TECHNICAL MANUAL

OPERATOR AND ORGANIZATIONAL MAINTENANCE MANUAL

CRANE, TRUCK, WAREHOUSE, 10,000 LB. CAPACITY, GED, PT

PETTIBONE MODEL 10FM

ARMY MODEL MHE 216, FSN 3950-197-4935

This copy is a reprint which includes current pages from Change 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY

JULY 1971

WARNING

Do not fill fuel tank while the engine is in operation.

Do not operate equipment with protective covers or guards removed.

Do not operate the engine in an enclosed area for a lengthy interval unless the exhaust is piped to an open area.

The exhaust contain carbon monoxide, a colorless, odorless, deadly poisonous gas.

When inflating tires of the crane, remain to one side of the tire rather than directly in front of it Serious injury may result if the tire blows out, or is forced off the rim.

Keep a fully charged fire extinguisher in good working order, mounted in bracket, and ready for quick use.

Wear safety goggles or lenses when grinding, chipping, or using compressed air for cleaning.

Keep the equipment free of grease, oil, and dirt.

Remove all oily rags and/or dirt accumulations from equipment during repair. Eliminate fire hazards.

Remove bars, tools, or loose parts lying in or on any part of the equipment before commencing starting operations.

Be sure all personnel are clear of the crane before starting operations.

Do not lift a load unless it is properly hooked and the lifting sling or device is adequate. -

Test the load after lifting off the ground to be sure crane will hold the load.

Do not move loads over personnel or equipment.

Do not leave crane with load suspended or engine running. _

Keep lift height to the minimum required and use handle to guide loads.

When jacking up frame to remove components, use at least two jacks. Do not depend on the jacks to *sustain the load.* Install blocking, minimum 8 inch x 8 inch, for permanent blocking, to prevent sidewise shifting.

When servicing batteries, do not smoke or use an open flame in the vicinity. Batteries generate hydrogen, a highly explosive gas.

Make sure that the parking brake i set before engaging in any inspection or repair of the crane.

Keep the boom at least 10 feet away from overhead wires.

***Caution:* If boom contacts overhead wires stay on the machine until the boom is cleared or current is turned off. Warn personnel on the ground to stay away from machine. If necessary to leave the machine, jump, do not step off.**

Changes in force: C 2, and C 3 TM 1039502012

C3

CHANGE

NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D.C., *30 September 1991*

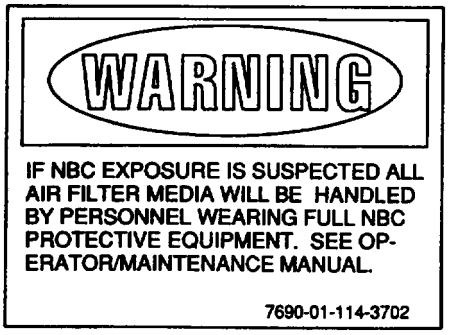
Operator and Organizational Maintenance Manual
CRANE, TRUCK, WAREHOUSE; 10, 000 LB CAPACITY; GED;
(PETTIBONE MODEL 1OFM, ARMY MODEL MHE-216)
NSN 3950-00-197-4935

TM 10-395206-12, 14 July 1971, is changed as follows:

Cover and title page is changed shown above.

Page 2-5, the following paragraph is added after Section IV, "OPERATION UNDER USUAL CONDITIONS."

A decal has been developed that warns of NBC exposure. It is to be positioned in a noticeable place on or near the air cleaner or air filter housing. You may order the decal using part number 12296626, CAGEC 19207. Refer TB 43-0219 for further information. Add the decal to the air cleaner Page 3-2, figure 3-2 and on page 4-32, figure 4-25



Add the following WARNING to the following pages;

Inside front cover, after the list of WARNINGS;

page 2, change 2, TABLE 2-2, preceding, "AIR CLEANER;"

page 1-2, preceding item (12), "Air cleaner";

page 2-6, paragraph 2-14, preceding *d*

page 3-1, paragraph 3-3 preceding *f*, "Air Cleaner Service";

page 3-3, table 3-1, preceding item 8, "Air cleaner";

page 3-4, table 3-2, preceding item 2;

page 4-6, table 4-2, preceding item 3;

page 4-8, table 4-2, preceding item 15 *e*;

page 4-31, after paragraph 4-41, "Air Cleaner";

page 4-2, paragraph 4-41, preceding e. "Installation";

page 4-39, paragraph 4- 50, preceding *b.* (3):

page B-3. preceding item I, "AIR CLEANER";

page C-2. **MAINTENANCE ALLOCATION CHART, FUEL SYSTEM. preceding, "Air cleaner":**

WARNING

If NBC exposure Is suspected, all air filter media should be handled by personnel wearing protective equipment. Consult your unit NBC Officer or NBC NCO for appropriate handling or disposal Instructions.

By Order of the Secretary of the Army:

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

Official:

PATRICIA P. HICKERSON
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-25-E, block 2107, Operator and Unit maintenance requirements for TM 10-3950-206-12.

* U.S. GOVERNMENT PRINTING OFFICE: 1991 543-016/40119

Changes in force: C2

CHANGE

No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *22 April 1974*

Operator and Organizational Maintenance Manual
CRANE, TRUCK, WAREHOUSE; 10, 000 POUND CAPACITY;
GED; (PETTIBONE MODEL 10FM, ARMY
MODEL MHE216)
FSN 3950-1974935

TM 14 3950-2012, 14 July 1971, is changed as follows:

Inside Front Cover. Add the following warnings to the inside front cover:

WARNING

Operation of this equipment presents a nose hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat Flash point of solvent is 100 F. - 138° F.

Page i. Appendix B title is changed to read "Basic Issue Items List and Items Troop Installed or Authorized List".

Page 1-1. Paragraph 1-2b is superseded as follows:

b. You can help to improve this manual by calling attention to errors and by recommending improvements. Your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) should be mailed direct to: Commander, US Army Troop Support Command, ATTN: AMSTS-MPP, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished direct to you.

Page 2-1. Paragraph 2-1*b* (8) is added as follows:

(8) Maintenance and operating supplies required for initial 8 hours of operation are listed in Table 2-2.

Page 2-2. Table 2-2 is added as follows:

*This change supersedes C1, 30 April 1973.

Table 2-2. MAINTENANCE AND OPERATING SUPPLIES

(1) COMPONENT APPLICATION	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION	(4) Quantity required f/initial operation	(5) Quantity required F/8 hrs operation	(6) NOTES
AIR CLEANER		OIL, LUBRICATING: ENGINE, 55 gal, drum as follows:			(1) Includes quantity of oil to fill engine oil system as follows: 7. qts - Engine crankcase and oil cooler 1 qt - filter
	9150-265-9437 (2)	OE-30	1 3/8 qt	(3)	
	9150-265-9430 (2)	OE-010	1 3/8 qt.		
	9150-242-7605 (2)	OES	1 3/8 qt.	(3)	(2) See C9100-IL for additional data and reqisitioning procedure.
BRAKES		BRAKE FLUID: AUTOMOTIVE: 1 gal. can as follow			(3) See current LO for grade application and replenishment intervals
	9150-252-6375 (2)	HBA	1 pt.	(3)	
CRANKCASE		OIL, LUBRICATING (4)			(4) Use oil identified in air cleaner FSN column.
		OE30	8 qt.	(3)	
		OE10	8 qt.	(3)	(5) Tank capacity
		OES	8qt. (1)	(3)	
DIFFERENTIAL		OIL LUBRICATING, GEAR: 5 gal. pail as follows:			
	9150-577-5844	GO-90	14 qt.	(3)	
	9150-577-5440	GOS	14 qt.	(3)	
GREASE POINTS		GREASE, AUTOMTIVE AND ARTILLERY: 5 lb. can as follows:			
	9150-190-0905	GAA	As Req.	(3)	
HYDRAULIC RESERVOIR		OIL LUBRICATING: (4)			
		OE-10	248 qt.	(3)	
		OES	248 qt.	(3)	
OIL CAN POINTS		OILLUBRICATING (4)			
		OE-30	As Req.		
RADIATOR		WATER	16 qt.		
	6850-243-1992	ANTIFREEZ: Ethylene Glycol 1 gal. can	10 qt.		

Table 2-2. MAINTENANCE AND OPERATING SUPPLIES - (Continued)

(1) COMPONENT APPLICATION	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION	(4) Quantity required f/initial operation	(5) Quantity required F/8 hrs operation	(6) NOTES
	6850-174-1806	ANTIFREEZ Arctic Grade	16 q		
TANK, FUEL		GASOLINE, AUTOMOTIVE COMBAT, Bulk as follows:			
	9130-160-1818 (2)	91A	40 gal.	(5)	
	9130-160-1830	91C	40 gal.	(5)	
TRANSMISSION CONVERTER		OIL LUBRICATING: (4)			
		OE-10	18 qt.	(3)	
		OES	18 qt.		

Page 2-5. Immediately after Section IV title, add the following warning:

WARNING

Operation of this equipment presents a noise hazard to personnel in the are. he noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

Page 4-1. Immediately after Chapter 4 title, add the following warning:

WARNING

Dry cleaning solvent, P-680, used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F.

Page A-1. Appendix A is superseded as follows:

APPENDIX A
REFERENCES

A-1. Fire Protection

TB 54200-200-10	Hand Portable Fire Extinguishers Approved for Army Users

A-2. Lubrication

C9100IL	Fuels, Lubricants, Oils, and Waxes
LO 10-3950-206-12	Crane, truck, warehouse: 10, 000 lb capacity, ged pneumatic tired wheels (Pettibone model 10 FM) (Army model MHE 216) w/engine Continental model FS-244.
	TB 703-1 Specification List of Standard Liquid Fuels, Lubricants, Preservatives, and Related Products Authorized for use by US Army

A-3. Painting

AR 74&1	Color, Marking and Preparation of Equipment for Shipment
TB 74693-1	Color and Marking of Military Vehicles, Construction Equipment and Materials Handling Equipment

A-4. Radio Suppression

TM 11-483	Radio Interference Suppression

A-5. Maintenance

TB MED 251	Noise and Conservation of Hearing
TB 750651	Use of Anti-Freeze Solutions, and Cleaning Compounds in Engine Cooling Systems
TM 92610-200-20	Organizational Care, Maintenance and Repair of Pneumatic Tires and Inner Tubes
TM 5331B	Utilization of Engineer Construction Equipment Vol. B, Lifting, Loading and Handling Equipment
TM 10-3950-206-20P	Organizational Maintenance, Repair Parts and Special Tools Lists, Crane, Truck, Warehouse, 10, 00 lb. Capacity, Pettibone Model 10FM, Army Model MHE-216
TM 38-750	The Army Maintenance Management System CAMMS)
TM 9-6140-200-14	Operator Organization, Depot Support and General Support Maintenance Manual, Storage Batteries, Lead-Acid Type Batteries

A-6. Shipment and Storage

TB 740-97-2	Preservation of USAMECOM Mechanical Equipment for Storage
TM 740-90-1	Administrative Storage of Equipment

Page B-1. Appendix B is superseded as follows:

APPENDIX B
BASIC ISSUE ITEMS LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST
Section I. INTRODUCTION

B1. Scope

This appendix lists items required by the operator for operation of the truck crane.

B-2. General

This list is divided into the following sections:

a. Basic Issue Items List - Section II. Not applicable.

b. Items Troop Installed or Authorized List - Section III. A list of items in alphabetical sequence, which at the discretion of the unit commander may accompany the truck crane. These items are NOT subject to turn-in with the truck crane when evacuated.

B-3. Explanation Columns

The following provides an explanation of columns in the tabular list of Basic Issue Items List, Section II, and Items Troop Installed or Authorized, Section III.

a. Source, Maintenance, and Recoverability (Code(s) (SMR). Not applicable.

b. Federal Stock Number. This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Description. This column indicates the Federal item name and any additional description of the item required.

d. Unit of Measure (UM). A two-character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

e. Quantity Furnished With Equipment (BIIL). Not applicable.

f. Quantity Authorized (Items Troop Installed or Authorized). This column indicates the quantity of the item authorized to be used with the equipment.

Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST

Federal stock number	Description	U/M	Qty auth
7520-559-9618	CASE, Maintenance and operation manuals	EA	1
4210-889-2221	EXTINGUISHER, Fire	EA	1

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Official:

VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25A, (qty rqr block No 893) Operator maintenance requirements for Warehouse, Equipment.

TECHNCAL MANUAL

No. 10495-206-12

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *14 July 1971*

OPERATOR AND ORGAZATION MAINTENANCE MANUAL

CRANE, TRUCK, WAREHOUSE, 10, 000 LB. CAPACITY, GED, PT. PETTIBONE MODEL 10FM, ARMY MODEL MHE 216 FSN 3950-197-4935

LIST OF ILLUSTRATIONS

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope

a. These instructions are published for the use of personnel to whom the Pettibone Model 10FM, Army Model MHE 216, Warehouse Truck Crane is issued. They provide information on the operation and organizational maintenance of the equipment. Also included are descriptions of the main components and systems and their functions.

b. Refer to TM 750-24413 for instructions on the destruction of Army material to prevent enemy use.

1-2. Forms and Records

a. DA Forms and records used for equipment maintenance will be only those prescribed in TM 38-750.

b. Reports of error omissions, and recommendations for improving this publication by the individual user is encouraged. Report should be submitted on DA Form 2028 (Recommended Changes to Publications), and forwarded direct to Commanding General, U.S. Army Mobility Equipment Command, ATTN: AMSME-MPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

Section II. DESCRIPTION AND DATA

1-3. Description

The Pettibone Model 10FM Warehouse Truck Crane (fig. 1-1 and 1-2) is a front wheel drive, pneumatic tired, materials handling vehicle. The crane is powered by a six-cylinder gasoline engine coupled through a torque converter to a two-speed forward and reverse, power shift transmission. The crane is equipped with a hydraulic powered slewing boom capable of lifting and transporting loads up to 10, 000 pounds at a 36 inch load center front of bumper.

1-4. Identification and Tabulated Data

a. Identification and Data Plates. The crane has three major identification and data pates.

(1) The U.S. Army identification plate (A, fig. 1-4) is located on the left side of the instrument control support.

(2) The transportation data plate (B, fig., 1-3) is located on the left side of the instrument control support immediately below the identification plate.

(3) The load capacity data plate (C, fig. 1-3) is located to the right of the operator's seat on the battery access cover.

b. Tabulated Data.

(1) Performance data.

Load capacity (fig. 1-3 C) ..... 10, 00 lb. max.
Towing capacity (level) ..... 9, 000 lb. max.
Maximum gradability (with rated
load on dry surface) 15%
Speed (maximum):
Forward 20 mph
Revere ..... 19.4 mph
Turning radius:
Outside ..... 16 ft. 2 in.
Inside ..... 3 ft. 9 in.
Slewing: Arc maximum 180
Radius (from front of bumper)
Minimum ..... 1 ft. 1 in.
Maximum ..... 17 ft. 3 in.
Boom lift ..... 70°
Boom hydraulic extended ..... ft.
Maximum hook height ..... 23 ft.

(2) Dimensions and weight.

Height ..... 9 ft. 1/2 in.
Length:
Overall ..... 24 ft.
Bumper to bumper ..... 14 ft.
Width ..... 8 ft.
Weight ..... 31, 000 lb.
Ground clearance ..... 8 in.
Wheel base ..... 10 ft. 3 in.
Wheel loading (no load):
Front wheels (dual) ..... 14, 580 lb.

Rear wheels.....6, 280 lb.
Wheel loading (rated load):
Front Wheels (dual).....29, 475 lb.
Rear Wheels.....1560 lb.
Bridge Weight Classification.....Class 20
(3) Capacities.
Cooling system.....16 qt.
Transmission and torque converter.....14 qt.
Fuel tank.....40 gal.
Crankcase (with oil filter change).....8 qt.
Brake master cylinder.....1 pt.
Hydraulic tank.....62 gal.
Differential.....14 qt.
Air cleaner.....1 3/8 qt.
Hoist Cable, 9/16 DIA. 8x25 Plow
Steel-Regular Lay.....135 ft.
(4) Engine.
Make.....Continental
Model.....FS244
Specification.....06096
Number of cylinders.....6
Bore.....8 7/16 in.
Stroke '.....4 8/8 in.
Displacement.....244 cu in.
Compression ratio.....6.9:1
Firing order.....16-3-24
Weight (basic engine).....565- lb.
(5) Transmission.
Make.....Allison
Model.....TRT 2220
Part number.....6777122
Type.....Two speed, forward and reverse, torque converter coupled
Ratios: Forward
1st.....6.402:1
2nd.....2.321:1
Reverse
1st.....6.610:1
2nd-.....2.395:1
(6) Drive axle.
Make.....Rockwell-Standard
Model.....R140HX1
Ratio.....5.286:1
(7) Starting motor.
Make.....Delo-Remy
Model.....1107395
Voltage.....12 V.
(8) Alternator.
Make.....Motorola
Model.....8MA2004K
Output (at 2600 rpm engine speed).....51 amps.
Voltage.....12 V.
(9) Distributor.
Make.....Delco-Remy
Model.....1112672
Rotation.....Counterclockwise
Contact point gap.....0.020 in.
(10) Spark plugs.
Type.....XD 16is
Gap.....0.025 in.
(11) Batteries.
Type.....14H90
Voltage.....12
Amperage hours, 20 hr. rate.....90
(12) Air cleaner.
Make.....Donaldson
Mode.....KAX00-0376
Type.....Oil bath
(13) Carburetor.
Make.....Zenith
Model.....228BV10
Type.....Down-Draft
(14) Main hydraulic pump.
Make.....Vickers
Model.....2B20V17A11-11BC12F11LlL
Type.....Vane (Dual)
Capacity (@ 2200 rpm, 2000 psi) . 26 gpm and 19 gpm
(15) Hydraulic control valve
Make.....Sundstrand
Model.....S6-409
Number operating sections.....4
Capacity.....86 gpm.
Maximum operating pressure.....2000 psi.
(16) Double overcenter valve.
Make.....Fluid Controls
Part Number.....1EXP94002
(17) Relief valve.
Make.....Fluid Controls
Part number.....1A32F6-15S
(18) Double overcenter valves.
Make.....Fluid Controls
Part number.....1EE13P4-30S
(19) Dual relief valve.
Make.....Fluid Controls
Part number.....1LL22-F4-25S
(20) Hydraulic cylinder, slewing.
Make Pettibone
Part number.....C26401-2
Stroke.....33 in.
Bore.....4 1/2 in.

(21) Hydraulic cylinder, boom lift.
Make ..... Pettibone
Part number C32492-3
Stroke ..... 32 1/8 in.
Bore ..... 6.030 in.

(22) Hydraulic cylinder, boom extension.
Make ..... Pettibone
Part number C31698-14
Stroke ..... 96 in.
Bore ..... 4 1/32 in.

(23) Hydraulic cylinder, steering.
Make ..... Pettibone
Part number C26361-2
Stroke ..... 10 in.
Bore ..... 4 1/2 in.

(24) Hydraulic steering unit.
Make ..... Char-Lynn
Model ..... Y P3-12

(25) Hydraulic winch motor.
Make ..... Commercial Shearing
Model M25X-797-BERT22-25

(26) Hook block.
Make ..... Upson-Walton
Model 265D
Number sheaves 1
Working load ..... 5-6 1/2 ton

(27) Wheel brakes.
Make ..... Rockwell-Standard
Model ..... 17 1/4 x 4
Type ..... H

(28) Brake master cylinder.
Make ..... Wagner Electric
Model FE13066C

(29) Brake power assist unit.
Make ..... Bendix
Model 374750

(30) Tires.
Front (drive) ..... 9:00 x 20-12 ply
Rear (steering) ..... 7:50 x 15-10 ply
Drive wheel pressure ..... 90 psi
Steering wheel pressure ..... 85 p

c. Wiring Diagram. The crane is equipped with a 12 volt, negative ground, electrical system. Refer to figure 1-4 for the wiring diagram.

d. Hydraulic Diagram. Refer to figure 1-5 for the crane hydraulic diagram.

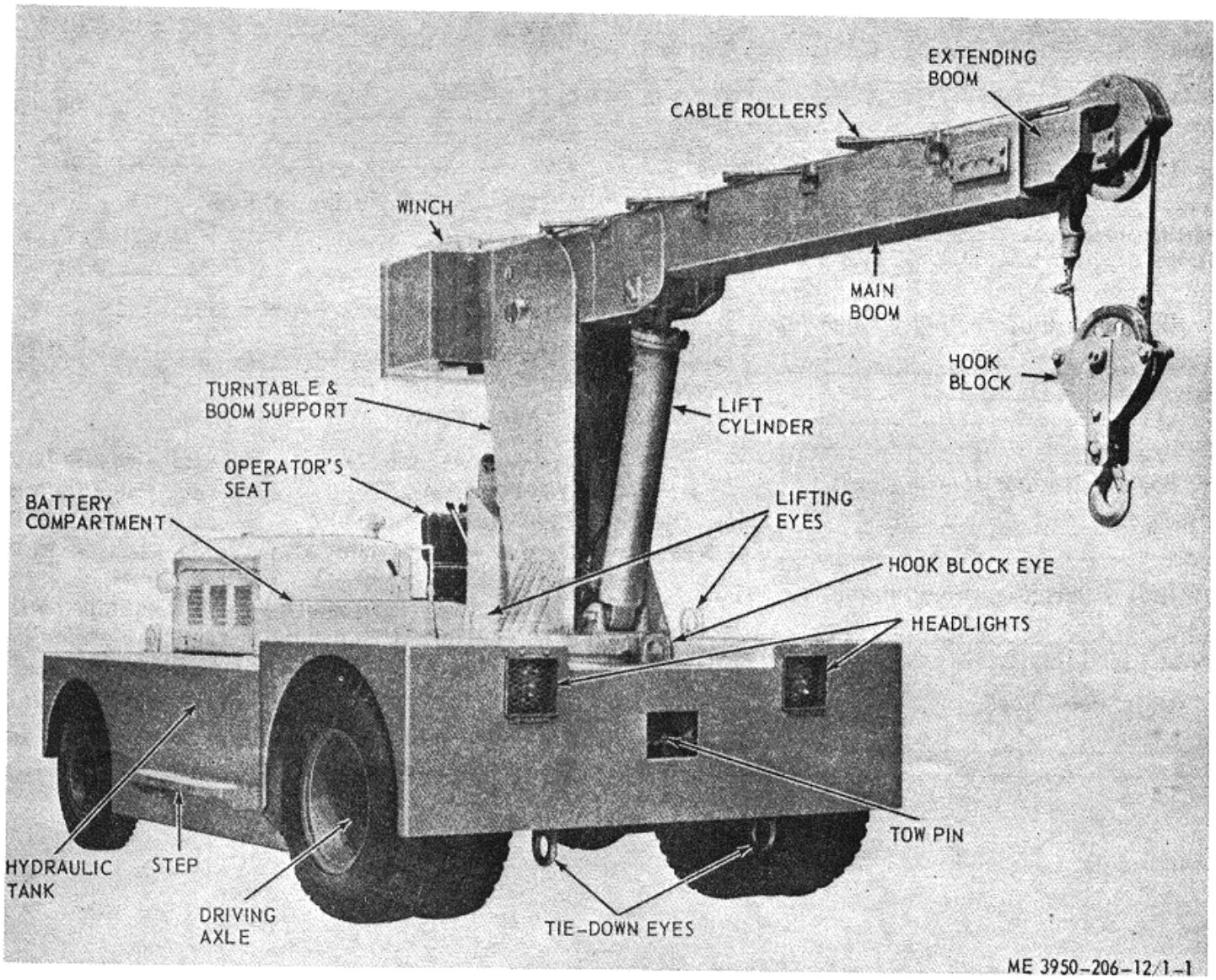


Figure 1-1. Warehouse truck crane, right front three-quarter view.

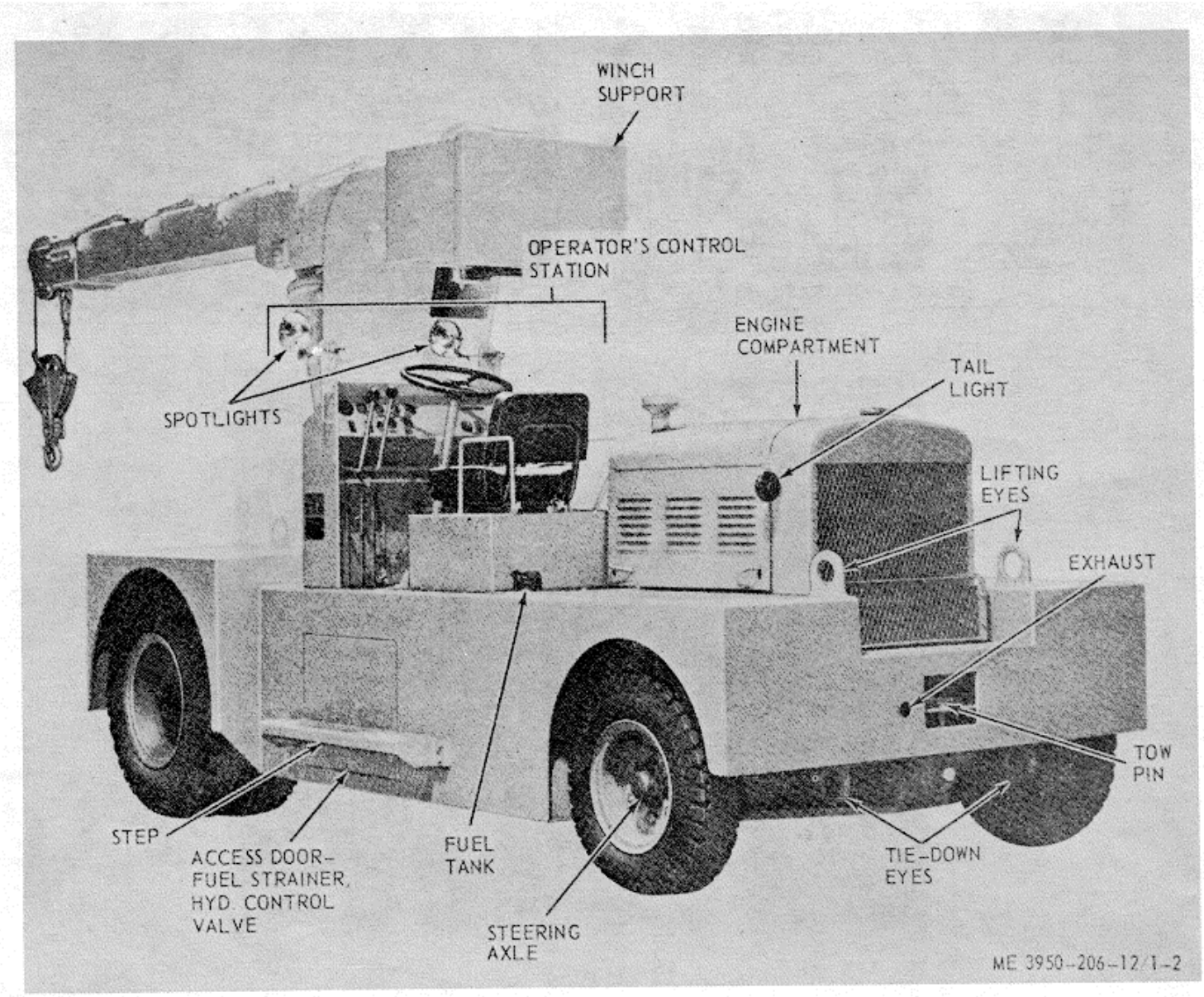


Figure 1-2. Warehouse truck crane, left rear three-quarter view.

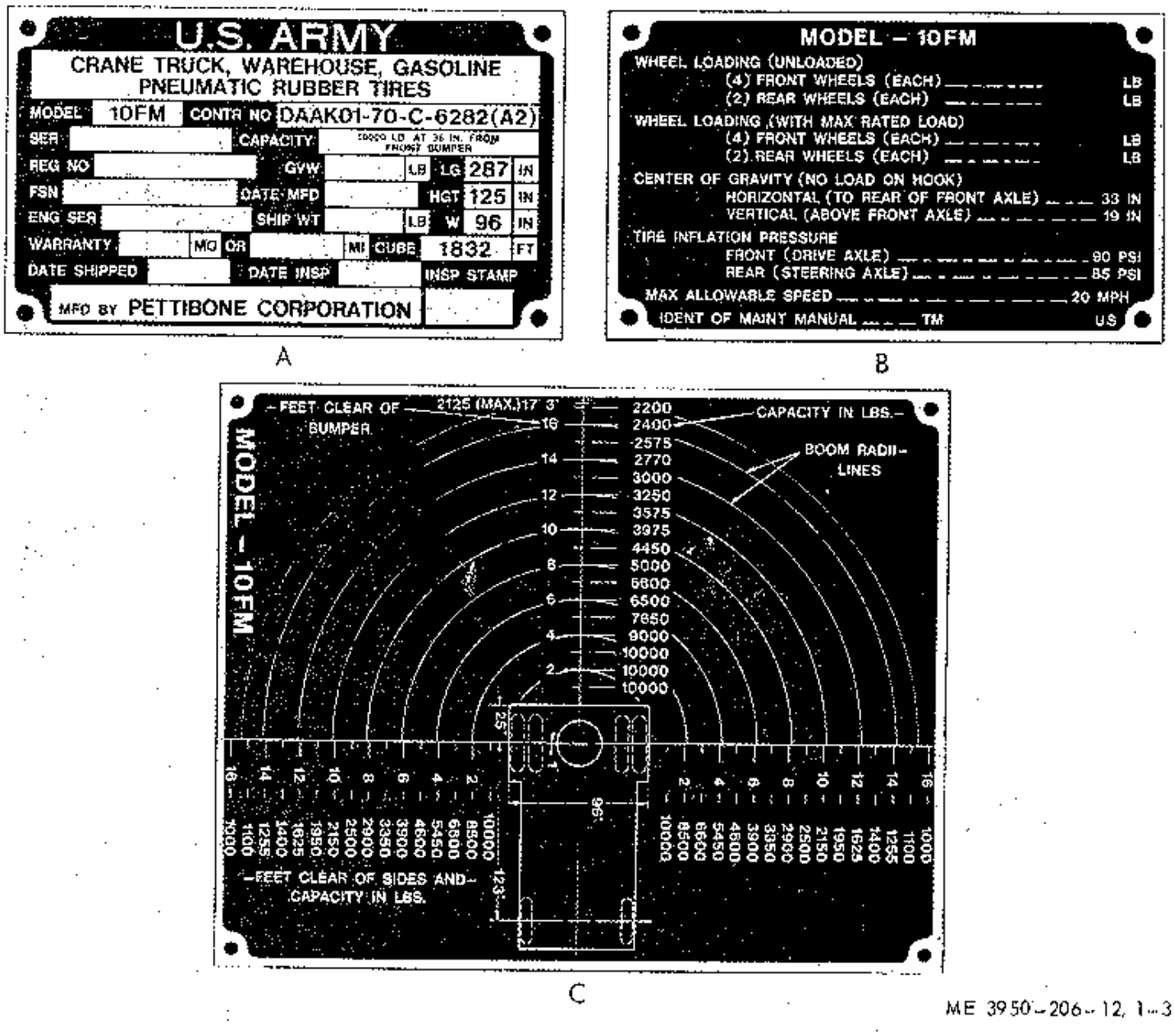
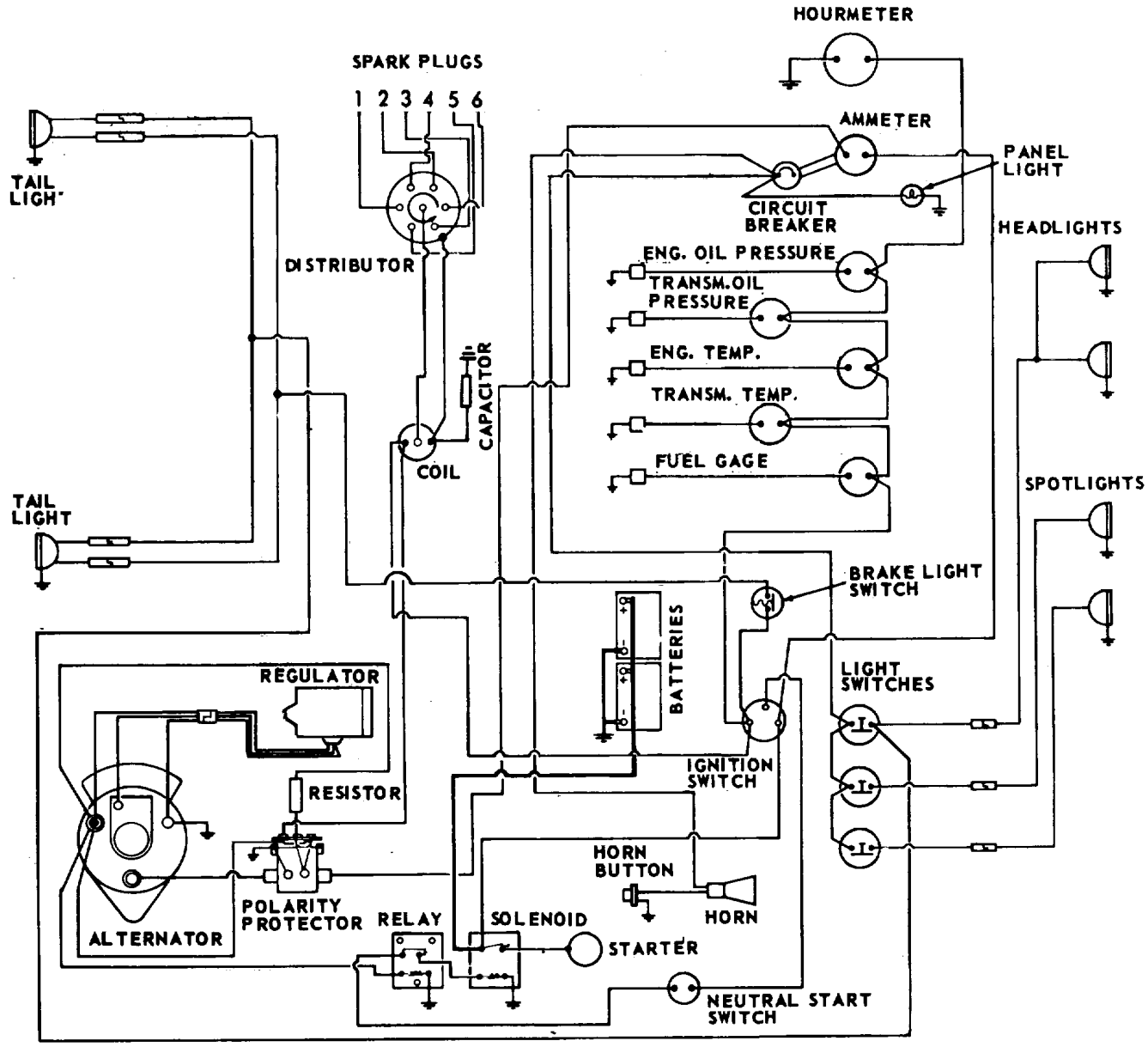


Figure 1-3. Identification and data plates.



ME 3950-206-12/1-4

Figure 1-4. Wiring diagram.

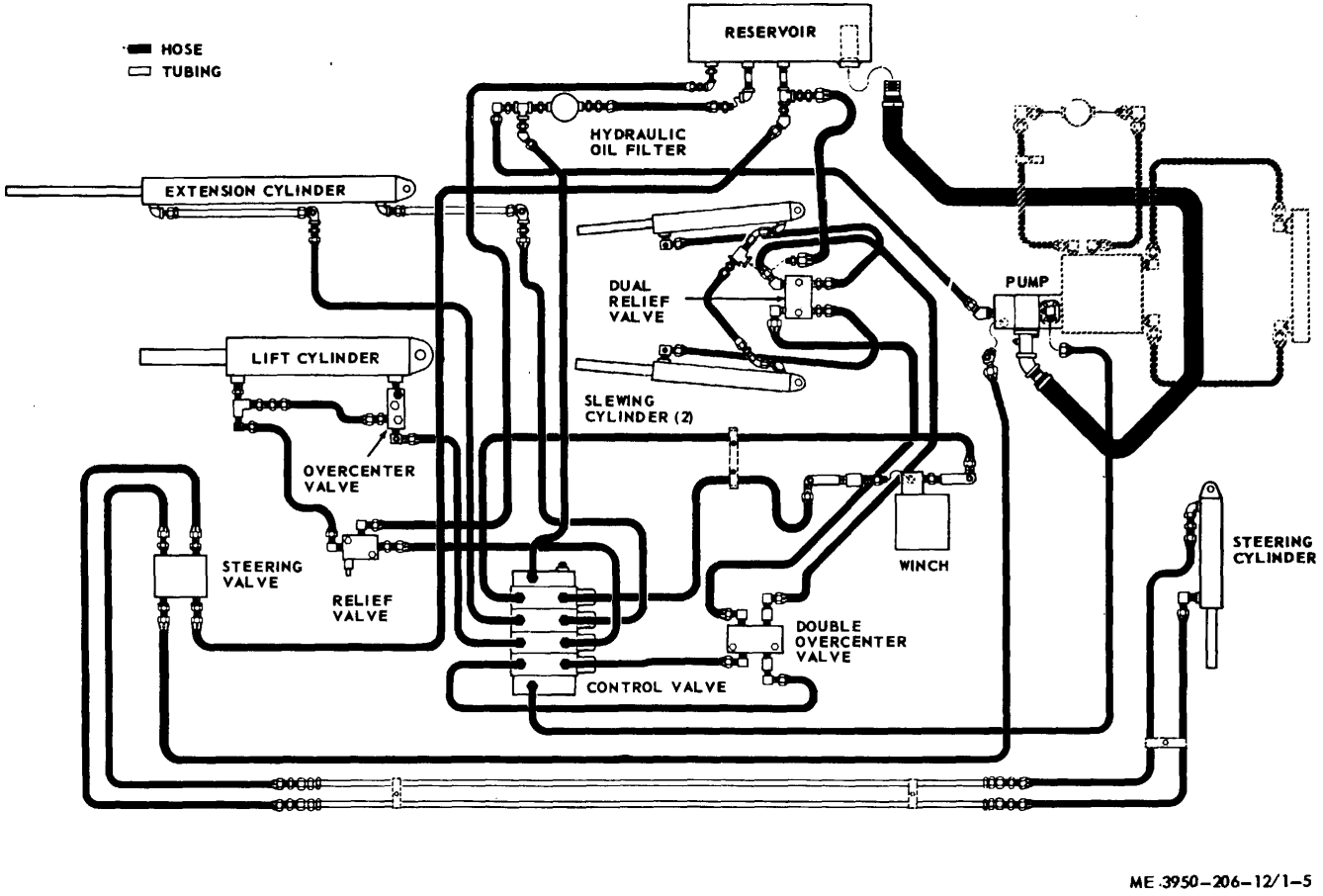


Figure 1-5. Hydraulic diagram.

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

2-1. Inspecting and Servicing the Equipment

a. Inspection.

(1) Make a visual inspection to assure the required tools, repair parts, publications, and other basic issue items are included with the equipment.

(2) Inspect the crane engine and mounted components for missing items or damage which may have occurred during loading, shipment, or unloading.

(3) Inspect wiring, fuel and oil lines, radiator and hoses, fuel and hydraulic oil tanks, hydraulic system piping, gages, instruments, and lights for missing, loose, broken, or damaged parts.

(4) Inspect drain plugs, breathers, filler caps, and drain cocks to be sure they are secured and not leaking or damaged.

(5) Inspect air and hydraulic hoses and lines, and electrical leads for cuts, breaks, cracks or signs of deterioration.

b. Servicing.

(1) Perform depreservation services as required.

Note. **If the crane has been preserved, a depreservaton guide, DA Form 2258, (Depreservation Guide for Vehicles and Equipment), will be attached to the controls.**

(2) Perform the necessary daily preventive maintenance services (para 3-4).

(3) Remove the battery vent fill caps, and fill each cell with electrolyte to a level 3/8 inch above the tops of the plate separators.

Warning: **Pour the electrolyte slowly. If splashed in the eye, wash immediately and thoroughly with cold water and secure medical attention If splashed on any other part of body, wash immediately and thoroughly with cold water. If splashed on clothing or other areas wash immediately with cold water, and neutralize with a solution of baking soda or household ammonia.**

(4) Replace vent caps.

(5) Install the battery cables. Tighten the cable terminals securely. Apply a light coating of nonmetallic grease or petroleum jelly to the battery terminals.

(6) Wipe the tops of the batteries and retaining clamps with a cloth moistened with baking soda or ammonia solution to remove any acid which may have been spilled. Wipe dry with clean cloth.

(7) The crane is shipped initially with 50% solution of antifreeze, however, make .sure that all drain valves on the engine and radiator are closed. If required, fill the cooling system with dean water to a level of 1 inch below the neck of the radiator.

Note. **When operation in temperatures 32°F. or bow is expected, add antifreeze to the cooling system as specified in table 2-1. Operate the engine for several minutes to thoroughly mix the coolant solution.**

2-2. Installation of Separately Packed Components

For shipment the spotlights are removed and stored in the frame compartment on the left side of the unit Unpack and install the spotlights as follows:

a. Remove the four capscrews and lockwashers that secure the left step to the frame. Remove the step.

Table 2-1. Freezing Points, Composition, and Specific Gravities of Military Antifreeze Materials

Lowest expected ambient temp. "F.	Pints of inhibited glycol per gal. Of coolant[1]	Compound, antifreeze arctic[2]	Ethylene glycol coolant solution specific gravity at 68°F.[3]
+20	1-1/2	Issued full strength and ready mixed	1.022
+10	2	for 0 to -65°F. temperatures for	1.036
0	2-3/4	both initial installation and re	1.047
-10	3-1/4	plenishment of losses.	1.055
-20	3-1/2		1.062
-30	4		1.067
-40	4-1/4		1.073
-50		Arctic Antifreeze DO NOT DILUTE WITH WATER	
-60		preferred OR ANY OTHER SUBSTANCE	
-75			

[1] Maximum protection s obtained at 60 percent by volume (4.8 pints of ethylene glycol per gallon of solution.)

[2]. Military Specifications MIL-C-11755 Arctic type, nonvolatile antifreeze compound is intended for use in the cooling system of liquid-cooled internal combustion engines. It is used for protection against freezing primarily in Arctic region where the ambient temperature remains- for extended period close to -40°F. or drop below, to as low as -90°F.

[3]. Use an accurate hydrometer. To test hydrometer, use 1 part ethylene glycol antifreeze to 2 parts water. This should produce a hydrometer reading of 0°F.

Note. Fasten a tag near the radiator cap indicating the type of anti-freeze.

b. Remove the capscrew and lockwasher s curing the access door and open.

c. Remove the spotlight assemblies and inspect for any damage or missing parts. d. Install the spotlight assemblies as follows:

(1) Remove nut (12, fig. 4-17) and bolt wedge (14) that secures handle (13) to shaft (11). Remove handle from shaft.

(2) Insert shaft through mounting bracket clamp and tighten clamp.

(3) Position handle on shaft and secure with nut and bolt wedge.

(4) Connect wire connectors to leads provided.

2-3. Installation or Setting-Up Instructions

Refer to paragraph 2-1, *b* for complete instructions.

Section II. MOVEMENT TO A NEW WORKSITE

2-4. Dismantling for Movement

a. Comparatively short distances of movement to a new worksite will not require shipping preparations or dismantling.

b. For long-distance shipment of crane or for limited storage, prepare crane as follows:

(1) Fill the crankcase to operating level with preservative oil conforming to Specification MIL-L-21260, grade 2. Operate the engine at a fast idle long enough to bring it up to operating temperature. Do not drain the oil from crankcase.

(2) After engine has cooled to a cylinder head temperature of not more than 100°F., re move spark plugs. Rotate crankshaft with starting motor and spray 2 ounces of lubricating oil conforming to Specification MI[L-21260, grade 2 into each cylinder. Coat threaded end of spark plugs with the preservative oil and reinstall. A caution tag showing "Engine Preserved Do Not Crank" will be prepared and attached to an operator's control.

(3) Drain fuel tank and fog interior with preservative oil conforming with Specification MIL-L-21260, grade 2. Drain excessive oil and reinstall plug.

(4) Drain the entire cooling system. One caution tag marked "RADIATOR EMPTY" will be affixed to filler neck of radiator and one to steering wheel of crane.

(5) Seal openings that permit direct entry of water to interior of crane components with tape conforming to Specification PPP-T-60, type III, class 1.

(6) Retract hydraulic rams as far as linkage permits. Coat exposed machined surfaces with compound conforming to Specification MIL-C-11796,

class 3, and overwrap with barrier material conforming to Specification MILB-121, grade A. Secure wrap in place with PPP-T-60 tape. Secure hydraulic controls in a neutral position.

(7) Check oil filler cap, fuel tank cap and radiator cap to be sure they are securely in place.

2-5. Reinstallation after Movement

Prepare the crane for operation after movement in accordance with instructions of paragraphs 2-1, 2-2, and 2-3.

Section III. CONTROLS AND INSTRUMENTS

2-6. General

This section describes, locates, illustrates, and furnishes the operator, crew, or organizational maintenance personnel with sufficient information about the various controls and instruments for orientation in the operation of the Pettibone Model 10FM Warehouse Crane.

