SERVICE MANUAL

FOR

MODEL HD6 TRACTOR

FEBRUARY 1958

PROPERTY OF

_____

_____

_____

Litho. in U.S.A.

FOREWORD

This manual has been prepared to provide the customer and maintenance personnel with information and instructions for repairing and maintenance of the Model "HD-6B" Tractor (standard model). The Model HD-6 Tractor is a product of practical and proven design. Extreme care has been exercised in the selection of materials and the manufacturing of the tractor. By skillful operation and proper maintenance of the tractor, the utmost satisfaction in performance and service will be obtained.

In order to become familiar with the various parts of the tractor, it is urged that the maintenance personnel study the instructions and illustrations in this manual and use it as a reference when performing repair or maintenance operations. An Operators Manual is provided with each tractor for the purpose of providing the operator essential information regarding day-to-day care, adjustments, and lubrication of the tractor. It is important that the Operators Manual be kept with the tractor so that the information contained therein is available to the operator and service personnel at all times.

All information and illustrations shown throughout this manual pertain to the Model "HD-6B" Tractor (standard model) unless otherwise stated.

Sections I through XVIII of this manual contain detailed instructions for the removal, disassembly, inspection, assembly, installation, and adjustment of the various assemblies of the tractor when repairs or overhaul become necessary.

Section XIX describes the Special Equipment available for the tractor.

General Maintenance Instructions are given in Section XX, and Fits and Tolerances in Section XXI.

Trouble Shooting Information given in Section XXII will aid in determining the cause of operating irregularities and tells what may be done to correct them. General information on the availability of Special Tools is given in Section XXIII.

Many owners of "Allis-Chalmers" equipment employ the Dealer's Service Department for all work other than routine care and adjustments. This is encouraged as the dealers are kept well informed by the factory regarding advanced methods of servicing "Allis-Chalmers" products and are equipped to render satisfactory service. IMPORTANT: ALWAYS FURNISH THE DEALER WITH BOTH THE TRACTOR AND ENGINE SERIAL NUMBERS WHEN ORDERING PARTS.

To assure the best results and to maintain the original quality built into the tractor, it is important that Genuine "Allis-Chalmers" Parts be used when new parts are required.

SUBJECT INDEX

SECTION I — DESCRIPTION AND SPECIFICATIONS

1. GENERAL DESCRIPTION

The description given herein and the information contained in this manual pertains to the Model "HD-6B" Tractor (Standard Model), unless otherwise stated.

The Model "HD-6B" Tractor is a 12,600 pound track-type tractor powered with a 4 cylinder, 4-stroke cycle, naturally aspirated, "Allis-Chalmers" Diesel Engine. Power from the engine is transmitted through a single plate, over-center type engine clutch to the transmission through a universal joint drive shaft assembly. From the transmission, the power is transmitted to the bevel gear, and from the bevel gear through the steering clutches to the final drives and the track drive sprockets.

The transmission provides 5 forward and 1 reverse speed ranges. At rated engine speed of 1800 R.P.M. (governed full load), the transmission provides forward speeds ranging from 1.5 M.P.H. in low gear to 5.5 M.P.H. in high gear and a reverse speed of 2.0 M.P.H.

Mechanical self-energizing brakes, wide operator's seat, and an unobstructed view of the front of both tracks assure easy, positive control of the tractor at all times.

The standard model tractor is equipped with 24-volt electric starting and lighting equipment, suction type cooling fan, muffler, full-width crankcase guard, bumper, hinged radiator guard, and 13" integral grouser track shoes. The truck wheels, track idlers, and track support rollers have positive type seals.

