DEPARTMENT OF THE ARMY
TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 5-1185
TO 19-40ABB-35

ROLLER, ROAD

GASOLINE-DRIVEN
TANDEM, 2-AXLE
5-TO 8-TON
GALION MODEL T5G
WITH ENGINE

CONTINENTAL MODEL F-244

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
10 JANUARY 1955

SAFETY PRECAUTIONS

Do not use the roller to compact coarse, abrasive materials which will scratch or damage the faces of the rolls, thereby rendering the roller less efficient in finish rolling.

Do not leave the roller standing on a cooling or setting road surface, because the weight exerted by the rolls will leave depressions in the pavement.

Do not accelerate the road roller on soft, pliable road material.

Always use sprinkler system when rolling hot or tacky materials.

Start the roller moving slowly and smoothly, and do not make sharp or fast turns. Steer the roller slowly so that the paving material will not be marked or shoved out of place.

Do not allow lubricants to drip onto paving material if it is of an asphaltic nature. Oil damages new asphalt by weakening its ability to set properly. After lubricating the roller, be sure that all drain plugs are tightly closed and that excess lubricants have been wiped off.

Before starting the engine, make certain that the master clutch lever is disengaged.

Do not operate the engine in confined spaces, due to danger from carbon monoxide gas.

When hand cranking the engine, keep the thumb on the same side of the handle as the fingers to avoid a broken wrist, should the engine kick.

Never run the engine without oil pressure.

Never put full load or speed on a cold engine.

Always see that the choke valve is wide open when the engine is running at operating temperature.

If the engine overheats because of lack of coolant, allow it to cool before filling the radiator. Otherwise, there is danger of cracking the cylinder head and block. If it is necessary to fill the radiator before the engine has cooled, be sure to fill it very slowly with the engine running at fast idling speed.

Always stop the engine when filling the fuel tank.

When handling gasoline, always provide a metallic contact between the container and the tank. This contact will prevent a spark from being generated as gasoline flows over the metallic surface.

Do not add water to a battery in below-freezing temperatures unless the battery is to be charged immediately. If water is added and the battery not charged, the added water will stay at the top and freeze before it has had a chance to mix with acid. Continuous use of water with a high mineral content will damage the battery.

When servicing the battery, do not smoke or allow open flame in the vicinity.

When filling the fire extinguisher, do not allow any water to get into the fluid or the extinguisher case. Carbon tetrachloride mixed with water will cause serious corrosion. Carbon tetrachloride fumes are toxic.

Avoid excessive inhaling and see that the room is properly ventilated.

Never use emery cloth or metal-surfaced grinding or polishing stones to service the battery generator and starting motor commutators.

Do not drive a screwdriver, chisel, or other sharp instrument between the cylinder head and cylinder block, as this may cause serious damage to the cylinder head and cylinder block.

Do not rotate the valve continuously all the way around when grinding valves. Such rotation will cut grooves in the valve seat.

Do not try to fit the bearing by scraping or filing the shell or connecting rod cap, or the connecting rod will be permanently ruined.

If engine trouble develops, correct it before it becomes serious. Do not run an engine that is not operating properly.

DEPARTMENT OF THE ARMY TECHNICAL MANUAL
DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

ROLLER, ROAD, GASOLINE DRIVEN, TANDEM, 2 AXLE, 5 TO 8 TON, GALLON MODEL T5G, WITH ENGINE, CONTINENTAL MODEL F-244

TM 5-1185 ,
TO 19-40ABB-35
CHANGES NO. 1

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D.C., *17 May 1963*

TM 5-1185/TO 19-40ABB-35, 10 January 1955, is changed as follows:

Page 3, paragraph 1.

c. (Added) *Report all deficiencies in this manual on DA Form 2028*. Submit recommendations for changes, additions, or deletions to the Commanding Officer, U. S. Army Mobility Support Center, ATTN: SMOMS-MS, P.O. Box 119, Columbus 16, Ohio. Direct communication is authorized.

d. (Added) *Report all Equipment Improvement Recommendations as prescribed by TM 38-750.*

2. Record and Report Forms
(Superseded)

a. DA Form 1258 (Depreservation Guide of Engineer Equipment).

b. For other record and report forms applicable to the operator, organizational, field and depot maintenance, refer to TM 38-750.

Note. Applicable forms, excluding Standard Form 46, which is carried by the operator, will be kept in a canvas bag mounted on the equipment.

Page 26, paragraph 28*a*. Delete before-operation and substitute: daily preventive maintenance.

Page 47

TAGO 9250B--678236--May 1963

51. General

(Superseded)

To insure that the road roller 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 Services to be performed are listed and described in paragraphs 52 and 54. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit shall 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 shortcomings will be recorded, together with the corrective action taken, on DA Form 2404 at the earliest possible opportunity.

Page 47.

52. Daily Preventive Maintenance Services

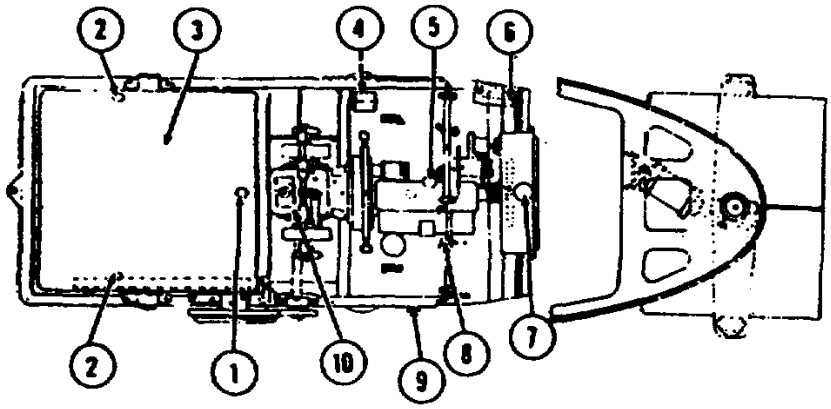
(Superseded)

This paragraph contains an illustrated tabulated listing of preventive maintenance services which must be performed by the operator. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to figure 15.1 for the Daily Preventive Maintenance Services.

PREVENTIVE MAINTENANCE SERVICES

DAILY

TM5 1185 **GALION MODEL T5G** **ROAD ROLLER**



LUBRICATE IN ACCORDANCE WITH CURRENT LUBRICATION ORDER

ITEM		PAR REF
1	FUEL TANK. Check for leaks. Add fuel as required.	
2	WATER TANK. Check for leaks. Add water as required.	
3	SPRINKLER SYSTEM. Check for proper operation.	
4	BATTERIES. Tighten loose cables. Remove corrosion. Inspect for cracks and leaks. Fill with water to 3/8 in above plates. Clean vents. (weekly)	
5	OIL LEVEL GAGE. Add oils as indicated by level gages. Reference current L.O.	
6	HYDRAULIC OIL TANK. Check tank for leaks. Add oil as indicated by level gage. Reference current L.O. (Weekly)	
7	RADIATOR. Fill to proper coolant level. 2 inches below filler neck.	
8	FUEL FILTER. Drain sediment. (Weekly)	
9	FIRE EXTINGUISHER. Check for broken seal.	

Figure 15.1. (Added) Daily preventive maintenance services.

ITEM		PAR REF
10	CONTROLS AND INSTRUMENTS. Check for damage. With the unit operating, check for proper operation. Normal operating readings for instruments are is follows: Oil pressure gage - 20 to 50 psi Ammeter - Plus side of 0 Temperature gage - 130° to 130°F	
	NOTE 1. OPERATION. During operation observe for any unusual noise or vibration.	

MSC 1185/15.1

Figure 15.1.-Continued

Page 50, paragraph 53. (Rescinded)

Page 51.

54. Quarterly Preventive Maintenance Services

(Superseded)

a. This paragraph contains an illustrated tabulated listing of preventive maintenance services which must be

performed by Organizational Maintenance personnel at quarterly intervals. A quarterly interval is equal to 3 calendar months, or 250 hours of operation, whichever occurs first.

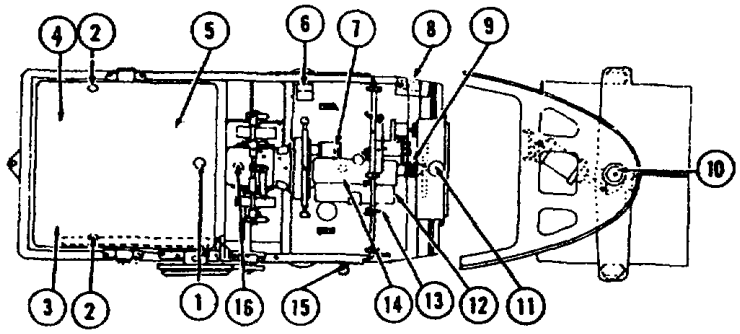
b. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to Figure 15.2 for the Quarterly Preventive Maintenance Services.

PREVENTIVE MAINTENANCE SERVICES

QUARTERLY

TM5 1185 **ROAD ROLLER**

GALION MODEL T5G



ITEM	LUBRICATE IN ACCORDANCE WITH CURRENT LUBRICATION ORDER	PAR REF
1	FUEL TANK. Check for leaks. Repair or replace a defective tank.	109
2	WATER TANK. Check for leaks. Repair or replace a defective tank.	166
3	COMPRESSION ROLL. Repair a damaged roll.	219
4	SCRAPER. Tighten loose scraper mounting.	
5	SPRINKLER SYSTEM. Tighten loose mounting. Replace defective pipe and valves. Replace worn or damaged sprinkler mats.	166
6	BATTERIES. Tighten loose cables and mountings. Remove corrosion. Fill with water to 3/8 inch above plates. Clean vents. Replace a leaking or cracked battery.	111
7	OIL LEVEL GAGE. Add oil as indicated by level gage. Reference current L.O.	
8	HYDRAULIC OIL TANK. Add oil as indicated by level gage. Reference current L.O. Repair or replace a defective tank.	154
9	FAN BELT. Proper adjustment is a deflection of 1/2 inch midway between pulleys. Replace a worn or frayed belt.	112

Figure 15.2. (Added) *Quarterly preventive maintenance services.*

ITEM		PAR REF
10	HYDRAULIC STEERING CYLINDER. Tighten loose mounting. Repair or replace a leaking cylinder.	152
11	RADIATOR. Tighten loose mounting. Replace a leaking or damaged radiator. Proper coolant level is 2 inches below filler neck.	129
12	MAGNETO. Tighten loose mounting or loose electrical connections. Replace a burned or pitted breaker point set. Check breaker point gap. Proper gap is 0.015 inch. (Check adjustment every 500 hours.)	116
13	FUEL FILTER. Drain sediment. Repair a leaking filler or a cracked filter bowl.	103
14	SPARK PLUGS. Inspect plugs for proper gap and torque. Proper gap is 0.025 inch. Proper torque is 26 to 30 foot-pounds. Replace plugs that have cracked porcelain or burned electrodes.	117
15	FIRE EXTINGUISHER. Check for full charge by shaking for sound and weight. Check tor broken seal. Replace a defective fire extinguisher.	
16	CONTROLS AND INSTRUMENTS. Check for damage. With the unit operating. Check for proper operation. Normal operating readings for instruments are as follows:	
	Oil pressure gage - 20 to 50 psi Ammeter - Plus side of 0 Temperature gage - 130° to 190°F	
	NOTE 1. OPERATIONAL TEST. During operation observe lot any unusual noise or vibration.	
	NOTE 2. ADJUSTMENTS. Rake all necessary adjustments during operational test.	

Figure 15.2-Continued

Page 365, paragraph 5. Delete TB 5-505 and insert the following:

AR 750-5 Organization, Policies, and Responsibilities for Maintenance Operation.

TM 38-750 The Army Equipment Record System and Procedures.

BY ORDER OF THE SECRETARIES OF THE ARMY
AND THE AIR FORCE:

EARLE G. WHEELER,
General, United States Army
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

CURTIS E. LEMAY,
Chief of Staff, United States Air Force.

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USAAESWBD (2)
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USCONARC (3)
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USARJ (10)
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Armies (2)
Corps (2)
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Engr Dep (OS) (10)
Army Dep (2)
USA Trans Tml Comd (2)
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Engr Fld Maint Shop (2)
USAERL (3)
Engr Cen (5)
AMS (3)
Chicago Engr Proc Ofe (10)
USA Mbl Spt Cen (36)
ESCO (10)
Fld Comd, DASA (8)
USACOMZEUR (2)
USAREUR Engr Sup Con Agcy (10)
USAREUR Engr Proc Cen (2)
MAAG (1)
JBUSMC (1)
Units org under fol TOE:.
(2 copies each UNOINDC)
5-48
5-114
5-115
5-117
5-237 (5)
5-262 (5)
5-267 (1)
5-278 (5)
5-279
5-500 (EA,EB)

NG: State AG (3)

USAR: Units - same as Active Army except allowance is one copy each unit.

For explanation of abbreviations used, see AR 320-50.

TAGO 9250B

*U.S. GOVERNMENT PRINTING OFFICE : 1984 O - 461-421 (10726)

TECHNICAL MANUAL
No. 5-1185
TECHNICAL ORDER
No. 19-40ABB-35

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *10 January 1955*

ROLLER, ROAD, GASOLINE DRIVEN, TANDEM, 2 AXLE, 5 TO 8 TON, GALION MODEL T5G, WITH ENGINE, CONTINENTAL MODEL F-244

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the information and guidance of the personnel to whom this road roller is issued. They contain information on the operation and organizational maintenance of the road roller as well as a description of the major units and their function in relation to other components of the materiel. They apply only to the Roller, Road, Gasoline Driven, Tandem, 2 Axle, 5 to 8 Ton, Galion Model T5G, with Engine, Continental Model F-244.

b. Supply manuals, technical manuals, and other publications applicable to the equipment covered by this manual are listed in appendix I. Appendix II tabulates the replaceable parts available for the equipment. Appendix III lists the tools and spare parts issued with and carried on or with the equipment.

2. Record and Report Forms

Maintenance record forms listed and briefly described in a through I below will be used in the maintenance of this equipment.

a. DD Form. 110, Vehicle and Equipment Operational Record. This form is used by equipment operators for reporting the accomplishment of daily preventive maintenance services, and for reporting any equipment deficiencies observed during operation.

b. Standard Form 91, Operator's Report of Motor-Vehicle Accident. One copy of this form is kept with the equipment at all times In case of an accident resulting in injury or property damage, Form No. 91 is filled out immediately (or as promptly thereafter as is practical) by the operator.

c. DA Form 464, Work Sheet for Preventive Maintenance and Technical Inspection of Engineer Equipment. This form is used by personnel of the using organization and higher echelons for reporting the results of preventive maintenance services and technical inspections.

d. DA Form 460, Preventive Maintenance Roster. This form is used for scheduling preventive maintenance services at proper intervals. Refer to TM 5-505.

e. DA Form 478, Organizational Equipment File. Major repairs or rebuilding, replacement of major unit assemblies, and accomplishment of equipment modifications are recorded on this form.

f. DA Form 468, Unsatisfactory Equipment Report. This form is used for reporting manufacturing, design, or operational defects in the materiel, with a view to correcting such defects; it is also used for recommending modifications of the materiel. Form No. 468 is not used for reporting failures, isolated materiel defects, or malfunctions of materiel resulting from fair wear and tear or accidental damage. Form No. 468 is not used to report issue of parts and equipment, or for reporting replacements and/or repairs.

g. DD Form 6, Report of Damaged or Improper Shipment. This form is used for reporting damages incurred in shipment.

h. DA Form 9-81, Exchange Part or Unit Identification Tag. This form is used to accomplish the direct exchange of unserviceable for serviceable parts.

i. DA Form 811, Work Request and Job Order. This form is used to request work done by higher echelon organizations.

j. DA Form 867, Statue of Modification Work Order. This form is used to maintain records of all modification work performed on equipment.

k. DA Form 5-13, Spot Check Inspection Report of Organizational Maintenance of Engineer Equipment. Organizations having engineer field maintenance responsibility use this form for reporting the results of semiannual spot-check inspections.

l. DA Form 5-14, Annual Technical Inspection Report of Engineer Equipment. Organizations having engineer field maintenance responsibility use this form for reporting the results of annual technical inspections.

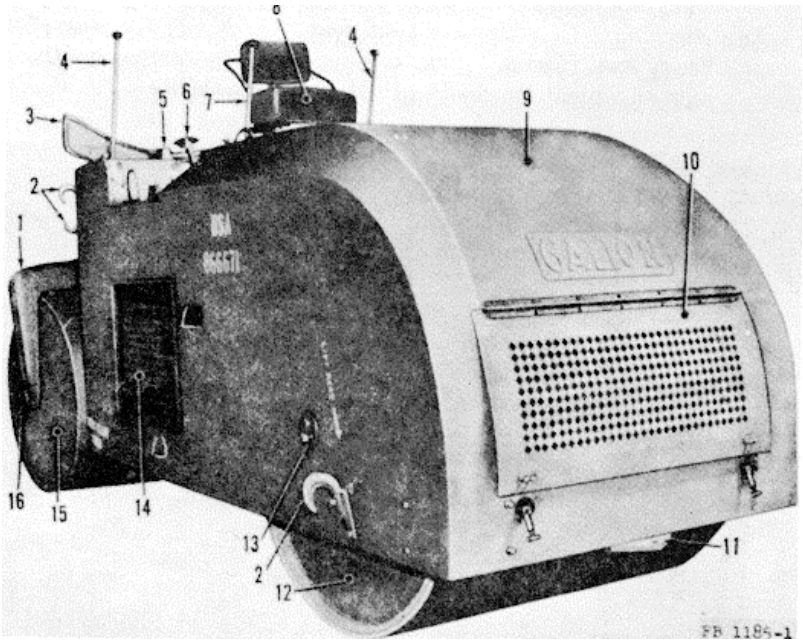
Section II. DESCRIPTION AND DATA

3. Description

a. General. The Galion road roller Model T5G is a 5-8 ton variable-weight tandem roller, complete with all controls, switches, and indicators necessary for normal road rolling operations. The compression roll (12, fig. 1) and the steering roll (15) can be filled with water ballast to change the compression factor for any rolling job. The engine and transmission are accessible through hinged side doors (14). All operating controls and gages are contained on the operator's platform. Reference to "right" and "left" refer to a view of the roller from the operator's seat (8) facing the compression roll (12).

(1) *Steering roll*. The steering roll (15, fig. 1) consists of two separate compression rolls mounted on a single axle (16). The steering roll is hydraulically operated and controlled by the steering lever (7) on the operator's platform.

(2) *Compression roll*. The compression roll (12, fig. 1) consists of a single welded roll mounted on a single axle (13). The compression roll can be inspected and cleaned by opening the compression roll door (10).



1	Steering yoke	9	Compression roll cover
2	Lifting hook	10	Compression roll door
8	Carbine rack	11	Towing bracket
4	Clutch lever	12	Compression roll
5	Seat post	18	Compression roll axle
6	Brake pedal	14	Side door
7	Steering lever	15	Steering roll
8	Operator's seat	16	Steering roll axle

Figure 1. Road roller, right front view.

(3) *Clutch levers*. The forward and reverse clutch levers (4, fig. 1) are located at each side of the operator's platform. Either lever controls the forward or reverse movement of the roller.

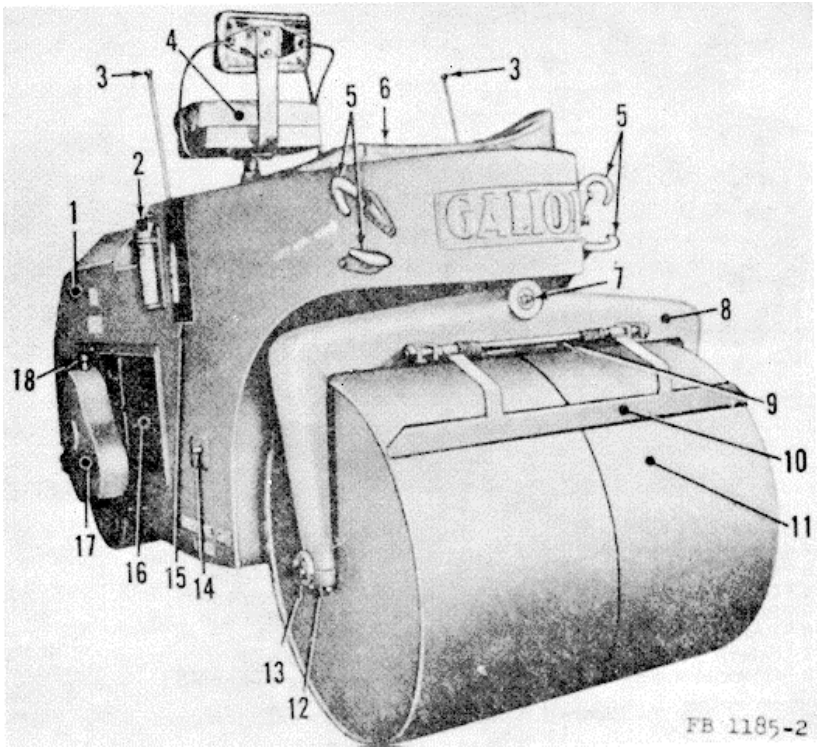
(4) *Steering lever*. The steering lever (7, fig. 1), is located in the center of the operator's platform. The steering lever (7) controls the steering roll (15) hydraulically.

(5) *Brake pedals*. The brake pedals (6, fig. 1) are located at each side of the operator's platform. The brake pedals are the lockable ratchet type and can be used during operation and for parking.

(6) *Operator's seat.* The operator's seat (8, fig. 1) can be mounted on the seat posts (5) on either side of the roller. The seat has four height adjustments.

(7) *Lifting hooks*. The lifting hooks (2, fig. 1) are mounted on the left and right sides in the front and rear of the roller. They are used for lifting, loading, and unloading purposes.

(8) *Steering yoke.* The steering yoke (8, fig. 2) is made of a heavy steel casting. The yoke supports the stationary front axle on which the steering roll (11) is mounted.



1	Compression roll cover	10	Steering roll scraper
2	Fire extinguisher	11	Steering roll
3	Clutch lever	12	Steering axle bracket
4	Operator's seat	13	Steering roll axle cap
5	Lifting hook	14	Cranking shaft
6	Carbine rack	15	Identification plates
7	Steering yoke kingpin	16	Side door
8	Steering yoke	17	Gear cover
9	Scraper shaft	18	Grease pipe

Figure 2. Road roller, left rear view.

(9) *Scraper*. The roll scraper. (10, fig. 2) and scraper shaft (9) are mounted on the steering yoke (8). The scraper removes dirt, gravel, and imbedded foreign matter from the roll.

(10) *Side doors*. The hinged side doors (16, fig. 2) are located on the left and right sides of the roller. The doors provide access to the inside components of the road roller.

(11) *Cranking shaft*. The cranking shaft (14, fig. 2) of the engine is located on the left rear side of the road roller. If the starting motor should fail, the cranking shaft is used to start the engine.

(12) *Gear cover*. The gear cover (17, fig. 2) protects the driving gears from dirt, water, and damage.

(13) *Grease pipe*. The grease pipe (18, fig. 2) is located on the gear cover (17). It is used for the lubrication of the driving gears.

(14) *Carbine rack*. The carbine rack (6, fig. 2) is mounted in the front of the road roller. The rack is provided with a zippered canvas cover.

b. Engine. The road roller is driven by a Continental Model F244-201 gasoline engine (figs. 3 and 4). The engine is a 6-cylinder, 4-cycle, L-head, water-cooled, gasoline engine developing 48 hp at 1,500 rpm.

(1) *Manifolds*. The intake (19, fig. 3) and exhaust (1) manifolds are mounted on the right side of the engine. The heat control valve (2) is mounted on the exhaust manifold.

(2) *Carburetor*. The carburetor (17, fig. 3) is the updraft type and is mounted on the right side of the engine. The fuel filter (16) is mounted on the inlet elbow of the carburetor.

(3) *Governor*. The governor (13, fig. 3) is mounted on the right front side of the engine and is driven by the camshaft gear.

(4) *Magneto.* The magneto (14, fig. 3) is mounted on the right side of the engine and is driven by the governor (13).

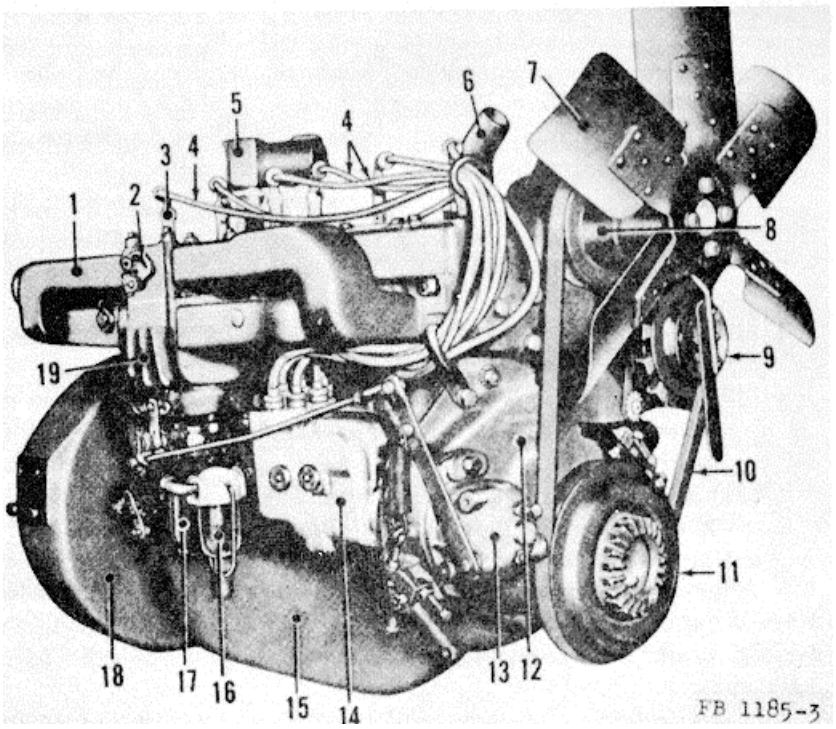
(5) *Fan drive pulley*. The fan drive pulley (11, fig. 3) is mounted on the crankshaft and drives the fan (7), the battery generator (18, fig. 4), and the hydraulic pump.

(6) *Oil filter*. The oil filter (3, fig. 4) is mounted on the left side of the engine.

(7) *Hour meter*. The hour meter (4, fig. 4) is mounted on the cylinder head (7) and is driven by the oil pump.

(8) *Spark plugs and leads*. The spark plugs (6, fig. 4) and spark-plug leads (5) are shielded to eliminate radio interference.

(9) *Starting motor*. The starting motor (12, fig. 4) is mounted on the left side of the flywheel housing (10).



1	**Exhaust manifold**	**11**	**Fan drive pulley**
2	**Heat control valve**	**12**	**Timing gear cover**
3	**Shielded spark plug**	**13**	**Governor**
4	**Shielded spark plug lead**	**14**	**Magneto**
5	**Hour meter**	**15**	**Oil pan**
6	**Water outlet elbow**	**16**	**Fuel filter**
7	**Fan**	**17**	**Carburetor**
8	**Water pump**	**18**	**Flywheel housing**
9	**Battery generator**	**19**	**Intake manifold**
10	**Fan belt**		

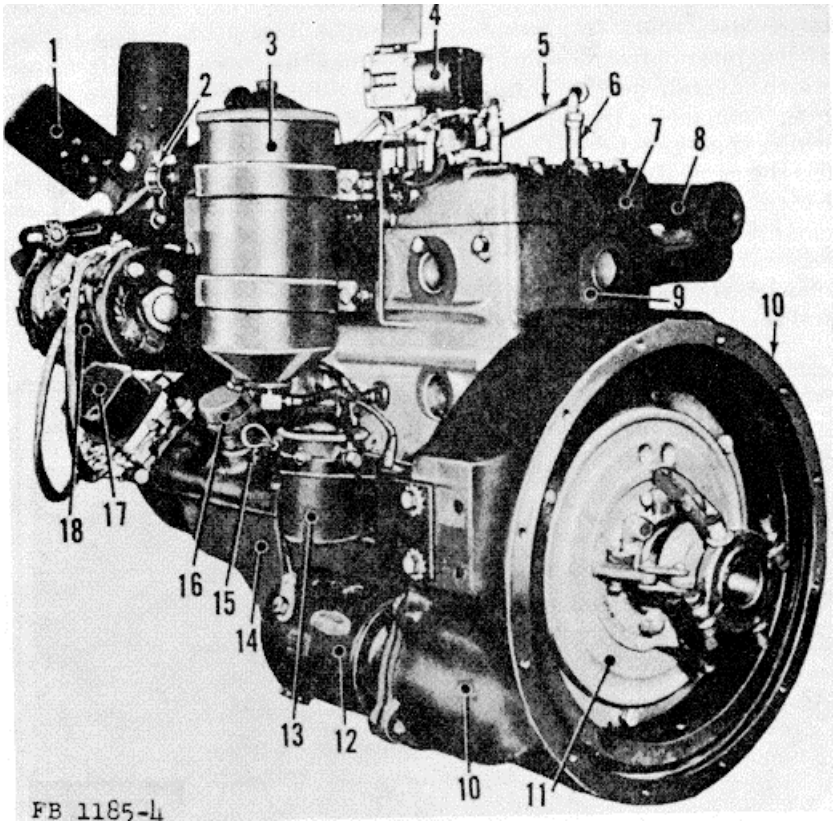
Figure 3. Engine, right front view.

(10) *Magnetic switch*. The magnetic switch (13, fig. 4) is mounted on the left side of the engine, directly above the starting motor (12).

(11) *Oil-level gage*. The oil-level gage (15, fig. 4) is mounted on the left side of the cylinder block (9), below the oil filter (3).

(12) *Oil filler cap*. The oil filler cap (16, fig. 4) is mounted on the left side of the engine and can be unscrewed and removed from the oil filler tube.

(13) *Battery generator*. The battery generator (18, fig. 4) is mounted on the left front side of the engine and is driven by the fan drive pulley (11, fig. 3).



1	**Fan**	**10**	**Flywheel housing**
2	**Water pump**	**11**	**Clutch**
3	**Oil filter**	**12**	**Starting motor**
4	**Hour-meter**	**13**	**Magnetic switch**
5	**Shielded spark plug lead**	**14**	**Oil pan**
6	**Shielded spark plug**	**15**	**Oil level gage**
7	**Cylinder head**	**16**	**Oil filler cap**
8	**Exhaust manifold**	**17**	**Voltage regulator**
9	**Cylinder block**	**18**	**Battery generator**

Figure 4. Engine, left rear view.

(14) *Voltage regulator*. The voltage regulator (17, fig. 4) is mounted on the left front side of the engine, directly below the battery generator (18).

4. Identification Plates

The road roller has four identification plates. The Corps of Engineers identification plate (B, fig. 5) is located on the left side of the steering roll housing (15, fig. 2) and specifies the official nomenclature of the roller, weight with and without ballast, manufacturers' name, model and serial numbers, U. S. Army specification and regis-

tration numbers, and stock list number. The road roller transportation data plate (C), which is mounted directly below the Corps of Engineers identification plate, specifies the overall length, overall width, overall height, shipping cubage, shipping weight, and shipping tonnage. The lifting attachments identification plate (D), which is mounted directly below the transportation data plate, specifies the capacity of the lifting hooks and illustrates schematically the location of the lifting hooks. The road roller data plate (A) is mounted on the left side of the instrument panel and specifies the necessary data applicable to the road roller. When requisitioning spare parts for this equipment, specify the U. S. Army registration and serial numbers, and model and serial numbers of the road roller.

A

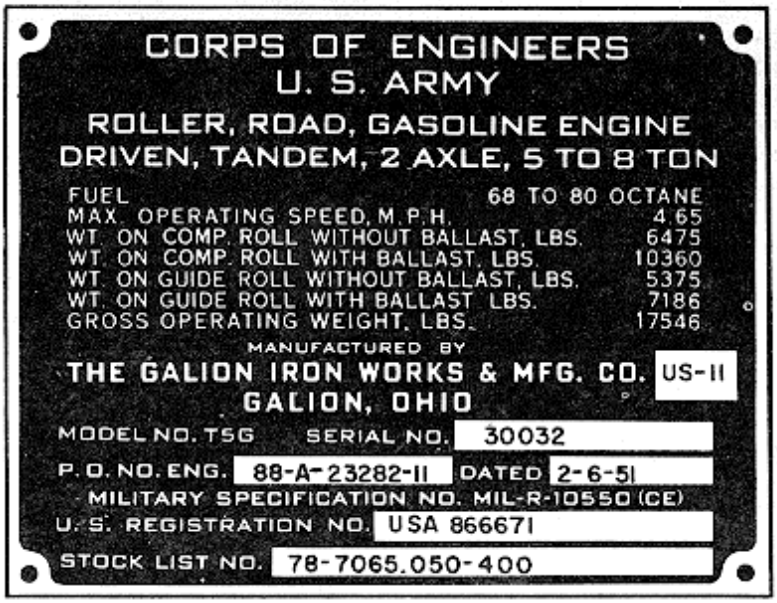
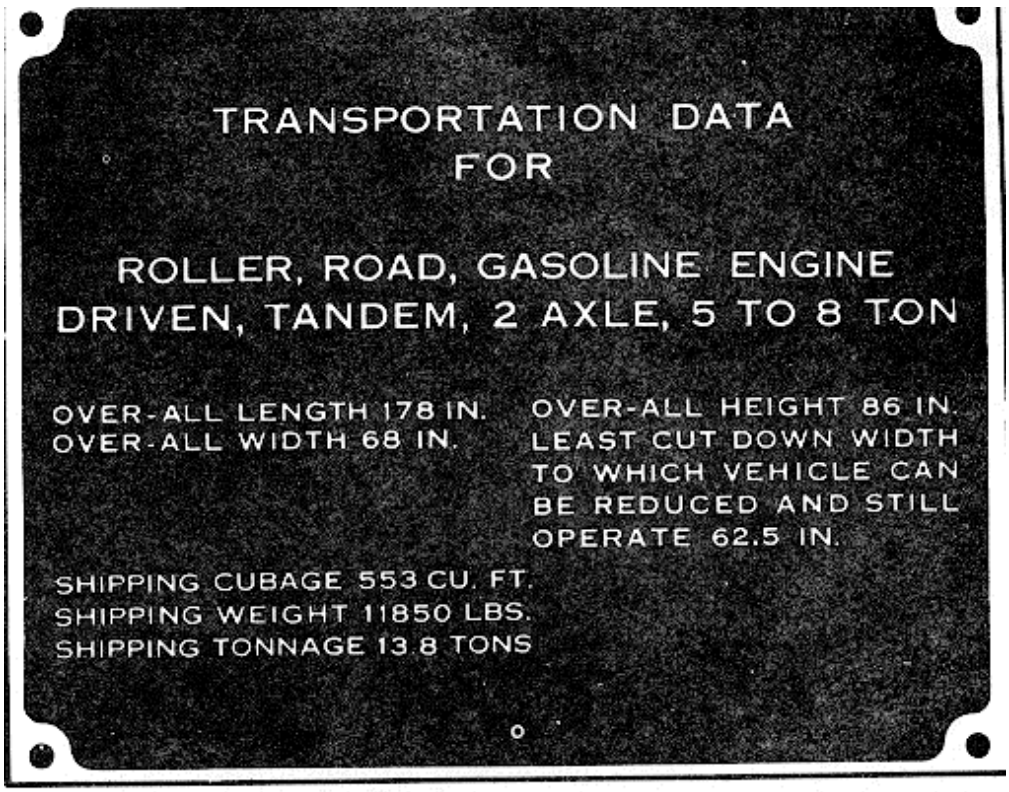


Figure 5. Identification plates.



C

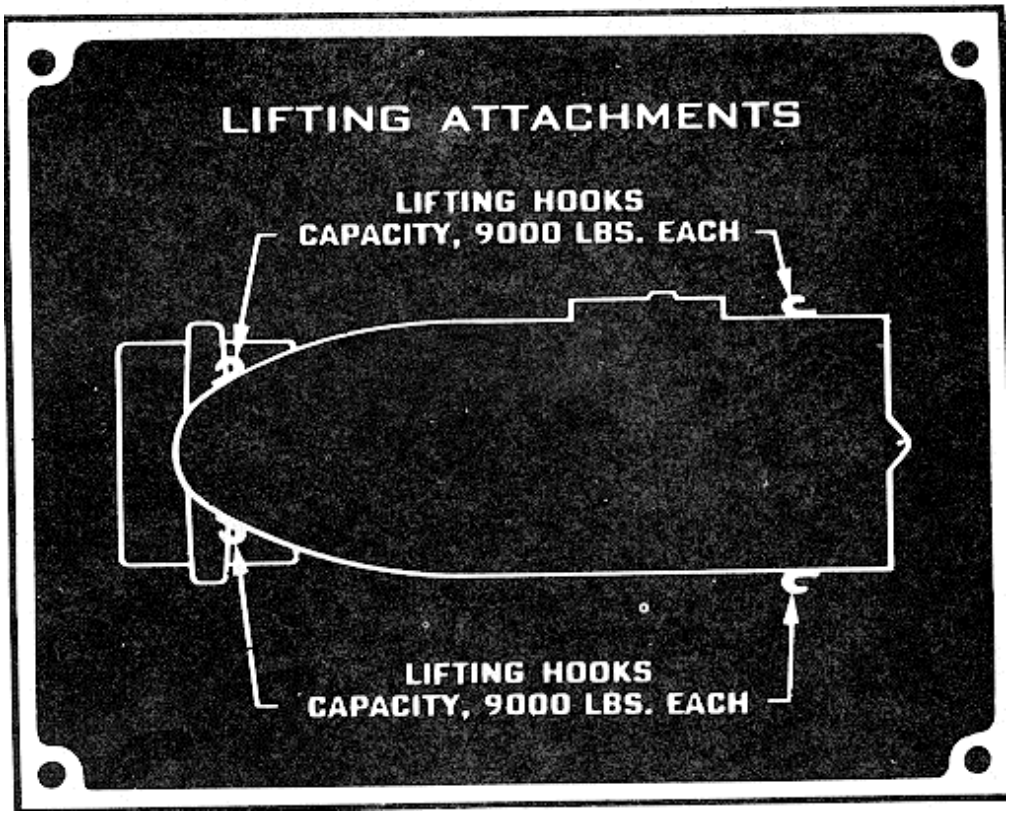


Figure 5-Continued.

5. Differences in Models

a. General. There are no major constructional or design differences within the T5G models. The frame, housing, and transmission components are identical for all rollers of this model.

b. Engines. Some of the late production Model T5G road rollers are equipped with Continental Model F226 engines. Both engines, the Model F244 and Model F226, are similar in design, construction, and maintenance. Differences exist in engine performance and parts numbers. Service, maintenance, and repair procedures are identical for both engines.

c. Engine Accessories.

(1) *Magneto*. The Continental Model F244 engine has Fairbanks Morse Model FM E 6 B 16 magneto. The Continental Model F226 engine has Eisemann Model 1128 magneto. Both magnetos are interchangeable.

(2) *Hourmeter*. The Continental Model F244 engine has mechanical Durant hourmeter driven by the oil pump shaft. The Continental Model F226 engine has electrical Hobbs hourmeter mounted on the cylinder block and operated by the battery. These hourmeters are not interchangeable.

(3) *Oil filter*. The Continental Model F244 engine has Fram Senior oil filter. The Continental Model F226 engine has Fram Junior oil filter. Both oil filters are interchangeable.

6. Tabulated Data

a. Dimensions and Weight.

Wheelbase	124 in.
Overall length	178 in.
Overall width	68 in.
Overall height	86 in.
Rolling width	50 in.
Ground clearance	18 in.
Turning radius	17 ft 8 in.
Shipping weight	11,850 lb.
Operating weight	17,546 lb.
Steering roll diameter	40 in.
Steering roll width (2 secs)	50 in.
Compression roll diameter	50 in.
Compression roll width	50 in.
Extra weight	Variable from 5 to 8 tons by water ballast

b. Engine.

Make	Continental.
Model	F244.
Type	4-cycle, L-head.
Cooling	Water-cooled.
Fuel	Gasoline.
Number of cylinders	6.

Firing order ---------- 1-5-3-6-2-4.
Spark plug, make ---------- Auto Lite.
Spark plug, type ---------- Resistor BR 8 S.
Spark plug, thread size ---------- 14 mm.
Spark plug gap ---------- 0.025 in.
Breaker point gap ---------- 0.015 in.
Cylinder bore ---------- 3 7/16 in.
Stroke ---------- 4 3/8 in.
Displacement ---------- 244 cu. in.
Valve tappet clearance ---------- 0.014 in.
Oil pump ---------- Gear type, internally mounted, positive displacement.
Cylinder head screw torque ---------- 70-75 ft. lb.
Engine speed:
  Maximum governed ---------- 1,500 rpm.
  Transmission in high gear:
    1.00 mph ---------- 400 rpm.
    4.65 mph ---------- 1,500 rpm.
  Transmission in low gear:
    1.00 mph ---------- 750 rpm.
    2.23 mph ---------- 1,500 rpm.
Fan belt deflection ---------- ½ in.
Hydraulic pump belt deflection ---------- ½ in.
Brake horsepower ---------- 48.
Oil pressure ---------- 20-50 psi.

c. Capacities.

Fuel tank ---------- 24 gal.
Cooling system ---------- 5 gal.
Sprinkler tank ---------- 130 gal.
Crankcase ---------- 2 1/4 gal.
Transmission case ---------- 2 gal.
Hydraulic tank ---------- 6 gal.
Air cleaner ---------- 0.7 pint.
Oil filter ---------- 1 qt.

d. Accessories.

Battery generator, make ---------- Delco-Remy.
Battery generator, type ---------- 1105960.
Voltage regulator, make ---------- Delco-Remy.
Voltage regulator, type ---------- 1118379.
Starting motor, make ---------- Delco-Remy.
Starting motor, type ---------- 1108583.
Magneto, make ---------- Fairbanks Morse.
Magneto, type ---------- FM E 6 B 16.
Carburetor, make ---------- Zenith.
Carburetor, type ---------- 11411, 63 AW 11.
Fuel filter, make ---------- Zenith.
Fuel filter, type ---------- F 385 X 3 GTS.
Air cleaner, make ---------- Vortox.
Air cleaner, type ---------- S60.
Hydraulic pump, make ---------- Vickers.
Hydraulic pump, type ---------- V230-8-1A-12.
Governor, make ---------- Novi.

Governor, type ---------- 5186-AB.
Hourmeter, make ---------- Durant.
Hourmeter, type ---------- HM-7429-13-AC.
Oil filter, make ---------- Fram.
Oil filter, type ---------- 8080.
Oil filter, case ---------- 5214.
Oil filter element ---------- Senior.
Oil pressure adapter, make ---------- Stewart Warner.
Oil pressure adapter, type ---------- 353 L 80.
Suppression capacitor, make ---------- Tobe.
Suppression capacitor, type ---------- SIR 9 C4-442.
Suppression capacitor, rating ---------- 0.1 MFD 100 V DC.
Battery, make ---------- Auto Lite.
Battery, type ---------- CFR-129.
Battery, volts ---------- 12.
Battery, group ---------- 2.

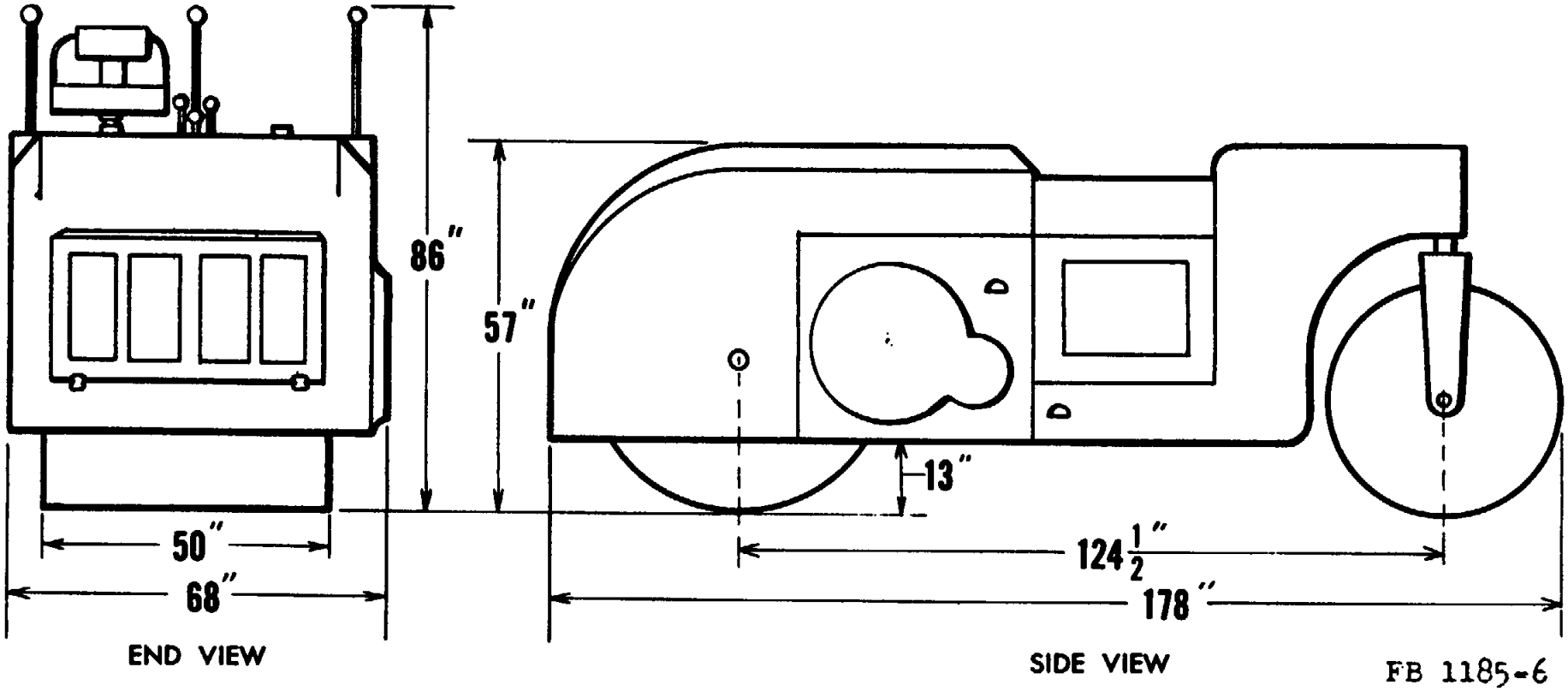


Figure 6. Road roller dimensions .

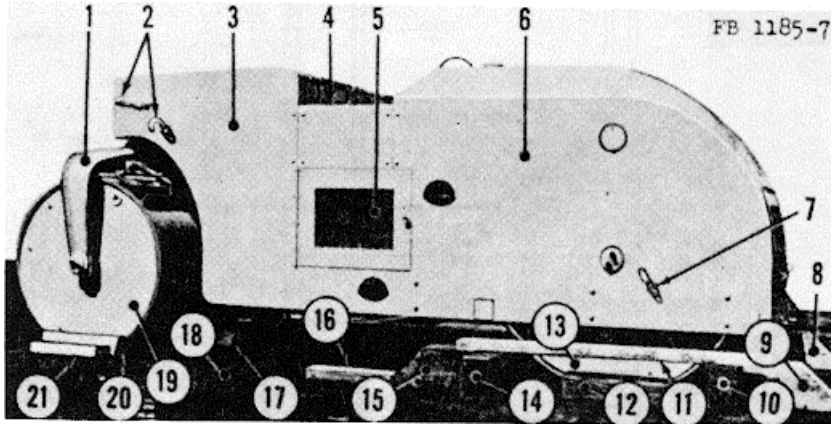
CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

7. New Equipment

a. General (fig. 7). The road roller is usually delivered on a flatcar (18). The steering roll (19) is secured on the left and right sides with blocks (17 and 20) and reinforcing blocks (21). There are no loading blocks in the front and rear of the steering roll. The compression roll (13) is secured with front (10) and rear (14) blocks, support blocks (8, 9, and 15), side blocks (12), and reinforcing boards (11 and 16). The sprinkler tank and the water ballast in the rolls are drained before shipment.



1	Steering yoke	12	Side block
2	Rear lifting hooks	13	Compression roll
3	Rear housing	14	Rear block
4	Operator's platform	15	Support block, right rear
5	Side door	16	Rear reinforcing block
6	Compression roll housing	17	Steering roll block, left
7	Front lifting hook	18	Flatcar
8	Support block, left front	19	Steering roll
9	Support block, right front	20	Steering roll block, right
10	Front block	21	Reinforcing block, right
11	Reinforcing board		

Figure 7. Road roller blocking for shipment.

b. Unloading the Roller With Crane (fig. 7).

(1) Remove the loading blocks (20 and 17) and reinforcing blocks (21) which secure the steering roll (19) on the flatcar (18).

(2) Remove the reinforcing boards (11) on the right and left sides of the compression roll (13).

(3) Remove the support blocks (8, 9, and 15) which secure the front (10) and rear (14) blocks.

(4) Remove the front (10) and rear (14) blocks from the compression roll (13).

(5) Remove the side blocks (12).

(6) Use reliable crane and make sure that the lifting capacity of the crane is not less than 17,000 lbs.

(7) Fasten cables or chains of the crane to the front (7) and rear (2) lifting hooks of the road roller and take up the slack.

(8) Slowly and carefully lift the road roller clear of the flatcar and move it to a convenient location.

(9) Slowly lower the roller to the ground and remove lifting cables or chains.

c. Assembly of Removed Parts.

(1) *Operator's seat.* The operator's seat (8, fig. 1) has been removed from the operator's platform and stored on the floor of the engine compartment. Remove the waterproof paper and protective tape from the operator's sent. Install the operator's seat on the seat post (5, fig. 1).

(2) *Control levers.* The forward and reverse clutch levers (4, fig. 1) and the steering lever (7) have been removed from the road roller and stored on the floor of the engine compartment. Remove the waterproof paper and protective tape from the levers. Install the levers in their proper places and tighten the mounting nuts securely.

(3) *Batteries.* The batteries are shipped on the road roller in their proper mounting place. Remove the insulating tape from the battery cables and install the cables on the battery terminals. Make sure that the terminal connections are clean and tight. Check the battery charge and electrolyte level. Add distilled water if necessary (par. 111*g*).

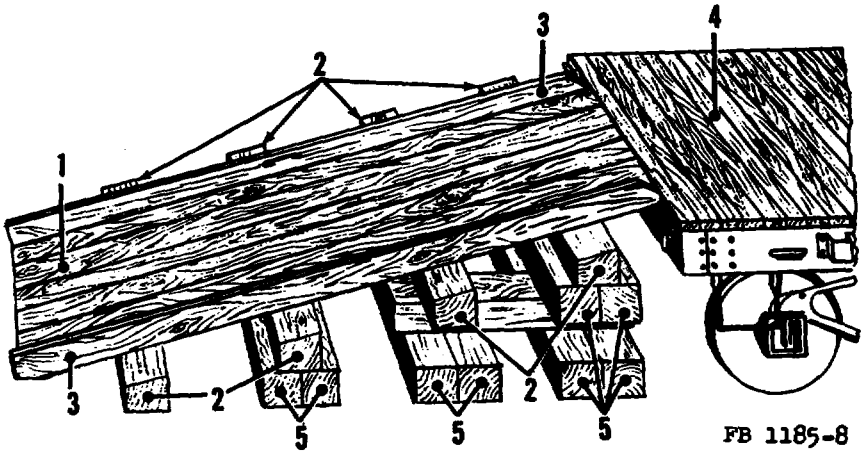
d. Unloading the Road Roller With a Ramp.

(1) *General.* If crane equipment is not available, a ramp (fig. 8) must be used to unload or load the roller on a flatcar. The roller may be moved over several flatcars to its proper flatcar by the use of spanning platforms (fig. 9) placed between cars. This method requires that the order of loading be carefully planned, so that rollers are arranged on flatcars in the desired

order. Do not forget to lower the brake wheel to the floor of each flatcar to allow the road roller to pass.

(2) *Runway.* Level the road bed at the loading end of the rearmost flatcar to the top of the rails, using 6 - x 8 - inch timbers. When such timbers are not available, use dirt and cinders to make a level approach or runway.

(3) *Ramp.* Use permanent ramps for unloading when available. When such ramps are not available, use improvised ramps (17,500-lb. maximum capacity), constructed of railroad ties and other available lumber.



1 Runner board
2 Beveled ties
3 Guide board
4 Flatcar
5 Lower ties

Figure 8. Construction of improvised ramp.

(a) *Railroad ties.* For the construction of the ramp, 14 railroad ties are required. Locate the ties (5, fig. 8) across the tracks. Bevel the four ties (2) on which the runner boards (1) rest, so that the boards are not resting on the edges of the ties. Secure the lower ties (5) with stakes when positioned on a dirt runway or with nails when positioned on a timber runway.

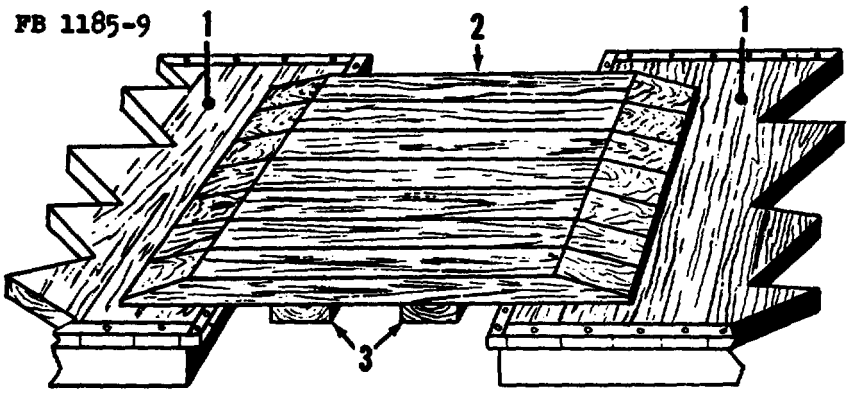
(b) *Runner boards.* Six 3-in. x 15-in. x 16-ft. boards are also required. Bevel both ends of boards (1, fig. 8) to permit ease in unloading. Locate the boards (1) across the beveled ties (2). Nail all boards to the beveled railroad ties (2).

(c) *Guide boards*. Two 1-in. x 6-in. x 16-ft. boards complete the ramp. Nail the guide boards (3) on the outer side of the runner boards to guide the road roller during unloading.

(4) *Spanning platforms* (fig. 9). Use spanning platforms between flatcars (1) to move the road roller along the length of the train.

(a) *Spanner boards* (fig. 9). Use six 3-in.x 15-in. x 48-in. boards for the construction of spanning platforms. Bevel both ends of each board. Nail the spanner boards (2) to cleats (3).

(b) *Spanner cleats* (fig. 9). Use two 2-in. x 6-in.x 30-in. boards for the construction of the spanner cleats (3). Nail cleats to the spanner boards (2) approximately 15 inches apart.



1 Flatcar 2 Spanner board 3 Spanner cleats

Figure 9. Construction of spanning platform.

(5) *Unloading.* Assemble the removed parts (*c* above), start the engine (par. 28), and drive the road roller down the platform to the desired location.

e. Removal of Preservative Compounds, Lubricants, and Devices.

(1) *Doors.* Remove the protective tape and cardboard from the compression roll door (10, fig. 1) and side doors (14).

(2) *Instrument panel.* Remove protective tape from the instrument panel door. Open the door and remove the protective tape and plywood board from the instrument panel glass cover.

(3) *Operator's seat.* Remove the waterproof paper and protective tape from the operator's seat (8, fig. 1) cushion and backrest. Remove the protective tape from the operator's seat posts (5).

(4) *Control levers.* Remove the waterproof paper and protective tape from forward and reverse clutch levers (4, fig. 1), steering lever (7), and from all control lever mounting holes.

(5) *Carburetor.* Remove the waterproof paper and protective tape from the carburetor (17, fig. 3) and fuel filter (16).

(6) *Magneto.* Remove the waterproof paper and protective tape from the magneto (14, fig. 3); remove the protective tape from the magneto's ventilation holes.

(7) *Governor*. Remove the waterproof paper and protective tape from the governor (13, fig. 3) and its levers and linkages.

(8) *Fan belt.* Remove the protective paper from the fan belt (10, fig. 3). Turn the engine by hand to facilitate removal of the protective paper.

(9) *Oil filter.* Remove the waterproof paper and protective tape from the oil filter (3, fig. 4) and oil filter lines.

(10) *Hourmeter.* Remove the waterproof paper and protective tape from the hourmeter (4, fig. 4); remove the protective tape from the hourmeter glass cover.

(11) *Spark plugs and leads.* Remove the protective tape from the spark plugs (6, fig. 4) and spark-plug leads (5).

(12) *Starting motor.* Remove the waterproof paper and protective tape from the starting motor (12, fig. 4); remove the protective tape from the starting motor terminals and magnetic switch (13) leads.

(13) *Oil filler cap.* Remove the waterproof paper and protective tape from the oil filler cap (16, fig. 4) ; remove the protective tape from the oil-level gage (15).

(14) *Battery generator.* Remove the waterproof paper and protective tape from the battery generator (18, fig. 4); remove the paper strip from between the commutator and brushes. Remove the protective tape from the voltage regulator (17) and battery generator shielded leads.

(15) *Air cleaner.* Remove the protective tape from the air cleaner cup.

(16) *Tank caps.* Remove the protective tape from the radiator cap, fuel tank cap, hydraulic tank cap, and sprinkler tank caps.

(17) *Rolls.* The rolls have been drained and sprayed with a preservative. This preservative does not have to be removed.

(18) *Gears.* The gears have been covered with a rust-preventive lubricant. Do not remove this lubricant from the exposed gears.

f. Inspection.

(1) Make a visual inspection of the entire road roller. Look for broken or damaged parts, cracked housings, bent members and levers, and loose, broken, or missing bolts, nuts, and lockwashers.

(2) Open the side doors (14, fig. 1) and inspect the engine (figs. 3 and 4) for broken, damaged, or missing parts and accessories.

(3) Inspect the floor of the road roller under the engine and transmission for oil and grease drippings.

(4) Check the oil level in the crankcase and air cleaner cup.

(5) Check the level of the hydraulic fluid in the hydraulic tank. See that the hose connections are tight, clean, and leakproof.

(6) Inspect the fuel, oil, and sprinkler lines for leaks and loose or damaged connections.

(7) Check the coolant level in the radiator; check the radiator hose and connections for leaks.

(8) Inspect the fan-belt and hydraulic-pump-belt tension. Tension is correct when the belt can be depressed by thumb pressure one-half inch midway between the pulleys.

(9) With the ignition turned off, crank the engine by hand to be sure that the pistons and bearings are free.

(10) Start the engine and see that all instruments and control levers are operating properly.

(11) Drive the road roller forward and backward and check the operation of the forward and reverse clutches, master clutch, gearshift, and steering mechanism.

(12) While the roller is moving, depress the brake pedal to make sure it is operating properly.

(13) Fill the sprinkler tank with water and check the operation of the sprinkler system.

(14) See that all tools and publications assigned to the road roller are accounted for.

g. Service.

(1) Lubricate the road roller according to LO 5-1185.

(2) Perform preventive maintenance services described in paragraph 54*c*.

(3) Remove the fuel tank cap and fill the fuel tank with clean fuel. The capacity of the fuel tank is 24 gallons.

(4) Remove the hydraulic tank pipe cap and fill the hydraulic tank with hydraulic fluid. The capacity of the hydraulic tank is 6 gallons.

(5) Remove the sprinkler tank caps and fill the sprinkler tank with water. The capacity of the sprinkler tank is 130 gallons.

(6) Remove the radiator cap and fill the radiator with clean water. Do not use water with high mineral content. When adding antifreeze, allow enough room for expansion. The capacity of the cooling system is 5 gallons.

8. Used Equipment

a. General. Used road rollers which have been stored and shipped in conformance with Army specifications are ready for use on arrival, after a brief check. Special care must be paid to inspection.

b. Unloading. Refer to paragraph 7*b* and *d*.

c. Inspection. Refer to paragraph 7*f*.

d. Service. Perform all services described in paragraph 7*g*. Clean dust and dirt from the road roller housing and operator's platform. Inspect and clean the engine. Check the oil level in the crankcase; add oil if necessary. Correct or report any deficiencies noted.

Section II. CONTROLS AND INSTRUMENTS

9. General

This section describes, locates, illustrates, and furnishes the operator sufficient information about the various controls and instruments for the proper operation of the materiel.

10. Forward and Reverse Clutch Levers

a. Location. The forward and reverse clutch levers (1, fig. 10) are located on the extreme left and right sides of the rear housing assembly (19).

b. Purpose. The forward and reverse clutch levers control the forward and reverse movement of the road roller.

11. Brake Pedals

a. Location. The brake pedals (2, fig. 10) are located on the extreme left and right sides of the operator's platform (11).

b. Purpose. The brake pedals are used to stop, the roller while in operation and to set the parking brake. A ratchet locks the brake pedal for parking position.

12. Steering Lever

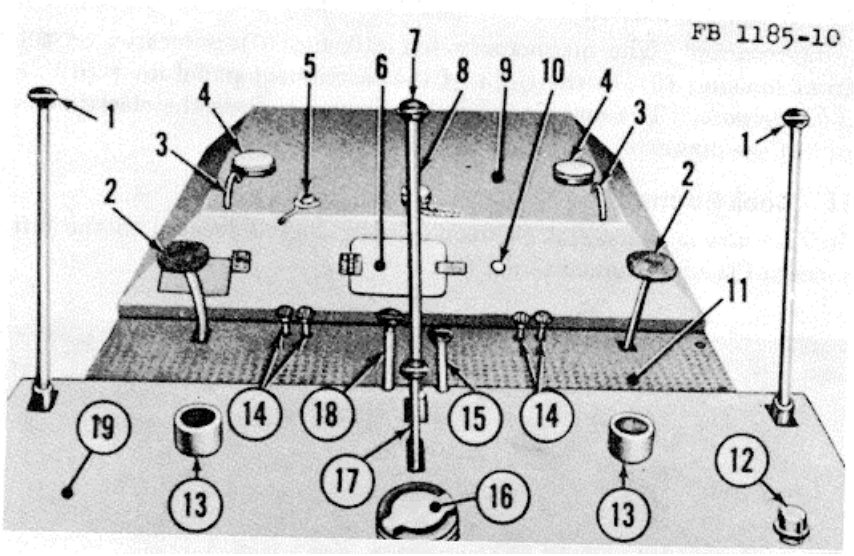
a. Location. The steering lever (7, fig. 10) is located in the center of the rear housing (19).

b. Purpose. The steering lever controls the movement of the steering roll to the left or right and provides directional control of the entire road roller.

13. Master Clutch Lever

a. Location. The master clutch lever (18, fig. 10) is located on the rear housing (19), at the left side of the steering lever (7).

b. Purpose. The master clutch lever is used for engaging and disengaging the master clutch. It also reduces the load on the starting motor when starting the engine.



EB 1185-10

1 Forward and reverse clutch lever
2 Brake pedal
3 Front housing lifting eye
4 Sprinkler tank filler cap
5 Fuel gage transmitter
6 Instrument panel door
7 Steering lever
8 Fuel tank cap
9 Front housing
10 Magneto switch
11 Operator's platform
12 Hydraulic tank filler cap
13 Operator's seat post
14 Sprinkler pedals
15 Gear shift lever
16 Radiator filler cap
17 Governor control lever
18 Master clutch lever
19 Rear housing

Figure 10. Road roller, top view.

14. Gearshift Lever

a. Location. The gearshift lever (15, Fig. 10) is located on the rear housing (19), at the right side of the steering lever (7).

b. Purpose. The gearshift lever is used for low and high-gear shifting.

15. Governor Control Lever

a. Location. The governor control lever (17, fig. 10) is located on the rear housing (19), behind the steering lever (7).

b. Purpose. The governor control lever adjusts the engine speed to compensate for momentary operational load demands.

16. Sprinkler Control Pedals

a. Location. The dual sprinkler control pedals (14, fig. 10) are located on the left and right sides of the operator's platform (11).

b. Purpose. The sprinkler control pedals operate the valves which open and close the sprinkler system.

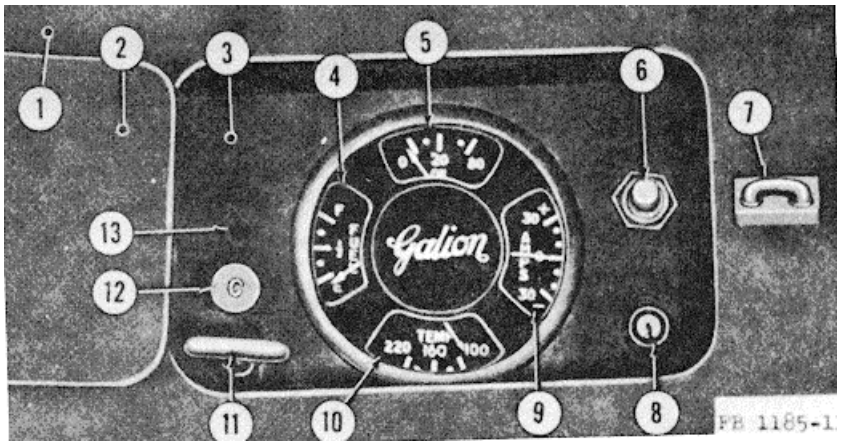
17. Magneto Switch

a. Location. The magneto switch (10, fig. 10) is located on the front housing (9), to the right of the instrument panel door (6).

b. Purpose. The magneto switch opens and closes the electric circuit of the magneto.

18. Choke Button

a. Location. The choke button (12, fig. 11) is located in the left corner of the instrument panel (3).



1 Front housing
2 Instrument panel door
3 Instrument panel
4 Fuel gage
5 Oil pressure gage
6 Starter button
7 Door latch
8 Ignition switch
9 Battery charging ammeter
10 Temperature gage
11 Throttle lever
12 Choke button
13 Hole for additional control installation

Figure 11. Instrument panel

b. Purpose. The choke button closes the carburetor choke valve and enrichens the combustion mixture to help start the engine in cold weather.

19. Throttle Lever

a. Location. The throttle lever (11, fig. 11) is located in the lower left corner of the instrument panel (3), below the choke button (12).

b. Purpose. The throttle lever is used to increase or decrease the speed of the engine.

20. Starter Button

a. Location. The starter button (6, fig. 11) is located on the instrument panel (3) at the right of the cluster gage.

b. Purpose. The starting button is used to start the engine.

21. Ignition Switch

a. Location. The ignition switch (8, fig. 11) is located in the lower right corner of the instrument panel (3).

b. Purpose. The ignition switch is used to open and close the electrical circuit of the engine.

22. Oil Pressure Gage

a. Location. The oil pressure gage (5, fig. 11) is located on the top of the cluster gage.

b. Purpose. The oil pressure gage indicates the pressure at which the oil is being supplied to the engine. At normal operating speeds, the pressure must range between 20 and 50 pounds.

Note. When the oil pressure is less than 10 pounds, or more than 50 pounds, stop the engine and determine the cause of the low or high reading.

23. Battery Charging Ammeter

a. Location. The battery charging ammeter (9, fig. 11) is located on the right side of the cluster gage.

b. Purpose. The battery charging ammeter shows the amount of electricity flowing into the battery or out of the battery. If the electrical units of the engine require more electricity than the generator is producing, the indicating hand of the ammeter will be on the minus side of the ammeter and show a discharge of the battery. If the output of the generator is greater than the electricity required, the indicating hand will be on the plus side of the ammeter and show charge. With the engine running at normal operating speeds, the battery charging ammeter should approach zero or show just a slight charge.

Note. **If the ammeter shows a continuous low or high charge, stop the engine and determine the cause of the low or high readings.**

24. Temperature Gage

a. Location. The temperature gage (10, fig. 11) is located on the bottom of the cluster gage.

b. Purpose. The temperature gage indicates the temperature of the coolant in the cylinder block. The normal temperature reading is between 130° and 190° F. Readings above or below this range indicate trouble in the cooling or lubricating systems.

Note. **When the engine overheats, or Is continuously overcooled, stop the engine and determine and correct the trouble.**

25. Fuel Gage

a. Location. The fuel gage (4, fig. 11) is located on the left side of the cluster gage.

b. Purpose. The fuel gage indicates the amount of fuel in the fuel tank.

26. Hour-Meter

a. Location. The hourmeter (4, fig. 4) is mounted on the cylinder head of the engine.

b. Purpose. The hourmeter records the hours of operation by converting the number of engine revolutions into hours of running time.

Section III. OPERATION UNDER USUAL CONDITIONS

27. General

a. The instructions in this section are published for the information and guidance of the personnel responsible for the operation of this road roller.

b. It is essential that the operator know how to perform every operation of which this road roller is capable. This section gives instructions on starting and stopping the road roller, instructions on the basic motions of the road roller, and instructions on how to coordinate the basic motions to perform the specific tasks for which the road roller is designed. Since nearly every job presents a different problem, the operator may have to vary the given procedure to fit the individual job.

28. Starting

a. Refer to paragraph 52*c* and perform the before-operation services.

b. Open the fuel shutoff valve under the fuel tank.

c. Pull the master clutch lever (18, fig. 10) back away from the compression roll to disengage the master clutch.

d. Put the forward and reverse clutch lever (1, fig. 10) in neutral (central position).

e. Pull out the choke button (12, fig. 11). When starting in cold weather, pull the choke button all the way out. When starting at normal temperatures, pull the choke button about one-quarter of the way out.

f. Pull out the magneto switch (10, fig. 10).

g. Turn the key in the ignition switch (8, fig. 11) clockwise to the ON position.

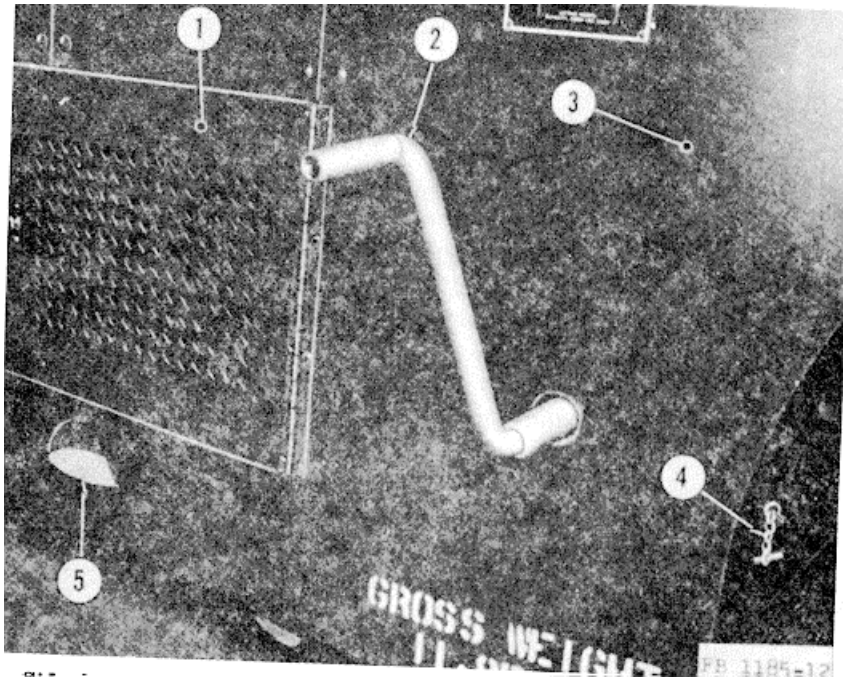
h. Push the starter button (6, fig. 11). If the engine does not start in 10 seconds, release the starter button.

Note. **Do not keep the starter button depressed for longer than 10 seconds.**

Release the starter button immediately after the engine starts. If the engine was overchoked, allow it to stand for a few minutes and then restart.

i. If the starting motor is defective or if the battery is discharged, use the cranking shaft (14, fig. 2) to start the engine. Insert the

cranking handle (2, fig. 12) on the cranking shaft and push the cranking handle until the gears engage. Turn the engine over until it starts. As soon as the engine starts, pull out the cranking shaft locking chain (4) to return the cranking shaft to neutral position. J As soon as the engine starts, push the choke button in and adjust it so that the engine runs smoothly without missing or spitting. When the engine reaches the normal operating temperature, push the choke button all the way in.



1 Side door
2 Cranking handle
3 Rear housing, left side
4 Cranking shaft locking chain
5 Step well

Figure 12. Side view showing cranking handle.

k. Check the oil pressure on the oil pressure gage (5, fig. 11). The normal oil pressure is between 20 and 50 pounds per square inch. The pressure may be higher while the engine is cold and should drop to a normal position when the engine warms up. If the oil pressure gage does not register oil pressure, stop the engine immediately and determine the cause.

l. Check the coolant temperature on the temperature gage (10, fig. 11). The normal temperature reading is between 130° and 190° F. Readings above or below this range indicate trouble in the cooling or lubricating systems.

29. Stopping

a. Pull the master clutch lever (18, fig. 10) back (away from the compression roll) to disengage the master clutch.

b. Put the forward and reverse clutch lever (1) in neutral position.

c. Apply the brake pedal (2) and secure it with the ratchet.

d. Let the engine idle for 2 or 3 minutes to allow the pistons and valves to cool.

e. Push in the magneto switch (10).

f. Turn the key in the ignition switch (8, fig. 11) counterclockwise to OFF position.

g. Close the fuel shutoff valve.

30. Operating Details

a. Gear Shifting.

(1) Pull the master clutch lever (18, fig. 10) back and disengage the master clutch.

(2) Push the gearshift lever (15) forward (towards the compression roll) to engage the high gear.

(3) Pull the gearshift lever back (away from the compression roll) to engage the low gear.

(4) Push the master clutch lever forward (toward the compression roll) and engage the master clutch.

b. Forward and Reverse Shifting.

(1) Push the forward and reverse lever (1) toward the compression roll to move the roller forward.

(2) Pull the forward and reverse lever away from the compression roll to move the roller backward.

(3) Control all movement of the roller with these levers. Do not slip clutches. Operate the lever for complete engagement of the clutch.

c. Steering.

(1) Push the steering lever (7) toward the compression roll to turn left.

(2) Pull the steering lever away from the compression roll to turn right.

d. Turning on Loose Gravel. Avoid large, sharp stones and other abrasive material that may damage the rolls. Do not turn sharply. Allow sufficient space for turning in order to protect rolls and graveled surface. Drive at slow speed to prevent displacing gravel and damaging rolls. Do not accelerate suddenly.

e. Turning on Plyable Material. When driving on freshly made pavement avoid sudden stops and starts. Engage the clutch slowly and do not jerk or brake suddenly. Do not attempt to turn around on freshly made pavement.

f. Backing Road Roller. Do not accelerate suddenly. Watch for stones, metal scrap, and other sharp matter which may damage the rolls. Avoid sharp and fast turns. Do not jerk or brake suddenly.

g. Sprinkler. The sprinkler system is controlled by the dual sprinkler pedals (14, fig. 10). The outside pedal operates the steering roll sprinkler valve. The inside pedal operates the compression roll sprinkler valve. Push the pedal down to open sprinkler valve. Use the sprinkler system only when needed. When not in use, raise the sprinkler mats to prevent unnecessary wear.

31. Operating on Bituminous-Macadam Pavements

a. Foundation Course. After the foundation course of crushed stone or gravel with a depth of 6 to 8 inches is laid evenly over the subgrade, the rolling must begin from the sides and progress toward the center. The roller must be kept moving parallel to the center line of the road. In the case of a superelevated road the rolling must be started at the low side of the curve and progress to the high side.

b. Wearing Course. Roll the wearing course in the same manner as described in *a* above. Continue to roll the wearing course stone until it is well keyed and suitable for the application of bituminous binder.

c. Key or Filler Stone. After the key or filler stone is evenly spread over the bituminous binder, the stone must be rolled as described in a above until the stone is bonded with the penetrated wearing course and makes tight and compact surface.

d. Cover Stone. The cover stone is rolled in the same manner as the key or filler stone (see *c* above).

32. Operating on Bituminous-Concrete and Sheet-Asphalt Pavements

a. *General.* The rolling methods described in b and c below will apply to the following types of bituminous-concrete and sheet-asphalt pavement constructions: Topeka (fine-graded bituminous concrete), Warrenite-Bitulithic (coarse-graded bituminous concrete), Amiesite, Tarvialithic, Tarmac, Slagmac, Westphalt, Colprovia, Macasphalt, and Precote.

b. Binder Course. The binder course mixture must be distributed in place by means of hot shovels and spread with hot rakes in a loose layer of uniform density and depth that when rolled will compact to the desired thickness. The binder course mixture must be rolled while hot. The rolling should start at the sides and proceed longitudinally toward the center by overlapping on successive trips by about one-half of the width of compression roll. After this rolling is finished, the pavement should be rolled diagonally, in two directions, so that the

second diagonal rolling crosses the lines of the first. The rolls must be sprinkled in order to prevent the asphalt from adhering to the rolls.

c. Wearing Course. The wearing course mixture should be rolled in the same manner as described in a and b above. During the rolling the surface must be tested for trueness and all irregularities must be corrected.

33. Operating on Fill Soils

Many fill soils will compress very little under this type of tandem roller. If available, use for such soils the tamping roller (also called the sheep's-foot roller) which is much more effective for fill soil jobs.

34. Handling on the Paving Job

a. While the officer in charge of the work must prescribe the amount and method of rolling necessary for a particular road material, the operator of the roller, to obtain the best results, must be guided by a few basic rules in handling the roller.

b. On soft, pliable materials, the roller must be run at slow speed so that the material will not be shoved or displaced. Do not accelerate the roller on the road material.

c. When rolling hot or tacky materials, the sprinkler system (which prevents material from sticking to the rolls) should be in perfect working condition. The roll scrapers must be properly adjusted.

d. Do not make sharp and fast turns. The roller must be steered slowly so that the material will not be marked or shoved out of place.

e. Start the roller moving slowly and smoothly. One of the easiest ways of damaging an asphaltic pavement during construction is to start rolling too fast and jerkily.

f. Do not leave the roller standing on a cooling or setting road surface, as the weight exerted by the rolls will leave depressions in the pavement.

g. Do not allow lubricants to drip onto the new material if it is of an asphaltic nature. Oil damages new asphalt by weakening its ability-to set properly. After lubricating the roller, be sure that all drain plugs are tightly closed, and that excess lubricants have been wiped off.

35. Movement to a New Location

If it is necessary to move the road roller a long distance, the road roller must be loaded on a flatcar or carrier. For complete loading and shipping instructions, refer to paragraph 7. When moving the road roller for short distances under its own power, the water must be drained from the rolls. Avoid paved surfaces. If it is necessary to drive over paved surfaces, drive slowly and avoid damage to the pavement. Watch the road for sharp rocks, nails, and scrap iron that may damage the roll faces. Do not drive at high speeds.

Section IV. OPERATION OF MATERIEL USED IN CONJUNCTION WITH THE ROAD ROLLER

36. Fire Extinguisher

a. Description. The fire extinguisher used on the road roller is of a vaporizing liquid type, pump operated, and uses carbon tetrachloride. The capacity of the fire extinguisher is 1 quart. This fire extinguisher is recommended and suitable for extinguishing fires on engine and electric equipment.

b. Location. The fire extinguisher is located on the left side of the rear housing.

c. Operation.

(1) In case of fire, remove the fire extinguisher from the road roller.

(2) Turn the pump handle (1, fig. 13) to the left, or counterclockwise, to release it from its locked position.

(3) Hold a finger over the outlet nozzle (4) and work the pump handle (1) 2 or 3 times, first with the outlet nozzle pointed up,

1 Pump handle
2 Pump valve
3 Body
4 Outlet nozzle
5 Filler cap
6 Shutoff valve

Figure 13. Fire extinguisher.

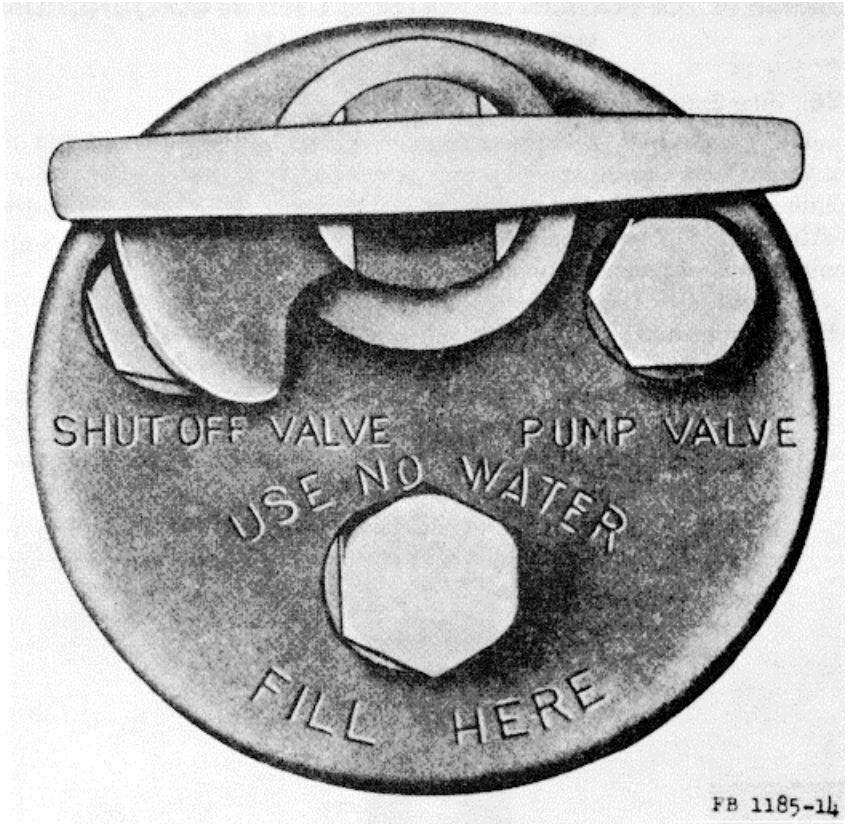


Figure 14. Top of fire extinguisher.

and then with the nozzle pointed down. This operation builds up pressure in the air chamber and forces the fluid to flow in a strong and steady stream when it is released.

(4) Continue to work the pump handle (1) up and down and direct the stream of the fluid on the fire at the base of the flame.

Caution: **Do not attempt to extinguish a fire in electrical equipment with water or other fluids that will conduct electricity.**

d. Recharging.

(1) Recharge the fire extinguisher at least once a year and after each use.

(2) Remove the filler cap (5, fig. 13) on the top of the fire extinguisher body.

Caution: **Carbon tetrachloride fumes are toxic. Avoid excessive inhaling and see that the room is properly ventilated.**

(3) Pour any liquid remaining in the extinguisher into a small container which can be used to refill the extinguisher.

(4) If the fluid is clean and contains no sediment, it may be reused.

(5) Use a small funnel to refill the extinguisher. Pour the fluid into the extinguisher until the fluid level is about one quarter of an inch from the top of the extinguisher body.

Caution: **Do not allow any water to get into the fluid or the extinguisher during the filling operation. Carbon tetrachloride mixed with water will cause serious corrosion.**

(6) Replace the filler cap (5, fig. 13) and tighten it with a wrench. Do not tighten the filler cap beyond a leakproof fit.

37. Lifting and Towing Attachments

a. Location. The road roller has two front lifting hooks (2, fig. 1) and four rear lifting hooks (5, fig. 2). The front lifting hooks are attached to the front housing and bolted to the longitudinal member of the frame. The rear mounting hooks are mounted on the rear housing, above the steering yoke. The towing bracket (11, fig. 1) is welded to the front cross-member of the frame.

b. Use. The lifting hooks are used for lifting the road roller to a carrier or flatcar or tying the roller down while it is being transported. The towing bracket is used for towing the road roller from one location to another. It may also be used as a tiedown attachment if necessary.

Section V. OPERATION UNDER UNUSUAL CONDITIONS

38. Operation in Extreme Cold (Below 0° F.)

a. Lubrication. Lubricate the road roller according to LO 5-1185.

b. Preventive Maintenance Services. Perform preventive maintenance services (paras. 51-54).

c. Cooling System. Check the antifreeze solution in the cooling system with an hydrometer. Add antifreeze if necessary. Check the cooling system and connections for leaks. Cover the radiator in extremely cold temperatures. When filling the radiator with antifreeze solution, refer to table I, showing the amount of antifreeze required for the protection at the temperatures indicated.

d. Fuel System. Moisture condenses and freezes in extremely cold temperatures, and ice particles may obstruct the flow of fuel through the fuel system. Keep the fuel tank full to avoid accumulation of moisture. Clean sediment and accumulated moisture from the fuel filter frequently. See that the fuel-line connections are tight.

Table I. Guide for the Initial Preparation of Antifreeze Solutions

Protection to -	Pints of antifreeze compound to be included in 1 gallon of water	Protection to -	Pints of antifreeze compound to be included in 1 gallon of water
20° F----------	1 1/2	-30° F ----------	4
10° F----------	2	-40° F ----------	4 1/4
0° F ----------	2 3/4	-50° F ----------	4 1/2
-10° F----------	3 1/4	-60° F ----------	4 3/4
-20° F----------	3/12		

Always use the proper grade of fuel to facilitate starting and achieve smoother engine operation in extremely cold weather.

e. Electrical System. Clean and tighten all electrical connections. See that the electrical wiring is free from ice particles and frozen moisture Check the battery cables and see that the cables and terminals are clean, free of ice or snow, properly connected, and tight. Check the specific gravity and freezing point of the electrolyte in the battery (refer to table III).

f. Personal Safety Precautions. Do not touch metal parts with bare hands in extremely cold temperatures. See that the step wells and the operator's platform are free from ice, slush, and snow.

g. Compression and Steering Rolls. Drain all water from the compression and steering rolls. If extra weight is needed, fill the rolls with used oil or an antifreeze solution (refer to table I).

h. Sprinkler Tank. Drain the sprinkler tank. Make sure that the sprinkler tank, pipes, hose, and connections are completely dry.

39. Operation in Extreme Heat

a. Lubrication. Lubricate the road roller according to LO 5-1185.

b. Preventive. Maintenance Services. Perform the services outlined in paragraphs 51 through 54.

c. Radiator. Check the radiator and see that the coolant is at its proper level, just below the overflow pipe. Fill the radiator if necessary. Inspect the radiator and cooling system for leaks.

d. Battery. Check the electrolyte level in the battery daily. Add distilled water if necessary.

e. Electric Wiring. Electric wiring insulation tends to swell up and soften in extremely high temperatures. Check the electric wiring system for swollen and broken insulation. Handle the wiring carefully and do not damage the insulation.

f. Side Doors. If possible, operate the road roller with the side doors open or removed.

40. Operation Under Dusty or Sandy Conditions

a. Effect on Equipment. Dust and flying sand penetrate bearings, bushings, and all moving parts and cause excessive wear. The road roller must be cleaned and lubricated more often when it is operated under dusty or sandy conditions.

b. Protection.

(1) Install protective screens or walls to protect the roller from flying sand during sandstorms.

(2) Every 4 hours, inspect the air cleaner, fuel filter, exposed gears, and all moving parts.

(3) When operating in a sandstorm, cover the aircleaner and fuel tank cap with a clean cloth to prevent the passage of dust and sand.

(4) Keep the side doors and the compression roll door closed.

(5) Use clean compressed air to remove sand and dust from the road roller and the engine.

(6) If possible, position the road roller so that the compression roll faces into the wind.

c. Lubrication. Lubricate the road roller more often according to LO 5-1185. Clean excess grease and lubricants from the grease fittings, bearings, bushings, and linkages.

d. Fuel System. Inspect the fuel filter frequently. Clean the sediment bowl if necessary. Cover the fuel tank cap with a clean cloth.

e. Cooling System. Inspect the radiator core and remove all imbedded foreign matter and sand by blowing it out from the fan side of the radiator. Check hose and connections for leaks.

f. Gears. Inspect exposed gears for sand deposits which might cause excessive wear. Clean the gears with cleaning solvent and apply new lubricant. Refer to LO 5-1185.

41. Operation in Salt Spray

a. Effect on Equipment. Salt spray develops a very fast corrosive action that may seriously damage the road roller. After each operation near salt spray, the road roller must be cleaned carefully.

b. Precautions.

(1) If possible, operate the road roller so that the compression roll is facing into the salt spray.

(2) Cover the compression roll housing with canvas to break the intensity of the flying salt spray.

(3) Keep the side doors closed.

(4) After each operation, wash the exposed parts of the road roller with clean water. Check for corroded or rust spots and repaint if necessary.

(5) Inspect the entire wiring system for salt sediment and wipe it clean.

42. Operation at High Altitude

The carburetor used on this road roller compensates automatically for changes in the atmospheric density resulting from changes of altitude. The road roller does not need special servicing or adjustment and will perform satisfactorily in high altitude areas.

43. Operation in Rain, Snow, or Sleet

a. Engine.

(1) Keep the side doors closed when operating the road roller in rain, snow, or sleet. Install protective shields to prevent snow or rain from entering the engine compartment.

(2) Keep the magneto, spark plugs, and spark plug cables dry. Accumulated moisture on the ignition wires and spark plugs may cause shorts in the electrical circuit, and the engine may miss or stop.

(3) When operating the road roller in high wind and rain, drive the road roller so that the radiator faces into the wind. This will lessen the amount of moisture and rain entering through the openings in the side doors.

(4) If it is necessary to operate the road roller in a blizzard, drive the road roller so that the radiator faces into the wind. Install a protective shield in front of the road roller to break the impact of the wind. Cover the top of the compression roll housing with a canvas cover and fasten the cover ends securely. Do not cover the radiator, or the engine will overheat.

(5) Do not handle the engine ignition wiring with wet hands. Moisture is a good conductor of electricity, and handling electrical wiring may cause serious shock. Always wipe hands dry and use woolen or rubber gloves when handling the wiring.

b. Transmission and Gears.

(1) Cover the side doors of the road roller to prevent rain, snow, or sleet from entering and settling on transmission and exposed gears.

(2) Wipe off accumulated moisture and lubricate the gears as specified in LO 5-1185.

44. Operation in Humid Climates

a. Effect on Equipment. The moisture caused by humid climates condenses on the road roller and may cause serious corrosion of all metal parts and wiring insulation. The road roller must be protected from moisture to avoid possible short circuits or engine misfiring.

b. Precautions and Remedies.

(1) If possible, keep the road roller in an open area where the wind will lessen the amount of condensation.

(2) If the road roller has to be located under trees, protect the top of the roller with a canvas cover.

(3) After each operating period, inspect the engine and wipe off the accumulated moisture from the wiring system, magneto, and spark plugs.

(4) If the road roller is idle for some time in humid weather, close the side doors and cover the road roller with a canvas cover.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

45. General

The tools and equipment listed in this section are those that are required to perform organizational maintenance on the tandem road roller. Standard mechanic's hand tools and on-equipment tools are not enumerated in this section.

46. On-Equipment Tools

The on-equipment tools normally supplied with this equipment for the use of the operator are listed in appendix III.

47. Special Organizational Maintenance Tools and Equipment

No special tools or equipment are required to perform the operations described in this chapter.

Section II. LUBRICATION AND PAINTING

48. General Lubrication Information

a. Lubrication Order 5-1185 prescribes first and second-echelon lubrication maintenance for the Roller, Road, Gasoline Driven, Tandem, 2 Axle, 5 to 8 Ton, Galion Model T5G, with Engine, Continental Model F-244.

b. A lubrication order is published for each item of equipment. The lubrication order for this materiel is shown in figure 15. For current LO 5-1185, refer to DA Pam 310-4.

c. Lubrication orders prescribe approved first and second-echelon lubrication procedures. The instructions contained therein are mandatory.

49. Detailed Lubrication Information

a. Care of Lubricant. Clean lubrication is one of the most important items in the maintenance of this roller. All lubricant chambers, fittings, and grease-gun nozzles must be kept clean and free of dirt and other abrasive materials. Cover lubricant chambers with a clean cloth when covers are removed.

LUBRICATION ORDER

LO5-1185

ROLLER, ROAD, GASOLINE DRIVEN, TANDEM, 2 AXLE, 5 TO 8 TON, GALION MODEL T5G WITH ENGINE, CONTINENTAL MODEL F-244

References: TM 5-1185

Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be shortened to compensate.

Clean fittings before lubricating.

Relubricate after washing or fording.

Clean parts with SOLVENT, dry-cleaning, or with OIL, fuel, Diesel. Dry before lubricating.

Lubricate points indicated by dotted arrow shafts on both sides of equipment.

Drain crankcase and gear cases only when hot after operation; replenish and check level when cool.

—KEY—

LUBRICANT	CAPACITY	EXPECTED TEMPERATURE			INTERVALS
		Above +32°F	+32°F to −10°F	Below −10°F	
OE—Oil, Engine Heavy Duty		OE 30 or 9250	OE 10 or 9110	See Note 1	D—Daily
Crankcase	5 qts				
Air Cleaner		OE 30 or 9250	OE 10 or 9110	OHA	W—Weekly
Other Points					
OH—Oil, Hydraulic		OH	OH	OHA	2W—2 Weeks
Hydraulic Oil Tank	24 qts				
GO—Lubricant, Gear, Universal		GO-90	GO-75	GO-S	Q—Quarterly
Trans-mission	8 qts				
CW—LUBRICANT, Chain, Exposed Gear and Wire Rope, Type II.					
GAA—GREASE, Automotive and Artillery.					

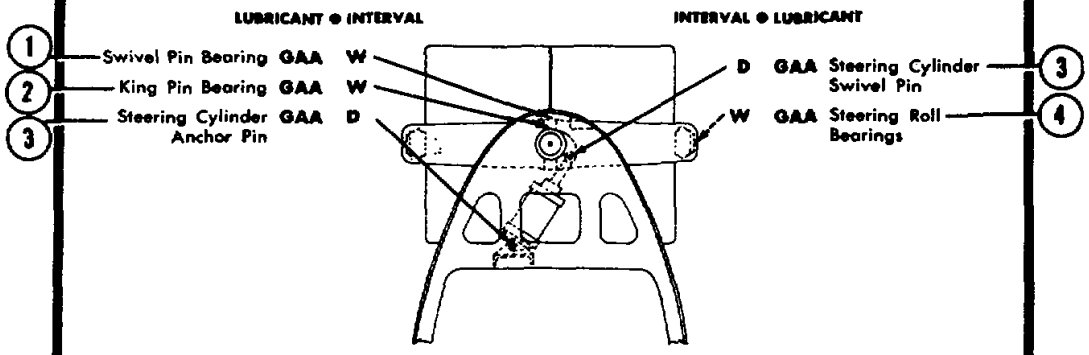


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Figure 15. Lubrication order-LO 5-1185.

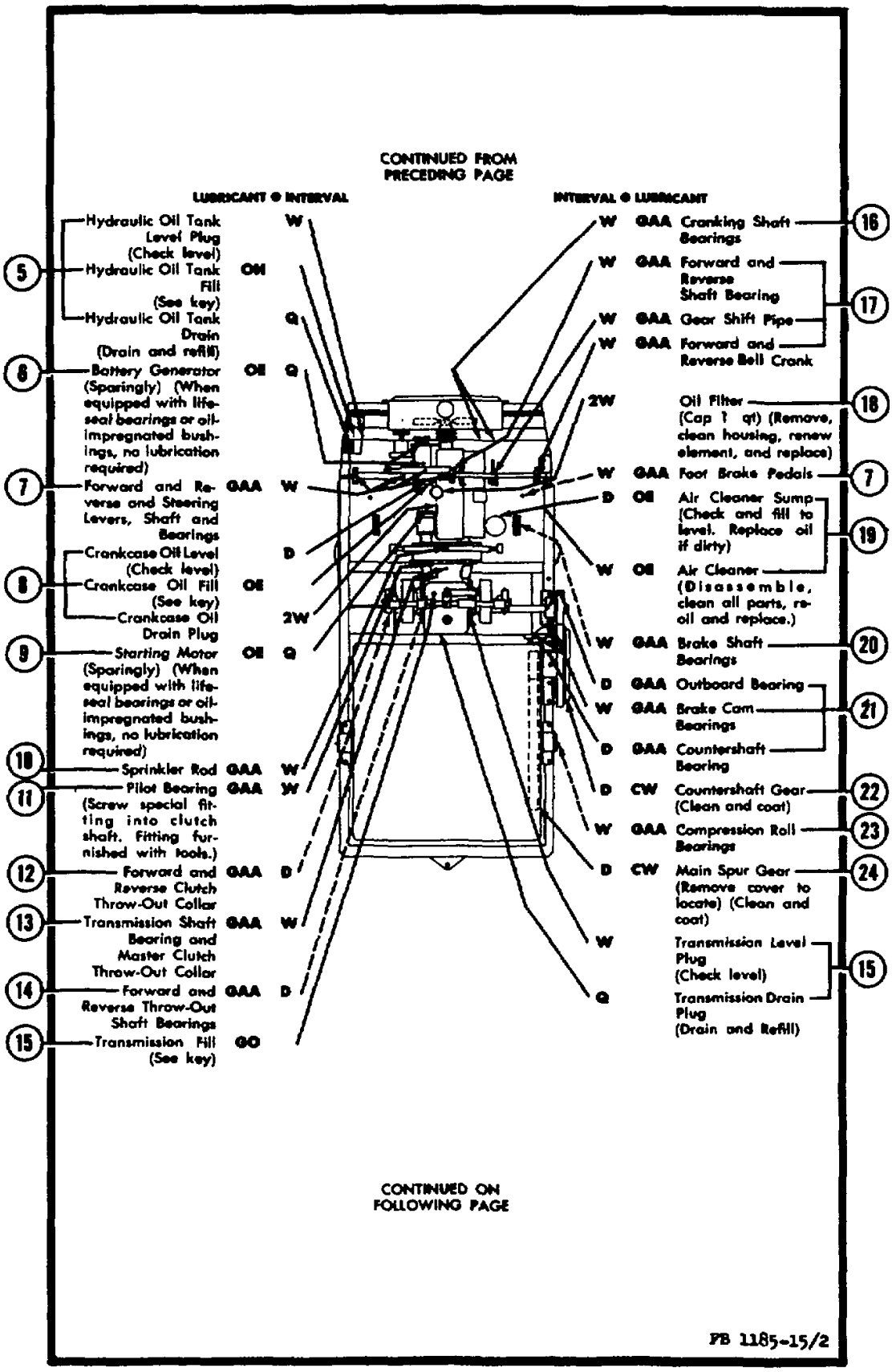

Figure 15-continued.

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NOTES:

1. COLD WEATHER (When winterization kit is not available). ENGINE CRANKCASE: Every 3 days drain crankcase; refill to "Full" mark with OE 10. Add 1 1/2 qts. of gasoline and run engine 5 minutes to mix. Mark the new level on the gage for reference. CAUTION: Every 1/2 day check level and fill to "Full" mark with OE 10. If engine is to be shut down for 1/2 day or more, add 1 1/2 qts gasoline to reach new level mark and operate engine 5 minutes to mix. NOTE: OIL, fuel, Diesel may be used as a temporary dilutent only when sufficient gasoline is not available. WARNING: Dilutent used is flammable. Do not service equipment near heater or open flame.

2. FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURE BELOW -10° F. Remove the lubricant prescribed in the key for above -10° F. Clean parts with solvent, dry-cleaning, and drain gear cases. Relubricate with lubricants indicated in the key for below -10F temperatures.

3. OIL CAN POINTS. Weekly, lubricate throttle and governor connections, clutch, brake, and steering valve linkage clevis pins, hood, fasteners, and door latches.

4. DO NOT LUBRICATE - The governor, magneto, or water pump.

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained herein are mandatory and supersede all conflicting lubrication instructions dated prior to the date of this Lubrication Order.

BY ORDER OF THE SECRETARY OF THE ARMY

M. B. RIDGWAY
General, United States Army
Chief of Staff.

OFFICIAL:

JOHN A KLEIN,
Major General, United States Army,
The Adjutant General.

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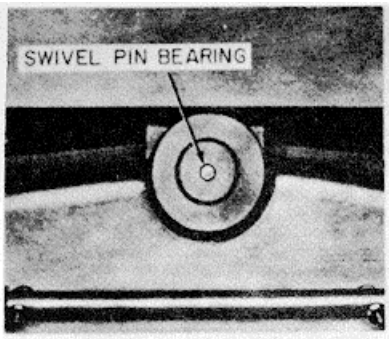
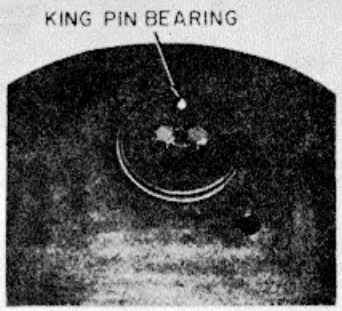
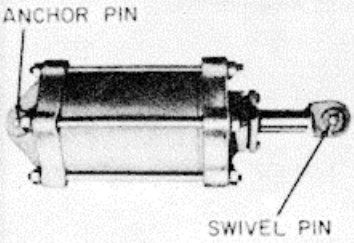
Figure 15-Continued.



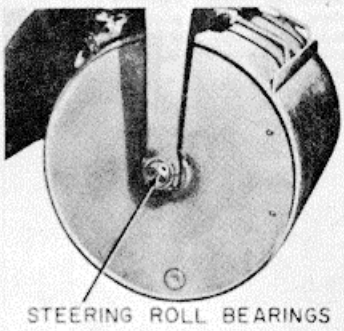
REFERENCE 1: Clean fitting and lubricate with grease gun.



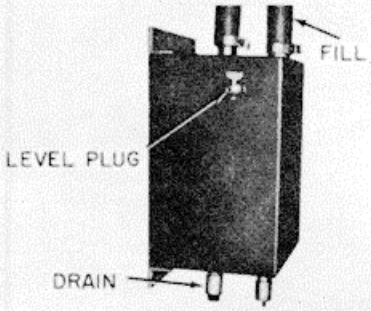
REFERENCE 2: Clean fitting and lubricate with grease gun.



REFERENCE 3: Clean fittings and lubricate with grease gun.



REFERENCE 4: Clean fittings and lubricate with grease gun.



REFERENCE 5: Check level and fill if necessary. Drain and refill as required.

REFERENCE 6: Lubricate sparingly. See lubrication order.

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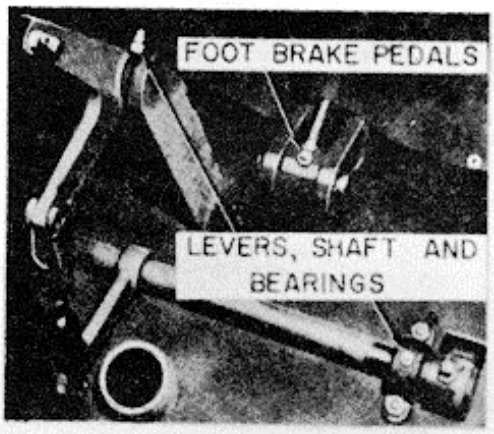
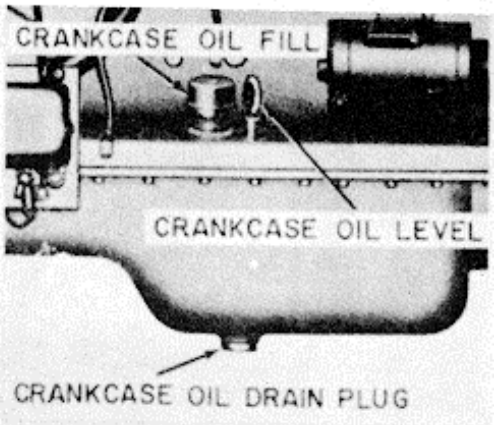
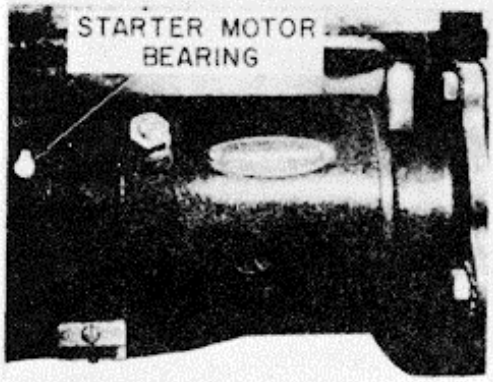
Figure 15-Continued.



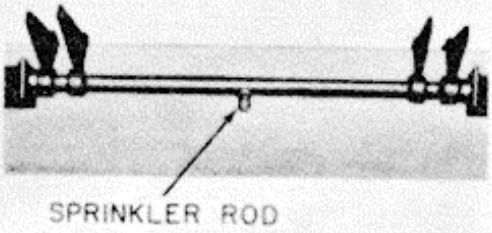
REFERENCE 7: Clean fittings and lubricate with grease gun.



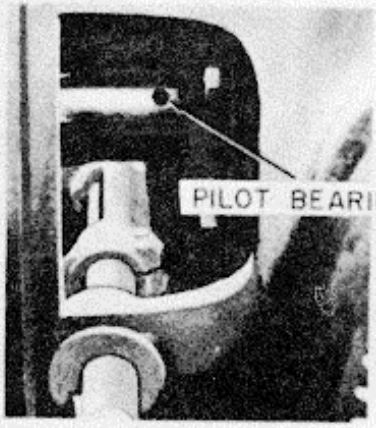
REFERENCE 8: Check level on gage. Remove cap and fill if necessary. Drain and refill as required.



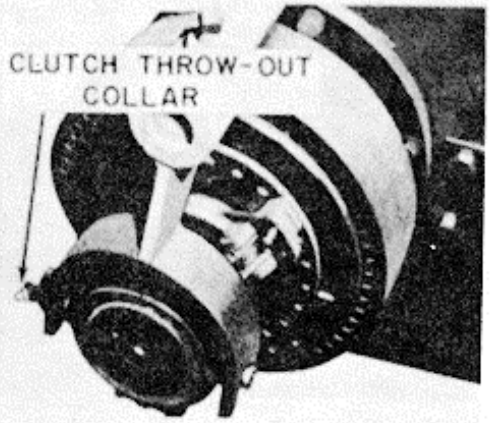
REFERENCE 9: Lubricate sparingly. See lubrication order.



REFERENCE 10: Clean fittings and lubricate with grease gun.



REFERENCE 11: Screw special fitting into clutch shaft. Lubricate with grease gun.



REFERENCE 12: Clean fittings and lubricate with grease gun.

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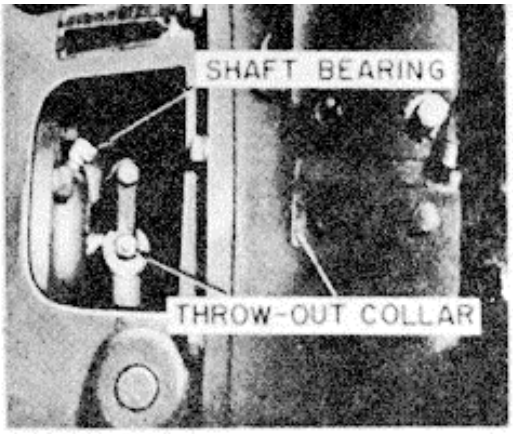
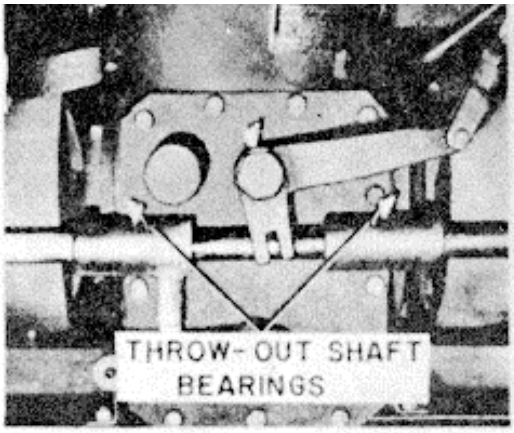
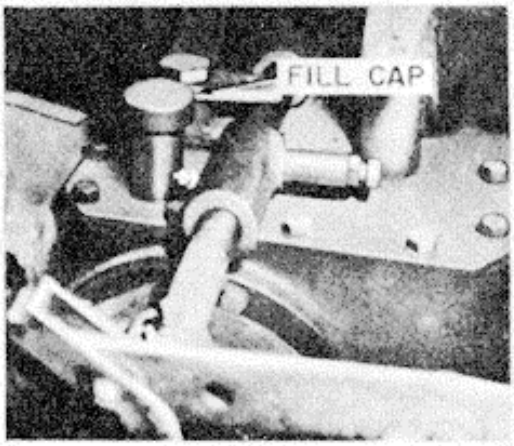
Figure 15. --Continued.



REFERENCE 13: Clean fitting and lubricate with grease gun

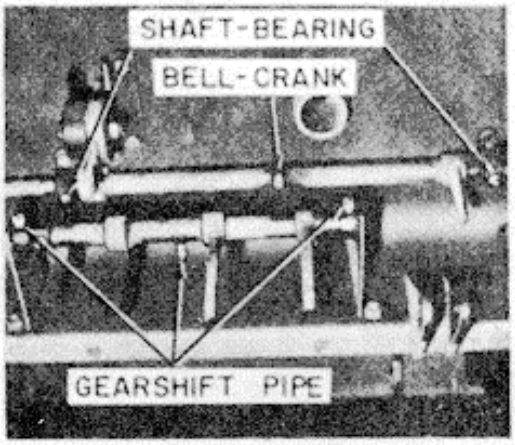


REFERENCE 14: Clean fittings and lubricate with grease gun.

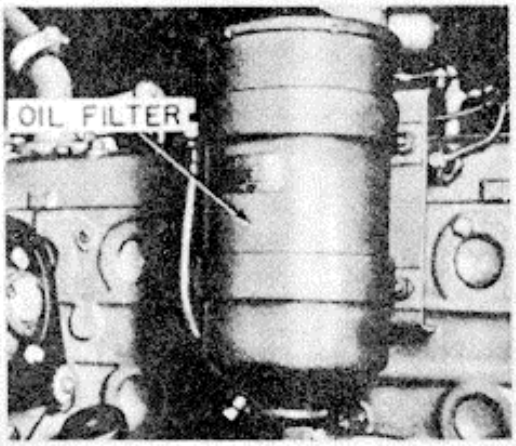


REFERENCE 15: Check level at plug on side. Remove cap to fill. Remove plug at bottom of case to drain.

REFERENCE 16: Clean fittings and lubricate with grease gun.



REFERENCE 17: Clean fittings and lubricate with grease gun.



REFERENCE 18: Remove, clean housing, renew element, and replace.

Figure 15. -Continued.

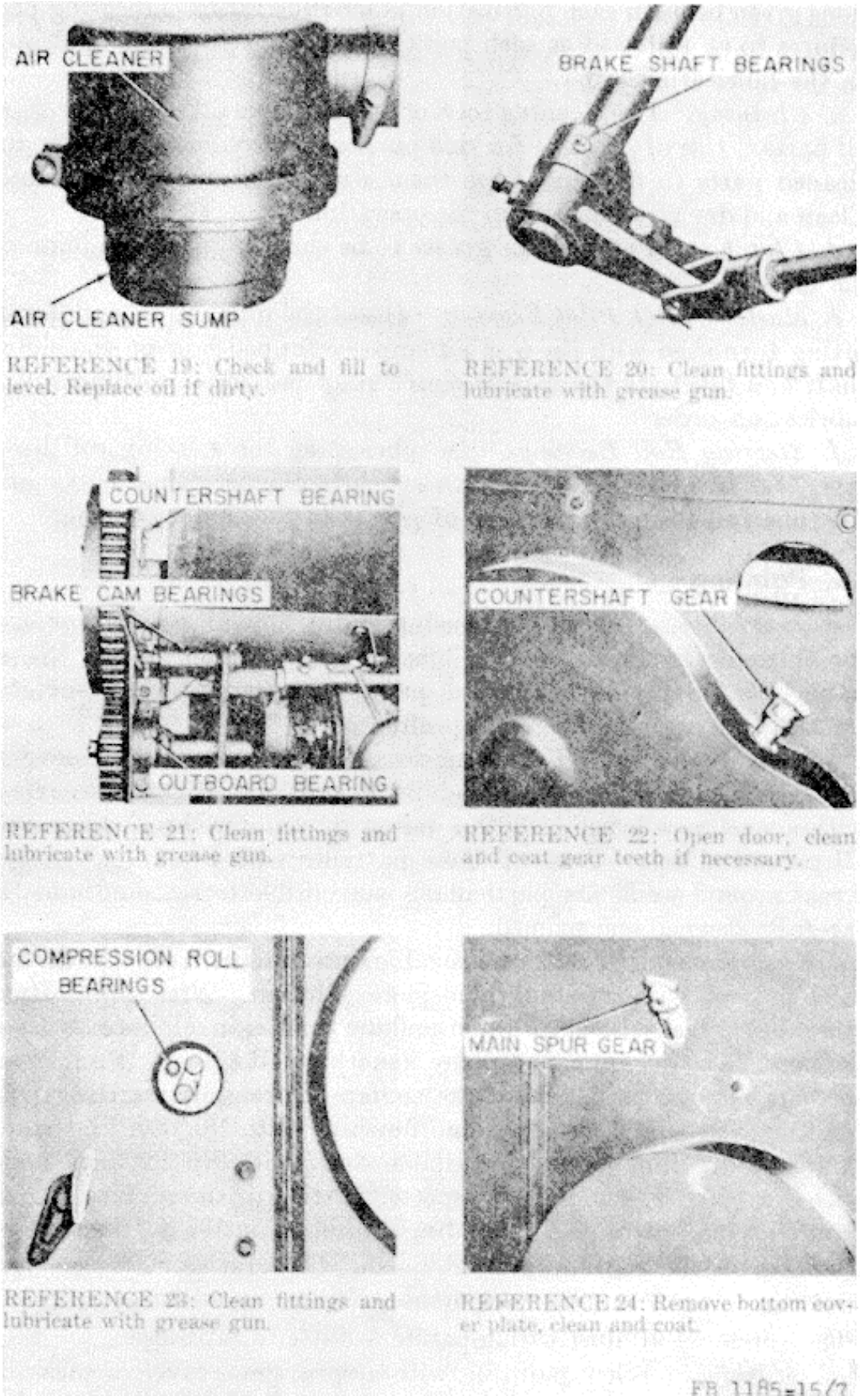


Figure 15. --Continued.

b. Points of Application. Follow the detailed lubrication instructions given beneath each lubrication point illustration indicating procedures to be followed at each point. Apply the lubricant indicated on the lubrication order.

c. Cleaning. Use cleaning solvent or diesel fuel oil to clean or wash all parts. Use of gasoline for this purpose is prohibited. Allow the cleaned parts to dry and wipe them with a clean absorbent cloth. Clean and dry all tools used in the operation.

d. Clutch. Do not permit grease to be thrown and accumulate on the clutch.

e. Master Clutch Pilot Bearing. Insert the pipe nipple and grease fitting furnished with the tool kit into the tapped hole on the clutch shaft and lubricate the master clutch pilot bearing according to the lubrication order.

f. Steering Roll Bearing. In lubricating the steering roll bearings, bear in mind that you must keep the space between the axle and the tube full to insure delivery of grease to the center bearings.

50. Painting

a. Inspection. Inspect the housing, engine, and all painted surfaces for chipping, cracked, peeling, blistering, or swollen paint. Never paint over loose or badly cracked paint. Inspect the metal surfaces for rust, corrosion, pitting, and peeling paint.

b. Removing Rust. Use paint scrapers and chisels to remove as much scale, rust, peeled paint, and dirt as possible. Brush the surface with a steel wire brush or with a power-driven wire brush to remove all paint and rust. Dust off loose particles with a painter's duster. Areas around welds are particularly susceptible to rust and must be carefully cleaned and primed.

c. Cleaning Bare Metal. Wash all grease and dirt from the surface to be painted with trisodium phosphate solution. After application, rinse the surface with clean water and dry with clean cloths or with an air hose. If trisodium phosphate is not available, paint thinners or solvents may be used. Sand the surface thoroughly, starting with No. 1 or No. 2 dry flint paper and finishing with No. 000 flint paper. If wet-or-dry flint paper is available, start with No. 220 and finish with No. 600. When only one spot or portion of the surface is to be painted, sand down the surrounding old finish until a feather edge is attained on the edge of the old finish. The old finish must slope smoothly away from the broken spot without any distinct ridge or edge. Remove all dust with a painter's duster or air hose.

d. Masking. When painting with a spray gun, cover or mask all gages, identification plates, instruments, threaded surfaces, lubrication fittings, and other parts which are not to be painted. Small areas or irregular shaped parts may be covered with crepe-backed masking

tape. On larger areas, use a sheet of wrapping or other paper slightly smaller than the part to be masked. Fasten the paper in place with masking tape, which is a convenient material to mask off irregular outlines. When spraying the engine, use painting bandages and painting socks instead of masking tape to protect rubber hose, ignition wires, and flexible tubing. Cut the bandages from closely woven cloth to fit the object to be covered. When calculating the length of the bandage, allow for hose clamps and similar obstructions. Let the bandage overlap generously. Drawstrings at each end and a string wrapped around the middle of the bandage and tucked under prevents overspray from striking the protected object. The painting sock is a cloth bag which fits over the ignition wires and distributor cap and has a drawstring which is drawn and tied below the distributor cap.

e. Painting. Paint the cleaned and sanded surfaces, using a spray gun or paintbrush. For detailed painting technique and selection of paint, refer to TM 9-2851.

Section III. PREVENTIVE MAINTENANCE SERVICES

51. General

The operator of the road roller and the organizational maintenance personnel must perform their preventive maintenance services regularly to make sure the road roller operates well and to lessen the chances of mechanical failure.

52. Operator Maintenance

a. Inspections. Inspections must be made before operation, during operation, at halt, and after operation, as described in this section. All inspections of assemblies, subassemblies, or parts must include any supporting members or connections and must determine whether the unit is in good condition, correctly assembled, secure, or excessively worn. Any mechanical condition which may result in further damage to the unit must be corrected before the equipment is operated.

(1) The inspection for "good condition" is usually an external visual inspection to determine whether the unit is damaged beyond safe or serviceable limits, or to determine if it is in such a condition that damage will result from the operation. The term "good condition" is further defined as not bent or twisted; not chafed or burned; not broken or cracked; not bare or frayed; not dented or collapsed; not torn or cut; adequately lubricated.

(2) Inspection of a unit to see that it is "correctly assembled" is usually an external visual inspection to determine whether it is in normal assembled position in the equipment.

(3) Check of a unit to determine if it is "secure" is usually an external inspection, a hand-feel, or a pry-bar or wrench check for looseness in the unit. Such an inspection should include brackets, lockwashers, locknuts, locking wires, or cotter pins used in the assembly.

(4) "Excessively worn" means worn close to or beyond serviceable limits, a condition likely to result in a failure if replacement of the affected parts is not made before the next scheduled inspection.

b. Reporting Deficiencies. The operator will report all deficiencies on DD Form 110.

c. Before-Operation Services. The following services will be performed to determine if the condition of the equipment has changed since it was last operated, and to make sure the equipment is ready for operation. Any deficiencies must be corrected or reported to the proper authority before the unit is put into operation.

(1) *Fuel.* Check fuel supply. See that fuel tank is full. Check reserve supply of fuel and replenish if necessary.

(2) *Water.* Check coolant level in radiator and see that it is up to proper level. When filling a cold radiator containing antifreeze, allow room for expansion. Check water level in the roll ballast. If sprinkler system is to be used, check water level in the sprinkler tank.

(3) *Lubrication.* Check oil level. Add oil if necessary. Check hydraulic oil tank supply; add oil if necessary.

(4) *Leaks, general.* Check for fuel and coolant leaks.

(5) *Visual inspection.* Check for loose or missing bolts, nuts, screws, loose connections, broken wires, and any damage that may have occurred since the equipment was last operated.

(6) *Starting.*

(*a*) Disengage master clutch; put forward and reverse clutch lever in neutral.

(*b*) Clear any obstructions from the path of the roller.

(*c*) Start engine (para. 28), and adjust equipment to proper operating tempo.

(7) *Instruments (gages).* Check all gage readings. Normal oil pressure is 30 pounds. Oil pressure will be above normal while engine is cold. It may drop below normal at idling speed after engine has warmed up. If oil-pressure indicator shows an unusual drop or no pressure, stop engine immediately and report condition to proper authority. Coolant temperature gage should show a gradual rise during the warmup period until it reaches the maximum of 1600 to 180° F. The ammeter should show in charge range. The hourmeter should register the number of hours that the equipment has been in operation.

d. During-Operation Services. The operator is responsible for correcting or reporting unusual sounds or odors, deficiencies in performance, or other signs of abnormal operation.

(1) *Instruments.* Check all gage readings frequently. At normal operating speeds, temperature, and load, readings should be as follows:

Engine oil pressure	20 to 50 psi.
Coolant temperatures	160° to 180° F.
Battery-charging ammeter	In charge range.

(2) *Unusual operation.* Check for unusual operation such as clutch or brakes slipping, steering faulty, gear shifting hard or impossible. Report any irregularity immediately to the proper authority.

(3) *Unusual noises.* Check for abnormal noises, especially from the engine and transmission. If any are noted, stop operation and report to the proper authority.

e. At-Halt Service. During halts, even if only for short periods, the operator should make a general check of the equipment and correct or report any deficiencies noted, in addition to performing the following specific duties:

(1) *Fuel.* Check fuel supply. Add fuel if necessary.

(2) *Oil.* Check oil in crankcase. Add oil if necessary. Check oil supply in hydraulic tank and add if necessary.

(3) *Water.* Check coolant level and add if necessary. Check water level in sprinkler tank if sprinkler system is being used. Check roll ballast water level.

Caution: **If the engine overheats because of lack of coolant, allow it to cool before filling the radiator. Otherwise, there is danger of cracking the cylinder head and block. If it is necessary to fill the radiator before the engine has cooled, be sure to fill it very slowly with the engine running at fast idling speed.**

(4) *Leaks, general.* Check for fuel, oil, and coolant leaks.

(5) *Visual inspection.* Make a visual inspection of the equipment checking for excessively worn, bent, cracked, or broken parts, and loose or missing bolts and pins.

f. After-Operation Services. To insure that the equipment is ready to operate at any time, the operator must perform the following services immediately after any operating period of 8 hours or less. All deficiencies must be corrected or reported to the proper authority.

(1) *Shutdown precautions.* Move the equipment to an area where there is the least danger of its being damaged. Park it on firm, level footing, especially if freezing temperatures are expected. Use blocks or other suitable material at the

front, rear, and outside the compression roll if necessary. Do not block the steering roll.

(a) Place the master clutch and forward and reverse clutch in neutral. Lock the brake pedals.

(*b*) Allow the engine to idle for a few minutes before stopping.

(2) *Fuel, oil, and water.* Check and refill all tanks. Change contaminated coolant. Check antifreeze if used. If antifreeze is added, mix the solution thoroughly by running the engine. When the temperature is below freezing, drain the sprinkler tank and roll ballast if the roller is to be idle.

(3) *Clean equipment.* Remove all dirt, excess grease, and asphalt from the machinery and operator's platform. See that the rolls and scrapers are clean. If freezing weather is expected, clean mud and dirt from parts where frozen material would interfere with the movement of any part of the roller.

(4) *Tools and equipment.* See that all tools and equipment assigned to the roller are serviceable, clean, and properly stowed or mounted.

(5) *Lubrication.* Lubricate as required by LO 5-1185.

(6) *Fuel strainer*. Remove, clean, and replace the fuel strainer (par. 103*b*).

(7) *Fire extinguisher*. Check its condition, mounting, and charge (par. 36*d*). Do not discharge any of contents.

(8) *Visual inspection*. Check for fuel, oil, and water leaks; loose or missing bolts, nuts, and pins; and for bent, cracked, or broken parts-paying particular attention to the rolls, scrapers, and operating controls. See that the battery is securely mounted and that connections and caps are clean and tight.

