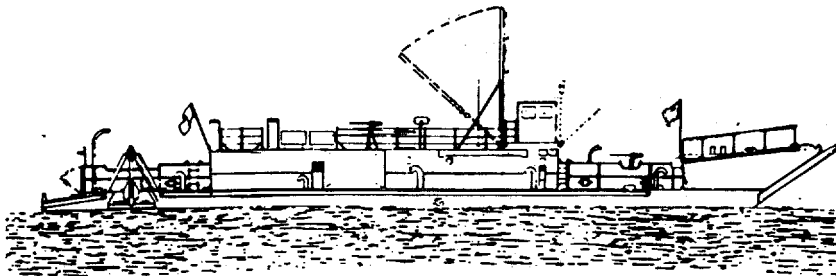


**TECHNICAL MANUAL
OPERATOR, ORGANIZATIONAL,
DIRECT SUPPORT AND
GENERAL SUPPORT
MAINTENANCE MANUAL**

**OPERATOR/CREW
BOW RAMP AND
ANCHOR HANDLING SYSTEM
MAINTENANCE INSTRUCTIONS**

**LANDING CRAFT UTILITY
LCU 1667-1670
NSN 1905-00-168-5764**



**HEADQUARTERS, DEPARTMENT OF THE ARMY
14 MARCH 1984**

CHANGE
NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 13 MARCH 1992

Operator's, Organizational,
Direct Support, and General Support
Maintenance Manual

LANDING CRAFT UTILITY
LCU 1667-1670
(1905-00-168-5764)

Approved for public release; distribution is unlimited

TM 55-1905-219-14-6, 14 March 1984, is changed as follows:

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Remove pages

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CHANGE



NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 28 June 1984

Operator's, Organizational,
Direct Support, and General Support
Maintenance Manual

LANDING CRAFT UTILITY
LCU 1667-1670
(1905-00-168-5764)

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WARNINGDEATH

OR SEVERE INJURY MAY RESULT IF PERSONNEL FAIL TO OBSERVE THE GENERAL SAFETY PRECAUTIONS BELOW, AND THE SPECIFIC PRECAUTIONS CONTAINED IN THE TEXT.

- Wear safety glasses, safety shoes, and a hard hat to provide adequate protection.
- Death or severe injury may result if personnel fail to use a lifting device that is adequate for the item to be lifted.
- Ear protection must be worn when engines or machinery are in operation.
- Use care when using power tools.
- If cleaning agents are used, be sure area is adequately ventilated, and use protective gloves and goggles, or face shield and apron.
- Avoid excessive injection of ether into an engine during starting attempts. Follow the instructions on the container or by the manufacturer of the starting aid.
- Use the recommended air pressure when using compressed air to clean components. Too much air pressure can rupture or in some way damage a component and create a hazardous situation that can lead to personal injury.
- When working on an engine that is running, accidental contact with the hot exhaust manifold can cause severe burns.
- Use extreme care when near rotating fans, belts, and pulleys.
- Avoid making contact across the terminals of the batteries, and do not spill the contents of the battery.

WARNING

(Cont)

- Keep clear of the Anchor Winch or Bow Ramp Winch while it is in operation.
- During any removal, disassembly, assembly, or installation of an electrical device, make sure all electrical power is disconnected and tagged. (Circuit breaker in the OFF position and tagged).
- Improper functioning of the Engine Exhaust System can cause injury or death.
- Personnel should know the location and operation of all equipment for emergency use.
- Before attempting to operate any equipment, read the instructions completely. Then, return to the appropriate section and follow the instructions.
- Do not enter the Winch Compartment alone.
- If the Halon Fire System is activated (horn sounds), leave the compartment immediately. Check that no one is left, and then close and dog the hatch.
- Use extreme care when handling gasoline for the Salvage Pump.
- Store all flammable material in the Flammable Storage Compartment.

WARNING

(Cont)

- When cutting with a torch, or when welding, always station fire watches, ready with fire extinguishers, in the vicinity on both sides of the plate that is being cut or welded.
- Prior to cutting or welding on the ramp, remove drain plugs on both sides of the ramp and check if ramp interior is primer coated. If primer coated, flush thoroughly with steam, carbon dioxide, or water. Do not reinstall drain plugs until the cutting and/or welding operation is completed. Failure to take this precaution may result in explosion of accumulated primer vapors.
- When refueling, shut down the electrical system. Observe the no smoking rule. Do not permit anyone to operate tools or equipment which may produce sparks near the refueling operation. Sparks or fire may ignite the diesel fuel and produce an explosion.
- Fuel oil and other petroleum products are highly volatile in extreme heat. To minimize the possibility of explosion, wipe up all spills at once, see that fuel lines and valves are not leaking and pump bilges regularly.
- Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or possible death to maintenance personnel.
- Before disconnecting a line in the hydraulic system, bleed the pressure from that portion of the line. Failure to do so may result in injury or possible death to maintenance personnel.
- When working inside the hydraulic oil supply tank, a portable-type circulating blower should be used to prevent vapor accumulation. For extended work periods inside the tank, an air line tube respirator should be worn. Station an observer outside tank in case worker is overcome by fumes.

WARNING

(Cont)

- Acids can cause serious burns or blindness. Avoid contact with eyes, skin, or clothing. Do not breathe vapors. Wear rubber gloves, goggles, and a rubber apron when handling them. When diluting acids, do not add water to acid; the acid must be added to the mixture slowly and with constant mixing. In case of contact with acid, flush the affected area with plenty of water and obtain medical aid immediately.
- Ramp hinge pins must be replaced one at a time, allowing three remaining pins to support ramp. Removal of two or more hinge pins may result in the weight of the ramp misaligning the remaining hinges, resulting in damage to ramp and possible injury or death to maintenance personnel.

CHAPTER III (CONTINUED).
SECTION V. MAINTENANCE PROCEDURES
(CONTINUED).

3-115. BOW RAMP AND WINCH.

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Bow Ramp, Sheaves, and Fairleads	3-116
Winch Assembly	3-117
Torque Coupling	3-118
Speed Reducer	3-119
Winch Brake and Motor	3-120
Controller	3-121
Master Switches (Disconnect)	3-122
Limit Switches	3-123

3-116. BOW RAMP, FAIRLEADS AND SHEAVES - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Inspection

b. Repair

INITIAL SETUP

Test Equipment

None

References

Paragraph

2-53 Operation Procedures

Equipment

Special Tools

None

Condition Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

3-116. BOW RAMP, FAIRLEADS AND SHEAVES - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
INSPECTION			
1. Bow ramp	a. Tee-bolt assembly	<ol style="list-style-type: none"> 1. Check to see if tee-bolt is bent. 2. Check for cracks or breaks. 3. Check for wear. 4. Make sure fittings are tight. 	
	b. Lubrication fitting	<ol style="list-style-type: none"> 1. Make sure fitting has enough lubricant. 2. Clean fitting. 3. Make sure fittings are tight. 	
2. Port or starboard bulkhead	a. Turn-buckle	<ol style="list-style-type: none"> 1. Check connection to wire cable. 2. Check connection to bow chain. 3. Check for cracks or breaks. 4. Check for wear. 5. Check threads for wear or stripping. 	
	b. Chain stop	<ol style="list-style-type: none"> 1. Check for wear. 2. Check for cracks and dents. 	

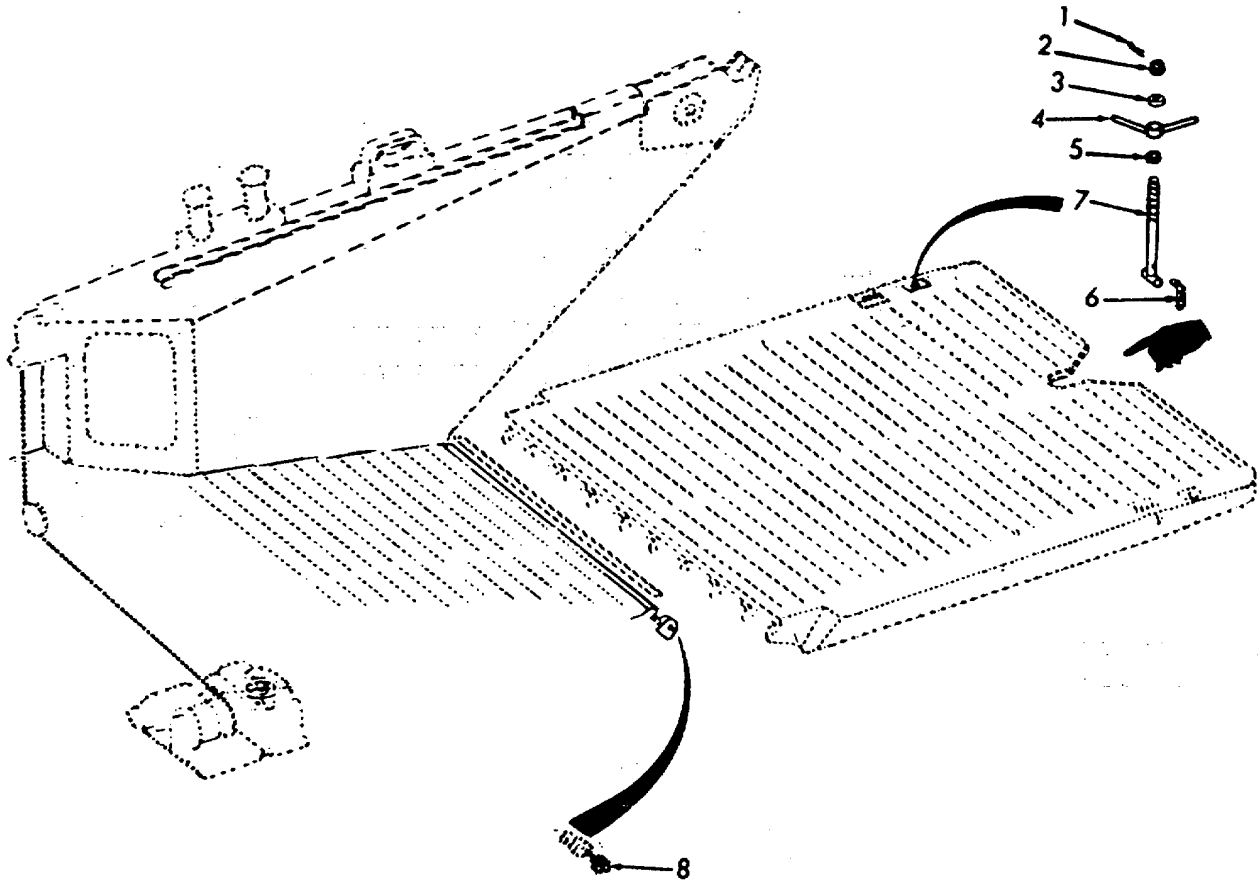
3-116. BOW RAMP, FAIRLEADS AND SHEAVES - MAINTENANCE INSTRUCTIONS: (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
WARNING			
Disconnect power to the winch whenever working on the ramp gate, the wire rope or in the vicinity of the winch in the winch room.			
3. Bow ramp	a. Tee-bolt	<ol style="list-style-type: none"> 1. Lower bow ramp to repair tee-bolt. 2. Remove cotter pin (1), ferrule (2) and washer (3). 3. Remove wingnut (4) and washer (5). 4. Remove toggle pin (6) from tee-bolt (7). 5. Turn tee-bolt (7) counter-clockwise to remove from bow ramp. 	Refer to paragraph 2-53 for operating procedures to lower the bow ramp.
	b. Lubrication fitting (8)	Remove lubrication fitting (8) from ramp hinge pin (9).	
	c. Tee-bolt (7)	<ol style="list-style-type: none"> 1. Turn tee-bolt (7) clockwise to install in bow ramp. 2. Replace toggle pin (6) into tee-bolt (7). 	

3-116. BOW RAMP, FAIRLEADS AND SHEAVES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



Change 2 3-1995

3-116. BOW RAMP, FAIRLEADS AND SHEAVES - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
		2. Replace toggle pin (6) into tee-bolt (7).	
		3. Install washer (5), and wingnut (4).	
		4. Install washer (3), ferrule, (2) and cotter pin (1).	
	d. Lubrication fitting (8)	1. Lubricate fittings. 2. Insert lubrication fitting (8) into bow ramp hinge pin (9).	Tighten.
	e. Bow ramp	Raise bow ramp.	Refer to paragraph 2-53 for operating procedures to raise the bow ramp.
4. Port or starboard bulkhead			

NOTE

Secure wire cable from winch to prevent slippage while repairing turnbuckle.

- | | |
|--------------------|---|
| a. Turnbuckle (10) | 1. Loosen turnbuckle (10).

2. Remove pins (11).

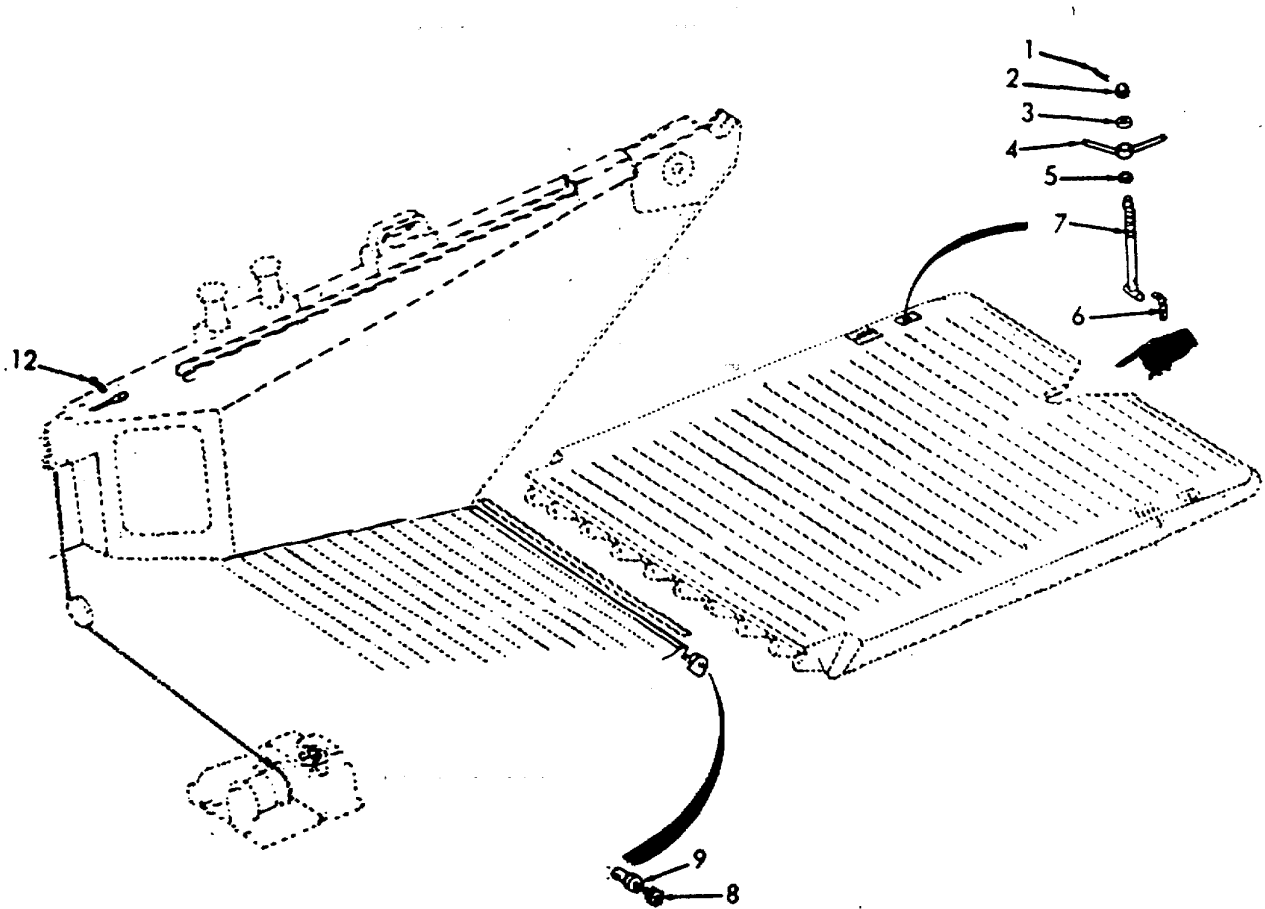
3. Remove turnbuckle (10).

4. Remove swivel (12) from winch cable. |
|--------------------|---|

3-116. BOW RAMP, FAIRLEADS AND SHEAVES - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



Change 2 3-1997

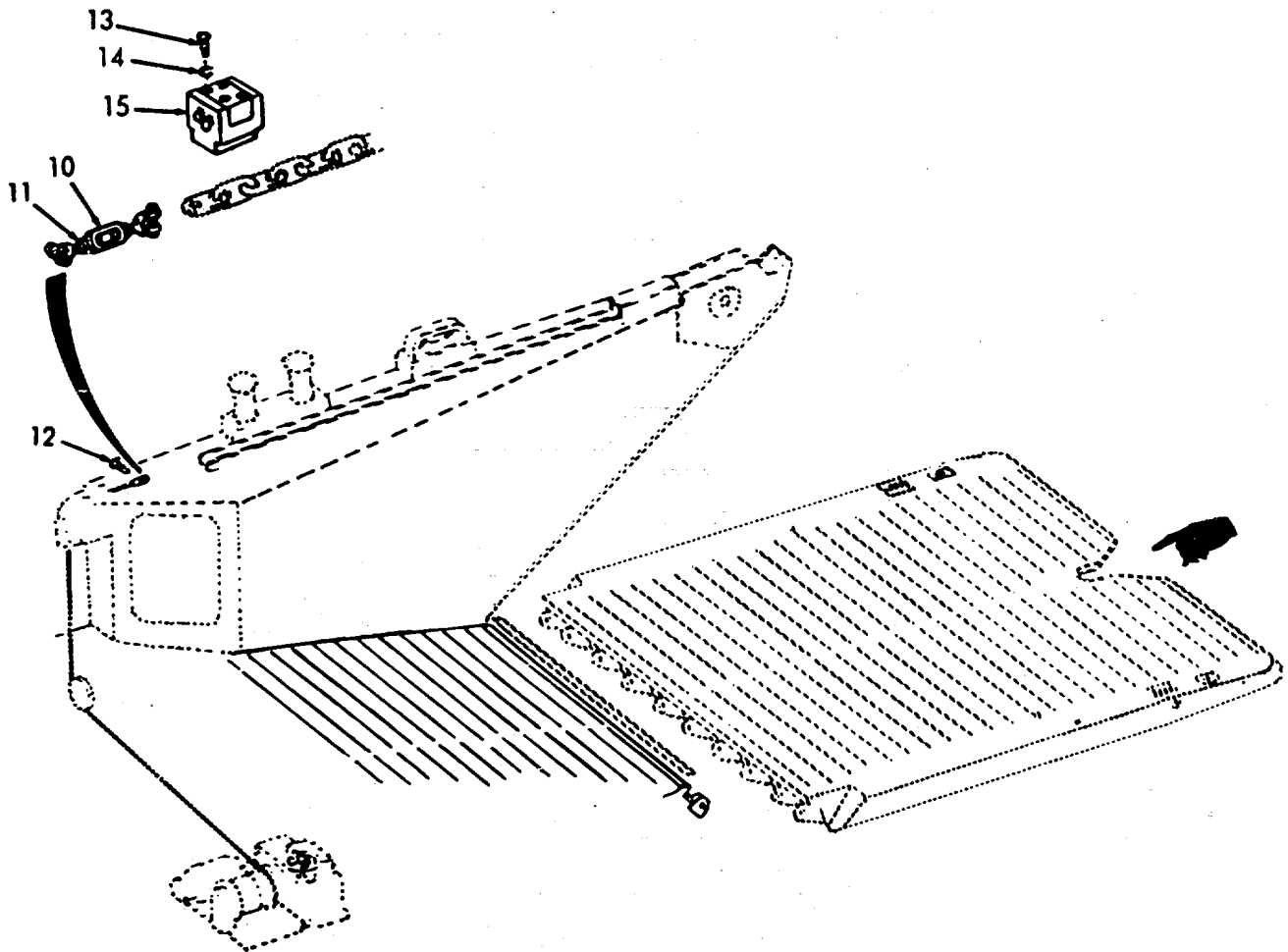
3-116. BOW RAMP, FAIRLEADS AND SHEAVES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
		5. Install swivel (12) onto winch cable.	
		6. Install turnbuckle (10).	
		7. Replace pins (11).	
		8. Tighten turnbuckle (10).	
	b. Chain stop (15)	1. Remove capscrews (13), and lockwashers (14).	Loosen cap-screws to adjust bow chain run-out while lowering ramp. Retighten cap-screws after adjustment.
		2. Remove chain stop (15).	If damaged.
		3. Replace chain stop (15).	
		4. Install lockwashers (14), and capscrews (13).	

3-116. BOW RAMP, FAIRLEADS AND SHEAVES - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



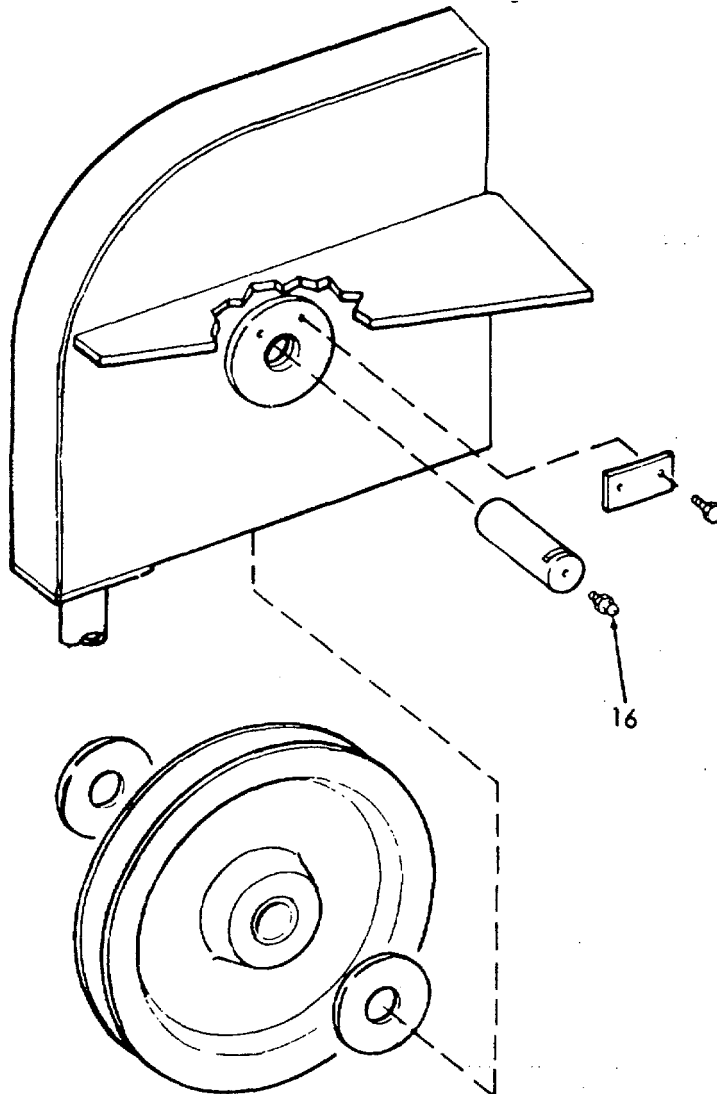
Change 2 3-1999

3-116. BOW RAMP, FAIRLEADS AND SHEAVES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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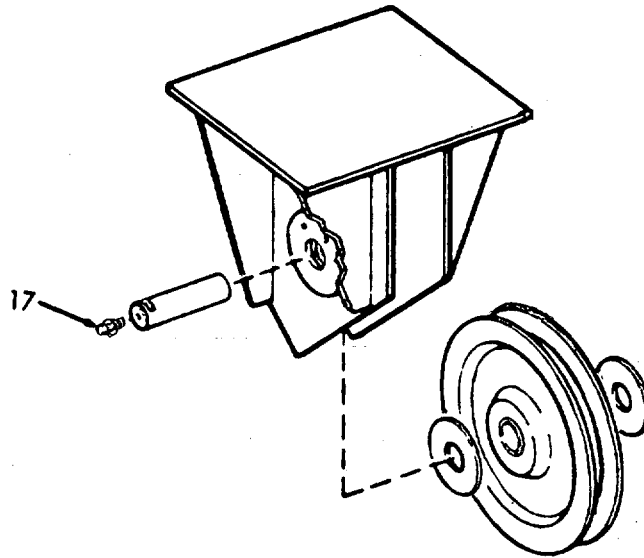
REPAIR (Cont)

- | | | |
|------------------------------------|---|-----------------------|
| c. Upper fair-lead sheave assembly | <ol style="list-style-type: none"> 1. Remove lubrication fitting (16). 2. Install lubrication fitting (16). 3. Grease fitting. | Replace if necessary. |
|------------------------------------|---|-----------------------|



3-116. BOW RAMP, FAIRLEADS AND SHEAVES - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
5. Winch compartment	a. Lower fair-lead sheave assembly	<ol style="list-style-type: none"> 1. Remove lubrication fitting (17). 2. Install lubrication fitting (17). 3. Grease fitting. 	Replace if necessary.



3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection b. Disassembly c. Reassembly

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment Condition Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNINGS in procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

1.	Bearing housing	a. Bearing housing Cover	1. Check lubrication fittings for leaks. 2. Check for cracks or dents.	a. Clean. b. Tighten.
		b. Bearing housing	1. Check for dents, or cracks. 2. Check for leaks.	
2.	Hand brake	a. Hand brake wheel and shaft	1. Check for cracks, dents or breaks. 2. Make sure shaft is not bent.	

3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
	b. Brake band	1. Check for cracks, dents or breaks. 2. Check for wear.	
	c. Brake links	1. Check for dents, breaks, and cracks. 2. Check for wear.	
	d. Brake pin	1. Make sure cotter pin is secure. 2. Check for cracks, bends, dents, or breaks. 3. Check for wear.	
	e. Brake nut	1. Check for cracks and breaks. 2. Check for wear.	
3. Pawl	a. Pawl lever	1. Check for cracks, bends, dents, or breaks. 2. Check for wear.	
	b. Pawl	1. Check for wear. 2. Check for cracks, bends, dents, or breaks.	

3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY

WARNING

- Disconnect power to the winch whenever working on the ramp gate, the wire rope, or in the vicinity of the winch in the winch room.
- Ensure ramp is dogged closed.

NOTE

Disengage hand brake, and slacken cable around the drum.

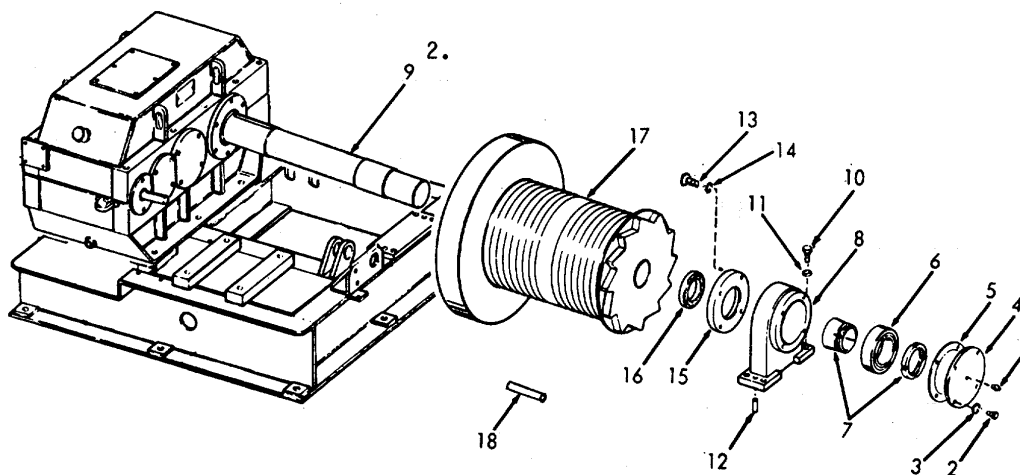
4. Bearing housing	a. Bearing housing cover	<ol style="list-style-type: none"> 1. Remove lubricating fitting (1). 2. Remove screws (2), and lockwashers (3). 3. Remove bearing housing cover (4). 4. Remove ring cover (5). 	
	b. Bearing roller	<ol style="list-style-type: none"> 1. Loosen bearing adapter (7). 2. Remove bearing roller (6), and bearing adapter (7) from bearing housing (8) and speed reducer shaft (9). 3. Remove bearing adapter (7) from bearing roller (6). if necessary. 	Check bearing roller for wear. Replace if necessary.
	c. Bearing housing	<ol style="list-style-type: none"> 1. Remove capscrews (10) and lockwashers (11). 	

3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY (Cont)

- | | | | |
|-------------------|--|---|--|
| | | 2. Remove dowel pins (12). | |
| | | 3. Remove bearing housing (8) from speed reducer shaft (9). | |
| | | 4. Remove capscrews (13), and lockwashers (14) from seal plate holder (15). | |
| | | 5. Remove seal plate holder (15) from bearing housing (8). | |
| | | 6. Remove oil seal bearing (16). | |
| d. Cable drum key | | 1. Slide cable drum (17) down speed reducer shaft (9) far enough to remove cable drum key (18). | Place a wood support block under cable drum. |
| | | 2. Slide cable drum (17) back into place. | Remove wood support blocks. |



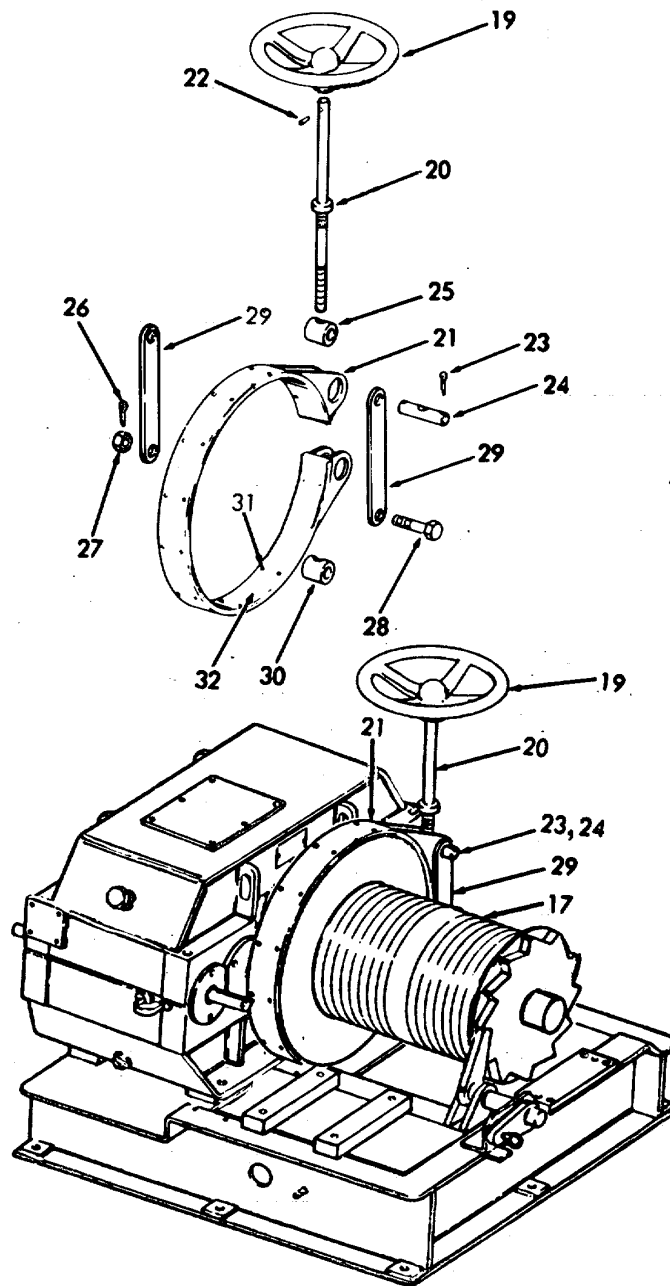
3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			
5. Hand brake	a. Hand brake wheel (19) and shaft (20)	<ol style="list-style-type: none"> 1. Completely unscrew hand brake wheel (19) and shaft (20) from brake band (21). 2. Remove hand brake wheel (19) and shaft (20). 3. Remove taper pin (22) from hand brake wheel (19), and shaft (20). 	
	b. Brake band (21)	<ol style="list-style-type: none"> 1. Remove cotter pins (23) from brake pin (24). 2. Remove brake pin (24). 3. Remove brake screw (25) from brake band (21). 	
	c. Brake links (29)	<ol style="list-style-type: none"> 1. Remove cotter pin (26) from hex nut (27). 2. Remove hex nut (27) and screw (28). 3. Remove brake links (29). 	
	d. Brake band (21)	<ol style="list-style-type: none"> 1. Remove brake nut (30) from brake band (21). 2. Remove brake band (21) from cable drum (17). 3. Drill out brake band rivets (31) from brake band (21). 4. Remove brake lining (32). 	Check brake lining for wear. Replace if worn.

3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

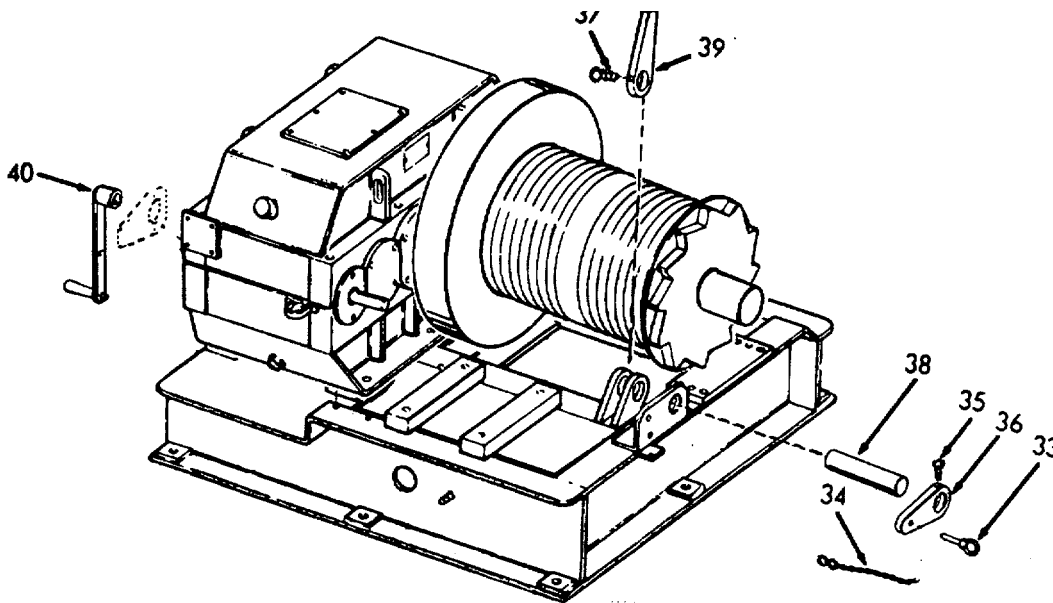


3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

- | | | | |
|----|-----------|---|--|
| 6. | Pawl (39) | <ol style="list-style-type: none"> a. Remove eyebolt pawl locking lever (33) with retaining chain (34). b. Remove screw (35). c. Remove pawl lever (36). d. Remove screw (37). e. Remove pawl pin (38). f. Remove pawl (39). g. Remove hand crank (40) from speed reducer. | <p>If engaged in speed reducer. If not, leave attached to storage on winch bedframe.</p> |
|----|-----------|---|--|

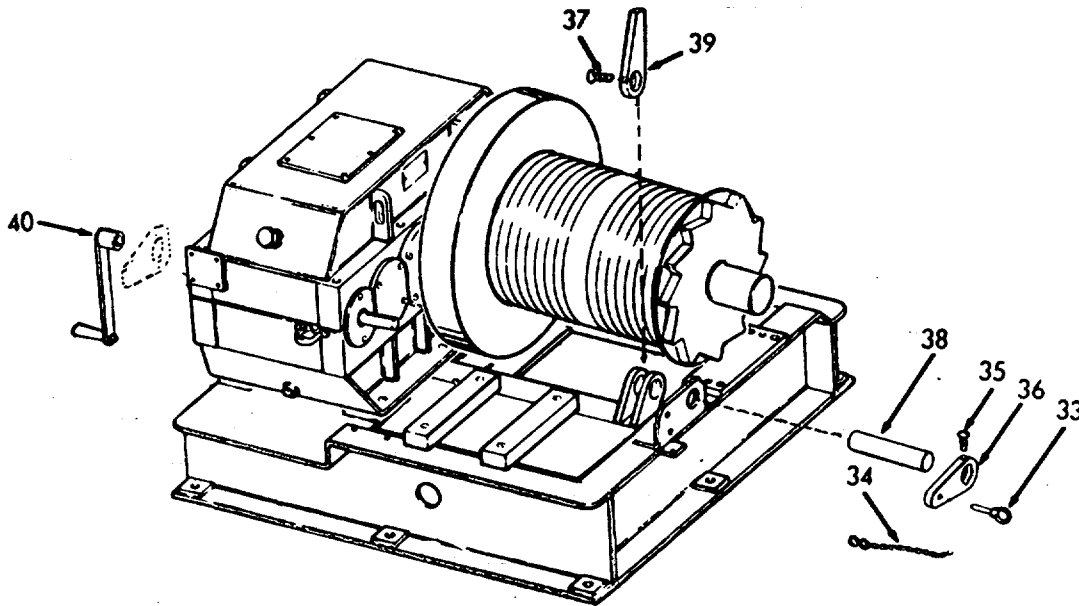


3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY

- | | | | |
|----|-----------|--|---|
| 7. | Pawl (39) | <ol style="list-style-type: none"> a. Install pawl (39), pawl pin (38) and screw (37). b. Install pawl lever (36) and screw (35). c. Install hand crank (40) onto speed reducer. d. Install eyebolt pawl locking lever (33), with retaining chain (34). e. Secure pawl lever (36) to winch bed frame. | Carefully turn hand crank to check pawl's engagement with cable drum ratchet. |
|----|-----------|--|---|



3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
8. Hand brake	a. Brake band (21)	1. Install brake lining (32).	Make sure rivet heads do not interfere with the brake drum.
		2. Install brake band rivets (31) onto brake lining (32) and brake band (21).	
		3. Install brake band (21) onto cable drum (17).	
		4. Install brake nut (30) into brake band (21).	
	b. Brake links (29)	1. Install bolt (28) and hex nut (27) onto brake links (29), and winch bed frame.	Hand tighten until brake band is adjusted.
	c. Brake band (21)	1. Install brake screw (25).	Adjust brake band, brake links, and brake pin.
		2. Install brake links (29).	
		3. Install brake pin (24).	
		4. Install cotter pins (23) into brake pin (24).	
	d. Brake links (29)	1. Tighten screw (28) and hex nut (27).	
		2. Install cotter pin (26).	
	e. Hand brake wheel (19)	1. Install taper pin (22) into hand brake wheel (19) and shaft (20).	

3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

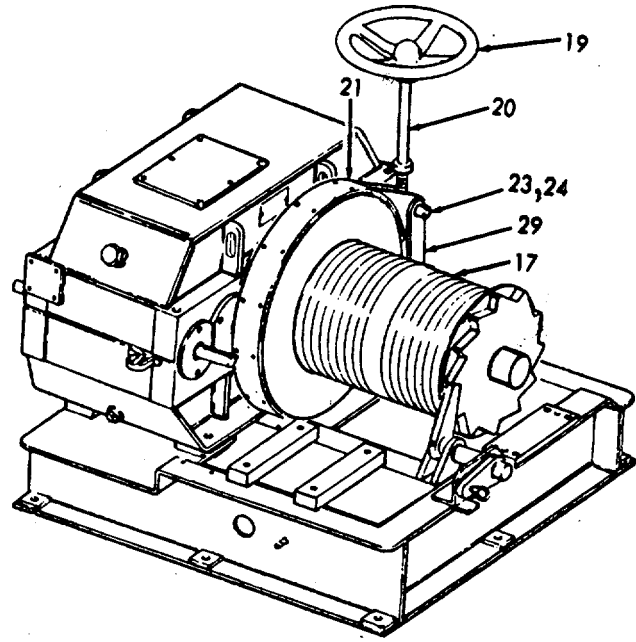
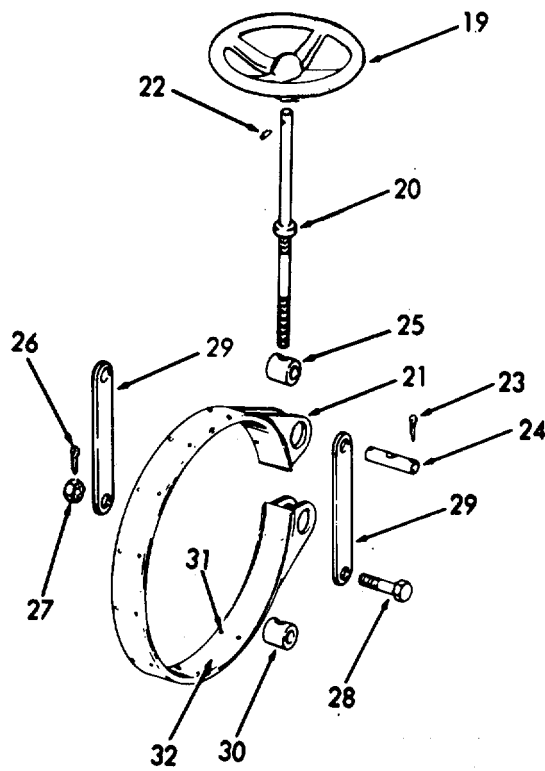
LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

and shaft (20)

2. Screw hand brake wheel (19), and shaft (20) into brake band (21), brake screw (25) and brake nut (30).

Tighten to proper setting.



3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY (Cont)

NOTE

Hand brake must be disengaged to complete disassembly or reassembly.

9.	Bearing housing (8)	a. Cable drum key	1. Slide cable drum (17) down speed reducer shaft (9) far enough to install cable drum key (18).	Place a wood support block under cable drum.
			2. Slide cable drum (17) back into place.	Remove wood support block.
		b. Bearing housing	1. Install oil seal bearing (16), and seal plate holder (15) onto speed reducer shaft (9).	
			2. Install bearing housing (8) onto speed reducer shaft (9).	
			3. Install lockwashers (14), capscrews (13) onto seal plate holder (15) and bearing housing (8).	
			4. Install dowel pins (12), lockwashers (11), and capscrews (10) onto bearing housing (8).	
		c. Bearing roller	1. Install bearing adapter (7) onto bearing roller (6).	
			2. Install bearing roller (6) and bearing adapter (7) onto speed reducer shaft (9) and into bearing housing (8).	

3-117. WINCH ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

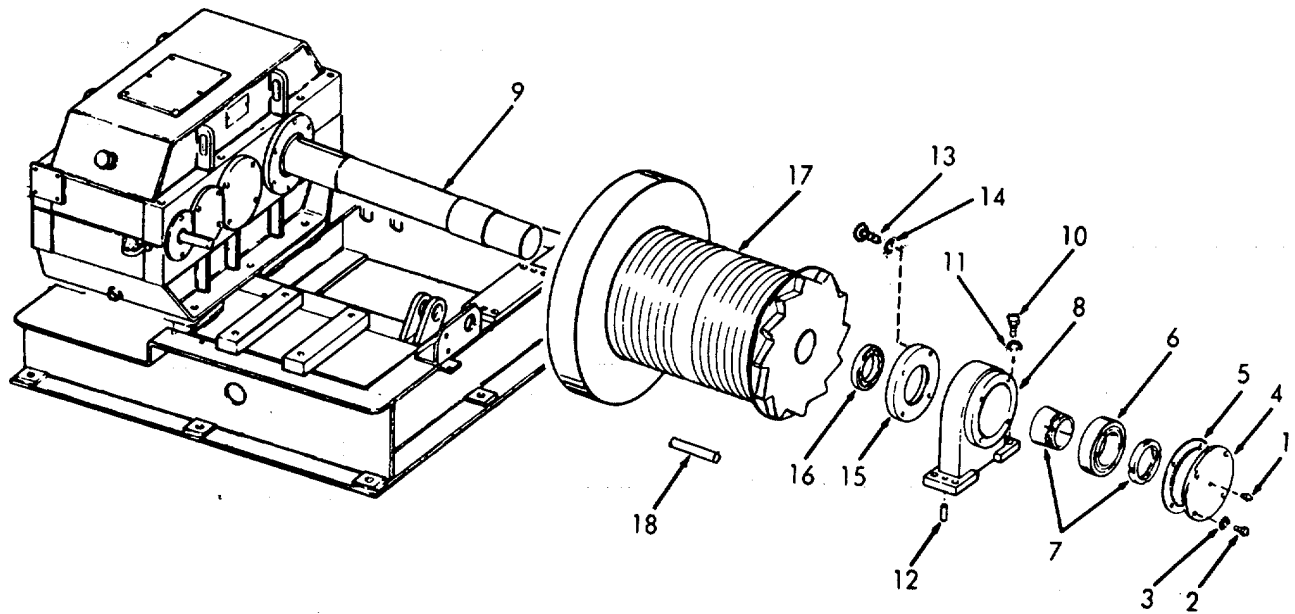
LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

d. Bearing housing cover (4)

1. Install ring cover (5).
2. Install bearing housing cover (4), lockwashers (3) and screws (2).
3. Install lubricating fitting (1).

Apply GAA lubricant to lubricating fitting.



3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS.

This task covers:

- | | | | |
|----|------------|----|--------------|
| a. | Inspection | c. | Repair |
| b. | Replace | d. | Installation |

INITIAL SETUP

Test Equipment

None

References
Paragraph

3-117 Winch Brake and Motor

Special Tools

None

Equipment
Condition

Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

Check for cracks, dents, breaks, excess grease, and wear on springs, grids, studs, hubs and covers.

Check friction lining for wear and excess oil or grease.

REPLACE

WARNING

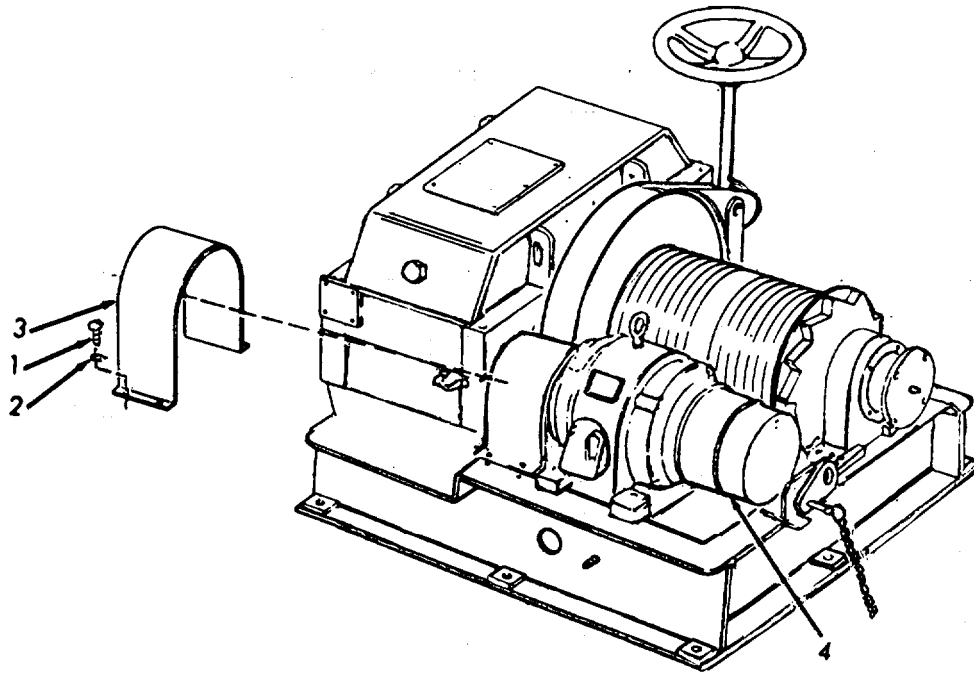
Disconnect power to the winch whenever working on the ramp gate, wire rope, or in the vicinity of the winch in the winch room.

3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACE (Cont)

- | | | | |
|-------------------|-------------------------------|---|--|
| 1. Winch assembly | a. Torque coupling guard (3) | <ol style="list-style-type: none"> 1. Remove screws (1) and lockwashers (2). 2. Remove torque coupling guard (3) to expose torque coupling. | |
| | b. Winch Motor (4) and Motor. | Remove bolts and lockwashers from motor (4) and winch frame. | Refer to paragraph 3-117 - Winch Brake |

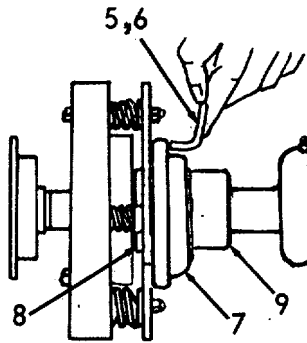


3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

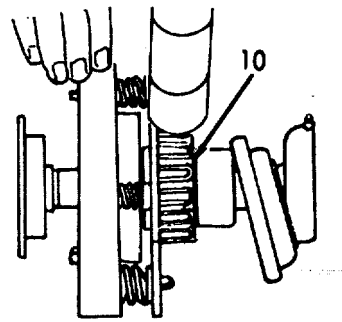
LOCATION	ITEM	ACTION	REMARKS
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REPLACE (Cont)

- | | | | |
|--------------------|----------------------------------|---|--|
| 2. Torque coupling | a. Torque cover halves (7 and 8) | <ol style="list-style-type: none"> 1. Remove capscrews (5) and self-locking nuts (6). 2. Slide torque cover (7), and gasket (9) down shaft. | |
|--------------------|----------------------------------|---|--|



- | | | | |
|--|--------------|--|--|
| | b. Grid (10) | <ol style="list-style-type: none"> 1. Remove grid (10) at the open end of the grid section. 2. Insert the rod or screwdriver into the looped ends. | Use a round rod or screwdriver that will conveniently fit into the open loop ends. |
|--|--------------|--|--|



3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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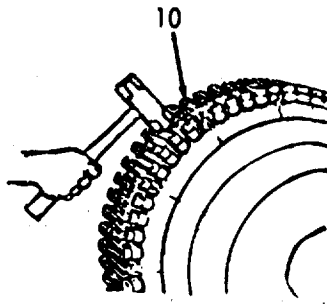
REPLACE (Cont)

3. Use adjacent teeth as a fulcrum and pry the grid (10) out radically.

Even and gradual stages.

4. Proceed alternately from side to side, lifting the grid halfway out until the end of the grid (10) is reached.

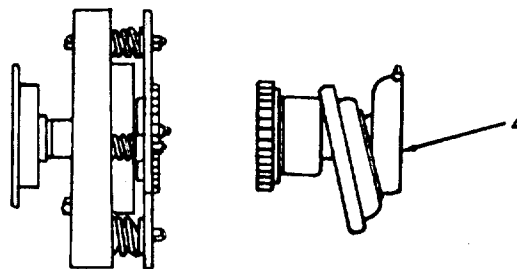
Proceed around the grid again until all teeth are clear.



c. Winch motor (4)

Slide winch motor (4) back.

Separate the two torque halves.

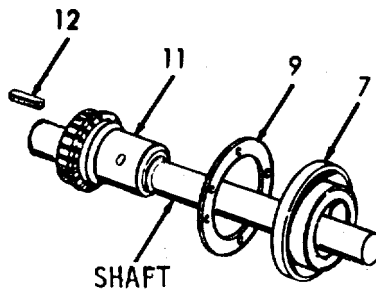


3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACE (Cont)

- | | | | |
|----|----------------------------|--|--|
| d. | Hub
(type
F)
(11) | <ol style="list-style-type: none"> 1. Remove hub (type F) (11), from winch motor shaft. 2. Remove key (12). 3. Remove gasket (9). 4. Remove torque cover half (7). | |
|----|----------------------------|--|--|

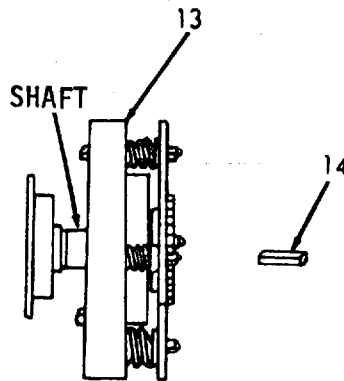


- | | | | |
|----|-----------------------------|---|--|
| e. | Hub
(type
FT)
(13) | <ol style="list-style-type: none"> 1. Remove hub (type FT) (13) from speed reducer shaft. 2. Remove key (14). | |
|----|-----------------------------|---|--|

3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

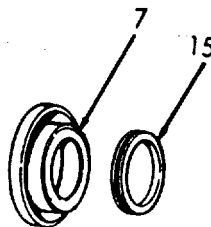
LOCATION	ITEM	ACTION	REMARKS
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REPLACE (Cont)

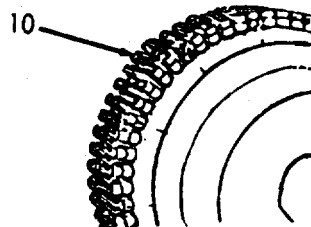


REPAIR

3.	Torque cover half (7)	Remove seal ring (15).	Degrease and check for wear. Replace if necessary.
----	-----------------------	------------------------	--



4.	Grid (10)	Degrease.	
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5.	Hub (type F) (11)	Degrease.	Check for wear. Replace if necessary.
----	-------------------	-----------	---------------------------------------

3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
6.	Hub (type FT) (13)	<ol style="list-style-type: none"> 1. Remove self-locking nuts (16). 2. Remove ring spring guide (17). 3. Remove capwashers (18) and load regulating springs (19). 4. Remove driving plate (20). 5. Remove grooved ring (21). 6. Remove torque cover half (8). Replace if necessary. 	<p>Degrease. Check for wear.</p> <p>Degrease. Check springs for wear.</p> <p>Degrease. Check for wear.</p> <p>Degrease. Check for wear.</p> <p>Degrease and check for wear.</p>
NOTE			
Keep friction lining on torque sleeve clean and free of grease and oil.			
		<ol style="list-style-type: none"> 7. Remove torque sleeve (22). 	<p>Degrease and check for wear.</p>

3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

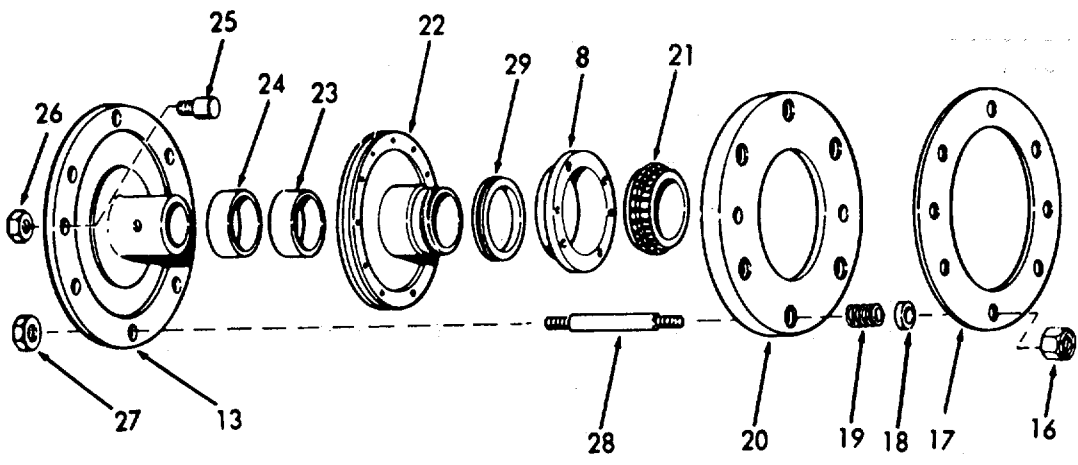
LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

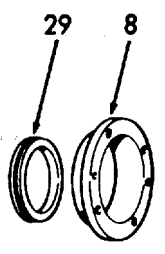
- 8. Remove bearings (23 and 24).
- 9. Remove driving pins (25) and nuts (26).
- 10. Remove jam hex nuts (27) and studs (28).

Degrease. Check for wear and replace if necessary.

Degrease and check for wear.



- 7. Torque cover half (8)
- Remove seal ring (29).
- Degrease and check for wear. Replace if necessary.



3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

NOTE

Keep friction lining clean and free of grease and oil.

8.	Torque sleeve (22)	Drill out rivets (30) holding friction linings (31 and 32) onto torque sleeve (22).	
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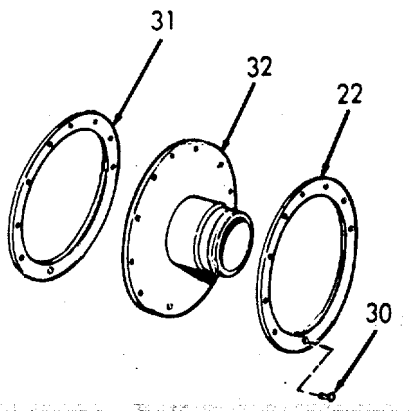
INSTALLATION

NOTE

Keep friction lining clean and free of grease and oil.

9.	Torque sleeve (22)	<ol style="list-style-type: none"> 1. Install friction linings (31 and 32). 2. Install rivets (30) 	
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Make sure rivet heads do not interfere with the torque sleeve and hub (type FT).

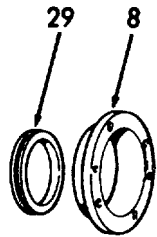


3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

10.	Torque cover half (8)	Install seal ring (29).	
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NOTE

For best results, assemble standard couplings with minimum misalignment and with "normal gap". Heat small interference fit hubs in an oven or in oil. The oil flash point must be 350°F (1770C) or higher. Apply flame heat evenly to large hubs.

3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

CAUTION

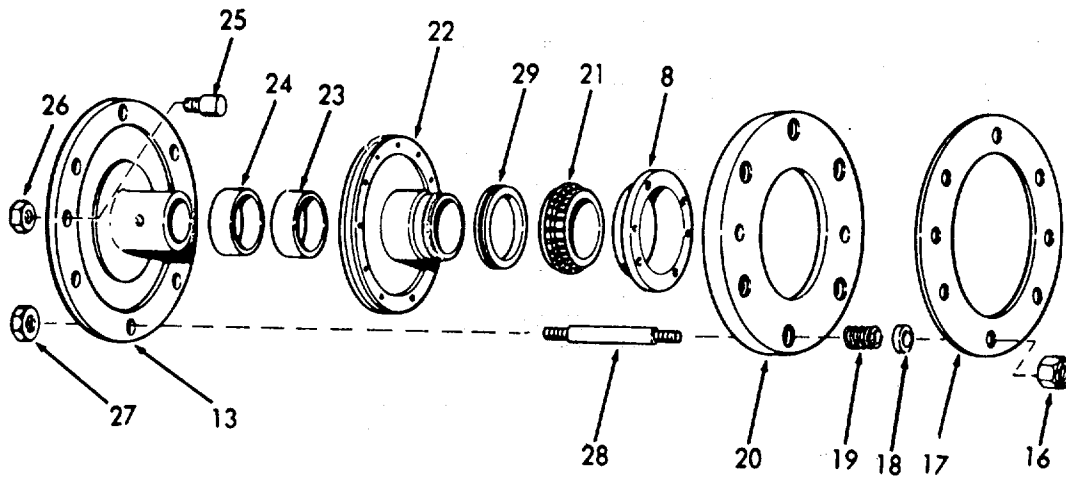
Do not apply flame directly to the grid groove area.
Do not heat hubs over 275°F (135°C).

Hub (type FT) (13)	<ol style="list-style-type: none"> 1. Install studs (28) and jam hex nuts (27). 2. Install driving pins (25) and nuts (26). 3. Install bearings (24 and 23). 4. Install sleeve (23). 5. Install torque cover half (8). 6. Install grooved ring (21). 7. Install driving plate (20). 8. Install loading regulating springs (19) and cap washers (18). 9. Install ring spring guide (17). 10. Install self-locking nuts (16). 	<p>Bearing and sleeve clearance min. .005 inches (.013 cm) max. .008 inches (.020 cm).</p> <p>Engage driving pins (25).</p> <p>Tighten lock-nuts until springs are slightly compressed.</p>
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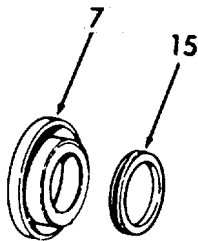
3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



- | | | |
|-----|-----------------------|-------------------------|
| 12. | Torque cover half (7) | Install seal ring (15). |
|-----|-----------------------|-------------------------|

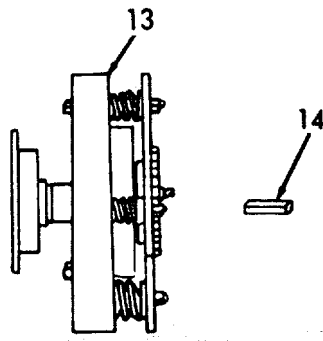


3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

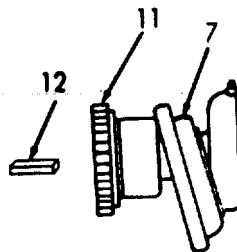
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

- | | | | |
|---------------------|-----------------------|---|--|
| 13. Torque coupling | a. Hub (type FT) (13) | <ol style="list-style-type: none"> 1. Install hub (13) onto speed reducer shaft. 2. Install key (14). | |
|---------------------|-----------------------|---|--|



- | | | | |
|--|-----------------|--|--|
| | b. Hub (type F) | <ol style="list-style-type: none"> 1. Install torque cover half (7) onto winch motor shaft. 2. Install hub (11). 3. Install key (12). | |
|--|-----------------|--|--|

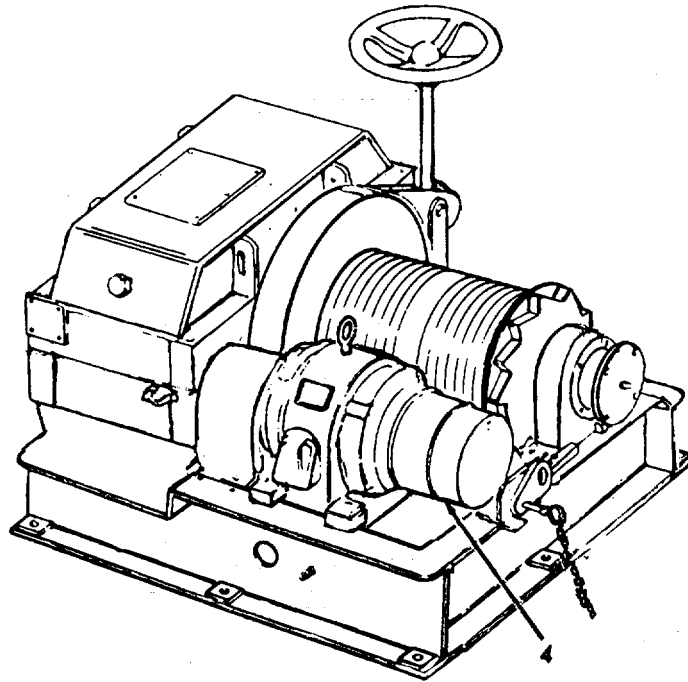


- | | | | |
|--|--------------------|-----------------------|------------------------------------|
| | c. Winch motor (4) | Slide winch motor up. | Decrease the gap between the hubs. |
|--|--------------------|-----------------------|------------------------------------|

3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



NOTE

Provide for shaft end play in the coupling gap when the sleeve bearing units are used. After mounting the coupling hubs, position the free unit so that the coupling gap will be within the minimum and the maximum limits when both shafts are in their extended or retracted positions. After the gap has been set, and the shafts aligned, tighten the unit foundation bolts and recheck the alignment.

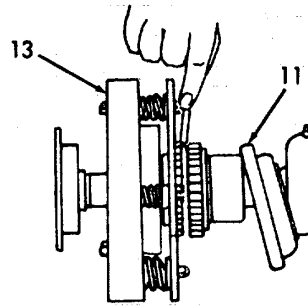
3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

d. Hubs (11 and 13)

1. Insert spacer bar equal in thickness to normal gap .1250 inches (.0318 cm), between the two hubs (11 and 13).

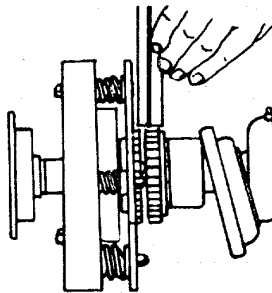


a. Insert bar to same depth at 90° intervals.

b. Measure clearance between bar and hub face with feelers.

c. The difference in minimum .0625 in. (.0159 cm) and maximum .1875 in. (.0476 cm) must not exceed the angular limit specified (.005 in. (.013 cm).

2. Use straight edge to check offset alignment.



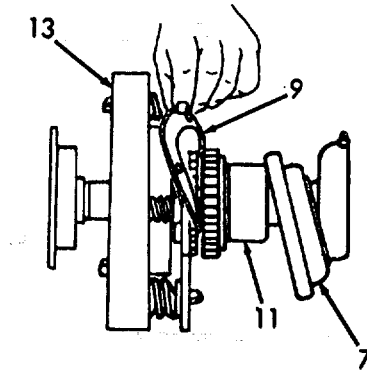
a. Place squarely on Both hubs at 90° intervals.

b. Check with feelers.

c. Clearance must not exceed the offset limit .005 in. (.013 cm).

3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
14. Winch assembly	Winch motor (4)	Install bolts and lockwashers into motor (4) and winch frame.	Tighten.
15. Torque coupling	a. Hubs (11 and 13)	1. After tightening motor to winch frame, check the alignment between hubs (11 and 13).	Realign coupling, if necessary.
		2. Insert gasket (9) between hubs (11 and 13).	Hang gasket next to cover (7).
		3. Lubricate - force as much lubricant into the gap and grid grooves as possible.	Use OE/HDO lubricant.



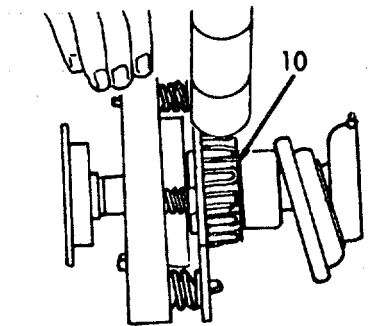
3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

b. Grid (10)

1. Install grid (10), slightly spread, to pass over the coupling teeth at the outside diameter.

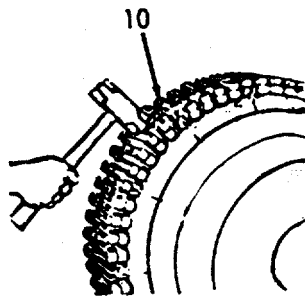


2. Start the grid (10) at either end and tap the rungs part way into the grooves.

Use mallet.

3. After all the rungs are partially in their respective grooves -

Tap the grid all the way into place.



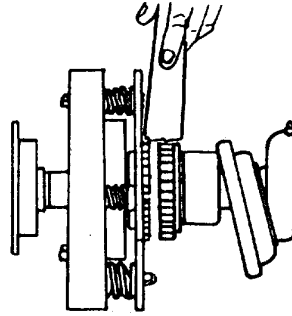
3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

4. Pack the spaces between the grid with as much lubricant as possible.

Scrape or wipe excess lubricant off flush with top of grid.

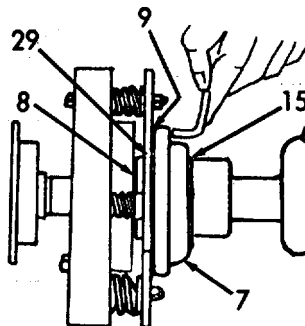


- c. Torque cover halves (7 and 8)

1. Lightly oil seal rings (15 and 29) in torque cover halves (7 and 8).
2. Slide up gasket (9).
3. Slide up torque cover (7).

a. Align covers so that tube holes or fittings are 180° apart.

b. Align covers to prevent wobble.



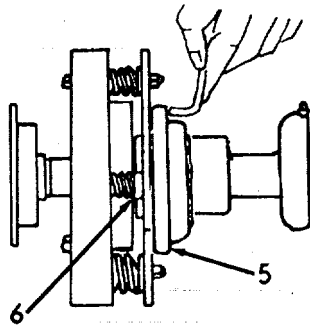
3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

4. Install capscrews (5), and self-locking nuts (6).

- a. Tighten to 100 ft. lbs. (135.6 Nm).
- b. Check seal rings for proper seating.

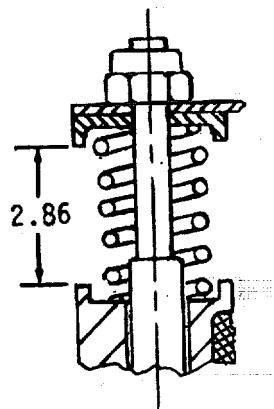


16. Hub (type FT) (13)

Load regulating springs (19)

Tighten.

- a. Compress springs to 2.86 in. (7.16 cm)
- b. Torque springs to 800 in. lbs. (91 Nm).

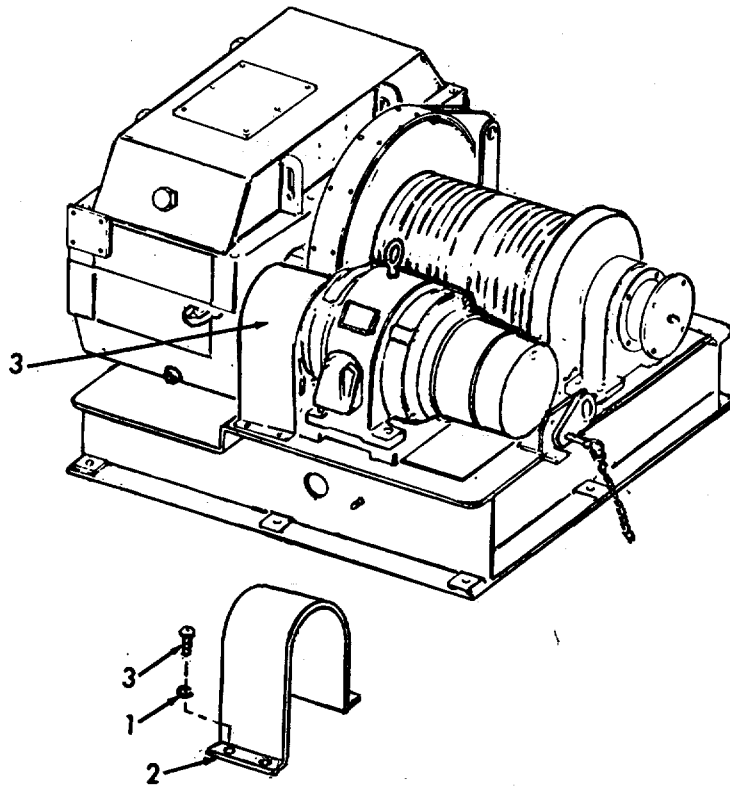


3-118. TORQUE COUPLING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

- | | | | |
|--------------------|------------------------------|--|--|
| 17. Winch assembly | a. Torque coupling guard (3) | <ol style="list-style-type: none"> 1. Install torque coupling guard (3) over torque coupling. 2. Install lockwashers (2) and screws (1). | |
|--------------------|------------------------------|--|--|



3-119. SPEED REDUCER - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Repair

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment

Condition Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNINGS in procedure.

LOCATION	ITEM	ACTION	REMARKS
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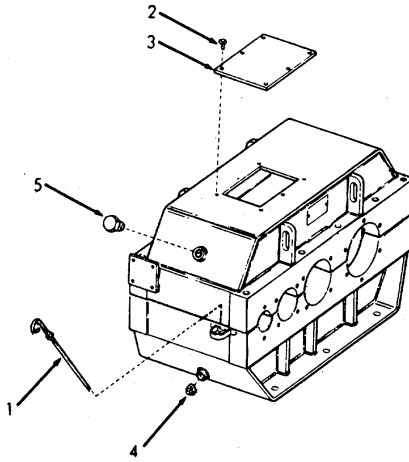
INSPECTION

- | | | | |
|------------------|----------------------|--|--|
| 1. | Reducer vent plug | <ul style="list-style-type: none"> a. Check for leaks. b. Check for wear and cracks. c. Check for clogging. | |
| 2. | Drain plug | Check for leaks, wear and cracks. | |
| 3.
(1) level. | Dipstick | Remove and check oil | Replace if bent or damaged. |
| 4. | Inspection plate (3) | <ul style="list-style-type: none"> a. Remove screws (2). b. Remove inspection plate (3). | <ul style="list-style-type: none"> a. Check for foreign objects, dirt, and metal chips. |

3-119. SPEED REDUCER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)



- b. Check gears for wear and stripping.
- c. Report findings to Direct Support Maintenance.

REPAIR

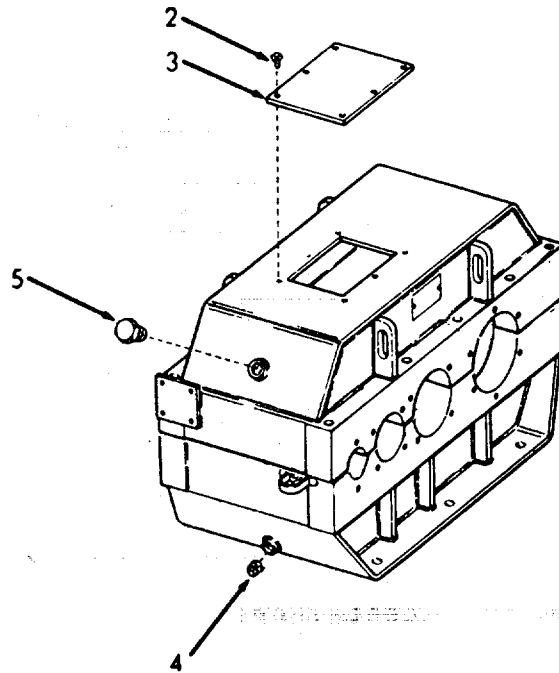
WARNING

- ☐ Disconnect power to the winch whenever working on the ramp gate, wire rope, or in the vicinity of the winch in the winch room.
- ☐ Ensure bow ramp is dogged shut and brake is set.

5.	Drain plug (4)	Remove and drain oil into a suitable container.	Replace if necessary.
6.	Reducer vent plug (5)	Remove.	Replace if necessary.

3-119. SPEED REDUCER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
7.	Drain plug (4)	Install.	
8.	Reducer vent plug (5)	a. Pour in 1 gallon (3.78 l) of oil. b. Install reducer vent plug (5).	Use G090 gear oil.
9.	Inspection plate (3)	Install inspection plate (3) and screws (2).	
10.	Dipstick	Install.	



3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Test
- c. Repair

INITIAL SETUP

Test Equipment

None

References
Paragraph

2-52 Bow Winch Operation Procedures.

Special Tools

None

Equipment
Condition Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe all WARNINGS.

LOCATION	ITEM	ACTION	REMARKS
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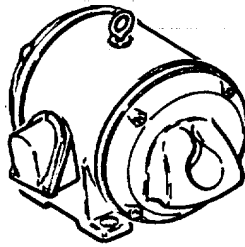
INSPECTION

- | | | | | |
|----|-------------|---------------------|--|------------------------------|
| 1. | Winch brake | a. Brake cover | Check for cracks, dents, leaks and wear. | |
| | | b. Bracket assembly | Check for cracks, dents, leaks and wear. | |
| | | c. Wiring conduit | Check for frayed, worn or loose wiring. | |
| 2. | Winch motor | a. Stator assembly | Check for cracks, dents, leaks, and wear. | |
| | | b. Terminal box | 1. Check for cracks, dents, and wear.
2. Remove terminal box cover. | a. Check wiring connections. |

3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION (Cont)



- b. Check for frayed, loose or worn connections.
- c. Replace terminal box cover.

TEST

Lower and raise bow ramp, making sure the winch brake stops the bow ramp. If winch brake fails to engage, stop the bow winch manually and proceed as follows:

Refer to paragraph 2-53 - Operation Procedures.

REPAIR

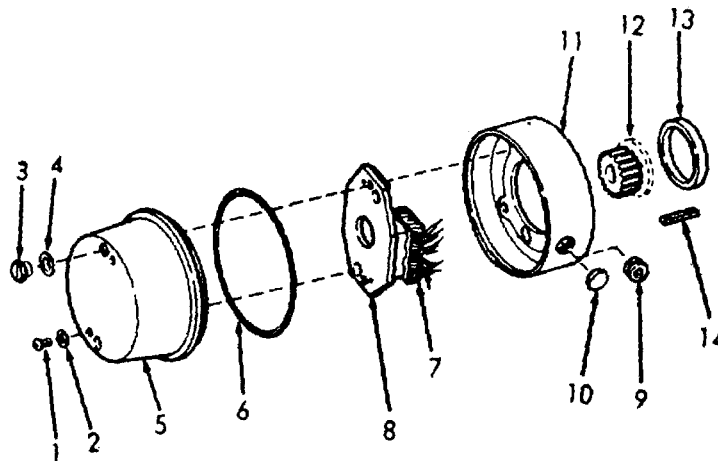
WARNING

- Disconnect power to the winch whenever working on the ramp gate, wire rope, or in the vicinity of the winch in the winch room.
- Ensure bow ramp is dogged shut and brake is set.
- Improper installation of a brake and/or a lack of maintenance, may cause brake failure which could result in injury or death.

- | | | |
|----|-----------------|---|
| 3. | Brake cover (5) | <ul style="list-style-type: none"> a. Remove screws (1) and gasket cover (2). b. Remove release caps (3) and gasket covers (4) from brake cover (5). c. Remove seal (6). |
|----|-----------------|---|

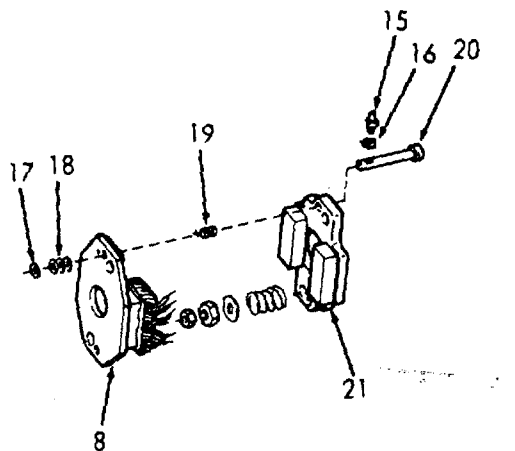
3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
4.	Magnetic brake assembly (8)	a. Disconnect wiring (7) from magnetic brake assembly (8). b. Remove wiring (7) from conduit (9).	Check for frayed, cracked or broken wiring. Replace if needed.
5.	Bracket assembly	a. Remove caps (10). b. Remove bracket assembly (11) from winch motor. c. Remove hub (12), and hub seal (13) from winch motor. d. Remove key (14).	Releasing brake from motor. Check for wear or cracks. Replace if necessary.



3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
6. Magnetic brake assembly (8)	a. Manual release rod (20)	<ol style="list-style-type: none"> 1. Remove stop screw (15) and lockwasher (16) 2. Remove flatwasher (17) and shim washer (18). 3. Release torsion spring (19) from magnetic brake assembly (8). 4. Remove torsion spring (19). 5. Remove manual release rod (20) from pressure plate (21) and magnetic brake assembly (8). 	<p>Check for wear.</p> <p>Remove from magnetic brake assembly. Check shim washer for wear.</p> <p>Check for wear.</p> <p>Check for wear, bends, dents and cracks.</p>

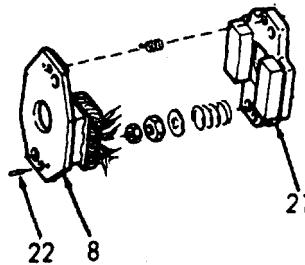


3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

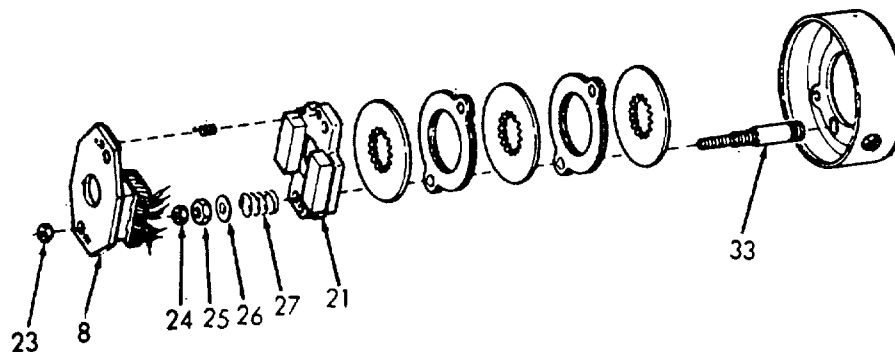
LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|----|---------------------|--|--|
| b. | Pressure plate (21) | Remove pins (22) from magnetic brake assembly (8) and pressure plate | |
|----|---------------------|--|--|



- | | | | |
|----|----------------|--|---|
| c. | Disc stud (33) | 1. Remove gap adjusting locking nuts (23). | |
| | | 2. Remove magnetic brake assembly (8). | Check for wear and cracks. |
| | | 3. Remove gap nuts (24). | |
| | | 4. Remove torque nuts | Check for wear and cracks. |
| | | 5. Remove spring washers (26) and torque springs (27). | Check torque springs for wear and cracks. |
| | | 6. Remove pressure plate (21). | Check for wear and cracks. |



3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

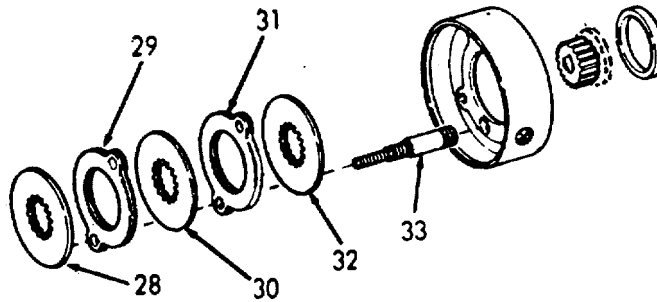
LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

NOTE

When total wear on friction discs (28, 30 and 32) reaches 5/32 inch (3.969 cm), replace discs.

- | | |
|--|---|
| 7. Remove friction disc (28). | Don't drop. Check for wear and cracks. |
| 8. Remove stationary disc (29). | Check for wear and cracks. |
| 9. Remove friction disc (30). | Check for wear and cracks. |
| 10. Remove stationary disc (31). | Check for wear and cracks. |
| 11. Remove friction disc (32) from disc stud (33). | Do not let drop. Check for wear and cracks. |

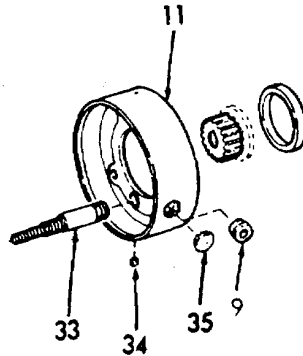


- | | | | |
|----|-----------------------|--|-----------------|
| 7. | Bracket assembly (11) | <ul style="list-style-type: none"> a. Remove conduit (9). b. Remove disc stud (33). c. Remove pipe plug (34). d. Remove plug (35). | Check for wear. |
|----|-----------------------|--|-----------------|

3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)			
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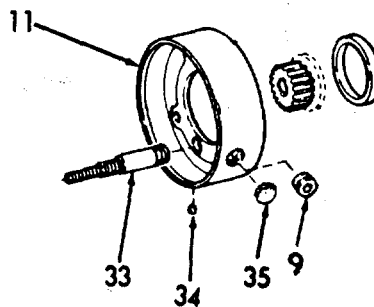
WARNING

Improper installation of a brake and/or lack of maintenance may cause brake failure which could result in damages to property and/or injury to personnel.

CAUTION

Do not operate manual release or energize brake coil before installation in order to preserve pre-alignment of rotating discs for ease of installation.

- | | | |
|--------------------------|--------------------------|--|
| 8. Bracket assembly (11) | a. Bracket assembly (11) | 1. Install conduit (9), plug (35), pipe plug (34), and disc stud (33). |
|--------------------------|--------------------------|--|



3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)	b. Disc stud (33)	1. Install friction disc (32), stationary disc (31), friction disc (30), stationary disc (29), and friction disc (28).	Set spring length to 1.25 in. (3.18 cm) and magnet gap (max. .065 in (.225 cm) min. .035 in. (.089 cm).
		2. Install pressure plate (21).	
		3. Install torque springs (27).	
		4. Install spring washers (26).	

NOTE

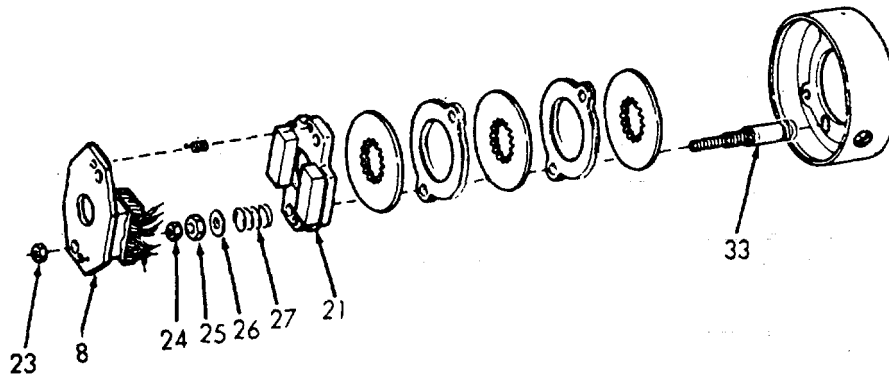
To increase stopping time and lower torque, turn two torque nuts (25) counter-clockwise, increasing dimension 1.25 in. (3.18 cm). To increase torque, decrease dimension 1.25 in. (3.18 cm). Both spring lengths should be equal.

CAUTION

Do not decrease spring length 1.25 inches (3.18 cm) beyond .125 inches (.318 cm) less value 1.25 inches (3.18 cm), as this may cause coil to burn out.

3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)		5. Install torque nuts (25).	Torque the torque nuts to 50 ft. lbs (67.8 Nm) not to decrease spring length 1.25 in. (3.18 cm) beyond 1.25 -.125 in. (3.18 -.318 cm), as this may cause coil to burn out.
		6. Install gap nuts (24).	Tighten. Do not compress torque spring beyond 1.25 in. (3.18 cm) with this nut.
		7. Install magnetic brake assembly (8).	
		8. Install pin (22) into magnetic brake assembly (8) and pressure plate (21).	

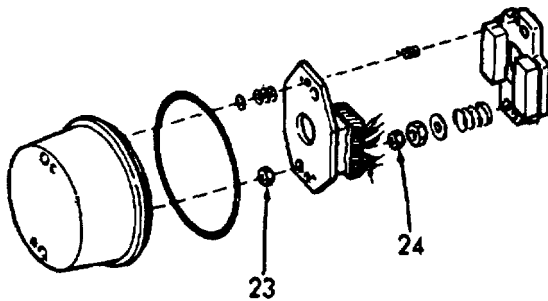


3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

9. Install gap adjusting locking nuts (23 and 24).



Set magnetic gap as follows: Magnet gap [max. .065 in. (.225 cm)] increases as friction disc wears. When gap approaches max. [.065 in. (.225 cm)], adjust gap to min. [.035 in. (.089)] dimension by turning nuts (23 and 24). Magnet gap can vary from nominal $\pm .005$ in. (.013 cm) between corners. After setting gap, readjust torque springs length 1.25 in. (3.18 cm).

CAUTION

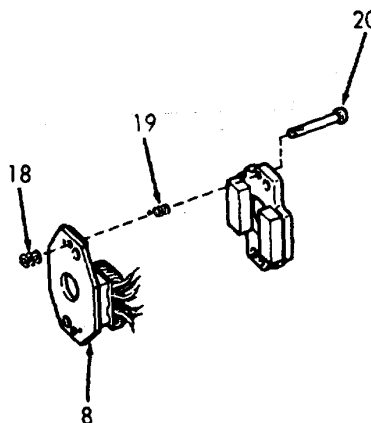
Magnet gap must not exceed maximum [.065 inches (.225 cm)].

c. Manual release rod (20)

1. Insert manual release rod (20).

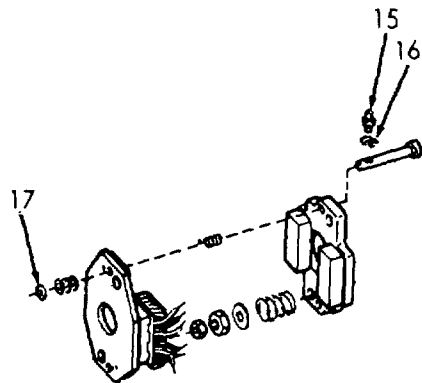
3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)		2. Install torsion spring (19).	Wind each torsion spring approximately 1/4 turn and hook spring loop over pin on magnetic brake assembly.
		3. Push manual release rod (20) thru torsion spring (19) and magnetic brake assembly (8).	
		4. Install shim washer (18).	Add only enough shim washers to obtain proper release action. Too many shim washers will prevent automatic reset when electrical power is applied. Too few washers will prevent the motor shaft from turning freely.



3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)		5. Install flatwasher (17).	
		6. Install lockwashers (16) and stopscrew (15).	Tighten stop-screw (15). To check manual release action turn stop-screw. Motor shaft should turn freely. Apply power. Stop-screw should return to position automatically. If shaft does not turn freely, turn stop-screw clockwise 1/4 turn.
9. Motor shaft	a. Hub (12)	1. Install hub seal (13) on hub (12). 2. Install hub (12).	Stamped part number on hub should face away from motor.



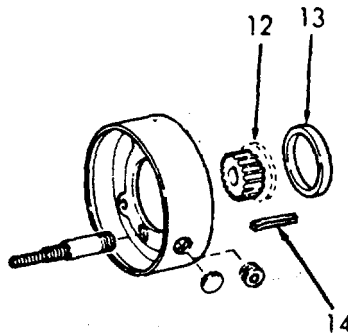
3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

3. Install key (14).

Not to exceed
2.5 + 1/32 in.
(7.35 ± .0794
cm).



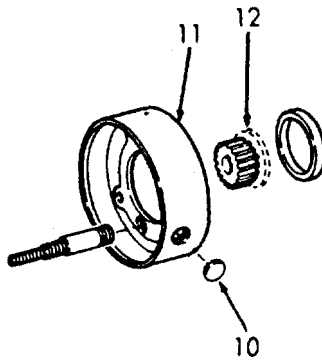
b. Bracket
assembly
(11)

1. Install bracket
assembly (11) onto
hub (12).

Guide friction
discs onto hub.

2. Install cap (10).

Bolting bracket
to motor not
to exceed 7 in.
(17.78 cm).



3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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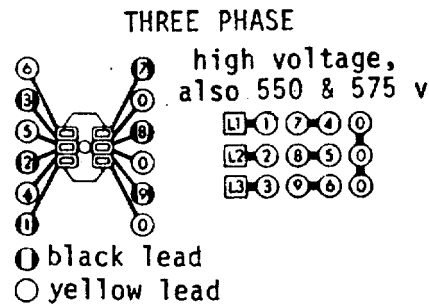
REPAIR (Cont)

- | | | | |
|--|--|--|--|
| 10. Mag-
netic
assem-
bly (8) | a. Run wiring (7) thru conduit (9).

b. Connect wiring (7) to magnetic coil on magnetic assembly (8) as follows: | | |
|--|--|--|--|

CAUTION

The sequence of black and yellow leads is important. DO NOT INVERT COILS. Specify voltage, phase and frequency stamped on brake nameplate.



Single Phase

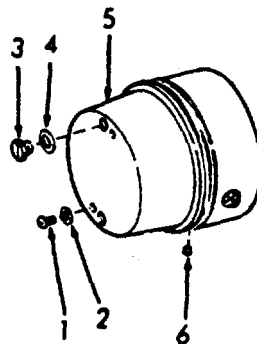
High voltage - Connect black lead of one coil to yellow lead of other coil and connect remaining two leads to power supply.

3-120. WINCH BRAKE AND MOTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|-----|-----------------|---|--|
| 11. | Brake cover (5) | <ul style="list-style-type: none"> a. Install seal (6). b. Install brake cover (5). c. Install gasket caps (4) and release caps (3). d. Install gasket caps (2) and screws (1). | |
|-----|-----------------|---|--|



3-121. CONTROLLER - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Replace .

INITIAL SETUP

Test Equipment
None

References
None

Special Tools
None

Equipment
Condition Condition Description
None

Material/Parts
None

Special Environmental Conditions
None

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

A. EXTERNAL INSPECTION

- | | | |
|-------------------|-----------------------|--|
| 1. Controller box | a. Controller box (1) | 1. Check for dents, cracks, and breaks. |
| | | 2. Check bulkhead fittings. |
| | b. Electrical leads | 1. Check for frayed, broken, loose or worn wiring. |
| | | 2. Check connections to control box. |

3-121. CONTROLLER - MAINTENANCE INSTRUCTIONS (Continued).

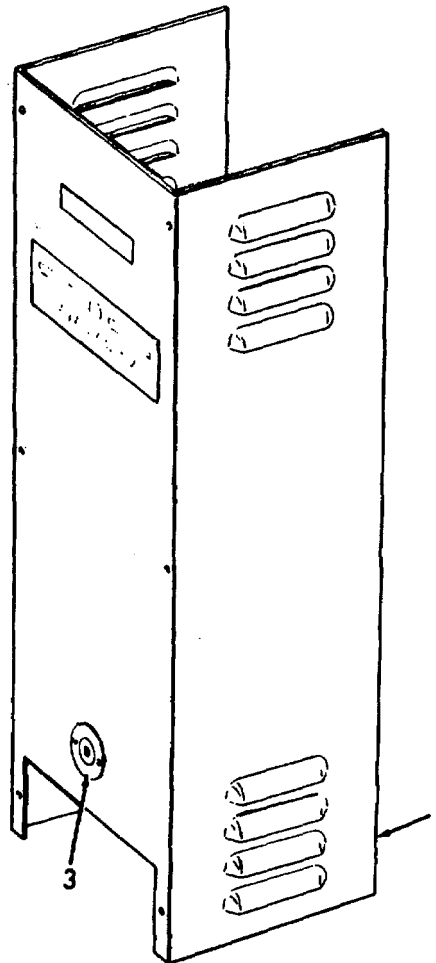
LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)

A. EXTERNAL INSPECTION (Cont)

c. Reset assembly (3)

1. Clean off dust and dirt.
2. Check for damage.
3. Does assembly operate properly?



3-121. CONTROLLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)

B. INTERNAL INSPECTION



- Disconnect electrical power, failure to do so is hazardous to personnel and can cause death.
- Do not open controller box until power has been turned off and disconnected.
- Disconnect power to the winch whenever working on the ramp gate, the wire rope, or in the vicinity of the winch in the winch room.

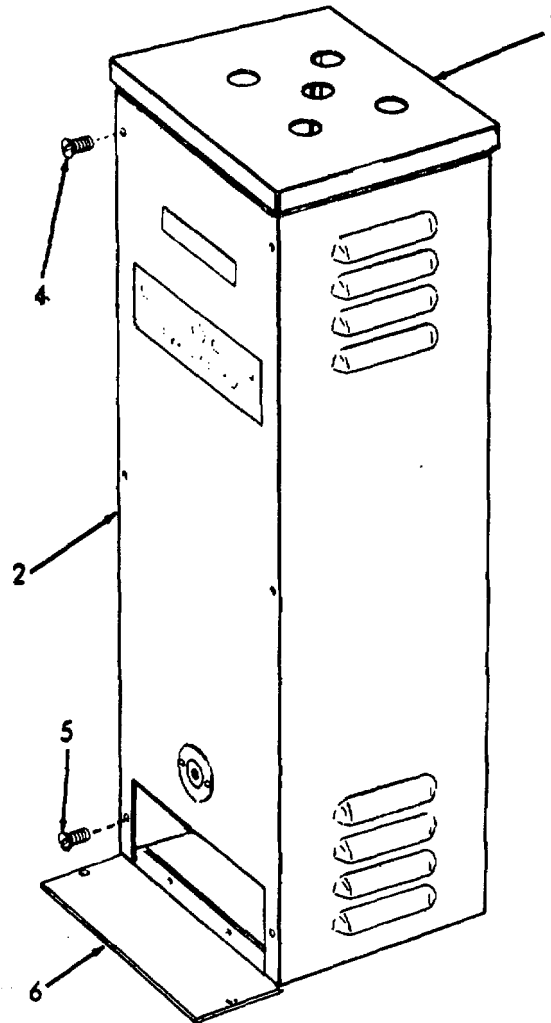
2. Controller box (1)	a. Controller front panel (2)	1. Turn four (4) upper captive screws (4) counter-clockwise to loosen controller front panel (2).	Remove front panel (2).
		2. Turn two (2) lower captive screws (5) counter-clockwise to loosen fascia assembly panel (6).	
	b. Wire connections	1. Check for frayed, broken, loose or worn wiring.	Replace, if necessary.
		2. Check for burned, damaged, or defective wiring;	Replace, if necessary.

3-121. CONTROLLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)

B. INTERNAL INSPECTION (Cont)



3-121. CONTROLLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACE			
3. Control- ler box (1)	a. Fuse block (12)	Remove fuse (11) and replace with new fuse.	
	b. Elec- trical wiring	1. Tag, disconnect and replace defective wiring. 2. Tighten or solder loose wire connec- tions.	Burned, broken, frayed or worn wiring.
	c. Control- ler box (1)	1. Disconnect external wiring. 2. Remove attaching hard- ware from bulkhead. 3. Remove controller box (1). 4. Replace with new controller box (1) attaching hardware. 5. Connect external wiring. 6. Close front panel.	Tag. Remove tags. Turn captive screws (4), and fascia assembly panel captive screws (5), clockwise.

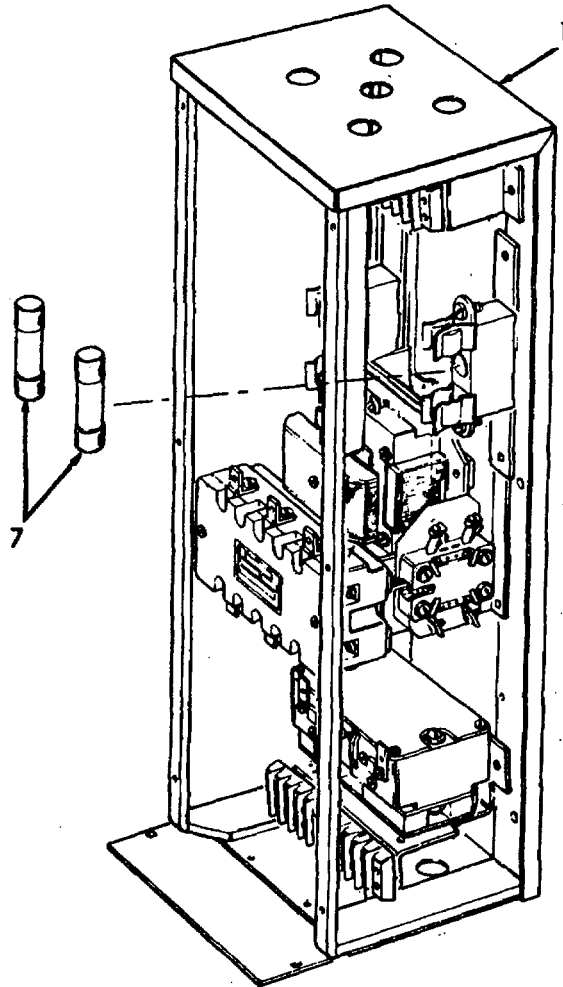
NOTE

Turn electrical power back on.

3-121. CONTROLLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACE (Cont)



3-122. MASTER CONTROLLER SWITCHES.

3-122.1. REMOTE CONTROLLER SWITCH - PILOTHOUSE - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Repair

INITIAL SETUP

Test Equipment
None

References
None

Special Tools
None

Equipment
Condition Condition Description
None

Material/Parts
None

Special Environmental Conditions
None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

1.	Pilot-house control station	<ul style="list-style-type: none"> a. Pilot-house control station box 	<ul style="list-style-type: none"> 1. Check for dents, or cracks, 2. Check electrical connections. 3. Check bulkhead fittings; 	Frayed, broken, burned, or worn wiring.
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3-122.1. REMOTE CONTROLLER SWITCH - PILOTHOUSE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
	b. Rotary selector switch	<ol style="list-style-type: none"> 1. Clean off dust and dirt. 2. Check switch's function. 	Rotate between local and remote. Make sure it does not bind.
	c. Push-buttons	<ol style="list-style-type: none"> 1. Clean off dust and dirt. 2. Check for damage. 	Do pushbuttons depress easily?

REPAIR



Disconnect electrical power before working on Pilothouse control station.

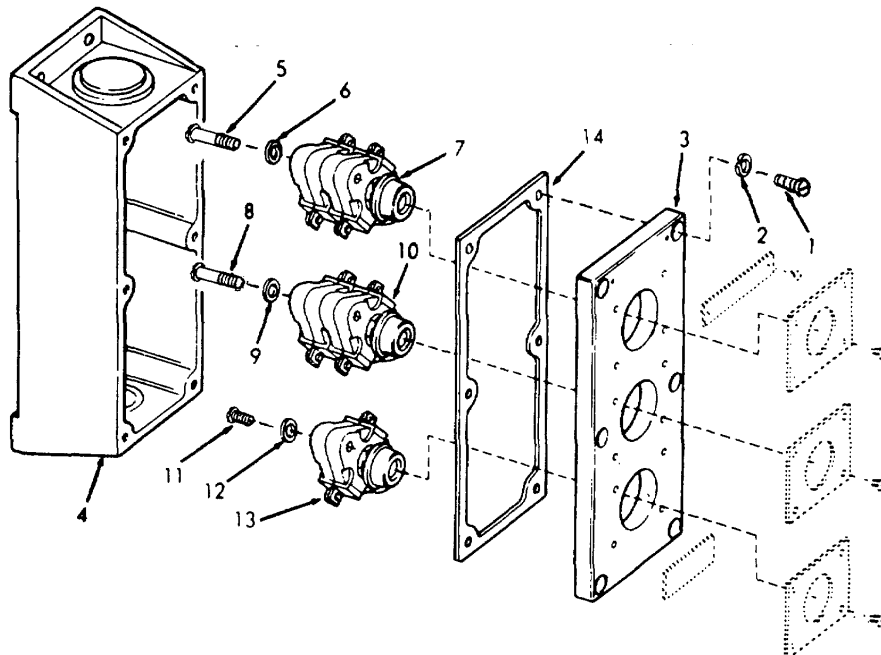
2.	Pilothouse upper controller switch box (4)	<ol style="list-style-type: none"> a. Switch cover (3) <ol style="list-style-type: none"> 1. Remove screws (1) and washers (2). 2. Remove switch cover (3) from control switch box (4). b. RAISE push-button (7) <ol style="list-style-type: none"> 1. Tag and disconnect all wiring. 2. Remove screws (5), and washers (6). 3. Remove RAISE push-button (7). 	Replace nameplate, if damaged.
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3-122.1. REMOTE CONTROLLER SWITCH - PILOTHOUSE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|----|--------------------------------|---|--|
| c. | LOWER push-button (10) | <ol style="list-style-type: none"> 1. Tag and disconnect all wiring. 2. Remove screws (8), and washers (9). 3. Remove LOWER push-button (10). | |
| d. | EMERGENCY RUN push-button (13) | <ol style="list-style-type: none"> 1. Tag and disconnect all wiring. 2. Remove screws (11), and washers (12). 3. Remove EMERGENCY RUN pushbutton (13). | |
| e. | Switch cover (3) | Remove cover gasket (14). | |



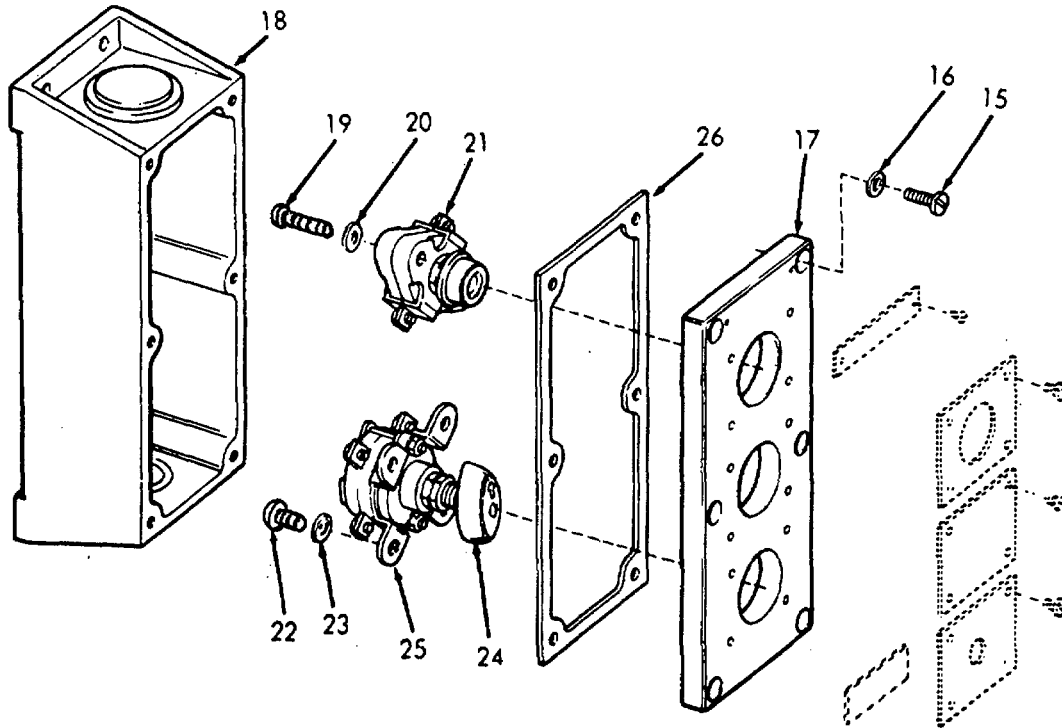
3-122.1. REMOTE CONTROLLER SWITCH - PILOTHOUSE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
3. Pilot-house LOWER control switch box (18)	a. Switch cover (17)	1. Remove screws (15), and washers (16).	Replace name-plate, if damaged.
	NOTE		
	Cover cannot be removed.		
		2. Remove switch cover (17) from control switch box (18).	
	b. STOP-push-button (21)	1. Tag and disconnect all wiring. 2. Remove screws (19), and washers (20). 3. Remove STOP push-button (21).	
	c. Rotary selector switch (25)	1. Tag and disconnect all wiring. 2. Remove screws (22), and washers (23). 3. Remove setscrew and rotary knob (24).	
		4. Remove rotary selector switch (25).	Remove gasket (26).

3-122.1. REMOTE CONTROLLER SWITCH - PILOTHOUSE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



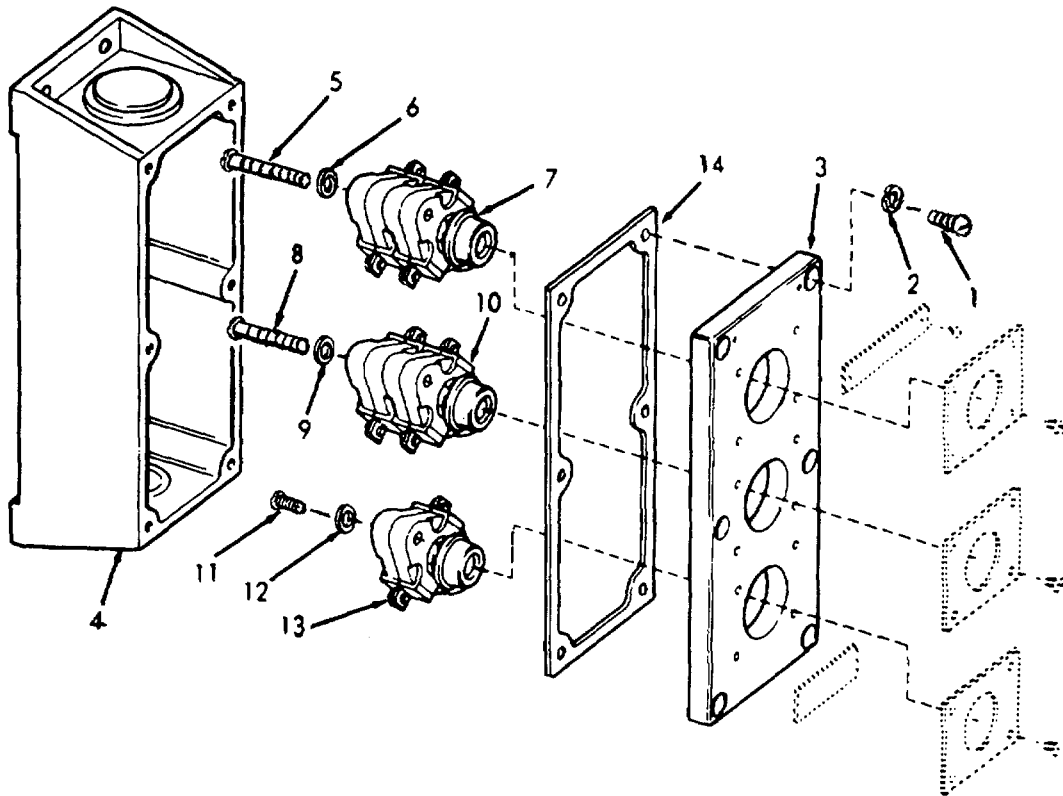
3-122.1. REMOTE CONTROLLER SWITCH - PILOTHOUSE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
4. Pilot-house upper control switch box (4)	a. EMERGENCY RUN push-button (13)	1. Install washers (12), and screws (11).	Hand tight. Do not screw into switch cover (3).
		2. Connect wiring.	Remove tags.
	b. LOWER push-button (10)	1. Install washers (9), and screws (8).	Hand tight. Do not screw into switch cover (3).
		2. Connect wiring.	Remove tags.
	c. RAISE push-button (7)	1. Install washers (6), and screws (5).	Hand tight. Do not screw into switch cover (3).
		2. Connect wiring.	Remove tags.
	d. Switch cover (3)	1. Install gasket (14).	Tighten.
		2. Insert screws of EMERGENCY RUN (13), RAISE (7), and LOWER (10) pushbuttons into switch cover (3).	
3. Install washers (2), and screws (1).			

3-122.1. REMOTE CONTROLLER SWITCH - PILOTHOUSE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-122.1. REMOTE CONTROLLER SWITCH - PILOTHOUSE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
5. Pilot-house LOWER control switch box (18)	a. Rotary selector switch (25)	1. Install washers (23), and screws (22).	Hand tight only. Do not screw into switch cover (17).
		2. Connect wiring.	Remove tags.
	b. STOP push-button (21)	1. Install washers (20), and screws (19).	Hand tight. Do not screw into switch cover (17).
		2. Connect wiring.	Remove tags.
	c. Switch cover (17)	1. Install gasket (26).	
		2. Insert screws of rotary selector switch (25), and STOP pushbutton (21) into the switch cover (17).	Tighten.
	d. Rotary selector switch (25)	Install setscrew of the rotary knob (24) into the rotary selector switch (25).	
	e. Switch cover (17)	Install washers (16), and screws (15).	

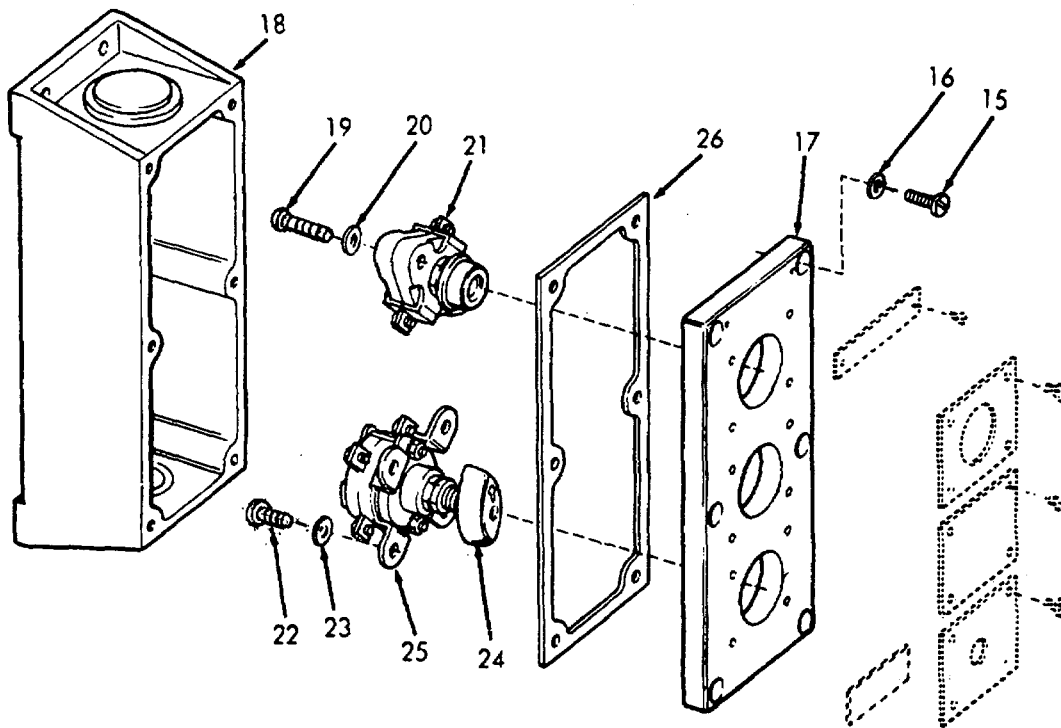
NOTE

Reconnect electrical power.

3-122.1. REMOTE CONTROLLER SWITCH - PILOTHOUSE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-122.2. LOCAL CONTROLLER SWITCHES - WINCH COMPARTMENT AND DECK LOCKER.

This task covers:

a. Inspection

b. Repair

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment
Condition Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

NOTE

The controller switches for the winch compartment and the deck locker are identical.

1.	Con-troller switch	a.	Con-troller switch boxes	1. Check for dents or cracks. 2. Check electrical connections. 3. Check bulkhead fittings.	Frayed, broken, burned, or worn wiring.
		b.	Push-buttons	1. Clean off dust and dirt.	

3-122.2. LOCAL CONTROLLER SWITCHES - WINCH COMPARTMENT AND DECK LOCKER (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
		2. Check for damage.	Do pushbuttons depress easily?

REPAIR



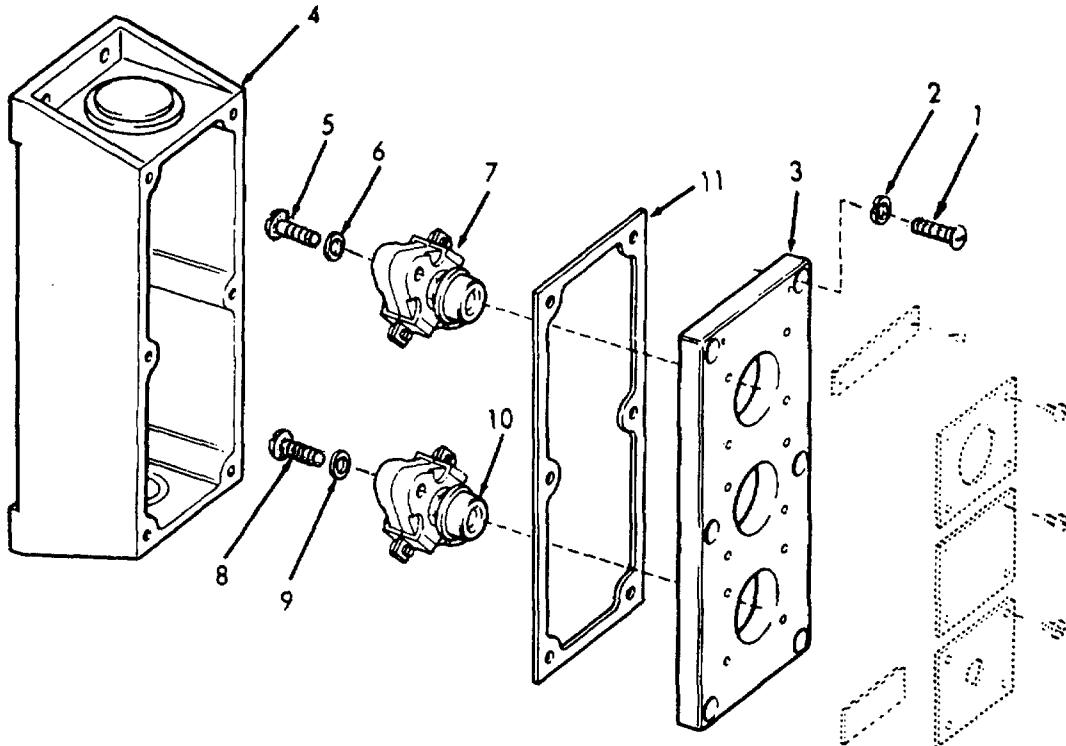
Disconnect electrical power before working on winch compartment or deck locker controller switches.

2. Upper controller switch box (4)	a. Switch cover (3)	<ol style="list-style-type: none"> 1. Remove screws (1) and washers (2). 2. Remove switch cover (3) from upper controller switch box (4). 	Replace nameplates if damaged.
	b. EMERGENCY RUN push-button (7)	<ol style="list-style-type: none"> 1. Tag and disconnect wiring. 2. Remove screws (5), and washers (6). 3. Remove EMERGENCY RUN pushbutton (7). 	
	c. STOP push-button (10)	<ol style="list-style-type: none"> 1. Tag and disconnect wiring. 2. Remove screws (8), and washers (9). 3. Remove STOP push-button (10). 	
	d. Switch cover (3)	Remove cover gasket (11).	

3-122.2. LOCAL CONTROLLER SWITCHES - WINCH COMPARTMENT AND DECK
 LOCKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



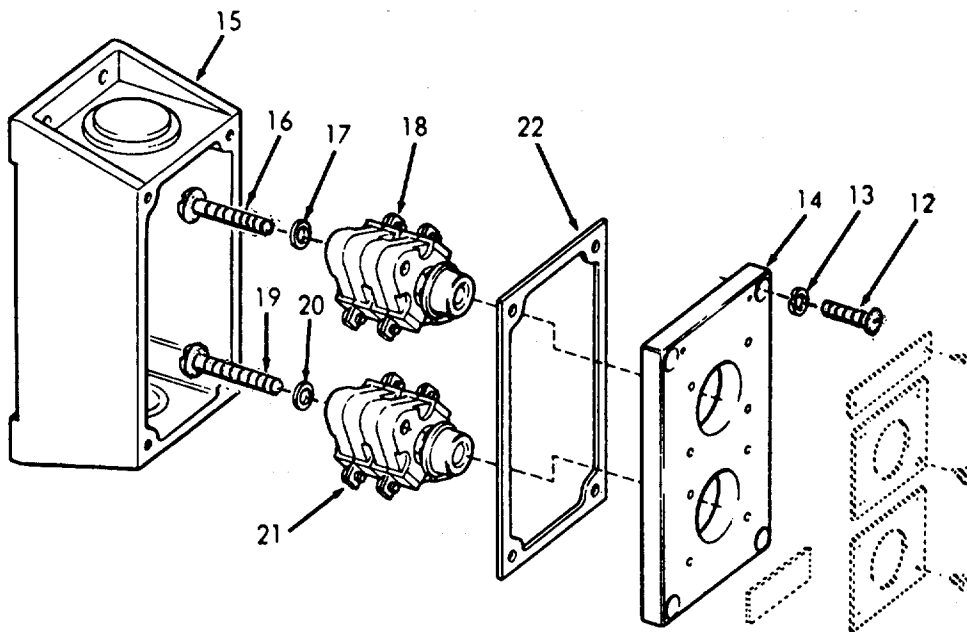
3-122.2. LOCAL CONTROLLER SWITCHES - WINCH COMPARTMENT AND DECK
LOCKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
3. Lower controller switch box (15)	a. Switch cover (14)	<ol style="list-style-type: none"> 1. Remove screws (12), and washers (13). 2. Remove switch cover (14) from LOWER controller switch box (15). 	Replace nameplate, if damaged.
	b. RAISE push-button (18)	<ol style="list-style-type: none"> 1. Tag and disconnect wiring. 2. Remove screws (16), and washers (17). 3. Remove RAISE push-button (18). 	
	c. LOWER push-button (21)	<ol style="list-style-type: none"> 1. Tag and disconnect wiring. 2. Remove screws (19), and washers (20). 3. Remove LOWER push-button (21). 	
	d. Switch cover (14)	Remove gasket cover (22).	

3-122.2. LOCAL CONTROLLER SWITCHES - WINCH COMPARTMENT AND DECK
 LOCKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



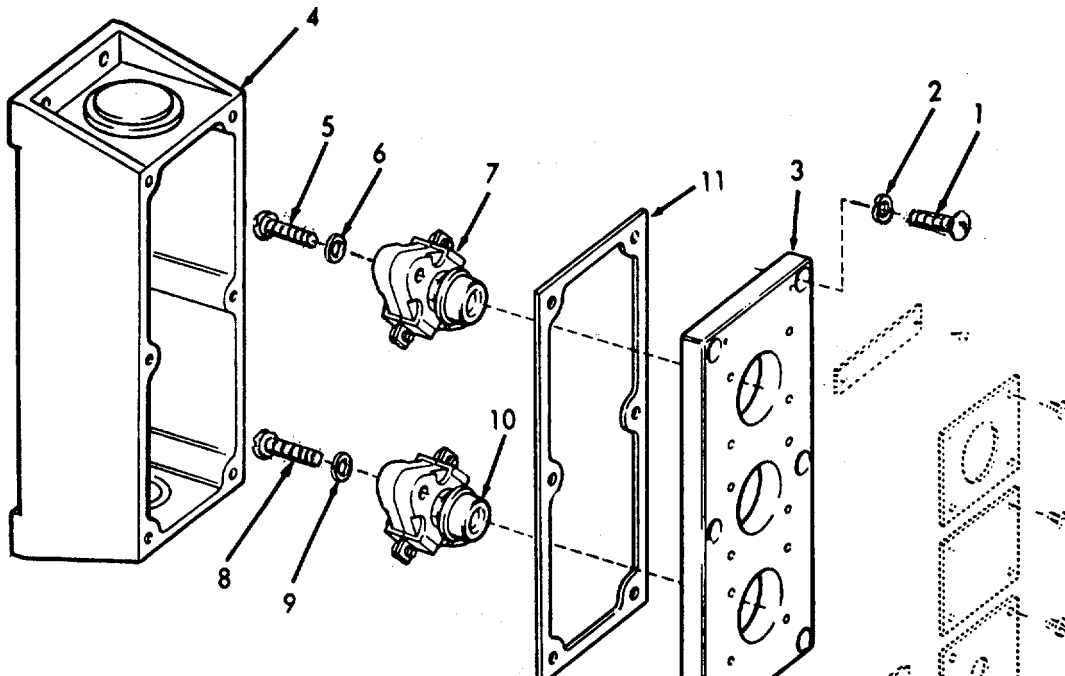
3-122.2. LOCAL CONTROLLER SWITCHES - WINCH COMPARTMENT AND DECK
 LOCKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
4. Upper controller box	a. STOP push-button (10)	1. Install washers (9), and screws (8) into switch cover (3).	Hand tight. Do not screw
		2. Connect wiring.	Remove tags.
	b. EMERGENCY RUN push-button (7)	1. Install washers (6), and screws (5) into cover (3).	Hand tight. Do not screw into switch
		2. Connect wiring.	Remove tags.
	c. Switch cover (3)	1. Install gasket (11).	Hand tight. Do not screw into switch cover (3).
		2. Insert screws of STOP (10), and EMERGENCY RUN (7) pushbuttons into switch cover (3), and controller switch box (4).	Tighten.
		3. Install washers (2), and screws (1) into switch cover (3), and controller switch box (4).	

3-122.2. LOCAL CONTROLLER SWITCHES - WINCH COMPARTMENT AND DECK
 LOCKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-122.2. LOCAL CONTROLLER SWITCHES - WINCH COMPARTMENT AND DECK -- .
 LOCKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
5. LOWER controller switch box	a. LOWER push-button (21)	1. Install washers (20), and screws (19). switch cover (14).	Hand tight only. Do not screw into
		2. Connect wiring.	Remove tags.
	b. RAISE push-button (18)	1. Install washers (17), and screws (16). cover (14).	Hand tight. Do not screw into switch
		2. Connect wiring.	Remove tags.
	c. Switch cover (14)	1. Install gasket (22).	
		2. Insert screws of LOWER (21), and RAISE (18) push-buttons into switch cover (14).	Tighten.
		3. Install washers (13), and screws (12) into switch cover (14), and controller switch box (15).	Tighten.

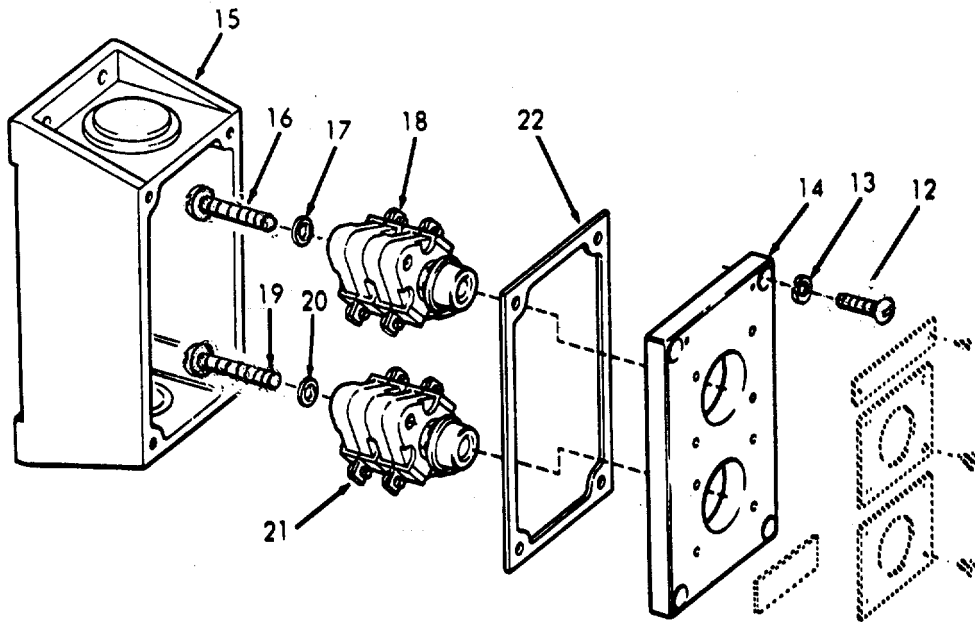
NOTE

Turn on electrical power.

3-122.2. LOCAL CONTROLLER SWITCHES - WINCH COMPARTMENT AND DECK
 LOCKER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-123. LIMIT SWITCHES AND WIRE ROPE GUARDS.

3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Replacement
- c. Disassembly
- d. Reassembly
- e. Installation

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment Condition Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

1.	Slack cable interlock limit switch	<ul style="list-style-type: none"> a. Keep clean, dry and free from grease. b. Check for dents, cracks, scratches, nicks and burrs. 	
2.	Wiring	<ul style="list-style-type: none"> a. Check for loose connections. b. Check for frayed, broken, burned or worn wiring. 	

3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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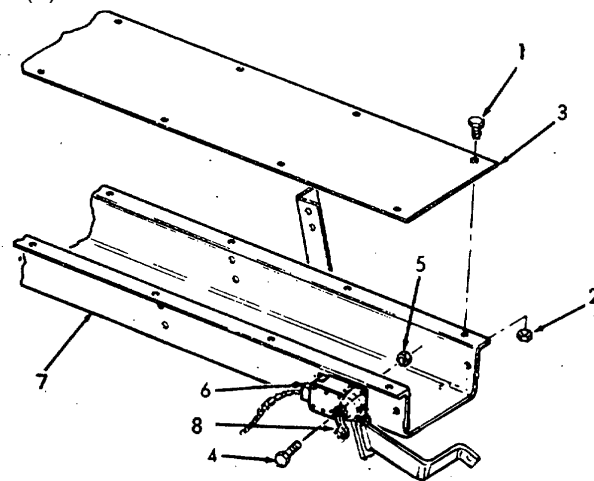
REPLACEMENT

WARNING

- Disconnect power to the winch whenever working on the ramp gate, the wire rope, or in the vicinity of the winch in the winch room.
- Disconnect power to the slack cable interlock limit switch.

3. Slack cable interlock limit switch (6)

- a. Wire rope guard tray (7)
1. Remove capscrews (1) and hex nuts (2).
 2. Remove wire rope guard cover (3).
 3. Remove mounting screws (4) and hex nuts (5).
 4. Remove interlock limit switch (6) from wire rope guard tray (7).
- b. Press-fitted lever (8) Remove

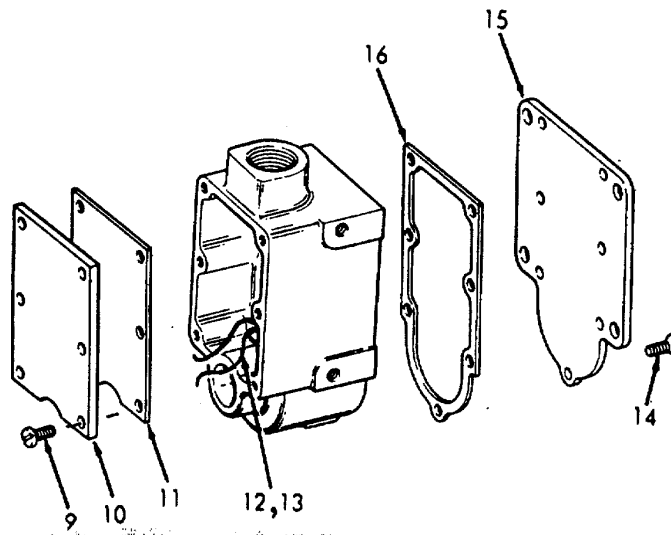


3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT (Cont)

- | | | | |
|----|-------------------|---|------|
| c. | Top cover (10) | <ol style="list-style-type: none"> 1. Remove screws (9). 2. Remove top cover (10). 3. Remove gasket (11). | |
| d. | Wiring (12) | <ol style="list-style-type: none"> 1. Disconnect wiring (12). 2. Remove wiring from contact block (13). 3. Remove wiring (12). | Tag. |
| e. | Bottom cover (15) | <ol style="list-style-type: none"> 1. Remove screws (14). 2. Remove bottom cover (15). 3. Remove gasket (16). | |

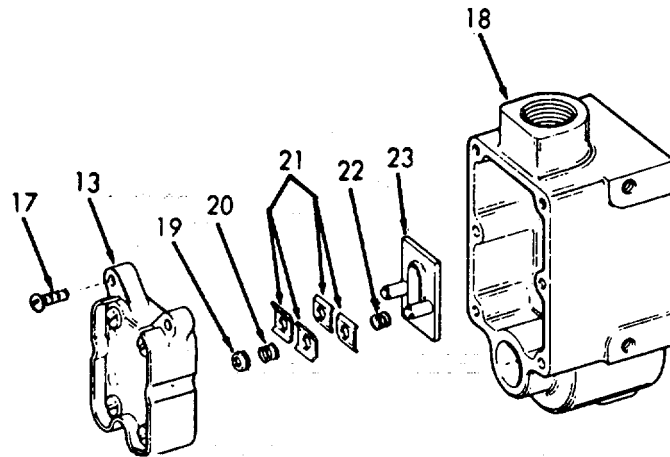


3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY

- | | | |
|---------------------------|-------------------------|---|
| 4. Interlock limit switch | a. Contact block (13) | 1. Remove screws (17) from contact block (13) and housing (18). |
| | | 2. Remove contact block (13) from housing (18). |
| | b. Contact carrier (23) | 1. Remove cup washers (19) and contact springs (20). |
| | | 2. Remove contact plates (21). |
| | | 3. Remove contact springs (22). |
| | | 4. Remove contact carrier (23) from housing (18). |

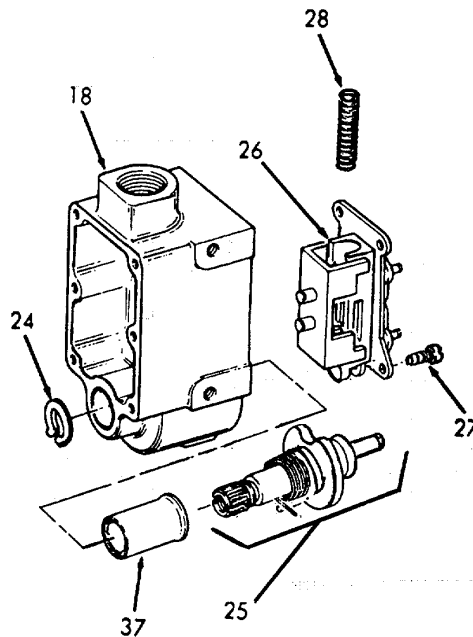


3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

- | | | | |
|----|---------------------------|--|--|
| c. | Shaft assembly (25) | <ol style="list-style-type: none"> 1. Remove retaining ring (24) holding shaft assembly (25) in housing (18). 2. With a screwdriver, hold up latch plate assembly (26) and pull out shaft assembly (25). | Bushing (37) may remain in housing. Remove. |
| d. | Latch plate assembly (26) | <ol style="list-style-type: none"> 1. Remove screws (27). 2. Remove latch plate assembly (26) from housing (18). | Return spring (28) will pop out when latch plate assembly (26) is removed from housing (18). |

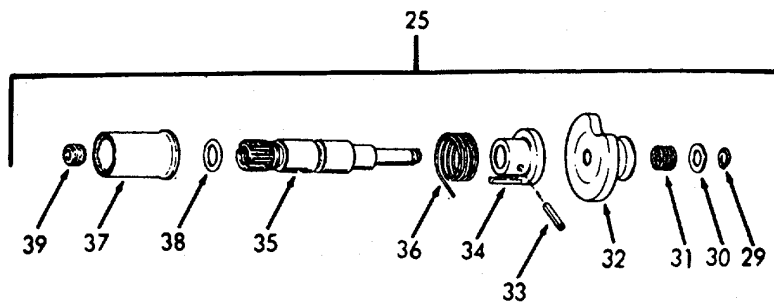


3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

5. Shaft assembly (25)	a. Retaining ring (29), washer (30), and cam spring (31)	Remove.	
	b. Cam limit switch (32)	Remove.	
	c. Shaft (35)	<ol style="list-style-type: none"> 1. Remove roll lever pin (33) from cam clutch (34) and shaft (35). 2. Remove cam clutch (34). 3. Remove torsion spring (36). 4. Remove bushing (37) from shaft (35). If bushing (37) is still on the shaft (35). 5. Remove "O" ring (38). 6. Remove pipe plug (39). 	

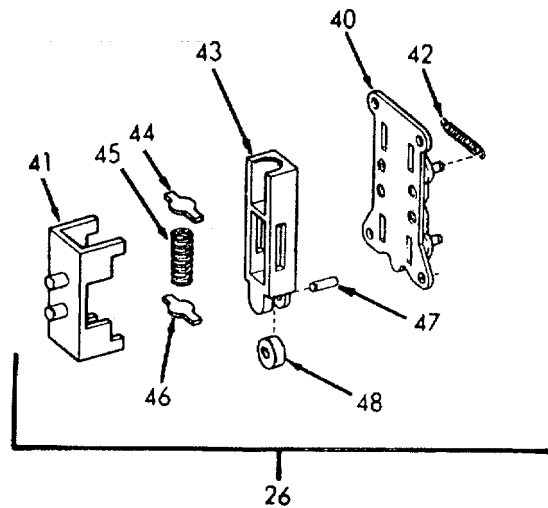


3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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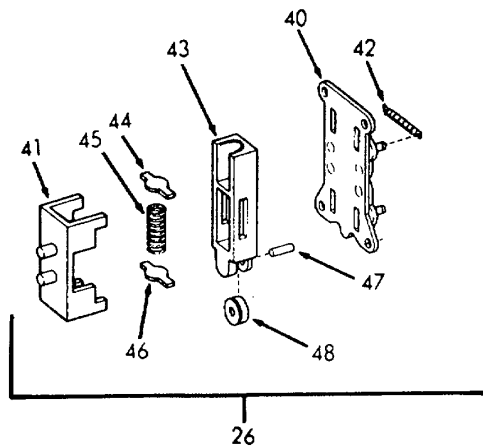
DISASSEMBLY (Cont)

- | | | | |
|------------------------------|-----------------------|--|------------------------------|
| 6. Latch plate assembly (26) | a. Shuttle (41). | <ol style="list-style-type: none"> 1. Remove latch plate (40) from shuttle (41), if necessary. 2. Remove slide shuttle (43). | Latch springs (42). Replace, |
| | b. Shuttle slide (43) | <ol style="list-style-type: none"> 1. Remove spring stop (44), slide spring (45) and spring stop (46). 2. Remove roller stud (47) and cam roller (48). | |



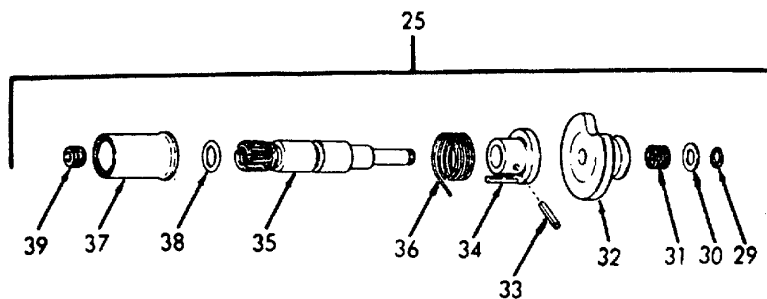
3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY			
7. Latch plate assembly (26)	a. Shuttle slide (43)	1. Install cam roller (48) and insert roller stud (47).	Lubricate roller stud (47).
		2. Install spring stop (46).	Lubricate.
		3. Insert slide spring (45).	Lubricate.
		4. Install spring stop (44).	Lubricate. Depress slide spring (45) slightly.
	b. Shuttle (41)	1. Install slide shuttle (43).	Lubricate before installing.
		2. Install latch plate (40) and spring (42).	



3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY Cont			
8. Shaft assembly (25)	a. Shaft (35)	1. Install pipe plug (39).	
		2. Install O-ring (38).	Wet with instrument oil, NYE #181.
		3. Install bushing (37) onto shaft (35)	Wet with instrument oil, NYE #181.
		4. Install torsion spring (36).	Lubricate.
		5. Install cam clutch (34) onto shaft (35).	
		6. Insert roll lever pin (33) into cam clutch (34) and shaft (35).	Lubricate.
	b. Cam limit switch (32)	Install on shaft (35).	
	c. Cam spring (31), washer (30), and retaining ring (29)	Install on shaft (35).	Lubricate.

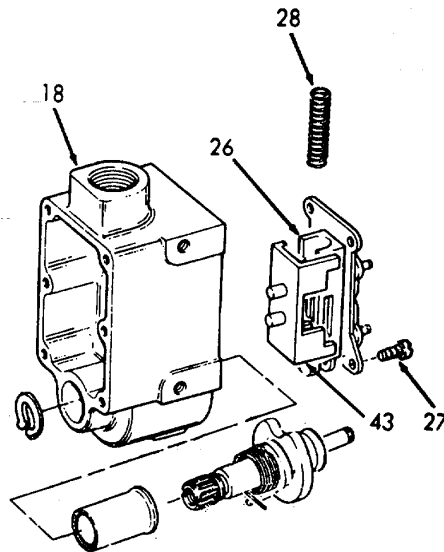


3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

9. Interlock limit switch	a. Latch plate assembly (26)	<ol style="list-style-type: none"> 1. Insert return spring (28) into slide shuttle (43). 2. Install latch plate assembly (26) into housing (18). 3. Install screws (27). 	<p>Lubricate return spring before installing.</p> <p>Depress return spring (28) while installing latch plate assembly (26).</p> <p>Apply primer and Loctite to screws. Secure latch plate assembly (26) into housing (18).</p>
---------------------------	------------------------------	---	--



3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	b. Shaft assembly (25) push in shaft assembly (25).	<ol style="list-style-type: none"> 1. With screwdriver, hold up latch plate assembly (26) and limit switch (32). 2. Install retaining ring (24) to hold shaft assembly (25) in housing (18). 	Allow cam roller (48) to slide into cam

CAUTION

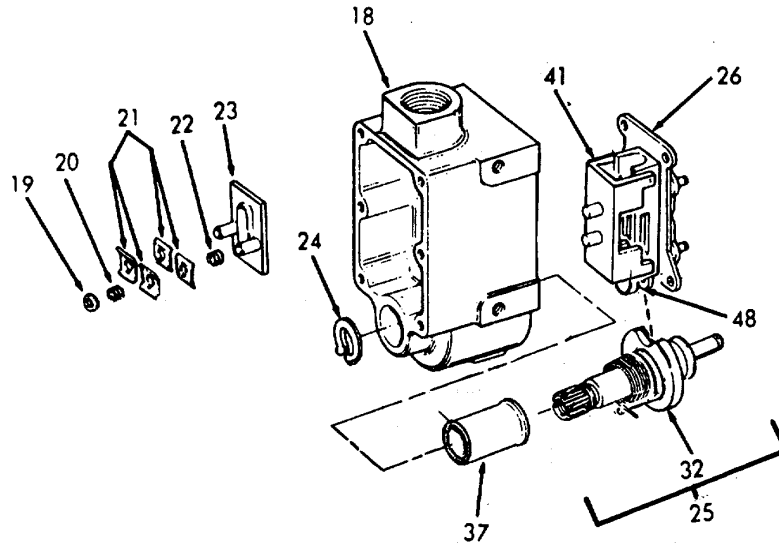
Do not lubricate in electrical contact area.

	c. Contact carrier (23)	<ol style="list-style-type: none"> 1. Install contact springs (22). 2. Install contact plates (21). 3. Install contact springs (20) and cup washers (19). 4. Insert contact carrier (23) into housing (18). 	<p>Check contact carrier gap .093 in (.236 cm).</p> <p>Align contact carrier (23) with latch plate assembly (26) and shuttle (41). Check contact with fingers by moving back and forth.</p>
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3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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PREASSEMBLY (Cont)



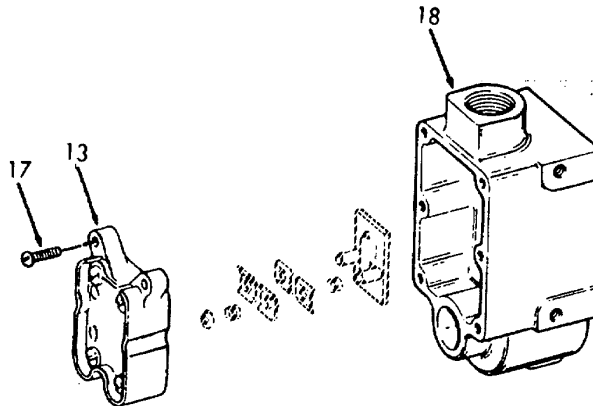
3-2089

3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH --MAINTENANCE - INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|--------------------|--|---|
| d. | Contact block (13) | <ol style="list-style-type: none"> 1. Install contact block (13) into housing (18). 2. Install screws (17) into contact block (13) and housing (18). | <p>Check contact block alignment .089/.078 in. (.226/.198 cm) DIM and .469 in. (1.191 cm) DIM.</p> <p>Torque screws to 4 to 6 in. lbs. (.445 to .683 Nm).</p> |
|----|--------------------|--|---|



INSTALLATION

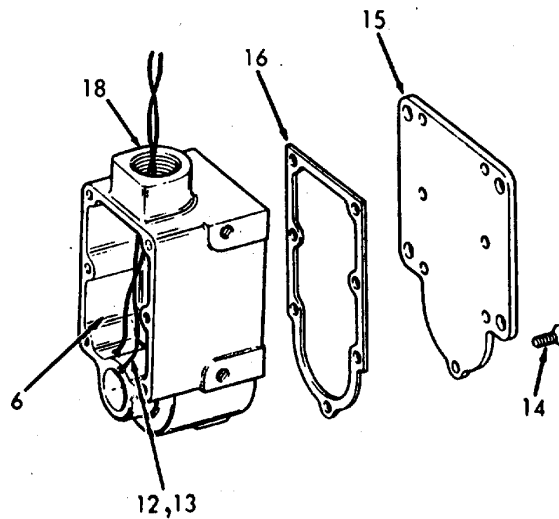
- | | | | |
|-----|--|---|--|
| 10. | Slack cable interlock limit switch (6) | <ol style="list-style-type: none"> a. Bottom cover (15) <ol style="list-style-type: none"> 1. Install gasket (16). 2. Install bottom cover (15). | <p>Check alignment of screw holes.</p> |
|-----|--|---|--|

3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- | | | | |
|----|-------------|--|---|
| | | 3. Insert screws (14). | Hand tight; then torque to 10-15 in. lbs. (1.138-1.706 Nm). Torque screws in a staggered pattern (from one side of cover to the other). |
| b. | Wiring (12) | 1. Thread wiring (12) through housing (18).
2. Connect wiring (12) to contact block (13). | Remove tags. |



3-123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

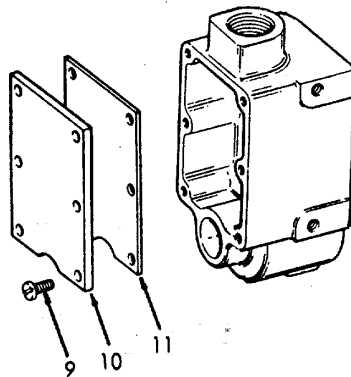
c. Top cover (10)

1. Install gasket (11).
2. Install top cover (10).

Check alignment of screw holes. Use Bostik adhesive #1142 to cement gasket (11) onto top cover (10).

3. Insert screws (9).

Hand tight; then torque to 10-15 in. lbs. (1.138-1.706 Nm). Torque screws in a staggered pattern (from one side of cover to the other).



3-2092

3.123.1. SLACK CABLE INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

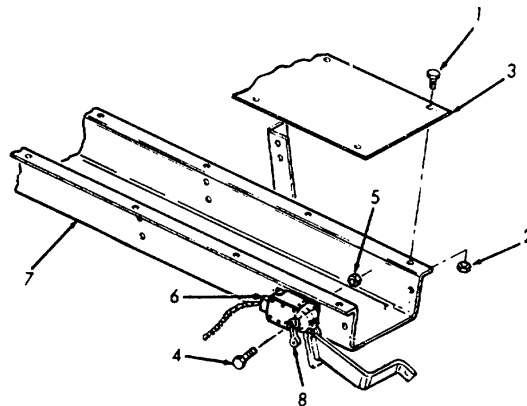
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

- | | | | |
|----|--------------------------|--|---|
| d. | Press-fitted lever (8) | Install. | |
| e. | Wire rope guard tray (7) | <ol style="list-style-type: none"> 1. Install slack cable interlock limit switch (6) into chain guard tray (7). 2. Install mounting screws (4) and hex nuts (5). 3. Install wire rope guard cover (3). 4. Insert capscrews (1) and hex nuts (2). | Tighten. Secure wire rope guard cover on-to wire rope tray. |

NOTE

Reconnect power to the winch and slack cable interlock limit switch.



3-123.2. HAND CRANK INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS.

This task covers:

- | | | |
|----------------|----------------|-----------------|
| a. Inspection | c. Disassembly | e. Installation |
| b. Replacement | d. Reassembly | |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment
Condition Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNINGS in procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | |
|----|--|---|
| 1. | Hand crank interlock limit switch cracks | <ul style="list-style-type: none"> a. Keep clean, dry and free from grease. b. Check for dents, scratches, nicks and burrs. |
| 2. | Wiring | <ul style="list-style-type: none"> a. Check for loose connections. b. Check for frayed, broken, burned or worn wiring. |

3-123.2. HAND CRANK INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

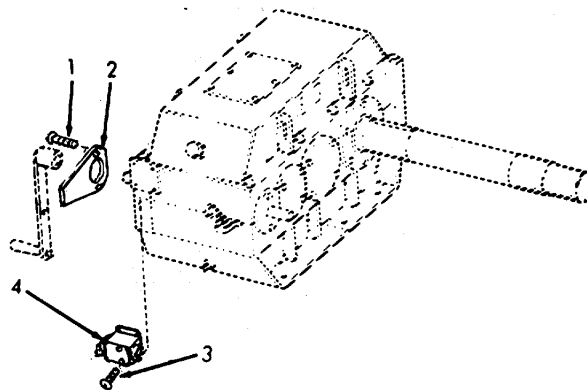
LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT

WARNING

- Disconnect power to the winch whenever working on the ramp gate, the wire rope or in the vicinity of the winch in the winch room.
- Disconnect power to the hand crank interlock limit switch.

3.	Hand crank interlock limit switch (4)	<p>a. Hand crank cover (2)</p> <p>b. Speed reducer</p>	<p>1. Remove screws (1).</p> <p>2. Remove hand crank cover (2).</p> <p>1. Remove mounting screws (3).</p> <p>2. Remove interlock limit switch (4) from speed reducer.</p>	To prevent accidental starting of the speed reducer.
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3-123.2. HAND CRANK INTERLOCK LIMIT SWITCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)

NOTE

Missing item numbers are used within the slack cable interlock limit switch replacement procedure.

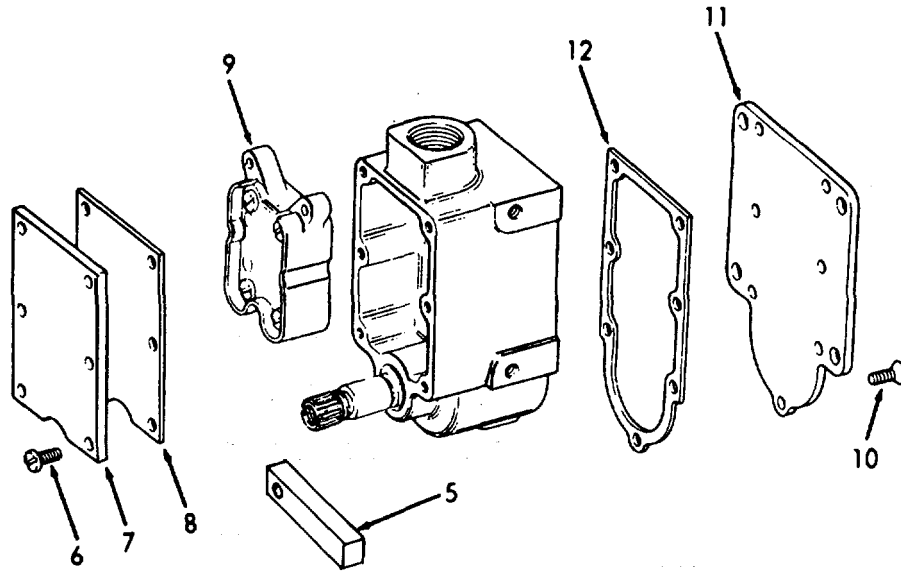
- | | | | |
|----|------------------------|--|--|
| c. | Press-fitted lever (5) | Remove. | |
| d. | Top cover | <ol style="list-style-type: none"> 1. Remove screws (6). 2. Remove top cover (7). 3. Remove gaskets (8). | |
| e. | Wiring | <ol style="list-style-type: none"> 1. Tag wiring 2. Remove wiring from contact block (9). | |
| f. | Bottom cover | <ol style="list-style-type: none"> 1. Remove screws (10). 2. Remove bottom cover (11). 3. Remove gasket (12). | |

3-123.2.

HAND CRANK INTERLOCK LIMIT SWITCH - MAINTENANCE
INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT (Cont.)



DISASSEMBLY/REASSEMBLY

Refer to paragraph 3-123.1 for Slack Cable Interlock Limit Switch disassembly/reassembly.

3-123.2.

HAND CRANK INTERLOCK LIMIT SWITCH - MAINTENANCE
INSTRUCTIONS (Continued)

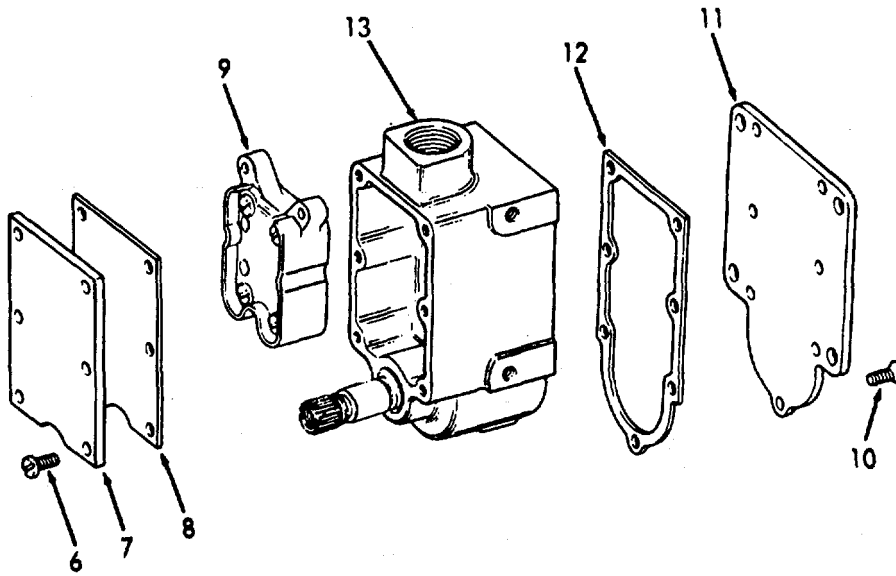
LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
4. Hand Crank interlock limit switch	a. Bottom cover	1. Install gasket (12).	
		2. Install bottom cover (11).	Check alignment of screw holes.
		3. Insert screws (10)	Hand tight only; then torque to 10-15 in. lbs. (1.138-1.706 Nm). Torque screws in a staggered pattern (from one side of cover to the other).
	b. Wiring	1. Thread wiring thru housing (13).	
		2. Connect wiring to contact block (9).	Remove tags.
	c. Top cover	1. Install :gasket (8).	
		2. Install top cover (7).	
		3. Insert screws (6).	Hand tight only; then torque to 10-15 in. lbs. (1.138-1.706 Nm). Torque screws in a staggered pattern (from one side of cover to the other).

3-123.2.

HAND CRANK INTERLOCK LIMIT SWITCH - MAINTENANCE
INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont.)



3-2099

3-123.2. HAND CRANK INTERLOCK LIMIT SWITCH - MAINTENANCE
INSTRUCTIONS (Continued)

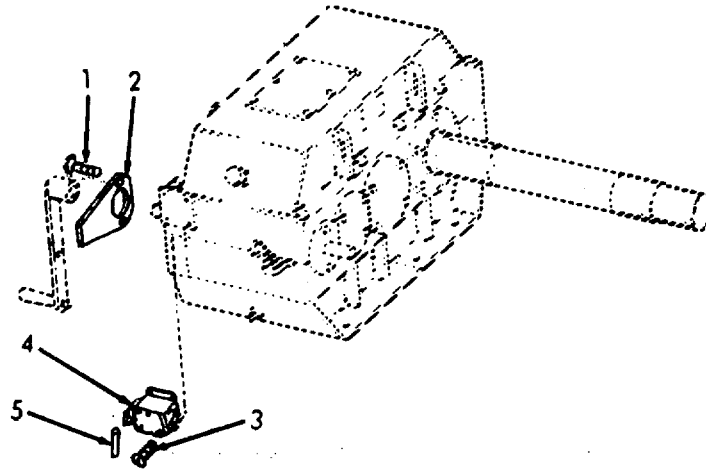
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont.)

- | | | | |
|----|------------------------|--|--|
| d. | Press-fitted lever (5) | Install. | |
| e. | Speed reducer | <ol style="list-style-type: none"> 1. Install interlock limit switch (4) onto speed reducer. 2. Install mounting screws (3). | |
| f. | Hand crank cover | <ol style="list-style-type: none"> 1. Install hand crank cover (2). 2. Install screws (1). | |

NOTE

Reconnect power to the winch and hand crank interlock limit switch.



3-123.3.

WIRE ROPE GUARD AND SLACK CABLE INTERLOCK LIMIT SWITCH
BRACKET - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Inspection

b. Removal

c. Installation

INITIAL SETUP

Test Equipment
None

References
None

Special Tools
None

Equipment
Condition Condition Description
None

Material/Parts
None

Special Environmental Conditions
None

Personnel Required
1

General Safety Instructions
None

LOCATION

ITEM

ACTION

REMARKS

INSPECTION

- | | | | | |
|----|----------------------|----|-----------------------|---|
| 1. | Wire rope guard tray | a. | Wire rope guard tray | Check for dents, cracks, scratches, and burrs. |
| | | b. | Wire rope guard cover | Check for dents, cracks, scratches, and burrs. |
| | | c. | Braces | 1. Check for dents, cracks or breaks.

2. Is it bent?

3. Check fittings. |

3-2101

3-123.3. WIRE ROPE GUARD AND SLACK CABLE INTERLOCK LIMIT SWITCH BRACKET - MAINTENANCE INSTRUCTIONS (Continued).

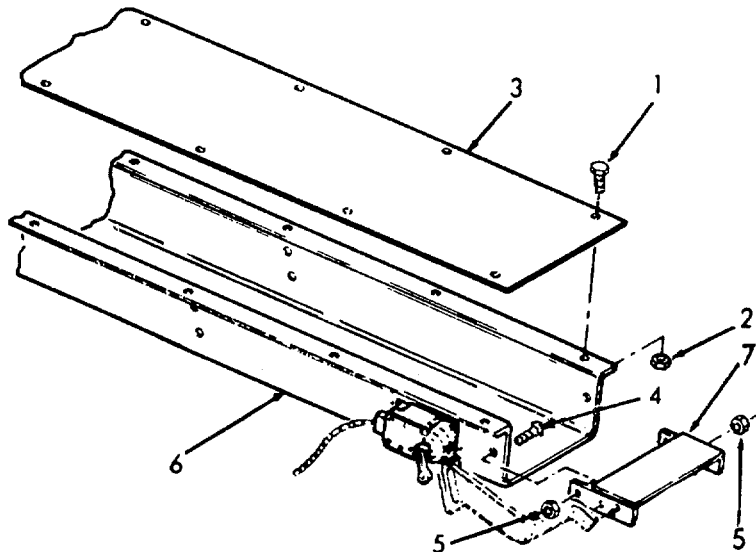
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION (Cont.)

- | | | | |
|----|--|--|--|
| d. | Slack cable interlock limit switch bracket | <ol style="list-style-type: none"> 1. Check for bent, dented, cracked, scratched or burrs. 2. Check lever to see if it is bent or cracked. | |
|----|--|--|--|

REMOVAL

- | | | | |
|----|-----------------------------|---|--|
| 2. | Wire rope guard | <ol style="list-style-type: none"> 1. Remove capscrews (1) and hex nuts (2). 2. Remove wire rope guard cover (3). | |
| | a. Wire rope guard cover | | |
| | b. Wire rope guard tray (6) | Remove capscrews (4), and hex nuts (5) from wire rope guard tray (6) and slack cable interlock limit switch bracket (7). | |

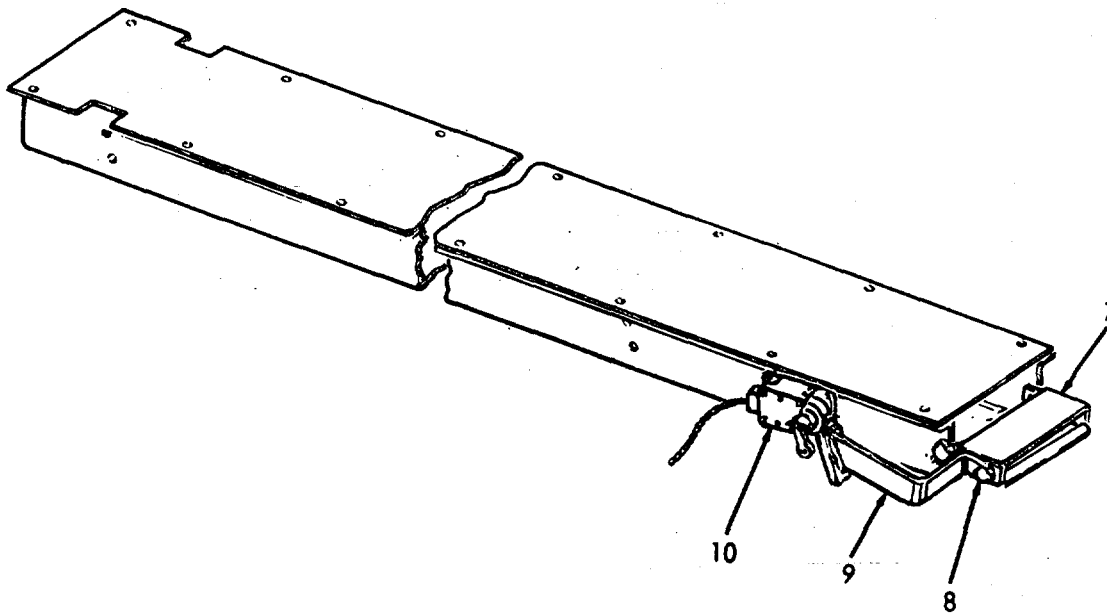


3-123.3. WIRE ROPE GUARD AND SLACK CABLE INTERLOCK LIMIT SWITCH BRACKET - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont.)

3.	Slack cable interlock limit switch bracket (7)	a. Slack cable interlock limit lever (9)	1. Remove capscrews (8). 2. Remove slack cable interlock limit switch lever (9).	Slack cable interlock limit switch lever is attached to the bracket only and floats against the slack cable interlock limit switch (10).
----	--	--	---	--

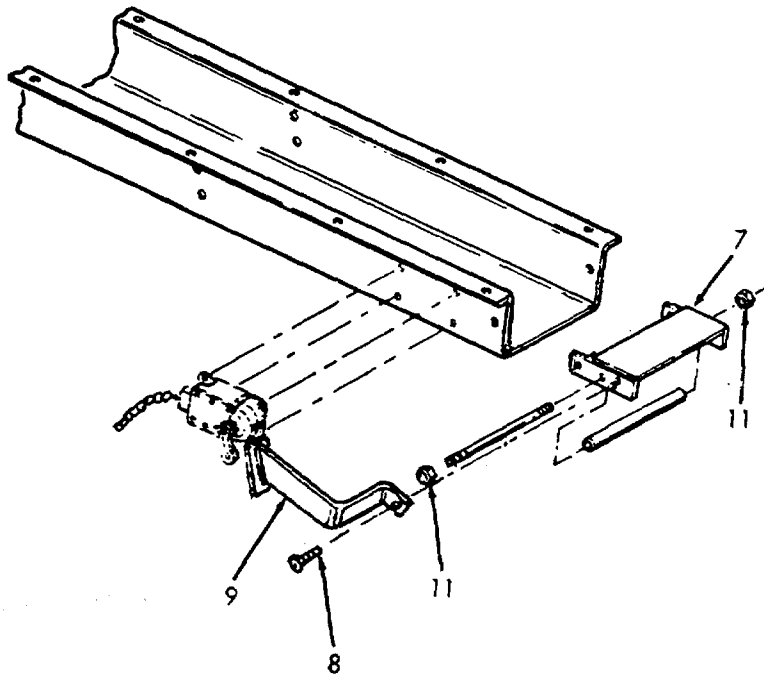


3-123.3. WIRE ROPE GUARD AND SLACK CABLE INTERLOCK LIMIT SWITCH BRACKET - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont.)

- | | | | |
|----|--|---|--|
| b. | Slack cable interlock limit switch bracket (7) | <ol style="list-style-type: none"> 1. Remove hex nuts (11). 2. Pull out stud (12) while holding onto the steel pipe (13). 3. Remove steel pipe (13). | |
|----|--|---|--|



INSTALLATION

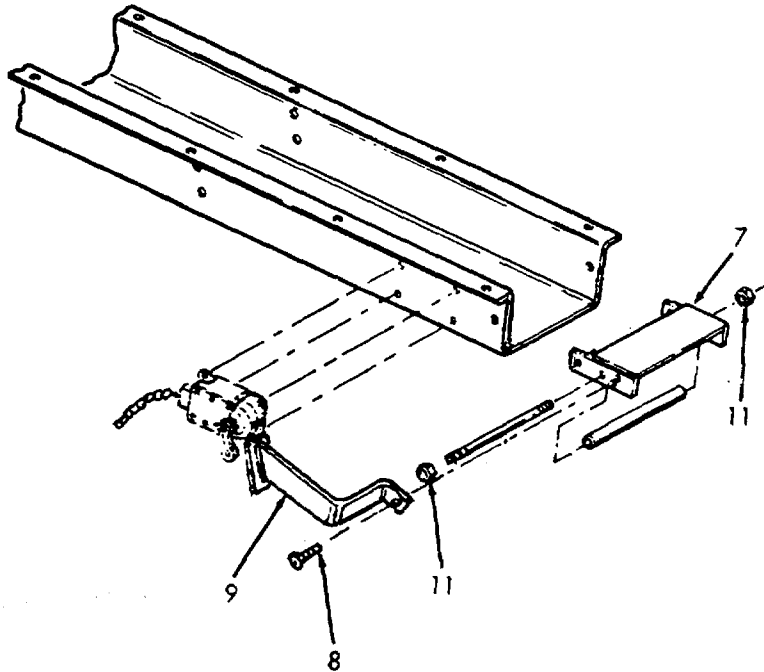
- | | | | | |
|----|--|----|--|---|
| 4. | Slack cable interlock limit switch bracket | a. | Slack cable interlock limit switch bracket | <ol style="list-style-type: none"> 1. Hold steel pipe (13) in place under slack cable interlock limit switch bracket (7). 2. Slide stud (12) into slack cable interlock limit switch bracket (7) and steel pipe (13). |
|----|--|----|--|---|

3-123.3. WIRE ROPE GUARD AND SLACK CABLE INTERLOCK LIMIT SWITCH BRACKET - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont.)

- | | | | |
|----|--|--|----------|
| | | 3. Install hex nuts (11). | Tighten. |
| b. | Slack cable interlock limit switch lever (9) | 1. Install slack cable interlock limit switch lever (9) onto slack cable interlock limit switch bracket (7). | |
| | | 2. Install capscrews (8). | Tighten. |

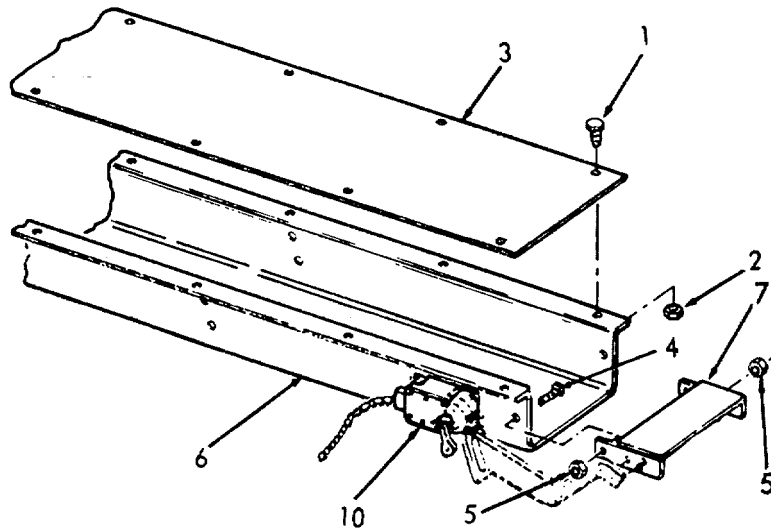


3-123.3. WIRE ROPE GUARD AND SLACK CABLE INTERLOCK LIMIT SWITCH BRACKET - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont.)

5.	Wire rope guard	<p>a. Wire rope guard tray (6)</p> <p>b. Wire rope guard cover (3)</p>	<p>1. Install slack cable interlock limit switch bracket (7) onto wire rope guard tray (6).</p> <p>2. Install capscrews (4) and hex nuts (5).</p> <p>1. Place the wire rope guard cover (3) on top of the wire rope guard tray (6).</p> <p>2. Install capscrews (1) and hex nuts (2).</p>	<p>Position the slack cable interlock limit switch lever on the press-fitted lever of the slack cable interlock limit switch (10).</p> <p>Tighten.</p>
----	-----------------	--	---	--



3-2106

3-123.4. STERN GATE OVERALL - MAINTENANCE INSTRUCTIONS

The following is an index-to the maintenance procedures:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Stern Gate	3-125
Gate, Hinges, Springs	3-126
Portable Davit	3-127

3-125. STERN GATE - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Service

INITIAL SETUP

Test Equipment
None

References
None

Special Tools
Grease gun

Equipment
Condition Condition Description
None

Material/Parts
Grease MIL-G-10924
Type GAA

Special Environmental Conditions
None

Personnel Required
1

General Safety Instructions
None

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

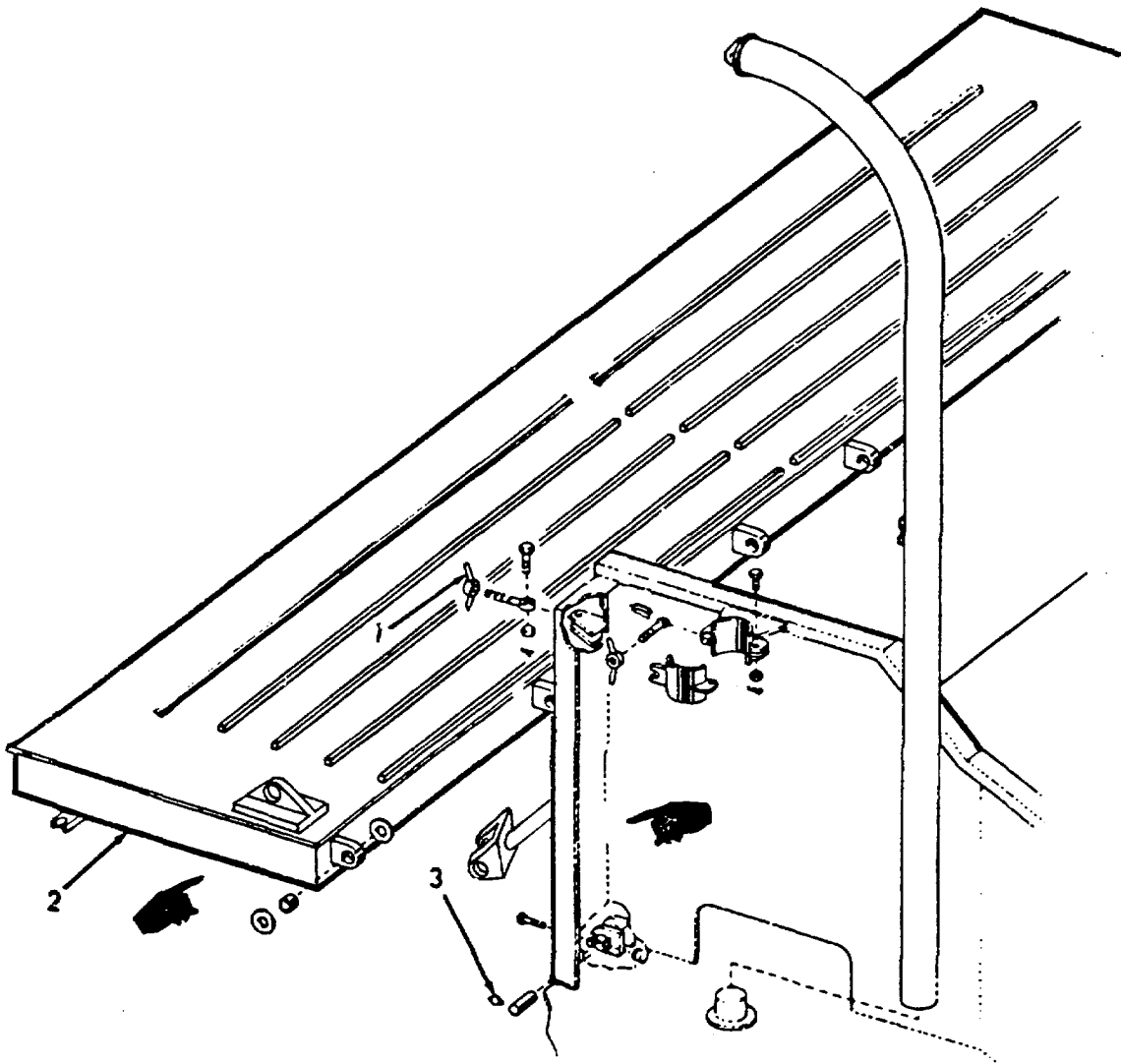
- | | | |
|---------------|--------------|---|
| 1. Stern gate | a. Dog bolts | Inspect for missing and damaged parts. |
| | b. Hinges | Inspect for broken, missing or damaged grease fittings. |
| | c. Gate | Inspect for breaks, dents, cracks and fatigue signs. |

3-2107

3-123.4. STERN GATE - MAINTENANCE INSTRUCTIONS

SERVICE

- | | | |
|----|------------------|--|
| 2. | a. Dog bolts (1) | Apply grease to all thread and pivot points. |
| | b. Gate (2) | Apply grease to fitting (3) in two places. |



3-2108

3-126. GATE, HINGES, AND SPRINGS - MAINTENANCE INSTRUCTIONS

This task covers:

Inspection

INITIAL SETUP

Test Equipment
None

References
None

Special Tools
None

Equipment
Condition Condition Description
None

Material/Parts
None

Special Environmental Conditions
None

Personnel Required
1

General Safety Instructions
None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

NOTE

For repair and replacement, refer to Direct Support Maintenance.

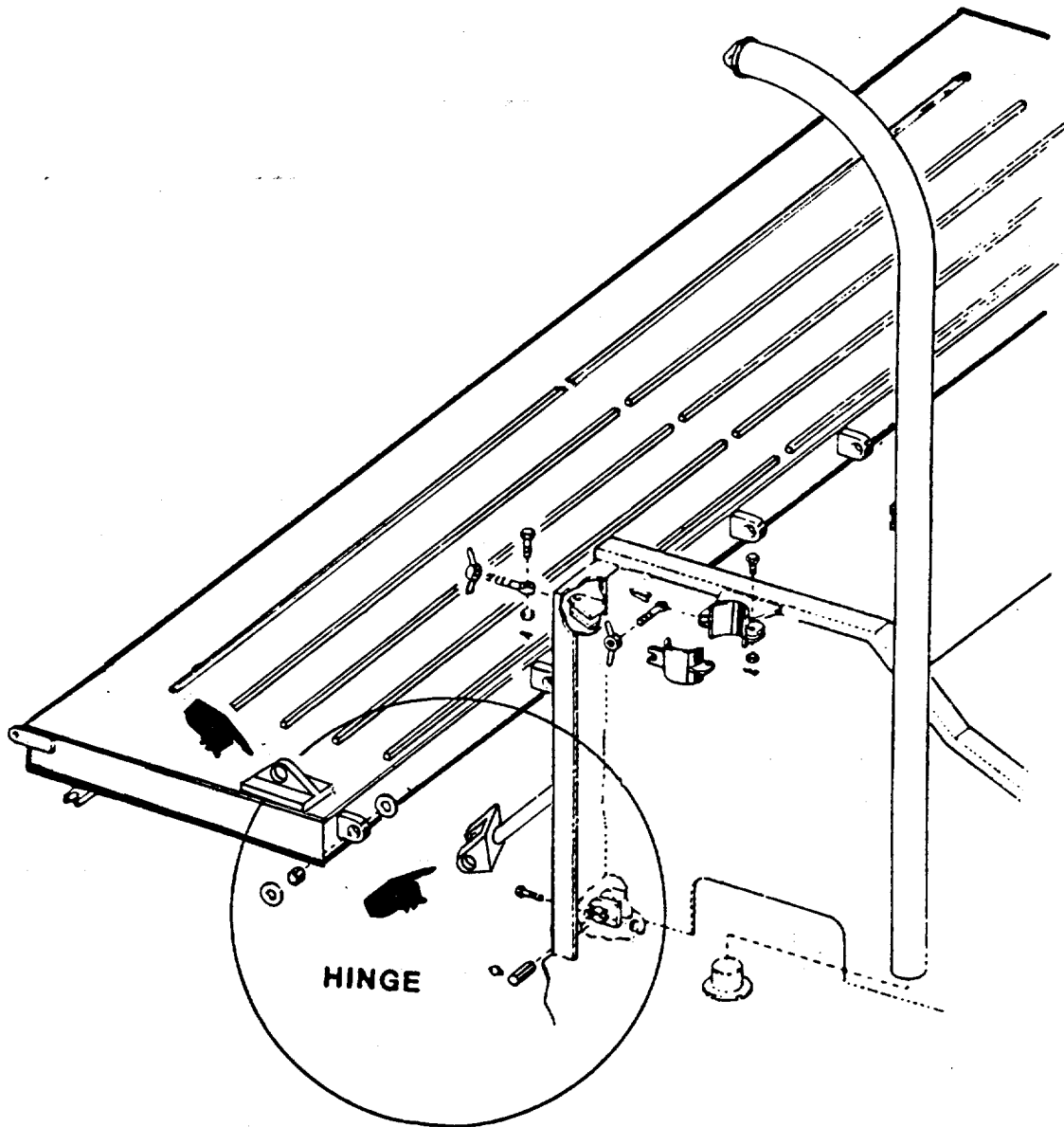
Stern gate	Hinges	Inspect for breaks, cracks, bends, missing or damaged parts.
	Springs	Inspect for breaks, cracks, bends, missing or damaged parts.

3-2110

3-126. GATE, HINGES, AND SPRINGS - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont.)



4954-066

3-127. PORTABLE DAVIT - MAINTENANCE INSTRUCTIONS

This task covers:

a.. Inspection

b. Replacement

INITIAL SETUP

Test Equipment
None

References
None

Special Tools
None

Equipment
Condition Condition Description
None

Material/Parts
Grease MIL-G-10924
Type GAA

Special Environmental Conditions
None

Personnel Required
2

General Safety Instructions
None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | | |
|----|----------------|-------------|--|
| 1. | Clamp assembly | a. Dog bolt | Inspect for missing and damaged parts. |
| | | b. lamp | Inspect for cracked, bent or broken welds. |
| 2. | Davit | | 1. Inspect for bends, dents or breaks in the tubing. |
| | | | 2. Inspect for bad or broken welds. |
| 3. | Chain oist | Chain hoist | Inspect for missing or damaged parts. |

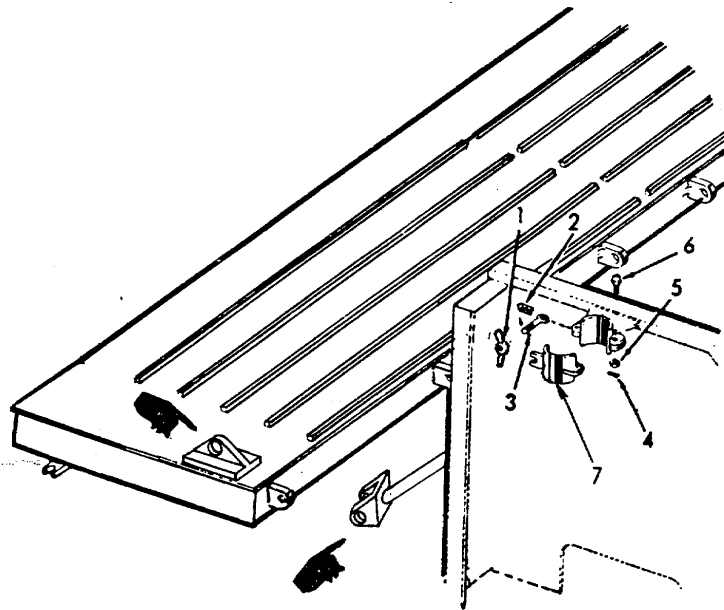
3-2112

3-127. PORTABLE DAVIT - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT (Cont.)

4. Clamp Assembly	a. Dog handle (1)	Unscrew.	
	b. Pin (2), and dog bolt (3)	Remove.	
	c. Cotter pin (4), slotted nut (5), screw (6), and clamp (7)	Disassemble.	

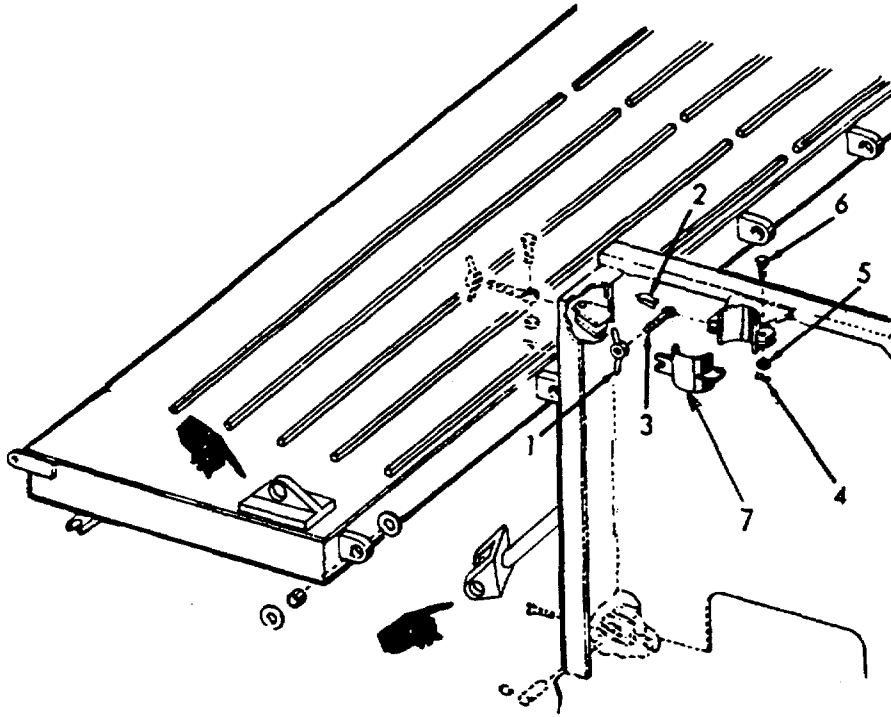


3-127. PORTABLE DAVIT - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT (Cont.)

- | | | | |
|----|--|-------------|-------------------|
| d. | Clamp (7), screws (6), slotted nuts (5), and cotter pins (4) | Reassemble | Grease as needed. |
| e. | Dog Bolts (3), pins (2), and dog handle (1) | Reassemble. | Grease as needed. |



3-128. ANCHOR HANDLING SYSTEM - MAINTENANCE INSTRUCTIONS.