2-7. Controls and Instruments

a. Slewing Lever. The slewing lever (fig. 2-1) is located to the left of the steering wheel, below instrument panel. Push lever forward to swing boom to the right, pull lever backward to swing boom to the left.

b. Lift Cylinder Lever. The lift cylinder lever (fig. 2-1) is located to the left of the steering wheel next to the slewing lever, below instrument panel. Push lever forward to lower boom, pull backward to raise boom.

c. Winch Cable Lever. The winch cable lever (fig. 2-1) is located to the right of the steering wheel below instrument panel. Push lever for- ward to let cable down. Pull lever backward to raise cable up.

d. Boom Extension Lever. The boom extension lever (fig. 2-1) is located to the right side of the steering wheel next to the winch lever. Push forward to extend boom, pull lever back to retract boom.

e. Horn Button. The horn button (fig. 2-1) is located in the center of the steering wheel. Depress button to sound horn.

f. Steering Wheel. The steering wheel (fig. 2-1) controls direction of travel of crane. Turn clockwise to move crane in right direction. Turn counterclockwise to move crane in a left direction.

g. Service Brake Pedal. The service brake pedal (fig. 2-1) is located to the right of the steering column suspended above the floor plate. Re- lease pedal before putting crane in motion.

h. Accelerator Pedal. The accelerator pedal (fig. 2-1) is located to the right of the service brake pedal. It is used to increase or decrease engine speed. Depress pedal to increase engine speed and release the pressure on pedal to decrease engine speed.

i. Choke. The choke (fig. 2-1) is located on bottom left side of panel, to the right of lift cylinder plate. The choke is used to enrich airfuel mixture. The normal operating position for the control is pushed in toward the front hood support as far as it will go. To enrich mixture when starting a cold engine, pull control out. Push control in as engine warms up.

j. Parking Brake Hand Lever. The parking brake (fig. 2-1) is located to the right front of the driver's seat on the floor plate. Pull up on lever to apply brake and hold crane in a stationary position. To release brake, push lever down.

k. Shifting Lever. The shifting lever (fig. 2-1) is located to the right of driver's seat. This lever controls forward and reverse movement of the crane. Low and high speed ranges are provided by movement of' the lever through the shift lever gate per the diagram on the shift plate.

I. Light Switch. The light switch (fig. 2-1) is located on top right side of instrument panel. This controls both head lights and tail lights. To turn the lights on, pull switch out from instrument panel. To turn lights off, push switch in toward instrument panel.

m. Spot Light Switches. Two spot light switches, (fig. 2-1) are provided on the top right side of the instrument panel. The push-pull type switches independently control the right and left spot lights respectively. Pull switch out to turn lights on, push in to turn lights off.

n. Panel Light. The panel light (fig. 2-1) located over the center of the instrument duster has a self contained switch. To turn light on, move lever down and to the left To turn light off, move lever to the right.

o. Ignition Switch. The ignition switch s located on bottom right side of panel. The ignition switch is a three-position switch, "OFF-ON-START" which activates the electrical system and provides the momentary starting circuit. Place shifting lever in neutral position. Turn the switch clockwise to "ON" position and then to "START" position and hold until engine starts.

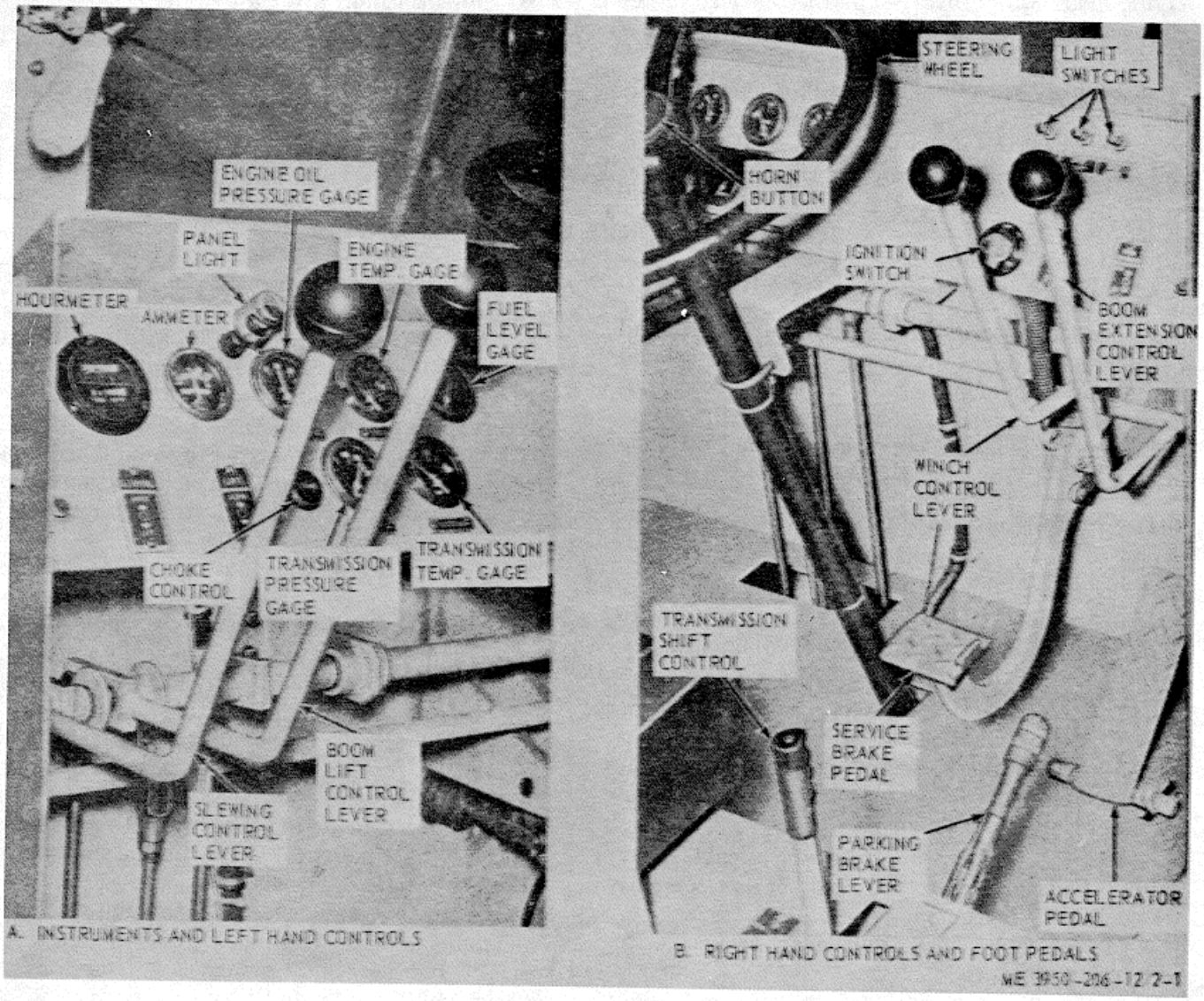


Figure 2-1. Controls and instruments.

Release switch and it will return to "ON" position.

p. Hour Meter. The hour meter (fig. 2-1) is located on top left side of instrument panel. It indicates total number of hours engine has been in operation. The meter is equipped with a scale that reads from tenths of hours to thousands of hours. Always check to be sure hour meter is operating properly when engine is in operation.

q. Ammeter. The ammeter (fig. 2-1) is located on top left side of instrument panel. The ammeter indicates amount of current being put into or withdrawn from battery. The dial reads 2-4 from -50 amperes to +50 amperes. When engine is running at full governed speed and battery is fully charged, the needle should move slightly to the positive side of the O mark on the dial. When needle indicates a constant discharge, stop engine and do not operate again until the malfunction has been corrected.

r. Engine Oil Pressure Gauge. The engine oil pressure gauge (fig. 2-1) is located top left side of panel, to the right of ammeter. The oil pressure gauge indicates pressure of the oil in the engine lubricating system and has a dial reading from 0 to 80 pounds per square inch. At normal operating temperature and

governed speed, gauge should show pressure between 25 to 35 pounds per square inch. If the gauge fails to show proper pressure reading, stop engine immediately and do not operate crane again until cause of the malfunction has been corrected.

s. Engine Temperature Gauge. The engine temperature gauge (fig. 2-1) is located on top left side of panel, to the right of engine oil pressure gauge. The temperature gauge indicates temperature of engine cooling fluid on a dial reading from 100°F. to 250°F. Under normal conditions, this temperature should be approximately 180°F. When gauge indicates temperatures excessively higher or lower than 180°, stop engine and do not operate crane until cause has been determined and corrected.

t. Fuel Gauge. The fuel gauge (fig. 2-1) is located on top left side of panel, to the right of engine temperature gauge. The fuel gauge indicates amount of fuel in tank. The dial reads from empty to full in one-quarter increments.

u. Transmission Oil Pressure Gauge. The transmission oil pressure gauge (0-200 lbs.) (fig. 2-1) is located on right side of choke on panel. This indicates pressure of oil in transmission. Under normal conditions, pressure will be between 140 to 170 lbs. at engine full throttle.

v. Transmission Temperature Gauge. The transmission temperature gauge (100-280°F) (fig. 2-1) is located on right side of transmission pressure gauge. This indicates temperature of oil circulating in transmission. Under normal conditions temperature will be between 180-200"F. Under no condition should temperature rise above 250°F.

Section IV. OPERATION UNDER USUAL CONDITIONS

2-8. General

a. The instructions in this section are published for the information and guidance of personnel responsible for operation of the Pettibone Model 10FM Warehouse Crane.

b. The operator must know how to perform every operation of which the crane is capable. This section gives instructions on starting and stopping the crane, operation of the crane, and on coordinating the basic motions to perform the specific tasks of loading, lifting, and transporting items of equipment. Since nearly every job presents a different problem, the operator may have to vary given procedures to fit the individual job.

2-9. Starting

a. Perform before-operation services (table 3-1).

b. Make certain that shift lever (fig. 2-1) is in neutral position.

c. Make certain that parking brake hand lever (fig. 2-1) is pulled up in parking position.

d. If engine is cold, pull choke control (fig. 2-1) all the way out.

e. Turn ignition switch (fig. 2-1) to "START" position, and release as soon as engine starts. Do not hold switch in "START" position longer than eight seconds. If engine fails to start on the first try, allow engine and starter to come to a complete stop before making a second attempt.

Note. **The starting motor will not operate unless the transmission lever is in the neutral position.**

f. Hold accelerator pedal steady and allow engine to warm up at a fast idling speed. Immediately observe engine oil pressure gauge (fig. 2-1) and ammeter (fig. 2-1) for normal readings. Also observe transmission oil temperature gauge (fig. 2-1) for indications of trouble. As engine begins to warm up, gradually push in on choke control; as soon as engine is warm, push choke control all the way in.

g. Warm engine until it will idle smoothly with choke control pushed all the way in. Check for proper readings on ammeter (fig. 2-1) engine oil pressure gauge (fig. 2-1), engine temperature gauge, (fig. 2-1) and fuel gauge (fig. 2-1). Be sure hourmeter (fig. 2-1) is operating properly.

h. Remove foot pressure from accelerator pedal. Report any malfunctions to the proper authority.

2-10. Stopping

a. Remove foot from accelerator pedal and depress service brake pedal slowly and bring crane to gradual stop.

b. Move shift lever into neutral position.

c. Apply parking brake.

d. Return boom to its retracted, horizontal position.

e. Turn ignition switch to OFF position.

f. Perform after-operation services (table 3-1).

2-11. Operation of Equipment

a. Vehicle operation.

(1) Start the engine (para 2-9).

Warning: The crane must be completely stopped before moving the transmission shift lever from its FWD to REV position or vice versa.

(2) Move directional shift lever to desired position (para 2-7, k).

(3) When operating the crane for any appreciable distance without load attached to the crane hook block, engage he hook block in the crane hook block eye to prevent oscillation of the block.

(4) Release the parking brake hand lever (fig. 2-1).

(5) Depress the accelerator pedal (fig. 2-1) until desired driving speed is attained.

(6) Control the braking of the crane by operation of the service brake foot pedal.

(7) Steering is controlled by the steering wheel, turning the rear wheels in the desired direction. The amount of effort required to turn the wheel is minimized by the hydraulically operated power steering system.

b. Crane operation.

(1) Approach load squarely.

(2) Stop machine by depressing brake pedal, and set parking brake hand lever.

(3) Place the transmission shift lever in neutral position.

(4) Position boom with lift, boom extension, and slewing controls.

Note. **Make sure winch cable is down when extending boom because winch cable e goes up when boom is being extended.**

(5) Lower hook block to load with winch control.

(6) When raising load, accelerate engine by depressing accelerator pedal.

(7) If load has to be moved, place load against front bumper.

(8) To lower load, position load by driving crane to desired spot, whenever possible.

(9) Lower load by moving winch lever forward.

Section V. OPERATION UNDER UNUSUAL CONDITIONS

2-12. Operation in Extreme Cold (below 0°F.)

a. See that antifreeze solution is correct for the lowest temperature expected (table 2-1).

b. Inspect cooling system. Correct or report any leaks.

c. Keep batteries fully charged. After adding water to the batteries, run the engine for at least one hour.

d. Keep the fuel tank filler cap tight to prevent condensation in the tank and lines.

e. Empty the fuel strainer bowl and replace.

f. Lubricate in accordance with approved lubrication order.

g. Allow engine to reach normal operation temperature before applying load.

2-13. Operation in Extreme Heat

a. Inspect cooling system to see that it is clean and free flowing. Keep coolant level in radiator at height specified (para 2-1, b(8)).

b. Keep radiator fins free from insects, leaves, dirt, and other obstructions.

c. Keep fan belt adjusted properly and see that there is no obstruction of air to the fan.

d. Open side panels of the engine housing to provide as much ventilation as possible.

e. Keep the fuel tank filler cap tight. Service the fuel tank daily.

2-14. Operation in Dusty or Sandy Areas

a. Keep the unit clean and clear of dust as much as possible. Lubricate in accordance with the approved lubrication order. Increase the frequency of lubrication of all exposed wearing surfaces.

Note. Clean exposed surfaces frequently. Sharp sand mixed wit oil makes an excellent abrasive.

b. Clean the hoist cable, sheaves, and telescoping boom frequently with an approved solvent to minimize wear.

c. After operation, blow loose sand and grit from the unit. Inspect universal joints, drive shaft, tie rods, and steering system pivot pins.

Wash with an approved solvent and relubricate.

d. Service the air cleaner and all filter units daily (para 3-5).

e. Keep the fuel tank filler cap tight. Service the fuel tank daily (para 3-8).

f. Clean the crane hydraulic tank breather cap daily.

2-15. Operation Under Rainy or Humid Conditions

a. Keep the fuel tank filler cap tight to prevent water from entering the fuel tank. Service the fuel tank frequently to prevent condensation in the tank and lines (para 3-8).

b. Inspect transmission, axles, crankcase, and lubrication fittings to see that no water has entered.

c. Frequent inspection of the electrical wiring for corrosion, loose connections, or deteriorated insulation should be made, which, unless re- paired could cause a short-circuit.

d. Lubricate in accordance with the approved lubrication order.

2-16. Operation in Salt Water Areas

a. Inspect the unit for rust and corrosion. Rust and corroded conditions at any point on the unit must be corrected immediately. Remove all rust, and paint the bare surfaces. Place a light film of lubricant on polished or machined metal surfaces.

b. Although the wiring of the crane has been specially treated to resist fungus and rot, frequent inspection is necessary. Inspect all wiring for corrosion or deteriorated insulation and correct any deficiencies immediately.

c. Keep thoroughly lubricated to prevent en- try of water into bearings and polished metal surfaces. Keep hoist cables clean. Lubricate as directed in approved lubrication order.

2-17. Operation in High Altitudes

a. Operation in high altitudes presents operational problems due to lower atmospheric pressure and wide temperature ranges.

b. Keep air cleaner clean and free of obstructions and service frequently.

c. Maximum performance can be maintained by carefully following the operator's daily preventive maintenance services (para 3-5). Caution: Check the unit frequently for overheating of the engine at high-altitude operation.

Section VI. OPERATION OF MATERIEL USED IN CONJUNCTION WITH THE EQUIPMENT

2-18. General

This section coven the description and operation of the auxiliary equipment supplied for use with the crane, but not necessary for the basic functioning of the crane.

2-19. Fire Extinguisher (Dry Chemical Type)

a. Description. The dry chemical type fire extinguisher is suitable for use on all types of fire and is effective in areas when ambient temperature is -40°F and above. The fire extinguisher has a 2 1/2 pound capacity, and is a stored pressure, lever-operated type.

b. Operation. Remove the fire extinguisher from its bracket. Remove the tape seal. Lift the handle and press the top lever. Direct the powder at the base of the flame, using a side-to-side sweeping motion.

c. Replacement. After using the extinguisher, do not replace in bracket until after inspecting as instructed below.

d. Maintenance. Weigh the fire extinguisher every 6 months and replace the extinguisher if weight is less than 3 3/4 pounds, or if pressure is below 125 pounds. Refer to SB-114. The dry chemical fire extinguisher will be serviced by re- placement of entire extinguisher.

CHAPTER 3
OPERATOR MAINTENANCE INSTRUCTIONS

Section I. BASIC ISSUE ITEMS

3-1. Basic Issue Items

Tools, equipment, and repair parts issued with or authorized for the Pettibone Model 10FM Warehouse Crane are listed in the basic issue items list, Appendix B.

Section II. LUBRICATION INSTRUCTIONS

3-2. General Lubrication Information

This section contains lubrication instructions which are supplemental to and may not be specifically covered in the lubrication order.

3-3. Detailed Lubrication Information

a. General. Keep all lubricants in dosed containers and store in a clean, dry place away from external heat. Keep container covers clean and allow no dust, dirt, or other foreign material to mix with the lubricants. Keep all lubrication equipment clean and ready for use.

b. Cleaning. Keep all external parts, not requiring lubrication, free from lubricants. Before lubricating the equipment, wipe all lubrication points free of dirt and grease. Clean all lubrication points after servicing to prevent accumulation of foreign matter.

c. Points of Lubrication. Service the lubrication points at the proper intervals as specified on the lubrication order. The intervals of lubrication specified are based on operation under normal conditions. Modification of the recommended intervals may be required under unusual operating conditions.

d. OES Oil.

(1) Crankcase oil level must be checked frequently, as oil consumption may increase.

(2) Oil may require changing more frequently than usual because contamination by dilution and sludge formation will increase under cold weather operation conditions.

e. Crankcase Service. Refer to figure 3-1 and check the oil level in the crankcase. Inspect filter, crankcase, oil cooler, lines and fittings for leaks. Notify organizational maintenance if leakage is encountered. Add or change oil, as required in accordance with Lubrication Order. Note. Engine must be stopped check oil level.

f. A Cleaner Service. The air cleaner is an oil bath type air cleaner equipped with a pre-leaner cap. Refer to figure 3-2 and service the air cleaner as instructed.

g. Transmission Service. Refer to figure 3-3 and check oil level. Add oil as required, if oil level is at "L" or below. Consult Lubrication Order for proper type oil. Report any increase in oil consumption to organizational maintenance.

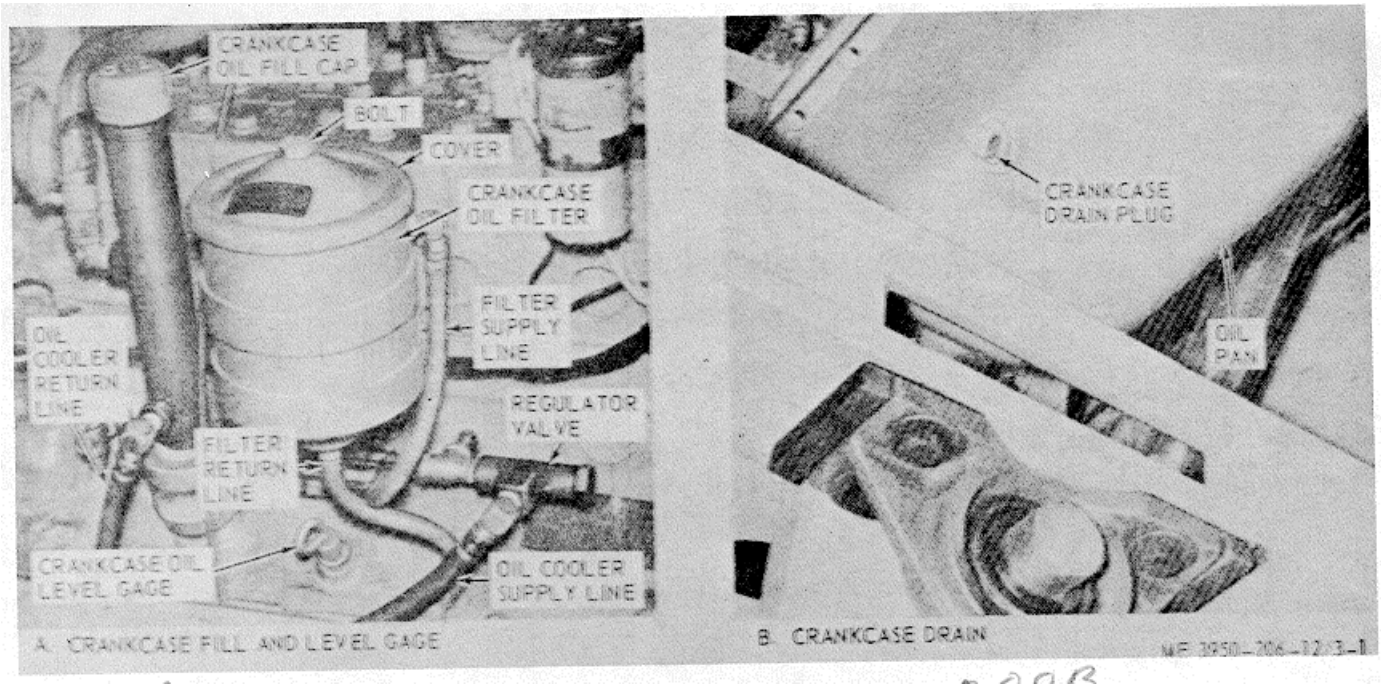


Figure 3-1. Crankcase service points.

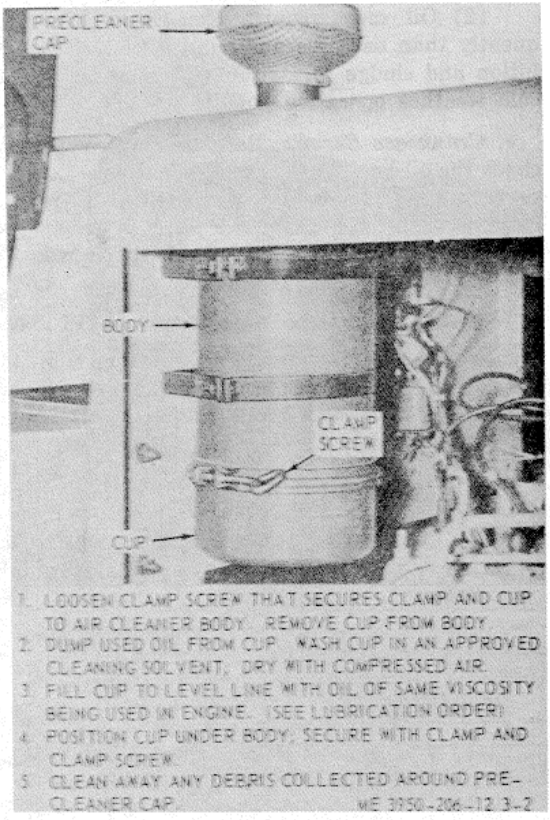


Figure 3-2. Air cleaner service.

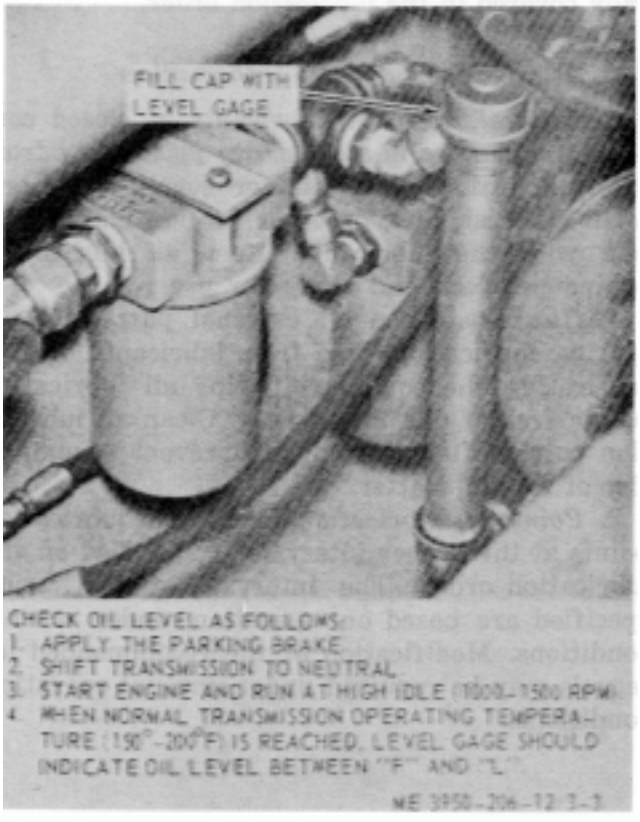


Figure 3-3. Transmission service points.

Section III. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

3-4. General

To insure that the Pettibone Model 10FM Ware- house Crane is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services to be performed are listed as described in table 3-1. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit will be noted for future correction to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment if operation were continued. All deficiencies and short comings will be recorded together with the corrective action taken on DA Form 2404 at the earliest possible opportunity.

3-5. Preventive Maintenance Checks and Services

The daily and weekly preventive maintenance checks are as sequenced and described in table 3-1.

Table 3-1. Preventive Maintenance Checks and Services

Item no.	Interval				B--Before operation D--During operation A--After operation W--Weekly		
	Daily			W	Item a be Inspected	Procedure	Reference'
	B	D	A				
						Lubricate in accordance with the Lubrication Order.	LO 10-3950-206-12-1/2
1.				X	Fan belt	Check belt tension. Deflection to be 3/4 to 1 inch midway between crankshaft and fan pulley.	(para 4-37)
2.	X				Tires	Check tire pressures: Drive wheels 90 psi Steering wheels 85psi. Check for cuts, or foreign material in tires (weekly).	(para 3-11)
3.	X	X	X		Fuel tank	Check fuel level. Fill as required.	(para 3-8)
4.	X				Horn Button	Check operation.	(para 2-7)
5.	X				Fire Extinguisher	Inspect for broken sea] and full charge.	(para 2-19)
6.	X	X			Controls and Instruments	Inspect instruments for proper operation.	(para 2-7)
7	.X				Brake Pedal	Check operation.	(para 2-7)
8.				X	Air cleaner	Service oil cup.	(para 3-3f)
9.	X				Radiator	Check coolant level	(para 3-9)
10.	X				Oil lev1e gage (Eng.)	Check oil level. Add oil as required.	(para 3-3e)
11.				X	Oil level gage (Transmission)	Check oil level. Add oil as required	(para 3-3g)
12.				X	Batteries	Check for loose cables. Remove corrosion. Check level of electrolyte. Clean vent holes in caps.	(para 3-10)

Section IV. TROUBLESHOOTING

3-6. Troubleshooting

This section provides information for the operator's use in diagnosing and correcting unsatisfactory operation of the Pettibone Model 10FM Warehouse Crane and its components. Table 3-2, provides a tabulated listing of malfunctions followed by a list of probable causes. The corrective action recommended is described opposite the probable cause. Any trouble beyond the scope of operator maintenance as reflected in the maintenance chart shall be reported to organizational maintenance.

Table 3-2. Troubleshooting

Malfunction	*Probable cause*	*Corrective action*
1. Engine overheats	a. Coolant level low.	a. Add water as required.
b. Loss of coolant.	b. Inspect hoses for cracks, deteriora-	tion or collapsing.
c. Insufficient heat transfer.	c. Clean dust, dirt, and foreign	matter from radiator fins
2. Engine lacks power or hard to start..	Insufficient air.	Clean oil cup of air cleaner.
3. Excessive fuel consumption.	a. Sustained operation at high speeds.	a. Avoid operating continuously at high speeds.
	b. Operation at prolonged periods at idle speed.	b. Avoid operating at idle speed for long periods.
4. No oil pressure.	Insufficient oil in crankcase.	Check level. Add oil as required.
5. Batteries discharged.	Electrolyte level low.	Service batteries (para 3-10).
6. Lights do not light.	Switch not fully on.	Pull switch fully on.
7. Steering is difficult.	Lack of lubrication at pivot points.	Lubricate.
8. Crane will not move in either direction.	a. Parking brake not released.	b. Release brake.
	b. Transmission oil level low.	b. Fill to proper level (para 3-3g).
9. Crane will not move in one direction.	(See 8, b above.)	
10. Crane will not lift load.	Load too heavy.	Remove excessive weight.

Section V. OPERATOR'S MAINTENANCE

3-7. General

The instructions of this section are published for the information and guidance of the operator to maintain the Pettibone Model 10FM Ware- house Crane.

3-8. Fuel Tank Service

Service the fuel tank as instructed on figure 3-4. Note. Keeping the fuel tank full when unit is not in use will reduce the amount of condensation and water contamination of the gasoline

3-9. Radiator Service

Service the radiator as instructed in paragraph 2-1b (8).

3-10. Battery Service

Service the batteries as instructed in paragraph 2-1b (3).

3-11. Tire Service

a. Operator maintenance of tires is limited to maintaining proper tire inflation. Need for re- placement or repair of punctured tire or tube should be reported to organizational maintenance.

b. Service the rear steering tires as instructed on figure 3-5A.

c. Service the front, dual driving tires as instructed in figure 3-5B.

3-12. Seat Adjustment

The operator's seat is provided with a sliding track mounting for sliding the seat forward or backward to suit the individual operator. The side release lever is located at the left, front, be- low the seat cushion.

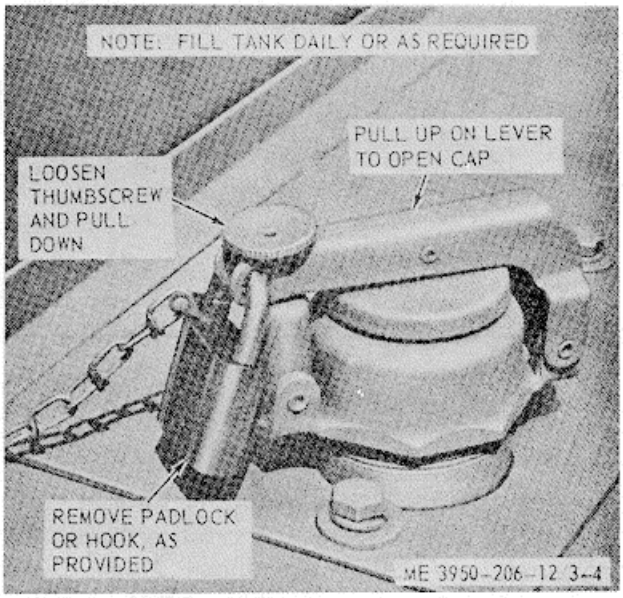


Figure 3-4. Fuel tank service points.

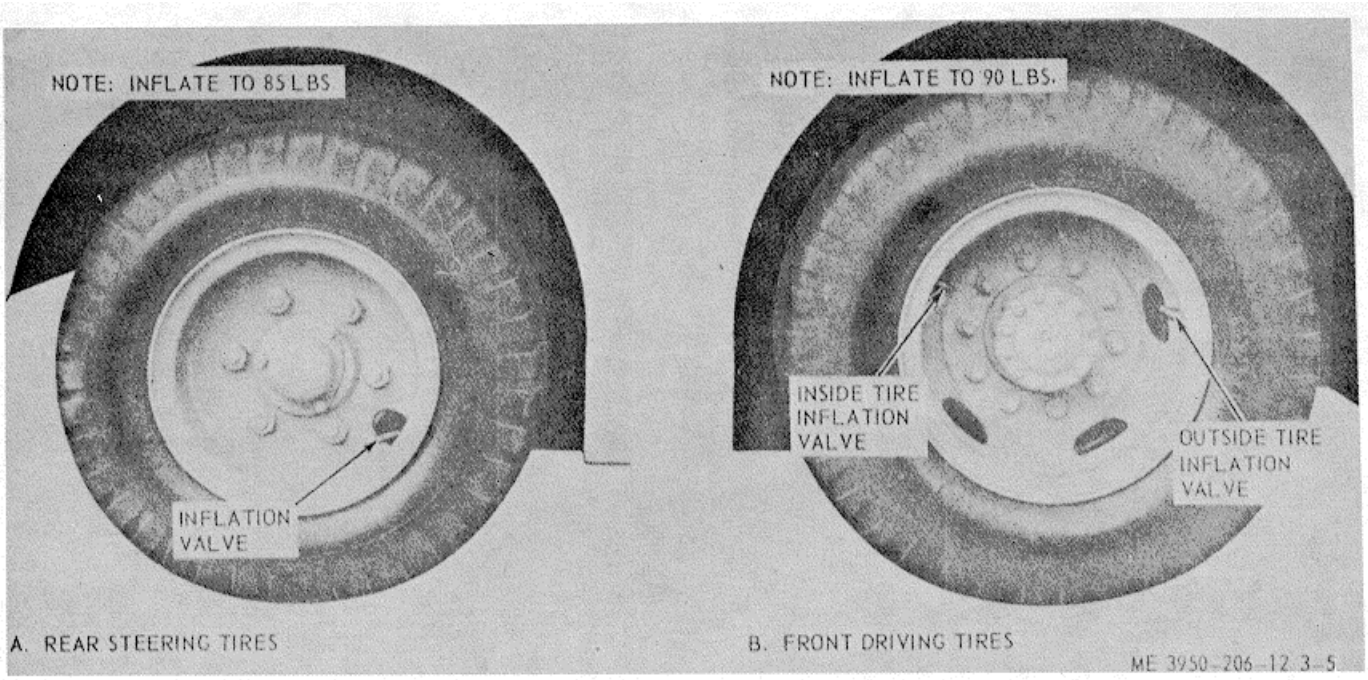


Figure 3-5. Tire service.

CHAPTER 4
ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIAL

4-1. Service Upon Receipt of Material
Refer to Section I of Chapter 2 for service instructions upon receipt of material.

Section II. MOVEMENT TO A NEW WORKSITE

4-2. Movement to a New Worksite
Refer to Section II of Chapter 2 for instructions on movement to a new worksite.

Section III. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

4-3. Tools and Equipment
Tools, equipment, and repair parts issued with or authorized for the Pettibone Model 10FM Warehouse Crane are listed in the basic issue items list, appendix B.

4-4. Special Tools and Equipment
No special tools or equipment are required for the performance of organizational maintenance functions of the Warehouse Crane.

4-5. Maintenance Repair Parts
Repair parts and equipment are listed and illustrated in the Repair Parts and Special Tools List, TM 10-3950-206-20P, covering organizational maintenance for this equipment.

Section IV. LUBRICATION INSTRUCTIONS

4-6. General
This section contains organizational level lubrication instructions, which are supplemental to, and may not be specifically covered in the lubrication order. Refer to paragraph 3-3, for detailed operator lubrication instructions.

4-7. Engine Oil Filter Service
Refer to figure 3-1, and service the engine oil filter as follows:

a. Loosen the top bolt and remove the cover assembly.

b. Remove the cover gasket and discard.

c. Lift out the used filter element and discard.

d. With clean rag or toweling clean the inside of the filter shell.

e. Position new filter element in the shell and a new cover gasket in the cover.

f. Position the cover over the shell and secure with the top bolt.

Caution: Do not over tighten the bolt as damage to the gasket may occur.

g. Operate engine at idle speed for one minute. Check oil level. Add oil as required. Operate at governed speed for 10 minutes. Check for oil leaks around filter cover.

4-8. Transmission Service
a. Refer to figure 4-1 and service the transmission oil filter, sump, and strainer as instructed. Consult lubrication order for proper lubricant.

b. After servicing transmission operate for approximately five minutes. Check for leaks and maintain proper oil level.

4-9. Drive Shaft Service
Refer to figure 4-2 and service the drive shaft in accordance with lubrication order.

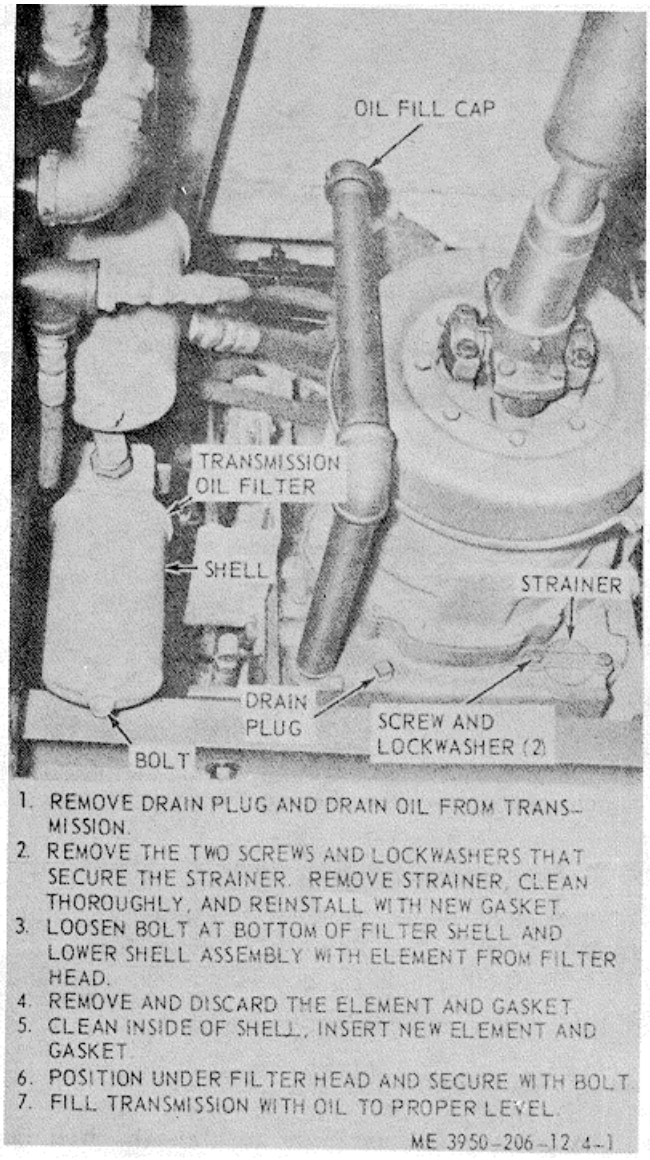


Figure 4-1. Transmission service instructions..

4-10. Drive Axle Service

a. Remove drain plug (fig. 4-3) and drain lubricant from axle housing.

Note. More thorough drainage will occur if axle is warm.

b. Clean the magnetic drain plug and reinstall.

c. Remove fill plug (fig. 4-3) and fill with lubricant specified on lubrication order.

d. Reinstall fin plug and check for leaks.

4-11. Rear Steering Axle Service

Refer to figure 4-4, and service the rear steering axle in accordance with lubrication order.

4-12. Hydraulic System Service

a. Remove drain plug (fig. 4-5B) and drain entire hydraulic system.

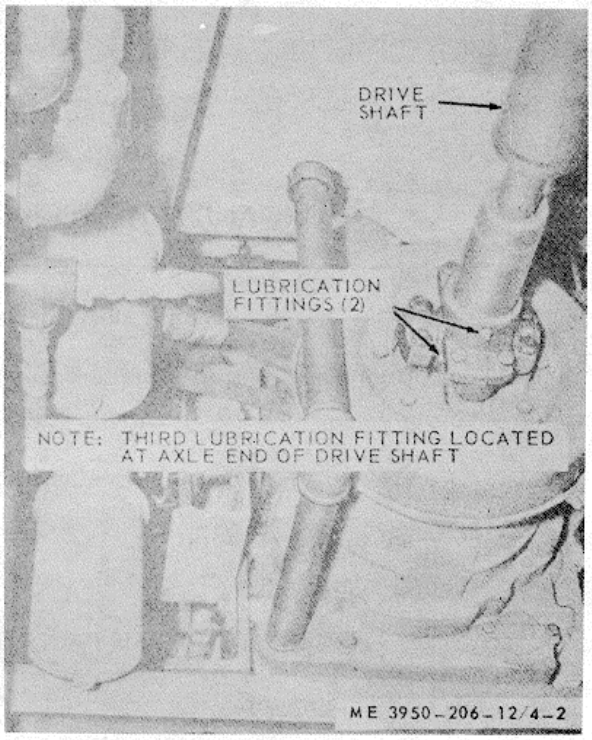


Figure 4-2. Drive shaft service points.

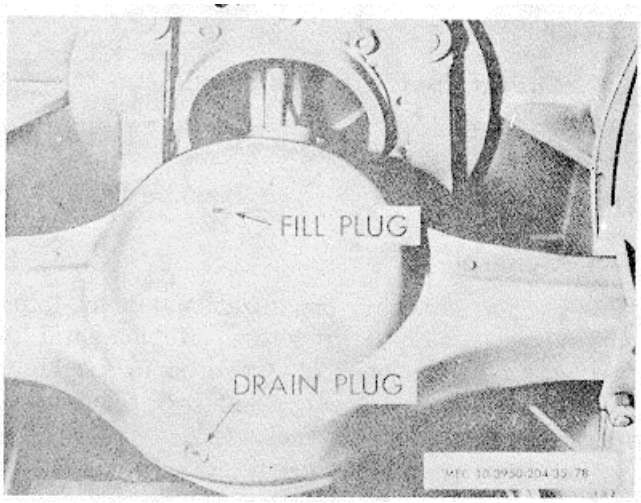


Figure 4-3. Drive axle service points.

b. Servicing procedure for the hydraulic system filter is identical to that of the transmission oil filter, paragraph 4-8.

c. Remove the small and large covers (fig. 4-5A) and clean any sludge from bottom of tank.

d. The sump filter, assessable through the larger opening may be removed and cleaned by back- flushing oil through the filter. Reinstall after cleaning.

e. Remove breather and fill cap (fig. 4-5A). Clean in an approved cleaning solvent and dry.

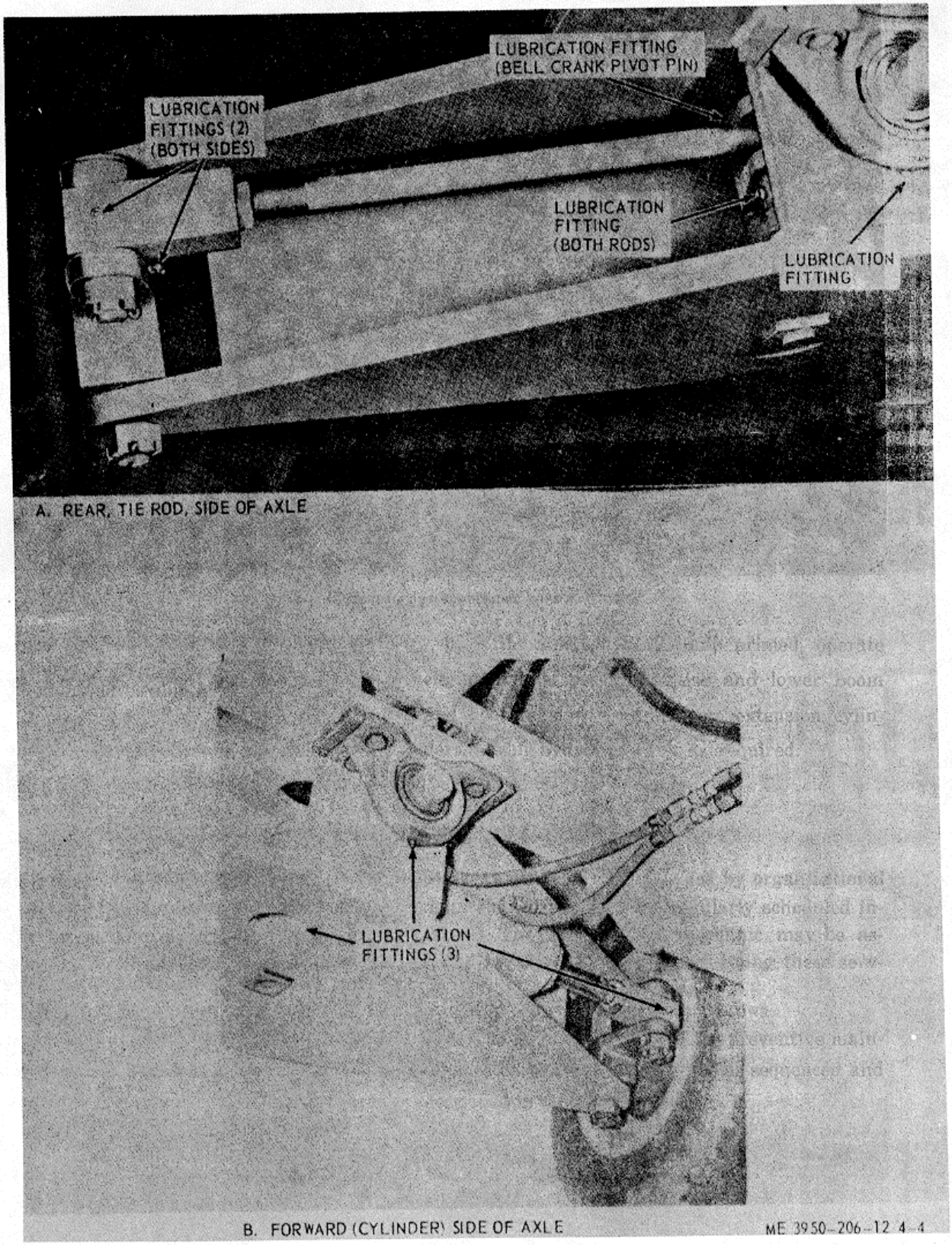


Figure 4-4. Rear steering axle service points.