(9) *Protection.* Follow instructions outlined in (1) above. See that the front door assembly, side door assembly, instrument panel door, top cover assembly, and toolbox lid are closed and fastened. Cover the roller with a tarpaulin if exposed to weather.

53. Maintenance and Safety Precautions

a. Report or correct any mechanical deficiencies that may result in further damage to the roller if operation is continued.

b. When rolling a hot or "tacky" surface, it is necessary that the sprinkler system be operated to keep all roll surfaces wet.

c. Apply brakes and engage clutches carefully. Sudden engagement of clutches or application of brakes causes undue strain on the roller.

d. Keep clutch and brake linings free of oil and grease.

e. Do not attempt to pave areas that are excessively rocky.
f. Never operate the engine under a continuous strain for long periods of time.

54. Organizational Maintenance

a. Organizational preventive maintenance is performed by organizational maintenance personnel, with the aid of the operator, at weekly and monthly intervals. The weekly interval will be equivalent to 60 hours of use. The monthly interval will be equivalent to 4 weeks, or 240 hours, of use, whichever occurs first.

b. The technical inspection column is provided for the information and guidance of personnel performing technical inspection, and constitutes the minimum inspection requirements for the equipment.

c. The preventive maintenance services -to be performed at these regular intervals are listed and described below. The numbers appearing in the columns opposite each service refer to a corresponding number appearing on DA Form 464, and indicate that a report of the service should be made at that particular number on DA Form 464. These numbers appear in either second, third, or both columns, as an indication of the interval at which the service is to be performed.

Tech-nical inspec-tion	Service		GENERAL
	Monthly	Weekly	
1	1	1	*Before-operation services.* Check and perform services described in paragraph 52*c*.
2	2	2	*Lubrication.* Inspect the entire unit for missing or damaged lubrication fittings, lines, and grease cups, as well as for indications of insufficient lubrication.
2	2		Replace missing or damaged fittings, lines, and grease cups. Lubricate as specified in LO 5-1185.
3	3	3	*Tools and equipment.* Inspect the condition of all tools and equipment assigned to the unit. Check the condition and mounting of tool boxes and compartments.
3	3		See that all tools and equipment assigned to the unit are clean, serviceable, and properly stowed or mounted. See that tool boxes or compartments are in good condition and that they close and fasten properly.
4	4	4	*Fire extinguisher.* Check the fire extinguisher and inspect for full charge, proper working order, and secure mounting. The amount of charge in the carbon dioxide type of extinguisher can be checked only by weighing. Empty and full weights are stamped on the valve head. The amount of charge in the carbon tetrachloride type can be determined by shaking the extinguisher and judging by sound and weight whether it is full.
	4	4	See that any deficiencies are corrected or reported to the proper authority.

Technical inspection	Service: Monthly	Service: Weekly	
			GENERAL-Continued
5	5	5	*Publications.* See that a copy of this technical manual and LO 5-1185 are on the equipment and in serviceable condition. Standard Form 91, Operator's Report of Motor Vehicle Accident, must be included on all self-propelled equipment.
6	6	6	*Appearance.* Inspect the general appearance of the unit, paying particular attention to cleanness, legibility of identification markings, and condition of paint.
	6	6	Correct or report any deficiencies noted.
7	7	7	*Modifications.* See if all available modification work orders applying to this unit have been completed and recorded on DA Form 478, Organizational Equipment File.
			ENGINE AND ACCESSORIES
11	11	11	*Cylinder head, manifold, and gaskets (engine).* Inspect the cylinder head, manifold, and exhaust pipe for leaks, loose bolts and nuts, and defective gaskets. Check the condition of the exhaust muffler.
11	11	11	Tighten any loose bolts and nuts. Replace defective gaskets. On new or reconditioned engines, check the cylinder-head bolts for tightness at the first weekly service (par. 135*d*).
12	12	12	*Valve mechanism.* Check the valve adjustment if excessive tappet noise or loss of power is noted. The correct valve-tappet clearance with the engine warm is 0.014 inch.
	12	12	Adjust valve clearance if necessary (par. 136*b*). See that the valve cover gasket is in good condition and that the cover fits securely
13	13	13	*Compression test.* Test the compression of all cylinders and record readings on DA Form 464. For normal compression pressure at cranking speed with the engine at operating temperature, see paragraph 137.
14	14	14	*Crankcase.* Inspect the crankcase for leaks. Inspect the crankcase breather for dirt or damage.
	14	14	Correct or report any oil leaks noticed. Change oil and clean the breather if necessary.
15	15	15	Inspect the oil filter assembly and connections for leaks while the engine is running.
16	16	16	*Radiator.* Inspect the radiator for leaks, obstructions in the core air passages, and loose mounting bolts. Check the operating temperature and condition of the coolant. If the coolant temperature remains below 140° F. or rises above 190° F. during operation, the thermostat may be defective. If antifreeze is used, check the freezing point of the coolant.
	16	16	Drain, flush, and refill the cooling system if the coolant is contaminated with rust or dirt (par. 128). See that the core air passages are clean. Renew any damaged or defective cooling system hose, line, or gaskets. See that

Technical inspection	Service: Monthly	Service: Weekly	ENGINE AND ACCESSORIES-Continued
			all mounting bolts and connections are tight. Protect the coolant from freezing, and record its freezing point in DA Form 464.
17	17	17	*Water pump, fan, and shroud*. Inspect the water pump for leaks and for loose mounting and assembly bolts. Check the condition and mounting of the fan blades and shroud.
17	17		Tighten or replace loose or missing bolts and screws. If the pump leaks, tighten the packing nut only enough to stop the leak. Repack if necessary.
18	18	18	*Bells and pulleys.* Inspect for excessively worn, cracked, or frayed belt. Check the belt tension and condition and alinement of pulleys. Belts are properly adjusted when they can be deflected 1 inch from their normal positions, at a point midway between the pulleys.
18	18		Adjust tension of the belts if necessary (par. 130). Replace belts if frayed or badly worn. Replace all belts in sets. Never install new belts with worn pulleys or new pulleys with worn or frayed belts.
20	20	20	*Governor and linkage*. Check the governor adjustment. If the engine surges when running at top speed without load, the governor is out of adjustment.
	20	20	Adjust the governor if necessary (par. 108*c).*
			FUEL SYSTEM
39	39	39	*Carburetor and linkage*. See that all carburetor mounting and assembly bolts and screws are in place and secure. Check the condition and operation of linkage.
39	39		Tighten any loose mounting and assembly bolts and screws. Replace excessively worn or damaged linkage connections.
40	40	40	*Filters.* See that their mountings are secure. Check for loose screws and faulty gaskets. Inspect for fuel leaks.
40	40		Tighten any loose mounting screws. Remove and clean sediment and water out of the bowl. Replace the gasket if worn.
41	41	41	*Air cleaner*. Inspect for loose connections. Check the condition and level of oil in the bowl.
41	41		Service the air cleaner as specified in LO 5-1185. Make sure there are no air leaks between the air cleaner and carburetor.
43	43	43	*Fuel, lank, cap, and gaskets*. Inspect the condition and mounting of the fuel tank. Check the tank, fuel lines, feed valves, and connections for leaks.
43	43		See that the tank is securely mounted with its air vent open and filler cap clean and tight fitting. Repair or renew leaky or damaged fuel lines.

Technical inspection	Service: Monthly	Service: Weekly	ELECTRICAL SYSTEM
46	46	46	*Spark plug.* Inspect spark plugs for dirty or cracked insulators.
	46	46	Clean dirt and oil from spark-plug insulators.
46	------		Remove and clean the plugs and adjust the point gaps (par. 117*d*). See that plugs and gaskets are in good condition before they are replaced.
47	47	47	*Battery*. Inspect for a cracked or leaky case, for loose holddown clamps, and for dirt and corrosion on top of the battery. Check for loose, corroded, and damaged terminals and cables. Check level of the electrolyte; proper level is approximately one-half of an inch above the plates. Check the specific gravity and record reading on DA Form 464. A reading from 1.275 to 1.300 indicates a fully charged battery. Readings of 1.225 or below indicate the battery should be recharged or replaced.
47	47		Clean all dirt and corrosion off the top of the battery, posts, cables, and terminals. Replace damaged cables. Apply a thin film of chassis grease over the terminals. Add distilled water if needed to bring the solution up to proper level. If freezing temperatures prevail, the battery must be charged for a period long enough to mix the solution thoroughly. See that the battery is securely mounted, that filler caps are tight, and that vent holes are open.
48	48	48	*Generator and starter*. Inspect the generator and starting motor for loose mounting bolts and wire connections.
48	48	-----	Inspect commutators and brushes for excessive wear, dirt, and oil deposits. gee that brushes are free in their holders and that brush wires are secure.
48	48		Tighten any loose mounting bolts and wire connections. Replace or free-up brushes and clean commutators if necessary (par. 112*d*).
49	49	49	*Magneto.* Inspect the points and rotor for cracks, burned contacts, a faulty impulse coupling, or corroded terminals. The correct breaker point gap is 0.015 inch at full separation.
49	49		Clean or replace the end cap assembly if necessary. Adjust the breaker points if necessary (par. 116*a*).
60	50	50	*Wiring and switches.* Inspect the wiring for oil-soaked, cracked, or frayed insulation, broken wires, and loose or corroded connections.
51	51		Replace defective switches and wires. See that all connections are clean and tight.
51	61	61	*Voltage regulator.* Check the voltage regulator for proper operation and secure mounting. See that wire connections are tight. The regulator should allow an appreciable charge to go into the battery after the starter is used. After the battery is fully charged, the ammeter should read zero or show only a slight charge.

Technical inspection	Service		
	Monthly	Weekly	
			CONTROL SYSTEM
57	57	57	*Gages.* Check the condition and mounting of the fuel supply gage, oil pressure gage, and coolant temperature gage. See that all gages and connections are secure.
	57	57	Tighten loose gage mountings. Replace or repair defective gages and connections (par. 120*b*).
58	58	58	*Meters.* Check the ammeter and hourmeter for condition, secure mountings, and proper operation.
	58	58	Tighten any loose mounting screws and connections. Replace the ammeter (par. 120*b*) and hourmeter (par. 121*b*) if damaged or defective.
60	60	60	*Pumps and drives.* Check condition and mounting of the hydraulic pump and pump drive. With the pump operating, check for any unusual noise and for oil leaks in the suction line. Inspect the pump drive belt for wear and belt tension.
	60	60	Tighten any loose bolts or nuts and leaky line connections. Replace a defective pump with new or reconditioned one (par. 150*b*). Replace the pump drive belt if worn.
61	61	61	*Valves and cylinders.* Check for excessive wear or play in the operating valve. Check the operating valve and regulator valve mountings. Check for leaks in hydraulic oil lines. Inspect the hydraulic cylinder for loose mountings, loose line fittings, gasket leaks, and loose gland packing.
	61	61	Tighten the operating valve, regulator valve, and hydraulic cylinder mountings if loose. Replace worn or damaged mounting bolts. Replace line fittings and oil seals if leaking. Tighten the gland packing in the hydraulic cylinder (par. 153*c*). Replace the operating valve (par. 155*c*) if defective. Replace the hydraulic cylinder (par. 152*b*) if defective.
62	62	62	*Levers, pedals, linkage.* Check levers and pedals for proper operation and adjustment. Inspect the control rods and linkage and see that all connecting pins, locknuts , and bolts are in place and secure.
	62	62	Adjust the lever and pedal linkage if necessary. Tighten or replace any loose or missing mounting items. Straighten or replace bent or damaged control rods.
			FRAME AND MOUNTINGS
80	80	80	*Frame.* Inspect the frame for broken or damaged parts. Check all weldings. Inspect the braces and brackets for damage and loose mountings. Check the oil cover, bottom sheet assembly, cover assembly, handles, and side plate and head assembly for broken or damaged parts. Inspect the operator's platform, brackets, and supports for broken or damaged parts. Inspect the gear guards and gear guard supports for broken or damaged parts. Check the doors, top cover assembly,

Technical inspection	Service		
	Monthly	Weekly	
			FRAME AND MOUNTINGS
			and compression roll housing assembly for damaged or broken parts.
80	80		Repair or report cracks, misalignment, and damaged welds before continuing operation of the roller. Repair or replace frame components (pars. 156-162) if necessary. Report any frame misalignment to the proper authority.
86	86	86	Compression and steering rolls. Inspect the rolls for damage. Report any defects in the rolls or deficiencies in steering to the proper authority. Lubricate compression and steering roll bearings according to LO 5-1185.
			DRIVE SYSTEM
93	93	93	Transmission. Inspect the transmission case assembly for oil leaks, loose mountings, leaking gaskets, and damage to the case assembly. Listen for unusual noises originating in the transmission. Check for proper lubrication.
93	93		Report any deficiencies noted in the transmission case assembly to the proper authority. If unusual noises are noted in the transmission, report this to the proper authority; do not operate the roller unit until this condition has been corrected. Lubricate according to LO 5-1185.
95	95	95	Master clutch. Inspect the master clutch mounting bolts. Check for unusual noise or clutch slippage, for proper adjustment, and for proper lubrication.
95	95		Tighten or replace loose mounting bolts. Adjust the master clutch if necessary (par. 138b). Lubricate according to LO 5-1185. Report unusual noises or faulty operation to the proper authority.
110	110	110	Forward and reverse clutch. Inspect forward and reverse clutch mounting lock nuts, set screws, and mounting bolts for looseness or wear. Check the forward and reverse clutch for proper adjustment. Inspect the cone assembly for wear. Check for proper lubrication.
	110	110	Tighten or replace loose or worn mounting bolts, lock nuts, and set screws. Lubricate according to LO 5-1185. Report any deficiencies in the forward and reverse clutch assembly to the proper authority. Adjust the forward and reverse clutch (par. 140*b*) if necessary.
111	111	111	Second countershaft and brake. Inspect the second countershaft for loose mountings. Check the gear and pinion for wear or damage. Inspect the brake drum for scoring and its lining for wear. Inspect for oil leaks. Check lubrication and brake adjustment.

Technical inspection	Service		
	Monthly	Weekly	
			DRIVE SYSTEM--Continued
	111	111	Tighten or replace loose or worn mounting bolts. Adjust the brake band if necessary (par. 147*b*). Lubricate according to LO 5-1185. Report gear, pinion, brake assembly, and countershaft deficiencies to the proper authority.
112	112	112	First countershaft and drive pinion. Inspect for loose mountings. Check the countershaft and pinion for wear or damage and for proper pinion adjustment. Inspect for leaking oil seals and proper lubrication.
	112	112	Tighten or replace loose or damaged mounting bolts. Lubricate according to LO 5-1185. Report a broken or damaged countershaft and other deficiencies to the proper authority.
			MISCELLANEOUS ITEMS
133	133	133	Sprinkler system. Inspect for loose sprinkler tank mountings. Check hose, pipe, pipe clamps, hose clamps, the filler cap, and the drain petcock for loose connections and leaks. Inspect the water strainer. Check operation of valves and sprinkler mats. Check the entire system, tank, and lines before storage or freezing weather.
	133	133	Repair the sprinkler tank mounting if loose. Replace worn or damaged hose, pipe, hose clamps, filler cap, and drain petcock. Replace or repair damaged or faulty mats, mat supports, and mat plate support (par. 167*b*). Replace the valve if damaged. Drain the entire system before storage or freezing weather.
134134	134		Roll scrapers. Inspect the steering roll scraper assembly mounting bracket and compression roll scraper assembly mounting. Check the spring tension for adjustment. Inspect for loose bolts, lockwashers, cotter pins, and nuts. Check the scrapers for accumulation of dirt and grease.
134	134		Tighten the mounting bracket on the steering roll scraper assembly if loose. Check the mounting of the compression roll scraper assembly. Replace worn or damaged mounting bolts, screws, and other hardware. Adjust the spring tension for both steering and compression roll scraper assemblies. Clean dirt and grease from the scraper assemblies. Repair or replace the steering roll scraper (par. 163*b*) if damaged. Repair or replace the compression roll scraper assembly (par. 164*b*) if damaged.

Section IV. TROUBLESHOOTING

55. Use of Troubleshooting Section

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the road roller or any of its components. Each trouble symptom stated is followed by a list of probable causes of the trouble. The possible remedy recommended is described opposite the probable cause.

***Note*. All reference in this section to paragraphs in chapter 4 pertain to operations that are the responsibility of the field and depot maintenance personnel. Organizational maintenance personnel should not proceed without proper authority.**

56. Starting Motor Fails to Operate

Probable cause	*Possible remedy*
Magnetic switch defective.	Replace magnetic switch (par. 115).
Starting motor defective.	Replace starting motor (par. 114).
Battery discharged.	Check and charge the battery (par. 111). Inspect and tighten battery cables (par. 111*h*).
Battery cables loose or disconnected.	Replace the starter button (par. 120*e*).
Starter button defective.	

57. Starting Motor Operates Slowly

Probable cause	*Possible remedy*
Battery discharged.	Check and charge the battery (par. 111).
Battery cables loose or disconnected.	Inspect and tighten battery cables (par. 111*h*).
Oil in the crankcase cold and thick.	Move the roller to a warm location and allow oil to warm up. Fill the crankcase with oil as specified in LO 5 1185.

58. Engine Fails to Start

Probable cause	*Possible remedy*
Ignition key turned off.	Turn the ignition key to ON position.
Magneto switch not pulled out.	Pull out the magneto switch.
Lack of fuel.	Fill the fuel tank.
Overchoking.	Allow the engine to stand a few minutes. Open throttle beyond the normal starting position and turn the engine over until it starts. Set the throttle back to normal idling position.
Dirt or grime in fuel lines.	Clean lines and fuel filter (pars. 103, 104).
Fuel line pinched or punctured.	Inspect, repair, or replace (par. 104).
Carburetor out of adjustment.	Adjust carburetor (par. 106*d*).
Spark plugs dirty or damaged.	Remove, inspect, clean, adjust, and replace (par. 117).

Probable causes	*Possible remedy*
Magneto breaker points pitted or not adjusted.	Remove, inspect, clean, replace, and adjust (par. 116).
Condenser open or shorted.	Replace the condenser (par. 116h).
Ignition cable ground.	Locate ground, tape the cable for temporary operation, or replace cable (par. 118).
Fuel tank valve dosed.	Open the fuel tank valve.
Compression poor.	Overhaul valves and rings (para. 186, 178). See note in paragraph 55.
Valve timing Improper.	Adjust valve timing (par. 182*e*). See note In paragraph 55.
Air leak in the intake manifold.	Replace manifold gasket or manifold (par. 182).
Fuel line frozen.	Remove and clean fuel line (par. 104). Check and clean the fuel tank (par. 109). Cheek source of supply for purity.
Ice In carburetor.	Disassemble and clean the carburetor (par. 187). See note in paragraph 65. Check the fuel tank for water. Drain and clean the fuel tank if necessary. Check the source of fuel supply for purity.

59. Engine Starts and Stops

Probable cause	*Possible remedy*
Choke adjusted improperly.	Adjust choke (par. 28*j*).
Lack of fuel.	Fill the fuel tank.
Fuel lines clogged.	Inspect, clean, and replace fuel lines (par. 104).
Carburetor out of adjustment.	Adjust carburetor (par. 106*d*).
Spark plugs dirty or damaged.	Remove, inspect, clean, or replace (par. 117).

60. Engine Misses or Operates Erratically

Probable cause	*Possible remedy*
Spark plug fouled.	Remove, inspect, clean, adjust, or replace (par. 117).
Valve timing incorrect.	Adjust valve timing (par. 182*e*). See note In paragraph 55.
Ignition wires loose or shorted.	Tighten connections, check for worn or frayed insulation, tape wires for temporary operation, or replace (par. 118).
Carburetor out of adjustment.	Adjust carburetor (par. 106*d*).
Fuel lines clogged.	Inspect, remove, clean, and replace (par. 104).
Foreign substance or water in the fuel system.	Clean fuel tank, fuel lines, and fuel filter (pars. 103,104). To avoid water in system, keep tank filled. Check source of fuel supply for purity.
Valves warped or burned.	Grind or replace (par. 186).
Timing wrong.	Adjust timing (par. 182*e*). See note in paragraph 55.

Probable cause	*Possible remedy*
Valve tappets out of adjustment	Adjust valve tappets (par. 136*b*).
Valve guides worn out.	Replace valve guides (par. 176*d*). See note in paragraph 55.
Valve seat cracked.	Replace valve seat (par, 177*c*). See note in paragraph 55.
Cylinder head gasket leaking.	Tighten cylinder head nuts or replace the cylinder head gasket (par. 135*a*).
Cylinder head warped.	Replace cylinder head (par. 135a).
Air leak in the intake manifold.	Replace gasket or manifold (par. 132).
Spark plug gap incorrectly set.	Adjust spark plug gap (par. 117*d*).
Magneto breaker cam worn out.	Replace magneto breaker cam (par. 190*d*). See note in paragraph 55.

61. Engine Knocks or Pings

Probable cause	*Possible remedy*
Magneto out of adjustment.	Adjust magneto (par. 116*b*).
Carbon in the combustion chambers	Remove carbon (par. 135*b*).
Valve timing incorrect	Adjust valve timing (par. 182*c*). See note in paragraph 55.
Piston ring broken	Replace piston ring (par. 178*l*). See note in paragraph 55.
Piston pins loose.	Replace piston pins (par. 178*c*). See note In paragraph 55.
Main bearings loose or worn.	Tighten or replace main bearings (par. 180). Bee note in paragraph 55.
Connecting rod bent.	Replace connecting rod (par. 178). See note in paragraph 55.
Connecting rod bearings loose or worn	Tighten or replace connecting rod bearings (par. 178). See note in paragraph 55.
Cylinder bores and pistons worn out.	Rebore cylinders and install oversize pistons (par. 181). See note in paragraph 55.
Lack of lubricating oil.	Fill the crankcase with proper grade and quantity of oil. Refer to LO 5-1185.
Grade of fuel inferior.	Use proper grade of fuel.

62. Engine Foils to Stop

Probable cause	*Possible remedy*
Combustion chambers overheated.	Inspect coolant level in the radiator. Provide sufficient ventilation.
Carbon in the combustion chambers.	Remove carbon (par. 135*b*).

63. Engine Overheats

Probable cause	*Possible remedy*
No coolant in the radiator.	Let the engine cool off completely and add coolant (par. 128*d*).
Coolant level low.	Check level. The level must be at the overflow pipe line. Add coolant if necessary (par. 128*d*).
Water pump defective.	Replace the water pump (par. 130*b*).

Probable cause	*Possible remedy*
Lack of lubricating oil.	Fill the crankcase with proper grade and quantity of oil. Refer to LO 5-1185.
Fuel mixture too lean.	Adjust carburetor (par. 106*d*).
Heavy carbon deposits in combustion chambers.	Remove carbon (par. 135*b*.)
Fan belt broken.	Replace fan belt (par. 130*c*).
Fan belt slipping.	Adjust fan belt (par. 130*c*).
Choke button pulled out.	Push in the choke button.
Engine overloaded.	Check load against operating capacity of the engine.
Cooling system frozen.	Thaw out cooling system.
Radiator clogged.	Clean radiator (par. 129*e*).
Coolant passages clogged.	Clean coolant passages (par. 129*e*).
Valve timing incorrect.	Adjust valve timing (par. 182*e*). See note in paragraph 55.
Breaker cam retarded.	Adjust magneto (par. 116).
Exhaust pipes restricted.	Clean or replace exhaust pipes and muffler (par. 133).

64. Engine Backfires

Probable cause	*Possible remedy*
Fuel mixture too lean.	Adjust carburetor (par. 106*d*).
Valve timing incorrect.	Adjust valve timing (par. 182*e*). See note in paragraph 55.
Valve damaged.	Replace valves (par. 136*c*).
Valves sticking.	If the intake valves stick, the engine will backfire through the carburetor; if the exhaust valves stick, It will fire through the exhaust system. Remove the spark plug and pour penetrating oil into the cylinder. Let the engine stand idle for a few minutes. Rotate the engine by hand and if the valve has not freed itself, tap valve lightly with a soft copper rod. Replace the spark plug and start the engine. If the valve is still stuck, pour carbon solvent into the carburetor through its air intake, and mix some carbon solvent with the oil. Start the engine and allow it to run for a few minutes. If the trouble has not disappeared, a carbon and valve job is needed (par. 136).

65. Engine Becomes Noisy

Probable cause	*Possible remedy*
Muffler damaged or corroded.	Replace muffler (par. 133).
Exhaust pipe broken.	Replace exhaust pipe (par. 133*b*).
Muffler gasket damaged.	Replace muffler gasket (par. 138*b*).
Exhaust manifold loose or broken.	Tighten or replace exhaust manifold (par. 132).
Manifold gasket blown.	Replace manifold gasket (par. 132).

66. Exhaust Becomes Smoky

Probable cause	*Possible remedy*
Oil too thick.	Refer to LO 5-1185 and fill the crankcase with proper grade of oil
Oil pressure too high.	Adjust oil pressure relief valve (par. 197*d*). See note in paragraph 55.
Oil level too high.	Check and maintain proper oil level.
Pistol rings worn or broken.	Replace piston rings (par. 178l). See note in paragraph 55.
Cylinder bore out of round.	Rebore cylinders (par. 181). See note in paragraph 55.
Carburetor out of adjustment.	Adjust carburetor (par. 106*d*).

67. Engine Lacks Power

Probable cause	*Possible remedy*
Compression faulty.	Check compression. If the pressure varies more than 10 lb. between the cylinders, engine overhaul will be needed. See note in paragraph 55.
Valve timing incorrect.	Adjust valve timing (par. 182l). See note in paragraph 55.
Carburetor out of adjustment.	Adjust carburetor (par. 106*d*).
Throttle valve not fully opening.	Adjust throttle valve (par. 108*d).*
Dirt in fuel lines.	Clean fuel lines (par. 104).
Air leak in the manifold gasket.	Replace manifold gasket (par. 132).
Overheating.	Inspect and correct source causing overheating
Preignition, caused by carbon deposits	Clean carbon (par. 135).
Valve seats leaking.	Grind or replace valve seats (par. 177). See note in paragraph 55.
Piston rings broken.	Replace piston rings (par. 178). See note in paragraph 55.
Valve-tappet adjustment incorrect.	Adjust valve-tappet clearance (par. 136*b*).
Air cleaner clogged.	Clean air cleaner (par. 105*d*).
Exhaust pipe and muffler restricted.	Clean or replace exhaust pipe and muffler (par. 133).
Magneto out of adjustment	Adjust magneto (par. 116).
Spark plugs leaking.	Tighten spark plugs or replace gaskets (par. 117).

68. Cooling System Leaks

Probable cause	*Possible remedy*
Radiator core leaking.	Repair or replace (par. 129).
Hose connections defective.	Tighten clamps or replace hose (par. 129).
Water pump leaking.	Repair or replace water pump (par. 130).
Cylinder head cracked.	Replace cylinder head (par. 135).
Cylinder head gasket blown.	Replace cylinder head gasket (par. 135).

69. Engine Idles Improperly

Probable case	*Possible remedy*
Carburetor fuel and air mixture not properly adjusted.	Adjust carburetor (par. 10).
Idling speed too slow.	Adjust the idling speed screw (par. 106).
Timing incorrect.	Adjust timing (par. 182*e*). See note in paragraph 55.
Spark plug fouled.	Inspect, remove, clean, and replace spark plugs (par. 117).
Magneto points dirty.	Clean and adjust magneto points (par. 116*b*).

70. Magneto Fails to Spark

Probable cause	*Possible remedy*
Breaker points not adjusted.	Adjust breaker points (par. 116*e*).
Magneto timing incorrect.	Adjust magneto timing (par. 116*g*).
Breaker points defective.	Replace breaker points (par. 116*b*).
Rotor defective.	Replace rotor (par. 116).
Coil defective.	Replace coil (par. 116).
Condenser defective.	Replace condenser (par. 116).
Terminals loose or grounded.	Clean, tighten, or replace terminals.

71. Oil Pressure Drops

Probable cause	*Possible remedy*
Lack of oil	Check and add oil. Refer to LO 5-1186.
Oil line clogged.	Inspect and clean oil line.
Oil filter clogged or dirty.	Clean filter housing and replace element (par. 123).
Oil too thin.	Fill the crankcase with proper grade of oil. Refer to LO 5-1185.
Pressure relief valve broken or damaged.	Inspect, adjust, or replace (par. 197). See note in paragraph 55.
Oil pump worn out.	Replace oil pump (par. 196). See note in paragraph 55.
Bearings and piston rings worn out.	Replace bearings and rings (par. 178). See note in paragraph 55.

72. Oil Pressure Rises Too High

Probable cause	*Possible remedy*
Oil too thick.	Fill the crankcase with proper grade of oil. Refer to LO 5-1185.
Pressure relief valve broken or damaged.	Inspect, adjust, or replace pressure relief valve (par. 197). See note in paragraph 55.

73. Spark Plugs Fail to Spark

Probable cause	*Possible remedy*
Spark plugs defective.	Replace spark plugs (par. 117).
Magneto out of adjustment.	Adjust magneto (par. 116).
Spark plug cables loose or disconnected.	Tighten or connect the spark plug cables.

Probable cause	*Possible remedy*
Ignition switch turned off.	Turn on the ignition switch.
Magneto breaker points out of adjustment.	Adjust magneto breaker points (par. 116*e*).
Spark plugs terminals covered with oil.	Inspect, clean, adjust, and replace (par. 117).

74. Generator Fails to Charge

Probable cause	*Possible remedy*
Fan belt broken.	Replace fan belt (par. 130).
Fan belt loose.	Tighten fan belt (par. 180).
Generator defective.	Repair or replace (par. 112).
Ammeter defective.	Replace ammeter (par. 120).
Voltage regulator defective.	Replace voltage regulator (par. 113).
Generator leads loose or broken.	Tighten or replace generator leads (par. 112).

75. Ammeter Does not Register Charge

Probable cause	*Possible remedy*
Fan belt broken.	Replace fan belt (par. 130).
Regulator circuit breaker open.	Adjust circuit breaker (par. 192). See note in paragraph 55.
Regulator defective	Replace regulator (par. 113).
Generator defective.	Replace generator (par. 112).
Ammeter connections loose.	Tighten connections.
Ammeter band stuck.	With a handle of a screwdriver tap lightly against the ammeter housing; if the hand still remains stuck, replace the ammeter (par. 120).
Ammeter defective.	Replace ammeter (par. 120).

76. Ammeter Shows Excessive Charge

Probable cause	*Possible remedy*
Regulator adjusted improperly.	Adjust regulator (par. 192). See note in paragraph 55.
Battery discharged considerably.	Inspect and charge the battery (par. 111).
Battery shorted internally.	Replace battery (par. 111).

77. Ammeter Shows Discharge With Engine Running

Probable cause	*Possible remedy*
Fan belt broken.	Replace fan belt (par. 130).
Fan belt slipping.	Adjust fan belt (par. 130).
Generator defective.	Repair or replace generator (par. 112).
Regulator circuit cut-in voltage too high.	Adjust circuit breaker cut-in voltage (par. 192). See note in paragraph 55.

78. Ammeter Shows Heavy Discharge With Engine Stopped

Probable cause	*Possible remedy*
Circuit shorted.	Inspect and repair.
Circuit breaker points stuck.	Adjust circuit breaker (par. 192). See note in paragraph 55.
Ammeter hand stuck.	With a handle of a screwdriver tap lightly against the ammeter housing; if the hand still remains stuck, replace ammeter (par. 120).
Ammeter burned out.	Replace ammeter (par. 120).

79. Ammeter Hand Vibrates Rapidly

Probable cause	*Possible remedy*
Fan belt slipping.	Adjust fan belt (par. 130).
Generator wiring loose or broken.	Repair or replace generator (par. 112).
Circuit breaker cut-in voltage too low.	Adjust circuit breaker cut-in voltage (par. 192). See note in paragraph 55.
Circuit breaker contacts burned.	Clean or replace (par. 192). See note in paragraph 55.
Regulator loose or not properly grounded.	Check and correct the mounting (par. 113).
Generator defective.	Repair or replace generator (par. 112).
Regulator defective.	Repair or replace regulator (par. 113).

80. Steering lever Fails to Move the Roller in Desired Direction

Probable cause	*Possible remedy*
Linkage disconnected.	Connect linkage properly.
Hydraulic oil tank empty.	Fill the hydraulic system.
Hydraulic pump drive belt broken.	Replace hydraulic pump drive belt (par. 150).
Hydraulic pump defective.	Replace hydraulic pump (par. 150).
Operating valve defective.	Repair or replace operating valve (par. 212). See note in paragraph 55.
Hydraulic lines broken or damaged.	Replace hydraulic lines.
Steering cylinder defective.	Repair or replace steering cylinder (par. 152).
Steering arm broken.	Replace steering arm (par. 213). See note in paragraph 55.
Steering arm pin broken or missing.	Replace steering arm pin (par. 152).
Swivel pin stuck.	Replace swivel pin (par. 213). See note in paragraph 55.
King pin stuck or damaged.	Repair or replace king pin (par. 213). See note in paragraph 55.

81. Master Clutch Does Not Engage

Probable cause	*Possible remedy*
Linkage disconnected.	Connect linkage (par. 139).
Too much play in linkage and pins.	Replace or adjust linkage (par. 139).
Linkage twisted.	Repair or replace linkage (par. 189).
Clutch out of adjustment.	Adjust master clutch (par. 138*b*).

82. Master Clutch Engagement Becomes Rough

Probable cause	*Possible remedy*
Too much play in linkage and pins.	Replace or adjust linkage (par. 139).
Clutch out of adjustment.	Adjust master clutch (par. 138*b*).
Linkage twisted or bent.	Repair or replace linkage (par. 139).
Engine speed too high.	Engage and disengage master clutch when the engine is running at idling speed.

83. Master Clutch Slips

Probable cause	*Possible remedy*
Clutch out of adjustment.	Adjust master clutch (par. 138*b*).
Too much play in linkage and pins.	Replace or adjust linkage (par. 139).
Clutch saturated with oil.	Replace friction disks, clean clutch assembly (par. 199). See note in paragraph 55.
Friction disks worn out.	Replace friction disks (par. 199). See note in paragraph 55.

84. Forward and Reverse Clutch Does Not Engage

Probable cause	*Possible remedy*
Linkage disconnected.	Connect linkage (par. 141).
Too much play in linkage and pins.	Replace or adjust linkage (par. 141).
Linkage out of adjustment.	Adjust linkage (par. 141).
Linkage twisted or bent.	Repair or replace linkage (par. 141).
Clutch out of adjustment.	Adjust forward and reverse clutch (par. 140*b*).

85. Forward and Reverse Clutch Engagement Becomes Rough

Probable cause	*Possible remedy*
Too much play in linkage and pins.	Replace or adjust linkage (par. 141).
Clutch out of adjustment.	Adjust forward and reverse clutch (par. 140*b*).
Linkage twisted or bent.	Repair or replace linkage (par. 141).
Engine speed too high.	Engage and disengage forward and reverse clutch when the engine is running at idling speed.

86. Forward and Reverse Clutch Slips

Probable cause	*Possible remedy*
Clutch out of adjustment.	Adjust forward and reverse clutch (par. 140*b*).
Too much play in linkage and pins.	Adjust or replace linkage (par. 141).
Clutch saturated with oil.	Replace friction disks, clean clutch assembly (par. 200). See note in paragraph 55.
Friction disks worn out.	Replace friction disks (par. 200*b*). See note in paragraph 55.

87. Gear Shifting Becomes Hard

Probable cause	*Possible remedy*
Master clutch out of adjustment.	Adjust master clutch (par. 140*b*).
Linkage twisted or bent	Repair or replace linkage (par. 145).
Gears not meshing.	Shift gears when the engine is running at idling speed. Combine the operation of the gearshift lever with the forward and reverse lever until proper gear meshing is achieved.
Engine speed too high.	Shift the gears when the engine is running at idling speed.

88. Bakes Fail

Probable cause	*Possible remedy*
Linkage disconnected.	Connect linkage (par. 148).
Linkage twisted, bent, or obstructed.	Repair, adjust, or replace linkage (par. 148).
Too much play in linkage and pins.	Adjust or replace linkage (par. 148).
Brake lining worn out.	Replace brake lining (par. 208). See note in paragraph 55.
Brake out of adjustment.	Adjust brake (par. 141*b*).
Brake lining saturated with oil or grease.	Replace brake lining (par. 208). See note In paragraph 55.

89. Governor Control Lever Does Not Operate

Probable cause	*Possible remedy*
Linkage disconnected.	Connect linkage (par. 108).
Linkage twisted, bent, or obstructed.	Inspect, repair, or replace linkage (par. 108).

90. Sprinkler Pedals Fail

Probable cause	*Possible remedy*
Linkage disconnected.	Connect linkage.
Linkage bent, twisted, or obstructed.	Inspect, repair, or replace linkage (par. 166).
Sprinkler tank pet cocks closed.	Open pet cocks.
Sprinkler valve lever bent or damaged.	Replace sprinkler valve (par. 166).
Sprinkler lines clogged.	Inspect and clean sprinkler lines.
Sprinkler tank empty.	Fill the sprinkler tank.

91. Water Does Not Sprinkle Evenly

Probable cause	*Possible remedy*
Sprinkler mats damaged or worn.	Replace sprinkler mats (par. 167).
Sprinkler valves damaged or clogged	Replace sprinkler valves (par. 166).
Sprinkler lines leaky or rusted.	Inspect, clean, or replace sprinkler lines (par. 166).

92. Hydraulic Pump Becomes Noisy

Probable cause	*Possible remedy*
Air bubbles In the oil tank.	Check connections for oil leaks. Tighten hose clamps (par. 154).
Oil tank empty.	Fill the hydraulic oil tank (par. 154).
Bearing worn out.	Replace bearing (par. 210). See note in paragraph 55.
Head gasket blown.	Replace head gasket (par. 210*b*). See note in paragraph 55.

93. Hydraulic Pump Leaks

Probable cause	*Possible remedy*
Hose connections loose.	Tighten hose connections.
Shaft packing worn out.	Replace shaft packing (par. 210). See note in paragraph 55.
Head gasket blown.	Replace head gasket (par. 210*b*). See note in paragraph 55.

94. Rolls Squeak

Probable cause	*Possible remedy*
Lubrication insufficient.	Lubricate according to LO -1185.
Bearings too tight.	Adjust bearings (pars. 218, 219). Be note in paragraph 55.
Bearings damaged.	Replace bearings (pars. 218, 219). See note in paragraph 55.
Foreign matter on the axle shaft.	Remove and clean axle (par 218, 219). See note In paragraph 55.

95. Steering Roll Slides

Probable cause	*Possible remedy*
Bearings frozen.	Replace bearings (par. 218*b*). See note in paragraph 55.
Bearings too tight.	Adjust bearings (par. 218*b*). See note In paragraph 55.
Axle shaft broken.	Replace axle shaft (par. 218*b*). See note in paragraph 55.

Section V. RADIO SUPPRESSION

96. Definition of Suppression

Radio noise suppression is the elimination or minimizing of engine electrical disturbances within the equipment which interfere with the radio reception and disclose the location of the road roller and its associated equipment to sensitive electrical detectors.

97. Source of Interference

Spark plugs, high tension leads from the magneto to the spark plugs, magneto breaker points, magnetic switches, voltage regulators, electrically operated gages and meters, generators, and poor electrical joints between the adjacent parts on the road roller frame are sources of electrical interference.

98. Methods Used to Suppress Interference

The radio interference suppression equipment consists of capacitors, shielding and bonding cables, and internal toothed lockwashers, placed at various points in the electrical circuit of the engine and the road roller. The capacitors bypass radio frequencies to ground and prevent them from being radiated. The shielding and bonding cables and internal toothed lockwashers prevent radio frequency radiation

from wires and shielded parts, and conduct any radio frequencies to a grounded portion of the road roller.

99. Effect of Suppression

There is no interference from equipment satisfactorily suppressed for radiated and conducted interference over the frequency range of 0.55 through 156.0 megacycles at a distance of 25 feet from the road roller.

100. Testing Suppression System

a. Install a battery-powered radio receiver in good operating condition not more than 10 feet from the road roller. If possible, use a wide-band receiver covering the frequency range of 0.55 to 156.0 megacycles.

b. Start the engine and tune the receiver. Turn the receiver volume control to maximum, and select three widely separated frequencies for listening. Use frequencies that are free from signals with strong carriers so that the receiver will be in its most sensitive operating condition.

c. Operate the engine throttle, and listen to the receiver speaker or headset. A regular clicking sound, which varies with engine speed and ceases the instant the ignition is shut off, is caused by the ignition circuit.

d. A whining sound, which varies with the engine speed and continues a few seconds after the ignition is shut off, is caused by the battery charging genertor.

e. Systematically replace suppression components in the circuit causing trouble, testing after the replacement of each component to see that the trouble has been eliminated.

101. Suppression Components

a. Battery Generator Capacitor. The battery generator capacitor (A, fig. 16) is mounted on the top of the battery charging generator.

(1) *Removal.* Disconnect the capacitor lead, remove the mounting screw, and remove the capacitor.

(2) *Installation.* Install the capacitor on the battery generator and tighten the mounting screw securely. Connect the lead with the capacitor terminal. Start the engine and check capacitor for proper operation.

b. Voltage Regulator Capacitors. The voltage regulator has two capacitors (B, fig. 16) mounted on the bottom part of the regulator.

(1) *Removal.* Disconnect the leads, remove the mounting screws, and remove the capacitors.

(2) *Installation.* Install capacitors and tighten the mounting screws securely. Connect the capacitor leads and start the engine. Check the capacitors for proper operation as described in paragraph 100.

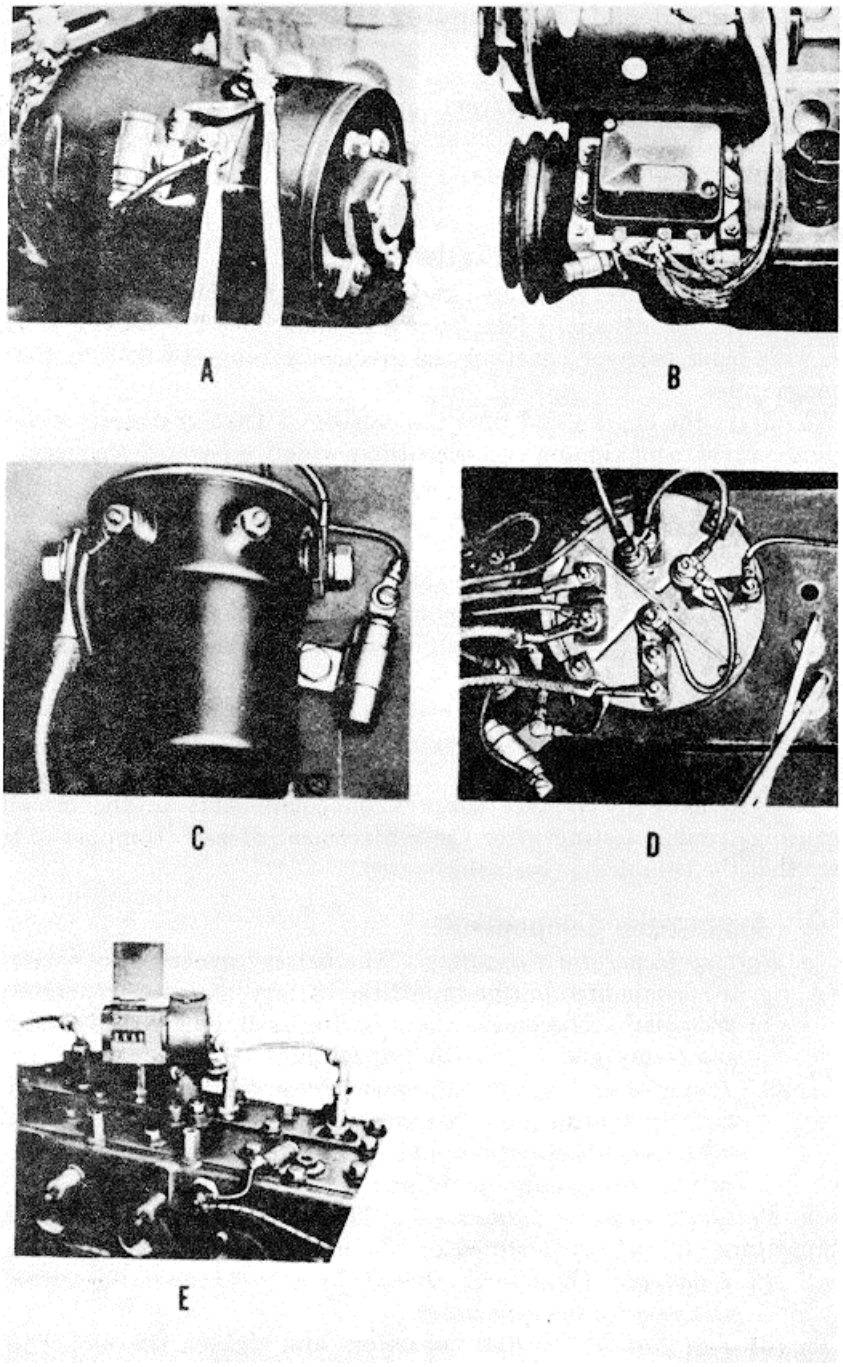


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Figure 16. Suppression components.

c. Magnetic Switch Capacitor. The magnetic switch capacitor (C, fig. 16) is mounted on the right side of the switch and is attached to the cylinder block.

(1) *Removal.* Disconnect the capacitor lead, remove the mounting screw and lockwasher, and remove the capacitor.

(2) *Installation*. Install the capacitor on the cylinder block and tighten the mounting screw and lockwasher securely. Connect the lead with the capacitor terminal. Crank the engine with the starting motor and check for radio interference as described in paragraph 100.

d. Instrument Panel Capacitor. The instrument panel capacitor (D, fig. 16) is mounted on the rear bottom part of the instrument panel.

(1) *Removal*. Disconnect the capacitor lead and remove the mounting nut. Disconnect the shielded cables and remove the capacitor.

(2) *Installation*. Install the capacitor on the rear bottom part of the instrument panel and connect the shielded leads to the capacitor's mounting stud. Install and tighten the mounting nut. Connect the capacitor lead with the capacitor terminal. Start the engine and check the capacitor for proper operation as described in paragraph 100.

e. Shielded Spark Plugs and Leads. The spark plugs and high tension spark plug leads (E, fig. 16) are encased in shielded housings.

(1) *Removal*. Refer to paragraph 117b.

(2) *Installation*. Refer to paragraph 117/.

f. Water Temperature Transmitter Capacitor. The water temperature transmitter capacitor (E, fig. 16) is mounted on the cylinder head.

(1) *Removal*. Disconnect the capacitor lead from the water temperature transmitter and unscrew the cylinder head stud nut. Lift and remove the capacitor from the cylinder head stud.

(2) *Installation*. Install the capacitor on the cylinder head stud and tighten the stud nut. Connect the capacitor lead with the water temperature transmitter. Start the engine and check the capacitor for proper operation.

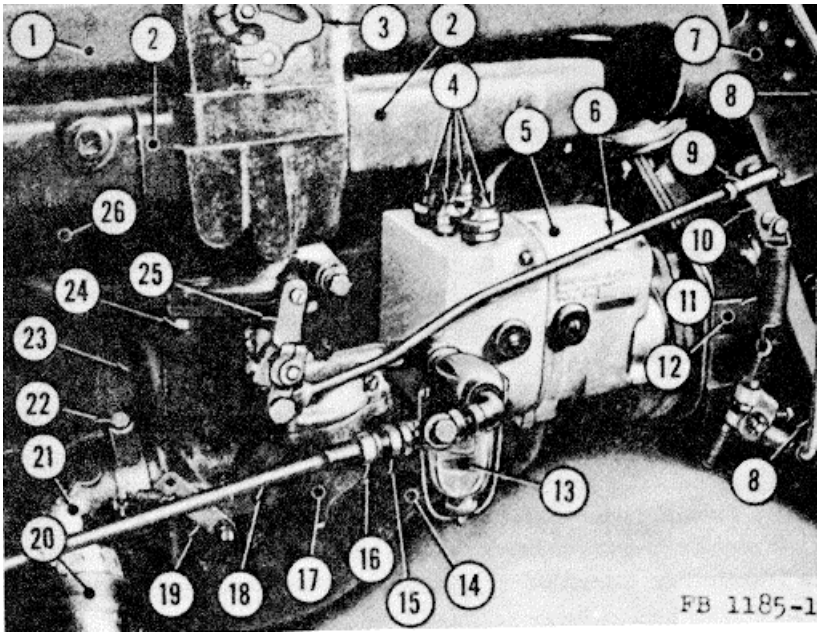
Section VI. FUEL SYSTEM

102. Description

(fig. 17)

The fuel system of this road roller is of the gravity type. The fuel tank is located under the compression roll housing and has two fuel shutoff valves. When the valves are open, the fuel flows through the

fuel line (18) from the fuel tank into the fuel filter (13) and carburetor (17). The suction created by engine operation draws the fuel and air mixture from the carburetor (17) into the intake manifold (2) and cylinder combustion chambers, where it is ignited and converted into a mechanical force. The carburetor is the updraft type and has an oil-bath air cleaner. The air cleaner is attached to the carburetor body by a clamping elbow (21) and clamping elbow screw (22).



1	Exhaust manifold	14	Oil pan
2	Intake manifold	15	Fuel line fitting
3	Heat control valve	16	Fitting nut
4	Spark plug leads	17	Carburetor
5	Magneto	18	Fuel line
6	Carburetor control rod	19	Choke lever
7	Fan	20	Air cleaner hose
8	Governor control rod	21	Clamping elbow
9	Carburetor rod hall joint	22	Clamping elbow screw
10	Governor lever	23	Ventilation pipe
11	Governor spring	24	Carburetor mounting screw
12	Governor	25	Carburetor throttle lever
13	Fuel filter	26	Valve cover

Figure 17. Fuel system components.

103. Fuel Filter

a. Removal (fig. 17).

(1) Make sure that the fuel shutoff valves on the fuel tank are closed.

(2) Hold the fuel line fitting (15) with a wrench to prevent it from turning and unscrew the fuel line fitting nut (16). Disconnect the fuel line (18) from the fuel filter (13).

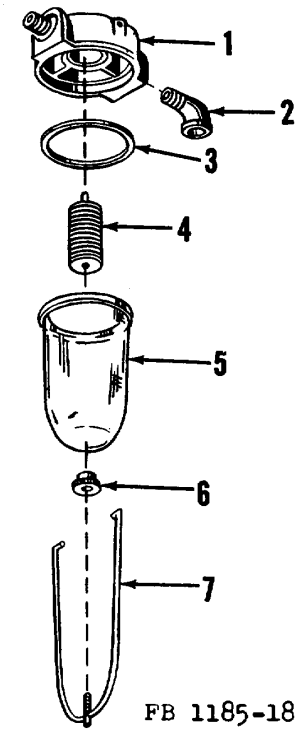
(3) Unscrew the fitting nut attaching the fuel filter (13) to the carburetor (17) and remove the fuel filter.

Note. Do not smoke or permit open flame in the vicinity when removing or disassembling the fuel filter.

*b. Disassembly (*fig. 18).

(1) Loosen the thumb nut (6) and remove the sediment bowl (5) and gasket (3).

(2) Spread the arms of the sediment bowl clamp (7) and remove the clamp.



1	Fuel filter cover	5	Sediment bowl
2	Elbow	6	Thumb nut
3	Gasket	7	Bowl clamp
4	Strainer		

Figure 18. Fuel filter disassembled.

(3) Unscrew the strainer (4) from the fuel filter cover (1).
(4) Unscrew the elbow (2) from the fuel filter cover (1).

c. Inspection (fig. 18). Inspect the fuel filter cover (1) for breaks and damage. Check the strainer (4), thumb nut (6), and clamp (7) for damaged or stripped threads. Inspect the top edge of the sediment bowl for cracks, broken glass, or adhering pieces of the gasket.
Inspect the gasket (3) for wear, swelling, and breaks.

d. Cleaning. Wash all parts in cleaning solvent and wipe them dry with a soft absorbent cloth. Remove all dirt and foreign matter from the sediment bowl. Replace the gasket, if it shows signs of wear or damage.

e. Reassembly (fig. 18).
(1) Install the strainer (4) in the fuel filter cover (1). Tighten the strainer securely.
(2) Position the gasket (3) in the fuel filter cover (1) and see that it seats properly without bending or twisting.
(3) Install the sediment bowl clamp (7) and thumb nut (6).
(4) Pull the sediment bowl clamp (7) aside and install the sediment bowl (5). See that the bowl adheres firmly and securely to the gasket (3).
(5) Tighten the thumb nut (6) securely.
(6) Install the elbow (2) in the inlet opening of the fuel filter cover (1).

f. Installation (fig. 17).
(1) Attach the fuel filter (13) to the carburetor (17) inlet opening and tighten the fitting nut.
(2) Connect the fuel line (18) with the fuel filter (13). Tighten the fuel line fitting nut (16). Hold the fuel line fitting (15) with a wrench to prevent it from turning, while tightening the fuel line fitting nut (16).
(3) Open the shutoff valves on the fuel tank and start the engine. Check the fuel filter for leaks. Tighten the thumb nut if necessary. If the thumb nut is tight and the fuel filter is leaking, the gasket is defective and must be replaced.

104. Fuel Line
(fig. 17)

a. General. The fuel line (18) connects the fuel tank with the fuel filter (13).

b. Removal.
(1) Unscrew the fuel fitting nut on the fuel line and disconnect the fuel line (18) from the fuel tank line.
(2) Unscrew the fuel line fitting nut (16) and disconnect the fuel line (18) from the fuel filter (13).
(3) Remove the fuel line (18).

c. Inspection. Inspect the fuel line for cracks, dents, and kinks Inspect the fuel line for imbedded foreign matter. Check the fuel line nuts for damaged or stripped threads.

d. Cleaning. Wash the fuel line in cleaning solvent and blow clean compressed air through it. Replace the fuel line if punctured or cracked.

e. Installation.

(1) Connect the fuel line (18) with the fitting on the fuel line and tighten the nut securely.

(2) Connect the fuel line (18) with the fuel line fitting (15) on the fuel filter (13) and tighten the fuel line fitting nut (16).

(3) Open the shutoff valves on the fuel tank and check the fuel line connections for leaks.

105. Air Cleaner

(fig. 19)

a. Removal.

(1) Remove the screws (5), nuts (1), and lockwashers (2) attaching the saddle bracket (4) to the mounting bracket (3).

(2) Loosen the clamping bolt (9) and remove the air cleaner.

b. Disassembly.

(1) Loosen the saddle bracket screw (8) and remove the saddle bracket (4) from the air cleaner body (16).

(2) Loosen the hose clamp screws (12) and remove the hose clamps (11) and hose (13) from the clamping elbow (10).

(3) Twist the air cleaner cup (18) counterclockwise and disconnect it from the air cleaner body (16).

(4) Lift out the vortex chamber (17) from the air cleaner cup (18).

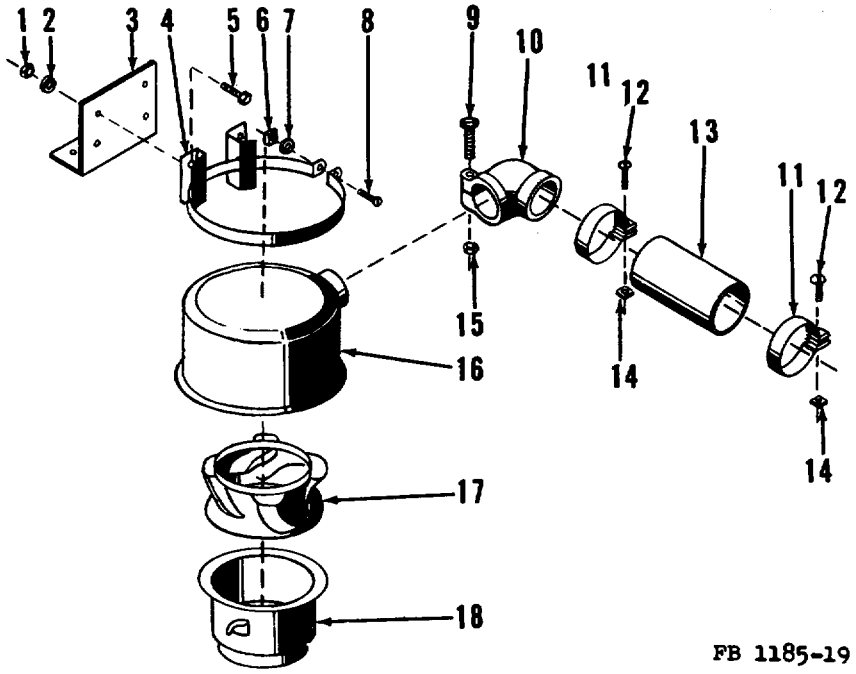
c. Inspection. Inspect the vortex chamber (17), air cleaner cup (18), and air cleaner body (16), for dents, cracks, and corrosion. Check all bolts and screws for stripped or damaged threads. Inspect the hose (13) for a swollen, damaged, frayed, or corroded rubber cover. Hold the hose against a light and inspect the inside of the hose for breaks and deteriorated rubber and cord. Replace the hose if swollen, cracked, or frayed. Inspect the hose clamps (11) for proper tension. Inspect the square nuts (14) for stripped or damaged threads.

d. Cleaning. Wash all metal parts in cleaning solvent and wipe them dry with a soft absorbent cloth. See that the bottom groove of the air cleaner cup is free from dirt and sediment.

e. Reassembly.

(1) Install the saddle bracket (4) on the air cleaner body (16) and tighten the screw (8).

(2) Install the vortex chamber (17) in the air cleaner cup (18).



1 Nuts, hex, %-16 NC (4 req'd)
2 Washers, lock, std, % (4 req'd)
3 Mounting bracket
4 Saddle bracket
5 Screws, hex hd, %-16 NC x % (4 req'd)
6 Nut, square, %-16 NC
7 Washer, lock, std, %
8 Screw, rd hd, %-16 NC x 1%
9 Clamping bolt
10 Clamping elbow
11 Hose clamps (2 req'd)
12 Hose clamp screws (2 req'd)
13 Hose
14 Hose clamp screw nuts (2 req'd)
15 Clamping bolt nut
16 Air cleaner body
17 Vortex chamber
18 Air cleaner cup

Figure 19. Air cleaner disassembled.

(3) Install the air cleaner cup (18) on the bottom part of the air cleaner body (16). Turn the cup clockwise to engage the latches. Fill the cup with oil. Refer to LO 5-1185.
(4) Install the hose (13) and hose clamps (11) on the clamping elbow (10) and tighten the hose clamp screw (12).
(5) Connect the hose (13) with the air cleaner body (16) and tighten the hose clamp screw (12) securely.

f. Installation.

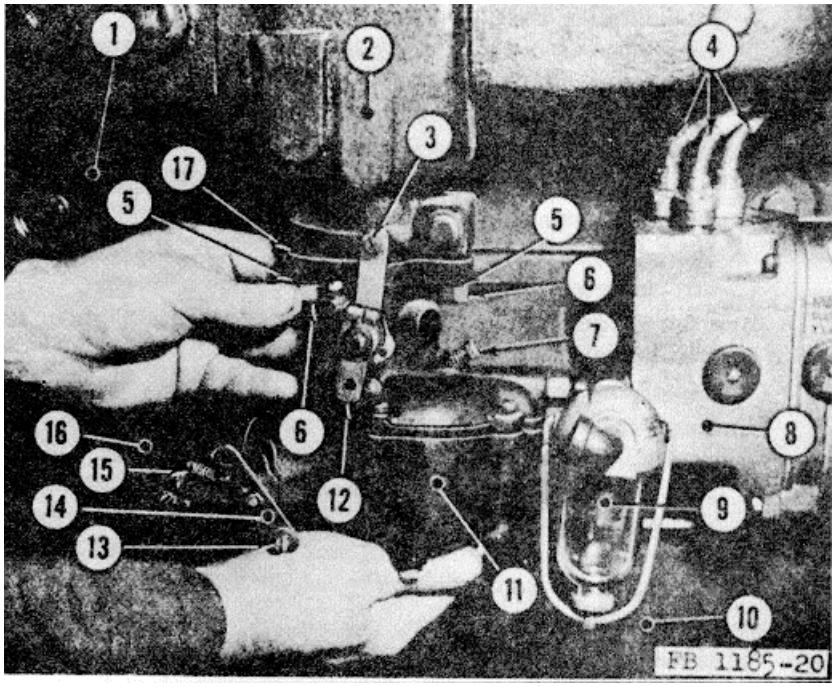
(1) Install the air cleaner on the carburetor and tighten the clamping bolt (9).
(2) Aline the saddle bracket (4) with the air cleaner mounting bracket (3) and install the mounting screws (5), lockwashers (2), and nuts (1).
(3) Tighten all mounting screws securely. Start the engine and check the air cleaner for proper operation.

106. Carburetor

a. General. The carburetor used on this roller is an updraft carburetor of the double-venturi design. It is "sealed" and "balanced" in that all air for fuel bowl chamber ventilation and idling must come through the air cleaner. The power jet and accelerating pump systems are operated by engine vacuum. They are completely enclosed and protected from dirt. The carburetor is gravity fed from the fuel tank; the fuel and air mixture is vaporized in the carburetor and directed to the intake manifold and combustion chambers, where it is ignited and converted into a mechanical force.

b. Removal (fig. 20).

(1) Remove the hexagon bolt attaching the carburetor control rod to the carburetor throttle lever (12) and disconnect the control rod.



1	Valve cover	10	Oil pan
2	Intake manifold	11	Carburetor
3	Throttle cable clamp screw	12	Throttle lever
4	Shielded Ignition leads	13	Choke cable clamp screw
5	Lockwasher	14	Choke lever
6	Mounting screw	15	Choke lever spring
7	Fuel mixture adjustment screw	16	Cylinder block
8	Magneto	17	Gasket
9	Fuel filter		

Figure 20. Carburetor removal.

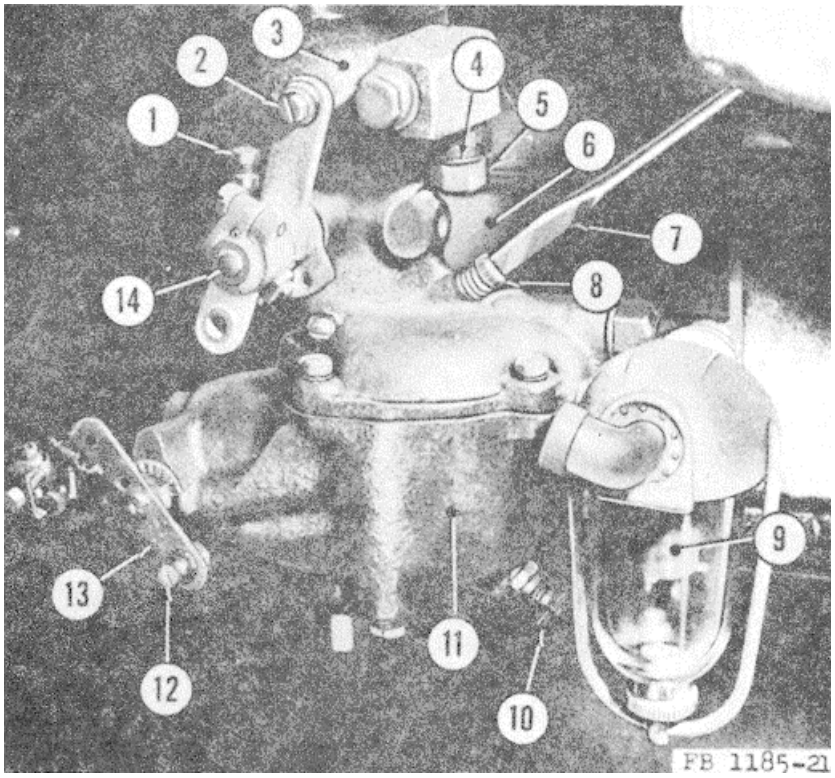
(2) Loosen the throttle cable clamp screw (8) and disconnect the throttle cable from the throttle lever (12).
(3) Remove the air cleaner (par. 105a).
(4) Loosen the choke cable clamp screw (13) and disconnect the choke cable from the choke lever (14).
(5) Loosen the fuel line fitting nut and disconnect the fuel line from the fuel filter (9).
(6) Remove the carburetor mounting screws (6) and lockwashers (5).
(7) Remove the carburetor (11) and gasket (17).
(8) Cover the opening in the intake manifold (2) with a clean cloth to prevent the entrance of dirt into the combustion chambers.

c. Installation

(1) Install the gasket (17) on the carburetor body and attach the carburetor (11) to the intake manifold (2). See that the mounting holes are properly alined.
(2) Install lockwashers (5) and mounting screws (6) and tighten them evenly and securely.
(3) Connect the throttle cable with the throttle cable clamp screw (8). Tighten the screw securely.
(4) Connect the choke cable with the choke cable clamp screw (13). Tighten the screw securely.
(5) Connect the carburetor control rod with the carburetor throttle lever (12) and tighten the hexagon screw.
(6) Connect the fuel line with the fuel filter (9). Tighten the fuel line nut.
(7) Install the air cleaner (par. 105f).
(8) Start the engine and check the carburetor for proper operation. Inspect the fuel line connection for leaks; tighten the fuel line fitting nut if necessary. Do not tighten the fitting nut beyond a leakproof fit. Check the operation of the choke cable, throttle cable, and governor control rod. If the engine operates erratically, adjust the carburetor.

d. Adjustment (fig. 21).

(1) *Main adjustment screw.* The main adjustment screw (10) controls the amount of fuel delivered for high-speed engine operation. Open the throttle about one quarter and turn the adjustment screw (10) clockwise until the engine speed decreases and the engine starts to miss. This indicates that the engine is not receiving a sufficient amount of fuel and that the mixture is too lean. Turn the adjustment screw (10) counterclockwise until the engine reaches its maximum speed and runs smoothly without missing.



1	Idling speed adjustment screw	8	Idling mixture adjustment screw
2	Throttle cable clamp screw	9	Fuel filter
8	Intake manifold	10	Main adjustment screw
4	Lockwasher	11	Carburetor
5	Mounting screw	12	Choke cable clamp screw
6	Valve cover	13	Choke lever
7	Screwdriver	14	Throttle lever shaft

Figure 21. Carburetor adjustment.

(2) Idling mixture adjustment screw. The idling mixture adjustment screw (8) controls the amount of air admitted to the idling system, which operates only at low speeds. Turning the adjustment screw (8) counterclockwise admits more air and makes the fuel mixture leaner. Turn the adjustment screw (8) clockwise or counterclockwise until the engine reaches its smoothest running point and operates without missing, jerking, or spitting. If a vacuum gage is available, attach the gage to the intake manifold (3) and adjust the carburetor for highest manifold vacuum. This point will coincide with the smooth running of the engine.

(3) Idling speed adjustment screw. The idling speed adjustment screw (1) adjusts the idling speed of the engine. Turn the adjustment screw (1) clockwise to increase the speed and counterclockwise to decrease the idling speed.

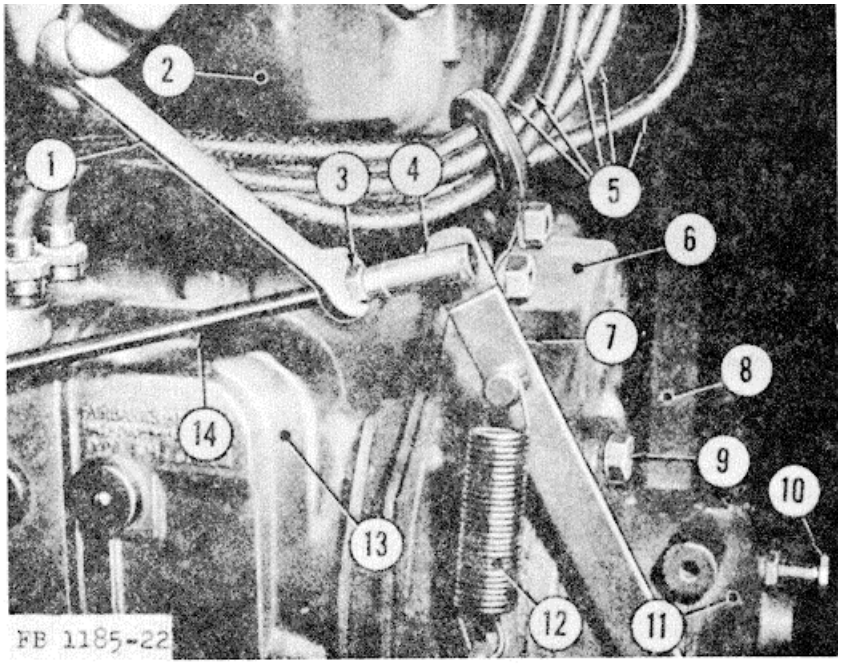
107. Carburetor Linkage

a. Carburetor Control Rod (fig. 17). The carburetor control rod (6) connects the governor lever (10) with the carburetor throttle lever (25).

(1) *Removal*. Remove the screw attaching the carburetor control rod (6) to the carburetor throttle lever (25) and disconnect the rod from the lever. Remove the nut attaching the rod ball joint (9) to the governor lever (10) and remove the carburetor control rod.

(2) *Installation*. Connect the carburetor control rod (6) with the throttle lever (25) and install the mounting screw. Connect the rod ball joint (9) with the governor lever (10) and tighten the mounting nut.

(3) *Adjustment* (fig. 22). The length of the carburetor control rod can be adjusted by screwing it in or out of the ball joint. Disconnect the control rod (14) from the carburetor throttle lever and loosen the locknut (3). Screw the rod (14) into



1	Wrench	8	Fan belt
2	Intake manifold	9	Mounting screw
3	Locknut	10	Bumper screw
4	Ball joint	11	Governor
5	Shielded spark plug leads	12	Governor spring
6	Timing gear cover	13	Magneto
7	Governor lever	14	Carburetor control rod

Figure 22. Carburetor control rod adjustment.

the ball joint (4) to shorten the road; unscrew the rod slightly to lengthen it. Tighten the locknut (3) after the proper adjustment is made.

b. Throttle Cable (fig. 20). The throttle cable is used for the manual operation of the throttle lever (12). The cable can be removed from its housing by loosening the clamp screw (3) and pulling the cable out of the housing.

c. Choke Cable (fig. 20). The choke cable is used for the manual operation of the carburetor choke lever (14). The cable can be removed from its housing by loosening the clamp screw (13) and pulling the cable out of the housing.

108. Governor

(fig. 23)

a. General. The speed of the engine is controlled by the centrifugal flyball type of governor. In this governor, two forces are used to achieve the regulation desired. The first is the centrifugal force created by the balls located inside the governor. This centrifugal force tends to close the throttle as the speed of the engine increases. The second force is exerted by the governor spring. This force remains constant and tends to hold the carburetor throttle in wide-open position. When these two forces are in proper balance, the engine is operating at the predetermined governor speed.

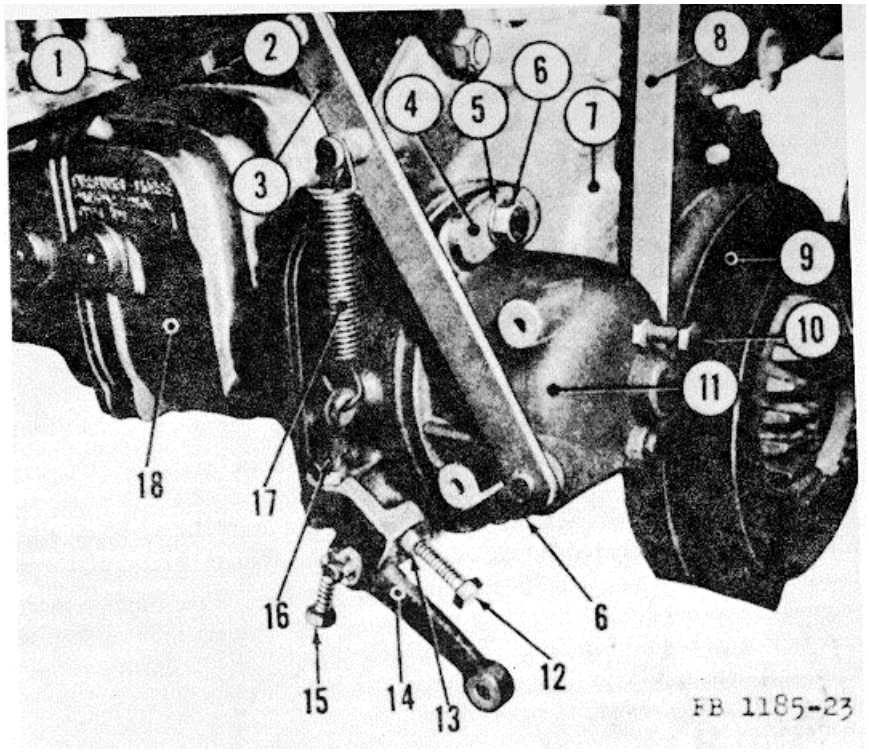
b. Removal.

(1) Remove the nut attaching the ball joint (2) to the governor lever (3) and disconnect the carburetor control rod (1) from the governor lever (3).
(2) Disconnect the governor spring (17) from the governor lever (3).
(3) Remove the mounting screws (6), lockwashers (5), and mounting washer (4).
(4) Remove the governor (11) and gasket. Discard the gasket.

c. Inspection. Inspect the mounting screws for stripped or damaged threads. Check the governor housing and mounting surfaces for breaks, corrosion, and pitting. See that the mounting washer is not bent or twisted.

d. Installation.

(1) Install a new gasket and position the governor (11) for proper mounting. See that the mounting holes are alined and that the drive gear of the governor is meshing with the camshaft gear.
(2) Install the flat mounting washer (4), lockwashers (5), and mounting screws (6). Tighten the screws evenly and securely.
(3) Connect the governor spring (17) with the governor lever (3).



1	Carburetor control rod	10	Governor bumper screw
2	Locknut	11	Governor
3	Governor lever	12	Speed adjustment screw
4	Mounting washer	13	Locknut
5	Lockwasher	14	Speed adjustment lever
6	Mounting screw	15	Spring tension adjustment screw
7	Timing gear cover	16	Spring screw
8	Fan belt	17	Governor spring
9	Fan drive pulley	18	Magneto

Figure 23. Governor mounting and adjustment points.

(4) Connect the carburetor control rod (1) with the governor lever (3) and tighten the nut attaching the ball joint to the lever.

e. Adjustment. The governor setting can be adjusted by increasing or decreasing the governor spring (17) tension. When the spring tension is increased, the speed of the engine will increase. When the spring tension is decreased, the speed of the engine will decrease.

(1) *Increasing spring tension.* Loosen the locknut (13) and turn the speed adjustment screw (12) counterclockwise. Loosen the locknut on the spring tension adjustment screw (15) and turn the screw clockwise. When the proper spring tension is achieved, tighten the locknut (13) securely.

(2) *Decreasing spring tension.* Loosen the locknut (13) and turn the speed adjustment screw (12) clockwise. Loosen

the locknut on the spring tension adjustment screw (15) and turn the screw counterclockwise. Tighten the locknut (13) securely.

(3) *Bumper screw*. If the governor surges at the "no load" speed, turn the bumper screw (10) clockwise until the surge is eliminated. Be careful not to turn the bumper screw in far enough to increase speed.

109. Fuel Tank

(fig. 24)

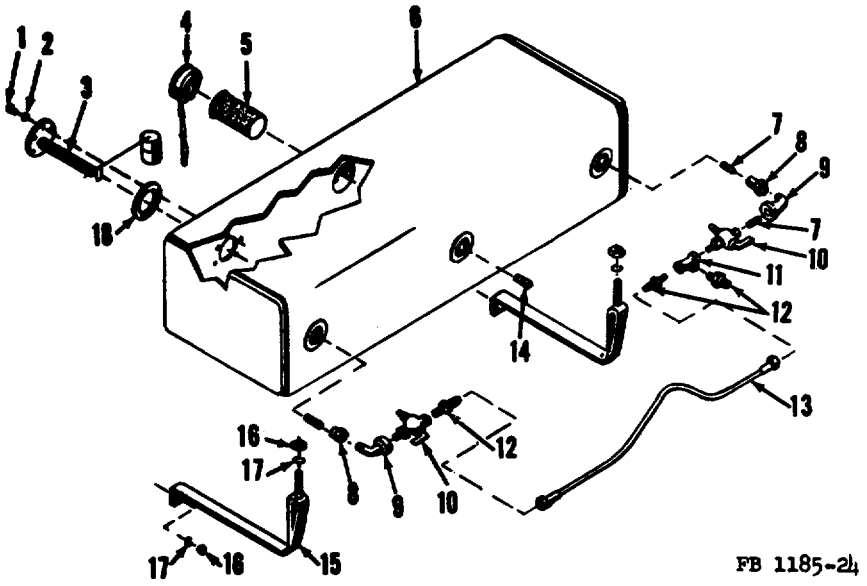
a. General. The fuel tank is of conventional all-welded sheet-metal construction and is mounted under the compression roll housing.

b. Removal.

(1) Remove the fuel tank cap (4) and place a clean container under the drain plug (14).

(2) Remove the drain plug (14) and drain the fuel tank (6).

Caution: Do not permit open flame in the vicinity when removing, draining, or cleaning the fuel tank.



1	Screw, machine, rd hd, No. 10-82 x 3 (5 req'd)	9	Elbows, %, 90° (2 req'd)
2	Washer lock, std, No. 10 (5 req'd)	10	Fuel tank valves (2 req'd)
3	Fuel gage transmitter	11	Tee connector, 36 x s xs
4	Fuel tank cap	12	Nipples. close, % (8 req'd)
5	Fuel tank strainer	13	Fuel line
6	Fuel tank	14	Plug, pipe, std, %
7	Pipe nipples (3 req'd)	15	Fuel tank straps (2 req'd)
8	Reducing bushings (2 req'd)	16	Nuts, A-18NC (4 req'd)
		17	Washers, lock, std, '1 (4 req'd)
		18	Gasket

Figure 24. Fuel tank disassembled.

(3) Unscrew the fitting nut and disconnect the fuel line which joins the carburetor with the close nipple (12).
(4) Remove the nuts (16) and lockwashers (17) attaching the fuel tank straps (15) to the fuel tank (6).
(5) Bend the fuel tank straps (15) away from the fuel tank (6). Remove the fuel tank.

c. Disassembly.

(1) Place the fuel tank on a workbench and make sure that there is no open flame in the vicinity. Unscrew and remove the close nipple (12) from the tee connector (11).
(2) Unscrew the fitting nuts and remove the fuel line (13).
(3) Unscrew and remove the close nipples (12) and tee connector (11).
(4) Remove the fuel tank valves (10).
(5) Use a pipe wrench to remove the pipe nipple (7) and both elbows (9).
(6) Remove the reducing bushings (8).
(7) Remove the pipe nipples (7) from the fuel tank (6).
(8) Twist the fuel strainer (5) counterclockwise and remove it from the filler neck of the fuel tank (6).
(9) Unscrew and remove five screws (1) and lockwashers (2) attaching the fuel gage transmitter (3) to the fuel tank (6).
(10) Tap the fuel gage transmitter (3) lightly with the wooden handle of a screwdriver to loosen it from the fuel tank body. Lift up the transmitter, being careful not to damage or bend the float lever. Remove the transmitter gasket (18).

d. Cleaning and Inspection. Wash the fuel tank with cleaning solvent and drain all sediment and foreign matter. Clean the fuel tank with live steam and dry it thoroughly with clean compressed air. Inspect the tank for holes, cracks, and dents. Check all mounting nuts for corroded or damaged threads. Clean the fuel tank straps with cleaning solvent and blow off all fuel lines and pipe nipples with clean compressed air. Inspect all threaded surfaces. Clean rust and corrosion from them with a stiff wire brush.

e. Repair. Weld minor holes and cracks in the fuel tank. Always fill the fuel tank with water before welding. Avoid excessive heat while welding or soldering because it may cause warpage or distortion of the fuel tank. Clean the welds when completed and drain the water from the fuel tank. Clean the tank with live steam and dry it with clean compressed air. Replace all damaged or worn pipe nipples, reducer bushings, elbows, valves, and mounting nuts. Use a softfaced hammer to straighten out bent or twisted fuel tank straps. Replace the straps if broken or cracked. Replace the fuel strainer if the screen mesh is torn, corroded, or splitting. Clean the screen mesh with compressed air. Check the fuel tank cap for tightness and replace if it is worn or cracked, or if the locking lugs are broken off.

Replace the fuel gage transmitter and gasket if damaged, broken, or worn.

f. Reassembly.

(1) Coat the fuel gage transmitter gasket (18) with fast-drying gasket sealer and install it on the fuel tank. Make sure that the mounting holes in the gasket and the tank body are properly alined.
(2) Insert the fuel gage transmitter (3) into the fuel tank (6), being careful not to bend or twist the float lever.
(3) Install and tighten the fuel gage transmitter mounting screws (1) and lockwashers (2).
(4) Insert the fuel tank strainer (5) into the fuel tank (6) and twist it clockwise to lock it in its mounting slot.
(5) Install and tighten the pipe nipples (7) and reducing bushings (8).
(6) Install the elbows (9) and tighten them securely.
(7) Install and tighten the pipe nipple (7), valves (10), tee connector (11), and close nipples (12).
(8) Connect the fuel line (13) with the close nipples (12) and tighten the fitting nuts securely. Make sure that all connections are secure and tight.
(9) Install and tighten the drain plug (14).

g. Installation.

(1) Position the fuel tank (6) under the top cover of the road roller and attach the fuel tank straps (15).
(2) Install the fuel tank strap nuts (16) and lockwashers (17). Tighten them securely.
(3) Connect the fuel line that leads from the carburetor with the close nipple (12) and tighten the fitting nut securely.
(4) Check all connections to make sure they are secure and tight. Fill the fuel tank and install the fuel tank cap (4). Open the fuel tank valves (10) and check all connections for leaks. Tighten the connections if necessary. If the connection is tight and still leaking, the threads are damaged and the connections must be replaced. With the fuel tank full, check the fuel gage readings. If these readings are not correct, the fuel gage transmitter or fuel gage is defective and must be replaced.

Section VII. ELECTRICAL SYSTEM

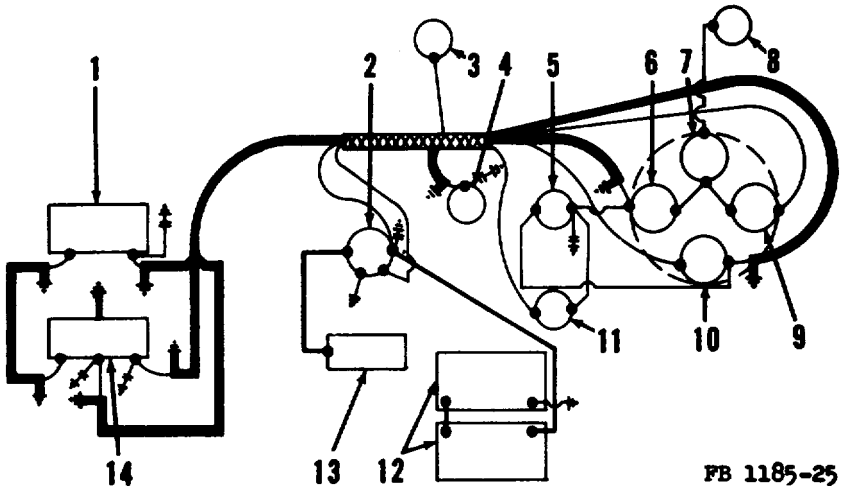
110. Description

(fig. 25)

a. The Starting Circuit. The starting circuit of the road roller engine includes the battery (12), ignition switch (5), magnetic

switch (2), starter button (11),starting motor (13), and wiring. The starting circuit is designed to carry high current with a minimum loss of voltage. When the starter button (11) is depressed, the electrical current from the battery (12) operates the magnetic switch (2) and flows to the starting motor (13). The starting motor converts the electric current into a mechanical force used to crank the engine.

Caution: When electrical components are removed or installed, the battery ground cable should be disconnected from the battery terminal to prevent accidental arcing at the electrical connections.



1	Battery generator	8	Fuel gage transmitter
2	Magnetic switch	9	Oil pressure gage
3	Oil pressure sender	10	Ammeter
4	Temperature sender	11	Starter button
5	Ignition switch	12	Battery
6	Temperature gage	13	Starting motor
7	Fuel gage	14	Voltage regulator

Figure 25. Practical wiring diagram.

b. The Charging Circuit. The charging circuit includes the generator (1), voltage regulator (14), battery (12), ammeter (10), and wiring. The generator (1) produces the electric current, and the voltage regulator (14) controls the output of the generator to conform to the requirements of the circuits.

c. The Ignition Circuit. The ignition circuit includes the magneto, shielded spark plug leads, and spark plugs. The magneto produces electric current and directs it at properly timed intervals to the spark plugs.

111. Battery and Cables

a. General. The battery converts the electricity into chemical energy which is stored until the battery is connected to an external

circuit. When the connection takes place, this chemical energy is transformed back into the electrical energy used to start the engine. It is very important to keep the battery properly charged at all times. The ability of the battery to power the starting motor properly depends upon the strength of the battery charge. The degree of the battery charge is measured by the specific gravity of the electrolyte. Table II shows how to determine battery condition from specific gravity readings corrected to 800 F.

Table II. Battery Condition (Corrected to 80 F.)

Specific gravity	Battery condition	Specific gravity	Battery condition
1.280.....	Fully charged.	1.190.....	25% charged.
1.250.....	75% charged.	1.160.....	Almost discharged.
1.220.....	50% charged.	1.130.....	Discharged.

b. Temperature influence. Cold weather has a considerable effect on electrochemical reactions, and battery capacity is greatly reduced by cold temperatures. The battery will deliver its peak cranking power when the temperature of the electrolyte is about 800 F. At 30° F., a fully charged battery will deliver only 65 percent of its cranking power. At 0° F. the cranking power of the battery will be reduced to 40 percent. It is important to keep the battery fully charged when it is operated in cold temperatures. The freezing point of the electrolyte depends on its specific gravity; the battery can be protected from freezing by keeping it fully charged at all times. Table III lists freezing points and specific gravity of the standard electrolyte commonly used in all batteries.

Table III. Electrolyte Freezing Points

Specific gravity	Temperature	Specific gravity	Temperature
1.280	-900 F.	1.150	+5° F.
1.250	-620 F.	1.100	+19° F.
1.200	-16° F.		

The specific gravity of the electrolyte varies with the temperature of the electrolyte. When checking the specific gravity of the electrolyte in cold temperatures, the readings of the hydrometer must be corrected to 800 F. by referring to table IV. At the top of table IV, find the column which indicates the temperature nearest to the temperature of the electrolyte. In this column find the figure nearest to the specific gravity reading indicated on the hydrometer. Trace horizontally

across the table to the 800 F. column. This reading in the 800 F. column is the normal specific gravity. This normal figure must be used to establish the condition of the battery and its available cranking power.

Table IV. Specific Gravity Temperature Corrections

Available cranking power	-65°F.	-40°F.	-20°F.	-10°F.	-0°	+20°F.	40°F.	+80°F.	+100°F.	+110°F.	+120°F.
50%.....	1.277	1.267	1.259	1.255	1.251	1.243	1.236	1.220	1.213	1.209	1.205
58.3%.....	1.287	1.277	1.269	1.265	1.261	1.253	1.246	1.230	1.223	1.219	1.215
66.6%.....	1.297	1.287	1.279	1.275	1.271	1.263	1.256	1.240	1.233	1.229	1.225
75 %.....	1.307	1.297	1.289	1.285	1.281	1.273	1.266	1.250	1.243	1.239	1.235
83.3%.....	1.317	1.307	1.299	1.295	1.291	1.283	1.276	1.260	1.252	1.248	1.245
91.6%.....	1.327	1.317	1.309	1.305	1.301	1.294	1.286	1.270	1.262	1.258	1.255
100%.....	1.338	1.328	1.320	1.316	1.312	1.304	1.296	1.280	1.272	1.268	1.265

c. Storage. When the charged battery is put in storage, the electrolyte will show a gradual and continuous drop in specific gravity. This is caused by a slow acid reaction with the active materials, even when there is no closed external circuit. When the batteries are kept in storage below 800 F., the drop will average about 0.001 per day over a month's time. The battery must, be recharged every 30 days to keep it ready for service. The recharging rate must equal one ampere per positive plate per cell.

Note. Do not smoke or permit open flame in the vicinity when recharging batteries.

d. Testing.

(1) Test batteries for specific gravity weekly. If the ambient temperature is extremely high or low, measure the temperature of the electrolyte first, using a mercury thermometer. Use a standard hydrometer to test each battery cell and correct the readings by referring to table IV. Determine the battery condition by referring to table II. Recharge, if necessary, using a standard battery charger. Be sure to observe the polarity of the battery when charging.

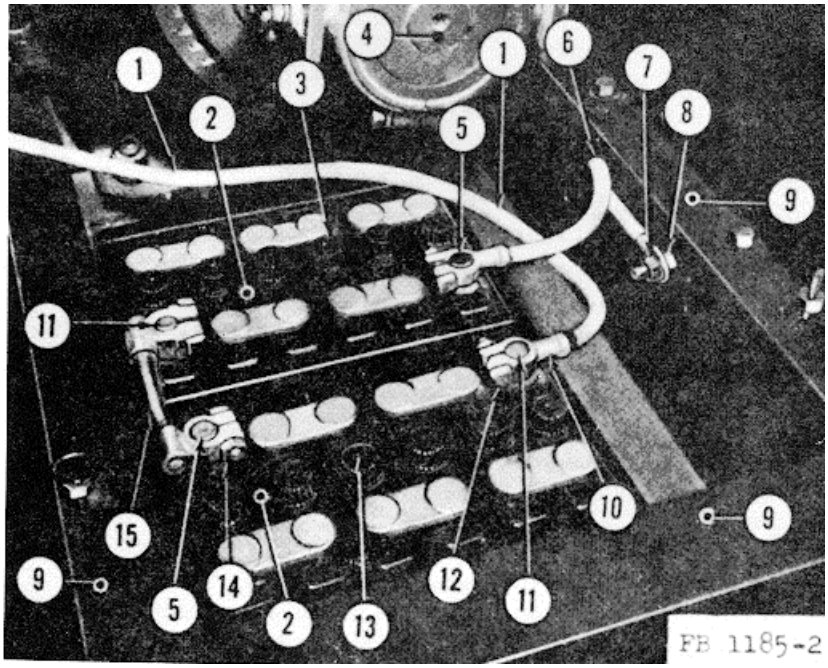
(2) Use a voltmeter to test each cell for terminal voltage. Each fully charged ell must deliver about 2 volts. A low output voltage may indicate a low charge or internal trouble. Check the specific gravity and charge the battery if necessary. If the output voltage is still low, replace the battery.

Note. Do not take battery test readings immediately after adding water to the battery.

e. *Removal* (fig. 26). The two 12-volt batteries (2) are mounted on the base of the road roller, on the left side of the engine, directly below the forward and reverse clutch (4).

(1) Remove the battery cover.

(2) Unscrew the ground cable mounting nut (7) and disconnect the ground cable (6) from the mounting bolt (8).



1	Battery cable	9	Roller frame
2	Battery	10	Cable clamp
3	Filler cap	11	Battery terminal, negative
4	Forward and reverse clutch	12	Cable clamp bolt
5	Battery terminal, positive	13	Vent hole
6	Ground cable	14	Cable clamp nut
7	Ground cable mounting nut	15	Connecting cable
8	Ground cable mounting bolt		

Figure 26. Batteries and cables.

(3) Loosen the ground cable terminal clamp nut and twist the terminal clamp to loosen it from the battery terminal (5). If the clamp is corroded to the terminal, tap the clamp lightly with the wooden handle of a screwdriver. Lift up and remove the ground cable.

Note. Do not use extreme force when removing the cable from the battery. This may break or damage the battery terminal.

(4) Loosen the battery cable terminal clamp nut and remove the cable clamp (10) from the battery terminal (11). Clean the

clamp and wrap it with protective tape. This will prevent accidental arcing when removing the battery.

(5) Loosen the connecting cable clamp nuts (14). Remove the connecting cable (15) from the battery terminals (5 and 11).

(6) Remove the batteries.

f. Cleaning. Wash the top of the batteries and the battery cases with a warm solution of baking soda and water. Be extremely careful not to let any of the solution enter the batteries Inspect the battery case for cracks and leaks. Clean the battery terminals and remove the accumulated copper sulphate from the terminals and battery cables. See that the filler caps are in place, fitting properly, and that the vent holes in the filler caps are open. Clean the terminals and battery cables and apply a light coat of petroleum jelly to prevent corrosion.

g. Servicing. See that the water level in the battery case is about three-eights of an inch above the plates. Use only distilled water if available. Do not fill the battery with water containing high percentages of lime, alkali, or other minerals. Do not add water in freezing temperatures unless the battery can be charged long enough to mix the electrolyte and prevent the battery from freezing. Replace leaky or cracked batteries.

h. Installation (fig. 26).

(1) Position both batteries between the cross members (9) of the frame.

(2) Install the battery cable clamp (10) on the battery terminal (11) and tighten the clamp nut securely.

(3) Install the connecting cable (15) on the battery terminals (5 and 11) and tighten the clamp nuts (14) securely.

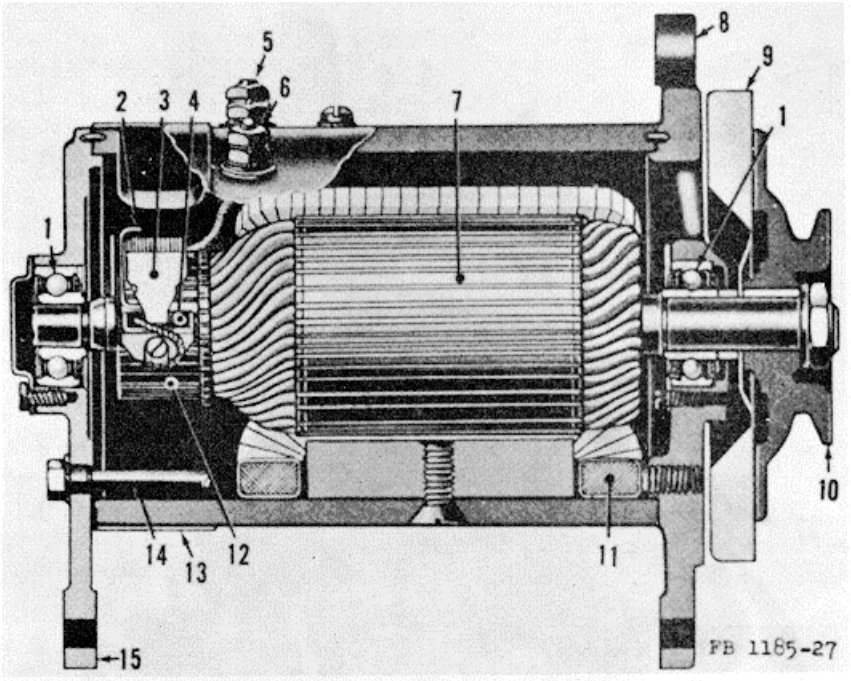
(4) Install the ground cable (6) on the battery terminal (5) and tighten the clamp nut.

(5) Connect the ground cable (6) with the ground cable bolt (8) and tighten the mounting nut (7).

(6) Install the battery cover.

112. Battery Generator

*a. Description (*fig. 27). The battery charging generator supplies all of the electricity needed for the starting circuit of the engine. The armature (7) rotates between the field coils (11) and produces voltage. Due to the rotating action of the armature, the armature conductors cut through the magnetic field first in one direction and then in the other to produce an alternating current in the armature conductors. A commutator (12), consisting of copper segments insulated from each other and from the armature core and shaft, reverses the connections of each field coil (11) as the generated voltages reverses in each revolution. This results in a direct current which is carried away by the brushes (4). The generator is cooled



1	Ball bearing	9	Fan
2	Brush holder	10	Drive pulley
8	Tension lever	11	Field coil
4	Brush	12	Commutator
5	Armature terminal	18	Cover band
6	Field terminal	14	Thru bolt
7	Armature	15	Commutator end frame
8	Drive end frame		

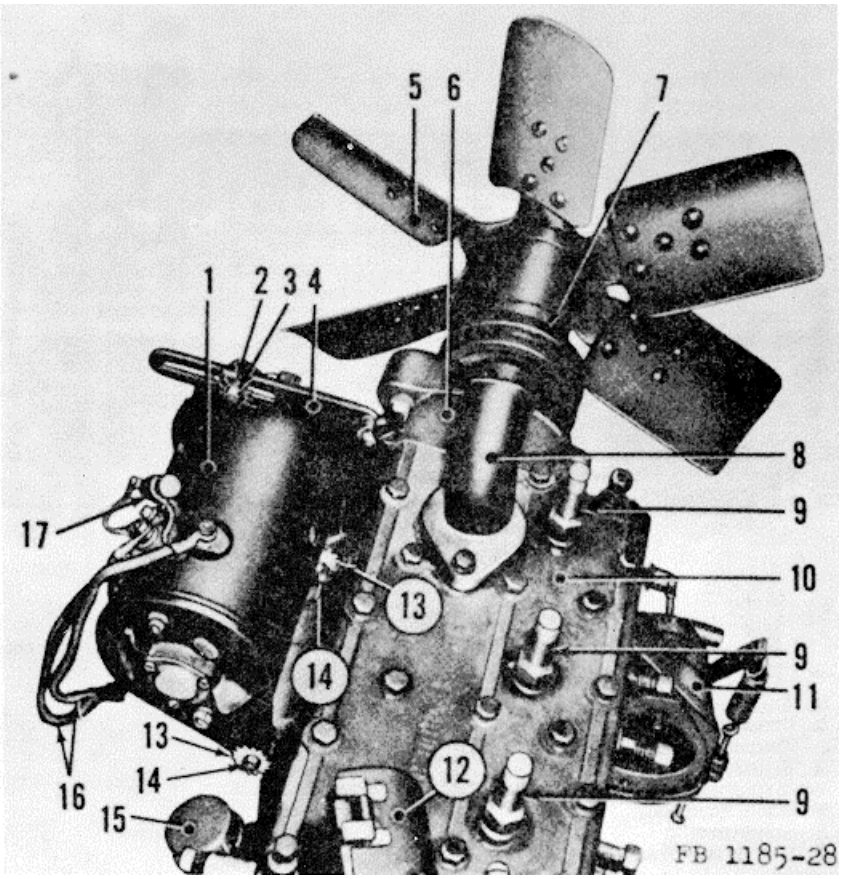
Figure 27. Generator, sectional view.

by a fan (9) mounted on the drive pulley (10). The armature shaft rotates on two ball bearings (1), located at the drive end frame (8) and commutator end frame (15). The generated current is carried away through the armature (5) and field (6) terminals.

b. Removal (fig. 28).

(1) Disconnect the shielded leads (16) from the generator (1). Tag the leads to facilitate installation.
(2) Remove the adjusting nut (3) and lockwasher (2).
(3) Loosen the mounting bolts (14).
(4) Push the generator against the engine and remove the fan belt from the generator pulley.
(5) Remove the mounting bolts (14) and lockwashers (13).
(6) Remove the generator (1).

c. Inspection and Repair. Inspect the commutator and brushes for wear, dirt, cracking, or damage. Check the mounting bolts and nut for damaged or stripped threads. See that the star lockwasher



1	Battery generator	10	Cylinder head
2	Lockwasher	11	Governor
3	Adjusting nut	12	Hour meter
4	Adjusting bracket	13	Lockwasher
5	Fan	14	Mounting bolt
6	Water pump	15	Oil filler cap
7	Water pump pulley	16	Shielded leads
8	Water outlet elbow	17	Suppression capacitor
9	Shielded spark plug		

Figure 28. Generator removal points.

edges are sharp enough to bite into the metal surface. Replace the star lockwashers if they are flat, or if the edges are broken and dull. Inspect the mounting bracket for corrosions, warpage, breaks, cracks, and elongated mounting holes. Replace the bracket if warped or cracked. Inspect the pulley for broken off edges, worn, damaged, or corroded belt groove, pitted or cracked pulley shaft hole. Replace the pulley if it is cracked, twisted, or worn. Do not attempt to weld a cracked pulley as the deposit of weld metal will throw the pulley off

balance and will result in damaged battery generator bearings. Check the terminal nuts for corrosion, damage, and twisted, stripped, or galled threads. Replace damaged or corroded terminal nuts. Inspect the terminal nut washers for pitting, cracking, etching, and corrosion. Replace damaged, pitted, or corroded terminal nut washers.

d. Cleaning the Commutator.

(1) Insert a piece of No. 00 sandpaper between the brushes and commutator, with the abrasive side against the commutator.
(2) Hold the sandpaper against the commutator and slowly turn the armature.
(3) Clean the generator with compressed air and remove all particles of sand from the commutator.

Note. It the commutator is rough or worn, report the condition to the proper authority. Never oil the commutator.

e. Replacing Brushes.

(1) If the brushes are oil soaked, cracked, or worn down to less than one-half of their original length, they must be replaced.
(2) Remove the brush lead screw and disconnect the brush lead.
(3) Lift the tension lever and remove the brush.
(4) Install the new brush and see that the beveled edge of the brush is parallel with the commutator segments.
(5) Connect the brush lead and tighten the brush lead screw. Make sure that the brush is not binding in the holder and that it moves freely.

f. Sanding Brushes.

(1) Cut a strip of 00 sandpaper to match the exact width of the commutator.
(2) Slip the strip under the brush with its abrasive side against the brush.
(3) Hold the sandpaper against the commutator and move the commutator back and forth. Be careful not to round or break the edges of the brush.
(4) Clean the commutator, brush, and tension lever with clean compressed air.

g. Testing Brush Spring Tension.

(1) Hook a spring scale in the hole at the end of the tension lever.
(2) Pull the scale in a straight line outward from the commutator center and take the reading just as the tension lever starts to leave the brush. Be careful to exert the pull in the same plane as the plane of the brush face.
(3) The proper brush spring tension is 37 to 44 ounces. Bend the spring to increase or decrease its tension.

h. Installation (fig. 28).

(1) Position the generator (1) in its mounting and see that the mounting holes are properly alined.
(2) Install the mounting bolts (14), lockwashers (13), and nuts. Do not tighten the bolts.
(3) Install the adjusting bolt, lockwasher (2), and nut (3), attaching the generator to the adjusting bracket (4). Do not tighten the adjusting nut.
(4) Push the generator against the engine and install the fan belt on the generator pulley.
(5) Pull the generator away from the engine and check the fan belt tension. If the fan belt can be depressed one-half of an inch by thumb pressure between the pulleys, the adjustment is correct.
(6) Hold the generator firmly in the position which permits the fan belt to be depressed one-half inch and tighten the adjusting nut (3) securely.
(7) Tighten the mounting bolts (14).
(8) Connect the shielded leads (16) to the generator terminals Note. When the generator is repaired or replaced, it is necessary to connect a Jumper lead momentarily between the battery terminal and generator terminal of the voltage regulator to polarize the generator to the battery.

113. Voltage Regulator

(fig. 29)

a. General. The voltage regulator (5) is mounted directly below the generator (2). The voltage regulator limits the voltage and current of the generator and protects the battery from overcharging.

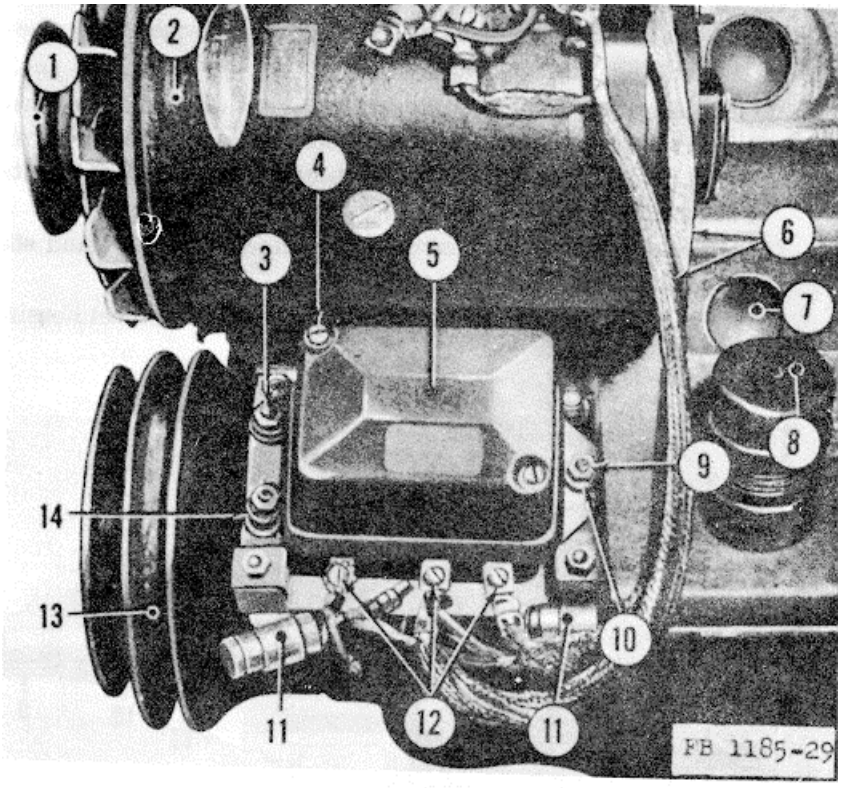
When removing the voltage regulator, be sure to mark the leads properly to facilitate installation.

b. Removal.

(1) Remove the lead mounting screws (12) and disconnect the leads (6) from the voltage regulator (5). Tag the leads to facilitate installation.
(2) Remove the mounting nuts (9), washers (10), rubber washers (14), and screws (3).
(3) Remove the voltage regulator (5).

c. Installation.

(1) Position the voltage regulator (5) over the mounting bracket and see that the mounting holes are properly alined.
(2) Install the mounting screws (3), rubber washers (14), washers (10), and nuts (9). Tighten the nuts securely.
(3) Connect the leads (6) with the voltage regulator and tighten the lead mounting screws (12).



1	Generator pulley	8	Oil filler cap
2	Generator	9	Mounting nut
3	Mounting screw	10	Mounting washer
4	Voltage regulator cover screw	11	Radio suppression capacitor
5	Voltage regulator	12	Lead mounting screw
6	Shielded leads	13	Crankshaft pulley
7	Cylinder block	14	Mounting rubber washer

Figure 29. Voltage regulator removal points.

114. Starting Motor

a. Description (fig. 30). The starting motor converts electrical energy from the battery into mechanical power and transmits this power to the engine. It consists of the end bracket (16), armature (13), frame and field coils (12), drive housing (7), and drive assembly (6, 8, 10, and 11), located inside the drive housing. The drive pinion (11) is mounted on the screw shaft (8) which is driven by a spring (6) connected with the armature shaft (5) and the drive shaft (8). When the starting motor circuit is closed, the armature (13) revolves and turns the screw shaft (8) within the pinion (11). This screw action forces the pinion (11) forward into mesh with the flywheel gear. The sudden shock of meshing is absorbed by the drive spring (6). When

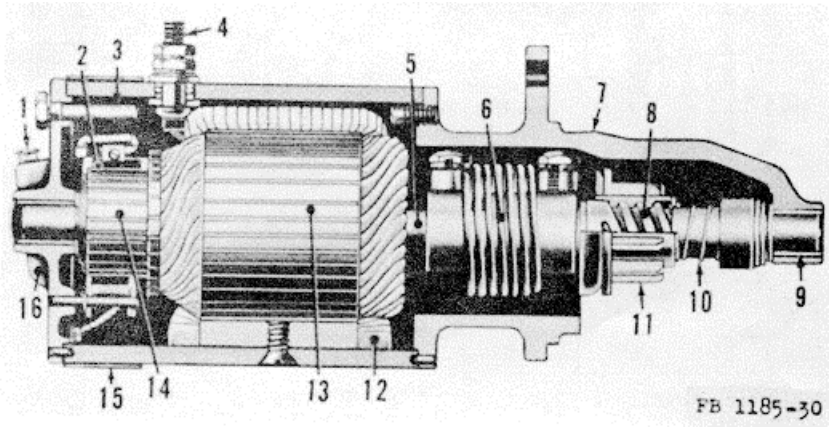
the engine starts, the pinion (11) is driven faster than the shaft and is threaded back along the screw shaft (8) out of mesh with the flywheel.

b. Removal (fig. 31).

(1) Unscrew the starting motor terminal nut (19) and disconnect the starting motor cable (20) from the starting motor terminal (17). Tape the starting motor cable to prevent accidental arcing.

(2) Remove the starting motor mounting screws (13) and star lockwashers (12).

(3) Pull out the starting motor (16) from the flywheel housing (15).



1	Oiler cup	9	Drive shaft bearing
2	Brush	10	Antidrift spring
3	Thru bolt	11	Pinion
4	Terminal stud	12	Field coil
5	Armature shaft	13	Armature
6	Drive spring	14	Commutator
7	Drive housing	15	Cover band
8	Screw shaft	16	End bracket

Figure 30. Starting motor, sectional view.

c. Ispection. Inspect the commutator and brushes for wear, dirt, cracking, or damage. Check the mounting screws and nuts for damaged or stripped threads. See that the star lockwasher edges are sharp enough to bite into the metal surface. Replace the star lockwashers if they are flat or if the edges are broken or dull.

d. Cleaning the Commutator. The commutator is cleaned in the same manner as the battery generator commutator (par. 112d).

e. Replacing Brushes. Refer to paragraph 112e.

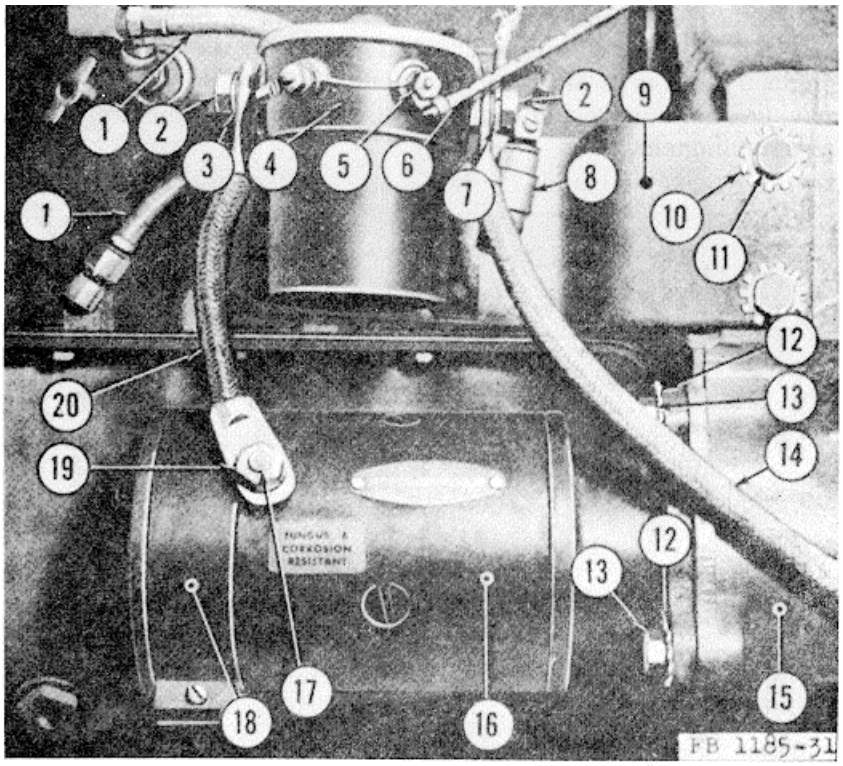
f. Sanding Brushes. Refer to paragraph 112f.

g. Testing Brush Spring Tension. Refer to paragraph 112g.

h. installation

(1) Install the starting motor (16) in the flywheel housing (15) and see that the mounting holes are properly alined.

(2) Install the star lockwashers (12) and mounting screws (13). Tighten the screws firmly and evenly. See that the star lockwashers (12) bite into the starting motor mounting flange.



1	Oil filter line	11	Bracket screw
2	Magnetic switch stud nut	12	Star lockwasher
8	Washer	13	Starting motor mounting screw
4	Magnetic switch	14	Battery cable
5	Magnetic switch terminal nut	15	Flywheel housing
6	Lead	16	Starting motor
7	Lockwasher	17	Starting motor terminal
8	Suppression capacitor	18	Cover band
9	Magnetic switch mounting bracket	19	Starting motor terminal nut g
10	Star lockwasher	20	Starting motor cable

Figure 31. Starting motor removal points.

(3) Remove the protective tape from the starting motor cable (20) and connect the cable with the starting motor terminal (17).

(4) Install the starting motor terminal nut (19). Tighten the nut securely.

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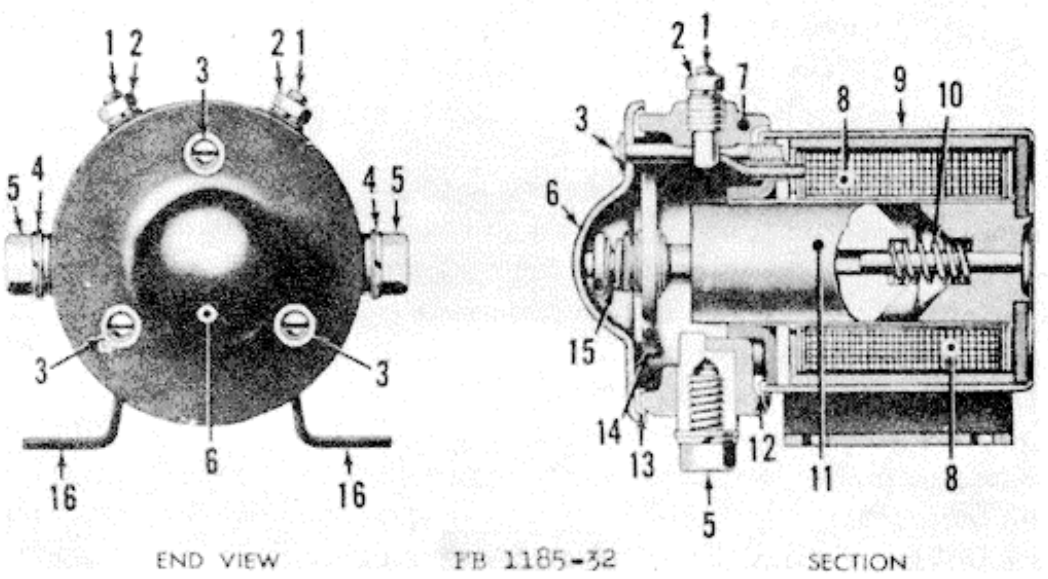
115. Magnetic Switch

a. Description (fig. 32). The magnetic switch closes the starting circuit through. the magnetic pull of a solenoid plunger (11) which carries a contact disk (14). The contact disk strikes two contacts that are connected with the external switch terminals (5). The contact disk is mounted on springs (10) and (15) to make the opening and closing action more positive and to assure contact over the full surface. When the contacts are closed, the current flows to the starting motor, where it is converted into mechanical energy for the cranking of the engine. This type of magnetic switch is used with starting motors having bendix drive and cannot be used on starting motors with an overrunning clutch.



1	Coil winding terminal stud	9	Switch housing
2	Coil winding terminal nut	10	Return spring
3	Cover screw	11	Plunger
4	Switch terminal lockwasher	12	Housing gasket
5	Switch terminal screw	13	Cover gasket
6	Cover	14	Contact disk
7	Molded terminal ring	15	Contact disk spring
8	Coil winding	16	Mounting bracket

Figure 32. Magnetic switch, end and sectional . view.

b. Removal (fig. 31).

(1) Remove the magnetic switch stud nut (2) and lockwasher (7). Disconnect the battery cable (14) from the magnetic switch (4). Tape the battery cable to prevent accidental arcing.

(2) Remove the magnetic switch stud nut (2) and washer (3) and disconnect the starting motor cable (20) from the magnetic switch (4).

(3) Unscrew the magnetic switch terminal nut (5) and disconnect the lead (6).

(4) Remove the mounting screws attaching the magnetic switch (4) to the mounting bracket (9). Remove the switch and the suppression capacitor (8).

c. Installation (fig. 81).

(1) Attach the magnetic switch (4) and suppression capacitor (8) to the mounting bracket (9). Tighten the mounting screws securely.

(2) Connect the lead (6) with the magnetic switch terminal and tighten the nut (5).

(3) Connect the starting motor cable (20) with the magnetic switch stud. Tighten the stud nut (2).

(4) Remove all protective tape from the battery cable (14). Connect the cable with the magnetic switch stud and install the lockwasher (7) and nut (2). Tighten the nut securely.

(5) With the ignition switch on, push the starter button and check the magnetic switch for proper operation.

116. Magneto

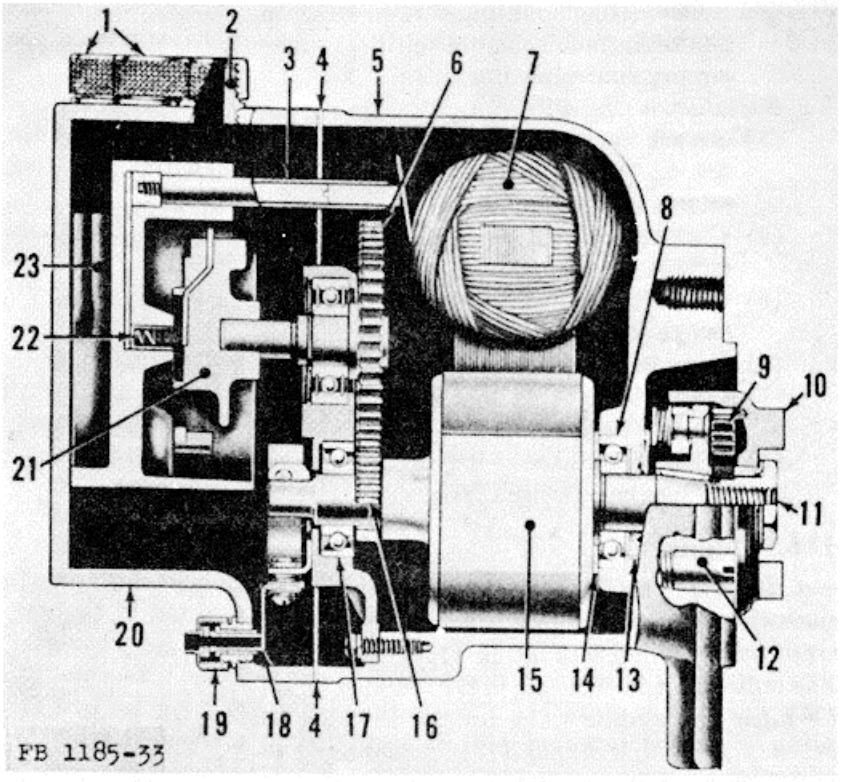
a. Description (fig. 33). The magneto is a continuous, heavy-duty, clockwise rotation, radio shielded unit. It is connected to the governor by the impulse coupling (10) and driven by the governor gear. The entire unit is enclosed in a grounded metal frame. The end cap (20) has six adapters (1) for the shielded spark plug leads The primary ground terminal (19) is connected to a shielded cable for operation by the remote control switch. When the breaker points in the end cap are closed, the revolving magnetic rotor (15) causes an induced current to flow in the primary circuit of the stationary coil (7). When the breaker points open, the primary current stops instantly and its field collapses immediately, thus inducing a very high voltage in the secondary winding of the stationary coil. The secondary circuit is completed when the ignition spark jumps the spark plug point gap to ground. The impulse coupling (10) facilitates starting of the engine by automatically retarding the ignition spark during the starting operation and at the same time producing an intense, hot spark which would otherwise be impossible at very low engine speeds. The impulse feature disengages as soon as the engine develops speed, after which the coupling serves as a conventional drive member.

b. Testing Magneto for Spark (fig. 33).

(1) Tag the spark-plug leads to insure their proper replacement.

(2) Unscrew the spark plug lead adapters (1) on the top of the magneto end cap and pull out the shielded spark-plug leads.

(3) Use a short piece of stiff, rubber-insulated wire to test the spark. Remove one-half of an inch of insulation from the



1	Spark plug lead adapter	13	Drive end seal
2	High tension insert	14	Rotor bearing seal
8	Distributor high tension lead rod	15	Magnetic rotor assembly
4	Gasket	16	Magnetic rotor gear
5	Frame	17	Rotor bearing, distributor end
6	Distributor gear and shaft	18	Primary ground spring
7	Coil assembly	19	Primary ground terminal
8	Rotor drive end bearing	20	End cap assembly
9	Impulse coupling spring	21	Distributor rotor
10	Impulse coupling	22	Brush and spring
11	Impulse coupling nut	23	Distributor block
12	Impulse coupling stop pin		

Figure 33. Magneto, sectional view.

end of the wire and insert this end into the high tension insert (2). Make sure that the bare wire makes a good contact with the insert.

(4) Bend the other end of the wire to within one-eighth inch of the engine frame.

(5) Crank the engine slowly and watch for a spark between the wire and the engine frame. Test each insert for spark. If a strong spark is observed with the wire in each insert, the magneto is in proper operating condition. If no spark is observed from one or more of the magneto terminals, check adjustment of the breaker points. See e below.

c. Removal (fig. 34).

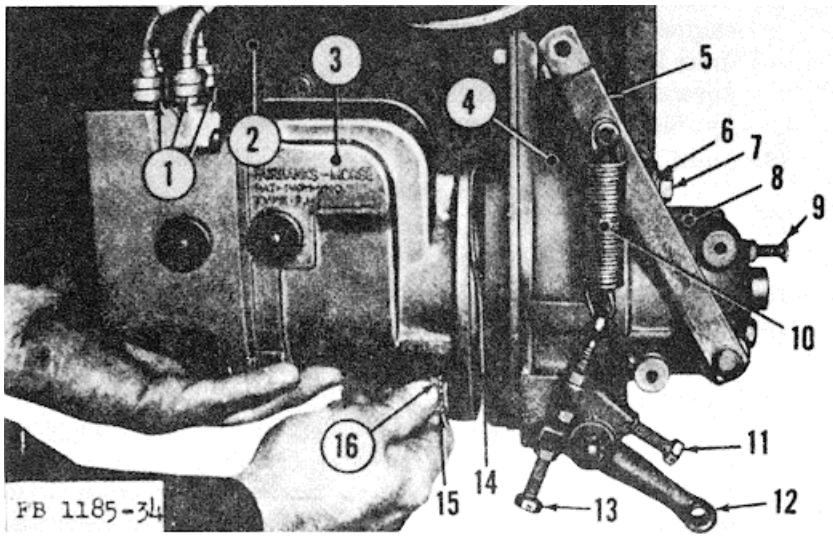
(1) Tag the spark-,plug leads to insure their proper replacement.

(2) Unscrew the adapters from the magneto terminals and pull out the spark-plug leads (1).

(3) Remove the mounting screw (7) and lockwasher (6) attaching the governor (8) to the magneto (3).

(4) Remove the mounting screw (16) and lockwasher (15) on the bottom of the magneto (3).

(5) Remove the magneto (3) and gasket (14).



1	Shielded ignition leads	9	Governor bumper screw
2	Valve cover	10	Spring
3	Magneto	11	Speed adjustment screw
4	Timing gear cover	12	Speed adjusting lever
5	Governor lever	13	spring tension adjusting screw
6	Lockwasher	14	Gasket
7	Screw, governor to magneto	15	Lockwasher
8	Governor	16	Mounting screw

Figure 34. Magneto removal points.

d. Installation.

(1) The magneto must be properly timed with the engine before installation. To insure proper timing, remove the No. 1 spark plug (nearest to the fan).

(2) Crank the engine slowly until the piston in the No. 1 cylinder is at top dead center on its compression stroke. This dead center position can be determined by placing a thumb over the opening of the No. 1 spark plug and cranking the engine slowly until a definite outward pressure is felt. Continue cranking slowly until the notch marked "DC" on the flywheel is lined up with the marking on the flywheel housing.

