE

Assistant will help with steps 1 and 2.

1. Converter retaining strap (3) and trans- mission (7)
- Four screws (4), nuts (1), and washers (2)
- Remove.

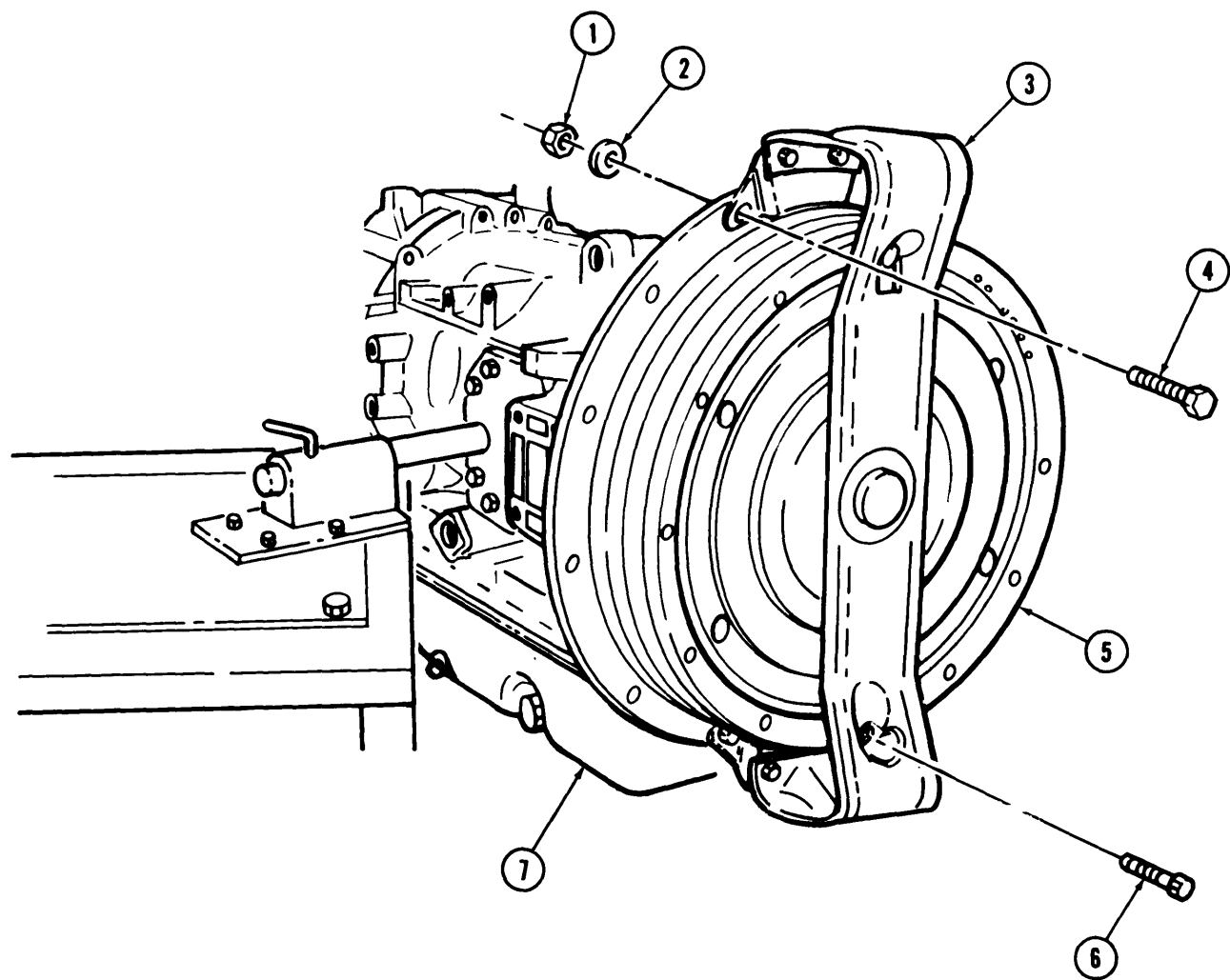
CAUTION

Torque converter must be pulled straight out of transmission and not moved from side to side. Side movement will damage hook-type seal ring on turbine shaft.

7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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- | | | | | |
|----|----------------------|---|---|--|
| 2. | Transmission (7) | Torque converter (5)
and retaining strap (3) | Pull straight out of
transmission (7). | |
| 3. | Torque converter (5) | Two screws (6) and
retaining strap (3) | Remove. | |



7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Contd)
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STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Disassembly

NOTE

Hook-type seal ring is used on early models.

4. Torque converter pump hub (11)	Hook-type seal ring (12)	Remove.	Discard seal ring (12).
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NOTE

- Have drainage container ready to catch transmission oil.
- Assistant will help with step 5.

5. Converter pump (7) to converter flywheel (1)	Thirty self-locking screws (13) and washers (14)	Remove and drain transmission oil.	Discard screws (13).
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6.	Converter pump (7)	Separate from flywheel (1).	
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7. Converter pump (7)	Converter pump seal ring (6)	Remove.	Discard seal ring (6).
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8. Flywheel (1) or converter pump (7)	Roller thrust bearing (2) and bearing race (3)	Remove.	
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9. Converter pump (7)	Six lockstrips (5) and twelve screws (4)	a. Flatten corners at lockstrips (5). b. Remove screws (4) and lockstrips (5).	Discard lockstrips (5).
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10.	Retainer (15)	Remove.	
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11.	Pump hub (11) and gasket (10)	Remove from converter pump (7).	Discard gasket (10).
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Clean gasket remains from mating surfaces.

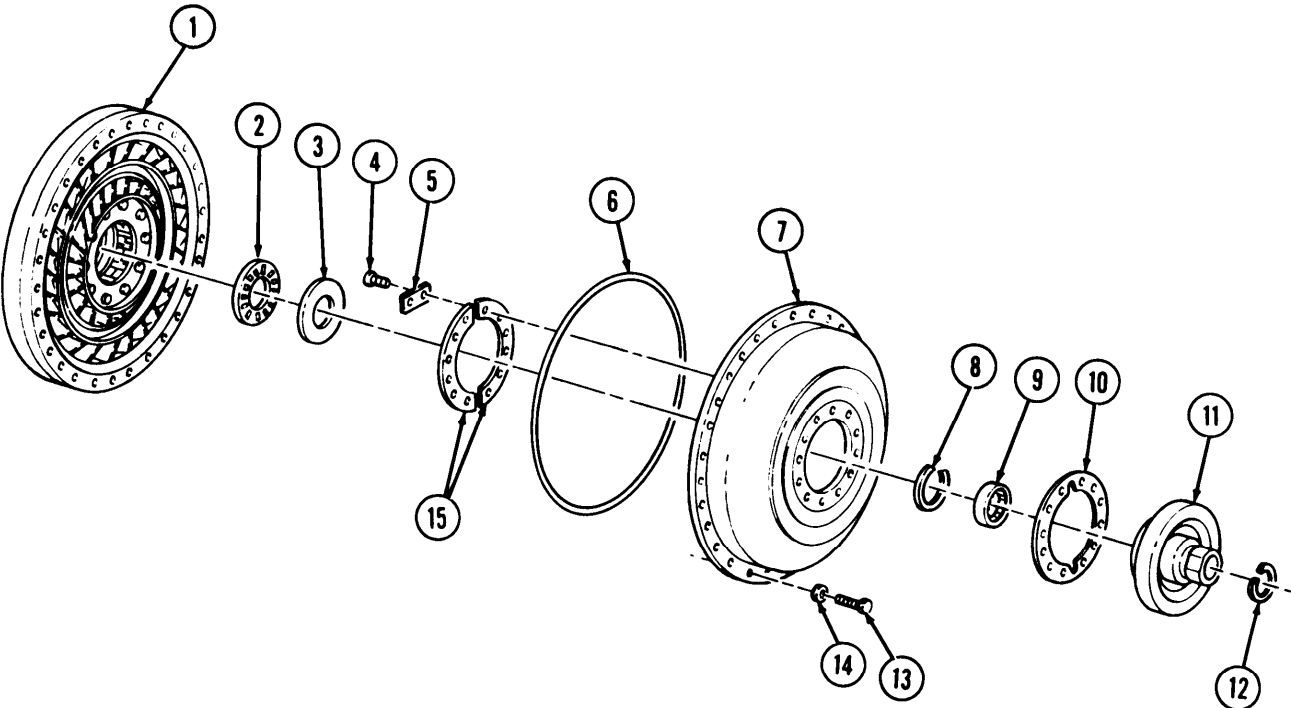
NOTE

- Early model transmission converter pump hub has a snapping and roller bearing inside front bore. Late model converter pump hub has no snapping or roller bearing but does have a nose with flats.
- Perform step 12 for early model transmission.

12. Converter pump hub (11)	Snapping (8) and roller bearing (9)	Remove.	Use bearing puller set.
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7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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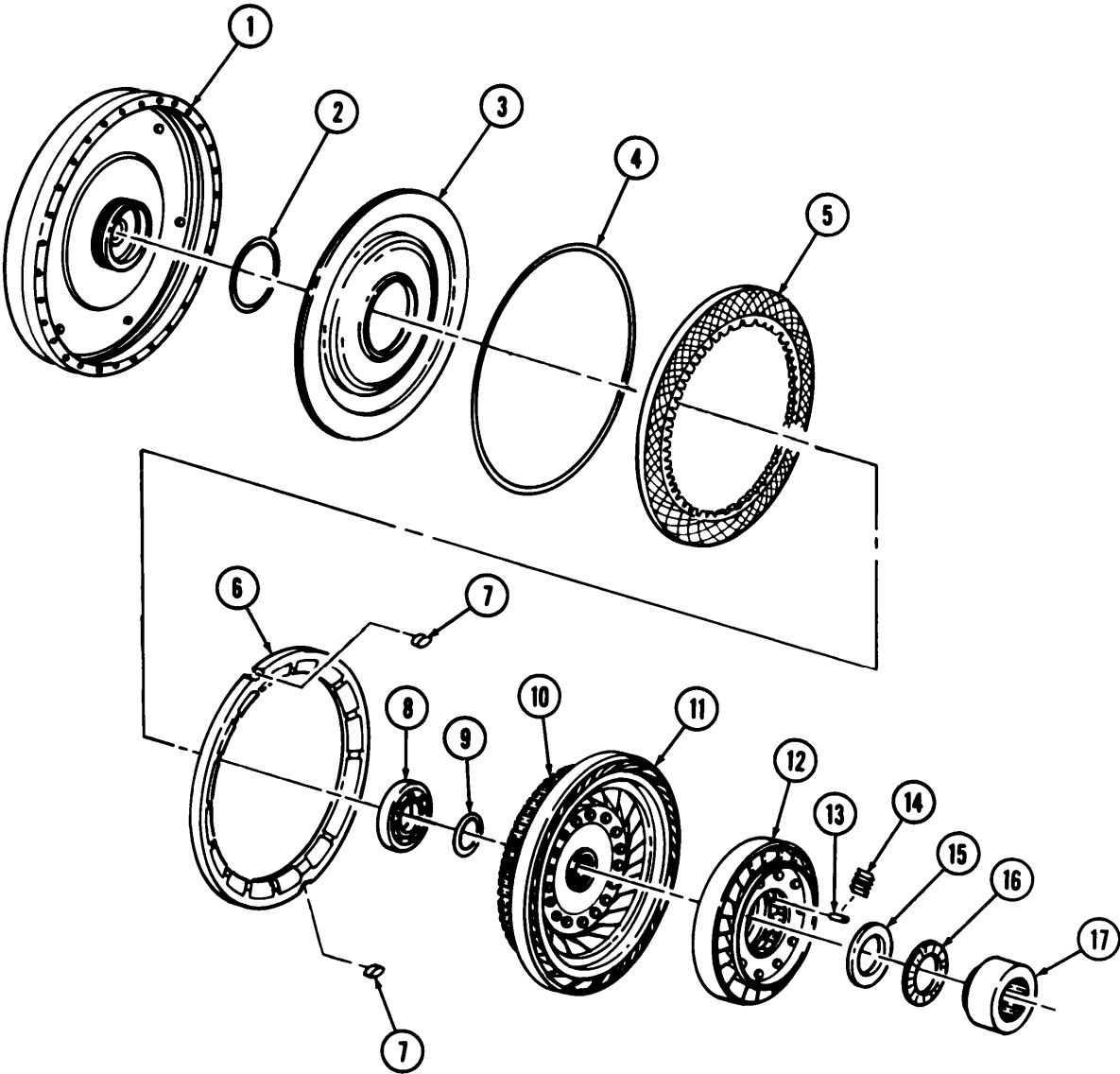


7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
13.	Converter turbine (11)	Stator(12)	Remove.	
14.	Stator (12)	Roller race (17)	Turn clockwise and lift off.	
15.		Ten rollers (13) and springs (14)	Remove.	
16.		Thrust bearing (16) and race (15)	Remove.	
17.	Flywheel (1)	Converter turbine (11)	Remove.	Must be pulled straight off, If not, turbine (11) will bind.
18.	Turbine hub (10)	Ball bearing (8) and spacer (9)	Remove.	Use special bearing puller.
19.	Flywheel (1)	Lockup clutch plate (5), backplate (6), and two backplate keys (7)	Remove.	
20.		Lockup clutch piston (3)	Place flywheel (1) up-right and remove piston (3).	a, Scribe mark on flywheel (1) and lockup clutch piston (3) for installation. b.If piston (3) sticks, tap flywheel (1) lightly with soft-faced hammer.
21.	Piston (3)	Piston seal ring (4)	Remove.	Discard.
22.	Flywheel (1)	Flywheel seal ring (2)	Remove.	Discard.

7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)

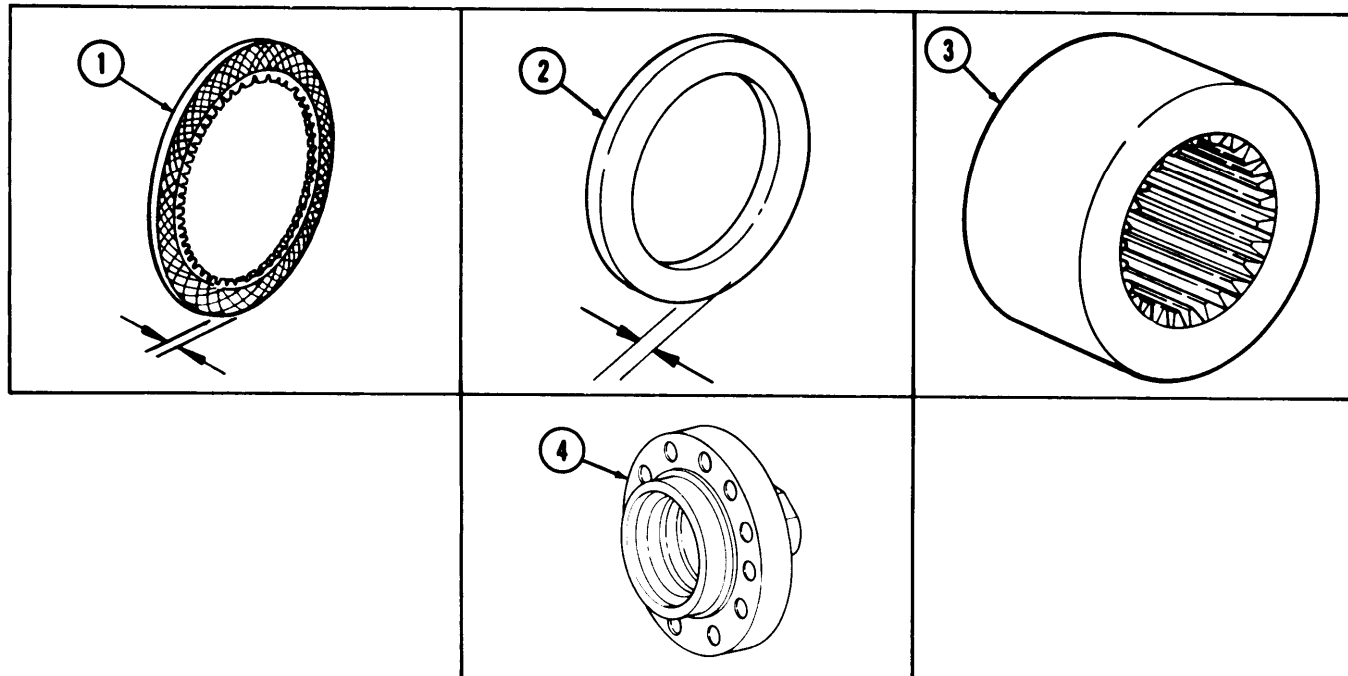
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Inspection

NOTE

Clean all parts before inspection (para 7-13).

23.	All torque converter components	Inspect.	Refer to para. 2-8 for inspection instructions.
24.	Lockup clutch disc (1)	a. Inspect for burned surfaces. b. Measure clutch disc (1) thickness.	Discard if burned. Discard if less than 0.190 in. (4.83 mm).
25.	Thrust bearing race (2)	Measure thickness.	Discard if less than 0.029 in. (.74 mm).
26.	Roller race (3)	Inspect for scoring.	Discard if scored.
26.1.	Pump hub (4)	a. Inspect for cracks, breaks, burred flats, and scored seal surface and bearing bore. b. Inspect for cracks, breaks, burred flats, and scored seal surface and bushing journal.	Applies to early model pump hub. Discard if damage is more than minor scoring. Refer to para. 2-9. Applies to late model pump hub. Discard if damage is more than minor scoring. Refer to para. 2-9.



7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)

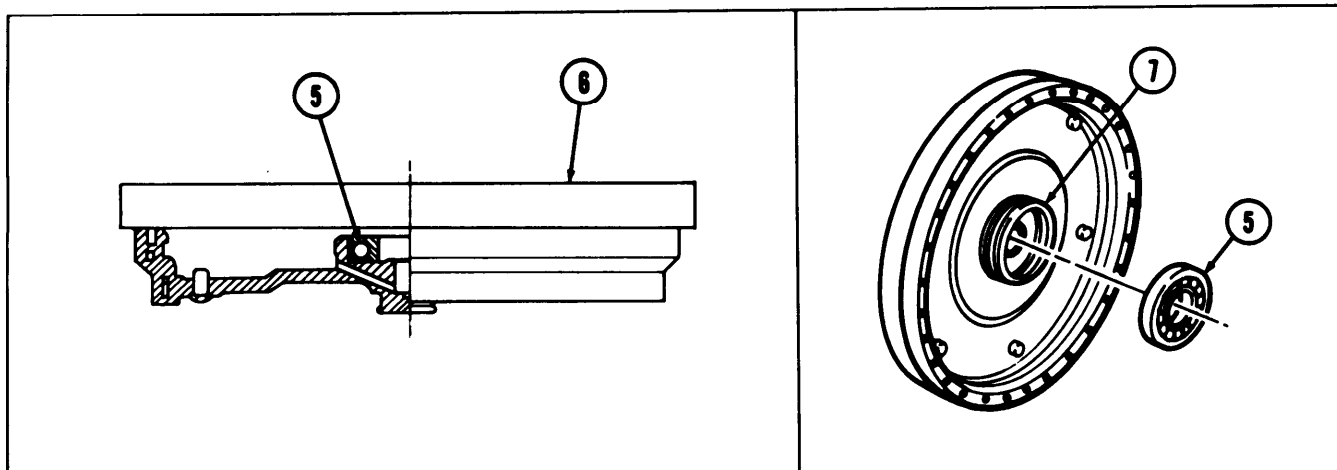
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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I d. Reassembly I

NOTE

- Steps 27 and 40 obtain measurements to select proper spacer thickness. These measuring steps are treated as assembly steps.
- Steps 27 and 28 are performed only if new bearing is being installed.

27.	Ball bearing (5)	a. Install in flywheel bore (7).	Make sure bearing (5) seats against shoulder of bore (7).
		b. Place straightedge (6) across bore (7) and measure the distance from inner race of bearing(5) to straightedge (6).	Record this measurement for use in step 40d.



17-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
28.	Flywheel (1)	Ball bearing (8)	Remove.	
29.		New piston seal ring (2)	Lubricate and install on flywheel.	Use OE/HDO-10 oil.
30.		New flywheel seal ring (4)	Lubricate and install on lockup clutch piston (3).	Use OE/HDO-10 oil.
31.		Lockup clutch piston (3)	Align previously scribed marks and install in flywheel (1).	Install cupped side first.
32.		Lockup clutch plate (5)	a. Soak in clean oil for at least two minutes. b. Install on clutch piston (3).	OE/HDO-10 oil.
33.		Two backplate keys (7)	Position in flywheel (1) recesses.	
34.		Lockup clutch backplate (6)	Install as follows: a. Position in flywheel (1) engaging notch in backplate (6) with backplate keys (7).	Backplate (6) and backplate keys (7) must be level.

CAUTION

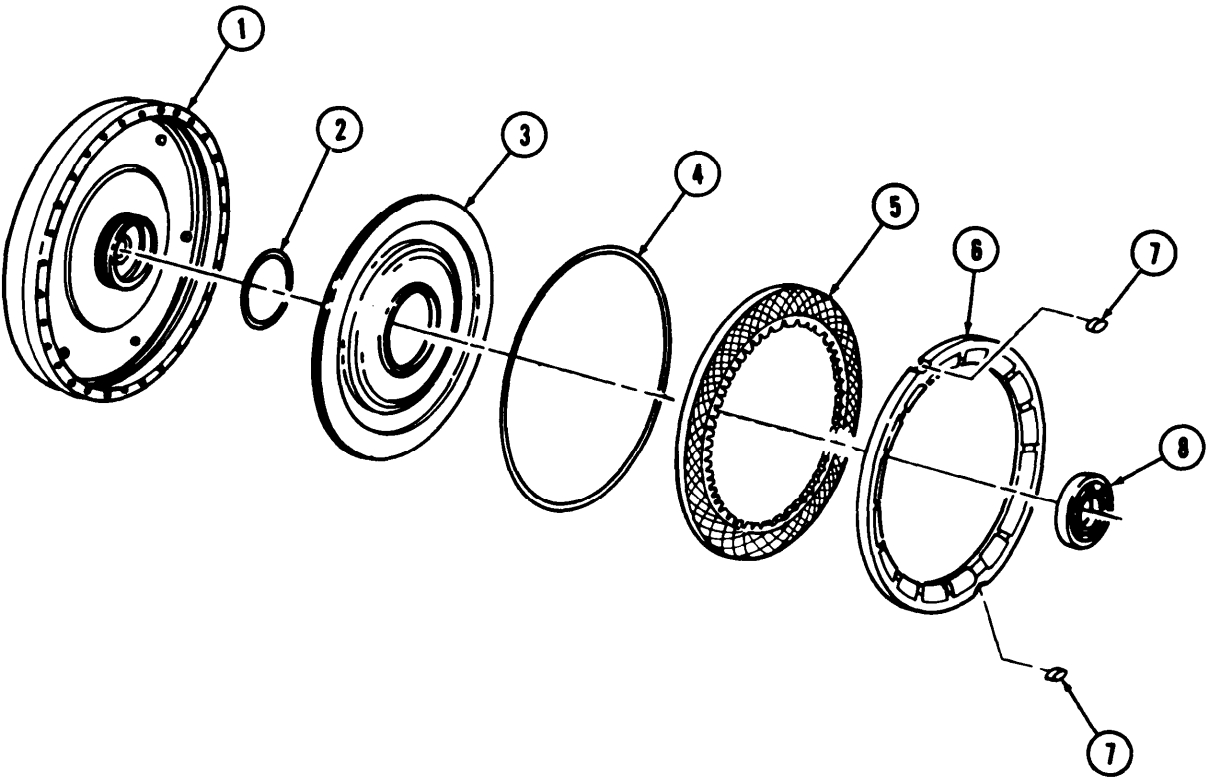
If backplate is not approximately level with the key, the lockup clutch piston is not properly engaged with the drive pins in the flywheel. Rotate the piston until it drops into plate on the pins.

NOTE

Perform step 34b only if backplate is not level with keys.

- b. Rotate piston (3) until pin holes and flywheel (1) pins are aligned.

7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)				
STEP NO.	LOCATION	ITEM	ACTION	REMARKS



7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

I Late model transmission does not have roller bearing or snapping in front bore of converter pump hub.

I Perform step 35 if bearing is to be installed in early model transmission.

35.		Roller bearing (8)	Press in converter pump hub (10) and install with snapping (7).	Use arbor press and bearing remover/installer.
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CAUTION

Identify transmission model. Late model converter pump hub has longer nose and has 1 in. (25.4 mm) long flats that fit into oil pump. Refer to para. 7-13. Do not intermix parts from early and late model transmissions. Damage to transmission will result.

38.		Bearing race (14), thrust bearing (15), and freewheel roller race (16)	Install in stator (13).	
39.		Stator (13)	Place in converter pump (6).	
39.1.		Turbine (12)	Place in converter pump (6).	

NOTE

Step 40 is performed only if new bearing was installed in early model transmission.

40.		Spacer (11)	Select size as follows: a. Place gage blocks (18) of equal height on edge of converter pump (6) as shown. b. Place straightedge (17) across gage blocks (19) and measure the distance "B" from straightedge (17) to shoulder (18) adjacent to hub of turbine (12).	Record the measurement.
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7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)

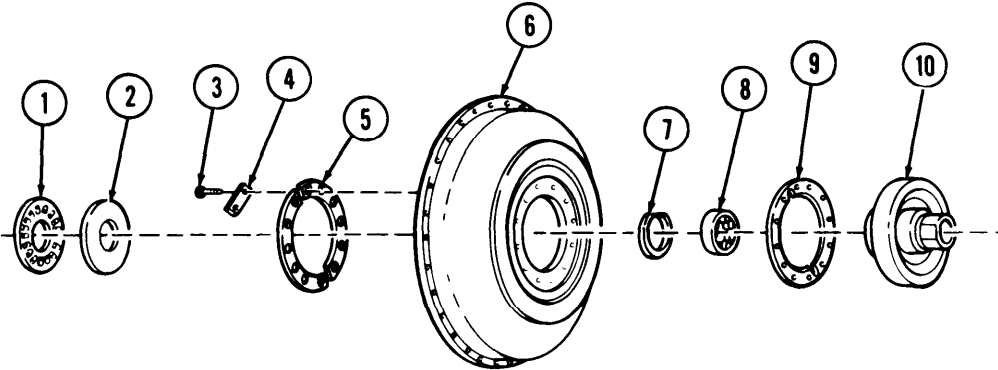
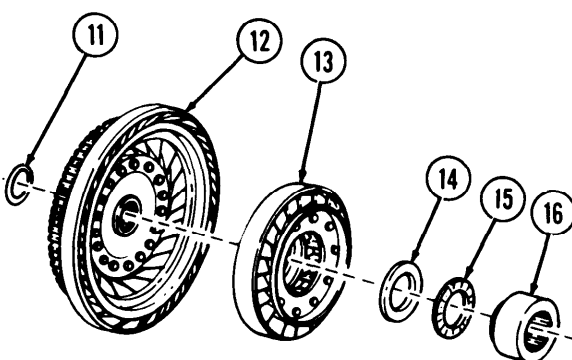
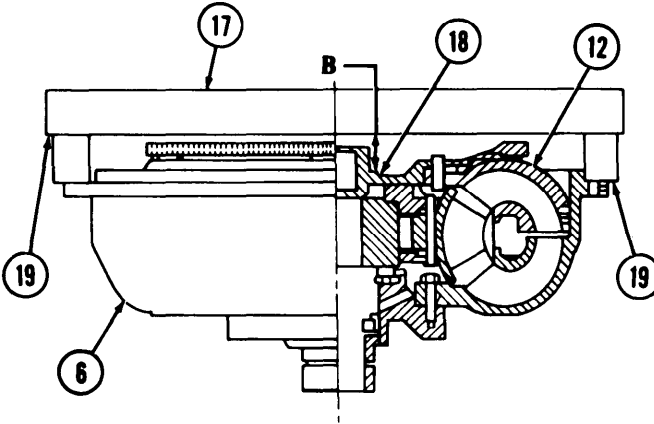
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			c. Subtract step 40b measurement from gage block height.	Record this measurement.
			d. Subtract step 40b measurement from step 27b measurement.	Refer to table 7-2 to select correct size spacer (11).
				
				
				

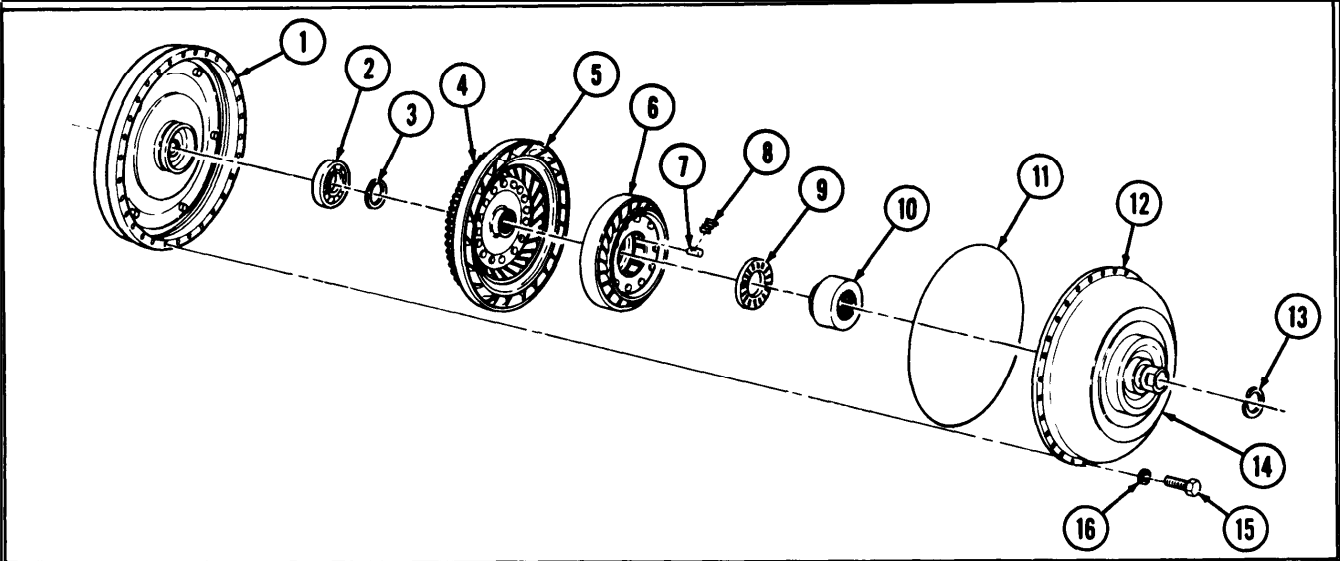
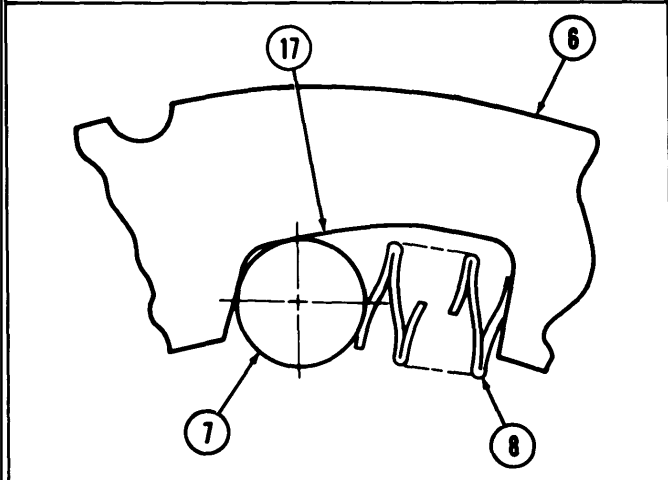
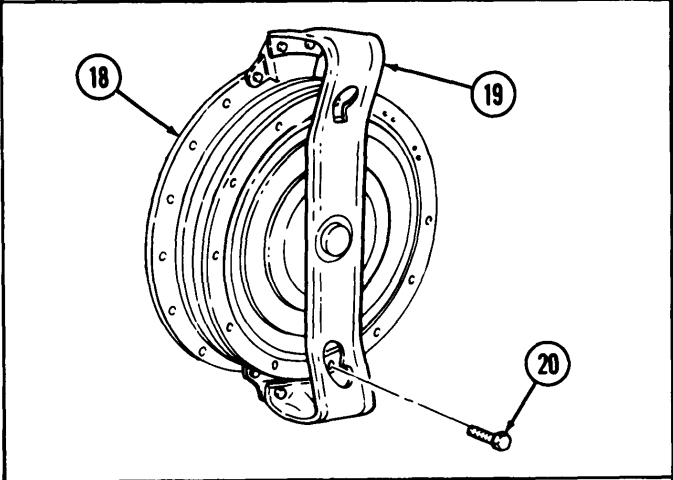
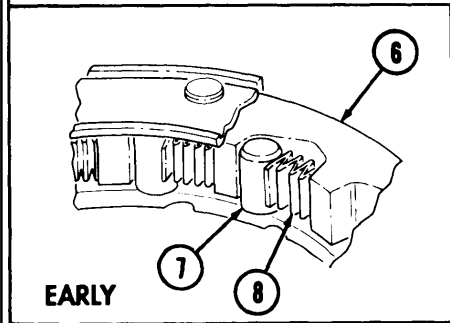
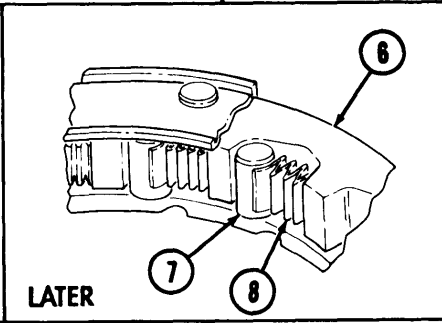
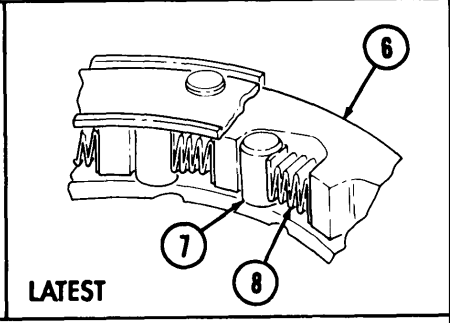
Table 7-2. Torque Converter Turbine Spacer Sizes

MEASUREMENT	SPACER
(.018-.032 in. (0.457-(.813 mm)	Gold
0.032-(.044 in. (.813- 1.1 17 mm)	Silver
(.044-(.062 in. (1.117-1.575 mm)	Plain
(.062-(.077 in. (1.575-1.956 mm)	Black
0.077-0.096 in. (1.956-2.438 mm)	Copper

7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
41.		Spacer (3)	Install on converter turbine hub (4).	
42.		Ball bearing (2)	Install on converter turbine hub (4) until seated against spacer (3).	
43.	Turbine (5)		Remove from converter pump hub (12) and install in flywheel (1).	
43.1.	Converter pump (12)	Stator (6)	Remove.	
44.	Stator (6)	Freewheel roller race (10) and thrust bearing (9)	Remove.	
NOTE				
<p>1 One of three different types of roller springs will be present in early stators as shown. Either the later or latest type should be used but all springs must be of the same type.</p> <p>1 The latest type roller springs are installed in a different manner. The old tab may be either up or down.</p>				
45.		Ten springs (8) and rollers (7)	Install as follows: a. Pack stator cam pockets (17) with oil-soluble grease. b. Position springs (8) and rollers (7) in stator cam pockets (17).	Oil soluble grease will hold springs (8) and rollers (7) in place.
46.		Thrust bearing (9)	Position to freewheel roller race (10).	Use oil-soluble grease sparingly to hold in place.
47.		Freewheel roller race (10) and thrust bearing (9)	Position in stator (6) and turn clockwise until seated on thrust bearing (9) in stator (6).	
48.		Stator (6)	Position on turbine (5).	
49.		New seal ring (11)	Lubricate and install on converter pump (12).	Use OE/HDO-10 oil.
50.		Converter pump (12)	Install on flywheel (1) with thirty new self-locking screws (15) and washers (16).	Tighten 41-49 lb-ft (56-66 N-m).
51.		New hook-type seal ring (13)	Install on converter pump hub (14).	Use on early model.

7-16. TRANSMISSION TORQUE CONVERTER REMOVAL (Cont'd)

	LOCATION	ITEM	ACTION	REMARKS
52.		Converter retaining strap (19)	Position to torque converter (18) and install with two screws (20).	
				
				
				

END OF TASK!

7-17. TRANSMISSION OIL PAN REMOVAL

This task covers:

- a. Removal
- b. Inspection

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-16	Transmission torque converter removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

(4)	Twenty-one screws (1), oil pan (2), and gasket (3)	Remove.	Discard gasket (3). Clean remains from mating surfaces.
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b. Inspection

2.	Oil pan (2)	Inspect for cracks and stripped threads.	If cracked or threads are stripped, replace.
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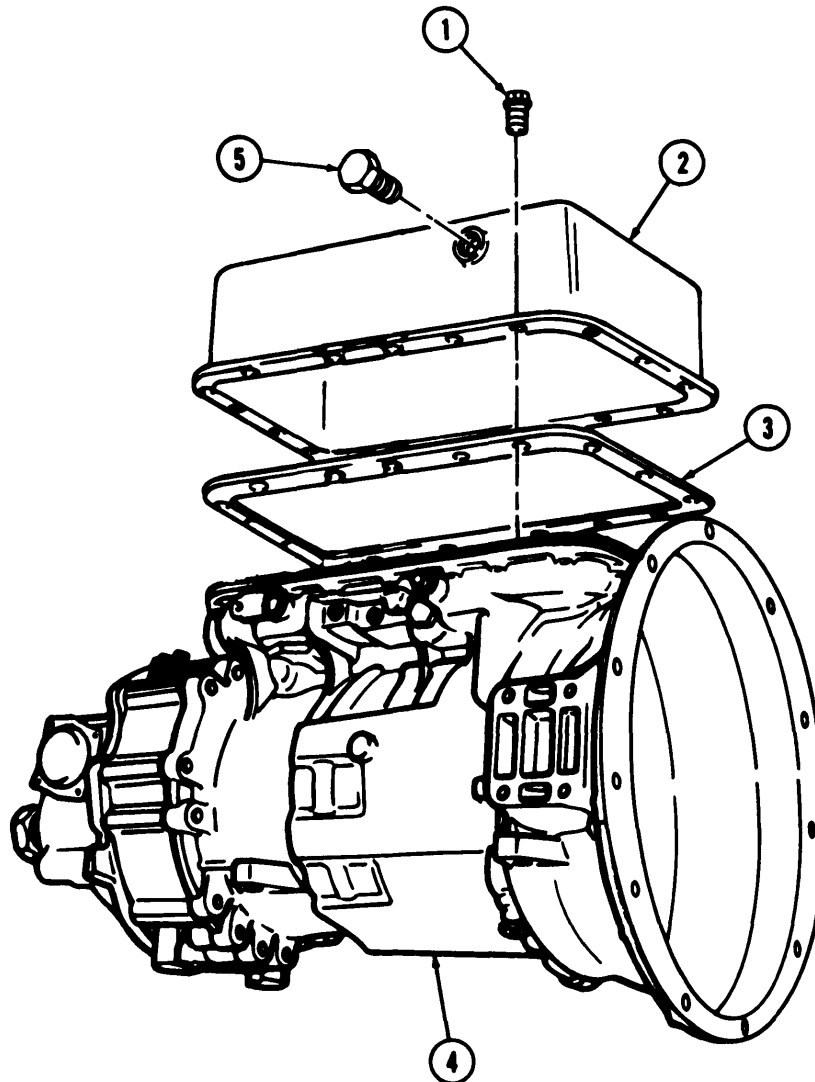
NOTE

- New oil pan has a plug in left side fill port.
- If oil pan is defective, remove plug if present.

3.	Oil plug (5)	Remove.	Retain for installation in new oil pan (2).
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7-17. TRANSMISSION OIL PAN REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

7-18. TRANSMISSION OIL FILTER REMOVAL

This task covers:

Removal**INITIAL SETUP:**

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para, 7-17	Transmission oil pan removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special</u>	<u>Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W	None	
<u>Manual References</u>		
TM9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

- | | | | | |
|----|-------------------------|---|---|-------------------------|
| 1. | | Transmission (5) | Rotate in stand until oil pan mounting surface is horizontal and facing upward. | |
| 2. | Transmission (5) | Oil filter screw (1), oil filter (2), and filter suction tube (3) | Remove. | |
| 3. | Oil filter (2) | Filter suction tube (3) | Remove. | Discard oil filter (2). |
| 4. | Filter suction tube (3) | "O" ring (4) | Remove. | Discard "O" ring (4). |

7-18. TRANSMISSION OIL FILTER REMOVAL (Cont'd)

S T E P NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 349957

7-81

7-19. MODULATED LOCKUP VALVE REMOVAL

This task covers:
Removal

INITIAL SETUP		
<u>Applicable Models</u>	<u>EQUIPMENT CONDITION Reference</u>	<u>Condition Description</u>
All	Para. 7-18	Transmission oil filter removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

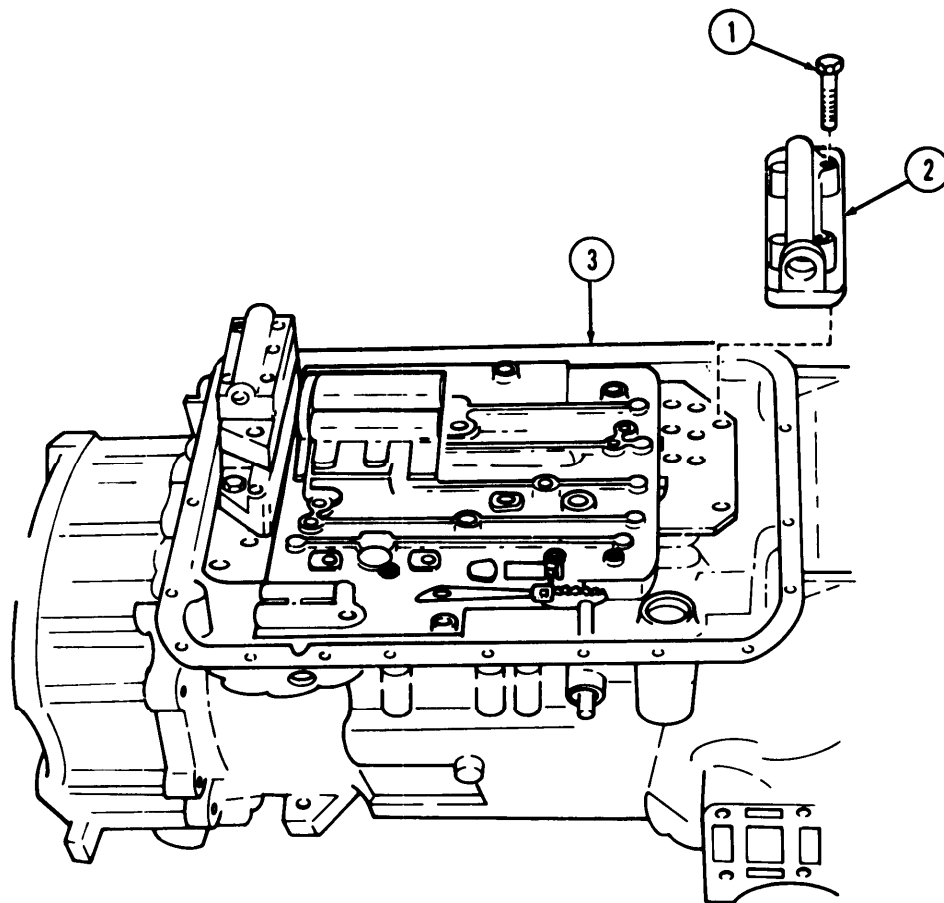
Step NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1.	Transmission (3)	Three screws (1) and modulated lockup valve (2)	Remove.	
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7-19. MODULATED LOCKUP VALVE REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 349958

7-20. LOW TRIMMER VALVE REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-19	Modulated lockup valve removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

1.

Low shift valve (3)

Six screws (1) and low trimmer valve (2)

Remove.

7-20. LOW TRIMMER VALVE REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

TA 349959

7-85

7-21. LOW SHIFT VALVE REMOVAL

This task covers:

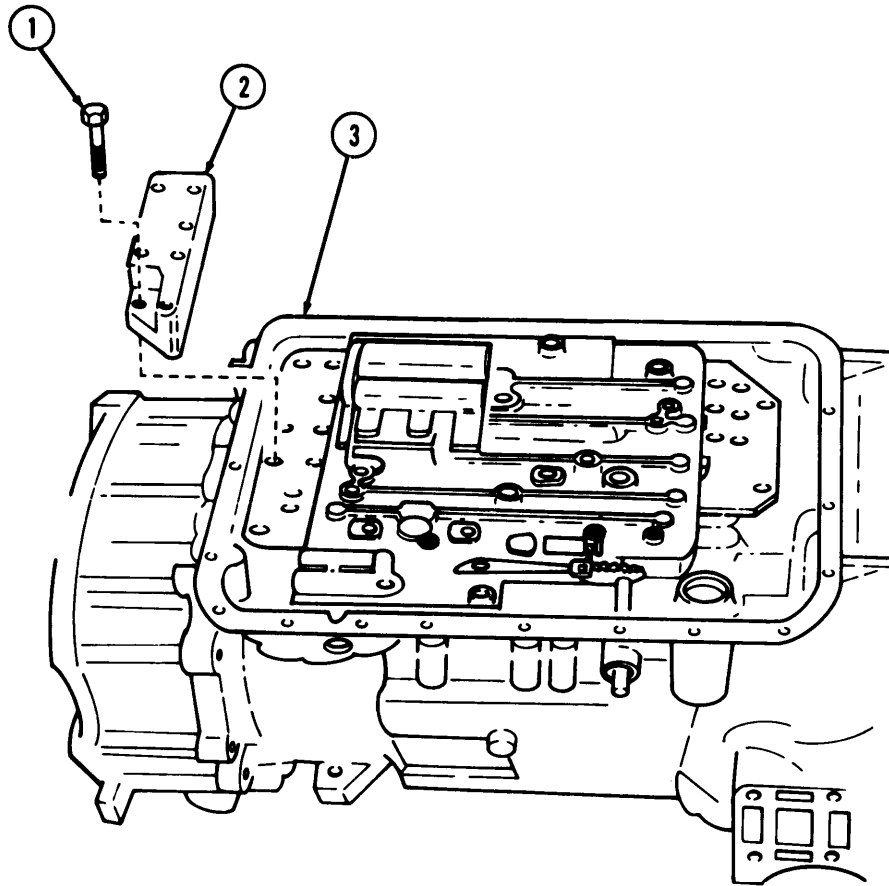
Removal**INITIAL SETUP:**

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-20	Low trimmer valve removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
Removal				
1.	Transmission (3)	Two screws (1) and low shift valve (2)	Remove.	

7-21. LOW SHIFT VALVE REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK

TA 349960

7-22. TRANSMISSION CONTROL VALVE REMOVAL

This task covers:

Removal

INITIAL SETUP:

<u>Applicable Models</u>	Equipment Condition Reference	<u>Condition Description</u>
All	Para. 7-21	Low shift valve removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

NOTE

Separate and tag screws for installation.

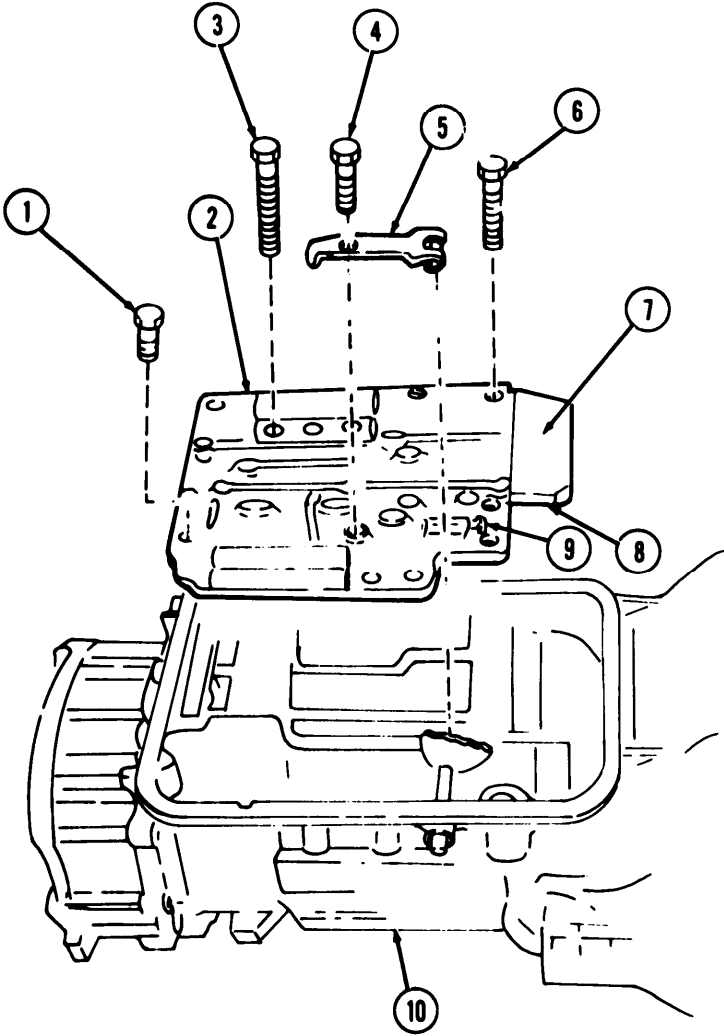
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|----|-------------------|--|---------|------------------------------------|
| 1. | Control valve (2) | Screw (4) and detent spring and roller (5) | Remove. | Screw is 2-1/2 in. (64 mm) long. |
| 2. | | Three screws (3) | Remove. | Screws are 3-1/2 in. (89 mm) long. |
| 3. | | Screw (1) | Remove, | Screw is 1-1/2 in. (38 mm) long, |
| 4. | | Fifteen screws (6) | Remove. | Screws are 3 in. (76 mm) long. |

NOTE

Do not tilt control valve to allow selector valve (9) to drop out. Selector valve may be damaged.

- | | | | | |
|----|-------------------|--|---------|--|
| 5. | Transmission (10) | Control valve (2) separator plate (7) and oil transfer plate (8) | Remove. | Remove items as an assembly and do not separate. Loose parts inside will fall free. |
|----|-------------------|--|---------|--|

7-22. TRANSMISSION CONTROL VALVE REMOVAL (Cont'd)				
STEP NO.	LOCATION	ITEM	ACTION	REMARKS



END OF TASK!