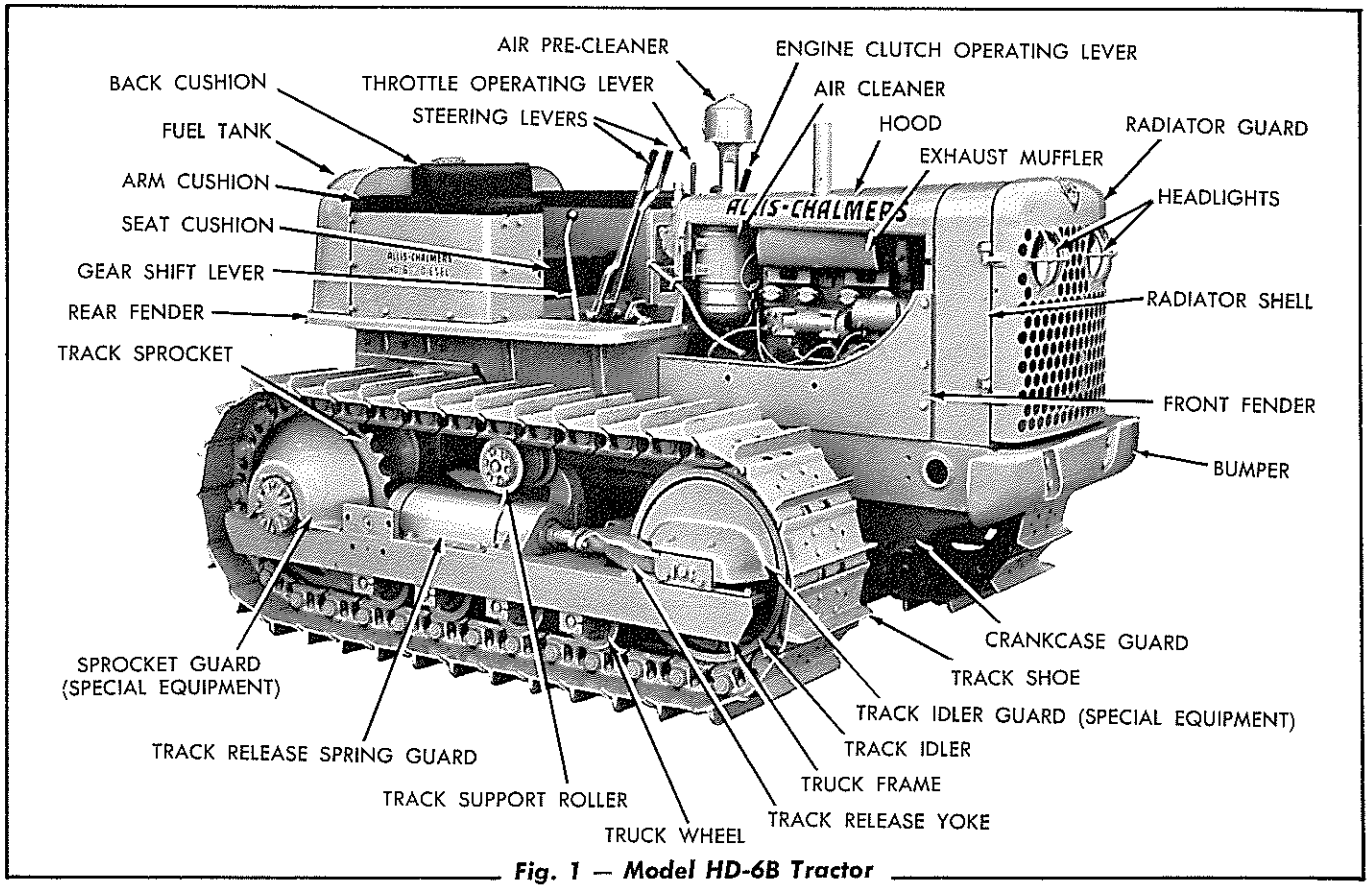

Fig. 1 — Model HD-6B Tractor

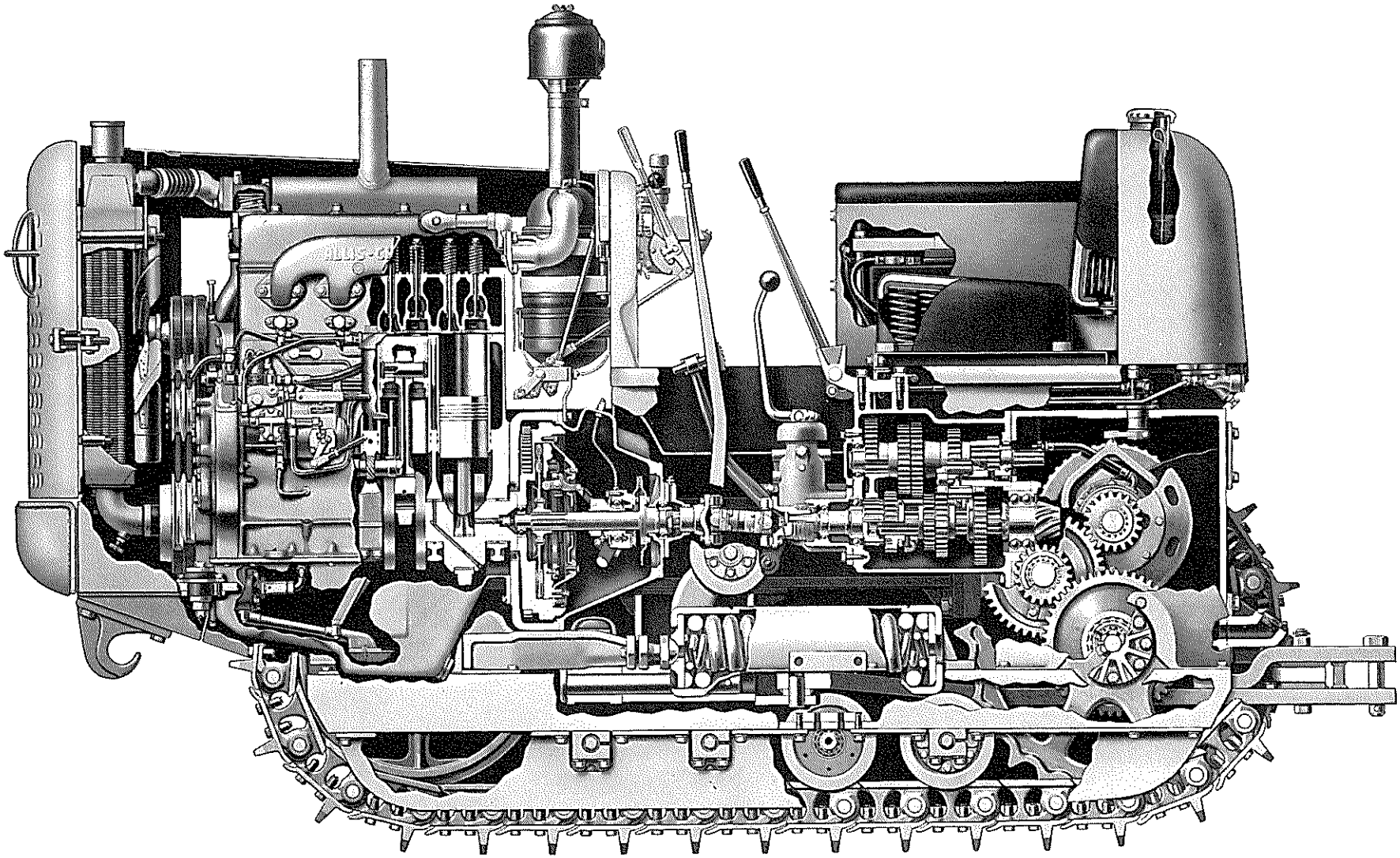

Fig. 2 — HD-6B Tractor (Sectional View)

2. GENERAL SPECIFICATIONS

GENERAL SPECIFICATIONS:

Overall Length	10 ft. 7 3/16 in.
Overall Height (including exhaust stack)	5 ft. 8 5/8 in.
Overall Width (standard shoes)	6 ft. 6 in.
Ground Clearance	11 1/4 in.
Drawbar Height (center line of jaw)	13 15/16 in.
Lateral Drawbar Movement	21 in.
Shipping Weight (approximate)	12,600 lbs.
Number of Track Shoes per Track:	
Prior to Tractor Serial Number 5100	33
Tractor Serial Number 5100 and above	34
Height of Grouser	2 1/8 in.
Diameter of Track Shoe Shoulder Bolt	1/2 in.
Diameter of Track Pins	1 3/8 in.
Diameter of Track Pin Bushings	2 in.
Length of Track on Ground (34 link track)	5 ft. 6 7/8 in.
Width of Standard Track Shoes	13 in.
Maximum Width Track Shoes Available	20 in.
Ground Contact Area (34 link track with standard shoes)	1739 sq. in.
Ground Pressure lbs. per sq. in. (34 link track with standard shoes)	7.2
Tread Width (center-to-center of tracks)	60 in.