(3) Place the end cap on the frame of the magneto and set the magneto for spark discharge to the No. 1 terminal. This may be accomplished by removing the spark plug lead and inserting a short, stiff wire into the No. 1 socket. Bend the wire to within one-eighth inch of the magneto or engine frame.

(4) Turn the impulse coupling clockwise until a spark is observed between the wire and the frame. Hold the coupling in the position in which the spark appeared.

(5) Without disturbing the setting of either the magneto or engine, couple the magneto to the engine by engaging the drive lugs of the impulse coupling with the drive slots of the governor drive member. A slight movement of the engine flywheel may be necessary to insure accurate alignment.

(6) Install the mounting screw (16, fig. 34) and lockwasher v (15) on the bottom part of the magneto (3).

(7) Install the mounting screw (7) and lockwasher (6) attaching the governor (8) to the magneto (3).

(8) Tighten the mounting screws (7 and 16) securely.

(9) Install the proper spark-plug leads (1) in their terminals and tighten the terminal nuts.

(10) Double-check the magneto timing by removing the end cap (20, fig. 33) and inspecting the distributor rotor (21) position. With the magneto timed as described above, the distributor rotor must be pointing to No. 1 spark-plug lead terminal with the breaker points just starting to separate. Adjust the breaker points if necessary (see e below) and replace the magneto end cap.

e. Adjusting Magneto Breaker Points.

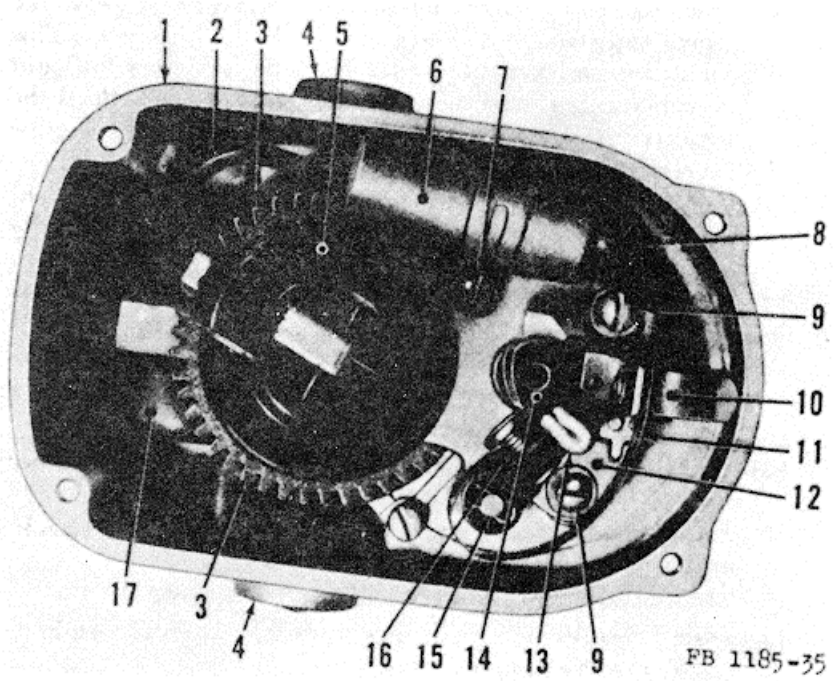
(1) Remove the four mounting screws and remove the magneto end cap assembly (20, fig. 33).

(2) Check the clearance of the breaker points (16, fig. 35) when they are in fully open position. The proper clearance is 0.015 inch at full separation.

(3) Adjust the breaker points by loosening the two screws (9) and moving the breaker plate (12) until the proper clearance is obtained.

(4) Tighten the screws (9) and take a final measurement of the breaker point gap. Readjust if necessary.

f. Cleaning Magneto Breaker Points. Inspect the magneto breaker points for wear, pitting, or pyramiding. A small tungsten file or fine stone may be used to resurface the points. Remove the oil from the breaker points with a small brush dipped in a cleaning solvent. If the points are badly pitted or worn, they must be replaced.



1	Magneto frame	10	Primary ground spring
2	Coil lead	11	Breaker spring
3	Distributor gear	12	Breaker plate
4	Ventilator hood	13	Felt
5	Distributor rotor	14	Breaker cam
6	Condenser	15	Lock pin
7	Condenser mounting screw	16	Breaker points
8	Condenser lead	17	Coil
9	Screw, locking		

Figure 35. Magneto.

g. Replacing Magneto Breaker Points (fig. 35).

(1) Unscrew the breaker arm terminal screw and disconnect the coil lead (2) and condenser lead (8) from the terminal.

(2) Remove the lock pin (15) and lift up the breaker arm from the stud.

(3) Remove the screws (9) and breaker plate.

(4) Install a new breaker plate (12) and tighten the screws (9).

(5) Install the breaker arm on the stud and secure it with the lock pin (15).

(6) Connect the breaker arm spring (11), condenser lead (8), and coil lead (2) with the breaker arm terminal. Tighten the screw.

(7) Adjust the breaker points (e above).

h. Replacing Condenser (fig. 35).

(1) Disconnect the condenser lead (8) from the breaker arm terminal.

(2) Remove the condenser mounting screw (7) and remove the condenser (6).

(3) Test the condenser on a reliable condenser tester for shorts, opens, leakage, and capacitance. Replace the condenser if defective or if the lead is broken or damaged.

(4) Install the condenser in its proper mounting place and tighten the mounting screw (7).

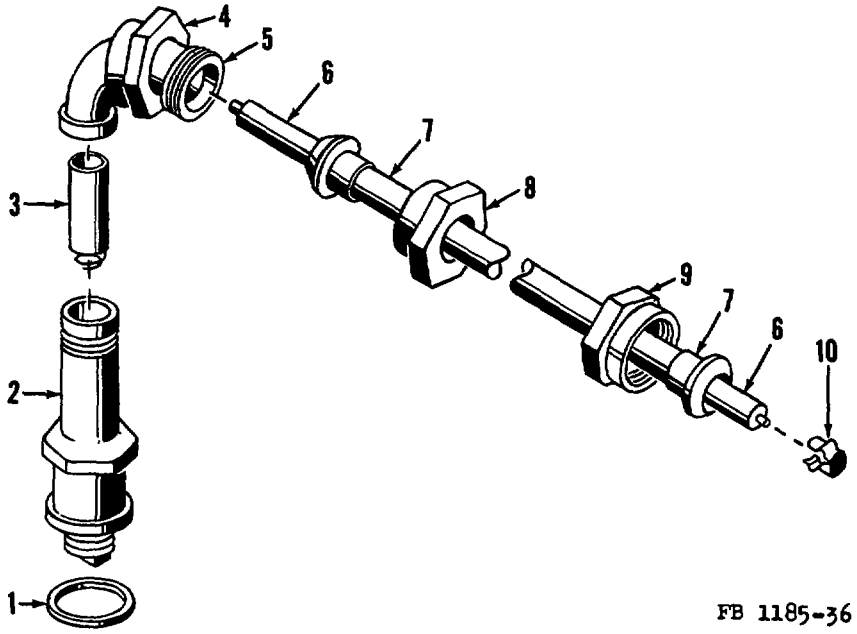
(5) Connect the condenser lead (8) with the breaker arm terminal and tighten the screw securely.

117. Spark Plugs
(fig. 36)

a. Description. The engine of the road roller has six spark plugs (2), encased in radio suppression housings. Each housing and spark plug form an integral assembly and cannot be disassembled. The shielded cable (7) from the magneto to the spark plug (2) is attached by the adapter elbow nut (4) to the spark plug.

b. Removal.

(1) Unscrew the adapter elbow nut (4) and disconnect the adapter elbow (5) and cables (6 and 7) from the spark plug (2).



1	Spark-plug washer	6	Ignition cable
2	Spark plug	7	Shielded cable
3	Contact spring	8	Nut, cable to adapter elbow
4	Adapter elbow nut	9	Nut, cable to magneto
5	Adapter elbow	10	Cable terminal

Figure 36. Spark plug and cables disas8embled.

(2) Use a spark-plug wrench to turn the spark plug (2) counterclockwise.

(3) Remove the spark plug (2) and spark-plug washer (1).

c. Cleaning. Clean the spark-plug body and poles with a stiff wire brush. Remove all carbon deposits from the spark-plug gap and threads. Clean the threads and washer seat with a wire brush. Cover the spark-plug hole in the cylinder head. Blow off dust and dirt from the spark-plug seat in the cylinder head with compressed air.

d. Adjusting.

(1) Always adjust the spark plug by bending the outer electrode mounted in the plug shell.

(2) The proper spark-plug gap is 0.025 inch. Use a wire gage to measure the gap and bend the outer electrode until the gage just clears the electrode gap. Do not twist the electrode while bending it.

(3) If the spark-plug gap is too small, use a small screwdriver to enlarge the spark-plug gap by pushing the outer electrode upward until the correct gap is obtained.

e. Testing. Test the spark plug on a spark-plug-testing machine. If the plug produces no spark, weak spark, or a spark which jumps over the housing body, the spark plug must be replaced. If a spark-plug-testing machine is not available, test the spark plugs as described below:

(1) Start the engine and place a screwdriver so that the bare shaft of the screwdriver is touching the terminal head of the spark plug and the tip of the screwdriver is approximately one fourth of an inch from the cylinder head. Be sure to hold the screwdriver on insulated handle.

(2) If the engine misses every time when the spark jumps from the tip of the screwdriver to the cylinder head, the spark plug is operating.

(3) If there is no spark between the screwdriver tip and the cylinder head, the spark-plug cable is defective and must be replaced.

(4) If the spark jumps between the screwdriver tip and the cylinder head, but there is no noticeable change in the operating rhythm of the engine, the spark plug is defective and must be replaced.

f. Installation (fig. 36).

(1) See that the spark-plug seat in the cylinder head is free from dirt and corrosion.

(2) Install a new washer (1) on the spark-plug body (2) and screw the spark plug into the seat until it is fingertight.

Use a spark-plug socket wrench to tighten the spark plug. The proper torque reading is 26 to 30 ft-lb.

(3) Connect the cables (6 and 7) and adapter elbow (5) with the spark plug (2) and tighten the adapter elbow nut (4).

118. Ignition Cables
(fig. 36)

a. Description. The high tension ignition cables (6) are encased in the shielded cables (7). The shielded cables (7) are attached to the spark plugs (2) and magneto by cable nuts (4 and 8). It is important to check the shielding frequently and keep the nuts tight.

b. Removal.

(1) Unscrew the adapter elbow nut (8) and disconnect the cables (6 and 7) from the adapter elbow (5).

(2) Unscrew the nut (9) attaching the shielded cable (7) to the magneto and disconnect the shielded cable from the magneto.

(3) Pull out the ignition cable (6) from the magneto.

(4) Thread the cables (6 and 7) through the holes in their support brackets mounted on cylinder head and timing gear cover. Remove the cables from the engine.

(5) Pull out the ignition cable (6) from the shielded cable (7).

c. Inspection. Inspect the shielded cables for breaks, fraying, or cuts. See that the nut threads are clean and not stripped or damaged. Check the insulation of the ignition cable for swollen, peeling, cut, or oil-soaked rubber insulation. Replace the cables if necessary.

d. Installation.

(1) Push the ignition cable (6) into the shielded cable (7). Refer to table V for cable dimensions

Table V. Length of the Ignition and Shielded Cables.

Cylinder No.'	Cable length in inches		Cylinder No.	Cable length in inches	
	Ignition cable	Shielded cable		Ignition cable	Shielded cable
1----------	21½	20	4----------	32	29
2----------	26 5/8	23	5----------	35½	34
3----------	30	27	6----------	41 5/8	38

(2) Thread the cables (6 and 7) through the holes in their support brackets mounted on the cylinder head and timing gear cover.

(3) Connect the cables (6 and 7) with the magneto and tighten the cable nut (9).

(4) Connect the cables with the adapter elbow (5) and tighten the cable nut (8).

119. Wiring

a. Inspection. Inspect the entire wiring system for loose or dirty connections. Follow each lead and check for cut, damaged, swollen, frayed, or chaffed insulation. Pay particular attention to the wiring around the starting motor and battery generator; see that the insulation is dry and free from oil and grease drippings.

b. Repair. In emergencies, broken cables may be soldered, but the entire wiring cable from one terminal to another must be replaced when the emergency is over. Broken or damaged insulation can be temporarily repaired in emergencies by taping the damaged place with insulation tape. Replace the entire wiring cable when the emergency is over.

c. Cleaning. Clean the wiring cables with a soft cloth dipped in cleaning solvent. If the connections are rusted, dirty, or covered with oil, remove the mounting screws and clean the terminals with a brush and cleaning solvent. Use a wire brush and No. 00 sandpaper to remove dirt and rust from the terminals. Clean the terminals with No. 00 sandpaper until clean, bare metal is visible. Inspect the threads and heads of the mounting screws. Clean them with a wire brush. See that the screw head makes contact with the terminal and that they both are clean and tight. Tighten all connections and double-check the entire wiring system for proper mounting and secure connections.

120. Instrument Panel

(fig. 37)

a. Description. The instrument panel consists of the instrument panel bracket (13) and the cluster gage assembly (14). The instrument panel bracket (13) is welded to the housing of the compression roll. The cluster gage (14) is attached to the instrument panel bracket (13) by two mounting clamps (5) and nuts (6).

b. Cluster Gage Removal.

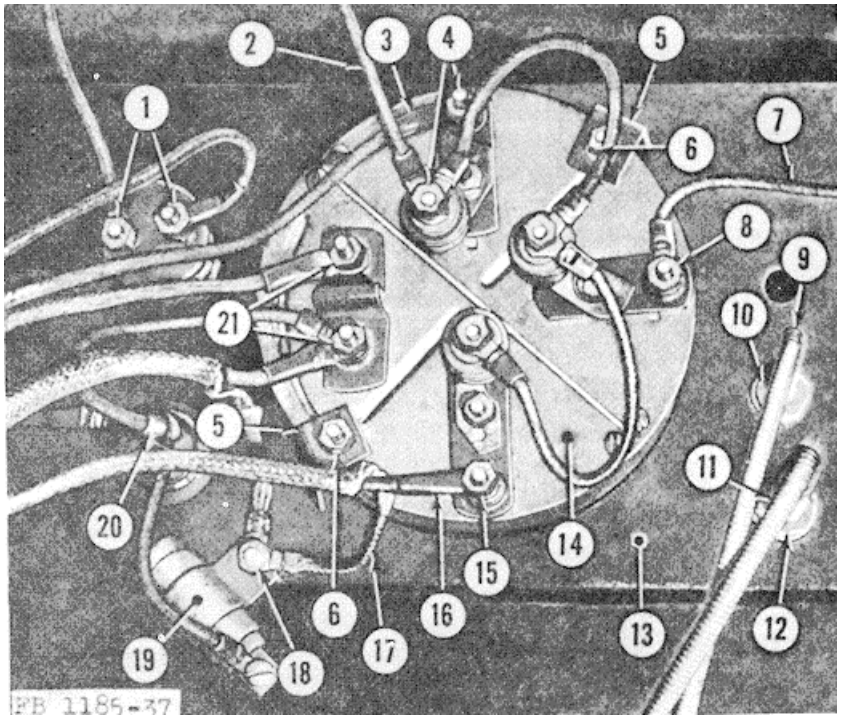
(1) Disconnect the battery ground cable from the battery terminal to prevent accidental arcing. Refer to paragraph 111h.

(2) Remove the oil gage terminal nut (4) and disconnect the starter button lead (2) and the oil gage lead (3) from the oil gage terminals. Tag the leads.

(3) Remove the fuel gage terminal nut (8) and disconnect the fuel gage lead (7) from the fuel gage terminal. Tag the lead to facilitate-installation.

(4) Remove the temperature gage terminal nut (15) and disconnect the temperature gage lead (16) from the terminal. Tag the lead.

(5) Remove the ammeter terminal nuts (21) and disconnect the ammeter leads from the terminals. Tag the leads.



1	Starter button terminal nut	12	Throttle cable mounting nut
2	Starter button lead	13	Instrument panel bracket
3	Oil gage lead	14	Cluster gage
4	Oil gage terminal nut	15	Temperature gage terminal nut
5	Cluster gage clamp	16	Temperature gage lead
6	Clamp nut	17	Shielding strap
7	Fuel gage lead	18	Capacitor nut
8	Fuel gage terminal nut	19	Capacitor
9	Choke cable	20	Ignition switch
10	Choke cable mounting nut	21	Ammeter terminal nut
11	Throttle cable		

Figure 37. Instrument panel, rear view.

(6) Remove the mounting nuts (6) and clamps (5) and remove the cluster gage (14) from the front side of the instrument panel bracket (13).

c. Cluster Gage Inspection. Inspect the oil pressure, fuel, temperature, and ammeter gages for proper operation. If one of the gages is damaged or defective, the entire cluster gage assembly must be replaced. The cluster gage assembly is not repairable.

d. Cluster Gage Installation.

(1) Position the cluster gage (14) over the mounting hole in the instrument panel bracket (13) so that the oil pressure gage is on the top, and the temperature gage is on the bottom of the instrument panel.

(2) Press the cluster gage (14) against the instrument panel bracket (13) and install the mounting clamps (5) on the cluster gage studs.

(3) Install and tighten the cluster gage clamp nuts (6).

(4) Connect the starter button lead (2) and the oil gage lead (3) with the oil gage terminals. Tighten the terminal nuts (4).

(5) Connect the fuel gage lead (7) with the fuel gage terminal. Tighten the terminal nut (8).

(6) Connect the temperature gage lead (16) with the temperature gage terminal. Tighten the terminal nut (15).

(7) Connect the ammeter leads with the arnmeter terminals. Tighten the terminal nuts (21).

(8) Connect the battery ground cable with the battery terminal. Refer to paragraph 111h.

e. Instrument Panel Removal.

(1) Remove the cluster gage (b above).

(2) Remove the starter button terminal nuts (1) and disconnect the leads from the terminals. Tag the leads to facilitate installation.

(3) Remove the starter button flange nut in the front of the instrument panel. Remove the starter button.

(4) Disconnect the leads from the ignition switch (20). Tag the leads.

(5) Unscrew the ignition switch mounting nut and remove the ignition switch (20) from the instrument panel.

(6) Remove the capacitor mounting nut (18) and remove the capacitor (19).

(7) Disconnect the choke cable (9) from the carburetor.

(8) Unscrew the choke cable mounting nut (10) and pull the choke cable (9) from the instrument panel.

(9) Disconnect the throttle cable (11) from the carburetor.

(10) Unscrew the throttle cable mounting nut (12) and pull the throttle cable from the instrument panel.

(11) Use a cutting torch to remove the instrument panel bracket (13) from the compression roll housing. Do not use too much heat as it may cause the bracket or roll housing to warp. Place an asbestos sheet under the instrument panel and watch the molten metal drippings. Be careful not to damage or burn electrical leads or adjacent parts.

f. Instrument Panel Installation.

(1) Weld the instrument panel bracket (13) to the compression roll housing. Clean and paint the weld.

(2) Insert the throttle cable (11) in its mounting hole on the instrument panel and tighten the mounting nut (12). Connect the throttle cable with the carburetor.

(3) Insert the choke cable (9) in its mounting hole on the instrument panel and tighten the mounting nut (10). Connect the choke cable to the carburetor.

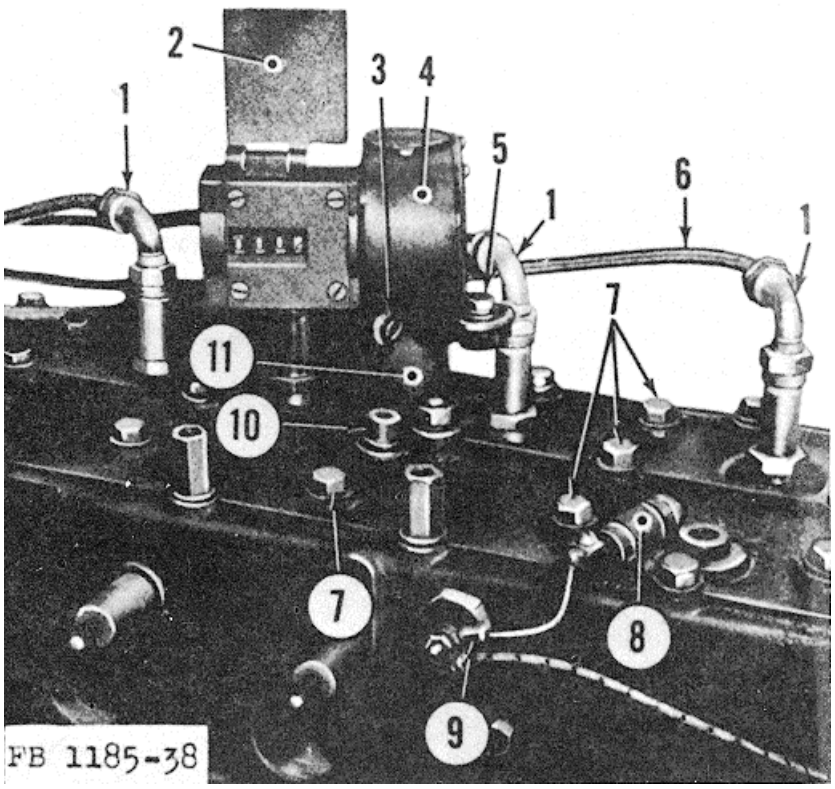
(4) Install the capacitor (19), mount the shielding strap (17) on the mounting screw, and tighten the capacitor mounting nut (18).

(5) Install the ignition switch (20) and tighten the mounting nuts. Connect the marked leads with the ignition switch (20).

(6) Install the starter button switch and tighten the flange nut in the front of the instrument panel. Connect the marked leads with the starter button switch and secure with the terminal nuts (1).

(7) Install the cluster gage assembly (d above).

(8) Check all leads for proper mounting and tighten all terminal connections.



1	Spark plug adapter elbow	7	Cylinder head screw
2	Hourmeter cover	8	Radio suppression capacitor
3	Clamp screw	9	Water temperature transmitter ,
4	Hourmeter	10	Hourmeter adapter screw
5	Mounting screw	11	Hourmeter adapter
6	Spark plug lead		

Figure 38. Hourmeter removal points.

121. Hourmeter
(fig. 38)

a. Description. The mechanically operated hourmeter (4) is mounted on the cylinder head of the engine. The hourmeter is driven by the oil pump. It converts the crankshaft speed into hours of running time. The hourmeter is sealed at the factory. The hourmeter should not be repaired or disassembled.

b. Removal.

(1) Loosen the hourmeter clamp screw (3).

(2) Remove the hourmeter mounting screw (5) and lockwasher.

(3) Lift up the hourmeter (4) and remove it from the adapter (11).

(4) Remove the adapter mounting screw (10) and remove the hourmeter adapter (11).

c. Installation.

(1) Install the hourmeter adapter (11) on the cylinder head and tighten the mounting screw (10).

(2) Install the hourmeter (4) and see that its shaft is properly connected with the oil pump drive shaft.

(3) Tighten the clamp screw (3).

(4) Install and tighten the mounting lockwasher and screw (5).

Section VIII. ENGINE LUBRICATION SYSTEM

122. Description

The lubrication system of the engine is of a pressure and splash type. An internally mounted oil pump is driven by the camshaft and delivers the oil under pressure to the main and connecting rod bearings. The camshaft, pistons, cylinders, valve tappets, and valve stems are lubricated by splash. The oil pump forces oil through the oil filter, which traps sediment and dirt. The lubricating system consists of the crankcase filler tube, oil level gage, oil filter, oil pump, oil pressure relief valve, oil pan, electric oil pressure adapter, oil pressure gage, and oil lines.

123. Oil Filter
(fig. 39)

a. Removal.

(1) Remove the oil filter drain plug (18) at the bottom of the oil filter body (7) and drain the oil and sediment from the oil filter.

(2) Unscrew the fitting nut of the filter inlet hose (23) and disconnect the hose from the inlet elbow (19).

(3) Unscrew the fitting nut of the filter outlet hose (20) and disconnect the hose from the filter outlet elbow (21).

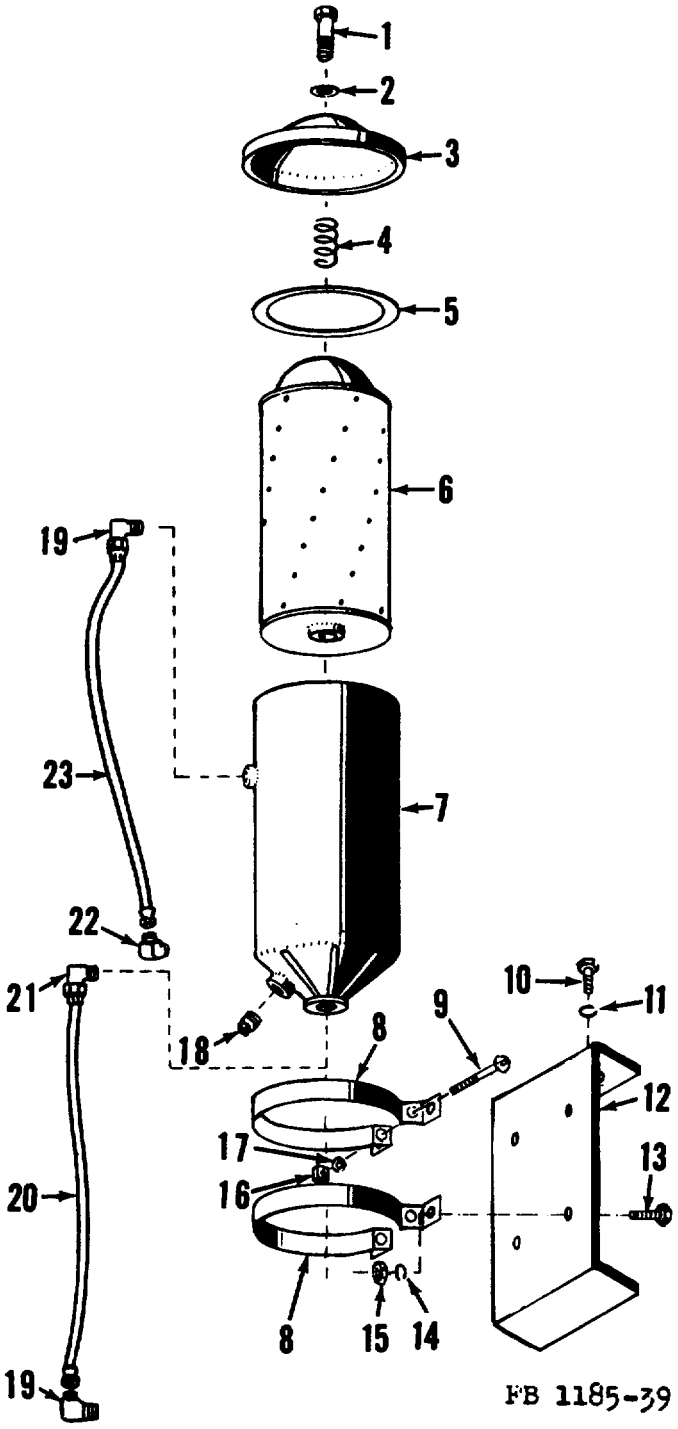


Figure 39. Oil filter disassembled.

(4) Remove the four clamp strap mounting bolts (13), lockwashers (14), and nuts (15), attaching the clamp straps to the adapter plate (12).

(5) Remove the oil filter.

b. Disassembly.

(1) Unscrew the oil filter cover screw (1) and remove the oil filter cover (3) and gasket (5).

(2) Turn the cover spring (4) counterclockwise and at the same time pull it away from the cover screw (1).

(3) Remove the cover screw (1),washer (2),and cover spring (4) from the cover (3).

(4) Lift up the handle of the oil filter element (6) and remove the element from the oil filter body (7). Discard the element.

(5) Remove the clamp strap bolts (9), lockwashers (17), and square nuts (16). Remove the clamp straps (8) from the oil filter body (7).

(6) Remove the oil line elbows (21) and (19).

c. Inspection. Inspect the oil filter body for dents and cracks. Check the inlet and outlet holes for damaged or stripped threads. Inspect the top edge of the oil filter body and see that it is not chipped, dented, or cracked. Check the hose fittings and elbows for corroded, damaged, stripped, or galled threads. Inspect the hose for swelling, cracks, cuts, and damaged or peeling rubber. Replace all defective parts. Check the adapter plate for breaks, cracks, and warpage. Replace defective or damaged adapter plate. Inspect all mounting bolts and nuts for damaged, corroded, stripped, and galled threads. Replace all defective mounting and assembly bolts and nuts.

d. Cleaning. Wash all metal parts in cleaning solvent. Use a blunt screwdriver to remove all embedded dirt and sludge from the bottom groove of the oil filter body. Wipe all parts dry with a soft absorbent cloth.

---

1 Cover screw
2 Washer
3 Cover
4 Cover spring
5 Gasket
6 Filter element
7 Filter body
8 Clamp strap
9 Clamp strap bolts (2 req'd)
10 Adapter plate mounting screws, 3/8 -16 NC x 23/4 (2 req'd)
11 Washers, lock, std, 3/8 (2 req'd)
12 Adapter plate
13 Clamp strap mounting bolts, 5/16-18 NC x 7/8 (4 req'd)
14 Washers, lock, std, 5/16 (4 req'd)
15 Nuts. 5/16-18 NC (4 req'd)
16 Clamp strap bolt nuts (2 req'd)
17 Lockwashers (2 req'd)
18 Drain plug
19 Elbows (2 req'd)
20 Filter outlet hose
21 Outlet elbow
22 Reducer bushing
23 Filter inlet hose

Figure. 39-Continued.

e. Reassembly.

(1) Spread the oil filter clamp straps (8) and install them on the oil filter body (7).

('2) Install the clamp strap bolts (9), lockwashers (17), and nuts (16). Tighten the bolts.

(3) Install a new filter element (6) in the oil filter body (7') with the element handle up. Push the handle down until it is lying flat on the top of the filter element.

(4) Install the cover screw (1) and washer (2) in the filter cover (3).

(5) Turn the cover spring (4) clockwise and at the same time push it against the cover screw (1) until tile spring snaps into the groove on the cover screw.

(6) Install a new gasket (5) on the cover (3). Coat the gasket lightly with engine oil.

(7) Position the cover (3) over the oil filter body (7) and see that the gasket (5) fits snugly and evenly on the top edge of the oil filter body.

(8) Tighten the cover screw (1) securely.

(9) Install and tighten the 6il filter drain plug (18).

(10) Install the oil filter inlet hose elbow (19) and outlet hose elbow (21) on the filter body (7). Tighten both elbows securely.

f. Installation.

(1) Attach the oil filter to the adapter plate (12) and see that the mounting holes are properly alined.

(2) Install clamp strap mounting bolts (13), lockwashers (14), and nuts (15). Tighten the bolts securely.

(3) Connect the oil filter outlet line (20) with the outlet elbow (21) and tighten the fitting nut.

(4) Connect the oil filter inlet line (23) with the inlet elbow (19) and tighten the fitting nut.

(5) Start the engine and check the oil filter and oil filter lines for leaks.

(6) Check the oil level and add oil if necessary.

124. Oil Lines
(fig. 39)

a. Description. There are only two external oil lines on the engine. The oil filter inlet hose (23) connects the oil filter with the engine crankcase. Through this line, oil is delivered under pressure from the engine to the oil filter. The oil filter outlet hose (20) drains the cleaned oil from the oil filter into the engine.

b. Removal.

(1) Unscrew the fitting nut of the outlet hose (20) and disconnect the hose from the elbow (19). Be careful not to twist the hose.

(2) Unscrew the fitting nut and disconnect the outlet hose (20) from the outlet elbow (21) on the bottom part of the oil filter body (7).

(3) Remove the outlet hose (20).

(4) Unscrew the fitting nut from the reducer bushing (22) on the cylinder block. Disconnect the inlet hose (23) from the reducer bushing.

(5) Unscrew the fitting nut from the oil filter elbow (19) on the side of the oil filter body (7). Disconnect the inlet hose (23) from the elbow.

(6) Remove the oil filter inlet hose (23).

c. Inspection. Inspect all oil hose for broken, cracked, swollen, or decayed rubber walls. Check the fitting nuts for damaged, broken, or stripped threads. Replace the oil hose if the rubber walls show signs of swelling or decay.

d. Cleaning. Wipe the hose with a soft absorbent cloth. Clean the inside passages of the hose with clean compressed air.

e. Installation.

(1) Connect the inlet hose (23) with the reducer bushing (22) on the cylinder block and tighten the fitting nut.

(2) Connect the inlet hose (23) with the elbow (19) on the side part of the oil filter body (7) and tighten the fitting nut.

(3) Connect the outlet hose (20) with the elbow (19) on the lower part of the cylinder block and tighten the fitting nut.

(4) Connect the outlet hose (20) with the elbow (21) on the bottom part of the oil filter body (7) and tighten the fitting nut.

(5) Start the engine and check the oil hose and connections for leaks.

125. Oil Pressure Transmitter

a. Description. The oil pressure transmitter is mounted on the right side of the engine, in the back of the air cleaner and directly below the exhaust manifold. The transmitter is electrically operated. It transmits the engine oil pressure to the oil pressure gage located on the instrument panel.

b. Removal.

(1) Disconnect the lead from the transmitter.

(2) Turn the transmitter counterclockwise and remove it from the cylinder block.

(3) The transmitter has no replaceable parts and cannot be repaired. Replace the transmitter if damaged or defective.

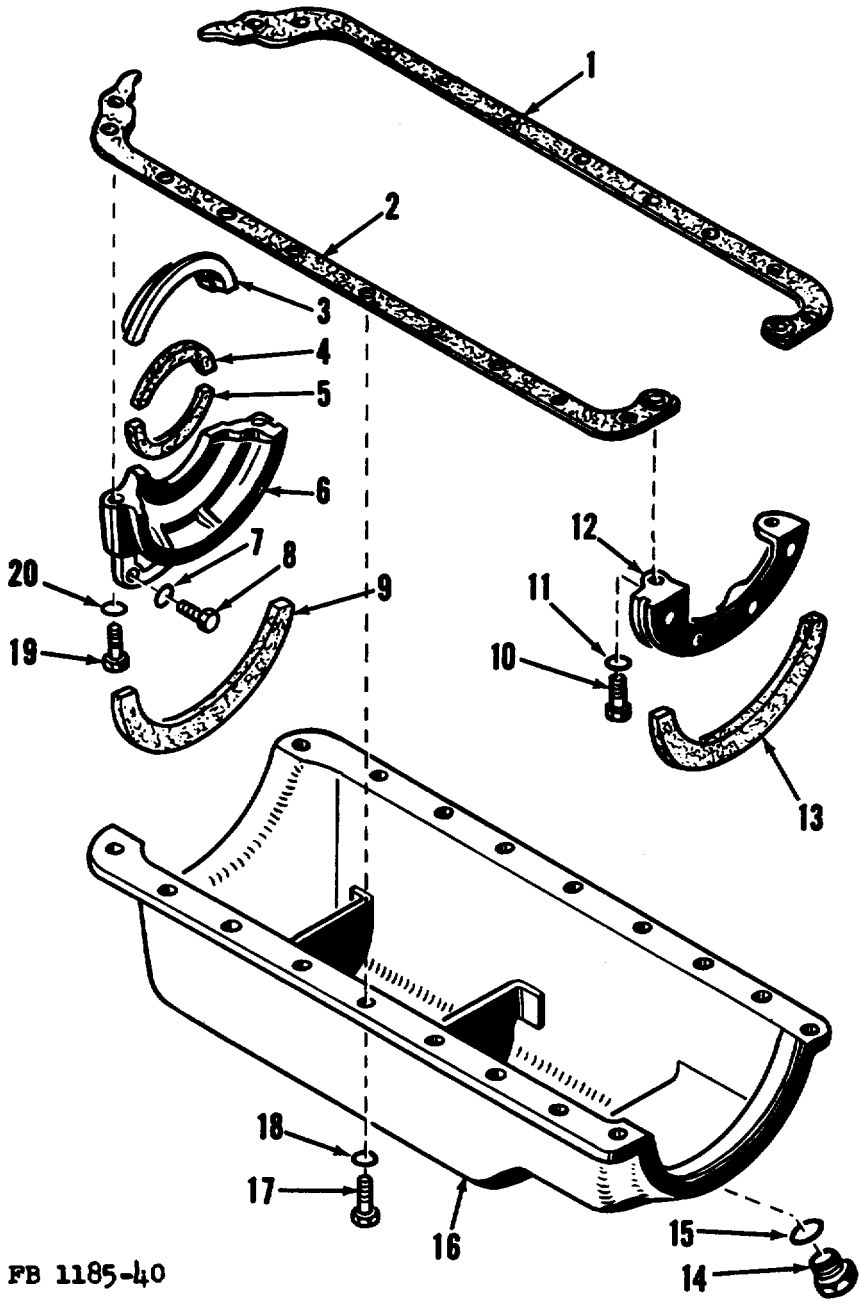


Figure 40. Oil pan disassembled.

c. Installation.

(1) Screw the transmitter into the cylinder block.

(2) Connect the transmitter lead with the terminal and tighten the screw.

(3) Start the engine and check the oil pressure gage on the instrument panel for proper operation.

126. Oil Pan
(fig. 40)

a. Removal.

(1) Remove the cover plate located on the floor of the road roller, directly below the oil pan. If the plate is bolted to the floor, remove the mounting bolts and lockwashers and remove the plate. On some road rollers, the cover plate is tack-welded to the floor; cut the welds with a cold chisel or with a cutting torch and remove the plate.

(2) Place a bucket under the oil pan (16) and remove the oil drain plug (14) and gasket (15). Drain the oil from the oil pan (16).

(3) Remove the oil pan mounting screws (17) and lockwashers (18). If the oil pan sticks tightly to the cylinder block, insert a thin screwdriver between the oil pan and cylinder block and loosen the oil pan. Be careful not to bend the mounting edge of the oil pan. Remove the oil pan.

(4) Remove the screws (10) and lockwashers (11) attaching the front filler block (12) to the cylinder block. Remove the front filler block (12) and cork gasket (13). Discard the cork gasket (13).

(5) Remove the screws (8 and 19) and lockwashers (7 and 20) attaching the rear filler block (6) to the cylinder block and flywheel housing. Remove the rear filler block (6).

(6) Remove the left and right oil pan gaskets (1 and 2). Discard the gaskets (1 and 2).

---

1 Oil pan gasket, left
2 Oil pan gasket, right
3 Oil guard
4 Filler block seal, upper
5 Filler block seal, lower
6 Rear filler block
7 Washers, lock, std, 1/4 (2 req'd)
8 Screws, to flywheel housing, '4 dia, 20 NC x 5/8 (2 req'd)
9 Filler block cork, rear
10 Screws, 51/6-18 NC x 7/8 (2 req'd)
11 Washers, lock std Re (2 req'd)
12 Filler block, front
13 Filler block cork, front
14 Drain plug
15 Gasket
16 Oil pan
17 Oil pan mounting screws, 5/16-18 NC x 3/4 (18 req'd)
18 Washers, lock, 5/16 (18 req'd)
19 Screws, to cylinder block, 5/16-18 NC x 7/8 (2 req'd)
20 Washers, lock. std, 5/16 (2 req'd)

Figure 40. Continued.

(7) Use a blunt screwdriver to remove the lower filler block seal (5) from the rear filler block (6). Discard the seal (5).

b. Cleaning.

(1) Clean the mounting surface of the cylinder block with cleaning solvent. Use a blunt screwdriver to remove gasket pieces and gasket sealer from the mounting surface.

(2) Inspect the mounting holes in the cylinder block and clean them with a small brush dipped in cleaning solvent.

(3) Wash the oil pan in cleaning solvent and remove all sludge and dirt from the bottom of the oil pan. Wipe the oil pan dry with a soft absorbent cloth. Clean residue of the old gasket from the mounting edge of the oil pan.

(4) Wash the mounting screws in cleaning solvent and use a wire brush to remove the imbedded gasket sealer from the threads.

c. Inspection.

(1) Inspect the oil pan for cracks and dents. Check the oil pan drain hole for damaged or stripped threads.

(2) Inspect the mounting screws for damaged or stripped threads.

(3) Inspect the drain plug and gasket for damage, cracks, wear, and worn out or stripped threads.

d. Repair. Weld small holes in the oil pan. Be careful and do not apply too much heat to the oil pan, as it may warp. Replace the oil pan, if the cracks or holes are excessively large.

e. Installation.

(1) Coat the new gaskets (1 and 2, fig. 40) and the mounting surface on the cylinder block with a fast-drying gasket sealer.

(2) Install both gaskets (1 and 2) on the cylinder block and see that the mounting holes in the gasket and the cylinder block are properly alined. Allow about 5 minutes for the gasket sealer to set.

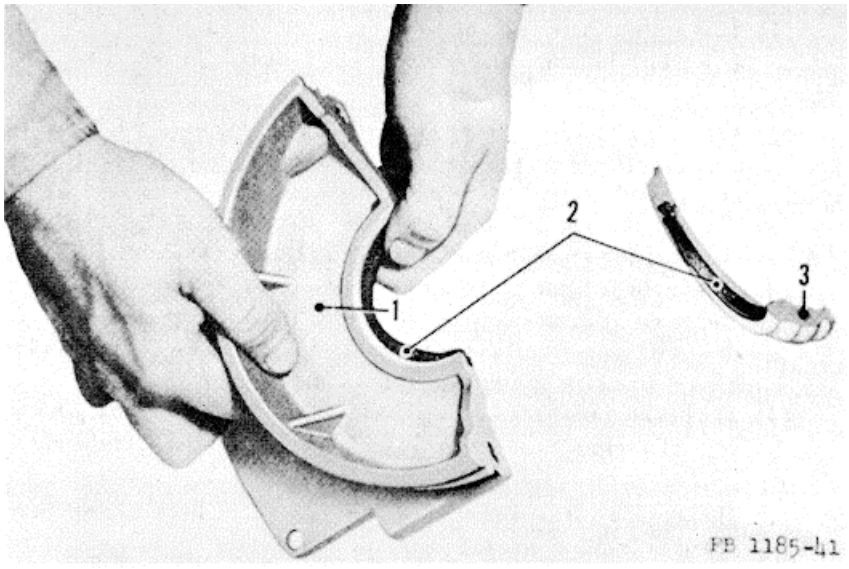
(3) Install a new oil seal (2, fig. 41) in the rear filler block. Coat the seal lightly with engine oil and see that it is seated properly in the groove on the filler block body (1). The proper oil seal installation method is shown in figure 41.

(4) Attach the rear filler block (6, fig. 40) to the cylinder block. Be careful not to bend the oil pan gasket while attaching the block. Install and tighten the lockwashers (20) and screws (19).

(5) Install and tighten the lockwashers (7) and screws (8) attaching the rear filler block (6) to the flywheel housing.

(6) Attach the front filler block (12) to the cylinder block and tighten the mounting lockwashers (11) and screws (10).

(7) Coat the new cork gaskets (9 and 13) and their mounting surfaces on the filler blocks (6 and 12) with a fast-drying gasket sealer. Install the cork gaskets (9 and 13) on the filler blocks



1 Rear filler block
2 Oil seal
3 Oil guard

Figure 41. Oil seal installation.

(6 and 12) and allow about 5 minutes for the gasket sealer to set.

(8) Coat the mounting edge of the oil pan (16) with a fast-drying gasket sealer and install the oil pan on the cylinder block. See that the mounting holes are properly alined and that the gaskets are not bent or twisted.

(9) Install the oil pan mounting screws (17) and lockwashers (18) and tighten them evenly and securely.

(10) Install and tighten the drain plug (14) and gasket (15).

(11) Allow about 20 minutes for the gasket sealer to set and harden. Then fill the oil pan with oil. Refer to LO 5-1185.

(12) Start the engine and inspect the oil pan for leaks. After the engine reaches its normal operating temperature, check the oil pan again for leaks.

(13) Install the oil pan cover on the road roller floor and tighten the mounting bolts. If the cover was tackwelded to the floor, clean the old welds and tackweld the cover to the floor. Clean and paint the tackwelds.

Section IX. COOLING SYSTEM

127. Description

The cooling system of the engine consists of a suction-type fan, a radiator assembly, and a centrifugal water pump. The engine block

is water jacketed to prevent distortion of the cylinder walls. The hot water surrounding the combustion chambers is forced by the water pump to the radiator where it is cooled by the slipstream of air created by the ventilator fan. The engine does not have a thermostat for the control of the water temperature and for this reason it is very important to cover the radiator in cold weather to avoid overcooling of the engine.

128. Draining and Cleaning Cooling System

a. General. Rust and scale form in every cooling system. The amount of these deposits depends on the water used for cooling. Avoid the use of water with high mineral content. The cooling system must be flushed at least twice a year. The cooling system must be drained if the water becomes contaminated with dirt, oil, or sludge.

b. Draining.

(1) Remove the radiator cap to break any vacuum that may have developed in the cooling system.

(2) If the cooling system contains antifreeze, place containers under the radiator and engine block to save the antifreeze for future use.

(3) Open the draincock (13, fig. 42) on the radiator bottom extension tube. If the draincock is stuck, tap it lightly with the wooden handle of a screwdriver until it is loose.

(4) Open the draincock on the left side of the engine, slightly above the engine identification plate.

(5) If the engine draincock is clogged, unscrew it from the engine block and clean the opening. Wash the draincock in cleaning solvent.

c. Cleaning.

(1) Radiator. Disconnect the radiator bottom hose (7, fig. 42). Flush the radiator through the hose (7) until clean water comes out of the radiator filler (2).

Note. Avoid extreme high water pressure when flushing the radiator, as it may distort or damage the radiator core.

(2) Engine. Flush the engine block through the water outlet elbow (6, fig. 3). After flushing the block, tighten the cylinder-head screws. The proper torque wrench reading is 35 to 40 ft-lb.

d. Filling.

(1) Connect the upper radiator hose with the water outlet elbow (6, fig. 3) and the lower radiator hose (7, fig. 42) with the hose elbow (12). See that the clamps (6) are tight and in good condition. Inspect the rubber hose and replace if swollen, frayed, cut, or damaged.

(2) Close the draincocks (13) on the radiator bottom extension tube and on the left side of the engine.

(3) Fill the radiator with clean water. When filling the radiator with antifreeze, allow room for expansion. Fill the radiator until the antifreeze solution is about one-half of an inch below the overflow pipe.

Caution: **If the engine overheats because of lack of coolant, allow it to cool before filling the radiator; otherwise, there is danger of cracking the cylinder head and block. If it is necessary to fill the radiator before the engine has cooled, be sure to fill it very slowly with the engine running at fast idling speed.**

(4) Start the engine and check all connections for leaks.

129. Radiator (fig. 42)

a. Description. The radiator consists of the top tank (1), radiator core (4), and bottom tank (11). The radiator filler (2) is welded to the radiator top tank assembly (1). The radiator draincock (13) is mounted on the hose elbow (12), connecting the radiator with the water pump.

b. Removal.

(1) Remove the cover from the steering roll (par. 162b).

(2) Drain the cooling system (par. 128b).

(3) Loosen the hose clamp and disconnect the upper radiator hose from the inlet adapter (4, fig. 43).

(4) Loosen the hose clamp (6, fig. 42) and disconnect the radiator hose (7) from the water pump.

(5) Remove the screws attaching the side panels (5, fig. 43) to the radiator plates. Disconnect the panels from the radiator. Be careful not to damage the sprinkler hose (6) when disconnecting the panels.

(6) Remove the radiator mounting screws (7), fiatwashers (19), and lockwashers (17) on the bottom part of the radiator.

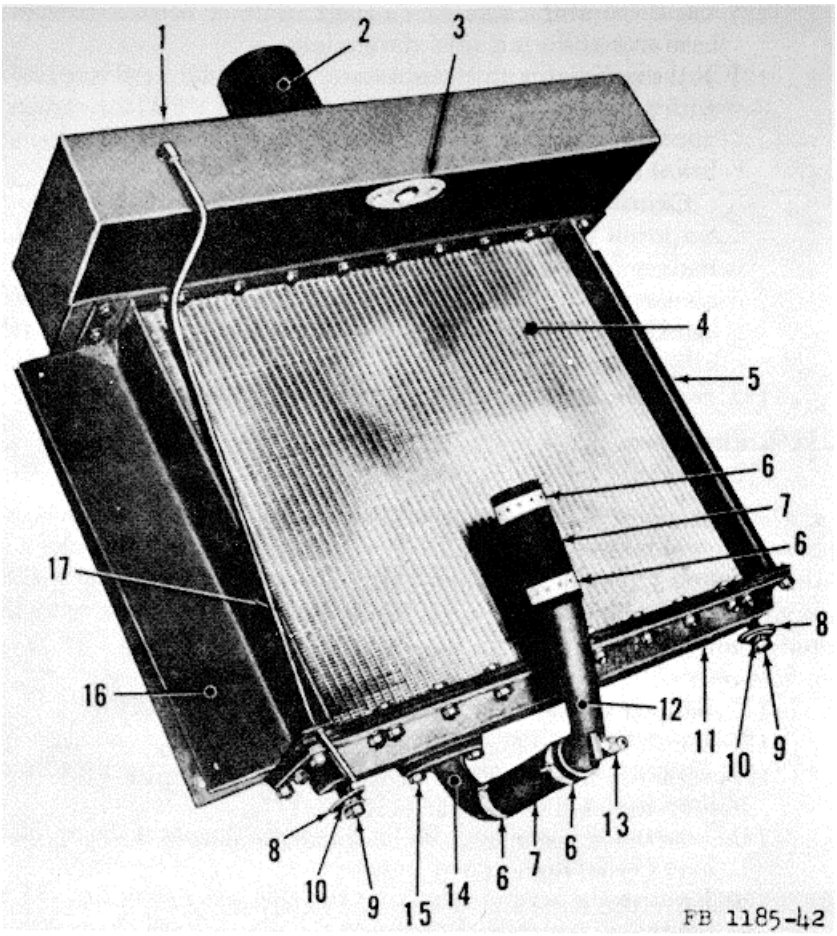
(7) Tilt the radiator in the direction of the steering roll and remove it from the steering roll housing.

Caution: **The radiator and radiator core can be easily damaged. Be careful not to drop the radiator while removing it. Place the radiator on a suitable bench to protect it from damage during disassembly.**

c. Disassembly (fig. 44).

(1) Remove the radiator cap (1).

(2) Remove the mounting screws (2) and lockwashers (3) attaching the inlet adapter (5) to the radiator top tank (8). Remove the inlet adapter (5) and gasket (6). Discard the gasket (6).



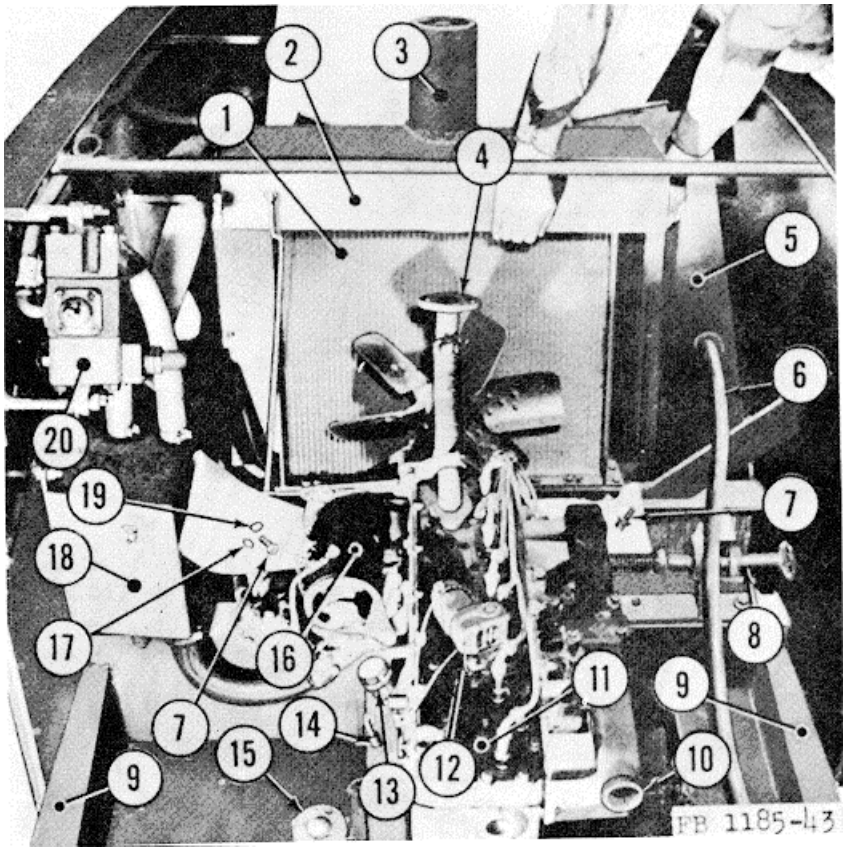
1	Top tank	10	Lockwasher
2	Filler	11	Bottom tank
3	Top outlet	12	Hose elbow
4	Radiator core	13	Draincock
5	Right side plate	14	Bottom outlet elbow
6	Hose clamp	15	Bottom elbow screw
7	Radiator hose	16	Left side plate
8	Flat washer	17	Overflow pipe
9	Mounting screw		

Figure 42. Radiator assembly, rear view

(3) Remove the cap screws (2 and 7) and lockwashers (3) attaching the radiator top tank (8) to the right and left radiator plates (12 and 18).

(4) Remove the screws (2 and 7), lockwashers (3), radiator header strips (11), and spacers (10).

(5) Remove the radiator top tank (8) from the radiator core (13). Remove and discard the gasket (9).



1	Radiator core	11	Cylinder bead
2	Radiator top tank	12	Hourmeter
3	Filler tube	13	Oil filler cap
4	Inlet adapter	14	Oil level gage
5	Side panel	15	Magnetic switch
6	Sprinkler hose	16	Battery generator
7	Mounting screw	17	Lockwasher
8	Engine cranking shaft	18	Hydraulic tank
9	Frame	19	Flatwasher
10	Exhaust manifold	20	Hydraulic valve

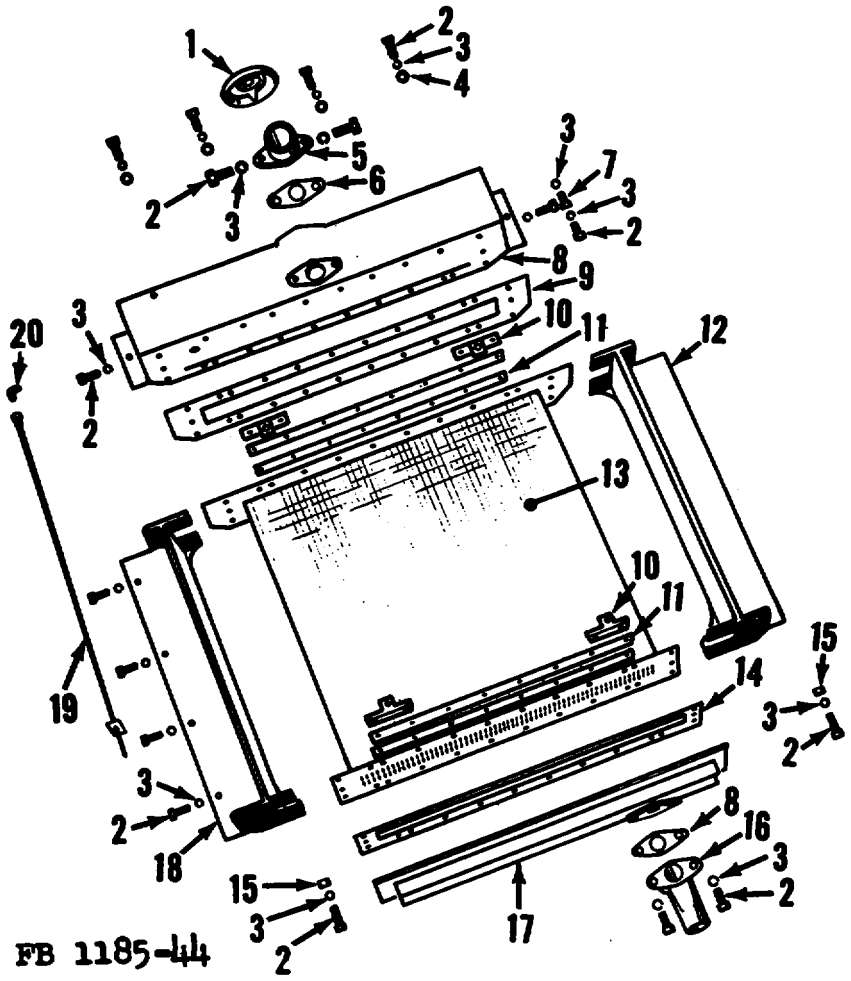
Figure 43. Radiator removal.

(6) Remove the screws (2), nuts (15), and lockwashers (3) attaching the bottom tank (17) to the radiator core (13). Remove the bottom tank (17), bottom header strips (11), and spacers (10).

(7) Remove the right and left radiator plates (12 and 18).

(8) Use small pipe wrench and unscrew the overflow pipe (19) from the elbow (20). Unscrew and remove the elbow (20).

d. Cleaning. If the radiator core is clogged with dirt, dust, or foreign matter, clean it with compressed air or water pressure. Direct pressure from the rear of the radiator (the ventilator fan side). If the



1 Radiator cap
2 Screw, cap 3/8-16NC x 1 1/8 (43 req'd)
3 Washers, lock, std, 3/8 (52 req'd)
4 Washers, flat, std, 3/8 (4 req'd)
5 Inlet adapter
6 Gasket
7 Screws, cap 3/8-16NC x 1 (14 req'd)
8 Top tank
9 Top tank gasket
10 Spacer
11 Header strip
12 Radiator plate, right
13 Radiator core
14 Bottom tank gasket
15 Nuts, hex, 3/8-16NC (38 req'd)
16 Outlet elbow
17 Bottom tank
18 Radiator plate, left
19 Overflow pipe
20 Overflow pipe elbow

Figure 44. Radiator disassembled.

core passages inside the radiator are clogged with rust, sediment, and scale, flush the radiator with a recommended inhibitor.

Note. Avoid extremely high water pressure when flushing the radiator, as it may distort the radiator core.

Clean the draincock with compressed air or water. When cleaning the draincock with compressed air, make sure that the pressure does not exceed 90 psi and hold the nozzle 1 inch from the radiator. When cleaning with water, make sure that the pressure does not exceed 80 psi and hold the nozzle 3 inches from the radiator. Clean the accumulated dirt and rust from the mounting bolts, nuts, and lockwashers. Replace bolts, screws, and nuts if worn out, stripped, or damaged.

e. Inspection and Repair.

(1) Clean the radiator and plug the upper inlet and the overflow pipe. Tighten the radiator cap.

(2) Insert an air hose in the lower outlet pipe and caulk it securely with cotton waste.

(3) Immerse the radiator in a tub of water and apply 5 pounds' pressure.

Note. Do not use higher air pressure than 5 pounds per square inch, as it may damage the radiator core.

(4) Watch for air bubbles. When they appear, mark the point of origin.

(5) Solder the leak carefully. Do not use excess solder and do not permit the solder to leak into the radiator core passages because it may obstruct or clog the water flow.

(6) If the radiator core is badly damaged, replace it with a new one. Always install new top and bottom gaskets when disassembling or reassembling the radiator.

(7) Inspect the radiator hoses for worn, cut, swollen, or peeling rubber. Check the inside surface of the hoses for breaks, cracks, and damage. Replace defective or swollen hoses.

(8) Inspect the hose clamps for breaks, cracks, corrosion, and damaged or worn clamp screws. Replace worn or damaged hose clamps.

(9) Check the radiator plates for breaks, cracks, twisting, and warpage. Weld small breaks and cracks. Be careful and do not apply too much heat when welding, as it may cause the plates to warp. Grind, clean, and paint the welds. Replace the radiator plates if they are badly broken, dented, or if the mounting holes are worn or elongated.

f. Reassembly (fig. 44).

(1) Coat the outlet elbow gasket with fast-drying gasket sealer and install the water outlet elbow (16) on the bottom tank (17). Install and tighten the lockwashers (3) and screws (2).

(2) Coat the bottom tank gasket (14) with a fast-drying gasket sealer and install the gasket on the bottom tank (17). See that the mounting holes are properly alined.

(3) Attach the bottom tank (17) to the radiator core (13) and install header strips (11), spacers (10), nuts (15), lockwashers (3), and screws (2). Tighten the screws securely.

(4) Coat the top tank gasket (9) with a fast-drying gasket sealer and install the gasket on the top tank (8). See that the mounting holes are properly alined.

(5) Attach the top tank (8) to the radiator core (13) and install header strips (11), spacers (10), lockwashers (3), and screws (2 and 7). Tighten the screws securely.

(6) Install the right (12) and left (18) radiator plates and tighten the mounting screws (2).

(7) Coat the inlet adapter gasket (6) with a fast-drying gasket sealer and install the adapter (5) on the top tank (8). Tighten the mounting screws (2).

(8) Install the overflow pipe elbow (20) and the overflow pipe (19).

g. Installation.

(1) Install the radiator in its mounting and see that the mounting holes on the bottom of the radiator are properly alined with the mounting holes on the road roller frame.

(2) Install the flatwashers (19, fig. 43), lockwashers (17), and mounting screws (7).

(3) Attach the side panels (5) to the radiator body and tighten the mounting screws.

(4) Tighten the mounting screws (7) securely.

(5) Connect the upper and lower radiator hose and tighten the hose clamps.

(6) Fill the radiator with water and start the engine. Check the radiator and connections for leaks.

(7) Install the steering roll cover (par. 162).

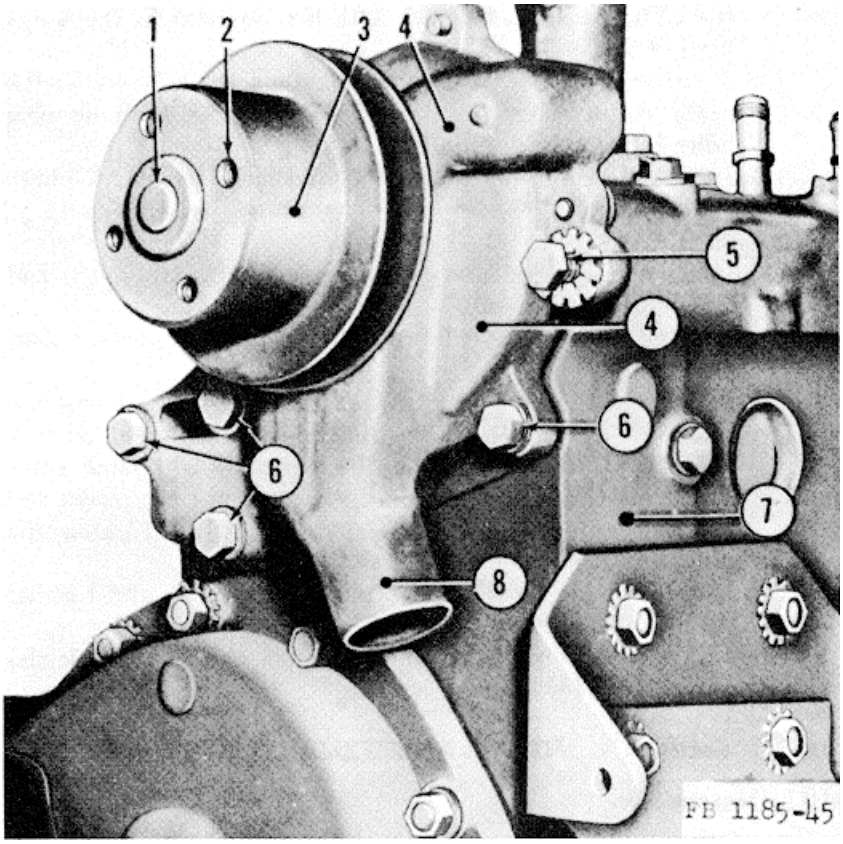
130. Water Pump and Fan (fig. 45)

a. Description. The water pump is a centrifugal impeller type of large capacity. The bearing is integral with the shaft and is packed with a special high-melting-point grease which lasts the life of the bearing. The bearing is sealed to prevent the entrance of dirt and dust. The water pump is driven by a V-type belt. The fan is bolted to the water pump pulley and has four blades.

b. Removal.

(1) Drain the cooling system (par. 128b).

(2) Remove the four screws attaching the fan to the water pump pulley (3) and remove the fan.



1 Water pump shaft
2 Fan mounting hole
3 Water pump pulley
4 Water pump
5 Generator bracket screw
6 Mounting screw
7 Cylinder block
8 Radiator hose adapter

Figure 45. Water pump removal points.

(3) Loosen the generator mounting bolts (par. 112b) and push the generator against the cylinder block (7).

(4) Remove the fan belt from the crankshaft pulley and the generator pulley and slip the belt off the water pump pulley (3).

(5) Remove the generator bracket screw (5).

(6) Loosen the hose clamp and disconnect the radiator hose from the adapter (8).

(7) Remove the mounting screws (6) and lockwashers and remove the water pump (4) and gasket.

c. Installation.

(1) Coat the new water pump gasket with a fast-drying gasket sealer. Apply the gasket sealer to the cylinder block where

the water pump is seated. Attach the gasket to the water pump body.

(2) Position the water pump (4) over its seat and see that the holes in the gasket are properly alined with the mounting holes in the cylinder block.

(3) Install the mounting screws (6) and lockwashers. Tighten them evenly. The proper torque wrench reading is 15 to 20 ft-lb.

(4) Install the radiator hose on the water pump adapter (8) and tighten the hose clamp.

(5) Slip the fan belt over the water pump pulley and the crankshaft pulley.

(6) Install the fan belt over the generator pulley and pull the generator away from the cylinder block until the fan belt is tight. If the fan belt can be depressed by thumb pressure from three-quarters to 1 inch between the pulleys, the fan belt adjustment is correct (par. 112). Tighten the generator mounting bolts (par. 112h).

(7) Install the fan on the water pump pulley (3) and tighten the mounting screws.

(8) Fill the cooling system and start the engine. Check the water pump for leaks.

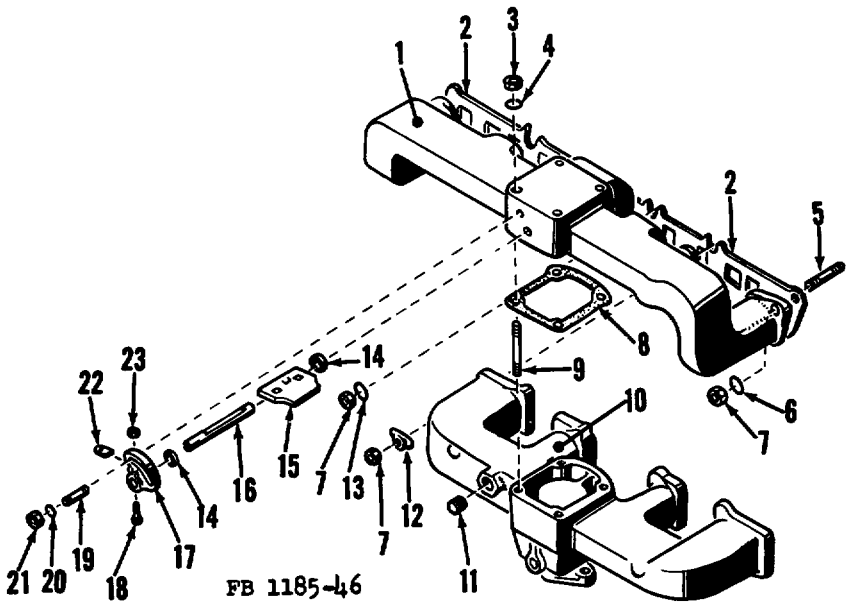
Section X. INTAKE AND EXHAUST SYSTEM

131. Description

The intake and exhaust system of the engine consists of the intake and exhaust manifolds, the heat control valve mounted on the exhaust manifold, the exhaust pipe, and muffler. The combustible mixture is drawn from the carburetor into the intake manifold and directed into the cylinders, where it is ignited. The exhaust resulting from the explosion is forced into the exhaust manifold and directed away from the engine through the exhaust pipe and muffler. The heat control valve is mounted on the exhaust manifold and helps to vaporize the fuel when the engine is cold. When the valve weight is moved to the left, the valve is closed and directs the hot exhaust gases around the intake manifold. When the valve weight is moved to the right, the valve is open and the exhaust gases are directed into the exhaust pipe.

132. Intake and Exhaust Manifold (fig. 46)

a. Description. The intake (10) and exhaust (1) manifolds are mounted on the right side of the engine and secured to the cylinder block with studs (5), bridge clamps (12), and nuts (7). The exhaust



1	Exhaust manifold	13	Washers, plain, 13/32 (3 req'd)
2	Gasket	14	Bushings (2 req'd)
3	Nuts, brass, 3/8-16NC (4 req'd)	15	Heat control valve
4	Washers, plain, 3/8 (4 req'd)	16	Valve shaft
5	Studs, 3/8-16 NC x 1 3/4 (3 req'd)	17	Valve weight
6	Washers, plain, 25/64 (2 req'd)	18	Screw, No. 10-32 x 3/4
7	Nuts, brass, 3/8-16 NC (11 req'd)	19	Stud, y4-20 NC x 1
8	Gasket	20	Washer, plain, 1/4
9	Studs, 3/8-16 NC x 3 5/16 (4 req'd)	21	Nut, 1/4-20 NC
10	Intake manifold	22	Key
11	Pipe plug	23	Nut, No. 10-32
12	Bridge clamp		

Figure 46. Intake and e2haust manifolds disassembled.

manifold (1) is attached to the intake manifold (10) by four studs (9), washers (4), and nuts (3).

b. Removal.

(1) Remove the carburetor (par. 106(b)).

(2) Unscrew the pipe nipple and disconnect the exhaust pipe from the exhaust manifold (1).

(3) Remove the mounting nuts (7), bridge clamps (12), and washers (6) from the mounting studs (5).

(4) Slightly lift up the exhaust (1) and intake (10) manifolds and pull them off the mounting studs (5). Remove and discard the gasket (2).

(5) Remove and replace mounting studs (5) if bent, cracked, or stripped.

c. Disassembly.

(1) Remove the four nuts (3) and washers (4) from the exhaust and intake manifold studs (9).

(2) Lift up the exhaust manifold (1) and disconnect it from the intake manifold (10).

(3) Remove and discard the gasket (8).

(4) Remove and replace the mounting studs (9), if bent, corroded, cracked, or stripped.

(5) Remove the pipe plug (11) from the intake manifold (10).

(6) Remove the nut (21) and washers (20) from the heat control valve stud (19).

(7) Remove the heat control valve weight screw (18) and nut (23) and pull the weight off the valve shaft (16).

(8) Remove the valve weight key (22).

(9) Remove the valve shaft bushings (14) and valve (15) from the valve shaft (16).

d. Inspection. Inspect the intake and exhaust manifolds for cracks, warpage, and pitted mounting surfaces. Check the heat control valve for corrosion, carbon deposits, and wear. Inspect the mounting nuts and studs for damaged or stripped threads.

e. Cleaning. Clean all metal parts in cleaning solvent. Remove all carbon deposits, using a stiff wire brush or scraper. Remove old gasket deposits from the mounting surfaces and see that they are clean and free from carbon and sludge.

f. Reassembly.

(1) Screw the pipe plug (11) into the intake manifold (10).

(2) Install the bushings (14) in the exhaust manifold.

(3) Install the valve shaft (16) in the exhaust manifold. Mount the valve (15) on the valve shaft (16).

(4) Install the key (22) and heat control valve weight (17).

(5) Install the valve weight screw (18) and nut (23).

(6) Install and tighten the heat control valve mounting washer (20) and nut (21).

(7) Install a new gasket (8) on the intake manifold (10).

(8) Position the exhaust manifold (1) over the intake manifold (10) and see that the mounting studs (9) of the intake manifold are properly alined with the mounting holes in the exhaust manifold (1).

(9) Install and tighten the mounting washers (4) and nuts (3). Make sure that the gasket (8) is not bent, twisted, or cracked.

g. Installation.

(1) Install a new gasket (2) on the mounting studs (5) in the cylinder block.

(2) Lift up the intake (10) and exhaust (1) manifold assembly and position it over the mounting studs (5).

(3) Press the manifold assembly against the cylinder block. See that the gasket is fitting properly and that it is not bent or twisted.

(4) Install the mounting washers (6), bridge clamps (12) and nuts (7). Tighten the nuts (7) securely. The proper torque wrench reading is 25 to 30 ft-lb.

(5) Connect the exhaust pipe with the exhaust manifold (1).

(6) Install the carburetor (par. 106c).

133. Exhaust Pipe and Muffler (fig. 47)

a. Description. The exhaust pipe directs the flow of the exhaust gases from the exhaust manifold into the muffler. In the muffler, these gases are split into thin streams and expanded; this action silences the noise without creating back pressure. The muffler is mounted on the floor of the road roller and is supported by two brackets (16 and 19). The exhaust pipe is constructed of threaded pipe nipples (1, 3, and 4) and pipe elbows (2).

b. Removal.

(1) Unscrew the pipe nipple (1) from the exhaust manifold and disconnect the exhaust pipe from the exhaust manifold.

(2) Remove the mounting bolts (11), lockwashers (15), and nuts (14) attaching the muffler to the brackets (16 and 19).

(3) Remove the exhaust pipe and muffler assembly.

c. Disassembly.

(1) Unscrew and disconnect the pipe elbows (2) and connecting pipe (3).

(2) Unscrew the exhaust pipe (4) and remove the pipe cap (5), packing (6), and muffler nipple (7).

(3) Remove the muffler bolts (20) and nuts (21) and lift up the muffler top cover (8).

(4) Remove the top (9) and bottom (10) deflectors.

(5) Remove the bracket mounting bolts (13), lockwashers (18), and nuts (17). Remove the mounting brackets (16 and 19) from the floor of the road roller.

d. Inspection. Inspect all muffler parts for corrosion, cracks, or breaks. Inspect the mounting brackets and bolts for wear, damage, and corrosion. Inspect the pipe threads and see that they are not stripped or damaged. Inspect the packing and replace if burned, worn, or damaged.

e. Cleaning. Wash all metal parts in cleaning solvent. Clean the rust and scale from the muffler with a stiff wire brush. Clean all pipe and bolt threads. Replace bolts and nuts if the threads are corroded or stripped.

f. Reassembly.

(1) Install the mounting brackets (16 and 19) on the road roller floor and tighten the mounting bolts (13), lockwashers (18), and nuts (17).

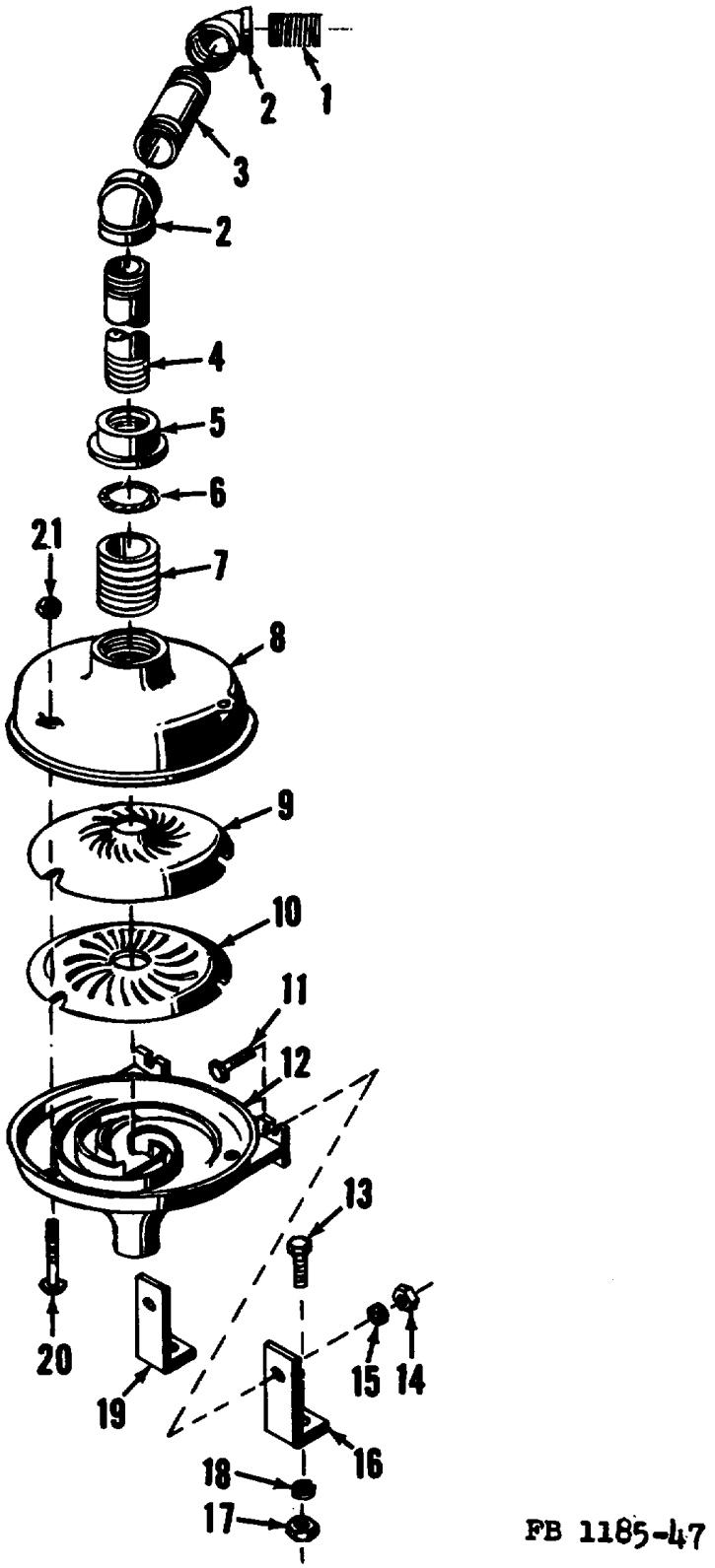


Figure 47. Exhaust pipe and muffler disassembled.

(2) Install new packing (6) in the pipe cap (5).

(3) Install the bottom (10) and top (9) deflectors in the bottom cover (12) of the muffler.

(4) Install the top cover (8) and tighten the mounting bolts (20) and nuts (21).

(5) Connect tile muffler nipple (7) with the top cover (8) and install the exhaust pipe (4) and pipe cap (5) with packing (6).

(6) Install the pipe elbows (2) and connecting pipe (3).

g. Installation.

(1) Attach the muffler assembly to the mounting brackets (16 and 19) and tighten the mounting bolts (11), lockwashers (15), and nuts (14).

(2) Install the pipe nipple (1) and connect it with the exhaust manifold.

(3) Tighten the pipe nipple (1) securely.

(4) Start the engine and check the exhaust pipe and muffler for proper operation.

Note. Do not be alarmed if a new exhaust pipe or muffler will start smoking after a few minutes of operation. This is caused by the evaporation of protective paint or oil. The smoking will stop after a short while when the exhaust pipe gets hot.

Section XI. CYLINDER HEAD AND VALVES

134. Description

The cylinder head is of the conventional cast iron type and is attached to the engine block with flat washers and hex head screws. The cylinder head gasket is made either of copper or steel and asbestos. The intake and exhaust valves are held in position by retaining pins. The exhaust valves are self-rotating and are held in position by retaining keys. The angle of the intake valve seat is 30° and that of the exhaust valve is 45°. The valves can be reached for inspection and

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1 Pipe nipple
2 Pipe elbows (2 req'd)
3 Connecting pipe
4 Exhaust pipe
5 Pipe cap
6 Packing
7 Muffler nipple
8 Muffler topcover
9 Deflector, top
10 Deflector, bottom
11 Bolts, hex hd, 3/8-16 NC x 1 1/4 (4 req'd)
12 Muffler bottom cover
13 Bolts, hex hd, 1/2-13 NC x 2 3/4 (4 req'd)
14 Nuts, hex, 3/8-16 NC (4 req'd)
15 Washers, lock, std, 3/8 (4 req'd)
16 Mounting bracket, right hand
17 Nuts, hex, 1/2-13 NC (4 req'd)
18 Washers, lock, std, 1/2 (4 req'd)
19 Mounting bracket, left hand
20 Muffler bolts (3 req'd)
21 Muffler bolt nuts (3req'd)

Figure 47. -Continued.

adjustment by removing the valve cover, located on the right side of the engine block, directly below the exhaust and intake manifolds.

135. Cylinder Head (fig. 48)

a. Removal.

(1) Drain the cooling system (par. 128b).

(2) Loosen the radiator hose clamp and disconnect the hose from the cylinder head water outlet elbow (9).

(3) Remove the water outlet elbow mounting nuts (10) and lockwashers (12).

(4) Lift up the water outlet elbow (9) and remove it from the mounting studs (13). If the water outlet elbow (9) sticks to the cylinder head (7), tap it lightly with a plastic hammer.

(5) Remove and discard the water outlet elbow gasket (8).

(6) Remove the hourmeter and hourmeter adapter (4).

(7) Remove the spark plugs and spark-plug leads.

(8) Remove the oil filter and oil-filter mounting plate (par. 123a).

(9) Disconnect the leads from the water temperature gage transmitter and remove the transmitter and the suppression capacitor.

(10) Remove the cylinder head mounting screws (37) and flatwashers (36). Check to see that all screws (37) are removed before attempting to remove the cylinder head (7).

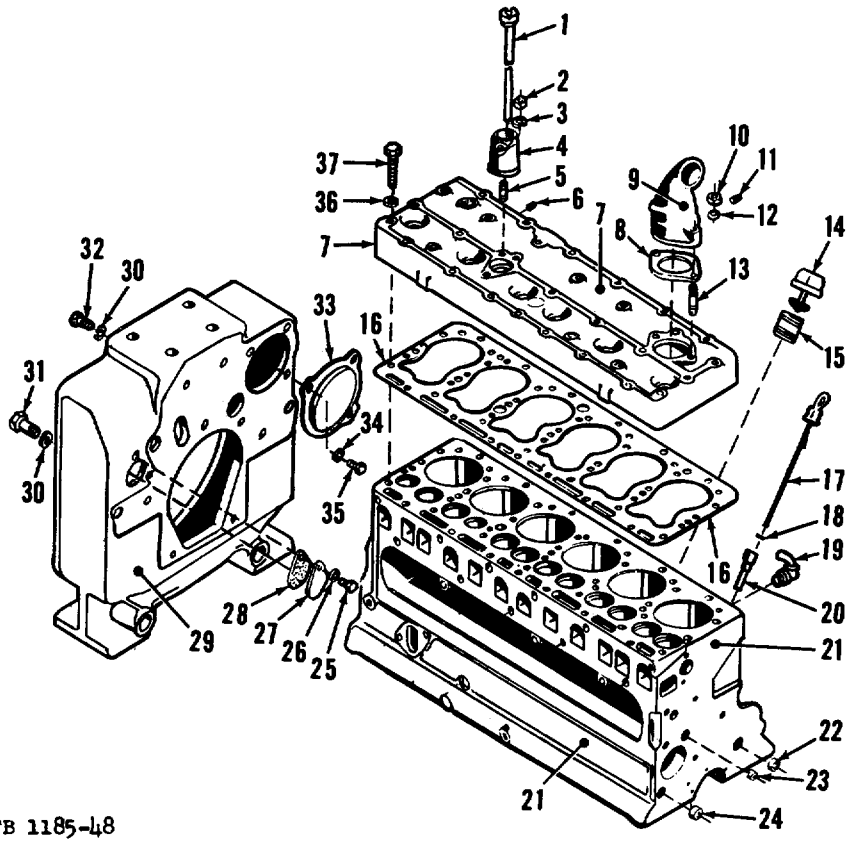
(11) Remove the cylinder head (7). If the cylinder head (7) sticks to the engine block (21), tap it with a plastic hammer.

Note. Do not drive a screwdriver, chisel, or other sharp instrument between the cylinder head and engine block, as this may cause serious damage to the cylinder head and engine block.

(12) Remove the cylinder head gasket (16). Use the old gasket only in an emergency. If possible, use a new gasket when reassembling the cylinder head.

b. Cleaning. Clean the cylinder head with a stiff wire brush and a carbon scraper. Remove all carbon deposits from the piston tops and combustion chambers on the cylinder head. Clean accumulated rust, carbon, and sediment from the spark-plug holes and mounting holes. Wash the cylinder head in cleaning solvent and blow it dry with compressed air. Wash the mounting screws and washers in cleaning solvent and clean the threads with a stiff wire brush.

c. Inspection. Inspect the cylinder head for flaws, breaks, cracks, and warpage. Check the spark-plug holes for damaged or stripped threads. Inspect the mounting holes in the engine block and clean or tap them if necessary.



1	Hourmeter drive shaft	19	Draincock
2	Adapter nut, 3/8-16 NC	20	Oil gage support
3	Washer, lock, std, 3/8	21	Engine block
4	Hourmeter adapter	22	Dowel ring
5	Adapter stud	23	Pipe plug
6	Pipe plug, countersunk, 1/2	24	Dowel ring
7	Cylinder head	25	Screw, 3/8-16 NC x 5/8
8	Outlet elbow gasket	26	Washers, lock std, %
9	Water outlet elbow	27	Flywheel pointer cover
10	Outlet elbow nuts, 5A6-18 NC (2 req'd)	28	Cover felt
		29	Flywheel housing
11	Pipe plug, ext. head, 1/4	30	Washers, lock, std, 7A6 (5 req'd)
12	Washers, lock, std, 5/16 (2 req'd)	31	Screws, dowel, 7/16-14 NC x 1/2 (2 req'd)
13	Elbow studs, /6-18 NC x 1 7/8 (2 req'd)	32	Screws, 7A6-14 NC x 1/4 (3 req'd)
		33	Cover
14	Oil filler cap	34	Washers, lock, std, 3/8 (3 req'd)
15	Oil filler nipple	35	Screws, 3/8-16 NC x 1/2, (3 req'd)
16	Cylinder head gasket	36	Washers, plain, std, 3/8 (31 req'd)
17	Oil level gage	37	Screws, 3/8-16 NC x 2 3/4 (32 req'd)
18	Oil gage felt		

Figure 48. Cylinder head and engine block disassembled.

d. Installation.

(1) Place the new cylinder head gasket (16) on the engine block (21). The gasket must be installed with the bead (the rolled edge around the combustion chambers) down.

(2) Coat the top of the gasket (16) lightly with engine oil.

(3) Install the cylinder head (7) on the engine block (21) and see that the holes in the gasket, cylinder head, and engine block are properly alined.

(4) Install the flat washers (36) and mounting screws (37). Screw them in until they are finger-tight.

(5) Tighten the mounting screws (37), following the numerical order shown in figure 49. The proper torque wrench tension is 35 to 40 ft-lb.

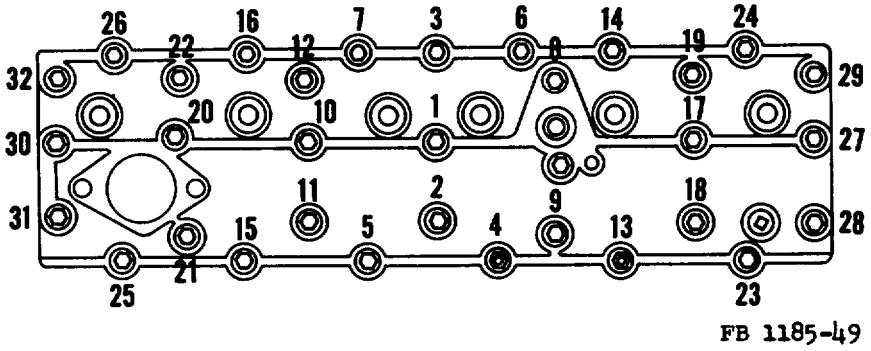


Figure 49. Tightening cylinder head screws.

(6) Install the water temperature transmitter and suppression capacitor.

(7) Install the oil filter (par. 123).

(8) Install the hourmeter.

(9) Install the spark plugs and leads.

(10) Coat a new water outlet elbow gasket (8) with a fast-drying gasket sealer.

(11) Install the gasket (8) and water outlet elbow (9) on the cylinder head (7) and tighten the mounting nuts (10) and lockwashers (12).

(12) Connect the radiator hose with the water outlet elbow (9). Tighten the hose clamp.

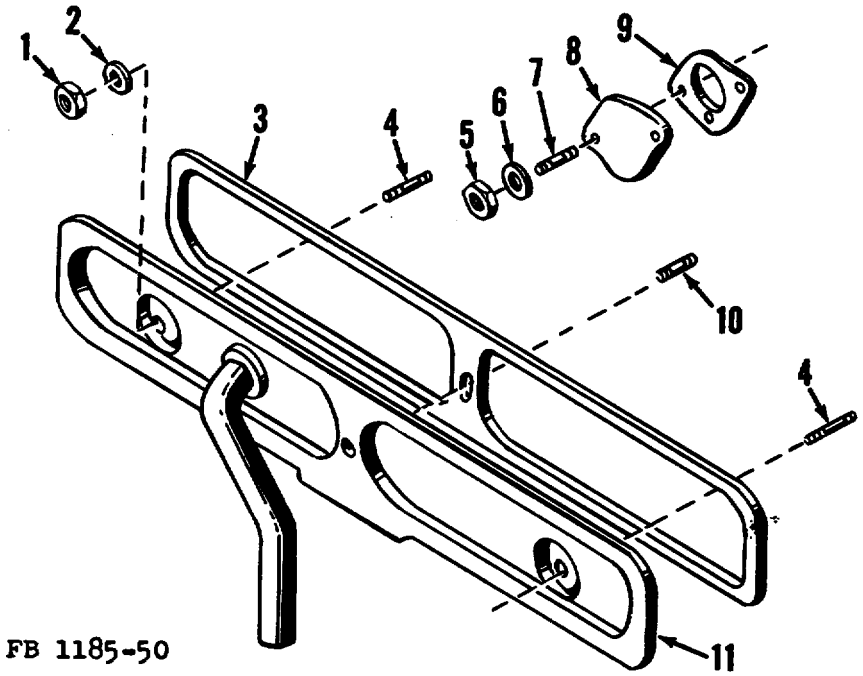
(13) Fill the cooling system (par. 128).

(14) Start the engine and inspect the cylinder head for leaks.

(15) After the engine has operated for about 20 hours, check the cylinder head mounting screws (37) for tightness. Tighten if necessary.

136. Valves and Tappets

a. General. The intake and exhaust valves are accessible by removing the valve cover (11, fig. 50) and gasket (3). The ventilation pipe is welded to the valve cover (11) and cannot be removed. Both valves operate in the valve guides pressed into the engine block. The valves can be adjusted without removing the cylinder head. It is advisable to remove the manifold assembly to facilitate the valve adjustment.



1 Cover nuts, 1/4-28NF (3 req'd)
2 Stud gasket
3 Valve chamber cover gasket
4 Cover end studs, 1/4-28NF x 1 (2 req'd)
5 Fuel pump cover nuts, 5/16-24NF (2 req'd)
6 Washers, lock, std, 5/16 (2 req'd)
7 Cover studs, 5/16-24NF x 1 1/4 (2 req'd)
8 Fuel pump hole cover
9 Cover gasket
10 Cover center stud, 1/4-28NF x 3 1/4
11 Valve chamber cover

Figure 50. Valve chamber cover and fuel pump cover disassembled.

b. Adjustment.

(1) Run the engine until normal operating temperature is reached. Shut off the engine.

(2) Remove the manifold assembly (par 132b).

(3) Remove the valve cover stud nuts (1) and gaskets (2).

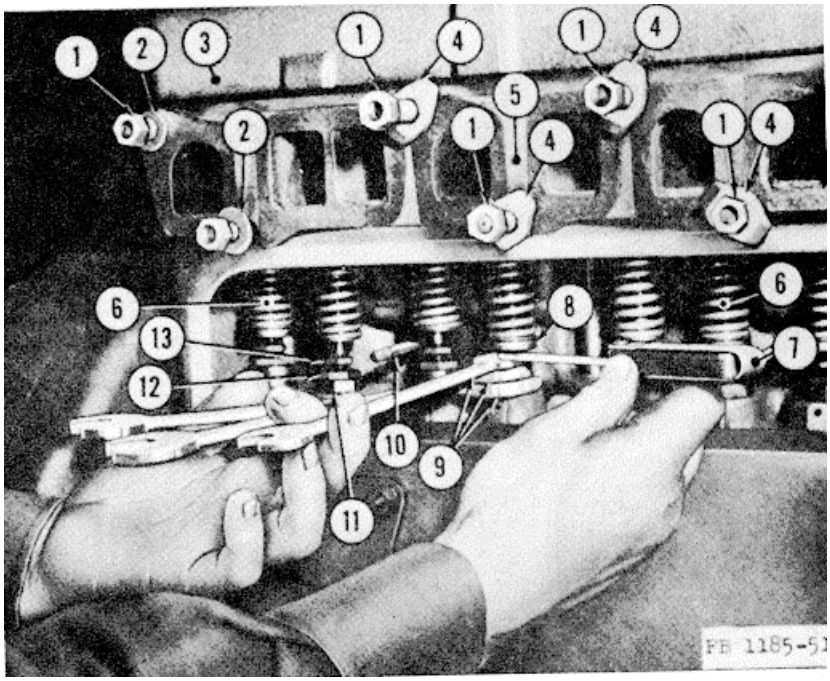
(4) Remove the valve cover (11) and valve cover gasket (3). Discard the gasket (3).

(5) Use three open-end tappet wrenches and a 0.014 feeler gage for-the adjustment of the valve-tappet clearance. Use 0.015 feeler gage if the engine is cool.

(6) Place the first wrench (9, fig. 51) on the valve tappet (11), the second wrench on the tappet locknut (12), and the third wrench on the adjusting screw (13), as shown in figure 51.

(7) Hold the valve tappet (11) and loosen the locknut (12) by turning it counterclockwise.

(8) Insert the feeler gage (7) between the adjusting screw (13) and valve stem and check the clearance.



1 Manifold mounting nut
2 Washer
3 Cylinder head
4 Bridge clamp
5 Engine block
6 Valve spring
7 Feeler gage
8 Valve spring retainer
9 Adjusting wrenches
10 Valve cover stud
11 Valve tappet
12 Locknut
13 Adjusting screw

Figure 51. Valve-tappet clearance adjustment.

(9) Turn the adjusting screw (13) clockwise to increase the gap and counterclockwise to decrease the gap between tile valve stem and the adjusting screw (13).

(10) The valve-tappet adjustment is correct when a 0.014 feeler gage passes without excessive binding between the valve stem and the adjusting screw (13). Use a 0.015 feeler gage if the engine is cold.

(11) When clearance is properly adjusted, hold the adjusting screw (13) and turn the locknut clockwise. This will lock the adjusting screw (13) in its position.

(12) Remove the wrenches (9) and check the valve-tappet clearance again. Readjust if necessary.

(13) Adjust all valves, using 0.014 feeler gage for warm engines and 0.015 feeler gage for cold engines. Make a final adjustment check.

(14) Coat the new valve cover gasket (3, fig. 50) with a fastdrying gasket sealer and install it on the valve cover (11).

c. Removal.

(1) Remove the cylinder head (par. 135).

(2) Remove the manifold assembly (par. 132b).

(3) Remove the valve cover (see b above).

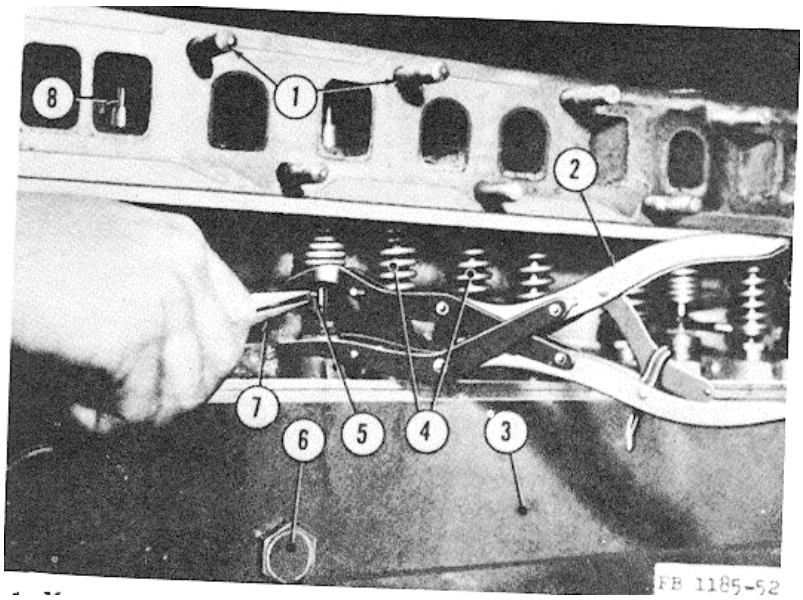
(4) Cover the openings around the tappet seats with a clean cloth to prevent dropping retainer pins and keys into the oil pan.

(5) Use a valve compressing tool (2, fig. 52) to compress the valve spring (4). See that the tool is properly seated and locked before attempting to remove valve keys or pins.

(6) Remove the locking pin (5) from the intake valve and locking keys from the exhaust valve.

(7) Remove the valve compressing tool (2).

(8) Pull out the valves (1 and 10, fig. 53) from the valve guide.



1 Manifold mounting stud
2 Valve compressing tool
3 Engine block
4 Valve spring
5 Locking pin
6 Oil pressure relief valve
7 Pliers
8 Valve stem

Figure 52. Valve removal.

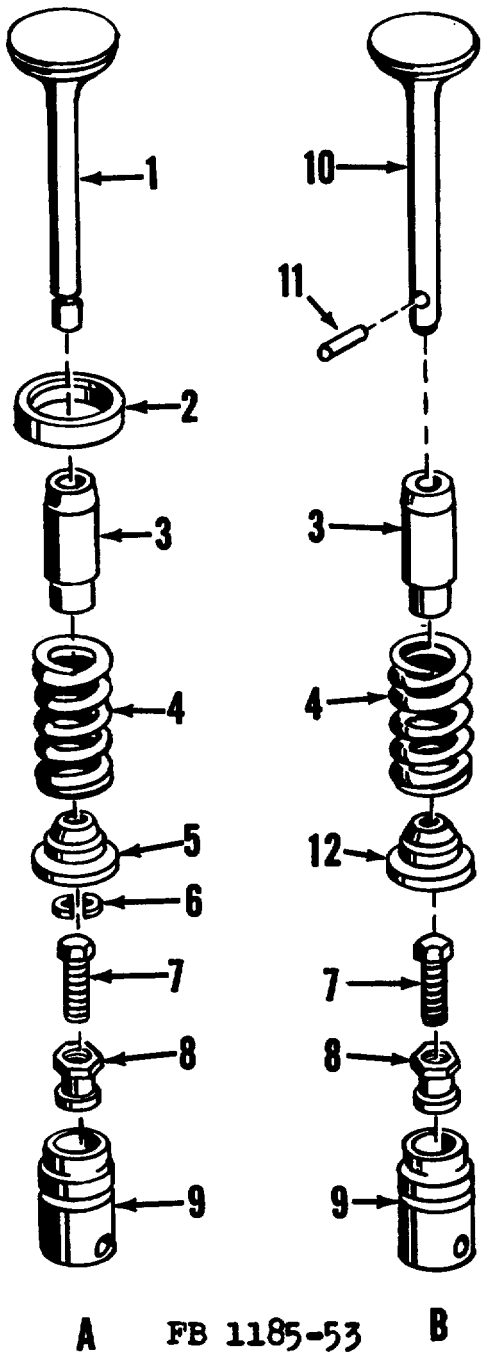


Figure 53. Exhaust and intake valves and tappets disassembled.

(3). Place the valves in a numbered holder as they are removed, because each valve must be reinstalled in the same valve guide from which it was removed.

(9) Remove the valve spring (4) and spring retainers (5 and 12).

(10) Loosen the locknut (8) and unscrew the adjusting screw (7) from the valve tappet (9).

(11) Unscrew the locknut (8) from the adjusting screw (7).

d. Cleaning. Wash all parts in cleaning solvent and blow dry with clean compressed air. Remove all carbon and scale deposits from the valve stem, head, and face. Clean the adjusting screw and tappet threads and coat them with engine oil.

e. Inspection.

(1) Inspect the valve stein for warpage, flaws, cracks, breaks, chipping metal, and wear. Check the valve face for pitting, grooving, scoring, cracks, and warpage.

(2) Inspect the threads on the adjusting screw, locknut, and valve tappet. See that the threads are not worn, stripped, or galled. Replace all damaged or worn parts.

(3) Check the valve tappet for excessive wear, grooving, pitting, etching, scoring, and flaws. Replace worn, grooved, pitted, or scored valve tappets.

(4) Inspect the valve seats for pitting, uneven wear, cracks, splintering, and damage. If the intake valve seats are so badly cracked, worn, or splintered that they cannot be repaired by refacing, the engine block must be replaced.

(5) Check the valve seats for out-of-round with a dial gage. The out-of-round must not exceed 0.002 inch.

(6) Inspect the valve springs for twisting, breaks, cracks, and metal fatigue. Test the valve springs on a valve spring tester. The proper valve spring pressure is 47 to 53 pounds with the valve closed and 103 to 110 pounds with the valve open. Replace all damaged, worn, or twisted valve springs.

f. Reseating.

(1) Make sure that the valve tappet is in low position. If the tappet is lifted, crank the engine by hand until the tappet goes down.

(2) Apply a small amount of valve grinding compound to the valve seat.

---

1 Exhaust valve
2 Exhaust valve seat
3 Valve guide
4 Valve spring
5 Exhaust valve spring retainer
6 Lock key
7 Adjusting screw
8 Locknut
9 Valve tappet
10 Intake valve
11 Lock pin
12 Intake valve spring retainer

Figure 53. -Continued.

(3) Insert the valve in the guide and press it against the valve seat, using a screwdriver or valve grinding tool.

(4) Rotate the valve back and forth for about one-quarter turn.

Note. Do not rotate the valve continuously all the way around. Such rotation will cut grooves in the valve seat.

(5) Raise the valve and rotate slightly to a new position. Repeat the grinding procedure.

(6) Remove the valve and carefully clean the grinding compound from the valve face and valve seat.

(7) Draw lines with a pencil or chalk across the valve face. The lines should be about one-eighth of an inch apart.

(8) Press the valve against the valve seat and rotate with firm pressure.

(9) Lift the valve and inspect the valve face. If the lines are rubbed off, the grinding job is completed. Repeat the grinding procedure until the lines are rubbed off.

Note. Do not remove more metal than is necessary to provide a good seat.

(10) Carefully clean the valve face, seat, and stem and see that the grinding compound is completely removed. Wash valves in cleaning solvent and apply a light coat of engine oil to the valve stems.

g. Installation.

(1) Assemble the locknut (8, fig. 53) and adjusting screw (7) and install in the valve tappet (9).

(2) Coat the valve stem with engine oil and insert it in the valve guide. Make sure that the valve is inserted in the same guide from which it was removed.

(3) Lift up the valve and install the valve spring (4).

(4) Install the valve spring retainers (5 and 12). Remember that the intake valve has a standard spring retainer, and the exhaust valve self-rotating spring retainer.

(5) Compress the valve spring (4). Make sure that the valve compressing tool is securely locked.

(6) Insert the lock pin (11) on the intake valve (10) and lock keys (6) on the exhaust valve (1).

(7) Unlock the valve compressing tool and slowly lower the spring (4).

(8) Remove the cloth from the openings around the tappet seats.

(9) Make preliminary adjustment of each valve (see b above).

(10) Install the cylinder head (par. 135).

(11) Install the manifold assembly (par. 132f).

(12) Fill the cooling system (par. 128d).

(13) Start the engine and let it idle until normal operating temperature is reached.

(14) Check the valve adjustment and readjust if necessary (see b above).

(15) Install the valve cover.

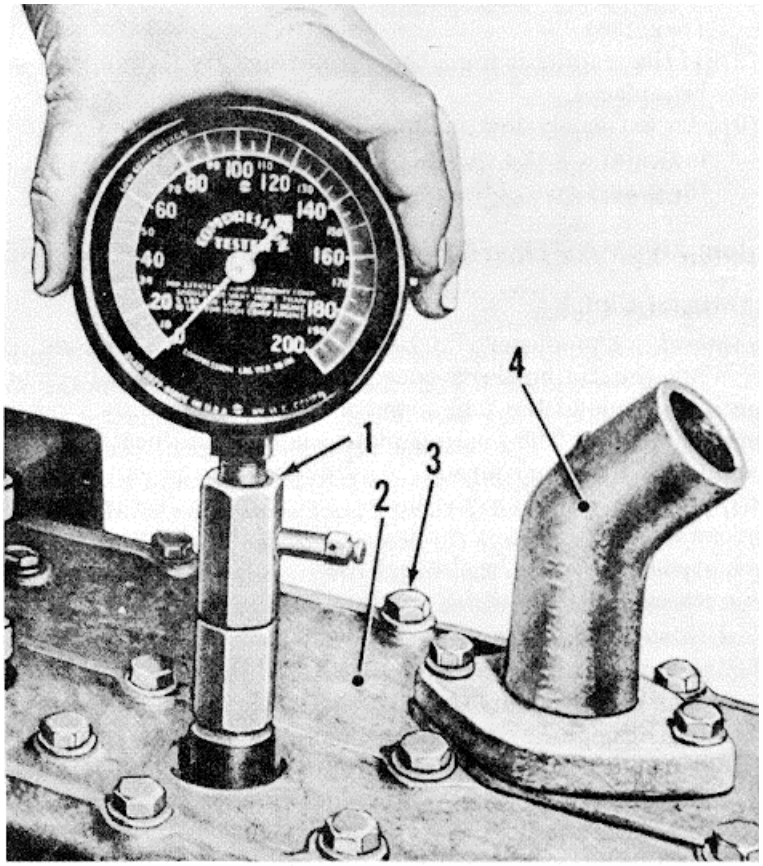
(16) Start the engine and check the valve cover for oil leaks.

137. Cylinder Compression Test (fig. 54)

a. General. Normal and uniform compression is important to efficient engine operation. A compression pressure test is affected by engine cranking speed, engine temperature, compression ratio, and condition of valves and piston rings, as well as the amount of carbon deposit in the combustion chambers.

b. Procedure.

(1) Run the engine until normal operating temperature is reached (160° F.).



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1	Compression tester	3	Cylinder head screw
2	Cylinder head	4	Water outlet elbow

Figure 54. Compression testing.

(2) Shut off the engine and remove all spark plugs.

(3) Install the compression tester (1) in the spark plug hole. Make sure that the rubber adapter of the tester makes an airtight contact with the cylinder head (2).

(4) Crank the engine with the starter and observe the readings on the compression tester (1). Record the highest reading.

(5) Repeat the test on the rest of the cylinders. If the reading on the compression tester is from 90 to 110 pounds at sea level and not varying more than 10 pounds between cylinders, the compression pressure can be considered normal.

(6) If the pressure of any cylinder is weak, inject oil through the spark-plug hole onto the top of the piston, with the piston down. Wait a few minutes for the oil to run down over the piston rings so it will not get on the valves.

(7) Repeat the compression test. If the reading is still low, the valves are leaking and a valve grinding job is needed (par. 136).

(8) If the reading is high, the piston rings are leaking and must be replaced.

(9) An extremely low reading between two adjacent cylinders indicates a leaky cylinder head gasket. Inspect and replace the gasket (par. 135).

Section XII. MASTER, FORWARD AND REVERSE CLUTCHES

138. Master Clutch

a. General. The master clutch (fig. 55) is engaged by toggle action. When the sliding sleeve cone (2) is moved towards the clutch, the machined ends of the four finger levers (13) contact a ring on a floating plate (6). The floating plate has a special heat-treated insert to prevent the finger levers (13) from biting and cutting into it. When pressure is applied to the sliding sleeve cone (2), the links (14) move forward and engage the clutch. When the sliding sleeve cone (2) is moved away from the clutch, pressure against the floating plate (6) is released and the clutch becomes disengaged.

b. Adjustment (fig. 56).

(1) A new clutch may require several adjustments until all moving parts are worn in.

(2) Disengage the clutch before making clutch adjustments.

(3) Turn the clutch until the adjusting lock pin (12) can be reached. The clutch is accessible through the openings in the flywheel housing.

(4) Pullout the adjusting lock pin (12).

(5) Push a short piece of wire through the small cross-drilled hole in the adjusting lock pin (12) and lock the pin in the "out" position.

(6) Turn the adjusting yoke (13) clockwise one or two adjusting holes until the operating lever requires distinct pressure to engage the clutch. Each adjusting hole represents about 0.005-inch clutch adjustment.

(7) Turn the adjusting yoke (13) clockwise to tighten and counterclockwise to loosen the clutch adjustment.

(8) The clutch adjustment is correct when the operating lever requires distinct pressure to engage the clutch.

(9) Remove the wire from the small cross-drilled hole in the adjusting lock pin (12).

(10) See that the adjusting lock pin (12) is seated properly in the adjusting hole.

(11) Start the engine and check the master clutch for proper operation. If the master clutch does not pull or if it heats, slips, or jumps out of engagement, it must be readjusted.

139. Master Clutch Linkage (fig. 57)

a. General. The master clutch arm (6) is connected with the clutch lever shaft arm (1) by a master clutch rod (5).

b. Removal.

(1) Remove the cotter pin (7) and pin (3) from the lever shaft arm (1).

(2) Disconnect the yoke (2) from the lever shaft arm (1).

(3) Remove the cotter pin (7) and pin (3) from the master clutch arm (6).

(4) Disconnect the yoke (2) from the master clutch arm (6) and remove the master clutch rod (5).

c. Disassembly.

(1) Loosen the jam nuts (4) and unscrew the yokes (2) from the master clutch rod (5).

(2) Remove the jam nuts (4) from the master clutch rod (5).

d. Inspection. Inspect the jam nuts and yokes for cracks, wear, and damaged or stripped threads. Check the yoke pins for wear, corrosion, and pitting. Inspect the threads on the master clutch rod for corrosion, damage, and wear. Use new cotter pins when reassembling the linkage.

e. Repair.

(1) Replace all damaged, corroded, stripped, or galled jam nuts.

(2) Replace the yokes if the pin mounting holes are elongated, cracked, or if the edges of the yoke mounting forks are broken off . Replace all cracked or twisted yokes.

(3) Inspect the master clutch rod for twisting and warping. Replace the master clutch rod if it is badly twisted or if the

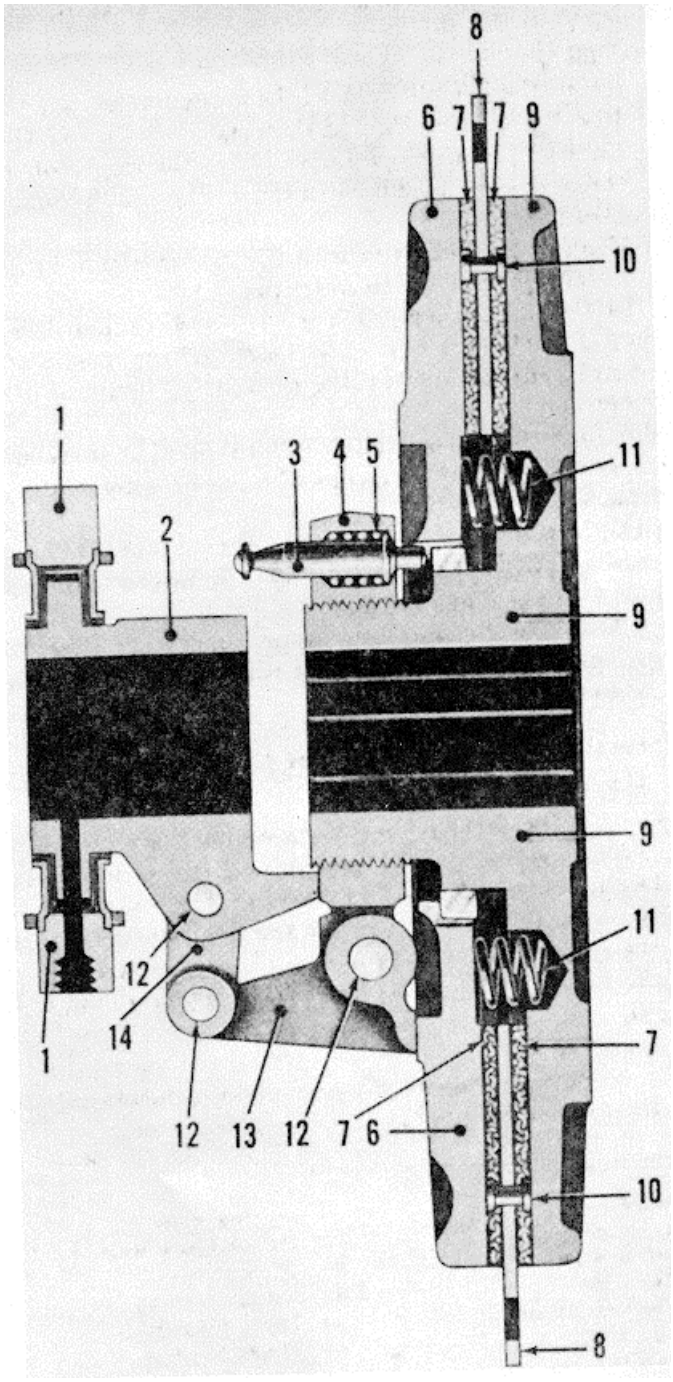


Figure 55. Master clutch, sectional view.

rod mounting threads are corroded, damaged, stripped, or galled.

f. Reassembly.

(1) Install the jam nuts (4) on the master clutch rod (5).
(2) Install the yokes (2) on the master clutch rod (5).
(3) Do not tighten the jam nuts (4) as the length of the master clutch rod (5) must be adjusted during installation.

g. Installation.

(1) Connect the yoke (2) with the master clutch arm (6) and install the pin (3) and cotter pin (7).
(2) Lift up the master clutch rod (5) and see that it reaches the lever shaft arm (1). The length of the master clutch rod can be adjusted by turning the rod (5) in or out of the yoke (2).
(8) Adjust the master clutch rod (5) so that there will be no great play in the linkage when the master clutch lever is moved.
(4) Connect the yoke (2) with the lever shaft arm (1) and install the pin (3) and cotter-pin (7). Secure the cotter pins (7).
(5) Tighten the jam nuts (4).
(6) Check the linkage for proper operation. See that the master clutch rod (5) is not rubbing against accessories of the engine.

140. Forward and Reverse Clutches

(fig. 58)

a. General. The forward and reverse clutches are cone engaged. When the cone sleeve (8) is moved in towards the clutch, the rollers (6) of the three clutch levers (5) travel up the contour of the cone. This action applies pressure against the floating plate (13) which engages the clutch. When the cone sleeve (8) is moved out, pressure against the floating plate (13) is released and the clutch becomes disengaged.

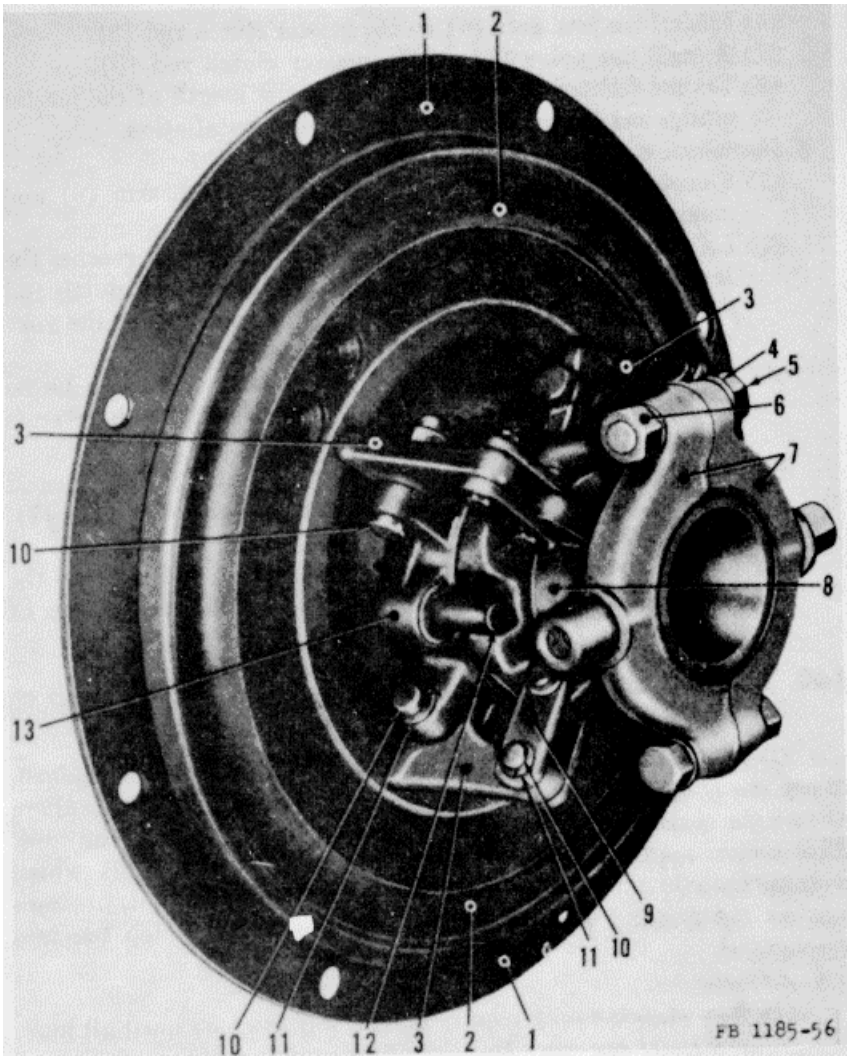
b. Adjustment.

(1) New clutches may require several adjustments until all moving parts are worn in.

---

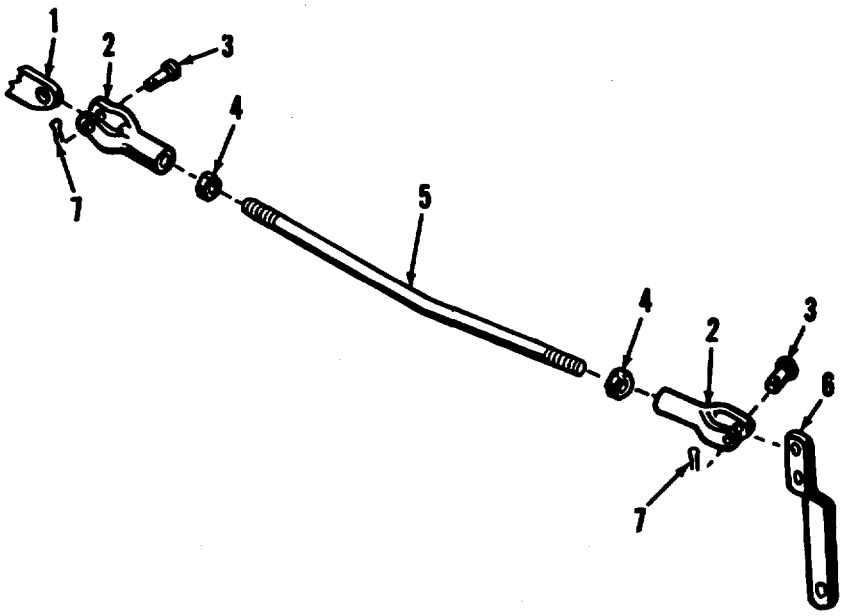
1 Cone collar
2 Sliding sleeve cone
3 Adjusting lock pin
4 Adjusting yoke
5 Adjusting lock pin spring
6 Floating plate
7 Friction disk
8 Driving plate
9 Hub and back plate
10 Rivet
11 Release spring
12 Lever link pin
13 Finger lever
14 Lever link

Figure 55-Continued.



1 Driving plate
2 Floating plate
3 Finger lever
4 Cone collar washer
5 Cone collar bolt
6 Cone collar nut
7 Cone collar
8 Sliding sleeve
9 Lever link
10 Finger pin
11 Snap ring
12 Adjusting lock pin
13 Adjusting yoke

Figure 56. Master clutch.



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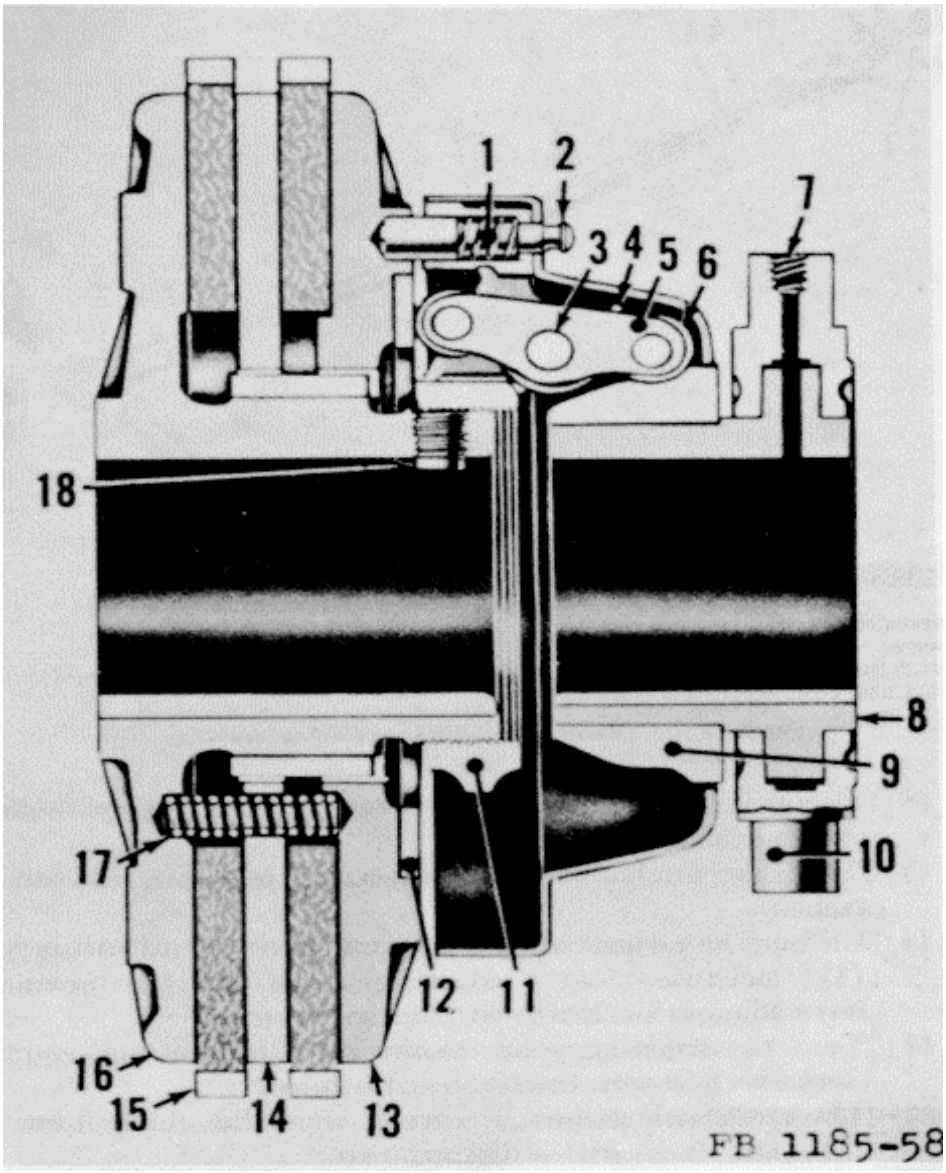
1 Lever shaft arm
2 Yoke
3 Pins, headed (2 req'd)
4 Jam nuts, hex, 3/4-10 NC (2 req'd)
5 Master clutch rod
6 Master clutch arm
7 Pins, cotter, 3/16 x 1 (2 req'd)

Figure 57. Master clutch linkage disassembled.