The following is an index to the maintenance procedures:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Winch	3-129
Drive Brake and Brake Control	3-130
Drive Gear	3-131
Level Wind	3-132
Drum Assembly	3-133
Slack Puller	3-134
Disconnect Clutch	3-135
Torque Converter	3-136
Hydraulic Tank Assembly and Piping	3-137
Winch, Brake Control	3-138
Hydraulic Pump, Hoses, Lines and Fittings	3-139
Engine	3-140
Engine Controls	3-141
Governor and Breather Tube	3-142
Air Intake	3-143
Blower	3-144
Fuel Pump	3-145
Fuel Filter and Strainer - Fuel Lines and Manifold Connect	3-146
Fuel Injector	3-147
Lube Oil Filter, Hoses and Housing	3-148
Lube Oil Cooler	3-149
Fresh Water Pump	3-150
Water Connections	3-151
Water Manifold	3-152
Thermostat and Housing	3-153
Overspeed Governor	3-154
Tachometer Drive	3-155
Air Cleaner	3-156
Crankshaft Vibration Dampener	3-157
Balance Weight and Cover	3-158
Engine Supports and Lifting Brackets	3-159
Exhaust Manifold	3-160
Rocker Arm Cover	3-161
Injector Controls	3-162
Oil Pan and Dipstick	3-163
Cylinder Head	3-164
Valve Operating Mechanism	3-165
Camshaft and Gear Train	3-166
Flywheel and Housing	3-167
Lube Oil Pressure Regulator Valve and By-pass	3-168
Lube Oil Pump	3-169
Lube Oil Distribution System	3-170
Pistons, Connecting Rods, Cylinder Liner	3-171

3-128. ANCHOR HANDLING SYSTEM - MAINTENANCE INSTRUCTIONS.
(Continued).

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Crankshaft and Main Bearings	3-172
Cylinder Block	3-173
Instrument Panel	3-174
Starting Aid	3-175
Hydrostarter - Hydrotor	3-176
Accumulator	3-177
Hydrostarter Pump (Engine Driven)	3-178
Hydraulic Pump (Hand)	3-179
Reservoir	3-180
Hydraulic Filter and Hoses	3-181
"A" Frame, Wire Rope and Anchor	3-182
Fairleader	3-183
Wire Rope Cutter	3-184

3-2116

3-129. WINCH - MAINTENANCE INSTRUCTIONS

This task covers:

- a.. Inspection b. Service c. Repair

INITIAL SETUP

Test Equipment

None

References

Paragraph

Special Tools

None

- 3-130 Drive Brake Service
- 3-132 Level Wind Service
- 3-133 Drum Assembly Service
- 3-134 Slack Puller Service
- 3-135 Disconnect Clutch Service

Material/Parts

Grease MIL-G-81322
Type GH

Equipment

Condition Condition Description

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe Safety Regulations.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | | |
|----|--------------------------|----------------|--|
| 1. | Universal joint assembly | a. Bearings | Inspect for broken, loose or missing hardware. |
| | | b. Cross | <ul style="list-style-type: none"> 1. Inspect for looseness and wear in bearing housing. 2. Inspect for leaking seals. |
| | | c. Drive shaft | Inspect for wear, breaks and cracks. |

3-2117

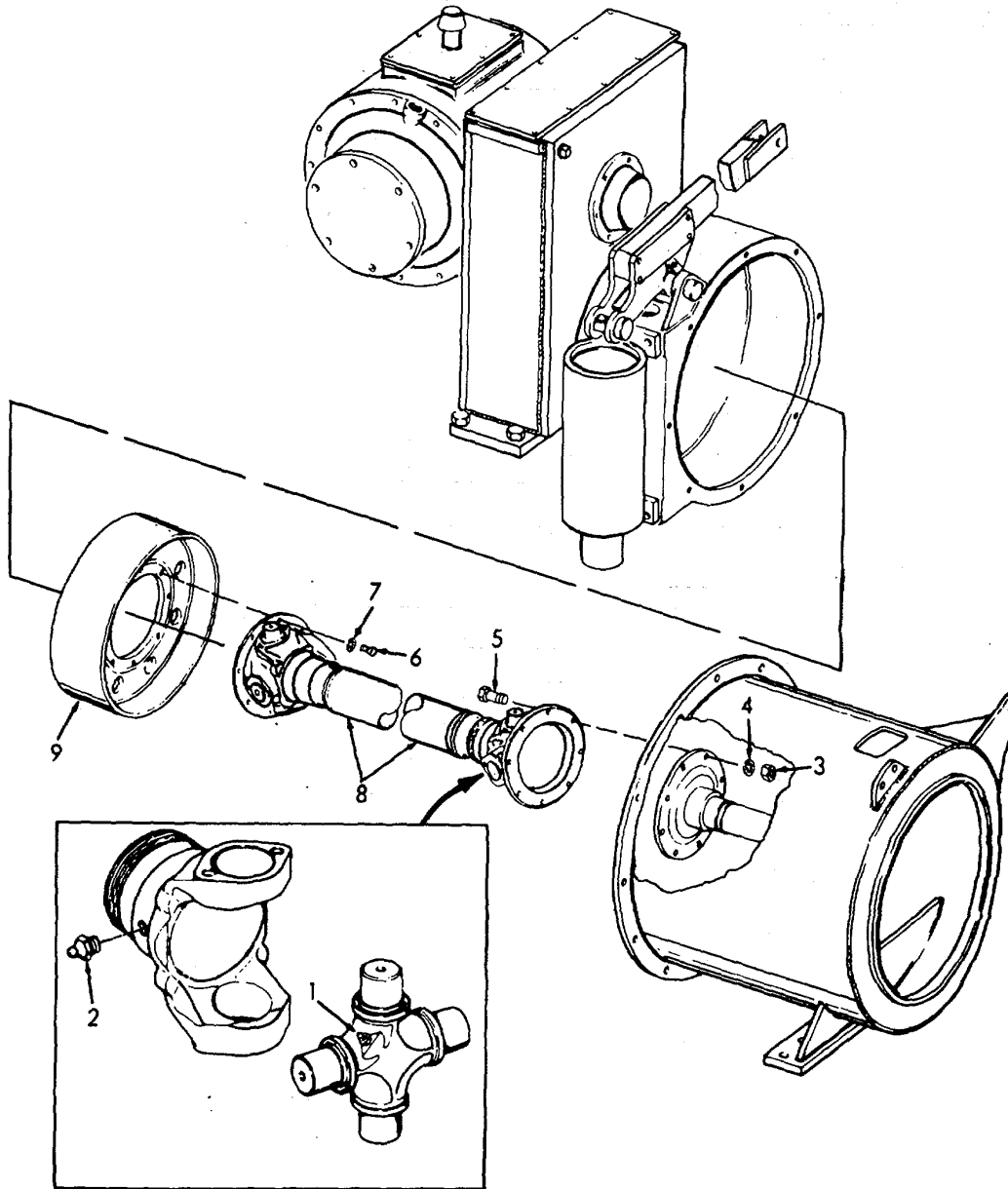
3-129. WINCH - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont.)			
	d. Yoke grease.	Inspect for leaking	
	e. Hard ware	Ensure all hardware is tight.	
SERVICE			
2. Cross	Grease fitting (1)	Grease in two places.	
3. Yoke	Grease fitting (2)	Grease in one place.	
REPAIR			
4. Universal joint assembly	a. Eight nuts (3), lock-washers (4) and screws (5)	Remove.	
	b. Eight screws (6), and lockwash-ers (7)	Remove.	
	c. Universal joint assembly (8)	Lift out and remove.	
	d. Brake drum (9)	Remove.	

3-129. WINCH - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)



3-129. WINCH - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
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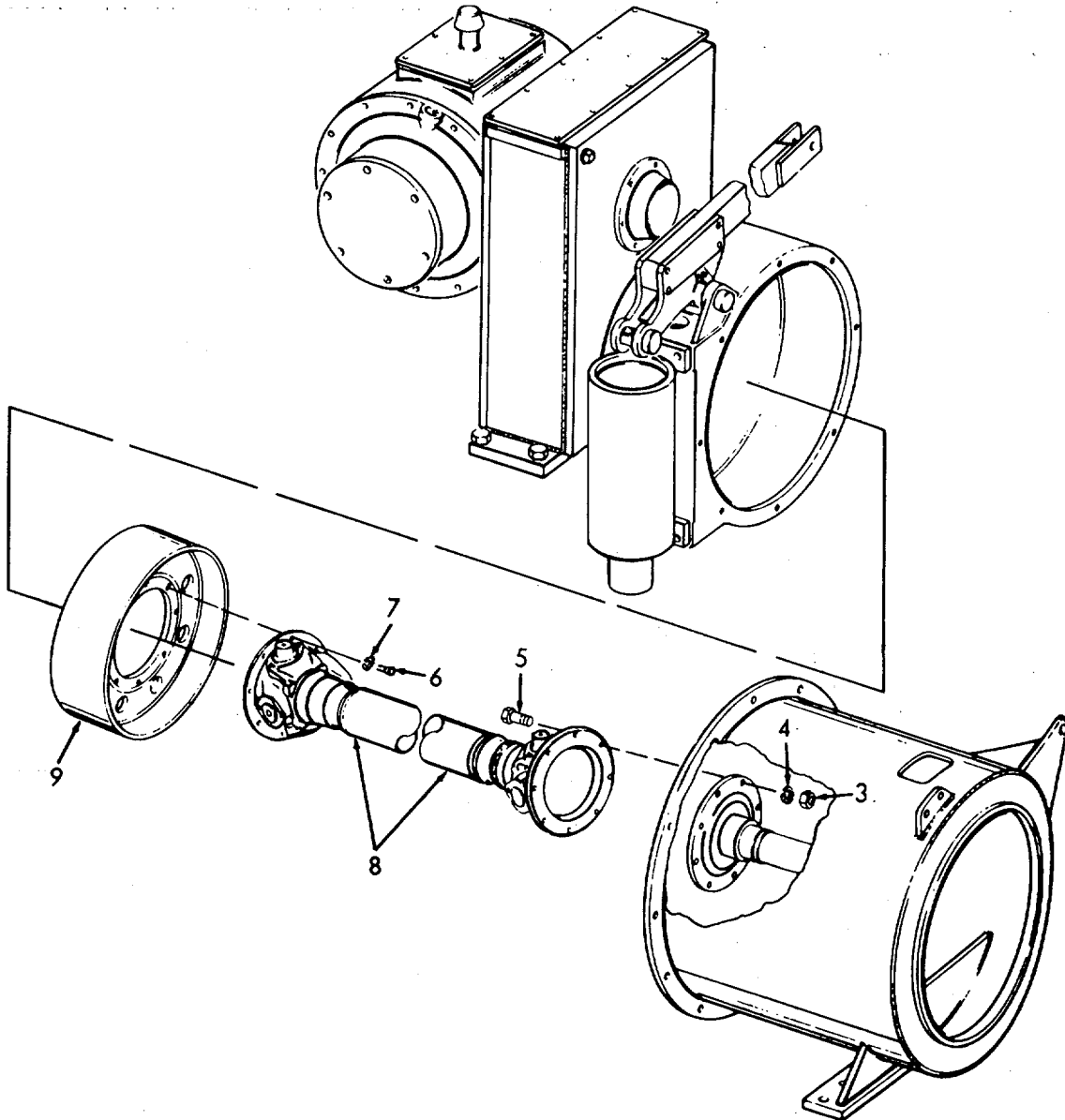
REPAIR (Cont.)

- | | | | |
|----|---|---|--|
| e. | Brake drum (9) | Install in brake housing. | |
| f. | Universal Install. joint assembly (8) | | |
| g. | Screws (6), and lock-washers (7) | Align holes in brake drum, and universal joint assembly, and install screws and washers. | |
| h. | Screw (5), lock-washer (4), and nut (3) | Align holes in universal joint assembly, and disconnect clutch flange and install screws, washers, and nut. | |

3-129. WINCH - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont.)



3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Service
- c. Replacement
- d. Repair
- e. Adjustment

INITIAL SETUP

Test Equipment
None

References
Paragraph

3-139 Hydraulic Piping

Special Tools
"C" Clamp

Equipment Condition Condition Description
3-129 Universal Joint Assembly and Brake Wheel Removal

Material/Parts
Grease MIL-G-81322
Type GAA

Special Environmental Conditions
None

Personnel Required
1

General Safety Instructions
None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

1. Drive brake	a. Hydraulic tubing	Inspect for leaks, breaks, cracks, and bends.	Replace. Refer to paragraph 3-139.
	b. Cylinder	Inspect for dents, cracks, breaks, and leaking.	
	c. Lever and double Toggle	Inspect for breaks, bends, cracks, and binding.	
	d. All parts	Check that all hardware is tight.	

3-2123

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS.
(Continued).

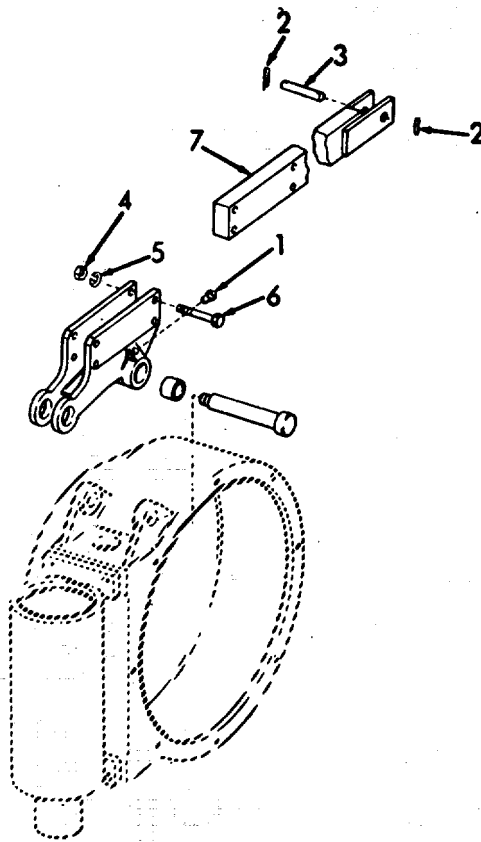
LOCATION	ITEM	ACTION	REMARKS
SERVICE			
2.	Grease fitting	Fitting (1)	Grease.
REPLACEMENT			
3.	Drive brake lever	a. Cotter pins (2), and lever pin (3)	Remove.
		b. Nuts (4), lock-washers (5), and screws (6)	Remove.
		c. Drive brake lever (7)	Remove.
		d. Drive brake lever (7)	Install.
		e. Screws (6), lock-washers (5), and nuts (4)	Install.

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS.
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT (Cont.)

- | | | | |
|----|-----------------------------------|----------|--|
| f. | Lever pin (3) and cotter pins (2) | Install. | |
|----|-----------------------------------|----------|--|

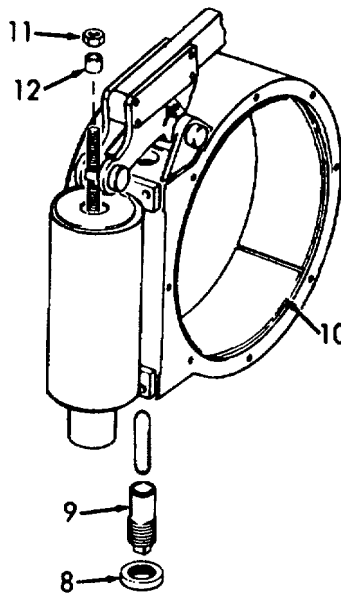


3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS.
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT (Cont.)

- | | | |
|------------------|--|---|
| 4. Double toggle | a. Anchor pin lock-nut (8), and adjusting plug (9) | Loosen to relieve tension on brake band (10). |
| | b. Nut (11), and spacer (12) | Remove |

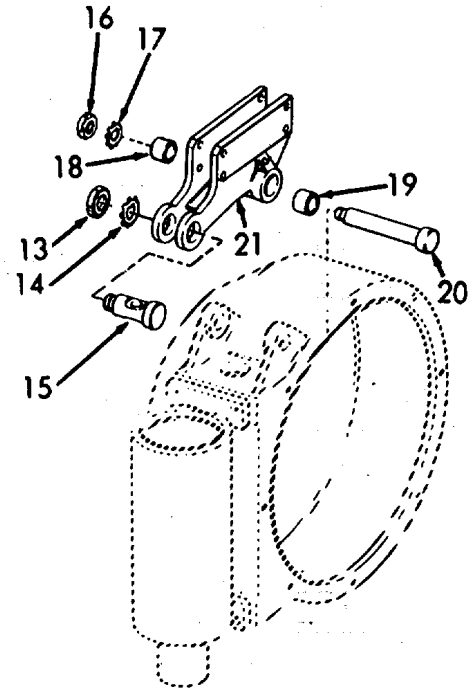


3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT (Cont.)

- c. Nuts (13), lock-washers (14), and lug pin (15) Remove.
- d. Nuts (16), lock-washers (17), bushings (18 and 19), and pivot pins (20) Remove.
- e. Double toggle (31) Remove.



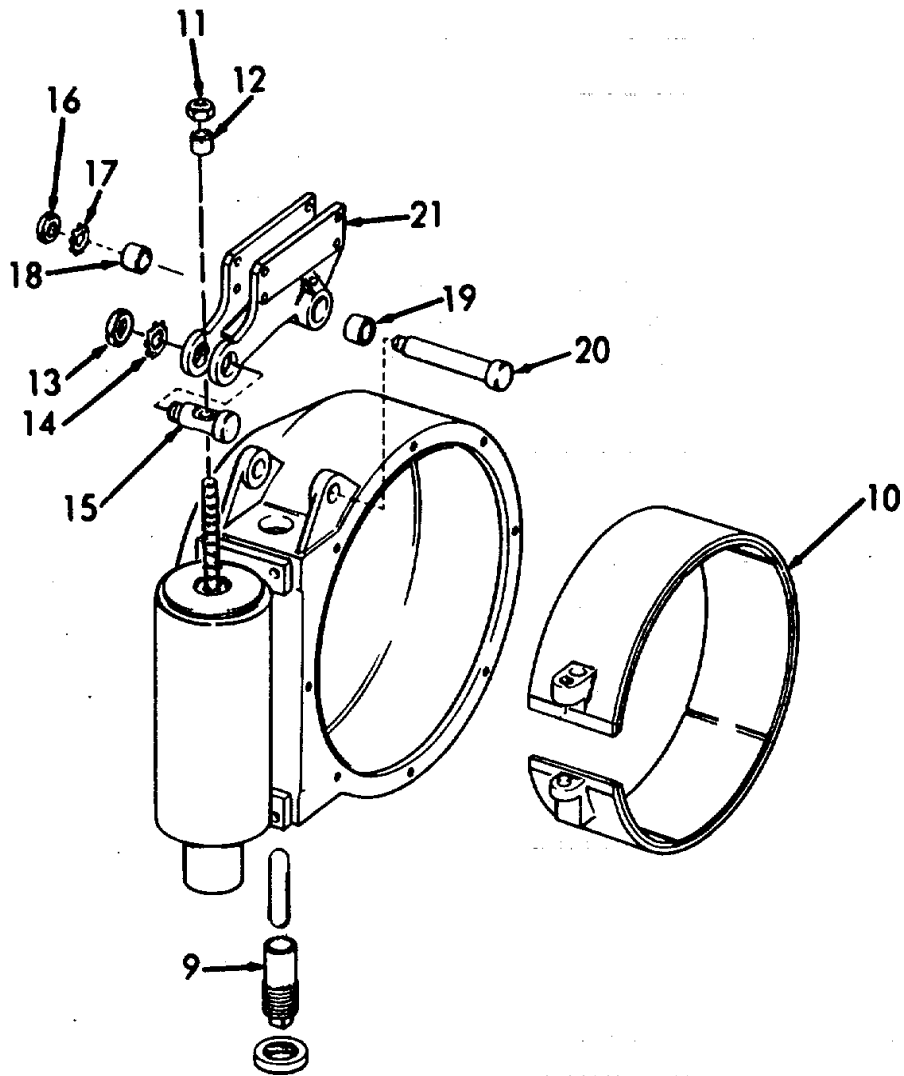
3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REPLACEMENT (Cont.)</div>	f. Double toggle (21)	Replace.	
	g. Pivot pin (20), bushings (19 and 18), lock-washers (17), and nuts (16)	Replace.	
	h. Lug pin (15), lock-washer (14), and nut (13)	Replace.	
	i. Spacer (12), and nut (11)	Replace.	
	j. Adjusting plug (9) on brake band (10)	Adjust.	Refer to step 10.

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont.)



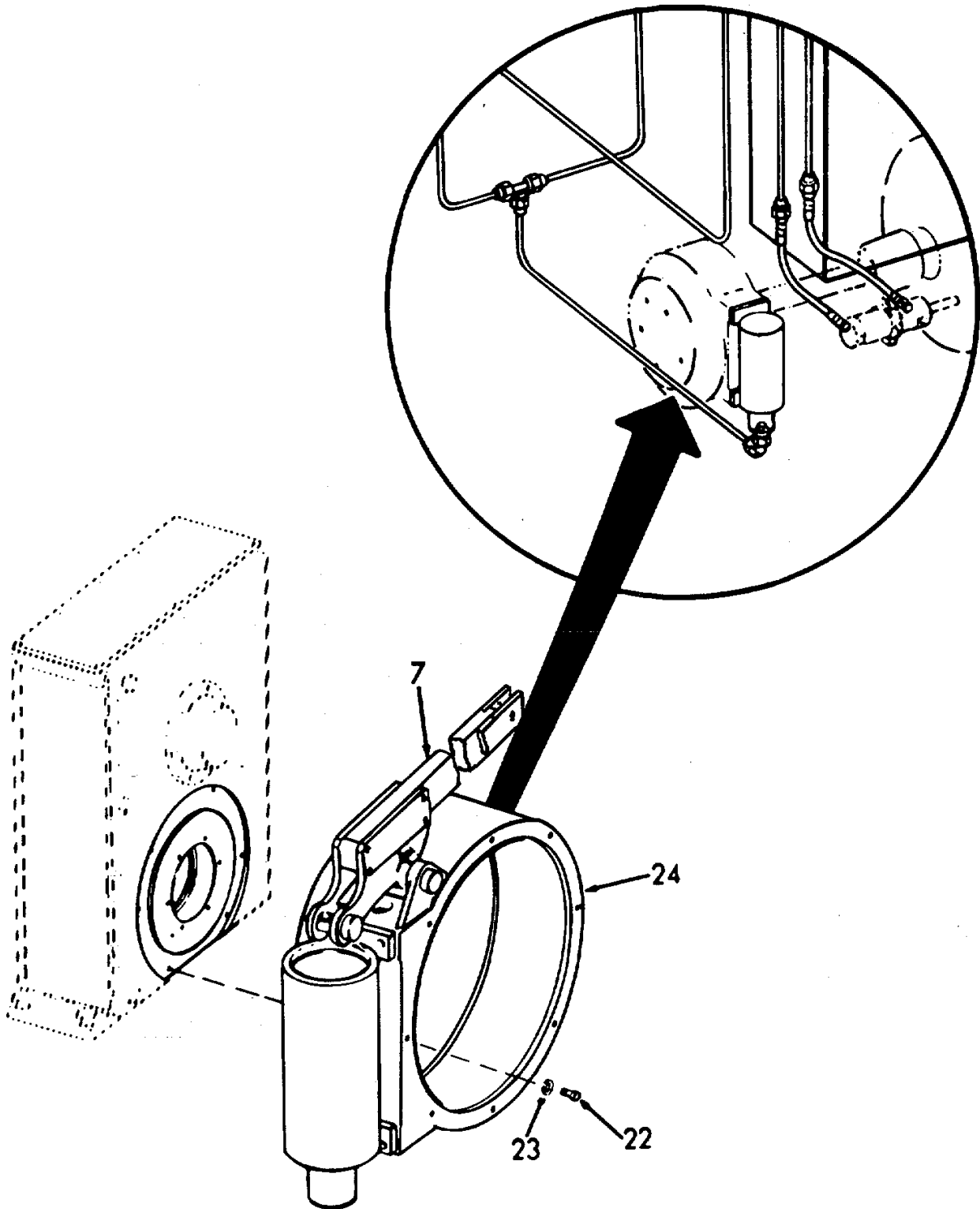
3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACEMENT (Cont.)			
5.	Drive brake housing	a. Hydraulic tubing	Disconnect. Refer to paragraph 3-139.
		b. Drive brake lever (7)	Remove. Refer to step 3.
		c. Six screws (22), and lock-washers (23)	Remove.
		d. Drive brake housing (24)	Remove.
		e. Drive brake housing (24), screw (22), and lock-washers (23)	Install.
		f. Drive brake lever (7)	Install. Refer to step 3.
		g. Hydraulic tubing	Reconnect. Refer to paragraph 3-139.

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

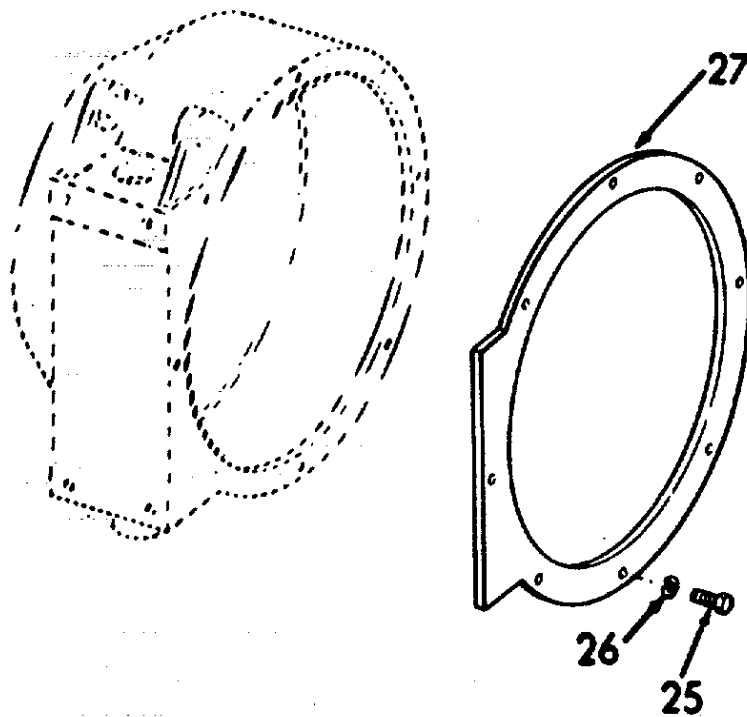
LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont.)



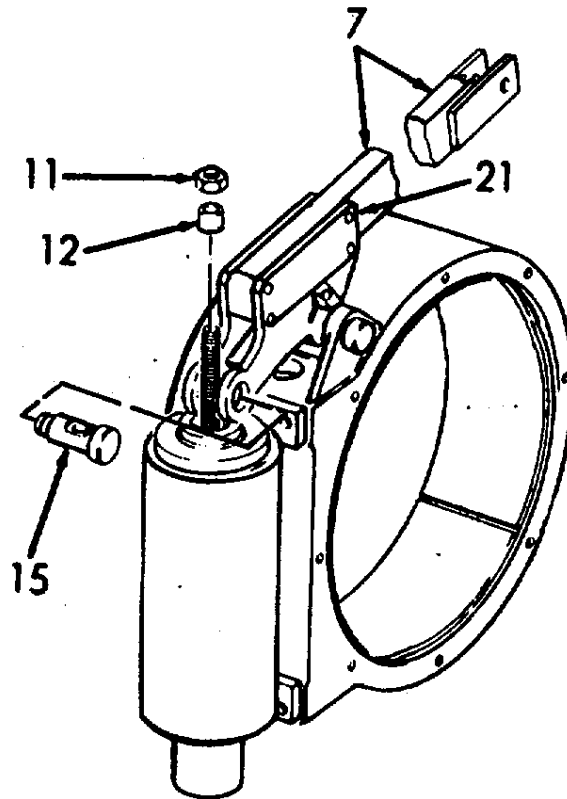
3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACEMENT (Cont.)			
6. Drive brake cover	a. Screws (25), and lock- washers (26)	Remove.	
	b. Cover (27)	Remove.	
	c. Cover (27), screws (25), and washers (26)	Install.	



3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
7. Drive brake cylinder	a. Adjusting nut (11), and spacer (12)	Remove.	
	b. Drive brake lever (7)	Remove.	Refer to step 3.
	c. Double toggle (21), and lug pin (15)	Remove.	Swing toggle up to lift lug pin off of rod.



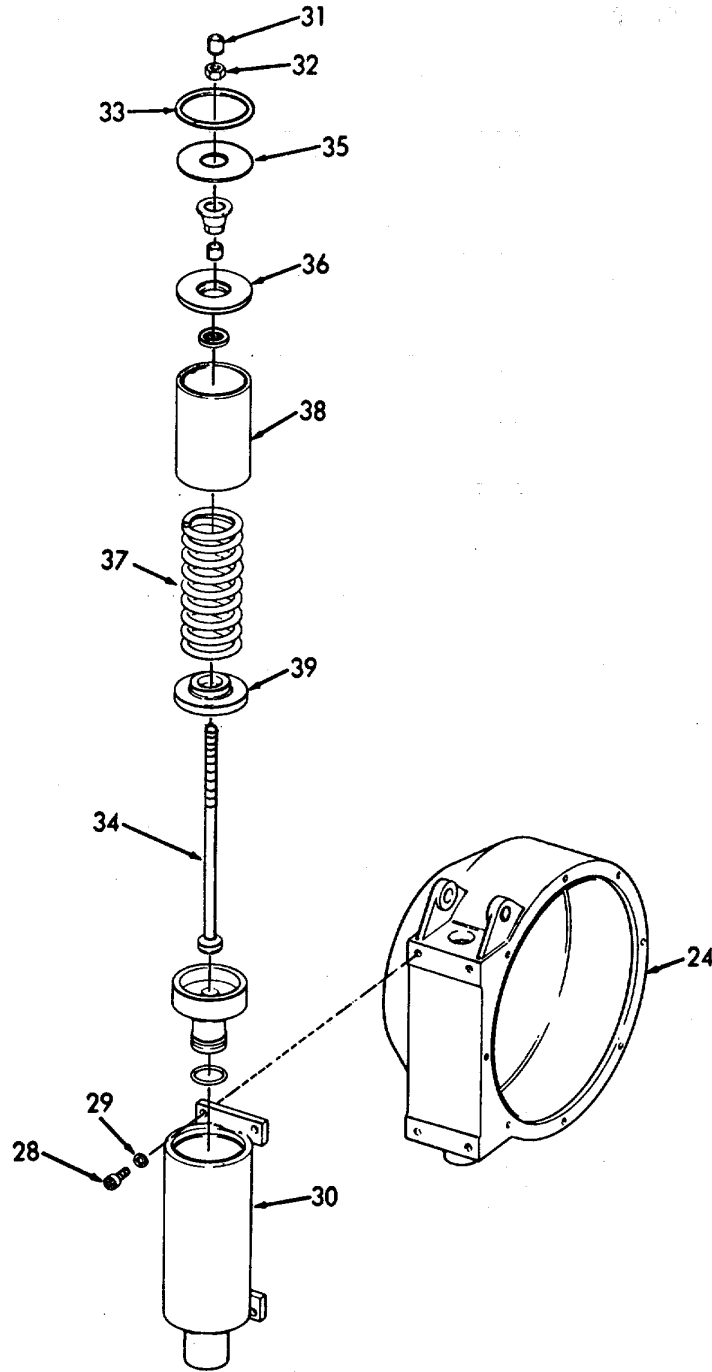
3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REPAIR (Cont.)</div>	d. Screws (28), and lock-washers (29)	Remove.	
	e. Cylinder (30)	Separate from housing (24).	
	f. Spacer (31), and adjusting nut (32)	Remove.	
	g. Cylinder (30)	Clamp cylinder so that rod faces downward.	
	h. Snap ring (33)	Remove.	
	i. Cylinder (30)	Release "C" clamp and allow spring to expand.	
	j. Piston rod (34), seal retain-er (35), endplate (36), and asso-ciated parts, spring (37), spacer (38), and spring piston (39)	1. Remove as one assembly. 2. Disassemble.	

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)



3-2135

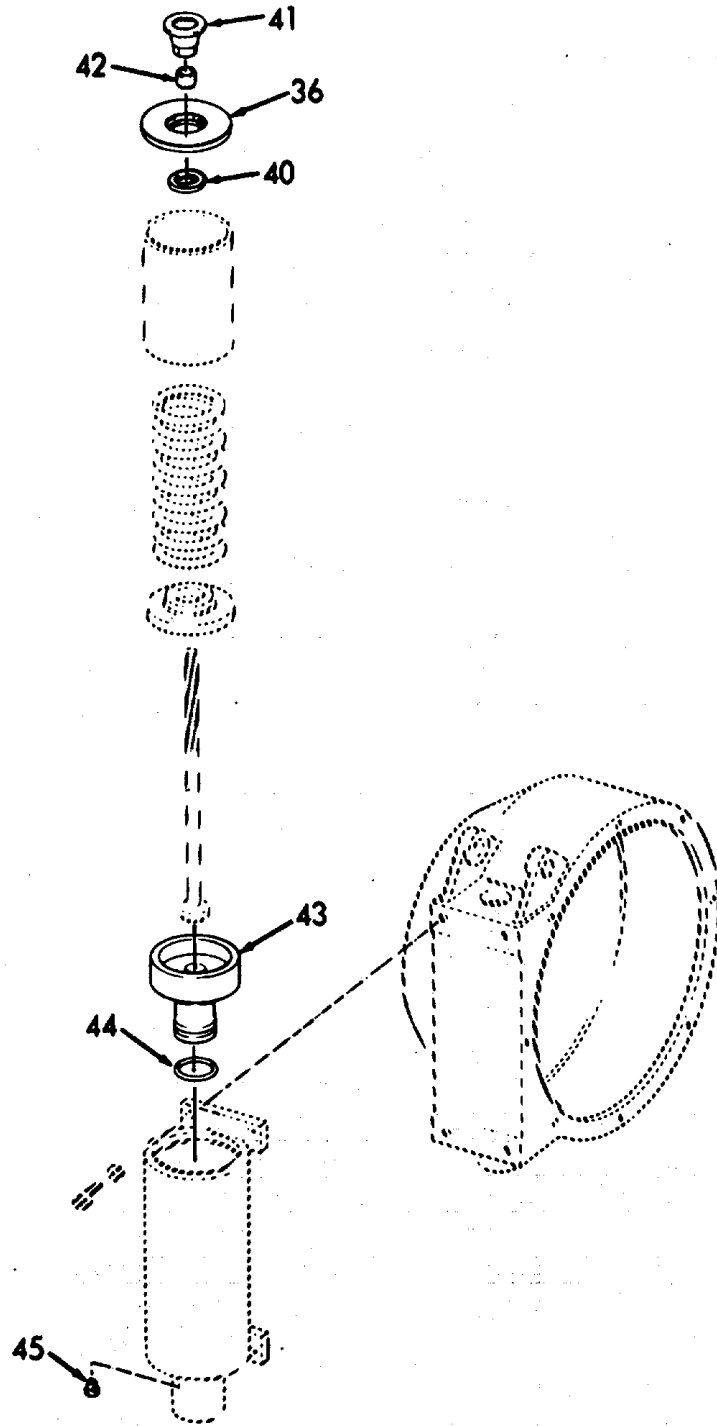
3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont.)	k. Seal clamp (40), neoprene seal (41), and bushing (42)	Disassemble from end plate (36).	
	l. Piston (43), and pre-formed packing (44)	Remove.	
	m. Pipe plug (45)	Remove if necessary.	
	n. Pre-formed packing (44), and piston (43)	Replace. Lubricate with hydraulic fluid.	
	o. End plate (36), neoprene seal (41), bushing (42), and seal clamp (40)	Install.	

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)



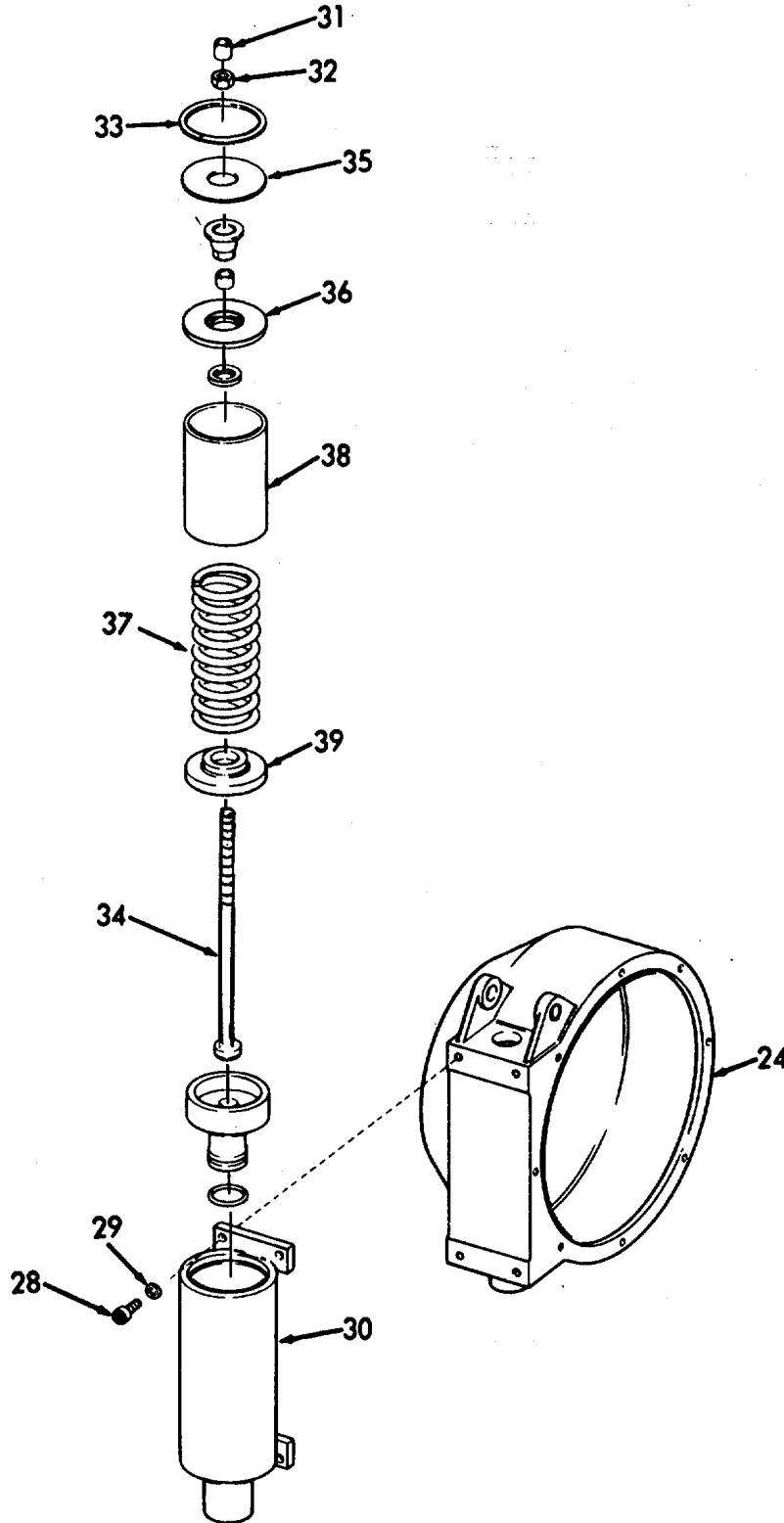
3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont.)	p. Piston rod (34), spring piston (39), spacer (38), spring (37), assembled endplate (36), and retainer (35)	Reassemble and place in cylinder (30).	
	q. Cylinder (30), and snap ring (33)	Clamp and tighten to install seal ring. Then, remove clamp.	
	r. Adjusting nut (32), and spacer (31)	Install.	
	s. Cylinder (30), screws (28), and lock-washers (29)	Install onto housing (24).	

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)



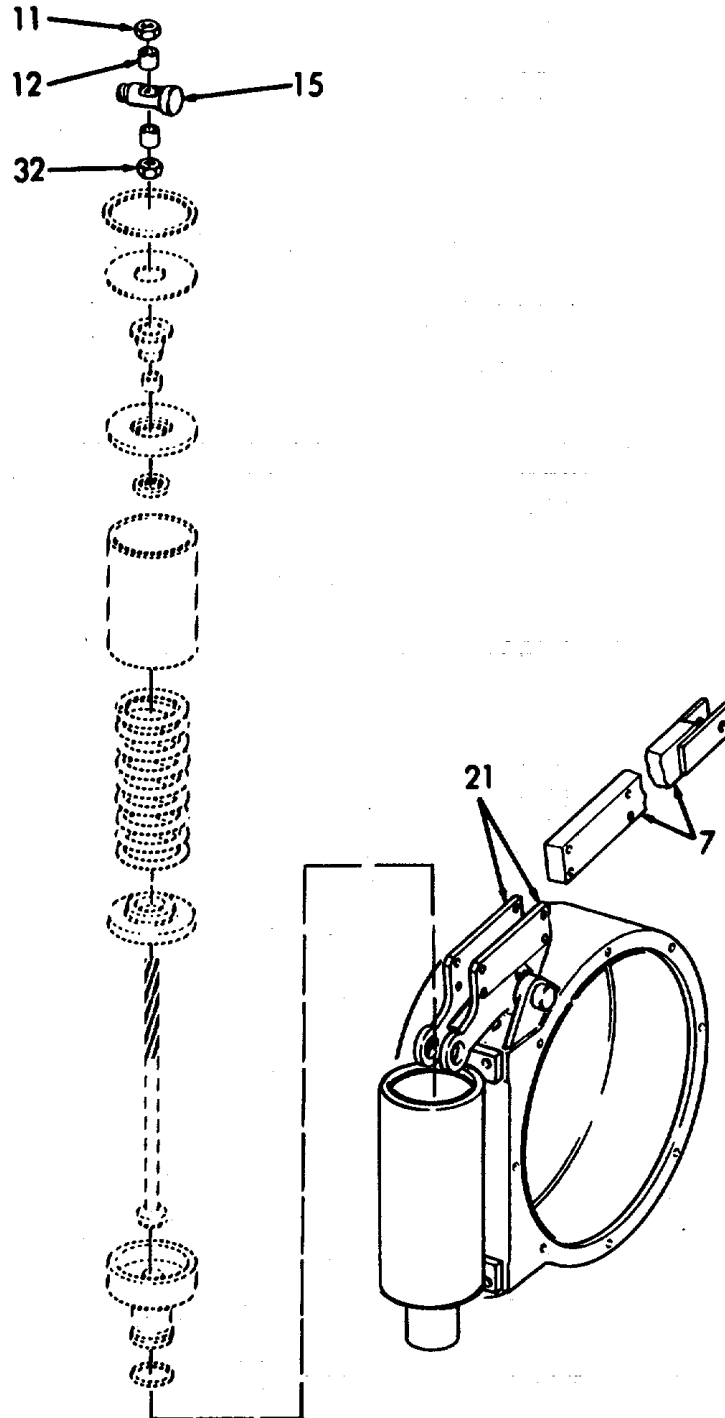
3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REPAIR (Cont.)</div>	t. Lug pin (15), and double toggle (21)	Install.	
	u. Drive brake lever (7)	Install.	Refer to step 3.
	v. Spacer (12), and adjusting nut (11)	Install.	
	w. Adjusting nuts (11 and 32)	Adjust.	Refer to step 11.
3-2140			

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)



3-2141

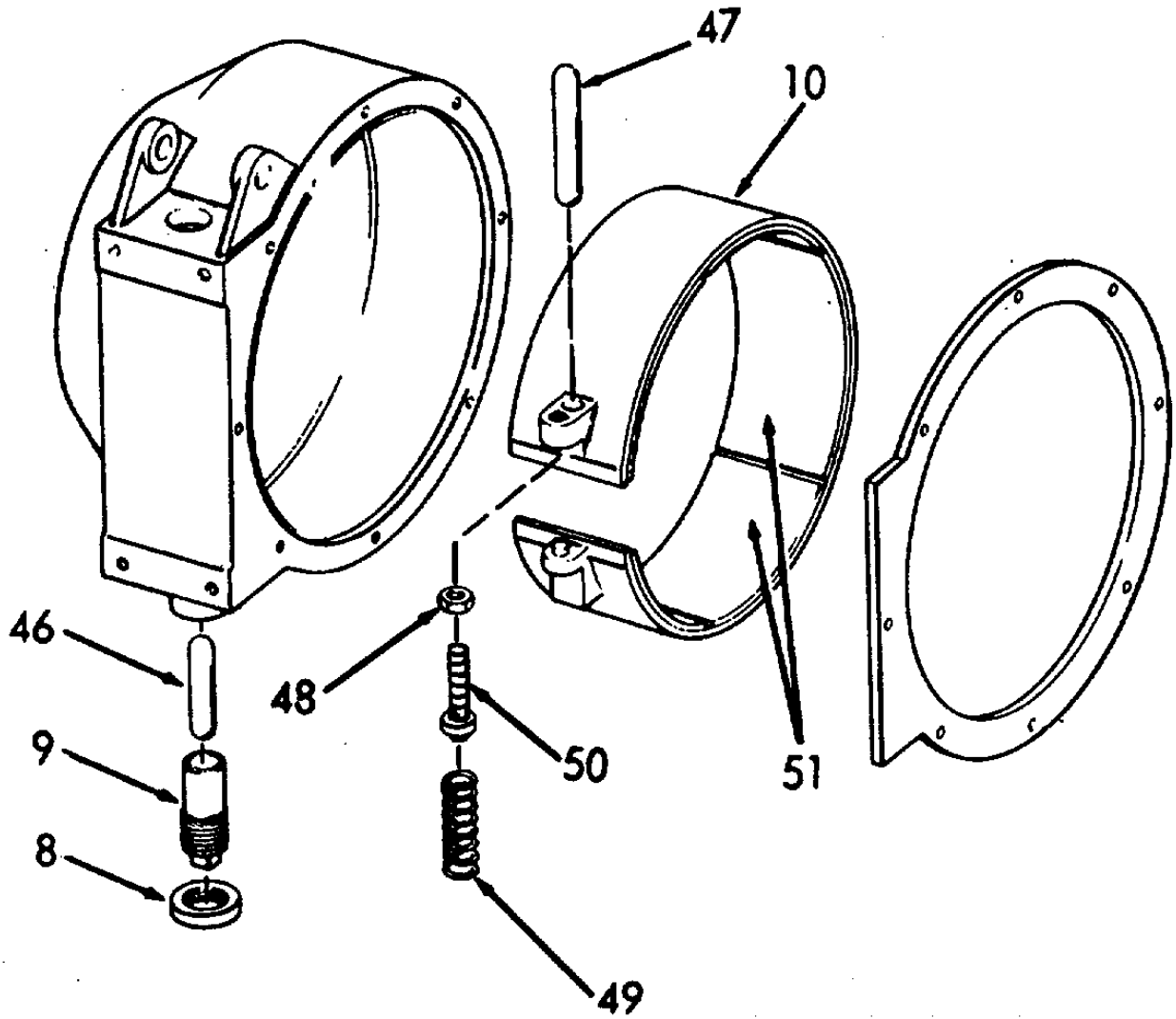
3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont.)			
8. Brake	a. Anchor pin lock-nut (8), adjusting pin (9), and anchor pin (46)	Remove.	
	b. Brake band (10)	Lift and rotate.	
	c. Brake band (10), and operating pin (47)	Remove.	
	d. Nut (48)	Loosen.	
	e. Spring (49), adjusting screw (50), and nut (48)	Remove.	
	f. Brake linings (51)	Replace if necessary.	

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-2143

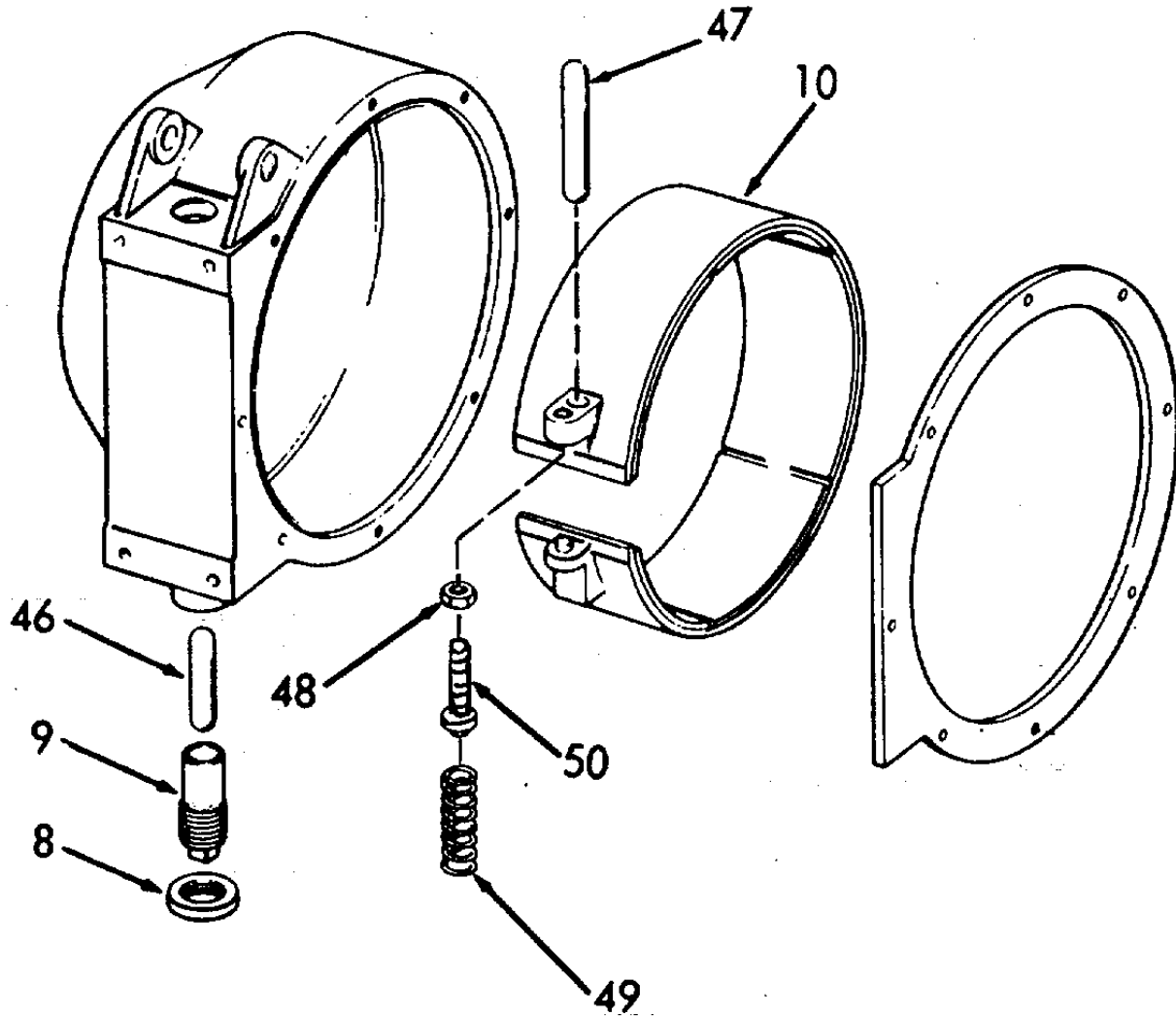
3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont.)	g. Nut (48), adjusting screw (50), and spring (49)	1. Assemble and install in brake band (10).	
	h. Operating pin (47), and brake band (10)	Install.	
	i. Anchor pin (46), adjusting (9), and anchor lock-nut (8)	Install.	
	j. Adjusting screw (50)	Adjust.	Refer to step 10.
		3-2144	

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)



3-2145

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

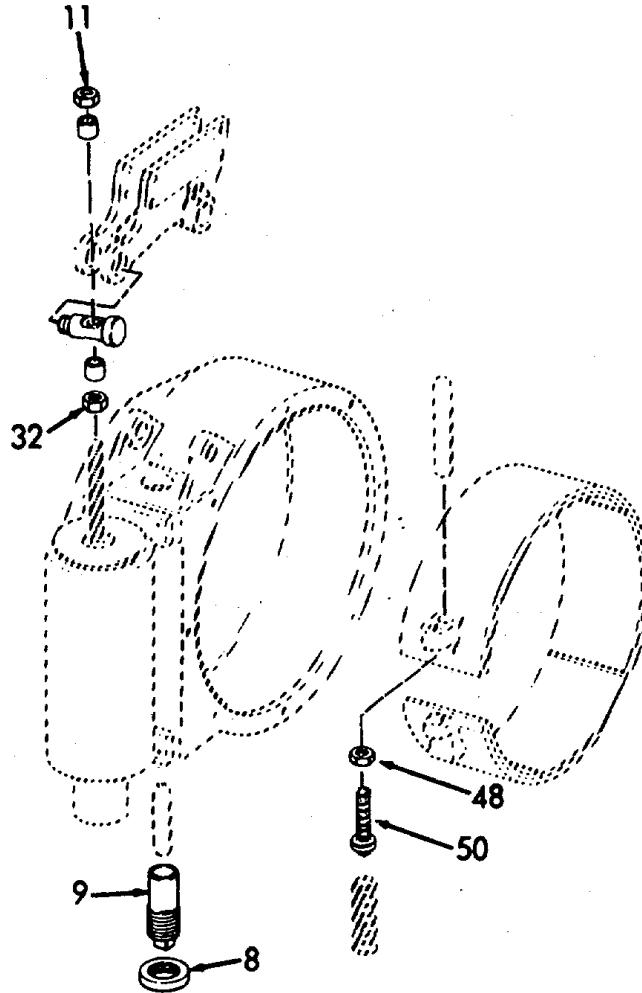
LOCATION	ITEM	ACTION	REMARKS
ADJUSTMENTS			
9.	Brake band adjusting screw	Screw (50), and locknut (48)	<ol style="list-style-type: none"> 1. Place brake drum down in brake band. 2. Adjust screw so that drum fits snugly. 3. Tighten locknut. 4. Remove brake drum.
NOTE			
The following adjustments must be made when the anchor winch is fully assembled and operational.			
10.	Anchor pin adjusting plug	Adjusting plug (9), and locknut (8)	Adjust so that when the foot brake is depressed, the brake drum will not rotate.
11.	Cylinder	Adjusting nuts (11 and 32)	Adjust so that brake drum will not rotate when the engine is operating.

3-2146

3-130. DRIVE BRAKE AND BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENTS (Cont)



3-2147

3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
This task covers:			
	a. Inspection	b. Repair	
<u>INITIAL SETUP</u>			
	<u>Test Equipment</u>	<u>References</u>	
	None	None	
		Equipment	
	<u>Special Tools</u>	<u>Condition</u> <u>Condition Description</u>	
	None	None	
	<u>Material/Parts</u>	<u>Special Environmental Conditions</u>	
	Permatex #2	None	
	<u>Personnel Required</u>	<u>General Safety Instructions</u>	
	1	None	

LOCATION	ITEM	ACTION	REMARKS
INSPECTION			
1.	Drive gear	a. Gaskets	Inspect for leaks, cracks, and deterioration. Replace.
		b. Breather	Inspect for cracks, breaks, and damage. Replace.
		c. Hydraulic hose	Inspect for cracks, breaks, leaks and deterioration. Replace.
		d. Tubing	Inspect for cracks, breaks, bends and leaking. Replace.
3-2149			

3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS (Continued).

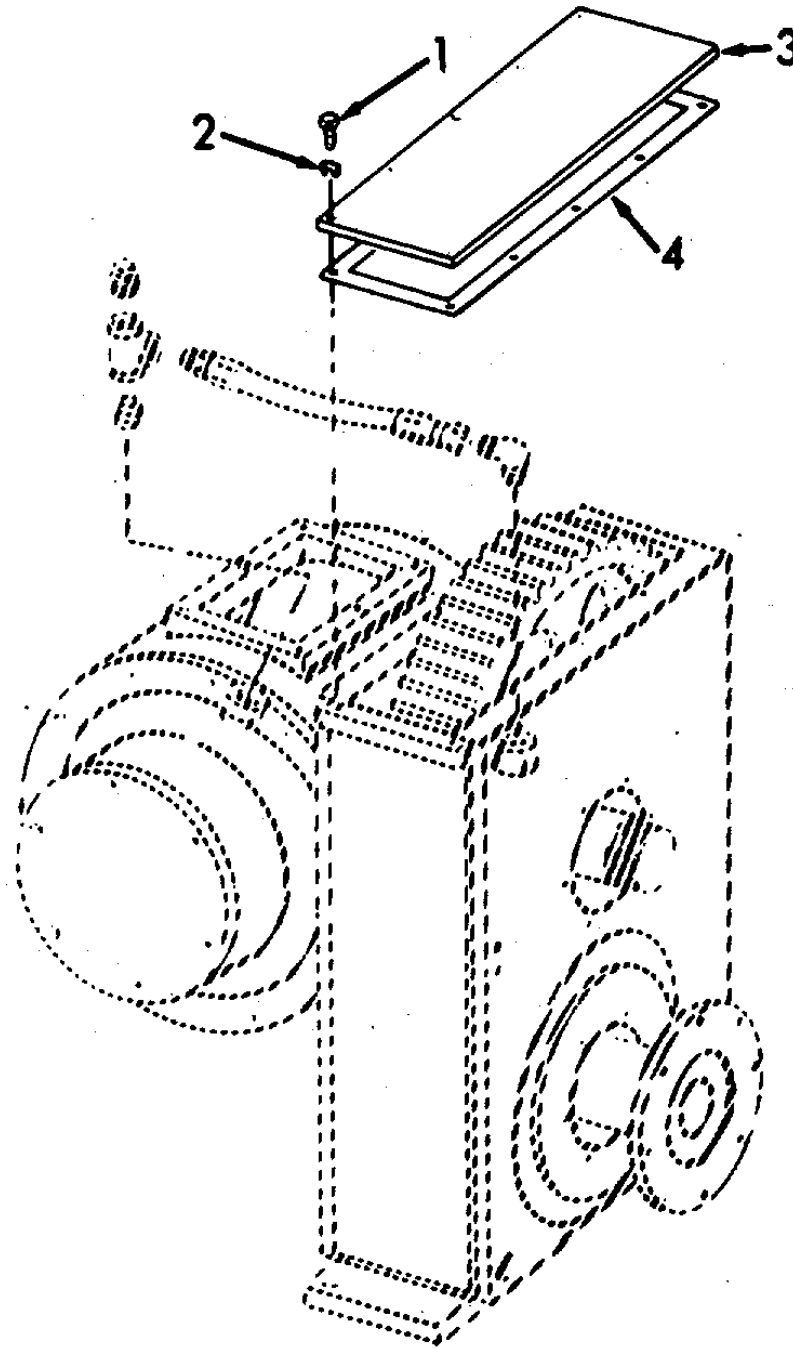
LOCATION	ITEM	ACTION	REMARKS	
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REPAIR</div>	2. Drive gear cover	a. Ten screws (1), lock-washers (2), cover (3), and gasket (4)	Remove.	Discard gasket.
	b. Gasket (4)	1. Remove all traces of the old gasket. 2. Attach new gasket with Permatex.		
	c. Cover (3), screws (1), and lock-washers (2)	Install.		

3-2150

3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)



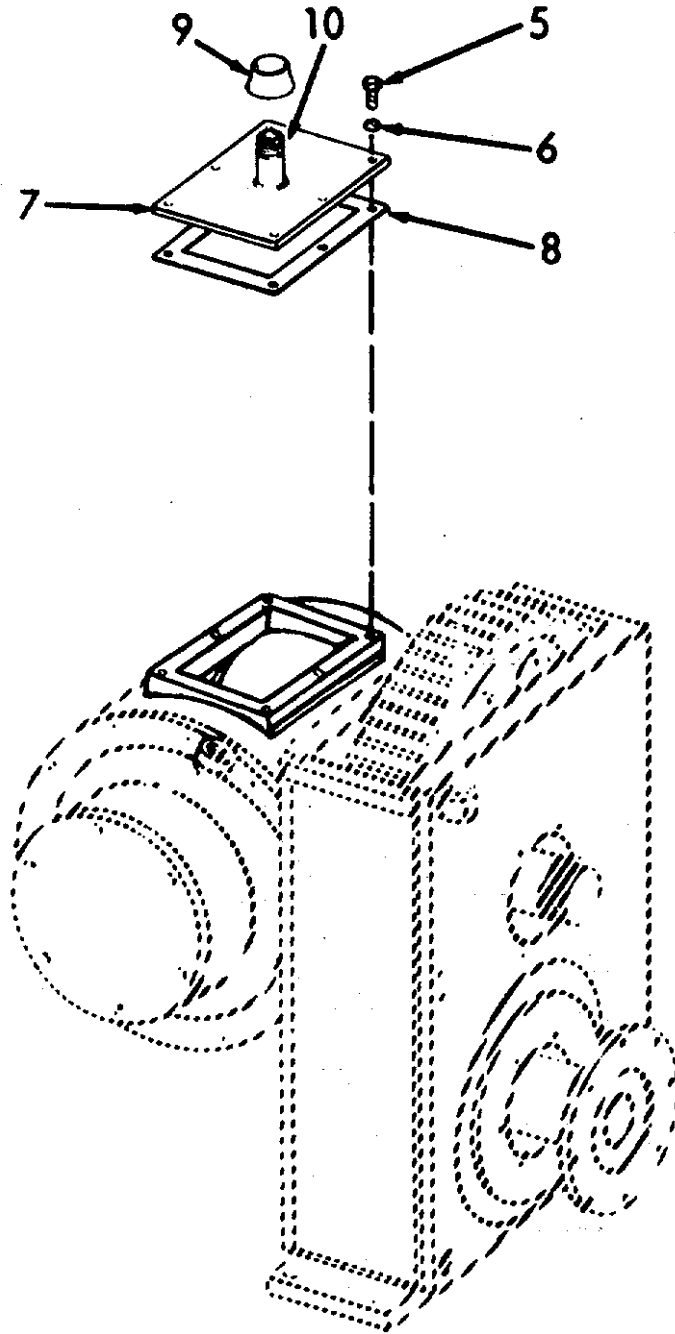
3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont.)			
3. Breather Cover	a. Six screws (5), lock-washers (6), cover (7), and gasket (8)	Remove.	Discard gasket.
	b. Breather cap (9), and pipe nipple (10)	Disassemble.	If necessary.
	c. Gasket (8)	1. Remove all traces of old gasket. 2. Attach new gasket with Permatex.	
	d. Cover (7), screws (5), and lock-washers (6)	Install.	

3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)



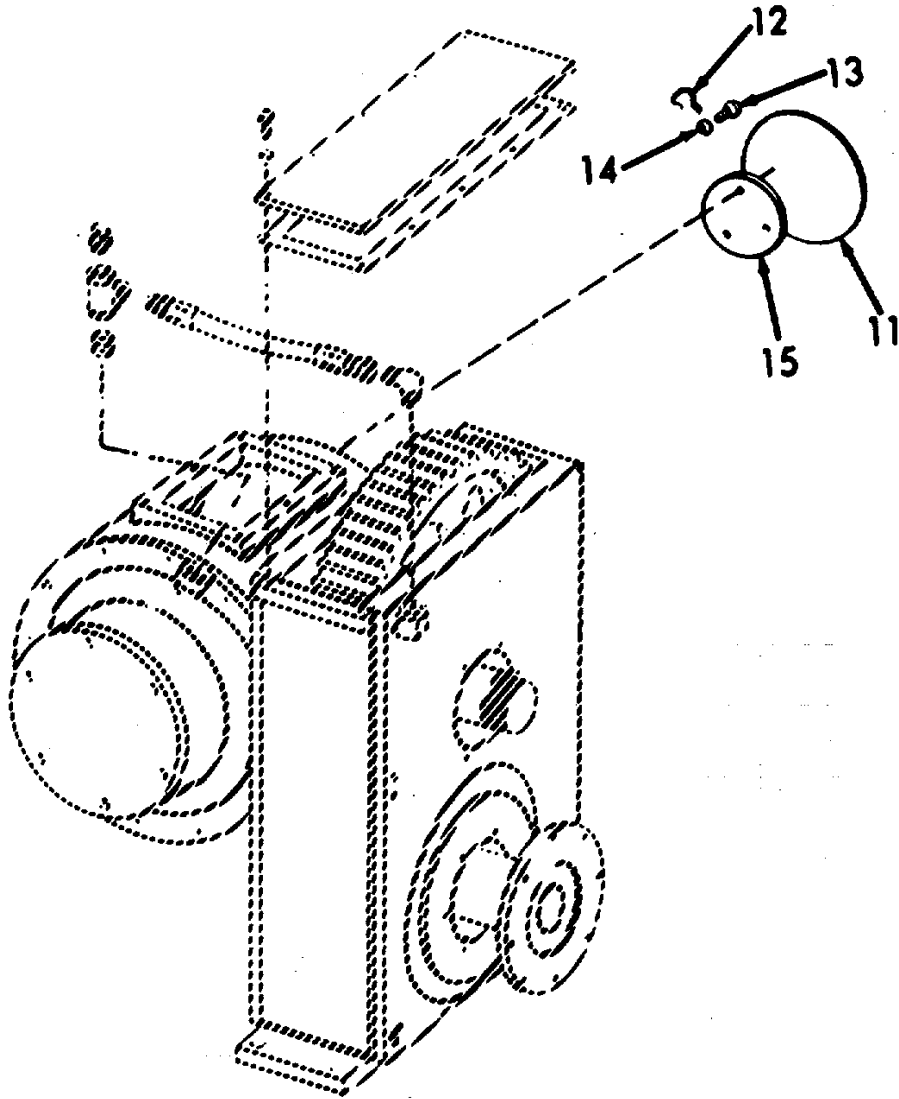
3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont.)			
4. Bearing seal cover	a. Bearing seal cover (11)	Remove.	
	b. Lockwire (12), screws (13), lock-washers (14), and bearing retaining cover (15)	Remove.	
	c. Cover (15), screws (13), and lock-washers (14)	Install.	
	d. Lockwire (12)	Lockwire three screws securely.	
	e. Bearing seal cover (11)	Install.	Tap gently into place with a mallet.

3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS (Continued).

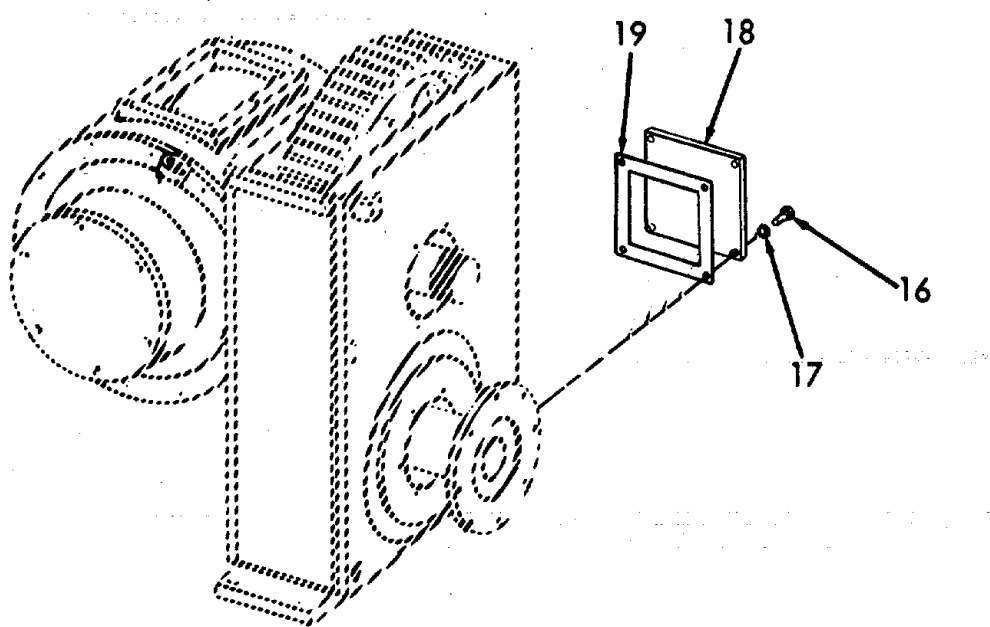
LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)



3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont.)			
5. Side Cover	a. Four screws (16), lock-washers (17), side cover (18), and gasket (19)	Remove.	Discard gasket.
	b. Gasket (19)	1. Remove all traces of old gasket. 2. Attach new gasket with Permatex.	
	c. Side cover (18), lock-washers (17) and screws (16)	Install.	

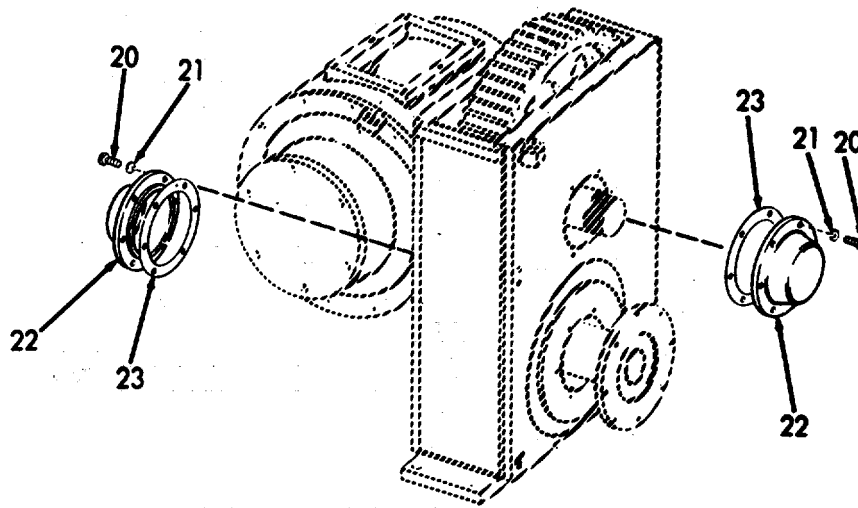


3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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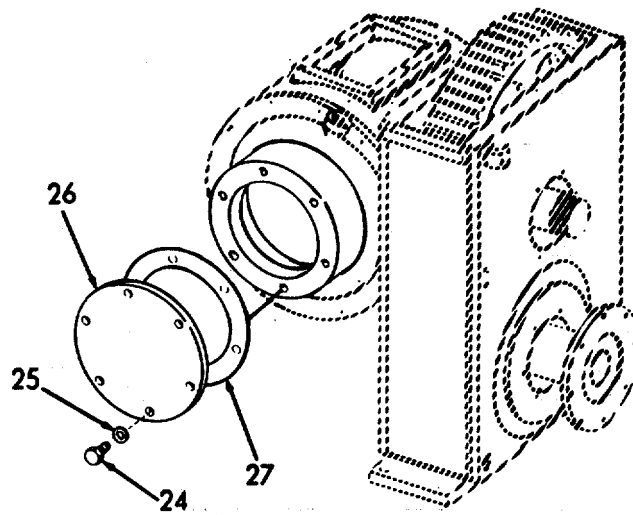
REPAIR (Cont)

- | | | | |
|-------------------|---|--|-----------------|
| 6. Bearing covers | a. Screws (20), lock-washers (21), cover (22) and gasket (23) | Remove | Discard gasket. |
| | b. Gasket (23) | <ol style="list-style-type: none"> 1. Remove all traces of old gasket. 2. Attach new gasket with Permatex. | |
| | c. Cover (22), lock-washers (21), and screws (20) | Install. | |



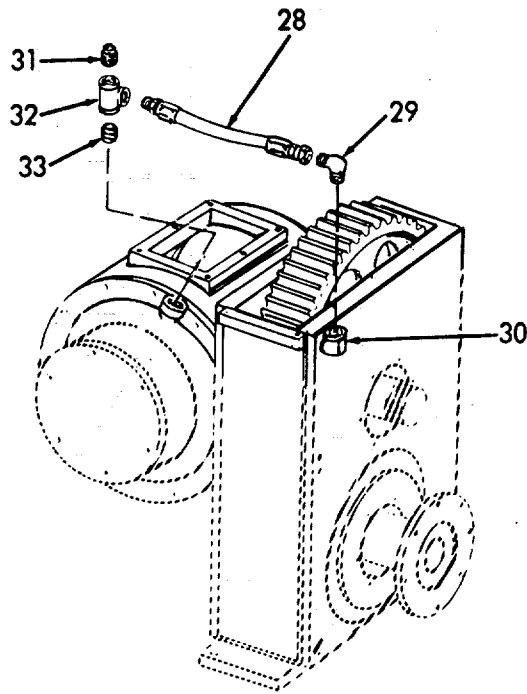
3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REPAIR (Cont)</div>	7. Bearing Carrier cover	Remove.	Discard gasket.
	a. Six screws (24), lock-washers (25), over (26), and gasket (27)	1. Remove all traces of old gasket.	
	b. Gasket (27)	2. Attach new gasket with Permatex.	
	c. Cover (26), lock-washers (25), and screws (24)	Install.	



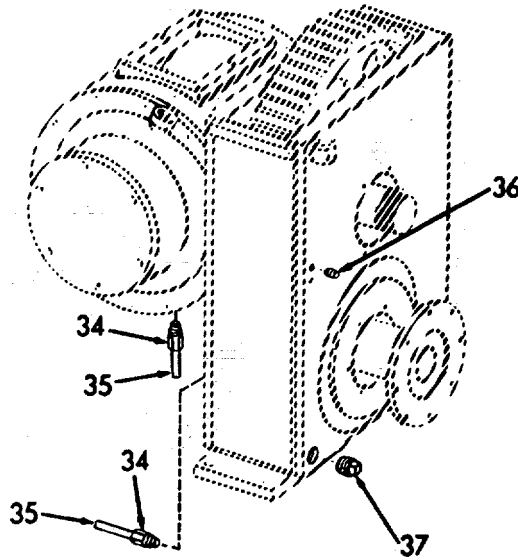
3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
8. Hose Assembly	a. Hose (28)	Unscrew.	
	b. Elbows (29) and (30)	Unscrew.	If necessary.
	c. Pipe plug (31)	Remove.	If necessary.
	d. T-fitting (32), and nipple (33)	Remove.	If necessary.



3-131. DRIVE GEAR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
9. Tubing	Adaptors (34)	Unscrew and remove tubing (35).	
10. Pipe plugs	a. Two pipe plugs (36)	Remove if necessary.	
	b. Pipe plug (37)	Remove if necessary.	



3-132. LEVEL WIND - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection b. Service c. Repair

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment Condition Condition Description
Paragraph

3-182 "A" Frame Wire Rope
and Anchor

Material/Parts

Grease MIL-G-81322 Type GH
Grease VV-L-751 Type CW
Grease MIL-G-10924 Type GAA

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

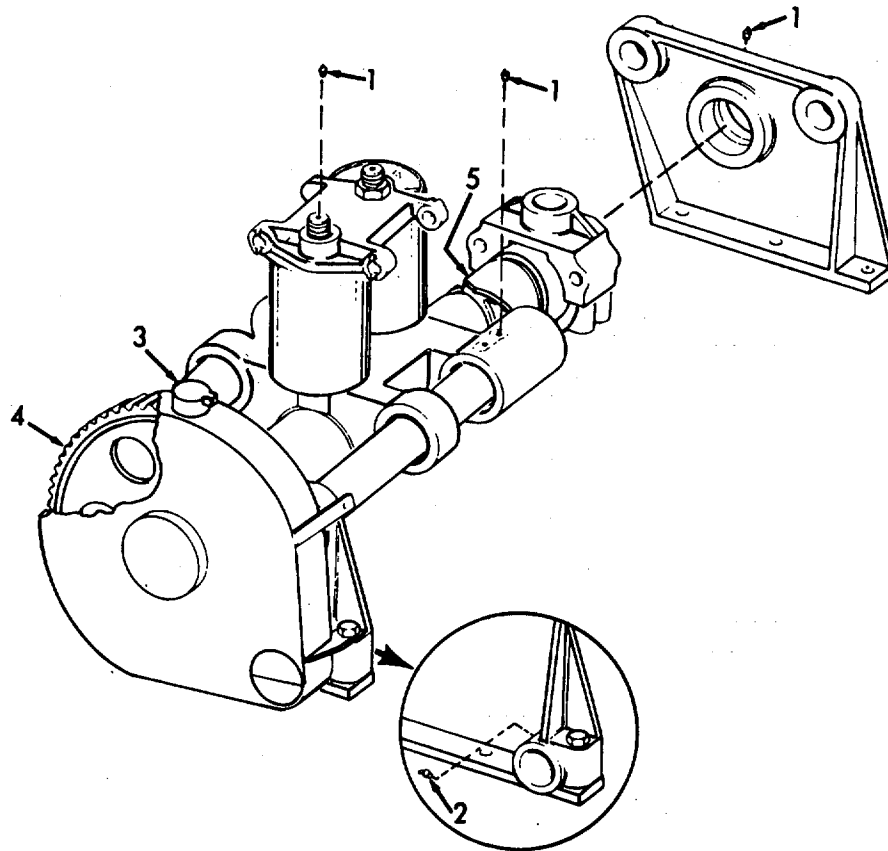
LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

1.	Level wind	a. Cable	Inspect for breaks, cuts, bends and kinks.	Replace. Refer to para. 3-182.
		b. Chain and driver sprocket	Inspect for wear, breaks and defective parts.	
		c. Gear guard	Inspect for dents, breaks and cracks.	
		d. Hand wheel	1. Inspect for breaks and cracks. 2. Check that hand wheel disengages level wind.	

3-132. LEVEL WIND - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
SERVICE			
2.	Grease fittings	Grease five places.	Use grease type GH.
3.	Gear	Lift and pour lubrication onto gear (4) while winch is operating.	Use grease type CW.
4.	Worm gear	Grease.	Use grease type GAA.



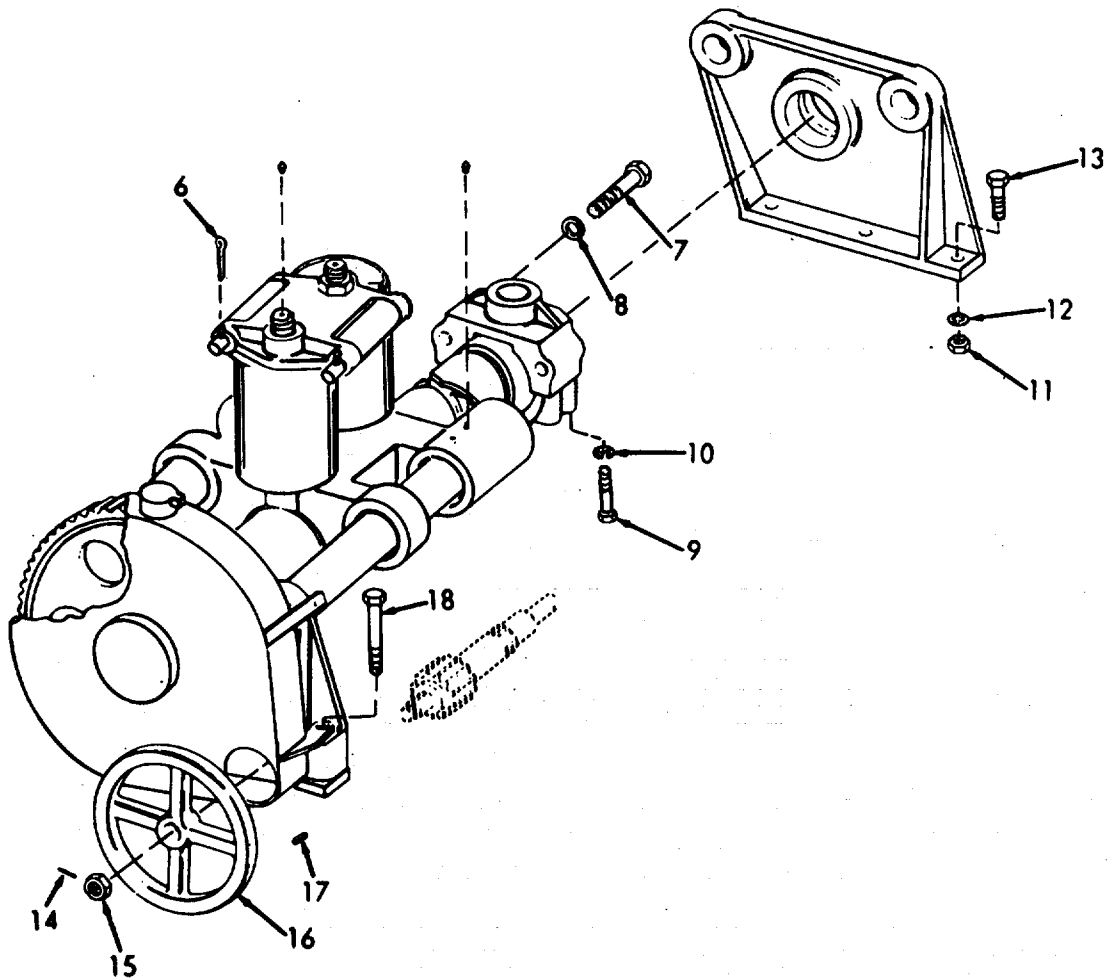
3-132. LEVEL WIND - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
5.	Cotter pins	Cotter pins (6)	Remove and replace in four places.
6.	Shuttle	a. Bolts (7), and lock-washers (8)	Replace. If necessary.
		b. Screws (9), and lock-washers (10)	Replace. If necessary.
7.	Mounting	Nuts (11), lockwashers (12), and bolts (13)	Replace. If necessary.
8.	Hand wheel and gear cover	a. Pin (14)	Remove.
		b. Nut (15)	Remove.
		c. Hand wheel (16), and key (17)	Remove.
		d. Bolt (18)	Remove.

3-132. LEVEL WIND - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



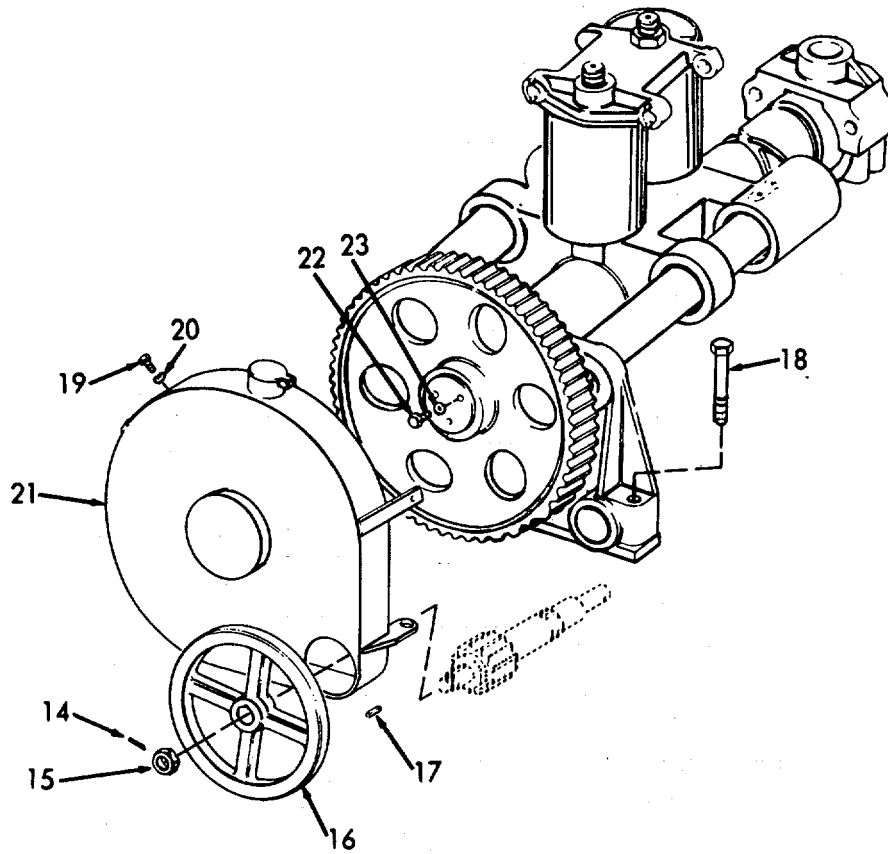
3-132. LEVEL WIND - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	e. Four screws (19), and lock-washers (20)	Remove.	
	f. Guard (21)	Remove.	
	g. Three screws (22), and lock washers (23)	Replace.	
	h. Guard (21), screws (19), lock-washers (20), and screw (18)	Replace.	
	i. Hand wheel (16), and key (17)	Replace.	
	j. Nut (15), and pin (14)	Replace.	

3-132. LEVEL WIND - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

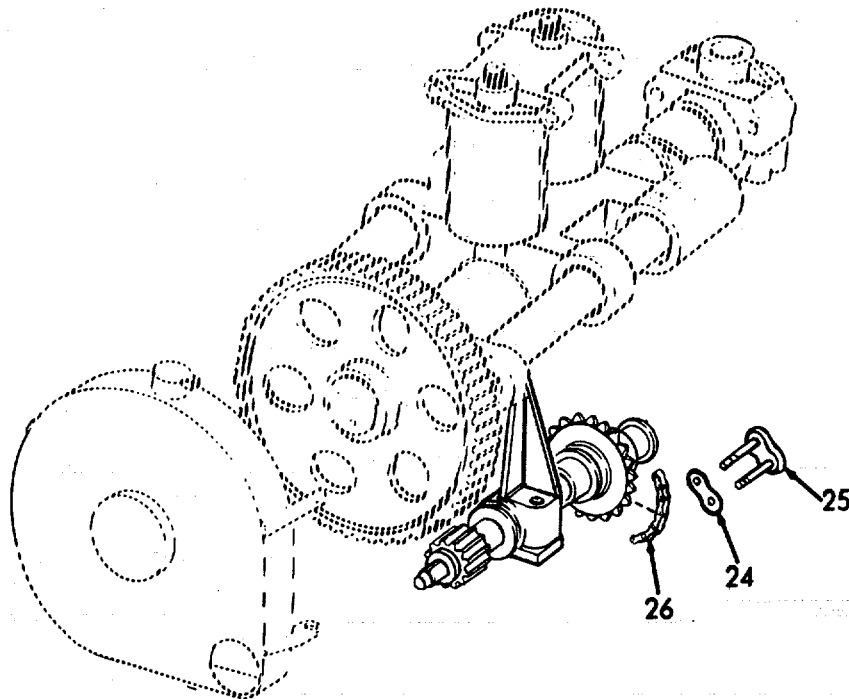


3-132. LEVEL WIND - MAINTENANCE INSTRUCTIONS (Continued). "

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | |
|----------------|---|--------------|
| 9. Drive chain | a. Keeper (24) | Remove. |
| | b. Master link (25) and chain (26) | Disassemble. |
| | c. Chain (26), master link (25) and keeper (24) | Reassemble. |



3-133. DRUM ASSEMBLY - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection b. Service c. Repair

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

<u>Equipment Condition Paragraph</u>	<u>Condition Description</u>
--------------------------------------	------------------------------

3-182	"A" Frame Wire Rope and Anchor
-------	--------------------------------

Material/Parts

Grease MIL-G-81322 Type GH

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | | |
|------------------|--------------------|---|------------------------------------|
| 1. Drum assembly | a. Cable | Inspect for wear, cuts, breaks and kinks. | Replace. Refer to paragraph 3-182. |
| | b. Mounting | Inspect for loose, missing or defective components. | Replace. |
| | c. Cable hold-down | Inspect for worn, loose and missing components. | |
| | d. Guards | Inspect for breaks, dents, cracks and loose hardware. | |

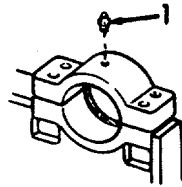
3-133. DRUM ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued). -

LOCATION	ITEM	ACTION	REMARKS
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SERVICE

2. Grease

Grease.
fitting
(1)



REPAIR

3. Cable
hold-
down

a. Nuts
(2),
lock-
washers
(3),
clamp
plate
(4),
and
U-bolt
(5)

Loosen and remove
cable.

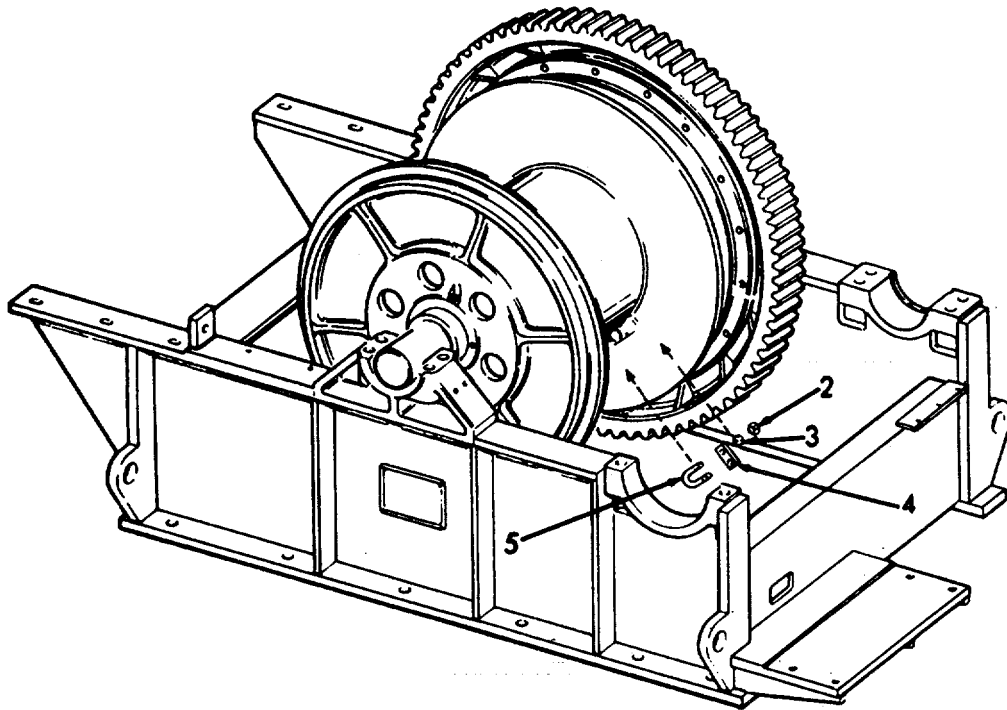
b. U-bolt
(5),
clamp
plate
(4),
lock-
washers
(3),
and
nuts
(2)

Insert cable and
tighten.

3-133. DRUM ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

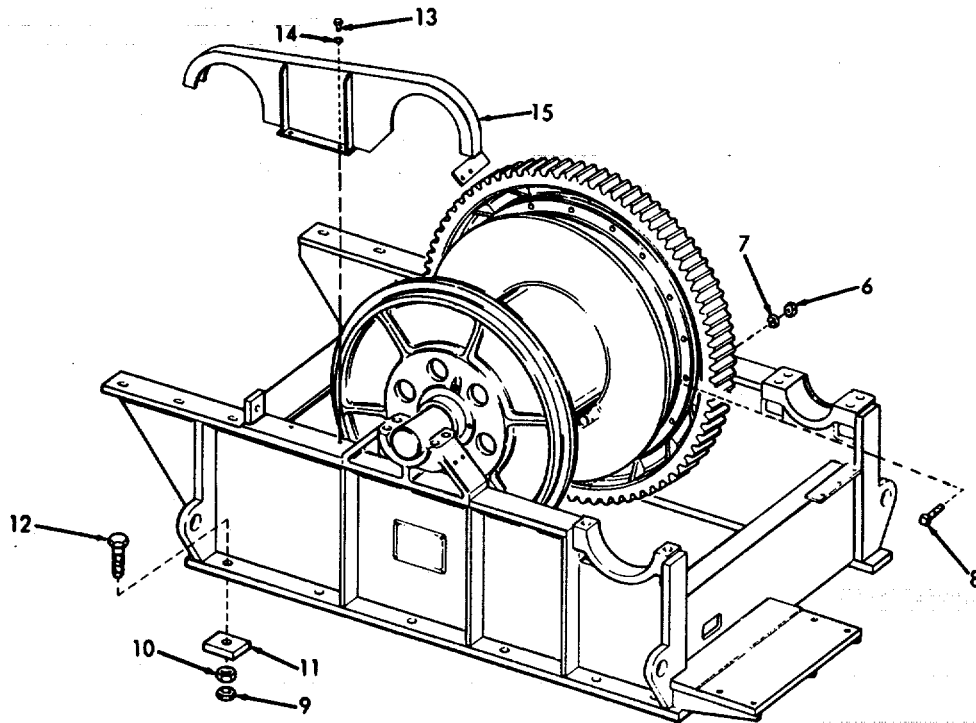


3-133. DRUM ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).--

LOCATION	ITEM	ACTION	REMARKS
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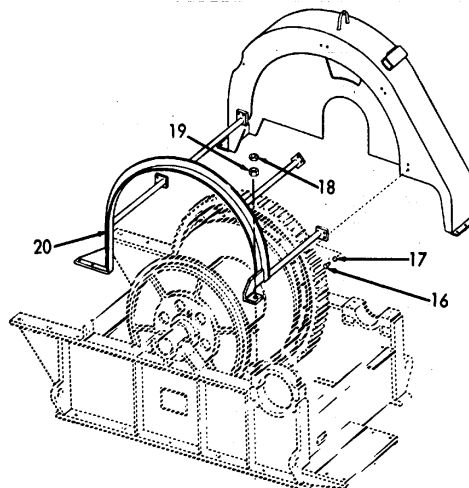
REPAIR (Cont)

- | | | | |
|----|--------------------|--|----------------------------------|
| 4. | Drum-to gear bolts | Nuts (6), lockwashers (7), and bolts (8) | Replace and tighten as required. |
| 5. | Mounting | Nuts (9), lockwashers (10), steel chock (11), and bolts (12) | Replace and tighten as required. |
| 6. | Chain guard | Screw (13), lockwasher (14), and chain and (15) | Replace if necessary. |



3-133. DRUM ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
7. Drum guard	a. Screws (16), and lock-washers (17)	Remove.	
	b. Hex nut (18), and jam nut (19)	Remove.	
	c. Drum guard (20)	Remove and replace.	
	d. Jam nut (19), and hex nut (18)	Replace.	
	e. Screws (16), and lock-washers (17)	Replace.	



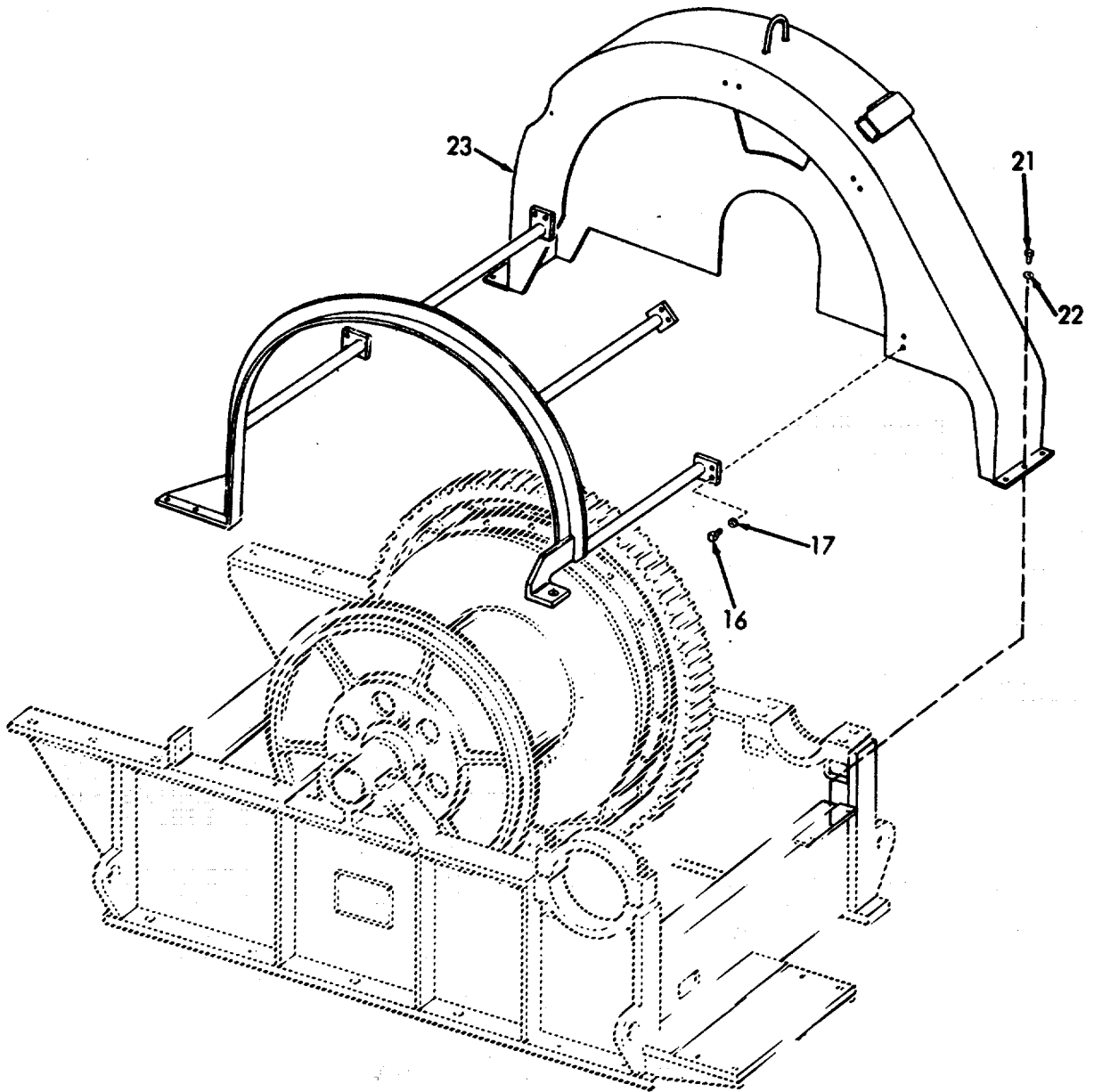
3-133. DRUM ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
8. Gear guard	a. Screws (16), and lock-washers (17)	Remove.	
	b. Screws (21) and lock-washers (22)	Remove.	
	c. Chain guard (23)	Remove and replace.	
	d. Screws (21) and lock-washers (22)	Install.	
	e. Screws (16) and lock-washers (17)	Install.	

3-133. DRUM ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-147. SLACK PULLER - MAINTENANCE INSTRUCTIONS.

This task covers: a. Inspection b. Service c. Repair

INITIAL SETUP

Test Equipment

None

References

Paragraph

3-139

Hydraulic Piping

Special Tools

None

Equipment

Condition

Condition Description

None

Material/Parts

Grease MIL-G-81322 Type GH.6
Lubricating oil (Gear)
MIL-L-2105 Type G090

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

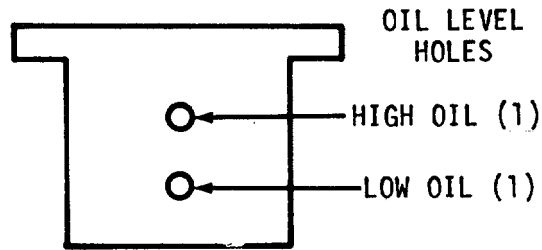
1.	Slack-puller	a. Hydraulic hoses	Inspect for breaks, cracks, and leaking.	Replace. Refer to paragraph 3-139.
		b. Hydraulic motor	Inspect for breaks, cracks, and leaking gaskets.	Replace.
		c. Hydraulic fluid	Inspect for proper level of fluid.	Refer to Service.
		d. All parts	Make sure all parts are tight.	

3-134. SLACK PULLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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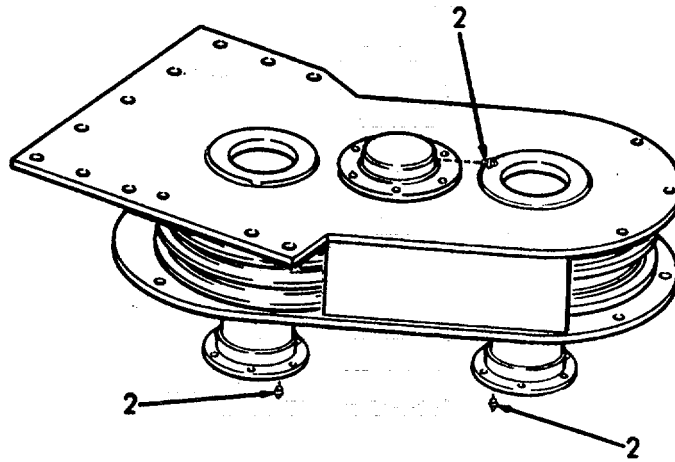
SERVICE

2.	Hydraulic housing	a. Pipe plug (1) Remove to check oil level.	Add oil if necessary.
----	-------------------	--	-----------------------



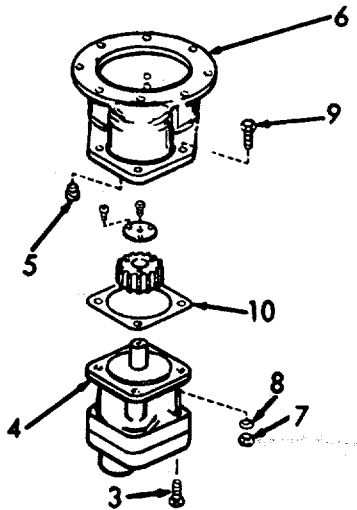
		b. Pipe plug (1) Replace.	
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3.	Grease fittings	Fittings (2) Grease three places.	
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3-134. SLACK PULLER - MAINTENANCE INSTRUCTIONS (Continued)' -

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
4. Hydraulic Motor	a. Hoses	Remove.	Refer to paragraph 3-137.
	b. Pipe plug (3)	Remove.	Drain fluid from motor (4).
	c. Pipe plug (5)	Remove.	Drain fluid from motor drive housing (6).
	d. Nuts (7), lock-washers (8), and screws (9)	Remove.	
	e. Motor (4), and gasket (10)	Remove.	

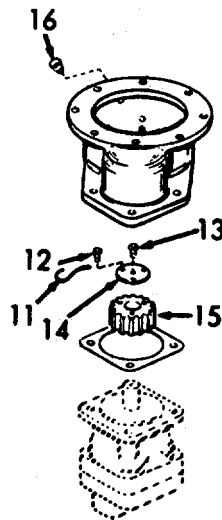


3-134. SLACK PULLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|----|-------------------|--|-----------------------------|
| 5. | Drive pinion Gear | a. Lock-wire (11), and three screws (12) | Cut wire and remove screws. |
| | | b. Screw (13), clamp plate (14), and gear (15) | Remove. |
| 6. | Breather | Breather (16) | Remove if necessary. |

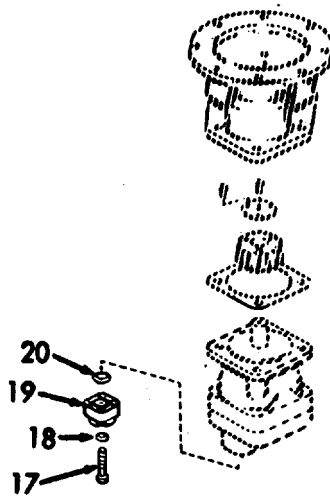


3-134. SLACK PULLER - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

7. Flange connectors	Four screws (17), lock-washers (18), connectors (19), and packing (20)	Remove.	
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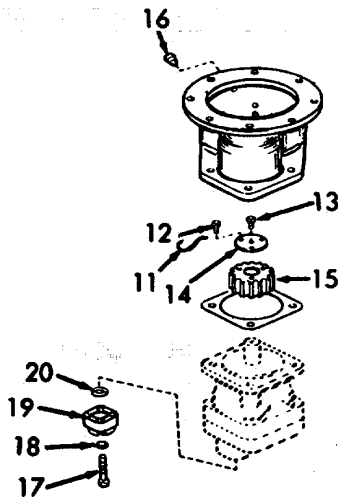


3-134. SLACK PULLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION

- | | | | |
|-----|-------------------|--|------------------------------|
| 8. | Flange connectors | Packing (20), connectors (19), screws (17) and lock-washers (18) | Reassemble. |
| 9. | Breather | Breather (16) | Reinstall. |
| 10. | Drive pinion gear | a. Gear (15), clamp plate (14), and screw (13) | Reassemble. |
| | | b. Screws (12), and lock wire (11) | Install screws and lockwire. |

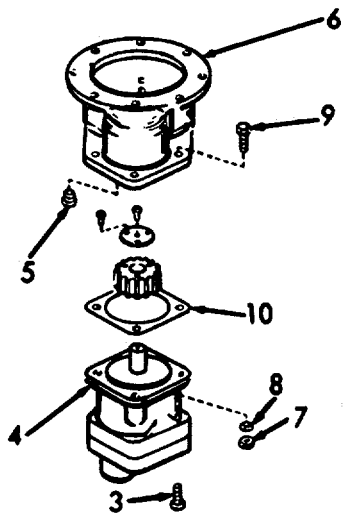


3-134. SLACK PDULLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

- | | | | |
|---------------------|---|-----------------------|--|
| 11. Hydraulic motor | a. Motor (4), gasket (10), screws (9), lock-washers (8), and nuts (7) | Reassemble. | |
| | b. Pipe plugs (3 and 5) | Install. | |
| | c. Hoses | Install. | |
| | d. Drive housing (6) | Refill with gear oil. | |



3-135. DISCONNECT CLUTCH - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Service
- c. Adjustment

INITIAL SETUP

Test Equipment

None

References

Paragraph
3-139

Hydraulic Piping

Special Tools

Straight edge scale
(Machinist)

Equipment
Condition
Paragraph

3-129

Condition Description

Winch - Universal
Joint Assembly -
Removal

Material/Parts

Grease MIL-G-81322 Type GH

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | | | |
|----|---------------------------|--------------------------|---|--|
| 1. | Discon-
nect
clutch | a. Housing | Inspect for breaks,
cracks, dents and
signs of fatigue. | |
| | | b. Hydraulic
cylinder | Inspect for leaks. | |
| | | c. Hydraulic
hoses | Inspect for breaks,
cracks, and leaks. | Replace. Refer
to paragraph
3-139. |

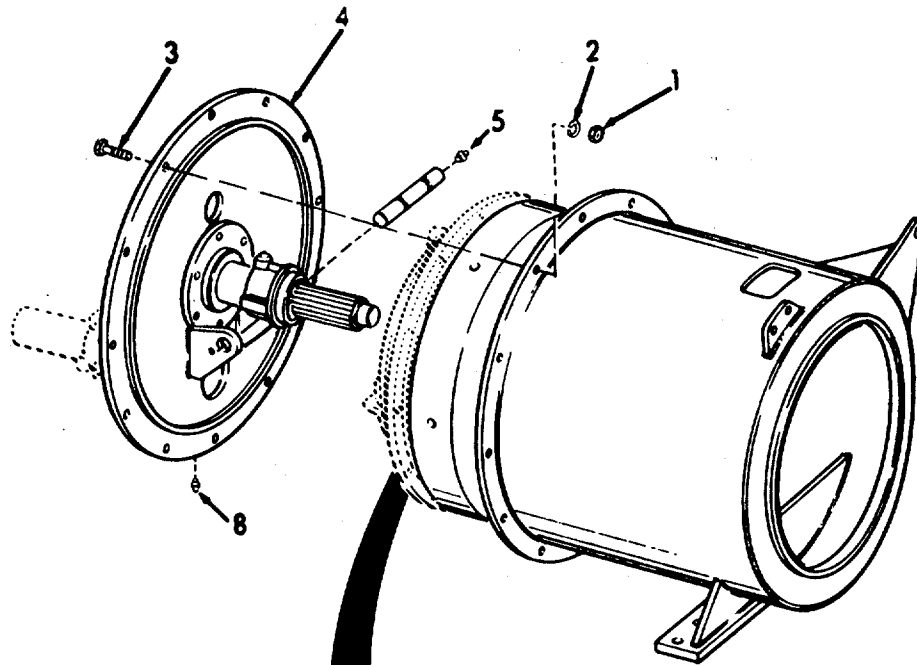
3-135. DISCONNECT CLUTCH - MAINTENANCE INSTRUCTIONS (Continued).'

LOCATION	ITEM	ACTION	REMARKS
SERVICE			
2.	a. Nuts (1), lock- washers (2), and screws (3)	Remove.	
	b. Clutch cover plate (4)	Slide out of housing.	Slide out only far enough to gain access to grease fittings and adjustment screws.
	c. Fittings (5)	Grease.	
	d. Adjust- ing screw (6), and nut (7)	Replace if necessary.	For adjusting, refer to step 3.
	e. Clutch cover plate (4)	Slide into housing.	
	f. Screws (3), lock- washers (2), and nuts (1)	Install.	
	g. Grease fitting (8)	Grease.	

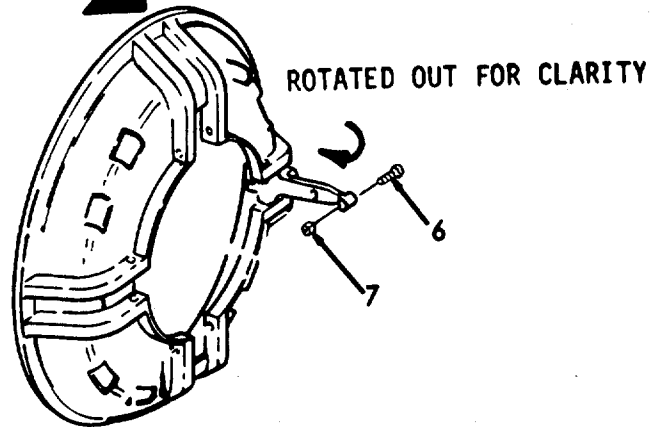
3-135. DISCONNECT CLUTCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont)



NOTE: EXPLODED FOR CLARITY

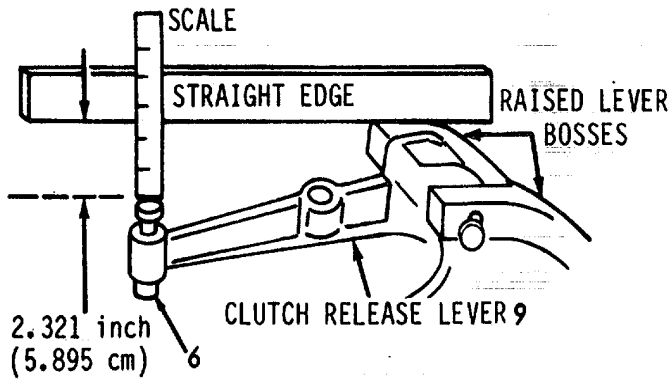


3-135. DISCONNECT CLUTCH - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT

3. Clutch release levers	Levers (9)	Using a straight edge and scale, set adjusting screw (6) to a depth of 2.321 inch (5.895 cm).	<ol style="list-style-type: none"> The depth is the distance from the ground surface on the raised lever bosses of the clutch flywheel ring (cover) to the heads of the lever adjusting screw when the clutch is installed and in the engaged position.
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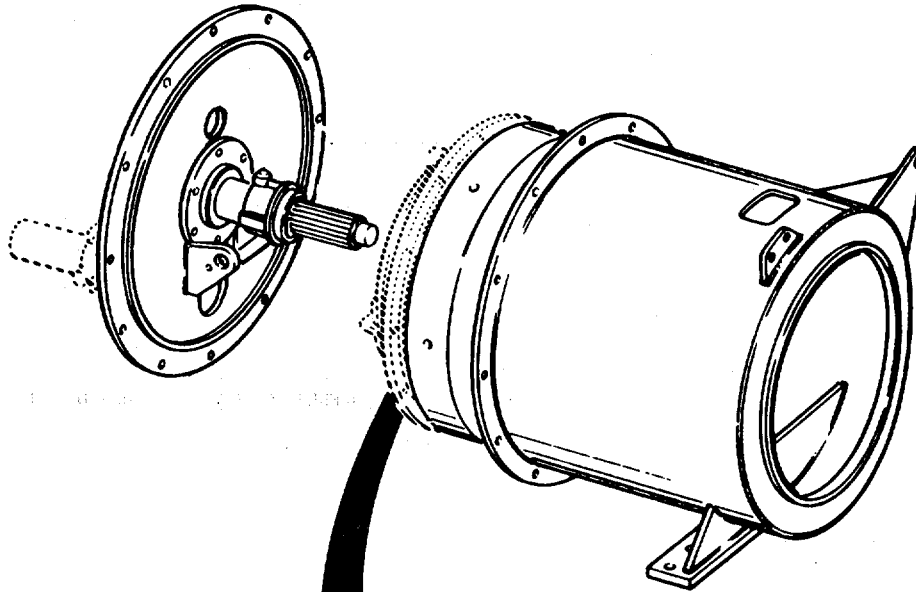
- The contact points of these adjusting screws should be set at a uniform distance from the underside of the straight edge. The adjusting screws must be in the same plane within 0.0312 inch (0.0792 cm).

3-135. DISCONNECT CLUTCH - MAINTENANCE INSTRUCTIONS (Continued).

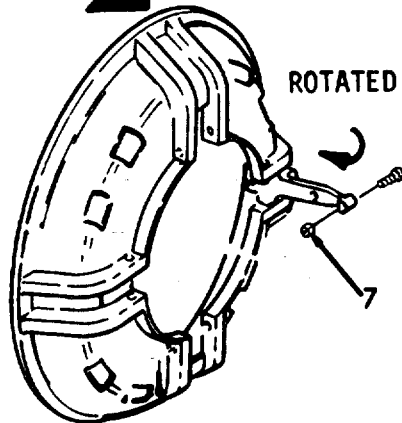
LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT (Cont)

3. Be sure to tighten locknuts (7) securely after making screw adjustments.



NOTE: EXPLODED FOR CLARITY



ROTATED OUT FOR CLARITY

3-136.. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Service
- c. Repair

INITIAL SETUP

Test Equipment

None

References
Paragraph

3-139 Hydraulic Piping

Special Tools

None

Equipment Condition Condition Description
Paragraph

3-135 Disconnect Clutch Removal

Material/Parts

Grease MIL-G-81322 Type GH
Oil MIL-L-2104 Type OE/HDO

Special Environmental Conditions

Do not drain oil into bilges.
Use the oil/water separation and recovery system to collect used oil.

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | |
|----------|-----------------|---|
| 1. Fluid | a. Hoses group | Inspect for breaks, leaks, and cracks. |
| | b. Tubing | Inspect for breaks, bends, cracks, and leaking. |
| | c. Reserve tank | Inspect for leaks, breaks, cracks, and dents. |

3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
	d. Filter	Inspect for leaks, breaks, cracks, and dents.	
	e. Gages	Inspect for broken glass, and bent needles.	
	f. Orifice filter assembly	Inspect for leaks' and dirt.	
2. Basic group	a. Motor	Inspect for cracks and leaks.	
	b. Chain	Inspect for wear, breaks, cracks, and signs of possible failure.	
	c. Piping	Inspect for breaks, cracks, dents, and leaks.	
3. Torque converter	Hardware	Insure all hardware is tight.	

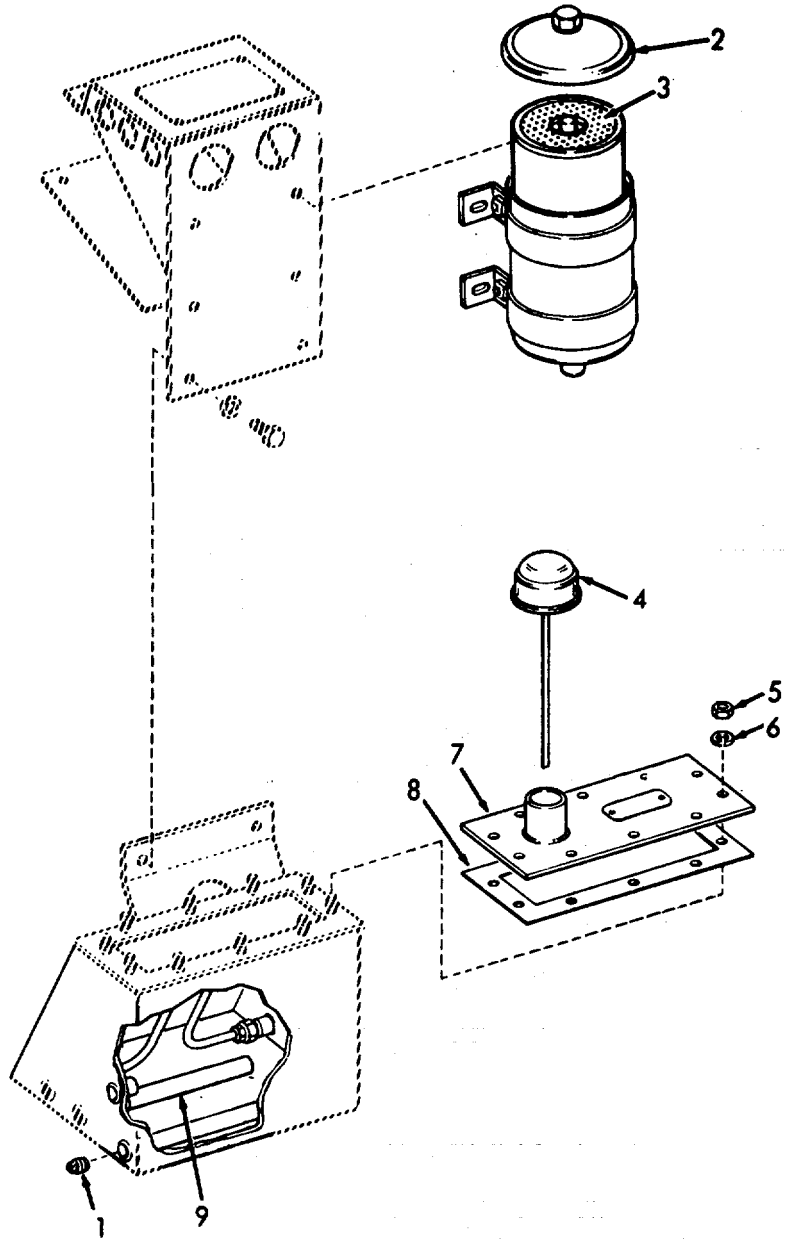
3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
SERVICE			
4. Fluid group	a. Drain plug (1)	Remove.	Drain oil into a suitable container.
	b. Filter cover (2)	Remove.	
	c. Filter (3)	Remove.	Dispose of properly.
	d. Fluid gage (4)	Remove.	
	e. Nuts (5), and lock-washers (6)	Remove.	
	f. Cover (7), and gasket (8)	Remove.	
	g. Screen filter (9)	Unscrew, remove, and clean.	

3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont)



3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

-j

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

SERVICE (Cont)

- | | |
|--|---------------------|
| h. Screen filter (9) | Install. |
| i. Gasket (8), cover (7), lock-washer (6), and nut (5) | Install. |
| j. Filter (3), and cover (2) | Install new filter. |
| k. Drain plug (1) | Replace. |

3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

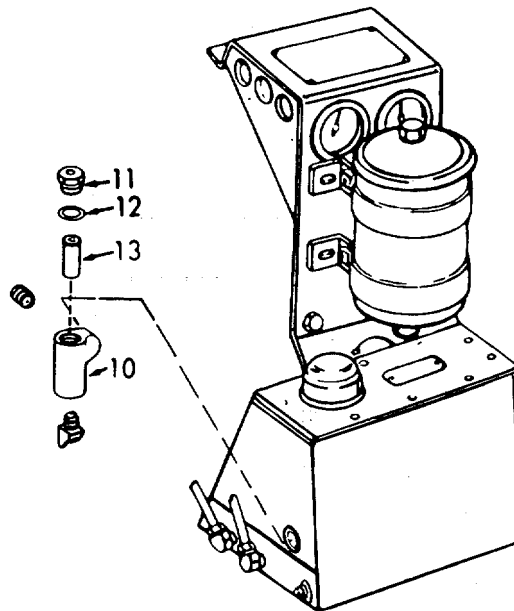
LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont)

- | | |
|------------------------|---|
| 1. Orifice filter (10) | 1. Remove head (11), gasket (12), and screen element (13).

2. Clean screen.

3. Make sure orifice hole in body is clean. |
|------------------------|---|

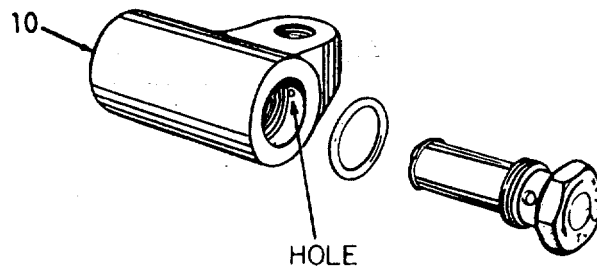


3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

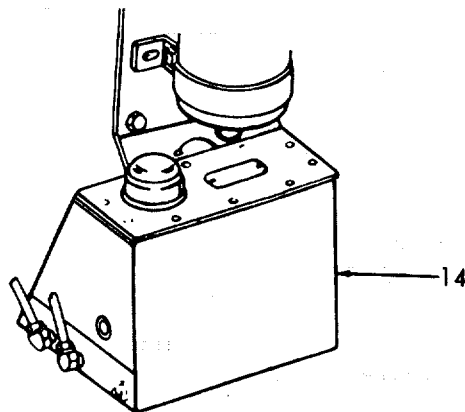
LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont)

	m. Orifice filter (10)	Reassemble.	
--	------------------------	-------------	--



	n. Reserve tank (14)	<ol style="list-style-type: none"> 1. Fill with 3 quarts (2.84 liters) of engine oil to about one inch (2.54 cm) below full mark on the dipstick. 2. Operate engine at half speed. Check oil level frequently and add oil as needed. 	Use oil type OE/HDO-30.
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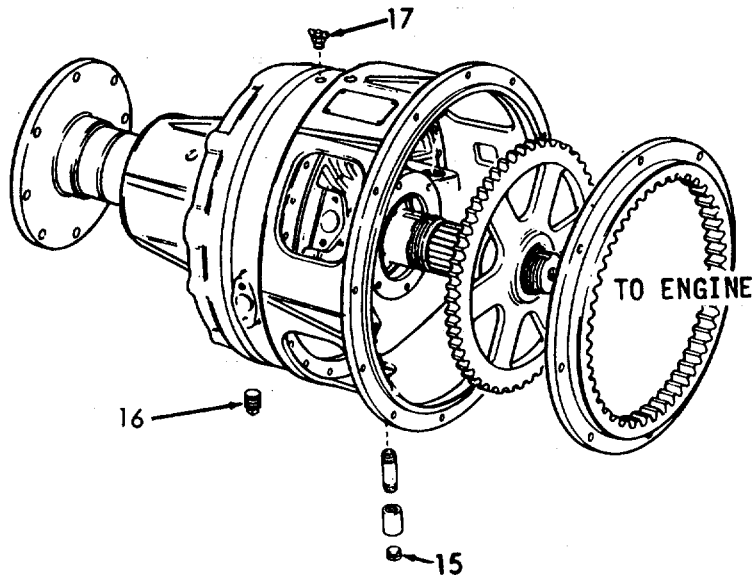


3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont)

- | | | | |
|----|-------------|-------------------|---|
| 5. | Input group | a. Pipe plug (15) | Remove oil and drain into a suitable container. |
| | | b. Pipe plug (15) | Replace when drained. |
| 6. | Basic group | a. Pipe plug (16) | Remove oil and drain into a suitable container. |
| | | b. Pipe plug (16) | Replace when drained. |
| | | c. Vent (17) | Open. |

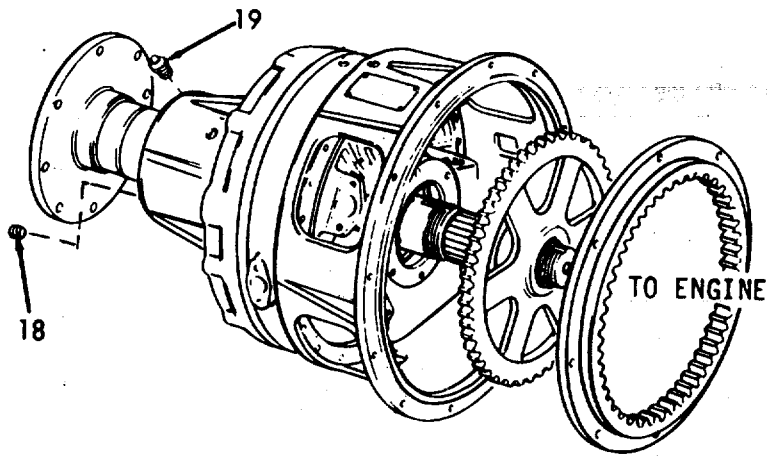


3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont)

- | | | | |
|-----------------|------------------------|---|---------------------|
| 7. Output group | a. Pipe plug (18) | Remove. | |
| | b. Grease fitting (19) | Apply grease until grease runs out of pipe plug (18). | Use grease type GH. |
| | c. Pipe plug (18) | Replace. | |



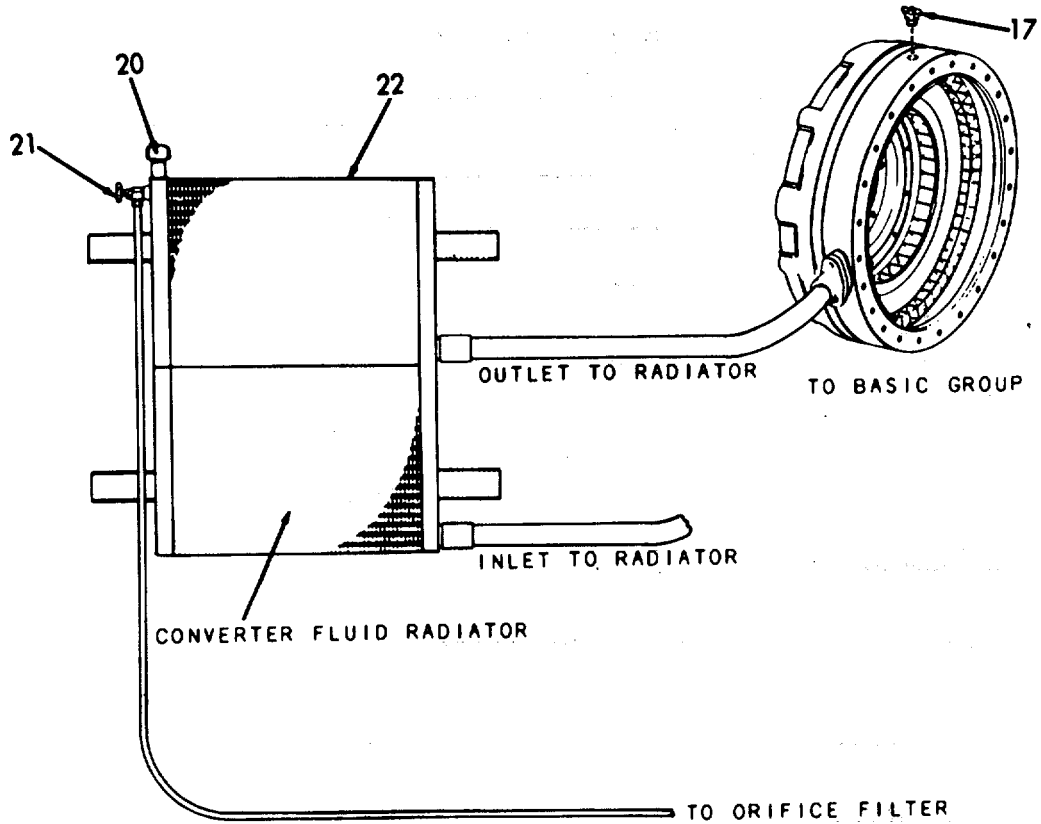
- | | | | |
|----------------------|---------------------|---|--------------------|
| 8. Radiator cap (20) | a. Filter | Remove. | |
| | b. Bleed valve (21) | Open. | |
| | c. Radiator (22) | 1. Add approximately 7 gallons (26.5 liters) of engine oil. | Use oil OE/HDO-30. |

3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont)

- | | | | |
|----|------------------|--|--|
| | | 2. Add oil until oil flows from vent (17) in basic group. | |
| | | 3. Close vent (17) and continue adding oil until oil reaches filter opening. | |
| d. | Bleed valve (21) | Close. | |
| e. | Filter cap (20) | Replace. | |

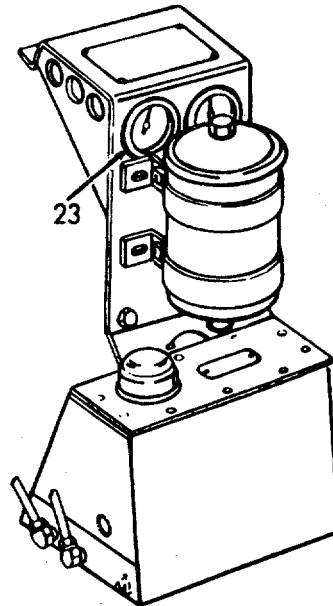


3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont)

- | | | | | |
|----|------------------|--------------------|---|--|
| 9. | Torque converter | Pressure gage (23) | <ol style="list-style-type: none"> 1. Operate engine and check oil pressure of 45 psi (310.3 kPa), to 65 psi (448.2 kPa). 2. Check for leaks. | |
|----|------------------|--------------------|---|--|



REPAIR

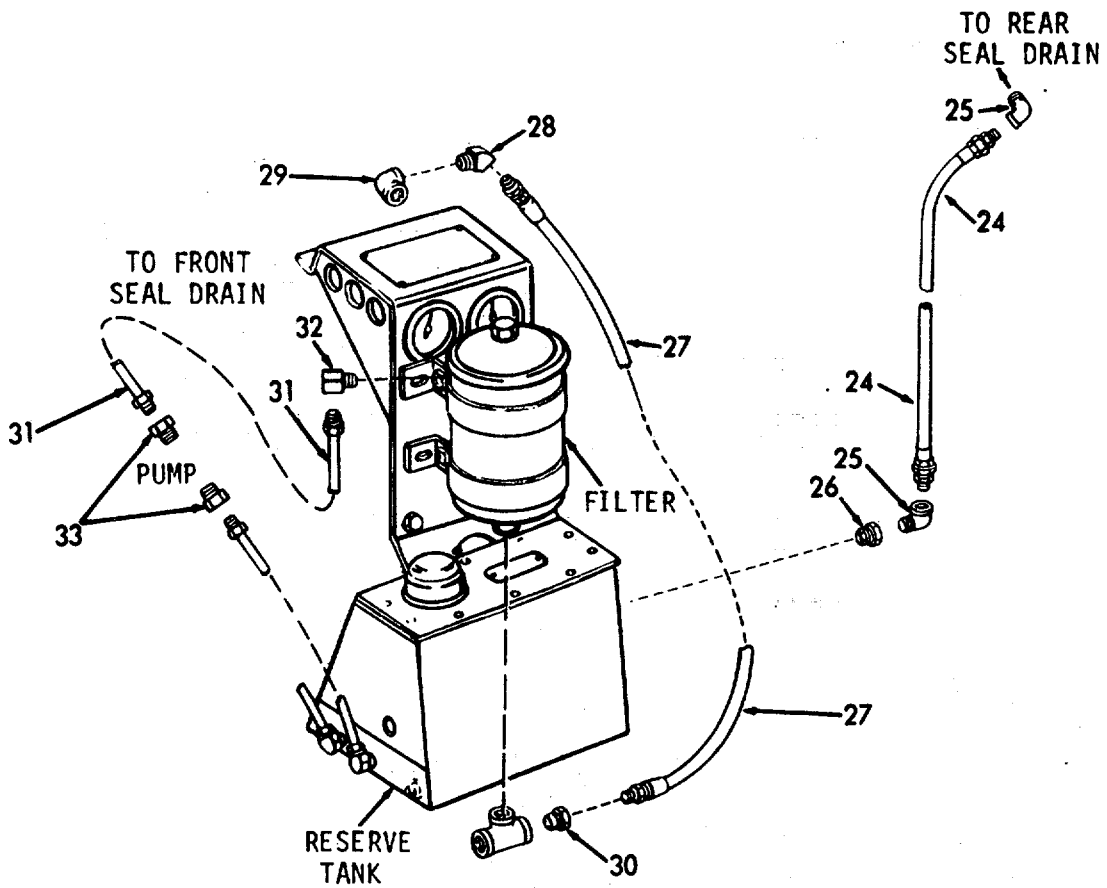
- | | | | | |
|-----|-------------|------------------------------|---|---------------|
| 10. | Fluid group | a. Rear seal drain hose (24) | <ol style="list-style-type: none"> 1. Remove hose. 2. Remove elbows (25), and reducer bushing (26). | If necessary. |
| | | b. Hose (27) | <ol style="list-style-type: none"> 1. Remove hose. | If necessary. |

3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|----|--------------------------|--|---------------|
| | | 2. Remove elbows (28 and 29), and reducer bushing (30). | |
| c. | Filter-to-pump hose (31) | 1. Remove hose.
2. Remove elbows (32), and connectors (33). | If necessary. |



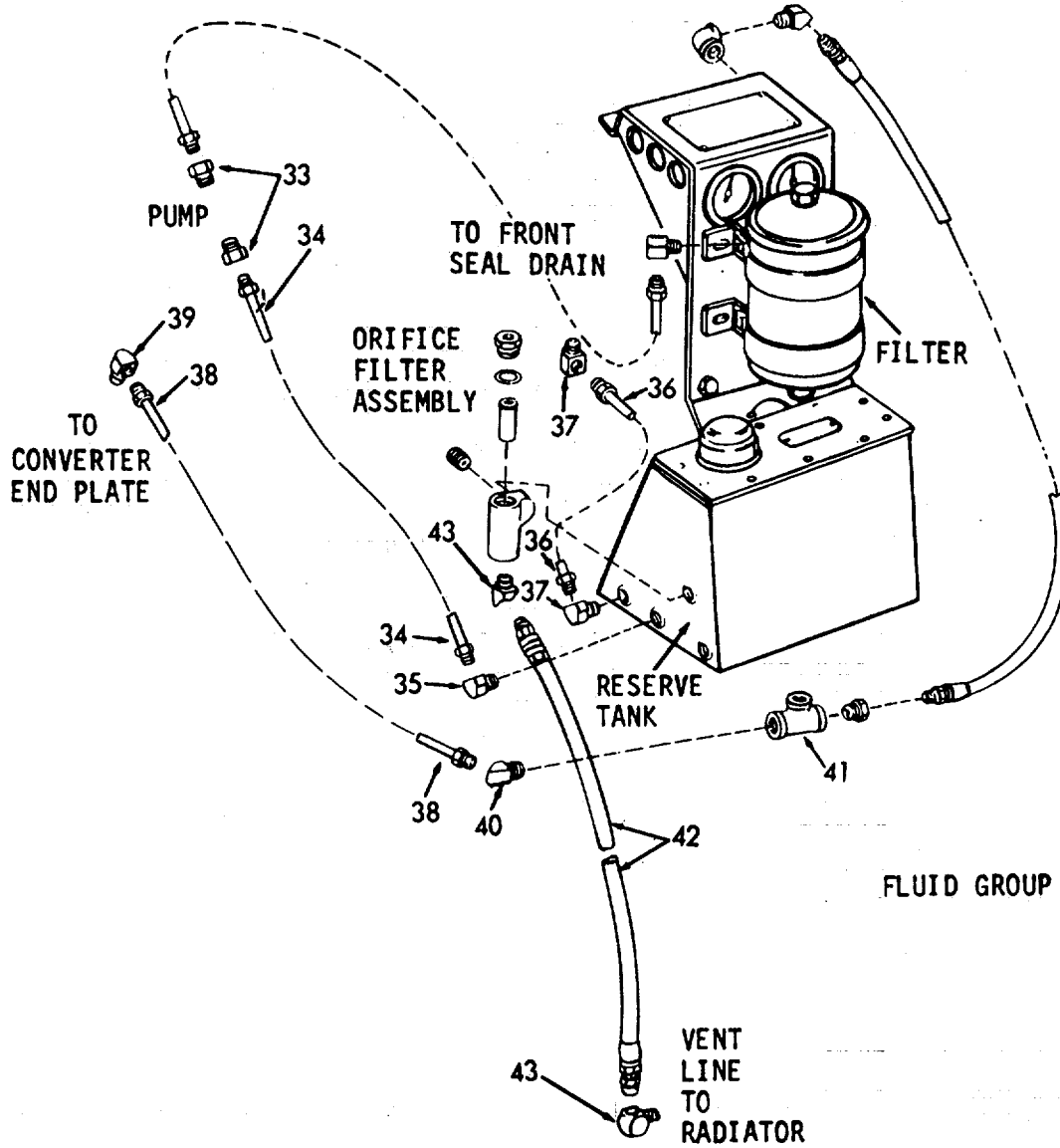
3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	d. Pump-to reserve tank tubing (34)	1. Remove tubing. 2. Remove connector (33), and elbow (35).	If necessary.
	e. Reserve tank to converter tubing (36)	1. Remove tubing. 2. Remove elbows (37).	If necessary.
	f. Filter to converter end plate tubing (38)	1. Remove tubing. 2. Remove elbows (39 and 40), and tee (41).	If necessary.
	g. Vent line hose (42)	1. Remove hose. 2. Remove elbows (43).	If necessary.

3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



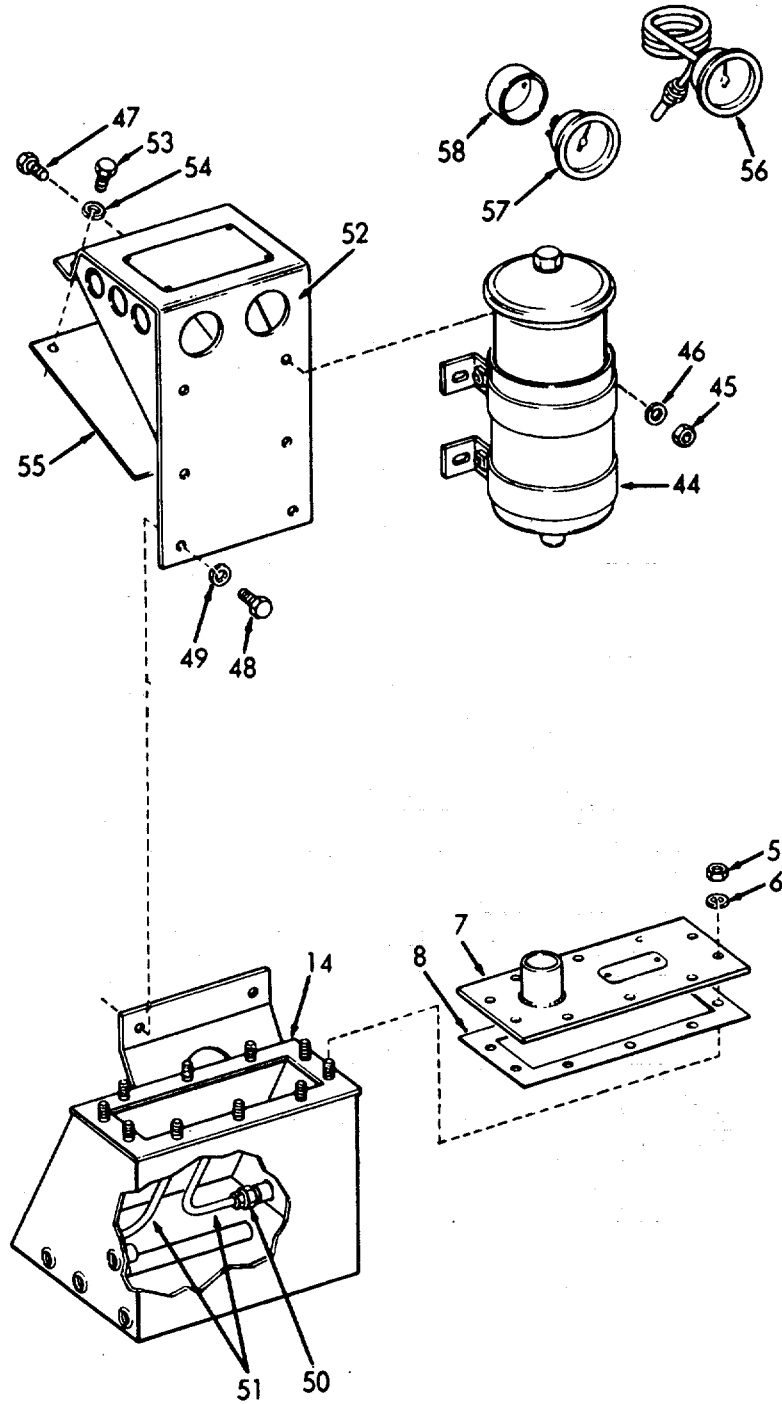
3-136. TORQUT CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	h. Filter (44)	Remove nuts (45), lock-washers (46), and bolts (47).	
	i. Reservoir tank (14)	<ol style="list-style-type: none"> 1. Remove nuts (5), and lockwashers (6). 2. Remove cover (7), and gasket (8). 3. Remove screws (48), and lockwashers (49). 4. Remove tank (14). 5. Remove tube connectors (50). 6. Remove stand pipes (51). 	If necessary.
	j. Filter bracket (52)	Remove bolts (53), lock-washers (54), and heat shield (55).	If necessary.
	k. Temperature gage (56)	Remove.	If necessary.
	l. Oil pressure gage (57)	Remove mounting (58), and gage (57).	If necessary.

3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

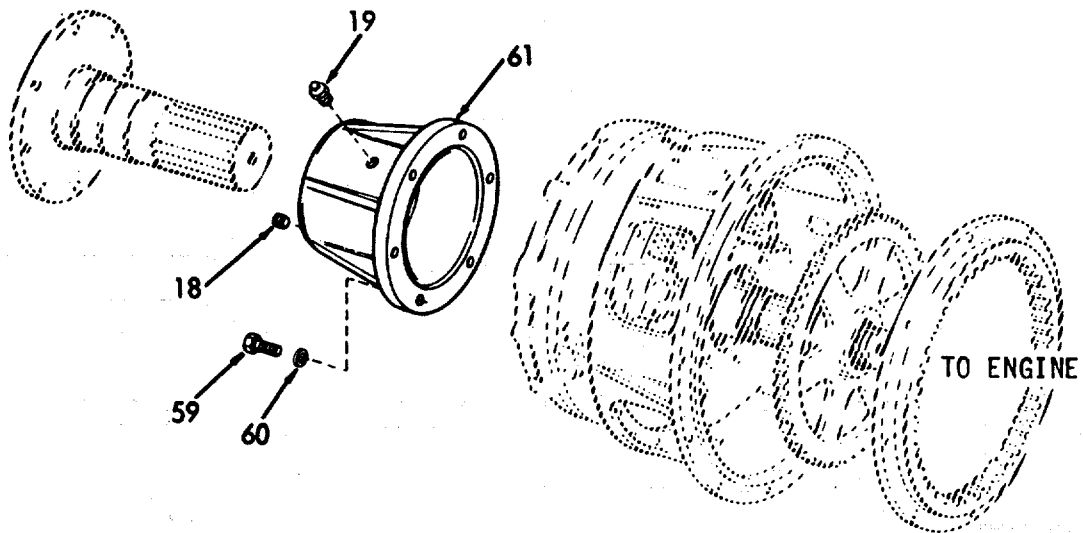


3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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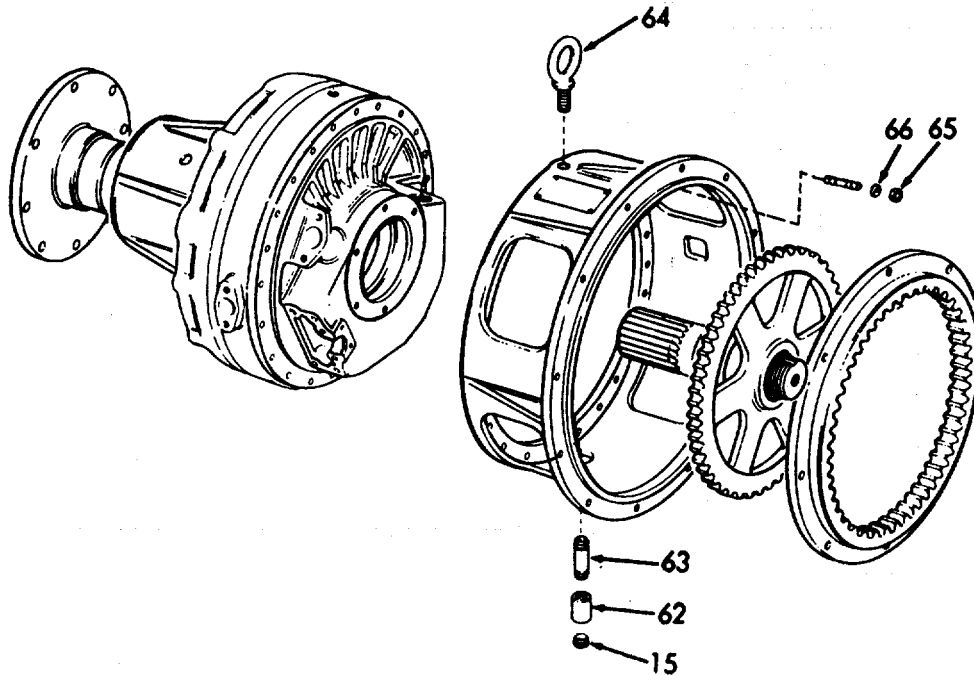
REPAIR (Cont)

- | | | | |
|------------|---|-----------------------|--|
| 11. Output | a. Screw group (59), lock-washer (60), and shaft bearing carrier (61) | Remove. | |
| | b. Grease fitting (19), and pipe plug (18) | Replace if defective. | |



3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
12. Input group	a. Pipe plug (15), coupling (62), and nipple (63)	Replace if damaged.	
	b. Eye bolt (64)	Replace if damaged.	
	c. Nuts (65), and lock-washers (66)	Remove and separate input and basic groups.	



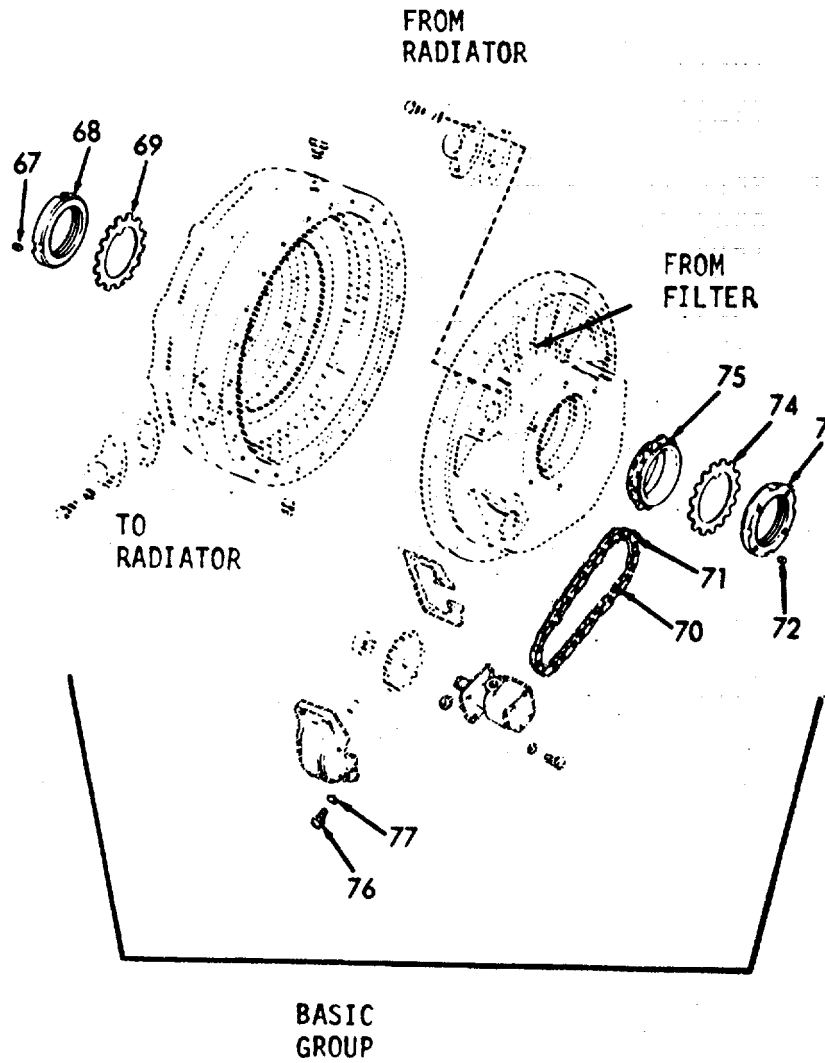
3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
13. Basic group	a. Setscrew (67), locknut (68), and washers (69)	Remove.	
	b. Coupler link (70), and chain (71)	Remove link and open chain.	
	c. Setscrew (72), locknut (73), washer (74), and sprocket (75)	Remove.	
	d. Four screws (76), and lock-washers (77)	Remove.	

3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



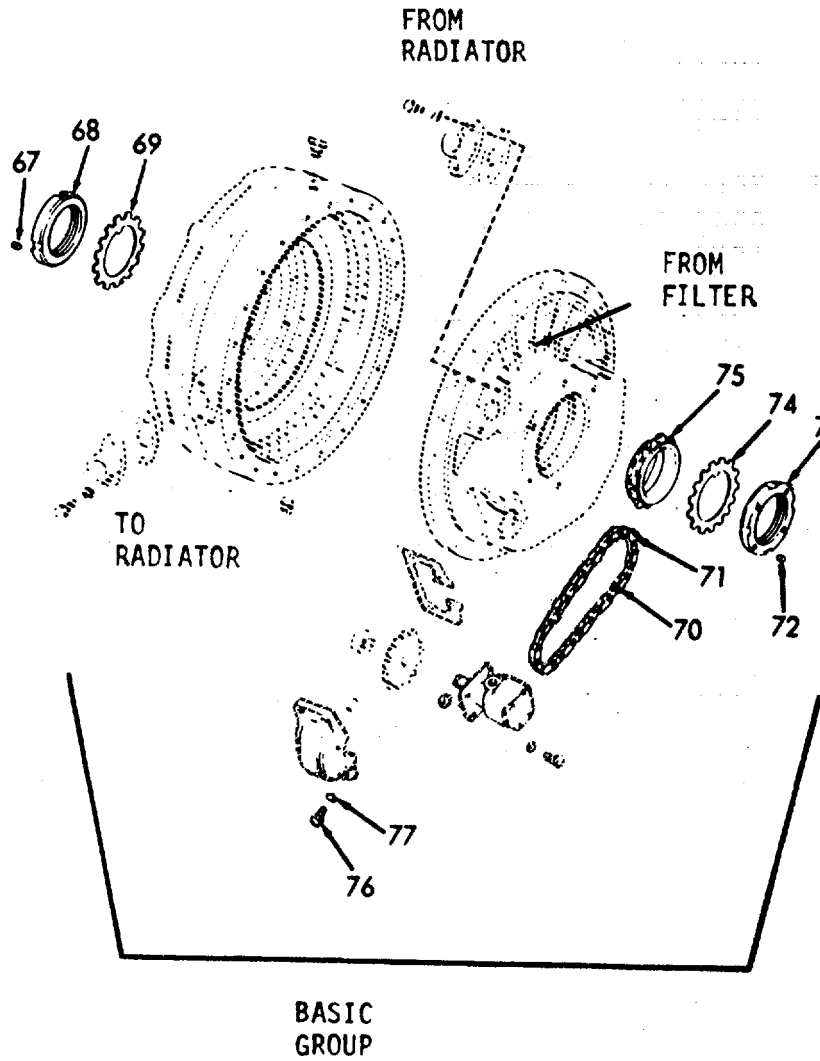
3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)	e. Two screws (78), and lock-washers (79)	Remove.	
	f. Sprocket housing (80)	Remove.	
	g. Dowel pin (81)	Replace.	If necessary.
	h. Two additional screws (78), and lock-washers (79)	Remove.	
	i. Hoses to pump	Remove.	
	j. Pump (82)	Remove.	
	k. Gasket (83)	Remove.	
	l. Bearing (84), sprocket (85), and key (86)	Remove.	If necessary.

3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



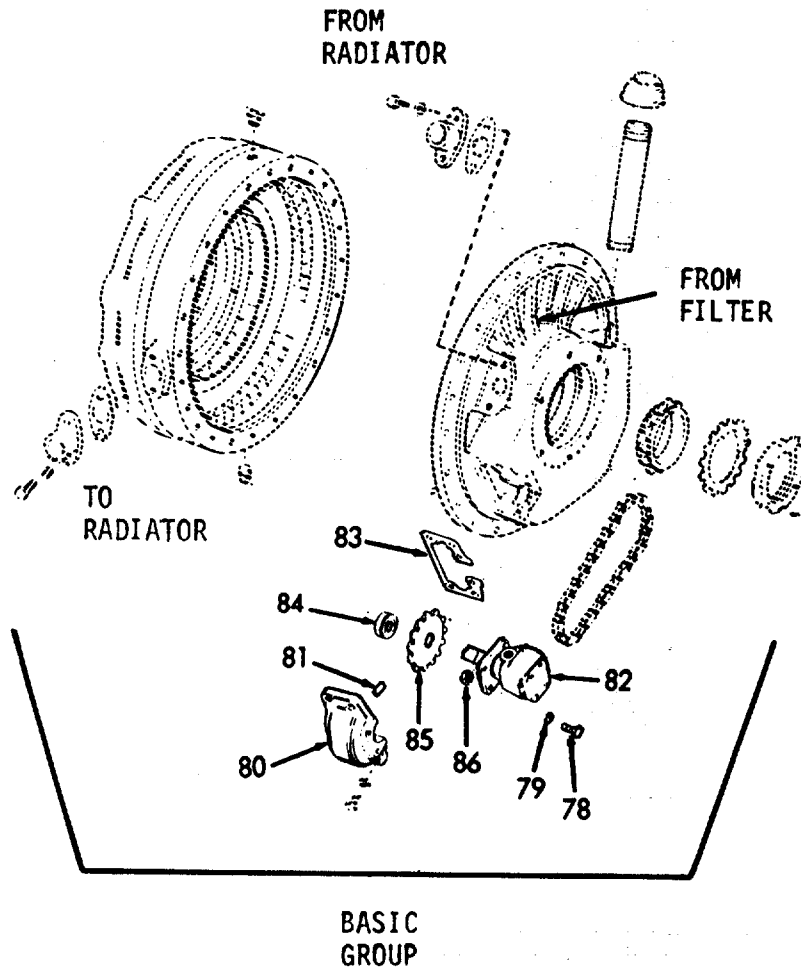
3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	m. Gasket (83), pump (82), sprocket housing (80), screw (78), lock- washer (79), screw (76), and lock- washer (77)	Install.	
	n. Sprocket Assemble. (75), washer (74), locknut (73), and setscrew (72)		
	o. Chain (71), and coupler link (70)	Reassemble.	

3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



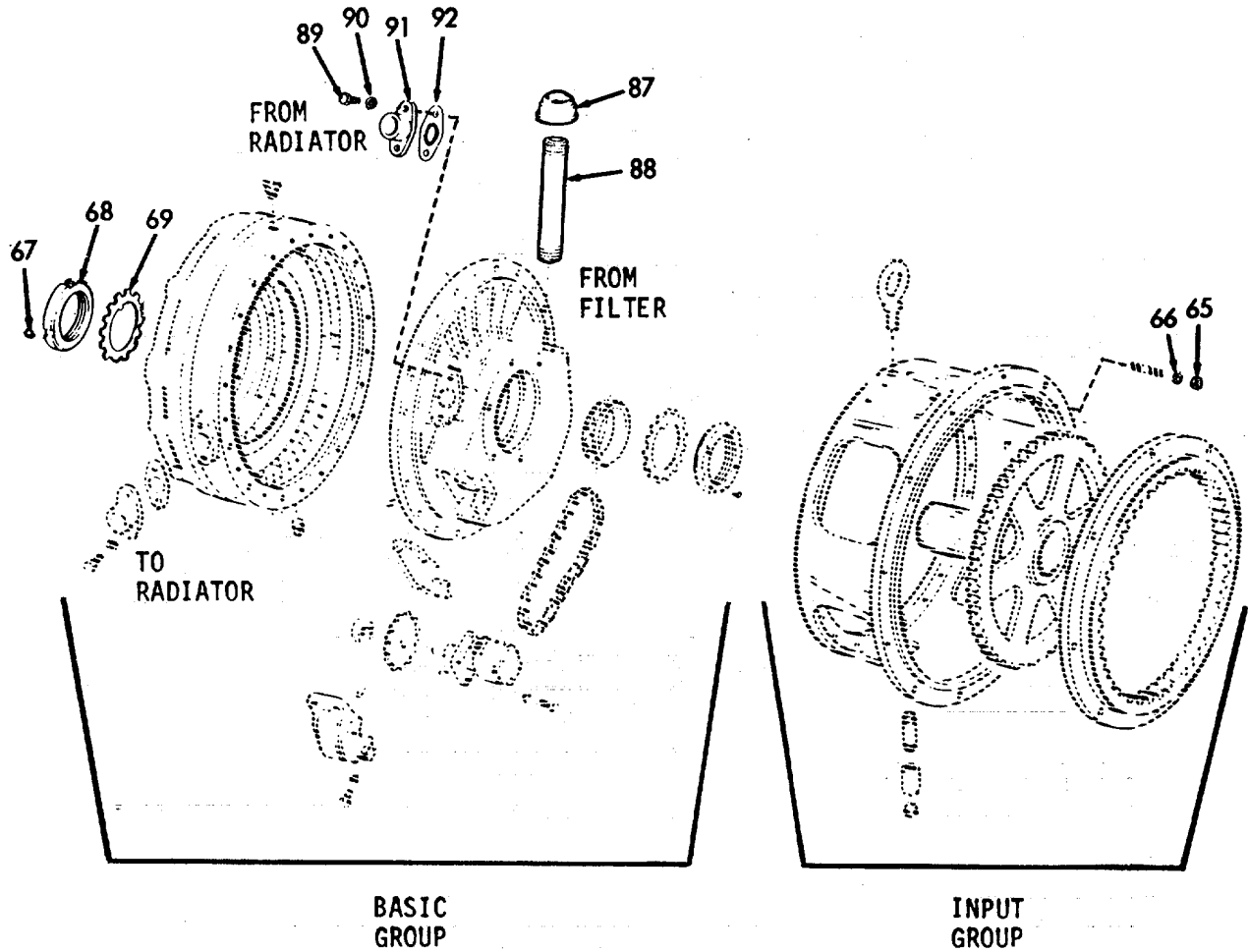
3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).'

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
	p. Washer (69), nut (68), and setscrew (67)	Install.	
	q. Gage (87), and breather nipple (88)	Remove.	If necessary.
	r. Bolts (89), lock-washers (90), flange (91), and gasket (92)	Remove.	If necessary
14. Input group	a. Basic group, and input group	Slide together.	
	b. Lock-washers (66), and nuts (65)		

3-136. TORQUE CONVERTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-137. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS.

The hydraulic tank assembly maintenance instructions are contained in the following paragraphs:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Tank Assembly	3-137.1
Hydraulic Filter	3-137.2
Pilot Valve and Manifold	3-137.3
Pressure Control Valve	3-137.4
Check Valve	3-137.5
Directional Valve - Pilot Operated	3-137.6
Relief Valve	3-137.7
Pressure Reducing Valve	3-137.8
Directional Valve - Spring Centered Solenoid	3-137.9

3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS.

This task covers: a. Inspection b. Service c. Repair

INITIAL SETUP

<u>Test Equipment</u>	<u>References</u>
None	None
<u>Special Tools</u>	<u>Equipment</u>
Flairing tool	<u>Condition</u> <u>Condition Description</u>
	<u>Paragraph</u>
	3-137.2 Hydraulic Filter Removal
	3-137.3 Pilot Valve and Manifold Removal
	3-137.4 Pressure Control Valve Removal
	3-137.5 Check Valves Removal
	3-137.6 Directional Valve Removal
	3-137.7 Relief Valve Removal
	3-137.8 Pressure Reducing Valve Removal
<u>Material/Parts</u>	<u>Special Environmental Conditions</u>
Lubricating oil	Do not drain oil into bilges.
MIL-L-17672	Use the oil/water separation and
Type 2110th	recovery system to collect used oil.
(55 gal)	
(208.18 liters)	
Cover gasket	
(P/N 83-7978)	
<u>Personnel Required</u>	<u>General Safety Instructions</u>
1	Observe WARNING in procedure.

3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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WARNING

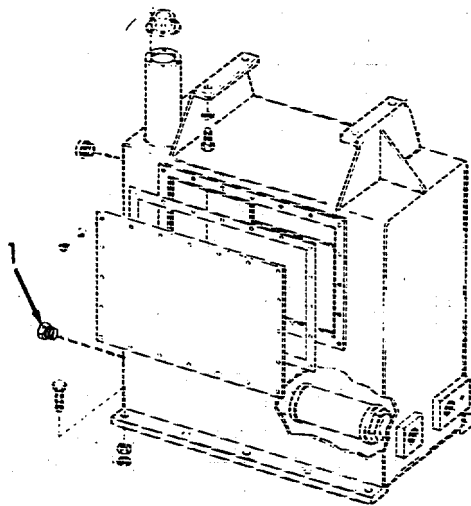
To avoid possible injury, turn off all electrical power and relieve hydraulic pressure.

INSPECTION

- | | | | |
|------------------|-----------|--|--|
| 1. Tank assembly | a. Gages | Inspect for broken glass, and bent needle. | |
| | b. Tubing | Inspect for breaks, cracks, bends and leaking. | |
| | c. Tank | Inspect for dents, cracks, and leaking. | |

SERVICE

- | | | | |
|----|----------------------------|---------|---|
| 2. | a. Magnetic drain plug (1) | Remove. | Drain oil into a suitable container. Clean strainer monthly and change oil annually |
|----|----------------------------|---------|---|



3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">SERVICE (Cont)</div>	b. Magnetic drain plug (1)	Remove collected metallic particles.	
	c. Screws (2), lock - washers (3), and breather cap (4)	Remove.	
<div style="border: 2px solid black; padding: 5px; display: inline-block; background-color: #f0f0f0;">WARNING</div>			
Wear protective eye covering when using compressed air.			
	d. Breather cap (4)	Clean screen with clean lubricating oil and blow dry with compressed air.	
	e. Magnetic drain plug (1)	Replace.	
3. Strainer	a. Screws (5), and lock-washers (6)	Remove.	
	b. Cover (7), and gasket (8)	Remove.	Discard gasket.
	c. Strainer (9)	Clean with lubricating oil and blow dry with compressed air, from inside to outside.	

3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont)

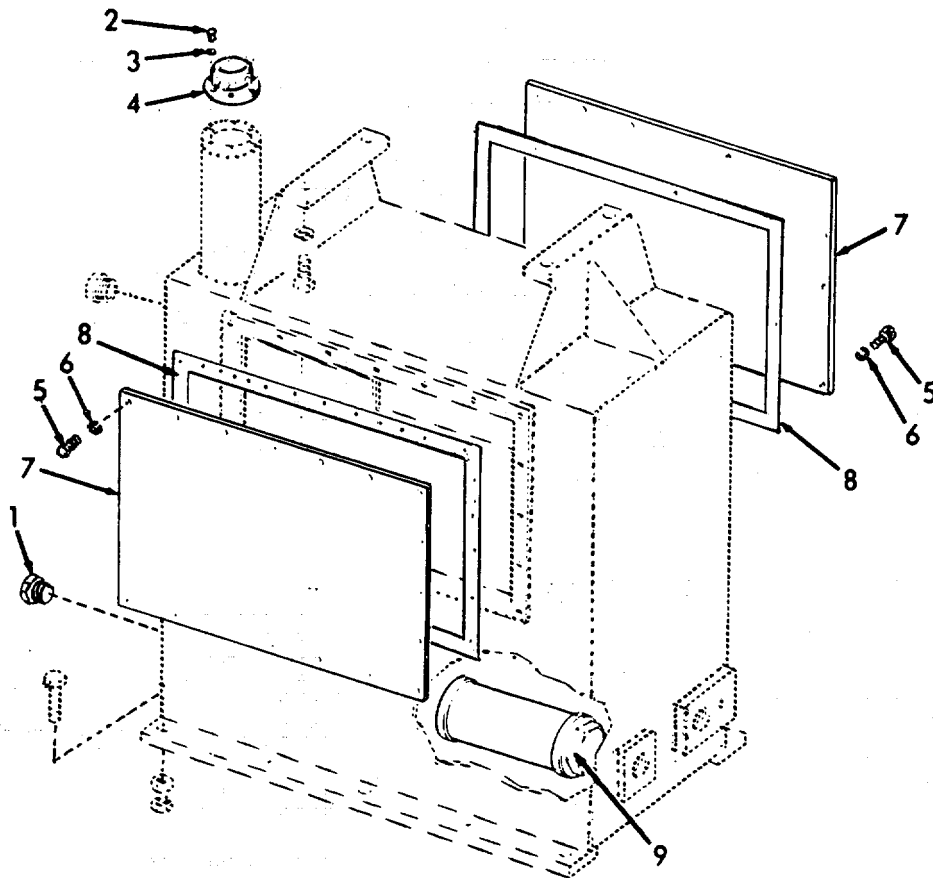
d. Strainer
(9)

Replace.

e. Gasket
(8),
cover
(7),
screws
(5),
and
lock-
washers
(6)

Replace.

Use new gasket.



3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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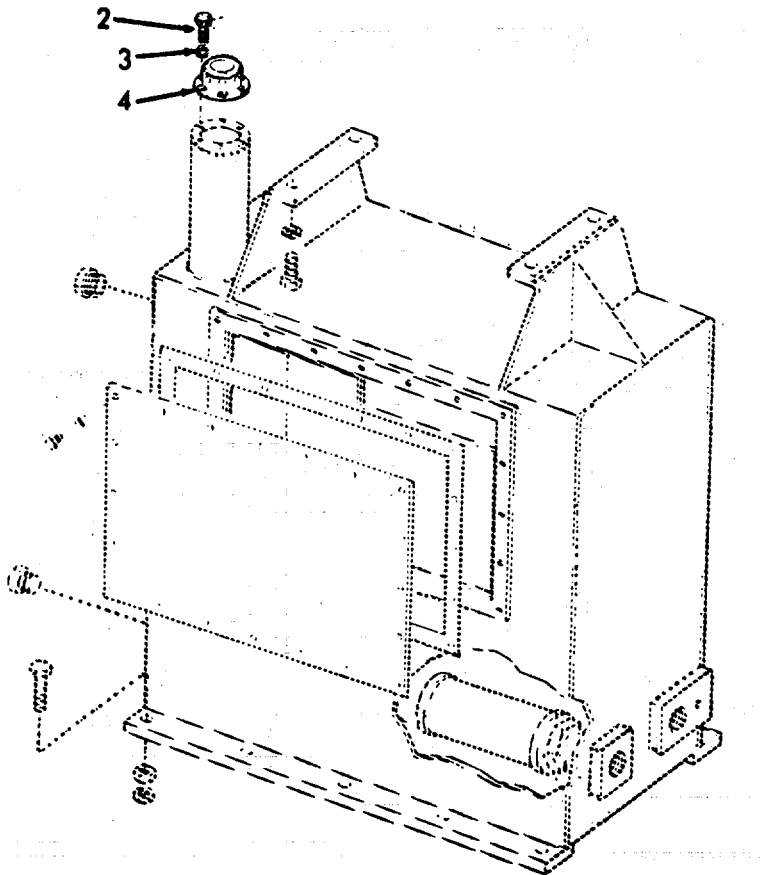
SERVICE (Cont)

4. Tank assembly

a. Breather pipe

Fill with oil. Capacity is 55 gallons (208.18 liters).

b. Breather Install. cap (4), screws (2), and lock-washers (3)

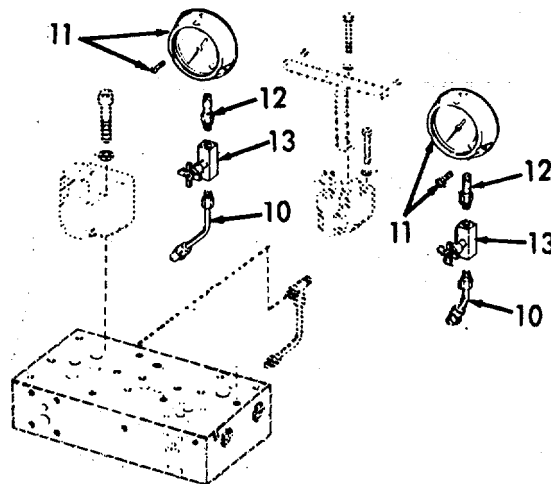


3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR

- | | | | |
|----------|---|--|--|
| 5. Gages | a. Tubing (10) | Loosen and remove. | |
| | b. Gage (11) | Remove nuts, screws and gage from bracket. | |
| | c. Gage snubber (12), and needle valve (13) | Disassemble. | |
| | d. Needle valve (13) and gage snubber (12) | Reassemble. | |
| | e. Gage (11) | Install new gage. | |
| | f. Tubing (10) | Install and tighten. | |



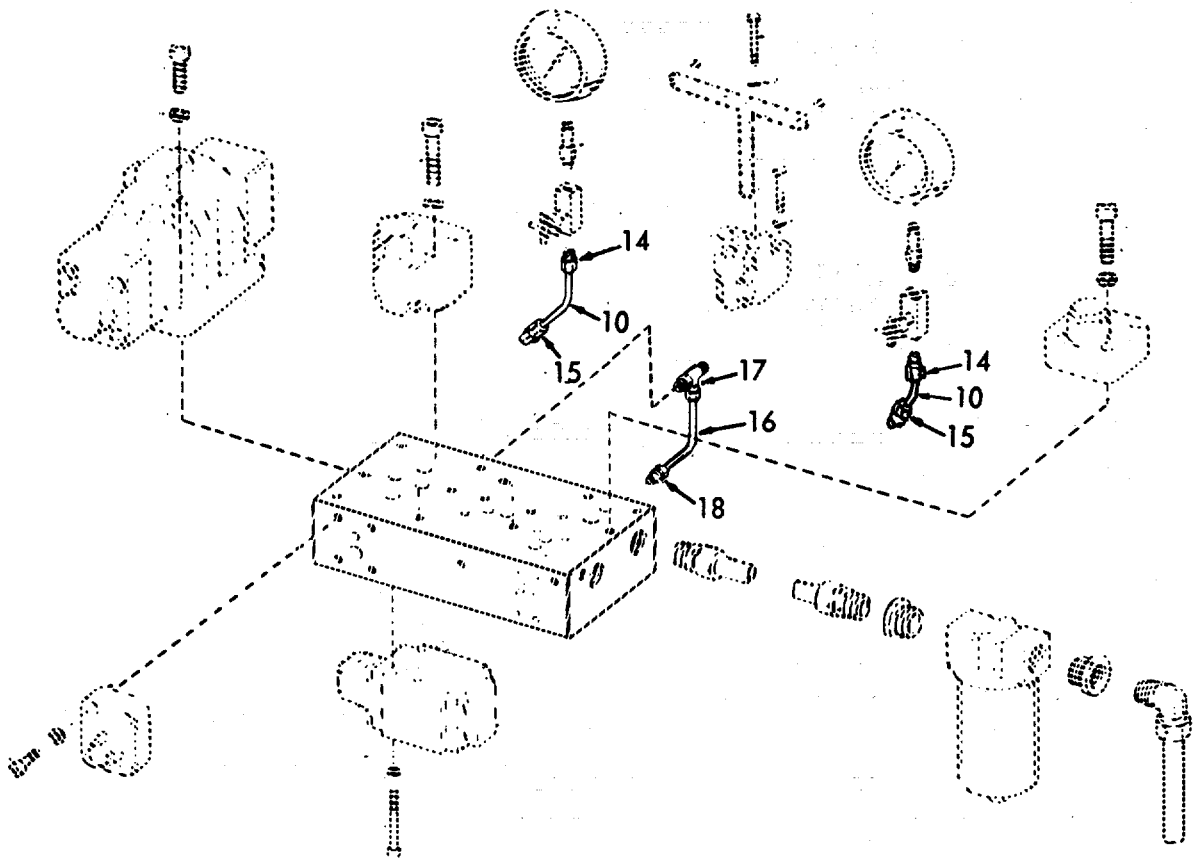
3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
6. Gage tubing (10)	Tube connector (14), and tube elbow (15).	Remove.	
	b. Tube connector (14), and tube elbow (15)	Reassemble.	Use flaring tool.
7. Pressure Control valve tubing	a. Tubing (16)	Loosen and remove.	
	b. T-fitting (17), and connector (18)	Remove from tube.	
	c. Connector (18), T-fitting (17), and tubing	Replace and tighten.	

3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



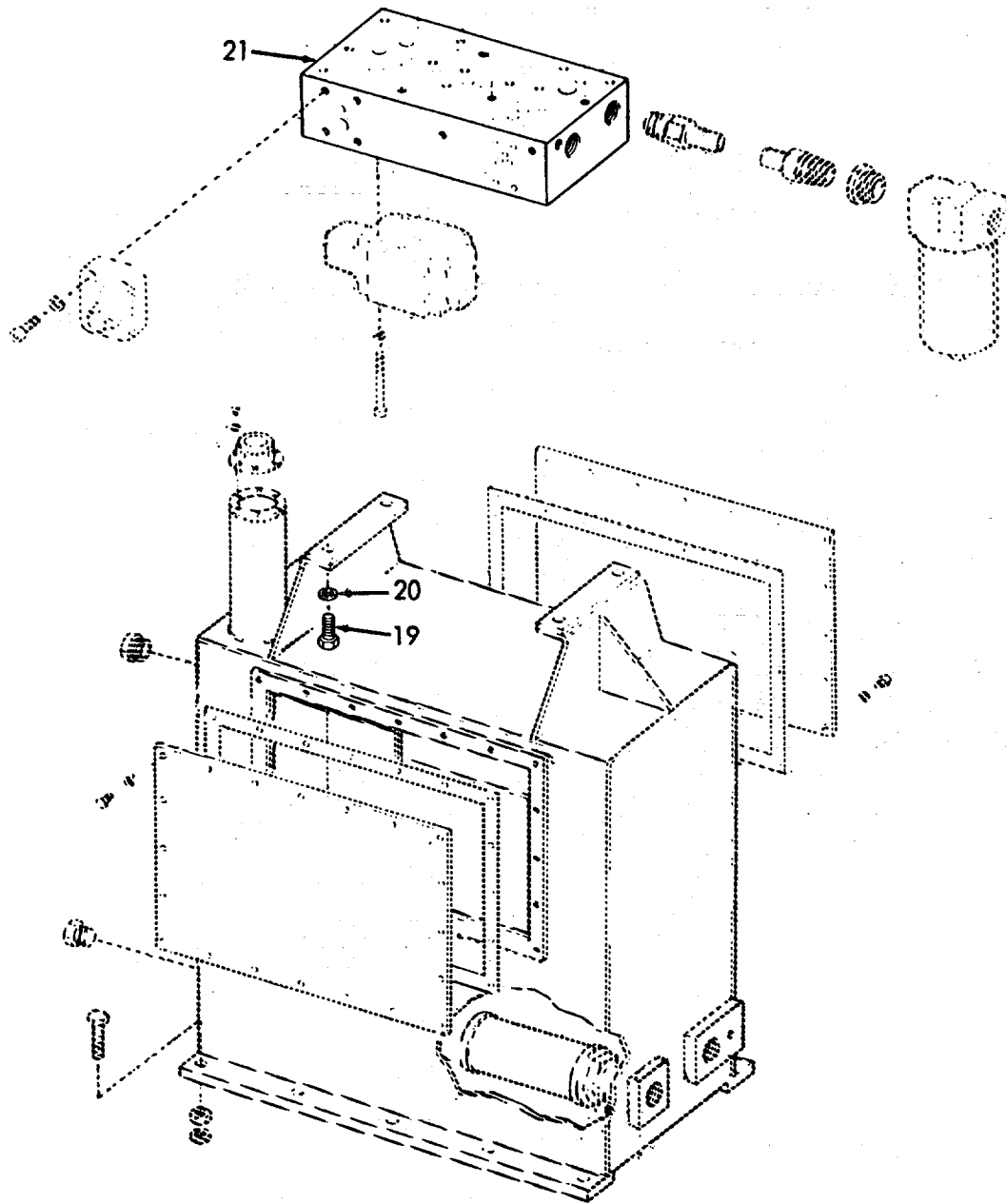
3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
8. Manifold	a. Valves	Remove all valves and components mounted on manifold.	
	b. Screws (19), and lock-washers (20)	Remove.	
	c. Manifold (21)	Remove.	
	d. Manifold (21), screws (19), and lock-washers (20)	Reassemble.	
	e. Valves	Reinstall.	

3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



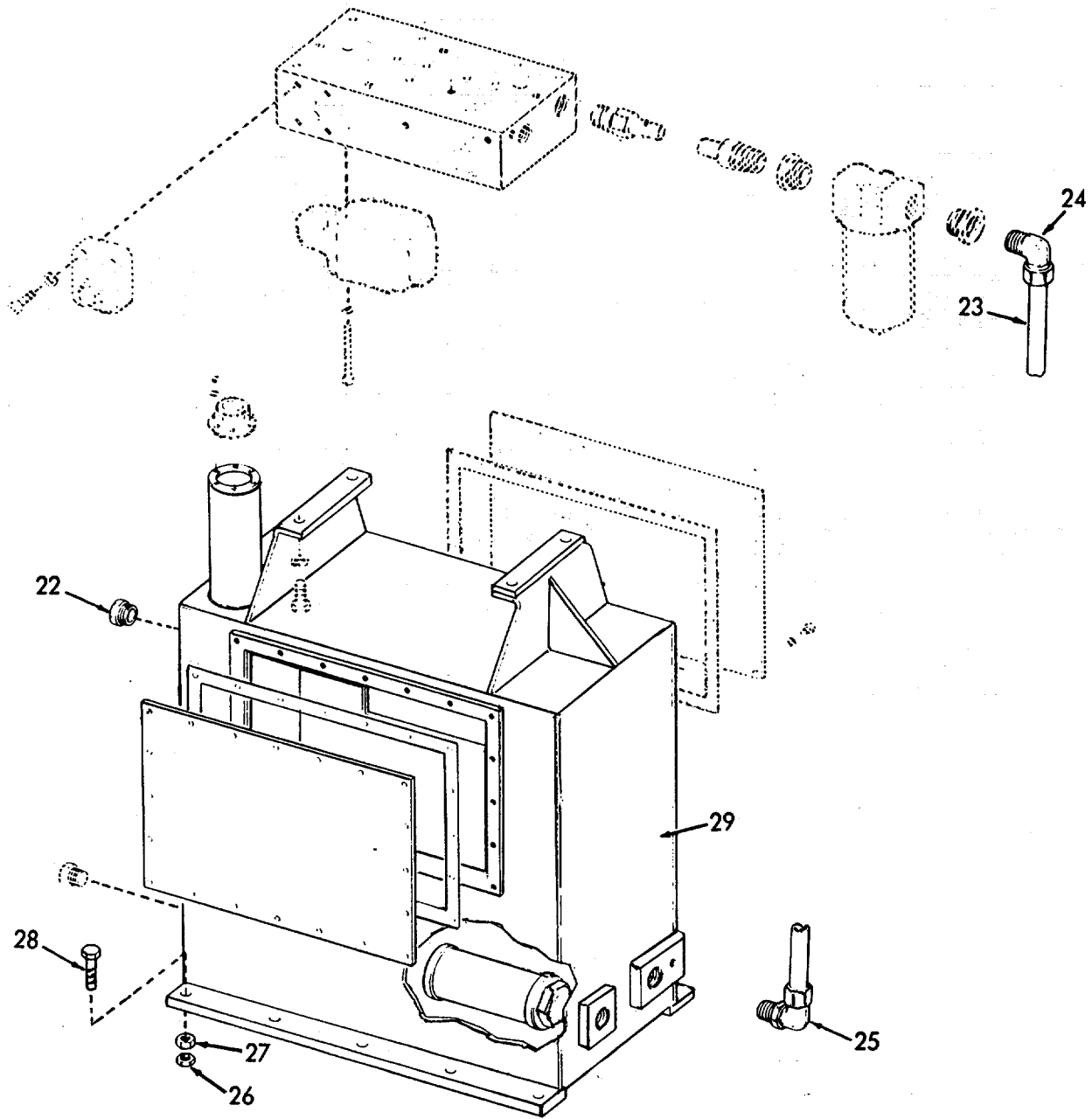
3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS	
REPAIR (Cont)				
9.	Sight glass	Glass (22)	Remove.	If necessary.
10.	Filter inlet tube	a. Tube (23)	Loosen and remove.	If necessary.
		b. Elbows (24 and 25)	Remove.	
11.	Tank	a. Ten jam nuts (26), nuts (27), and screws (28)	Remove.	If necessary.
		b. Tank (29)	Remove.	

3-137.1. HYDRAULIC TANK ASSEMBLY - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)



3-137.2. HYDRAULIC FILTER - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Service
- b. Repair

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment Condition Condition Description

None

Material/Parts

Lubricating oil
MIL-L-17672
Type 2110th
Filter element

Special Environmental Conditions.

Do not drain oil into bilges.
Use the oil/water separation
and recovery system to collect
drained oil.

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

WARNING

To avoid possible injury, turn off all electrical power and relieve hydraulic pressure.

SERVICE

- | | | | |
|----------------|-----------------------|------------------------------------|-------------------|
| 1. Filter body | a. Body bolt (1) | Loosen and remove filter body (2). | |
| | b. Gasket (3) | Remove. | |
| | c. Filter element (4) | Remove. | Clean or discard. |

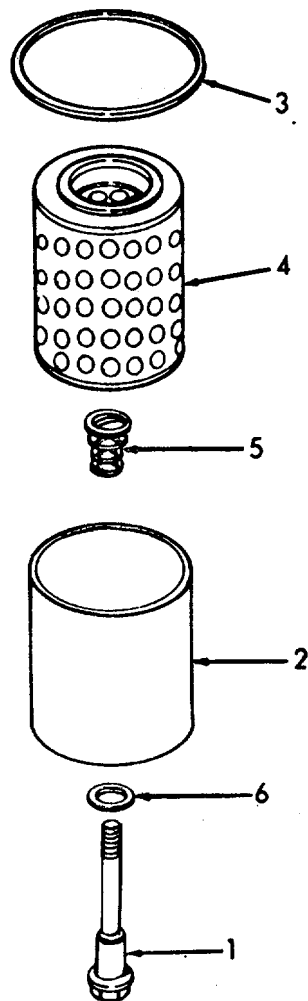
3-137.2. HYDRAULIC FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

SERVICE (Cont)

d. Spring
 (5),
 filter
 body
 (2),
 washers
 (6),
 and
 body
 bolt
 (1)

Disassemble.