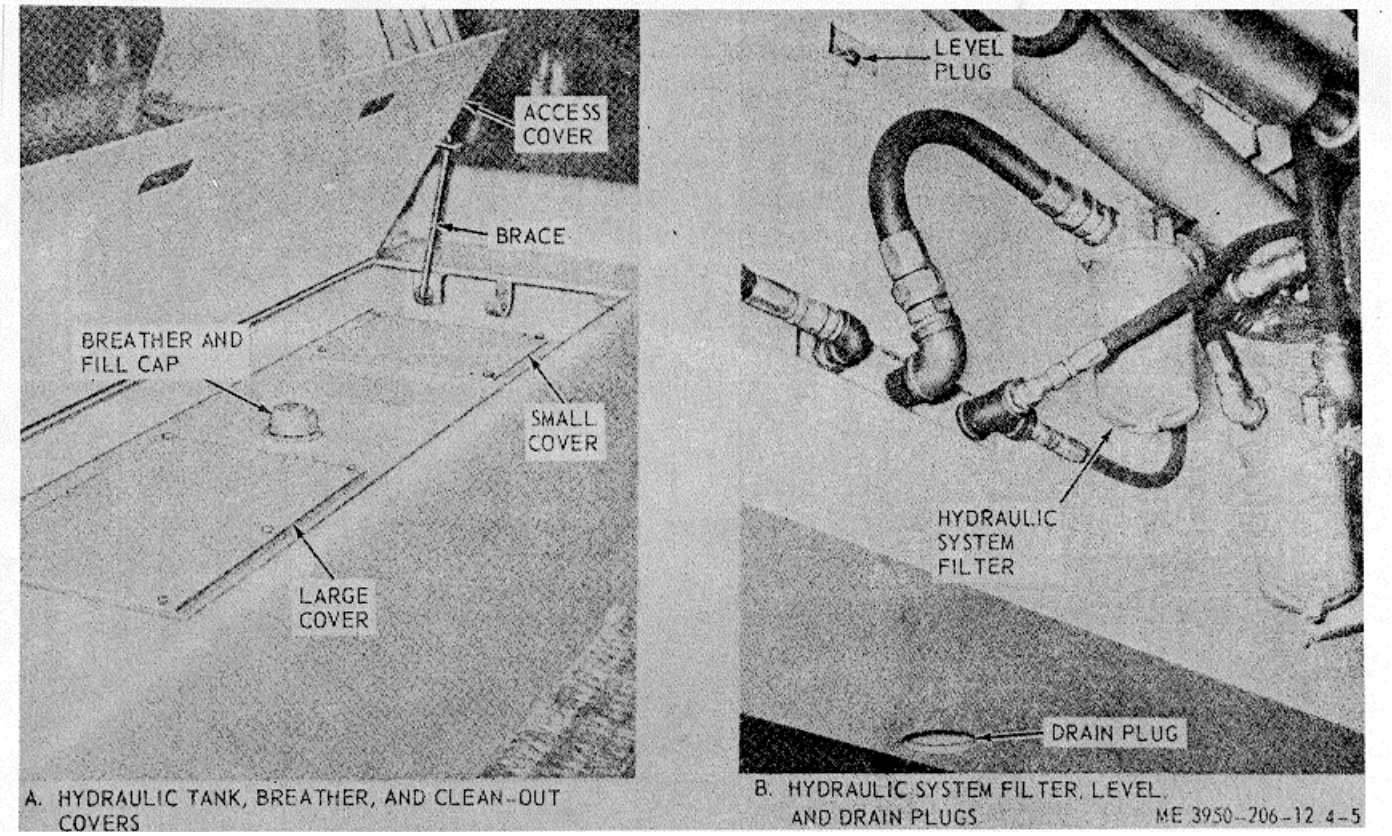


Figure 4-5.. Hydraulic system service points.

f. Install the drain plug, small and large covers and fill tank with oil as specified in lubrication order. Remove level plug to check for proper level.

Note. If suction hose has been drained, disconnect pressure hose from elbow on top of hydraulic pump and fill pump with oil.

g. With tank full and pump primed, operate engine at idle speed and raise and lower boom and operate slewing and boom extension cylinders. Refill hydraulic tank as required.

Section V. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

4-13. General

Preventive maintenance is defined as the systematic care, inspection, and servicing of equipment to maintain it in serviceable condition, to prevent breakdowns, and to assure maximum operational capability.

4-14. Organizational Preventive Maintenance Checks and Services

a. The services described in this section are those which must be performed by organizational maintenance personnel at regularly scheduled intervals. The organization mechanic may be assisted by the operator in performing these services.

b. The monthly and quarterly preventive maintenance checks and services are as sequenced and described in table 4-1.

Table 4-1. Troubleshooting Chart - Continued

Item no.	Interval M	Interval Q	M-Monthly Item to be inspected	Q-Quarterly Procedure	Reference
				Lubricate in accordance with the Lubrication Order.	
1.		X	Fan Belt	Check belt tension. Deflection to be 3/4 to 1 inch midway between crankshaft and fan pulleys.	(para 4-37)
2.	X		Tires	Check tire pressure: Drive wheels-90 psi Steering wheels-85 psi. Check for cuts or foreign material in tires (weekly).	(para 3-11)
3.		X	Distributor	Check for pitted or burned points. Replace if necessary. Gap at 0.020 inch.	(para 4-26g)
4.			Fuel Tank	Check fuel level. Fill as required (daily).	(para 3-8)
5.	X		Transmission	Check for leaks. Check linkage for operation.	(para 4-57)
6.		X	Fuel Filter	Remove bowl and clean.	(para 4-47a)
7.		X	Horn Button	Check operation.	(para 2-7e)
8.	X		Fire Extinguisher	Inspect for broken seal and full charge.	(para 2-19)
9.	X		Brake Pedal	Check operation.	(para 4-67)
10.			Controls and Instruments	Inspect instruments for proper operation.	(para 2-7)
11.		X	Master Cylinder	Check fluid level.	(para 4-8)
12.		X	Hoist Drum and Cable	Check for wear and correct operation.	(para 4-78)
13.	X		Lift Cylinder	Check for leaks at hose connections, with shipper raised, then lowered.	
14.		X	Boom Wear Shoes	Check for cracked, broken or excessively worn wear shoes.	(para 4-80b)
15.		X	Boom and Boom Sheave	Check for defects and sheave wear.	(para 4-79b)
16.	X		Lights	Check for defective lamps or lamp unit.	(para 4-30, 4-31, 4-32)
17.	X		Drive axle	Check for leaks	
18.	X		Slewing Cylinder	Check for leaks with engine running and rotating shipper to the left, then to the right.	
19.	X		Hydraulic Oil Reservoir	Add hydraulic oil as required. Refer to current lubrication chart. Check breather. Replace if necessary.	(para 4-12)
20.		X	Hand Brake	Check operation and adjust.	(para 4-63)
21.	X		Batteries	Check for loose cables. Remove corrosion. Check level of electrolyte. Clean vent holes in caps.	(para 3-10)
22.		X	Spark Plugs	Check. Replace if necessary. Gap to 0.025.	(para 4-24)
23.	X		Oil level gage (Eng).	Add oil as indicated. Refer to current lubrication order.	
24.		X	Fan	Check for loose, bent or damaged blades.	(para 4-37)
25.	X		Radiator	Proper coolant level is 1 inch below filler neck. Check hoses for leaks and soft spots.	(para 3-9)
26.		X	Muffler	Check muffler and exhaust pipe for obstructions, cracks, corrosion, and other damage.	(para 4-39)

Section VI. TROUBLESHOOTING

4-15. Troubleshooting

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the Pettibone Model 10FM Warehouse Crane and its components. Each malfunction stated is followed by a list of probable causes. The corrective action recommended is described opposite the probable cause. Any trouble beyond the scope of organizational maintenance as reflected in the maintenance allocation chart shall be reported to direct support maintenance. Refer to table 4-2.

Table 4-2. Troubleshooting Chart

Malfunction	*Probable cause*	*Corrective action*
1. Engine will not crank	Dead battery or loose leads to starting motor.	Check battery to ground lead, battery to starter lead and then, once satisfied there is continuity test batteries (para 4-27).
2. Engine cranks but will not start.	a. Weak battery.	a. Charge or replace with serviceable battery (para 3-10).
	b. Faulty ignition or fuel system.	b. Turn on ignition switch and disconnect one spark plug lead and hold it about 3/16 from engine block. Crank engine to see whether spark occurs. If spark is present, fault is probably in fuel system. If spark is absent, check ignition coil, distributor, and points (para 4-24, 4-25, and 4-26).
	c. Defective distributor.	c. Remove cap from distributor. Connect short piece of high tension wire to terminal of coil. Turn on ignition switch and hold lead about 3/16 inch from engine block. Crank engine. If no spark occurs, inspect and replace distributor or coil as necessary (para 4-25 and 4-26).
	d. No fuel in tank.	d. Fill fuel tank (para 4-48).
	e. Fuel not reaching the	e. Open carburetor shutoff cock at carburetor. fuel tank. If this does not help, check for restrictions in fuel lines and fuel pump; remove restrictions (para 4-48).
	f. Carburetor flooded.	f. Turn ignition switch to ON position, and press accelerator pedal to floor plate, attempt to start engine (para 2-9).
	g. Air leak in intake manifold.	g. Place a small quantity of oil around suspected leak. A leak is indicated when oil is drawn to interior of manifold. If possible, repair manifold and install new gasket (para 4-54).
	h. Spark plug gap improperly set	h. Using a spark plug gage, set gap 0.025 (para 4-24).
3. Engine does not develop full power.	a. Air cleaner dogged.	a. Clean air cleaner (para 4-41).
	b. Low compression.	b. Perform compression test (para 4-50).
	c. Fuel lines clogged.	c. Clean fuel lines (para 4-46 & 4-48)
	d. Intake manifold leaking.	d. Tighten manifold nuts or install new gaskets (para 4-54.)
	e. Improper ignition timing.	e. Correct ignition timing (para 4-50).

Table 4-2. Troubleshooting Chart - Continued

Malfunction	*Probable cause*	*Corrective action*
4. Engine misfires.	a. Defective spark plug.	a. If porcelain is cracked, point gap too wide, or points and porcelain are coated with soot, replace or clean plug as required (para 4-24).
	b. Cylinder head gasket leaking.	b. Replace gasket (para 4-53).
	c. Intake manifold leaking.	Tighten manifold nuts or install new gaskets (para 4-54).
	d. Spark plug gap improperly set	d. Set gap at 0.025 inch (para 4-24).
	e. Contact points sticking or improperly set	e. Clean and set point opening at 0.020 inch (para 4-26g).
	f. Improper ignition timing.	f. Correct ignition timing (para 4-50).
	g. Low compression.	g. Perform compression test (para 4-50).
5. Engine overheats	a. Lack of coolant.	a. Fill radiator (para 3-9).
	b. Fan and alternator belt loose.	b. Tighten to 3/4 to 1-inch finger pressure deflection midway between pulleys (para 4-37c).
	c. Cooling system clogged . .	c. Clean and flush system (para 3-9).
	d. Thermostat sticking closed.	d. Eliminate sticking or replace thermostat (para 4-36).
	e. Rotted hose.	e. Replace hose (para 4-35).
	f. Dirt, insect, or other foreign matter in radiator.	f. Blow out with compressed air (para 4-35a).
	g. Improper timing.	g. Correct timing (para 4-50).
	h. Cylinder head gasket improperly installed.	h. Correct or replace gasket (para 4-3).
	i. Flow of water is restricted in cylinder head, engine block, water jacket, distributing tube or radiator.	i. Inspect cooling system and clean thoroughly (para 3-9).
	j. Oil cooler or lines restricted or clogged.	j. Clean and flush system (para 4-34b).
6. Engine runs too hot.	Thermostat sticking closed.	Eliminate sticking or replace thermostat (para 4-36b, c).
7. loss of coolant	a. Radiator leaks.	a. Repair or replace radiator (para 4-35, c).
	b. Cracked cylinder head or block.	b. Replace cylinder head (para 4-53).
	c. Defective water pump.	c. Replace water pump (para 4-38b).
	d. Defective hose connections.	d. Tighten or replace connections.
	e. Faulty cylinder head gasket or loose nuts.	e. Tighten nuts, replace gasket, if necessary (para 4-53).
8. Water pump noises.	a. Pulley loose on pump shaft.	a. Tighten pulley (para 4-38b).
	b. Impeller broken.	b. Replace water pump (para 4-38b).
	c Impeller blades rubbing water pump housing	c. Replace water pump (para 4-38b).
9. Rapid fan and alternator belt breakage or wear.	a. Belt adjusted too tight or too loose.	a. Adjust to 3/4- to 1-inch finger pressure deflection midway between pulleys (para 4-37).
	b. Incorrect type belt.	. Use correct belt.
	c. Oil on belt.	c. Clean belt.
	d. Misalignment of pulleys.	d. Align properly.
	e. Broken or rough flanges on fan pulley, alternator pulley.	e. Repair pulleys as necessary or replace alternator pulley (para 4-37) and fan pulley.
10. Fan noises.	a. Belt adjusted too tight (squeak).	a. Adjust to 3/4- to 1-inch finger pressure deflection midway between pulleys (para 4-37c).
	b. Belt adjusted too loose (squeak on acceleration).	b. Adjust to 3/4- to 1-inch finger pressure deflection midway between pulleys (para 4-37c).

Table 4-2. Troubleshooting Chart - Continued

Malfunction	*Probable cause*	*Corrective action*
	c. Incorrect type V-belt.	c. Use correct V-belt.
	d. Fan V-belt worn or burned.	d. Replace V-belt.
	e. Misalignment of pulleys.	e. Align properly.
	f. Fan blades loose on hub	f. Tighten capscrews.
	g. Alternator, crankshaft fan drive or fan pulleys cracked or distorted.	g. Replace defective pulley.
	h. Fan blade striking V-belt or radiator.	h. Adjust blades or replace fan.
	i. Unbalanced fan blade assembly, bent or distorted blades, or blades with uneven pitch.	i. Replace fan.
11. Engine pings or knocks.	a. Improper ignition timing.	a. Set ignition timing (para 4-50).
	b. Low-grade fuel.	b. Drain tank and refill with proper grade fuel (para 4-48).
12. Large amount or carbon on spark plugs.	a. Improper grade of fuel.	a. Drain and refill with proper grade . fuel (para 4-48).
	b. Weak spark.	b. Inspect distributor, coil and condenser. Replace if necessary (para 4-26).
	c. Improper timing.	c. Correct timing (para 4-50).
13. Excessive smoke.	a. Too much oil in crankcase.	a. Fill only to proper level.
	b. Poor carburetion.	b. Adjust carburetor (para 4-42).
14. Explosion in muffler.	a. Incorrect timing.	a. Correct timing (para 4-50).
	b. Too lean fuel mixture.	b. Adjust carburetor (para 4-42).
15. Excessive fuel consumption.	a. Engine idles too fast	a. Adjust carburetor (para 4-42).
	b. Incorrect timing	b. Correct timing (para 4-50).
	c. Distributor points improperly set.	c. Set point opening at 0.020" (para 4-26b).
	d. Defective spark plugs.	d. Replace spark plugs (para 4-24).
	e. Clogged air cleaner.	e. Clean air cleaner (para 4-41).
	f. Fuel pump diaphragm punctured.	f. Install new pump.
	g. Restricted exhaust	g. Remove restrictions (Crimp) or replace defective exhaust system component.
	h. Throttle stopscrew set improperly	h. Adjust stopscrew.
16. Intake and exhaust manifolds leak.	a. Loose manifold connections.	a. Tighten connections.
	b. Damaged or improperly installed gaskets.	b. Install correctly. Replace if necessary (para 4-54).
	c. Restricted exhaust	a. Remove restrictions (Crimp) or replace defective exhaust system component
17. Low fuel pump pressure.	a. Clogged gasoline tank cap vent.	a. Clean vent (para 4-46).
	b. Fuel pump filter bowl loose.	b. Tighten filter bowl (para 4-46).
	c. Clogged fuel pump filter.	c. Clean filter (para 4-46).
	d. Damaged or improperly installed bowl gasket.	d. Install properly or replace gasket (fig. 4-30).
	e. Leaky fuel lines or fu line connections.	e. Inspect, replace broken pieces (fig. 4-30).
18. No oil pressure.	a. Insufficient oil in crankcase	a. Stop engine immediately and fill to prescribed level with OE as shown on lubrication order. Inspect for oil leaks while operating engine.
	b. Inaccurate oil pressure gage	b. Replace pressure gage. Normal pressure at idling speed is 20 to 25 pounds and at normal speed 30 to 40 pounds (para 4-29).
19. Engine uses too much oil.	a. Oil leak	a. Inspect for oil leaks, especially in oil filter and cooler connections.

Table 4-2. Troubleshooting Chart - Continued

Malfunction	*Probable cause*	*Corrective action*
	b. Worn piston ring.	b. Take compression check and report an abnormal condition to direct support unit.
20. Ammeter shows constant discharge.	a. Fan V-belt loose or broken. b. Short circuit. c. Faulty alternator or regulator	a. Tighten or replace V-belt. b. Check wiring c. Test charging circuit, isolate and repair fault.
21. Brakes drag.	a. Weak or broken return spring. Improperly adjusted pedal or linkage. b. Wheel bearing loose.	a. Replace spring. Adjust pedal for free play of 3/16 to 5/16 inch (para 4-67). b. Adjust wheel bearings (para 4-69c).
22. Defective brakes.	a. Air in system. b. Fluid low in master cylinder. c. Leaks in system.	a. Bleed system (fig. 4-56). b. Fill master cylinder to within 1/4 inch below top. c. Check system and correct.
23. Springy. spongy brake pedal.	Air in system.	Bleed system (fig. 4-46).
24. Brake locked.	a. Brake pedal lacking free travel. b. Brakes frozen to drums (cold	a. Adjust pedal for free play (para 4-67). b. Break loose by driving vehicle. weather).
25. Brake noise or clatter.	a Brake lining worn. b. Grease on lining. c. embedded in linings. d. Improper or loose lining. e. Brake shoe or drum distorted.	a. Replace shoe and lining assembly (para 4-69). b. Correct leakage, clean or replace shoe and lining assemblies (para 4-69). c. Clean lining with wire brush. d. Replace shoe and lining assembly. e. Replace defective components. (para 4-69).
26. Excessive brake pedal pressure necessary to activate brakes.	a. Grease on linings. b. Worn or glazed linings.	a. Correct grease leakage and replace linings (para 4-63 & 4-69). b. Clean up and replace shoe and lining assembly (para 4-69).
27. Crane pulls to one side.	Fluid or grease on brake lining.	Correct leaks and install new service brakeshoes (para 4-64).
28. Lift mechanism will not lift load.	a. Hydraulic oil level too low. b. Over load. c. Hydraulic oil lines leaking.	a. Fill to proper level as shown on lubrication order. b. Remove excessive weight from hook block (para 4-78). c. Tighten fittings and install new hose if necessary (para 4-76).
29. Load creeps down from	a. Hydraulic oil lines leaking. raised position. b. Hydraulic oil leak in dither intake line connection or packing glands.	a. Tighten fittings, and install new hose if necessary. b. Inspect and tighten (para 4-76).
30. Noise in power steering system.	a. Low oil level in power steering system. b. Clogged outlet line or oil filter element. c. Warped brakeshoes or defective brake lining. d. Brakedrum scored or distorted.	a. Fill to proper level as shown on lubrication order. b. Clean reservoir. Clean lines, and replace element fill system to proper level (para 4-76 and 4-77). c. Replace shoe and lining assembly (para 4-69). d. Repair or replace drum (para 4-69).
31. Wheel wobbles.	a. Wheel bent. b. Wheel loose on hub. c. Wheel bearing not adjusted.	a. Inspect mounting on hub, spindles and drive axle. b. Tighten nuts or bolts. c. Adjust; lubricate wheel bearings (para 4-69c).

Table 4-2. Troubleshooting Chart - Continued

Malfunction	*Probable cause*	*Corrective action*
32. Battery discharged.	a. Battery solution low.	a. Add distilled water to bring level above plates. Inspect for cracked case (para 3-10).
	b. Short in battery cell.	b. Replace battery (para 3-10).
	c. Alternator not charging	c. Tighten V-belt. Test or replace regulator (para 4-22). Test or replace alternator (para 4-21).
	d. Loose or dirty connections.	d. Clean and tighten connections.
	e. Broken cables.	e. Replace cables (para 4-27).
	f. Excessive use of starting motor.	f. Tune up engine. Charge battery.
	g. Short circuits.	g. Replace defective wiring
33. Lights do not light	a. Switch not fully on.	a. Turn switch on fully (para 2-7).
	b. Loose or dirty connections.	b. Clean and tighten.
	c. Broken wire.	c. Replace or repair wire or terminal.
	d. Wiring circuit open.	d. Repair wiring circuit or replace defective parts.
	e. Light burned out.	e. Replace light (para 4-30).
	f. Defective switch.	f. Replace switch.
34-. Lights dim.	a. Loose or dirty connections.	a. Clean and tighten connections (para 4-30).
	b. Wiring short-circuited.	b. Correct short-circuit or replace defective parts.
35. Horn sounds continuously.	Short circuit in wiring between horn and horn button.	Replace wire.
36. Horn will not operate.	a. Loose or dirty connections.	a. Clean and tighten connections.
	b. Open circuit.	b. Repair or replace wire.
	c. Defective horn.	c. Replace horn.
37. Drive axle noise.	a. Unevenly worn tires.	a. Replace tires (para 4-62a).
	b. Improperly adjusted wheel bearing	b. Adjust bearing (para 4-63).
	c. Lack of lubricant.	e. Add lubricant.
38. Steering is difficult.	a. Lack of lubrication.	a. Lubricate.
	b. Steering system hydraulic oil low.	b. Fill to proper level.
	c. Power steering cylinder defective.	C. Replace cylinder (para 4-72).
39. Crane wanders or weaves.	Loose wheel bearings.	Adjust wheel bearing (para 4-63).
40. Shimmy or wobble at low speeds.	Loose wheel bearings.	Adjust wheel bearing (para 4-63).
41. Vehicle pulls to one side.	a. Odd size or new and old tires on opposite wheels.	a. Match tires.
	b. Tight wheel bearing. (para 4-43).	b. Adjust, lubricate wheel bearing
42. Hydraulic pump not delivering.	a. Tank oil level low.	a. Add recommended oil.
	b. Oil intake hose or suction filter plugged.	b. Replace filter cartridge, clean intake pipe (para 4-75).
	c. Air leak in suction line.	c. Tighten connections or replace line.
	d. Oil viscosity too high.	d. Use oil recommended by lubrication order.
43. Lift mechanism will not lift load.	a. Hydraulic oil level too low.	a. Fill to proper level as shown on lubrication order.
	b. Overload.	b. Remove excessive weight from hook block.
	c. Hydraulic oil lines leaking.	c. Tighten fitting and install new hose if necessary.
44. Load creeps down from raised position.	a. Hydraulic oil lines leaking.	a. Tighten fittings, and install new hose if necessary.
	b. Hydraulic oil leak in either intake line connection or packing glands.	b. Inspect and tighten (para 4-76).
45. Crane will not move in either direction.	a. Parking brake not released.	a. Release bake.
	b. Transmission oil level low.	b. Fill to proper level.
	c. Transmission control linkage not properly adjusted.	c. Readjust linkage (para 4-57).

Table 4-2. Troubleshooting Chart - Continued

Malfunction	*Probable cause*	*Corrective action*
46. Crane will not move in one direction.	Transmission control linkage not adjusted.	Adjust linkage (para 4-57).
47. Crane moves slowly in both directions at wide open throttle.	a. Oil level low. b. Brakes dragging.	a. Fill to correct level. b. Refer to "brakes drag" above.
48. Transmission overheating.	a. Oil level low. b. Brake s dragging. c. Plugged radiator.	a. Fill to correct level. b. Refer to "brakes drag" above. c. Flush radiator (para 4-35a).

Section VII. RADIO INTERFERENCE SUPPRESSION

4-16. General Methods Used to Attain Proper Suppression

Essentially, suppression is attained by providing a low resistance path to ground for the stray currents. The methods used to attain suppression in- dude shielding the ignition and high-frequency wires, grounding the frame with bonding straps, and using capacitors and resistors.

4-17. Interference Suppression Components

a. General. Interference suppression components of the Model 10FM Warehouse Crane consist of an excitation resistor, capacitor and lead assembly, and TVRS type ignition cable. Metal to metal contact on all crane components establishes equipotential conditions on the unit, and generally eliminates the need for bonding de- vices.

b. Excitation Resistor. The excitation resistor is located on the rear hood support as shown on figure 4-6A. The resistor is rated at 75 ohms at a current of 0.2 amps direct current.

c. Capacitor and Lead Assembly. The capacitor and lead assembly is located on the ignition coil bracket, reference figure 4-6B. The capacitor is rated at 0.10 mf-100 V.D.C. and is grounded through the mounting clamp.

4-18. Replacement of Suppression Components

Refer to figure 4-6, for instructions on the re- placement of the interference suppression components.

4-19. Testing of Radio Interference Suppression Components

Test the capacitors for leaks and shorts on a capacitor tester; replace defective capacitors. If test equipment is not available and interference is indicated, isolate the cause of interference by the trial-and-error method of replacing each capacitor or suppression component in turn until the cause of interference is located and eliminated.

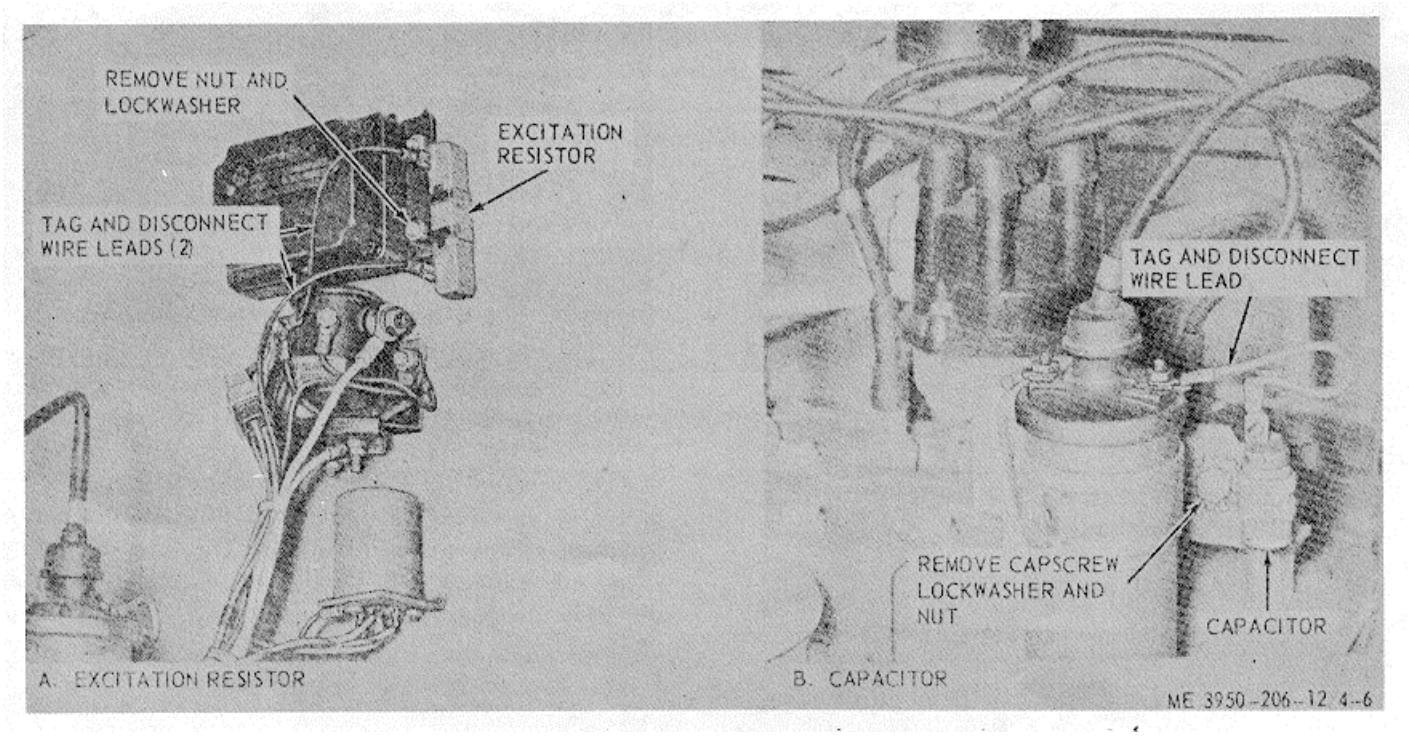


Figure 4-6. Radio interference suppression components.

Section VIII. ELECTRICAL SYSTEM MAINTENANCE

4-20. General

The electrical wiring diagram for the crane is shown in figure 1-4. Power to operate the starting motor is supplied by two 12-volt batteries. When starter switch is closed, the starting relay is energized. This, in turn, closes the circuit that energizes the starter solenoid. The starter solenoid then completes a circuit from the batteries to the starting motor to crank engine. When engine is running, it turns the alternator which recharges the battery. An ammeter on the instrument panel indicates rate of charge. The headlights, taillights and spotlights are operated by light switches mounted on the instrument panel. The stoplight is operated by a pressure switch mounted on the hydrovac. This circuit closes only when starter and ignition switch is in the run position.

4-21. Alternator Assembly

a. General. The electrical circuit of the alternator uses six silicon diodes in a full wave rectifier circuit. Since the diodes will pass current from the alternator to the battery or load, but not in the reverse direction, the alternator does not use a circuit breaker. Terminal points on the alternator are located as shown on figure 4-7. The entire DC output of the system passes through the "Isolation Diode". This diode is not essential for rectification. It is used to:

(1) Automatically connect the voltage regulator to the alternator and battery when the alternator is operating.

(2) Eliminate electrical leakage over the alternator insulators so that maximum leakage is less than one milliampere when the vehicle is not in use.

Warning: **When connecting booster battery or charger to batteries hooked up parallel to produce the same voltage at double the amp hour rating. Make certain to connect negative terminals together and positive battery terminals together.**

b. Testing (On Equipment). Alternators and voltage regulators should be tested on vehicle, using circuit conductors and accessories that are a permanent part of the system. Before actual in- vehicle testing commences, the charging system and battery must be checked to eliminate possible difficulty, as follows:

(1) The battery must be at least 75,% (1.240 Sp. Gr.) full charged and properly secured in the carrier. The carrier must not place excessive physical strain on the battery.

(2) All cables between the battery, starter and engine ground must be equal to or better in

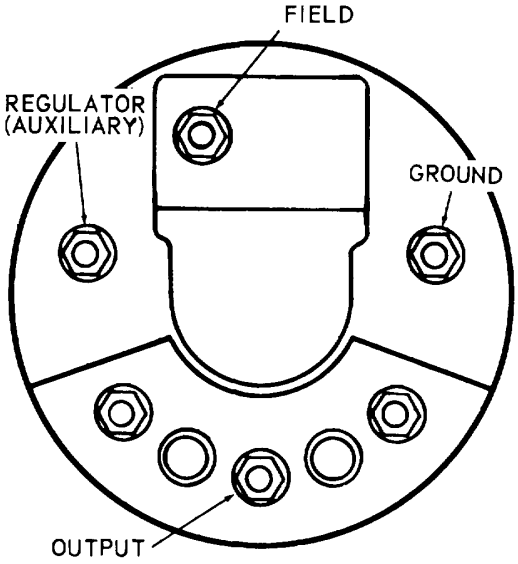


Figure 4-7. Diagram of alternator terminal points.

wire size than the original equipment. Wires and cables must be free of corrosion with cable sup- porting clamps to reduce strain on battery posts.

(3) All leads, junctions, switches and panel instruments that are directly related to the charging circuit must be clean and tight.

(4) The inspection of the alternator drive system should include the following:

(a) Engine driving and alternator driven pulleys must be capable of transmitting required energy from the engine output shaft to the alternator.

(b) The drive belt must be in good condition, free of grease or oils that may induce slip- ping under load.

Warning: **Never disconnect any alternator circuit or battery circuit cable from battery or alternator with engine running.**

(5) Test No. 1, battery voltage and shorted isolation diode test.

(a) Conditions: Ignition switch off. Engine not running.

(b) This test will determine if the battery is properly connected to the alternator. Secondly, the isolation diode will be tested for a shorted condition. An improperly connected battery or a shorted isolation diode can damage the alternator and/or voltage regulator.

(c) A shorted isolation diode would allow the battery to discharge through the voltage regulator to ground.

(d) Refer to figure 4-8A, connect volt meter, negative to ground, positive to output terminal on the isolation diode, voltmeter will indicate battery voltage. With the voltmeter connected at this point, check the leads between the alternator and battery. If movement of the leads causes the voltmeter reading to vary, check for loose connections. Repair as needed.

(e) Move positive voltmeter lead to the alternator auxiliary terminal. Voltmeter should indicate zero volts. One of two faults will cause voltmeter to indicate above zero volts, (1) the metal wire terminal on the alternator output (positive) lead may be in contact with the heat sink or (2) the isolation diode may be shorted. Reposition wire terminal and retest. If diode is defective, report to Direct Support Maintenance.

(6) Test No. 2, excitation voltage test.

(a) Conditions: Ignition switch on, engine not running. (fig. 4-8B).

(b) This test will indicate if the excitation current circuit, from the vehicle's ignition switch to the rotor (field) winding is correct.

(c) When the current for the voltage regulator and the rotor winding is passed through the field excitation resistor, a voltage drop develops across the resistor. This action reduces battery voltage from 12.0-12.6 volts at the ignition switch side of the resistor, to 1.5-2.5 volts on the alternator side of the resistor. If the circuit through the regulator or the rotor is not correct, and a lighter load was passed through the excitation resistor, the voltage drop would be less.

(d) This circuit may be defective in two ways; an open circuit or a shorted circuit.

(e) Connect voltmeter negative to ground, positive to auxiliary terminal. 'Meter should indicate 1.5-2.5 volts, or if the circuit is defective due to:

Open rotor (field) circuit 6.0-7.0 volts.
Grounded rotor circuit, .75-1.1 volts.
Open in regulator's Load Circuit, 8.5-10.0 volts.
Open key switch, or open excitation resistor, zero volts.

(f) If initial test results are uncertain, the voltage regulator may be bypassed with a short jumper between the auxiliary and field terminals. If the jumper provides approximate correct voltage, fault is in the regulator. No

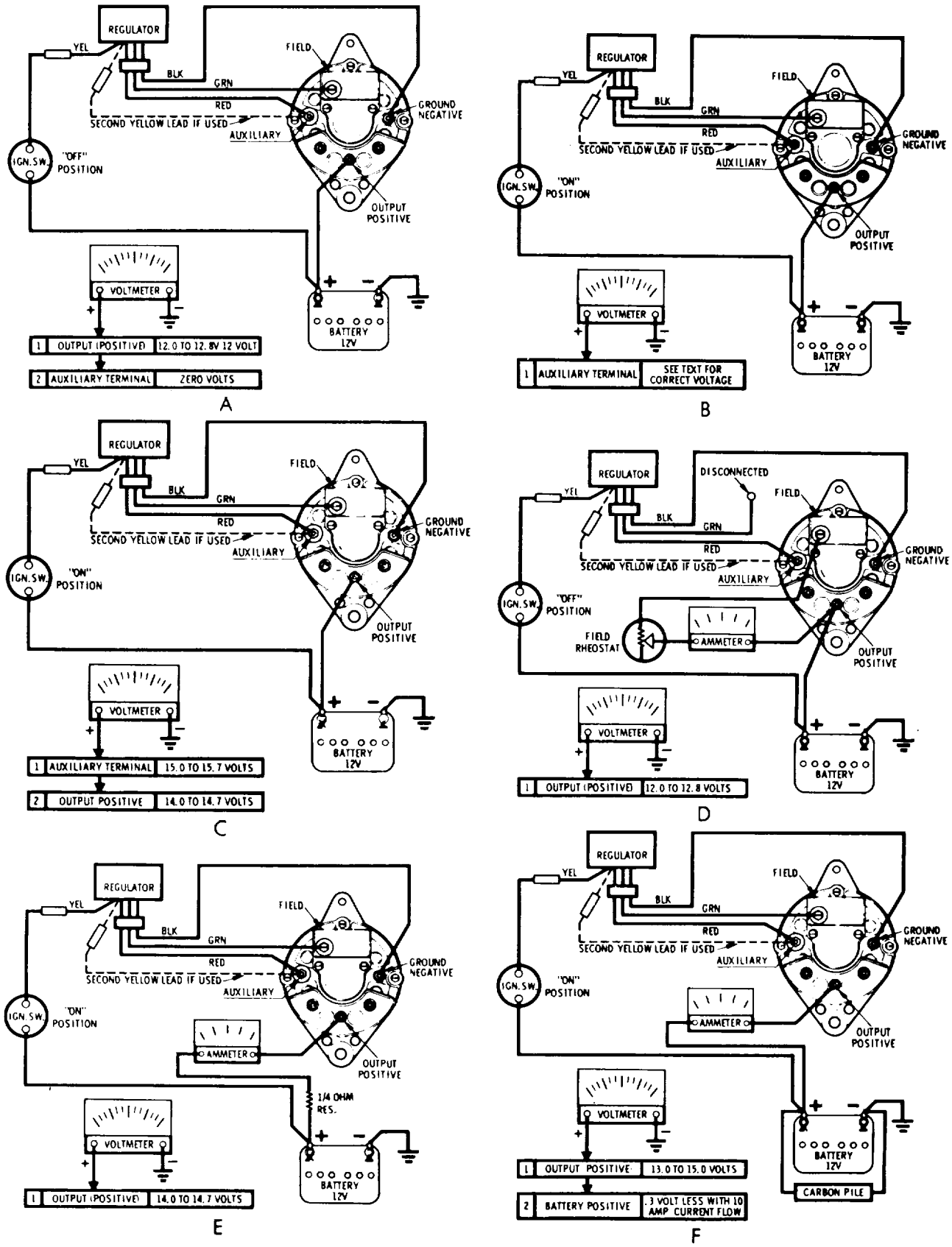


Figure 4-8. Alternator test circuits, on equipment testing.

change from high voltage indicates that the defect is in the brush or rotor circuit.

(g) The rotor (field) circuit may be checked in more detail a' outlined in Test No. 4.

(7) Test No. 3, open isolation diode test.

(a) Conditions: Ignition switch on. Engine running at fast idle.

(b) This test will determine if the isolation diode is conducting alternator energy, from the rectifier diode assembly, to the output stud. If the isolation diode is open, alternator energy would not travel beyond the rectifier diodes. A high voltage may develop in the alternator that could damage the voltage regulator.

(c) With the engine running at fast idle, connect voltmeter, negative lead to ground, positive lead to the auxiliary terminal, (fig. 4-8C). Note voltmeter reading at this point.

(d) Move voltmeter positive lead to the alternator output terminal. Note voltmeter read- ing.

(e) The voltage indicated at the output (positive) terminal should be 0.8 to 1.2 volts lower than voltage noted at the auxiliary terminal. If voltmeter reading at the output (positive) terminal is battery voltage (12.0-12.6 volts) the isolation diode is "open".

(f) Report an open diode to Direct Sup- port Maintenance for replacement

(8) Test No. 4, field current test.

(a) Conditions: Ignition switch off. Engine not running.

(b) This test will determine if the electrical circuit (field winding) of the alternator rotor is in good condition.

(c) High field current may produce uncontrolled alternator output and probable damage to the voltage regulator. Low field current will result in low alternator output.

(d) Disconnect the field lead from the alternator brush connecting terminal. Switch test ammeter to the low current scale (0 to 10 amperes). Set control knob of field rheostat in maximum resistance position. The field rheostat will prevent damage to the test ammeter if the rotor winding is shorted or grounded. Place the field rheostat and the test ammeter in a series circuit between the alternator output (positive) and field terminals, as shown in figure 4-8D.

(e) Slowly reduce field rheostat resistance, noting test ammeter reading. If entire field rheostat resistance can be eliminated with the ammeter indicating less than 3.5 amperes, the field winding is not shorted or grounded. The test ammeter reading, with the field rheostat resistance eliminated, is the current draw of the rotor (field) circuit.

(f) Generally, this is approximately 2.0 to 2.5 amperes at battery voltage (12.0-12.6v). If the ammeter tends to vary when the rotor is slightly turned, the slip rings and brushes re- quire cleaning, refer to Direct Support Maintenance.

(g) If normal rotor current can not be obtained, the alternator will require disassembly and replacement of defective parts, refer to Direct Support Maintenance.

(h) If a satisfactory ammeter reading is noted, proceed with Test No. 5.

(9) Test No. 5, voltage regulator operating voltage.

(a) Conditions: Ignition switch on. Engine running at fast idle.

(b) This test will determine operating level of the voltage regulator. Voltage tests are most accurate when the alternator is charging a fully charged battery, as current output is at minimum. Under this condition, charging voltage will rise to regulator limiting maximum.

(c) A 1/4 ohm 25 watt resistor may be placed in series with the alternator. output lead to reduce current to 8 to 10 amperes for a battery that is less than fully charged. The connections for the 1/4 ohm resistor and test ammeter is shown in figure 4-8E.

(d) Connect voltmeter negative to ground, positive to output terminal.

(e) Start engine, run for a few minutes to stabilize component temperature. Voltage indicated, is the level established by the voltage regulator. Usually 13.9 volts to 14.7 volts depending on regulator ambient temperature.

(f) High voltage may be due to a poor ground connection for the voltage regulator circuit board. Since the circuit board is insulated from the regulator housing, one regulator lead, usually black, serves as the ground connection. The ground lead must be a clean and tight connection at the alternator ground.

(g) If ground connection is not faulty, the regulator is probably inoperative and will require replacement (para 4-22).

(h) A low charging rate is usually due to a faulty regulator. Replace regulator if necessary.

(i) Remove the 1/4 ohm resistor from the alternator positive output lead immediately after this test.

(10) Test No. 6, alternator output and system test.

(a) Conditions: Ignition switch on, engine running.

(b) This is a test of the alternator capability to produce maximum current. A carbon pile load is applied to the battery to induce maximum charging current (fig. 4-8F).

(c) Place ammeter on 0-100 amp scale. Unload carbon pile when connecting to battery posts. Start engine, set at fast idle. Apply partial carbon pile load, or vehicle accessory load, to produce a 20 ampere charge for a few minutes to warm up components.

(d) Adjust engine speed to provide 3000 to 4000 alternator R.P.M. Increase carbon pile load, note maximum current produced with, volt- meter between 13.0-15.0 volts.

(e) The minimum acceptable output current is 43.0 to 46.0 amperes. Output voltage must remain between 13.0 and 15.0 volts.

(f) Unload carbon pile immediately after test to avoid battery discharge. If the alternator cannot produce its minimum rated output it should be disassembled for inspection and repair, refer to Direct Support Maintenance.

(g) System voltage drop is tested with the alternator producing 10 amperes. The maximum allowable voltage drop between the alternator and the battery is 0.3 (three tenths) volts.

(h) Voltage loss above allowable maximum may require cleaning and tightening connections or use of heavier gauge output cables.

c. Removal

(1) Disconnect the positive battery cable from the battery.

(2) Tag and disconnect all electrical leads from alternator.

(3) Loosen screw assembled washer (5, fig. 4-9) and disengage fan belt from alternator pulley (13).

(4) Remove screw assembled washer (5), washer (4), nut (7), spacer (10), washer (12), capscrew (14), and lift alternator (11) from mounting bracket.

(5) Remove screw assembled washer (1), adjusting strap (2), and spacer (3).

(6) Remove two nuts (6) and bracket (15). Remove studs (16) only if replacement is required.

d. Cleaning, Inspection, and repair.

(1) Clean the exterior of the alternator assembly with a damp cloth and dry. Inspect alternator for cracked housing, excessive end play of shaft or other signs of damage. If damaged in any way or "on equipment testing", (para b, above) indicates repair required refer to direct support maintenance.

(2) Clean all other parts in an approved cleaning solvent and inspect for damage. Replace any defective parts found.

e. Installation.

(1) Install the alternator by reversing instructions for removal.

(2) Adjust fan belt tension, by pulling out on alternator and securing with adjusting strap (2) at a point that will provide approximately 3/4 inch deflection in the belt, midway between the crankshaft and fan pulleys.

4-22. Voltage Regulator

a. The voltage regulator is an electrical switch- ing device sealed at the factory, requiring no adjustments. It senses the voltage appearing at the regulator terminal of the alternator and supplies the necessary field current for maintaining the system voltage at the output terminal.

b. Testing of the voltage regulator is accomplished in the on-equipment testing of the alternator, paragraph 4-21, b.

4-23. Starting Motor

a. General. The starting motor is a self-contained, electromechanical unit, mounted on the engine flywheel housing, and engaging the fly- wheel ring gear during starting periods. Organizational maintenance is limited to starter and I solenoid on equipment test and replacement.

b. On Vehicle Testing. Before removal of starter, inspect and test a faulty starter system as follows:

(1) Inspect all wiring and terminals for looseness and corrosion. Check for worn or frayed insulation which could result in short circuits (grounding). Clean and tighten all connections.

(2) Check batteries (para 3-10). Replace batteries which indicate one or more defective cells.