(2) Disengage the forward and reverse clutch before making clutch adjustments.
(3) Turn the clutch until the adjusting lock pin (2) can be reached.
(4) Pull out the adjusting pin (2) and turn the adjusting yoke (11) clockwise 1 or 2 adjusting holes until the operating lever engages the clutch with a distinct snap.
(5) Turn the adjusting yoke clockwise to tighten and counter clockwise to loosen the clutch adjustment.
(6) The clutch adjustment is correct when the clutch lever engages the clutch with a distinct snap.
(7) Start the engine and check the forward and reverse clutches for proper operation. If the clutches do not pull or if they heat, slip, or jump out of engagement, they must be readjusted.

141. Forward and Reverse Clutch Linkage (fig. 59)

a. General. The forward and reverse shifting arm (1) and the clutch lever shaft arm (9) are connected by the long rod (5), short rod (8), linkage bracket (6) and yokes (3). The movement-of the



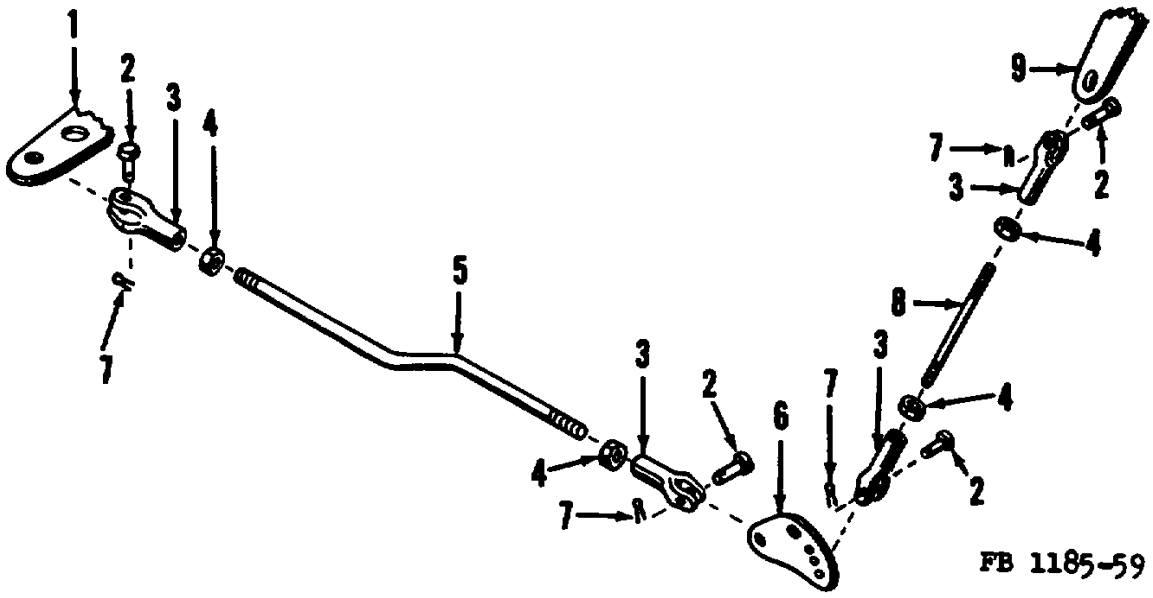
1 Adjusting lock pin spring
2 Adjusting lock pin
3 Lever pin
4 Lever spring
5 Lever
6 Roller
7 Pipe tap for grease fitting
8 Cone sleeve
9 Cone ring
10 Cone collar
11 Adjusting yoke
12 Roller disk
13 Floating plate
14 Center plate
15 Driving plate
16 Hub and back plate
17 Release spring
18 Setscrew

Figure 58. Forward and rever8e clutch, sectional view.

forward and reverse clutch lever activates the linkage rods and the shifting rods and the shifting arm. The yokes are secured by pins (2) and cotter pins (7).

b. Removal.

(1) Remove the cotter pin (7) and pin (2) attaching the long rod yoke (3) to the shifting arm (1).
(2) Disconnect the yoke (3) from the shifting arm (1).
(3) Remove the cotter pin (7) and pin (2) attaching the long rod yoke (3) to the linkage bracket (6).
(4) Disconnect the yoke (3) from the linkage bracket (6) and remove the long rod (5).
(5) Remove the cotter pin (7) and pin (2) attaching the short rod yoke (3) to the linkage bracket (6).



1 Shifting arm
2 Pins, headed, (4 req'd)
3 Yoke
4 Jam nuts, hex, 3/4-10 NC (4 req'd)
5 Long rod
6 Linkage bracket
7 Cotter pins, 3/16 x 1 (4 req'd)
8 Short rod
9 Lever shaft arm

Figure 59. Forward and reverse clutch linkage disassembled.

(6) Disconnect the short rod yoke (3) from the linkage bracket (6).
(7) Remove the cotter pin (7) and pin (2) attaching the short rod yoke (3) to the lever shaft arm (9).
(8) Disconnect the short rod yoke (3) from the lever shaft arm (9) and remove the short rod (8).

c. Disassembly.

(1) Loosen the jam nuts (4) on the long (5) and short (8) rods.
(2) Unscrew the yokes (3) from the long (5) and short (8) rods.
(3) Unscrew the jam nuts (4) from the long (5) and short (8) rods.

d. Inspection. Inspect the jam nuts and yokes for cracks, wear, and damaged or stripped threads. Check the yoke pins for wear, corrosion, and pitting. Inspect the threads on the long and short rods for corrosion, damage, and wear. Use new cotter pins when reassembling the linkage.

e. Repair.

(1) Replace the jam nuts if their threads are corroded, damaged, stripped, or galled.
(2) Replace the yoke pins if pitted, etched, grooved, worn, or cracked.
(3) Replace the yokes if the edges of the forks are broken off or cracked. Check the yoke pin mounting holes and replace the yokes if the pin holes are worn or elongated.
(4) Replace the long rod if it is badly twisted, bent, or warped.
(5) The short rod may be straightened out by placing it on an anvil and pounding out the bend or twist with a heavy hammer. Replace the short rod if it is badly twisted, warped, or cracked.
(6) Replace the long and short rods if the threads are corroded, damaged, stripped, or galled.

f. Reassembly.

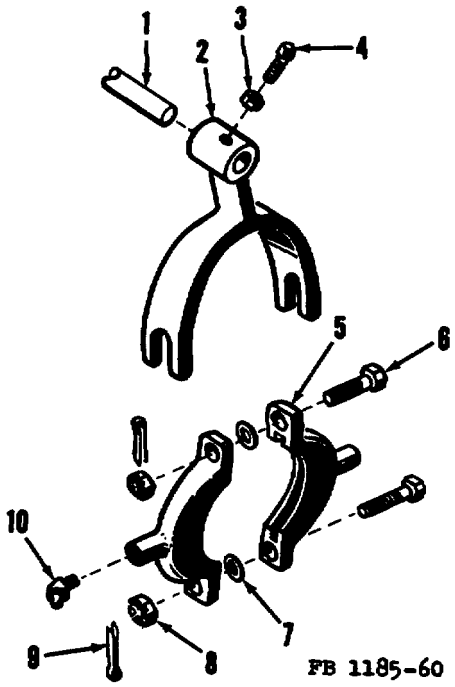
(1) Install the jam nuts (4) on the long (5) and short (8) rods.
(2) Install the yokes (3) on the long (5) and short (8) rods.
(3) Do not tighten the jam nuts (4) as the length of both rods must be adjusted during installation.

g. Installation.

(1) Connect the yoke (3) of the long rod (5) with the forward and reverse clutch shifting arm (1) and install the pin (2) and cotter pin (7).
(2) Lift up the long rod (5) and see that it reaches the linkage bracket (6). The length of the rod (5) can be adjusted by turning the yoke (3) clockwise or counterclockwise.
(3) Connect the yoke (3) of the long rod (5) with the linkage bracket (6) and install the pin (2) and cotter pin (7).
(4) Connect the yoke (3) of the short rod (8) with the linkage bracket (6) and install the pin (2) and cotter pin (7).
(5) Connect the yoke (3) of the short rod (8) with the lever shaft arm (9) and install the pin (2) and cotter pin (7).
(6) Adjust both rods (5 and 8) so that there will be no excessive play in the linkage when the forward and reverse clutch lever is moved.
(7) Secure the cotter pills (7) and tighten the jam nuts (4).
(8) Check the linkage for proper operation. See that the rods (5 and 8) are not rubbing against accessories of the engine.

142. Forward and Reverse Clutch Cone Collar (fig. 60)

a. General. The clutch cone collar (5) is operated by the forward and reverse clutch yoke (2). The clutch yoke (2) is mounted on the forward and reverse clutch shift shaft (1) and is secured with a jam nut (3) and setscrew (4).



1 Forward and reverse clutch shift shaft
2 Clutch yoke
3 Nuts, jam, hex, ½-13NC
4 Setscrew, square head ½-13NC x 1 ¾
5 Cone collar
6 Bolt
7 Shim
8 Nut
9 Cotter pin
10 Fitting, grease, 1/8, pipe thread. 45°

Figure 60. Clutch yoke and cone collar disassembled.

b. Removal and disassembly.
(1) Disengage the forward and reverse clutch.
(2) Loosen the jam nut (3) and remove the setscrew (4).
(3) Remove the clutch yoke (2) from the clutch shift shaft (1).
(4) Remove the cone collar (5).
(5) Remove the grease fitting (10) from the cone collar (5).
(6) Remove the cotter pins (9), cone collar nuts (8), and bolts (6).
(7) Remove the cone collar shims (7).

c. Inspection. Inspect the cone collar for wear, out-of-round, cracks, and breaks. Check the cone collar bolts and nuts for corrosion and damaged or stripped threads. Inspect the shims for corrosion and breaks. Use new cotter pins when reassembling the cone collar.

d. Repair.

(1) Replace all damaged, corroded, stripped, or galled bolts and nuts.
(2) Replace the shims if they are warped, cracked, or splintered.
(3) Replace the cone collar if it is cracked, broken, or worn more than one-eighth inch out-of-round.
(4) Replace damaged, corroded, or broken grease fitting.

e. Reassembly and Installation.

(1) Install the grease fitting (10) on the cone collar (5).
(2) Assemble both halves of the cone collar (5) and install the shims (7), bolts (6), and nuts (8).
(3) Install the cone collar and check for free sliding. If the cone collar sticks, install additional shims. If the cone collar is too loose, remove shims until the cone collar slides freely and without binding.
(4) Tighten the nuts (8) and install new cotter pins (9).
(5) Install the cone collar assembly (5) in its proper place.
(6) Install the clutch yoke (2) on the shift shaft (1) and connect it with the cone collar (5).
(7) Install the setscrew (4) and jam nut (3).
(8) Tighten the setscrew (4) and secure it with the jam nut (3).

Section XIII. TRANSMISSION

143. Description

(fig. 61)

The heavy-duty transmission is enclosed in an oil and dusttight case (14) bolted to two cross-members of the roller main frame. The transmission case (14) encloses the master clutch housing (42), which is bolted to the engine flywheel housing. All transmission gears are made of machined and heat-treated alloy steel. The bevel pinion (45) is mounted on the master clutch shaft (40) and is secured with a jam nut (44) and cotter pin. The bevel pinion (45) runs in constant mesh with the two bevel gears (47) mounted on the forward and reverse clutch shaft (53) and controls the forward and reverse movement of the roller. The gear shift shaft (20) is mounted on two large bearings (13 and 23) and assures proper alinement when engaging or disengaging either clutch. The slow (16) and the fast (27) gears are mounted on the first countershaft (8) and driven by the double speed pinion (35) on the forward and reverse clutch shaft (53). The first countershaft (8) is enclosed in the first countershaft bearing tube

(9) and runs on a large outboard bearing (5). The first countershaft pinion (3) is secured with a key, retainer washer (2), and nut (1) on the first countershaft (8) and drives the second countershaft, which in turn drives the main spur drive gear on the compression roll.

144. First Countershaft Pinion

(fig. 61)

a. General. The first countershaft pinion (3) is mounted on the first countershaft (8) and is secured with a key, retainer washer (2), nut (1), and cotter pin. The oil seal (4) is mounted on the inner end of the pinion (3) and prevents the entrance of dirt and dust into the outboard bearing (5) housing.

b. Removal.

(1) Remove the cotter pin and unscrew the nut (2). Discard the cotter pin.
(2) Remove the retainer washer (2).
(3) Use a suitable gear puller and pull the pinion (3) off the first countershaft (8).
(4) Remove the oil seal (4). Discard the oil seal. Always use a new oil seal when installing the pinion.
(5) Remove the key.
(6) Cover the outboard bearing (5) housing with a clean cloth to prevent the entrance of dirt, dust, and grit.

c. Inspection. Inspect all pinion teeth for broken off edges, pitting, breaks, and cracks. Check the pinion nut for damaged or stripped threads. Inspect the key for wear, breaks, or rounded corners.

d. Cleaning. Wash all removed parts in cleaning solvent and wipe them dry with a soft absorbent cloth. Wipe off the mounting surface on the first countershaft with a soft cloth soaked in cleaning solvent. Remove all imbedded dirt .and foreign matter from the keyway.

e. Installation.

(1) Install the key on the first countershaft (8) and see that it is seated properly in the keyway.
(2) Install the oil seal (4) on the pinion (3). Make sure that the recessed lip of the seal is facing the outboard bearing (5).
(3) Position the pinion (3) on the first countershaft (8) and see that the oil seal (4) is riding properly on the pinion mounting surface. Apply a few drops of oil between the pinion and seal and make sure that the keyway in the pinion and the key on the first countershaft are properly alined. Press the pinion on the first countershaft being careful not to damage or pinch the oil seal (4).
(4) See that the teeth on the pinion and on the second countershaft gear are properly alined.
(5) Install the retainer washer (2).

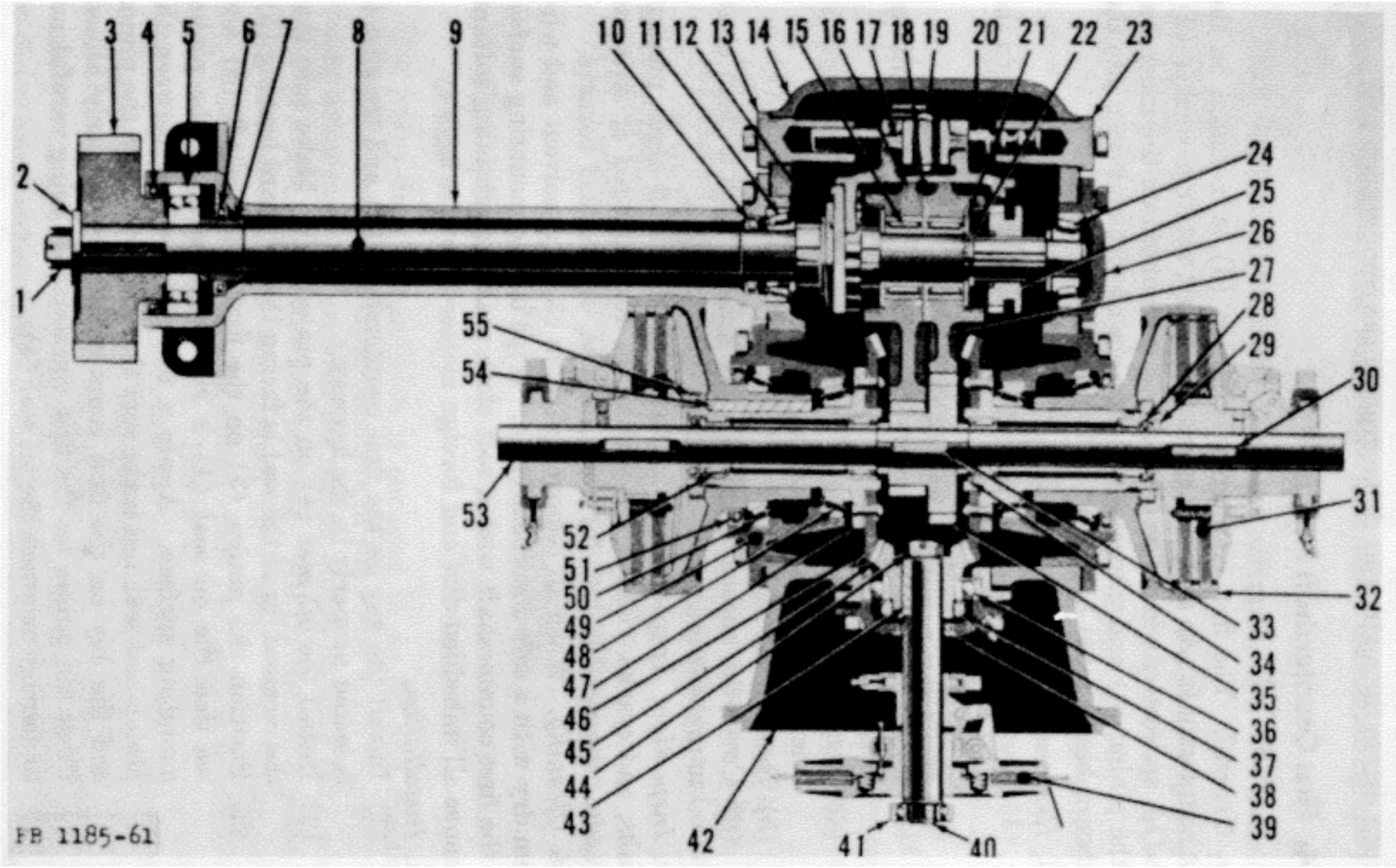


Figure 61. Transmission, sectional for view.

1 Nut
2 Pinion retainer washer
3 First countershaft pinion
4 Oil seal
5 Outboard bearing
4 Oil seal
7 Outboard bearing spacer
8 First countershaft
9 First countershaft bearing tube
10 Oil seal
11 Bearing
12 Sliding gear (slow gear)
13 Left-hand shift shaft bearing
14 Transmission case
15 Needle bearing
16 Slow gear
17 Gear shifting yoke
18 Spacer washer
19 Shaft retainer
20 Shift shaft
21 First countershaft washer
22 First countershaft snap ring
23 Right-hand shift shaft bearing
24 Bearing
25 Sliding gear (fast gear)
26 Right hand bearing housing
27 Fast gear
28 Hub spacer
29 Thrust washer
30 Hub key
31 Forward and reverse clutch assembly
32 Clutch driving spider
33 Shaft key
34 Hub snap ring
35 Double speed pinion
36 Master clutch shaft bearing
37 Locknut
38 Master clutch shaft oil seal
39 Master clutch assembly
40 Master clutch shaft
41 Outer bearing
42 Master clutch housing
43 Bevel pinion key
44 Jam nut
45 Bevel pinion
46 Bevel gear
47 Bevel gear hub
48 Bevel hub bearing
49 Bearing housing
50 Bearing
51 Oil seal
52 Forward and reverse clutch shaft bearing
53 Forward and reverse clutch shaft
54 Key
55 Locknut

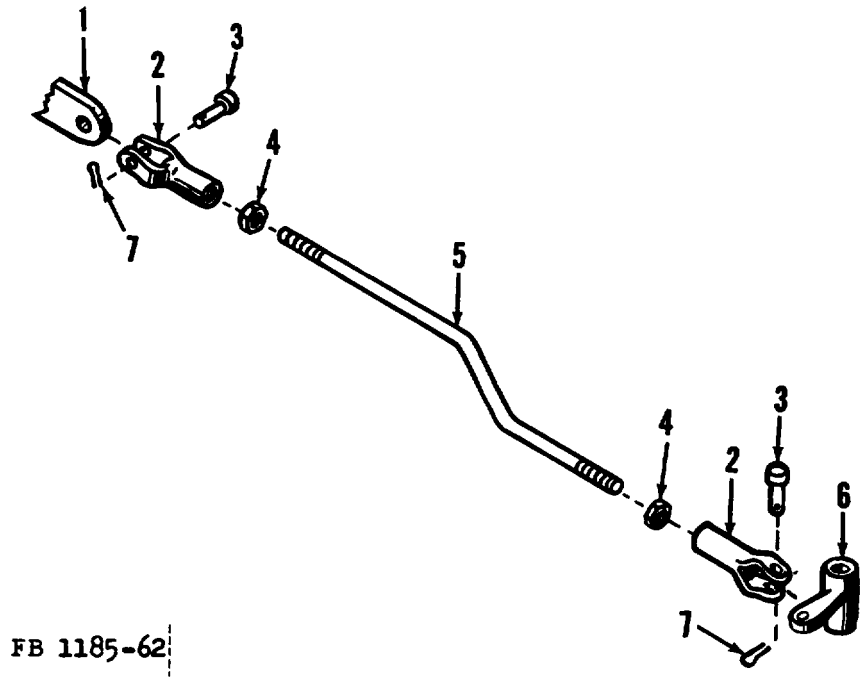
Figure 61-Continued.

(6) Install and tighten the nut (1).
(7) Secure the nut with a new cotter pin.

f. Adjustment. Adjust the pinion so that the teeth of the pinioin and of the second countershaft gears are properly meshing and alined. The teeth must make full contact with each other. See that the outer edges of all teeth are flush with each other. Replace the pinion if its teeth are excessively worn, pitted, or broken.

145. Gear Shifting Linkage
(fig. 62)

a. General. The gear shifting arm (6) is connected with the gear shaft arm (1) by the gear shifting rod (5). When the gear shifting



1 Gear shaft arm
2 Yoke
3 Pins, headed (2 req'd)
4 Nuts, jam, hex, 3/4-10NC (2 req'd)
5 Shifting rod
6 Gear shifting arm
7 Pins, cotter, 3/16 x 1 (2 req'd)

Figure 62. Gear shifting linkage disassembled.

lever is moved, the gear shifting rod (5) activates the gear shifting arm (6) and shifts gears.

b. Removal.
(1) Remove the cotter pin (7) and pin (3) attaching the yoke (2) to the gear shaft arm (1).
(2) Disconnect the yoke (2) from the gear shaft arm (1).

(3) Remove the cotter pin (7) and pin (3) attaching the yoke (2) to the gear shifting arm (6).
(4) Disconnect the yoke (2) from the gear shifting arm (6) and remove the gear shifting rod (5).

c. Disassembly.
(1) Loosen the jam nut (4) and unscrew the yoke (2) from the gear shifting rod (5).
(2) Unscrew the jam nuts (4) from the gear shifting rod (5).

d. Inspection. Inspect the jam nuts and yokes for cracks, excessive wear, and damaged or stripped threads. Check the yoke pins for excessive wear, corrosion, and pitting. Inspect the threads on the gear shifting rod for corrosion, damage, and wear. Use new cotter pins when reassembling the linkage.

e. Reassembly.
(1) Install the jam nuts (4) on the gear shifting rod (5).
(2) Install the yokes (2) on the gear shifting rod (5).
(3) Do not tighten the jam nuts (4), as the length of the rod must be adjusted during installation.

f. Installation.
(1) Connect the yoke (2) with the gear shaft arm (1) and install the pin (3) and cotter pin (7). Secure the cotter pin (7).
(2) Lift up the gear shifting rod (5) and see that it reaches the gear shifting arm (6). The length of the rod (5) can be adjusted by turning the yoke (2) clockwise or counterclockwise.
(3) Connect the yoke (2) with the gear shifting arm (6) and install the pin (3) and cotter pin (7). Secure the cotter pin (7).

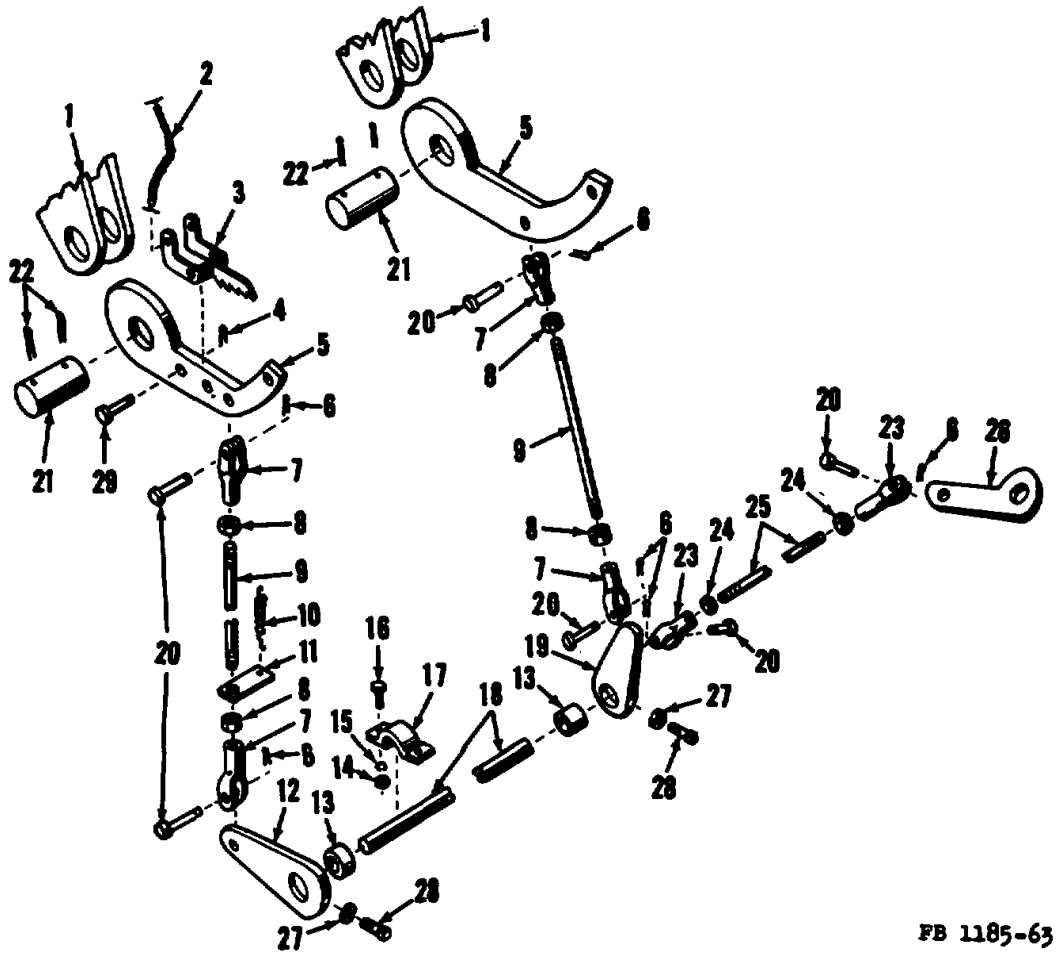
Section XIV. BRAKING SYSTEM

146. Description (fig. 63)

The road roller brake is of the internal expanding type and is located within the second countershaft. The brake is operated by dual brake pedals (5), located on the right and left side of the driver's platform. The brake is used for parking and for braking the road roller when operating on steep grades. A brake ratchet (3) locks the brake in applied position. The brake pedals (5) are connected with the brake control shaft (18) and brake adjusting rod (25). The adjusting rod (25) is connected with the brake arm (26), which operates the brake.

147. Brake Adjustment (fig. 63)

a. General. The brake is adjusted by shortening or lengthening the brake adjusting rod (25). If the brake is too tight, the adjusting rod



1 Brake pedal bracket
2 Ratchet chain sash, 18 in. long (1 req'd)
3 Brake ratchet
4 Cotter pin, 1/16 x 3/4
5 Brake pedal
6 Pin, cotter, 3/16 x 1 (6 req'd)
7 Yoke
8 Nuts, Jam, hex, 3/4-10 NC (4 req'd)
9 Brake rod
10 Return spring
11 Spring clip
12 Right brake arm
13 Brake shaft bearing
14 Nuts, hex, ½-13 NC (4 req'd)
15 Washers, lock, std, ½ (4 req'd)
16 Bolts, hex head, ½-13 NC x 2 ¼ (4 req'd)
17 Brake shaft bracket
18 Brake control shaft
19 Left brake arm
20 Pins, headed, (6 req'd)
21 Swivel pin
22 Pins, cotter, 3/16 x 1 ½ (4 req'd)
28 Adjusting rod yoke
24 Nuts, jam, hex, 1/2-13 NC (2 req'd)
25 Adjusting rod
26 Brake arm
27 Nuts, Jam, hex, 3/8-16 NC (2 req'd)
28 Screws, set, sq head, cup point, 3/8-16 NC x 3/4 (2 req'd)
29 Brake ratchet pin

Figure 63. Brake linkage disassembled.

(25) must be shortened. If the brake is too loose, the rod must be lengthened.

b. Adjustment.

(1) Remove the cotter pin (6) and pin (20) connecting the adjusting rod (25) with the brake arm (26).
(2) Disconnect the adjusting rod yoke (23) from the brake arm (26).
(3) Loosen the jam nut (24) on the adjusting rod (25).

(4) Turn the adjusting rod yoke (23) clockwise to shorten the rod (25) and counterclockwise to lengthen it.
(5) Tighten the jam nut (24) after the proper rod length is obtained.
(6) Connect the adjusting rod yoke (23) with the brake arm (26).
(7) Install the pin (20) and cotter pin (6).
(8) Check the brake for proper operation.

148. Brake Linkage (fig. 63)

a. Removal.
(1) Remove the cotter pin (6) and pin (20) connecting the right rod yoke (7) with the right brake pedal (5).
(2) Disconnect the right rod yoke (7) from the right brake pedal (5).
(3) Remove the cotter pin (6) and pin (20) connecting the right rod yoke (7) with the right brake shaft arm (12).
(4) Disconnect the return spring (10) from the hook on the driver's platform.
(5) Disconnect the right rod yoke (7) from the right brake shaft arm (12) and remove the right brake rod (9).
(6) Remove the left rod (9) in the same manner as the right rod.
(7) Remove the cotter pin (6) and pin (20) connecting the adjusting rod yoke (23) with the left brake shaft arm (19).
(8) Disconnect the adjusting rod yoke (23) from the left brake shaft arm (19).
(9) Remove the cotter pin (6) and pin (20) connecting the adjusting rod yoke (23) with the brake arm (26) and remove the adjusting rod (25).
(10) Remove the bolts (16), nuts (14), and lockwashers (15) attaching the brake shaft brackets (17) to the roller floor. Remove the brackets (17).
(11) Remove the brake control shaft assembly (18).

b. Disassembly.
(1) Brake control shaft.
(a) Loosen the jam nuts (27) and unscrew the setscrews (28) attaching the brake shaft arms (12 and 19) to the brake shaft (18).
(b) Remove the left (12) and right (19) brake shaft arm.
(c) Remove the brake shaft bearings (13).
(2) Left brake rod.
(a) Loosen the jam nuts (8) on the left brake rod (9) and unscrew the rod yokes (7) from the rod.
(b) Unscrew the jam nuts (8) from the left brake rod (9).

(3) *Right brake rod.*
(*a*) Ioosen the jam nuts (8) on the right brake rod (9) and unscrew the rod yokes (7) from the rod.
(*b*) Unscrew the jam nuts (8) from the right brake rod (9).
(*c*) Remove the spring clip (11) from the right brake rod (9).
(*d*) Disconnect the return spring (10) from the spring clip (11).

(4) *Adjusting rod.* The adjusting rod is disassembled in the same manner as the left brake rod.

(5) *Brake pedals.*
(*a*) Disconnect the chain (2) from the brake ratchet (3) and remove the chain.
(*b*) Remove the cotter pin (4) and pin (29) connecting the brake ratchet (3) with the right brake pedal (5).
(*c*) Remove the brake ratchet (3).
(*d*) Remove the cotter pins (22) and pins (21) connecting the brake pedals (5) with the brake pedal brackets (1).
(*e*) Remove the brake pedals (5). The brake pedal brackets (1) are welded to the bottom part of the driver's platform and cannot be removed.

c. Inspection. Inspect all pins for excessive wear, cracks, damage, and pitting. Discard all used cotter pins. Always use new cotter pins when reassembling the linkage. Inspect rods, yokes, jam nuts, bolts, and screws for corroded, damaged or stripped threads. Check the brake control shaft bearings for excessive wear and pitting.

d. Cleaning. Wash all parts in cleaning solvent and wipe them dry with a soft absorbent cloth. Clean the rod threads with a stiff wire brush.

e. Reassembly.
(1) *Brake pedals.*
(*a*) Install the brake pedals (5) in their mounting brackets (1).
(*b*) Install the pins (21) and cotter pins (22).
(*c*) Secure the cotter pins (22).
(*d*) Install the brake ratchet (3) on the right brake pedal (5).
(*e*) Install the brake ratchet pin (29) and cotter pin (4).
(*f*) Connect the chain (2) with the brake ratchet (3).
(*g*) Secure the chain (2) by spreading the chain ends apart.

(2) *Brake control shaft.*
(*a*) Install bearings (13) on the brake control shaft (18).
(*b*) Install the right (12) and left (19) brake control shaft arms.
(*c*) Install and tighten the jam nuts (27) and setscrews (28).
(*d*) Tighten the jam nuts (27).

(3) *Right brake rod.*
(*a*) Install the spring clip (11) on the right brake rod (9).

(*b*) Install the jam nuts (8) on both ends of the right brake rod (9).
(*c*) Install yokes (7) on tile brake rod (9). Do not tighten the jam nuts (8), as the length of the brake rod must be adjusted during installation.
(*d*) Connect the spring (10) with the spring clip (11).

(4) *Left brake rod.*
(*a*) Install the jam nuts (8) on both ends of the left brake rod (9).
(*b*) Install yokes (7) on the left brake rod (9). Do not tighten the jam nuts (8), as the length of the brake rod must be adjusted during installation.

(5) *Adjusting rod.* The adjusting rod is reassembled in the same manner as the left brake rod.

f. Installation.
(*1*) Position the brake control shaft (18) assembly in its proper place on the floor and install the brake shaft brackets (17).
(*2*) Install bolts (16), lockwashers (15), and nuts (14). Tighten the bolts securely.
(*3*) Connect the right rod yoke (7) with the right brake pedal (5).
(*4*) Install the right rod yoke pin (20) and cotter pin (6). Secure the cotter pin (6).
(*5*) Turn the lower right rod yoke (7) clockwise or counter- clockwise and adjust the rod (9) to proper length. The adjustment is correct when there is no appreciable play in the linkage.
(*6*) Connect the lower right rod yoke (7) with the right brake shaft arm (12) and install the pin (20) and cotter pin (6).
(*7*) Tighten the jam nut (8) and connect the spring (10) with the hook on the bottom part of the driver's platform.
(*8*) Connect the upper left rod yoke (7) with the left brake pedal (5) and install the pin (20) and cotter pin (6).
(*9*) Turn the lower left rod yoke (7) clockwise or counterclockwise and adjust the left rod (9) to proper length. The adjustment is correct when there is no appreciable play in the linkage.
(*10*) Connect the lower left rod yoke (7) with left brake shaft arm (19) and install pin (20) and cotter pin (6).
(*11*) Tighten the jam nut (8).
(*12*) Connect the adjusting rod (25) with the brake shaft left arm (19) and brake arm (26) in the same manner as the left brake rod.
(*13*) Adjust brake (par. 147).
(*14*) Start the engine and check brake and brake linkage for proper operation.

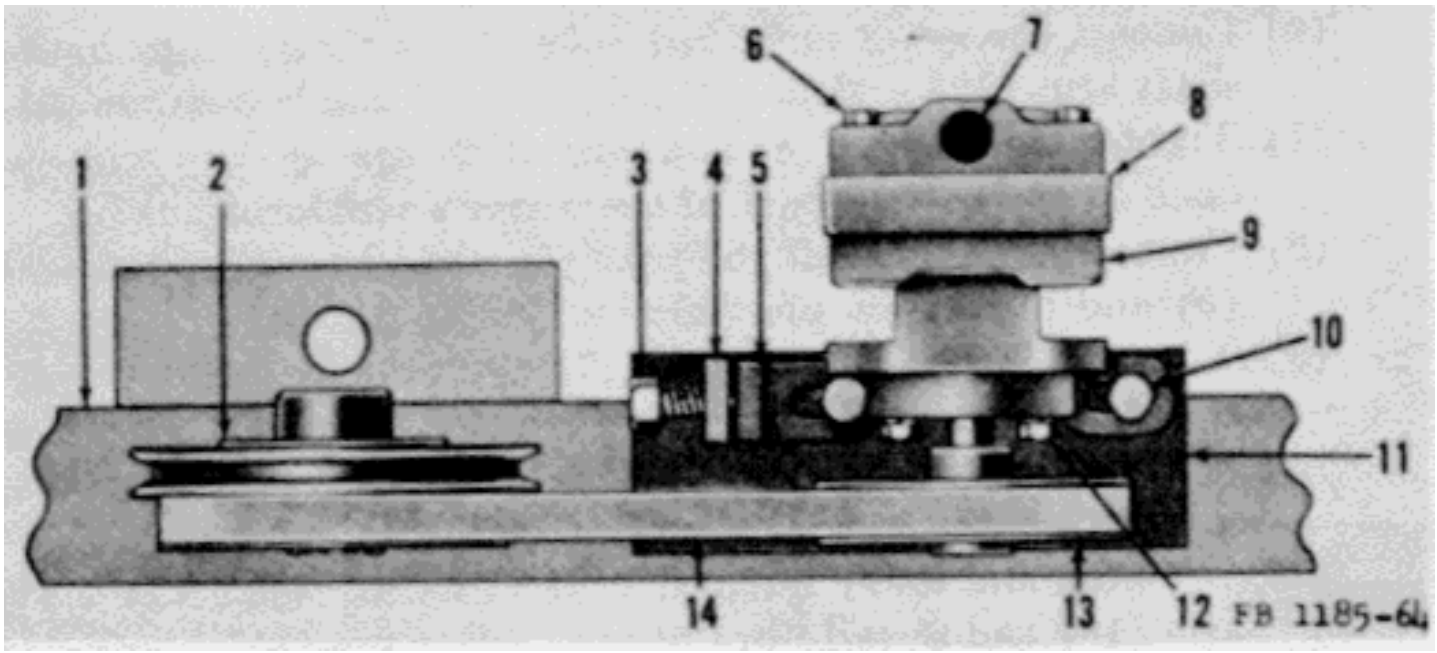
Section XV. HYDRAULIC SYSTEM

149. Description

The steering roll of the road roller is hydraulically operated. Hydraulic oil is stored in the hydraulic tank attached to the right side of the roller frame. A hydraulic pump is mounted on the cross-member of the roller frame, on the left side of the engine. The pump is driven by a V-belt from the crankshaft pulley. The hydraulic pump pressure is regulated by the regulator valve, which reduces the pressure to zero when the valve is closed. When the operating valve is opened, the pump immediately pumps the required pressure to the hydraulic cylinder. The hydraulic steering cylinder is connected with the king pin on the steering roll yoke and operates the movement of the steering roll to the right or left.

150. Hydraulic Pump (fig. 64)

a. General. The hydraulic pump (9) is of vane type and delivers a given amount of oil per minute to the hydraulic system as demanded by any working pressure up to 1,000 pound per square inch. The pump is mounted on the adjusting base (11) and attached to the cross-member (1) of the roller frame. The belt (14) connects the hydraulic pump pulley (13) with the crankshaft pulley (2) and drives the pump. The pump does not require any lubrication and there are no adjustments required on the pump. The belt tension is adjusted by means of the adjusting screw (3).



1 Frame cross-member
2 Crankshaft pulley
3 Adjusting screw
4 Adjusting screw bracket
5 Mounting bracket
6 Cover screw
7 Pump outlet
8 Pump ring
9 Pump body
10 Mounting screw
11 Adjusting base
12 Mounting bracket screw
13 Pump pulley
14 Belt

Figure 64. Hydraulic pump drive.

b. Removal.

(1) Drain the hydraulic system (par. 154).
(2) Disconnect the hydraulic lines from the inlet and outlet(7) ports of the pump. There will be some hydraulic oil left in the lines. Keep a container ready to catch the oil bled from the lines.
(3) Turn the adjusting screw (3) counterclockwise and remove it from the adjusting screw bracket (4).
(4) Loosen the mounting screws (10).
(5) Push the hydraulic pump (9) toward the crankshaft pulley (2) in order to loosen the belt (14).
(6) Remove the belt (14).
(7) Remove the mounting screws (10) and lockwashers.
(8) Lift up and remove the hydraulic pump (9).
(9) Hold the pump over the hydraulic oil container and drain the hydraulic oil from the pump body.

c. Inspection. Inspect the hydraulic pump for leaks, corroded connections, cracks, and breaks. Inspect the belt for corroded, swollen, damaged, or oil soaked rubber. Replace the belt if cut, peeling, or heavily oil soaked. Check all mounting screws and adjusting screws for corroded, damaged, or stripped threads.

d. Cleaning. Clean the hydraulic pump with a cloth dipped in cleaning solvent. Cover the inlet and outlet ports with a clean cloth to prevent the entrance of dirt, dust, and grit. Wash all screws and lockwashers in cleaning solvent and clean the threads with a stiff wire brush. Replace the screws if the threads are corroded, worn, or stripped.

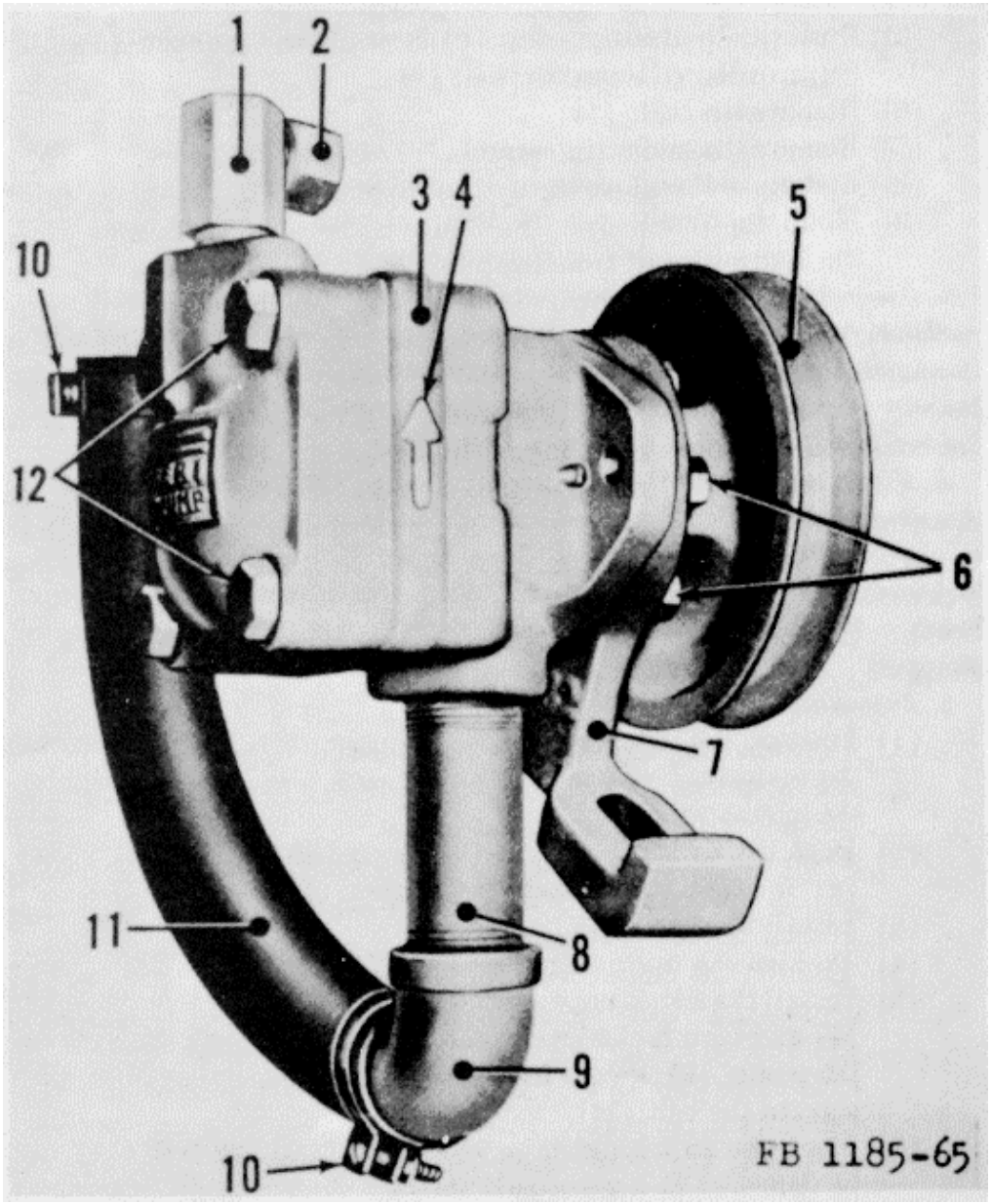
e. Installation.

(1) Position the pump (9) on the adjusting base (11) and install the mounting lockwashers and screws (10). Do not tighten the mounting screws.
(2) Push the hydraulic pump (9) toward the crankshaft pulley (2) in order to facilitate installation of the belt (14).
(3) Install the belt (14).
(4) Tighten the mounting screws (10) fingertight.
(5) Install the adjusting screw (3) in the adjusting screw bracket (4) and turn it clockwise. This action will push the hydraulic pump (9) away from the crankshaft pulley and thus tighten the belt (14).
(6) Turn the adjusting screw clockwise until the belt (14) can be deflected about one-half inch by thumb pressure midway between the crankshaft (2) and hydraulic pump pulleys (13).
(7) Tighten the mounting screws (10) securely.
(8) Connect the hydraulic lines with the inlet and outlet (7) ports of the pump. Tighten the hydraulic line clamps.
(9) Fill the hydraulic system.

(10) Operate the roller and check the hydraulic pump for leaks and proper operation.

151. Hydraulic Pump Packing (fig. 65)

a. General. The pump packing is mounted on the pulley (5) end of the hydraulic pump shaft. It prevents air leakage into the pump and oil leakage out of the pump when the pump is not running.



1 Outlet line fitting
2 Fitting nut
3 Pump body
4 Arrow indicating pump rotation
5 Pump pulley
6 Mounting bracket screws
7 Mounting bracket
8 Inlet pipe
9 Pipe elbow
10 Hose clamp
11 Inlet hose
12 Cover screws

Figure 65. Hydraulic pump.

b. Removal.

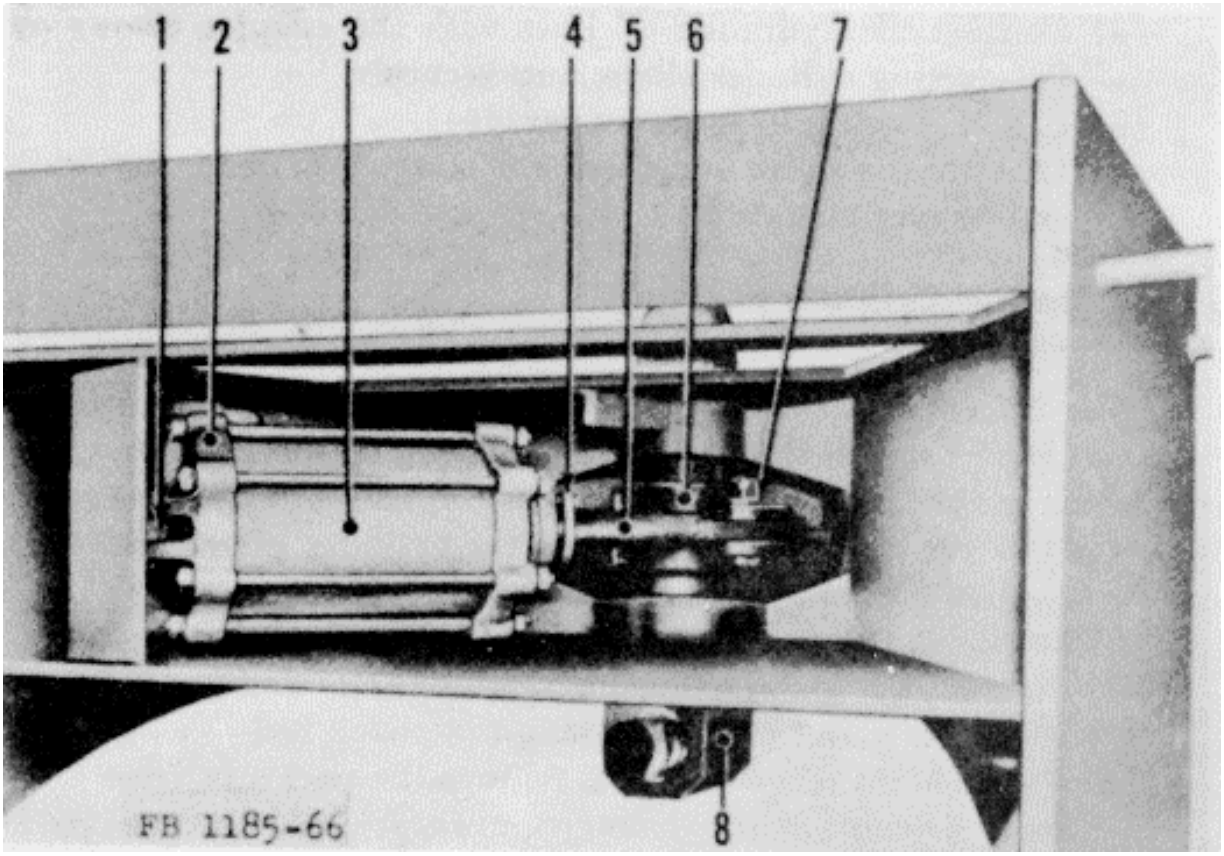
(1) Remove the hydraulic pump (par. 150b).
(2) Remove the pump pulley (5).
(3) Remove the mounting bracket screws (6) and remove the mounting bracket (7).
(4) Remove the bearing retaining ring, bearing, steel packing gland, and cork packing.

c. Installation.

(1) Install the cork packing and packing gland.
(2) Install the shaft bearing. Make sure that the outside diameter of the gland bears on the outer ball bearing race and the inside diameter against the cork packing.
(3) Install the mounting bracket (7).
(4) Install and tighten the mounting bracket screws (6).
(5) Install the pump pulley (5).
(6) Install the hydraulic pump (par. 150e).

152. Hydraulic Steering Cylinder

a. General. The hydraulic steering cylinder (3, fig. 66) is mounted under the steering roll top cover and can be reached for inspection and removal through the top cover holes. Hydraulic oil is forced under pressure from the hydraulic oil pump to the hydraulic cylinder (3)



1 Mounting bracket
2 Cylinder swivel head
3 Cylinder
4 Gland
5 Piston rod
6 Steering arm
7 Piston rod pin
8 King pin

Figure 66. Hydraulic steering cylinder mounting.

and activates the piston rod (5). The piston rod (5) is connected with the steering arm (6) which moves the steering roll to the left or to the right.

b. Removal.

(1) Drain the hydraulic system (par. 154b).
(2) Disconnect the hydraulic lines from the cylinder (3).
(3) Remove the cotter pin and drive out the pin connecting the cylinder swivel head (2) with the mounting bracket (1).
(4) Remove the cotter pin and drive out the piston rod pin (7) connecting the piston rod (5) with the steering arm (6).
(5) Remove the hydraulic steering cylinder (3).

c. Inspection. Inspect the hydraulic steering cylinder for loose stud nuts, corrosion, dents, and cracks. Inspect the cylinder gland for leaks. Check the piston rod and piston pins for corrosion, pitting, and excessive wear. Discard used cotter pins. Always use new cotter pins when reassembling and installing the steering cylinder.

d. Installation.

(1) Install the steering cylinder in its proper mounting place and connect the cylinder swivel head (2) with the mounting bracket (1). Install the pin and secure it with the cotter pin.
(2) Connect the piston rod (5) with the steering arm (6).
(3) Install the piston rod pin (7) and secure it with the cotter pin.
(4) Connect the hydraulic oil lines with the adapter elbows on the steering cylinder elbow nuts securely.
(5) Fill the hydraulic system (par. 154).
(6) Operate the roller and check the steering cylinder for leaks and proper operation.

153. Steering Cylinder Packing (fig. 67)

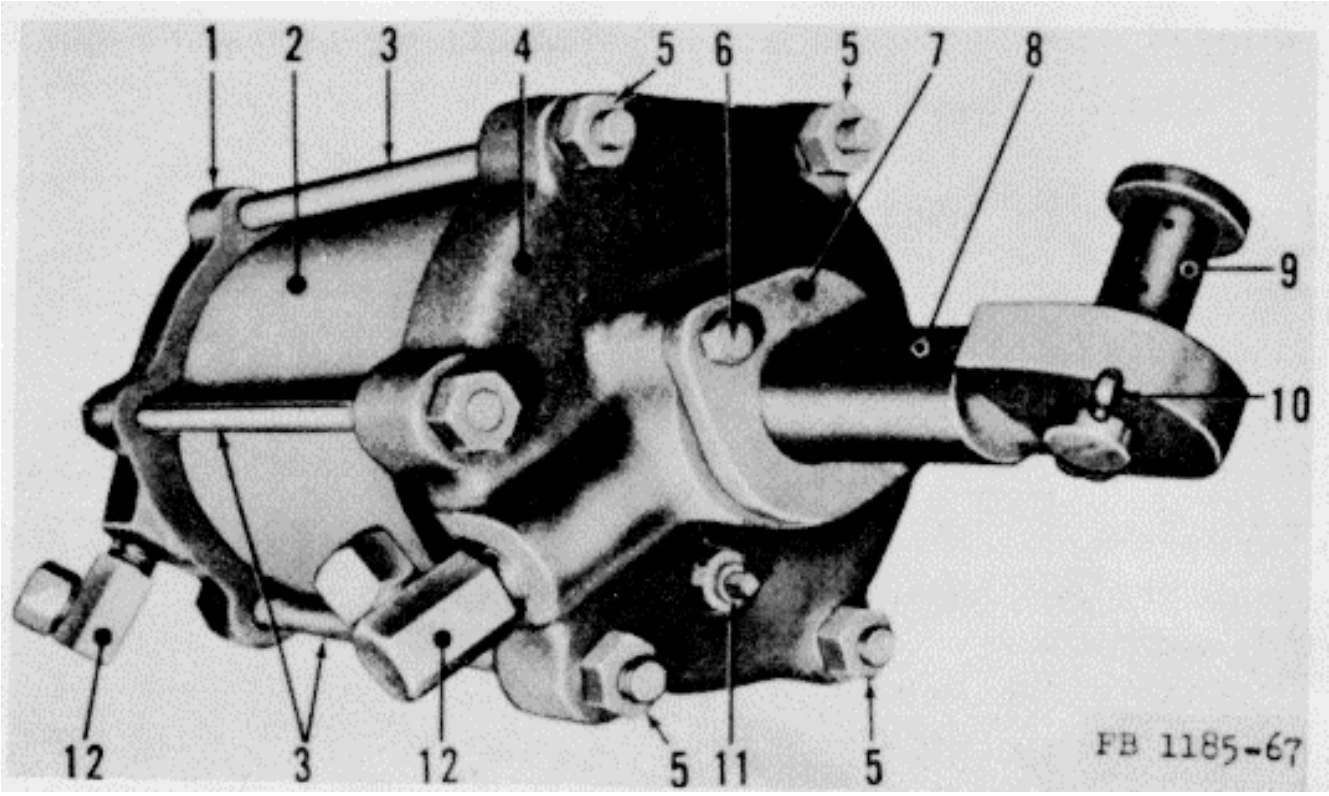
a. General. The steering cylinder packing is of the split-collar type and can be installed on the piston rod (8) without removing the rod from the steering cylinder (2). Packing is retained in its place by the gland (7) which is attached to the cylinder gland seat head (4) by two gland screws (6).

b. Removal.

(1) Remove the gland mounting screws (6).
(2) Push the gland (7) back along the piston rod (8).
(3) Use a blunt screwdriver to remove the packings from their seat. Discard gritty, damaged, worn, frayed, or ragged packings.

c. Installation.

(1) Place the packing around the piston rod (8). Place each section separately.



1	Cylinder swivel head	7	Gland
2	Cylinder	8	Piston rod
8	Cylinder stud	9	Piston rod pin
4	Cylinder gland seat head	10	Cotter pin
5	Stud nut	11	Pipe plug
6	Gland mounting screw	12	Adapter elbow

Figure 67. Hydraulic steering cylinder.

(2) Make sure that the hollow of the V is toward the cylinder gland seat head (4).
(3) Push the packing along the piston rod (8) until all sections are properly seated.
(4) Attach the gland (7) to the cylinder gland seat head (4) and install the mounting screws (6).
(5) Tighten the screws snugly but not too tight.
(6) Operate the road roller and check the gland (7) for leaks.

154. Hydraulic Oil Tank (fig. 68)

a. General. The hydraulic oil tank (3) stores the oil used for operating the hydraulic system. The tank is mounted on four studs welded to the road roller frame, at the left side of the engine. The drain plug (7) is located on the bottom of the tank (3) and is used to drain the hydraulic tank and system. A rubber hose (6) on the bottom of the tank connects the tank (3) with the hydraulic oil pump. There are two hoses (2 and 9) on the top of the tank. The filler hose (9) is used for refilling and the tank to valve hose (2) connects the tank with the operating valve. A pet cock (8) mounted on the side of the tank is used to check the hydraulic oil level in the tank (3). b. Draining. Place a clean container under the tank (3) and remove the pipe plug (7) on the bottom of the tank. Disconnect the

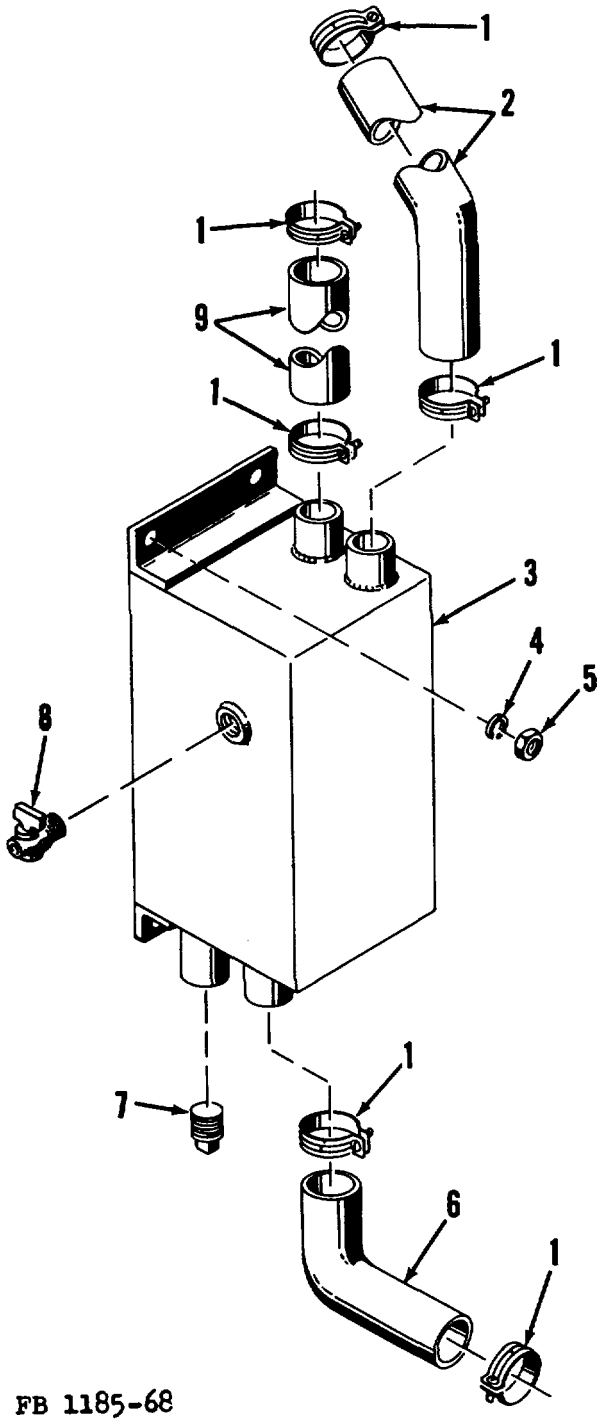


Figure 68. Hydraulic oil tank disassembled.

hose (6) connecting the tank with the hydraulic oil pump and drain the oil from the pump and hose.

c. Filling. Connect the bottom hose (6) with the tank (3) and tighten the pipe plug (7) on the bottom of the tank. Fill the hydraulic oil tank (3) through the filler hose (9) on the top of the steering roll cover. Tank will be full when the hydraulic oil starts to run from the pet cock (8). Tighten all hose clamps (1) and check the tank for leaks.

d. Removal.

(1) Drain the hydraulic system (b above).
(2) Loosen the hose clamp (1) and disconnect the filler hose (9) from the hydraulic oil tank (3).
(3) Loosen the hose clamp (1) and disconnect the tank to valve hose (2) from the hydraulic oil tank (3).
(4) Unscrew and remove the mounting nuts (5) and lockwashers (4).
(5) Pull the hydraulic oil tank (3) away from its mounting studs and remove the tank.
(6) Unscrew and remove the pet cock (8) from the hydraulic oil tank (3).

e. Cleaning. Wash the hydraulic oil tank in cleaning solvent and blow it dry with clean compressed air. Clean the mounting nuts and lockwashers with a stiff wire brush and cleaning solvent. Wipe off the rubber hoses with soft absorbent cloth.

f. Inspection.

(1) Inspect the hydraulic oil tank for breaks, cracks, splitting welds, and damage. Weld small cracks and breaks. Replace the hydraulic oil tank if it is badly dented or corroded.
(2) Inspect the rubber hoses for swollen, peeling, and cut rubber. Hold the hoses against the light and inspect the inside of the hoses for deteriorated and swollen or cut rubber. Replace all damaged or worn rubber hoses.
(3) Check the hose clamps for twisting, breaks, cracks, corrosion, and damaged clamp screws and nuts. Replace damaged, corroded, or worn clamps.
(4) Check the pet cock and drain plug for damaged, corroded, stripped, or galled thread. Replace leaking pet cock. Replace the drain plug if the threads are corroded or damaged.

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1 Hose clamp
2 Hose, tank to valve (1 1/4 ID x 19)
3 Oil tank body
4 Washer, lock, std, 5/16 (4 req'd)
5 Nut, hex, 5/16-18NC (4 req'd)
6 Hose, tank to pump (1 1/4 ID x 15 1/2)
7 Plug, pipe, std, 3/4
8 Pet cock, std, 1/8
9 Filler hose (1 ¼ ID x 21 1/2)

Figure 68-Continued.

g. Installation.

(1) Install tile petcock (8) on the hydraulic oil tank body (3). Tighten the petcock securely.
(2) Position the hydraulic oil tank (3) on its mounting studs and install the mounting lockwashers (4) and nuts (5). Tighten tile nuts securely.
(3) Install the drain plug (7) on the bottom of the hydraulic oil tank body (3). Tighten the drain plug securely.
(4) Connect the filler hose (9) with the hydraulic oil tank (3) and tighten the hose clamp (1).
(5) Connect the tank to valve hose (2) with the hydraulic oil tank (3) and tighten the hose clamp (1).
(6) Connect the tank to pump hose (6) with the hydraulic oil tank (3) and tighten the hose clamp.
(7) Check to see that all hose connections are tight and secure.
(8) Fill the hydraulic system (c above) and check the oil tank and hose connections for leaks.

155. Hydraulic Operating Valve

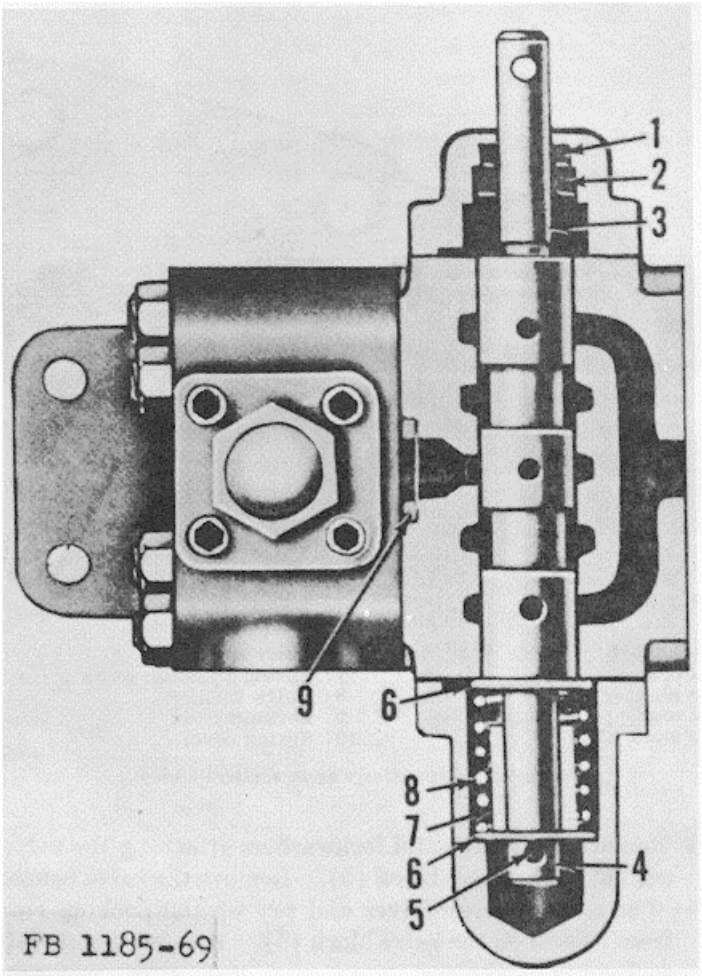
a. General. The hydraulic operating valve consists of the operating valve (fig. 69) and the regulator valve (fig. 70). The operating valve (fig. 69) controls the flow of hydraulic oil to the steering cylinder for the right or left turn of the steering roll. The regulator valve (fig. 70) reduces the pressure to a free-flowing circulation of hydraulic oil when the valve is closed. It is also used to adjust the working pressure of the operating valve.

b. Regulator Valve Adjustment (fig. 70).

(1) Turn the spring cover (10) counterclockwise and unscrew it from the spring adjusting screw (7).
(2) Loosen the locknut (9).
(3) Turn the spring adjusting screw (7) clockwise to increase pressure.
(4) Turn the spring adjusting screw (7) counterclockwise to decrease pressure.
(5) The operating valve must be adjusted for a positive steering action. Excessive pressure will make the steering action jerky.
(6) The recommended hydraulic system working pressure is from 300 to 350 pounds per square inch.
(7) After the proper adjustment is reached, tighten the locknut (9) securely.

c. Operating Valve Removal and Disassembly.

(1) Drain the hydraulic system (par. 154b).
(2) Disconnect and tag all hydraulic lines leading from the operating valve.



1 Felt washer
2 Oil seal ring
3 Piston
4 Piston extension
5 Spring retainer pin
6 Piston spring control washer
7 Piston stop block
8 Piston centering spring
9 Block oil seal

Figure 69. Operating valve, sectional view.

(3) Remove the four mounting nuts, lockwashers, and spacers from the mounting studs.

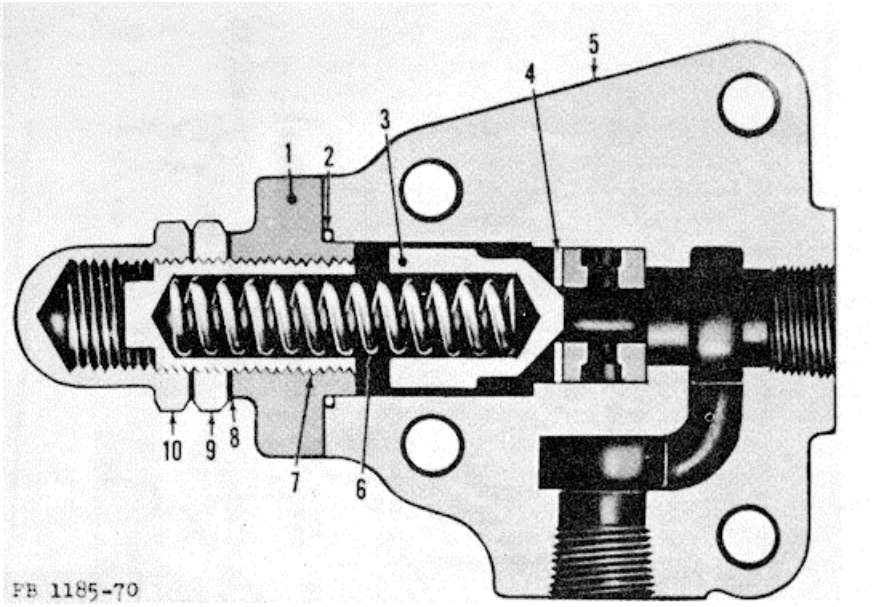
(4) Remove the operating valve.

(5) Use an open-end wrench and unscrew the regulator valve spring cover (10, fig. 70).

(6) Unscrew and remove the locknut (9).

(7) Turn the spring adjusting screw (7) counterclockwise and remove it from the valve bonnet (1).

(8) Pull out and remove the valve spring (6).



1	Valve bonnet	6	Valve spring
2	Packing ring g	7	Spring adjusting screw
3	Valve plunger	8	Valve washer
4	Valve seat	9	Locknut
5	Valve block	10	Spring cover

Figure 70. Regulator valve, sectional view.

(9) Remove the screws and lockwashers attaching the valve bonnet (1) to the valve block (5). Remove the valve bonnet (1).

(10) Use a blunt screwdriver and pry up the packing ring (2) from its seat on the valve block (5). Remove and discard the packing ring (2).

(11) Lift out and remove the valve plunger (3).

d. Inspection.

(1) Inspect the mounting studs and nuts for corroded, damaged, or stripped threads.

(2) Check all hydraulic lines for damaged, cut, or swollen rubber. Replace damaged or worn hydraulic lines.

(3) Inspect the valve plunger (3) for scoring, pitting, etching, and wear. Replace worn or damaged valve plunger.

(4) Check the valve spring (6) for twisting, corrosion, cracks, and metal fatigue. Replace damaged or worn valve spring.

(5) Inspect the spring cover (10), locknut (9), valve bonnet (1), and spring adjusting screw (7) for damaged, corroded, galled, or stripped threads. Replace all defective parts.

e. Operating Valve Reassembly and Installation.

(1) Use a new packing ring (2) and install it on the valve block. Push the packing ring (2) with fingers until it is seated properly in its mounting groove on the valve block (5). Be careful not to twist or break the packing ring during the installation.

(2) Coat the valve plunger (3) with hydraulic oil and install it in the valve block (5).

(3) Install the valve spring (6) in the valve block (5). Make sure that the valve spring (6) bottoms properly in the valve plunger hole.

(4) Install the valve bonnet (1) on the valve block and see that the mounting holes in the bonnet and valve block (5) are properly alined. Install and tighten the valve bonnet (1) mounting screws and lockwashers.

(5) Position the spring adjusting screw (7) over the valve spring (6) and turn it clockwise to install it into the valve bonnet (1).

(6) Install the locknut (9) on the spring adjusting screw (7).

(7) Install the spring cover (10).

(8) Install the mounting spacers on the operating valve mounting studs.

(9) Install the operating valve and tighten the mounting lockwashers and nuts.

(10) Connect the hydraulic lines with the valve and tighten the connections securely. Remove the tags from the hydraulic lines.

(11) Fill the hydraulic system and adjust the regulator valve (b above). Check the operating valve for leaks and proper operation.

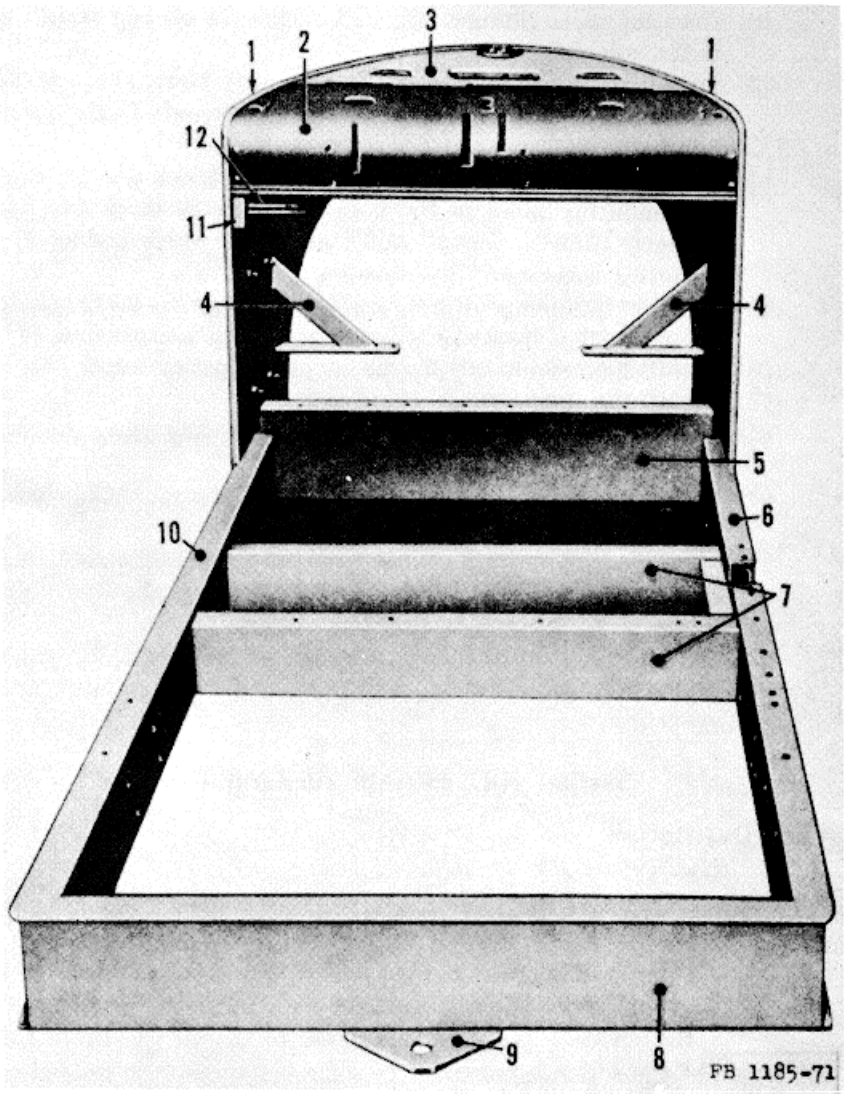
Section XVI. FRAME ASSEMBLY

156. Description

(fig. 71)

The main frame of the road roller is of all-welded construction, made of heavy structural channel (6, 8, and 10) and plate (1) members, secured by cross-members (7). The frame is reinforced by a floor plate welded under the entire engine and transmission compartments. A removable cover plate for access to the oil pan from the underside of the roller is bolted or in some instances tack welded to the bottom cover plate. The side plates (1) are cut to arch over the steering roll yoke, with an upper and lower cross plate welded in place to hold the king pin bearing seats. A towing connecting (9) is welded to the front channel (8) at the compression roll end of the roller. The compression roll housing is of welded construction with a built-in sprinkler tank.

The roller frame has three ventilation and inspection doors. The doors have cross-wired screens and are located on each side of the roller as well as on the front of the compression roll housing. A gear guard is located on the left side of the roller. The operator's platform and the steering roll top cover (3) are bolted to the frame.



1 Steering roll housing
2 Control panel
3 Steering roll cover
4 Housing bracket
5 Rear cross-channel
6 Left side channel
7 Cross-channels
8 Front channel
9 Towing bracket
10 Right side channel
11 Hydraulic valve bracket
12 Hydraulic valve stud

Figure 71. Road roller frame.

A dust shield, used to prevent damage to the radiator and the engine compartment, consists of a solid steel plate which completely covers the underside portion of the frame where it arches over the steering roll. Air for the radiator, fan, and engine is drawn in through the large openings in the top cover (3) of the steering roll.

157. Braces and Brackets

a. Removal.

(1) If braces or brackets become loose, damaged, broken, or cracked, they must be removed and repaired.

(2) Cut off the brace or bracket with a welding torch.

(3) Clean and paint the weld.

(4) Weld the breaks or cracks in the bracket or brace; replace if badly damaged.

b. Installation.

(1) Make sure that the new bracket or brace fits snugly in its proper place.

(2) Secure the bracket or brace in its mounting place with clamps and tack-weld to the frame.

(3) Remove the clamps and weld the bracket or brace to the frame.

(4) Clean and paint the weld and check for proper alinement.

158. Compression Roll Housing
(fig. 72)

a. General. The compression roll housing (23) is of all-welded construction and is attached to the frame by screws (7), lockwashers (6), and plain washers (5). The sprinkler tank is welded to the housing, and the fuel tank is strap mounted to the sprinkler tank.

b. Removal.

(1) Disconnect all linkages and wiring on the bottom part of the compression roll housing assembly. Tag all linkages and wires to facilitate installation; make sure that the tags are attached securely to all linkages and wiring.

(2) Drain the fuel tank and disconnect the file line from the fuel tank.

(3) Drain the sprinkler tank and disconnect the sprinkler hoses. Remove the sprinkler tank caps (1).

(4) Unscrew and remove the long mounting screws (17), lockwashers (16), and plain washers (15) attaching the lifting hooks (21) to the compression roll housing (23) and roller frame.

(5) Unscrew and remove the short screws (18), lockwashers (19), and plain washers (20) attaching the lifting hooks (21) to the compression roll housing (23) and roller frame.

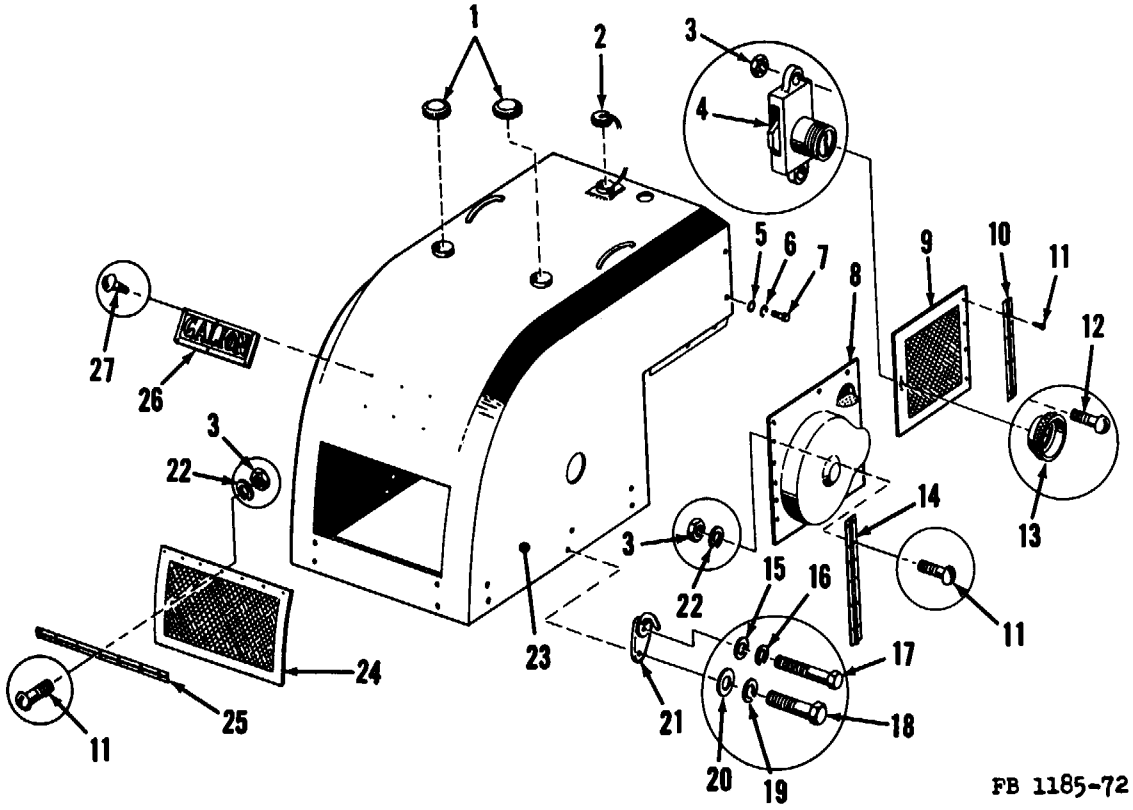


Figure 72. Compression roll housing and doors disassembled.

1 Sprinkler tank cap
2 Fuel tank cap
8 Nuts, hex, No. 10 (40 req'd)
4 Door lock
5 Washers, plain, std, 1/2 (16 req'd)
6 Washers, lock, std, 1/2 (16 req'd)
7 Screws, hex hd, 1/2-13NC x 1 (16 req'd)
8 Gear guard
9 Door
10 Hinge
11 Screws, rd hd, No. 10 x 3/4 (36 req'd)
12 Screws, rd hd, No. 10 x 1/2 (4 req'd)
13 Door lock handle
14 Hinge
15 Washers, plain, std, 3/4 (4 req'd)
16 Washers, lock, std, 3/4 (4 req'd)
17 Screws, hex hd, 3/4-10NC x 21/2 (4 req'd)
18 Screws, hex hd, 5/8-11NC x 2 (4 req'd)
19 Washers, lock, std, 5/8 (4 req'd)
20 Washers, plain, std, 5/8 (4 req'd)
21 Lifting hook
22 Washers, lock. std, No. 10 (36 req'd)
23 Compression roll housing
24 Housing front door
25 Front door hinge
26 Identification plate
27 Screws, drive, No. 6 x 1/4 (6 req'd)

Figure 72—Continued.

(6) Remove the lifting hooks (21).

(7) Unscrew and remove the mounting screws (7), lockwashers (6), and plain washers (5) attaching the compression roll housing (23) to the road roller frame.

(8) Lift up the compression roll housing until it clears the compression roll and remove the housing from the road roller.

c. Disassembly.

(1) Remove the six drive screws (27) attaching the identification plate (26) to the compression roll housing (23).

(2) Remove the identification plate (26).

(3) Remove the screws (11), lockwashers (22), and nuts (3) attaching the front door (24) to the compression roll housing (23).

(4) Lift up and remove the front door (24).

(5) Remove the screws (11), lockwashers (22), and nuts (3) attaching the hinge (25) to the front door (24).

(6) Remove the hinge (25) from the front door.

(7) Remove the screws (11), lockwashers (22), and nuts (3) attaching the doors (9) to the compression roll housing (23).

(8) Remove the doors (9).

(9) Remove the door hinges (10) from the doors (9).

(10) Turn the door lock handle (13) counterclockwise and remove it from the door (9).

(11) Remove the mounting screws (12) and nuts (3) attaching the door locks (4) to the doors (9).

(12) Remove the door locks (4).

(13) Remove the mounting screws (7), lockwashers (6), and plain washers (5) attaching the gear guard (8) to the compression roll housing (23).

(14) Remove the gear guard (8).

(15) Remove the screws (11), lockwashers (22), and nuts (3) attaching the hinge (14) to the gear guard (8).

(16) Remove the gear guard hinge (14).

d. Cleaning. Wash all parts in cleaning solvent and blow them dry with clean compressed air. Clean the screw threads with cleaning solvent and stiff wire brush. Remove all dirt, sludge, and foreign matter from the inside surfaces of the compression roll housing. Clean the hinges with a stiff bristle brush and cleaning solvent. Wipe the hinges dry with a soft absorbent cloth and apply a few drops of light engine oil on the hinge shafts.

e. Inspection and Repair.

(1) Inspect the compression roll housing for breaks, cracks, dents, and splitting welds. Pound out small dents with a soft-faced hammer. Weld all minor breaks and cracks. Avoid excessive heat when welding as it may cause the housing panels to warp.

(2) Check the doors for breaks, cracks, and damage. Weld minor breaks and cracks. Replace the doors if badly cracked or warped.

(3) Check the door locks for corrosion, wear, binding, and sticking. Replace defective or worn door locks.

(4) Inspect the door hinges for corrosion, etching, twisting, and wear. Make sure that the hinges are swinging freely on their shafts. Replace damaged or twisted hinges.

(5) Inspect the gear guard for dents, breaks, cracks, and splitting welds. Weld minor cracks and breaks. Avoid excessive heat when welding as it may cause the gear guard to warp. Replace the gear guard if badly broken or warped.

(6) Check all mounting screws for corroded, worn, damaged, stripped, or galled threads. Replace all defective or worn mounting screws and nuts.

(7) Check the lifting hooks for breaks and cracks. Replace broken, cracked, or twisted lifting hooks.

f. Reassembly.

(1) Install the gear-guard hinge (14) on the gear guard (8) and tighten the mounting screws (11), lockwashers (22), and nuts (3).

(2) Install the gear guard (8) on the compression roll housing (23) and tighten the mounting screws (7), lockwashers (6), and plain washers (5).

(3) Position the door locks (4) in the doors (9) and see that the mounting holes are properly alined.

(4) Install and tighten the door lock mounting screws (12) and nuts (3).

(5) Install the door hinges (10) on the doors (9) and tighten the mounting screws (11).

(6) Install the doors (9) and see that the door locks are properly alined with the door lock latches. Install the door lock handles (13) on the door locks (4). Turn the door lock handles (13) clockwise until they are seated securely on their shafts.

(7) Install the front door hinge (25) on the front door (24) and tighten the mounting screws (11), lockwashers (22), and nuts (3).

(8) Position the front door (24) on the compression roll housing (23) and see that the mounting holes in the housing and door are properly alined.

(9) Install and tighten the front door mounting screws (11), lockwashers (22), and nuts (3).

(10) Install the identification plate (26) on the compression roll housing (23) and tighten the six drive screws (27) attaching the identification plate to the housing.

g. Installation.

(1) Lift up the compression roll housing (23) and position it in its proper mounting place. See that the mounting holes in the housing and road roller frame are properly alined.

(2) Install and tighten the compression roll housing mounting screws (7), lockwashers (6), and plain washers (5).

(3) Install the lifting hooks (21) on the housing (23) and see that the mounting holes in the hooks, housing, and roller frame are properly alined.

(4) Install and tighten the long screws (17), lockwashers (16), and plain washers (15).

(5) Install and tighten the short screws (18), lockwashers (19), and plain washers (20).

(6) Install the sprinkler tank caps (1).

(7) Connect the fuel line with the fuel tank.

(8) Connect the sprinkler hose with the sprinkler tank.

(9) Connect all linkages and wiring on the bottom part of the housing. Remove the tags from the linkages and wiring.

159. Operator's Seat Assembly

a. General. The operator's seat can be mounted on the seat posts on the left and right sides of the roller. The seat posts are welded to the top cover of the roller. The seat is secured to the seat posts with a post pin and cotter pin.

b. Removal.

(1) Remove and discard the cotter pin securing the seat post pin.

(2) Remove the seat post pin.

(3) Lift up and remove the seat.

c. Disassembly (fig. 73).

(1) Remove the nut (3) and lockwasher (4) attaching the right hand brace (8) to the back rest cushion (1).

(2) Remove the nut (3) and lockwasher (4) attaching the right-hand brace (8) to the seat cushion (9).

(3) Remove the right-hand brace (8).

(4) Remove the left-hand brace (11) in the same manner as the right-hand brace (8).

(5) Remove the plow bolts (6), lockwashers (4), and nuts (3) attaching the backrest bracket (5) to the backrest brace (7).

(6) Remove the backrest bracket (5) and backrest cushion (1).

(7) Remove the square nuts (3) and lockwashers (4) attaching the seat base (10) to the seat cushion (9).

(8) Remove the seat base (10) and seat cushion (9).

d. Cleaning. Wash all metal parts in cleaning solvent and wipe them off with a soft absorbent cloth. Clean the threads of the mounting studs with a stiff wire brush.

Wipe off the seat cushion covers with a wet cloth. Remove all dust, dirt, and imbedded foreign matter from the seat cushion springs.

e. Inspection. Inspect the cushions for damaged covers and broken springs. Replace the cushions if excessively worn or damaged. Check the mounting bolts and nuts for corroded, damaged, or stripped threads. Replace defective mounting bolts and nuts.

f. Reassembly (fig. 73).

(1) Attach the backrest bracket (5) to the backrest cushion (1).

(2) Install the right (8) and left (11) braces on the backrest cushion (1).

(3) Install the mounting lockwashers (4) and square nuts (3) and tighten them securely.

(4) Attach the backrest cushion (1) to the backrest brace (7) and install the plow bolts (6), lockwashers (4), and nuts (3). Tighten the bolts (6) securely.

(5) Install the seat base (10) on the seat cushion (9).

(6) Attach the right (8) and left (11) braces to the seat cushion (9). The braces must be attached to the center outside studs (2) of the cushion (9).

(7) Install and tighten the lockwashers (4) and square nuts (3).

g. Installation.

(1) Install the seat on the seat post. Aline the mounting holes properly.

(2) Insert the seat post pin.

(3) Install and secure the cotter pin.

160. Steering Roll Housing Dust Shield

a. General. The steering roll housing dust shield protects the radiator and engine from flying stones, dust, and dirt.

b. Removal.

(1) Disconnect the sprinkler hose from the steering roll sprinkler system.

(2) Remove all mounting bolts and lockwashers attaching the dust shield to the frame.

(3) Remove the dust shield. Due to the weight of the shield, two men will be required for the removal operation.

c. Installation.

(1) See that the sprinkler hose is properly inserted through the dust shield.

(2) Position the dust shield and see that the mounting holes are properly alined.

(3) Install and tighten all mounting bolts and lockwashers.

(4) Connect the sprinkler hose with the steering roll sprinkler and tighten the hose clamp securely.

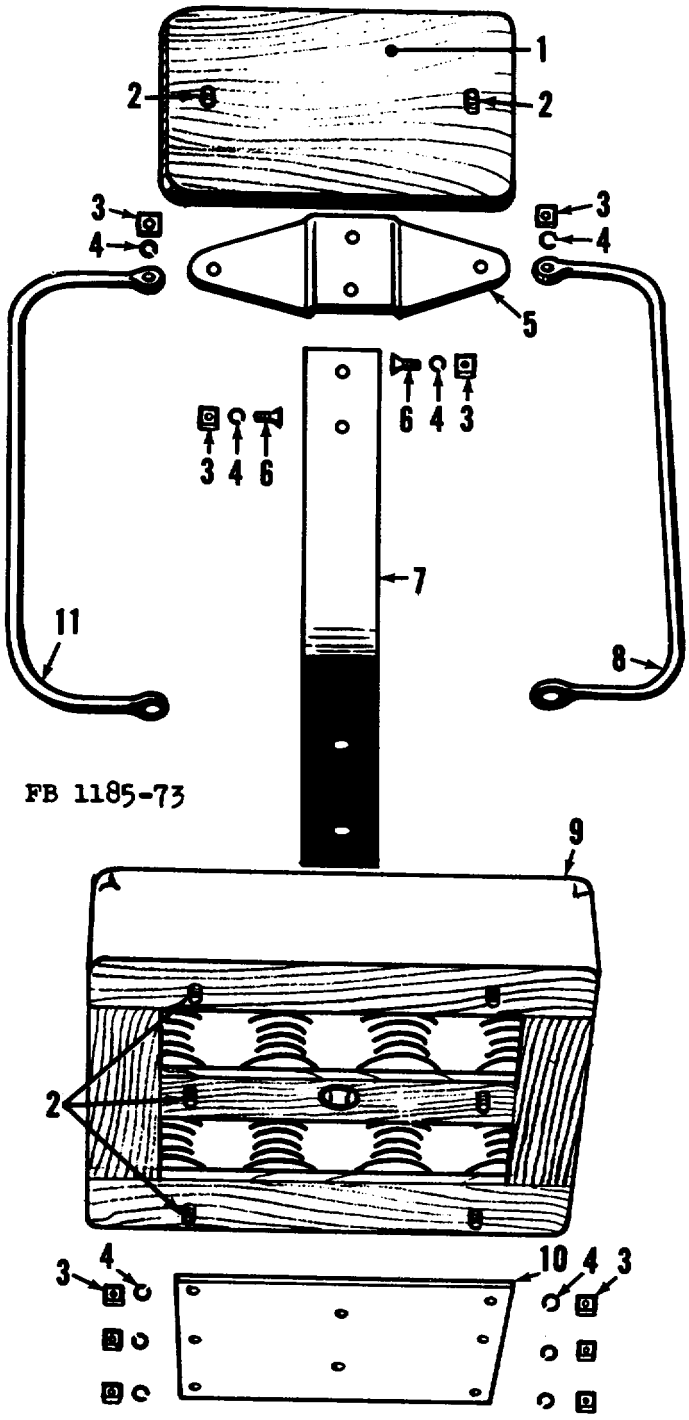


Figure 73. Operator's seat disassembled.

161. Operator's Platform
(fig. 74)

a. Removal.

(1) Remove the bolts, lockwashers, and nuts attaching the brake pedal pads to the brake pedals. Remove the brake pedal pads.

(2) Unscrew the sprinkler tank pedal pads from the pedals.

(3) Disconnect the sprinkler linkage on the bottom part of the operator's platform (5).

(4) Remove the hex head screws (2), lockwashers (3), and nuts (4) attaching the operator's platform (5) to the top cover (1).

(5) Remove the carriage bolts (9), lockwashers (3), and nuts (4) attaching the operator's platform (5) to the platform supports (7).

(6) Lift up and remove the operator's platform (5).

(7) Remove the platform spacers (6).

(8) Remove the carriage bolts (9), lockwashers (3), and nuts (4) attaching the brackets (8) to the supports (7).

(9) Remove the brackets (8) and supports (7).

b. Cleaning. Wash all parts in cleaning solvent and blow them dry with clean compressed air. Clean the mounting screw and bolt threads with cleaning solvent and stiff wire brush. Remove all dirt, sludge, and foreign matter from the top and bottom of the operator's platform.

c. Inspection and Repair.

(1) Inspect the operator's platform for breaks, cracks, elongated mounting holes, and warpage. Weld minor breaks and cracks. Replace the operator's platform if badly warped or broken.

(2) Check the supports and brackets for twisting, breaks, cracks, and warpage. Weld minor breaks and cracks. Replace the supports and brackets if badly cracked or warped.

(3) Inspect all mounting screws, bolts, and nuts for corroded, worn, damaged, stripped, or galled threads. Replace all defective mounting screws, bolts, and nuts.

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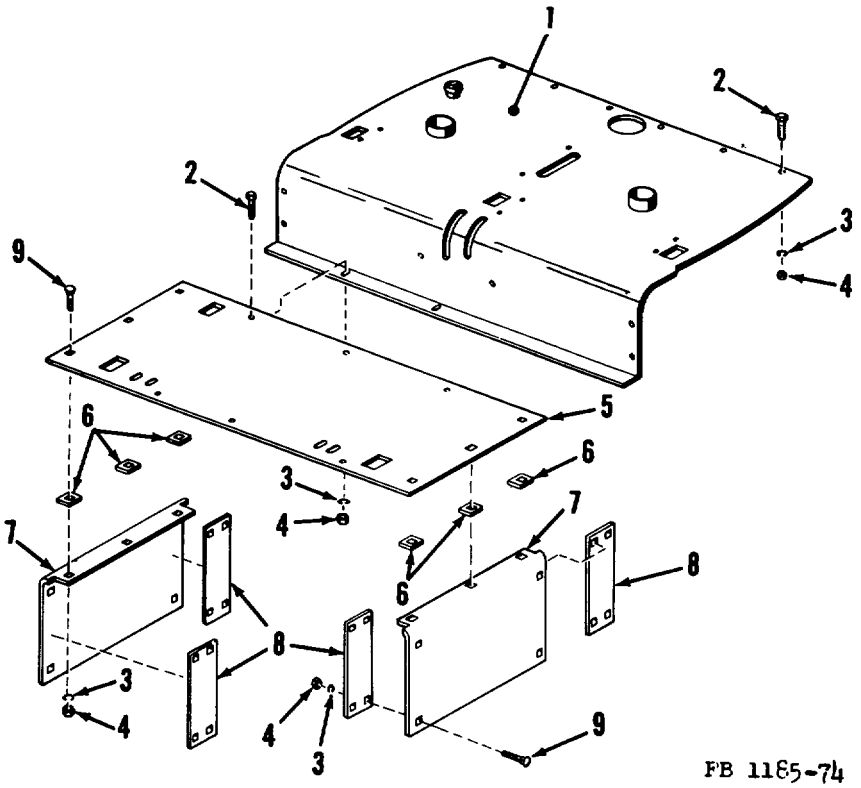
1 Back rest cushion
2 Studs, 3/8-16NC x 1 3/4 (8 req'd)
3 Nuts, square, 3/8-16NC (10 req'd)
4 Washers, lock, std, 3/8 (10 req'd)
5 Back rest bracket
6 Bolts, plow, No. 3 x 1 (2 req'd)
7 Back rest brace
8 Brace, right hand
9 Seat cushion
10 Seat base
11 Brace, left hand

Figure 73—Continued.



1 Top cover
2 Screws, hex hd, 1/2 -13NC x 1 1/4 (22 req'd)
3 Washers, lock, std, 1/2 (34 req'd)
4 Nuts, hex, 1/2-13NC (34 req'd)
5 Operator's platform
6 Spacer
7 Support
8 Bracket
9 Bolts, carriage, 1/2-13NC x 1 1/4 (22 req'd)

Figure 74. Top cover and operator's platform disassembled.

d. Installation.

(1) Install the supports (7) and brackets (8) and tighten the carriage bolts (9), lockwashers (3), and nuts (4).

(2) Position the operator's platform (5) over the supports (7) and top cover (1) and see that all mounting holes are properly alined.

(3) Lift up the operator's platform (5) and insert the spacers (6) between the platform and supports (7). Make sure that the square mounting holes in the spacers, operator's platform, and supports are properly alined.

(4) Install and tighten the carriage bolts (9), lockwashers (3), and nuts (4) attaching the operator's platform (5) to the supports (7).

(5) Install and tighten the hex head screws (2), lockwashers (3), and nuts (4) attaching the operator's platform (5) to the top cover (1).

(6) Connect the sprinkler linkage with the sprinkler shaft arms.

(7) Install the sprinkler pedal pads.

(8) Install the brake pedal pads and tighten the mounting bolts, lockwashers, and nuts.

162. Steering Roll Top Cover
(fig. 74)

a. General. The steering roll top cover (1) is bolted to the frame and operator's platform of the road roller. It is necessary to disconnect all linkages on the bottom part of the top cover assembly before attempting to remove the cover.

b. Removal

(1) Loosen the hose clamp and disconnect the hydraulic oil tank filler hose from the filler pipe (par. 154).

(2) Remove the radiator cap.

(3) Unscrew the mounting nuts on the operating control shafts and remove the shafts.

(4) Remove the seat (par. 159).

(5) Disconnect all linkages on the bottom part of the top cover (1) assembly.

(6) Remove the hex head screws (2), lockwashers (3), and nuts (4) attaching the top cover (1) to the road roller frame and operator's platform (5).

(7) Lift up and remove the top cover (1).

c. Cleaning. Wash the top cover in cleaning solvent and blow it dry with clean compressed air. Remove all dirt and imbedded foreign matter from all welded flanges and brackets. Clean the mounting screws with cleaning solvent and a stiff wire brush.

d. Inspection and Repair.

(1) Inspect the top cover for breaks, cracks, twisting, warpage, and splitting or elongated mounting holes. Weld all cracks and breaks. Replace the top cover if badly warped or cracked.

(2) Check all mounting screws and nuts for worn, corroded, damaged, and stripped threads. Replace all defective mounting screws and nuts.

e. Installation.

(1) Position the top cover (1) in its proper mounting place and see that the mounting holes in the cover, road roller frame, and operator's platform are properly alined.

(2) Install and tighten the top cover mounting screws (2), lockwashers (3), and nuts (4).

(3) Connect all linkages on the bottom part of the top cover (1) assembly.

(4) Install the operating control shafts.

(5) Connect the hydraulic oil tank filler hose with the filler pipe and tighten the hose clamp (par. 154).

(6) Install the radiator cap.

(7) Install the operator's seat (par. 159).

Section XVII. ROAD ROLLER

163. Steering Roll Scrapers

a. General. The spring-actuated steering roll scrapers are mounted on both sides of the steering roll. The scrapers remove dirt, tacky materials, gravel, and other embedded foreign matter from the steering roll face.

b. Removal (fig. 75).

(1) Remove and discard the cotter pin (7) securing the scraper bolt nut (8).

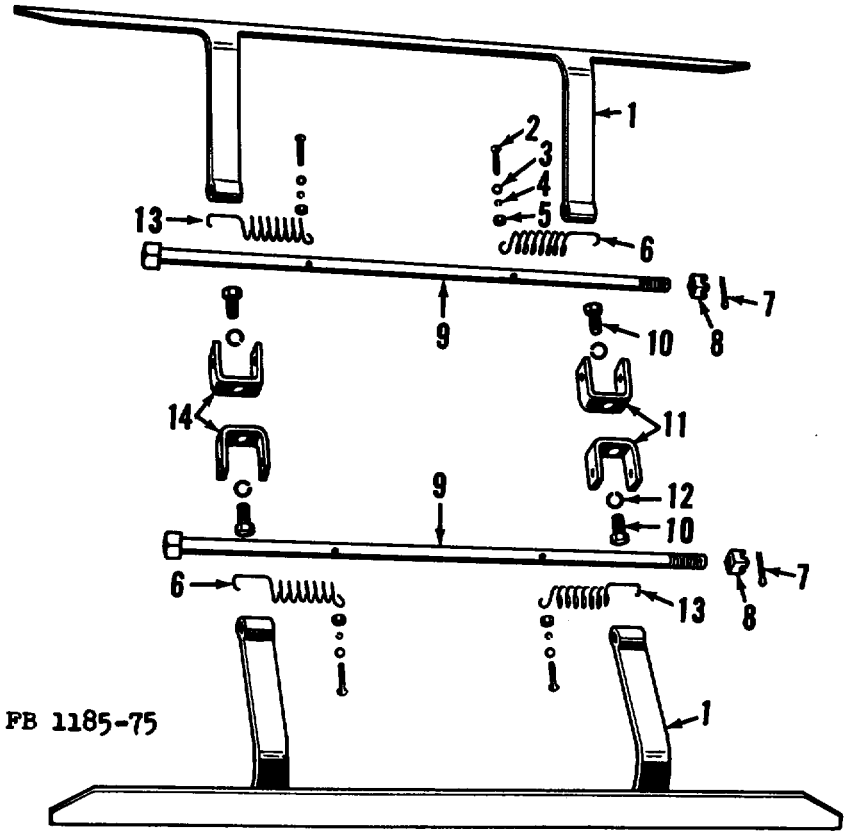


Figure 75. Steering roll scrapers disassembled.

(2) Unscrew and remove the scraper bolt nut (8).

(3) Place a wrench on the scraper bolt (9) head and make sure that the wrench holds the bolt head securely.

(4) Turn the scraper bolt (9) to relieve the tension on the bolt head and at the same time drive the bolt through the bracket (14) until the head clears the bracket stop lug.

(5) Turn the wrench and release the tension on the scraper springs (6 and 13).

(6) Unscrew and remove the bolts (2), lockwashers (4), flatwashers (3), and nuts (5).

(7) Drive out the scraper bolt (9) and remove the scraper (1).

c. Inspection. Inspect the scrapers for wear, cracks, pitting, and damage. Straighten the scrapers if bent or twisted. Check the tension of the scraper springs and replace if necessary. Inspect all bolts, screws, and nuts for corroded, damaged, and stripped threads. Clean the threads with a stiff wire brush and apply a few drops of engine oil before reassembling the scrapers. Always use new cotter pins when reassembling the scraper bolts.

d. Cleaning. Wash all parts in cleaning solvent and wipe them dry with a soft absorbent cloth.

e. Installation (fig. 75).

(1) Install the scraper bolt (9) and springs (6 and 13) on the scraper (1).

(2) Install and tighten the mounting bolts (2), lockwashers (4), flat washers (3), and nuts (5).

(3) Install the scraper bolt nut (8).

f. Spring Tension Adjustment (fig. 75).

(1) Back off the scraper bolt nut (8) about three turns.

(2) Push the scraper bolt (9) until the head clears the stop lug on the bracket (14).

(3) Place a wrench on the scraper bolt (9) head and turn the bolt to increase the tension. Make sure that the wrench will not slip while turning the scraper bolt.

(4) Hold the scraper bolt (9) head with the wrench and drive the bolt into the bracket until the stop lug of the bracket (14) locks the scraper bolt head.

---

1 Steering roll scrapers (2 req'd)
2 Bolts, hex hd, 5/16-18 NC x 2 (4 req'd)
3 Washers, flat, std, 5/16 (4 req'd)
4 Washers, lock, std, 5/16 (4 req'd)
5 Nuts, hex 5/16-18 NC (4 req'd)
6 Scraper springs, left (2 req'd)
7 Pins, cotter, 3/16 x 2 (2 req'd)
8 Nuts, hex, slotted, 1-8 NC (2 req'd)
9 Scraper bolts (2 req'd)
10 Screws, cap, 5/16-18 NC x 2 (4 req'd)
11 Scraper mounting brackets (2 req'd)
12 Washers, lock, std, 5/16 (4 req'd)
13 Scraper springs, right (2 req'd)
14 Mounting brackets with stop lugs (2 req'd)

Figure 75—Continued.

(5) Install and tighten the scraper bolt nut (8).

(6) Install and secure the cotter pin (7).

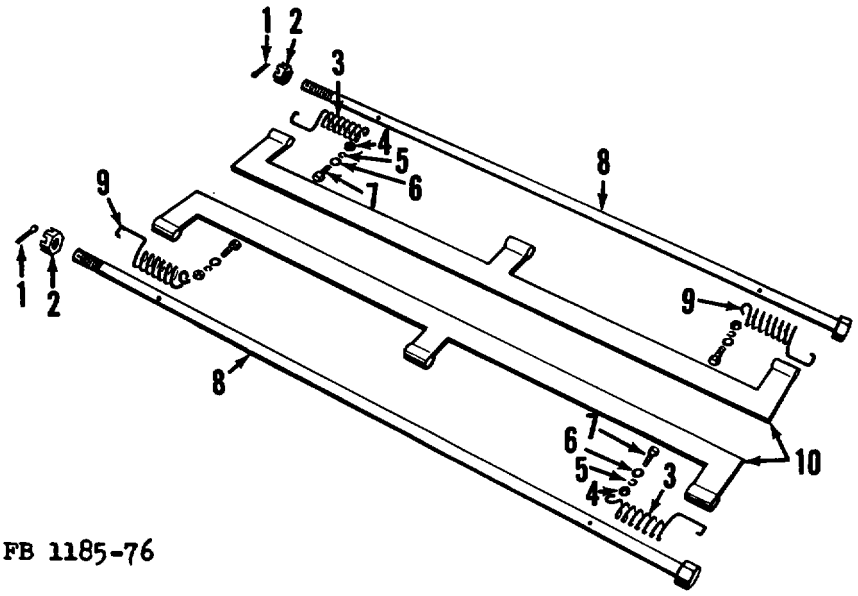
(7) Operate the road roller and check the steering roll scrapers for proper operation.

164. Compression Roll Scrapers

a. General. The spring-actuated compression roll scrapers are mounted on both sides of the compression roll. The scraper bolts extend to the outside of the roller frame, and the spring tension can be adjusted from the outside.

b. Removal (fig. 76).

(1) Remove and discard the cotter pin (1) securing the scraper bolt nut (2).



1 Pins, cotter, 3/16 x 2 (2 req'd)
2 Nuts, hex slotted, 1-8 NC (2 req'd)
3 Scraper springs, right (2 req'd)
4 Nuts, hex, 5/16-18 NC (4 req'd)
5 Washers, lock, std, 5/16 (4 req'd)
6 Washers, fiat, std, 5/16 (4 req'd)
7 Bolts, hex hd, 5/16-18 NC x 2 (4 req'd)
8 Scraper bolts (2 req'd)
9 Scraper springs, left (2 req'd)
10 Compression roll scrapers (2 req'd)

Figure 76. Compression roll scrapers disassembled.

(2) Unscrew and remove the scraper bolt nut (2).

(3) Turn the scraper bolt (8) and release the tension on the springs (3 and 9).

(4) Remove the mounting bolts (7), lockwashers (5), flat washers (6), and nuts (4).

(5) Drive out the scraper bolt (8) and remove the compression roll scrapers (10).

c. Inspection. Refer to paragraph 163c.

d. Cleaning. Refer to paragraph 163d.

e. Spring Tension Adjustment. Tension of the compression roll scraper spring is adjusted in the same manner as the steering roll spring tension. Refer to paragraph 163*f*.

f. Installation (fig. 76).

(1) Install the springs (3 and 9) and scraper bolt (8) on the scraper (10).

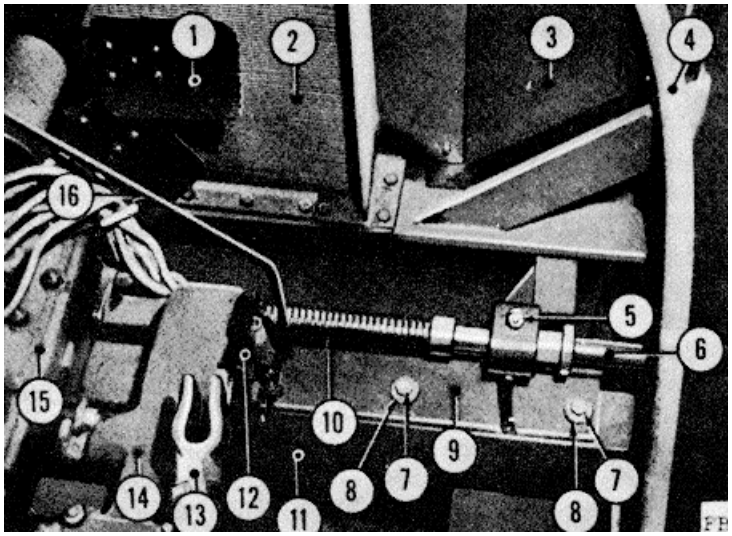
(2) Tighten the mounting bolts (7), flat washers (6), lockwashers (5), and nuts (4).

(3) Install and tighten the scraper bolt nut (2).

(4) Install and secure the cotter pin (1).

165. Engine Cranking Unit
(fig. 77)

a. General. The engine cranking unit is mounted in the front of the engine on the cross-member of the road roller frame. The cranking shaft (6) has a gear meshing with the crankshaft pulley gear and is used to start the engine when the electrical starting system fails to operate. For information on the operating procedure of the cranking shaft and installation of the cranking handle, refer to paragraph 28*i*.



1 Fan
2 Radiator
3 Radiator side panel
4 Sprinkler hose
5 Grease fitting
6 Cranking shaft
7 Mounting screw
8 Washer
9 Mounting bracket
10 Cranking shaft spring
11 Frame
12 Governor
13 Clutch lever
14 Exhaust manifold
15 Cylinder head
16 Governor rod

Figure 77. Engine cranking unit.

b. Removal.

(1) Remove the mounting screws (7), washers (8), and nuts attaching the cranking shaft mounting bracket (9) to the crossmember of the frame (11).

(2) Pull out the lock chain from the dust shield plate.

(3) Lift up and remove the cranking unit.

c. Installation.

(1) Position the cranking unit; see that the holes in the mounting bracket (9) and cross-member of the frame (11) are properly alined.

(2) Install and tighten the mounting screws (7), washers (8), and nuts.

(3) Insert the lock chain through the hole in the dust shield.

(4) Install the cranking handle (par. 28i) and turn the engine over with the ignition off. Check the cranking unit for proper operation. When the cranking shaft is pushed forward, the gear of the shaft must engage the crankshaft pulley gear. When pressure on the cranking shaft is released, the cranking shaft spring must return the shaft to neutral position.

Section XVIII. SPRINKLER SYSTEM

166. Sprinkler Tank and Pipes

(fig. 78)

a. General. The sprinkler tank (14) is welded to the compression roll housing. Waterflow from the sprinkler tank (14) is controlled by the compression roll valve (9) and the steering roll valve (29). The valve levers (28) are connected with dual sprinkler pedals on the operator's platform. When a pedal is depressed, the valve opens and water flows from the sprinkler tank to the steering or compression roll. The sprinkler system is used when rolling hot and tacky materials.

b. Draining.

(1) Remove the sprinkler tank filler caps

(2) Open the two petcocks (2) on the sprinkler tank outlet pipe (4).

(3) Open the petcock (2) on the steering roll sprinkler pipe (16).

(4) Make sure that the sprinkler tank drains completely.

(5) Close the petcocks and replace the sprinkler tank filler caps

c. Filling.

(1) Do not use dirty water or water containing leaves, grass, moss, or other foreign matter.

(2) Make sure that the petcocks are closed.

(3) Remove the sprinkler tank filler caps and fill the tank.

(4) Replace the sprinkler tank filler caps.

d. Removal.

(1) Drain the sprinkler tank (see b above).

(2) Loosen the clamp and remove the steering roll sprinkler hose from the steering roll outlet pipe (17).

(3) Unscrew and remove the steering roll sprinkler pipe (16), street elbow (3), and steering roll valve (29).

(4) Loosen the hose clamps (11) and remove the hose (12) from the outlet pipe (4).

(5) Unscrew and remove the outlet pipes (4), connector, and street elbow (3).

(6) Unscrew and remove the street elbow (8), connecting the outlet pipe (4) with the compression roll valve (9).

(7) Unscrew and remove the close nipple (10).

(8) Remove the clamp screws (6) and clamps (5). Remove the compression roll sprinkler pipe.

e. Inspection and Repair.

(1) Inspect the inside and outside of the sprinkler pipes for corrosion, breaks, cracks, etching, and sediment accumulation. Clean the pipes, using strong water pressure. Replace the pipes if cracked, corroded, twisted, or damaged.

(2) Inspect the pipe hose for swollen, cut, frayed, or damaged rubber. Replace all damaged, cut, or damaged pipe hoses.

(3) Check the hose clamp screws for damaged, corroded, or stripped threads. Replace all defective hose clamp screws and nuts. Inspect the hose clamps for corrosion, breaks, cracks, and warpage. Replace damaged or worn hose clamps.

(4) Inspect the petcocks for leaks around the valve stem. Replace leaking petcocks. Check the petcock mounting screws for damaged, corroded, galled, or stripped threads. Replace the petcocks if the mounting threads are worn, corroded, or damaged.

(5) Check all valves for corrosion, wear, and leaks. Do not attempt to repair a leaking valve. Replace all corroded, damaged, or leaking valves. Check the valve mounting threads for wear, damage, and galling. Replace the valve if the threads are stripped or damaged.

f. Installation.

(1) Coat all pipe threads with a sealer of good quality.

(2) Install the compression roll sprinkler pipe (1) and tighten the mounting screws (6) and clamps (5).

(3) Install the street elbow (8), compression roll valve (9), and close nipple (10).

(4) Install the outlet pipes (4), street elbows (3), and tee-connecter. Make sure that all joints are tight.

(5) Install the hose (12) and tighten the hose clamps (11) securely.

(6) Install the steering roll sprinkler valve (29), sprinkler pipe (16), street elbow (3), and outlet pipe (17).

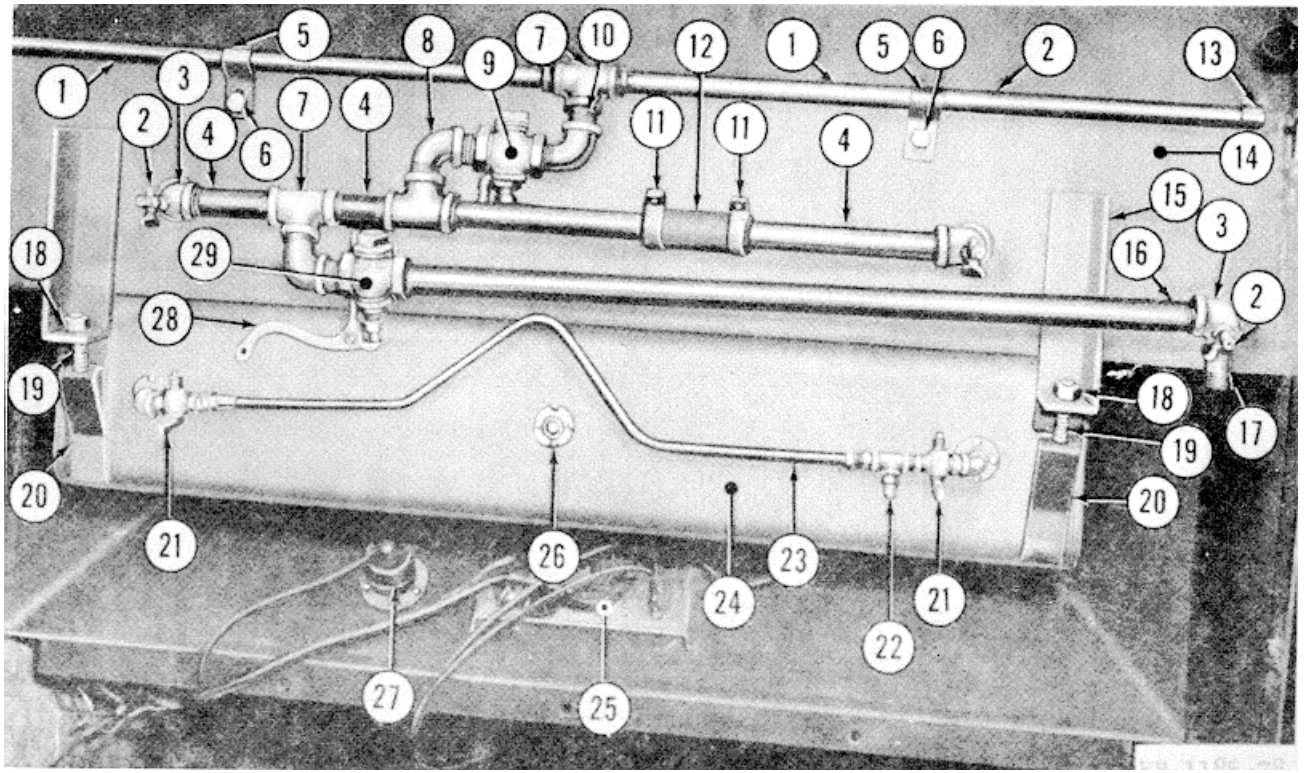


Figure 78. Sprinkler and fuel tanks, bottom view.

1 Compression roll sprinkler pipe
2 Petcock
3 Street elbow
4 Pipe nipple, tank outlet
5 Pipe clamp
6 Clamp screw
7 Pipe tee-connecter
8 Street elbow, outlet to valve
9 Compression roll valve
10 Close nipple
11 Hose clamp
12 Hose
13 Pipe cap
14 Sprinkler tank
15 Fuel tank mounting bracket
16 Steering roll sprinkler pipe
17 Outlet to steering roll
18 Fuel tank mounting nut
19 Fuel tank mounting .bolt
20 Fuel tank mounting strap
21 Fuel shutoff valve
22 Fuel outlet
23 Fuel tank line
24 Fuel tank
25 Instrument panel
26 Fuel tank drain plug
27 Magneto switch
28 Steering roll valve lever
29 Steering roll valve

Figure 78—Continued.

(7) Check all connections and make sure that they are tight.

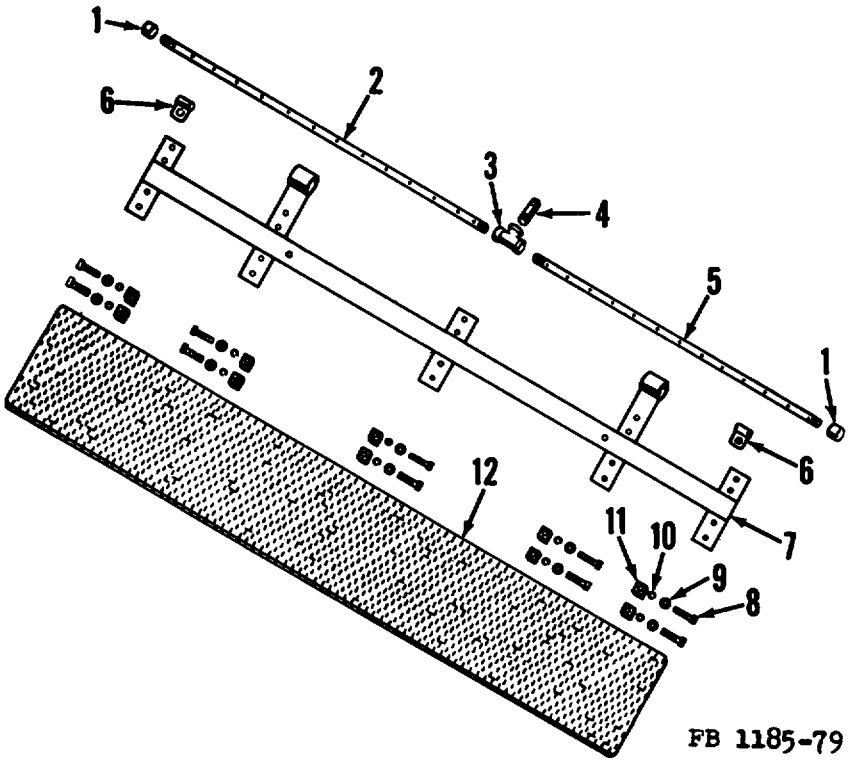
(8) Connect the steering roll sprinkler hose with the sprinkler pipe outlet (17) and tighten the hose clamp securely.

(9) Fill the sprinkler tank and check the sprinkler system, pipes, and connections for leaks.

(10) Connect the sprinkler valve linkages with the sprinkler pedals and check the valves and pedals for proper operation.

167. Steering Roll Sprinkler Mat
(fig. 79)

a. General. The steering roll sprinkler mat distributes water evenly over the steering roll surface. The mats are mounted under the steering roll scraper assembly. In some instances, it will be necessary to remove the scraper assembly to gain access to the sprinkler mats. Water from the sprinkler tank enters the steering roll sprinkler pipes (2 and 5) and flows down through the drilled holes on the sprinkler mat (12).



1 Caps, pipe, galv, 3/8 (2 req'd)
2 Sprinkler pipe, 25 in. long
3 Tee-connecter, galv, 3/8 x % x y
4 Nipples, pipes galv, 1/2 x 2 (2 req'd)
5 Sprinkler pipe, 24 in. long
6 Pipe clamps (2 req'd)
7 Sprinkler mat support
8 Screws, cap, hex hd, 3/4-20 NC x1 1/4 (10 req'd)
9 Washers, flat, 1/4 (10 req'd)
10 Washers, lock, std, 1/4, (10 req'd)
11 Nuts, hex, 1/4-20 NC (10 req'd)
12 Sprinkler mat

Figure 79. Steering roll sprinkler mat disassembled.

Sprinkler mats should be used when rolling hot and tacky materials. Keep the mats raised when they are not in use to prevent unnecessary wear.

b. Removal.

(1) Remove the cotter pins and remove the sprinkler mat support (7) and sprinkler mat (12).

(2) Remove the pipe clamps (6).

(3) Unscrew the pipe nipple (4) and remove the steering roll pipe (2 and 5).

c. Disassembly.

(1) Unscrew and remove the pipe caps (1) from the steering roll sprinkler pipe (2 and 5).

(2) Unscrew and remove the steering roll sprinkler pipes (2 and 5) from the tee-connecter (3).

(3) Remove the screws (8), flat washers (9), lockwashers (10), and nuts (11) attaching the sprinkler mat (12) to the sprinkler mat support (7).

(4) Remove the sprinkler mat (12).

d. Inspection. Inspect the sprinkler pipes for clogged or corroded holes. Replace the pipes if extremely corroded or damaged. Inspect the sprinkler mat for excessive wear, deterioration, excessively worn areas. Replace the mat if necessary.

e. Clean. Clean all metal parts with cleaning solvent. Clean the mat with a stiff brush or broom and medium water pressure. Remove all embedded foreign matter from the sprinkler mat. Clean the screw threads with a stiff wire brush and apply a few drops of engine oil on the threads before reassembling the sprinkler mat.

f. Reassembly.

(1) Install the sprinkler mat (12) on the sprinkler mat support (7).

(2) Install and tighten the sprinkler mat mounting screws (8), flat washers (9), lockwashers (10), and nuts (11).

(3) Connect the steering roll sprinkler pipes (2 and 5) with the tee-connecter (3).

(4) Install the pipe caps.

g. Installation.