3-137.-2. HYDRAULIC FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

SERVICE (Cont)

WARNING

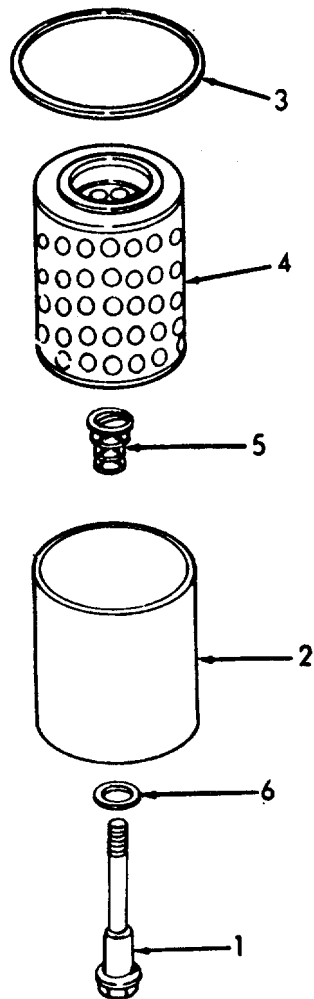
Wear protective eye goggles when using compressed air.

- | | |
|---|--|
| e. All parts | Clean in fuel oil and dry with compressed air. |
| f. Body bolt (1) washers (6), filter body (2), and spring (5) | Reassemble. |
| g. Filter element (4) | Insert in filter body. |
| h. Gasket (3) | Lightly coat with lubricating oil. |
| i. Filter body element (4), and gasket (3) | Install and tighten body bolt (1). |

3-137.2. HYDRAULIC FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont)



3-2229

3-137.2. HYDRAULIC FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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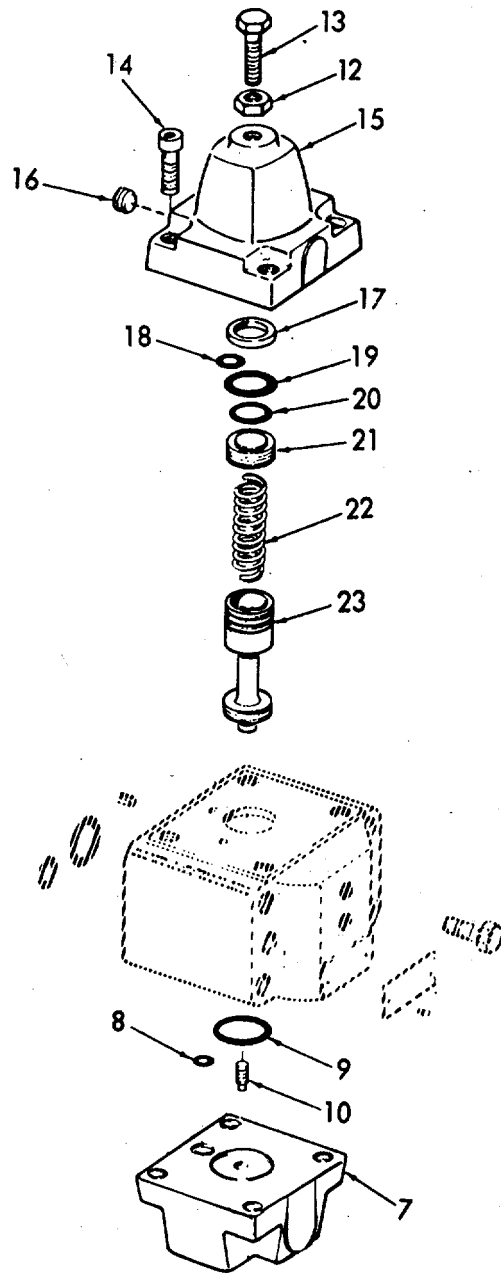
REPAIR (Cont)

- | | | | |
|----------------------------|--|--------------------------|--|
| 2. Hydraulic filter piping | a. Tubing (7) | Disconnect at elbow (8). | |
| | b. Elbow (8), and bushing (9) | Remove. | |
| | c. Filter base (10) | Remove. | |
| | d. Tubing (11), and connectors (12 and 13) | Disconnect. | |
| | e. Bushing (14) | Remove. | |
| | f. Bushing (14) | Replace. | |
| | g. Tubing (11), and connectors (12 and 13) | Replace. | |

3-137.4. PRESSURE CONTROL VALVE - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)



3-137.4. PRESSURE CONTROL VALVE - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	f. Cap (7), and screws (6)	Reassemble to body (27).	
	g. Plug (11)	Install.	
	h. Screws (6 and 14)	Tighten.	Tighten to 375 to 400 in. lbs. (42.7 to 45.5 Nm) torque.
	i. Valve, two pre- formed packing (4), screw (2), and lock- washer (3)	Install on manifold.	Use new pack- ing.
	j. Fit- ting (1)	Install on valve.	
ADJUSTMENT			
5.	Adjust- ing screw (13), and locknut (14)	When system is oper- ating, adjust to 1000 psi (700 kg/sq cm).	

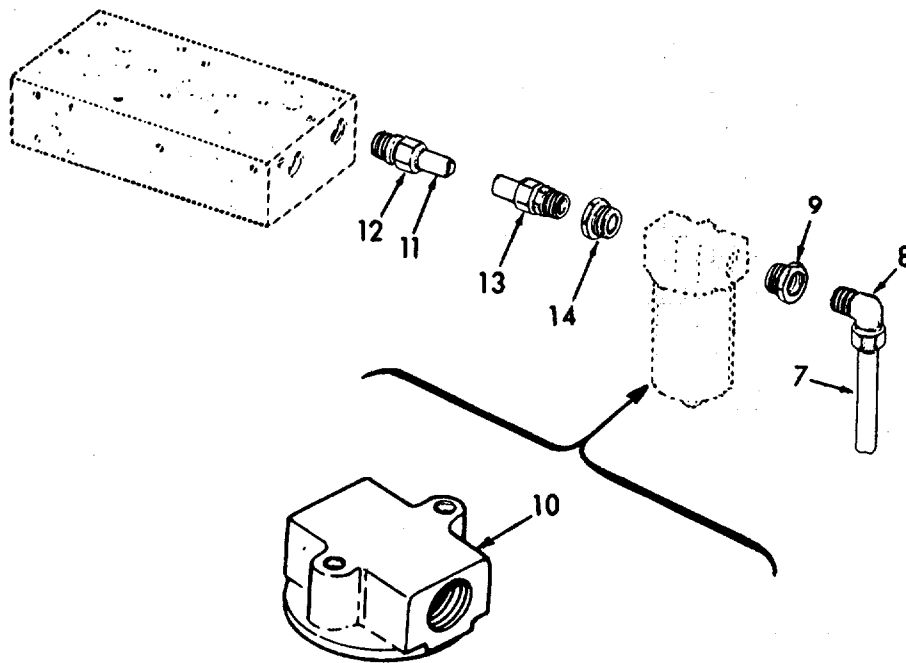
3-137.2. HYDRAULIC FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

h.	Filter base (10), bushing (9), and elbow (8)	Replace.	
----	--	----------	--

i.	Tubing (7)	Reconnect.	
----	------------	------------	--



3-2231

3-137.2. HYDRAULIC FILTER - MAINTENANCE INSTRUCTIONS(Continued).

LOCATION	ITEM	ACTION	REMARKS
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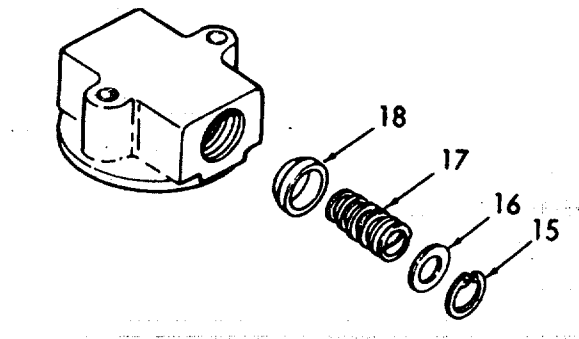
REPAIR (Cont)

3. Relief valve	a. Snap ring (15)	Remove.	
-----------------	-------------------	---------	--



Wear protective eye goggles when using compressed air.

- | | |
|--|---|
| b. Flat-washer (16), spring (17), and poppet (18) | Remove and clean with fuel oil and dry with compressed air. |
| c. Poppet (18), spring (17), flat-washer (16) and snap ring (15) | Reassemble. |



3-137.3. PILOT VALVE AND MANIFOLD - MAINTENANCE INSTRUCTIONS.

This task covers:

a. Inspection

b. Replacement

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment Condition Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

WARNING

To avoid possible injury, turn off all electrical power and relieve hydraulic pressure.

INSPECTION

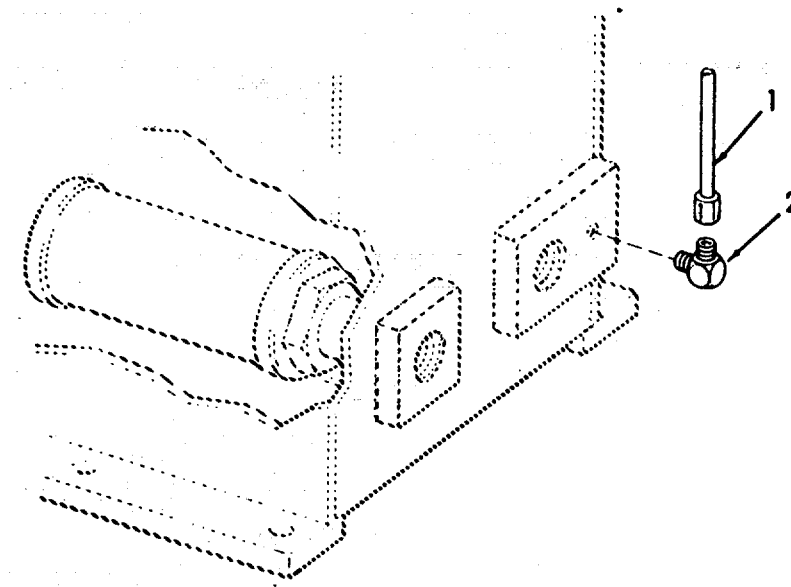
- | | | | |
|----|-------------|-----------------------------|------------------------------------|
| 1. | Manifold | a. Tubing cracks and leaks. | Inspect for bends, breaks, |
| | | b. Manifold | Inspect for leaks. |
| 2. | Pilot valve | a. Valve | Inspect for leaks. |
| | | b. Hardware | Insure that all hardware is tight. |

3-137.3. PILOT VALVE AND MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT

- | | | | |
|-----------|------------------|----------------------|--|
| 1. Tubing | a. Tubing
(1) | Loosen and remove. | |
| | b. Elbow
(2) | Remove. | |
| | c. Elbow
(2) | Replace. | |
| | d. Tubing
(1) | Install and tighten. | |



- | | | | |
|----------------|---|---------|--|
| 2. Pilot Valve | a. Screws
(3),
and
lock-
washers
(4) | Remove. | |
|----------------|---|---------|--|

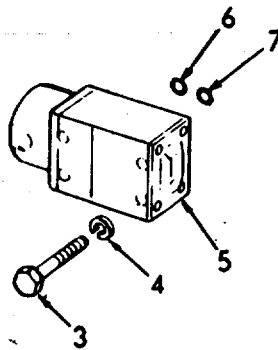
3-137.3. PILOT VALVE AND MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)

	b. Pilot valve (5), five pre-formed packing (6), and two pre-formed packing (7)	Remove.	Discard packing.
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	c. Pilot valve (5), five pre-formed packing (6), two pre-formed packing (7), lock-washers (4), and screws (3)	Reassemble.	
--	---	-------------	--



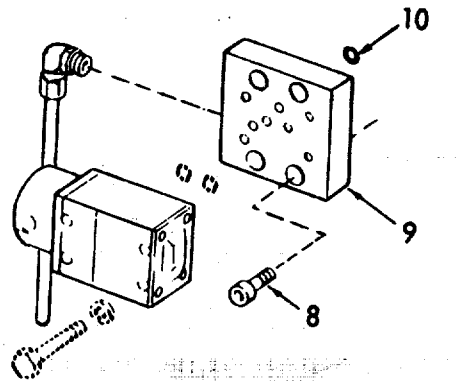
3-2235

3-137.3. PILOT VALVE AND MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT (Cont)

- | | | | | |
|----|----------|---|-------------|------------------|
| 3. | Manifold | a. Screws (8) | Remove. | |
| | | b. Manifold (9), and four pre-formed packing (10) | Remove. | Discard packing. |
| | | c. Manifold (9), four pre-formed packing (10), and screws (8) | Reassemble. | |



3-137.4. PRESSURE CONTROL VALVE - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Disassembly
- c. Cleaning
- d. Reassembly
- e. Adjustment

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Torque wrench

Equipment

Condition Condition Description

None

Material/Parts

Gasket kit P/N 919442
Lubricating oil
MIL-L-17672 Type 2110th

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

WARNING

To avoid possible injury, turn off all electrical power and relieve hydraulic pressure.

INSPECTION

- | | | | |
|---------------------------|----------------------|--|----------------------------|
| 1. Pressure control valve | a. Tubing | Inspect for cracks, breaks, bends and leaks. | Refer to paragraph 3-137.1 |
| | b. Seals | Inspect for leaking. | |
| | c. Mounting hardware | Insure that all hardware is tight. | |

3-137.4. PRESSURE CONTROL VALVE - MAINTENANCE INSTRUCTIONS. (Continued).

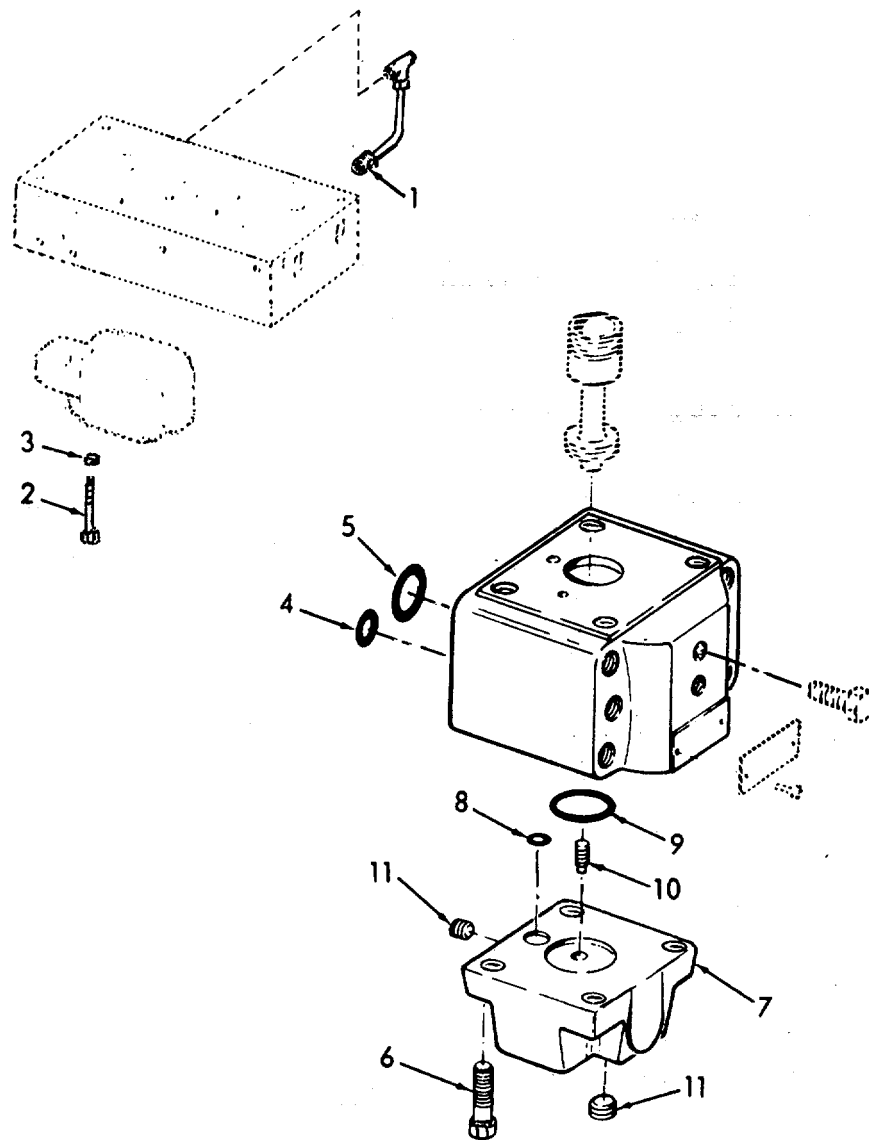
LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
2.	a. Fitting (1)	Loosen and remove tubing.	
	b. Screw (2), and lock- washer (3)	Remove.	
	c. Valve, two pre- formed packings (4), and two pre- formed packings (5)	Remove.	Discard packing.
	d. Four screws (6), and cover (7)	Remove.	
	e. Pre- formed packing (8 and 9)	Remove.	Discard packing.
	f. Plunger (10)	Remove.	

3-137.4. PRESSURE CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

	g. Two plugs (11)	Remove.	
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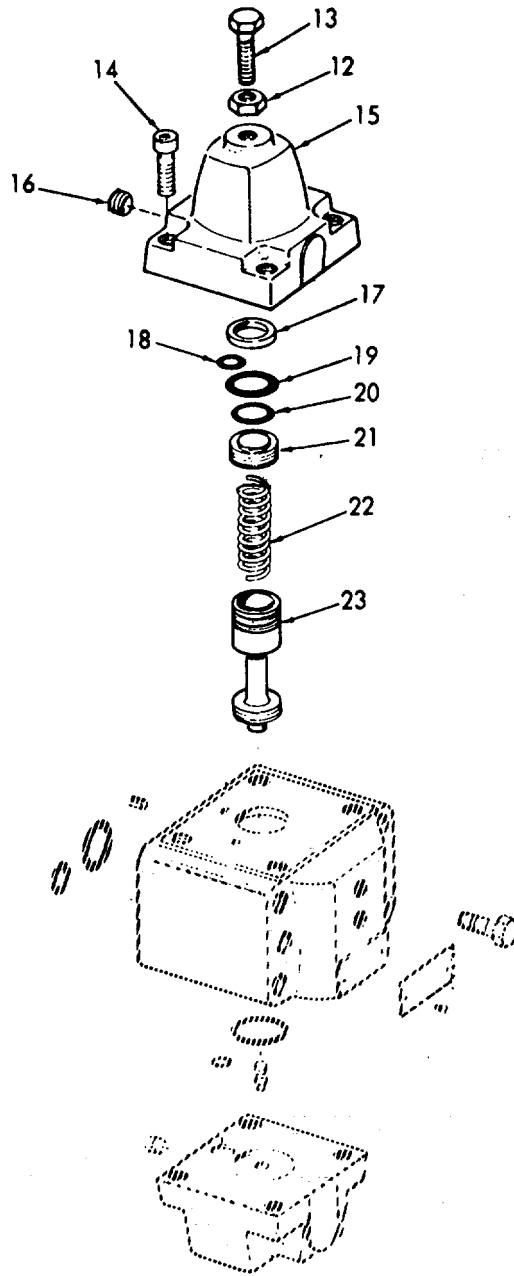
3-137.4. PRESSURE CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px;">DISASSEMBLY (Cont)</div>	h. Adjusting nut (12)	Loosen.	
	i. Adjusting screw (13)	Remove.	
	j. Screw (14)	Remove.	
	k. Top cap (15)	Remove.	
	l. Plug (16)	Remove.	
	m. Flat washer (17), pre-formed packing (18, 19, and 20), spring plug (21), spring (22), and spool (23)	Disassemble.	Use new packing.

3-137.4. PRESSURE CONTROL VALVE - MAINTENANCE INSTRUCTIONS.
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

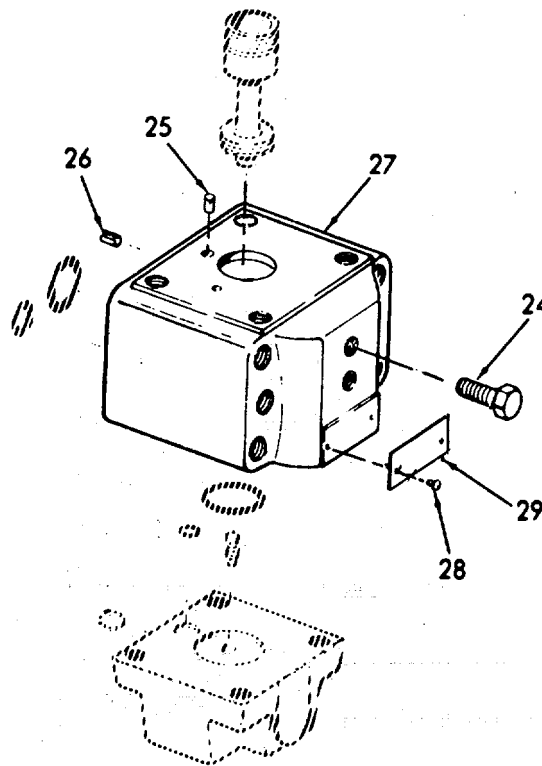


3-137.4. PRESSURE CONTROL VALVE - MAINTENANCE INSTRUCTIONS.
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY (Cont)

- | | | | |
|----|---|------------------------|--|
| n. | Two plugs (24), two plugs (25), and roll pin (26) | Remove from body (27). | |
| o. | Screws (28), and identification plate | Remove if necessary. | |



(29)

3-137.4. PRESSURE CONTROL VALVE - MAINTENANCE INSTRUCTIONS.
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING

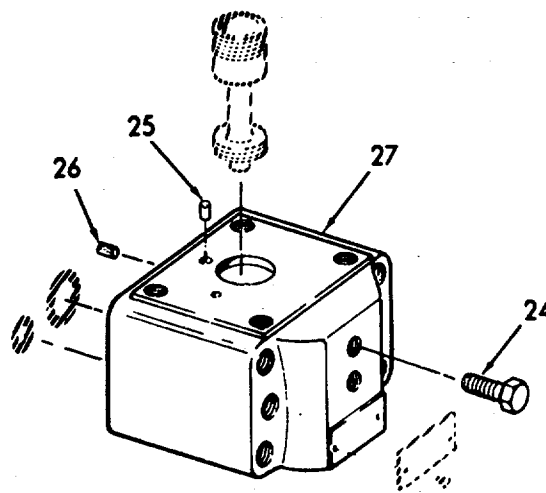
3. All parts must be thoroughly cleaned and kept clean during inspection and assembly. Contamination in unit will cause excessive wear, leakage and decreased service life. Clean in accordance with standard procedures for hydraulic parts. Do not use compressed air to dry parts unless the air is completely filtered, in order to remove water and contaminants.

REASSEMBLY

NOTE

Coat all internal parts lightly with lubricating oil.

4.
 - a. Two plugs (24), two plugs (25) and roll pin (26) Install in body (27).



3-2243

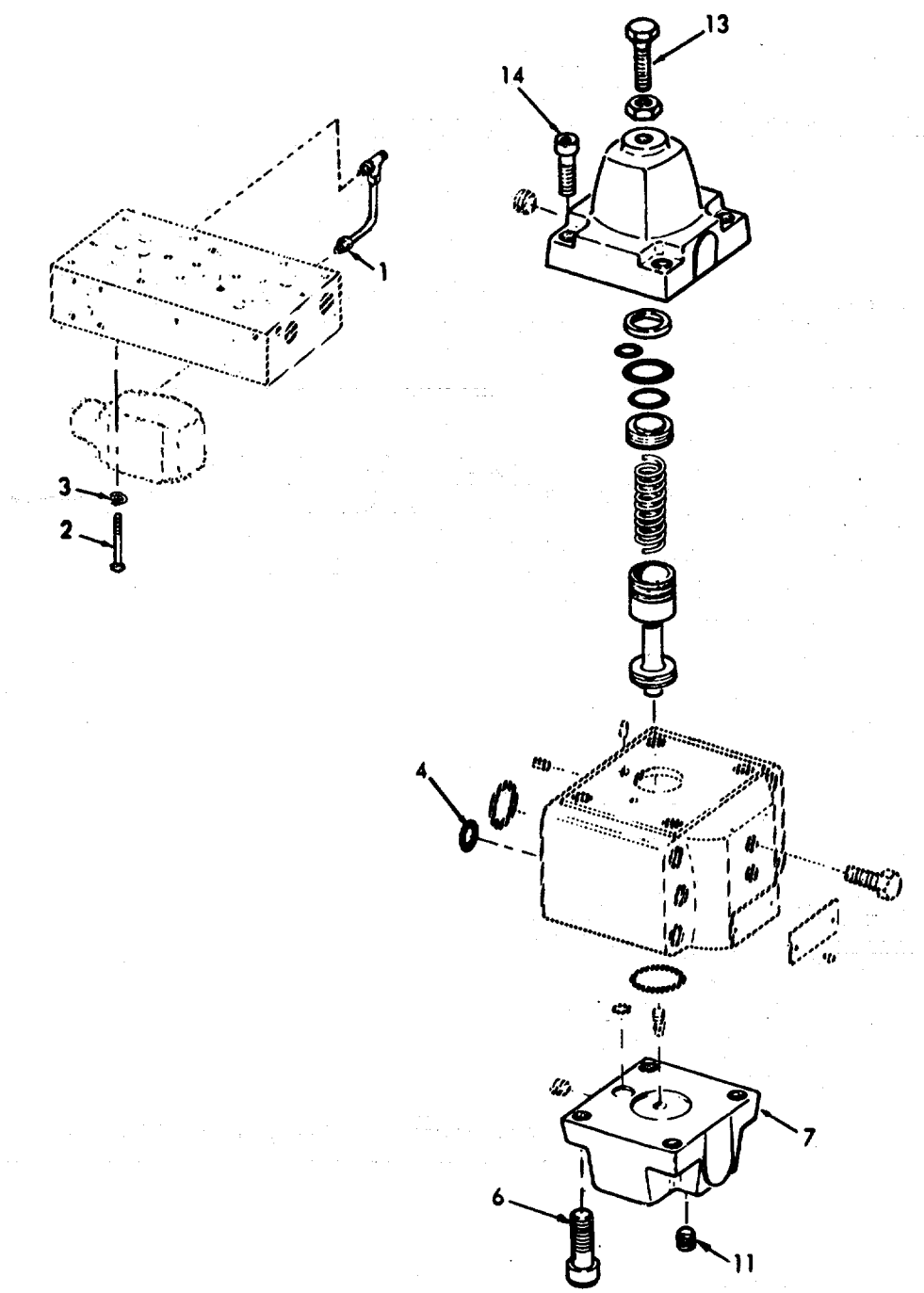
3-137.4. PRESSURE CONTROL VALVE - MAINTENANCE INSTRUCTIONS.
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	b. Spool (23), spring (22), spring plug (21), pre-formed packing (20, 19, and 18), flat-washer (17), top cap (15), and screws (14)	Reassemble.	Use new packing.
	c. Plug (16)	Replace.	
	d. Adjusting screw (13), and nut (12)	Install in top cap (15).	
	e. Pre-formed packing (8 and 9), and plunger (10)	Install in cap (7).	Use new packing.

3-137.4. PRESSURE CONTROL VALVE - MAINTENANCE INSTRUCTIONS.
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY (Cont)



3-137.5. CHECK VALVE - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Repair
- b. Cleaning

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment Condition Condition Description

None

Material/Parts

Lubricating oil
MIL-L-17672, Type 2110th

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
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WARNING

To avoid possible injury, turn off all electrical power and relieve hydraulic pressure.

REPAIR

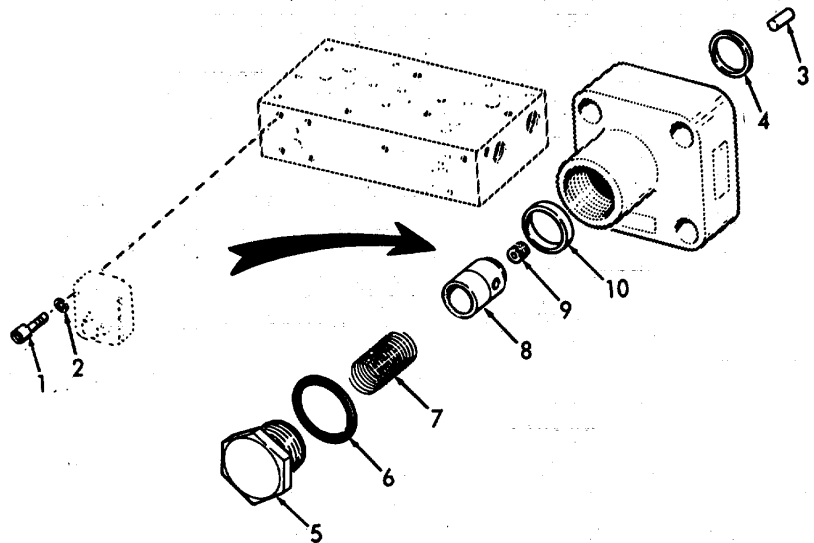
- | | | |
|-----------------------------|------------------------------------|---------|
| 1. Check valve type C4G-815 | a. Screws (1) and lock-washers (2) | Remove. |
|-----------------------------|------------------------------------|---------|

3-137.5. CHECK VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|--|---|---|--|
| | b. Two dowel pins (3), and two seals (4) | Remove. | |
| | c. Valve plug (5), and pre-formed packing (6) | Remove. | |
| | d. Spring (7), check valve (8), valve plug (9), and valve seat (10) | <ol style="list-style-type: none"> 1. Remove from body (11). 2. Refer to step 3 for cleaning. | |



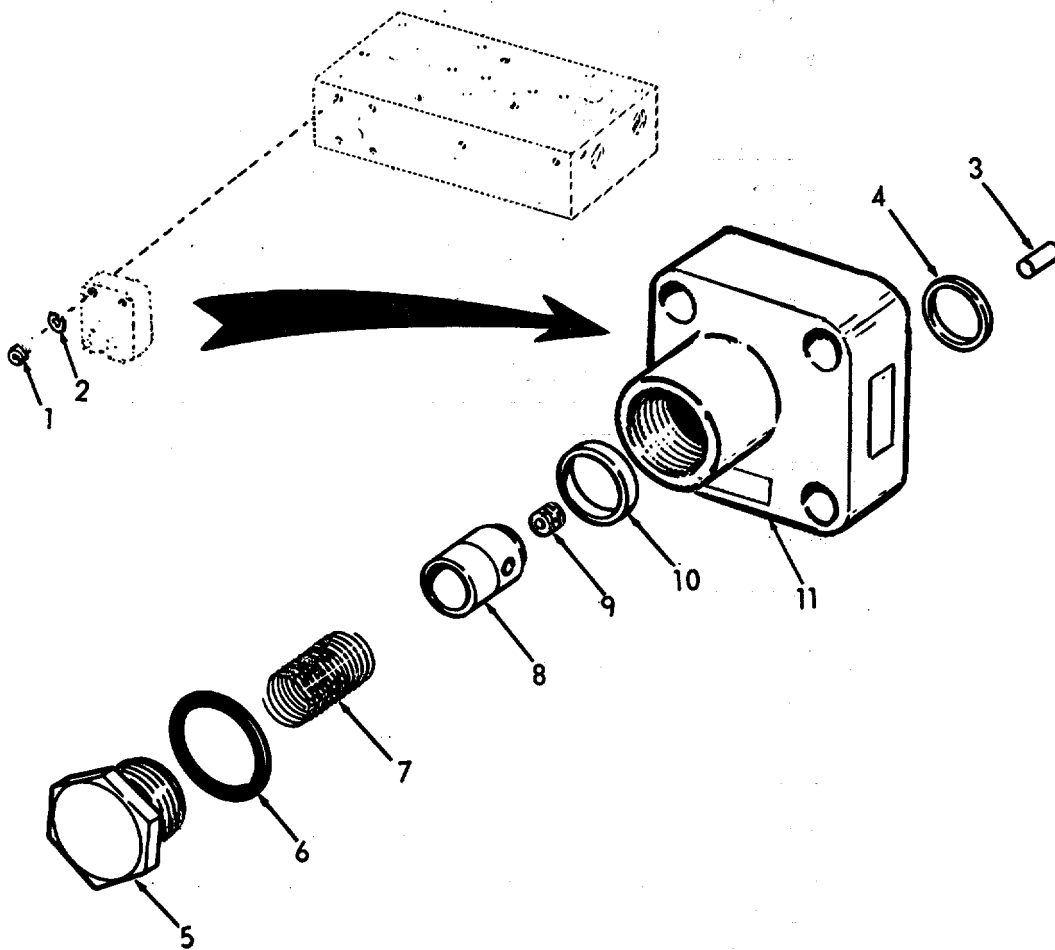
3-137.5. CHECK VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
NOTE			
Coat all internal parts lightly with lubricating oil.			
	e. Valve seat (10), valve plug (9), 1 check valve (8), and.. spring (7)	Install in body (11).	
	f. Pre-formed packing (6), and valve plug (5)	Install.	
	g. Seals (4) and dowel pins (3)	Install in body (11).	
	h. Body (11), screws (1), and lock-washers (2)	Reassemble.	

3-137.5. CHECK VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



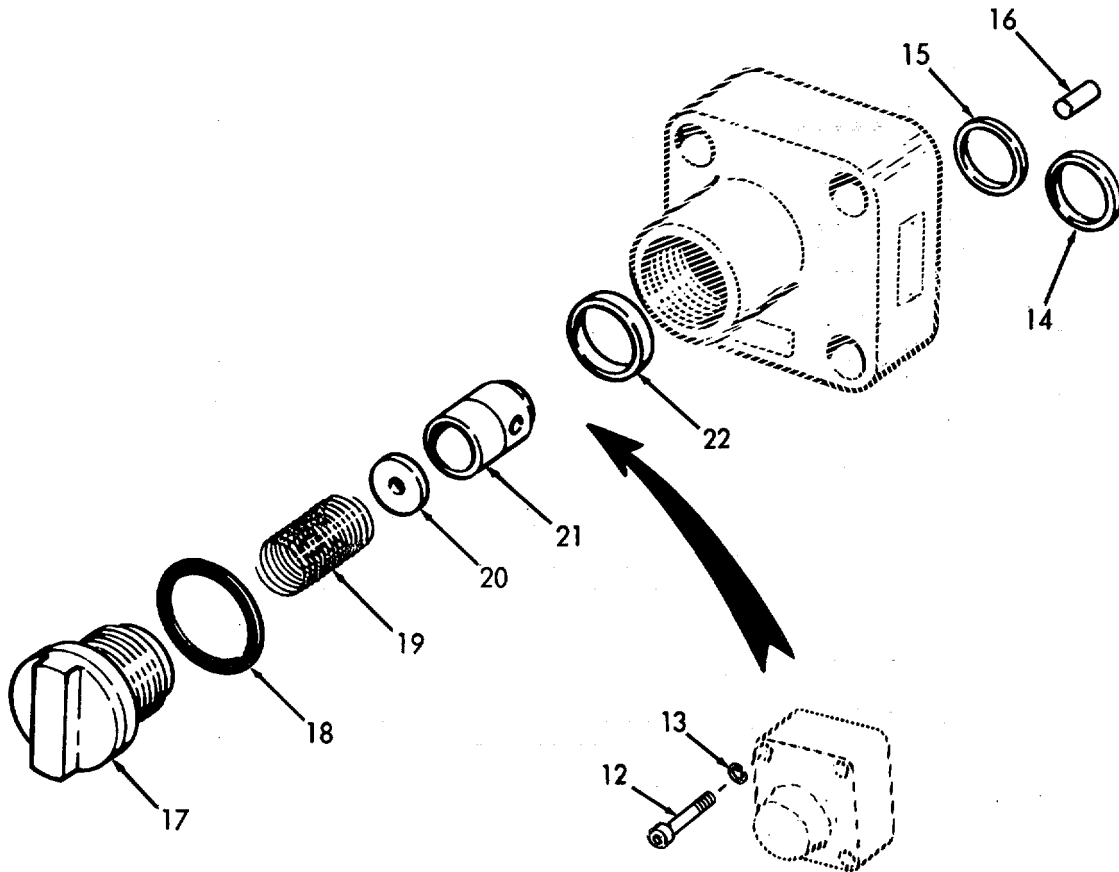
3-137.5. CHECK VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
2.	Check valve type C4G-825	a. Screws (12), and lock-washers (13)	Remove.
		b. Inlet seal (14), outlet seal (15), and two dowel pins' (16)	Remove.
		c. Valve plug ' (17), and pre-formed packing (18)	Remove.
		d. Spring (19), spacer (20), check valve (21), and valve seat (22)	1. Remove from body. (23). 2. For cleaning, refer to step 3.

3-137.5. CHECK VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)



3-137.5. CHECK VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

NOTE

Coat all internal parts lightly with lubricating oil.

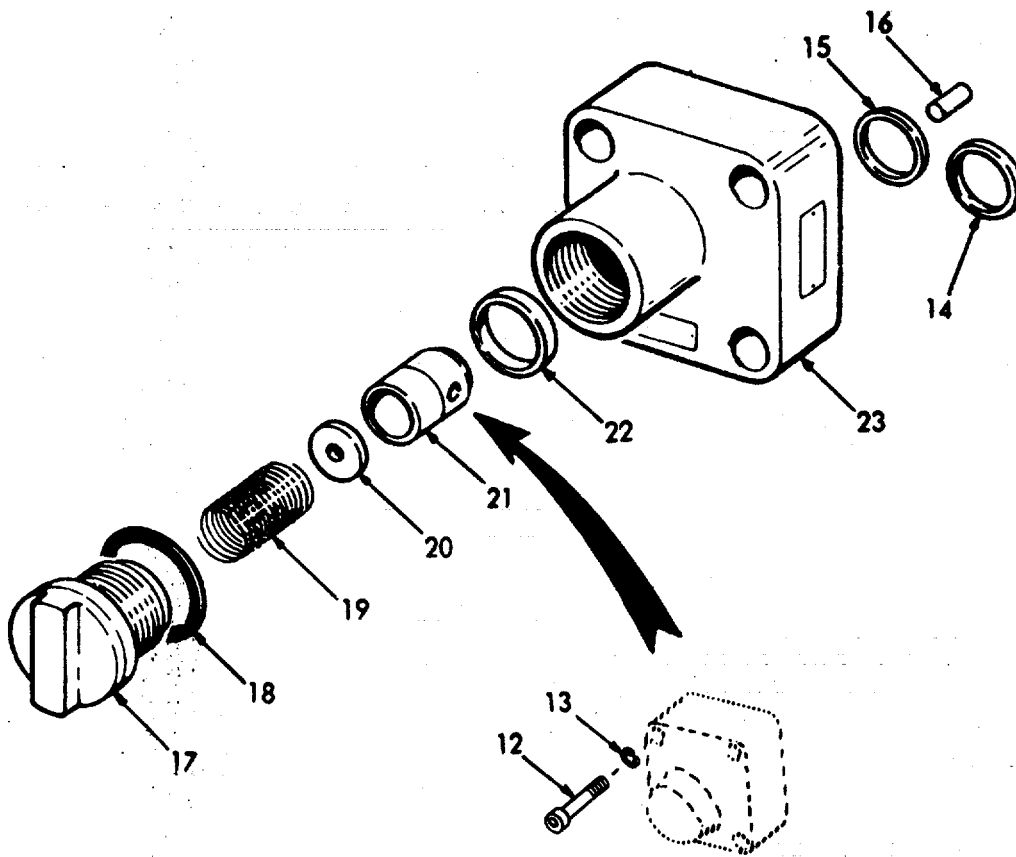
- | | | | |
|----|--|-----------------------|--|
| e. | Valve seat (22), check valve (21), spacer (20), and spring (19)- | Install in body (23). | |
| f. | Pre-formed packing (18), and valve plug (17) | Install. | Tighten to 40-50 ft. lb (54-68 Nm) torque. |
| g. | Inlet seal (14), outlet seal (15), and dowel pins (16) | Install in body (23). | |
| h. | Body (23), screw (12), and lock-washer (13) | Reassemble. | |

3-137.5. CHECK VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

CLEANING

- All parts must be thoroughly cleaned and kept clean during inspection and assembly. Contamination in the unit will cause excessive wear, leakage and decreased service life. Clean in accordance with standard procedures for hydraulic parts. Do not use compressed air to dry parts unless the air is completely filtered in order to remove water and contaminants.



3-137.6. DIRECTIONAL VALVE - MAINTENANCE INSTRUCTIONS.

This task covers:

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

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment
Condition Condition Description

None

Material/Parts

Lubricating oil
MIL-L-17672, Type 2110th
Gasket kit P/N 919190

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

WARNING

To avoid possible injury, turn off all electrical power and relieve hydraulic pressure.

REMOVAL

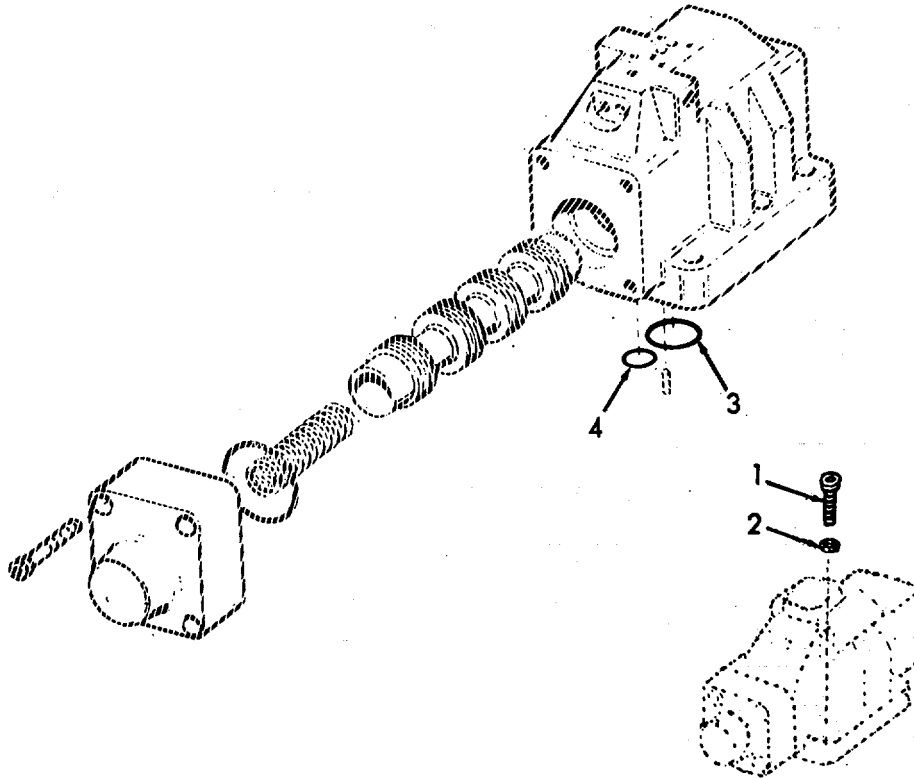
- | | | | |
|----------------------|-------------------------------------|---------------|--|
| 1. Directional valve | a. Screws (1), and lock-washers (2) | Remove valve. | Cap all openings to prevent entry of dirt or moisture. |
|----------------------|-------------------------------------|---------------|--|

3.137.6. DIRECTIONAL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL Cont

- | | | |
|---|----------------|-------------------------|
| <p>b. Two pre-formed packings (3), and four pre-formed packings (4)</p> | <p>Remove.</p> | <p>Discard packing.</p> |
|---|----------------|-------------------------|



3.137.6. DIRECTIONAL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY

NOTE

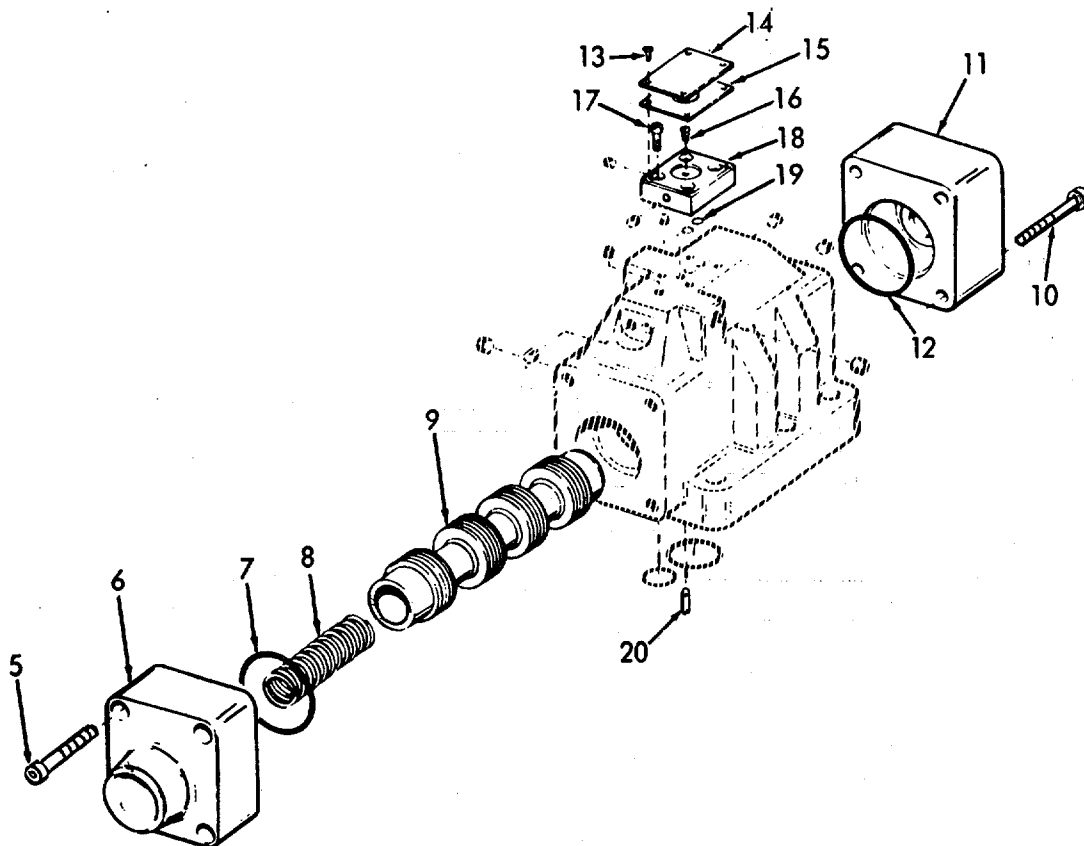
2. Valve body plugs are not included in the disassembly sequence because of the rare necessity for removing them.
- a. Screw (5) Remove.
 - b. Spring end cover (6), and pre-formed packing (7) Remove. Discard packing.
 - c. Spring (8), and spool (9) Remove.
 - d. Screw (10) Remove.
 - e. Cover (11), and pre-formed packing (12) Remove. Discard packing.
 - f. Screw (13), identification plate (14), and gasket (15) Remove.

3.137.6. DIRECTIONAL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY (Cont)

- | | | | |
|--|--|------------------------|------------------|
| | g. Screw (16) | Remove. | |
| | h. Screw (17), top cover (18), and five pre-formed packings (19) | Remove. | Discard packing. |
| | i. Two locating pins (20) | Remove from body (21). | If necessary. |



3.137.6. DIRECTIONAL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

CLEANING

3. All parts must be thoroughly cleaned and kept clean during inspection and assembly. Contamination in the unit will cause excessive wear, leakage and decreased service life. Clean in accordance with standard procedures for hydraulic parts. Do not use compressed air to dry parts unless the air is completely filtered in order to remove water and contaminants.

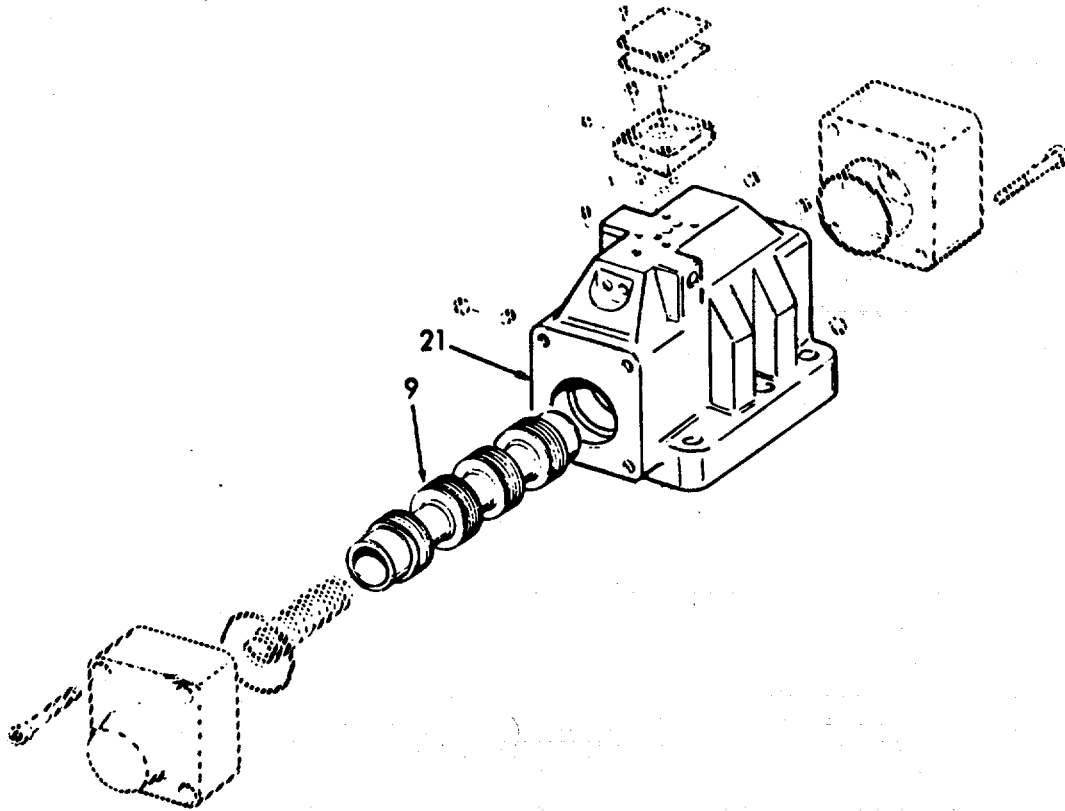
INSPECTION

- | | | |
|--------------|--|---|
| 4. General | a. Internal passages | Check that they are clean and unobstructed. |
| | b. Mating surfaces | Inspect for nicks and burrs. |
| | c. Threaded parts and holes | Inspect for wear. |
| 5. Spool (9) | Inspect for scoring and wear. Minor scratches can be removed with crocus cloth. Do not round off sharp corners of spool bands. | |
| 6. Body (21) | Inspect the body bore for scoring and wear. If excessive wear or scoring is evident on the spool, the body bore is most likely damaged. Any excess clearances between the spool and body will increase the leakage of the valve. The maximum clearance is 0.0012 inch (0.0030 cm). | |

3.137.6. DIRECTIONAL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)



3.137.6. DIRECTIONAL VALVE - MAINTENANCE INSTRUCTION'S (Continued).

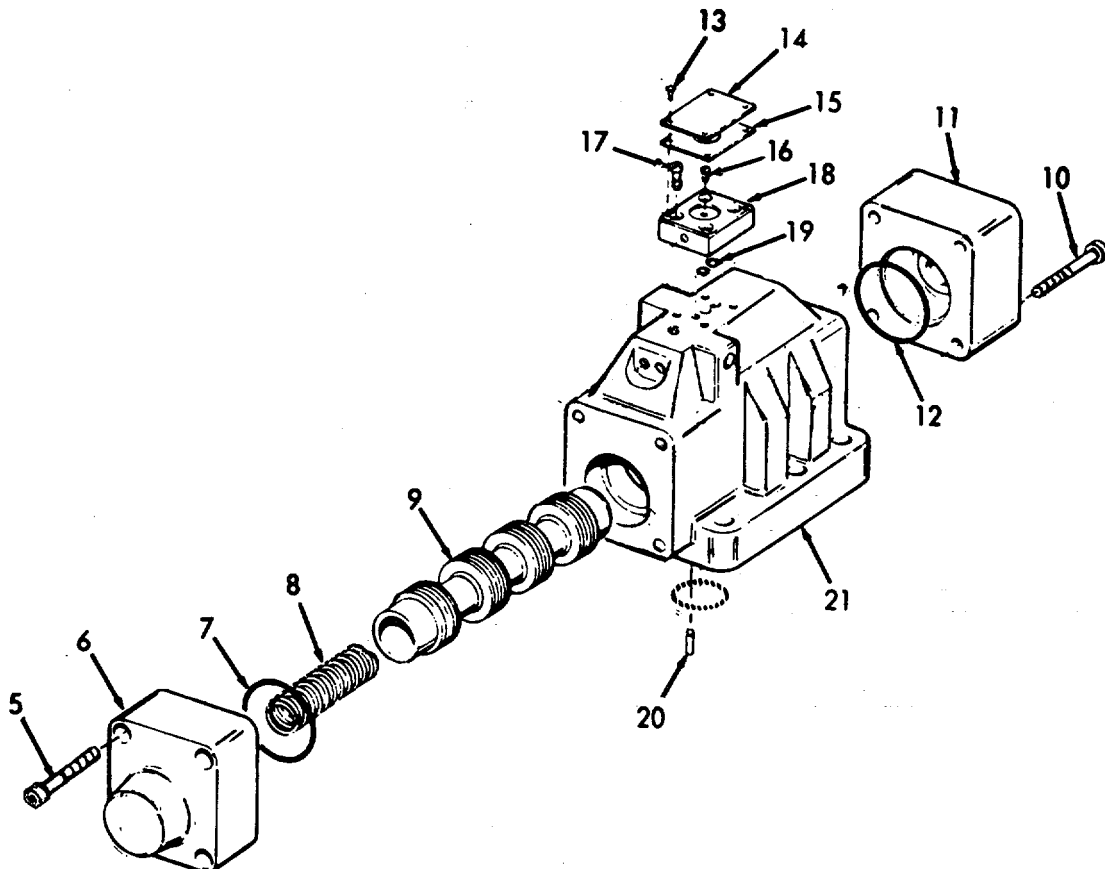
LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY			
7. Directional valve (20)	a. Two locating pins	Install in body (21).	
	NOTE		
	Coat all internal parts lightly with lubricating oil.		
	b. Five pre-formed packings (19), top covers (18), and screws (17)	Assemble.	Use new packing.
	c. Screw (16)	Install.	
d. Gasket (15), identification plate (14), and screw (13)	Install		
e. Pre-formed packing (12), cover (11), and screw (10)	Assemble.	Use new packing.	

3.137.6. DIRECTIONAL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY (Cont)

- | | | | |
|----|--|--|--|
| f. | Spool
(9) | 1. Coat with clean lubricating oil.
2. Insert in body as shown. | |
| g. | Spring
(8),
pre-
formed
packing
(7),
spring
end
cover
(6),
and
screw
(5) | Reassemble. | |

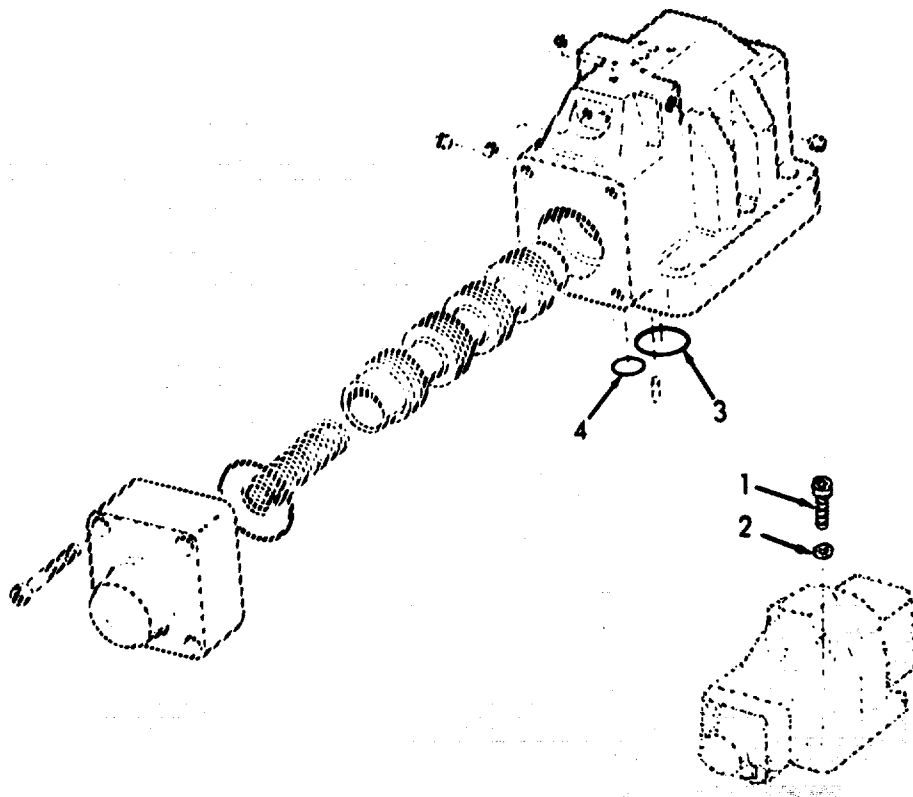


3.137.6. DIRECTIONAL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION

- | | | | |
|----|---|---|--|
| 8. | Two pre-formed packings (3), four pre-formed packings (4), screw (1), and lock-washer (2) | <ol style="list-style-type: none"> 1. Coat packings lightly with lubricating oil. 2. Install valve to manifold. | |
|----|---|---|--|



3-137.7. RELIEF VALVE - MAINTENANCE INSTRUCTIONS.

This task covers:

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

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment
Condition Condition Description

None

Material/Parts

Lubricating oil
MIL-L-17672, Type 2110th
Gasket kit P/N 919418

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

3-137.7. RELIEF VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

WARNING

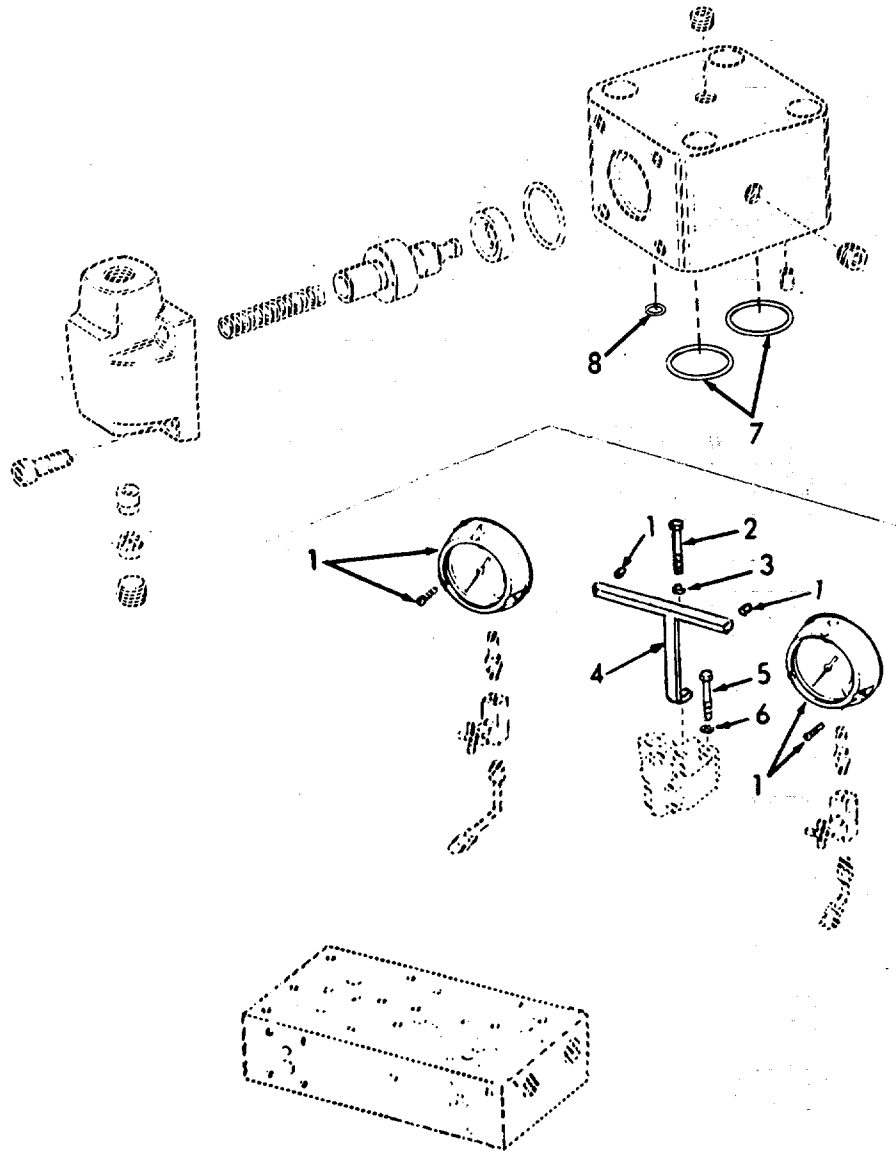
To avoid possible injury, turn off all electrical power and relieve hydraulic pressure.

- | | | | |
|-----------------|--|-------------------------|---|
| 1. Relief valve | a. Gages (1) | Remove nuts and screws. | |
| | b. Screws (2), lock-washers (3), and bracket (4) | Remove. | |
| | c. Three screws (5), and lock-washers (6) | Remove. | |
| | d. Valve, two pre-formed packing (7), and pre-formed packing (8) | Remove. | Discard packing. Cap all openings to prevent entry of dirt, moisture or contaminants. |

3-137.7. RELIEF VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



3-137.7. RELIEF VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY

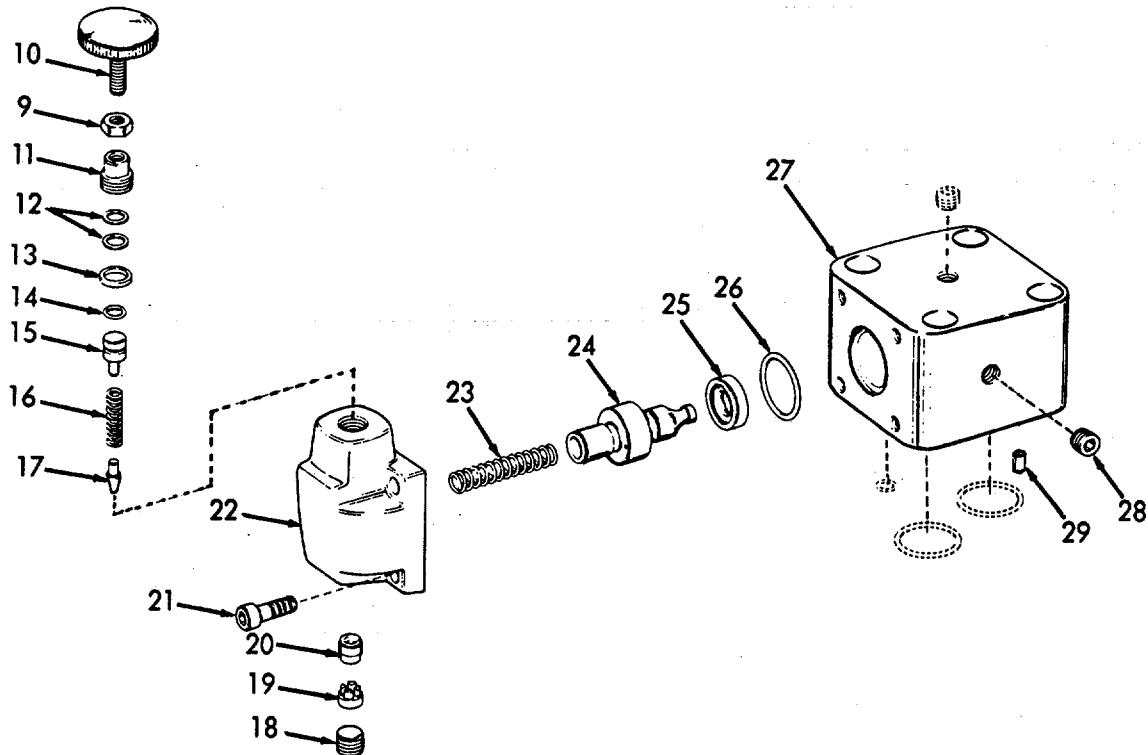
- | | | | |
|----|--|---------|------------------|
| 2. | a. Locknut (9) | Loosen. | |
| | b. Knob (10) | Remove. | |
| | c. Lock screws (11), shims (12), spacer (13), pre-formed packing (14), plunger (15), spring (16), and adjustment piston (17) | Remove. | Discard packing. |
| | d. Plug cover (18), spacer (19), and piston seat (20) | Remove. | |
| | e. Screw (21). | Remove. | |
| | f. Cover (22) | Remove. | |

3-137.7. RELIEF VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY (Cont)

- | | | | |
|--|--|------------------------|------------------|
| | g. Spring (23), main piston (24), seat (25), and pre-formed packing (26) | Remove from body (27). | Discard packing. |
| | h. Plug (28), and locating pin (29) | Remove. | If necessary. |



3-137.7. RELIEF VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING

3. All parts must be thoroughly cleaned and kept clean during inspection and assembly. Contamination in the unit will cause excessive wear, leakage and decreased service life. Clean in accordance with standard procedures for hydraulic parts. Do not use compressed air to dry parts unless the air is completely filtered in order to remove water and contaminants.

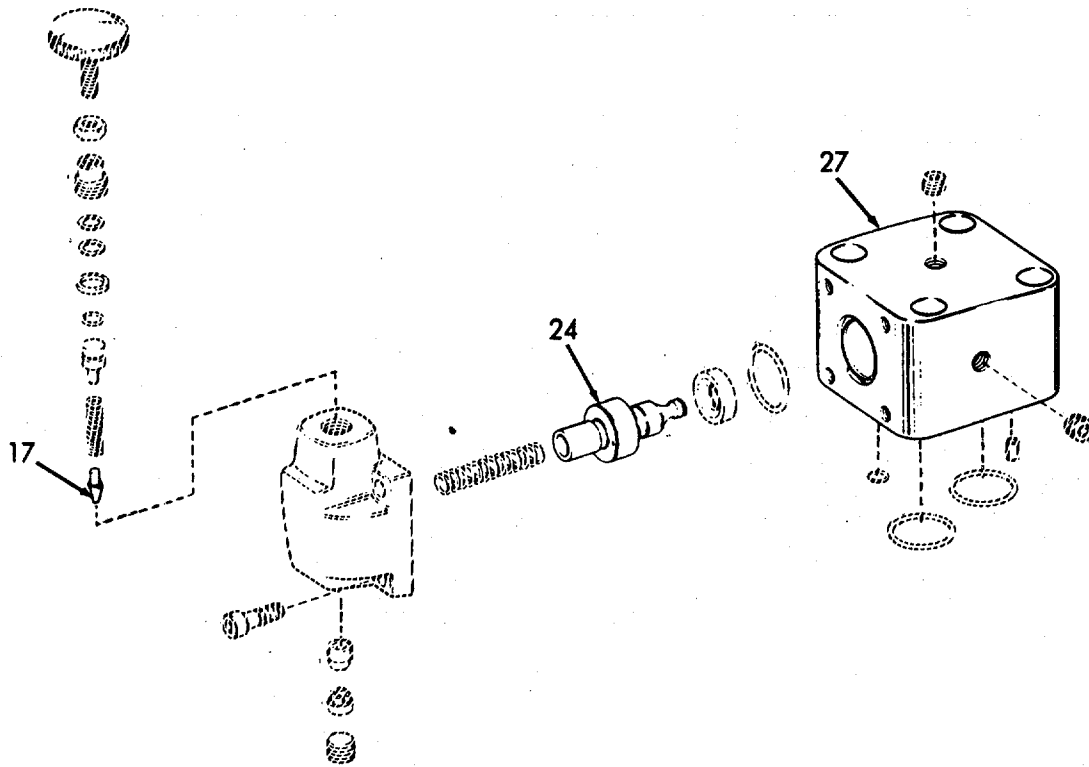
INSPECTION

- | | | | |
|----|---------------------|---|---|
| 4. | General | <ol style="list-style-type: none"> a. Internal passages b. Mating surfaces c. Threaded parts and holes | <p>Check that they are clean and unobstructed.</p> <p>Inspect-for nicks and burrs.</p> <p>Inspect for wear.</p> |
| 5. | Pistons (17 and 24) | Inspect for scoring or wear. Minor scratches can be removed with crocus cloth. | |
| 6. | Body (27) | Inspect the body bore for scoring and wear. If excessive wear or scoring is evident on the pistons, the body bore is most likely damaged. | |

3.137.7. RELIEF VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)



REASSEMBLY

NOTE
Coat all internal parts lightly with lubricating oil

3.137.7. RELIEF VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
7. Relief valve	a. Plug (28), and locating pin (29)	Install.	
	b. Pre-formed packing (26), seat (25), main piston (24), spring (23), cover (22), and screws (21)	Reinstall in body (27).	
	c. Piston seat (20), spacer (19), and plug cover (18)	Install in cover (22).	
	d. Adjust-ment piston (17), spring (16),	Install in cover (22).	

3-137.7. RELIEF VALVE - MAINTENANCE INSTRUCTIONS (Continued).

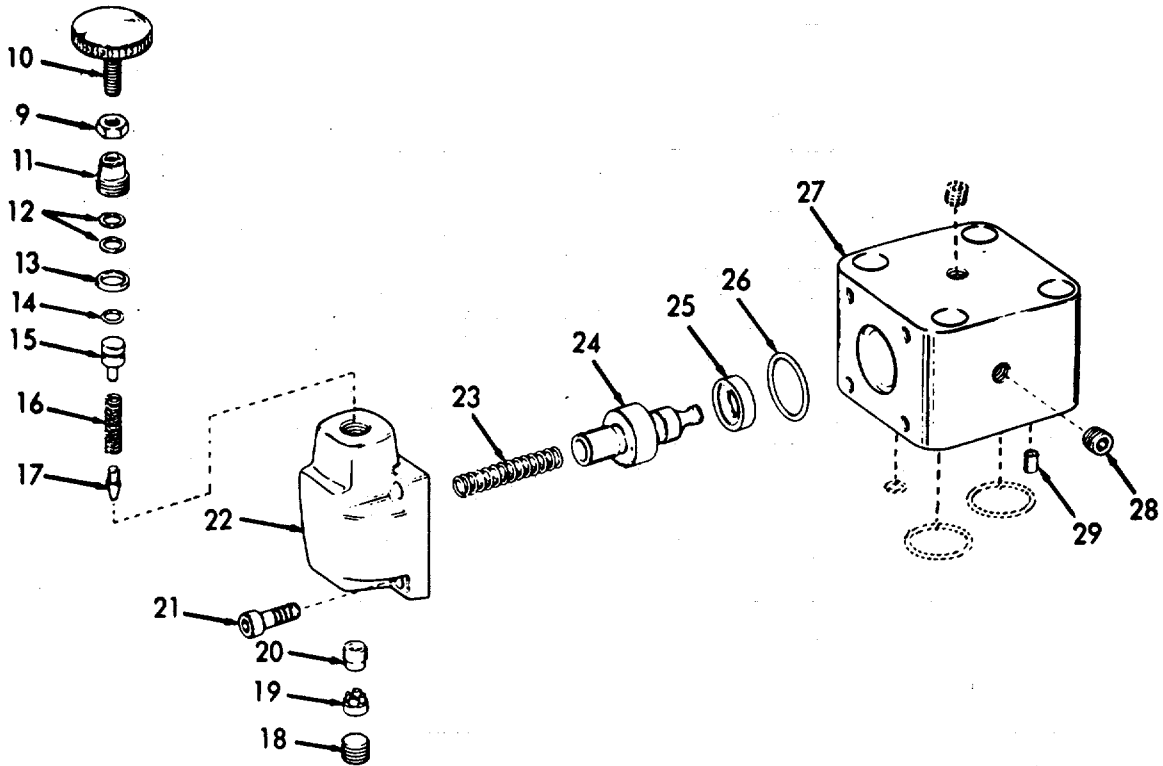
LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

plunger
15),
pre-
formed
packing
(14),
spacer
(13),
shims
(12),
and
lock-
screw
(11)

e. Lock-
nut
(9),
and
knob
(10)

Install.



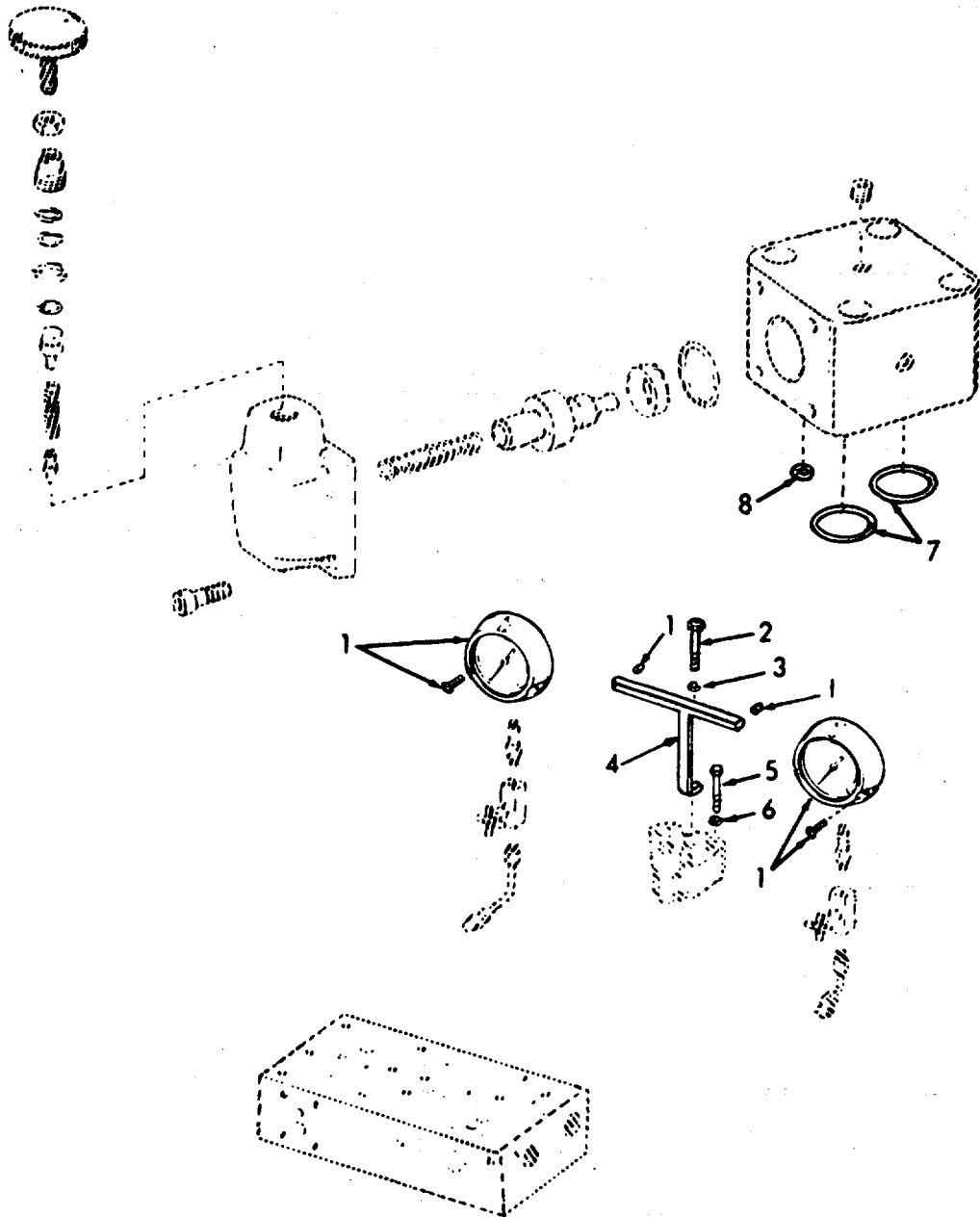
3.137.7. RELIEF VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<p>INSTALLATION</p>			
8.	<p>a. Pre-formed packing (8), and two pre-formed packings (7)</p>	<p>1. Coat lightly with hydraulic fluid. 2. Install in body (27).</p>	
	<p>b. Valve, three screws (5), and lock-washers (6)</p>	Install.	
	<p>c. Screws (2), lock-washers (3), and bracket (4)</p>	Install.	
	<p>d. Gages (1)</p>	Install using screws and nuts.	

3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



3-2275

3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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This task covers:

- | | |
|----------------|---------------|
| a. Disassembly | c. Inspection |
| b. Cleaning | d. Reassembly |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment

Condition	Condition Description
-----------	-----------------------

None

Material/Parts

Lubricating Oil
MIL-L-17672, Type 2110th
Gasket kit P/N 919448

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
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WARNING

To avoid possible injury, turn off all electrical power and relieve hydraulic pressure.

DISASSEMBLY

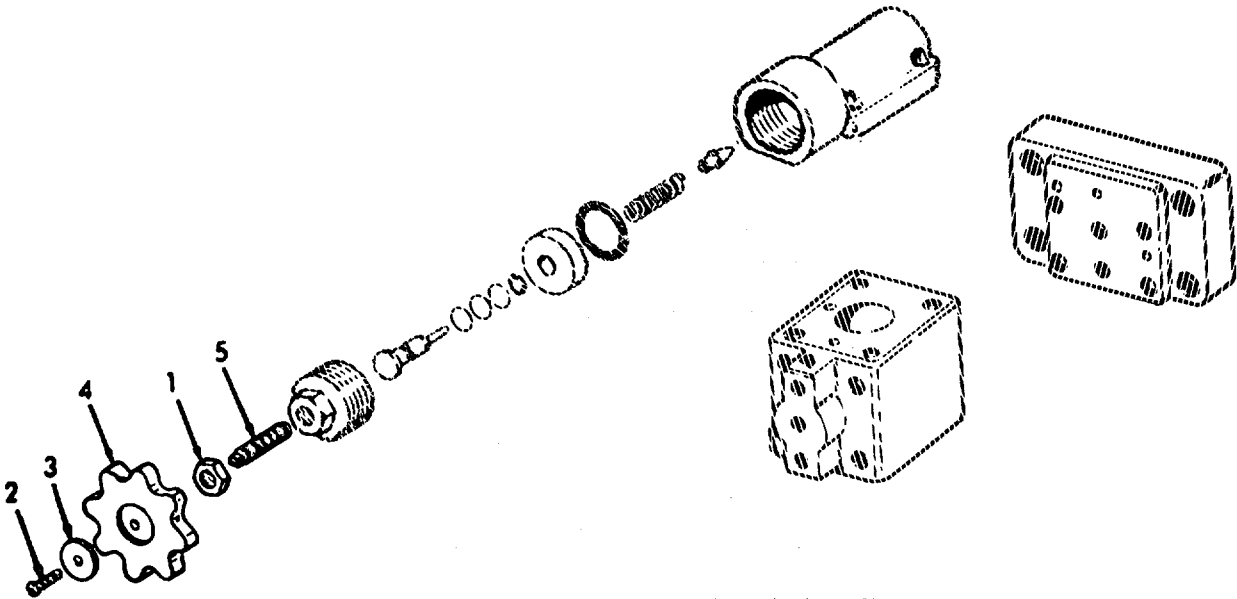
- | | | |
|----------------------------|----------------|---------|
| 1. Pressure reducing valve | a. Locknut (1) | Loosen. |
|----------------------------|----------------|---------|

3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY (Cont)

- | | | | |
|----|--|-------------------------|--|
| b. | Screws
(2),
plate
(3),
knob
(4),
and
screw
(5) | Remove and disassemble. | |
|----|--|-------------------------|--|



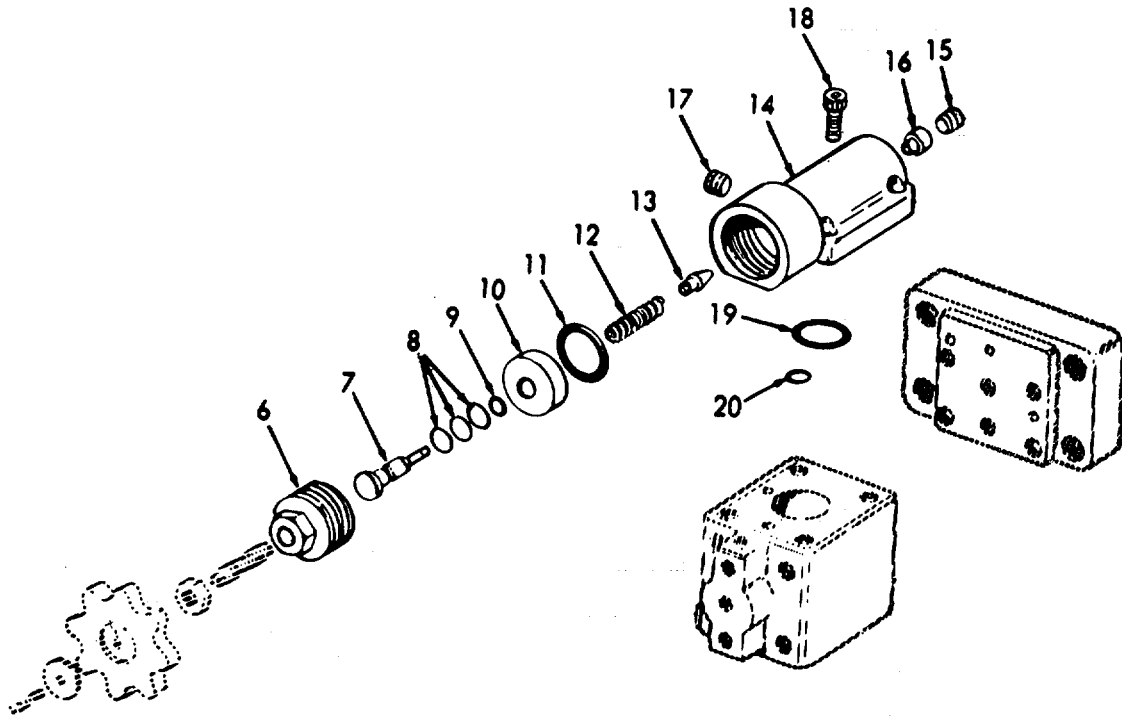
3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">DISASSEMBLY (Cont)</div>	c. Retainer (6), plunger (7), spacer (8), pre-formed packing (9), sleeve spacer (10), pre-formed packing (11), spring (12), and piston (13)	Remove from cover (14).	Discard packing.
	d. Orifice plug (15), and piston seat (16)	Remove.	
	e. Orifice plug (17)	Remove.	
	f. Screw (18)	Remove.	
	g. Cover (14), and pre-formed packings (19 and 20)	Remove.	Discard packing.

3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)



3-2279

3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

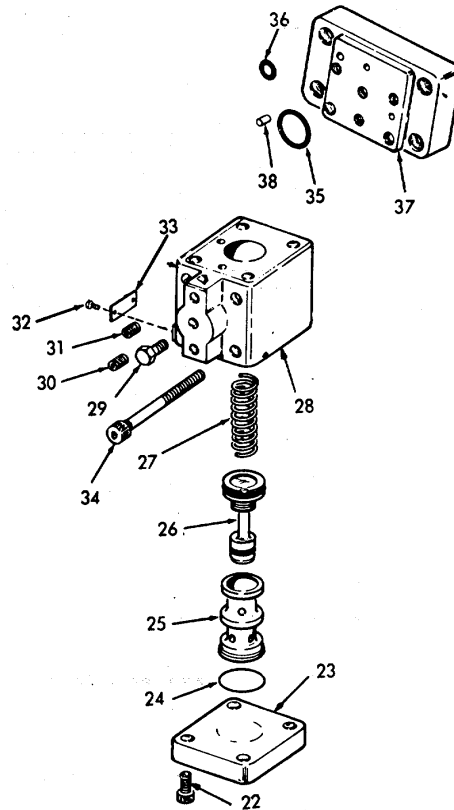
LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			
	h. Plug (21)	Remove.	Discard plug.
	i. Screws (22), and lower cover (23)	Remove.	
	j. Cover seal (24)	Remove.	Discard seal.
	k. Reducing sleeve (25), valve (26), and main spring (27)	Remove from body (28).	
	l. Hex head plug (29), and orifice plugs (30 and 31)	Remove.	
	m. Two screws (32), and identi- fication plate (33)	Remove.	If necessary.

3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

- | | | | |
|----|--|---------------------------|------------------|
| n. | Bolt (34) | Remove. | |
| o. | Body (28), two pre-formed packings (35), and pre-formed packing (36) | Remove from sub-plate 37. | Discard packing. |
| p. | Locating pins (38) | Remove. | |



3-2281

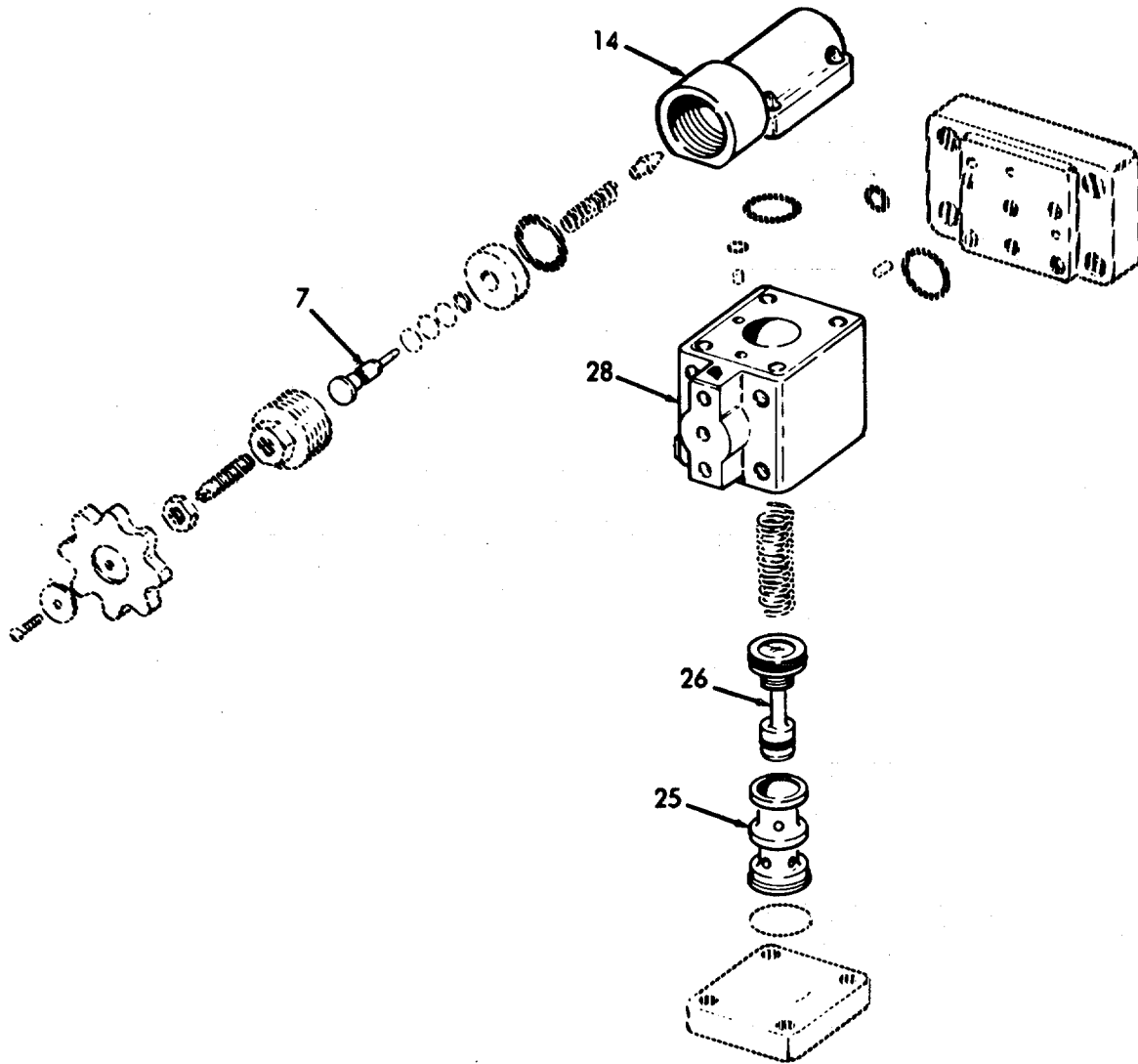
3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
CLEANING			
2.	All parts must be thoroughly cleaned and kept clean during inspection and assembly. Contamination in the unit will cause excessive wear, leakage and decreased service life. Clean in accordance with standard procedures for hydraulic parts. Do not use compressed air to dry parts unless the air is completely filtered in order to remove water and contaminants.		
INSPECTION			
3.	General	<ul style="list-style-type: none"> a. Internal passages b. Mating surfaces c. Threaded parts and holes 	<ul style="list-style-type: none"> Check that they are clean and unobstructed. Inspect for nicks and burrs. Inspect for wear.
4.	Sleeve (25), valve (26), and plunger (7)	Inspect for scoring or wear. Minor scratches can be removed with crocus cloth.	
5.	Body (28), And cover (14)	Inspect body and cover bore for scoring and wear. If excessive wear or scoring is evident on valve body or cover, bore is most likely damaged.	

3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)



3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY

NOTE

Coat all internal parts lightly with lubricating oil.

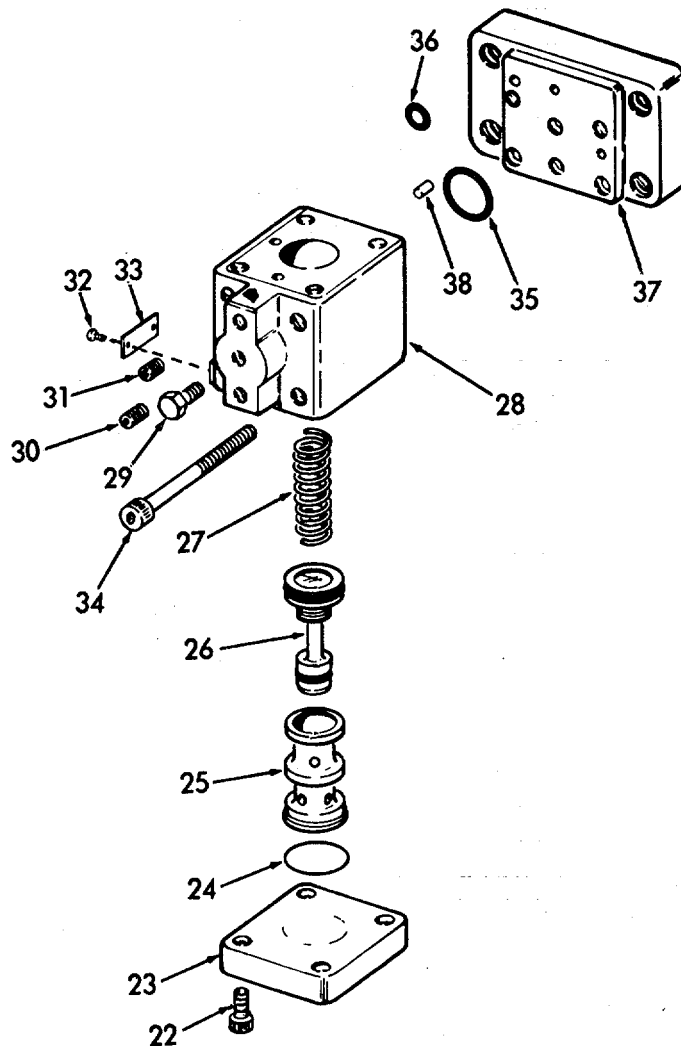
6.	Pressure reducing valve	a. Sub-plate (37), pre-formed packing (36), two pre-formed packings (35), body (28), and bolt (34)	Reassemble.	Use new packing.
		b. Orifice plugs (30 and 31), and hex head plug (29)	Install.	

3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY (Cont)

- | | | | |
|----|--|----------|---------------------|
| c. | Spring (27), valve (26), sleeve (25), cover seal (24), cover (23), and screws (22) | Install. | Use new cover seal. |
|----|--|----------|---------------------|



3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

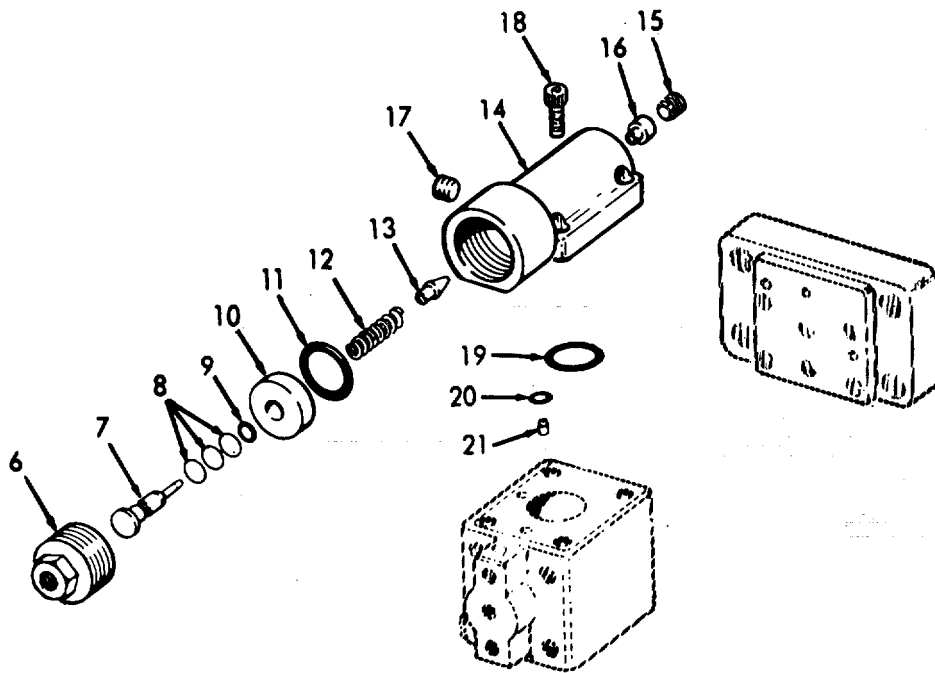
LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REASSEMBLY (Cont)</div>	d. Plug (21)	Install.	Use new plug.
	e. Pre-formed packings (19 and 20), cover (14), and screws (18)	Assemble.	Use new packing.
	f. Orifice plug (17)	Install.	
	g. Piston seat (16), and orifice plug (15)	Install.	
	h. Piston (13), spring (12), pre-formed packing (11), sleeve spacer (10), pre-formed packing (9),	Install in cover (14).	Use new packing.

3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY (Cont)

spacer
(8),
plunger
(7),
and
retainer
(6)

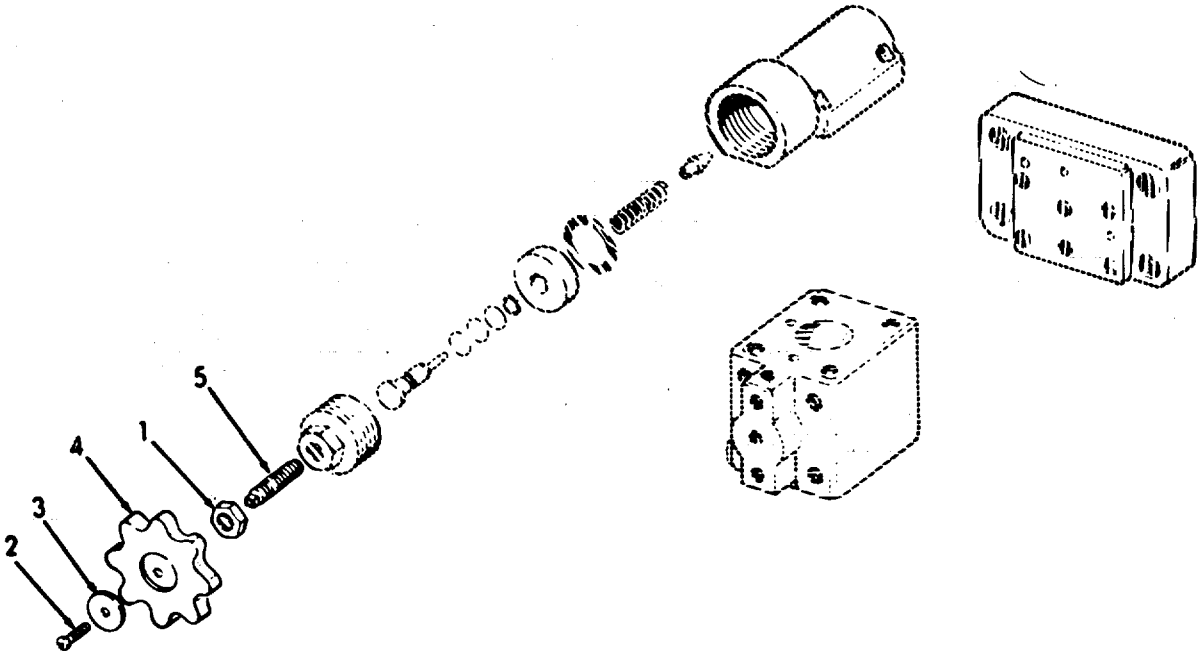


3-137.8. PRESSURE REDUCING VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY (Cont)

- | | | |
|----|------------------------------------|----------|
| i. | Screw (5), and locknut (1) | Install. |
| j. | Knob (4), plate (3), and screw (2) | Install. |



3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

a. GENERAL

The directional control valve is comprised of a rectangular valve body containing a precision fitted sliding spool in a central, longitudinal bore. Spool lands serve to divide the bore into a series of separate chambers, and ports in valve body lead into these chambers. The position of the spool determines which ports are open to each other and which are sealed off from the others. Thus, oil flow is directed from one port to another within the valve body.

b. PRINCIPLES OF OPERATION

(1) VALVE TYPE:

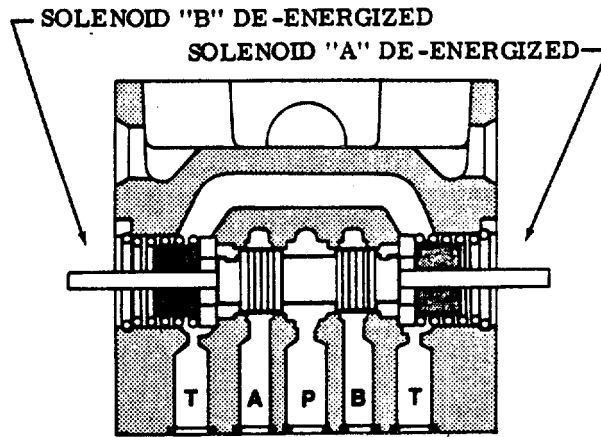
SPRING CENTERED - Spring centered valves are provided with a spring and centering washer at each end of the spool. The springs and washers center the spool within the valve body, when solenoids are de-energized.

(2) FUNCTION

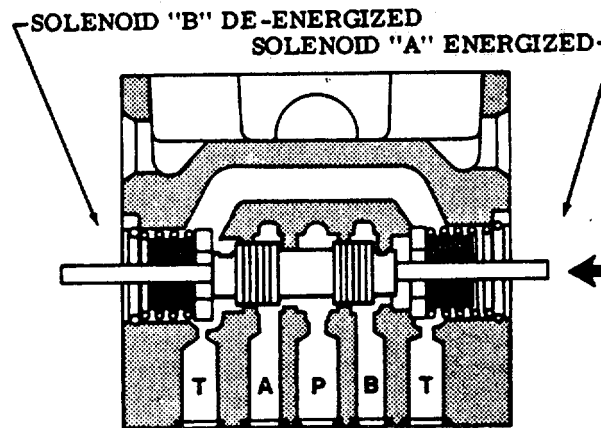
(a) Three cross section views of a valve are shown. The cross sections show locations of the spool lands and the basic valve block machining. Each cross section is provided to show porting of the valve as the spool is moved within the valve block. Assume the spool is moved to the left within the valve body. The "P" pressure port will connect to the "A" cylinder port and the "B" cylinder port will open to the "T" tank port.

(b) If the spool is moved to the right as shown, the "P" pressure port will connect to the "B" cylinder port and the "A" cylinder port will connect to the "T" tank. When the spool returns to center, (solenoids de-energized), flow is blocked in all ports. It can be seen that the function of a valve is to direct the flow of system fluid within a circuit. The valve is actually used to direct flow from the pump to the actuator and from the actuator to the tank or reservoir.

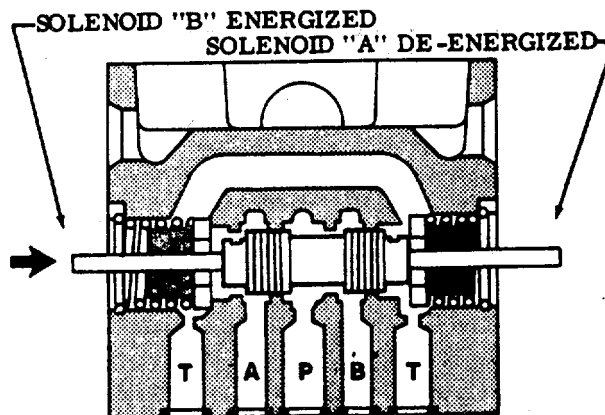
3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).



Flow Conditions
Flow Blocked (Center Condition #2 Spool)



Flow Conditions
Pressure to "A" - "B" to Tank



Flow Conditions
Pressure to "B" - "A" to Tank


3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

(3) VALVE SPOOLS

Each spool is constructed for a specific valve application and is dynamically and hydrostatically balanced to prevent pressure forces from moving the spool within the bore. The spool used is a four-way type.

(4) METHODS OF CONTROL

SOLENOID - Push type solenoids are used to control movement of the spool. A manual plunger is available in each solenoid to check spool movement during test. Push-type solenoids move the spool away from the solenoid when energized.

CENTER CONDITION DIAGRAM	SPOOL NUMBER	DESCRIPTION
	0	Open center. all ports.

WARNING

When a valve uses two solenoids, only one solenoid should be energized at a time or damage may result.

3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

This task covers:

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

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment

Condition Condition Description

None

Material/Parts

Gasket kit P/N 919428

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

WARNING

To avoid possible injury, turn off all electrical power and relieve hydraulic pressure.

INSPECTION

- | | | |
|----------------------|-----------|---|
| 1. Directional valve | a. Tubing | Inspect for breaks, cracks, bends and leaking. |
| | b. Wiring | Inspect for breaks, cracks and worn insulation. |

3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

INSPECTION (Cont)

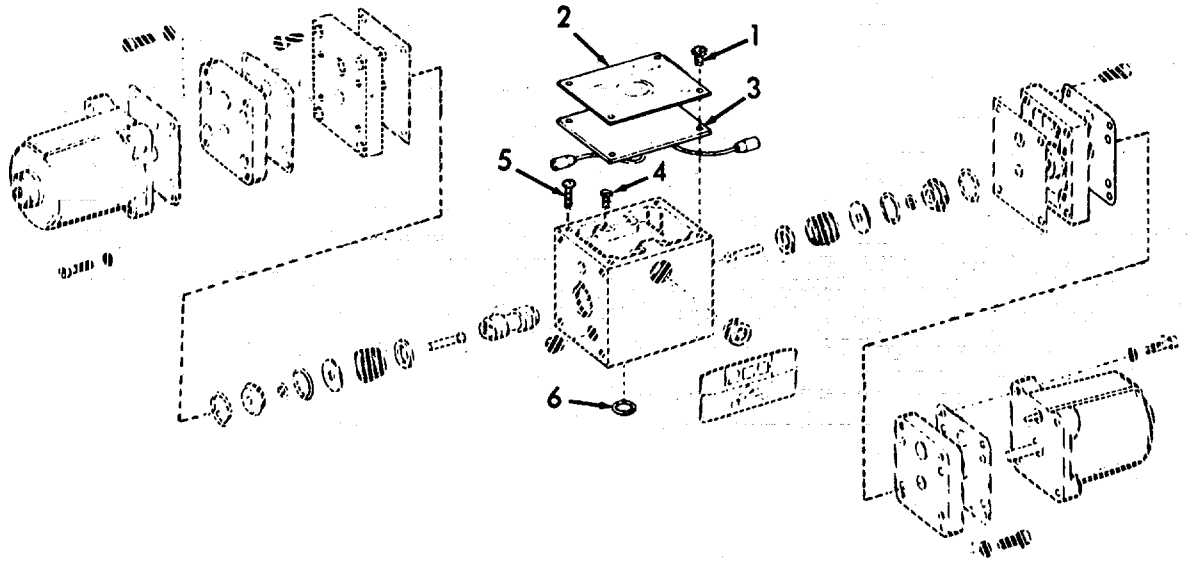
- c. Valve
 1. Inspect for cracks and leaking.
 2. Insure that all hardware is tight.

REMOVAL

- a. Screw (1), and identification plate (2)
 - Remove.
- b. Gasket and wire sub-assembly (3)
 1. Lift to disconnect ground screw (4).
 2. Tag and disconnect external wiring.
 3. Remove gasket and wire subassembly (3).
- c. Piping
 - Disconnect piping at union.
- d. Screw (5)
 - Remove.
- e. Valve "O" ring (6)
 - Remove from mounting.
 - Discard "O" rings.

3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

REMOVAL (Cont)



3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

DISASSEMBLY

- | | | | | |
|----|----|---|---|-----------------|
| 3. | a. | Screws
(7),
and
lock-
washers
(8) | Remove. | |
| | b. | Solenoid
(9) | 1. Remove.

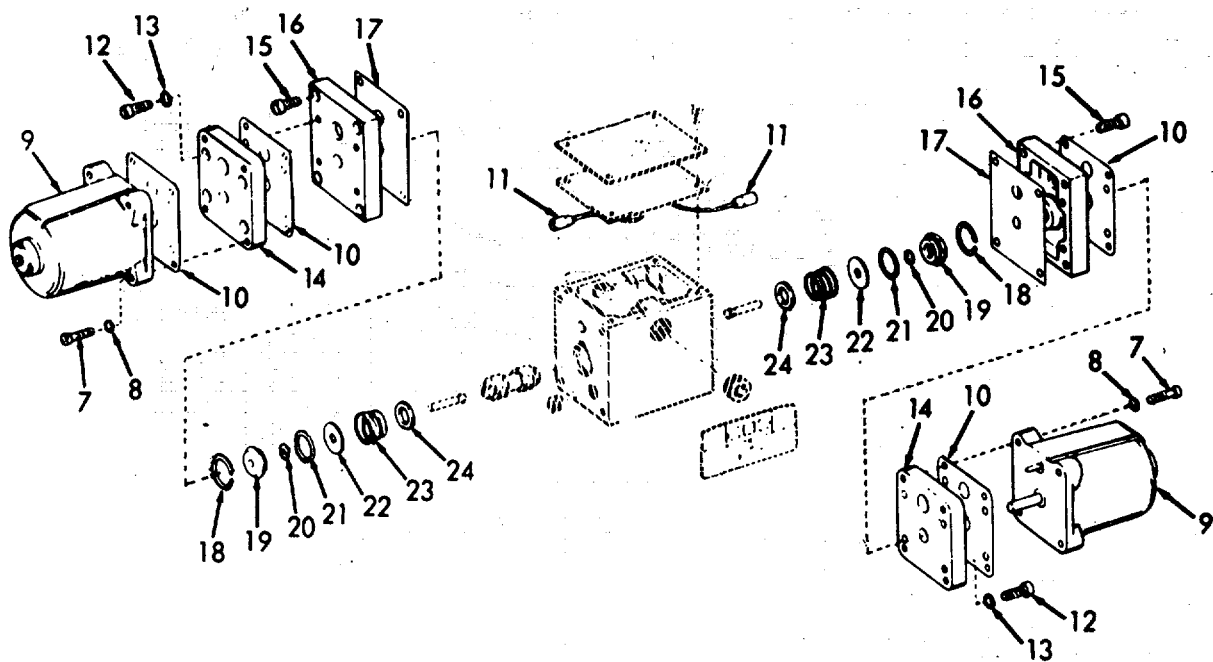
2. Disconnect receptacle
(11). | Discard gasket. |
| | c. | Screws
(12),
and
lock-
washers
(13) | Remove. | |
| | d. | Solenoid
mounting
plate
(14),
and
gasket
(10) | Remove. | Discard gasket. |
| | e. | Screw
(15) | Remove. | |
| | f. | Adaptor
plate
(16),
and
gasket
(17) | Remove. | Discard gasket. |

DISASSEMBLY (Cont)

- g. Retain-
ing
ring
(18),
spring
guide
(19),
110°1
rings
(20 and
21),
washers
(22),
spring
(23),
and
spring
washers
(24)

Remove.

Discard "O"
rings.



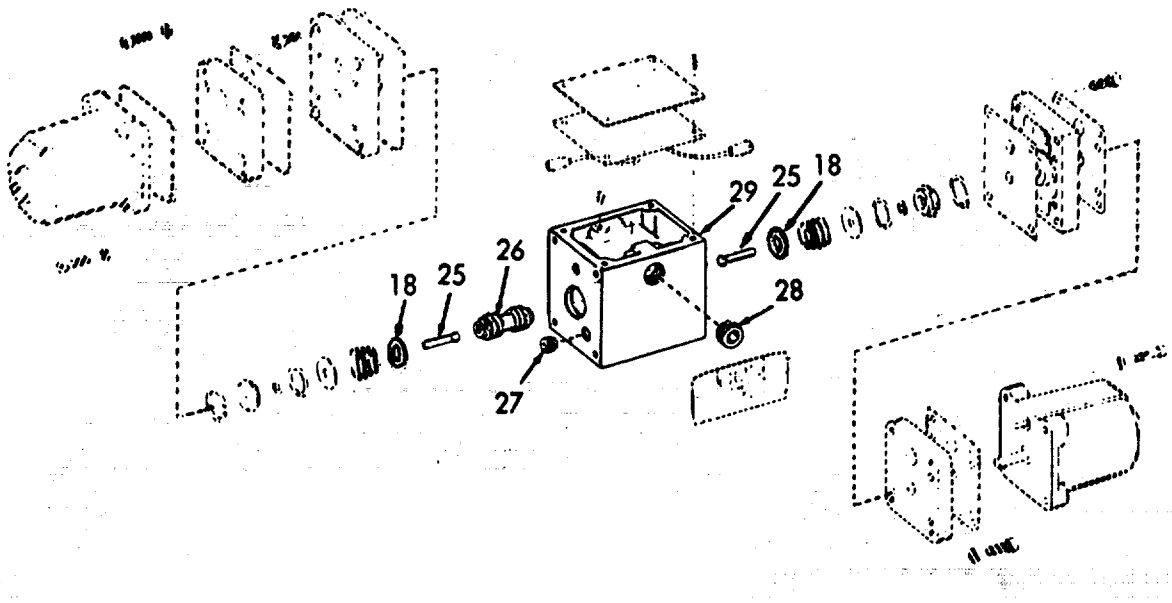
3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

DISASSEMBLY (Cont)

NOTE

To help remove retaining ring (18), apply force to the end of the push pin (25) located in the opposite end of the valve.

- | | | | |
|----|------------------------------|-------------------------|---------------|
| h. | Push pin (25) and spool (26) | Remove and disassemble. | |
| i. | Plugs (27 and 28) | Remove from body (29). | If necessary. |



3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

CLEANING

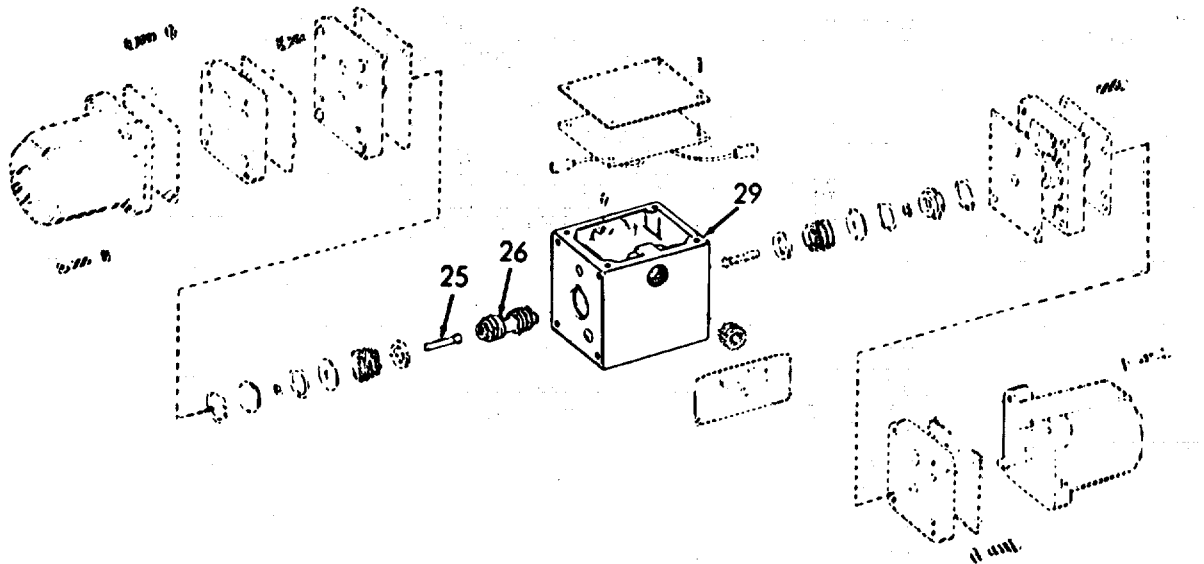
- 4. All parts must be thoroughly cleaned and kept clean during inspection and assembly. Contamination in the unit will cause excessive wear, leakage and decreased service life. Clean in accordance with standard procedures for hydraulic parts. Do not use compressed air to dry parts unless the air is completely filtered in order to remove water and contaminants.

REASSEMBLY

NOTE

Coat all internal parts lightly with lubricating oil.

- 5. a. Push pin (25) and spool (26) Reassemble and insert into body (29).



3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

REASSEMBLY (Cont)

- | | | |
|---|------------------------------|--------------------------|
| <p>b. Spring washer (24), spring (23), washer (22), "O" rings (21 and 20, spring guide (19) and retaining ring (18)</p> | <p>Install in body (28).</p> | <p>Use new "O" ring.</p> |
| <p>c. Gasket (17), adaptor plate (16), and screw (15)</p> | <p>Reassemble.</p> | <p>Use new gasket.</p> |
| <p>d. Gasket (10), solenoid mounting plate (14), screws (12), and lock-washers (13)</p> | <p>Reassemble.</p> | <p>Use new gasket.</p> |

3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

REASSEMBLY (Cont)

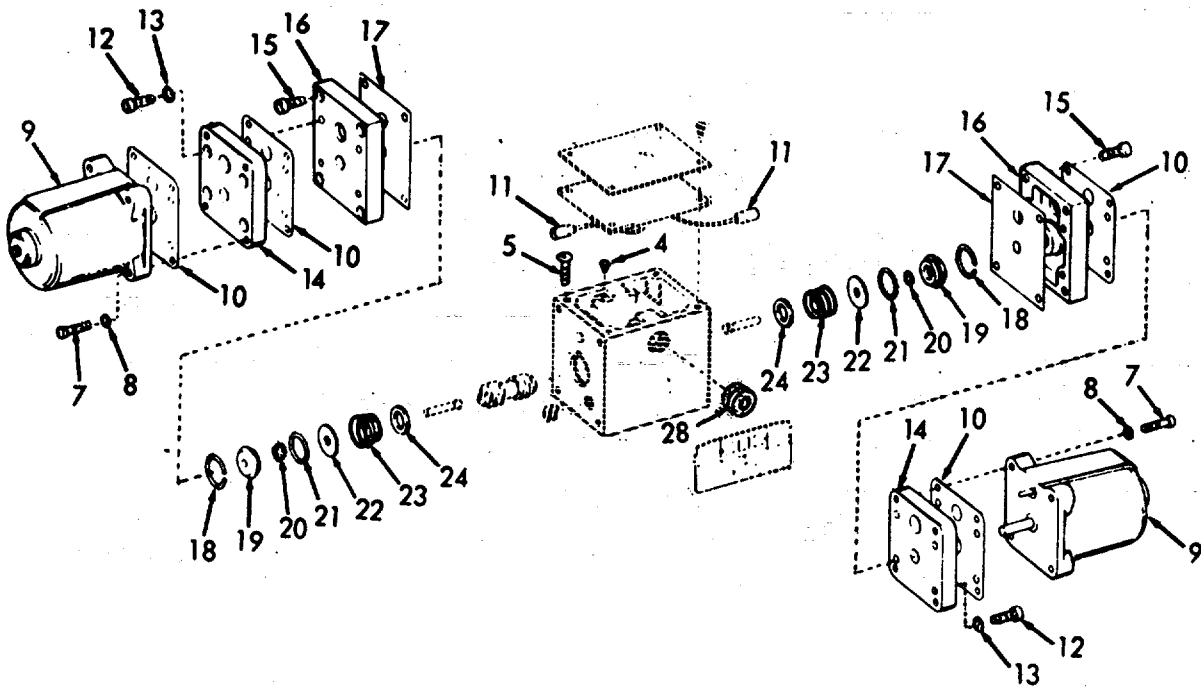
e. Receptacle (11)

Feed through holes in gasket (17), adaptor plate (16), gasket (10) and solenoid mounting plate (14). Attach receptacles (11) to Solenoid (9).

f. Gasket (10), solenoid (9), screws (7), and lock-washers (8)

Reassemble.

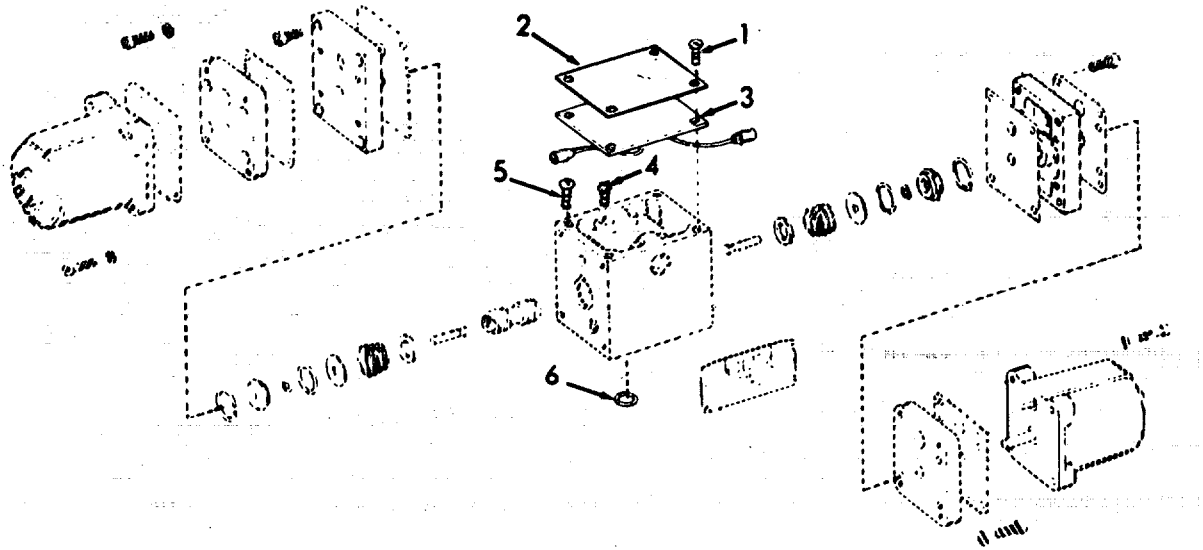
Use new gasket.



3-137.9. DIRECTIONAL CONTROL VALVE - MAINTENANCE INSTRUCTIONS (Continued).

INSTALLATION

- | | | | | |
|----|----|---|---|--------------------|
| 6. | a. | "O" ring (6) and screw (5) | Lubricate and install. | Use new "O" rings. |
| | b. | Wiring and piping | Install. | |
| | c. | Gasket and wire sub-assembly (3), identification plate (2), and screw (1) | 1. Install.
2. Reconnect ground wire to screw (4). | |



3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Service
- c. Replacement
- d. Repair

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment Condition Condition Description

None

Material/Parts

Grease MK-G-81322 Type GH
Oil MIL-L-2104 Type
OE/HDO 30

Special Environmental Conditions

None

Personnel Required

2

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | | |
|----|------------------------------|---------------|--|
| 1. | Vehicle deck
stbd-
aft | Foot
brake | 1. Inspect for cracks, breaks and signs of damage.

2. Inspect for loose or missing hardware.

3. Inspect spring for wear and fatigue. |
| 2. | Anchor winch compartment | Linkage | 1. Inspect for breaks, bends, cracks and signs of damage.

2. Inspect for loose or missing hardware. |

3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
SERVICE			
3.	Foot brake	Two grease fittings	Grease.
4.	Linkage	Three oil fill holes on bearing collars	Lubricate with oil.
REPLACEMENT			
5.	Linkage-foot brake to - control shaft	a. Cotter pins (1), and rod end pin (2)	Remove from lever (3) and yoke on connecting link (4).
		b. Cotter pins (5), and rod end pin (6)	Remove from lever (7) and yoke (8).
		c. Connecting link (4), jam nut (9), and adjustable yoke (8)	Disassemble.

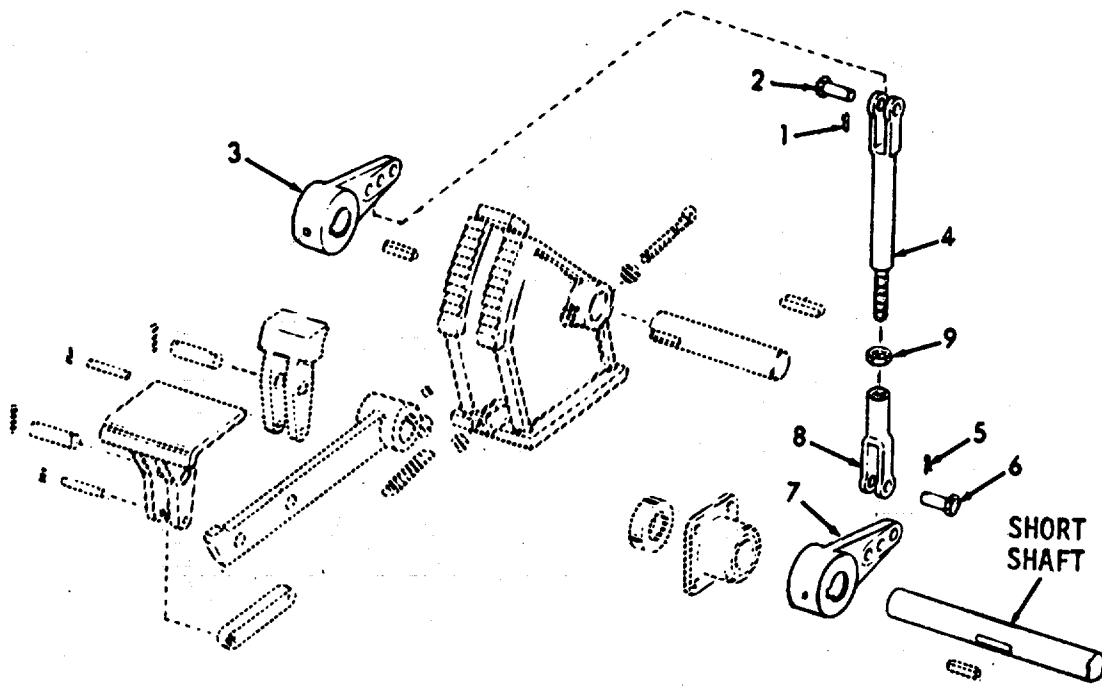
3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)

d. Connecting link (4), jam nut (9), and adjustable yoke (8)

Reassemble and adjust to proper length.



3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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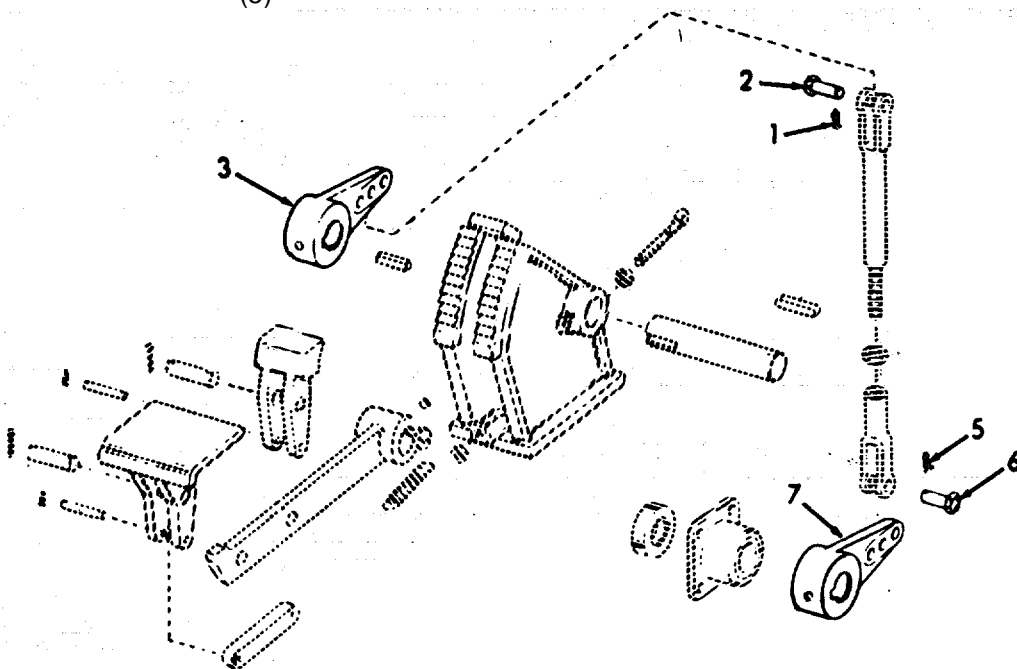
REPLACEMENT (Cont)

e. Rod end pin (2), and cotter pin (1)

Tighten jam nut. Install in center hole in lever (3).

f. Rod end pin (6), and cotter pin (5)

Install in center hole in lever (7).

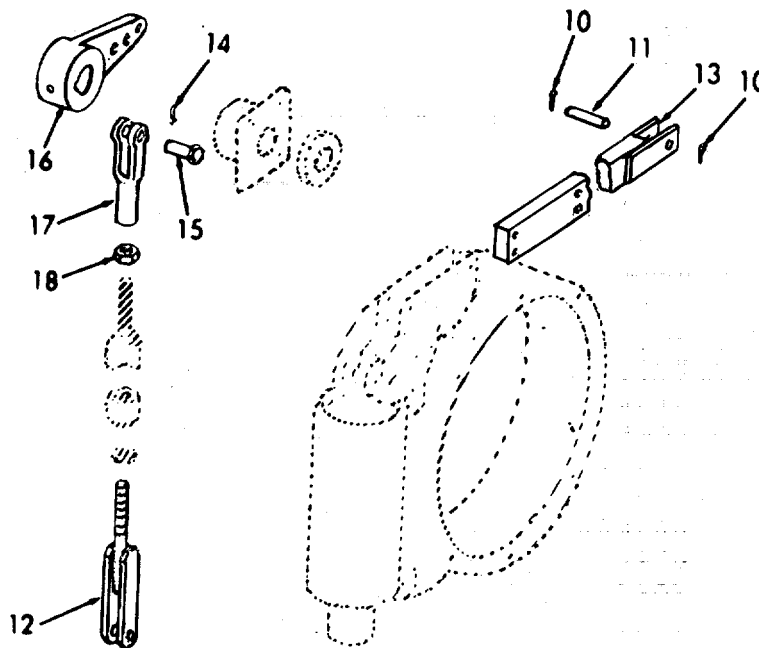


3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)

6. Linkage control shaft to winch	a. Cotter pins (10), and pin (11)	Remove from yoke (12) and lever (13).	
	b. Cotter pin (14), and rod end pin (15)	Remove from lever (16) and yoke (17).	
	c. Jam nut (18)	Loosen.	



3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

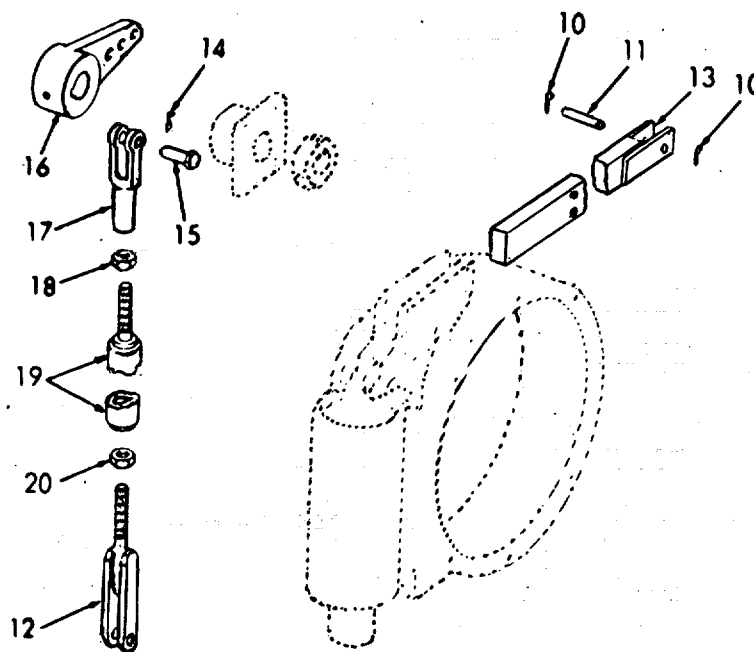
LOCATION	ITEM	ACTION	REMARKS
REPLACEMENT (Cont)			
	d. Adjust-able yoke (17), and connecting link (19)	Disassemble.	
	e. Jam nut (20)	Loosen.	
	f. Slotted yoke (12), and connecting link (19)	Disassemble.	
	g. Connect-ing link (19), jam nuts (18 and 20), slotted yoke (12), and adjust-able yoke (17)	<ol style="list-style-type: none"> 1. Reassemble. 2. Adjust to proper length and tighten jam nuts. 	

3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT (Cont)

- h. Yoke (17), rod end pin (15), and cotter pin (14)
Install in outside hole in lever (16).
- i. Yoke (12), pin (11), and cotter pin (10)
Install on lever (13).



3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

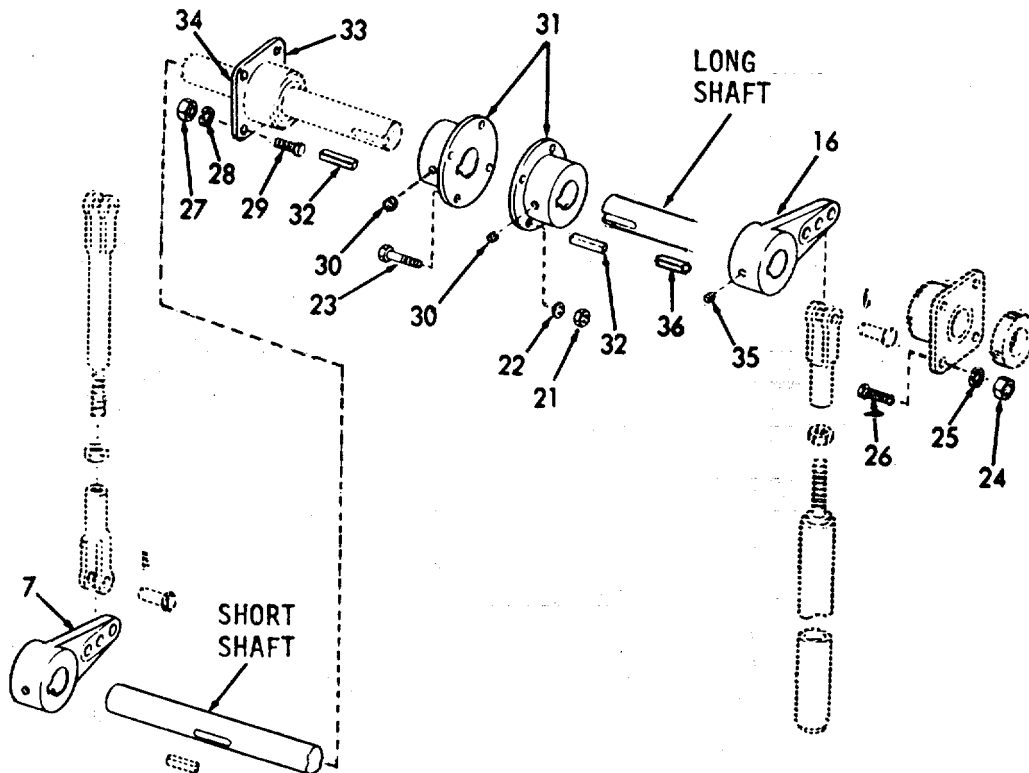
LOCATION	ITEM	ACTION	REMARKS
REPLACEMENT (Cont)			
7. Control shaft	a. Linkage to control shaft	Remove.	Refer to step 5 or 6.
	b. Nut (21), lock-washer (22), and screw (23)	Remove.	Support end of shaft.
	c. Nut (24), lock-washer (25), and screw (26)	Remove.	Support end of shaft.
	d. Nut (27), lock-washer (28), and screw (29) (Short shaft only)	Remove.	Lower shaft assembly and remove.
	e. Setscrew (30)	Loosen.	
	f. Shaft coupling (31), and key (32)	Remove from shaft.	

3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)

- | | | |
|----|-------------------------------------|-------------------|
| g. | Shaft collar (33), and bearing (34) | Slide from shaft. |
| h. | Setscrew (35) | Loosen. |
| i. | Lever (7 and/or 16), key (36) | Slide from shaft. |



3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

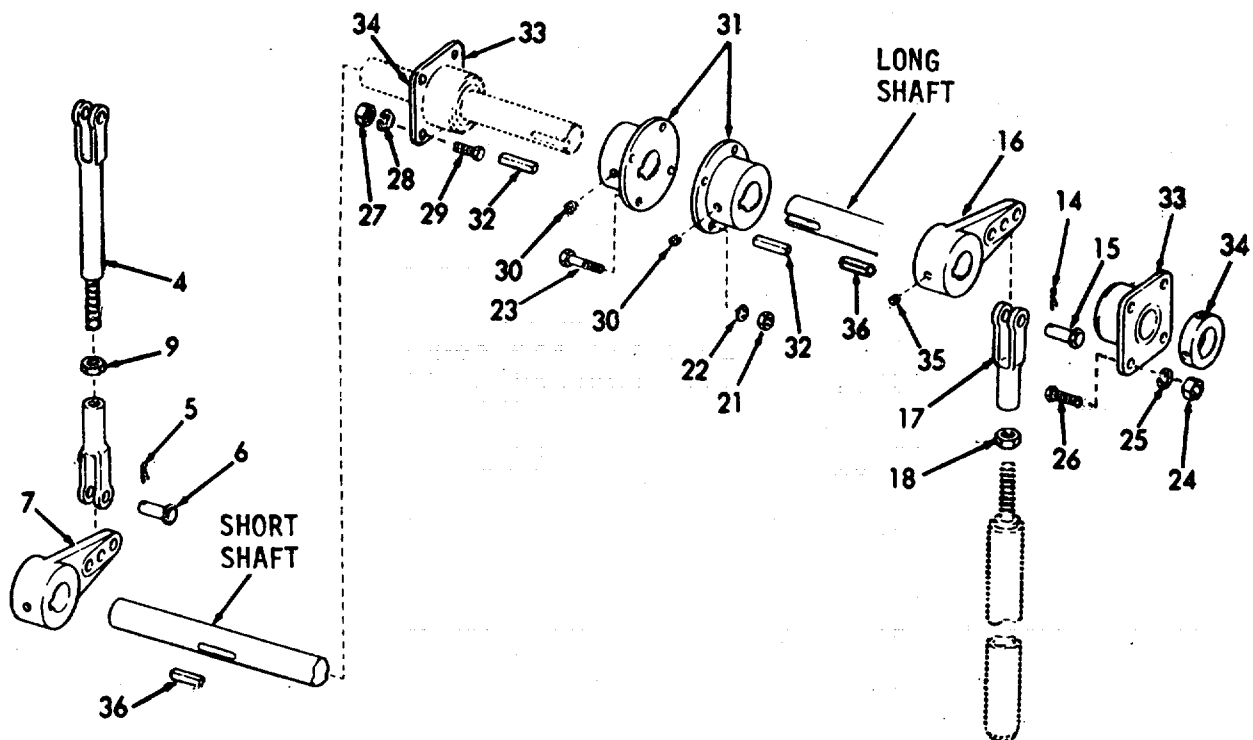
LOCATION	ITEM	ACTION	REMARKS
REPLACEMENT (Cont)			
	j. Key (36), lever (7 and/or 16)	Slide on shaft.	
	k. Setscrew (35)	Tighten.	
	l. Shaft collar (33), and bearing (34)	Slide on shaft.	
	m. Key (32), and shaft coupling (31)	Install.	
	n. Screw (29), lock-washer (28), and nut (27), (Short shaft only).	Install.	
	o. Screw (26), lock-washer (25), and nut (24)	Install.	

3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)

- | | | | |
|----|--|----------------------------|-----------------------|
| p. | Screw (23), lock-washer (22), and nut (21) | Install on shaft coupling. | |
| q. | Linkage to control shafts | Install. | Refer to step 5 or 6. |



3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
8. Foot brake pedestal	a. Linkage foot brake to control shaft	Remove.	Refer to step 5.
	b. Nut (37)	Loosen and remove.	
	c. Spring rod end, and nut assembly (38), and spring (39)	Remove.	
	d. Set- screws (40 and 41)	Loosen.	
	e. Lever shaft (42), key (43), brake lever (44), lever (3), and key (45)	Drive shaft out of pedestal and remove all components.	

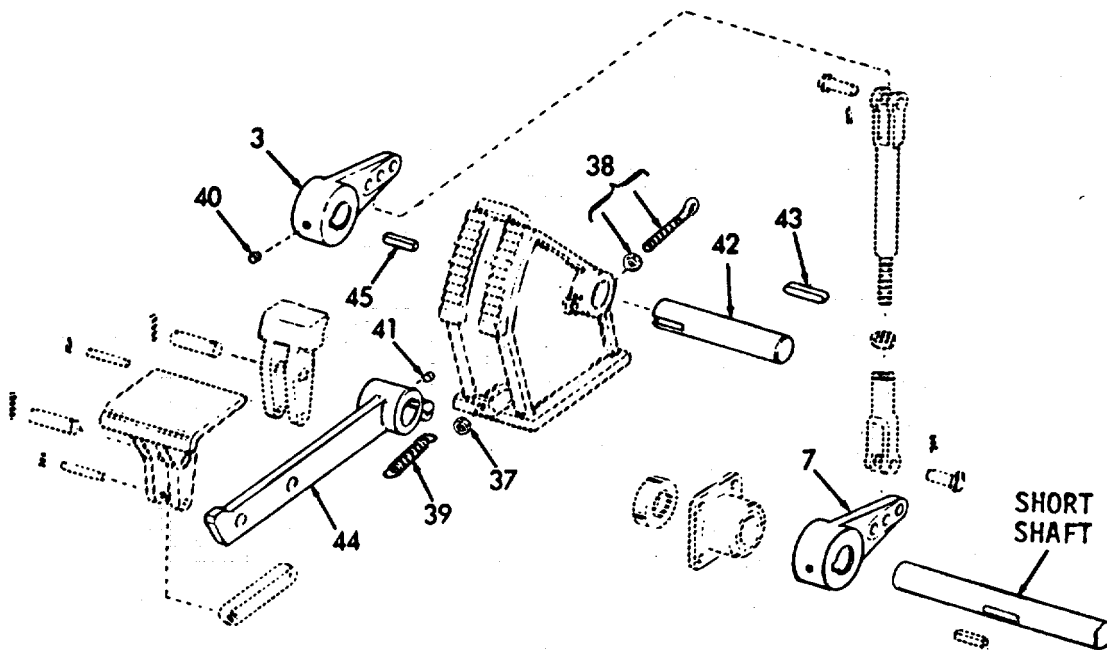
3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

f.	Key (45), lever (3), brake lever (44), key (43), and lever shaft (42)	Reassemble in pedestal.	
----	---	-------------------------	--

g.	Set-screws (41 and 40)	Tighten.	
----	------------------------	----------	--

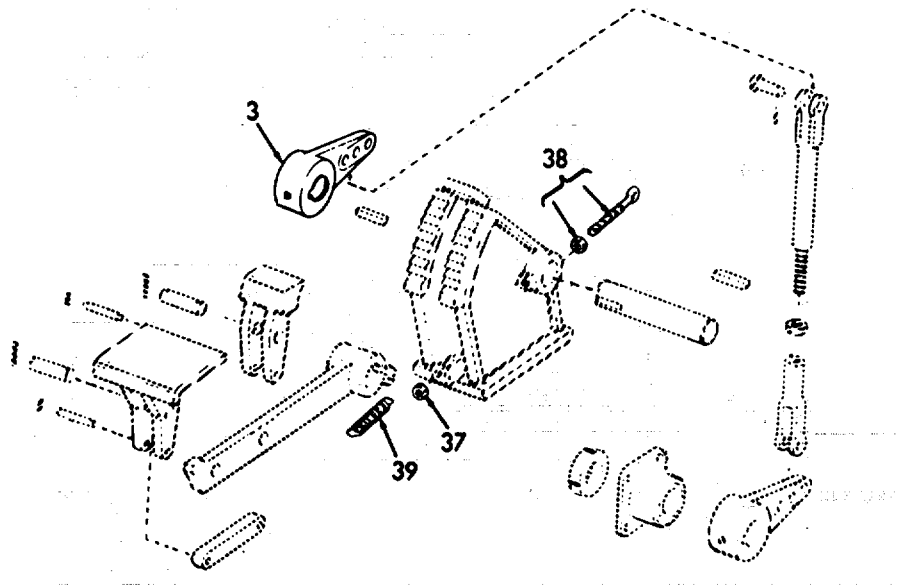


3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- h. Spring rod end and nut assembly (38), and spring (39)
Assemble, and attach one end of spring to brake lever.
- i. Nut (37)
Install on spring rod end and tighten up to existing nut.
- j. Linkage foot brake-to control shaft
Reconnect to center hole of lever (3).

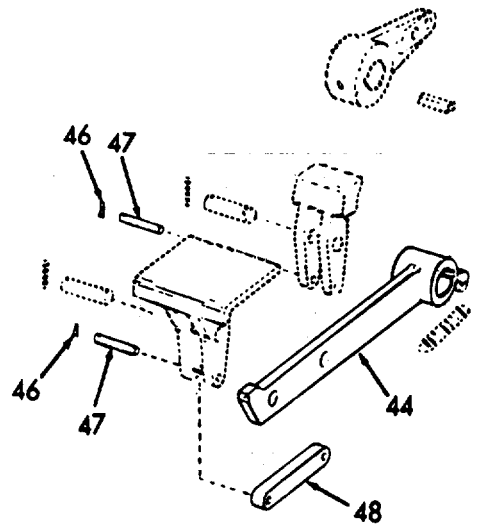


3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | | |
|----|------------------------|---|-------------------------|------------------|
| 9. | Foot
brake
lever | a. Foot
brake
lever
(44) | Remove. | Refer to step 7. |
| | | b. Four
cotter
pins
(46),
pin
(47),
and
pawl
link
(48) | Remove and disassemble. | |



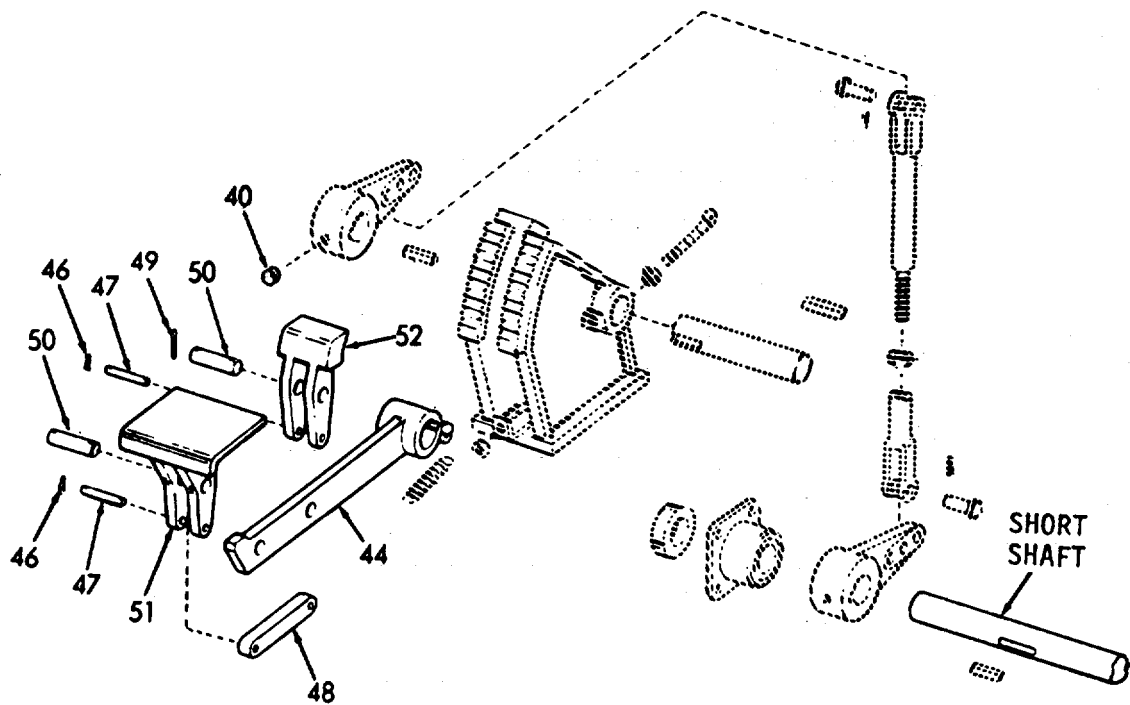
3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REPAIR (Cont)</div>	c. Four cotter pins (49), pin (50), brake pedal (51), and ratchet pawl (52)	Remove and disassemble.	
	d. Ratchet pawl (52), brake pedal (51), pin (50), and cotter pin (49)	Reassemble.	
	e. Pawl link (48), pin (47), and cotter pin (46)	Reassemble.	
	f. Foot brake lever (44)	Reassemble.	Refer to step 7.

3-138. WINCH BRAKE CONTROL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-139. HYDRAULIC PUMP, HOSES, LINES AND FITTINGS.

The maintenance instructions are contained in the following paragraphs:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Hydraulic Pump	3-139.1
Hoses, Lines and Fittings	3-139.2

3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS.

This task covers:

- | | | |
|---------------|----------------|---------------|
| a. Inspection | c. Replacement | |
| b. Service | d. Disassembly | e. Reassembly |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Hammer - soft
Torque wrench
Arbor press
Bearing puller

Equipment
Condition Condition Description

None

Material/Parts

Grease MIL-G-81322 Type GH
Gasket A-1014-1-003 (Qty-2)
Shaft seals R3006-55
Pocket seals K3026-3
and K3026-4

Special Environmental Conditions

Do not drain oil into bilges.
Use oil/water separation and
recovery system to collect used
oil. Dispose of properly.

Personnel Required

1

General Safety Instructions

Observe Warning.

3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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WARNING

To avoid possible injury, turn off all electrical power and relieve hydraulic pressure.

INSPECTION

- | | | | |
|---------|-------------|---|--|
| 1. Pump | a. Hoses | Inspect for breaks, cracks, bends, and leaking. | |
| | b. Coupling | Insure that all hardware is tight. | |
| | c. Pump | Inspect for cracks and leaking. | |

SERVICE

- | | | | |
|---------|----------------|---------|--|
| 2. Pump | Grease fitting | Grease. | |
|---------|----------------|---------|--|

REPLACEMENT

- | | | | |
|----|-----------|--|--|
| 3. | a. Unions | <ol style="list-style-type: none"> 1. Disconnect two unions on input and output hoses. 2. Drain oil into a suitable container. | |
| | b. Hoses | Disconnect input and output hoses. | |

3-139.1. HYDRAULIC PUMP - MAINTENANC-E INSTRUCTIONS (Continued).

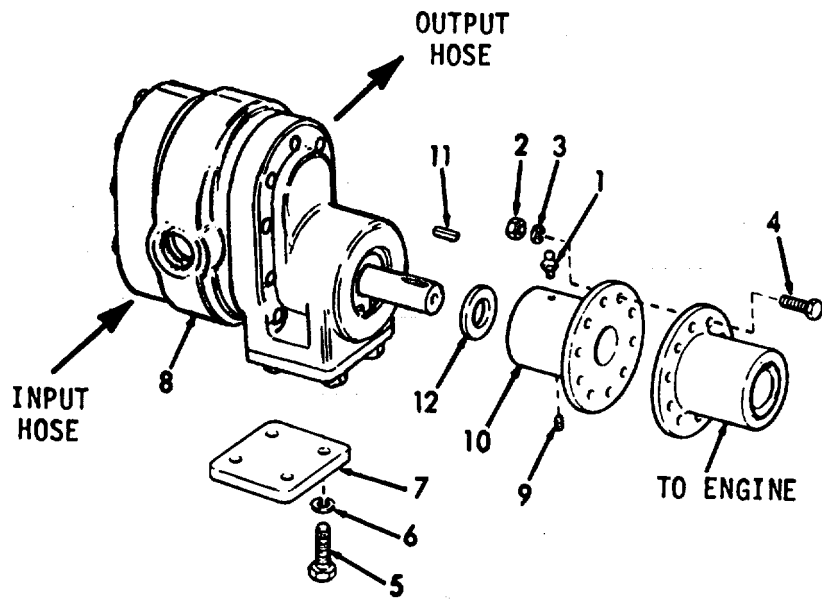
LOCATION	ITEM	ACTION	REMARKS
REPLACEMENT (Cont)			
	c. Grease fitting (1)	Change.	If necessary
	d. Ten nuts (2), lock-washers (3) and screws (4)	Remove.	
	e. Four screws (5), lock-washers (6) and chock (7)	Remove.	
	f. Pump (8)	Remove.	
	g. Set-screw (9)	Loosen.	
	h. Coup-ling (10), and key	Remove.	
	i. Oil seal (12)	Replace.	If necessary.

3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)

- | | | | |
|----|--|--------------------------------|--|
| j. | Coupling (10), key (11), and set-screw (9) | Replace and tighten set-screw. | |
|----|--|--------------------------------|--|



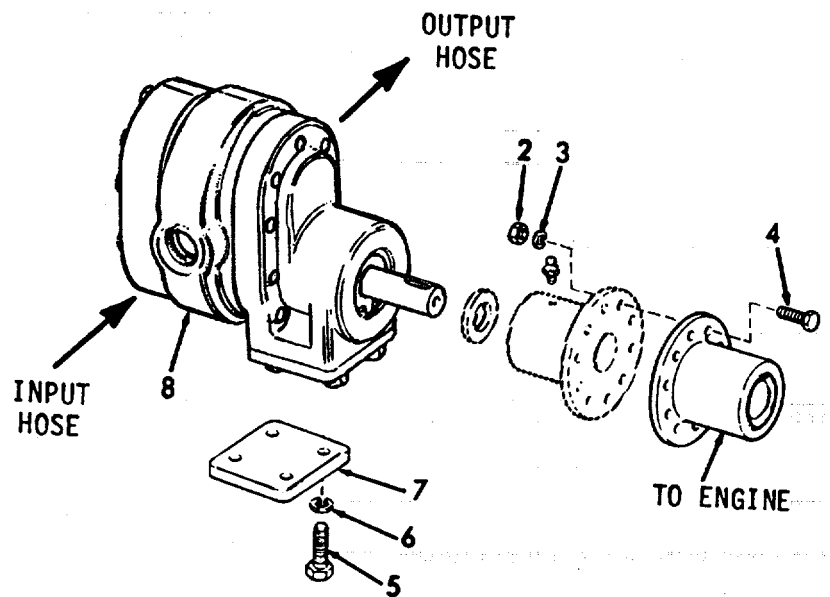
3-2323

3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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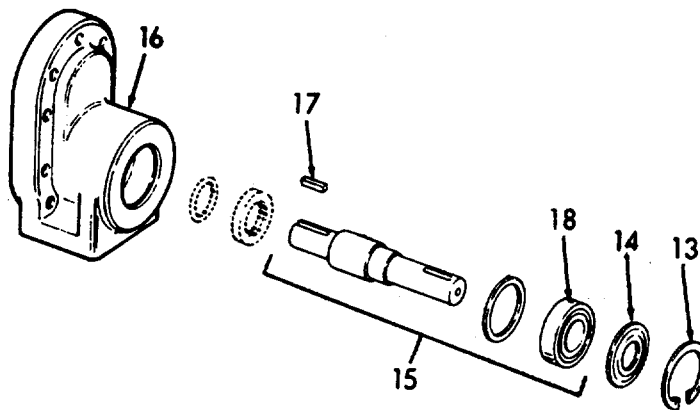
REPLACEMENT (Cont)

- | | | | |
|----|---|-------------------------------------|--|
| k. | Pump (8), chock (7), screw (5), and lock-washer (6) | Install. | |
| l. | Ten screws (4), lock-washers (3), and nuts (2) | Install. | |
| m. | Hoses and Unions | Install hoses and reconnect unions. | |



3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
4.	a. Retain- ing ring (13)	Remove	Use a sharp, pointed tool or screwdriver.
	b. Bearing shield (14) of wire.	Remove.	Lift out with a hooked piece
	c. Shaft and bearing assembly (15)	Insert a screwdriver into keyway and tap out of housing (16).	
	d. Key (17)	Remove.	
	e. Bearing (18)	Remove.	Press off with an arbor press.



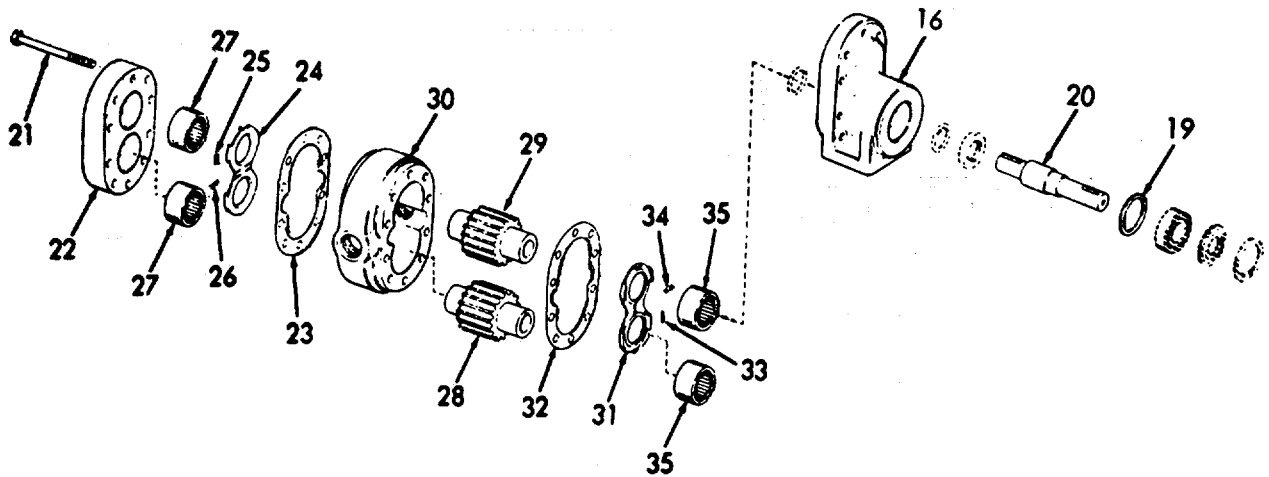
3-2325

3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			
	f. Spacer (19)	Remove from shaft (20).	
	g. Ten bolts (21)	Remove.	
	h. Port end cover (22) and shaft end cover (16)	Disassemble.	Tap loose using a soft hammer.
	i. Gasket (23)	Remove.	Discard gasket.
	j. Thrust plate (24)	Remove.	Insert a knife blade under the thrust plate and pry it loose from bearing races.
	k. Pocket seals (25 and 26)	Remove from thrust plate (24).	Discard pocket seals.
	l. Roller bearing (27)	Remove.	Use a bearing puller.
	m. Drive gear (28), and driven gear (29)	Remove from housing (30).	

3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			
	n. Housing (30)	Remove.	It may be necessary to tap it loose from the thrust plate (31).
	o. Gasket (32)	Remove.	Discard gasket.
	p. Thrust plate (31)	Remove.	Insert a knife blade under the thrust plate and pry it loose from bearing races.
	q. Pocket seals (33 and 34)	Remove.	Discard pocket seals.
	r. Roller bearing (35)	Remove.	Use a bearing puller.

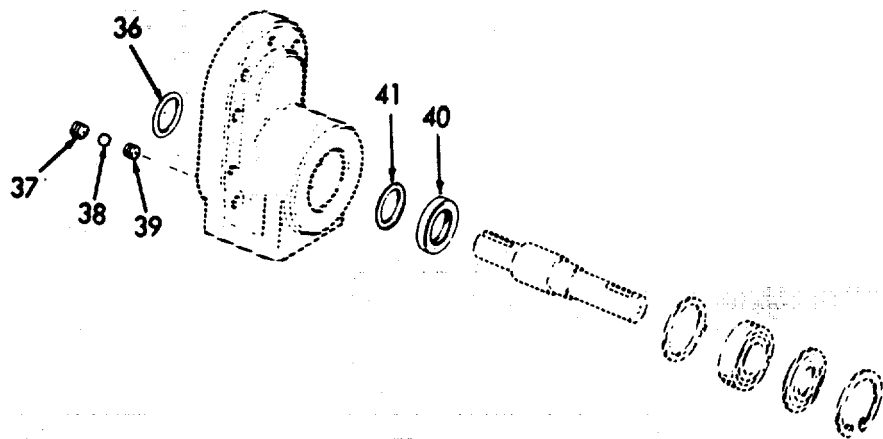


3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

- s. Pre-formed packing (36) Remove.
- t. Ball check retainer (37), check ball (38), and seat (39) Remove.
- u. Shaft oil seal (40), and pre-formed packing (41) Remove.

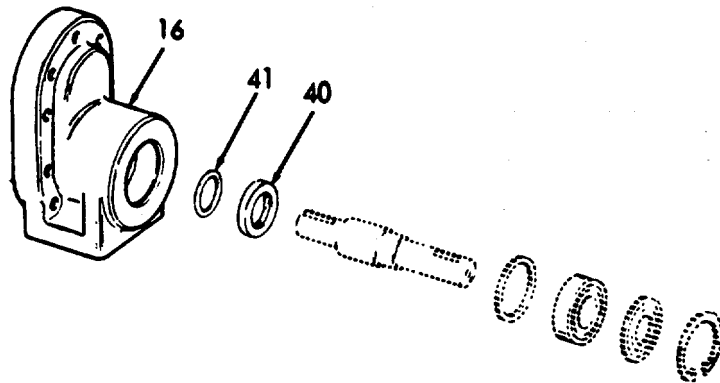


3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY

- | | | | |
|----|---|---------------------------------|--|
| s. | a. Pre-formed packing (41), and shaft oil seal (40) | Insert in shaft end cover (16). | |
|----|---|---------------------------------|--|



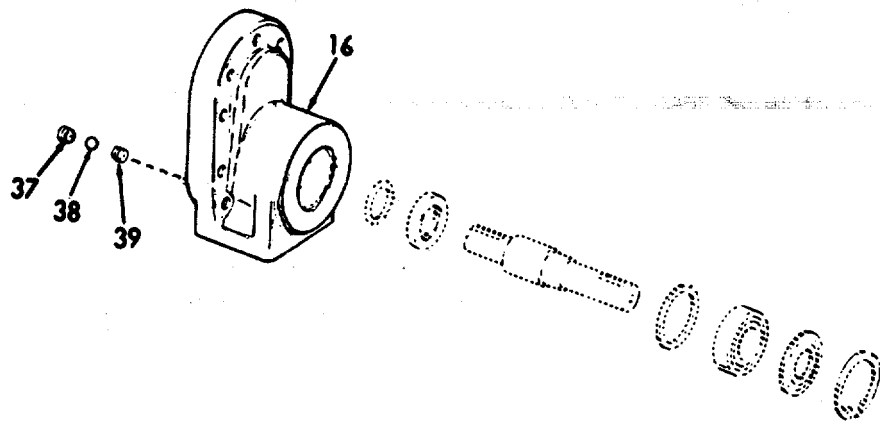
3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- b. Check ball seat (39), ball check (38), and retainer (37)

Insert in shaft end cover (16).

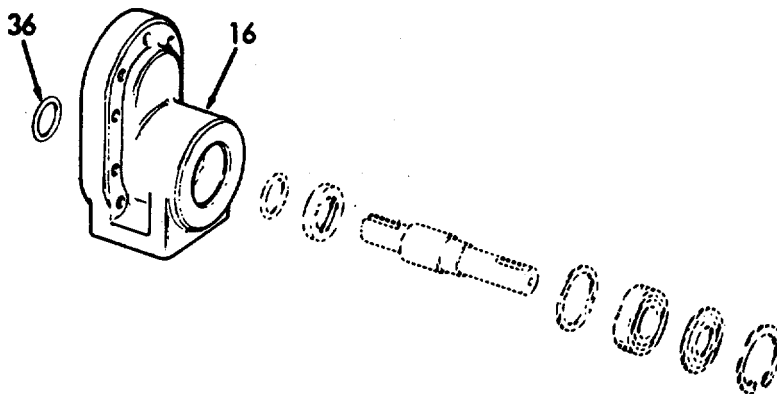


3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | |
|----------------------------|---|
| c. Pre-formed packing (36) | Install in shaft end cover (16). |
| d. Shaft end cover (16) | <ol style="list-style-type: none"> 1. Clamp in a vise. Tighten the jaws so that they clamp the cover about 1/4 inch (3.65 cm) below the ten hole face. 2. Store the face, and air blow or wipe clean. |



3-139.1. HYDRAULIC PUMP - MAINTENANCE INSTRUCTIONS (Continued).

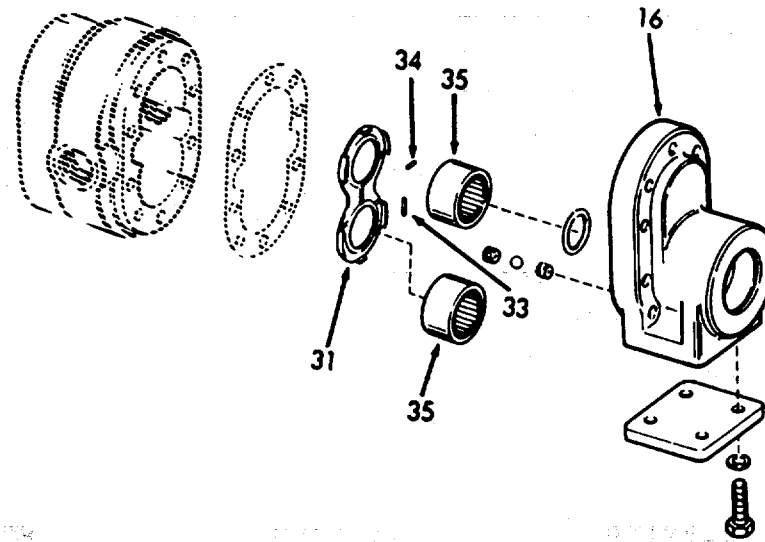
LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	e. Roller bearing (35)	Insert.	Use an arbor press.
	f. Thrust plate (31)	<ol style="list-style-type: none"> 1. Store the face which will be closest to the gears. 2. Air blow or wipe clean. 3. Place a small amount of grease into the middle slot in the thrust plate. 	
	g. Pocket seal (34)	Place a 29/64 inch (1.1509 cm) long pocket seal into the middle slot.	Use pocket seal K3026-4. Be sure the seal is cut straight across and the seal is the same length as the slot.
	h. Thrust plate (31), and shaft end cover (16)	Assemble.	<ol style="list-style-type: none"> 1. Tap together with inserted pocket shield (34) over the bearing races in the shaft end cover. Use a soft hammer. 2. Be sure a small clearance 1/32 inch (0.079 cm) is left between the thrust plate and the face of the shaft end cover.

3-139.1. HYDRAULIC PUMP MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|------------------------|--|--|
| i. | Four pocket seals (33) | Insert four pocket seals, cut to 7/16 inch (1.113 cm) into the four slots underneath the thrust plate. | <ol style="list-style-type: none"> 1. Use pocket seal K3026-3. 2. Make sure they are pushed completely into the groove so that the inner ends are flush against the bearing races. |
| j. | Thrust plate (31) | Tap down tightly against shaft end cover (16). | Use a soft hammer. |



3-139.1. HYDRAULIC PUMP MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	k. Pocket seals (33) and (34)	Trim the excess length of each pocket seal so that they are flush with the edge of the thrust plate.	Use a pocket knife or razor blade.
	l. Drive gear (28)	Insert in recess in shaft end cover.	
	m. Shaft end cover (16), and gasket (32) tearing of the screw holes.	<ol style="list-style-type: none"> 1. Put several drops of oil, or cover to hold gasket. 2. Carefully line up the ten holes. This will avoid 	
	n. Housing (30)	<ol style="list-style-type: none"> 1. Store both faces of housing and air blow or wipe clean. 2. Press housing onto 	It may be necessary to tap the housing lightly with a soft hammer to make it fit over the thrust plate (31).
	o. Driven gear (29)	Insert into housing.	
	p. Port end cover (22)	Store the face of the cover and air blow or wipe clean.	
	q. Roller bearing (27)	Insert into cover.	Use an arbor press.

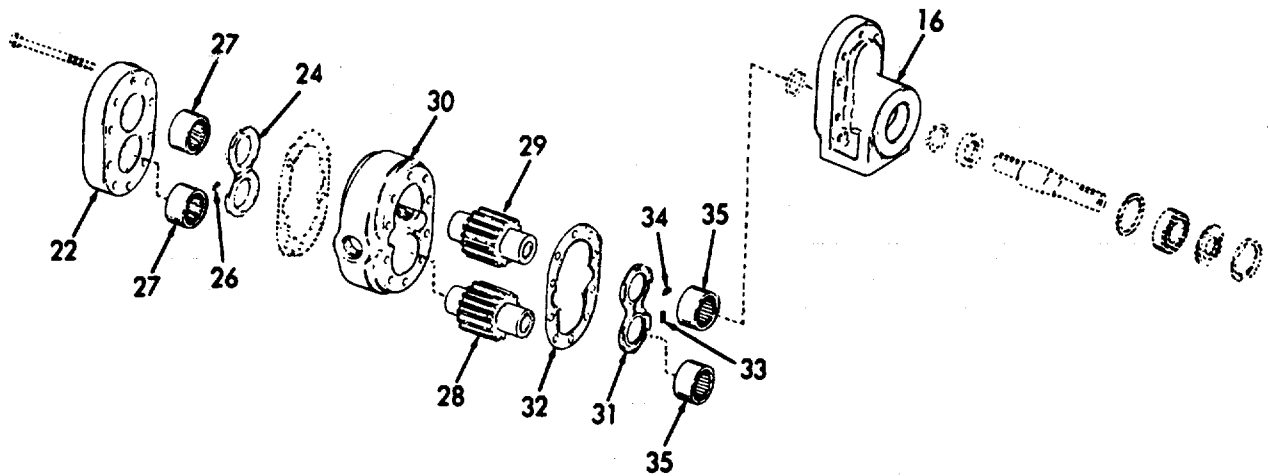
3-139.1. HYDRAULIC PUMP MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|-------------------|--|--|
| r. | Thrust plate (24) | <ol style="list-style-type: none"> 1. Store the flat face. 2. Air blow or wipe clean. 3. Place a small amount of grease into the middle slot in the thrust plate. | |
|----|-------------------|--|--|

- | | | | |
|----|------------------|---|---|
| s. | Pocket seal (26) | Place a 29/64 inch (1.1509 cm) long pocket seal into the middle slot. | Use pocket seal K3026-4. Be sure the seal is cut straight across and the seal is the same length as the slot. |
|----|------------------|---|---|



3-139.1. HYDRAULIC PUMP MAINTENANCE INSTRUCTIONS (Continued).

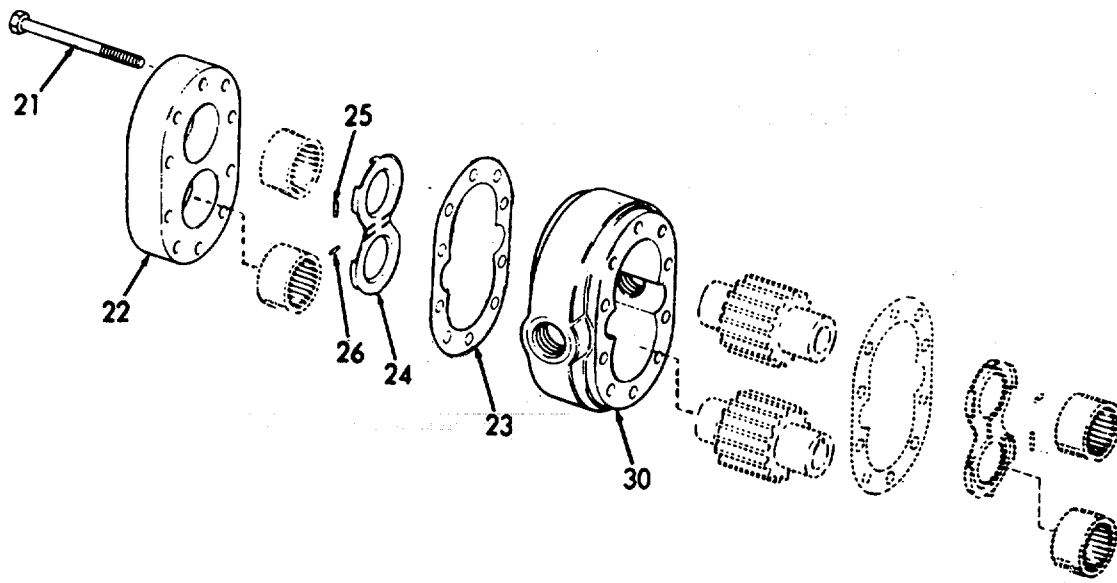
LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	t. Thrust plate (24), and port end cover (22)	Assemble.	<p>1. Tap together with inserted pocket shield (26) over the bearing races in the port end cover. Use a soft hammer.</p> <p>2. Be sure a small clearance 1/32 inch (0.079 cm), is left between the thrust plate and the face of the Port end cover.</p>
	u. Four pocket seals (25)	Insert four pocket seals cut to 7/16 inch (1.113 cm) into the four slots underneath the thrust plate.	<p>1. Use pocket seal K3026-3.</p> <p>2. Make sure they are pushed completely into the grooves so that the inner ends are flush against the bearing races.</p>
	v. Thrust plate (24)	Tap down tightly against port end cover (22).	Use a soft hammer.
	w. Pocket seals (25) and (26)	Trim the excess lengths of each pocket seal so that they are flush with the thrust plate.	Use a pocket knife or razor blade.

3-139.1. HYDRAULIC PUMP MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|--------------------------------------|---|---|
| x. | Port end cover (22) and gasket (23) | <ol style="list-style-type: none"> Put several drops of oil on cover to hold gasket. Carefully line up the ten holes. This will avoid tearing of the screw holes. | Use new gasket. |
| y. | Port end cover (22) and housing (30) | Assemble. | Tap the cover with a soft hammer to seat it firmly. |
| z. | Four screws (21) torque. | Insert in middle holes in port end cover (22). | Tighten to 1000 inch pounds (112.98 Nm) |



3-139.1. HYDRAULIC PUMP MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
	aa. Ball bearing (18), and shaft	Press bearing onto shaft.	Use an arbor press.
	ab. Key (17)	Place into keyway on shaft (20).	
	ac. Spacer (19), and shaft assembly (15)	Insert into shaft end cover (16).	<p>1. Do this carefully so that the key (17) does not damage the preformed packing (41) and seal (40).</p> <p>2. The bearing should press into place easily. Do not drive the bearing as it may be damaged.</p>
	ad. Bearing shield (14), and retaining ring (13)	Install.	
	ae. Pump	Using pliers, test the pump for tightness by rotating the shaft.	There will be a slight drag due to the friction of the thrust plates on the gears, but there should be no distinct bind.

3-139.1. HYDRAULIC PUMP MAINTENANCE INSTRUCTIONS (Continued).

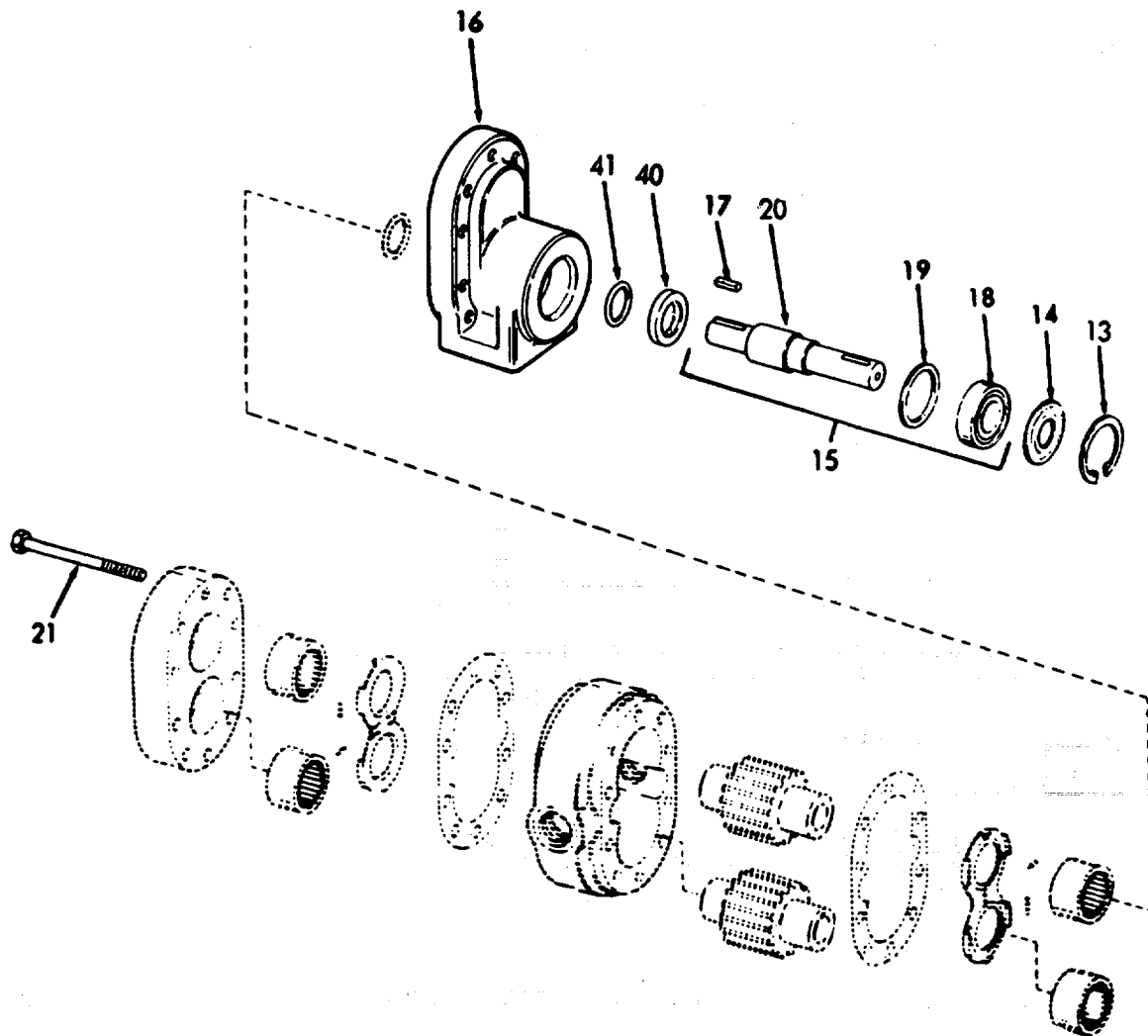
LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

af. Six screws (21)

Install.

Tighten to 1000 inch pounds (112.98 Nm) torque.



3-139.2. HOSES, LINES AND FITTINGS - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Repair

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment Condition Condition Description

None

Material/Parts

NONE

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING

LOCATION	ITEM	ACTION	REMARKS
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WARNING

To avoid possible injury, turn off all electrical power and relieve hydraulic pressure.

INSPECTION

- | | | | |
|----|---------------------------|----------|--|
| 1. | Hoses, lines and fittings | a. Hose | Inspect for kinks, breaks, cracks and leaking. |
| | | b. Lines | Inspect for bends, breaks, cracks and leaking. |

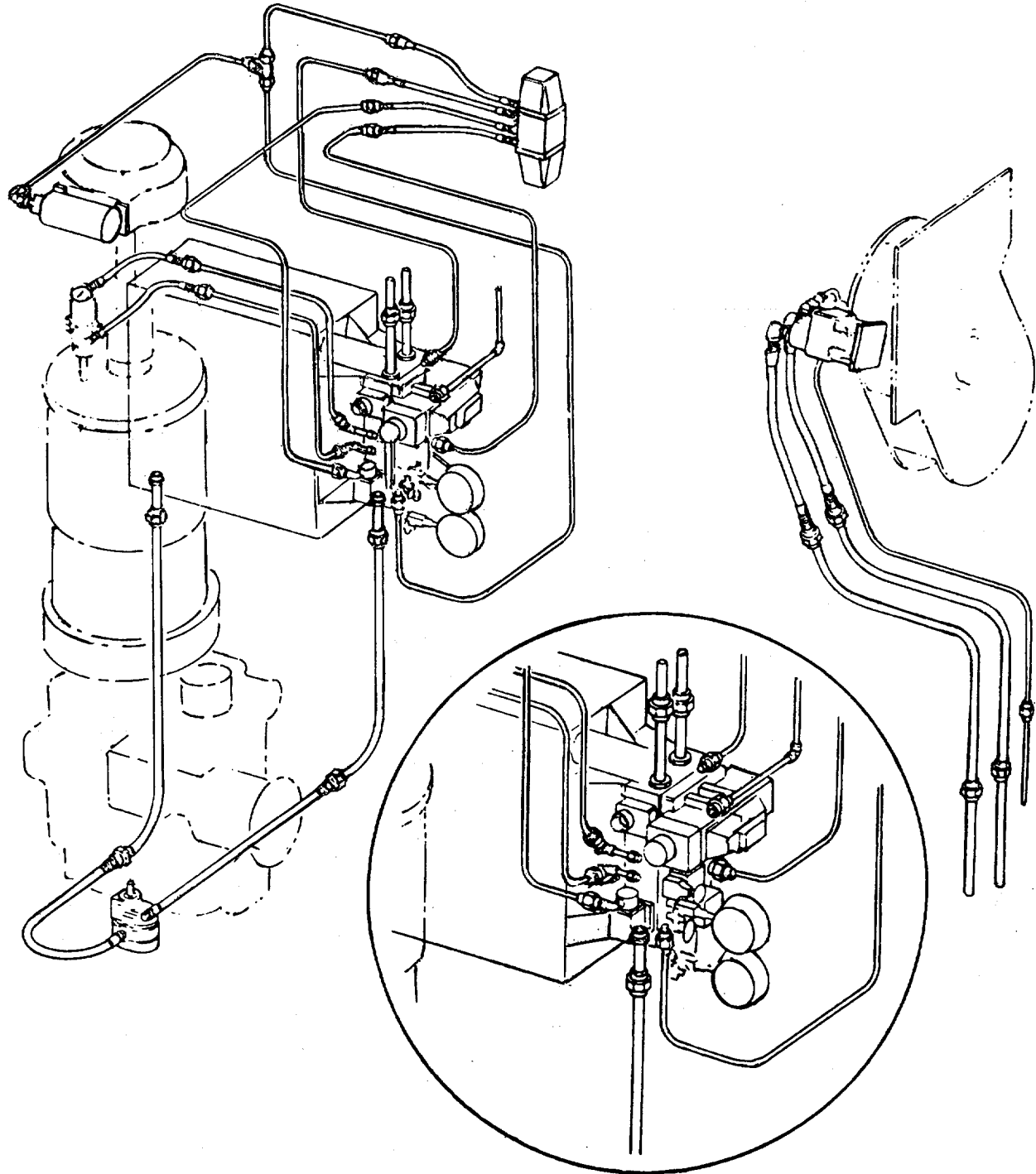
REPAIR

- 2. Repair in accordance with standard procedures.

3-139. 2. HOSES, LINES AND FITTINGS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS.

a. General

(1) The anchor winch engine covered in this manual is a 4 cylinder Detroit Diesel. The engine is equipped with an oil cooler, lubricating oil filter, fuel oil strainer, fuel oil filter, air cleaner, governor, water pump and a starting motor.

(2) Fuel is drawn from the supply tank through a strainer by a gear-type fuel pump, and then forced through the filter and fuel inlet gallery in the cylinder head and to the injectors. Excess fuel is returned to the supply tank via the fuel outlet gallery and connecting lines. Since fuel is constantly circulating through the injectors, it serves to cool the injectors and carry off any air in the fuel system.

(3) Air for scavenging and combustion is supplied by a blower which pumps air into the engine cylinders via the air box and cylinder liner ports. All air entering the blower first passes through an air cleaner.

(4) Full pressure lubrication is supplied to all main connecting rod and camshaft bearings, and to other moving parts of the engine. A gear-type pump draws oil from the oil pan through an intake screen and delivers it to the oil filter and then to the oil cooler. From the oil cooler, the oil enters a longitudinal oil gallery in the cylinder block where the supply divides; a portion entering the by-pass filter and then draining back into the oil pan, part going to the cam and balance shaft end bearings and cylinder head, with the remainder going to the main bearings and connecting rod bearings via the drilled crankshaft.

(5) Coolant is circulated through the engine by a centrifugal type water pump. Heat is removed from the coolant, which circulates in a closed system. Control of the engine temperature is accomplished by thermostats that regulate the flow of the coolant within the cooling system.

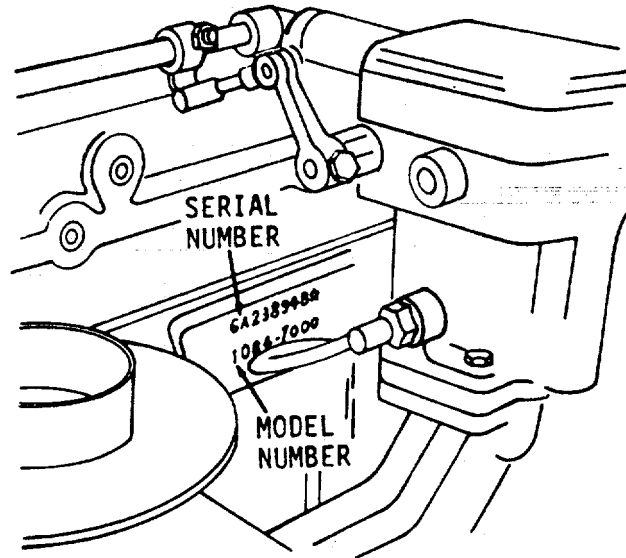
(6) Engine starting is provided by a hydraulic starting system.