7-23. TRANSMISSION MANUAL SELECTOR SHAFT REMOVAL

This task covers:		
Removal		
INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	PARA.7-5	Transmission selector shaft oil seal removal
	PARA.7-22	Transmission control valve removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		None
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM9-2320-272-34P		

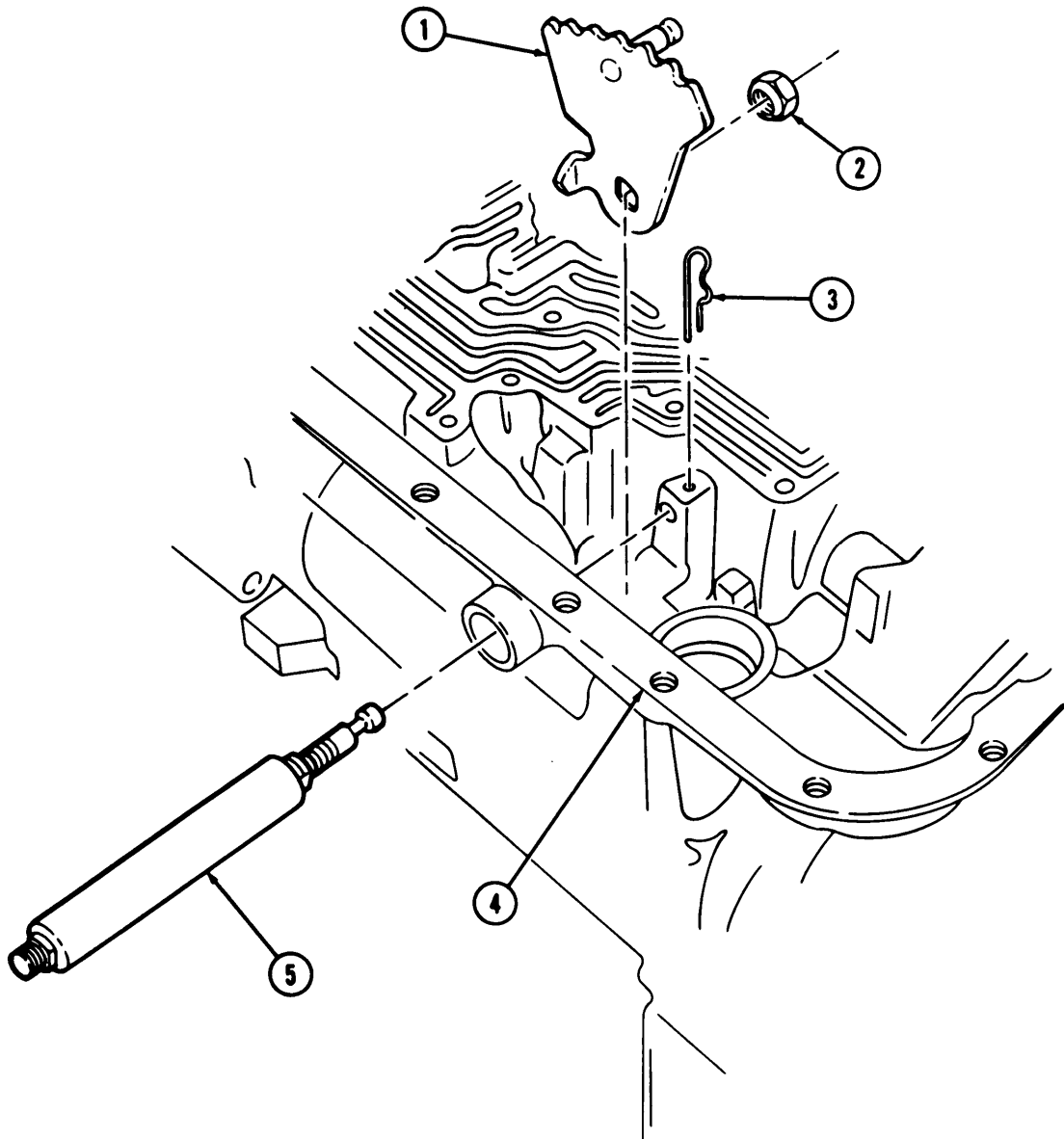
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

1.	Transmission (4)	Shrift retainer pin (3))	Remove	
2.	Manual selector shaft (5)	Nut (2) and detent lever(1)	Remove	
3.	Transmission(4)	Manual selector shall (5.)	Remove	

7-23. TRANSMISSION MANUAL SELECTOR SHAFT REMOVAL (Cont'd)

Step No.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL

This task covers:

- a. Removal
b. Disassembly

- c. Inspection
d. Reassembly

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-23	Transmission manual selector shaft removed.

Test Equipment

None

Special Tool

Front support lifter **J-24473**
Bearing installer J-24457
Driver handle J-8092
Valve pin remover J-24412-2
Slide hammer J-6125-1
Main regulator and lockup spring compressor J-24459
Adapters J-24459 (2 ea.)
Centering band J-24461
Bushing remover/installer J-36376

Special Environmental Conditions

Work area clean and free from blowing dirt and dust.

Materials/Parts

Fourteen self-locking screws
Two hook-type seal rings
Twelve washers
Oil pump seal ring
Oil pump gasket
Pump body oil seal
Valve guide pin
Lubricating oil OE/HDO-10 (Appendix C, Item 16)
Oil-soluble grease (Appendix C, Item 19)
Sealing compound (Appendix C, Item 24)

General Safety Instructions

- Keep fire extinguisher nearby when using drycleaning solvent.
- Do not use more than 30 psi (207 kPa) when cleaning with air.
- Always wear safety eyeshields when using compressed air.
- Use care when removing valve springs. Springs are under extreme compression.

Personnel Required

Wheeled vehicle repairman MOS 63W (2)

Manual References

TM 9-2320-272-34P

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Identify transmission model (para. 7-13). Late model transmission has a thicker oil pump, a bushing in oil pump hub, and a thicker oil pump hub seal. Early model has no bushing and has a thin oil pump hub seal.

- | | | |
|----|------------------|------------------------|
| 1. | Transmission (6) | Position front upward. |
|----|------------------|------------------------|

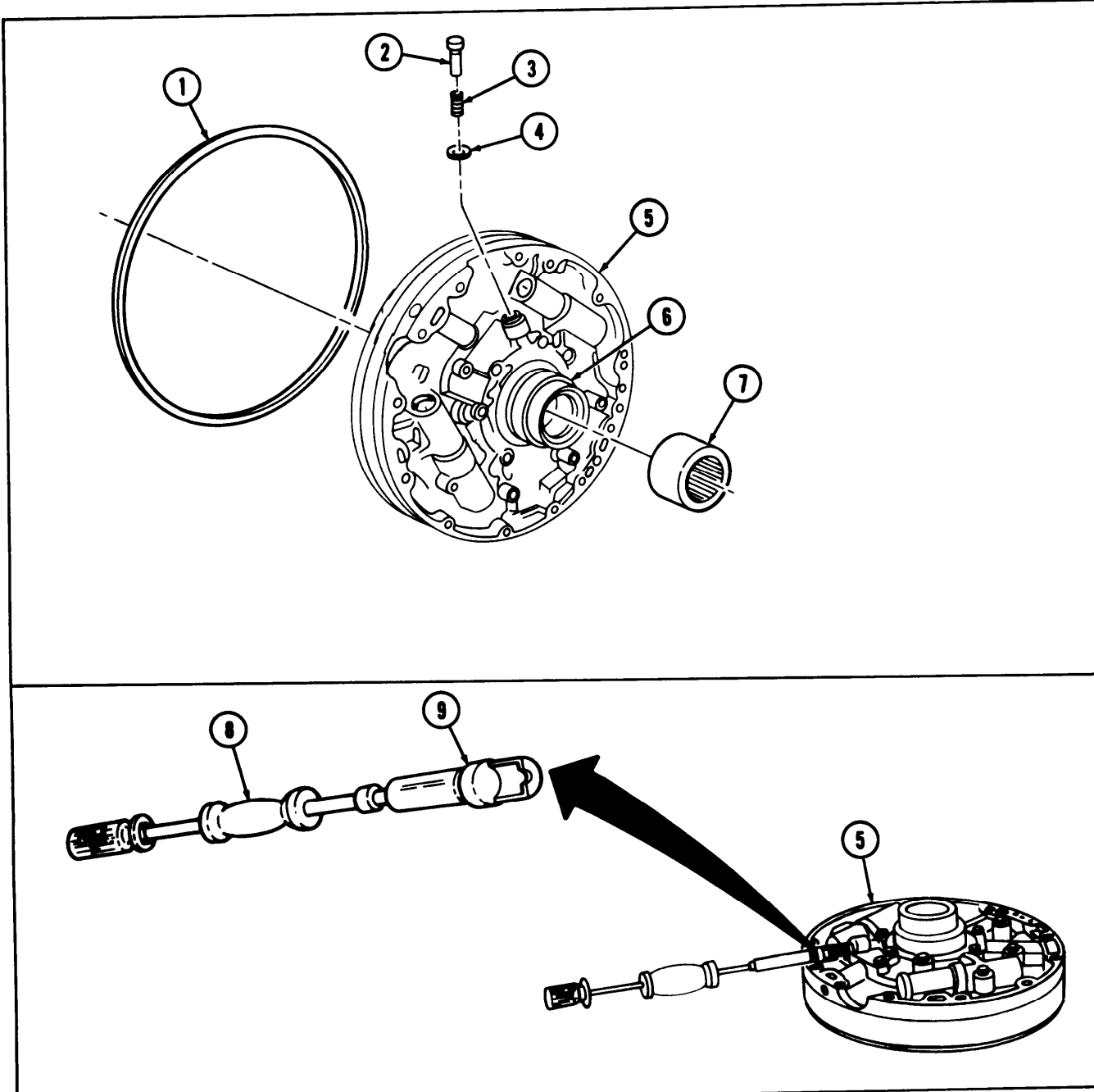
7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)
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STEP NO.	LOCATION	ITEM	ACTION	REMARKS
2.	Oil pump and front support (5) to transmission (6)	Twelve screws (2) and washers (1)	Remove.	Discard washers (1).
3.	Oil pump and front support (5)	Front support lifter (3)	Attach to converter ground sleeve (4).	
<p style="text-align: center;">NOTE Assistant will help with Step 4.</p>				
4.	Transmission (6)	Oil pump and front support (5)	Remove by lifting straight up.	Assistant may tap surface with a rubber hammer to ease removal.
5.		Oil pump gasket (9)	Remove.	Discard oil pump gasket (9).
b. Disassembly				
6.	Oil pump and front support (5)	Two hook-type seal rings (8)	Remove.	Discard seal rings (8).
7.	Oil pump and front support (5) or transmission (6)	Bearing and race (7)	Remove.	

7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
8.	Oil pump and front support (5)	Oil pump seal ring (1)	Remove.	Discard oil pump seal ring (1).
9.	Front support hub (6)	Needle bearing (7)	Remove only if replacement is required.	
10.	Oil pump and front support (5)	Valve pin remover tool (9)	a. Install on slide hammer (8). b. Attach between coils of spring (3) and valve guide pin (2).	
<p style="text-align: center;">NOTE Assistant will help with step 11.</p>				
11.		Valve guide pin (2), valve spring (3), and converter pressure regulator valve (4)	Remove.	Discard valve guide pin (2). Tag valve spring (3) for installation.

7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
 <p>The diagram is divided into two sections. The top section shows a perspective view of the transmission oil pump assembly. Callout 1 points to the pump cover. Callouts 2, 3, and 4 point to a bolt and nut assembly. Callout 5 points to the pump housing. Callout 6 points to a pin. Callout 7 points to a filter. The bottom section shows a perspective view of the front support assembly. Callout 8 points to the support arm. Callout 9 points to the support bracket. A large black arrow points from the front support assembly towards the pump assembly, indicating the removal of the front support.</p>				

7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cent'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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WARNING

Regulator valve spring is under approximately 65 lb (29 kg) compression. Do not remove retaining snapping until compressor is in place as regulator valve spring will fly out causing injury.

12.		Main regulator and lockup spring compressor (6)	Attach to front support (5) and tighten screws (2).	For transmissions with serial number 21628 and higher, use two adapters with spring compressor (6). Tighten to relieve spring compression.
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NOTE

Perform steps 12.1 and 12.2 for transmissions with serial numbers 21268 and higher.

12.1. Oil pump (1) and front support (5)	11elve self-locking screws (4 and two self-locking screws (3)	Remove and separate oil pump (1) from front support (5).	Mark location for installation. Discard self-locking screws (4) and (2).
12.2. Front support (5)	Two cross pins (7)	Remove.	

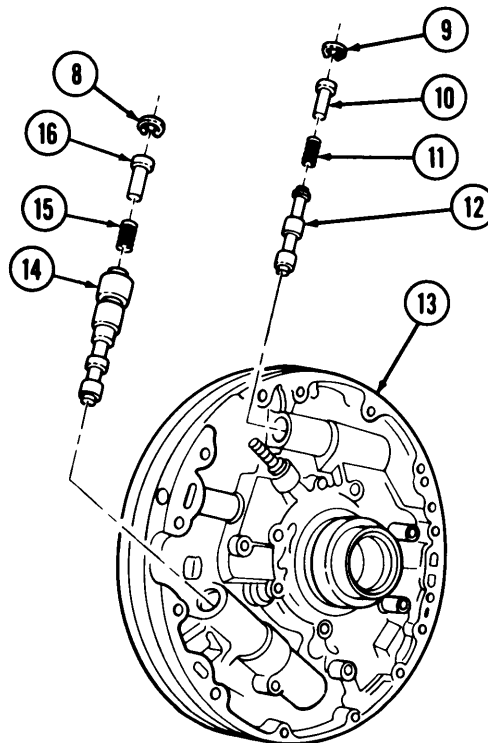
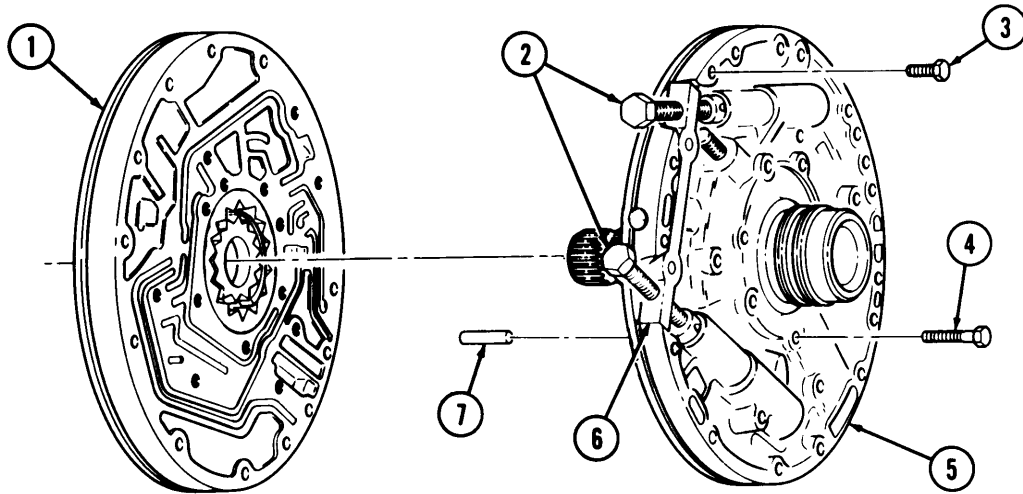
NOTE

Perform step 13 for transmissions with serial numbers prior to 21628.

13. Oil pump and front support (13)	Snaprings (8) and (9)	Remove.	
14.	Main regulator and lockup spring compressor (6), valve Stops (10) and (16), valve springs (11) and (15), regulator valve (14), and lock-up valve (12)	Carefully remove and detach from front support (5), valve stops (10) and (16), valve springs (11) and (15), regulator valve (14), and lockup valve (12).	Mark locations for installation. Tag valve springs (11) and (15) for installation.

7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)

STEP No.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

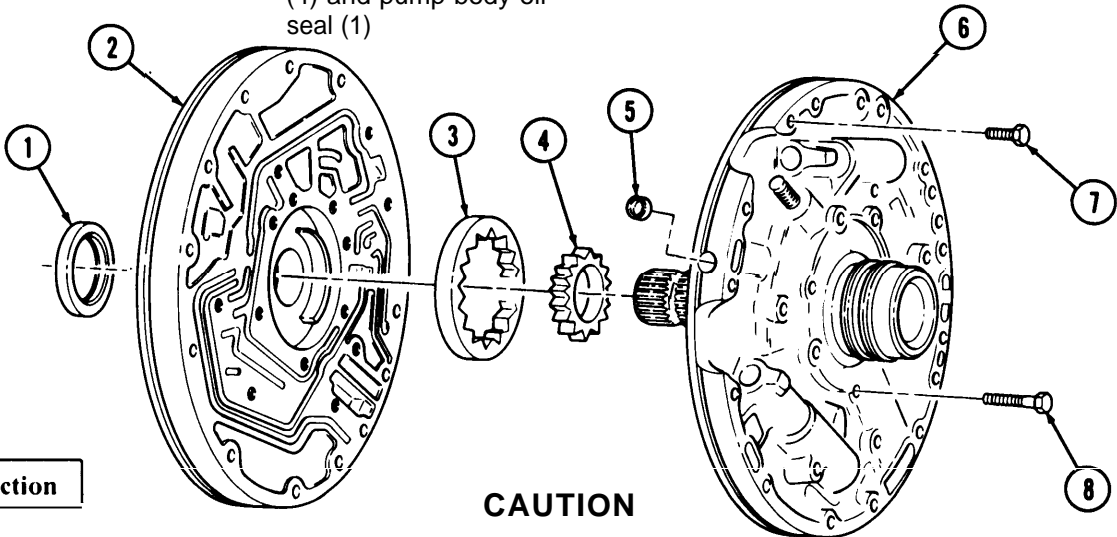
Perform step 15 for transmissions with serial numbers prior to 21628.

15.	Oil pump (2) to front support (6)	Twelve self-locking screws (8) and two self-locking screws (7)	Remove and separate oil pump (2) from front support (6).	Mark location for installation and discard self-locking screws (7) and (8).
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NOTE

Do not perform steps 16 and 17 unless relative movement is apparent between ground sleeve and front support.

16.	Front support (6)	Plug (5)	Remove if necessary.	Remove only if loose or damaged.
17.	Oil pump body (2)	Oil pump gears (3) and (4) and pump body oil seal (1)	Remove.	Discard oil seal (1).



c. Inspection

CAUTION

Early model and late model converter pump hub, front support, seals, and oil pump are not interchangeable. Do not intermix parts from early and late transmissions. Damage to transmission will result.

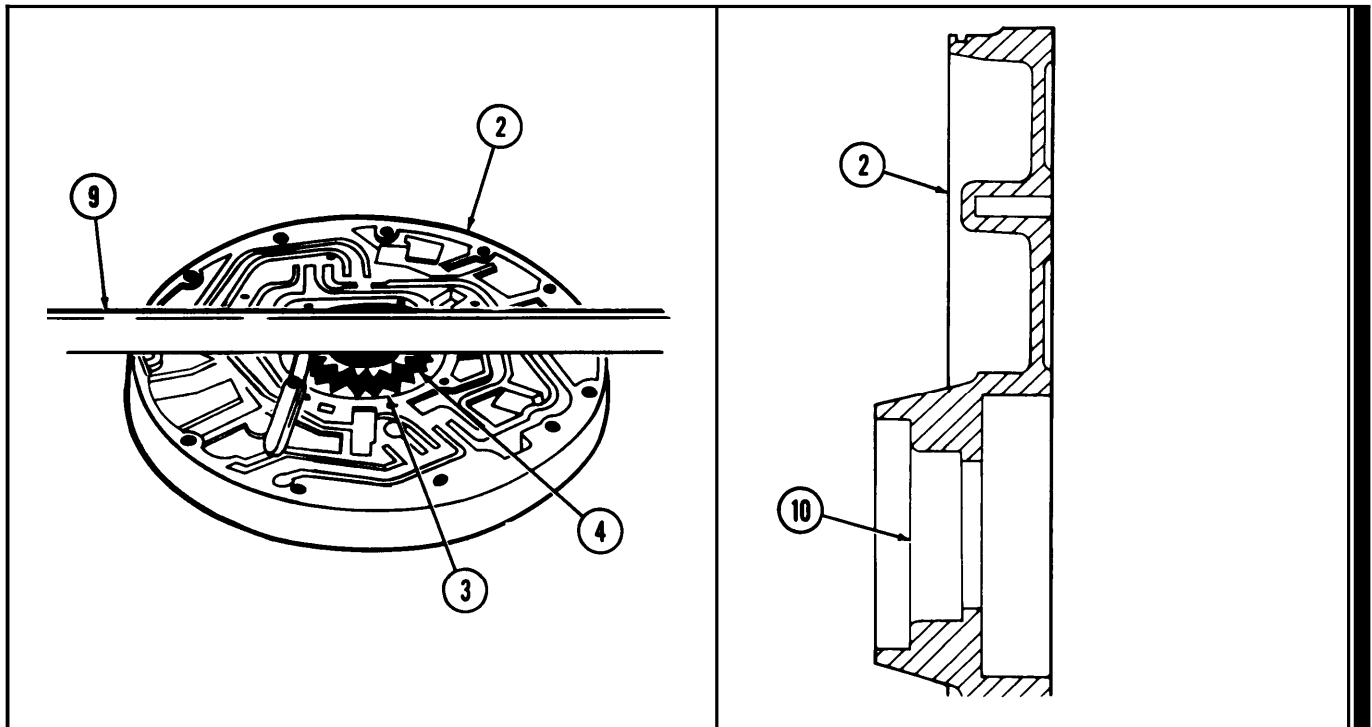
NOTE

Clean all parts before inspection (para. 7-13).

18.	All oil pump and front support components	Inspect.	Refer to para. 2-8 for inspection instructions.
19.	Oil pump gears (3) and (4)	a. Inspect for broken teeth. b. Install in pump body (2). c. Place straight-edge (9) across oil pump (2) face.	Discard if broken.

7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL Cont'd

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			d. Measure clearance between straight-edge (9) and gear (3).	If clearance is more than .0020 in. (0.51 mm), replace with thicker gear (3). Repeat steps 19b, 19c, and 19d.
<p style="text-align: center;">NOTE</p> <p>Perform step 19.1 for late model transmissions only. Early model transmissions do not have bushing.</p>				
19.1. Oil pump (2)		Bushing (10)	<p>a. Measure inside diameter at 5 o'clock position when viewed from front.</p> <p>b. Inspect for scoring.</p> <p>c. Inspect for discoloration due to overheating.</p>	<p>Maximum wear limit is 2.257 in. (57.33 mm). Brass backing showing through is acceptable if wear limit is not exceeded.</p> <p>Replace if scoring can be felt. Use installer/remover tool and arbor press.</p> <p>Replace if discolored.</p>



7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
20.		All springs (2)	a. Inspect for discoloration due to over-heating. b. Inspect for broken coils or coils distorted due to wear. Using spring tester (1), inspect for serviceability by checking load when spring (2) is compressed to the correct length (table 7-3).	Discard if discolored. Discard if broken or distorted. Discard if spring (2) does not give the correct load (table 7-3).

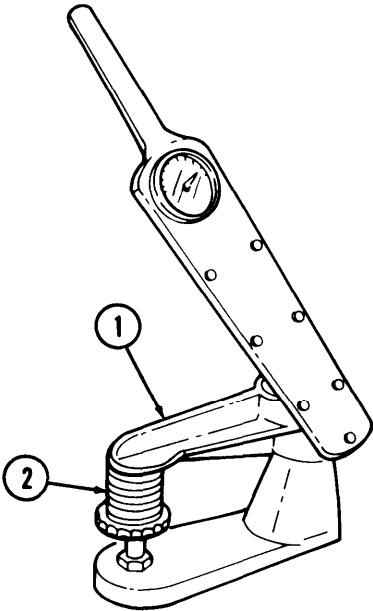


Table 7-3. Spring Data

SPRING	COLOR	FREELNGTH	COMPRESSED LENGTH	UNDERLOAD
Main pressure regulator valve spring	Green	3.57 in. (90.7 mm)	2.01 in. (51.0 mm)	70.6-76.6 lb 314-341 N)
Converter pressure regulator valve spring	Blue	1.24 in. (31.5 mm)	1.05 in. (26.7 mm)	33.1 -40.5 lb (147-180 N)
Lockup valve	Yellow	2.84 in. (72.1 mm)	1.46 in. (37.1 mm)	26.1 -28.9 lb (116-129N)

7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Reassembly

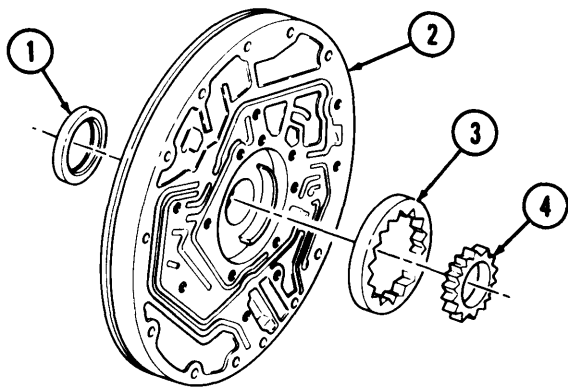
CAUTION

Oil seals for early and late model oil pumps are not interchangeable (para. 7-13).

NOTE

- Coat all internal parts except oil pump with lubricating oil OE/HDO-10 prior to reassembly.
- Perform steps 21 and 22 only if gears and oil seal were removed.

21.		New oil pump body seal (1)	a. Coat outside diameter with grease sealing compound. b. Install in oil pump body (2) 0.030-0.050 in. (0.76-1.27 mm) below outer edge of bore. c. Coat seal(1) lip with grease.	Use oil-soluble grease. Install spring loaded lip first. Use depth micrometer for measurement. Use oil-soluble grease.
22.		Oil pump gears (3) and (4)	Install.	



23.		Regulator valve (11) and lockup valve (9), valve springs (12) and (8), and valve stops (x3) and (7)	Install in front support (10) at location marked during disassembly.	For transmissions with serial numbers 21628 and higher, use two adapters (16) with spring compressor (14).
24.		Main regulator and lockup spring compressor (14)	Attach to front support (10) and tighten two new self-locking screws (15).	Tighten screws (15) until snapping grooves or crosspin holes are visible in front of valve stops.

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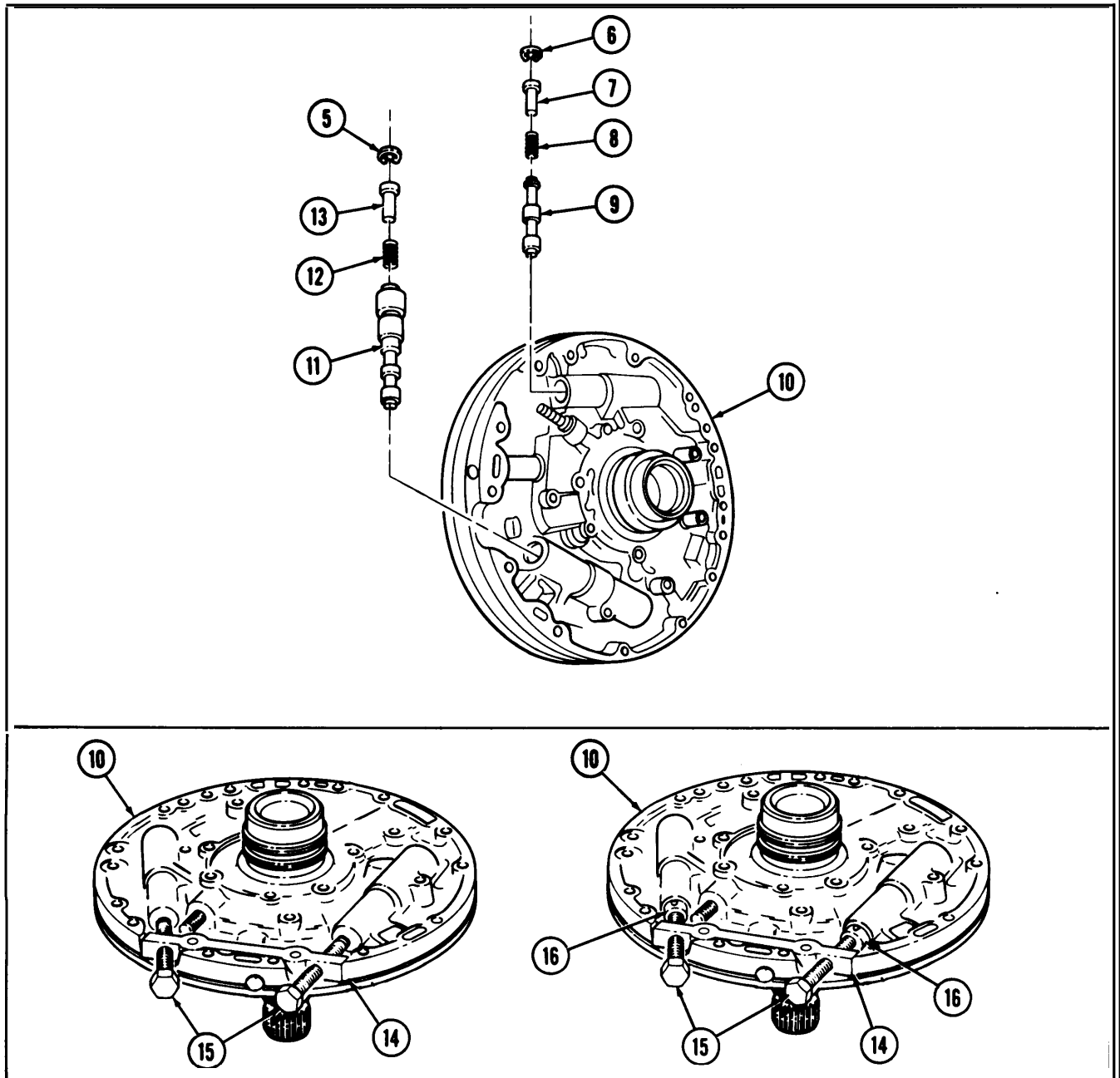
7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Perform step 25 for transmissions with serial numbers prior to 21628.

25.		Snappings (5) and (6)	Install over valve stops (13) and (7).	Tighten screws (15) until snapping grooves are visible in front of valve stops (7) and (13).
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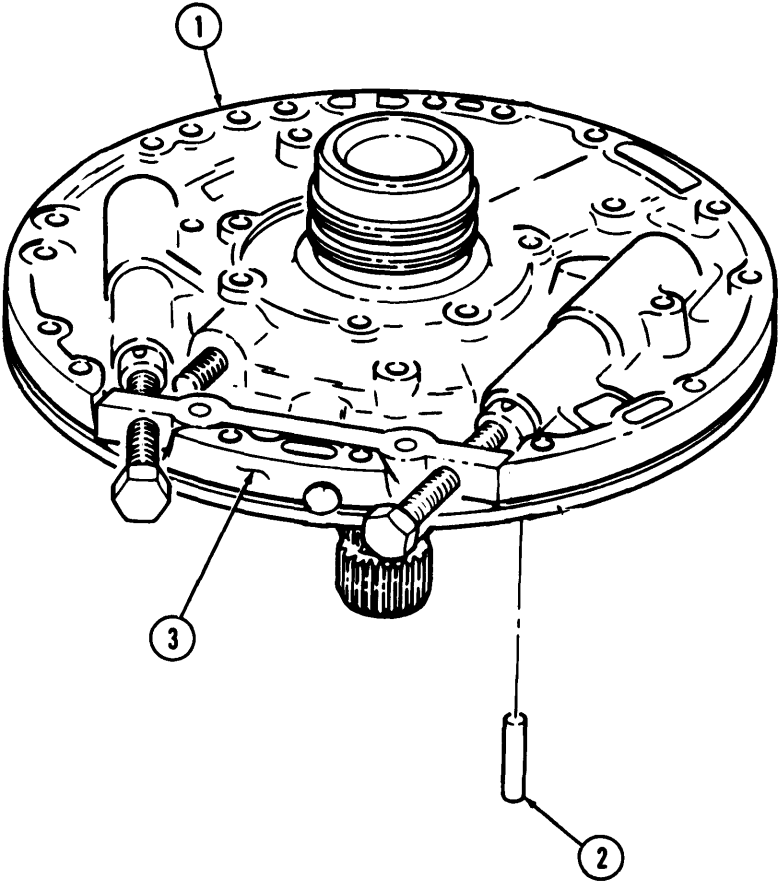
7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

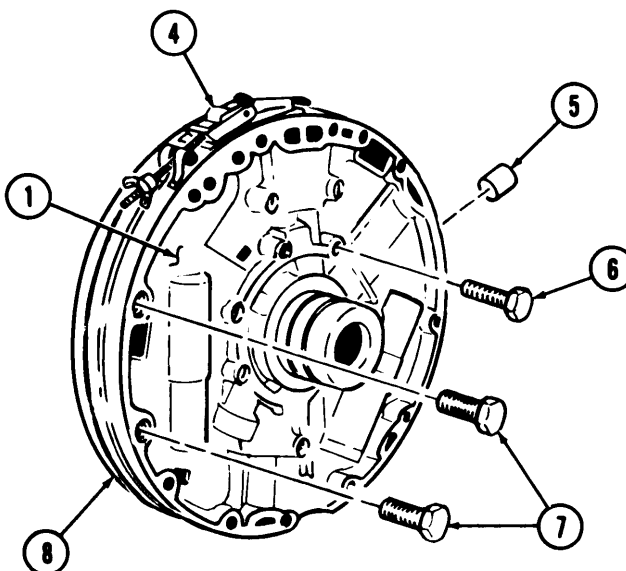
Perform step 26 for transmissions with serial numbers 21628 and higher.

- | | | |
|-----|--|--|
| 26. | Two cross pins (2) | Install in pin holes of front support (1). |
| 27. | Main regulator and spring compressor (3) | Detach from front support (1) and remove. |



7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
28.		Plug (5)	Install in front support (1).	Perform only if removed previously.
29.		Oil pump (8)	a. Position to front support (1) and align holes for screws (6) and (7). b. Install to front support (1) with two new self-locking screws (6) positioned 180 degrees apart.	Finger tighten screws (6).
30.		Centering band (4)	Install around oil pump (8).	
31.		Oil pump (8)	Install to front support (1) with remaining ten new self-locking screws (6) and two new self-locking screws (7).	Tighten screws (6) 17-20 lb-ft (23-27 Nom). Tighten screws (7) 36-42 lb-ft (49-57 N=m).
32.	Oil pump (8) to front support (1)	Centering band (4)	Remove and check separation line between oil pump (8) and front support (1).	If mating point between oil pump (8) and front support (1) is not perfectly smooth by touch, loosen screws (6) and (7) and centering band (4). Repeat steps 30 through 32.



7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Perform step 33 only if needle bearing was previously removed.

33.		Needle bearing (3)	a. Position on ground sleeve (4). b. Press into ground sleeve (4) 1.240-1.260 in. (31.496-32.0 mm) below outer edge of bore.	Numbered end of bearing (3) must face out Use bearing installer and drive handle.
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NOTE

Perform steps 34 and 35 only if pressure regulator valve was previously removed.

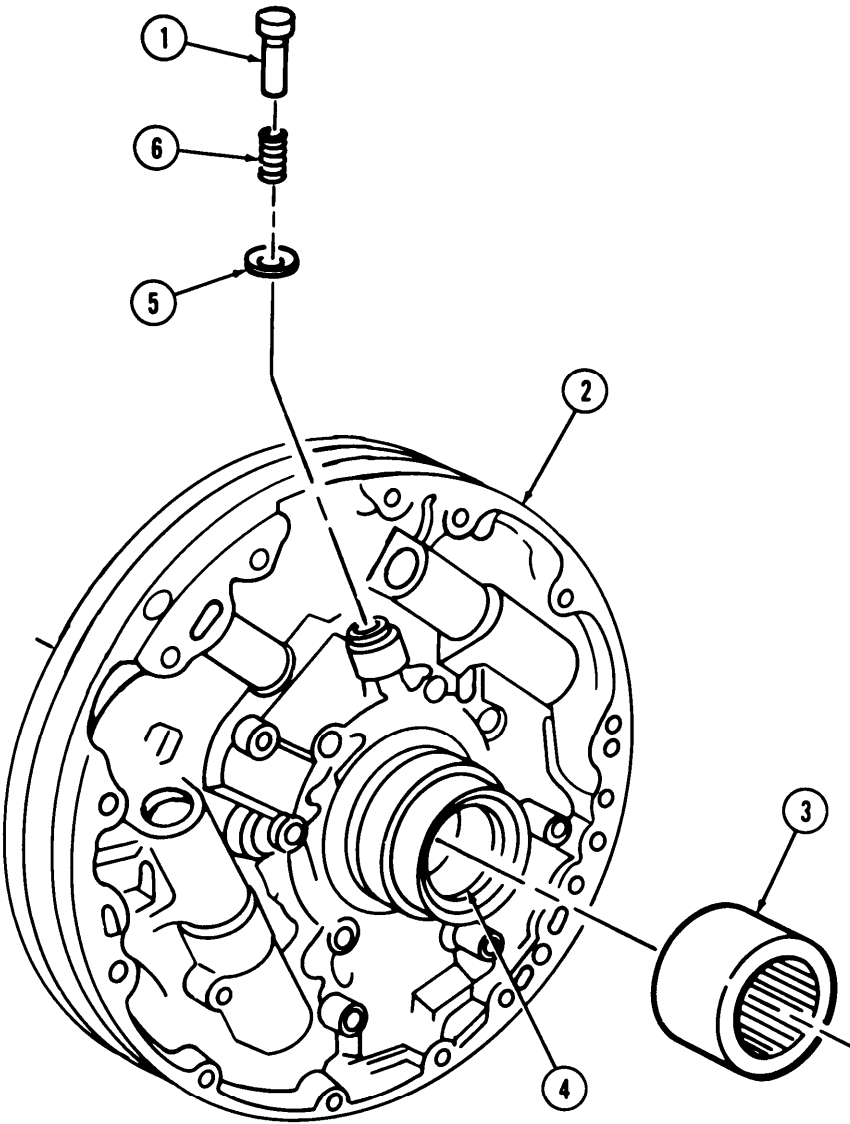
34.		Spring (6) and converter pressure regulator valve (5)	Place on new valve guide pin (I).	
35.		New valve guide pin (1)	Press into front support (2) until pin (1) extends 1.16-1.20 in. (29.46-30.48 mm) above finished surface.	

NOTE

Two seal rings for front support hub are installed when oil pump and front support are installed in transmission (para. 7-51).

7-24. TRANSMISSION OIL PUMP AND FRONT SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

7-25. TURBINE SHAFT REMOVAL

This task covers:

- a. Removal
- b. Disassembly
- c. Inspection
- d. Reassembly

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 7-24	Transmission oil pump and front support removed.
Test Equipment		
None		
Special Tool		Special Environmental Conditions
Compressor tool J-6438-01		Work area clean and free from blowing dirt and dust.
Forward clutch clearance gage J-29146		
Materials/Parts		General Safety Instructions
Three turbine shaft seal rings		• Keep fire extinguisher nearby when using drycleaning solvent.
Piston inner seal ring		• Do not use more than 30 psi (207 kPa) when cleaning with air.
Piston outer seal ring		• Eyeshields must be worn when using compressed air.
Shim stock 0.094 x 0.020 x 3 in. (six)		
Lubricating oil OE/HDO-10		
(Appendix C, Item 16)		
Oil-soluble grease (Appendix C, Item 19)		
Personnel Required		
Wheeled vehicle repairman MOS 63W		
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1. Transmission (5)
- Forward clutch and turbine shaft (1)
- Lift straight out.

NOTE

Perform step 2 for transmissions with three-piece bearing.

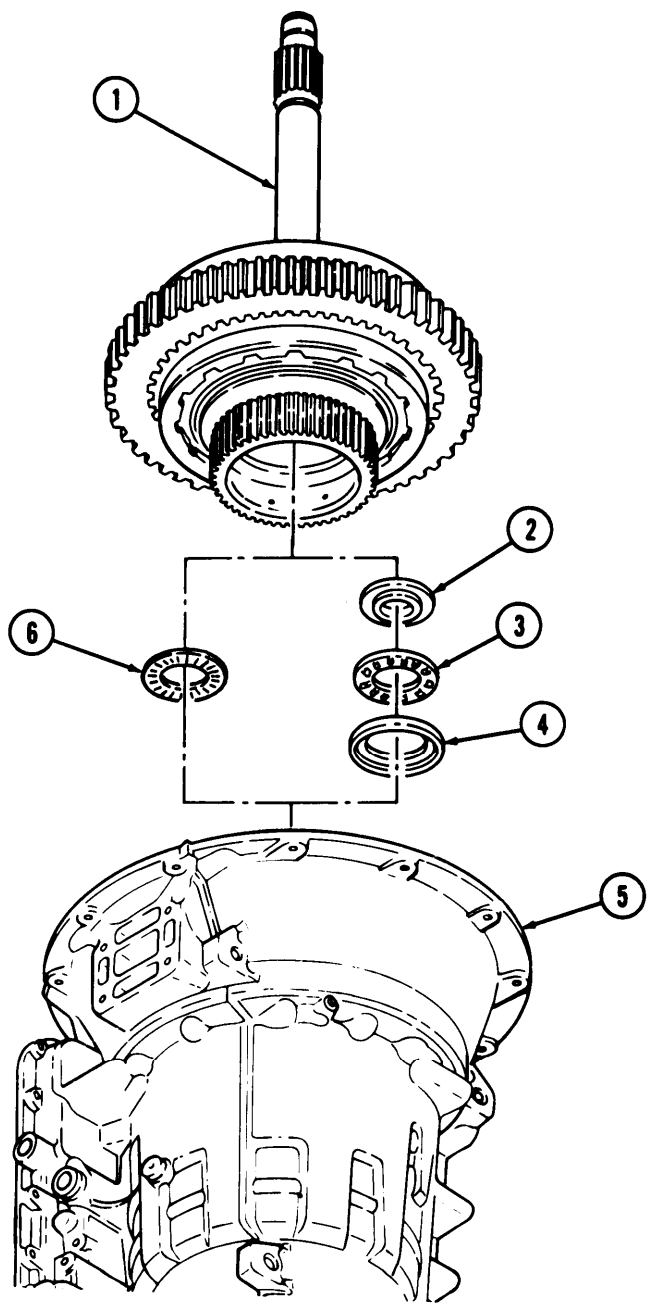
2. Turbine shaft (1)
- Bearing race (2) roller bearing (3) and bearing race (4)
- Remove.

NOTE

Perform step 2.1 for transmissions with single-piece bearing assembly.

- 2.1. Turbine shaft (1)
- Bearing assembly (6)
- Remove.

7-25. TURBINE SHAFT REMOVAL (Cont'd)				
STEP NO.	LOCATION	ITEM	ACTION	REMARKS

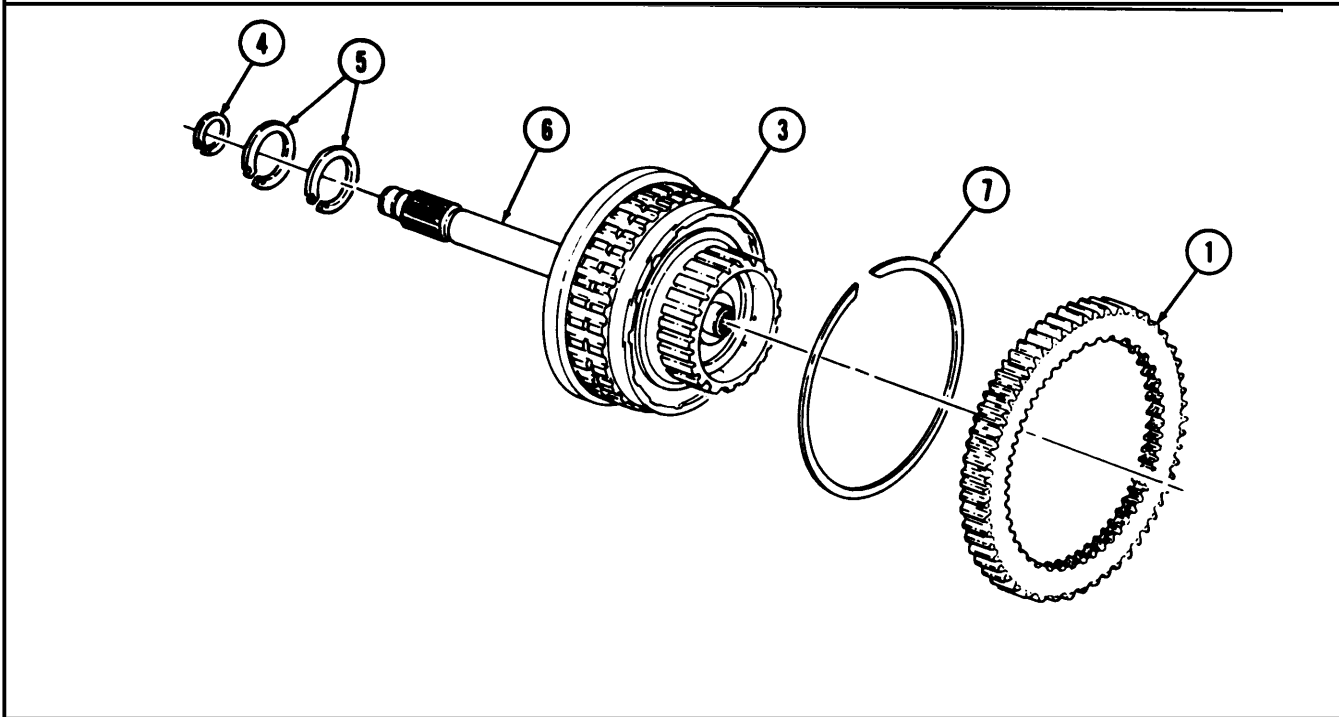
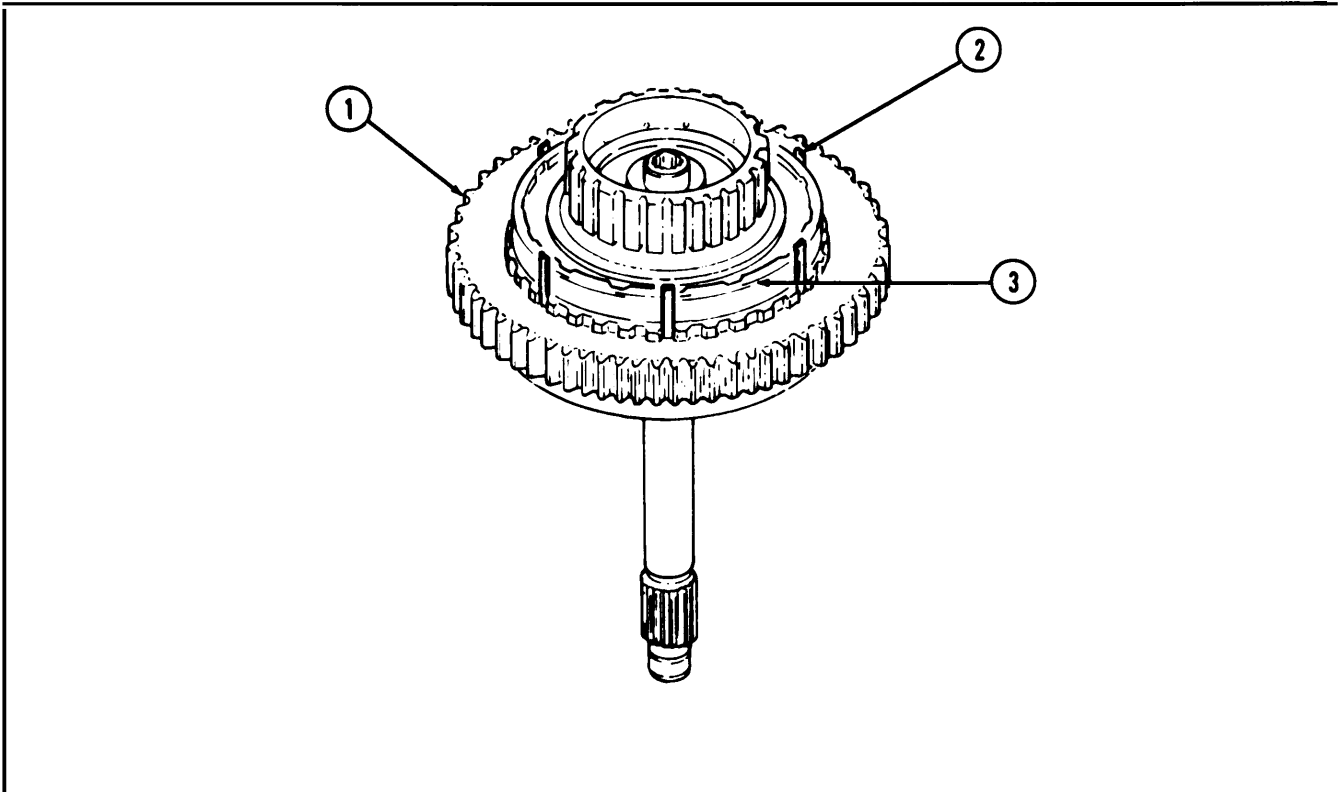


7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Disassembly				
3.	Turbine shaft (6)	Seal ring (4) and two seal rings (5)	Remove.	Discard seal ring (4) and two seal rings (5).
4.	Power takeoff drive gear (1)	Snapring (7)	a. Locate snapring (7) gap and clutch housing (3) cutnut nearest snapring (7) gap. b. Press snapring (7) into groove in clutch housing (3) and insert one piece of shim stock (2) between snapring (7), PTO gear (1), and clutch housing (3) teeth. c. Repeating step 4b, insert remaining pieces of shim stock (2) approximately 5 in. (127 mm) apart.	Support on arbor press. Use six pieces of shim stock 0.094 x 0.020 x 3 in.
5.	Forward clutch housing PTO gear (1) (3)		Lift off clutch housing (3).	
6.		Snapring (7) and shim stock (2)	Remove from clutch housing (3).	

7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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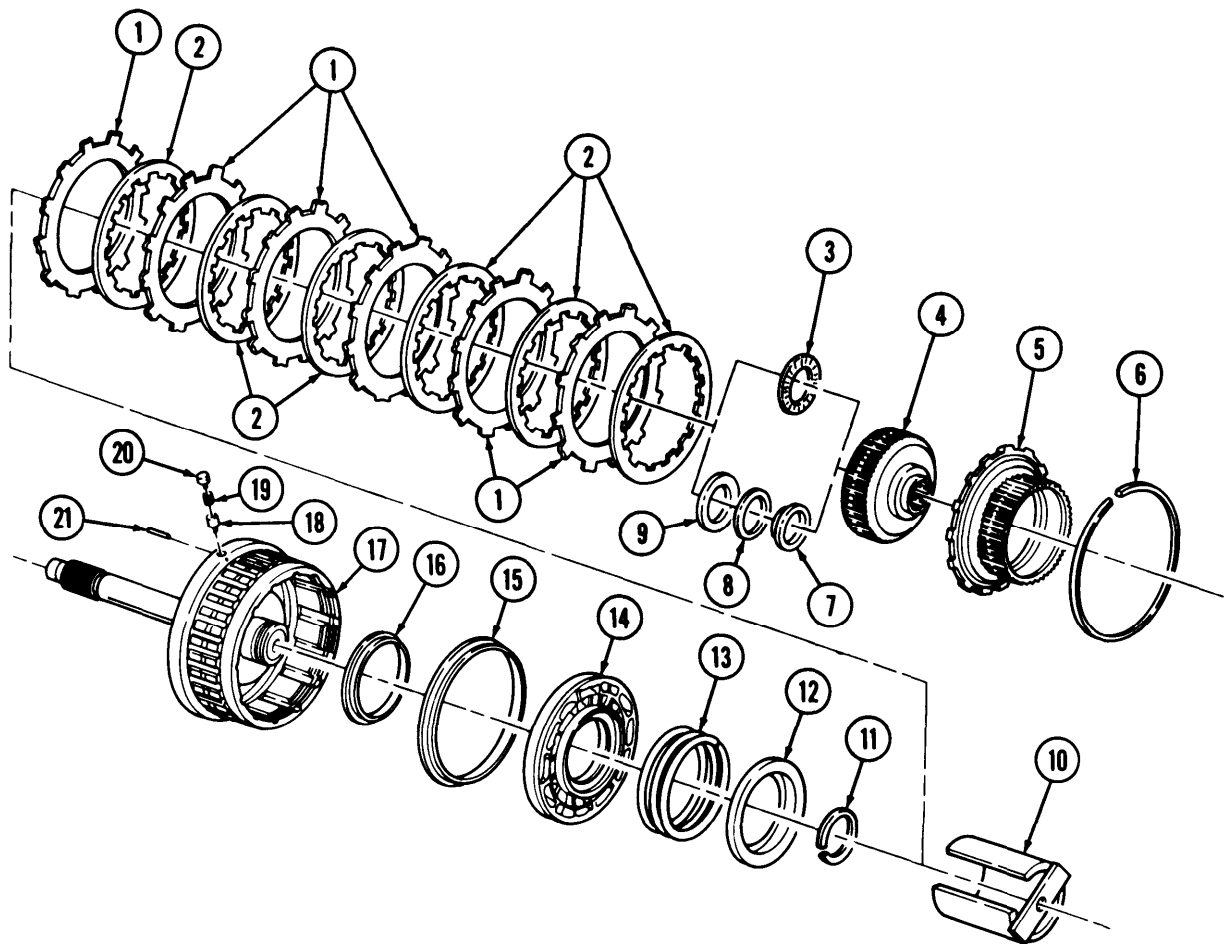


7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
7.	Forward clutch housing (17)	Snapring (6)	Remove.	
8.		Fourth clutch drive hub (5) and forward clutch hub (4)	Remove.	
NOTE				
Perform step 9 for transmissions with three-piece bearing.				
9.	Forward clutch housing (17) or fourth clutch hub (5)	Bearing race (7) bearing (8) and bearing race (9)	Remove.	
NOTE				
Perform step 9.1 for transmissions with single-piece bearing assembly.				
9.1.	Forward clutch housing (17) or fourth clutch hub (5)	Bearing assembly (3)	Remove.	
<u>CAUTION</u>				
Keep all clutch parts together. Intermixing forward clutch parts with any other clutch pack will cause transmission damage.				
10.		Six clutch plates (1) and six clutch discs (2)	Remove.	
11.		Compressor tool (10)	Position on spring retainer (12) and apply pressure to relieve tension on snapring (11).	Use arbor press with compression tool (10).
12.		Snapring (11)	Remove from forward clutch housing (17).	
13.		Compressor tool (10)	Remove from spring retainer (12).	
14*		Spring retainer (12), piston return spring (13), piston (14), and piston inner seal ring (16)	Remove from forward clutch housing (17).	Discard seal ring (16).
15.	Piston (14)	Piston outer seal ring (15)	Remove.	Discard seal ring (15).
16.	Valve plug (20) and forward clutch housing (17)	Retainer pin (21)	Remove.	
17.		Valve plug (20), valve spring (19), and centrifugal valve (18)	Remove from forward.	