TRACTOR SPEEDS (At Rated Engine Speed):

1st Gear	1.5 M.P.H.
2nd Gear	2.4 M.P.H.
3rd Gear	3.3 M.P.H.
4th Gear	4.0 M.P.H.
5th Gear	5.5 M.P.H.
Reverse Gear	2.0 M.P.H.

STEERING:

Method	Clutches
Controls	Mechanical
Turning Radius	7 ft. 1/4 in.

ENGINE:

Make	"Allis-Chalmers" Diesel
Model	HD-344
Type	Four-stroke Cycle (Naturally Aspirated)
Lubrication	Full Pressure
Fuel Used	Diesel Fuel
Fuel Supplied By	"American Bosch" Fuel Injection Pump
Number of Cylinders	4
Compression Ratio	15:1
Bore (in.)	4 7/16
Stroke (in.)	5 7/16
Piston Displacement (cu. in.)	344
Crankshaft Rotation (when viewed from fan end)	Clockwise
Number of Main Bearings	5
Rated R.P.M. (Governed At Full Load)	1800
Low Idle Speed R.P.M.	525 to 550
High Idle Speed R.P.M.	1930 (+ or — 25)
Valve Timing	
Intake Valve Opens B.T.D.C.	24°
Intake Valve Closes A.B.D.C.	58°
Intake Valve Open — Duration	262°
Exhaust Valve Opens B.B.D.C.	65°
Exhaust Valve Closes A.T.D.C.	35°
Exhaust Valve Open — Duration	280°
Firing Order	1 — 3 — 4 — 2
Generator Speed	1.8 x Crankshaft Speed
Transmission Top Shaft Speed	.535 x Crankshaft Speed
Fuel Transfer Pump Speed	.5 x Crankshaft Speed
Fuel Injection Pump Timing (Prior to Tractor Serial Number 5100)	28° B.T.D.C.
Fuel Injection Pump Timing (After Tractor Serial Number 5100)	32° B.T.D.C.

CAPACITIES (Approximate):	Metric Measure	U. S. Standard Measure
Cooling System	32.2 liters	8½ gals.
Crankcase and Filter	11.4 liters	3 gals.
Air Cleaner	1.9 liters	2 qts.
Transmission	18.9 liters	5 gals.
Final Drives (each)	11.4 liters	3 gals.
Fuel Tank	151.4 liters	40 gals.
Support Roller	.5 kg.	1 lb.
Track Idler	.8 kg.	1¾ lbs.
Truck Wheel	.5 kg.	1 lb.

The Allis-Chalmers Manufacturing Company reserves the right to make changes in the above specifications or to add improvements at any time without notice or obligation.

3. SPECIFICATIONS OF LUBRICANTS

A. Engine Crankcase Lubricant

USE NON-CORROSIVE "DIESEL" ENGINE LUBRICATING OIL CONTAINING ADDITIVES WHICH WILL PREVENT SLUDGE OR GUM DEPOSITS. UNDER NO CIRCUMSTANCES SHOULD A CORROSIVE ENGINE LUBRICATING OIL EVER BE USED.

Use oils of the following viscosities:

Atmospheric Temperature	Viscosity
90° F. and above	Use SAE 40
32° F. to 90° F.	Use SAE 30
0° F. to 32° F.	Use SAE 20W
0° F. and below	Use SAE 10W

Manufacturers of lubricants recognize the importance of the qualities required for use in our equipment and they are cooperating fully to assure the use of only those oils which fulfill these requirements. The oil distributor and/or oil manufacturer are to be held responsible for the results obtained from their products.