(7) Engine speed is controlled by a mechanical type engine governor.

3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS (Continued)..

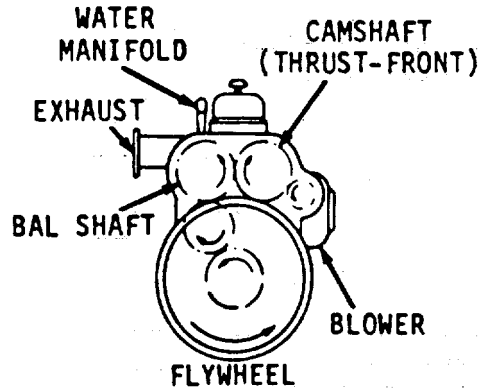
b. Engine Model And Serial Number Designation.

The engine serial number and model number are stamped on the cylinder block. The engine and model numbers are also stamped on the Option Plate attached to the valve rocker cover.



3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS (Continued)..

c. Engine Rotation And Firing Order.



ROTATION VIEWED
FROM REAR OF
ENGINE

GENERAL SPECIFICATIONS

4-71

Number of Cylinders.....	4
Bore	4 1/4 in. (10.8 cm)
Stroke.....	5 in. (12.7 cm)
Compression Ratio	18.7 to 1
Total Displacement - Cubic Inches.....	284
Firing Order - R.H. Rotation	1-3-4-2
Number of Main Bearings	5

3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS (Continued)..

d. General Information - Detroit Diesel N-71

(1) In many cases, the maintenance man is justified in replacing parts with new material rather than attempting repair. However, there are times where a slight amount of reworking or reconditioning may save time. Crankshafts, cylinder liners and other parts are in this category. For example, if a cylinder liner is only slightly worn and within usable limits, a honing operation to remove the glaze may make it suitable for reuse. Exchange assemblies such as injectors, fuel pumps, water pumps and blowers are also desirable service items.

(2) Various factors such as the type of operation of the engine, hours in service and next overhaul period must be considered when determining whether new parts are installed or used parts are reconditioned to provide trouble-free operation.

(3) For convenience and logical order in disassembly and assembly, the various subassemblies and other related parts mounted on the cylinder block will be treated as separate items in the various sections.

(4) Disassembly

(a) Before any major disassembly, the engine must be drained of lubricating oil, water and fuel. On engines cooled by a heat exchanger, the fresh water system must be drained. Lubricating oil should also be drained from the marine gear.

NOTE

Do not drain oil into bilges.
Use the oil/water separation
and recovery system to collect
drained oil.

(b) Parts removed from an individual engine should be kept together so they will be available for inspection and assembly. Those items having machined faces, which might be easily damaged by steel should be stored on suitable wooden racks or blocks.

(5) Cleaning

Before removing any of the sub-assemblies from the engine (but after removal of the electrical equipment), the exterior of the engine should be thoroughly cleaned. Then, after each subassembly is removed and disassembled, the individual parts should be cleaned. Thorough cleaning of each part is absolutely necessary before it can be satisfactorily inspected.

3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS (Continued)..

d. General Information - Detroit Diesel N-71 (Cont)

(6) Rust Preventive

If parts are not to be used immediately after cleaning, dip them in a rust preventive compound (NSN 6850-00-753-4967). The rust preventive compound should be removed before installing the parts in an engine.

(7) Inspection

(a) The purpose of parts inspection is to determine which parts can be used and which must be replaced. Although the engine overhaul specifications given throughout the text will aid in determining which parts should be replaced, considerable judgement must be exercised.

(b) The guiding factors in determining the usability of worn parts, which are otherwise in good condition, is the clearance between the mating parts and the rate of wear on each of the parts. If it is determined that the rate of wear will maintain the clearances within the specified maximum allowable until the next overhaul period, the reinstallation of used parts may be justified. Rate of wear of a part is determined by dividing the amount the part has worn by the hours it has operated.

(c) Many service replacement parts are available in various undersize and/or oversize as well as standard sizes. Also, service kits for reconditioning certain parts and service sets which include all of the parts necessary to complete a particular repair job are available.

(d) A complete discussion of the proper methods of precision measuring and inspection are outside the scope of this manual. However, every shop kit should be equipped with standard gages, such as dial bore gages, dial indicators, and inside and outside micrometers.

(e) In addition to measuring the used parts after cleaning, the parts should be carefully inspected for cracks, scoring, chipping and other defects.

3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS (Continued)..

d. General Information - Detroit Diesel N-71 (Cont)

(8) Assembly

(a) Following cleaning and inspection, the engine should be assembled using new parts as determined by the inspection.

(b) Use of the proper equipment and tools makes the job progress faster and produces better results. Likewise, a suitable working space with proper lighting must be provided.

(c) Keep the working space, equipment, tools and engine assemblies and parts clean at all times. The area where assembly operations take place should, if possible, be located away from the disassembly and cleaning operation. Also, any machining operations should be removed as far as possible from the assembly area.

(d) Particular attention should be paid to the storing of parts and sub-assemblies. After removal and cleaning, and prior to assembly, they should be stored in such a place or manner as to keep them clean. If there is any doubt as to the cleanliness of such parts, they should be recleaned.

(e) When assembling an engine or any part thereof, refer to the table of torque specifications for proper bolt, nut and stud torques.

(9) Work Safety

(a) A maintenanceman can be severely injured if caught in the pulley or belts of an engine that is accidentally started. To avoid such a misfortune, take these precautions before starting to work on an engine: Tag all electrical switches so that the electrical circuit is disrupted. Accidental contact with the starter button will not produce an engine start.

(b) Make sure the mechanism provided at the governor for stopping the engine is in the STOP position. This will mean the governor is in the NO-FUEL position. The possibility of the engine firing by accident is minimized.

(c) Some Safety Precautions to Observe When Working On The Engine:

- 1 Consider the hazards of the job and wear protective gear such as safety glasses, safety shoes, hard hat, etc., to provide adequate protection.
- 2 When lifting an engine component, make sure the lifting device is fastened securely. Be sure the item to be lifted does not exceed the capacity of the lifting device.

3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS (Continued)..

d. General Information - Detroit Diesel N-71 (Cont)

- 3 Always use caution when using power tools.



WARNING

Always wear protective eye goggles
when working with compressed air.

- 4 When using compressed air to clean a component such as an air silencer, use a safe amount of air. Recommendations regarding the use of air are indicated throughout the manual. Too much air can rupture or in some other way damage a component and create a hazardous situation that can lead to personal injury.
- 5 Avoid the use of carbon tetrachloride as a cleaning agent because of the harmful vapors that it releases. Use perchlorethylene or trichlorethylene. However, while less toxic than other chlorinated solvents, use these cleaning agents with caution. Be sure the work area is adequately ventilated and use protective gloves, goggles or face shield and apron. Exercise caution against burns when using oxalic acid to clean the cooling passages of the engine.
- 6 Avoid excessive injection of ether into the engine during start attempts. Follow the instructions on the container of the starting aid.
- 7 When working on an engine that is running, accidental contact with the hot exhaust manifold can cause severe burns. Remain alert to the location of the rotating pulleys and belts.

(10) Engine Specifications - (Less Major Assemblies).

Specifications, clearances and wear limits are listed below. It should be specifically noted that the clearances apply only when all new parts are used at the point where the various specifications apply. This also applies to references within the text of the manual. The column entitled "Limits" in this chart lists the amount of wear or increase in clearance which can be tolerated in used engine parts and still ensure satisfactory performance. It should be emphasized that the figures given as "Limits" must be qualified by the judgement of the personnel responsible for installing new parts. These wear limits are, in general, listed only for the parts more frequently replaced in engine overhaul work. For additional information, refer to the text.

TABLE OF SPECIFICATIONS, NEW CLEARANCES AND WEAR LIMITS

These limits also apply to oversize and undersize parts

ENGINE PARTS (Standard Size, New)	MINIMUM		MAXIMUM		LIMITS	
	(inches)	(cm)	(inches)	(cm)	(inches)	(cm)
CYLINDER BLOCK						
Block bore:						
Diameter	4.6260	11.7500	4.6270	11.7526		
Out-of-round.....			.0010	.0025	.0020	.0051
Taper .....			.0010	.0025	.0020	.0051
Cylinder liner counterbore:						
Diameter	5.0460	12.8168	5.0485	12.8000		
Depth .....	.4770	1.2116	.4795	1.2179		
Main bearing bore:						
Inside diameter (vertical axis).....	3.8120	9.6700	3.8130	9.6700		
Top surface of block:						
Centerline of main bearing bore to top of block.....	16.1840	41.1074	16.1890	41.1201	16.176 min	41.0870 min
Flatness-transverse.....					.0030	.0076
Flatness-longitudinal.....					.0060	.0152
Depth of counterbores (top surface):						
Cylinder head seal strip groove .....	.0970	.2464	.1070	.2718		
Large water holes (between cylinders).....	.1090	.2769	.1200	.3048		
Small water holes (at ends).....	.0870	.2210	.0980	.2489		
Combination water and oil holes.....	.0870	.2210	.0980	.2489		
CYLINDER LINER						
Outside diameter	4.6250	11.7475	4.6260	11.7500		
Inside diameter.....	4.2495	10.7937	4.2511	10.7978		
Clearance--liner-to-block:.....	.0000	.0000	.0020	.0051	.0025	.0064
Out-of-round--inside diameter.....			.0020	.0051	.0025	.0064
Taper-inside diameter.....			.0010	.0025	.0020	.0051
Depth of flange.....	.0450	.1143	.0500	.1270	.0500	.1270
Variation in depth between adjacent liners.....			.0020	.0051	.0020	.0051
Insert thickness.....	.1795	.4559	.1800	.4572		

Table of Specifications (Continued).

ENGINE PARTS (Standard Size, New)	MINIMUM		MAXIMUM		LIMITS	
	(inches)	(cm)	(inches)	(cm)	(inches)	(cm)
PISTON						
Height (centerline of bushing to top).....	3.5430	8.9992	3.5480	9.0119		
Diameter (above compression rings).....	4.2225	10.7252	4.2255	10.7328		
Diameter (at skirt).....	4.2428	10.7767	4.2450			
Clearance-piston skirt-to-liner.....	.0045	.0114	.0083	.0211	.0120	.0309
Out-of-round.....			.0005	.0013		
Taper.....			.0005	.0013		
COMPRESSION RINGS						
Gap (top-fire ring).....	.0230	.0584	.0380	.0965	.0600	.1524
Gap (No. 2, 3 and 4).....	.0180	.0457	.0430	.1092	.0600	.1524
Clearance-ring-to-groove:						
No. 1 (top-fire ring).....	.0040	.0102	.0060	.0152	.0100	.0254
No. 2.....	.0100	.0254	.0130	.0330	.0220	.0559
No. 3 and 4.....	.0040	.0102	.0070	.0178	.0130	.0330
OIL CONTROL RINGS						
Gap.....	.0080	.0203	.0230	.0584	.0430	.1092
Clearance.....	.0015	.0038	.0055	.0140	.0080	.0203
PISTON PINS (Trunk Pistons)						
Length.....	3.6050	9.1570	3.6200	9.1950		
Diameter.....	1.4996	3.8090	1.5000	3.8100	1.4980	3.8050
Clearance-pin to piston bearing.....	.0025	.0064	.0034	.0086	.0100	.0254
Clearance-pin to conn.rod bushing.....	.0015	.0038	.0024	.0061	.0100	.0254
Clearance-end (pin-to-retainer-retainer with lock ring).....	.0160	.0406	.0640	.1626	.0640	.1626
Piston bushing-inside diameter.....	1.5025	3.8164	1.5030	3.8176	1.5050	3.8227
CONNECTING ROD						
Length-center-to-center of upper and lower bores.....	10.1240	25.7150	10.1260	25.7200		
Inside diameter (upper bushing).....	1.5025	3.8164	1.5030	3.8176	1.5080	3.8303
Normal side clearance.....	.0060	.0152	.0120	.0305		

Table of Specifications (Continued).

ENGINE PARTS (Standard Size, New)	MINIMUM		MAXIMUM		LIMITS	
	(inches)	(cm)	(inches)	(cm)	(inches)	(cm)
CRANKSHAFT						
Journal diameter-main, bearing.....	3.4990	8.8875	3.5000	8.8900		
Journal diameter-conn. rod bearing.....	2.7490	6.9825	2.7500	6.9850		
Journal out-of-round.....			.00025	.00064	.0010	.0025
Journal taper.....			.0005	.0013	.0015	.0038
*Runout on journals-total indicator reading: 4 cylinder (mounted on No. 1 and No. 5 journals): at No. 2 and No. 4 journals.....			.0020	.0051		
At No. 3 journal.....			.0040	.0102		
Thrust washer thickness.....	.1190	.3023	.1220	.3099		
End play (end thrust clearance).....	.0040	.0102	.0140	.0356	.0180	.0457

* Runout tolerance given for guidance when regrinding crankshaft. When the runout on adjacent journals is in the OPPOSITE direction, the sum must not exceed .003 inches, (.008 cm) total indicator reading. When the runout on adjacent journals is in the SAME direction, the difference must not exceed .003 inch (.008 cm) total indicator reading. When high spots of the runout on adjacent journals are at RIGHT ANGLES to each other, the sum must not exceed .004 inches (.010 cm) total indicator reading or .002 inches (.005 cm) on each journal.

CONNECTING ROD BEARINGS

Inside diameter (vertical axis).....	2.7514	6.9886	2.7534	6.9936		
Bearing-to-journal clearance.....	.0014	.0036	.0044	.0112	.0060	.0152
Bearing thickness 90° from parting line.....	.1548	.3932	.1553	.3945	.153 min	.388 min

MAIN BEARINGS

Inside diameter (vertical axis).....	3.5014	8.8936	3.5034	8.8986		
Bearing-to-journal clearance.....	.0014	.0036	.0044	.0112	.0060	.0152
Bearing thickness 90° from parting line.....	.1548	.3932	.1553	.3945	.153 min	.389 min

Table of Specifications (Continued).

ENGINE PARTS (Standard Size, New)	MINIMUM		MAXIMUM		LIMITS	
	(inches)	(cm)	(inches)	(cm)	(inches)	(cm)
<u>CAMSHAFT</u>						
Diameter (at bearing journals):						
Front and rear	1.4970	3.8024	1.4975	3.8037		
Center and intermediate	1.4980	3.8049	1.4985	3.8062		
Runout at center bearing (when mounted on end bearings)						
			.0020	.0051		
Shaft diameter at gear	1.1875	3.0162	1.1880	3.0175		
Length-thrust bearing end journal						
	2.8740	7.3000	2.8760	7.3050		
End thrust .....	.1190	.3023	.1220	.3099	.0180	.0457
Thrust washer thickness .....	.1190	.3023	.1220	.3099		
<u>CAMSHAFT BEARINGS</u>						
Inside diameter:						
Front and rear	1.5000	3.8100	1.5010	3.8125		
Center and intermediate	1.5010	3.8125	1.5030	3.8176		
Clearance-bearing-to-shaft:						
Front and rear .....	.0025	.0064	.0040	.0102	.0060	.0152
Center and intermediate .....	.0025	.0064	.0050	.0127	.0090	.0229
Outside diameter:						
Front and rear	2.1880	5.5575	2.1885	5.5588		
Center and intermediate	2.1840	5.5474	2.1860	5.5524		
Diameter of cylinder block bore						
	2.1875	5.5563	2.1885	5.5588		
Clearance-bearings-to-block:						
Front and rear .....	.0010	.0025	.0005	.0013		
		press	press	loose	loose	
Intermediate (extruded) .....	.0015	.0038	.0065	.0165		
Intermediate (die cast) .....	.0015	.0038	.0105	.0267		
<u>CAMSHAFT and BALANCE SHAFT GEARS</u>						
Inside diameter	1.1865	3.0137	1.1875	3.0163		
Clearance-gear-to-shaft .....	.0015	.0038	.0000	.0000		
		press	press			
Backlash .....	.0030	.0076	.080	.0203	.0100	.0254

Table of Specifications (Continued).

ENGINE PARTS (Standard Size, New)	MINIMUM		MAXIMUM		LIMITS	
	(inches)	(cm)	(inches)	(cm)	(inches)	(cm)
<u>IDLER GEAR</u>						
Backlash.....	.0030	.0076	.0080	.0203	.0100	.0254
Pre-load-Variation						
on pull 2 lbs. 11 oz	1.2500	.5675	6.7500	3.0645		
(1.219 kg)						
<u>CRANKSHAFT TIMING GEAR</u>						
Inside diameter.....	4.7490	12.0625	4.7500	12.0650		
Clearance-gear-to-shaft.....	.001		.0025	.001	.0025	
	press	press	loose	loose		
Backlash.....	.0030	.0076	.0080	.0203	.0100	.0254
<u>BLOWER DRIVE GEAR</u>						
Backlash.....	.0030	.0076	.0080	.0203	.0100	.0254
Gear-to-hub fit .....	.0005	.0013	.001	.0025		
	press	press	loose	loose		
Support-to-end plate.....	.0005	.0013	.0025	.0064		
	press	press	loose	loose		
Inside diameter						
(support bushing).....	1.6260	4.1300	1.6265	4.1313		
Hub diameter						
(at bearing).....	1.6240	4.1250	1.6250	4.1275		
Hub-to-support bushing						
clearance .....	.0010	.0025	.0025	.0064	.0050	.0127
Hub-to-cam clearance .....	.0020	.0051	.0070	.0178		
End thrust.(current						
bearing.....	.0060	.0152	.0140	.0356		
<u>CYLINDER HEAD</u>						
Flatness-transverse .....					.0040	.0102
Flatness-longitudinal.....					.0055	.0140
Distance between top						
deck and fire deck.....	3.5560	9.0322	3.5680	9.0627	3.5360	8.9814
Water nozzles.....	.0132	.0335	Flush	Flush		
	Recess	Recess				
Cam follower bores.....	1.0620	2.6975	1.0630	2.7000	1.0650	2.7051

Table of Specifications (Continued).

ENGINE PARTS (Standard Size, New)	MINIMUM		MAXIMUM		LIMITS	
	(inches)	(cm)	(inches)	(cm)	(inches)	(cm)
<u>EXHAUST VALVE SEAT INSERTS</u>						
Seat width- 30□ (4-valve) .....	.0468	.1189	.0937	.2380	.0937	.2380
Valve seat runout .....			.0020	.0051		
<u>EXHAUST VALVES</u>						
Stem diameter .....	.3100	.7874	.3105	.7887	.3090	.7849
Valve head-to-cylinder head: 30° .....	.023	.0584	.006	.0152		
	recess	recess	protr	protr		
<u>VALVE GUIDES</u>						
Height above cylinder head						
4-valve (chamfered guide) .....	.8800	2.2352	.8800	2.2352	.3140	.7976
4-Valve (machined guide) .....	.6900	1.7526	.6900	1.7526		
Diameter-inside .....	.3125	.7938	.3135	.7963	.3140	.7976
Clearance-valve-to-guide .....	.0020	.0051	.0036	.0089	.0050	.0127
<u>VALVE BRIDGE GUIDES</u>						
Height above cylinder head	2.0400	5.1816	2.0400	5.1816		
<u>ROCKER ARMS AND SHAFTS</u>						
Diameter-rocker shaft .....	.8735	2.2187	.8740	2.2200		
Diameter-inside (rocker arm bushing) .....	.8750	2.2225	.8760	2.2250		
Clearance-shaft-to- bushing .....	.0010	.0025	.0025	.0064	.0040	.0102
<u>CAM FOLLOWERS</u>						
Diameter	1.0600	2.6924	1.0610	2.6949		
Clearance-follower- to-head .....	.0010	.0025	.0030	.0076	.0060	.0152
Rollers and pins: Clearance-pin-to- bushing .....	.0013	.0033	.0021	.0053	.010	.0254
					horiz	horiz
Side clearance- roller to follower .....	.0150	.0381	.0230	.0584	.0230	.0584

AIR INTAKE SYSTEM
SPECIFICATIONS

TABLE OF SPECIFICATIONS, NEW CLEARANCES AND WEAR LIMITS

ENGINE PARTS (Standard Size, New)	MINIMUM		MAXIMUM		LIMITS	
	(inches)	(cm)	(inches)	(cm)	(inches)	(cm)
BLOWER						
Backlash (timing gears) .....	.0005	.001270	.0025	.006350	.0040	.010160
Oil seal (below end plate surface) .....	.0020	.005080	.0080	.020320		
Oil strainer (below end plate surface).....	.0000	.000000	.0150	.038100		
Dowel pin (projection beyond inside face of front end plate).....	.3800	.965299				
Dowel pin (projection beyond inside face rear end plate).....	.2700	.685800				
<u>Clearances:</u>						
Rotor to end plate (gear end).....	.0070	.017780				
Rotor to end plate (front end).....	.0120	.030480				
Rotor to housing (inlet side) .....	.0160	.040640				
Rotor to housing (outlet side) .....	.0040	.010160				
Trailing edge of R.H. helix rotor to leading edge of L.H. helix rotor .....	.0020	.005080	.0060	.015240	.0060	.015240
Leading edge of R.H. helix rotor to trailing edge of L.H. helix.....	.0120	.030480				
rotor						

HYDROSTARTER SYSTEM
SPECIFICATIONS

<u>HYDROSTARTER MOTOR</u>	English	Metric
Type	Swash plate	
Number of pistons	Seven	
Displacement per revolution (20 Series).....	2 cu. in..	12.9 cm ²
Displacement per revolution (35 Series).....	3.5 cu. in..	22.6 cm ²
Maximum torque at 3000 psi (206.85 kPa) (20 Series).....	80 lb. ft.	108.5 nm ²
Maximum torque at 3000 psi (206.85 kPa) (35 Series).....	140 lb. ft.	189.8 nm ²
Drive	Overrunning clutch	
<u>ENGINE-DRIVEN PUMP</u>		
Type	Positive displacement	
Number of pistons	One	
Displacement per revolution	0.0208 cu. in..	13.3 mm ²
Maximum discharge pressure	3250 psi	22409 kPa
Maximum continuous speed	2500 rpm	
<u>MANUAL PUMP</u>		
Type	Positive displacement	
Number of pistons	One	
Displacement per stroke	0.773 cu. in..	498.7 mm ²
<u>ACCUMULATOR</u>		
Type	Piston	
Capacity	200 or 300 cu. in..	1290 or 1935 cm ²
Precharge (nitrogen).....	1250 psi	8618.8 kPa
Operating pressure.....	900-3000 psi	19996-20685 kPa

STANDARD BOLT AND NUT TORQUE SPECIFICATIONS

Thread Size	TORQUE			
	Minimum (lb ft)	Minimum (Nm)	Maximum (lb ft)	Maximum (Nm)
1/4 - 20.....	7	9.4920	9	12.2040
1/4 - 28.....	8	10.8480	10	13.5600
5/16 - 18.....	13	17.6280	17	23.0520
5/16 - 24.....	15	20.3400	19	25.7640
3/8 - 16.....	30	40.6800	35	47.4600
3/8 - 24.....	35	47.4600	39	52.8840
7/16 - 14.....	46	62.3760	50	67.8000
7/16 - 20.....	57	77.2920	61	82.7160
1/2 - 13.....	71	96.2760	75	101.7000
1/2 - 20.....	83	112.5480	93	126.1080
9/16 - 12.....	90	122.0400	100	135.6000
9/16 - 18.....	107	145.0920	117	158.6520
5/8 - 11.....	137	185.7720	147	199.3320
5/8 - 18.....	168	227.8080	178	241.3680
3/4 - 10.....	240	325.4400	250	339.0000
3/4 - 16.....	290	393.2400	300	406.8000
7/8 - 9.....	410	555.9600	420	569.5200
7/8 - 14.....	475	644.1000	485	657.6600
1 - 8.....	580	786.4800	590	800.0400
1 - 14.....	685	928.8600	695	942.4200

STANDARD PIPE PLUG TORQUE SPECIFICATIONS

Use sealing compound on plugs without gaskets or Teflon. These specifications apply to plugs installed below the surface of the part of which they are a component

Thread Size	TORQUE			
	Minimum (lb ft)	Minimum (Nm)	Maximum (lb ft)	Maximum (Nm)
1/8	10	13.5600	12	16.2720
1/4	14	18.9840	16	21.6960
3/8	18	24.4080	22	29.8320
1/2	23	31.1880	27	36.6120
3/4	33	44.7480	37	50.1720
1	75	101.7000	85	115.2600
1-1/4	95	128.8200	105	142.3800
1-1/2	10	149.1600	130	176.2800

FUEL SYSTEM AND GOVENOR

EXCEPTIONS TO STANDARD BOLT AND NUT TORQUE SPECIFICATIONS

Application	Thread Size	TORQUE			
		Minimum (lb ft)	Minimum (Nm)	Maximum (lb ft)	Maximum (Nm)
Variable speed spring lever set screw	5/16-24	12	16.2720	15	20.3400
Governor weight shaft bearing retaining bolt...	5/16-24	15	20.3400	19	25.7640
Injector clamp bolt	3/8-16	20	27.1200	20	27.1200
Air inlet housing adaptor-to blower housing bolt ..	3/8-16	16	21.6960	20	27.1200
Air inlet housing-to-adaptor bolts	3/8-16	16	21.6960	20	27.1200
Fuel pipe nut.....	3/8-24	12	16.2720	15	20.3400
Blower end plate-to-cylinder block bolts	7/16-14	40	54.2400	45	61.0200
*Rocker arm bracket bolts	1/2-13	90	122.0400	100	135.6000
Injector filter caps	5/8-24	65	88.1400	75	101.7000
Injector nut	15/16-24	75	101.7000	85	115.2600

* 75-85 lb-ft torque (101.70-115.26 Nm) on the two bolts attaching a load limit bracket to the rocker arm shaft brackets.

AIR INTAKE SYSTEM

EXCEPTIONS TO STANDARD BOLT AND NUT TORQUE SPECIFICATIONS

Application	Thread Size	TORQUE			
		Minimum (lb ft)	Minimum (Nm)	Maximum (lb ft)	Maximum (Nm)
Blower drive coupling- to rotor gear bolt.....	5/16 - 24	20	27.1200	25	33.9000
Air inlet housing adaptor- to-blower housing bolt..	3/8 - 16	16	21.6960	20	27.1200
Air inlet housing-to- adaptor bolt.....	3/8 - 16	16	21.6960	20	27.1200
Blower end plate-to- cylinder block bolt	7/16 - 14	40	54.2400	45	61.0200
Blower rotor gear retainer bolt (Allen head).....	1/2 - 20	55	74.5800	65	88.1400
Fuel pump drive disc bolt	1/2 - 20	55	74.5800	65	88.1400
Blower rotor gear retainer bolt (large bearing blower)	1/2 - 20	100	135.6000	110	149.1600

LUBRICATION SYSTEM
SPECIFICATIONS

EXCEPTIONS TO STANDARD BOLT AND NUT TORQUE SPECIFICATIONS

Application	Size nut or bolt	TORQUE			
		Minimum (lb ft)	Minimum (Nm)	Maximum (lb ft)	Maximum (Nm)
Oil pan bolts	5/16 - 18	10	13.5600	12	16.2720
Oil pan bolts	3/8 - 16	15	20.3400	20	27.1200
Lubricating oil filter center stud.....	5/8 - 18	40	54.2400	50	67.8000
Oil pan drain plug (nylon washer).....	18 MM	25	33.9000	35	47.4600

ENGINE BLOCK AND CYLINDER HEAD

EXCEPTIONS TO STANDARD BOLT AND NUT TORQUE SPECIFICATIONS

APPLICATION	Thread size	TORQUE			
		Minimum (lb ft)	Minimum (Nm)	Maximum (lb ft)	Maximum (Nm)
Cam follower guide bolt.....	1/4 -20	12	16.2720	15	20.3400
Injector control shaft bracket bolt.....	1/4 -20	10	13.5600	12	16.2720
Air box cover bolt.....	5/16 -18	8	10.8480	12	16.2720
Oil pan bolts (lower pan).....	5/16 -18	10	13.5600	12	16.2720
Exhaust valve bridge adjusting screw lock nut	5/16 -24	20	27.1200	25	33.9000
Idle gear bearing retainer bolts.....	5/16 -24	24	32.5440	29	39.3240
Injector clamp bolts	3/8 -16	20	27.1200	25	33.9000
Front end plate bolt (two bolts into water jacket plug).....	3/8 -16	20	27.1200	25	33.9000
Flywheel housing bolts.....	3/8 -16	25	33.9000	30	40.6800
Oil pan bolts (upper).....	3/8 -16	15	20.3400	20	27.1200
Idle gear hub and spacer bolts.....	3/8 -16	40	54.2400	45	61.0200
Front accessory drive pulley bolt.....	3/8 -16	25	33.9000		
Camshaft end bearing bolts.....	3/8 -16	35	47.4600	40	54.2400
Flywheel housing bolts (threaded into plug nuts).....	3/8 -24	25	33.9000	30	40.6800
Camshaft intermediate bearing lock screw.....	3/8 -24	15	20.3400	20	27.1200
Balance weight-to-camshaft gear plain nut.....	3/8 -24	18	24.4080	22	29.8320
Balance weight-to-camshaft gear lock nut.....	3/8 -24	25	33.9000	30	40.6800
Blower drive support bolts and nuts.....	3/8 -24	25	33.9000	30	40.6800
Balance weight-to-camshaft gear bolt.....	3/8 -24	15	20.3400	18	24.4080

ENGINE BLOCK AND CYLINDER HEAD

EXCEPTIONS TO STANDARD BOLT AND NUT TORQUE SPECIFICATIONS (Continued)

APPLICATION	Thread size	TORQUE			
		Minimum (lb ft)	Minimum (Nm)	Maximum (lb ft)	Maximum (Nm)
Balance weight-to-camshaft gear slotted nut.....	3/8 -24	28	37.9680	32	43.3920
Accessory drive hub to camshaft gear bolt.....	3/8 -24	45	61.0200	50	67.8000
Accessory drive disc to camshaft gear bolt	3/8 -24	45	61.0200	50	67.8000
Injector clamp nut	3/8 -24	20	27.1200	25	33.9000
Exhaust manifold outlet flange nuts (brass)	3/8 -24	20	27.1200	25	33.9000
Water manifold cover nuts	3/8 -24	20	27.1200	25	33.9000
Fuel pipe nuts	3/8 -24	12	16.2720	15	20.3400
#Threaded exhaust valve bridge guide (Nylon insert)	7/16 -14	46	62.3760	50	67.8000
Rear accessory drive pulley bolt.....	7/16 -14	35	47.4600		
Connecting rod nut (Lubrite).....	7/16 -20	60	81.3600	70	94.9200
Connecting rod nut (castellated).....	7/16 -20	65	88.1400	75	101.7000
Flywheel housing bolts	1/2 -13	90	122.0400	100	135.6000
@Rocker shaft bolts	1/2 -13	90	122.0400	100	135.6000
Generator drive bearing retaining bolts.....	1/2 -13	30	40.6800	35	47.4600
Generator drive oil seal retaining bolt.....	1/2 -13	30	40.6800	35	47.4600
Idler gear hub and dummy hub bolt.....	1/2 -3	80	108.4800	90	122.0400

EXCEPTIONS TO STANDARD BOLT AND NUT TORQUE SPECIFICATIONS (Continued)

APPLICATION	Thread size	TORQUE			
		Minimum (lb ft)	Minimum (Nm)	Maximum (lb ft)	Maximum (Nm)
** Flywheel bolts.....	9/16 -18	180	244.0800	190	257.6400
** Main bearing bolts (assembly).....	5/8 -11	180	244.0800	190	257.6400
** Main bearing bolts (boring).....	5/8 -11	165	223.7400	175	237.3000
** Cylinder head bolts.....	5/8 -11	175	237.3000	185	250.8600
** Cylinder head nuts.....	5/8 -18	175	237.3000	185	250.8600
Accessory drive pulley nut.....	3/4 -16	80	108.4800	100	135.6000
Crankshaft end bolt.....	1 -14	290	393.2400	310	420.3600
Camshaft nut.....	1 1/8 -18	300	406.8000	325	440.7000
Accessory drive pulley nut.....	3/4 -16	80	108.4800	100	135.6000
Crankshaft end bolt.....	1 -14	290	393.2400	310	420.3600
Camshaft nut.....	1 1/8 -18	300	406.8000	325	440.7000
Blower drive gear hub nut.....	1 7/16-16	50	67.8000	60	81.3600

\$ Stake nut after tightening.

Lubricate before assembling to cylinder head.

@ 75-85 lb-ft (1-1.70-115.26 Nm) torque on the two bolts attaching load limit bracket to the rocker arm shaft bracket.

** Lubricate at assembly with International Compound No. 2 or equivalent.

ENGINE BLOCK AND CYLINDER HEAD
SPECIAL PIPE PLUG TORQUE SPECIFICATIONS

Application	Plug	Assembly	TORQUE			
			Minimum (lb ft)	Minimum (Nm)	Maximum (lb ft)	Maximum (Nm)
Oil gallery plug	3/8" Dryseal+	Assemble with max. 1/16" PT thread protrusion from surface				
Cylinder head (side).....	3/8 - 16"	Assemble flush to 1/16" protrusion from surface				
Cylinder head (end)	3/4" Dryseal PTF-SAE	Flush to 1/8" recessed.				
Core hole plug (air box floor).....	1 3/4" -16		150	203.4000	180	244.0800
Core hole plug (air box floor).....	2 1/2" -16		230	311.8800	270	366.1200
Oil drain plug (Nylon washer).....	18 mm		25	33.9000	35	47.4600

* Apply sealing compound to plugs used without gaskets.

+ After installation, a 7/32" rod inserted in oil line must pass inner face of plug.

CYLINDER HEAD
STUD TORQUE SPECIFICATIONS

APPLICATION	TORQUE				Height
	MINIMUM (lb ft)	MINIMUM (Nm)	MAXIMUM (lb ft)	MAXIMUM (Nm)	
Cylinder head stud	75	101.7000			4.3750+0.0312 (11.1125+0.0792 cm)
Injector clamp stud	10	13.5600	25	33.9000	
Water hole cover stud	10	13.5600	25	33.9000	
Exhaust manifold stud	25	33.9000	40	54.2400	

SPRING SPECIFICATIONS

SPRING	REPLACE WHEN LOAD IS LESS THAN:	
	(English)	(Metric)
Cam follower (11 coils - .177" wire)	172 lbs @ 2.1250"	78.09 kg @ 5.3975 cm
Cam follower (11 1/2 coils - .162" wire)	133 lbs @ 2.1094"	60.38 kg @ 5.3579 cm
Exhaust valve and bridge guide (9 3/4 coils - .135" wire)	79 lbs @ 1.4160"	35.87 kg @ 3.5966 cm
Exhaust valve (8 3/4 coils - .148" wire)	100 lbs @ 1.3970"	45.40 kg @ 3.5484 cm

ENGINE OPERATING CONDITIONS
N ENGINES (English)

	1200 rpm	1800 rpm	2100 rpm
<u>LUBRICATING SYSTEM</u>			
Lubricating oil pressure (psi):			
Normal.....	35-55	50-70	50-70
Minimum for safe operation.....	25	28	30
* Lubricating oil temperature (degrees F.):			
Normal	200-235	200-235	200-235
<u>AIR SYSTEM</u>			
Air box pressure (inches mercury) - min. at full load:			
At zero exhaust back pressure:.....	1.1	3.8	5.0
At maximum full-load exhaust back pressure	2.3	6.4	8.2
Air inlet restriction (inches water) - full-load speed, max.:			
Dirty air cleaner	12.4	25.0	25.0
Clean air cleaner.....	5.2	9.1	11.5
Crankcase pressure (inches water) - maximum:.....	1.0	2.2	3.0
Exhaust back pressure (inches mercury) - maximum:			
Full load	1.5	3.3	4.4
No load.....	1.0	2.1	3.0
<u>FUEL SYSTEM</u>			
Fuel pressure at inlet manifold (psi):			
Normal (.080" orifice).....	45-70	45-70	45-70
Minimum	30	30	30
Fuel spill (gpm) - minimum at no load	0.8	0.9	0.9
Fuel pump suction at pump inlet (inches mercury) - max.:			
Clean system.....	6.0	6.0	6.0
Dirty system	12.0	12.0	12.0
<u>COOLING SYSTEM</u>			
Coolant temperature (degrees F.) - normal.....	160-185	160-185	160-185
<u>COMPRESSION</u>			
Compression pressure (psi)			
Average - new engine at 600 rpm.....	565		
Minimum at 600 rpm.....	515		

ENGINE OPERATING CONDITIONS (Continued).

- * The lubricating oil temperature range is based on the temperature measurement in the oil pan at the oil pump inlet.
When measuring the oil temperature at the cylinder block oil gallery, it will be approximately 10° lower.

3-2369

ENGINE OPERATING CONDITIONS
N ENGINES (Metric)

	1200 rpm	1800 rpm	2100 rpm
<u>LUBRICATING SYSTEM</u>			
Lubricating oil pressure (kPa):			
Normal	241-379	344.8-482.7	344.8-482.7
Minimum for safe operation	172.4	193.1	206.9
* Lubricating oil temperature (degrees C.):			
Normal	93-113	93-113	93-113
<u>AIR SYSTEM</u>			
Air box pressure (kPa) - minimum at full load:			
At zero exhaust back pressure:	3.7	12.8	16.9
At maximum full-load exhaust back pressure:	7.8	21.6	27.7
Air inlet restriction (kPa) - full-load speed, maximum:			
Dirty air cleaner	3.9	6.2	6.2
Clean air cleaner.....	1.3	2.3	2.9
Crankcase pressure (kPa) - maximum:	0.2	0.5	0.7
Exhaust back pressure (kPa) - maximum:			
Full load.	5.1	11.1	14.9
No load.....	3.4	7.1	10.1
<u>FUEL SYSTEM</u>			
Fuel pressure at inlet manifold (kPa):			
Normal (.080" orifice).....	310-483	310-483	310-483
Minimum	207	207	207
Fuel spill (lpm) - minimum at no load.....	1.9	2.1	2.1
Fuel pump suction at pump inlet (kPa) -maximum:			
Clean system	20.3	20.3	20.3
Dirty system	40.5	40.5	40.5
<u>COOLING SYSTEM</u>			
Coolant temperature (degrees C.) - normal	71-85	71-85	71-85
<u>COMPRESSION</u>			
Compression pressure (kPa)			
Average - new engine at 600 rpm.....	3895		
Minimum at 600 rpm.....	3551		

**ENGINE OPERATING CONDITIONS (Continued).
N ENGINES (Metric)**

* The lubricating oil temperature range is based on the temperature measurement in the oil pan at the oil pump inlet.

When measuring the oil temperature at the cylinder block oil gallery, it will be approximately 5.5° lower.

3-2371

3-140. ANCHOR WINCH ENGINE -MAINTENANCE INSTRUCTIONS (Continued).

This task covers:

- a. Inspection
- b. Test
- c. Service
- d. Repair

INITIAL SETUP

Test Equipment
None

References
None

Special Tools
None

Equipment Condition	Condition Description
	None

Material/Parts

Special Environmental Conditions

Oil MIL-L-2104 Type OE/HDO
Oil MIL-L-17672 Type 2135 TH
Grease MIL-G-10924 Type GAA

None

Personnel Required
1

General Safety Instructions
None

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

1.	Emergency shutdown system	Cable, control head linkage	Inspect.	Refer to paragraph 3-141.
2.	Alarm system	Alarm switches	Inspect.	Refer to paragraph 3-141.
3.	Governor	Housing linkage	Inspect.	Refer to paragraph 3-142.
4.	Air intake	Silencers, housing	Inspect.	Refer to paragraph 3-143.

3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS	
INSPECTION (Cont)				
5.	Blower	Housing, oil seals	Inspect.	Refer to paragraph 3-144.
6.	Fuel pump	Housing, hoses and fittings	Inspect.	Refer to paragraph 3-145.
7.	Fuel filter and strainer fuel lines	Housing, shell, hoses and fittings	Inspect.	Refer to paragraph 3-146.
8.	Lube oil filters	Housing, shell, hoses, and fittings	Inspect.	Refer to paragraph 3-148.
9.	Oil cooler	Housing, gaskets	Inspect.	Refer to paragraph 3-149.
10.	Fresh water pump	Inspect.		Refer to paragraph 3-150.
11.	Water manifold	Inspect.		Refer to paragraph 3-152.
12.	Thermostat and housing	Inspect.		Refer to paragraph 3-153.
13.	Overspeed governor	Inspect.		Refer to paragraph 3-154.
14.	Tachometer drive	Inspect.		Refer to paragraph 3-155.

3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
15.	Air cleaner	Inspect.	Refer to paragraph 3-156.
16.	Crankshaft pulley	Inspect.	Refer to paragraph 3-157.
17.	Balance weight cover	Inspect.	Refer to paragraph 3-158.
18.	Engine supports and lift brackets	Inspect.	Refer to paragraph 3-159.
19.	Exhaust manifold	Inspect.	Refer to paragraph 3-160.
20.	Rocker arm cover	Inspect.	Refer to paragraph 3-161.
21.	Oil pan and dipstick	Inspect.	Refer to paragraph 3-163.
22.	Cylinder head	Inspect.	Refer to paragraph 3-164.
23.	Valve operating mechanism	Inspect.	Refer to paragraph 3-165.
24.	Flywheel housing	Inspect.	Refer to paragraph 3-167.
25.	Lube oil distribution	Inspect.	Refer to paragraph 3-170.
26.	Cylinder block	Inspect.	Refer to paragraph 3-173.

3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
27.	Instrument panel	Inspect.	Refer to paragraph 3-174.
28.	Starting aid	Inspect.	Refer to paragraph 3-3-175.
29.	Hydro-starter	Inspect.	Refer to paragraph 3-3-176.
30.	Accumulator	Inspect.	Refer to paragraph 3-177.
31.	Hydro-starter pump (engine driven)	Inspect.	Refer to paragraph 3-178.
32.	Hydro-starter pump (hand)	Inspect.	Refer to paragraph 3-179.
33.	Hydro-starter piping	Inspect.	Refer to paragraph 3-180.
Hoses, lines and fittings			
34.	Reservoir filters and solenoids	Inspect.	Refer to paragraph 3-181.
Hoses, filter fittings, and wiring			

3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
TEST			
35. Engine	a. Control panel	Start engine and run until warm.	Check all gages for proper readings.
	b. Engine	While running-	Check for vibrations and uneven operation.
	c. Engine	Stop and let cool.	Proceed with service checks.
SERVICE			
36. Engine oil panel	Dipstick	Remove and check oil level.	Add oil if necessary - type OE/HDO.
NOTE			
FULL engine has 15 quarts (14.19 liters)			
LOW engine has 11 quarts (10.41 liters)			
37. Tachometer drive	Grease fitting	Lubricate.	Use grease (MIL-G-10924 Symbol GAA).
38. Emergency stop control	Linkage	Lubricate.	Use oil (MIL-L-2104 - type OE/HDO).
39. Hydro-starter reservoir	Cap	Remove and check level.	Add mineral oil (MIL-L-17672 - type 2135TH).

3-140. ANCHOR WINCH ENGINE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR			
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40.	Engine	Perform maintenance on any component that may, or is producing a problem.	
-----	--------	---	--

3-141. ENGINE CONTROLS.

The maintenance instructions for the engine controls are contained in the following paragraphs:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Engine, Clutch and Throttle Controls	3-141.1
Engine Throttle Linkage	3-141.2
Stop Cable and Linkage	3-141.3

3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS.

This task covers:

- | | | |
|---------------|-----------------|----------------|
| a. Inspection | c. Removal | e. Repair |
| b. Test | d. Installation | f. Adjustments |

INITIAL SETUP

Test Equipment
None

References
None

Special Tools
None

<u>Equipment</u>	<u>Condition</u>	<u>Condition Description</u>
		None

Material/Parts
None

Special Environmental Conditions
None

Personnel Required
2

General Safety Instructions
None

INSPECTION

- | | | | | |
|----|--------------------------|-------------------------------|--------------------------------------|--|
| 1. | Vehicle deck aft | Inhaul/payout clutch/throttle | Place in ahead and astern positions. | Check for ease of operation, broken, frayed coverings, and damaged control cables. |
| 2. | Anchor winch compartment | Inhaul/payout clutch/throttle | Inhaul and payout position. | Check for ease of operation, broken, frayed coverings, and damaged control cables. |

3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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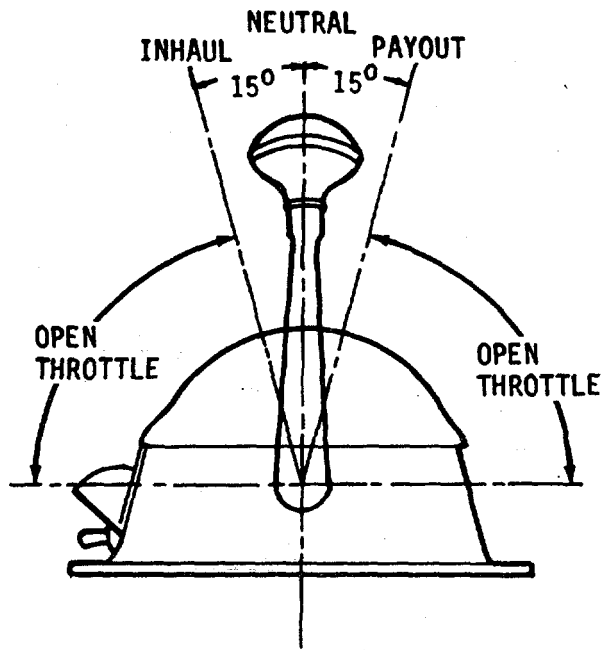
TEST

3. Vehicle deck aft

Inhaul/payout clutch/throttle

Check angle from neutral to payout and neutral to inhaul.

Angle should be 15°. The clutch should move only in the maneuvering range. Refer to adjustment procedure, step 19.
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3-2379

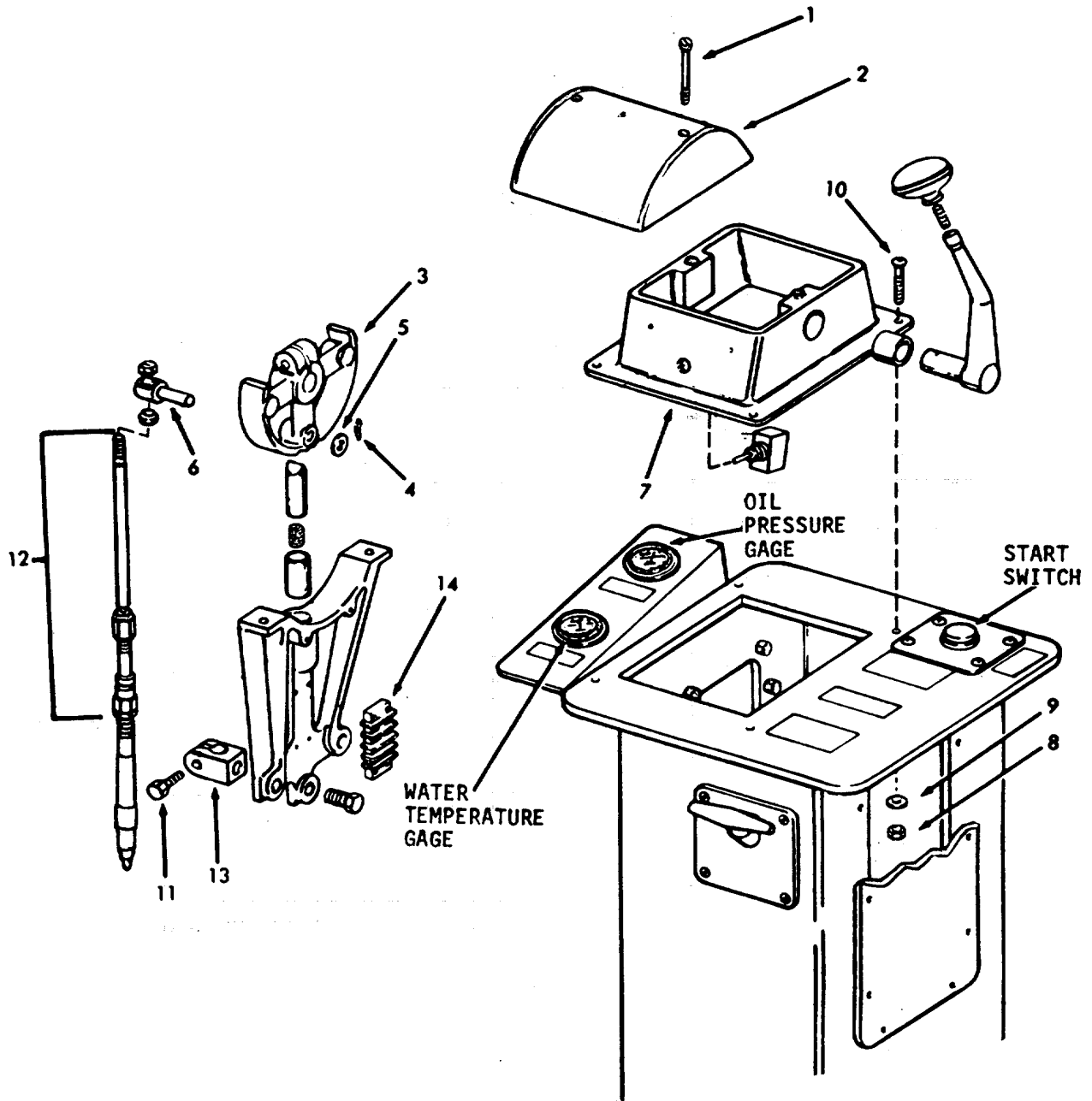
3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL - CONTROL STATION			
4. Control station	a. Screws (1)	Remove.	
	b. Cover (2)	Remove.	
5. Quadrant (3)	a. Cotter pin (4)	Remove.	
	b. Washer (5)	Remove.	
	c. Joint (6)	Remove from quadrant.	
6. Control station housing (7)	a. Nuts (8), and washers (9)	Remove.	
	b. Screws (10)	Remove.	
	c. Housing (7)	Lift to gain access to cables.	
	d. Screw (11)	Remove.	
	e. Cable (12)	Remove from cable clamp (13).	
	f. Wiring to terminal strip (14)	Tag and disconnect.	
	g. Control station	Remove.	

3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL - CONTROL STATION (Cont)

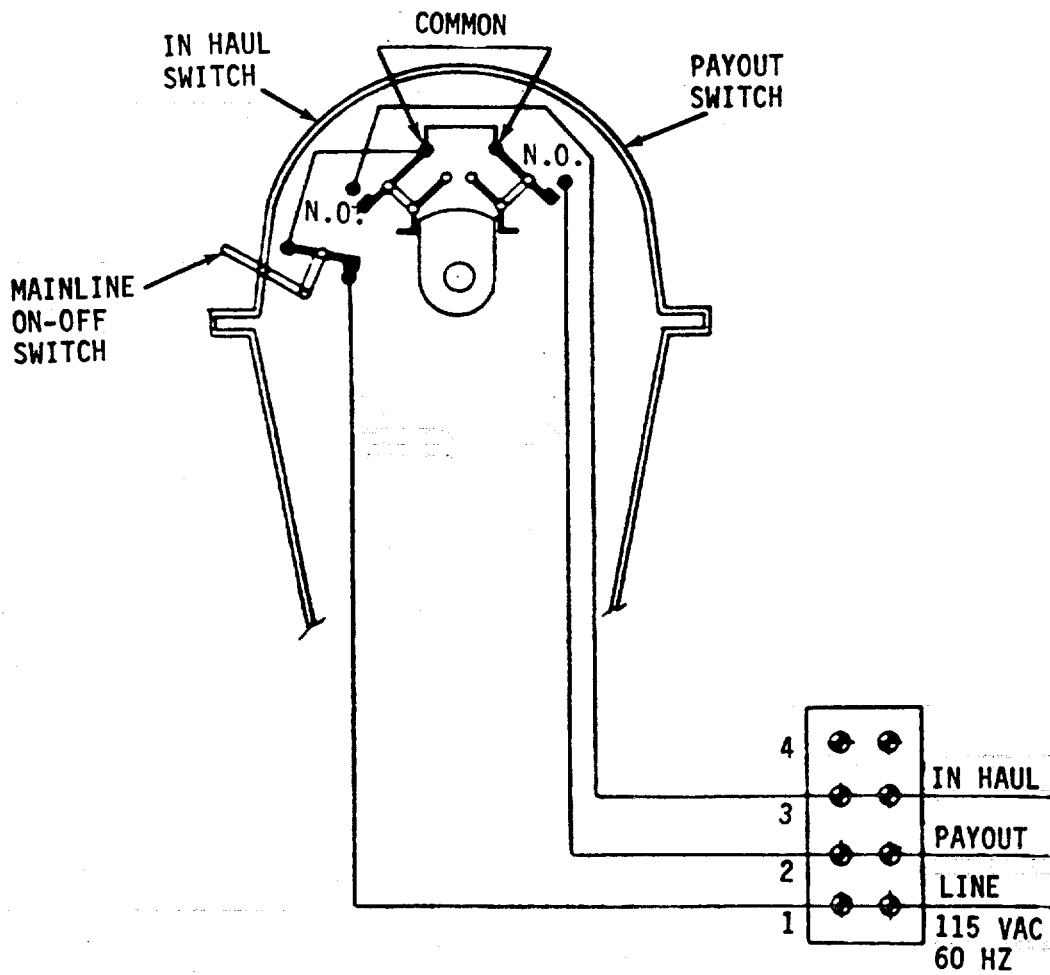


3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CONTROL STATION			
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7.	Control station housing	a. Wiring to terminal strip (14)	Reconnect.
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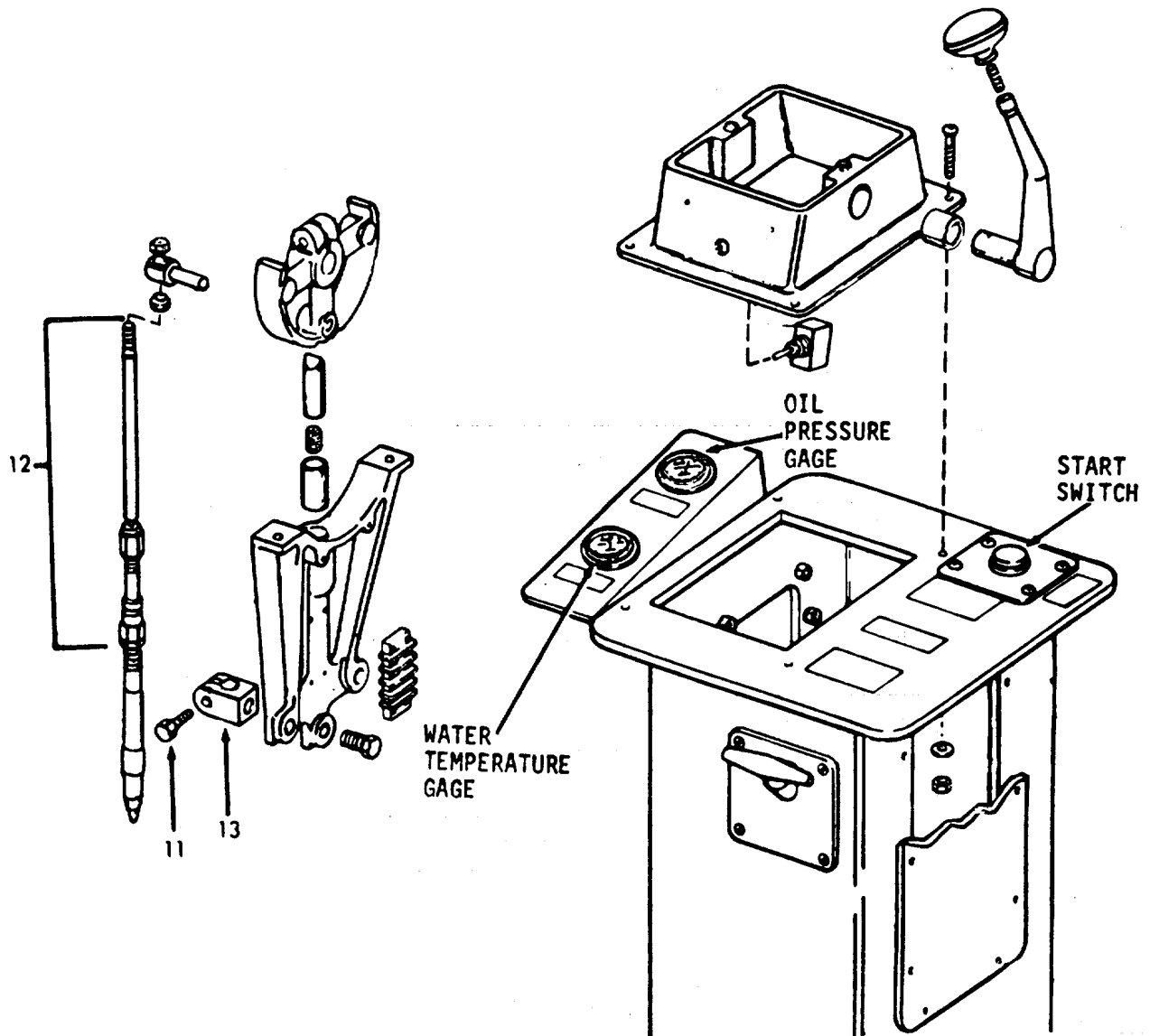
3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CONTROL STATION (Cont)			
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- b. Cable clamp (13), cable (12), and screw (11)

Insert cable in clamp and tighten screw.



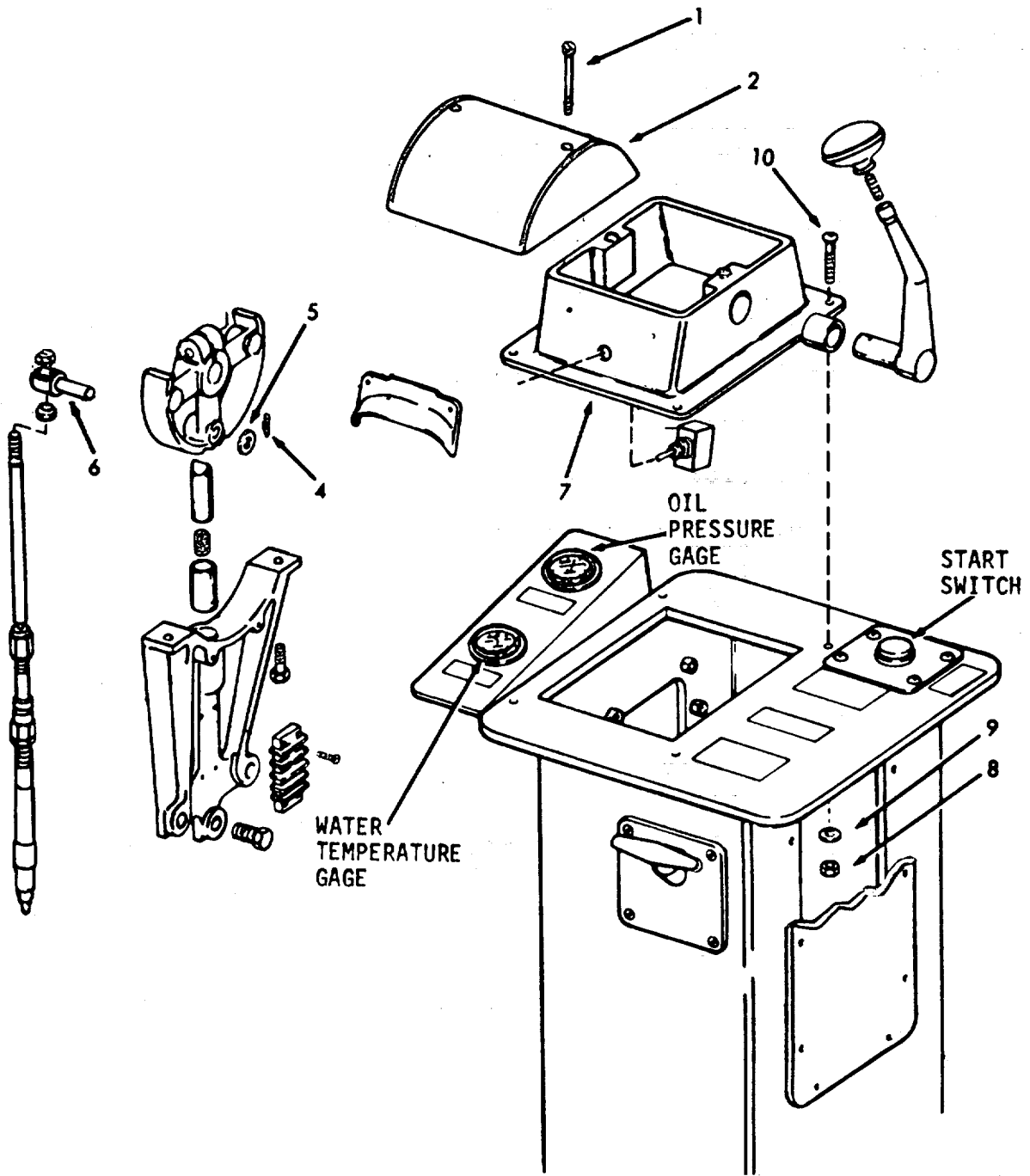
3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION - CONTROL STATION (Cont)			
	c. Housing (7)	Align holes in control station.	
	d. Screws (10), washers (9), and nuts (8)	Install.	
8. Throttle Quadrant (7)	a. Joint (6)	Place in quadrant.	
	b. Washer (5), and cotter pin (4)	Install.	
9. Control station	a. Lubricate bearings through hole for screw (1)	Use engine oil, Type OE/HDO-10.	
	b. Cover (2)	Install.	
	c. Screws (1)	Install.	
	d. Adjust	Refer to adjustments.	

3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CONTROL STATION (Cont)



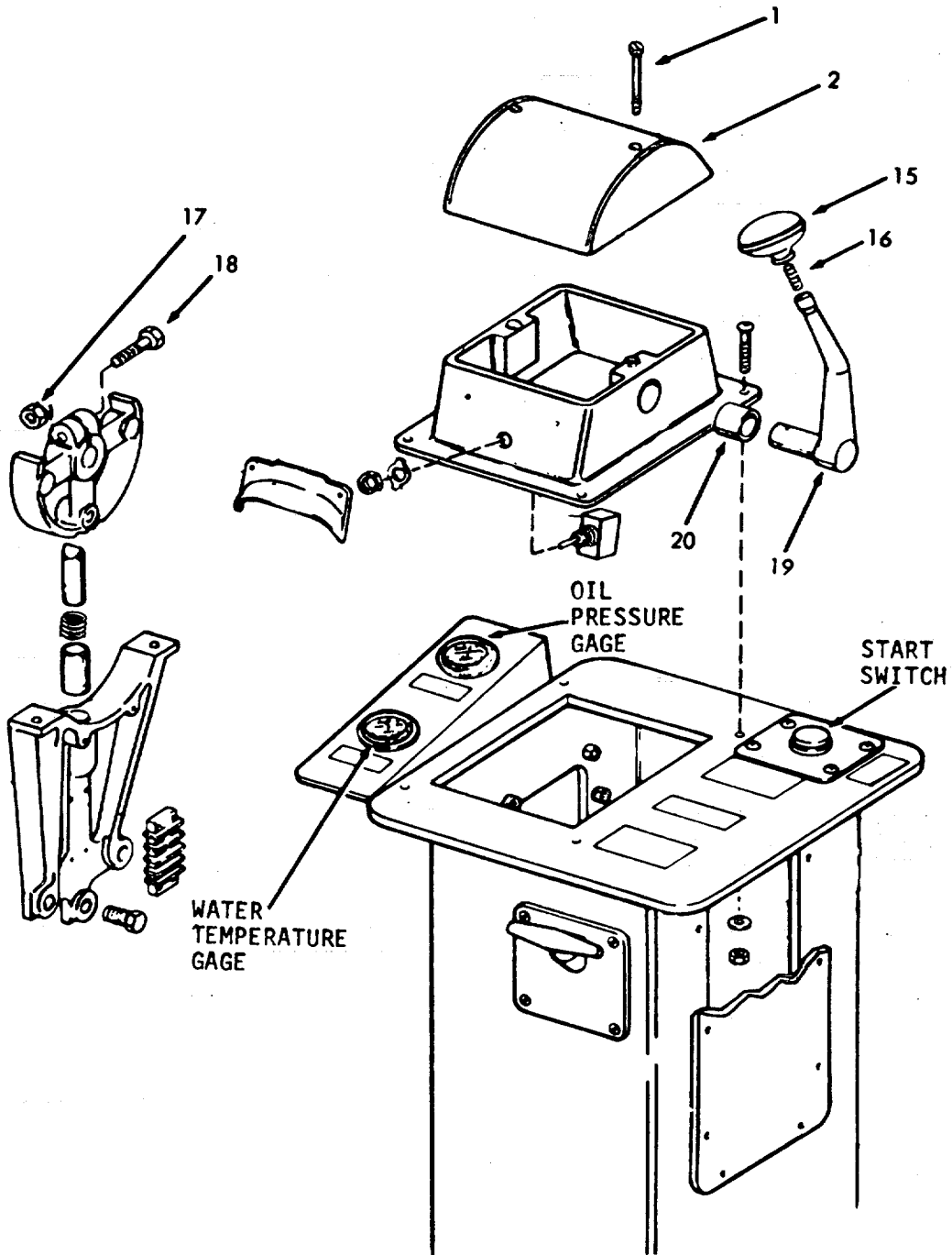
3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - CONTROL STATION			
10. Control station	a. Screw (1)	Remove.	
	b. Cover (2)	Remove.	
11. Control Lever	a. Knob (15)	Remove if required.	
	b. Stud (16)	Remove if required.	
	c. Nut (17), and screw (18)	Loosen.	
	d. Handle (19), and bushing (20)	Remove.	
	e. Handle (19), and bushing (20)	Install.	
	f. Nut (17), and screw (18)	Tighten.	
	g. Stud (16), and knob (15)	Reassemble.	

3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR - CONTROL STATION (Cont)			
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3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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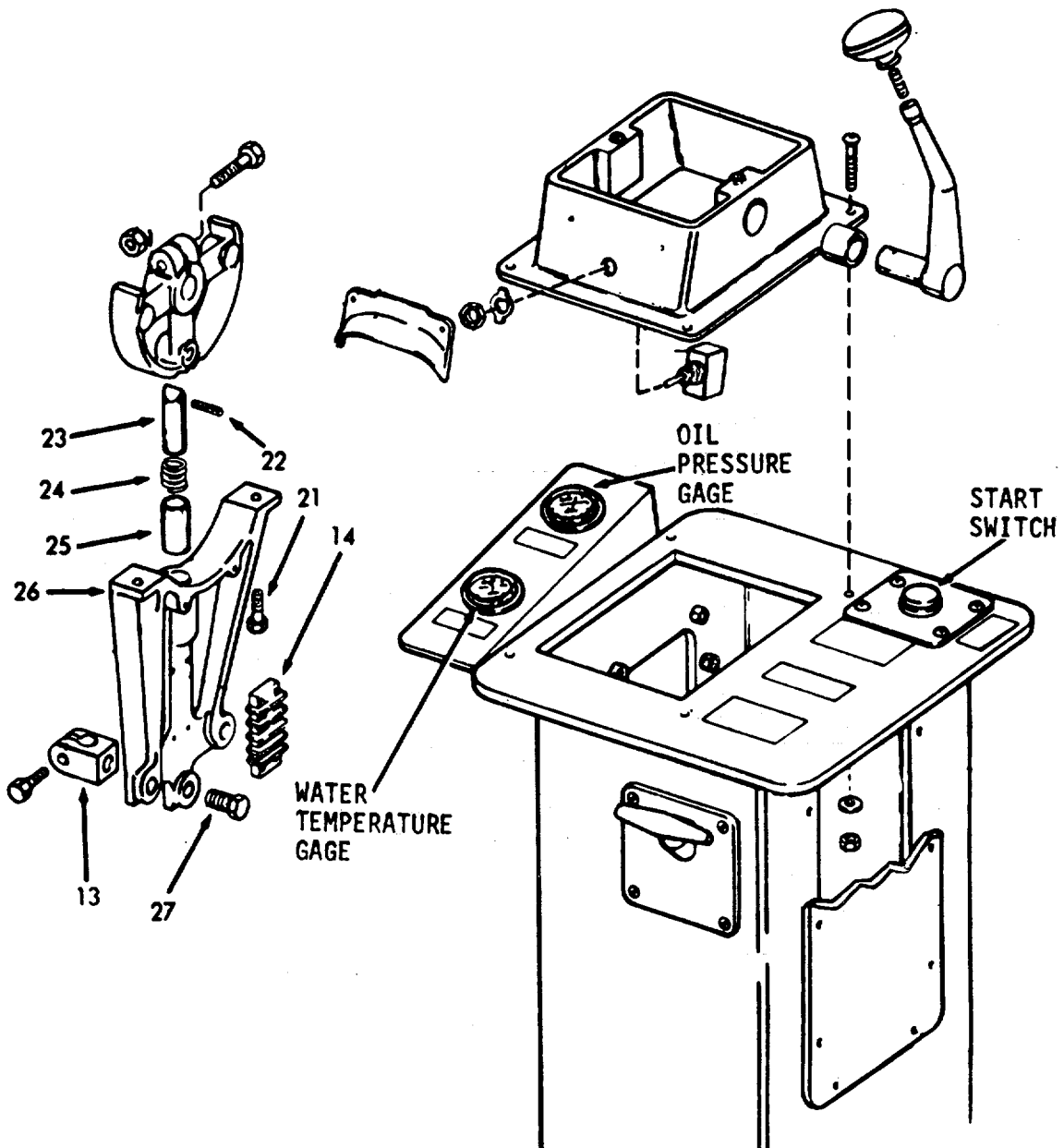
REPAIR - CONTROL STATION (Cont)

- | | | | |
|-------------------|---|-----------------------------------|--|
| 12. Cable Bracket | a. Wiring to terminal strip (14) | Tag and disconnect. | |
| | b. Screws (21) | Remove. | |
| | c. Guide pin (22), detent plunger (23), spring (24), bushing (25), and cable bracket (26) | Remove. | |
| | d. Screw (27), and cable clamp (13) | Remove. | |
| | e. Cable clamp (13), and screw (27) | Reassemble to cable bracket (26). | |

3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR - CONTROL STATION (Cont)			
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3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

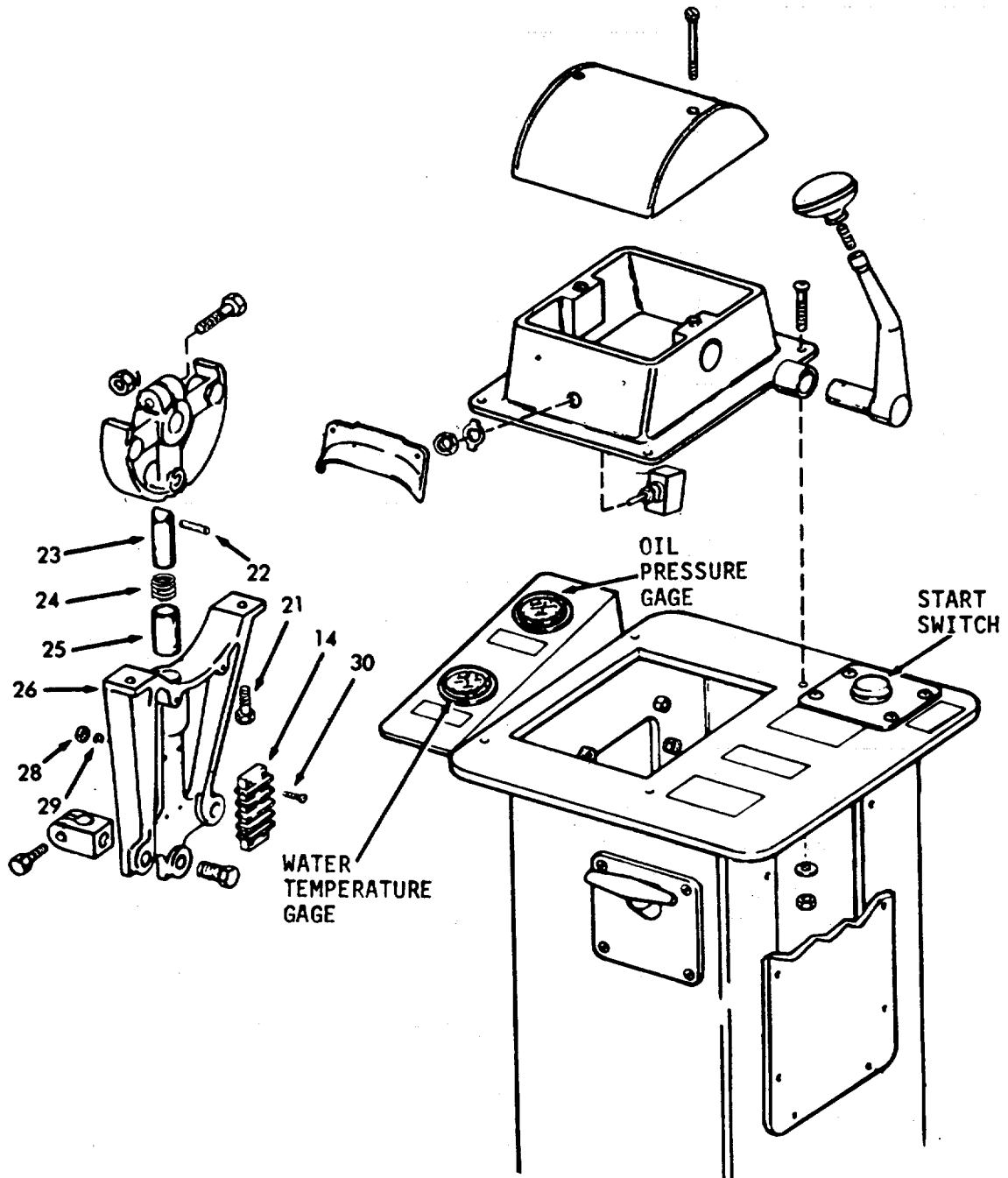
LOCATION	ITEM	ACTION	REMARKS
REPAIR - CONTROL STATION (Cont)			
13. Terminal strip	f. Bushing (25), spring (24), detent plunger (23), and guide pin (22)	Install in cable bracket (26).	
	g. Cable bracket (26), and screws (21)	Install.	
	h. Wiring	Reconnect.	
	a. Wiring	Tag and disconnect.	
	b. Nuts (28), lock - washers (29), and screws (30)		
	c. Terminal strip (14)	Replace.	
	d. Screws (30), lock-washers (29), and (28)	Install.	

3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR - CONTROL STATION (Cont)			
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e. Wiring	Reconnect		
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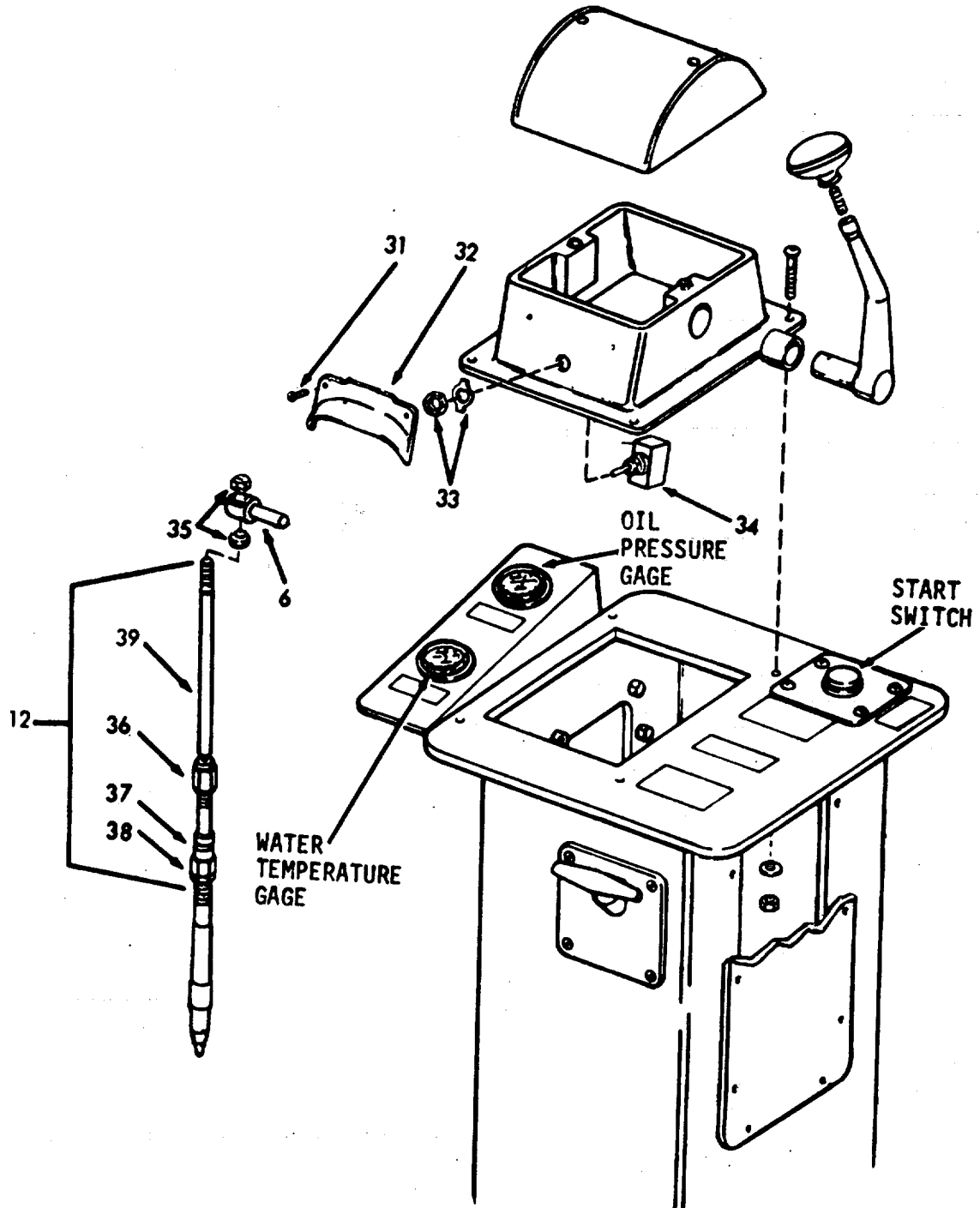
3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - CONTROL STATION (Cont)			
14. Main line switch	a. Wiring	Disconnect.	
	b. Screws (31), and switch cover (32)	Remove.	
	c. Nut and plate (33), and switch (34)	Replace.	
	d. Switch cover (32), and screws (31)	Install.	
	e. Wiring	Reconnect.	
15. Articulator assembly	a. Nuts (35), and swivel joint (6)	Loosen and remove.	
	b. Nuts (36), bushing (37), and nuts (38)	Remove from socket and rod assembly (39).	

3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR - CONTROL STATION (Cont)



3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR - CONTROL STATION (Cont)			
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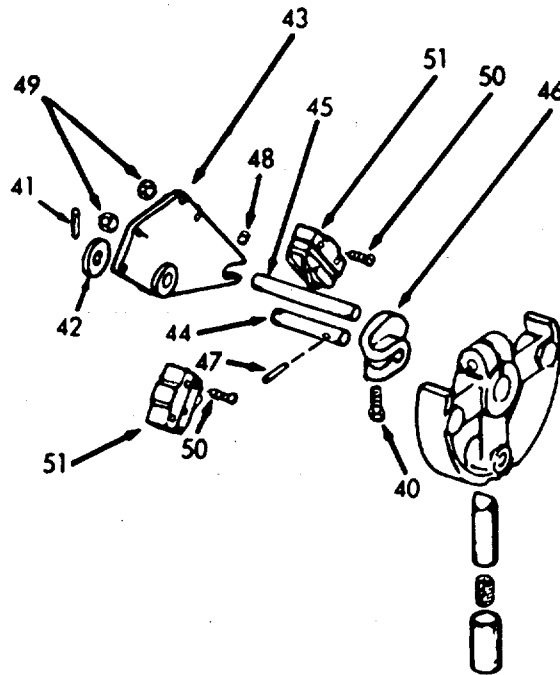
- | | | | |
|-----|-----------------------------|---|---------------------------|
| 16. | Switch
Mounting
plate | a. Screws
(40) | Loosen. |
| | | b. Cotter
pin
(41),
and
washers
(42) | Remove. |
| | | c. Plate
(43),
camshaft
(44),
switch
shaft
(45),
cam
(46),
pin
(47),
and
setscrew
(48) | Disassemble. |
| | | d. Nuts
(49),
screws
(50),
and
switches
(51) | Disassemble. |
| | | e. Switches
(51),
screws
(50),
and
nuts
(49) | Reassemble to plate (43). |

3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR - CONTROL STATION (Cont)

- | | | | |
|----|---|-------------|--|
| f. | Plate (43), camshaft (44), switch shaft (45), cam (46), pin (47), and setscrew (48) | Reassemble. | |
| g. | Washer (42), and cotter pin (41) | Install. | |
| h. | Screws (40) | Tighten. | |



3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR - CONTROL STATION (Cont)			
17. Gages	a. Wiring	Tag and disconnect.	
	b. Bracket and gage	Remove.	
18. Start switch	a. Wiring	Tag and disconnect.	
	b. Screws, switch	Remove.	

ADJUSTMENTS

NOTE

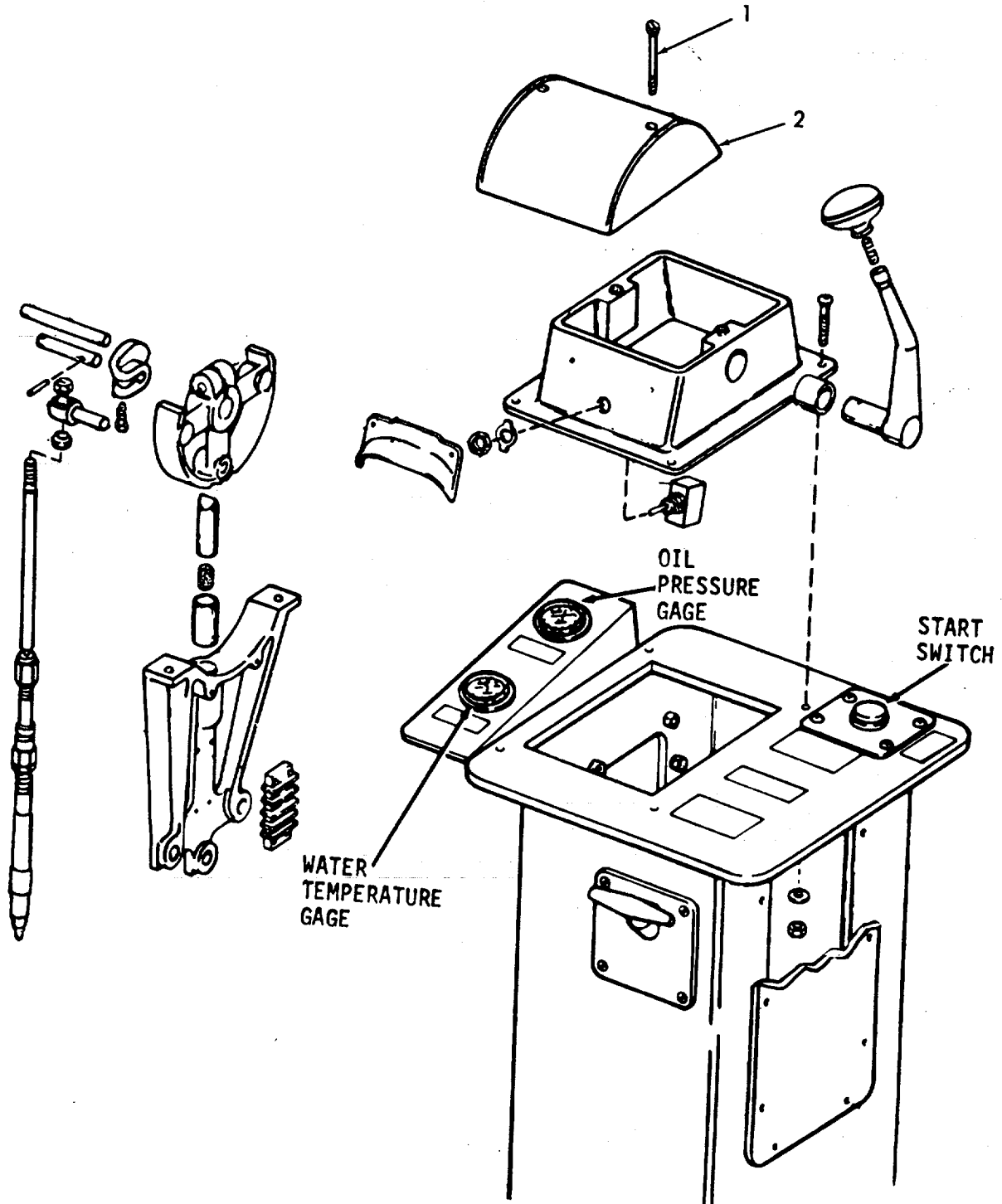
These adjustments to the control station, cables and control unit must be done when any of these components are repaired.

19. Throttle and clutch	a. Screw (1)	Remove.	
	b. Cover (2)	Remove.	
	c. Clutch and throttle lever	Place in mid-position.	

3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENTS (Cont)



3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
ADJUSTMENTS (Cont)			
20. Anchor winch compartment	Control unit	a. Observe position of control lever.	Should be on center line of lever fulcrums.
		b. Adjust as required between control station and control unit.	This is the clutch neutral position.
		c. Observe the position of the engine control lever.	Should be at 90° to center line of lever fulcrum.
		d. Adjust position of engine control lever on control unit shaft.	
		e. Observe the position of the engine control lever to lever on engine.	Should be at 90 to center line of lever fulcrum.

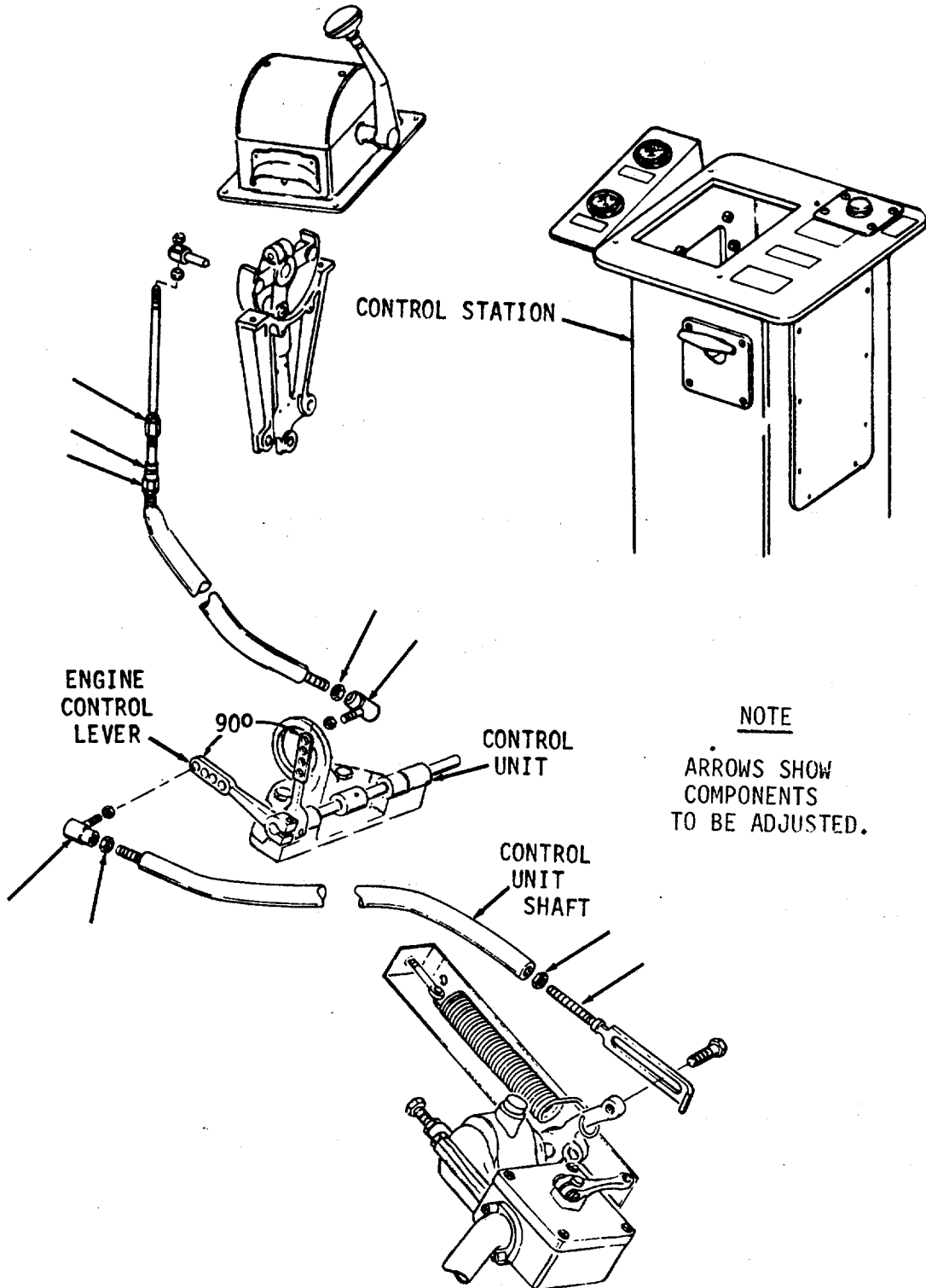
NOTE

At the mid-position of the cable, stroke the lever at the control station, the clutch and throttle levers on the engine. The manual control lever on the control unit must be in the mid position.

3-141.1. ENGINE CLUTCH AND THROTTLE CONTROLS - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

ADJUSTMENTS (Cont)



3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS.

The engine throttle provides a means of varying the stroke of the control cable to suit the stroke requirements of the lever being operated. This is accomplished by changing the length of the engine control lever. This lever is connected to the throttle lever or clutch lever on the engine by means of a connecting rod and ball joints.

NOTE

If a control cable is to be replaced, order by stock number and cable length.

This task covers:

- | | | |
|------------------------|-----------------|----------------|
| a. Inspection | c. Removal | e. Disassembly |
| b. Test and Adjustment | d. Installation | f. Reassembly |

INITIAL SETUP

Test Equipment

None

References

Paragraph

3-141.1

Control Station
Adjustments

Special Tools

None

Equipment

Condition Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

2

General Safety Instructions

None

3-2401

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

1. Control station	Inhaul/payout clutch/throttle	<ol style="list-style-type: none"> 1. Place in inhaul and payout positions. 2. Place in idle and full speed positions. 	Check for ease of operation, broken, frayed coverings and damaged control cables or control unit.
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TEST AND ADJUSTMENT

NOTE

Refer to paragraph 3-141.1 for test and adjustment procedures.

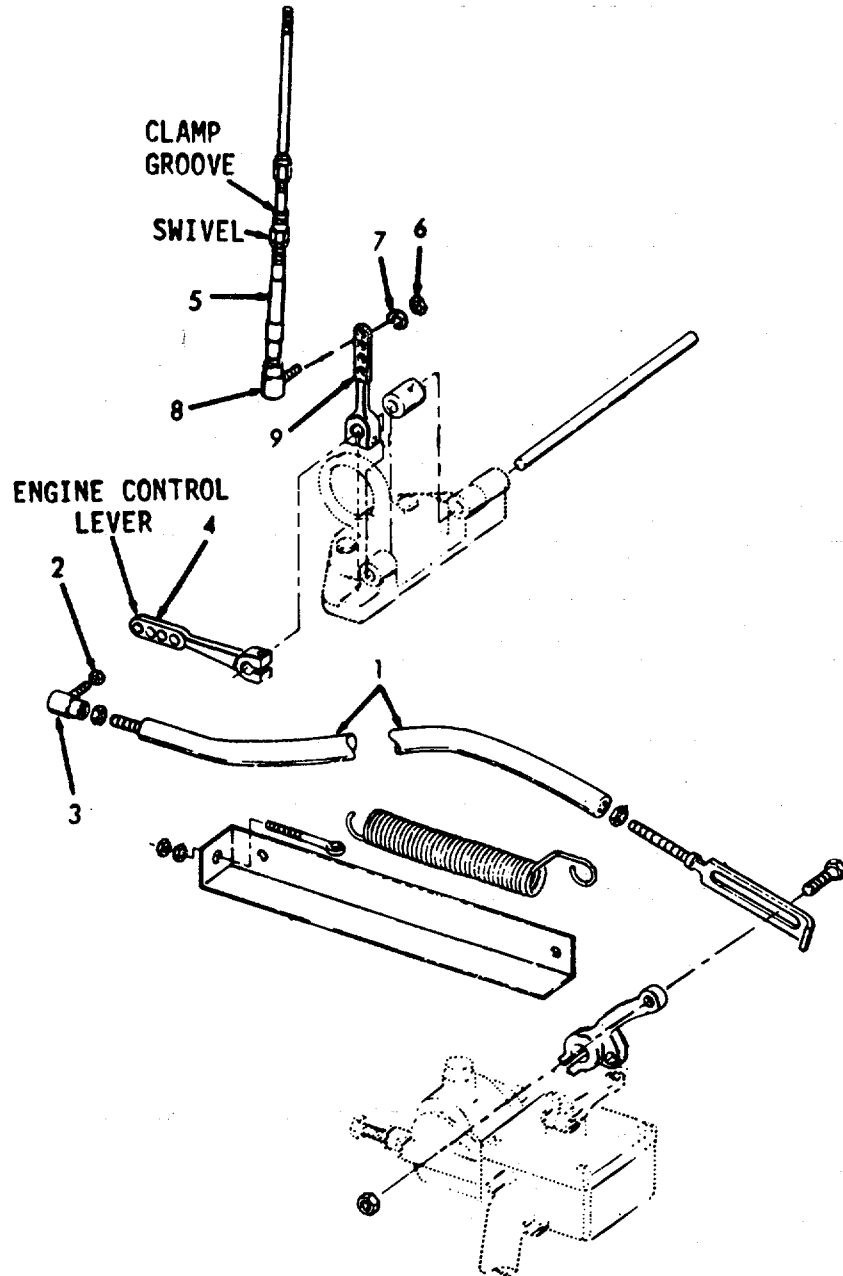
REMOVAL - CONTROL UNIT

2. Connecting rod assembly (1)	a. Nut (2)	Remove.	
	b. Ball joint (3)	Remove from engine control lever (4).	
3. Articulator assembly (5)	a. Nut (6), and lock-washer (7)	Remove.	
	b. Ball joint (8)	Remove from control lever (9).	
4. Control unit	Bolts and lock-washers	Remove.	Refer to paragraph 3-158.

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
 (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL - CONTROL UNIT (Cont)			
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3-2403

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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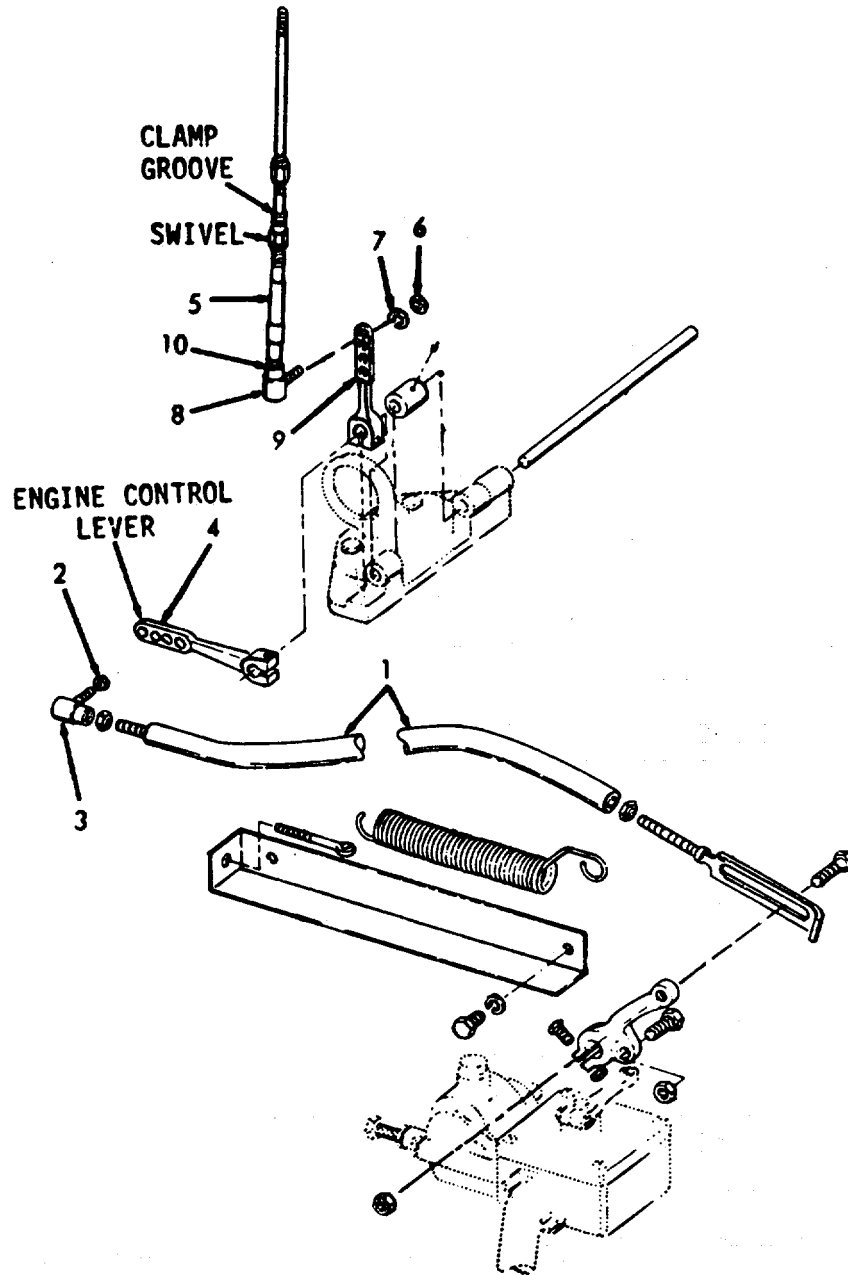
INSTALLATION - CONTROL UNIT

5.	Control unit	Control unit.	Install.	Refer to paragraph 3-158.
6.	Articulator assembly (5)	a. Ball joint (8)	Place in control lever (9).	
		b. Lock-washer (7), and nut (6)	Install.	
7.	Connecting rod assembly (1)	a. Ball joint (3)	Place in engine control lever (4).	
		b. Nut (2)	Install.	
8.	Control Cable	a. Nut (6), and lock-washer (7)	Remove.	
		b.. Articulator (5)	Remove from cable clamp.	
		c. Nut (10)	Loosen.	
		d. Ball joint (8)	Remove.	

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CONTROL UNIT (Cont)



3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CONTROL UNIT (Cont)

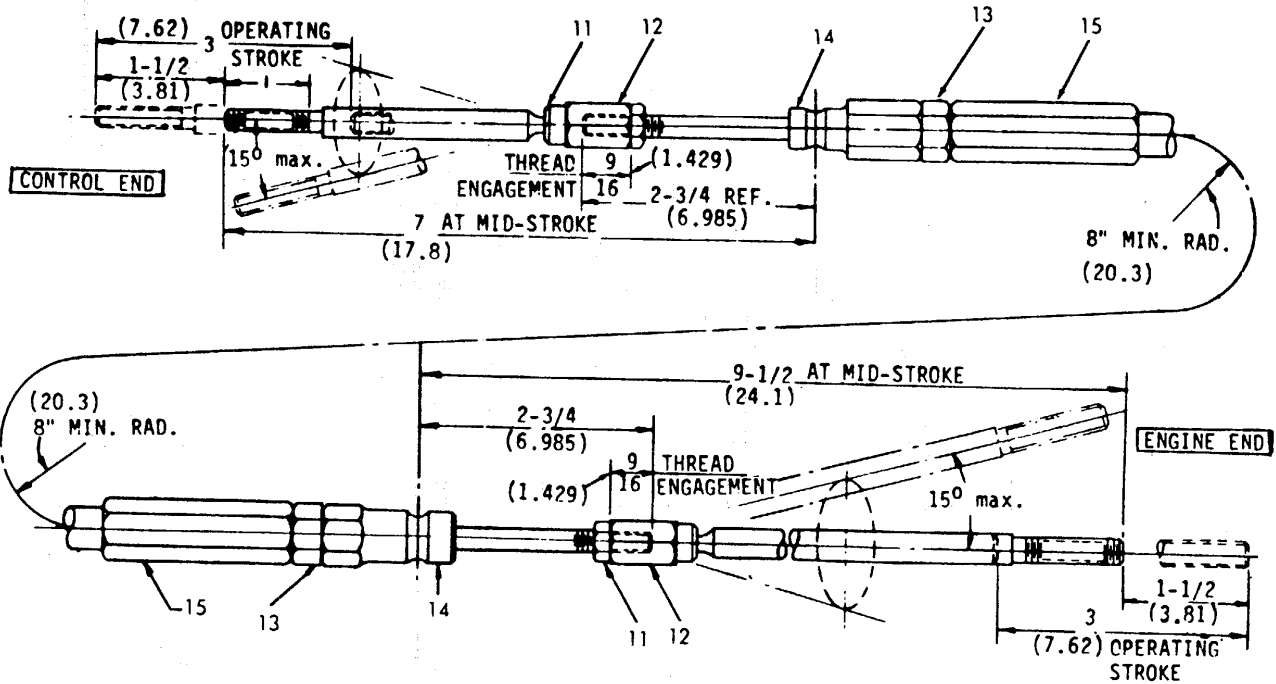
- | | | | |
|--|---|---------|-----------------------|
| | e. Nut
(11) | Loosen. | |
| | f. Rod
and
socket
assembly
(12) | Remove. | |
| | g. Nut
(11) | Remove. | From end of
cable. |
| | h. Nut
(13) | Loosen. | |
| | i. Cable
adaptor
bushing
(14) | Remove. | |
| | j. Nut
(13) | Remove. | From end of
cable. |
| | k. Cable
support
bushing
(15) | Remove. | |

3-2406

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION - CONTROL UNIT (Cont)



NOTE:

- 1- CONTROL CABLE SHOWN AT MID-STROKE POSITION.
- 2- ALL DIMENSIONS IN INCHES.
- 3- DIMENSIONS IN () ARE CENTIMETERS.

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS

(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION - CONTROL CABLE

NOTE

Control cables are precision equipment and should be handled with care. They should not be bent sharply, twisted, or forced into position. They should be allowed to adjust themselves to a given installation and worked into position rather than forced.

UNPACKING INSTRUCTIONS

The control cable is shipped in a figure 8 shape with sufficient number of layers to take care of its length. The whole package should be lifted out and laid on a smooth open surface. Cut the restraining ropes and, holding the top end, walk away from the package until the cable is straightened out. The cable should unfold smoothly and evenly. However, if a kink or loop develops, stop and uncoil this section.

When the control is out straight, lift one end up about 4 feet and walk along handing the cable through your hands, keeping it about 4 feet off the deck, until the other end is reached. This removes internal twists and gives the cable full flexibility.

INSTALLATION INSTRUCTIONS

Never force cable into any position. Let it take its natural shape by shaking it gently before and during operation. Be sure not to bend flexible parts of cable where it joins the rigid end fitting. Allow an inch or more to remain straight before starting bend. When installing articulator fittings, DO NOT twist end rod.

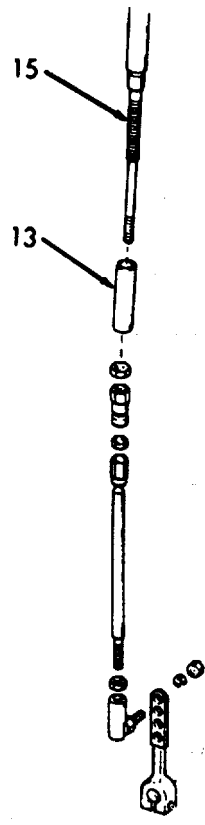
3-2408

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CONTROL CABLE (Cont)

- | | | | |
|-----------------|-------------------------------|----------|-----------------|
| 9. Control unit | a. Cable support bushing (15) | Install. | |
| | b. Nut (13) | Install. | Do not tighten. |



3-2409

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS - -
 (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CONTROL CABLE (Cont)			
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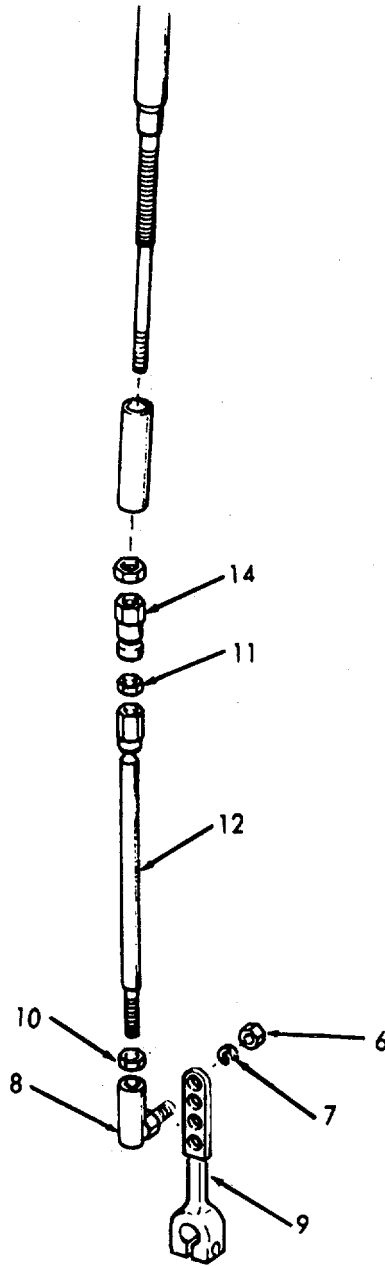
- | | | | |
|--|---------------------------------|---|-----------------|
| | c. Cable adaptor bushing (14) | Install. | |
| | d. Nut (11) | Install. | Do not tighten. |
| | e. Rod and socket assembly (12) | Install. | |
| | f. Nut (10) | Install. | Do not tighten. |
| | g. Ball joint (8) | Install on cable. Then place in remote control lever (9). | Do not tighten. |
| | h. Nut (6) and lock-washer (7) | Install. | |

3-2410

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
 (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CONTROL CABLE (Cont)



3-2411

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

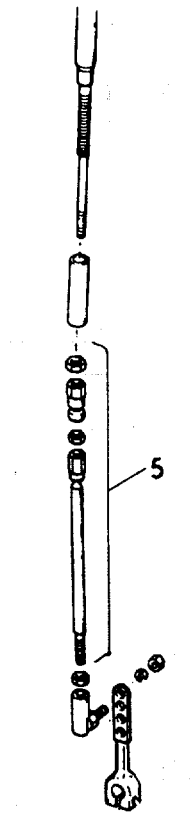
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CONTROL CABLE (Cont)

10. Articulator assembly	Articulator assembly (5)	Adjust, and then install in cable clamp.	Tighten nuts when adjusted.
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NOTE

Adjust control cables as per paragraph 3-141.1 and tighten all connections.



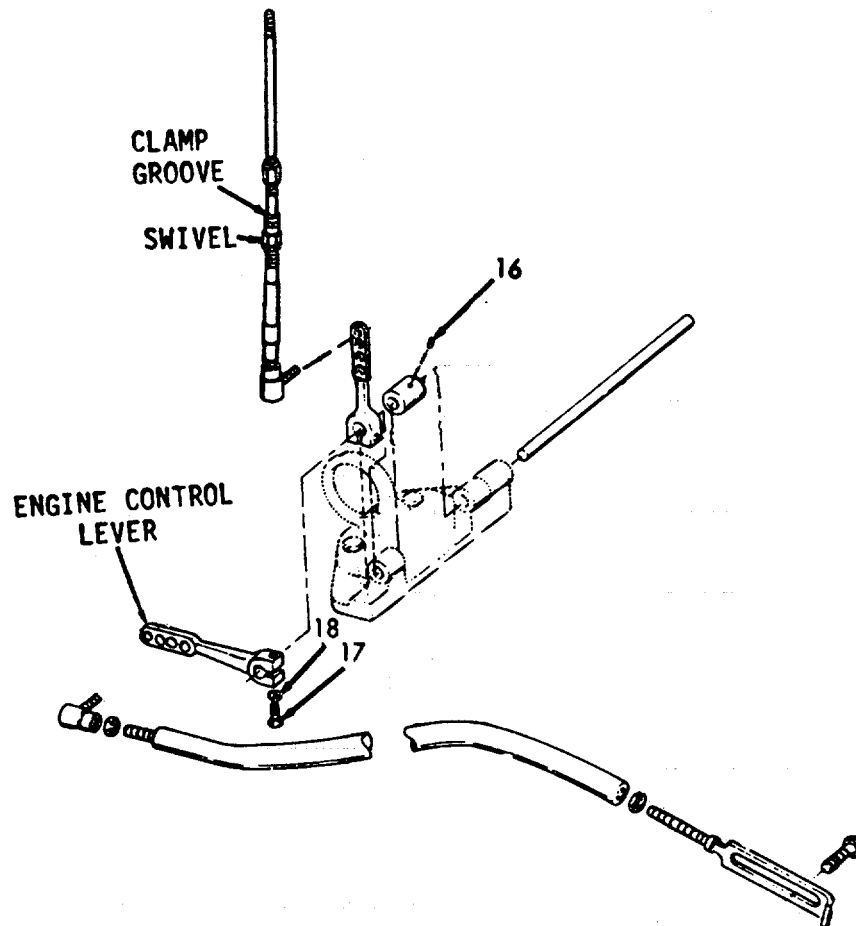
3-2412

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY

- | | | |
|------------------|-------------------------------------|--------------------------------|
| 11. Control unit | a. Control unit | Perform the removal procedure. |
| | b. Setscrew (16) | Loosen. |
| | c. Screw (17), and lock-washer (18) | Loosen. |



3-2413

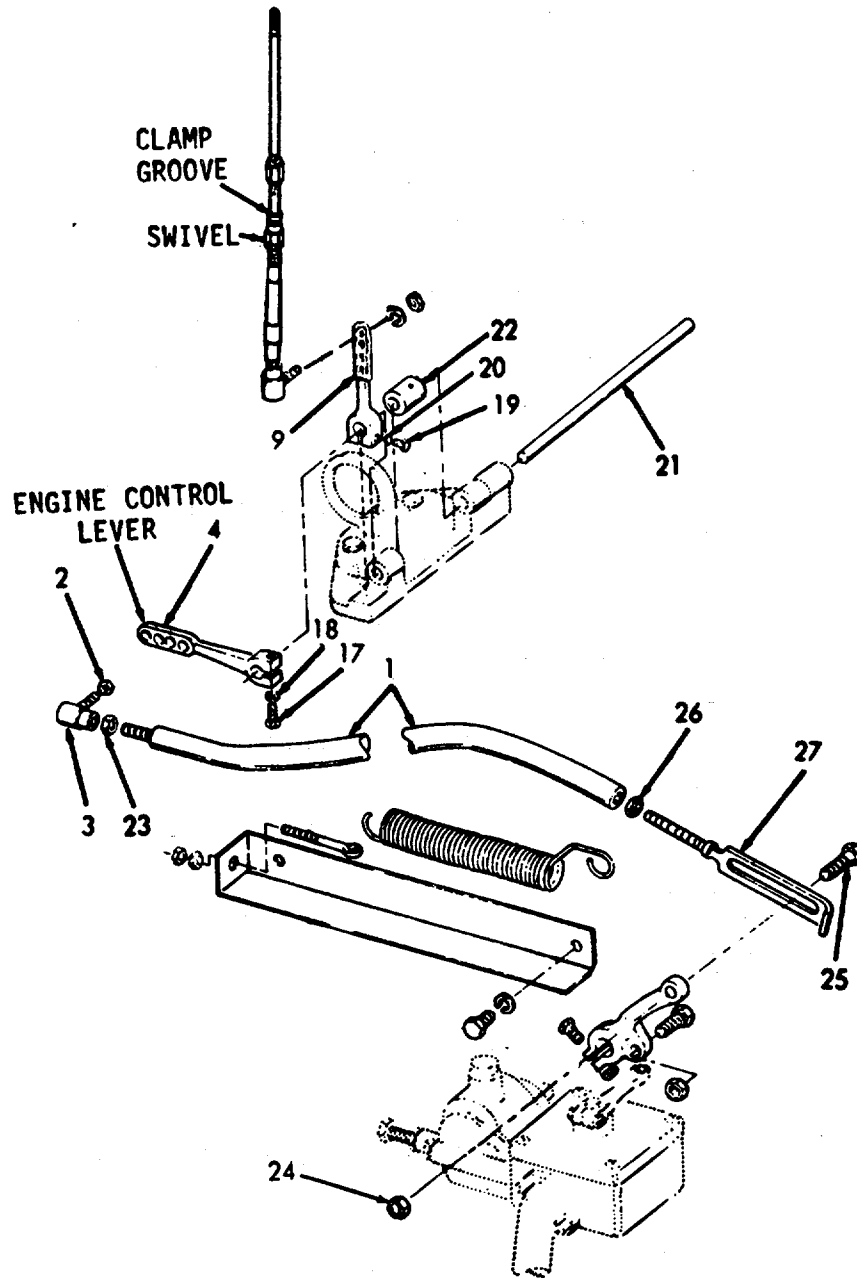
3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			
	d. Screw (19), and lock-washer (20)	Loosen.	
	e. Engine control lever (4)	Remove.	
	f. Control unit Shaft (21)	Remove.	Use drift pin and hammer. Control lever (9) and collar (22) will come apart.
12. Throttle	a. Nut (2) control shaft	Remove.	
	b. Nut (23)	Loosen.	
	c. Ball joint (3)	Remove.	
	d. Nut (24), and bolt (25)	Remove.	
	e. Nut (26)	Loosen.	
	f. Link (27), and shaft (1)	Disassemble.	

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)



3-2415

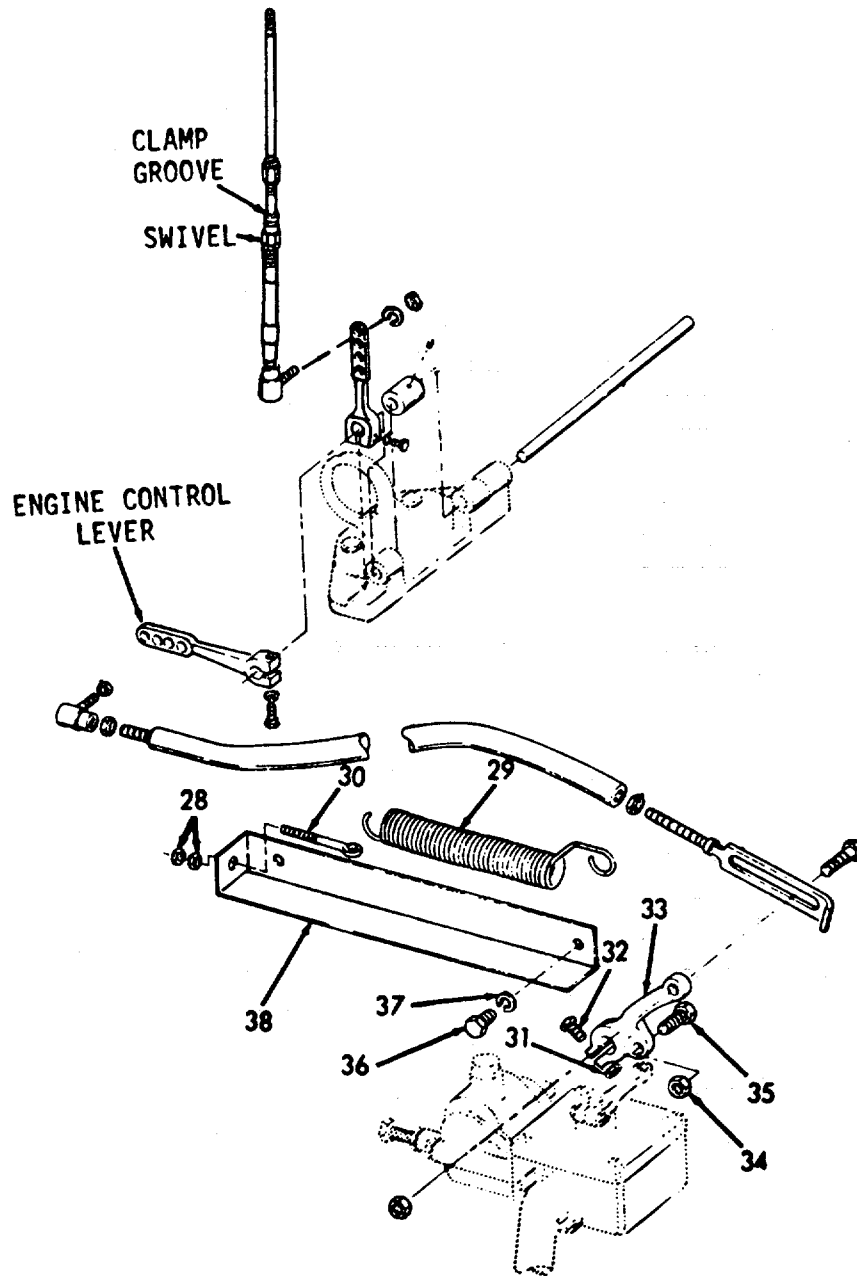
3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			
13. Governor control	a. Nut (28)	Loosen and remove.	Tension on spring will be reduced.
	b. Spring (29), and adjusting eye (30)	Disconnect and remove.	
	c. Nut (31), and screw (32)	Loosen.	
	d. Control lever (33)	Remove.	
	e. Nut (34), and bolt (35)	Remove if necessary.	
14. Spring bracket	Screws (36), lock-washers (37), and bracket (38)	Remove.	If necessary.

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)



3-2417

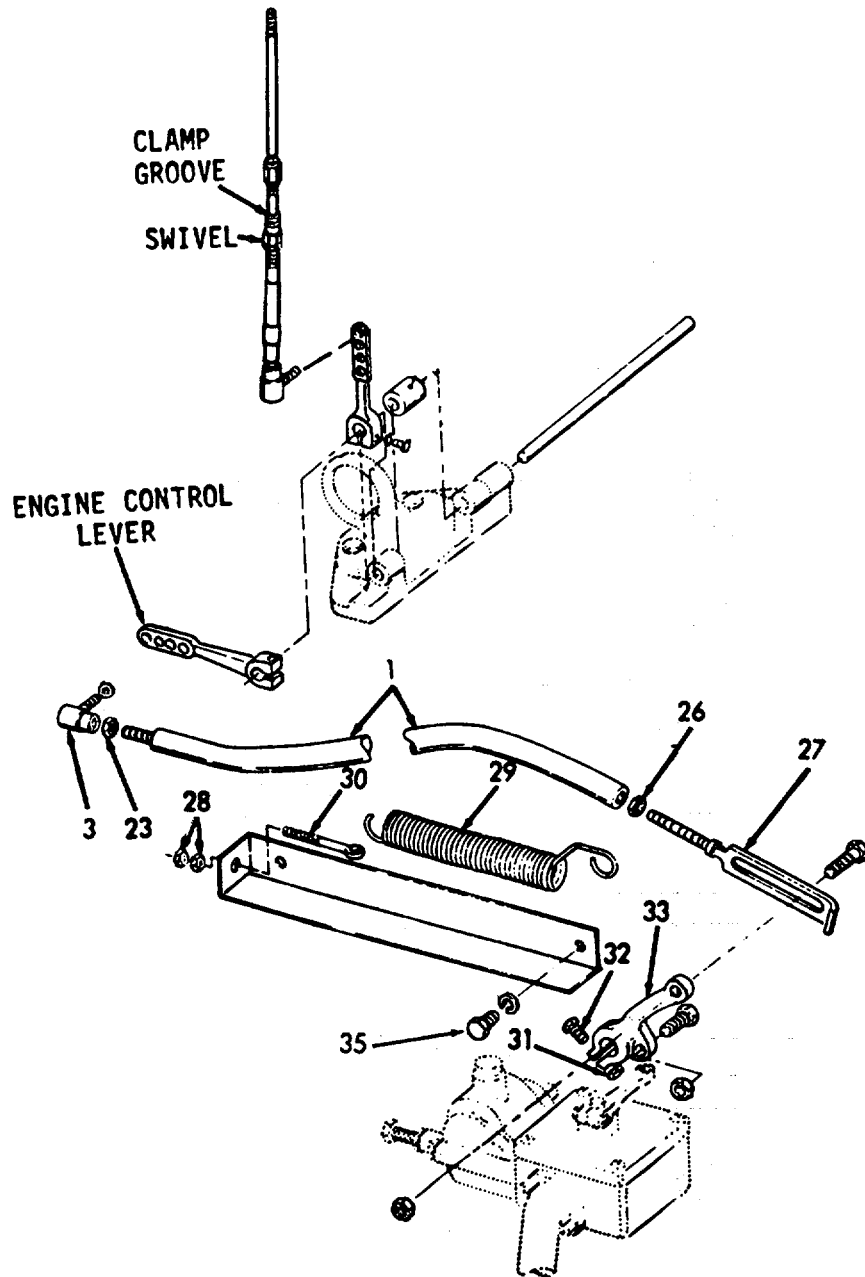
3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY			
15. Governor control lever	a. Control lever (33)	Install.	
	b. Screw (32), and nut (31)	Tighten.	
	c. Spring (29), adjusting eye (30), and nuts (28)	Attach one end of spring to bolt (35), and the other end to the adjusting eye (30). Install nuts (28) and adjust.	
16. Throttle Control shaft.	a. Nut (26), link (27), and shaft (1)	Reassemble.	
	b. Nut (23), shaft (1), and ball joint (3)	Reassemble.	

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY Cont



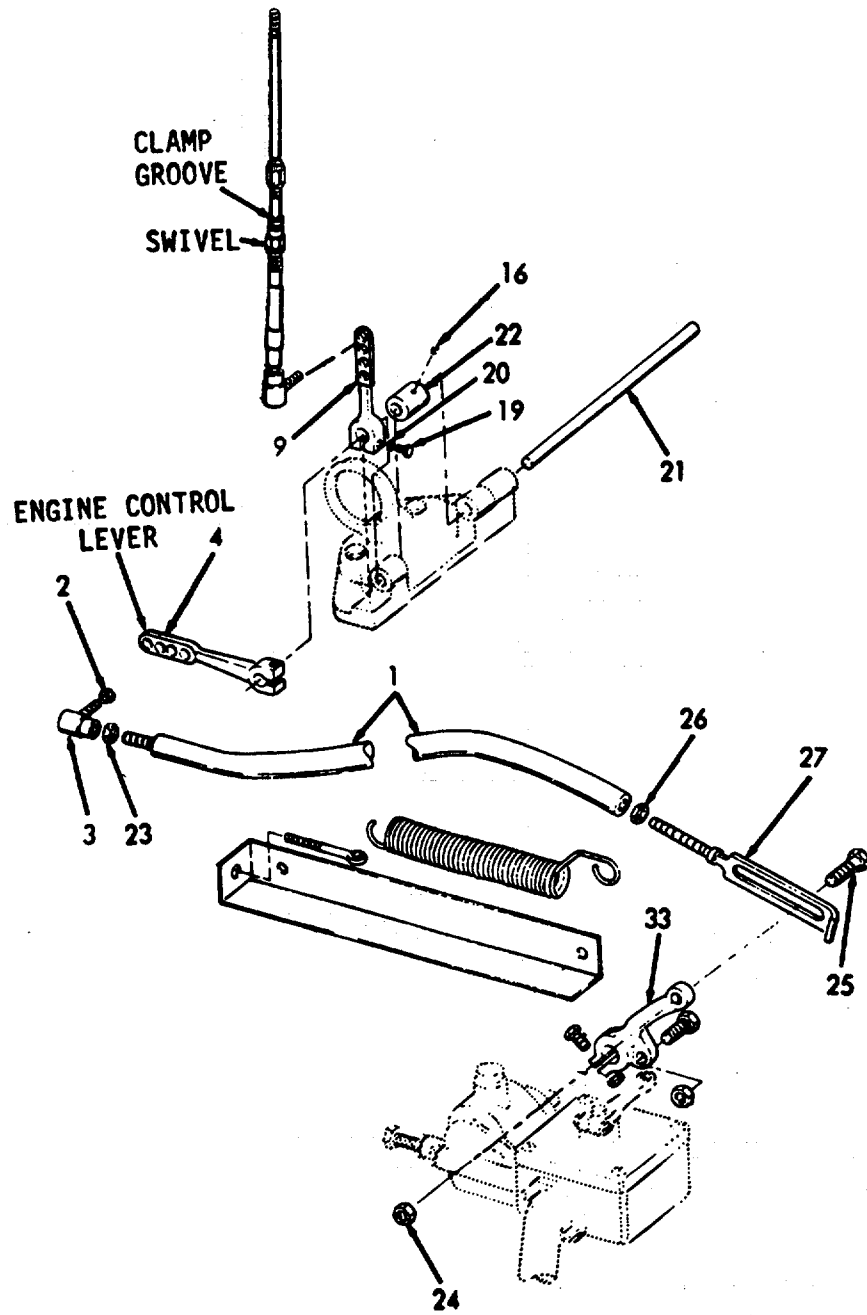
3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)]			
17. Control Unit	c. Link (27), screw (25), and nut (24)	Reassemble to manual control lever (33).	
	d. Ball joint (3), engine control lever (4), and nut (2)	Reassemble.	
	e. Shaft (1)	Readjust and tighten nuts (23 and 26).	
	a. Control lever (9), collar (22), and control unit shaft (21)	Reassemble.	
	b. Set-screw (16)	Tighten.	
	c. Screw (19), and lock-washer (20)	Tighten.	

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
 (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)



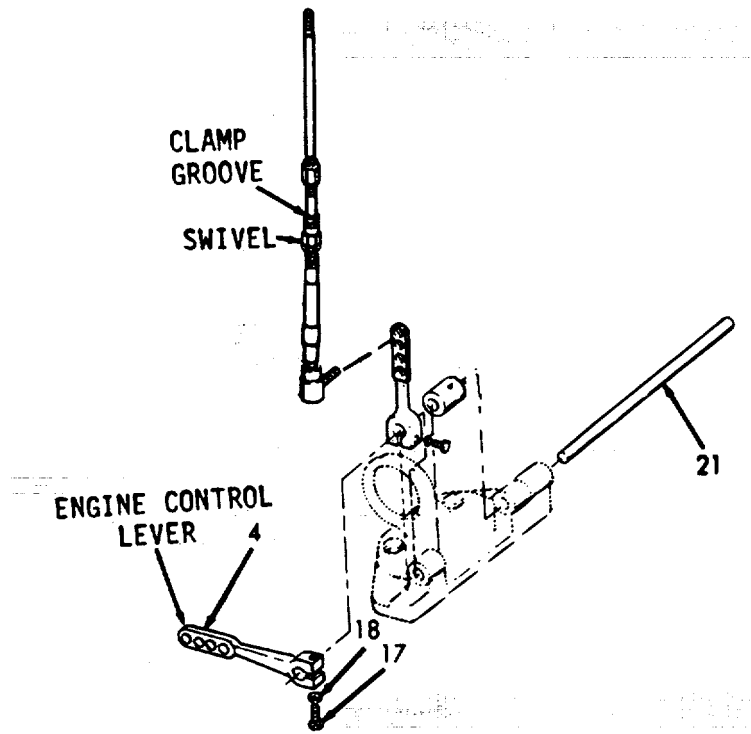
3-2421

3-141.2. ENGINE THROTTLE LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY (Cont)

- | | | | |
|----|----------------------------------|-------------------------------|--|
| d. | Engine control lever (4) | Install on end of shaft (21). | |
| e. | Screw (17), and lock-washer (18) | Tighten. | |



3-2422

3-141.3. STOP CABLE AND LINKAGE - MAINTENANCE INSTRUCTIONS.

a. A manually operated engine shutdown device enables the engine operator to stop the engine. The shutdown device will stop the engine by cutting off the air supply. The shutdown device consists of a flap valve mounted in the air inlet housing and a suitable operating mechanism.

b. When the handle is pulled sufficiently to stop the engine, a spring-loaded plunger prevents the handle from being returned to the RUN position. It is necessary to pull the plunger manually before the shutdown control can be returned to the RUN position.

NOTE

If a control cable is to be replaced, order by stock number and cable length.

This task covers:

- | | | | |
|----|------------|----|--------------|
| a. | Inspection | c. | Removal |
| b. | Service | d. | Installation |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment
<u>Condition</u> <u>Condition Description</u>

None

Material/Parts

Lubricating oil
MIL-L-2104 Type OE/HDO-10

Special Environmental Conditions

None

Personnel Required

2

General Safety Instructions

None

3-2423

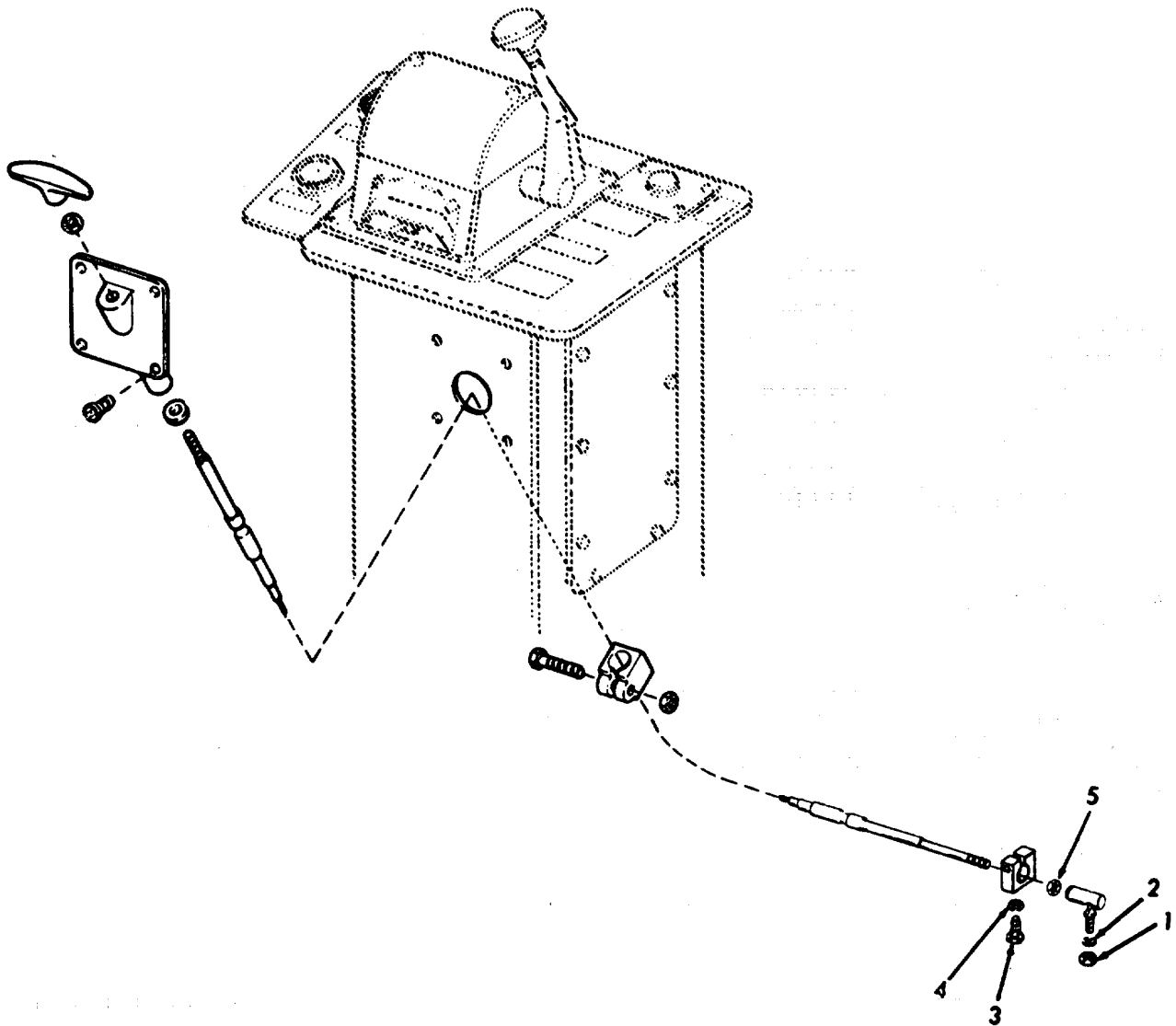
3-141.3. STOP CABLE-AND LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION			
1. Shutdown linkage	Cables	Inspect for binding, damage, and loose components.	Lubricate if binding, tighten if loose, or replace if required.
	Ball joints	Inspect for binding, damage, and loose connections.	Tighten if loose, or replace if required.
SERVICE			
2. Shutdown linkage	a. Cables	Lubricate.	Use oil type OE/HDO-10.
	b. Ball joint	Lubricate.	Use oil type OE/HDO-10.
REMOVAL			
3. Shutdown linkage and cable	a. Nut (1), and lock-washer (2)	Remove.	
	b. Cap-screw (3), and lock-washer (4)	Remove.	
	c. Nut (5)	Loosen.	

3-141.3. STOP CABLE-AND LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)



3-141.3. STOP CABLE-AND LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	d. Ball joint (6)	Remove.	
	e. Nut (5)	Remove.	
	f. Cap-screw (7)	Remove.	
	g. Cable clamp (8)	Remove.	
	h. Handle (9)	Unscrew to remove.	Do not remove nut (10).;
	i. Screws (11)	Remove.	Raise tube and bracket assembly (12) up to gain access to continue dis-assembly.
	j. Nut (13)	Remove.	
	k. Cap-screw (14)	Remove.	Cable clamp (15) will be loose, causing cable to drop down.
	l. Nut (10)	Remove.	
	m. Guide bushing (16)	Remove.	Push tube and bracket assembly (12) down while holding-cable. Guide bushing (16) will come out top of tube and bracket assembly.

3-141.3. STOP CABLE-AND LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

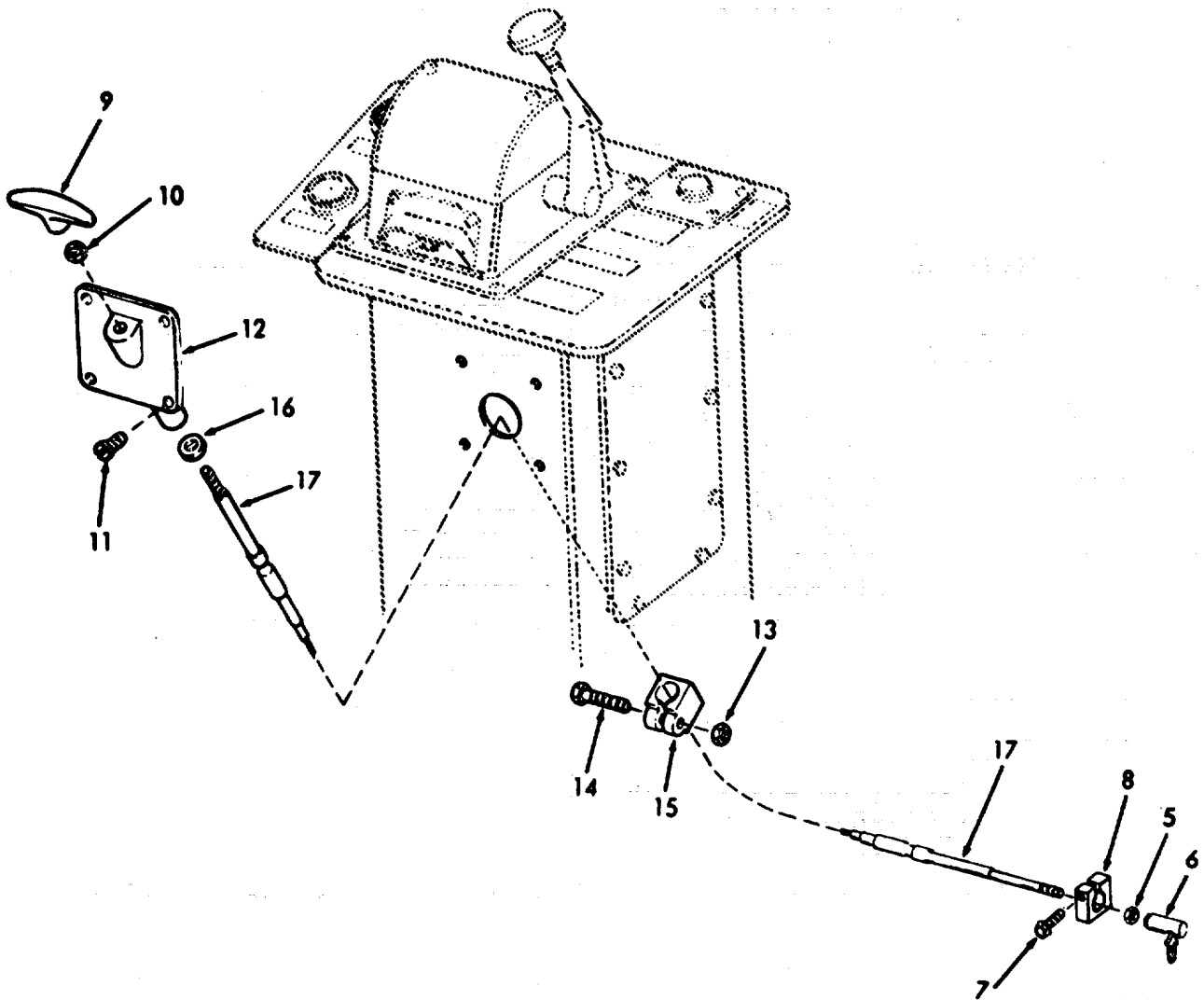
n. Cable clamp (15)

Remove.

o. Cable (17)

Remove.

Pull cable up to remove.



3-141.3. STOP CABLE-AND LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION

NOTE

Control cables are precision equipment and should be handled with care. They should not be bent sharply, twisted, or forced into position. They should be allowed to adjust themselves to a given installation and worked into position rather than forced.

UNPACKING INSTRUCTIONS

The control cable is shipped in a figure 8 shape with sufficient number of layers to take care of its length. The whole package should be lifted out and laid on a smooth open surface. Cut the restraining ropes and, holding the top end, walk away from the package until the cable is straightened out. The cable should unfold smoothly and evenly. However, if a kink or loop develops, stop and uncoil this section.

When the control is out straight, lift one end up about 4 feet and walk along, handing the cable through your hands, keeping it about 4 feet off the deck, until the other end is reached. This removes internal twists and gives the cable full flexibility.

INSTALLATION INSTRUCTIONS

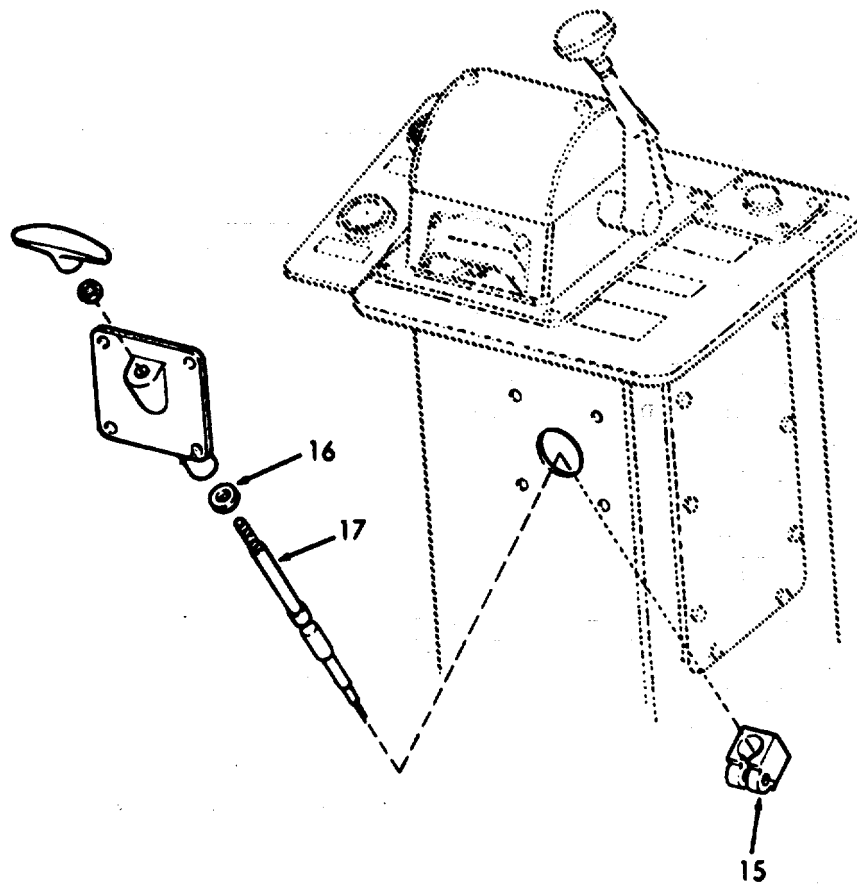
Never force cable into any position. Let it take its natural shape by shaking it gently before and during operation. Be sure not to bend flexible parts of cable where it joins the rigid end fitting. Allow an inch or more to remain straight before starting bend. When installing articulator fittings, DO NOT twist end rod.

3-141.3. STOP CABLE-AND LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- | | | |
|-------------------------------|-----------------------|--------------------------|
| 4. Shutdown cable and linkage | a. Guide bushing (16) | Install. |
| | b. Cable (17) | Install. |
| | c. Cable clamp (15) | Slide over end of cable. |



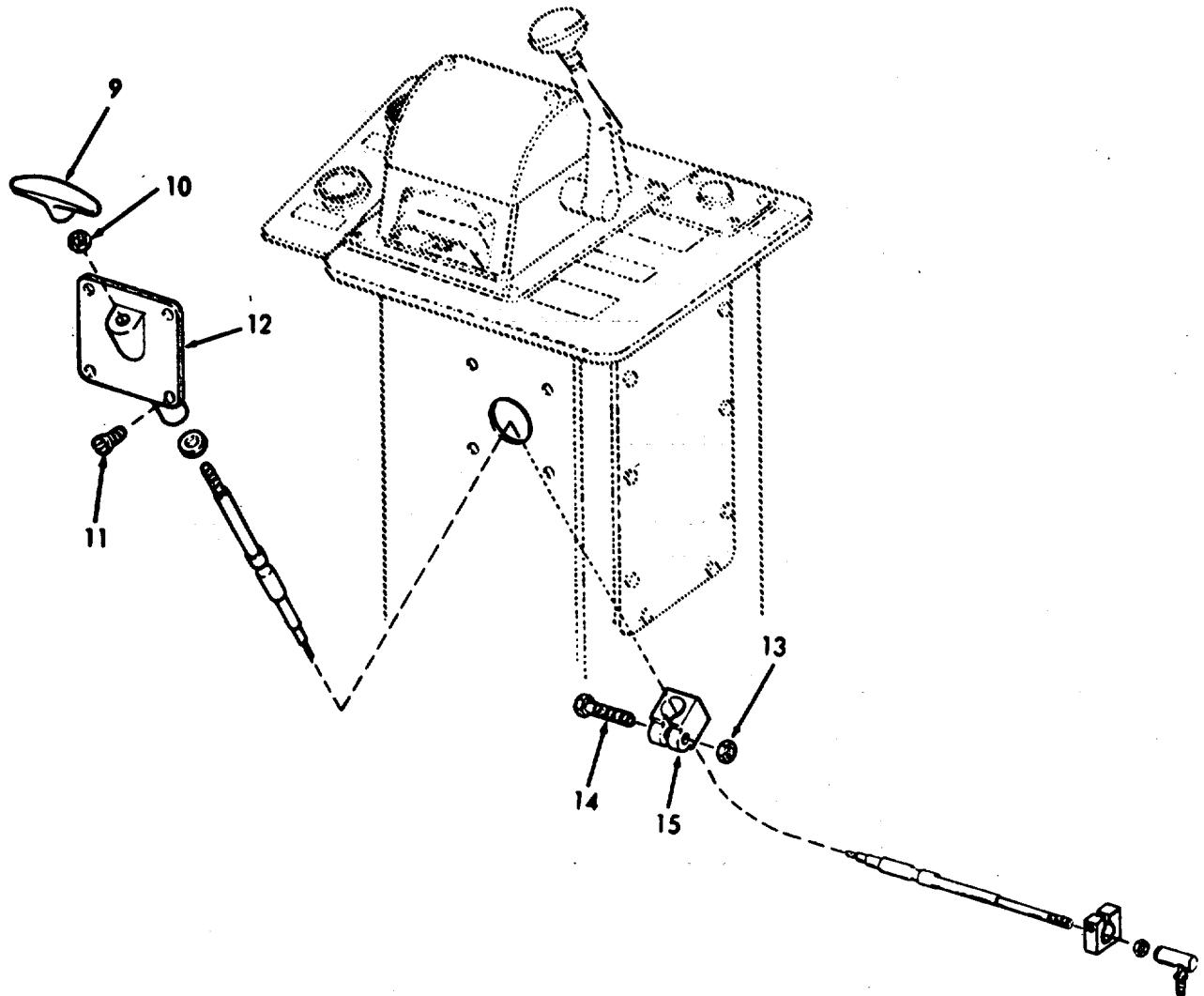
3-141.3. STOP CABLE-AND LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
	d. Capscrew (14), and nut (13)	Insert in cable clamp (15).	Tighten nut (13) finger tight.
	e. Tube and bracket assembly (12)	Slide over end of cable.	
	f. Nut (10)	Install.	
	g. Capscrew (11)	Install tube and bracket assembly (12).	
	h. Cable clamp (15)	Position so that notch on cable is in clamp.	
	i. Cap-screw (14), and nut (13)	Tighten.	
	j. Handle (9)	Install.	
	k. Nut (10), and handle (9)	Secure.	

3-141.3. STOP CABLE-AND LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



3-2431

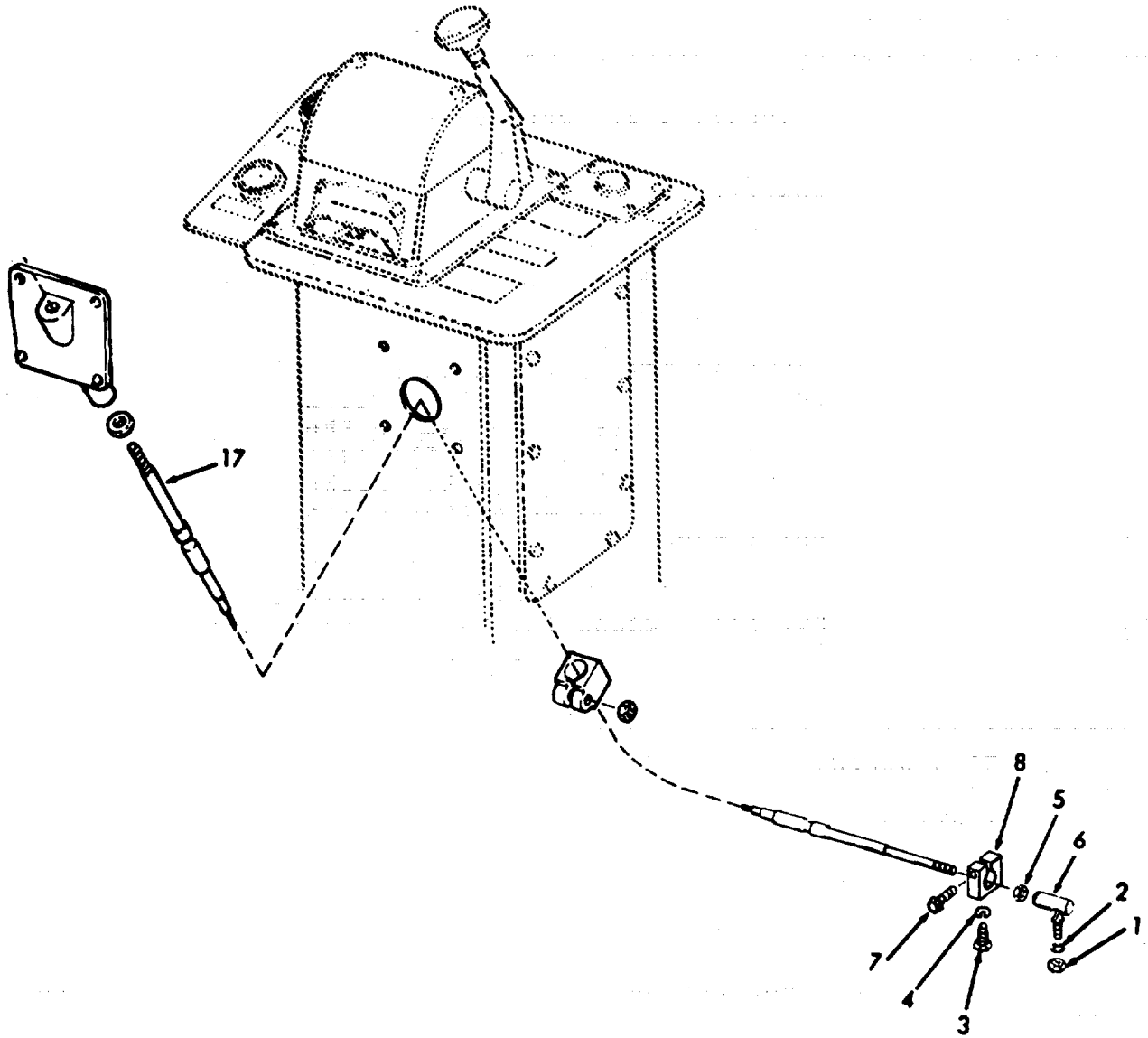
3-141.3. STOP CABLE-AND LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
	l. Cable clamp (8)	Install on cable (17).	
	m. Cap-screw (7)	Install in cable clamp (8) and secure.	
	n. Nut (5)	Install on cable (17).	
	o. Ball joint (6)	Install on cable (17).	
	p. Nut (5)	Jam against ball joint (6).	
	q. Ball joint (6)	Install in air intake latch.	
	r. Lock-washer (4), cable clamp (8), and screw (3)	Secure cable clamp to bracket.	
	s. Lock-washer (2), and nut (1)	Secure ball joint (6).	

3-141.3. STOP CABLE-AND LINKAGE - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



3-2433

3-142. GOVERNOR AND BREATHER TUBE-- MAINTENANCE INSTRUCTIONS.

a. General

(1) The variable speed mechanical governor performs three functions:

- (a) Controls the engine idle speed.
- (b) Limits the maximum no-load speed.
- (c) Holds the engine at any constant speed, between idle and maximum, as desired by the operator.

(2) The single weight governor is mounted on the front of the blower and is driven by the upper blower rotor.

(3) The governor consists of four sub-assemblies:

- (a) Control Housing Cover.
- (b) Control Housing.
- (c) Weight and Housing.
- (d) Variable Speed Spring Housing and Shaft.

b. Operation

(1) The manual controls are provided on the variable speed, governor: a stop lever for starting and stopping, and a speed control lever. For starting, the stop lever is moved to the RUN position, which holds the injector control racks near the full fuel position. Upon starting, the governor moves the injector racks toward the idle speed position. The engine speed is then controlled manually by moving the speed control lever.

(2) A fuel rod, connected to the differential lever and injector control tube lever, provides a means for the governor to change the fuel settings of the injector control racks.

(3) Adjustment of the engine idle speed is accomplished by changing the tension on the variable speed spring by means of the idle speed adjusting screw.

c. Lubrication

Surplus oil returning from the cylinder head provides lubrication for the parts in the governor control housing, the riser thrust bearings, and the weight shaft end bearing. Oil, picked up from a reservoir in the blower front end plate by a slinger attached to the lower rotor shaft, provides lubrication for the governor weights and weight carrier.

3-142. GOVERNOR AND BREATHER TUBE - MAINTENANCE INSTRUCTIONS.
(Continued).

d. The maintenance instructions for the governor and breather tube are contained in the following paragraphs:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Governor	3-142.1
Breather Tube	3-142.2

3-142.1. GOVERNOR - MAINTENANCE INSTRUCTIONS.

This task covers:

- | | | | |
|----|------------|----|--------------|
| a. | Inspection | c. | Removal |
| b. | Service | d. | Installation |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Wrench J4242

<u>Equipment</u>	<u>Condition</u>	<u>Condition Description</u>
		Paragraph

3-141	Engine Throttle Controls
3-141.2	Breather Tube Removal

Material/Parts

Gasket kit P/N 5193114

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

- | | | | |
|-------------|---------------|---|--|
| 1. Governor | a. Stop lever | Inspect for loose or missing hardware. | |
| | b. Housing | Inspect for breaks, cracks, dents and leaking. | |
| | c. Gaskets | Inspect for leaking. | |
| | d. Tube | Inspect for breaks, cracks, dents, and leaking. | |

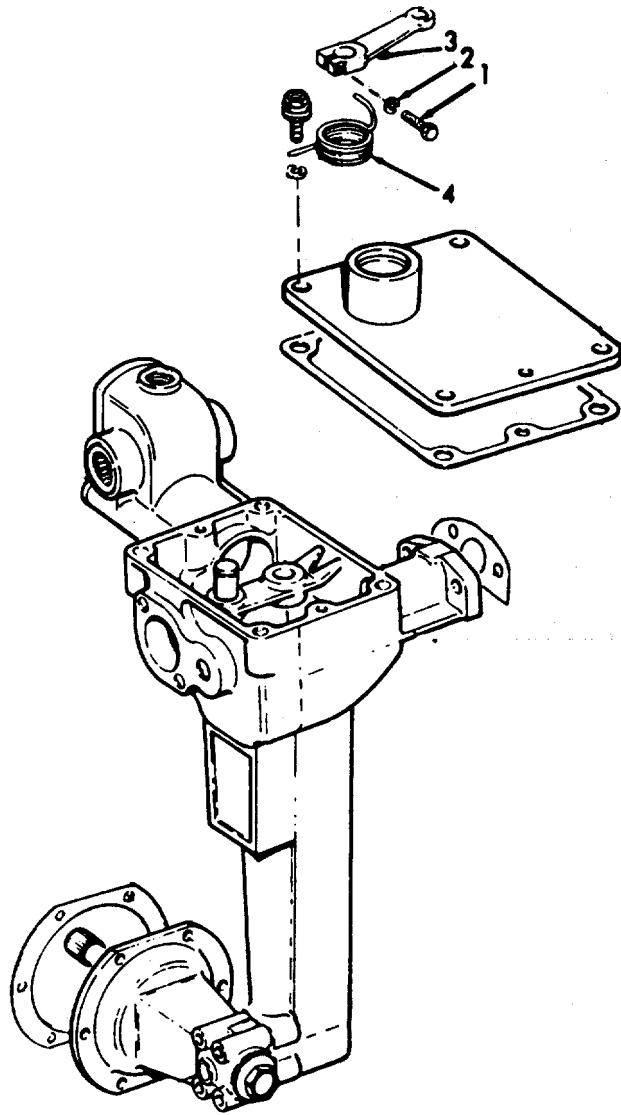
REMOVAL

- | | | | |
|----|---|---------|-----------------------------|
| 2. | a. Breather tube | Remove. | Refer to paragraph 3-142.2. |
| | b. Throttle/ Stop control | Remove. | Refer to paragraph 3-141. |
| | c. Screw (1), and lock-washer (2) | Loosen. | |
| | d. Shaft lever (3), and return spring (4) | Remove. | |

3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



3-2437

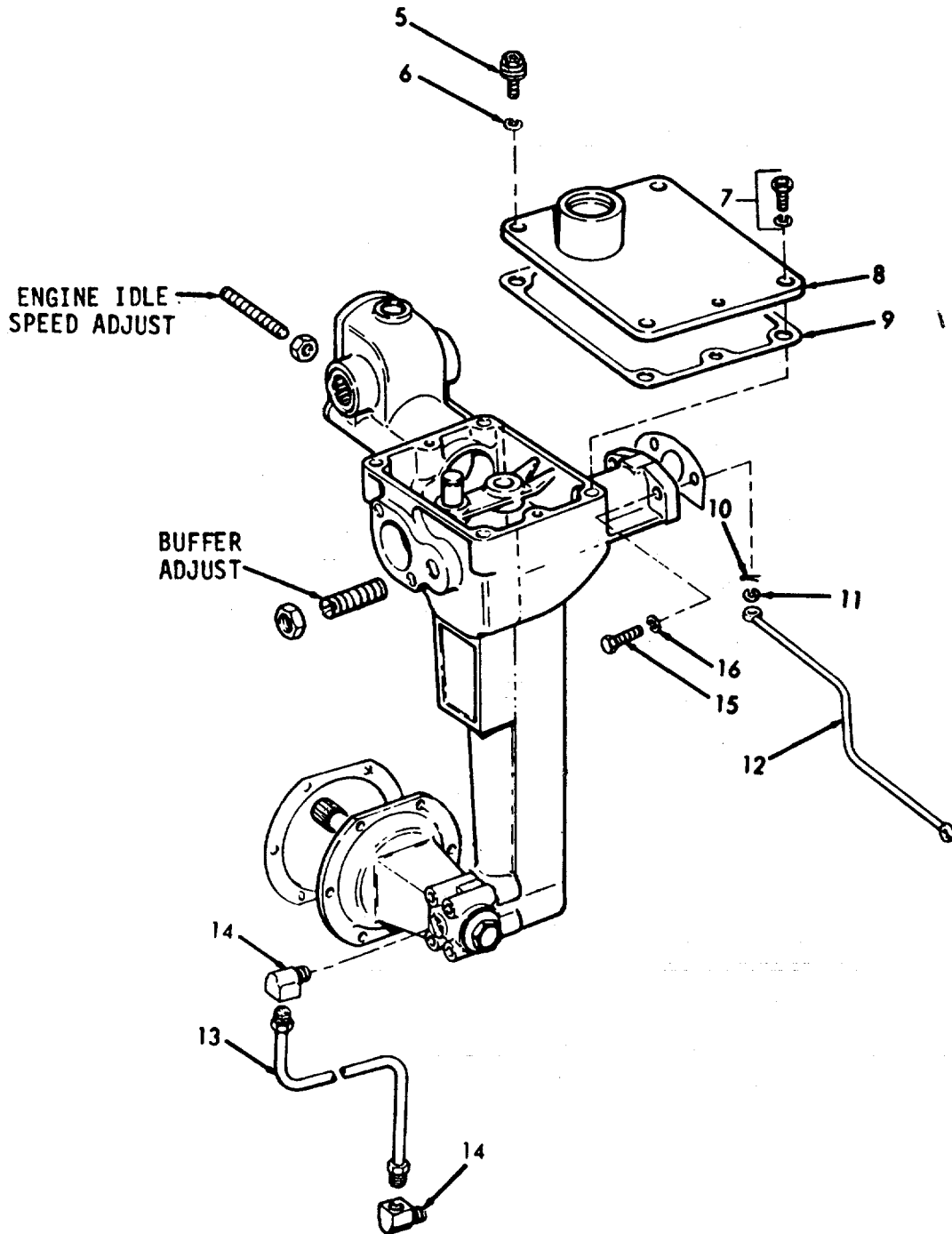
3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	e. Screw assembly (5), and lock-washer (6)	Remove.	
	f. Screw assemblies (7)	Remove.	
	g. Cover (8), and gasket (9)	Remove.	Do not discard gasket.
	h. Retainer spring (10), and washer (11)	Remove.	
	i. Control link (12)	Disengage.	
	j. Tube assembly (13)	Loosen and remove.	
	k. Elbow (14)	Remove.	If necessary.
	l. Screws (15), and lock-washers (16)	Remove.	

3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

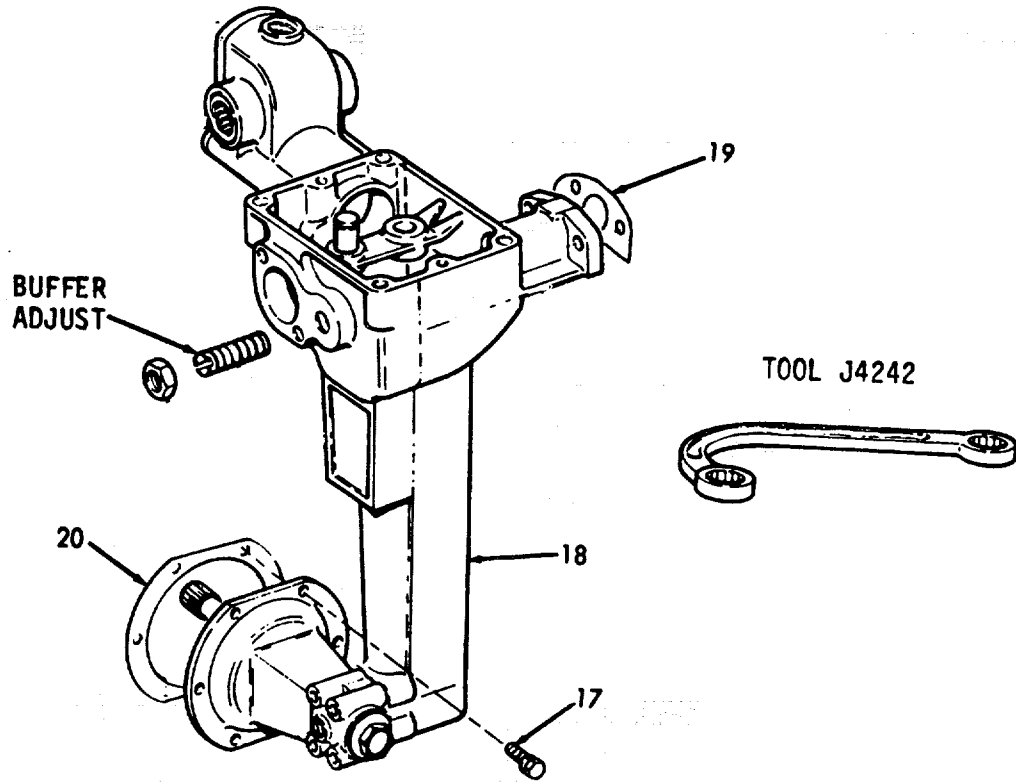


3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- | | | | |
|--|---------------------------|---------|------------------|
| | m. Bolt assembly (17) | Remove. | Use tool J4242. |
| | n. Governor assembly (18) | Remove. | |
| | o. Gaskets (19 and 20) | Remove. | Discard gaskets. |

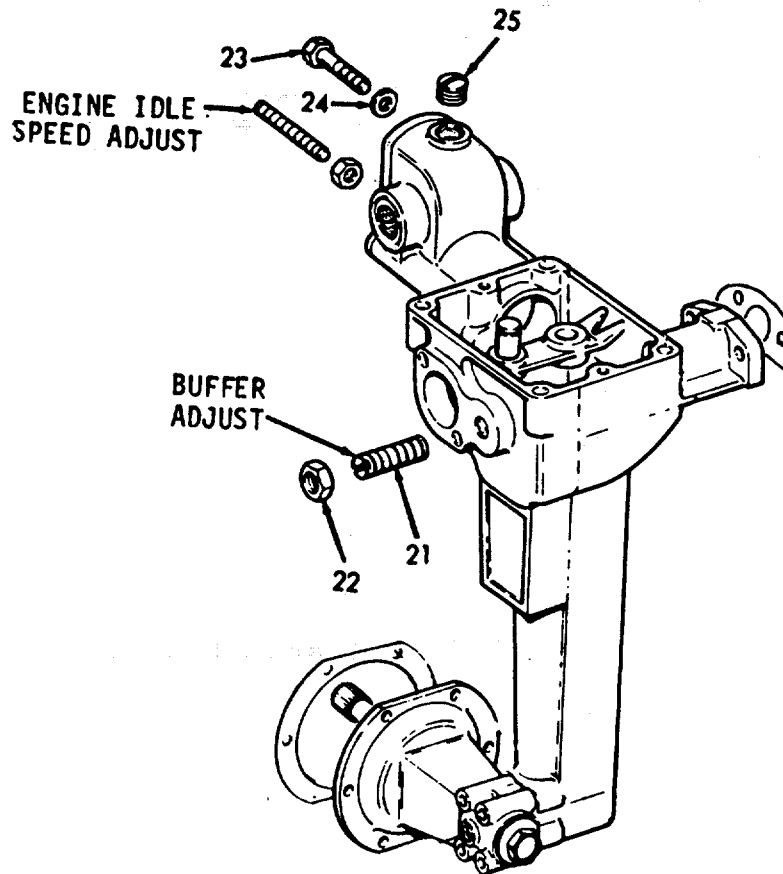


3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR

- | | | | |
|----|---|---------|---------------|
| 3. | a. Buffer screw (21), and nut (22) | Remove. | If necessary. |
| | b. Idle speed adjusting screw (23), and, nut (24) | Remove. | If necessary. |
| | c. Pipe plug (25) | Remove. | If necessary. |

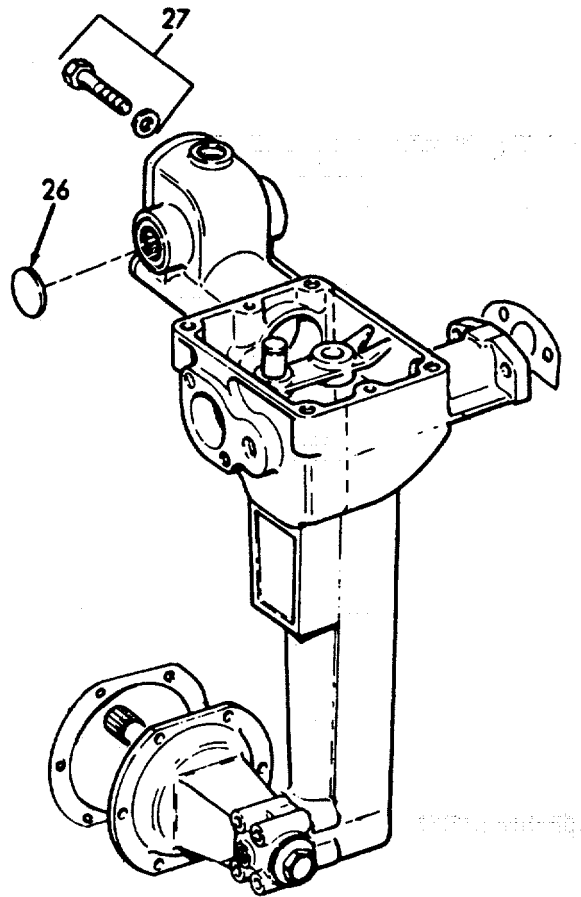


3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|--|--------------------------------|---------|---------------|
| | d. Expansion plug (26) | Remove. | If necessary. |
| | e. Screw assemblies cover (27) | Remove. | If necessary. |



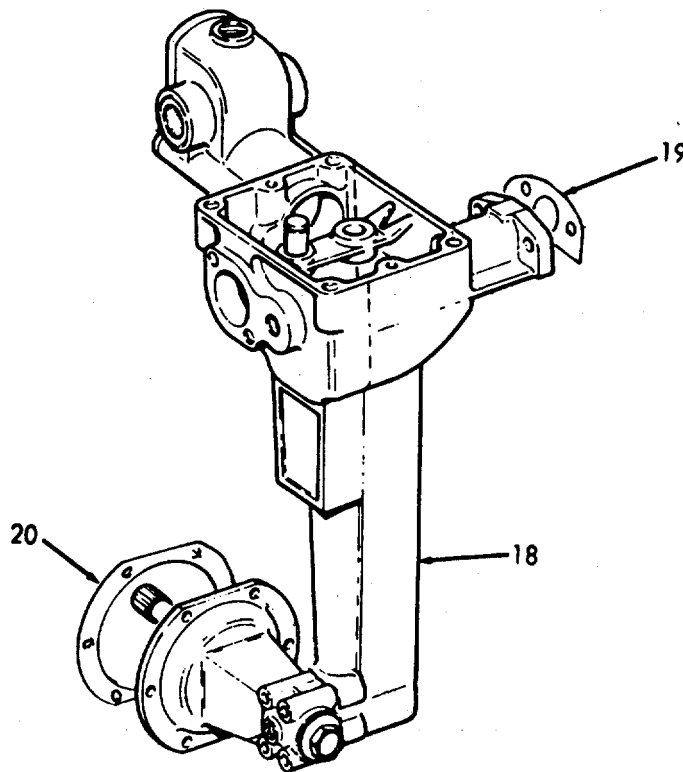
3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION

- | | | | |
|----|---------------------|---|------------------------|
| 4. | a. Gasket
(20) | Affix to governor. | Use a new gas-
ket. |
| | b. Governor
(18) | 1. Start the splined end
into the blower housing.

2. Position the governor
against the blower. | |
| | c. Gasket
(19) | Insert. | Use a new gas-
ket. |



3-2443

3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

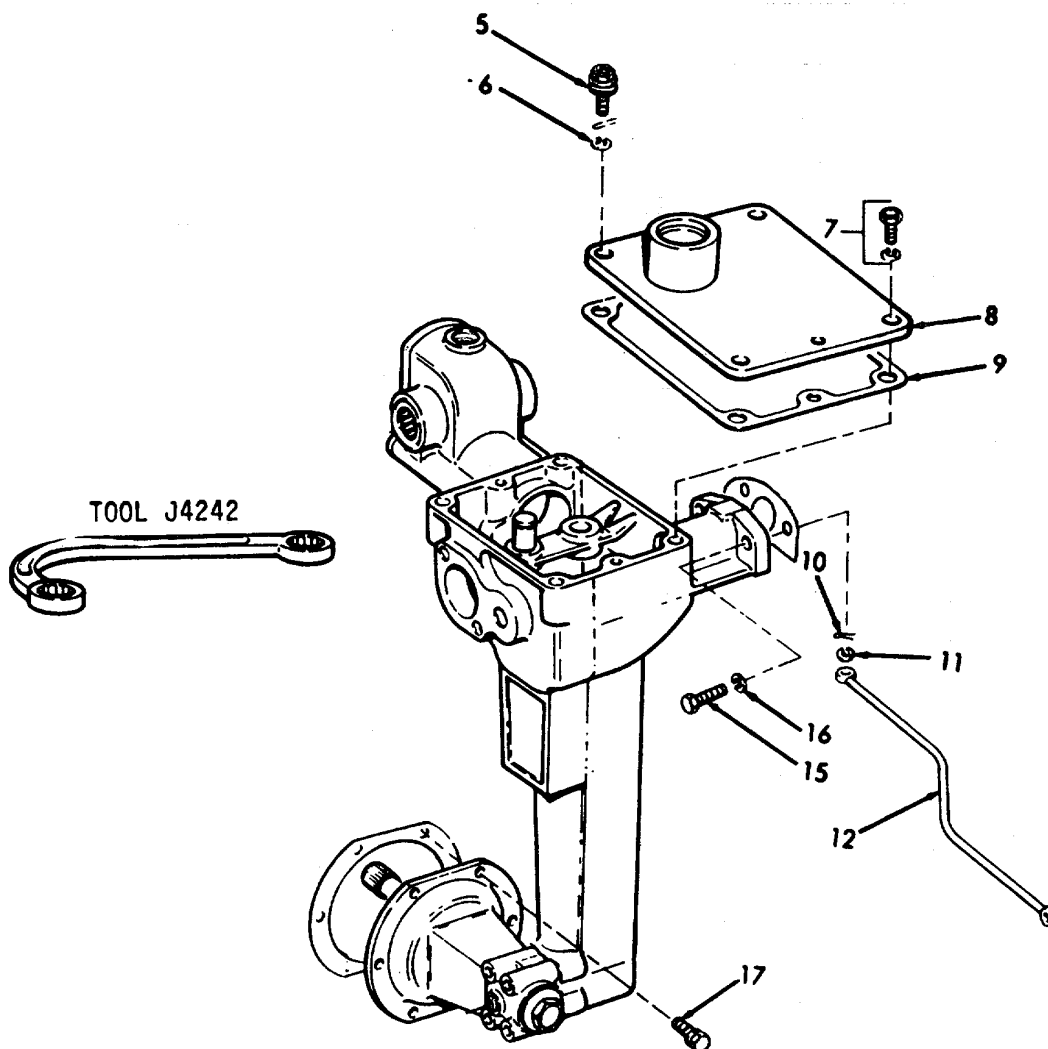
- | | | | |
|--|---|----------------------------|---|
| | d. Control link (12) | Feed into governor. | |
| | e. Bolt assemblies (17) | Install finger tight only. | Check that the copper gaskets on the bolts are not damaged. If they are, replace the bolt assemblies. |
| | f. Screws (15), and lock-washers (16) | Install and tighten. | |
| | g. Bolt assemblies (17) | Tighten. | Use tool J4242. |
| | h. Control link (12) | Place on lever pin. | |
| | i. Washer (11), and retaining spring (10) | Install. | |
| | j. Cover (8), and gasket (9) | Replace. | Align pin with lever inside governor. |

3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- | | | | |
|----|---|----------|--|
| k. | Screw assemblies (7) | Install. | |
| l. | Screw assembly (5), and lock-washer (6) | Install. | |



3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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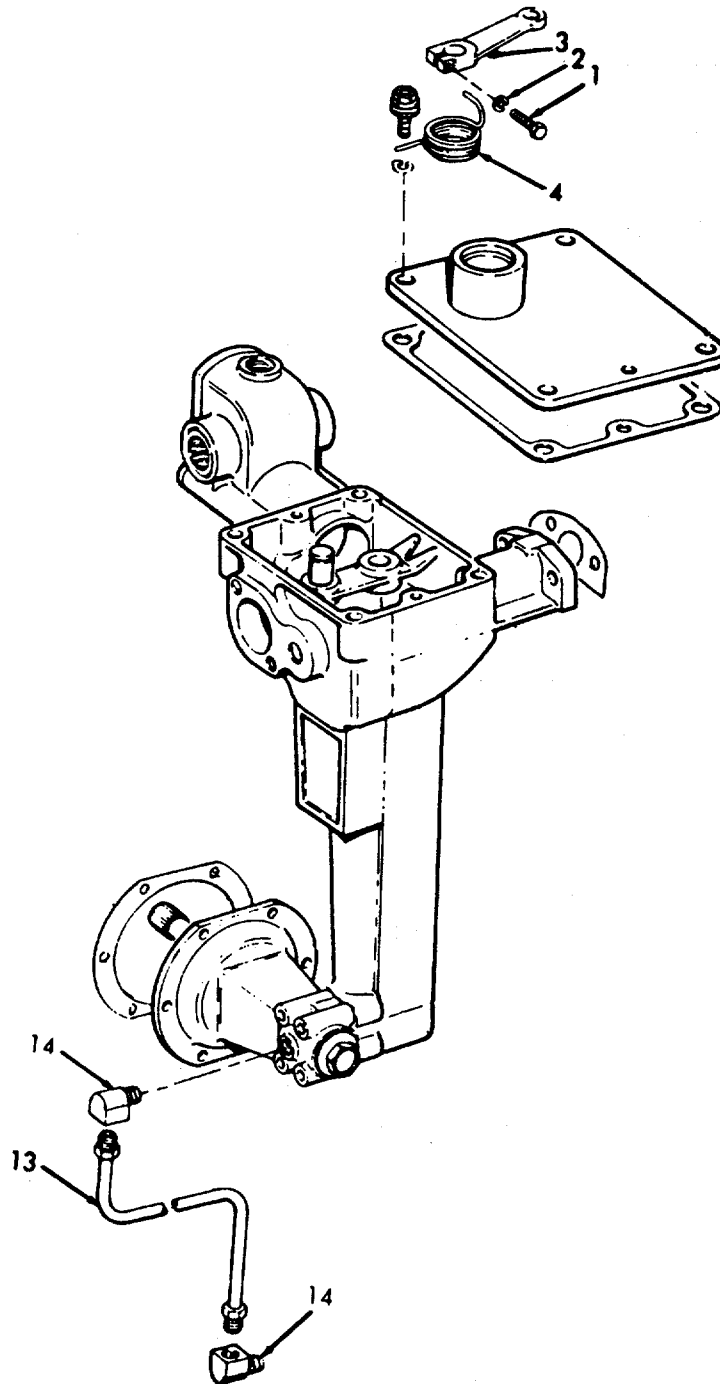
INSTALLATION (Cont)

- | | | | |
|--|---|--|-----------------------------|
| | m. Return spring (4), and shaft lever (3) | Install spring and align lever with slot in lever. | |
| | n. Screw (1), and lock-washer (2) | Tighten. | |
| | o. Breather tube | Install. | Refer to paragraph 3-142.2. |
| | p. Throttle/ Stop control | Install. | Refer to paragraph 3-141. |
| | q. Elbows (14), and tube (13) | Install. | |

3-142.1 GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)



3-142.2. BREATHER TUBE - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection b. Service c. Installation

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment Condition Condition Description

None

Material/Parts

Gasket kit P/N 5193114

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | |
|------------------|-----------|--|
| 1. Breather tube | a. Tube | Inspect for binds, breaks, cracks and dents. |
| | b. Gasket | Inspect for leaks. |

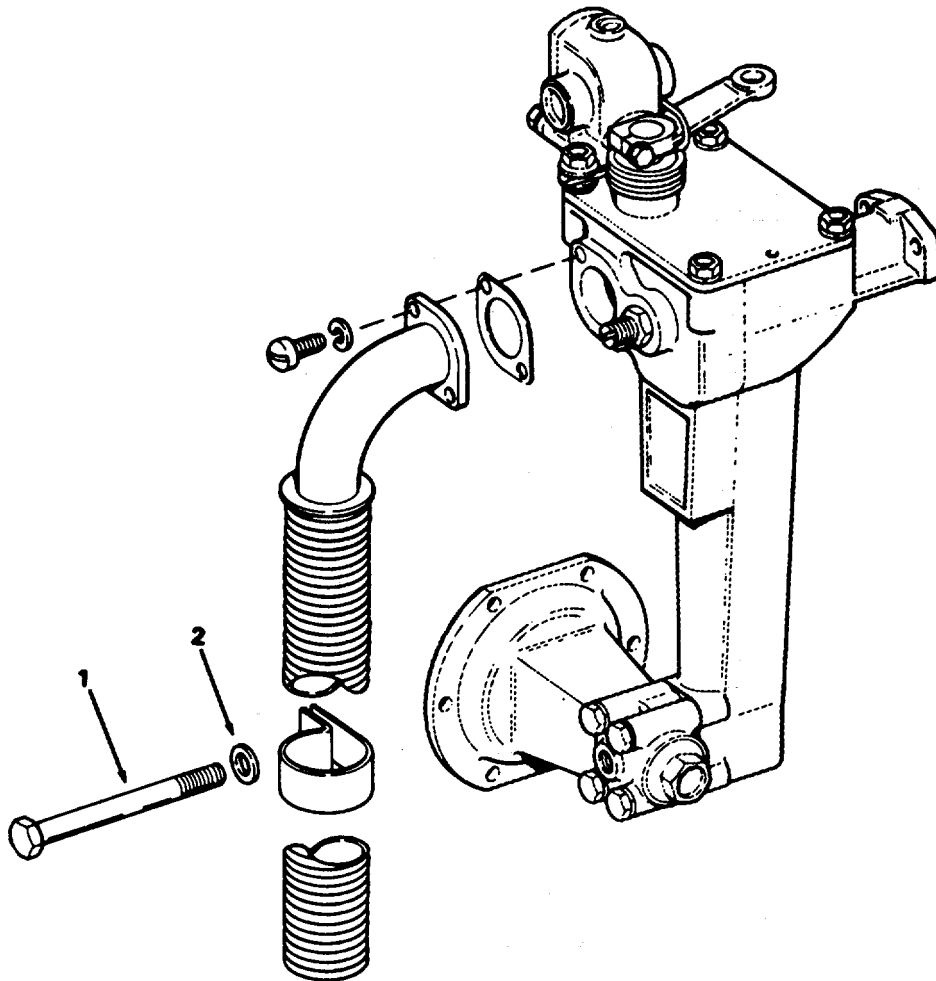
REMOVAL

- | | | |
|----|-----------------------------------|---------|
| 2. | a. Screw (1)1 and flat-washer (2) | Remove. |
|----|-----------------------------------|---------|

3-142.2 BREATHER TUBE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



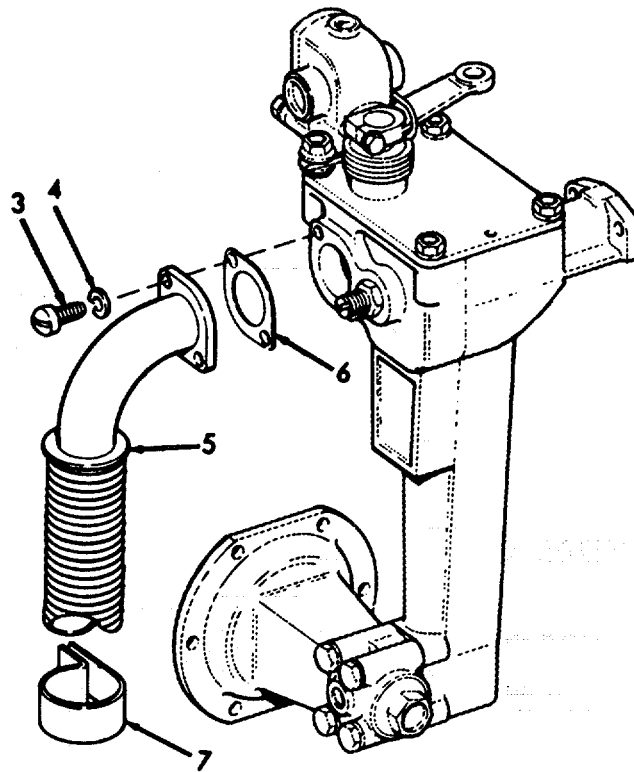
3-2449

3-142.2 BREATHER TUBE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|--|--------------------------------------|--------------|-----------------|
| | b. Screws (3), and lock-washers (4) | Remove. | |
| | c. Breather tube (5), and gasket (6) | Remove. | Discard gasket. |
| | d. Breather tube (5), and clip (7) | Disassemble. | |

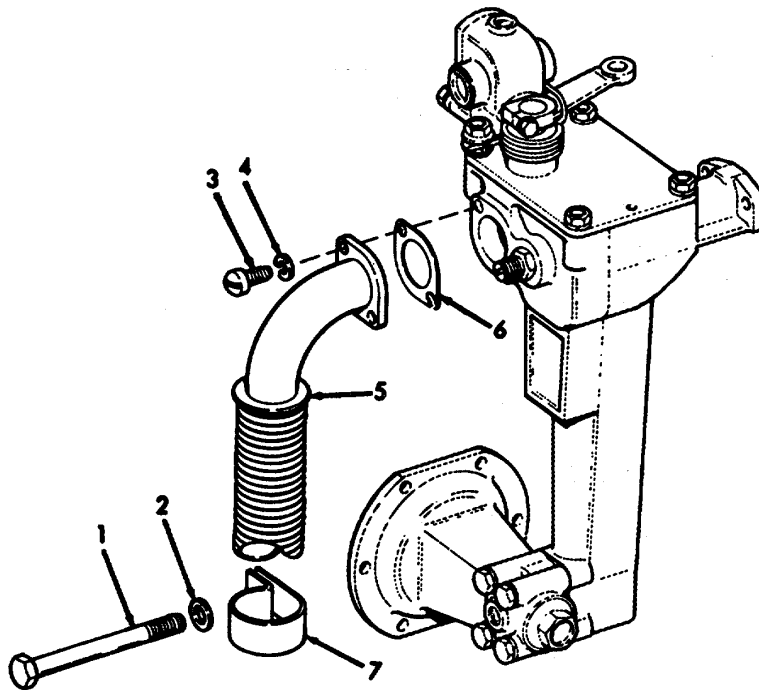


3-142.2 BREATHER TUBE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION

- | | | | |
|----|--|------------|-----------------|
| 3. | a. Breather tube (5), and clip (7) | Reassemble | |
| | b. Breather tube (5), gasket (6), screws (3), and lock-washers (4) | Install. | Use new gasket. |
| | c. Screw (1), and flat-washer (2) | Install. | |



3-2451

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS.