(1) Install the sprinkler pipe (2 and 5) and pipe nipple (4). Make sure that all joints and connections are tight.

(2) Install and tighten the pipe clamps (6).

(3) Install the sprinkler support (7) and sprinkler mat (12) assembly.

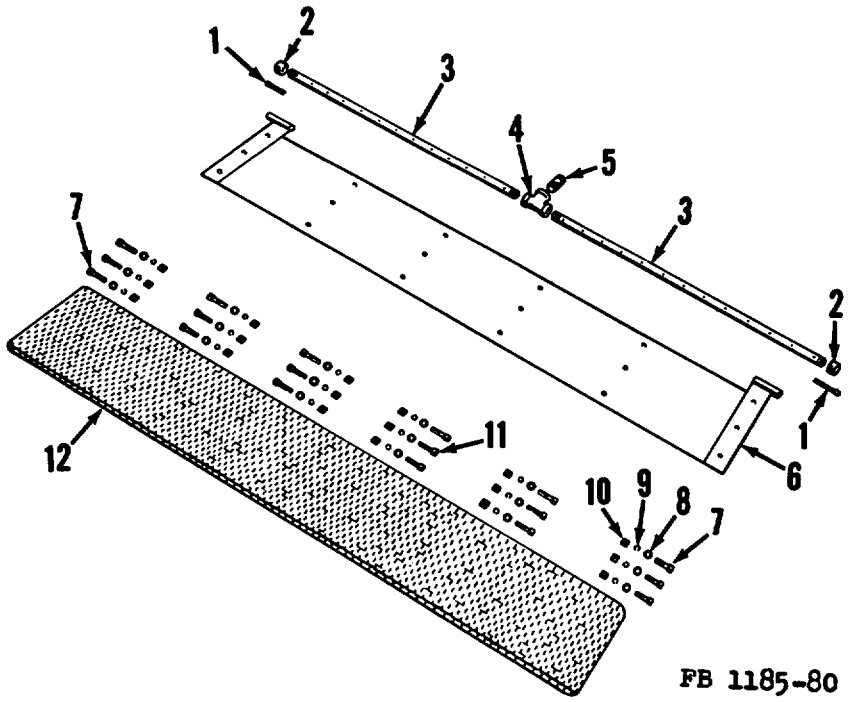
(4) Secure the sprinkler mat assembly with cotter pins.

168. Compression Roll Sprinkler Mat

a. General. The compression roll sprinkler mat assembly is similar in construction to the steering roll mat assembly. Refer to paragraph 161 above for a general description.

b. Removal (fig. 80).

(1) Remove the cotter pins (1) and remove the sprinkler mat support (6) and sprinkler mat (12).



1 Pins, cotter, 3/16 x 2 (2 req'd)
2 Caps, pipe, galv, 3/8 (2 req'd)
3 Sprinkler pipes, galv, 3/8 (2 req'd)
4 Tee-connector, galv, 3/8 x 3/8 x 3/4
5 Nipple, close, galv, 3/4
6 Sprinkler mat support
7 Screws, cap, hex hd, 1/4-20 NC x 1 1/2 (6 req'd)
8 Washers, flat, 1/4 (18 req.'d)
9 Washers, lock, std, 1/4 (18 req'd)
10 Nuts, hex, 1/4-20 NC (18 req'd)
11 Screws, cap, hex hd, 1/4-20 NC x1 1/4 (12 req'd)
12 Sprinkler mat

Figure 80. Compression roller sprinkler mat disassembled.

(2) Unscrew and remove the close nipple (5).

(3) Remove the compression roll sprinkler pipe (3).

c. Disassembly (fig. 80).

(1) Unscrew and remove the pipe caps (2).

(2) Unscrew and remove the compression roll sprinkler pipes (3) from the tee-connecter (4).

(3) Remove the mounting screws (7), flatwashers (8), lockwashers (9), and nuts (10), attaching the sprinkler mat (12) to the

sprinkler mat support (6). Note that these screws (7) are longer than the rest of the mounting screws (11); they must be reinstalled on the left and right sides of the sprinkler mat (12).

(4) Remove the remaining mounting screws (11), flatwashers (8), lockwashers (9), and nuts (10).

(5) Remove the sprinkler mat (12).

d. Inspection. Refer to paragraph 167*d.*

e. Cleaning. Refer to paragraph 167*e.*

f. Reassembly (fig. 80).

(1) Install the sprinkler mat (12) on the sprinkler mat support (6).

(2) Install the 12 short mounting screws (11), flatwashers (8), lockwashers (9), and nuts (10). Tighten the screws securely.

(3) Install the six long mounting screws (7) on the left and right sides of the sprinkler mat (12). Install the flatwashers (8), lockwashers (9), and nuts (10). Tighten the screws securely.

(4) Connect the compression roll sprinkler pipes (3) with the tee-connector (4). See that the connections are tight.

(5) Install the pipe caps (1).

g. Installation.

(1) Install the compression roll sprinkler pipe (3) and tighten the close nipple (5) securely.

(2) Install the sprinkler mat support (6) and sprinkler mat (12) assembly.

(3) Install and secure the cotter pins (1).

(4) Operate the sprinkler pedals and check the sprinkler mat for proper operation.

CHAPTER 4
FIELD AND DEPOT MAINTENANCE

Section I. INTRODUCTION

169. General

Instructions in this chapter are published for the information and guidance of maintenance personnel responsible for third and higher echelons of maintenance of the Roller, Road, Gasoline Driven, Tandem, 2 Axle, 5 to 8 Ton, Galion Model T5G, with Engine, Continental Model F-244. They contain information on maintenance which is beyond the scope of the tools, equipment, or supplies normally available to using organizations.

170. Procedure

The following sections describe the complete disassembly, repair. and reassembly of each major unit or system comprising the Roller, Road, Gasoline Driven, Tandem, 2 Axle, 5 to 8 Ton, Galion Model T5G, with Engine, Continental Model F-244. Before proceeding with the overhaul, check to see that replacement parts are available.

Section II. TOOLS AND EQUIPMENT

171. General

The tools and equipment as listed in this section are those that are required to perform field and depot maintenance on the Roller, Road, Gasoline Driven, Tandem, 2 Axle, 5 to 8 Tons, Galion Model T5G, with Engine, Continental Model F-244. Tools and equipment issued as on-equipment tools and common mechanic's handtools have not been enumerated in this section. Specially designed tools and equipment are not required for the overhaul of the road roller.

172. Field and Depot Maintenance Tools and Equipment

The tools and equipment in table VI bearing identification are listed in Department of the Army Supply Manual ENG 5-41. The tabulation contains only the tools and equipment necessary to perform the operations illustrated and/or described in this chapter.

This table is included for information only and is not to be used for requisitioning tools or equipment.

Table VI. Field and Depot Maintenance Tools and Equipment

Item	Stock No.	References		Use
		Fig.	Par.	
Compressor --------	41-2430.500.700-------	86	178	Piston rings.
Extractor----------	41-E-555-20 ----------	----------	187	Carburetor plug.
Growler ----------	17-5940 ----------	110	191	Armatures.
Lifter and com- --- pressor.	41-5329.200.300-------	52	136	Valve and valve spring.
Puller ----------	41-6272.275.513-------	89	180	Crankshaft pulley.
Puller ---------- pump.	41-6272.355.305-------	----------	184	Crankshaft and water
Puller ----------	41-6272.750.500-------	----------	182	Timing gear.
Wrench ---------- seat.	41-W-1496 ----------	----------	187	Carburetor fuel valve
Wrench ----------	41-W-1560 ----------	----------	187	Carburetor main jet.
Wrench ---------- valve.	41-W-1866 ----------	----------	187	Carburetor power jet
Wrench ---------- valve.	41-W-1868 ----------	----------	187	Carburetor power jet

173. Specially Designed Tools and Equipment

No specially designed tools and equipment are required for the over-haul of this road roller.

Section III. ENGINE

174. Engine Removal

a. General. Use a reliable overhead or motorized crane for removal of the engine. The most practical way to attach the crane cables to the engine is to remove two or more cylinder head screws and attach the lifting chain to the cylinder block. The crane cables or crane hook can be then attached to the lifting chain. If a lifting chain is not available, wrap strong manila rope or steel cables around the engine.

b. Removal Procedure (fig. 81).

(1) Remove the steering roll top cover (par. 161).

(2) Remove the operator's platform (par. 162).

(3) Remove the compression roll housing (par. 158).

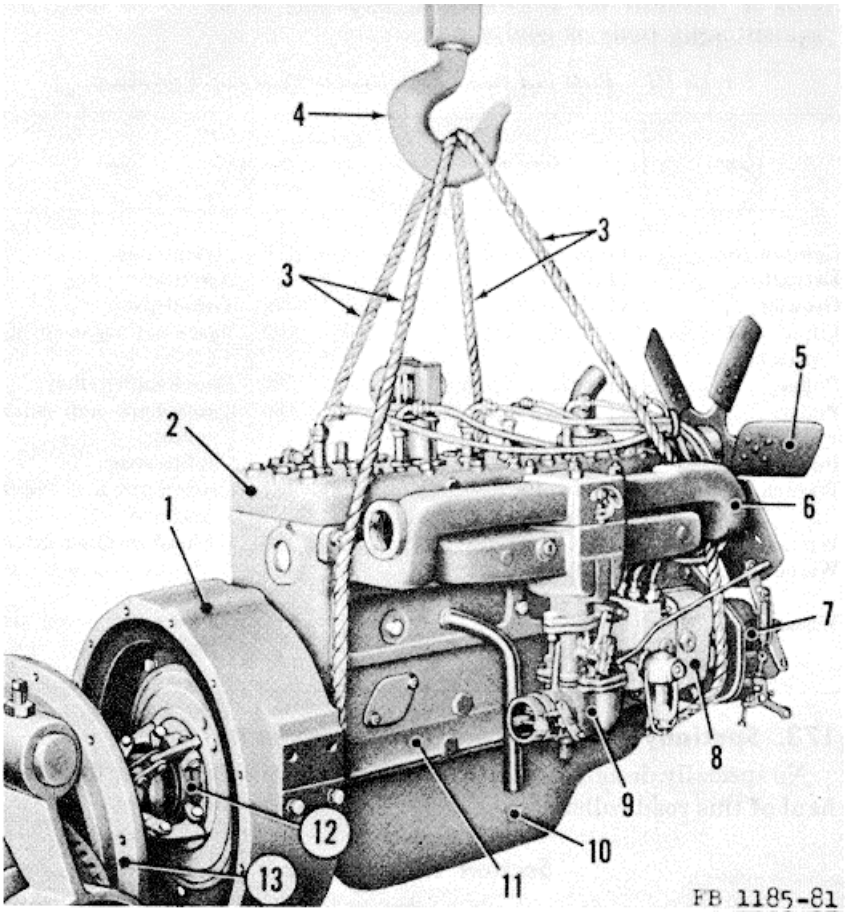
(4) Drain the cooling system (par. 128).

(5) Remove the radiator (par. 129).

(6) Drain the oil pan (par. 126).

(7) Remove the hydraulic pump belt (par. 150).

(8) Disconnect the exhaust pipe from the exhaust manifold and remove the exhaust pipe (par. 133).



1	Flywheel housing	8	Magneto
2	Cylinder head	9	Carburetor
3	Lifting ropes	10	Oil pan
4	Lifting hook	11	Engine block
5	Fan	12	Clutch
6	Exhaust manifold	13	Transmission
7	Governor housing		

Figure 81. Engine removal.

(9) Disconnect the fuel line from the carburetor (par. 106).

(10) Remove the air cleaner (par. 105).

(11) Check to see that all leads and linkages are disconnected.

(12) It is recommended to remove the engine with the clutch (12) attached to the engine. Be sure to engage the clutch before the removal of the engine. This will prevent the clutch hub and back plate assembly from slipping out of alinement, thus facilitating the installation of the engine and clutch assembly on the transmission when installing the engine.

13) Remove the engine front mounting bolt, lockwasher, flatwasher, and rubber dampener.

(14) Loosen the screws attaching the flywheel housing (1) to the transmission housing (13). Do not remove the screws.

(15) Attach the lifting chains or ropes (3) .to the lifting hook (4) of the crane. Take out the slack slowly.

(16) Check the lifting chains, ropes (3), or cables and see that they are properly attached to the lifting hook (4). See that the ropes are not touching such engine accessories as the battery generator, starting motor, or carburetor. See that the engine is properly balanced.

(17) Remove the screws attaching the flywheel housing (1) to the transmission housing (13).

(18) Very slowly and carefully raise the engine about one-half inch.

(19) Push the engine toward the steering roll and at the same time rock it gently to loosen the transmission housing. Continue this pushing and rocking action until the transmission shaft becomes loose. Do not use extreme force, as the transmission shaft splines may be damaged.

(20) Lift up the engine and move it to a convenient location. Place the engine on a stand or on solid blocks and make sure that it is properly balanced before removing the lifting chains or cables.

175. Engine Installation

a. General. Clean the road roller floor and mounting bracket before installing the engine. Check the mounting bolt and rubber dampener for wear and damage and replace if necessary. Inspect the flywheel housing mounting screws for corroded, damaged, or stripped threads. Make sure that all electrical leads and linkages will not obstruct the installation procedure.

b. Installation (fig. 81).

(1) Attach the lifting chains, cables, or ropes (3) to the engine and slightly raise the engine to see that it is properly balanced.

(2) Position the engine and see that the transmission shaft is properly alined with the clutch (12) splines.

(3) Gently lower the engine and push it toward the transmission housing (13) until the transmission shaft engages the splines in the master clutch (12) hub and back plate.

(4) Check the front mounting holes for proper alinement and install the rubber dampener, flatwasher, lockwasher, and mounting bolt.

(5) Install the flywheel housing mounting screws and tighten them evenly and securely.

6) Tighten the front mounting bolt.

(7) Install the hydraulic pump belt (par. 150).

(8) Install the radiator (par. 129).

(9) Connect all leads and linkages with the engine accessories.

(10) Connect the fuel line with the carburetor (par. 106).

(11) Install the air cleaner (par. 105).

(12) Fill the cooling system (par. 128).

(13) Fill the crankcase with oil. Refer to LO 5-1185.

(14) Install the compression roll housing and connect all electrical leads and linkages (par. 158).

(15) Install the operator's platform (par. 162).

(16) Install the steering roll top cover (par. 161).

(17) Start the engine and check for proper operation. Operate the road roller and check the clutch levers, gear shift levers, and forward and reverse clutches for proper operation.

176. Valve Guides

a. General. Excessive wear of the valve guides will make it impossible to secure tight valve seats by grinding the valves. A leaking valve seat will cause loss of power and compression and will result in erratic engine operation. It is important to clean the valve guides before checking them for wear.

b. Cleaning.

(1) Remove the engine (par. 174).

(2) Remove the cylinder head (par. 135).

(3) Remove the valves (par. 136).

(4) Use a valve guide cleaning tool to ream carbon from the valve guides.

(5) Rotate the valve guide cleaning tool in the guides until the gum, carbon, and other foreign material have been removed.

(6) Clean the valve guides with cleaning solvent and blow them dry with clean compressed air.

c. Inspection.

(1) Clean the valve stem and install the valve in the valve guide.
(2) Attach a dial indicator to a convenient stud on the cylinder block.
(3) Lift up the valve head about one-half inch above the cylinder block.
(4) Adjust the plunger of the dial indicator so that it will touch the edge of the valve heads.
(5) Hold the valve so it will not turn and move it toward and away from the dial indicator plunger. Note the amount of play shown on the indicator dial.
(6) The clearance between the valve stem and valve guide will be one-half of the amount shown on the indicator dial.

(7) The desired stem clearance is 0.0015 inch for the intake valve, and 0.0045 inch for the exhaust valve.

(8) If the clearance is greater than 0.0026 inch for the intake valve and 0.0055 inch for the exhaust valve, the valve guides must .be replaced.

d. Removal.

(1) Install the valve guide drift on the top of the valve guide and see that both are properly alined.

(2) Drive the valve guide down and out of the cylinder block.

(3) Clean the valve guide seat with cleaning solvent and blow dry with clean compressed air.

e. Installation.

(1) Start the valve guide in the valve guide seat with the tapered end up.

(2) Use the valve guide drift to drive the valve guide in place.

(3) The distance from the valve seat face to the top of the valve guide must be 1 15/32 inches for both intake and exhaust valves.

(4) Install the valves (par. 136).

(5) Install the cylinder head (par. 135).

(6) Install the engine (par. 175).

177. Valve Seats

a. General. The exhaust valve seats are replaceable. The intake valve seat is not exposed to such high temperatures and therefore is not replaceable. If the intake valve seat becomes badly damaged or cracked, the entire cylinder block must be replaced.

b. Inspection. Inspect the valve seats for pitting, excessive or uneven wear, cracks, and damage. If the intake valve seats cannot be repaired by grinding, replace the cylinder block. If the exhaust valve seat is cracked, damaged, or warped, it must be replaced.

c. Removal.

(1) Remove the engine (par. 174).

(2) Remove the cylinder head (par. 135).

(3) Remove the valves (par. 136).

(4) Clean the valve seat insert thoroughly.

(5) Use a valve seat insert removing tool and be sure to follow manufacturer's instructions supplied with the valve seat insert removing tool. Be careful not to damage the cylinder block. Remove the insert.

(6) Use a valve seat insert cutting tool and cut the counterbore 0.0035 inch smaller than the insert that is to be installed. Use 0. inch oversize valve seat insert.

***Note*. A standard insert should never be used as a replacement as it will not remain tight in service.**

(7) Run the cutter down until it bottoms in the original counterbore. Clean the cuttings from the counterbore and valve guide.

d. Installation.

(1) Cover the new exhaust valve seat insert with dry ice and let it chill for 10 minutes.

(2) Use a valve seat insert drifting tool to drive the insert into its seat.

(3) Allow the valve seat insert to warm up and expand. Then peen it over with a peening tool.

(4) Reseat the valve seats. The seat angle of the exhaust valve is 45° and that of the intake valve 30°.

(5) Grind and install the valves (par. 136).

(6) Install the cylinder head (par. 135).

(7) Install the engine (par. 175).

178. Connecting Rod and Piston

a. General. The connecting rods for cylinders 1, 3, and 5 are different from the connecting rods for cylinders 2, 4, and 6. Be sure to mark the connecting rods properly to facilitate installation. Refer to appendix II, Replaceable Parts List, for proper parts numbers when overhauling the connecting rods.

b. Removal.

(1) Remove the engine (par. 174).

(2) Remove the cylinder head (par. 135).

(3) Remove the oil pan (par. 126).

(4) Remove the piston (12, fig. 82) and connecting rod (16) assemblies one at a time.

(5) Turn the crankshaft (19) until the connecting rod cap (39) is in a suitable removal position.

(6) Remove the cotter pin (37) and unscrew the connecting rod bolt nut (38). The connecting rod cap removal procedure is shown in figure 83.

(7) Lift up and remove the connecting rod cap (39, fig. 82) and connecting rod bearing shell (17).

(8) Wrap the lower end of the connecting rod (16) with a clean cloth to prevent scoring damage when the connecting rod is removed from the cylinder.

(9) Scrape and remove carbon from the cylinder wall above the piston in order to facilitate removal of the connecting rod and piston.

(10) Push the connecting rod (16) and piston (12) out of the cylinder. If the piston sticks in the cylinder, tap the lower part of the connecting rod with a plastic hammer.

(11) Remove the connecting rod (16) and piston (12). Remove the cloth from the lower part of the connecting rod (16).

Mark the connecting rod and piston properly to make sure that they will be reinstalled in the same cylinder from which they were removed.

c. Disassembly.

(1) Remove the connecting rod cap bolts (7, fig. 82) and the upper bearing shell (17).

(2) Using a piston ring spreading tool (1, fig. 84), spread the top compression ring (2) and remove it from the piston.

(3) Remove the remaining two compression rings (9 and 10, fig. 82) and the oil ring (8) in the same manner as the top compression ring (11).

(4) Remove the piston pin retaining rings (14) on both sides of the piston pin (13).

(5) Immerse the piston in a hot water (about 100° F.) and allow it to expand in order to facilitate removal of the piston pin (13).

(6) Drive out the piston pin (13).

(7) Separate the connecting rod (16) from the piston (12).

d. Inspection. Wash all parts in cleaning solvent and blow them dry with clean compressed air. Remove the carbon and foreign matter from the piston grooves. Inspect all parts thoroughly for cracks, chips, breaks, and mechanical defects. Replace any defective parts.

e. Piston Pin Fitting.

(1) This engine has aluminum-alloy pistons. The pistons have been fitted with pins that cannot be pushed in by hand until the piston has been heated.

(2) Replace the pistons if the pins are loose in the pistons or the piston boss is out-of-round.

(3) The standard finished size of the piston pin is 0.8592 to 0.8593 inch. The pins are manufactured with an out-of-round and taper allowance of only 0.0002 inch. The proper piston pin fit is 0.0003 inch loose in the piston pin bushing and 0.0003 inch tight in the piston pin boss.

(4) When installing the piston pin, heat the piston in hot water (about 100° F). Install the pin (2, fig. 85) in the piston boss and drive it into the piston (3) and connecting rod bushing with a plastic hammer (1).

f. Piston Ring Gap.

(1) The correct piston-ring-gap clearance for this engine is 0.017 to 0.007 for both compression and oil rings.

(2) Install the piston ring in the cylinder sleeve and slide the piston into the sleeve above the piston ring.

(3) Push the piston up against the piston ring until the piston ring is square with the cylinder bore.

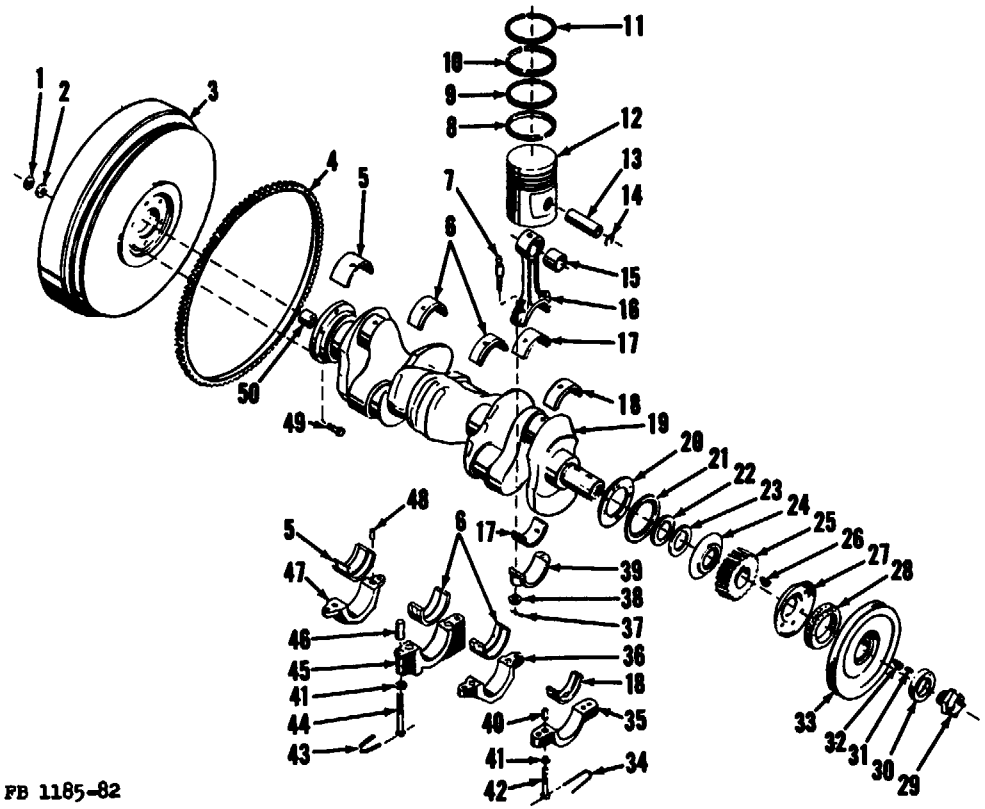
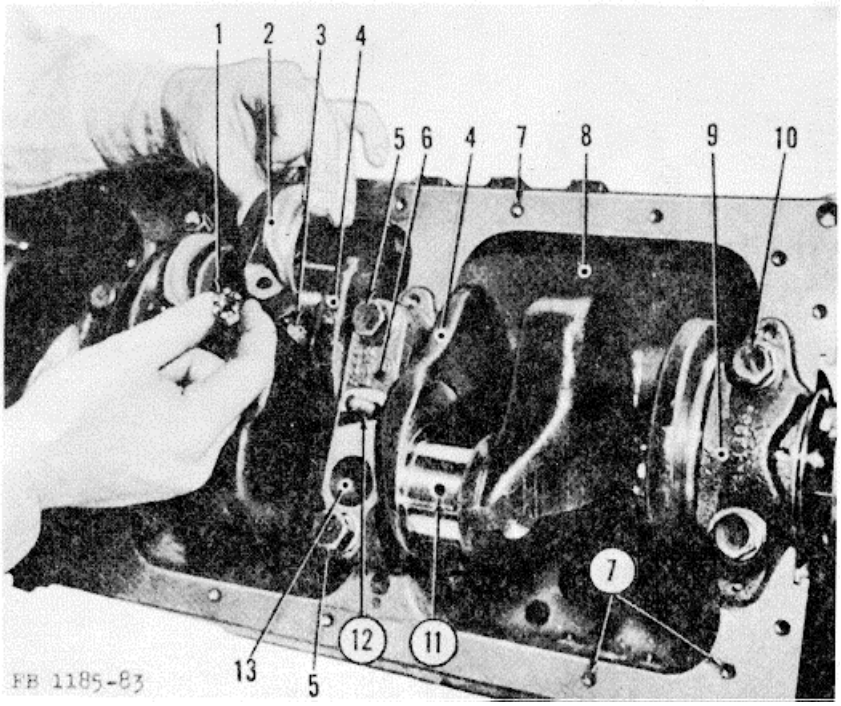


Figure 82. Crankshaft, piston, connecting rod, and flywheel disassembled.

1 Flywheel nut
2 Lockwasher
3 Flywheel
4 Ring gear
5 Rear upper and lower main bearing
6 Intermediate rear and front upper and lower bearings
7 Connecting rod cap bolt
8 Piston oil ring
9 Third groove piston ring
10 Second groove piston ring
11 Top groove piston ring
12 Piston
13 Piston pin
14 Piston pin retaining ring
15 Piston pin bushing
16 Connecting rod
17 Connecting rod bearing
18 Front upper and lower main bearing
19 Crankshaft
20 Front thrust washer
21 Thrust plate
22 Thrust shims, 0.002", (4 req'd)
23 Thrust shims, 0.008", (7 req'd)
24 Oil thrower
25 Crankshaft gear
26 Key, woodruff No. 5
27 Oil slinger
28 Seal
29 Starting jaw
30 Washer
31 Keyway plug
32 Key
33 Fan drive pulley
34 Wire, lock, No. 19 x 10 (3 req'd)
35 Crankshaft front bearing cap
36 Crankshaft intermediate front bearing cap
37 Cotter pin
38 Connecting rod bolt nut
39 Connecting rod cap
40 Dowel
41 Washers, plain, 1/2 (8 req'd)
42 Screws, 1/2-13 NC x 2 1/2 (6 req'd)
43 Wire, lock, No. 19 x 12
44 Screws, 1/2-13 NC x 3 1/4 (2 req'd)
45 Crankshaft intermediate rear bearing cap
46 Dowel ring
47 Crankshaft rear bearing cap
48 Dowel
49 Crankshaft bolt
50 Crankshaft bushing

Figure 82. Continued.



1	Connecting rod bolt nut	8	Crankcase
2	Connecting rod cap	9	Front main bearing cap
3	Connecting rod bolt	10	Front main bearing cap screw
4	Crankshaft	11	Crankshaft oil hole
5	Main bearing cap screw	12	Oil pump mounting stud
6	Intermediate main bearing cap	13	Oil pump mounting hole
7	Oil pan mounting hole		

Figure 83. Connecting rod cap removal.

(4) Remove the piston.

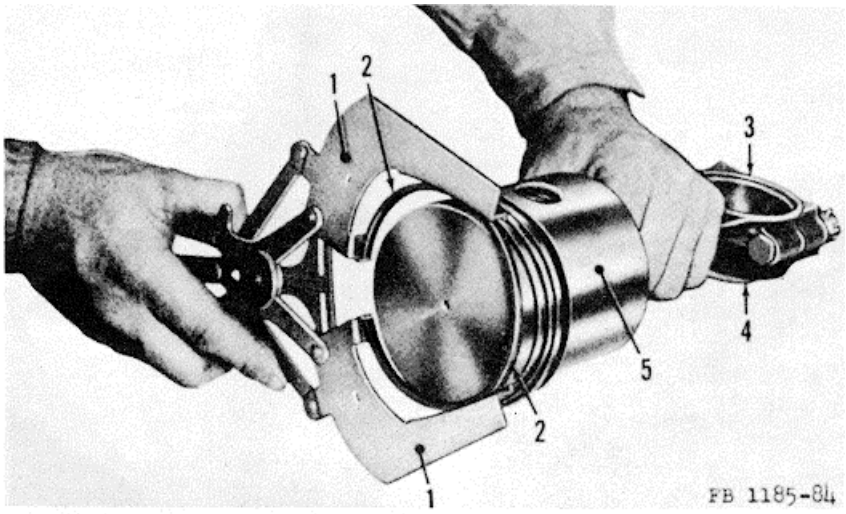
(5) Check the piston ring gap with a feeler gage. If the piston ring gap exceeds 0.017 inch, replace the piston ring.

(6) If the piston ring gap is less than 0.007 inch, file the ends of the piston ring with a flat file until the correct clearance is obtained. A fairly wide gap near the top limit is less detrimental to engine performance than an excessively tight fit.

g. Piston Ring Groove Clearance.

(1) Check the piston ring groove clearance when replacing rings on pistons which have been in service. The correct piston ring groove clearance for this engine is 0.0015 to 0.002 inch.

(2) Install the piston ring on the piston and attempt to slide the feeler gage in the groove between the piston ring and piston land.



1 Piston ring spreading tool
2 Piston ring
3 Connecting rod bearing cap
4 Connecting rod
5 Piston

Figure 84. Piston ring removal.

(3) If the feeler gage slides in at any point between the piston ring and piston land, clearance is at or over the allowable maximum, and the piston must be replaced.

(4) If the feeler gage fails to slide between the piston ring and piston land, clearance is below the allowable minimum. Reduce the thickness of the piston ring by lapping it on a sheet of No. 000 emery cloth. Place the emery cloth on a perfectly flat surface and make sure that the pressure on the ring is the same at all points.

(5) Replace any piston ring which is sprung out of its natural shape or permanently distorted.

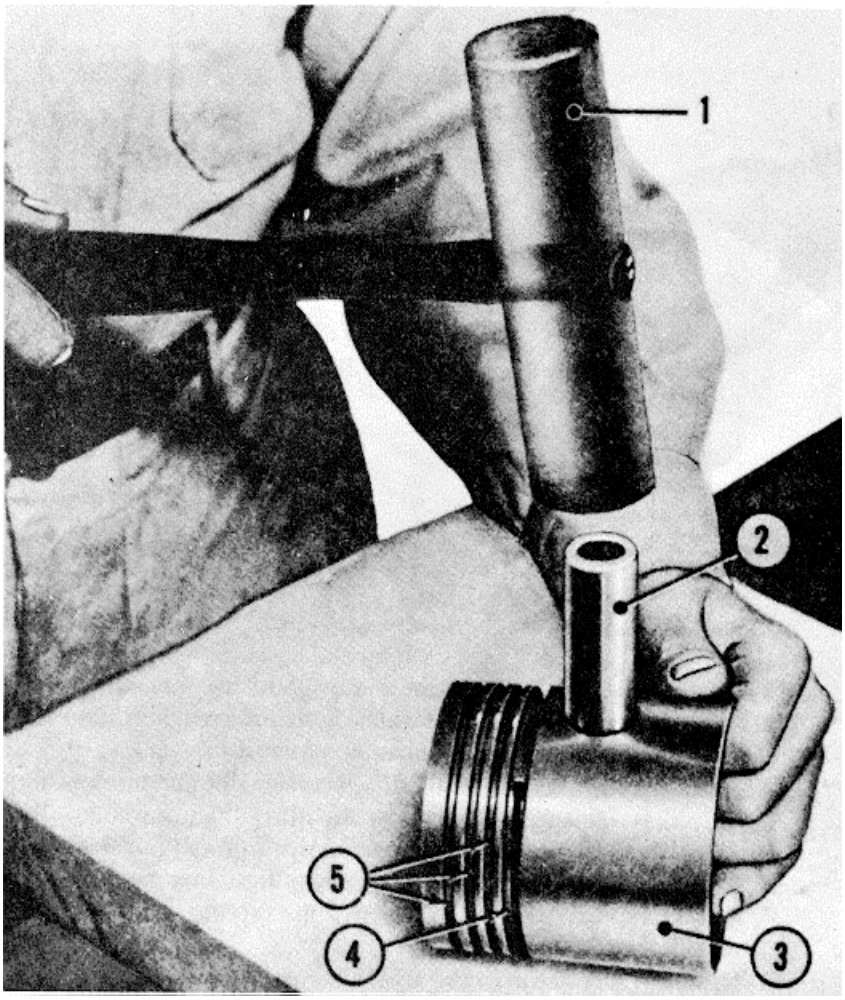
h. Piston Skirt to Sleeve Clearance.

(1) Before measuring the clearance between the piston skirt and cylinder sleeve, note that the piston skirt fits closer than the piston ring lands. Always check the piston skirt clearance, not the piston land clearance.

(2) Use a micrometer on the piston to make sure that it is perfectly round. Replace the piston if it is out-of-round beyond the wear limits.

(3) Select two pieces of 1/2-inch wide feeler stock 10 inches long and totaling 0.002 inch in thickness. Do not use a single feeler strip, because it is too stiff and will not conform to the curve of the cylinder sleeve bore.

(4) Attach the feeler stock to an accurate spring scale.



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1 Plastic hammer
2 Piston pin
3 Piston
4 Oil ring groove 1
5 Compression ring grooves

Figure 85. Piston pin fitting.

(5) Invert the piston and hold it with one hand over the cylinder sleeve. Hold the feeler stock and the spring scale in the other hand.

(6) Place the feeler stock in the cylinder sleeve and lower the piston into position.

(7) Withdraw the feeler stock, observing the spring scale reading.

(8) If clearance is correct, the tension required to withdraw the feeler stock will read 10 to 15 pounds. Too low or too high readings indicate too much or too little clearance.

(9) Test the cylinder sleeve bore by inserting the feeler stock in several positions around the sleeve walls. Any variation in roundness will be noted by increased or decreased weight readings.

i. Connecting Rod Bushing.

(1) To remove the connecting rod bushing from the connecting rod, press the bushing from the rod using a suitable driver. Be careful not to nick or scratch the inside bore of the connecting rod.

(2) The phosphor-bronze connecting rod bushing (15, fig. 82) has been diamond bored at the factory. Press the new bushing into the connecting rod using an arbor press.

(3) Ream the connecting rod bushing with a suitable reamer until the desired clearance is obtained.

j. Connecting Rod Bearings.

(1) The lower end of the connecting rod is fitted with thin steelbacked bearing shells (17, fig. 82) lined with cadmium nickel. The machined notches in the connecting rod cap (39) are matched with the ears stamped into the steel back of the bearing shells (17). When the bearing is assembled on the connecting rod, the notches and ears lock the shells and prevent them from rotating in the connecting rod.

(2) When the bearing shells are assembled to the crankshaft, the bearing clearance is 0.0015 to 0.002 inch.

(3) If the shell wears out or becomes defective, it must be replaced. Never replace only half of a bearing shell. Replacement must be made in complete bearing shell units. Because of the extremely close machining of this bearing shell, no fitting, filing, scraping, boring, or other adjustment is required or permissible.

Note. Do not try to fit the bearing by scraping or filing the shell or connecting rod cap, or the connecting rod will be permanently ruined.

k. Reassembly.

(1) Install the bushings in the connecting rods (see *i* above).

(2) Immerse the piston (12, fig. 82) in hot water (about 100° F.) and allow it to expand.

(3) Install the piston pin (13) in the piston (12) and connecting rod bushing (15).

(4) Install the piston pin retaining rings (14) in the grooves at each end of the piston pin (13).

(5) Clamp the connecting rod in a vise for installation of the piston rings.

(6) Spread the oil ring (8) with a piston ring spreading tool and install it in the bottom groove of the piston (12).

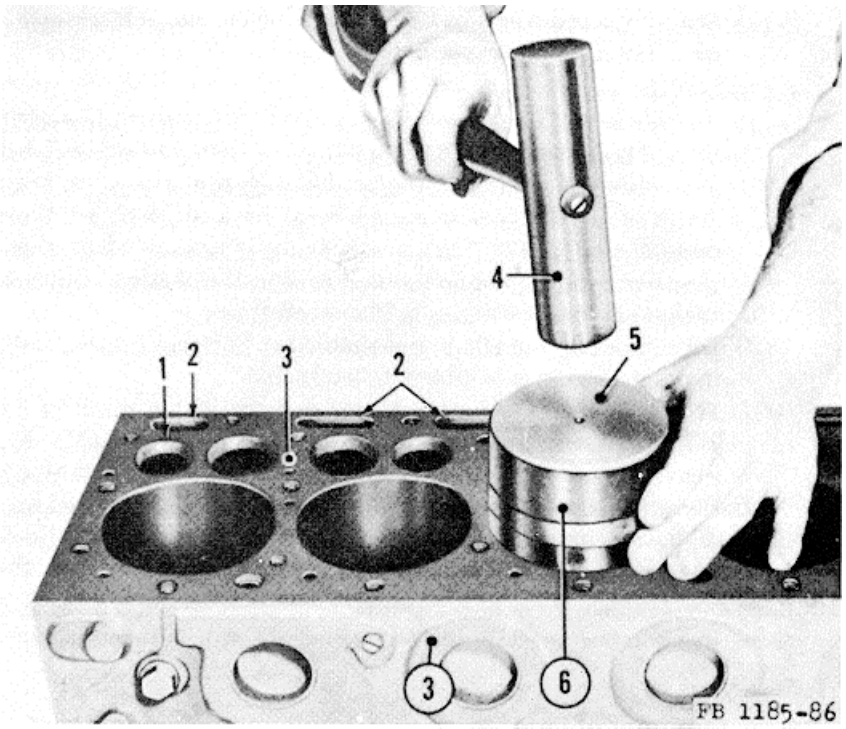
(7) Install the two grooved compression rings (9) and (10) in the third and second grooves of the piston.

(8) Install the plain compression ring (11) in the top groove of the piston (12).

(9) Lubricate the piston rings and grooves with light engine oil or castor oil. Stagger the ring gaps around the piston to prevent installing the piston with the gaps in line.

l. Installation.

(1) Use a piston ring compressing tool to compress the piston rings (8, 9, 10, and 11, fig. 82) on the piston (12).



1	Valve seat	4	Plastic hammer
2	Water passage hole	5	Piston
3	Cylinder block	6	Piston ring compressor

Figure 86. Piston installation.

(2) Lower the connecting rod (16) and piston (12) into the cylinder. Be careful not to damage the cylinder walls.

(3) Tap the piston down with a plastic hammer into the cylinder as illustrated in figure 86.

(4) Make sure that the bearing seat surfaces and the back of the bearings are perfectly clean. The slightest trace of dirt

or carbon squeezed between the back of the bearing and its seat can cause rapid bearing failure due to a localized high spot. Install the bearing shells (17, fig. 82) on the connecting rod (16) and connecting rod cap (39).

(5) Attach the connecting rod (16) and connecting rod cap (39) to the crankshaft (19) and install the connecting rod cap bolts (7) and nuts (38).

(6) Pull down on all nuts (38) evenly, going from one side of the bearing to the other. Apply final tension with a torque wrench, using a slow, steady pull and holding the wrench on torque for a few seconds when 20 to 25 foot-pounds' pressure is reached.

(7) Install and secure the cotter pin. Never back off the nut to install the cotter pin (37). It is better to go to a slightly higher tension if necessary. If it is apparent that the cotter pin cannot be installed without bringing the tension dangerously near the limit of the bolt, remove the nut and try again with another nut.

(8) Previous overtorquing or other damage to the bolt (7) or nut (38) will be felt by the torque "softening up" so that the nut can be turned without any appreciable increase in wrench tension. Replace the bolt and nut in such a situation.

(9) Check the connecting rod side clearance by forcing the rod fully to one side or the other. The correct connecting rod side clearance is 0.010 to 0.006 inch. The desired clearance is 0.006 inch. This procedure is illustrated in figure 87.

m. Running Clearance. The bearings are precision made, and it is not necessary to check their running clearance. With the bearings properly installed and the nuts tightened, the bearing clearance will be 0.0018 to 0.0000 inch. After the connecting rod bearings are assembled on the crankshaft, lubricate the connecting rod bearings and crankshaft with light engine oil.

179. Flywheel and Flywheel Gear

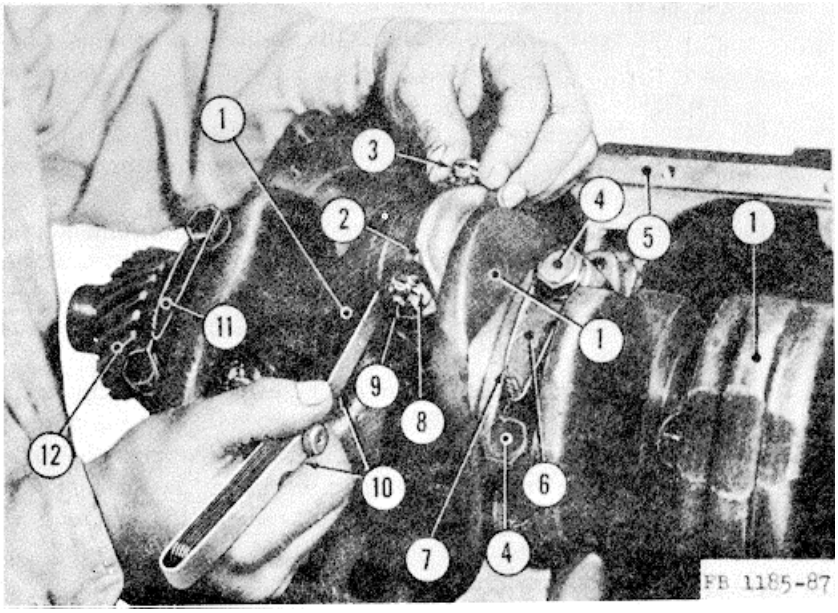
a. General. The flywheel is attached to the crankshaft flange with six bolts, lockwashers, and nuts. One of the bolts is offset one-sixteenth of an inch. A corresponding hole is located in the crankshaft flange so that the flywheel can be assembled in but one position with regard to number one and four crank pins. It is very important to tighten the flywheel bolts and nuts securely.

b. Removal.

(1) Remove the engine (par. 174).

(2) Remove the six bolts (49, fig. 82), lockwashers (2), and nuts (1) attaching the flywheel (3) to the crankshaft (19).

(3) Remove the flywheel (3).



1	Crankshaft	7	Lock wire
2	Connecting rod cap	8	Cotter pin
3	Connecting rod bolt	9	Connecting rod cap nut
4	Main bearing cap screw	10	Feeler gage
5	Crankcase	11	Front main bearing cap
6	Main bearing cap	12	Crankshaft gear

Figure 87. Checking connecting rod side clearance.

c. Disassembly.

(1) Pull out the master clutch shaft bearing (3, fig. 88) from the center of the flywheel (2).

Note. The flywheel gear should not be removed from the flywheel unless a new one is needed, and available, for replacement.

(2) Use a cold chisel to cut into the flywheel gear (5) between two of the teeth.

(3) Hammer the chisel a few times to expand the flywheel gear (5) a few thousandths of an inch.

(4) Tap the flywheel gear (5) off the flywheel (2).

d. Inspection. Inspect the flywheel carefully for cracks and breaks. Check the surface of the flywheel contacted by the clutch for warpage and scoring. Inspect the flywheel gear for broken, damaged, or worn teeth. Replace the flywheel gear if excessively worn. Check the master clutch bearing for cracked, pitted, or scored balls. Inspect the cones for cracks, wear, and grooving. Replace the bearing if it is sticking, binding, or if the cones or rollers are worn, cracked, or damaged.

e. Repair.

(1) Chuck the flywheel in a lathe if the surface contacted by the clutch is warped or scored.

(2) Refinish the surface to make it smooth and flat.

(3) Do not remove more than three sixty-fourths of an inch material from the flywheel. If it is necessary to cut more, the flywheel must be replaced.

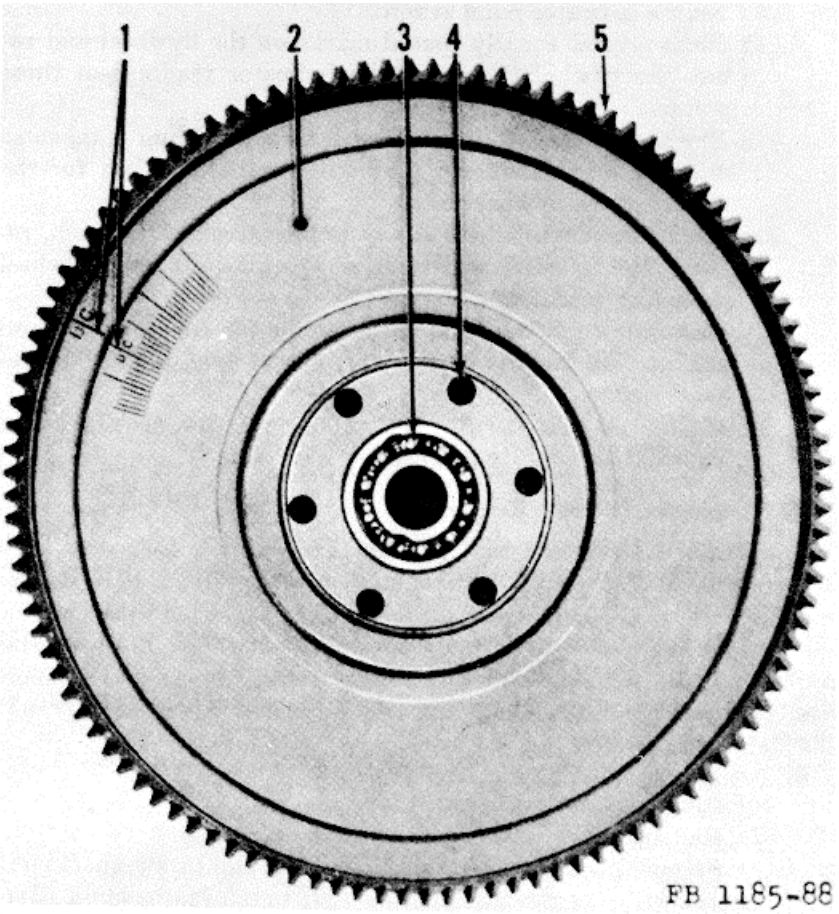
f. Reassembly.

(1) Heat the flywheel gear (5, fig. 88) until it expands enough to slip into place over the flywheel (2).

(2) Make sure that the side of the flywheel gear (5) which has chamfered teeth ends is away from the flywheel shoulder.

(3) Tap the flywheel gear (5) against the shoulder of the flywheel (2) and allow it to cool.

(4) Press the master clutch bearing (3) into the center of the flywheel (2).



1 Flywheel timing marks
2 Flywheel
3 Master clutch bearing
4 Flywheel mounting hole
5 Flywheel gear

Figure 88. Flywheel and flywheel gear.

g. Installation.

(1) Attach the flywheel (3, fig. 82) to the crankshaft (19) and see that the mounting holes are properly alined.

(2) Install the mounting bolts (49), lockwashers (2), and nuts (1).

(3) Tighten the bolts (49) evenly and securely. Proper torque wrench reading is 20 to 25 foot-pounds for five-sixteenth bolts and 35 to 40 pounds for three-eighths bolts.

h. Checking Flywheel Runout.

(1) Check the flywheel runout whenever the flywheel or clutch is installed.

(2) Attach a dial indicator to the flywheel housing and see that the indicator button is resting against the flywheel face at a point near the outside diameter of the flywheel.

(3) Set the indicator point at zero.

(4) Make several equally spaced marks on the flywheel and rotate the flywheel to obtain the indicator readings at those points.

(5) Pry the crankshaft forward each time a reading is taken so that the crankshaft end play will not be mistaken for the runout of the flywheel face.

(6) If the flywheel runout at any point exceeds 0.004 inch, remove the flywheel and clean the crankshaft and flywheel mounting surfaces.

(7) Install the flywheel and check again for concentricity and runout. If the flywheel is still out of line, it must be remachined.

(8) Make sure that the flywheel mounting bolts are tight and install the engine (par. 175).

180. Crankshaft and Bearings

a. General. The crankshaft used in this engine is forged of high carbon steel and is carried on four large main bearings. The crankshaft is precisely balanced and proportioned in relation to the engine size and should seldom cause trouble. Special attention must be paid to the end play of the crankshaft, because excessive play may damage the front main bearing, which carries the thrust. The correct crankshaft end play is 0.004 to 0.006 inch.

b. Removal.

(1) Remove the engine (par. 174).

(2) Remove the flywheel (par. 179).

(3) Remove the screws (31 and 32, fig. 48) and lockwashers (30) attaching the flywheel housing (29) to the engine block (21). Remove the flywheel housing.

(4) Unscrew and remove the starting jaw (29, fig. 82) and starting jaw washer (30).

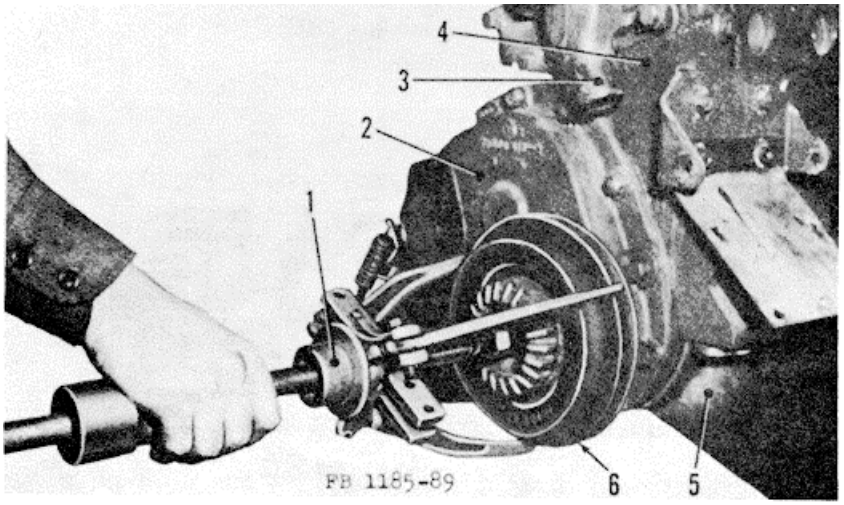
(5) Pull the fan drive pulley (33) off the crankshaft (19) and remove the keyway plug (31) and key (32). The fan drive pulley removal procedure is illustrated in figure 89.

(6) Remove the gear cover (2, fig. 89). Remove the oil seal (28, fig. 82) from the timing gear cover (2, fig. 39).

(7) Remove the oil slinger (27, fig. 82).

(8) Remove the connecting rod caps (39) and disconnect the connecting rods from the crankshaft (par. 178).

(9) Remove the oil pump.



1 Fan pulley puller
2 Timing
3 Water pump
4 Cylinder block
5 Oil pan
6 Fan drive pulley

Figure 89. Fan drive pulley removal.

(10) Cut the lock wires (34 and 43). Note that the lock wire (34) for the front main bearing cap (35), intermediate front bearing cap (36), and rear main bearing cap (47) is 10 inches long. The lock wire (43) for the intermediate rear bearing cap is 12 inches long. Remove and discard the lock wires (34) and (43).

(11) Remove the cap screws (42) and lockwashers (41) from the front main bearing cap (35), intermediate front bearing cap (36), and rear main bearing cap (47). Note that these cap screws (42) are 2 1/2 inches long and that the rear intermediate bearing cap screws (44) are 3 1/4 inches long.

(12) Remove the cap screws (44) and lockwashers (41) from the rear intermediate bearing cap (45).

(13) Remove each bearing cap (35, 36, 45, and 47) and bearing shell (18, 6, and 5) separately. Keep each bearing shell with the proper bearing cap.

(14) Lift out and remove the crankshaft (19). Crankshaft removal is shown iii figure 90.

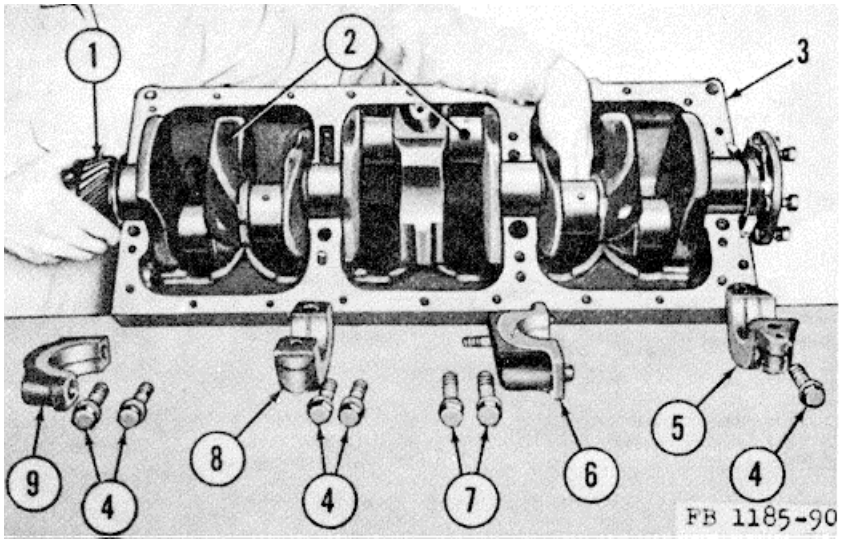
(15) Remove the upper bearing shells (18, 6, and 5, fig. 82) from the crankcase and lay them with their respective bearing caps and lower shells.

c. Disassembly.

(1) Use a crankshaft gear puller to remove the crankshaft gear (25, fig. 82).

(2) Remove the crankshaft gear key (26).

(3) Remove the oil thrower (24).



1 Crankshaft gear
2 Crankshaft
3 Crankcase
4 Bearing cap screw
5 Rear main bearing cap
6 Intermediate rear main bearing cap
7 Intermediate rear main bearing cap screw
8 Intermediate front main bearing cap
9 Front main bearing cap

Figure 90. Crankshaft removal.

(4) Remove the thrust shims (23 and 22). There are 7 shims (23) 0.008 inch thick and 4 shims (22) 0.002 inch thick.

(5) Remove the thrust plate (21) and front thrust washer (20).

d. Cleaning. Blow out all oil passages in the crankshaft with clean compressed air. Probe the passages to remove all accumulated carbon, sludge, and foreign matter. Wash the oil passages with cleaning solvent and dry them with clean compressed air. Wash the bearing cap screws in cleaning solvent and clean the threads with a stiff wire brush.

Replace the screws if the threads are corroded, damaged, or stripped.

e. Crankshaft Runout Check.

(1) Mount the crankshaft in V shaped blocks on the front and rear main bearing journals.

(2) Insert paper strips soaked in engine oil between the bearing journals and the blocks to prevent scoring of the journals.

(3) Take a dial indicator reading at the intermediate rear main bearing journal. If the crankshaft runout exceeds 0.002 inch, the crankshaft must be reground or replaced.

f. Crankshaft Visual Inspection. Make a careful visual inspection of the entire crankshaft, looking for scored or damaged bearing journals, cracks, breaks, or pitting.

g. Crankshaft Magnetic Inspection.

(1) If the equipment is available, make a magnetic inspection of the crankshaft.

(2) Strongly magnetize the crankshaft by means of a magnet or pass a heavy electric current through the crankshaft.

(3) This magnetizing will produce a flux leakage at cracks, breaks, or discontinuities in the crankshaft.

(4) Apply magnetic powder to the crankshaft; the powder will be attracted to the flux leakage areas and will form a pattern revealing the location and extent of the damage. The magnetic powder may be applied dry by dusting on the crankshaft, or wet by suspending it in light oil and flushing it over the crankshaft, or by immersing the crankshaft in a bath of magnetic dust oil.

h. Bearing Inspection. Inspect all bearing shells for cracks, breaks, pitting, overheating, and abnormal wear. Replace the bearing shells if necessary. Inspect the bearing caps for breaks and cracks and replace if necessary.

i. Reassembly (fig. 82).

(1) Install the front thrust washer (20) and thrust plate (21) on the crankshaft (19).

(2) Install the four 0.002-inch shims and seven 0.008-inch shims. This number of shims should be sufficient for the required crankshaft end play of 0.006 to 0.004 inch.

(3) Install the oil thrower (24).

(4) Install the key (26).

(5) Push the crankshaft gear (25) on the crankshaft (19). Make sure that the key (26) and the keyway hole in the crankshaft gear (25) are properly alined. The correct crankshaft gear fit is 1.4355 to 1.435 inch.

j. Installation.

(1) Install the upper main bearing shells (18, 6, and 5, fig. 82) in their proper places in the crankcase.

(2) Install the crankshaft (19).

(3) Install the lower main bearing shells (18, 6, and 5) in the main bearing caps (35, 36, 45, and 47). Never replace only half of a bearing shell. Replacement must be made in complete bearing shell units. Because of the extremely close machining of this bearing shell, no fitting, filing, scraping, boring, or other adjustment is required or permissible.

Note. Do not try to fit the bearing by scraping or filing the shell or main bearing cap.

(4) Make sure that the bearing seat surfaces and the back of the bearing are perfectly clean. The slightest trace of dirt or carbon squeezed between the back of the bearing and its seat can cause rapid bearing failure due to a localized high spot.

(5) Install the lower main bearing shells (18, 6, and 5) in the main bearing caps (35, 36, 45, and 47). Install the main bearing caps.

(6) Install the main bearing cap lockwashers (41) and screws (42 and 44).

(7) Pull down on all screws (42 and 44) evenly, going from one side of the bearing to the other. Apply final tension with a torque wrench, using a slow, steady pull and holding the wrench on torque for a few seconds when 20 to 25 foot-pounds' pressure is reached.

(8) Thread the lock wires (34 and 43) through the holes in the cap screw heads (42 and 44) and secure them with pliers. See that the lock wires are tight.

(9) Use a screwdriver and a feeler gage to check the crankshaft end play. Insert the screwdriver (1, fig. 91) between the crankshaft (2) and crankcase (3) and force the crankshaft fully to one side or the other. The correct crankshaft end play is 0.006 to 0.004 inch. This check is illustrated in figure 91.

(10) Attach the flywheel housing (29, fig. 48) to the engine block (21) and tighten the mounting screws (31 and 32) and lockwashers (30).

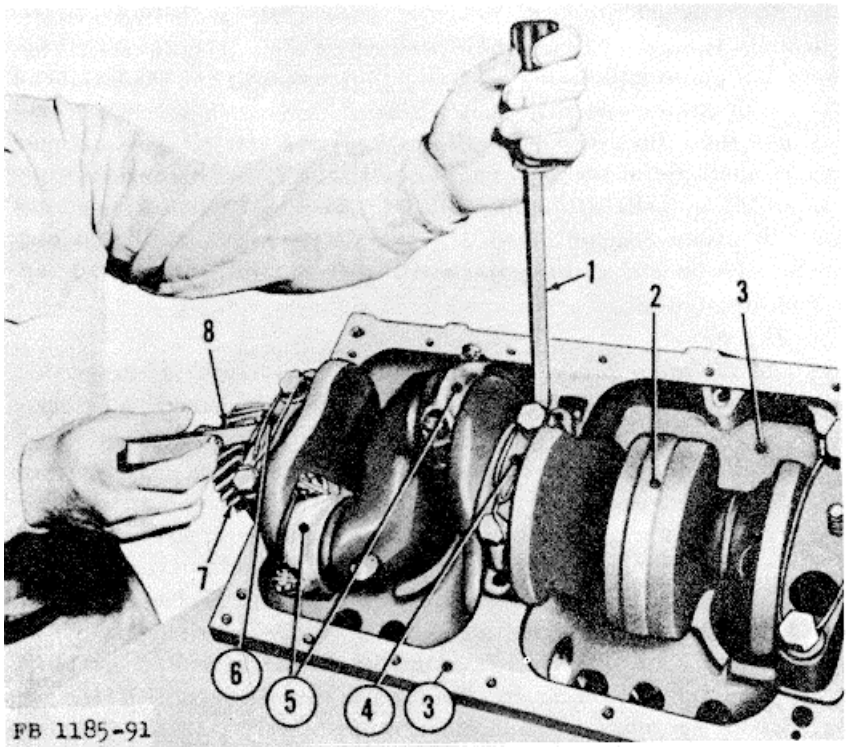
(11) Install the oil pump.

(12) Connect the connecting rods with the crankshaft (par. 178).

(13) Install the oil slinger (27, fig. 82).

(14) Install the oil seal (28) in the timing gear cover (2, fig. 89).

(15) Install the timing gear cover (2).



1	Screwdriver	5	Connecting rod bearing cap
2	Crankshaft	6	Front main bearing cap
3	Crankcase	7	Crankshaft timing gear
4	Main bearing cap	8	Feeler gage

Figure 91. Checking crankshaft end play.

(16) Install the key (32, fig. 82), keyway plug (31), and press the fan drive pulley on the crankshaft (19).

(17) Install the starting jaw washer (30) and starting jaw (29).

(18) Install the flywheel (par. 179).

(19) Install the engine (par. 175).

181. Cylinder Block

a. General. The cylinder block of this engine has a main frame with the cylinder and crankcase cast as an integral part. The block has large water jackets which surround cylinders and valves to provide sufficient cooling. The intake valve seats are machined on the cylinder block surface. The exhaust valve seats are replaceable and can be removed when damaged, worn, or cracked.

b. Inspection. Submerge the cylinder block in a strong caustic solvent and let it soak for 2 hours. Remove the cylinder block and clean it thoroughly with live steam or air pressure. Inspect the block for cracks, breaks, and warpage. Inspect all water passages and see that they are not plugged with rust, scale, dirt, or foreign matter.

Clean all passages with steam or compressed air. Inspect all oil passages and main galleries. Check the oil passages at the same time as the water jackets are inspected. Clean the oil passages with a rifle rod and blow them dry with clean compressed air. Inspect all machined surfaces for cracks, burrs, and pitting. Smooth down all rough and pitted surfaces with a fine mill file. Make sure that all machined surfaces are smooth and clean. It is very important that all machined surfaces be smooth so the gaskets will seat properly, eliminating any possibility of leaks.

c. Repair.

(1) *Cylinder block*. Replace the cylinder block if cracked or warped, or if the intake valve seats are burned or cracked beyond repair.

(2) *Core-hole plugs.* Inspect the core-hole plugs. If there are rust streaks or signs of corrosion around the outer edges of the plugs, they are leaking and must be replaced. Drill a hole through the plug and remove it from the cylinder block. Clean the plug hole carefully and remove all rust, scale, and corrosion from the plug seat. Coat the outer surface of the new core plug with fast-drying gasket sealer and start the plug in the block, making sure that it is square with the face of the block. Use a wood or metal driver made to fit the inside diameter of the plug and drive in the plug flush with the cylinder block.

(3) *Studs.* Inspect all studs for wear, warpage, and corroded, damaged, or stripped threads. Remove all defective studs and check the threads in the cylinder block. Install new studs and coat the threaded surfaces with light engine oil.

(4) *Cylinder ridge*. If the cylinders have a ridge at the top of the cylinder bore, remove the ridge, using a standard ridge reamer or hone.

(5) *Reboring*. If the cylinders are worn more than 0.008 inch, rebore the cylinders oversize and hone them until the bores are not more than 0.001 inch out of round or tapered more than 0.001 inch. Remember that the tapered bores must be larger at the bottom than at the top of the cylinder. When reboring the cylinders, be sure to follow the instructions supplied by the manufacturer of the boring machinery.

(6) *Honing.* If the oscillating movement is properly controlled and regulated during the honing procedure, the finished hone will form a diamond pattern on the cylinder walls. This surface will aid the initial run-in lubrication and the wearing in of the piston rings. Do not attempt to hone the cylinders to obtain a highly polished, smooth finish, with no hone

marks. Follow the instructions supplied by the manufacturer of the honing machinery.

(7) *Machined surfaces.* Check the machined surfaces of the cylinder block with a straightedge. If the machined surfaces are worn or warped to the extent that a 0.010-inch feeler gage can be passed between the straightedge and the machined surface, replace the cylinder block.

(8) *Planing and milling.* Do not attempt to plane or mill the top of the cylinder head to remove warpage or high spots. Any amount of metal removed from the face of the cylinder head will change the compression ratio of the engine and in many instances will cause a sharp detonation spark knock.

182. Camshaft and Cam Gear

a. General. The camshaft used on this engine is an alloy steel forging and operates in solid bronze bushings which are assembled to the cylinder block. The camshaft and crankshaft gears are helical cut and have a maximum tooth contact surface. Several parts of the teeth are engaged at one time, and this sliding action increases the strength and reduces the gear noise. All bearings and cam faces are ground to extremely hard surface and should not cause any trouble during the life time of the engine. It is seldom, if ever, necessary to replace the camshaft and bushings.

b. Removal.

(1) Remove the engine (par. 174*b*).

(2) Remove the fan drive pulley (par. 180*b*).

(3) Remove the governor (par. 108*b*).

(4) Remove the magneto (par. 116*c*).

(5) Remove the screws (10, 11, and 14, fig. 92), lockwashers (2), plain washers (6 and 13), and nuts (9) attaching the timing gear cover (15) to the cylinder block.

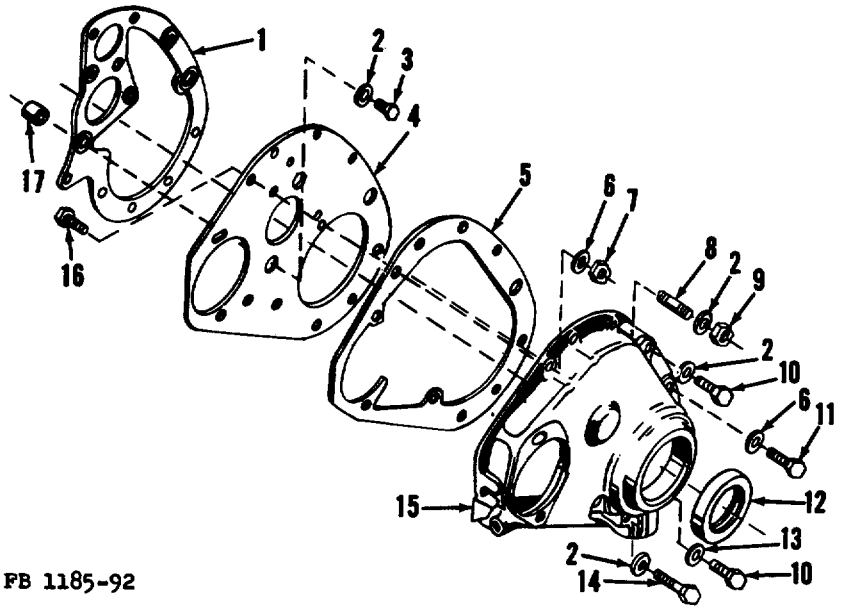
(6) Remove the timing gear cover (15) and inspect the seal (12) for wear, breaks, and damage. Drive out the seal and replace it if worn or damaged.

(7) Remove the timing gear cover gasket (5). Clean the gasket mounting surface with dry-cleaning solvent and make sure that the surface is clean and smooth.

(8) Drive the edge of the camshaft gear nut lockwasher away from the nut and remove the camshaft gear nut and lockwasher.

(9) Use a camshaft gear puller (2, fig 93) to pull the camshaft gear (3) off the camshaft (4).

(10) Use a blunt screwdriver to remove the camshaft gear key (7, fig. 94) from the camshaft (1). Be extremely careful



1 End plate gasket
2 Lockwashers (6 req'd)
3 End plate screw
4 End plate
5 Gear cover gasket
6 Plain washers (2 req'd)
7 Nut
8 Studs (2 req'd)
9 Gear cover nuts (2 req'd)
10 Gear cover screws (3 req'd)
11 Ring dowel screw
12 Seal
13 Copper washers (2 req'd)
14 Screws (3 req'd)
15 Cover
16 Dowel screw
17 Dowel ring

Figure 92. Timing gear cover disassembled.

not to damage or scratch the camshaft when removing the key.

(11) Remove the cylinder head (par. 135*a*).

(12) Remove all valves and valve tappets (par. 136*c*).

(13) Remove the oil pump (par. 196*b*).

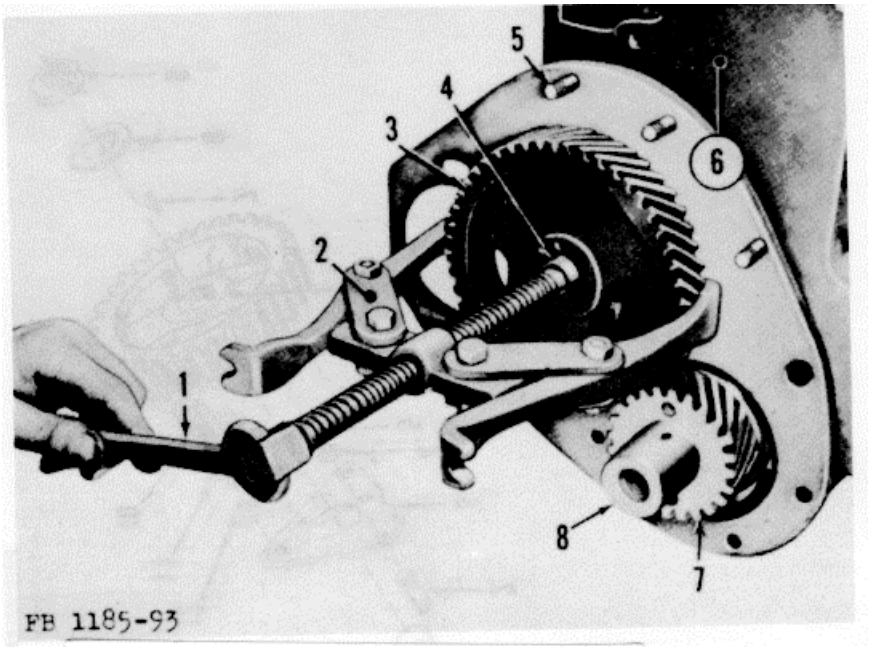
(14) Remove the screw (10), lockwashers (11 and 4), and nuts (5) attaching the thrust plate (3) and oiler plate (12) to the cylinder block.

(15) Remove the oiler plate (12) and the thrust plate (3).

(16) Lift up the end of the camshaft (1) slightly and pull out the camshaft from the cylinder block. Use extreme caution not to score or damage the camshaft bearings.

(17) Do not remove the camshaft bearings (13, 14, 15, and 16) unless they are worn or damaged. If it is necessary to remove the bearings, press or drive them out from the cylinder block.

c. Cleaning. Wash all parts in cleaning solvent and dry them with a soft absorbent cloth or clean compressed air. Be careful not to



1	Wrench	5	Cover stud
2	Gear puller	6	Cylinder block
3	Camshaft gear	7	Crankshaft gear
4	Camshaft	8	Crankshaft

Figure 93. Camshaft gear removal.

damage the cam lobes and camshaft journals. Clean all threaded surfaces with a stiff wire brush and remove all sludge, dirt, and corrosion from the threads.

d. Inspection.

(1) *Alinement.* Place the camshaft in V-blocks and install paper strips soaked in oil under the journals to prevent scoring. Attach a dial indicator to the center journal and rotate the camshaft. Replace a camshaft that is more than 0.003 inch out of line. Attach a dial indicator to the end journal and take a reading in the same manner. Replace a camshaft that is more than 0.003 inch out of line.

(2) *Journals.* Measure each camshaft journal with a micrometer for wear. Replace a camshaft if the journals are worn more than 0.002 inch.

(3) *Bearings.* Replace the bearings if they are worn, damaged, or scored. Insert a thickness gage not wider than one quarter inch between the camshaft and the bearing. The proper clearance is 0.0015 to 0.0025 inch. If one or all of the bearings are worn 0.003 inch, a new set of bearings must be installed. Always install bearings in sets.

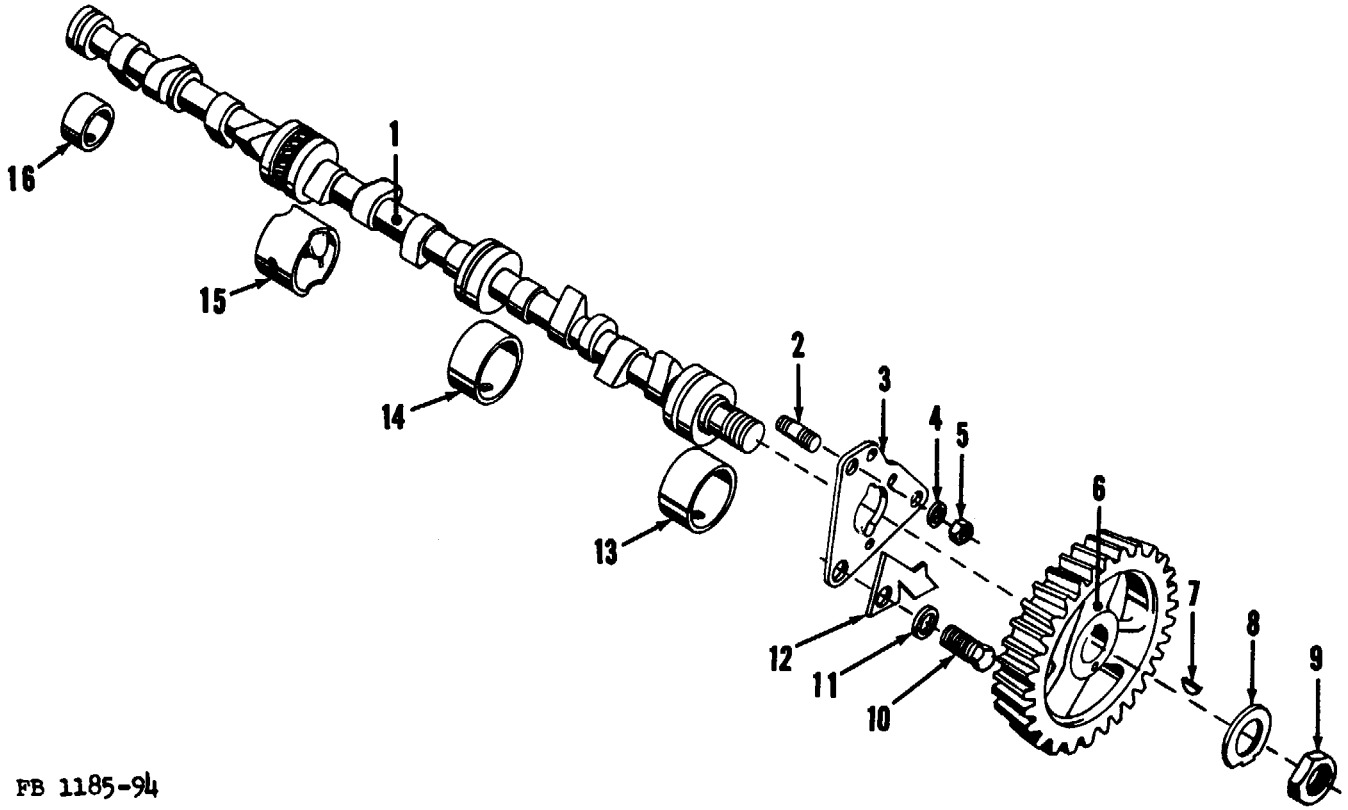


Figure 94. Camshaft disassembled.

1 Camshaft
2 Studs (2 req'd)
3 Thrust plate
4 Washers, lock, std, 3/8 (2 req'd)
5 Nuts, hex, 3/8-16 NC (2 req'd)
6 Gear
7 Key
8 Lockwasher
9 Nut
10 Screw, cap, 7/16-14 NC x 1 1/4
11 Washer, lock, std, 7/16
12 Oiler plate
13 Front bearing
14 Intermediate front bearing
15 Intermediate rear bearing
16 Rear bearing

Figure 94. - Continued

(4) *Screws and studs.* Inspect all mounting screws and studs for damaged, worn, or corroded threads. Replace all defective screws, studs, and nuts.

e. Installation.

(1) If the camshaft bearings have been removed, press them into the cylinder block with an arbor press. Make sure that the oil holes are properly alined. All bearings are precision finished, and line reaming is not necessary.

(2) Install the camshaft (1, fig. 94), being extremely careful not to damage the bearings.

(3) Install the thrust plate (3) and oiler plate (12). Tighten the screws (10) and nuts (5).

(4) Install the key (7) on the camshaft (1).

(5) Position the camshaft gear (6) on the camshaft and see that the keyway in the gear is properly alined with the key (7). Press the gear (6) on the camshaft (1).

(6) Camshaft end play is controlled by the thickness of the thrust plate (3) and the width of the spacer hub on the camshaft. The proper camshaft end play is 0.005 to 0.009 inch. Attach a dial indicator to the cylinder block so that the pointer of the indicator will rest against the face of the camshaft gear. Move the camshaft back and forth and observe the readings on the indicator. If the end play exceeds the high limit, remove the gear and replace the thrust plate (3).

(7) Inspect the camshaft and crankshaft gears for back lash and wear. If a 0.003-inch-thickness gage can be inserted between the matching teeth, the gears must be replaced. If either gear needs to be replaced, replace both gears.

(8) Make sure that the timing marks (3 and 5, fig. 95) on the camshaft and crankshaft gears are properly alined. The marked teeth on the crankshaft gear (4) must be placed between the two marked teeth on the camshaft gear (1).

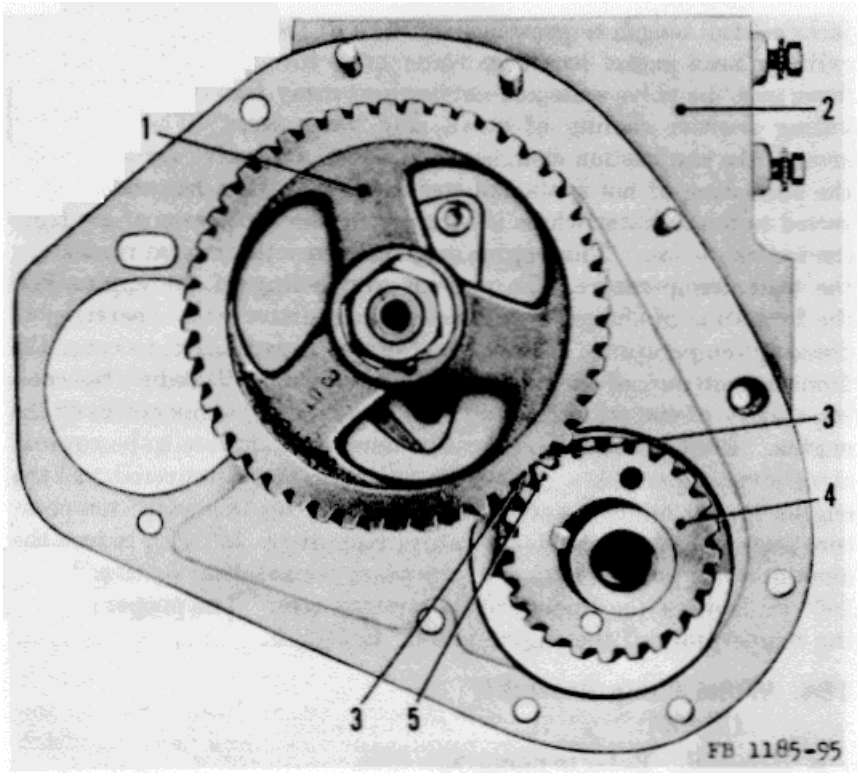
(9) Install the lockwasher (8, fig. 94) and nut (9). Tighten the nut (9) and bend the lip of the lockwasher (8) over the top edge of the nut.

(10) Install valve tappets and valves (par. 136).

(11) Time the valves by adjusting the No. 6 cylinder exhaust valve-tappet clearance to 0.014 inch. Turn the crankshaft until the No. 6 piston is at top dead center and is about to come down for the intake stroke. With the piston in this position, the exhaust valve should be closing and the inlet valve opening. Adjust all valves (par. 136).

(12) Install the oil pump (par. 196).

(13) Install the cylinder head (par. 135).



1 Camshaft gear
2 Cylinder block
3 Camshaft gear timing mark
4 Crankshaft gear
5 Crankshaft gear timing mark

Figure 95. Timing marks.

(14) Coat a new timing gear cover gasket (5, fig. 92) with a fastdrying gasket sealer. Install the gasket on the timing gear cover.

(15) Install the timing gear cover (15) on the cylinder block and tighten all mounting screws (10, 11, and 14).

(16) Install the fan drive pulley and crankshaft jaw (par. 180).

(17) Install the magneto (par. 116).

(18) Install the governor (par. 108).

(19) Install the engine (par. 175). Start the engine and check the timing gear cover for oil leaks. Tighten the mounting screws or replace the oil seal if necessary.

Section IV. COOLING SYSTEM

183. Operational Description of Cooling System

The engine cooling system consists of a suction-type fan, a radiator assembly, and a centrifugal water pump. The cylinder block is water

jacketed full length to prevent distortion of the cylinder walls. The cylinder head gasket has large water holes through which the water flows past the valve seats and carries heat away from the valves, providing positive cooling of valves and valve seats. The waterflow around the combustion chambers, cylinders, and valve seats prevents the formation of hot spots and steam pockets. The hot water is directed to the radiator where it is cooled by the slipstream of air from the ventilator fan. This engine does not have a thermostat regulating the water temperature. To prevent overcooling of the engine and the formation of sludge, always cover the radiator when operating in freezing temperatures. Use canvas, cloth, or cardboard to cover the front bottom part of the radiator. The covering will reduce the cooling surface of the radiator and raise the operating temperature of the engine. Refer to table VII for the amount of surface to be covered at various temperatures. After the radiator has been covered, run the engine for 10 minutes and observe readings on the water temperature gage. If the water temperature rises above 180°F., reduce the amount of the covered area. If the water temperature remains below 160°F., increase the amount of the covered area. The proper operating temperature of the engine is 160° to 180°F.

184. Water Pump Assembly (fig. 96)

a. Removal. Refer to paragraph 130*b.*

b. Disassembly.

(1) Remove the four screws and lockwashers attaching the fan to the water pump pulley (1) and remove the fan.

Table VII. Radiator Surface Covering Chart.

Temp. °F.	Surface to be covered	Temp. °F.	Surface to be covered
+25	1/4	0	1/2
+20	1/4	-10	3/4
+10	3/8	-20 an below	7/8

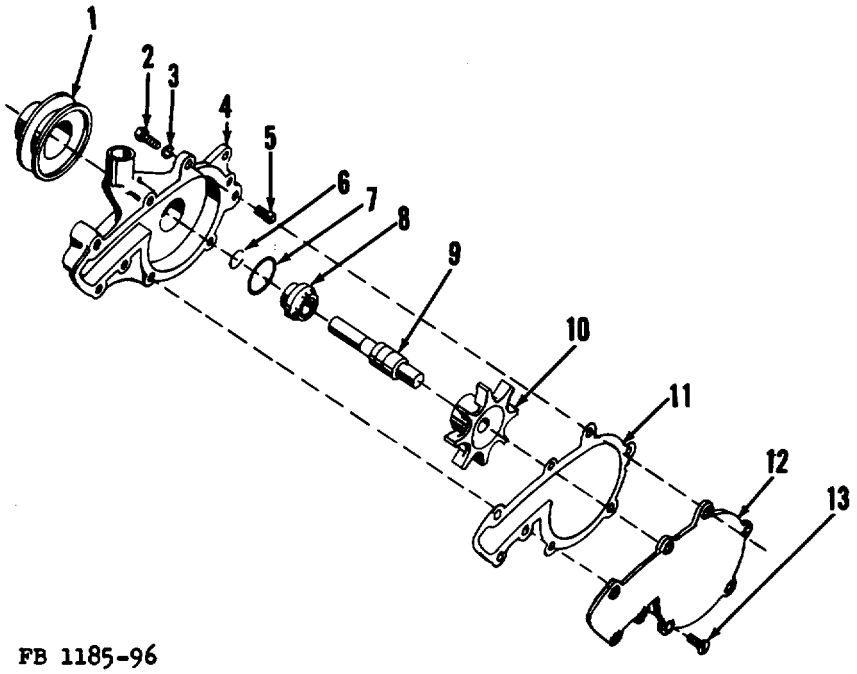
(2) Remove the pulley (1) from the water pump shaft (9).

(3) Remove the cover screws (13) attaching the cover (12) to the water pump body (4). Tap the cover (12) lightly with a plastic hammer and remove it from the body.

(4) Remove and discard the gasket (11).

(5) Pull the impeller (10) off the shaft (9).

(6) Use an arbor press and press the shaft (9) and bearing (8) assembly from the body (4). Be careful not to damage the water pump body when pressing out the shaft and bearing. Make sure that the water pump body



1 Pulley
2 Body screws (4 req'd)
3 Lockwashers (3 req'd)
4 Body
5 Pipe plug
6 Retainer
7 Seal
8 Bearing
9 Shaft
10 Impeller
11 Gasket
12 Cover
13 Cover screws (4 req'd)

Figure 96. Water pump disassembled.

is properly supported before pressing the shaft and bearing assembly out of the water pump body.

(7) Press the bearing (8) off the shaft (9). Support the bearing with a square shouldered mandrel to prevent it from collapsing during the presssing operation.

(8) Remove the retainer (6) and seal (7).

(9) Unscrew and remove the pipe plug (5) from the water pump body (4).

c. Cleaning and Inspection. Wash all parts in cleaning solvent and dry them with clean compressed air or a soft absorbent cloth. Use a stiff wire brush to remove all scale, lime, and rust deposits from the shaft, impeller, and water pump body. Clean the pipe plug threads and all mounting screws with a stiff wire brush and inspect them for corroded, etched, damaged, or stripped threads. Inspect the water pump body, impeller, and machined gasket surfaces for etching, cracks, damage, and wear. Replace the water pump body if it is badly etched, corroded, or cracked.

d. Repair. Replace the bearing if it is worn, corroded, scored, etched, or damaged. Inspect the mounting surfaces of the pump body. Replace the pump if it is badly etched, corroded, or worn. Replace the impeller if corroded or if the fins are broken or damaged. Replace all defective mounting screws.

e. Reassembly.

(1) Use an arbor press and press the bearing (8) on the water pump shaft (9).

(2) Install the seal (7) and retainer (6) on the shaft (9) facing the bearing (8).

(3) Press the impeller (10) on the water pump shaft (9).

(4) Use an arbor press and press the shaft (9), bearing (8), seal (7), and retainer (6) assembly into the water pump body (4).

(5) Install the pipe plug (5).

(6) Coat a new gasket (11) with fast-drying gasket sealer and install it on the water pump cover (12). Make sure that the holes in the gasket and in the cover are properly alined.

(7) Install the cover (12) on the water pump body (4), making sure that the mounting holes in the body, gasket, and cover are properly alined.

(8) Install and tighten the cover mounting screws (13).

(9) Press the water pump pulley (1) on the shaft (9). Check the water pump shaft for free rotation.

f. Installation. Refer to paragraph 130*c*.

185. Radiator Assembly (fig. 44)

a. Removal. Refer to paragraph 129.

b. Top tank.

(1) *Disassembly.* Refer to paragraph 129*c*.

(2) *Cleaning and inspection.* Discard the top tank gasket (9) and wash the top tank (8) in cleaning solvent. Clean all corners and recesses in the top tank with a stiff brush. Remove accumulated sludge, lime, corrosion, and foreign matter from the top tank. Inspect the tank for etching, cracks, breaks, and leaks. Inspect all mounting screws for corroded, damaged, or stripped threads. Check the mounting surface of the top tank for breaks, cracks, and dents.

(3) *Repair.* Use soft-faced hammers to pound out all dents in the mounting surfaces and top tank body. Weld or solder all cracks, breaks, and holes. Avoid excessive heat when welding or soldering, as it may warp or distort the top tank body. Replace the top tank if it is badly etched, corroded, or cracked. Replace all

damaged and defective mounting screws, nuts, and lockwashers. Always use a new top tank gasket when reassembling the top tank of the radiator core.

(4) *Reassembly.* Refer to paragraph 129*d*.

c. Bottom Tank.

(1) *Disassembly.* Refer to paragraph 129*c*.

(2) *Cleaning and inspection.* Discard the bottom tank gasket (14) and wash the bottom tank (17) in cleaning solvent. Use a stiff brush to clean all openings, corners, and recesses in the tank body. Clean the inside and outside surfaces of the outlet pipe and remove all traces of the gasket sealer from the mounting surface of the outlet pipe. Inspect the bottom tank for cracks, leaks, corrosion, etching, and damage. Inspect the mounting surface of the tank and clean it thoroughly. Remove all traces of the old gasket from the mounting surface and inspect the mounting ridge for bents, dents, and cracks. Inspect all mounting screws, nuts, and lockwashers for corrosion, damage, wear, and stripped threads.

(3) *Repair.* Weld all minor cracks, breaks, and holes. If the bottom tank is badly corroded, etched, or cracked, replace it. Avoid excessive heat when welding, because it may warp or distort the tank body. Replace the bottom tank if badly warped or if the mounting surfaces are distorted or bent out of shape. Replace all worn or defective mounting screws, nuts, and lockwashers. Always use a new bottom tank gasket when reassembling the bottom tank to the radiator core.

(4) *Reassembly.* Refer to paragraph 129*d*.

d. Installation. Refer to paragraph 129.

Section V. FUEL SYSTEM

186. Operational Description of Fuel System

The fuel system of this road roller is of the gravity type. The fuel tank is located under the compression roll housing, above the carburetor and engine mounting level. There is no fuel pump on this road roller. When the fuel tank valves are opened, the gravity of the fuel forces the fuel to flow to the carburetor. The updraft type carburetor vaporizes the fuel and directs the vaporized fuel and air mixture into the intake manifold and cylinder combustion chambers, where it is ignited and converted into a mechanical force.

187. Carburetor

a. Removal. Refer to paragraph 106*b*.

b. Disassembly.

(1) Remove the flange gasket (1, fig. 97) from the top of the throttle body (3).

(2) Unscrew and remove the fuel filter elbow (8).

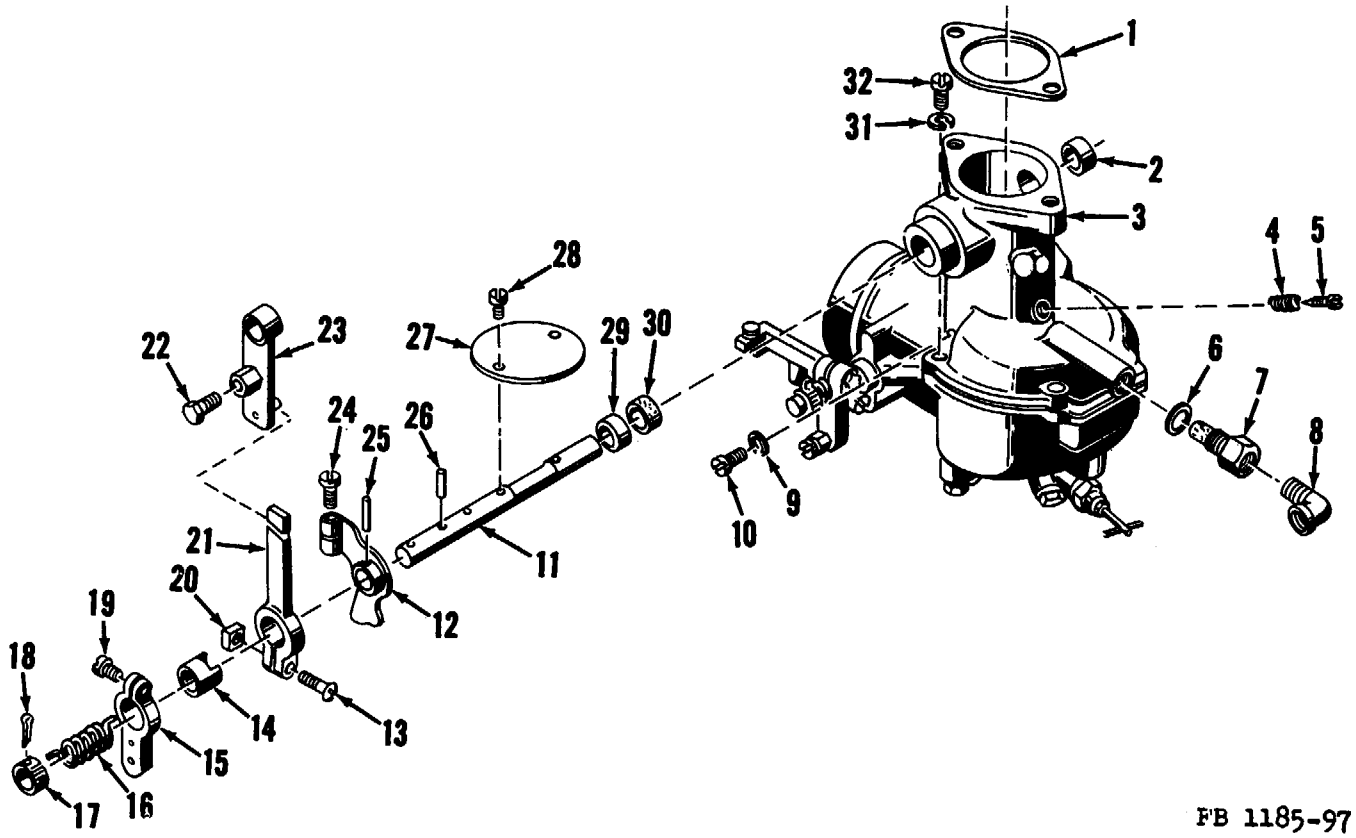


Figure 97. Carburetor throttle disassembled.

1 Flange gasket
2 Throttle shaft plug
3 Throttle body
4 Idle adjusting needle spring
5 Needle valve stem
6 Filter head gasket
7 Filter head
8 Elbow
9 Lockwasher
10 Venturi screw
11 Throttle shaft
12 Throttle stop lever
13 Stop clamp screw
14 Throttle shaft driver
15 Throttle clamp lever
16 Throttle lever spring
17 Spring retainer
18 Retainer cotter pin
19 Lever clamp screw
20 Clamp screw nut
21 Floating lever stop
22 Swivel screw
23 Floating lever and swivel
24 Lever stop screw
25 Stop lever pin
26 Throttle shaft pin
27 Throttle plate
28 Throttle plate screw
29 Packing retainer
30 Packing
31 Lockwasher
32 Bowl screw

Figure 97. -Continued.

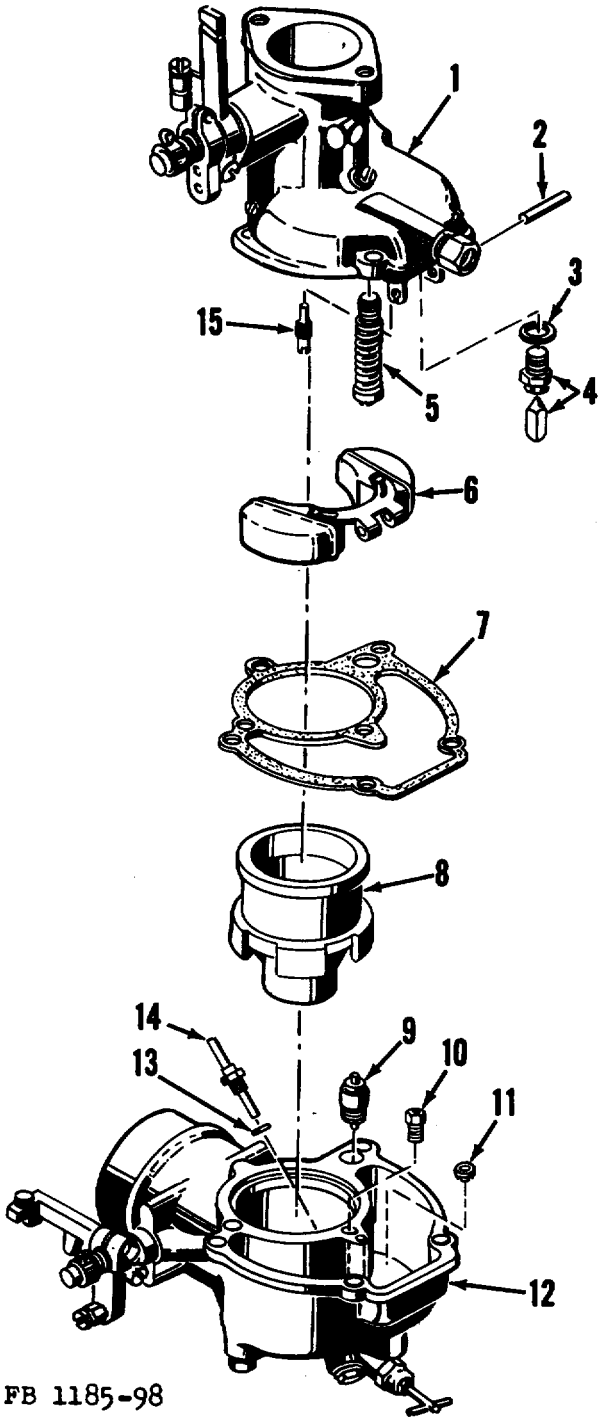


Figure 98. Carburetor fuel bowl disassembled.

(3) Remove the six mounting screws (32) and lockwashers (31) attaching the throttle body (3) to the fuel bowl.

(4) Lift the throttle body (3) slightly up and away from the fuel bowl (12, fig. 98).

(5) Loosen the gasket (7) from the machined surface on the throttle body (1).

(6) Remove the throttle body (1) being careful not to damage the float (6) assembly.

(7) Unscrew and remove the filter head (7, fig. 97) and gasket (6).

(8) To remove the pump (5, fig. 98), press it downward against the spring and then withdraw it sharply, striking the upper part against the retainer in the body.

(9) Press a screwdriver against the float axle (2) at the slotted side of the float hinge bracket and force the axle through the hinge bracket. Remove the axle (2) with fingers from the opposite side.

(10) Remove the float (6).

(11) Remove the fuel valve and seat (4) assembly.

(12) Remove the fuel valve seat gasket (3) from the machined surface of the throttle body (1).

(13) Remove the idle jet (15) from the passage in the throttle body (1) near the fuel valve seat (4).

(14) Remove the idle adjusting needle valve stem (5, fig. 97) and friction spring (4) from the side of the throttle body (3).

(15) Remove the venturi tube screw (10) and lockwasher (9) and lift out the venturi tube (8, fig. 98) from the throttle body.

(16) Use long-nosed pliers and pull out the retainer cotter pin (18, fig. 97) from the retainer (17).

(17) Remove the spring retainer (17) and throttle lever spring (16).

(18) Loosen the lever clamp screw (19) and slide the throttle clamp lever (15) off the throttle shaft (11).

(19) File off the riveted ends of the throttle plate screws (28) and remove them from the throttle plate (27).

(20) Lift up and remove the throttle plate (27).

---

1 Throttle body
2 Float axle
3 Fuel valve seat gasket
4 Valve and seat
5 Pump
6 Float
7 Gasket
8 Venturi
9 Power jet valve
10 Well vent jet
11 Pump check valve
12 Bowl
13 Discharge jet gasket
14 Discharge jet
15 Idle jet

Figure 98. - Continued.

(21) Remove the throttle shaft plug (2) from the throttle body (3).

(22) Pull out and remove the throttle shaft (11) assembly from the throttle body (3).

(23) Remove the packing (30) and packing retainer (29) from the throttle shaft (11).

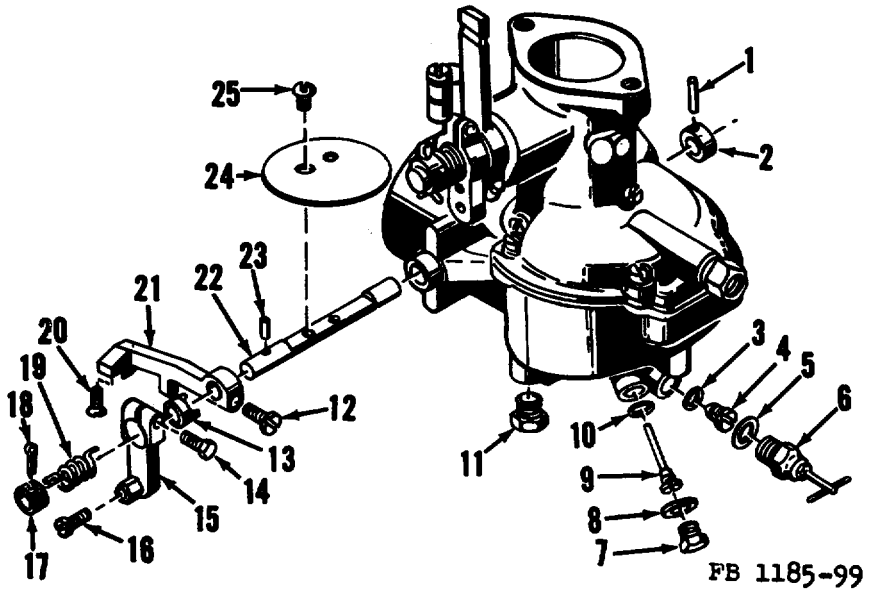
(24) Hold the clamp screw nut (20) with an open-end wrench and loosen the stop clamp screw (13).

(25) Slide the floating lever stop (21) and floating lever and swivel (23) off the throttle shaft (11).

(26) Use long-nosed pliers and pull out the stop lever pin (25).

(27) Loosen the lever stop screw (24) and remove the throttle stop lever (12) from the throttle shaft (11).

(28) Use an open-end wrench and turn the main jet adjustment assembly (6, fig. 99) counterclockwise. Remove



1	Thrust collar pin	14	Clamp screw
2	Thrust collar	15	Choke lever
3	Main Jet gasket	16	Swivel screw
4	Main jet	17	Spring retainer
5	Adjustment gasket	18	Retainer cotter pin
6	Main jet adjustment	19	Lever spring
7	Passage plug	20	Tube clamp screw
8	Passage plug gasket	21	Choke bracket
9	Power jet	22	Choke shaft
10	Power jet gasket	23	Shaft pin
11	Bowl drain plug	24	Choke plate
12	Bracket clamp screw	25	Choke plate screw
13	Choke shaft driver		

Figure 99. Carburetor choke disassembled.

the main jet adjustment assembly (6) and gasket (5) from the side of the fuel bowl.

(29) Remove the bowl drain plug (11) from the outside bottom of the fuel bowl.

(30) Remove the passage plug (7), gasket (8), power jet (9), and power jet gasket (10) from the threaded angle passage in the outside of the fuel bowl.

(31) Use a main jet wrench (41-W-1560) to remove the main jet (4) and main jet gasket (3) from the threaded passage in the bottom side of the fuel bowl.

(32) Use a special wrench (41-W-1866) to remove the discharge jet (14, fig. 98) and gasket (13) from the center of the large opening in the fuel bowl's machined surface.

(33) Remove the well vent jet (10) from the machined surface of the fuel bowl (12).

(34) Use an extractor (41-E-555-20) to remove the power jet valve (9) from the bottom of the pump cylinder.

(35) Use long-nosed pliers and pull out the retainer cotter pin (18) from the spring retainer (17).

(36) Loosen the clamp screw (14) and remove the lever spring (19) and choke lever from the choke shaft (22).

(37) Loosen the bracket clamp screw (12) and remove the choke bracket (21) and choke shaft driver (13) from the choke shaft (22).

(38) Remove the choke plate screws (25) and lift out the choke plate (24).

(39) Use a small drift and drive out the thrust collar pin (1).

(40) Remove the thrust collar (2).

(41) Pull out and remove the choke shaft (22).

(42) Use a small drift and drive out the choke shaft pin (23).

c. Inspection and Repair.

(1) Wash all metal parts in cleaning solvent and dry them with clean compressed air.

(2) Blow out all passages in the air intake assembly, fuel bowl assembly, and throttle body.

(3) Inspect the float. Replace the float if it is filled with fuel, damaged, bent, or if the float axle bearing is worn. Check the top side of the float lever for wear where it contacts the fuel valve needle.

(4) Inspect and replace the float axle if it is worn, bent, damaged, or corroded.

(5) Replace the fuel valve seat and valve assembly.

(6) Inspect the point of the idle adjustment needle and replace if worn or damaged.

(7) Inspect the throttle plate for burrs, cracks, warpage, or damaged edges. Replace the plate. if necessary. Do not clean the plate with a buffing wheel or sharp instrument. Remove all rust and carbon with No. 00 sandpaper.

(8) Inspect the pump for burrs, scratches, carbon, and rough edges. Check the fit of the pump in the cylinder. If clearance between the pump and cylinder at the operating end exceeds 0.003 inch, the pump must be replaced.

(9) Replace the power jet valve.

(10) Replace all gaskets.

(11) Inspect the choke plate for twisting, burrs, broken or damaged edges, and wear. Replace if necessary.

(12) Inspect the choke and throttle shafts for wear and damage. If the shafts are bent, twisted, corroded, or worn, replace them.

(13) Inspect the venturi tube, jets, and all threaded surfaces for wear and damage.

(14) Inspect all machined surfaces for cracks, breaks, etching, and corrosion. Replace all worn or damaged parts.

d. Reassembly.

(1) Install the pump check valve (11, fig. 98) in the bottom of the fuel bowl (12). Make sure that the small opening of the valve is up and that the valve is properly alined. Drive in the valve until it strikes bottom.

(2) Hold the fuel bowl (12) facing the air entrance with the machined surface up and install the thrust collar (2, fig. 99).

(3) Install the choke shaft (22) in the fuel bowl. Rotate the shaft until the flat section of the shaft is facing down.

(4) Center the choke plate (24) in closed position and aline the mounting holes with the threaded holes in the shaft (22). Install the choke plate screws (25) but do not tighten them.

(5) Tap the choke plate (24) lightly to center it and tighten the screws (25) firmly and evenly.

(6) Install the collar pin (1) and choke shaft pin (23).

(7) Install the choke bracket (21) and bracket clamp screw (12) on the choke shaft (22).

(8) Install the choke shaft driver (13), choke lever (15), and clamp screw (14).

(9) Check to see that the notch in the choke shaft driver (13) fits over the pin (23).

(10) Install the lever spring (19) on the shaft and enter the spring end into the hole on the choke shaft driver (13).

(11) Install the spring retainer (17) on the choke shaft (22) and insert the end of the spring (19) into the hole in the spring retainer.

(12) Turn the spring retainer (17) one-half turn in clockwise direction. Install the cotter pin (18) in the spring retainer (17) and shaft (22). Spread the cotter pin ends. Operate the choke shaft (22) and make sure that the choke plate (24) will open and close.

(13) Install the well vent jet (10, fig. 98) in the fuel bowl (12) and tighten it lightly with a screwdriver.

(14) Install the power jet (9, fig. 99) and gasket (10) in the threaded angular passage in the bottom of the fuel bowl.

(15) Install the discharge jet (14, fig. 98) and gasket (13) in the fuel bowl (12) and tighten it with the jet wrench (41-W-1866).

(16) Use a main jet wrench (41-W-1560) to install the main jet (4, fig. 99) and main jet gasket (3) in the large threaded passage of the fuel bowl.

(17) Install the plug (7) and gasket (8) in the threaded passage over the power jet (9).

(18) Install the main jet adjustment assembly (6) and gasket (5) in the threaded passage over the main jet (4).

(19) Install the drain plug (11) in the threaded passage on the bottom of the fuel bowl.

(20) Position the power jet valve (9, fig. 98) on the formed end of a special wrench (41-W-1868) and install the valve in the bottom of the pump cylinder.

(21) Place the throttle body (3, fig. 97) on a bench with the mounting flange up and facing the idling port plug on the inside of the throttle body bore.

(22) Insert the throttle shaft (11) in the throttle body (3) so that the levers may be assembled in the same position as removed.

(23) Assemble the packing (30) and packing retainer (29) on the throttle shaft (11).

(24) Rotate the throttle shaft (11) until the shaft screw holes are up when the slot in the shaft is in a vertical position. The screw holes in the throttle plate (27) are off center. Start the side of the throttle plate (27) which has the shortest distance between the screw holes and the beveled edge into the shaft first. Remember that the plate has two opposite edges beveled to fit the body bore when the plate is closed and will not close if installed upside down.

(25) Start the screws (28) in the shaft and close the plate (27). Tap the plate (27) on the mounting flange side and maintain pressure with fingers until the screws (28) are tightened securely. When properly installed, the side of the plate farthest from the mounting flange will be alined with the idle port when the plate is

closed. Do not attempt to rivet the threaded ends of the plate screws (28).

(26) Install the throttle shaft pin (26).

(27) Install the throttle shaft driver (14) and throttle clamp lever (15) on the floating lever stop (21).

(28) Install the throttle stop lever (12) and secure it with the pin (25) and stop screw (24).

(29) Install the floating lever stop (21) and tighten the stop clamp screw (13).

(30) Install the spring (16) and enter the projected end of the spring in a hole in the driver (14).

(31) Install the spring retainer (17) on the shaft (11) and enter the outer end of the spring (16) in the drilled hole.

(32) Turn the spring retainer (17) clockwise one full turn and insert the cotter pin (18). Spread the ends of the cotter pin.

(33) Install the needle valve stem (5) and needle spring (4) in the threaded passage on the rear of the throttle body (3).

(34) Install the floating lever and swivel (23) on the floating lever stop (21).

(35) Install the throttle shaft plug (2).

(36) Insert the venturi tube (8, fig. 98) in the throttle body bore with the large opening first. Rotate the tube (8) until the screw hole is alined with the hole in the throttle body (1). Install and tighten the venturi screw (10, fig. 97) and lockwasher (9).

(37) Install the idle jet (15, fig. 98) in the counterbored passage on the machined surface next to venturi.

(38) Use a special wrench (41-W-1496) to install the fuel valve and seat (4) and gasket (3).

(39) Install the float (6) and float axle (2).

(40) Check the position of the float (6) assembly for correct measurement to obtain proper fuel level in the fuel bowl. The float must move freely on its axle. When the throttle body is in an inverted position, viewed from the free end of the float, both float sections must be centered and at right angles to the machined surface. The float setting is measured from the machined surface (not the gasket) of the throttle cover to the top side of the float body at its highest point. This measurement should be 11%2 inches. Use long-nosed pliers to bend the float lever so that the distance between the float body and the machined surface is increased or decreased.

(41) Install the pump (5.) in the vacuum cylinder of the throttle body. Press the retainer in place and check the pump for free movement in the cylinder. If the pump piston has been disassembled, make sure that it is

reassembled on the guide rod in the same groove as when removed. The pump guide rod has three grooves at the lower end to determine the pump stroke length. Reassemble the piston with the slot in the center of the uppermost groove when a full stroke is required. The center groove is used for a three-quarter stroke and the bottom groove for a half stroke.

(42) Install the gasket (7) on the throttle body (1).

(43) Assemble the throttle body (1) on the fuel bowl (12). Install the mounting screws (32, fig. 97) and lockwashers (31) and tighten them firmly and evenly.

(44) Rotate the carburetor in your hand, listening carefully for the sound of the float dropping from open to closed position, to make sure that it has not been jammed or stuck during reassembly.

(45) Install the filter head gasket (6) and filter head (7) in the throttle body (3).

(46) Install the fuel filter elbow (8) in the fuel filter head (7).

(47) Install the carburetor flange gasket (1) on the throttle body (3).

e. Installation. Refer to paragraph 106*c*.

188. Governor (fig. 100)

a. Description. Refer to paragraph 108*a*.

b. Removal. Refer to paragraph 108*b*.

c. Disassembly.

(1) Place the governor assembly on a bench or other clean working surface, and remove the items (11) through (24) as an assembly from the body (5).

(2) Support the lever (2) so that it will not bend and drive out the grooved pin (8) with a small drift.

(3) Remove the lever (2) from the body (5).

(4) Remove the body plug (27), body bushing (26), bearing (4), and oil seal (3).

(5) Remove the pipe plug (28), bumper screw (29), and nut (30) from the governor body (5).

(6) Remove the bumper spring (6) and fork (7).

(7) Remove the governor shaft clip (11), flatwashers (12), and ball stop washer (13) from the shaft (18).

(8) Remove the base fork (14) from the upper race (16) and lift off the thrust bearing (15).

(9) Slide the upper race (16) from the shaft (18) and lay the balls (17) aside.

(10) Use an arbor press to remove the governor drive gear (24) from the governor shaft (18).

(11) Remove the governor base (22).

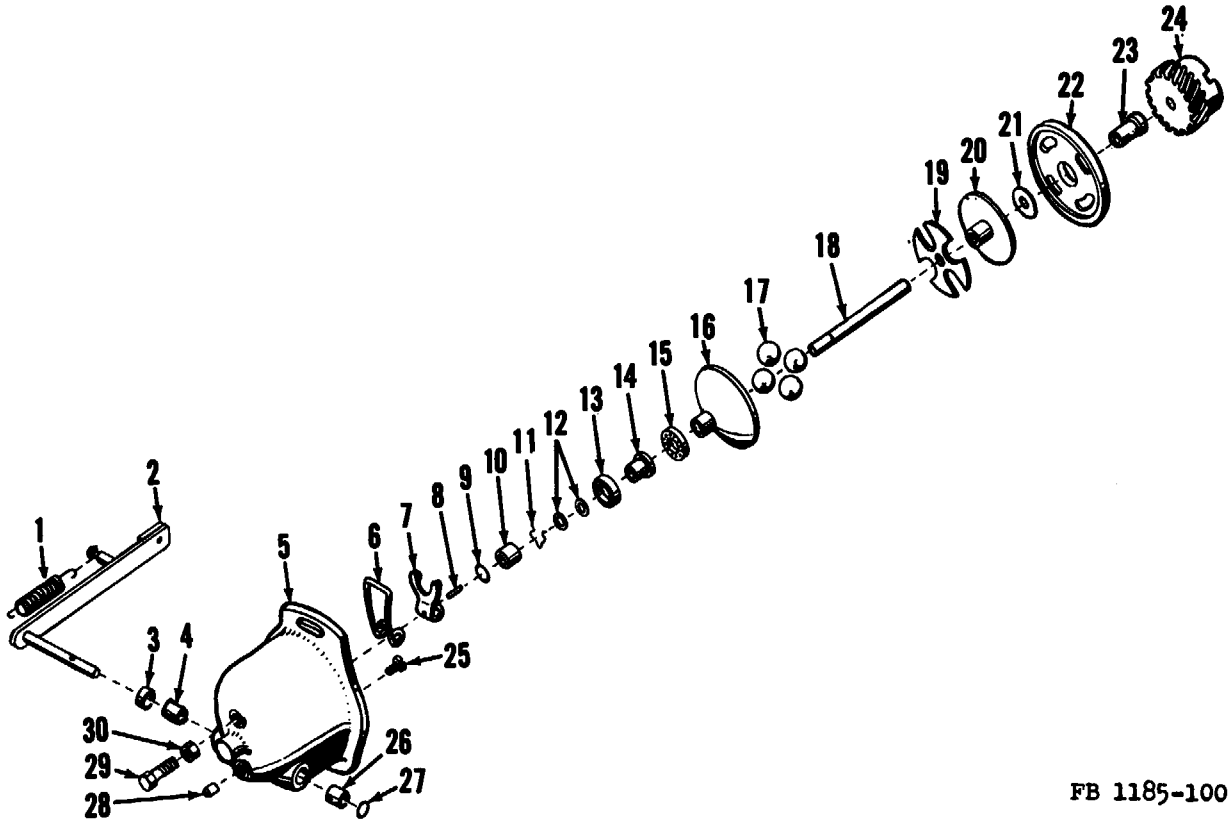


Figure 100. Governor disassembled.

1 Governor spring
2 Lever
3 Oil seal
4 Bearing
5 Body
6 Bumper spring
7 Fork
8 Grooved pin
9 Thrust washer
10 Bushing
11 Governor shaft clip
12 Flatwasher
13 Ball stop washer
14 Base fork
15 Thrust bearing
16 Upper race
17 Balls (4 req'd)
18 Drive shaft
19 Ball driver
20 Lower race
21 Thrust washer
22 Base
23 Base bushing
24 Drive gear
25 Locating screw
26 Body bushing
27 Body plug
28 Pipe plug
29 Bumper screw
30 Nut

Figure 100. - Continued.

(12) Lift off the thrust washer (21) and remove the lower race (20) from the governor shaft (18).

d. Inspection and Repair.

(1) Inspect the body bushing. If it is worn, damaged, cracked, or broken, replace it. Check the governor shaft and replace it if bent, twisted, or cracked.

(2) See that there are no broken teeth on the governor drive gear. If any teeth are broken, cracked, or chipped, replace the gear.

(3) Replace all worn, corroded, damaged, or cracked bearings.

(4) Do not remove the ball driver from the governor shaft unless either the shaft or the ball driver is to be replaced. If the driver is to be removed, heat it with a torch to remove the brazing and press the driver from the shaft. Press a new driver on the shaft and secure it by brazing.

(5) Inspect and replace all worn, damaged, or broken washers.

(6) Inspect the bushing in the base. If the bushing is worn, damaged, or cracked, drive it out with a cold chisel and press a new bushing into the base.

(7) Inspect the governor body for breaks, cracks, warpage, and damaged mounting surface. Replace the body if necessary.

(8) Inspect all screws and nuts for corrosion, damaged, worn, or stripped threads. Replace all defective screws and nuts.

e. Reassembly.

(1) Install the lower race (20), thrust washer (21), and base (22) on the governor shaft (18).

(2) Press the governor drive gear (24) into position on the shaft (18).

(3) Hold the governor drive shaft (18) in a vertical position, with the governor drive gear (24) at the lower end. Place the steel balls (17) in their slots on the ball driver (19).

(4) Place the upper race (16) in position over the governor shaft (18) and the balls (17).

(5) Place the thrust bearing (15) and base fork (14) over the sleeve end of the upper race (16).

(6) Install the ball stop washer (13) and flat washers (12). Secure the assembly with a clip (11).

(7) If the bushing (10) and thrust washer (9) have been removed, install the thrust washer in the body and press the bushing into the body.

(8) Install the bearing (4) and oil seal (8).

(9) Hold the bumper spring (6) and fork (7) in position in the governor body (5) and slide the lever (2) into place in the body (5).

(10) Support the lever (2) to avoid bending it and aline the grooved pin holes in the shaft and the fork.

(11) Install the grooved pin (8).

(12) Install the bushing (26) and body plug (27).

(13) Instal the pipeplug (28) in the body (5).

(14) Run the nut (30) part way on the bumper screw (29) and install the screw in the governor body. Leave the screw and nut loose for adjustment after installation.

(15) Install items (11) through (24) in the body (5) as an assembly.

(16) Install the locating screw (25) in the governor body (5).

f. Installation. Refer to paragraph 108d.

g. Adjustment. Refer to paragraph 108e.

Section VI. ENGINE ELECTRICAL SYSTEM

189. Description

The 12-volt engine electrical system consists of the starting circuit, the charging circuit, and the ignition circuit. The starting circuit includes two 6-volt batteries, ignition switch, magnetic switch, starter button, starting motor, and shielded wiring. The charging circuit includes a 12-volt battery charging generator, voltage regulator, two 6-volt batteries, ammeter, and shielded wiring. The ignition circuit includes radio shielded magneto, shielded spark plugs, and shielded spark plug leads.

190. Magneto

a. Removal. Refer to paragraph 116*c*.

b. Disassembly.

(1) Remove the four screws (39, fig. 101) attaching the end cap (2) to the frame and separate the end cap assembly from the frame assembly.

(2) Remove the gasket (6).

(3) Remove the high-tension lead rod (9).

(4) Remove the screws (18) attaching the distributor block (7) to the end cap (2).

(5) Lift out the distributor block (7) from the end cap (2) and remove the distributor brush (8).

(6) Remove the vent screws (5), vent hoods (4), and vent screens (3).

(7) Unscrew and remove the high-tension inserts (1).

(8) Unscrew-the ground cable nut (37) and remove the ferrule (36), insulator washer (35), and insulator (34). Unscrew and remove the ground cable terminal (33).

(9) Lift up and remove the distributor rotor (17).

(10) Remove the condenser mounting screw (29) and lockwasher (14).

(11) Remove the screw (27) and lockwasher (26) attaching the condenser and coil leads to the breaker arm (23). Disconnect the leads from the breaker arm (23) and lift out the condenser (28) from the magneto frame.

(12) Remove the stationary support bracket locking screws (5 and 32), lockwashers (19 and 14), and plate washers (20 and 31).

(13) Spread and remove the snap ring (22).

(14) Lift out and remove the stationary support bracket (21), breaker arm (23), cam wick (30), and primary ground spring (24) from the magneto frame.

(15) Spread and remove the distributor shaft snap ring (10) and distributor bearing snap ring (16).

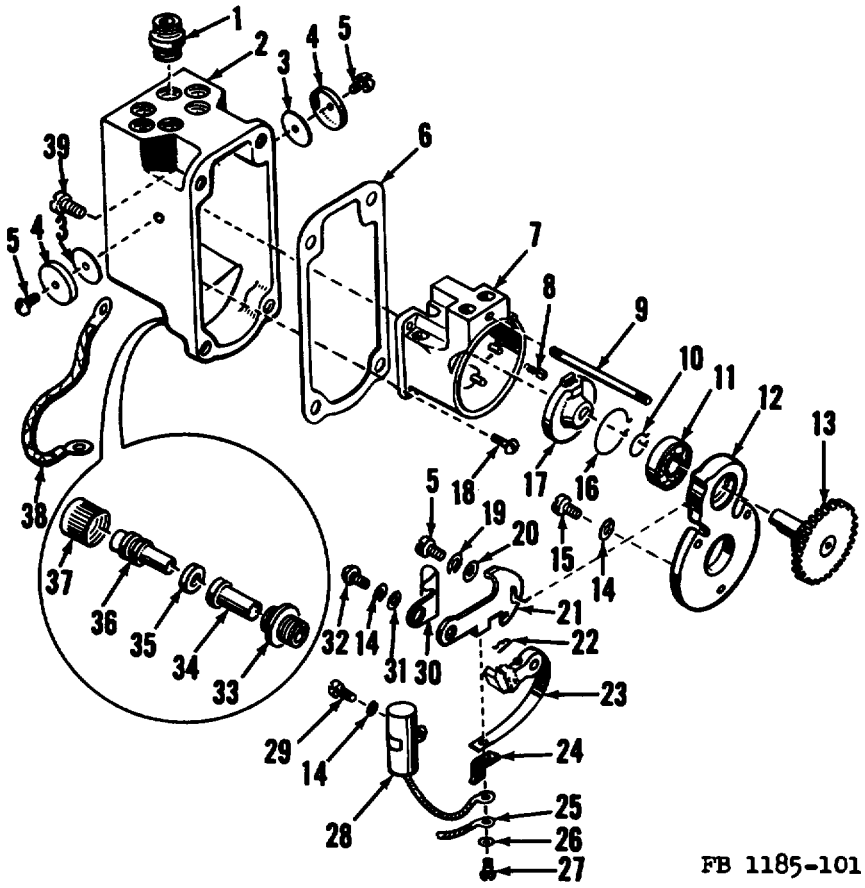


Figure 101. Magneto end cap disassembled.

(16) Remove the bearing support mounting screws (15) and lockwashers (14) and lift out the bearing support (12) from the magneto frame.

(17) Remove the distributor bearing (11) and distributor gear (13).

(18) Remove the gaskets (23, fig. 102) and spacer (24) from the magneto frame (14).

(19) Bend the ears of the lockwasher (26) away from the impulse coupling nut (25) and remove the nut and lockwasher. Discard the lockwasher (26).