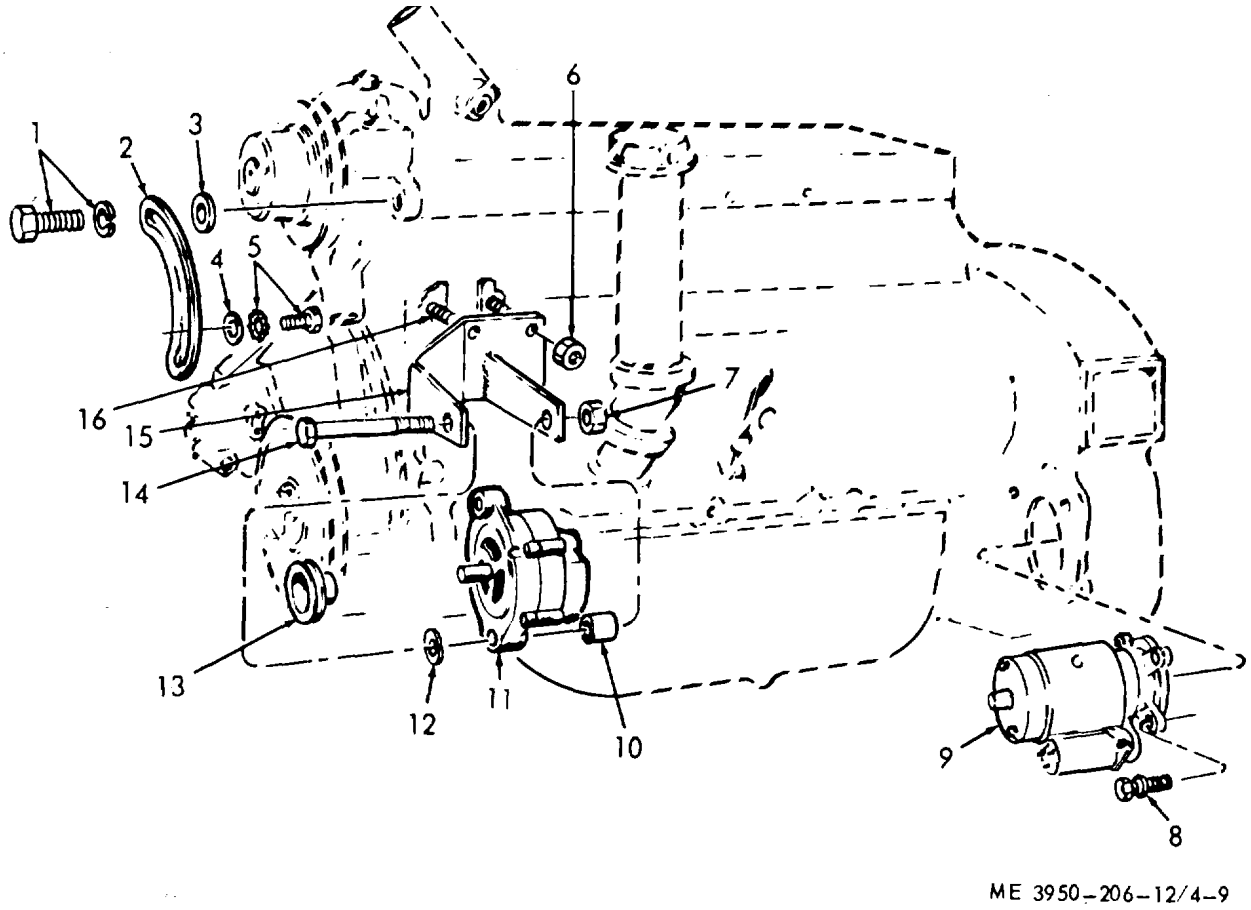
(3) Attach one end of a jumper cable to the solenoid motor terminal. Momentarily make con- tact with other end of jumper cable on solenoid battery terminal. If starting motor operates, the solenoid is defective and must be replaced. If starting motor does not operate, replace starting motor.

c. Removal.

Note. Disconnect the positive battery cable from- the battery.

(1) Disconnect leads to starting motor solenoid.

(2) Remove the two screw assembled washers (8, fig. 4-9) and slide the nose of the starter drive housing from the flywheel housing.



1. Screw assem washer
2. Adjusting strap
3. Spacer
4. Washer
5. Screw assem washer
6. Locknut (2)
7. Nut
8. Screw assem washer (3)
9. Starter
10. Spacer
11. Alternator
12. Washer
13. Pulley
14. Capscrew
15. Bracket
16. Std (s)

Figure 4-9. Alternator and starter mounting, exploded view.

d. Installation. Install the starter motor in re- verse of instructions for removal.

4-24. Spark Plugs and Wires

a. Removal.

(1) Clean cylinder head around spark plugs. Tag and disconnect spark plug wire (16, fig. 4-10).

(2) Using a deep well socket, remove spark plugs (9) from cylinder head. Remove spark plug gaskets.

b. Cleaning, Inspection, Adjustment, and Testing.

(1) Remove al carbon lead deposits from electrodes and insulator shell with a sand blast cleaner.

(2) Inspect spark plugs for cracked or damaged, porcelain, eroded or damaged electrodes, or other defects.

(3) Set plug gap at 0.025 inch using wire- type feeler gage.

(4) Test spark plugs on a standard spark plug tester.

(5) Replace defective spark plugs.

(6) Inspect spark plug wires for damaged covering or burned end connectors. Replace as required.

c. Installation. Reverse procedures in *a* above.

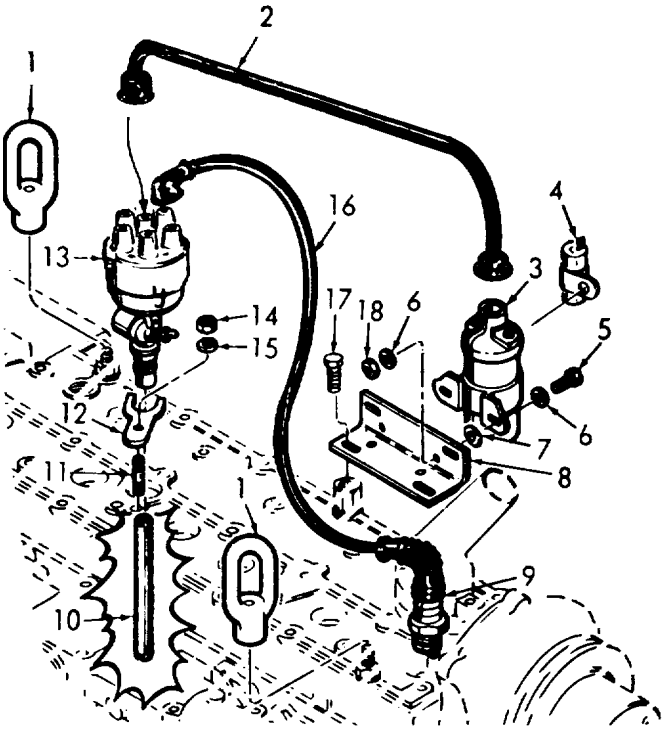
4-25. Ignition Coil

a. Removal.

(1) Disconnect coil wire (2, fig. 4-10).

(2) Tag and disconnect three small wire leads from coil terminals.

(3) Remove two capscrews (5), nuts (18), washers (7), and four lockwashers (6). Remove capacitor (4) and coil (3).



ME 3950-206-12/4-10

1. Lifting eye (2)
2. Coil wire
3. Coil
4. Capacitor
5. Capscrew (2)
6. Lockwasher (4)
7. Washer (2)
8. Bracket
9. Spark plug (6)
10. Drive shaft
11. Stud
12. Clamp
13. Distributor
14. Nut
15. Lockwasher
16. Wire assy (6)
17. Capsrew (2)
18. Nut (2)

Figure 4-10. Distributor, coil, plugs and wing, exploded view.

(4) Remove two capscrews (17) and bracket (8) as required.

b. Testing.

(1) If a coil tester is available, test the coil in accordance with tester instructions.

(2) In the absence of a coil tester, compare performance with that of a new coil.

c. Installation. Install the ignition coil in re- verse of instructions for removal.

4-26. Distributor Assembly

a. General. The distributor is mounted on the right side of the engine and is driven by a gear on the camshaft. One of the distributor functions is to interrupt the current flow through the primary winding of the ignition coil, thus causing the coil to produce voltage high enough to jump the gap at the spark plugs at the desired instant during the compression stroke. As engine speed increases, the spark must occur earlier at the spark plugs. This is accomplished by an automatic spark advance that is controlled by centrifugal weights in the distributor. This is necessary to allow the fuel air mixture sufficient time to ignite and burn. The centrifugal weights advance the breaker cam to give a predetermined variation in spark advance for different engine speeds. An accurate measurement of ignition timing at any given engine rpm can only be determined on the engine by use of a timing light.

b. Removal.

(1) Remove the spark plug wires (16, fig. 4-10) and coil wire (2) from the top of the distributor (13).

Note. Tag al holes and wires to insure correct installation.

(2) Remove nut (14), lockwasher (15), and camp (12). Lift distributor assembly (13) from cylinder head.

c. Disassembly.

(1) Remove screws (1 and 2, fig. 4-11) and distributor cap (3) from the housing (12).

(2) Remove rotor (5) from the shaft (9) and remove carbon button (4) and oil wick (6) from the rotor.

(3) Remove screw (24) and contact assembly (23) from the breaker plate (22).

(4) Remove screw (28) and bracket (26) from breaker plate (22). Slide the condensor (27) out of the bracket (26).

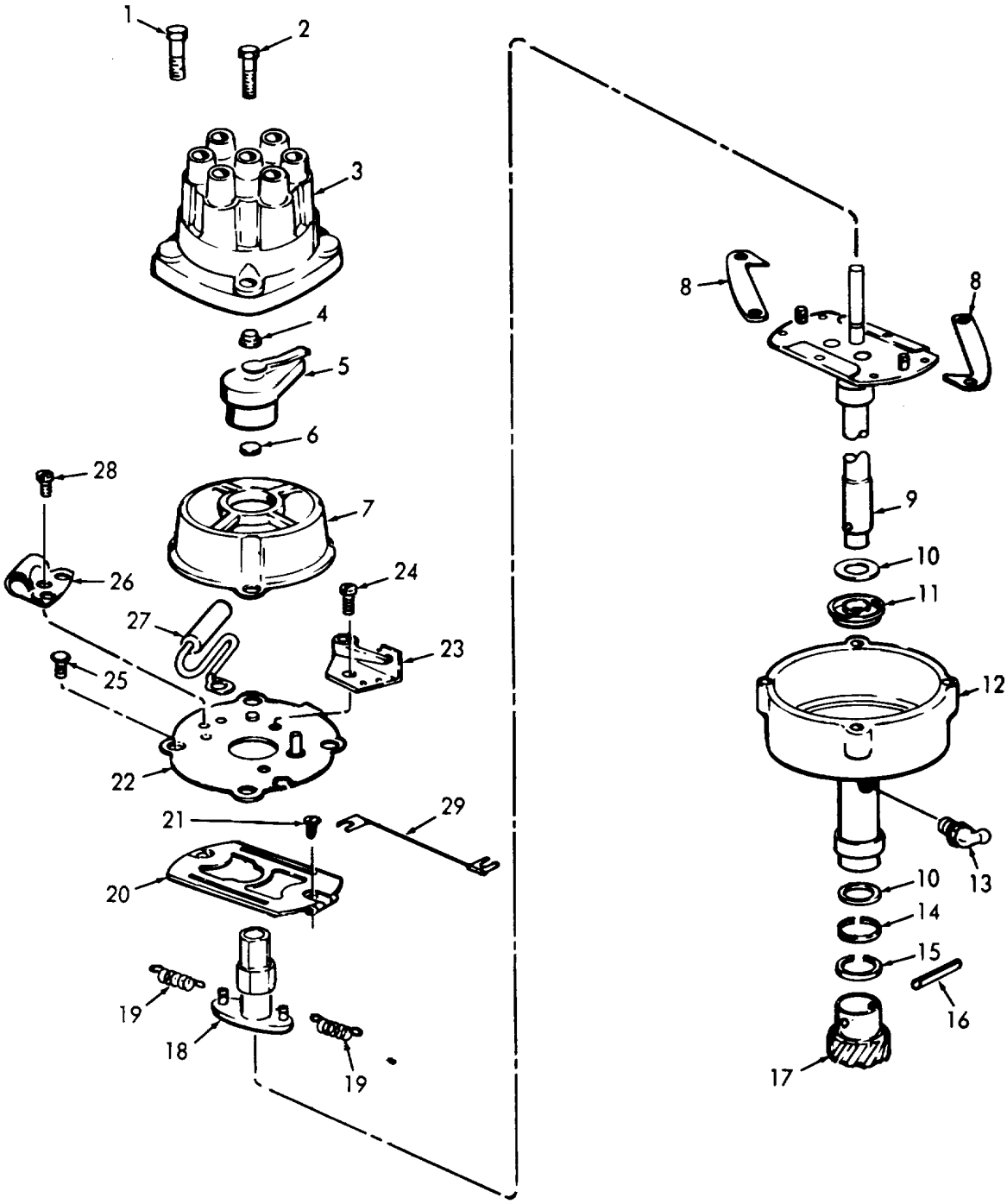
(5) Remove screws (25) breaker plate (22) and holddown (20) from the housing (12). Remove screw (21) and lead (29) from the hold- down (20).

(6) Disconnect springs (19) and remove springs and weights (8) and cam (18) from the shaft (9).

(7) Remove pin (16), drive gear (17), shims (15 and 14) and thrust washer (10) from the bottom of the shaft (9).

(8) Remove shaft (9) from the housing (12), and remove seal (11) and thrust washer (10) from the shaft (9).

(9) Remove lube fitting (13) from the housing (12).



1. Screw
2. Screw
3. Cap assy
4. Carbon button
5. Rotor
6. Oil wick
7. Dust cover
8. Weight (2)
9. Shaft
10. Trust washer (2)
11. Seal
12. Housing
13. Lube fitting
14. Shim, 0.005 in. thk
15. Shim, 0.010 in. thk
16. Pin
17. Drive gear
18. Cam
19. Spring (2)
20. Holddown
21. Screw (2)
22. Breaker plate
23. Contact assy
24. Screw
25. Screw (2)
26. Bracket
27. Condenser
28. Screw
29. Lead

Figure 4-11. Distributor Assembly, exploded view.

d. Cleaning, Inspection and Repair.

(1) Soak all parts of the distributor assembly (except condenser, breaker point assembly, and lead) in a mild cleaning solvent or mineral spirits. DO NOT USE A HARSH CLEANING SOLUTION. Wipe all parts that can not be immersed in a solvent with a dry, clean, lint free cloth. After foreign deposits have been loosened by soaking, scrub the parts with a soft bristle brush. DO NOT USE A WIRE BRUSH, FILE OR OTHER ABRASIVE OBJECTS. Dry all parts with compressed air.

(2) Inspect the cam lobes for scoring and signs of wear. If any lobe is scored or worn, re- place the cam and weights.

(3) Inspect the breaker plate assembly for signs of distortion or other defects. Replace if any defects are found.

(4) The breaker point assembly and con- denser should be replaced whenever the distributor is overhauled.

(5) Inspect cap and rotor for chips, cracks, carbon, carbon runners, corroded terminals or burnt inserts. Replace cap and rotor if found defective.

(6) Replace housing if cracks, chips, breaks or any other visual damage is noted.

(7) Inspect hardware and threaded openings for damaged threads. Chase damaged threads with the correct size tap or die and replace all damaged hardware as necessary.

e. Reassembly. Reassemble the distributor in reverse of the disassembly procedure as outlined in *c* above.

f. Installation. Install the distributor assembly in reverse of the removal instruction as outlined in *b* above.

g. Contact Point Adjustment.

(1) Remove distributor cap, rotor, and cover. It is not necessary to remove spark plug wires from distributor.

(2) If contact points are pitted or rough, dress them by using a fine ignition file. Remove only the worst of the roughness. Do not attempt to remove all roughness or to dress points until smooth.

(3) Using starting motor, rotate engine until contact point cam follower is at a high spot on cam. (points are spread as far as possible).

(4) Using a wire feeler gauge, check gap between points. If point gap is not 0.020 inch, loosen lock screw and with proper size screw driver in adjusting slot, move plate until proper adjustment is obtained. Tighten lock screw.

(5) Install cover, rotor and cap.

(6) Check ignition timing, refer to paragraph 4-50.

4-27. Batteries and Cables

a. Removal.

(1) Loosen nuts (fig. 4-12) that secure cables to battery posts; remove cables from posts.

(2) Remove hex head capscrew and washer that secure ground cable to transmission bell housing. Remove cable.

(3) Remove nut and lockwasher that secure positive battery cable (fig. 4-12) to starter solenoid; remove cable.

(4) Remove nuts, lockwashers, and plain washer that secure battery clamps to studs; re- move battery camps.

(5) Remove batteries from tray.

b. Cleaning and Inspection.

(1) Clean cables with a cloth dampened in an approved cleaning solvent. Clean cable clamps and lugs with a wire brush.

(2) Inspect cables for damaged insulation, breaks, or other damage.

(3) Inspect cable clamps and lugs for corrosion, distortion, poor connections to cables, or other damage.

(4) Replace cables if defective.

(5) Clean battery trays and clamps by flush- ing with a solution of baking soda. Flush parts until bubbling stops when new solution is applied.

(6) Inspect batteries for loose posts, cracks, evidence of leaks, or other damage.

(7) Test battery as directed in c below.

c. Testing.

(1) Test the specific gravity of each cell with a hydrometer. With ambient temperature of

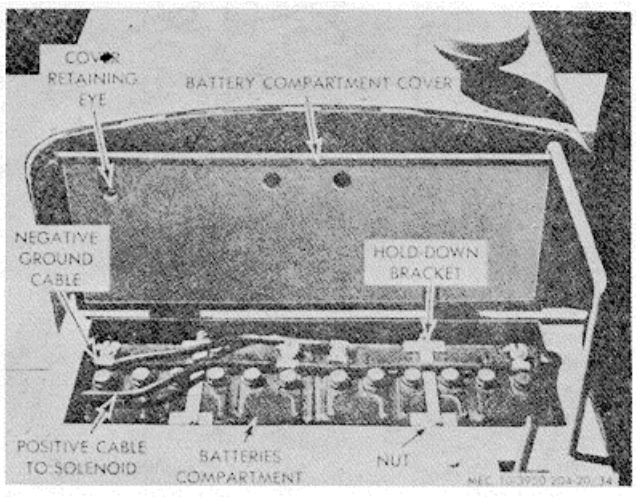


Figure 4-12. Batteries and cables, installed view.

80°F., the reading for each cell of a fully charged battery should read between 1.260-1.275. If the specific gravity readings between the highest and lowest cells exceeds 50 points (0.050), or the reading of the highest cell is below 1.200, the life of the battery is questionable and should be replaced.

(2) If the specific gravity readings are approximately 1.170 per cell, indicating a half- charged battery, place the battery on charge until the specific gravity approximates 1.260 per cell.

(3) The charging current rate for recharging can be varied to conform to the time available for recharging:

(a) Fast charge; 40-50 amperes.

(b) Booster charge; 20-25 amperes.

(c) Normal charge; 5-10 amperes.

However, two conditions must be observed: the temperature of the electrolyte must not exceed 125°F., and, the battery must be removed from charge after three consecutive hourly specific gravity tests have read approximately 1.260.

Caution: Do not use open flame near the batteries while charging. The mixture of oxygen and hydrogen gases released during charging are highly flammable.

(4) Refill the cells until the electrolyte level is approximately 3/8 inch above the separator plates. Use distilled water if electrolyte is not available.

Note. The specific gravity of the batteries should be checked biweekly. Continued usage of the batteries in a halfcharged condition will reduce their normal life cycle. Normal operation of crane will keep the batteries fully charged, but long periods of inactivity or continued operation in high humidity may necessitate recharging.

d. Installation. Install the batteries and cables in the reverse order of instructions for removal. After securing cable clamps to battery, apply a light coating of nonmetallic grease or petroleum jelly to battery terminals.

4-28. Sending Units and Miscellaneous Electrical Components

a. Temperature Sending Units. The two temperature sending units (13, fig. 4-13) are thermo sensitive units for monitoring the temperature of the engine coolant and the transmission oil temperature.

(1) Remove the units by disconnecting the electrical lead and unscrewing the unit.

(2) The units may be tested by reconnecting the wire lead and comparing the gage reading with a thermometer while suspending both in a heated pan of water. Replace sending unit if temperature varies more than 10*%.

(3) Install temperature sending units in re- verse of (1) above.

b. Engine Oil Pressure Sending Unit.

(1) Tag and disconnect the wire lead. Re- move the sending unit (6, fig. 4-13), elbow (7), and adapter (8) as required.

(2) Test the unit with electrical leads attached by connecting to a regulated air pressure source. Replace unit if gage reading differs by more than 10%.

Caution: Do not use an air pressure source greater than 80 psi.

(3) Install engine oil pressure sending unit in reverse of (1) above.

c. Transmission Oil Pressure Sending Unit.

(1) Tag and disconnect the wire lead. Remove the sending unit (14, fig. 4-13) and elbow (7).

(2) Test unit same as paragraph b, (2) above.

(3) Install transmission oil pressure sending unit in reverse of (1) above.

d. Reverse Polarity Protector.

(1) Tag and disconnect wire leads. Remove two capscrews (5, fig. 4-13), nuts (1), lock- washers (2), and polarity protector (9).

(2) Cleaning, Inspection, and Test.

(a) Clean the exterior of the relay with a damp cloth and dry.

(b) Inspect the relay for cracked case and/or damaged connectors. Replace relay if damaged in any way.

(c) Test the relay by connecting a 12 volt battery to the relay with the positive battery terminal connected to the small connector on the re- lay and the negative battery terminal grounded to the relay case. A discernable click should be noticed upon completing the circuit indicating a properly functioning relay. If no click is noticeable replace the relay.

(3) Installation. Install the relay in reverse order of removal.

e. Starter Relay.

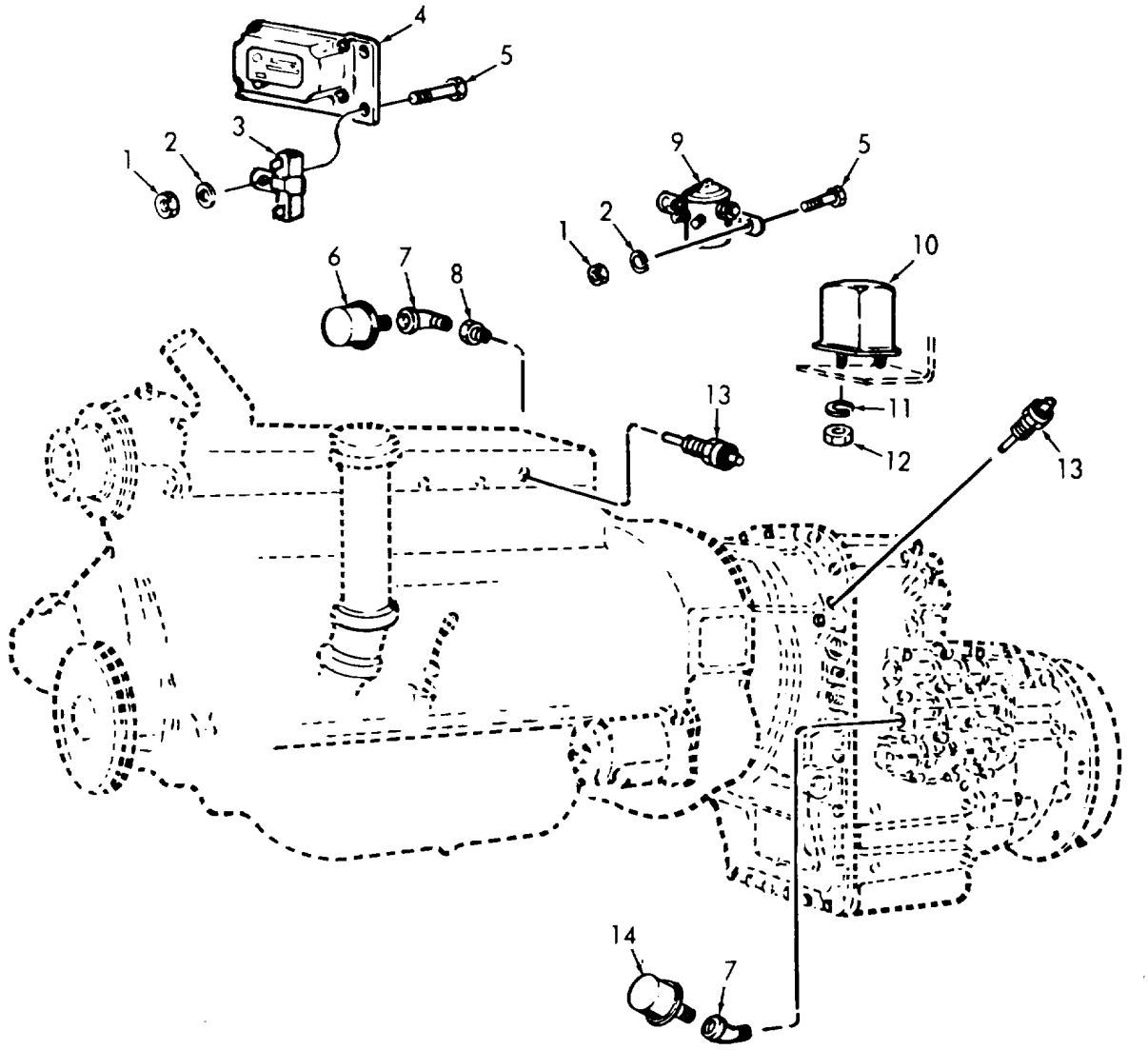
(1) Tag and disconnect wire leads. Remove three nuts (12, fig. 4-13) and lockwashers (11). Lift relay (10) from bracket.

(2) Install new relay in reverse of removal.

4-29. Gages and Instruments

a. Removal.

Warning: Before removing leads from switches, gages, or senders, disconnect positive battery cable.



1. Nut (5)
2. Lockwasher (5)
3. Resistor
4. Regulator
5. Capscrew (5)
6. Sending unit
7. Elbow (2)
8. Adapter
9. Polarity protector
10. Relay
11. Lockwasher (3)
12. Nut (3)
13. Temperature sender (2)
14. Sending unit

Figure 4-13. Sending units and miscellaneous electrical components exploded view.

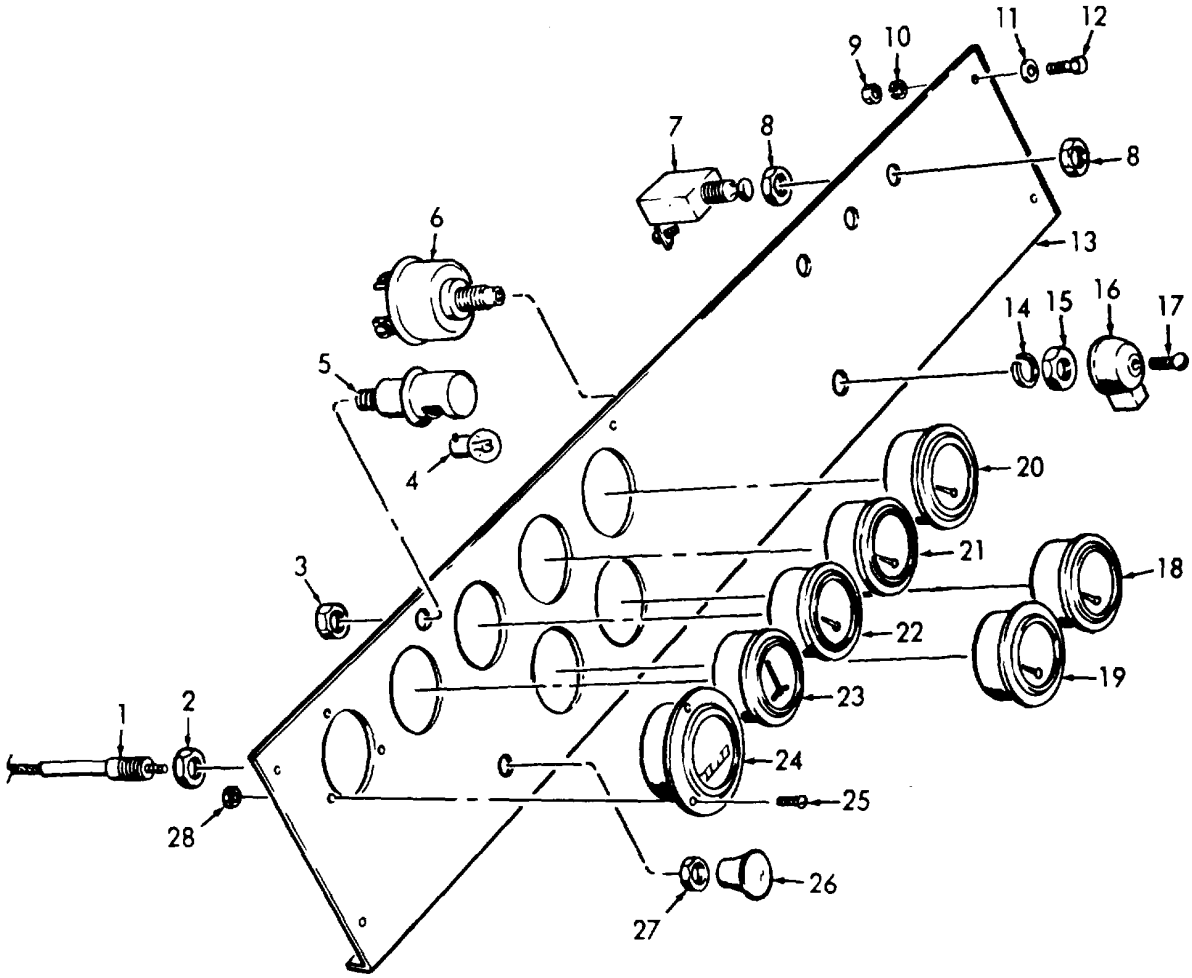
(1) Tag and remove leads to hourmeter (24, fig. 4-14). Remove screws (25) and nuts (28) that secure hourmeter to instrument panel; remove hourmeter from front of panel.

(2) Tag and remove leads to ammeter (23), engine oil pressure (22), engine temperature indicator (21), fuel gage (20), transmission oil pressure indicator (19), and transmission oil temperature indicator (18). Remove nuts and straps that secure gages to instrument panel; remove gages from front of panel.

(3) Tag and remove leads to headlight switch and spotlight switches (7). Remove nut (8) that secures light switches to instrument panel; remove light switches from rear of panel.

(4) Tag and remove leads to panel light

(5). Remove nut (3) that secures light to instrument panel; remove light from front of panel



1. Choke cable
2. Nut
3. Nut
4. Bulb
5. Panel light
6. Ignition switch
7. Light switch
8. Nut (2)
9. Nut (5)
10. Lockwasher (5)
11. Washer (5)
12. Capscrew (5)
13. Instrument pan
14. Lockwasher
15. Nut
16. Knob
17. Screw
18. Transm, temp. gage
19. Transm, press. gage
20. Fuel gage
21. Eng. temp. gage
22. Eng. press. gage
23. Ammeter
24. Hourmeter
25. Screw (3)
26. Knob
27. Nut
28. Nut (3)

Figure 4-14. Instrument panel and instruments, exploded view.

(5) Tag and disconnect lead to ignition switch (6). Remove screw (17) and pull knob (16) off; remove nut (15) and ignition OFF- ON plate; remove switch from rear of panel.

b. Cleaning and Inspection.

(1) Clean gages, switches, lights, and senders with a cloth dampened in an approved cleaning solvent.

(2) Inspect gages for broken glass, damaged threads, damaged or illegible dial, dents, or other damage.

(3) Inspect lights for broken glass, a burned-out bulb, damaged threads, or other dam- age

(4) Inspect switches for rough or binding operation, burnt terminals, damaged threads, or other damage.

(5) Replace damaged or defective parts.

c. Installation. Reverse procedures in *a* above.

4-30. Headlight Assembly

a. Sealed Beam Unit Replacement.

(1) Remove four capscrews (12, fig. 4-15), lockwashers (11), and guard (1).

(2) Remove screw at base of door (2). Remove door and lift out sealed beam unit (3). Disconnect connector (4).

(3) Install new sealed beam unit in reverse of removal.

b. Headlight Assembly Removal

(1) Remove four capscrews (12), lockwashers (11), and guard (1).

(2) Disconnect wire assembly (7) from crane wiring harness.

(3) Remove assembled headlight and housing (6) as a unit from frame.

(4) Remove nut (8), lockwasher (9), adapter (10) and headlight from housing.

(5) Remove sealed beam unit, paragraph *a*, above.

c. Cleaning and Inspection.

(1) Clean all parts with a cloth dampened in an approved cleaning solvent.

(2) Inspect lamp for burnt or damaged terminals, chipped glass, or other damage.

(3) Inspect body and door for dents, distortion, or other damage.

(4) Replace lamp if defective; replace headlight assembly if other parts are defective.

d. Headlight assembly Installation. Reverse procedures in *b* above.

4-31. Stoplight/Taillight Assembly

a. Stoplight and Taillight Lamp Replacement.

(1) Remove lens (1, fig. 4-16) from body (4).

(2) Depress lamp (3) rotate one-quarter turn, and pull it from body.

(3) Install lamp in body. Depress and rotate one-quarter turn to engage it in socket.

(4) Push lens on to body.

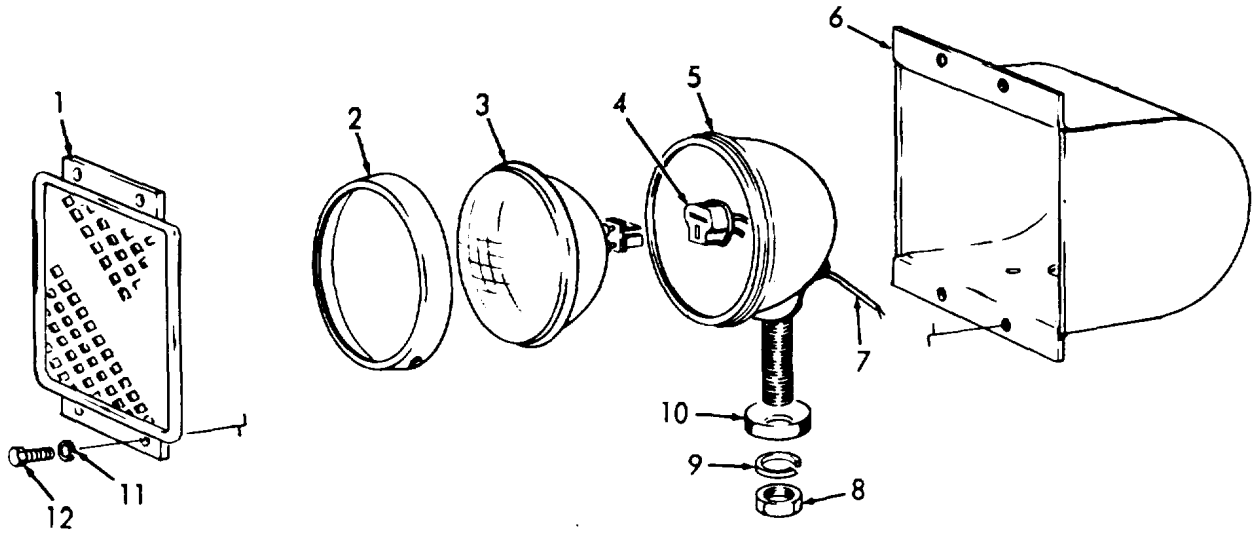
b. Stoplight and Taillight Assembly Removal

(1) Friction-type connectors secure stop- light and taillight leads to crane wiring harness. Pull on connectors to disconnect leads.

(2) Remove nut (7) and lockwasher (6) that secure body to rear engine hood support. Remove assembled body and lens.

c. Cleaning and Inspection.

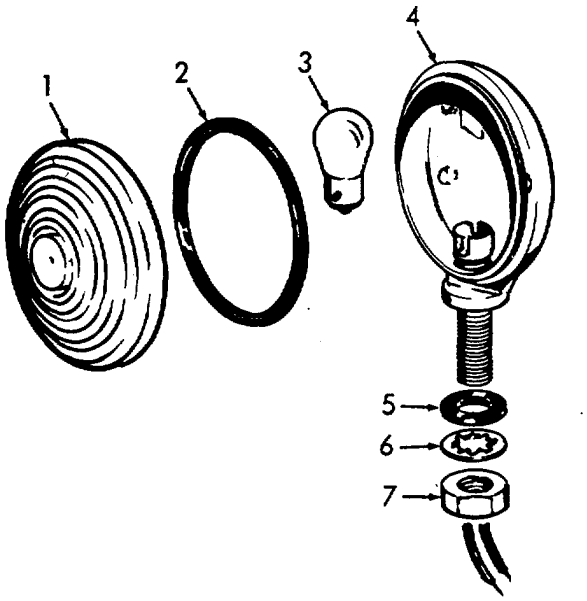
(1) Clean taillight assembly with a cloth dampened in an approved cleaning solvent.



ME 3950-206-12/4-15

1. Guard
2. Door
3. Sealed beam
4. Connector
5. Body
6. Housing
7. Wire assy
8. Nut
9. Lockwasher
10. Adapter
11. Lockwasher (8)
12. Capscrew (8)

Figure 4-15. Headlight and mounting, exploded view



ME 3950-206-12/4-16

1. Lens
2. Gasket
8. Lamp
4. Body
5. Pad
6. Lockwasher
7. Nut

Figure 4-16. Tail-stop light, exploded view.

(2) Inspect taillight for dents, damaged threads, damaged lens, distortion, or other damage.

(3) Replace lamp if defective, replace stoplight and taillight assembly if other parts are defective.

d. Stoplight and Taillight Installation. Reverse procedures in b above.

4-32. Spotlight Assembly

a. Spotlight Lamp Replacement.

(1) Remove phillips head screw (19, fig. 4- 17) that secures cowl (1) to body (7).

(2) Loosen and remove screw (6) that secures cap (5) to body.

(3) Remove cowl from body.

(4) Pry retainers (18) off that secure lamp (2) in cowl.

(5) Remove two screws that secure leads to lamp; remove lamp.

b. Spotlight Assembly Removal. Remove nut (12) and bolt wedge (14) that secures handle (13) to shaft; remove handle from shaft, loosen clamp that holds shaft/sleeve to mounting bracket. Disconnect wire leads. Remove spotlight assembly.

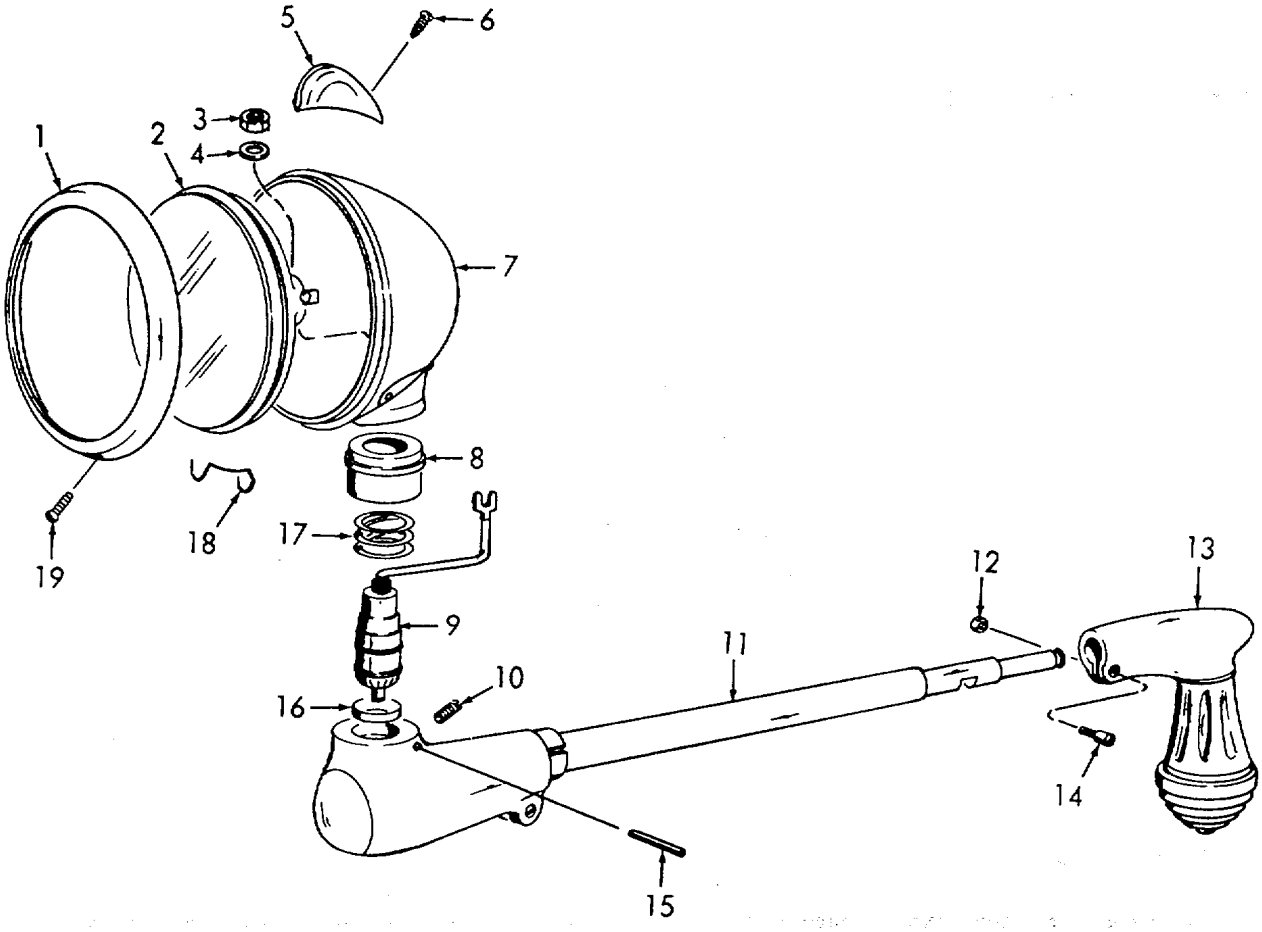
c. Cleaning and Inspection.

(1) Clean spotlight assembly with a cloth dampened in an approved cleaning solvent.

(2) Inspect lamp for burnt or damaged terminals, chipped glass, or other damage.

(3) Replace lamp if defective, and inspect body and cowl for dents and distortion.

d. Installation. Reverse procedures in *b* above.



ME 3950-206-12/4-17

1. Cowl
2. Lamp
3. Nut
4. Washer
5. Cap
6. Screw
7. Body
8. Bushing
9. Headpost assy
10. Setscrew
11. Shaft assembly
12. Nut
13. Handle
14. Bolt wedge
15. Pin
16. Felt washer
17. Spring
18. Retainer (3)
19. Screw

Figure 4-17. Spotlight assembly, exploded, view.

Section IX. COOLING SYSTEM MAINTENANCE

4-33. General

a. The cooling system cools the engine, torque converter, and transmission. The system consists of radiator, thermostat, fan, water pump, and hoses. Engine coolant is circulated by the water pump through engine to radiator where it is cooled. The radiator is cooled by the flow of air circulated by the fan. When engine is below operating temperature, the thermostat closes, preventing circulation of coolant. Torque converter and transmission oil is transferred through hoses to lower part of radiator where it is cooled.

b. Additional cooling of the engine is provided by an external oil cooler mounted next to the radiator.

4-34. Oil Cooler (Engine)

a. Removal. Refer to figure 4-18, and remove the oil cooler.

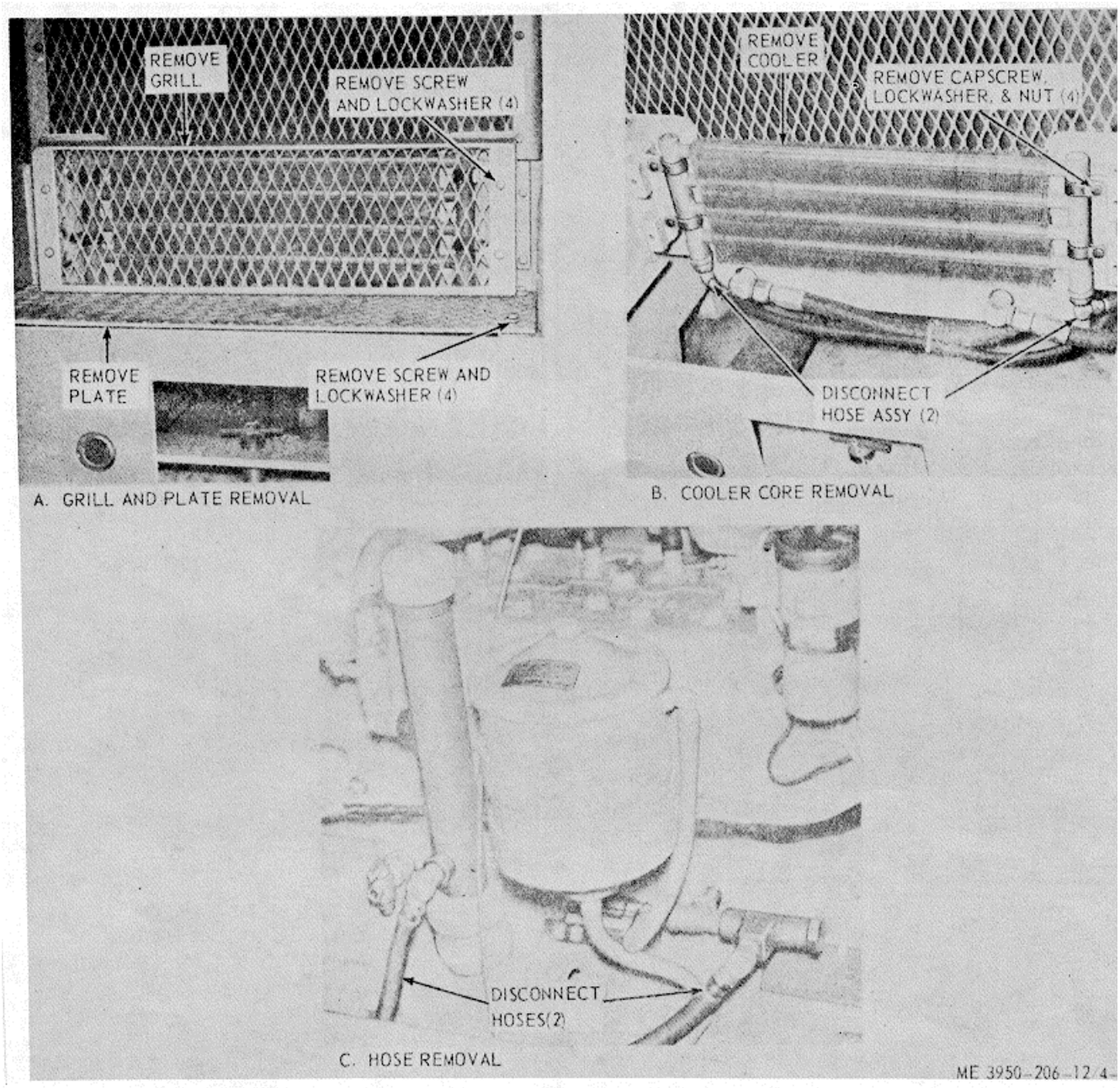


Figure 4-18. Engine oil cooler, removal.

b. Cleaning and Inspection.