The outstanding lubricating requirements for efficient operation of the engine are: The maintaining of piston rings in a clean, free condition; absence of hard carbon and "varnish" deposits on or within engine parts; the prevention of bearing corrosion; and the promotion of general cleanliness within the engine.

Proper operation and maintenance of the engine are necessary to obtain the desired results from the lubrication oil.

For additional information regarding engine lubricating oil, contact your "Allis-Chalmers" Construction Machinery Dealer.

B. Air Cleaner

Use the same viscosity oil in the air cleaner as used in the engine crankcase. CAUTION: *Do not use an oil that foams.*

C. Transmission and Final Drive Lubricant

Lubricate these assemblies with a good grade of engine lubricating oil purchased from a reputable oil company.

Use oils of the following viscosities:

Atmospheric Temperature	Viscosity
Above 32° F.	Use SAE 50
32° F. and below	Use SAE 30

D. Truck Wheel, Track Idler, and Track Support Roller Lubricant

Lubricate these assemblies with a grease that meets certain definite specifications:

The type of grease used for lubricating these assemblies must:

1. Have good pumpability and cold temperature characteristics.
2. Have a minimum effect on the synthetic rubber seal boots.
3. Be an extremely stable grease both mechanically and chemically that will not deteriorate excessively with long usage.

Detailed specifications of the greases are as follows:

Worked Penetration (60 Strokes)
(ASTM-D-217) . . . . . .355 to 385
Worked Penetration (10,000 Strokes) . . . 400 max.
Dropping Point °F. (ASTM-D-566) . . . . . 180 min.
Water Content % (ASTM-D-128) . . . . . 1.0 max.
Ash Content % (ASTM-D-128) . . . . . 1.5 max.
Acidity or Alkalinity % (ASTM-D-218) . . . 0.3 max.
Fillers . . . . . None
Corrosion (Federal Spec. 530.4) . . . . . None
Norma-Hoffman Oxidation Test:
Pressure Drop, psi, 100 hours at 210° F. . . 5 max.
Viscosity of Oil S.U. sec. at 130° F. . . . 120 to 185
Aniline Point of Oil, °F. (ASTM-611) . . . . 225 min.

Contact your local supplier for a grease which meets these specifications. The distributor and/or manufacturer of the lubricant used are responsible for the results obtained from their products.

E. Pressure Gun Lubricant

Use a ball and roller bearing lubricant with a minimum melting point of 300° F. This lubricant should have a viscosity range so as to assure easy handling in the lubricating gun at prevailing atmospheric temperature, and *MUST* be waterproof.

4. SPECIFICATIONS OF FUEL

The "DIESEL" fuel should be a natural distillate petroleum oil and must have certain qualities in order to ignite and burn at the proper rate and temperature. Field experience has shown that the fuel best suited for this engine closely approximates the following specifications:

Gravity API	30 - 35
Viscosity Saybolt Universal at 100° F.	35 - 40
Flash Point	150° F.
Diesel Index	48.5 to 65.5
Cetane Number	46 - 60
Pour Point	0° F.
Volatility 90%	650° F. Max.
End Point 98%	
Summer	700° F. Max.
Winter	600° F. Preferable
Sediment and Water	Trace
Ash	.02 of 1% Max.
Conradson Carbon	.03 of 1% Max.
Sulphur	½ of 1% Max.

For satisfactory fuel flow through lines and filters in cold weather, the pour point of fuel must be at least 10° F. below the prevailing atmospheric temperature.

The API gravity of a fuel varies with its specific gravity. The low API fuels are desirable because they have a high specific gravity and more heat units per gallon; however, the higher the API gravity, the better will be the ignition quality of the fuel.

The ignition quality of the fuel is expressed as a "cetane number." The higher the cetane number, the higher the quality of the fuel. The higher cetane fuel shortens the ignition delay period to facilitate starting and improve combustion. The "DIESEL" index number, which is a close approximation of the cetane number, is a field method to represent ignition quality.