The air intake shut-down housing, mounted on the side of the blower, serves as a mounting for the air cleaner. The air shut-down housing contains an air shut-down valve that shuts off the air supply and stops the engine whenever abnormal operating conditions require an emergency shut-down.

This task covers:

- | | | | | | |
|----|------------|----|-------------|----|------------|
| a. | Inspection | c. | Removal | e. | Repair |
| b. | Service | d. | Disassembly | f. | Inspection |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Torque wrench -
0-50 lbs. ft.

Equipment

<u>Condition</u>	<u>Condition Description</u>
	<u>Paragraph</u>

3-148	Fuel Injector
3-141.1	Engine, Clutch and Throttle Controls
3-141.2	Engine Throttle Linkage

Material/Parts

Repair kit P/N 5193114
Oil MIL-L-2104 Type OE/HDO-10

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

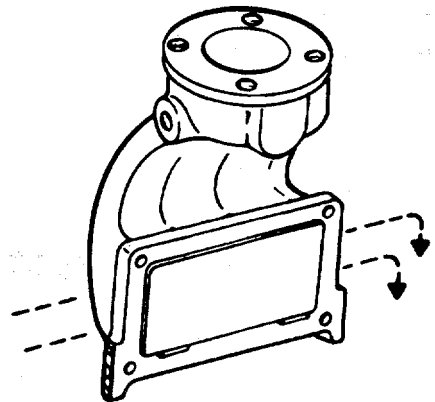
Observe WARNING in procedure.

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION			
1. Air intake	a. Shut-down valve shaft	Inspect for binding. Disconnect latch from ball joint and link. Move latch manually.	Lubricate if binding, or replace if required.
	b. Air intake housing	Inspect for cracks, breaks or damage.	Replace if defective.
	c. Air intake housing-to-blower housing gaskets	Inspect for leaking.	Replace if defective.

SERVICE

2. Air intake	Shut-down valve shaft	Lubricate.	Use oil type OE/HDO-10.
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3-2453

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
3. Air intake	a. Air cleaner mounting tube (1)	Remove.	
	b. Cap-screws (2), and lock-washers (3)	Remove.	Screw 3/8-16 x 1-5/8 inch.
	c. Air intake housing (4)	Remove.	
	d. Air intake housing striker plate (5)	Remove.	
	e. Striker plate-to-air intake housing gasket (6)	Remove.	Discard.
	f. Mating surfaces blower housing-to-striker plate (5)	Clean.	Remove gasket particles.

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

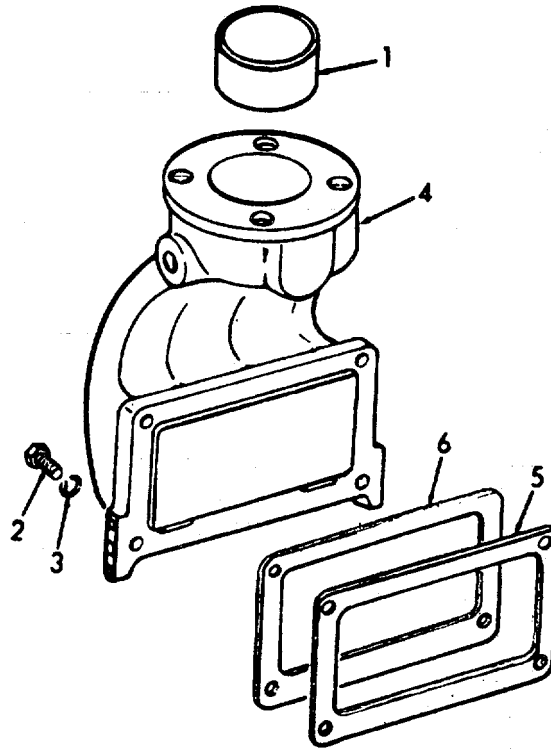
LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

g. Mating surfaces intake housing-to-striker plate (5)

Clean.

Remove gasket particles.



3-2455

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued):

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY

WARNING

Wear eye protection when using compressed air.

NOTE

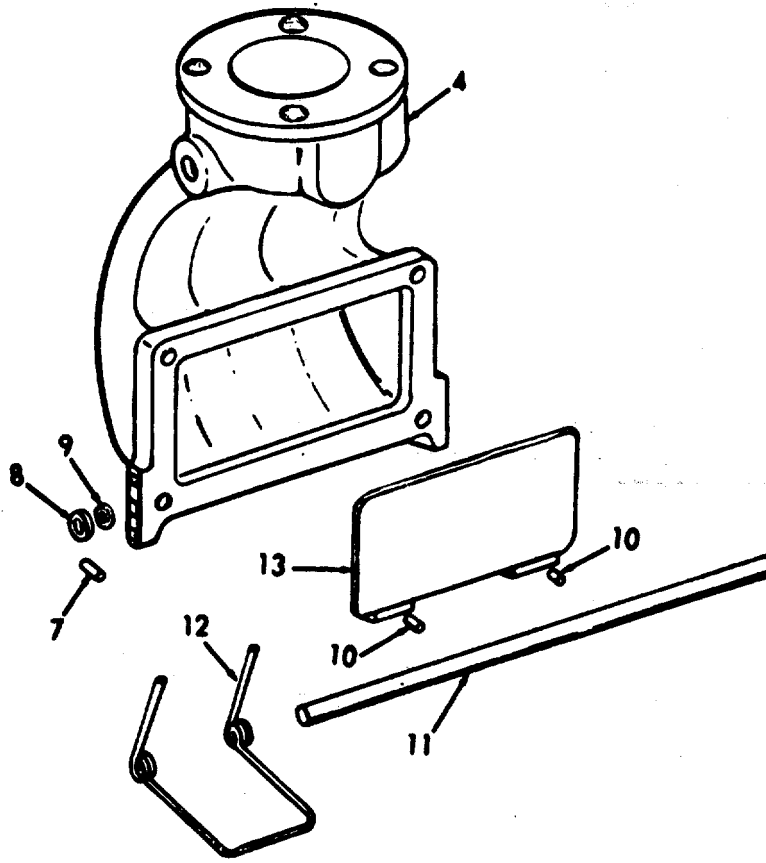
Clean all parts in fuel oil and dry with compressed air.

4. Air intake	a. Air intake housing (4)	Remove, clean and inspect for cracks or damaged threads.	
	b. Roll pin (7)	Remove and inspect.	Use small punch to remove.
	c. Flat-washer (8)	Remove.	
	d. Seal ring (9)	Remove and discard.	
	e. 2 roll pins (10)	Remove and inspect.	
	f. Shutdown valve shaft (11)	Remove, clean and inspect for wear or damage.	Note position of shutdown valve spring (12) and shutdown valve (13) before withdrawing shaft.
	g. Shutdown valve (13)	Inspect for flatness.	

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)			
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3-2457

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

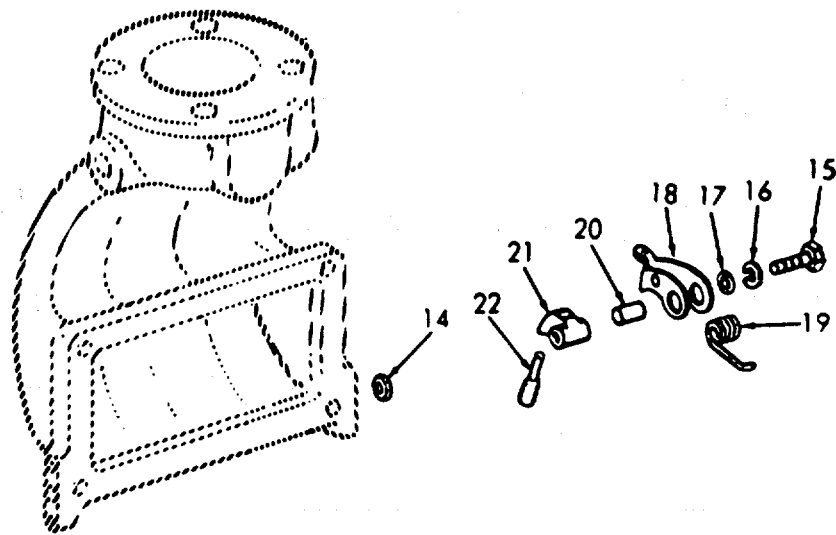
LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px;">DISASSEMBLY (Cont)</div>	h. Seal ring (14)	Remove and discard.	
	i. Cap-screw (15), lock-washer (16), and flat-washer (17)	Remove.	
	j. Latch (18)	Remove, clean and inspect for wear or damage.	
	k. Latch spring (19)	Remove, clean and inspect for wear or damage.	
	l. Latch spacer (20)	Remove, clean and inspect for wear or damage.	
	m. Cam (21)	Clean and inspect for wear or damage.	
	n. Handle (22)	Clean and inspect for wear or damage.	

3-2458

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)



3-2459

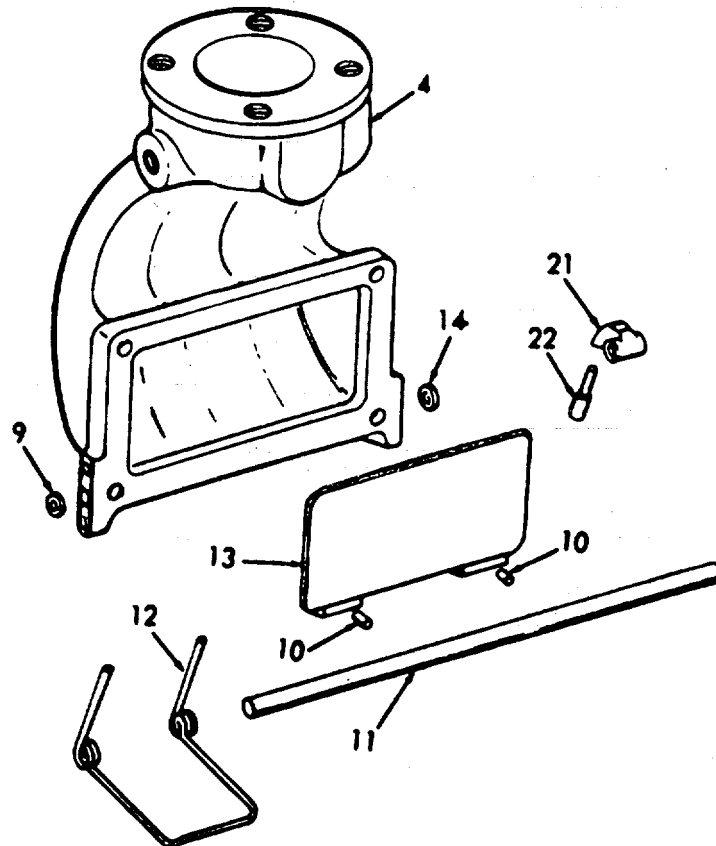
3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
5. Air intake	a. Shut-down valve (13) and shut-down valve spring (12)	Place in position in air intake housing (4) before installing shut-down valve shaft (11).	Face of shut-down valve must be perfectly tight to assure a tight seal in the shutdown position.
	b. Shut-down valve shaft (11)	Install in air intake housing (4).	Shaft (11) must extend 0.76 inch (1.9 cm) from latch side of housing (4).
	c. 2 roll pins (10)	Install.	If new shutdown valve (13) or shaft (11) is installed, holes for roll pins (10) must be drilled.
	d. Seal rings (14 and 9)	Install.	
	e. Cam (21)	Install.	
	f. Handle (22)	Install	If new shaft (11) is installed, hole for handle (22) pin must be drilled.

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-2461

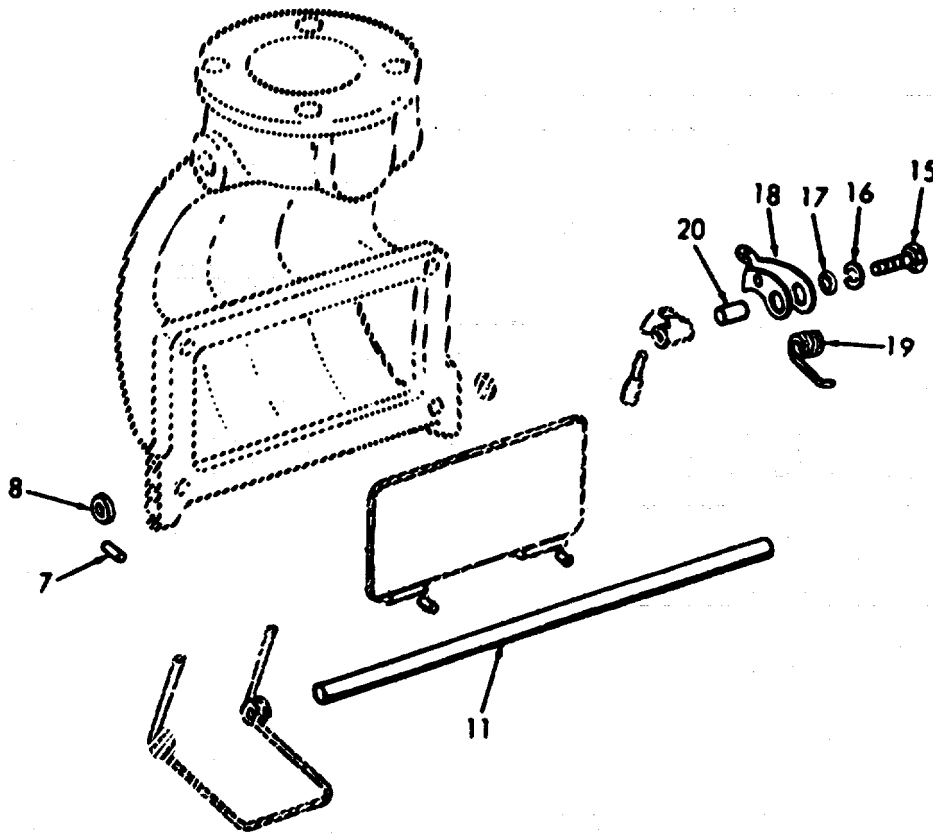
3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REPAIR (Cont)</div>	g. Flat-washer (8)	Install.	
	h. Roll pin (7) roll pin (7) must be drilled.	Install.	If new shaft (11) is installed, hole for
	i. Latch spacer (20)	Assemble on shaft (11).	
	j. Latch spring (19)	Assemble in latch(19).	
	k. Flat-washer (17), lock-washer (16), and capscrew (15)	Slip through latch (18) and secure to shaft (11).	

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-2463

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

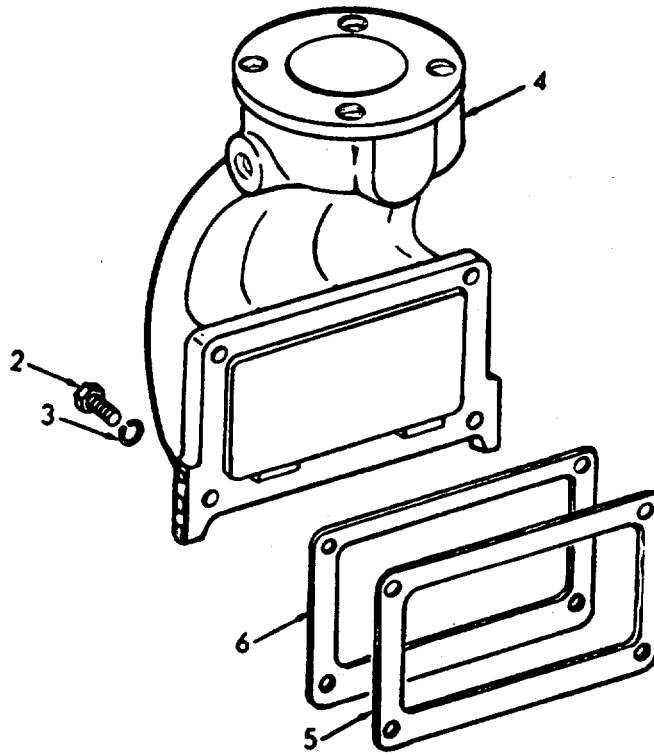
LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
6. Air intake	a. Striker plate-to-air intake housing gasket (6)	Place against air intake housing (4).	
	b. Striker plate (5)	Place against striker plate-to-air intake housing gasket.	
	c. Air intake housing (4)	Position on blower housing.	
	d. Cap-screw (2), and lock-washer (3)	Install.	Screw 3/8-16 x 1-5/8 inch.

3-2464

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



3-2465

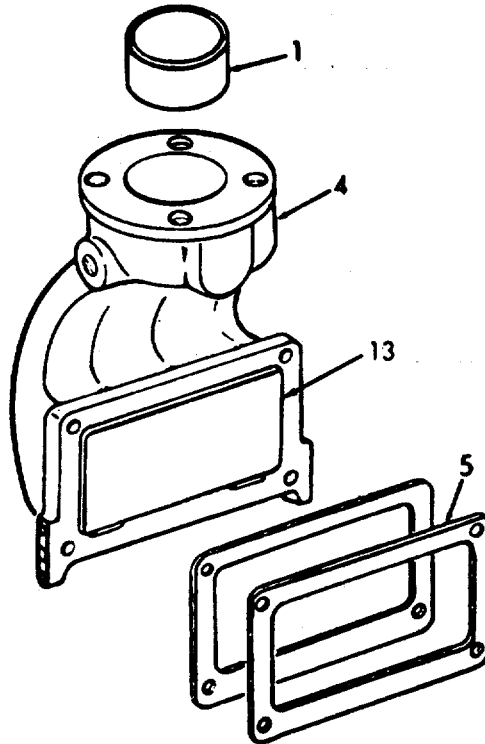
3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
7. Emergency shutdown	Cable and linkage	Install.	Refer to paragraph 3-141.1.
8. Shutdown solenoid bracket	Linkage and	Install.	Refer to paragraph 3-141.2.
9. Air intake	a. Cap-screw (5), and those from paragraph 3-141.2	Tighten.	Torque cap screws evenly to 16-20 lb. ft. (21.8 to 27.3 Nm).
	b. Air cleaner mounting tube (1)	Install.	
	c. Air intake housing (4)	Check by starting and running the generator engine at idle speed and no load. Trip the air shutdown. If the engine does not stop, check for air leakage between the shutdown valve (13) and the striker plate (5). Reposition valve as necessary.	
	d. Air cleaner	Install.	See paragraph 3-156.

3-143. AIR INTAKE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



3-2467

3-144. BLOWER - MAINTENANCE INSTRUCTIONS.

a. General

(1) The blower supplies the fresh air needed for combustion and scavenging. Its operation is similar to that of a gear-type oil pump. Two hollow, three-lobe rotors revolve with very close clearances in a housing bolted to the cylinder block. To provide continuous and uniform displacement of air, the rotor lobes are made with a helical (spiral) form.

(2) Two timing gears, located in the rear end-plate of the rotor shafts, space the rotor lobes with a close tolerance; therefore, as the lobes of the upper and lower rotors do not touch at any time, no lubrication is required.

(3) Oil seals located in the front and rear blower end plates prevent air leakage, and also keeps the oil used for lubricating the timing gears and rotor shaft bearings from entering the rotor compartment.

(4) The blower upper rotor is driven by the blower drive shaft which is coupled to the upper rotor timing gear by means of a flexible drive hub located in the flywheel housing.

(5) A flexible coupling, formed by an elliptical cam, driven by two bundles of leaf springs which ride on four semi-cylindrical supports and spring seats is attached to the blower drive gear and prevents the transfer of torque fluctuations to the blower.

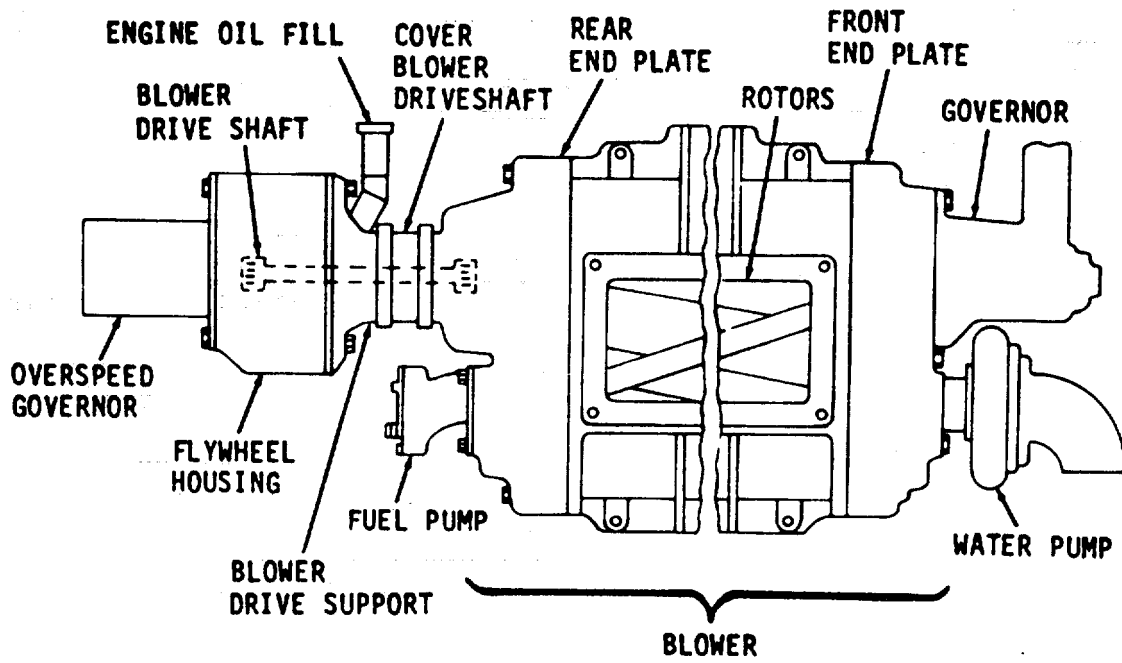
(6) The blower drive gear is mounted in the blower drive gear support and in addition to driving the blower, drives the governor, water pump and fuel pump.

b. Lubrication

(1) Oil drains from the valve operating mechanism on the cylinder head into the camshaft pocket in the cylinder block; then, when it reaches a certain level, the oil flows from the pocket into cavities at the upper corners of the blower and through passages in the blower and end plates to lubricate the bearings, governor and water pump drives at the front end, and bearings and gears at the rear end of the blower. A slinger attached to the front end of the lower rotor shaft throws oil onto the front roller bearings and governor weights. A dam in the blower end plates maintains oil at a level adequate to submerge the lower portion of the slinger and the driven gear.

(2) Surplus oil overflows the dams in the end plates and returns through two drilled holes in the cylinder block to the engine crank-case.

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).



3-2469

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

This task covers:

- a. Inspection
- b. Repair
- c. Removal
- d. Service
- e. Installation

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Torque wrench

Equipment Condition Condition Description Paragraph

3-141
3-142

Engine Controls
Governor and Breather
Tube
Air Intake
Fuel Pump
Lube Oil Cooler
Air Cleaner
Centralized Hydraulic
System

Material/Parts

Gasket kit P/N 5193114
Gasket kit P/N 5192753

3-143
3-145
3-149
3-156
3-181

Special Environmental Conditions

Do not drain oil or anti-freeze into bilges. Use the oil/water separation system to collect drained oil or anti-freeze. Dispose of properly.

Personnel Required

2

General Safety Instructions

Observe WARNINGS when operating engine.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | | |
|------------------------------------|----------|---|--|
| 1. Blower-
(Engine not running) | a. Hoses | 1. Inspect for breaks, wear or defects.

2. Inspect for leaks.

3. Inspect for loose hose clamps. | |
|------------------------------------|----------|---|--|

3-2470

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
	b. Housing	1. Inspect for oil leaks. 2. Inspect for breaks, dents, cracks or damage. 3. Inspect for loose mounting hardware.	
2. Blower drive support	a. Oil fill pipe	Inspect for leaks, breaks and damage.	
	b. Housing	1. Inspect for breaks, cracks and damage. 2. Inspect for leaking oil. 3. Inspect for tight hardware.	
	c. Hoses	Inspect for wear, breaks, or defects.	
	d. Tubing	Inspect for breaks, bends, or damage.	
3. Blower (engine running)			

NOTE

The air intake (paragraph 3-143) must be removed to perform the following inspections.



When inspecting a blower on an engine with the engine running, keep fingers and clothing away from the moving parts of the blower and run the engine at low speeds only.

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

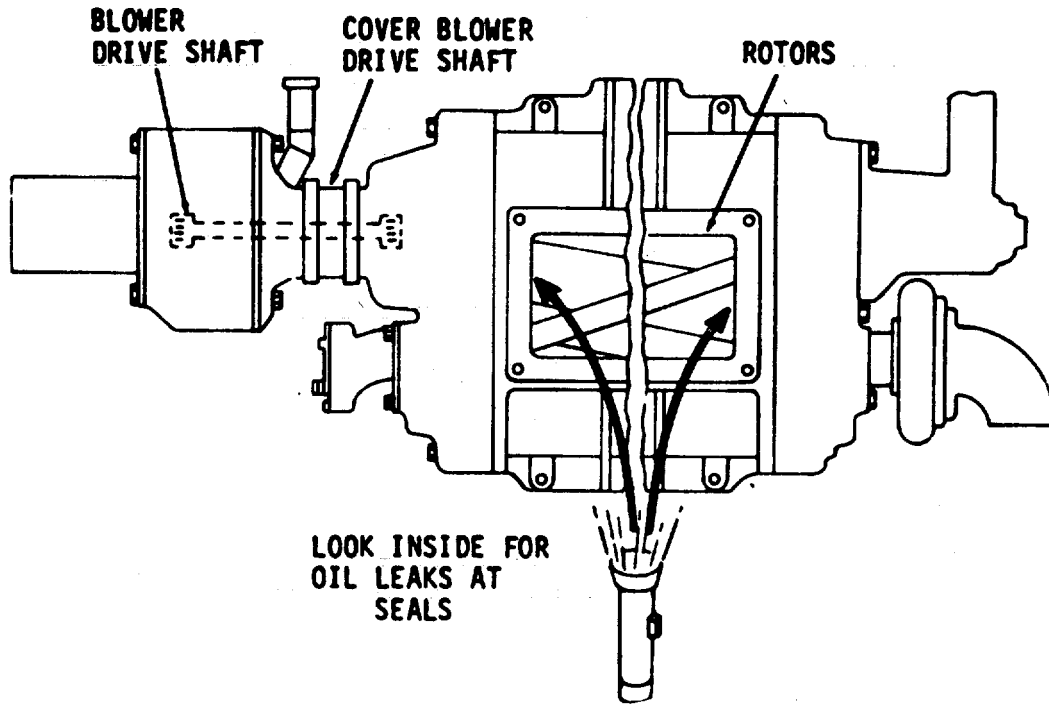
LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)	a. Rotors	Dirt or chips drawn thru the blower will make deep scratches in rotors and housing and throw up burrs around such abrasions. If burrs cause interference between rotors or between the rotors and the housing, remove the blower from the engine and dress the parts down to eliminate the interference, or replace the rotors if they are too badly scored.	
	b. Oil seals	Leaky oil seals are usually manifested by the presence of oil on the blower end plates and rotors or the inside surfaces of the housing. This condition may be checked by running the engine at low speed and directing a light into the rotor compartment at the end plates and the oil seals. A thin film of oil radiating away from the seals is indicative of an oil leak.	To correct any of the above conditions, remove the blower from the engine and replace it.

3-2472

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)



c. Blower drive

A worn blower drive, resulting in a rattling noise inside the blower, may be detected by grasping the top rotor firmly and attempting to rotate it. Rotors may move from 3/8" to 5/8", measured at the lobe crown, with a springing action. When released, the rotors should move back at least 1/4 inch. If the rotors cannot be moved as directed above, or if the rotors move too freely, inspect the flexible blower drive coupling and replace it if necessary.

To correct any of the above conditions, remove the blower from the engine and replace it.

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

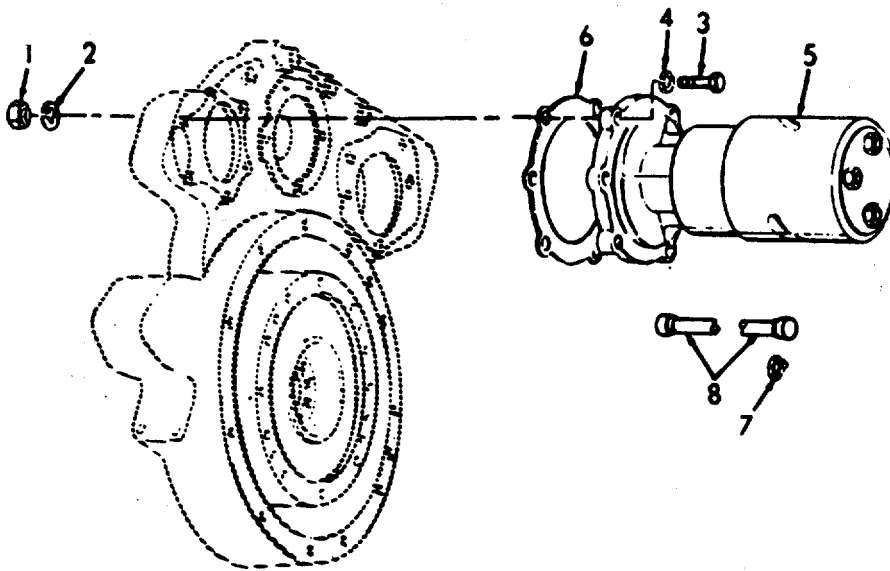
LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)	d. Rotor shaft	<p>Loose rotor shafts or damaged bearings will cause rubbing and scoring between the crowns of the rotor lobes and the mating rotor roots, between the rotors and the end plates, or between the rotors and the housing. Generally, a combination of these conditions exist. A loose shaft usually causes rubbing between the rotors and the end plates. Worn or damaged bearings will cause rubbing between the mating rotor lobes at some point or perhaps allow the rotor assemblies to rub the blower housing. This condition will usually show up at the end where the bearings have failed. Excessive backlash between the blower timing gears usually results in the rotor lobes rubbing thru-out their entire length.</p>	<p>To correct any of the above conditions, remove the blower from the engine and replace it.</p>
	e. Blower screen	<p>Inspect the blower inlet screen periodically for an accumulation of dirt which, after prolonged operation, may affect the air flow.</p>	<p>To correct any of the above conditions, remove the blower from the engine and replace it.</p>

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

- | | | | |
|-----------------------|---|---|-----------------|
| 4. Blower drive shaft | a. Nuts (1), and lock-washers (2) | Remove four nuts. | |
| | b. Screws (3), and flat-washers (4) | Remove four screws. | |
| | c. Overspeed governor (5), and gasket (6) | Remove. | Discard gasket. |
| | d. Snap ring (7) | Remove. | |
| | e. Blower drive shaft (8) | Pull drive shaft out of flywheel housing. | |



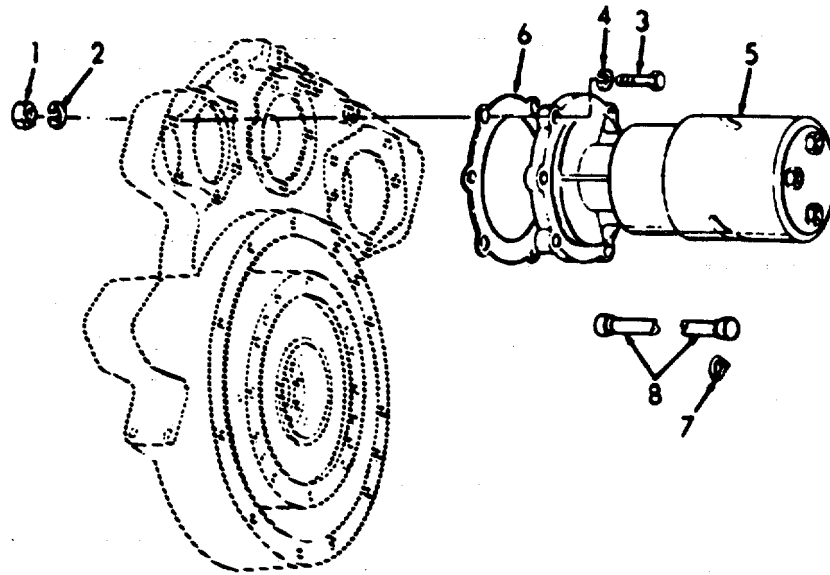
3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
NOTE			
1. The blower drive shaft may have a hole tapped into the shaft end. This can be an aid in removing the shaft.			
2. If the blower drive shaft is broken and it is not possible to remove all the pieces, the blower MUST be removed. Refer to step #5.			
	f. Blower drive shaft (8)	Install. Push the plain end, without the squared hole, through the blower drive coupling in the flywheel housing.	
	g. Snap ring (7)	Replace.	
	h. Gasket (6), and over-speed governor (5)	Replace.	Use new gasket.
	i. Screws (3), flat-washers (4), lock-washers (2), and nuts (1)	Replace.	

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



REMOVAL

5. Engine	a. Air cleaner	Remove.	Refer to paragraph 3-156.
	b. Hydro-starter solenoid	Remove.	Refer to paragraph 3-181.
	c. Governor	Remove.	Refer to paragraph 3-142.
	d. Fresh water pump	Remove.	Refer to paragraph 3-150.
	e. Fuel pump	Remove.	Refer to paragraph 3-145.
	f. Air intake housing	Remove.	Refer to paragraph 3-143.
	g. Blower drive shaft	Remove.	Refer to step 4.

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

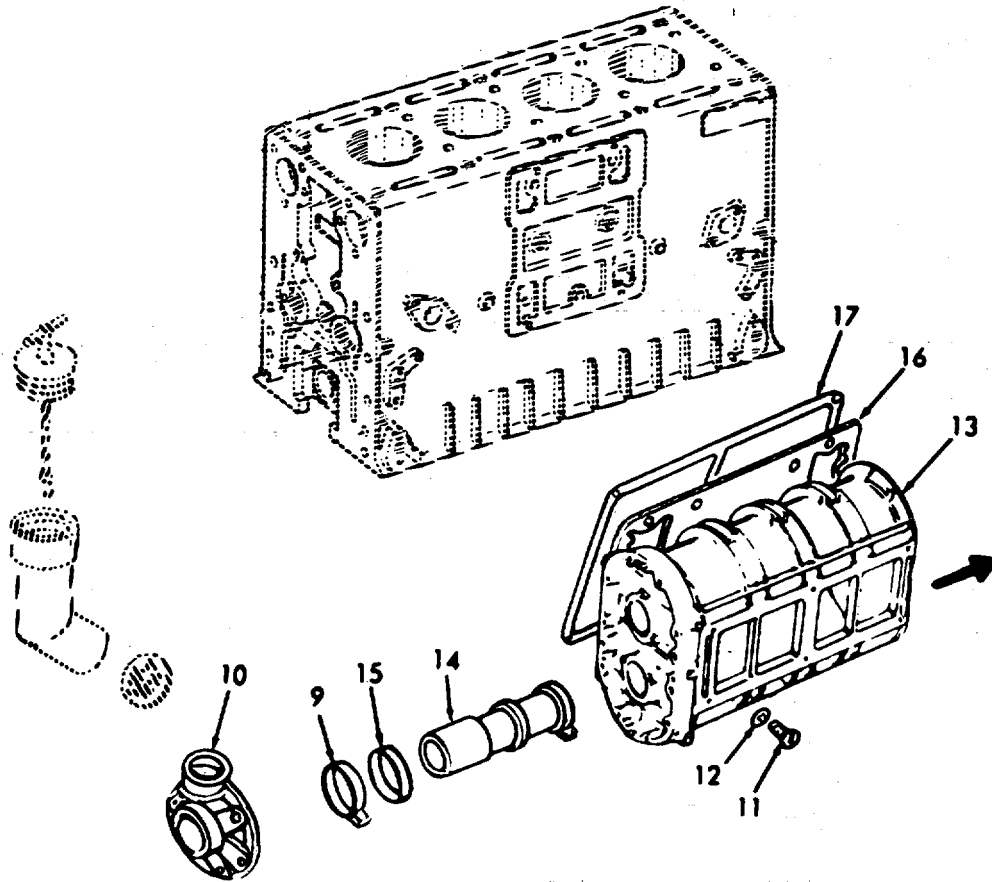
LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
6. Blower	a. Blower drive cover packing clamp (9)	Loosen at blower drive gear hub support (10).	
	b. Screws (11), and flat-washers (12)	Remove.	
	c. Blower (13)	Slide forward slightly.	
	d. Blower drive shaft cover (14), and seal (15)	Withdraw cover from seal.	
	e. Blower (13)	Lift blower from cylinder block.	
	f. Gasket (16)	Remove.	Discard gasket.
	g. Screen (17)	Remove.	Discard screen.

3-2478

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



SERVICE

7. Blower screen

The blower screen can be washed in fuel oil and cleaned with a stiff brush until the screen is free of all dirt deposits.

3-2479

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION

NOTE

The fuel pump and fresh water pump can be installed onto the blower prior to reassembly.

8. Blower

NOTE

Before attaching the blower to the engine, check the inside of the blower for any foreign material and revolve the rotors by hand to be sure they turn freely.

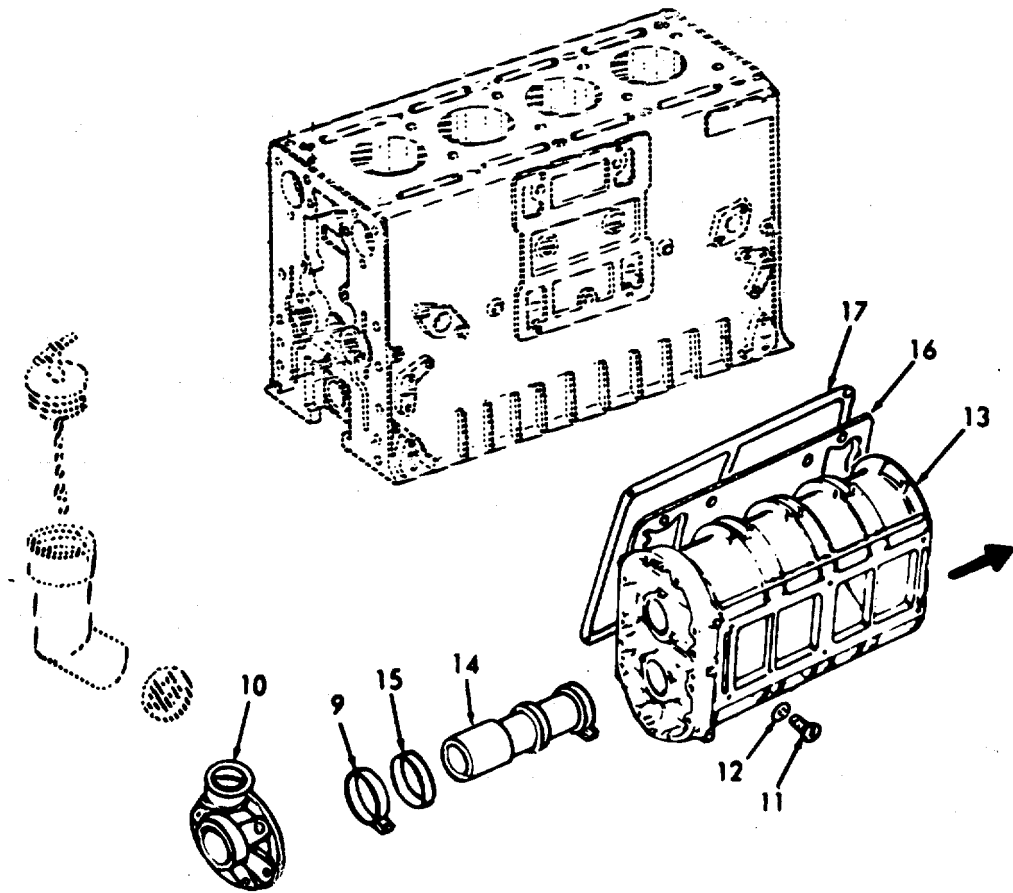
a. Gasket (16)	Affix to engine block.	Use a new gasket. Affix with Scotch Grip Rubber Adhesive #4300 or equivalent.
b. Blower drive seal (15), and packing clamp (9)	Place on drive shaft cover (14).	Use a new seal and clamp.
c. Fresh water pump	Install on blower.	Refer to paragraph 3-150.
d. Fuel pump	Install on blower.	Refer to paragraph 3-145.
e. Blower (13)	Place into position against cylinder block.	Do not move blower gasket.
f. Screws (11), and flat-washers (12)	Install.	Torque to 55-60 lb. ft. (74.58- 81.36 Nm) torque.

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

- | | | | |
|---------------------------------|--|-----------------|--|
| g. Blower drive shaft seal (15) | Slide seal into position against the blower drive gear hub support (10). | | |
| h. Packing clamp (9) | Tighten. | | |
| i. Screen (17) | Install blower screen. | Use new screen. | |



3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

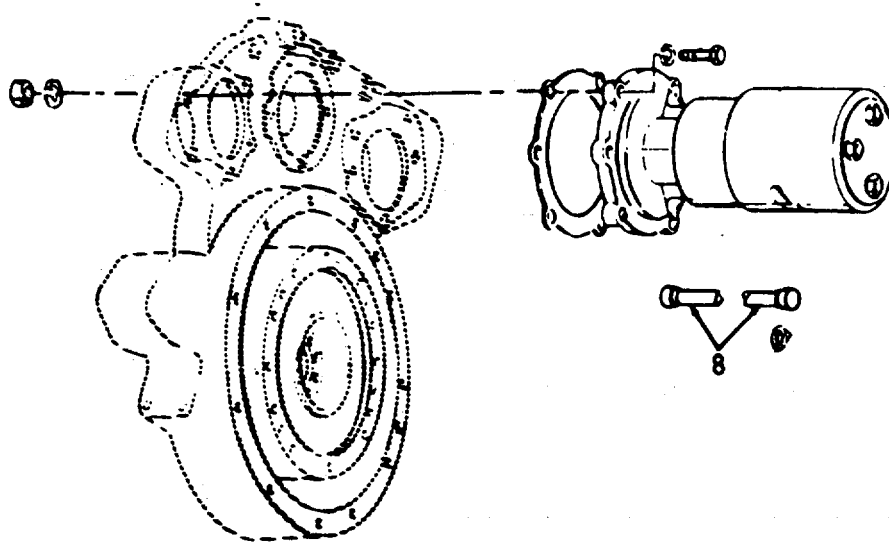
	j. Blower Drive shaft (8)	Install.	Refer to step 4. If necessary, rotate the blower rotors slightly to align the splines of the drive shaft with those in the gear hub.
	k. Fresh water pump	Complete installation.	Refer to paragraph 3-150.
	l. Fuel pump	Complete installation.	Refer to paragraph 3-145.
	m. Governor graph 3-142.	Install.	Refer to para-
	n. Air intake housing	Install.	Refer to paragraph 3-143.
	o. Hydro-starter solenoid	Install.	Refer to paragraph 3-181.
	p. Air cleaner	Install.	Refer to paragraph 3-156.

3-2482'

3-144. BLOWER - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS.

- a. The fuel pump is constructed to be basically trouble-free. Clean, water-free fuel, and maintenance of the fuel filters, will give long, satisfactory service.
- b. If the fuel pump fails to function satisfactorily:
 - Check the level in the fuel tank.
 - Make sure the fuel supply valve is open.
 - Check for external fuel leaks at the fuel line connections, filter gaskets, and air heater lines.
 - Check for a broken-drive shaft or drive coupling. Insert the end of a wire thru one of the pump flange drain holes and crank the engine momentarily. Note if the wire vibrates. Vibration will be felt if the pump shaft rotates.
- c. All fuel pump failures result in no fuel or insufficient fuel being delivered to the fuel injectors and may be indicated by:
 - Uneven running of the engine
 - Excessive vibration
 - Stalling at idling speeds
 - Loss of power
- d. The most common reason for a fuel pump to function improperly is a sticking relief valve. The relief valve, due to its close fit in the valve bore, may stick in a fully open, or partially open position. A small amount of grit or foreign material, lodged between the relief valve and its bore or seat will cause the fuel oil to circulate within the pump, rather than being forced thru the fuel system.
- e. After the relief valve has been checked and the fuel pump reinstalled on the engine, start the engine. Check the fuel flow between the restricted fitting in the fuel return manifold at the cylinder head, and the fuel tank.

3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

This task covers:

- | | | | |
|----|-------------|----|------------------------------|
| a. | Inspection | d. | Inspection after Disassembly |
| b. | Removal | e. | Reassembly |
| c. | Disassembly | f. | Installation |

INITIAL SETUP

Test Equipment

None

References
Paragraph

3-144 Blower Housing

Special Tools

Holding fixture J1508-10
Oil seal puller J1508-13
Oil seal installer J1508-8 & 9
Wrench J4242

Equipment
Condition Condition Description
Paragraph

3-146.3 Fuel Filter, Strainer,
Lines and Manifold
Connections Removal

Material/Parts

Gasket, part of kit
P/N 5196938
Vegetable shortening

Special Environmental Conditions

Do not drain fuel oil into bilges. Use the oil/water separation system to collect fluid. Dispose of properly.

Personnel Required

1

General Safety Instructions

None

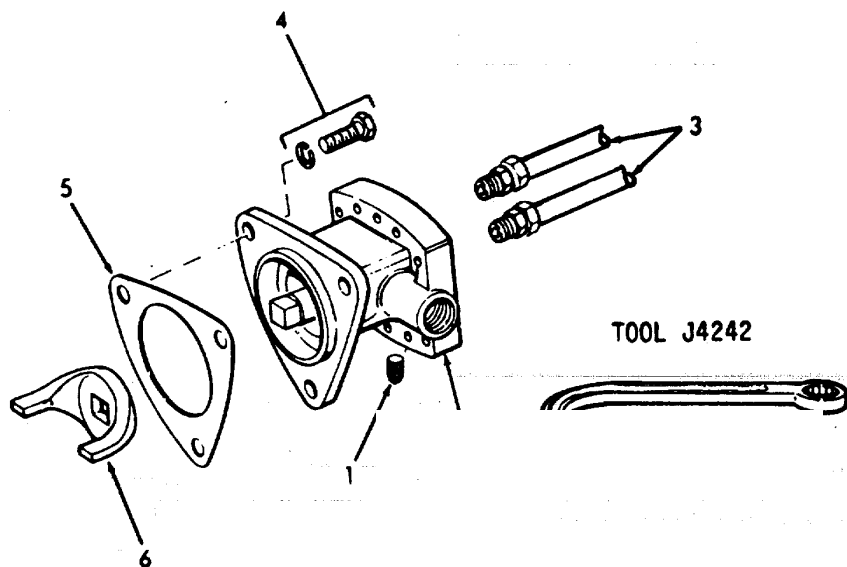
LOCATION	ITEM	ACTION	REMARKS
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(INSPECTION)

- | | | |
|----|-----------|--|
| 1. | Fuel pump | <ul style="list-style-type: none"> a. Check for leaks and cracks. b. Check for secure fit to the blower. c. Check for secure fit of the fuel lines. |
|----|-----------|--|

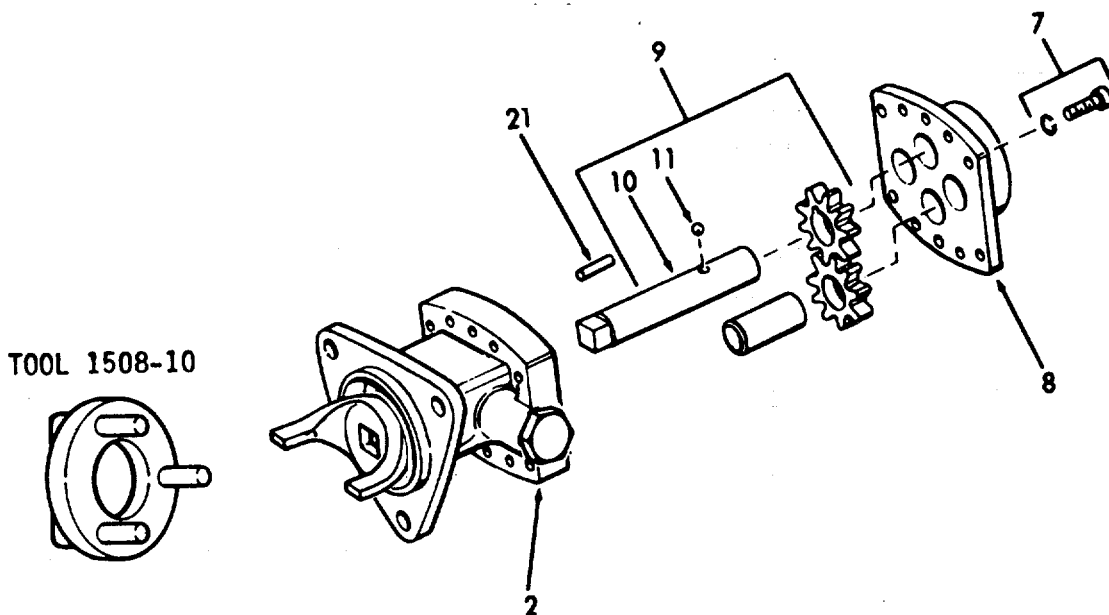
3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
2. Fuel Pump (1)	a. Pipe plugs	1. Remove. 2. Drain fuel pump (2).	Do not drain fuel oil into bilges. Use a suitable container.
	b. Fuel lines (3)	Disconnect.	
3. Blower housing and fuel pump	a. Fuel pump (2)	1. Remove bolt and seal assemblies (4). 2. Withdraw fuel pump (2) from the blower housing. Remove.	Use wrench J4242. Discard gasket.
	b. Gasket (5)	1. Remove.	If broken or worn, replace with a new coupling.
	c. Drive coupling fork (6)	2. Inspect.	



3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
<p>NOTE Mount fuel pump in holding fixture J1508-10 and then disassemble.</p>			
4.	Fuel pump (2)	<p>a. Pump cover (8)</p> <ol style="list-style-type: none"> 1. Remove hex head bolt assemblies (7). 2. Withdraw pump cover (8) from fuel pump (2). 3. Dowel pins (21). <p>b. Drive shaft assembly (9)</p> <p>Remove from fuel pump (2).</p>	Use care. Do not damage the finished faces of the fuel pump and cover. Remove if necessary.
5.	Drive shaft assembly (9)	<p>Drive shaft (10)</p> <ol style="list-style-type: none"> 1. Press drive shaft (10) far enough to remove the steel locking ball (11). 2. Invert drive shaft assembly (9). 	DO NOT MISPLACE STEEL LOCKING BALL.



3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

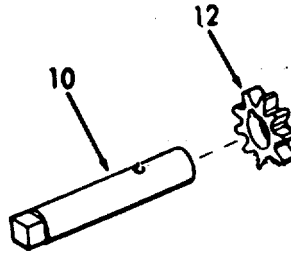
LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

CAUTION

Do not press the square end of the drive shaft through the drive gear, as slight score marks will damage the oil seal contact surface.

3. Press drive shaft (10) from the drive gear (12).



6.	Fuel pump (2)	Driven gear and shaft assembly (13)	Remove.	DO NOT REMOVE GEAR FROM THE SHAFT. The driven gear and shaft are serviced as an assembly only.
7.		a. Relief valve plug (14) and copper gasket (15)	Remove.	Discard copper gasket.

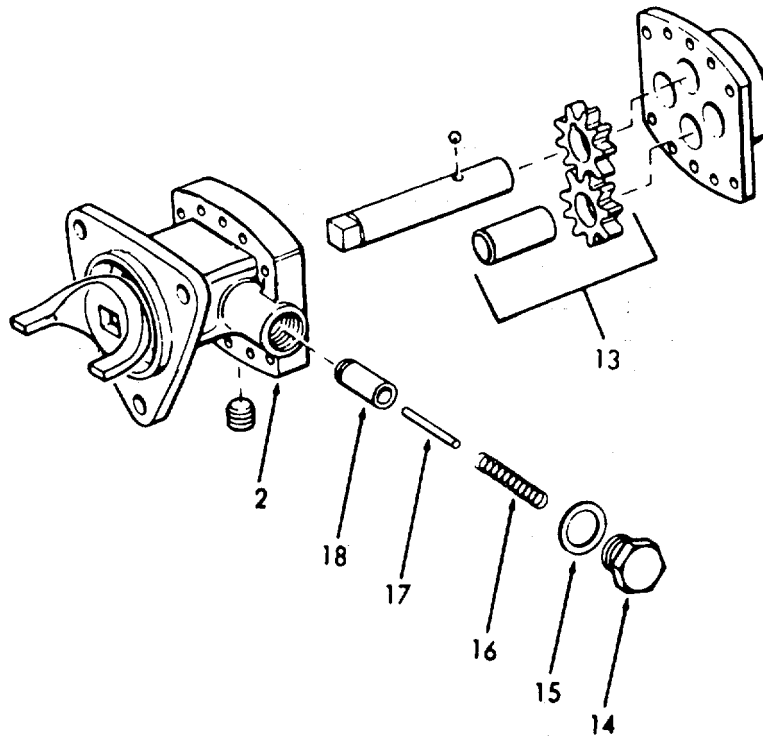
3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

b. Valve spring (16), pin (17), and relief valve (18)

Remove.



3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

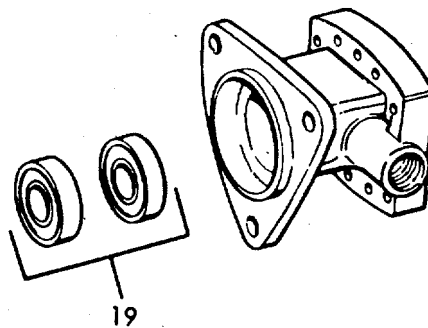
LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

NOTE

Note the position of the oil seal lips before removing the old oil seals. This permits the installation of new oil seals in the same position.

- | | | | |
|----|---------------|---------|--|
| 8. | Oil seal (19) | Remove. | <ul style="list-style-type: none"> a. Use oil seal remover J1508-13. b. Clamp the fuel pump body in a vise and tap the end of the tool with a hammer to remove the outer and inner seals. c. Discard oil seals. |
|----|---------------|---------|--|



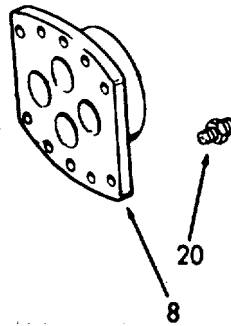
TOOL J1508-13

3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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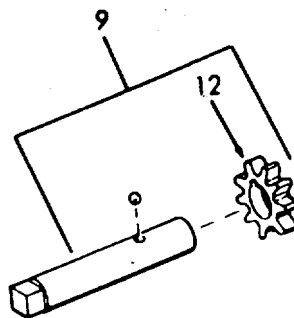
DISASSEMBLY (Cont)

- | | | | |
|----|----------------|-------------------|---------|
| 9. | Pump cover (8) | Pipe reducer (20) | Remove. |
|----|----------------|-------------------|---------|



INSPECTION AFTER DISASSEMBLY

- | | | | | |
|-----|--------------------------|--------------------|--|---------------------------------|
| 10. | Drive shaft assembly (9) | a. Drive gear (12) | 1. Inspect drive gear teeth for scoring, chipping or wear. | If necessary, replace the gear. |
|-----|--------------------------|--------------------|--|---------------------------------|



3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION AFTER DISASSEMBLY			
		2. Inspect ball slot (11) in drive gear (12) for wear.	
	b. Drive shaft (10)	Inspect for scoring or wear.	If necessary, replace the shaft.
11. Driven gear and shaft assembly (13)		Inspect driven gear teeth for scoring, chipping or wear.	If necessary, replace. The driven gear and shaft assembly is replaced as an assembly only.
12. Fuel pump (2), and pump cover (8)	a. Fuel pump (2)	1. Inspect mating face for nicks, burrs, scratches, scoring or wear.	Mating face must be flat and smooth to insure a tight fit with the pump cover. Any scratches or slight damage may result in a pressure leak.
		2. Inspect areas contacted by the gears and shafts for wear, scoring, nicks, or burrs.	If necessary, replace fuel pump.

3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION AFTER DISASSEMBLY

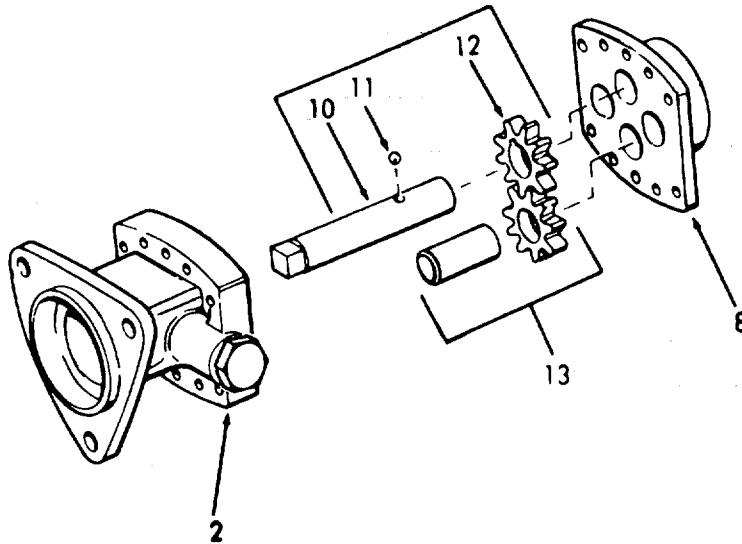
b. Pump cover (8)

1. Inspect mating face for nicks, burrs, scratches, scoring or wear.

Mating face must be flat and smooth to insure a tight fit with the fuel pump. Any scratches or slight damage may result in a pressure leak.

2. Inspect areas contacted by the gears and shafts for wear, scoring, nicks or burrs.

If necessary, replace pump cover.



3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

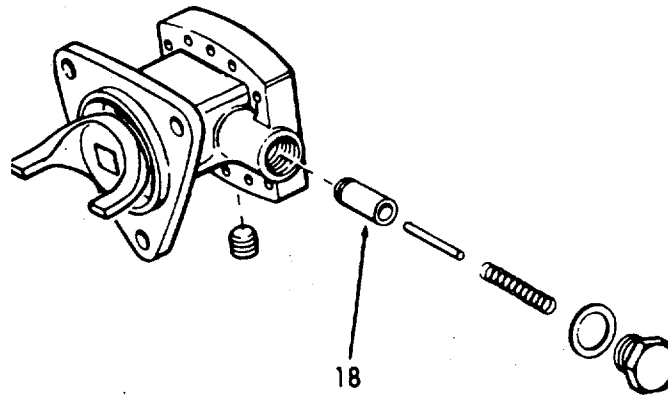
LOCATION	ITEM	ACTION	REMARKS
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INSPECTION AFTER DISASSEMBLY

13. Relief valve (18)

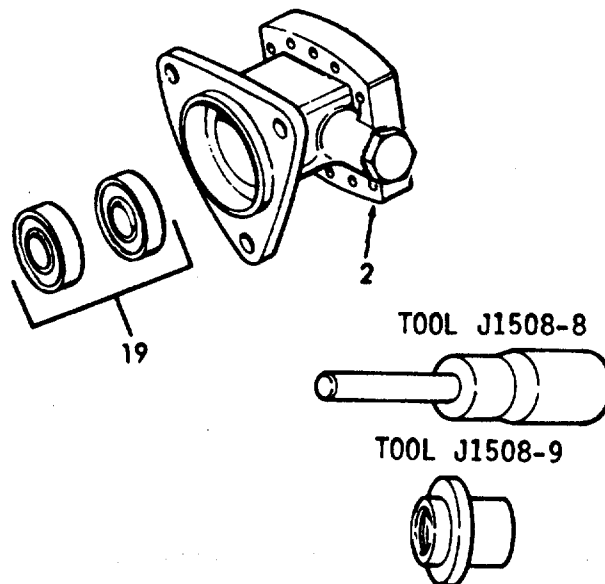
- a. Inspect for score marks and burrs.
- b. If scored, clean relief valve with fine emery cloth or crocus cloth.
- c. Inspect the seat of the relief valve for proper fit.

If relief valve cannot be cleaned with a fine emery cloth or crocus cloth, replace relief valve.



3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY			
14. Fuel pump (2)	Oil seals (19)	<p>a. Lubricate lips of oil seals (19) with a light coating of vegetable shortening.</p> <p>b. Inner oil seal:</p> <ol style="list-style-type: none"> 1. Place the inner oil seal on the pilot of the oil seal installer handle so that the lip of the oil seal will face in the same direction as the original oil seal which was removed. 	Use oil seal installer J1508-8 and 9.



3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

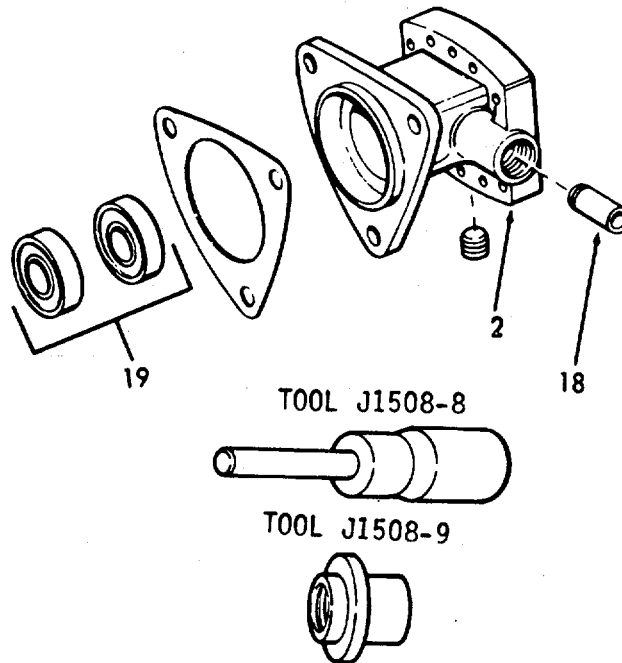
LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REASSEMBLY (Cont)</div>		<ol style="list-style-type: none"> 2. Support fuel pump on wood blocks. Insert the pilot of the oil seal installer handle in the fuel pump so the seal starts straight into the pump flange. 3. Drive the oil seal in until it bottoms. 	
	c. Outer oil seal:	<ol style="list-style-type: none"> 1. Place the shorter end of the adaptor J1508-9 over the pilot and against the shoulder of the oil seal installer handle J1508-8. 2. Place the outer oil seal on the pilot of the installer handle with the lips of the oil seal facing the adaptor. Insert the pilot of the oil seal installer handle into the fuel pump. 3. Drive the oil seal in until the shoulder of the adaptor contacts the fuel pump. 	<p>Use oil seal installer J1508-8 and 9.</p>

3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|------------------------------|----------------------|--|----------------------------------|
| | | d. The oil seals (19) are now positioned so that the space between them will correspond with the drain holes located in the bottom of the fuel pump. | |
| 15. Fuel pump (2) soft jaws. | a. Relief valve (18) | <ol style="list-style-type: none"> 1. Clamp fuel pump (2) in a bench vise with the valve cavity up. 2. Lubricate outside diameter of valve, and place it in the cavity with hollow end up. | Bench vise must be equipped with |

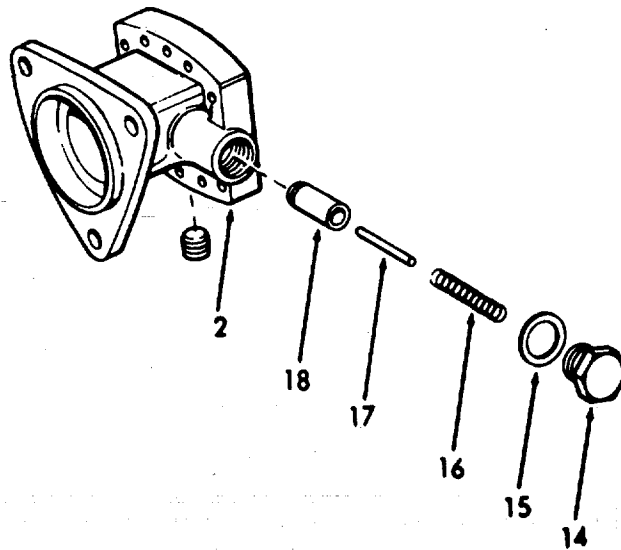


3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|--|--|--|
| b. | Valve spring (16) | <ol style="list-style-type: none"> 1. Insert valve spring (16) into relief valve (18). 2. Insert pin (17) inside of valve spring (16). | |
| c. | Copper gasket (15), and relief valve plug (14) | <ol style="list-style-type: none"> 1. Install. 2. Screw relief valve plug (14) into fuel pump (2). | <p>Use new copper gasket.</p> <p>Tighten relief valve plug to 18-24 lb. ft. (24-33 Nm) torque.</p> |



3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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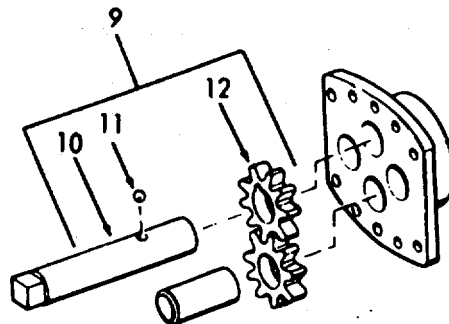
REASSEMBLY (Cont)

16. Drive shaft assembly (9)	a. Drive gear (12)	<ol style="list-style-type: none"> 1. Install drive gear (12) over end of drive shaft (10). 2. Make sure the slot in the drive gear (12) will face the plain end of the drive shaft (10). 	Do not use the squared end.
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NOTE

This operation is very important; otherwise fine score marks caused by pressing the gear into position from the square end of the shaft, may cause rapid wear of the oil seals.

3. Press the drive gear (12) beyond the retaining locking steel ball (11) detent.
4. Install locking steel ball (11) into detent.
5. Press drive gear (12) back until the drive gear (12) slot contacts the locking steel ball (11).



3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
17. Driven gear and shaft assembly (13)	b. Drive shaft (10)	1. Lubricate the drive shaft (10).	Use clean engine oil.
		2. Insert the square end of the drive shaft (10) into the gear side of the fuel pump (2), and through the oil seals (19).	
		a. Lubricate	Use clean engine oil.

CAUTION

The driven gear must be centered on the driven shaft to give proper end clearance. Also, the chamfered end of the gear teeth of the production gear must face the fuel pump. If a service replacement gear with a slot is used, the slot must face toward the pump cover.

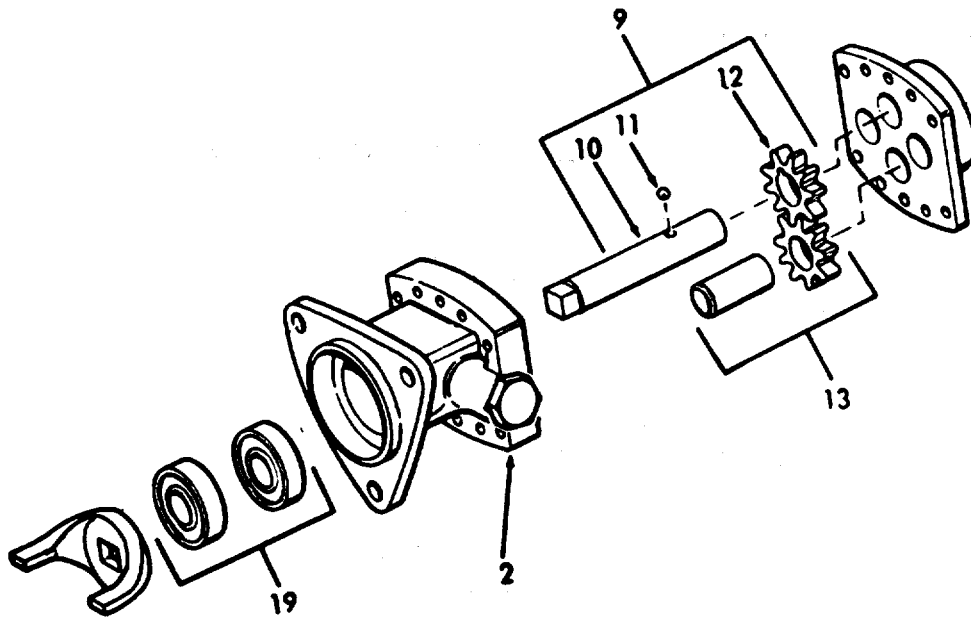
- b. Install.

3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|---|--|-----------------------|-----------------------|
| 18. Drive shaft assembly (9), and driven gear and shaft assembly (13) | | Lubricate assemblies. | Use clean engine oil. |
|---|--|-----------------------|-----------------------|



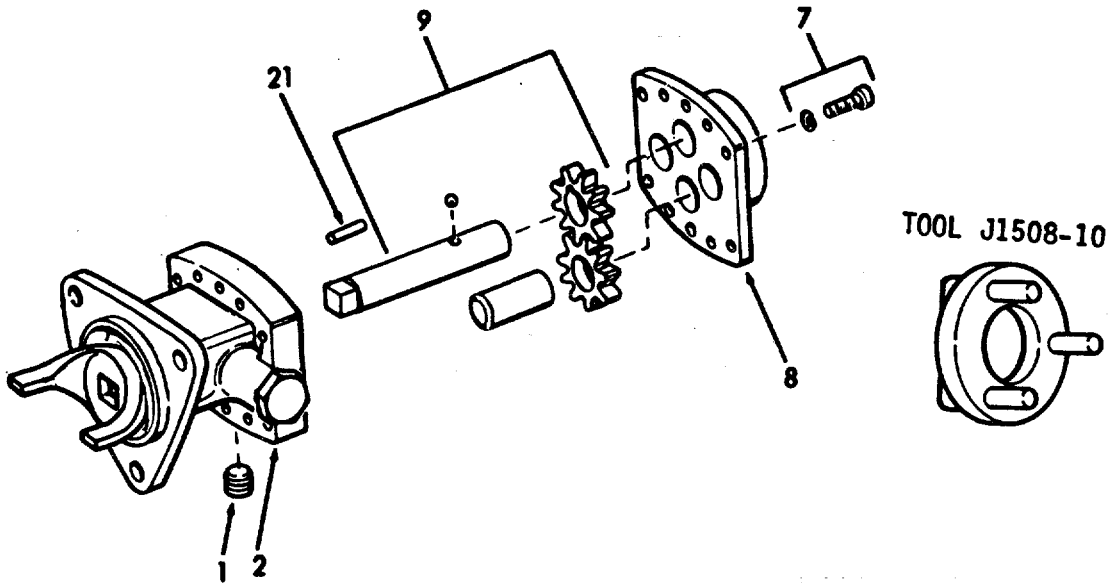
3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
CAUTION			
<p>The coating of sealant must be extremely thin since the pump clearances have been set up on the basis of metal-to-metal contact. Too much sealant could increase the clearances and affect the efficiency of the pump. Use care that sealant is not squeezed into the gear compartment, otherwise damage to the gears and shafts may result.</p>			
19. Fuel pump (2)	a. Pump cover (8)	<ol style="list-style-type: none"> 1. Apply a thin coat of quality sealant on the face of the pump cover, (8) outside of the gear area. 2. Install pump cover (8) onto fuel pump (2) by the alignment of the dowel pins (21). 3. Install hex head bolt assemblies (7). 	<p>If removed during disassembly, install dowel pins (21) into pump cover (8). Pump cover (8) can be installed in one position only over the shafts.</p> <p>lighten bolt assemblies alternately and evenly.</p>
	b. Drive shaft assembly (9)	Turn the drive shaft (9) by hand to make certain that the parts rotate freely.	If drive shaft does not rotate freely, attempt to free by tapping a corner of the pump.
	c. Pipe plugs (1)	Install.	

3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)



INSTALLATION

NOTE

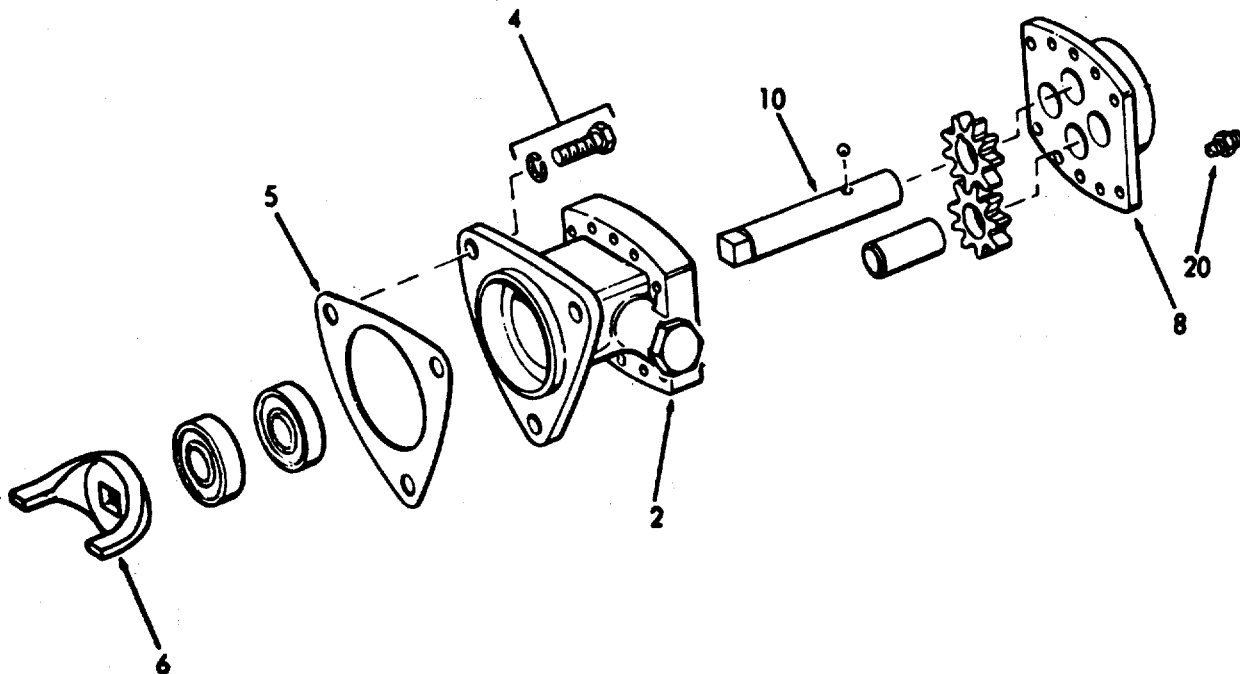
The fuel pump is bolted to the blower. The fuel pump is driven by a drive disc at the rear of the blower's lower rotor.

3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

20. Fuel Pump (2), and blower	a. Gasket (5)	Install.	
	b. Drive coupling fork (6)	Install onto square end of drive shaft (10).	
	c. Fuel pump (2)	1. Install onto blower.	Make sure drive coupling fork (6) registers with the slots in the blower rotor shaft drive disc.
		2. Install bolt and seal assemblies (4).	Tighten.
d. Pipe reducers (20)	Install into pump cover (8).		



3-145. FUEL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

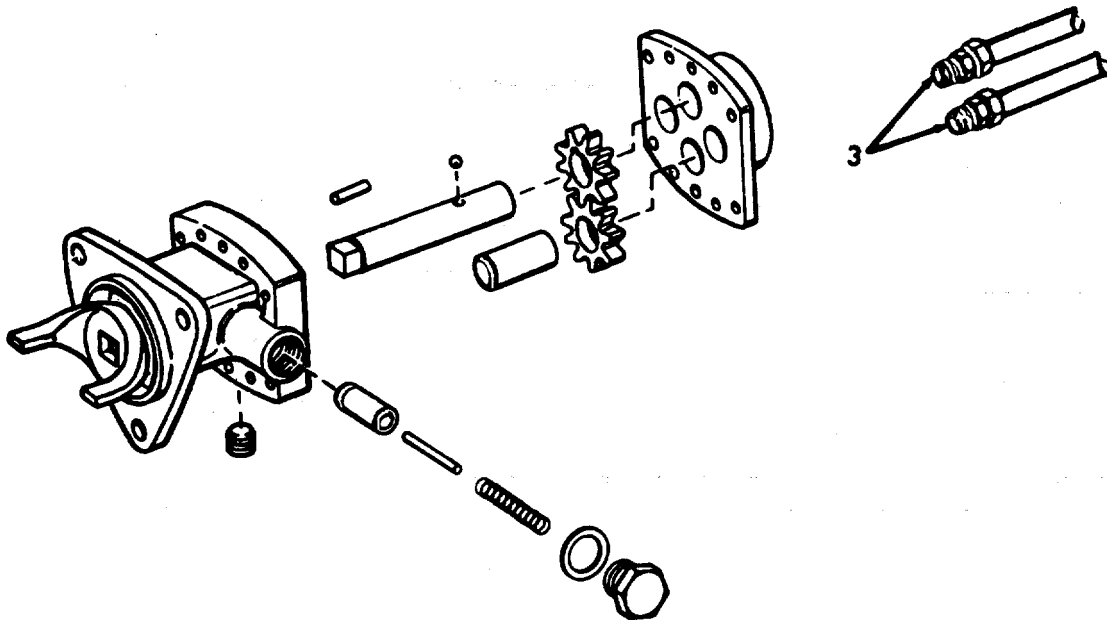
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

e.	Fuel lines (3)	Connect.	
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NOTE

If fuel pump is replaced or rebuilt, prime the fuel system before starting the engine. This will prevent the possibility of pump seizure upon initial starting.



3-146. FUEL FILTER, FUEL STRAINER, FUEL LINES AND MANIFOLD CONNECTIONS - MAINTENANCE INSTRUCTIONS.

a. General

(1) A fuel strainer (primary) and fuel filter (secondary), are used to remove impurities from the fuel. The fuel strainer is located between the fuel tank and the fuel pump. The replaceable density-type element is capable of filtering out particles of 30 microns (a micron is approximately .00004 inch). The fuel filter is installed between the fuel pump and the fuel inlet manifold. The replaceable paper-type element can remove particles as small as 10 microns.

(2) The fuel strainer and fuel filter are essentially the same in construction and operation.

(3) The filter and strainer consist basically of a shell, a cover and a replaceable filtering element. The assembly is made oil tight by a shell gasket, a cover nut or bolt, and a cover nut or bolt gasket.

(4) The central stud is a permanent part of the shell and, when the unit is assembled, extends up through the cover where the nut or bolt holds the assembly together.

(5) A filter element sets over the central stud inside the shell and is centered in the shell by the stud.

b. Operation

(1) Since the fuel strainer is between the fuel supply tank and the fuel pump, it functions under suction. The fuel filter, placed between the fuel pump and the fuel inlet manifold in the cylinder head, operates under pressure. Fuel enters through the inlet passage in the cover and into the shell surrounding the filter element. Pressure or suction created by the pump causes the fuel to flow through the filter element where dirt particles are removed. Clean fuel flows to the interior of the filter element, up through the central passage in the cover and into the outlet passage, then to the fuel inlet manifold in the cylinder head.

(2) The following paragraphs contain the maintenance instructions:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Fuel Filter	3-146.1
Fuel Strainer	3-146.2
Fuel Lines and Manifold Connections	3-146.3

3-146.1. FUEL FILTER - MAINTENANCE INSTRUCTIONS.

This task covers:

- | | | |
|---------------|-----------------|-----------|
| a. Inspection | c. Removal | |
| b. Service | d. Installation | e. Repair |

INITIAL SETUP

Test Equipment
None

References
None

Special Tools
None

Equipment
Condition Condition Description
None

Material/Parts
Filter element with
gasket P/N 5573261

Special Environmental Conditions
Do not drain fuel into bilges.

Personnel Required
1

General Safety Instructions
Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

1.	Fuel filter assembly	a. Shell and cover	Inspect shell-to-cover seals for leakage.	
		b. Inlet and outlet tube connections	Inspect for leakage.	
		c. Cover screw gasket	Check for leakage under screw head.	
		d. Engine	Check for erratic operation caused by shortage of fuel or flow obstruction.	If fuel flow is restricted, replace filter element.

3-146.1. FUEL FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
SERVICE			
2. Fuel filter assembly	a. Engine	Shut down.	
	b. Drain-cock (1)	Rotate counter-clockwise.	Place a suitable container under the filter assembly to catch fuel oil. Loosen screw (2) just enough to allow fuel to drain freely. When fuel has drained out, close draincock.

CAUTION

The wiring harness or other electrical equipment must be shielded when draining the fuel, since fuel oil can permanently damage the electrical insulation.

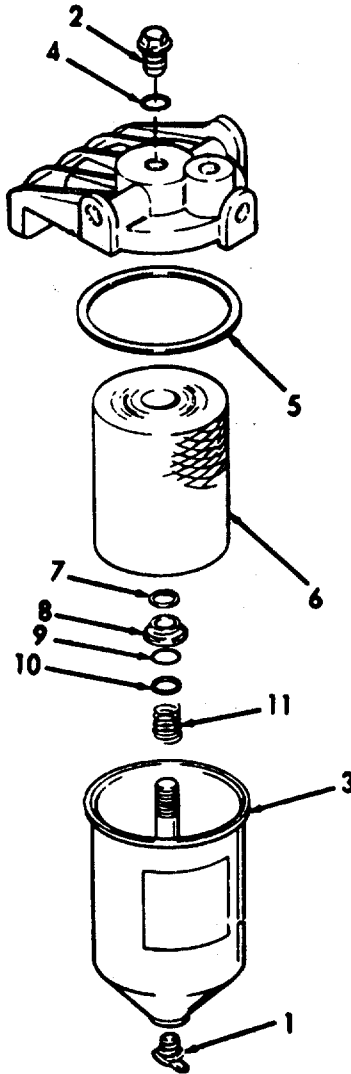
c. Screw (2)	Remove while supporting shell (3).	
d. Gasket (4)	Remove.	Discard gasket.
e. Gasket (5)	Remove.	Discard gasket.
f. Filter element (6)	Remove.	Discard filter element.
g. Filter element seat retainer (7), and seat (8)	Remove.	

3-146.1. FUEL FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont)

	h. Seat seal (9), spring seat (10), and spring (11)	Remove.	
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3-146.1. FUEL FILTER - MAINTENANCE INSTRUCTIONS (Continued).

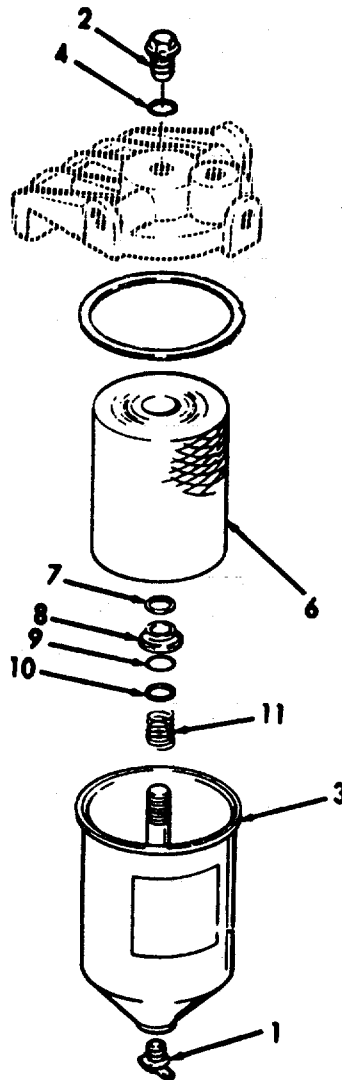
LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">SERVICE (Cont)</div>			
<div style="border: 2px solid black; padding: 5px; display: inline-block; background-color: black; color: white;">WARNING</div>			
<p>Wear eye protection when using compressed air.</p>			
	i. Shell (3)	Clean all parts.	Wash thoroughly with clean fuel oil and dry with compressed air.
	j. Seat seal (9)	Inspect for hardening or cracks.	
	k. Spring (11), spring seat (10), seat seal (9), seat (8), and element seat retainer (7)	Install.	Check by pressing on element seat (8). When released, the spring must return against the retainer (7). If necessary, replace the spring.
	l. Drain-cock (1)	Rotate clockwise to close.	
	m. Replace element (6)	Place over center stud of shell (3) and push it against the element seat (8)	

3-146.1. FUEL FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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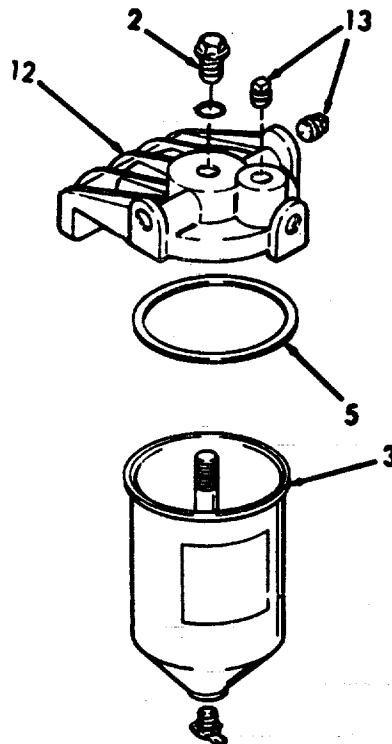
SERVICE (Cont)

- | | | | |
|----|------------------------|---|-----------------|
| n. | Shell (3). | Fill about two-thirds full with clean fuel oil. | |
| o. | Cover screw gasket (4) | Install on screw (2). | Use new gasket. |



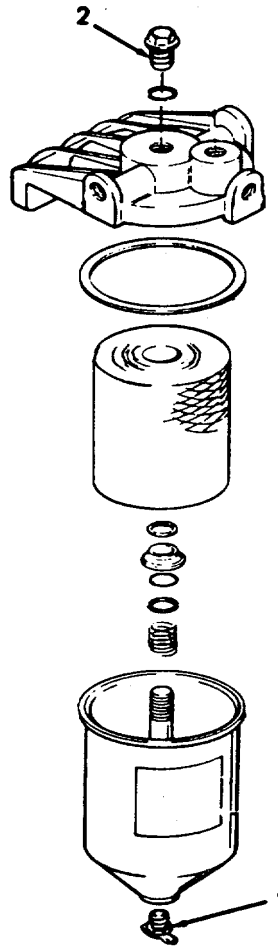
3-146.1. FUEL FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
SERVICE (Cont)			
	p. Shell gasket (5)	Place in recess of shell (3).	Use new gasket.
	q. Shell (3) with filter element	Place under cover (12). Secure with screw (2).	Tighten screw just enough to prevent fuel leakage.
	r. Plug (13)	Remove.	Completely fill shell (3) with fuel oil.
	s. Plug (13)	Reinstall plug.	
	t. Engine	Start and check the fuel system for leaks.	



3-146.1. FUEL FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
3. Fuel filter assembly	a. Engine b. Draincock (1)	Shut down. Rotate counter-clockwise.	Open draincock after placing a suitable container under the filter assembly to catch the fuel oil. Loosen screw (2) just enough to drain freely. When fuel has drained out, close the draincock.



3-146.1. FUEL FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

CAUTION

The wiring harness or other electrical equipment must be shielded when draining the fuel, since fuel oil can permanently damage the electrical insulation.

- | | | | |
|----|---|-----------------------------|--|
| c. | Inlet hose | Disconnect at fitting (14). | |
| d. | Outlet hose | Disconnect at elbow (15). | |
| e. | Screws (16), lock-washers (17), and flat-washers (18) | Remove. | |
| f. | Filter cap (12) including filter shell | Remove. | |

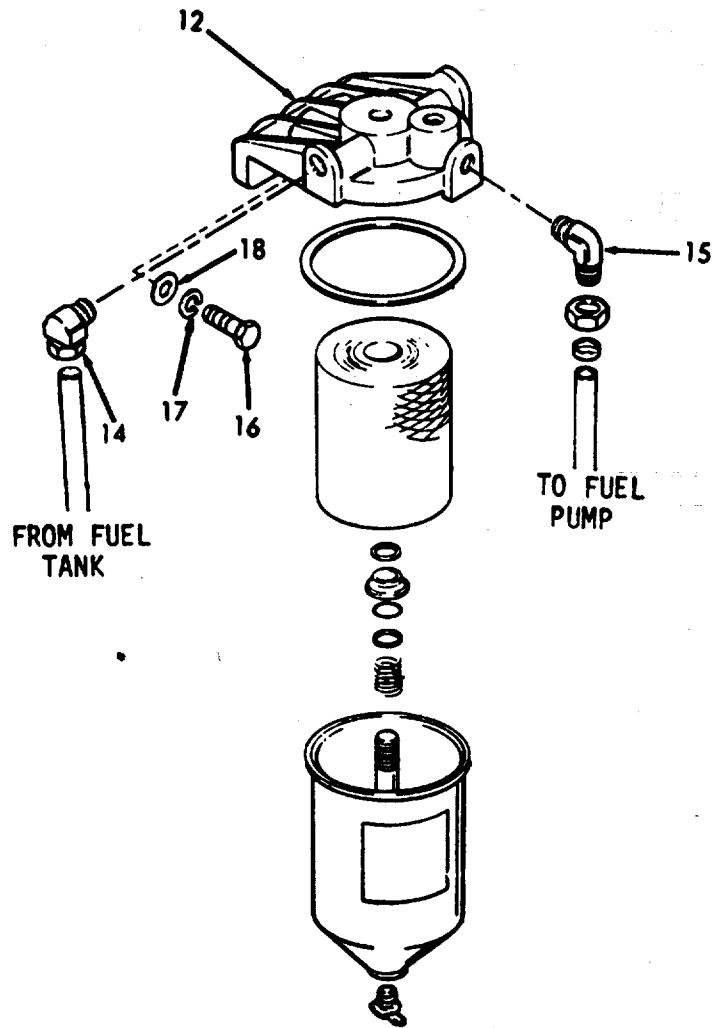
NOTE

Removal of the fuel filter assembly can be made easier if the filter element shell is removed first. Refer to Service - step 2.

3-146.1. FUEL FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



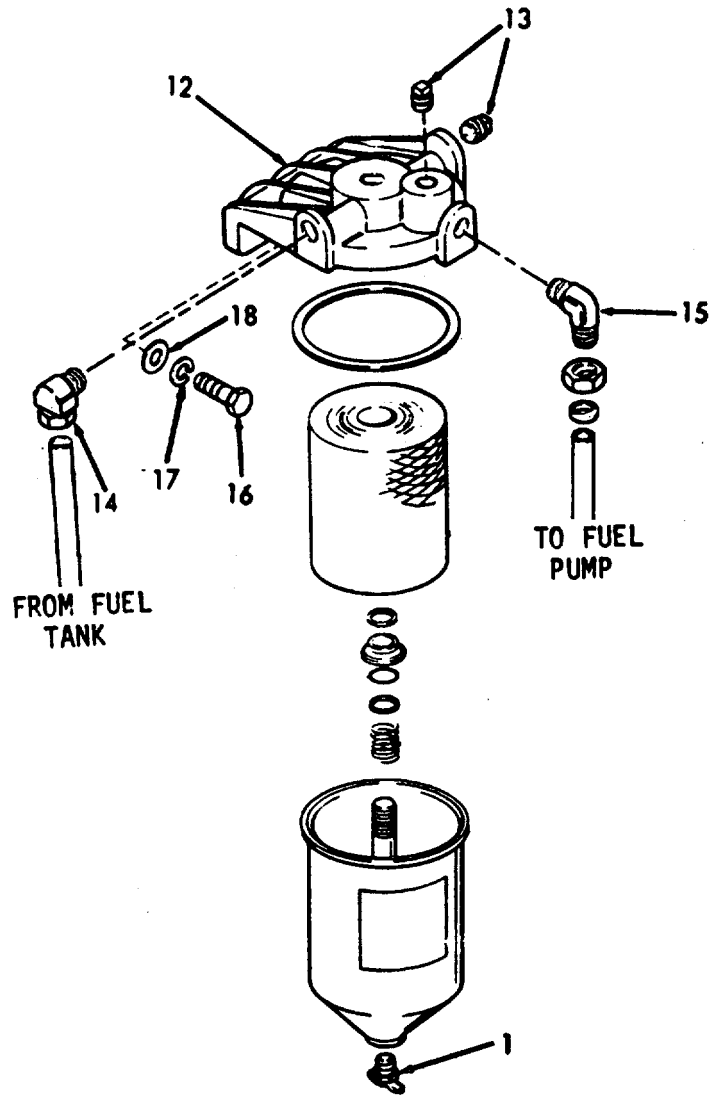
3-146.1. FUEL FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
4. Fuel filter assembly	a. Screws (16), lock-washers (17), flat-washers (18), and strainer cap (12), including strainer shell	Reassemble.	
	b. Outlet hose	Reinstall at elbow (15).	
	c. Inlet hose	Reinstall at fitting (14).	
	d. Drain-cock (1)	Make sure it is closed.	
	e. Plug (13)	Remove completely. Fill shell with fuel oil. Re-install plug (13).	
	f. Engine	Start and check fuel system for leaks.	

3-146.1. FUEL FILTER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION



REPAIR

- | | | |
|----|----------------------|---|
| 5. | Fuel filter assembly | Repair fuel filter bracket and cap in accordance with standard procedures |
|----|----------------------|---|

3-146.2 FUEL STRAINER - MAINTENANCE INSTRUCTIONS

This task covers:

- | | | | | | |
|----|------------|----|--------------|----|--------|
| a. | Inspection | c. | Removal | e. | Repair |
| b. | Service | d. | Installation | | |

INITIAL SETUP

Test Equipment
None

References
Paragraph

3-146.3 Fuel Lines and Manifold Connections

Special Tools

None

Equipment
Condition Condition Description

None

Material/Parts
Strainer element with gasket P/N T553

Special Environmental Conditions
Do not drain fuel into bilges.

Personnel Required

1

General Safety Instructions

Observe all CAUTIONS and WARNINGS

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | | |
|---------------------------|--------------------------------------|---|---|
| 1. Fuel strainer assembly | a. Shell and cover | Inspect shell-to-cover seal for leakage. | |
| | b. Inlet and outlet tube connections | Inspect for leakage. | |
| | c. Cover screw gasket | Check for leakage under screw head. | |
| | d. Engine | Check for erratic operation caused by a shortage of fuel or flow obstruction. | If fuel flow is restricted, replace strainer element. |

3-146.2 FUEL STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
SERVICE			
2. Fuel strainer assembly	a. Engine	Shut down.	
	b. Drain-cock (1)	Rotate counter-clockwise.	Open draincock after placing a suitable container under the strainer assembly to catch the fuel oil. Loosen screw (2) just enough to allow fuel to drain freely. When fuel had drained out, close the draincock.

CAUTION

The wiring harness, or other electrical equipment must be shielded when draining the fuel, since fuel oil can permanently damage the electrical insulation.

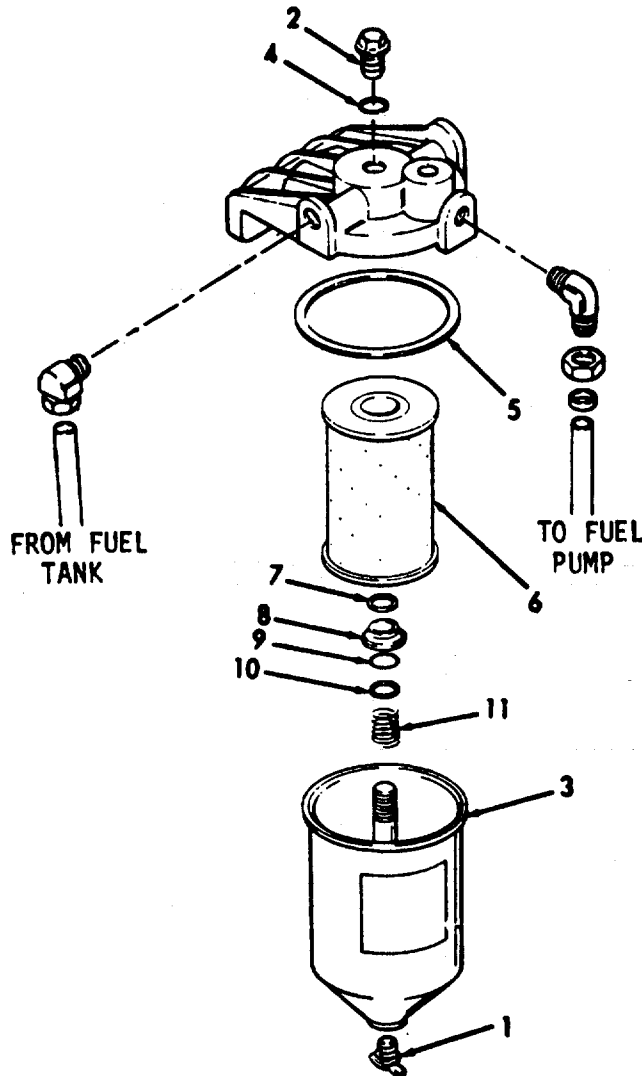
c. Screw (2)	Remove supporting shell (3).	
d. Gasket (4)	Remove.	Discard gasket.
e. Gasket (5)	Remove.	Discard gasket.
f. Strainer element (6)	Remove.	Discard element.
g. Strainer element seat retainer (7) and seat (8)	Remove.	

3-146.2 FUEL STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

SERVICE (Cont)

- | | | | |
|----|--|---------|--|
| h. | Seat seal (9), spring seat (10), and spring (11) | Remove. | |
|----|--|---------|--|



3-146.2 FUEL STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

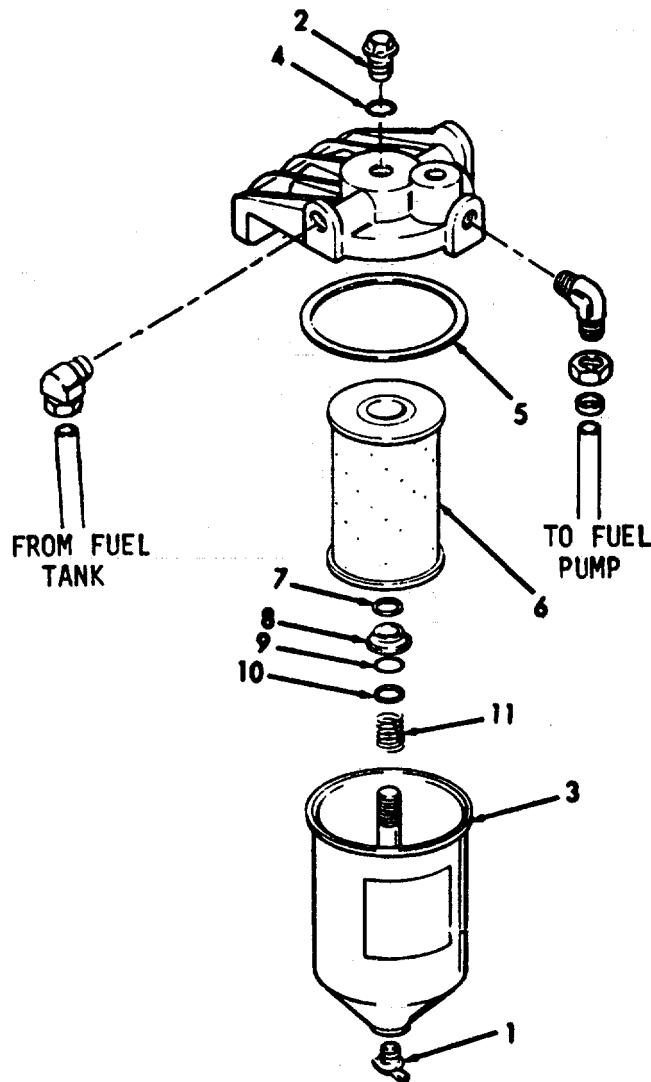
LOCATION	ITEM	ACTION	REMARKS
SERVICE (Cont)			
WARNING			
Wear protective eye goggles when using compressed air.			
	i. Shell (3)	Clean all parts.	Wash thoroughly with clean fuel oil and dry with compressed air.
	j. Seat seal (9)	Inspect for hardening or cracks.	
	k. Spring (11), spring seat (10), seat seal (9), seat (8), and element seat retainer (7)	Install.	Check by pressing on element seat (8). When released, the spring must return against the retainer (7). If necessary, replace the spring.
	l. Drain-cock (1)	Rotate clockwise to close.	
	m. Replacement element (6)	Place over center stud of shell (3) and push it against the element seat (8).	
	n. Shell (3)	Fill about two-thirds full with clean fuel oil.	

3-146.2 FUEL STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

SERVICE (Cont)

- | | | | |
|--|---------------------------|-------------------------------|-----------------|
| | o. Cover screw gasket (4) | Install on screw (2). | Use new gasket. |
| | p. Shell gasket (5) | Place in recess of shell (3). | Use new gasket. |

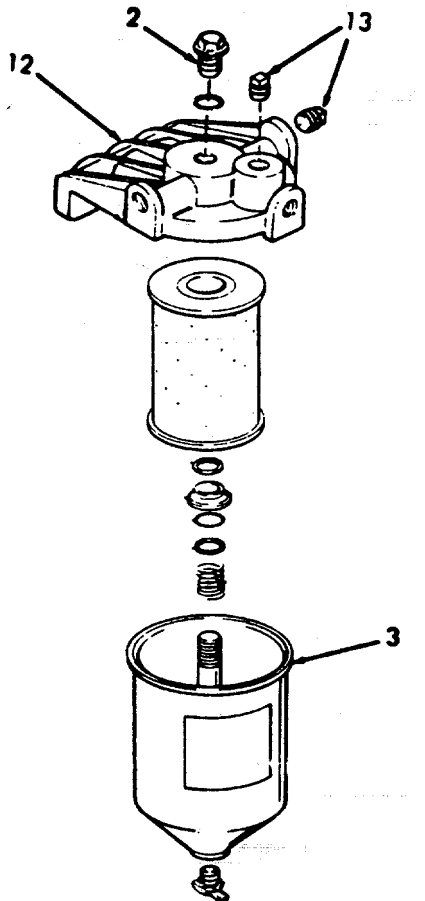


3-146.2 FUEL STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

SERVICE (Cont)

- | | | | |
|----|---------------------------------|--|--|
| q. | Shell (3) with strainer element | Place under cover (12). Secure with screw (2). | Tighten screw just enough to prevent fuel leakage. |
| r. | Plug (13) | Remove. | Completely fill shell (3) with fuel oil. |
| s. | Plug (13) | Reinstall. | |
| t. | Engine | Start, and check fuel system for leaks. | |

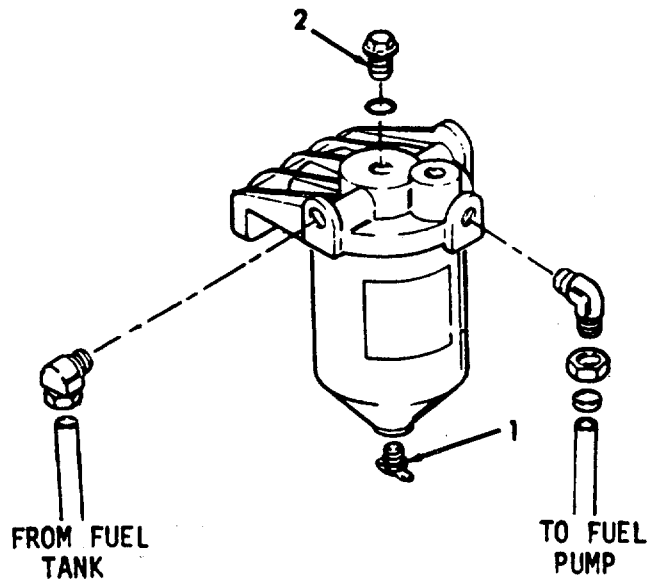


3-146.2 FUEL STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL

- | | | | |
|---------------------------|-------------------|---------------------------|---|
| 3. Fuel strainer assembly | a. Engine | Shut down. | Open drain-cock after placing a suitable container under the strainer assembly to catch the fuel oil. Loosen screw (2) just enough to allow fuel to drain freely. When fuel has drained out close the drain-cock. |
| | b. Drain-cock (1) | Rotate counter-clockwise. | |



3-146.2 FUEL STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

CAUTION

The wiring harness, or other electrical equipment must be shielded when draining the fuel oil since fuel oil can permanently damage the electrical insulation.

- | | | |
|----|-------------|----------------------|
| c. | Inlet hose | Disconnect at elbow. |
| d. | Outlet hose | Disconnect at elbow. |

NOTE

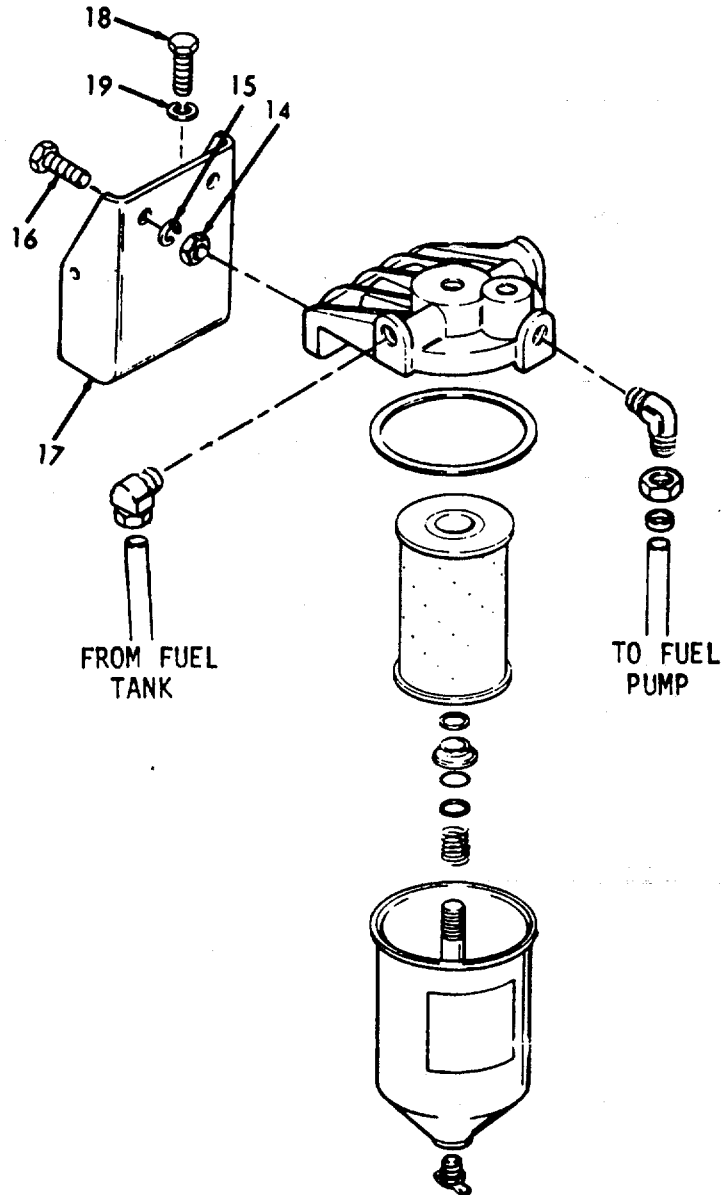
Removal of the fuel strainer assembly can be made easier if the strainer element shell is removed. Refer to Service - step 2.

- | | | |
|----|--|------------------------------------|
| e. | Nuts (14), lock-washers (15), cap-screws (16), and strainer assembly | Remove from mounting bracket (17). |
| f. | Screws (18) and lock-washers (19) | Remove. |
| g. | Bracket (17) | Remove. |

3-146.2 FUEL STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



3-146.2 FUEL STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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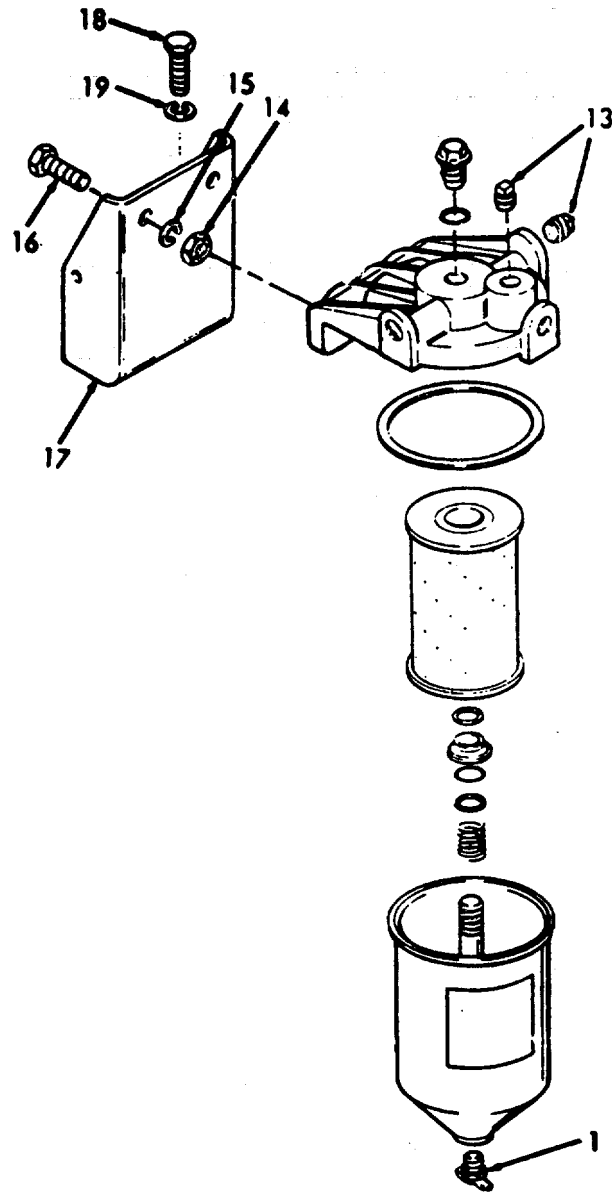
INSTALLATION

- | | | | |
|---------------------------|---|--|--|
| 4. Fuel strainer assembly | a. Bracket (17), screws (18), and lock-washers (19) | Reassemble. | |
| | b. Strainer assembly, screws (16), lock-washers (15), and nuts (14) | Reassemble on bracket (17). | |
| | c. Outlet line | Reconnect elbow. | |
| | d. Inlet line | Reconnect elbow. | |
| | e. Drain-cock (1) | Make sure it is closed. | |
| | f. Plug (13) | Remove completely. Fill shell with fuel oil. Re-install plug (13). | |
| | g. Engine | Start and check fuel system for leaks. | |

3-146.2 FUEL STRAINER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



REPAIR

5. Fuel strainer assembly

Repair fuel strainer bracket and cap in accordance with standard procedures

3-146.3. FUEL LINES AND—MANIFOLD CONNECTIONS - MAINTENANCE INSTRUCTIONS

a. The fuel system includes the following which are integral to the engine fuel injectors, fuel pipes and fuel manifold. The external components of the fuel system are a fuel filter, a fuel strainer, a fuel pump and fuel lines.

b. Fuel is drawn from the supply tank through the fuel strainer, and enters the fuel pump at the inlet side. Leaving the pump under pressure, the fuel is forced through the fuel filter and into the inlet fuel manifold, then through the fuel pipes and into the inlet side of each fuel injector.

c. The fuel manifold is identified by the words IN (top passage) and OUT (bottom passage) cast into the engine block.

d. Surplus fuel returns from the outlet side of the injectors to the fuel return manifold and then back to the supply tank.

This task covers:

- a. Inspection b. Replacement

INITIAL SETUP

Test Equipment
None

References
None

Special Tools
None

Equipment
Condition Condition Description
None

Material/Parts
None

Special Environmental Conditions
Do not drain fuel into bilges.
Use the oil/water separation
and recovery system to collect
drained oil. Discard properly.

Personnel Required

General Safety Instructions

1

None

3-146.3. FUEL LINES AND MANIFOLD CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued).

This task covers:

- a. Inspection b. Replacement
-

INSPECTION

- | | | | |
|----|---|-------------|--|
| 1. | Tube
filter-
to
cylinder
head | a. Tube | Inspect for cracks,
breaks, dents and bends. |
| | | b. Fittings | Inspect for leaking. |
| 2. | Tube
filter-
to-
fuel
pump | a. Tube | Inspect for cracks,
breaks, dents and bends. |
| | | b. Fittings | Inspect for leaking. |
| 3. | Tube
drain | a. Tube | Inspect for cracks,
breaks, dents and bends. |
| | | b. Fittings | Inspect for leaking. |
| 4. | Tube
fuel
pump-
to-
strainer | a. Tube | Inspect for cracks,
breaks, dents and
bends. |
| | | b. Fittings | Inspect for leaking. |
| 5. | Tube
strainer | a. Tube | Inspect for cracks,
breaks, dents and
bends. |
| | | b. Fittings | Inspect for leaking. |

3-146.3. FUEL LINES AND MANIFOLD CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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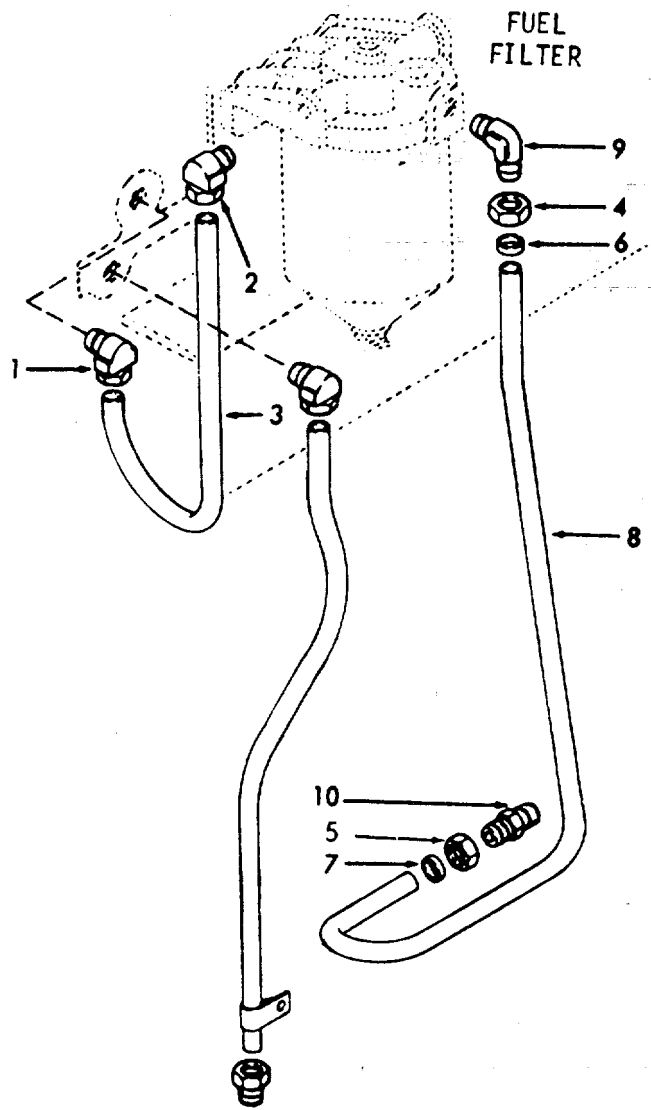
REPLACEMENT

- | | | | |
|----|------------------------------|-------------------------|----------|
| 6. | Tube filter-to-cylinder head | a. Elbow (1) | Loosen. |
| | | b. Elbow (2) | Loosen. |
| | | c. Tube (3) | Remove. |
| | | d. Tube (3) | Replace. |
| | | e. Elbow (2) | Tighten. |
| | | f. Elbow (1) | Tighten. |
| 7. | Tube filter-to-fuel | a. Tube nuts (4 and 5) | Remove. |
| | | b. Ring seals (6 and 7) | Remove. |
| | | c. Tube (8) | Remove. |
| | | d. Elbow (9) | Remove. |
| | | e. Connector (10) | Remove. |

3-146.3. FUEL LINES AND MANIFOLD CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)



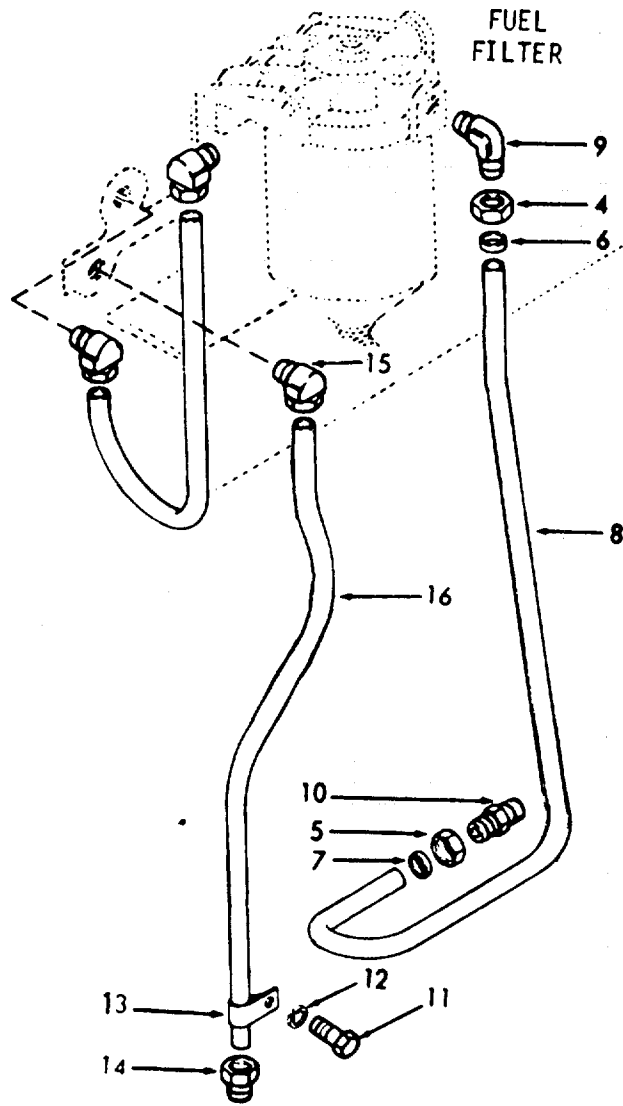
3-146.3. FUEL LINES AND MANIFOLD CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACEMENT (Cont)			
	f. Con- nector (10)	Install.	
	g. Elbow (9)	Install.	
	h. Tube (8)	Install.	
	i. Ring seals (6 and 7)	Install.	
	j. Tube nuts (4 and 5)	Install.	
8. Tube- Drain	a. Screw (11) and lock- washer (12)	Remove from clamp (13).	
	b. Con- nector (14)	Remove.	
	c. Elbow (15)	Remove.	
	d. Tube (16)	Remove.	
	e. Tube (16)	Install.	

3-146.3. FUEL LINES AND MANIFOLD CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)



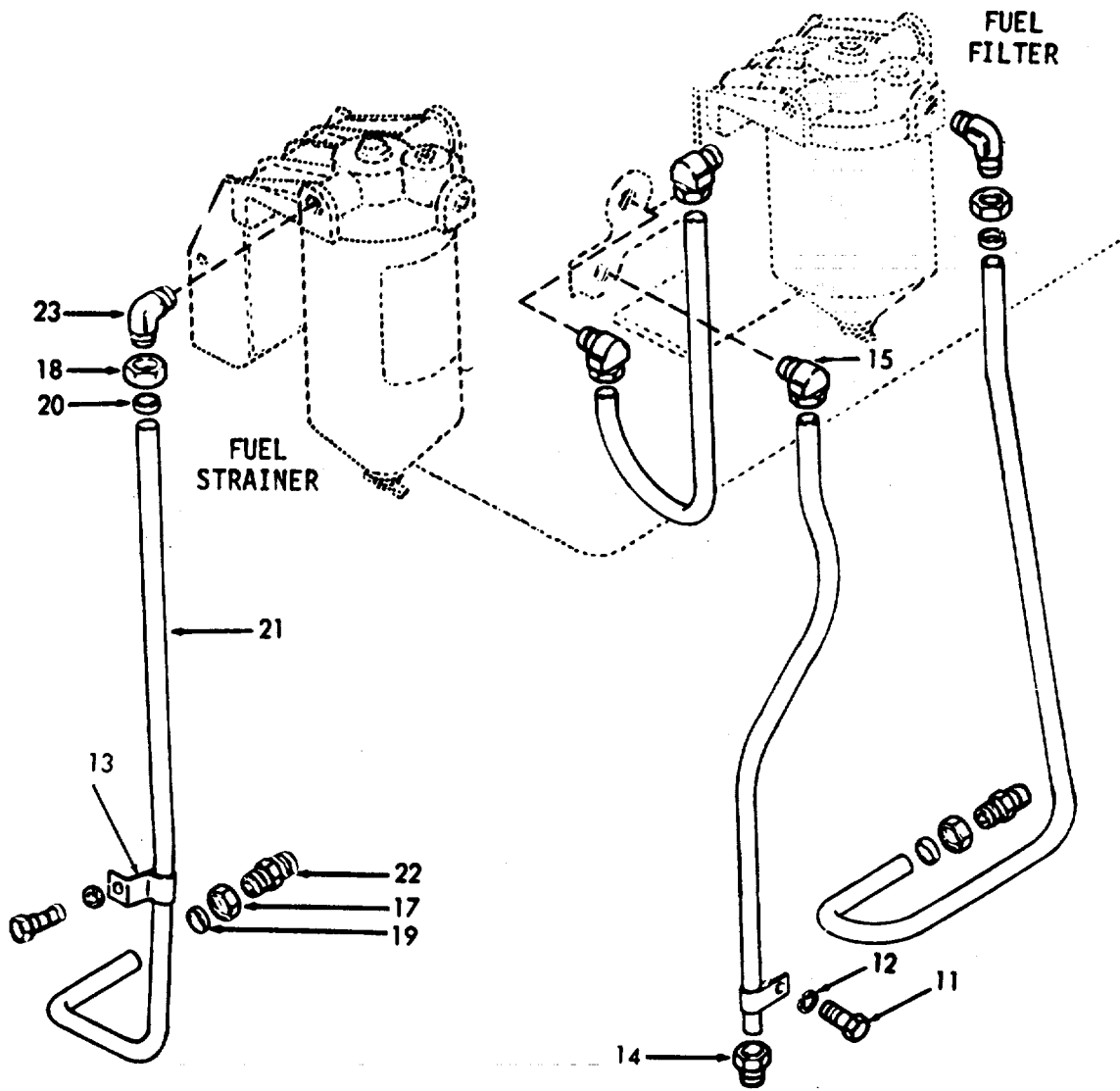
3-146.3. FUEL LINES AND MANIFOLD CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACEMENT (Cont)			
9. Tube fuel pump-to-strainer	f. Elbow (15)	Install.	
	g. Connector (14)	Install.	
	h. Screw (11), and lock-washer (12)	Install in clamp (13).	
	a. Tube nuts (17 and 18)	Remove.	
	b. Seal rings (19 and 20)	Remove.	
	c. Tube (21)	Remove.	
	d. Connectors (22), and elbow (23)	Remove.	
	e. Connectors (22), and elbow (23)	Install.	

3-146.3. FUEL LINES AND MANIFOLD CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPLACEMENT (Cont)



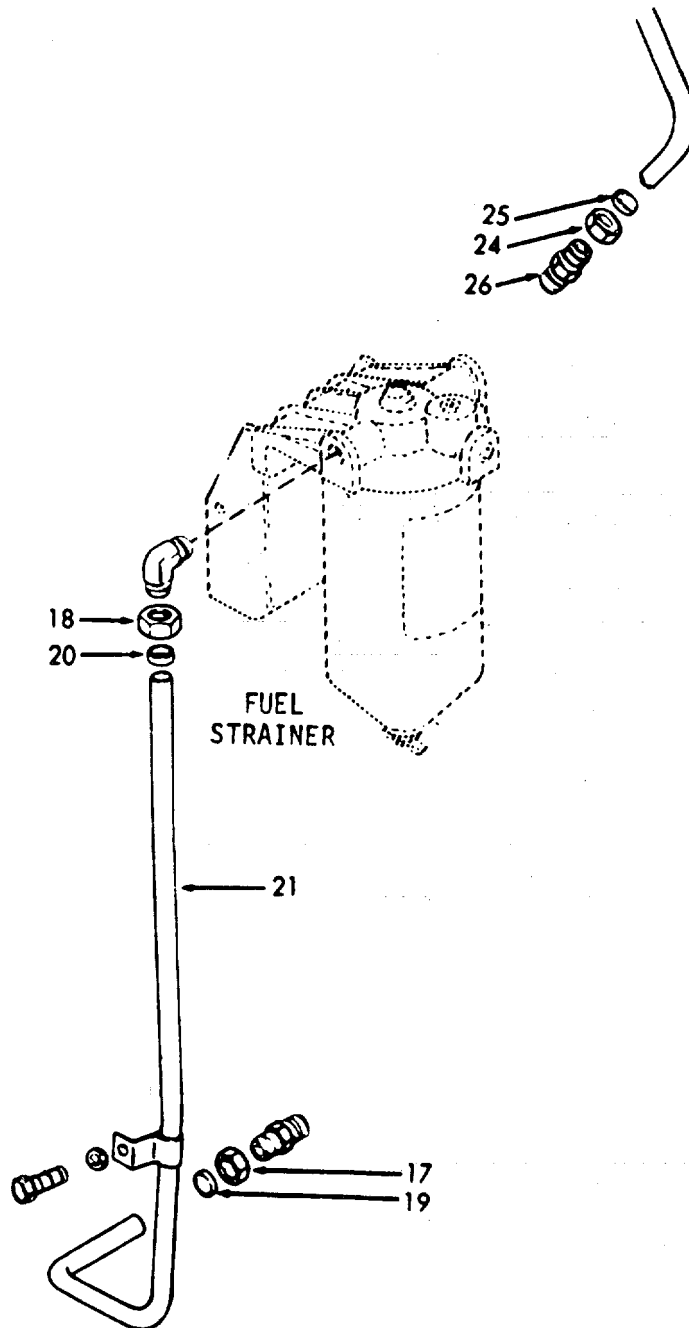
3-146.3. FUEL LINES AND MANIFOLD CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPLACEMENT (Cont)			
	f. Tube (21)	Install.	
	g. Seal rings (19 and 20)	Install.	
	h. Tube nuts (17 and 18)	Install.	
10. Tube-strainer	a. Tube nut (24)	Remove.	
	b. Seal ring (25)	Remove.	
	c. Connector (26)	Remove.	
	d. Connector (26)	Install.	
	e. Seal ring (25)	Install.	
	f. Tube nut (24)	Install.	

3-146.3. FUEL LINES AND MANIFOLD CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)



3-147. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS.

a. The fuel injector is a lightweight, compact unit which enables quick, easy starting directly on diesel fuel and permits the use of a simple, open-type combustion chamber. The simplicity of design and operation provides for simplified controls and easy adjustment.

b. The fuel injector performs four functions:

- (1) Creates the high fuel pressure required for efficient injection.
- (2) Meters and injects the exact amount of fuel required to handle the load.
- (3) Atomizes the fuel for mixing with the air in the combustion chamber.
- (4) Permits continuous fuel flow.

c. Combustion required for satisfactory engine operation is obtained by injecting, under pressure, a small quantity of accurately metered and finely atomized fuel oil into the cylinder.

d. The continuous fuel flow through the injector provides:

- Prevention of air pockets in the fuel system.
- A coolant for those injector parts subjected to high combustion temperatures.

CAUTION

Do not intermix the needle valve injectors with the other types of injectors in an engine.

e. Each fuel injector has a circular disc pressed into a recess at the front side of the injector body for identification purposes. The identification tag indicates the nominal output of the injector in cubic millimeters.

f. Fuel under pressure enters the injector from a fuel manifold. Motion of the rocker arm allows the injector to release a spray of fuel into a cylinder. A control rack on the side of the injector controls the amount of fuel being dispensed, and the speed of the engine. The injector control rack is actuated by a lever on the injector control tube which, in turn, is connected to the governor by means of a fuel rod. These levers can be adjusted independently on the control tube, thus permitting a uniform setting of all injector racks. Excess fuel exits the injector and is returned to a fuel manifold. The fuel then returns to the fuel tank.

3-147. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

g. The fuel injector is one of the most important and precisely built parts of the engine. The injection of the correct amount of fuel into the combustion chamber at exactly the right time depends upon this unit. Because the injector operates against high compression pressure in the combustion chamber, efficient operation demands that the injector assembly be maintained in first class condition at all times. Proper maintenance of the fuel system and the use of the recommended type of fuel filters and clean water-free fuel are the keys to trouble-free operation of the injectors.

This task covers:

a. Removal and Cleaning

b. Installation

INITIAL SETUP

Test Equipment
None

References
None

Special Tools
None

<u>Equipment</u>	
<u>Condition</u>	<u>Condition Description</u>
Paragraph	
3-161	Rock Arm Cover

Material/Parts
None

Special Environmental Conditions
Use clean, lint-free cloths.

Personnel Required
1

General Safety Instructions
Observe WARNING in procedure.

3-147. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

REMOVAL and CLEANING

1.	Top of cylinder	Fuel pipes (1 and 2)	Remove from injector (3), and connectors (4).	Protect fuel pipes and fuel connectors from dirt or foreign particles.
2.	Top of injector	Filter cap (5)	Cover filter cap with shipping cap.	Do immediately after fuel pipes are removed.
3.	Start switch	Engine	Crank engine to bring outer ends of injector push rods and rocker arms in line horizontally.	
4.	Rocker arms (6)	Two rocker shaft bracket bolts (7)	Remove bolts and swing rocker arms away from injector and valves.	
5.	Underneath rocker arm	Injector clamp (8)	Loosen and remove injector clamp bolt (9), washer (10) and clamp (8).	
6.	Injector tube (11), (outer side of cylinder head)	Injector rack control lever (12)	Loosen two screws on lever. Slide lever away from injector.	Refer to first figure.
7.	Cylinder head	Injector (13)	Lift injector out of cylinder head.	Immediately after removal of injector, cover injector hole to keep out dirt or foreign particles.

3-147. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL AND CLEANING (Cont.)

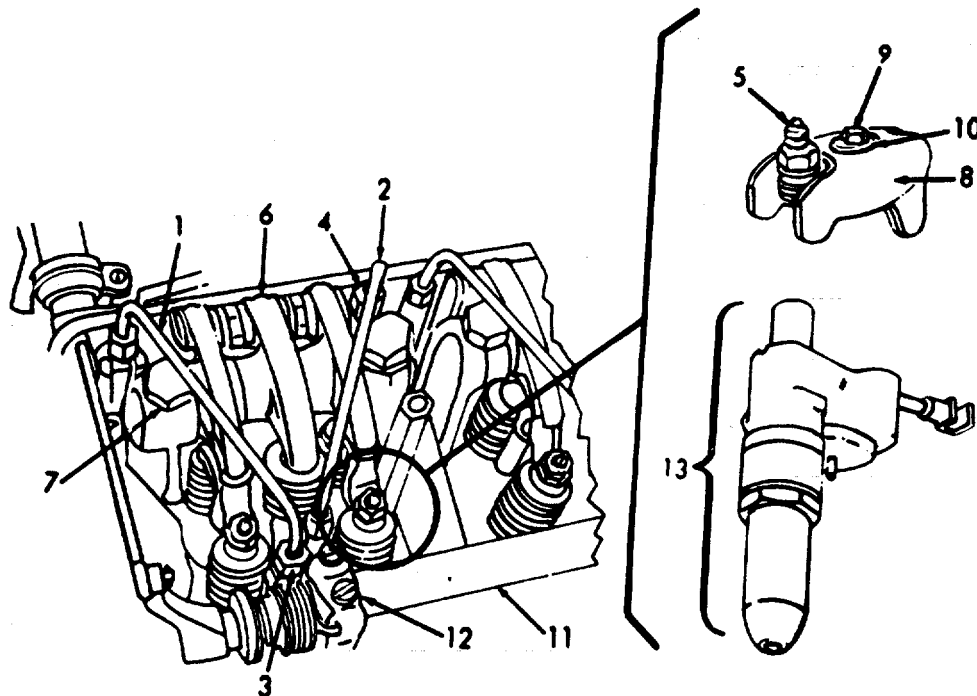
WARNING

Wear protective eye goggles when using compressed air.

- | | | |
|----|----------|---|
| 8. | Injector | Clean exterior with fuel oil and dry with compressed air. |
|----|----------|---|

NOTE

Perform a complete engine tune-up. However, if only one injector was replaced and the other injectors and governor adjustments were not disturbed, it is necessary to adjust valve clearance and time the injector for that cylinder and to position the injector rack control lever.

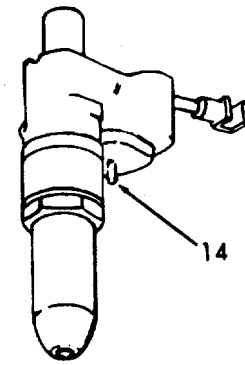


3-147. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION

9.	Injector tube	Injector	Insert into tube.	Make sure dowel pin (14) in the injector body registers with locating hole in cylinder head.
----	---------------	----------	-------------------	--



10.	Injector rack (15)	Injector rack control lever (12)	Slide lever so it registers with injector rack.	Tighten two bolts.
11.		Injector clamp (8), bolt (9), and washer (10)	Install torque bolt to 20-25 lb-ft (29.8 to 37 kg/m). Make sure that clamp does not interfere with injector follower spring or exhaust valves.	Curved side of washer must face injector clamp.
12.		Injector rack (15)	Check rack for free movement.	
13.	Top of injector	Rocker arm assembly (6)	Swing rocker arms into position. Secure brackets to cylinder head by tightening two bolts (7).	Torque bolts (90 to 100 lbs. ft.) (130 to 145 kg/m).

3-147. FUEL INJECTOR - MAINTENANCE INSTRUCTIONS (Continued).

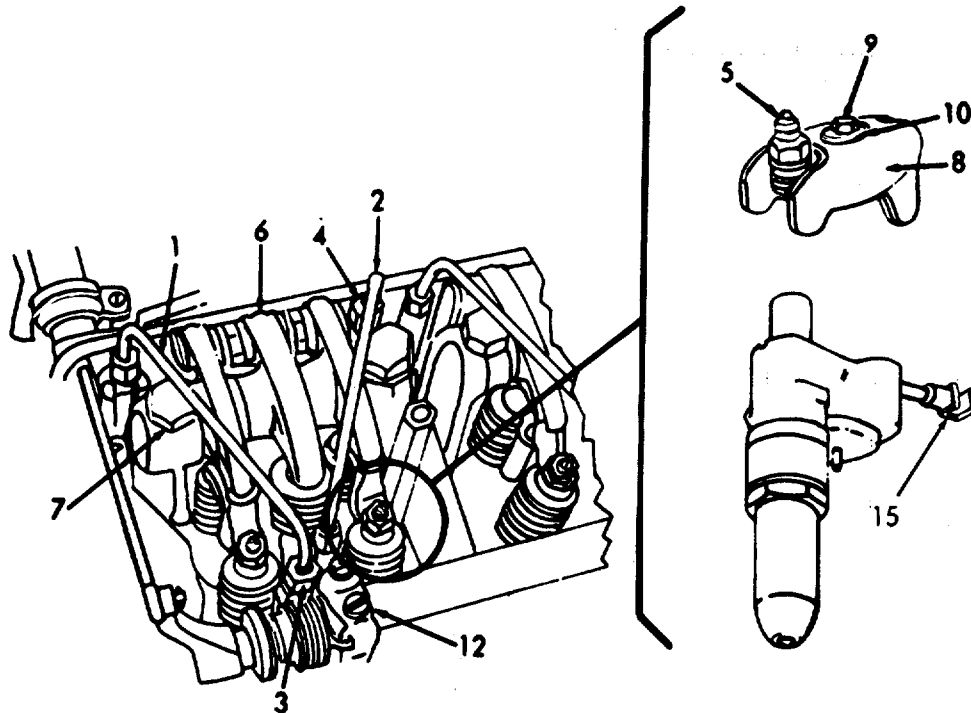
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont.)

NOTE

Exhaust valve bridge must rest on exhaust valves before, during and after tightening the rocker shaft bolts. If not, exhaust valves can be damaged. Make sure the exhaust valve bridge is resting on the ends of the exhaust valves when tightening rocker shaft bracket bolts.

- | | | | | |
|-----|---------------------------------------|----------------------|--|---|
| 14. | Filter cap (5) | Shipping caps | Remove. | |
| 15. | Injector (3), and fuel connectors (4) | Fuel pipes (1 and 2) | Replace and tighten connections. Do not bend fuel pipes. | Use torque wrench and tighten to 12-15 lb. ft. (17.9 to 22.3 kg/m). Do not overtighten since leaks or damage can occur. |



3-148. LUBE OIL FILTER, HOSES AND HOUSING - MAINTENANCE INSTRUCTIONS.

The maintenance instructions for the lube oil filter, hoses and housing are contained in the following paragraphs:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Oil Filter - (Full Flow)	3-148.1
Oil Filter - (By-Pass) - Hoses and Housing	3-148.2

3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS.

- a. The full-flow type lubricating oil filter is installed ahead of the oil cooler in the lubrication system.
- b. The filter assembly consists of a replaceable element enclosed within a shell which is mounted on an adaptor. When the filter shell is in place, the element is restrained from movement by a coil spring.
- c. All of the oil supplied to the engine by the oil pump passes through the filter before reaching the various moving parts of the engine. The oil is forced by pump pressure through a passage in the filter adaptor to the space surrounding the filter element. Impurities are filtered out as the oil is forced through the element to a central passage surrounding the center stud and out through another passage in the filter adaptor and then to the oil cooler.
- d. A valve, which opens at approximately 18-21 psi (124-145 kPa), is located in the filter adaptor and will by-pass the oil directly to the oil cooler should the filter become clogged.

3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

This task covers:

- | | | |
|---------------|----------------|-----------------|
| a. Inspection | c. Disassembly | e. Installation |
| b. Service | d. Reassembly | |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment

<u>Condition</u>	<u>Condition Description</u>
Paragraph	

3-149	Lube Oil Cooler Removal
-------	-------------------------

Material/Parts

Gasket kit P/N 5193114

Special Environmental Conditions

Do not drain oil into bilges.
Use the oil/water separation
and recovery system to collect
drained oil. Dispose of properly.

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

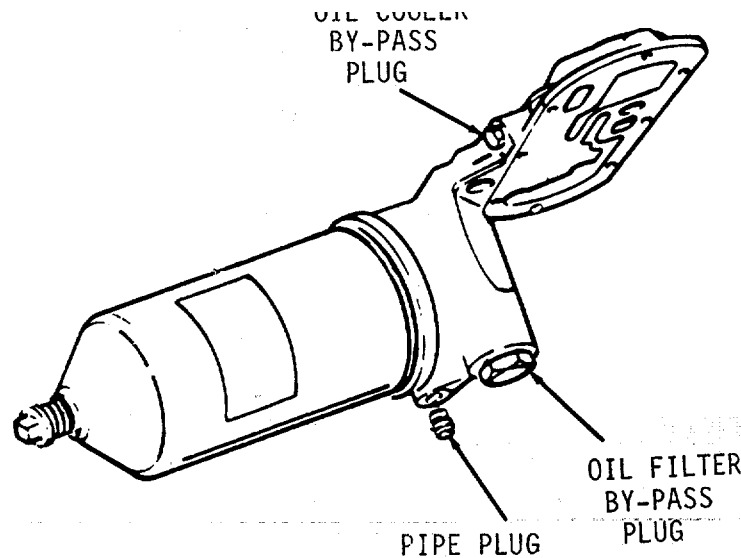
- | | | |
|---------------|-----------------------|-------------------------------------|
| 1. Oil filter | a. Shell | 1. Check for cracks, dents or wear |
| | | 2. Check for leaks. |
| | b. Center stud | 1. Check for leaks. |
| | | 2. Check tightness of center stud. |
| | c. Oil cooler adaptor | 1. Check for cracks, dents or wear. |
| | | 2. Check for leaks. |

3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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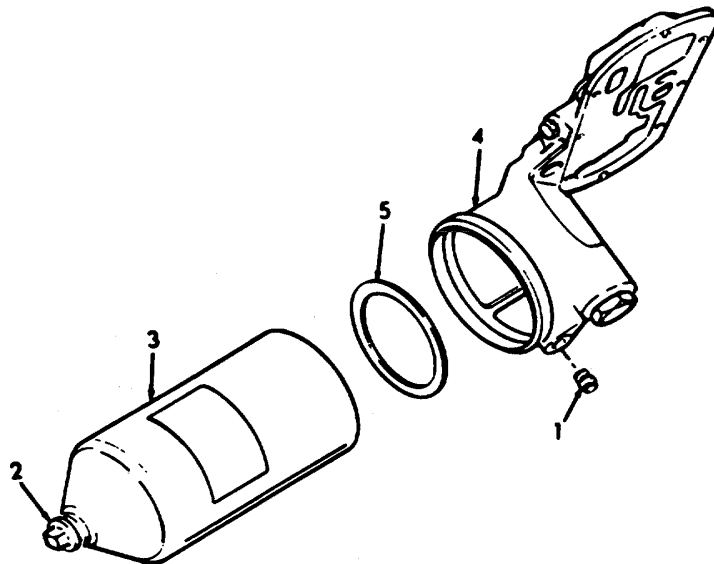
INSPECTION (Cont.)

- | | | | |
|----|-------------------------|--|--|
| | | 3. Check shell's fitting to oil cooler adaptor. | |
| d. | Pipe plug | 1. Check tightness.
2. Check for leaks. | |
| e. | Oil filter by-pass plug | 1. Check tightness.
2. Check for wear.
3. Check for leaks. | |
| f. | Oil cooler by-pass plug | 1. Check tightness.
2. Check for wear.
3. Check for leaks. | |



3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
SERVICE			
2. Oil filter	a. Pipe plug (1)	Remove.	Drain oil into a suitable container. Do not drain into bilges. Use the oil/water recovery system.
	b. Shell	<ol style="list-style-type: none"> 1. Unscrew center stud (2). 2. Withdraw the shell (3) from the oil cooler adaptor (4). 3. Remove cover gasket (5). 	<p>Leave filter element and center stud intact.</p> <p>Discard. Check gasket surfaces of shell (3) and oil cooler adaptor (4) for nicks, burrs, or other damage. If found, replace the oil filter and oil cooler adaptor.</p>



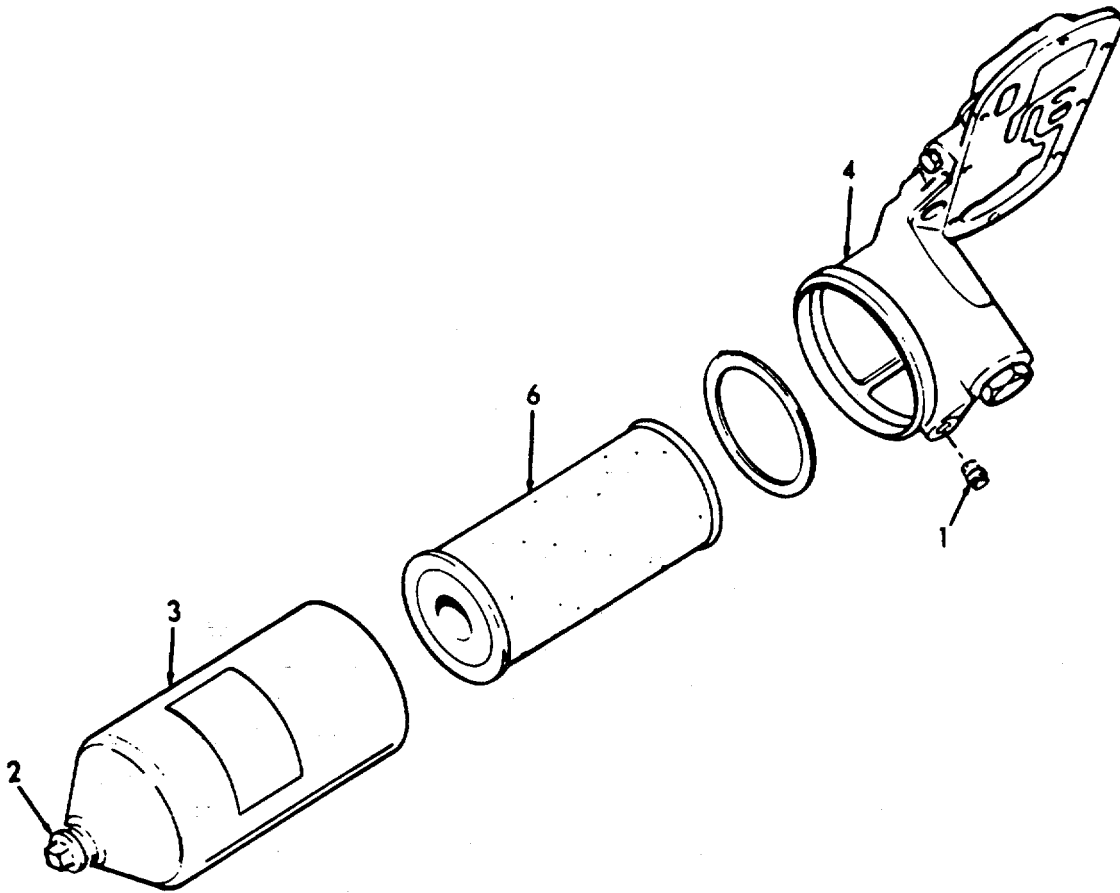
3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
SERVICE (Cont.)			
	c. Filter element (6)	Remove from shell (3).	Discard and dispose of properly.
WARNING			
Wear protective eye goggles when using compressed air.			
	d. Shell (3)	Clean.	Use clean fuel oil and dry with compressed air.
	e. Filter element	Carefully position filter element (6) over center stud (2) and within shell (3).	
	f. Oil cooler adaptor	1. Insert shell (3) onto oil cooler adaptor (4). 2. Tighten center stud (2).	Torque to 50-60 ft. lb. (67.8-81.3 Nm).
	g. Oil filter	Install pipe plug (1).	Start and run engine for a short period of time. Check for oil leaks. Stop engine for 10 minutes and check oil level. Add sufficient oil to bring level up to full on the dipstick.

3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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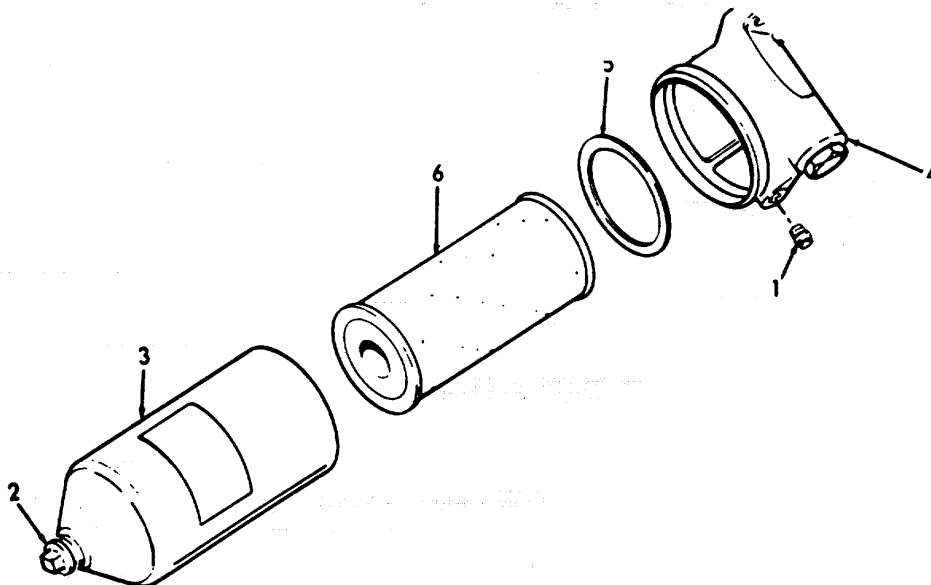
SERVICE (Cont.)



3-2551

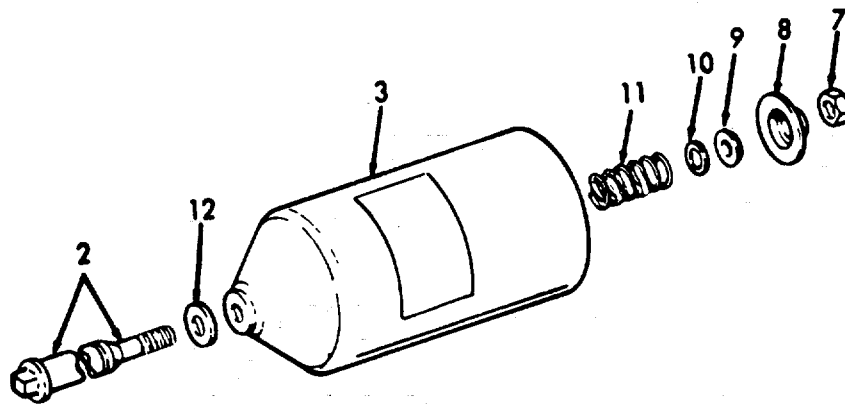
3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
3. Oil filter	a. Pipe plug (1)	Remove.	Drain oil into a suitable container.
	b. Shell	1. Unscrew center stud (2).	Leave filter element and Center stud intact.
		2. Withdraw the shell (3) from oil cooler adaptor (4).	
		3. Remove cover gasket (5).	Discard. Check gasket surfaces of shell (3) and oil cooler adaptor (4) for nicks, burrs, or other damage. Discard and dispose of properly.
	c. Filter element (6)	Remove from shell (3).	



3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont.)			
4. Shell	Center Stud	<ul style="list-style-type: none"> a. Remove hex nut (7). b. Remove spring retainer (8). c. Remove retainer gasket (9). d. Remove washer (10). e. Remove spring (11). f. Remove center stud (2) from shell (3). g. Remove gasket (12). 	<p>Inspect for hardening or cracks. Replace if necessary.</p> <p>Inspect for wear.</p> <p>Replace if damage or leaks occur.</p>

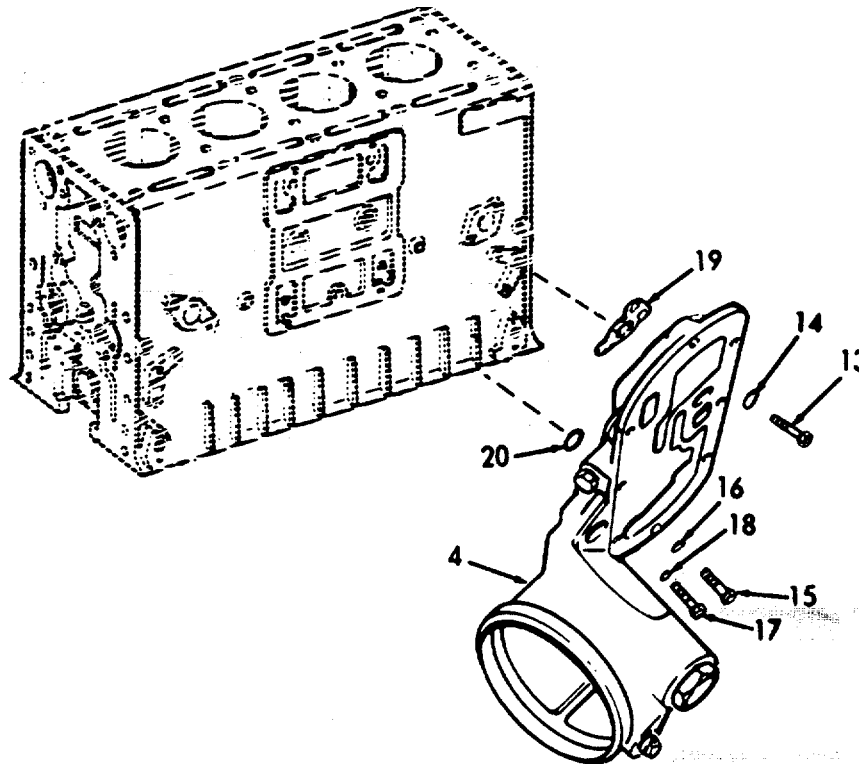


3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont.)

- | | | | | |
|----|---------------------------|--------------------|---|----------|
| 5. | Anchor Winch engine block | Oil cooler adaptor | <ul style="list-style-type: none"> a. Remove capscrews (13) and washers (14). b. Remove capscrews (15) and lockwashers (16). c. Remove capscrews (17) and lockwashers (18). d. Remove oil cooler adaptor (4) from anchor winch block. e. Remove gaskets (19 and 20). | Discard. |
|----|---------------------------|--------------------|---|----------|



3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

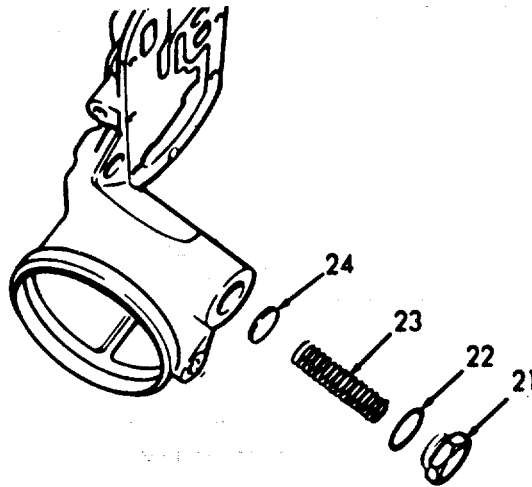
WARNING

Wear protective eye goggles when using compressed air.

6. Oil cooler adaptor	a. Oil filter by-pass	1. Remove by-pass plug (21).	Inspect for wear. Replace if necessary.
		2. Remove by-pass gasket (22).	Inspect for wear. Replace if necessary.
		3. Remove by-pass spring (23).	Inspect for wear. Replace if necessary.
		4. Remove by-pass valve (24).	Inspect for wear. Replace if necessary.

NOTE

Clean the above parts in clean fuel oil and dry with compressed air.



3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

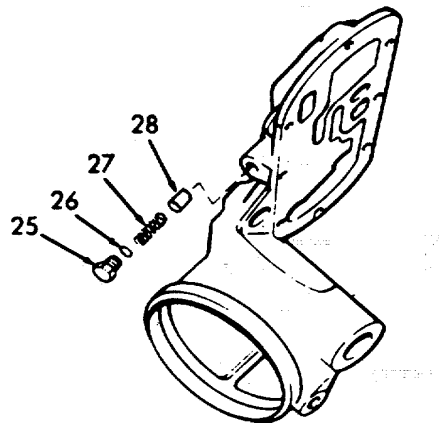
NOTE

Clean parts in clean fuel oil and dry with compressed air.

WARNING

Wear protective eye goggles when using compressed air.

- | | | |
|-----------------------|--|---|
| b. Oil cooler by-pass | 1. Remove by-pass plug (25). | Inspect for wear. Replace if necessary. |
| | 2. Remove by-pass gasket (26). | Discard. |
| | 3. Remove by-pass spring valve (27). if necessary. | Inspect for wear. Replace if necessary. |
| | 4. Remove by-pass valve (28). | Inspect for wear. Replace if necessary. |
| c. Oil cooler adaptor | Clean with clean fuel oil and dry with compressed air. | |



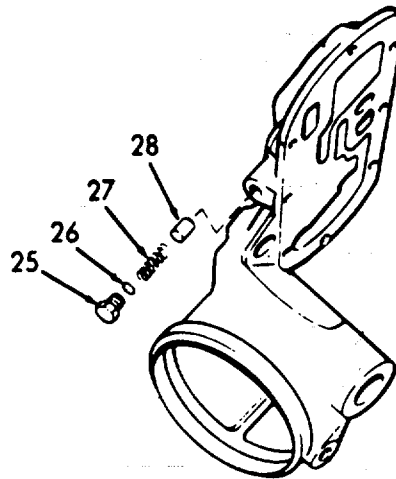
3-2556

3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY

- | | | | | |
|----|--------------------|-----------------------|---|-----------------------------|
| 7. | Oil cooler adaptor | a. Oil cooler by-pass | <ol style="list-style-type: none"> 1. Install by-pass valve (28). 2. Install by-pass spring valve (27). 3. Install by-pass gasket (26). 4. Install by-pass plug (25). | Use repair kit P/N 5193114. |
|----|--------------------|-----------------------|---|-----------------------------|



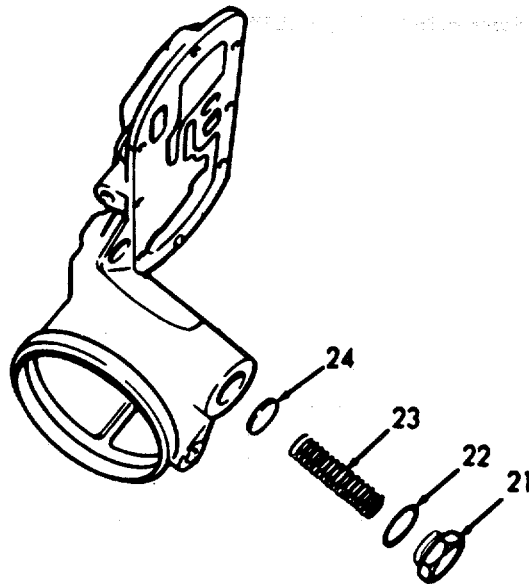
3-2557

3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont.)

- | | |
|-----------------------|---------------------------------|
| b. Oil filter by-pass | 1. Install by-pass valve (24). |
| | 2. Install by-pass spring (23). |
| | 3. Install by-pass gasket (22). |
| | 4. Install by-pass plug (21). |



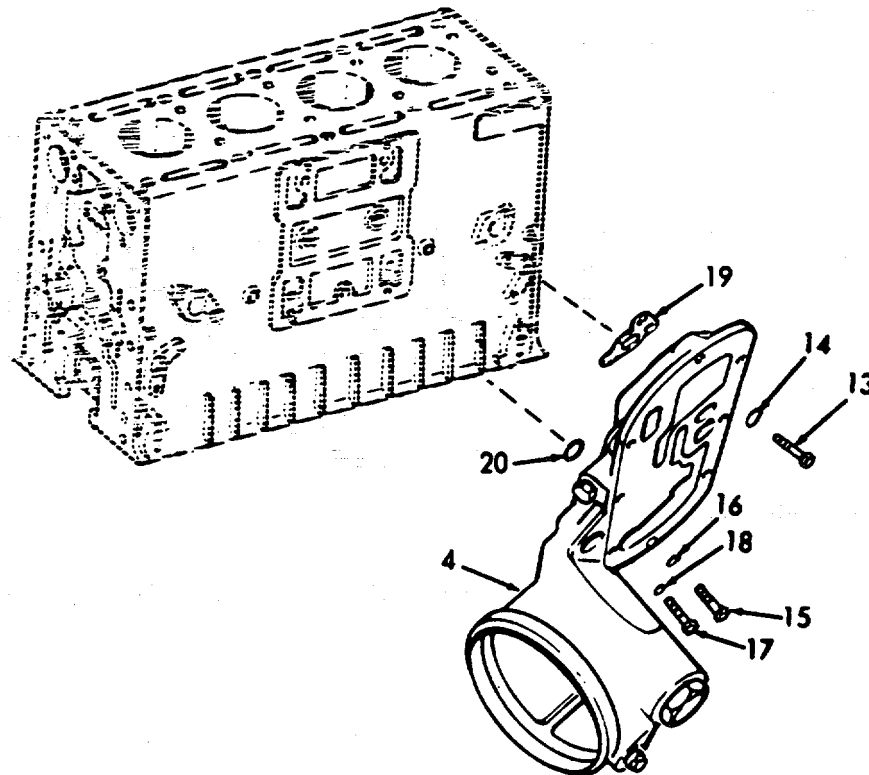
3-2558

3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont.)

- | | | | |
|------------------------------|--------------------|---|-----------------------------|
| 8. Anchor winch engine block | Oil cooler adaptor | <ul style="list-style-type: none"> a. Install gaskets (19 and 20). b. Mount oil cooler adaptor (4) onto anchor winch engine block. c. Install lockwashers (18) and capscrews (17). d. Install lockwashers (16) and capscrews (15). e. Install washer (14) and capscrew (13). | Use repair kit P/N 5193114. |
|------------------------------|--------------------|---|-----------------------------|

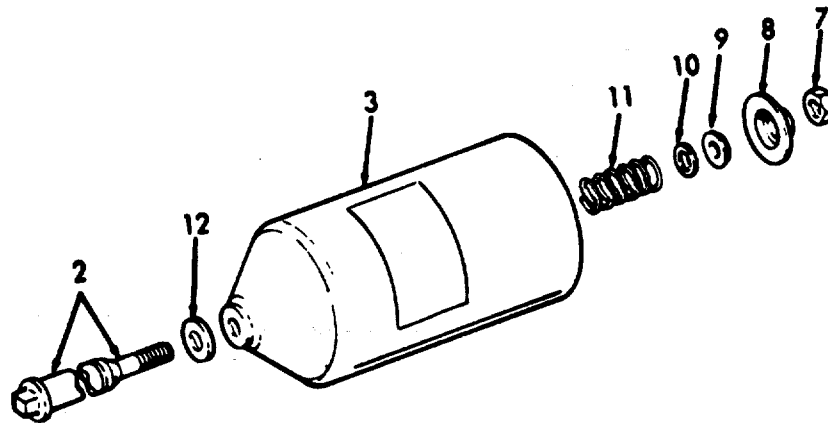


3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY (Cont.)

- | | | | |
|----------|-------------|--|--|
| 9. Shell | Center stud | <ul style="list-style-type: none"> a. Install gasket (12) onto center stud (2). b. Insert center stud (2) into shell (3). c. Install spring (11). d. Install washer (10). e. Install retainer gasket (9). f. Install spring retainer (8). g. Install hex nut (7). | |
|----------|-------------|--|--|



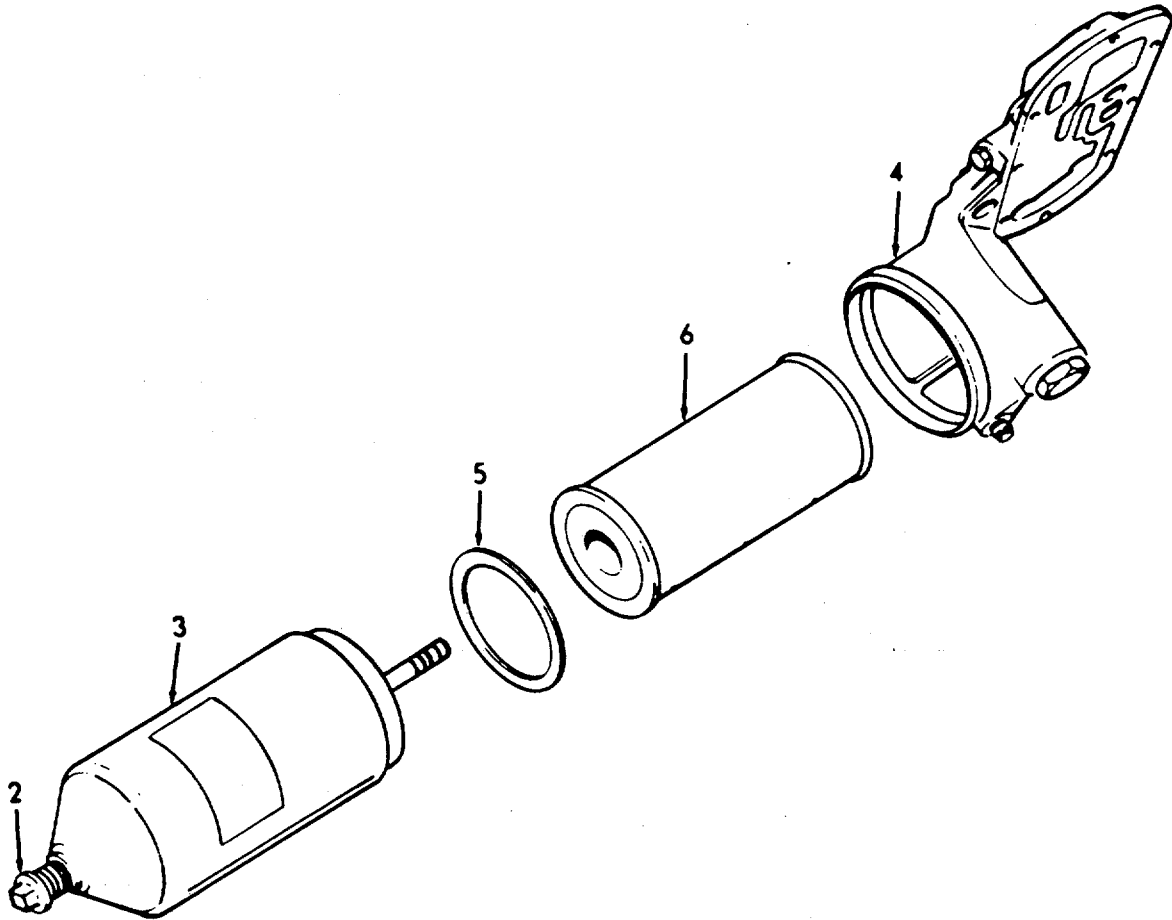
3-2560

3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION

- | | | | |
|----------------|-------------------|--|--|
| 10. Oil filter | a. Shell | Install cover gasket (5). | Use new cover gasket. Make sure the gasket surfaces of the shell (3) and oil cooler adaptor (4) have no nicks, burrs, or other damage. |
| | b. Filter element | Carefully position filter element (6) over center stud (2) and within shell (3). | |

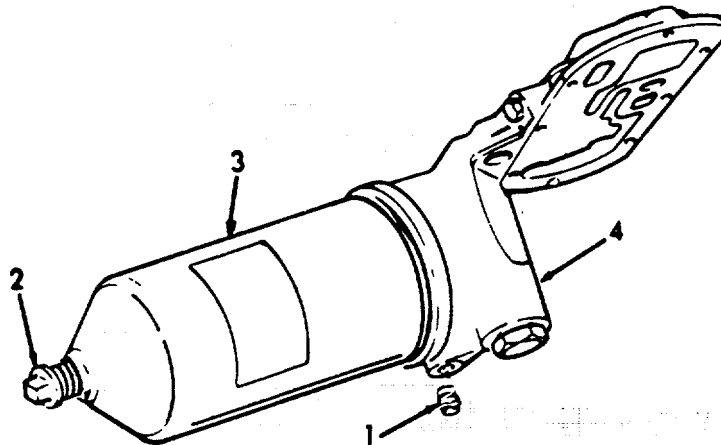


3-148.1. LUBE OIL FILTER (FULL FLOW) - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- | | | | |
|----|--------------------|---|--|
| c. | Oil cooler adaptor | <ol style="list-style-type: none"> 1. Insert shell (3) onto oil cooler adaptor (4). 2. Tighten center stud (2). | Torque to 50-60 ft. lb. (67.8-81.3 Nm). |
| d. | Oil filter | Install pipe plug (1). | <p>Start the engine and run for a short period of time. Check for oil leaks. Stop engine for 10 minutes and check oil level. Add sufficient oil to bring the level up to full on the dipstick.</p> |



3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE INSTRUCTIONS.

a. An oil filter of the by-pass type is installed on the engine. However, the size of the orifice on the discharge side of the filter must not exceed .062 inch (.217 cm) to control the oil flow rate and to provide sufficient oil pressure when the engine is running at idle speed.

b. When the engine is running, a portion of the lubricating oil is bled off the oil gallery and passed through the by-pass filter. Eventually all of the oil passes through the filter, filtering out fine foreign particles that may be present.

c. The by-pass filter assembly consists of a replaceable element contained in a shell mounted on a combination base and mounting bracket. When the shell is in place, the filter element is restrained from movement by a coil spring at the top. A hollow center stud serves as the outlet passage from the filter as well as securing the shell in place.

This task covers:

- | | | |
|---------------|----------------|-----------------|
| a. Inspection | c. Disassembly | |
| b. Service | d. Reassembly | e. Installation |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment Condition Condition Description

None

Material/Parts

Gasket and element
P/N MS35345-1

Special Environmental Conditions

Do not drain oil into bilges.
Use the oil/water separation and recovery system to collect drained oil. Dispose of properly.

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION			
1. Oil filter	a. Shell	1. Check for cracks, dents or wear. 2. Check for leaks.	
	b. Center stud	1. Check for leaks. 2. Check tightness of center stud.	
	c. Pipe plugs	1. Check for tightness. 2. Check for leaks.	
	d. Tubing	1. Inspect for cracks, breaks and dents. 2. Inspect for leaks. 3. Inspect for tightness.	

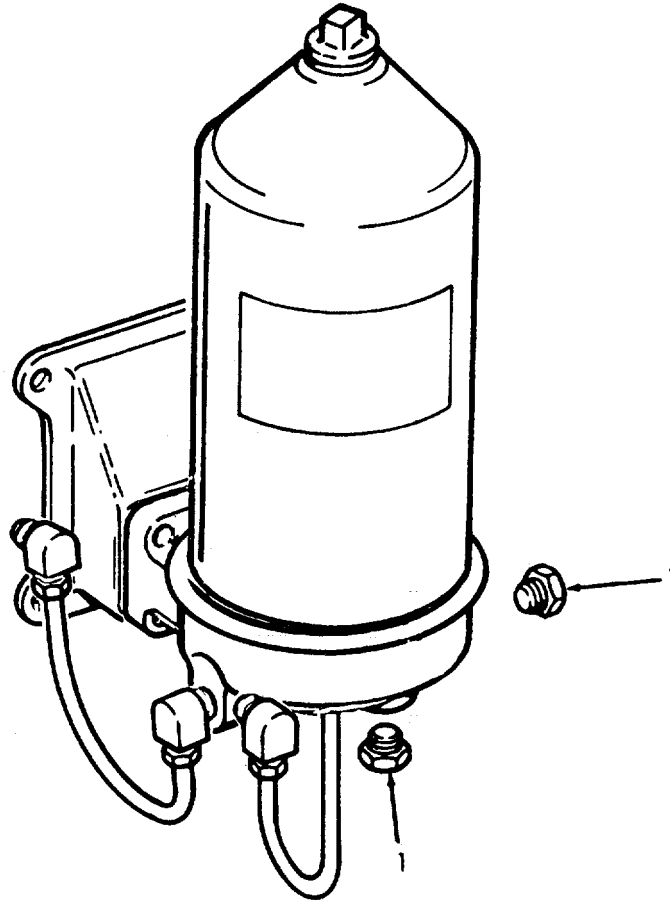
SERVICE

2. Oil filter	a. Pipe plug (1)	Remove.	Drain oil into a suitable container. Do not drain into bilges. Use the oil/water separation and recovery system. Dispose of properly.
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3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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SERVICE (Cont.)



3-2565

3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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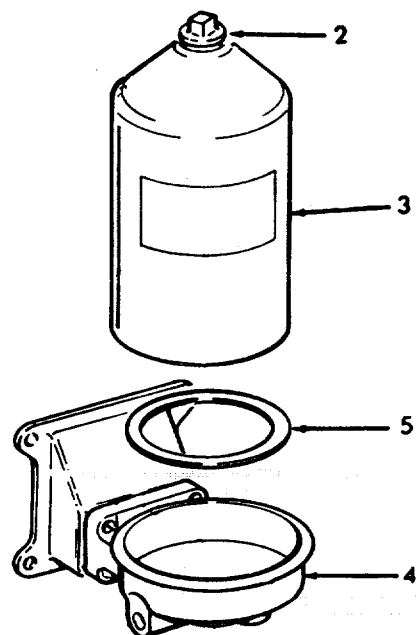
SERVICE (Cont.)

b. Shell
(2).

1. Unscrew center stud
2. Withdraw the shell
(3) from the cover
(4).
3. Remove cover gasket
(5).

Leave filter
element and
center stud
intact.

Discard. Check
gasket surfaces
of shell (3)
and cover (4)
for nicks,
burrs, or other
damage. If
nicks, burrs,
or damage are
found, the oil
filter and oil
cooler adaptor
must be re-
placed.



3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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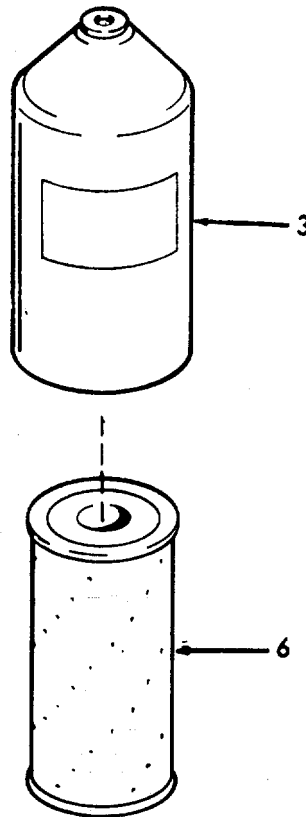
SERVICE (Cont.)

	c. Filter element (6)	Remove from shell (3).	Discard and dispose of properly.
--	-----------------------	------------------------	----------------------------------

WARNING

Wear protective eye goggles when using compressed air.

	d. Shell (3)	Clean.	Use clean fuel oil and dry with compressed air.
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3-2567

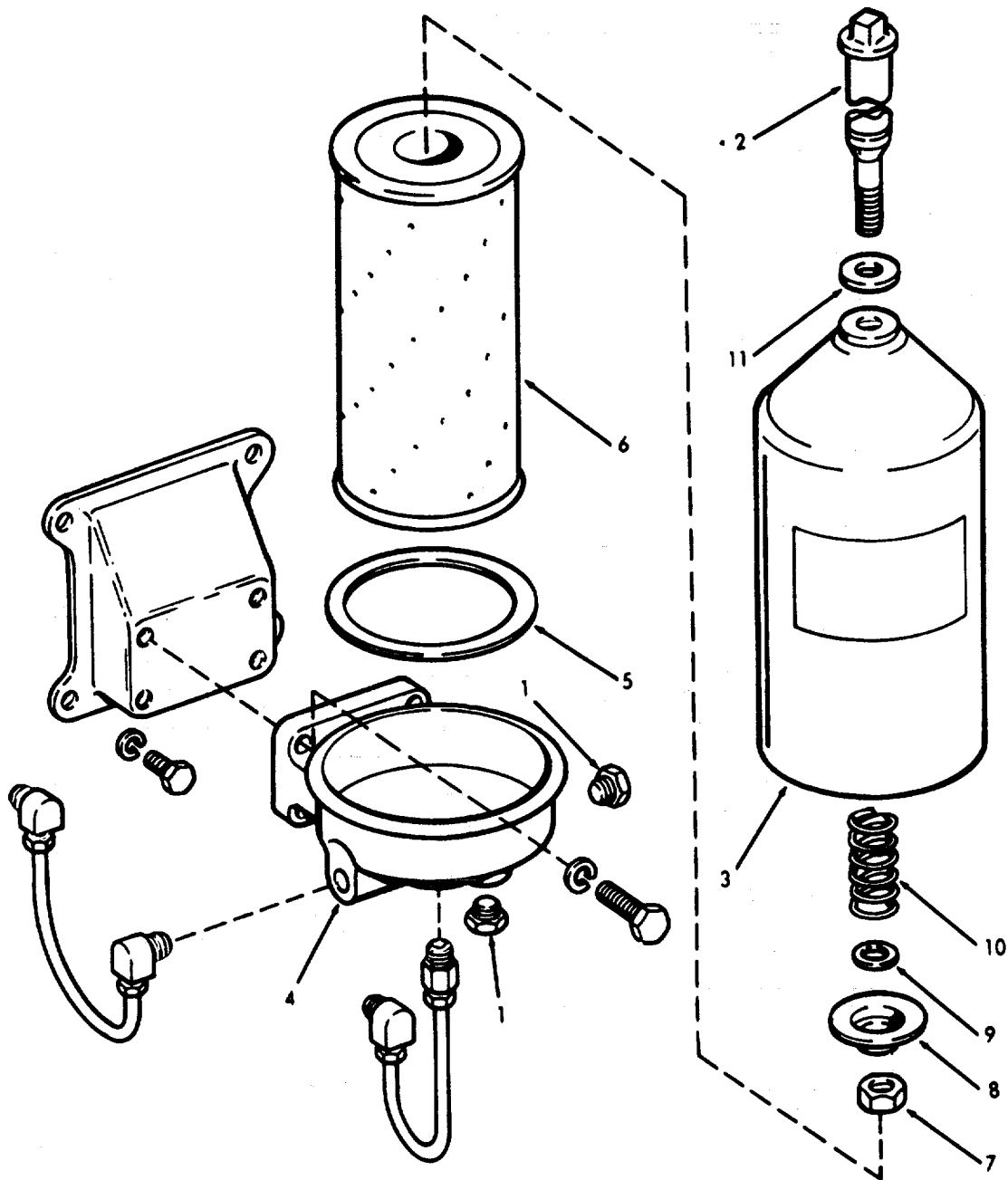
3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
3.	Oil filter	a. Pipe plug (1)	Remove. Drain oil into a suitable container.
		b. Shell	1. Unscrew center stud (2). 2. Withdraw the shell (3) from cover (4). 3. Remove cover gasket (5). Leave filter element and center stud intact. Discard. Check gasket surface of shell (3), and cover (4) for nicks, burrs, or other damage. Discard and dispose of properly.
		c. Filter element (6)	Remove from shell (3).
4.	Shell Center stud	a. Remove hex nut (7).	
		b. Remove spring retainer (8).	
		c. Remove washer (9).	
		d. Remove spring (10).	
		e. Remove center stud (2) from shell (3).	Inspect for wear.
		f. Remove gasket (11).	Replace if damage, or if leaks occur.

3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont.)

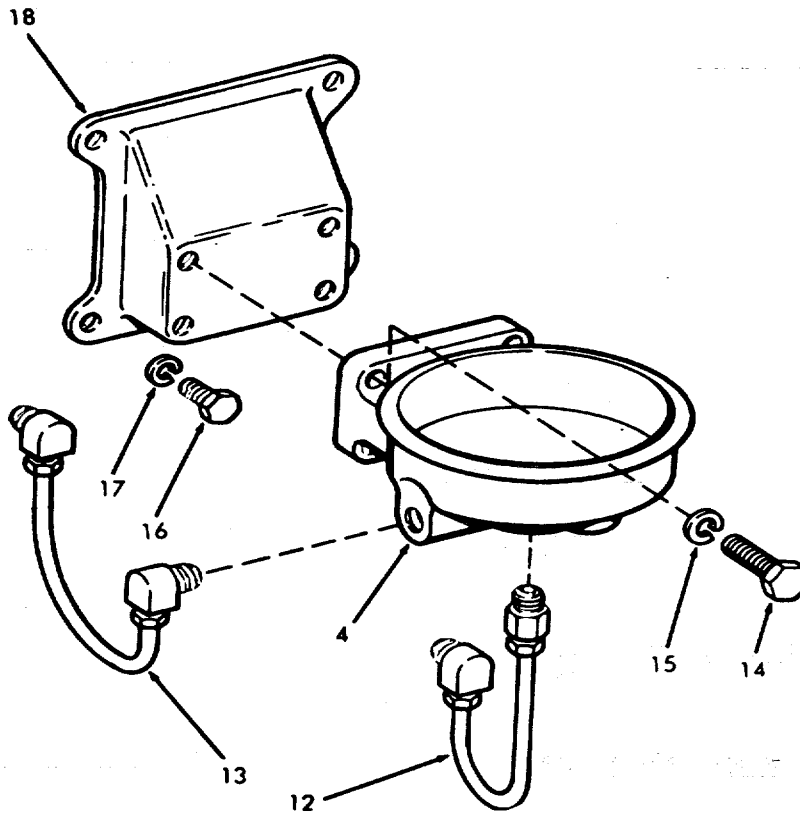


3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont.)