(1) Clean all parts in an approved cleaning solvent and dry thoroughly.

(2) Straighten any bent cooling fins.

(3) Inspect cooler for cracks and damaged threads. Replace as required.

(4) Inspect hoses for worn or cracked condition. Replace defective hoses.

c. Installation.

(1) Reverse instructions for removal.

(2) Operate engine for 5 minutes at idle speed, observe for leaks at connections. Replenish oil as required.

4-35. Radiator Assembly

a. Cleaning.

(1) Clean foreign matter from cooling fins by forcing compressed air through radiator.

(2) Flush cooling system with a chemical cleaner in accordance with current directives. After flushing, fill cooling system with anti- freeze (table 2-1) containing rust inhibitor or water and rust inhibitor in accordance with cur- rent directives.

(3) If cooling system is badly clogged with rust and scale, reverse flow. Flush radiator and engine as follows:

(a) Drain cooling system.

(b) Loosen clamps (3, fig. 4-21), disconnect hoses (4) from thermostat housing, and water pump.

(c) Connect flushing gun to hose (fig. 4-19). Fill radiator with water. Shut off water sup- ply and blow water out of radiator with air. Apply air pressure gradually to prevent damage to radiator. Repeat this process until flushing stream runs clear. Disconnect flushing gun.

(d) Remove by-pass tube assembly from thermostat housing (1, fig. 4-22) and water pump. Install a plug in opening of thermostat housing.

(e) Remove nuts (3) and lockwashers (4) that secure thermostat housing (1) to cylinder head; remove thermostat housing, thermostat (5) and adapter (6). Reinstall thermostat housing; secure nuts (3).

(f) Connect flushing gun to thermostat housing (fig. 4-20). Completely fill engine water jacket with water. Hold hand over water supply. Blow water out of water jacket with air. Re- peat this procedure until flushing stream runs clear. Disconnect flushing gun.

(g) Install thermostat in thermostat housing; install tube' assembly, install hoses on radiator, thermostat housing, and water pump; secure with clamps. Close engine and radiator drain cocks. In accordance with current directives, fill

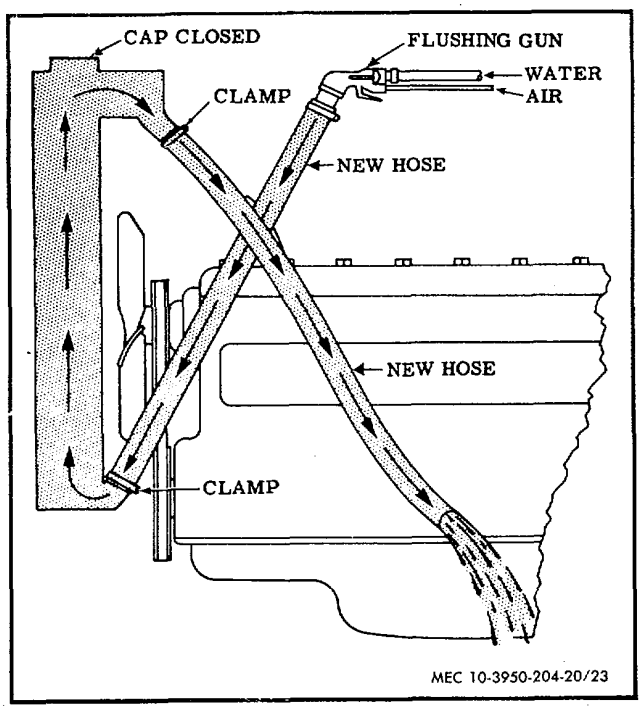


Figure 4-19. Reverse flow radiator flushing

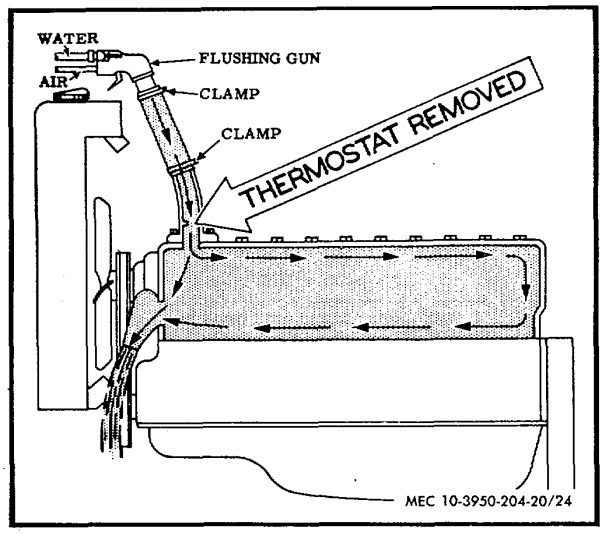


Figure 4-20. Reverse flow engine flushing.

cooling system with antifreeze (table 2-1) containing a rust inhibitor.

b. Removal.

(1) Remove engine oil cooler, paragraph 4-34.

(2) Loosen clamp that secures pre-cleaner cap to air cleaner and remove.

(3) Remove sixteen capscrews, lockwashers, and nuts that secure engine hood support and fire wall; remove hood.

(4) Drain radiator by opening drain cock (11, fig. 4-21) and removing radiator cap (5).

(5) Loosen clamps (3) that secure hoses (4) to radiator (6); remove hoses (4).

(6) Place a drain pan under radiator. Disconnect transmission oil lines from radiator and drain oil from lines.

(7) Remove taillight wire clamps that se- cure light wires to shroud.

(8) Remove four capscrews and washers that secure hood support to frame; remove hood support with shroud and radiator attached.

(9) Remove six capscrews (8), flat washers (7), lockwashers (9) and nuts (10) that secure support to radiator. Remove hood support.

(10) Remove five screws (2), nuts (12), and fan guard (1) from radiator (6).

c. Inspection.

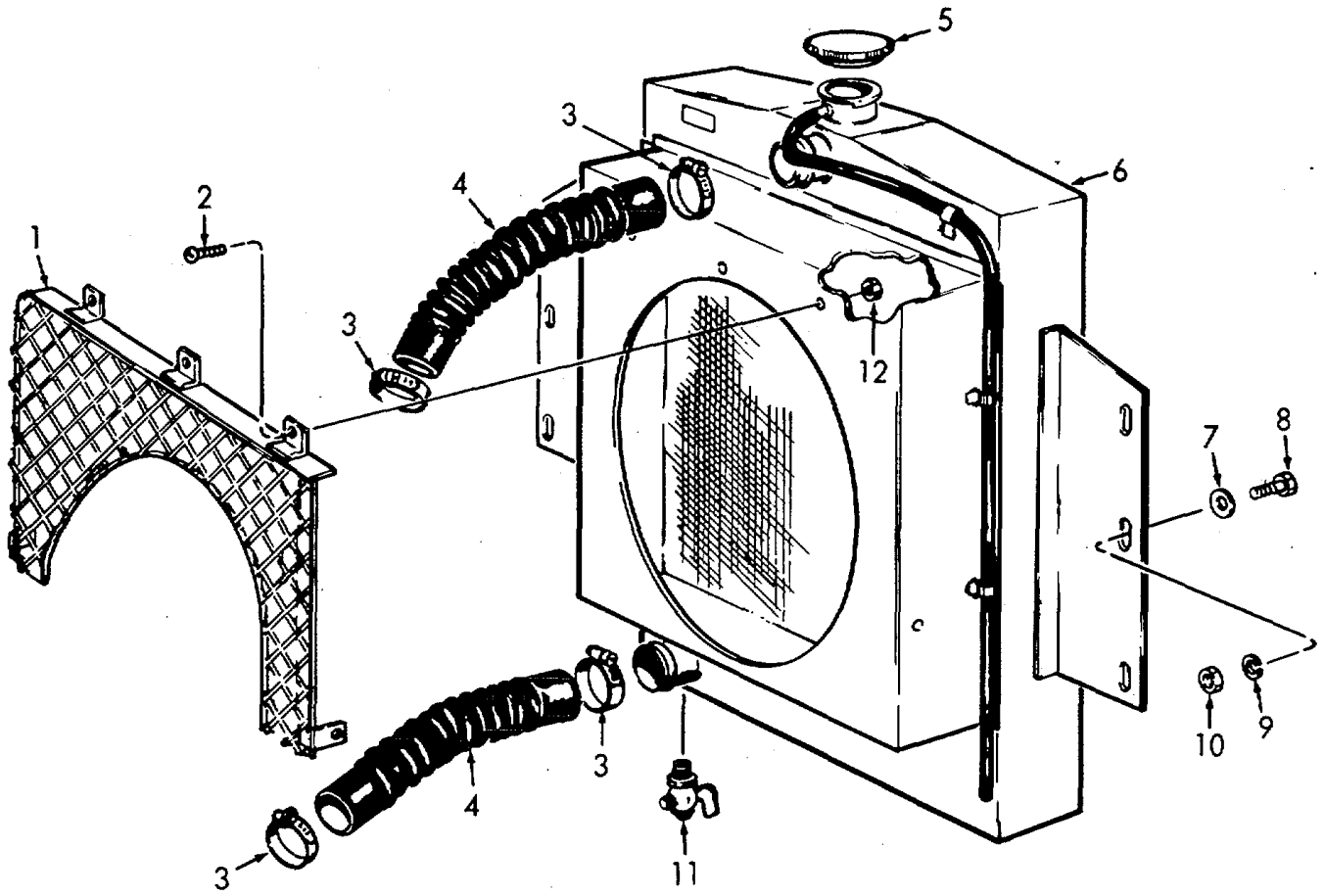
(1) Inspect radiator core and tanks for cracks, dents, distortion, or other damage.

(2) Inspect solder joints between tanks and core for evidence of leaks or other damage.

(3) Replace radiator if defective.

d. Installation. Reverse procedures in b above.

(1) Close radiator drain cock (11). In accordance with current directives, fill cooling system



ME 3950-206-12/4-21

1. Fan Guard
2. Screw (5)
3. Clamp (4)
4. Hose (2)
5. Cap
6. Radiator
7. Washer (6)
8. Capscrew (6)
9. Lockwasher (6)
10. Nut (6)
11. Draincock
12. Nut (5)

Figure 4-21. Fan guard, radiator and hoses, exploded view.

with antifreeze (table 2-1) containing a rust inhibitor or with water and rust inhibitor.

(2) Run engine until it reaches operating temperature. Check cooling system for leaks. Run crane a few feet forward and backward under its own power. Check transmission oil level; add oil if necessary. Check oil level in engine; add oil as required.

4-36. Thermostat

a. Removal.

(1) Drain radiator.

(2) Loosen clamp (3, fig. 4-21) and remove hose (4) from thermostat housing (1, fig. 4-22).

(3) Remove by-pass tube assembly from thermostat housing and water pump.

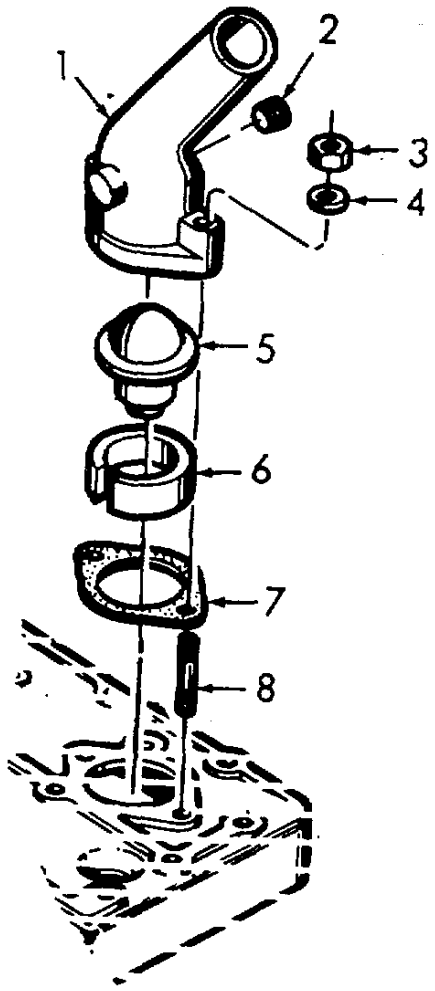
(4) Remove two nuts (3), lockwashers (4) and thermostat housing (1).

(5) Lift out thermostat (5) and adapter (6). Discard gasket (7).

b. Inspection and Testing.

(1) Inspect thermostat for cracks, distortion, scale or dirt deposits, or other physical dam- age.

(2) Suspend thermostat in a pan of water on a stove. Place a thermometer capable of reading temperatures up to the boiling point in the



1. Thermostat housing
2. Plug
3. Nut (2)
4. Lockwasher (2)
5. Thermostat
6. Adapter
7. Gasket
8. Stud (2)

Figure 4-22. Thermostat housing and related items, exploded view.

pan. Heat water. The thermostat must open between 150° to 180°F.

(3) Replace gasket, and if defective, replace thermostat.

c. Installation.

(1) Reverse procedures in a above.

(2) Fill cooling system with antifreeze (table 2-1) containing a rust inhibitor or with water and rust inhibitor.

4-37. Fan and Alternator Belt

a. Removal.

(1) Loosen alternator adjusting strap bolts (fig. 4-23).

(2) Push alternator toward engine; slip alternator belt off alternator pulley and remove from fan and crankshaft pulleys.

b. Installation. Reverse procedures in a above.

c. Adjustment.

(1) Pull alternator away from engine until there is tension on belt; temporarily tighten alternator adjusting strap screw (fig. 4-23).

(2) Check belt deflection on the span between fan pulley and engine crankshaft drive pulley. Change position of alternator to allow 3/4 to 1 inch deflection of belt with firm thumb pressure.

(3) Tighten alternator mounting bolts and nuts and adjusting strap screw.

4-38. Water Pump

a. Removal.

(1) Remove radiator (para 4-35).

(2) Remove fan belt (para 4-37).

(3) Remove adjusting :strap pivot bolt (fig. 4-23).

(4) Remove four capscrews, lockwashers, and the fan from fan pulley.

(5) Remove bolts and lockwashers that secure water pump to cylinder block; remove water pump and gasket.

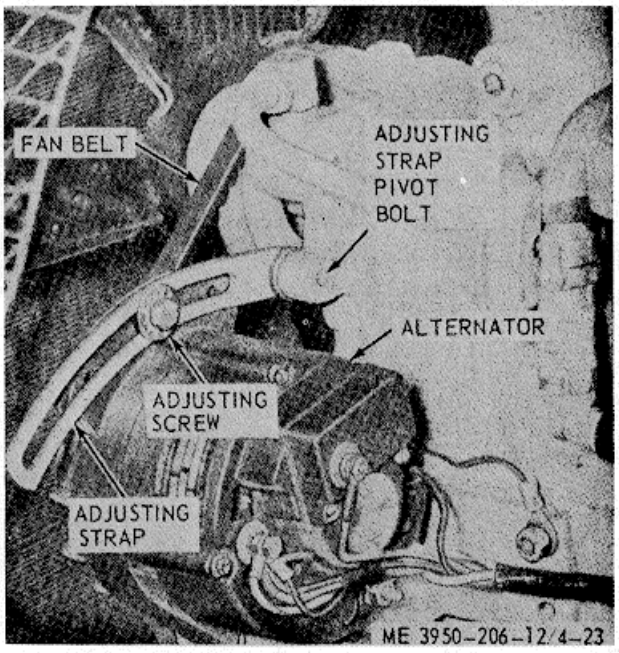


Figure 4-23. Fan belt adjustment points and replacement.

b. Cleaning and Inspection.

(1) Clean exterior of water pump with a cloth dampened in an approved cleaning solvent.

(2) Inspect water pump for cracks, evidence of leaks, shaft play, or other defects.

(3) Inspect pulley for cracks, wear, distortion, or other defects.

(4) Replace gasket; replace water pump if defective.

c. Installation. Install in reverse procedures of *a.* above.

Section X. EXHAUST SYSTEM MAINTENANCE

4-39. Exhaust Piping and Muffler

a. Removal.

(1) Remove cover plate (fig. 4-18A).

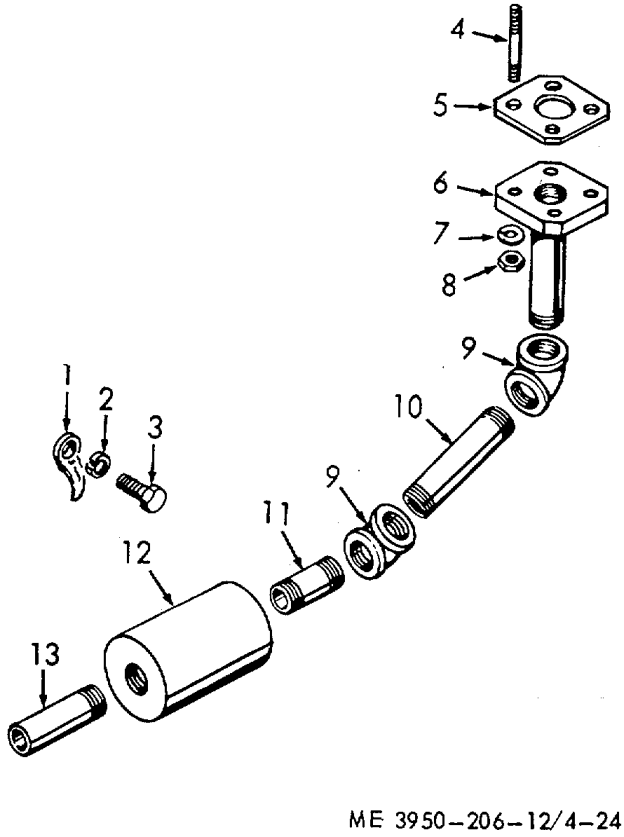


Figure 4-24. Muffler and exhaust piping, exploded view.

1. Clamp
2. Lockwasher
3. Capscrew
4. Stud (4)
5. Gasket
6. Flange
7. Lockwasher (4)
8. Nut (4)
9. Elbow (2)
10. Nipple
11. Nipple
12. Muffler
13. Tail pipe

Figure 4-24 - Continued.

(2) Remove capscrew (3, fig. 4-24), lockwasher (2), and clamp (1).

(3) Remove tail pipe (13) from muffler (12).

(4) Remove muffler from exhaust nipple (11) and separate nipple from elbow (9); remove elbow.

(5) Remove nipple (10) from elbow (9). Remove elbow from exhaust flange (6).

(6) Remove nuts (8) and lockwashers (7) that secure exhaust flange (6) to manifold studs (4); remove exhaust flange and gasket (5).

b. Cleaning and Inspection.

(1) Clean muffler and exhaust pipes with a wire brush.

(2) Inspect muffler for corrosion, cracks, dents, separated seams, or other damage.

(3) Inspect exhaust pipes and flange for corrosion, cracks, dents, distortion, or other dam- age.

(4) Replace damaged or defective parts.

c. Installation. Reverse procedures in a. above.

Section XI. FUEL SYSTEM MAINTENANCE

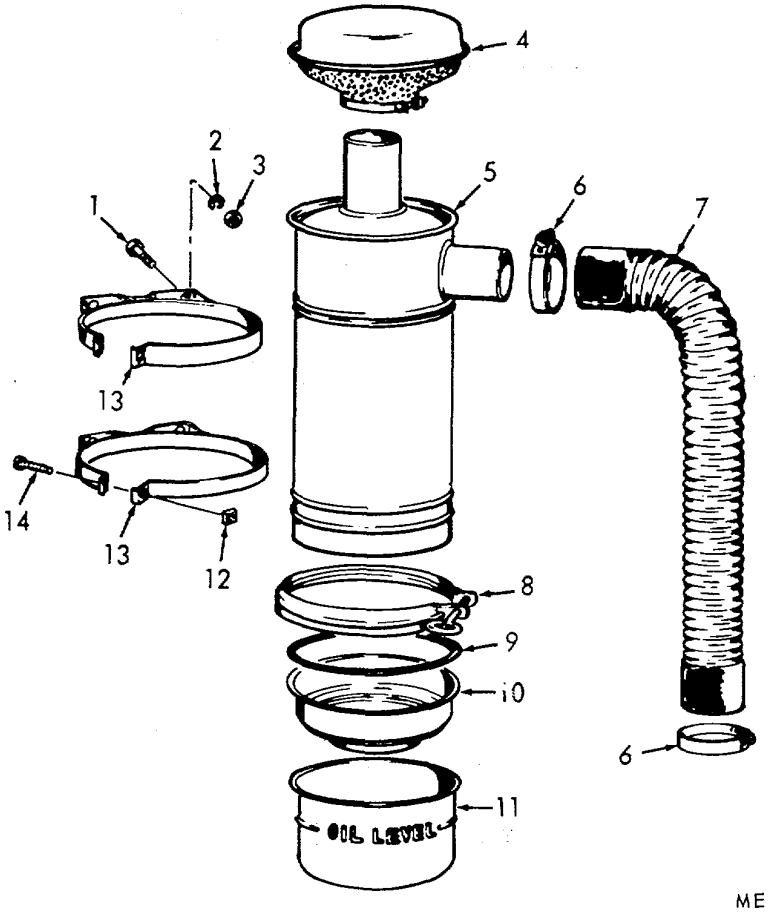
4-40. General

The fuel system consists of fuel tank, fuel filter, lines, fuel pump, carburetor, accelerator pedal and linkage, governor, air cleaner, and pollution control valve. Fuel is drawn from the fuel tank, through the fuel filter, by the fuel pump. From the fuel pump, fuel goes to the carburetor where it is combined with air to form a mixture that is combustible in the engine. Exhaust gases from the engine are carried to the rear of crane by the exhaust pipe. Exhaust noise of the running engine is controlled by the muffler. The governor limits maximum speed of engine.

4-41. Air Cleaner

a. Removal.

(1) Loosen screw on clamp of precleaner cap (4, fig. 4-25) and remove cap.



1. Capscrew (4)
2. Lockwasher (4)
3. Nut (4)
4. Cap
5. Body assy
6. Clamp (2)
7. Hose
8. Clamp
9. Packing
10. Inner cup
11. Outer cup
12. Nut (2)
13. Clamp (2)
14. Screw (2)

Figure 4-25. Air cleaner, exploded view.

(2) Loosen clamps (6) and remove hose (7).

(3) Remove four capscrews (1), lockwashers (2), and nuts (3) and remove air cleaner from firewall.

b. Disassembly.

(1) Remove screw (14) and nut (12) to remove clamp (13).

(2) Loosen thumb screw of clamp (8) and separate outer cup (11), inner cup (10), packing (9) and body assembly (5).

c. Cleaning and inspection. Refer to paragraph 3-3 f.

d. Reassembly. Reassemble the air cleaner in reverse of disassembly.

e. Installation. Install the air cleaner in reverse of removal. Service air cleaner (para 3-3 *f.*).

4-42. Carburetor

a. Adjustment.

(1) Remove intake manifold pipe plug (fig. 4-26); install an adapter in pipe plug hole; connect a vacuum gage to the adapter.

(2) Connect a tachometer to engine.

(3) Run engine at fast idle until it is at operating temperature.

(4) Loosen choke adjusting screw (fig. 4-26); push choke control knob all the way in; then pull it out about 1/16 inch. Push choke control lever as far as possible; secure choke adjusting screw against choke wire.

(5) Set idle speed adjusting screw for an engine speed of 450 to 500 rpm.

(6) Set idle mixture adjusting screw to obtain highest reading possible on vacuum gage.

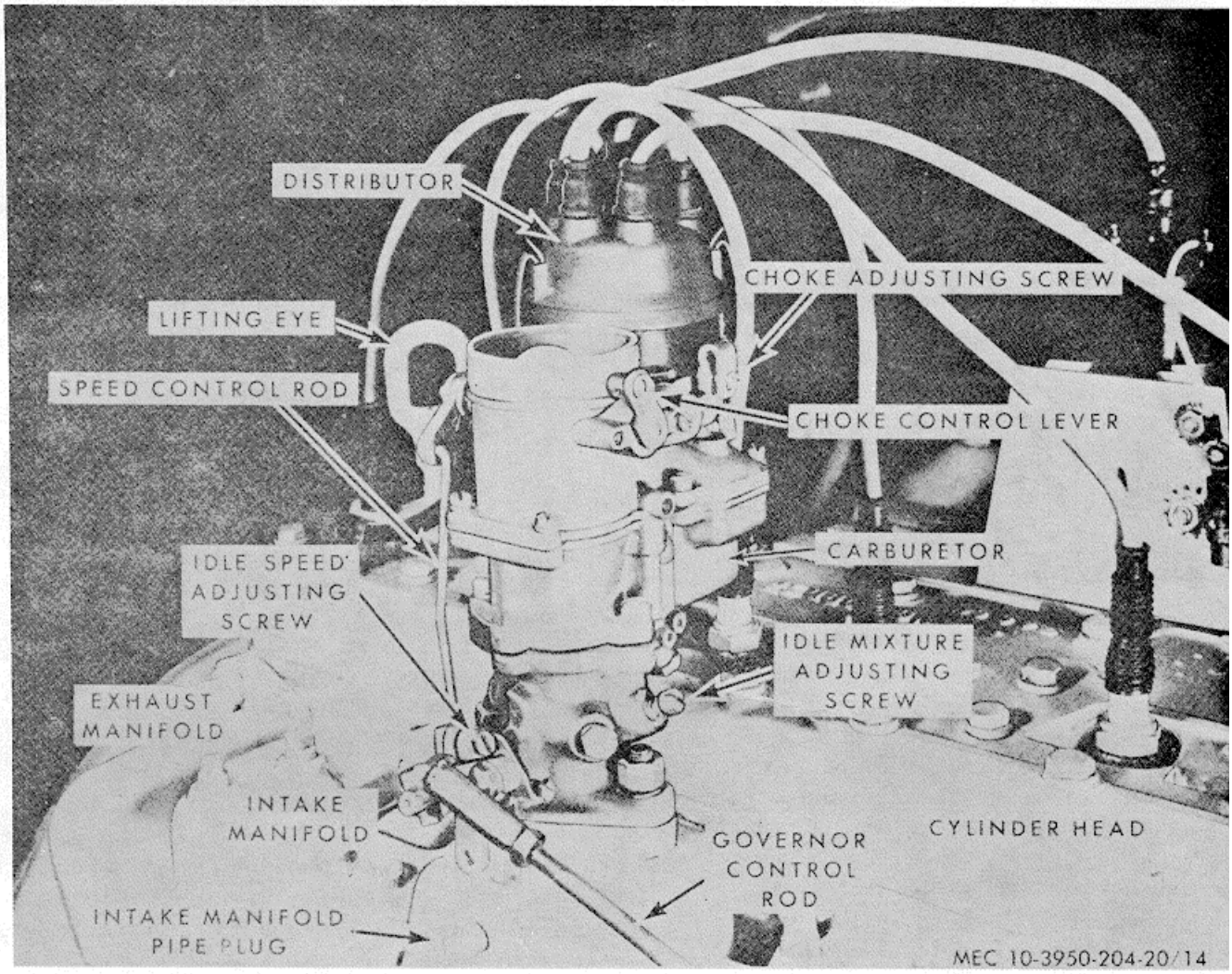


Figure 4-26. Carburetor adjustment points.

(7) If engine speed is not between 450 and 500 rpm, reset engine idle speed as directed in (5) above.

(8) If any idle speed readjustment is necessary, readjust idle mixture as directed in (6) above.

b. Removal.

(1) Loosen hose clamp, at carburetor, and disconnect air cleaner hose.

(2) Loosen choke adjusting screw (fig. 4-26) and choke cable bracket screw. Pull choke cable from bracket and control lever.

(3) Remove clip that secures linkage to throttle control lever; disconnect linkage.

(4) Disconnect fuel line. Remove from carburetor.

(5) Remove nuts that secure carburetor to manifold; remove carburetor and gasket.

c. Installation. Reverse procedures in *b* above.

4-43. Governor Adjustment

a. Back out surge screw (fig. 4-27) until only 3 to 4 threads hold, then lock with locknut.

b. Connect an electric tachometer to engine.

c. Start engine and idle 450 to 500 rpm until warmed to operating temperature.

d. Set specified high idle no load speed 2, 450 rpm by moving throttle to required position and adjusting high speed screw.

e. Check regulation by applying and removing engine load.

(1) If regulation is too broad, increase spring tension with sensitivity screw and readjust high speed screw throttle stop to obtain high idle speed.

(2) If regulation is too narrow decrease spring tension with sensitivity screw and readjust high speed screw throttle stop to obtain desired high idle speed.

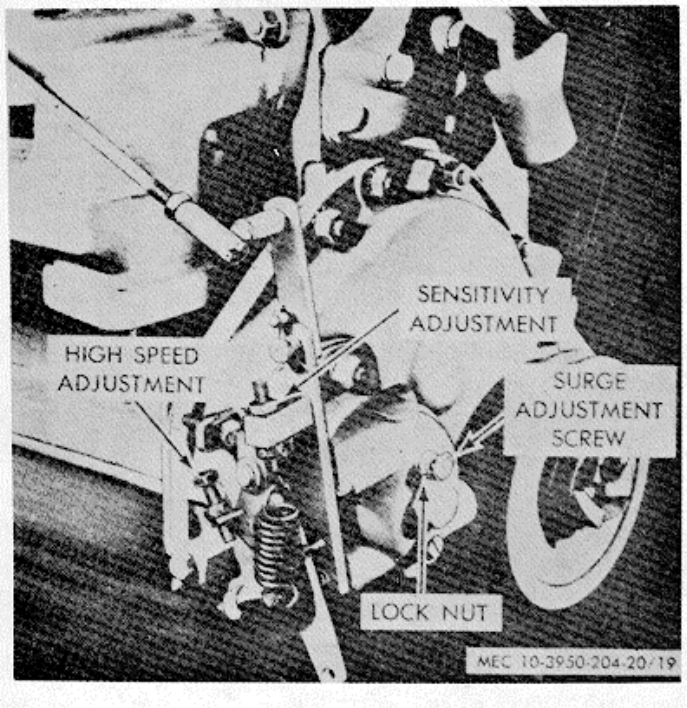


Figure 4-27. Governor adjustment.

(3) If governor surges under load, decrease spring tension with sensitivity screw and readjust throttle lever position to desired high idle speed.

(4) Repeat above procedures as required until desired performance is obtained. When adjustment is complete lock all locknuts to maintain settings.

f. Remove electric tachometer.

4-44. Accelerator Pedal and Linkage

a. Removal.

(1) Remove cotter pin (12, fig. 4-28) and pin (16) that connect clevis (13) to governor arm. Loosen locknut (14). Remove clevis and locknut from rod (15).

(2) Remove cotter pin (12) and pin (16) that connect clevis (13) to pivot arm (9).

(3) Remove cotter pin (10) and pin (5) that connects accelerator pedal clevis (6) to pivot arm. Loosen locknut (7). Remove clevis and lock- nut from rod (8).

(4) Remove cotter pin (10) and washer (17) that secures pivot arm; remove pivot arm from pin (11).

(5) Disconnect and remove spring (18) and pin (5) that operates accelerator pedal and rod; loosen locknut (7). Remove clevis and locknut from rod.

(6) Remove capscrews (2) and lockwashers (3) that secure bearings (4) to floor plate. Remove bearings and accelerator pedal assembly.

b. Cleaning and Inspection.

(1) Clean all metal parts in an approved solvent.

(2) Inspect rods, brackets, clevises, pins, bell crank, and roller for wear.

(3) Inspect spring for cracks, distortion, and loss of tension.

(4) Replace damaged or defective parts.

c. Installation. Reverse procedures in a above.

d. Adjustment. If clevis (13, fig. 4-28) was removed from rod (15), adjust governor and link- age (para 4-43).

4-45. Pollution Control Valve

a. Removal.

(1) Slide formed hose (1, fig. 4-29) from tube assembly (2) and control valve (5).

(2) Loosen tube nut from elbow (3). Lift off tube assembly (2).

(3) Remove elbow (3) from tee at intake manifold.

(4) Loosen nut of elbow assembly (4) and lift off control valve (5).

(5) Remove elbow (4).

b. Installation. Install in reverse of removal.

4-46. Fuel Pump

a. Testing.

(1) Disconnect fuel line (1, fig. 4-30) from elbow (6) on carburetor. Install a tee fitting between elbow and fuel line. Connect a 0 to 5-psi pressure gage to tee fitting.

(2) Connect a tachometer to engine.

(3) Operate engine at 1, 800 rpm. If gage does not indicate between 1 1/4 and 2 1/4 psi with gage held 16 inches above fuel pump, inspect fuel lines and filter for obstructions. If filter and lines are unobstructed, replace fuel pump.

(4) Remove tee fitting and tachometer. Connect fuel line to carburetor.

b. Removal.

(1) Disconnect the two fuel lines from the elbows at fuel pump.

(2) Remove two nuts (14) and lockwashers (13) that secure fuel pump (10) to cylinder block; remove fuel pump and gasket (11).

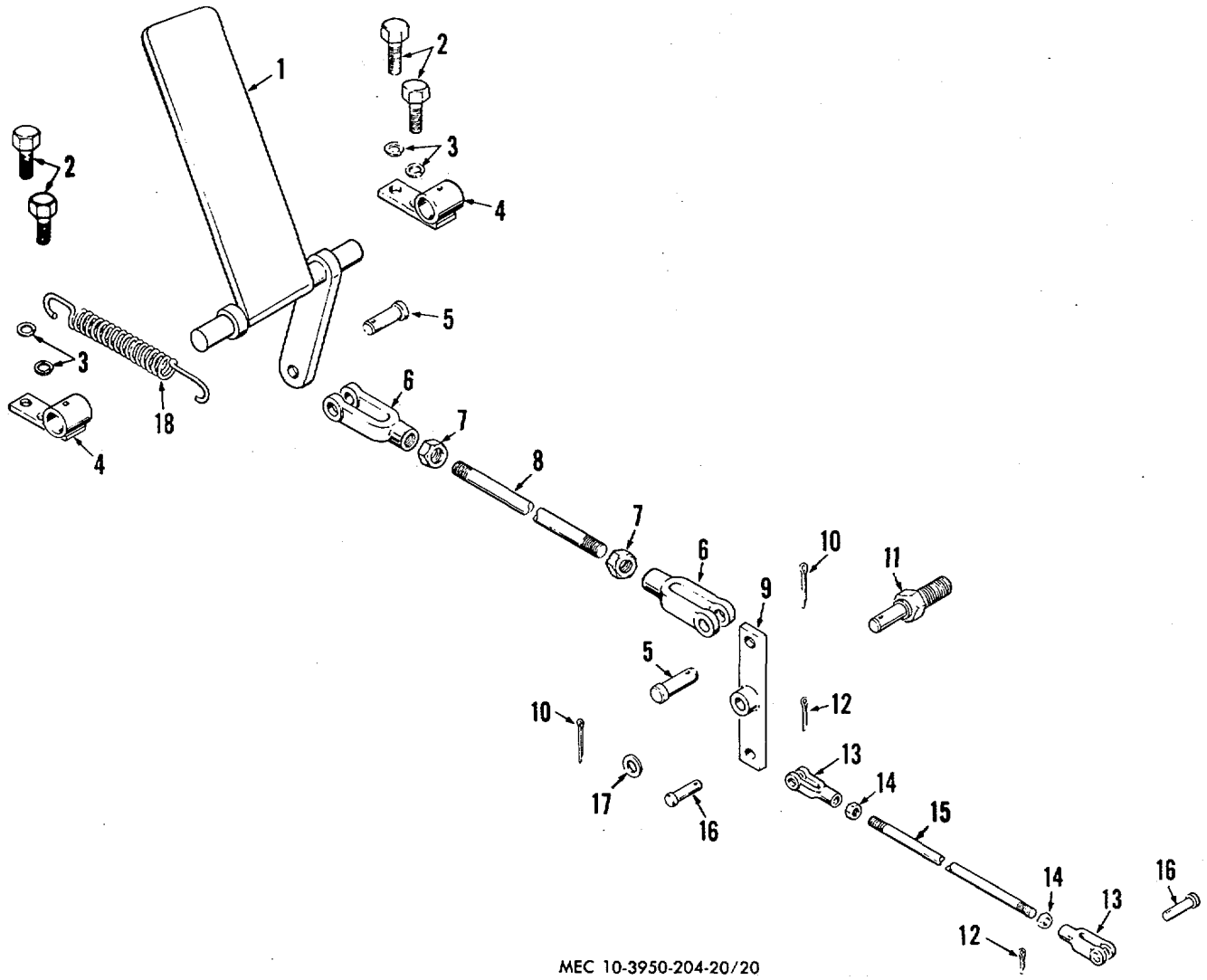
(3) Replace pump if defective.

c. Installation. Reverse procedures in *b* above.

4-47. Fuel Filter

a. Filter Element Replacement.

(1) Close fuel shutoff valve (15, fig. 4-32). Place drain pan under fuel filter to catch gas spillage. Loosen nut on bail (6, fig. 4-31) of fuel filter.



1. Pedal assembly
2. Capscrew (4)
3. Lockwasher (4)
4. Bearing (2)
5. Clevis Pin (2)
6. Clevis (2)
7. Locknut (2)
8. Rod
9. Pivot Arm
10. Cotter pin (2)
11. Pin
12. Cotter pin (2)
13. Clevis (2)
14. Locknut (2)
15. Rod
16. Clevis pin (2)
17. Washer
18. Spring

Figure 4-28. Accelerator pedal and linkage, exploded view.

(2) Remove bowl (5), gasket (4), element (3), from cover (2).

(3) Clean bowl and cover with a cloth dampened in an approved cleaning solvent.

(4) Install a new gasket and element on the cover. Position bowl and bail; tighten bail nut.

(5) Check for leaks around bowl gasket.

b. Removal.

(1) Turn off shut off valve (15, fig. 4-32).

(2) Disconnect fuel pump line from filter.

(3) Disconnect filter from reducing bushing.

c. Installation. Reverse procedures in *b* above.

4-48. Fuel Tank

a. Removal.

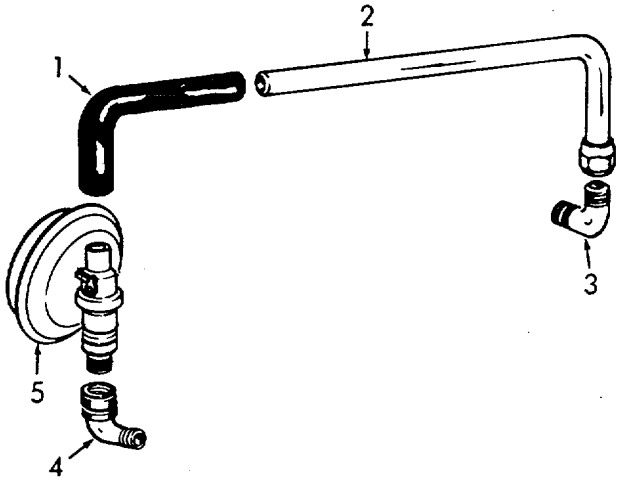
(1) Remove seat support (para 4-84).

(2) Remove assembled cap (7, fig. 4-32) and screen (8).

(3) Remove five capscrews, lockwashers, nuts and lift cover plate from over tank filler neck.

(4) Remove drain plug (12) and allow tank to drain.

(5) Disconnect wire lead from level sending unit (5). Remove five screws (4), washers (R) sending unit (5) and gasket (6).



ME 3950-206-12/4-29

1. Hose
2. Tube assy
3. Elbow
4. Elbow
5. Control valve

Figure 4-29. Pollution control valve and piping, exploded view.

(6) Disconnect hose (22) from adapter (20).

(7) Remove swivel (20), strainer (19), close nipple (18), bushing (17), street ell (16), and gate valve (15).

(8) Remove four capscrews (11), lockwashers (10), and flat washers (9).

(9) With suitable hoist lift fuel tank (2) from well in frame.

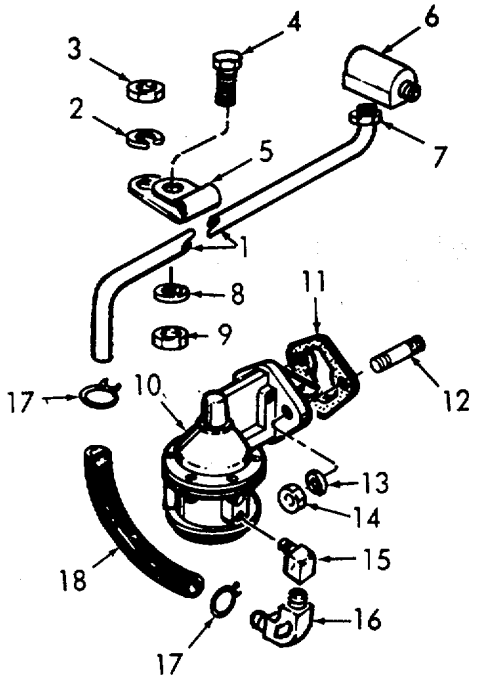
b. Cleaning and Inspection.

(1) Clean cap and strainer in an approved cleaning solvent; dry with compressed air.

(2) Inspect strainer for distortion, dents or other damage. Replace if defective.

(3) Inspect tank and fittings for damage; replace as required.

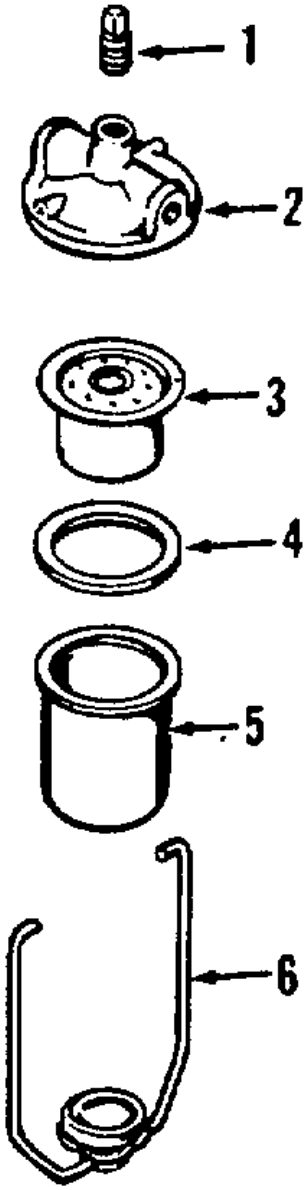
c. Installation. Reverse the procedure for removal.