The distillation 90% point and the end point are important. High volatility is required to enable complete vaporization of the fuel, clean combustion, and low residue formation.

The flash point of the fuel has no quality significance, but it is important with respect to safety in storage and handling of the fuel.

It is important that the fuel be within the specified limits for ash, carbon, water, and sediment content, etc., to prevent excessive wear and damage to the engine parts.

It is also important that the fuel has lubricating properties so that the fuel injection pump and fuel injection nozzles are adequately lubricated. At times it may be necessary to use fuel with no lubricating properties. If this occasion arises, add one quart of SAE 10 engine oil to every 10 gallons of fuel. NOTE: *Distillates should be used only in emergencies.* When the proper fuel is again available, the fuel system must be drained before the proper fuel is added.

CAUTION: *The sulphur content of "DIESEL" fuel should be as low as possible. The fuel should not contain a sulphur content of more than ½ of 1%.*

Generally speaking, a No. 2 "Diesel" fuel purchased from a reputable oil company will meet the above specifications.

5. FUEL STORAGE

Refer to "FUEL STORAGE" in the HD-6 Tractor Operators Manual for information concerning fuel storage.

6. TRACTOR AND ENGINE SERIAL NUMBERS

On all parts orders and in all correspondence relative to the tractor, it is necessary that both the tractor and engine serial numbers be given. This information will properly identify the particular tractor or engine and will assure obtaining the correct replacement parts.

The tractor serial number is stamped in the rear face of the steering clutch housing (near the upper right corner) and is also stamped on a serial number plate attached to the cowl.

The engine serial number is stamped on a plate attached to the left rear side of the cylinder block, below the fuel filters, and is also stamped on the serial number plate attached to the cowl.