(20) Pull the impulse coupling assembly as an integral unit from the rotor shaft. Remove the key (19).

(21) Allow the drive spring (20) to unwind slowly and disconnect the spring ends from the slots in the impulse coupling shell (27) and hub (21).

(22) Remove the pawl springs (18) from the impulse coupling hub (21).

(23) Remove the disk (17), seal washer (16), and drive end seal (15).

(24) Pull out the rotor (5) from the drive end frame (14) and remove the bearing (9), shims (8), and seal (7).

(25) Pull the bearing (1) off the shaft and remove the rotor shaft shims (2) and thrust washer (3).

(26) Drive out the rotor gear pin (28) and remove the rotor gear (4).

(27) Loosen the coil bridge setscrews (10) and pull out the coil (6) from the magneto drive end frame (14).

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1 High-tension inserts (6 req'd)
2 End cap
3 Vent screens (2 req'd)
4 Vent hoods (2 req'd)
5 Screws (3 req'd)
6 Gasket
7 Distributor block
8 Brush
9 High-tension lead rod
10 Distributor shaft snap ring
11 Distributor bearing
12 Bearing support
13 Distributor gear
14 Lockwashers (5 req'd)
15 Bearing support screws (3 req'd)
16 Distributor bearing snap ring
17 Distributor rotor
18 Distributor block screws (4 req'd)
19 Lockwashers (2 req'd)
20 Plate washer
21 Stationary support bracket
22 Snap ring
23 Breaker arm
24 Primary ground spring
25 Coil lead
26 Lockwasher
27 Breaker arm terminal screw
28 Condenser
29 Condenser screw
30 Cam wick
31 Plate washer
32 Locking screw
33 Ground cable terminal
34 Insulator
35 Insulator washer
36 Ferrule
37 Ground cable nut
38 Ground lead
39 End cap screws (4 req'd)

Figure 101. -Continued.

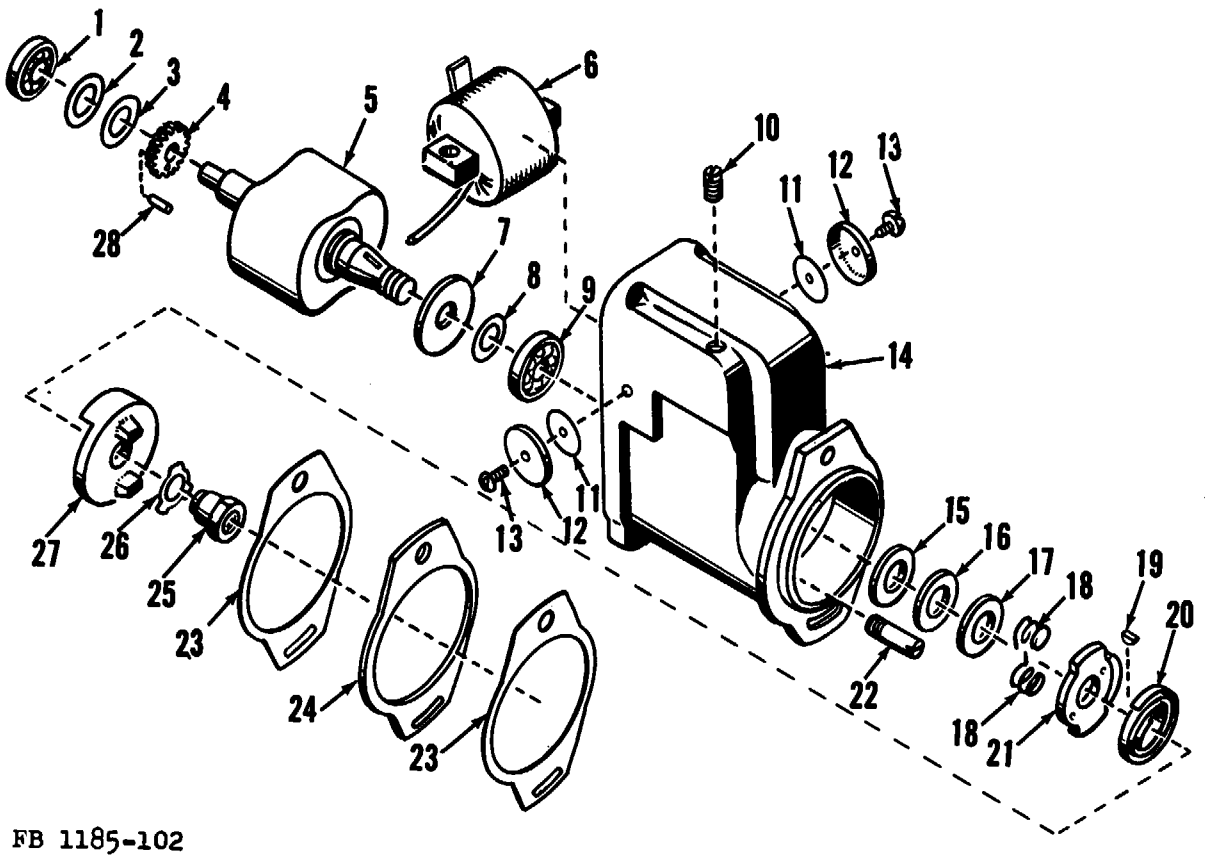


Figure 102. Magneto drive end frame disassembled.

1 Bearing
2 Rotor shaft shims (2 req’d)
3 Thrust washer
4 Rotor gear
5 Rotor
6 Coil
7 Seal
8 Coupling end shims (2 req’d)
9 Drive end bearing
10 Setscrews (2 req’d)
11 Vent screens (2 req’d)
12 Vent hoods (2 req’d)
13 Vent hood screws (2 req’d)
14 Frame
15 Drive end seal
16 Seal washer
17 Disk
18 Pawl springs (2 req’d)
19 Key
20 Drive spring
21 Impulse coupling hub
22 Stop pin
23 Gaskets (2 req’d)
24 Spacer
25 Impulse coupling nut
26 Lockwasher
27 Impulse coupling shell
28 Rotor gear pin

Figure 102. -Continued.

(28) Unscrew and remove the stop pin (22).

(29) Remove the vent hood screws (13), vent hoods (12), and vent screens (11).

c. Inspection and Repair.

(1) Wash all metal parts in cleaning solvent, except the condenser, coil, bearings, and breaker contacts. Dry all parts with clean compressed air.

(2) Inspect the vent screens for corrosion, torn or damaged meshwork, and foreign matter. Blow the screens clean with compressed air.

(3) Inspect the distributor block for breaks, cracks, carbon tracking, burned electrodes, and a worn or damaged brush. Replace all defective parts.

(4) Replace the distributor rotor if broken, cracked, or oil soaked, or if the contact surface is burned, pitted, or chipping.

(5) Place the condenser on a tester and test it for capacity, series resistance, and leakage resistance. The condenser capacity must be between 0.17 to 0.22 microfarad. The series resistance must not exceed 0.4 ohm. The leakage resistance must be not less than 50,000 ohms.

(6) Replace the breaker arm and stationary contact support. Replace these parts in sets. Do not install a new breaker arm with a used stationary bracket support, or a new stationary bracket support with a used breaker arm.

(7) Check the tension of the breaker arm spring. The correct tension is from 15 to 30 ounces.

(8) Inspect all bearings for cracks, scoring, damage, flaws, and wear. Replace all defective bearings.

(9) Inspect the rotor shaft journals. Replace the rotor if the journals are worn, etched, or pitted. Check the rotor for breaks, cracks, and twisting. Replace the rotor if worn or damaged.

(10) Inspect all seals and shims for wear, corrosion, chipped edges, and cracks. Replace all defective seals and shims.

(11) Replace the lockwasher of the impulse coupling nut.

(12) Inspect all drive gears for broken, chipped, worn, or pitted teeth. Replace the gears if worn or damaged.

(13) Check all mounting and assembly screws for damaged, corroded, or stripped threads. Replace all defective screws.

(14) Inspect the drive spring and pawl springs for corrosion, twisting, and metal fatigue. Replace defective or worn springs.

d. Reassembly.

(1) Install the seal (7, fig. 102) and shims (8) on the rotor (5) and press the bearing (9) on the rotor shaft.

(2) Install the rotor gear (4) on the rotor shaft and secure it with a new rotor gear pin (28).

(3) Install the thrust washer (3), rotor shaft shims (2), and bearing (1) on the rotor shaft.

(4) Install the coil (6) in the drive end frame (14) and tighten the setscrews (10). Bend the coil lead upward so that it will not interfere with the rotor shaft installation.

(5) Install the stop pin (22).

(6) Install the rotor (5) in the drive end frame (14).

(7) Install the drive end seal (15), seal washer (16), and disk (17) on the rotor shaft.

(8) Install the pawl springs (18) on the impulse coupling hub (21).

(9) Engage the outer end of the spring (20) in the slot of the impulse coupling shell (27) and wind up the spring until it is compressed sufficiently to fit completely into the impulse coupling shell.

(10) Lift the inside end of the spring (20) just enough to engage it with the anchoring slot in the impulse coupling hub (21). Secure the spring in the slot.

(11) Turn the hub (21) and wind up the spring (20) three-quarters of a turn until both of the cam lugs on the hub have passed once over both of the cam lugs on the impulse coupling shell (27). Press the hub (21) and shell (27) together.

(12) Install the key (19) and press the impulse coupling assembly on the rotor shaft.

(13) Install the lockwasher (26) and impulse coupling nut (25). Tighten the nut (25). Bend the ears of the lockwasher (26) over the nut (25).

(14) Install the vent screws (11), vent hoods (12), and vent hood screws (13).

(15) Install the distributor gear (13, fig. 101) and distributor bearing (11) in the bearing support (12). Make sure that the filed-off tooth on the rotor gear (4, fig. 102) is meshing with the two teeth marked "C" on the distributor gear (13, fig. 101). With gears in this position, the magneto will be properly timed internally. Secure the assembly with the distributor shaft snap ring (10) and distributor bearing snap ring (16).

(16) Install the bearing support (12) and tighten the mounting screws (15) and lockwashers (14).

(17) Install the condenser and tighten the mounting screw (29) and lockwasher (14).

(18) Install the stationary support bracket (21), cam wick (30), breaker arm (23), snap ring (22), and primary ground spring (24).

(19) Install the stationary support bracket locking screws (5 and 32), lockwashers (19 and 14), and plate washers (20 and 31). Do not tighten the screws.

(20) Connect the condenser lead and coil lead (25) with the breaker arm (23) and tighten the screw (27) and lockwasher (26).

(21) Adjust the breaker point gap to 0.015 inch at full separation (par. 116e) and tighten the locking screws (5 and 32).

(22) Install the distributor rotor (17).

(23) Install the brush (8) in the distributor block (7).

(24) Install the ground cable terminal (33), insulator washer (35), insulator (34), and ferrule (36) in the end cap (2). Install and tighten the ground cable nut (37).

(25) Install the distributor block (7) in the end cap (2) and tighten the mounting screws (18).

(26) Install the high-tension lead rod (9) and high-tension inserts (1) on the end cap (2).

(27) Assemble the vent screens (3) and vent hoods (4) on both sides of the end cap (2). Tighten the mounting screws (5).

(28) Position the gasket (6) on the end cap (2) and see that the mounting holes in the gasket and cap are properly alined.

(29) Attach the end cap (2) to the drive end frame (14, fig. 102) and line the mounting holes in the gasket, end cap, and drive end frame. Install and tighten the mounting screws (39, fig. 101) firmly and evenly.

(30) Install the gaskets (23, fig. 102) and spacer (24).

e. Installation. Refer to paragraph 116*d*.

191. Battery Charging Generator

a. Removal. Refer to paragraph 112*b*.

b. Disassembly (fig. 103).

(1) Remove the cover band screw (23) and nut (25). Remove the cover band (24).

(2) Remove the shaft nut (1) and shaft nut lockwasher (2).

(3) Remove the groove pulley (3), fan (4), and key (5).

(4) Remove the through bolts (26) and lockwashers (28) securing the commutator end frame (16) and the drive end frame (6) to the generator frame (38).

(5) Pull the commutator end frame (16) away from the generator frame (38) slightly.

(6) Remove the brush lead screws (21), lockwashers (20), and brush spacer washers (19). Remove the brushes (18).

(7) Lift up and remove the tension levers (22) and brush springs (17).

(8) Remove the screws (29) and lockwashers (30) attaching the cover plate (31) to the commutator end frame (16). Remove the cover plate (31) and gasket (32).

(9) Use an arbor press to remove the bearing (33) from the commutator end frame (16).

(10) Remove the drive end frame (6) and armature (15) from the generator frame (38). The drive end frame and armature must be removed as an integral unit.

(11) Remove the retainer plate screws (29), lockwashers (30), retainer plate (19), and spacer (9).

(12) Remove the drive end frame (6) and spacer collar (7).

(13) Press the armature shaft from the ball bearing (8). Make sure that the inner race of the bearing seats squarely and firmly on the arbor press bed blocks, so that strain is removed from the ball bearing during the pressing operation.

(14) Remove the pole piece screws (11) and pole pieces (13) from the generator frame (38).

(15) Remove the armature and field terminal nuts (34), lockwashers (35), plain washers (36), and terminal stud bushings (37).

(16) Remove the field windings (12 and 27) and terminal clip (14) from the generator frame (38).

c. Inspection and Repair.

(1) *Drive end frame.*

(*a*) Inspect the drive end frame for breaks, cracks, and warp age. Replace if necessary.

(*b*) Inspect the ball bearing for wear, scoring, pitting, and damage. Replace the bearing if defective. Check the new ball bearing in the drive end frame for proper fitting. If the bearing fits loosely or binds in its seat, replace the drive end frame.

(*c*) Inspect the retainer plate and spacer for breaks, damage, and warpage. Replace if necessary. Inspect all screws for corroded, damaged, or stripped threads. Replace all defective screws and lockwashers.

(*d*) Inspect the spacer collar and replace it if worn, ragged, or gritty.

(2) *Commutator end frame.*

(*a*) Inspect the brushes. Replace the brushes if they are oil soaked or worn down to less than half of their original length.

(*b*) Inspect the brush springs for tension, distortion, metal fatigue, and breaks. Replace if necessary.

(*c*) Inspect the tension levers and replace if cracked, bent, or distorted.

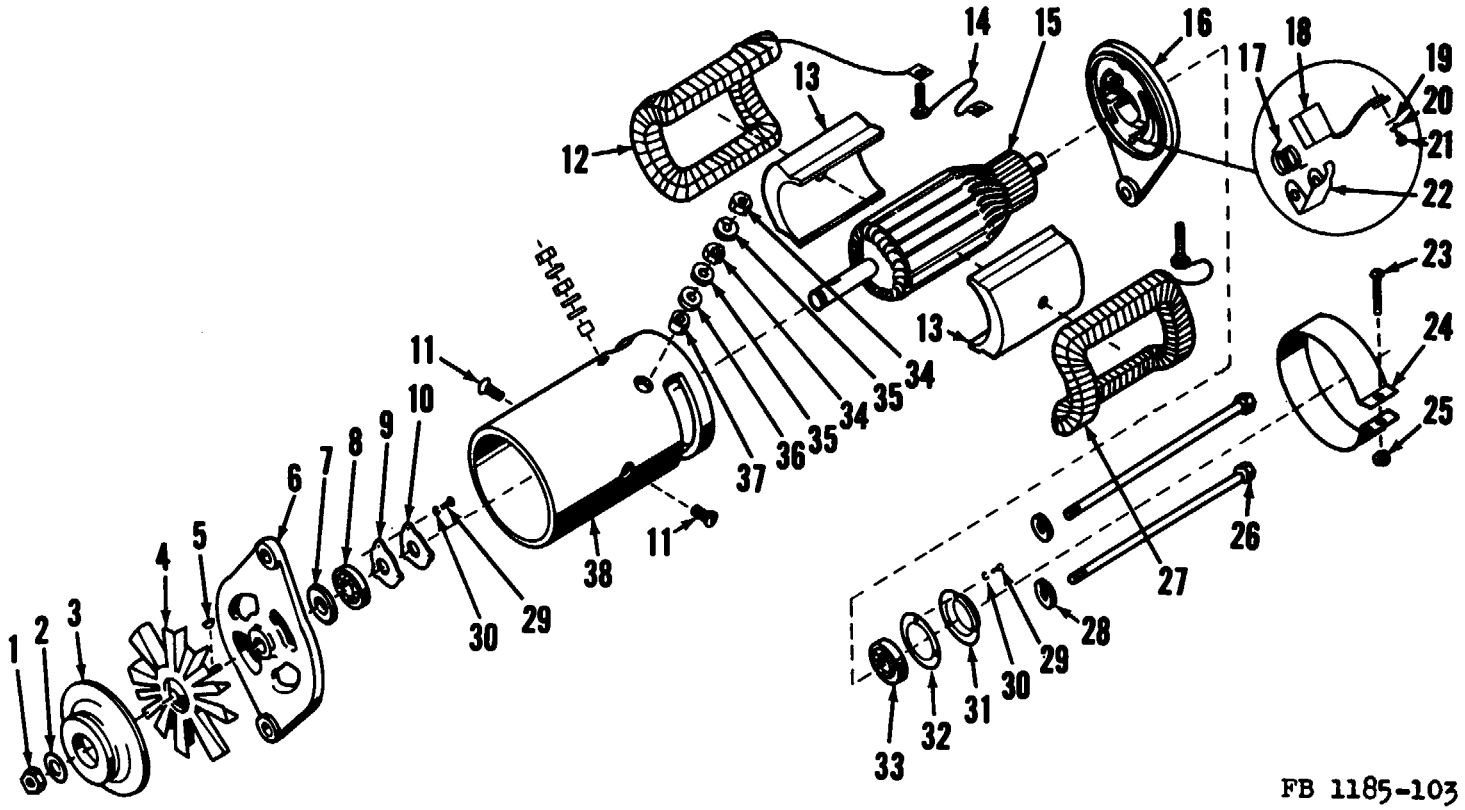


Figure 103. Battery charging generator disassembled.

1 Shaft nut
2 Lockwasher
3 Groove pulley
4 Fan
5 Key
6 Drive end frame
7 Spacer collar
8 Drive end bearing
9 Spacer
10 Retainer plate
11 Pole piece screws (2 req'd)
12 Field winding, right
13 Pole pieces (2 req'd)
14 Terminal clip
15 Armature
16 Commutator end frame
17 Brush springs (2 req'd)
18 Brushes (2 req'd)
19 Brush spacer washers (2 req'd)
20 Brush lead lockwashers (2 req'd)
21 Brush lead screws (2 req'd)
22 Tension levers (2 req'd)
23 Cover band screw
24 Cover band
25 Cover band nut
26 Thru bolts (2 req'd)
27 Field winding, left
28 Lockwashers (2 req'd)
29 Retainer plate screws (6 req'd)
30 Lockwashers (6 req'd)
31 Cover plate
32 Gasket
33 Commutator end bearing
34 Terminal stud nuts (4 req'd)
35 Lockwashers (4 req'd)
36 Plain washers (2 req'd)
37 Terminal stud bushings (2 req'd)
38 Generator frame

Figure 103. - Continued.

(d) Inspect the bearing for wear, scoring, pitting, and damage. Replace if defective.

(e) Inspect the cover plate for cracks and warpage. Replace if necessary. Replace the cover plate gasket.

(f) Inspect the commutator end frame for breaks, cracks, and warpage. Replace if broken or damaged.

(3) *Armature.*

(a) Inspect the armature for wear, pitting, and scoring. Replace if worn or damaged.

(b) Inspect the armature windings and see that they are properly pressed into the core slots and tightly soldered to the commutator risers. Replace the armature if the coils are loose or unsoldered.

(c) Inspect the commutator for rough spots, discoloration, pitting, scoring, and high mica. If the commutator is rough, pitted, or worn, mount the armature in a lathe (preferable on the shaft bearing seats, if the lathe is so equipped). Otherwise, mount the armature on the shaft centers (fig. 104). Take light cuts until the commutator is completely cleaned. Remove all burrs by holding No. 00 sandpaper lightly against the commutator while the armature is turning in the lathe.

(d) Use a dial indicator to measure the commutator out of round (fig. 105). Repeat the turning procedure if

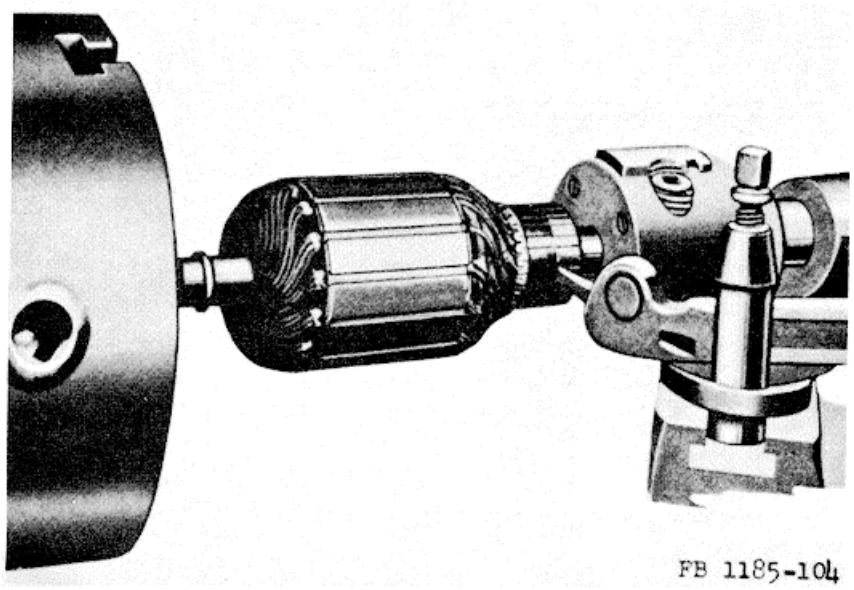


Figure 104. Turning commutator down.

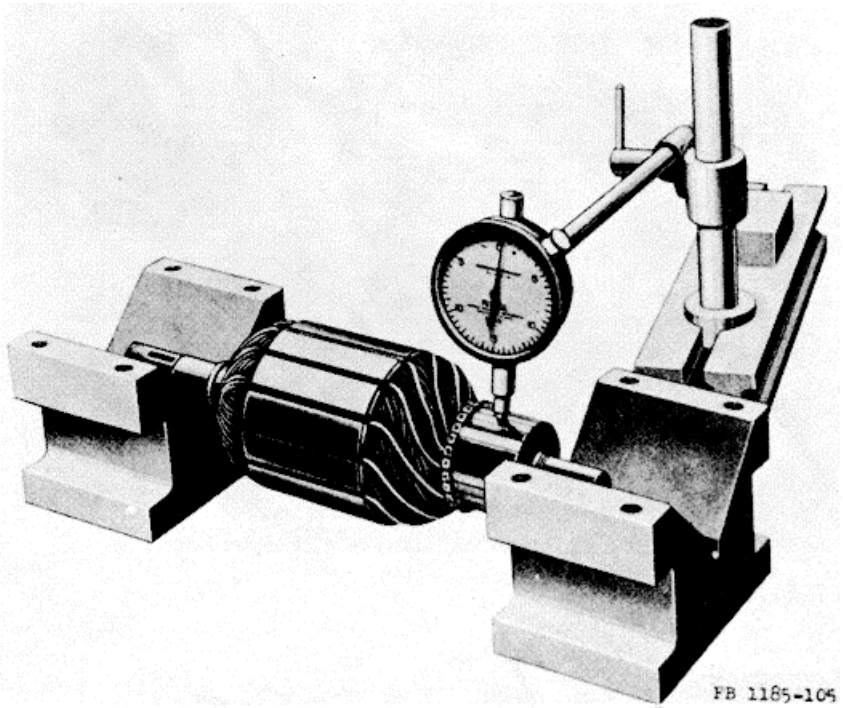


Figure 105. Measuring commutator out of round.

the commutator is out of round or if it has rough spots on the surface.

(e) Undercut the mica after turning the commutator. The mica must be undercut to a depth of one thirty-second to three sixty-fourths of an inch. Use an undercutter if available (fig. 106). If no undercutter is available, use a three-cornered file and a piece of hacksaw blade. Start the groove in the mica with the file and undercut it with the hacksaw blade. The mica must be cut away clean between the commutator segments. Do not leave a thin edge of mica next to the segments. Samples of good and bad undercutting are shown in figure 107.

(f) Check the armature for open and grounded circuits with a test lamp. Touch the test probes to each pair of adjacent commutator bars (fig. 108). If the lamp does not light, an open circuit is indicated and the armature must be replaced.

(g) Check the armature for grounds by touching one test probe to the shaft and other probe to each

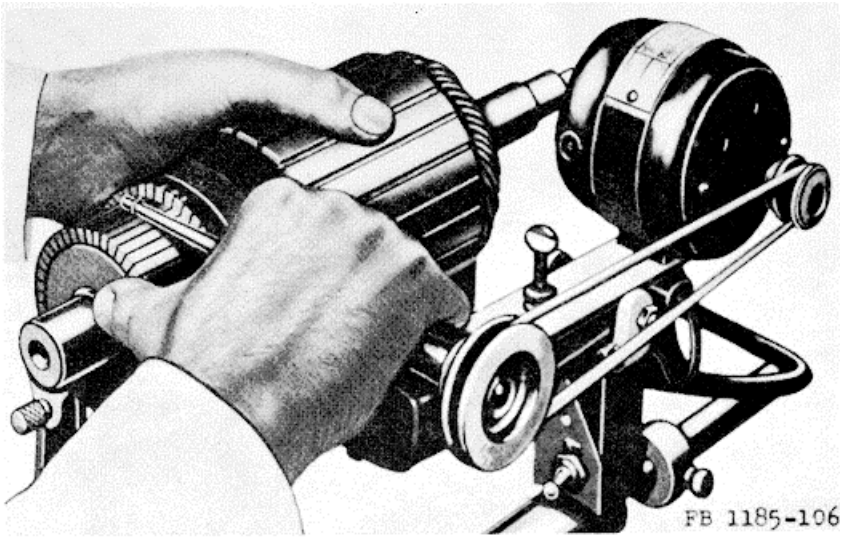
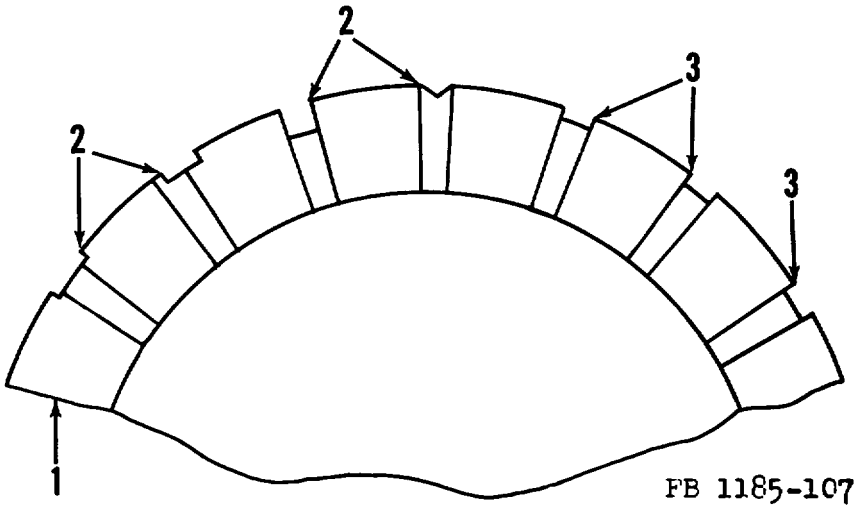


Figure 106. Undercutting mica with undercutter.



1 Commutator
2 Poor undercutting
3 Good undercutting

Figure 107. Samples of good and bad undercutting.

commutator segment in turn (fig. 109). If the lamp lights, a ground is present and the armature must be replaced.

***Note*. Do not touch probes to bearing or brush surfaces, because an arc will mar the finish.**

(h) Check the armature for short circuits by placing it on a growler (17-G-5940) and holding a thin steel strip

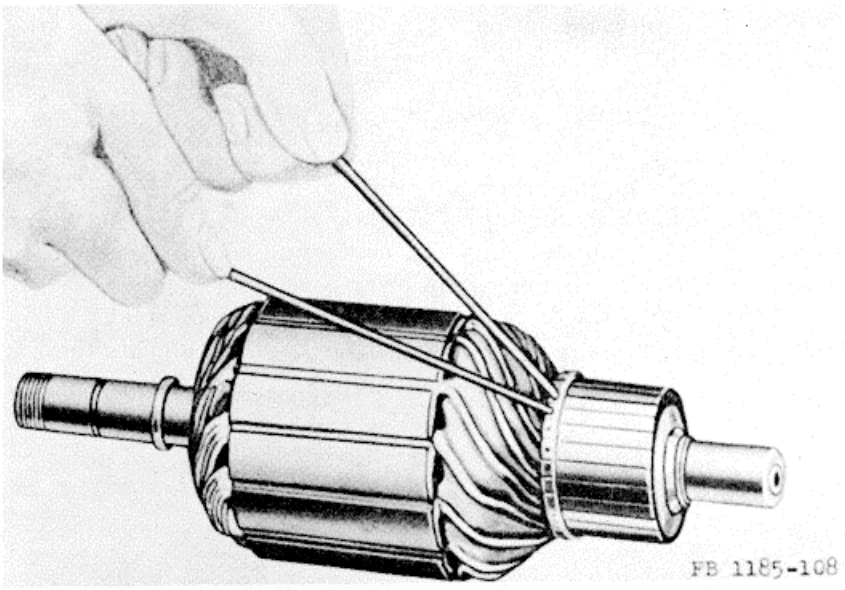


Figure 108. Testing armature for open circuit.

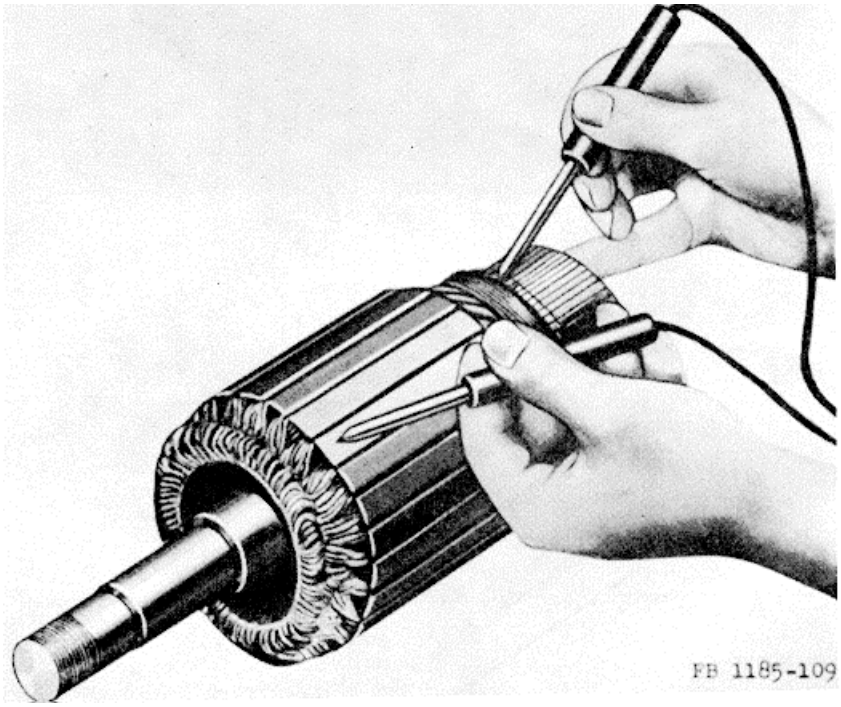


Figure 109. Testing armature for grounds.

on the case (fig. 110). Rotate the armature slowly through a complete revolution. If a short circuit is present, the steel strip will become magnetized and vibrate. Replace the armature if shorted.

(i) Inspect the bearing journals on both sides of the armature shaft for wear, scoring, and pitting. Replace the armature if the journals are excessively worn.

(j) Inspect the armature shaft keyway and key for burrs, cracks, and pitting. If necessary, smooth the surfaces with a small, fine-cut file or carborundum stone.

(k) Inspect the drive pulley and fan for cracks, breaks, warpage, and broken or damaged fan blades. Replace the fan if the blades are broken or if the body is cracked or warped.

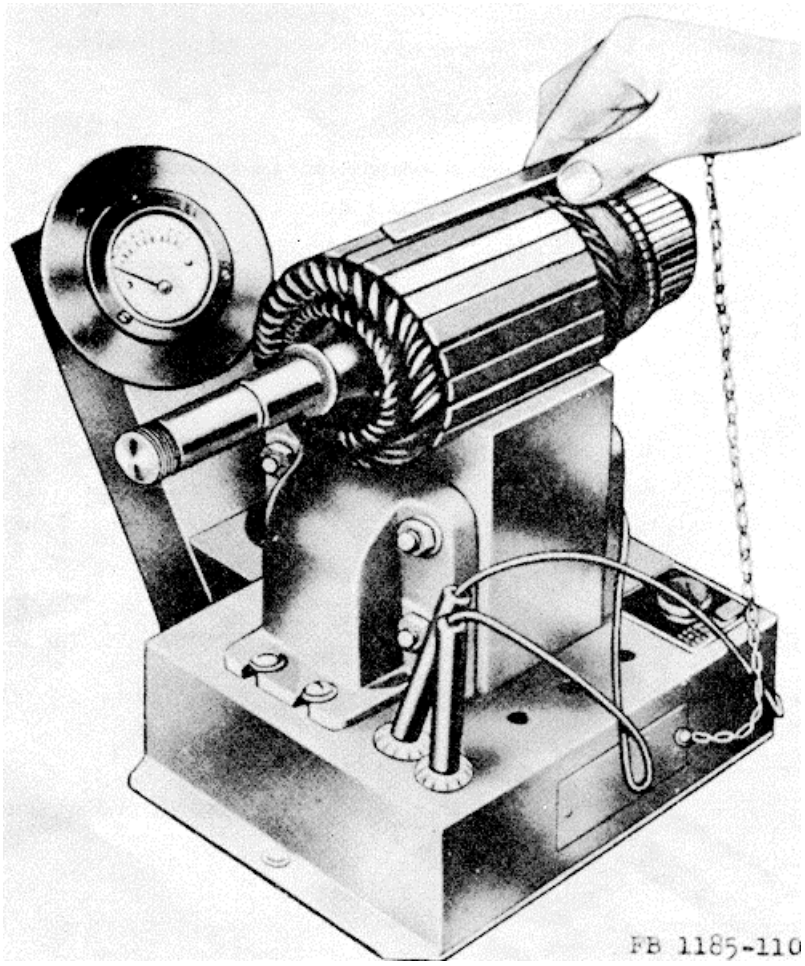


Figure 110. Testing armature for short circuit on growler.

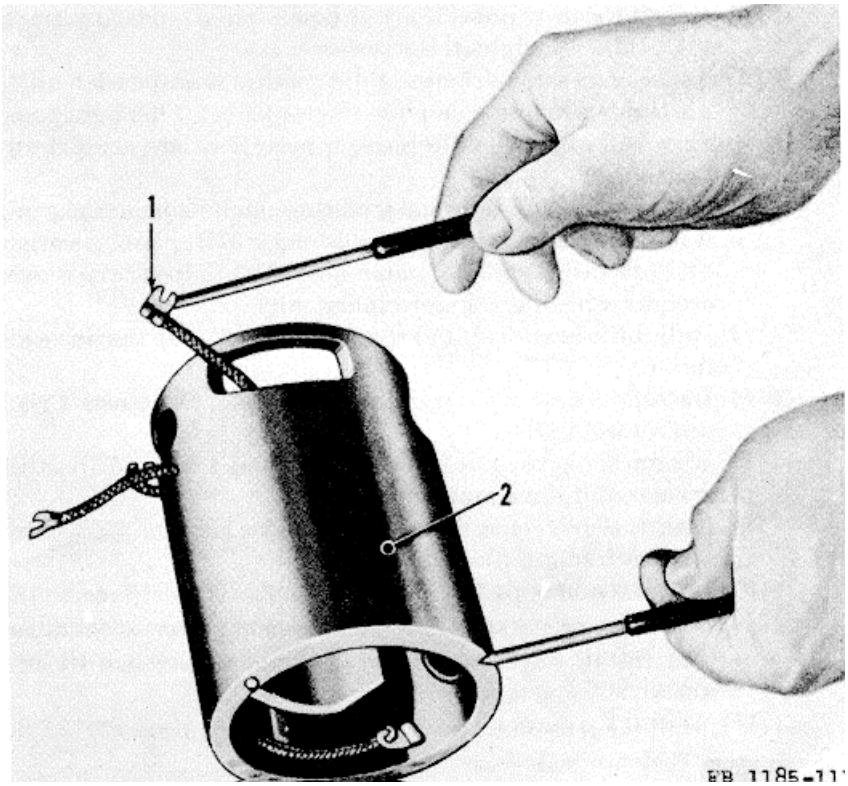
(*l*) Check the drive pulley nut for corrode(c, damaged or stripped threads. Replace if necessary.

(4) *Frame.*

(a) Inspect the generator frame and pole pieces for breaks, cracks, and damage. Replace all defective parts. Replace field insulation if broken, torn, or dirty. Replace the insulating bushings if they are broken, corroded, or oil soaked.

(b) Inspect the field windings for worn, cracked, peeling, and frayed insulation. Replace the coils if necessary. Inspect all leads and terminals for breaks and corrosion. Replace all defective parts.

(c) Use a test lamp to check the field windings for grounds. Touch one probe to the field terminal lead and the other probe to an unpainted surface on the generator frame (fig. 111). If the lamp lights, a ground is indicated. Un-



1 Field lead 2 Generator frame

Figure 111. Testing field windings for grounds.

solder the connection between the two windings and test each winding separately. Replace the defective winding.

(*d*) Check the field windings for open circuits by touching one probe to the field terminal stud and the other probe to the field winding ground lead. If the lamp does not light, an open circuit is indicated. Check each winding separately by touching one probe to the connection between the windings and the other probe to the lead at the end of the winding. Replace the winding if defective.

(*e*) Check the field winding draw by connecting a battery and ammeter in series with the field winding. Connect a voltmeter across the field winding terminals. Adjust the voltage to 24 volts. The ammeter should read from 0.66 to 0.74 ampere. Any other readings indicate defective field windings or connections.

d. Reassembly (fig. 103).

(1) Install the field windings (12 and 27) in the generator frame (38).

(2) Install the pole pieces (13) and pole piece mounting screws (11). Do not tighten the screws.

(3) Tap the generator frame lightly with a soft-faced mallet while tightening the pole piece screws (11). This light tapping will seat the pole pieces properly as they are drawn tight.

(4) Draw the armature terminal stud through its hole in the generator frame and install the bushing (37), plain washers (36), lockwashers (35), and nuts (34). Repeat the same procedure with the field terminal stud.

(5) Install the bearing (8) and spacer collar (7) in the drive end frame (6).

(6) Install the spacer (9), retainer plate (10), lockwashers (30), and screws (29).

(7) Use an arbor press to press the drive end frame (6) on the drive end of the armature shaft.

(8) Attach the drive end frame (6) and armature (15) to the generator frame (38).

(9) Install the bearing (33) in the commutator end frame (16).

(10) Install a new gasket (32) on the commutator end frame (16). Install the cover plate (31) and secure it with lockwashers (30) and screws (29).

(11) Install the tension levers (22) and brush springs (17). See that they are seated securely on their pins.

(12) Position the assembled commutator end frame (16) on the generator frame (38) but do not secure.

(13) Install the brushes (18).

(14) Connect the terminal clip (14) with the brush (18) terminal and tighten the brush spacer washers (19), lockwashers (20), and screws (21).

(15) Install and tighten the through bolts (26) and lockwashers (28).

(16) Install the cover band (24) and secure it with the cover band screw (23) and nut (25).

(17) Install the key (5) on the armature shaft. See that the key and the keyway in the grooved pulley (3) are properly alined.

(18) Install and tighten the drive pulley lockwasher (2) and nut (1).

e. Installation. Refer to paragraph 112*h*.

192. Voltage Regulator

a. General. The voltage regulator is of the vibrating-current type used with shunt generators. When replacing the voltage regulator, make sure that the new regulator is the same model as the old one. The voltage regulator consists of three units: the cutout relay (10, fig. 112), the voltage regulator (14), and the current regulator (12)all mounted on the same base (16) and inclosed by the same cover.

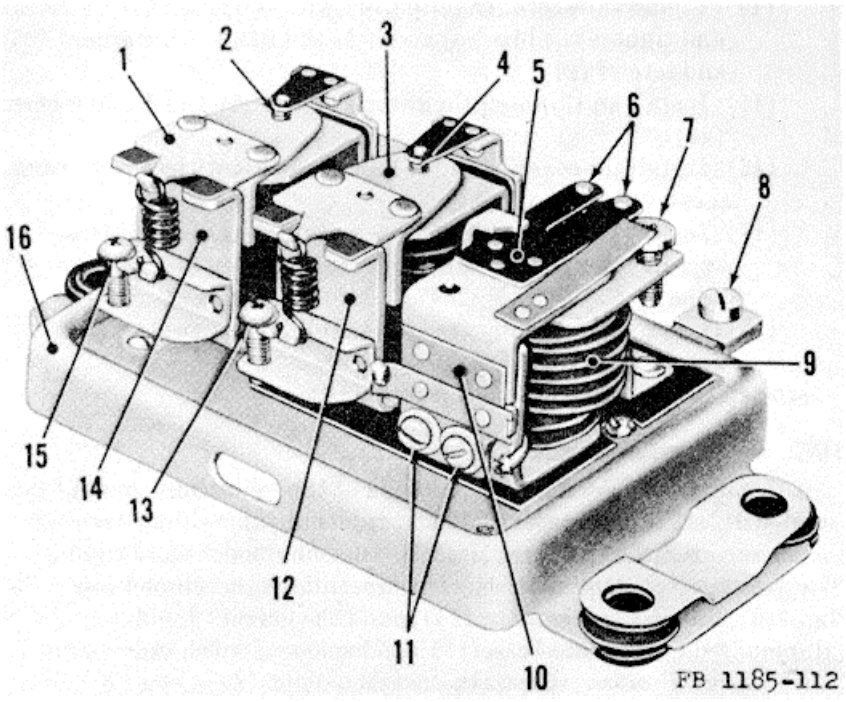
b. Contact Points. Clean the contact points (2, 4, and 6) with a spoon or riffler file. The flat contact point is on the upper contact bracket (1, 2, and 5), and the bracket must be removed for cleaning the points. A flat file cannot be used successfully to clean the contact points because it will not touch the center of the point, which is most apt to wear.

Caution: **Do not use emery cloth or sandpaper to clean the contact points.**

c. Cutout Relay.

(1) *Air gap.* Disconnect the battery before testing the air gap and point opening adjustment. Place your fingers on the armature (9), directly above the core, and move the armature down until the points (6) just close. Measure the air gap between the armature (9) and center of the core. This dimension must be 0.017 inch. On multiple point relays, make sure that all points close at the same time. If they do not, bend the spring fingers until they close at the same time. Loosen the two screws (11) at the back of the cutout relay (10) and raise or lower the armature until the air gap of 0.017 inch is obtained. Tighten the screws (11) after adjustment.

(2) *Point opening.* The correct point opening is 0.032 inch. Adjust the point opening by bending the upper armature stop until the required opening is obtained.



1	Voltage regulator bracket	9	Cutout relay armature
2	Voltage regulator points	10	Cutout relay
3	Current regulator bracket	11	Contact mounting screws
4	Current regulator points	12	Current regulator
5	Cutout relay bracket	13	Current adjusting screw
6	Cutout relay points	14	Voltage regulator
7	Closing voltage adjustment screw	15	Voltage adjusting screw
8	Battery terminal	16	Base

Figure 112. Voltage regulator.

(3) *Closing voltage.* To check the closing voltage of the cutout relay, the voltage regulator must be connected with the generator and battery. Connect a voltmeter between the regulator GEN terminal and the regulator base (16). Slowly increase the generator speed and note the relay closing voltage. The correct closing voltage is 12.0 to 15.0 volts. Decrease the generator speed and make sure that the circuit breaker contact points open. Adjust the closing voltage to 13.5 volts by turning the adjusting screw (7). Turn the screw (7) clockwise to increase the spring tension and closing voltage-counterclockwise to decrease the closing voltage. The closing voltage checking is shown in figure 113.

d. Voltage Regulator.

(1) *Air gap.* The correct air gap is 0.075 inch. Push the armature down until the contact points (2, fig. 112) are

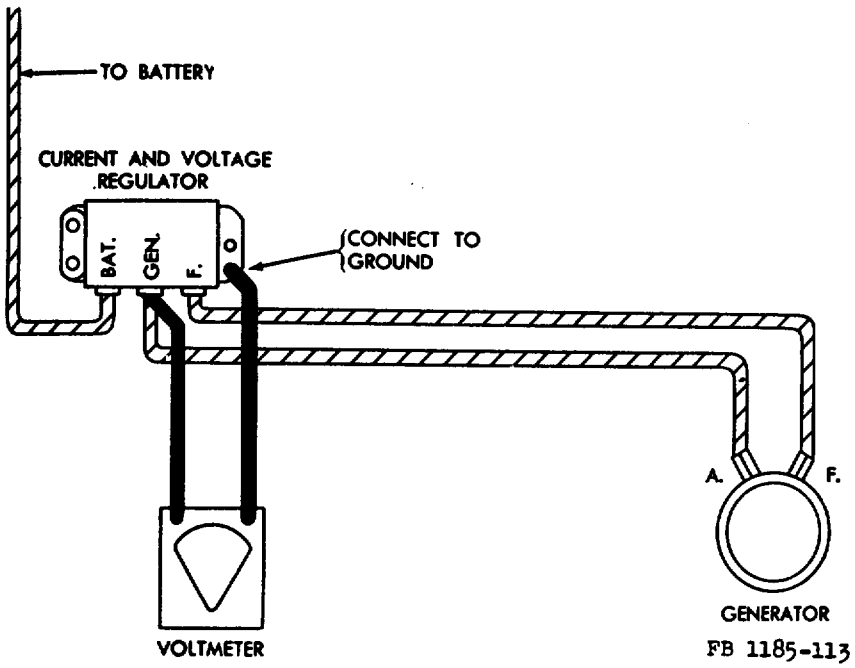


Figure 113. Checking closing voltage on cutout relay.

commutator segment touching and measure the gap. Adjust the air gap by loosening the contact mounting screws and raising or lowering the contact bracket (1) until the proper gap is obtained. Be sure that the points (2) are properly alined. Tighten the screws after adjustment.

(2) *Voltage setting.*

(*a*) *Fixed resistance method.* When checking the voltage setting by this method, a fixed resistance is substituted for the external charging circuit. Disconnect the battery lead at the regulator and connect the resistance between the regulator BAT terminal and ground. Connect a test voltmeter in parallel with the fixed resistance. The resistance must be 21/4 ohms for 12-volt units and must be capable of carrying 10 amperes without any change of resistance with temperature changes. Note the voltage setting. The allowable range is from 15.5 to 20.5 volts with the voltage regulator cover in place. To adjust the voltage setting, turn the adjusting screw (15) clockwise to increase and counterclockwise to decrease the voltage. Adjust the voltage setting to 16.5 volts. If the adjusting screw is turned clockwise beyond normal adjustment range, the spring support may fail to return when pressure is relieved. If the support does not return, turn the screw (15) counter-clockwise until sufficient clearance is obtained

between the screw head and spring support and bend the spring upward until contact is made with the screw head. Always adjust the voltage setting by increasing the spring tension and not by reducing it. If the current voltage setting is too high, adjust the unit below the required value and then raise to the exact setting by increasing the spring tension. After each adjustment and before taking voltage readings, replace the regulator cover, reduce the generator speed until the relay points open, and then bring the generator back to speed again.

(*b*) Variable resistance method. Connect an ammeter into the charging circuit at the BAT terminal of the regulator with a 1/4-ohm variable resistance in series. Connect a voltmeter from the regulator BAT terminal to the ground. Increase the generator speed to 25 percent above rated output speed. Cut in the resistance until the output is reduced to 4-6 amperes. Operate the unit for 15 minutes until the regulator reaches the correct operating temperature to obtain stable voltage and current readings. Retard the generator speed until the relay points open and then bring the generator back to speed and note the voltage setting. The voltage reading must be taken with the regulator at operating temperature and with 4-6 amperes flowing. The voltage regulator cover must be in place. Be sure to readjust the variable resistance after each voltage adjustment and then reduce and increase the generator speed before taking the voltage reading.

e. Current Regulator.

(1) *Air gap.* The correct current regulator air gap is 0.075 inch. The air gap is checked and adjusted in the same manner as voltage regulator air gap. Refer to d above.

(2) *Current setting.* To check the current regulator setting, the voltage regulator must be prevented from operating. If it is necessary to adjust the current setting, remove the cover and adjust it in the same manner as the voltage regulator (d above) by turning the adjusting screw (13) clockwise to increase the current setting and counterclockwise to decrease the setting. If the unit is badly out of adjustment, the springs must be replaced. Four different methods may be used to prevent the voltage regulator from operating. In all four of the methods, an ammeter must be connected to the charging circuit at the BAT terminal.

(*a*) *Quick check method.* Insert a screwdriver blade through the oblong hole in the regulator base (16) until

contact is made with the shield around resistor. Be sure to keep the screwdriver at right angles to the base and hold it firmly in place during the check so that the blade touches the regular base and shield at the same time. This action temporarily cuts out the voltage regulator unit. With an ammeter connected between the battery and regulator at operating temperature, operate the generator at 50 percent above rated output speed and note the current setting.

(b) Jumper lead method. Remove the voltage regulator cover and connect a jumper lead across the voltage regulator contact points (2). With the generator operating at 50 percent above the rated output speed and with the regulator at operating temperature, note the current setting.

(c) Battery discharge method. Partly discharge the battery by cranking the engine for 30 seconds with the ignition turned off. Do not run the starting motor continuously for more than 30 seconds. Immediately after cranking, start the engine and note the current setting with the generator operating at 50 percent above the rated output speed.

(d) Load method. If a load approximating the current regulator setting is placed across the battery while the current regulator is being checked, voltage will not increase sufficiently to cause the voltage regulator to operate. This load may be provided by a carbon pile or a bank of lights.

f. Polarizing the Generator.

(1) After any tests or regulator adjustments, the generator must be repolarized after the leads are reconnected but before the engine is started.

(2) Disconnect the lead from the FIELD terminal of the regulator and momentarily touch this lead to the regulator BATTERY terminal. This allows a momentary surge of current to flow through the generator field windings which correctly polarizes the generator. Failure to do this may result in severe damage since reversed generator polarity causes vibration, heavy arcing and burning of the relay contact points.

193. Starting Motor
(fig. 114)

a. Removal. Refer to paragraph 114*b*.

b. Disassembly.

(1) Remove the cover band screw (23) and nut (24). Remove the cover band (22).

(2) Remove the through bolts (21) and lockwashers (20).

(3) Pull the commutator end frame (19) away from the starting motor frame (40) slightly.

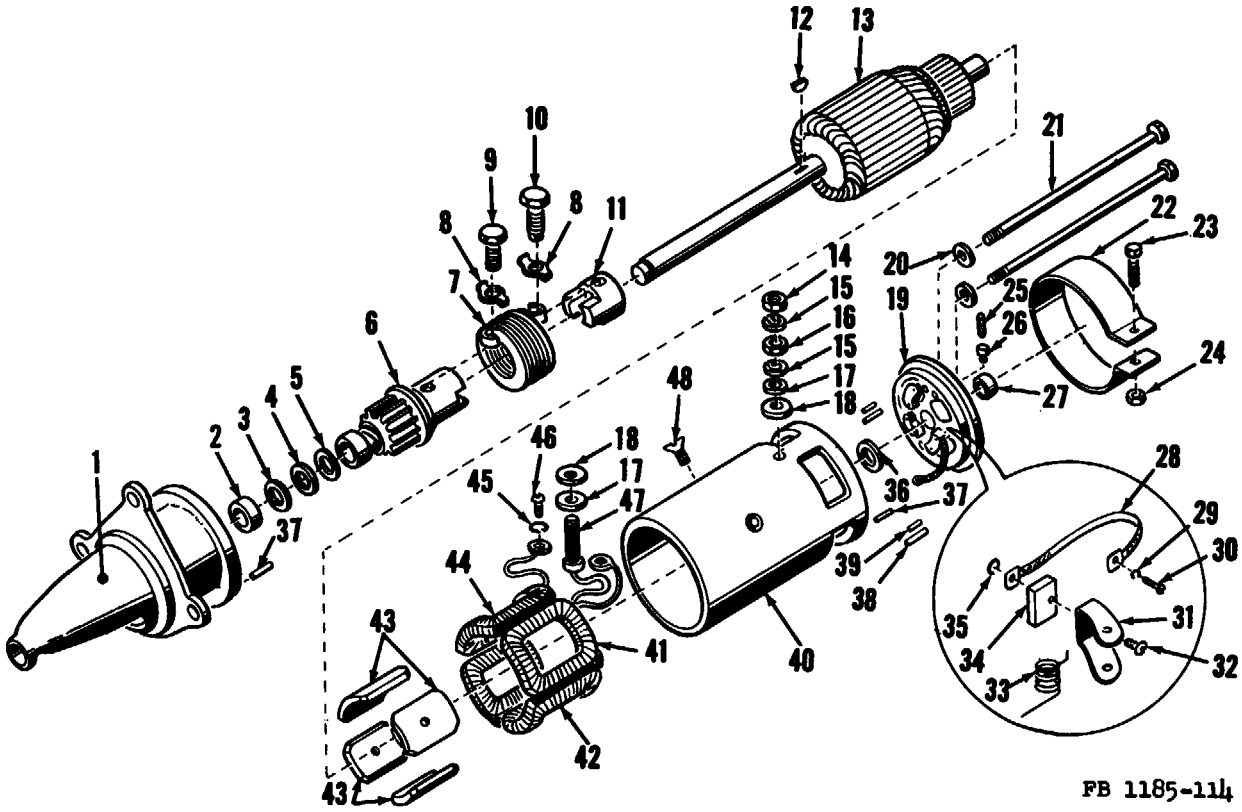


Figure 114. Starting motor disassembled.

1 Drive housing
2 Bushing
3 Space washer, outer
4 Space washer, center
5 Space washer, inner
6 Drive gear
7 Drive spring
8 Spring lockwashers (2 req'd)
9 Spring screw, shaft end
10 Spring screw, head end
11 Drive head
12 Key
13 Armature
14 Terminal stud nut, 3/16 thick
15 Terminal stud lockwashers (2 req'd)
16 Terminal stud nut ¼ thick
17 Terminal stud washers (3 req'd)
18 Insulating washers, ¾ OD (2 req'd)
19 Commutator end frame
20 Through bolt lockwashers (2 req'd)
21 Through bolts (2 req'd)
22 Cover band
23 Cover band screw
24 Cover band nut
25 Wick
26 Oiler
27 End plug
28 Brush ground leads (2 req'd)
29 Ground lead lockwashers (2 req'd)
30 Ground lead screws (2 req'd)
31 Brush holders (4 req'd)
32 Brush lead screws (2 req'd)
33 Brush springs (4 req'd)
34 Brushes (4 req'd)
35 Brush lead lockwashers (2 req'd)
36 Bushing
37 Hinge pins (2 req'd)
38 Insulator pins (2 req'd)
39 Stop pins (2 req'd)
40 Frame
41 Field winding, right
42 Field winding, lower half
43 Pole pieces (4 req'd)
44 Field winding, shunt
45 Field screw lockwasher
46 Field screws (2 req'd)
47 Terminal stud
48 Pole piece screws (4 req'd)

Figure 114. -Continued

(4) Remove the brush ground lead screws (30) and lockwashers (35). Remove the brush lead screws (32) and brushes (34). If the brush leads are clinched and soldered, unsolder and unclinch their connections.

(5) Remove the commutator end frame (19) and drive out the end plug (27) and bushing (36).

(6) Drive out and remove the hinge pin (37), insulator pin (38), and stop pin (39).

(7) Pull out and remove the armature (13) and drive end (1) assembly.

(8) Remove the shaft spring screw (9) and lockwasher (8).

(9) Remove the head spring screw (10) and lockwasher (8).

(10) Remove the head (11), drive spring (7), and drive gear (6).

(11) Remove the key (12), inner space washer (5), center space washer (4), and outer space washer (3).

(12) Drive out and remove the drive end bushing (2).

(13) Remove the terminal stud nuts (14 and 16), lockwashers (15), plain washers (17), and insulating washers (18).

(14) Push the terminal stud (47) down into the starting motor frame (40).

(15) Remove the pole piece screws (48) and pole pieces (43).

(16) Remove the field windings (41, 42 and 44), inner insulating washers (18), and plain washers (17).

c. Inspection and Repair.

(1) Inspect the starting motor frame and drive end housing for breaks and cracks. Replace if necessary.

(2) Inspect the drive gear for broken or damaged teeth, chips, pitting, and rough surfaces. Replace if damaged or cracked.

(3) Inspect the drive head for broken or chipped lugs. Replace if defective.

(4) Inspect the bushings for wear, pitting, distortion, and damage. Replace if necessary.

(5) Inspect the field windings for damaged, peeling, frayed, or swollen insulation. Test for shorted, grounded, and open circuits (par. 191c). Replace defective field windings.

(6) Inspect the pole pieces for damage, cracks, pitting, and breaks. Replace damaged pole pieces.

(7) Inspect the field connection insulation and replace the connection if the insulation is frayed or torn.

(8) Inspect the brushes and replace them if they are worn, oil soaked, or damaged. Unsolder and unclinch the brush lead connections carefully. Solder the new leads in place to make a strong, low-resistance connection.

(9) Inspect the armature for wear, pitting, and scoring. Inspect the armature shaft journals for wear, flaws, pitting, and damage. Replace the armature if necessary.

(10) Inspect the commutator for scoring, wear, rough spots, and high mica. To repair the commutator, follow the same procedure outlined in paragraph 191c.

(11) Inspect all threaded surfaces for corrosion, damage, and stripped threads. Replace all worn, corroded, and damaged parts.

d. Reassembly.

(1) Install the field windings (41, 42, 44) and pole pieces (43) in the starting motor frame (40).

(2) Install the inner insulating washers (18) and plain washers (17) on the terminal stud (47) and push the stud through the opening in the frame.

(3) Install the pole piece screws (48) but do not tighten them.

(4) Tap the frame (40) lightly with a soft-faced mallet to seat the pole pieces properly while tightening the pole piece screws (48).

(5) Install the insulating washer (18), plain washers (17), lockwashers (15), and nuts (16 and 14) on the terminal stud (47).

(6) Discard the drive end bronze bushing (2) if it was removed. Soak the new bushing in heated medium grade engine oil and drain off excess oil before reassembly. Use a square shouldered mandrel or bushing driver of proper size in the bushing to prevent it from collapsing and press the bushing into the drive housing (1).

(7) Install the key (12) on the armature shaft.

(8) Assemble the drive head (11), drive spring (7), and drive gear (6) on the armature shaft. Install and tighten the lockwashers (8) and screws (9 and 10).

(9) Install the space washers (3, 4, 5) and assemble the drive housing (1) on the armature shaft.

(10) Install the armature assembly in the starting motor frame (40).

(11) If the brushes were removed, clinch and solder the new brush leads to make strong, low-resistance connections.

(12) Install the bushing (36) and end plug (27) in the commutator end frame (19).

(13) Install the grounded brushes (34) on the commutator end frame (19).

(14) Attach the commutator end frame (19) to the starting motor frame (40) and see that all brushes are properly installed in their brush holders.

(15) Install and tighten the thru bolts (21) and lockwashers (20).

(16) Install the cover band (22).

(17) Install and tighten the cover band screw (23) and nut (24).

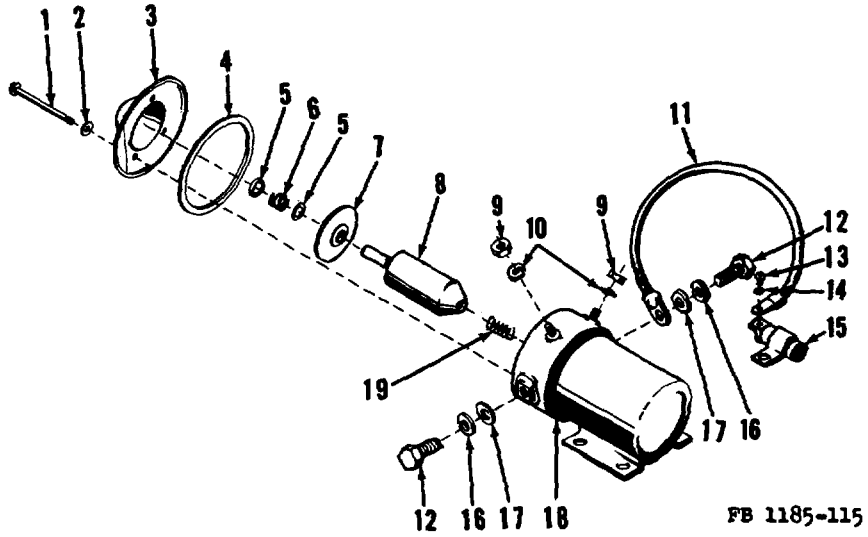
e. Installation. Refer to paragraph 114*c*.

194. Magnetic Switch
(fig. 115)

a. Removal. Refer to paragraph 115*b*.

b. Disassembly.

(1) Remove the terminal studs (12), lockwashers (16), and plain washers (17). Disconnect the capacitor lead (11) from the magnetic switch case (18).



1 Cover screws (3 req'd)
2 Washers (3 req'd)
3 Cover
4 Gasket
5 Cupped washers (2 req'd)
6 Contact spring
7 Contact disk
8 Plunger
9 Nuts, hex, No. 10 (2 req'd)
10 Washers, lock, std, No. 10 (2 req'd)
11 Capacitor lead
12 Terminal studs (2 req'd)
13 Screw, machine, rd hd, No. 6
14 Washer, lock, std, No. 6
15 Capacitor
16 Lockwashers (2 req'd)
17 Flat washers (2 req'd)
18 Case and coil
19 Plunger return spring

Figure 115. Magnetic switch disassembled.

(2) Remove the nuts (9) and lockwashers (10) from the magnetic switch case (18).

(3) Remove the three cover screws (1) and washers (2) attaching the cover (3) to the case (18).

(4) Lift up and remove the cover (3) and gasket (4).

(5) Remove the top cupped washer (5) and pull out the contact spring (6).
(6) Remove the bottom cupped washer (5) and lift out the contact disk (7).
(7) Turn the magnetic switch case (18) upside down and remove the plunger (8) and plunger return spring (19).

c Inspection and Repair.

(1) Wash all metal parts in cleaning solvent and dry them with clean compressed air. Blow off all dust and foreign matter from the inside of the case with compressed air.
(2) Inspect the coil inside the case for frayed, burned, corroded, or damaged windings. Replace the case if the coil is damaged, defective, or oil soaked.
(3) Inspect all contact surfaces for pitting, burrs, breaks, cracks, and chipping. Replace all defective parts.
(4) Install the plunger in the case and check the action of the plunger return spring. If the spring is sluggish, weak, or twisted, it must be replaced. Replace the plunger if it is cracked or broken.
(5) Check the cover for dents, breaks, and broken or twisted mounting edges. Replace the cover if necessary.
(6) Inspect the gasket and replace if it is corroded, cut, frayed, or ragged.
(7) Inspect all threaded surfaces for corroded, damaged, worn, and stripped threads. Replace all defective parts.
(8) Check the cupped washers and contact spring for wear, twisting, and damage. Replace the washers and spring if they are twisted, worn, or damaged.

d Reassembly.

(1) Install the plunger return spring (19) in the recess at the bottom part of the plunger (8).
(2) Install the plunger (8) and spring (19) in the case (18).
(3) Install the contact disk (7).
(4) Install the cupped washers (5) and contact spring (6) on the plunger (8).
(5) Position the gasket (4) on the cover (3) and attach the cover to the case (18).
(6) Install and tighten the three cover screws (1) and washers (2).
(7) Install the nuts (9) and lockwashers (10) on the case terminals.
(8) Attach the capacitor lead (11) to the terminal stud (12).
(9) Install the flatwashers (17), lockwashers (16), and terminal studs (12).

e Installation. Refer to paragraph 115*c*.

Section VII. ENGINE LUBRICATION SYSTEM

195. Operational Description

The lubrication system of the engine is of a pressure and splash type. An internally mounted oil pump is driven by the camshaft and delivers the oil under pressure to the main bearings, connecting rod bearings, camshaft bearings, and timing gears. The pistons, cylinder walls, piston rings, valve tappets, and valve stems are lubricated by oil splash from the connecting rod bearings and crankshaft. The oil pump forces the oil through a bypass-type oil filter which traps sediment and dirt. The oil pressure is controlled by an externally mounted oil pressure relief valve. The normal oil pressure is from 10 to 15 psi at idling speeds and from 30 to 50 psi at sustained governed speeds.

196. Oil Pump

(fig. 116)

a General. The internally mounted oil pump is a helical-gear type and is driven by the spiral gear on the camshaft. The oil pump supplies direct oil pressure to the main bearings, connecting rod bearings, camshaft bearings, and timing gears. With the engine hot, the oil pump delivers from 10to 15-psi pressure at idling speeds and from 30to 50-psi pressure at sustained governed speeds.

b Removal.

(1) Run the engine until it reaches normal operating temperature. Drain the oil.
(2) Remove the oil pan (par. 126a).
(3) Remove the mounting nut (7) and lockwasher (6) attaching the oil pump to the mounting stud (5).
(4) Turn the pump counterclockwise slightly to disengage it from the camshaft gear. Pull out the pump from the cylinder block.

c Disassembly.

(1) Use a small drift to drive out the drive gear pin (24).
(2) Remove the drive gear (2) from the drive shaft (8).
(3) Use a blunt screwdriver to spread the lock wire (21) until it snaps off the outer edge of the screen (20).
(4) Remove the screws (16) and lockwashers (15) attaching the spacer (19), strainer frame (18), and gasket (17) to the oil pump body (4).
(5) Remove the spacer (19), strainer frame (18), and strainer frame gasket (17).
(6) Remove the screws (16) and lockwashers (15) attaching the cover (14) to the pump body (4).
(7) Remove the cover (14) and cover gasket (13).

(8) Pull out the drive shaft (8) and driver gear (22) assembly from the oil pump body (4).
(9) Remove the retaining ring (12) and pull the driver gear (22) off the shaft (8). Remove the key (23).
(10) Remove the idler gear (11) and idler gear stud (9).
(11) Press out the bushing (10) from the idler gear (11).

d Inspection and Repair.

(1) Wash all parts in cleaning solvent and dry them with clean compressed air or a soft absorbent cloth.
(2) Inspect the bushing in the oil pump body for wear, etching, pitting, flaws, and cracks. Replace the bushing if necessary.
(3) Replace the oil pump body if it is cracked, broken, or damaged.
(4) Inspect the bushing in the idler gear and replace it if worn, pitted, cracked, or broken.
(5) Use a stiff brush to clean the meshwork of the screen. Blow out the meshwork with clean compressed air. Replace the screen if the meshwork is torn, corroded, or broken.
(6) Inspect the gears for worn, broken, damaged, or pitted teeth. Check the edges of the teeth for wear, cracks, and pitting. Replace all defective gears. Always replace gears in sets. Do not replace a new driver gear with a used idler gear, or a new idler gear with a used driver gear.
(7) Inspect the cover and strainer frame for breaks, cracks, and twisting. Replace if necessary. Replace the cover and strainer frame gaskets.
(8) Check the cover screws for damaged, corroded, or stripped threads. Replace all defective screws.

e Reassembly.

(1) Install the key (23) on the drive shaft (8).
(2) Press the driver gear (22) on the shaft (8) and secure it with the retaining ring (12).
(3) If the pump body bushing (3) has been removed, press a new bushing in the pump body (4) and ream it to size.
(4) Install the drive shaft (8) in the oil pump body (4) and press the drive gear (2) on the shaft. Secure the gear with the drive gear pin (24). Check the end play of the drive shaft. If the end play exceeds 0.006 inch, replace the drive shaft (8) and drill a hole in the shaft for the pin to obtain an end play from 0.002 to 0.004 inch.
(5) Press a new idler gear bushing (10) into the idler gear (11) and ream it to size.
(6) Install the idler gear (11) and idler gear stud (9).
(7) Position a new cover gasket (13) on the oil pump body (4) and see that the mounting holes are properly alined.

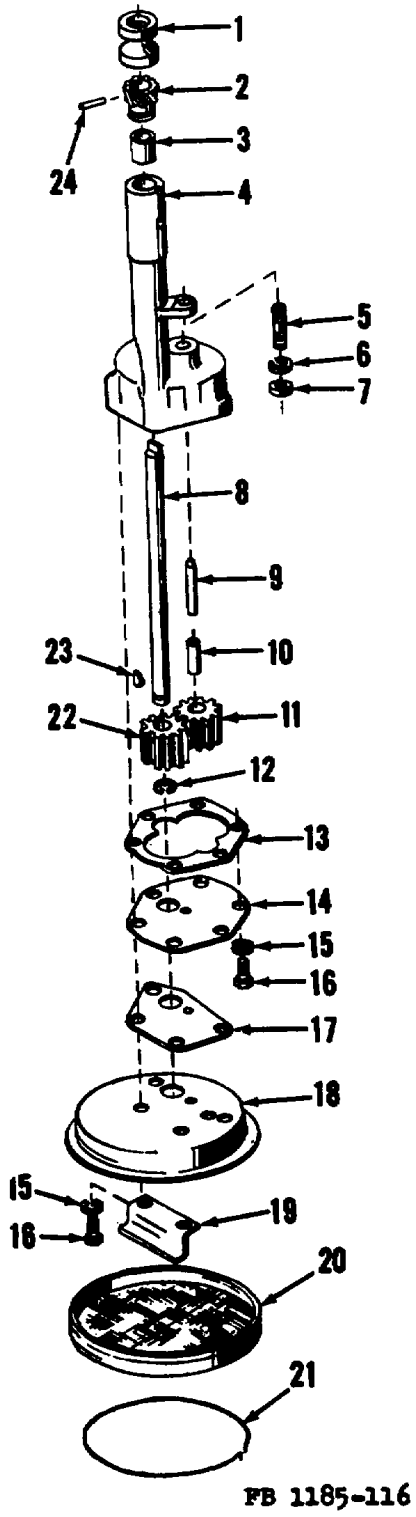


Figure 116. Oil pump disassembled.

(8) Check the clearance between the driver and idler gears and the pump body before installing the cover. Clearance must not exceed 0.003 inch. Replace the pump body if the clearance exceeds 0.003 inch.
(9) Install the cover (14) and tighten the cover mounting screws (16) and lockwashers (15).
(10) Install the frame gasket (17), strainer frame (18), and spacer (19). Tighten the mounting screws (16) and lockwashers (15).
(11) Install the screen (20) and secure it with the lock wire (21).

f. Installation.

(1) Insert the drive shaft (8) into its mounting hole in the cylinder block, making sure that the oil pump mounting hole is properly alined with the mounting stud (5).
(2) Rotate the oil pump back and forth until the drive gear (2) is properly meshed with the spiral gear on the camshaft.
(3) Install and tighten the mounting lockwasher (6) and nut (7).
(4) Install the oil pan (par. 126e) and fill it with oil.
(5) Start the engine and let it run until normal operating temperature is reached. Check the oil pressure on the oil pressure gage. With the engine hot, proper oil pressure is from 10 to 15 lbs at idling speeds and from 30 to 50 lbs at sustained governed speeds.

197. Oil Pressure Relief Valve
(fig. 117)

a Description. The oil pressure relief valve is mounted on the right side of the engine, directly below the valve cover. The opening point of the valve is set at the factory. It is very seldom, if ever, necessary to change the adjustment. The oil pressure relief valve regulates the oil pressure at higher speeds and is inoperative at idling speeds.

---

1 Drive shaft bushing
2 Drive gear
8 Pump body bushing
4 Pump body
5 Mounting stud
6 Lockwasher
7 Mounting nut
8 Drive shaft
9 Idler gear stud
10 Idler gear bushing
11 Idler gear
12 Retaining ring
18 Cover gasket
14 Cover
15 Lockwashers (6 req'd)
16 Pump cover and strainer screws (6 req'd)
17 Frame gasket
18 Strainer frame
19 Spacer
20 Screen
21 Lock wire
22 Driver gear
28 Key
24 Drive gear pin

Figure 116--Continued.

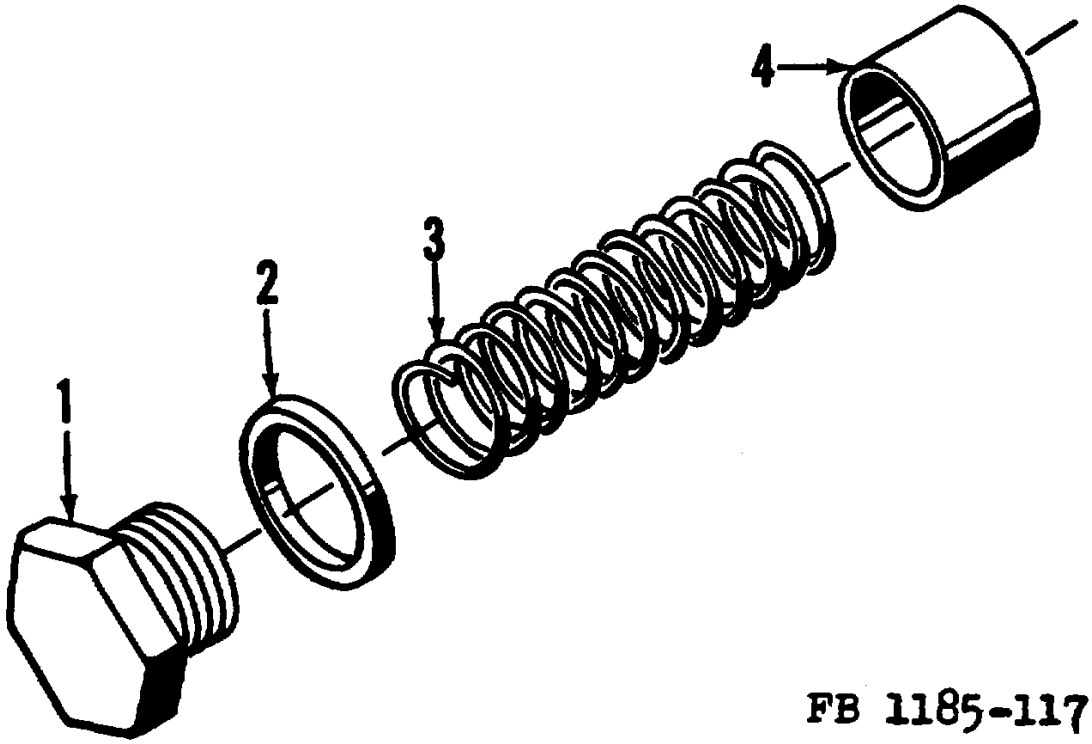
b Removal.

(1) Turn the valve plug (1) counterclockwise and remove it from the cylinder block.
(2) Remove the adjusting washer (2) and pull out the valve spring (3) and valve (4).

c Installation.

(1) Install the valve spring (3) in the valve body (4).
(2) Install the valve spring (3) and valve (4) into the opening in the cylinder block.
(3) Install the adjusting washer (2) and valve plug (1). Tighten the valve plug.

d Adjustment. The oil pressure relief valve is adjusted by means of the adjusting washers (2). Install additional washers to increase the opening pressure of the valve. Remove the washers to decrease the opening pressure of the valve.



1 Valve plug
2 Adjusting washer
3 Valve spring
4 Valve

Figure 117. Oil pressure relief valve disassembled.

Section VIII. TRANSMISSION AND CLUTCHES

198. Description

The heavy-duty transmission is enclosed in a machined case bolted to two welded cross-members of the road roller frame. The transmission case also encloses the master clutch and bolts directly to the engine flywheel housing. Transmission gears are machined of special alloy steel and heat treated. Forward and reverse movement of the roller is accomplished through the use of a bevel pinion which is keyed

on the end of the transmission shaft and runs in constant mesh with two bevel gears mounted on a cross-shaft through the transmission case. A constant mesh change of gear ratio provides high and low speed in both forward and reverse gears. All transmission shafts are machined from special alloy steel, heat treated, and mounted on anti-friction bearings. Gears, shafts, and bearings operate constantly in an oil bath. The first countershaft outboard bearing is a self-alining, double-row ball bearing with its housing secured to the side member of the road roller frame. The entire transmission is enclosed and protected from dust and grit.

199. Master Clutch

(fig. 118)

a General. For the general description of the master clutch, refer to paragraph 138.

b. Removal.

(1) Remove the engine (par. 174). While the engine is being removed, the master clutch assembly will slide off the clutch shaft and remain on the flywheel of the engine.
(2) Remove the six screws and lockwashers attaching the master clutch assembly to the flywheel.
(3) Remove the master clutch from the flywheel.

c Disassembly.

(1) Pull out the adjusting lock pin (14) and secure it in unlocked position.
(2) Turn the adjusting yoke (17) counterclockwise until it is released from the threads on the hub and back plate (13).
(3) Remove the adjusting yoke (17), sliding sleeve (18), and cone collar (4).
(4) Lift up and remove the floating plate (8).
(5) Remove the driving plate (11) and six release springs (12).
(6) Drive out the rivets (9) attaching the friction disks (10) to the driving plate (11). Remove the friction disks from both sides of the driving plate.
(7) Remove the bolts (1), nuts (5), and washers (2) attaching the upper half of the cone collar (4) to the lower half of the collar. Unscrew and remove the grease fitting (3) from the cone collar.
(8) Remove the lever]ink pills (21) and retaining rings (19). Disconnect the sliding sleeve (18) from the adjusting yoke (17). Remove the lever links (20) from the sliding sleeve.
(9) Remove the retaining rings (16) and drive out the lever pins (6).
(10) Remove the finger levers (7) from the adjustment yoke (17).

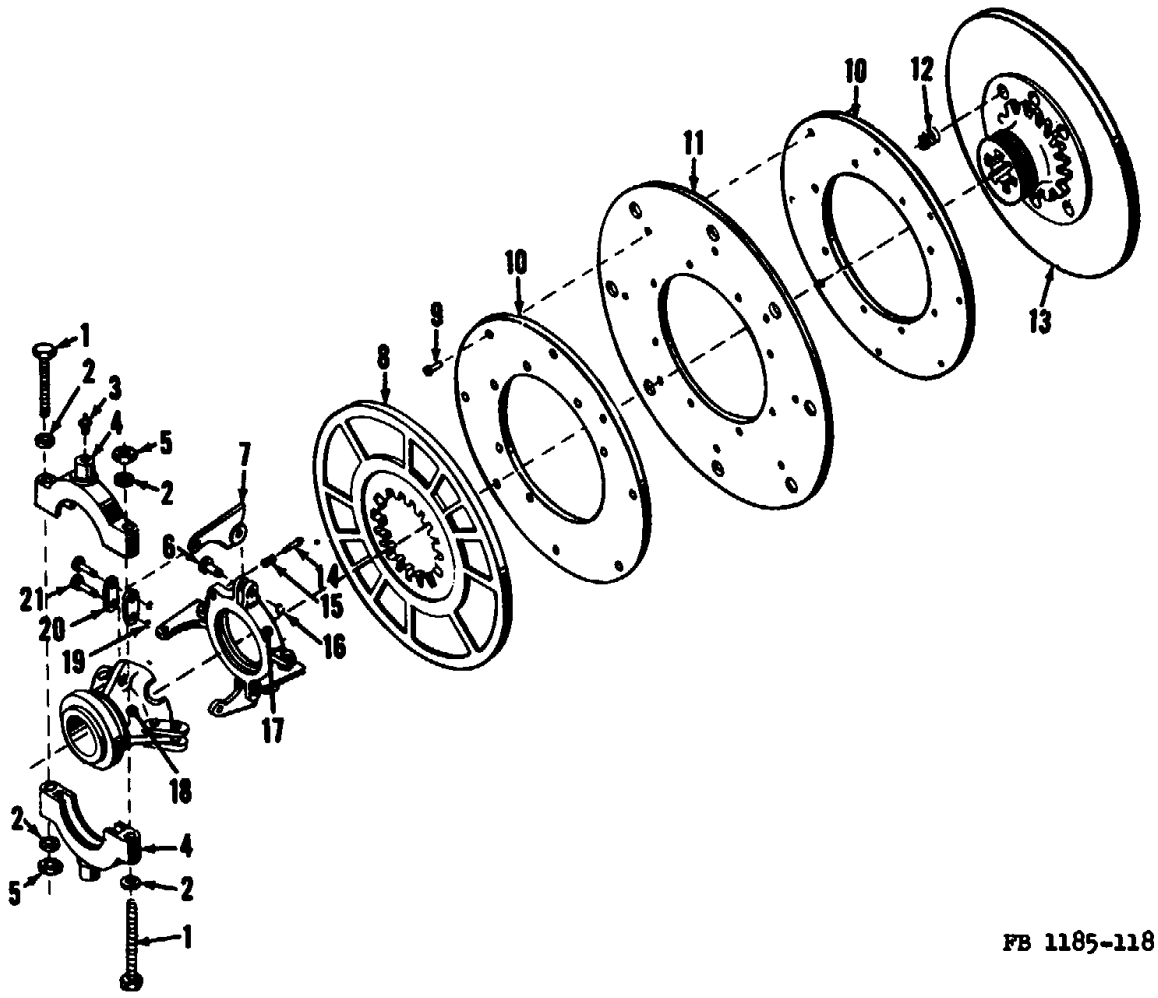


Figure 118. Master clutch disassembled.

1 Cone collar bolts (2 req’d)
2 Washers (4 req’d)
3 Grease fitting
4 Cone collar
5 Nuts (2 req’d)
6 Lever pins (4 req'd)
7 Finger levers (4 req'd)
8 Floating plate
9 Rivets (12 req'd)
10 Friction disks (2 req'd)
11 Driving plate
12 Release springs (6 req’d)
13 Hub and back plate
14 Adjusting lock pin
15 Spring
16 Retaining rings (4 req’d
17 Adjusting yoke
18 Sliding sleeve
19 Retaining rings (8 req'd)
20 Lever links (8 req'd)
21 Lever link pins (8 req'd)

Figure 118-Continued.

( ) Remove the adjusting lock pin (14) and spring (15).

d Cleaning. Wash all metal parts in cleaning solvent and dry them with a soft absorbent cloth or clean compressed air. Use a stiff brush to clean all threaded surfaces. Remove all dirt, sludge, rust, and corrosion from threaded and machined surfaces. Blow out the lubricant passage in the cone collar with clean compressed air.

e. Inspection and Repair.

(1) Inspect the cone collar for wear, breaks, cracks, pitting, and distortion. Replace the cone collar if worn or damaged. Always replace both cone collars in sets, to avoid excessive plate and clutch slippage.
(2) Inspect all threaded surfaces for damaged, corroded, or stripped threads. Replace all defective parts.
(3) Inspect the steel insert on the floating plate for flaws, cracks, and wear. If the steel insert is grooved, chipped, or worn, the floating plate must be replaced.
(4) Replace the hub and back plate if the threads, teeth, or splines are broken, worn, or damaged.
(5) Check the finger levers and lever links for wears, breaks, cracks, damaged or worn pin holes, and excessive play. Replace all finger levers and lever links if some of them are damaged or worn. Always replace the finger levers and lever links in complete sets.

f Reassembly.

(1) Install new friction disks (10) and rivet them to the driving plate (11). Make sure that the friction disks adhere firmly and evenly to the driving plate.
(2) Install the lever links (20) on the sliding sleeve (18) and secure them with the lever link pins (21) and retaining rings (19).
(3) Install the finger levers (7) on the adjusting yoke (17) and secure them with the lever pins (6) and retaining rings (16).
(4) Attach the sliding sleeve (18) to the adjusting yoke (17) and secure the connecting links with lever link pins (21) and retaining rings (19).
(5) Install the adjusting lock pin (14) and spring (15).
(6) Install the cone collar (4) and secure it with the mounting bolts (1), washers (2),and nuts (5).
(7) Install the grease fitting (3).
(8) Assemble the springs (12) and driving plate (11) on the hub and back plate (13). Make sure that the springs are properly seated between both plates.
(9) Install the floating plate (8).
(10) Position the adjusting yoke (17) on the hub and back plate (13), being careful not to damage the threads. Turn the

adjusting yoke (17) clockwise as far as it will go. Do not tighten the adjusting yoke.

g installation.

(1) Install the clutch assembly on the engine flywheel and see that the mounting holes are properly alined.
(2) Install and tighten the mounting screws and lockwashers.
(3) Install the engine (par. 175).
(4) Adjust the clutch (par. 138b).

200. Forward and Reverse Clutch
(fig. 119)

a Description. Refer to paragraph 140a.

b. Removal.

(1) Remove the cone collar assembly (par. 142b).
(2) Pull out the adjusting lock pin (5) and secure it in unlocked position.
(3) Turn the adjusting yoke (13) counterclockwise until it is released from the threads on the hub and back plate (29).
(4) Remove the adjusting yoke (13) and thrust washers (16).
(5) Lift up and remove the floating plate (4) and roller disk (6).
(6) Remove the six release springs (3).
(7) Lift up and remove the driving plates (1) and center plate (2).
(8) Unscrew and remove the hub and back plate lock screw (27). Loosen the setscrew (28).
(9) Pull the hub and back plate (29) off the shaft and remove it from the driving spider (30).

c Digass8mbly.

(1) Disassemble the cone collar (par. 142c).
(2) Remove the adjusting lock pin (5) and spring (7) from the adjusting yoke (13).
(3) Remove the cotter pin (12) and drive out the lever pin (8).
(4) Remove the lever springs (11), rollers (10), and levers (9).
(5) Remove the cone ring (14) and cone sleeve (15).

d Cleaning. Wash all metal parts in cleaning solvent and dry them with a soft absorbent cloth or clean compressed air. Use a stiff brush dipped in cleaning solvent to clean all threaded surfaces. Remove all dirt, sludge, and corrosion from the driving plates and floating plate.

e Inspection and Repair.

(1) Inspect the roller and levers for wear, etching, pitting, corrosion, and damage. Always replace rollers and levers in sets. If one roller or lever is worn or damaged, all rollers and levers must be replaced.

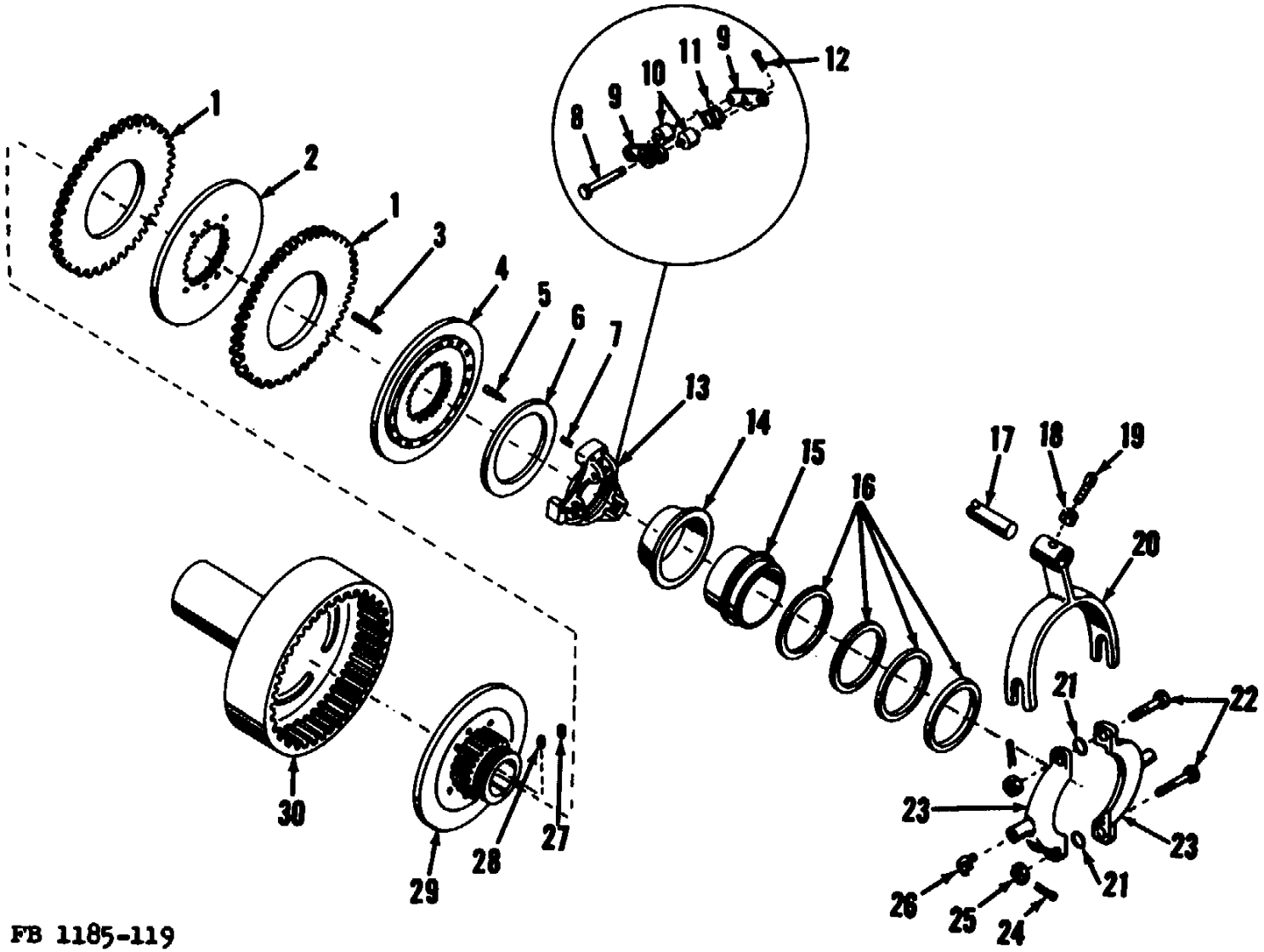


Figure 119. Forward and reverse clutch disassembled.

1 Driving plates (2 req’d)
2 Center plate
3 Release springs (6 req’d)
4 Floating plate
5 Adjusting lock pin
6 Roller disk
7 Spring
8 Lever pins (3 req'd)
9 Levers (6 req'd)
10 Rollers (6 req'd)
11 Lever springs (3 req'd)
12 Cotter pins (3 req'd)
13 Adjusting yoke
14 Cone ring
15 Cone sleeve
16 Thrust washers (4 req’d)
17 Shift shaft
18 Nut, jam, hex, ½-13 NC
19 Screw, set, sq hd, ½-13 NC x 1¾
20 Clutch yoke
21 Shims (2 req'd)
22 Cone collar bolts (2 req'd)
23 Cone collar
24 Cotter pins (2 req'd)
25 Nuts (2 req'd)
26 Fitting, grease, $^{1}/_{8}$, 45°
27 Lock screw
28 Setscrew
29 Hub and back plate
30 Driving spider

Figure 119--Continued.

(2) Inspect the lever pins for wear, twisting, corrosion, and damage. Replace all defective pins. Discard used cotter pins and install new ones when reassembling the adjusting yoke or cone collar.
(3) Inspect all machined surfaces for breaks, cuts, cracks, and pitting. Replace all defective parts.
(4) Check the hub and back plate for damaged, corroded, or worn threads and teeth. Replace the hub and back plate if the threads or teeth are broken off, chipped, or worn.
(5) Inspect all mounting and assembly screws for damaged, corroded, worn, twisted, or stripped threads. Replace all defective screws, nuts, and washers.
(6) Inspect the release springs for twisting, warpage, breaks, corrosion, and metal fatigue. Replace all damaged or worn release springs.

f. Reassembly.

(1) Assemble the rollers (10), lever springs (11), and levers (9) on the adjusting yoke (13).
(2) Install the lever pins (8) and secure them with new cotter pins (12).
(3) Assemble the cone ring (14) and cone sleeve (15).
(4) Install the adjusting lock pin (5) and spring (7).
(5) Assemble the cone collar (par. 142e).

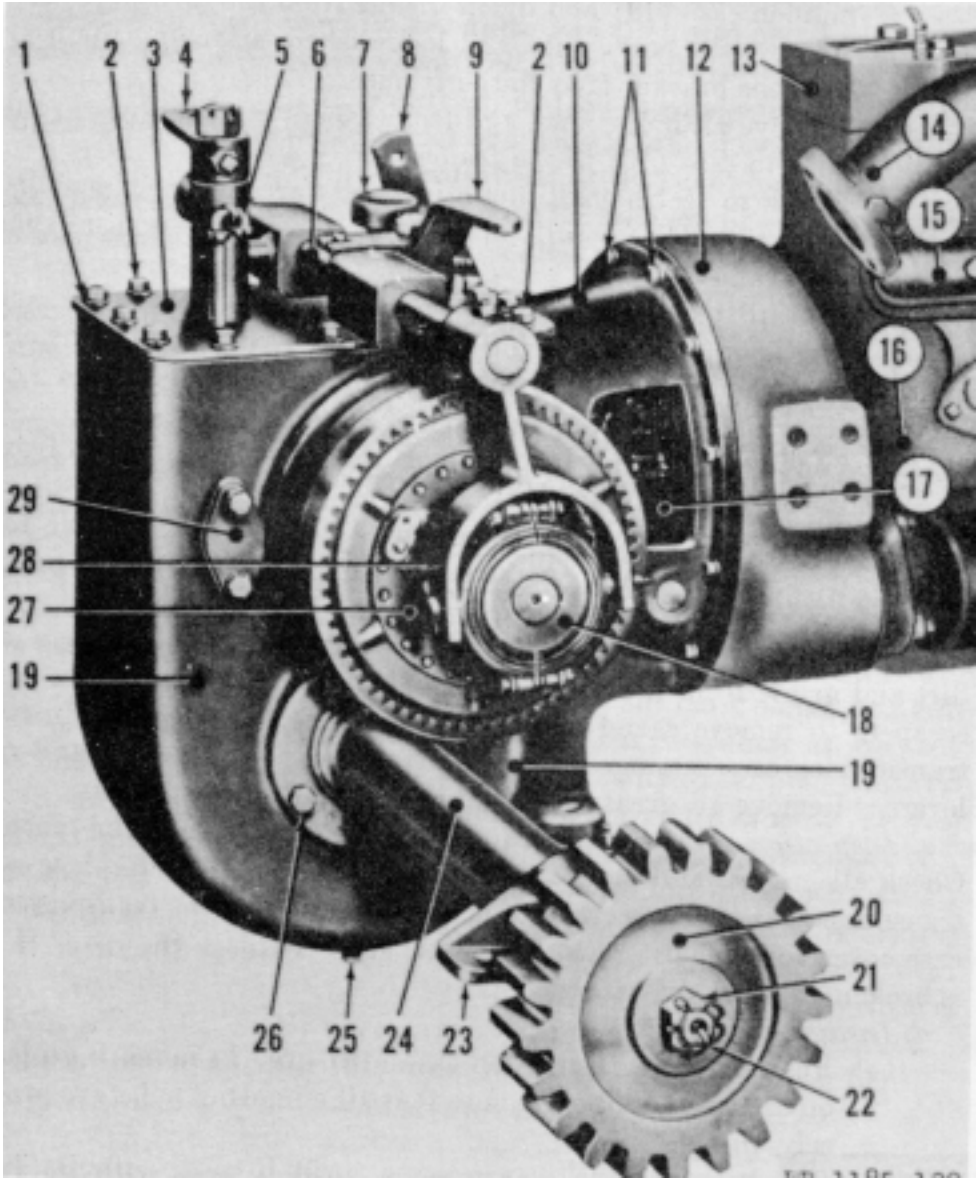
g. Installation.

(1) Press the hub and back plate (29) on the shaft.
(2) Install and tighten the setscrew (28). Secure the setscrew with the lock screw (27).
(3) Install the driving plates (1) and the center plate (2).
(4) Install the release springs (3) and floating plate (4). Make sure that the release springs are seated properly between the plates.
(5) Install the roller disk (6).
(6) Install the adjusting yoke (13) and turn it clockwise as far as it will go. Do not tighten the yoke.
(7) Install the cone collar (par. 142*f*).
(8) Adjust the forward and reverse clutch (par. 140b).

201. Transmission Case
(fig. 120)

a. Removal.

(1) Remove the steering roll top cover (par. 162).
(2) Remove the operator's platform (par. 161).
(3) Remove the compression roll housing (par. 158).
(4) Remove the engine (par. 174).
(5) Check to see that all leads and linkages are disconnected.



1	Lockwasher	16	Cylinder block
2	Transmission cover screw	17	Master clutch
3	Transmission case cover	18	Forward and reverse clutch
4	Gear shift arm	19	Transmission case
5	Ventilation pipe	20	First countershaft pinion
6	Forward and reverse clutch shaft	21	Pinion nut
7	Oil filler cap	22	Cotter pin
8	Master clutch lever	23	Bearing tube bracket
9	Forward and reverse clutch lever	24	First countershaft bearing tube
10	Master clutch housing	25	Transmission drain plug
11	Mounting screws	26	Bearing tube mounting screw
12	Flywheel housing	27	Hub and back plate
13	Cylinder head	28	Throwout collar yoke
14	Exhaust manifold	29	Gear shift shaft bearing cover
15	Valve cover		

Figure 120. Transmission and first countershaft.

(6) Remove the drain plug (25) on the bottom of the transmission case (19) and drain the oil from the transmission.
(7) Remove the bolts, nuts, and lockwashers attaching the bearing tube bracket (23) to the frame.
(8) Remove all bolts, nuts, and lockwashers attaching the transmission case (19) to the frame.
(9) Check to see that all mounting bolts are removed and that linkage and leads will not interfere with the transmission removal.
(10) Wrap steel cables around the transmission case (19) and first countershaft bearing tube (24). Lift up the transmission about an inch to see that it is properly balanced and secure. Change the position of the cables until the transmission is properly balanced. Remove the transmission from the road roller frame.
(11) Place the transmission on blocks in a location suitable for disassembly work. Make sure that the transmission is properly blocked and secured.

b. Cleaning. Use a stiff brush and cleaning solvent to remove all dirt and grime from the outer surface of the transmission case. Use scrapers to remove caked mud and sludge from all recesses in the transmission case casting. Clean the transmission case cover and all levers. Remove all grease and sludge from the shifting parts.

c. Inspection. Inspect the transmission case for breaks and cracks. Check all gaskets and mounting surfaces for oil leaks. Replace the transmission case if it is cracked or broken. Inspect the transmission case cover for breaks, cracks, and warpage. Replace the cover if it is broken, cracked, or warped.

d. Installation.

(1) Position the transmission case (19) over its mounting place on the frame and make sure that all mounting holes are properly alined.
(2) Slowly lower the transmission until it rests with its full weight on the frame. Check to see that the mounting holes in the transmission case (19), first countershaft bearing tube bracket (23), and frame are properly alined.
(3) Install and tighten the bolts, nuts, and lockwashers attaching the transmission case to the frame.
(4) Install and tighten the bolts, nuts, and lockwashers attaching the first countershaft bearing tube bracket (23) to the frame.
(5) Install the drain plug (25) and fill the transmission with oil.
(6) Install the engine (par. 175) and connect all linkages between the transmission, engine, and operating controls.
(7) Install the compression roll housing (par. 158).
(8) Install the operator's platform (par. 161).
(9) Install the steering roll top cover (par. 162).

202. Transmission Cover
(fig. 120)

a. Removal.

(1) Disconnect all leads and linkages connecting the transmission cover (3) with the engine and operating controls.
(2) Remove the drain plug (25) on the bottom of the transmission case (19) and drain the oil from the transmission.
(3) Remove the forward and reverse clutches (par. 200b).
(4) Remove the transmission case cover mounting screws (2) and lockwashers (1).
(5) Lift up the transmission case cover and remove it from the transmission case (19).
(6) Remove and discard the transmission case cover gasket.

b. Cleaning. Wash the cover in cleaning solvent and dry it with clean compressed air. Use a stiff brush and cleaning solvent to clean the top of the cover. Make sure that the linkage and shifting arms move freely and that they are free of dirt and sludge. Blow off the ventilation and filler pipe holes with clean compressed air.

c. Inspection. Inspect the top cover assembly for breaks, cracks, and warpage. Replace the cover if it is badly warped or twisted. Always use a new cover gasket when replacing the cover on the transmission case. Check all arms and linkage on top of the cover for free operation and sufficient lubrication. Replace all damaged or worn parts.

d. Installation.

(1) Coat the top of the transmission case with fast-drying gasket sealer and install a new transmission cover gasket.
(2) Position the cover (3) over the transmission case (19) and see that the mounting holes in the cover, gasket, and case are properly alined.
(3) Make sure that the gearshift arm (4) shaft fits properly in the gearshift yoke in the transmission case.
(4) Install and tighten the mounting screws (2) and lockwashers (1).
(5) Install the forward and reverse clutches (par. 200g).
(6) Check the forward and reverse clutches (18) for proper operation. Adjust the clutches if necessary (par. 140b).
(7) Install the transmission drain plug (25) and fill the transmission with oil. Check for leaks around the transmission case gaskets.
(8) Check for oil leaks around the drain plug. Tighten the plug if necessary.

203. Gearshift Fork
(fig. 121)

a. General. The gearshift fork assembly is removed from the top of the transmission case. The shaft bearings are removed from the

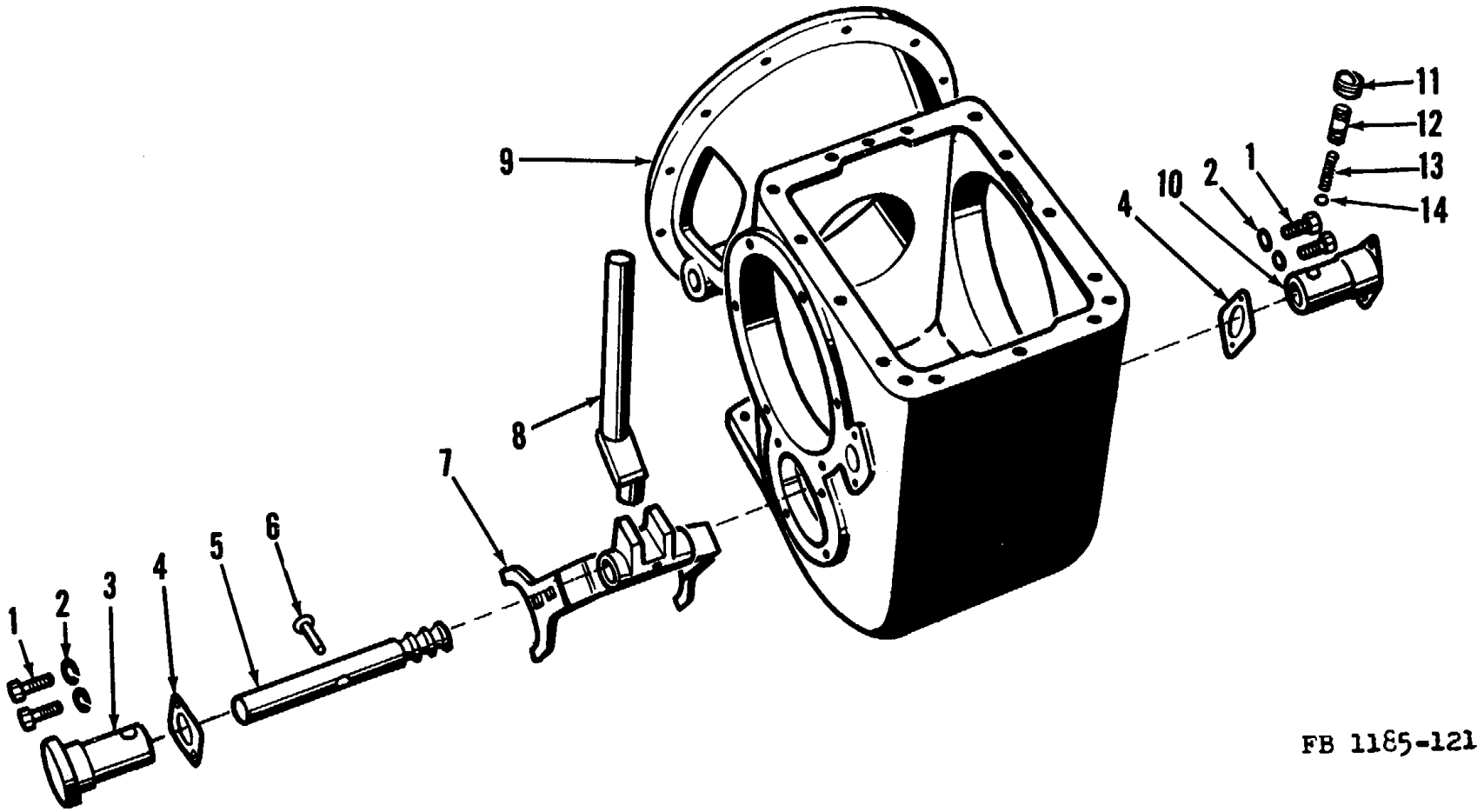


Figure 121. Gear shift fork disassembled.

1 Screws, cap, hex hd, ½-18 NO x 1½ (4 req'd)
2 Washers, lock, std, ½ (4 req'd)
3 Bearing, left
4 Gaskets (6 req'd)
5 Gear shifter shaft
6 Shaft ptn
7 Yoke
8 Gear shifting crank
9 Transmission case
10 Bearing, right
11 Cap, pipe, $^{3}/_{8}$
12 Nipple, pipe, $^{3}/_{8}$ x 1¾
13 Lock spring
14 Ball, steel, $1^{15}/_{32}$ dia

Figure 121--Continued

outer left and right sides of the case. When servicing or removing the gearshift fork assembly, be extremely careful not to drop tools, lockwashers, or screws into the transmission case. Use clean tools and do not allow dirt or dust to enter into the bearings or gears. Make sure that hands and rags are free of dust and grit. Always cover the transmission case with a clean cloth when the transmission case cover is removed.

b. Removal.

(1) Remove the transmission case cover (par. 202a).
(2) Slowly unscrew the pipe cap (11), being careful not to lose the lock spring (13) located inside the pipe nipple (12).
(3) Remove the lock spring (13) from the pipe nipple (12).
(4) Use a pipe wrench to unscrew the pipe nipple (12).
(5) Remove the steel ball (14).
(6) Unscrew and remove the bearing retainer screws (1) and lockwashers (2) on the left and right sides of the transmission case.
(7) Remove the left (3) and right (10) bearings.
(8) Remove and discard the gaskets (4).
(9) Lift up and remove the gear shifter shaft (5), yoke (7), and gear shifting crank (8) from the transmission case (9).
(10) Drive out the shaft pin (6) and remove the yoke (7) from the gear shifter shaft (5).
(11) Inspect the bearings (3) and (10) in the bearing retainers. If the bearings are worn, scored, or damaged, press or drive them out from the retainers.

c. Cleaning. Wash all parts in cleaning solvent and dry them with a clean absorbent cloth or compressed air. Use a wire brush to clean the threads of the mounting screws and pipe nipples. Remove all grease, dirt, and sludge from the bearing retainers. Clean the bearing mounting holes in the transmission case with cleaning solvent and remove all rust and dirt from the machined gasket surfaces.

d. Inspection and Repair.

(1) Inspect the gear shifter shaft for wear, twisting, pitting, etching, and cracks. Replace the shaft if it is defective.
(2) Inspect the yoke for cracks, breaks, and warpage. Do not attempt to disassemble the yoke by driving out the rivets. If the yoke is damaged or worn, replace the complete yoke assembly as a unit.
(3) Inspect the gear shifting crank for twisting, wear, cracks, and breaks. Replace the crank if it is twisted, broken, or cracked.
(4) Check the bearings for wear, pitting, etching, scoring, and damage. Replace defective bearings. Always replace both

bearings in sets. If one bearing is worn or damaged, replace both bearings.
(5) Check the steel ball for pitting, etching, out of round, and cracks. Replace steel ball if it is defective.
(6) Inspect the mounting screws, pipe nipple, and pipe cap for damaged, corroded, twisted, or stripped threads. Replace all damaged or defective parts.
(7) Use a new shaft pin when installing the yoke on the gear shifter shaft.
(8) Replace all gaskets.
(9) Inspect the lock spring for corrosion, twisting, breaks, and metal fatigue. Replace the lock spring if defective.

e. Installation.

(1) Install the yoke (7) on the gear shifter shaft (5) and make sure that the pin hole in the shaft and yoke are properly alined.
(2) Install the shaft pin (6) securing the yoke (7) to the shaft (5).
(3) Press new bearings (3 and 10) into the bearing retainers.
(4) Install the gear shifter shaft (5), yoke (7), and gear shifting crank (8) in the transmission case.
(5) Aline the shaft (5) with the bearing mounting holes and install the bearings (3 and 10) and gaskets (4).
(6) Install and tighten the screws (1) and lockwashers (2).
(7) Install the pipe nipple (12) and steel ball (14).
(8) Install the lock spring (13) in the pipe nipple (12) and tighten the pipe cap (11).
(9) Operate the gear shifting crank (8) and see that the shaft engages the gears properly.
(10) Install the transmission case cover (par. 202d).

204. Forward and Reverse Clutch Shaft
(fig. 122)

a. Removal.

(1) Remove the forward and reverse clutches (par. 200b).
(2) Remove the transmission case cover (par. 202a).
(3) Remove the gearshift fork (par. 203b).
(4) Remove the thrust washers (22) and oil seals (21) from both ends of the clutch shaft (4).
(5) Remove the screws (24) and lockwashers (25) attaching the bearing housings (14) to the transmission case (1).
(6) Pull both bearing housings (14) off the shaft (4). The hubs, bevel gears, and spiders will remain in the bearing housing.

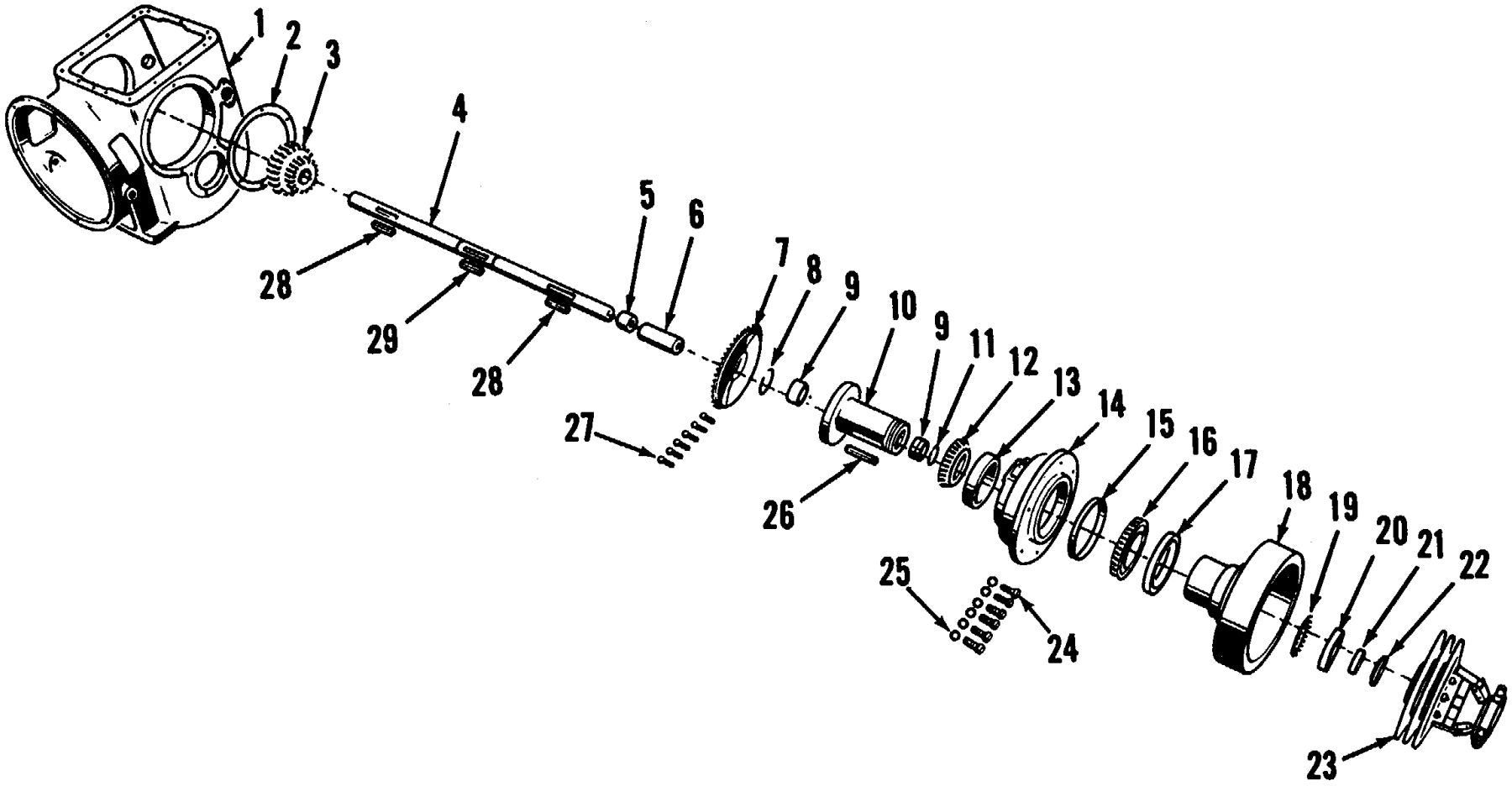


Figure 122. Forward and reverse clutch shaft disassembled.

1 Transmission ease
2 Gaskets (4 req’d)
3 Double speed pinion
4 Forward and reverse clutch shaft
5 Pinion spacers (2 req'd)
6 Shaft bearing spacers (2 req'd)
7 Bevel gears (2 req'd)
8 Retaining rings (2 req'd)
9 Bearings (4 req'd)
10 Hubs (2 req'd)
11 Hub spacers (2 req'd)
12 Bearing rollers, inner (2 req’d)
13 Bearing cones, inner (2 req’d)
14 Bearing housings (2 req’d)
15 Oil seals (2 req’d)
16 Bearing rollers, outer (2 req'd)
17 Bearing cones, outer (2 req'd)
18 Clutch driving spiders (2 req'd)
19 Lockwashers (2 req'd)
20 Locknuts (2 req'd)
21 Oil seals (2 req'd)
22 Thrust washers (2 req’d)
23 Forward and reverse clutches (2 req’d)
24 Screws, cap, hex hd, ½-13 NC x 1¼ (12 req'd)
25 Washers, lock, std, ½ (12 req'd)
26 Hub keys (2 req'd)
27 Rivets, rd hd, ½ x $1^{3}/_{8}$, (4 req'd)
28 Shaft keys (2 req'd)
29 Pinion key

Figure 122-Continued.

(7) Remove and count the gaskets (2) or shims located under each housing (14). The same number of gaskets or shims must be used during installation.
(8) Pull the clutch shaft (4) away from the first countershaft bearing tube and remove it from the transmission case (1). The gears, bearing cones, and spacers will remain on the shaft.

b. Disassembly.

(1) Bend the ears of the lockwashers (19) away from the locknut (20). Remove the locknut and lockwasher.
(2) Remove the outer bearing (9). Spread the retaining ring (8) and remove the inner bearing (9).
(3) Press the hub (10) out of the bearing housing (14) and remove the key (26).
(4) Remove the oil seal (15) from the bearing housing (14).
(5) Remove the bearing roller (16) from the clutch driving spider (18).
(6) Remove the bearing roller (12) from the hub (10).
(7) Press out the inner (13) and outer (17) bearing cones from the bearing housing (14).
(8) Remove the shaft keys (28) from the clutch shaft (4).
(9) Remove the shaft bearing spacer (6) and pinion spacer (5) from the clutch shaft (4).
(10) Press the double-speed pinion (3) off the clutch shaft (4) and remove the key (29).
(11) Do not remove the bevel gear (7) from the hub (10). If the gear is damaged, broken, or worn, replace the bevel gear and hub as an assembly.

c. Cleaning. Wash all parts with cleaning solvent and dry them with clean compressed air. Remove all sludge, dirt, and foreign matter from the keyways. Use a stiff brush dipped in cleaning solvent to clean the outer and inner walls of the bearing housings. Make sure that al2l machined surfaces and bearing seats are free from sludge, dirt, corrosion, and old grease.

d. Inspection and Repair.

(1) Inspect the clutch shaft for breaks, cracks, and twisting. Check the keyway edges for broken, chipping, or pitted metal. Smooth down pitted or chipped edges with a fine-cut file. Inspect the shaft bearing journals for scoring, burrs, and wear. Replace the clutch shaft if it is cracked, broken, or twisted.
(2) Check the double-speed pinion for broken, chipped, damaged, or worn teeth. Inspect the keyway for cracks, burrs, and chipping edges. Check the mounting surface for cracks,

scoring, and corrosion. Replace the pinion if its teeth are broken, chipped, damaged, or worn.

(3) Inspect the bevel gear and hub for loose rivets, broken or chipped gear teeth, and worn or damaged teeth surfaces. Replace the bevel gear and hub if it is worn or damaged, or if the contact surfaces of the teeth are broken, chipped, or worn.

(4) Check all bearings for wear, scoring, and damage. Check the bearing rollers for free rotation. Replace all defective, worn, or damaged bearings.

(5) Inspect the bearing housing for cracks and breaks. Check all machined surfaces for pitting and etching. Replace the bearing housing if it is broken or cracked, or if the mounting surfaces are excessively pitted.

(6) Check the clutch driving spider for broken lugs, a damaged keyway, and broken or damaged teeth. Replace the spider if it is worn, damaged, or cracked.

(7) Replace oil seals. Do not use old oil seals during reassembly.

(8) Check all spacers for wear, cracks, breaks, damage, and twisting. Replace all damaged, worn, or defective spacers.

(9) Inspect all mounting screws for corroded, damaged, twisted, or stripped threads. Replace all defective mounting screws.

(10) Check all gaskets and shims for damage, cracks, and torn edges. Replace all defective gaskets and shims.

(11) Inspect all machined surfaces for pitting, corrosion, and etching. Remove all sludge and dirt from the machined mounting surfaces. Dress down all pitted surfaces with a fine-cut file.

e. Reassembly.

(1) Install the pinion key (29) and press the double-speed pinion (3) on the clutch shaft (4):

(2) Install the pinion spacers (5) on both sides of the double-speed pinion (3).

(3) Install the bearing (9) and secure it with the retaining ring (8).

(4) Install the bearing roller (12) on the hub (10).

(5) Press the inner (3) and outer (17) bearing cones into the bearing housing (14).

(6) Install the bearing roller (16) on the clutch driving spider (18).

(7) Install the oil seal (15) in the bearing housing (14).

(8) Install the key (26) on the hub (10) and press the bearing housing and driving spider (18) assemblies on the hub.

f. Installation.

(1) Install the clutch shaft (4) in the transmission case (1).

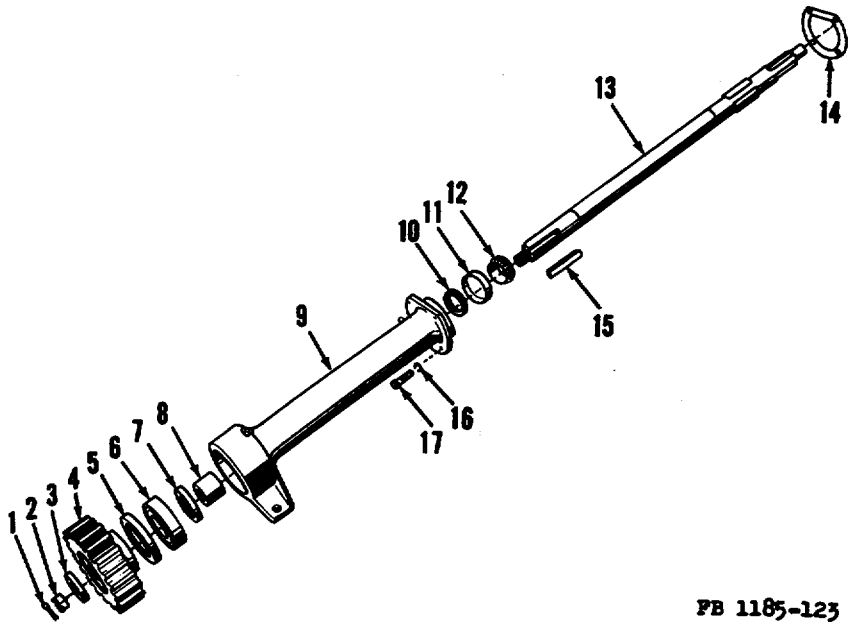
(2) Install the bearing housing (14) and driving spider (18) assemblies on the clutch shaft (4). Use the same number of gaskets (2) or shims between the bearing housing and transmission case as were used before removal. These shims and gaskets are used to adjust the meshing clearance between the bevel gears and bevel pinion on the master clutch shaft. Be careful not to adjust the meshing clearance too tight. The meshing clearance is properly adjusted when a slight play can be noticed in the meshing.
(3) Install and tighten the bearing housing screws (24) and lockwashers (25).
(4) Install the shaft bearing spacers (6).
(5) Install the outer bearings (9) and hub spacers (11).
(6) Install the lockwashers (19) and locknuts (20). Turn the locknuts (20) clockwise to adjust the bearings. The bearings are properly adjusted when there is no binding or excessive side play as the shaft is turned by hand.
(7) Bend the ear of the lockwasher (19) over the locknut (20).
(8) Install the oil seals (21) and thrust washers (22).
(9) Install the outer shaft keys (28) and forward and reverse clutches (par. 200g).
(10) Install the gearshift fork (par. 203g).
(11) Install the transmission case cover (par. 202d).

205. First Countershaft Bearing Tube

(fig. 123)

a. Removal.

(1) Remove the transmission (par. 201a).
(2) Remove the transmission case cover (par. 202a).
(3) Remove the gearshift fork (par. 203b).
(4) Remove the forward and reverse clutch shaft (par. 204a).
(5) Unlock the cotter pin (1) and drive it out from the first countershaft (13) with a small drift. Discard the cotter pin.
(6) Unscrew and remove the slotted nut (2) and retainer washer (3).
(7) Use standard gear puller (41-6279,.330.500) and pull the pinion gear (4) off the countershaft (13).
(8) Remove the pinion gear key (15).
(9) Block the countershaft gears inside the transmission case to prevent them from shifting when the bearing tube (9) is removed.
(10) Remove the four screws (17) and lockwashers (16) attaching the bearing tube (9) to the transmission case.
(11) Pull the bearing tube (9) away from the transmission case. If the bearing tube sticks to the case or shaft, strike the



1	Pin, cotter, 3/16 x 2 1/8	10	Oil seal
2	Pinion gear nut	11	Bearing cone
3	Retainer washer	12	Bearing rollers
4	Pinion gear	13	Countershaft
5	Outer seal	14	Gasket
6	Outer bearing	15	Pinion gear key
7	Inner seal	16	Washers, lock, std, ½ (4 req'd)
8	Spacer	17	Screws, cap, hex hd, ½ -13NC x 1 ½ (req'd)
9	Bearing tube		

Figure 123. First countershaft bearing tube disassembled.

countershaft (13) a few times with a soft faced hammer to loosen the tube.

(12) Remove and discard the gasket (14).

b. Disassembly.

(1) Use an arbor press and press the bearing (6) and outer oil seal (5) from the bearing tube. Discard the oil seal.

(2) Remove the inner oil seal (7) and spacer (8).

(3) Remove the bearing rollers (12) from the shaft and press out the bearing cone (11) from the bearing tube (9).