ME 3950-206-12/4-30

1. Fuel line
2. Lockwasher
3. Nut
4. Capscrew
5. Clip
6. Elbow
7. Tube nut
8. Lockwasher
9. Nut
10. Fuel pump
11. Gasket
12. Stud (2)
13. Lockwasher (2)
14. Nut (2)
15. Elbow
16. Elbow
17. Clamp (2)
18. Hose

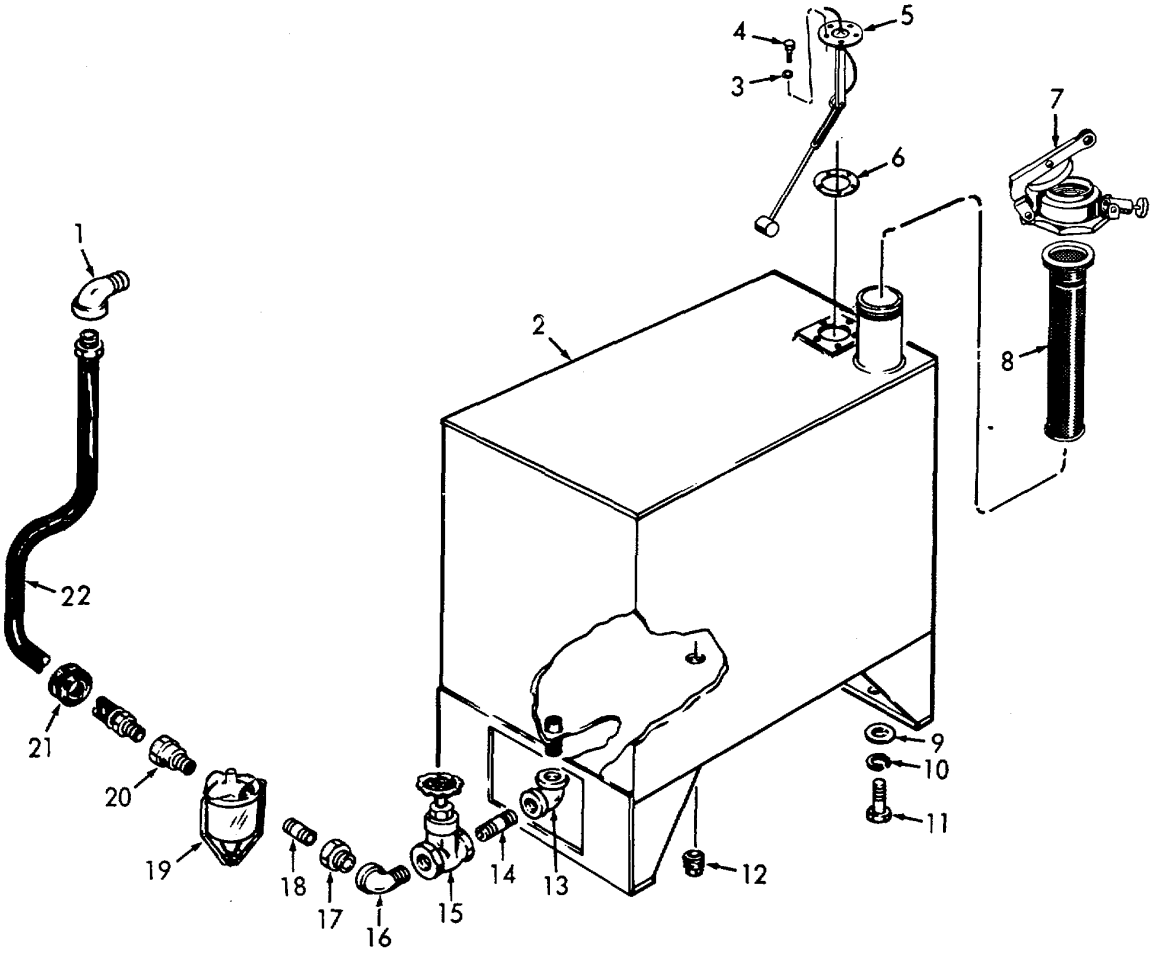
Figure 4-30. Fuel pump and lines, exploded view.



MEC 10-3950-204-20/17

1. Plug
2. Cover
3. Element
4. Gasket
5. Bowl
6. Bail

Figure 4-31. Fuel filter, exploded view.



1. Street ell
2. Tank
3. Lockwasher (5)
4. Screw (5)
5. Spending unit
6. Gasket
7. Cap assy
8. Screen
9. Washer (4)
10. Lockwasher (4)
11. Capscrew (4)
12. Plug
13. Elbow
14. Nipple
15. Gate valve
16. Street ell
17. Bushing
18. Close nipple
19. Fuel filter
20. Adapter
21. Grommet
22. Hose assy

Figure 4-32. Fuel tank, lines, and fittings, exploded view.

Section XII. ENGINE ASSEMBLY MAINTENANCE

4-49. General

The crane is powered by a Continental 6-cylinder, internal combustion, water-cooled, L-head, gasoline engine. A combustible mixture of fuel and air is delivered by the carburetor through the manifold and intake valves to the combustion chambers, where it is ignited by an electrical spark across the electrodes of the spark plugs. The burning mixture of fuel and air causes a heat rise in the combustion chamber. This heat rise causes an expansion of the gases in the combustion chamber that forces the pistons downward in the cylinders. The motion of the pistons causes rotation of the crankshaft. The burned mixture

and hot gases are passed through the exhaust valves to the exhaust manifold. Heat left in the engine is transferred to the radiator by coolants as the primary cooling system. An external oil cooler, through which the crankcase oil passes provides additional cooling. The exhaust and intake valves are operated by the camshaft which is geared to the crankshaft. Moving parts of engine are pressure-lubricated by an oil pump driven off the camshaft.

4-50. Testing

a. Compression Test.

(1) Test battery (para 4-27).

(2) Clean around spark plug ports with compressed air and a cloth dampened in an approved cleaning solvent. Remove spark plugs.

(3) Hold a compression gage in front spark plug port. Crank engine with starting motor until highest gage reading is reached. Record reading. Repeat this process at each remaining spark plug port.

(4) Compression readings above 110 psi, and within 10 psi of each other are normal. If readings are below 100 psi or are irregular, seal the piston with a teaspoon of engine oil poured through spark plug hole and take new readings. If readings are below 110 psi or

if readings at different ports vary more than 10 psi, the valves or valve seats are burned, piston rings are worn, or there are other internal engine problems.

(5) If compression fails to read within required range, report to proper authority.

b. Vacuum Test.

(1) Remove intake manifold pipe plug. In- stall an adapter and connect a vacuum , gage to. the adapter.

(2,) With engine at operating temperature and running at idle speed adjust carburetor idle mixture adjusting screw for highest vacuum gage reading.

(3) A vacuum reading of 18 to 22 inches of mercury with a slight needle flutter is normal. Readings below this range or extreme our erratic needle flutter may indicate burned valves, improper valve or ignition timing, improper carburetor adjustment, dirty air cleaner, exhaust obstruction, or other engine difficulties.

(4) If vacuum reading is out of required range, report to proper authority.

(5) Remove gage and adapter and replace manifold plug.

c. Ignition Timing Test and Adjustment.

(1) Set contact gap (para 4-26).

(2) Remove spark plug (No. 1) nearest radiator. Place a finger or thumb over spark plug port. Crank engine with starting motor until air is forced out of No. 1 cylinder past thumb or finger plugging port.

(3) Hold a light in a position to light timing hole on flywheel housing. Crank engine until dead center mark on flywheel lines up with pointer in timing hole (fig. 4-33).

Note. Do not make a 360° revolution to align D. C. with pointer. If D. C. Mark has been passed, turn engine counter-clockwise or repeat step indicated in 4-50 *c*(2).

4-51. Oil Pressure Regulator Valve

a. Removal. Remove the oil pressure regulator valve from the engine as indicated on figure 4-34.

b. Cleaning, Inspection, and Repair.

(1) Clean all parts in approved cleaning solvent.

(2) Inspect the valve for damage or evidence of wear where valve sets in block.

(3) Inspect the spring for weak or broken condition. If engine is not badly worn, low engine oil pressure can be caused by a defective spring. Normal oil pressure under' load should be 20-30 psi.

(4) Replace defective parts.

c. Installation. Install the oil pressure regulator valve in the engine block in reverse of the instructions on figure 4-34.

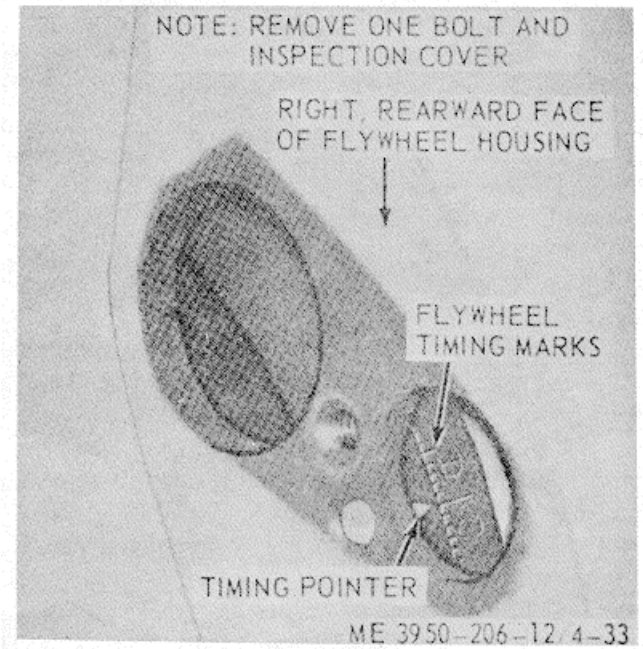


Figure 4-33. Ignition timing

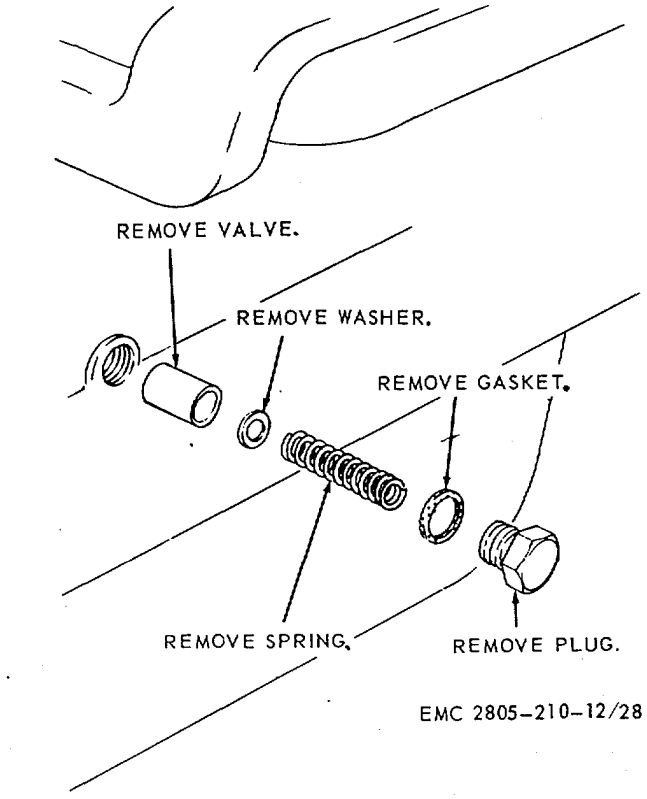


Figure 4-34. Oil pressure regulator valve, exploded view.

4-52. Engine Oil Filter

a. Removal.

(1) Remove oil hoses (13 and 18, fig. 4--35). Remove elbows (10 and 11) and bushing (12).

(2) Remove two cylinder head bolts and washers that secure filter bracket (20) to cylinder head. Remove oil filter assembly.

b. Disassembly.

(1) Loosen screw (1) and lift off cover assembly. Remove spring (4) from detent in screw (1) and remove screw and washer (2) from cover (3).

(2) Remove and discard gasket (5) and element (6).

(3 If further disassembly is required; re- move four nuts (9), lockwashers (8), flat washers (7), and bracket (20).

(4) Remove brackets (15) by loosening screws (17) and sliding off shell assembly (19).

c. Cleaning and Inspection.

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect sealing edges of shell and cover for burrs, or deformation. Inspect threaded parts for damaged or stripped threads.

(3) Replace any defective parts found.

d. Reassembly. Reassemble the oil filter in reverse of disassembly.

e. Installation. Install the oil filter in reverse order of removal. Tighten cylinder head bolts and re-torque cylinder head (after engine has reached normal operating temperature) in accordance with figure 4-9.

4-53. Cylinder Head

a. Removal.

(1) Remove the pollution control valve hose and tube assembly (para 4-45).

(2) Remove cylinder head per instructions on figure 4-36.

b. Cleaning and Inspection.

(1) Remove all carbon from combustion areas with a scraper and wire brush. Clean all remaining residue from cylinder head with an approved cleaning solvent. Dry with compressed air.

(2) Clean top of cylinder block- with a scraper and a cloth dampened in an approved cleaning solvent. Be very careful not to get dirt in cylinders or water jacket.

(3) Inspect cylinder head for cracks, corrosion, damaged threads, plugged water ports, or other defects.

(4) Check flatness lengthwise with a straight edge and feeler gage (fig. 4-37). The maximum permissible low spot is 0.004 inch in , the center, gradually decreasing towards the ends. Check flatness lengthwise at each edge and in the middle of the head.

(5) Check flatness crosswise with a straight edge and a feeler gage (fig. 4-38). The maximum permissible low spot is 0.003 inch in localized areas. Check flatness crosswise at each end and between each combustion chamber.

(6) Inspect cylinder head studs for looseness or damaged threads.

(7) Replace gasket, hoses, and defective parts.

c. Installation.

(1) Install the cylinder head in reverse order of removal.

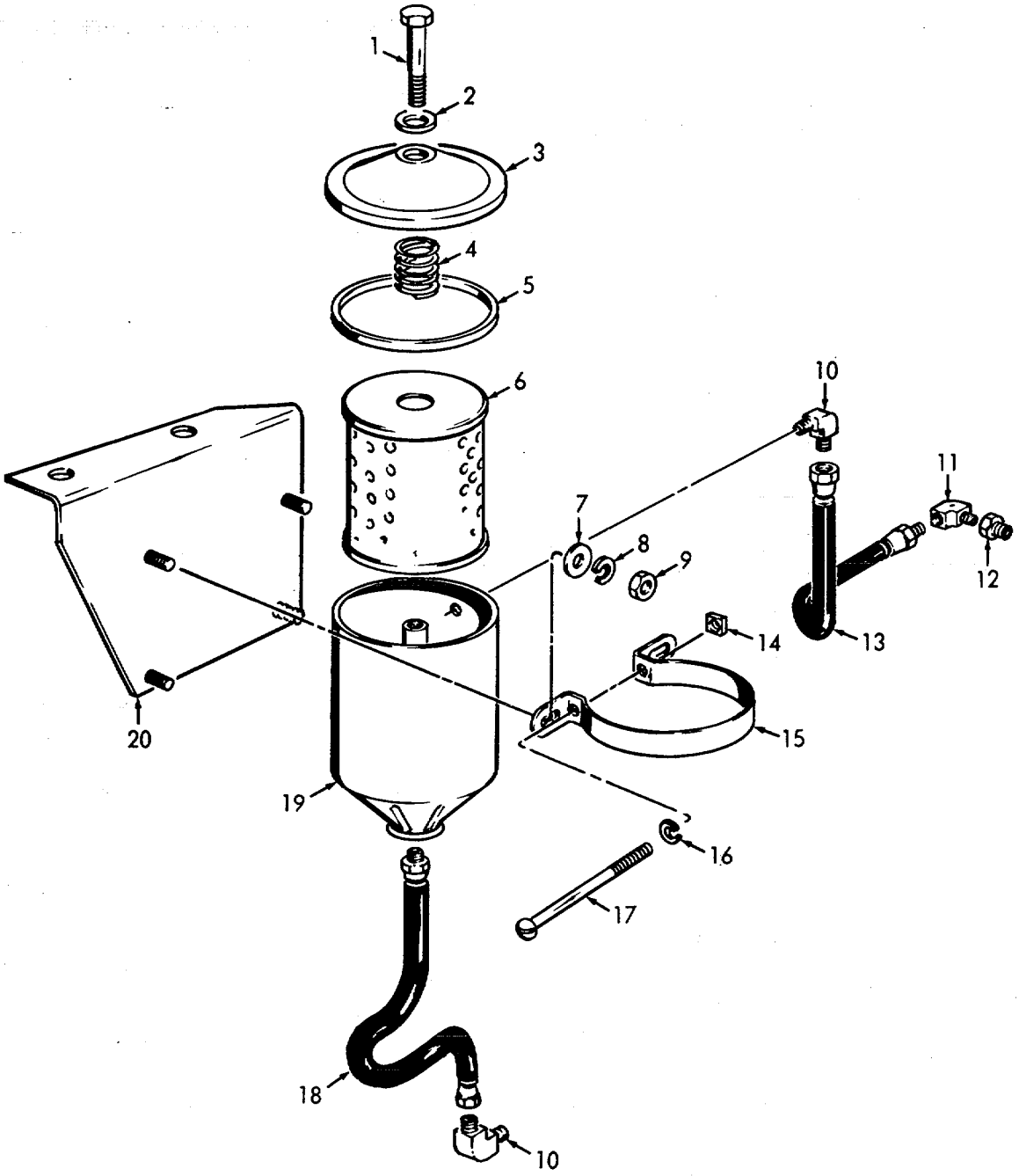
(2) Tighten cylinder head bolts in sequence shown in figure 4-39.

(3) Run engine until it reaches normal operating temperature and re-torque cylinder head bolts to specification.

4-54. Manifolds

a. Removal,

(1) Remove carburetor (para 4-42).



ME 3950-206-12/4-35

1. Screw
2. Washer
3. Cover
4. Spring
5. Gasket
6. Element
7. Washer (4)
8. Lockwasher (4)
9. Nut (4)
10. Elbow (2)
11. Elbow
12. Bushing
13. Hose assy
14. Nut (2)
15. Bracket (2)
16. Lockwasher (2)
17. Screw (2)
18. Hose assy
19. Shell assy
20. Bracket

Figure 4-35. Engine oil filter assembly, exploded view.

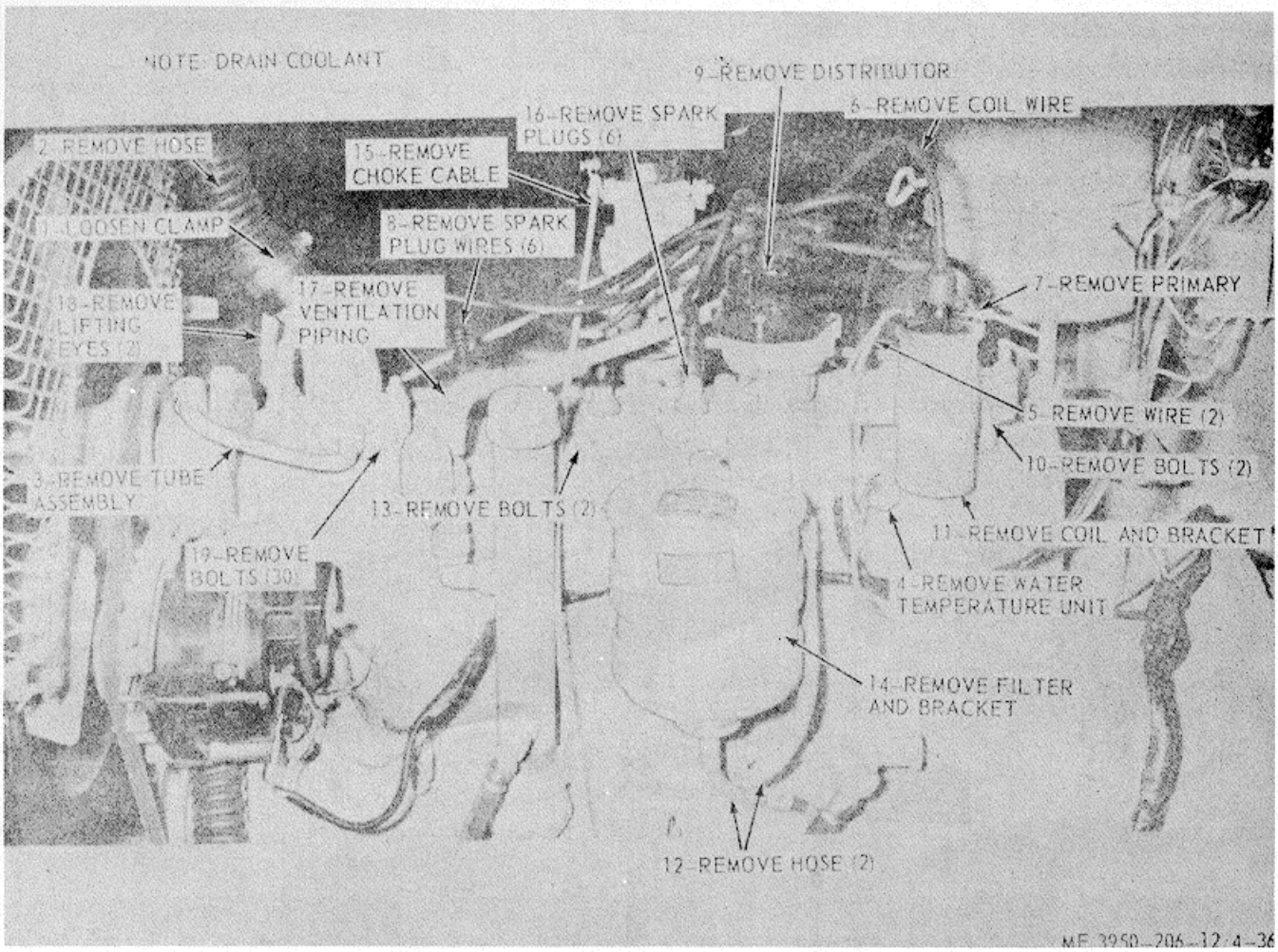


Figure 4-36. Cylinder head removal.

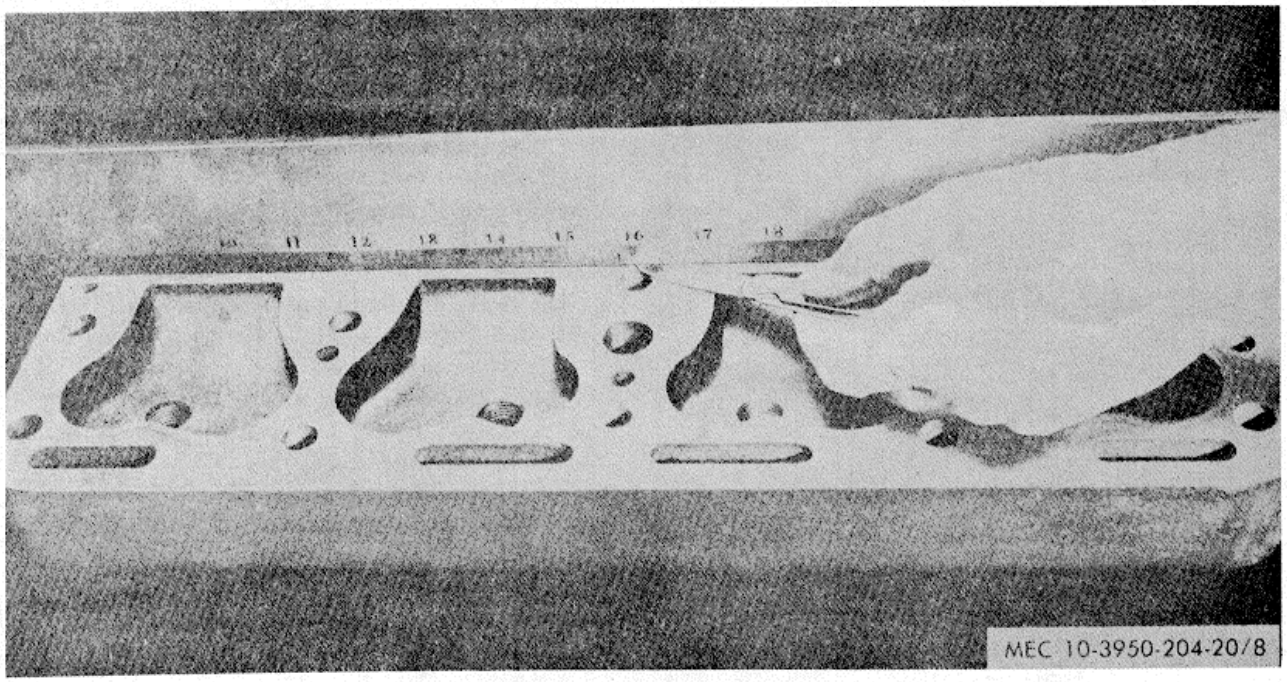


Figure 4-37. Checking cylinder head flatness lengthwise.

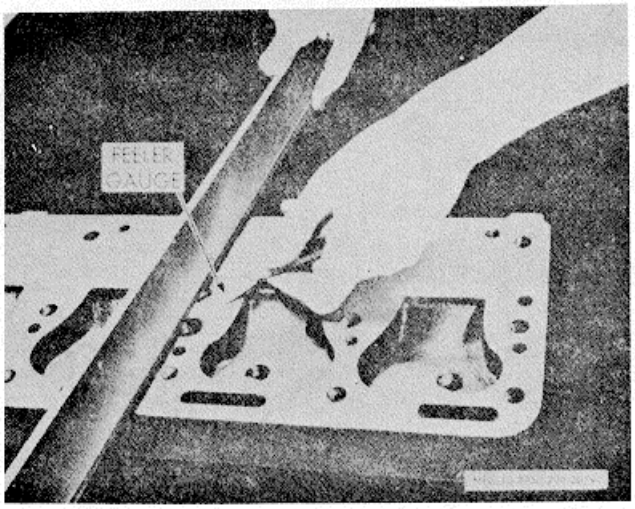


Figure 4-38. Checking cylinder head flatness crosswise.

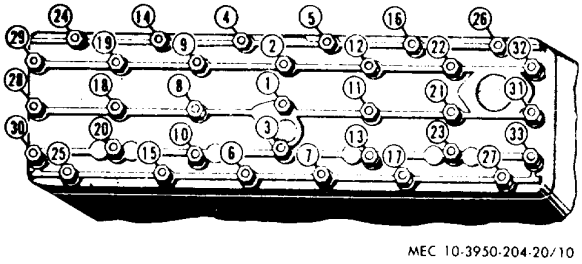


Figure 4-39. Cylinder head bolt tightening sequence.

(2) Remove exhaust piping (para 4-39).

(3) Disconnect vacuum line and pollution control valve piping from intake manifold.

(4) Remove eleven nuts (4, fig, 4-40), washers (5 and 13). Remove manifold assembly from block.

(5) Separate intake manifold (1) and exhaust manifold (8) by removing four nuts (10) and washers (9). Remove gaskets (7 and 11).

b. Cleaning and Inspection.

(1) Clean dirt from manifold with a wire brush; then clean with a cloth dampened in an approved cleaning solvent.

(2) Inspect manifold for cracks, warping, damaged sealing surfaces, corroded areas, damaged threads, or other defects.

(3) Inspect for loose or damaged studs.

(4) Replace gaskets; replace other parts if defective.

c. Installation. Reverse procedures in a above.

4-55. Valve Adjustment

a. Remove carburetor (para 4-42).

b. Remove manifolds (para 4-54).

c. Remove three valve cover stud nuts with gaskets. Remove valve cover and gasket.

d. Inspect valve springs, locks, spring seats, and caps for distortion or improper placement. If defective parts are found, report to proper authority.

e. Adjust intake valves, to 0.014 inch, and exhaust valves to 0.017 inch clearance, with engine cold, per the following 'instructions:

(1) Remove all spark plugs.

(2) Place thumb over No. 1 spark plug hole and crank engine with starting motor a little at a time by momentarily turning starter and ignition switch. When No. 1 piston starts up on its compression stroke pressure will be felt against thumb. When pressure is felt, stop cranking engine with starting motor, remove thumb and continue cranking engine by hand while observing timing pointer. When timing pointer and top dead center mark is aligned, the No. 1 cylinder valves are in position for adjusting.

(3) Slide feeler gage between the valve lifter adjusting screw and the valve stem cap, (fig. 4-41). A slight drag should be felt with the feeler gage when the clearance is correct.

(4) To increase clearance, hold valve lifter with an open end wrench while using a second to turn adjusting screw one-quarter to one-half turn clockwise. Repeat clearance check and adjustment until proper clearance is obtained. The adjustable-type valve lifters have self-locking adjusting screws that require no locknuts.

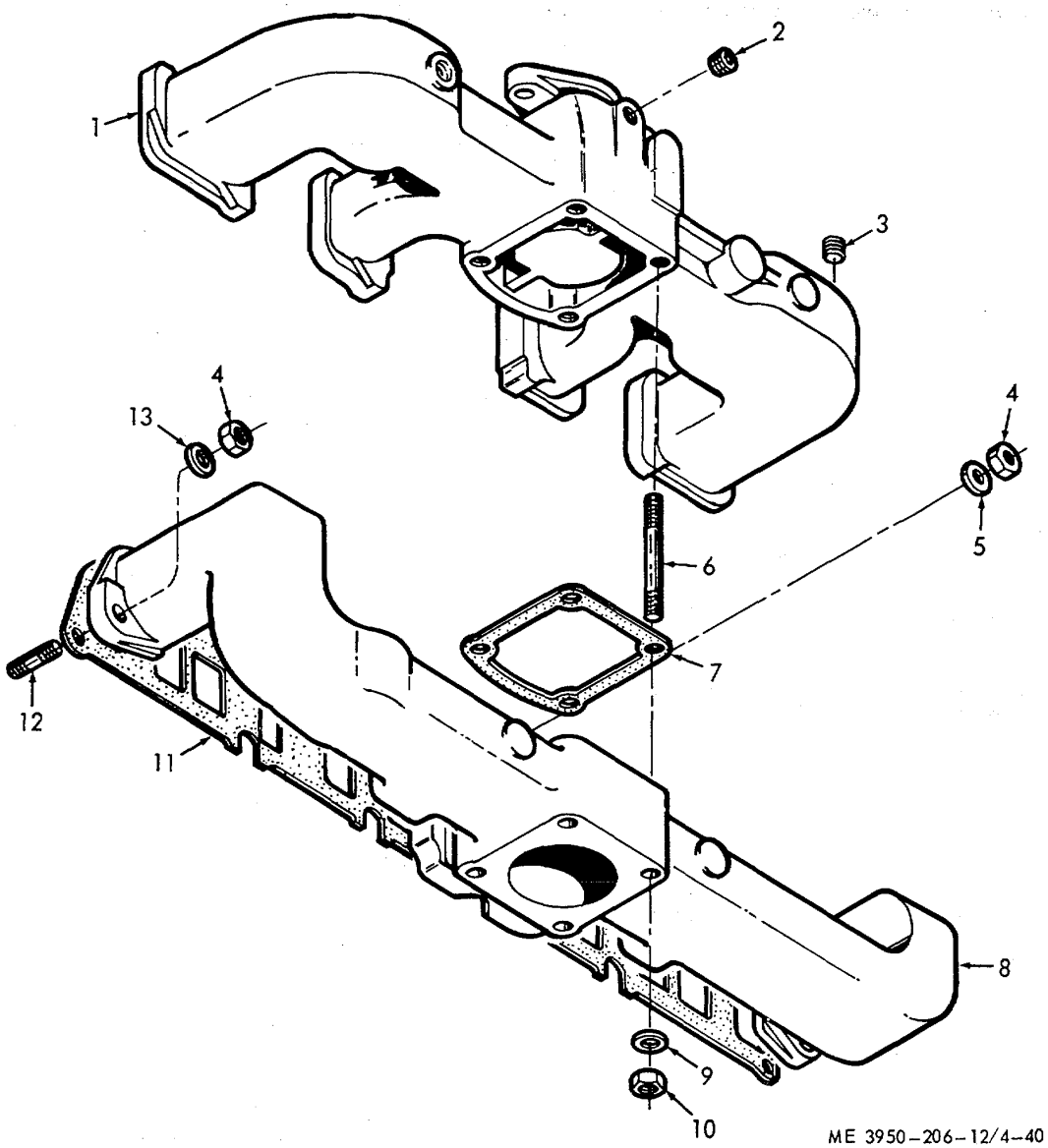
(5) To decrease clearance, hold valve lifter with an open end wrench while using a second wrench to turn valve lifter adjusting screw counterclockwise one-quarter to one-half turn. Repeat clearance check and adjustment until proper clearance is obtained.

(6) Following firing order, turn crankshaft one-half revolution and adjust valves for No. 5 cylinder. Turn crankshaft one-half revolution and adjust valves for No. 3 cylinder. Turn crankshaft one-half revolution and adjust valves for No. 6 cylinder. Turn crankshaft one-half revolution and adjust valves for No. 2 cylinder. Turn crankshaft one half revolution and adjust valves for No. 4 cylinder.

f. Install valve cover with a new gasket and secure with three valve cover stud nuts with gaskets.

g. Install manifolds (para 4-54).

h. Install carburetor (para 4-42).



1. Intake Manifold
2. Plug
3. Plug (6)
4. Nut (11)
5. Washer (8)
6. Stud (4)
7. Gasket
8. Exhaust Manifold
9. Washer (4)
1t0. Nut (4)
11. Gasket
12. Stud (11)
13. Washer (3)

Figure 4-40. Exhaust and Intake Manifolds, exploded view.

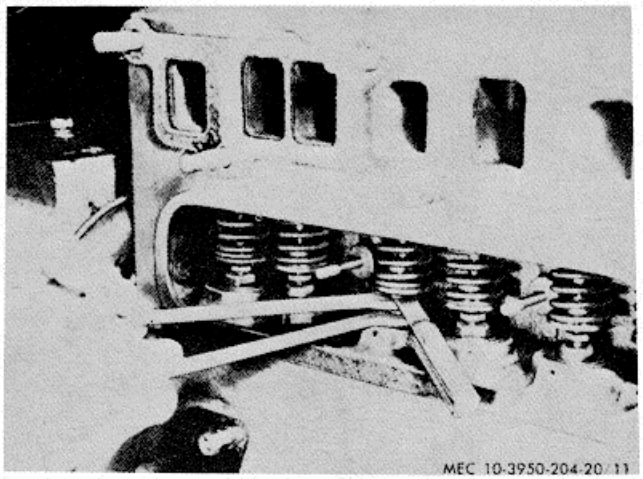


Figure 4-41. Valve adjustment.

Section XIII. TRANSMISSION MAINTENANCE

4-56. General

The transmission is mounted between the engine and drive axle assembly, immediately below operator's compartment floor plates. The transmission is connected to the torque' converter on one end and to the differential pinion gear on the other. It is a constant-mesh, full reversing, power-shifted type. The forward and reverse directions are selected by positioning direction shift lever mounted on right side of operator's seat. The direction shift lever is connected by mechanical linkage to selector lever on side of transmission. A neutral start switch is provided as a safety feature.

4-57. Lever and Linkage Adjustment

If direction shift lever is in neutral position and too far forward or too far to the rear for convenient operation, adjust shift lever linkage as follows:

a. Move direction shift lever (30, fig. 4-42) to neutral position in shift gate (2). Remove cotter pin (33) and pin (13) that secure yoke (, 12) to pivot lever (16).

b. Move pivot lever (16) until transmission range selector is in neutral position. Note. At this point neutral start switch (36) should be depressed by pin (34).

c. Loosen nut (14) that locks yoke (12) on rod (15).

d. Adjust yoke (12) so that direction shift lever (30) will be in neutral position of shift gate (2) when yoke is connected to pivot lever (16). Shortening the linkage moves shift lever position forward. Lengthening the linkage moves shift lever position to the rear.

e. Install yoke (12) on pivot lever (16) with pin (13) and cotter pin (33). Tighten nut (14) against yoke (12) to lock adjustment.

f. Using direction shift lever (30) shift transmission into forward and reverse. Watch linkage, shift lever, and transmission range selector during shifting to be sure there is no obstruction and transmission goes completely into all gears.

4-58. Transmission Oil Piping

a. Refer to figure 4-43, and remove the transmission oil piping as required.

b. Replace any parts which are damaged in any way

4-59. Transmission Oil Filter

a. Removal.

(1) Disconnect oil hose assemblies from filter head (fig. 4-1).

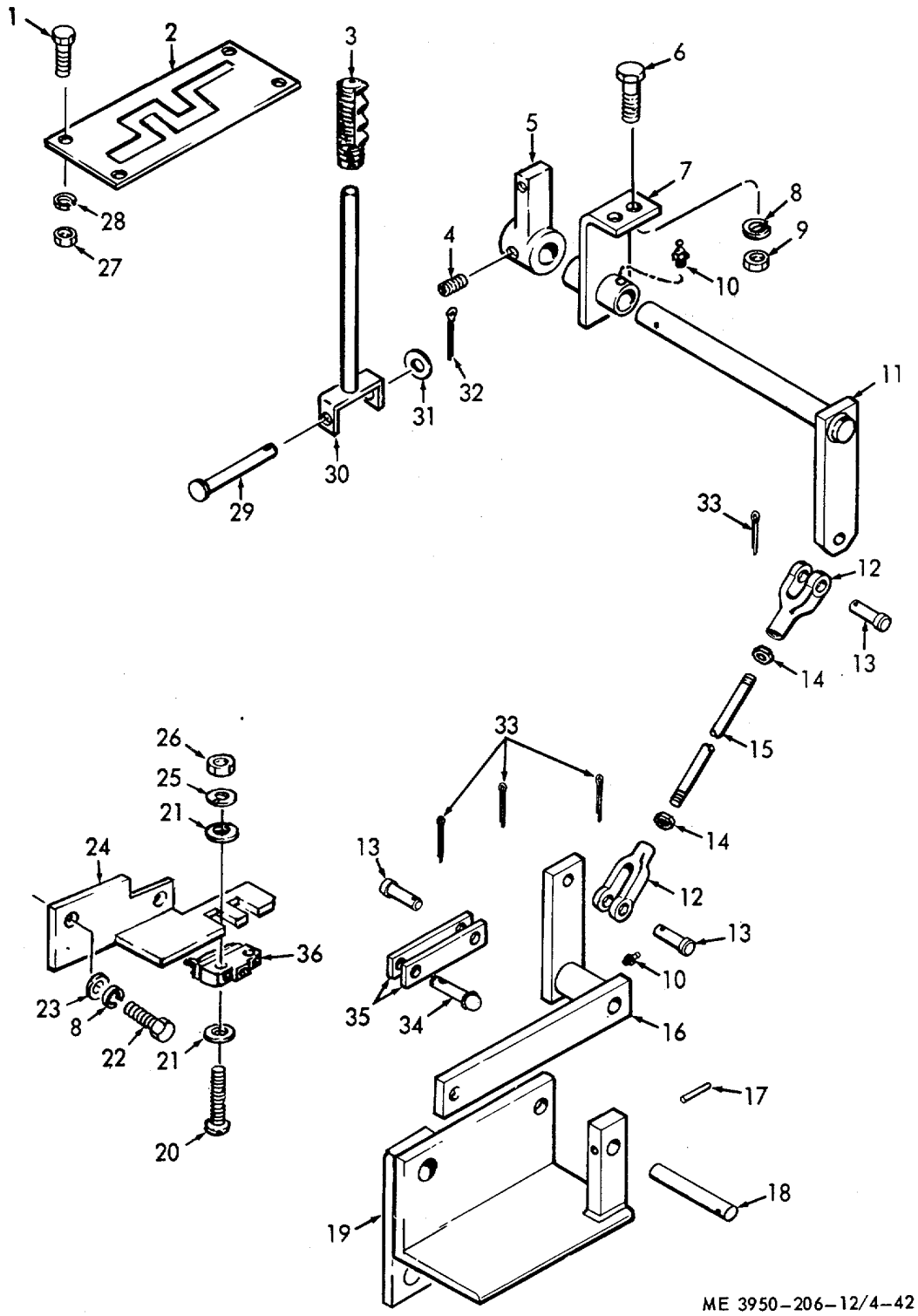
(2) Remove two capscrews and lockwashers that secure oil filter to frame. Remove filter assembly.

b. Disassembly.

(1) Loosen bolt (11, fig. 4-44) and separate head (5) from body (9).

(2) Remove and discard seal (6) and element (7).

(3) Remove spring (8) from detent in bolt (11) and remove bolt and washer (10) from body (9).

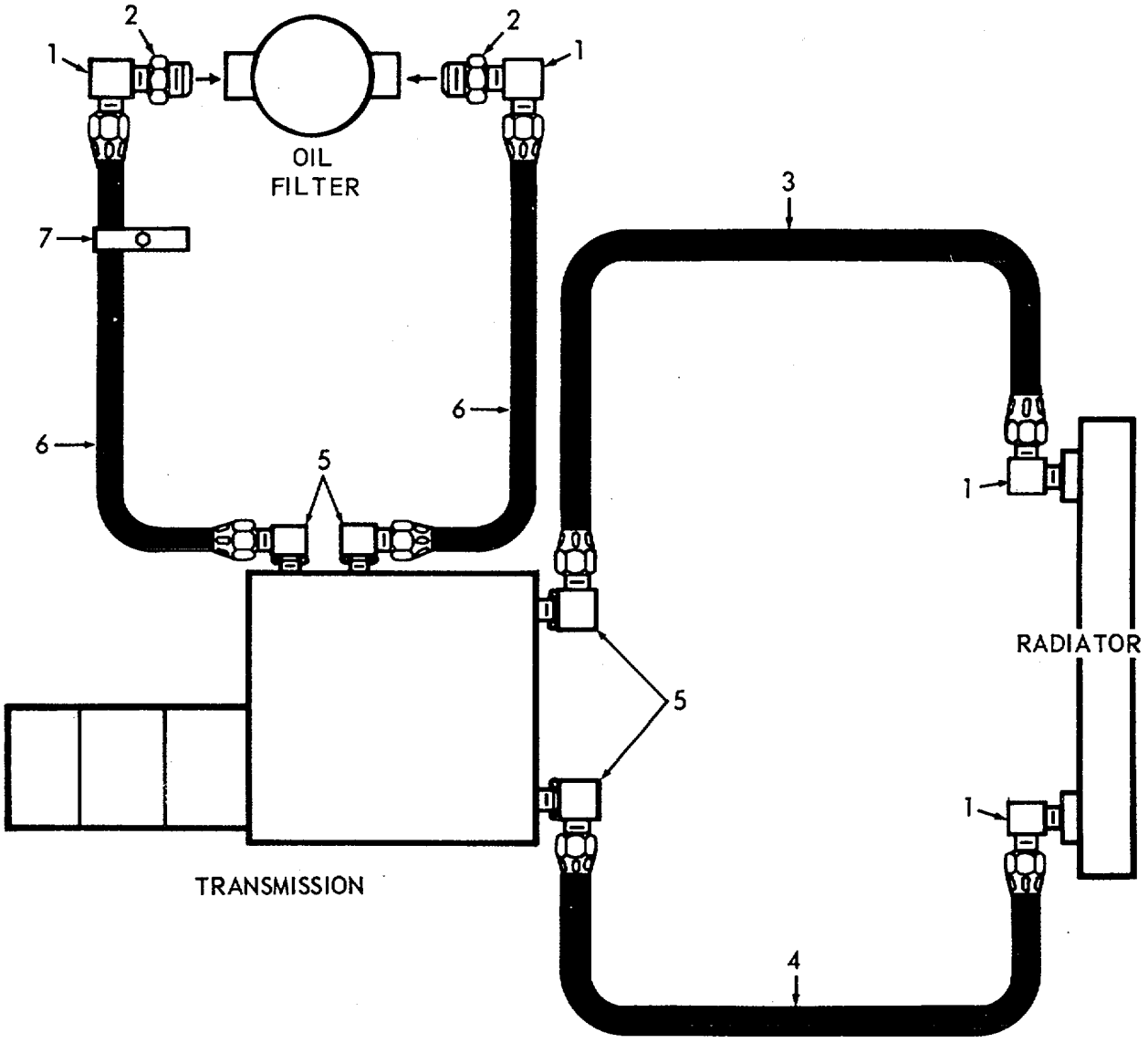


1. Capscrew (4)
2. Shift gate
3. Grip
4. Setscrew (2)
5. Lever support
6. Capscrew (4)
7. Support (2)
8. Lockwasher (6)
9. Nut (4)
10. Lube fitting (3)
11. Shift rod
12. Yoke (2)
13. Pin (3)
14. Nut (2)
15. Rod

Figure 4-42. Transmission shift lever and linkage, exploded view.

16. Pivot lever
17. Pin
18. Pin
19. Bracket
20. Screw (2)
21. Washer (4)
22. Capscrew (2)
'23. Washer (2)
24. Bracket
25. Lockwasher (25)
26. Nut (2)
27. Nut (4)
28. Lockwasher (4)
29. Pin
30. Shift lever
31. Washer
32. Cotter pin
33. Cotter pin (4)
34. Pin
35. Link (2)
36. Switch

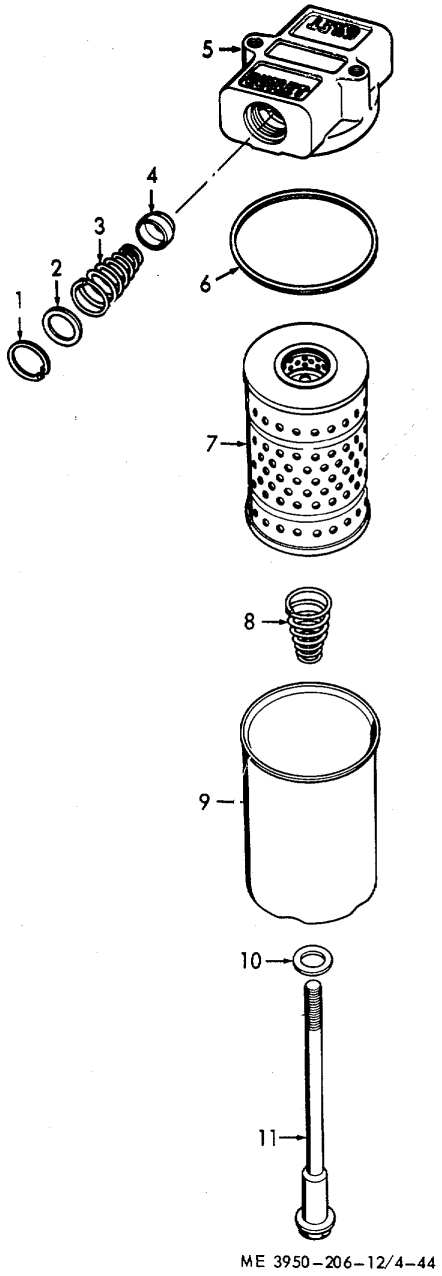
Figure 4-43-Continued.



ME 3950-206-12/4-43

1. Elbow (4)
2. Bushing (2)
3. Hose assy
4. Hose assy
5. Elbow assy (4)
6. Hose assy (2)
7. Clamp

Figure 4-43. Transmission oil piping diagram.