- | | | | |
|----|---------------------------|--------------|--|
| 5. | Anchor Winch engine block | Filter cover | <ul style="list-style-type: none"> a. Remove tubes (12 and 13). b. Remove capscrews (14), and lockwashers (15). c. Remove cover (4). d. Remove capscrews (16), and lockwashers (17). e. Remove mounting bracket (18). |
|----|---------------------------|--------------|--|



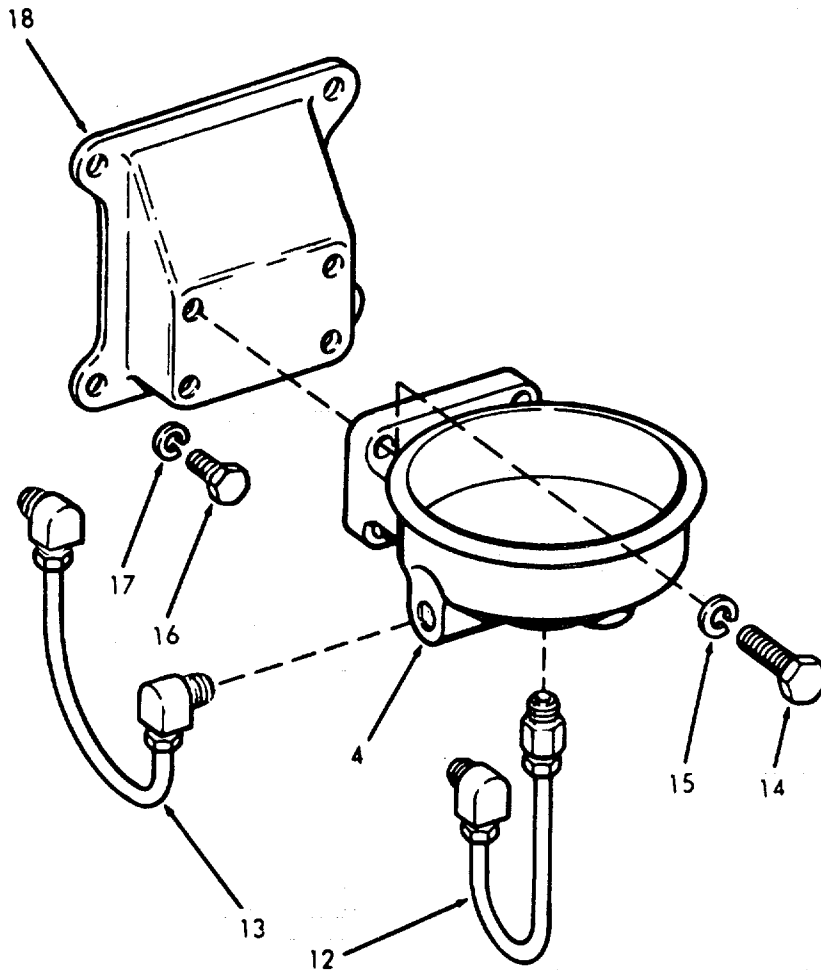
3-2570

3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY

- | | | | |
|----|---------------------------|--------------|---|
| 6. | Anchor winch engine block | Filter cover | <p>a. Install mounting bracket (18), using screws (16) and lockwashers (17).</p> <p>b. Install cover (4), using screws (14), and lockwashers (15).</p> <p>c. Install tubes (12 and 13).</p> |
|----|---------------------------|--------------|---|

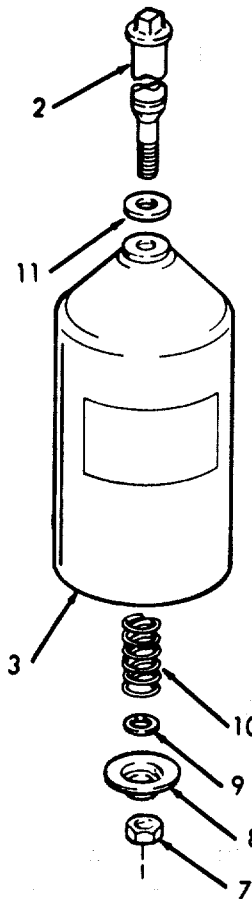


3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY (Cont.)

- | | | | |
|----|-------|-------------|---|
| 7. | Shell | Center stud | <ul style="list-style-type: none"> a. Install gasket (11) onto center stud (2). b. Insert center stud (2) into shell (3). c. Install spring (10). d. Install washer (9). e. Install spring re-tainer (8). f. Install hex nut (7). |
|----|-------|-------------|---|

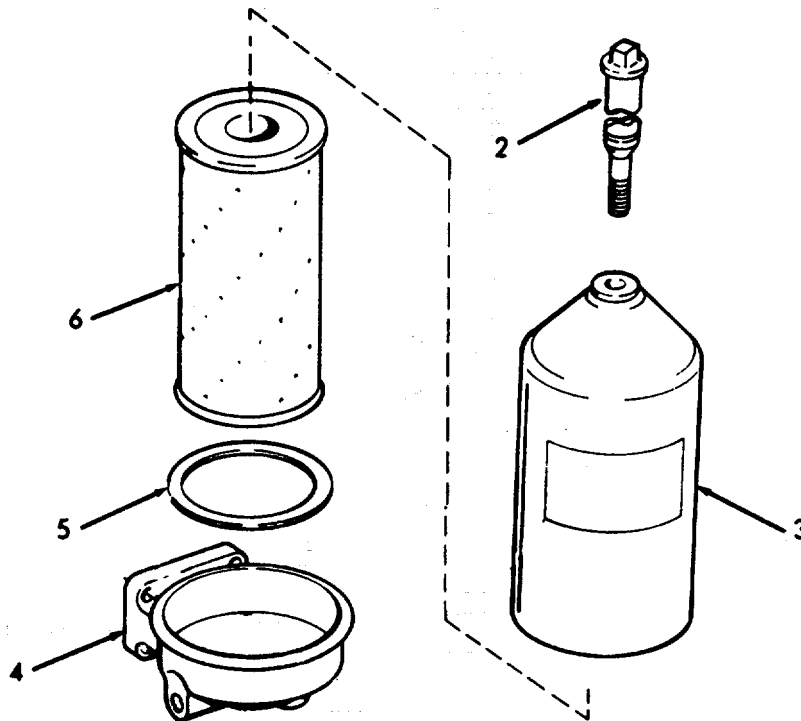


3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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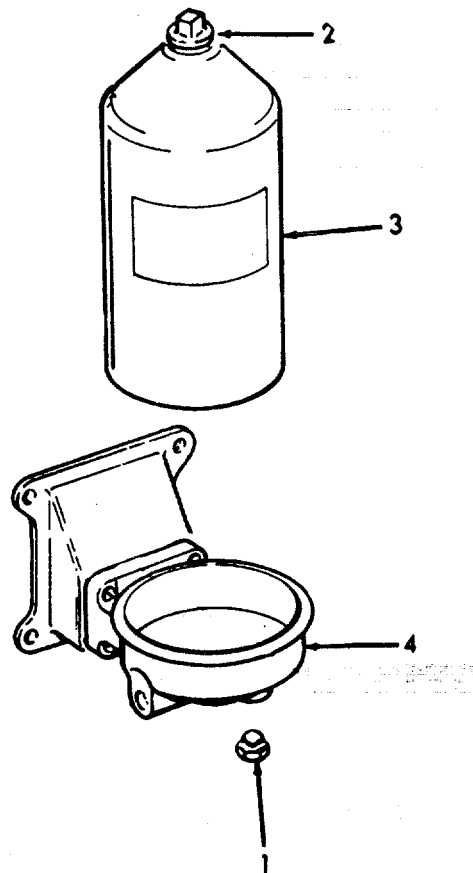
INSTALLATION

- | | | | |
|---------------|-------------------|---|---|
| 8. Oil filter | a. Shell | Install cover gasket (5). | Use new cover gasket. Make sure the gasket surfaces of the shell (3) and oil cooler adaptor (4) have no nicks, burrs or other damage. |
| | b. Filter element | Position filter element (6) over center stud (2), and within shell (3). | |



3-148.2. OIL FILTER (BY-PASS), HOSES AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px;">INSTALLATION (Cont)</div>	c. Cover	1. Insert shell (3) onto cover (4). 2. Tighten center stud (2).	Torque to 50-60 ft. lb. (60.8 - 81.3 Nm).
	d. Oil	Install pipe plug (1). filter	Start engine, and run for a short period of time. Check for oil leaks. Stop engine for 10 minutes and check oil level. Add sufficient oil to bring level up to full on the dipstick



3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS.

- a. In order to perform its functions satisfactorily the lubricating oil must be kept within the proper temperature limits. If the oil is too cold, it will not flow freely. If the oil is too hot, it cannot support the bearing loads, or carry away enough heat, and it may result in too great an oil flow.
- b. In performing its lubricating and cooling functions, the oil absorbs a considerable amount of heat and this heat must be dissipated by an oil cooler.
- c. To assure engine lubrication if the oil cooler becomes clogged, a by-pass valve located at the oil inlet to the oil cooler, by-passes the oil around the oil cooler directly to the oil gallery in the cylinder block.
- d. The oil cooler core is sealed to prevent the coolant from getting into the oil.

This task covers:

- a. Inspection
- b. Removal
- c. Cleaning
- d. Testing
- e. Repair
- f. Installation

INITIAL SETUP

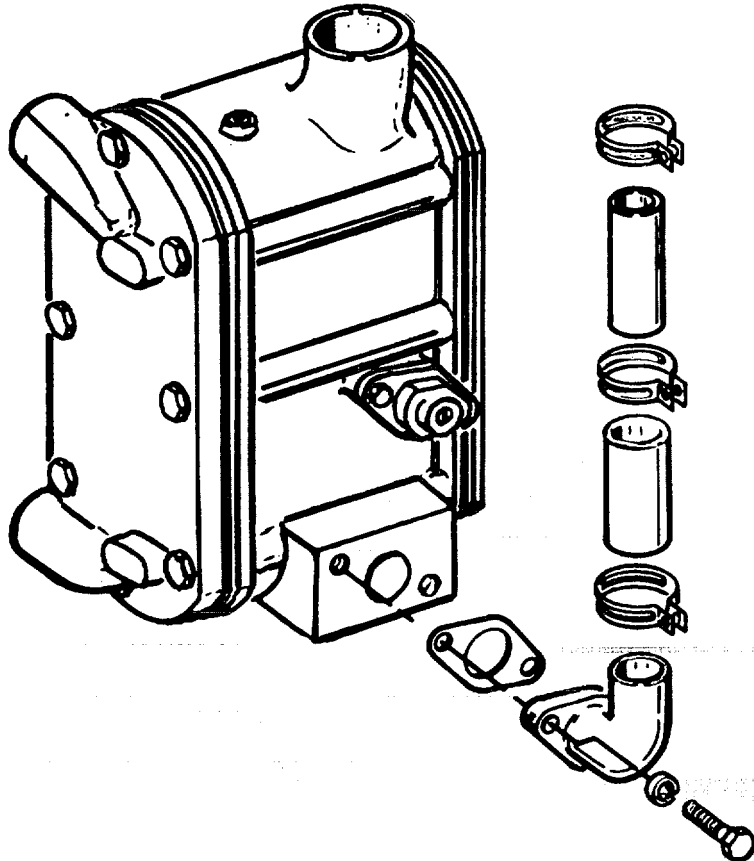
<u>Test Equipment</u>	<u>References</u> Paragraph
None	3-148 Lube Oil Filter
<u>Special Tools</u>	<u>Equipment</u> <u>Condition</u> <u>Condition Description</u>
None	None
<u>Material/Parts</u>	<u>Special Environmental Conditions</u>
Gasket kit P/N 5193114	Do not drain oil into bilges. Use the oil/water separation and recovery system to collect drained oil. Dispose of properly.
<u>Personnel Required</u>	<u>General Safety Instructions</u>
1	Observe WARNINGS in procedure.

3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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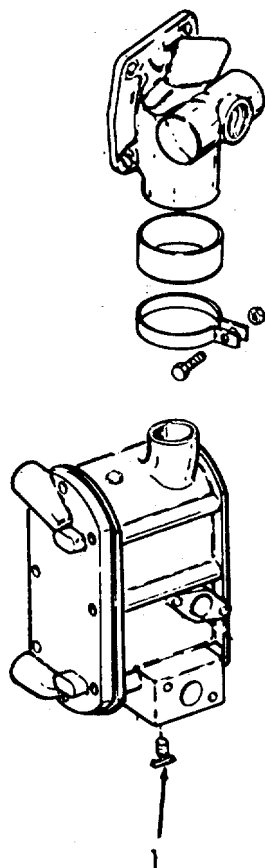
INSPECTION

1.	Anchor winch	Dipstick	Remove dipstick and check for presence of water in engine oil.	Engine oil will be creamy tan if water is present.
2.	Oil cooler	a. Drain-cock	<ol style="list-style-type: none"> 1. Check for leaks. 2. Check for tightness. 	Water only.
		b. Water hole flange Cover	<ol style="list-style-type: none"> 1. Check fitting. 2. Check for leaks. 	Oil and water.
		c. Oil cover housing	<ol style="list-style-type: none"> 1. Check for dents or cracks. 2. Check for leaks. 	Oil and water.



3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
3. Oil filter	Drain plug	Remove.	Refer to paragraph 3-148.1. Drain into a suitable container. Do not dump into the bilges. Use oil/water separation and recovery system. Dispose of properly.
4. Oil cooler housing	a. Drain-cock (1)	Turn counter-clockwise to open.	Drain into a suitable container. Do not dump into the bilges. Use oil/water separation and recovery system. Dispose of properly.



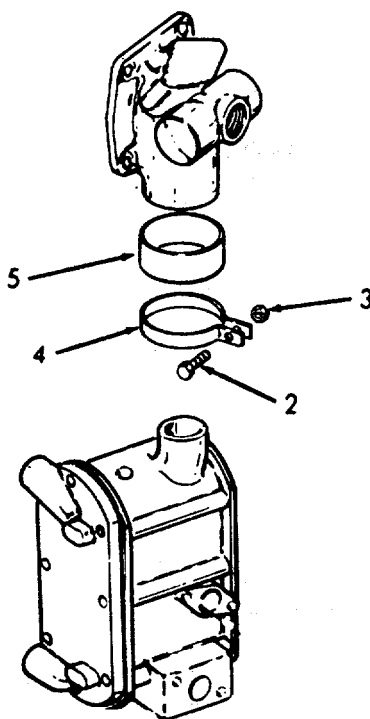
3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

b. Seal water pump

1. Remove screw (2) and nut (3).
2. Remove clamp (4).
3. Remove the water pump seal (5).



3-2578

3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)
]

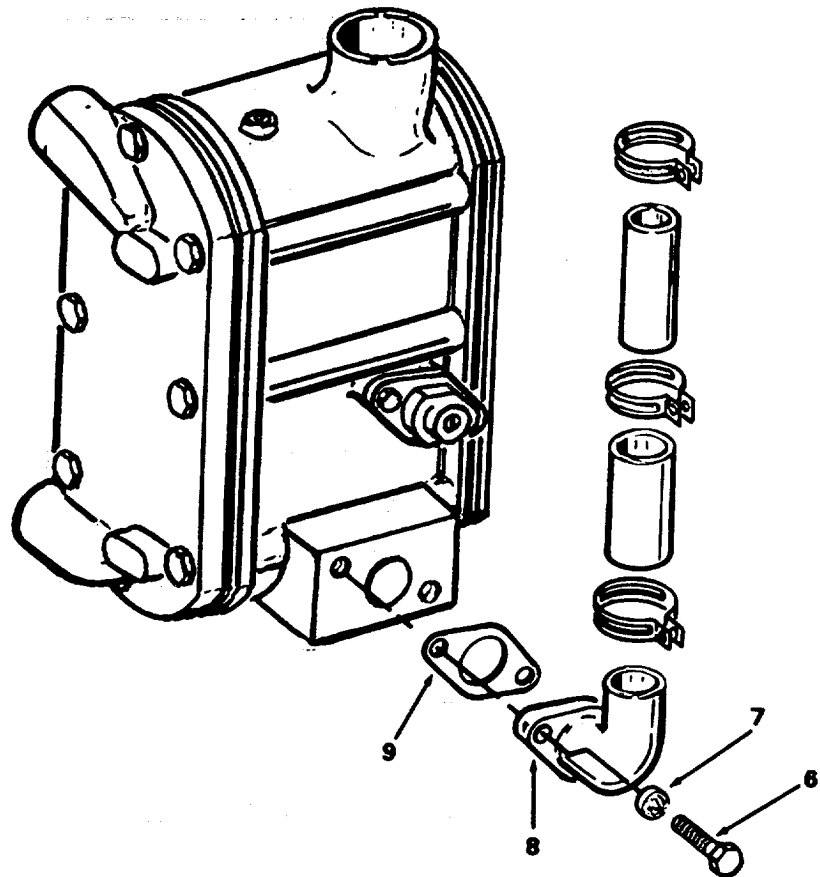
c. Oil/
water
inlet
connec-
tions

1. Remove capscrews (6),
and lockwashers (7).

2. Swing oil cooler water
inlet connection (8)
out of the way.

3. Remove gasket (9).

Discard.

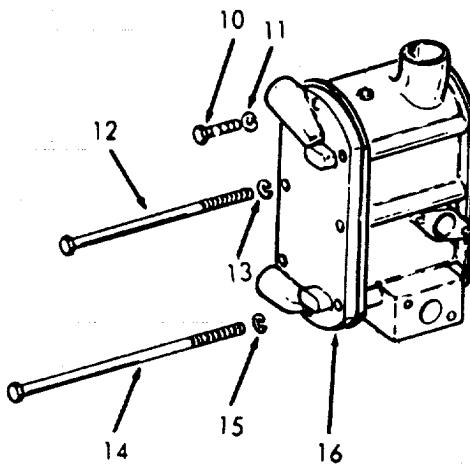


3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|----|-------------------------------|---|--|
| d. | Oil hoses to torque converter | Remove. | |
| e. | Oil cooler housing | <ol style="list-style-type: none"> 1. Remove capscrew (10), and lockwasher (11). 2. Remove six bolts (12), and lockwashers (13). 3. Remove one bolt (14), and lockwasher (15). 4. Remove oil cooler housing cover (16). | |



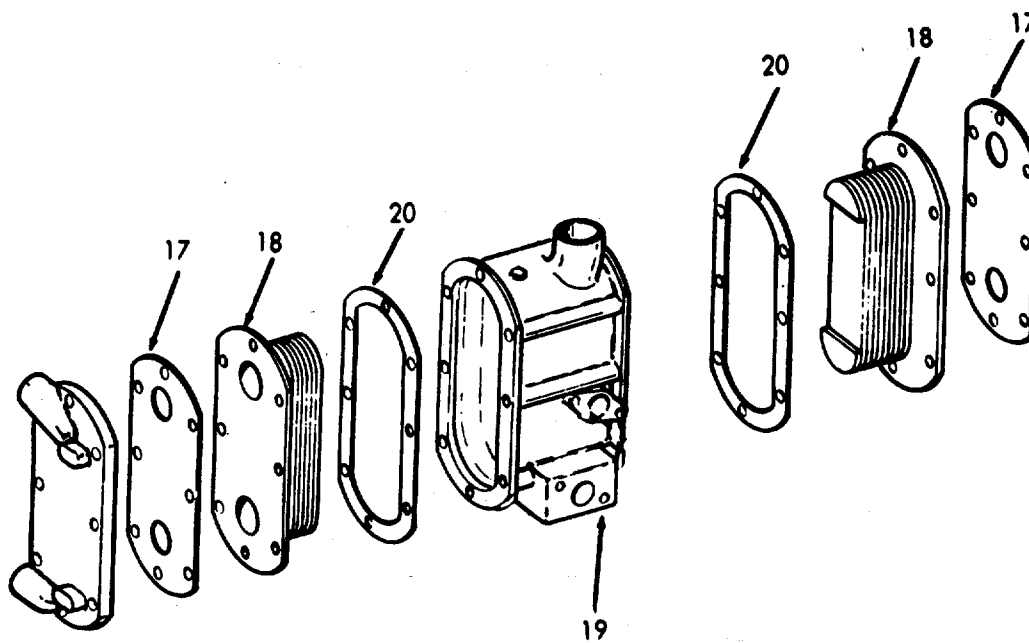
3-2580

3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | |
|--|----------|
| 5. Remove two outer gaskets (17). | Discard. |
| 6. Remove two oil cooler cores (18), from oil cooler housing (19). | |
| 7. Remove two inner gaskets (20) from oil cooler cores (18). | Discard. |



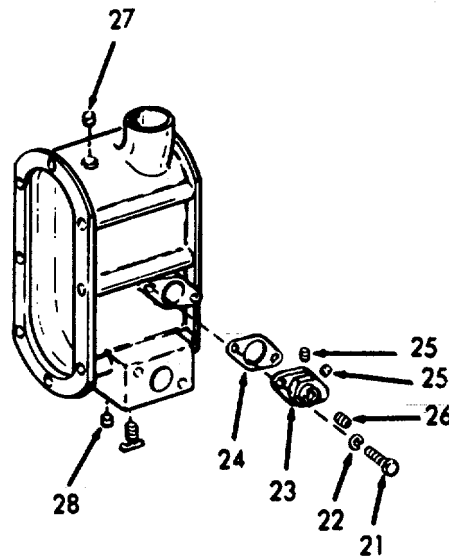
3-2581

3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|--|--|--|---------------|
| | | 8. Remove capscrews (21), and lockwashers (22). | |
| | | 9. Remove oil cooler water hole cover (23). | |
| | | 10. Remove gasket (24). | Discard. |
| | | 11. Remove two pipe plugs (25), and pipe plugs (26). | If necessary. |
| | | 12. Remove pipe plug (27), and pipe plug (28). | If necessary. |



3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING

WARNING

Cleaning solvent trichloroethylene, used to clean parts, is potentially dangerous to personnel and property. Use in the open, or a well-ventilated room to prevent toxic fumes from building up.

5. Oil cooler	a. Oil cooler (oil side)	<ol style="list-style-type: none"> 1. Circulate a solution of trichloroethylene through the core passages. 2. Clean the oil cooler core before the sludge hardens. 3. Oil passages are badly clogged. 	<p>Use a force pump to remove carbon and sludge.</p> <p>Circulate an Oakite or alkali solution through the oil cooler core. Flush thoroughly with clean, hot water.</p>
	b. Oil cooler (water side)	<ol style="list-style-type: none"> 1. Immerse oil cooler core (water side) in the following solution: <ol style="list-style-type: none"> a. 1/2 lb. (0.227 kg) of oxalic acid to each 2-1/2 gals. (9.46 L) solution. b. Composition of 1/3 muriatic acid and 2/3 water. 	<p>Clean oil cooler (oil side) first.</p> <p>Cleaning action evidenced by bubbling and foaming.</p>

3-149. LUBE OIL COOLER -MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING (Cont)			
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- | | | | |
|--|--|---|--|
| | | <ol style="list-style-type: none"> 2. Carefully watch process and when bubbling stops, remove oil cooler core. 3. Thoroughly flush with clean, hot water. 4. After cleaning, dip oil cooler core in light oil. | <p>30 to 60 seconds after oil cooler core is immersed.</p> |
|--|--|---|--|

NOTE

Do not attempt to clean an oil cooler core when engine failure occurs in which metal particles from worn or broken parts are released into the lubricating oil. In this instance, replacement of the oil cooler core is recommended.

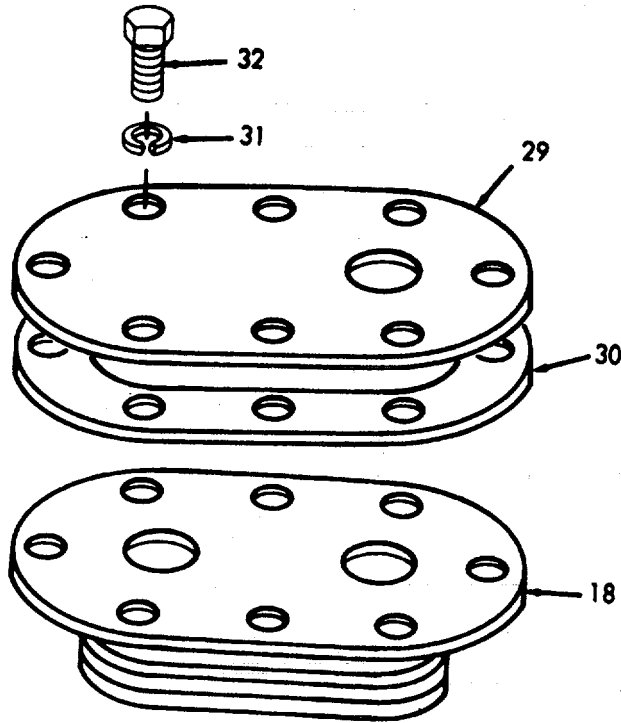
3-2584

3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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TESTING PRESSURE	-
------------------	---

6. Oil cooler	a. Plate	<ol style="list-style-type: none"> 1. Make a suitable plate (29) to attach to the oil cooler core (18). 2. Drill and tap plate (29) on inlet side of the oil cooler core (18). 	<p>Use a suitable rubber gasket to ensure a tight seal.</p> <p>To attach an air hose fitting.</p>
	b. Oil cooler	<ol style="list-style-type: none"> 1. Install rubber gasket (30). Core 2. Install plate (29). 3. Install lockwashers (31) and screws (32). 	Tighten plate to oil cooler



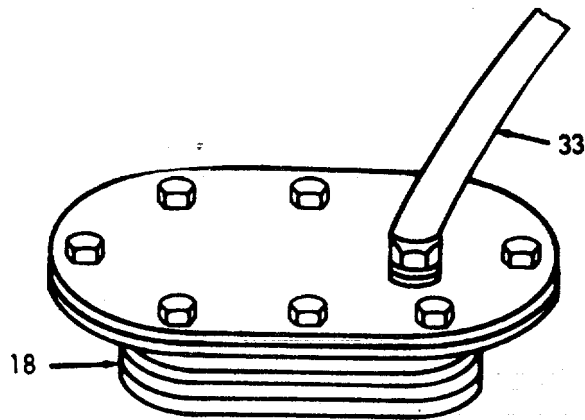
3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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TESTING PRESSURE	-
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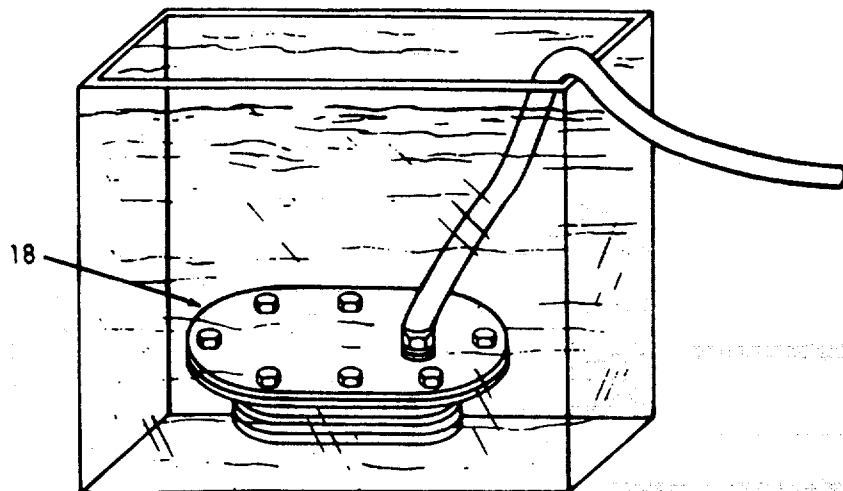
- Attach air hose (33) to oil cooler core (18).

Apply 75-150 psi (517-1034 kPa) air pressure.



- Submerge oil cooler core in a tank of heated water (180°F) (82°C).

Any leaks will be indicated by air bubbles in the water.



3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS.

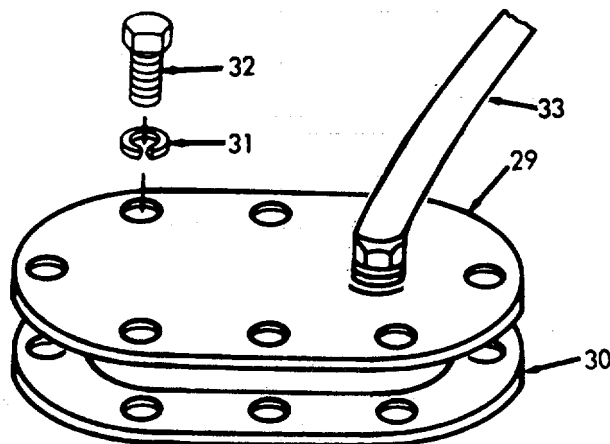
LOCATION	ITEM	ACTION	REMARKS
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TESTING - PRESSURE (Cont)

WARNING

When making the pressure test be sure that personnel are adequately protected against any stream of pressurized water from a leak or rupture of a fitting, hose or the oil cooler core.

- | | |
|--|---|
| <p>6. Pressure test completed.</p> <p>a. Remove oil cooler core (18) from water tank.</p> <p>b. Remove air hose (33).</p> <p>c. Remove screw (32), and lockwashers (31).</p> <p>d. Remove plate (29), and gasket (30).</p> | <p>Indication of leaks in oil cooler core. Replace.</p> |
|--|---|



3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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TESTING - PRESSURE (Cont)

NOTE

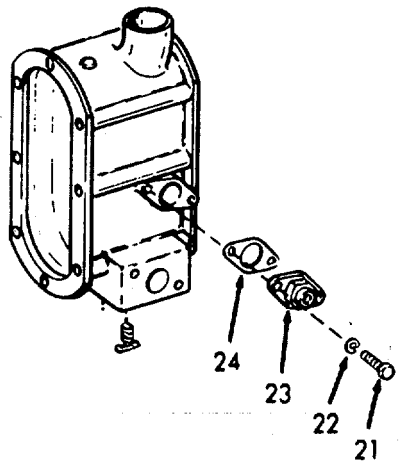
In cases where leaking oil cooler core has caused contamination of the engine, the engine must be flushed immediately to prevent serious damage.

REPAIR

Repair according to standard practices and procedures.

INSTALLATION

- | | | | |
|---------------|-----------------------|--|-----------------------------|
| 7. Oil cooler | a. Oil cooler housing | <ol style="list-style-type: none"> 1. Install gasket (24). 2. Install oil cooler water hole cover (23). 3. Install lockwashers (22) and capscrews (21). | Use repair kit P/N 5193114. |
|---------------|-----------------------|--|-----------------------------|



3-2588

3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

4. Install two inner gaskets (20) on oil cooler cores (18).

Use repair kit P/N 5193114.

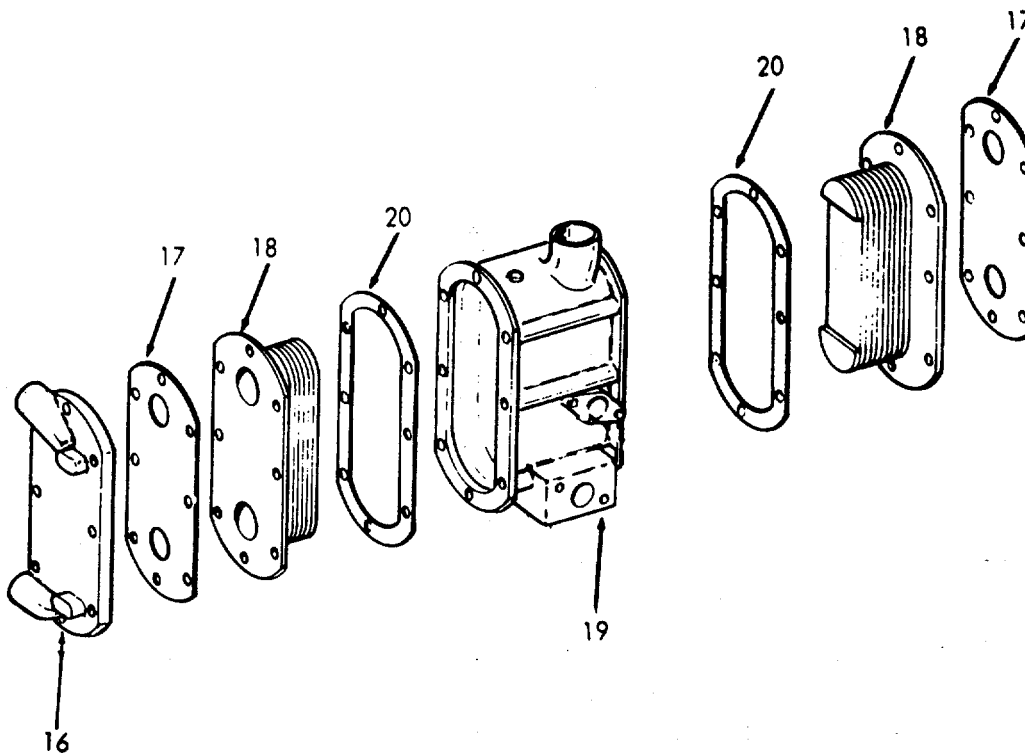
5. Install two oil cooler cores (18) into oil cooler housing (19).

NOTE

The inlet and outlet openings in the oil cooler core are marked IN and OUT. Make sure the oil cooler core is reinstalled in its original position; otherwise the oil flow will be reversed and could result in foreign particles that may not have been removed to be loosened and circulated through the engine.

6. Install two outer gaskets (117), and oil cooler housing cover (16).

Use repair kit P/N 5193114.

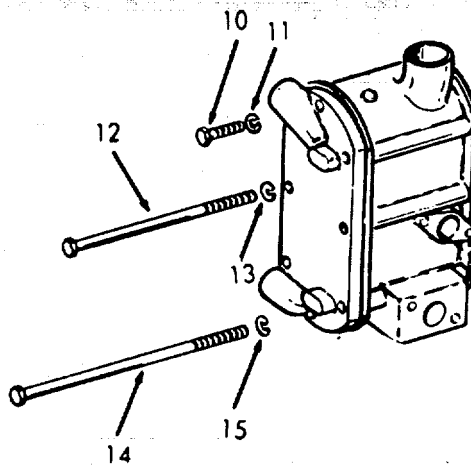


3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

7. Install six lock-washers (13) and bolts (12).
8. Install one lock-washer (15) and bolt (14).
9. Install one lock-washer (11) and cap-screw (10).



3-2590

3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS (Continued)

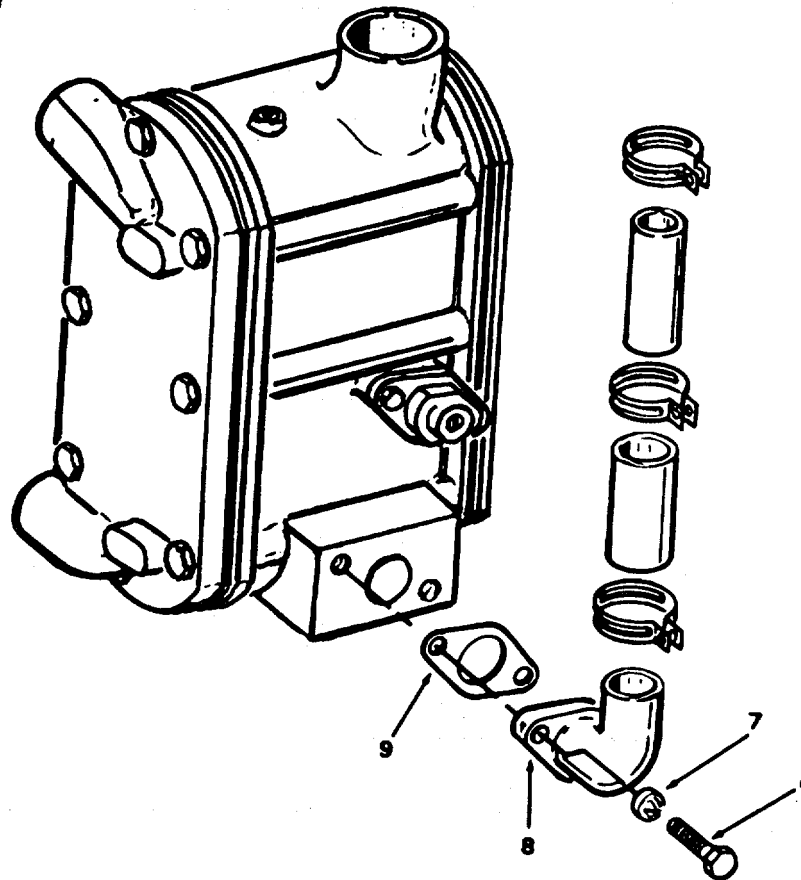
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

b. Oil cooler water inlet connection

1. Install gasket (9).
2. Swing oil cooler water inlet connection (8) back into place.
3. Install lockwashers (7) and capscrews (6).

Use repair kit P/N 5193114.



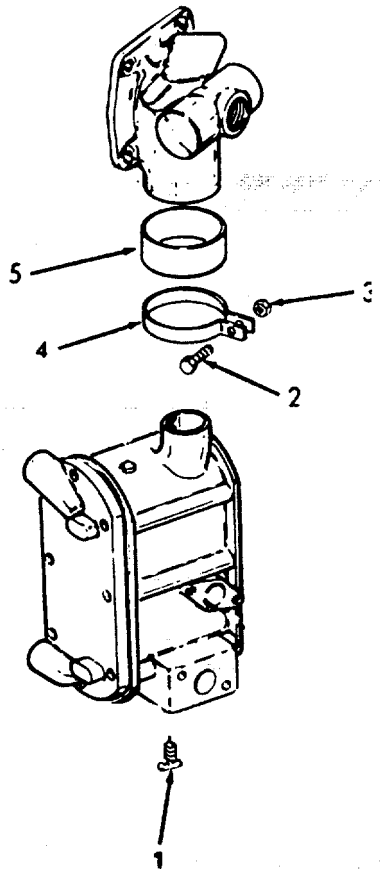
3-2591

3-149. LUBE OIL COOLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION(Cont)

- | | | | |
|----|-----------------|---|----------|
| c. | Seal water pump | <ol style="list-style-type: none"> 1. Install water seal in pump (5). 2. Install clamp (4). 3. Install screw (2), and nut (3). | Tighten. |
| d. | Drain- | Turn clockwise to close. cock (1) | |



- | | | | |
|----|--|--|--|
| 8. | | Reconnect hoses from the torque converter. | |
| 9. | | Fill system with anti-freeze. | |

3-150. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS.

The fresh water pump circulates the engine coolant through the cylinder block, cylinder head, heat exchanger and the oil cooler.

This task covers:

- a. Inspection
- b. Replacement
- c. Installation

INITIAL SETUP

Test Equipment

None

References

Paragraph
3-148

Lube Oil Cooler

Special Tools

Wrench, J4242

Equipment
Condition

None

Condition Description

Material/Parts

Seal kit P/N 5193605

Special Environmental Conditions

Do not drain oil into bilges.
Use the oil/water separation
and recovery system to collect
drained oil. Dispose of properly.

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | |
|---------------------|---------|---|
| 1. Fresh water pump | a. Hose | <ol style="list-style-type: none"> 1. Check for cracks, breaks or wear. 2. Check for leaks. 3. Check fittings for tightness. |
|---------------------|---------|---|

3-2594

3-150. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

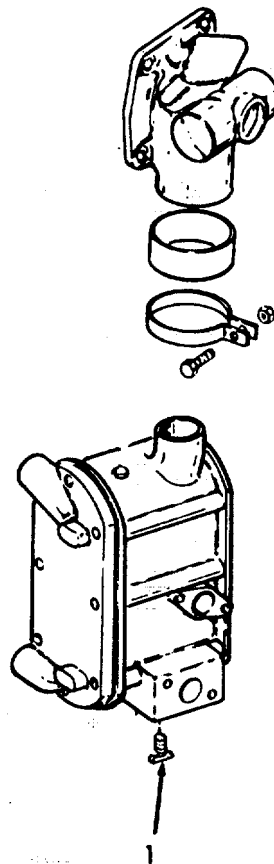
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION (Cont)

- | | | | |
|----|------------|-------------------------------|--|
| b. | Water pump | Check for cracks or dents. | |
| c. | Outlet | 1. Check for leaks.
Flange | |
| | | 2. Check for cracks. | |

REPLACEMENT

- | | | | | |
|----|-----------------|----------------|---------------------------------|--|
| 2. | Lube oil cooler | Drain-cock (1) | Turn counter-clockwise to open. | Drain into a suitable container. Do not drain into bilges. Use the oil and water separation system, and dispose of properly. |
|----|-----------------|----------------|---------------------------------|--|



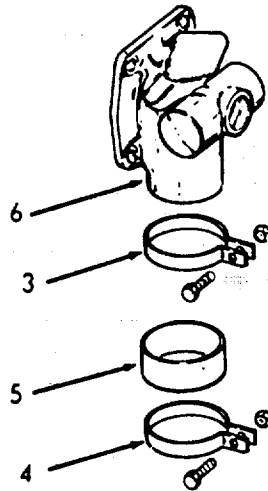
3-150. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)

3. Fresh water Pump	a. Drain-cock (2)	Turn counter-clockwise to open.	Drain into a suitable container. Do not drain into bilges. Use the oil and water separation system, and dispose of properly.
---------------------	-------------------	---------------------------------	--

- b. Hose
1. Loosen hose clamps (3 and 4).
 2. Slide hose clamp (4) down onto lube oil cooler.
 3. Slide seal (5) back against pump cover (6) from lube oil cooler.



3-2596

3-150. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

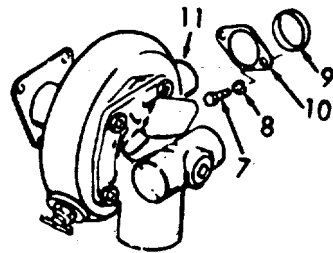
LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont)

c. Outlet flange

1. Remove capscrews (7), and lock-washers (8).
2. Remove outlet packing (9).
3. Remove outlet flange (10) from fresh water pump outlet (11).

Discard.

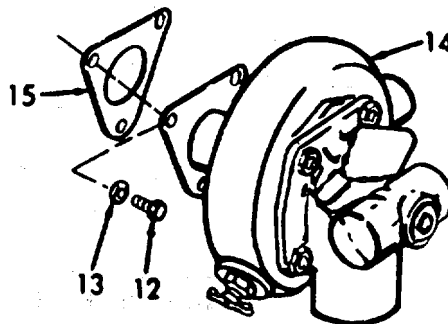


d. Fresh water (13).

1. Remove bolts (12) and seal washers
2. Remove fresh water pump (14) from blower.
3. Remove gasket (15).

Use J4242 wrench to loosen bolts.

Discard.



3-150. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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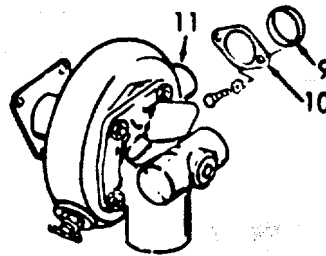
INSTALLATION

4. Fresh water pump

a. Outlet flange

1. Place the outlet flange (10) on fresh water pump outlet (11).
2. Slip outlet packing (9) over fresh water pump outlet (11).

Use repair kit P/N 5193605.



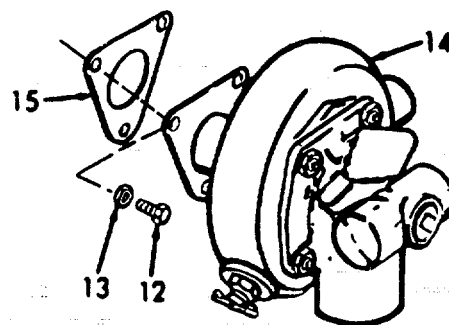
b. Fresh water Pump

1. Install gasket (15).
2. Place fresh water pump (14) against the blower end plate.
3. Install seal washers (13) and bolts (12).

Use repair kit P/N 5193605.

Align and mesh lugs on the drive coupling with the lugs on the intermediate shaft coupling.

Tighten and secure to the blower.



3-150. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued).

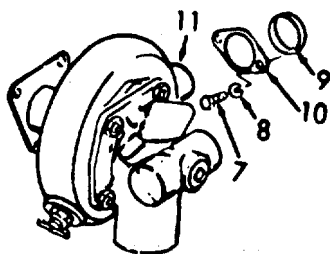
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

c. Outlet flange

1. Slide outlet packing (9) and outlet flange (10) against the cylinder block.
2. Install lockwashers (8), and capscrews (7).

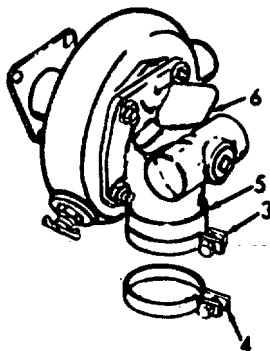
Tighten.



d. Hose

1. Slide seal (5) down from pump cover (6) to lube oil cooler.
2. Slide hose clamp (4) up from lube oil cooler.
3. Tighten hose clamps (3 and 4).

Secure fresh water pump to lube oil cooler.



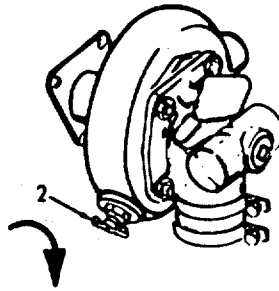
3-150. FRESH WATER PUMP - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

e. Drain
cock
(2)

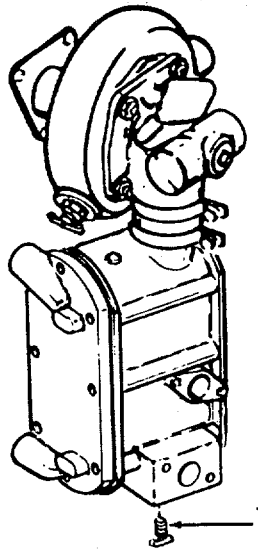
Turn clockwise to close.



5. Lube
oil
cooler

Drain
cock
(1)

Turn clockwise to close.



6.

Fill the engine cooling
system with antifreeze.

NOTE

When filling the cooling system of certain models, it is necessary to open the vent valve at the top of the thermostat housing.

3-151. WATER CONNECTIONS - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Repair

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

<u>Equipment Condition</u>	<u>Condition Description</u>
Paragraph	

3-149 Lube Oil Cooler Drain

Material/Parts

Gasket kit P/N 5193114

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | | |
|----|------------|------|---|
| 1. | Water pump | Hose | <ul style="list-style-type: none"> a. Inspect for breaks, cracks, and bends. b. Insure all hardware is tight. |
| 2. | Oil cooler | Hose | <ul style="list-style-type: none"> a. Inspect for breaks, cracks, and bends. b. Insure all hardware is tight. |

REPAIR

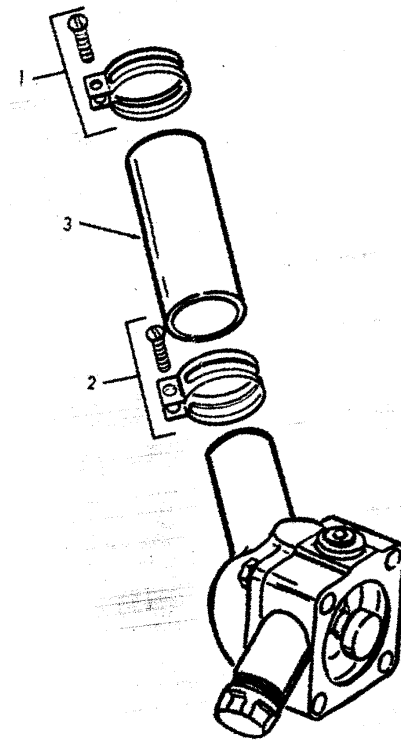
- | | | | |
|----|------------|--------------------------|---------|
| 3. | Water Pump | a. Hose clamps (1 and 2) | Loosen. |
|----|------------|--------------------------|---------|

3-151. WATER CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|----|--------------------------------|---------|------------|
| b. | Hose
(3) | Replace | If Needed |
| c. | Hose
Clamps
(1 and
2) | Replace | If needed. |



3-2603

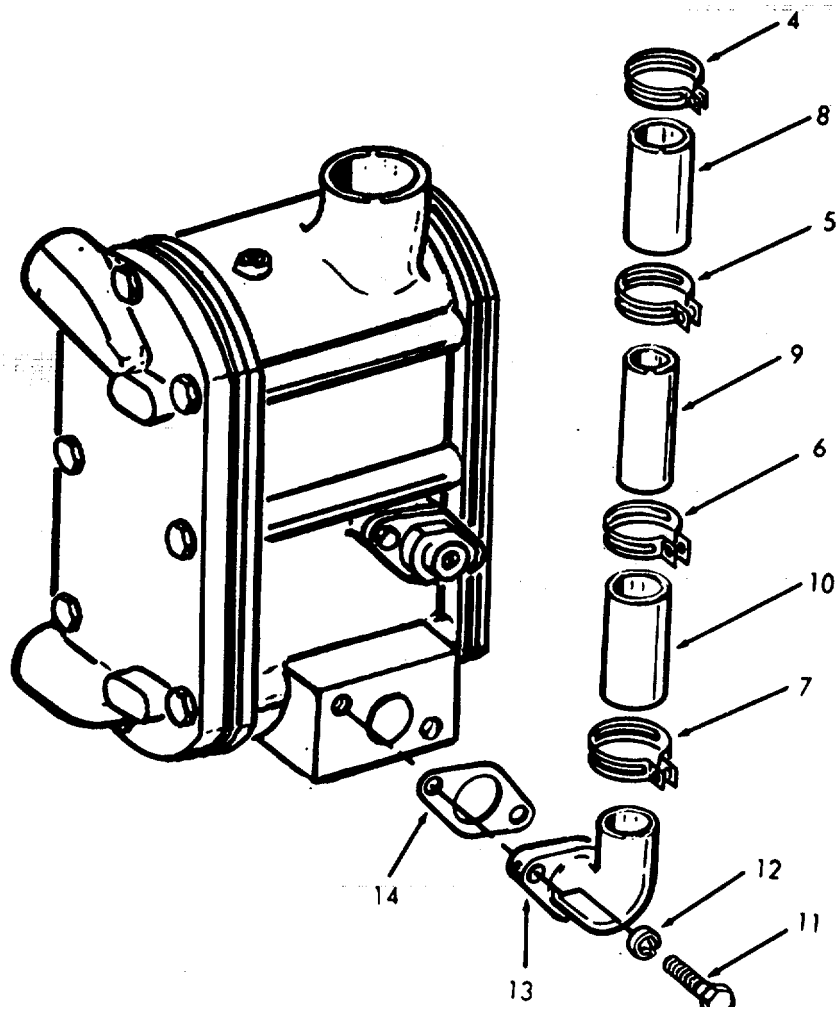
3-151. WATER CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
Repair (Cont)			
4. Oil cooler	a. Hose (4, 5, 6 and 7)	Loosen.	
	b. Hoses 8, 9, and 10	Remove.	
	c. Screws (11) and lock-washers (12)	Remove.	
	d. Inlet Connector (13), and gasket (14)	Remove.	Discard gasket.
	e. Gasket (14), inlet connector (13), screws (11), and lock-washers (12)	Reassemble.	
	f. Hoses (8, 9, and 10), and base clamps (4, 5, 6 and 7)	Reassemble.	

3-151. WATER CONNECTIONS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-2605

3-152. WATER MANIFOLD - MAINTENANCE INSTRUCTIONS.

Cooling water, leaving the cylinder head through an opening over each exhaust port, enters the water manifold. The front section of the water manifold is connected to the thermostat housing. The aft section of the water manifold contains a flexible by-pass hose to the exhaust manifold, where it will leave the exhaust manifold and flow to the oil cooler.

This task covers:

- a. Inspection b. Removal c. Installation

INITIAL SETUP

Test Equipment

None

References

Paragraph

- 3-150 Fresh Water Pump
3-153 Thermostat and Housing

Special Tools

None

Equipment

Condition Condition Description

None

Material/Parts

- Gasket kit P/N 5193114
Gasket kit P/N 5193116

Special Environmental Conditions

Do not drain water into bilges.
Use the oil/water separation
and recovery system. Dispose
of properly.

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

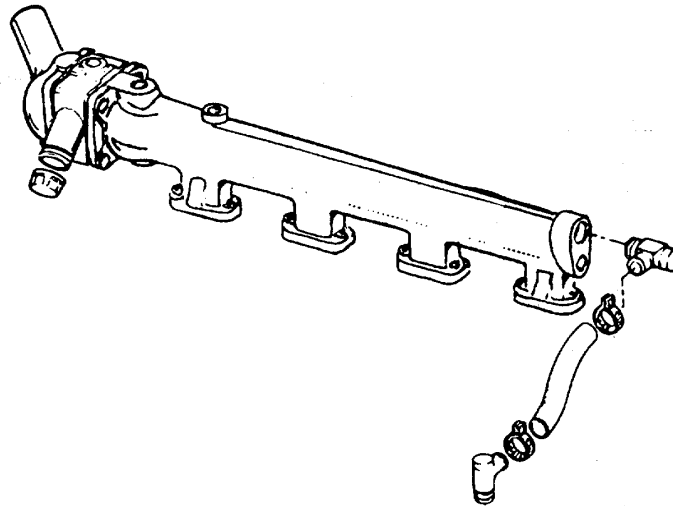
- | | | | |
|-------------------|-------------------------------|---|--|
| 1. Water manifold | a. Water manifold outlet seal | <ol style="list-style-type: none"> 1. Check for leaks. 2. Check for wear. 3. Check for cracks or breaks. | |
|-------------------|-------------------------------|---|--|

3-152. WATER MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION (Cont)

- | | |
|-------------------|--|
| b. Water manifold | <ol style="list-style-type: none"> 1. Check for leaks. 2. Check for cracks or dents. 3. Check for wear. 4. Check tightness of fitting to cylinder block. |
|-------------------|--|



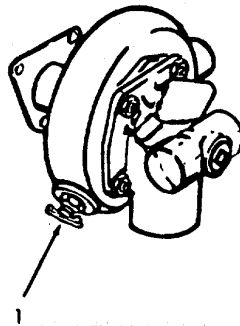
3-2607

3-152. WATER MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

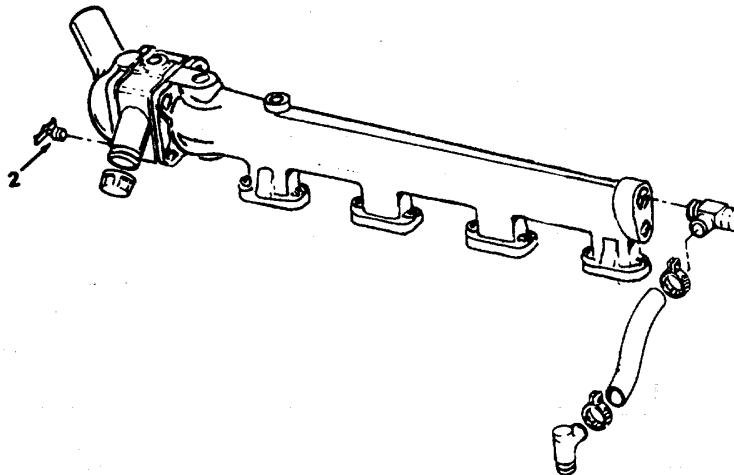
LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

- | | | | |
|---------------------|---------------|---------------------------------|---|
| 2. Fresh water pump | Draincock (1) | Turn counter-clockwise to open. | Drain into a suitable container. Drain to necessary level to repair water manifold. |
|---------------------|---------------|---------------------------------|---|

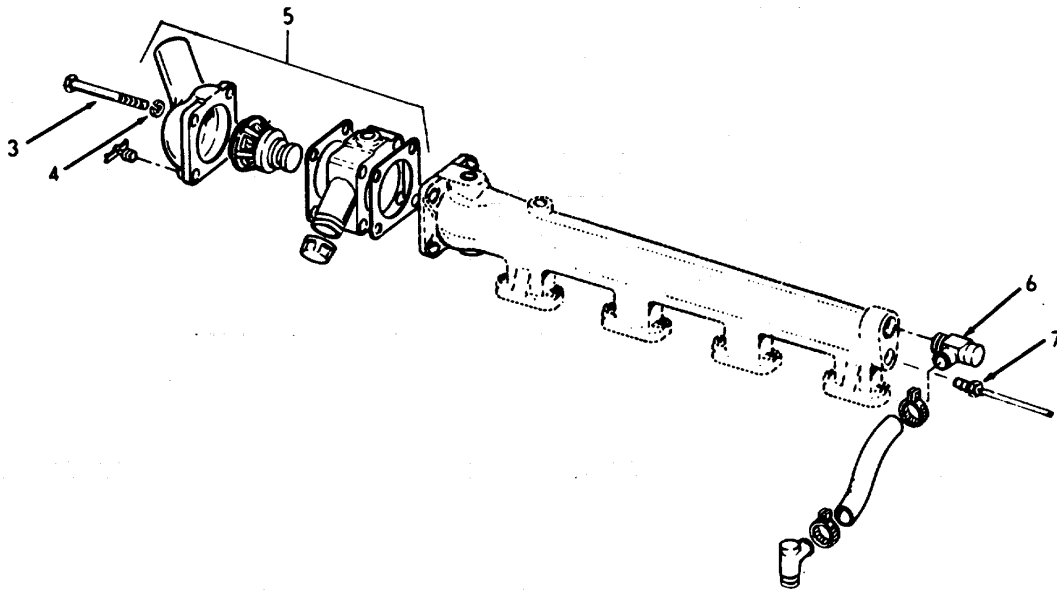


- | | | | |
|-----------------------|---------------|---------------------------------|---|
| 3. Thermostat housing | Draincock (2) | Turn counter-clockwise to open. | Drain into a suitable container. Drain to necessary level to repair water manifold. |
|-----------------------|---------------|---------------------------------|---|



3-152. WATER MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
4. Water manifold	a. Water manifold outlet seal	1. Remove screws (3) and lockwashers (4).	
	b. Water manifold outlet to exhaust manifold	2. Remove thermostat housing (5).	
	c. Water temperature gauge (7)	Remove 900 elbow (6) and hose clamps and hoses.	
		Remove.	

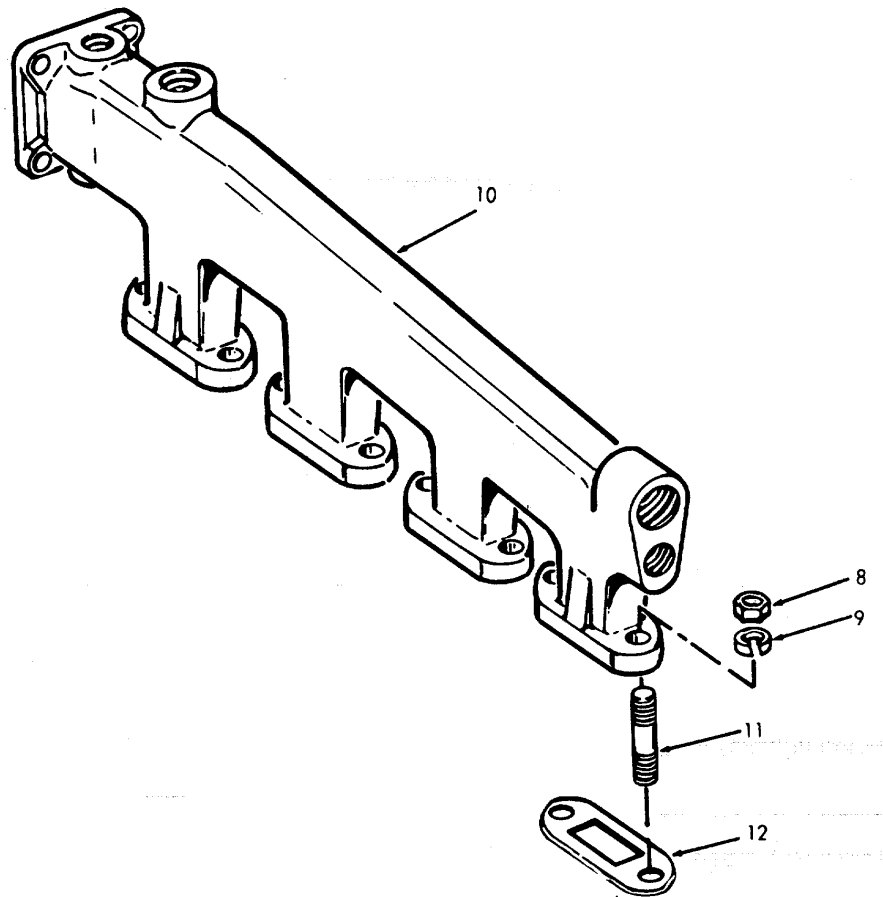


3-152. WATER MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|-------------------|--|---|----------|
| d. Water manifold | 1. Remove stud nuts (8) and lockwashers (9). | 2. Remove water manifold (10) straight up off studs (11). | Discard. |
| | 3. Remove studs (11). | 4. Remove gaskets (12). | |

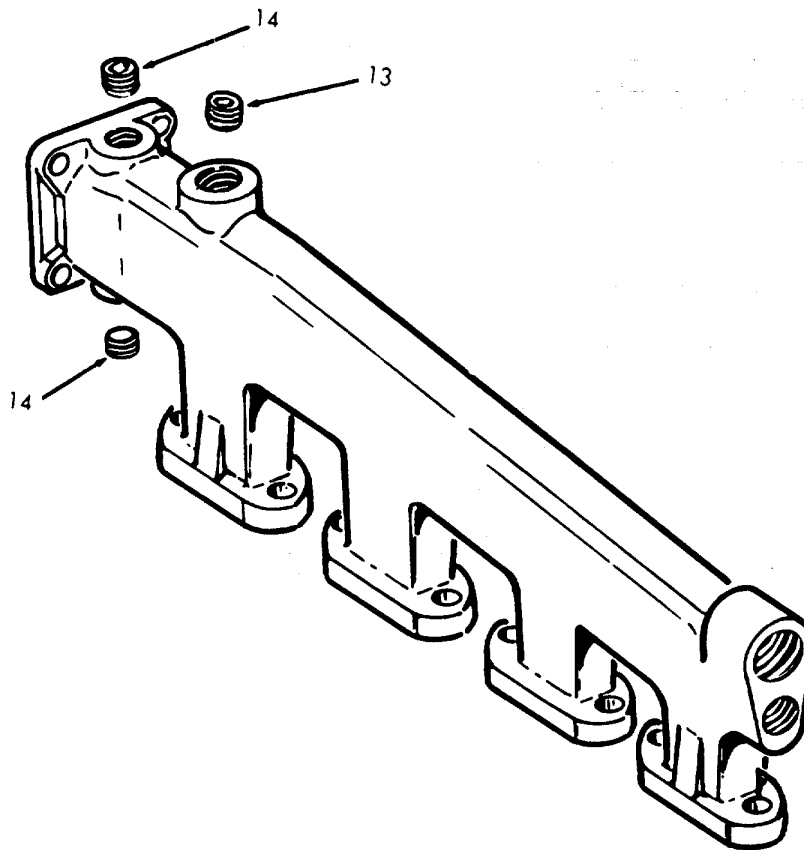


3-152. WATER MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- | | |
|--------------------------------|---------------|
| 5. Remove pipe plug (13). | If necessary. |
| 6. Remove two pipe plugs (14). | If necessary. |

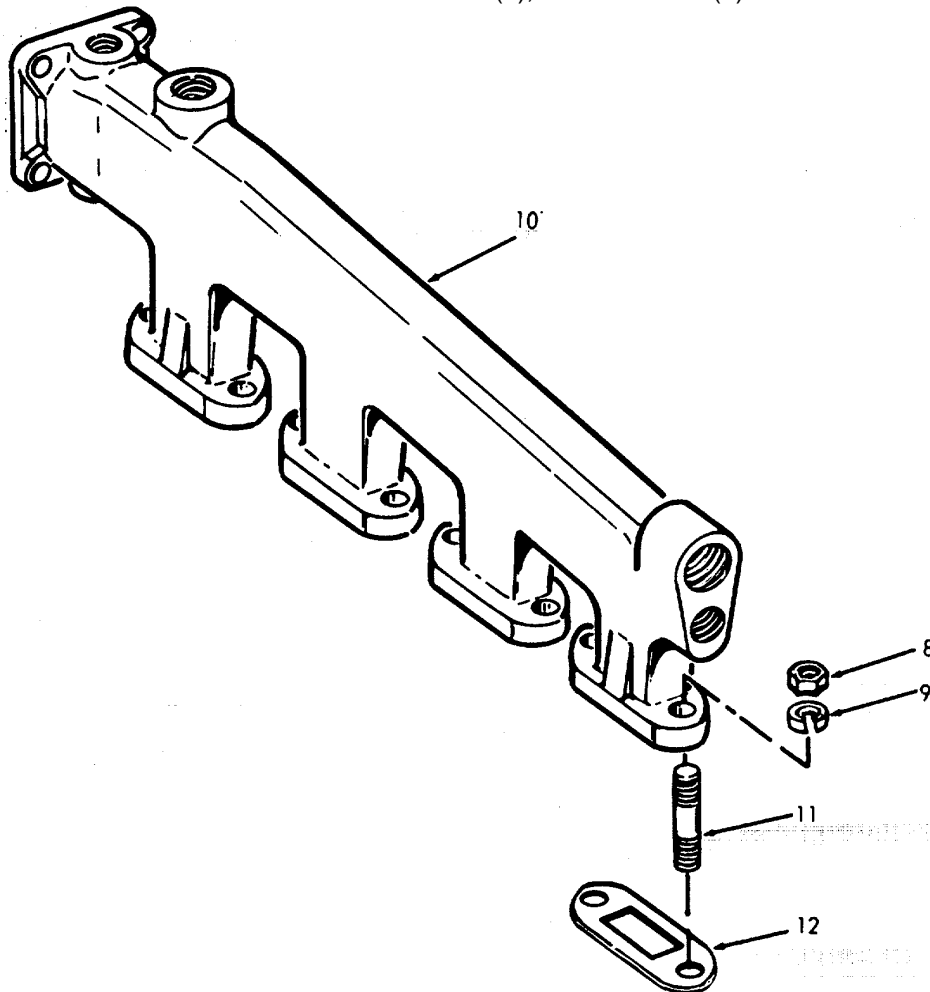


3-152. WATER MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

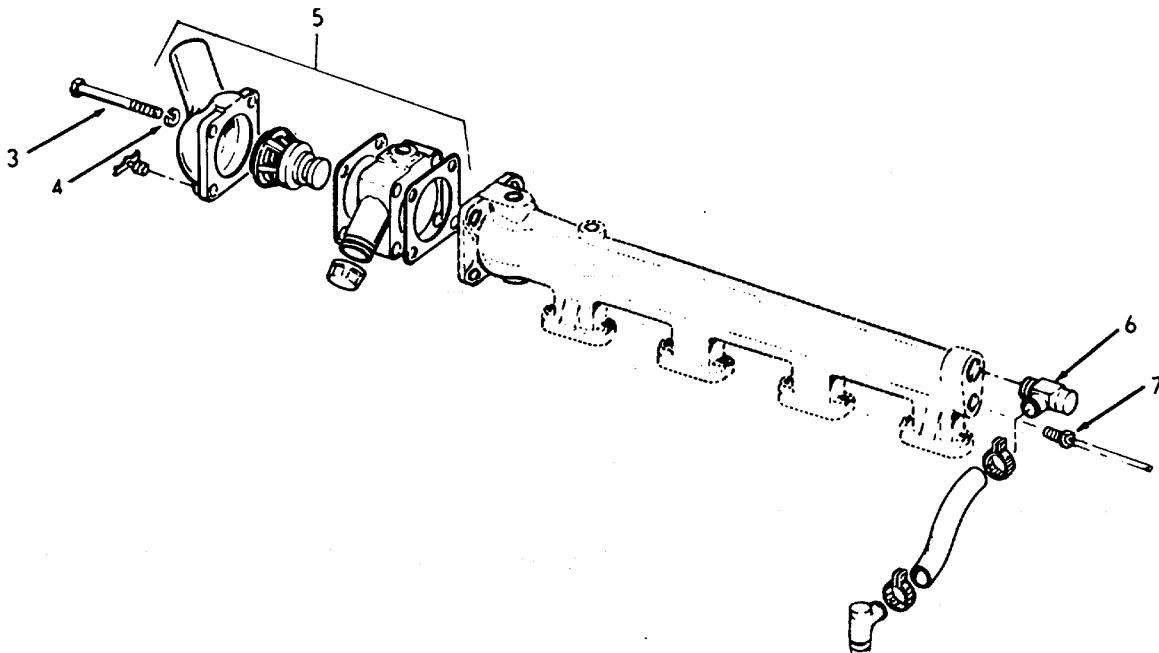
INSTALLATION

- | | | | |
|-------------------|-------------------|--|---|
| 5. Water manifold | a. Water manifold | <ol style="list-style-type: none"> 1. Install gasket (12). 2. Install studs (11). 3. Install water manifold (10) onto studs (11). 4. Install lockwashers (9), and stud nuts (8). | Use repair kit P/N 5193114 and P/N 5193116. |
|-------------------|-------------------|--|---|



3-152. WATER MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
	b. Water temperature gauge (7)	Install.	
	c. Water manifold outlet to exhaust manifold	Install 90° elbow (6).	
	d. Water manifold outlet seal	Install thermostat housing (5), screws (3), and lockwashers (4).	Refer to paragraph 3-153 for thermostat housing maintenance instructions.

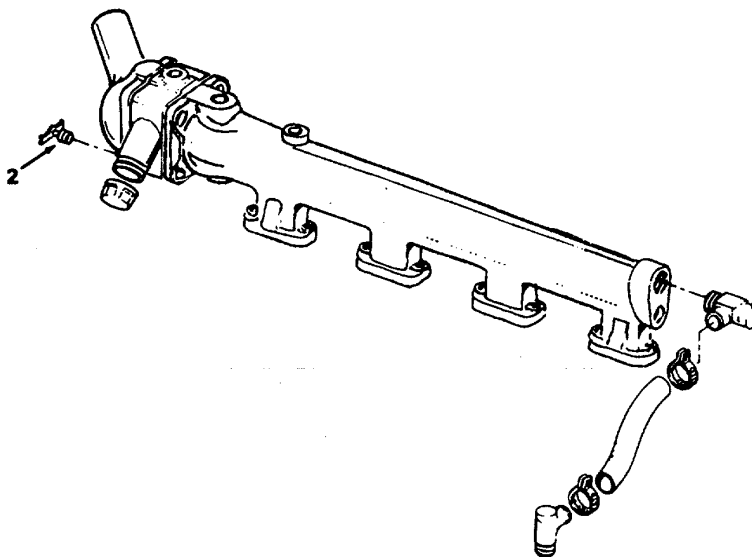


3-152. WATER MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

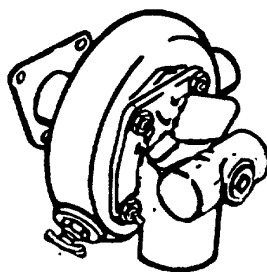
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- | | | | |
|----|----------------------------|------------------|--------------------------|
| 6. | Thermo-
stat
housing | Draincock
(2) | Turn clockwise to close. |
|----|----------------------------|------------------|--------------------------|



- | | | | |
|----|------------------------|------------------|--------------------------|
| 7. | Fresh
water
pump | Draincock
(1) | Turn clockwise to close. |
|----|------------------------|------------------|--------------------------|



- | | | | |
|----|--|--|---|
| 8. | | | Fill cooling system
to proper level. |
|----|--|--|---|

NOTE

When filling cooling system on certain models, it is necessary to open the vent valve at the top of the thermostat housing.

3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS.

a. The temperature of the engine coolant is automatically controlled by a thermostat located in the housing connected to the outlet end of the water manifold and to the keel coolers.

b. At coolant temperatures below approximately 170°F (76.7°C), the thermostat valves remain closed and block the flow of coolant to the keel coolers. During this period, all of the coolant is circulated through the engine and is directed back to the suction side of the water pump via the by-pass tube. As the coolant temperature rises above 170°F (76.7°C), the thermostat valves start to open, restricting the by-pass system, and permitting a portion of the coolant to circulate through the keel coolers. When the coolant temperature reaches approximately 185°F (85°C), the thermostat valves are fully open, the by-pass system is partially blocked off, and most of the coolant is directed through the keel coolers.

c. A properly operating thermostat is essential for efficient operation of the engine. If the engine operating temperature deviates from the normal range of 160° to 185°F (71° to 85°C) remove the thermostat and check it.

d. The by-pass hoses and tubes of the water and exhaust manifolds help to by-pass the thermostat while the engine is warming up.

3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS.

This task covers:

- | | |
|---------------|-----------------|
| a. Inspection | c. Testing |
| b. Removal | d. Installation |

INITIAL SETUP

Test Equipment

None

References

Paragraph

- | | |
|-------|-------------------|
| 3-149 | Lube Oil Cooler |
| 3-150 | Fresh Water Pump |
| 3-151 | Water Connections |
| 3-152 | Water Manifold |
| 3-160 | Exhaust Manifold |

Special Tools

Thermostat seal
replacer - J8499

Equipment

Condition Condition Description

Paragraph

- | | |
|-------|------------------------------|
| 3-151 | Water Connections
Removal |
| 3-152 | Water Manifold Removal |
| 3-160 | Exhaust Manifold
Removal |

Material/Parts

Gasket kit P/N 5193114

Special Environmental Conditions

Do not drain oil into bilges.
Use the oil/water separation
and recovery system. Dispose
of properly.

Personnel Required

1

General Safety Instructions

None

3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

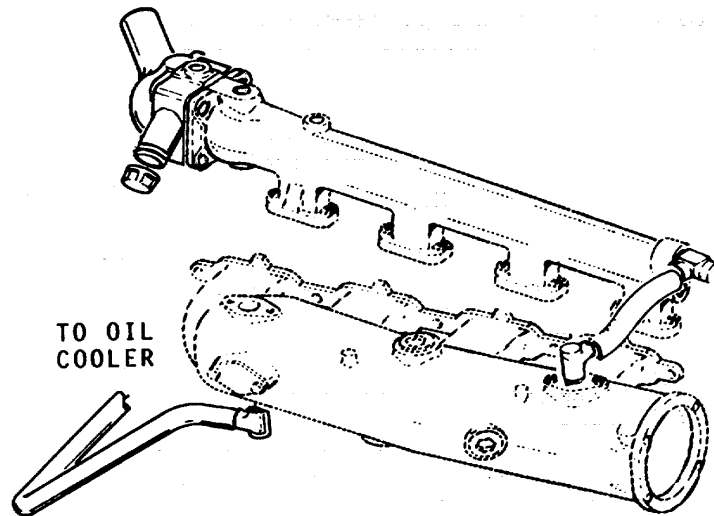
LOCATION	ITEM	ACTION	REMARKS
INSPECTION			
1.	Thermostat housing	<ul style="list-style-type: none"> a. Check for cracks or dents. b. Check for leaks. c. Check connections from thermostat housing to keel cooler and water manifold. 	
2.	Water manifold to exhaust manifold	a. 90° elbows	<ul style="list-style-type: none"> 1. Check for cracks or dents. 2. Check for leaks.
		b. By-pass hose	<ul style="list-style-type: none"> 1. Check for cracks or breaks. 2. Check for wear. 3. Check for leaks. 4. Check tightness of hose clamps and fittings.
3.	Exhaust manifold to oil cooler	a. By-pass tube	<ul style="list-style-type: none"> 1. Check for cracks. 2. Check for wear. 3. Check for leaks. 4. Check tightness of hose clamps and fittings.

3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)

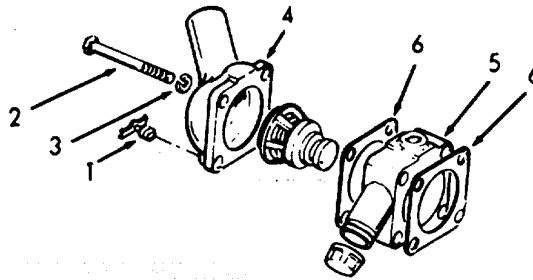
- | | |
|------------------|--|
| b. Flexible hose | <ol style="list-style-type: none"> 1. Check for cracks or breaks. 2. Check for wear. 3. Check for leaks. 4. Check tightness of hose clamps and fittings. |
|------------------|--|



3-2618

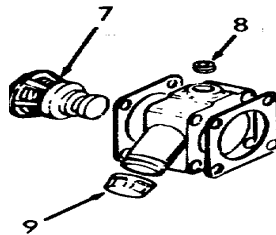
3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
4. Thermostat housing	Draincock (1)	Turn counter-clockwise to open.	Drain the cooling system to the necessary level in order to repair the thermostat and housing. Drain into a suitable container. Do not use bilges. Dispose of properly.
5. Water manifold and thermostat housing	Thermostat	<ol style="list-style-type: none"> 1. Remove screws (2) and lockwashers (3). 2. Remove outlet elbow (4), housing (5), and gaskets (6). 	Discard gasket.



3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
6. Thermo- stat housing	Thermostat housing (7).	a. Remove thermostat	Clean the thermostat seat in the thermostat housing.
		b. Remove pipe plug (8).	If necessary.
		c. Remove pipe cap (9).	If necessary.



NOTE

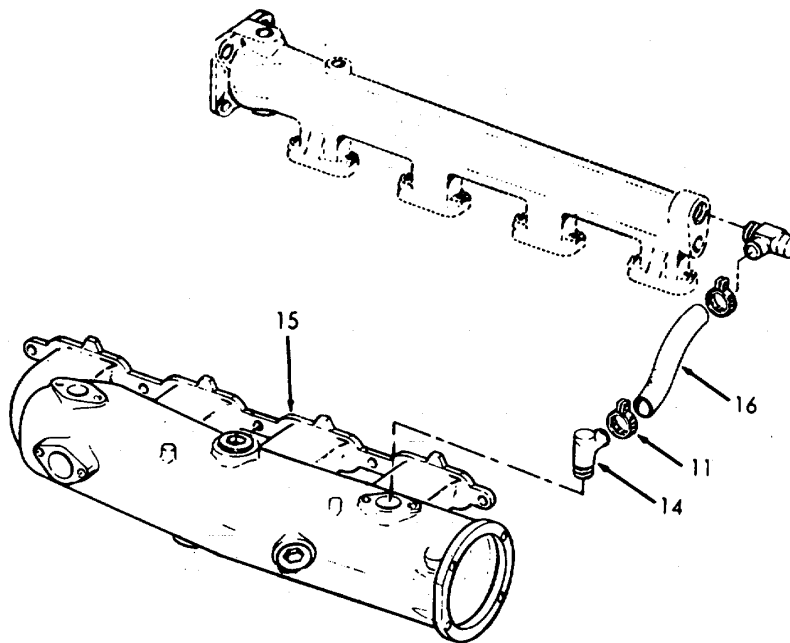
When working on the water manifold by-pass hose and exhaust manifold by-pass tube, it will be necessary to drain the cooling system further for maintenance. Refer to paragraphs 3-149 Lube Oil Cooler, 3-150 Water Pump and 3-151 Water Connection, for instructions on draining the cooling system.

3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- d. Slide hose clamp (11) onto 90° elbow (14) at exhaust manifold (15).
- e. Remove by-pass hose (16).
- f. Remove 90° elbow (14) from exhaust manifold (15).



3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

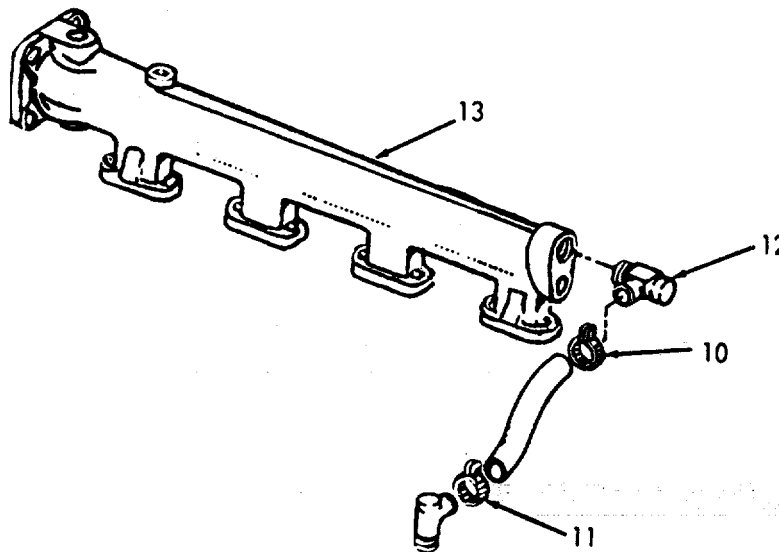
LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

CAUTION

Completely drain cooling system before maintenance repairs to water manifold by-pass hose or exhaust manifold by-pass tube can be made. Do not drain into bilges.

- | | | | | |
|----|------------------------------------|--------------|--|----------------------|
| 7. | Water manifold to exhaust manifold | By-pass hose | <ol style="list-style-type: none"> Loosen hose clamps (10 and 11). Slide hose clamp (10) onto 90° elbow (12) at water manifold (13). Remove 90° elbow (12). | Remove if necessary. |
|----|------------------------------------|--------------|--|----------------------|

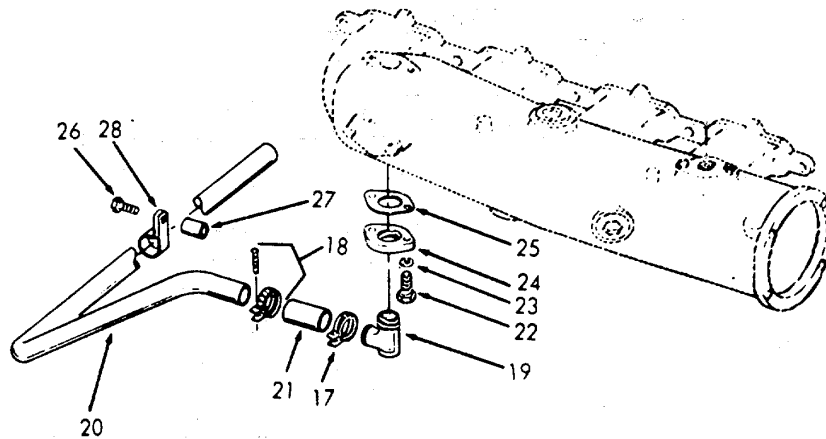


3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | | |
|----|--------------------------------|--------------|--|--|
| 8. | Exhaust manifold to oil cooler | By-pass tube | <ol style="list-style-type: none"> a. Loosen hose clamps (17 and 18). b. Slide hose clamp (17) onto elbow (19). c. Slide hose clamp (18) onto by-pass tube (20). d. Remove hose (21). e. Remove elbow (19). f. Remove capscrews(22) and lockwashers (23). g. Remove cover plate (24) and gasket (25). h. Remove screw (26), spacer (27), clip (28), and by-pass tube (20). | <p>Remove if necessary.</p> <p>Discard gasket.</p> |
|----|--------------------------------|--------------|--|--|



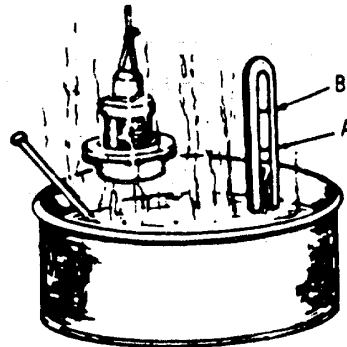
3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
TESTING	Thermostat	a. Check for accumulation of rust and corrosion from the engine coolant. If present, it can restrict the flow of water, causing engine overheating.	Allows incomplete combustion of fuel and build-up of carbon deposit on
		b. Thermostat stuck in wide open position will not allow engine to reach normal operating temperature. pistons, rings and valves.	
		c. Check thermostat operation by immersing it in a container of hot water.	
		1. Place thermometer in the container. Do not let it touch the bottom of the container.	Water temperature at 170°F (76.7°C).
		2. Agitate water to maintain an even temperature.	
		3. As the water is heated, the thermostat should begin to open.	Few types fully open at 195°F (90.6°C).
		4. Thermostat should be fully open by 185°F (85°C).	

3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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TESTING (Cont)



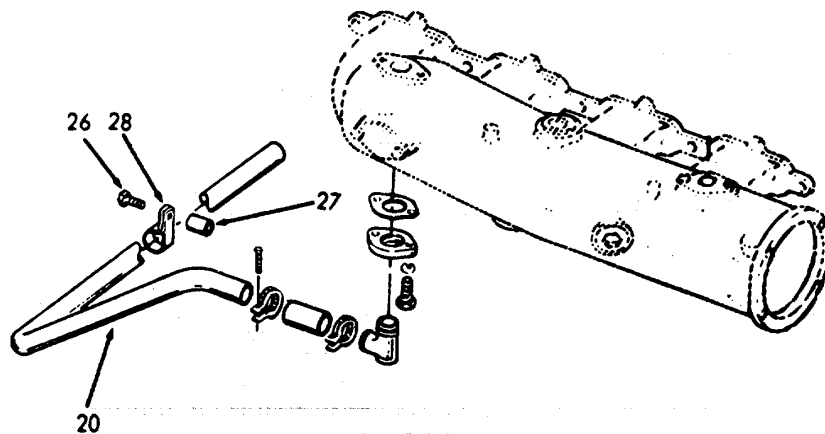
A - START TO OPEN
B - FULLY OPEN

INSTALLATION

10. Exhaust manifold to oil cooler

By-pass tube

a. Assemble by-pass tube (20), screw (26), spacer (27) and clip (28).



3-153. THERMOSTAT AND HOUSING - MAINTENANCE- INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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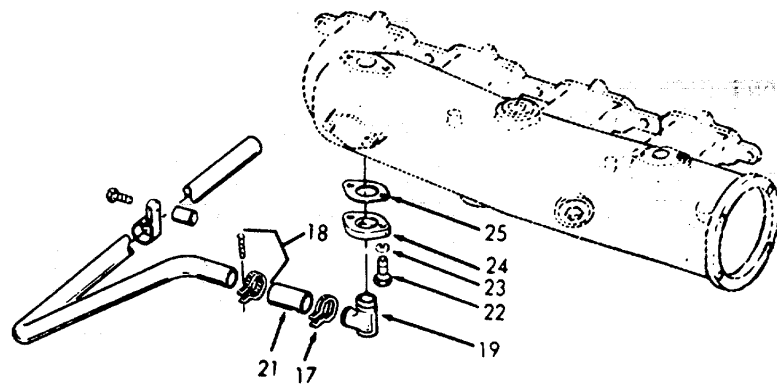
INSTALLATION (Cont)

b. Install cover plate (24), gasket (25), capscrews (22) and lockwashers (23).

Use a new gasket. Use repair kit, P/N 5193114.

c. Install elbow (19).

d. Install hose (21), and hose clamps (17 and 18).



11. Water manifold to exhaust manifold

By-pass hose

a. Install 90° elbow (14) onto exhaust manifold (15).

b. Slide hose clamp (11) up from 90° elbow (14), attach by-pass hose (16), and tighten hose clamp (11).

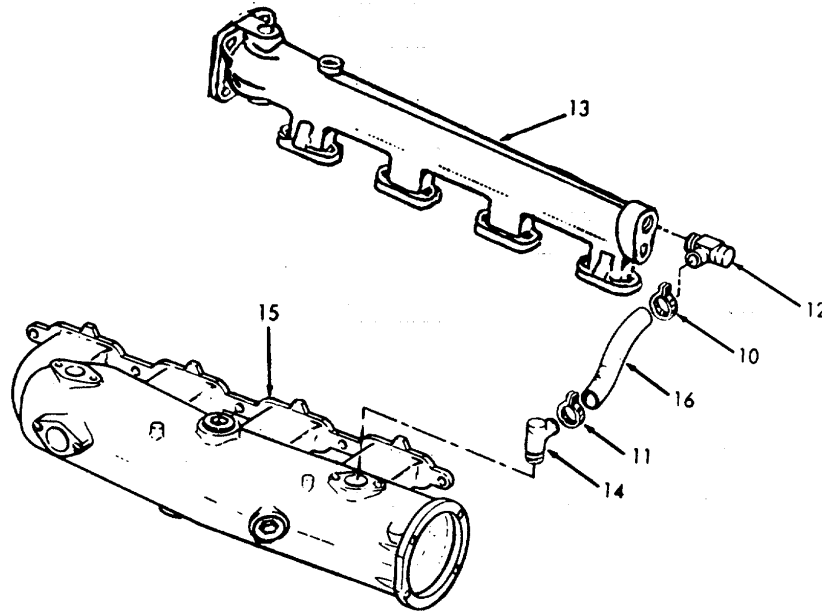
3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

c. Install 90° elbow (12) onto water manifold (13).

d. Slide hose clamp (10) down from 90° elbow (12), attach by-pass hose (16) and tighten hose clamp (10).



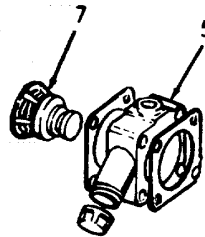
3-2627

3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

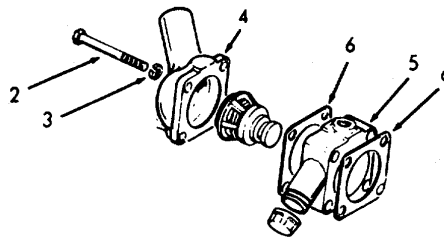
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

12. Thermo- stat housing	a. Thermo- stat	Install thermostat (7) into thermostat housing (5).	
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	b. Water outlet thermo- stat housing	<ol style="list-style-type: none"> 1. Assemble gasket (6), housing (5) and out- let elbow (4). 2. Install thermostat housing using screws (2), and lockwashers (3). 	Use repair kit, P/N 5193114.
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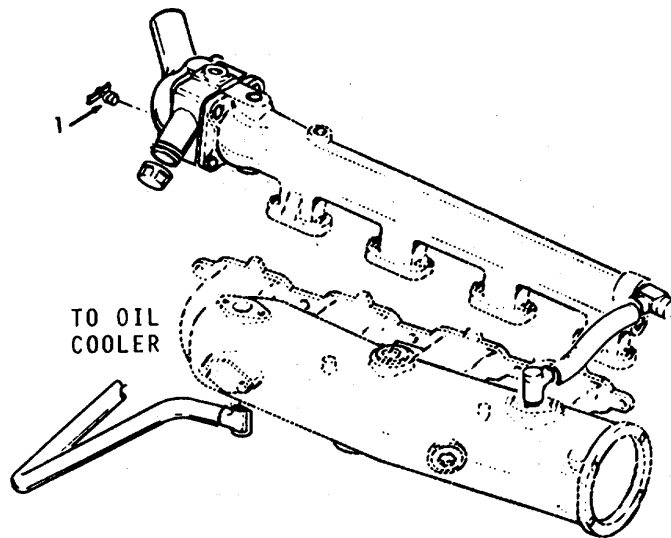


3-153. THERMOSTAT AND HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

13. Thermo- stat housing	Draincock (1) TO KEEL COOLER	Turn clockwise to close.	
--------------------------------	---------------------------------------	--------------------------	--



14.		Fill the cooling system to proper level.	Refer to paragraphs 3-149, 3-150, and 3-151 on closing draincocks, if opened for maintenance of water manifold by-pass hose and exhaust manifold by-pass tube.
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NOTE

When filling the cooling system, it is necessary to open the vent valve at top of the thermostat housing.

3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS

This task covers:

- | | | | |
|----------------|---------------|-----------------|---------------|
| a. Removal | c. Inspection | e. Reassembly | g. Adjustment |
| b. Disassembly | d. Repair | f. Installation | |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Sharp pointed instrument
Arbor press
Rod 9/16 inch diameter

Equipment

Condition Condition Description

None

Material/Parts

Gasket kit P/N 5193114
Grease MIL-G-18709

Special Environmental Description

None

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

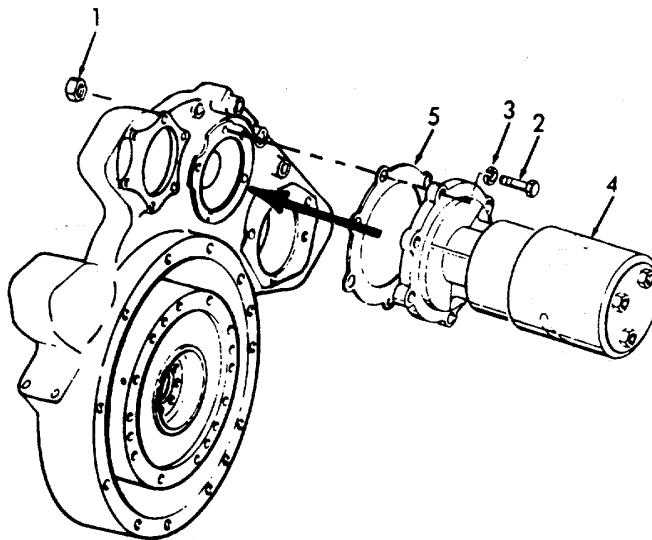
- | | | | |
|----|------------------|---|---------------------|
| 1. | Flywheel housing | a. Wiring | Tag and disconnect. |
| | | b. Nuts (1), screws (2), and lock-washers (3) | Remove four sets. |

3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|----|---|----------------------------|--|
| c. | Over-speed governor (4), and gasket (5) | Remove and discard gasket. | |
|----|---|----------------------------|--|



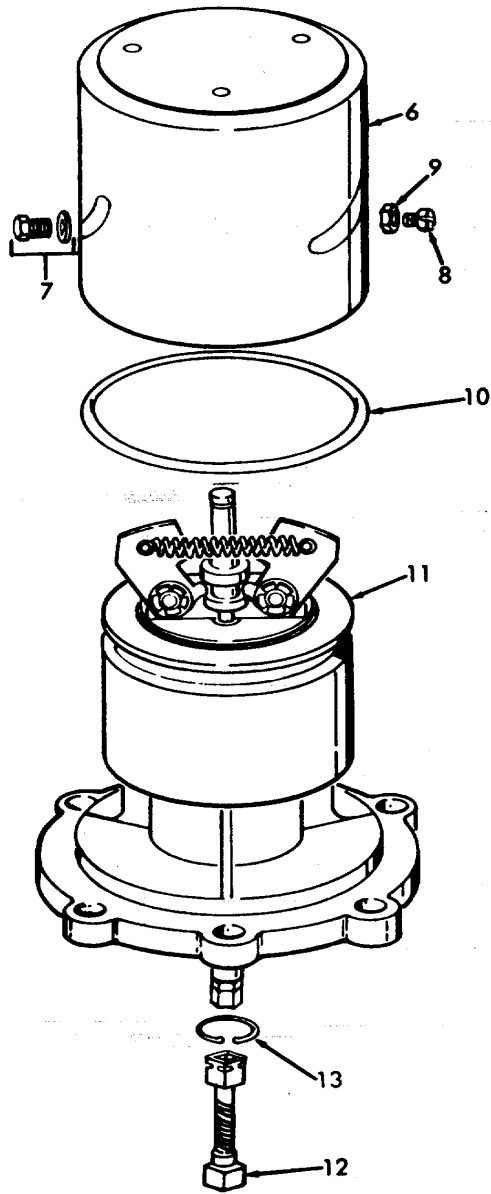
3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
2. Overspeed governor cap (6)	a. Screw and washer assembly (7)	Remove.	
	b. Adjusting stud (8), and nut (9)	Remove.	
	c. Cap(6)	Remove.	
	d. Seal ring (10)	Remove from body (11).	
3. Flexible shaft (12)	a. Spring clip (13)	Insert a sharp pointed instrument in the loop of the spring clip (13) and pull the clip from the flexible shaft (12) as far as possible.	
	b. Flexible shaft assembly (12)		Remove.

3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

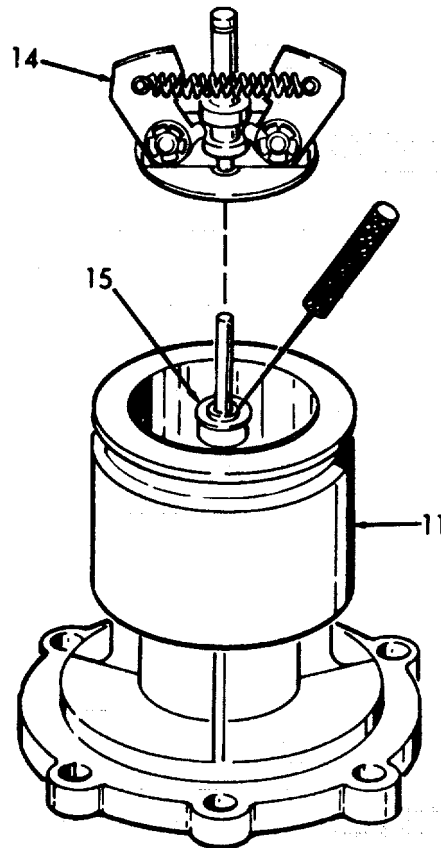


3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY (Cont)

- | | | | |
|----|----------------------|--------------------------|--|
| 4. | Weight assembly (14) | a. Weight assembly (14) | Remove. |
| | | b. Bearing retainer (15) | Insert a sharp pointed instrument in the bearing retainer (15) and remove from housing (11). |



3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			
5. Shaft and weight assembly	a. Shaft and bearing assembly (16)	Remove from body (11).	
	b. Springs (17)	Remove from posts on weight assembly (18).	

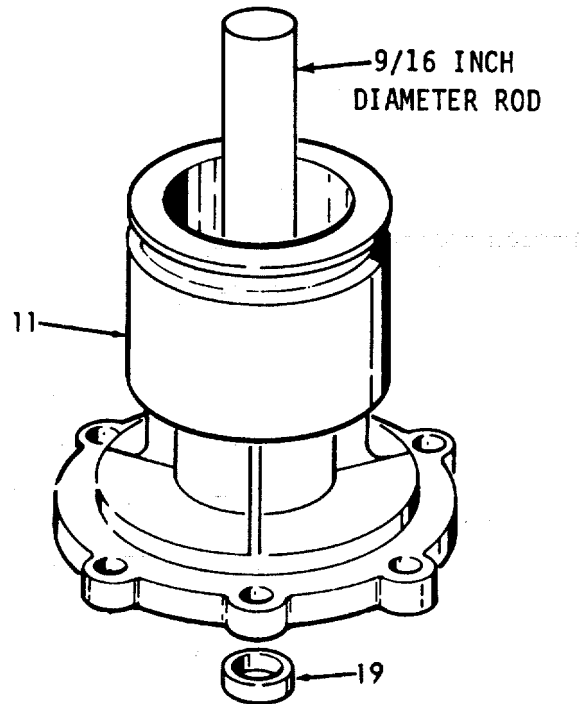
3-2635

3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

6. Body (11)	Seal (19)	Inspect the oil seal. If damaged or leaking, replace.	
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REPAIR

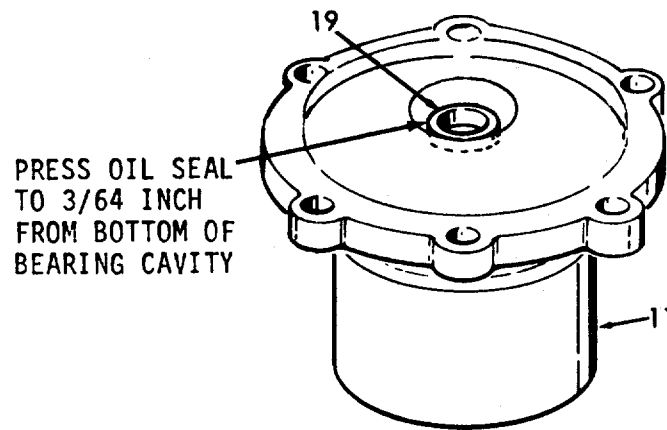
7. Oil seal	Body (11)	a. Place body in arbor press with the mounting flange facing down. Use a 9/16 inch diameter rod to press out the oil seal (19).	
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3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- b. Turn body (11) over and press in new oil seal (19). Seal (19), must be 3/64 inch (0.119 cm) from bottom of bearing cavity.



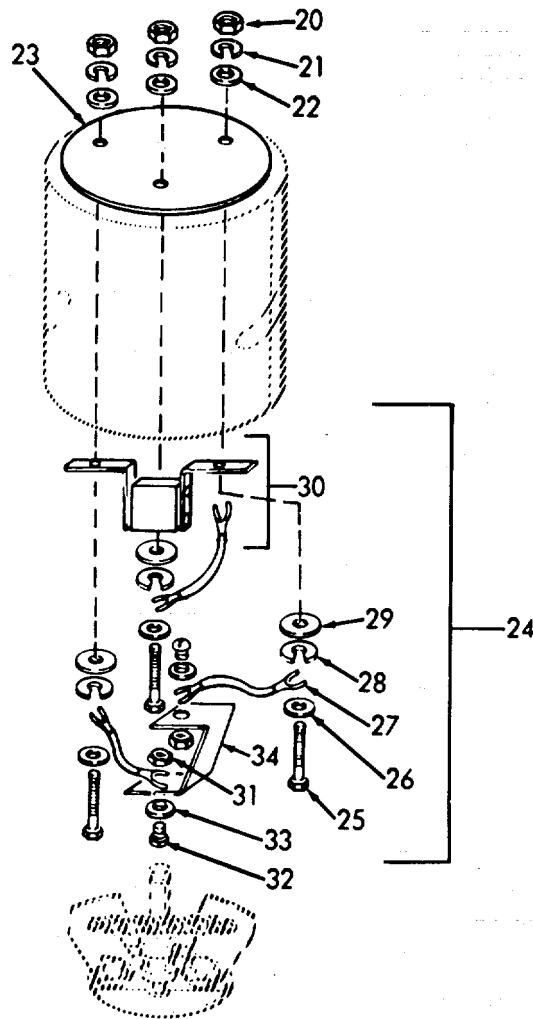
3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
8. Cap	a. Nuts (20), lock - washers (21), insulating washers (22), and insulator (23)	Remove.	
	b. Switch and wiring (24)	Remove from cap.	
	c. Screws (25), flat-washers (26), wires (27), lock-washers (28), bushings (29), and switch assembly (30)	Remove.	
	d. Nuts (31), screws (32), flat-washers (33), and connector (34)	Disassemble.	

3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-2639

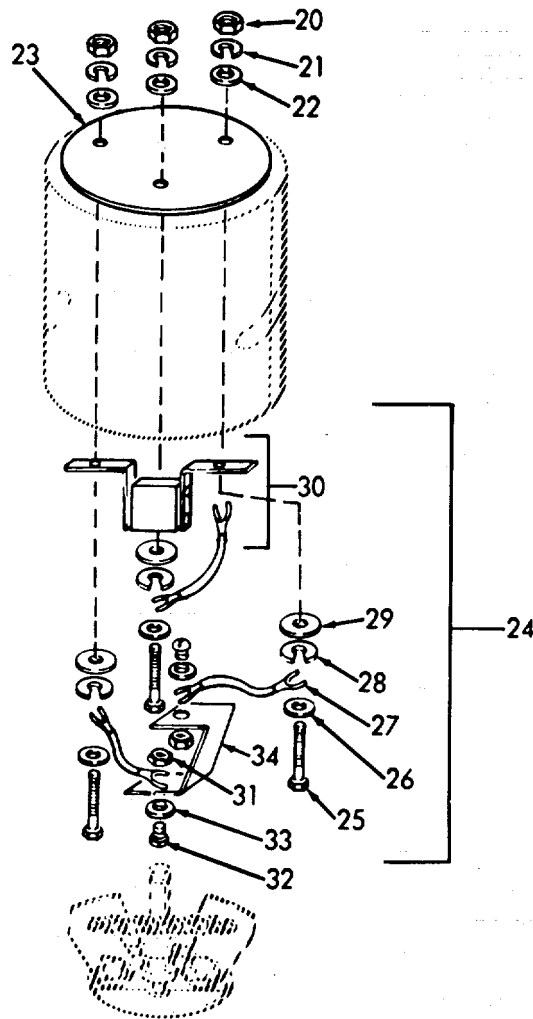
3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)	e. Connector (34), screws (32), flat-washers (33), and nuts (31)	Reassemble.	
	f. Switch assembly (30), bushings (29), lock-washers (28), wires (27), flat-washers (26), and screws (25)	Reassemble.	
	g. Switch and wiring (24)	Insert in cap.	
	h. Insulator (23), insulating washers (22), lock-washers (21), and nuts (20)	Reassemble on cap.	

3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

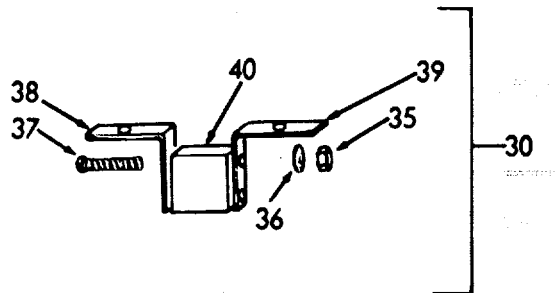
LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).-

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
9. Switch assembly (30)	a. Nuts (35), lock-washers (36), and screws (37)	Remove.	
	b. Bracket (left) (38), bracket (right) (39), and switch (40)	Remove.	
	c. Bracket (right) (39), bracket (left) (38), switch (40), screws (37), lock-washers (36), and nuts (35)	Reassemble.	

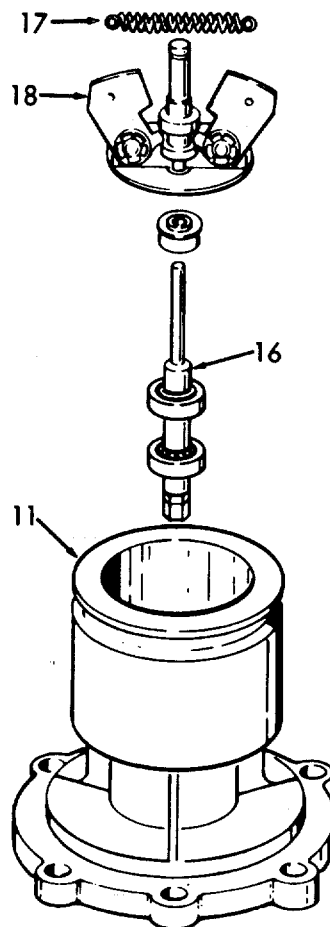


3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REASSEMBLY

- | | | | |
|----------------------|------------------------------------|-------------------------------------|--|
| 10. Shaft and weight | a. Springs (17) | Reassemble on weight assembly (18). | |
| | b. Shaft and bearing assembly (16) | Insert in body (11). | |
| | c. Bearing retainer (15) | Install. | |



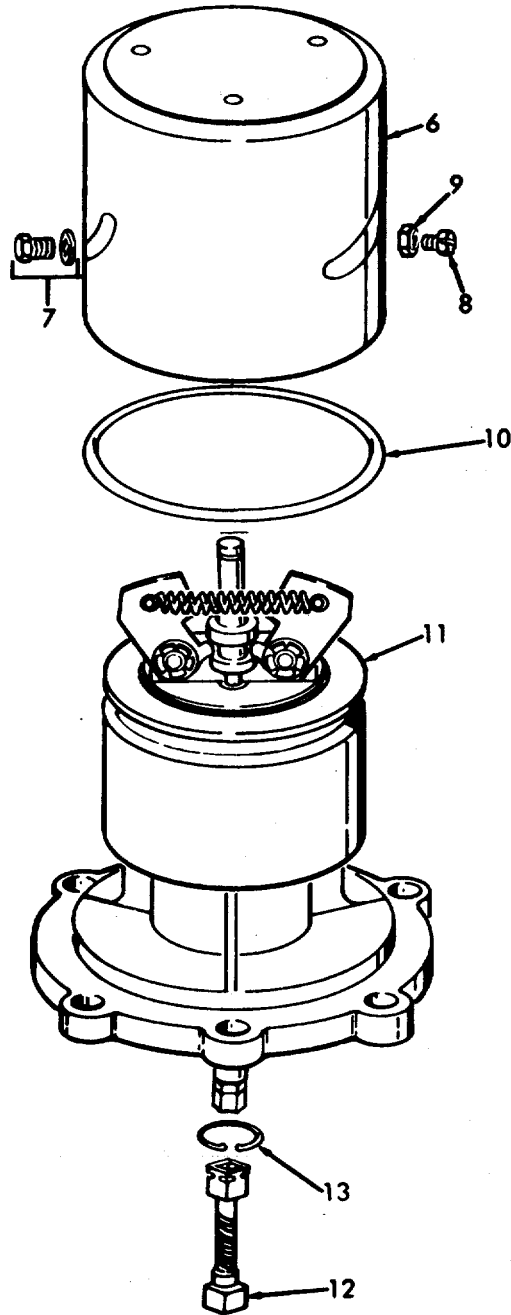
3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REASSEMBLY (Cont)			
11. Flexible shaft	Flexible shaft (12), and spring clip (13)	Install.	
12. Cap	a. Seal ring (10)	Install on body (11).	
	b. Cap (6)	Place over seal ring and align holes for screws.	
	c. Adjusting stud (8), and nut (9)	Install.	
	d. Screw and washer assembly (7)	Install.	

3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

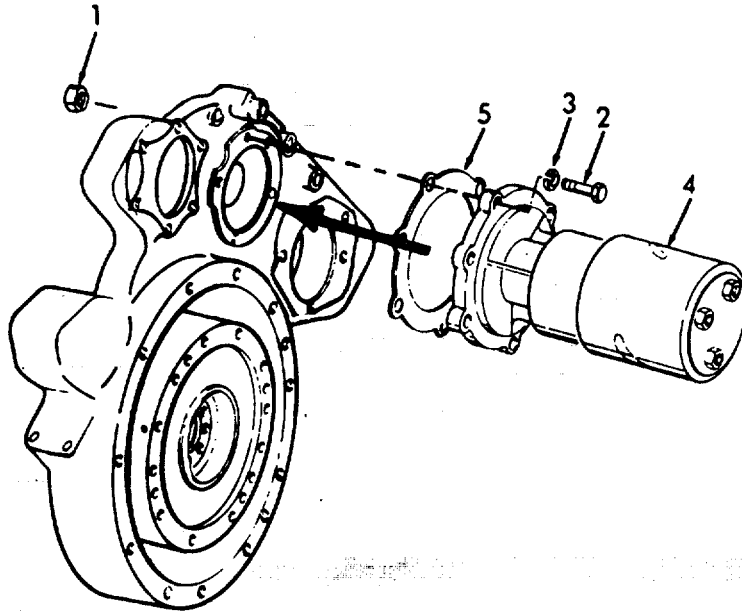


3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION

- | | | | |
|-----------------------|---|-------------|-----------------|
| 13. Governor assembly | a. Governor (4), gasket (5), screws (2), lock-washers (3), and nuts (1) | Reassemble. | Use new gasket. |
| | b. Wiring | Reinstall. | |



3-154. OVERSPEED GOVERNOR - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
ADJUSTMENT			
14. Overspeed governor	Cap adjusting lockscrew	<ol style="list-style-type: none"> 1. Loosen. 2. Rotate cap clockwise to lower the trip speed. 3. Rotate cap counter-clockwise to raise the trip speed. name plate on 4. Tighten the screw when the adjustment is complete. adjusted to trip below 100 RPM above the normal running speed of the engine. 	<p>The total range of adjustment is shown on the</p> <p>the governor. The governor should not be</p>

CAUTION

Under no circumstances should the governor switch be by-passed to prevent engine shutdown in the event of overspeed. Serious damage to not only the engine, but also to the governor may be incurred since the governor is not designed to operate above its tripping speed.

3-155. TACHOMETER DRIVE - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Repair

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment Condition Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

1. Tachometer	a. Glass	Inspect for broken glass.	Replace, if defective.
	b. Needle	Inspect for damage.	Replace, if defective.
	c. Tachometer	Does not indicate engine speed.	Replace tachometer or drive.

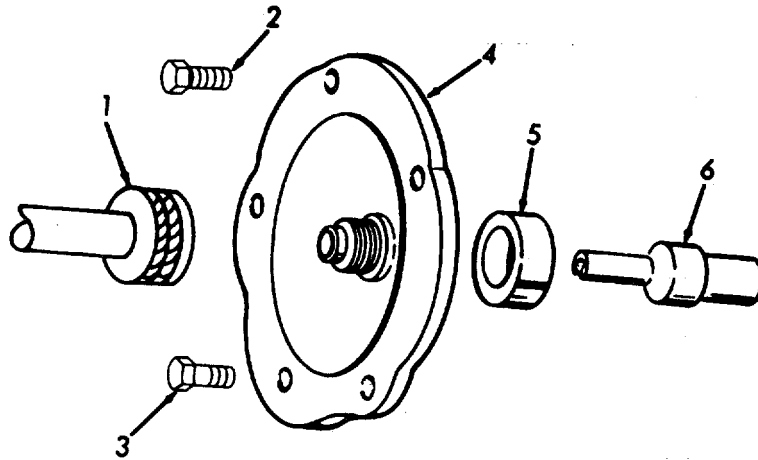
3-155. TACHOMETER DRIVE - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
REPAIR			
2. Flywheel housing	a. Cable assembly (1)	Unscrew and remove.	
	b. Four screws (2)	Remove.	Screws are 1/2-13 x 1-1/8 long.
	c. Screw (3) long.	Remove.	Screw is 7/16-14 x 1
	d. Cover assembly (4)	Remove.	
	e. Seal (5)	Remove.	
	f. Drive shaft (6)	Remove.	
	g. Drive shaft (6)	Align with slot in blower drive, and install.	
	h. Seal (5), cover assembly (4)	Align and install.	
	i. Screw (3), and four screws (2)	Install.	
	j. Cable assembly (1)	Reinstall.	

3-155. TACHOMETER DRIVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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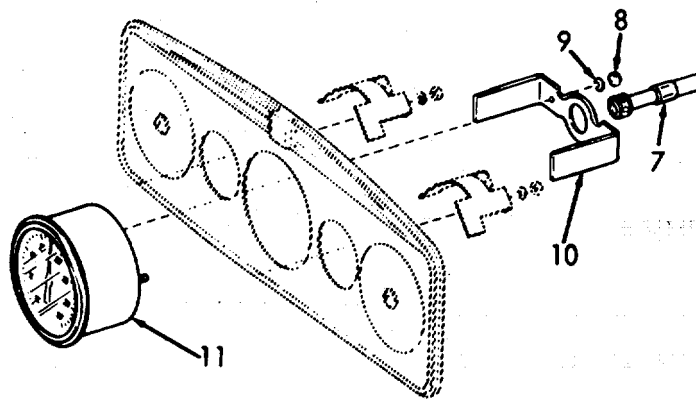
REPAIR (Cont)



3-2651

3-155. TACHOMETER DRIVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REPAIR (Cont)			
3. Instrument panel	a. Cable assembly (7)	Unscrew and remove.	
	b. Nuts (8), and lock-washers (9)	Remove.	
	c. Clamp (10)	Remove.	
	d. Tachometer (11)	Replace.	
	e. Clamp (10), lock-washers (9), and nuts (8)	Install	
	f. Cable assembly (7)	Reconnect.	



3-156. AIR CLEANER -- MAINTENANCE INSTRUCTIONS.

- a. The air cleaner is designed to remove foreign matter from the air, pass the required volume of air for proper combustion and maintain their efficiency for a reasonable period of time before requiring service.
- b. The importance of keeping dirt and grit-laden air out of an engine cannot be over-emphasized since clean air is so essential to satisfactory engine operation and long engine life. The air cleaner must be able to remove fine materials such as dust as well as coarse materials such as lint from the air.
- c. The fins on the element give high speed rotation to the intake air, which separates a large portion of the dust from the air by centrifugal action. The plastic fins, the element and the gasket make up a single replaceable element assembly.
- d. The dust is swept through a space in the side of the baffle and collects in the lower portion of the body. The dust remaining in the precleaned air is removed by the element.
- e. The air cleaner has a replaceable impregnated paper filter element that can be cleaned.

This task covers:

- a. Inspection
- b. Removal
- c. Service
- d. Installation

INITIAL SETUP

Test Equipment

None

Special Tools

None

Material/Parts

None

Personnel Required

1

References

None

Equipment
Condition Condition Description

None

Special Environmental Conditions

None

General Safety Instructions

Observe WARNING in procedure.

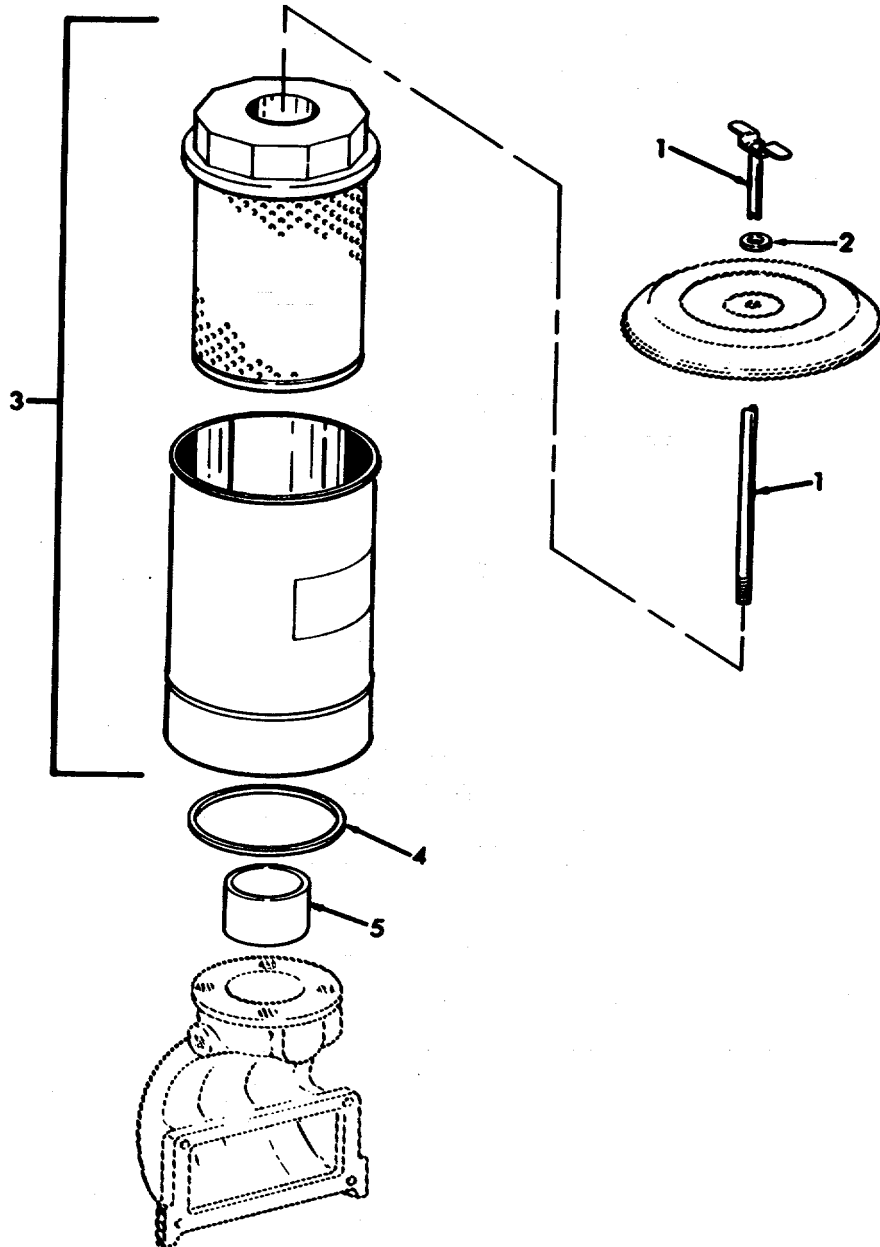
3-156. AIR CLEANER - MAINTENANCE INSTRUCTIONS (Continued).'

LOCATION	ITEM	ACTION	REMARKS
INSPECTION			
1. Air cleaner	a. Air cleaner housing	1. Check for dents and cracks. 2. Check air cleaner's tightness on air intake pipe. 3. Check that element is clean.	
REMOVAL			
2. Air cleaner	a. Wing bolt (1)	Unscrew and remove rod.	
	b. Washer (2)	Remove.	
	c. Air cleaner housing (3)	Remove from air inlet housing.	
	d. Gasket (4)	Remove.	
	e. Mounting tube (5)	Remove.	

3-156. AIR CLEANER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)



3-156. AIR CLEANER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
SERVICE			
3. Air cleaner	a. Cover (6)	Lift off.	
	b. Element (7)	Remove from body (8).	



Wear protective eye goggles when using compressed air.

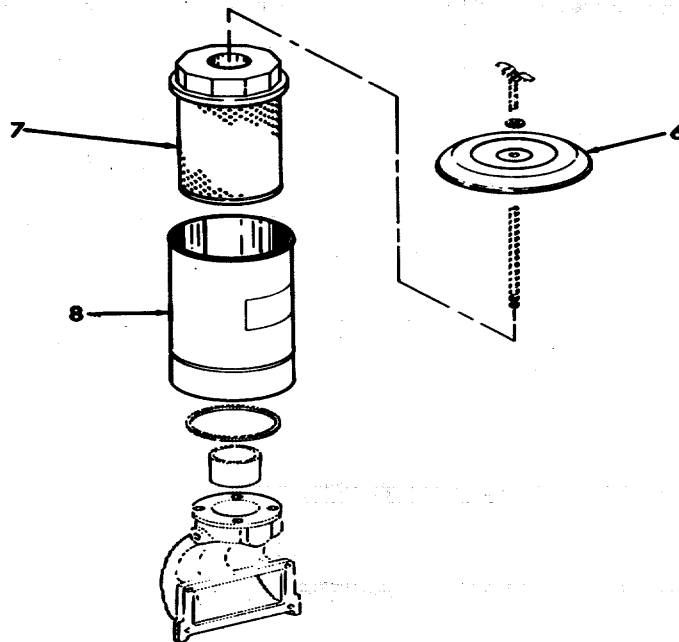
c. Element (7)	Wash in a mild detergent solution, and blow dry with compressed air.	Make sure there are no holes in the element.
----------------	--	--

3-156. AIR CLEANER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION

- | | | | |
|----------------|--|------------------------|--|
| 4. Air cleaner | a. Mounting tube (5), and gasket (4) | Install on air intake. | |
| | b. Body (8) | Install. | |
| | c. Filter element (7) | Insert in body (8). | |
| | d. Cover (6), washer (2), wiring nut and rod (1) | Reassemble. | |



3-157. CRANKSHAFT VIBRATION DAMPENER - MAINTENANCE INSTRUCTIONS.

The crankshaft vibration dampener is used to drive the hydraulic pump.

This task covers:

- | | | | |
|----|------------|----|------------------------|
| a. | Inspection | c. | Inspection/disassembly |
| b. | Removal | d. | Installation |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Crankshaft pulley puller
 Hammer (lead)
 Tool J4558-01
 Torque wrench

<u>Equipment</u>	<u>Condition</u>	<u>Condition Description</u>
<u>Paragraph</u>		

3-139	Hydraulic Pump, Hoses, Lines and Fittings
-------	--

Material/Parts

Grease MIL-G-10924,
Type GAA

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

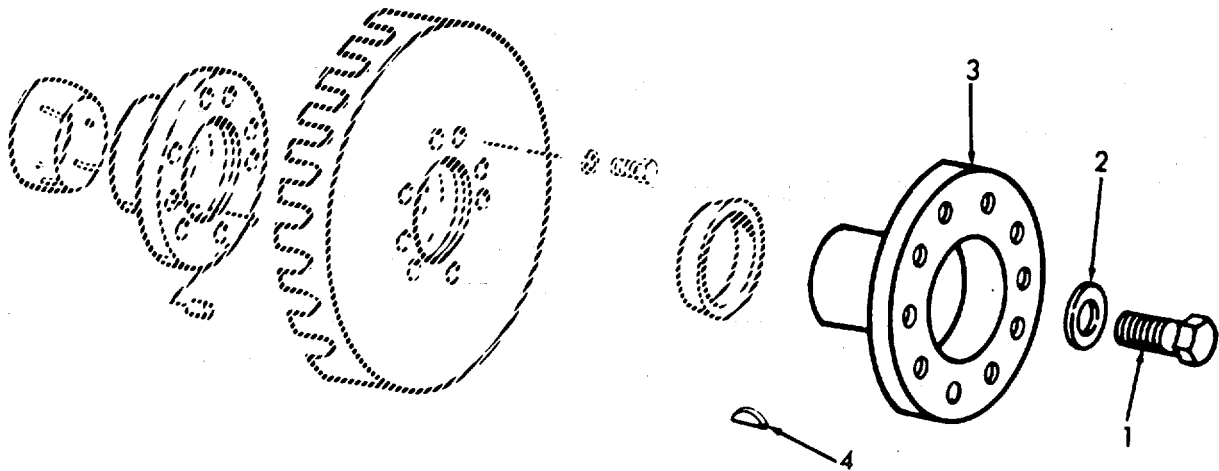
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | | | |
|----|--------------|----|-------------------------------|--|
| 1. | Engine front | a. | Crankshaft flange | 1. Inspect for cracks and breaks. |
| | | | | 2. Inspect for slipping on crankshaft. |
| | | b. | Crankshaft vibration dampener | Inspect for cracks and breaks. |

3-157. CRANKSHAFT VIBRATION DAMPENER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
2. Crankshaft flange	a. Hydraulic Remove. pump	Refer to paragraph 3-139.	
	b. Screw (1) and retainer (2)	Remove.	
	c. Flange (3)	<ol style="list-style-type: none"> 1. Install screw (1). 2. Install puller and nuts. 3. Remove flange (3). 4. Remove puller. 5. Remove screw (1). 	Use tool J4558-01.
	d. Woodruff key (4)	Remove.	

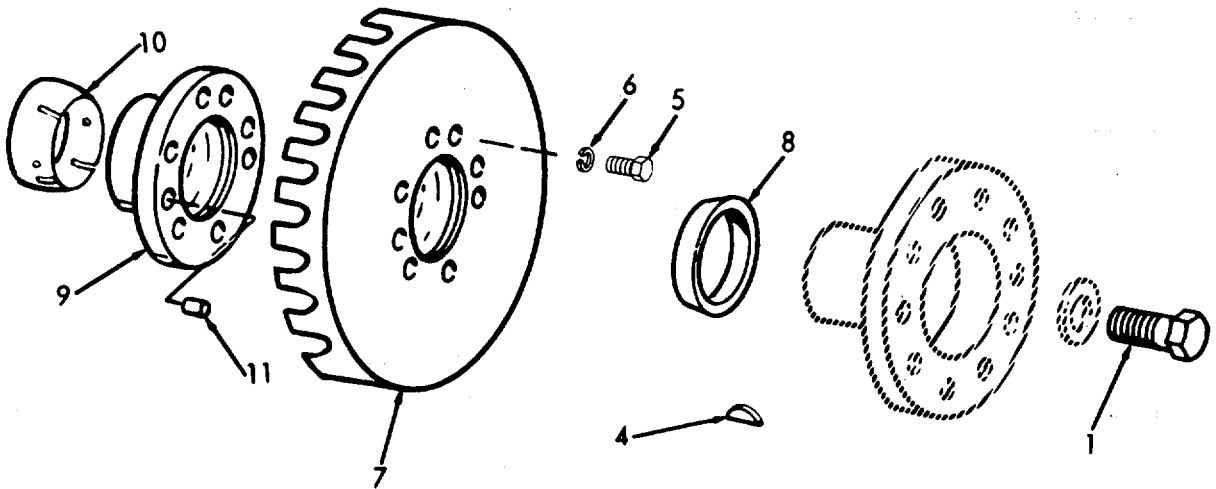


3-157. CRANKSHAFT VIBRATION DAMPENER - MAINTENANCE INSTRUCTIONS-
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
3. Vibration dampener	a. Two screws (5), and lock-washers (6)	Remove.	They must be opposite to each other.
	b. Vibration dampener	1. Install screw (1).	
		2. Install puller.	Use tool J4558-01.
		3. Loosen dampener (7) and outer cable (8).	
		4. Remove puller core.	
		5. Remove screw (1).	
c. Outer core (8)	Remove.	Use two thin shank screw-drivers and "fish" from inner diameter of dampener hub.	
d. Dampener (7), and hub (9)	Slide off the end of the crankshaft by hand, and as an assembly.		
e. Woodruff key (4)	Remove.		
f. Inner core (10)	Slide off crankshaft.		

3-157. CRANKSHAFT VIBRATION DAMPENER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)	g. Four screws (5), and lock-washers (6)	Remove.	
	h. Vibration Disassemble dampener (7), and hub (9)		
	i. Dowels (11)	Remove.	If necessary.



3-157. -CRANKSHAFT VIBRATION DAMPENER - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION - DISASSEMBLY

- | | | | |
|----|--------------------|-----------------------|--------------------------------|
| 4. | Vibration dampener | a. Inner/ outer cores | Inspect for galling and burrs. |
| | | b. Hub and burrs. | Inspect for galling |
| | | c. Crank-shaft | Inspect for galling and burrs. |

NOTE

Slight scratches or burrs may be removed with emery cloth. If seriously damaged, the parts should be replaced, and the end of the crankshaft refinished. Check the outside diameter of the inner core for wear at the crankshaft front oil seal contact surface. If worn, replace the oil seal. (Refer to paragraph 3-172).

INSTALLATION

- | | | | |
|----|----------------------------|--|---------------------------|
| 5. | Crank-shaft | a. Oil seal | Coat lightly with grease. |
| | | b. Inner core (10) | Slide on crankshaft. |
| 6. | Vibration dampener and hub | a. Vibration dampener (7), hub (9), six screws (5), and lock-washers (6) | Reassemble. |

3-157. CRANKSHAFT VIBRATION DAMPENER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

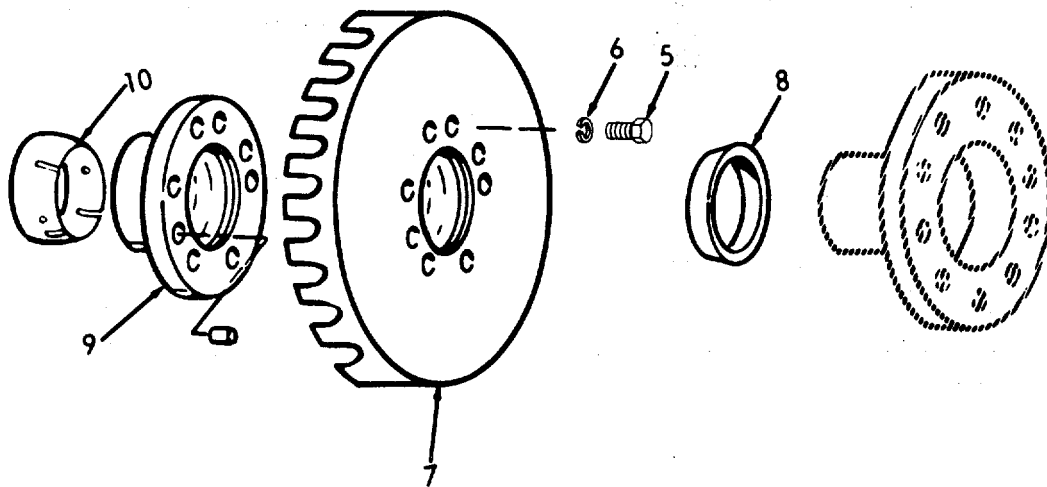
INSTALLATION (Cont)

b. Dampener and hub assembly

Slide on crankshaft.

c. Outer core (8)

Slide on crankshaft.

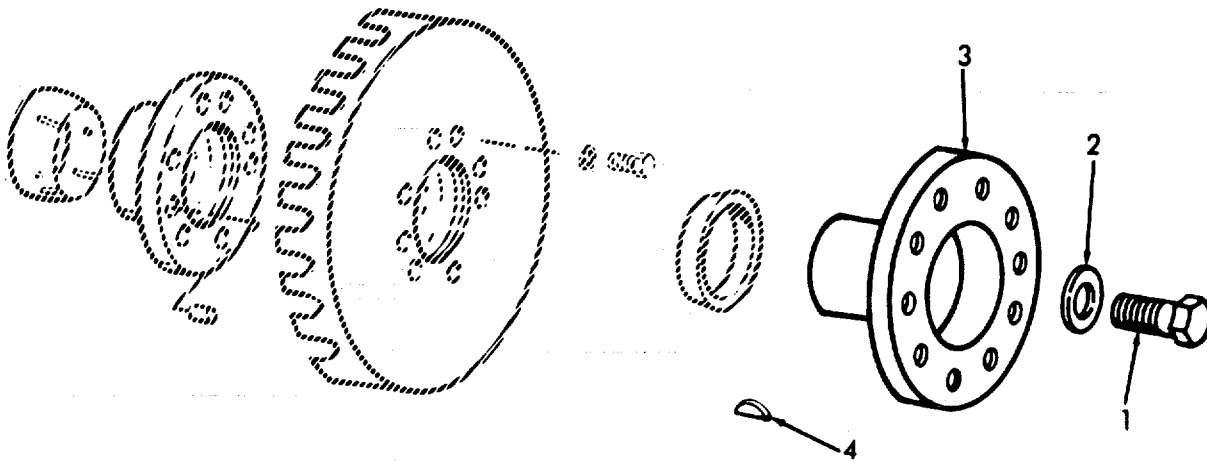


3-157. CRANKSHAFT VIBRATION DAMPENER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

7. Crankshaft flange	a. Woodruff key (4)	Place in crankshaft.	Tapered end pointed to the front of the crankshaft.
	b. Flange (3)	Slide on crankshaft.	
	c. Screw (1), and retainer (2)	1. Install. 2. Tighten.	Tighten to 180 lb. ft. (244 Nm) torque.

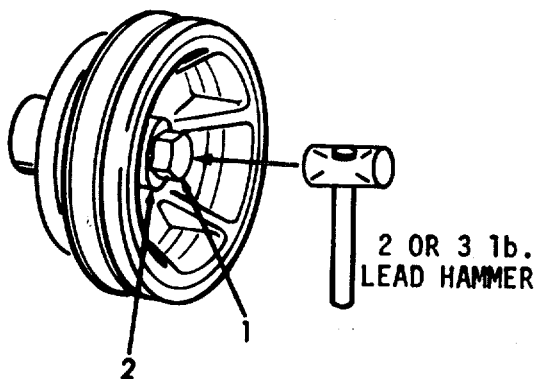


3-157. CRANKSHAFT VIBRATION DAMPENER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- | | | | |
|----|---------------|--|---------------------------------------|
| d. | Flange
(3) | 1. Strike the end of the screw a sharp blow with a 2 or 3 lb. lead hammer. | |
| | | 2. Tighten screw. | Tighten to 300 lb-ft (406 Nm) torque. |
| | | 3. Strike screw again. | |
| | | 4. Tighten screw. | Tighten to 300 lb-ft (406 Nm) torque. |



3-158. BALANCE WEIGHT COVER - MAINTENANCE INSTRUCTIONS.

The balance weight cover covers the front engine balance weights.

This task covers:

- a. Inspection b. Removal c. Installation

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Torque wrench

Equipment Condition Condition Description

None

Material/Parts

Gasket kit P/N 51217534
Scotch Adhesive #4027

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

- | | | | |
|-------------------------|------------|--------------------------------|--|
| 1. Balance weight cover | a. Cover | Inspect for cracks and breaks. | |
| | b. Gaskets | Inspect for leaks. | |

REMOVAL

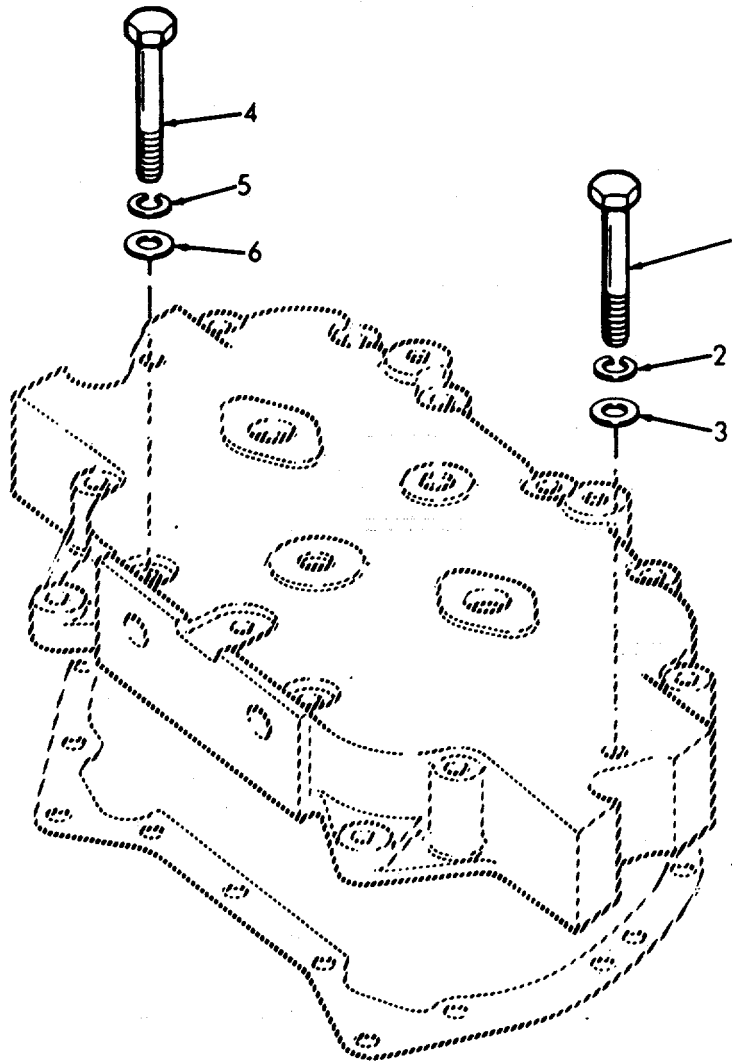
- | | | | |
|----|---|--------------------|---------------------------------|
| 2. | a. Screws (1), lock-washers (2), and flat-washers (3) | Remove two places. | Screws are 3/8-24 x 3-1/4 Inch. |
|----|---|--------------------|---------------------------------|

3-158. BALANCE WEIGHT COVER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- | | | |
|--|--------------------------------|--|
| <p>b. Screws (4), lock-washers (5), and flat-washers (6)</p> | <p>Remove from two places.</p> | <p>Screws are 3/8-16 x 3-3/4 inch.</p> |
|--|--------------------------------|--|



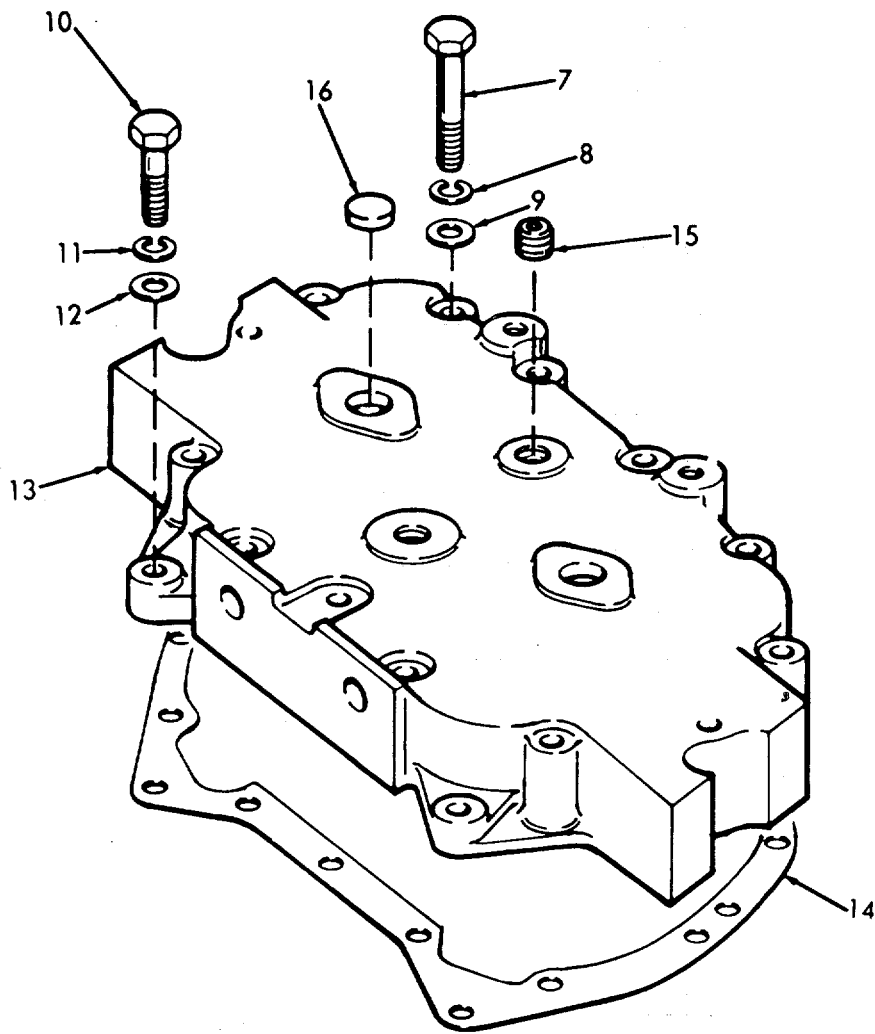
3-158. BALANCE WEIGHT COVER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	c. Screws (7), lock-washers (8), and flat-washers (9)	Remove from nine places.	Screws are 3/8-24 x 2-3/8 inch.
	d. Screws (10), lock-washers (11), and flat-washers (12)	Remove two places.	Screws are 3/8-16 x 1-7/8 inch.
	e. Cover (13)	Remove.	
	f. Gasket (14)	Remove.	Discard gasket.
	g. Plugs (15), and hole plug (16)	Remove.	If necessary.

3-158. BALANCE WEIGHT COVER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



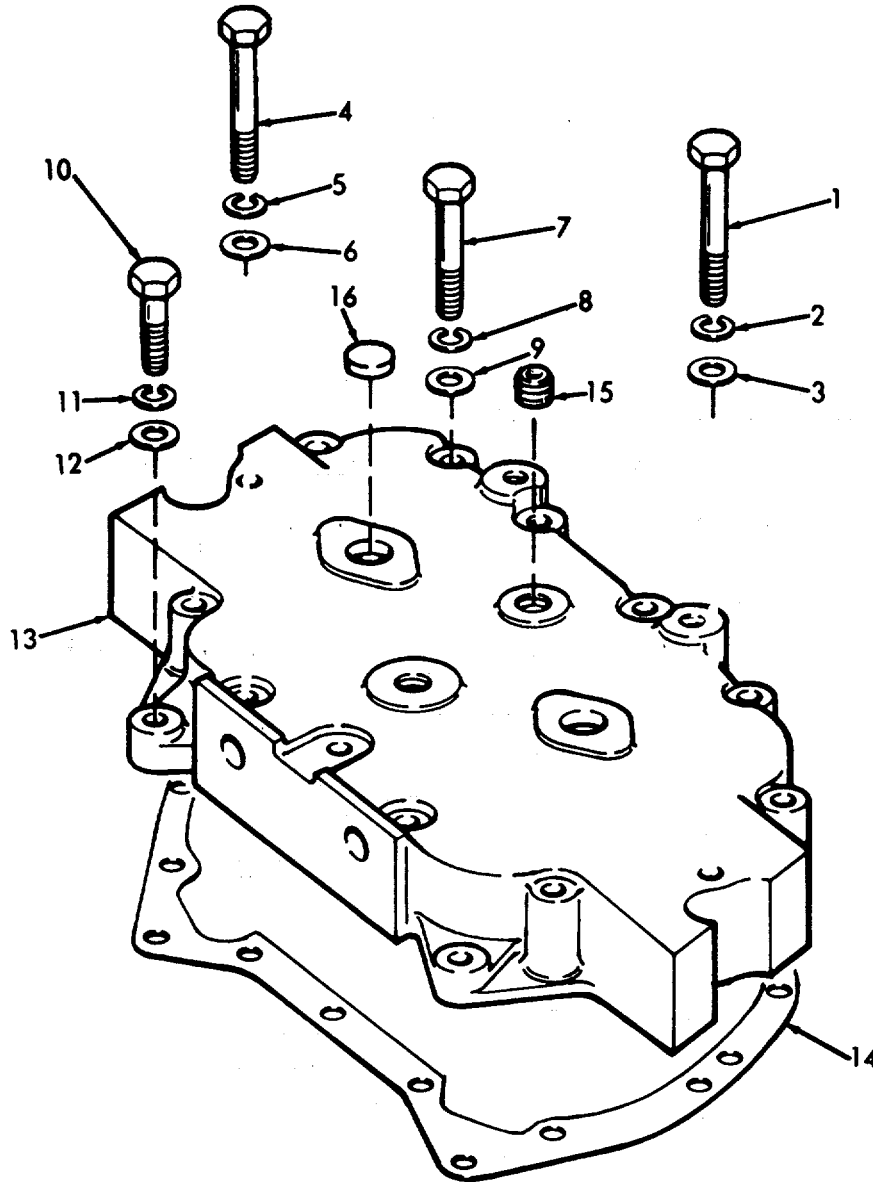
3-158. BALANCE WEIGHT COVER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
	a. Gasket (14)	Attach to balance weight cover.	Use Scotch Adhesive #4027.
	b. Cover (13)	Align holes with holes in engine.	
	c. Screws (7), lock-washers (8), and flat-washers (9)	Install in holes 1, 2, 3, 4, 5, 6, 7, 8, and 14.	Screws are 3/8-24 x 2-3/8 inch. Tighten finger tight.
	d. Screws (4), lock-washers (5), and flat-washers (6)	Install in holes 10 and 12.	Screws are 3/8-16 x 3-3/4 inch. Tighten finger tight.
	e. Screws (1), lock-washers (2), and flat-washers (3)	Install in holes 7 and 15.	Screws are 3/8-24 x 3-1/4 inch. Tighten finger tight.
	f. Screws (10), lock-washers (11), and flat-washers (12)	Install in holes 9 and 13.	Screws are 3/8-16 x 1-7/8 inch. Tighten finger tight.

3-158. BALANCE WEIGHT COVER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)



3-158. BALANCE WEIGHT COVER - MAINTENANCE INSTRUCTIONS (Continued).

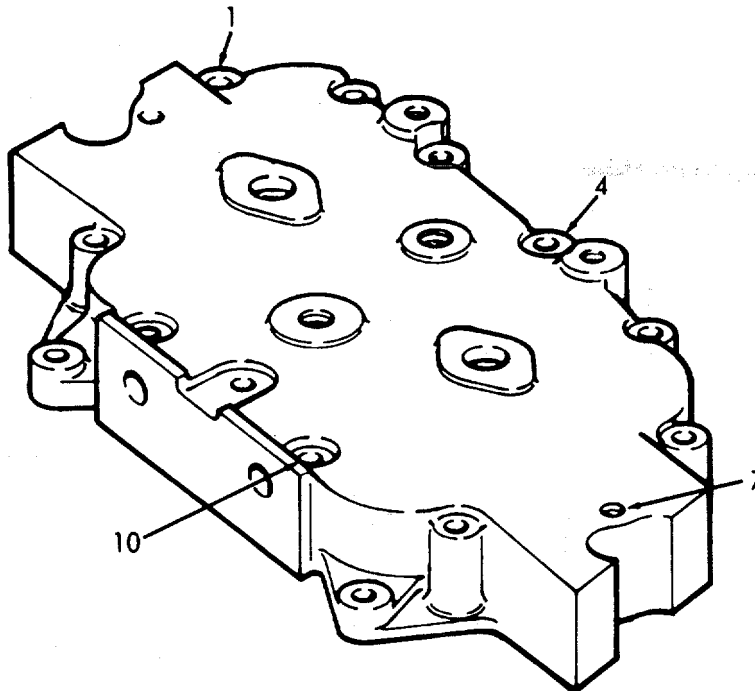
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

g. Screws
(1,4,
7,10)

Tighten in sequence
shown.

Tighten to
25-30-lb.ft.
(34-41 Nm)
torque.



3-159. LIFTING BRACKETS AND SUPPORTS - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Removal
- c. Installation
- d. Repair

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Chain hoist
Torque wrench

Equipment Condition

None

Condition Description

Material/Parts

Gasket kit P/N 5193114

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

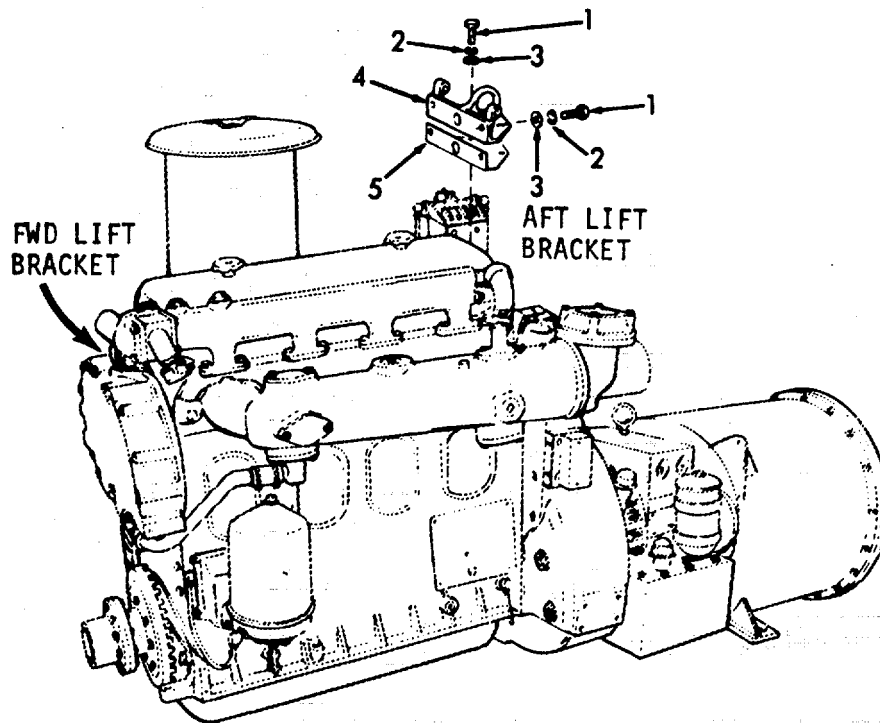
1.	Lifter brackets	a. Eye bolts	Inspect for breaks, cracks and signs of wear.	Replace if defective.
		b. Rear engine Bracket	Inspect for breaks, cracks and signs of wear.	Replace if defective.
2.	Supports	a. Front engine supports	Inspect for missing or damaged parts, spongy or defective spacer or mounting cushions.	Replace.
		b. Generator support	1. Inspect for missing or damaged parts. 2. Inspect for a spongy or defective mounting insulator.	Replace. Replace.

3-159. LIFTING BRACKETS AND SUPPORTS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL

- | | | | |
|----------------------------|---|---------|-----------------|
| 3. Engine Lifting brackets | a. Screws (1), lock-washers (2), and flat-washers (3) | Remove. | |
| | b. Brackets (4), and gaskets (5) | Remove. | Discard gasket. |

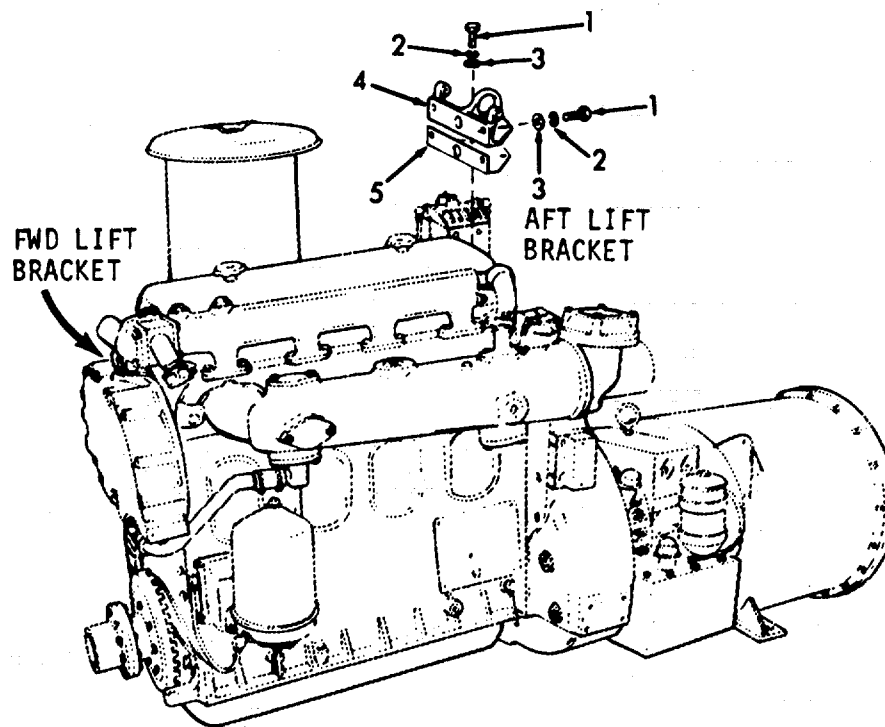


3-159. LIFTING BRACKETS AND SUPPORTS - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION

- | | | | |
|------------------------|---|----------|---|
| 4. Engine lift bracket | a. Brackets (4), gaskets (5), screws (1), lock-washers (2) and flat-washers (3) | Install. | Use new gasket. Tighten to 55 to 60 lb-ft (74.6 to 81.2 Nm) torque. |
|------------------------|---|----------|---|



3-159. LIFTING BRACKETS AND SUPPORTS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

NOTE

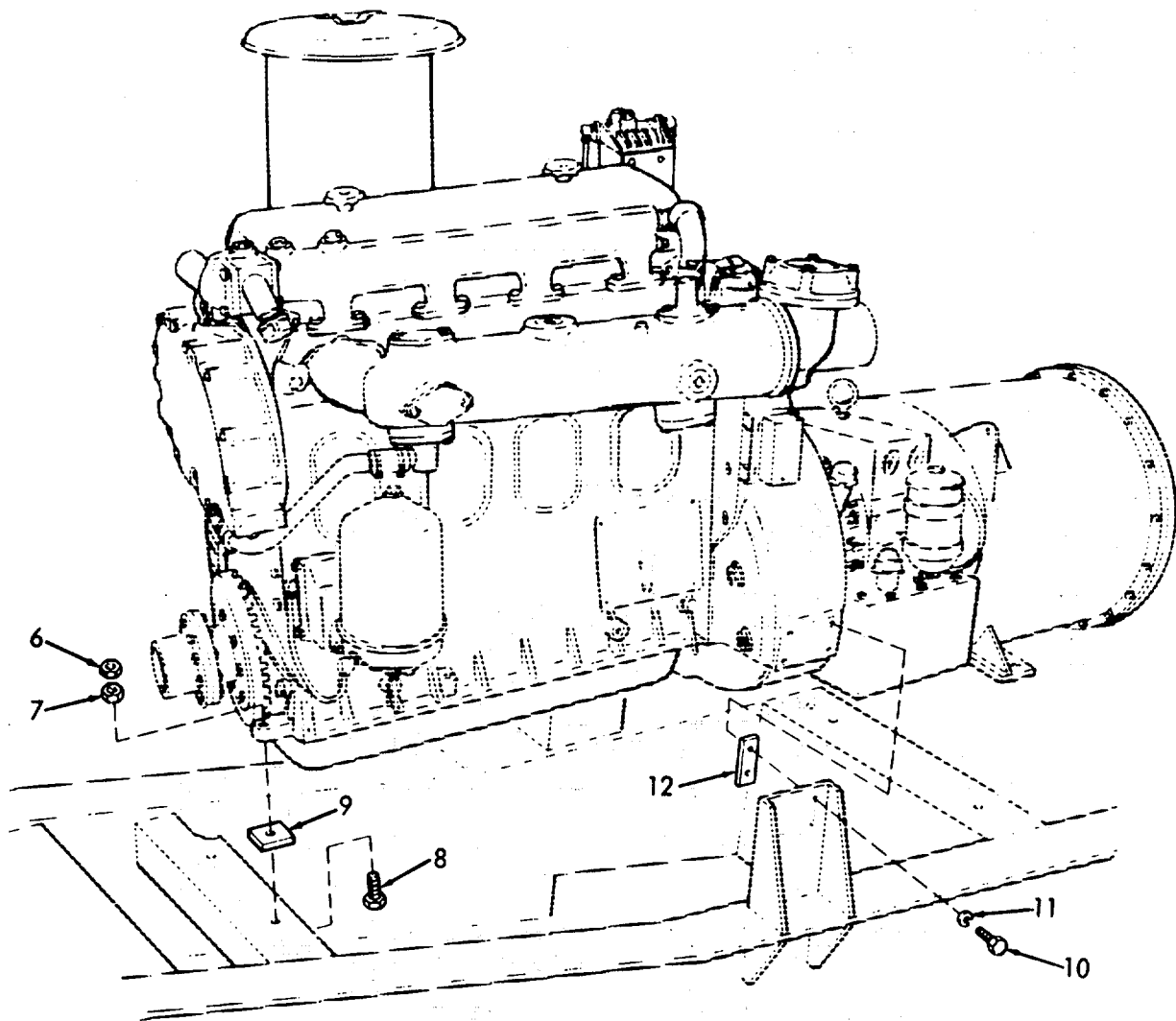
The following require the use of the chain hoist.

- | | | | |
|--------------------|--|----------|---------------|
| 5. Engine supports | a. Nuts (6 and 7), screws (8), and chocks (9) | Remove. | |
| | b. Screws (10), lock-washers (11), and chocks (12) | Remove. | |
| | c. Chocks (12), screws (10), and lock-washers (11) | Replace. | If necessary. |
| | d. Chocks (9), screws (8), and nuts (6 and 7) | Replace. | If necessary, |

3-159. LIFTING BRACKETS AND SUPPORTS - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)



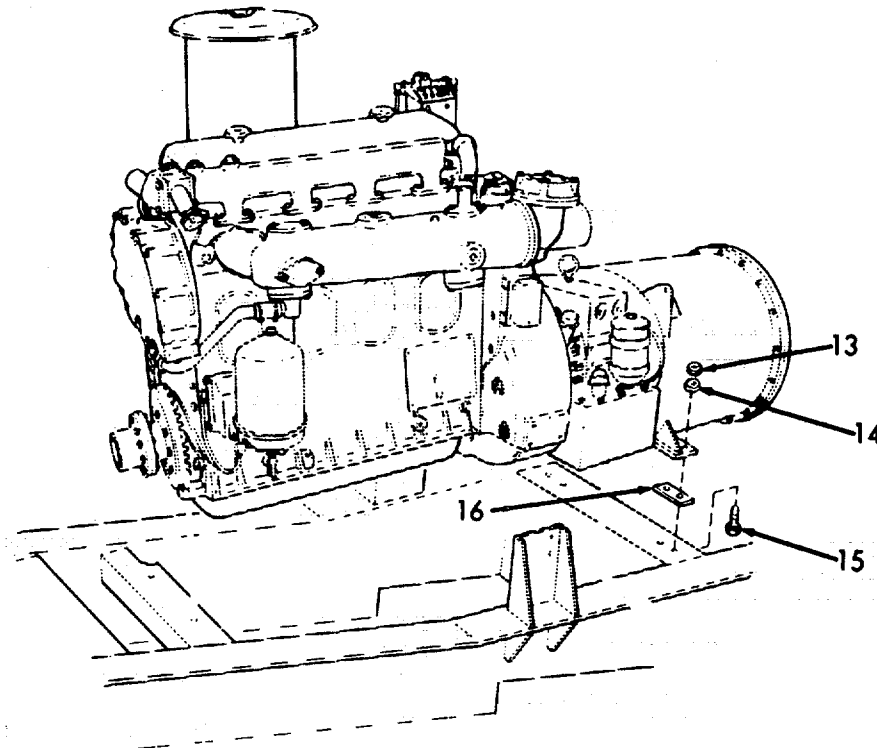
3-2677

3-159. LIFTING BRACKETS AND SUPPORTS - MAINTENANCE INSTRUCTIONS. (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REPAIR (Cont)

- | | | | |
|------------------------------|---|----------|---------------|
| 6. Torque Converter supports | a. Nuts (13) and (14), screws (15), and chocks (16) | Remove. | |
| | b. Chocks (16), screws (15), and nuts (13 and 14) | Replace. | If necessary. |



3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS.

The one-piece, water cooled exhaust manifold is cast with an integral water jacket surrounding the exhaust chamber. The diameter of the exhaust chamber increases uniformly from one end to the other where it terminates in a flange to which an elbow and flexible exhaust connection is attached. A portion of the engine coolant is by-passed from the water manifold into the rear end of the jacket surrounding the exhaust manifold and is discharged from the forward end through a tube into the lower section of the expansion tank. A draincock is installed in the bottom of the manifold for draining the water jacket. A plug is provided in the bottom of the exhaust outlet elbow for draining moisture condensed from the exhaust gases.

This task covers:

- a. Removal
- b. Inspection
- c. Repair
- d. Installation

INITIAL SETUP

<u>Test Equipment</u>	<u>References</u>	
None	None	
<u>Special Tools</u>	<u>Equipment Condition</u>	<u>Condition Description</u>
Torque wrench	Paragraph	
	3-151	Water Connections Removal
<u>Material/Parts</u>	<u>Special Environmental Conditions</u>	
Gasket kit P/N 5193114	None	
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
1	None	

3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued)

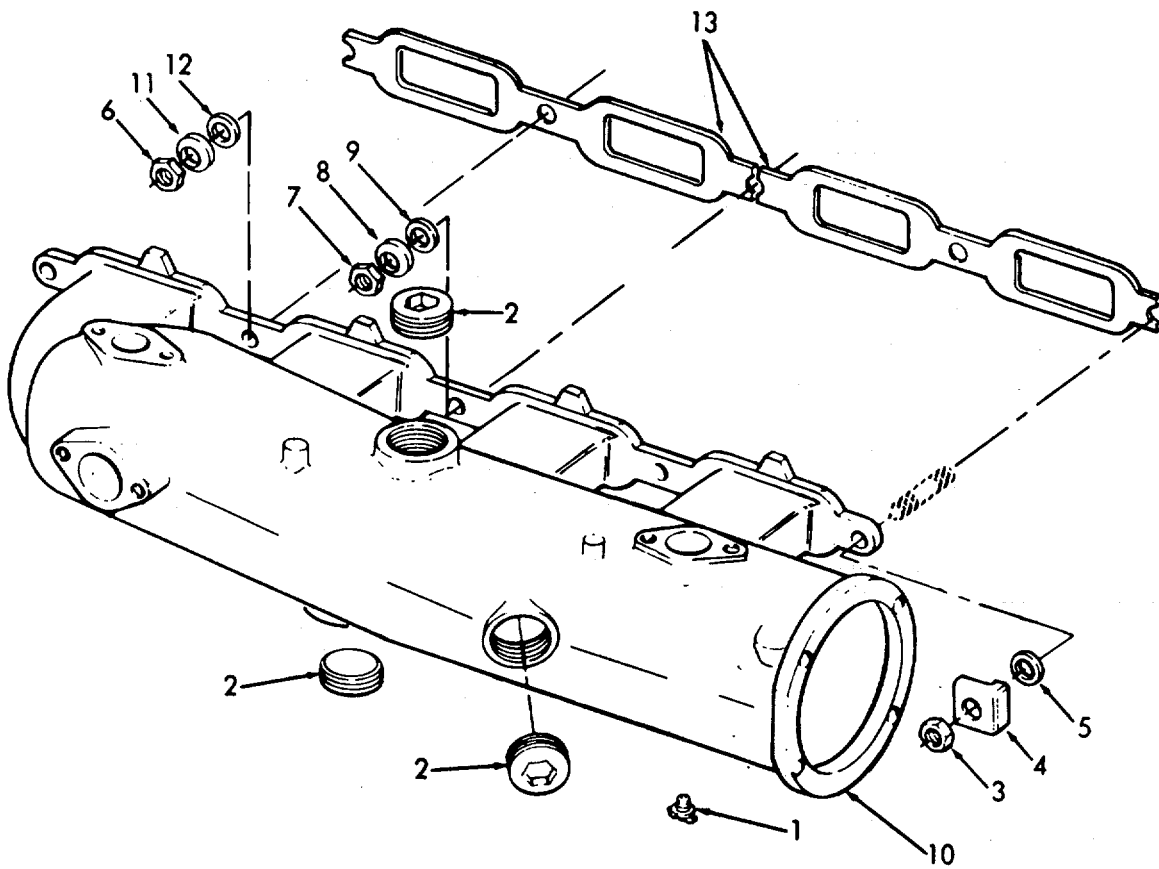
LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
1. Exhaust system	a. Drain-cock (1)	Open to drain water.	
	b. Pipe plug (2)	Remove to drain water.	
2. By-pass hoses	Hose	Loosen.	Refer to paragraph 3-151.
3. Exhaust manifold	a. Nuts (3), crab washers (4), and flat-washers (5)	Remove on both ends of manifold.	
	b. Nut (6)	Unscrew to end of stud.	
	c. Nuts (7), Belleville washers (8), and flat-washers (9)	Remove.	
	d. Manifold (10)	Pull away from engine as far as possible.	
	e. Nut (6), Belleville washer (11),	Remove.	

3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

	and flat-washer (12)		
f.	Manifold (10) and gaskets (13)	Remove.	Discard gaskets.



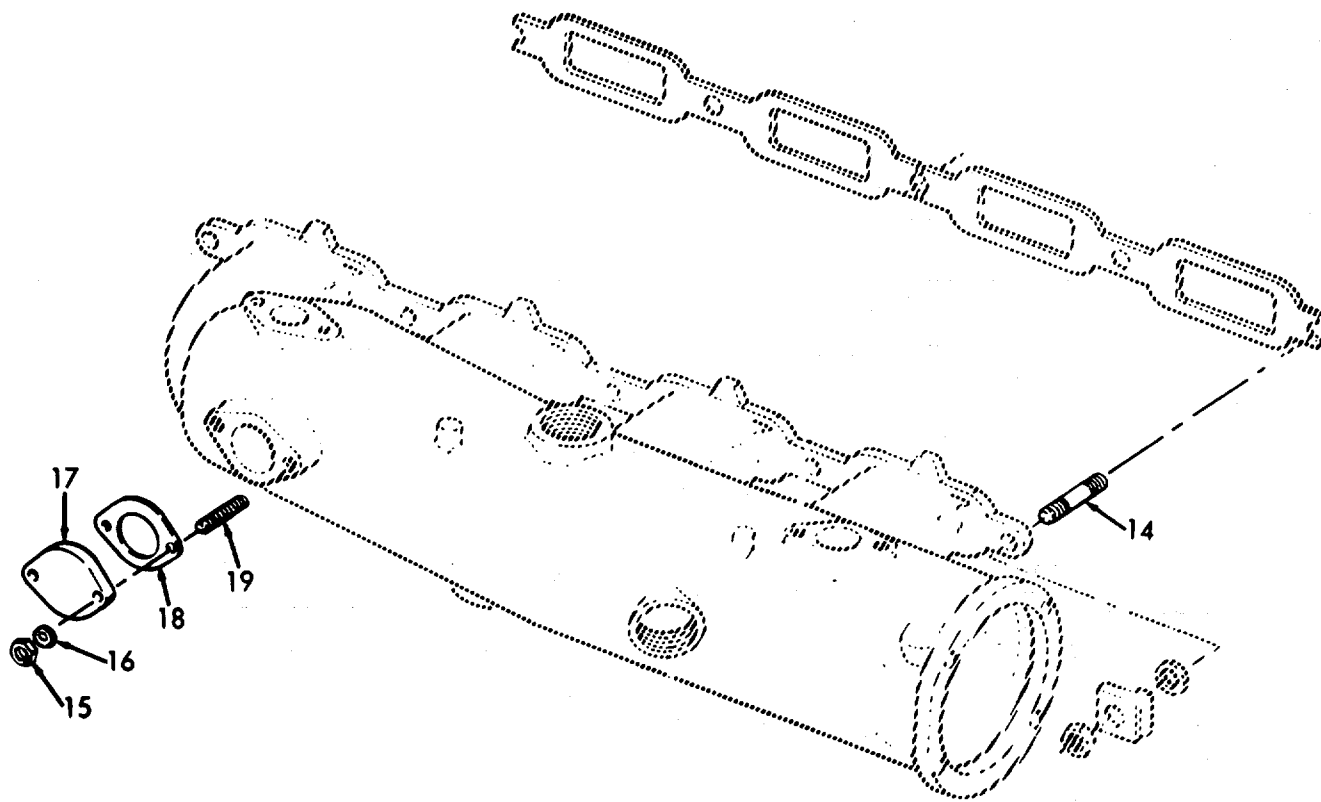
3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION			
4. Exhaust manifold		Remove the loose scale and carbon that may have accumulated on the internal walls of the manifold.	
	Studs (14)	Inspect for damage and stripped threads.	Replace if damaged.
REPAIR			
5. Cover Plate (plain)	a. Nuts (15), lock-washers (16), cover (17), and gasket (18)	Remove.	Discard gasket.
	b. Studs (19)	Remove if necessary.	
	c. Studs (19)	Install.	Torque to 25-40 ft. lb. (33.9-54.2 Nm). 54.3
	d. Gasket (18), cover (17), lock-washers (16), and nuts (15)	Reassemble.	Use new gasket.

3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

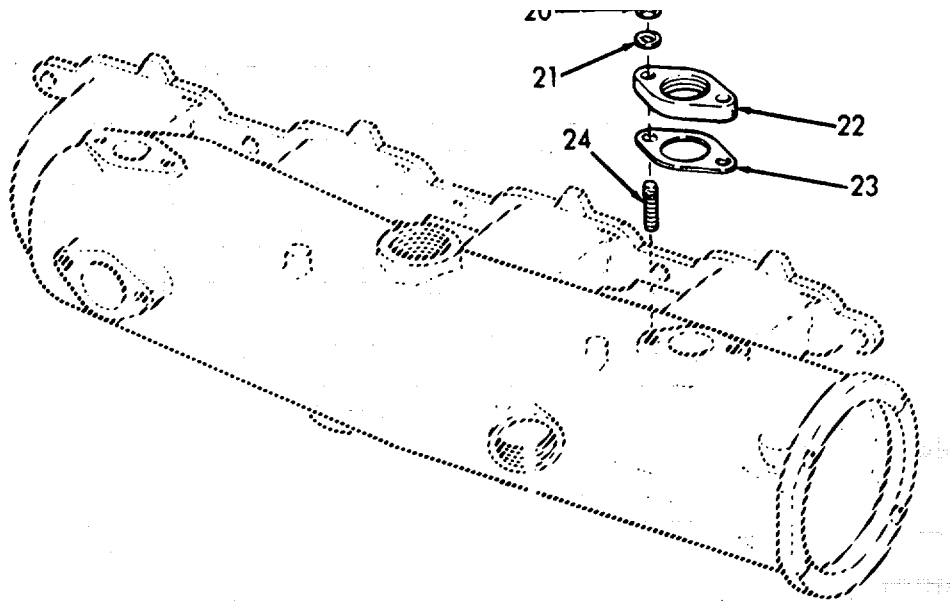


3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|------------------------------------|--|----------------------|---|
| 6. Cover Plate (large tapped hole) | a. Nuts (20), lockwashers (21), coverplate (22), and gasket (23) | Remove. | Discard gasket. |
| | b. Studs (24) | Remove if necessary. | |
| | c. Studs (24) | Install. | Torque to 25-40 ft. lb. (33.9-54.2 Nm). |
| | d. Gasket (23), coverplate (22), lockwashers (21), and nuts (20) | Reassemble. | Use new gasket. |

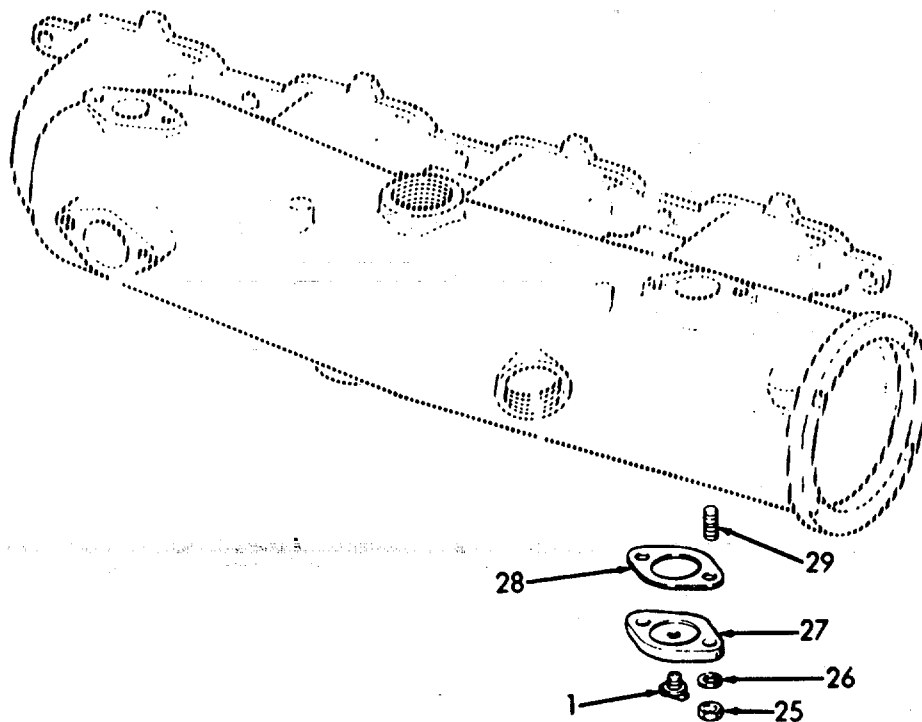


3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|------------------------------------|--|----------------------|-----------------|
| 7. Cover Plate (small tapped hole) | a. Nuts (25), lock-washers (26), cover plate (27), and gasket (28) | Remove. | Discard gasket. |
| | b. Drain-cock (1) | Remove. | |
| | c. Studs (29) | Remove if necessary. | |



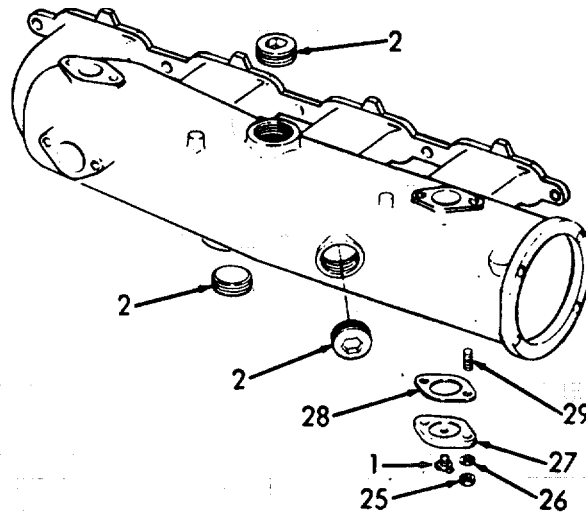
3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | | | |
|--|--|-------------|---|
| | d. Studs (29) | Replace. | Torque to 25-40 ft. lb. (33.9-54.2 Nm).
54.3 |
| | e. Drain-cock (1) | Install. | |
| | f. Gasket (28), cover plate (27), lock-washers (26), and nuts (25) | Reassemble. | |

- | | | | |
|----|------------|----------|---------------|
| 8. | Pipe plugs | Replace. | If necessary. |
|----|------------|----------|---------------|

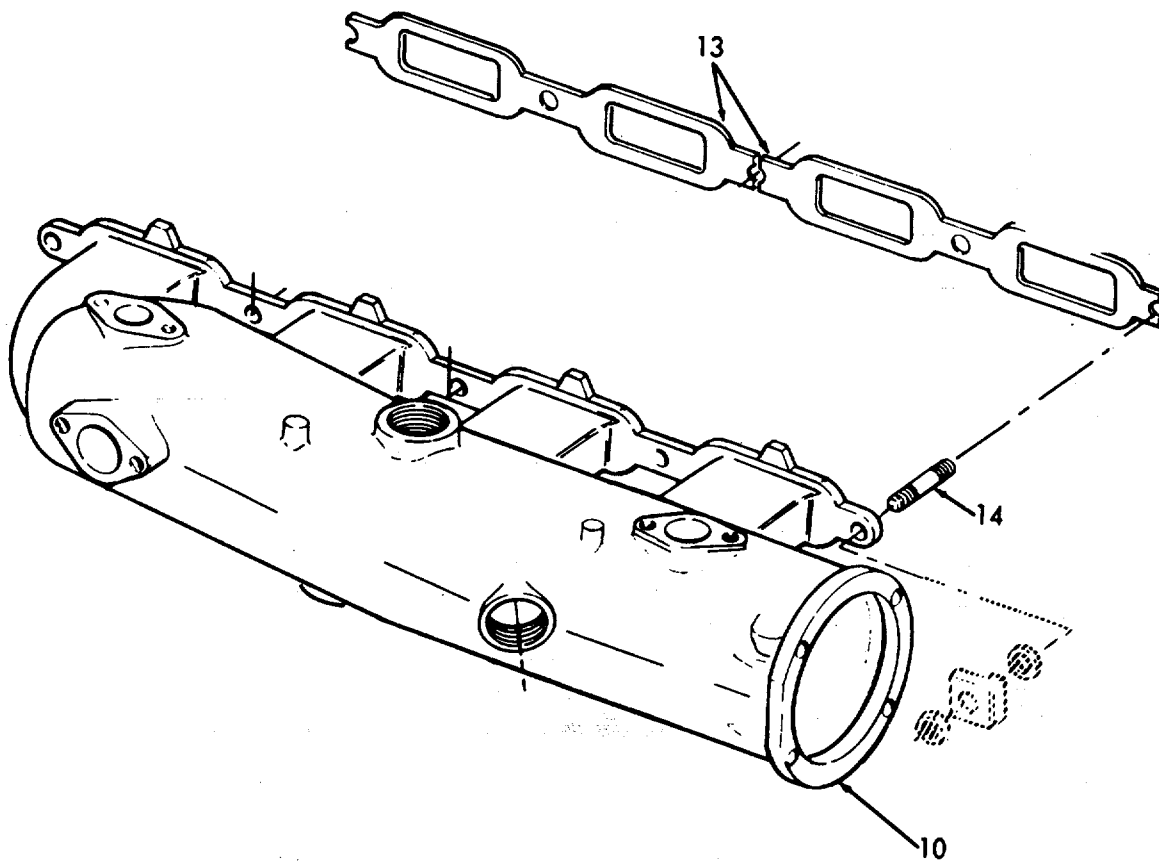


3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION

9. Studs	Studs (14)	Replace.	Drive in to 25-40 ft-lb (33.9-54.2 Nm) torque.
10. Exhaust manifold	a. Gaskets (13)	Place over studs and against cylinder head.	Use new gaskets.
	b. Exhaust manifold (10)	Position on studs (14) so that 1/2 inch (27 cm) of the stud threads extend beyond the mounting flanges of the manifold legs.	



3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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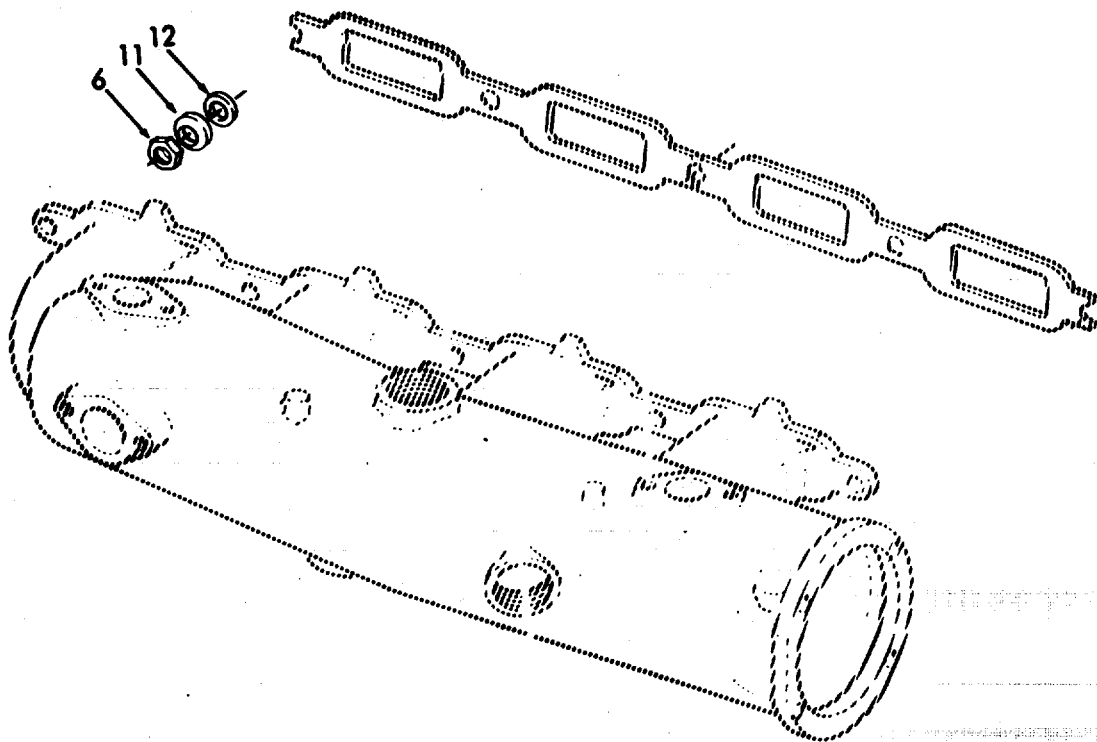
INSTALLATION (Cont)

NOTE

The Belleville washers are installed so that the outer diameter will rest against the manifold, and the crown of the washer will be next to the nut.

- c. Flat-washers (12), Belleville washer (11), and nut (6)

Install and rotate nut several turns.

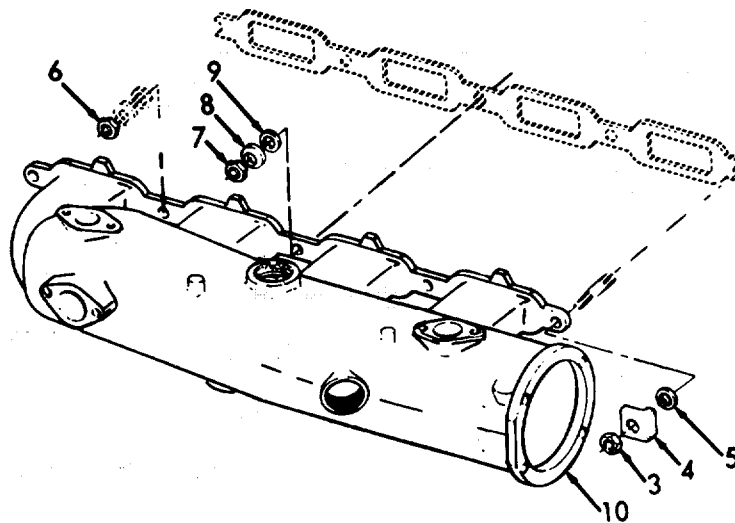


3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

- | | | | |
|----|--|---|--|
| d. | Exhaust manifold (10) | Slide up against cylinder head. | |
| e. | Flat-washers (9), Belleville washers (8), and nuts (7) | Install. | |
| f. | Flat-washers (5), crab washers (4), and nuts (3) | Install. | |
| g. | Nuts (3, 6 and 7) | Tighten with center nut and work alternately toward each end. | Torque nuts to 30 to 35 lb. ft. (40.7 to 47.5 Nm). |



3-160. EXHAUST MANIFOLD - MAINTENANCE INSTRUCTIONS (Continued).