(4) Remove and discard the oil seal (10).

c. Cleaning. Wash all parts in cleaning solvent and dry them with clean compressed air. Clean all rust, dirt, and sludge from the inside walls of the bearing tube. Use a wire brush to clean all rust, corrosion, and dirt from the mounting screw threads. Use scrapers to remove old gaskets adhering to the mounting surfaces of the transmission case.

d. Inspection and Repair.

(1) Inspect the pinion gear for damaged, broken, or stripped teeth. Inspect the teeth surfaces for cracks, pitting, etching, and chipping metal. Check the pinion gear keyway for distortion, cracks, and broken edges. Replace the pinion gear if it is broken, damaged, cracked, or if the teeth are missing or worn.

(2) Inspect all bearings for wear, scoring, corrosion, and damage. Check the rollers for free rotation. Inspect the bearing cones for cracks and flaws. Replace all defective bearings.

(3) Replace all oil seals and gaskets.

(4) Inspect the bearing tube for breaks, cracks, twisting, dents, and warpage. Check the mounting and machined surfaces for pitting and etching. Dress down pitted or scratched surfaces with a fine-cut file. Check the inside walls and bearing seats for cracks, scoring, and flaws. Replace the bearing tube if it is broken, twisted, or dented.

(5) Inspect the key for broken, damaged, or pitted edges. Replace the key if the edges are worn, broken off, or cracked.

(6) Inspect all mounting screws for damaged, stripped, or corroded threads. Replace all defective screws.

e. Reassembly.

(1) Install the oil seal (10) and press the bearing cone (11) into the bearing tube (9). Install the bearing rollers (12) on the countershaft (18).

(2) Install the spacer (8) and the inner oil seal (7) so that the sealing lip is facing away from the bearing.

(3) Install the bearing (6) and the outer oil seal (5) so that the sealing lip is facing toward the bearing.

f. Installation.

(1) Coat a new gasket (14) with fast-drying gasket sealer and install it on the bearing tube (9). See that the mounting holes on the bearing tube and gasket are properly alined and that the gasket adheres firmly to the machined mounting surface of the bearing tube.

(2) Install the bearing tube (9) on the countershaft (13) and tighten the mounting screws (17) and lockwashers (16). Remove the blocks securing the countershaft gears inside the transmission case.

(8) Install the key (15) and press the pinion gear (4) on the countershaft (13).

(4) Install the retainer washer (8) and slotted nut (2).

(5) Tighten the slotted nut (2) and secure it with the cotter pin (1).

(6) Install the forward and reverse clutch shaft (par. 204f).

(7) Install the gearshift fork (par. 203g).
(8) Install the transmission case cover (par. 202d).
(9) Install the transmission (par. 201d).

206. First Countershaft
(fig. 124).

a. Removal.
(1) Remove the transmission (par. 201a).
(2) Remove the transmission case cover (par. 202a).
(3) Remove the gearshift fork (par. 203b).
(4) Remove the forward and reverse clutch shaft (par. 204a).
(5) Remove the first countershaft bearing tube (par. 205a).
(6) Remove the mounting screws (17) and lockwashers (18) attaching the outer bearing housing (16) to the transmission case (14).
(7) Remove the outer bearing housing (16) and gasket (15). If there are any shims between the gasket (15) and the transmission case (14), note the exact number of shims so that the same number can be replaced during installation. (8) Remove the outer bearing cone (13) and pull the outer bearing roller (12) off the countershaft (1).
(9) Spread and remove the retaining ring (9).
(10) Block the countershaft gears to prevent them from falling down into the transmission case when the countershaft is removed.
(11) Pull out and remove the countershaft (1) from the transmission case (14).
(12) Lift out and remove the countershaft gears (6 and 8), sliding gears (2 and 10), and washers (3 and 7) from the transmission case (14).

b. Disassembly.
(1) Press out and remove the bearing (4) and cone (5) from the slow gear (6).
(2) Press out and remove the bearing (4) and cone (5) from the fast gear (8).

c. Cleaning. Wash all parts in cleaning solvent and dry them with clean compressed air. Use a stiff brush dipped in cleaning solvent to remove all dirt, sludge, and caked grease from the countershaft splines and gear teeth recesses. Use a wire brush to clean the threads on mounting screws. Remove all dirt, sludge, old grease, and rust from all machined and mounting surfaces on the transmission case and outer bearing lousing. Remove used oil, grease, and sludge front the countershaft journals and mounting holes in the transmission case.

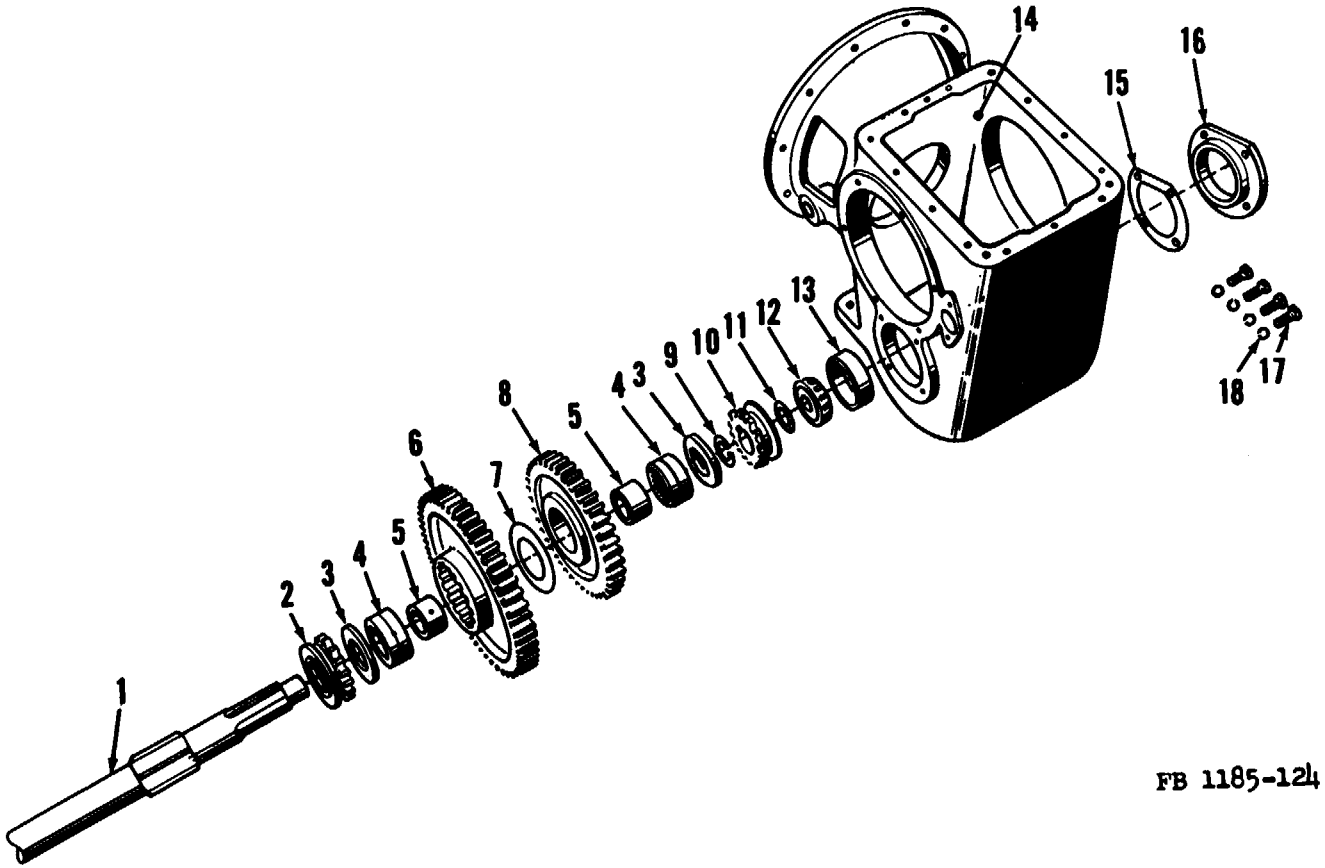


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Figure 124. First countershaft disassembled.

1 Countershaft
2 Sliding slow gear
3 Flatwasher
4 Bearing rollers (2 req’d)
5 Bearing cones (2 req’d)
6 Slow gear
7 Spacer washer
8 Fast gear
9 Retaining ring
10 Sliding fast gear
11 Flatwasher
12 Outer bearing roller
13 Outer bearing cone
14 Transmission case
15 Gasket
16 Bearing housing
17 Screws, cap, hex hd, ½ -13 NC x 1 ½ (4 req'd)
18 Washers, lock, std, ½ (4 req'd)

Figure 124. Continued.

d. Inspection and Repair.

(1) Check the countershaft for breaks, cracks, twisting, and damaged or stripped splines. Replace the countershaft if it is bent or damaged, or if the splines are broken off or stripped.
(2) Inspect all gears for damaged, worn, and chipping teeth. Replace all damaged or worn gears.
(3) Inspect the bearings for wear, scoring, binding, and corrosion. Replace all defective bearings.
(4) Check all washers for cracks and warpage. Replace the washers if the edges are chipping or cracked.
(5) Check all screws for damaged, corroded, worn, or stripped threads. Replace all defective screws and lockwashers.
(6) Inspect all machined and mounting surfaces for scoring, pitting, and etching. Dress down pitted surfaces with a fine-cut file.
(7) Replace all used gaskets with new ones. Replace defective shims.

e. Reassembly.

(1) Press the bearing (4) and cone (5) assembly into the slow gear (6) and check the gear for proper fit on the countershaft (1).
(2) Press the bearing (4) and cone (5) assembly into the fast gear (8) and check the gear for proper fit on the countershaft (1).

f. Installation.

(1) Install and block the countershaft sliding gears (2 and 10), gears (6 and 8), and washers (3 and 7) in proper order in the transmission case. Make sure that all parts are assembled in proper sequence and properly alined with the countershaft mounting holes.
(2) Install the countershaft (1) and secure it with the retaining ring (9).
(3) Press the outer bearing (12) on the countershaft (1) and the cone (13) assembly into the housing (16).
(4) Replace the same number of gaskets (15) or shims used previously. The shims are used for bearing adjustment. Reduce the number of shims to tighten the bearing adjustment and increase the number of shims to loosen the adjustment. The bearings must have no play. The bearing adjustment is correct when a slight drag is felt when the countershaft is turned by hand.
(5) Install the outer bearing housing (16) and tighten the mounting screws (17) and lockwashers (18).
(6) Install the first countershaft bearing tube (par. 205*f).*
(7) Install the forward and reverse clutch shaft (par. 204*f).*

(8) Install the gearshift fork (par. 203).
(9) Install the transmission (par. 201*d*).

207. Master Clutch Shaft

(fig. 125)

a. Removal.

(1) Remove the transmission (par. 201a).
(2) Remove the transmission case cover (par. 202a).
(3) Loosen the jam nut (15) and remove the setscrew (16) attaching the rocker shaft]ever (14) to the rocker shaft (12).
(4) Pull the rocker shaft lever (14) off the rocker shaft (12) and remove the key (18).
(5) Drive out the yoke pins (17).
(6) Drive out the rocker shaft (12) from the transmission case (11) and remove the shifter yoke (13) and keys (18).
(7) Remove the six screws (23) and lockwashers (22) attaching the bearing retainer (4) to the transmission case (11).
(8) Remove the bearing retainer gasket (8).
(9) Pull out and remove the master clutch shaft assembly from the transmission case.

b. Disassembly.

(1) Remove the oil seal (3) from the bearing retainer (4).
(2) Unlock the cotter pin (10) and drive it out from the drive shaft (2) with a small drift.
(3) Remove the jam nut (19).
(4) Pull out the drive shaft (2) from the bevel pinion gear (20).
(5) Remove the pinion gear key (24).
(6) Bend the ear of the lockwasher (6) away from the locknut (5) and remove the locknut and lockwasher.
(7) Drive out the bevel pinion gear (20) from the bearing (7).
(8) Press out the bearing (7) from the bearing cup (9).

c. Cleaning. Wash all parts in cleaning solvent and dry them with clean compressed air. Wipe off all dirt, sludge, and old grease from the shaft, gears, and mounting surfaces. Clean the threaded surfaces with a wire brush dipped in cleaning solvent.

d. Inspection and Repair.

(1) Inspect the bevel pinion gear for wear, cracks, breaks, damaged or chipping teeth. Check the keyway for cracked or twisted edges. Inspect the teeth surfaces for excessive pitting and etching. Replace the bevel pinion gear if cracked, broken, or if the teeth are worn or chipping.
(2) Inspect the master clutch drive shaft for warpage, scoring, and damaged or broken splines and threads. Replace the shaft if it is damaged or defective.

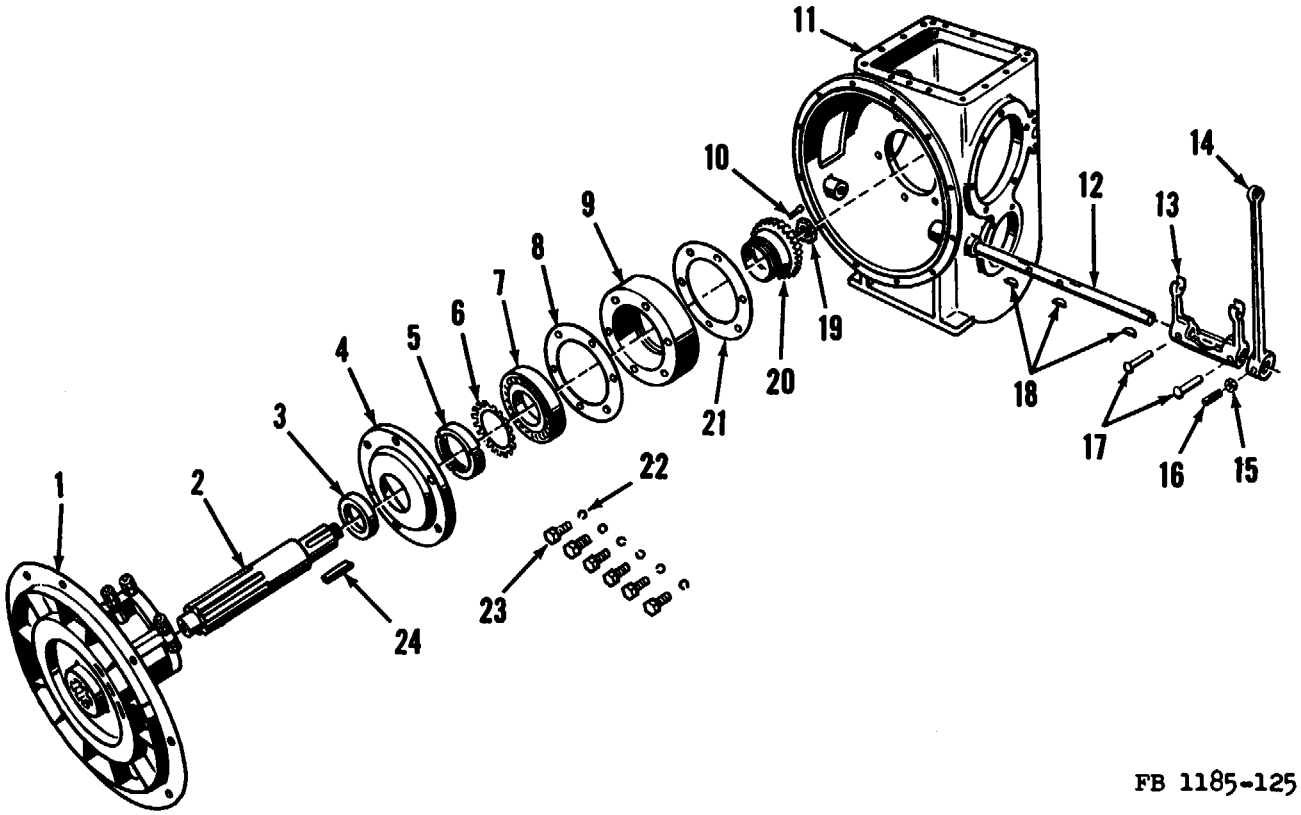


Figure 125. Master clutch shaft disassembled.

1 Master clutch
2 Drive shaft
3 Oil seal
4 Bearing retainer
5 Locknut
6 Lockwasher
7 Bearing
8 Bearing retainer gasket
9 Bearing cup
10 Pin, cotter, 3/6 x 2 1/8
11 Transmission case
12 Rocker shaft
13 Shifter yoke
14 Rocker shaft lever
15 Nut, jam, 3/8-16 NC
16 Screw, set, cup point, 3/8 -16 NC x ¾
17 Yoke pins (2 req'd)
18 Rocker shaft keys (3 req'd)
19 Jam nut
20 Bevel pinion gear
21 Bearing cup gaskets (3 req'd)
22 Washers, lock, std, ½ (6 req'd)
23 Screws, cap, hex hd, 1/2-13 NC x 1 ½ (6 req'd)
24 Pinion gear key

Figure 125. Continued.

(3) Inspect the bearing retainer for breaks, cracks, and warpage. Replace the retainer if it is cracked or warped.
(4) Inspect the bearing and bearing cup for wear, cracks, scoring, and damage. Check the bearing for free rotation. Replace defective bearings and bearing cups.
(5) Inspect all gaskets and shims for wear, corrosion, and cracked or chipping edges. Replace all defective gaskets and shims.
(6) Replace the oil seal. Check all mounting screws and assembly jam nuts for damaged, corroded, or stripped threads. Replace all defective screws, jam nuts, and lockwashers.

e. Reassembly.
(1) Press the bearing (7) into the bearing cup (9).
(2) Press the bevel pinion gear (20) into the bearing cup.
(3) Install the lockwashers (6) and locknut (5). Tighten the locknut and bend the ear of the lockwasher into the slot on the locknut.
(4) Install the key (24) and press the shaft (2) into the bevel pinion gear (20).
(5) Install the jam nut (19) and tighten it securely. Secure the jam nut (19) with a new cotter pin (10).
(6) Install the oil seal (3) in the bearing retainer (4).

f. Installation.
(1) Install the bearing cup gaskets (21) and shims (if any) on the bearing cup (9). Use the same number of shims and gaskets used previously. The shims adjust the meshing between the bevel pinion and bevel gears.
(2) Install the shaft (2) into the transmission case (11) and check from the top of the transmission case for proper meshing of the bevel pinion and bevel gears. Install or remove gaskets and shims until the gears are meshing properly.
(3) Install the bearing retainer gaskets (8) and shims (if any) and bearing retainer (4). The gaskets and shims must fill completely the space between the bearing retainer (4) and ing cup (9). Install additional gaskets or shims if necessary until this space is completely filled.
(4) Install and tighten the mounting screws (23) and lockwashers (22).
(5) Start the rocker shaft (12) into the transmission case (11) and install the yoke keys (18).
(6) Position the shifter yoke (13) on the rocker shaft (12) inside the transmission case (11) and drive the shaft all the way through the transmission case.
(7) Install the yoke pins (17).

(8) Install the key (18) and press the rocker shaft lever (14) on the rocker shaft (12). Secure the lever (14) with the jam nut (15) and setscrew (16).
(9) Install the transmission case cover (par. 202d).
(10) Install the transmission (par. 201d).

208. Second Countershaft and Brake

a. Removal.
(1) Open the side door (8, fig. 126).
(2) Remove the screws attaching the gear guard (18) to the compression roll cover (1). Swing open the gear guard.
(3) Disconnect the brake rod (12) from the arm (13).
(4) Remove the inner gear guard (14) and loosen the main gear guard (22, fig. 134).
(5) Unlock the cotter pin (1, fig. 127) and drive it out with a small drift.
(6) Remove the slotted nut (2) and retainer washer (3).
(7) Pull the ring gear (4) off the second countershaft (25).
(8) Remove the 3 long bolts (24), 7 short bolts (23), lockwashers (22), and nuts (21) attaching the second countershaft assembly to the frame.
(9) Tip the second countershaft assembly away from the roller and remove it from the frame.

b. Disassembly (fig. 127).
(1) Loosen the screw (18) and remove the brake arm (17) from the brake camshaft (13).
(2) Remove the cotter pin (14) and drive out the brake camshaft (13) from the brake cam (16).
(3) Remove the adjusting flange bearing (15).
(4) Remove the screws (12) and springs (20). Disconnect the brake band (11) from the brake spider (34).
(5) Remove the screws (9 and 33), lockwashers (8), and nuts (10). Remove the brake spider (34).
(6) Press the second countershaft (25) toward the spur gear (28) and remove it from the bearing bracket (32).
(7) Remove the bearing cones (7 and 31) from the bearing bracket (32).
(8) Remove the bearing rollers (30) and oil seal (29) from the second countershaft (25).
(9) Press the second countershaft (25) at the splined end through the spur gear (28) and spacer (27).
(10) Remove the key (26) from the second countershaft (25).
(11) Remove the bearing rollers (6) and oil seal (5) from the ring gear (4).

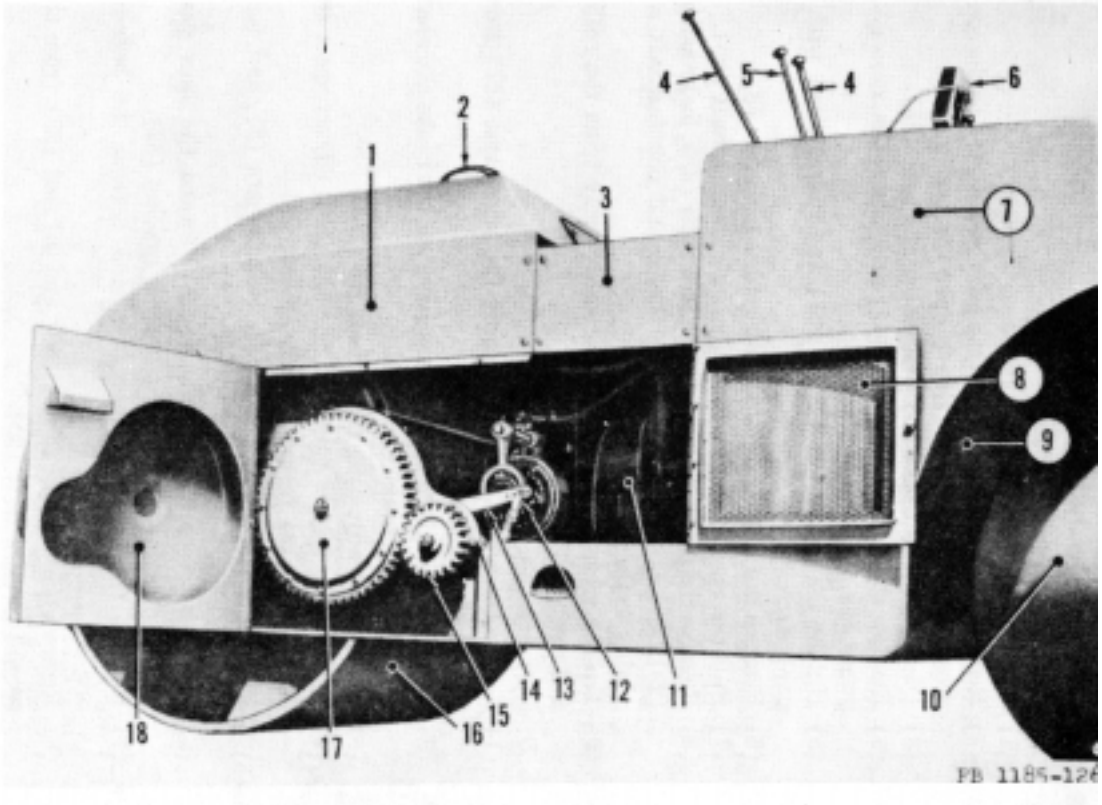
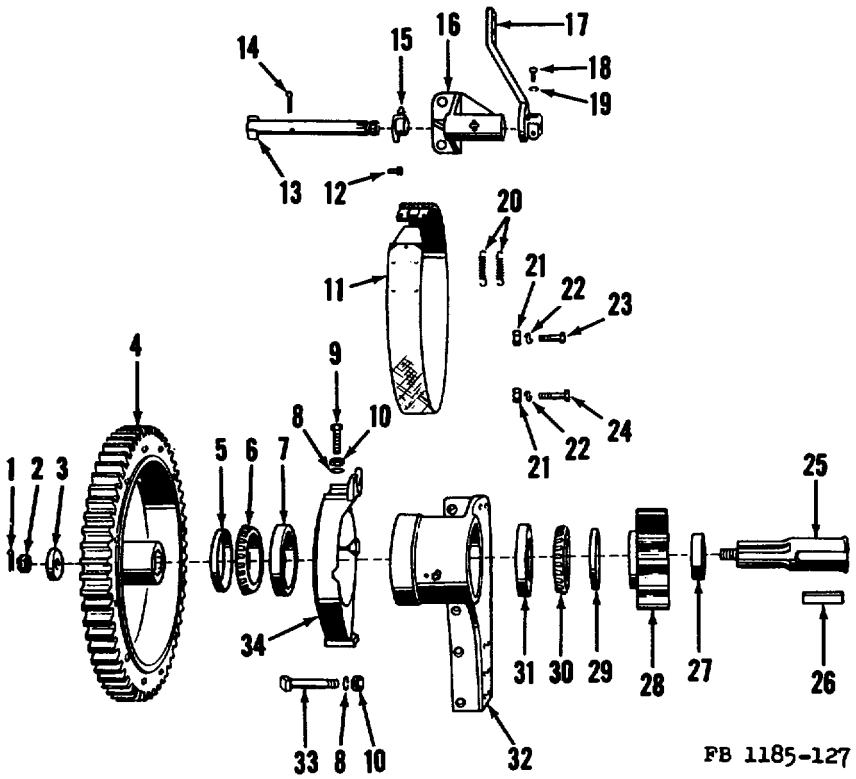


Figure 126. First and second countershaft mounting.

1 Compression roll cover
2 Cover lifting eye
3 Operator’s platform plate
4 Forward and reverse clutch lever
5 Steering lever
6 Operator’s seat
7 Steering roll cover
8 Side door
9 Dust guard
10 Steering roll
11 Flywheel housing
12 Brake rod
13 Brake arm
14 Inner gear guard
15 First countershaft pinion
16 Compression roll
17 Second countershaft gear
18 Gear guard

Figure 126. Continued.



1	Pin, cotter, 1/8 x 2	18	Screw, cap, hex hd, 3/8 -16 NC x 2
2	Slotted nut	19	Washer, lock, std, 3/8
3	Retainer washer	20	Brake band springs (2 req'd)
4	Ring gear	21	Nuts, hex, 5/8 -11 NC (10 req'd)
5	Oil seal	22	Washers, lock std, 5/8 (10 req'd)
6	Bearing rollers	23	Bolts, hex hd, 5/8-11 NC x 2 (7 req'd)
7	Bearing cone	24	Bolts, hex hd, 5/8-11 NC x 2 ¼ (3 req'd)
8	Washers, lock, std, ¾ (2 req'd)	25	Second countershaft
9	Screw, set, sq hd, 3/4 10 NC x 2 ½	26	Key
10	Nuts, jam, hex ¾ 10 NC (2 req'd)	27	Spacer
11	Brake band	28	Spur gear
12	Screws, cap, hex hd, 3/8 -16 NC x 1 ¼ (2 req'd)	29	Oil seal
13	Brake camshaft	30	Bearing rollers
14	Pin, cotter, 3/16 x 1 ½	31	Bearing cone
15	Adjusting bearing	32	Bearing bracket
16	Brake cam	33	Bolt, hex hd, ¾ -10 NC x 5 ½
17	Brake arm	34	Brake spider

Figure 127. Second countershaft and brake disassembled.

c. Cleaning. Wash all parts ill cleaning solvent and dry them with clean compressed air. Use stiff brushes to remove sludge, dirt, and old grease from the gears, threaded surfaces, and shaft splines. Wipe off the brake lining with soft absorbent cloth and remove all dirt and foreign matter from the outer' surface of the lining.

d. Inspection and Repair.

(1) Inspect the brake lining for wear, cracks, peeling, and shifting. Replace the brake lining if it is worn, damaged, or oil soaked. Cut the rivets, drive them out from the brake band, and remove the old lining. Install the new brake lining on the brake band and secure it with rivets. Make sure that the lining adheres firmly and evenly to the brake band and that the rivets are properly located in the countersunk holes.

(2) Inspect all gears for wear, damage, corrosion, and broken or chipping teeth. Inspect the keyways for burrs and cracked or damaged edges. Check all mounting surfaces for scoring and wear. Replace all damaged or worn gears.

(3) Inspect the second countershaft for damaged or stripped threads, broken-off splines, twisting, wear, cracks, and damage. Replace the countershaft if it is defective.

(4) Inspect all bearings for wear, corrosion, damage, and free rotation. Replace all defective or worn bearings.

(5) Replace all oil seals.

(6) Inspect all mounting and assembly screws and nuts for corroded, damaged, twisted, and stripped threads. Replace all defective screws, nuts, and lockwashers. Replace all cotter pins.

(7) Inspect all machined surfaces for cracks, chipping edges, and etching. Smooth down all rough surfaces with a fine-cut file. Replace all parts if their machined surfaces are broken, damaged, or badly etched.

e. Reassembly (fig. 127).

(1) Install the key (26) on the second countershaft (25).

(2) Install the spacer (27) on the second countershaft (25).

(3) Position the spur gear (28) on the second countershaft (25) and make sure that the key (26) and the keyway in the spur gear are properly alined. Press the spur gear (28) on the second countershaft (25).

(4) Press the bearing cones (7 and 31) into the bearing bracket (32).

(5) Install the oil seal (29) on the second countershaft (25), making sure that the open end of the seal is facing the spur gear (28).

(6) Install the bearing rollers (30) on the second countershaft (25).

(7) Install the second countershaft (25) in the bearing bracket (32) and make sure that the oil seal (29) is seated properly in the bracket.

(8) Install the brake band (11) and springs (20) on the brake spider (34).

(9) Install the brake spider (34) on the bearing bracket (32) and tighten the bolts (9 and 33), lockwashers (8), and nuts (10).
(10) Install the adjusting flange bearing (15) on the brake camshaft (13) and press the brake camshaft (13) into the cam (16). Secure the brake camshaft (13) with the cotter pin (14).
(11) Install the brake arm (17) and tighten the screw (18).
(12) Install the oil seal (5) and bearing rollers (6) on the ring gear (4). Make sure that the open end of the seal (5) is facing the bearing bracket (32).

f. Installation.

(1) Install the assembled bearing bracket (32, fig. 127) on the frame and tighten the 3 long bolts (24), the 7 short bolts (23), lockwashers (22), and nuts (21).
(2) Install the ring gear (4) on the splined end of the second countershaft (25). Make sure that the oil seal (5) is started properly into the bearing bracket (32). Tap the oil seal (5) lightly through the holes in the gear until it is properly seated in the bearing bracket (32).
(3) Install the retainer washer (3) and slotted nut (2). Tighten the nut (2) until there is no play in the countershaft bearings. Secure the nut (2) with the cotter pin (1).
(4) Lubricate the second countershaft and gears. Install the inner gear guard (14, fig. 126) and tighten the main gear guard (22, fig. 134).
(5) Connect the brake rod (12, fig. 126) with the brake arm (13) and adjust the brake (par. 147).
(6) Close the gear guard (18) and tighten the screws attaching the guard to the compression roll cover. Close the side door (8).

Section IX. STEERING SYSTEM

209. Description

The steering roll of the road roller is hydraulically operated. Hydraulic oil is stored in the hydraulic tank attached to the right side of the roller frame. A hydraulic pump is mounted on the crossmember of the roller frame, on the left side of the engine. The pump is driven by a V-belt from the crankshaft pulley. The hydraulic pump pressure is regulated by the regulator valve, which reduces the pressure to zero when the valve is closed. When the operating valve is opened, the pump immediately pumps the required pressure to the hydraulic cylinder. The hydraulic steering cylinder is connected with the king pin on the steering roll yoke and operates the movement of the steering roll to the right or left.

210. Hydraulic Pump
(fig. 128)

a. Removal. Refer to paragraph 150b.

b. Disassembly.

(1) Remove the four screws (1) attaching the pump cover (2) to the pump body (9).
(2) Remove the pump cover (2) and plate spring (3).
(3) Remove the pressure plate (4) and seal ring (5). Discard the seal ring.
(4) Lift out and remove the ring (6) and seal ring (5). Discard the seal ring.
(5) Remove the vanes (20) from the rotor (7) and pull the rotor off the shaft (15).
(6) Remove the two bracket bolts (8) and separate the bracket (11) from the pump body (9).
(7) Remove and discard the gasket (10).
(8) Remove the key (16). Spread and remove the retaining ring (17) from the bracket (11).
(9) Pull out the shaft (15) from the bracket (11).
(10) Pull the outer bearing (18) off the shaft.
(11) The oil seal (14) is pressed into the body and must be split into two pieces for removal. Use a cold chisel to split the oil seal, being careful not to damage the body (9). Remove and discard the oil seal.
(12) Use a small drift punch to drive out the inner bearing (12) and spacer (13) from the pump body (9).
(13) Tap the bearing out from the ring (6) side.

c. Cleaning. Wash all parts in cleaning solvent and dry them with clean compressed air. Make sure that all sludge, grease, and oil is removed from the parts. Cover the cleaned parts with a clean rag to protect them from dust and dirt. Clean all mounting screws with a stiff wire brush. Make sure that all machined surfaces are perfectly clean and free of foreign matter. Even the slightest trace of dirt or foreign matter in the pump will impair its performance. Handle the cleaned pump parts with clean hands and tools.

d. Inspection and Repair.

(1) Replace all gaskets and oil seal rings.
(2) Inspect the rotor and vanes for wear, cracking, and chipping.

Replace the rotor and vanes if even the slightest trace of wear is found.

(3) Inspect the shaft for twisting, cracks, breaks, a chipped keyway, and damaged, stripped, or broken splines and threads. Replace the shaft if it is bent or corroded, or if the bearing journals are scored or etched.

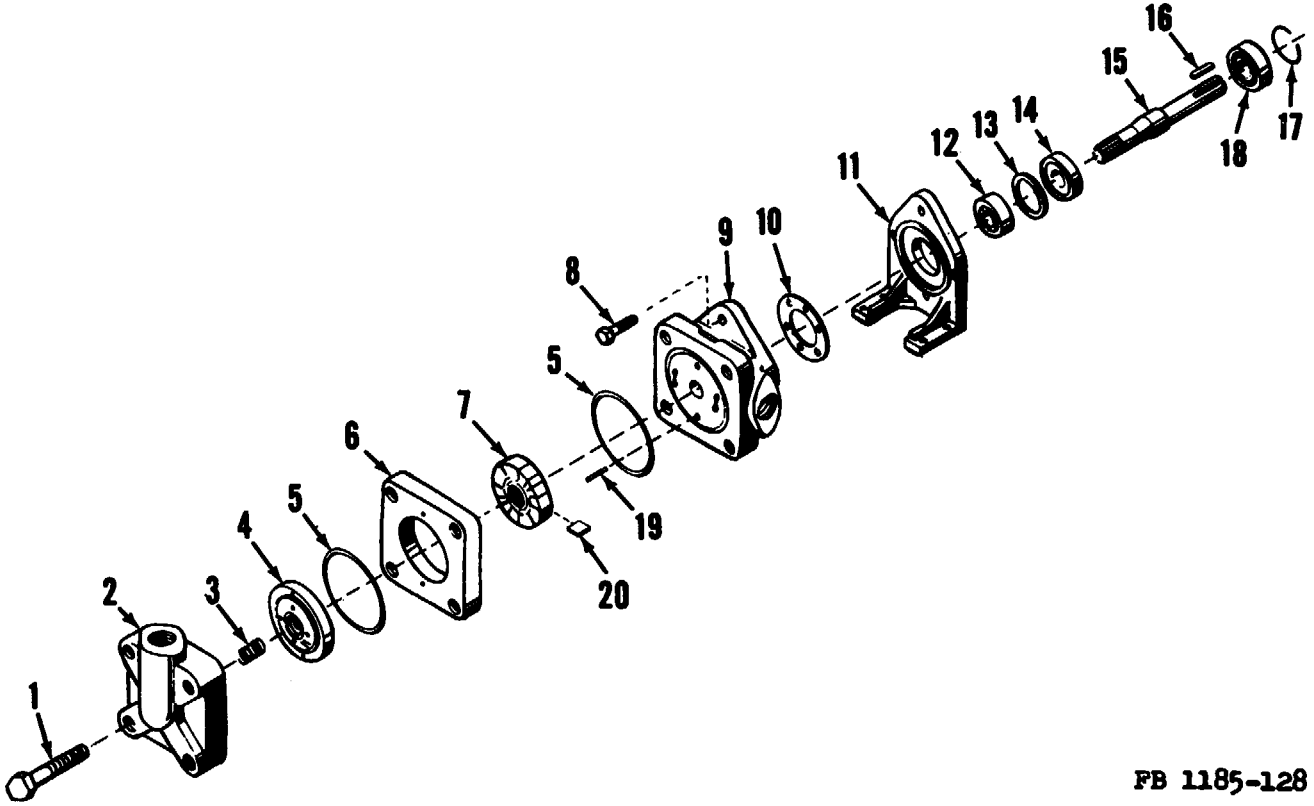


Figure 128. Hydraulic pump disassembled.

1 Cover screws (4 req'd)
2 Cover
3 Plate spring
4 Pressure plate
5 Seal rings (2 req'd)
6 Ring
7 Rotor
8 Bracket bolts (2 req'd)
9 Body
10 Gaskets (2 req'd)
11 Bracket
12 Inner bearing
13 Spacer
14 Oil seal
15 Shaft
16 Key
17 Retaining ring
18 Outer bearing
19 Pins (2 req'd)
20 Vanes (12 req'd)

Figure 128. Continued.

(4) Check the bearings for wear, corrosion, and free rotation. Replace all defective bearings.
(5) Inspect the pressure plate for breaks, cracks, and chipped edges. Replace the pressure plate if it is damaged or defective.
(6) Replace the plate spring if it is twisted, collapsed, or corroded.
(7) Inspect the machined surfaces on the cover and pump body for corrosion, pitting, etching, and broken outer and inner edges. Replace the cover and pump body if it is badly etched or cracked.
(8) Inspect the bracket for warpage, breaks, cracks, and corrosion. If the bracket is defective or cracked, replace it.
(9) Check all mounting and assembly screws for damaged, corroded, twisted, or stripped threads. Replace all defective mounting and assembly screws.
(10) Check the retaining ring for twisting, tension, and breaks. If the retaining ring is defective, replace it.

e. Reassembly.

(1) Press the inner bearing (12) and spacer (13) in the pump body (9).
(2) Press the oil seal (14) into the oil pump body (9), making sure that the pressing tool is resting against the outside diameter of the oil seal. The oil seal (14) must be installed in the pump body (9) with the sealing lip facing the outer bearing (18).
(3) Press the outer bearing (18) on the shaft (15), making sure that the bearing driver tool is resting against the inner race of the bearing.
(4) Install the assembled shaft (15) in the bracket (11). Install the retaining ring (17).
(5) Install the pump body (9) and gasket (10) and tighten the bolts (8).
(6) Push the rotor (7) on the splined end of the shaft (15).
(7) Install the vanes (20) and see that the radius edge of each vane is facing the ring (6).
(8) Install the seal ring (5) on the pump body (9) and position the ring (6) so that the holes in the ring are properly alined with the pins (19) in the pump body.
(9) Attach the ring (6) to the pump body (9) and install the seal ring (5) and pressure plate (4).
(10) Install the plate spring (3) and press the cover (2) against the pump body (9).
(11) Install the cover screws (1). Rotate the pump shaft (15) by hand and gradually tighten the cover screws (1) so that

they draw up evenly without causing the pump shaft to bind. The cover screws must be drawn up snugly but not too tight.

(12) Install the shaft key (16) and press the pulley on the shaft.

f. Installation. Refer to paragraph 150e.

211. Hydraulic Steering Cylinder

(fig. 129)

a. Removal. Refer to paragraph 152*b*.

b. Disassembly.

(1) Use a cold chisel to scratch or punch marks across the gland seat head (3), cylinder (15), and swivel head (11).

(2) Remove the screws (21) and lockwashers (20) attaching the packing gland (2) to the gland seat head (3).

(3) Unscrew and remove the locknuts (8) and lockwashers (9). Pull out the draw studs (10)

(4) Pull the swivel head (11) away from the cylinder (15) and remove the swivel head and cylinder gasket (4).

(5) If worn, remove the swivel head bearings (14). Discard the cotter pins (12).

(6) Pull out the piston rod (1) from the cylinder (15).

(7) Cut the lock wires (16) and pull them out from the cup retainer bolts (17).

(8) Remove the bolts (17) on both sides of the piston (7).

(9) Remove the packing cup retainer (5) and packing cup (6) from the piston (7).

(10) Use a small drift to drive out the locking pin (18) securing the piston (7) to the piston rod (1).

(11) Turn the piston (7) counterclockwise and unscrew it from the threaded end of the piston rod (1).

(12) Pull the packing cup (6), packing cup retainer (5), and cylinder gasket (4) from the piston rod (1).

(13) Pull the gland seat head (3) from the piston rod (1).

(14) Remove the piston rod packing (19) from the gland seat head (3).

(15) Remove the packing gland (2) and piston rod gasket (22).

(16) If worn, remove the piston rod bearing (24).

c. Cleaning. Wash all metal parts in cleaning solvent and dry them with clean compressed air. Blow off all passages in the gland seat head and swivel head with compressed air. Remove all sludge, dirt, and foreign matter from the cylinder and mounting surfaces. Clean all threaded surfaces with a wire brush dipped in cleaning solvent. Soak the mounting pins in cleaning solvent and blow off the lubrication passages with clean compressed air. Use a stiff brush to clean the piston rod packing recess in the gland seat head, making

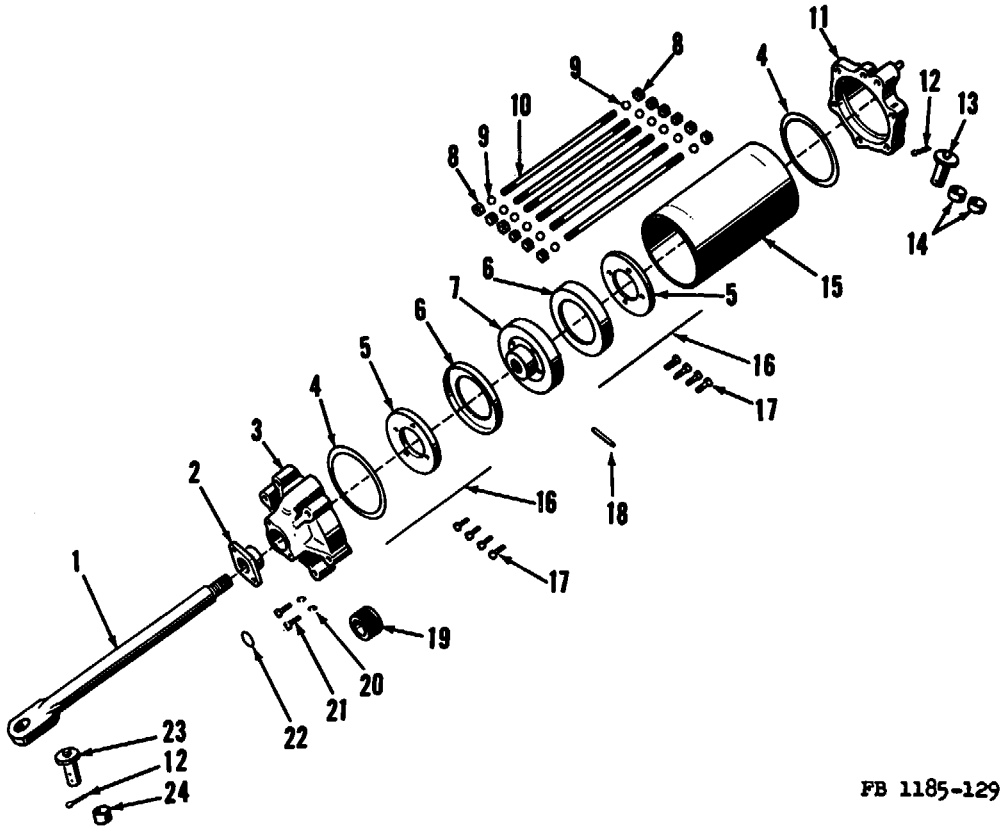


Figure 129. Hydraulic steering cylinder disassembled.

1 Piston rod
2 Packing gland
3 Gland seat head
4 Cylinder gaskets (2 req’d)
5 Packing cup retainers (2 req’d)
6 Packing cups (2 req’d)
7 Piston
8 Nuts, lock, hex, ½ -13 NC (12 req'd)
9 Washers, lock, std, ½ (12 req'd)
10 Draw studs (6 req'd)
11 Swivel head
12 Pins, cotter, 36 x 1 ½ (2 req'd)
13 Swivel head pin
14 Swivel end bearings (2 req’d)
15 Cylinder
16 Lockwire. 12 in. (2 req’d)
17 Cup retainer bolts (8 req’d)
18 Locking pin
19 Piston rod packing
20 Washers. lock, std, 3/8 (2 req'd)
21 Screws, cap, hex hd, 3/8 -16 NC x 1 3/8 (2 req'd)
22 Piston rod gasket
23 Piston rod pin
24 Piston rod bearing

Figure 129. Continued.

sure that all packing traces are removed from the packing mounting surfaces.

d. Inspection and Repair.

(1) Replace the piston rod packing (19) and cylinder gaskets (4).
(2) Inspect the cylinder for cracks, twisting, warpage, dents, and broken or chipped mounting edges. If the cylinder is defective or damaged, replace it.
(3) Check the piston rod for wear, twisting, etching, and damaged or corroded threads. Replace the piston rod if it is bent, cracked, or damaged.
(4) Inspect the gland seat and swivel heads for cracks and breaks. Replace the heads if they are broken or cracked, or if the machined mounting surfaces are badly corroded, etched, or chipped.
(5) Inspect both packing cups for frayed edges, wear, cuts, and damage. Replace defective packing cups. Always allow the new packing cups to soak for 2 hours in hydraulic oil before installation.
(6) Check the mounting bearings for wear, scoring, pitting, and etching. Replace all defective bearings.
(7) Inspect all threaded surfaces for corroded, damaged, twisted, or stripped threads. Replace the draw studs if they are bent or twisted, or if the threads are damaged or worn.
(8) Inspect the mounting pins for wear, out of round, pitting, corrosion, and damage. Replace defective mounting pins.

e. Reassembly.

(1) Install the packing glands (2) on the piston rod (1).
(2) Slide the gland seat head (3) on the piston rod (1), making sure that the gland seat in the head is facing the packing gland (2).
(3) Install the cylinder gasket (4) on the gland seat head (3).
(4) Place the packing cup (6) on the piston (7) with the cup lip away from the piston mounting surface.
(5) Install the packing cup retainer (5). Make sure that the mounting holes in the retainer and piston (7) are properly alined.
(6) Install and tighten the packing cup retainer bolts (17). Thread the lock wire (16) through the holes in the bolt heads and make sure that the wire is properly secured.
(7) Install the gasket (22) on the threaded end of the piston rod (1).
(8) Turn the piston (7) clockwise and install it on the piston rod (1). Make sure that the gasket (22) is seated in the bevel on the piston (7). Tighten the piston securely.

(9) Drive the locking pin (18) through the piston (7) and piston rod (1).
(10) Install the cylinder (15) on the piston rod (1) and make sure that the scratch marks are properly alined and that the mounting edge of the cylinder is pressing against the gasket (4) and gland seat head (3).
(11) Push the piston rod (1) into the cylinder (15) until the piston (7) reaches the open end of the cylinder.
(12) Install the packing cup (6) on the piston (7) with the packing cup lip facing the open end of the cylinder (15).
(13) Install the packing cup retainer (5) and retainer bolts (17). Tighten the bolts securely and thread the lock wire (16) through the holes in the holt heads. Twist the wire to secure it on the piston.
(14) Pull the piston (7) until it is about half way out of the cylinder (15) and install the cylinder gasket (4) and swivel head (11). Make sure that the scratch marks on the swivel head (11) and cylinder (15) are properly alined.
(15) Install the draw studs (10), lockwashers (9), and locknuts (8). Tighten the locknuts (8) securely.
(16) Pull the packing gland (2) away from the cylinder (15) and install the piston rod packing (19). Install the sections of packing one at a time, making sure that the hollow part of the V is facing the gland seat head (3).
(17) Push the packing gland (2) against the gland seat head (3) and install the lockwashers (20) and screws (21). Tighten the screws until they are snug, but do not overtighten.
(18) If the bearings (14 and 24) have been removed, press them in place with an arbor press.

f. Installation. Refer to paragraph 152d.

212. Hydraulic Operating Valve
(fig. 130)

a. Removal. Refer to paragraph 155c.
b. Disassembly.
(1) Unscrew and remove the pipe plug (29). Hold the hydraulic operating valve over a waste container and drain all oil from the valve chambers.
(2) Unscrew and remove the adapter unions (4) from the operating valve body (13).
(3) Use a pipe wrench to remove the pipe nipple (12) from the exhaust body (10).
(4) Unscrew the nuts (1). Remove the four tie rods (11).

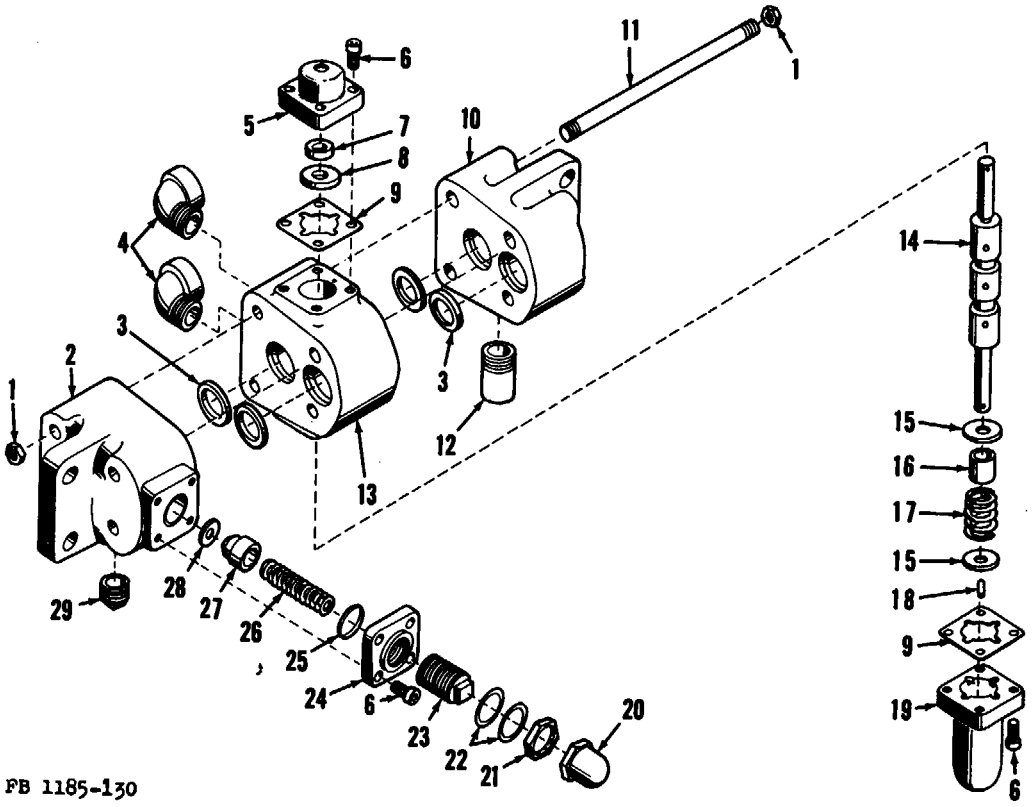


Figure 130. Hydraulic operating valve disassembled.

1 Nuts, hex, 1/2-20 NF (8 req'd)
2 Regulating valve body
3 Oil seals .(4 req'd)
4 Adapter unions (2 req'd)
5 Lever bracket
6 Setscrews (12 req'd)
7 Felt washer
8 Piston seal
9 Gaskets (2 req'd)
10 Exhaust body
11 Tie rods (4 req'd)
12 Nipple, pipe, 1 in.
13 Operating valve body
14 Piston
15 Spring control washers (2 req'd)
16 Piston stop block
17 Operating valve spring
18 Piston pin
19 Operating valve spring cover
20 Regulating valve spring cover
21 Locknut
22 Washers (2 req'd)
23 Adjusting screw
24 Cover
25 Packing ring
26 Spring
27 Plunger
28 Seat
29 Plug, pipe, flush type, 3/4

Figure 130. Continued.

(5) Separate the regulating (2), operating (13), and exhaust (10) valve bodies. Remove and discard the oil seals (3). Be careful not to damage or scratch the mounting surfaces when removing the seals.

(6) Remove the four setscrews (6) attaching the lever bracket (5) to the operating valve body (13). Lift up and remove the lever bracket (5).

(7) Remove and discard the gasket (9).

(8) Remove the four setscrews (6) attaching the operating valve spring cover (19) to the operating valve body (13). Remove the operating valve spring cover (19).

(9) Remove and discard the gasket (9).

(10) Remove the felt washer (7) and piston seal (8). Push out the piston (14) from the operating valve body (13).

(11) Use a small drift to drive out the piston pin (18) from the piston (14).

(12) Remove the spring (17), piston stop block (16), and spring control washers (15) from the piston (14).

(13) Turn the regulating valve spring cover counterclockwise and remove the cover (20) from the regulating valve body (2).

(14) Remove the locknut (21), washers (22), and adjusting screw (23).

(15) Unscrew the four setscrews (6) and remove the cover (24) from the regulating valve body (2).

(16) Lift out and remove the packing ring (25), regulating valve spring (26), plunger (27), and seat (28). Discard the packing ring (25).

c. Cleaning. Wash all metal parts in cleaning solvent and wipe them dry with a soft absorbent cloth. Blow off all passages in the valve bodies and piston with clean compressed air. Remove all dirt and sludge from the mounting surfaces and make sure that all parts are absolutely clean and free from the slightest trace of dirt or dust particles.

d. Inspection and Repair.

(1) Replace all gaskets, oil seals, and packing rings.

(2) Check the mounting surfaces for scratches, etching, and pitting. The mounting surfaces are machined to very close tolerances, and even the slightest scratch or flaw will cause the valve to leak. Replace the valve bodies if the mounting surfaces are corroded, pitted, scored, or etched.

(3) Inspect the springs for corrosion, twisting, and metal fatigue. Replace defective springs.

(4) Check the tie rods for twisting, breaks, and damaged, corroded, or stripped threads. Replace defective tie rods and tie rod nuts.

(5) Inspect the piston for wear, warpage, twisting, corrosion, and scoring. Replace the piston if it is worn, corroded, or damaged.

(6) Inspect all washers for cracking or chipping edges. Replace defective washers.

(7) Inspect all threaded surfaces for damaged, corroded, twisted, broken off, or stripped threads. Replace all defective parts.

(8) Check the valve bodies for cracks, breaks, and leaks. Replace broken, cracked, or leaking valve bodies.

e. Reassembly.

(1) Install a new packing ring (25) in the cover (24).

(2) Install the valve seat (28), plunger (27), and regulating valve spring (26) in the regulating valve body (2).

(3) Install the cover (24) and tighten the setscrews (6).

(4) Install the adjusting screw (23), washers (22), and locknut (21).

(5) Install the regulating valve spring cover (20) but do not tighten. The valve must be adjusted after installation.

(6) Assemble the upper spring control washer (15), piston stop block (16), spring (17), and lower spring control washer (15) on the piston (14).

(7) Install the piston pin (18).

(8) Push the piston assembly into the operating valve body (13). Install the operating valve spring cover (19) and gasket (9). Install and tighten the setscrews (6).

(9) Install the piston seal (8) and felt washer (7) on the upper part of the piston (14).

(10) Install the gasket (9) and lever bracket (5) and tighten the setscrews (6).

(11) Install new oil seals (3) in the operating valve body (13) and the exhaust valve body (10). Make sure that the seals are seated firmly and evenly in their seats.

(12) Attach the exhaust valve body (10) to the operating valve body (13), being extremely careful not to shift the oil seals (3).

(13) Attach the regulating valve body (2) to the operating valve body (13) and make sure that the oil seals (3) have not shifted from their seats.

(14) Install the tie rods (11). Tighten the nuts (1) firmly and evenly.

(15) Install the pipe nipple (12) in the exhaust valve body (10).

(16) Install the adapter unions (4) in the operating valve body (13).

(17) Install the pipe plug (29) in the regulating valve body (2).

f. Installation. Refer to paragraph 155e.

g. Adjustment. Refer to paragraph 155b.

213. Steering Yoke and Roll
(fig. 131)

a. Removal.

(1) Drain the water ballast from the steering rolls.

(2) Remove the steering roll scraper assembly (par. 163*b*).

(3) Remove the steering roll sprinkler mat assembly (par. 167*b).*

(4) Block the compression roll securely.

(5) Cut the lock wires (12) and loosen the axle screws (11) on both sides of the steering roll axle (17).

(6) Remove the clamp screws (14) and lockwashers. Remove the axle clamps (13) from the steering yoke (7).

(7) Use a crane or jacks to lift the steering roll end of the road roller just high enough for the steering yoke (7) to clear the axle (17).

(8) Place solid blocking under the road roller frame and make sure tile roller is resting securely with its full weight on the blocks.

(9) Roll the steering roll assembly (8) away from tile road roller.

(10) Unscrew and remove the swivel pin bolt (19), lockwasher, and nut.

(11) Use a crane, jacks, or blocking to hold the steering yoke in place while removing the swivel pin (18). Use a wood block and sledge hammer to remove the swivel pin (18). Position the wood block on the swivel pin and drive the pin out by pounding at it from the engine side of the steering yoke.

(12) Lower the steering yoke (7) until it clears the kingpin (5) and move it to a suitable location for cleaning and inspection.

b. Cleaning. Wash the steering yoke with cleaning solvent and dry it with a soft absorbent cloth. Use a wire brush to clean all corroded and pitted spots. Repaint if necessary. Clean the swivel pin mounted hole with a stiff brush and cleaning solvent. Be sure to remove all dirt, dust sludge and old grease. Wash the swivel pin in cleaning solvent and blow off grease passages with clean compressed air.

c. Inspection and Repair. Inspect the steering yoke for breaks and cracks. Replace the steering yoke if it is badly twisted or warped. Weld all minor cracks and breaks, using reinforcing plates if necessary.

Replace the steering yoke if it is broken or cracked more than halfway through. Inspect the swivel pin for breaks, cracks, wear, pitting, corrosion and etching. Check the bolt groove in the swivel pin for wear, broken or chipped edges, cracks, and breaks. If the swivel pin is defective, replace it. Inspect all mounting bolts and screws for worn, damaged, twisted, corroded, or stripped threads. Replace all worn or damaged bolts and screws.

d. Installation.

(1) Position the steering yoke (7) under the kingpin (5), making sure that the mounting surfaces are properly alined.

(2) Lift up the steering yoke until the swivel pin hole in the steering yoke is properly alined with the kingpin hole.

(3) Drive the swivel pin (18) through the steering yoke (7) and kingpin (5) with a wood block and a sledge hammer. Pound the swivel pin from the front of the steering yoke.

(4) Drive the swivel pin into the kingpin until the swivel pill bolt hole is in proper alinement with the bolt slot on the swivel pin.

(5) Install and tighten the swivel pin bolt (19), lockwasher, and nut.

(6) Position the steering roll assembly under the steering yoke (7) so that the axle (17) and axle pins (15) are properly alined with the grooves in the bottom part of the steering yoke.

(7) Remove all blocking from under the road roller. Lower the road roller until the steering yoke (7) rests with its full weight on the steering roll axle (17).

(8) Install the axle clamps (13) on both sides of the steering roll (8).

(9) Install and tighten the axle clamp screws (14) and lockwashers.

(10) Tighten the axle screws (11) on both sides of the axle (17) until all side play is eliminated from the axle bearings. Make sure that the bearings do not bind. Secure the axle screws (11) with lock wires (12).

(11) Install the steering roll sprinkler mat assembly (par. 167g).

(12) Install the steering roll scraper assembly (par. 163e).

(13) Fill the steering roll with water if necessary.

214. Kingpin
(fig. 132)

a. Removal.

(1) Remove the steering yoke (par. 213a).

(2) Disconnect the steering cylinder from the kingpin steering arm (par. 152b).

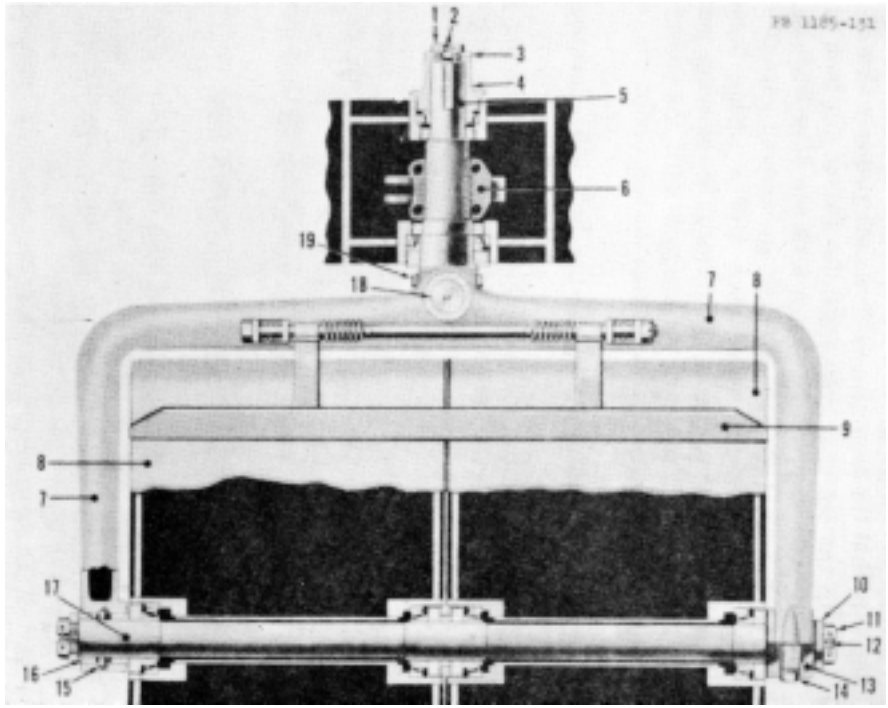


Figure 131. Steering yoke and kingpin mounting.

1 Bearing adjusting screw
2 Lock wire
3 Kingpin cap washer
4 Kingpin cap
5 Kingpin
6 Steering arm
7 Steering yoke
8 Steering roll
9 Steering roll scraper
10 Axle washer
11 Axle screw
12 Lock wire
13 Axle clamp
14 Clamp screw
15 Axle pin
16 Bushing
17 Axle
18 Swivel pin
19 Swivel pin bolt

Figure 131. Continued.

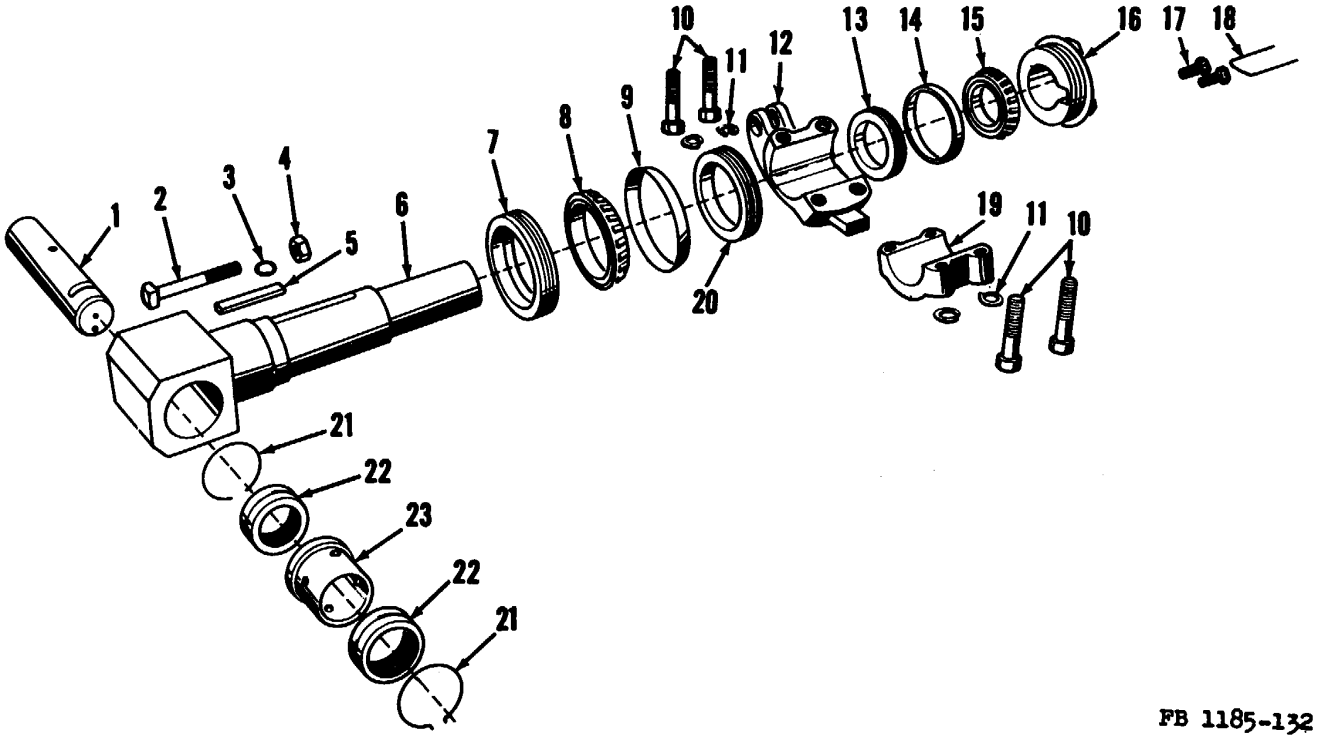


Figure 132. Kingpin disassembled.

1 Swivel pin
2 Swivel pin bolt
3 Washer, lock, std, 3/4
4 Nut, hex, 3/4-10NC
5 Key
6 Kingpin
7 Lower dust collar
8 Lower bearing
9 Lower bearing cup
10 Screws, cap, hex hd, 7/8-9NC x 3 1/2 (4 req'd)
11 Washers, lock, std, 7/8 (4 req'd)
12 Steering lever and arm
13 Upper bearing dust collar
14 Upper bearing cup
15 Upper bearing
16 Kingpin cap
17 Adjusting bolts (2 req'd)
18 Lock wire
19 Steering arm
20 Upper dust collar
21 Swivel pin spacers (2 req'd)
22 Needle bearings (2 req'd)
23 Bearing spacer

Figure 132. Continued.

(3) Remove the four screws (10) and lockwashers (11) attaching the steering lever and arm (12) and steering arm (19) to the kingpin (6).

(4) Remove the steering lever and arm (12) and steering arm (19) from the kingpin (6).

(5) Remove the steering arm key (5).

(6) Cut the lockwire (18) and remove the bearing adjusting bolts (17).

(7) Turn the kingpin cap (16) counterclockwise and remove it from the road roller head.

(8) Insert a bar or shaft through the swivel pin opening in the kingpin (6) and support the kingpin weight with a crane. Use fork truck, jacks, or suitable blocking if crane is not available.

(9) Use a wood block and sledge hammer to drive out the kingpin (6) from the road roller head. Pound the kingpin from the top of the road roller until it slips out from the road roller head.

b. Disassembly.

(1) Use an arbor press to remove the upper dust collar (20), lower bearing (8), and lower dust collar (7) from the kingpin (6).

(2) Lift out and remove the upper bearing dust collar (13) and upper bearing (15) from the road roller head.

(3) Drive out the bearing cups (9 and 14) from the road roller head.

(4) Remove the swivel pin spacers (21) from the kingpin (6).

(5) Remove the needle bearings (22) and bearing spacer (23) from the kingpin (6).

c. Cleaning. Wash all parts in cleaning solvent and dry them with clean compressed air. Use stiff brushes to remove all dirt, dust, sludge, and old grease from the swivel pin mounting hole, steering arm mounting surfaces, and kingpin keyway. Use wire brushes and cleaning solvent to remove all dirt, corrosion, and sludge from the threaded surfaces.

d. Inspection and Repair.

(1) Inspect the bearing cups and rollers for wear, cracks, scoring, and damage. Check the bearings for free rotation. Replace all defective bearings.

(2) Inspect the swivel pin for breaks, cracks, wear, pitting, corrosion, and etching. Check the bolt groove in the swivel pin for wear, broken or chipped edges, cracks, and breaks. If the swivel pin is defective, replace it.

(3) Inspect the kingpin for wear, cracks, corrosion, and damaged or twisted keyway. Replace the kingpin if it is cracked,

twisted, or worn, or if the bearing journals are scored and damaged.

(4) Check the steering arm mounting surfaces for wear, etching, and pitting. Replace the steering arm if it is broken or cracked.

(5) Inspect all mounting bolts and screws for damaged, corroded, twisted, or stripped threads. Replace all defective mounting bolts and screws.

e. Reassembly.

(1) Install the bearing spacer (23) and needle bearings (22) in the kingpin (6).

(2) Install the swivel pin spacers (21) in the kingpin (6).

(3) Press the bearing cups (9 and 14) into the road roller head.

(4) Install the lower dust collar (7) and lower bearing (8) on the kingpin (6).

f. Installation.

(1) Push the kingpin (6) through the mounting hole in the road roller head and install the upper dust collar (20).

(2) Install the key (5) and steering lever and arm (12) and steering arm (19). Install and tighten the steering arm screws (10) and lockwashers (11).

(3) Install the upper bearing dust collar (13) and bearing (15).

(4) Install the kingpin cap (16) and adjusting bolts (17). Tighten the adjusting bolts (17) until there is no end play in the kingpin bearings. Make sure that the bearings are not too tight or binding.

(5) Secure the adjusting bolts (17) with the lock wire (18).

(6) Install the steering yoke (par. 213d) and lubricate the kingpin and yoke.

Section X. FRAME ASSEMBLY

215. General

The main frame of the road roller is of all-welded construction. The main members and reinforcing braces are made of structural steel channel. The steering roll cover and steering roll yoke head housing are constructed of heavy gage steel sheets, electrically welded to the main frame. The structural channel cross-members reinforce the main frame and provide mounting support for the transmission, engine, and its accessories. The operating load is distributed between the steering and compression rolls and their axles. The road roller frame is designed to withstand high stresses and will seldom require repair.

216. Frame

a. Cleaning. Clean tile frame with steam pressure and remove all dirt, paving materials, grit, grease deposits, and sludge from the outer

surfaces of the frame members and cross-members. Use wire brushes and cleaning solvent to remove all foreign matter from the frame corners, recesses, and welds. Remove all rust and corrosion with wire brushes and sanders. Use scrapers and chisels to remove the road tar and paving materials from the edges and corners of the frame members. Clean all welds with wire brushes until bare metal is visible. Blow off all dust and dirt with compressed air.

b. Inspection. Check all welds for breaks, cracks, and splitting. Clean the welds until bare metal is visible before checking for damage. Inspect the welding seams for poor weld penetration, peeling beads, and corrosion between the weld beads and frame members. Inspect the cross-members for twisting warpage, breaks, and cracks. Check the outer surfaces for excessive corrosion and etching. Inspect the steel sheets for cracks, breaks, and warpage. Pound out minor dents from the steel sheet surface.

c. Repair. All breaks and cracks in the frame members and crossmembers must be reinforced and electrically welded. Clean the metal thoroughly around the crack or break. Check the length of the crack and drill a small hole about one-half to 1 inch beyond the visible end of the crack. This hole will prevent the crack from running when heat is applied. Use an acetylene torch or a blowtorch to preheat the metal around the crack to about 200° F. Weld the crack by the arcwelding method, using reverse polarity and a mild steel shielded arc electrode. Allow the weld to cool slowly. Then clean the weld and spatter. Check the weld bead for proper penetration. Reinforce the weld and frame member by welding a reinforcing plate over the crack.

Section XI. ROLLS

217. General

The rolls are designed not only to compact the paving materials densely for long wear, but to obtain the smoothest possible finished surface. Outer surfaces of the steering and compression rolls are machined to assure a smooth and even paving job. The sprinkler tank and sprinkler system direct a flow of water over both rolls to prevent tacky paving materials from sticking to both rolls. The variable weight of the road roller is controlled by the water ballast in the steering and compression rolls. With both rolls filled with water ballast, the total weight of the road roller is increased by 5, 700 lb. The steering roll is of split-section design to eliminate the gouging of paving materials when turning and reduce strain on the kingpin and other steering parts.

218. Steering Roll
(fig. 133)

a. Removal. Refer to paragraph 213*a*.

b. Disassembly.

(1) Remove the bearing adjusting bolts (2) on both sides of the axle shaft (6).

(2) Drive out the collar pins (7) and remove the axle shaft collars (4) from both ends of the axle shaft (6).

(3) Unscrew and remove the grease fittings (5).

(4) Use a wood block and sledge hammer to bump the axle shaft (6) until there is sufficient opening between the steering rolls to insert a bar.

(5) Insert a pry bar between the two roll sections and pry the rolls apart until the outer dust guards (8) and bearings (9) leave the axle shaft (6).

(6) Block one of the steering rolls to prevent it from sliding and insert a greased steel plate under the roll to be removed.

(7) Wrap chain or rope around the roll and pull it off the axle shaft with a fork truck.

(8) Support the axle shaft with a crane, jacks, or blocks and pull the second steering roll from the axle shaft.

(9) Press the inner dust guards (8), spacers (if they are used), and bearings (9) off the axle shaft (6).

(10) Use a bearing puller and pull the bearing cups (10) from the rolls.

c. Cleaning. Wash all parts in cleaning solvent and wipe them with a clean absorbent cloth. Blow off all lubrication passages in the shaft with clean compressed air. Clean the adjusting bolt threads with a wire brush and cleaning solvent.

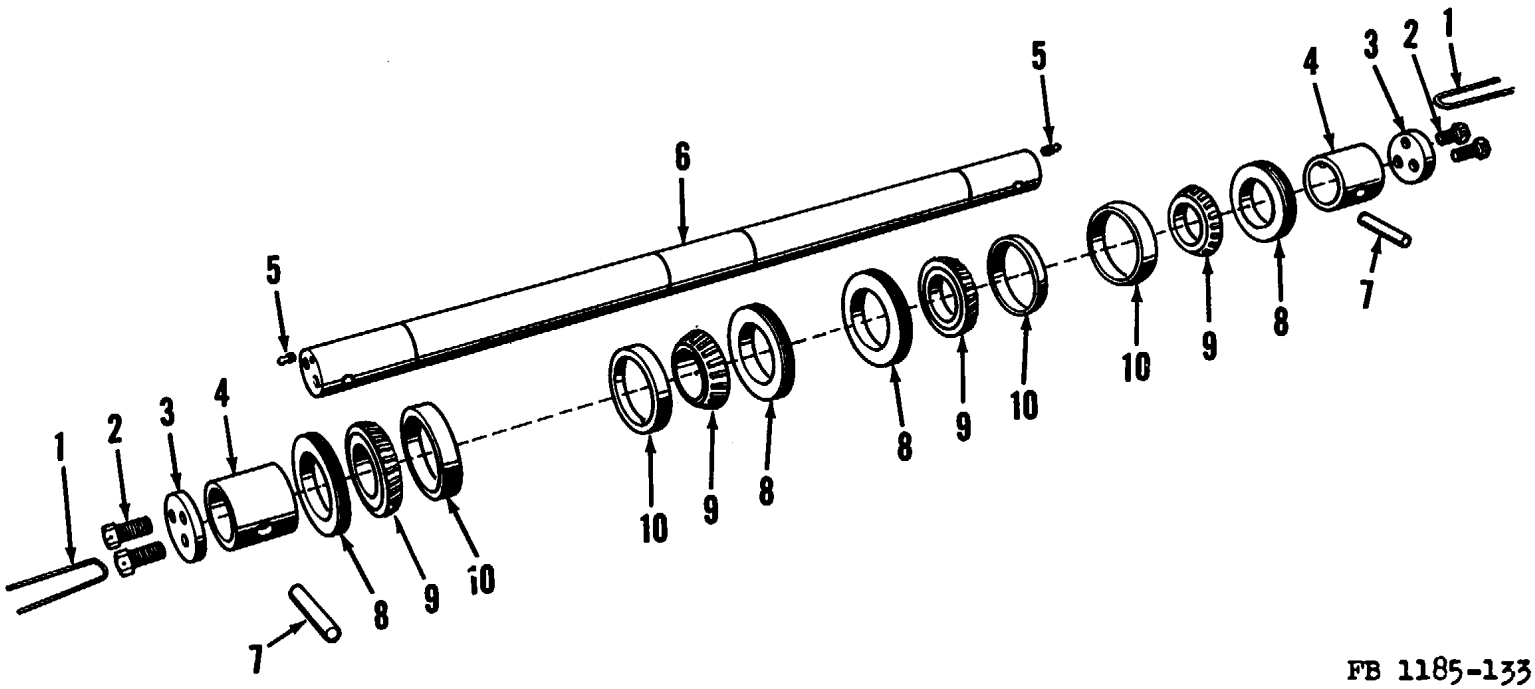
d. Inspection and Repair.

(1) Inspect the steering rolls for breaks, cracks, and leaks. Weld all minor cracks and breaks. Replace the steering rolls if they are badly broken, cracked, warped, or damaged. Inspect the machined surface of the rolls and replace the rolls if the surface is badly scored, cut, or damaged.

(2) Inspect all bearings for wear, corrosion, damage, and scoring. Check the bearing rollers for free rotation. Inspect the roller faces for scoring, pitting, and cracking. Replace all defective bearings and cups.

(3) Replace the lock wires.

(4) Inspect the dust guards for twisting, warpage, wear, and damaged or scored sealing surfaces. Replace the dust guards if they are worn, cracked, or warped.



1 Lock wires (2 req'd)
2 Bearing adjusting bolts (4 req'd)
3 Bearing adjusting plates (2 req'd)
4 Axle shaft collars (2 req'd)
5 Grease fittings (2 req'd)
6 Axle shaft
7 Collar pins (2 req'd)
8 Dust guards (4 req'd)
9 Bearings (4 req'd)
10 Bearing cups (4 req'd)

Figure 133. Steering roll axle shaft disassembled.

(5) Check the axle shaft collars for wear, damage, out of round, and corrosion. Check the pin holes for wear and cracking or splitting edges. Replace worn and defective axle shaft collars.

(6) Inspect the pins for wear, scoring, and worn grooves in the pin body. Replace the pins if they are twisted, cracked, or grooved.

(7) Check the adjusting bolts for damaged, corroded, twisted, or stripped threads Replace all defective adjusting bolts.

(8) Inspect the axle shaft for wear, twisting, cracks, and breaks; check the bearing journals for wear, scoring, cuts, and flaws. Replace the axle shaft if it is bent or twisted, or if the bearing journals are worn or scored.

e. Reassembly.

(1) Press the inner dust guards (8) and bearings (9) on the axle shaft (6). Pack the bearings with grease.

(2) Press the outer and inner bearing cups (10) into the steering rolls.

(3) Install the steering rolls on the axle shaft (6) and press the outer bearings (9) and dust guards (8) on the outer ends of the axle shaft (6).

(4) Press the axle shaft collars (4) on both ends of the axle shaft (6), making sure that the pin holes in the axle shaft and axle shaft collars are properly alined.

(5) Secure the axle shaft collars (4) with the collar pins (7).

(6) Install the bearing adjusting plates (3) on both ends of the axle shaft (6).

(7) Install the bearing adjusting bolts (2) but do not tighten them.

f. Installation. Refer to paragraph 213d.

g. Adjustment. The steering roll axle shaft bearings are adjusted by means of the bearing adjusting plates (3) and bolts (2). Turn the adjusting bolts clockwise to tighten the bearings and counterclockwise to loosen them. The two adjusting bolts on each side of the axle shaft (6) adjust the bearings in the entire steering roll assembly. Adjust the bearings so that there is no excessive side play in the bearings. Make sure that the bearings are not too tight or binding.

219. Compression Roll

a. Removal.

(1) Disconnect all linkage, leads, and fuel and water lines, and remove the compression roll housing (par. 158b).

(2) Drain the water ballast from the compression roll (1, fig. 134).

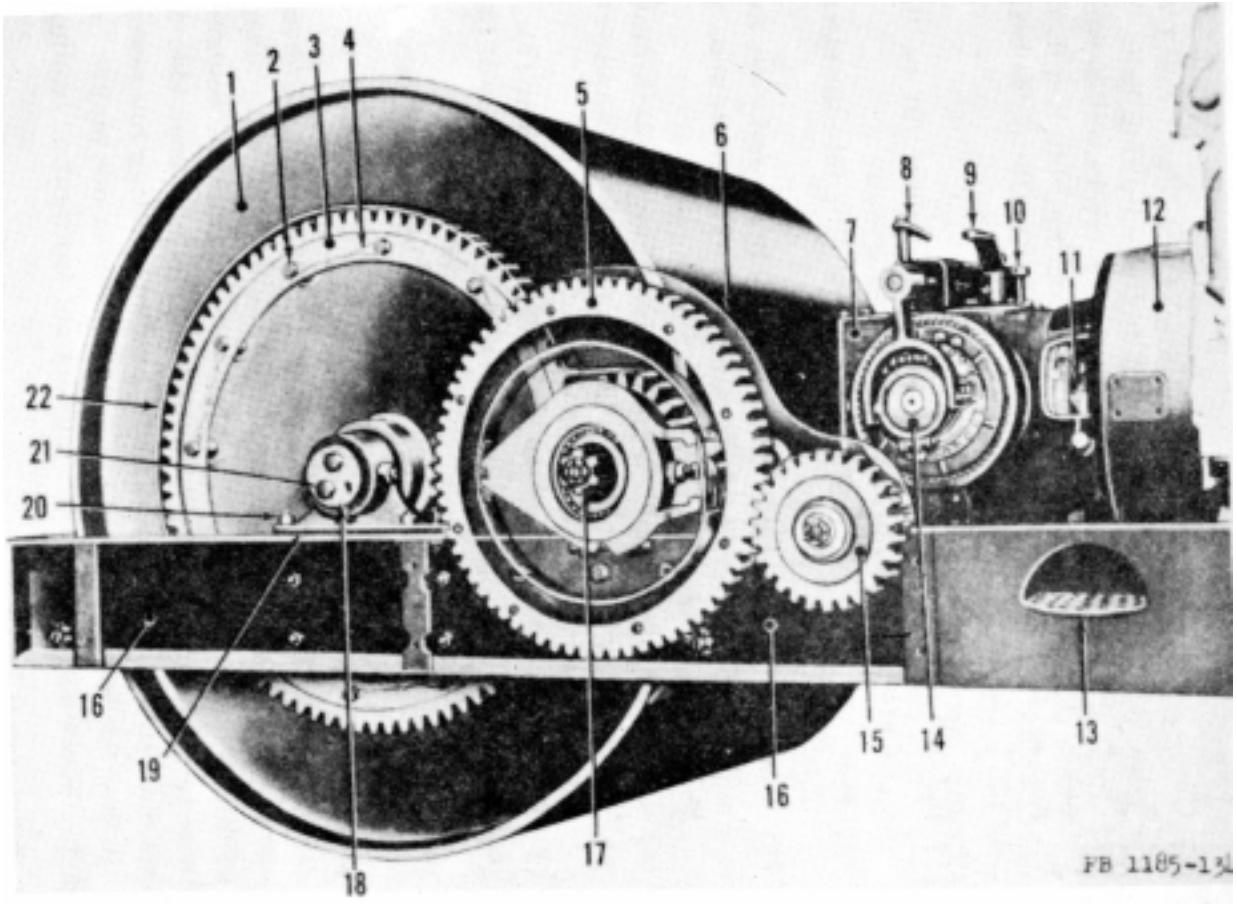


Figure 134. Compression roll mounting.

1 Compression roll
2 Spur gear screw
3 Spur gear
4 Lock wire
5 Second countershaft gear
6 Dust guard
7 Transmission case
8 Gear shift lever
9 Forward and reverse clutch lever
10 Oil filler cap
11 Master clutch
12 Flywheel housing
13 Step well
14 Forward and reverse clutch
15 First countershaft gear
16 Frame
17 Second countershaft
18 Adjusting plate
19 Mounting bracket
20 Mounting nut
21 Adjusting bolt
22 Main gear guard

Figure 134. Continued.

(3) Remove the dust guards (6) from the second countershaft (17) and compression roll (1).

(4) Remove the second countershaft (par. 208a).

(5) Place solid timber blocks under the road roller frame (16) on both sides of the compression roll (1).

(6) Remove the bolts, lockwashers, and nuts (20) attaching the compression roll mounting brackets (19) to the road roller frame (16).

(7) Wrap steel cables around the ends of the compression roll axle shaft and lift up the compression roll (1) with a crane.

b. Disassembly (fig. 135).

(1) Cut the lock wires (1) and remove the adjusting bolts (2) from both ends of the compression roll axle shaft (10).

(2) Remove the adjusting plates (3).

(3) Remove the bolts (5), lockwashers (17), and nuts (16) by pulling them out from the mounting brackets (4) and axle shaft (10).

(4) Remove the mounting brackets (4) and adjusting collars (6).

(5) Use a wood block and sledge hammer to drive the axle shaft (10) out of the compression roll until the shaft clears the dust guard (7) and bearing (8).

(6) Remove the dust guard and bearing from the compression roll.

(7) Pull out the axle shaft (10) from the compression roll.

(8) Press the remaining dust guard (7) and bearing (8) from the axle shaft (10).

(9) Remove the bearing cups (9) from the compression roll hub.

(10) If it is necessary to remove the compression roll spur gear, cut the lock wire and remove the screws attaching the gear to the roll. Remove the spur gear from the compression roll.

c. Cleaning. Wash all parts in cleaning solvent and wipe them dry with a clean absorbent cloth. Blow off all lubrication and pin mounting passages with clean compressed air. Clean the adjusting bolt and mounting bolt threads with a wire brush and cleaning solvent.

d. Inspection and Repair.

(1) Inspect the compression roll for breaks, cracks, and leaks. Weld all minor cracks and breaks. Replace the compression roll if it is badly broken, cracked, warped, or damaged. Inspect the machined surface of the roll and replace the compression roll if the surface is badly scored, cut, or damaged.

(2) Inspect the axle shaft for wear, twisting, cracks, and breaks. Check the bearing journals for wear, scoring, cuts, and flaws. Replace the axle shaft if bent, twisted, or if the bearing journals are worn or scored.

(3) Inspect the bearings for wear, corrosion, damage, and scoring. Check the bearing rollers for free rotation. Inspect the roller faces for scoring, pitting, and cracking. Replace all defective bearings and bearing cups.

(4) Replace the lock wires.

(5) Inspect the dust guards for twisting, warpage, wear, and damaged or scored sealing surfaces. Replace the dust guards if they are worn, cracked, pitted or warped.

(6) Check the adjusting collars for wear, damage, out-of-round, corrosion, pitting, and etching. Check the bolt holes for wear and cracking or splitting edges. Replace worn or defective adjusting collars.

(7) Inspect the collar bolts for wear, corrosion, and damaged threads. Replace defective collar bolts, nuts, and lockwashers.

(8) Check the adjusting and mounting bolts and nuts for damaged, corroded, twisted, or stripped threads. Replace all defective adjusting and mounting bolts, nuts, and lockwashers.

e. Reassembly (fig. 135).

(1) Press the bearing cups (9) into the compression roll hub.

(2) If the spur gear has been removed, install it on the compression roll and secure it with screws and lockwire.

(3) Press the bearing (8) and dust guard (7) on the axle shaft (10). Pack the bearing with grease.

(4) Install the axle shaft (10) in the compression roll and press the bearing (8) and dust guard (7) on the opposite end of the axle shaft.

(5) Install the adjusting collars (6) and make sure that the boll holes in the collars and axle shaft are properly alined.

(6) Install the mounting brackets (4) on both ends of the axle shaft (10). Aline the bolt holes in the mounting brackets (4), adjusting collars (6) and axle shaft (10).

(7) Install and tighten the mounting bracket bolts (5), lockwashers (17), and nuts (16).

(8) Install the adjusting plates (3) and adjusting bolts (2). Do not tighten the adjusting bolts (2).

f. Installation (fig. 134).

(1) Lift up the compression roll assembly over the road roller frame (16) and make sure that the holes in the mounting brackets (19) and frame are properly alined.

(2) Lower the compression roll (1) and install the mounting bracket bolts, lockwashers, and nuts (20). Tighten the mounting bolts securely.

(3) Install the second countershaft (par. 208).

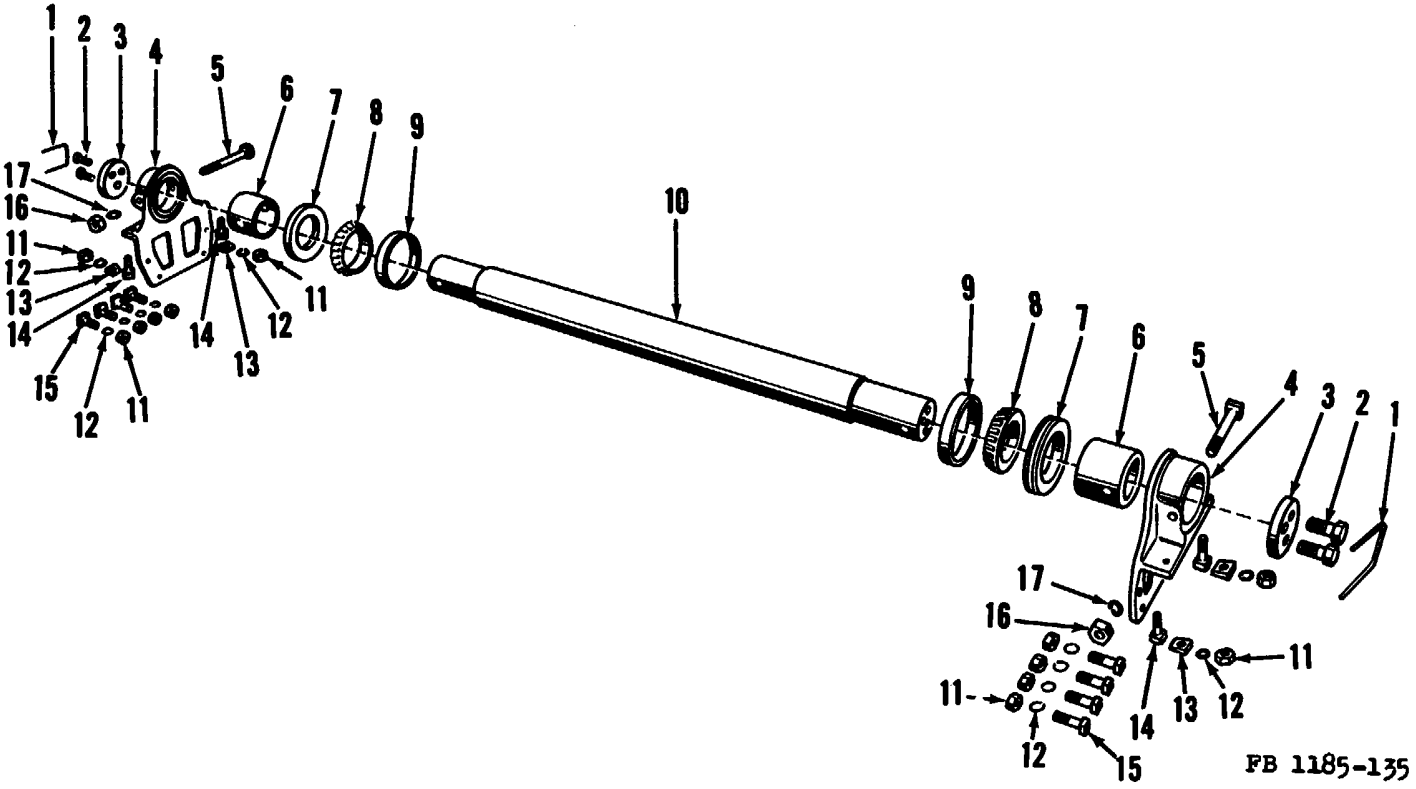


Figure 135. Compression roll axle shaft disassembled.

1 Lock wires (2 req’d)
2 Adjusting bolts (4 req’d)
3 Adjusting plates (2 req’d)
4 Mounting brackets (2 req’d)
5 Bolts, hex hd, 7/8-9 NC x 6 1/2 2 req’d)
6 Adjusting collars (2 req’d)
7 Dust guards (2 req’d)
8 Bearings (2 req’d)
9 Bearing cups (2 req’d)
10 Axle shaft
11 Nuts, hex, 5/8-11 NC (12 req’d)
12 Washers, lock, std, 5/8 (12 req’d)
13 Washers, bevel, 5/8 (4 req’d)
14 Bolts, hex hd, 5/8-11 NC x 2Y4 (4 req’d)
15 Bolts, hex hd, 5/8-11 NC x 2 (8 req’d)
16 Nuts, hex, 7/8-9 NC (2 req’d)
17 Washers, lock, std, 7/8 (2 req’d)

Figure 135. Continued.

(4) Install the second countershaft and compression roll dust guards (6).

(5) Remove the timber blocks from the road roller frame (16).

(6) Install the compression roll housing (par. 158) and connect all linkage, leads, and fuel and water lines.

(7) Fill the compression roll with water if necessary. Lubricate the compression roll bearings.

g. Bearing Adjustment. Turn the adjusting bolts (2, fig. 135) clockwise to tighten and counterclockwise to loosen the compression roll bearings. Tighten the adjusting bolts until all side play is eliminated from the bearings. Make sure that the bearings are not binding. Secure the adjusting bolts with the lockwire.

220. Sprinkler Tank

a. General. The sprinkler tank is made of heavy gage steel sheets and is directly welded to the compression roll housing. The capacity of the sprinkler tank is 130 gallons. The tank must be flushed at least once a year and cleaned with steam.

b. Inspection. Inspect the sprinkler tank for breaks, cracks, and leaks. Check tile inside of the sprinkler tank with a small flashlight for accumulations of rust, lime, corrosion, and sediment. Check all the outlet holes and fittings for corroded or damaged threads.

c. Cleaning. Clean the sprinkler tank with steam pressure and treat it with a rust inhibitor of standard issue.

d. Repair. Weld all minor cracks and breaks by the metal arc welding method, using straight polarity and mild steel bare or light coated electrodes. Clean the welds and fill the sprinkler tank with clean water. Check the welds for leaks and reweld if necessary.

e. Water. Do not use water with high mineral content. Do not use rusty water, because it will cause additional rust to accumulate even more rapidly in the tank. Filter the water if possible to remove all foreign matter such as leaves, grass, and mud. Drain the sprinkler tank in freezing weather or protect it from freezing by adding antifreeze. Use the sprinkler system only when rolling wet or tacky paving materials.

Section XII. ENGINEERING DATA

221. Engine

a. Piston.

Material	Aluminum alloy.
Cylinder diameter	3.4395-3.4375.
Pin hole diameter	0.8594-0.8592.
Compression ring groove diameter	3.086-3.076.
Oil ring groove diameter	3.046-3.036.
First ring groove width	0.1285-0.1275.

Second ring groove width ---------- 0.1285-0.12756.
Third ring groove width ---------- 0.1285-0.1275.
Fourth ring groove width ---------- 0.253-0.252.
First ring land diameter ---------- 3.413-3.410.
Second ring land diameter ---------- 3.413-3.410.
Third ring land diameter ---------- 3.41.410.
Fourth ring land diameter ---------- 3.413-3.410.
Fit in cylinder bore ---------- 0.002 feeler gage, 510 lb pull.

b. Piston Rings.

(1) *Plain compression.*

Cylinder diameter ---------- 3.4395-3.4375.
Groove position ---------- First.
Width ---------- 0.124-0.1285.
Thickness ---------- 0.150-0.140.
Gap clearance ---------- 0.017-0.007.
Side clearance ---------- 0.005-0.0035.
Weight compressed lb ---------- 11 lb minimum.

(2) *T. F. compression.*

Cylinder diameter ---------- 3.4395-3.4375.
Groove position ---------- Second and third.
Width ---------- 0.124-0.123.
Thickness ---------- 0.150-0.140.
Gap clearance ---------- 0.017-0.007.
Side clearance ---------- 0.0055.005.
Weight compressed lb ---------- 12-16.

(3) *Ventilated oil control.*

Cylinder diameter ---------- 3.4395-3.4375.
Groove position ---------- Fourth.
Width ---------- 0.2490.2485.
Thickness ---------- 155-0.145.
Gap clearance ---------- 0.017-0.007.
Side clearance ---------- 0.0045-.003.
Weight compressed lb ---------- 12-16.

c. Piston Pin.

Length ---------- 2.878-2.868.
Diameter ---------- 0.8593-0.8591.
Diameter piston pin hole in rod ---------- 0.914-0.913.
Finished diameter pin bushing ---------- 0.8597-0.8595.
Piston pin fit in piston:
Possible ---------- 0.0003-0.0001.
Desired ---------- Light push.
Piston pin clearance in bushing:
Possible ---------- 0.0006-0.0002.
Desired ---------- 0.0004.

d. Valve Guide.

Length, intake ---------- 2 5/16.
Length, exhaust ---------- 2 5/16.
Outside diameter, intake ---------- 0.657-0.65.
Outside diameter, exhaust ---------- 0.6575-0.56, 5.
Stem hole diameter ---------- 0.3432-0.3422.

Valve seat face to top of guide:
Intake ---------- 1 15/32.
Exhaust ---------- 1 15/32.
Valve stem clearance limits:
Intake ---------- 0.0026-0.0008.
Exhaust ---------- 0.0055-0.0037.
Desired stem clearance:
Intake ---------- 0.0015.
Exhaust ---------- 0.0045.

e. Intake Valve.

Material ---------- SAE 3140.
Overall length ---------- 5 3/16.
Stem diameter ---------- 0.3414-0.3406.
Head diameter ---------- 1 33/64.
Seat angle ---------- 30°.
Clearance limits ---------- 0.0026-0.0008.
Desired stem clearance in guide ---------- 0.0015.

f. Exhaust Valve.

Material ---------- XCR.
Type ---------- Positive rotating.
Overall length ---------- 5 3/16.
Stem diameter ---------- 30.0.3877.
Head diameter ---------- 1.208-1.198.
Seat angle ---------- 45°.
Clearance limit ---------- 0.0055-0.0037.
Desired stem clearance in guide ---------- 0.0045.

g. Valve Spring.

Outside diameter ---------- 1.150-1.130.
Wire size ---------- 0.156.
Length, valve closed ---------- 1 21/32.
Length, valve open ---------- 1 3/8.
Spring load, valve closed ---------- 47-53 lb.
Spring load, valve ---------- 103-110 lb.

h. Camshaft.

Material ---------- Drop forged steel.
First bearing journal diameter ---------- 1.8725-1.8715.
Second bearing journal diameter ---------- 1.8096-1.8086.
Third bearing journal diameter ---------- 1.7465-1.7457.
Fourth bearing journal diameter ---------- 1.2475-12465.
Cam lift, intake ---------- 0.329.
Cam lift, exhaust ---------- 0885.
Tappet hole diameter ---------- 1.0005-1.000.
Tappet diameter ---------- 0.9995-0.999.
Clearance limits ---------- 0.0015-0.005.
End play ---------- 0.009-0.006.

i. Camshaft Bushings.

Inside diameter, first ---------- 1.8755-1.8745.
second ---------- 1.8125-1.8115.
third ---------- 1.7502-1.7495.
fourth ---------- 1.2605-1.2495.

Clearance limits, first ---------- 0.004-0.002.
second ---------- 0.004-0.002.
third ---------- 0.0045-0.003.
fourth ---------- 0.004-0.002.
Oil pump gear backlash ---------- 0.0065-0.003.

j. Connecting Rod.

Length between centers ---------- 7.002-6.998.
Bushing hole diameter ---------- 0.914-0.913.
Bearing hole diameter ---------- 2.187-2.1865.
Crank pin length ---------- 1.3135-1.3115.
Bearing end width ---------- 1.3055-1.3035.
Side play, possible ---------- 0.010-0.006.
Side play desired ---------- 0.006 minimum

k. Connecting Rod Bearing.

Type ---------- Precision replaceable.
Number used ---------- 6.
Rod hole diameter ---------- 2.187-2.1865.
Bearing thickness ---------- 0.0619-.06165.
Crankshaft hearing size ---------- 2.0627-2.0619.
Clearance ---------- 0.0018-0.0000.
Desired clearance ---------- 0.001.

l. Main Bearings.

Type ---------- Precision replaceable.
Number used ---------- 4.
Position ---------- Front.
Case hole ---------- 2.5622-2.5615.
Bearing thickness ---------- 0.09315-0.09290.
Crankshaft size ---------- 2.3752-2.3744.
Clearance ---------- 0.002-0.0000.
Desired clearance ---------- 0.001.

m. Crankshaft.

End thrust ---------- 0.00-0.004.
Thrust on ---------- Front bearing.
Pulley fit diameter ---------- 1.4345-1.434.
Gear fit diameter ---------- 1.4355-1.435.
Main bearing journal fit diameter ---------- 2.3752-2.3744.
Crank pin ---------- 2.0627-2.0619.
Flywheel flange diameter ---------- 4.498-4.497.
Flywheel flange runout ---------- 0.002 indicator reading.

n. Fillet Radii.

Rear journal ---------- 1/8 ± 1/64
Other journals and pins ---------- 13/32 ± 1/64.

o. Oil Pump.

Drive and idler gears to body ---------- 0.003.
Drive shaft end play ---------- 0.006 maximum.
Drive shaft end play, desirable ---------- 0.002-0.004.
Gear backlash ---------- 0.0065-0.003.

p. Master Clutch.

Floating plate	Cast iron.
Floating plate insert	High carbon steel.
Friction disk	Molded asbestos.
Working HP per 100 rpm	9.0.
HP capacity	60.
Axial pressure	150.
Working torque ft-lb	470.
Maximum speed rpm	2675.
Weight lb	61.

222. Road Roller

a. Bevel Gear.

Number required	2.
Material	A5140 fine grain steel.
Rough weight	28.0 lb.
Finished weight	7.5 lb.
Outside diameter	9.081.
Number of teeth	54.
Pitch angle	66°2'.
Pitch	6-20° full depth.
Depth of teeth	0.3595.
Bore	3.2500-3.2505.
Chamfer	1/8 x 45°.
Number of holes	6.
Hole diameter	9/16 drill.
Treatment	Heat to 1525-1550, quench in oil, draw; Rockwell "C"-34-38.

b. Bevel Pinion.

Number required	1.
Material	A5140 fine grain steel.
Rough weight	14.0 lb.
Finished weight	4.5 lb.
Outside diameter	4.426.
Width of teeth	1.00.
Number of teeth	24.
Pitch angle	23°58'.
Pitch	20 full depth.
Depth of teeth	0.3595.
Bore	1.3750-1.3745.
Threaded end diameter	2.542-2.547.
Threading	18 threads per inch.
Threaded length	5/8.
Groove width	1/8.
Keyway width	0.501-0.499.
Treatment	Heat to 1525-1500, quench in oil, draw, Rockwell "C"-34-48.

c. Clutch Driving Spider.

Number required	2.
Material	Semisteel.
Rough weight	50 lb.
Finished weight	29.12 lb.
Outside diameter	1111/16.
Number of teeth	63.
Pitch	6/8, 20° angle.
Depth of teeth	0.3185.
Bore	3.189-3.188.
Keyway width	0.750-0.749.
Shaft outside diameter, small	4.241-4.240.
medium	4.2520-4.2530.
large	4.876-4.877.
Set screw hole	¼-18 pipe tap, 2%4 drill.

d. Double Speed Pinion.

Number required	1.
Material	A5140 fine grain HRS.
Rough weight	24 lb.
Finished weight	9.5 lb.
Outside diameter, large	5.900-5.896.
Number of teeth	22.
Pitch	4/5
Depth of teeth	0.5393.
Outside diameter, small	3.650-3.645.
Number of teeth	13.
Pitch	4/5.
Depth of teeth	0.5393.
Bore	1.5625-1.5620.
Overall width	2 3/4
Keyway width	0.500-0.499.
Treatment	Heat to 1525-1550. quench in oil, draw; Rockwell "C"-34-38.

e. Fast Gear.

Number required	1.
Material	SAE 5140 steel forging
Rough weight	42 lb.
Finished weight	17.4 lb.
Outside diameter	9.900.
Number of teeth	38.
Pitch	4/5
Depth of teeth	0.5393.
Bore before heat treatment	3.2000-3.1995.
Bore after heat treatment	3.2500-3.2495.
Number of holes	16.
Hole diameter	27/64 drill 11/16deep.
Hole spacing	Equal; spot with 3/4 drill 3/32 deep.

Treatment---------- Heat to 1525-1550, quench in oil, draw; Rockwell "C"-34-38.

f. Fast Gear Sliding Gear.

Number required---------- 1.
Material---------- A5140 fine grain ---------- HRS.
Rough weight---------- 7.33 lb.
Finished weight---------- 3.25 lb.
Outside diameter---------- 4.330-4.325.
Number of teeth b ---------- 16.
Pitch---------- 4/5.
Depth of teeth---------- 0.4543.
Inside diameter, large---------- 1.750-1.749.
Overall width ---------- 1 3/8.
Treatment---------- Heat to 1525-1550, quench in oil, draw; Rockwell "C"-34-38.

g. First Countershaft Pinion.

Number required---------- 1.
Material---------- 40-50 carbon steel forging.
Width of teeth---------- 2 1/8.
Thickness---------- 3.
Number of teeth---------- 26.
Pitch---------- 3.
Outside diameter---------- 9.332-9.328.
Depth of teeth---------- 0.7190.
Bore before heat treatment---------- 1.742-1.740.
Bore after heat treatment ---------- 1.7722-1.7717.
Keyway width ---------- 0.500-0.499.
Treatment---------- Heat to 1475-1525, quench in oil, draw; Rockwell "C" 22-.26.

h. Main Spur Gear.

Number required---------- 1.
Material---------- C1045 steel forging.
Rough weight---------- 907.2 lb.
Outside diameter---------- 35.200-35.195.
Number of teeth---------- 86.
Pitch---------- 2 1/2.
Depth of teeth---------- 0.8628.
Width of teeth---------- 2 1/2.
Number of holes ---------- 12.
Hole diameter---------- 49/64 drill.

i. Second Counter8haft Pinion.

Number required---------- 1.
Material---------- A51400H HRS.
Rough weight---------- 46.6 lb.

Outside diameter---------- 7.600-7.595.
Number of teeth---------- 17.
Depth of teeth---------- 0.8628.
Bore before heat treatment---------- 2.972-2.970.
Bore after heat treatment ---------- 3.0000-3.0005.
Chamfer---------- 1/64 x 45°.
Keyway width ---------- 1.000-0.999.
Treatment---------- Heat to 1525-1550, quench in oil, draw; Rockwell "C"-34-38.

j. Second Countershaft Ring Gear.
Material---------- C1045 steel forging.
Thickness---------- 2.
Outside diameter---------- 22.999-22.998.
Number of teeth---------- 67.
Depth of teeth---------- 0.n90.
Bore---------- 18.771-18.772.
Chamfer---------- 3/16 x 45°.
Number of holes ---------- 12.
Hole diameter---------- 25/64 drill.

k. Slow Gear.
Material---------- SAE 5140 steel forging.
Rough weight---------- 60 lb.
Finished weight---------- 26 lb.
Outside diameter---------- 12.150-12.145.
Number of teeth---------- 47.
Pitch---------- 4/5
Width of teeth---------- 1 1/2.
Depth of teeth---------- 0.5393.
Bore, before heat treatment---------- 3.2005-3.1995.
Bore, after heat treatment ---------- 3.2500-3.2495
Number of holes ---------- 16.
Hole diameter---------- 27/64 drill 11/16 deep; equal; spot with 3/4 drill 3/32 deep.
Treatment---------- Heat to 1525-1550, quench in oil, draw; Rockwell “C”-34-38

l. Slow Gear . Sliding Gear.
Number required---------- 1.
Material---------- A5140 fine grain steel
Rough weight---------- 9 lb.
Finished weight---------- 8 lb.
Outside diameter---------- 4.330-4.325.
Inside diameter, large---------- 2.500-2.498.
Inside diameter, small ---------- 2.125-2.123.
Number of teeth---------- 16.
Depth of teeth---------- 0.4548.

Overall width	1 5/8.
Chamfer	¼ x 45°.
Treatment	Heat to 1526.1550, quench in oil, draw; Rockwell “C”-34-38

223. Torque Wrench Data

Note. Specifications given apply for clean, dry threads. Reduce torque 10% when the threads are clean and oiled.

a. Cylinder Head.

Bolt size	*Limit in foot. pounds torque*
3/8	35-40
7/16	70-75
1/2	100-110
9/16	130-140
5/8	145-155

b. Main Bearing Cap and Connecting Rod.

Bolt Size	*Limit in foot. pounds torque*
5/16	20-25
3/8	35-40
7/16	70-75
1/2	85-95
9/16	100-110

c. Manifolds.

Bolt size	*Limit in foot. pounds torque*
5/16	15-20
3/8	35-40
7/16	60-55
1/2	80-90
9/16	100-110
5/8	130-140

d. Gear Cover, Water Pump, Front and Rear End Plates, Oil Pan.

Bolt size	*Limit in foot. pounds torque*
5/16	15-20
3/8	25-30
7/16	50-55
1/2	80-90

e. Flywheel.

Bolt size	*Limit in foot. pounds torque*
5/16	20-25
3/8	35-40
7/16	70-75
1/2	85-95
9/16	100-110
5/8	145-155

f. Flywheel Housing.

Bolt size	*Limit in foot. pounds torque*
5/16	15-20
3/8	25-40
7/16	50-55
1/2	80-90
9/16	115-125

CHAPTER 5
SHIPMENT, LIMITED STORAGE, AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

224. Limited Storage

a. Inspection. Refer to organizational preventive maintenance services (par. 54).

b. Cleaning and Painting. To insure perfect operating conditions, the road roller must be given a special treatment prior to storage when not intended for immediate use. This procedure protects the exterior surfaces of the road roller, as well as exterior and interior engine surfaces, against rust and corrosion. Inspect the entire road roller and engine for dirt, accumulated dust, and grease and oil residue. Clean all metal parts with cleaning solvent and wipe them dry with a soft absorbent cloth. Inspect the road roller for cracked, blistering, and peeling paint. Remove rust spots with a stiff wire brush and smooth the metal with a fine sandpaper. Use a spray-gun or brush to repaint the rusted surfaces.

c. Lubrication. Service in accordance with instructions in LO 5-1185.

d. Fuel System. Make sure that the fuel tank cap is tight and secure.

e. Cooling System. Drain the cooling system and leave the drain cocks open.

f. Batteries. Remove the batteries and clean the cables and terminals with a strong solution of baking soda. Wipe them dry. Do not let any of the soda solution enter the cells, or it will destroy the battery. Coat the battery terminals with petroleum jelly and store the batteries in a warm, dry place.

g. Engine. Remove grease and dirt from the exterior of the engine. Make sure that all surfaces are clean and dry. Spray or brush all exterior surfaces and accessories with compound No. AXS858. Seal the air cleaner, oil filler tube, and exhaust pipe. The material used for sealing must be waterproof and vaporproof and must also possess sufficient physical strength to resist punctures and damage due to expansion of entrapped air.

h. Sprinkler System. Drain the sprinkler system and leave the drain valves open. Make sure that the sprinkler tank caps are tight and secure.

i. Rolls. Drain *the water ballast from the steering and compression rolls. Make sure that the drain plugs are tight and secure.

225. Dead Storage

Refer to TM 5-9715.

226. Shipment

a. General. Information in this section is published for the guidance of personnel responsible for the packaging and shipment of the road roller.

b. Domestic Shipment.

(1) Clean the exterior with cleaning solvent or other noninflammable cleaning fluid and wipe it dry. Spray or brush all exterior surfaces with compound No. 858.

(2) Check all parts for tightness. Secure all connections. Check the unit for mechanical fitness.

(3) Drain the coolant from the cooling system and radiator. Leave the drain cocks open.

(4) Drain the sprinkler tank and steering and compression rolls.

(5) Drain the fuel tank.

(6) Seal the air cleaner, oil filler pipe, and exhaust pipe.

(7) Drain the lubricating oil.

(8) Close the side doors and fasten them securely.

(9) Tag the road roller, indicating that it is being shipped dry but with the batteries in place.

(10) Protect the road roller with a tarpaulin or cover.

(11) Block and secure the road roller in a carrier or railroad car as illustrated in figure 8. Block the steering roll on the sides only. Do not block the steering roll in front and rear.

c. Export Shipping. See instructions in TB 5-9711-1.

Section II. DEMOLITION OF THE ROAD ROLLER TO PREVENT ENEMY USE

227. General

When capture or the abandonment of the road roller to an enemy is imminent, the responsible unit commander makes the decision either to destroy the unit or to render it inoperative. Based on this decision, orders are issued which cover the desired extent of destruction. Whatever method of demolition is employed, it is essential to destroy the same vital parts of all road roller and all corresponding repair parts.

228. Preferred Demolition Methods

Explosives and mechanical means, either alone or in combination, are the most effective methods to employ. Listed below are the vital parts in order of priority of demolition for each preferred method. In each case, completion of the first two steps will render the unit inoperative. Completion of the additional steps listed will further destroy the unit.

a. Demolition by Explosives (fig. 136). Place as many of the following charges as the situation permits and detonate them simultaneously with detonating cord and a suitable detonator.

(1) A 2-pound charge on engine flywheel case.

(2) A 4-pound charge between the first countershaft pinion and second countershaft gear and pinion.

Note. The above charges are the minimum requirement for this method.

(3) A 4-pound charge on each forward and reverse clutch assembly.

(4) A 2-pound charge between the steering lever and master clutch and gear shift levers on the control platform.

(5) A 2-pound charge between the brake pedals and sprinkler pedals on both sides of the road roller.

(6) A 2-pound charge on the hydraulic oil pump.

(7) A 2-pound charge on the engine block behind the manifold.

(8) A 1-pound charge on the engine block behind the magneto.

(9) An 8-pound charge between the steering roll swivel pin and the sprinkler mat.

(10) A 4-pound charge between the second countershaft gear and the final spur gear drive on the frame side member.

(11) A 6-pound charge against each roll in the roll path.

b. *Demolition by Mechanical Means.* Use sledge hammers, crowbars, picks, axes, or any other heavy tool which may be available together with the tools normally included with the road roller to destroy the following:

(1) Transmission.

(2) First countershaft pinion, second countershaft gear, pinion, and final spur gear drive.

Note. The above steps are the minimum requirement for this method.

(3) Engine block, head, magneto, and carburetor.

(4) All control mechanisms.

(5) Hydraulic steering cylinder and hydraulic pump.

(6) Steering roll kingpin.

(7) Radiator core and tanks.

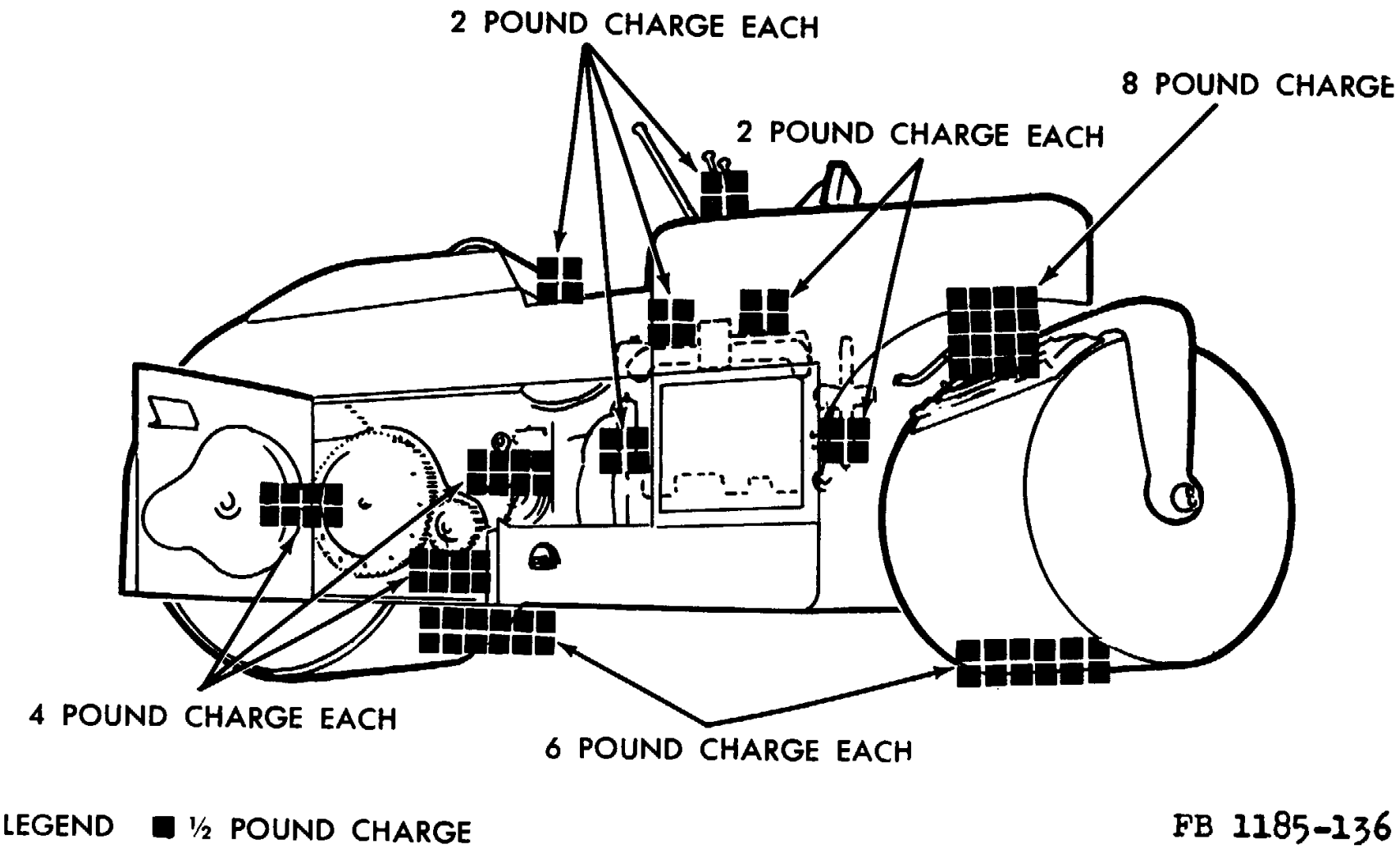


Figure 136. Placement of charges.

229. Other Demolition Methods

If the situation prohibits employing either of the preferred methods, use the following, either singly or in combination.

a. Demolition by Weapon, Fire. Fire on the road roller with the heaviest weapons available.

b. Demolition by Scattering and Concealment. Remove all easily accessible vital parts, such as the engine carburetor, magneto, and parts of the operating controls. Scatter these parts through dense foilage, bury them in dirt or sand, or throw them in a lake, stream, well, or other body of water.

c. Demolition by Burning. Pack rags, clothing, or canvas under, and around the unit. Saturate this packing with gasoline, oil, or diesel fuel and ignite.

d. Demolition by Submersion. Totally submerge the unit in a body of water to provide some water damage and concealment. Salt water will do the greatest damage to metal parts.

e. Demolition by Misuse. Perform the steps listed below to make the unit inoperative.

(1) Drain the engine radiator and crankcase.

(2) Throw sand or other abrasive into the transmission case, hydraulic oil tank, and engine oil pan.

(3) Start the engine and engage the gear shift lever.

(4) Drop bolts, nuts, and tools into the gear trains.

(5) Operate the unit until failure occurs.

(6) Drive the unit over a bank or into a solid object to damage it.

230. Training

All operators should receive thorough training in the destruction of the road roller. Simulated destruction, using all the methods and priorities listed above, should be included in the operators training program. It must be emphasized in training that demolition operations are usually necessitated by critical situations, when the time available for destruction is limited. For this reason, it is necessary that operators be thoroughly familiar with all methods of destruction and be able to carry out demolition instructions without reference to this or any other manual.

APPENDIX I

REFERENCES

1. Accessory Equipment
TM 9-1826C Carburetors (Zenith).
TM 9-8627 Electrical Equipment (Delco-Remy).

2. Dictionaries of Terms and Abbreviations
SR 320-5-1 Dictionary of United States Army Terms.
SR 320-50-1 Authorized Abbreviations.

3. Lubrication and Painting
LO 5-1185 Lubrication Order.
TM 9-2851 Painting Instructions for Field Use.

4. Preparation for Export Shipment
TB 5-9711-1 Preparation of Corps of Engineers Equipment for Overseas Shipment.
TB 5-9713-1 Preparation for Export, Spare Parts for Corps of Engineers Equipment.

5. Preventive Maintenance
TB 5-505 Maintenance of Engineer Equipment.

6. Publications Indexes
Special Regulations in the 310-20 series, and DA Pam 108-1, should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to the equipment covered in this manual.

7. Training Aids
FM 21-8 Military Training Aids.

LIST OF MANUFACTURER'S CODE NUMBERS

092	Twin Disc Clutch Co.
097	Fram Corp.
141	Novi Equipment Co., Inc.
226	Chicago Rawhide Mfg. Co., The
347	Cleveland Hardware & Forging Co., The
354	Eclipse Machine Div., Bendix Aviation Corp.
381	Torrington Co., The
390	Gits Bros. Mfg. Co.
522	Fafnir Bearing Co., The
537	Roller Bearing Co. of America
540	SKF Industries, Inc.
300	AC Spark Plug Div., General Motors Corp.
617	Continental Motors Corp.
623	Delco-Remy Div., General Motors Corp.
636	Fairbanks-Morse and Co., Magnetos
699	Zenith Carburetor Div., Bendix Aviation Corp.
789	Vortox Co.
806	Alemite Div., Stewart-Warner Corp.
834	Dayton Rubber Co., The
887	Stewart-Warner Corp.
896	Weatherhead Co., The
910	Federal Class 08 through 40
912	Federal Class 42
913	Federal Class 43
914	Federal Class 44 through 66
962	Galion Iron Works & Mfg. Co., The
969	Engines, Gasoline and Diesel
994	Vickers, Inc.