1. Retainer ring
2. Washer
3. Spring
4. Valve
5. Head
6. Seal
7. Element
8. Spring
9. Body.
10. Washer
11. Bolt

Figure 4-44. Transmission oil filter, exploded view.

Figure 4-44.-Continued.

(4) Remove retaining ring (1), washer (2), spring (3), and valve (4) from filter head (5).

c. Cleaning and Inspection.

(1) Clean all parts in an approved cleaning solvent and dry thoroughly.

(2) Inspect sealing edges of body and head for damage or deformation.

(3) Inspect valve for burrs and pitting.

(4) Replace any parts found defective.'

d. Reassembly. Reassemble in reverse of instructions for disassembly.

e. Installation. Install the filter in reverse of removal.

Section XIV. PROPELLER SHAFT MAINTENANCE

4-60. Propeller Shaft

a. Removal.

(1) Remove lockwire from screws (2 and 13, fig. 4-45).

(2) Remove four capscrews (2) that secure shaft to transmission.

(3) Remove four capscrews (13) that secure shaft to axle.

b. Disassembly.

(1) Remove four capscrews (2), lockwashers (4), and cross and bearing assembly (1).

(2) Bend down tabs on lockplates (10) and remove four capscrews (9), lockplates (10), and cross and bearing assembly (12).

(3) Separate shaft (8) from yoke (3) and remove dust cover (7), washers (5) and felt washer (6).

c. Cleaning and Inspection.

(1) Clean all parts with an approved cleaning solvent. Dry thoroughly with compressed air.

(2) Inspect capscrews for wear and damaged threads. Replace as required.

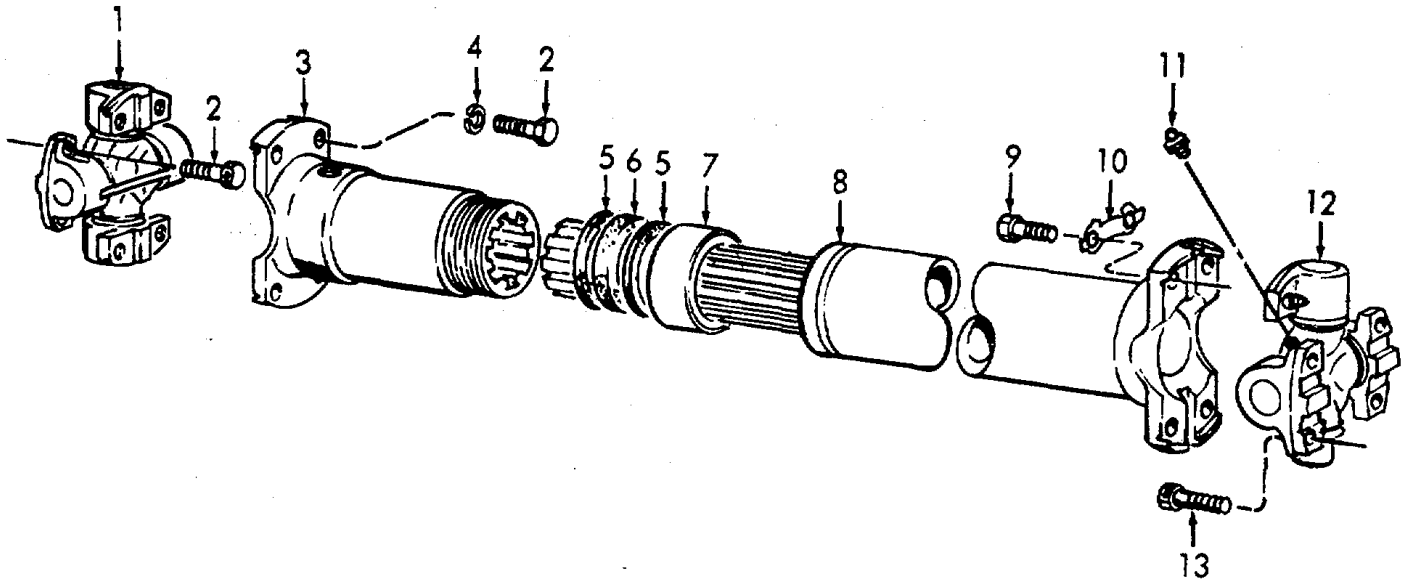
(3) Inspect the splines of the yokes. If appreciable wear or scoring is evidenced, replace the propeller shaft assembly.

Note. Appreciable wear is defined as that sufficient to allow a 15-25 degree angle of radial movement of the propeller shaft assembly when installed. Continued use of a worn assembly may result in damage to the components of the carrier drive train.

d. Installation.

(1) Install the propeller shaft in the reverse order of removal. Use new lockplates (10) and lockwires.

(2) Lubricate in accordance with current lubrication order.



ME 3950-206-12/4-45

1. Cross & brg assy
2. Capscrew (8)
3. Yoke
4. Lockwasher (8)
5. Washer (2)
6. Felt washer
7. Dust cover
8. Shaft
9. Capscrew (4)
10. Lock plate (2)
11. Lube fitting
12. Cross & brg assy
13. Capscrew (4)

Figure 4-45. Propeller shaft assembly, exploded view.

Section XV. WHEELS AND TIRES

4-61. General

The crane is equipped with tube type tires on both the rear steering axle and dual tires on the front driving axle. With proper inflation, the tires will provide many hours of operation.

4-62. Wheels and Tires

a. Removal.

(1) Jack up the crane to remove all weight from the tire. Caution: Place heavy timbers under the axle to prevent slipping off the jack. Block at least one wheel to prevent movement of the crane.

(2) Remove valve core from tube stem to completely deflate tire.

(3) Remove wheel nuts and remove tire and wheel assembly from crane.

(4) Remove the retaining ring (2, fig. 4-46) and side ring (1) (rear wheel only).

(5) Remove the rim and disc (6).

(6) Remove flap (3) and tube (4) from tire (5).

b. Cleaning and Inspection.

(1) Clean all metallic parts with an approved cleaning solvent. Dry thoroughly with compressed air.

(2) Wipe out interior of tire with moistened cloth.

(3) Inspect interior of tire for punctures, cracks or signs of deterioration.

(4) Inspect tube for punctures, cracking, or deterioration.

(5) Repair all minor defects. Replace tire or tube if major defects are discovered.

c. Installation.

(1) Install tire on wheel in reverse order of removal.

(2) Install wheel on crane and inflate tire to proper pressure (fig. 3-6).

4-63. Wheel Bearings

a. Removal.

(1) Remove tires and wheels (para 4-62).

(2) Remove front wheel hubs and bearings (para 4-69).

(3) Remove rear wheel hubs and bearings as follows:

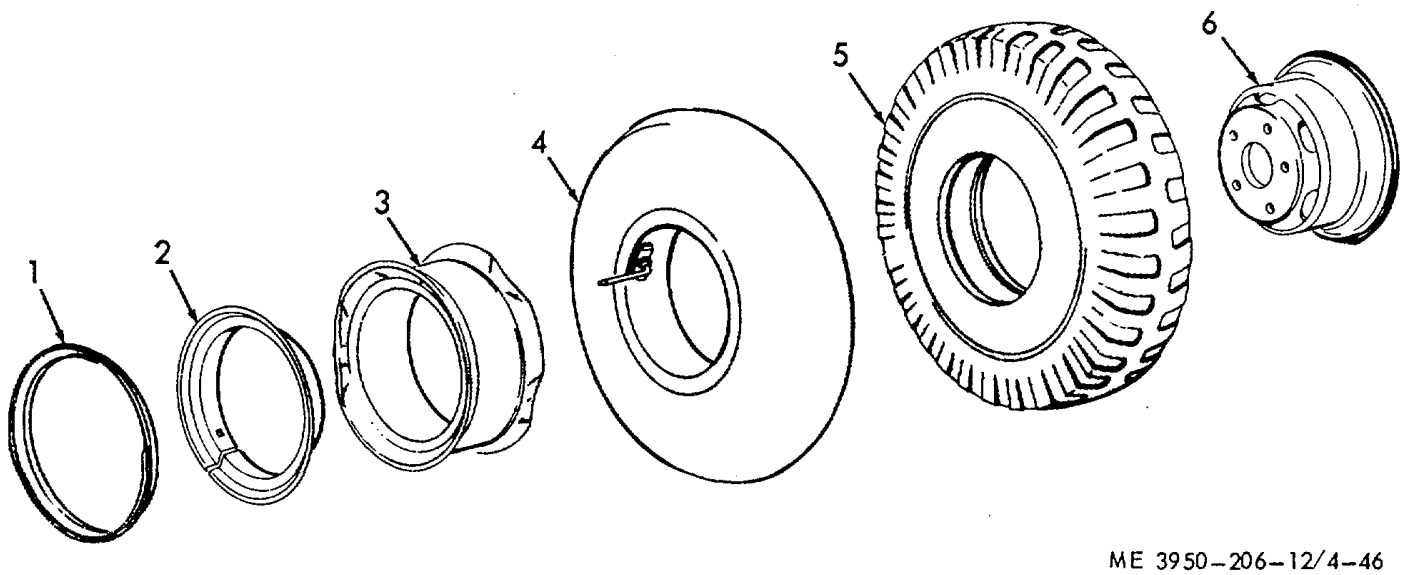
(a) Remove three capscrews (1, fig. 4-47), three lockwashers (2), cap (3), and gasket (4).

(b) Remove cotter pin (5), slotted nut (6), spacer (7), and bearing (8).

(c) Remove hub (9), seal (11) and bearing (10).

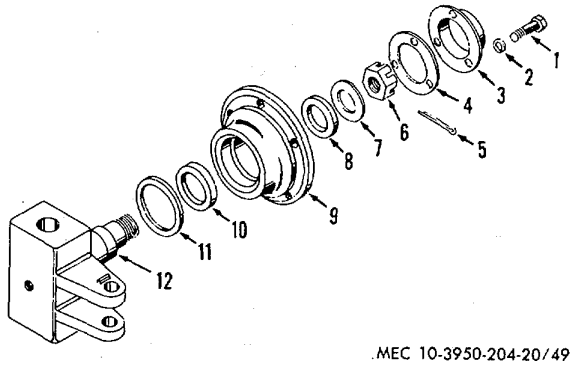
b. Cleaning and Inspection.

(1) Clean bearings in an approved cleaning solvent; dry with compressed air. If necessary, tap large side of bearings on a wooden block to dislodge solidified lubricant. Direct stream of air at bearing so that bearing will not be rotated by the force of air. Dip bearings in oil immediately after cleaning.



1. Side ring (rear wheel only)
2. Retainer ring
3. Flap
4. Tube
5. Tire
6. Rim and disc

Figure 4-46. Tire and wheel assembly, exploded view.



1. Capscrew (3)
2. Lockwasher (3)
3. Cap
4. Gasket
5. Cotter pin
6. Slotted nut
7. Spacer
8. Bearing
9. Hub
10. Bearing
11. Seal
12. Spindle

Figure 4-47. Rear wheel bearing, hub and spindle, exploded view.

(2) Clean hub and spindle with a clean cloth dampened in an approved cleaning solvent.

(3) Inspect bearings for pitting, scoring, wear, or other damage, and for rough or binding operation.

(4) Inspect spindle for scoring, damaged threads, cracks, or other damage.

(5) Inspect hubs for damaged threads, cracks, or other damage.

(6) Replace damaged parts.

c. Packing, Installation, and Adjustment.

(1) Pack the wheel bearings with lubricant

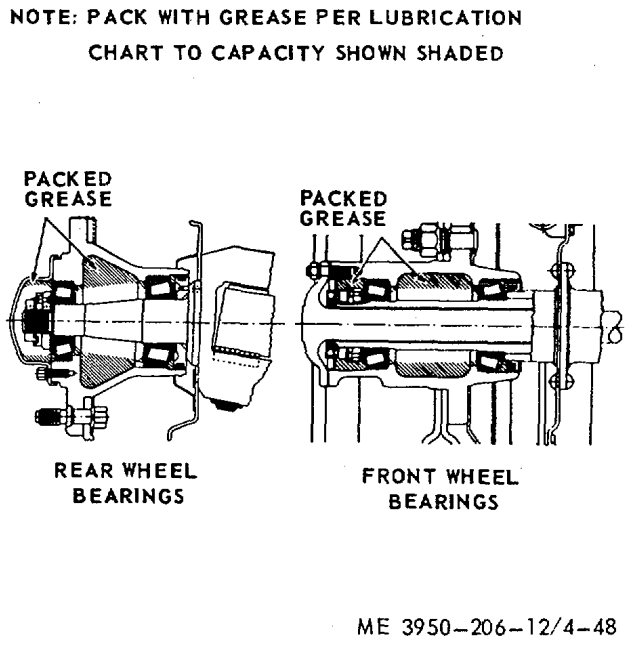


Figure 4-48. Diagram of wheel bearing grease packing.

recommended in lubrication order. For recommended amount of grease refer to figure 4-48.

(2) Install front wheel bearings and adjust in accordance with paragraph 4-69, c.

(3) Install rear wheel bearings and adjust as follows:

(a) Install inner bearing (10, fig. 4-47) and new seal (11) in hub (9).

(b) Position hub on spindle (12) and install outer bearing (8), spacer (7) and nut (6). Tighten nut and back off 1/4 to 1/2 turn, and lock in place with cotter pin (5).

(c) Position gasket (4) and cap (3) on hub and secure with capscrews (1) and lock- washers (2).

(4) Install wheels and tires (para 4-62).

Section XVI. BRAKE MAINTENANCE

4-64. General

The service brakes are mounted between the front wheels inside the axle adapters on either side of differential housing. The brakedrum rotates with the drive axles, and the shoe assemblies are secured to the spindle supports. These brakes are hydraulically operated by the brake master cylinder, which is mechanically linked to the service brake pedal. The parking brake drum rotates on the transmission output shaft, and the brakeshoes backing plate assembly is secured to the transmission housing. The brakeshoe is connected by a mechanical linkage to the handbrake handle.

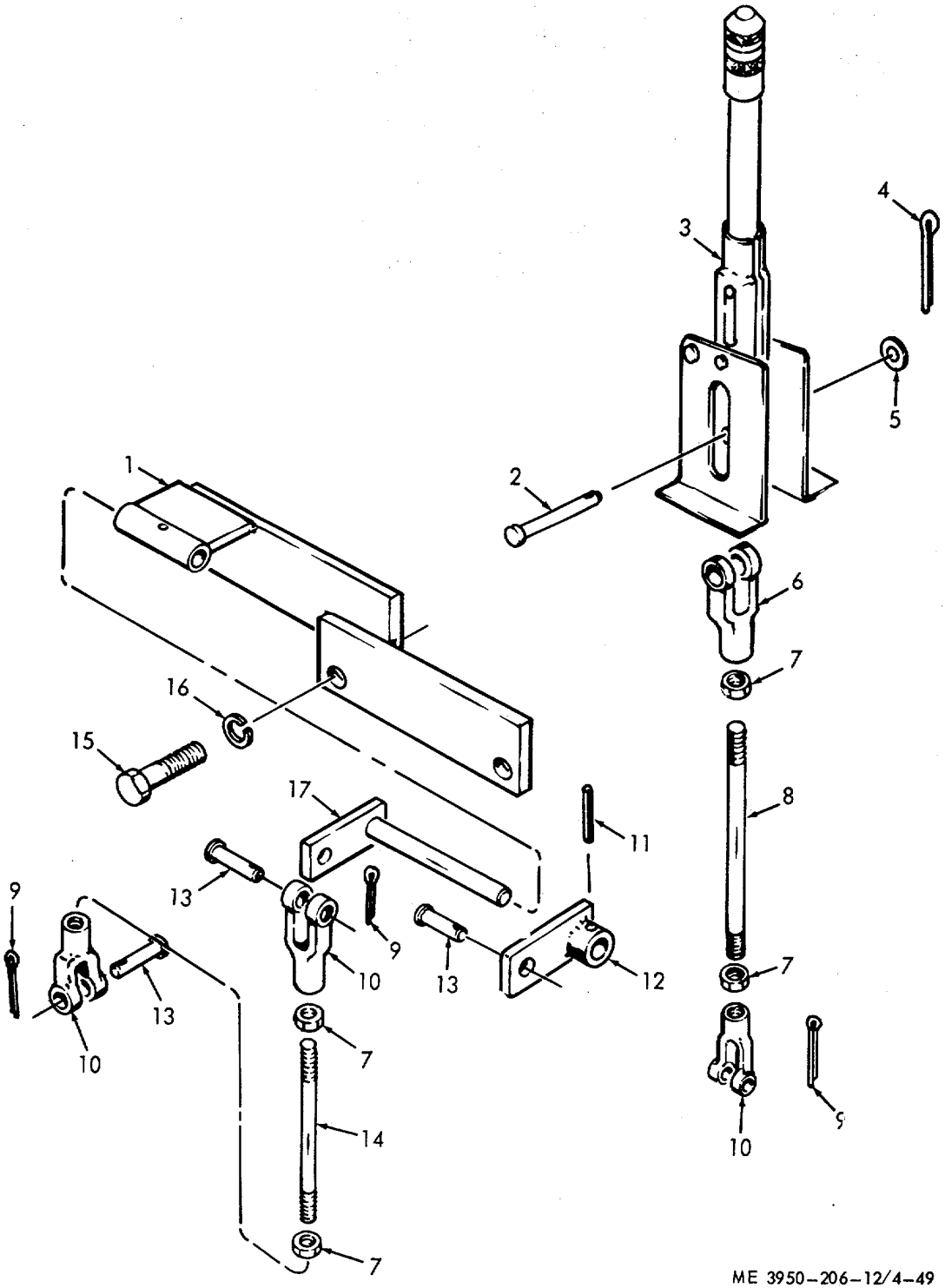
4-65. Parkingbrake Control Linkage

a. Removal.

(1) Place lever body assembly (3, fig 4-49) in released position.

(2) Remove cotter pin (4), flat washer (5) and pin (2). Remove link from clevis (6).

(3) Remove clevis (6) and nut (7) from rod (8).



1. Support
2. Pin
3. Lever assy
4. Cotter pin
5. Washer
6. Clevis
7. Nut (4)
8. Rod
9. Cotter pin (3)
10. Clevis (3)
11. Pin
1:2. Lever
13. Pin (3)
14. Rod
15. Bolt (2)
16. Lockwasher (2)
17. Lever

Figure 4-49. Parking brake control linkage, exploded view.

(4) Loosen nut (7) and remove rod from clevis (10) Remove nut from rod.

(5) Remove cotter pin (9) and pin (13) to remove clevis at rear of lever (12).

(6) Remove cotter pin (9) and pin (13) to disengage clevis (10) at front of lever (17).

(7) Remove roll pin (11) which secures lever arm (12) to lever (17). Remove lever arm from lever. Remove lever from lever support (1).

(8) Remove bolts (15) and lockwashers (16) which secure lever support to transmission.

(9) Loosen nut (7) and remove clevis (10) from rod (14). Remove rod. Remove second nut from rod.

(10) Remove cotter pin (9) and pin (13) and clevis (10) at brake assembly.

b. Cleaning and Inspection.

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for damage or broken welds.

(3) A defective lever assembly (3) will have to be cut off of the seat support with a cutting torch.

(4) Replace any defective or damaged parts.

c. Installation. Reverse procedures in *a.* above.

d. Adjustment. When adjusted, parking brake must be capable of holding crane on a 15 percent grade with a full, rated load.

(1) In order to draw brakeshoes closer to the drum, the adjusting knob cap must be turned clockwise. This shortens the stroke of adjusting tube assembly.

(2) If further adjustment is needed, turn adjusting knob cap counterclockwise until stroke of adjusting tube assembly is lengthened as much as possible.

(3) Remove pin from clevis and loosen nut on tension rod. This enables the clevis to take up on tension rod.

(4) Replace pin and take up adjusting tube assembly with adjusting knob cap as much as is required for final adjustment.

4-66. Parking Brake

a. General. The parking brake is an internal, expanding shoe-type, mounted on the rear output of the transmission. The shoe assembly back plate is bolted to the transmission rear housing. The brake is a 13 3/8 x 2 inch size and is manually operated.

b. Removal and Disassembly.

(1) Disconnect the propeller shaft from the transmission drive yoke (para 4-60).

(2) Remove eight self-locking capscrews and brake drum, refer to figure 4-50, also flatten the lockstrip and remove the flange bolts, lockstrip, washer and shims.

(3) Using a suitable puller remove the drive yoke from the drive shaft.

(4) Remove springs (4, fig. 4-51) and shoe and lining assemblies (3) from the backing plate (1).

(5) Remove operating lever (5) and roller (2).

(6) Remove four capscrews (13), lockwashers, (14), and backing plate (1).

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts with an approved cleaning solvent and dry thoroughly with compressed air or a clean lint free cloth.

(2) Inspect the brake linings for excessive wear, glazing or any other visual damage and repair by replacement.

(3) Inspect the springs for broken, cracked or deformed condition. Replace any spring that is broken, weak or otherwised damaged.

d. Assembly and Installation.

(1) Assemble the parking brake and drive yoke in reverse of the disassembly, paragraph b above.

(2) Install the transmission drive yoke and parking in reverse of removal.

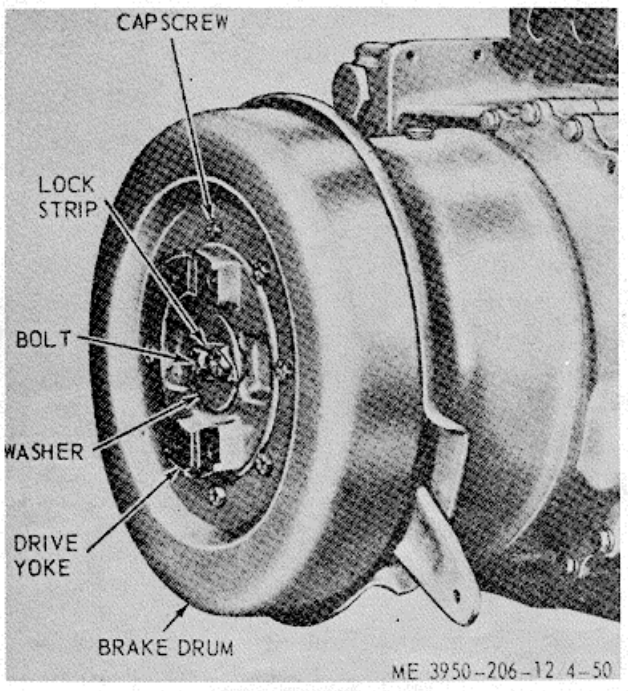
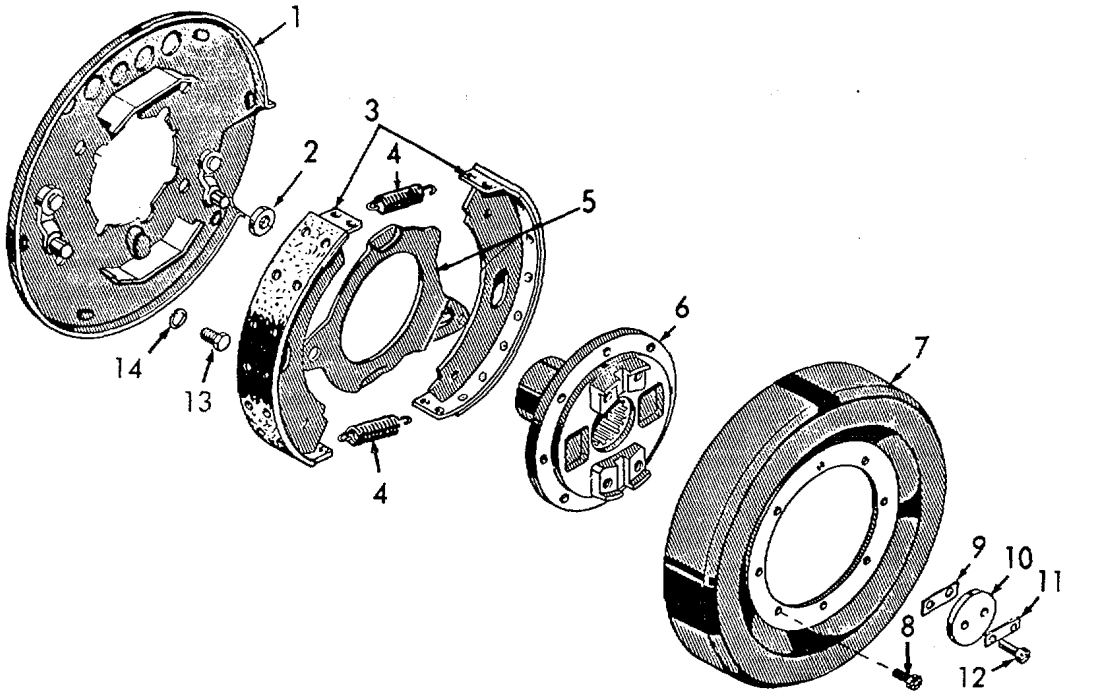


Figure 4-50. Brake drum, installed view.



1. Backing plate
2. Roller
3. Shoe & lining assy (2)
4. Extension spring (2)
5. Operating lever
6. Drive flange
7. Brake drum
8. Hex Hd cap screw (8)
9. Shim (AR)
10. Washer
11. Locking strip
12. Hex Hd cap screw (2)
13. Hex Hd cap screw (4)
14. Lockwasher (4)

Figure 4-51. Transmission drive yoke and parking brake, exploded view.

(3) Tighten brakedrum capscrews (8) to 41 to 49 ft. lbs. torque.

(4) Tighten brake back mounting capscrews (13) to 164 to 192 ft. lbs. torque.

(5) Tighten flange capscrews (12) to 96 to 115 ft. lbs. torque.

4-67. Service Brake Pedal and Linkage Adjustment

a. Measure brake pedal free travel with a ruler. If free travel is between 3/16 and 5/16 inch, no linkage adjustment is necessary.

b. Adjust brake linkage at master cylinder as follows:

(1) Remove cotter pin (12, fig. 4-52) and pin (5).

(2) Loosen locknut (3).

(3) Rotate clevis (4) until free brake pedal travel is between 3/16 and 5/16 inch.

(4) Tighten locknut against clevis (4).

(5) Install pin (5) and secure with cotter pin (12).

4-68. Brake Master Cylinder

a. Removal.

(1) Remove cotter pin (12, fig. 4-52) and clevis pin (5) that secure clevis (4) to brake pedal (11).

(2) Disconnect hydraulic brake line at master cylinder (2).

(3) Remove two capscrews (1), lockwashers (14) and nuts (13) that secure master cylinder to bracket; remove master cylinder.

b. Installation. Reverse procedures in *a* above.

4-69. Service , Brakeshoes

a. Removal.

(1) Jack up front wheels of crane.

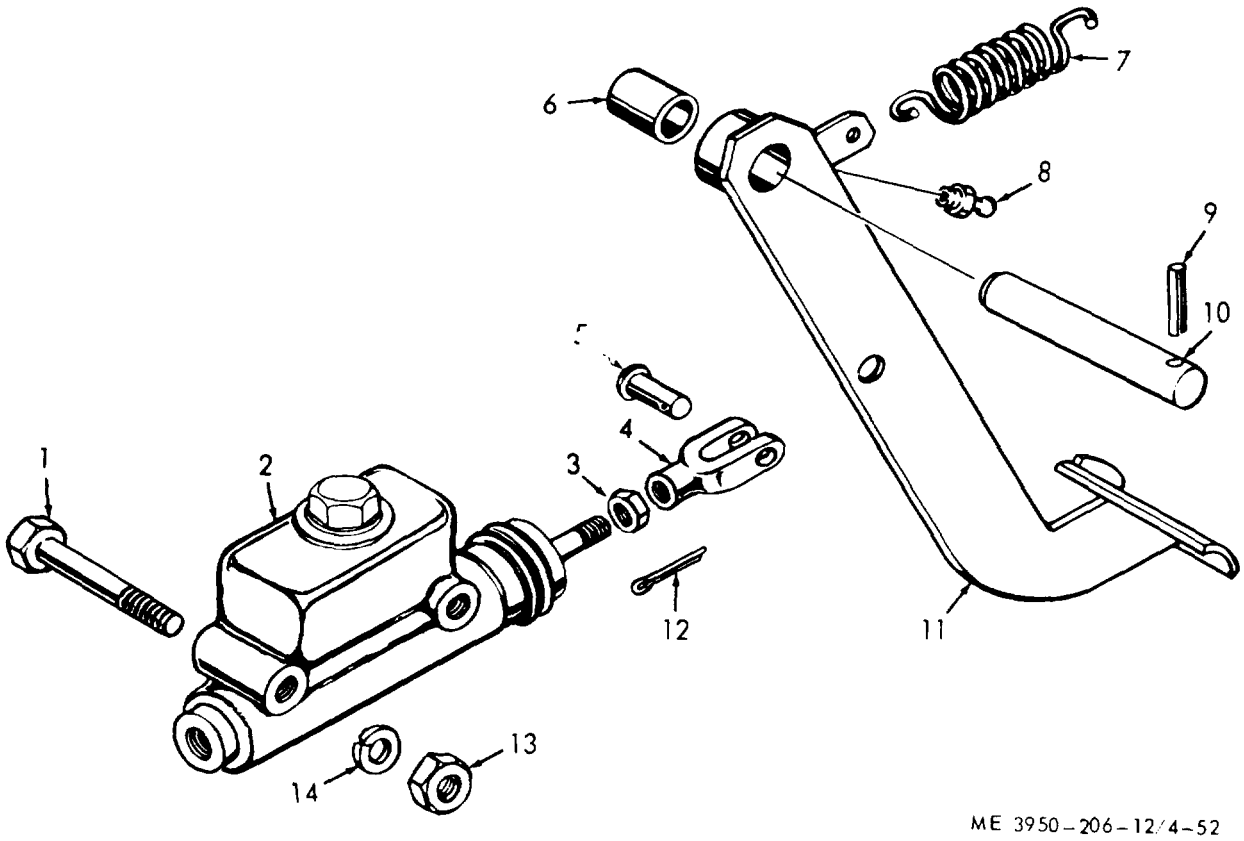
(2) Remove wheels and tires (para 4-62).

(3) Remove nuts (15, fig. 4-53) and lock-washers (14).

(4) Remove tapered locks (13) and remove axle (12).

(5) Remove gaskets (10), seal (11), lock- nut (9), lockwasher (8) and adjusting nut (7).

(6) Remove bearing cone (6) by removing brakedrum and hub (3).



1. Capscrew (2)
2. Master cylinder
3. Nut
4. Clevis
5. Pin
6. Bushing
7. Spring
8. Lube fitting
9. Pin
10. Pin
11. Pedal
12. Cotter pin
13. Nut (2)
14. Lockwasher (2)

Figure 4-52. Service brake pedal and linkage, exploded view.

(7) Remove c-washers (9, fig. 4-54), washers (8), c-washers (10), and strap (11).

(8) Remove springs (6) and remove shoes (7).

b. Installation. Reverse procedures in a above.

c. Wheel Bearing Adjustment

(1) Install hub (3) and bearing (6, fig. 4-54) on spindle.

(2) Install wheel bearing adjusting nut (7). Screw nut against bearing as wheel is revolved.

(3) Tighten adjusting nut to 50 foot-pound torque while wheel is being rotated. Rotate wheel in both directions to correctly position bearings.

(4) Back off adjusting nut (7) 1/4 to 1/3 turn.

(5) Position lockwasher (8) against adjusting nut (7) and lock in place with locknut (9). Tighten locknut to 325 foot-pound torque.

d. Adjustment of Brakeshoes.

(1) Jack up front wheels of crane.

(2) Turn eccentric cam adjuster (fig. 4-55), until brake lining contacts the brakedrum.

(3) Loosen nut at anchor pin adjuster and rotate anchor pin sufficiently to relieve drag on brakedrum when rotating wheel by hand.

(4) Repeat steps (2) and (3) until additional rotation of anchor pin will no longer relieve drag.

(5) Lock anchor pin position with nut.

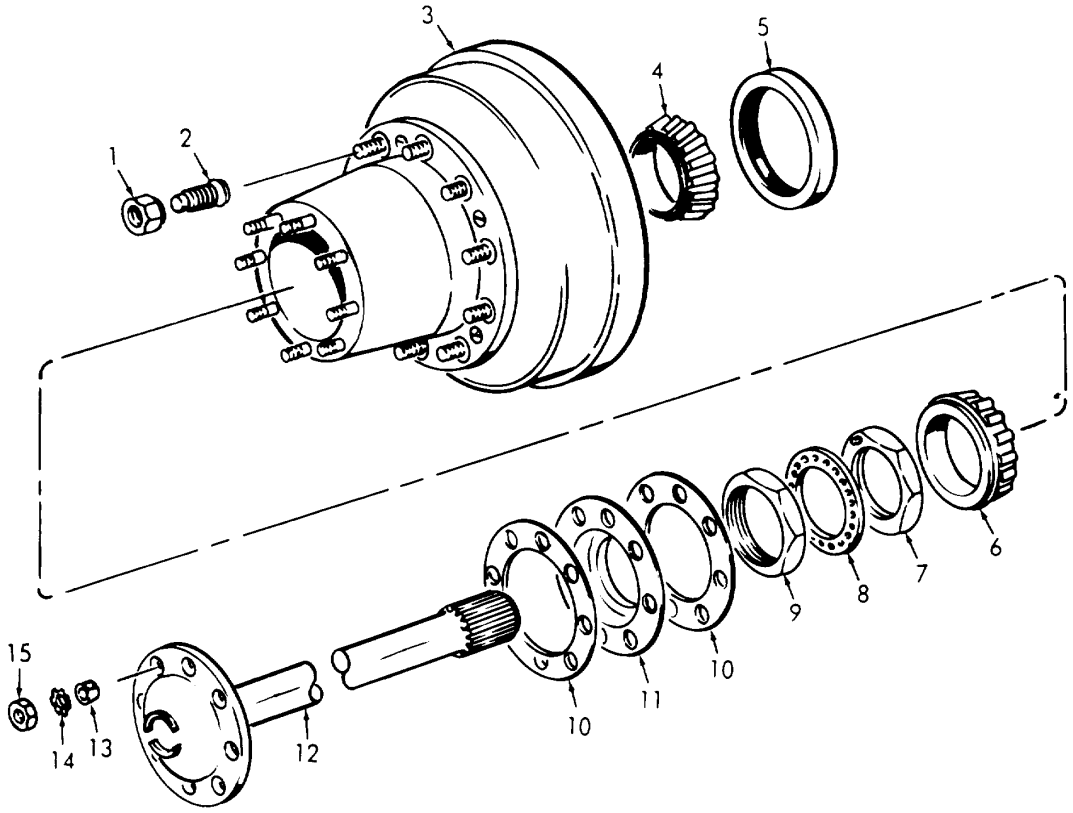
(6) Back off eccentric cam sufficiently to permit wheel to turn freely.

(7) Adjust each brakeshoe in turn following steps (2) thru (6).

(8) Subsequent adjustments to compensate for lining wear are made with the eccentric cam only. Turn cam to bring lining into contact with the drum. Back off sufficiently to permit wheel to turn freely.

e. Bleeding the Brake System.

(1) Bleeding is required after original installation when the hydraulic system is filled with fluid and whenever the system has been



1. Capscrew (2)
2. Lockwasher (2)
3. Shield assy
4. Spacer
5. Wheel cylinder
6. Spring
7. Shoe assy (2)
8. Washer (8)
9. C-washer (4)
10. C-Washer (2)
11. Strap
12. Anchor pin (2)
13. Lockwasher (2)
14. Nut (2)
15. Nut (8)
16. Lockwasher (8)
17. Capscrew (8)
18. Spring washer (4)

Figure 4-53. Front axle shaft, hub, and brakedrum, exploded view.

connected or disrupted at any point for replacement of parts.

Caution: **The bleeding operation must be done with the engine off, and no vacuum in the system.**

(2) It is recommended that a reliable pressure bleeder tank be used to bleed the system. The following general procedure can be used:

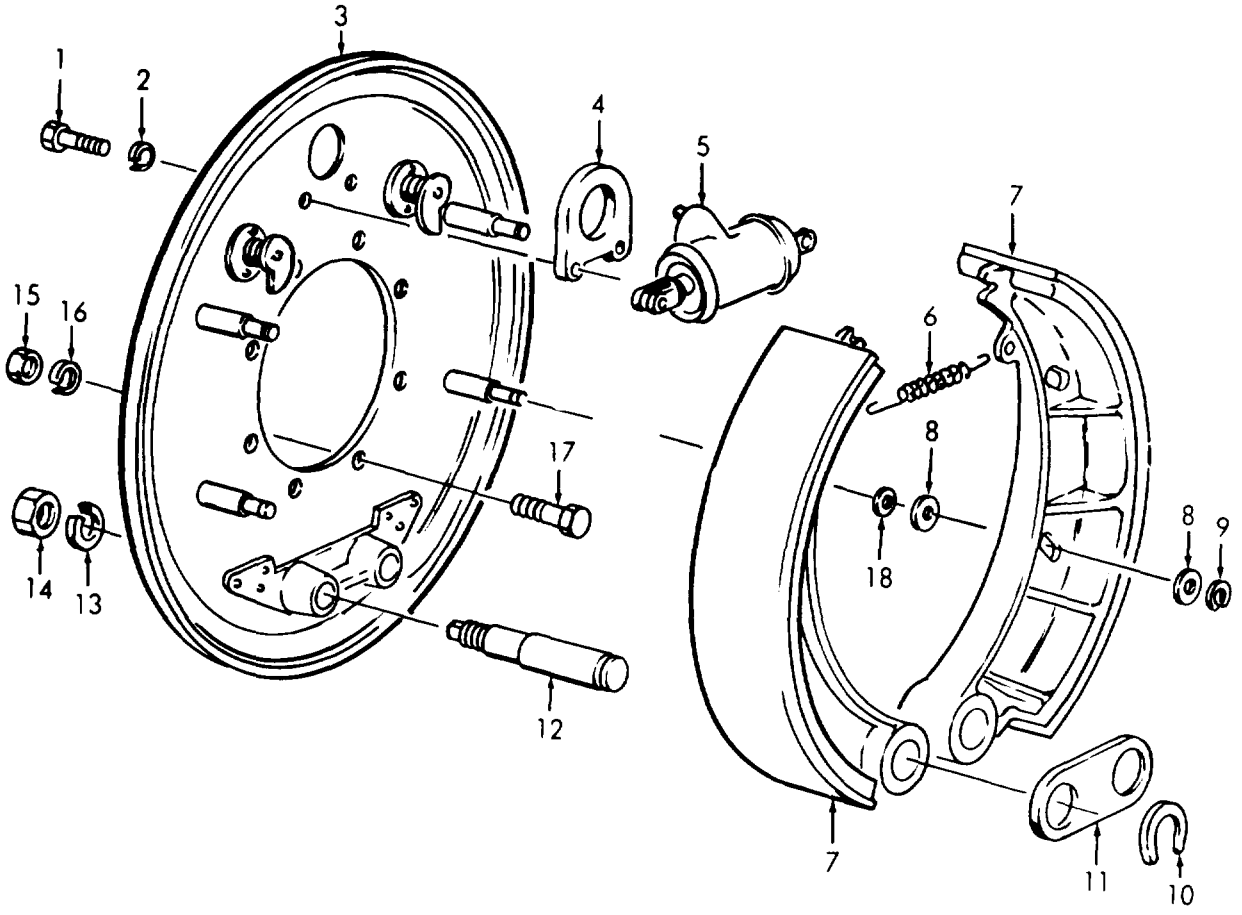
(a) Clean dirt from around the filler cap of the master cylinder reservoir and then remove the filler cap.

(b) Fill the master cylinder reservoir with brake fluid.

Note. **Only new, clean and genuine hydraulic brake fluid (heavy duty type) approved by the vehicle manufacturer, should be used.**

(c) Charge the pressure bleeder tank to 25-30 psi. The tank pressure should not be al- lowed to fall below 20 psi.

(d) Attach the hose of the pressure bleeder to the master cylinder. Apply pressure to the reservoir, bleeding air from the hose before tightening the hose connection at the reservoir port.



1. Capscrew (2)
2. Lockwasher (2)
3. Shield assy
4. Spacer
5. Wheel cylinder
6. Spring
7. Shoe assy (2)
8. Washer (8)
9. C-washer (4)
10. C-washer (2)
11. Strap
12. Anchor pin (2)
13. Lockwasher (2)
14. Nut (2)
15. Nut (8)
16. Lockwasher (8)
17. Capscrew (8)
18. Spring washer (4)

Figure 4-54. Service brakes, exploded view.

(e) Attach a rubber drain tube to the bleed screw (B, fig. 4-56) located on the Hydrovac end plate and place the free end of the drain tube in a container for receiving the expelled brake fluid.

(f) Open the bleed screw approximately 3/4 turn and allow air and brake fluid to flow into the container.

(g) When a solid stream of brake fluid free of bubbles is obtained, dose and tighten the bleed screw. The amount of time required to re- move the air completely will vary with the length of hydraulic line between the master cylinder and the Hydrovac. When in doubt, allow passage of at least one-half pint of fluid.

(h) Attach the rubber drain tube to the bleed screw (A) located at the end of the Hydrovac hydraulic cylinder and again place the free end of the drain tube in the container.

(i) Open the bleed screw approximately 3/4 turn and allow air and brake fluid to flow into the container. Be sure to allow sufficient flow to insure removal of all 'of the air.

(j) When a solid stream of fluid free of bubbles is obtained, close and tighten the bleed screw.

(k) Attach the rubber drain tube to the bleed screw (C) located at the brake wheel cylinder at the furthest line distance from the Hydrovac. Place the free end of the drain tube in the container.

(l) Open the bleed screw approximately 3/4 turn and allow air and brake fluid to flow into the container.

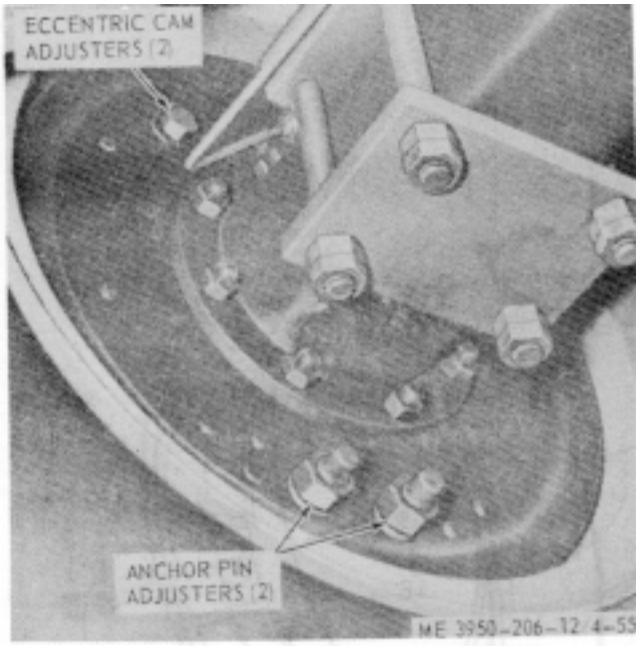


Figure 4-55. Brakeshoe adjustment points

(m) When a solid stream of fluid free of bubbles is obtained, close and tighten the bleed screw.

(n) Repeat steps (k), (l), and (m) at the bleed screw (D).

(o) After the system bleeding is completed, remove the rubber drain tube from the wheel cylinder

Note. **Do not reuse brake fluid which has been removed from the brake system.**

(p) Close the shut-off valve in the line from the pressure bleeder tank to the master cylinder reservoir, and then remove the line from the reservoir.

(q) Fill the master cylinder reservoir to approximately 3/4 inch from the filler port opening (if fluid is required) and then replace the filler cap.

4-70. Wheel Cylinder Assembly

a. Removal

(1) Remove axle shaft, hub, brakedrum, and brakeshoes (para 4-69).

(2) Remove brake line from wheel cylinder (5, fig. 4-54).

(3) Remove capscrews (1) and lockwashers (2) that secures wheel cylinder to back plate; re- move wheel cylinder and spacer (4).

b. Installation. Reverse procedures in *a* above.

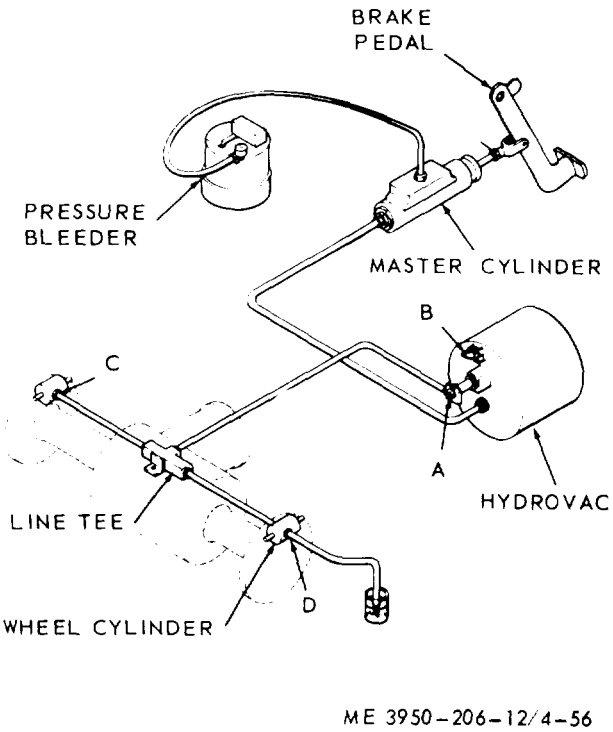


Figure 4-56. Brake bleeding diagram.