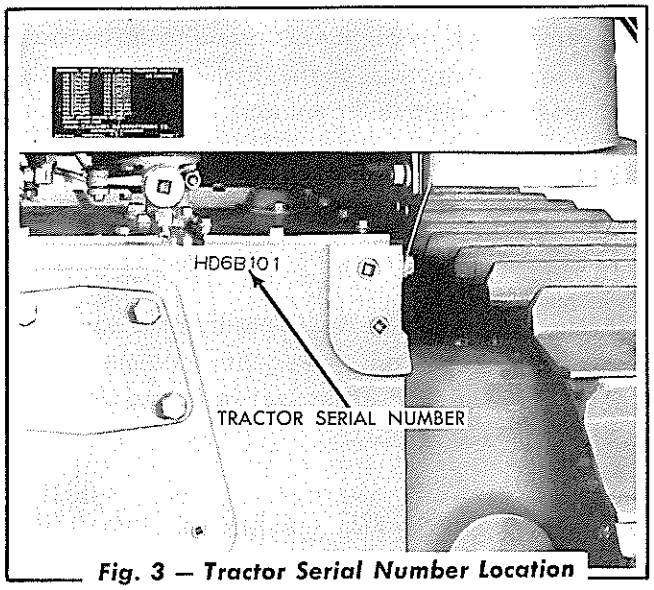

Fig. 3 — Tractor Serial Number Location

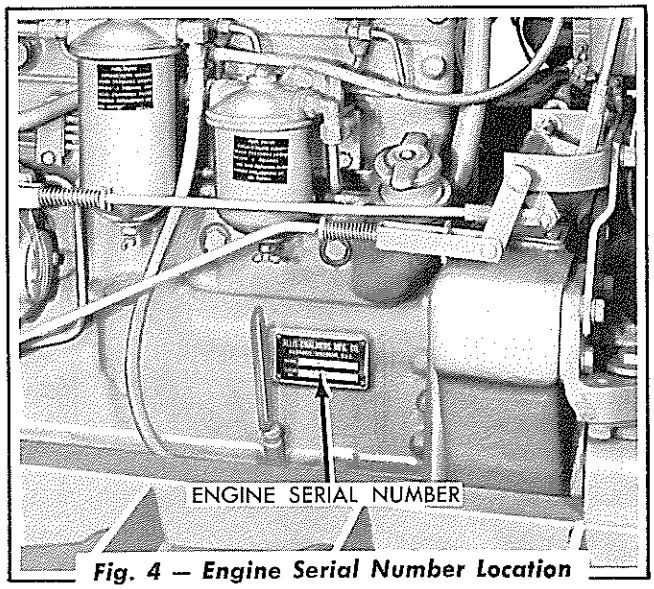

Fig. 4 — Engine Serial Number Location

SECTION II — ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS

1. DESCRIPTION OF SYSTEM

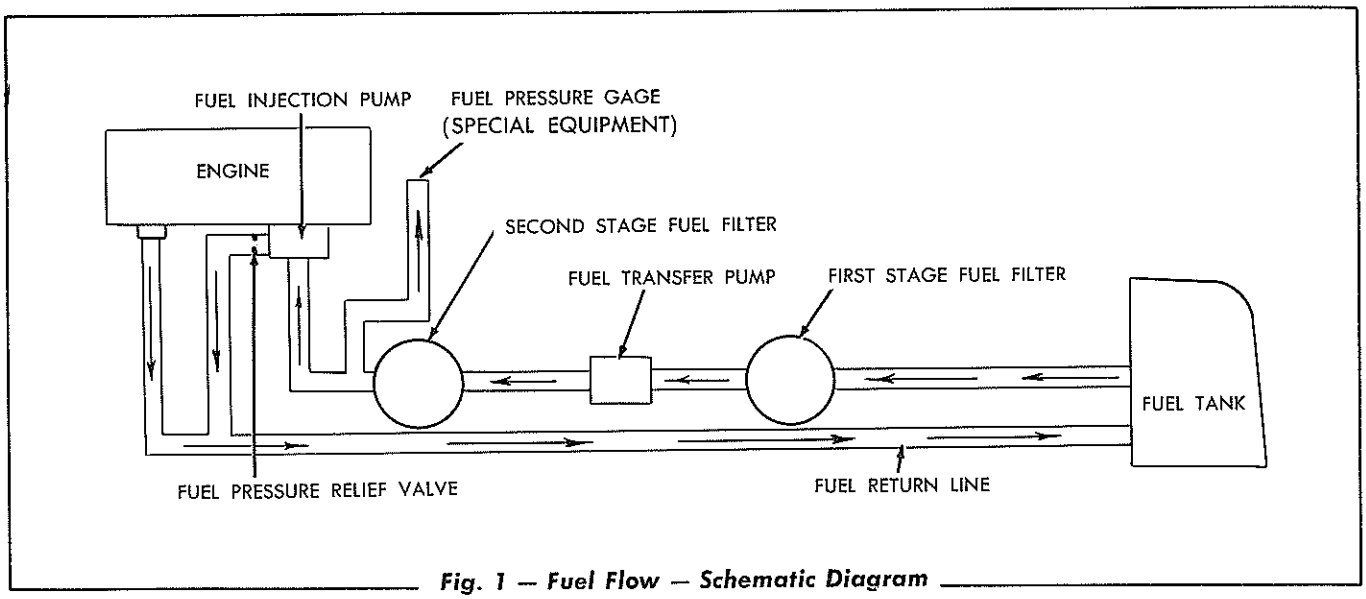

Fig. 1 — Fuel Flow — Schematic Diagram

The engine fuel system consists of a fuel tank, first stage fuel filter, fuel transfer pump, second stage fuel filter, fuel injection pump, fuel injection nozzles, and the fuel lines. There are two fuel pressure systems; the low pressure system and the high pressure system.

The low pressure system consists of the fuel tank, first stage fuel filter, fuel transfer pump, second stage fuel filter, fuel return manifold, and the fuel return line leading from the fuel pressure relief valve of the fuel injection pump to the fuel tank.

The high pressure system consists of the fuel injection pump, fuel injection nozzles, and fuel injection lines connecting the fuel injection pump to the fuel nozzles. The fuel injection lines are seamless steel tubing and each line is the same length. These lines being the same length assures the proper timing and the proper amount of fuel to each fuel injection nozzle. These lines are not interchangeable; when ordering lines for replacement, specify for which cylinder the line is ordered.