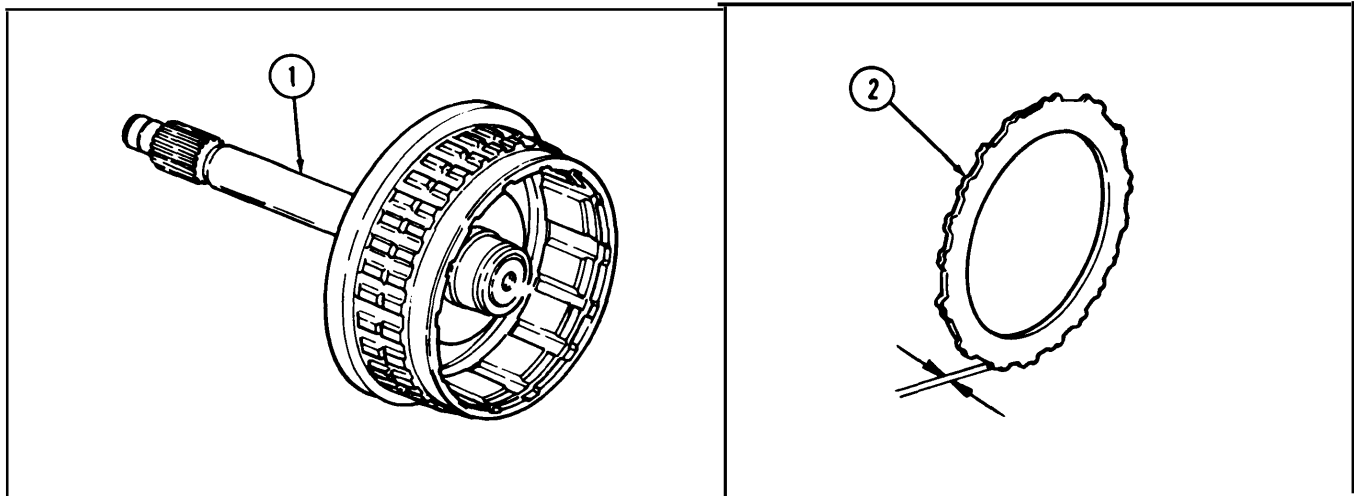
7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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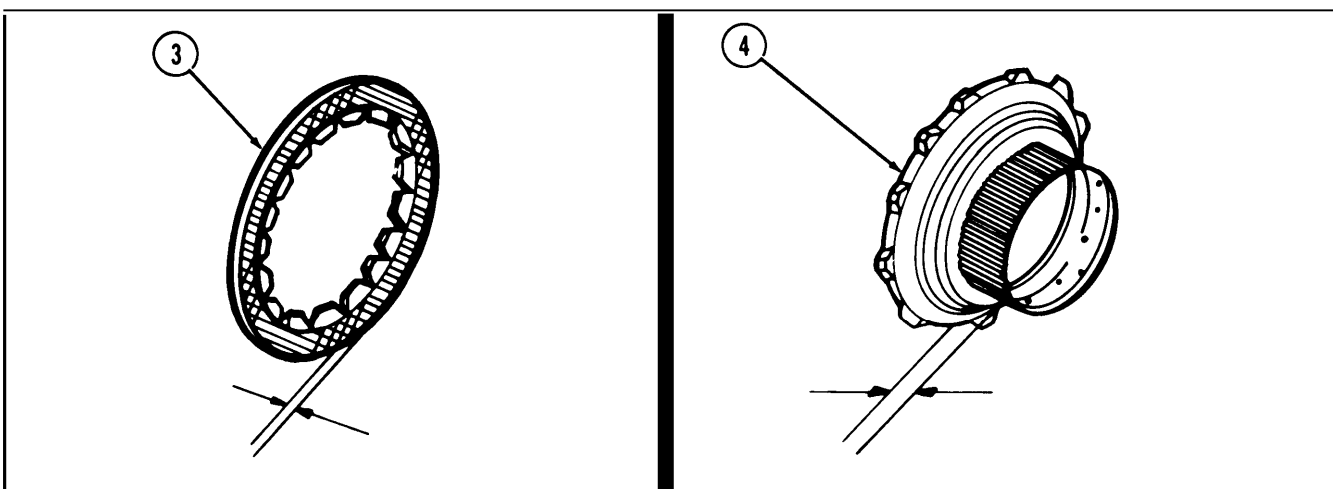
7-25. TURBINE SHAFT REMOVAL [Cont'd]

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
c. Inspection				
NOTE				
Clean all parts before inspection (para. 7-13).				
18.		All turbine shaft components	Inspect.	Refer to para. 2-8 for inspection instructions.
19.		Turbine shaft and forward clutch housing (1)	Inspect for scoring in area where seals contact shaft (1).	Discard if scored.
20.		Clutch plates (2)	Measure clutch plate (2) thickness.	Discard if less than 0.955 in. (24.25 mm).
21.		Clutch discs (3)	a. Inspect for burned surfaces. b. Measure clutch disc (3) thickness.	Discard if burned. Discard if less than 0.248 in. (6.30 mm).
22.		Fourth clutch drive hub (4)	Measure thickness at clutch disc (4) contact area.	Discard if less than 0.248 in. (6.30 mm).



7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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23.

Spring (5) and (6)

- Inspect for discoloration due to overheating.
- Inspect for broken coils or coils distorted due to wear.
- Using spring tester, inspect for serviceability by checking load when spring is compressed to the correct length (para. 7-4).

Discard if discolored.

Discard if broken or distorted.

Discard if spring does not give the correct load (table 7-4).

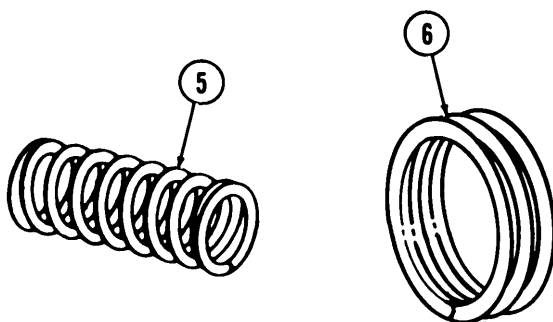


Table 7-4. Spring Data.

SPRING	COLOR	FREE LENGTH	COMPRESSED LENGTH	UNDER LOAD
Valve spring	Green	0.76 in. (19.3 mm)	0.61 in. (15.5 mm)	5.7-6.3 lb (25.3-28 N)
Piston	None	3.22 in. (81.8 mm)	1.28 in. (32.5 mm)	158-178 lb (702-791 N)

7-25. TURBINE SHAFT REMOVAL (Cont'd)

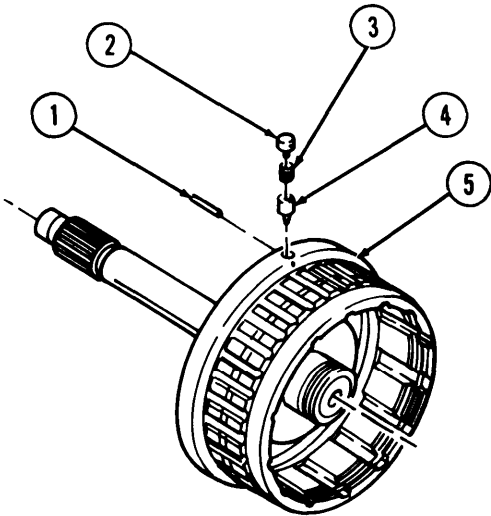
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Reassembly

NOTE

If new centrifugal valve is being installed, all components must have same color as old valve.

24.		Centrifugal valve (4) and valve spring (3)	Install in clutch housing (5).	Pointed end of valve (4) must be installed first.
25.		Valve plug (2)	Push into clutch housing (5) and install with retainer pin (1).	Pin (1) protrudes 0.080-0.100 in. (2.03-2.54 mm) over face of housing (5) when seated.



26.		New piston outer seal ring (7)	Install on piston (b)	Seal ring (7) lips must face toward oil pressure side of piston (8).
27.		New piston inner seal ring (6)	Install on forward clutch housing (5) hub.	Seal ring (6) lips must face toward oil pressure side of piston (8).
28.		Piston (8)	Install in forward clutch housing (5).	

7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

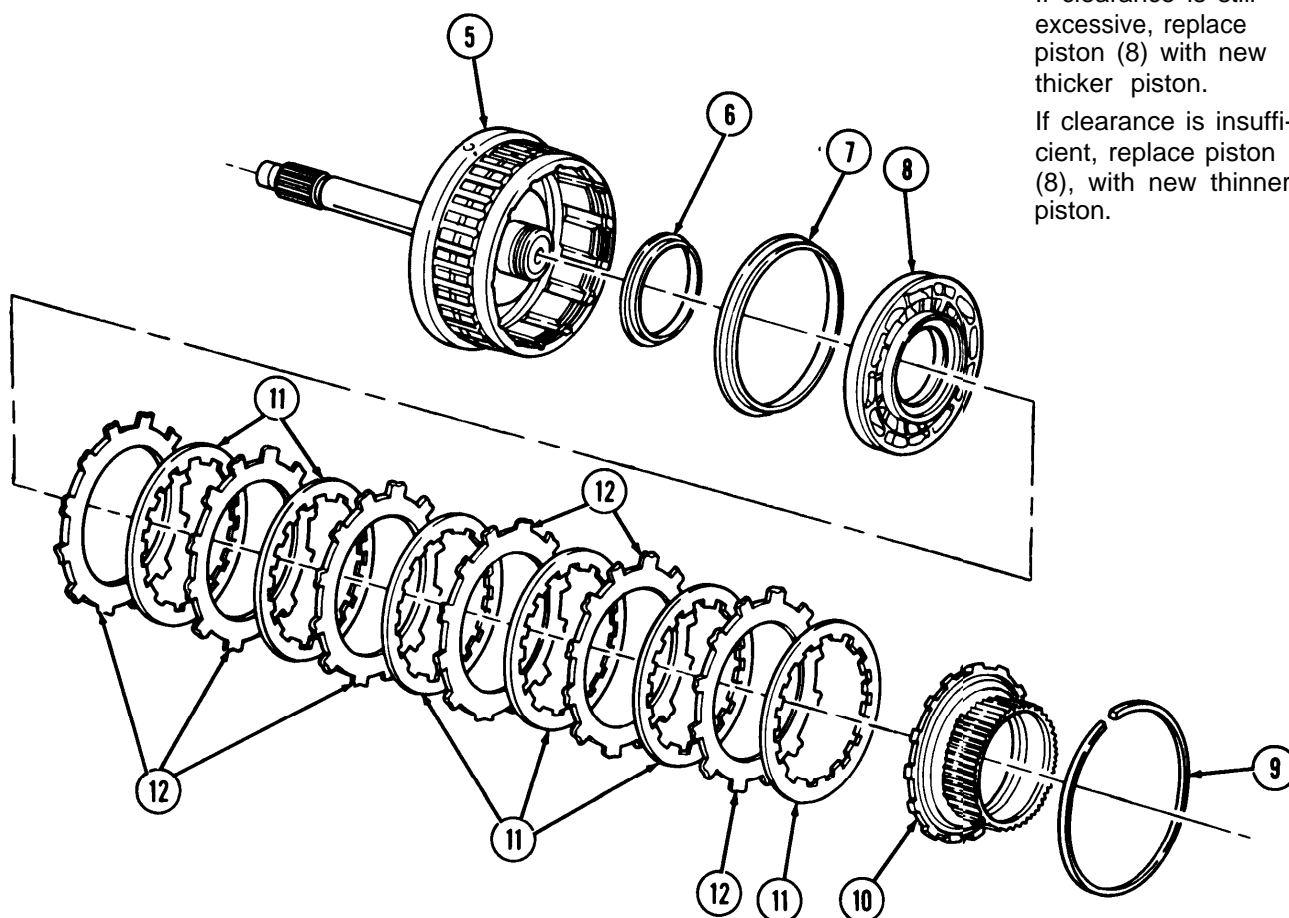
Steps 29 and 30 obtain clutch running clearance.

- | | | | |
|-----|--|--|--|
| 29. | Six clutch plates (12) and six clutch discs (11) | Alternately install in forward clutch housing plate (12). | Start with a clutch |
| 30. | Fourth clutch drive hub (10) | a. Install in forward clutch housing (5) and install snapping (9).
b. Measure clearance between hub (10) and clutch disc (11).
c. Clutch running clearance should be 0.091-0.148 in. (2.311-3.759 mm). | Use forward clutch clearance gage.

If clearance is excessive, replace thinner plates (12) and discs (11) with new plates and discs.

If clearance is still excessive, replace piston (8) with new thicker piston.

If clearance is insufficient, replace piston (8), with new thinner piston. |



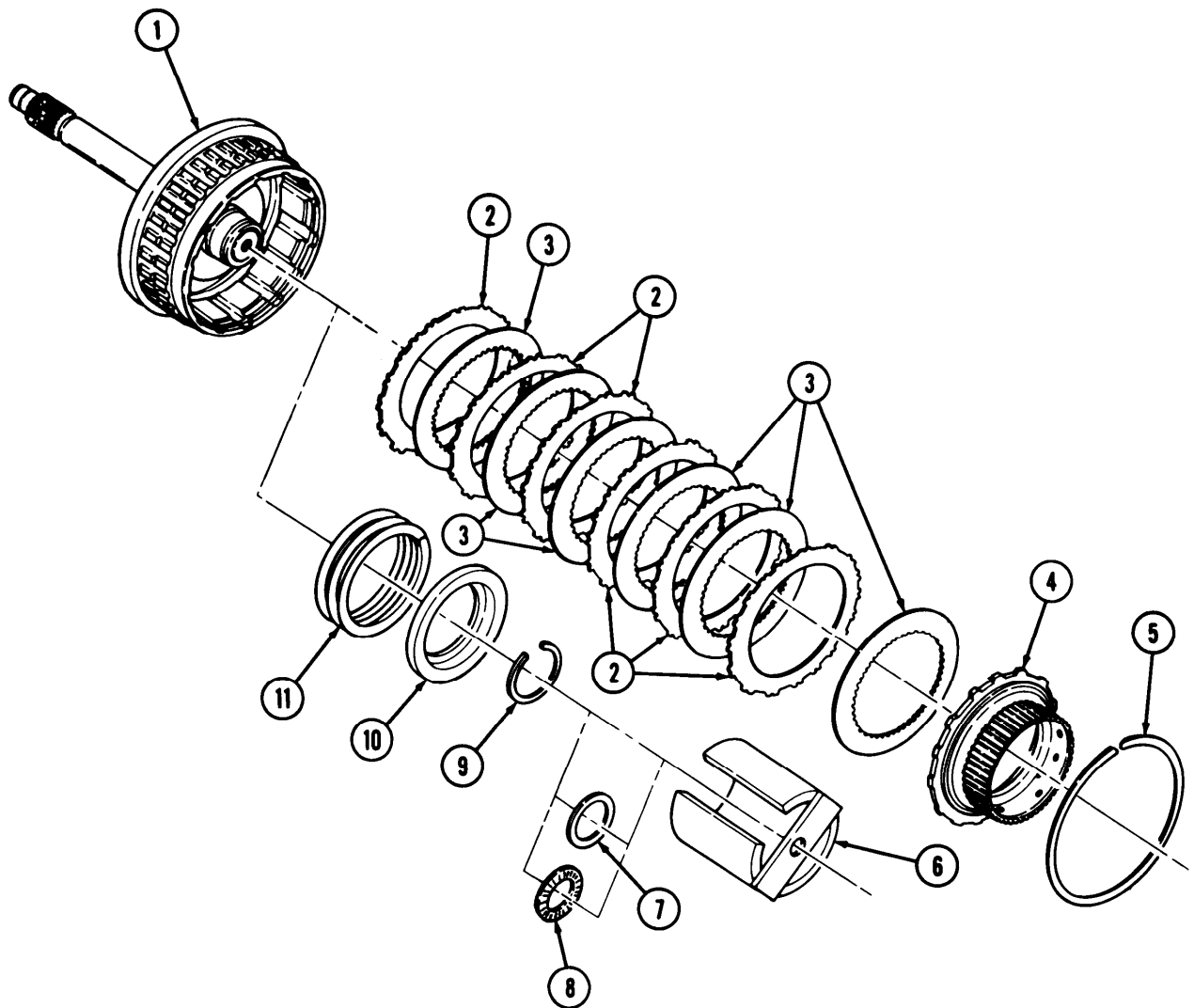
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7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
31.	Forward clutch housing (1)	Fourth clutch drive hub (4), snapring (5) six clutch discs (3) and six clutch plates (2)	Remove.	
32.		Piston return spring (11) and spring retainer (10)	Place in forward clutch housing (1).	
33.		Compressor tool (6)	a. Place on spring retainer (10) and compress piston return spring (11). b. Install spring retainer (10) with snapring (9)	Use arbor press with compressor tool (6).
34.		Compressor tool (6)	Remove from spring retainer (10).	
NOTE				
Perform step 34.1 for transmissions with single-piece bearing assembly.				
34.1.		Bearing assembly (8)	Install in forward clutch housing (1).	Install scalloped side down.
NOTE				
Perform steps 35 through 37 for transmissions with three-piece bearing.				
35.		Bearing race (7)	Install in forward clutch housing (1).	Outer lip of race (7) must be installed. Use oil-soluble grease sparingly to hold in place.

7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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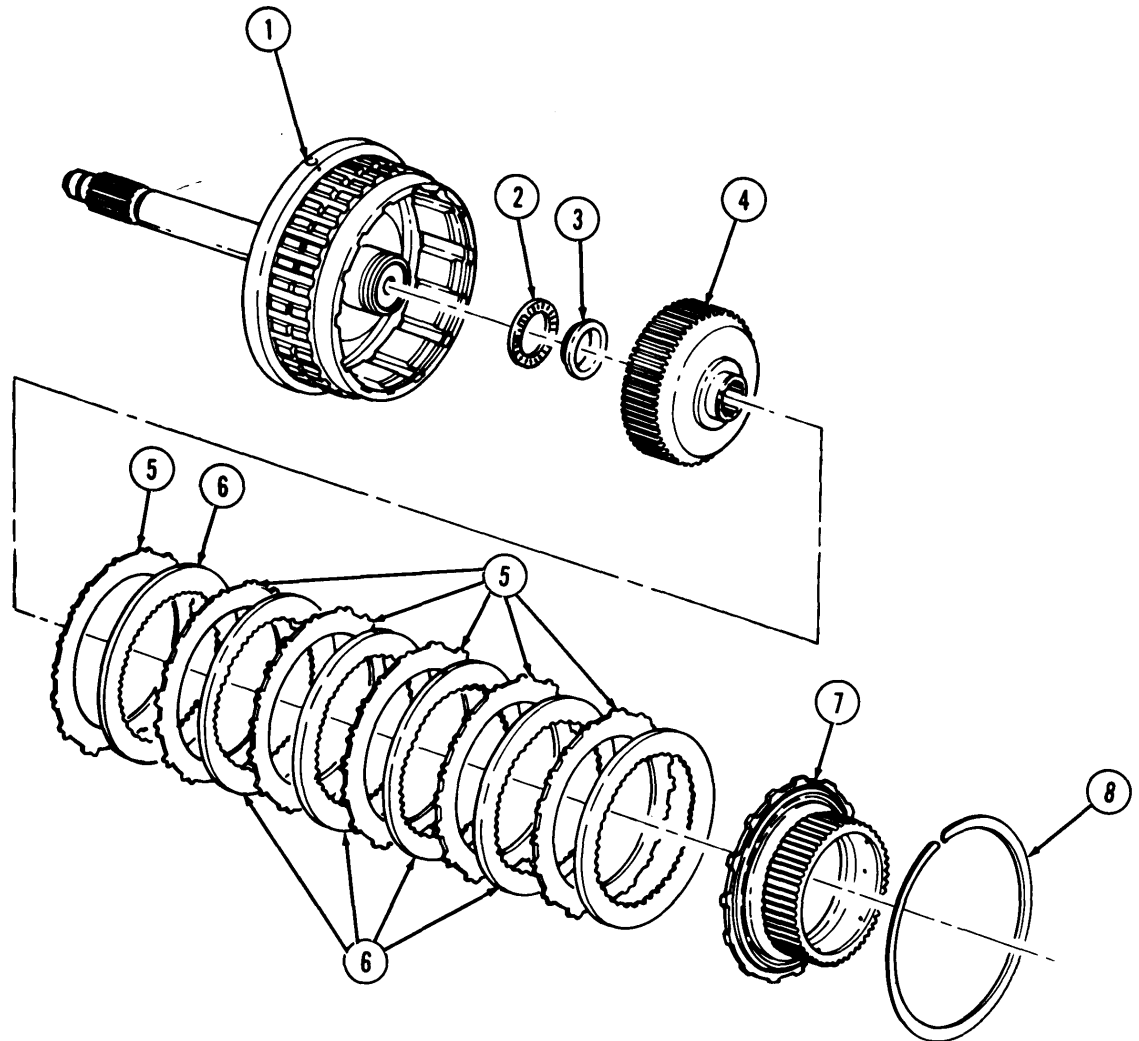


7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
36.		Bearing race (3)	Install on forward clutch hub (4).	Flat side of race (3) must be installed first. Use oil-soluble grease sparingly to hold in place.
37.		Bearing (2)	Install on forward clutch hub (4).	Use oil-soluble grease sparingly to hold in place.
38.		Forward clutch hub (4)	Install in forward clutch housing (1).	Splined edge must be installed first.
39.		Six clutch discs (6)	Soak in clean transmission oil for at least two minutes.	Use OE/HDO-10 lubricating oil.
40.		Six clutch plates (5) and six clutch discs (6)	Alternately install in forward clutch housing (1).	Start with clutch plate (5) first.
41.		Fourth clutch drive hub (7)	Install in forward clutch housing (1) with snapping (8).	

7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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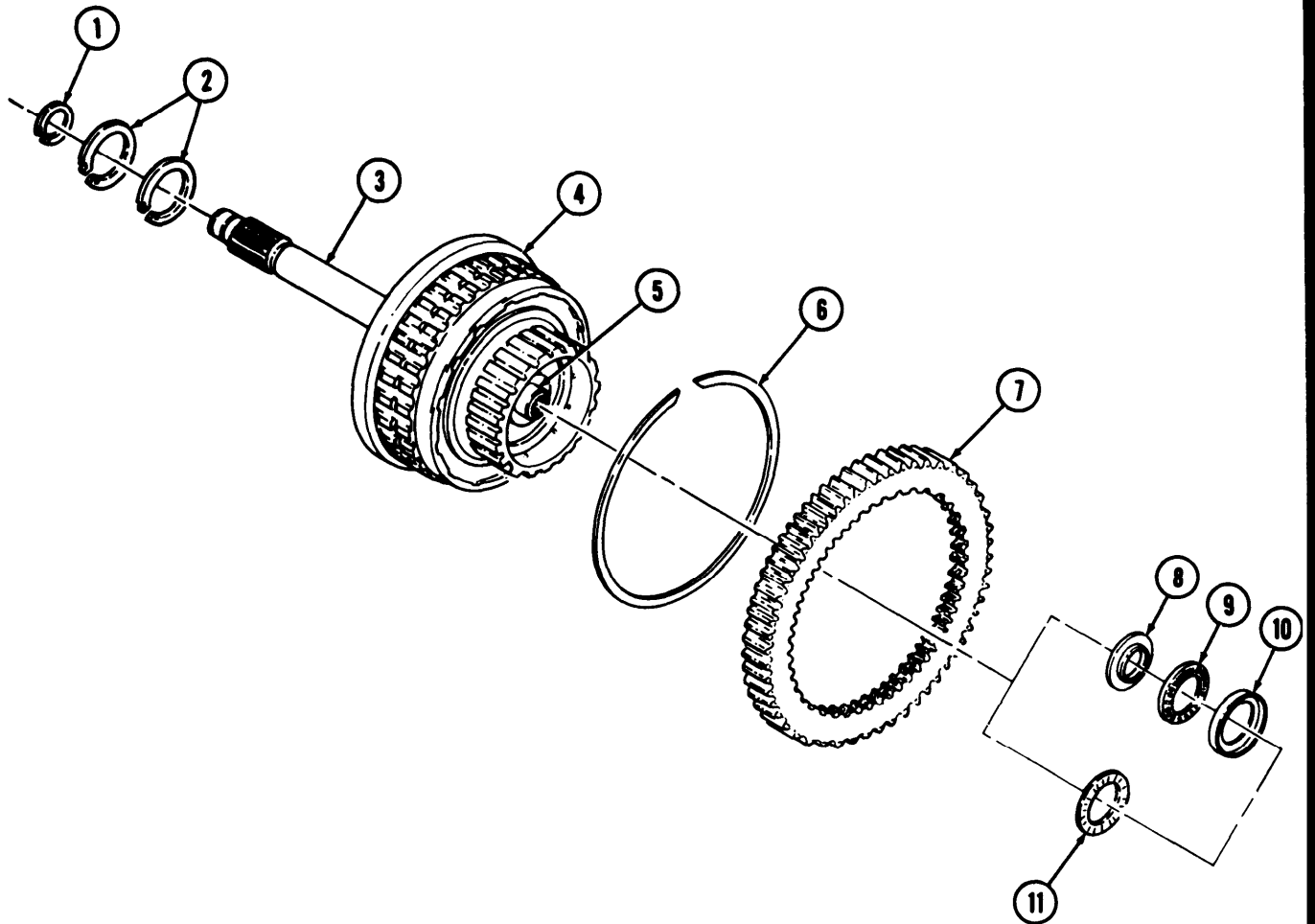
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7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
42.		PTO gear (7) and gear snapping (6)	Install on forward clutch housing (4) as follows: a. Install snapping (6) on forward clutch housing (4).	
NOTE				
Chamfered end of PTO gear must be installed first.				
			b. Slide PTO gear (7) over snapping (6) on forward clutch housing (4).	Make sure snapping (6) springs outward into internal groove on PTO gear (7).
NOTE				
Perform step 42.1 for transmissions with single-piece bearing assembly.				
42.1.		Roller bearing (11)	Install on forward clutch hub (5).	
NOTE				
Perform steps 43 and 44 for transmissions with three-piece bearing.				
43.		Bearing race (8)	Install on forward clutch hub (5).	Flat side of race (8) must be installed first. Use oil-soluble grease sparingly to hold in place.
44.		Bearing (9) and bearing race (10)	Install on forward clutch hub (5).	Use oil-soluble grease sparingly to hold in place.
45.		Two new seal rings (2)	Install on turbine shaft (3).	Use oil-soluble grease sparingly to hold in place.
46.		New seal ring (1)	Install on turbine shaft (3).	

7-25. TURBINE SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

7-26. FOURTH CLUTCH REMOVAL

This task covers:

- a. Removal
b. Disassembly

- c. Inspection
d. Reassembly

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-25	Turbine shaft removed,
<u>Test Equipment</u>		<u>Special Environmental Conditions</u>
None		Work are clean and free from blowing dirt and dust.
<u>Special Tools</u>		
Piston return spring compressor J-6438-01 Fourth clutch clearance gage J-29156		
<u>Materials/Parts</u>		<u>General Safety Instructions</u>
Piston inner seal ring Piston outer seal ring OEHD0-10 lubricating oil (Appendix C, Item 16) Oil-soluble grease (Appendix C, Item 19)		<ul style="list-style-type: none"> • Keep fire extinguisher nearby when using drycleaning solvent. • Compressed air source will not exceed 30 psi (207 kPa). • Eyeshields must be worn when cleaning with compressed air. • Use care when removing piston return spring. Spring is under great compression.
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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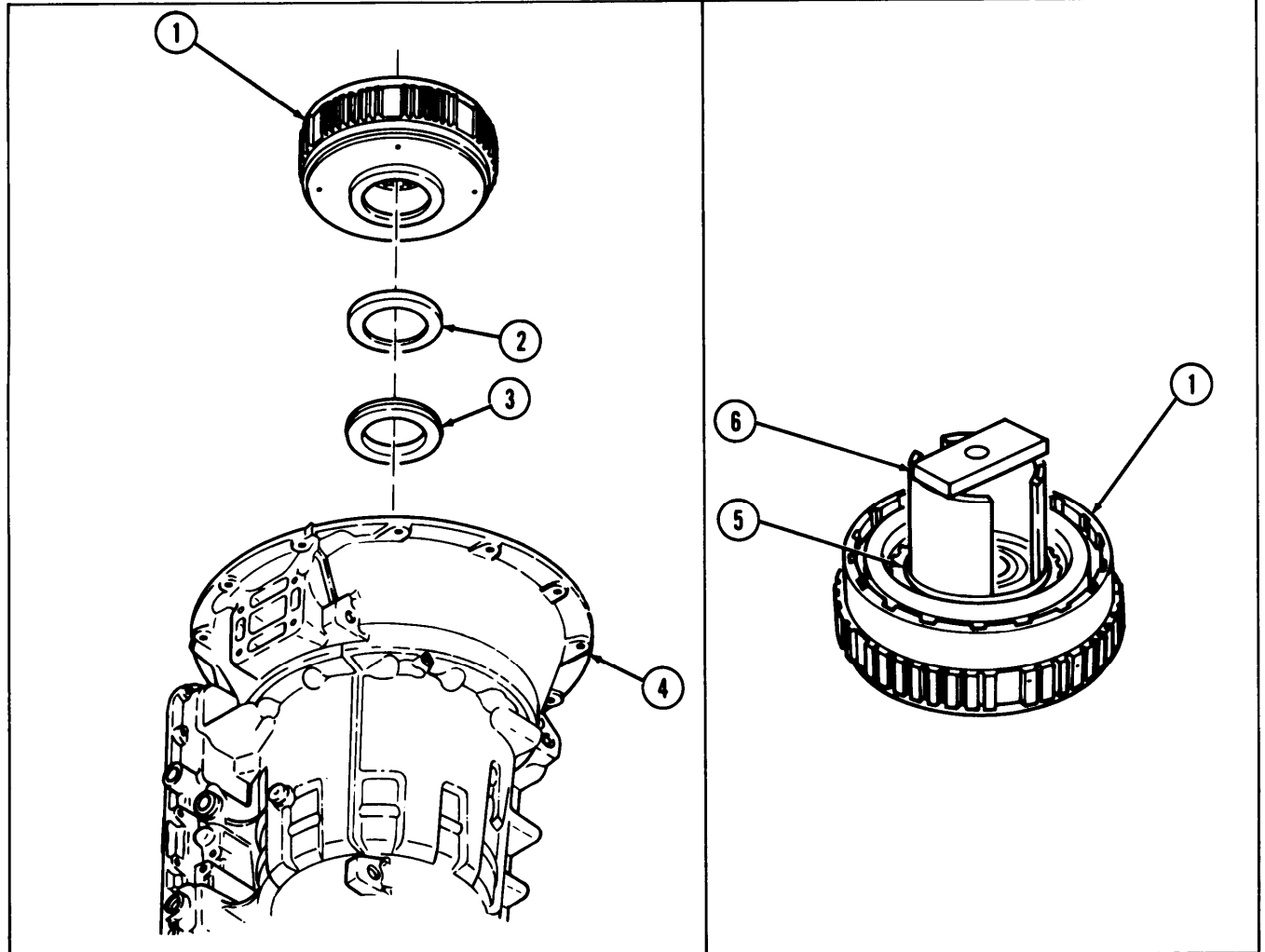
a. Removal

- | | | |
|--|---|--------------------|
| 1. Transmission (4) | Fourth clutch (1) | Lift straight out. |
| 2. Fourth clutch (1) or transmission (4) | Bearing race (2) and bearing assembly (3) | Remove. |

b. Disassembly

- | | | |
|------------------------------|-------------------------------------|---|
| 3. Fourth clutch housing (1) | Piston return spring compressor (6) | Position on spring retainer (5) and place on arbor press. |
|------------------------------|-------------------------------------|---|

7-26. FOURTH CLUTCH REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				

7-26. FOURTH CLUTCH REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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WARNING

Piston return spring is under great compression. Do not remove snapping until pressure is applied to spring retainer. If not, piston return spring may fly out, causing injury to personnel.

- | | | | | |
|----|--|-------------------------------------|---|--|
| 4. | | Snapping (2) | Apply pressure to spring retainer (3) and remove. | |
| 5. | | Piston return spring compressor (1) | Carefully remove. | |

NOTE

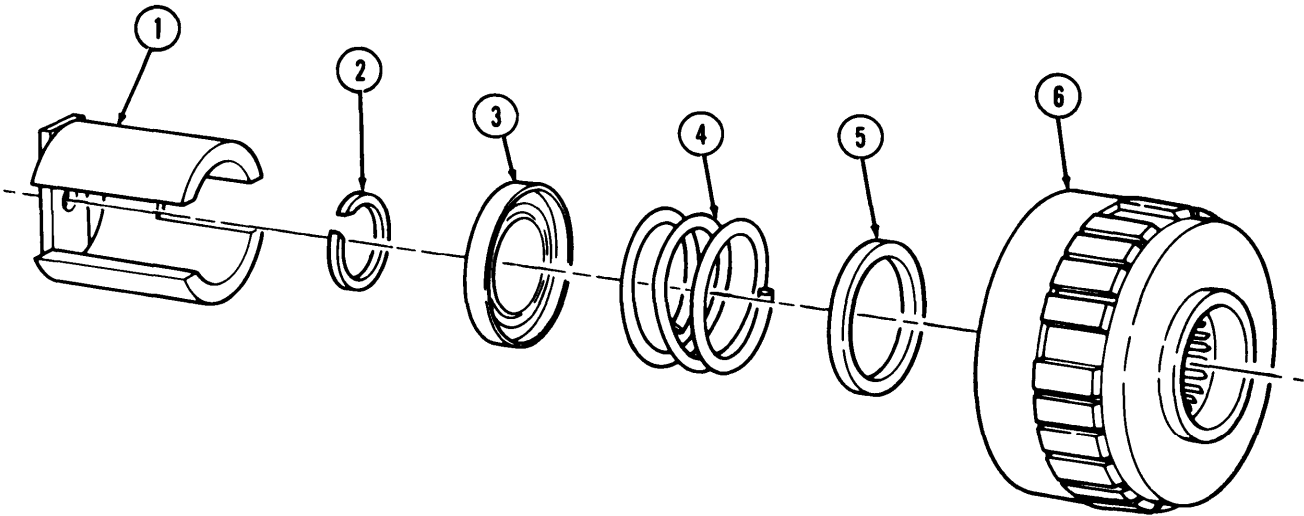
Perform step 6 for transmissions with spacer.

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|----|--|---|--|--|
| 6. | | Spring retainer (3), piston return spring (4), and spacer (5) | Remove from fourth clutch housing (6). | |
|----|--|---|--|--|

NOTE

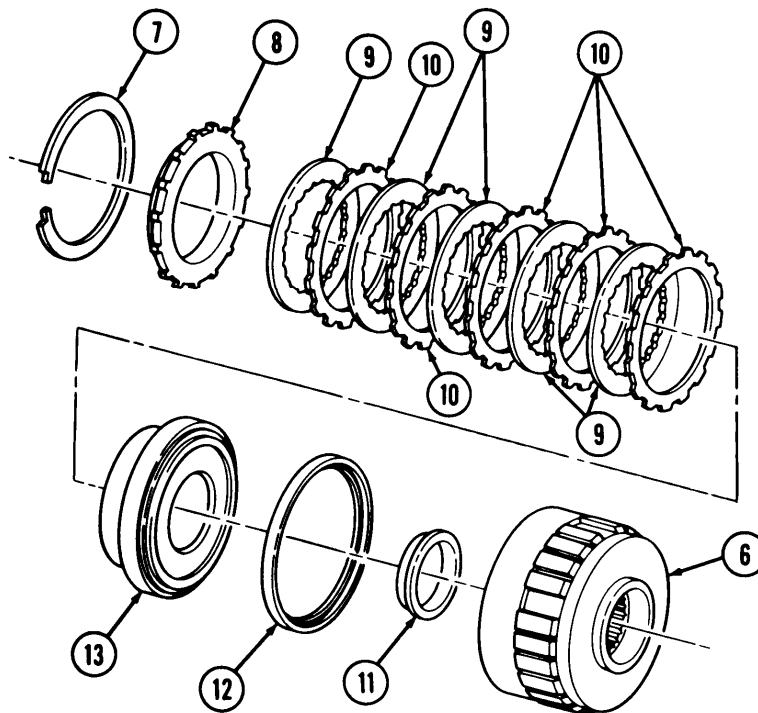
Perform step 6.1 for transmissions without spacer.

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|------|--|--|--|--|
| 6.1. | | Spring retainer (3) and piston return spring (4) | Remove from fourth clutch housing (6). | |
|------|--|--|--|--|



7-26. FOURTH CLUTCH REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
7.		Backplate snapping (7)	Remove.	
<p style="text-align: center;">CAUTION</p> <p>The fourth clutch consists of a backplate, five clutch plates, and five clutch discs. Keep all clutch parts together. Intermixing fourth clutch parts with any other clutch pack will cause transmission damage.</p>				
8.		Backplate (8), five clutch plates (10), five clutch discs (9), and piston (13)	Remove from fourth clutch housing (6).	
9.	Piston (13)	Piston outer seal ring (12)	Remove.	Discard.
10.	Fourth clutch housing (6)	Piston inner seal ring (11)	Remove.	Discard.



7-26. FOURTH CLUTCH REMOVAL (Cont'd)

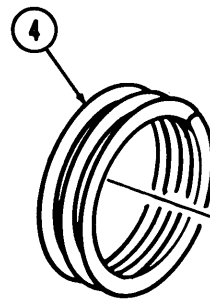
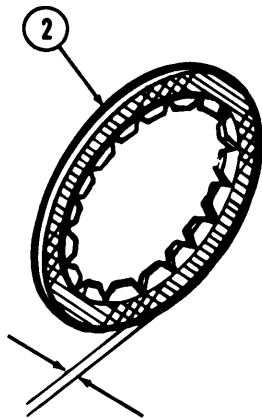
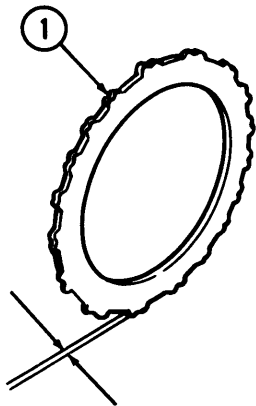
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Inspection

NOTE

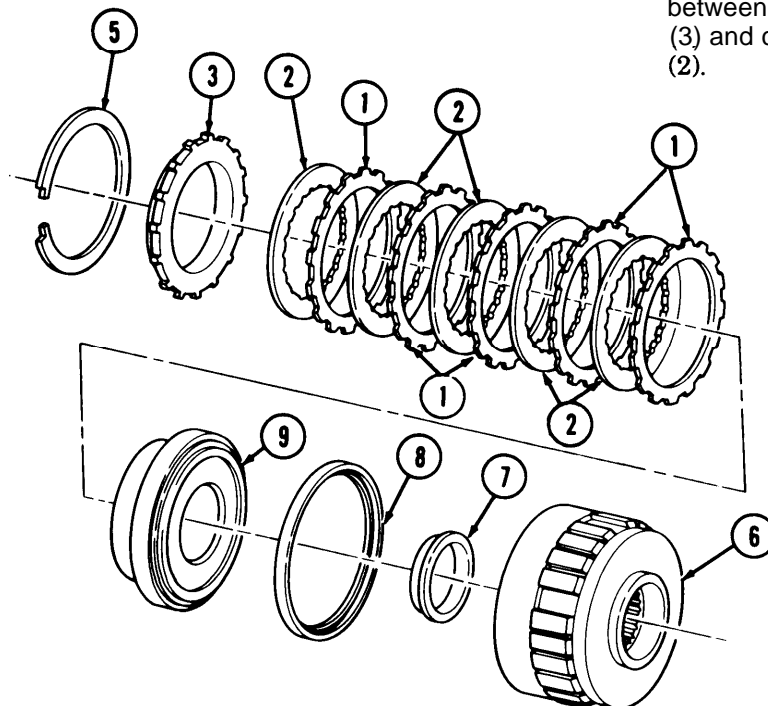
Clean all parts before inspection (para. 7-13).

11.		All fourth clutch components	Inspect.	Refer to para. 2-8 for inspection instructions.
12.		Five clutch plates (1)	Measure clutch plate (1) thickness.	Discard if less than 0.090 in. (2.286 mm).
13.		Five clutch discs (2)	a. Inspect for burned surfaces. b. Measure clutch disc (2) thickness.	Discard if burned. Discard if less than 0.096 in. (2.438 mm).
14.		Piston return spring (4)	a. Inspect for discoloration due to overheating. b. Inspect for broken coils or coils distorted due to wear. c. Using spring tester, inspect for serviceability by checking load when spring is compressed to 1.28 in. (32.5 mm).	Discard if discolored. Discard if broken or distorted. Free length is 3.22 in. (81.8 mm). Discard if spring does not give load of 158-178 lb (703-791 N).
15.		Backplate (3)	Measure thickness.	Discard backplate if less than 0.248 in. (6.30 mm) thick.



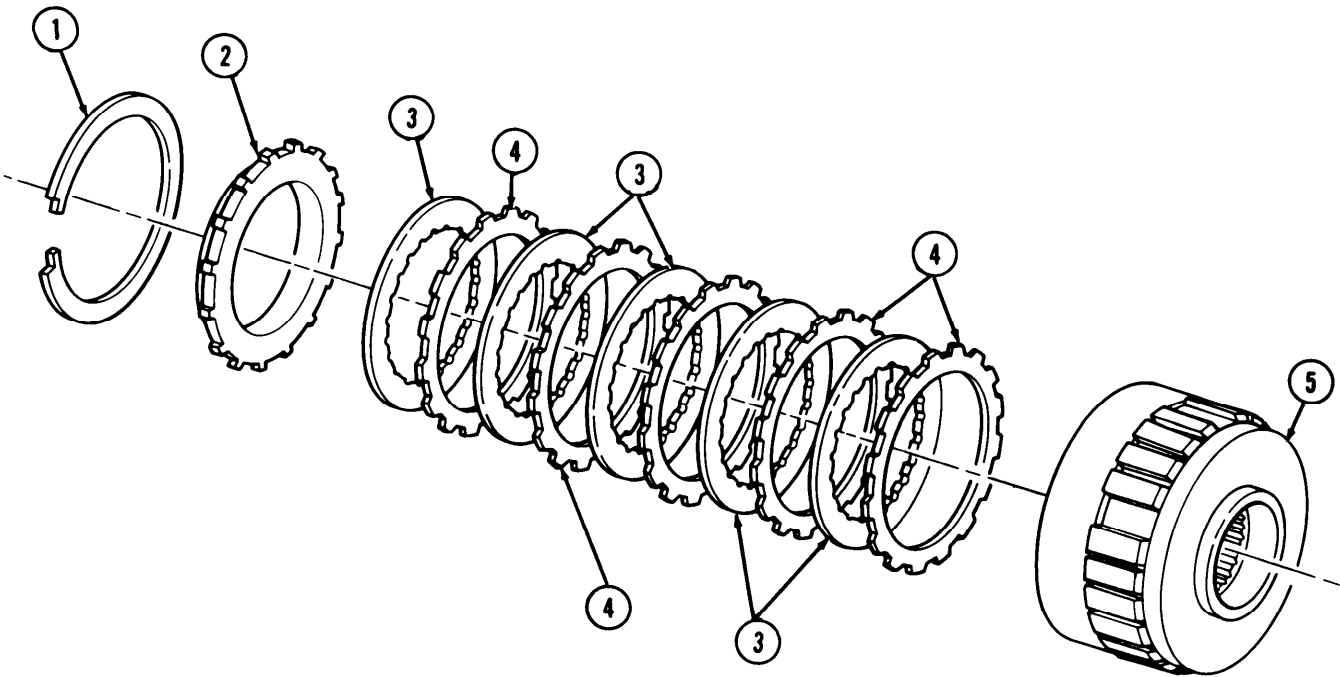
7-26. FOURTH CLUTCH REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Installation				
16.		New piston outer seal ring (8)	Install on piston (9).	Seal ring (8) lips must face toward oil pressure side of piston (9). Use oil-soluble grease to hold in place.
17.		New piston inner seal ring (7)	Install in fourth clutch housing (6).	Seal ring (7) lips must face toward oil pressure side of piston (9). Use oil-soluble grease to hold in place.
18.		Piston (9)	Install in fourth clutch housing (6).	
<p align="center">NOTE</p> <p>Steps 19 and 20 obtain clutch running clearance.</p>				
19.		Five clutch plates (1) and five clutch discs (2)	Alternately install in fourth clutch housing (6).	Start with clutch plate (1).
20.		Backplate (3)	<p>a. Install in fourth clutch housing (6) and install snapping (5).</p> <p>b. Measure clearance between backplate (3) and clutch disc (2).</p>	<p>Use fourth clutch clearance gage.</p> <p>Clutch running clearance should be 0.68-0.127 in. (1.727-3.226 mm).</p> <p>If clearance is excessive, replace thinner disc (2) and plates (1) with new discs and plates.</p> <p>If clearance is still excessive, replace piston (9) with new, thicker piston.</p> <p>If clearance is insufficient, replace piston (9) with new, thinner piston.</p>



7-26. FOURTH CLUTCH REMOVAL (Cent'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
21.		Snapring (1), backing plate (2), five clutch discs (3), and five clutch plates (4)	Remove from fourth clutch housing (5).	
22.		Five clutch discs (3)	Soak in clean transmission oil for at least two minutes.	Use OE/HDO-10 lubricating oil.
23.		Five clutch plates (4) and five clutch discs (3)	Install.	Start with clutch plate (4).
23.1.		Backing plate (2) and snapring (1)	Install.	



7-26. FOURTH CLUTCH REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

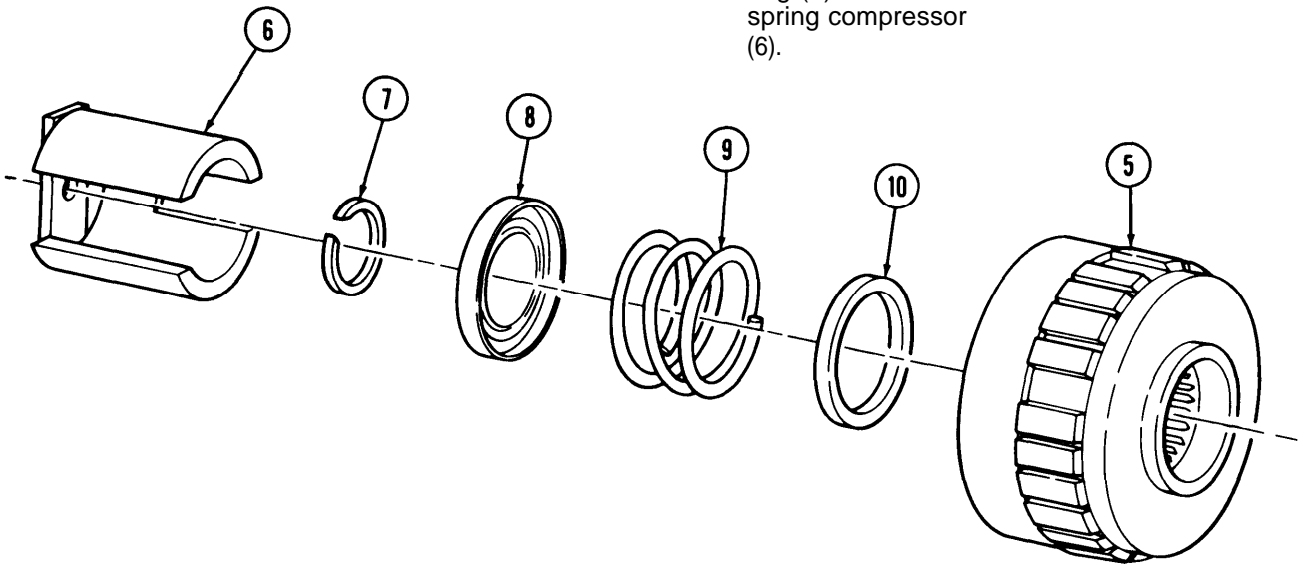
Perform step 24 for transmissions with spacer.

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|-----|--|--|-------------------------------------|--|
| 24. | | Spacer (10), piston return spring (9), and spring retainer (8) | Place in fourth clutch housing (5). | |
|-----|--|--|-------------------------------------|--|

NOTE

Perform step 24.1 for transmissions without spacer.

- | | | | | |
|-------|--|--|--|--|
| 24.1. | | Piston return spring (9) and spring retainer (8) | Place in fourth clutch housing (5). | |
| 25. | | Piston return spring compressor (6) | a. Position on spring retainer (8) and compress piston return spring (9).
b. Install spring retainer (8) with snap-ring (7) and remove spring compressor (6). | |



END OF TASK!

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7-27. THIRD CLUTCH REMOVAL

This task covers:

- a. Removal
- b. Inspection

INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-26	Fourth clutch removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		<ul style="list-style-type: none">• Keep fire extinguisher nearby when using drycleaning solvent.• Compressed air source will not exceed 30 psi (207kPa).• Eyeshields must be worn when cleaning with compressed air.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Keep all clutch parts together. Intermixing third clutch parts with any other clutch pack will cause transmission damage.

a. Removal

1. Transmission housing (4)	Snapping (1), back-plate (2), three clutch discs (1), and clutch plates (5)	Remove.	Mark position of clutch plates (5) in transmission housing (4) for reassembly.
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b. Inspection

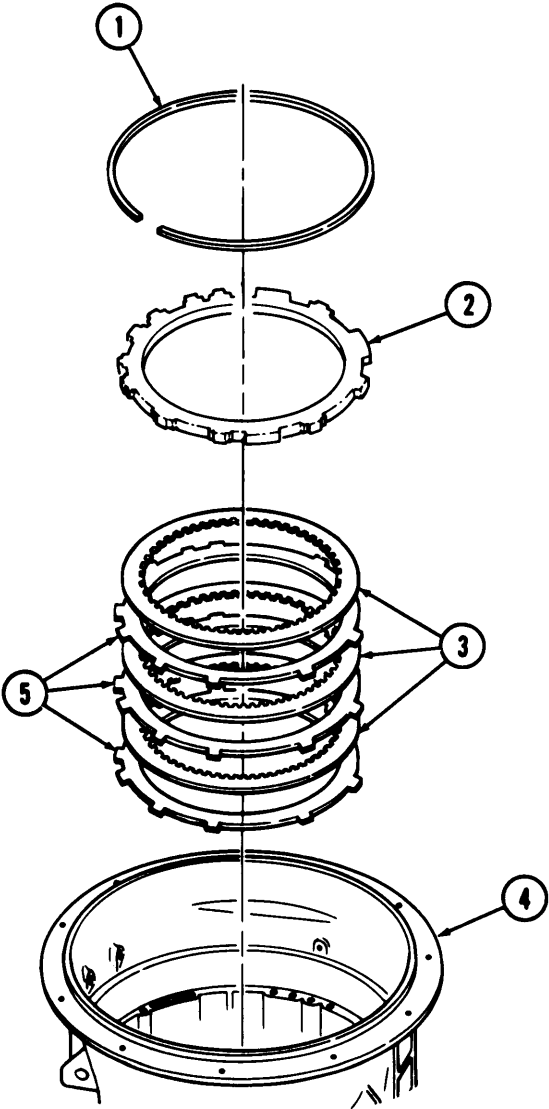
NOTE

Clean all parts before inspection (para. 7-13).