Section XVII. STEERING SYSTEM MAINTENANCE

4-71. General

The crane is steered by the rear wheels. Steering is done by a steering handwheel, through the steering valve, and a hydraulic cylinder mounted in the rear axle connected to the steering arm of the axle.

4-72. Steering Cylinder

a. Removal. Refer to figure 4-57, and remove the steering cylinder.

b. Installation. Reverse procedures for removal.

c. Adjustment.

(1) To adjust turning radius, set rear wheels in straight position, remove cotter pin, (fig. 4-57).

(2) Rotate steering wheel from full left position to full right; measure length of stroke of cylinder rod.

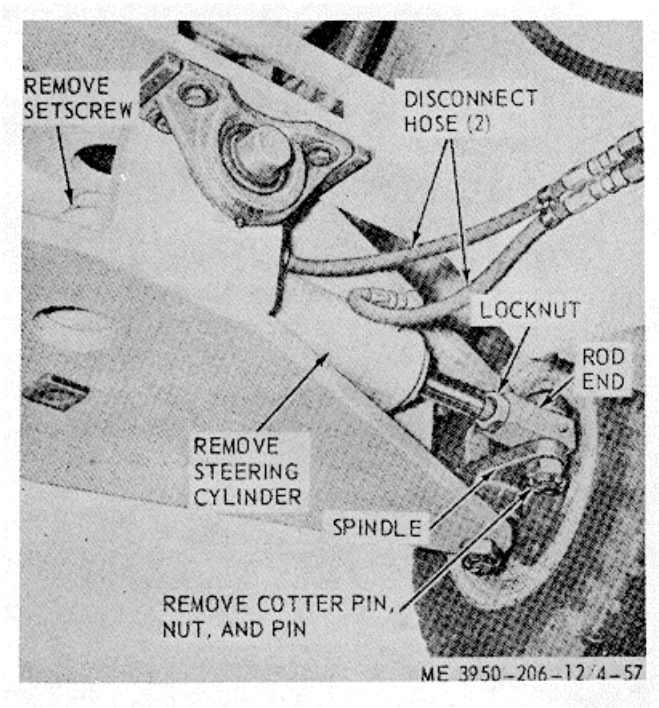


Figure 4-57. Steering cylinder removal.

(3) Rotate steering wheel until cylinder rod moves half the stroke plus approximately one inch.

(4) Loosen locknut and rotate rod end until pin will fit through hole of spindle and rod end.

(5) Tighten locknut against rod end.

(6) Replace nut and cotter pin.

(7) Steer wheels to full left and full right positions, and measure, at each position, the distance between side ring of wheel and the axle frame. Both measurements should be equal within ±1/8 inch. Adjust steering cylinder rod end accordingly, repeating steps (1), (4), (5), and (6) above.

Section XVIII. HYDRAULIC SYSTEM MAINTENANCE

4-73. General

The crane hydraulic system is comprised of the pump, hydraulic winch, control valve, slewing, lift, and boom extension cylinders, reservoir, and filter with associated lines and fittings. Hydraulic oil is drawn from the reservoir by the pump which is mounted on the transmission. The oil is forced through a high pressure line to the control valve. When the lift, boom extension, slewing, and winch control levers are in neutral position, oil flows through the valve and back to the reservoir. When one of the control levers is de- pressed, oil is diverted through tubes and hoses to the corresponding cylinder and the desired motion is performed. When the limit of this motion or stroke is reached (piston rod fully ex- tended or retracted), pressure built up in the system to approximately 1, 750 psi forces a plunger in relief valve section of control valve to open and return excess oil to reservoir. The lift cylinder overcenter valve prevents flow of oil from lift cylinder when hydraulic system is not pressurized, even though control valve lever is de- pressed. This prevents boom from lowering when engine is not running. Refer to figure 1-5 for schematic diagram of hydraulic system.

4-74. Control Levers Adjustment

a. General. The control levers are connected directly to the hydraulic valve unit by ridged mechanical linkage and should require no adjustment after installation. If relocation of the lever position is desired for operator's convenience, fellow the instructions below.

b. Adjustment.

(1) Adjustment may be made at either end of the tie rods between the control levers and the valve spools.

(2) Remove cotter pin and headed pin se- curing yoke to spool (fig. 4-58).

(3) Loosen nut on tie rod and turn yoke to achieve desired adjustment. Turning yoke clock- wise onto the rod will move the relative neutral position of the control lever up. Turning the yoke counter-clockwise will lower the control lever position.

Note. **Regardless of the adjustment the full swing of the control lever must provide compete activation of the valve spools in either direction.**

(4) Align yoke with spool end and install pin and cotter pin.

(5) Secure the adjustment by tightening the nut against the yoke.

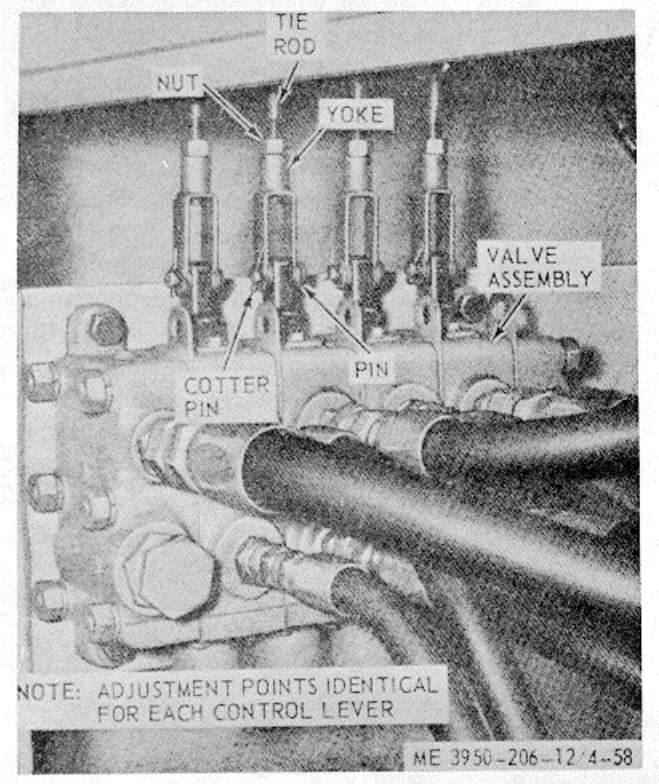


Figure 4-58. Valve linkage adjustment points.

4-75. Oil Filter

The hydraulic system oil filter (fig. 4-5) is identical to the transmission oil filter. Refer to paragraph 4-59 for replacement instructions.

Note. **The hydraulic reservoir must be drained before disconnecting hoses or removing filter assembly.**

4-76. Hydraulic Lines and Fittings

All of the crane hydraulic circuitry is contained within precision formed steel tubing and synthetic rubber, metal-reinforced hose. Fittings are high quality types, designed to withstand the high pressure of the system. Inspect all connections periodically for leakage. Tighten connections, or replace components as required.

4-77. Hydraulic Reservoir Breather

a. Removal. Refer to figure 4-59, and remove the breather/fill cap as instructed.

b. Cleaning and Inspection.

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect cap, filler neck, and strainer for damage. Replace as required.

c. Installation. Using new gaskets install the breather assembly in reverse of removal instructions.

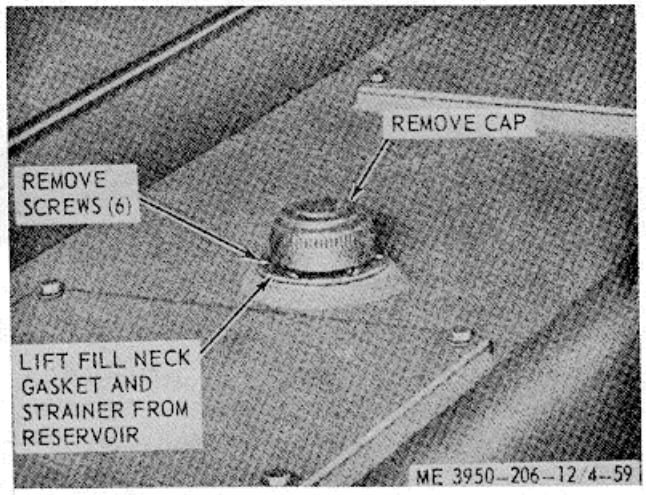


Figure 4-59. Hydraulic reservoir breather, removal

Section XIX. CABLE, HOOK BLOCK, AND BOOM MAINTENANCE

4-78. Hook Block and Hoist Cable

a. Removal.

(1) Lower the hook block to the ground and run off adequate slack of the hoist cable.

(2) Remove cable clamp, pin, and cable-wedge assembly from the boom head (fig. 4-60).

(3) Remove the wedge and unreeve the hoist cable from the hook block and boom head.

(4) Run off the remainder of the hoist cable from the hoist cable drum, removing the drum anchor wedge to release the hoist cable from drum.

b. Cleaning and Inspection.

(1) Clean all parts with an approved cleaning solvent. Dry thoroughly with compressed air.

(2) Inspect the sheaves for cracked or damaged edges, and excessive wear in grooves.

(3) Inspect the hook block for cracks and excessive play in sheave bearing. Inspect safety latch for operation. Replace hook block as required.

(4) Inspect the hoist cable carefully for broken wires and/or excessive wear. If more than four broken wires are found in one rope lay, or the wear on the individual wires exceeds one- third of their original diameter, replace the hoist cable (refer to tab data, para 1-4*b*, for length of wire rope required).

c. Installation.

(1) Install the hoist cable and hook block in reverse order of removal.

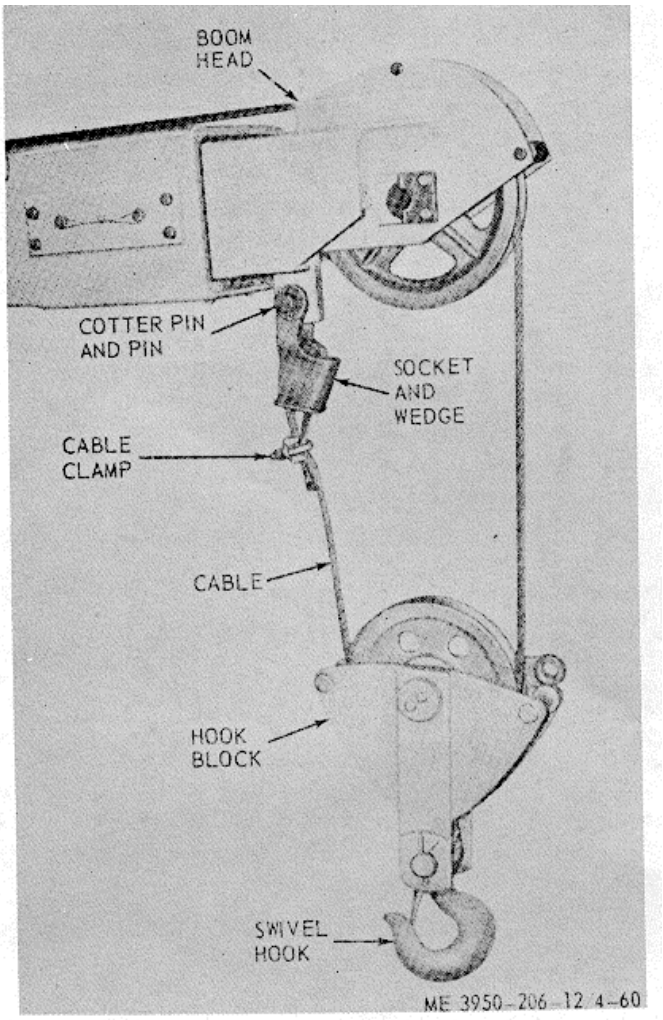


Figure 4-60. Hook block and cable, removal points.

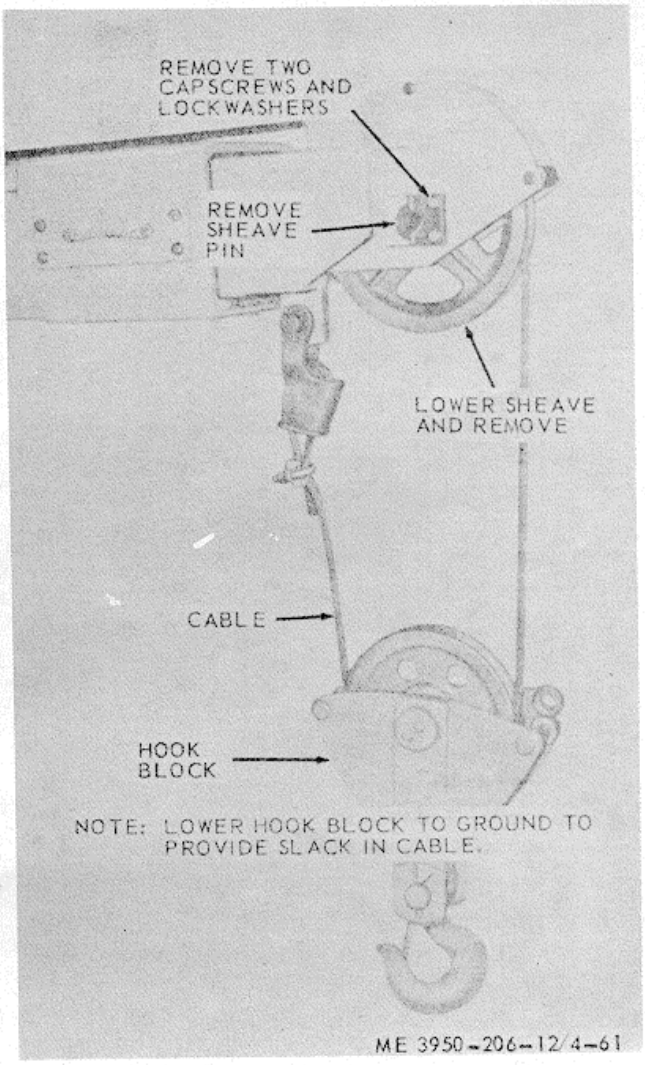


Figure 4-61. Boom sheave, removal.

(2) Lubricate in accordance with current lubrication chart.

4-79. Boom Sheave

a. Removal. Refer to figure 4-61, and remove the boom sheave as instructed.

b. Inspection and repair.

(1) Inspect sheave groove for excessive wear.

(2) Replace a sheave that shows wear on the groove bottom.

c. Installation. Install in the reverse of removal.

4-80. Boom Adjustment

a. General. Organizational maintenance is limited to adjusting the side wear plates on the boom. Adjustment of other wear plates, requires the removal of the boom, and must be referred to Direct Support Maintenance.

b. Adjustment.

Note. **Both side wear plates should be adjusted in the same manner, to maintain the boom in a "centered" position.**

(1) Remove four capscrews and lockwashers (fig. 4-62).

(2) Remove wear plate and holder assembly and shims.

(3) Install shims, equally on both sides, to provide a total of 0.125 to 0.250 inch clearance between wear plates and boom.

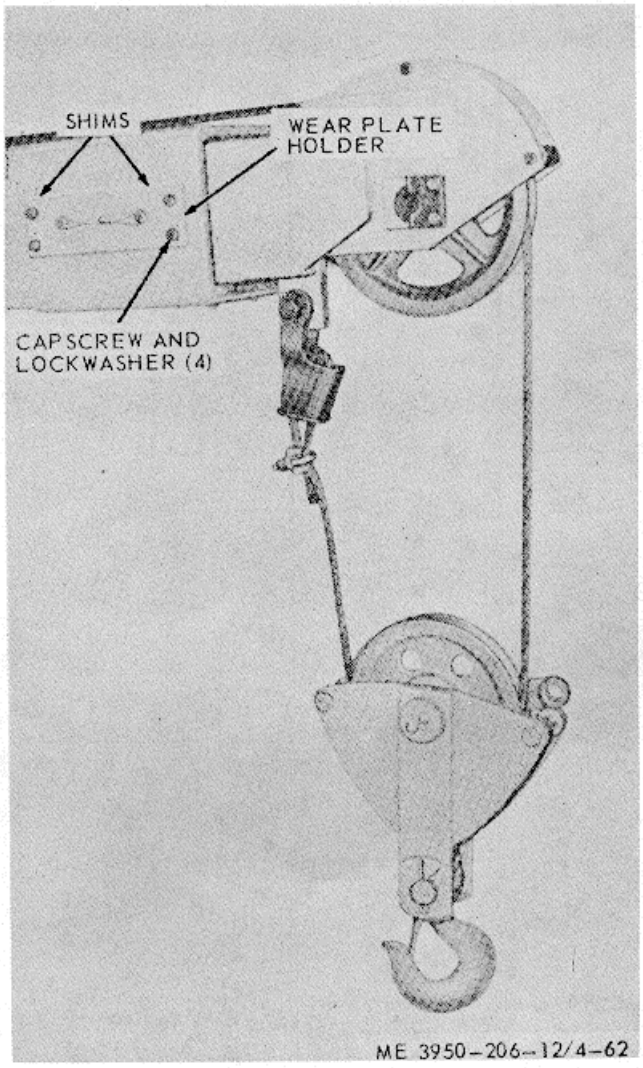


Figure 4-62. Boom side wear plates adjustment points.

Section XX. SEAT AND FRAME MAINTENANCE

4-81. General

The crane is equipped with a single operator's seat mounted on the left side of the frame. The engine compartment is completely enclosed with hood panels, with easily removed side access panels. Hinged access panels are provided for access to the hydraulic tank, batteries, transmission slewing cylinders, propeller shaft, and hydraulic oil filters. The access door to the fuel filter, hydraulic control valve, and steering valve is accessible after removing the step on the left side of frame.

4-82. Seat Assembly

a. Removal.

(1) Remove four nuts (7, fig. 4-63) and lockwashers (6).

(2) Lift assembled seat and slides from seat support

b. Disassembly.

(1) Remove seat cushion (1) by lifting from frame.

(2) Remove two screws (4) and back cushion from frame.

(3) If replacement is required remove four nuts and lockwashers that secure slide assembly (5) to seat frame (3).

c. Reassembly. Reverse procedure for disassembly.

d. Installation. Reverse procedure for removal.

4-83. Hoods

a. Removal.

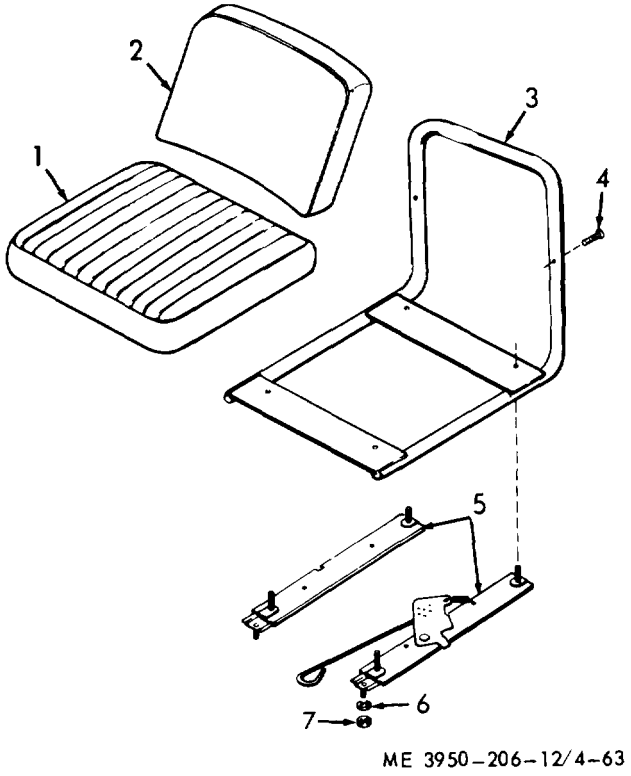
(1) Remove side shields (1, fig. 4-64).

(2) Remove air cleaner (para 4-41).

(3) Remove sixteen capscrews (2), lockwashers (14), and nuts (15). Remove hood top panel (3).

(4) Refer to paragraph 4-35b, and remove the radiator shroud (13).

(5) Remove voltage regulator, starter relay, polarity protector, and resistor (para 4-28).



1. Seat cushion
2. Back cushion
3. Frame
4. Screw (2)
5. Slide assy
6. Lockwasher (4)
7. Nut (4)

Figure 4-63. Seat assembly, exploded view.

(6) Remove four capscrews (9), lockwashers (11), nuts (12), and eight washers (10). Lift hood support (4) from frame.

b. Cleaning and Inspection.

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect hood panels for cracks, rusted areas, and deformation. Clean rusted areas with wire brush and repaint. Replace a panel that is cracked or deformed in any way.

c. Installation. Install the engine hoods in reverse of removal.

4-84. Frame, Steps, and Covers

a. Removal

(1) Remove four capscrews (22, fig. 4-65), lockwashers (21), and step (20).

(2) Remove opposite step in similar manner.

(3) Remove four capscrews (5), lockwashers (4), washers (31, and grill cover (2).

(4) Remove five capscrews (10), lockwashers (8), washers (7), and cover (11).

(5) Remove capscrews (6 and 9), lockwashers (8), washers (7), nuts (13), and seat support (12).

(6) Remove capscrew (15), nuts (13), and latch (14).

(7) Remove cotter pin (17), washer (18), and brace (19).

b. Cleaning and Inspection.

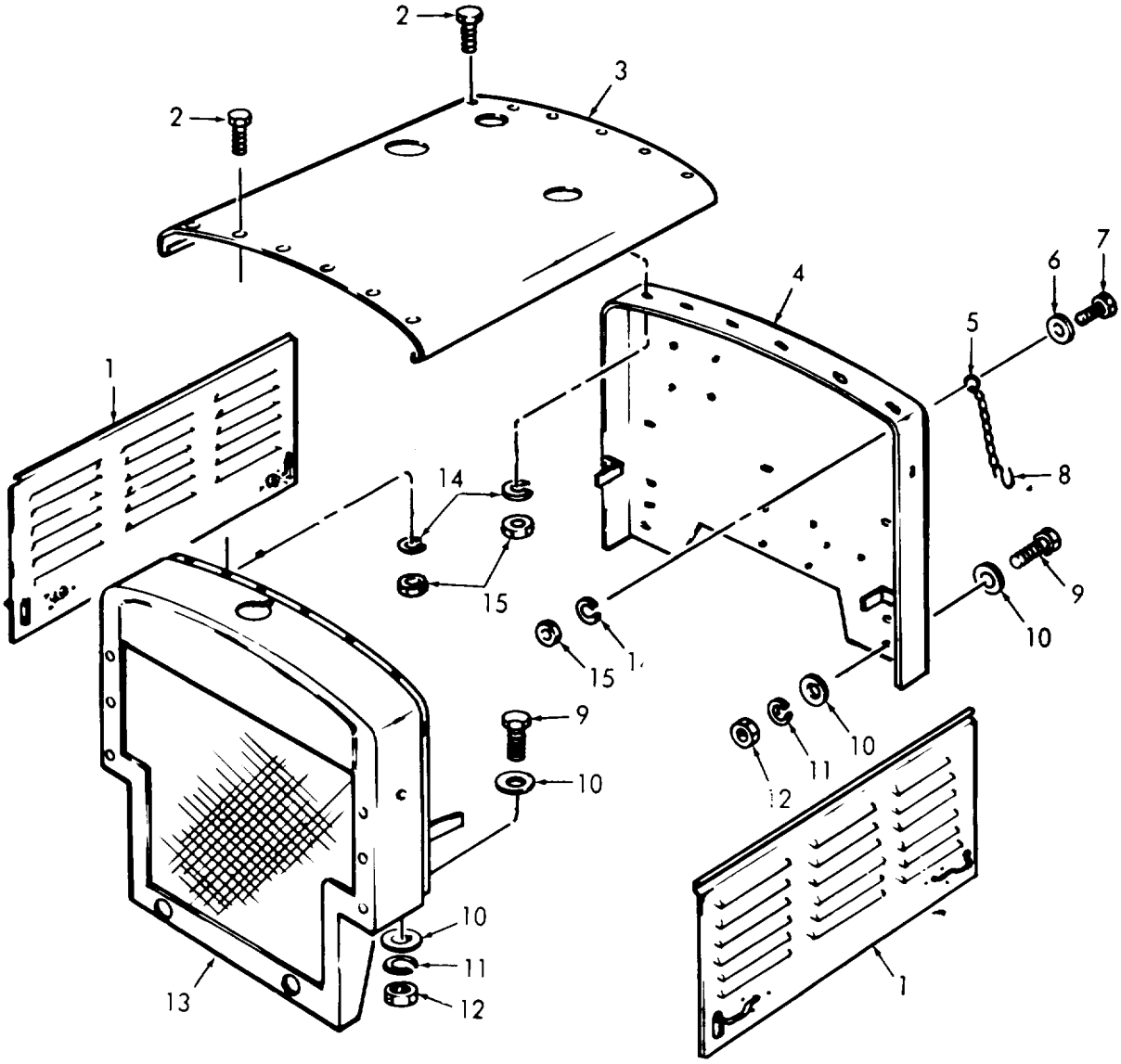
(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for cracks or broken welds. Weld cracks or broken welds where possible. Replace a badly damaged part.

(3) Remove any rust found and repaint.

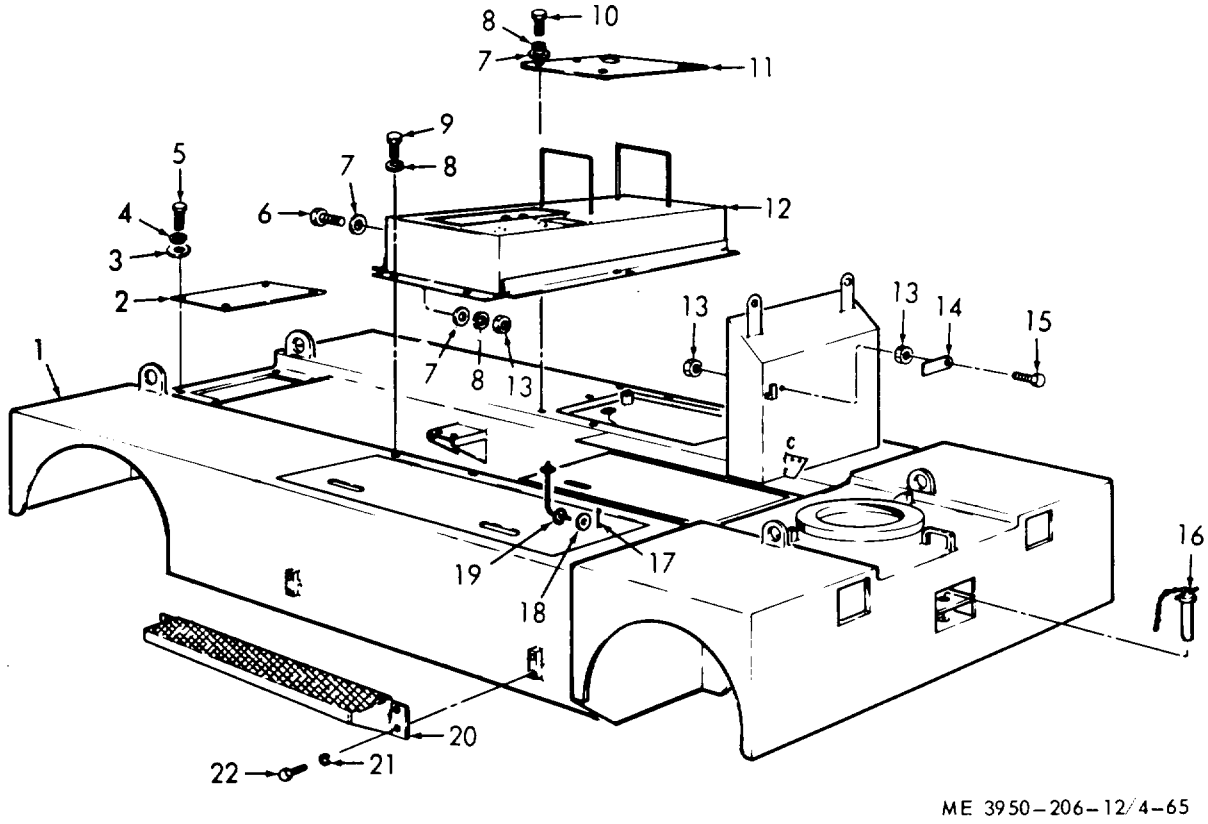
(4) The repair of the frame is primarily limited to the rework of welds, filling cracks, and the replacement of various small brackets and braces that may require replacement. The location of a point of repair on the frame will dictate the need for component removal to provide access to accomplish the repair.

c. Installation. Install the covers, seat support and steps in reverse of removal.



1. Side shield (2)
2. Capscrew (1)
3. Hood S-hook
4. Hood support
5. Chain
6. Washer
7. Capscrew
8. S-hook
9. Capscrew (4)
10. Washer (16)
11. Lockwasher (8)
12. Nut (8)
13. Radiator shroud
14. Lockwasher (17)
15. Nut (17)

Figure 4-64. Engine hoods, exploded view.



1. Main frame
2. Grill cover
3. Washer (4)
4. Lockwasher (4)
5. Capscrew (4)
6. Capscrew (5)
7. Washer (15)
8. Lockwasher (18)
9. Capscrew (8)
10. Capscrew (5)
11. Cover
12. Seat support
13. Nut (7)
14. Latch
15. Capscrew
16. Tow pin (2)
17. Cotter pin
18. Washer
19. Brace
20. Step (2)
21. Lockwasher (8)
22. Capscrew (8)

Figure 4-65. Main frame, steps and covers, exploded view.

APPENDIX A

REFERENCES

A-1. Fire Protection

TB 5-4200-200-10	Hand Portable Fire extinguishers Approved for Army Users

A-2. Lubrication

C9100IL	Fuels Lubricants, Oils and Waxes
LO 10-3950-206-12	Crane, Truck, Warehouse 10, 000 LB. Capacity, GED, PT, Pettibone Model 10FM, Army Model MHE 216

A-3. Painting

TM 9-213 Painting Instructions for Field Use

A-4. Radio Suppression

TM 11-483 Radio Interference Suppression

A-5. Maintenance

TM 9-1870-1	Care and Maintenance of Pneumatic Tires
TB ORD 651	Use of Antifreeze solutions and Cleaning Compounds in engine cooling systems
TM 38-750	Army Equipment Record Procedures
TM 9-6140-200-15	Operation and Organizational Field and Depot Maintenance Storage Batteries, Lead Acid Type
TM 103950-206-34	Direct Support and General Support Maintenance Manual, Crane, Truck, Warehouse, Pettibone Model 1OFM Army Model MHE 216
TM 10-3950-206-20P	Organizational Maintenance Repair Parts and Special Tools List Manual, Crane, Truck, Warehouse, Pettibone Model 1OFM, Army Model MHE 216
TM 10-3950-206-35P	Direct and General Support and Depot Maintenance Repair Parts and Special Tools List Manual, Crane, Truck, Warehouse, Pettibone Model 10FM, Army Model MHE 216
TM 5-4920-200-15	Operator, Organizational, Field and Depot Maintenance Manual, Engine Analyzer, Gas Turbine
TB 385-101	Safety Use of Cranes, Crane-Shovel Dragline, and Similar Equipment Near Electric Power Lines

A-6. Shipment and Storage

TB 740-93-2	Preservation of USAMEC Mechanical Equipment for Shipment and Storage
TM 740-90-1	Administrative Storage of Equipment

APPENDIX B

BASIC ISSUE ITEMS LIST

Section I. INTRODUCTION

B-1. Scope

This appendix list items which accompany the Pettibone Model LOFM Warehouse Truck Crane, or are required for installation, operation, or operator's maintenance.

B-2. General

This Basic Issue Items List is divided into the following sections:

a. Basic Issue Items - Section II. A list of items which accompany the Pettibone Model 10-FM Warehouse Truck Crane and are required by the operator/crew for installation, operation, or maintenance.

b. Maintenance and Operating Supplies Section III. A listing of maintenance and operating supplies required for initial operation.

B-3. Explanation of Columns

The following provides an explanation of columns in the tabular list of Basic Issue Items, Section II.

a. Source, Maintenance, and Recoverability Codes (SMR).

(1) Source code indicates the source for the listed item. Source codes are:

Code	*Explanation*
P	Repair parts which are stocked in or supplied from the GSA/DSA, or Army supply system and authorized for use at indicated maintenance categories.
P2	Repair parts which are procured and stocked for insurance purposes because the combat or military essentially of the end item dictates that a minimum quantity be available in the supply system.
M	Repair parts which are not procured or stocked, but are to be manufactured at indicated maintenance levels.
A	Assemblies which are not procured or stocked as such, but are made up of two or more units. Such component units carry individual stock numbers and descriptions, are procured and stocked separately and can be assembled to form the required assembly at indicated maintenance categories.
X	Parts and assemblies which are not procured or stocked and the mortality of which normally is below that of the applicable end item or component. The failure of such part or assembly should result in retirement of the end item from the supply system.
X1	Repair parts which are not procured or stocked. The requirement for such items will be filled by use of the next higher assembly or component.
X2	Repair parts which are not stocked. The indicated maintenance category requiring such repair parts will attempt to obtain them through cannibalization. Where such repair part are not obtainable through cannibalization, requirements will be requisitioned, with accompanying justification, through normal supply channels
G	Major assembles that are procured with PEMA funds for initial issue only as exchange assemblies at DSU and GSU level. These assemblies will not be stocked above GS and DS level or returned to depot sup ply level.

(2) Maintenance code indicates the lowest category of maintenance authorized to install the listed item. The maintenance level code is:

Code	*Explanation*
C	Operator/crew

(3) Recoverability code indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are expend- able. Recoverability codes are:

Code	*Explanation*
R	Repair parts (assemblies and components) which are considered economically reparable at direct and general support maintenance levels. When the maintenance capability to repair these items does not exist, they are normally disposed of at the GS level. When supply considerations dictate, some of these repair park may be listed for automatic return to supply for depot level repair as set forth in

Code	*Explanation*
	AR 710-50. When so listed, they will be replaced by supply on an exchange basis.
S	Repair parts and assemblies which are economically reparable at DSU and GSU activities and which normally are furnished by supply on an exchange basis. When items are determined by a GSU to be uneconomically reparable they will be evacuated to a depot for evaluation and analysis before final deposition.
T	High dollar value recoverable repair parts which are subject to special handling and are issued on an exchange basis. Such repair parts normally are repaired or overhauled at depot maintenance activities.
U	Repair parts specifically selected for salvage by reclamation units because of precious metal content, critical materials, or high dollar value reusable casings or castings.

b. Federal Stock Number. This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Description. This column indicates the Federal item name and any additional description of the item required. The abbreviation "w/e", when used as a part of the nomenclature, indicates the Federal stock number, includes all armament, equipment, accessories, and repair parts issued with the item. A part number or other reference number is followed by the applicable five-digit Federal supply code for manufacturers in parenthesis. Repair parts quantities included in kits, sets, and assemblies are shown in front of the repair part name.

d. Unit of Measure (U/M). A two character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

e. Quantity Incorporated in Unit. This column indicates the quantity of the item used in the assembly group. A "V" appearing in this column in lieu of a quantity indicates that a definite quantity cannot be indicated (e.g. shim, spacers, etc.)

f. Quantity Furnished With Equipment. This column indicates the quantity of an item furnished with the equipment.

g. Illustration. This column is divided as follows:

(1) Figure number. Indicates the figure number of the illustration in which the item is shown.

(2) Item number. Indicates the callout number used to reference the item in the illustration.

B-4. Explanation of Columns in the Tabular List of Maintenance and Operating Supplies-Section III

a. Component Application. This column identifies the component application of each maintenance or operating supply item.

b. Federal Stock Number. This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Description. This column indicates the item name and brief description.

d. Quantity Required for Initial Operation. This column indicates the quantity of each maintenance or operating supply item required for initial Operation of the equipment.

e. Quantity Required for 8 Hours Operation. This column indicates the estimated quantities required for an average 8 hours of operation.

f. Notes. This column indicates informative notes eyed to data appearing in a preceding column.

Section II. BASIC ISSUE ITEMS

(1) SMR code	(2) Federal Stock number	(3) Description: Ref no. & mfr code / Usable on code	(4) Unit of meas	(5) Qty inc in unit	(6) Qty furn with equip	(7) Illustration (A) Fig no.	(7) Illustration (B) Item no.
PC	7510-889-3494	Binder, Loose Leaf	EA		1		
PC	7520-559-9618	Case, Maintenance and Operation Manuals	EA		1		
PC	4210-889-2221	Extinguisher, Fire, 2 1/2 lb. Fed. Spec. O-E95	EA		1		
		Department of the Army Technical Manual TM 10-3950-206-12	EA		1		
		Department of the Army Lubrication Order LO 10-3950-206-12	EA		1		

Section III. Maintenance and Operating Supplies

(1) Component application	(2) Federal stock number	(3) Description	(4) Quantity required for initial operation	(5) Quantity required for 8 hours operation	(6) Notes
AIR CLEANER	.....	OIL, LUBRICATING: ENGINE 55 gal drum follows:			(1) Includes quantity of oil to f11 engine oil system a follows:
	9150-265-9437(2)	OE 30	1 3/8	(3)	7-qts Engine crankcase & oil
	9150-265-9430(2)	OE 10	1 3/8 qt	(3)	cooler
	9150-242-7605(2)	OES	1 3/8	(3)	1-qt Oil filter
BRAKES	.....	BRAKE FLUID: AUTOMOTIVE: 1 gal can follows:			(2) See C910IL for additional data and requisitioning procedure.
	9150-252-6375(2)	HBA	1 pt	(3)	(3) See current LO for grade application and replenishment interval
CRANKCASE	.....	OIL, LUBRICATING (4)			
		OE 30	8t (1)	(3)	(4) Use oil identified in air cleaner FSN column.
		OE 10	8 qt (1)	(3)	
		OES	8 qt (1)	(3)	(5) Tank capacity.
DIFFERENTIAL	.....	OIL, LUBRICATING, GEAR: 5 gal. pail a follows:			
	9150-577-5844(2)	GO 90	14 qt	(3)	
	9150-577-5440(2)	GOS	14 qt	(3)	
GREASE POINTS	.....	GREASE, AUTOMOTIVE AND ARTILLERY: 5 b can as follows.			
	9150-190-0905(2)	GAA As re. (3)			
HYDRAULIC RESERVOIR	.....	OIL, LUBRICATING: (4)			
		OE 10	248 qt	(3)	
		OES	248 qt	(3)	
OIL CAN POINTS		OIL, LUBRICATING (4)			
		OE 30	As req.		
RADIATOR	.....	WATER.	16 qt		
		ANTIFREEZE: Ethylene			
	6850-243-1992	Glycol: 1 gal can	10 qt		
	6850-174-1806	ANTIFREEZE: Artic Grade	16 qt		
TANK, FUEL	.....	GASOLINE, AUTOMOTIVE COMBAT, Bulk as follows:			
	9130-160-1818(2)	91A	40 gal	(5)	
	9130-160-1830(2)	91C	40 gal	(5)	
TRANMISSION CONVERTER	.....	OIL, LUBRICATING: (4)			
		OE 10	18 qt	(3)	
		OES	18 qt	(3)	

APPENDIX C

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

C-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. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II. (Not applicable)

d. Section IV contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance function.

C-2. Explanations of Columns in Section II

a. Group Number Column (1). This assembly group is a numerical group assigned to each assembly in a top down breakdown sequence. The applicable assembly groups are listed on the MAC in disassembly sequence beginning with the first assembly removed in a top down disassembly sequence.

b. Assembly Group, Column (2). This column contains a brief description of the components of each assembly group.

c. Maintenance Functions, Column (3). This column lists the various maintenance functions (A through K) and indicates the lowest maintenance category authorized to perform these functions. The symbol designations for the various maintenance categories are as follows:

C-Operator or crew
O-Organizational maintenance
F-Direct support maintenance
H-General support maintenance
D-Depot maintenance

The maintenance functions are defined as follows:

A-Inspect. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

B-Test. To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

C-Service. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

D-Adjust. To rectify to the extent necessary to bring into proper operating range.

E-Align. To adjust specified variable elements of an item to bring to optimum performance.

F-Calibrate. To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the 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 with the certified standards.

G-Install. To set up for use in an operational environment such as an emplacement, site, or vehicle.

H-Replace. To repair unserviceable items with serviceable like items.

I-Repair. Those maintenance operations necessary to restore an item to serviceable condition through correction of material damage or a specific failure. Repair may be accomplished at each category of maintenance.

J-Overhaul. Normally, the highest degree of maintenance performed by the Army in order to minimize time work in process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable

condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

K-Rebuild. The highest degree of material maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by operational considerations or other paramount factors and then only at the depot maintenance category. Rebuild reduces to zero the hours or miles the equipment, or component there- of, has been in use.

d. Tools and Equipment, Column (4). This column is provided for referencing by code the special tools and test equipment, required to per- form the maintenance functions (sec. II).

e. Remarks, Column (5). This column is provided for referencing by code the remarks (sec. IV) pertinent to the maintenance function.

C-3. Explanation of Columns in Section II (Not applicable)

a. Reference Code. This column consists of a number and a letter separated by a dash. The number references the T&TE requirements column on the MAC. The letter represents the specific maintenance function the item is to be used with. The letter is representative of columns A through K on the MAC.

b. Maintenance Category. This column shows the lowest level of Maintenance authorized to use the special tool or test equipment.

c. Nomenclature. This column lists the name or identification of the tool or test equipment.

d. Tool Number. This column lists the manufacturer's code and part number, or Federal Stock Number of tools and test equipment.

C-4. Explanation of Columns in Section IV

a. Reference Code. This column consists of two letters separated by a dash, both of which are references to Section II. The first letter references column 5 and the second letter references a maintenance function, column 3, A through K.

b. Remarks. This column lists information pertinent to the maintenance function being per- formed, as indicated on the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART

(1) Group No.	(2) Functional Group	(3) Maintenance functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and equipment	(5) Remarks
	ENGINE:													
	Engine Assembly	O	O	C	O				F	O	H	D		A
	Block, Engine	H										D		
	Cylinder Head								O	F				
	Valves, Engine				O				F	F				
	Flywheel Assembly								F	F				
	Crankshaft								H			D		B
	Gear Timing	F						F						
	Filter, Oil			O					O					
	Pump, Oil	F							F					
	Valve, Oil Pressure	O							O					
	Manifold	O							O					
	Oil Cooler	O							O					
	FUEL SYSTEM:													
	Carburetor				O				O	F				
	Fuel Pump		O	O					O					
	Air Cleaner				C				O					
	Tank, Fuel				C				O	F				

(1) Group No.	(2) Functional Group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild		
	Governor				O				F	F				
	Valve, PCV			O					O					
	Filter, Fuel			O					O					
	Pedal, Linkage and Accelerator				O				O					
	EXHAUST SYSTEM:													
	Muffler and Pipes	O							O					
	COOLING SYSTEM:													
	Radiator		F	C					O	F				
	Thermostat		O						O					
	Water Pump	O							O					
	Belts, Fan				O				O					
	ELECTRICAL SYSTEM:													
	Alternator		O						O	F				
	Regulator, Voltage		O						O					
	Starting Motor		O						O	F				
	Distributor				O				O	O				
	Spark Plugs		O	O	O				O					
	Ignition Coil		O						O					
	Battery		O	O	C				O					
	Cables, Battery			O					O					
	Switches, Gages, Sending Units and Warning Switches	O						O						
	TRANSMISSION:													
	Filter, Oil		O						O					
	Control Valve		F						F	F				
	Transmission Assembly	F	C						F	F	H	D		
	PROPELLER SHAFTS:													
	Propeller Shafts			O					O	O				
	FRONT AXLE:													
	Front Axle Assembly (Drive)			O	O				F	F				
	Differential			O					F	H				
	REAR AXLE:													
	Rear Axle Assembly (Steering)			O	F				F	H				
	BRAKES:													
	Brake Shoes, Hand Brake				O				O	F				
	Lever, Hand Brake				O				O					
	Cable, Hand Brake				O				O					
	Brake Shoe, Service Brake	O							O	F				
	Master Cylinder			O					O	F				
	Wheel Cylinder								O	F				
	Pedal and Linkage, Service				O				F					
	WHEELS:													
	Wheel Assembly								O	O				
	Tires and Tubes	O		C					O	O				
	STEERING:													
	Gear Assembly Steering				F				F	H				
	Hydraulic Cylinder				O				O	F				
	Tie Rods				F				F	F				

(1) Group No.	(2) Functional Group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild		
	BODY:													
	Seat Assembly				C				O	O				
	WINCH:													
	Winch Assembly Hoist	O			F				F	H				
	Brake, Winch	O							H	H				
	Motor, Winch Drive	O							F	F				
	BOOM:													
	Boom Assembly	O			O				F	F				
	Sheaves, Pins, and Bushings	O							O					
	Cables, Clamps and Thimbles		O						O					
	Block Assembly								O	F				
	Turntable			O					F	F				
	HYDRAULIC LIFT CONDITIONS:													
	Pump Assembly, Hydraulic		F						F	F				
	Valve Assembly, Hydraulic Control								F	F				
	Lever and Linkage, Lift and Slew Control				F				F					
	Slewing Cylinder				F				F	F				
	Crowd Cylinder				F				F	F				
	Lift Cylinder				F				F	F				
	Tank Assembly, Hydraulic Oil			O					O					
	Oil Tank Breather			O					O					
	Filter, Hydraulic Oil			O					O					
	Lines and Fittings	O							O					

Section IV. REMARKS

Reference Code	Remarks
AB	Test includes compression, vacuum and timing
B-K	Rebuild includes align, metalize and resize

INDEX

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