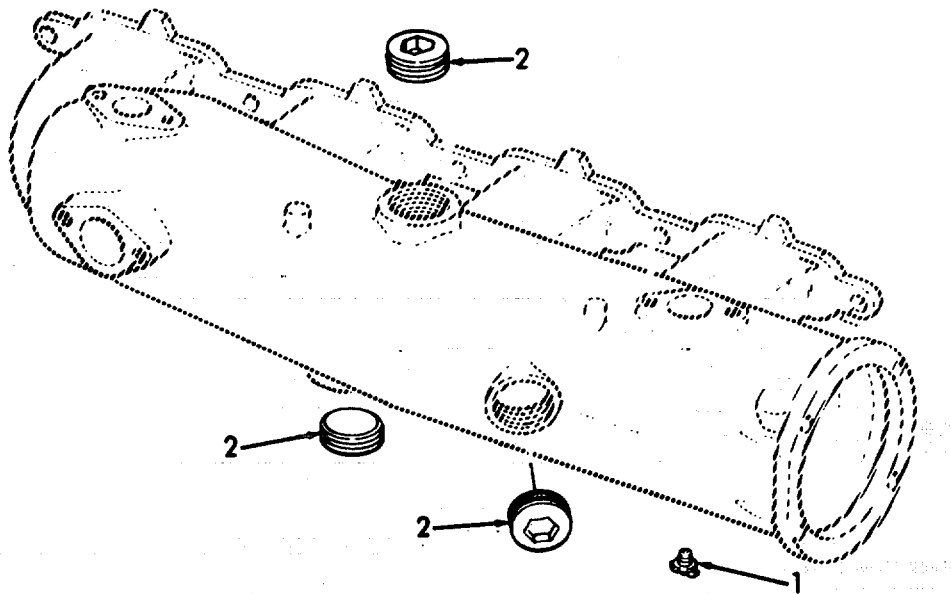
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

NOTE

If the cylinder head was removed from the engine, do not tighten the manifold nuts until AFTER the head is re-installed. Otherwise, interference may be encountered between the manifold and cylinder block bases which serve as a support for the manifold when the cylinder head is installed.

- | | | | |
|----|----------------|----------|---------------------------|
| h. | Drain plug (2) | Install. | |
| i. | Drain-cock (1) | Close. | |
| j. | By-pass hoses | Install. | Refer to paragraph 3-151. |



3-2690

3-161. VALVE ROCKER ARM COVER - MAINTENANCE INSTRUCTIONS.

The valve rocker cover assembly completely encloses the valve and the injector rocker arm compartment at the top of the cylinder head. The top of the cylinder head is sealed against oil leakage by a gasket located in the flanged edge of the cover.

This task covers:

- | | |
|-------------|-----------------|
| a. Cleaning | c. Installation |
| b. Removal | d. Repair |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

<u>Equipment</u>	
<u>Condition</u>	<u>Condition Description</u>

None

Material/Parts

Gasket kit P/N 5193114

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

3-161. VALVE ROCKER ARM COVER - MAINTENANCE INSTRUCTIONS.

CLEANING

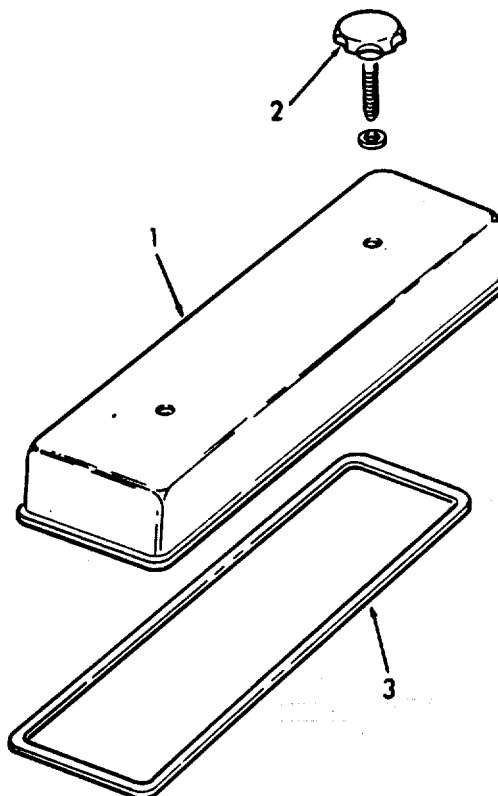
- | | | | |
|---------------------|-----------|-----------------------|------------------------|
| 1. Rocker arm cover | Cover (1) | Clean before removal. | Use clean rag to wipe. |
|---------------------|-----------|-----------------------|------------------------|

REMOVAL

- | | | | |
|---------------------|---------------|--------------------------------|--|
| 2. Rocker arm cover | a. Knobs (2) | Loosen. | |
| | b. Cover (1) | Lift cover from cylinder head. | |
| | c. Gasket (3) | Remove. | Discard gasket. Clean inside of cover. |

INSTALLATION

- | | | | |
|---------------------|---------------|---------------------------|-----------------|
| 3. Rocker arm cover | a. Gasket (3) | Place on cylinder head. | Use new gasket. |
| | b. Cover (1) | Replace on cylinder head. | |
| | c. Knobs (2) | Tighten. | |

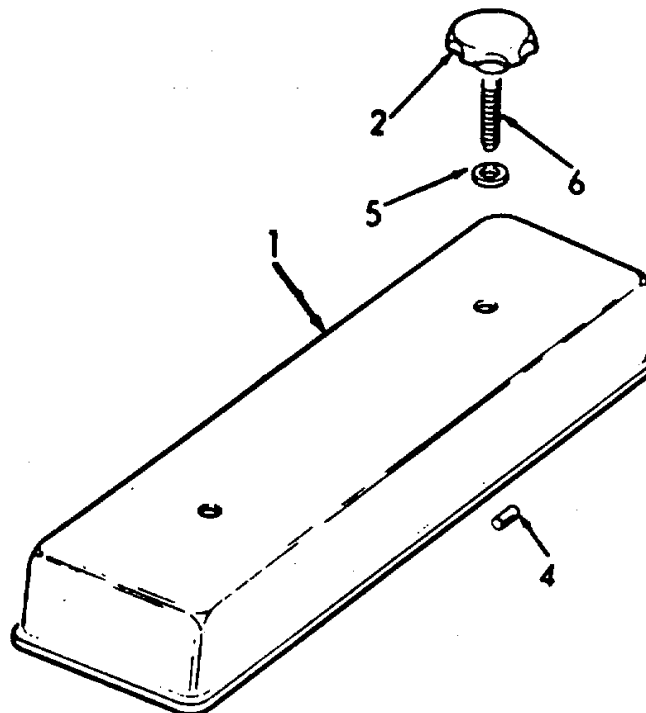


3-161. VALVE ROCKER ARM COVER - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

- | | | | |
|----------|--|--------------------------|--|
| 4. Knobs | a. Slotted roll spring pin (4) | Remove. | |
| | b. Washer (5) | Remove. | |
| | c. Knob (2), and screw (6) | Disassemble. | |
| | d. Knob (2), and screw (6) | Assemble. | |
| | e. Washer (5), slotted roll spring pin (4), and knob (2) | Reassemble on cover (1). | |



3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS.

a. The fuel injector control tube assembly is mounted on the cylinder head and consists of a control tube, injector rack control levers, a return spring and injector control tube lever mounted in two bracket and bearing assemblies attached to each cylinder head.

b. The injector rack control levers connect with the fuel injector control racks and are held in position on the control tube with two adjusting screws. The return spring enables the rack levers to return to the NO-fuel position. The injector control tube lever is pinned to the end of the control tube and connects with the fuel rod which connects with the engine governor.

c. A load limit device is located between the second and third cylinders. The load limit device can be adjusted to the maximum horsepower desired. The device limits the travel of the injector control rack and thereby the fuel output of the injectors.

This task covers:

- | | | |
|---------------|----------------|-----------------|
| a. Inspection | c. Disassembly | e. Installation |
| b. Removal | d. Reassembly | f. Adjustment |

INITIAL SETUP

Test Equipment

None

References

Paragraph

3-142 Control Tube Links Removal

Equipment

Special Tools

Condition Condition Description

None

Paragraph

3-142 Governor Maintenance
Instructions

3-161 Rocker Arm Cover Removal

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

None

3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
INSPECTION			
1. Rocker arm cover	a. Cover	Remove.	Refer to paragraph 3-161.
	b. Control tube	Inspect for broken springs, loose levers and bent or damaged control tubes.	
	c. Fuel rod	Inspect for wear or damage.	Refer to paragraph 3-142 for replacement.
REMOVAL			
2. Control Tube	a. Cotter pins (1), and link pin (2)	Remove.	
	b. Fuel rod (3)	Remove from control lever (4).	One end of fuel rod will remain connected inside the governor. Refer to paragraph 3-142 for removal.
	c. Screws (5), and lock-washers (6)	Remove.	
	d. Screws (7), and plate (8)	Remove.	

3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS.

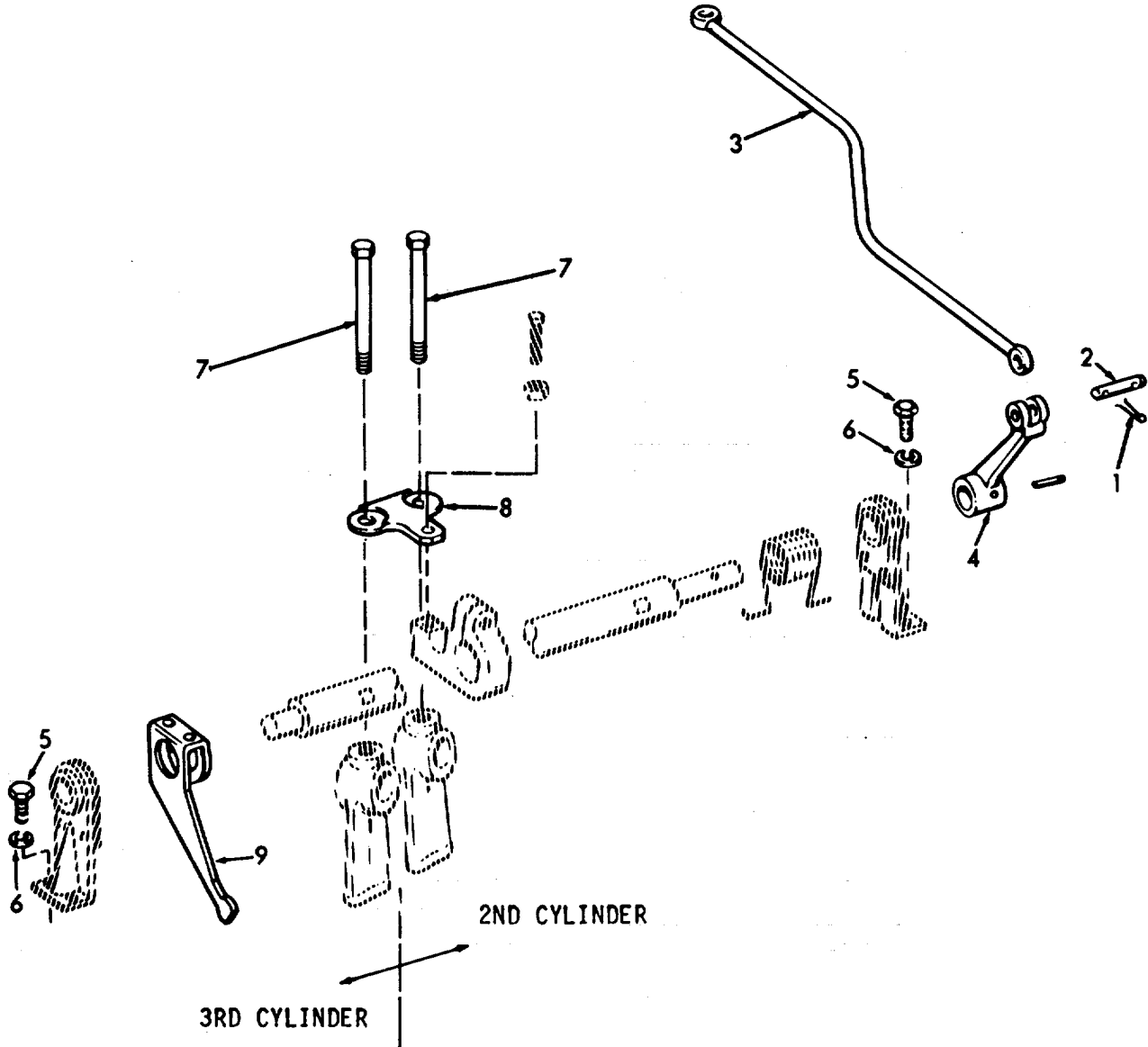
LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

e. Rack levers (9)

Disengage from injector control tubes.

Lift the control tube assembly from the cylinder head.



3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY

NOTE

The injector control tube, one mounting bracket, a spacer, and injector control tube lever, are available as a service assembly. When any part of this assembly needs replacing, it is recommended the complete service assembly be replaced. The following procedure includes complete disassembly and reassembly:

3. Control Tube	a. Pin (10)	Remove.	
	b. Lever (4)	Remove.	
	c. Bracket (11)	Remove.	
	d. Spring (12)	Remove.	
	e. Adjusting screws (13)	Remove.	
	f. Levers (9)	Remove.	
	g. Bracket (14)	Remove when control tube is removed.	
	h. Screw (15), and lock-washer (16)	Remove.	
	i. Lever arm (17)	Remove.	

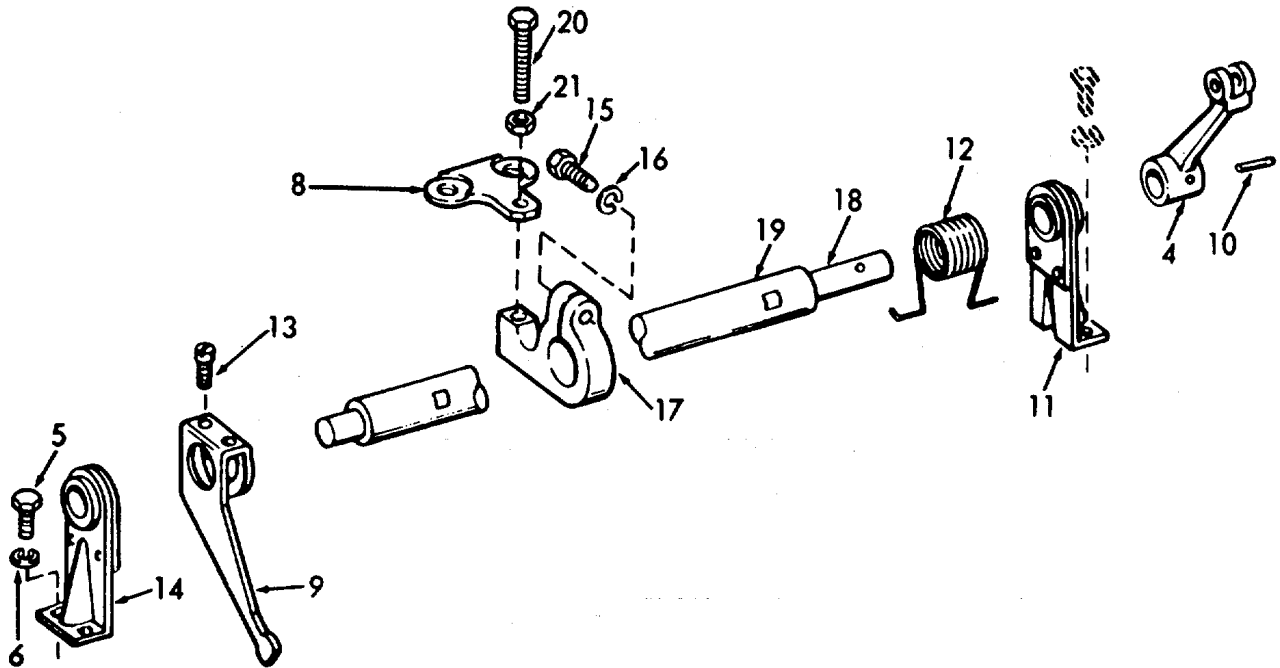
3-2698

3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

- | | | | |
|----|------------------------------------|--------------------------------|---------------|
| j. | End shaft (18) | Remove from control tube (19). | |
| k. | Adjusting screw (20), and nut (21) | Remove from plate (8). | If necessary. |

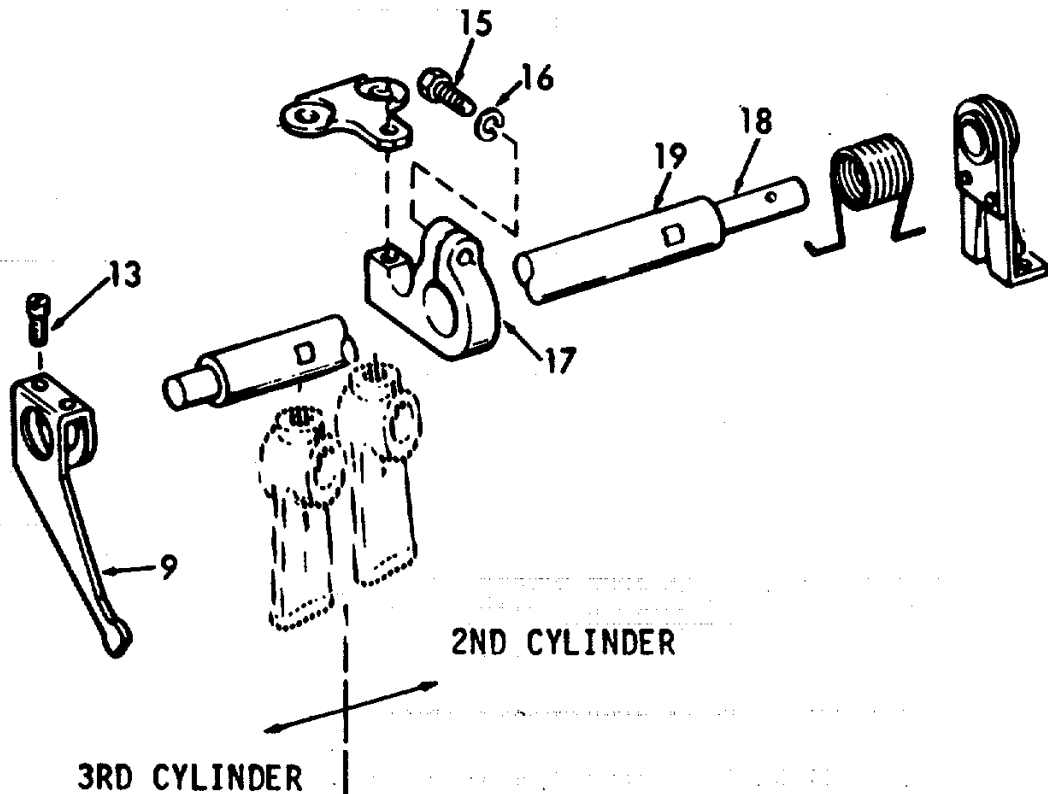


3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY

4. Control Tube	a. End shaft (18), and control tube (19)	Reassemble.	
	b. Lever arm (17), screw (15), and lock-washer (16)	Install on control tube.	
	c. Levers (9), and adjusting screws (13)	Assemble on control tube.	Levers to face the rear bracket position. Turn adjusting screws in far enough to position the levers on the control tube.

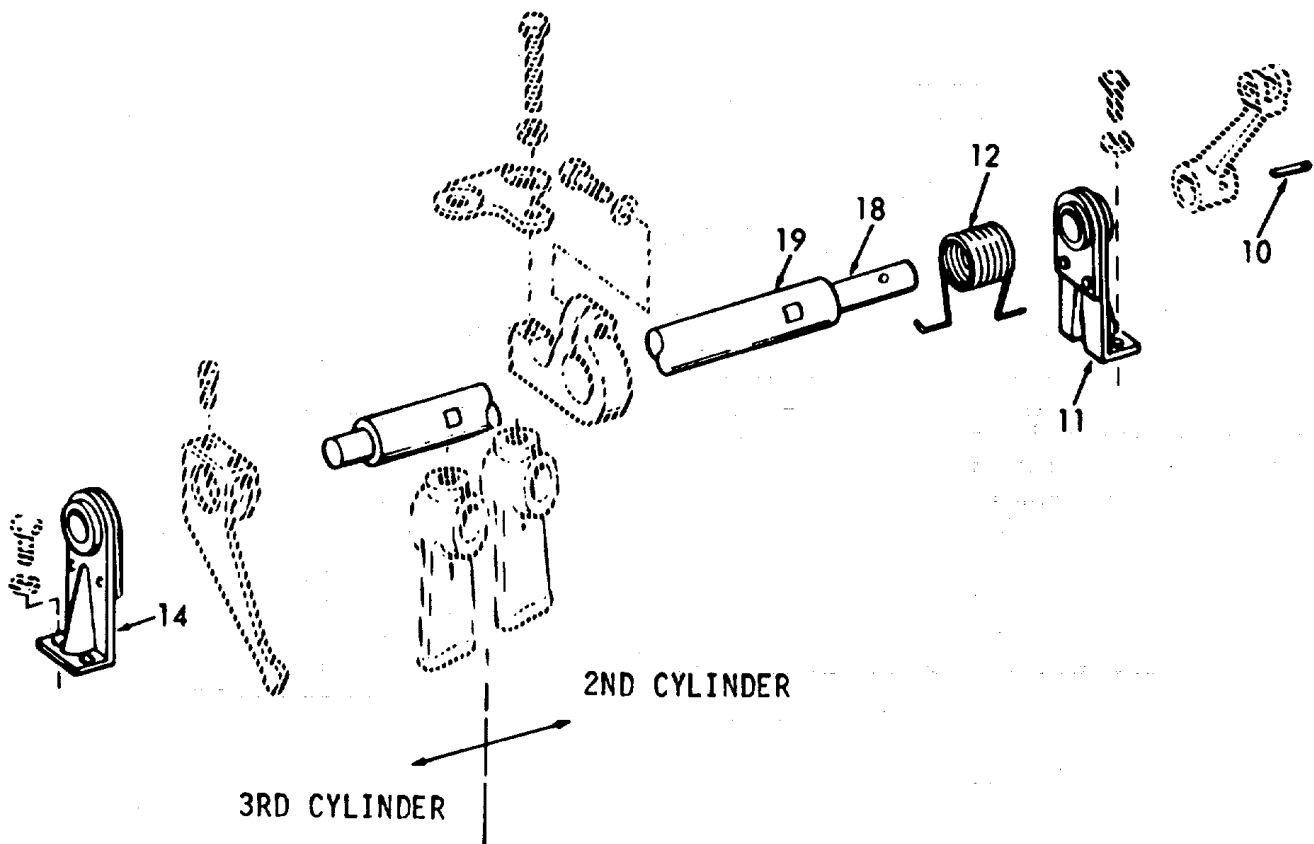


3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

- | | | | |
|----|--|--------------------------|---|
| d. | Spring (12), bracket (11), and control tube (19) | Reassemble. | Attach the curled end of spring to lever and the extended end of spring behind the front bracket. |
| e. | Control lever (11), and pin (10) | | Install on control tube. |
| f. | Bracket (14) | Install on control tube. | |



3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
5. Control tube	a. Levers (9)	Engage the injector control racks.	
	b. Brackets (11 and 14)	Align holes in cylinder head.	
	c. Screws (5), and lock-washers (6)	Install.	Screws are 1/4-20 x 5/8. Torque to 10-12 lb. ft. (14-16 Nm).
	d. Control tube	Check to be sure that it is free in the brackets.	Tap control lightly to align bearings in the brackets.
	e. Fuel rod (3), link pin (2), and cotter pins (1)	Install.	
	f. Screws (7), and plate (8)	Install with the counter bores in the plate face up.	Tighten to 75-85 lb. ft. (101.7-115.3 Nm) torque.

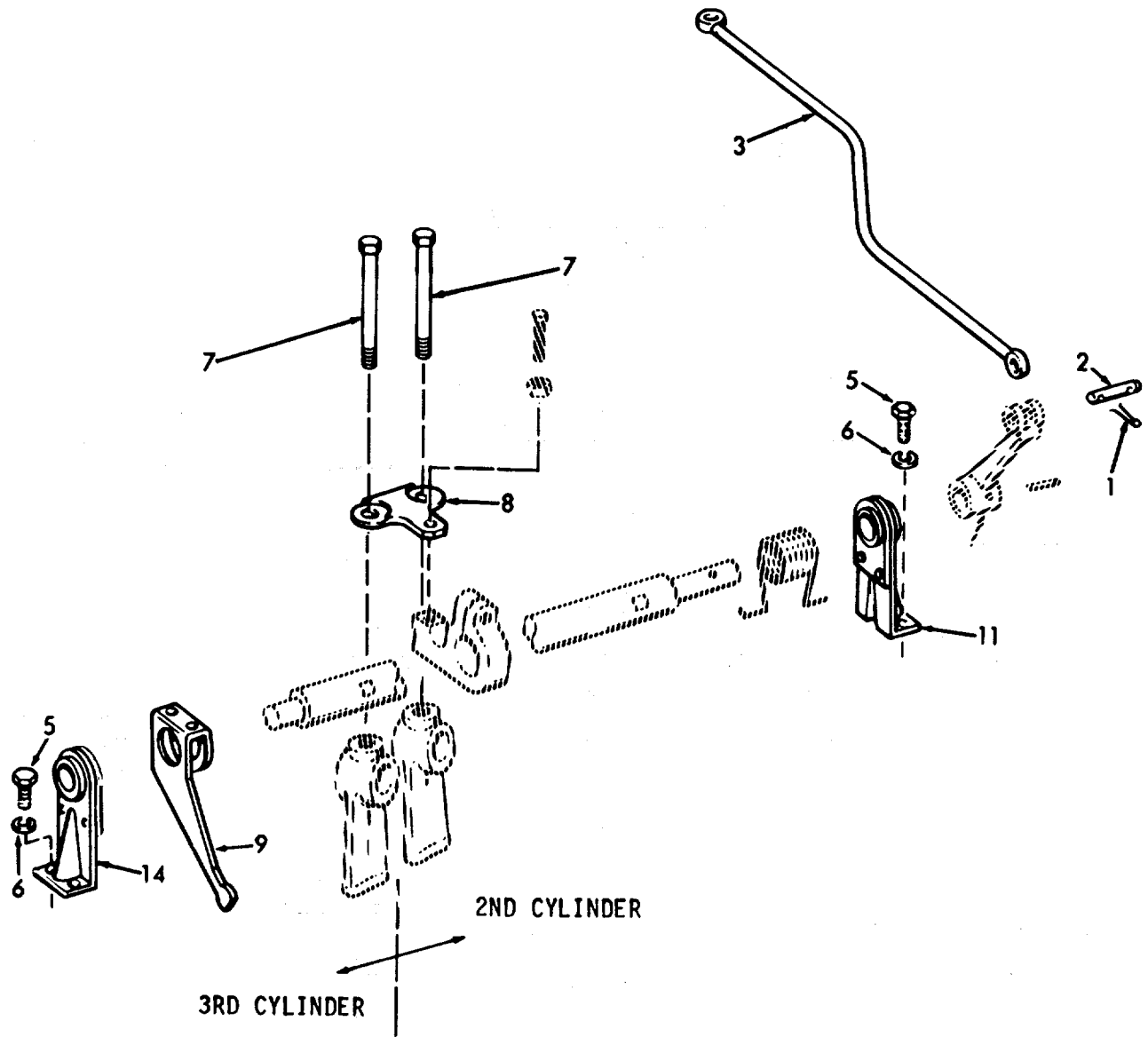
CAUTION

Be sure the injector rack control levers can be placed in a NO-fuel position before re-starting the engine.

3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont.)



3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT

- | | | | | |
|----|-------------------|------------------------------------|---|---|
| 6. | Load limit device | a. Nut (21) | Loosen and remove adjusting screw (20). | |
| | | b. Screw (15) | Loosen screw so arm (17) is free to turn on the injector control tube (19). | |
| | | c. Screw (20), and nut (21) | Adjust so bottom of nut is 1-3/4 inch (4.45 cm) from bottom of screw. | This is an initial setting. |
| | | d. Screw (20), and plate (8) | Screw the screw into plate until nut (21) bottoms against top of the plate. | |
| | | e. Injector rack control tube (19) | <ol style="list-style-type: none"> 1. Hold in full-fuel position. 2. Place arm (17) against bottom of screw (20). 3. Tighten screw (15). | Check that control tube will just go into the full-fuel position. Re-adjust arm if necessary. |

3-2704

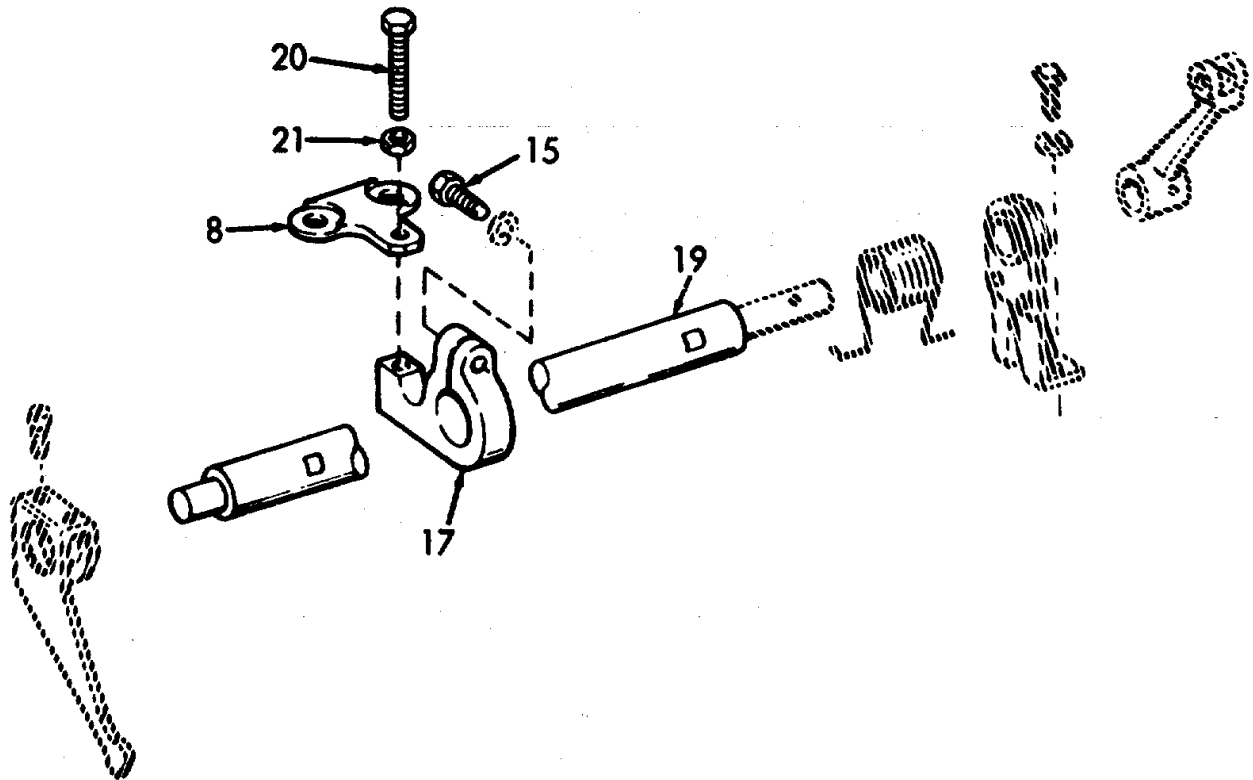
3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT (Cont.)

f. Screw (20), and nut (21)

1. Hold screw to keep it from turning. Set nut until the distance between bottom of the nut and the top of the plate corresponds to the dimension (or number of turns) stamped on the plate. Each full turn of the screw equals .007 inch (.018 cm) or .042 inch (.107 cm) for each flat on the hexagon head.



3-162. FUEL INJECTOR CONTROLS - MAINTENANCE INSTRUCTIONS (Continued).

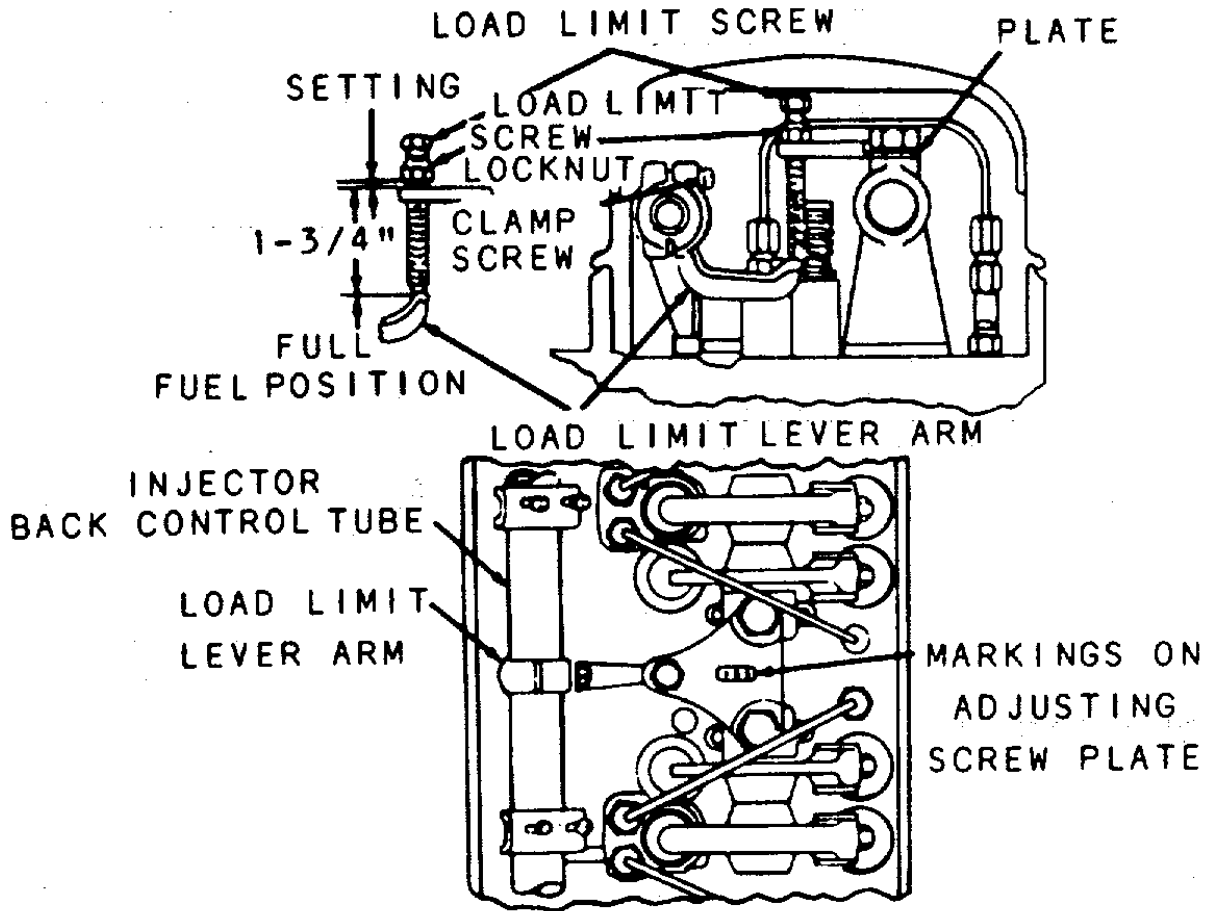
LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT (Cont.)

NOTE

If the plate is not stamped, adjust the screw while operating engine on a dynamometer test stand and note the number of turns required to obtain the desired horsepower. Then stamp the plate accordingly.

2. Thread the screw into the plate until the nut bottoms against the top of the plate. Be sure the nut turns with the screw.
3. Hold the screw to keep it from turning. Then tighten the nut to secure the setting.



3-163. OIL PAN, DIPSTICK AND OIL FILLER.

The maintenance instructions for the oil pan, dipstick and oil filler are contained in the following paragraphs:

DESCRIPTION	PARAGRAPH
Oil Pan and Dipstick	3-163.1
Oil Filler	3-163.2

3-163.1. OIL PAN AND DIPSTICK - MAINTENANCE INSTRUCTIONS.

a. A ribbon type oil level dipstick is used to determine the quantity of oil in the engine oil pan. The dipstick is located in an adaptor attached by a guide to an opening in the cylinder block which leads to the oil pan.

b. The oil should never be allowed to drop below the LOW mark; nor is anything gained by having it above the FULL mark. The oil level should be checked in the engine crankcase with the engine stopped a minimum of ten (10) minutes to permit oil in various parts of the engine to drain back into the crankcase.

This task covers:

- | | |
|-------------|-----------------|
| a. Remove | c. Inspection |
| b. Cleaning | d. Installation |

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Torque wrench

Equipment

Condition Condition Description

Pump, hand

None

NSN-4930-00-263-9886

Special Environmental Conditions

Do not drain oil into bilges.

Material/Parts

Gasket kit P/N 5193114

Use oil/water separation and

Oil MIL-L-2104, Type OE/HDO

recovery system to collect

drained oil. Dispose of properly.

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

3-163.1. OIL PAN AND DIPSTICK - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

NOTE

Engine contains 15 quarts (14.19 liters) of oil.

1.	Side of cylinder block	a. Oil dipstick (1)	Remove.
		b. Dipstick guide (2)	Remove.
		c. Dipstick adaptor (3)	Remove.

CAUTION

Do not damage oil pump piping and inlet screen.

2.	Oil pan	a. Bolt set (4)	Remove.	
		b. Oil pan (5)	Remove.	
		c. Oil pan gasket (6)	Remove.	
		d. Pipe plug (7)	Remove.	If necessary.

3-2708

3-163.1. OIL PAN AND DIPSTICK - MAINTENANCE INSTRUCTIONS
(Continued).

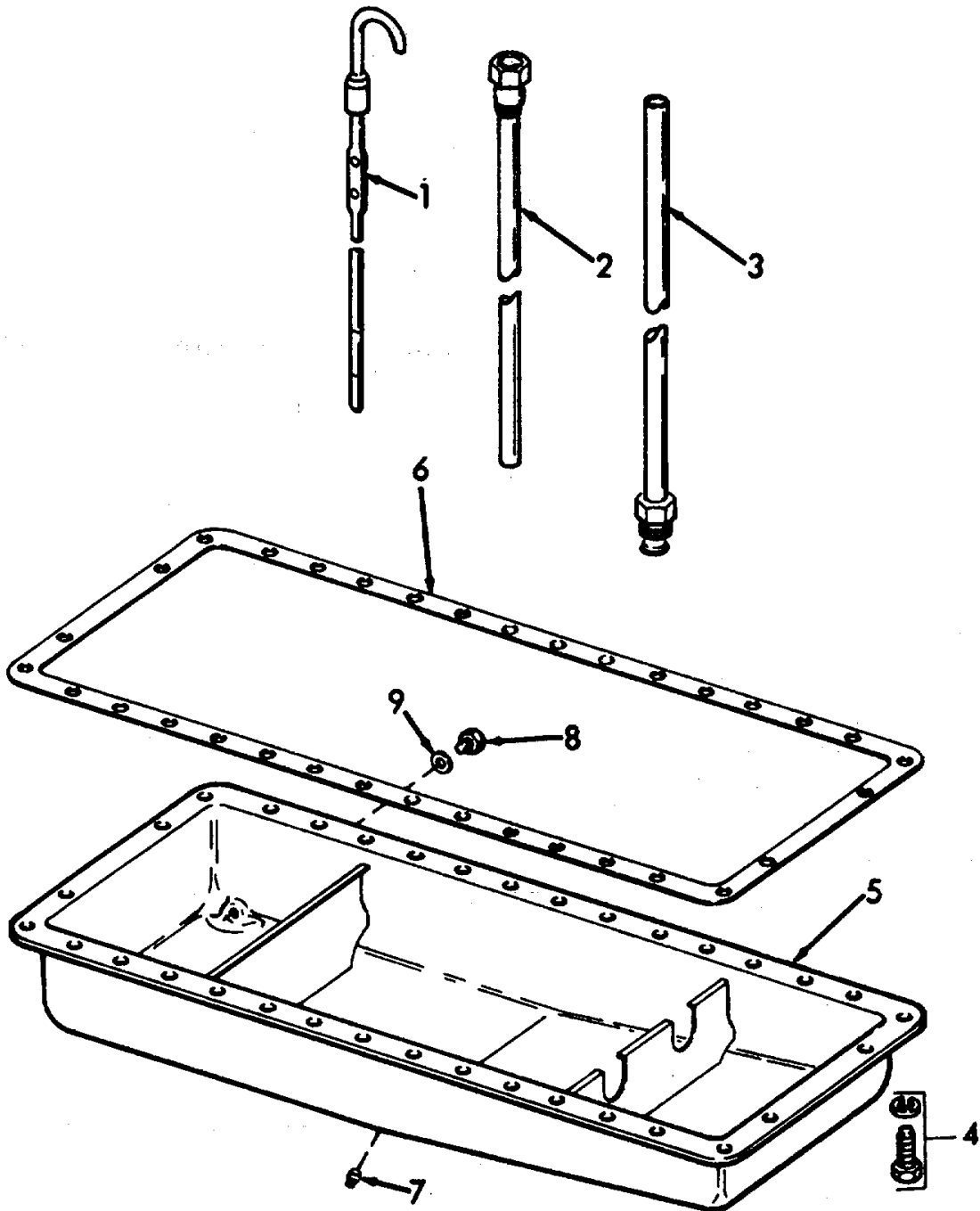
LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont.)

e. Drain plug (8), and gasket (9)

Remove.

If necessary, and discard gasket.



3-163.1. OIL PAN AN-DIPSTICK -MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING

WARNING

Wear protective eye goggles when using compressed air.

3.	Oil pan	Gasket (6)	Remove oil gasket from cylinder block and oil pan. Clean oil pan (interior) with fuel oil and dry thoroughly with compressed air.	Discard gasket.
----	---------	------------	---	-----------------

INSPECTION

4.		Oil pan (5)	Inspect for large dents, misaligned flanges, or raised surfaces surrounding bolt holes. If either pan leaks through dents, cracks, or other imperfections, replace pan.	Place on surface plate or other large, flat surface to inspect.
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INSTALLATION

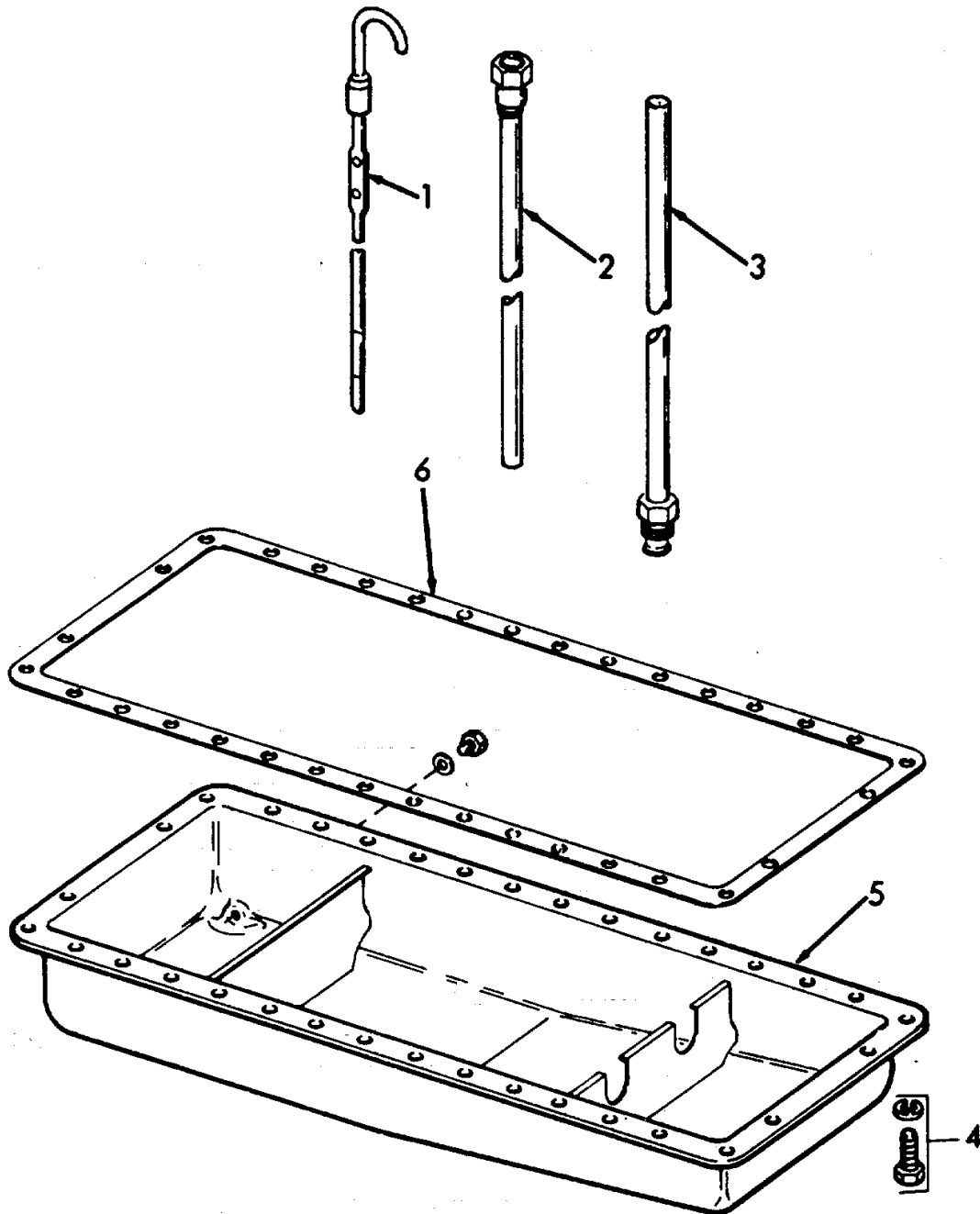
5.	Oil pan	a. Oil pan gasket (6)	Install.	
		b. Oil pan (5)	Install.	
		c. Bolt sets (4)	Install.	Tighten bolt sets to 10-12 lb. ft. (13.6 Nm) torque.

3-163.1. OIL PAN AND DIPSTICK - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont.)

- | | | |
|---------------------------|-------------------------|----------------------|
| 6. Side of cylinder block | a. Dipstick adaptor (3) | Install. |
| | b. Dipstick tube (2) | Slide into dipstick. |
| | c. Dipstick (1) | Insert. |



3-163.1. OIL PAN AND DIPSTICK - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont.)			
7.	Oil filler tube assembly	Oil Add oil as follows:	Engine contains 15 quarts (14.19 liters).

LUBRICANTS		EXPECTED TEMPERATURES		
OE HDO	Lubricating oil (internal)	Above +32°F Above +0°F	+40°F to 10°F + 5°C to 23°C	0°F to 65°F 18°C to 50°C
(MIL-L-2104)	Combustion engine (general) or	OE/HDO 30	OE/HDO 10	OES
OES	Lubricating oil (internal)			
(MIL-L-10295)	Combustion engine, (sub-zero)			

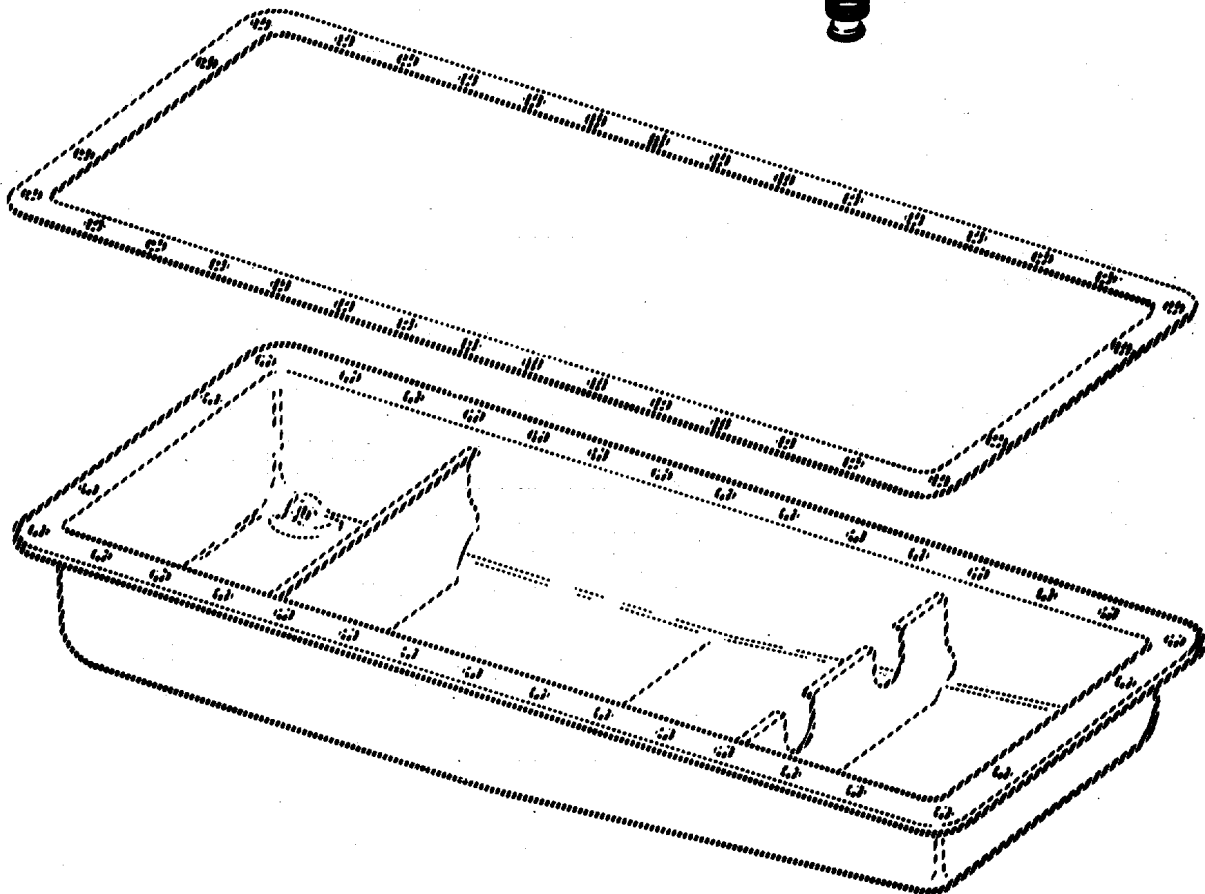
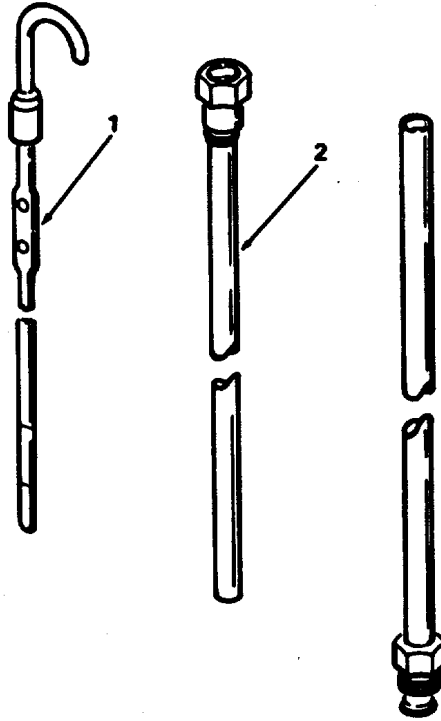
8.	Side of cylinder block	Oil dipstick	Remove dipstick (1) and wipe with rag. Re-insert dipstick into tube (2), and remove. Read oil level and return dipstick. Add enough oil to bring level to full mark.	
9.		Start engine	Check for leaks around gasket and see that oil pressure is normal.	Operate for at least 5 minutes.

3-163.1. OIL PAN AND DIPSTICK - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont.)

1
2



3-163.2. OIL FILLER - MAINTENANCE INSTRUCTIONS.

This task covers:

- a. Inspection
- b. Replacement

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment

Condition Condition Description

None

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

- | | | |
|-------------------------------|-------------------------|-------------------------------|
| 1. Blower drive support | a. Oil filler tube | 1. Check for dents or cracks. |
| | | 2. Check for leaks. |
| | b. Oil filler cap | 1. Check for dents or cracks. |
| | | 2. Check for leaks. |
| | | 3. Check tightness of cap. |
| | c. Blower drive support | 1. Check for leaks. |
| 2. Check for dents or cracks. | | |

3-2715

3-163.2. OIL FILLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT

2.	Oil filler cap (1)	<ul style="list-style-type: none"> a. Turn counter-clockwise to remove. b. Lift off oil filler tube (2) and let it hang onto the tube side. 	Oil filler cap (1) is attached to oil filler tube (2) by the oil filler cap hook (3). Do not remove oil filler cap hook (3) unless replacing oil filler cap (1).
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WARNING

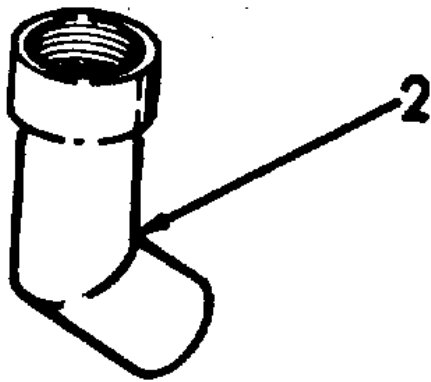
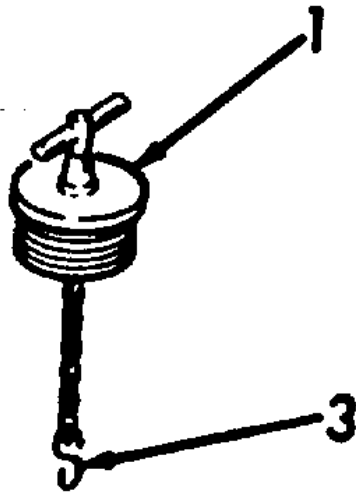
Wear protective eye goggles when using compressed air.

3.	Oil filler tube	Remove from oil filler tube (2) and blower tubedrive support (5). strainer (4)	Replace if necessary. Clean thoroughly with fuel oil and dry with compressed air.
4.	Oil filler tube	<ul style="list-style-type: none"> a. Install oil filler tube strainer (4) into oil filler tube (2) and blower drive support (5). b. Fill oil filler tube with oil. c. Replace oil filler cap (1) and turn clockwise to close. 	<p>Fill to proper level. Check dipstick.</p> <p>Make sure oil filler cap hook (3) is on inside of oil filler tube (2).</p>

3-163.2. OIL FILLER - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPLACEMENT (Cont.)



3-164. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS.

LOCATION	ITEM	ACTION	REMARKS
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a. General

(1) The cylinder head, one on each cylinder bank, is a one-piece casting securely held to the cylinder block by special bolts. The exhaust valves, fuel injectors and the valve and injector operating mechanisms are located in the cylinder head.

(2) Four exhaust valves are provided for each cylinder. Exhaust valve seat inserts, pressed into the cylinder head, permit accurate seating of valves under varying conditions of temperature and prolong the life of the cylinder head.

(3) To ensure efficient cooling, each fuel injector is inserted into a thin-walled tube, which passes thru the water space in the cylinder head. The lower end of the injector tube is pressed into the cylinder head and flared over; the upper end is flanged and sealed with neoprene seal. The sealed upper end and flared lower end of the injector tube prevent water and compression leaks.

(4) The exhaust passages from the exhaust valves of each cylinder lead through a single port to the exhaust manifold. The exhaust passages and the injector tubes are surrounded by engine coolant. Cooling is further ensured by the use of water nozzles pressed into the water inlet ports in the cylinder head. The nozzles direct the comparatively cool engine coolant at high velocity toward the sections of the cylinder head which are subjected to the greatest heat.

(5) The fuel inlet and outlet manifolds are cast as an integral part of the cylinder heads. Tapped holes are provided for connection of the fuel lines at various points along each manifold.

(6) To seal compressions between the cylinder head and the cylinder liner, separate laminated metal gaskets are provided at each cylinder. Water and oil passages between the cylinder head and cylinder block are sealed with synthetic rubber seal rings which fit into counter-bored holes in the block. A synthetic rubber seal fits into a milled groove near the perimeter of the block. When the cylinder head is drawn down, a positive leak-proof, metal-to-metal contact is assured between the head and the block.

b. Cylinder Head Maintenance

(1) The engine operating temperature should be maintained between 160° to 185°F (71° to 85°C), and the cooling system should be inspected daily and kept full at all times. The cylinder head fire deck will overheat and crack in a short time if the coolant does not cover the fire deck surface. When necessary, add water very slowly to a hot engine to avoid rapid cooling which can result in cracking and distortion of the cylinder head and block.

3-164. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

(2) Abnormal operating conditions or neglect of certain maintenance items may cause cracks to develop in the cylinder head. A careful inspection should be made to find the cause and avoid a recurrence of the failure.

(3) Unsuitable water in the cooling system may result in lime and scale formation and prevent proper cooling. The cylinder head should be inspected around the exhaust valve water jackets. This can be done by removing an injector tube. Remove such deposits from the cooling system of the engine by using a reliable non-corrosive scale remover. A similar condition can exist in the cylinder block and other components of the engine.

(4) Loose or improperly seated injector tubes may result in compression leaks into the cooling system and in loss of engine coolant. The tubes must be tight to be properly seated.

(5) Both excessive fuel in the cylinders and overtightened injector clamp bolts can cause cracks in the cylinder head. Always use a torque wrench to tighten the bolts to the specified torque.

(6) Certain service operations on the engine require removal of the cylinder head:

(a) Remove and install pistons. (Refer to paragraph 3-171).

(b) Remove and install cylinder liners. (Refer to paragraph 3-171).

(c) Remove and install exhaust valves. (Refer to paragraph 3-165.2).

(d) Remove and install exhaust valve guides. (Refer to paragraph 3-165.2).

(e) Replace fuel injector tubes. (Refer to paragraph 3-164.1).

(f) Install new cylinder head gaskets and seals. (Refer to paragraph 3-164.1).

(g) Remove and install camshaft. (Refer to paragraph 3-166).

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS.

This task covers:

- | | |
|----------------------|--------------------------------|
| a. Removal | e. Repair |
| b. Disassembly | f. Assembly |
| c. Cleaning | g. Pre-Installation Inspection |
| d. Inspection/Repair | h. Installation |
-

INITIAL SETUP

Test Equipment

Straight edge
Feeler edge

Special Tools

Torque wrench

References

None

Equipment

Condition Condition Description

Paragraph

3-142	Governor
3-146	Fuel Lines
3-147	Fuel Injectors
3-151	Water Connections
3-152	Water Manifold
3-153	Thermostat and Housing
3-160	Exhaust Manifold
3-161	Rocker Arm Cover
3-162	Injector Controls
3-165	Valve and Injector Operating Mechanism

Material/Parts

Gasket kit P/N 5193114
or 5198676

Special Environmental Conditions

Do not dump oil into bilges.
Use the oil/water separation
and recovery system. Dispose
of properly.

Personnel Required

2

General Safety Instructions

Observe WARNING in procedure.

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS	
REMOVAL				
1.	Exhaust manifold	Exhaust piping	Disconnect.	Refer to paragraph 3-160.
2.	Cylinder head	Fuel lines	Disconnect.	Refer to paragraph 3-146.
3.	Thermostat Housing cover	Hose	a. Loosen hose clamps. b. Remove hose.	Refer to paragraph 3-153.
4.	Water by-pass tube	Water by-pass tube	a. Loosen hose clamps. b. Remove tube.	
5.	Thermostat housing assembly	Thermostat housing assembly	Remove.	Refer to paragraph 3-153.
6.	Cylinder head cover	Valve rocker	Remove.	Clean before removal. Refer to paragraph 3-161.
7.	Cylinder head	Governor cover	Remove.	Refer to paragraph 3-142.
8.	Injector control tube lever and governor	Fuel rod	Disconnect and remove.	Refer to paragraph 3-162.
9.	Fuel rod cover	Hose clamp	Loosen and slide hose up on fuel rod cover toward governor.	
10.	Cylinder head	a. Exhaust manifold	Remove.	Refer to paragraph 3-160.
		b. Water manifold	Remove.	Refer to paragraph 3-152.

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued). - -

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont.)

11.	Injector control tube and brackets	Injector control tube and brackets	Remove.	Remove as an assembly. Refer to paragraph 3-162.
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CAUTION

- If the cylinder head is to be disassembled for reconditioning of the exhaust valves and valve seat inserts, or for a complete overhaul, remove fuel pipes and injectors at this time. See paragraph 3-147 for removal of the injectors.

- Check the torque on cylinder head bolts and stud nuts (if used) before removing the head. Then remove bolts and nuts and lift the cylinder head from the cylinder block. If interference is encountered between the rear end of the right-back cylinder head and any of the flywheel attaching bolts, loosen the bolts. Checking the torque before removing the head bolts and examining the condition of the compression gaskets and seals after the head is removed may reveal the causes of any cylinder head problems.

NOTE

When placing the cylinder head assembly on a bench, protect cam followers and injector spray tips, if the injectors were not removed, by resting the valve side of the head on 2 inch (5.08 cm) wood blocks.

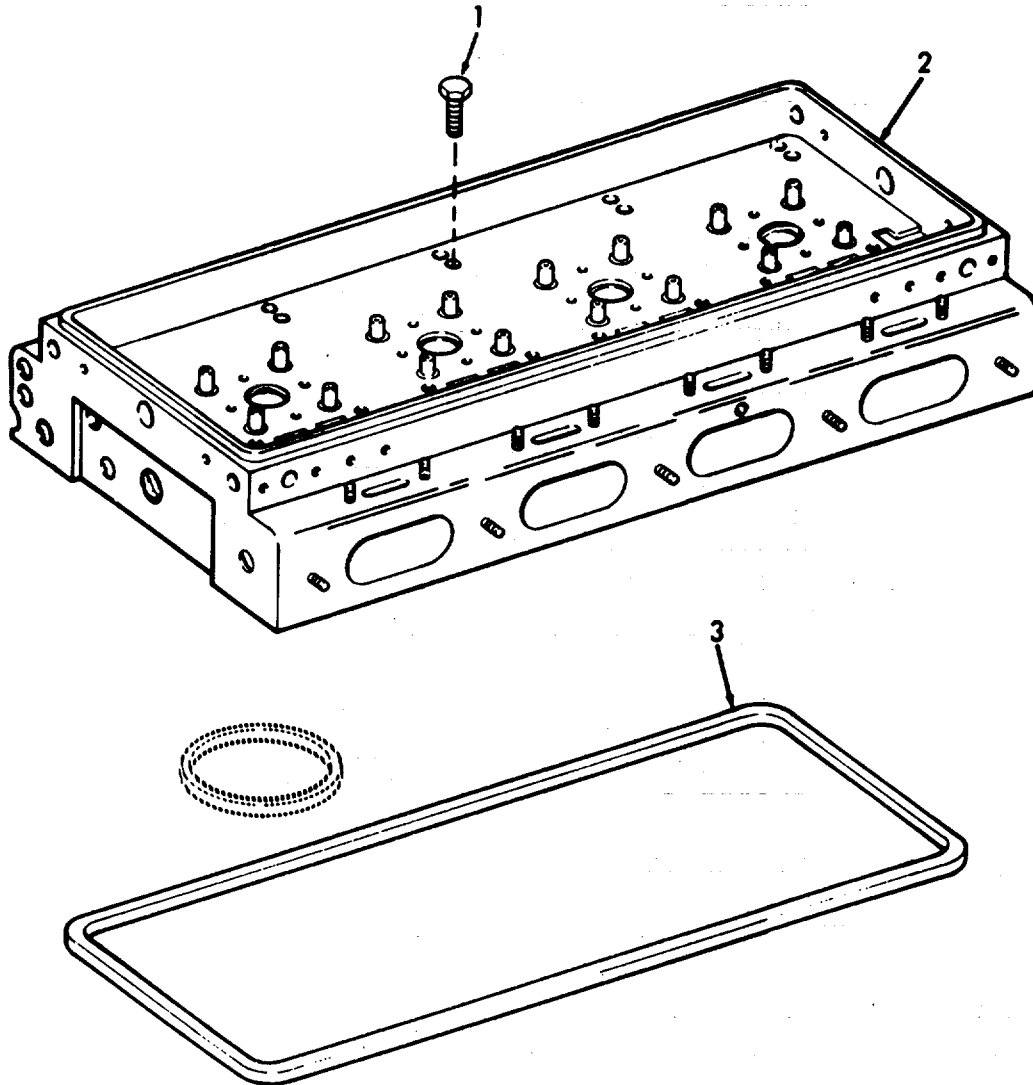
12.	Cylinder Head	a. Bolts (1)	Remove fourteen bolts.	
		b. Head (2)	Remove.	Requires two persons.
		c. Oil seal ring (3)	Remove.	Discard.

3-2722

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



3-2723

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	d. Seal rings (water hole) (4)	Remove ten rings.	Discard.
	e. Seal ring (end water hole) (5)	Remove.	Discard.
	f. Compression gaskets (6)	Remove six gaskets.	Discard.
	g. Oil and water gasket (7)	Remove.	Discard.
	h. Exhaust valves	Remove.	Refer to paragraph 3-162.2
	i. Valve and injector operating mechanism	Remove.	Refer to paragraph 3-165.1
13. Engine	Engine oil	Remove oil.	Pump oil into a suitable container. Removing the oil will remove any coolant that may have worked its way to the oil pan when the head was removed.

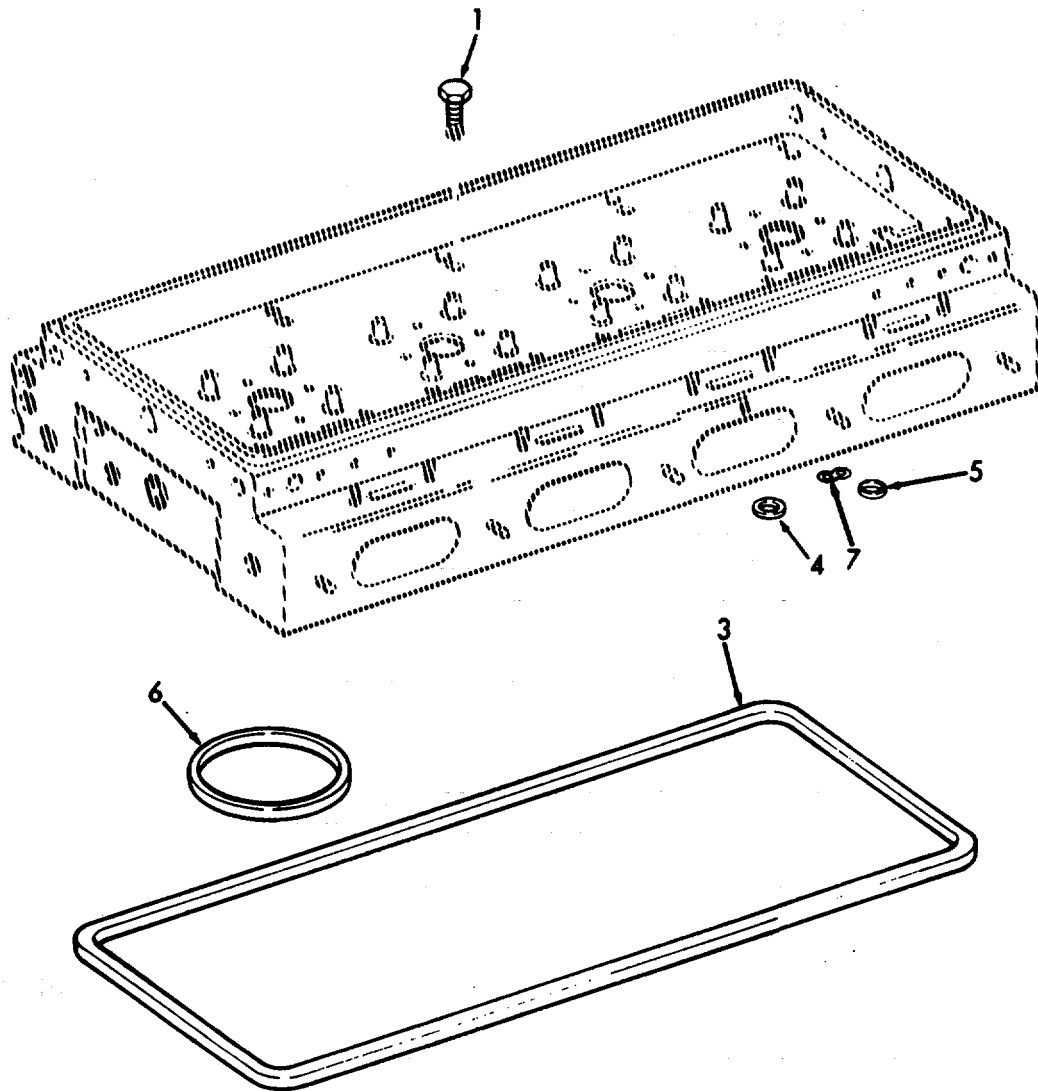
3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

NOTE

Do not drain oil bilges. Use the oil/water separation and recovery system to collect used oil.



3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

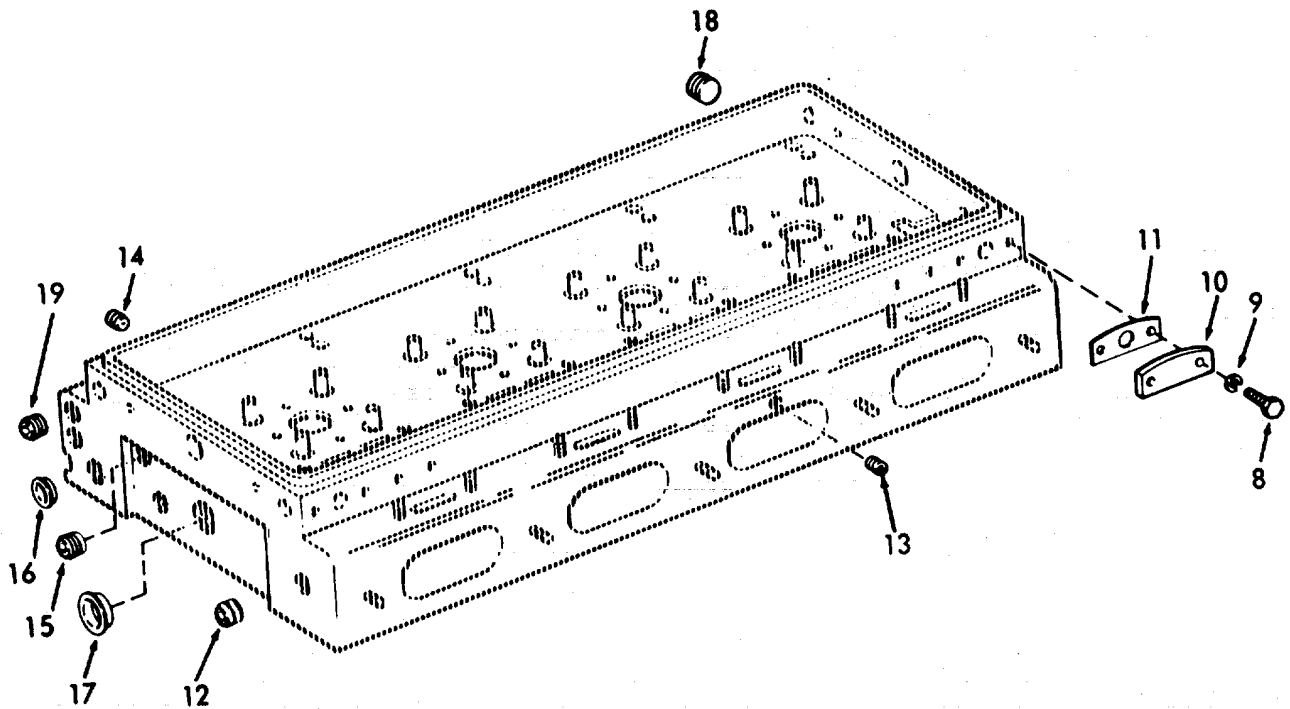
LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
14. Cylinder head	a. Screws (8), and flat washers (9)	Remove three places.	
	b. Governor hole covers (10), and gaskets (11)	Remove three places.	Discard gaskets.
	c. Pipe plugs (12)	Remove seven plugs.	Plug is a 1/4 inch raised square drive.
	d. Oil gallery plugs (13)	Remove four plugs.	Plug is a special 3/8-16.
	e. Plugs (14)	Remove four plugs.	Plug is a special 7/16-14.
	f. Pipe plugs (15)	Remove two plugs.	Plug is a 3/4 inch square drive.
	g. Cup plugs (16 and 17)	DO NOT REMOVE, unless damaged. Cup plugs are located in six places.	
	h. Pipe plugs (18)	Remove five plugs.	Plug is a 1/4-18.
	i. Pipe Plug (19)	Remove one plug	Plug is a 3/8-18.

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

- | | | | |
|----|--------------|---------|-----------------------------|
| j. | Valve insert | Remove. | Refer to paragraph 3-165.2. |
| k. | Valve guide | Remove. | Refer to paragraph 3-165.2. |



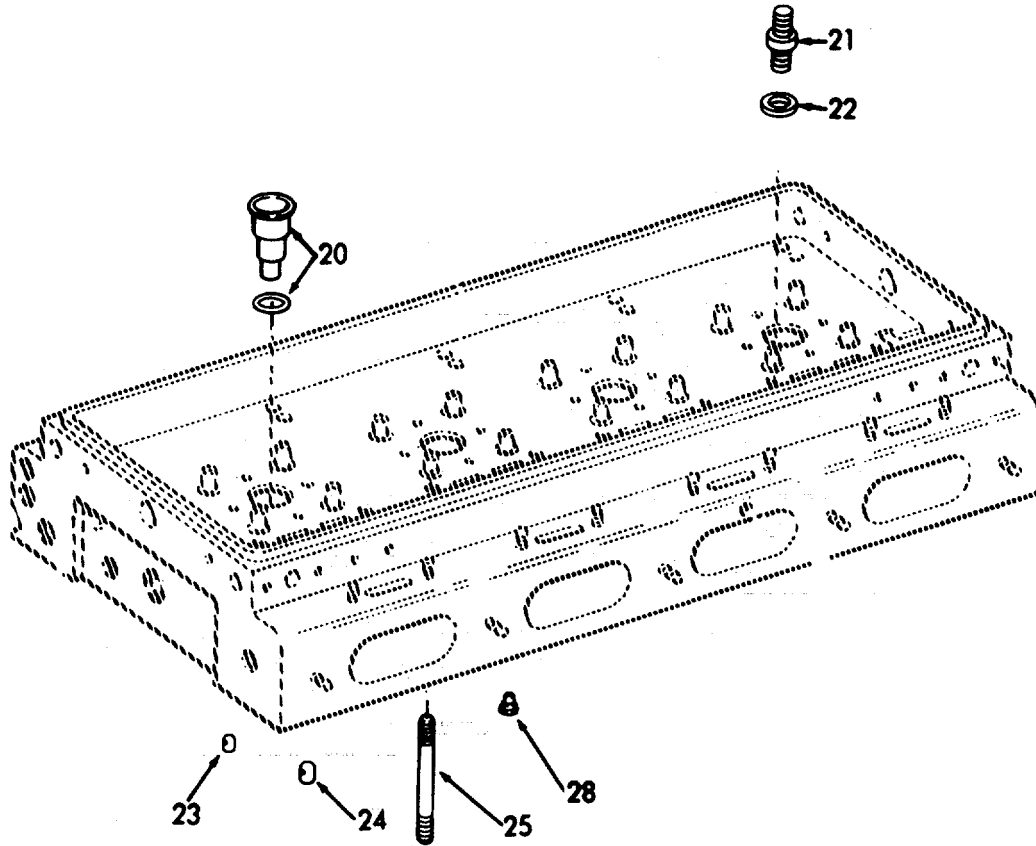
3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)			
	i. Fuel injector tube (20)	Remove if heavily coated with scale.	Refer to step 15.
	m. Fuel pipe connectors (21), and washer (22)	Remove six.	
	n. Water nozzle (single outlet) (23)	Remove if heavily coated with scale. The water nozzle (single outlet) is located in four places.	
	o. Water nozzle (double outlet) (24)	Remove if heavily coated with scale. The water nozzle (double outlet) is located in ten places.	
	p. Cylinder head stud (25)	Remove.	If necessary.
15. Fuel injector tubes	Tubes	Remove.	Refer to paragraph 3-164.1.

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)



3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING

WARNING

Wear protective eye goggles when using compressed air.

- | | | | |
|-------------------|---|--|--|
| 16. Cylinder head | <p>After the cylinder head has been disassembled and all of the plugs (except cup plugs) have been removed, thoroughly clean the head. If the water passages are heavily coated with scale, remove the injector tubes and water nozzles. (Refer to step 15).
Clean all of the cylinder head components with fuel oil and dry with compressed air.</p> | | |
|-------------------|---|--|--|

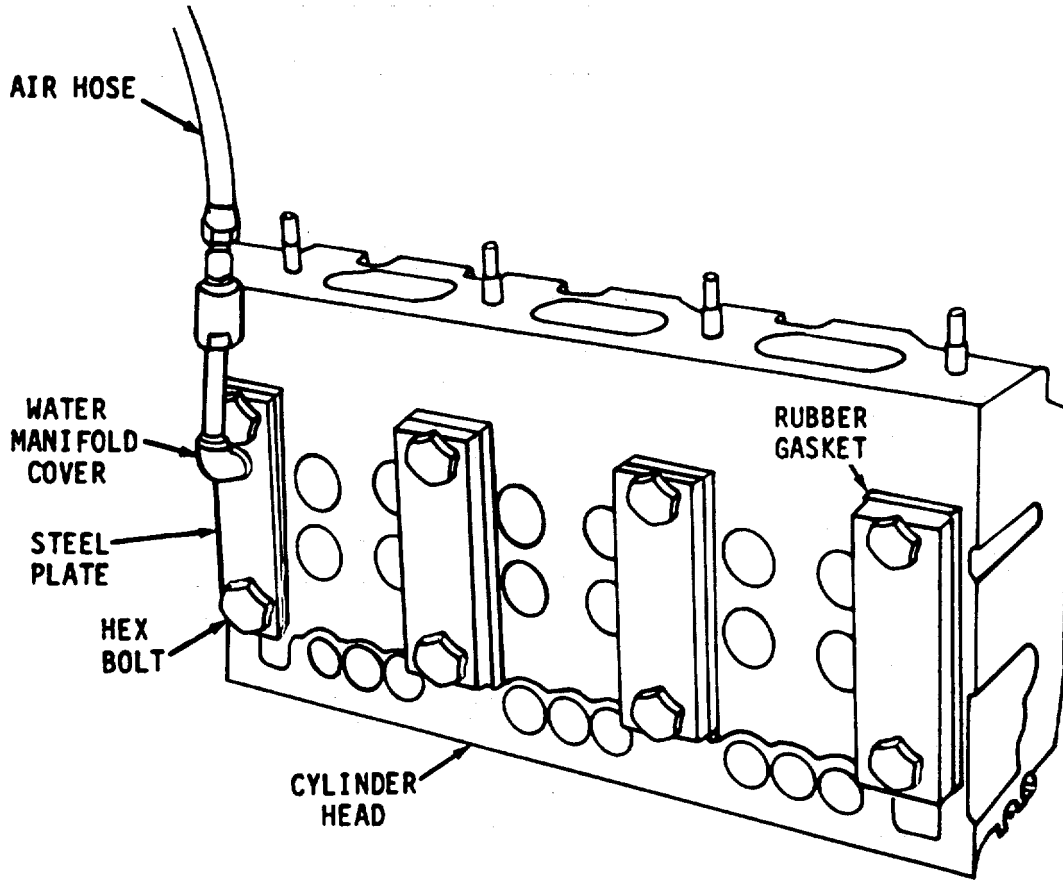
INSPECTION AND REPAIR

- | | | | |
|-------------------|---------------------------------|--|--|
| 17. Cylinder head | 1. Pressure check cylinder head | <p>a. Seal off the water holes in the head with steel plates and suitable rubber gaskets secured in place with bolts and washers. Drill and tap one of the cover plates for an air hose connection.</p> <p>b. Install scrap or dummy injectors to ensure proper seating of the injector tubes. Dummy injectors may be made from oil injector nuts and bodies (the injector spray tips are not necessary). Tighten the injector clamp bolts to 20-25 lb-ft (27-34 Nm) torque.</p> | |
|-------------------|---------------------------------|--|--|

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION AND REPAIR (Cont)



3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

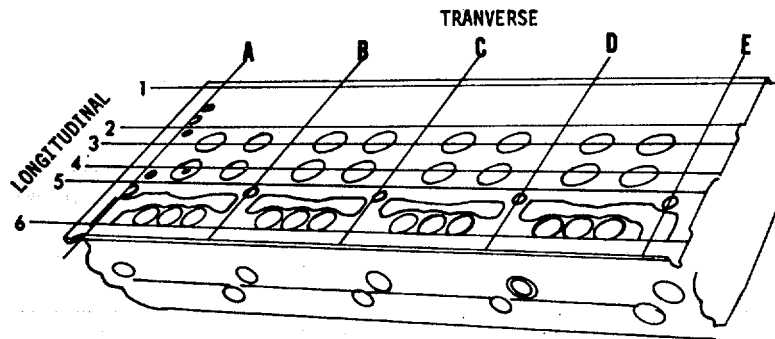
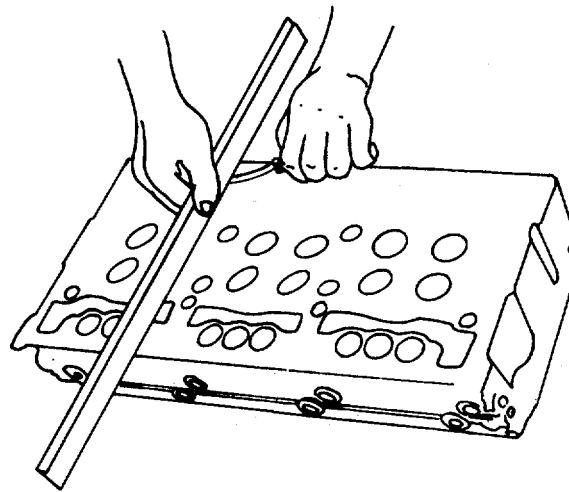
LOCATION	ITEM	ACTION	REMARKS
INSPECTION AND REPAIR (Cont)			
		<ul style="list-style-type: none"> c. Apply 80-100 psi (522-689 kPa) air pressure to the water jacket. Immerse the cylinder head in a tank of water, previously heated to 180-200°F (82-93°C) for about twenty minutes to thoroughly heat the head. Observe the water in the tank for bubbles which indicate a leak or crack. Check for leaks at the top and bottom of the injector tubes, oil gallery, exhaust ports, fuel manifolds, and at the top and bottom of the cylinder head. d. Relieve air pressure and remove the cylinder head from the water tank. Remove the plates, gaskets, and injectors, and dry the head with compressed air. e. If the pressure check reveals any cracks, install a new cylinder head. 	

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION AND REPAIR (Cont)

- | | |
|---|--|
| <p>2. Check the bottom (fire-deck) of the cylinder head for flatness warpage.</p> | <p>a. Use a heavy, accurate, straight-edge, and feeler gage, to check for transverse warpage at each end, and between all cylinder. Also check for longitudinal warpage in six places. Refer to table for maximum allowable warpage.</p> |
|---|--|



3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION AND REPAIR (Cont)

Maximum Longitudinal Warpage		Maximum Transverse Warpage	
INCHES	CENTIMETERS	INCHES	CENTIMETERS
.010	.025	.004	.010

- b. Use the measurements obtained and the limits given in the table as a guide to determine the advisability of reinstalling the head of the engine or of refacing it. The number of times a cylinder head may be refaced will depend upon the amount of stock previously removed.
- c. If the cylinder head is to be refaced, refer to Direct Support Maintenance.



When a cylinder head has been refaced, critical dimensions such as the protrusion of valve seat inserts, exhaust valves, injector tubes and injector spray tips must be checked and corrected. The push rods must also be adjusted to prevent the exhaust valves from striking the pistons after the cylinder head is re-installed in the engine.

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION AND REPAIR (Cont)			
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18. Exhaust valve areas	Exhaust valve seat inserts and valve guides	Inspect.	Refer to paragraph 3-165.2
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REPAIR			
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19. Cam follower	Cam follower bores	Inspect for scoring or wear.	Light score marks may be cleaned up with crocus cloth wet with fuel oil. Measure the bore diameter. The cam follower-to-cylinder head clearance must not exceed .006 inch (.015 cm) with used parts (refer to specifications). If the bores are excessively scored or worn, replace the cylinder head.
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3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

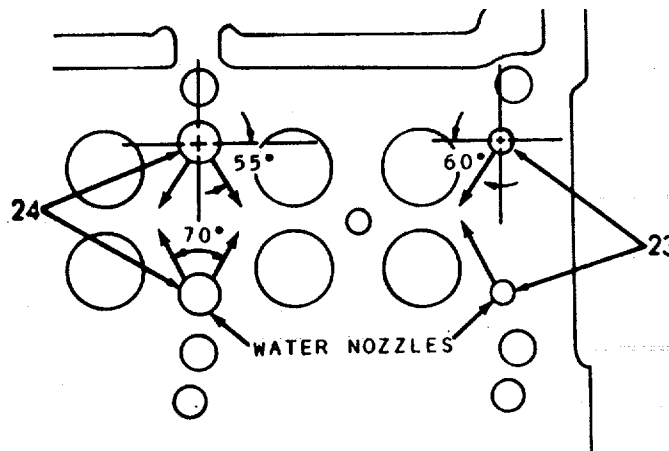
20. Water holes

Water hole nozzles (single outlet) (23), and old (double outlet) (24)

Check that they are not loose.

Replace, if necessary, as follows:

- a. Remove the nozzles.
- b. Make sure the water inlet ports in the cylinder head are clean and free of scale. The water holes at each end of the head may be cleaned with a 1/2 inch (1.27 cm) drill and the intermediate holes may be cleaned with a 13/16 inch (2.063 cm) drill. Break the edges of the holes slightly.



3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)			
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c. Press the nozzles in place with the nozzle openings parallel to the longitudinal centerline. Press the nozzles flush to .0312 inch (.0792 cm) recessed below surface of cylinder.

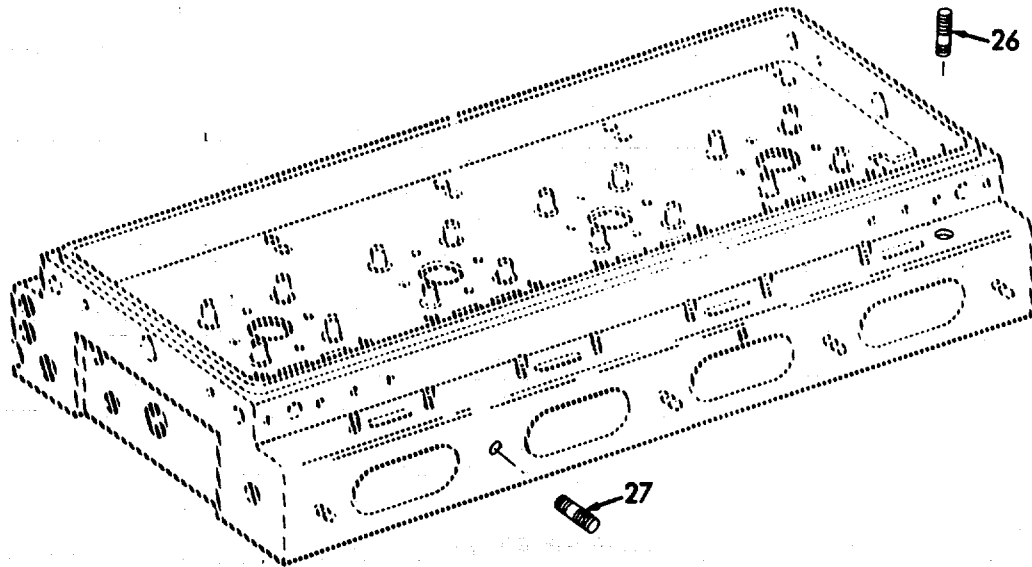
d. Check to make sure the nozzles fit tight. Use a wood plug or other suitable tool to expand the nozzles, or thin the outside diameter with solder to provide a tight fit. If solder is used, make sure orifices in nozzles are not closed with solder.

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

21. Studs	Water manifold studs (26), and exhaust manifold studs (27)	Replace broken or damaged studs.	Apply sealant to the threads of new studs and drive them to 10-25 lb-ft (14-34 Nm) torque, water manifold cover studs (26) to 25-40 lb-ft (34-54 Nm) torque, and the exhaust manifold studs (27) to 25-40 lb-ft (34-54 Nm) torque.
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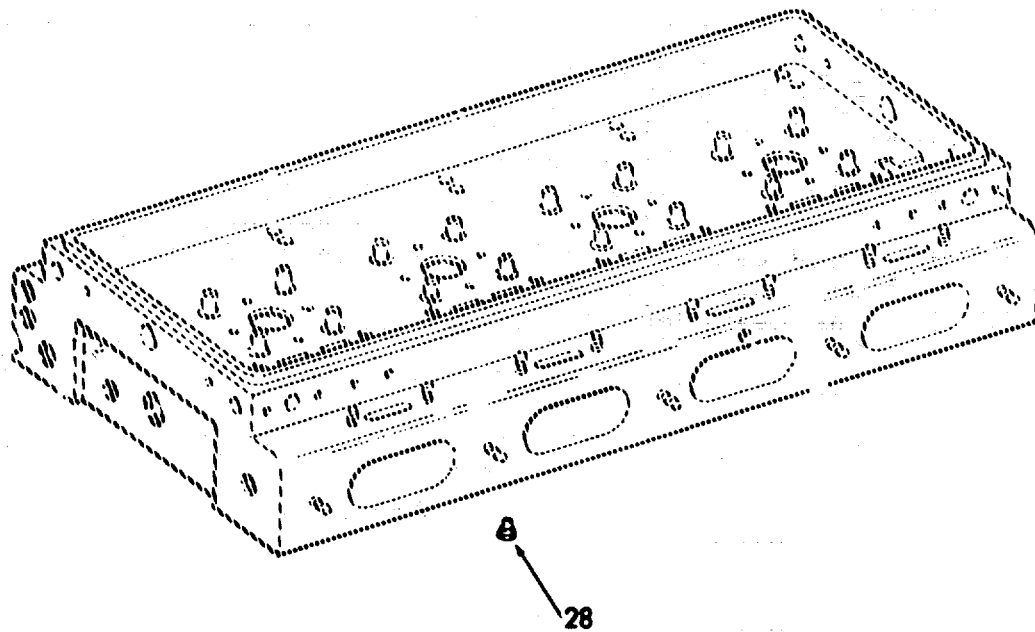


3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

22. Pilot sleeve	Pilot sleeves (28)	Pilot sleeves have been added to the head mounting bolt holes at each end of the cylinder heads. Make sure the sleeves are flush or recessed below the fire deck of the cylinder head. Replace damaged sleeves.	The sleeves, which act as a hollow dowel to provide a closer fit between the mounting bolts and the cylinder head, help to guide the head in place without disturbing the seals and gaskets.
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23.	Overall	Inspect all other components removed from the cylinder head.	
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3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ASSEMBLY

WARNING

Wear protective eye goggles when using compressed air.

CAUTION

Apply a small amount of dual-purpose sealer to the threads of the plugs only. Work the sealant into the threads and wipe the excess with a clean lint-free cloth so that the sealant will not be washed into the fuel and oil passages.

NOTE

If a service replacement cylinder head is to be installed, it must be thoroughly cleaned of all rust preventive compound, particularly inside the integral fuel manifolds, before installing the plugs. A simple method of removing the rust preventive compound is to immerse the head in solvent, oleum, or fuel oil. Then scrub the head and go through all of the openings with a soft bristle brush. A suitable brush for cleaning the various passages in the head can be made by attaching a 1/8 inch (.317 cm) diameter brass rod to a brush. After cleaning, dry the cylinder head with compressed air.

24. Cylinder head	a. Pipe plug (19)	Install one plug.	Tighten to 18-22 lb-ft (24.4-29.8 Nm).
	b. Pipe plugs (18)	Install five plugs.	Tighten to 14-16 lb-ft (18.9-21.7 Nm).
	c. Pipe plugs (15)	Install two plugs.	Tighten to flush or 1/8 inch recessed.
	d. Pipe plugs (12)	Install seven plugs.	Tighten to 14-16 lb-ft (18.9-21.7 Nm).

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ASSEMBLY (Cont)

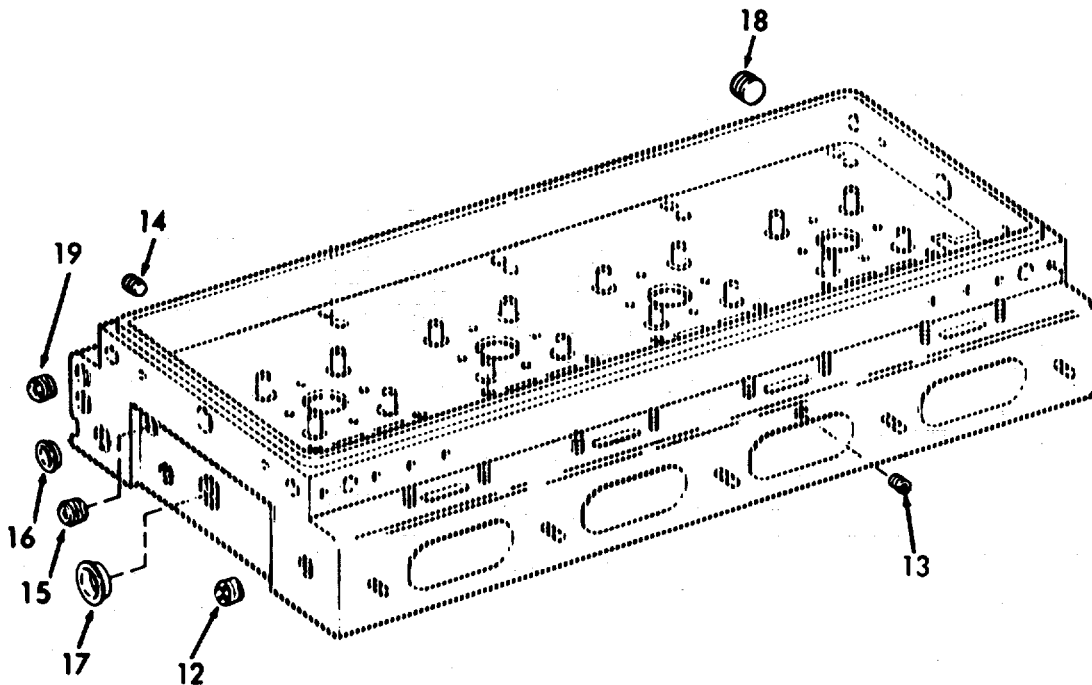
e.	Plugs (14)	Install four plugs.	
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NOTE

Apply sealant to threads of pipe plugs 12, 18 and 19.

f.	Cup plugs (16 and 17)	Drive into head.	Flush to .0625 inch (.1588 cm) below the sur- face of the cylinder head.
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g.	Oil gallery plugs (13)	Install twelve plugs.	Must not pro- trude more than .0625 inch (.1588 cm). A .2187 inch (.5555 cm) dia- meter rod placed in the vertical oil feed hole must pass the inner face of plug.
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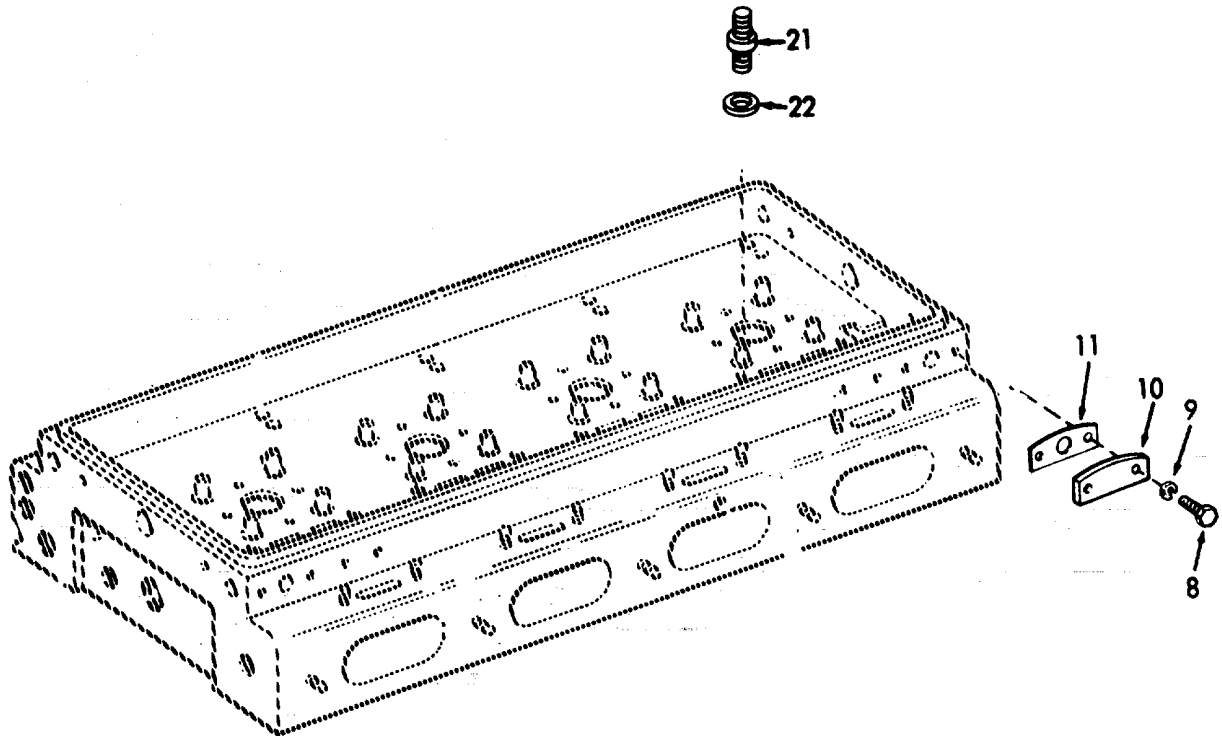


3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ASSEMBLY (Cont)

- | | | | |
|--|--|-----------------------|---|
| | h. Fuel pipe connectors (21), and washers (22) | Install twelve. | Use a new washers. Tighten to 40-45 lb-ft. (59-61 Nm) torque. |
| | i. Governor hole cover (10), gasket (11), screws (8), and flat-washers (9) | Install three covers. | Use new gas-kets. |



3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS		
ASSEMBLY (Cont)					
25.	Fuel injector tubes	Tubes	Install.	Refer to paragraph 3-164.1.	
26.	Cylinder head	a.	Exhaust valve guides	Replace.	Refer to paragraph 3-165-2.
		b.	Cam followers	Replace.	Refer to paragraph 3-165.1.
		c.	Exhaust valves	Replace.	Refer to paragraph 3-165.2.
		d.	Rocker arm assemblies	Replace.	Refer to paragraph 3-165.1.

NOTE

The fuel injectors, fuel pipes, injector control tube assembly, and water manifold can be installed at this time or after the cylinder head is installed on the engine.

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
PRE-INSTALLATION INSPECTION			
27. Engine		<p>Make the following inspections just prior to installing the cylinder head whether the head was removed to service only the head or to facilitate other repairs to the engine.</p> <ol style="list-style-type: none"> <li data-bbox="792 730 1003 905">1. Check the cylinder liner flange heights with relationship to the cylinder block. <li data-bbox="792 947 1003 1087">2. Make sure the piston crowns are clean and free of foreign material. <li data-bbox="792 1129 1040 1402">3. Make sure that each pushrod is threaded into its clevis until the end of the push rod projects through the end of the engine tune-up. <li data-bbox="792 1434 1052 1795">4. Check the cylinder block and cylinder head gasket surfaces, counterbores and seal grooves to be sure they are clean and free of foreign material. Also check to ensure that there are 	<p>Refer to paragraph 3-171.</p> <p>This is important since serious engine damage will be prevented when the crankshaft is rotated dur-</p>

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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PRE-INSTALLATION INSPECTION (Cont)

no burrs or sharp edges in the counterbores.

5. Inspect the cylinder head bolt holes in the block for accumulation of water, oil or any foreign material. Clean the bolt holes thoroughly and check for damaged threads.

NOTE

The 3/4 inch (1.905 cm) diameter cup pipe plug at the front end of the head must be removed prior to installation to prevent blocking the coolant flow out of the head.

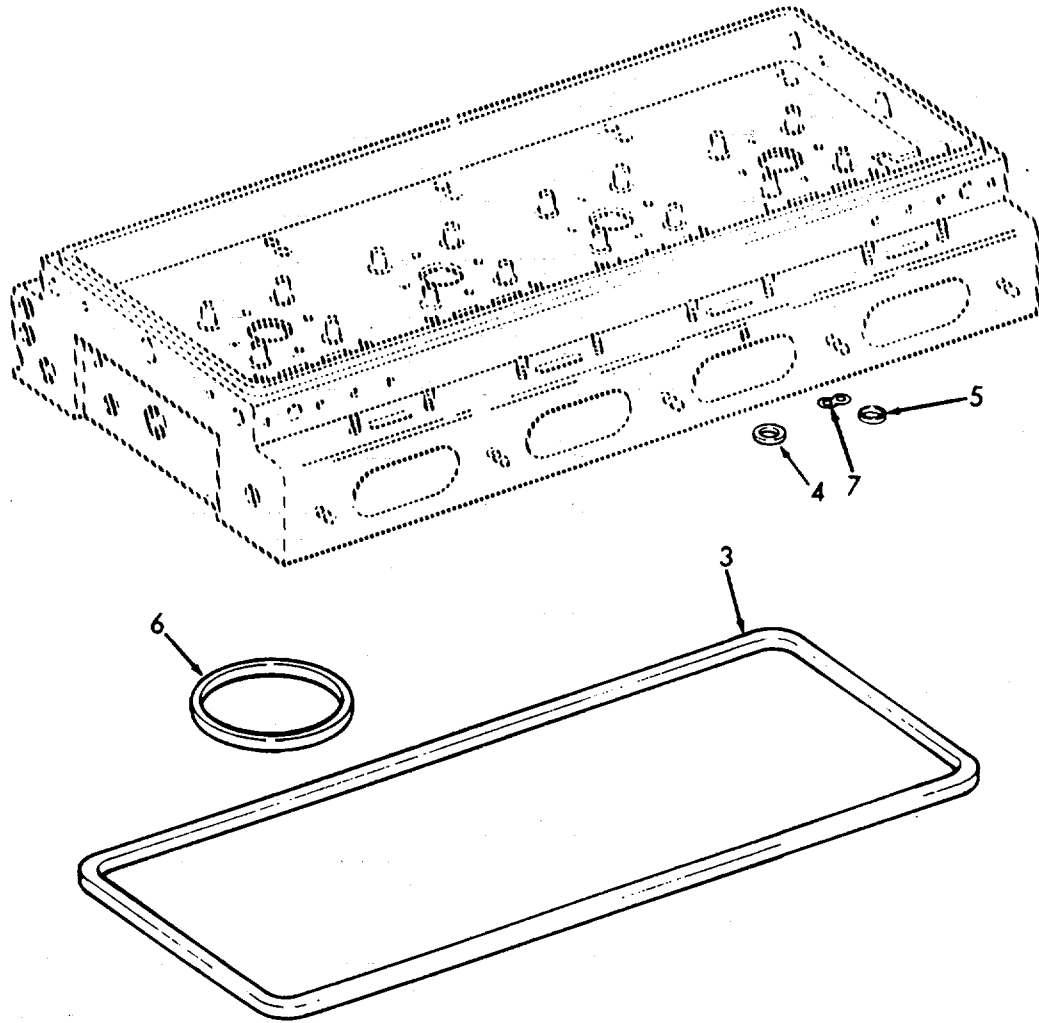
3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
NOTE			
Never install used compression gaskets or seals.			
28. Engine block	a. Compression gaskets (6)	Place on top of each cylinder liner.	Use new gasket.
	b. Water-hole seal rings (4)	Place in counterbore of the water holes.	Use ten new rings.
	c. End water hole seal ring (5)	Place in counterbore of the water holes.	Use three new rings.
	d. Oil/ and water gasket (7)	Install.	Use new gasket.
	e. Oil seal ring (3)	a. Place in groove at the perimeter of the block. b. The seal must lay flat in the groove. not use any adhesive or other material to secure it in the groove.	Use new seal. Do not stretch the seal and do

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

29. Cylinder head (2)			
--------------------------	--	--	--

NOTE

Make a final visual check of the compression gaskets and seals to ensure that they are in place before the cylinder head is lowered. This is a very important check. Gaskets and seals which are not seated properly will cause leaks and "blow-by" and result in poor engine performance and damage to the engine.

1. Apply a small amount of International Compound No.2, or equivalent, to threads and underside of the head of all cylinder head attaching bolts (1).
2. Wipe the bottom of the head clean. Lower the head over the guide studs.
3. Install a bolt thru each piloting sleeve at the corners of the head and thread them finger tight into the cylinder block. Continue to tighten these bolts (fingertight) as the head is lowered into position on the cylinder block.

NOTE

Cylinder head bolts are especially designed for this purpose and must not be replaced by ordinary bolts.

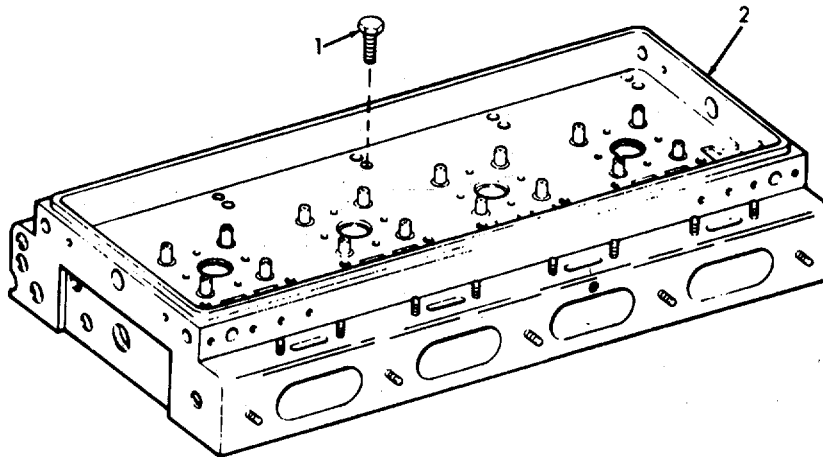
3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

4. After the head is in place, remove the guide studs and install the remaining bolts.

5. Tighten bolts to 175-185 lb-ft (238-251 Nm) torque, one-half turn at time, in sequence shown. Begin on cam follower side of head to take up tension in push rod springs. Tighten bolts to high side of torque specification, but do not exceed limit or bolts may stretch beyond their elastic limits. Attempting to tighten bolts in one step may result in trouble and consequent loss of time in diagnosis and correction of difficulties, such as compression leaks, when engine is put into operation.



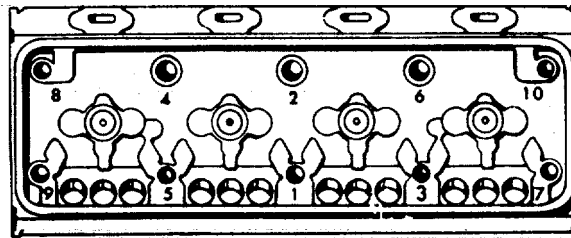
3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

NOTE

Tightening the cylinder head bolts will not correct a leaking compression gasket or seal. The head must be removed and the damaged gasket or seal replaced.



4-CYLINDER ENGINE CYLINDER HEAD

- | | | | |
|----|--------------------------|---|---|
| a. | Fuel injectors | Install. | Refer to paragraph 3-147. |
| b. | Exhaust valve bridges | Adjust. | Refer to paragraph 3-165.2. |
| c. | Rocker arm bracket bolts | Install. | Refer to paragraph 3-162.1 |
| d. | Fuel pipes | Align and connect them to the fuel injectors and fuel connectors. | Tighten to 12 - 15 lb-ft (16 - 20 Nm) torque. |

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



Do not bend the fuel pipes and do not exceed the specified torque. Excessive tightening will twist or fracture the flared ends of the fuel pipes and result in leaks. Lubricating oil diluted by fuel oil can cause serious damage to the engine bearings.

- | | |
|-----------------------------------|---|
| e. Injector control tube assembly | <ol style="list-style-type: none"> 1. Set the injector control tube assembly in place on the cylinder head and install the attaching bolts finger tight. When positioning the control tube, be sure the ball end of each injector rack control lever engages the slot in the corresponding injector control rack. With one end of the control tube, return the spring hooked around an injector rack control lever and the other end hooked around a control tube bracket. Tighten the bracket bolts to 10-12 lb-ft (14-16 Nm) torque. 2. After tightening the bolts, revolve the injector control tube to be sure the return spring pulls the injector racks out (no-fuel position) after they have been |
|-----------------------------------|---|

3-164.1. CYLINDER HEAD - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
		<p>moved all the way in (full-fuel position). Since the injector control tube is mounted in self-aligning bearings, tapping the tube lightly will remove any binding that may exist. The injector racks must return to the no-fuel position freely by aid of the return spring only. Do not bend the spring. If necessary, replace the spring.</p>	
	f. Fuel rods	Install.	Refer to paragraph 3-142.
	g. Fuel lines	Connect.	Refer to paragraph 3-146.
	h. Thermostat and housing	Install.	Refer to paragraph 3-153.
	i. Water manifold	Install.	Refer to paragraph 3-152.
	j. Water by-pass tube, hoses, and clamps	Install.	
	k. Exhaust manifold	Install.	Refer to paragraph 3-160.

3-164.1. CYLINDER HEAD - MAINTENACE INSTRUCTIIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont.)

NOTE

Fill lubrication system and cooling system. Start engine and perform necessary adjustments.

3-164.2. FUEL INJECTOR TUBE - MAINTENACE INSTRUCTIONS

LOCATION	ITEM	ACTION	REMARKS
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The bore in the cylinder head for the fuel injector is directly through the cylinder head water jacket. To prevent coolant from contacting the injector and to still maintain maximum cooling of the injector, a tube is pressed into the injector bore. This tube is sealed at the top with a neoprene ring and set into a flare on the lower side of the cylinder head to create water-tight and gas-tight joints at the top and bottom.

This task covers:

a. Removal

b. Cleaning

c. Installation

INITIAL SETUP

Test Equipment
None

References
None

Special Tools

Injector tube service tool
Kit J22525 (consisting of tool J5286)
Torque wrench

Equipment Condition	Condition Description
Paragraph	

3-164	Cylinder Head Removal
-------	-----------------------

Material/Parts
None

Special Environmental Conditions
None

Personnel Required
1

General Safety Instructions
Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

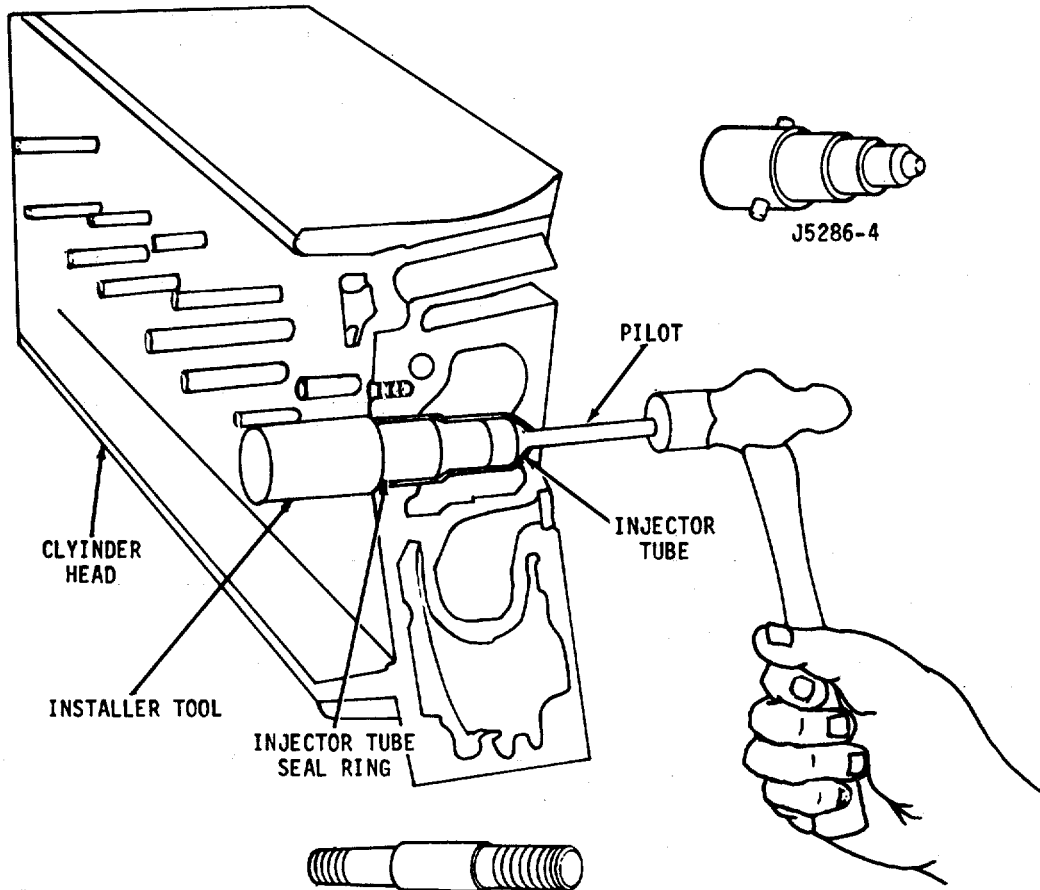
- | | | | | |
|----|---------------|--------------|---------------------------------|---------------------------|
| 1. | Cylinder head | Head | Remove, disassemble, and clean. | Refer to paragraph 3-164. |
| 2. | Injector tube | a. Installer | Place in injector tube. | Use tool J-5286-4. |

3-164.2. FUEL INJECTOR TUBE - MAINTENACE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont.)

- | | | | |
|----|-------------------------------------|---|--------------------|
| b. | Pilot | Insert through small opening of the injector tube and screw the pilot into the tapped hole in the end of the installer. | Use tool J-5286-5. |
| c. | Pilot | Tap on end of pilot to loosen the injector tube. | |
| d. | Injector tube, installer, and pilot | Remove from cylinder head. | |



3-164.2. FUEL INJECTOR TUBE - MAINTENACE INSTRUCTIONS (Continued).

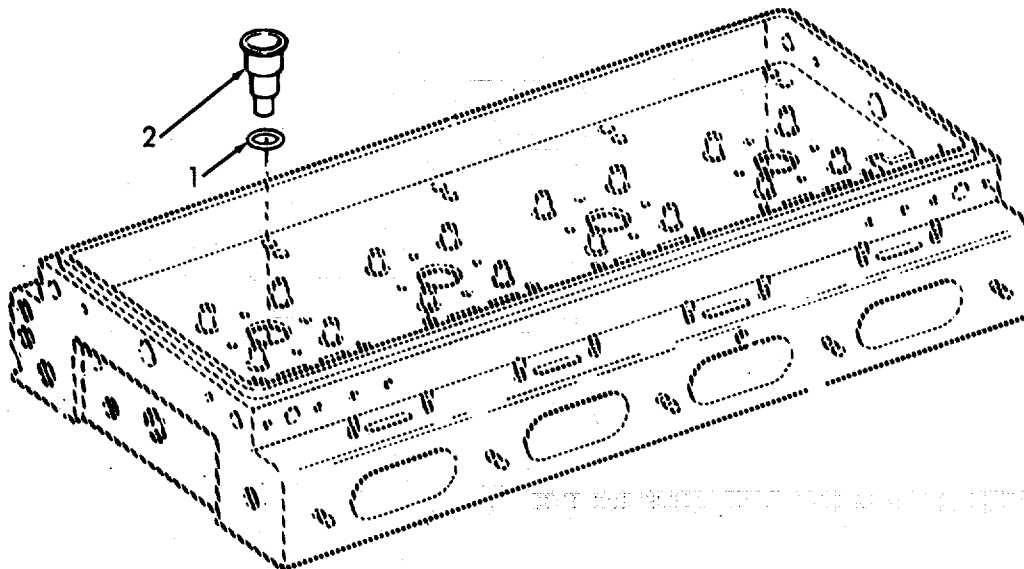
LOCATION	ITEM	ACTION	REMARKS
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CLEANING

- | | | | |
|----|---------------------------------------|--|--|
| 3. | Injector tube hole (in cylinder head) | Thoroughly clean the hole to remove dirt, burrs, or foreign material that may prevent injector tube from seating at the upper end. | |
|----|---------------------------------------|--|--|

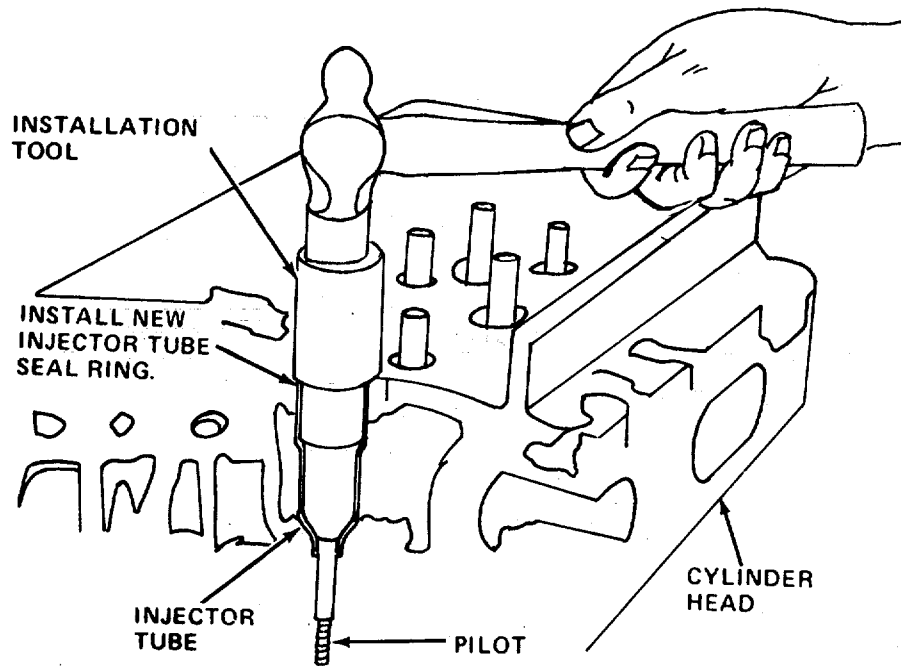
INSTALLATION

- | | | | |
|----|---------------|--------------------------------|---|
| 4. | Injector tube | a. Injector tube seal ring (1) | Place in counterbore in cylinder head. |
| | | b. Installer | Place in injector tube Use tool J5286-4. (2). |



3-164.2. FUEL INJECTOR TUBE - MAINTENACE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont.)			
	c. Pilot	Insert a small opening of the injector tube and screw into the tapped end of the installer.	Use tool J5286-5.
	d. Injector tube, pilot and installer	Place in injector bore, and drive it into place.	Sealing is accomplished between the head counterbore (inside diameter) and outside diameter of the injector tube. The tube flange is used to retain the seal ring.



3-164.2. FUEL INJECTOR TUBE - MAINTENACE INSTRUCTIONS (Continued).

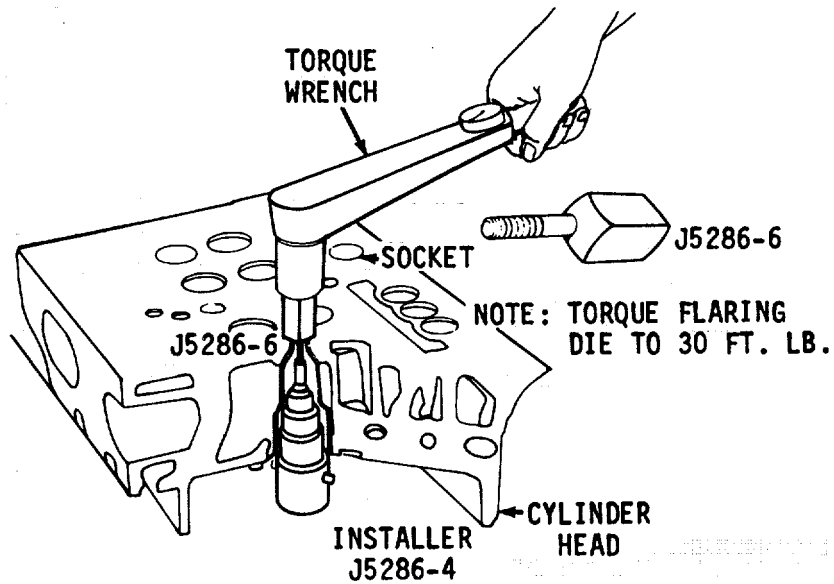
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont.)

NOTE

With the injector tube properly positioned in the cylinder head, upset (flare) the lower end of the injector tube.

- | | | | |
|--------------------|--|--|-------------------|
| e. Cylinder head | Turn bottom side up. | | |
| f. Pilot (J5286-5) | Remove. | | |
| g. Upsetting die | 1. Screw into tapped end of installer. | | Use tool J5286-6. |



3-164.2. FUEL INJECTOR TUBE - MAINTENACE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont.)			
		2. Use a socket and torque wrench.	Apply approximately 30 lb-ft (40.7 Nm).
		3. Remove installing tools.	
5.	Injector tube (reaming)	After an injector tube has been installed in a cylinder head, it must be finished in three operations: First, <u>hand reamed</u> , to receive the injector body nut and spray tip; second, <u>spot faced</u> to remove excess stock at the lower end of the injector tube; and third, <u>hand reamed</u> to provide a good seating surface for the bevel or the lower end of the injector nut. Reaming must be done carefully and without undue force or speed so as to avoid cutting through the thin wall of the injector tube.	

NOTE

The reamer should be turned in a clockwise direction only - both when inserting, and when withdrawing the reamer - because movement in the opposite direction will dull the cutting edges of the flutes.

3-164.2. FUEL INJECTOR TUBE - MAINTENACE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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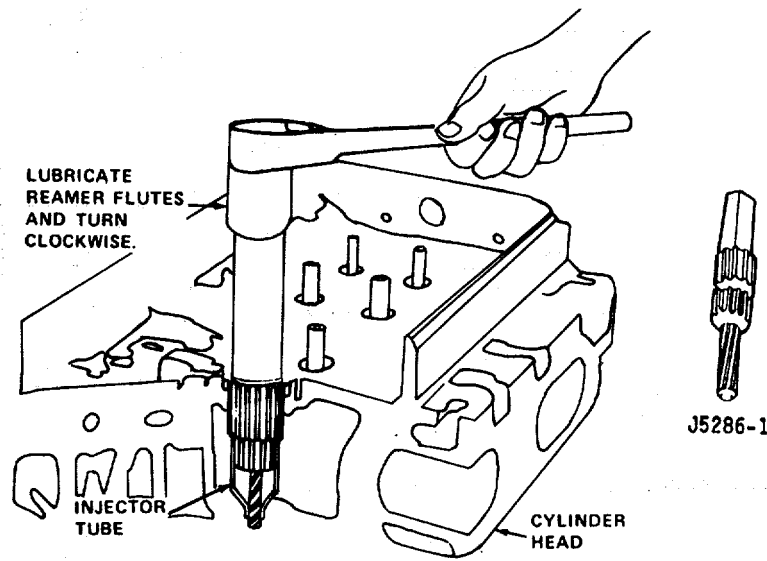
INSTALLATION (Cont.)

a. Hand reaming

Ream the injector tube for the injector nut and spray tip. With the cylinder head right side up and the injector tube free from dirt, proceed with the first reaming operation as follows:

1. Place a few drops of light cutting oil on the reamer flutes. Then carefully position the reamer in the injector tube.
2. Turn the reamer in a clockwise direction (withdrawing the reamer frequently for removal of chips), until the lower shoulder of the reamer contacts the injector tube. Clean out all of the chips.

Use tool J5286-1.



3-164.2. FUEL INJECTOR TUBE - MAINTENACE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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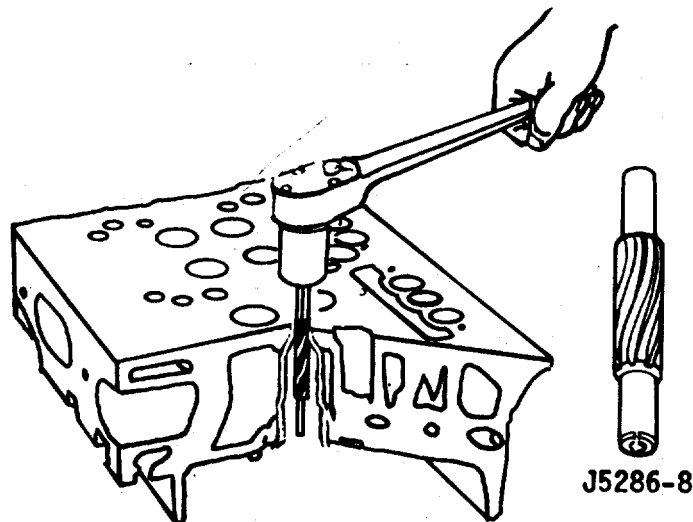
INSTALLATION (Cont.)

b. Spot facing

Remove excess stock:

1. With the cylinder head bottom side up, insert the pilot of cutting tool into the small hole of the injector tube.
2. Place a few drops of cutting oil on the tool. Then, using a socket and a speed handle, remove the excess stock so that the lower end of the injector tube is from flush to .005 inch (0.0127 cm) below the finished surface of the cylinder head.

Use tool J5286-8.



3-164.2. FUEL INJECTOR TUBE - MAINTENACE INSTRUCTIONS (Continued)

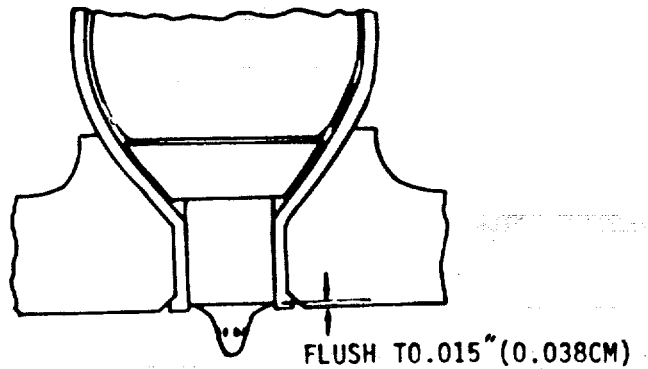
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont.)

c. Hand reaming

Ream the bevel seat in the injector tube:

The tapered lower end of the injector tube must provide a smooth and true seat for the lower end of the injector nut to effectively seal the cylinder pressures and properly position the injector tip in the combustion chamber. Therefore, to determine the amount of stock that must be reamed from the bevel seat of the tube, the injector assembly should be installed in the tube and the relationship between the numbered surface of the spray tip to the firedeck of the cylinder head noted.



3-164.2. FUEL INJECTOR TUBE - MAINTENACE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont.)

WARNING

Wear protective eye goggles when using compressed air.

With the first reaming operation completed, and the injector tube spot-faced, wash the interior of the injector tube with trichloroethylene or clean fuel oil, and dry it with compressed air. Then perform the second reaming operation as follows:

1. Place a few drops of cutting oil on the bevel seat of the tube. Carefully lower the reamer into the injector tube until it contacts the bevel seat.
2. Make a trial cut by turning the reamer steadily without applying any downward force on the reamer. Remove the reamer, blow out the chips, and look at the bevel seat to see what portion of the seat has been cut.

Use tool J52869.

3-164.2. FUEL INJECTOR TUBE - MAINTENACE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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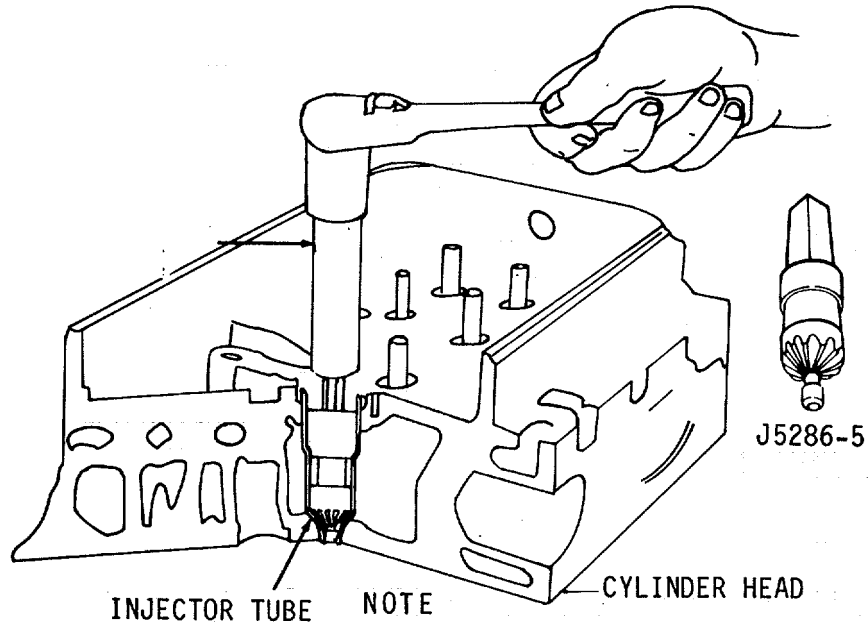
INSTALLATION (Cont.)

- Proceed carefully with the reaming operation, withdrawing the reamer occasionally to observe the reaming progress.

WARNING

Wear protective eye goggles when using compressed air.

- Remove the chips from injector tube, and using the injector as a gage, continue reaming until the shoulder of the spray tip is within the limits specified. Then, wash the interior of the injector tube with trichlorethylene or clean fuel oil and dry with compressed air.



To sharpen any reamers, use lapping tools.

3-165. VALVE AND INJECTOR OPERATING MECHANISM - EXHAUST VALVES -
 MAINTENANCE INSTRUCTIONS.

a. The valve and injector operating mechanism is located on the cylinder head.

b. Several operations may be performed on the valve and injector operating mechanism without removing the cylinder head from the block. These operations are:

(1) Rocker arm removal and installation. (Refer to paragraph 3-165.1).

(2) Rocker arm shaft or shaft bracket removal and installation. (Refer to paragraph 3-165.1).

(3) Fuel injector removal and installation. (Refer to paragraph 3-147).

c. It is also possible to remove or replace a push rod, push rod spring, spring seats or cam follower without removing the cylinder head. However, these parts are more easily changed from the lower side of the cylinder head when the head is off the engine. (Refer to paragraph 3-165.1).

d. Several operations may be performed on the exhaust valve mechanism without removing the cylinder head from the block. These operations are:

(1) Valve clearance adjustment. (Refer to paragraph 3-165.2).

(2) Exhaust valve bridge adjustment. (Refer to paragraph 3-165.2).

(3) Valve spring removal and installation. (Refer to paragraph 3-165.2).

(4) Exhaust valve bridge or bridge guide removal and installation. (Refer to paragraph 3-165.2).

e. In addition, the following operations require removal of the cylinder head. These operations are:

(1) Remove and install exhaust valves. (Refer to paragraph 3-165.2).

(2) Remove and install exhaust valve guides. (Refer to paragraph 3-165.2).

3-165.1. VALVE AND INJECTOR OPERATING MECHANISM - MAINTENANCE INSTRUCTIONS.

a. Three rocker arms are provided for each cylinder; the two outer arms operate the exhaust valves and the center arm operates the fuel injector.

b. Each set of three rocker arm assemblies pivot on a shaft supported by two brackets. A single bolt secures each bracket to the top of the cylinder head. The removal of the two bracket bolts permit the rocker arm assembly for one cylinder to be raised, providing easy access to the fuel injector and the exhaust valve springs.

c. The rocker arms are operated by a camshaft through cam followers and short push rods extending through each cylinder head.

d. Contact between each cam follower and the camshaft is done by a hardened roller having a pressed-in bushing, which runs on a pin in the lower end of the cam follower. Each cam follower operates in a bore in the cylinder head. A guide for each set of three cam followers is attached to the bottom of the cylinder head to keep the cam follower rollers in line with the cams and to serve as a retainer during assembly and disassembly of the cylinder head.

e. A coil spring inside each cam follower is held in place in the cylinder head by a spring seat and spring seat retainer.

f. The valve and injector operating mechanism is lubricated by oil from a longitudinal oil passage on the camshaft side of the cylinder head, which connects with the main oil gallery in the cylinder block. Oil from this passage flows through drilled passages in the rocker shaft bracket bolts, to the passages in the rocker arm shaft to lubricate the rocker arms.

g. Overflow oil from the rocker arms lubricate the exhaust valves, valve bridges and cam followers. The oil then drains from the top deck of the cylinder head through oil holes in the cam followers, into the camshaft pockets in the cylinder block and back to the oil pan.

h. The cam follower rollers are lubricated with oil from the cam followers; oil picked up by the camshaft lobes and by oil emitted under pressure from milled slots in the camshaft intermediate bearings.

3-165.1. VALVE AND INJECTOR OPERATING MECHANISM - MAINTENANCE
INSTRUCTIONS (Continued).

This task covers:

- | | |
|------------------------|-----------------|
| a. Removal | c. Repair |
| b. Cleaning/Inspection | d. Installation |

INITIAL SETUP

Test Equipment
None

References
Paragraph

3-162 Injector Controls

Special Tools

- Fuel pipenut wrench
J1928-01
- Remover set pushrod
J 3092-01
- Service fixture cam
follower J5840-01
- Torque wrench

Equipment
Condition Condition Description
Paragraph

3-161	Rocker Arm Cover Removal
3-164.1	Cylinder Head Maintenance Instructions

Material/Parts
Cindol 1705

Special Environmental Conditions
None

Personnel Required
1

General Safety Instructions
Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL

- | | | | | |
|----|-----------------------------|-------------------------|--|------------------------|
| 1. | Rocker
shaft
assembly | a. Fuel
pipes
(1) | Remove from injector
and connections. | Use tool J1928-
01. |
|----|-----------------------------|-------------------------|--|------------------------|

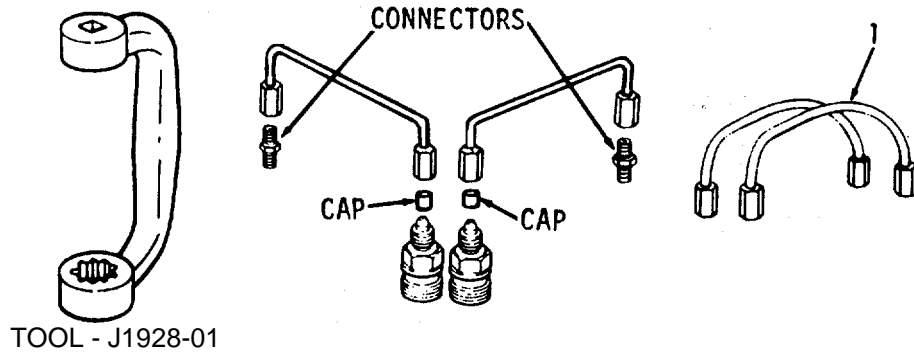


Immediately after removing the fuel pipes, cover the injector fuel inlet and outlet openings with shipping caps to prevent dirt or foreign material from entering the injector.

3-165.1. VALVE AND INJECTOR OPERATING MECHANISM - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont.)



b. Engine

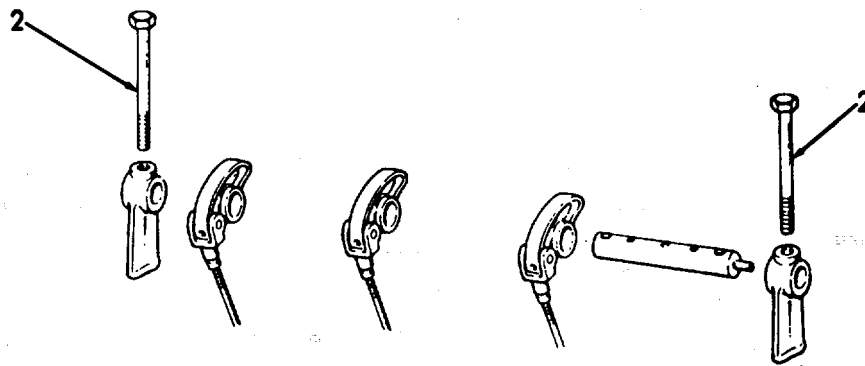
Turn the crankshaft, or crank the engine with starting motor to bring the injector and valve rocker arms line into horizontal.



Do not bar the crankshaft in a left-hand direction of rotation with a wrench or barring tool on the crankshaft bolt or the bolt may be loosened.

c. Bolts
(2)

Remove.



3-165.1. VALVE AND INJECTOR OPERATING MECHANISM - MAINTENANCE
INSTRUCTIONS (Continued).

REMOVAL (Cont.)

- | | |
|---|---------|
| d. Rocker shaft brackets (3), and shaft (4) | Remove. |
|---|---------|

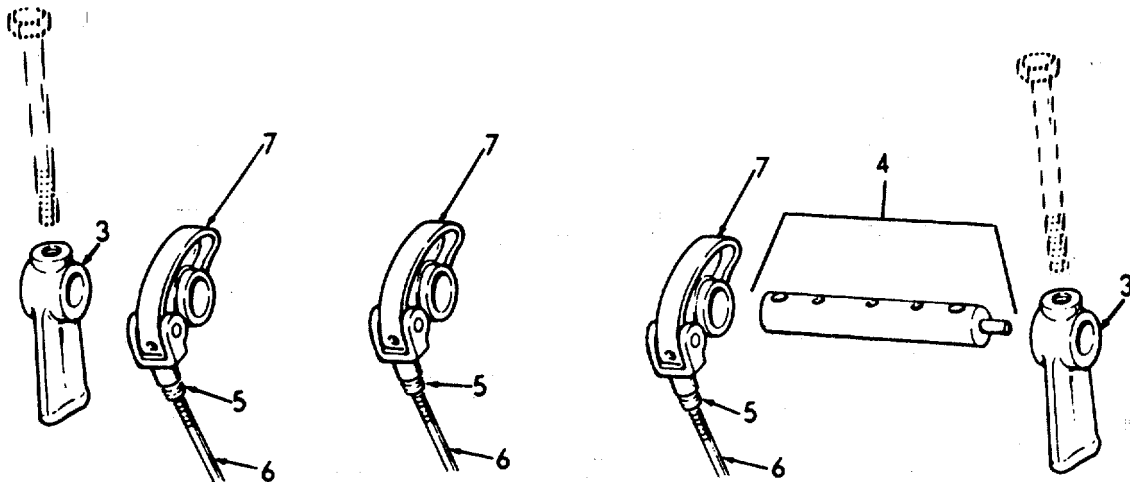


When removing the rocker arm shaft, fold the three rocker arms back just far enough so the shaft can be removed. Do not force the rocker arms all the way back with the shaft in place as this may impose a load that could bend the push rods.

- | | |
|-----------------|-------------------------------|
| e. Locknuts (5) | Loosen. |
| f. Pushrods (6) | Unscrew from rocker arms (7). |

NOTE

If the rocker arms and shafts from two or more cylinders are to be removed, tag them so they may be reinstalled in their original positions.



3-165.1. VALVE AND INJECTOR OPERATING MECHANISM - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL - CYLINDER HEAD ON ENGINE (Cont.)

2. Cam follower and pushrods

NOTE

When removing the cam followers and associated parts, tag them so they may be reinstalled in their original location.

- | | |
|-----------------|---------|
| a. Locknut, (5) | Remove. |
|-----------------|---------|

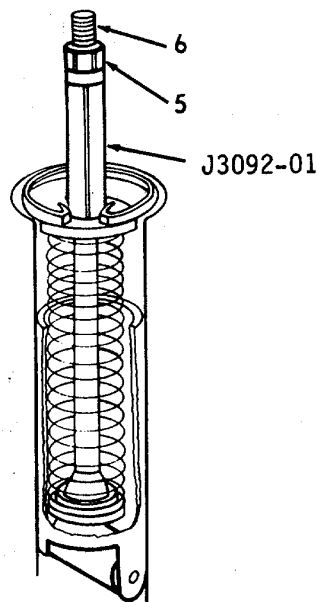
NOTE

Locknut cannot be removed until #6 or #7 is removed.

- | | |
|----------------|---|
| b. Pushrod (6) | Install remover J3092-01, a flatwasher and the locknut on the pushrod, with the lower end of tool resting on the upper spring seat. |
|----------------|---|

- | | |
|---------------------------------|------------------------------------|
| c. Pushrod (6), and locknut (5) | Screw nut down to compress spring. |
|---------------------------------|------------------------------------|

The push rod has milled flat sides, for ease of tightening.



3-165.1. VALVE AND INJECTOR OPERATING MECHANISM - MAINTENANCE
INSTRUCTIONS (Continued).

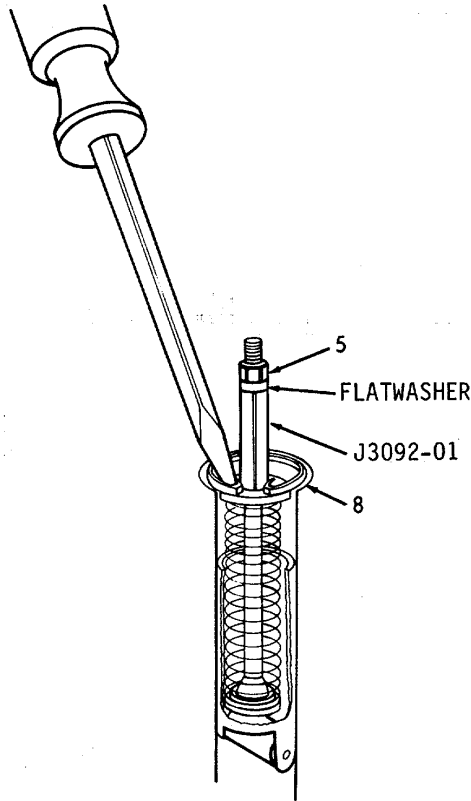
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL - CYLINDER HEAD ON ENGINE (Cont.)

d. Pushrod
retainer
(8)

Remove.

Use a screw-
driver to re-
lease retainer
from groove in
cylinder head.



e. Lock
nut
(5)

Remove.

Disassemble
tool J3092-01
and flat wash
Remove.

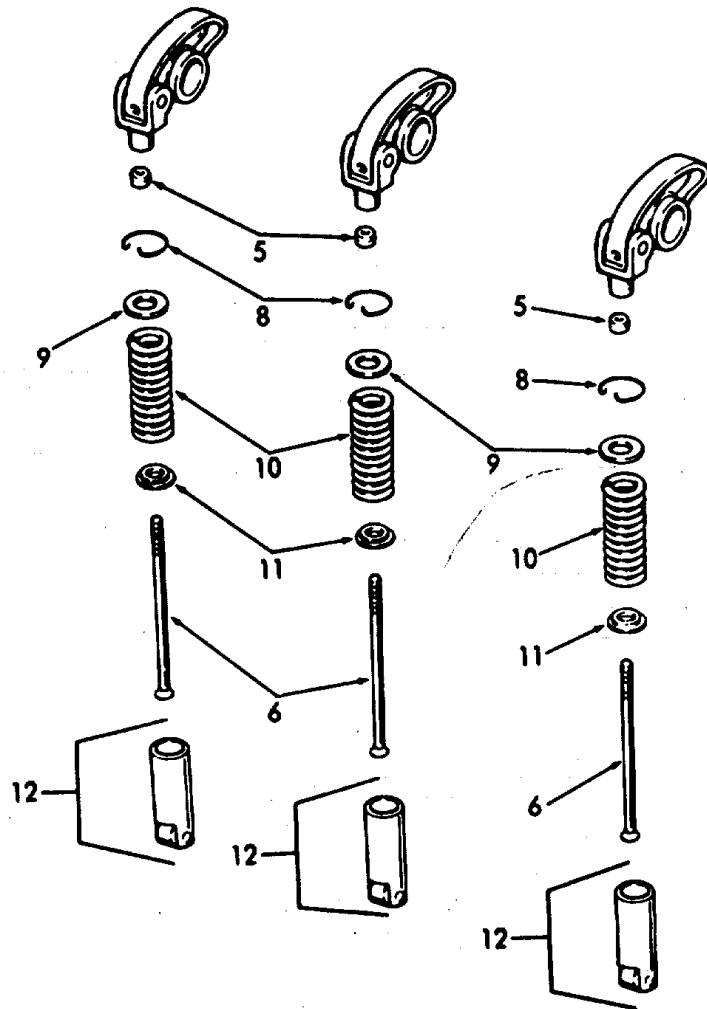
3-165.1. VALVE AND INJECTOR OPERATING MECHANISM - MAINTENANCE
INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL - CYLINDER HEAD ON ENGINE (Cont.)

- | | | |
|----|--|----------------------------|
| f. | Pushrod (6), upper spring seat (9), spring (10), lower spring seat (11), and cam follower (12) | Pull out of cylinder head. |
|----|--|----------------------------|

NOTE
Removal of Cam Follower
and Pushrod
(Cylinder Head Removed)



3-165.1. VALVE AND INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL - CYLINDER HEAD ON ENGINE (Cont.)

3. Cam follower and Pushrod

NOTE

When removing the cam followers and associated parts, tag them so they may be reinstalled in their original location.

- | | | |
|---------------------------------------|--------------------------------------|----------------------------------|
| a. Screws (13), and lock-washers (14) | Remove. | Rest cylinder head on its' side. |
| b. Cam follower guide (15) | Remove. | |
| c. Cam follower (12) | Pull out of cylinder head. | |
| d. Fuel pipes (1) | Remove from injector and connectors. | |



Immediately after removing the fuel pipes, cover injector fuel inlet and outlet openings with shipping caps to prevent direct or foreign material from entering.

- | | | |
|-----------------------------------|------------------------------------|--|
| e. Locknut (5) | Loosen. | |
| f. Pushrod (6) | Unscrew from rocker arm (7). | |
| g. Pushrod (6), upper spring seat | Pull from bottom of cylinder head. | |

3-165.1. VALVE AND INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS
(Continued).

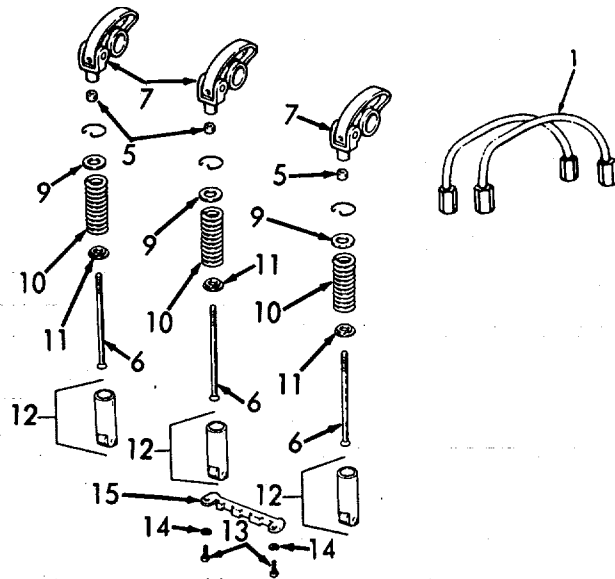
LOCATION	ITEM	ACTION	REMARKS
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REMOVAL - CYLINDER HEAD ON ENGINE (Cont.)

- | | | |
|----|--|-------------|
| | (9), spring (10), and lower spring seat (11) | |
| h. | Locknut (5), pushrod (6), upper spring seat (9), spring (10), and lower spring seat (11) | Disassemble |

NOTE

If the cylinder head is to be replaced, remove the spring retainers (8) and install them in new head.



NOTE

Removal of Cam Follower and Pushrod
(Cylinder Head Removed)

3-165.1. VALVE AND INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING AND INSPECTION



Wear protective eye goggles when using compressed air.

- | | | |
|----|-----------------------|---|
| 4. | Rocker shaft assembly | <ul style="list-style-type: none"> a. Wash the rocker arms, shaft, brackets and bolts with clean fuel oil. Use a small wire to clean out drilled oil passages in the rocker arms and rocker shaft bolts. Dry the parts with compressed air. b. Inspect the rocker arm shaft and rocker arm bushings. A maximum shaft bushing clearances of .004 inch (0.010 cm) is allowable with used parts. Service replacement bushings must be reamed to size after installation. c. Inspect the rocker arms for galling or wear on the pallets (valve or injector contact surfaces). If worn, the surface may be refaced up to a maximum of .010 inch (0.025 cm). However, proceed with caution when surface grinding to avoid overheating the rocker arm. Maintain the radius and finish as close to the original surface as possible. Inspect the valve bridges for wear. |
| 5. | Cam follower | <ul style="list-style-type: none"> a. Proper inspection and service of the cam follower is very necessary to obtain continued efficient engine performance. When any appreciable change in injector timing or exhaust valve clearance occurs during engine operation, remove the cam |

3-165.1. VALVE AND INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING AND INSPECTION (Cont.)

followers and their related parts and inspect them for excessive wear. This change in injector timing or valve clearance can usually be detected by excessive noise at idle speed.

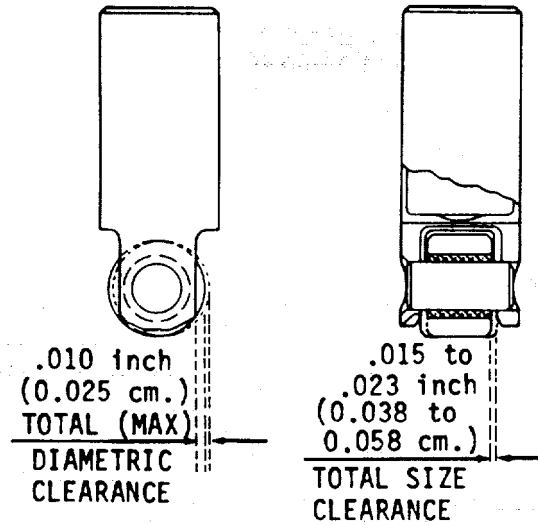
- b. Wash the cam followers with lubricating oil or Cindol 1705 and wipe dry. Do not use fuel oil. Fuel oil working its way in between the cam roller bushing and pin may cause scoring on initial startup of the engine since fuel oil does not provide adequate lubrication. The pushrods, springs and spring seat may be washed with clean fuel oil and dried with compressed air.
- c. Examine the cam follower rollers for scoring, pitting or flat spots. The rollers must turn freely on their pins. Measure the total diametric clearance and side clearance. Install a new roller and pin if the clearances exceed those shown below. Cam followers stamped with the letter "S" on the pin, roller and follower body are equipped with an oversize pin and roller. The same clearance apply to either a standard or oversize cam follower assembly.

3-165.1. VALVE AND INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING AND INSPECTION (Cont.)

- d. Examine the camshaft lobes for scoring, pitting or flat spots. Replace the camshaft if necessary. Refer to Direct Support Maintenance.



- e. Check the cam follower-to-cylinder head clearance. The clearance must not exceed $.006 \text{ inch}$ (0.015 cm) with used parts.
- f. Examine the cam follower bores in cylinder head to make sure they are clean, smooth and free of score marks. If necessary, clean up the bores.

- 6. Push rods and spring seats Inspect for wear.

3-165.1. VALVE AND INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING AND INSPECTION (Cont.)

- | | | | |
|-------------------------|--|--|--|
| 7. Cam follower springs | Examine the cam follower springs for wear or damage. Check the spring load. Replace a spring when a load of less than 172 lbs (765 N) will compress it to a length of 2.125 inch (5.398 cm). | | |
|-------------------------|--|--|--|

REPAIR

8. Cam follower



Do not attempt to bore out the legs of a standard cam follower for an oversize pin.

Cam follower (12)

- a. Clamp fixture J5840 securely in a vise. Place the cam follower in the groove in the top of the fixture with the follower pin resting on top of the corresponding size plunger in the fixture.
- b. Drive the pin from the roller with a suitable drive. Exercise caution in removing the cam follower body and roller from the fixture as the roller pin is seated on a spring-loaded plunger in the fixture.

3-165.1. VALVE AND INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)

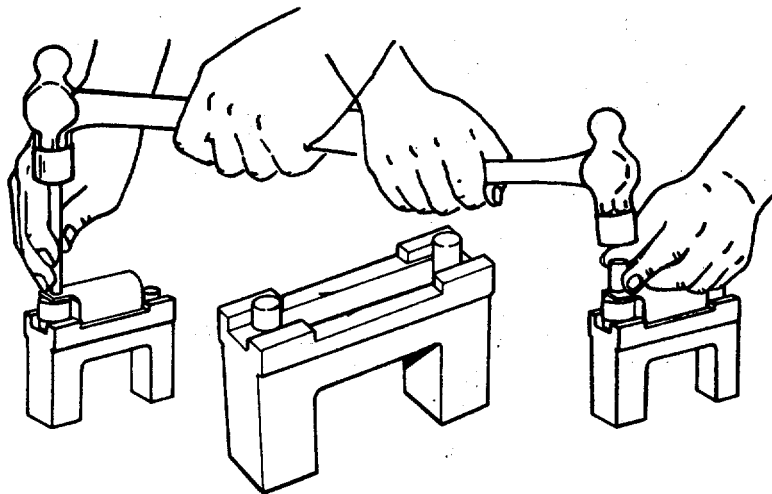
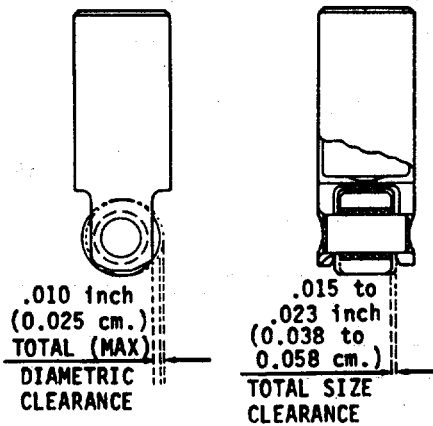
- c. Before installing the new roller pin, remove the preservative by washing the parts with clean lubricating oil or Cindol 1705 and wipe dry. Do not use fuel oil. After washing the parts, lubricate the roller and pin with Cindol 1705.
- d. Position the cam follower body in the groove of the fixture, with the small plunger extending through the roller pin hole in the lower leg of the follower body.
- e. Position the new cam roller in the cam follower body. When released, the plunger will extend into the roller bushing and align the roller with the cam follower body.
- f. Start the new pin in the cam follower body. Carefully tap it in until it is centered in the cam follower body.

3-165.1. VALVE AND INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)

- g. Remove the cam follower from the fixture and check the side clearance. The clearance must be .015 to .023 inch (0.038 to 0.058 cm).



3-2781

3-165.1. VALVE AND INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont.)

NOTE

- If new cam follower assemblies are to be installed, remove the preservative by washing with Cindol 1705 and wipe dry. Do not use fuel oil.
- Before cam followers are installed, immerse them in clean Cindol 1705 (heated to 100-125°F or 38-52°C) for at least one hour to ensure initial lubrication of the cam roller pins and bushings. Rotate the cam rollers during the soaking period to purge any air from the bushing-roller area. The heated Cindol oil results in better penetration as it is less viscous than engine oil and flows more easily between the cam roller bushing and pin. After the cam followers are removed from the heated Cindol 1705, the cooling action of any air trapped in the bushing and pin area will tend to pull the lubricant into the cavity.
- Heat the Cindol 1705 in a small pail with a screen insert. The screen will prevent the cam followers from touching the bottom of the pail and avoid the possibility of contamination.

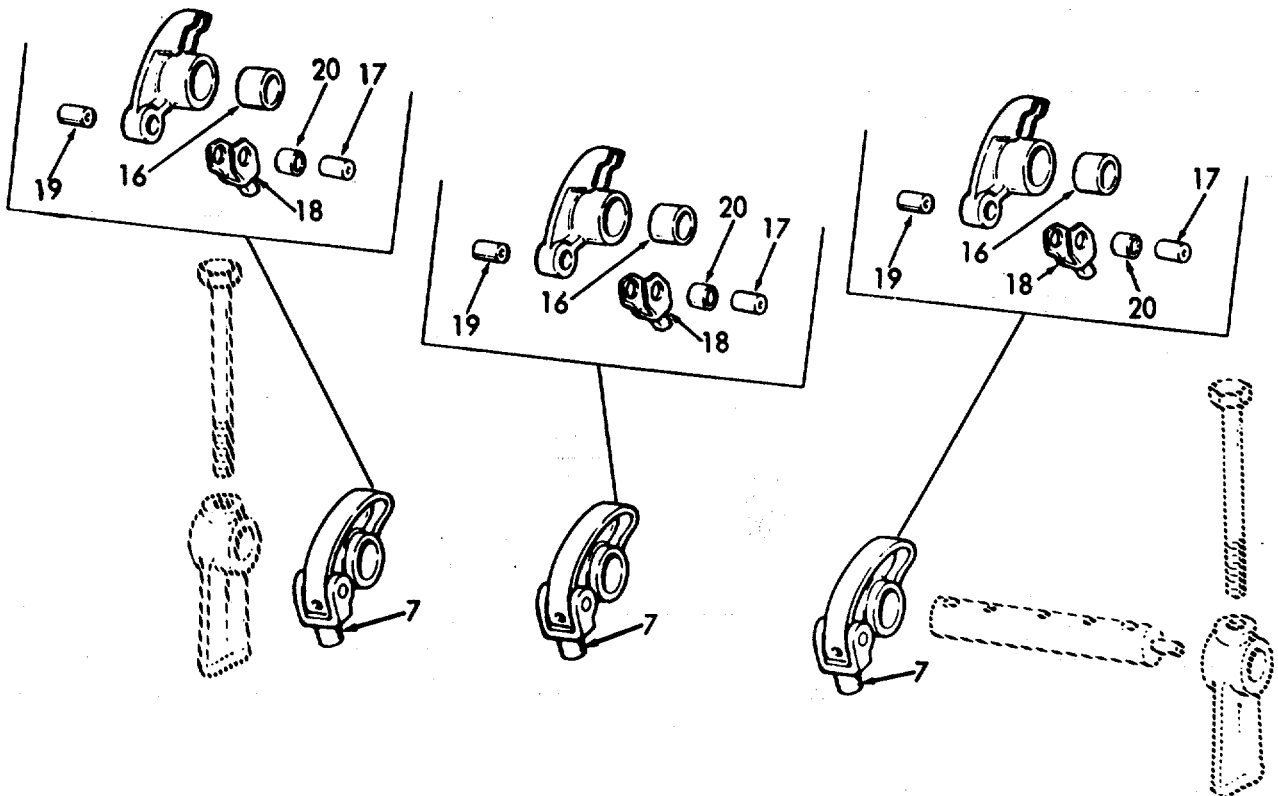
9. Rocker arm assembly (7)	a. Rocker arm large bushing (16)	Press out of rocker arm.
	b. Clevis pin (17)	Press out of rocker arm.
	c. Clevis (18)	Remove.
	d. Rocker arm small bushing (19)	Press out of rocker arm.

3-165.1. VALVE INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (Cont)

- | | |
|----------------------------------|------------------------|
| e. Clevis bushing (20) | Press out of clevis. |
| f. Clevis bushing (20) | Press into clevis. |
| g. Rocker arm small bushing (19) | Press into rocker arm. |

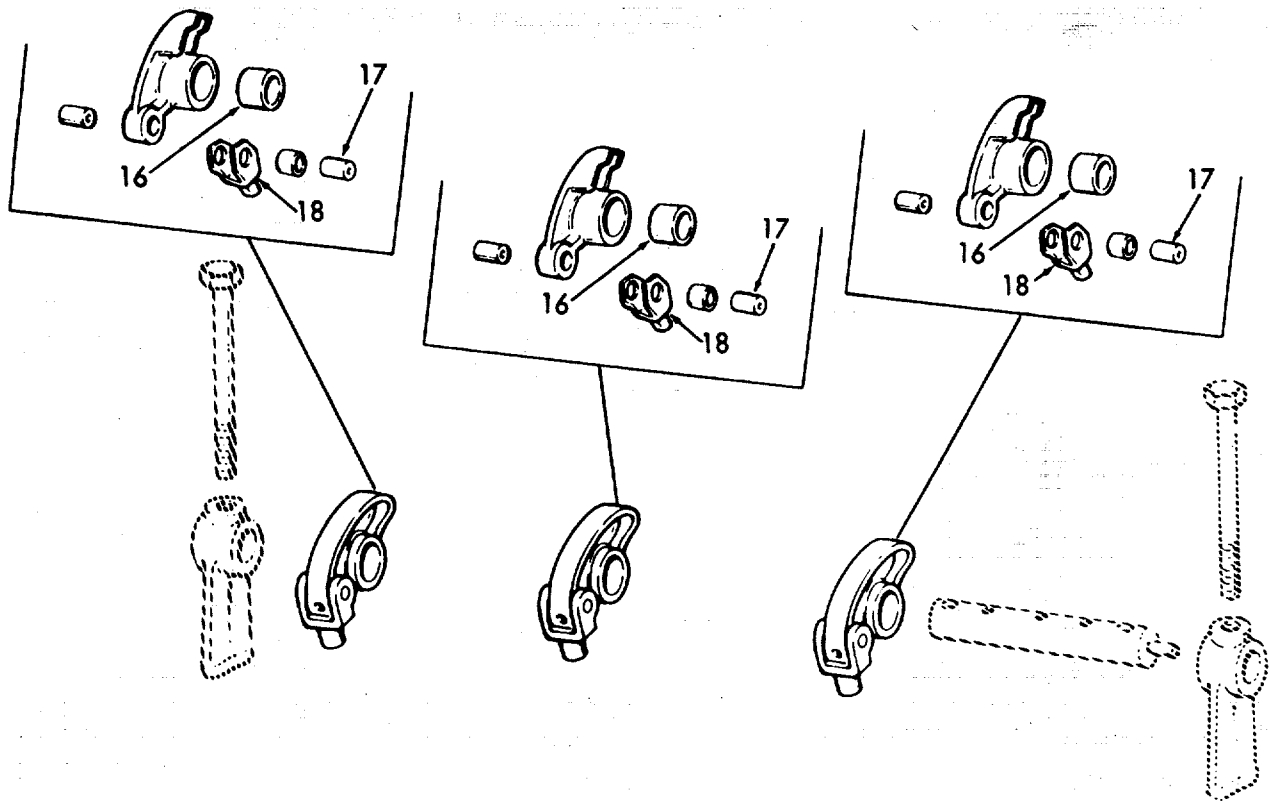


3-165.1. VALVE INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REPAIR (cont)

- | | |
|----------------------------------|-----------------------------------|
| h. Clevis (18) | Assemble. |
| i. Clevis pin (17) | Press into clevis and rocker arm. |
| j. Rocker arm large bushing (16) | Press into rocker arm. |

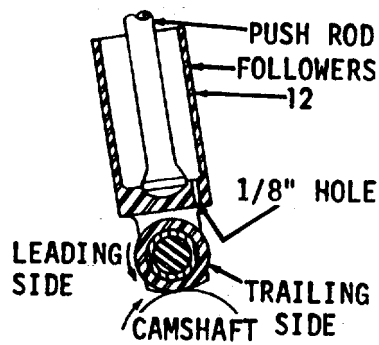


3-165.1. VALVE INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD ON ENGINE

10. Cam follower and push rod	a. Cam follower (12)	Slide into cylinder head.	Note the oil hole in the bottom of the cam follower. The oil hole should be directed away from the exhaust valve.
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3-2785

3-165.1. VALVE INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD ON ENGINE (Cont)			
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- | | | | |
|--|--|--|--------------------------------|
| | b. Lower spring seat (11), spring (10), upper spring seat (9), and pushrod (6) | Assemble. | Lower spring seat is serrated. |
| | c. Flat-washer and locknut (5) | Place a flatwasher over the upper spring seat and start the locknut on the pushrod. Place tool J3092-01 on the pushrod between the washer and the upper spring seat, and place the pushrod assembly into the cam follower. Then thread the locknut onto the pushrod (6) until the spring is compressed sufficiently to permit the spring retainer to be installed. | |
| | d. Retainer (8) | Install with tangs facing the notch in the cylinder head. | |
| | e. Locknut and flat-washer (5) | Remove. | Remove tool J3092-01. |

3-165.1. VALVE INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS (Continued).

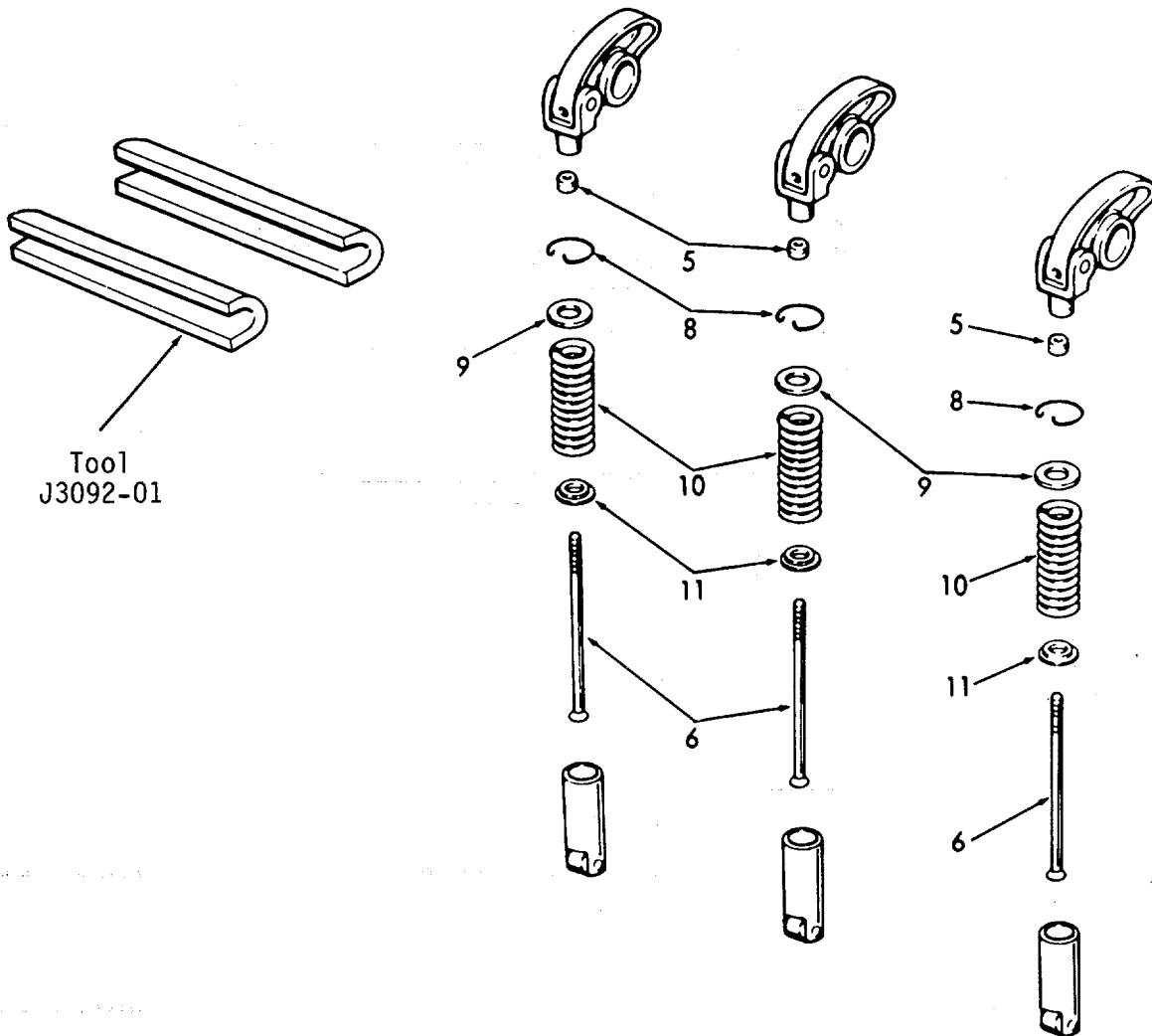
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD ON ENGINE (Cont)

f. Locknut and flat-washer (5)

Reinstall. far as possible onto the push-rod (6).

Thread it as



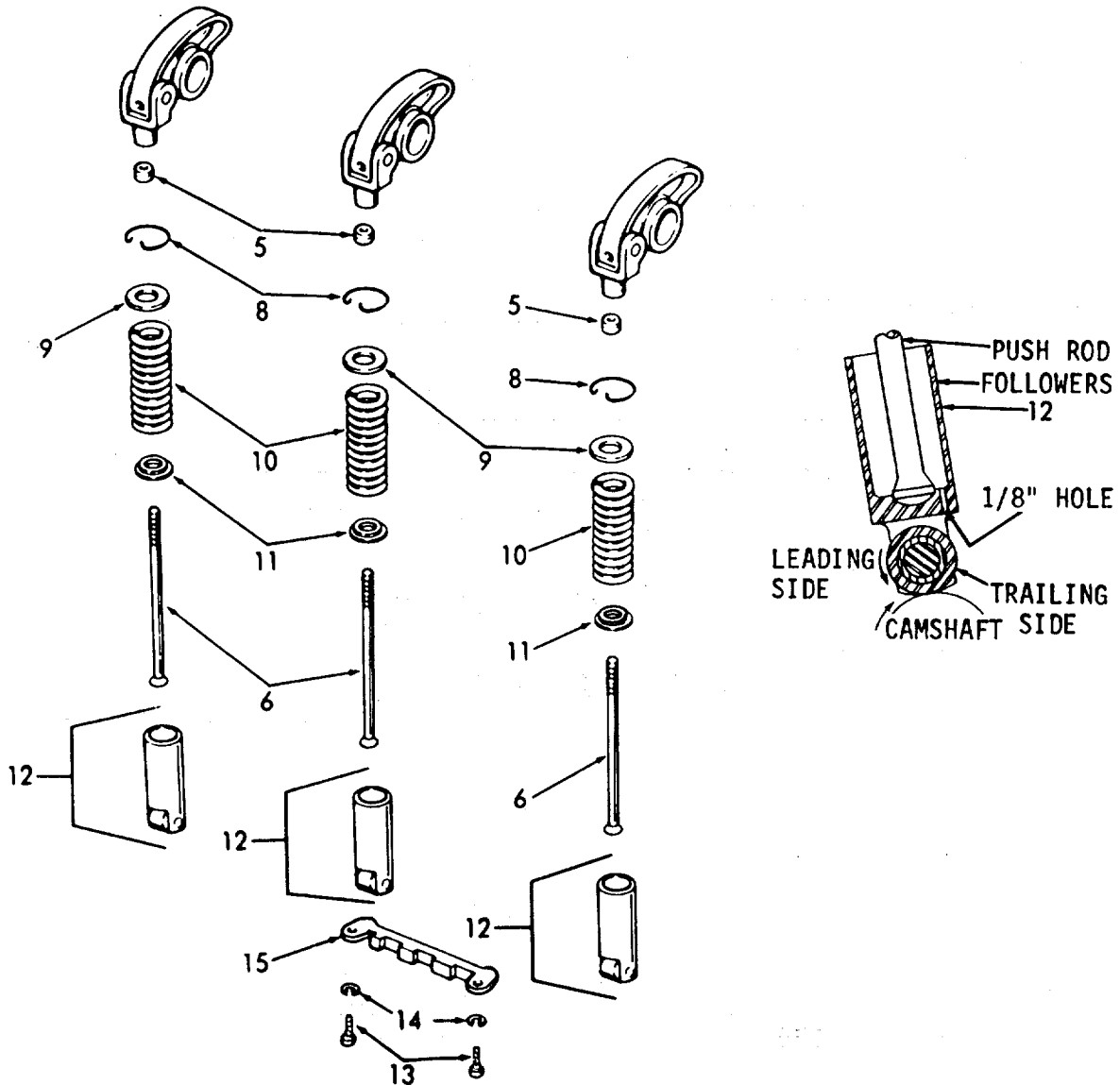
3-165.1. VALVE INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION - CYLINDER HEAD REMOVED FROM ENGINE			
11. Cam follower and Pushrod	a. Lower spring seat (11), spring (10), upper spring seat (9), pushrod (6), and locknut (5)	Assemble.	Lower spring seat is serrated.
	b. Retainer (8)	Install with tangs facing the notch in cylinder head.	
	c. Pushrod assembly	Slide in position from bottom of the head.	
	d. Cam follower (12)	Slide into cylinder head from bottom of the head.	Note oil hole in bottom of cam follower. Oil hole should be directed away from the exhaust valve.
	e. Screws (13), lock-washers (14), and cam follower guide (15)	Reassemble.	Guide holds the group of three cam followers in place. Make sure there is clearance between cam followers and cam follower guide. Tighten guide bolts to 12-15 lb-ft (16-20 Nm) torque.

3-165.1. VALVE INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD REMOVED FROM ENGINE (Cont)



3-165.1. VALVE INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
12.	Rocker shaft assembly	<p style="text-align: center;">NOTE</p> <p>The injector rocker arm (center arm of the group), is slightly different from the exhaust valve rocker arms; the boss for the shaft on the left and righthand valve rockers arms is longer on one side. The extended boss of each valve rocker arm must face toward the injector rocker arm.</p>	
	a. Rocker arm (7), and pushrod (6)	Thread each rocker arm on its pushrod until the end of pushrod is flush with, or above, the inner side of the clevis yoke.	Provide sufficient initial clearance between the exhaust valve and the piston when the crankshaft is turned during the valve clearance adjustment procedure.
	b. Rocker arm shaft (4), and rocker arm (7)	Assemble.	Apply clean engine oil to the rocker arm shaft and slide the shaft through the rocker arms.
	c. Bracket (3)	Assemble on shaft.	Finished face of bracket next to rocker arm.
	d. Bracket bolts (2)	Install.	Torque to 90-100 ft-lb (122-136 Nm) torque.

3-165.1. VALVE INJECTOR MECHANISM.- MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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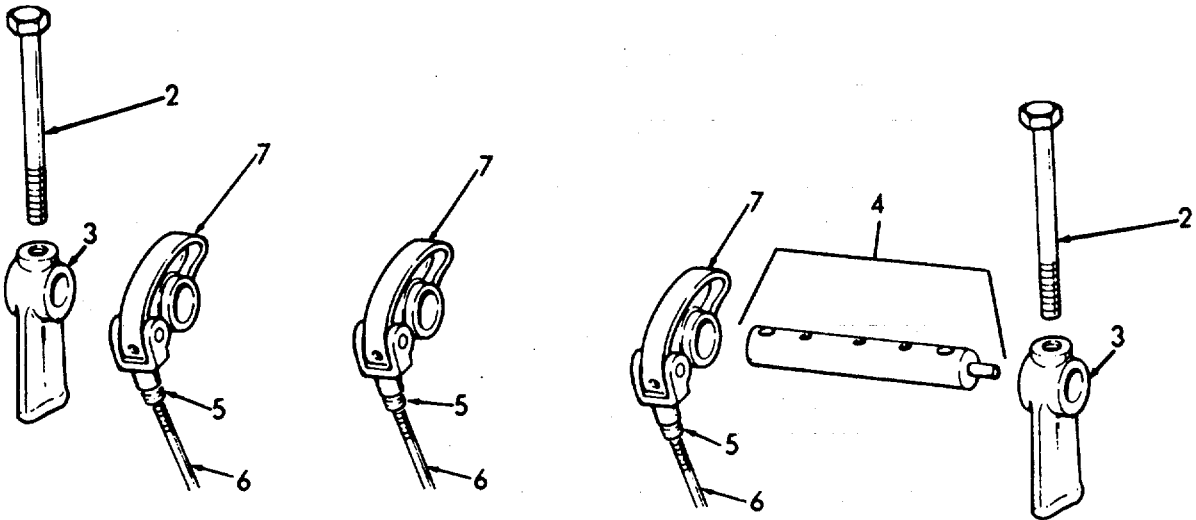
INSTALLATION (Cont)

NOTE

Bracket bolts go through the bracket and the shaft.

e. Caps on injectors and connectors

Remove.



3-2791

3-165.1. VALVE INJECTOR MECHANISM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

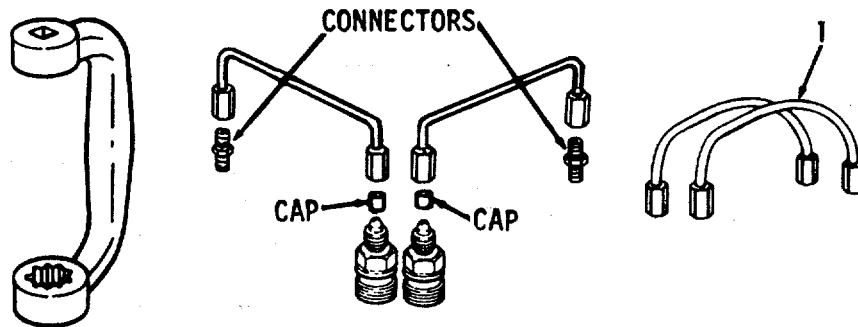
CAUTION

Immediately after removing the caps, install the fuel pipes. This prevents dirt and foreign material from entering the injector.

f. Fuel pipes (1)

Align and install.

Torque the fuel pipe nuts to 12-15 lb-ft. (16-20 Nm) torque.



CAUTION

Do not bend the fuel pipes and do not exceed the specified torque. Excessive tightening will twist or fracture the flared ends of the fuel pipes and result in leaks. Lubricating oil diluted by fuel oil can cause serious damage to the engine bearings.

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS.

a. General.

(1) Four exhaust valves are provided for each cylinder. The valve heads are heat-treated and ground to the proper seat angle and diameter, and the valve stems are ground to size and hardened at the end which contacts the rocker arm or exhaust valve bridge.

(2) Pre-finished, replaceable valve guides, are pressed into the cylinder head. Reaming of these guides is unnecessary.

(3) Exhaust valve seat inserts pressed into the cylinder head permit accurate seating of the exhaust valves under varying conditions of temperature and materially prolongs the life of the cylinder head. The inserts are ground to very close limits and the freedom from warpage, under ordinary conditions, reduces valve reconditioning to a minimum. The exhaust valves and valve seat inserts are ground to a 30° angle.

(4) The exhaust valve springs are held in place by the valve spring caps and tapered two-piece valve locks.

(5) Excess oil from the rocker arms lubricates the exhaust valve stems. The valves are cooled by the flow of air from the blower past the valves each time the air inlet ports are uncovered.

b. Exhaust Valve Clearance Adjustment.

Correct valve clearance adjustment is important for proper operation of the engine. Too little clearance between the exhaust valve stem and the rocker arm causes loss of compression, mis-firing cylinders, and eventual burning of the valves and valve seat inserts. Too much clearance results in noisy operation of the engine, especially in the idling speed range.

c. Exhaust Valve Maintenance.

(1) Efficient combustion in the engine requires that the exhaust valves be maintained in good operating condition. Valve seats must be true and unpitted to assure leakproof seating. Valve stems must work freely and smoothly within the valve guides and the correct valve clearances must be provided.

(2) Proper maintenance and operation of the engine is important to long valve life. Engine operating temperature should be maintained between 160° F and 185° F (71°C to 85°C). Low operating temperatures, usually due to extended periods of idling or light engine loads, result in incomplete combustion, formation of excessive carbon deposits and fuel lacquers on valves and related parts, and a greater tendency for lubricating oil to sludge.

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

c. Exhaust Valve Maintenance (Cont)

(3) Lubricating oil and oil filters should be changed periodically to avoid the accumulation of sludge. Use only good quality oil as specified for the engine.

(4) Unsuitable fuels may also cause formation of deposits on the valves, especially when operating at low temperatures.

(5) When carbon deposits, due to partially burned fuel, build-up around the valve stems and extend to that portion of the stem which operates in the valve guide, sticking valves will result. Thus, the valves cannot seat properly, and pitted and burned valves and valve seats and loss of compression will result.

(6) Valve sticking may also result from valve stems which have been scored due to foreign matter in the lubricating oil, leakage of anti-freeze (glycol) into the lubricating oil which forms a soft, sticky carbon and gums the valve stems, and bent or worn valve guides. Sticking valves may eventually result in valves being held in the open position, being struck by the piston and becoming bent or broken.

(7) It is highly important that injector timing and valve clearance be accurately adjusted and inspected periodically. Improperly timed injectors will have adverse effects upon combustion. Tightly adjusted valves will cause rapid pitting of the valve seats and a hotter running condition on the valve stems.

(8) The cylinder head must first be removed before the exhaust valves, valve seat inserts, or valve guides can be removed for replacement or reconditioning. However, the valve springs may be removed without removing the cylinder head, if necessary.

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

This task covers:

- | | |
|---------------|-----------------|
| a. Removal | c. Installation |
| b. Inspection | d. Adjustment |

INITIAL SETUP

Test Equipment

Micrometers and gages

References

None

Special Tools

Compressor valve springs
J7455-7
Installer valve seat
insert J6568
Remover valve seat
insert J6567-02
Feeler gage

Equipment

Condition Condition Description
Paragraph

3-147	Fuel Injector Removal
3-161	Rocker Arm Cover Removal
3-162	Fuel Injector Controls
3-164.1	Cylinder Head Maintenance Instructions
3-165.1	Valve and Injector Operating Instructions

Material/Parts

Gasket kit P/N 5193114

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL - CYLINDER HEAD ON ENGINE

- | | | | | |
|----|----------------------|---|---------|----------------------------|
| 1. | Exhaust valve spring | a. Rocker arm cover | Remove. | Refer to paragraph 3-161. |
| | | b. Valve and injector operating mechanism | Remove. | Refer to paragraph 3-165.1 |

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

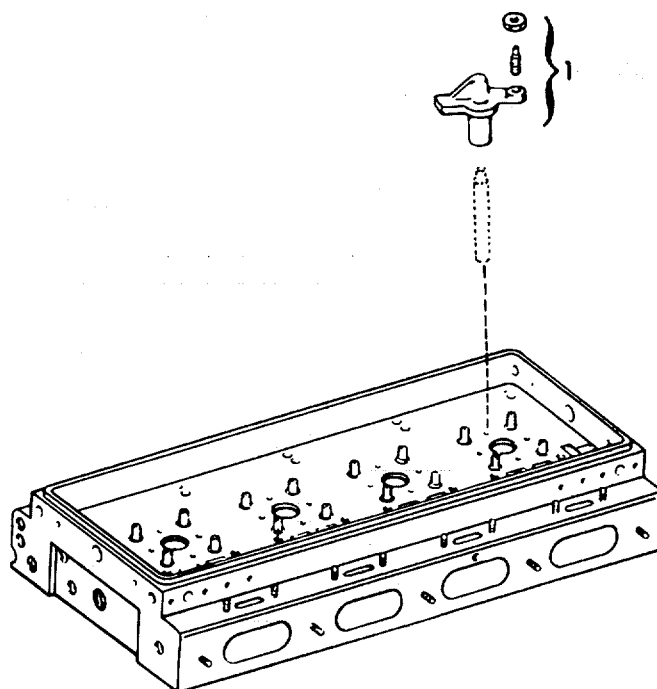
LOCATION	ITEM	ACTION	REMARKS
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REMOVAL - CYLINDER HEAD ON ENGINE

CAUTION

Immediately after removing the fuel pipes, cover each injector opening with a shipping cap to prevent dirt or other foreign matter from entering the injector.

c. Exhaust valve bridges (1)	Remove. move.	Lift up to re-
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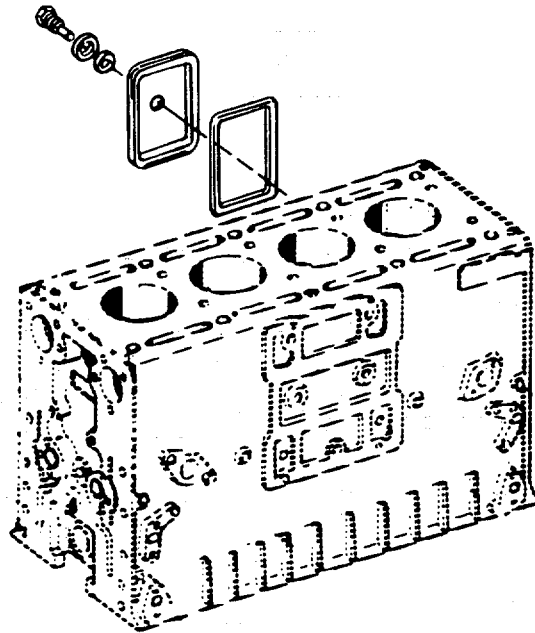


d. Air box cover	Remove nuts, lock-washers, flatwashers, cover and gasket.	Discard gasket.
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3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL - CYLINDER HEAD ON ENGINE (Cont)			
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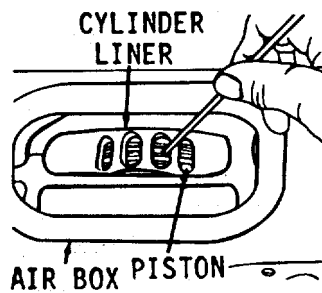
e. Piston

Observe piston while turning crankshaft.