2.	All third clutch components	Inspect.	Refer to para. 2-8 for inspection instructions.
3.	Clutch discs (3)	<div>a. Inspect for burned surfaces.</div> <div>b. Measure clutch disc (3) thickness.</div>	<div>Discard if burned.</div> <div>Discard if less than 0.177 in. (4.496 mm).</div>

7-27. THIRD CLUTCH REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
4.		Clutch plates (5)	Measure thickness.	Discard if less than 0.0955 in. (2.423 mm).
5.		Backplate (2)	Measure thickness.	Discard backplate marked no. 7 if less than 0.476 in. (12.09 mm); discard backplate marked no. 8 if less than 0.450 in. (11.43 mm); or discard backplate marked no. 9 if less than 0.463 in. (11.76 mm).



END OF TASK!

7-28. CENTER SUPPORT REMOVAL

This task covers:

- a. Removal
b. Disassembly

- c. Inspection
d. Reassembly

INITIAL SETUP:

Applicable Models

All

Equipment Condition Reference

Para. 7-27

Condition Description

Third clutch removed.

Test Equipment

None

Special Tools

Bushing installer J-24794
Retainer ring depth tool
Center support lifter J-24455

Special Environmental Conditions

Work area clean and free from blowing dirt and dust.

Materials/Parts

Bushing
Eight self-locking retainers rings
Filter screen and seal ring
Two piston inner seal rings
Two piston outer seal rings
Checkball
Two step-joint seal rings

General Safety Instructions

- Keep fire extinguisher nearby when using drycleaning solvent.
- Compressed air source will not exceed 30 psi (207 kPa).
- Eyeshields must be worn when cleaning with compressed air.

Personnel Rewired

Wheeled vehicle repairman MOS 63W

Manual References

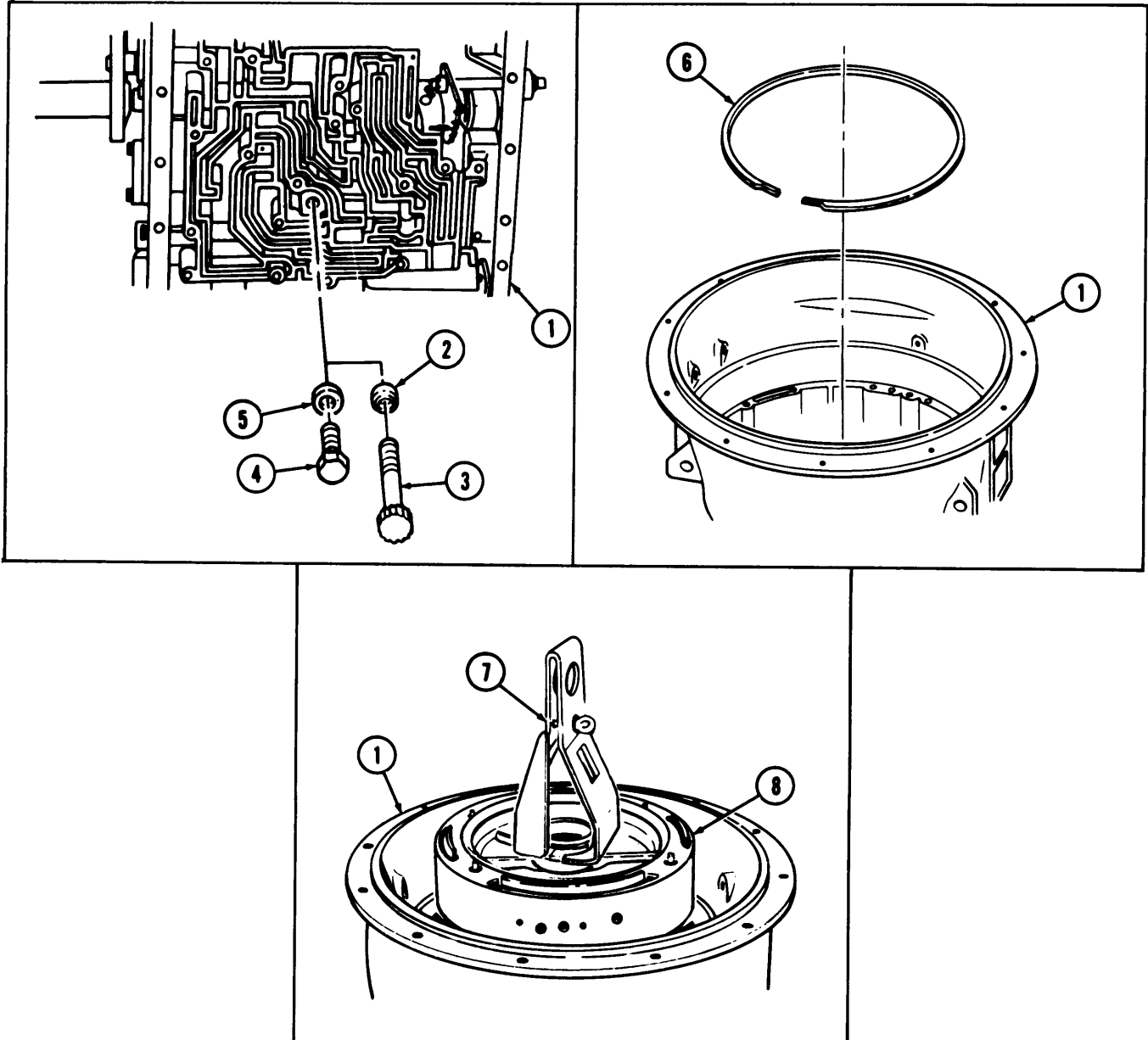
TM 9-2320-272-34P

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1.	Transmission housing (1)	Center support anchor bolt (3) or (4) and washer (5) or (2)	Remove.	Discard anchor bolt (3) or (4) and washer (5) or (2). If old style hex head bolt (4) and flat washer (5) were present, center support (8) must be rethreaded. Refer to subtask c.
2.		Snapping (6)	Remove.	
3.		Center support lifter (7)	Attach to center support (8).	
4.		Center support (8)	Remove.	Record location of any shims present.

7-28. CENTER SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				

7-28. CENTER SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Disassembly

5.	Center support (10)	Filter screen (13) and seal ring (12)	Remove.	Discard screen (13) and seal ring (12).
6.	Second clutch piston (11) and retainer (2)	Four self-locking retainers (1)	Remove from pins (14).	Discard retainers (1).
7.		Retainer (2) and twenty springs (3)	Remove.	
8.		Second clutch piston (11)	Remove from center support (10).	
9.	Second clutch piston (11)	Inner seal ring (5) and outer seal ring (6)	Remove.	Discard seal rings (5) and (6).
9.1.	Center support (10)	Third clutch piston (4)	Repeat steps 6 through 9.	
10.		Two step-joint seal rings (7)	Remove.	Discard.

NOTE

Bushing is removed only if it fails inspection (subtask c).

11.	Bushing (8)	Remove as follows:	
		a. Mark locaton of bushing (8) notch on center support (10).	Marked location used for reassembly
		b. Press out of center support (10).	Use arbor press and mandrel. Discard bushing (8).

NOTE

- Bushing must be removed to replace checkball.
- Replace checkball if bushing is replaced.

12.	Checkball (9)	Remove from center support (10).	Discard checkball (9).
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c. Inspection

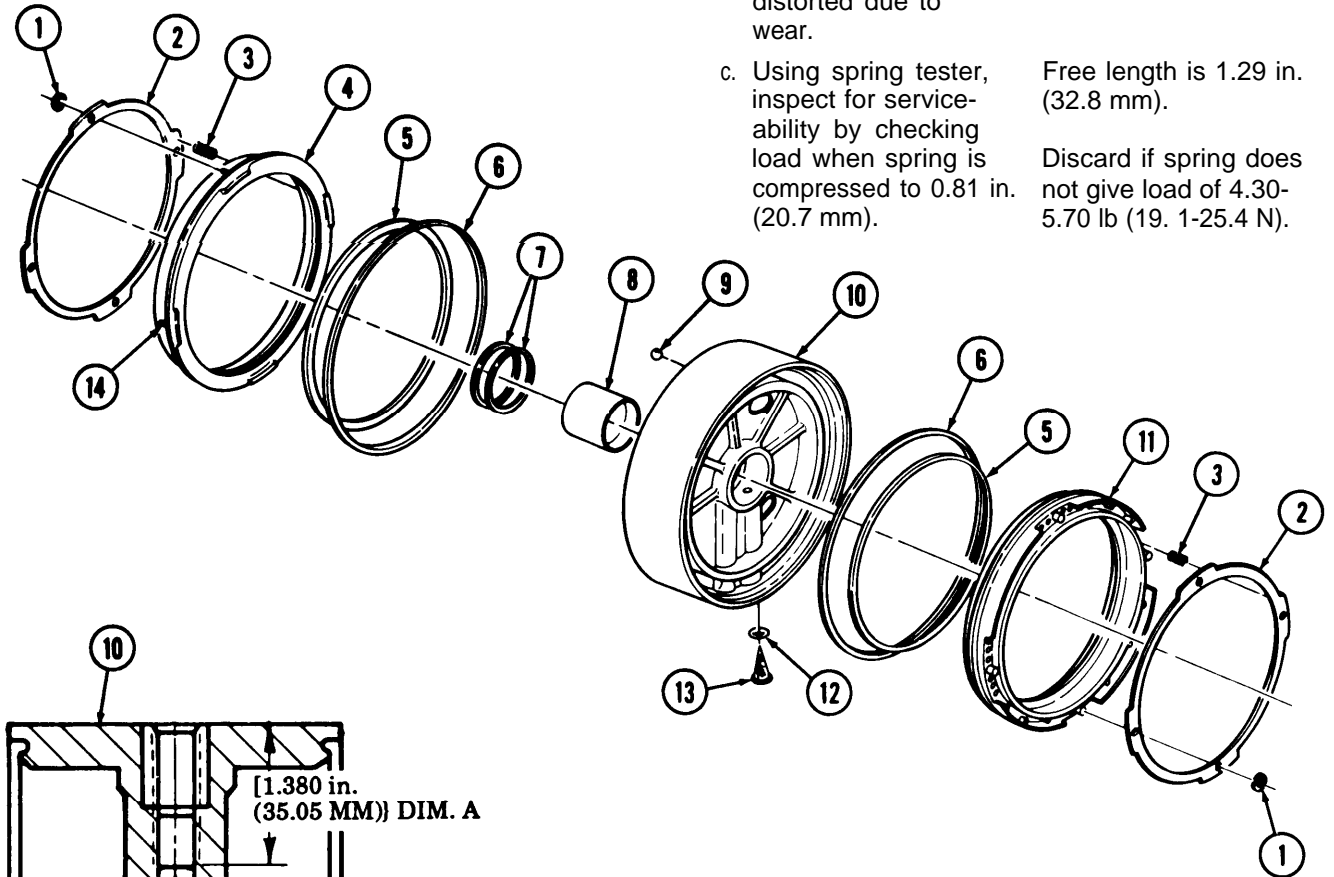
NOTE

Clean all parts before inspection (para. 7-13).

13.	All center support components	Inspect.	Refer to para. 2-8 for inspection instructions.
14.	Center support (10)	a. Inspect cavities for obstruction or foreign material.	Remove obstruction or foreign material.

7-28. CENTER SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			b. Measure depth of anchor bolt hole in center support (10).	Hole must be 1.610 in. (40.89 mm) deep. If not, rework center support (10) as shown.
			c. Inspect four pins (14) on each piston (4) and (11) for bends and breaks.	Replace piston (4) or (11) if any pin is damaged.
15.	All springs (3)		a. Inspect for discoloration due to overheating.	Springs (3) are painted green. Discard if discolored.
			b. Inspect for broken coils or coils distorted due to wear.	Discard if broken or distorted.
			c. Using spring tester, inspect for serviceability by checking load when spring is compressed to 0.81 in. (20.7 mm).	Free length is 1.29 in. (32.8 mm). Discard if spring does not give load of 4.30-5.70 lb (19.1-25.4 N).



USING A 5/16 IN. DRILL
DRILL HOLE 1.610 IN. (40.89 MM) DEEP

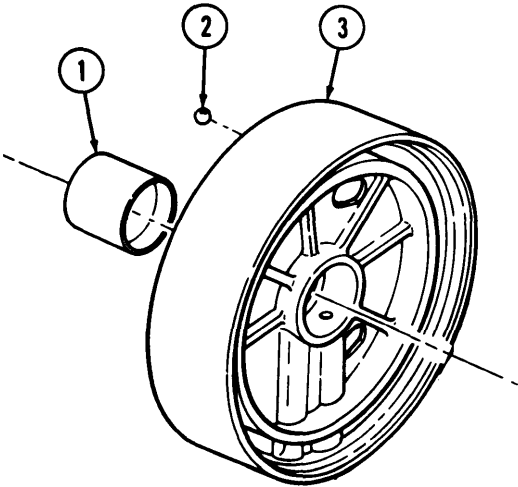
COUNTERBORE 0.469 IN. (11.91 MM) DIA.
0.66-0.70 IN. (16.8 -17.8 MM) DEEP

3/8 IN. (9.53 MM) TAP UNC2B MIN.
FULL THREAD TO DEPTH OF DIM A.

7-28. CENTER SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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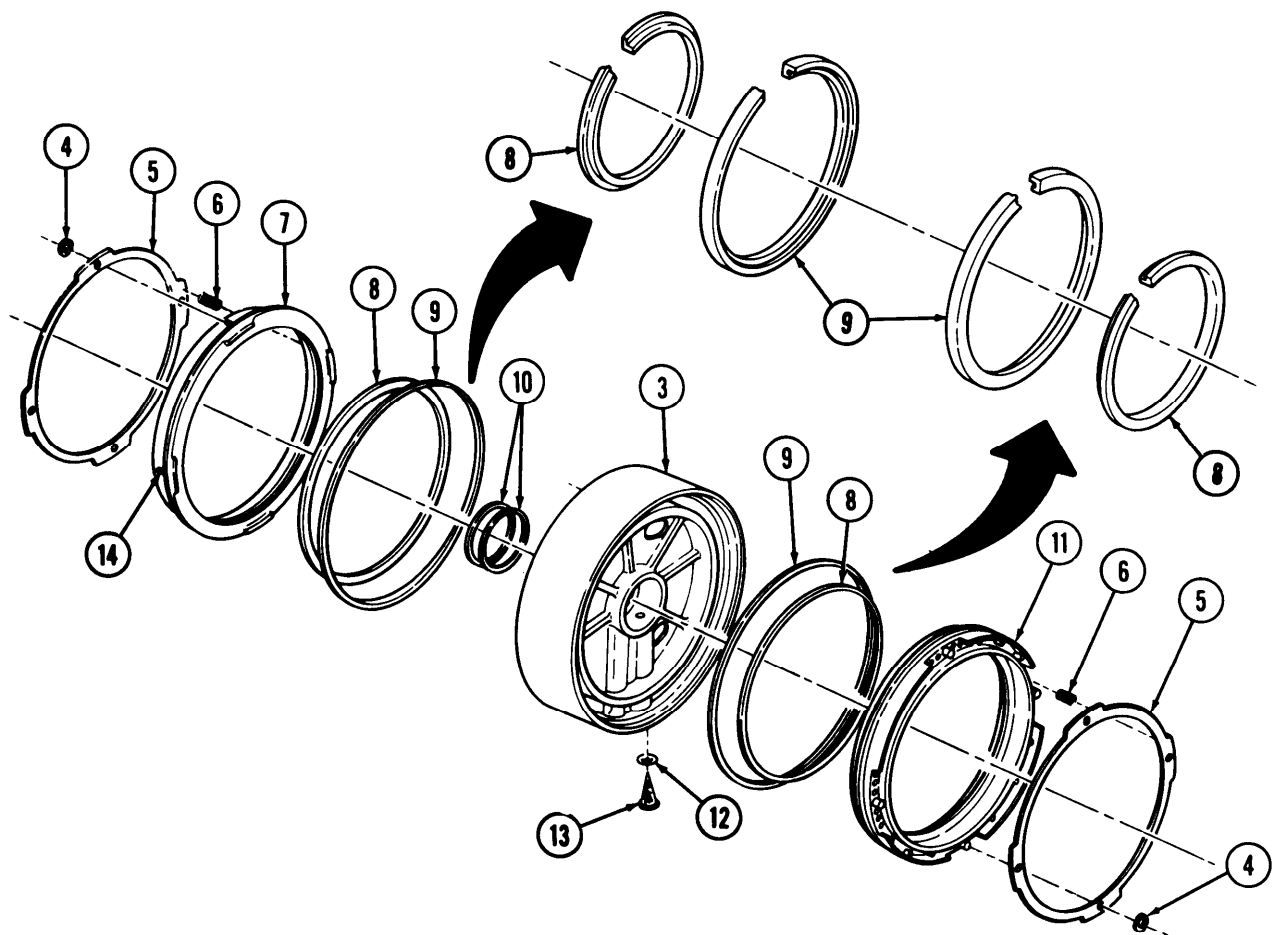
d. Reassembly

16.		New checkball (2) and new bushing (1)	<p>Install as follows:</p> <p>a. Position checkball (2) in center support (3).</p> <p>b. Aline notch on new bushing (1) with marked location on center support (3).</p> <p>c. Press new bushing (1) in center support (3) until flush.</p>	<p>Perform if bushing removed previously. Checkball (2) will be secured when new bushing (1) is pressed in.</p> <p>Use bushing installer and arbor press.</p>
				
16.1.		New inner seal ring (8) and new outer seal ring (9)	Install on each piston (7) and (11).	Make sure seal rings (8) and (9) lips face toward center support (3) when pistons are installed. Use oil - soluble grease as necessary to hold in place.
17.		Third clutch piston (7)	Place in center support (3).	
18.		Twenty springs (6)	Place in pockets on piston (7).	
19.		Spring retainer (5)	Aline to piston (7) over pins (14) and install four new self-locking retainer rings (4).	Use retainer ring depth tool.

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7-28. CENTER SUPPORT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
20.		Second clutch piston (11)	Repeat steps 11 through 19.	Second clutch piston assembled same as third clutch piston.
21.		Third clutch piston (7) and second clutch piston (11)	Install in center support (3).	
22.		New filter screen (13) and new seal ring (12)	Install.	
23.		Two new step-joint seal rings (10)	Install.	Use oil-soluble gease sparingly to hold in place.



END OF TASK!

7-29. GEAR UNIT AND MAIN SHAFT REMOVAL

This task covers:

- a. Removal
- b. Disassembly
- c. Inspection
- d. Reassembly

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-28	Center support removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Gear unit lifter J-24454		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
Oil-soluble grease (Appendix C, Item 19)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		<ul style="list-style-type: none">•Keep fire extinguisher nearby when using drycleaning solvent.• Compressed air source will not exceed 30 psi (207 kPa).• Eyeshields must be worn when cleaning with compressed air.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1.

Gear unit lifter (1)

Attach to gear unit main shaft (2).
2.

Transmission housing (4)

Gear unit (3)

Remove.

b. Disassembly

3.

Front planetary earner (9)

Thrust washer (5), front sun gear (6), sun gear shaft (8), and thrust washer (7)

Remove.
4.

Planetary carrier drum (13)

Front planetary carrier (9) and thrust washer (10)

Remove.
5.

Snapring (12)

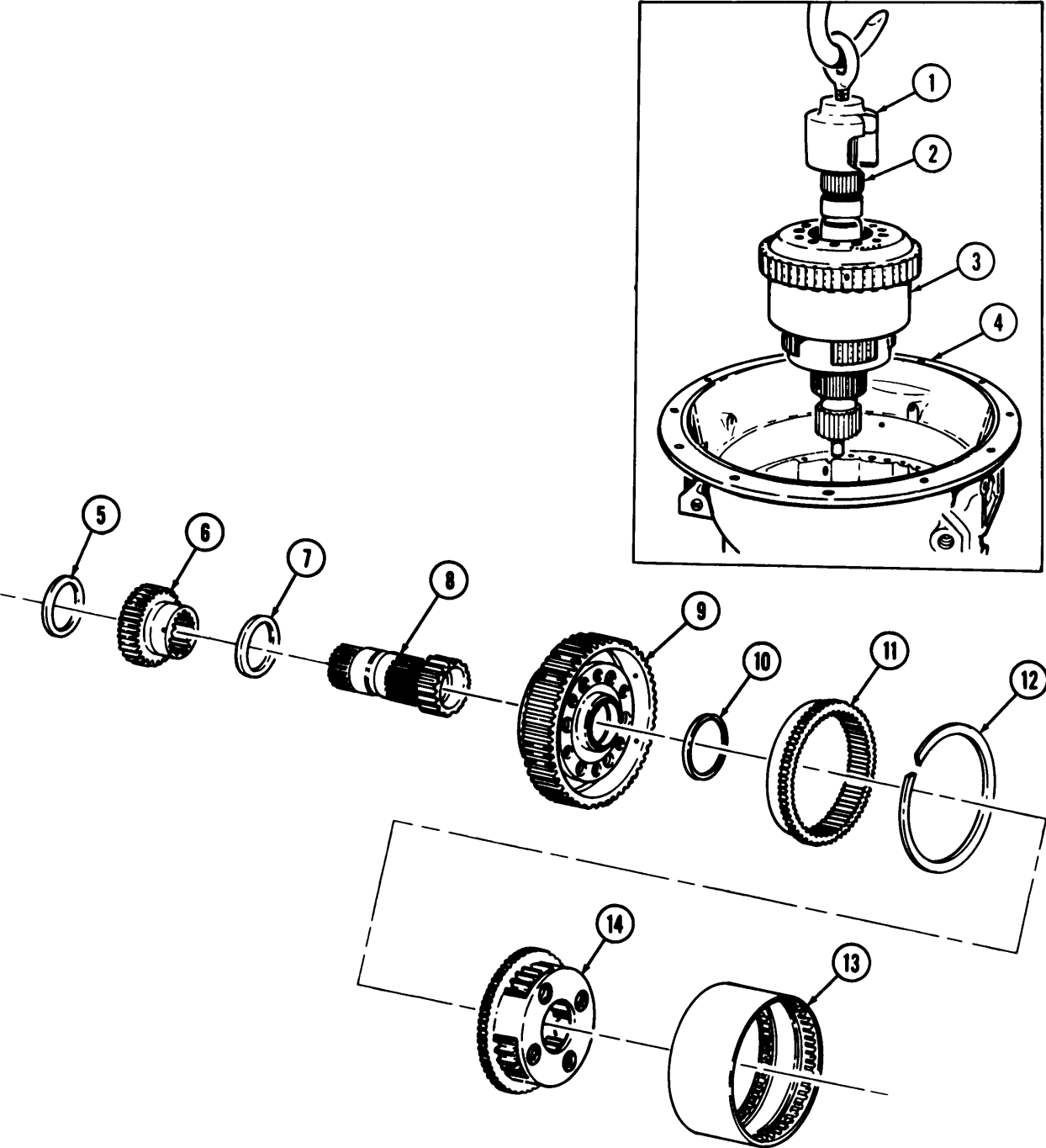
Remove and lift out ring gear (11).
6.

Center planetary earner (14)

Remove.

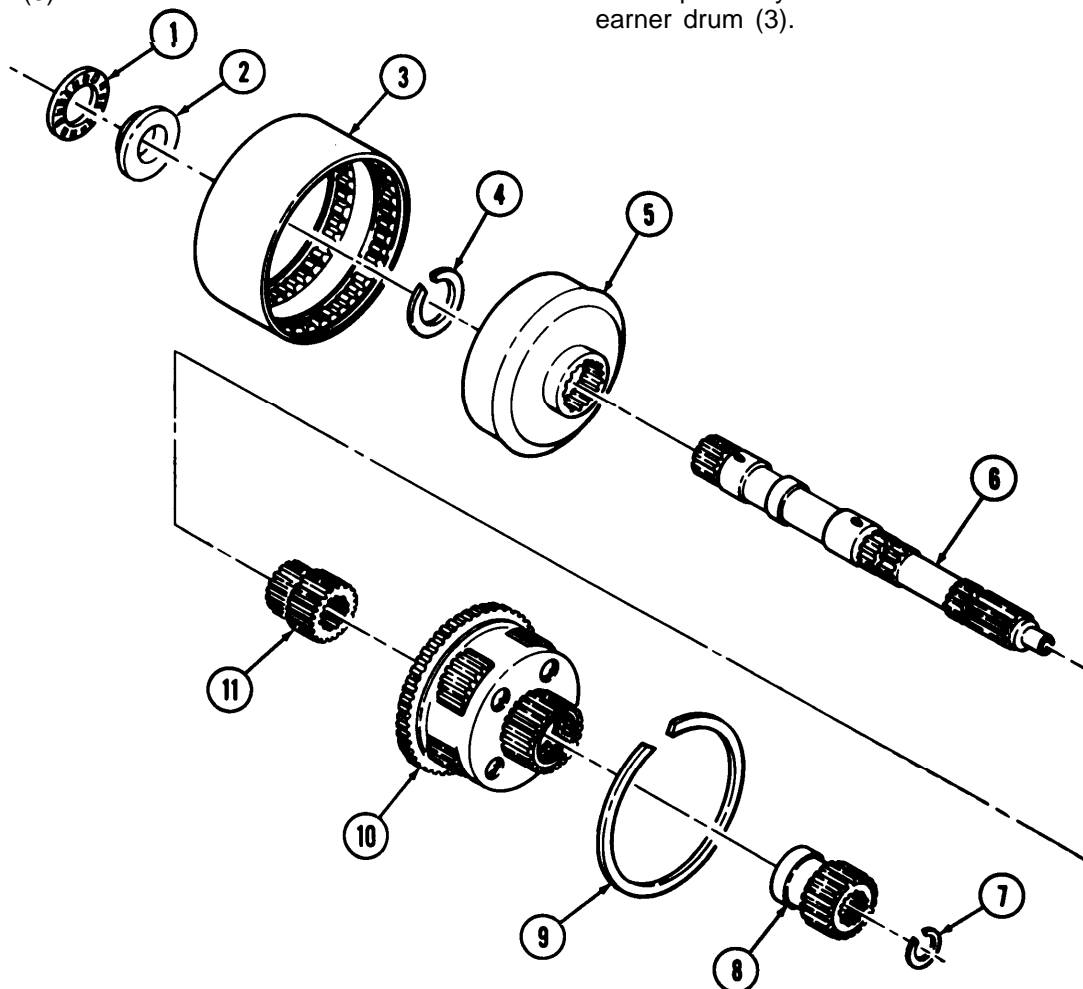
7-29. GEAR UNIT AND MAIN SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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7-29. GEAR UNIT AND MAIN SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
7.	Main shaft (6)	Snapring (7) and sun gear (8)	Remove snapring and slide sun gear (8) off main shaft (6).	
7.1		Roller bearing (1) and bearing race (2)	Remove.	
8.	Rear planetary sun gear (11)	Main shaft (6)	Remove.	
9.	Rear planetary carrier (10)	Center ring gear (5) and rear planetary sun gear (11)	Remove.	
10.	Rear planetary sun gear (11) to center ring gear (5)	Snapring (4)	Remove and slide rear sun gear (11) out of center ring gear (5).	
11.	Rear planetary earner (10) to planetary earner drum (3)	Snapring (9)	Remove and lift rear planetary earner (10) out of planetary earner drum (3).	



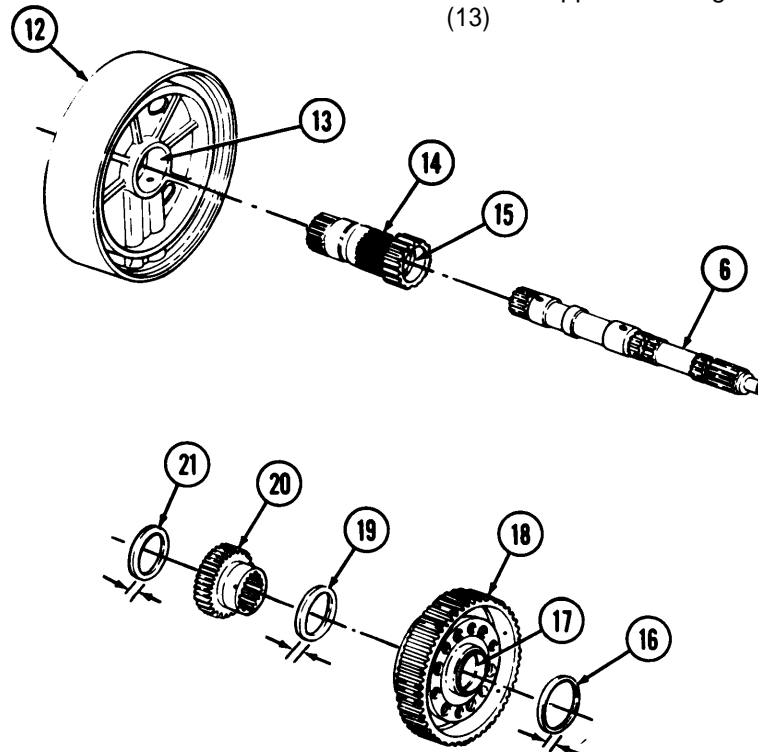
7-29. GEAR UNIT AND MAIN SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Clean all parts before inspection (para. 7-13).

12.		All gear units and main shaft components	Inspect.	Refer to para. 2-8 for inspection instructions.
13.		Thrust washer (21)	a. Measure thickness. b. Measure clearance to front sun gear (20).	Discard if less than 0.092 in. (2.34 mm) Discard if more than 0.005 in. (0.127 mm).
13.1.		Thrust washers (16) and (19)	a. Measure thickness. b. Inspect for scoring.	Discard if less than 0.091 in. (2.31 mm) No scoring allowed.
14.		Front planetary carrier bushing (17)	Measure clearance on front sun gear (20).	Remove from front planetary carrier (18) and discard if more than 0.005 in. (0.127 mm).
15.		Two sun gear shaft bushings (15)	Measure clearance on main shaft (6).	Remove from sun gear shaft (14) and discard if more than 0.006 in. (0.152 mm).
16.		Sun gear shaft (14)	Measure clearance on center support bushing (13)	Discard if more than 0.006 in. (0.152 mm) or replace bushing (13) in center support (12). Refer to para 7-28.



7-29. GEAR UNIT AND MAIN SHAFT REMOVAL (Cont'd)

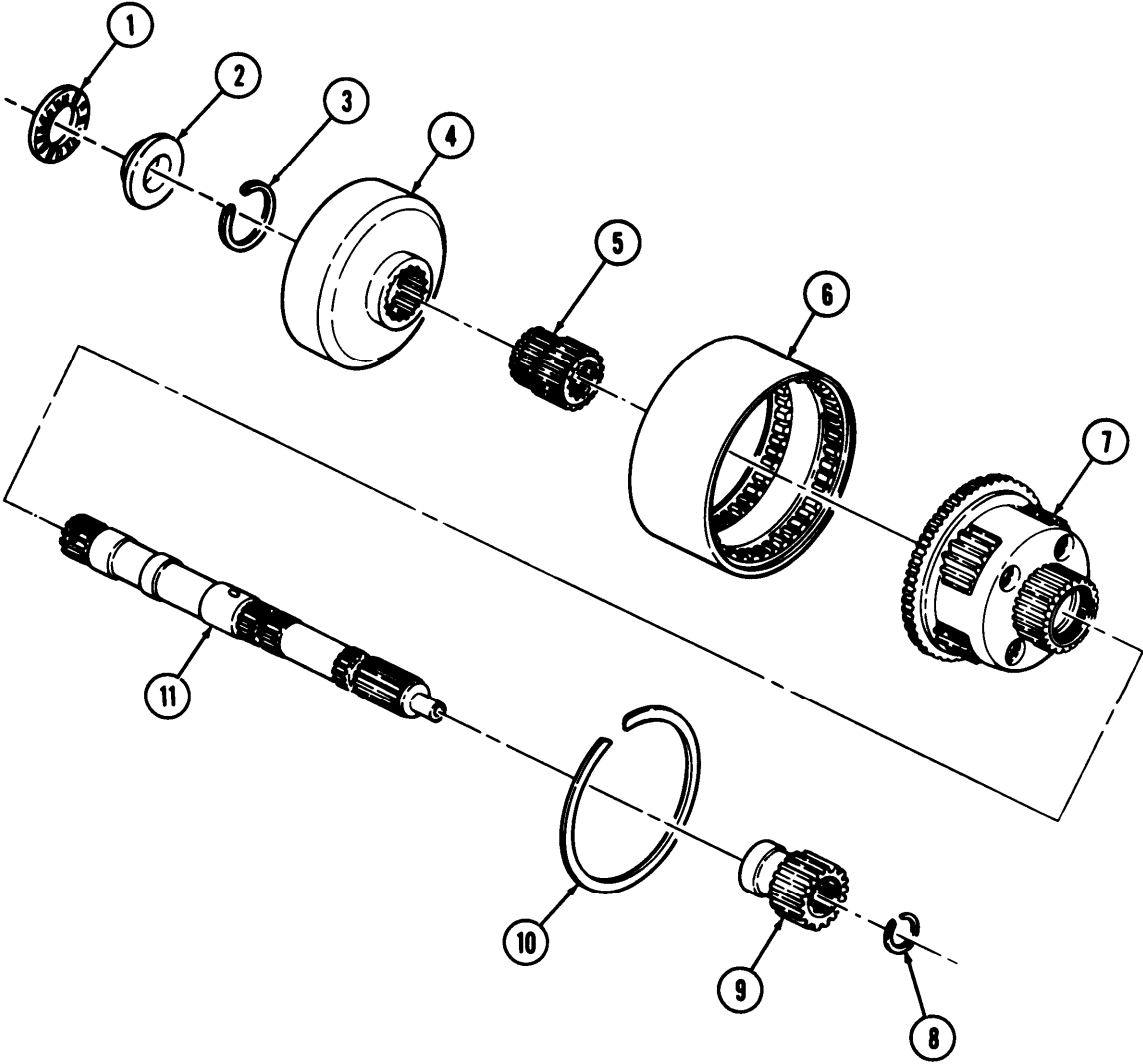
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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d. Disassembly

17.		Rear planetary carrier (7)	Install in short splined end of planetary earner drum (6) and install snapring (10).	
18.		Rear planetary sun gear (5)	Position in center ring gear (4) until seated and install with snapnng (3).	
19.		Center ring gear (4)	Install in planetary earner drum (6).	
20.		Main shaft (11)	Install into rear sun gear (5).	Smaller end must be installed first.
21.		Sun gear (9)	Install main shaft (11) with snapring (8).	
21.1		Main shaft (11)	Install bearing race (2) and bearing (1).	

7-29. GEAR UNIT AND MAIN SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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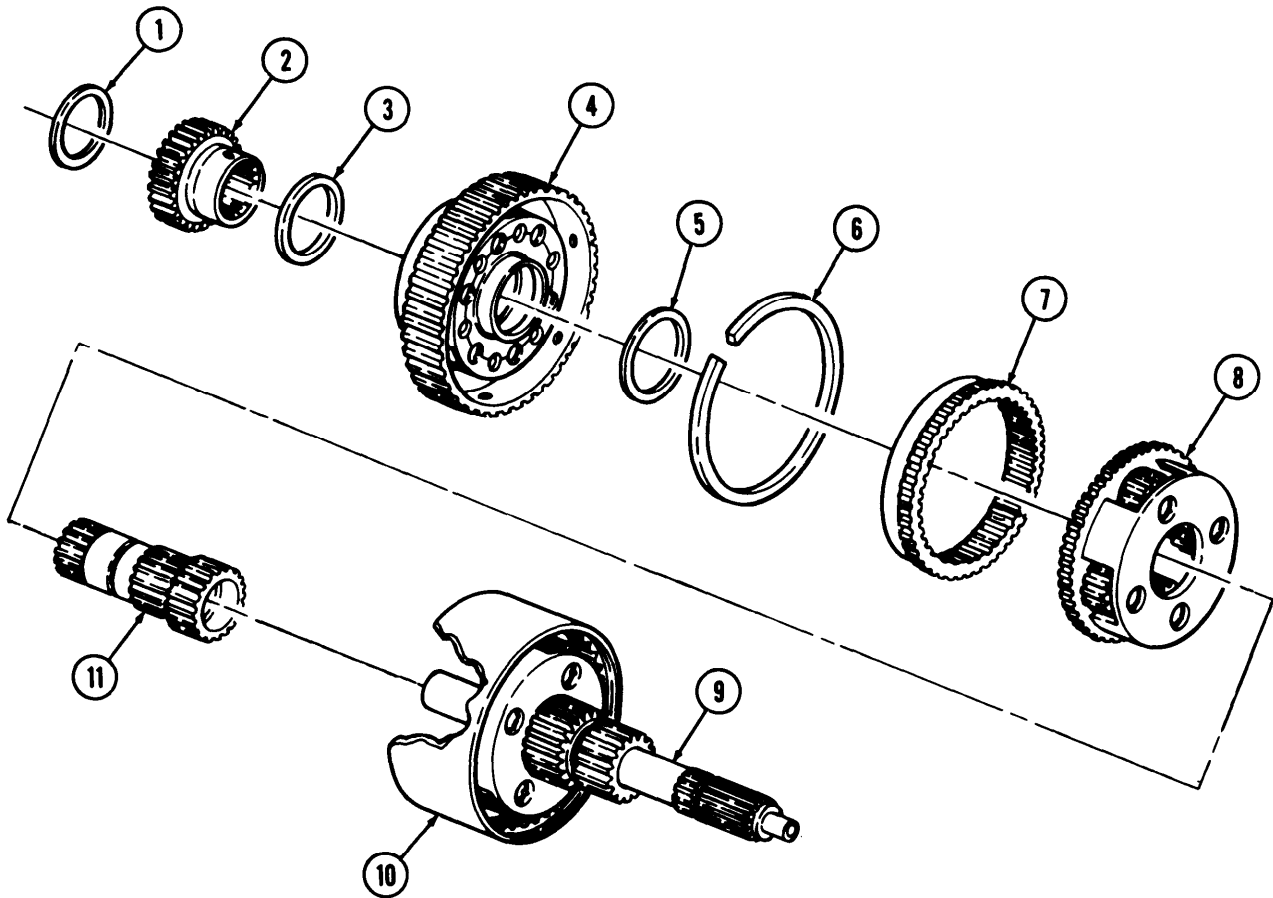


7-29. GEAR UNIT AND MAIN SHAFT REMOVAL (Cont'd)
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STEP NO.	LOCATION	ITEM	ACTION	REMARKS
22.		Center planetary carrier (8)	Install in long splined end of planetary earner drum (10).	
23.		Front planetary ring gear (7)	Install in planetary carrier drum (10) over center earner (8) and install snapping (6).	
24.		Thrust washer (5)	Install on front planetary carrier (4)	Use oil-soluble grease sparingly to hold in place.
25.		Front planetary earner (4)	Install in planetary earner drum (10).	
26.		Thrust washer (3)	Install on sun gear (2).	Spring pin on sun gear sparingly to hold in place.
27.		Front sun gear (2)	Install on sun gear shaft (11).	Spring pin on sun gear shaft (11) must be alined with wide spline on front sun gear.
NOTE				
Make sure sun gear teeth and front planetary pinion teeth are flush and the front of sun gear shaft is past groove between double splines on main shaft.				
28.		Sun gear shaft (11)	Install over main shaft (9) in planetary earner (10) until seated against bearing.	
28.1.		Thrust washer (1)	Install against front sun gear (2) and over sun gear shaft (11).	

7-29. GEAR UNIT AND MAIN SHAFT REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

7-30. SECOND CLUTCH REMOVAL

This task covers:

- a. Removal
- b. Inspection

INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-29	Gear unit and main shaft removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		<ul style="list-style-type: none">• Keep fire extinguisher nearby when using drycleaning solvent.• Compressed air source will not exceed 30 psi (207 kPa).• Eyeshields must be worn when cleaning with compressed air.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Second clutch consists of a backplate, four clutch plates, and four clutch discs. Keep all clutch parts together. Intermixing second clutch parts with any other clutch pack will cause transmission damage.

a. Removal

1.	Transmission housing (3)	Snapring (1), four clutch discs (5), four plates (2), and back-plate (4)	Remove.
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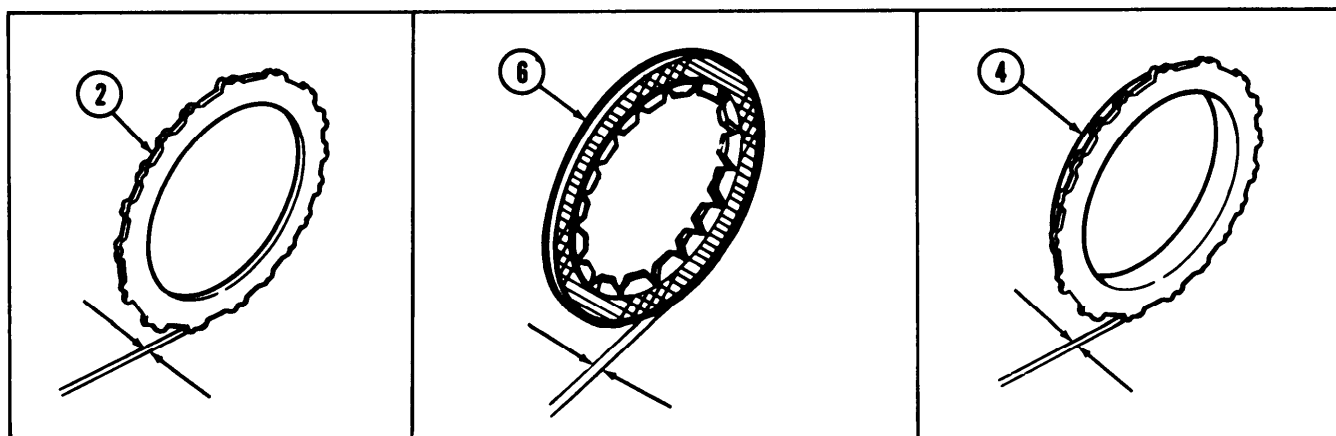
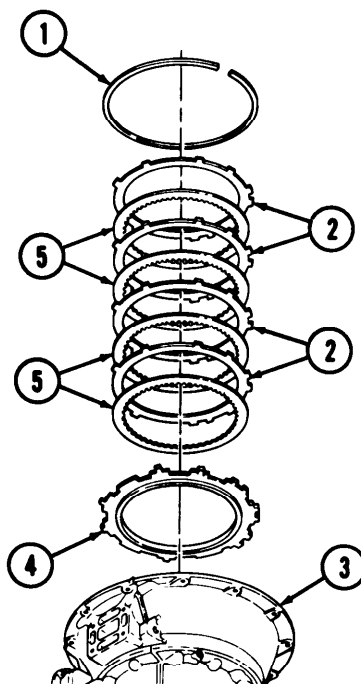
b. Inspection

NOTE

Clean all parts before inspection (para. 7-13).			
2.	All second clutch components	Inspect.	Refer to para. 2-8 for inspection instructions.
3.	Clutch plates (2)	Measure thickness of clutch plates (2).	Discard if less than 0.0955 in. (2.4 mm).

7-30. SECOND CLUTCH REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
4.		Clutch discs (5)	a. Inspect for burned surfaces. b. Measure clutch discs (6) thickness.	Discard if burned. Discard if less than 0.117 in. (2.97 mm).
5.		Backplate (4)	Measure thickness.	Discard backplate marked no. 10 if less than 0.234 in. (5.94 mm); discard backplate marked no. 11 if less than 0.208 in. (5.28 mm); or discard backplate marked no. 12 if less than 0.221 in. (5.61 mm).



END OF TASK!

7-31. FIRST CLUTCH REMOVAL

This task covers:

- a. Removal
- b. Inspection

INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-30	Second clutch removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		<ul style="list-style-type: none">•Keep fire extinguisher nearby when using drycleaning solvent.•Compressed air source will not exceed 30 psi (207 kPa).•Eyeshields must be worn when cleaning with compressed air.
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

First clutch consists of a backplate,four clutch plates, and five clutch discs. Keep all clutch parts together. Intermixing first clutch parts with any other clutch pack will cause transmission damage.

a. Removal

1. Transmission housing (3)
- Snapping (5), backplate (6), five clutch discs (3) four clutch plates (2), and rear planetary ring gear (4)
- Remove.

b. Inspection

NOTE

Clean all parts before inspection (para. 7-13).

3.
- All first clutch components
- Inspect.
- Refer to para. 2-8 for inspection instructions.
4.
- Clutch discs (3)
- a. Inspect for burned surfaces.
- Discard if burned.
- b. Measure clutch disc (3) thickness.
- Discard if less than 0.090 in. (2.29 mm).
5.
- Clutch plates (2)
- Measure clutch plate (2) thickness.
- Discard if less than 0.0955 in. (2.425 mm).

7-31. FIRST CLUTCH REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

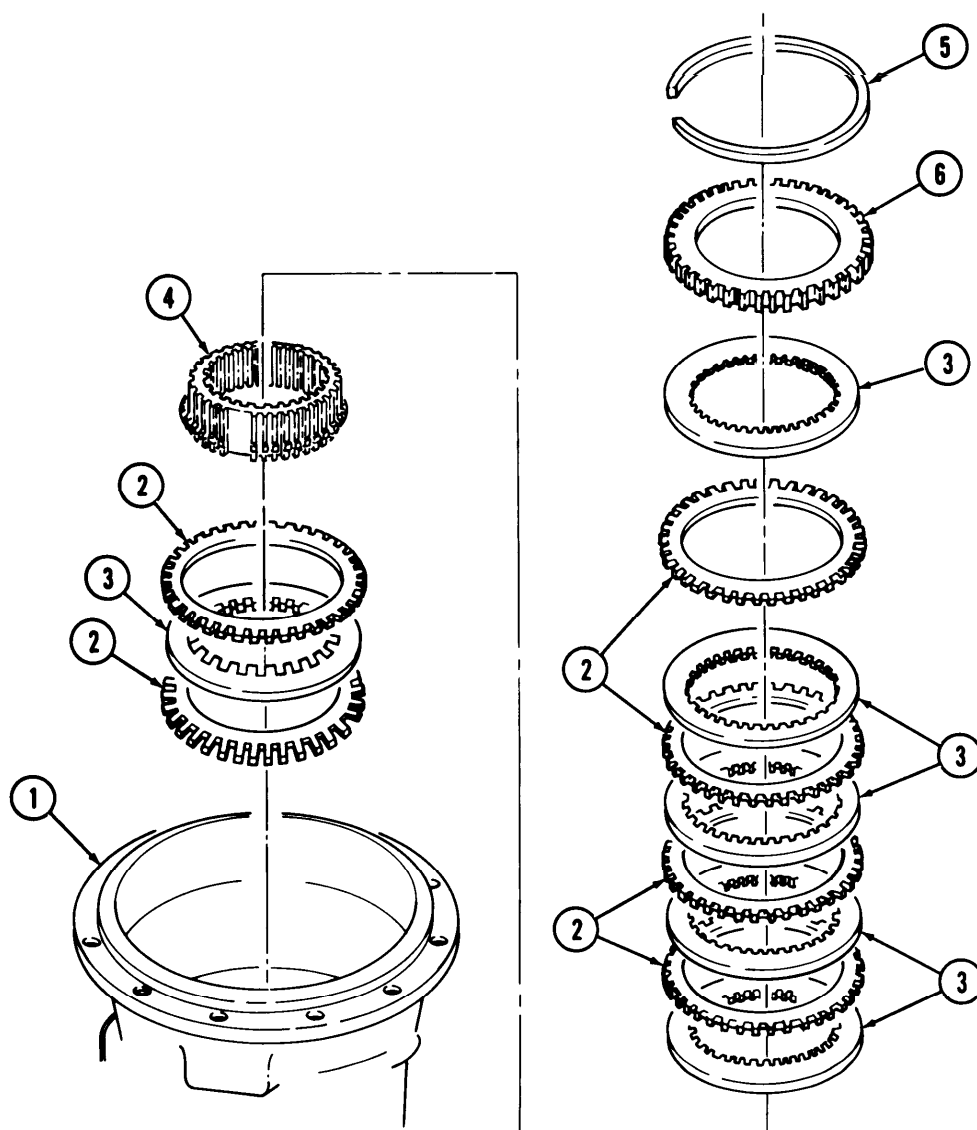
Cast iron backplanes marked number 1, 2, and 3 must have same thickness as corresponding new malleable iron backplanes 4, 5, and 6.

6.

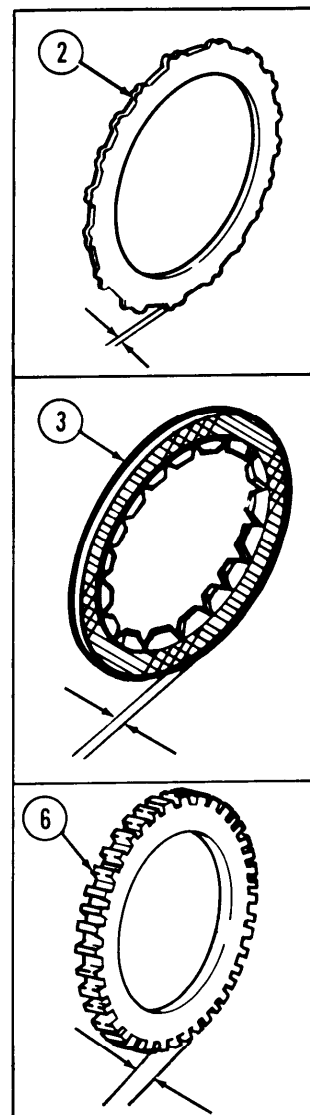
Backplate (6)

Measure thickness.

Discard backplate marked no. 4 if less than 0.702 in. (17.83 mm); discard backplate marked no. 5 if less than 0.671 in. (17.04 mm); or discard backplate marked no. 6 if less than 0.640 in. (16.26 mm).



END OF TASK!



7-32. TRANSMISSION GOVERNOR REMOVAL

This task covers:

Removal

INITIAL SETUP:

Applicable Models

All

Test Equipment

None

Special Tools

None

Materials/Parts

None

Personnel Required

Wheeled vehicle repairman MOS 63W

Manual References

TM 9-2320-272-34P

Equipment Condition Reference

Para. 7-31

Condition Description

First clutch removed.

Special Environmental Conditions

Work area clean and free from blowing dirt and dust.