Section I. STANDARD HARDWARE

Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
Code No.	Part No.	Code No.	Part No.			
912	42-1100.500.047	962	29-8525	----------	BALL: steel; 15/32 in. dia ---------- 1	
913	43-2325.040.017	----------	----------	496-8214	BOLT, machine: FS FF-B-571; steel; NC; sq hd; w/sq nut; black; 3/8 in. dia, 1 3/4 in. long; 7/8 in. thread length, 16 threads per in. (IMO 10).	2
913	43-2820. 040. 010	----------	----------	----------	BOLT, plow: steel; NC; rd hd; sq neck; w/sq nut; black; 3/8 in. dia, 1 in. long; 16 threads per in. (IMO 25).	4
913	43-3279. 040. 330	617	X-19889	----------	BOLT, stud: FS FF-B-571; steel; NC and NF; 3/8 in. dia, 3 ¼ in. long; 16 and 24 threads per in.	33
913	43-3226. 030. 100	617	X-19871	----------	BOLT, stud: FS FF-B-571; steel; NC; 1/4 in. dia, 1 in. long; 20 threads per in. (IMO 100).	1
913	43-3226. 035. 100	617	X-4125	----------	BOLT, stud: FS FF-B-571; steel; NC; 5/16 in. dia, 1 in. long; 18 threads per in. (IMO 25).	2
913	43-3226. 035. 130	617	X-1952	----------	BOLT, stud: FS FF-B-571; steel; NC; 5/16 in. dia, 1 1/4 in. long; 18 threads per in.	2
913	43-3226. 040. 130	617	X-19002	----------	BOLT, stud: FS FF-B-571; steel; NC; 3/8 in. dia, 1 1/4 in. long; 16 threads per in. (IMO 50).	4
913	43-3226. 040. 140	617	X-19003	----------	BOLT, stud: FS FF-B-571; steel; NC; 3/8 in. dia, 1 3/8 in. long; 16 threads per in. (IMO 50).	4
913	43-3226. 040. 150	617	X-19004-C	----------	BOLT, stud: FS FF-B-571; steel; NC; 3/8 in. dia, 1 1/2 in. long; 16 threads per in. (IMO 10).	3
913	43-3226. 040. 170	617	X-19006	----------	BOLT, stud: FS FF-B-571; steel; NC; 3/8 in. dia, 1 3/4 in. long; 16 threads per in. (IMO 25).	4
913	43-3226. 040. 210	617	X-4266	----------	BOLT, stud: FS FF-B-571; steel; NC; 3/8 in. dia, 2 1/8 in. long; 16 threads per in. (IMO 5).	8

Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
Code No.	Part No.	Code No.	Part No.			
913	43-3226. 040. 330	617	X-4275	----------	BOLT, stud: FS FF-B-571; steel; NC; 3/8 in. dia, 3 1/4 in. long; 16 threads per in. (IMO 5).	4
914	45-1760. 003.001	617	X-12166	----------	BUSHING, pipe: iron; black; headed; FS WW-P-471; 1/4 x 1/8 in_	1
914	45-2036. 300. 004	----------	----------	----------	CAP, pipe: malleable iron; 150 lb pressure; FS WW-P-521; threaded; black; Type I; 3/8 in.	1
914	45-2036. 500. 004	----------	----------	228-1622	CAP, pipe: malleable iron; 150 lb pressure; FS WW-P-521; threaded; galvanized; Type II; 3/8 in.	8
910	17-3045. 700. 050	----------	----------	----------	CLAMP, cable or conduit: 1 hole type; size conduit 1/2 in., cable 3/4 in. (IMO 5).	18
910	33-2340. 100.300 18	962	25-8294	----------	CLAMP, hose: universal; 1 to 3 in.; MIL-C-11569; size B----------	
914	45-2410. 300. 030	962	M153	----------	COCK, air and drainage: ground key; brass; pet; T-handle; 1/8 in. male pipe thread.	4
914	45-3716. 453. 015	----------	----------	----------	ELBOW, pipe: malleable iron; 150 lb pressure; FS W'W-P-521; straight; threaded; 45-deg; black; 1 1/2 in.	1
914	45-3716. 930.010	----------	----------	193-7081	ELBOW, pipe: malleable iron; 150 lb pressure; FS WW-P-521; straight; threaded; 90-deg; black; Type I; 1 in.	1
914	45-3716. 930. 015	----------	----------	230-8700	ELBOW, pipe: malleable iron; 150 lb pressure; FS WW-P-521; straight; threaded; 90-deg; black; Type I; 1 1/2 in.	1
914	45-3772. 830. 005	----------	----------	010-8686	ELBOW, pipe: malleable iron; 150 lb pressure; FS WW-P-521; street; straight; threaded; 90-deg; black; Type I; 1/2 in.	2
914	45-3772. 830. 010	----------	----------	----------	ELBOW, pipe: malleable iron; 150 lb pressure; FS WW-P-521; street; straight; threaded; 90-deg; black; Type I; 1 in.	1
914	45-3772. 900. 007	----------	----------	----------	ELBOW, pipe: malleable iron; 150 lb pressure; FS WW-P-521; street; straight; threaded; 90-deg; galvanized; Type II; 3/4 in.	3
912	42-5366. 470. 390	962	R-23952	193-9175	KEY, plain: flat; plain end; single; 3/8 in. wide, 3/4 in. thick; 3 15/16 in. long.	1

912	42-5390. 050. 330	962	R-17567	054-2773	KEY, plain: single; Y2 in. wide, 1/2 in. thick, 3 1/4 in. long----------	1
912	42-5416. 500. 300	962	M-508	012-4551	KEY, Woodruff: nickel steel; single; No. A, 1/4 x 7/8 in---------- ----------	3
912	42-5416. 500. 180	617	X-584	012-4543	KEY, Woodruff: nickel steel; single; No. 3, 1/8 x 1/2 in. (IMO5)----------	1
912	42-5416. 500. 210	617	X-506	012-4546	KEY, Woodruff: nickel steel; single; No. 6, 5/32 X 5/8 in ----------	1
912	42-5416. 500.330	617	X-511	012-4553	KEY, Woodruff: nickel steel; single; No. 15, 1/4 x 1 in ----------	2
912	42-5416. 500.470	----------	----------	011-7993	KEY, Woodruff: nickel steel; single; No. 22, ¼ x 1 3/8 in ----------	2
914	45-5600.001.015	----------	----------	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; black; 3/8 in. ips; 1 in. long.	1
914	45-5600.004.020	----------	----------	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; black; 3/8 in. ips, 2 in. long (IMO 10).	1
914	45-5600.007.100	----------	----------	253-6351	NIPPLE, pipe: FS WW-N-351; wrought iron; std; black; 3/4 in. ips, 10 in. long.	2
914	45-5600.010.040	----------	----------	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; black; 1 in. ips, 4 in. long.	1
914	45-5600.015.017	----------	----------	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; black; 1 1/2 in. ips, 1% in. long.	1
914	45-5600.025.030	962	R-28351	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; black; 2 1/2 in. ips, 3 in. long.	1
914	45-5676.004.010	----------	----------	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; galvanized; 3/8 in. ips, 1 in. long.	1
914	45-5676.005.020	----------	----------	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; galvanized; 1/2 in. ips, 2 in. long.	4
914	45-5676.007.014	----------	----------	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; galvanized 3/4 in. ips, 1% in. long.	3
914	45-5676.007.030	---------	----------	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; galvanized; 3/4 in. ips, 3 in. long.	1
914	45-5676.007.040	---------	----------	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; galvanized; 3/4 in. ips, 4 in. long.	1
914	45-5676.007.100	962	R-20586	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; galvanized; 3/4 in. ips, 10 in. long.	2
914	45-5676.013.016	617	X-12210	----------	NIPPLE, pipe: FS WW-N-351; wrought iron; std; galvanized; 1 1/4 in. ips, 1% in. long.	1

Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
Code No.	Part No.	Code No.	Part No.			
913	43-4092.040.240	962	R14161-M645	----------	NUT, Elastic Stop: steel; NF; hex; rh; 3/8 in.; 24 threads per in.	2
913	43-4162.035.240	----------	----------	----------	NUT, jam: regular; steel; finished; FS FF-B-571, grade 6; NF; hex; Type A; rh; 5/16 in.; 24 threads per in.	1
913	43-4164. 040.160	----------	----------	----------	NUT, jam: regular; steel; semifinished; FS FF-B-571, grade 5; NC; hex; Type A; rh; 3/8 in.; 16 threads per in.	1
913	43-4164. 050. 130	----------	----------	----------	NUT, jam: regular; steel; semifinished; FS FF-B-571, grade 5; NC; hex; Type A; rh; 1/2 in.; 13 threads per in.	12
913	43-4164. 070.100	----------	----------	222-7223	NUT, jam: regular; steel; semifinished; FS FF-B571, grade 5; NC; hex; type A; rh; 3/4 in.; 10 threads per in.	4
913	43-4350. 010. 320	617	X-1896	010-3088	NUT, machine screw: steel; NF; hex; rh; screw No. 10; 32 threads per in. (IMO 50).	1
913	43-4355. 008. 360	699	T21S-8	----------	NUT, machine screw: steel; NF; sq; rh; screw No. 8; 36 threads per in.	1
913	43-4445.030.200	617	X1800-C	----------	NUT, regular: steel; black; semifinished; FS FF-B-571; NC; hex; Type A-2; rh; 1/4 in.; 20 threads per in. (IMO 50).	29
913	43-4445. 035. 180	617	X-1801-E	189-4419	NUT, regular: steel; black; semifinished; FS FF-B-571; NC; hex; Type A-2; rh; 5/16 in.; 18 threads per in. (IMO 25).	16
913	43-4445. 040. 160	617	X-1802-G	----------	NUT, regular: steel; black; semifinished; FS FF-B-571; NC; hex; Type A-2; rh; 3/8 in.; 16 threads per in. (IMO 25).	59
----------	----------	617	15XX-1802-G	----------	NUT (Supplied under Stock No. 913 43-4445.040.160) ----------	----------
		962	M-73	----------	NUT (Supplied under Stock No. 913 43-4445.040.160) ----------	----------
913	43-4445. 050. 130	---------	----------	222-7222	NUT, regular: steel; black; semifinished; FS FF-B-571; NC; hex; Type A-2; rh; 1/2 in.; 13 threads per in. (IMO 25).	4
913	43-4489. 050. 200	---------	----------	----------	NUT, regular: steel; black; semifinished; FS FF-B-571; NC; hex; Type A-2; rh; 1/2 in.; 20 threads per in. (IMO 25).	8

913	43-4445. 060. 110	----------	----------	----------	NUT, regular: steel; black; semifinished; FS FF-B-571; NC; hex; Type A-2; rh; 5/8 in.; 11 threads per in. (IMO 25).	24
913	43-4445. 070. 100	962	M-79	----------	NUT, regular: steel; black; semifinished; FS FF-B-571; NC; hex; Type A-2; rh; 3/4 in.; 10 threads per in. (IMO 5).	4
913	43-4445.080.090	----------	----------	----------	NUT, regular: steel; black; semifinished; FS FF-B-571; NC; hex; Type A-2; rh; 7/8 in.; 9 threads per in.	2
913	43-4489.030.280	617	X18137	222-7217	NUT, regular: steel; black; semifinished; FS FF-B-571; NF; hex; Type A-2; rh; 1/4 in.; 28 threads per in. (IMO 100).	5
913	43-4489.035.240	617	15XX-18203	----------	NUT, regular: steel; black; semifinished; FS FF-B-571; NF; hex; Type A-2; rh; 5/16 in.; 24 threads per in. (IMO 100).	1
913	43-4489.040.240	617	X-18237	----------	NUT, regular: steel; black; semifinished; FS FF-B-571 NF; hex; Type A-2; rh; 3/8 in.; 24 threads per in. (IMO 25).	6
913	43-4519.012.240	623	115596	199-6562	NUT, regular: steel; cadmium plated; semifinished; FS FF-B-571; NC; hex; Type A-2; rh; bolt No. 12; 24 threads per in. (IMO 5).	4
913	43-4530.008.360	699	T22S8	----------	NUT, regular: steel; cadmium plated; semifinished; FS FF-B-571; NF; hex; Type A-2; rh; bolt No. 8; 36 threads per in.	2
913	43-4600.100.080	962	D-3295	----------	NUT, slotted: steel; black; semifinished; NC; hex; rh; 1 in.; 8 threads per in.	4
912	42-6880.050.100	617	X-608	010-8634	PIN, cotter; split; FS FF-P-386; steel; Type B; 1/16 x 1 in. (IMO 100).	2
912	42-6880.070.100	617	X-601	010-3374	PIN, cotter; split; FS FF-P-386; steel; Type B; 3/32 x 1 in	9
		962	R-29182-105	----------	PIN (Supplied under Stock No. 912 42-6880.070.100)----------	--------
		962	R-29182-A105	----------	PIN (Supplied under Stock No. 912 42-6880.070.100) ----------	--------
912	42-6880.100.100	---------	----------	----------	PIN, cotter: split; FS FF-P-386; steel; Type B; 1/8 x I in. (IMO 50).	4
912	42-6880.200.200	962	M-975	----------	PIN, cotter: split; FS FF-P-386; steel; Type B; 3/16 x 2 in -	9
912	42-7000.300.150	---------	----------	014-1205	PIN, dowel: steel; Y in. dia, 1% in. long ----------	1
910	08-4700.700.150	617	X-2236	----------	PLUG, expansion: standard-type; 1 1/2 in. (IMO 10) ----------	1
914	45-6040.500.001	617	X-100	187-4206	PLUG, pipe: cast iron; 125 lb pressure; threaded; sq hd; FS WW-P-471; black; Type I; 1/8 in. (IMO 5).	5

Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
Code No.	Part No.	Code No.	Part No.			
914	45-6040.500.005	----------	----------	----------	PLUG, pipe: cast iron; 125 lb pressure; threaded; sq hd; FS WW-P-471; black; Type I; 1/2 in.	1
914	45-6040.500.007	----------	----------	----------	PLUG, pipe: cast iron; 125 lb pressure; threaded; sq hd; FS WW-P-471; black; Type I; 3/4 in.	1
914	45-6040.500.010	----------	----------	----------	PLUG, pipe: cast iron; 125 lb pressure; threaded; sq hd; FS WW-P-471; black; Type I; 1 in.	1
914	45-6068.500.004	617	X-110	263-3123	PLUG, pipe; malleable iron: 150 lb pressure; threaded; hex socket; FS WW-P-471; black; Type I; 3/8 in.	2
914	45-068.500.005	617	X-101-B	----------	PLUG, pipe: malleable iron; 150 lb pressure; threaded; hex socket; FS WW-P-471; black; Type I; 1/2 in.	1
914	45-6075.500.003	617	X-101	----------	PLUG, pipe: malleable iron; 150 lb pressure; threaded; sq hd; F8 WW-P-471; black; Type I; 1/4 in.	1
910	17-7624.270.150	617	SP205-BR4S	----------	PLUG, spark: shielded; industrial; integral resistor; normal; Champion Type XE-15 A or equal; 18 mm thread size; 1 in. hex size; 3 in. installed height; 1/2 in. reach.	6
913	43-5445.030.061	962	R-14161-M115	----------	RIVET: brass; semitubular; brake band; flat hd; No. 3-6 (IMO 50).	12
913	43-5445.040.061	----------	----------	----------	RIVET: brass; semitubular; brake band; flat hd; No. 4-6 (IMO 50).	20
913	43-6247.040.201	----------	----------		RIVET: steel; countersunk; 78-deg; flat hd; 3/8 x 2 in ----------	1
913	43-6300.040.200	----------	----------	010-4288	RIVET: steel; fiat hd; 3/8 x 2 in ----------	1
913	43-6792.030.050	----------	----------	----------	SCREW: cap, steel; NC; hex hd; heat treated; 1/4 in. dia, 1/2 in. long; 20 threads per in.	3
913	43-6792.030.060	617	X-3056	----------	SCREW, cap: steel; NC; hex hd; heat treated; 1/4 in. dia, 5/8 in. long; 20 threads per in.	10

913	43-6792.030.130	----------	----------	496-8396	SCREW, cap: steel; NC; hex hd; beat treated; 1/4 in. dia, 1 1/4 in. long; 20 threads per in.	38
913	43-6792.035.050	617	X-3236	----------	SCREW, cap: steel; NC; hex hd; heat treated; 5/16 in. dia, 1/2 in. long; 18 threads per in.	2
913	43-6792. 035. 130	617	X-3232	----------	SCREW, cap: steel; NC; hex hd; heat treated; 5/16 in. dia, 1 ¼ in. long; 18 threads per in. (IMO 25).	1
913	43-6792. 035. 200	----------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 5/16 in. dia, 2 in. long; 18 threads per in. (IMO 25).	12
913	43-6792. 040. 070	617	XL194	----------	SCREW, cap: steel; NC; hex hd; heat treated; 3/8 in. dia, 3/4 in. long; 16 threads per in.	1
913	43-6792. 040. 100	617	B2B-111	----------	SCREW, cap: steel; NC; hex hd; heat treated; 3/8 in. dia, 1 in. long; 16 threads per in. (IMO 5).	2
913	43-6792.040.110	617	X-3295	----------	SCREW, cap: steel; NC; hex hd; heat treated; 3/8 in. dia, 1 1/8 in. long; 16 threads per in.	57
		962	M-264	----------	SCREW (Supplied under Stock No. 913 43-6792.040.110)----------	--------
913	43-6792. 040. 130	---------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 3/8 in. dia, 1 1/4 in. long; 16 threads per in.	4
913	43-6792. 040. 140	---------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 3/8 in. dia, 1 3/8 in. long; 16 threads per in.	2
913	43-6792. 040. 150	---------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 3/8 in. dia, 1 1/2 in. long; 16 threads per in. (IMO 5).	6
913	43-6834. 040. 170	962	R14161-M945	----------	SCREW, cap: steel; NC; hex hd; heat treated; 3/8 in. dia, 1 3/4 in. long; 24 threads per in.	2
913	43-6792. 040. 200	617	X-3299	----------	SCREW, cap: steel; NC; hex hd; heat treated; 3/8 in. dia, 2 in. long; 16 threads per in.	4
913	43-6792. 045. 110	617	D600B-221	----------	SCREW, cap: steel; NC; hex hd; heat treated; M6 in. dia, 1 1/8 in. long; 14 threads per in.	1
913	43-6792. 045. 130	617	X-3362	----------	SCREW, cap: steel; NC; hex hd; heat treated; 7/16 in. dia, 1 ¼ in. long; 14 threads per in.	4
913	43-6792. 045. 150	617	X-3368	----------	SCREW, cap: steel; NC; hex hd; heat treated; No in. dia, 1 1/2 in. long; 14 threads per in.	1

Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
Code No.	Part No.	Code No.	Part No.			
913	43-6792. 050. 070	----------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 1/2 in. dia, 3/4 in. long; 13 threads per in.	13
913	43-6792. 050. 100	----------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 1/2 in. dia, 1 in. long; 13 threads per in. (IMO 5).	1
913	43-6792. 050. 140	----------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 1/2 in. dia, 1 3/8 in. long; 13 threads per in.	2
913	43-6792. 050. 150	617	X-2986	----------	SCREW, cap: steel; NC; hex hd; heat treated; 1/2 in. dia, 1I in. long; 13 threads per in.	7
913	43-6792. 050. 200	----------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 1/2 in. dia, 2 in. long; 13 threads per in.	6
913	43-6792. 050. 270	----------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 1/2 in. dia, 2y% in. long; 13 threads per in.	4
913	43-6792. 060. 170	------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 5/8 in. dia, 1 3/4 in. long; 11 threads per in.	2
913	43-6792. 060. 200	----------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 5/8 in. dia, 2 in. long; 11 threads per in.	19
913	43-6792. 060. 230	----------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 5/8 in. dia, 2 1/4 in. long; 11 threads per in.	12
913	43-6792. 060. 270	----------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 5/8 in. dia, 2 3/4 in. long; 11 threads per in.	4
913	43-6792. 070. 250	----------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 3/4 in. dia, 2 1/2 in. long; 10 threads per in.	2
913	43-6792. 070. 300	----------	----------	----------	SCREW, cap: steel; NC; hex hd; heat treated; 3/4 in. dia, 3 in. long; 10 threads per in.	2
913	43-6792. 080. 350	962	R-27081	----------	SCREW, cap: steel; NC; hex hd; heat treated; 7/8 in. dia, 3 1/2 in. long; 9 threads per in.	4

913	43-6792. 080. 650	---------	----------		SCREW, cap: steel; NC; hex hd; heat treated; 7/8 in. dia, 6 1/2 in. long; 9 threads per in.	2
913	43-6777. 030. 065	617	X-3105	----------	SCREW, cap: steel; NC; hex hd; NS 42S5, class 2, free fit; 1/4 in. dia, 1’ in. long; 20 threads per in.	2
913	43-6777.035.070	617	X-3182	----------	SCREW, cap: steel; NC; hex hd; NS 42S5, class 2, free fit; 5/16 in. dia, 3/4 in. long; 18 threads per in. (IMO 100).	1
913	43-6777.040.060	617	6AB-107	----------	SCREW, cap: steel; NC; hex hd; NS 42S5, class 2, free fit; 3/8 in. dia, 5/8 in. long; 16 threads per in.	2
913	43-6777.040.100	962	M-1	----------	SCREW, cap: steel; NC; hex hd; NS 42S5, class 2, free fit; 3/8 in. dia, 1 in. long; 16 threads per in. (IMO 100).	19
913	43-685.060.030	962	R-29182-1333	011-3231	SCREW, drive: steel; FS FF-S-107; style 1P; rd hd; gage No. 6, 1/4 in. long (IMO 50).	2
913	43-6850.140.070	---------	----------	014-5397	SCREW, drive: steel; Type U; Parker-Kalon or equal; rd hd; gage No. 14; 3/4 in. long.	4
913	43-7290.080.050	617	X-3033-B	010-0712	SCREW, machine: FS FF-S-91; steel; NC; oval fillister hd; bright; size No. 8, 1/2 in. long; 32 threads per in.	2
913	43-7292.120.070	699	T11S12-12	013-2198	SCREW, machine: FS FF-S-91; steel; NC; oval fillister hd; cadmium plated; size No. 12, 3/4 in. long; 24 threads per in.	8.
913	7429.060.030	699	T15B6-4	013-2688	SCREW, machine: FS FF-S-91; steel; NC; rd hd; cadmiu m plated; size No. 6, 1/4 in. long; 32 threads per in.	4
913	43-7429.060.050	623	1914859	013-2705	SCREW, machine: FS FF-S-91; steel; NC; rd hd; cadmium plated; size No. 6, 1/2 in. long; 32 threads per in.	4
913	43-7429.080.040	623	132695	431-4832	SCREW, machine: FS FF-91; steel; NC; rd hd; cadmium plated; size No. 8, 3/8 in. long; 32 threads per in.	2
913	43-7506.080.060	699	T1S8-10	022-5456	SCREW, machine: FS FF-S-91; steel; NF; oval fillister bd; bright; size No. 8. 5/8 in. long; 36 threads per in.	2
913	43-7506.100.070	617	X-3009	010-0662	SCREW, machine: FS FF-S-91; steel; NF; oval fillister hd; bright; size No. 10, 3/4 in. long; 32 threads per in.	1
913	43-7948.050.070	962	M266	----------	SCREW, set: FS FF-S-103; steel; NC; Allen hd; Type III; dog point, style 5; single; 1/2 in. dia, 3/4 in. long; 13 threads per in.	1

Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
Code No.	Part No.	Code No.	Part No.			
913	43-8046.040.100	962	M-396	010-2896	SCREW, set: FS FF-S103; steel; NC; sq hd; Type I; cup point, style 4; single; 3/8 in. dia, 1 in. long; 16 threads per in.	2
913	43-8046.050.170	---	---	011-0453	SCREW, set: FS FF-S-103; steel; NC; sq hd; Type I; cup point, style 4; single; 1/2 in. dia, 1 3/4 in. long; 13 threads per in.	1
913	43-8046.070.250	---	---	013-7665	SCREW, set: FS FF-S-103; steel; NC; sq hd; Type I; cup point, style 4; single; 3/4 in. dia, 2 1/2 in. long; 10 threads per in.	1
GE	45-7670.040.405	---	---	---	TEE, pipe: malleable iron; 150 lb pressure; reducing; threaded; FS WW-P-521; galvanized; 3/8 x 3/8 x 1/2 in.	1
GE	45-7670.040.407	---	---	---	TEE, pipe: malleable iron; 150 lb pressure; reducing; threaded; FS WW-P-521; galvanized; 3/8 x 3/8 x 3/4 in.	
914	45-7725.500.007	---	---	---	TEE, pipe: malleable iron; 150 lb pressure; straight; threaded; FS WW-P-521; black; Type I; 3/4 in.	2
914	45-7725.500.001	---	---	---	TEE, pipe: malleable iron; 150 lb pressure; straight; threaded; FS WW-P-521; black; 1/8 in.	1
910	17-8978.200.200	617	HW300-24	---	TERMINAL, cable: distributor; solderless; 7 mm; clip-type-_	1
910	17-9004.700.200	617	HW300-24	---	TERMINAL, cable: spark plug; open ferrule; solderless; 7 mm; snap-type.	1
913	43-9160.450.061	---	---	---	WASHER: cast iron; sq; beveled; black; bolt size 5/8 in., 1 1/2 in. od, light end %2 in. thick, heavy end 13/32 in. thick.	7
913	43-9840.500.030	617	X-1373	---	WASHER: cold rolled steel; SAE; rd; cut; bright; single; bolt size 1/4 in.; 5/8 in. od, 1/6 in. thick (IMO 100).	21
913	43-9840.500.036	---	---	010-3340	WASHER: cold rolled steel; SAE; rd; cut; bright; single; bolt size 5/16 in.; 11/16 in. od, 1/16,, in. thick (IMO 100).	8
913	43-9840.500.041	617	X-1375	010-3341	WASHER: cold rolled steel; SAE; rd; cut; bright; single; bolt size 3/8 in.; 13/16 in. od, 1/16 in. thick.	2

913	43-9840.500.100	962	24-5277	010-3348	WASHER: cold rolled steel; SAE; rd; cut; bright; single; bolt size 1 in.; 2 in. od, 1/8 in. thick.	1
913	43-9350.500.081	699	T45-8	011-5544	WASHER, lock: high carbon steel; Shake proof; internal teeth; standard screw and bolt; bright; size No. 8.	2
913	43-9351.500.036	617	X-297-A	011-5548	WASHER, lock: high carbon steel; Shakeproof; internal teeth; standard screw and bolt; bright; 5/16 in. (IMO 100).	7
913	43-9351.500.041	617	X-297	011-5549	WASHER, lock: high carbon steel; Shakeproof; internal teeth; standard screw and bolt; bright; 3/8 in.	8
913	43-9405.500.036	----------	----------	----------	WASHER, lock: spring steel; regular; heavy weigh t; SAE; black; 5/16 in.	9
913	43-9405.500.046	617	X-204	----------	WASHER, lock: spring steel; regular; heavy weight; SAE; black; 7/16, in.	6
913	43-9405.500.068	962	M-87	----------	WASHER, lock: spring steel; regular; heavy weight; SAE; black; 3/4 in.	1
913	43-9532.500.061	699	T43-6	010-6495	WASHER, lock: spring steel; regular; std wt; SAE; bright; size No. 6.	4
913	43-9533.500.031	617	X-201	010-3319	WASHER, lock: spring steel; regular; std wt; SAE; bright; 1/4 in.	38
-----	-----	699	T41-12	----------	WASHER (Supplied under Stock No. 913 43-9533.500.031) ----------	
913	43-9533.500.033	617	X-202B	010-3320	WASHER, lock: spring steel; regular; std wt; SAE; bright; 5/16 in.	17
913	43-9533.500.041	962	M-83	010-3321	WASHER, lock: spring steel; regular; std wt; SAE; bright; 3/8 in.	105
617	X-203	----------			WASHER (Supplied under Stock No. 913 43-9533.500.041)----------	
913	43-9533.500.044	617	X-270	010-3322	WASHER, lock: spring steel; regular; std wt; SAE; bright; 7/16 in. (IMO 25).	3
913	43-9533.500.051	----------	----------	010-3323	WASHER, lock: spring steel; regular; std wt; SAE; bright; 31/2 in. (IMO 25).	11
913	43-9533. 500. 061	----------	----------	010-3325	WASHER, lock: spring steel; regular; std wt; SAE; bright; 5/8 in. (IMO 25).	30

Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
Code No.	Part No.	Code No.	Part No.			
913	43-9533. 500. 071	----------	----------	010-3326	WASHER, lock: spring steel; regular; std wt; SAE; bright; 3/4 in.	4
913	43-9533. 500. 081	962	M-88	010-3327	WASHER, lock: spring steel; regular; std wt; SAE; bright; 7/8 in. (IMO 5).	4
913	43-9215. 500. 061	----------	----------	187-5349	WASHER: wrought iron; rd; std; bright; single; JAN-W-1085, Type A; bolt size 5/8 in.; 1 3/4 in. od, 9/64 in. thick.	

BULK MATERIAL

910	15-2537. 070. 380	----------	----------	245-9739	CABLE, ignition: rubber insulated; rubber covered; oil and heat resisting; No. 16 AWG; 19 x 29 stranding; 7 mm (FT). (CABLE, Part Nos 14CA617, 15CA617, 16CA617, 17CA617, 18CA617 and 19CA617, will be supported by Stock No. 910 15-2537.070.380).	------
912	42-3140. 050. 005	----------	----------	----------	CHAIN, sash: weldless brass; 0.062 in. metal thickness; FS RR-C-271; Type B; class 3 (FT). (CHAIN, Part No. 52CA962, will be supported by Stock No. 912 42-3140.050.005).	------
910	33-5490. 100. 000	----------	----------	----------	HOSE, pneumatic: braided; FS ZZ-H-496; w/o couplings; 1 in. dia (FT). (HOSE, Part No. 51CA962, will be supported by Stock No. 910 33-5490.100.000).	..-.---
910	33-5490. 130. 000	----------	----------	----------	HOSE, pneumatic: braided; FS ZZ-H-496; w/o couplings; 1 1/4 in. dia (FT). (HOSE, Part Nos 44CA962 and 45CA962 will be supported by Stock No. 910 33-5490.130.000).	

ORD	H007-0100180	----------	----------	----------	HOSE, radiator: rubber; 1 in. id; 3 ply; 3 ft long. (HOSE, Part No. R-16935 will be supported by Stock No. ORD H007-0100180).	------
ORD	H007-0100160	----------	----------	----------	HOSE, radiator: rubber; 1 1/4 in. id; 3 ply; 3 ft long. (HOSE, Part No. 39CA962, will be supported by Stock No. ORD H007-0100160).	------
ORD	H007-0100170	----------	----------	----------	HOSE, radiator: rubber; 1 1/2 in. id; 3 ply; 3 ft long. (HOSE, Part Nos 40CA962 and 41CA962, will be supported by Stock No. ORD H007-0100170).	------
ORD	H007-0100300	----------	----------	----------	HOSE, radiator: rubber; 2 1/4 in. id; 5 ply; 9 in. long. (HOSE, Part No. 4479-A will be supported by Stock No. ORD H007-0100300).	------
910	33-8109.101.360	----------	----------	----------	PACKING, sheet: Vellumoid; FS HH-P-96L 1/64 in. thick, 36 in. wide, 75 ft long (SH). (GASKET, Part No. 17EL-204, will be supported by Stock No. 910 33-8109.101.360 for field fabrication).	------
910	33-8109.102.360	----------	----------	223-2670	PACKING, sheet: Vellumoid; FS HH-P-96; 1/32 in. thick, 36 in. wide, 75 ft long (SH). (GASKET, Part Nos C400K-215, F400K-340, F400S-202, will be supported by Stock No. 910 33-8109.102.360 for field fabrication).	------
910	33-8344.500.050	----------	----------	187-4166	PACKING, wick and rope: asbestos; FS HH-P-41; 1/2 in.; wick packing (LB). (PACKING, Part No. 49CA962, will be supported by Stock No. 910 33-8344.500.050).	------
914	44-8094.030.035	----------	----------	----------	TUBING: copper; seamless; Type N; annealed; for fuel and lubrication tubes; for solder-joints or flared-tube fittings; 1/4 in. nominal size; 0.250 in. actual od; 0.035 in. wall thickness; FS WW-T-799 (FT). (TUBING, Stock No. 50CA962, will be supported by Stock No. 44-8094.030.035).	------

Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
Code No.	Part No.	Code No.	Part No.			
910	22-8011.500.380	----------		198-9105	WIRE: steel; carbon; annealed; bare; FS QQ-W-461; form I finish I; grade FS 1045; 0.0625 in. dia; 5 lb reel (RL). (LOCK WIRE, Part Nos 6SH-100, 46CA962, 47CA962 and X-133B, will be supported by Stock No. 910 22-8011.500.380).	-------

PARTS PECULIAR WITH MORE THAN ONE APPLICATION

962	D6899	962	D-6899	447-3521	BALL, valve lever----------	4
962	R15901	962	R-15901	----------	CLAMP, pipe ----------	6
806	1610B	962	CLDX6	----------	FITTING, lubrication ----------	6
806	1688B	962	CLDX8	----------	FITTING, lubrication----------	4
962	M705	962	M705	----------	PLUG, pipe----------	9
962	M802	962	M802	----------	PLUG, pipe ----------	3
226	237116	962	R-11076	179-0990	SEAL, plain encased ----------	2

Section II. REPLACEABLE PARTS LIST

Figure No.	Index No.	Corps of Engineers stock No. Code No.	Corps of Engineers stock No. Part No.	Manufacturer's part No. Code No.	Manufacturer's part No. Part No.	Federal supply class and item identification No.	Description	Quantity per unit
18	1	---	---	699	F7X154	---	COVER, fuel filter, with elbow	1
18	3	---	---	699	F1X122	---	GASKET, fuel filter cover	1
18	4	---	---	699	F2X3T5	---	STRAINER, fuel filter	1
18	5	---	---	699	F8X12	---	BOWL, fuel filter	1
18	7	---	---	699	F10x2	---	CLAMP, fuel filter, with thumb nut	1
19	---	789	S60	617	Y112F-201		AIR CLEANER, carburetor, assembly	1
19	3	962	RH32241	962	RH-32241		BRACKET, mounting, air cleaner	1
19	4	789	6095	617	Y112F-202		BRACKET, saddle, with screws and nuts.	1
19	10	789	34	617	F226F-212	---	ELBOW, clamping, with screw and nut	1
19	13	962	4479A	962	4479A	---	HOSE, air cleaner, 2 in. long (See Stock No. ORD H007-0100300).	1
19	16	789	6111	789	6111	---	BODY, air cleaner	1
19	17	789	6028	789	6028	---	CHAMBER, vortex	1
19	18	789	6125	789	6125	---	CUP, air cleaner	1
19	18	789	6123	789	6123	---	CUP, assembly (includes vortex chamber)	1
24	3	---	---	962	RH-36574	---	TRANSMITTER, fuel tank gage	1
24	4	---	---	962	R-11305	---	CAP, fuel tank	1
24	5	962	RH34956	962	RH-34956		STRAINER, fuel tank	1
24	6			962	RSAG-35958		TANK, fuel	1
24	7	---	---	962	R-29247	---	NIPPLE, pipe	3
24	8	---	---	962	R-28424	---	BUSHING, reducing	2
24	10	---	---	962	R-14764	---	VALVE, fuel tank shut-off	2

Figure No.	Index No.	Corps of Engineers stock No. Code No.	Corps of Engineers stock No. Part No.	Manufacturer's part No. Code No.	Manufacturer's part No. Part No.	Federal supply class and item identification No.	Description	Quantity per unit
24	13	--	---------- ----------	962	R-36216-1	----------	LINE, fuel	1
24	15	--	---------- ----------	962	RSAH-36078	----------	STRAP, fuel tank	2
24	18	--	---------- ----------	962	D-32368	----------	GASKET, fuel tank gage transmitter	1
36	2	---	---------- ----------		SP205-BR8S	----------	PLUG, spark: shielded, industrial; integral resistor; normal; Auto Lite Resistor BR8S or equal; 18 mm thread size; 1 in. hex size; 3 in. installed height; X in. reach.	6
36	3			2042			SPRING, contact: spark plug to ignition cable; with housing.	6
36	4-5			3129			ELBOW, adaptor: spark plug, with nut.	6
36	6						CABLE, ignition: rubber insulated; rubber covered; oil and heat resisting; No. 16 AWG; 19 x 29 stranding; 7 mm (See Stock No. 15-2537. 070.380).	
							CABLE, ignition: rubber insulated; rubber covered; oil and heat resisting; No. 16 AWG; 19 x 29 stranding; 7 mm; for No. 1 cylinder; 21 in. long.	1
							CABLE, ignition: rubber insulated; rubber covered; oil and heat resisting; No. 16AWG; 19 x 29 stranding; 7 mm; for No. 2 cylinder; 265/8 in. long.	1

							CABLE, ignition: rubber insulated; rubber covered; oil an heat resisting; No. 16AWG; 19 x 29 stranding; 7 mm; for No. 3 cylinder; 30 in. long.
36		6					CABLE, ignition: rubber insulated; rubber covered; oil and heat resisting; No. 16AWG; 19 x 29 stranding; 7mm; for No. 4 cylinder; 32 in. long.
							CABLE, ignition: rubber insulated; rubber covered; oil and heat resisting; No. 16 AWG; 19 x 29 stranding; 7mm; for No. 5 cylinder; 35 1/2 in. long.
							CABLE, ignition; rubber insulated; rubber covered; oil and heat resisting; No. 16 AWG; 19 x 29 stranding; 7mm; for No. 6 cylinder; 41 5/8 in. long.
36		7		617	RW329-20		CABLE, shielded: fungus treated; 7mm, for No. 1 cylinder; 20 in. long; with two soldered sleeves.
				617	RW331-23		CABLE, shielded: fungus treated; 7mm; for No. 2 cylinder; 23 in. long; with two soldered sleeves.
				617	RW330-27		CABLE, shielded: fungus treated; 7mm; for No. 3 cylinder; 27 in. long; with two soldered sleeves.
				617	RW330-29		CABLE, shielded: fungus treated; 7mm; for No. 4 cylinder; 29 in. long; with two soldered sleeves.

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
				617	RW329-34		CABLE, shielded; fungus treated; 7mm; for No. 5 cylinder; 34 in. long; with two soldered sleeves.	1
36	7			617	RW331-38		CABLE, shielded: fungus treated; 7mm; for No. 6 cylinder; 38 in. long; with two soldered sleeves.	1
36	8-9				5604-R1		NUT, shielded cable, to adapter elbow and magneto.	12
36	10				7657		TERMINAL, ignition cable: spark plug; open ferrule; solderless; 7mm; snap type. (See STOCK No. 17-9004.700.200.	6
39		097	F21P2	097	F-21P2		FILTER ASSEMBLY, oil	1
39	1	097	11580	097	11580		SCREW, cover cap	1
39	2	097	11581	097	11581		WASHER, cover cap screw	1
39	3	097	5241	097	5241		COVER ASSEMBLY	1
39	3	097	11559	097	1159		COVER	1
39	4	097	11583	097	11583	253-7257	SPRING, cover, helical compression	1
39	5	097	11582	097	11582		GASKET, oil filter cover	1
39	6	097	C21P2	097	C-21P2	426-2010	FILTER ELEMENT, oil	1
39	7	097	5310	097	5310		BODY, oil filter	1
39	8	097	11563	097	11563		STRAP, clamp	2
39	9	097	12420	097	12420		BOLT, clamp, strap	2
39	12	617	F226I3240	617	F2261-3240		PLATE, adapter, oil filter mounting	1
39	16	097	12384	097	12384		NUT, plain, square, clamp strap bolt	2

Figure No.	Index No.	Corps of Engineers stock No. Code No.	Corps of Engineers stock No. Part No.	Manufacturer's part No. Code No.	Manufacturer's part No. Part No.	Federal supply class and item identification No.	Description	Quantity per unit
39.	17	097	10113	097	10113		WASHER, lock, clamp strap bolt nut----------	2
39	18	097	11584	097	11584		PLUG, drain, oil filter----------	1
39	19	617		617	X-14289		ELBOW, oil filter hose: 90°, SAE,---------- brass, 1/8 in. pipe thread, 7/16 in. dia; 20 threads per in.	2
39	20			617	X-8016-9		HOSE, outlet: flexible, oil ----------	1
39	21			617	X-12393		ELBOW, oil filter hose: 90°, SAE,---------- 1/8 in. pipe thread.	1
39	22			617	X-12166		BUSHING, reducer: pipe; iron; black;---------- headed; FS WW-P-471;1/4 in. to 1/8 in. (See STOCK No. 45-1760. 003.001).	1
39	23			617	X-8016-10		HOSE, inlet: flexible, oil ----------	1
40	1-2	617	D600B402	617	F600B-443		GASKET, oil pan (IM02) ----------	2
40	3	617	D600B305	617	D600B-305		GUARD, bearing oil, rear ----------	1
40	4-5	617	F600B241	617	F600B-241		SEAL, oil, rear crankshaft bearing---------- (IM02).	2
40	6	617	D600B406	617	D600B-406		BLOCK, crankshaft rear bearing filler----------	1
40	8			617	X-3056		SCREW, filler block to flywheel housing:-------- 1/4 in., 20 threads per in., 5/8 in. long.	2
40	9	617	D600B214	617	D6005-214		CORK, filler block to oil pan, rear, ---------- gasket (IM02).	1
40	10	617	X3924	617	X-3924		SCREW, crankshaft bearing filler---------- block, front; 5/16 in., 18 threads per in.,7/8 in. long.	2
40	12	617	D600B340	617	D600B-340		BLOCK, crankshaft front bearing---------- filler.	1
40	13	617	D600B214	617	D600B-214		CORK, filler block to oil pan, front, ---------- gasket (IM02).	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
40	14	617	22RB221	617	22RB-221		PLUG, oil pan: drain; machine; magnetic.	1
40	15	617	W4B108	617	W4B-108	250-5807	GASKET, oil pan drain plug (IM05)_	1
40	16	617	D600B4012	617	D600B-4012		PAN ASSEMBLY, oil	1
40	17	617	X3896	617	X-3896 422-9628		SCREW, assembly, oil pan, w/washer (IM020) (See Stock Nos. 913 43-6777.035.070 and 913 43-9405.500.-035).	18
40	17			617	X-3182		SCREW, oil pan (See Stock No. 913 18 43-6777.035.070).	
40	19	617	X2958	617	X-2958		SCREW, filler block to crankcase, 2 rear, 5/16 in. dia, 7/8 in. long, 18 threads per in.	
44	1	962	R11305	962	R-11305		CAP, radiator filler	1
44	5	962	RH32017	962	RH-32017	-	ADAPTER, inlet, radiator	1
44	6	962	25-8193	962	25-8193	447-3586	GASKET, radiator inlet and outlet	2
44	8	962	RSAB31915	962	RSAB-31915		TANK ASSEMBLY, top	1
44	9	962	R11371	962	R-11371	430-9419	GASKET, top tank	1
44	10	962	RSA31823	962	RSA-31823	-	SPACER, radiator	4
44	11	962	R11113	962	R-11113		STEEL STRIP, header	4
44	12	962	RSA31821	962	RSA-31821		PLATE, radiator, right-hand	1
44	13	962	RG30727	962	RG-30727		CORE, radiator	1
44	14	962	R11372	962	R-11372	430-9420	GASKET, bottom tank	1
44	16	962	RH32018	962	RH-32018		ELBOW, outlet, radiator	1
44	17	962	R11950	962	R-11950		TANK, bottom	1
44	18	962	RSA31822	962	RSA-31822		PLATE, radiator, left-hand	1

44	19	962	RSA11420	962	RSA-11420		PIPE, radiator overflow ----------	1
44	20	896	W49X4	962	R-10036		ELBOW, male ----------	1
		962	RSA32069	962	RSA-32069		RADIATOR ASSEMBLY ----------	1
46		617	F226E5014	617	F226E-56014		MANIFOLD ASSEMBLY, intake and ---------- exhaust.	1
46	1	617	F226E501	617	F226E-501		MANIFOLD, exhaust ----------	1
46	2	617	F600E306	617	F600E-306		GASKET, exhaust and intake mani---------- fold to cylinder block.	1
46	3	617	X18278	617	X-18278		NUT, plain, hexagon (IM05) ----------	4
46	4	617	UB110	617	UB-110		WASHER, flat (IM020) ----------	4
46	5	617	X19006	617	X-19006		STUD, exhaust and intake manifold to---------- cylinder block.	3
46		617	X4266	617	X-4266		STUD, exhaust and intake manifold to ---------- cylinder block.	8
46	6	617	X1375	617	X-13756		WASHER, plain, end studs ----------	2
46	7	617	X18278	617	X-18278		NUT, cylinder block stud, plain, hexa-- ---------- gon (IM05).	11
46	8	617	F600E212	617	F600E-212		GASKET (IM010), exhaust to intake ---------- manifold.	1
46	9	617	X4275	617	X-4275		STUD, exhaust to intake manifold - ----------	4
46	10	617	F244F400	617	F244F-400		MANIFOLD, intake ----------	1
46	11	617	X100	617	X-100		PLUG, pipe,1/8 in. exten. head----------	1
46		617	X110	617	X-110		PLUG, pipe,3/8 in., countersunk ----------	1
46	12	617	16SE203	617	16SE-203		CLAMP, bridge (IM010) ----------	6
46	13	617	X14141	617	X-14141	188-4234	WASHER, flat (IM010) ----------	3
46	14	617	F600G200	617	F600G-200		BUSHING, exhaust manifold heat ---------- control valve (IM010).	2
46	15	617	F600E208	617	F600E-208		VALVE, heat control (IM05) ----------	1
46	16	617	F600E213	617	F600E-213		SHAFT, exhaust manifold heat control ---------- valve.	1
46	17	617	F600E210	617	F600E-210		WEIGHT, heat control valve ----------	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
46	18	617	X3009	617	X-3009		SCREW, heat control valve weight clamp.	1
46	19	617	X19871	617	X-19871		STUD, heat control valve weight to manifold.	1
46	20	617	A70K222	617	A70K-222		WASHER, stud nut, heat control valve.	1
46	21	617	X1800C	617	X-1800-C		NUT, heat control valve stud	1
46	22	617	F600E211	617	F600E-211	-	KEY, exhaust manifold heat control valve weight.	1
46	23	617	X1896	617	X-1896		NUT, heat control valve weight clamp screw.	1
47		962	RSAB32352	962	RSAB-32352		MUFFLER ASSEMBLY	1
47	1	962	R28351	962	R-138351		NIPPLE, pipe	1
47	4	962	RD32356	962	RD-32356		PIPE, exhaust	1
47	5	962	R28349	962	R-28349		CAP, pipe	1
47	6	962	49CA962				PACKING: 3 in dia, 73 in. long (See Stock No. 910 33-8344.500.050).	1
47	8, 9, 10, 12	962	RSA28346	962	RSA-28346		MUFFLER, model "CX" with 2i in. 1 pipe tap.	
47	16	962	R28348	962	R-28348		BRACKET, mounting, right-hand	1
47	19	962	R28347	962	R-28347		BRACKET, mounting, left-hand	1
48	1	617	F600M2160	617	F600M-2160		SHAFT ASSEMBLY, hour meter or I distributor drive.	
48	2	617	X1802G	617	X-1802-G		NUT, hour meter adapter stud	1
48	3	617	X203	617	X-203		WASHER, lock:3/8 in. dia, hour meter adapter stud.	1

48	4	617	F600M206	617	F600M-206		ADAPTER, hour meter ----------	1
48	5	617	X19003	617	X-19003		STUD, hour meter adapter ----------	1
48	6	617	X1O1B	617	X-101-B		PLUG, pipe: cylinder head thermom- ---------- eter hole.	1
48	7	617	F224A400	617	F224A-400		HEAD, cylinder ----------	1
48	8	617	C400K215	617	C400K-215		GASKET, cylinder water outlet elbow ---------- to head.	1
48	9	617	RH32018	617	RH-32018		ELBOW, cylinder water outlet ----------	1
48	10	617	X1801E	617	X-1801-E		NUT, cylinder water outlet elbow stud ----------	2
48	11	617	X101	617	X-101		PLUG, pipe: 1/4 in. ext head; cylinder ---------- water outlet elbow.	1
48	12	617	X202	617	X-202		WASHER, lock: cylinder water outlet ---------- elbow stud.	2
48	13	617	X4106	617	X-4106		STUD, cylinder water outlet elbow to ---------- head.	2
48	14	617	D600L2270	617	D600L-2270		CAP ASSEMBLY, oil filler ----------	1
48	15	617	X12210	617	X-12210		NIPPLE, close, oil filler ----------	1
48	16	617	F600A281	617	F600A-281		GASKET, cylinder head ----------	1
48	17	617	D600L2170	617	D600L-2170		GAGE ASSEMBLY, oil ----------	1
48		617	D600L217	617	D600L-217		ROD, oil gage ----------	1
48		617	K404L209	617	K404L-209		COVER, oil gage rod ----------	1
48	18	617	K404L210	617	K404L-210		FELT, washer: oil gage ----------	1
48	19	617	X1015	617	X-1015		COCK, drain, cylinder water ----------	1
48	20	617	10EL227	617	10EL-227		SUPPORT, oil gage rod ----------	1
48	21	617	F244A600	617	F244A-600		CYLINDER AND CRANKCASE ----------	1
48	22	617	8TC200	617	8TC-200		RING, dowel ----------	1
48	23	617	X137A	617	X-137-A		PLUG, pipe ----------	1
48	24	617	D600B203	617	D600B-203		RING, dowel ----------	1
48	25	617	6AB107	617	6AB-107		SCREW, flywheel pointer cover to ---------- housing.	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
48	26	617	X203	617	X-203		WASHER, lock: flywheel pointer cover to housing screw.	1
48	27	617	8FC205	617	8FC-205		COVER, flywheel pointer	1
48	28	617	F400C208	617	F400C-208		FELT, flywheel pointer cover	1
48	29	617	F600B412	617	F600B-412		HOUSING, flywheel	1
48	30	617	X204	617	X-204		WASHER, lock: flywheel housing to crankcase screw.	5
48	31	617	C400B226	617	C400B-226		SCREW, dowel: flywheel housing to crankcase.	2
48	32	617	X3362	617	X-3362		SCREW, flywheel housing to crankcase	3
48	33	617	W10B302	617	W10OB-302		COVER, starter hole	1
48	34	617	X203	617	X-203		WASHER, lock: starter hole cover screw.	3
48	35	617	6AB107	617	6AB-107		SCREW, starter hole cover	3
48	36	617	3XUB110	617	3X-UB-110		WASHER, plain: cylinder head to cylinder screw.	31
48	37	617	X3963	617	X-3963		SCREW, cylinder head to cylinder	32
50	1	617	8FA208	617	8FA-208		NUT, valve chamber cover to stud	3
50	2	617	X334	617	X-334		GASKET, valve chamber cover to stud_	3
50	3	617	F600A369	617	F600A-369		GASKET, valve chamber cover to crankcase.	1
50	4	617	X1915	617	X-1915		STUD, valve chamber cover, ends	2
50	5	617	X1801E	617	X-1801-E		NUT, fuel pump hole cover stud	2
50	6	617	X202	617	X-202		WASHER, lock, cover stud	2
50	7	617	X1952	617	X-1952		STUD, fuel pump hole cover to crank-case.	2

50	8	617	16EB202	617	16EB-202		COVER, fuel pump hole----------	1
50	9	617	16EV201	617	16EV-201		GASKET, fuel pump hole cover to crankcase.----------	1
50	10	617	X4016	617	X-4016		STUD, valve chamber cover, center -.----------	1
50	11	617	F600A3670	617	F600A-3670		COVER, valve chamber ----------	1
53	1	617	F6001I261	617	F6001-261		VALVE, exhaust, rotostellite ----------	6
53	2	617	F140A212	617	F140A-212		INSERT, exhaust valve seat ----------	6
53	3	617	F400I213	617	F4001-213		GUIDE, valve stem ----------	12
53	4	617	Y400I215	617	F400I-215		SPRING, valve, helical, compression----------	12
53	5	617	Z12013000	617	Z1201-3000		RETAINER, exhaust valve spring ----------	6
53	6	617	Z120I1235	617	Z1201-235		KEY, lock, exhaust valve spring retainer.----------	12
53	7	617	Y400I213	617	Y400I-213		SCREW, valve tappet adjusting (IM010).	12
53	8	617	Y400I212	617	Y400I-212		NUT, lock, adjusting screw (IM05)----------	12
53	9	617	Y400I211	617	Y400I-211		TAPPET, valve ----------	12
53		617	Y400I2110	617	Y400I-2110		TAPPET ASSEMBLY, valve ----------	12
53	10	617	F600I229	617	F6001-229		VALVE, intake----------	6
53	11	617	F4001205	617	F400I-205		PIN, lock, valve spring retainer ----------	6
53	12	617	F400I202	617	F400I-202		RETAINER, intake valve spring ----------	6
57	1	962	RH31532	962	RH-31532		ARM, master lever shaft ----------	1
57	2	962	R17565	962	R-17565		YOKE, master clutch rod ----------	2
57	5	962	RH31838	962	RH-31838		ROD, master clutch ----------	1
57	6	962	RSAH31542	962	RSAH-31542		ARM, master clutch ----------	1
59	1	962	RB31448	962	RB-31448		ARM, forward and reverse clutch shifting.----------	1
59	3	962	R17565	962	R-17565		YOKE----------	4
59	5	962	RD31835	962	RD-31835		ROD, long----------	1
59	8	962	RD31834	962	RD-31834		ROD, short----------	1
59	9	962	RSAH31542	962	RSAH-31542		ARM, lever shaft ----------	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
60	1	962	RH31438	962	RH-31438		SHAFT, forward and reverse clutch shift.	1
60	5	092	117C10	962	R-29182-C-390-117-C10		COLLAR, cone	1
60	6	092	118	962	R-29182-C-390-118		BOLT, cone collar	2
60	7	092	1294	962	R-29182-C-390-1294	447-8860	SHIM, cone collar	2
60	8	092	1180	962	R-29182-C-390 1180		NUT, cone collar bolt	2
60	9			962	R-29182-C-390-105		PIN, cotter	2
62	1	962	RB31801	962	RB-31801		ARM, gear shaft	1
62	2	962	R17565	962	R-17565		YOKE	2
62	5	962	RH31839	962	RH-31839		ROD, shifting	1
63	1	962	RSA32065	962	RSA-32065 -	-	BRACKET, brake pedal (welded as-sembly).	1
63	3	962	H24183	962	H-24183		RATCHET, brake	1
63	5	962	RH32191	962	RH-32191		PEDAL, brake	2
63	7	962	R17565	962	R-17565		YOKE	4
63	9	962	RD32296	962	RD-32296		ROD, brake	2
63	10	962	D552	962	D-552		SPRING, return	1
63	11	962	RD32174	962	RD-32174		CLIP, spring	1
63	12	962	RSAH32195	962	RSAH-32195		ARM, brake, right	1
63	13	962	RH32189	962	RH-32189		BEARING, brake shaft	2
63	17	962	RD32172	962	RD-32172		BRACKET, brake shaft	4

63	18	962	RD32199	962	RD-32199	SHAFT, brake control	1
63	19	962	RSAH32196	962	RSAH-32196	ARM, brake, left	1
63	21	962	RD32186	962	RD-32186	PIN, swivel, headless	2
63	23	962	R10353	962	R-10353	YOKE, adjusting rod	2
63	25	962	D30637	962	D-30637	ROD, adjusting	1
63	26	962	RSA31689	962	RSA-31689	ARM, brake	1
63	29	962	D24171	962	D-24171	PIN, brake ratchet	1
68		962	RSAB31378	962	RSAB-31378	TANK, hydraulic oil, assembly	1
68	1			962	25-8294	CLAMP, hose	6
68	3			962	RB-31376	BODY, hydraulic oil tank (not serviced separately).	1
72	1	962	R11305	962	R-11305	CAP, sprinkler tank	2
72	2	962	RSAG35958	962	RSAG-35958	CAP, fuel tank	1
72	4	962	RD32032	962	RD-32032'	LOCK, door	2
72	8	962	RB31432	962	RB-31432	GUARD, gear	1
72	9	962	RSA31647	962	RSA-31647	DOOR, side housing	1
72	9	962	RSAB31840	962	RSAB-31840	DOORS, side housing	1
72	10			962	RH-31798	HINGE, door	2
72	14			962	RH-31744	HINGE, door	1
72	21	962	25-8502	962	25-8502	HOOK, lifting, left	2
72	21	962	25-8501	962	25-8501	HOOK, lifting, right	2
72	23	962	RSA34959	962	RSA-34959	HOUSING ASSEMBLY, compression roll, w/tanks.	1
72	24	962	RSAB31874	962	RSAB-31874	DOOR, front housing	
72	25					HINGE, front door	1
72	26					PLATE, identification	1
73		962	RSA13066	962	RSA-13066	SEAT ASSEMBLY	1
73	1	962	H6778	962	H-6778	CUSHION, back rest	1
73	5	962	R13068	962	R-13068	BRACKET, back rest	1
73	7	962	R13069	962	R-13069	BRACE, back rest	1
73	8	962	R13071	962	R-13071	BRACE, right hand	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
73	9	962	H6779	962	H-6779		CUSHION, seat	
73	10	962	RSA13067	962	RSA-13067		BASE, seat	1
73	11	962	R13070	962	R-13070		BRACE, left hand	1
73		962	RSAH31407	962	RSAH-31407		POST, seat	1
73		962	RD31408	962	RD-31408		PIN	1
74	1	962	RSAG31809	962	RSAG-31809		COVER, top	1
74	5	962	RSA32065	962	RSA-32065		PLATFORM, operator's	1
74	6	962	RD31419	962	RD-31419		SPACER, platform support	6
74	7	962	RB31399	962	RB-31399		SUPPORT, platform	2
74	8	962	RD31400	962	RD-31400		BRACKET, platform support	4
75	1	962	RSA20333	962	RSA-20333		SCRAPER, steering roll	2
75	6	962	R15306	962	R-15306	447-3565	SPRING, scraper, helical, torsion, left hand.	2
75	9	962	RSA23202	962	RSA-23202		BOLT, machine: steering roll scraper attaching.	2
75	11	962	R15790	962	R-15790		BRACKET, scraper mounting	2
75	13	962	R15305	962	R-15305	447-3564	SPRING, scraper, helical, torsion, right hand.	2
75	14	962	RSA15791	962	RSA-15791		BRACKET, scraper mounting with bolt head stop lug.	2
76	3	962	R15305	962	R-15305	447-3564	SPRING, scraper, right hand, helical, torsion.	2
76	8	962	RSA20294	962	RSA-20294		BOLT, machine: compression roll scraper.	2
76	9	962	R15306	962	R-15306		SPRING, scraper, left hand, helical, torsion.	2

76	10	962	RSA20334	962	RSA-20334		SCRAPER, compression roll	2
78	1	962	R26223	962	R-26223		PIPE, compression roll sprinkler	2
78	3	962	R24135	962	R-24135		ELBOW, street, 3/44 in. drilled for pet cock.	2
78	5	962	R15901	962	R-15901		CLAMP, pipe	4
78	11	962		962	25-8294		CLAMP, hose, adjustable	4
78	12	962	R16935	962	R-16935		HOSE, lin, inside dia, 4 in. long	1
78	16	962	R20587	962	R-20587		NIPPLE, pipe, 3/4 in. dia, 301/2 in. long_	1
79	2	962	R20562	962	R-20562		PIPE, sprinkler: steering roll, galv., 25 in. long.	1
79	5	962	R20561	962	R-20561		PIPE, sprinkler: steering roll, galv., 24 in. long.	1
79	6	962	R15901	962	R-15901		CLAMP, pipe	2
79	7	962	RSA20491	962	RSA-20491		SUPPORT, steering roll sprinkler mat_	1
79	12	962	R20492	962	R-20492		MAT, steering roll sprinkler	1
79		962	RSA30456	962	RSA-30456		STEERING ROLL SPRINKLER AS-SEMBLY; includes the following items: RSA20491 and R20492.	1
80	6	962	R20297	962	R-20297		PLATE, support, compression roll sprinkler mat.	1
80	12	962	R20296	962	R-20296		MAT, compression roll sprinkler.	1
80		962	RSA31894	962	RSA-31894		COMPRESSION ROLL SPRINK-LER ASSEMBLY; includes follow-ing items:	
80		962	RSAD31893	962	RSAD-31893		PIN, sprinkler mat support hinge.	
80		962	R20297	962	R-20297		SUPPORT, compression roll sprinkler mat.	
80		962	R20296	962	R-20296		MAT, compression roll sprinkler.	
82	1	617	X18237	617	X-18237		NUT, flywheel	6
82	2	617	X297	617	X-297		WASHER, lock	6
82	3	617	F226C302	617	F226C-302		FLYWHEEL	1

Figure No.	Index No.	Corps of Engineers stock No. Code No.	Corps of Engineers stock No. Part No.	Manufacturer's part No. Code No.	Manufacturer's part No. Part No.	Federal supply class and item identification No.	Description	Quantity per unit
82	4	617	16CC302	617	16CC-302		GEAR, spur	1
82	5	617	F600G395	617	F600G-395		BEARING, main, rear upper and lower	1
82	6	617	F600G393	617	F600G-393		BEARING, intermediate, rear and front, upper and lower.	2
82	7	617	C600D206	617	C600D-206		BOLT, connecting rod cap	12
82	8	617	F400A350	617	F400A-350		RING, piston oil ..	6
82	9-10	617	A600A333	617	A600A-333		RING, piston, second and third groove_	12
82	11	617	F162A221	617	F162A-221		RING, piston, top groove	6
82	12	617	F162A410	617	F162-A-410		PISTON	6
82	13	617	11EA200	617	llEA-200		PIN, piston	6
82	14	617	X7011	617	X-7011		RING, piston pin retaining	12
82	15	617	F400G211	617	F40(G-211		BEARING, plain, sleeve, piston pin	6
82	16	617	F226D4007	617	F226D-4007		CONNECTING ROD ASSEMBLY, cylinders 1-3-5.	3
82		617	F226D4000	617	F226D-4000		ROD AND CAP, connecting (not serviced separately).	3
82	17	617	F600G389	617	F600G-389		BEARING, connecting rod, cylinder 1-3-5.	6
82	17	617	F600G390	617	F60OG-390		BEARING, connecting rod, cylinders 2-4-6.	6
82	16	617	F226D3001	617	F226D-3001		CONNECTING ROD ASSEMBLY, cylinders 246.	3
82	16	617	F226D3000	617	F226D-3000		ROD AND CAP, connecting (not serviced separately).	3
82	18	617	F600G391	617	F600G-391		BEARING, crankshaft, main, front, upper and lower.	1

82	19	617	F600C6065	617	F600C6065		CRANKSHAFT ASSEMBLY; consisting of:	1
82		617	F600C606	617	F600C -606		CRANKSHAFT, not serviced separately.	1
82		617	15LG202	617	15LG-202		BEARING, plain, sleeve, crankshaft.	1
82	20	617	F600C220	617	F600C-220		WASHER, thrust, crankshaft, front	1
82	21	617	F600C214	617	F600C-214		PLATE, thrust, crankshaft	1
82	22	617	10EC204	617	10EC-204		SHIM, thrust, crankshaft, .002	4
82	23	617	10EC205	617	10EC-205		SHIM, thrust, crankshaft, .008	7
82	24	617	A600C204	617	A600C-204		DEFLECTOR, oil, crankshaft	1
82	25	617	D600H300	617	D600H-300		GEAR, timing, crankshaft	1
82	26	617	X511	617	X-511		KEY, crankshaft timing gear to crankshaft, Woodruff No. 15.	1
82	27	61	A600C204	617	A60C-204		DEFLECTOR, oil, crankshaft	1
82	28	617	D600K232	617	D600K-232		SEAL, fan drive pulley	1
82	29	617	F6000206	617	F600-0-206		JAW starting, crankshaft	1
82	30	617	F6000205	617	F60 0-205		WASHER, crankshaft starting jaw to crankshaft.	1
82	31	617	C400K217	617	C400K-217		PLUG, keyway, fan drive pulley	1
82	32	617	C400K218	617	C400K-218		KEY	1
82	33	617	F140K302	617	F140K-302		PULLEY, fan drive	1
82	34	617	6SH100	617	6SH-100		WIRE, lock, crankshaft bearing cap to cylinder screw, front intermediate, and rear, No. 19 x 10.	3
82	35	617	F226B337	617	F226B337		CAP, bearing, crankshaft, front	1
82	36	617	F600B453	617	F600B-453		CAP, bearing, crankshaft, intermediate front.	1
82	37	617	X607	617	X-607		PIN, collar, connecting rod bolt	12
82	38	617	X18188	617	X-18188		NUT, connecting rod cap bolt	12
82	39	617	F226D4000	617	F226D-4000		CAP AND ROD, connecting, cylinders 1-3-5, not serviced separately.	3

Figure No.	Index No.	Corps of Engineers stock No. Code No.	Corps of Engineers stock No. Part No.	Manufacturer's part No. Code No.	Manufacturer's part No. Part No.	Federal supply class and item identification No.	Description	Quantity per unit
82	39	617	F226D3000	617	F226D-300		CAP AND ROD, connecting, cylinders ---------- 2-4-6, not serviced separately.	3
82	40	617	F600B242	617	F600B-242		DOWEL, crankshaft front bearing cap----------	2
82	41	617	3XB2B110	617	3X-B2B-1i0		WASHER, plain, crankshaft bearing, ---------- cap to cylinder screw.	8
82	42	617	X3511	617	X-3511		SCREW, crankshaft bearing cap to ---------- cylinder, 1/2-13 x 31/4.	2
82	43	617	X1333B	617	X-1333-B		WIRE, lock, crankshaft bearing cap to --------- cylinder screw, rear intermediate, No. 19 x 12.	1
82	44	617	X3555	617	X-3555		SCREW, crankshaft bearing cap to ---------- cylinder, 1/213 x 21/2.	6
82	45	617	F226B334	617	F226B-334		CAP, bearing, crankshaft, intermedi- ---------- ate rear.	1
82	46	617	14HC215	617	14HC-215		RING, dowel, crankshaft bearing cap ---------- to cylinder.	1
82	47	617	F600B336	617	F600B-336		CAP, bearing, crankshaft, rear ..----------	1
82	48	617	F600B247	617	F600B-247		DOWEL ----------	5
82	49	617	C400C206	617	C400C-206		BOLT, crankshaft to flywheel ----------	6
82	50	617	15LG202	617	15LG-202		BEARING, plain, sleeve, crankshaft----------	1
92	1	617	D600B339	617	D600B-339		GASKET, end plate to crankcase ----------	1
92	2	617	X203	617	X-203		WASHER, lock----------	6
92	3	617	NL194	617	NL-194		SCREW, end plate .----------	1
92	4	617	F600B356	617	F600B-356		PLATE, end ----------	1
92	5	617	F600B357	617	F600B-357		GASKET, gear cover to end plate ---------- (IM05).	1

92	6	617	X270	617	X-270		WASHER, plain	2
92	7	617	X1803H	617	X-1803-H		NUT	1
92	8	617	X4200	617	X-4200		STUD	2
92	9	617	X1802G	617	X1802-G		NUT, gear cover to cylinder stud -	2
92	10	617	X3295	617	X-3295		SCREW, gear cover to cylinder and filler block.	3
92	11	617	X3368	617	X-3368		SCREW, gear cover to crankcase, at ring dowel.	1
92	12	226	29924	617	A600L202	154-8864	SEAL, plain, encased	1
92	13	617	X14134	617	X-14134		WASHER, flat, copper (IM020)	2
92	14	617	X3299	617	X-3299		SCREW, gear cover to filler block	3
92	15	617	F600B4163	617	F600B-4163		COVER ASSEMBLY, timing gear, includes cover and oil seal	1
92	15	617	F600B416	617	F600B-416		COVER, timing gear (not serviced separately).	1
92	16	617	D600B221	617	D600B-221		SCREW, dowel, end plate to gear cover.	1
92	17	617	8TC200	617	8TC-200		RING, dowel, gear cover to crankcase	1
94	1	617	F218I401	617	F218I-401		CAMSHAFT	1
94	2	617	X19003	617	X-19003		STUD	2
94	3	617	D6001I259	617	D6001-259	422-9329	PLATE, thrust, camshaft	1
94	6	617	F400H310	617	F400H-310		GEAR, hel:cal	1
94	7	912	42-5416.500.210	617	X-506	012-4546	KEY	1
94	8	617	PYC202	617	PYC-202		WASHER, lock	1
94	9	617	X18156	617	X-18156	222-7221	NUT, plain, hexagon	1
94	12	617	F600L203	617	F600L-203		PLATE, oiler, gear cover (IM05) -	1
94	13	617	F600G295	617	F600C-295	422-5680	BEARING, plain, sleeve; camshaft; front (IM05).	1
94	14	617	F600G296	617	F600G-296		BEARING, plain, sleeve; camshaft; front intermediate (IM05).	1

Figure No.	Index No.	Corps of Engineers stock No. Code No.	Corps of Engineers stock No. Part No.	Manufacturer's part No. Code No.	Manufacturer's part No. Part No.	Federal supply class and item identification No.	Description	Quantity per unit
94	15	617	Y400G228	617	Y400G-228		BEARING, plain, sleeve; camshaft; rear intermediate (IM05).	1
94	16	617	Y400G229	617	Y400G-229		BEARING, plain, sleeve; camshaft; rear (IM05).	1
96		617	F400K39413	617	F400K-39413		PUMP ASSEMBLY, water	1
96	8	617	F400K4041	617	F400K-4041		PUMP ASSEMBLY, water, ball bearing type.	1
96	1	617	F209K307	617	F209K-307		PULLEY	1
96	2	617	X3794	617	X-3794		SCREW, machine	4
96	3	617	X203	617	X203		WASHER, lock	3
96	4	617	F400K404	617	F400K-404		BODY, water pump	1
96	5	617	X102	617	X-102		PLUG, pipe	1
96	6	617	X7021	617	X-7021		RETAINER	1
96	7	617	NG2K211	617	NG2K-211		SEAL	1
96	8	617	X7022	617	X-7022		RACE, bearing, inner	1
96	9	617	F226K2230	617	F226K-2230		SHAFT	1
96	10	617	F400K393	617	F400K-393		IMPELLER	1
96	11	617	F400K340	617	F400K-340		GASKET	1
96	12	617	F400K392	617	F400K-392		COVER	1
96	13	617	X3794	617	X-3794		SCREW, cover	4
97				699	63AW11		CARBURETOR, ASSEMBLY	1
97	1			699	C141-4-3		GASKET, flange	1
97	2	699	C131-2	699	C131-2		PLUG, throttle shaft hole, expansion (IMO 5).	1
97	3			699	B12-11411		BODY, throttle, complete	1

97	4	699	C111-17	699	C111-17		SPRING, idle adjusting needle, helical, compression.	1
97	5	699	C46-38	699	C46-38	-	STEM, needle valve	1
97	6			699	T56-3		GASKET, filter head, fiber	1
97	7			699	C138-46		HEAD, fuel filter	1
97	8						ELBOW, fuel filter	
97	9			699	T301S8-6		WASHER, lock, venturi screw	1
97	10			699	T301S8-6		SCREW, venturi	1
97	11			699	C29-1035		SHAFT, throttle, supplied with LEVER	1
97	12			699	CR28-28		LEVER, throttle stop	1
97	13			699	T1S10-12		SCREW, stop clamp	1
97	14	699	C26-81	699	C26-81		DRIVER, throttle shaft	1
97	15	699	C24-10WWX9	699	C24-10WWX9		LEVER, throttle clamp	1
97	16	699	C117-27	699	C117-27		SPRING, throttle lever, helical, torsion.	1
97	17	699	CR115-10	699	CR115-10		RETAINER, spring	1
97	18	699	T61-4	699	T61-4		PIN, cotter, spring retainer	1
97	19	699	T8S10-9	699	T8S10-9		SCREW, machine, lever clamp (IMO5)	1
97	20			699	T24S10		NUT, clamp screw	1
97	21			699	C25-98X2		STOP, floating lever	1
97	22			699	T8S8-10		SCREW, swivel	1
97	23			699	C25-18CX2		LEVER AND SWIVEL, floating	1
97	24			699	T1S8-10		SCREW, lever stop	1
97	25			699	CT63-9		PIN, taper, stop lever	1
97	26			699	C121-12		PIN, throttle shaft	1
97	27			699	C21-53		PLATE, throttle	1
97	28			699	C136-15		SCREW, throttle plate	2
97	29			699	C116-2X3		RETAINER, packing	1
97	30			699	CT57-8	238-3794	PACKING preformed (IMO 2)	1
97	31			699	T301S25-12		WASHER, lock (supplied with SCREW).	6

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
97	32			699	T301S25-12		SCREW, bowl to body----------	6
98	1			699	B12-11411		BODY, throttle, complete ----------	1
98	2	699	C120-15	699	C1215		AXLE, float ----------	1
98	3	699	T56-23	699	T5623		GASKET, fuel valve seat (IMO 5)----------	1
98	4			699	C81-1-45		VALVE and SEAT ----------	1
98	5			699	C36-52X1		PUMP ----------	1
98	6			699	C85-40		FLOAT ----------	1
98	7			699	C142-22		GASKET, bowl to body----------	1
98	&			699	B38-34-27		VENTURI, with cast-in secondary ----------	1
98	9			699	C97-10-18		VALVE, power, jet ----------	1
98	10			699	C77-18-24		JET, well vent ----------	1
98	11			699	CR41-1		VALVE, pump check----------	1
98	12			699	B3-58		BOWL, fuel ----------	1
98	13	699	T56-14	699	T56-14		GASKET, discharge jet, fibre (IMO 5)----------	1
98	14			699	C66-33-1-70		JET, discharge ----------	
98	15				C55-7-13		JET, idle ----------	1
99	1			699	CT63-9		PIN, taper, thrust, collar----------	1
99	2			699	C130-4		COLLAR, thrust----------	1
99	3	699	T56-48	699	T56-48		GASKET, main jet, fibre (IMO 5) ----------	1
99	4			699	C52-4-22		JET, main ----------	1
99	5	699	T56-10	699	T56-10		GASKET, adjustment, fibre (IMO) ----------	1
99	6			699	C71-25		ADJUSTMENT, main jet ----------	1
99	7	699	C138-23	699	C138-23		PLUG, power and accelerating jet passage.----	1
99	8	699	T56-23	699	T56-23		GASKET, passage plug, fibre (IMO 5)----------	2

99	9			699	C51-15-21		JET, power	1
99	10	699	T56-24	699	T56-24		GASKET, power	1
99	11	699	CT91-3	699	CT91-3		PLUG, bowl drain, pipe (IMO 2)	1
99	12	699	C140-2	699	C140-2		SCREW, bracket, machine (IMO 5)	1
99	13			699	C26-81		DRIVER, choke shaft	1
99	14			699	T8S8-7		SCREW, clamp	1
99	15			699	C106-28E		LEVER, choke	1
99	16	699	T858-6	699	T8S8-6		SCREW, swivel	1
99	17	699	CR115-10				RETAINER, spring	1
99	18		-	699	T51-4		PIN, cotter, retainer	1
99	19			699	C112-6		SPRING, choke lever	1
99	20			699	T8S8-10		SCREW, tube clamp	1
99	21	699	C109-2	699	C109-2		BRACKET, choke	1
99	22	699	C105-87				SHAFT, choke	1
99	23			699	C121-12		PIN, choke shaft	1
99	24	699	C101-21	699	C101-21		PLATE, choke	1
99	25			699	T315B6-4		SCREW, choke plate	2
100		141	51856AB	617	F600S-4080	247-6680	GOVERNOR ASSEMBLY	1
100	1	617	F140S216	617	F140S-216		SPRING, helical, compression	1
100	2	617	F226S306	617	F226S-306		LEVER, governor, speed change-	1
100	2	141	51841AB	141	51841AB		LEVER ASSEMBLY	1
100	3	141	50032-1	141	50032-1		SEAL, oil	1
100	4	381	B610-OH	141	B610-OH	3110-156-7714	BEARING, roller, needle	1
100	5	141	51875AB	141	51875AB		BODY ASSEMBLY	1
100	5	141	51828AB	141	51828AB		BODY	1
100	6	141	50306	141	50306		SPRING, tension, lever bumper (IMO 5)	1
100	7	141	50023	141	50023		FORK, governing lever	1
100	8	141	50591-2	141	50591-2		PIN, grooved, lever	1
100	9	141	50041	141	50041		WASHER. thrust (IMO 5) 1	1
100	10	141	50313-1	141	50313-1		BUSHING	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
100	11	141	50025	141	50025		CLIP	1
100	12	141	50026-32	141	50026-32		WASHER, fiat	AR
100	13	141	50026-18	141	50026-18		WASHER, ball stop (IMO 5)	1
100	14	141	50022	141	50022		FORK, base	1
100	15	141	50021	141	50021		BEARING, thrust	1
100	16	141	51170B	141	51170B		RACE, upper	1
100	17	141	50042-12	141	50042-12		BALL	4
100	18	141	52095A	141	52095A		SHAFT ASSEMBLY	1
100	18	141	50024-7	141	50024-7		SHAFT	1
100	19	141	50972B	141	50972B		DRIVER	1
100	20	141	50230B	141	50230B		RACE, lower, drive shaft	1
100	21	141	52468	141	52468		WASHER, thrust (IM05)	1
100	22	141	51055	141	51055		BASE	1
100	22	141	52637A	141	52637A		BASE ASSEMBLY	1
100	22	141	51056A	141	51056A		BASE AND BUSHING ASSEMBLY	1
100	22	141	50852AB	141	50852AB		CENTRIFUGAL ASSEMBLY	1
100	23	141	51209-11	141	51209-11		BUSHING	1
100	24	141	50443B	141	50443B		GEAR, governor drive, helical	1
100	25	141	51716	141	51716		SCREW. locating	1
100	26	141	50027	141	50027		BUSHING, body	1
100	27	141	50133-1	141	50133-1		PLUG, body	1
100	28	141	50311-9	141	50311-9		PLUG, pipe	1
100	29	617	51842	617	51842		SCREW, adjusting bumper (IMO 5)	1
100	30	141	50131-2	141	50131-2		NUT	I
100		617	F400S202	617	F400S-202		GASKET, mounting (IMO 10)	1
100		617	X318	617	X318		GASKET, mounting (IMO 10)	1

101				636	FM-E6B		MAGNETO ASSEMBLY ----------	1
101	1			636	D2744		INSERT, end cap high tension ----------	6
101	2			636	Q2430A		END CAP ASSEMBLY ----------	1
101	3			636	A6032A		SCREEN, vent----------	2
101	4			636	B1232		HOOD, vent----------	2
101	5			636	6S6N		SCREW ----------	3
101	6			636	M2498		GASKET, end cap to frame ----------	1
101	7			636	T2474		BLOCK, distributor ----------	1
101	8			636	E2460B		BRUSH, distributor block ----------	1
101	9			636	F983A		LEAD, distributor high tension rod ----------	1
101	10			636	C1498		RING, snap, distributor shaft ----------	1
101	11			636	A5949C		BEARING, distributor ----------	1
101	12			636	Z4631		SUPPORT, bearing ----------	1
101	13			636	BX5939		GEAR, distributor ----------	1
101	14			636	8LW3		WASHER, lock----------	5
101	15			636	8S8A		SCREW ----------	3
101	16			636	A1498A		RING, snap, distributor bearing ----------	1
101	17			636	82765		ROTOR, distributor ----------	1
101	18			636	888D		SCREW----------	4
101	19			636	6LW2		WASHER, lock----------	2
101	20			636	B5969		WASHER, plate, contact support lock---------- ing screw.	1
101	21			636	J2454		BRACKET, stationary support ----------	1
101	22			636	B1498G		RING, snap, fulcrum pin ----------	1
101	23			636	W2437		ARM, breaker----------	1
101	24			636	H2513		SPRING, primary ground ----------	1
101	25						LEAD, coil (supplied with COIL AS---------- SEMBLY).	1
101	26			636	6S5N		WASHER, lock ----------	1
101	27			636	D2458		SCREW ----------	1
101	28			636	Y2433		CONDENSER ----------	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
101	29			636	8S5N		SCREW	1
101	30			636	G2788		WICK, cam	1
101	31			636	D2458		WASHER, plate	1
101	32			636	886N		SCREW	1
101	33			636	B3969C		TERMINAL, primary ground cable	1
101	34			636	A1166		INSULATOR, ground cable terminal	1
101	35			636	A6018		INSULATOR WASHER, ground cable terminal.	1
101	36			636	B1077		FERRULE, primary ground cable	1
101	37			636	A2735		NUT, primary ground cable	1
101	38			636			LEAD, ground	1
101	39	-.		636	10S10D		SCREW, end cap	4
102	1			636	A5949A		BEARING, rotor, opposite drive end	1
102	2			636	D2665		SHIM, rotor shaft	2
102	3			636	A2665E		WASHER, thrust, rotor bearing	1
102	4			636	E5952		GEAR, magnetic rotor	1
102	5			636	CZ2480		ROTOR, magnetic	1
102	6			636	P2477		COIL	1
102	7			636	A6304		SEAL, rotor bearing	1
102	8			636	C2723		SHIM, rotor shaft, coupling end	2
102	9			636	B5949		BEARING, rotor drive end	1
102	10			636	25SS8A		SCREW, set	2
102	11			636	A6032A	-	SCREEN, vent	2
102	12			636	B1232		HOOD, vent	2
102	13			636	6S6N		SCREW	2
102	14			636	DZ2425		FRAME	1

102	15	---	---	636	D3861	---	SEAL, drive end	1
102	16	---	---	636	C2492	---	WASHER, drive end seal	1
102	17	---	---	636	E2303	---	DISK, oil slinger baffle	1
102	18	---	---	636	B5963	---	SPRING, impulse coupling pawl	2
102	19	---	---	636	3K1	---	KEY	1
102	20	---	---	636	E2565	---	SPRING, drive, impulse coupling	1
102	21	---	---	636	82563	---	HUB, impulse coupling, 300 lag	1
102	22	---	---	636	A2568	---	PIN, stop, impulse coupling	1
102	23	---	---	962	F140M-232	---	GASKET, magneto	2
102	24	---	---	962	F600M-225	---	SPACER, magneto	1
102	25	---	---	636	K2570	---	NUT, impulse coupling	1
102	26	---	---	636	A5931B	---	WASHER, lock, impulse coupling nut	1
102	27	---	---	636	Y5957	---	SHELL, impulse coupling	1
102	28	---	---	636	D2533	---	PIN, magnetic rotor gear	1
103		623	1105960	962	RSA-34827	---	GENERATOR, electric, battery charging.	1
103	1	623	1915172	623	1915172	---	NUT, shaft, plain, hexagon (IMO 5)	1
103	2	623	1915265	623	1915265	---	WASHER, lock	1
103	3	623	1921091	962	RD-34833	---	PULLEY, groove ..	1
103	4	623	1914628	962	RD-34828	---	FAN, generator drive end	1
103	5	623	103905	623	103905	---	KEY, Woodruff	1
103	6	623	1905527	623	1905527	---	FRAME, drive end, commutator	1
103	7	623	1916376	623	1916376	---	COLLAR, spacer, outside	1
103	8	522	203KLL2	623	954143	156-3502	BEARING, ball, annular	1
103	9	623	1916377	623	1916377	---	SPACER, drive end	1
103	10	623	1916378	623	1916378	---	PLATE, ball bearing retainer	1
103	11	623	1914750	623	1914750	---	SCREW, pole piece (IMO 2)-.	2
103	12	623	1920926	623	1920926	---	WINDING, field, right hand	1
103	13	623	190280	623	190280	---	POLE PIECE, magnetic	2
103	14	623	1882545	623	1882545	---	CLIP, terminal	1
103	15	623	1916373	623	1916373	---	ARMATURE	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
103	16	623	1916371	623	1916371	----------	FRAME, armature, commutator end_ ----------	1
103	17	623	1905219	623	1905219	----------	SPRING, brush ----------	2
103	18	623	1906927	623	1906927	----------	BRUSH, electrical contact ----------	2
103	19	623	1914741	623	1914741	----------	WASHER, brush arm spacer ----------	2
103	20	623	1914578	623	1914578	----------	WASHER, lock, brush lead attaching_ ----------	2
103	21	623	453460	623	453460	----------	SCREW, brush lead attaching ----------	2
103	22	623	1904514	623	1904514	----------	LEVER, tension, main spring brush ----------	2
103	23	---------	----------	--------	----------	----------	SCREW, cover band (supplied with ---------- BAND cover).	1
103	24	623	1914748	623	1914748	----------	BAND, cover (supplied with SCREW ---------- and NUT).	1
103	25	---------	----------	--------	----------	----------	NUT, cover band (supplied with ---------- BAND, cover).	1
103	26	623	1914755	623	1914755	----------	BOLT, thru end bracket ----------	2
103	27	623	1920928	623	1920928	----------	WINDING, field: left hand ----------	1
103	28	623	453301	623	453301	----------	WASHER, lock ----------	2
103	29	623	1914580	623	1914580 (IM03).	----------	SCREW, retainer plate, machine ----------	6
103	30	623	453296	623	453296	----------	WASHER, lock, retainer plate screw ----------	6
103	31	623	1914752	623	1914752	----------	PLATE, cover, commutator end ----------	1
103	32	623	1914753	623	1914753	----------	GASKET, cover plate ----------	1
103	33			623	954259	----------	BEARING, ball, commutator end ----------	1
103	34			623	115596	----------	NUT, terminal stud ----------	4
103	35	623	1914579	623	1914579	----------	WASHER, lock ----------	4
103	36	623	1914583	623	1914583	----------	WASHER, plain, terminal stud ---------- .	2
103	37	623	1885090	623	1885090	----------	BUSHING, terminal stud (IMO 5) ----------	2

103	38	---------	-------------------------	--------	-------------------------	-------------------	FRAME, generator (not serviced sep- arately).	1
114		623	1108583	962	RSA-34830	-------------------	STARTING MOTOR	1
114	1	623	1921094	623	1921094	-------------------	HOUSING, drive	1
114	2	623	810620	623	810620	-------------------	BUSHING, motor drive housing (IMO 5).	1
114	3	623	1914842	623	1914842	-------------------	WASHER, space, drive end, .563 x 63/64 x 1/16.	1
114	4	623	1913969	623	1913969	-------------------	WASHER, space, drive end, .626 x 1 1/16 x 3/32.	1
114	5	623	1914844	623	1914844	-------------------	WASHER, space, drive end, .626 x 1 1/16 x 3/32.	1
114	6	354	F4776	623	1906426	-------------------	GEAR, drive	1
114	7	354	F4723	623	1905957	-------------------	SPRING, drive torsion	1
114	8	354	F4610	623	1902736	-------------------	WASHER, lock, drive spring (IMO 10)	2
114	9	354	F4618	623	1905971	-------------------	SCREW, spring, shaft end	1
114	10	354	F4619	623	1905972	-------------------	SCREW, spring, head end	1
114	11	354	F4616	623	1905969	-------------------	HEAD, drive	1
114	12	623	453325	623	453325	-------------------	KEY, Woodruff	1
114	13	623	1921664	623	1921664	-------------------	ARMATURE	1
114	14	623	1904419	623	1904419	-------------------	NUT, terminal stud, 3/16 thick	1
114	15	623	453297	623	453297	-------------------	WASHER, lock, terminal stud	2
114	16	623	134569	623	134569	-------------------	NUT, terminal stud, ¼ thick	1
114	17	623	1904598	623	1904598	-------------------	WASHER, plain, terminal stud	3
114	18	623	1913959	623	1913959	-------------------	WASHER, insulating, terminal stud, ¾ OD.	2
114	18	623	1913958	623	1913958	-------------------	WASHER, insulating, terminal stud, 9/16 OD.	2
114	19	623	1915645	623	1915645	-------------------	FRAME, commutator end	1
114	20	623	453294	623	453294	-------------------	WASHER, lock, thru bolt	2
114	21	623	1914243	623	1914243	-------------------	BOLT, thru	2
114	22	623	1913933	623	1913933	-------------------	BAND, cover	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
114	23	623	453479	623	453479	----------	SCREW, cover band ----------	1
114	24	623	432230	623	432230	----------	NUT, cover band ----------	1
114	25	623	802694	623	802694	----------	WICK ----------	1
114	26	623	1914958	623	1914958	----------	OILER ----------	1
114	27	623	1914854	623	1914854	----------	PLUG, end ----------	1
114	28	623	1914952	623	1914952	----------	LEAD, brush, ground ----------	2
114	29	623	453299	623	453299	----------	WASHER, lock, brush ground lead ----------	2
114	30	623	1914857	623	1914857	----------	SCREW, brush ground lead ----------	2
114	31	623	1914954	623	1914954	----------	HOLDER, brush ----------	4
114	32	623	453463	623	453463	----------	SCREW, brush lead ----------	2
114	33	623	1904303	623	1904303	----------	SPRING, brush ----------	4
114	34	623	828448	623	828448	----------	BRUSH ----------	4
114	35	623	453296	623	453296	----------	WASHER, lock, brush lead ----------	2
114	36	623	1867610	623	1867610	----------	BUSHING, commutator end ----------	1
114	37	623	1904430	623	1904430	----------	PIN, brush holder hinge ----------	2
114	38	623	1904426	623	1904426	----------	PIN, brush holder hinge insulating ----------	2
114	39	623	1904431	623	1904431	----------	PIN, brush holder stop ----------	2
114	40	----------	----------	----------	----------	----------	FRAME, starting motor (not serviced separately). ----------	1
114	41	623	1905870	623	1905870	----------	WINDING, motor field, right hand - ----------	1
114	42	623	1919957	623	1919957	----------	WINDING, motor field, lower hand ----------	1
114	43	623	1904418	623	1904418	----------	POLE PIECE, magnet ----------	4
114	44	623	1905872	623	1905872	----------	WINDING, motor field, shunt ----------	1
114	45	623	453288	623	453288	----------	WASHER, lock: brush lead to field taching screw. ----------	1
114	46	623	132895 623	132895		----------	SCREW, brush lead to field ----------	2

114	47	623	811601	623	811601	----------	STUD, terminal	1
114	48	623	1913100	623	1913100	----------	SCREW, pole piece	4
115		623	1119753	962	RSA-34831	----------	SWITCH, magnetic, starting motor	1
115	1	623	1914475	623	1914475	----------	SCREW, cover	3
115	2	623	1914476	623	1914476	----------	WASHER, cover screw	3
115	3	623	1914479	623	1914479	----------	COVER	1
115	4	623	1904966	623	1904966	----------	GASKET	1
115	5	623	1913041	623	1913041	----------	WASHER, cupped, contact spring retainer.	2
115	6	623	1914478	623	1914478	----------	SPRING, contact	1
115	7	623	1914470	623	1914470	----------	DISK, contact	1
115	8	623	1904956	623	1904956	----------	PLUNGER	1
115	11	962	RSA32730	962	RSA-32730	----------	LEAD, electrical, capacitor	1
115	12	623	1914473	623	1914473	----------	STUD, terminal	2
115	15	962	RD32729	962	RD-32729	----------	CAPACITOR, magnetic switch	1
115	16	623	453290	623	453290	----------	WASHER, lock	2
115	17	623	1914472	623	1914472	----------	WASHER, flat	2
115	18	623	192369	623	1920369	----------	COIL ASSEMBLY, with case	1
115	19	623	1914477	623	1914477	----------	SPRING, plunger return	1
116.				617	D600L-4027	----------	PUMP ASSEMBI,Y, oil	1
116	1			617	F400L-210	----------	BUSHING, drive shaft, in crankcase	1
116	2	617	7600H205	617	F600H-205	----------	GEAR, drive	1
116	3	617	D600G274	617	D600G-274	----------	BUSHING, drive shaft, in pump body (IMO 10).	1
116	4			617	D600L-402	----------	BODY, oil pump (not serviced separately)	1
116	4			617	D600I-4020	----------	BODY ASSEMBLY, with bushing	1
116	5			617	X-19004-C	----------	STUD, pump body to bearing cap	1
116	6			617	X-203	----------	WASHER, lock	1
116	7			617	X-1802-G	----------	NUT	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
116	8	617	F218L204	617	F218L-204	----------	SHAFT, drive ----------	1
116	9	617	8UL212	617	8UL-212	----------	STUD, idler gear (IMO 5) ----------	1
116	10	--------	----------	617	F600G -204	----------	BUSHING, idler gear ----------	1
116	11	--------	----------	617	F600H-207	----------	GEAR, idler (not serviced separately) ----------	1
116	11	--------	----------	617	F600H-2070	----------	GEAR ASSEMBLY, idler ----------	1
116	12	617	D600L-204	617	D600L-204	----------	RING, retaining (IMO 10) ----------	1
116	13	617	C400L231	617	C400L-231	----------	GASKET (IMO 5) ----------	1
116	14	--------	----------	617	17EL-2001	----------	COVER, with suction tube ----------	1
116	15	--------	----------	617	X-201	----------	WASHER, lock ----------	6
116	16	--------	----------	617	X-3056	----------	SCREW, pump cover and strainer----------	6
116	17	617	17E0204	617	17EL-204	----------	GASKET, strainer frame (IMO 10)1	
116	18	617	17EL300	617	17EL-300	----------	FRAME, strainer (IMO 5)----------	1
116	19	617	C400L228	617	C400L-228	----------	SPACER, strainer frame ----------	1
116	20	617	D600L212	617	D600L-212	----------	SCREEN----------	1
116	21	617	6VB119	617	6VB-119	----------	WIRE, lock ----------	1
116	22	--------	----------	617	D600H-216	----------	GEAR, driver ----------	1
116	23	912	42-5416.500.180	617	X-584	012-4543	KEY, Woodruff: nickel steel: single; ---------- No. 3, 1/8 x ½ in.	1
116	24	617	6UH101	617	6UH-101	247-9871	PIN, straight, headless (IMO 10) - ----------	1
117	1	617	41AL200	617	41AL-200	----------	PLUG, oil pressure relief valve (IMO 5)- ---------	1
117	2	617	W5L213	617	W5L-213	----------	WASHER, spring adjusting (IMO 25) ----------	AR
117	3	617	F400L223	617	F400L-223	253-6962	SPRING, helical, compression (IMO 5)----------	1
117	4	617	15SL211	617	15SL-211	----------	VALVE, oil pressure relief ----------	1
118 ----------		--------	----------	962	R-14161	----------	MASTER CLUTCH ASSEMBLY ----------	1
118	1			092	M945	----------	BOLT, cone collar ----------	2
118	2			092	1395A	----------	WASHER, cone collar bolt ----------	4

118	3	--------	---------- - --------- -- ---------- -- ----------				FITTING, grease ----------	1
118	4	092	117C8S	092	117C8S	----------	COLLAR, clutch cone, split ----------	1
118	5		----------	092	M645A	----------	NUT, sliding sleeve bolt ----------	2
118	6	092	106A ----------	092	106A	244-3913	PIN, lever, straight, headed (IMO 4)----------	4
118	7	092	103F ----------	092	103F	----------	LEVER, finger (IMO 4) ----------	4
118	8	092	5752 ----------	962	R-14161-5752	----------	PLATE, floating, master clutch----------	1
118	9	092	----------	092	M115	----------	RIVET, tubular ----------	12
118	10	092	112B10----------	092	112B10	----------	DISK, friction clutch (IMO 2)----------	2
118	11	092	O116B10	092	O-116B10	----------	PLATE, clutch driving, lined ----------	1
118	11	092	----------	092	116B10	----------	PLATE, driving ----------	1
118	12	092	A1069	962	R-14161-A1069	----------	SPRING, release, helical, compression (IMO 6).	6
118	13	092	5747F	962	R-14161-5747-F	426-1899	HUB AND BACK PLATE, master clutch.	1
118	14	092	2245	092	2245	----------	PIN, lock, clutch adjusting ----------	1
118	15	092	115	092	115	----------	SPRING, adjusting pin, helical, compression (IMO 4).	1
118	16	092	M641	092	M641	----------	RING, retaining, finger lever pin (IMO 25).	4
118	17	092	A60	092	A-60	----------	YOKE ASSEMBLY, clutch adjusting ----------	1
118	17	092	1990	092	1990	----------	YOKE, adjusting ----------	1
118	18	092	S416	092	S-416	----------	SLEEVE ASSEMBLY, sliding ----------	1
118	18	092	2137B	092	2137B	----------	SLEEVE, sliding ----------	1
118	19	092	M642	092	M642	----------	RING, retaining (IMO 25)----------	8
118	20	092	119B2	092	119B2	----------	LINK, lever (IMO 8) ----------	8
118	21	092	1968A	092	1968A	----------	PIN, lever link (IMO 8)----------	8
119	.....	092	20711	962	R-29182	----------	CLUTCH ASSEMBLY, forward and reverse, roller.	2
119	1	092	5878	962	R-29182-5878	----------	PLATE, driving ----------	2
119	2	092	6525	962	R-29182-6525	----------	PLATE, center----------	1
119	3	092	1930A	962	R-29182-1930A	----------	SPRING, release, helical, compression ----------	6
119	4	092	A5384B	962	R-29182-A5384B	----------	PLATE, floating ----------	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
119	5	092	A1683	962	R-29182-A1683	----------	PIN, adjusting lock (IMO 5) ----------	1
119	6	092	A3649	962	R-29182-A3649	----------	DISK, roller----------	1
119	7	092	1382	962	R-29182-1382	----------	SPRING, adjusting pin, helical, compression --- (IMO 5).	1
119	8	092	A2356	962	R-29182-A2356	----------	PIN, lever----------	3
119	9	092	A3470	962	R-29182-A3470	----------	LEVER, adjusting yoke (IMO 6) ----------	6
119	10	092	A2234	962	R-29182-A2234	----------	ROLLER, (IMO 6) ----------	6
119	11	092	A2603	962	R-29182-A2603	----------	SPRING, torsion, yoke lever (IMO 3)----------	3
119	12	----------	----------	962	R-29182-105	----------	PIN, cotter---------- ..	3
119	13	092	A167	962	R-29182-A167	----------	YOKE ASSEMBLY, adjusting ----------	1
119	13	092	A3747	962	R-29182-A3747	----------	YOKE, adjusting ----------	1
119	14	092	C390	962	R-29182-C-390	----------	CONE ASSEMBLY ----------	1
119	14	092	A3469	962	R-29182-A3469	----------	RING, cone ----------	1
119	15	092	A3471L	962	R-29182-A3471L	----------	SLEEVE, cone 1----------	1
119	16	----------	----------	962	B1266	----------	WASHER, thrust----------	4
119	17	962	RH31438	962	RH-31438	----------	SHAFT, forward and reverse clutch shift---------	1
119	20	962	RSAD-31527	962	RSAD-31527	----------	YOKE, forward and reverse clutch - ----------	1
119	21	092	1294	962	R-29182-C-1294	447-8860	SHIM, cone collar ----------	2
119	22	092	118	962	R-29182-C-118	----------	BOLT, cone collar ----------	2
119	23	092	117C10	962	R-29182-C-390 117-C10.	----------	COLLAR, cone ----------	1
119	24	----------	----------	962	R-29182-C-390-105.	----------	PIN, cotter----------	2
119	25	092	1180	962	R-29182-C-390-1180.	----------	NUT, cone collar bolt ----------	2
119	27	092	M1144	962	M1144	----------	SCREW, lock----------	1

119	28	092	M266	962	M-266	----------	SCREW, set ----------	1
119	29	092	6520A	962	R-29182-6520A	----------	HUB AND BACK PLATE ----------	1
119	30	962	R14086	962	R-14086	----------	SPIDER, clutch driving ----------	1
121	3	962	R14139	962	R-14139	----------	BEARING, plain, flanged: 1h ----------	1
121	4	962	RSA14151	962	R14151	----------	GASKET ----------	6
121	5	962	R14140	962	R-14140	----------	SHAFT, gear shifter, transmission ----------	1
121	6	962	RD31439	962	RD-31439	----------	PIN, forward and reverse clutch shift shaft. -----	1
121	7	962	RSA23084	962	RSA-23084	----------	YOKE ASSEMBLY, gear shifting----------	1
121	8	962	RSA14138	962	RSA-14138	----------	CRANK, gear shifting ----------	1
121	9	962	R14145	962	R-141-45	164-2643 ----------	CASE, transmission ----------	1
121	10	962	R14139A	962	R-14139A	----------	BEARING, plain, flanged: rh----------	1
121	13	962	R11339	962	R-11339	246-7662 ----------	SPRING, gear shift lock, helical, compression.	1
122		962	RSA29409	962	RSA-29409	----------	SHAFT ASSEMBLY, forward and reverse clutch. ----------	1
122	1	962	R14145	962	R-141-45	164-2643 ----------	CASE, transmission ----------	1
122	2	962	R23238	962	R-23238	430-9506 ----------	GASKET----------	4
122	3	962	R20654	962	R-20654	----------	PINION, double speed ----------	1
122	4	962	R14077A	962	R-14077-A	----------	SHAFT, forward and reverse clutch ----------	1
122	5	962	R14079	962	R-14079	----------	SPACER, double speed pinion ----------	2
122	6	962	R14080	962	R-14080	----------	SPACER, shaft bearings ----------	2
122	7	962	RSA14084	962	RSA-14084	----------	BEVEL GEAR AND HUB ASSEMBLY.----------	2
122	7	962	R14082	962	R-14082	----------	GEAR, bevel (not serviced separately)----------	2
122	8	962	R14088	962	R-14088	----------	RING, retaining ----------	2
122	9	537	R7325	962	R-14078	----------	RACE, bearing, inner----------	4
122	10			962	R-14083	----------	HUB, bevel gear (not serviced separately). -----	2
122	11	962	R14087	962	R-14087	----------	SPACER, hub ----------	2

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
122	12-13	892	495	962	R-14092	100-0260	CONE AND ROLLERS, tapered roller bearing.	2
122	14	962	RSA14097	962	RSA-14097	----------	HOUSING ASSEMBLY, bearing ----------	2
122	14	962	R14085	962	R-14085	----------	HOUSING, bearing ----------	2
122	15	226	625428	962	R-14090	154-8457	SEAL, oil, plain encased ----------	2
122	16-17	892	37425	962	R-1192	100-3583	CONE AND ROLLERS, tapered roller bearing. ----------	2
122	18	962	R14086	962	R-14086	----------	SPIDER, clutch driving ----------	2
122	19	522	W16	962	R-14095	----------	WASHER, lock, key (IMO 5) ----------	2
122	20	540	AN16	962	R-14096	185-6357	NUT, lock, plain, round (IMO 5) ----------	2
122	21	226	237116	962	R-11076	179-0990	SEAL, oil, plain encased ----------	2
122	22	962	R14114	962	R-14114	----------	WASHER, thrust ----------	2
122	23	092	20711	962	R-29182	----------	CLUTCH ASSEMBLY, forward and reverse.----	2
122	26	962	R23952	962	R-23952	----------	KEY, hub, machine ----------	2
122	28	962	R16043	962	R-16043	----------	KEY, shaft, outer, machine ----------	2
122	29	962	R25823	962	R-25823	----------	KEY, pinion, machine ----------	1
123	2	962	D6223	962	D-6223	----------	NUT, slotted, hexagon ----------	1
123	3	962	R14135	962	R-14135	----------	WASHER, flat, pinion retainer ----------	1
123	4	962	RB31440	962	RB-31440	----------	GEAR, pinion, first countershaft ----------	1
123	5	226	475324	962	R-19974	154-5439	SEAL, plain, encased ----------	1
123	6	962	R19969	962	R-19969	----------	BEARING, ball, annular ----------	1
123	7	226	25028	962	R-19970	154-4955	SEAL, plain encased ----------	1
123	8	962	R19964	962	R-19964	----------	SPACER, first countershaft outboard bearing. -	1
123	9	962	RSAG31676	962	RSAG-31676	----------	TUBE, bearing, first countershaft ----------	1

123	10	226	30022	962	R-14132	----------	SEAL, oil ----------	1
123	11-12	892	3767	962	R-14129	100-0787	CONE AND ROLLERS, tapered roller bearing.	1
123	13	962	R19967	962	R-19967	----------	COUNTERSHAFT, first, transmission ----------	1
123	14	962	R23237	962	R-23237	447-3575	GASKET, first countershaft bearing tube. -------	1
123	15	962	R17567	962	R-17567	----------	KEY, first countershaft pinion gear ----------	1
124	1	962	R19967	962	R-19967	----------	COUNTERSHAFT, first, transmission ----------	1
124	2	962	R14108	962	R-14108	----------	GEAR, spur: sliding, slow ----------	1
124	3	962	R14073	962	R-14073	----------	WASHER, flat ----------	1
124	4-5	537	E8446	537	E-8446	----------	BEARING, roller, needle ----------	2
124	6	962	R14069	962	R-14069	----------	GEAR, spur: slow ----------	1
124	7	962	R14072	962	R-14072	----------	WASHER, spacer, flat: fast and slow gear. -----	1
124	8	962	R20655	962	R-20655	----------	GEAR, spur: fast ----------	1
124	9	962	R14105	962	R-14105	----------	RING, retaining, first countershaft ----------	1
124	10	962	R14107	962	R-14107	----------	GEAR, spur: sliding, fast ----------	1
124	11	962	R14106	962	R-14106	----------	WASHER, flat, first countershaft ----------	1
124	12-13	892	449	962	R-14128	100-0244	CONE AND ROLLERS , tapered roller bearing.	1
124	14	962	R14145	962	R-141-45	164-2643	CASE, transmission ----------	1
124	15	962	R14150	962	R-14150	447-3558 ----------	GASKET ----------	1
124	16	962	RB31316	962	RB-31316	----------	HOUSING, right hand bearing, first countershaft.	1
125	1	092	16288	962	R-14161	447-3559	CLUTCH ASSEMBLY, master ----------	1
125	2	962	R14098	962	R-14098	----------	SHAFT, drive, master clutch ----------	1
125	3	226	237116	962	R-11076	179-0990	SEAL, oil, plain, encased ----------	1
125	4	962	R14103	962	R-14103	----------	RETAINER, bearing, bevel pinion ----------	1
125	5	522	N13	962	R-14110	----------	NUT, lock, plain, round ----------	1
125	6	522	W13	962	R-14109	186-0972	WASHER, lock, key ----------	1
125	7	522	213WD	962	R-14101	155-6790	BEARING, ball, annular ----------	1
125	8	962	R15044	962	R-15044	245-5450	GASKET, bevel pinion bearing retainer ----------	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
125	9	962	R14100	962	R-14100	----------	CUP, bearing, bevel pinion ----------	1
125	11	962	R14145	962	R-141-45	164-2643	CASE, transmission ----------	1
125	12	962	R14160	962	R-14160	----------	SHAFT, rocker, master clutch . ----------	1
125	13	092	1037	962	R-11009	----------	YOKE, clutch shifter ----------	1
125	14	962	RSAH31573	962	RSAH-31573	----------	LEVER ASSEMBLY, master clutch rocker shaft.	1
125	17	962	R10114	962	R-10114	251-9333 ----------	PIN, straight, headed ----------	2
125	18	912	42-5416.500.300	962	M-508	----------	KEY, Woodruff: nickel steel; single; ---------- No. A, ¼ x 7/8 in.	3
125	19	962	R14050	962	R-14050	----------	NUT, jam slotted, hex ..----------	1
125	20	962	R14099	962	R-14099	----------	GEAR, bevel pinion ----------	1
125	21	962	R15043	962	R-15043	----------	GASKET, bevel gear pinion bearing cup.	3
125	24	962	R23952	962	R-23952	----------	KEY, bevel pinion gear ----------	1
127	2	962	D6223	962	D-6223	----------	NUT, slotted, hexagon ----------	1
127	3	962	R14135	962	R-14135	----------	WASHER, flat: pinion gear retainer ----------	1
127	4	962	RSA31735	962	RSA-31735	----------	GEAR, ring, spur: w/brake drum ----------	1
127	4	962	RSA19960	962	RSA-19960	----------	BRAKE DRUM, with center gear (not serviced separately).	1
127	4	962	RB31441	962	RB-31441	----------	GEAR, spur (not serviced separately) ----------	1
127	5	226	587424	962	R-14189	154-8447	SEAL, oil, plain encased ----------	1
127	6-7	892	42376	962	R-14186	100-3597	CONE AND ROLLERS, tapered roller bearing.	1
127	11	962	R14226	962	RSA-14226	164-2653 ----------	BAND, brake, lined ----------	1
127	11	962	R29297	962	R-29297	430-9515 ----------	LINING, brake ----------	1
127	13	962	R16302	962	R-16302	163-2457 ----------	CAMSHAFT, brake ----------	1

127	15	975	7159H	962	R-14225	----------	BEARING, adjusting, plain, flanged ----------	1
127	16	962	RB31677	962	RB-31677	----------	CAM, brake ----------	1
127	17	962	RSA31689	962	RSA-31689	----------	ARM, brake ----------	1
127	20	962	R14227	962	R-14227	----------	SPRING, tension, brake band ----------	2
127	25	962	R19962	962	R-19962	----------	COUNTERSHAFT, transmission second.	1
127	26	962	R22978	962	R-22978	----------	KEY, machine ----------	1
127	27	962	R14168	962	R-14168	----------	SPACER, second countershaft ----------	1
127	28	962	R19961	962	R-19961	----------	GEAR, pinion, spur ----------	1
127	29	226	60024	962	R-19987	----------	SEAL, oil, plain, encased ----------	1
127	30-31	892	748S	962	R-10776	142-4362	CONE AND ROLLERS, tapered roller bearings.	1
127	32	962	RB31663	962	RB-31663	----------	BRACKET, bearing, second counter shaft. ------	1
127	34	962	R10911	962	R-10911	163-2456	SPIDER, brake ----------	1
128		994	V230-8-1A12RH	962	RSA-35003	----------	HYDRAULIC PUMP ASSEMBLY ----------	1
128	1	994	131485	994	131485	----------	SCREW, cap, cover ----------	4
128	2	994	129343	994	129343	----------	COVER ----------	1
128	3	994	114139	994	114139	----------	SPRING, compression, plate ----------	1
128	4	994	131317	994	131317	----------	PLATE, pressure ----------	1
128	5	994	84120	994	84120	----------	RING, seal ----------	2
128	6	994	114154	994	114154	----------	RING ----------	1
128	7	994	127284	994	127284	----------	ROTOR, booster steering ----------	1
128	8	994	1070	994	1070	----------	BOLT ----------	2
128	9	994	119986	994	119986	----------	BODY ----------	1
128	10	994	2546	994	2546	251-3199	GASKET, (IMO 5) ----------	2
128	11	962	RB32082	962	RB-32082	----------	BRACKET, hydraulic pump ----------	1
128	12	522	203K	994	1703	144-8505	BEARING, ball, annular ----------	1
128	13	994	126199	994	126199	----------	SPACER, shaft bearing ----------	1
128	14	994	122626	994	122626	----------	SEAL, oil ----------	1
128	15	994	116644	994	116644	----------	SHAFT, bearing ----------	1
128	16	994	5881	994	5881	----------	KEY, machine ----------	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
128	17	994	109975	994	109975	----------	RING, retaining, shaft bearing ----------	1
128	18	522	204PP	994	98574	109-1123	BEARING, ball, annular ----------	1
128	19	994	2161	994	2161	246-9071	PIN, straight, headless ----------	2
128	20	994	127285	994	127285	----------	VANE, rotor (IMO 12). ----------	12
129	.....	962	RSA12013	962	RSA-12013	----------	CYLINDER ASSEMBLY, steering ----------	1
129	1	962	R8A11944	962	RSA-11944	----------	ROD ASSEMBLY, piston ----------	1
129	2	962	R11943	962	R-11943	----------	GLAND, packing, piston rod ----------	1
129	3	962	R11942	962	R-11942	----------	HEAD, gland seat ----------	1
129	4	962	R11402	962	R-11402	246-0299	GASKET, cylinder ----------	2
129	5	962	R11013	962	R-11013	----------	RETAINER, piston packing cup ----------	2
129	6	962	R11015	962	R-11015	----------	CUP, packing, steering cylinder piston ----------	2
129	7	962	R11940	962	R-11940	----------	PISTON, hydraulic ----------	1
129	10	962	R11947	962	R-11947	----------	STUD, draw, threaded ----------	6
129	11	962	R11941	962	R-11941	----------	HEAD, cylinder swivel ----------	1
129	13	962	R12094	962	R-12094	447-3556	PIN, straight, headed: long ----------	1
129	14	962	R11498	962	R-11498	447-3554	BEARING, plain, sleeve: swivel end ----------	2
129	15			962	R-11946	----------	CYLINDER ----------	1
129	16	962	46CA962	.....	.....	LOCK WIRE: 12 in. long (See Stock No. 910 22-8011.500.380). ----------		2
129	17	962	R10107	962	R-10107	----------	BOLT, machine, cup retainer ----------	8
129	18	962	D8506	962	D-8506	251-9996	PIN, straight, headless, piston locking ----------	1
129	19	962	D6065	962	D-6065	447-3520	PACKING, piston rod ----------	1
129	22	962	D5582	962	D-5582	251-4051	GASKET, piston rod ----------	1
129	23	962	R12093	962	R-12093	447-3555	PIN, straight, headed: short ----------	1
129	24	962	R11497	962	R-11497	447-3553	BEARING, plain, sleeve: piston rod ----------	1
end.								

130	.....	962	RSA30127	962	RSA-30127	----------	VALVE ASSEMBLY, operating, manifold. -------	1
130	2	962	B27367	962	B-27367	----------	BODY, regulating valve ----------	1
130	2	962	SA28108	962	SA-28108	----------	VALVE ASSEMBLY, regulating, manifold.	1
130	3	962	D27340	962	D-27340	----------	SEAL, oil, valve block ----------	4
130	4	962	D30149	962	D-30149	----------	UNION, adapter----------	2
130	5	962	RH30120	962	RH-30120	----------	BRACKET, lever----------	1
130	6	962	D27353	962	D-27353	----------	SETSCREW ----------	12
130	7	962	D27354	962	D-27354	----------	WASHER, felt ----------	1
130	8	962	8A32739	962	SA-32739	----------	SEAL ASSEMBLY, oil, piston ----------	1
130	9	962	D27379	962	D-27379	162-2250	GASKET ----------	2
130	10	962	B27345	962	B-27345	----------	BODY, exhaust ----------	1
130	11	962	RD30121	962	RD-30121	----------	ROD, tie----------	4
130	13	962	B27339	962	B-27339	----------	BODY, operating valve----------	1
130	14	962	SA27731	962	SA-27731	163-6747	PISTON, hydraulic ----------	1
130	15	962	D27350	962	D-27350	----------	WASHER, piston spring control ----------	2
130	16	962	D27348	962	D-27348	----------	BLOCK, piston stop ----------	1
130	17	962	D27349	962	D-27349	163-2105	SPRING, compression, piston ----------	1
130	18	962	D27351	962	D-27351	251-9999	PIN, straight, headless----------	1
130	19	962	H27352A	962	H-27352-A	----------	COVER, operating valve spring ----------	1
130	20	962	D27356	962	D-27356	----------	COVER, regulating valve spring ----------	1
130	21	962	D27362	962	D-27362	----------	NUT, lock----------	1
130	22	962	D27366	962	D-27366	----------	WASHER, flat ----------	2
130	23	962	D27355	962	D-27355	----------	SCREW, spring adjusting ----------	1
130	24	962	H27365	962	H27365	----------	COVER ----------	1
130	25	962	D27358	962	D-27358	239-8391	PACKING, preformed ----------	1
130	26	962	D27386	962	D-27386	246-7664	SPRING, helical, compression----------	1
130	27	962	D27363	962	D-27363	----------	PLUNGER----------	1
130	28	962	D27364	962	P-27364	----------	SEAT ----------	1
132		962	RSA19978	962	RSA-19978	----------	YOKE ASSEMBLY, steering roll----------	1
132	1	962	R18969	962	R-18969	----------	PIN, swivel, straight, headless ----------	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
132	2	962	R12130	962	R-12130	----------	BOLT, swivel pin, machine ----------	1
132	5	962	R19002	962	R-19002	----------	KEY, roller steering arm ----------	1
132	6	962	RB31688	962	RB-31688	----------	KINGPIN, steering roll ----------	1
132	7	962	R18981	962	R-18981	----------	COLLAR, dust, lower ----------	1
132	8	892	42362	962	R-18997	100-3593	CONE AND ROLLERS, tapered roller bearings.	1
132	9	892	42587	962	R-14185	100-0584	CUP, tapered roller bearings ----------	1
132	12	962	RSAB31800	962	RFAB-31800	----------	LEVER AND ARM, steering ----------	1
132	13	962	R18980	962	R-18980	----------	COLLAR, dust, upper ----------	1
132	14	892	472A	962	D-5841	100-0318	CUP, tapered roller bearing ----------	1
132	15	892	482	962	R-10504	100-0258	CONE AND ROLLERS, tapered roller bearing.	1
132	16	962	RH31669	962	RH-31669	----------	CAP. steering roll kingpin ----------	1
132	17	962	R15060	962	R-15060	430-9467	BOLT, machine, bearing adjusting ----------	2
132	19	962	R18982	962	R-18982	----------	ARM, steering ----------	1
132	20	962	R18979	962	R-18979	----------	COLLAR, dust, upper ----------	1
132	21	962	R18972	962	R-18972	----------	SPACER, swivel pin, steering roll ----------	2
132	22	537	E8446	962	R-14066	183-5205	BEARING, roller, needle ----------	2
132	23	962	R18975	962	R-18975	----------	SPACER, bearing, steering roll swivel pin. ------	1
133		962	RSA26221	962	RSA-26221	----------	STEERING ROLL ASSEMBLY ----------	2
133	....1....	962	M1052	962	M-1052	----------	LOCK WIRE: 12 in. lg ----------	2
133	2	962	R19984	962	R-19984	----------	BOLT, machine ----------	4
133	3	962	R19942	962	R-19942	----------	PLATE, bearing adjuster ----------	2
133	4	962	R11910	962	R-11910	----------	COLLAR, shaft ----------	2
133	5	806	1610B	962	CLDX-6	----------	FITTING, grease ----------	2

133	6	962	R19943	962	R-19943	----------	SHAFT, axle, automotive ----------	1
133	7	962	R11909	962	R-11909	251-6117	PIN, straight, headless----------	2
133	8	962	R26222	962	R-26222	----------	DUST GUARD, steering roll shaft bearing. ------	4
133	9	892	47679	962	R-26232	3110-100-3608---	CONE AND ROLLERS, tapered roller bearing.	4
133	10	892	47620	962	R-26233	3110-100-0589---	CUP, tapered roller bearing ----------	4
135		962	RSA19958	962	RSA-19958	----------	ROLL ASSEMBLY, compression----------	1
135	1	962	M1052	962	M-1052	----------	LOCK WIRE, 12 in. long ----------	2
135	2	962	RD31568	962	RD-31568	----------	BOLT, machine: bearing adjusting ----------	4
135	3	962	R19944	962	R-19944	----------	PLATE, bearing adjusting ----------	2
135	4	962	RB31646	962	RB-31646	----------	BRACKET, mounting, compression roll. --------	2
135	6	962	RH31643	962	RH-31643	----------	COLLAR, shaft bearing adjusting ----------	2
135	7	962	R11449	962	R-11449	----------	DUST GUARD, compression roll shaft bearing.	2
135	8	892	663	962	R-11468	100-0670	CONE AND ROLLERS, tapered roller bearings.	2
135	9	892	652	962	R-10770	100-0334	CUP, tapered roller bearing ----------	2
135	10	962	RB31818	962	RB-31818	----------	SHAFT, axle, automotive ----------	1

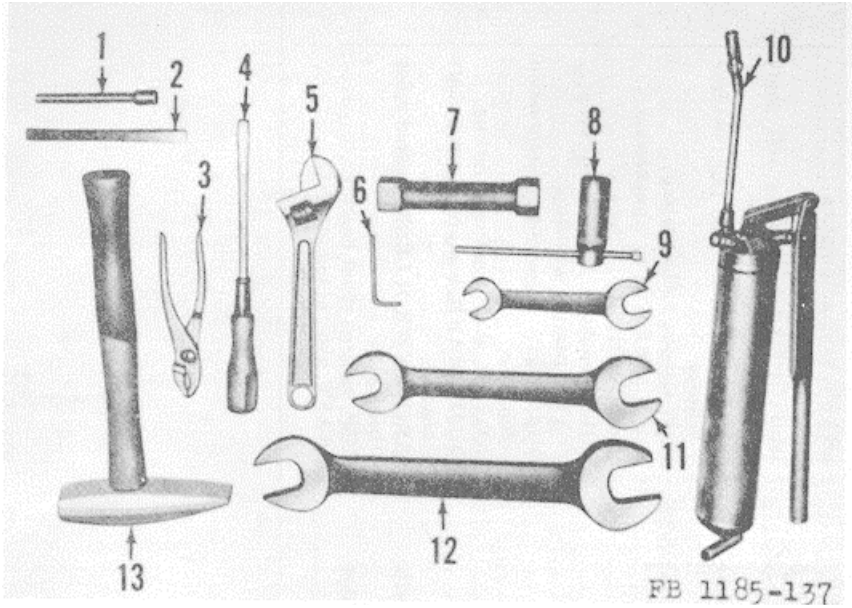


Figure 137. On-equipment tools.

APPENDIX III

ON-EQUIPMENT TOOLS

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
137	1	.....	.....	.....	.....	.....	Adapter, clutch grease fitting, consists of 1/8 pipe coupling and 1/8 x 4 pipe nipple.	1
137	2	GE	41-6343.060.060	--------	----------	----------	Punch, center: FS GGG-P-831; Type II; octagon; single, 5/8 x 6 in.	1
137	3	GE	41-5976.300.08	--------	----------	----------	Pliers, combination: slip joint; 8 in.; FS GGG-P-471; Type F.	1
137	4	GE	41-7165.060.035	--------	----------	----------	Screwdriver, common: plastic handle; 6 in. long x 5/16 in. wide blade; ES 36-4.	1
137	5	GE	41-9587.498.300	--------	----------	----------	Wrench, crescent type, single head, open end: normal duty, FS GGG-W-631, Type I, class A:1 1/8 in. opening x 10 in. long.	1
137	6	GE	41-9735.600.040	--------	----------	----------	Wrench, set screw: Allen; WS 41 W15; Type XVII; style A; single; short arm series; 3/8 in. hex size, 1 3/8 x 4 1/4 in. arm length.	1
137	7			962 --- --------	R-19137 ---------- plugs	----------	Wrench, 3/8 square x 6 in. long, for roll	1
137	8	GE	41-9783.085.102	--------	----------	----------	Wrench, spark plug: pressed steel type; w/bar handle; double end; 29/32 x 1 1/32 in. opening.	1

Figure No.	Index No.	Corps of Engineers stock No.		Manufacturer's part No.		Federal supply class and item identification No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
137	9	GE	41-9652.400.800	--------	----------	----------	Wrench, engineer's: 15-deg; double hd; open end; regular hd; heavy-duty; single; FS GGG-W-636; Type IV; style 1; class A;3/4 x 7/8 in. nominal opening; 9 ¼ in. approx. length.	1
137	10	GE	41-4140.016.275	--------	----------	----------	Gun, lubricating: lever-type; hand operated; Alemite; 16 oz; 1056 SE; with 4 accessories: No. 6819 ADAPTER, hydraulic-type. No. 6833 ADAPTER, pin-type No. 6638 EXTENSION, hydraulic-type. No. 1189 HOSE, button head-type.	1 1 1 1 1
137	11	GE	41-9652.400.920	--------	----------	----------	Wrench, engineer's: 15-deg; double hd; open end; regular hd; heavy-duty; single; FS GGG-W-636; Type IV; style 1; class A; 11/16 x 1 ¼ in. nominal opening; 12 in. approx. length.	1

137	12	GE	41-9652.400.975	--------	----------	----------	Wrench, engineer's: 15-deg; double hd; open end; regular hd; heavy duty; single; FS GGG-W-636; Type IV; style 1; class A; 1 7/16 x 1 5/8 in. nominal opening; 15 1/2 in. approx. length.	1
137	13	GE	41-4277.200.150	--------	----------	187-1027	Hammer, machinist's; FS GGG-H-86; Class I; Type L; handled; 1 1/2 lb.	

INDEX

[AG 413.8 (12 Oct 54)]

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1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

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

LIQUID MEASURE

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

SQUARE MEASURE

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

CUBIC MEASURE

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

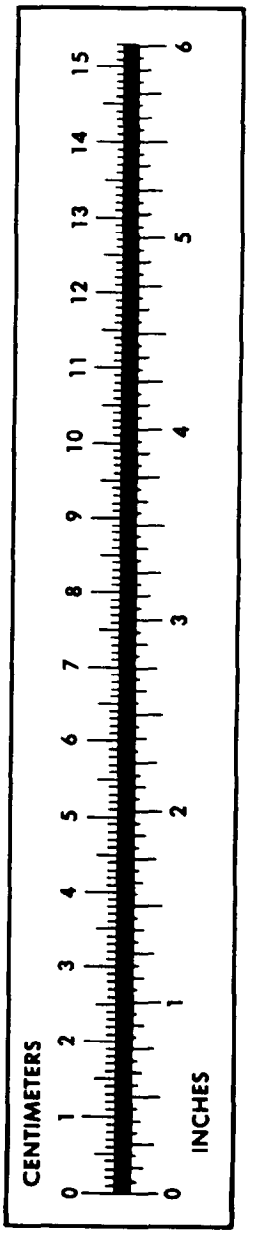
TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

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

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



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