Piston should be at top of its stroke.

NOTE

When using a wrench on the crankshaft bolt and at the front of the engine, do not turn the crankshaft in a left-hand direction of rotation or the bolt will be loosened.



3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL - CYLINDER HEAD ON ENGINE (Cont)

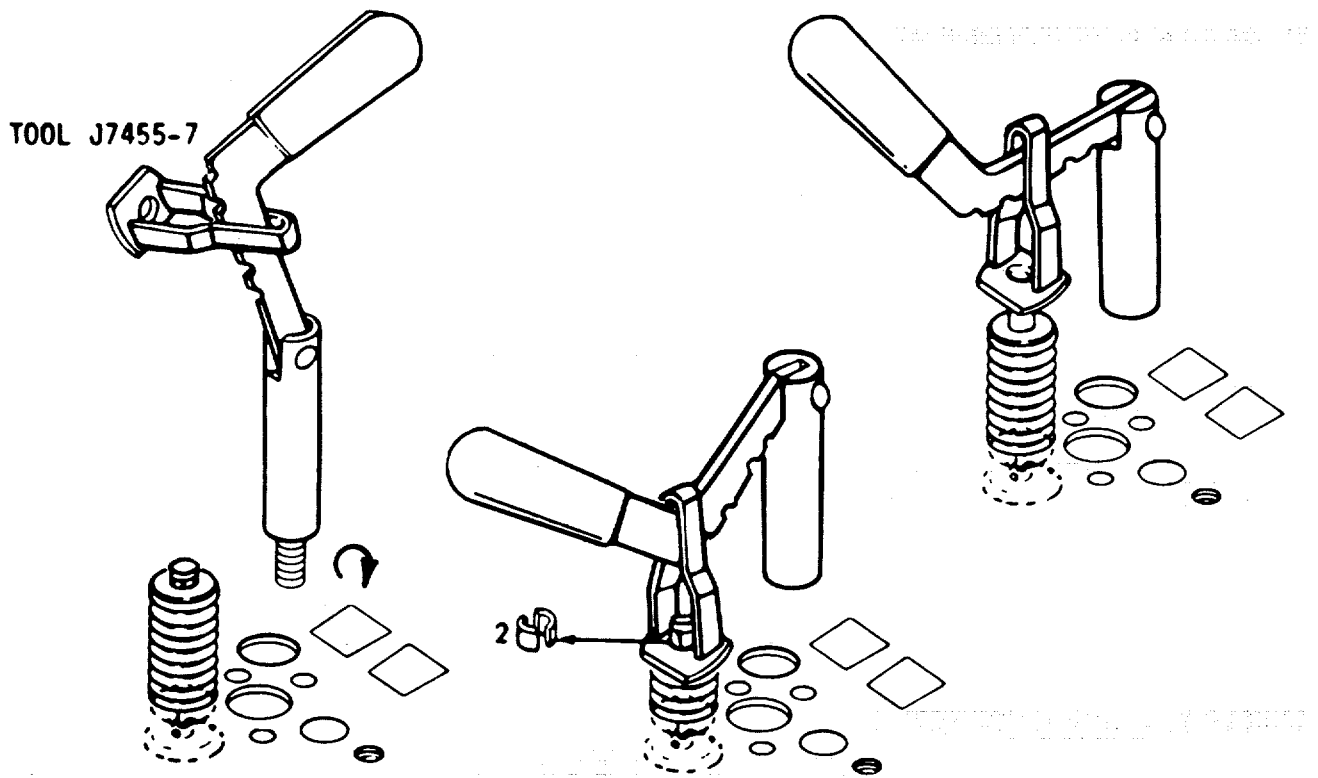
f. Valve spring compressor

Thread the valve spring compressor into the rocker shaft bolt hole in the cylinder head. Apply pressure to the end of the valve spring. Remove the two-piece tapered valve lock (2).

Use tool J7455-7.

g. Valve spring compressor

Raise slowly, then unscrew.

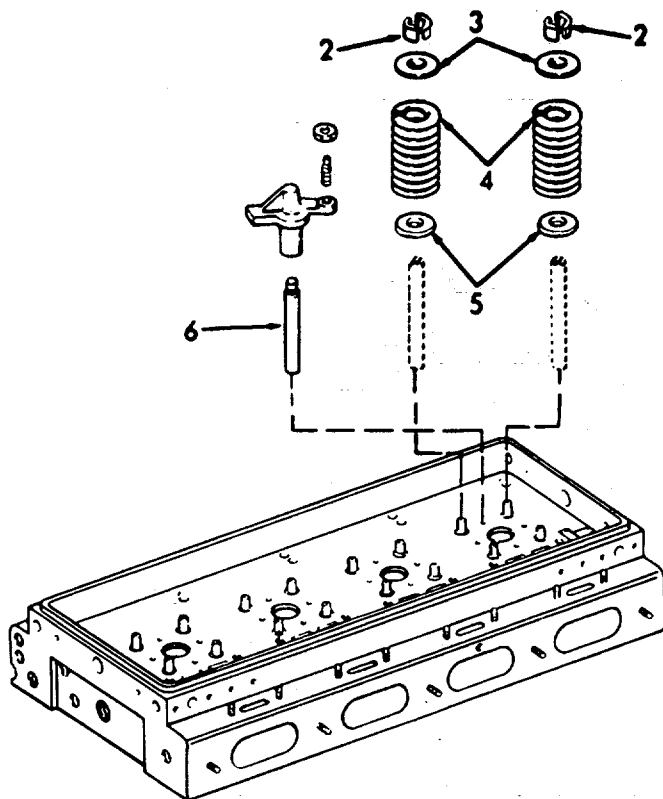


3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL - CYLINDER HEAD ON ENGINE (Cont)

	h. Spring cap (3), spring (4) and spring seat (5)	Remove.	
2.	Exhaust valve bridge guide (6)	<p>a. Remove.</p> <p>b. Drill a hole approximately 1/2 inch (1.27 cm) deep in the end of the guide with a No. 3 (.2130 inch) drill.</p>	Refer to paragraph 3-147.

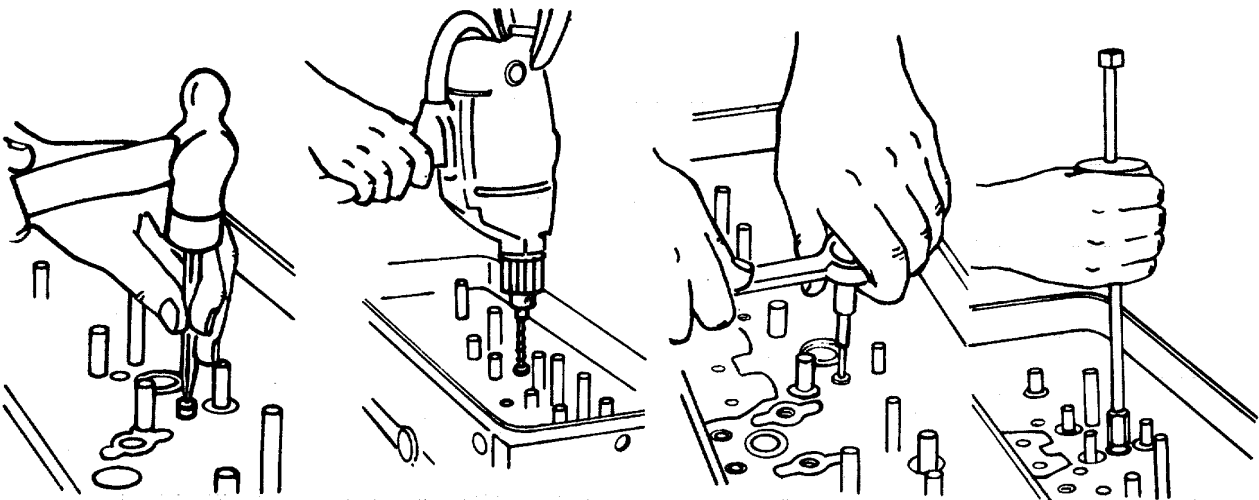


3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL - CYLINDER HEAD ON ENGINE (Cont)

- c. Tap the guide with a 1/4 inch-28 bottoming tap.
- d. Thread remover into guide and attach slide hammer to the remover tool.
- e. One or two sharp blows with the puller weight will remove the broken guide.



INSPECTION

WARNING

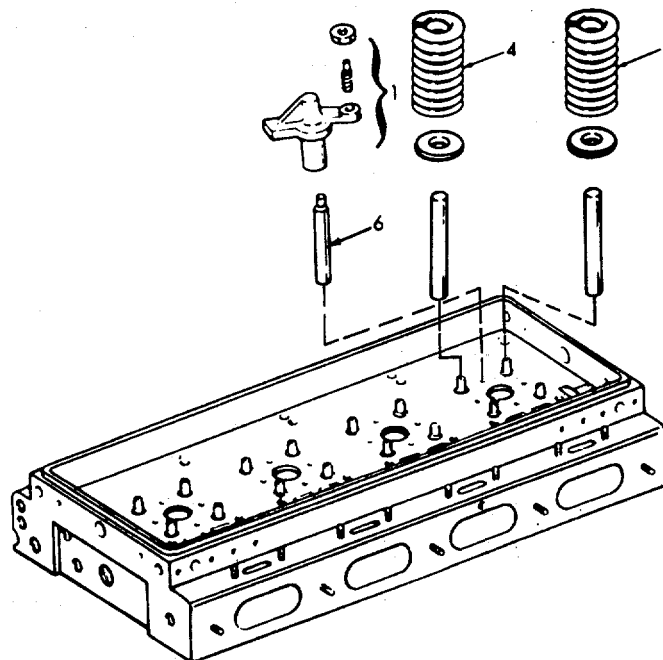
Wear protective eye goggles when using compressed air.

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)

- | | |
|--|---|
| <p>3. Exhaust valve spring (4)</p> | <p>a. Clean the spring with fuel oil and dry with compressed air. Inspect the spring for pitted or fractured coils. Use spring tester and an accurate torque wrench to check the spring load.</p> <p>b. The exhaust valve spring has an outside diameter of approximately 61/64 inch (2.4209 cm). Replace this spring when a load of less than 25 pounds (11.35 kg) will compress it to 1.80 inch (4.57 cm) (installed length).</p> <p>c. Inspect the valve spring seats and caps for wear. If worn, replace.</p> |
| <p>4. Exhaust valve bridge (1) and guide (6)</p> | <p>Inspect the valve bridge guide, valve bridge and adjusting screw for wear. Replace excessively worn parts.</p> |

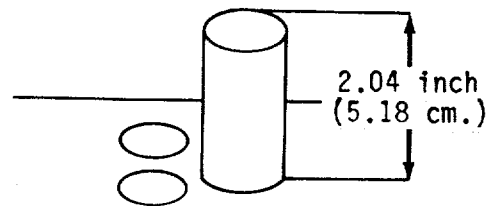
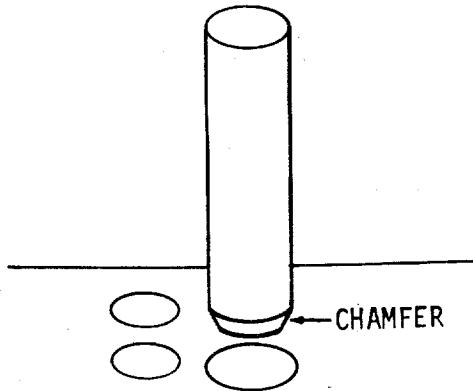


3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD ON ENGINE

- | | | | | |
|----|--------------------------------|-----------|--|--|
| 5. | Exhaust valve bridge guide (1) | Guide (6) | <p>a. Start guide straight into the cylinder head.</p> <p>b. Drive into place.</p> | <p>Chamfer end first.</p> <p>Height of guide shall be 2.04 inch (5.18 cm).</p> |
|----|--------------------------------|-----------|--|--|

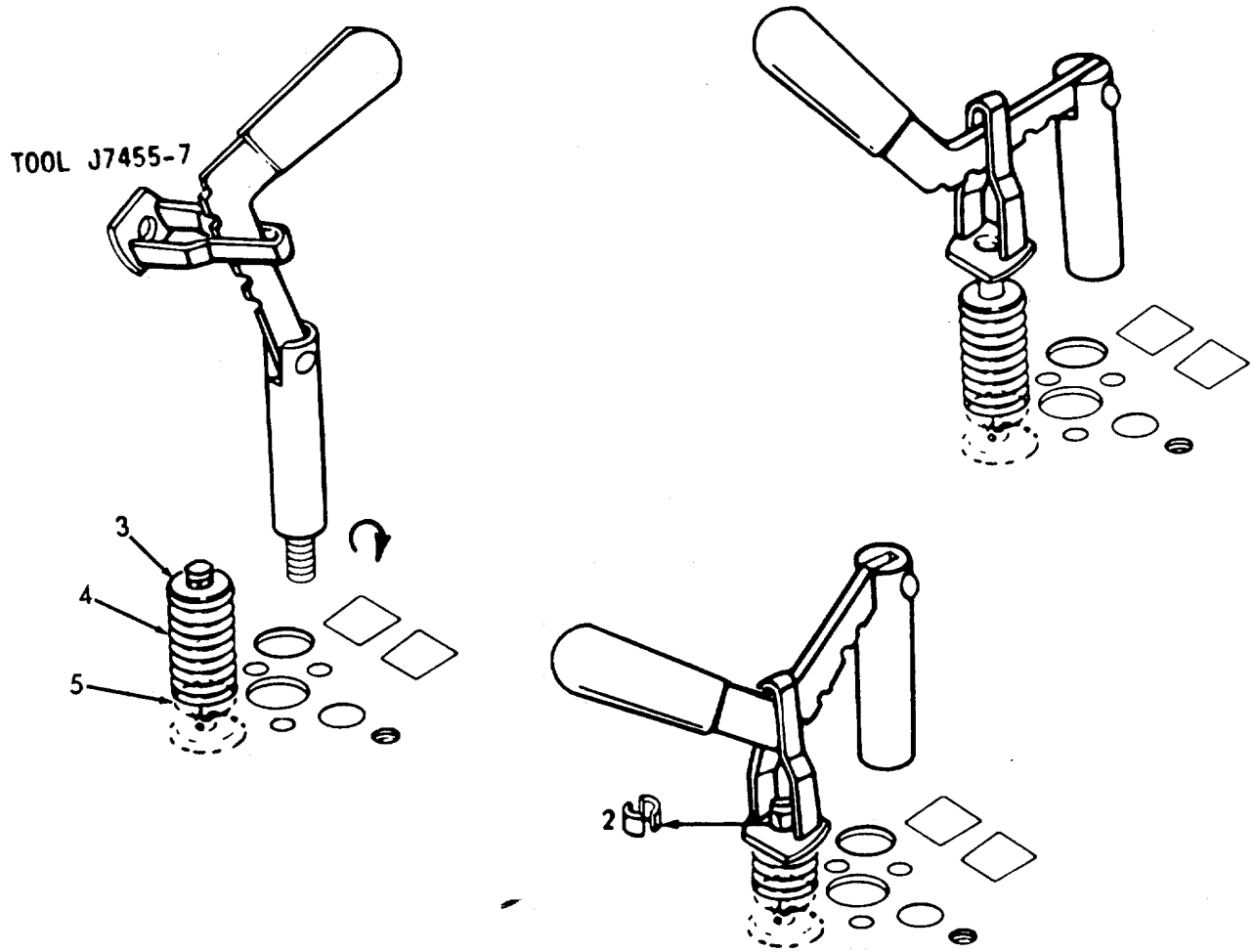


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|----|----------------------|---|--|--|
| 6. | Exhaust valve spring | <p>a. Spring seat (5), spring (4), and spring cap (3)</p> <p>b. Valve spring compressor</p> | <p>Place over valve stem.</p> <p>Thread the valve spring compressor into one of the rocker shaft bolt holes in the cylinder head.</p> <p>Apply pressure to the free end of the tool to compress the valve spring and install the two-piece tapered valve lock (2).</p> | <p>Use tool J7455-7.</p> <p>Exercise care to avoid scarring valve stem with the valve cap when compressing spring.</p> |
|----|----------------------|---|--|--|

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD ON ENGINE (Cont)



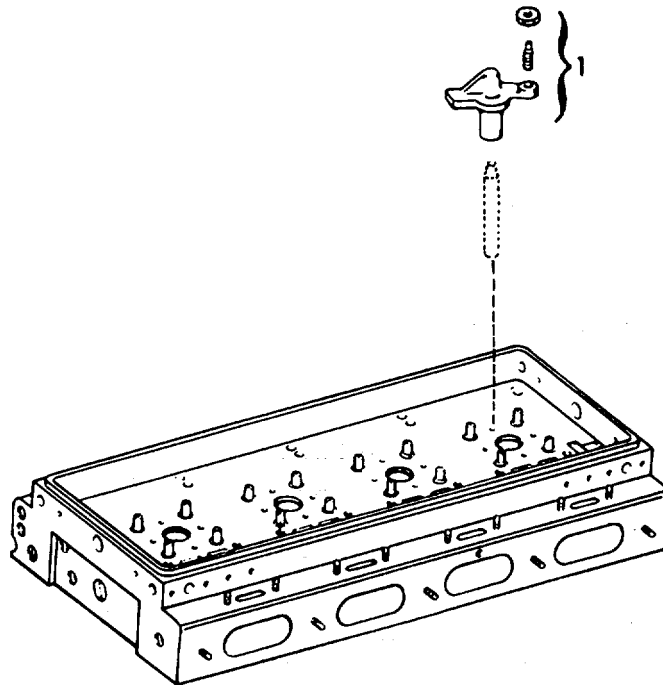
3-165.2.- EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION - CYLINDER HEAD ON ENGINE (Cont)			
	c. Air box covers	Install gasket, cover, lockwashers, nuts and flatwashers.	Use new gasket.
	d. Exhaust valve bridges (1)	Place on exhaust valve bridge guides.	Adjust. Refer to step 7.
	e. Valve and injector operating mechanism	Install.	Refer to para-
	f. Injector Install.		Refer to paragraph 3-147.
	g. Rocker arm cover	Install.	Refer to paragraph 3-161.

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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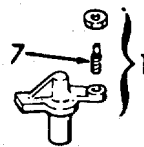
INSTALLATION - CYLINDER HEAD ON ENGINE (Cont)



ADJUSTMENTS

- 7. Exhaust valve bridge

The exhaust valve bridge assembly (1) is adjusted and the adjustment screw (7) is locked securely after the cylinder head is installed on the engine. Until wear occurs, or the cylinder head is reconditioned, no further adjustment is required on the valve bridge.



3-2805

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT (Cont)

A complete valve bridge adjustment is performed as follows:

- a. Place the valve bridge (8) in a vise and loosen the locknut (9) on the bridge adjusting screw (7).

CAUTION

Loosening or tightening the locknut with the bridge in place may result in a bent bridge guide or bent rear valve stem.

- b. Install in the valve bridge (1) on the valve bridge guide (6).
- c. While firmly pressing straight down on the pallet surface of the valve bridge (8), turn the adjusting screw (7) clockwise until it just touches the valve stem. Then, turn the screw an additional 1/8 to 1/4 turn clockwise and tighten locknut (9) finger-tight.
- d. Remove valve bridge (1) and place in a vise. Use a screwdriver to keep the adjustment screw (7) from turning and tighten the locknut (9) to 20-25 lb.ft. (27-34 Nm) torque.

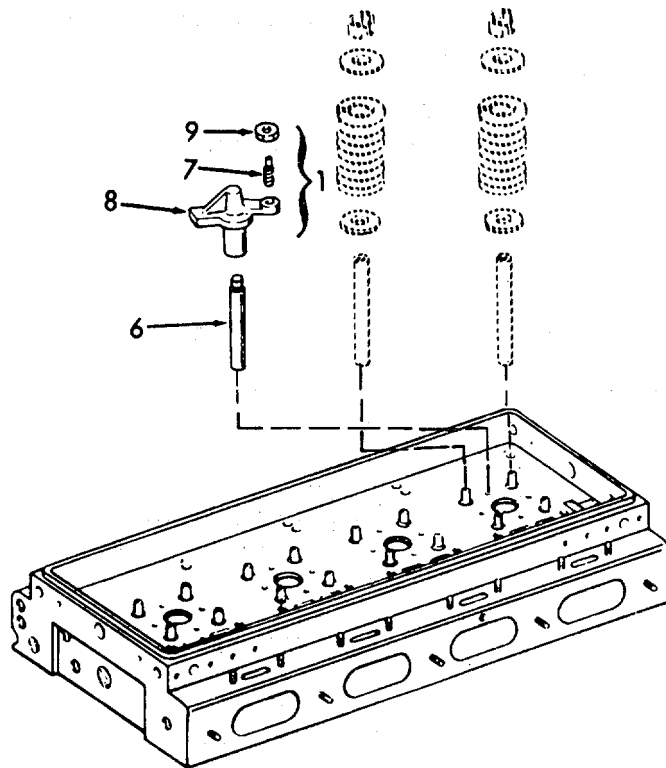
3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT (Cont)

e. Lubricate valve bridge guide (6) and the valve bridge (1) with engine oil.

f. Reinstall the valve bridge (1) into its ORIGINAL position.



3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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ADJUSTMENT (Cont)

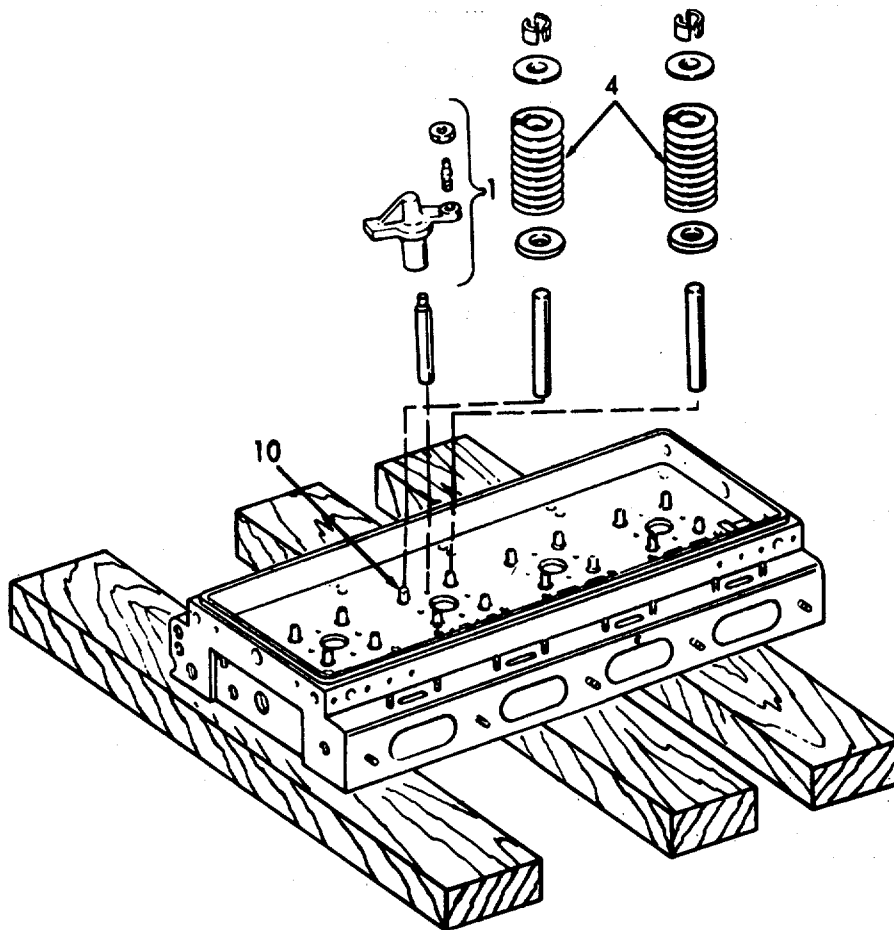
- g. Place a .0015 inch feeler gage under each end of the valve bridge, or use a narrow strip cut from .0015 inch feeler stock to fit in the bridge locating groove over the inner exhaust valve. While pressing down on the pallet surface of the valve bridge, both feeler gages must be tight. If both of the feeler gages are not tight, readjust the adjusting screw as outlined in steps c and d.
- h. Remove the valve bridge and reinstall it in its ORIGINAL position.
- i. Adjust the remaining valve bridges in the same manner.
- j. Swing the rocker arm assembly into position, making sure the valve bridges are properly positioned on the rear valve stems. This precaution is necessary to prevent valve damage due to mislocated valve bridges. Tighten the rocker arm shaft bracket bolts. Torque to 90-100 ft-lb (122-136 Nm) torque.

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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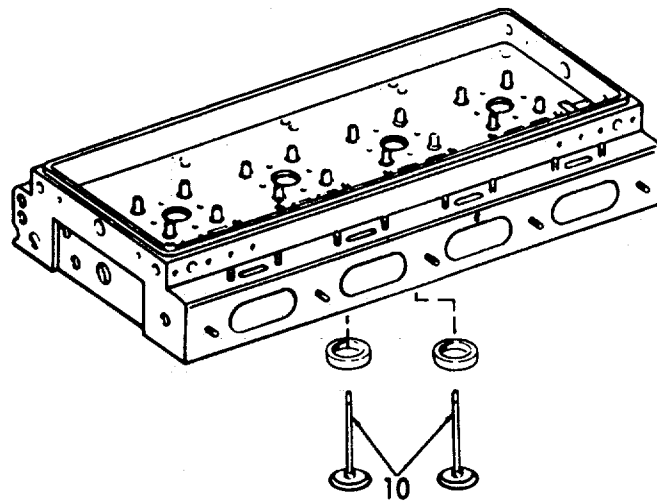
REMOVAL - CYLINDER HEAD OFF ENGINE

- | | | | | |
|----|---------------------------|--|---|--|
| 8. | Exhaust valve springs (4) | a. Cylinder head | Place on 2 inch wood blocks. | Keeps cam followers clear of work bench. |
| | | b. Exhaust valves (10) | Place a 2 inch wood block under valves. | |
| | | c. Exhaust valve bridge (1), and springs (4) | Refer to step 1. | |



3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL - CYLINDER HEAD OFF ENGINE (Cont)			
9.	Exhaust valves	a. Cylinder head b. Valves (10)	Turn on its side. Number and remove. Do not let the valves drop out. The valves must go back into their original locations.

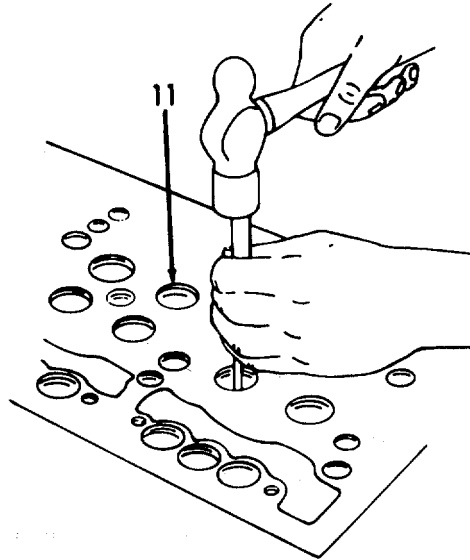


10.	Exhaust valve guides (11)	a. Cylinder head	1. Place on 2 inch wood block, bottom side up. 2. Drive the valve guide (11) out from the bottom of the cylinder head.
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3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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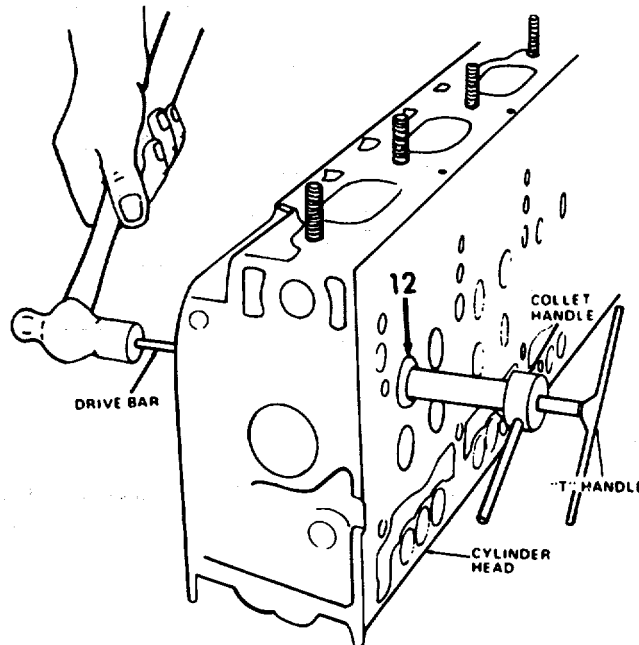
REMOVAL - CYLINDER HEAD OFF ENGINE (Cont)



11. Exhaust valve seat insert (12)

a. Cylinder head

Place on side.



3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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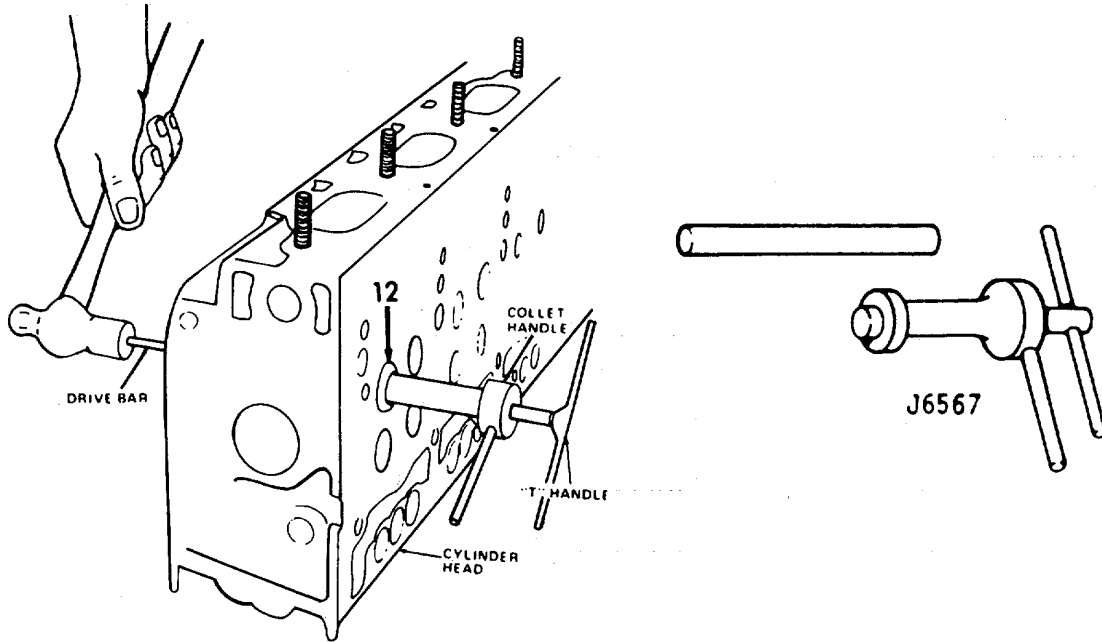
REMOVAL- CYLINDER HEAD OFF ENGINE (Cont)
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b. Remove valve seat insert (12)	<ol style="list-style-type: none"> 1. Place collet of tool J6567 inside the valve seat insert so the bottom of the collet is flush with the bottom of the insert. 2. Hold the collet handle and turn the T handle to expand the collet cone until the insert is held securely by the tool. 3. Insert the drive bar of the tool through the valve guide, and tap the drive bar once or twice to move the insert about 1/16 inch (1.588 cm). 4. Turn the T handle to loosen the collet cone and move the tool into the insert slightly so that the narrow flange at the bottom of the collet is below the valve seat insert. 5. Tighten the collet cone and continue to drive the insert out of the cylinder head.
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3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

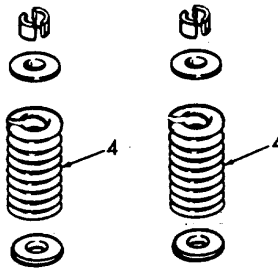
LOCATION	ITEM	ACTION	REMARKS
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REMOVAL - CYLINDER HEAD OFF ENGINE (Cont)



INSPECTION

12. Exhaust valve springs (4)	Springs	Inspect.	Refer to step 3.
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3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

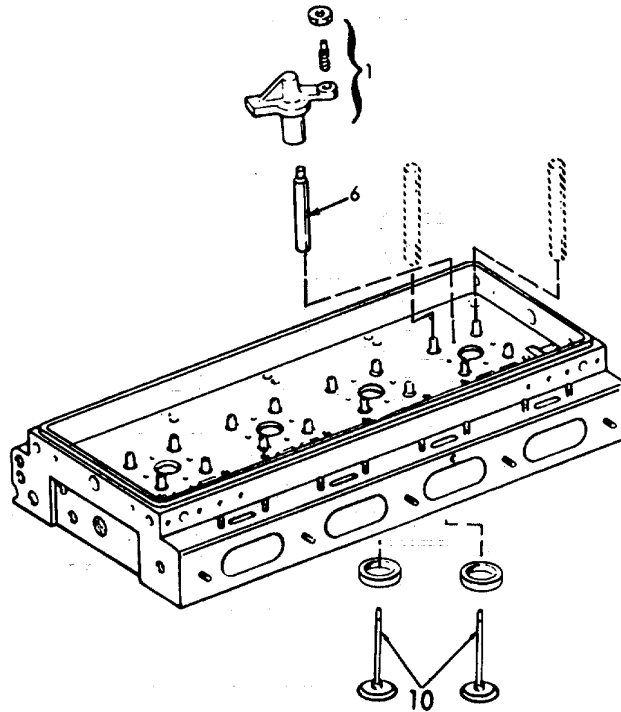
LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
13. Exhaust valve bridge (1), and guide (6)	Bridge and guide	Inspect.	Refer to step 4.
14. Exhaust valves (10)		<p>a. Carbon on the face of a valve indicates blow-by due to a fault seat. Black carbon deposits extending from the valve guides may result from cold operation due to light loads or the use of too light a grade of fuel. Rusty brown valve heads with carbon deposits forming narrow collars near the valve guides evidence hot operation due to overloads, inadequate cooling, or improper timing which results in carbonization of the lubricating oil.</p> <p>b. Clean the carbon from the valve stems and wash the valves with fuel oil. The valve stems must be free from scratches or scuff marks and the valve faces must be free from ridges, cracks or pitting.</p>	

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont

- c. If necessary, reface the valves or install new valves. If the valve heads are warped, replace the valves.
- d. If there is evidence of engine oil running down the exhaust valve stem into the exhaust chamber, creating a high oil consumption condition because of excessive idling and resultant low engine exhaust back pressures, install valve guide oil seals.



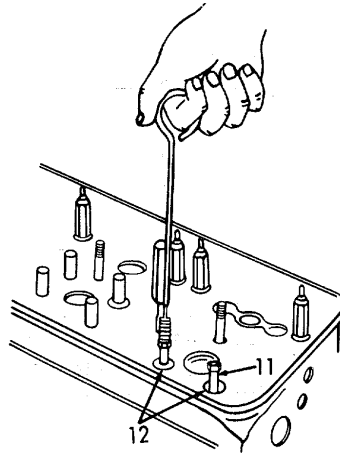
3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
15. Exhaust valve guides (11)	<ul style="list-style-type: none"> a. Remove and discard the valve guide oil seals, if used. b. Clean the inside diameter of the valve guides with a brush. This brush will remove all gum or carbon deposits from the guides, including the spiral grooves. c. Inspect the valve guides for fractures, chipping, scoring, or excessive wear. Check the valve-to-guide clearance, since worn valve guides may eventually result in improper valve seat contact. If the clearance exceeds .005 inch (0.0127 cm), replace the valve guides. 		
16. Exhaust valve seat insert (12)	<p>Inspect the valve seat inserts for excessive wear, pitting, cracking or an improper seat angle. The proper angle for the seating face of both the valve and insert is 30°.</p> <p>When a valve seat insert has been ground to such an extent that the 30° angle will- contact the cylinder head, install a new insert.</p>		

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

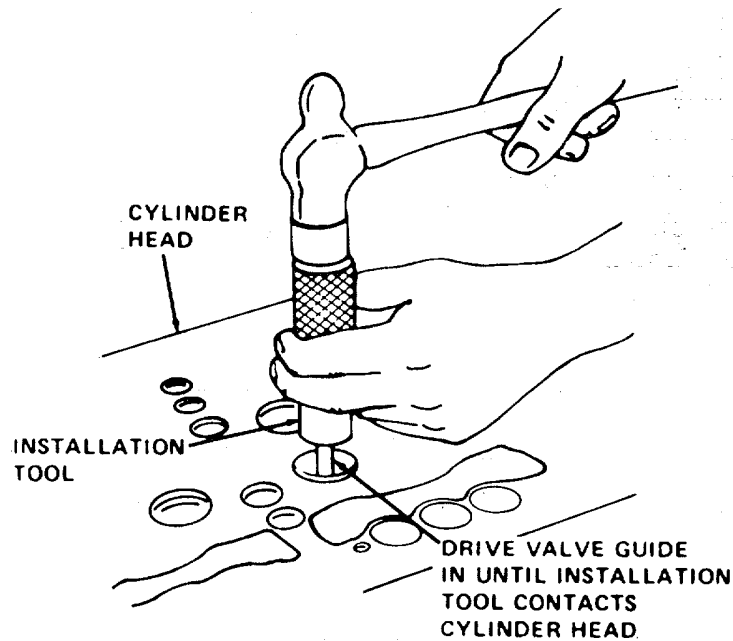
LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)



INSTALLATION - CYLINDER HEAD OFF ENGINE

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|-------------------------|------------------|--|
| 17. Exhaust valve guide | a. Cylinder head | Place cylinder head right side up on an arbor press. |
|-------------------------|------------------|--|



3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

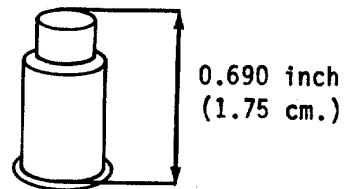
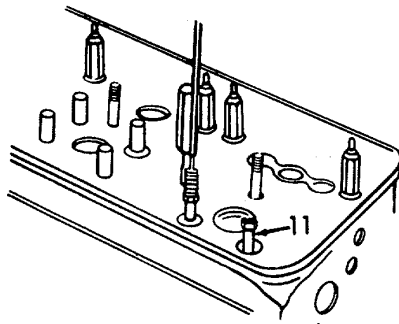
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD OFF ENGINE (Cont)

CAUTION

Do not use the valve guides as a means of turning the cylinder head over, or in handling the cylinder head.

- | | | |
|----------------------|--|--|
| b. Valve guides (11) | Position valve guide squarely in the bore of the cylinder head. Press into the head. | Height of valve guide above the cylinder head shall be 0.690 inch (1.75 cm). |
|----------------------|--|--|



3-2818

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD OFF ENGINE

18. Exhaust valve seat insert (12)

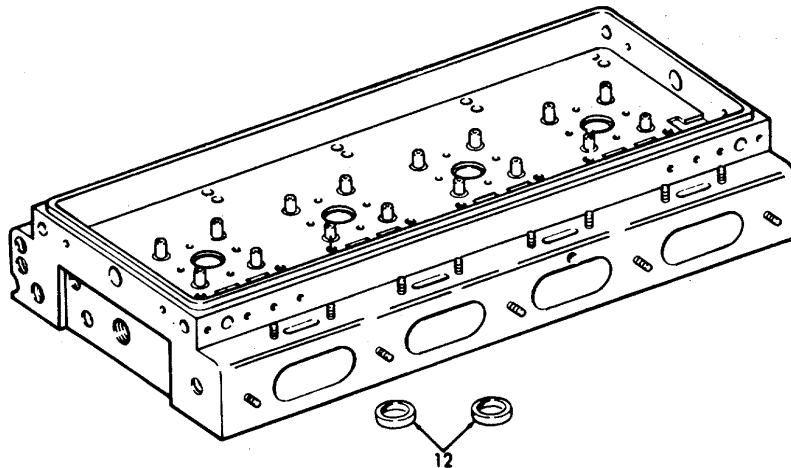
WARNING

Wear protective eye goggles when using compressed air.

CAUTION

Great care must be used during the installation of a valve seat insert since this part is a press-fit in the cylinder head.

- | | | |
|----------------------|--------|---|
| a. Cylinder head | Clean. | Wash with fuel oil and dry with compressed air. |
| b. Valve insert (12) | Clean. | Wash the valve insert counter-bore and valve insert with a good solvent. Dry with compressed air. |



3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD OFF ENGINE (Cont)

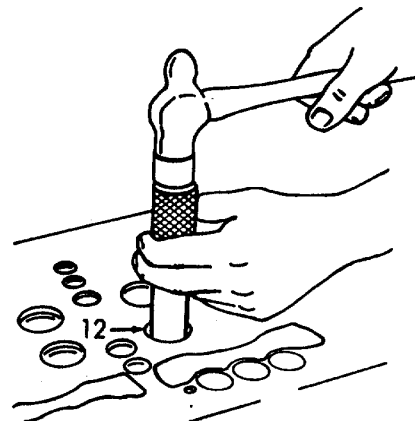
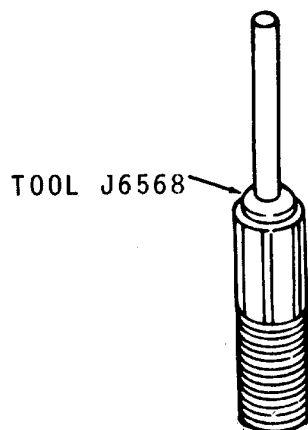
c.	Valve insert counterbore	Inspect.	Inspect the valve seat insert counterbore in the cylinder head for cleanliness, concentricity, flatness and cracks. The counterbores in a four valve cylinder head have a diameter of 1.260 inch to 1.261 inch (3.200 to 3.203 cm) and a depth of .338 inch to .352 inch (0.859 to 0.894 cm). The counterbores must be concentric with the valve guides within .033 inch (0.0076 cm) total indicator reading. If required, use a valve seat insert .010 inch (0.025 cm) oversize on the outside diameter.
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3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD OFF ENGINE (Cont)

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|--|---|---|---|
| | d. Cylinder head | Heat. | Immerse the cylinder head for at least 30 minutes in water heated to 180 to 200°F (82 to 93°C). |
| | e. Cylinder head, and valve seat insert | Rest the cylinder head, bottom side up, on a workbench and locate the insert squarely in the counterbore, seating face up. Install the insert in the cylinder head while the head is still hot and insert it at room temperature. Otherwise, installation will be difficult and the parts may be damaged. | |
| | f. Valve seat insert (12) | Drive insert in place until it sets solidly in cylinder head. | Use tool J6568. |

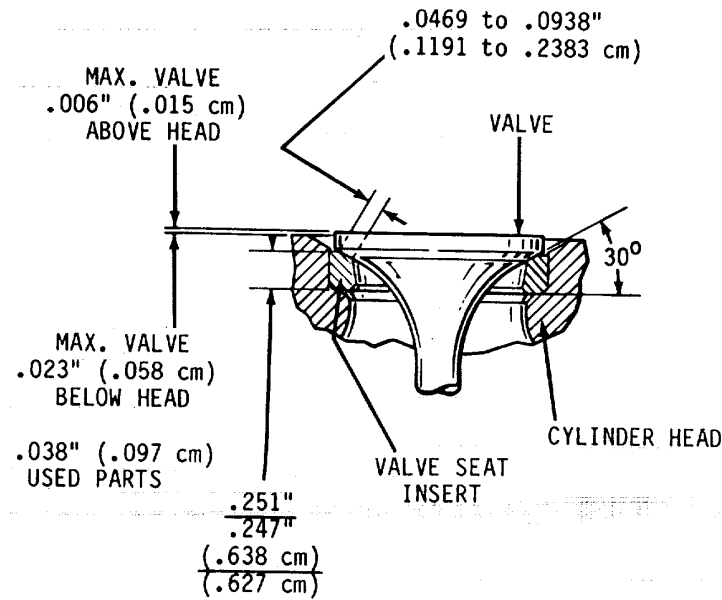


3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD OFF ENGINE (Cont)

19. Exhaust	a. Valve	Insert new valve into cylinder head.	The angle of the valve seat insert must be exactly the same as the angle of the valve face to provide proper seating of the valve. The proper angle for the seating face of both valve and valve insert is 30°.
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3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

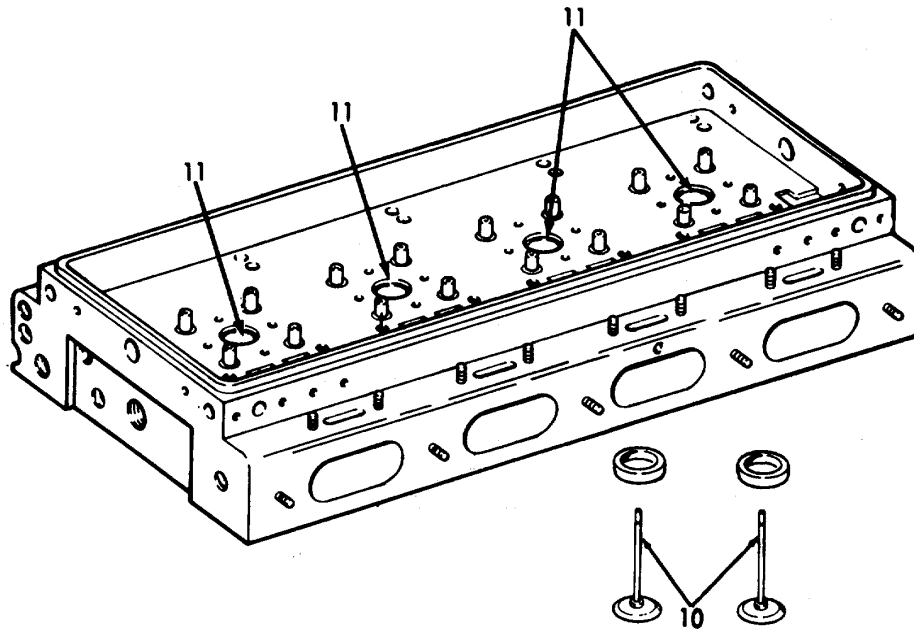
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD OFF ENGINE (Cont)

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|----|-------------------|------------|---|
| b. | Valve guides (11) | Clean. | |
| c. | Valve stems (10) | Lubricate. | Slide valves all the way into the guides. |

NOTE

If reconditioned valves are used, install them in the same relative location from which they were removed.



3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD OFF ENGINE (Cont)			
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Hold the valves in place with a strip of masking tape and turn the cylinder head right side up on the workbench. Place a board under the head to support the valves and to provide clearance between the cam followers and the bench.

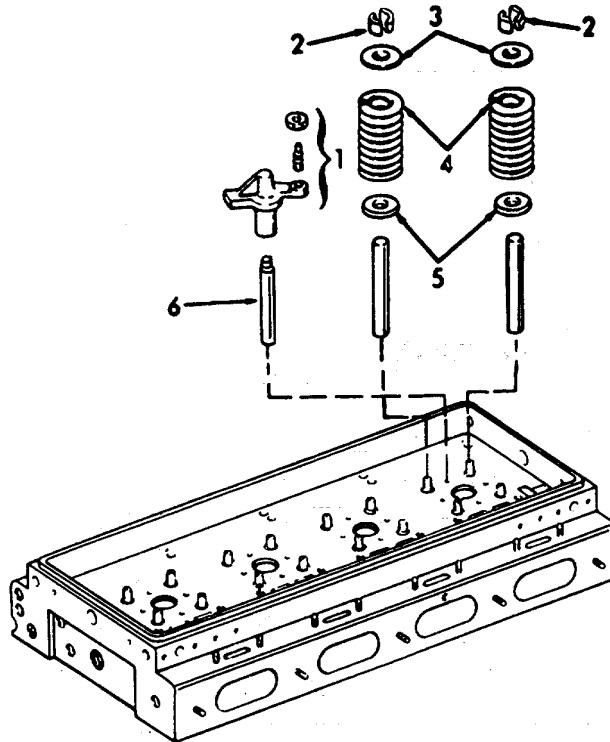
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|----|--|---|--------------------------|
| d. | Valve seat (5), spring (4), spring cap (3), and two-piece tapered valve lock (2) | Install. | Refer to step 6. |
| e. | Exhaust valve bridges (1) | Place on exhaust valve bridge guides (6). | Adjust. Refer to step 7. |

3-165.2. EXHAUST VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION - CYLINDER HEAD OFF ENGINE (Cont)

- | | | | |
|----|--|----------|---------------------------|
| f. | Valve and injector operating mechanism | Install. | Refer to paragraph 3-165. |
| g. | Injector | Install. | Refer to paragraph 3-147. |
| h. | Rocker arm cover | Install. | Refer to paragraph 3-161. |



3-166. CAMSHAFT AND GEAR TRAIN - MAINTENANCE INSTRUCTIONS.

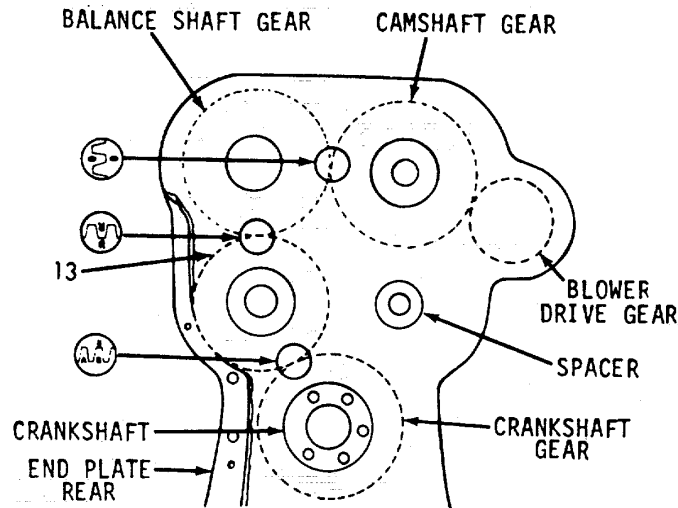
The camshaft, gear train and associated parts maintenance instructions are contained in the following paragraphs:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Gear Train	3-166.1
Engine Timing	3-166.2
Idler Gear and Bearing Assembly	3-166.3
Crankshaft Timing Gear	3-166.4
Camshaft and Balance Shaft	3-166.5

3-166.1. GEAR TRAIN - MAINTENANCE INSTRUCTIONS.

a. General

(1) A completely enclosed train of five helical gears is located at the rear end of the engine. A gear bolted to the crankshaft flange drives the camshaft and balance shaft gears, as well as the blower drive gear, through an idler gear mounted between the crankshaft and the balance shaft gears.



(2) The camshaft gear and balance shaft gear mesh with each other and run at the same speed as the crankshaft. Since these two gears must be in time with each other and the two as a unit in time with the crankshaft gear, the letter "0" is placed on one tooth of one of the gears with a corresponding mark at the root of the mating teeth of the other gear.

3-166.1. GEAR TRAIN - MAINTENANCE INSTRUCTIONS (Continued).

(3) The camshaft and balance shaft gears are keyed to their respective shafts and held securely against the shoulder on the shaft by a nut. Viewing the engine from the flywheel or gear train end, the right-hand gear is the camshaft and has left-hand helical teeth.

(4) The idler gear rotates on a double-row, tapered roller bearing mounted on a stationary hollow hub. This hub is accurately located on the cylinder block end plate at the left-hand side of the engines, as viewed from the gear train end.

(5) A blower drive gear is located on the blower side to transmit power to the blower, governor, fuel pump and water pump.

(6) Since the camshaft must be in time with the crankshaft, identification marks are located on two teeth of the idler gear with corresponding match marks stamped on the crankshaft gear and camshaft gear.

(7) However, the timing is advanced on certain engines by aligning the "A" on the crankshaft gears with the "L" or "R" (depending upon engine rotation) on the idler gears.

(8) Before removing or replacing any of the gear, note whether standard or advanced timing is used on the engine. To do this, rotate the crankshaft until the timing marks are aligned on the camshaft gears. Then check whether the "A", "L" or "R" timing mark on the crankshaft gear is aligned with the "L" or "R" on the idler gear and record this information for reassembly purposes.

(9) Balance weights, one fastened to the inner face of each gear (camshaft and balance shaft) are important in maintaining perfect engine balance. These are in addition to the weights cast integral with the gears.

(10) Gear train noise is usually an indication of excessive gear lash, scoring, pitting or excessive bearing wear. Therefore, when noise develops in a gear train, the flywheel housing should be removed and the gear train and its bearings inspected. A rattling noise usually indicates excessive gear lash whereas a whining noise is a result of too little gear lash.

(11) Excessive wear and scoring may result from abrasive substances or foreign material in the oil, introduced in the engine by such means as removal of the valve rocker cover without first cleaning away the dirt.

3-166.1. GEAR TRAIN - MAINTENANCE INSTRUCTIONS (Continued).

(12) Since the camshaft and balance shaft gears each have the same number of teeth as the crankshaft gear, they will turn at crank-shaft speed. However, as the blower drive gear has only about half as many teeth as the camshaft or balance shaft gear, it turns at approximately twice the speed of the crankshaft.

b. Lubrication

The gear train is lubricated by overflow oil from the camshaft and balance shaft pockets spilling into the gear train compartment. A certain amount of oil also spills into the gear train compartment from the camshaft and balance shaft end bearings, and idler gear bearings. The blower drive gear bearing is lubricated through an external pipe leading from the main cylinder block oil gallery to the gear hub bearing support. The idler gear bearing is pressure lubricated by oil passages in the idler gear hub which connect to the oil gallery in the cylinder block.

3-166.2. ENGINE TIMING - MAINTENANCE INSTRUCTIONS.

a. General

(1) The correct relationship between the crankshaft and camshaft must be maintained to properly control fuel injection and the opening and closing of the exhaust valves.

(2) The crankshaft timing gear can be mounted in only one position due to one attaching bolt hole being offset. The camshaft gear can also be mounted in only one position as a result of the location of the keyway relative to the cams. Therefore, when the engine is properly timed, the markings on the various gears will match as shown.

(3) An engine which is "out of time" may result in pre-ignition, uneven running and a loss of power.

(4) When an engine is suspected of being out of time, due to an improperly assembled gear train, a quick check can be made without having to remove the flywheel and flywheel housing by following the procedure outlined below.

b. Checking Engine Timing

Access to the vibration damper or crankshaft pulley, to mark the top-dead-center position of the selected piston, and to the front end of the crankshaft or flywheel for barring the engine over, is necessary in performing the timing check. Then, proceed as follows:

(1) Remove the valve rocker cover.

(2) Select any cylinder for the timing check - it is suggested that a cylinder adjacent to one of the cylinder head cover studs be chosen since the stud may be used for mounting a dial indicator.

(3) Remove the fuel lines (at the cylinder selected) and install shipping caps on the injector fuel fittings to prevent the entry of dirt. Make sure that the valve and injector rocker arms are all in the "UP" position. Then, remove the rocker shaft bracket bolts and swing the rocker arm assemblies back out of the way. Remove the injector assembly.

(4) Carefully place (do not drop) a rod approximately 12 inches long through the injector hole and on top of the piston.

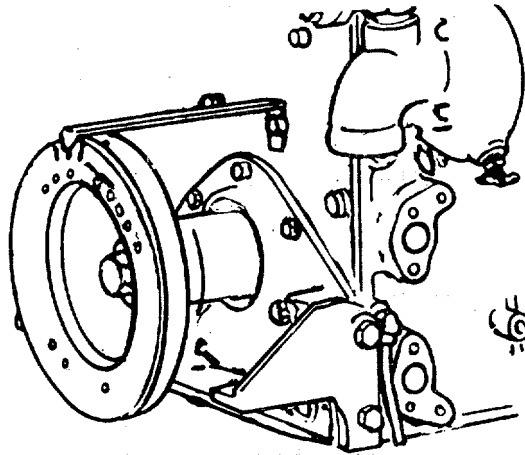
(5) With the throttle in the NO FUEL position, turn the crank-shaft slowly in the direction of rotation of the engine, and stop when the rod reaches the end of its upward travel. Remove the rod and turn the crankshaft opposite the direction of rotation between 1/16 and 1/8 of a turn.

3-166.2. ENGINE TIMING - MAINTENANCE INSTRUCTIONS (Continued).

(6) Select a dial indicator with .001 inch graduations and with a spindle movement of at least 1 inch. Use suitable mounting attachments for the indicator so that it can be mounted over the injector hole in the cylinder head. Provide an extension for the spindle of the indicator. The extension must be long enough to contact the piston as it approaches its upper position.

(7) Mount the indicator over the injector hole and tighten the mountings sufficiently to hold the indicator rigid. The mounting leg may be threaded into the rocker cover stud, or the stud may be removed from the cylinder head and the leg threaded into the tapped hole, depending upon the length of the rod used in making up the mounting attachments. Make sure the spindle extension is free in the injector hole, that it does not bind, and that it is free to travel its full 1 inch movement.

(8) Provide a suitable pointer and attach it to the engine front end plate. The pointer should extend over the vibration dampener, or crankshaft pulley.



(9) Rotate the crankshaft in the direction of rotation slowly until the hand on the dial indicator stops moving.

(10) Rotate the crankshaft in the direction of rotation until the indicator hand starts to move. Reset the dial to "0". Continue turning the crankshaft slowly until the indicator reading is .010 inch - then stop turning.

(11) Scribe a line on the dampener in line with the end of the pointer.

(12) Rotate the crankshaft slowly in the opposite direction of rotation until the hand on the dial indicator just stops moving.

3-166.2. ENGINE TIMING - MAINTENANCE INSTRUCTIONS (Continued).

(13) Rotate the crankshaft in the opposite direction of rotation until the indicator hand just starts to move. Reset the dial to "0". Continue turning the crankshaft slowly until the indicator reading is .010 inch - then stop turning.

(14) Scribe a second line on the vibration dampener in the same manner as in step (11).

(15) Scribe a third line halfway between the first two lines. This is positive top dead-center. The three scribed lines are shown on the crankshaft pulley. Remove the indicator from the engine.

NOTE

Make certain that the crankshaft pulley retaining bolts are not loosened while turning the crankshaft. The bolt must be tightened to 290-310 lb. ft. (393.2-420.4 Nm) torque if it becomes loose.

(16) Install the injector assembly. Swing injector and valve rocker arms back into position and install rocker arm brackets and tighten bolts to the specified torque. Adjust the valve clearance and time the injector. Rotate the crankshaft until the exhaust valves in the selected cylinder are open.

(17) Install the dial indicator again so the spindle of the indicator rests on top of the injector follower as illustrated. Set the indicator dial to "0". Rotate the crankshaft slowly in the direction of rotation, and stop when the TDC mark on the vibration damper or crankshaft pulley lines up with the pointer.

3-166.2. ENGINE TIMING - MAINTENANCE INSTRUCTIONS) (Continued).

(18) Note reading on dial indicator and compare it with chart. After completing the timing check, remove the dial indicator. Remove shipping caps from injector, and install injector fuel lines, making sure they are tightened to prevent any leaks.

* INDICATOR READING		
Standard	Retarded 1-Tooth	Advanced 1-Tooth
STANDARD TIMING		
.230 inch (.584 cm)	.197 inch (.500 cm)	.262 inch (.665 cm)
ADVANCED TIMING		
.262 inch (.665 cm)	.230 inch (.584 cm)	.289 inch (.734 cm)

Ⓕ Indicator readings shown are nominal values. The allowable tolerance is ± .005 in. (.013 cm).

Remove the pointer attached to the front of the engine.

(19) Adjust the exhaust valves and time the injectors as out-lined in paragraph 3-162.

(20) Install the valve rocker cover.

3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS.

- a. The idler gear mounts on a double row, tapered roller bearing which, in turn, is supported on a stationary hub. A hollow pin serves a two-fold purpose; first, as a locating dowel it prevents the idler gear hub from rotating and, second, the hollow pin conducts oil under pressure from an oil gallery in the cylinder block through a passage in the gear hub to the roller bearing inner races.
- b. The inner races of the idler gear bearing are pressed onto the gear hub and, therefore, do not rotate since the hub is doweled to the end plate and bolted to the cylinder block and also bolted to the fly-wheel housing. A spacer separates the two bearing inner races.
- c. The bearing outer race has a light press fit in the idler gear and is held against a flanged lip inside the idler gear on one side and by a retainer secured tightly with six bolts on the other side.
- d. A left-hand helix gear with "R" timing marks is provided for right-hand rotation engines.
- e. An idler gear hole spacer (dummy hub) is used on the side opposite the idler gear. No gasket is used between the idler gear hub or dummy hub and the flywheel housing. The flywheel housing bears against the inner races of the idler gear bearing and also against the dummy hub. Three self-locking bolts and steel washers are used to attach the flywheel housing at the idler gear and dummy hub locations. The washers seat in 7/8 inch spot faces at the flywheel housing attaching bolt holes, thus preventing oil leakage at these locations.

3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

This task covers:

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

INITIAL SETUP

Test Equipment

Spring scale

References

None

Special Tools

Arbor press
Torque wrench

Equipment
Condition Condition Description
Paragraph

3-167 Flywheel Housing Removal

Material/Parts

Oil MIL-L-2104 Type OE/HDO

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure

LOCATION	ITEM	ACTION	REMARKS
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NOTE

The flywheel housing must be removed to perform the following maintenance procedures.

REMOVAL

- | | | | |
|---|---|---------|-------------------------------|
| 1. Idler gear or idler gear hole spacer (2) | a. Cylinder block screw (1) and flat-washer | Remove. | Screw is ½ - 13 x 2 ½ inches. |
|---|---|---------|-------------------------------|

3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS.
(Continued).

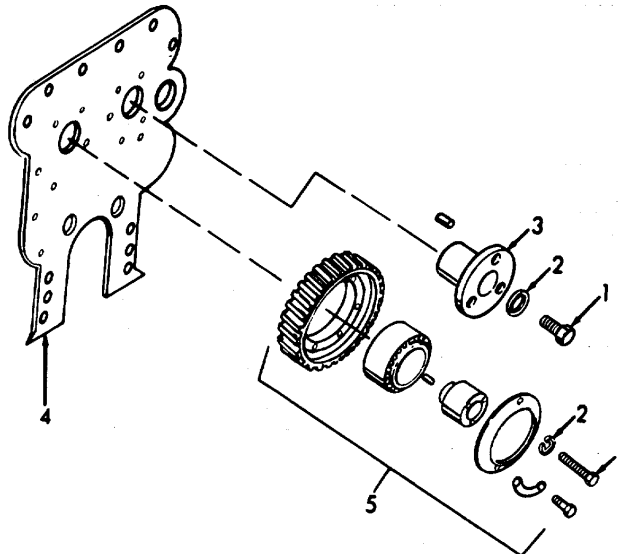
LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|----|----------------------------|---------------------------------|--|
| b. | Idler gear hole spacer (3) | Remove from rear end plate (4). | |
| c. | Idler gear (5) | Remove from rear end plate (4). | |

NOTE

Before removing the idler gear check the idler gear, hub and bearing assembly for any perceptible wobble or shake when pressure is applied; by firmly grasping the rim of the gear with both hands and rocking in relation to the bearing. The bearing must be replaced if the gear wobbles or shakes If the gear assembly is satisfactory, it is only necessary to check the pre-load before reinstallation.



3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY

- 2. Idler gear hub and bearing assembly

NOTE

While removing or installing an idler gear bearing, the bearing MUST be rotated to avoid the possibility of damaging the bearing by brinelling the bearing races. Brinelling refers to the marking of the races by applying a heavy load through the rollers of a non-rotating bearing in such a way that the rollers leave impressions on the contact surfaces of the races. These impressions may not be easily discerned during normal inspection. For example, a bearing may be brinelled if a load were applied to the inner race of the bearing assembly in order to force the outer race into the idler gear bore, thus transmitting the force through the bearing rollers. A brinelled bearing may have a very short life.

- a. Six bolts (6), three bolt locks (7), and bearing retainer (8) Remove.

WARNING

Wear protective eye goggles when using compressed air.

- b. Idler gear and bearing assembly (9) Clean with fuel oil and dry with compressed air.

3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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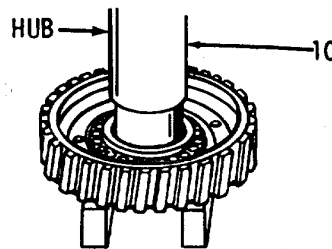
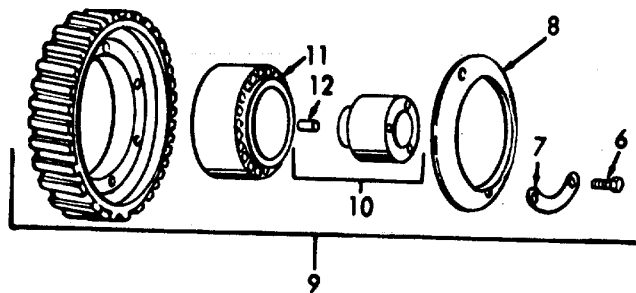
DISASSEMBLY (Cont)

c.	Bearing hub (10)	Place the idler gear and bearing assembly (9) in an arbor press with the bearing cone or inner race supported on steel blocks as shown. While rotating the gear assembly (9), press the hub (10) out of the bearing. Remove the gear assembly from the arbor press and remove the bearing cones and spacer (11).	
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NOTE

Component parts of the idler gear bearing are mated. Match-mark the parts during disassembly to assure they will be reassembled in their original positions.

d.	Dowel (12)	Remove.	If necessary.
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3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

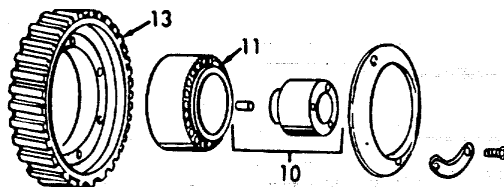
LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

WARNING

Wear protective eye goggles when using compressed air.

- | | | | |
|----|--|---|--|
| 3. | a. Idler gear (13), hub (10), and bearing (11) | <ol style="list-style-type: none"> 1. Wash in clean fuel oil and dry with compressed air. 2. Inspect all parts for wear. | |
| | b. Bearing (11) | Inspect bearings carefully. Wear, pitting, scoring, or flat spots on rollers or races are sufficient cause for rejection and the bearing assembly must be replaced. | |
| | c. Hub (10) | Check the idler gear hub and spacer. | |
| | d. Idler gear (13) | Examine the gear teeth for evidence of scoring, pitting and wear. If severely damaged or worn, replace the gear. Also inspect other gears in the gear trains. | |



3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY

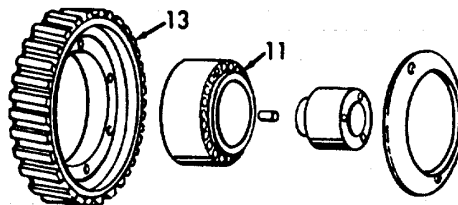
4. Idler gear

NOTE

Align match marks on the bearing components before proceeding.

a. Idler gear (13), and bearing (11)

1. Support the idler gear shoulder down, on the bed of an arbor press and start the outer bearing race squarely into the bore of the gear. Press the bearing race tightly against the shoulder of the gear, using a steel plate between the ram of the press and the bearing race.
2. Support one bearing cone, numbered side down, on bed of arbor press and lower the idler gear and bearing cup assembly down over the bearing cone.
3. Lay spacer ring on face of bearing cone.



3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

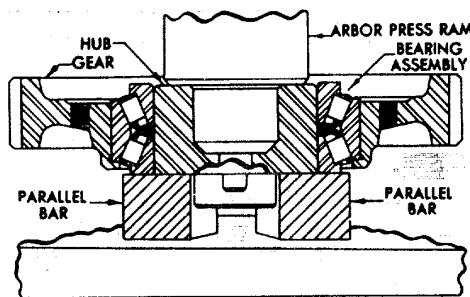
LOCATION	ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)			
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4. Place second bearing cone, numbered side up, in idler gear and bearing cup assembly, and against spacer ring.
5. Then, position the idler gear hub over the bearing cones so that the oil hole in the hub is 180° from the gap in the spacer ring.

b. Hub

Press the hub into the idler gear bearing cones, while rotating the gear (to seat rollers properly between cones) until the face of the hub which will be adjacent to the cylinder block end plate is flush with the corresponding face of the bearing cone. The bearing cones should be supported so as not to load the bearing rollers during this operation.



3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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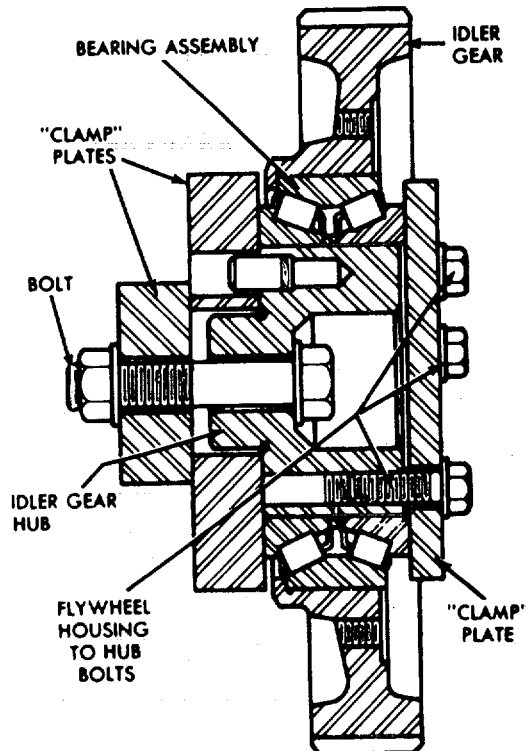
PRE-LOAD CHECK OF BEARING

5. Bearing

NOTE

Prior to installing and securing the bearing retainer, check the preload of the bearing assembly as outlined below.

a. The rollers of the bearing are loaded between the bearing cup and bearing cones in accordance with design requirements to provide a rigid idler gear and bearing assembly. As the bearing cones are moved toward each other in a tapered roller bearing assembly, the rollers will be more tightly held between the cones and cup. In the idler gear bearings, a slight pre-load is applied by means of a selected spacer ring between the bearing cones, to provide rigidity of the gear and bearing assembly when it is mounted on its hub. This method of pre-loading is measured in terms of "pounds-pull", by the effort required at the outer diameter of the gear to turn the bearing cup in relation to the bearing cones.



3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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PRE-LOAD CHECK OF BEARING (Cont)

b. Any time an idler gear assembly has been removed from an engine for servicing or inspection, while performing engine overhaul or other repairs, the pre-load should be measured as part of the operation.

c. After the idler gear, hub and bearing are assembled together, the bearing should be checked to see that the gear may be rotated on its bearing without exceeding the maximum torque specifications, nor be so loose as to permit the gear to be moved in relation to the hub by tilting, wobbling or shaking the gear.

d. If the mating crankshaft and camshaft or balance shaft gears are not already mounted on the engine, the torque required to rotate the idler gear may be checked by mounting the idler gear in position on the engine, using a steel plate 4 inch square and 3/8 inch thick against the hub and cone as outlined below.

e. However, if the crankshaft and camshaft gears are on the engine, a suitable fixture, which may be held in a vise, may be made.

f. Three plates, a 1/2-13 inch x 2 3/4 inch bolt and a plain washer are used with a 1/2-13 inch nut and plain washer for mounting. One of the plates is used to take the place of the flywheel housing, and the other two plates to take the place of the cylinder block. "Engine-mounted" conditions are simulated by tightening the nut to 80-90 lb-ft (108.5-122.0 Nm) torque and tightening the three plate-to-hub attaching bolts to 25-40 lb-ft (33.9-54.2 Nm) torque. The components of the fixture may be made from steel stock in accordance with the dimensions.

g. The idler gear bearing should be clean and lubricated with clean, light engine oil prior to the preload test. Idler gear assemblies which include new bearings should be "worked in" by grasping the gear firmly by hand and rotating the gear back and forth several times.

To check the pre-load by the first method:

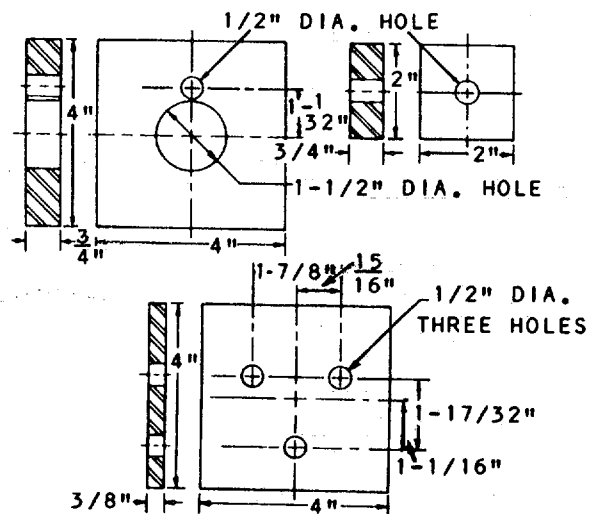
- (1) Mount the idler gear assembly on the engine.

3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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<p>PRE-LOAD CHECK OF BEARING (Cont)</p>

- Install the center bolt and washer through the gear hub and thread into the cylinder block a 1/2-13 inch x 2 1/2 inch bolt, (replacing the 1/2-13 inch x 2 inch bolt). Tighten the bolt to 80-90 lb-ft (108.5-122.Nm) torque.



- Place a steel plate (lower plate) against hub and bearing. Insert three 3/8-16 inch bolts through plate and threaded into hub. Tighten the bolts to 25-40 lb-ft (33.9-54.2 Nm) torque.
- Tie one end of a piece of lintless 1/8 inch cord around a 1/8 inch round piece of wood (or soft metal stock). Place the wood between the teeth of gear. then wrap the cord around the periphery of the gear several times. Attach the other end of the cord to a spring scale. Maintain a straight, steady pull on the scale, 90° to the axis of the hub, and note the pull, in pounds and ounces, required to start the gear rotating. Make several checks to obtain an average reading. If the pull is within 1 1/4 lb. minimum to 6 lbs. 12 ounces maximum and does not fluctuate more than 2 lbs. 11 ounces, the idler gear and bearing assembly are satisfactory for use.

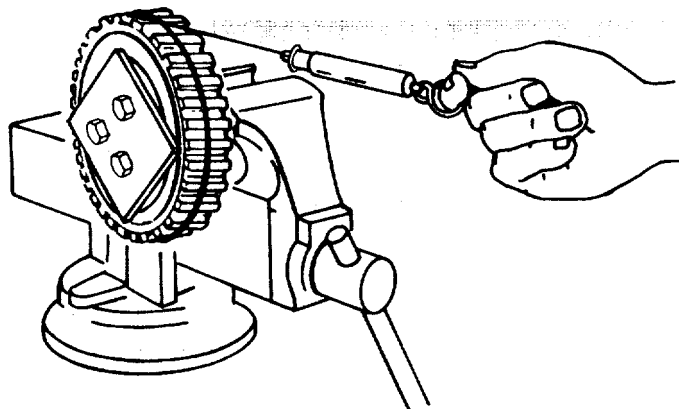
3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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PRE-LOAD CHECK OF BEARING (Cont)

h. To check the pre-load by the second method:

- (1) Attach the plates (two upper plates) to the idler gear with 1/2-13 inch center bolts, washers and nut as shown. Tighten the bolt to 80-90 lb. ft.(108.5-122 Nm) torque.
- (2) Attach the other plate to the idler gear with three 3/8-16 inch bolts. Tighten the bolts to 25-40 lb. ft. (37.9-54.2 Nm) torque.
- (3) Clamp the idler gear assembly and fixture in the vise as shown.



- (4) Attach the cord to the idler gear and spring scale and check the pre-load as outlined in item 4 of the first method.

i. If the scale reading is within the specified 1 1/4 to 6 3/4 lbs. But fluctuates more than the permissible 2 lbs. 11 ounces, the idler gear and bearing assembly must NOT be installed on the engine. Fluctuations in scale reading may be caused by the races not being concentric to each other, damaged races or rollers, or dirt or foreign material within the bearings. In these cases, the bearing should be inspected for the cause of fluctuation in the scale readings and corrected or a new bearing installed.

3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

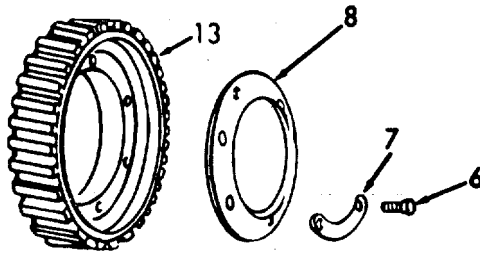
LOCATION	ITEM	ACTION	REMARKS
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<p>PRE-LOAD CHECK OF BEARING (Cont)</p>

j. A scale reading which exceeds the-specified maximum indicates binding of the bearing rollers, or rollers improperly installed. When the scale reading is less than the specified minimum, the bearing is more likely worn and should be replaced.

k. After the pre-load test is completed, remove the steel plates and attach the bearing retainer as follows:

- (1) Attach the bearing retainer (8) to the idler gear with six screws (6), and three screw locks (7). Tighten the screws to 24-29 lb-ft (32.5-39.3 Nm).
- (2) Bend the ears of each screw lock against the flat side of the attaching screw heads to secure the screws.

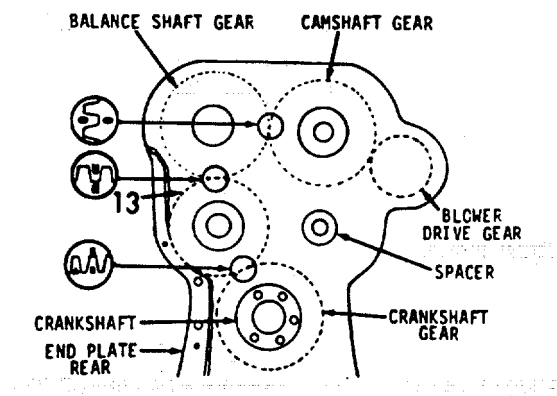


3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION

- | | | | |
|---|--|--|--|
| 6. Idler gear hub, and bearing assembly | Crankshaft gear, balance shaft gear, and idler gear (13) | <p>a. Position gears so that match marks will align with those on the idler gear.</p> <p>b. With these marks in alignment, start the idler gear (13) into mesh with the crankshaft gear and either the camshaft or balance shaft gear, and simultaneously rotate the gear hub so that the hollow pin (12) at the inner face of the hub nearly registers with the oil hole in the endplate.</p> | |
|---|--|--|--|



3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

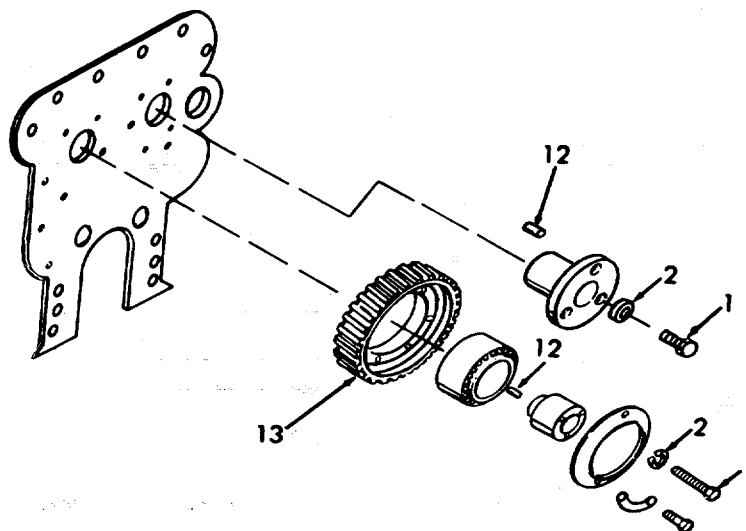
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

c. Roll the idler gear into position, align the hollow pin with the hole in the end plate, and gently tap the hub until it seals against the end plate. Thus the hollow dowel pin in the hub will conduct oil through the end plate and into the hub where it flows through a drilled passage to the roller bearing.

d. After making sure that hub is tight against the end-plate, secure the idler gear assembly into place with a 1/2-13 inch screw (1) and washer (2).

Tighten the screw to 80-90 lb. ft. (108.5-122 Nm) torque.

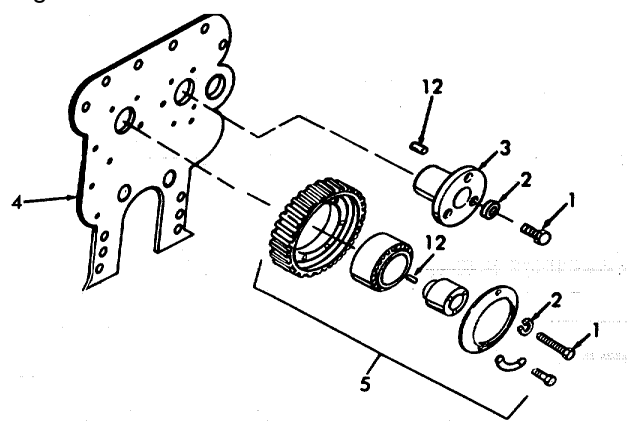


3-166.3. IDLER GEAR AND BEARING ASSEMBLY - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

7.	Idler gear hole spacer	a. Hollow dowel pin (12)	Insert into rear end-plate (4).	Tighten the screw to 80-90 lb. ft. (108.5-122 Nm) torque.
		b. Spacer (3), washer (2) and 1/2-13 screw (1)	Install over dowel pin (12).	
8.	Idler gear and spacer	a. Idler gear (5), and spacer (3)	Lubricate liberally with clean engine oil.	Check backlash between mating gears. The backlash must be .003 to .008 inch (.008-.019 cm).
		b. Crankshaft gear, balance shaft gear, and idler gear		



3-2848

3-166.4. CRANKSHAFT TIMING GEAR - MAINTENANCE INSTRUCTIONS.

a. The crankshaft timing gear is bolted to the flange at the rear end of the crankshaft and drives the balance shaft gear through an idler gear.

b. Since the camshaft must be in time with the crankshaft, timing marks are located on two teeth of the idler gear with corresponding timing marks stamped on the crankshaft gear and camshaft and balance shaft gears (refer to paragraph 3-166.2).

This task covers:

- | | | |
|------------|---------------|-----------------|
| a. Removal | b. Inspection | c. Installation |
|------------|---------------|-----------------|

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment
Condition Condition Description
Paragraph

3-167 Flywheel Housing Removal

Material/Parts

None

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

LOCATION	ITEM	ACTION	REMARKS
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NOTE

The flywheel housing and flywheel must be removed to perform the following maintenance instructions.

3-166.4. CRANKSHAFT TIMING GEAR - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

1. Crankshaft gear	a. Crankshaft rear oil seal (1)	Peen the outside diameter of the seal until it stretches sufficiently so it can be slipped off of the crankshaft.	
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NOTE

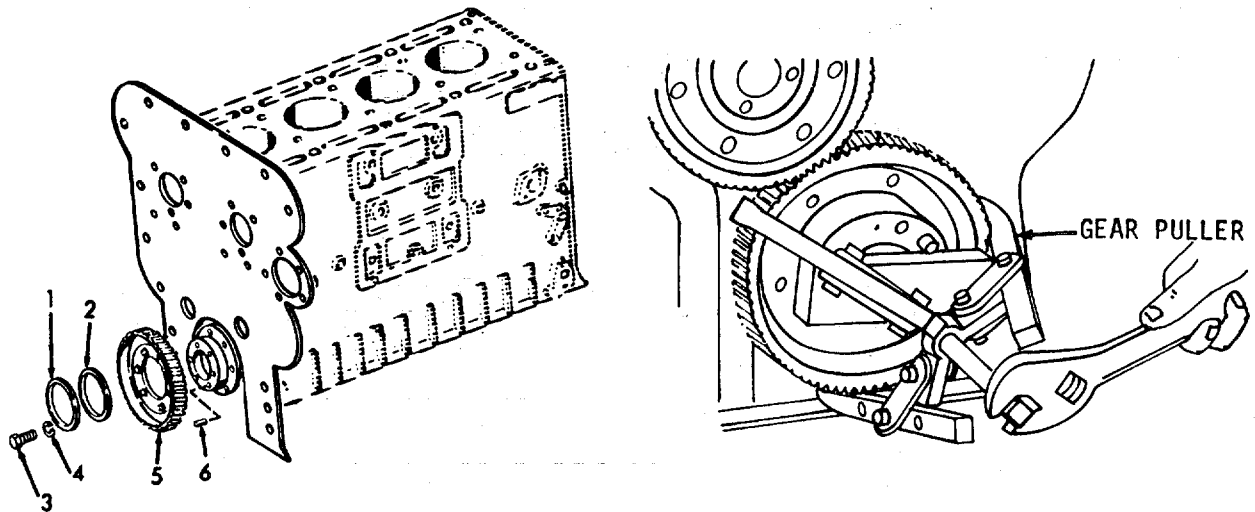
Before removing the crankshaft gear, align the timing marks of the gear train and note their location so the gear can be reinstalled in its original position.

	b. Oil seal spacer (2)	Remove.	
	c. Six bolts (3) and lock-washers (4)	Remove.	
	d. Crankshaft gear (5)	Provide a base for the puller screw by placing a steel plate across the cavity in the end of the crankshaft. Then remove the gear with a suitable puller as shown.	
	e. Dowel (6)	Remove.	If needed.

3-166.4. CRANKSHAFT TIMING GEAR - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



INSPECTION

WARNING

Wear protective eye goggles when using compressed air.

2. Clean the gear with fuel oil and dry it with compressed air. Examine the gear teeth for evidence of scoring, pitting or wear. If severely damaged or worn, install a new gear. Also check the other gears in the gear train.

3-166.4. CRANKSHAFT TIMING GEAR - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
3.	a. Dowel (6)	Install.	If needed.
	b. Gear (5)	<ol style="list-style-type: none"> 1. Position the gear on the rear end of the crankshaft with the flat finish hub of the gear facing toward the cylinder block and with all six bolt holes in the gear aligned with the tapped holes in the crankshaft. One bolt hole is offset so the gear can be attached in only one position. 2. Align the proper timing mark ("L" or "R") on the crankshaft gear tooth with the corresponding mark on the idler gear. 	
NOTE			
When advanced timing is required, align the timing mark "A" with the timing mark on the idler gear.			
	c. Six bolts (3), and lock-washers (4)	<ol style="list-style-type: none"> 1. Start the bolts thru the gear and into the crankshaft. 2. Draw the gear tightly against the shoulder on the crankshaft. 	<p>Bolts are 3/8-24.</p> <p>Tighten bolts to 35-39 lb-ft (70.5-78.6 Nm) torque.</p>

3-166.4. CRANKSHAFT TIMING GEAR - MAINTENANCE INSTRUCTIONS
(Continued).

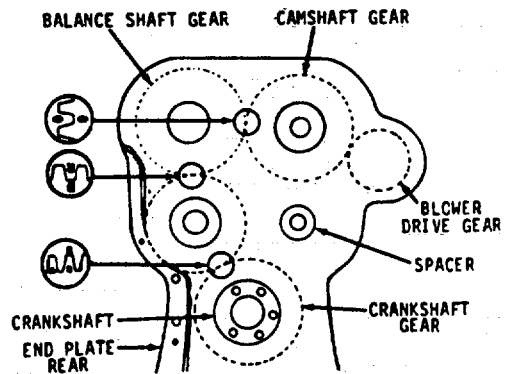
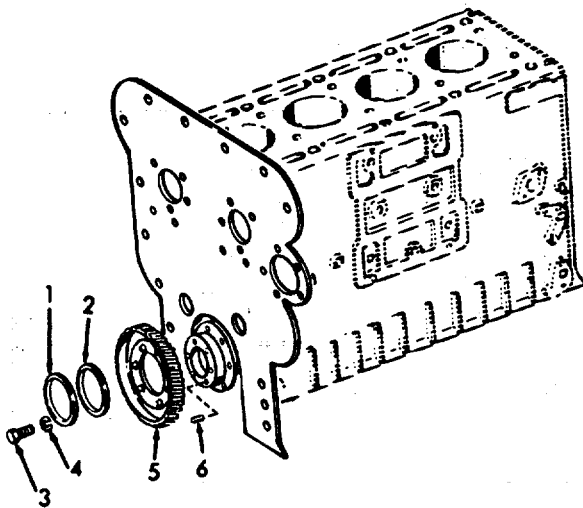
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

3. Check the backlash with the mating gear. The backlash should be .003 inch to .008 inch with new gears or .010 inch maximum with used gears.

d. Spacer (2), and oil seal (1)

Install after flywheel housing is installed.



3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS.'

a. General

(1) The camshaft and balance shaft are located near the top of the cylinder block. The camshaft actuates the valve and injector operating mechanism.

(2) The accurately ground cams on the camshaft ensure efficient, quiet cam follower roller action and are heat treated to provide a hard wear surface.

(3) The engine is equipped with a low velocity, low lift injector cam lobe and a long closing ramp exhaust cam lobe design camshaft and can be identified by the number "7" stamped on one end.

(4) Both ends of the cam and balance shaft are supported by bearing assemblies, each consisting of a flanged housing and two bushings. In addition, intermediate two-piece bearings support the camshaft at uniform intervals throughout its length. The intermediate bearings are secured to the camshaft by lock rings, thereby permitting them to be inserted into the cylinder block with the shaft. Each intermediate bearing is secured in place, after the camshaft is installed, with a lock screw threaded into a counterbored hole in the top of the cylinder block.

(5) On both the camshaft and the balance shaft, the gear thrust load is absorbed by two thrust washers. The thrust washers bear against thrust shoulders on the shafts.

(6) A helical drive gear with a counterweight is secured to each shaft with a Woodruff key, nut, nut retainer, retainer bolts and lockwashers. The drive gears are attached to the rear end of the shafts on all engines.

(7) To help maintain engine balance, a balance weight is installed on the front end of each shaft.

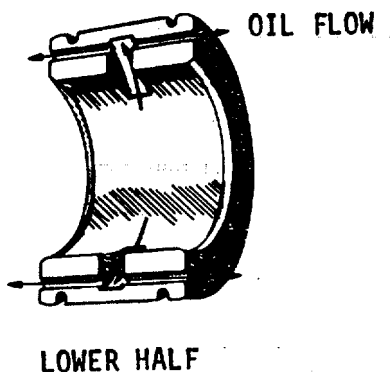
b. Lubrication

(1) Lubricating oil is supplied under pressure to the bearings from the longitudinal main oil gallery through a horizontal transverse passage at each end of the cylinder block, then up the connecting vertical passages in each corner of the block to the camshaft, and balance shaft end bearings. The camshaft intermediate bearings are lubricated by the oil from the end bearings passing through the drilled passage in the shaft.

(2) The lower halves of the camshaft intermediate bearings are grooved along the horizontal surface that mates with the upper halves of the bearings. Oil from the passage in the camshaft is forced thru the milled slots in the bearing and then out the grooves to furnish

3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS
(Continued).

additional oil to the cam follower assemblies. This permits the cam pocket to be filled rapidly to the operating oil level immediately after starting the engine.



This task covers:

- a. Removal
- b. Cleaning
- c. Inspection
- d. Repair/Adjust
- e. Installation

INITIAL SETUP

<u>Test Equipment</u>	<u>References</u> Paragraph	
None		
Removed	3-163	Cylinder Head
Cover	3-158	Balance Weight
		Removed
<u>Special Tools</u>	<u>Equipment</u> <u>Condition</u> <u>Condition Description</u> Paragraph	
Slide hammer		
Camshaft gear puller	3-151	Heat Exchanger
J1902-01	3-155	Tachometer Removal
Torque wrench	3-154	Overspeed Governor Removal
<u>Material/Parts</u>	<u>Special Environmental Condition</u>	
Grease	None	
<u>Personnel Required</u>	<u>General Safety Instructions</u>	
2	Observe WARNING in procedure.	

3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS
(Continued).

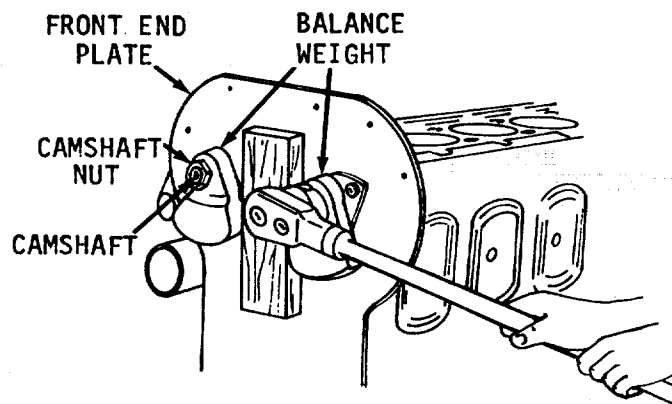
LOCATION	ITEM	ACTION	REMARKS
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NOTE

This procedure is to be used when removing the camshaft or balance shaft without removing the flywheel housing and disconnecting the torque converter. Refer to Direct Support Maintenance to remove the camshaft and balance shaft when the engine is removed from the vessel.

REMOVAL

- | | | | |
|----|-------------------|-----------------|--|
| 1. | Engine
(front) | Balance weights | Place a wooden block between tire weights. |
|----|-------------------|-----------------|--|



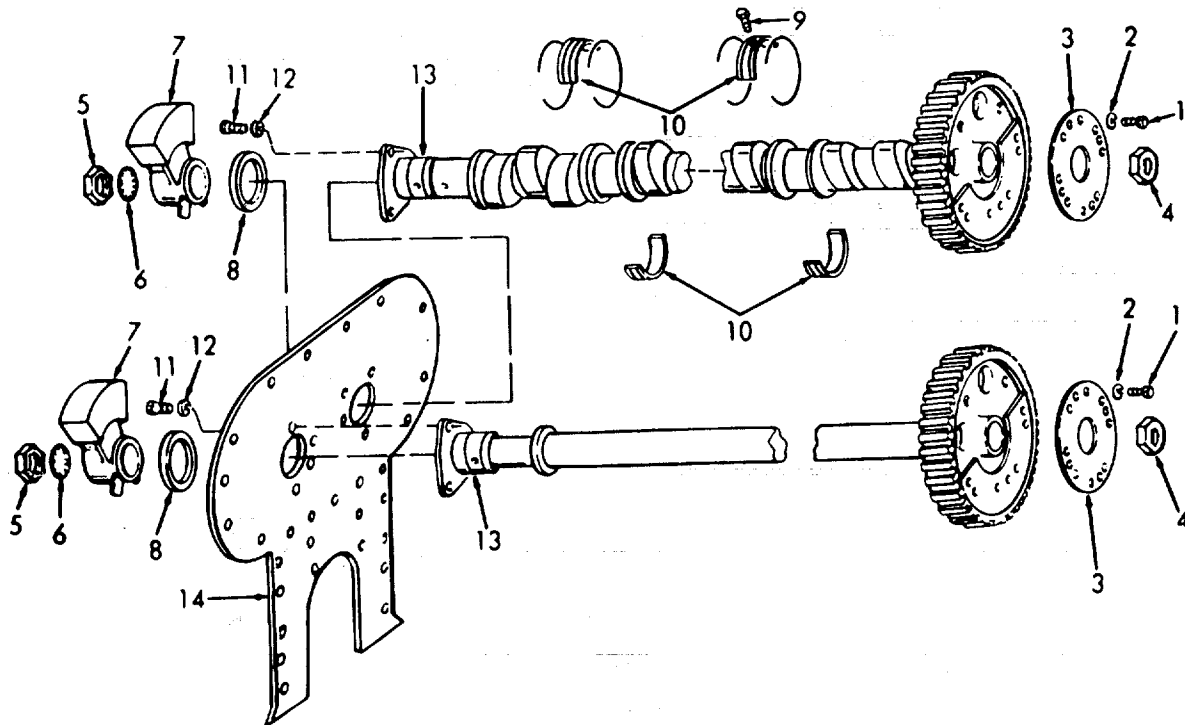
- | | | | |
|----|------------------------------|--|------------------------------------|
| 2. | Camshaft
balance
shaft | a. Screws
(1),
lock-
washers
(2),
and
gear
nut
retainer
(3) | Remove. |
| | | b. Nuts
(4)
(5) | Remove from camshaft
gear end. |
| | | c. Nuts (5),
and
lock-
washers
(6) | Remove from balance
weight end. |

3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|----|--------------------------------|---|--|
| d. | Balance weights (7) | Remove. | |
| e. | Thrust washers (8) | Remove. | |
| f. | Lock screws (9) (10). | Remove from camshaft intermediate bearings | |
| g. | Screws (11), lock-washers (12) | Remove screws that attach camshaft bearings (13) to the front end plate (14). | |

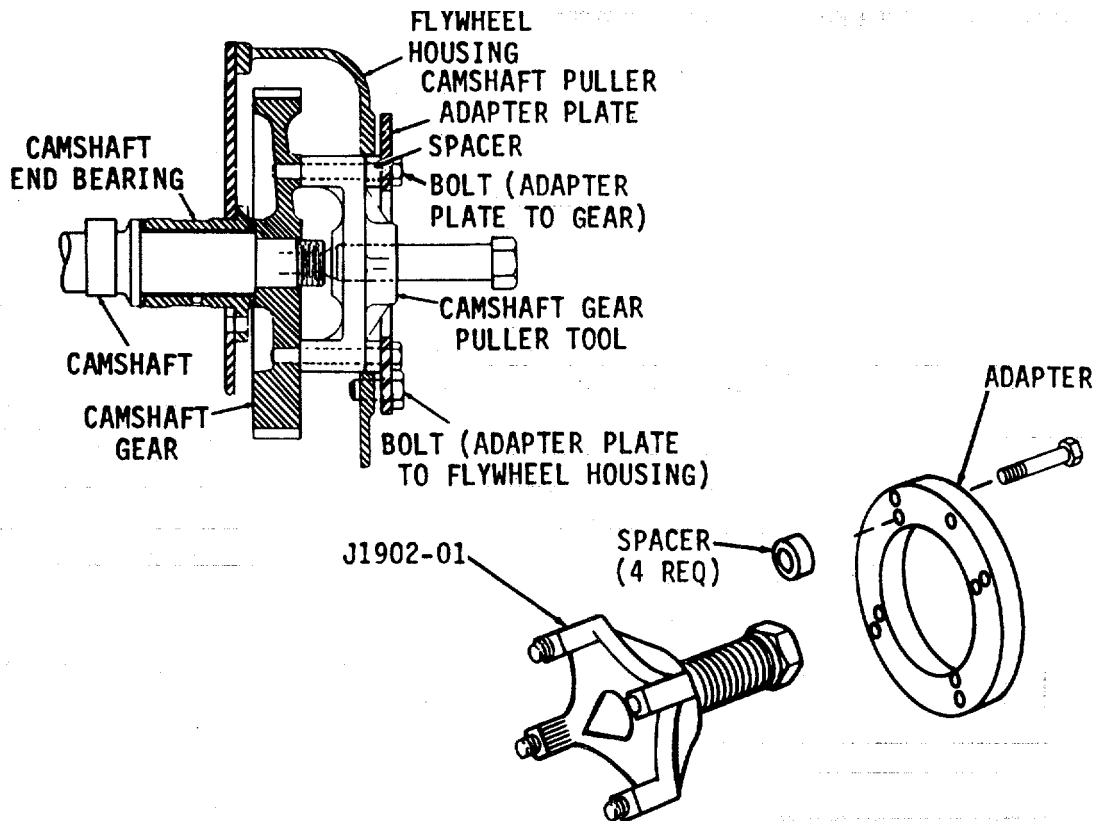


3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- | | | | |
|----|---|--|--|
| h. | Camshaft gear puller, spacers and adapter | Install as shown. | |
| i. | Camshaft gear Puller | Turn the center screw clockwise to disengage gear. | |



3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS
(Continued).

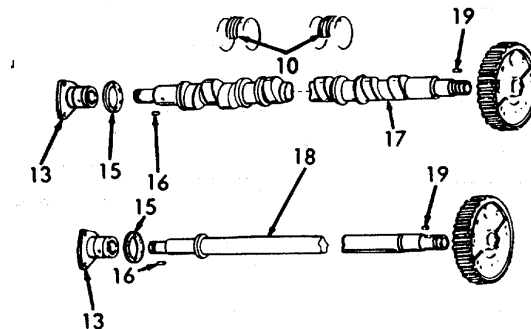
LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)

NOTE

Do not remove puller or adaptor plate until camshaft or balance shaft is reinstalled. The adaptor plate, secured to both the flywheel housing and the camshaft gear, will hold the gear securely in place and in alignment, which will aid in the reinstallation of the camshaft.

- | | | |
|----|--|----------------------------|
| j. | Front bearings (13), thrust washers (15), and Woodruff keys (16) | Remove. |
| k. | Camshaft (17), and intermediate bearings (10), or balance shaft (18) | Remove from cylinder block |
| l. | Woodruff keys (19) | Remove. |



3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSPECTION

WARNING

Wear protective eye goggles when using compressed air.

NOTE

Clean the camshaft, balance shaft and related parts with fuel oil. All foreign matter must be removed from the camshaft oil passage. Dry all parts with compressed air.

3.	a. Cams and journals	Examine for wear and bad scoring.	Replace if damaged.
	b. Center bearings	Check the runout at the center bearing with the camshaft mounted on the end bearing surfaces. Runout should not exceed .0002 inch (.0005 cm).	
	c. Cam followers scored.	Check the cam followers if the cam surfaces are scored.	
	d. Thrust washers	Inspect both faces of each thrust washer. Replace excessively scored or worn washers. Thrust washers are available in .005 inch and .010 inch oversize. The clearance between the thrust washer and the thrust shoulder of the shafts is .004 inch to .012 inch (.010 to .030 cm) with new parts or a maximum of .018 inch (.046 cm) with used parts.	

3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS
(Continued).

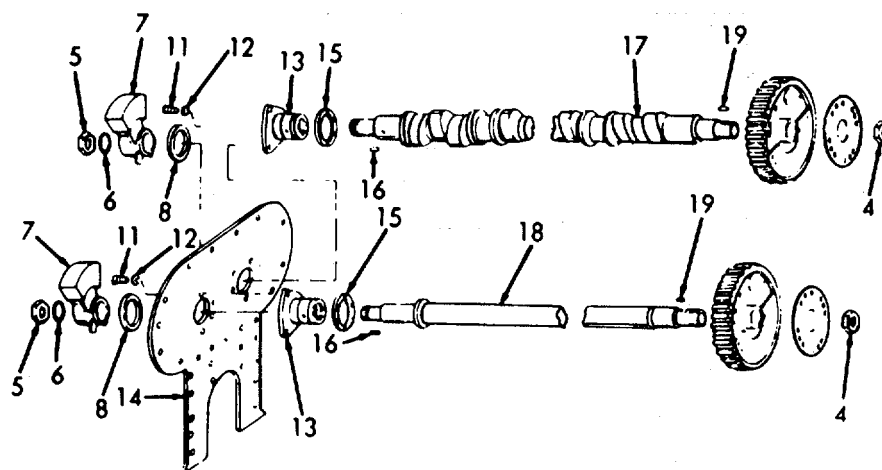
LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
	e. Shaft end bearings	<p>Examine the faces of the shaft end bearings and any other surface which comes into contact with the thrust washers. Parts that are badly marred must be replaced; parts with slight scratches may be cleaned up with an oil stone.</p>	
	f. Camshaft intermediate Bearings	<p>Replace excessively scored or worn camshaft intermediate bearings. The clearance between the camshaft journals and the intermediate bearings is .0025 inch to .005 inch (.0064 to .013 cm) with new parts or a maximum of .009 inch (.023 cm) with worn parts. Camshaft intermediate bearings are available in .010 inch and .020 inch undersize for use with worn or reground shafts in which the clearances exceed the specified limits. Examine the intermediate bearing lockscrews and the tapped holes in the block. Damaged holes in the cylinder block may be plugged, redrilled and tapped. Discard lockscrews with damaged threads.</p>	

3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
4. Camshaft or balance shaft	a. Camshaft (17), or balance shaft (18), and Woodruff keys (19)	Push into cylinder block. Align key with keyway in gear.	Tap shaft into gear with a soft hammer.
	b. Camshaft gear puller, spacers, and adapter plate	Remove.	
	c. Retaining nuts (4)	Install finger tight.	
	d. Thrust washers (15)	1. Apply grease to steel face of each washer. 2. Place thrust washer against inner end of shaft front end bearing.	The steel face of the thrust-washer must be against bearing.
	e. Front end bearings (13), screws (11), and lock-washers (12)	Install and secure to front end plate (14).	Tighten screws to 35-40 ft-lb (47.5-54.2 Nm).

3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
	f. Thrust washers (8)	Install and secure to front end plate (14).	Tighten screws to 35-40 ft-lb (47.5-54.2 Nm).
	g. Balance weights (7), and Woodruff keys (16)	Install.	
	h. Retaining nuts (5), and lock - washers (6)	Install finger tight.	
	i. Wooden block	Place between balance weights (7).	
	j. Retaining nuts (4 and 5)	Tighten.	Tighten to 300-325 ft-lb (406.7-440.6 Nm) torque.

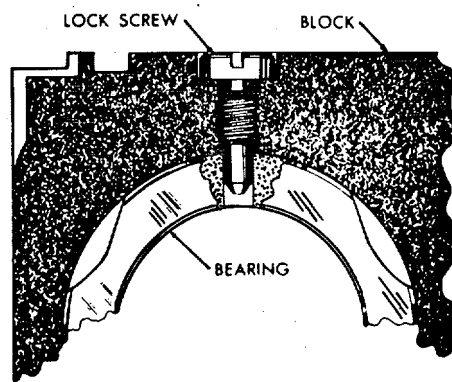


3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

- | | | | |
|--|---|--|---|
| | k. Camshaft intermediate bearings (10), and lock-screws (9) | Align holes in bearings with holes in the top of the cylinder block. | Tighten to 15-27 ft-lb (20.3-27.1 Nm) torque. |
|--|---|--|---|

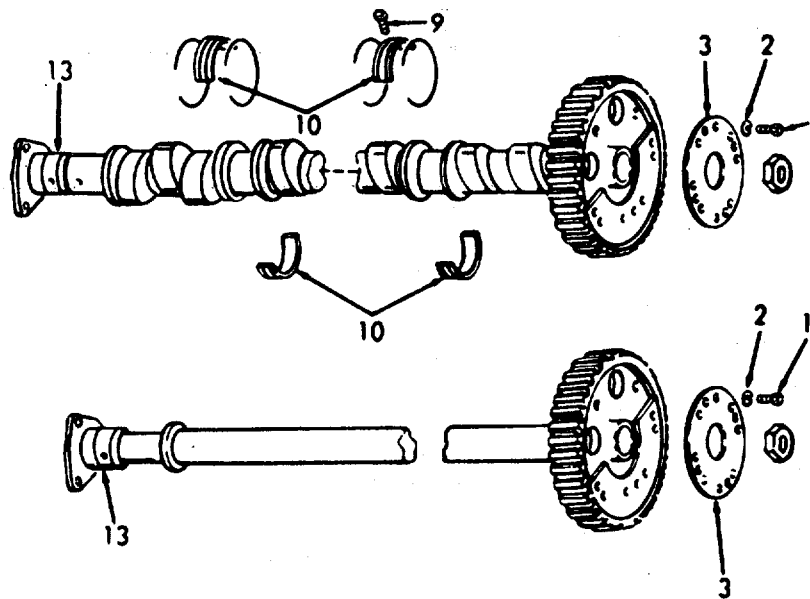


- | | | | |
|--|---|--|--|
| | l. Gear nut retainers (3), screws (1), and lock-washers (2) | Install. | |
| | m. Components removed engine | Replace and refill the cooling system. | |

3-166.5. CAMSHAFT AND BALANCE SHAFT - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



3-167. FLYWHEEL AND HOUSING.

The maintenance instructions for the flywheel and housing are contained in the following paragraphs:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Flywheel	3-167.1
Flywheel Housing	3-167.2

3-167.1. FLYWHEEL - MAINTENANCE INSTRUCTIONS.

a. The flywheel is attached to the rear end of the crankshaft with six self-locking bolts. Two dowels in the end of the crankshaft aid in flywheel alignment and provide support when the flywheel bolts are removed. A scuff plate is used between the flywheel and the bolt heads to prevent the bolt heads from scoring the flywheel surface.

b. A steel ring gear, which meshes with the starting motor pinion, is shrunk onto the rim of the flywheel.

c. The flywheel is machined to provide true alignment with the torque converter.

d. The flywheel must be removed for service operations such as replacing the starter ring gear, crankshaft or flywheel housing.

This task covers:

a. Removal

b. Inspection

c. Installation

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

Lifting tool - J6361-01
Chain hoist
Torque wrench
Dial Indicator

Equipment
Condition Condition Description
Paragraph

3-136 Torque Converter Removal

Material/Parts

International Compound
#2 or equivalent

Special Environmental Conditions

None

Personnel Required

2

General Safety Instructions

None

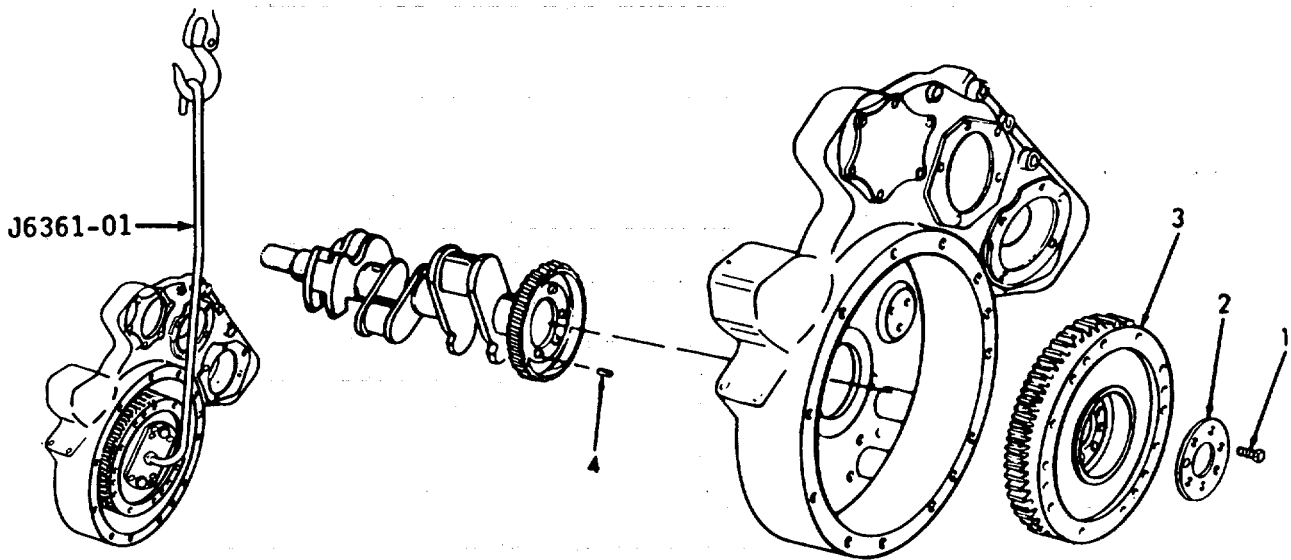
3-167.1. FLYWHEEL - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
1. Flywheel	a. Six bolts (1), and scuff plate (2)	Remove.	
	b. Fly-wheel (3)	<ol style="list-style-type: none"> 1. Attach flywheel lifting tool J 6361-01 to the flywheel with two 7/16 inch-14 bolts of suitable length. Remove remaining flywheel attaching bolt. 2. Attach a chain hoist to the lifting tool to support the flywheel as shown. 3. Move upper end of the lifting tool in and out to loosen flywheel. Then withdraw flywheel from crankshaft and flywheel housing. 	
	c. Dowels (4)	Remove if necessary.	

3-167.1. FLYWHEEL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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REMOVAL (Cont)



INSPECTION

2.
 - a. Check the contact face of the flywheel for scoring, overheating or cracks. If scored, the flywheel may be refaced. However, do not remove more than .020 inch (.051 cm) of metal from the flywheel. Maintain all of the radii when refacing the flywheel.

3-167.1. FLYWHEEL - MAINTENANCE INSTRUCTIONS (Continued)

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION (Cont)

b. Although the flywheel seldom requires replacement, the flywheel ring gear may become worn due to normal usage or damaged by improper use of the starting motor to the extent that it must be replaced. If replacement of the ring gear is necessary, refer to Direct Support Maintenance.

INSTALLATION

3.	a. Dowel pins. (4)	Check the extensions.	The dowels must not extend more than 1/2 inch (1.27 cm) from the crankshaft.
	b. Flywheel (3)	1. Attach flywheel lifting tool J6361-01 to the flywheel with two 7/16 inch-14 bolts. Then, using a chain hoist, position the flywheel in the flywheel housing and over the dowels in the crankshaft.	

NOTE

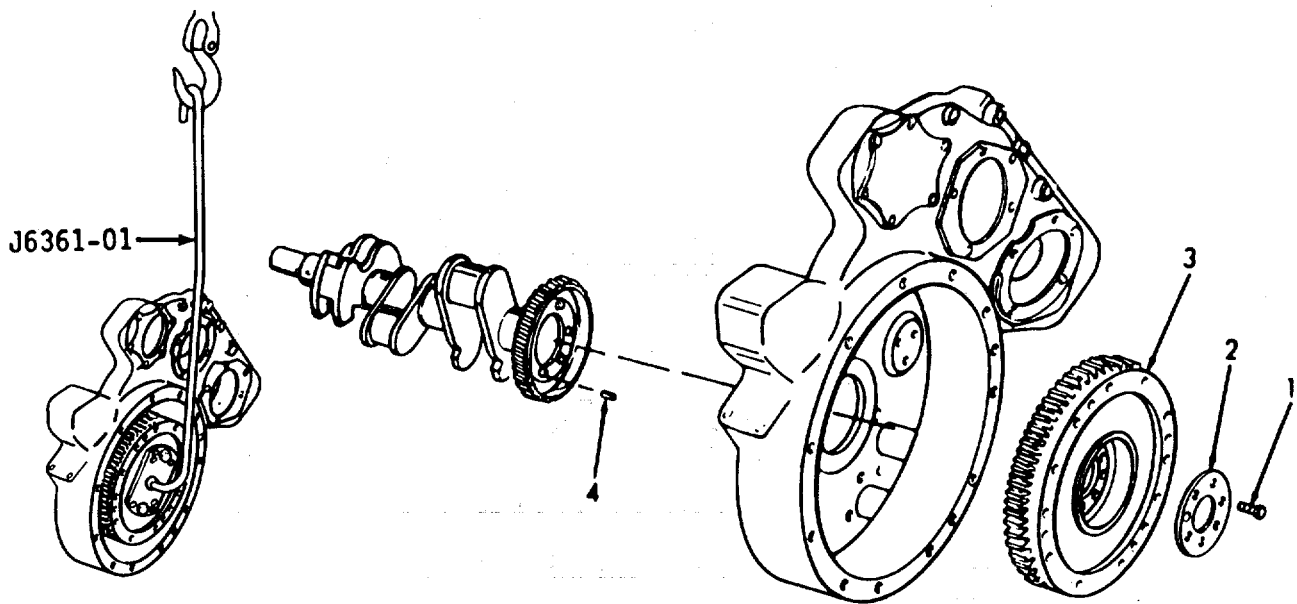
Since one bolt hole is offset, the flywheel can be installed in only one position.

3-167.1. FLYWHEEL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- | | | | |
|----|-----------------|--|--|
| | | 2. Remove the flywheel lifting tool. | |
| c. | Scuff-plate (2) | Place against flywheel. | |
| d. | Bolts (1) | 1. Apply a small quantity of International Compound No. 2 or equivalent, to the threads and contact area of the six attaching bolts. | Install and tighten the 9/16 inch-18 bolts to 180-190 ft-lb (244-258 Nm) torque. |



3-2871

3-167.1. FLYWHEEL - MAINTENANCE INSTRUCTIONS (Continued)

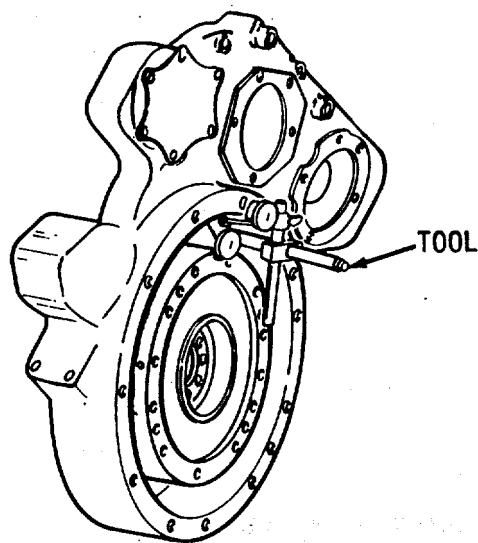
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

NOTE

Tighten the flywheel bolts accurately, but do not exceed the specified torque. International Compound No. 2 must never be used between two surfaces where maximum friction is desired, such as between the crankshaft and the flywheel.

2. Mount a dial indicator on the flywheel housing and check the runout of the flywheel at the clutch contact face. Maximum allowable runout is .001 inch (.003 cm) total indicator reading per inch of radius (the radius is measured from the center of the flywheel to the outer edge of the clutch contact face of the flywheel).



3-167.2. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS.

- a. The flywheel housing is a one-piece casting, mounted against the rear cylinder block end plate, which provides a cover for the gear train and the flywheel. It also serves as a support for the starting motor and the torque converter.
- b. The crankshaft rear oil seal, which is pressed into the housing may be removed or installed without removing the housing (see paragraph 166).

This task covers:

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

INITIAL SETUP

Test Equipment

Concentricity test
Gauges

References
Paragraph

3-154	Overspeed Governor
3-155	Tachometer Drive
3-163	Oil Pan
3-174	Instrument Panel
3-176	Starter Motor

Special Tools

Studs (four)
1/2-13 x 3 1/4 lg.
Chain hoist
Hammer (soft)

Equipment
Condition Condition Description
Paragraph

3-136	Torque Converter Removal
3-154	Overspeed Governor Removal
3-155	Tachometer Drive Removal
3-163	Oil Pan Removal
3-167.1	Flywheel Removal
3-174	Instrument Panel Removal
3-176	Starter Motor Removal

Material/Parts

Gasket kit P/N 5193114

Special Environmental Conditions

None

Personnel Required

2

General Safety Instructions

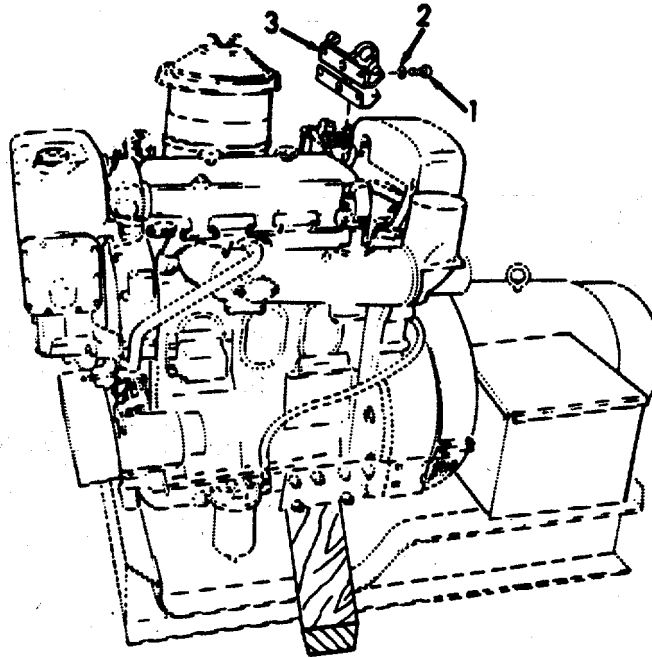
None

3-167.2. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL

- | | | | |
|-----------|---|--|--|
| 1. Engine | a. Engine | Block rear of engine. | |
| | b. Two screws (1), and lock-washers (2) | Remove screws that attach rear engine lifter bracket (3) to cylinder head. | The lifter bracket is left attached to the flywheel housing for ease in removal. |



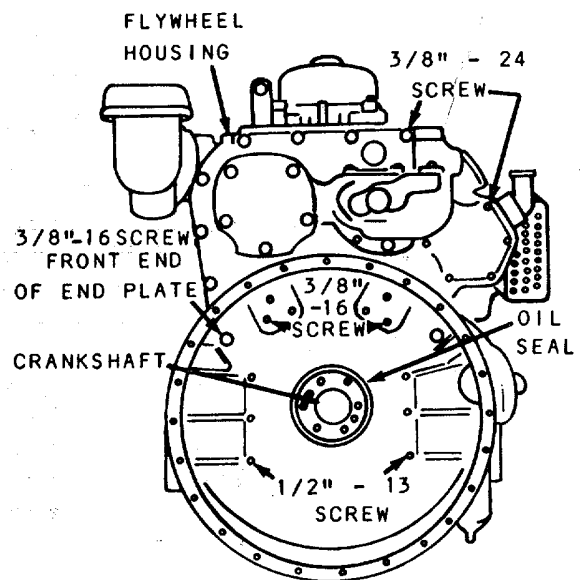
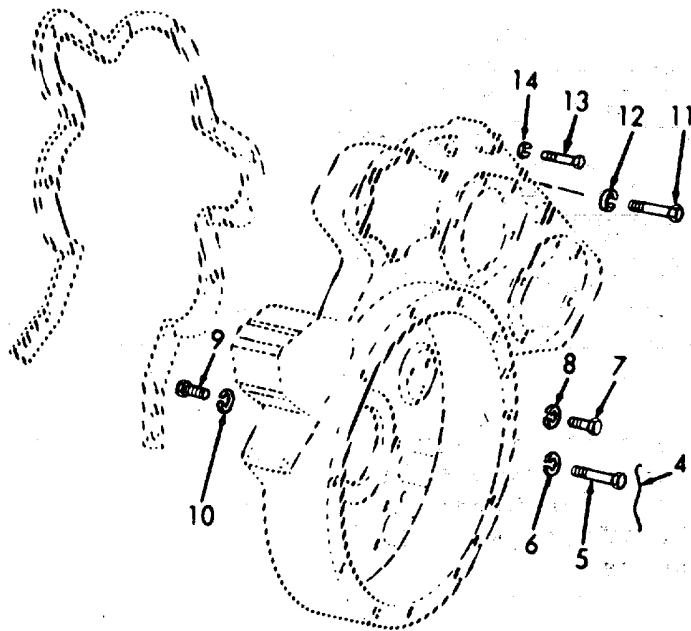
- | | | | |
|---------------------|--|--|-----------------------|
| 2. Flywheel housing | a. Two lock-wires (4) | Cut and remove. | |
| | b. Six bolts (5), and lock-washers (6) | Remove bolts inside flywheel housing bell attaches the housing to the idler gear hub and spacer. | Bolts are 3/8-2 x 16. |

3-167.2. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- | | | | |
|----|---|--|-------------------------------|
| c. | Six screws (7), and lock-washers (8) | Remove screws inside flywheel housing bell which attaches the housing to the cylinder block. | Screws are 1/2-12 x 3 1/4 1g. |
| d. | Two screws (9), and lock-washers (10) | Remove screws which go thru the rear end plate from the front and thread into the housing. | Screws are 3/8-16 x 1 1g. |
| e. | Four screws (11), and lock-washers (12) | Remove. | Screws are 3/8-24 x 4 1g. |



3-167.2. FLYWHEEL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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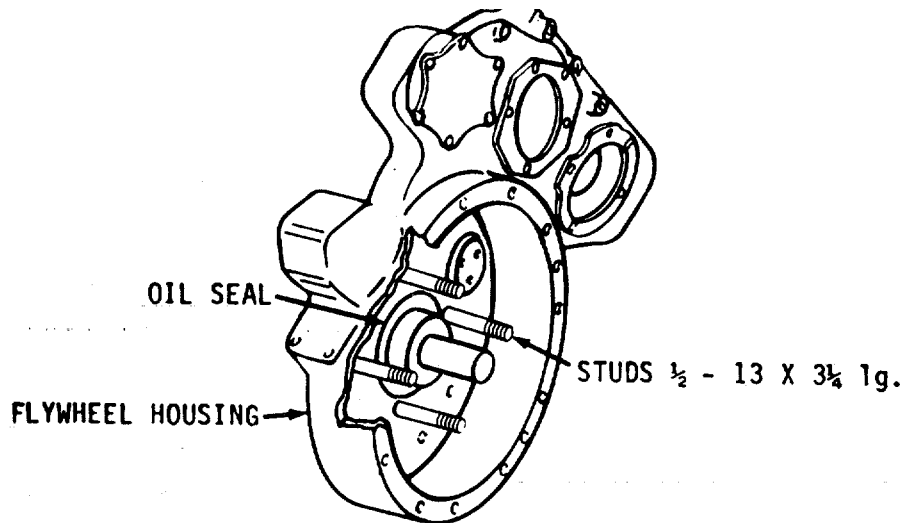
REMOVAL (Cont)

f.	Eight screws (13), and lock-washers (14)	Remove.	Screws are 3/8-24 x 5 1g.
----	--	---------	---------------------------

NOTE

When removing the flywheel housing bolts, note the location of the various bolts and washers so they may be reinstalled in their proper location.

g.	Studs	1. Obtain four pilot studs. 2. Insert in holes where screws were removed.	Studs are 1/2-13x3 1/4 inch 1g.
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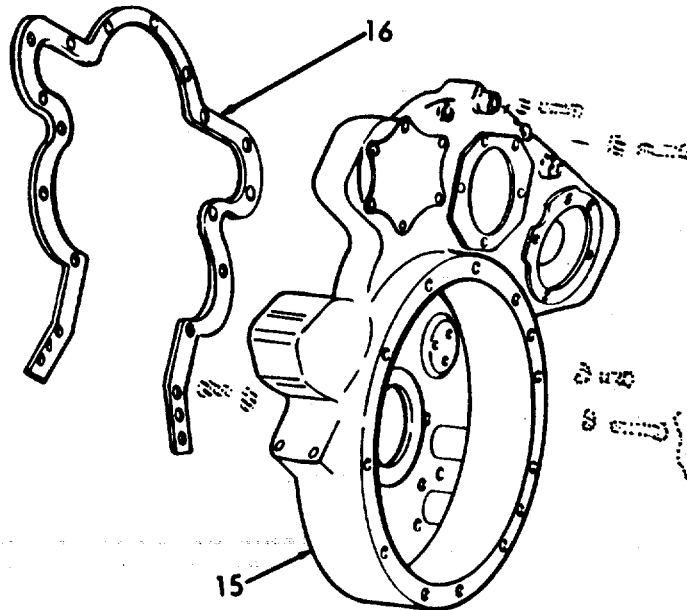
3-167.2. FLYWHEEL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- | | | | |
|----|------------------------|--|--|
| h. | Fly-wheel housing (15) | With the flywheel housing supported by a chain hoist attached to the lifter bracket, strike the front face of the housing alternately on each side with a soft hammer to work it off the dowels and away from the cylinder block rear end plate. | |
| i. | Gasket (16) | Remove. | |

It is very important that all old gasket material be thoroughly removed from the flywheel housing and the end plate.



3-167.2. FLYWHEEL - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION			
3.	Flywheel housing (15)	Clean and inspect for cracks and other damage.	
INSTALLATION			
4. Engine rear plate	a. Gear train	Lubricate the teeth with clean engine oil.	
	b. Gasket (16)	Attach to end plate.	
	c. Oil seal	Coat the lip of the seal with engine oil.	Replace if necessary.
	d. Pilot studs	Install if necessary.	
5. Flywheel housing	a. Flywheel housing (15)	1. Lift with chain hoist.	
		2. Position housing over crankshaft and up against the cylinder block rear end plate and gasket.	
	b. Six bolts (5), ,and flat-washers (6)	Install in positions 1 thru 6 (idler gear hub and idler gear hole spacer).	Bolts are 3/8-16. Tighten finger-tight.

NOTE

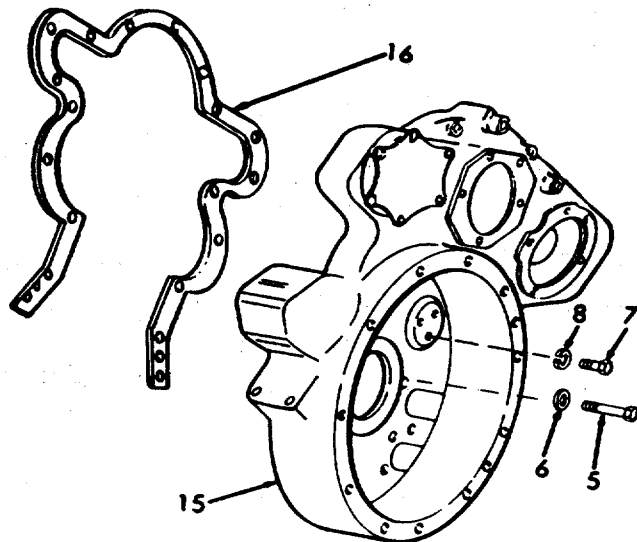
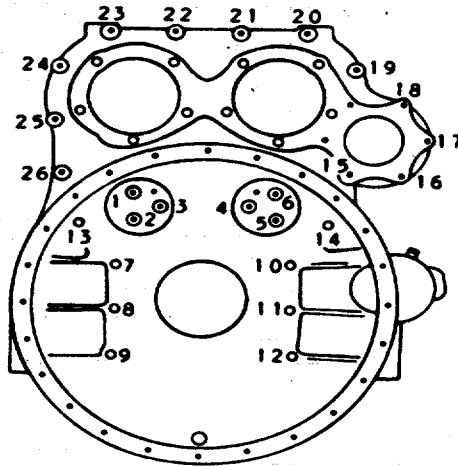
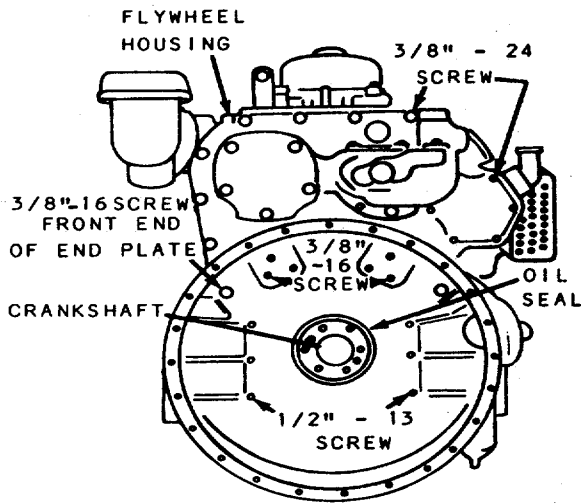
When tightening the idler gear hub bolts, turn the crankshaft to prevent any bind or brinelling of the idler gear bearing. The crankshaft must be rotated for the flywheel housing bell tightening also.

3-167.2. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- | | | | |
|----|--------------------------------------|---------------------------------|---|
| c. | Pilot studs | Remove. | |
| d. | six screws (7), and lock-washers (8) | Install in positions 7 thru 12. | Screws are 1/2-13 X 3 1/4 long. Tighten finger tight. |



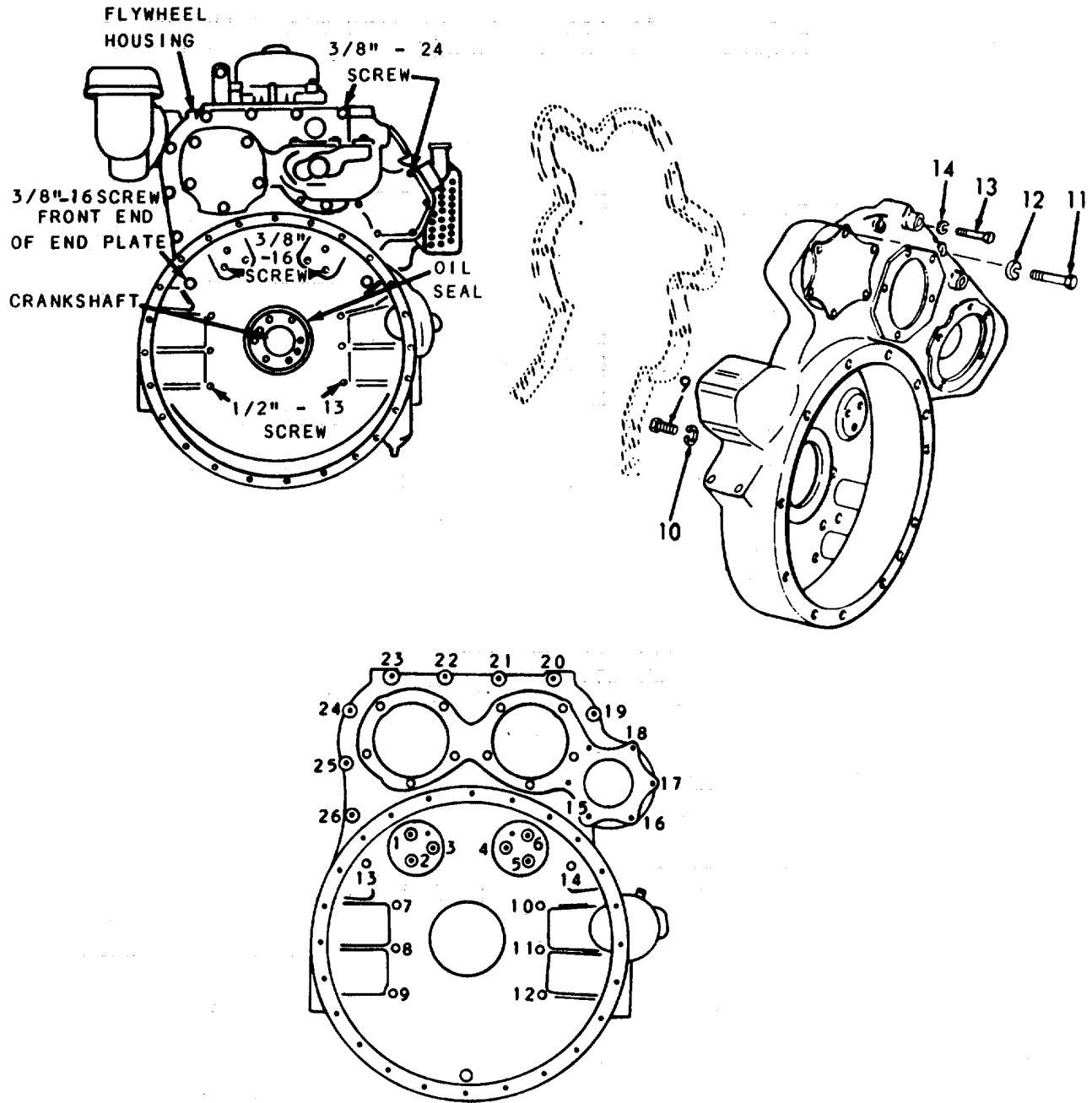
3-167.2. FLYWHEEL HOUS[NG - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
	e. Two screws (9), and lock-washers (10)	Install in positions 13 and 14.	Screws are 3/8-16 x 1 1g. Tighten finger tight.
	f. Four screws (11), and lock-washers (12)	Install in positions 15 thru 18.	Screws are 3/8-24 x 4 1g. Tighten finger tight.
	g. Eight screws (13), and lock-washers (14)	Install in positions 19 thru 26.	Screws are 3/8-24 x 5 1g. Tighten finger tight.

3-167.2. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)



3-167.2. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

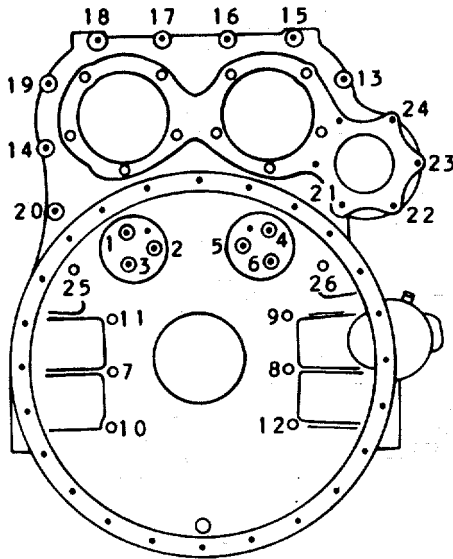
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

h.	Bolts and screws	Start at one and tighten in sequence, drawing mating parts together evenly.	Tighten to torque shown in table.
----	------------------	---	-----------------------------------

TORQUE

Bolts and Screws	lb-ft	Nm
1/2-13	75-85	102.4-116.0
3/8-16 (bolts)	15-25	20.5-34.1
3/8-16	15-20	20.5-27.3
3/8-24	15-20	20.5-27.3



3-167.2. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

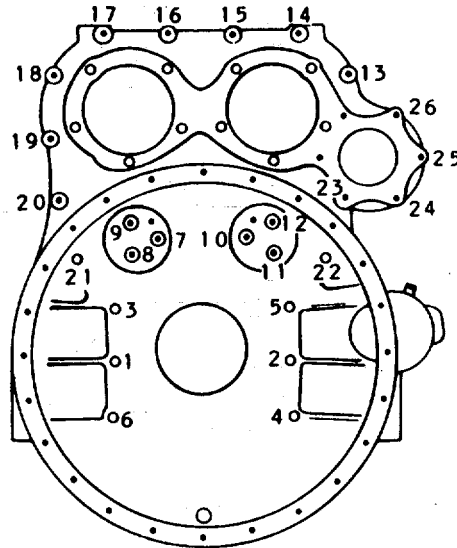
- | | | | |
|----|------------------|---------------------------------------|-----------------------------------|
| i. | Bolts and screws | Start at one and tighten in sequence. | Tighten to torque shown in table. |
|----|------------------|---------------------------------------|-----------------------------------|

TORQUE

Bolts and Screws	lb-ft	Nm
1/2-13	90-100	122.9-136.5
3/8-16 (bolts)	25-40	34.1- 54.6
3/8-16	25-30	34.1- 41.0
3/8-24	25-30	34.1- 41.0

NOTE

Be sure to rotate the crankshaft when tightening the idler gear hub bolts and flywheel housing bell.



3-167.2. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
	j. Lockwire bolts 3, 1, 6, 5, 2l and 4	Install two lockwires, locking each group of three bolts together.	The bolt heads should be lined up.
NOTE			
The idler gear hub and spacer bolts are tightened to 25-40 ft-lb (34.1-54.6 Nm) torque. The wide range in torque specification permits alignment of the bolt heads.			
6.	Flywheel	Install.	Refer to paragraph 3-165.1.
7.	Flywheel housing	Check the flywheel housing concentricity and bolting flange face as follows: a. Thread base post tightly into one of the tapped holes in the flywheel. Then assemble the dial indicators on the base post.	

3-167.2. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- b. Position the dial indicators straight and square with the flywheel housing bell face and inside bore of the bell. Make sure each indicator has adequate travel in each direction.

NOTE

If the flywheel extends beyond the housing bell, the bore and face must be checked separately. Use the special adaptor in the tool set to check the housing bore.

- c. Pry the crankshaft towards one end. Play is in one direction only.
- d. Adjust each dial indicator to read zero at the twelve o'clock position. Then rotate the crankshaft one full revolution, taking readings at 450 intervals (8 readings each for the bore and the bolting flange (face). Stop and remove the wrench or cranking bar before recording each reading to ensure accuracy. The maximum total indicator reading must not exceed .013 inch (.033 cm) for either the bore or the face.

3-167.2. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION (Cont)			
	<ul style="list-style-type: none"> e. If the run-out exceeds the maximum limits, remove the flywheel housing and check for dirt or foreign material between the end plate and flywheel housing, and the new gasket end plate and flywheel housing, and between the end plate and the cylinder block. f. Reinstall the flywheel housing and the flywheel, and tighten the attaching bolts in the proper sequence and to the specified torque. Then recheck the run-out. If necessary, replace the flywheel housing. 		
8. Lifter bracket (3)	<ul style="list-style-type: none"> a. Screws (17), lock-washers (18), and bracket (3) 	Remove from flywheel housing.	
	<ul style="list-style-type: none"> b. Gasket (19) 	Remove.	Discard gasket.
	<ul style="list-style-type: none"> c. Gasket (19) 	Affix new gasket to brackets	

3-167.2. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

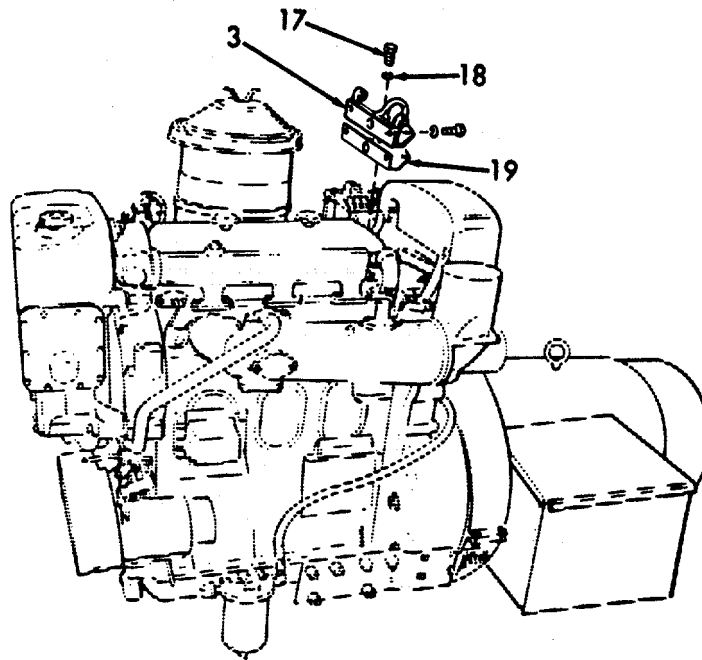
LOCATION	ITEM	ACTION	REMARKS
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INSTALLATION (Cont)

d. Screws (1 and 17), and lock-washers (2 and 18)

Install.

Alternately tighten the bracket-to-fly-wheel housing screws (17), and the bracket-to-cylinder head screws (1), which will draw the bracket into the corner formed by the cylinder head and housing.



9. Oil pan

Reinstall.

Refer to paragraph 3-163.

10. Components

Remove. Reinstall.

3-168. LUBE OIL PRESSURE REGULATOR AND OIL BY-PASS VALVE.

The maintenance instructions for the lube oil pressure regulator and the oil by-pass valve are contained in the following paragraphs:

<u>DESCRIPTION</u>	<u>PARAGRAPH</u>
Lube Oil Pressure Regulator	3-168.1
Oil By-pass Valve	3-168.2

3-168.1. LUBE OIL PRESSURE REGULATOR - MAINTENANCE INSTRUCTIONS.

- a. Stabilized lubricating oil pressure is maintained within the engine at all speeds, regardless of oil temperature, by means of a regulator installed between the oil pump outlet pipe and the cylinder block.
- b. The regulator assembly consists of a body, a hollow piston-type valve, a compression spring, and a plug to retain the spring in the body.
- c. The valve is held on its seat by the spring, which is compressed by the plug screwed into the valve opening in the regulator body. The entire assembly is bolted to the lower flange of the cylinder block and sealed against oil leaks by a gasket between the two members. When conditions are such that the oil pressure at the valve exceeds 50 pounds per square inch (35.2 kg/cm sq) the valve is forced from its seat and oil from the engine gallery is by-passed to the engine oil pan. Thus, stabilized lubricating oil pressure is maintained at all times regardless of oil temperature.
- d. Under normal conditions, the pressure regulator should require very little attention. If sludge has been allowed to accumulate in the lubricating system, the valve may not work freely, thereby remaining open or failing to open at the normal operating pressure.
- e. Whenever the lubricating oil pump is removed for inspection the regulator valve and spring should also be removed, thoroughly cleaned in fuel oil and inspected.

3-168.1. LUBE OIL PRESSURE REGULATOR - MAINTENANCE INSTRUCTIONS
(Continued).

This task covers:

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

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

Equipment	
<u>Condition</u>	<u>Condition Description</u>
Paragraph	

3-161	Oil Pan Removal
-------	-----------------

Material/Parts

Gasket Kit P/N 5193114

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe all WARNINGS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL

- | | | | |
|---------------------------|-------------------------------------|---------|-----------------|
| 1. Oil pressure regulator | a. Screws (1), and lock-washers (2) | Remove. | |
| | b. Gasket (3) | Remove. | Discard gasket. |
| | c. Screws (4), and lock-washers (5) | Remove. | |

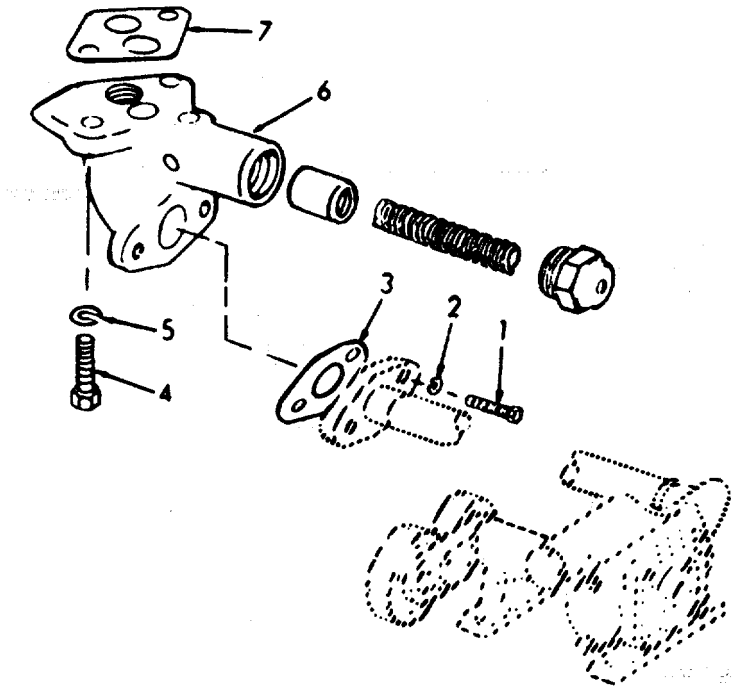
3-168.1. LUBE OIL PRESSURE REGULATOR - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)

- d. Regulator Remove.
(6),
and
gasket
(7),

Discard gasket.



3-168.1. LUBE OIL PRESSURE REGULATOR - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
DISASSEMBLY			
2.	a. Plug (8)	Clamp the flange of the body in a vise and remove the plug.	
	b. Spring (9), and valve (10)	Remove.	

INSPECTION

WARNING

Wear eye protection when using compressed air.

3.	a. Clean all parts in fuel oil, and dry with compressed air.		
	b. Inspect all parts for wear or damage.		

REASSEMBLY

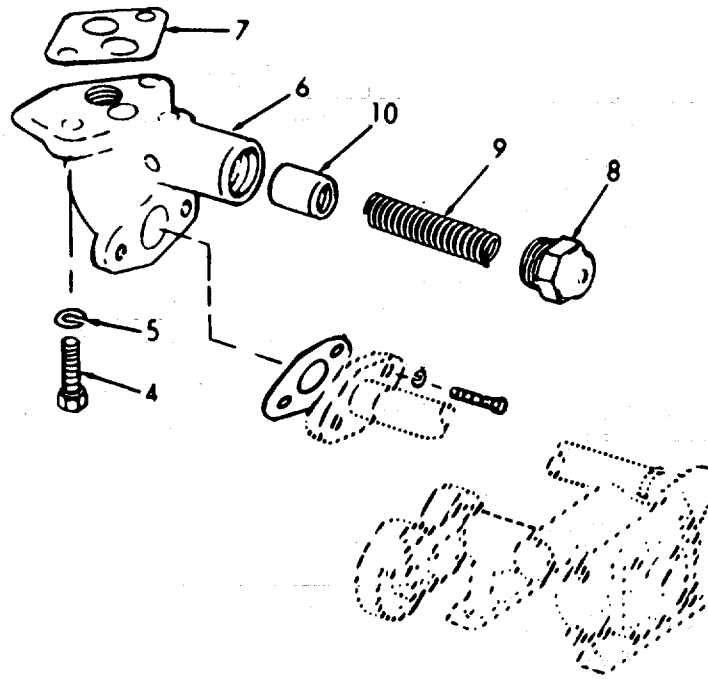
4.	a. Valve (10)	Apply clean engine oil to the outer surface of the valve and slide the valve into the regulator body, closed end first.	
----	---------------	---	--

3-168.1. LUBE OIL PRESSURE REGULATOR - MAINTENANCE INSTRUCTIONS
(Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

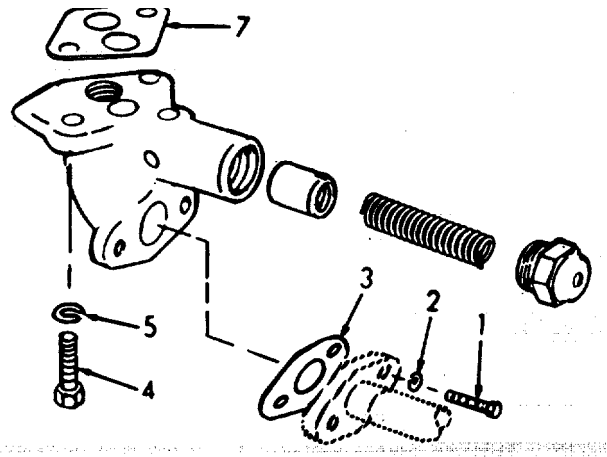
REASSEMBLY (Cont)

- | | | | |
|----|--------------------------|---|--|
| b. | Spring (9), and plug (8) | Insert the spring into the valve. While compressing the spring, start the plug into the body. Tighten the plug. | |
|----|--------------------------|---|--|



3-168.1. LUBE OIL PRESSURE REGULATOR - MAINTENANCE INSTRUCTIONS-
(Continued).

LOCATION	ITEM	ACTION	REMARKS
INSTALLATION			
5.	a. Gaskets	Remove all traces of the old gaskets from the regulator body, cylinder block, and pump outlet pipe flange.	
	b. Gasket (7)	Affix new gasket to the regulator body with oil passage holes in the gasket in alignment with the oil passages in the body.	
	c. Screws (4), and lock-washer (5)	Install.	
	d. Gasket (3)	Insert new gasket.	
	e. Screws (1), and lock-washers (2)	Install.	



3-168.2. OIL BY-PASS VALVE - MAINTENANCE INSTRUCTIONS.

a. To assure proper lubrication if the oil cooler core becomes clogged, a valve, located between the oil inlet and the core, by-passes the oil around the cooler directly to the oil gallery in the cylinder block.

b. The by-pass valve should be removed, cleaned and reassembled whenever the cooler core is cleaned or replaced. However, if required, the by-pass valve can be removed without removing the oil cooler.

This task covers:

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

INITIAL SETUP

Test Equipment

None

References

None

Special Tools

None

<u>Equipment Condition</u>	<u>Condition Description</u>
Paragraph	

3-163 Oil Pan Removal

Material/Parts

Gasket Kit P/N 5194800

Special Environmental Conditions

None

Personnel Required

1

General Safety Instructions

Observe WARNING in procedure.

3-168.2. OIL BY-PASS VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL			
1. By-pass valve	a. Cap (1), and gasket (2)	Remove	Discard gasket.
	b. Spring (3)	Remove.	
	c. Valve (4)	Remove.	

INSPECTION



Wear eye protection when using compressed air.

- | | | | |
|----|---|--|--|
| 2. | a. Wash all parts with clean fuel oil, and dry with compressed air. | | |
| | b. Inspect all parts for wear. | | |

INSTALLATION

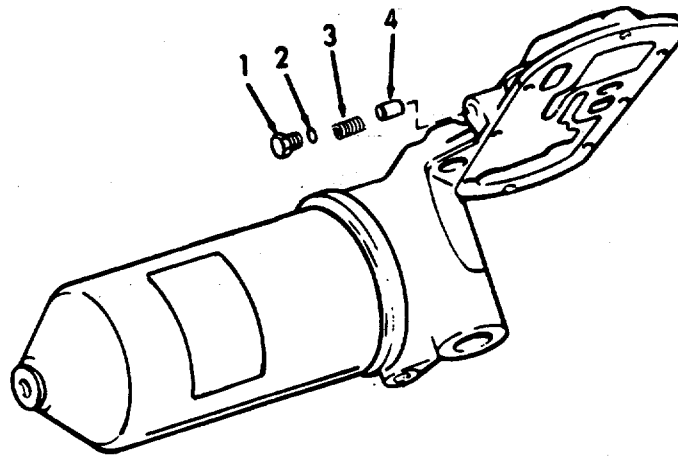
- | | | | |
|----|------------------------------|---------|--|
| 3. | a. Valve (4), and spring (3) | Insert. | |
|----|------------------------------|---------|--|

3-168.2. OIL BY-PASS VALVE - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- | | | |
|----------------------------|-----------------------|-----------------|
| b. Cap (1), and gasket (2) | Assemble and install. | Use new gasket. |
|----------------------------|-----------------------|-----------------|



3-169. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS.

- a. The gear-type oil pump is mounted on the first and second main bearing caps and is gear-driven from the, front end of the crankshaft.
- b. The oil pump helical gears rotate inside a housing. The drive gear is keyed to the drive shaft which is supported inside the housing on two bushings with a drive-driven gear keyed to the outer end of the shaft. The driven gear is supported on the driven gear shaft which is pressed into the pump body.
- c. An integral plunger-type relief valve by-passes excess oil to the inlet side of the pump when the pressure in the oil lines exceeds 105 pounds per square inch (724kPa).
- d. An inlet pipe, attached to the inlet opening in the pump body, leads to the inlet screen which is mounted with brackets to a main bearing cap.
- e. The inlet screen is located below the oil in the pan and serves to strain out any foreign material which might damage the pump.
- f. The oil pump inlet screen should be removed and cleaned periodically in addition to the cleaning it receives each time the engine is reconditioned.
- g. An idler gear is mounted on a support bracket which is attached to the pump body.
- h. Pressure lubrication of the idler gear bushing is provided by means of a drilled passage in the pump body and a connecting passage in the idler gear support bracket.

3-169. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

This task covers:

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

INITIAL SETUP

Test Equipment

Feeler gage

References
Paragraph

3-168.1 Oil Pressure Regulator

Special Tools

Torque wrench

Equipment Condition Condition Description
Paragraph

3-163 Oil Pan Removal

Material/Parts

Gasket Kit P/N 5193114

Special Environmental Conditions

Do not drain oil into bilges.
Use oil/water separation and recovery system to collect used oil.

Personnel Required

1

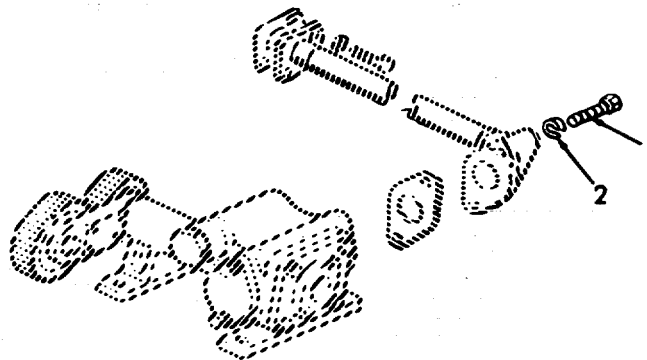
General Safety Instructions

Observe all CAUTIONS and WARNINGS.

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL

- | | | | |
|-------------|-------------------------------------|---------|--|
| 1. Oil pump | a. Screws (1), and lock-washers (2) | Remove. | |
|-------------|-------------------------------------|---------|--|



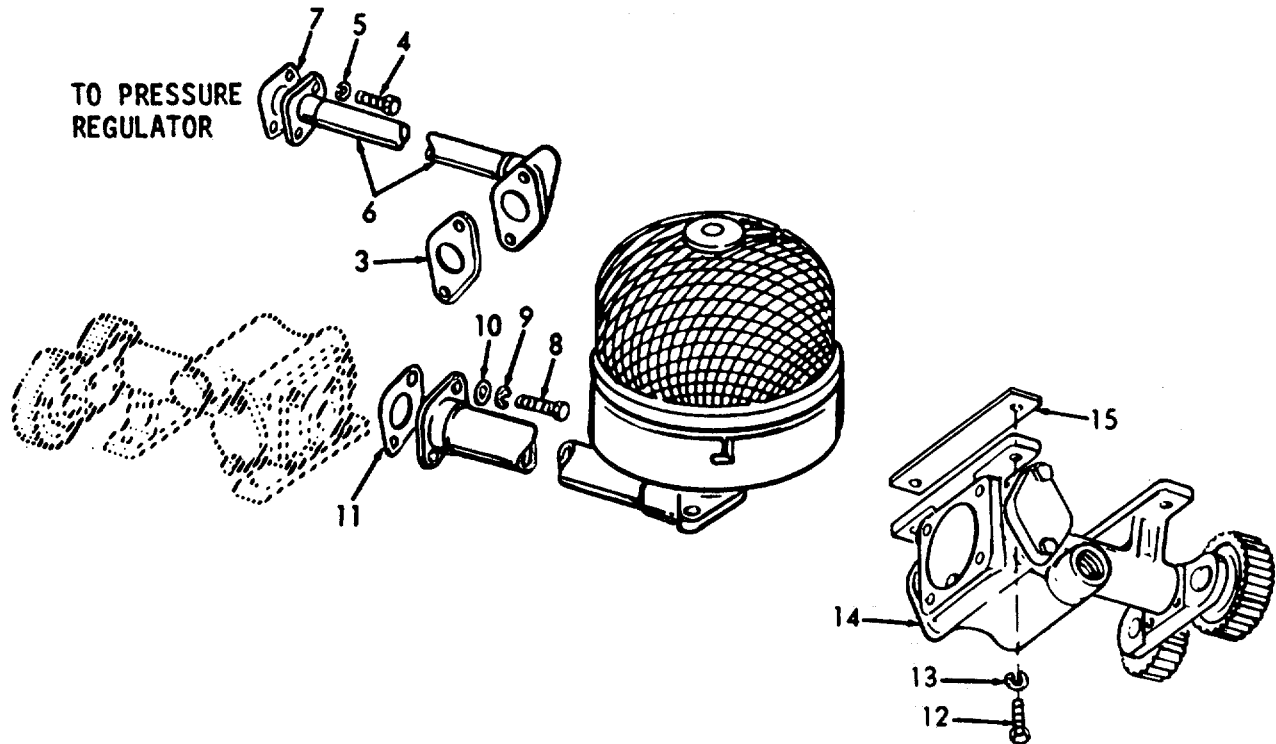
3-169. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
REMOVAL (Cont)			
	b. Gasket (3)	Remove.	Discard gasket.
	c. Screws (4), and lock- washers (5)	Remove.	
	d. Outlet pipe (6)	Remove.	
	e. Gasket (7)	Remove.	Discard gasket.
	f. Screws (8), lock- washers (9), and flat- washers (10)	Remove.	Discard gasket.
	g. Gasket (11)	Remove.	Discard gasket.
	h. Screws (12), and lock- washers (13)	Remove.	
	i. Oil pump (14), and shims (15)	Remove.	Do not discard shims.

3-169. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL (Cont)



INSPECTION

WARNING

Wear protective eye goggles when using compressed air.

2.
 - a. Wash all parts in clean fuel oil and dry with compressed air.

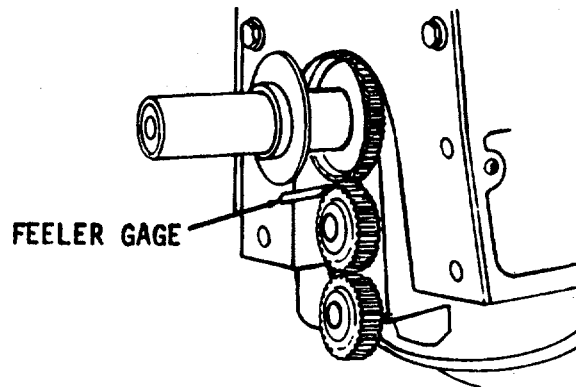
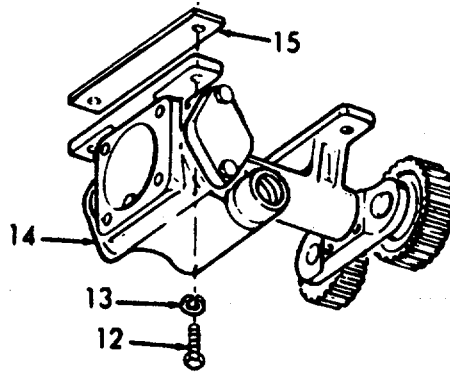
3-169. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
INSPECTION (Cont)			
	b. Gears		Gears should have a free-running fit (not loose) in the pump housing. If the gear teeth are scored or worn, refer to Direct Support Maintenance.
INSTALLATION			
3.	a. Oil pump (14), and shim (15)	Hold the pump assembly against the main bearing caps so the idler gear meshes with the driving gear on the crankshaft.	
	b. Screws (12), and lock-washers (13)	Insert the four bolts with lockwashers thru the mounting feet of the pump and into the bearing caps. Align the pump so that the teeth of the crankshaft gear and the idler gear are parallel; then tighten the bolts to 35-39 ft-lb (47.8-53.2 Nm) and check clearance between the gear teeth with a feeler gage. Proper clearance between the crankshaft gear and the idler gear is .005 inch (0.013 cm) minimum - .012 inch (0.030 cm) maximum.	

3-169. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)



CAUTION

Always check the clearance between the crankshaft gear and the oil pump idler gear with the engine in the upright or running position.

If shims were used between the pump mounting feet and the bearing caps and new gears are not installed, the same shims (cleaned), or the same number of new (identical) shims should be installed and the number then adjusted to obtain the proper clearance between gear teeth. However, if new gears have been installed, a larger number of shims will be required under the mounting feet. In either event, the pump must be tightened on the bearing cap before the clearance between the gear teeth is measured.

3-169. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

NOTE

When adjusting for gear tooth clearance by installing or removing shims, the same number of shims must be changed under each foot so that the pump will always be level on the main bearing caps. The insertion or removal of one .005 inch (0.013 cm) shim will change the gear tooth clearance by .0035 inch (0.0089 cm).

c.	Gasket (7), outlet pipe (6), screws (4), and lock-washers (5)	Assemble.	Use new gasket. Leave screws loose.
d.	Gasket (3), screws (1), and lock-washers (2)	Assemble.	Use new gasket. Leave screws loose.

NOTE

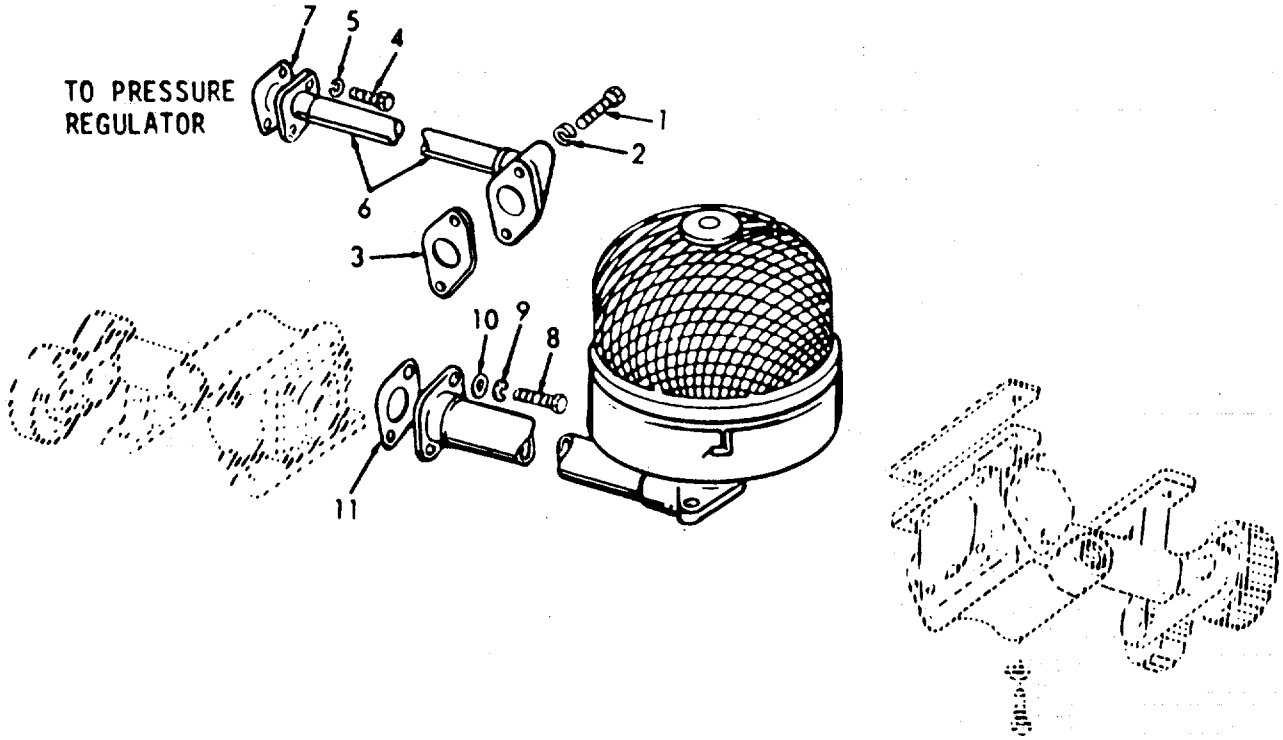
When attaching the pump outlet and the pressure regulator, none of the bolts should be tightened until all the bolts have been started. After all bolts are started, the outlet pipe bolts (1) should be tightened alternately, then the pressure regulator bolts (8) should be tightened, and finally the pipe-to-regulator screws (4) should be secured. This procedure prevents twisting the outlet pipe.

3-169. LUBE OIL PUMP - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

INSTALLATION (Cont)

- | | | | |
|----|--|-----------|-----------------|
| e. | Gasket (11), screws (8), lock-washers (9), and flat-washers (10) | Assemble. | Use new gasket. |
|----|--|-----------|-----------------|



3-170. LUBE OIL DISTRIBUTION SYSTEM - MAINTENANCE INSTRUCTIONS.

The oil distribution system consists of the oil inlet pipe and screen.

This task covers:

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

INITIAL SETUP

Test Equipment

None

Special Tools

None

Material/Parts

Gasket kit P/N 4193114

Personnel Required

1

References

None

Equipment

Condition Condition Description

None

Special Environmental Conditions

None

General Safety Instructions

Observe all WARNINGS

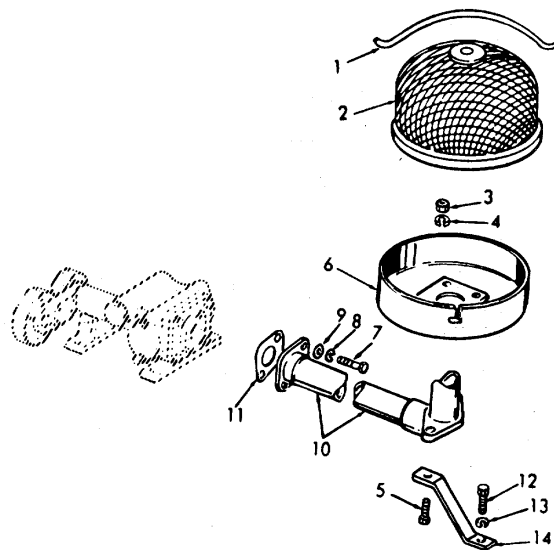
LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

REMOVAL

- | | | |
|--------------------------|--|---------|
| 1. Oil Pump inlet screen | a. Retainer (1), and screen (2) | Remove. |
| | b. Two nuts (3), lock-washers (4) and screws (5) | Remove. |

3-170. LUBE OIL DISTRIBUTION SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
<div style="border: 1px solid black; padding: 2px; display: inline-block;">REMOVAL (Cont)</div>	c. Cover (6)	Remove.	
	d. Screws (7), lock-washers (8), and flat-washers (9)	Remove.	
	e. Inlet pipe (10), and gasket (11)	Remove.	Discard gasket.
	f. Screws (12), lock-washers (13), and brackets (14)	Remove.	



3-170. LUBE OIL DISTRIBUTION SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

WARNING

2. Wear eye protection when using compressed air.
- a. Clean all parts in clean fuel oil and dry with compressed air.
 - b. Inspect all parts for wear or damage.

INSTALLATION

- 3.
- a. Brackets (14), screws (12) and lock-washers (13)
 - Install.
 - b. Inlet pipe (10), gasket (11), screws (7), lock-washers (8), and flat-washers (9)
 - Reassemble.
 - Use new gasket.

3-170. LUBE OIL DISTRIBUTION SYSTEM - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION	ITEM	ACTION	REMARKS
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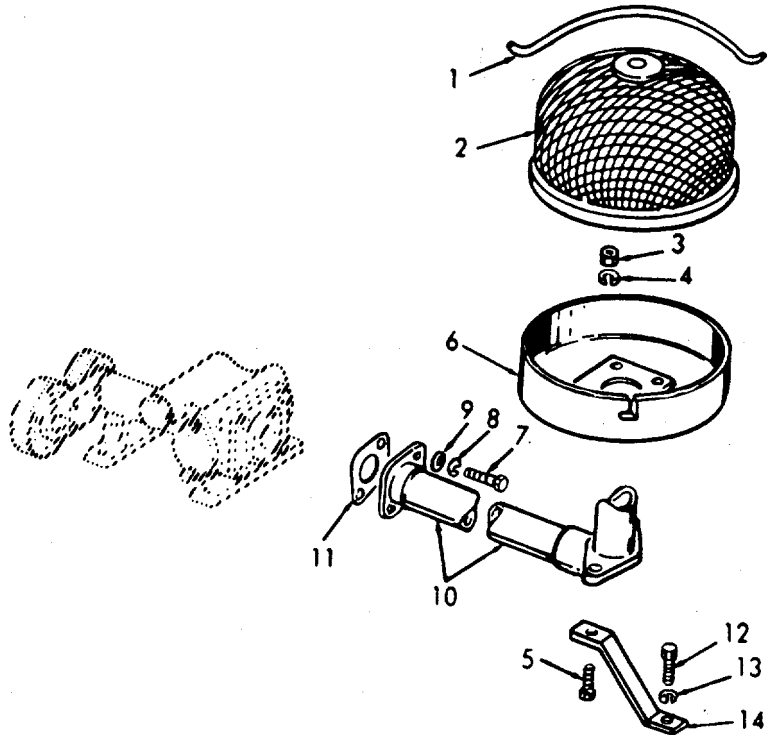
INSTALLATION (Cont)

- c. Screws (5), cover (6), nuts (3), and lock-washers (4)

Reassemble.

- d. Screen (2), and retainer (1)

Reassemble.



APPENDIX A

REFER TO VOLUME 12

APPENDIX B
MAINTENANCE ALLOCATION CHART
SECTION I. INTRODUCTION

B-1. GENERAL.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component and the work measurement time required to perform the functions by the designated maintenance level. The implementation of the maintenance functions upon the end item or components will be consistent with the assigned maintenance functions.

c. Section III lists the tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV lists the remarks referenced from Section II.

B-2. EXPLANATION OF COLUMNS IN Section II.

a. Column (1), Group Number. Column 1 lists group numbers to identify related components, assemblies, subassemblies, and modules with their next higher assembly. The applicable groups are listed in the MAC in disassembly sequence beginning with the first group removed.

b. Column (2), Component/Assembly. This column contains the known names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column (3), Maintenance Functions. This column lists the functions to be performed on the item listed in Column 2. The maintenance functions are defined as follows:

(1) Inspect. To determine serviceability of an item by comparing its physical, mechanical, or electrical characteristics with established standards through, examination.

(2) Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item, and comparing those characteristics with prescribed standards.

(3) Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

(4) Adjust. To maintain within prescribed limits, by grinding into proper or exact position, or by setting the operating characteristics to specified parameters.

(5) Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

(6) Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consist of comparison of two instruments, one of which is a certified standard of known accuracy to detect and adjust any discrepancy in the accuracy of the instrument being compared.

(7) Install. The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

(8) Replace. The act of substituting a serviceable like type part, subassembly or module (component or assembly) for an unserviceable counterpart.

(9) Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing remachining or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

(10) Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards in appropriate technical manuals. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to a like-new condition.

(11) Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with organizational manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered to classifying Army equipments/components.

d. Column (4), Maintenance Level. This column is made up of sub-columns or each category of maintenance. Work time figures are listed in these subcolumns for the lowest level of maintenance authorized to perform the function listed in Column 3. These figures indicate the average active time required to perform the maintenance function at the indicated category of maintenance under typical field operating conditions.

e. Column (5), Tools and Equipment. This column is provided for referencing by code, the common tool sets (not individual tools) special tools, test and support equipment required to perform the designated functions.

f. Column (6), Remarks. This column is provided for referencing by code of the remarks pertaining to the designated functions.

B-3. EXPLANATION OF COLUMNS IN Section III.

a. Column (1), Reference Code. The tool and test equipment referenced code correlates with a maintenance function on the identified end item or component.

b. Column (2), Maintenance Level. The lowest level of maintenance authorized to use the tool or test equipment.

c. Column (3), Nomenclature. Name or identification of the tool or test equipment.

d. Column (4), National/NATO Stock Number. The National or NATO stock number of the tool or test equipment.

e. Column (5), Tool Number. The manufacturer's part number.

SECTION II.

MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT	(6) REMARKS
			C	O	F	H	D		
0300	Bow Ramp and Winch	Inspect	.5						
0310	Bow Ramp, Sheaves, and Fairleads	Replace			12.0				
		Repair	2.5						
0320	Winch Assembly	Inspect	.3						
		Replace			80.0				
		Repair	20.0						
		Overhaul			10.0				
0322	Torque Coupling	Inspect	.3						
		Replace	2.5						
		Repair	2.5						
0323	Speed Reducer	Inspect	.3						
		Replace			25.0				
		Repair	1.0						
		Overhaul			10.0				
0324	Winch Brake and Motor	Inspect	.4						
		Test	1.0						
		Replace			4.5				
		Repair	2.0						
		Overhaul			20.0				
0325	Controller	Inspect	.2						
		Replace	3.5						
		Repair			2.0				
0326	Master Switch	Inspect	.3						
		Replace			2.0				
		Repair	2.5						
0327	Limit Switches	Inspect	.3						
		Replace	1.5						
		Repair	2.0						
0400	Stern Gate	Inspect	.6						
		Service	1.0						
		Replace			7.0				
		Repair			15.0				
0410	Gate, Hinges, Springs	Inspect	.6						
		Replace			7.0				
		Repair			15.0				
0420	Portable Davit	Inspect	.3						
		Replace	1.5						
		Repair			3.5				
0500	Anchor Handling System								
0510	Winch	Inspect	.3						
		Service	.4						
		Replace			100.0				
		Repair	2.0		29.0				
		Overhaul			30.0				

SECTION II.

MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT	(6) REMARKS
			C	O	F	H	D		
0511	Drive Brake	Inspect	.3						
		Service	.5						
		Replace	3.0						
		Repair	5.5		7.5				
		Adjust	1.0		1.0				
0512	Drive Gear	Inspect	.5		2.5				
		Replace			9.0				
		Repair	2.5						
0513	Level Wind	Overhaul			40.0				
		Inspect	.3						
		Service	.2						
		Replace			15.0				
0514	Drum Assembly	Repair	1.5		5.5				
		Overhaul			20.0				
		Inspect	.2						
		Service	.3						
0515	Slack Puller	Replace			30.0				
		Repair	2.5		4.5				
		Inspect	.2						
		Service	.2						
0516	Disconnect Clutch	Replace			20.0				
		Repair	5.0		15.0				
		Overhaul			24.0				
		Inspect	.3						
0517	Torque Converter	Service	.2						
		Replace			4.5				
		Repair			3.5				
		Inspect	.3						
0518	Hydraulic Tank Assembly	Service	.6						
		Replace	3.5						
		Repair	20.0		2.0 (weld)				
		Overhaul			40.0				
0519	Winch Control	Inspect	.2						
		Service	.3						
		Replace	2.0						
		Repair	2.5						
0519A	Hoses, Lines and Fittings	Inspect	.5						
		Repair	2.5						
		Replace	2.5						
0520	Engine	Inspect	.3						
		Service	1.0						
		Replace			30.0				
		Repair	8.5						
		Overhaul			40.0				
		Test			8.0				

SECTION II.

MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT	(6) REMARKS
			C	O	F	H	D		
0521	Diesel Throttle Controls	Inspect	.2						
		Service	.3						
		Replace			2.5 (Weld)				
0522	Governor	Repair	2.5						
		Inspect	.2						
		Test			1.0				
0523	Air Intake	Replace	1.0						
		Repair	1.0					3,4,5,6	
		Overhaul			6.0				
0524	Blower	Inspect	.2						
		Service	.4						
		Replace	1.5						
0525	Fuel Pump	Repair	3.0						
		Inspect	.3						7,8,9,49
		Service	.4						
0526	Fuel Filter and Strainer	Replace	2.0						
		Repair	1.0						
		Overhaul			8.0				
0527	Fuel Injector	Inspect	.2						
		Replace	1.0						10,11
		Repair			1.5				
0528	Lube Oil Filter, Hoses and Housing	Inspect	.2						
		Service	.5						
		Replace	1.5						
0529	Lube Oil Cooler	Repair	1.5						
		Inspect	.1						
		Test	.3		.5				
0530	Fresh Water Pump	Replace	1.5						
		Repair	1.5						12,13,14 15,50
		Overhaul			1.0				
0531	Water Connections	Inspect	.2						
		Service	.4						
		Replace	1.5						
0532	Water Manifold	Repair	1.4						
		Inspect	.2						
		Replace	1.2						
0533	Thermostat and Housing	Repair	1.5						
		Inspect	.2						11,16,17 18,19,51
		Replace	1.2						
0533	Thermostat and Housing	Repair			2.5				
		Inspect	.2						
		Repair	1.5						
0533	Thermostat and Housing	Inspect	.2						
		Replace	1.2						
		Repair	1.0			3.0 (Weld)			
0533	Thermostat and Housing	Inspect	.2						
		Replace	1.4						
		Repair	1.3		2.0 (Weld)				

SECTION II.

MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT	(6) REMARKS
			C	O	F	H	D		
0534	Overspeed Governor	Inspect	.2						
		Test	1.0						
		Adjust	.5						
		Replace	1.0						
		Repair	1.0						
0535	Tachometer Drive	Overhaul	4.0						
		Inspect	.2						
		Replace	1.6						
0535A	Air Cleaner	Repair	1.5						
		Inspect	.1						
		Service	.3						
0536	Crankshaft Pulley and Vibration Damper	Replace	1.0						
		Repair	1.0						
		Inspect	.2					21,53	
0537	Balance Weight and Cover	Replace	1.7						
		Inspect	.3					53	
0538	Engine Supports and Lifting Brackets	Replace	1.5						
		Repair	1.0						
		Inspect	.4						
0539	Exhaust Manifold	Replace	2.5						
		Repair	2.5						
		Inspect	.2						
0540	Rocker Arm Cover	Replace	2.5						
		Inspect	.1						
0541	Injector Controls	Replace	1.0						
		Inspect	.2						
		Adjust	.3						
0542	Oil Pan & Dipstick	Replace	1.5						
		Repair	2.0						
		Inspect	.2						
0543	Cylinder Head	Replace	1.5						
		Repair	1.5						
		Inspect	.2						27,28,29, 30,31,32, 33,34
0544	Valve Operating Mechanism	Replace	1.5						
		Repair	2.5						26
		Inspect	.2						23,24,25
0545	Camshaft & Gear Train	Adjust	.8						
		Replace	1.5						
		Repair	2.5						
0546	Flywheel & Housing	Inspect	.4						
		Replace	6.0						
		Repair	3.5						
0546	Flywheel & Housing	Inspect	.2						
		Replace	3.5						22
		Repair	2.0			2.0			

SECTION II.

MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT	(6) REMARKS
			C	O	F	H	D		
0547	Lube Oil Pressure Regulator Valve	Inspect Adjust Replace	.1 .4 1.0						
0548	Lube Oil Pump	Repair Inspect Replace	1.5 .2 1.0		2.0		52		
0549	Lube Oil Distribution System	Repair Inspect Replace	.2 1.5						

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By Order of the Secretary of the Army:

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Chief of Staff

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
 1 decimeter = 10 centimeters = 3.94 inches
 1 meter = 10 decimeters = 39.37 inches
 1 dekameter = 10 meters = 32.8 feet
 1 hectometer = 10 dekameters = 328.08 feet
 1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
 1 decigram = 10 centigrams = 1.54 grains
 1 gram = 10 decigrams = .035 ounce
 1 dekagram = 10 grams = .35 ounce
 1 hectogram = 10 dekagrams = 3.52 ounces
 1 kilogram = 10 hectograms = 2.2 pounds
 1 quintal = 100 kilograms = 220.46 pounds
 1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
 1 deciliter = 10 centiliters = 3.38 fl. ounces
 1 liter = 10 deciliters = 33.81 fl. ounces
 1 dekaliter = 10 liters = 2.64 gallons
 1 hectoliter = 10 dekaliters = 26.42 gallons
 1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
----	------------------------	----------------------------	---------------------	----