General Safety Instructions

None

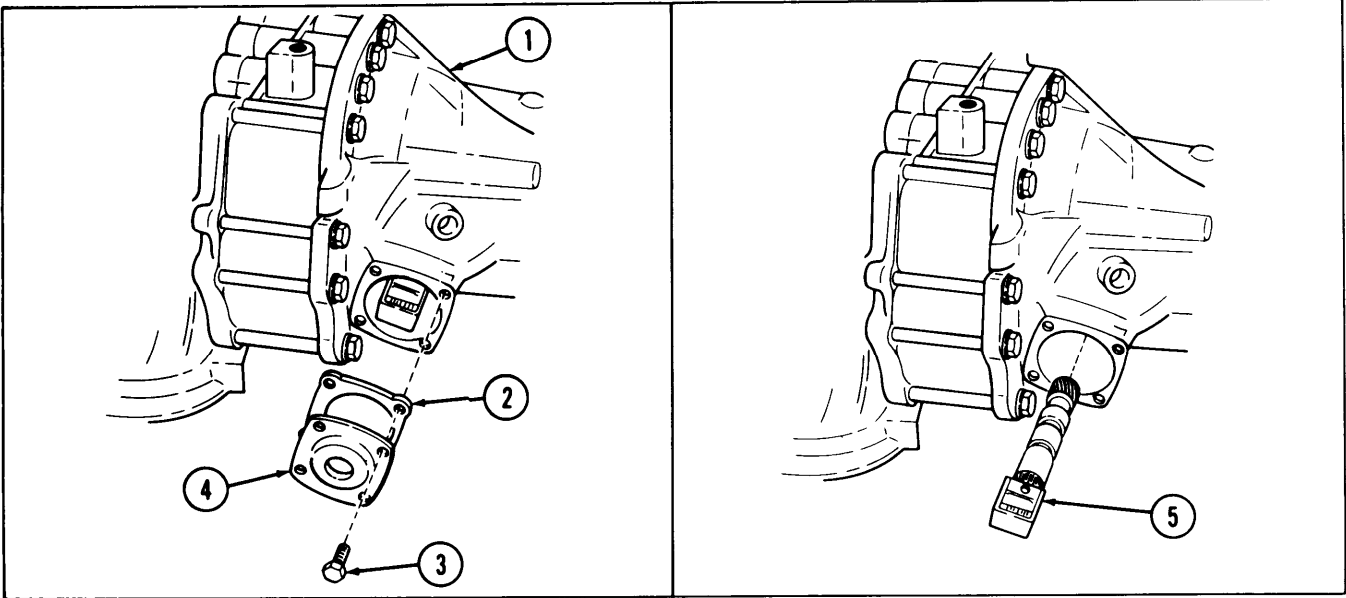
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Removal

- | | | | | |
|----|-----------------------------|---|---------|---|
| 1. | Transmission rear cover (1) | Four screws (3) governor cover (4) and gasket (2) | Remove. | Discard gasket (2).
Clean gasket remains from mating surfaces. |
| 2. | | Transmission governor (5) | Remove. | |

7-32. TRANSMISSION GOVERNOR REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

7-33. REAR COVER AND LOW PLANETARY CARRIER REMOVAL

This task covers:

a. Removal
b. Disassembly

c. Inspection
d. Reassembly

INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-32 Para. 7-7	Transmission governor removed. Transmission output shaft oil seal removed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Spring compressor J-24452 Ring bearing installer J-24447 Driver handle J-24202-4 Seal puller J-24171 Converter turbine bearing puller J-26956 Pin remover J-28708 Bearing installer J-25393A Drive handle J-8092		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		<u>General Safety Instructions</u>
Low clutch piston inner seal ring Low clutch piston outer seal ring Governor support pin Crocus cloth (Appendix C, Item 6) Oil-soluble grease (Appendix C, Item 19)		<ul style="list-style-type: none">• Keep fire extinguisher nearby when using drycleaning solvent.• Compressed air source will not exceed 30 psi (207 kPa).• Eyeshields must be worn when cleaning with compressed air.
<u>Personnel Required</u>		
Wheeled vehicle repairman MOS 63W		
<u>Manual References</u>		
TM 9-2320-272-34P		

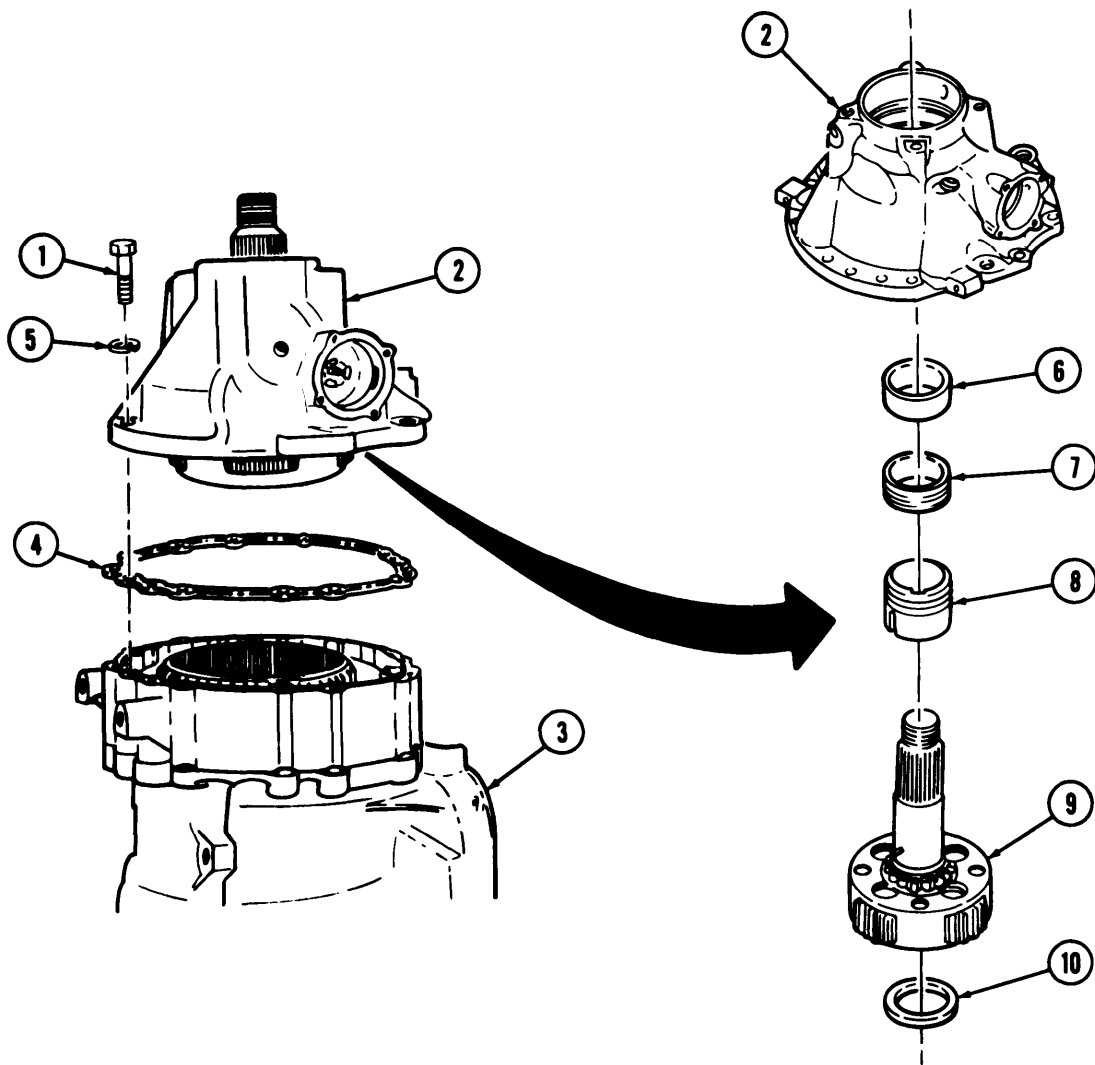
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1.	Rear cover (2)	Fourteen screws (1) and washers (5)	Remove.	Turn transmission housing (3) so rear cover (2) is up.
2.	Transmission housing (3)	Rear cover (2), low planetary earner (9), gasket (4) and thrust washer (10)	Remove.	Discard gasket (4). Clean gasket remains from mating surfaces.
3.	Low planetary earner (9)	Sleeve spacer (6), speedometer drive gear (7), and governor drive gear (8)	Remove.	

7-33. REAR COVER AND LOW PLANETARY CARRIER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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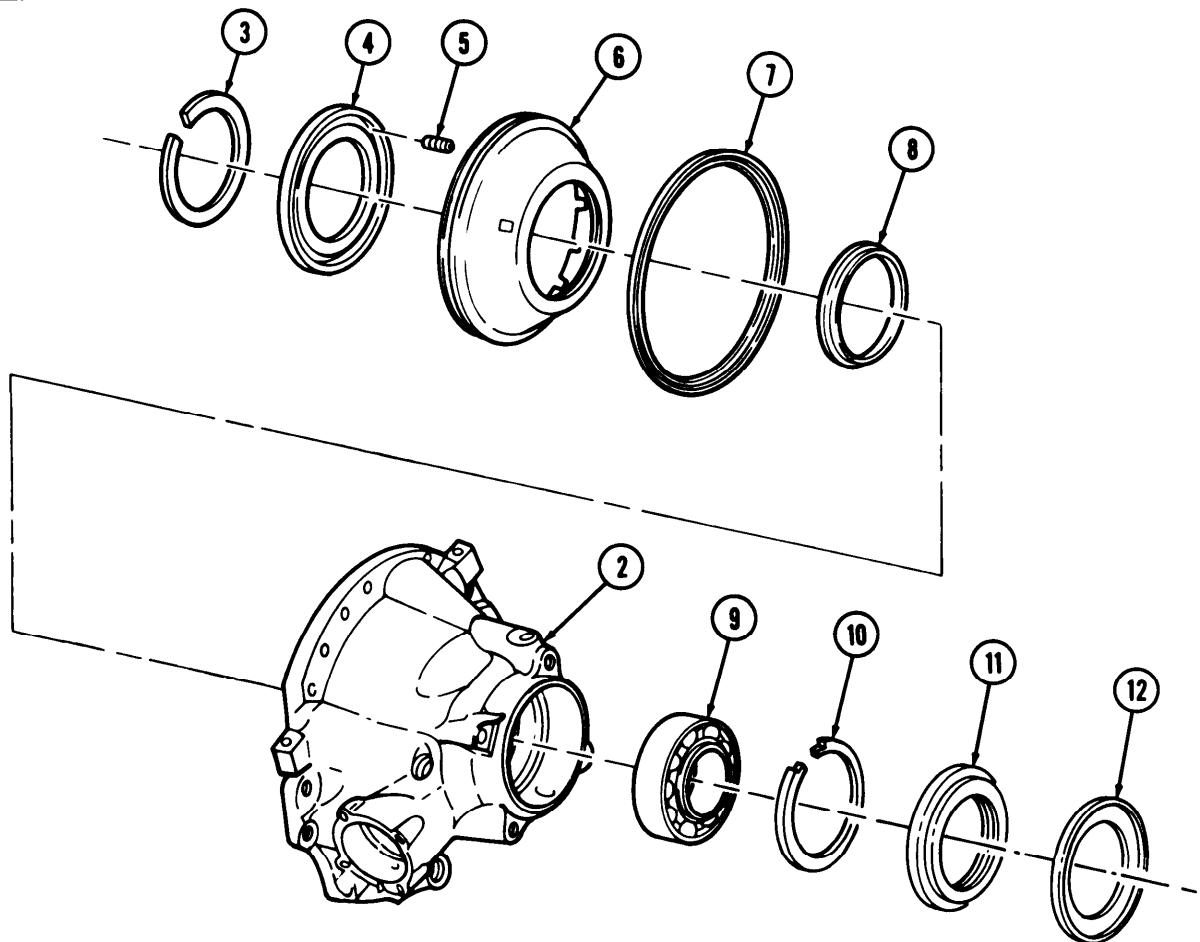
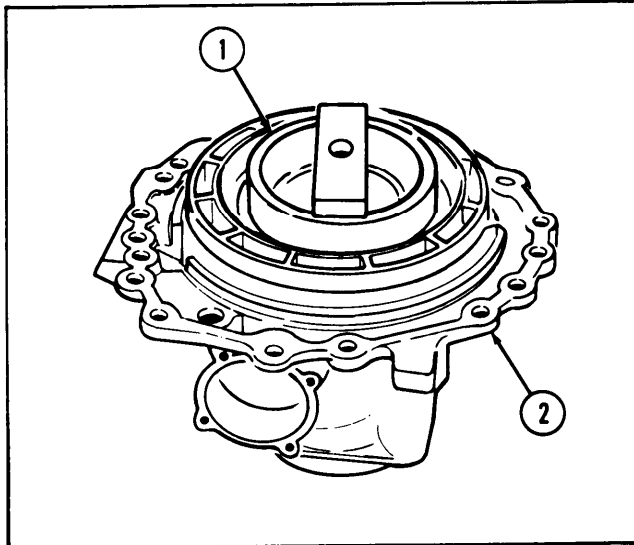


7-33. REAR COVER AND LOW PLANETARY CARRIER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
b. Disassembly				
3.1.	Rear cover (2)	Dust cover (12) and seal (11)	Remove.	Use seal puller and hook.
4.		Beveled snapring (10) and rear output shaft bearing (9)	Remove.	Use converter turbine bearing puller.
5.		Spring compressor (1)	Position on low clutch spring retainer (4) and apply pressure.	Use arbor press.
6.		Snapring (3)	Remove.	
7.		Spring compressor (1)	Remove.	
8.	Low clutch piston (6)	Spring retainer (4) and twenty-six piston return springs (5)	Remove.	
9.	Rear cover (2)	Low clutch piston (6)	Remove.	
10.	Low clutch piston (6)	Outer seal ring (7) and inner seal ring (8)	Remove.	Discard seal rings (7) and (8).

7-33. REAR COVER AND LOW PLANETARY CARRIER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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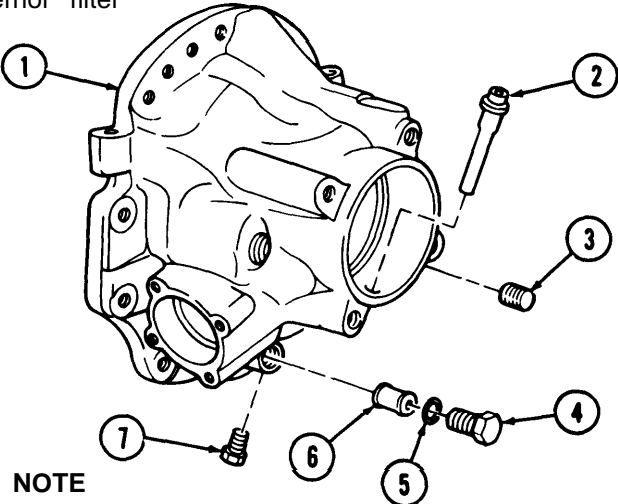


7-33. REAR COVER AND LOW PLANETARY CARRIER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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13. Rear cover (1) Plug (3), drain tube (2) Remove. and plug (7)

14. Filter plug (4), "O" ring (5), and governor filter (6) Remove.



NOTE

Clean all parts before inspection (para. 7-13).

c. Inspection

15. All rear cover (1) components and low planetary earner (11) Inspect. Refer to para. 2-8 for inspection instructions.

16. Rear cover (1)

- a. Inspect for breaks and cracks. Replace if broken or cracked.
- b. Measure governor clearance in bore (8) of rear cover (1). Replace rear cover (1) if more than 0.0035 in. (0.089 mm).
- c. Inspect governor support pin (15) for looseness, bends, and breaks. Remove if loose. Carefully inspect rear cover (1) using new pin (15). Replace pin (15) if bent or broken. Use pin remover.

17. Low planetary earner (11)

- a. Inspect for missing or twisted splines (12). Replace if splines (12) are missing or twisted.
- b. Inspect for burrs. Remove burrs with crocus cloth.
- c. Inspect roller bearing (13) and race (14). If bearing (13) or race (14) in rear cover (1) are defective, replace bearing (13) and race (14) as a set.

NOTE

Perform step 17d only if bearing or race is defective.

7-33. REAR COVER AND LOW PLANETARY CARRIER REMOVAL (Cont'd)

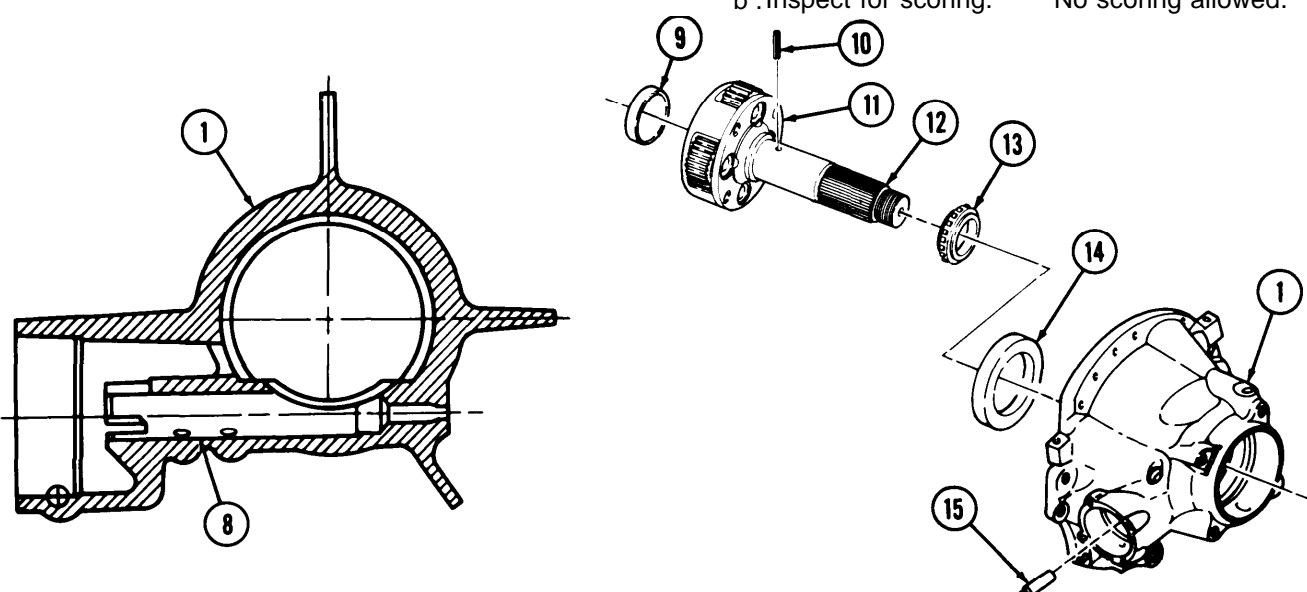
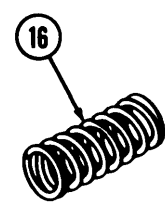
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
			d. Remove pin (10), roller bearing (13), and race (14).	Pin (10) must be removed to remove bearing (13). Discard pin (10). Use bearing puller.
17.1.		Thrust washer (9)	a. Measure thickness. b. Inspect for scoring.	Discard if less than 0.091 in. (2.31 mm). No scoring allowed.
				
18.		Twenty-six piston return springs (16)	a. Inspect for discoloration due to overheating. b. Inspect for broken coils or coils distorted due to wear. c. Using spring tester, inspect for serviceability by checking load when spring (16) is compressed to correct length (table 7-5).	Discard if discolored. Spring (16) is solid orange color with yellow stripe. Discard if broken or distorted. Discard if springs (16) do not give the correct load. Refer to table 7-5.
				

Table 7-5. Spring Data.

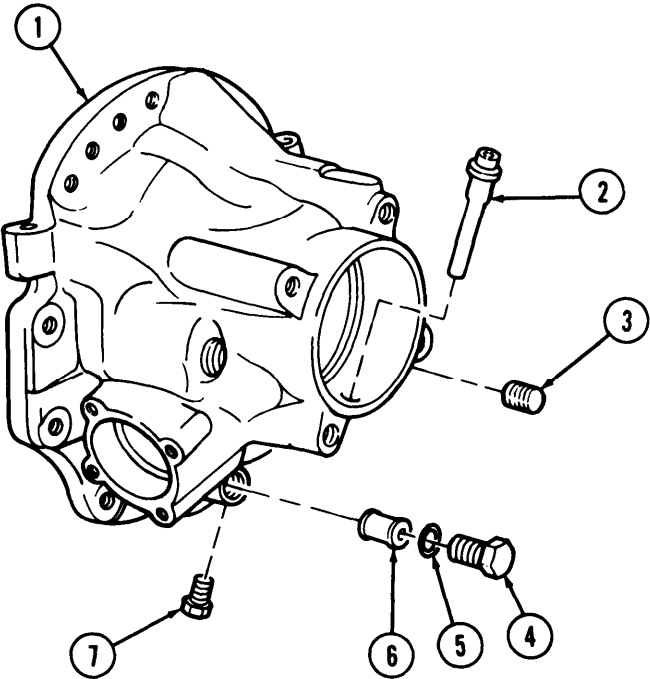
SPRING	COLOR	FREE LENGTH	COMPRESSED LENGTH	UNDER LOAD
Piston return spring	Solid orange, yellow stripe	1.28 in. (32.5 mm)	.95 in. (24.1 mm)	13.6 -16.4 lb (60.5-72.9 N)

7-33. REAR COVER AND LOW PLANETARY CARRIER REMOVAL (Cont'd)

STEP N O .	LOCATION	ITEM	ACTION	REMARKS
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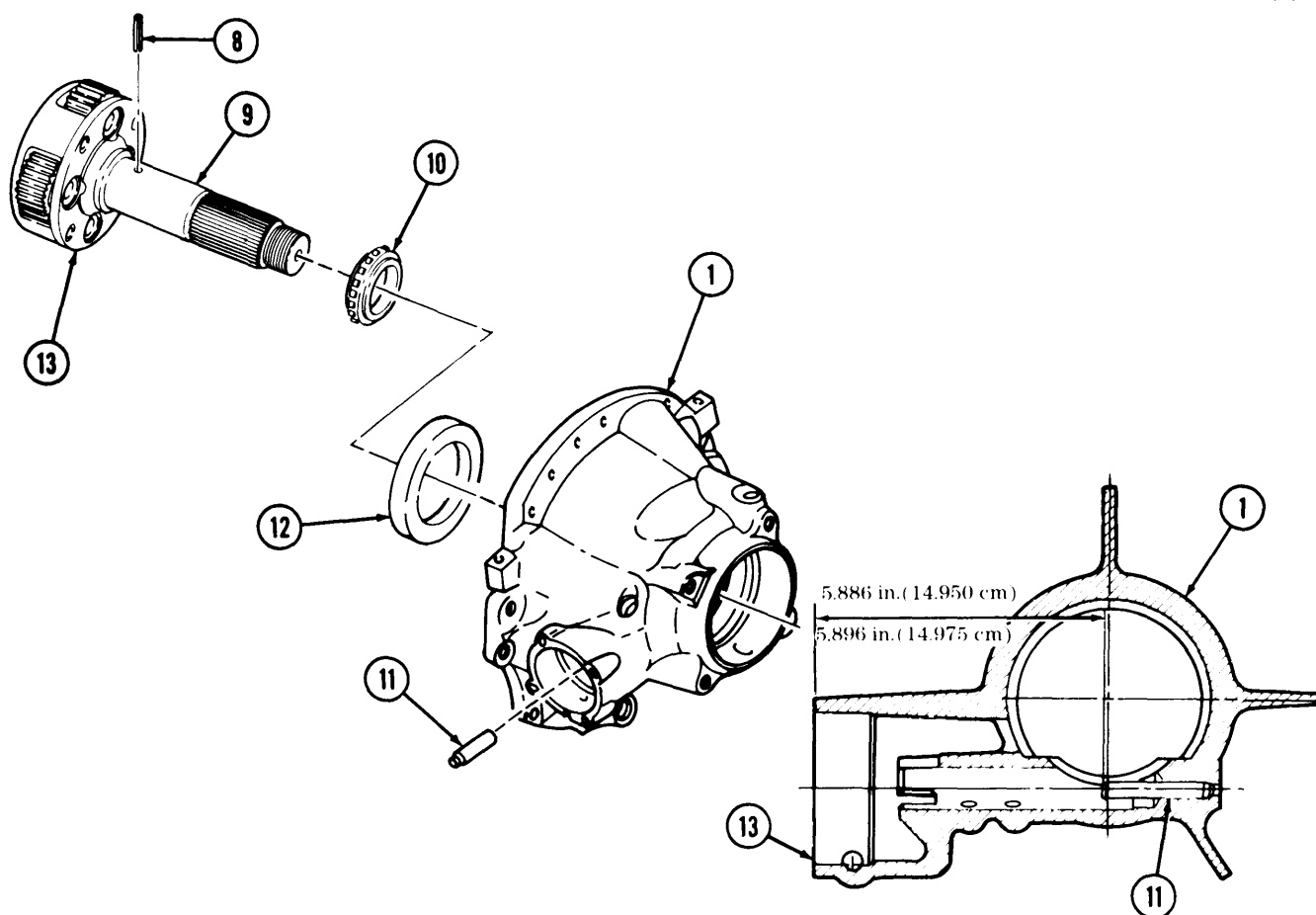
d. Reassembly

19.		Governor filter (6), "O" ring (5) and filter plug (4)	Install in rear cover (1).	Tighten filter plug (4) 50-70 lb-ft (68-95 N°m).
20.		Drain tube (2) and plug (3)	Install.	Tighten plug (3) 12-16 lb-ft (16-22 N°m).
21.		Plug (7)	Install.	Tighten 4-8 lb-ft (5-11 N°m).



7-33. REAR COVER AND LOW PLANETARY CARRIER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
22.		New governor support pin (11)	Press support pin (11) into rear cover (1) until end of pin (11) is 5.886-5.896 in. (14.950-14.975 cm) from outside face (14) of rear cover (1).	Perform if support pin (11) was previously removed. Use pin installer.
23.		Bearing outer race (12)	Install in rear cover (1).	Perform if previously removed. Seat race (12) 0.180-0.190 in. (4.57-4.83 mm) below hub lip. Use bearing race installer.
23.1.		Roller bearing (10) and new pin (8)	Install on low planetary carrier (13).	Install bearing (10) before installing pin (8). Seat bearing (10) to shoulder on shaft (9).

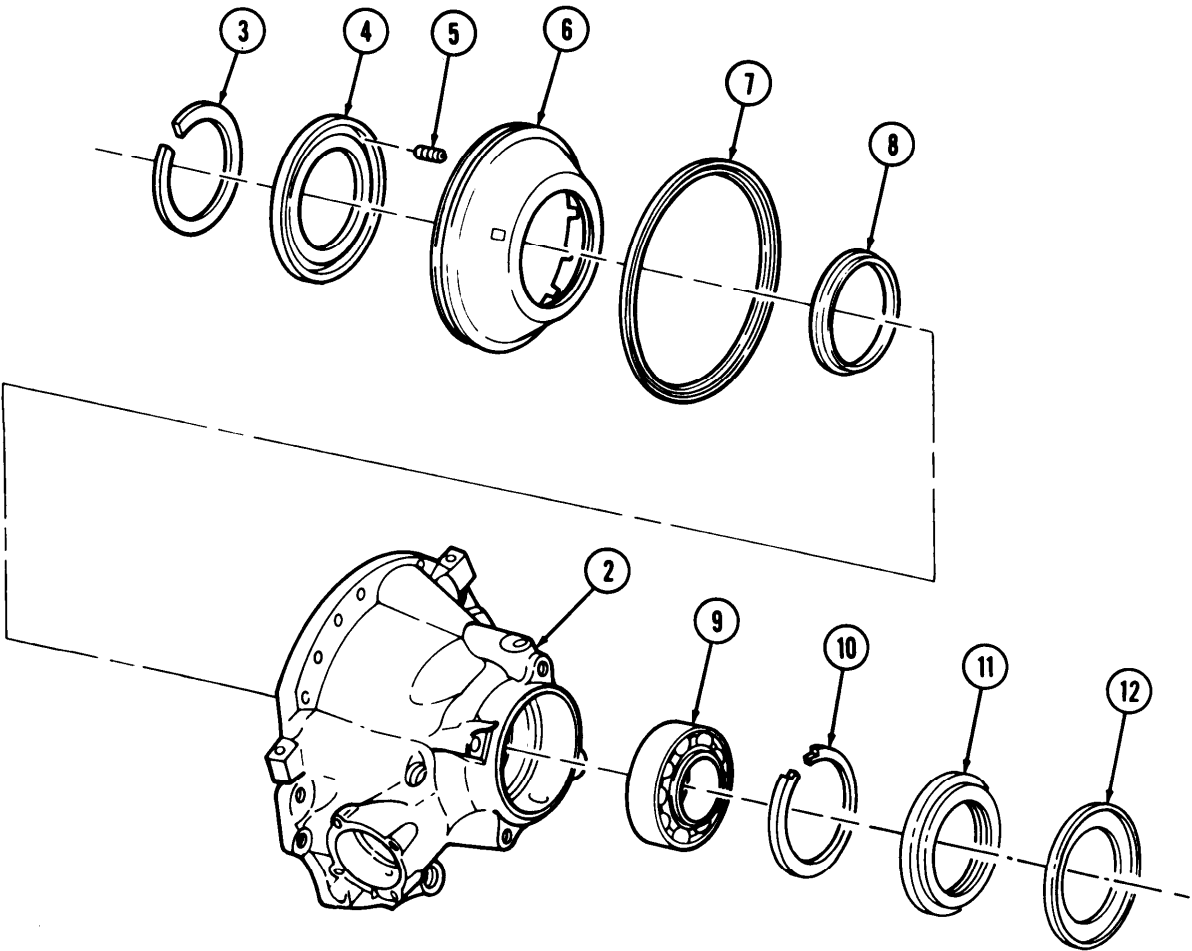
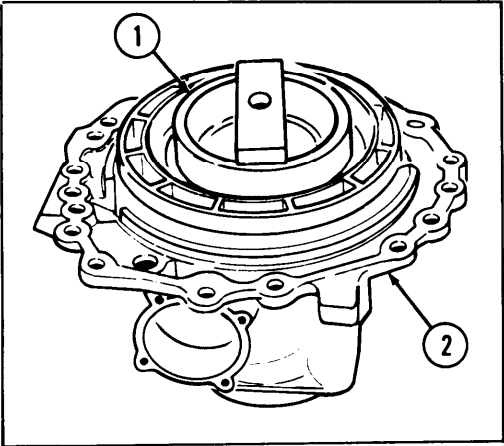


7-33. REAR COVER AND LOW PLANETARY CARRIER REMOVAL (Cont'd)
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STEP N O .	LOCATION	ITEM	ACTION	REMARKS
24.		New outer seal ring (7) and new inner seal ring (8)	Install on low clutch piston (6).	Make sure seal rings (7) and (8) lips face piston (6) oil pressure side. Use oil-soluble grease sparingly to hold in place.
25.		Low clutch piston (6)	Place in rear cover (2).	
26.		Twenty-six piston return springs (5)	Place in low clutch piston (6).	
27.		Spring retainer (4)	Place cupped side over piston return springs (5).	
28.		Spring compressor (1) and snapping (3)	a. Place on spring retainer (4) and compress piston return springs (5). b. Secure spring re- tainer (4) with snap- ring (3).	Use arbor press.
29.		Spring compressor (1)	Remove.	
30.		Rear output shaft bearing (9)	Install in rear cover (2) until seated.	Use bearing installer.
31.		Beveled snapping (10)	Install in rear cover (2) with beveled side toward rear of trans- mission.	
32.		Oil seal (11) and dust shield (12)	Install in rear cover (2).	

7-33. REAR COVER AND LOW PLANETARY CARRIER REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

7-34. LOW CLUTCH REMOVAL

This task covers:

- a. Removal
- b. Inspection

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 7-33	Rear cover and low planetary earner removed.
Test Equipment		
None		
Special Tools		Special Environmental Conditions
None		Work area clean and free from blowing dirt and dust.
Materials/Parts		General Safety Instructions
None		<ul style="list-style-type: none">• Keep fire extinguisher nearby when using drycleaning solvent.• Compressed air source will not exceed 30 psi (207 kPa).• Eyeshields must be worn when cleaning with compressed air.
Personnel Required		
Wheeled vehicle repairman MOS 63W		
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

1.	Adapter housing (6)	Low planetary ring gear (1)	Remove.	
1.1.	Low planetary ring gear (1)	Snpring (3) and low ring gear hub (2)	Remove.	
2.		Eight clutch plates (4) and seven clutch discs (5)	Remove.	Mark position of clutch plates (4) in adapter housing (6) for installation.

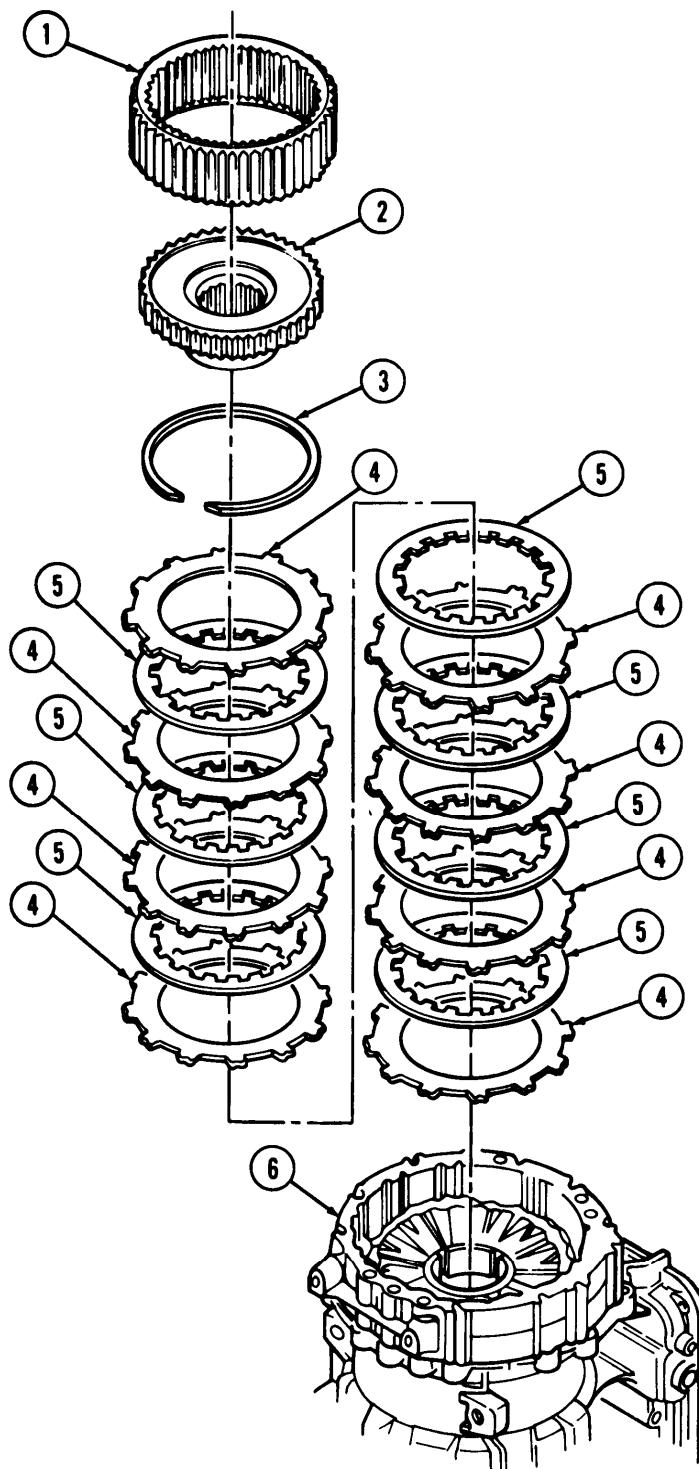
b. Inspection

NOTE

		Clean all parts before inspection (para. 7-13).		
3.		All low clutch components	Inspect.	Refer to para. 2-8 for inspection instructions.
4.		Clutch discs (5)	a. Inspect for burned surfaces. b. Measure clutch disc (5) thickness.	Discard if burned. Discard if less than 0.091 in. (2.31 mm).
5.		Clutch plates (4)	Measure clutch plate (4) thickness.	Discard if less than 0.0955 in. (2.425 mm).

7-34. LOW CLUTCH REMOVAL (Cont'd)

STEP N O .	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

7-35. ADAPTER HOUSING AND FIRST CLUTCH PISTON REMOVAL

This task covers:

- a. Removal
- b. Disassembly
- c. Inspection
- d. Reassembly

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 7-34	Low clutch removed.
Test Equipment		
None		
Special Tools		Special Environmental Conditions
Compressor tool J-24452		Work area clean and free from blowing dirt and dust.
Materials/Parts		
First clutch inner seal ring		
First clutch outer seal ring		
Adapter housing gasket		
Oil-soluble grease (Appendix C, Item 19)		General Safety Instructions
Personnel Required		<ul style="list-style-type: none">Keep fire extinguisher nearby when using drycleaning solvent.Compressed air source will not exceed 30 psi (207 kPa).Eyeshields must be worn when cleaning with compressed air.
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Removal

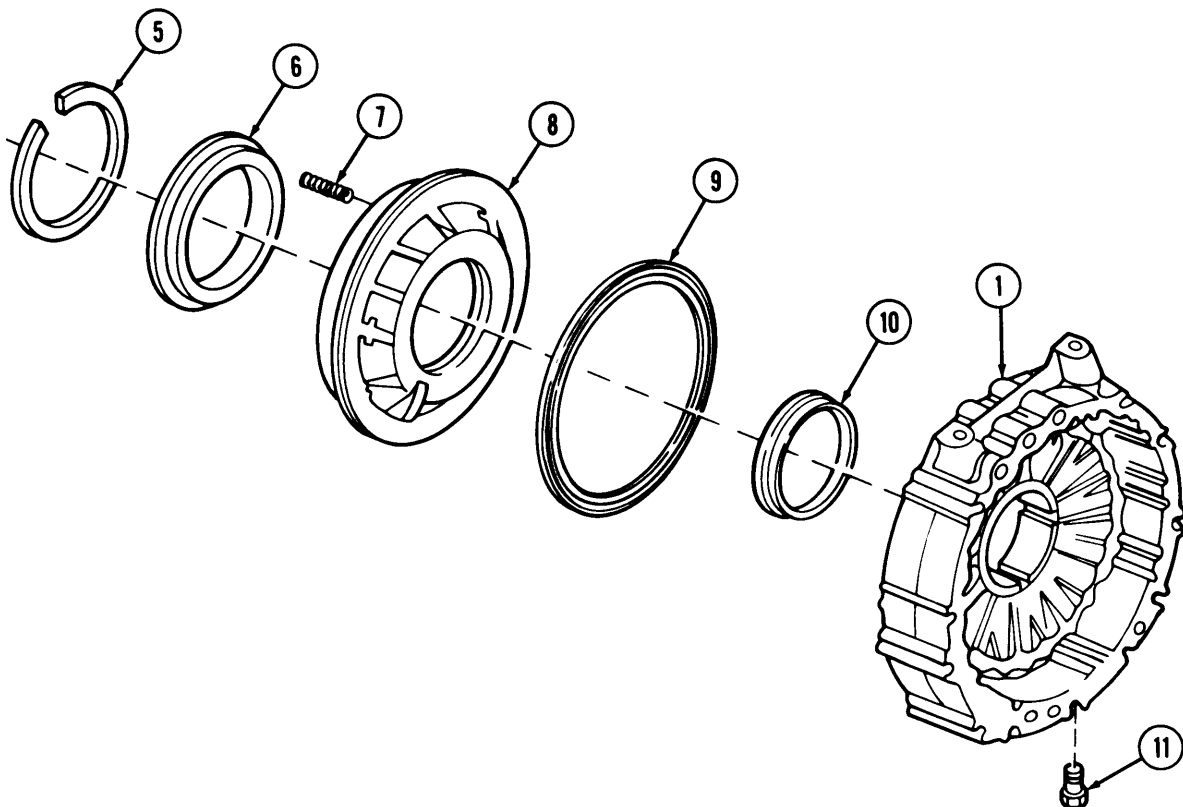
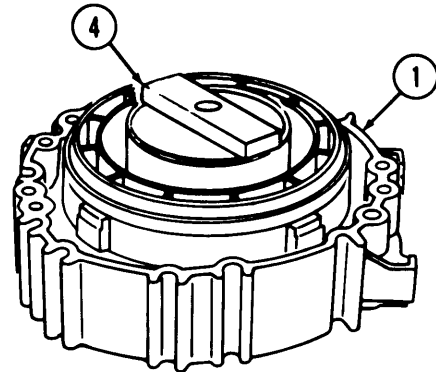
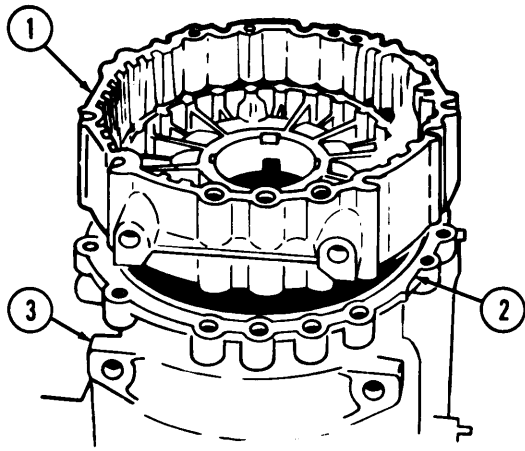
- | | | | | |
|----|--------------------------|------------------------------------|---------|---------------------|
| 1. | Transmission housing (3) | Adapter housing (1) and-gasket (2) | Remove, | Discard gasket (2). |
|----|--------------------------|------------------------------------|---------|---------------------|

b. Disassembly

- | | | | | |
|----|-------------------------|--|---|------------------|
| 2. | | Compressor tool (4) | Position on first clutch spring retainer (6) and apply pressure to relieve tension on snapping (5). | Use arbor press. |
| 3. | Adapter housing (1) | Snapping (5) | Remove. | |
| 4. | | Compressor tool (4) | Remove. | |
| 5. | First clutch piston (8) | Spring retainer (6) and twenty-six piston return springs (7) | Remove. | |
| 6. | Adapter housing (1) | First clutch piston (8) | Remove. | |

7-35. ADAPTER HOUSING AND FIRST CLUTCH PISTON REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
7.	First clutch piston (8)	Outer seal ring (9) and inner seal ring (10)	Remove.	Discard seal rings (9) and (10).
8.	Adapter housing (1)	Plug(11)	Remove.	



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7-35. ADAPTER HOUSING AND FIRST CLUTCH PISTON REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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c. Inspection

NOTE				
Clean all parts before inspection (para. 7-13).				
9.		All adapter housing (2) and first clutch piston (6) components	Inspect.	Refer to para. 2-8 for inspection instructions.
10.		Twenty-six piston return springs (5)	a. Inspect for discoloration due to overheating. b. Inspect for broken coils or coils distorted due to wear.	Discard if discolored. Springs (5) should be solid orange color with yellow stripe. Discard if damaged.
NOTE				
Perform step c if springs pass visual inspection.				
			c. Using spring tester, inspect for serviceability by checking load when spring (5) is compressed to 0.95 in. (24.1 mm).	Discard if springs (5) do not give the correct load. Refer to table 7-5.1.

d. Reassembly

11.		New outer seal ring (7) and new inner seal ring (8)	Install on first clutch piston (6).	Make sure seal rings (7) and (8) lips face piston (6) oil pressure side. Use oil-soluble grease sparingly to hold in place.
12.		First clutch piston (6)	Place in adapter housing (2).	
13.		Twenty-six piston return springs (5)	Place in first clutch piston (6).	
14.		Spring retainer (4)	Place cupped side over piston return springs (5).	
15.		Compressor tool (1) and snapring (3)	a. Place on spring retainer (4) and compress piston return springs (5). b. Install snapring (3).	Use arbor press.
16.		Compressor tool (1)	Remove.	
17.		Plug (9)	Install.	Tighten 4-8 lb-ft (5-11 N·m).

7-35. ADAPTER HOUSING AND FIRST CLUTCH PISTON REMOVAL (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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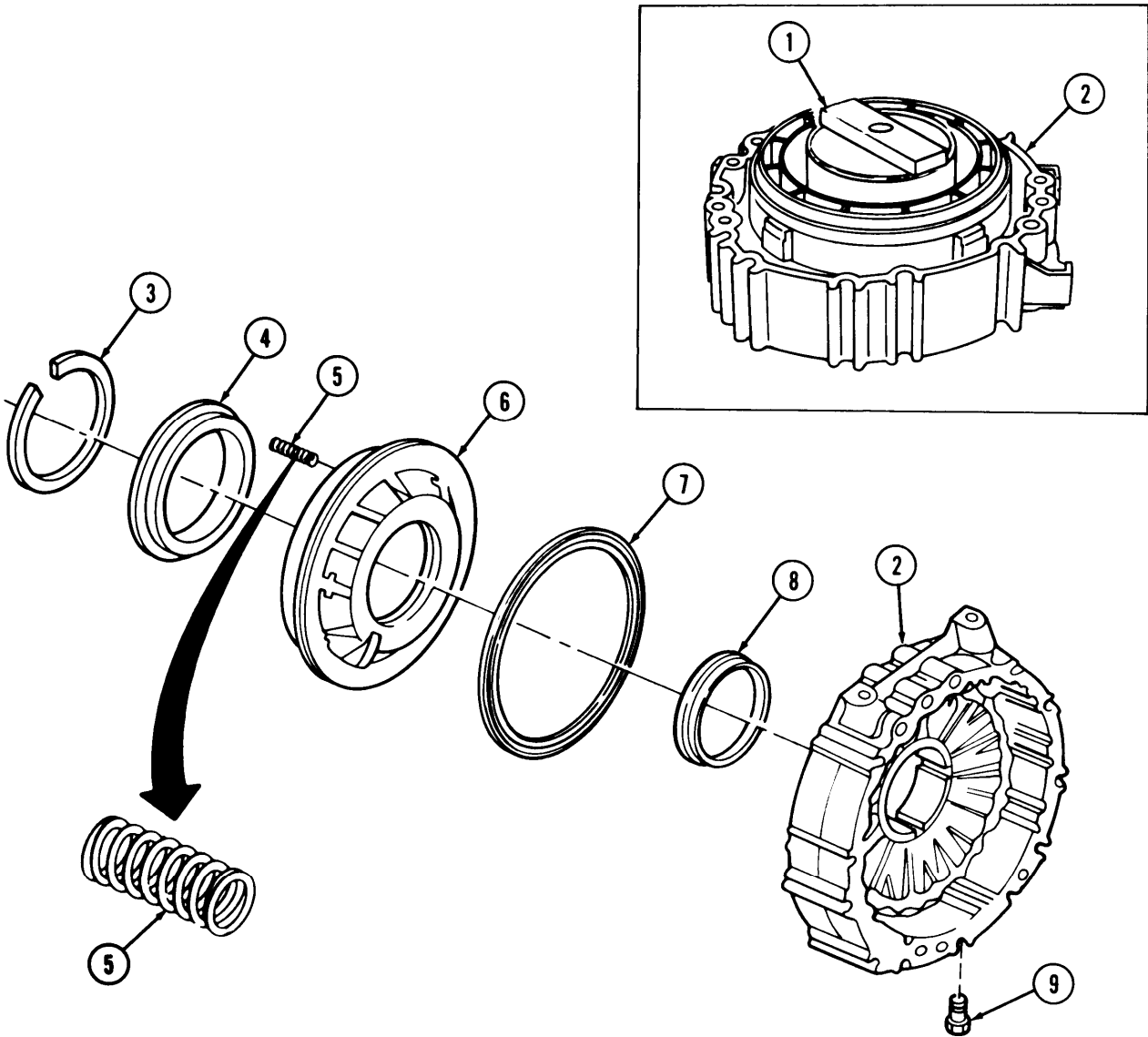


Table 7-5.1. Spring Data.

SPRING	COLOR	FREE LENGTH	COMPRESSED LENGTH	UNDER LOAD
Piston return spring	Solid orange, yellow stripe	1.28 in. (32.5 mm)	0.95 in. (24.1 mm)	13.6-16.4 lb (60.5-72.9 N)

END OF TASK!

7-36. TRANSMISSION HOUSING REPAIR

This task covers:

- a. Disassembly
- b. Inspection
- c. Reassembly

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 7-35	Low clutch removed.
Test Equipment		
None		
Special Tools		Special Environmental Conditions
None		Work area clean and free from blowing dirt and dust.
Materials/Parts		
None		
Personnel Required		General Safety Instructions
Wheeled vehicle repairman MOS 63W		<ul style="list-style-type: none">• Keep fire extinguisher nearby when using drycleaning solvent.• Compressed air source will not exceed 30 psi (207 kPa).• Eyeshields must be worn when cleaning with compressed air.
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Disassembly

1.
- Transmission housing (1)
- Four plugs (2)
- Remove.

b. Inspection

NOTE

Clean all parts before inspection (para. 7-13).

2.
- Transmission housing (1), four plugs (2), and adapter (3)
- Inspect.
- Refer to para. 2-8 for inspection instructions. Replace adapter (3) if defective.

c. Reassembly

3.
- Four plugs (2)
- Install.
- Tighten 4-5 lb-ft (5-7 N°m).

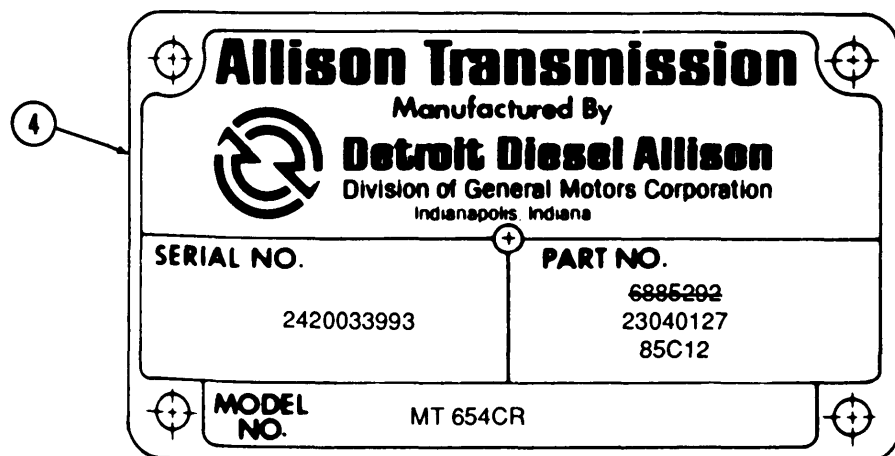
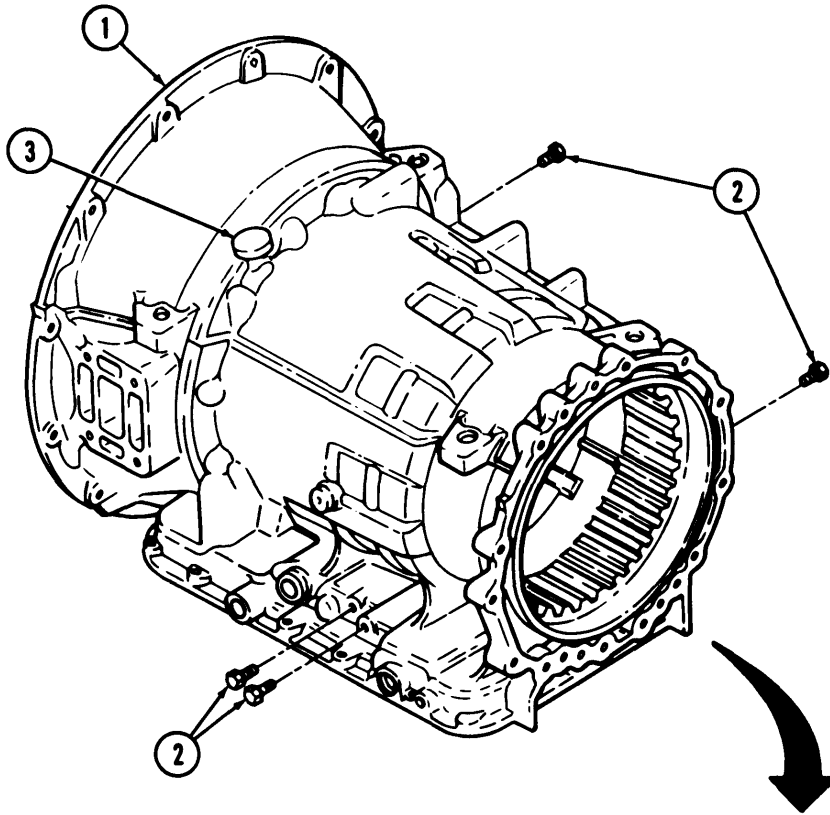
NOTE

Perform step 4 if early model transmission is to have wide oil pump installed. Refer to para. 7-13.

4.
- Data plate (4)
- Change part number to 23040127.
- Refer to para. 7-1.

7-36. TRANSMISSION HOUSING REPAIR (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Reassemble transmission (Section V).

Section V. TRANSMISSION REASSEMBLY

7-37. TRANSMISSION REASSEMBLY TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
7-38.	Selecting Center Support Snapping	7-170
7-39.	Establishing Second Clutch Clearance	7-174
7-40.	Establishing Low Clutch Clearance	7-176
7-41.	Adapter Housing, Low Clutch, and Low Planetary Carrier Installation	7-178
7-42.	Rear Cover Installation	7-180
7-43.	Transmission Governor Installation	7-182
7-44.	First Clutch Installation	7-184
7-45.	Gear Unit Installation	7-188
7-46.	Second Clutch Installation	7-190
7-47.	Center Support Installation	7-192
7-48.	Third Clutch Installation	7-194
7-49.	Fourth Clutch Installation	7-196
7-50.	Turbine Shaft Installation	7-198
7-51.	Transmission Oil Pump and Front Support Installation	7-200
7-52.	Transmission Manual Selector Shaft Installation	7-204
7-53.	Transmission Control Valve Installation	7-206
7-54.	Low Shift Valve Installation	7-208
7-55.	Low Trimmer Valve Installation	7-210
7-56.	Modulated Lockup Valve Installation	7-212
7-57.	Transmission Oil Filter Installation	7-214
7-58.	Transmission Oil Pan Installation	7-216
7-59.	Transmission Torque Converter Installation	7-218
7-60.	Transmission Removal from Holding Fixture	7-220

7-38. SELECTING CENTER SUPPORT SNAPRING

This task covers:

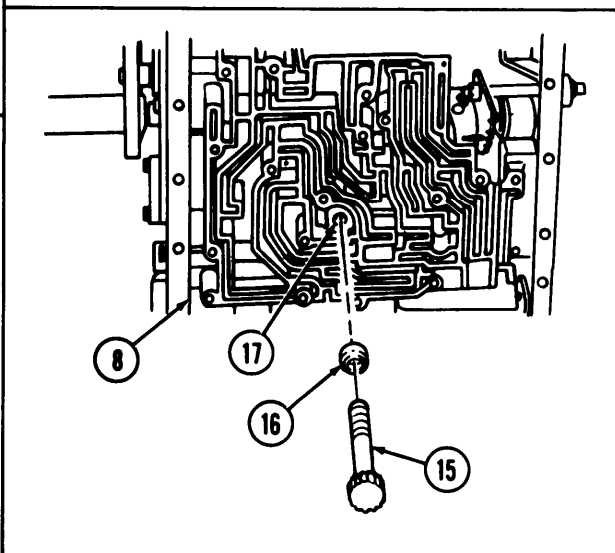
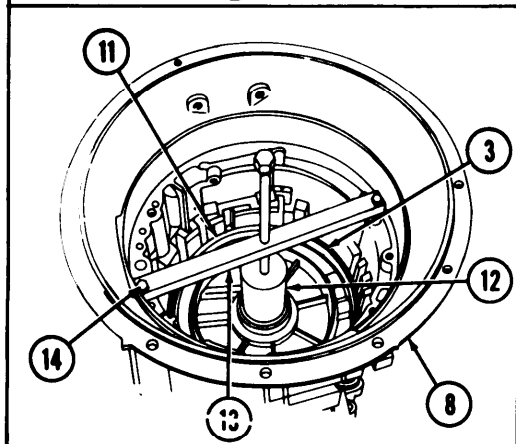
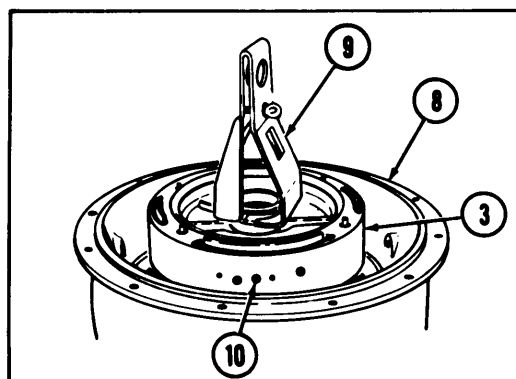
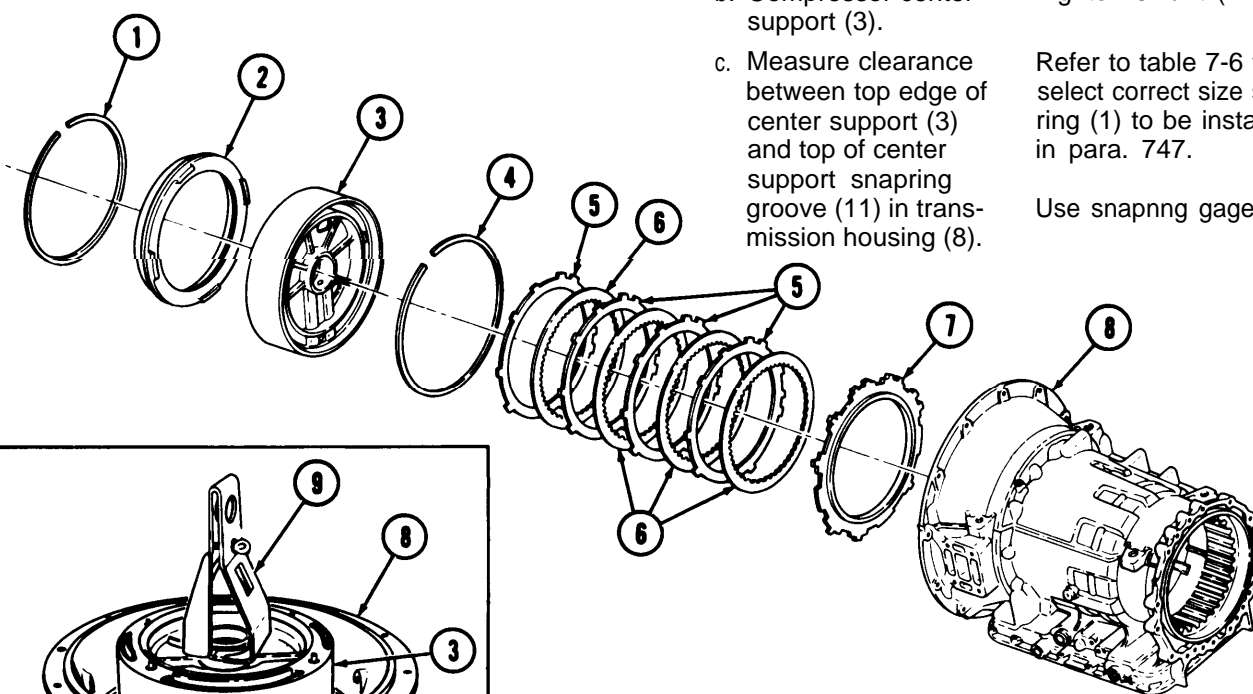
Selecting Snapping**INITIAL SETUP:**

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All		None
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
Center support lifter J-24455 Compressor bar and screw J-24475 Compressor base J-24475-A Snapping gage J-24208-4	Work area clean and free from blowing dirt and dust.	
<u>Materials/Parts</u>		
Anchor bolt		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W	None	
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
Selecting Snapping				
1.		Second clutch back-plate (7)	Install in transmission housing (8).	Tilt front end of housing (8) upward.
2.		Four clutch discs (6) and four clutch plates (5)	Alternately install in transmission housing (8) and install second clutch retaining snapping (4).	Start with clutch disc (6).
3.	Center support (3)	Third clutch piston (2)	Remove.	
4,		Center support lifter (9)	Attach to center support (3).	
5.		Center support (3)	a. Carefully position in transmission housing (8). Aline the anchor bolt hole (10) on support (3) and transmission housing center support hole (17).	Make sure center support (3) is seated firmly against second clutch snapping (4).
			b. Install in transmission housing (8) with new champhered washer (16) and new anchor bolt (15).	Tighten finger tight.

7-38. SELECTING CENTER SUPPORT SNAPRING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
6.	Compressor base (12)		c. Remove center support lifter (9). Position on center support (3).	
7.	Compressor bar and screw (13)		a. Install on transmission housing (8) with two screws (14). b. Compressor center support (3). c. Measure clearance between top edge of center support (3) and top of center support snapping groove (11) in transmission housing (8).	Tighten 5 lb-ft (7 N.m). Refer to table 7-6 to select correct size snapping (1) to be installed in para. 747. Use snapping gage.



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7-38. SELECTING CENTER SUPPORT SNAPRING (Cont'd)

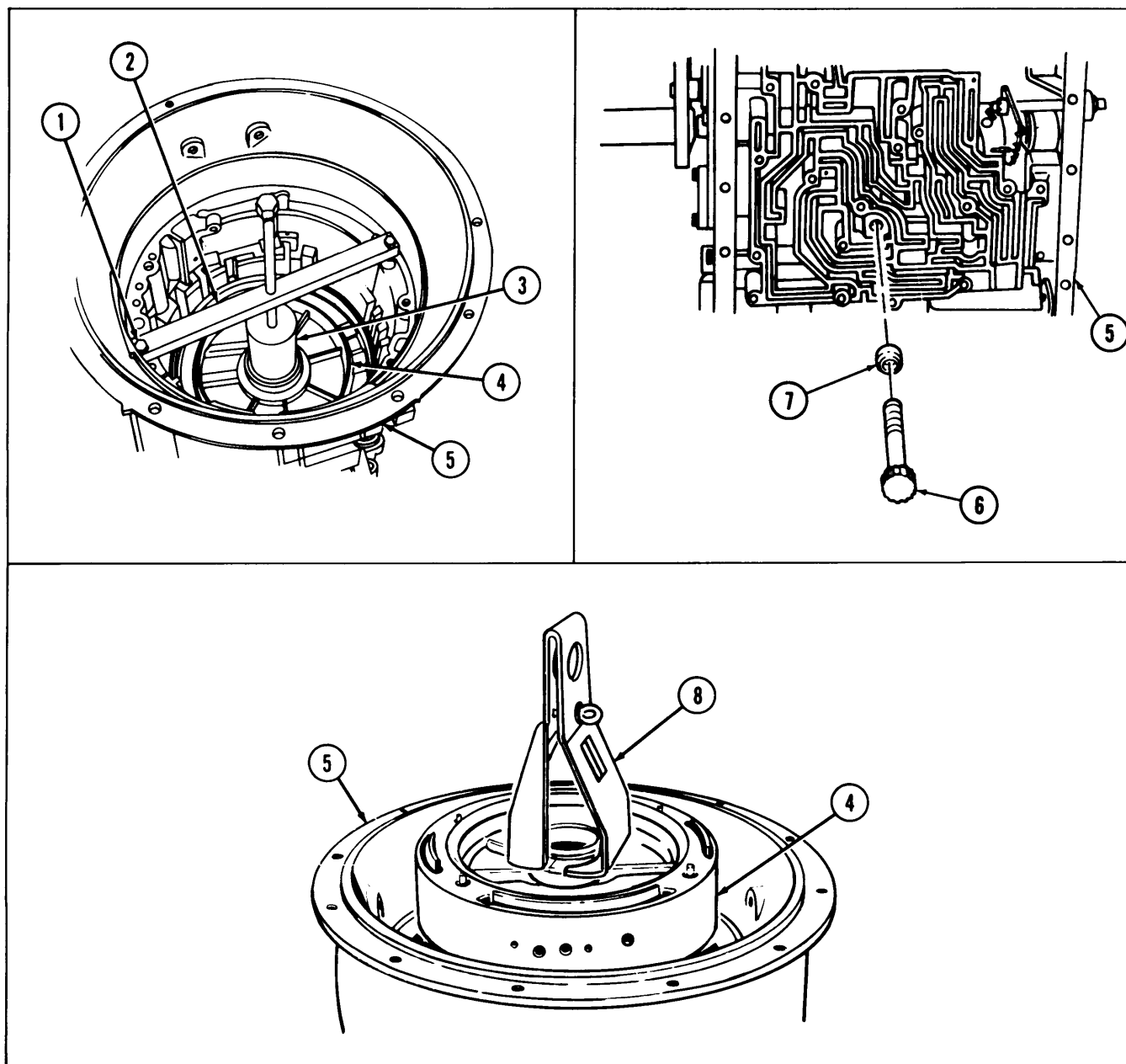
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
8,	Transmission housing (5)	Compressor bar and screw (2)	Release pressure from center support (4).	
9.		Compressor bar screws (1), compressor base (3), and compressor bar and screw (2)	Remove from center support (4),	
10.		Center support anchor bolt (6) and washer (7)	Remove.	Retain anchor bolt (6) and washer (7).
11.		Center support lifter (8)	Attach to center support (4).	
12.		Center support (4)	Carefully lift out of transmission housing (5).	

Table 7-6. Center Support Snapring.

MEASURED CLEARANCE	SNAPRING THICKNESS	SNAPRING COLOR
0.150-0.154 in. (3.81-3.91 mm)	0.148-0.150 in. (3.76-3.81 mm)	White
0.154-0.157 in. (3.91-3.99 mm)	0.152-0.154 in. (3.86-3.91 mm)	Yellow
0.157-0.160 in. 3.99-4.06 mm)	0.155-0.157 in. (3.94-3.99mm)	Green
0.160-0.164 in. (4.06-4.17 mm)	0.158-0.160 in. (4.01-4.06 mm)	Red

7-38. SELECTING CENTER SUPPORT SNAPRING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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FOLLOW-ON TASK: Establish second clutch clearance (para. 7-39).

7-39. ESTABLISHING SECOND CLUTCH CLEARANCE

This task covers:

Establishing Clearance

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-38	Center support snapping selected.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Second clutch clearance gage J-26918		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

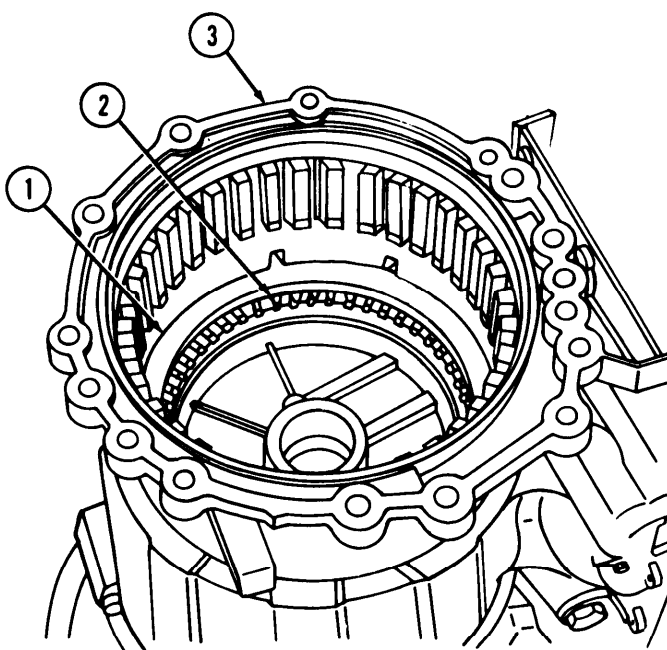
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Establishing Clearance

1.		Transmission housing (3)	<div>a. Tilt rear end of housing (3) upward.</div> <div>b. Measure clearance between backplate (1) and transmission housing (3).</div> <div>c. Second clutch clearance should be 0.059-0.129 in. (1.49-3.28 mm).</div>	<div>Use second clutch clearance gage.</div> <div>If clearance is excessive, replace clutch discs (2) with new discs (2).</div> <div>If clearance is still excessive, replace backplate (1).</div>
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7-39. ESTABLISHING SECOND CLUTCH CLEARANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Establishing low clutch clearance (para. 7-40).

7-40. ESTABLISHING LOW CLUTCH CLEARANCE

This task covers:

Establishing Clearance

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 7-39	Second clutch clearance established.
Test Equipment		
None		
Special Tools		Special Environmental Conditions
None		Work area clean and free from blowing dirt and dust.
Materials/Parts		
Gasket		
Personnel Required		General Safety Instructions
Wheeled vehicle repairman MOS 63W		None
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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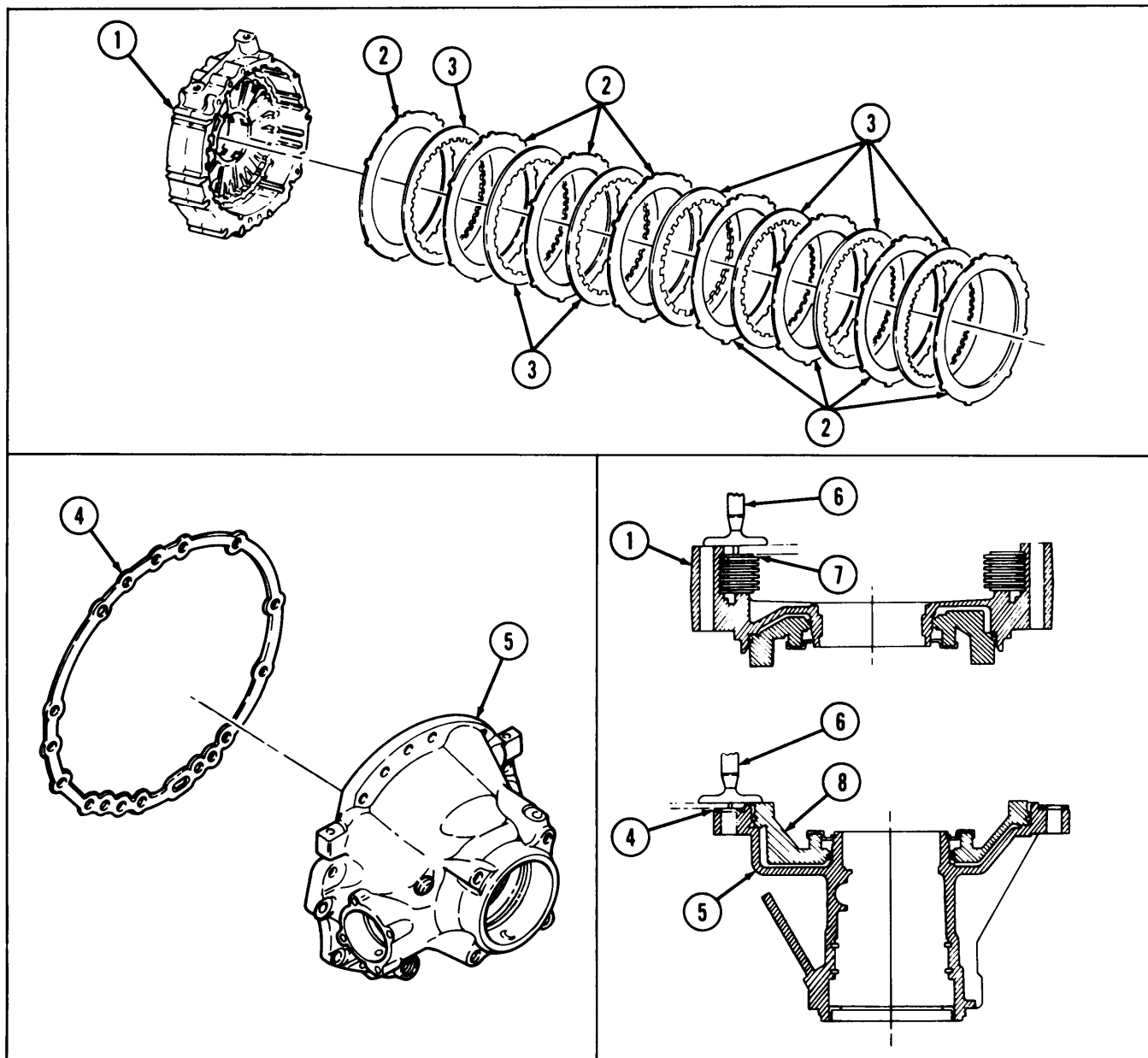
Establishing Clearance

1.		Eight clutch plates (2) and seven clutch discs (3)	a. Alternately install in adapter housing (1), b. Measure distance from top edge of adapter housing (1) to top of clutch plate (7).	Start with clutch plate (2). Use depth micrometer (6) and record measurement.
2.		New rear cover gasket (4)	a. Position on rear cover (5). b. Measure distance from top of edge of piston (8) to gasket (4). c. Subtract step 2b measurement from step 1b measurement. d. Low clutch clearance should be 0.073 to 0.141 in. (1.85-3.58 mm).	Use depth micrometer (6) and record measurement. Record this value. This measurement is low clutch clearance. If clearance is excessive, replace clutch plates (2) and discs (3) with new plates (2) and discs (3).

7-40. ESTABLISHING LOW CLUTCH CLEARANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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- | | | | | |
|----|---------------------|--|---------|--|
| 3. | Adapter housing (1) | Eight clutch plates (2) and seven clutch discs (3) | Remove. | |
|----|---------------------|--|---------|--|



FOLLOW-ON TASK: Install adapter housing, low clutch, and low planetary earner (para. 7-41).

TA 350015

7-41. ADAPTER HOUSING, LOW CLUTCH, AND LOW PLANETARY CARRIER
INSTALLATION

This task covers:

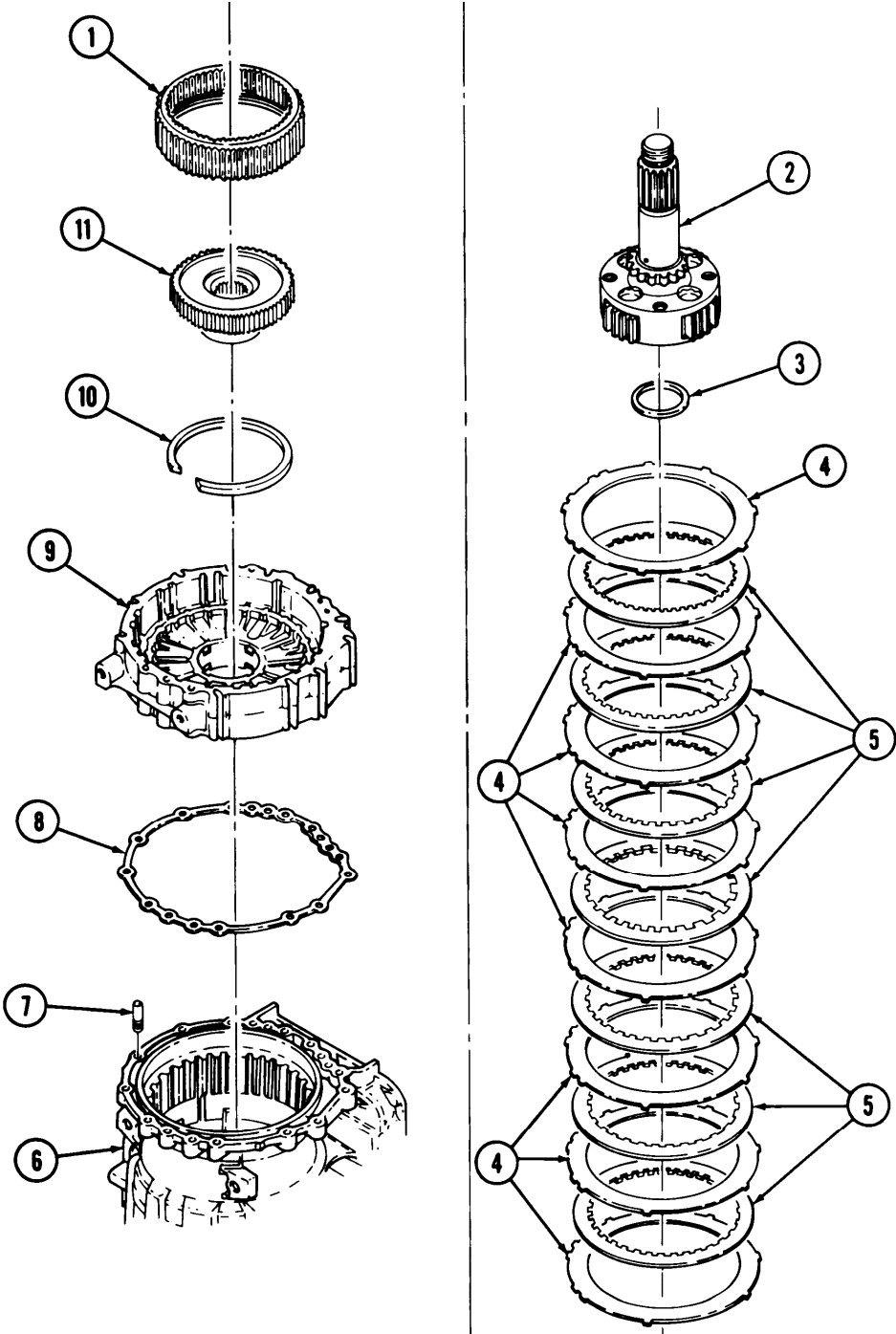
Installation

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 7-40	Low clutch clearance established.
Test Equipment		
None		
Special Tools		Special Environmental Conditions
Two guide pins J-1927-1		Work area clean and free from blowing dirt and dust.
Materials/Parts		
Adapter housing gasket Oil-soluble grease (Appendix C, Item 19)		
Personnel Required		General Safety Instructions
Wheeled vehicle repairman MOS 63W		None
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
1.		New adapter housing gasket (8)	Install on transmission housing (6).	
2.		Two guide pins (7)	Install.	Guide pins (7) maintain gasket (8) alignment.
3.		Adapter housing (9)	Install over guide pins (7).	
3.1.		Low ring gear hub (1) and snapping (10)	Install on low planetary ring gear (11).	
4.		Low planetary ring gear (11)	Install into adapter housing (9).	
5.		Eight clutch plates (4) and seven clutch discs (5)	Alternately install in adapter housing (9).	Start with clutch plate (4).
6.		Thrust washer (3)	Install on low planetary carrier (2) hub.	Use oil-soluble grease sparingly to hold in place.
7.		Low planetary carrier (2)	Install into adapter housing (9).	

7-41. ADAPTER HOUSING, LOW CLUTCH, AND LOW PLANETARY CARRIER

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				

END OF TASK!

FOLLOW-ONTASK: Install rear cover (para. 7-42).

7-42. REAR COVER INSTALLATION

This task covers:		
Installation		
INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-41	Adapter housing, low clutch, and low planetary carrier installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Two guide pins J-1927-1		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
Gasket		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

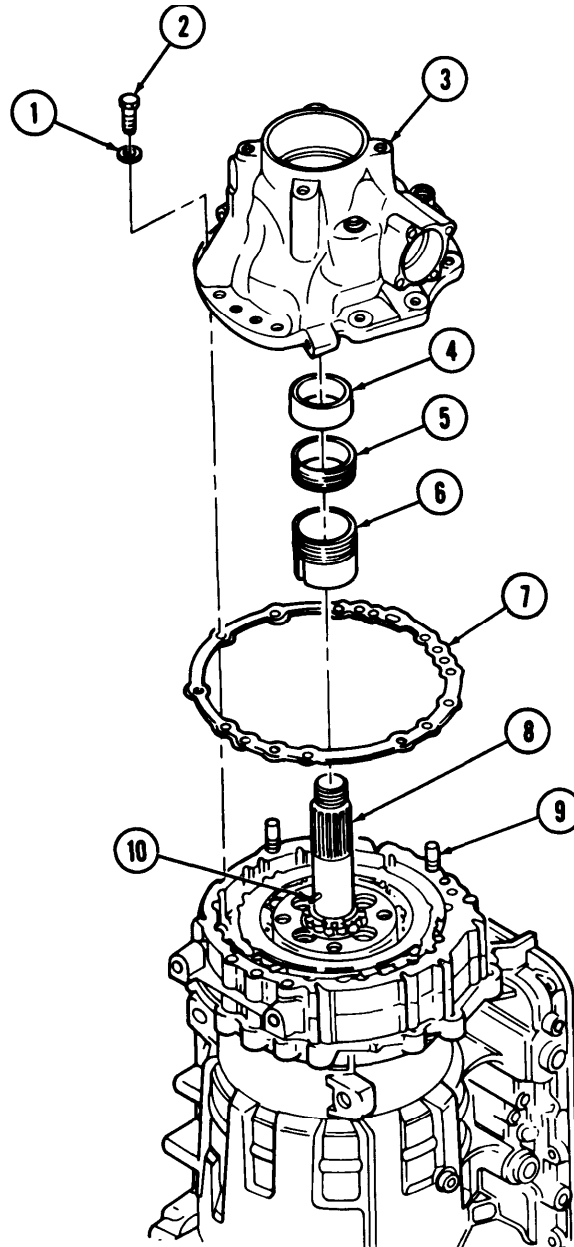
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.		Governor drive gear (6), speedometer drive gear (5), and sleeve spacer (4)	Install on low planetary carrier (8).	Seat governor drive gear (6) over pin (10).
2.		Rear cover (3) and new rear cover gasket (7)	a. Install over guide pins (9). b. Install with twelve washers (1) and screws (2).	Finger tighten.
3.		Two guide pins (9)	Remove and install remaining two washers (1) and screws (2).	
4.		Fourteen screws (2)	a. Tighten alternately 180 degrees apart. b. Repeat tightening sequence 180 degrees apart to achieve final torque.	Tighten screws (2) 30 lb-ft (41 N.m). Tighten screws (2) 81-97 lb-ft (110-132 N.m).

7-42. REAR COVER INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS . Install governor (para. 7-43).
 . Install output shaft oil seal (para. 7-7).

7-43. TRANSMISSION GOVERNOR INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-42	Rear cover installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
Governor cover gasket		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

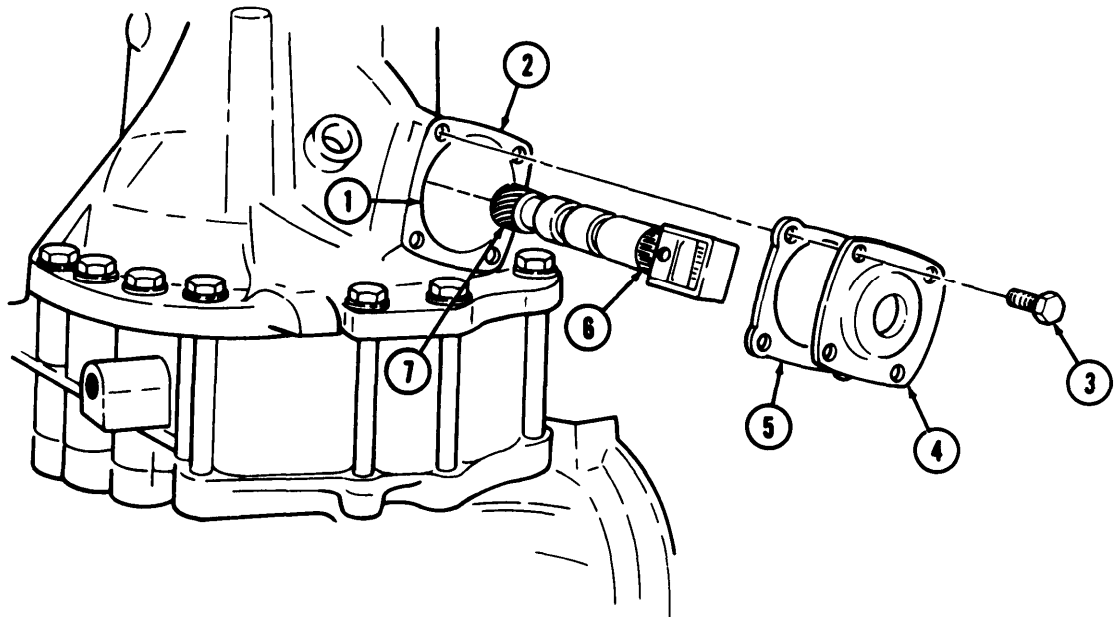
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.		Transmission governor (6)	Insert plastic gear (7) end into governor bore (1) and push inward.	Governor (6) rotates one-quarter turn counterclockwise.
NOTE				
Governor is properly seated only after counterclockwise rotation of governor gear is felt during installation.				
2.		New gasket (5) and governor cover (4)	Position against rear cover (2) and install with four screws (3).	Tighten screws (3) 15-20 lb-ft (20-27 N.m).

7-43. TRANSMISSION GOVERNOR INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install first clutch (para. 7-44).

TA 350018

7-44. FIRST CLUTCH INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u> All	<u>Equipment Condition Reference</u> Para. 7-43	<u>Condition Description</u> Transmission governor installed.
<u>Test Equipment</u> None		
<u>Special Tools</u> First clutch clearance gage J-26914		<u>Special Environmental Conditions</u> Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u> None		
<u>Personnel Required</u> Wheeled vehicle repairman MOS 63W		<u>General Safety Instructions</u> None
<u>Manual References</u> TM9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.

Transmission housing (4)

Tilt front end of housing (4) upward.
- NOTE**
Steps 2 and 3 remove the second clutch.
2. Transmission housing (4)

Snapping (1)

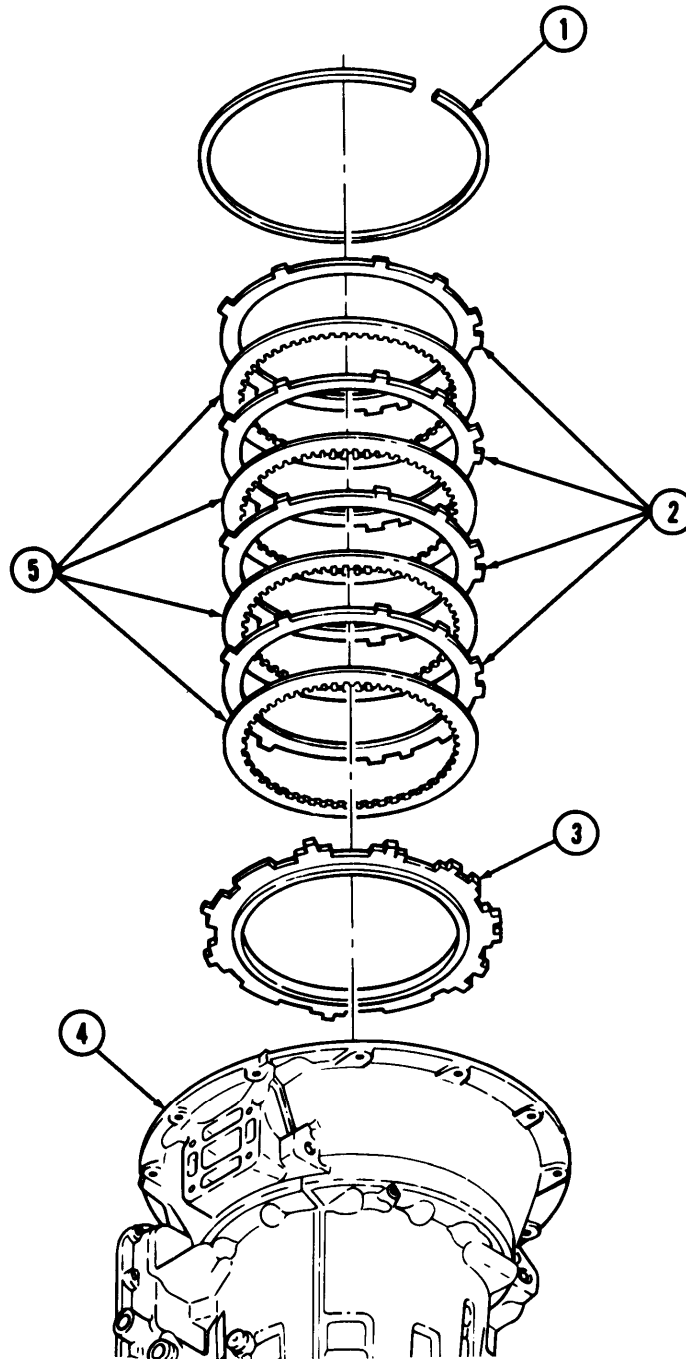
Remove.
3.

Four clutch plates (2), four clutch discs (5), and second clutch backplate (3)

Remove.

7-44. FIRST CLUTCH INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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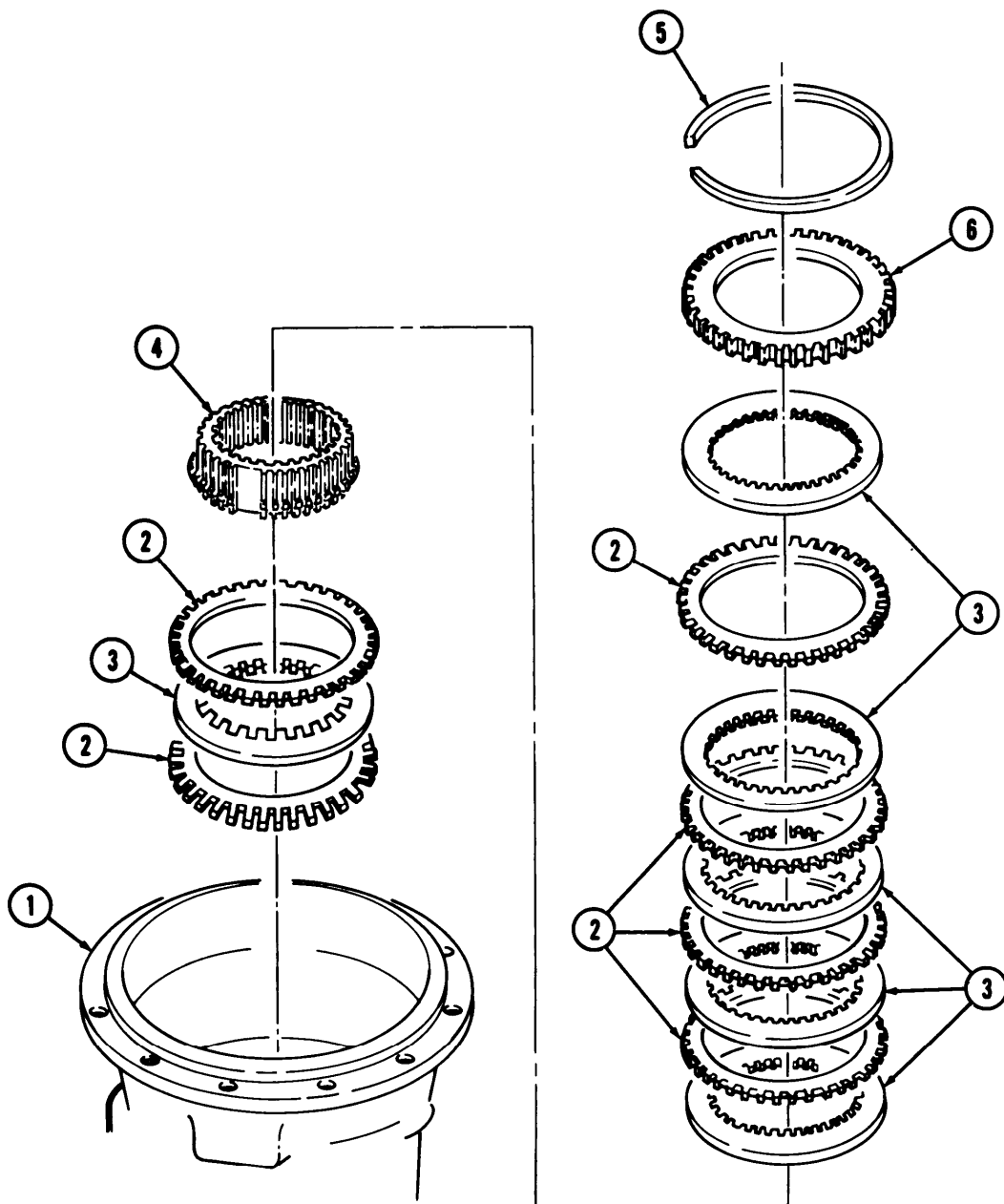


7-44. FIRST CLUTCH INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
4.	Transmission housing (1)	Two clutch plates (2) and one clutch disc (3)	Alternately install.	Start with clutch plate (2).
5.		Rear planetary ring gear (4)	Install.	Make sure all clutch plate (2) tangs and splines mesh.
6.		Five clutch discs (3) and four clutch plates (2)	Alternately install on rear planetary ring gear (4).	Start with clutch disc (3).
7.		Backplate (6) and snapping (5)	Install.	Flat side of backplate (6) must be installed first.
NOTE				
Step 8 obtains clutch running clearance.				
8.		Backplate (6)	a. Measure clearance between snapping (5) and backplate (6).	Use first clutch clearance gage.
			b. Clutch running clearance should be 0.074-0.147 in. (1.880-3.734 mm).	If clearance is excessive, replace clutch plates (2) and discs (3). If clearance is still excessive, replace backplate (6).

7-44. FIRST CLUTCH INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install gear unit (para. 7-45).

7-45. GEAR UNIT INSTALLATION

This task covers:

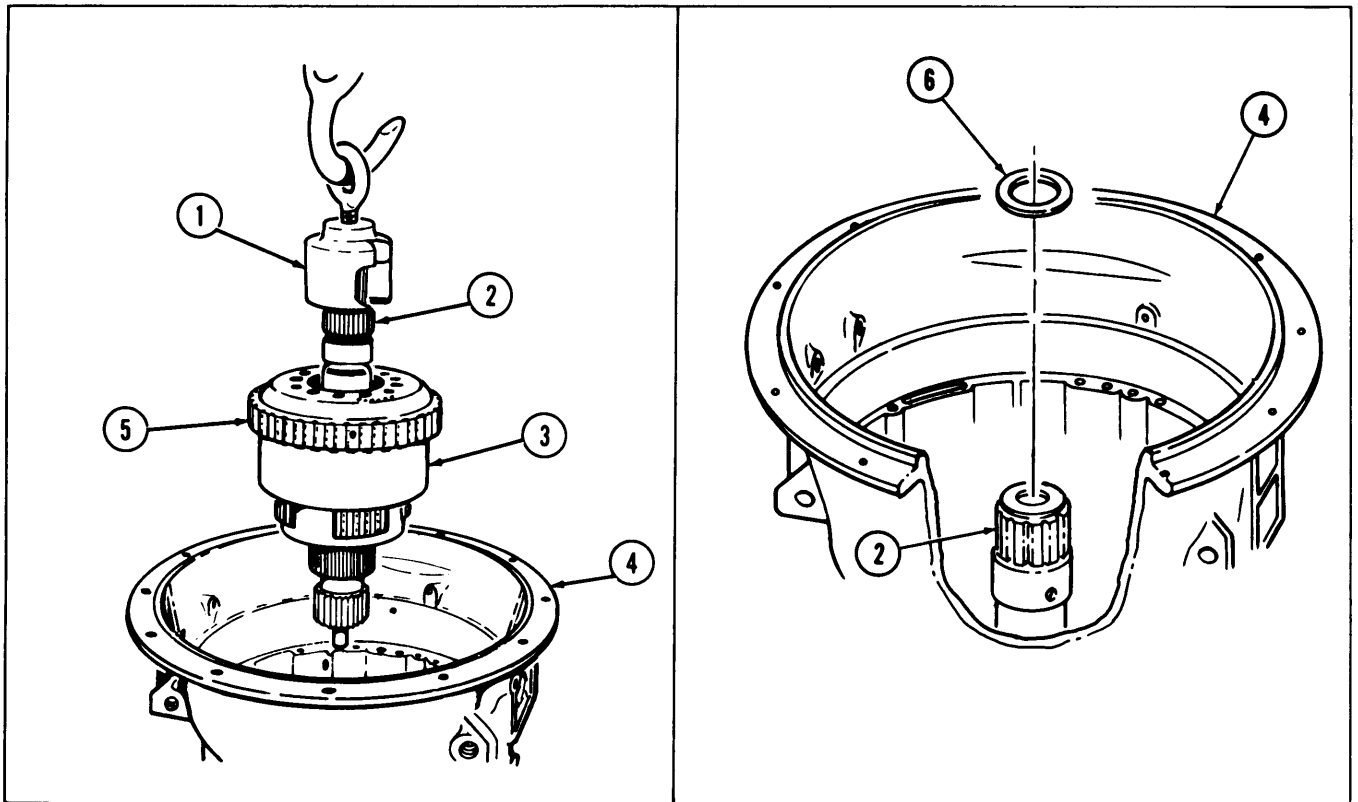
Installation**INITIAL SETUP:**

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-44	First clutch installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Gear unit lifter J-24454		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
Oil-soluble grease (Appendix C, Item 19)		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
Installation				
1.		Gear unit lifter (1)	Attach to gear unit mainshaft (2).	
2.		Gear unit (3)	Using hoist, carefully lower gear unit (3) into transmission housing (4).	Make sure all gear teeth (5) mesh.
3.		Gear unit lifter (1)	Remove.	
4.		Thrust washer (6)	Install over mainshaft (2) and seat on gear unit (3).	Use oil-soluble grease sparingly to hold in place.

7-45. GEAR UNIT INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install second clutch (para. 7-46).

7-46. SECOND CLUTCH INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-45	Gear unit installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

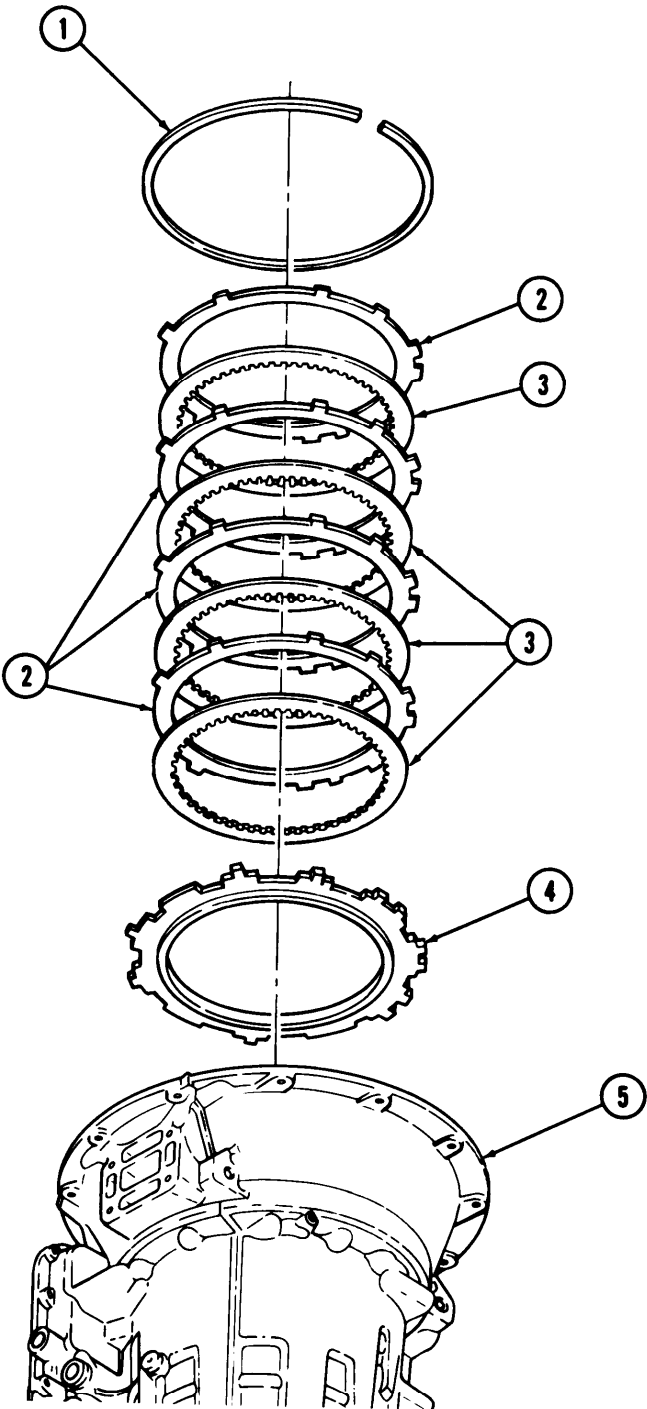
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.		Second clutch back-plate (4)	Install in transmission housing (5).	Install with flat side up.
2.		Four clutch discs (3) and four clutch plates (2)	Alternately install in transmission housing (5).	Start with clutch disc (3).
3.		Snapping (1)	Install.	

7-46. SECOND CLUTCH INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install center support (para. 7-47).

7-47. CENTER SUPPORT INSTALLATION

This task covers:		
Installation		
INITIAL SETUP:		
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-46	Second clutch installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Center support lifter J-24455		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
Anchor bolt		
Chamfered washer		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

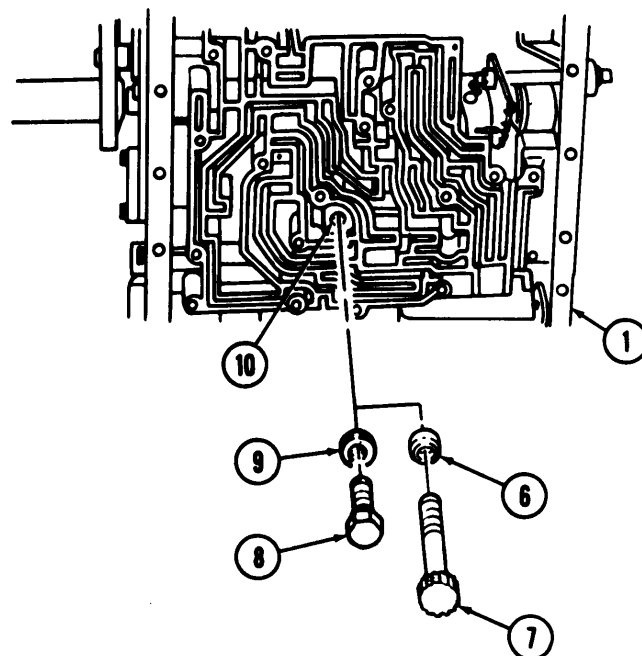
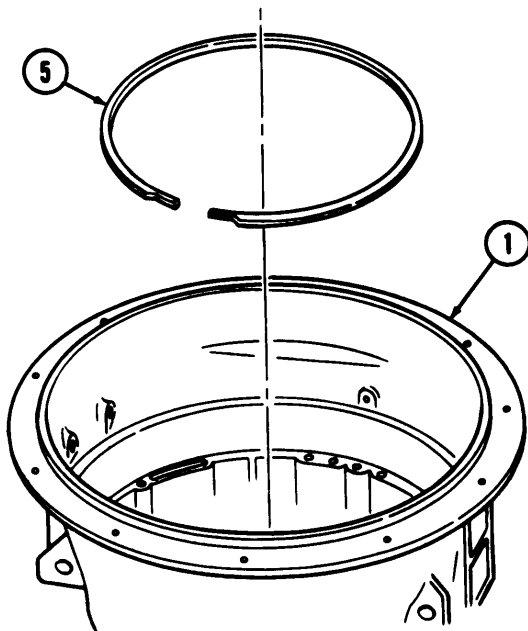
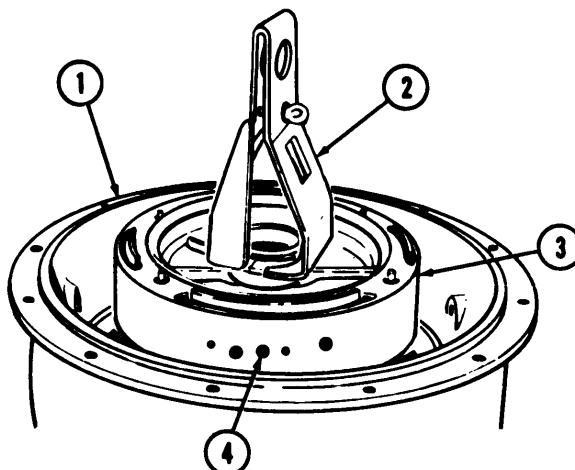
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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I Installation I

1.		Center support lifter (2)	Attach to center support (3).	
2.		Center support (3)	a. Install in transmission housing(l). Aline the anchor bolt hole (4) on support (3) with transmission housing (1) center support hole (10). b. Install in transmission housing (1) with new chamfered washer (6) and new anchor bolt (7). c. Remove center support lifter (2).	Make sure center support (3) is firmly seated. Do not tighten. Do not use old style flat washer (9) or hex head bolt (8).
3.		Center support snapping (5)	Install in transmission housing (l).	Make sure snapping (5) is fully seated.
4.		Anchor bolt (7)	Tighten.	Tighten bolt (7) 39-46 lb-ft (53-62 N.m).

7-47. CENTER SUPPORT INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK Install third clutch (para. 7-48).

7-48. THIRD CLUTCH INSTALLATION

This task covers:

Installation

INITIAL SETUP:

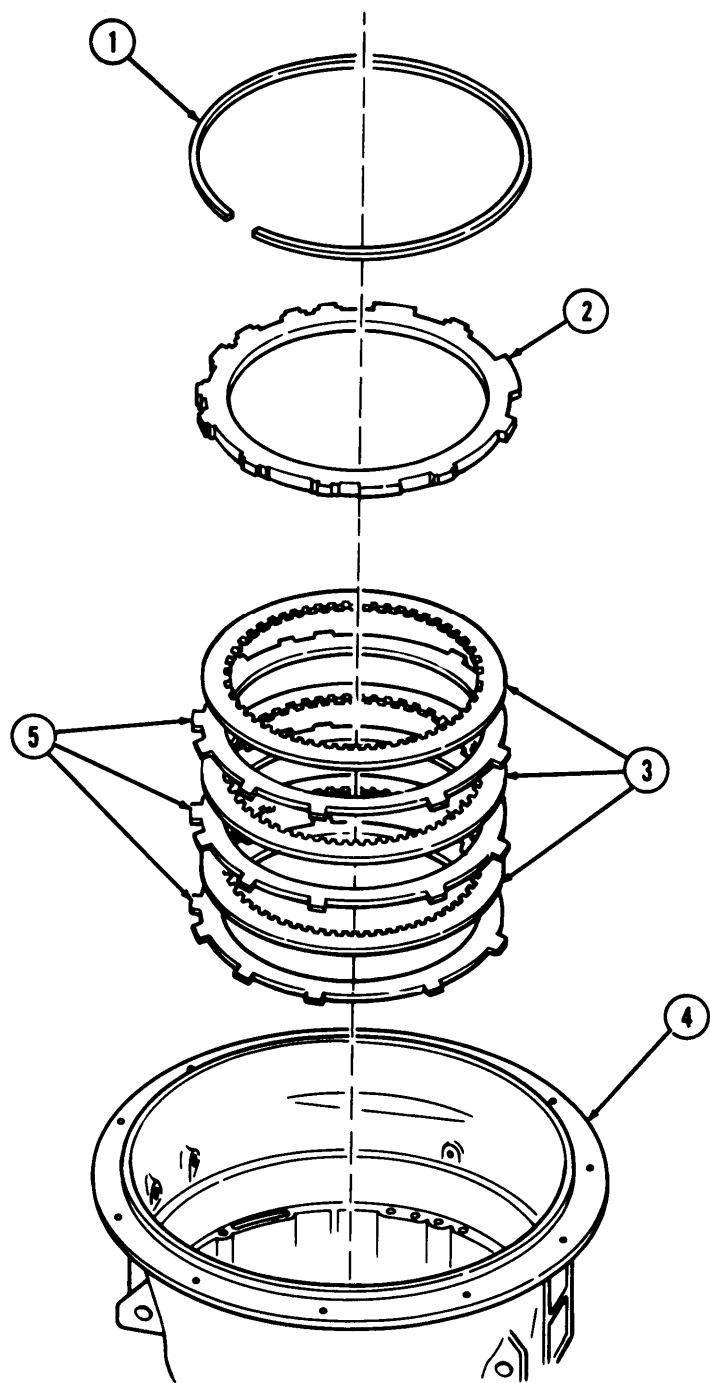
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-47	Center support installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
Third clutch clearance gage J-26916		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.	Three clutch plates (5) and three clutch discs (3)	Alternately install in transmission housing (4).	Start with clutch plate (5).
2.	Third clutch backplate (2) and snapping (1)	a. Install. b. Measure clearance between backplate (2) and snapping (1). c. Third clutch clearance should be 0.050-0.114 in. (1.270-2.896 mm).	Use third clutch clearance gage. If clearance is excessive, replace clutch discs (3) with new discs (3). If clearance is still excessive, replace backplate (2).

7-48. THIRD CLUTCH INSTALLATION (Cont'd)				
STEP NO.	LOCATION	ITEM	ACTION	REMARKS



END OF TASK!

FOLLOW-ON TASK: Install fourth clutch (para. 7-49)

7-49. FOURTH CLUTCH INSTALLATION

This task covers:

Installation

INITIAL SETUP:

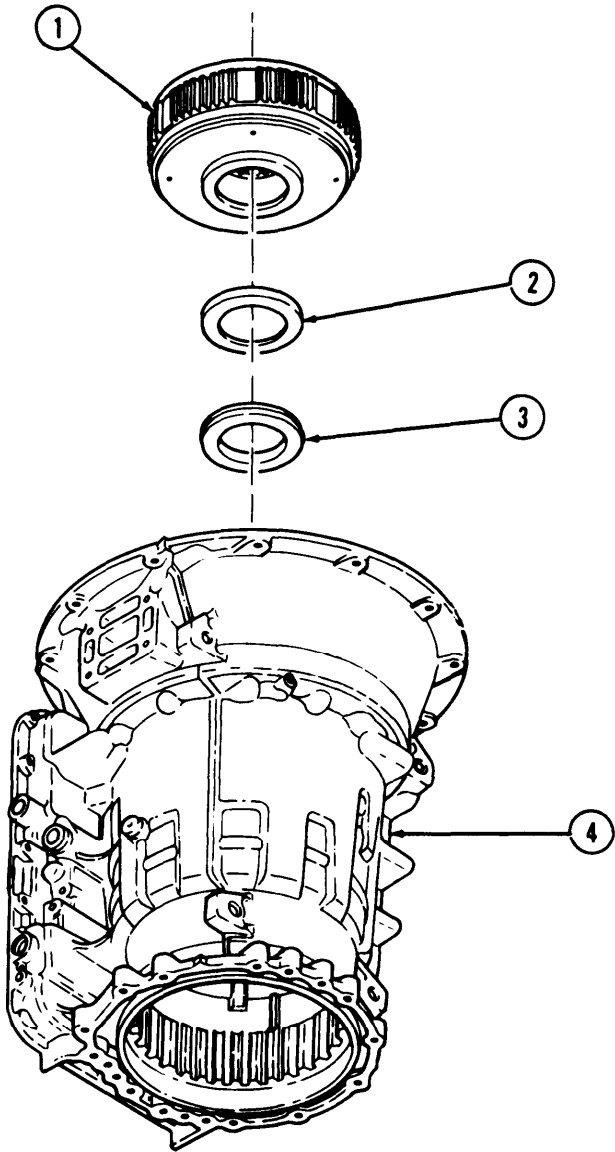
<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-48	Third clutch installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

1.		Bearing assembly (3) and bearing race (2)	Install.	Place race section of bearing assembly (3) into transmission housing (4) first.
2.		Fourth clutch (1)	Install.	

7-49. FOURTH CLUTCH INSTALLATION (Cont'd)				
STEP NO.	LOCATION	ITEM	ACTION	REMARKS



END OF TASK!

FOLLOW-ON TASK: Install turbine shaft (para. 7-50).

7-50. TURBINE SHAFT INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-49	Fourth clutch installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

NOTE

Perform step 1 for transmissions with three-piece bearing.

1.
- Bearing race (4), bearing (3), bearing race (2), housing (5). and turbine shaft (1)
- Install in transmission

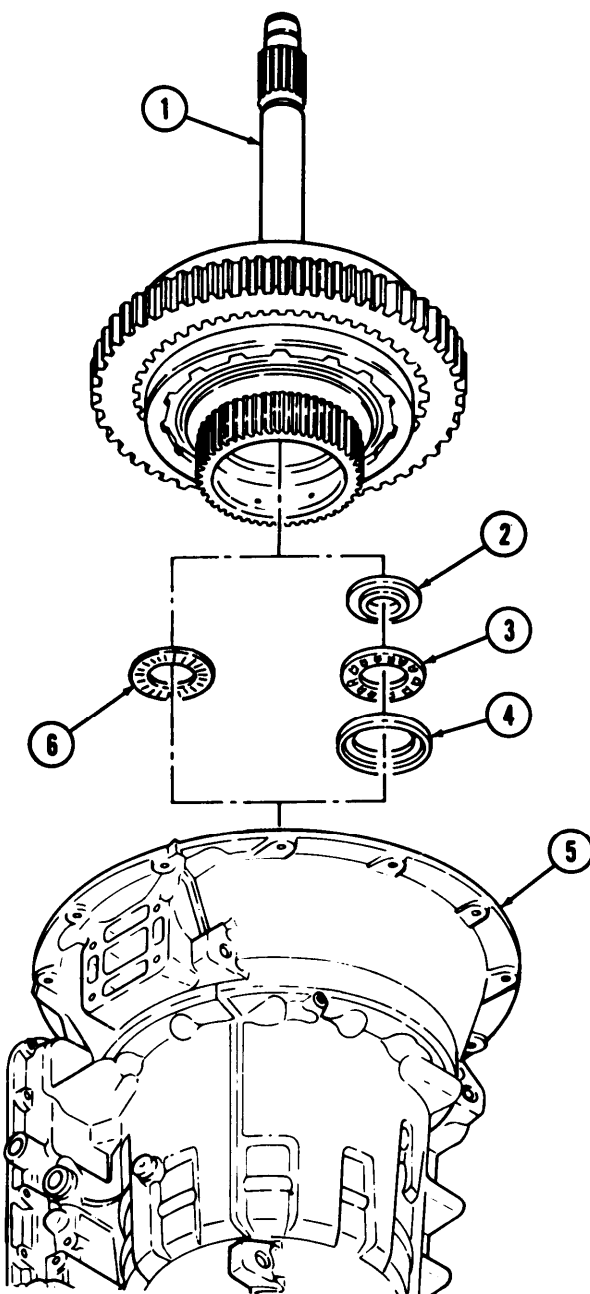
NOTE

Perform step 1.1 for transmissions with single-piece bearing assembly.

- 1.1.
- Bearing assembly (6)
- Install in transmission housing (5).

7-50. TURBINE SHAFT INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install transmission oil pump and front support (para 7-51).

75-1. TRANSMISSION OIL PUMP AND FRONT SUPPORT INSTALLATION

This task covers:

Installation

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 7-50	Turbine shaft installed.
Test Equipment		
None		
Special Tool		Special Environmental Conditions
IWO guide pins J-24315-1		Work area clean and free from blowing dirt and dust.
Front support lifter J-24473		
Materials/Parts		
Gasket		
Twelve rubber covered washers		
Oil-soluble grease (Appendix C, Item 19)		
Personnel Required		General Safety Instructions
Wheeled vehicle repairman MOS 63W		None
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Identify transmission model before assembly of oil pump and front support. If early model converter hub was replaced with late model converter hub, a late model oil pump and front support must be installed or transmission maybe damaged during assembly. Refer to para. 7-13.

NOTE

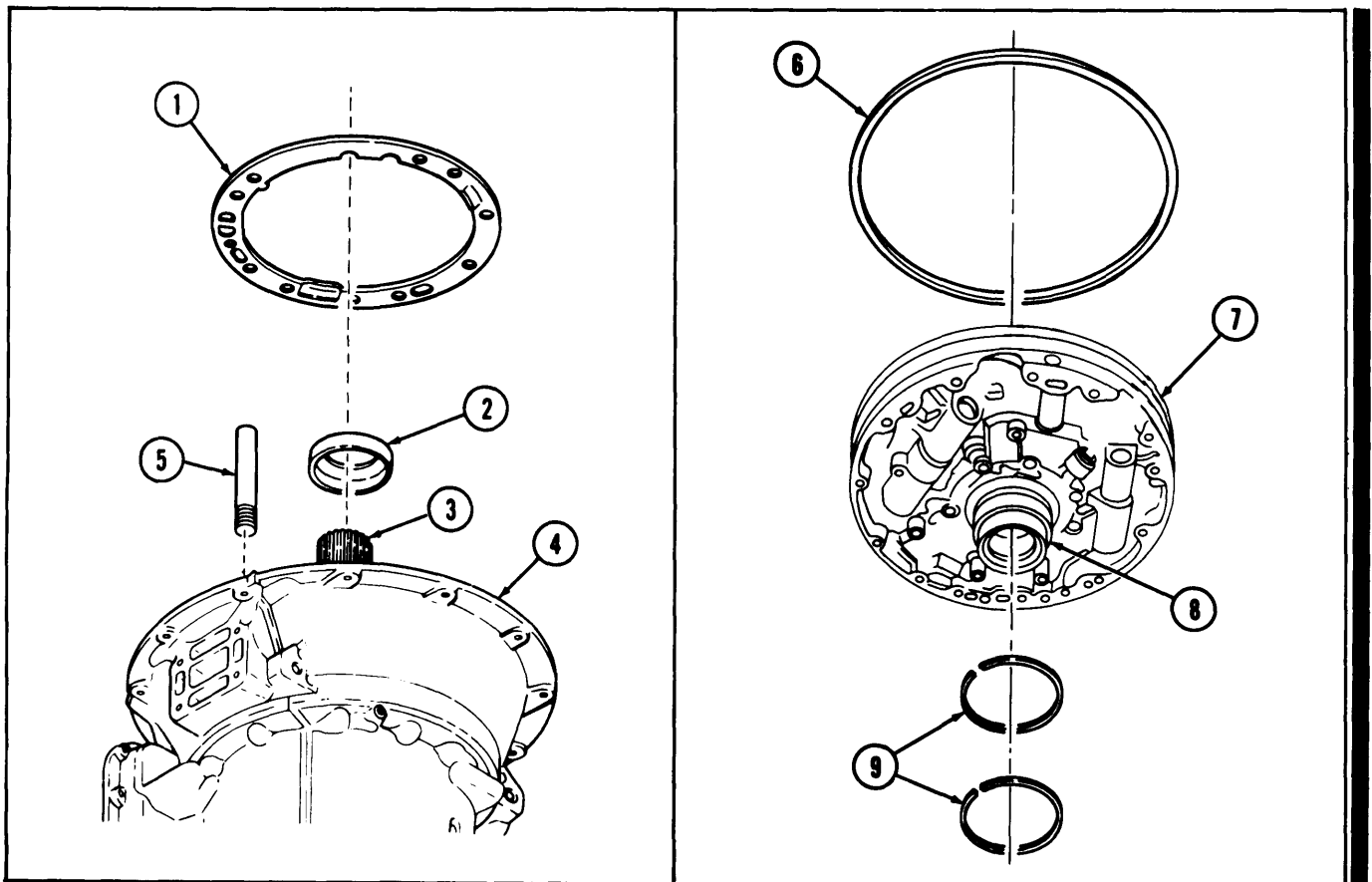
- Late model oil pump is thicker than early model oil pump.
- Late model front support has a bushing and a thicker seal in oil pump hub. Early model oil pump hub has a thin seal and the torque converter hub has a roller bearing.

Installation

1.	Bearing race (2)	Install on turbine shaft (3).	
2.	No guide pins (5) and new gasket (1)	Install into transmis- sion housing (4).	Guide pins (5) main- tain gasket (1) aline- ment.

7-51. TRANSMISSION OIL PUMP AND FRONT SUPPORT INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
3.		Two new seal rings (9)	Install on hub (8) of oil pump and front support (7).	Use oil-soluble grease sparingly to hold in place.
3.1.		New oil pump seal ring (6)	Install on oil pump and front support (7).	

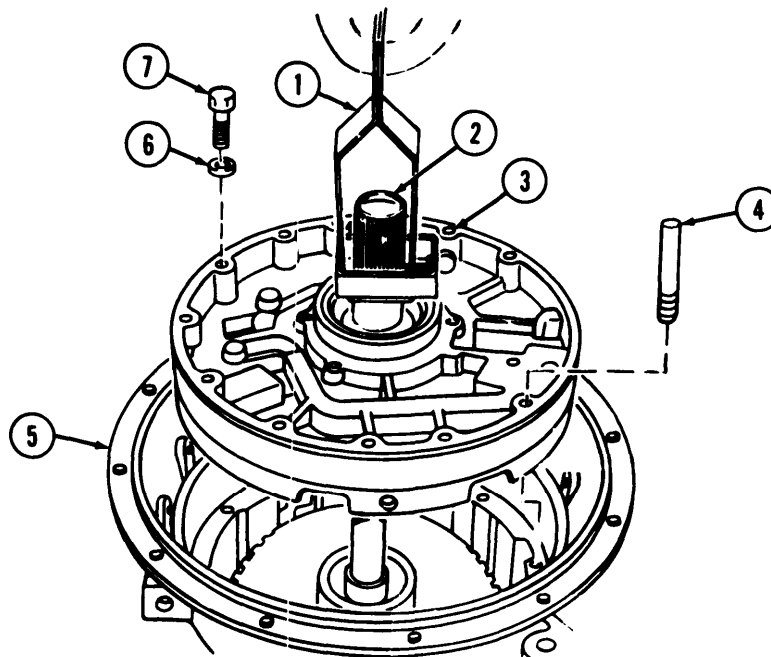


7-51. TRANSMISSION OIL PUMP AND FRONT SUPPORT INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
4.		Front support lifter (1)	Attach to converter ground sleeve (2).	
5.		Front support (3)	a. Aline holes in front support (3) with corresponding holes in transmission housing (5). b. Carefully install front support (3) in transmission (5) over guide pins (4).	
6.	Transmission (5)	Two guide pins (4) and front support lifter (1)	Remove.	
7.		Front support (3)	Install in transmission (5) with twelve new rubber covered washers (6) and screws (7). Tighten screws (7) as follows: a. Tighten alternately 180 degrees apart. b. Repeat tightening sequence 180 degrees apart to achieve final torque.	Tighten screws (7) 15 lb-ft (20 N.m). Tighten screws (7) 24-32 lb-ft (33-43 N.m).

7-51. TRANSMISSION OIL PUMP AND FRONT SUPPORT INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install transmission manual selector shaft (para. 7-52).

TA 350028

7-203

7-52. TRANSMISSION MANUAL SELECTOR SHAFT INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-51	Transmission oil pump and front support installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

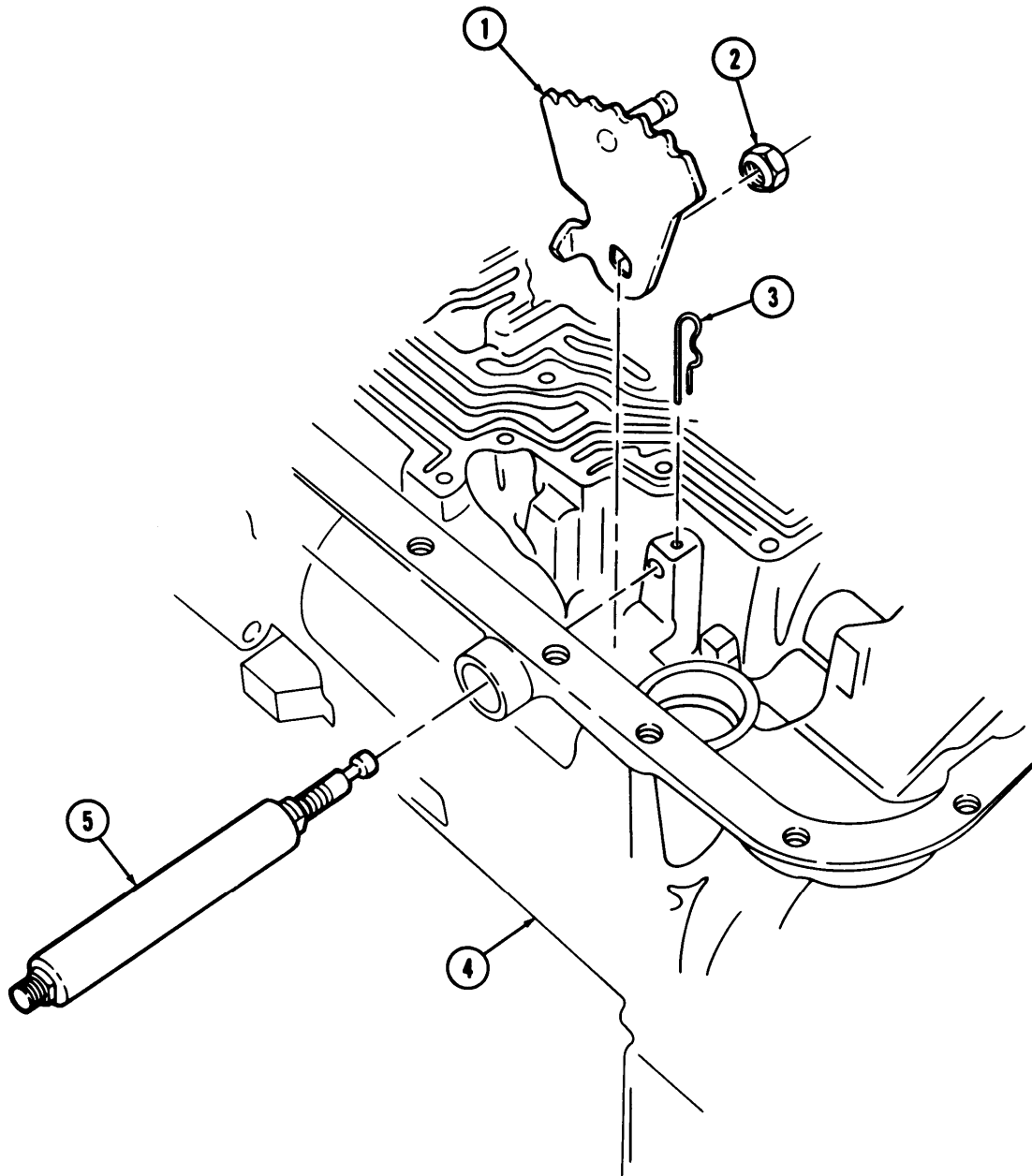
LOCATION	ITEM	ACTION	REMARKS
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Installation

1.	Transmission housing (4)	Tilt housing (4) to horizontal with the bottom facing upward.	
2.	Manual selector shaft (5) and detent lever (1)	Install in transmission housing (4).	
3.	Nut (2)	Install on selector shaft (5).	Tighten 15-20 lb-ft (20-27 N.m).
4.	Manual selector shaft (5)	Install with shaft retainer pin (3).	

7-52. TRANSMISSION MANUAL SELECTOR SHAFT INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASKS: •Install transmission selector shaft oil seal (para. 7-5).
 •Install transmission control valve (para. 7-53).

7-53. TRANSMISSION CONTROL VALVE INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-52	Transmission manual selector shaft installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

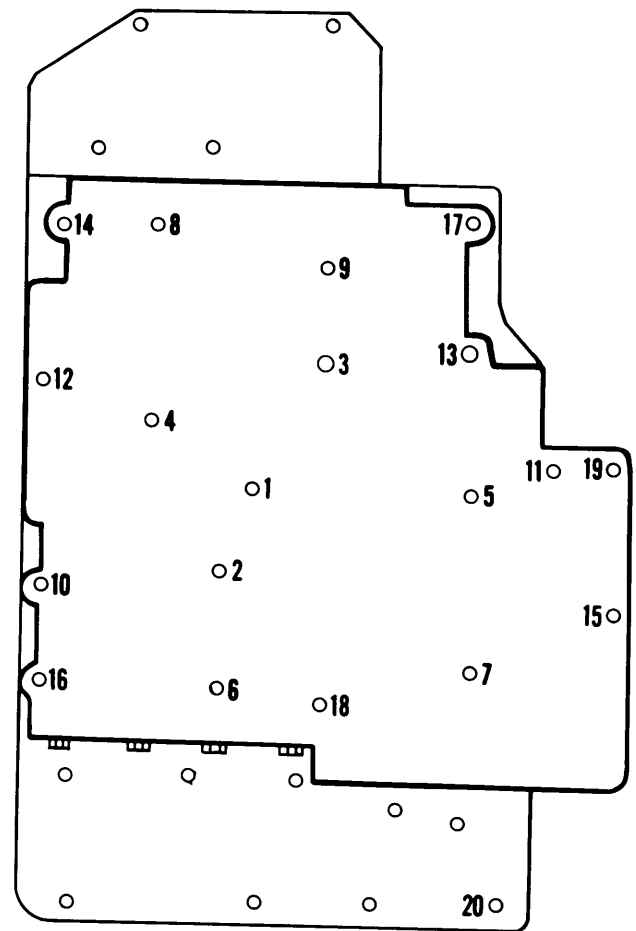
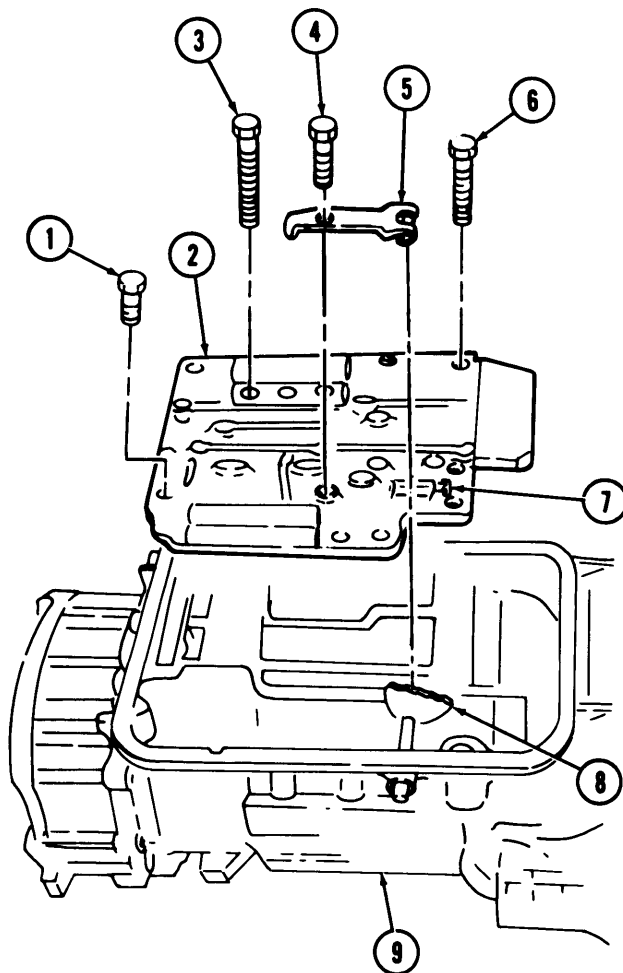
Do not tilt control valve to allow selector valve to drop out. Damage to selector valve may result.

Installation

1.	Control valve (2)	a. Position on transmission (9) so pin on detent lever (8) aligns with slot on selector valve (7). b. Install with fifteen screws (6). c. Install with three screws (3). d. Install with screw (1).	Finger tighten only.
2.	Detent spring and roller (5)	Position on control valve (2) with roller in notch of detent lever (8) and install with screw (4).	Finger tighten only.
3.	Screws (1), (3), (4), and (6)	Tighten twenty screws in sequence shown.	Tighten screws 9-11 lb-ft (12-15 N.m).

7-53. TRANSMISSION CONTROL VALVE INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install low shift valve (para. 7-54).

7-54. LOW SHIFT VALVE INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-53	Transmission control valve installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

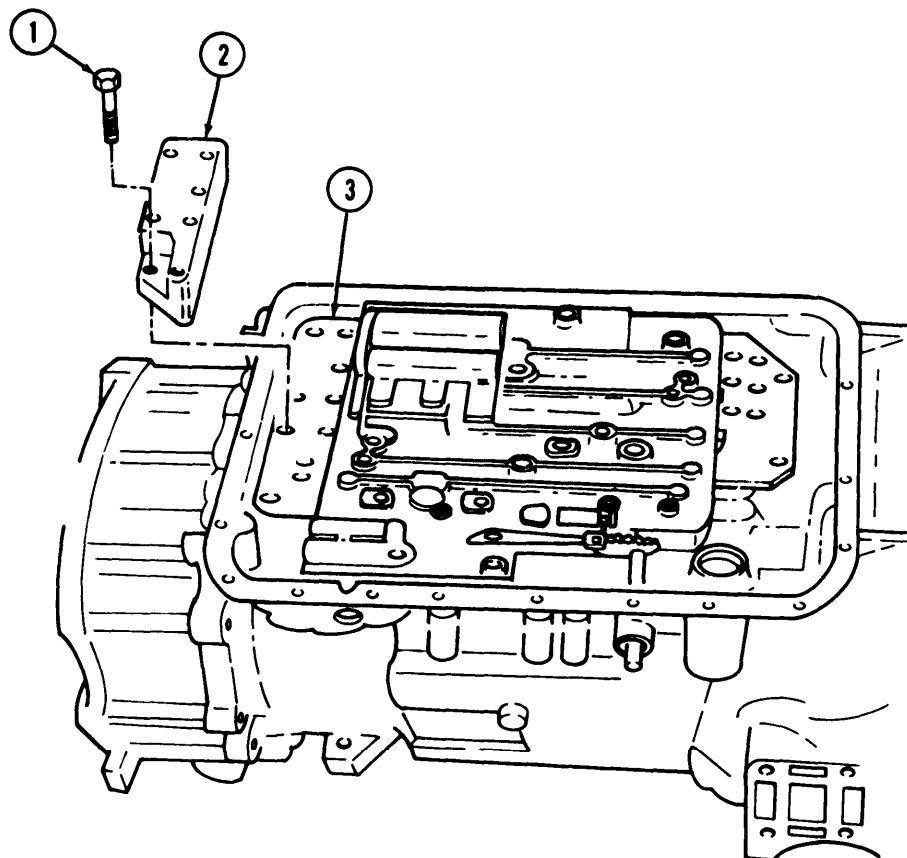
Keep oil pan mounting surface in horizontal position and facing upward.

Installation

1.	Low shift valve (2)	Install on oil transfer plate (3) with two screws (I).	Finger tighten only.
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7-54. LOW SHIFT VALVE INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install low trimmer valve (para. 7-55).

TA 350031

7-209

7-55. LOW TRIMMER VALVE INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para, 7-54	Low shift valve installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

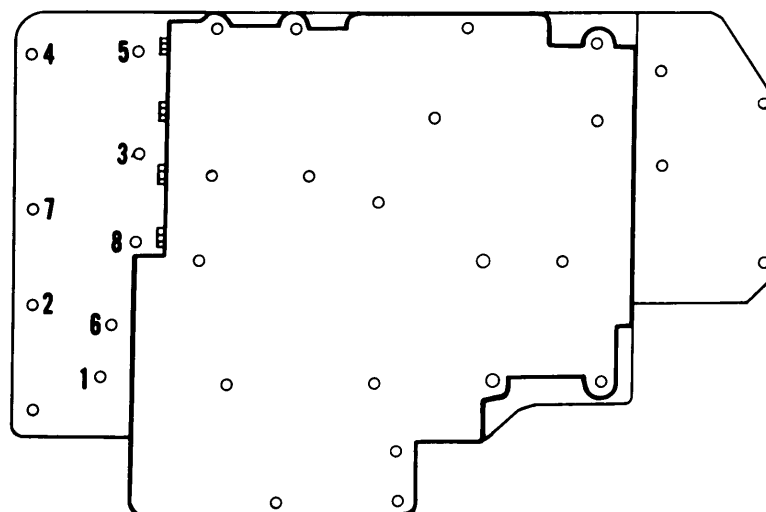
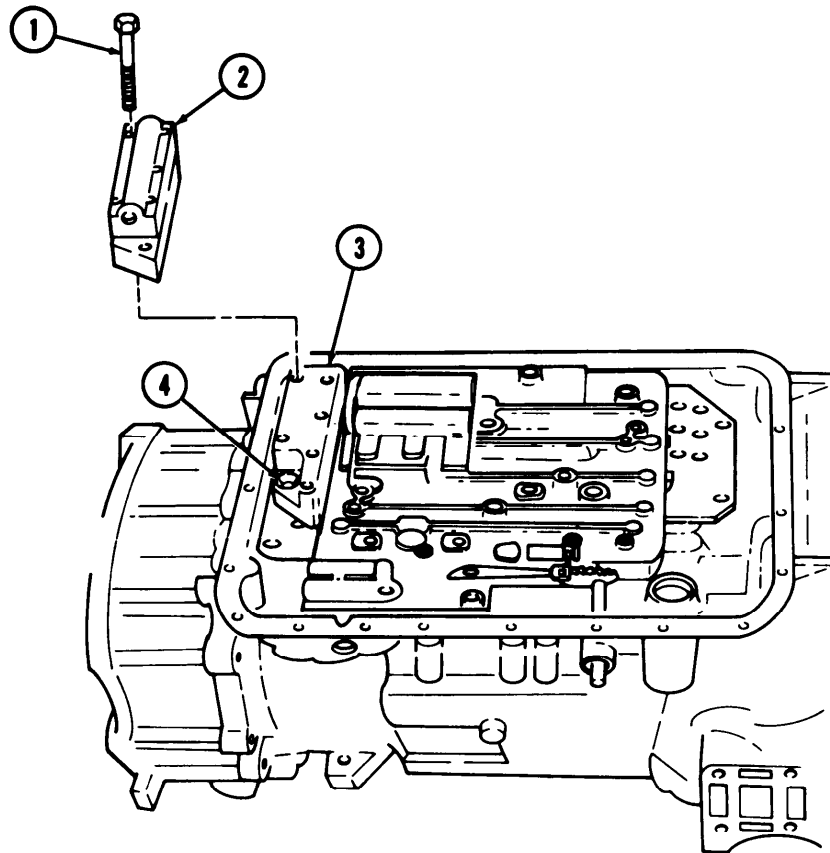
Keep oil pan mounting surface in horizontal position and facing upward.

Installation

1.	Low trimmer valve (2)	Install on low shift valve (3) with six screws (l).	Tighten screws (1) and (4) 9-11 lb-ft (12-15 N.m) in sequence shown.
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7-55. LOW TRIMMER VALVE INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install modulated lockup valve (para. 7-56).

7-56. MODULATED LOCKUP VALVE INSTALLATION

1

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para, 7-55	Low trimmer valve installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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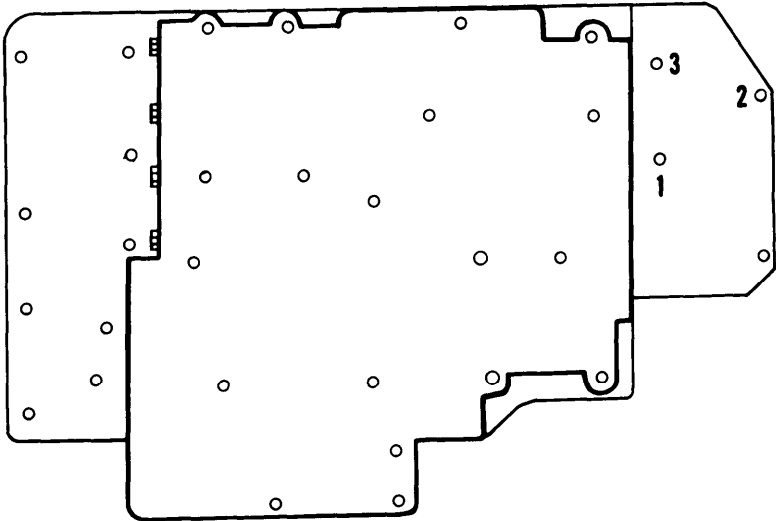
NOTE

Keep oil pan mounting surface in horizontal position and facing upward.

Installation

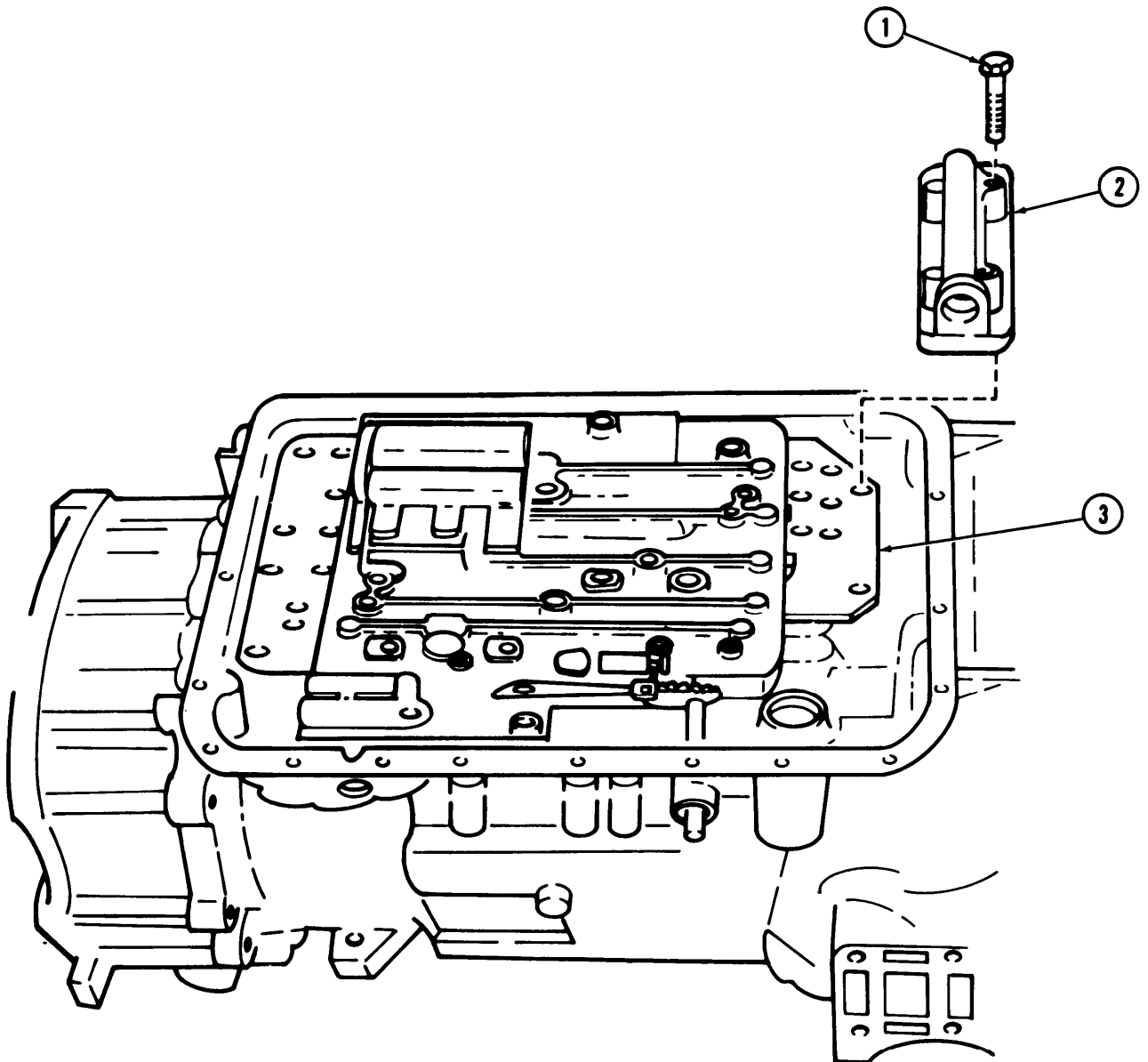
1,	Modulated lockup valve (2)	Install on oil transfer plate (3) with three screws (I).	Tighten screws 9-11 lb-ft (12-15 N.m) in sequence shown.
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7-56. MODULATED LOCKUP VALVE INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install transmission oil filter (para. 7-57).

TA360033

Change 2

7-213

7-57. TRANSMISSION OIL FILTER INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-56	Modulated lockup valve installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>	<u>Special Environmental Conditions</u>	
None	Work area clean and free from blowing dirt and dust.	
<u>Materials/Parts</u>		
“O” ring Transmission oil filter		
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
Wheeled vehicle repairman MOS 63W	None	
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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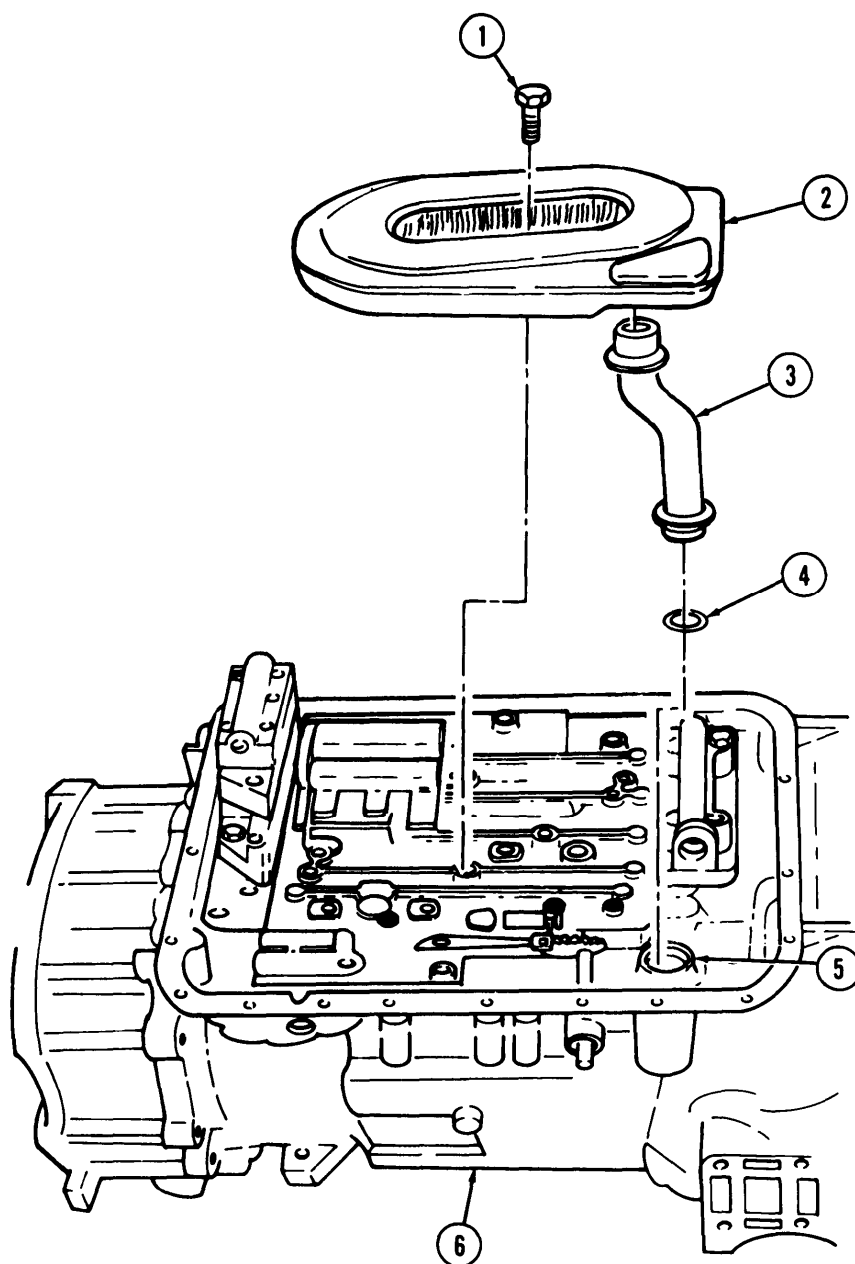
NOTE

Keep oil pan mounting surface in horizontal position and facing upward.

<u>Installation</u>				
1.		Filter suction tube (3)	Insert one end into new oil filter assembly (2).	Filter suction tube (3) ends are interchangeable.
2.		New “O” ring (4)	Install onto opposite end of filter suction tube (3).	
3.		New transmission oil filter assembly (2)	a. Position on transmission (6). b. Install on transmission (6) with screw (1).	Filter suction tube (3) must be inserted into oil input port (5). Tighten 10-15 lb-ft (14-20 N.m).

7-57. TRANSMISSION OIL FILTER INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Install transmission oil pan (para. 7-58).

TA350034

7-215

7-58. TRANSMISSION OIL PAN INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-57	Transmission oil filter installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
Gasket		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

CAUTION

Do not use silicone-type gasket sealing compound when installing gasket as oil leakage may result. Oil or light grease coating maybe used to hold gasket in position during installation.

1.	New oil pan gasket (5)	Position against trans- mission (4) housing.	Gasket (5) holes alined with screw (3) holes in transmission (4) hous- ing.
2.	Transmission oil pan (1)	Position against oil pan gasket (5) and install with twenty-one screws (3).	Finger tighten.
3.	Twenty-one screws (3)	a. Tighten following torque sequence shown.	Tighten 10-15 lb-ft (14-20 N.m).

7-58. TRANSMISSION OIL PAN INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

Due to gasket compression, torque values will be lost and screws must be retightened.

b. Retighten following torque sequence shown to achieve final torque.

Tighten 15-20 lb-ft (20-27 N.m).

NOTE

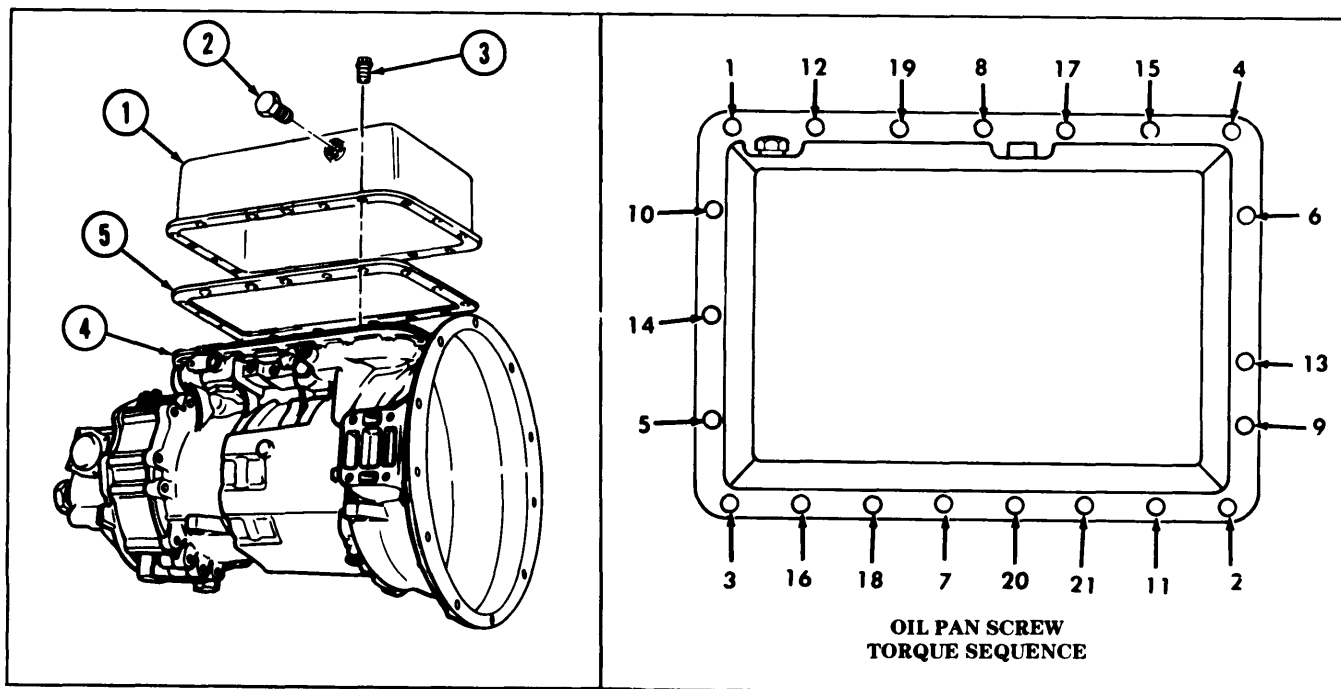
Perform step 4 if new oil pan was installed.

4.

Plug (2)

Install in oil pan (l).

Ensure plug is installed opposite hole for dipstick.



END OF TASK!

FOLLOW-ON TASK: Install transmission torque converter (para. 7-59).

7-59. TRANSMISSION TORQUE CONVERTER INSTALLATION

This task covers:

Installation

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	Para. 7-58	Transmission oil pan installed.
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Work area clean and free from blowing dirt and dust.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		None
<u>Manual References</u>		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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Installation

Transmission (7) Tilt to horizontal with oil pan (6) facing downward.

CAUTION

Torque converter must be installed straight on transmission and not moved from side to side. Side movement will damage hook-type seal ring on turbine shaft.

NOTE

Assistant will help with step 2.

2.

Torque converter (5)

Install in transmission (7)

Make sure hook-type seal ring is properly positioned.

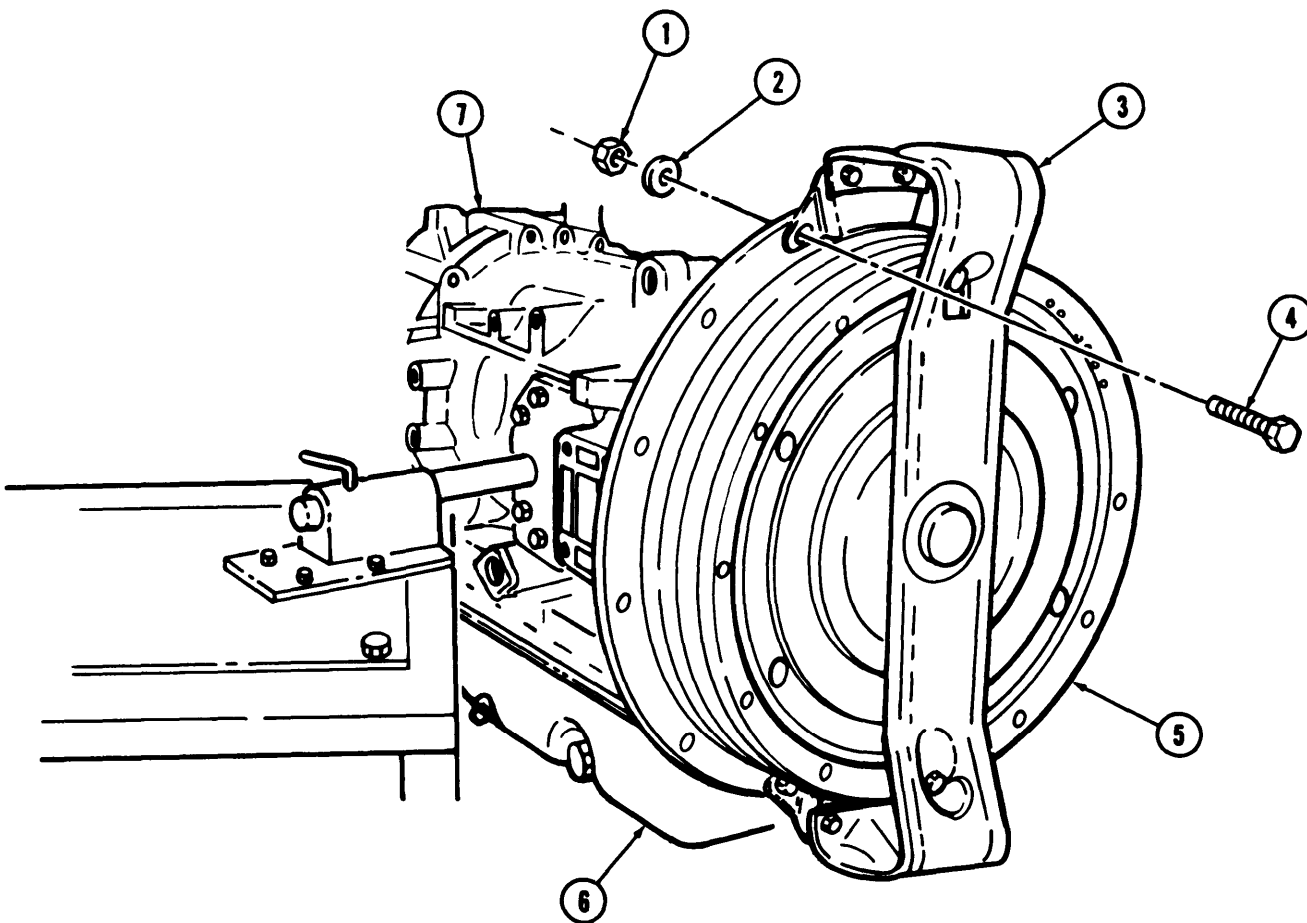
Torque converter may be rotated until flat sides of pump hub engage flats in oil pump drive gear.
3.

Converter retaining strap (3)

Install on transmission ('7) with four screws (4), washers (2), and nuts (1).

7-59. TRANSMISSION TORQUE CONVERTER INSTALLATION (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

FOLLOW-ON TASK: Remove transmission from holding fixture (para. 7-60),

7-60. TRANSMISSION REMOVAL FROM HOLDING FIXTURE

This task covers:

Removal.

INITIAL SETUP:

Applicable Models	Equipment Condition Reference	Condition Description
All	Para. 7-59	Transmission torque converter installed
Test Equipment		
None		
Special Tools	Special Environmental Conditions	
None	Work area clean and free from blowing dirt and dust.	
Materials/Parts		
Gasket		
Personnel Required	General Safety Instructions	
Wheeled vehicle repairman MOS 63W (2)	All personnel must stand clear during hoisting operations.	
Manual References		
TM 9-2320-272-34P		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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WARNING

All personnel must stand clear during hoisting operations. A snapped cable, heavy or swinging load may cause injury to personnel.

Removal

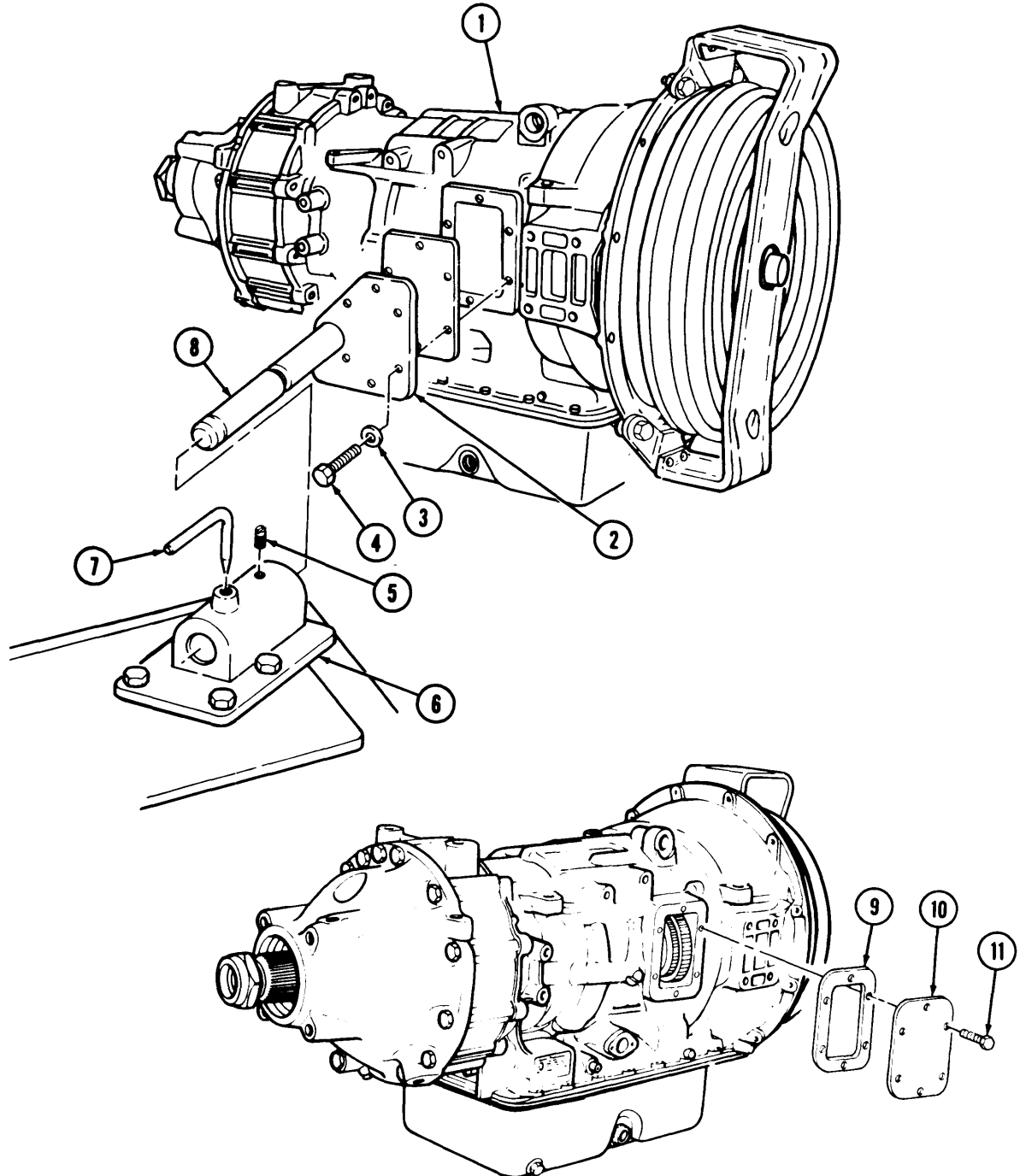
NOTE

Assistant will help with step 1.

1.	Transmission (1) and holding fixture (8)	Remove pin (7) and loosen setscrew (5) and remove from holding fixture base (6).	Support transmission (1) with chain and hoist.
2.	Six screws (4) and washers (3), holding fixture (8), and holding plate (2)	Remove.	
3.	Power takeoff cover (10) and new gasket (9)	Install with six screws (11).	

7-60. TRANSMISSION REMOVAL FROM HOLDING FIXTURE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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END OF TASK!

Section VI. TRANSMISSION TESTS AND ADJUSTMENTS**7-61. TRANSMISSION TESTS AND ADJUSTMENTS TASK SUMMARY**

TASK PARA.	PROCEDURES	PAGE NO.
7-62.	Transmission Oil Pressure Testing	7-224
7-63.	Transmission Modulator Maintenance	7-238
7-64,	Transmission Converter Stall Test	7-242

7-62. TRANSMISSION OIL PRESSURE TESTING

This task covers:

a. Oil Cooler Pressure Test**c. Automatic Shift Speed Test****b. Main Pressure and Governor Pressure Test****INITIAL SETUP:**

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10	Parking brake set.
	TM 9-2320-272-10	Transmission oil at proper level.
	TM 9-2320-272-10	Vehicle at curb weight (empty).
	TM 9-2320-272-10	Wheels blocked (chocked).

Test Equipment

Pressure gage set (300 psi)

Special Tools

None

Special Environmental Conditions

None

Materials/Parts

Pipe plug 1/4-18 NPTF Thd

Two pipe plugs 1/8-27 NPTF Thd
(4730-00-081-9618)

"O" ring

Protective cap-plugs (Appendix C, Item 5)

Personnel Required

Wheeled vehicle repairman MOS 63W (2)

General Safety Instructions

- Personnel must be clear from underside and front of vehicle when engine is running.
- Make sure transmission-to-transfer case propeller shaft has been removed before performing test.

Manual References

TM 9-2320-272-10

TM 9-2320-272-20-1

TM 9-2320-272-34P

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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CAUTION

Make sure disconnected hoses and openings are capped or plugged.
Dirt or dust in lines will damage transmission and oil cooler.

a. Oil Cooler Pressure Test

1.	Top of oil cooler (4)	Oil cooler supply hose (1)	Disconnect from elbow (2).	
2.		Locknut (3)	Loosen, and remove elbow (2) and "O" ring (5) from oil cooler (4).	Note elbow (2) alignment for connection. Discard "O" ring (5).

7-62. TRANSMISSION OIL PRESSURE TESTING (Cont'd)

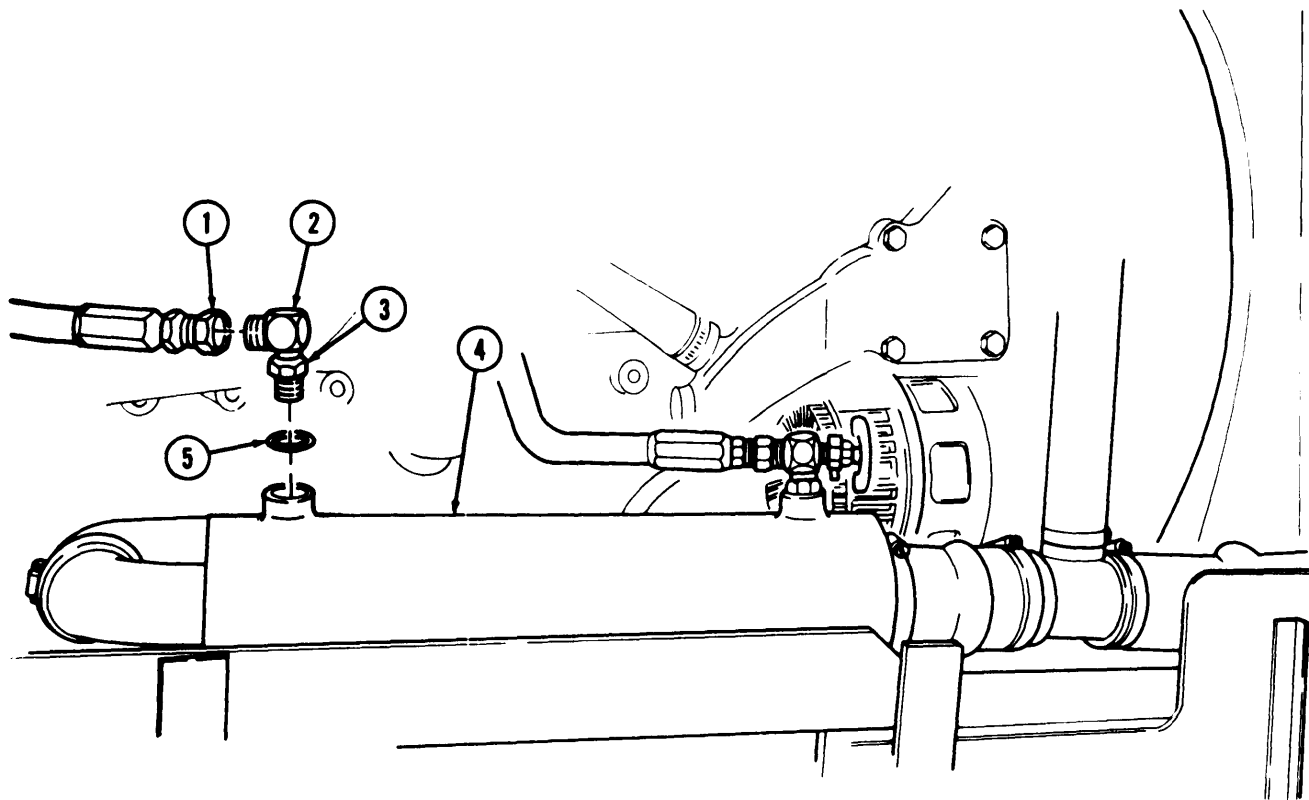
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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- | | | | | |
|----|--|-----------|---|--|
| 3. | | Elbow (2) | a. Drill hole in side opposite hose port.
b. Tap hole. | Use drill press and 21/64 in. drill bit.
Use 1/4-18 NPTF tap. |
|----|--|-----------|---|--|

CAUTION

After tapping, elbow must be thoroughly cleaned and all burrs and shavings removed. Any shavings entering system will damage transmission.

- c. Remove from drill press and thoroughly clean.

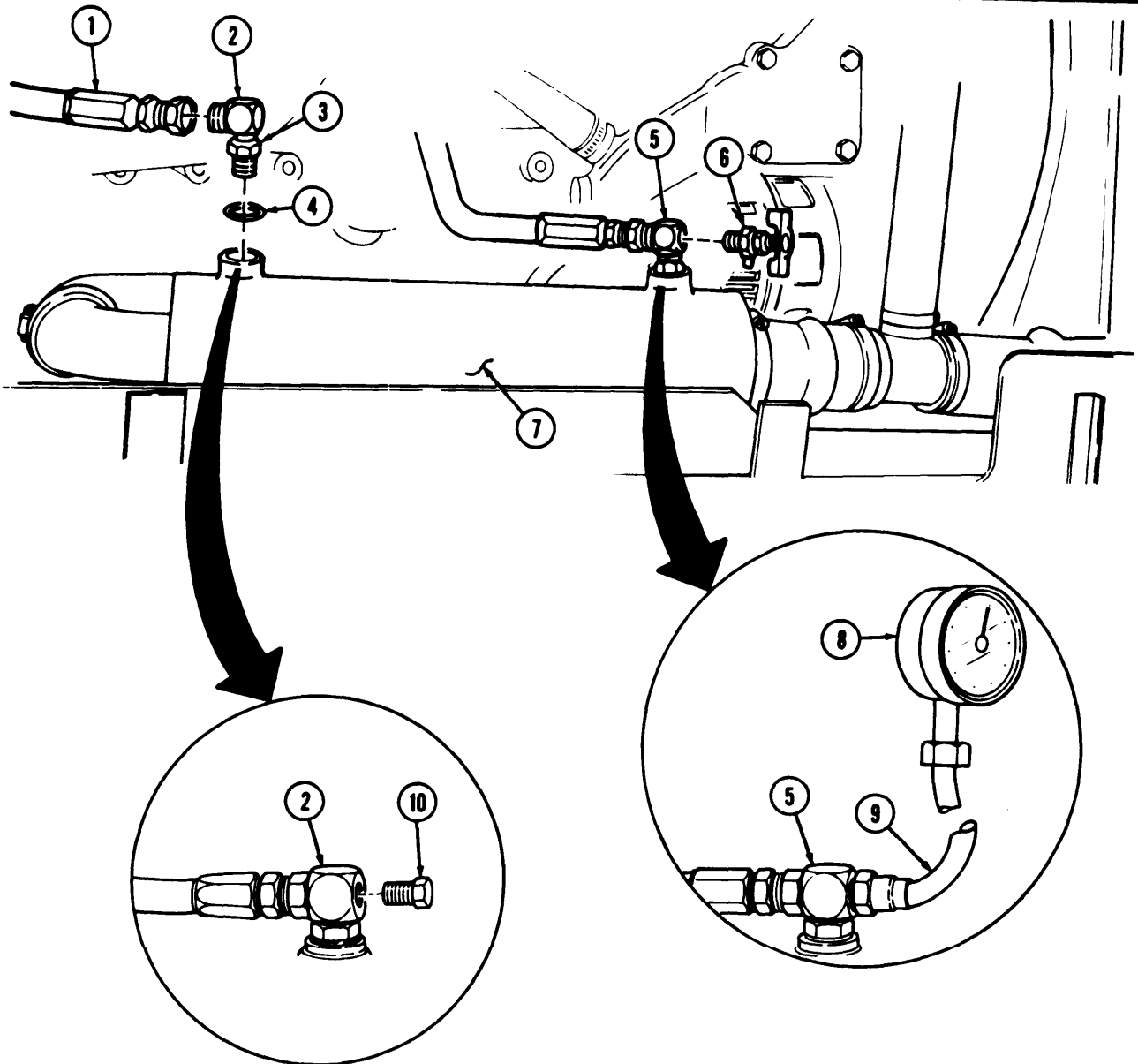


7-62. TRANSMISSION OIL PRESSURE TESTING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
4.		New 'O' ring (4) and elbow (2)	Install in oil cooler (7) as follows: a. Install elbow (2) until alined and locknut (3) seats. b. Tighten locknut (3) until new "O" ring (4) is seated.	
5.		Pipe plug (10)	Install in elbow (2).	
6.		Oil cooler supply hose (1)	Connect to elbow (2).	
7.	Elbow (5)	Draincock (6)	Remove.	
8.		Pressure gage (8) and gage hose (9)	Install in elbow (5).	
9.		Vehicle	Apply service brakes.	Refer to TM 9-2320-272-10.

7-62. TRANSMISSION OIL PRESSURE TESTING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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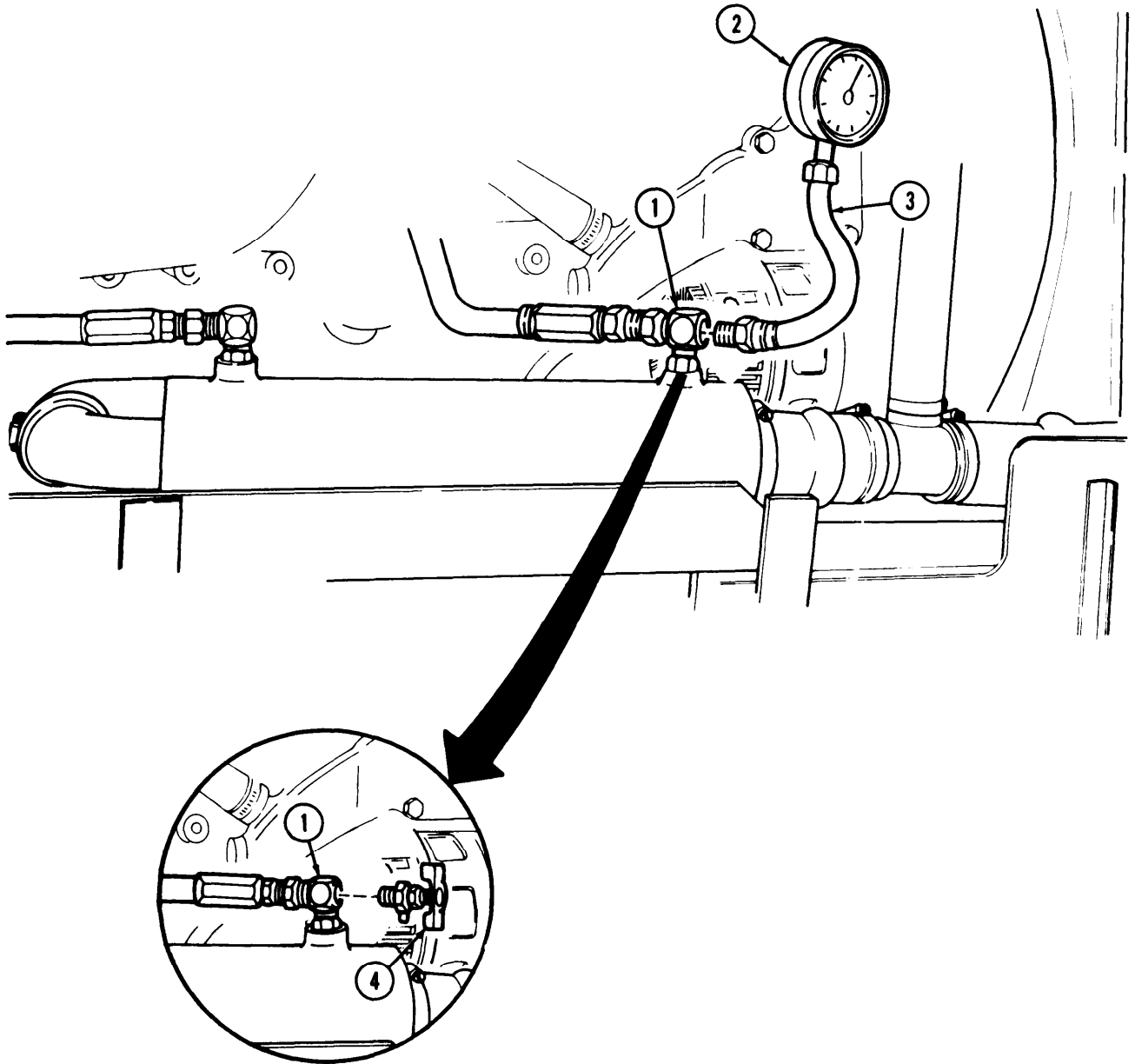


7-62. TRANSMISSION OIL PRESSURE TESTING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
<p style="text-align: center;"><u>WARNING</u></p> <p>Make sure all personnel are clear from underside and front of vehicle before starting engine. Transmission slipping into gear may cause injury to personnel.</p>				
10.	Engine		a. Start and check oil cooler connections for leaks.	Refer to TM 9-2320-272-10.
<p style="text-align: center;"><u>CAUTION</u></p> <p>Do not maintain stalled condition for longer than 30-second intervals. Transmission oil may overheat and cause transmission damage.</p>				
			b. Place transmission shift lever in "1-5" (drive).	Parking brake set.
			c. Operate engine at 1200 rpm.	
			d. Place transmission shift lever in "N" (neutral).	
			e. Operate at normal operating temperatures.	Refer to TM 9-2320-272-10.
			f. Check transmission oil level.	Refer to TM 9-2320-272-10.
			g. Operate engine at 1650 rpm.	Transmission in "N" (neutral), parking brake set.
11.	Pressure gage (2)		Check gage (2) and note reading.	Pressure should be 26 psi (179.2 kpa). If low, check for hose or internal oil cooler leakage. If high, check for cooler, cooler filter, or cooler hose restriction.
12.	Engine		stop.	Refer to TM 9-2320-272-10.
13.	Gage (2) and hose (3)		Disconnect from elbow (1).	
14.	Draincock (4)		Install in elbow (1).	

7-62. TRANSMISSION OIL PRESSURE TESTING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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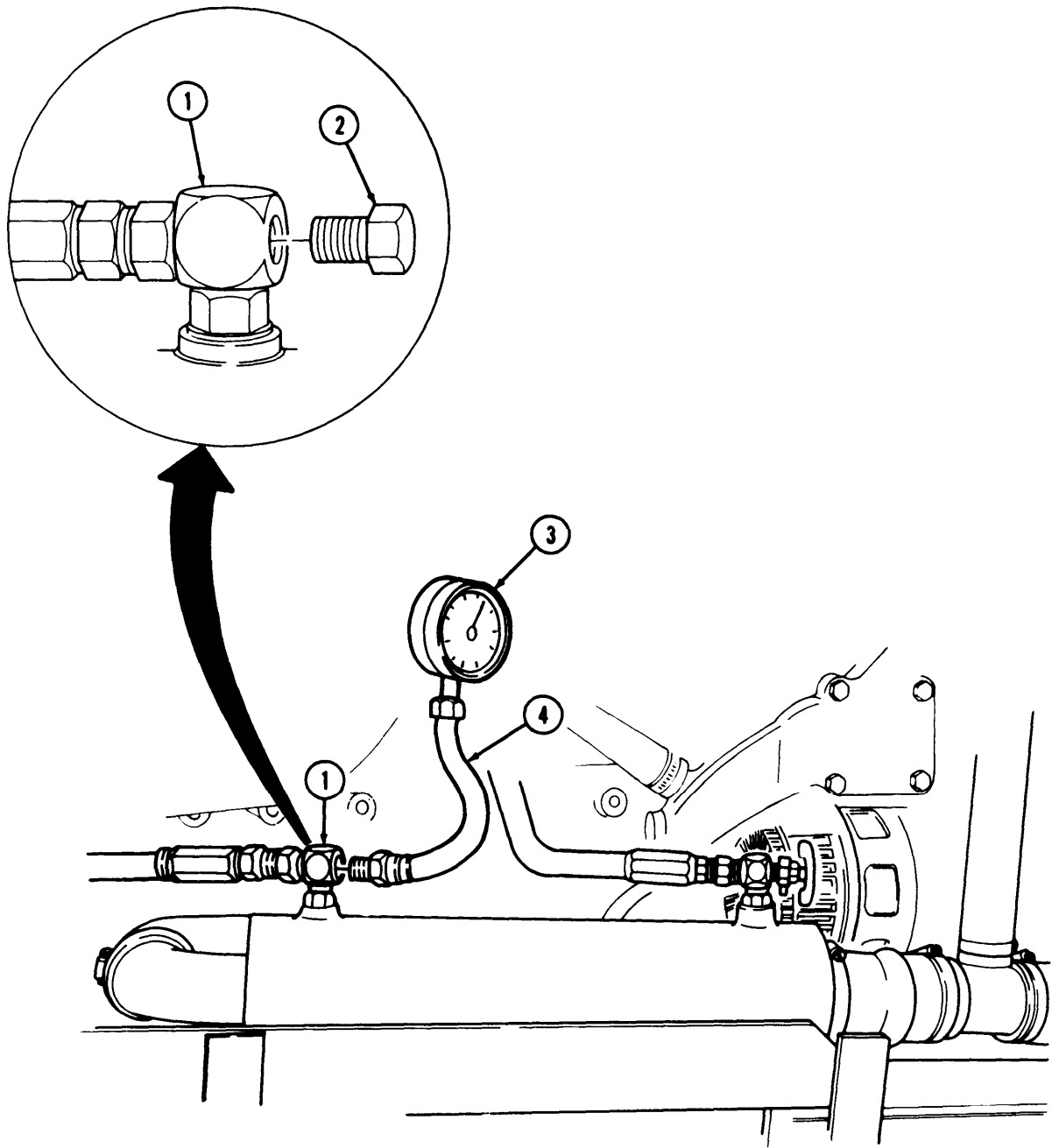


7-62. TRANSMISSION OIL PRESSURE TESTING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
15.		Pipe plug (2)	Remove from supply hose elbow (1).	
16.		Pressure gage (3) and gage hose (4)	Install in supply hose elbow (1).	
<p style="text-align: center;"><u>WARNING</u></p> <p>Make sure all personnel are clear from underside and front of vehicle before starting engine. Transmission slipping into gear may cause injury to personnel.</p>				
17.		Engine	a. Start and check oil cooler connections for leaks. b. Operate engine at 1650 rpm.	Refer to TM 9-2320-272-10. Transmission in 'N' (neutral), parking brake set.
18.		Pressure gage (3)	Check gage (3) and note reading.	Pressure should be 30-50 psi (207-345 kPa). If low, check for hose or internal oil cooler leakage. If high, check for cooler or cooler hose restriction.
19.		Engine	stop.	Refer to TM 9-2320-272-10.
20.		Gage (3) and hose (4)	Disconnect from supply hose elbow (1).	
21.		Pipe plug (2)	Install in elbow (1).	

7-62. TRANSMISSION OIL PRESSURE TESTING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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7-62. TRANSMISSION OIL PRESSURE TESTING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Main Pressure and Governor Pressure Test

WARNING

Make sure transmission-to-transfer case propeller shaft has been removed before performing this test. If test is performed with propeller shaft installed, wheel blocks (chocks) will not prevent vehicle from rolling, causing injury to personnel.

21.1.	Transmission-to-transfer case propeller shaft	Remove.	TM 9-2320-272-20-1.
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CAUTION

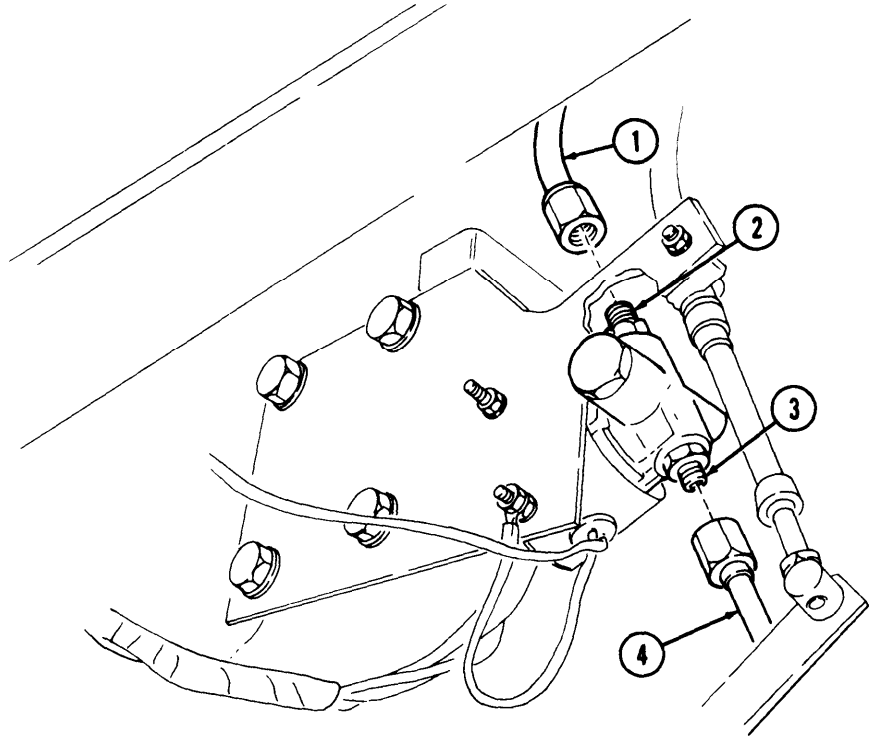
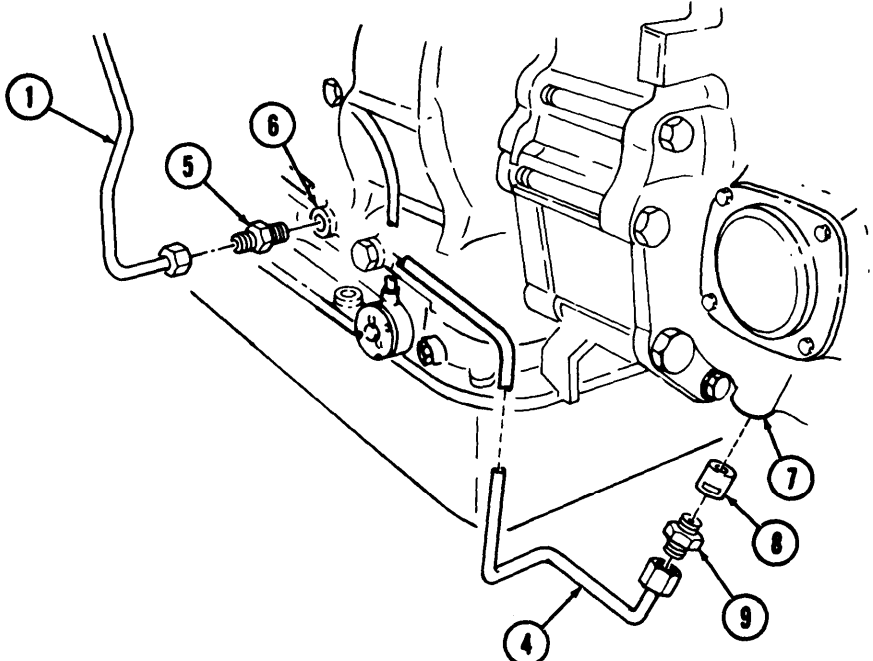
Before disconnecting any transmission pressure lines, clean surrounding surfaces and plug all openings to prevent entry of dirt or debris into transmission. Damage will occur if dirt or debris enters transmission.

NOTE

- **Transmission-to-transfer case propeller** shaft removal allows transmission output shaft to rotate to buildup governor oil pressure. Upshift will not occur without governor pressure.
- Have drainage container ready to catch oil.

22.	Adapter (2)	Main pressure line (1)	Disconnect
23.	Adapter (5)	Main pressure line (1)	Disconnect and remove.
24.	Transmission main pressure port (6)	Adapter (5)	Remove.
25.	Adapter (3)	Governor pressure line (4)	Disconnect.
26.	Adapter (9)	Governor pressure line (4)	Disconnect and remove.
27.	Transmission auxiliary governor pressure port (7)	Adapter (9) and check valve (8)	Remove.

7-62. TRANSMISSION OIL PRESSURE TESTING (Cent'd)

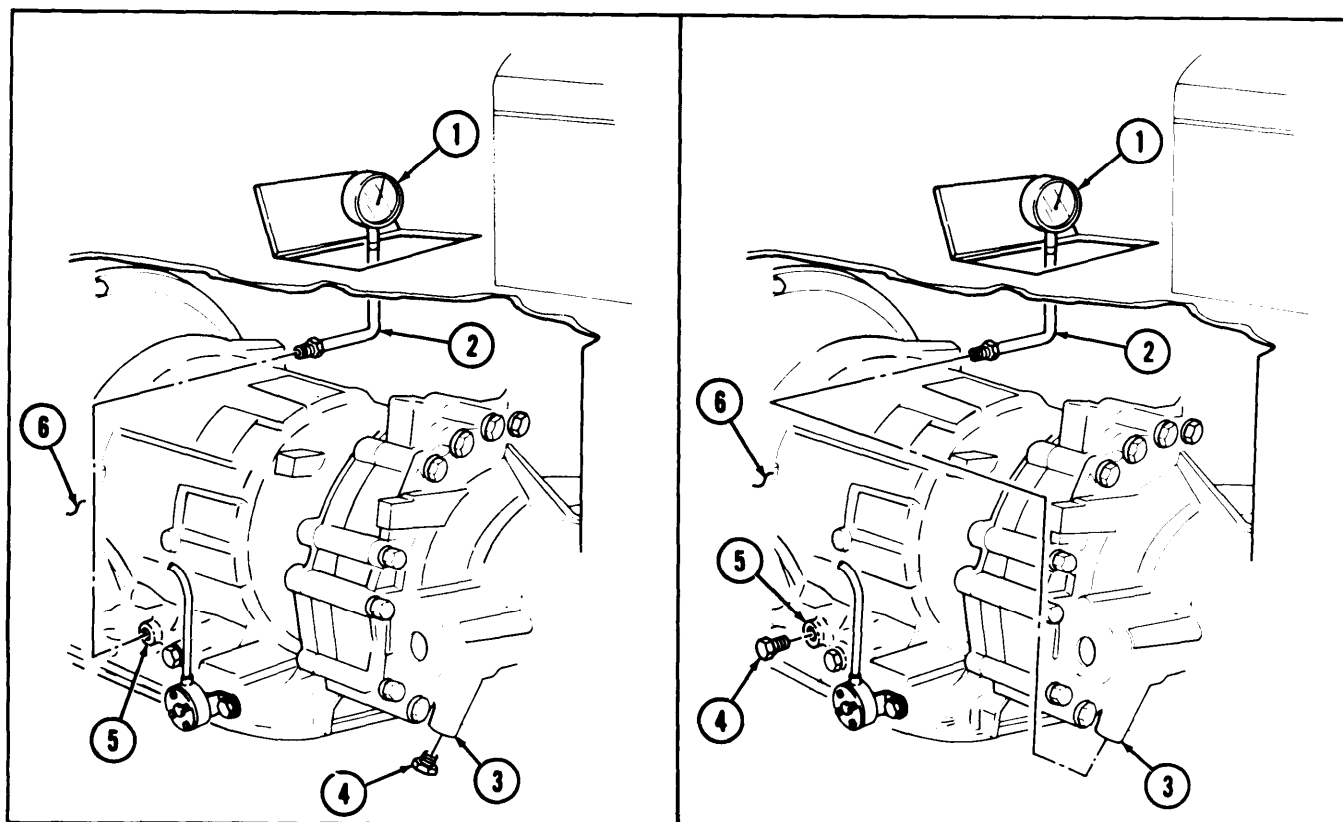
STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

7-62. TRANSMISSION OIL PRESSURE TESTING (Cent'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
28.		Pipe plug (4)	Install in auxiliary governor pressure port (3).	Use 1/8-27 NPTF Thd plug (4).
29.		Pressure gage (1) and hose (2)	Connect to main pressure port (5).	Use 1/8-27 NPTF Thd hose (2) fitting.
30.		Engine	a. Start, and check pressure port connections for leaks. b. Check transmission (6) oil level.	Refer to TM 9-2320-272-10. Refer to TM 9-2320-272-10.
31.		Engine	Operate at 625±25 rpm.	Refer to TM 9-2320-272-10. Transmission (6) in "N" (neutral), parking brake set.
32.		Pressure gage (1)	Note pressure reading.	Pressure should be 125 psi (802 kPa) minimum. If not, repair transmission (6) as necessary.
33.		Vehicle	a. Place transmission (6) selector lever in "1-5" (drive). b. Operate engine at 1200±25 rpm.	Refer to TM 9-2320-272-10.
34.		Pressure gage (1)	Note pressure reading.	Pressure should be 180-205 psi (1241-1413 kPa). If not, repair transmission (6) as necessary.

7-62. TRANSMISSION OIL PRESSURE TESTING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
35.	Engine		Stop, and place transmission selector lever in "N" (neutral).	Refer to TM 9-2320-272-10.
36.	Left side of transmission (6)	Pressure gage (1) and hose (2)	Disconnect from main pressure port (5).	
37.		Pipe plug (4)	Remove from auxiliary governor pressure port (3) and install in main pressure port (5).	
38.		Pressure gage (1) and hose (2)	Install in auxiliary governor pressure port (3).	
39.	Engine		a. Start, and check pressure port connection for leaks. b. Check transmission oil level.	Refer to TM 9-2320-272-10, Refer to TM 9-2320-272-10.



7-62. TRANSMISSION OIL PRESSURE TESTING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
40.		Engine	Place transmission (1) selector lever in "1-5" (drive) position and operate engine at 1650 rpm.	Refer to TM 9-2320-272-10.
41.		Pressure gage (2)	a. Note pressure reading.	Pressure should be 82-91 psi (565-627 kPa). If not, repair transmission (1) as necessary.
			b. Stop engine and disconnect pressure gage (2) and hose (3) from auxiliary governor pressure port (4).	
42.		Pipe plug (5)	Remove from main pressure port (6).	
NOTE				
Only M936 vehicles are equipped with check valve.				
43.		Check valve (9)	Install in auxiliary governor pressure port (4) with adapter (10).	Bleed hole end of valve (9) must be inserted into pressure port (4) first.
44.		Governor pressure line (11)	Install on adapter (10) and adapter (13).	
45.		Adapter (8)	Install in main pressure port (6).	
46.		Main pressure line (7)	Install on adapter (8) and adapter (12).	
47.		Engine.	a. Start, and check pressure port connections for leaks.	Refer to TM 9-2320-272-10.
			b. Check transmission (1) oil level.	Refer to TM 9-2320-272-10.
48.		Transmission-to-transfer case propeller shaft	Install.	Refer to TM 9-2320-272-20-1.

I c. Automatic Shift Speed Test I**NOTE**

Assistant will help with steps 49 and 50.

49.		Vehicle	Road test and record engine rpm at shift points.	Refer to TM 9-2320-272-10.
50.		Transmission (1) selector lever	a. With vehicle in operation, shift through range sequence.	See table 7-7 for lever range sequence.

7-62. TRANSMISSION OIL PRESSURE TESTING (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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b. Check recorded engine shift point rpm with table 7-7.

If shift points are incorrect, check modulator adjustment (para. 7-63). If modulator adjustment does not correct shift speed, repair transmission (1) as necessary.

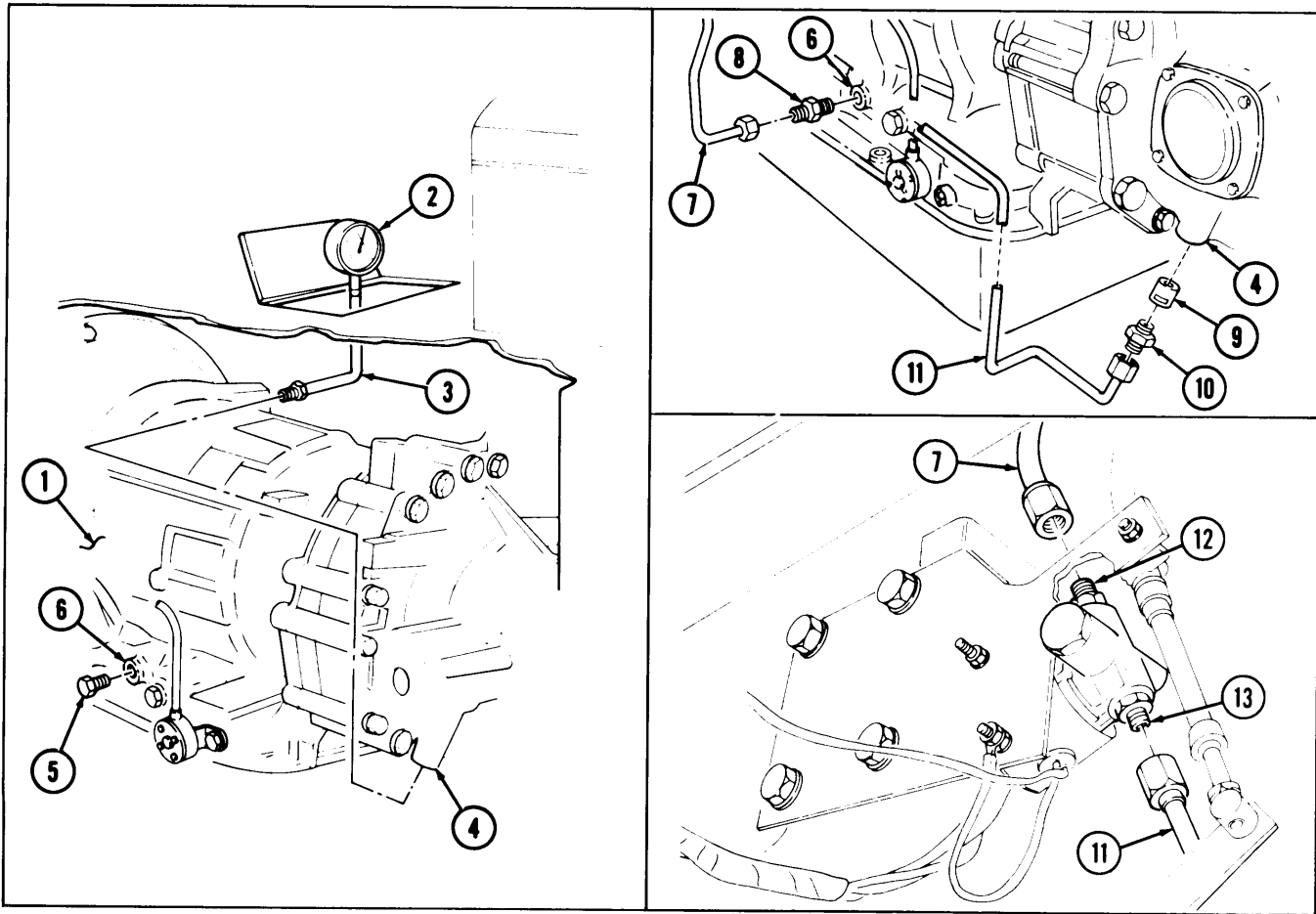


Table 7-7 Transmission Shift Point Check

SELECTOR LEVER RANGE	THROTTLE	AUTOMATIC SHIFTING	ENGINE (RPM)
1-2	Fully open	1-2	1900-2050
		2-2	1925-2050 (before converter lock-in)
		2-2	1600-1825 (after converter lock-in)
1-3		2-3	2000-2150
1-4		3-4	2030-2140
1-5 (Drive)		4-5	2015-2130

END OF TASK!

7-63. TRANSMISSION MODULATOR MAINTENANCE

This task covers:

- a. Testing
- b. Adjustment

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10 TM 9-2320-272-10	Parking brake set. Vehicle at curb weight (empty).
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Dry conditions, open roads, easy grades.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W (2)		None
<u>Manual References</u>		
TM 9-2320-272-10 TM 9-2320-272 -20-1 TM 9-2320-272-34P LO 9-2320-272-12		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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a. Testing

NOTE

Vehicle engine must be at normal operating temperature of 175°-195°F (79°-90°C) as indicated by temperature gage. Transmission oil temperature must be at normal operating temperature of 120°-220°F (49°-104°C) as indicated by temperature gage.

1.	Vehicle	a. Allow engine and transmission to reach normal operating temperatures. b. After warmup, depress accelerator pedal until engine reaches 2100 rpm.	Transmission in "N" (neutral), parking brake set. If engine does not reach 2100 rpm, see table 2-1, fuel system malfunction 15. Proceed with testing if engine reaches 2100 rpm.
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7-63. TRANSMISSION MODULATOR MAINTENANCE (Cont'd)
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STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

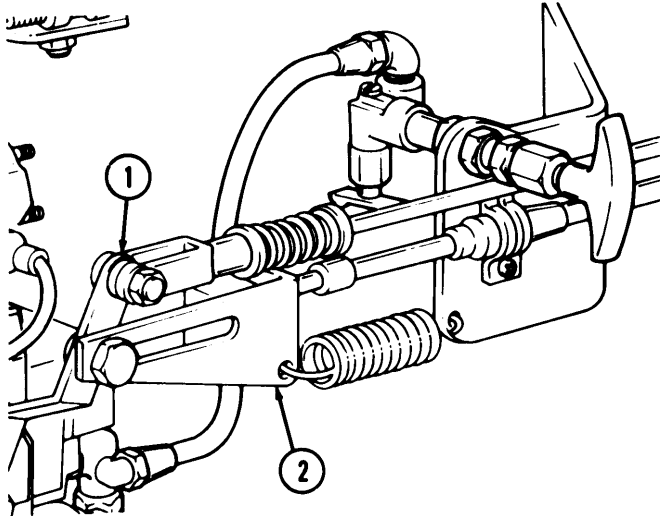
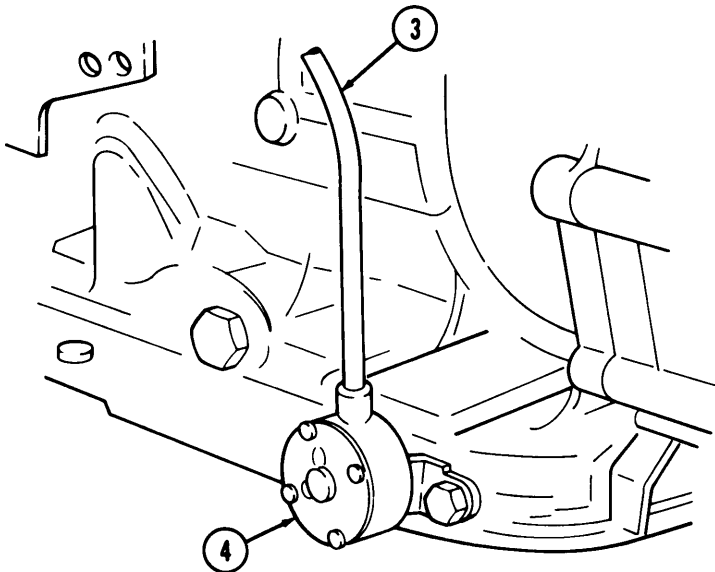
Assistant will operate vehicle as directed by mechanic. Mechanic will observe and record engine rpm indicated by tachometer during shift changes.

2.		Transmission selector lever	a. Place in "1-2" (second). b. Road test vehicle and accelerate at full throttle 1400-1700 rpm. c. Note shift change and record engine rpm at moment of shift change. d. Stop vehicle and repeat steps b and c in "1-3" (third). e. Stop vehicle and repeat steps b and c in "1-4" (fourth). f. Stop vehicle and repeat steps b and c in "1-5" (drive).	Refer to TM 9-2320-272-10.
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7-63. TRANSMISSION MODULATOR MAINTENANCE (Cont'd)
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STEP NO.	LOCATION	ITEM	ACTION	REMARKS
3.		Recorded engine rpm at shift points	Compare with correct shift point ranges given in table 7-7.	Adjust modulator (4) if all shift points are too high or too low by approximately same amount.
b. Adjustment				
4.		Modulator (4) and cable (3)	a. Inspect for looseness and improper installation. b. Correct and retest if looseness and/or improper installation are found.	Refer to TM 9-2320-272-20-1.
<p style="text-align: center;">NOTE</p> <p>Modulator will be adjusted if properly installed. Refer to TM 9-2320 -272-20-1 for correct modulator and cable installation instructions.</p>				
5.		Modulator link (2)	a. Remove from throttle lever (1). b. Reinstall, c. Retest modulator (4)	Refer to TM 9-2320-272-20-1. Proceed to step 6 if retest indicates defective modulation.
6.		Modulator (4)	Replace.	Refer to TM 9-2320-272-20-1.

7-63. TRANSMISSION MODULATOR MAINTENANCE (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
				
				

END OF TASK!

FOLLOW-ON TASKS: • Fill transmission to proper oil level (LO 9-2320-272-12).
 • Start engine (TM 9-2320-272-10) and road test vehicle.

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7-64. TRANSMISSION CONVERTER STALL TEST

This task covers:

Forward Stall Test

INITIAL SETUP:

<u>Applicable Models</u>	<u>Equipment Condition Reference</u>	<u>Condition Description</u>
All	TM 9-2320-272-10	Parking brake set.
	TM 9-2320-272-10	Wheels blocked (chocked).
<u>Test Equipment</u>		
None		
<u>Special Tools</u>		<u>Special Environmental Conditions</u>
None		Area in front of vehicle must be free of obstructions.
<u>Materials/Parts</u>		
None		
<u>Personnel Required</u>		<u>General Safety Instructions</u>
Wheeled vehicle repairman MOS 63W		Do not allow anyone to stand in front of vehicle when conducting a stall test.
<u>Manual References</u>		
TM 9-2320-272-10		
TM 9-2320-272-34P		
LO 9-2320-272-12		

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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WARNING

Do not allow anyone to stand in front of vehicle when conducting stall test. Vehicle movement may cause injury to personnel.

CAUTION

- Do not maintain the stalled condition longer than thirty seconds due to the rapid heating of the transmission oil, Observe transmission oil temperature gage. 120°-220°F (49°- 104°C) is normal operating range.
- Observe engine coolant temperature gage. Operating temperature is 175°-195°F (79°-90°C).
- If the oil temperature reaches 300°F (148°C), or if thirty seconds is insufficient time to complete the needed tests, the transmission oil temperature must be lowered.
- Run the engine 1200-1500 rpm with the transmission in neutral for two minutes to cool the oil between tests.

7-64. TRANSMISSION CONVERTER STALL TEST (Cont'd)

STEP NO.	LOCATION	ITEM	ACTION	REMARKS
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NOTE

- The stall test is conducted when the engine and/or transmission are not performing satisfactorily. The purpose of the stall test is to determine if the transmission or the engine is the malfunctioning unit.
- The vehicle's transmission will stay in first speed during the stall tests regardless of the transmission 5-4-3-2- and 1 quadrant position. The transmission does not and cannot upshift because the internal mechanism, output shaft, and governor are not turning. The stall test checks the engine performance, converter clutch operation or installation, and the holding ability of the converter one-way clutch.

Forward Stall Test

1.	Forward stall test	Perform as follows:	
		a. Apply service brakes.	Refer to TM 9-2320-272-10.
		b. Place transmission selector lever in any forward drive position 5-4-3-2-1.	Refer to TM 9-2320-272-10.
		c. Accelerate engine to full throttle (1400-1700 rpm).	If engine speed exceeds 1700 rpm proceed to step 2. If engine speed is less than 1400 rpm proceed to step 3.

NOTE

Step 2 is performed only if engine speed exceeds 1700 rpm.

2.	Transmission	Check transmission oil level.	If oil level is low, fill to proper level. Refer to LO 9-2320-272-12. If oil level is correct, repair transmission (para. 7-14).
----	--------------	-------------------------------	--

NOTE

Step 3 is performed only if engine speed is less than 1400 rpm.

3.	Engine	Troubleshoot for loss of power.	Refer to table 2-1. If engine is performing satisfactorily, repair converter (para. 7-16).
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END OF TASK!

FOLLOW-ON TASKS: • Remove blocks (chocks) from wheels (TM 9-2320-272-10).
• Start engine (TM 9-2320-272-10) and road test vehicle.

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PAGE NO.	PARA- GRAPH	FIGURE NO.	TABLE NO.			
PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBERS				SIGN HERE:		

DA FORM 1 JUL 79 **2028-2**

 PREVIOUS EDITIONS
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 P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR
RECOMMENDATION MAKE A CARBON COPY OF THIS
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TA 349787

FILL IN YOUR
UNIT'S ADDRESS



FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

COMMANDER
U.S. ARMY TANK-AUTOMOTIVE COMMAND
ATTN: AMSTA-MB
WARREN, MI 48397-5000

TEAR ALONG PERFORATED LINE

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
 1 Meter = 100 Centimeters = 1,000 Millimeters = 39.37 Inches
 1 Kilometer = 1,000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1,000 Milligrams = 0.035 Ounces
 1 Kilogram = 1,000 Grams = 2.2 Lb
 1 Metric Ton = 1,000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
 1 Liter = 1,000 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 = 1,000 Cu Millimeters = 0.06 Cu Inches
 1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

TEMPERATURE

$5/9 (^{\circ}\text{F} - 32) = ^{\circ}\text{C}$
 212° Fahrenheit is equivalent to 100° Celsius
 90° Fahrenheit is equivalent to 32.2° Celsius
 32° Fahrenheit is equivalent to 0° Celsius
 $9/5 \text{ C} + 32 = \text{F}^{\circ}$

APPROXIMATE CONVERSION FACTORS

TO CHANGE

Inches
 Feet
 Yards
 Miles
 Square Inches
 Square Feet
 Square Yards
 Square Miles
 Acres
 Cubic Feet
 Cubic Yards
 Fluid Ounces
 Pints
 Quarts
 Gallons
 Ounces
 Pounds
 Short Tons
 Pound-Feet
 Pounds Per Square Inch
 Miles Per Gallon
 Miles Per Hour

TO

Centimeters
 Meters
 Meters
 Kilometers
 Square Centimeters
 Square Meters
 Square Meters
 Square Kilometers
 Square Hectometers
 Cubic Meters
 Cubic Meters
 Milliliters
 Liters
 Liters
 Liters
 Grams
 Kilograms
 Metric Tons
 Newton-Meters
 Kilopascals
 Kilometers Per Liter
 Kilometers Per Hour

MULTIPLY BY

2.540
 0.305
 0.914
 1.609
 6.451
 0.093
 0.836
 2.590
 0.405
 0.028
 0.765
 29.573
 0.473
 0.946
 3.785
 28.349
 0.454
 0.907
 1.356
 6.895
 0.425
 1.609

TO CHANGE

Centimeters
 Meters
 Meters
 Kilometers
 Square Centimeters
 Square Meters
 Square Meters
 Square Kilometers
 Square Hectometers
 Cubic Meters
 Cubic Meters
 Milliliters
 Liters
 Liters
 Liters
 Grams
 Kilograms
 Metric Tons
 Newton-Meters
 Kilopascals
 Kilometers Per Liter
 Kilometers Per Hour

TO

Inches
 Feet
 Yards
 Miles
 Square Inches
 Square Feet
 Square Yards
 Square Miles
 Acres
 Cubic Feet
 Cubic Yards
 Fluid Ounces
 Pints
 Quarts
 Gallons
 Ounces
 Pounds
 Short Tons
 Pound-Feet
 Pounds Per Square Inch
 Miles Per Gallon
 Miles Per Hour

MULTIPLY BY

0.394
 3.280
 1.094
 0.621
 0.155
 10.764
 1.196
 0.386
 2.471
 35.315
 1.308
 0.034
 2.113
 1.057
 0.264
 0.035
 2.205
 1.102
 0.738
 0.145
 2.354
 0.621