The fuel is drawn from the fuel tank, through the first stage fuel filter, by the fuel transfer pump. The fuel is then forced by the transfer pump, through the second stage fuel filter and to the fuel injection pump. The amount of fuel required for combustion is forced under high pressure by the fuel injection pump, through the fuel injection lines to the fuel injection nozzles, from which the fuel enters the engine combustion chambers in the form of a fine cone-shaped spray.

There is a certain amount of fuel seepage between the lapped surfaces of each fuel injection nozzle valve and its body, which is necessary for lubrication. This leakage of fuel accumulates around the spindle and in the spring compartment of each fuel injection nozzle, and is returned through the fuel return manifold to the fuel pressure relief valve and then to the fuel tank. The excess fuel delivered to the fuel injection pump by the fuel transfer pump is also returned to the fuel tank through the fuel return line. A pressure of 5 to

15 P.S.I. is maintained within the low pressure fuel system by a fuel pressure relief valve installed in the fuel return outlet of the fuel injection pump.

The heavy-duty fuel injection pump is of the constant-stroke, distributing-plunger, sleeve control type, the plunger being actuated by a cam and tappet arrangement which also carries the gearing for the distribution function. Its purpose is to meter the fuel accurately and deliver it precisely at a definite moment in the engine cycle and under high pressure to the fuel injection nozzles. The fuel injection pump plunger is 9 mm. in diameter and the pump is controlled by a mechanical-centrifugal type (type "C") governor.

The function of the fuel injection nozzles is to direct the metered quantity of fuel, received from the fuel injection pump, into the engine combustion chambers in a definite spray pattern and in such a manner as to produce the most efficient engine performance. The valve of each fuel injection nozzle is operated hydraulically by the pressure of the fuel delivered by the fuel injection pump.

2. CHECKING OF SYSTEM

A. General

"Missing" or uneven running of the engine, excessive vibration, stalling when idling, and loss of power are indications of insufficient fuel supply to the engine. Before performing any of the following checks, make certain there is an ample supply of fuel in the fuel tank.

B. Check for Admission of Air Into System

Loosen the vent screw (Fig. 16) located in the top of the second stage fuel filter. Crank the engine with the starter. If fuel containing bubbles flows from around the vent screw, this indicates that air is being drawn into the system on the suction side of the fuel transfer pump. Correct this condition by tightening any loose low pressure fuel line connections, first stage fuel filter connections, and the first stage fuel filter shell retaining nut.

C. Check for Clogged Fuel Filters and Clogged or Collapsed Fuel Lines

Loosen the vent screw (Fig. 16) in the top of the second stage fuel filter and crank the engine with the starter. If a full flow of fuel is not obtained from around the loosened vent screw, this indicates a clogged or collapsed fuel line or a clogged first stage fuel filter element. If this condition exists, remove and replace the first stage fuel filter element or clean or replace the necessary fuel line.

If a full flow of fuel was obtained from around the loosened vent screw in the second stage fuel filter, tighten the vent screw. Loosen the pipe plug in pipe tee (Fig. 28) of the second stage fuel filter, crank the engine with the starter, and check for full flow of fuel from the pipe tee. If a full flow of fuel is not obtained from the pipe tee, this indicates a clogged second stage fuel filter element and the element must be replaced. Tighten the pipe plug.

D. Check for Inoperative Fuel Pressure Relief Valve or Inoperative Fuel Transfer Pump

The gear type fuel transfer pump (Fig. 2) should deliver more fuel to the fuel sump of the fuel injection pump than is required for engine operation. The fuel pressure relief valve (Fig. 2), connected into the fuel return passage of the fuel injection pump, controls the maximum fuel pressure within the fuel sump of the injection pump. When the fuel pressure within the fuel sump of the injection pump exceeds 15 P.S.I., the fuel pressure relief valve opens and allows the excess fuel to return to the fuel tank through the fuel return line. The fuel leak-off from the fuel injection nozzles is also returned to the fuel tank through this valve and the fuel return line. Check for an inoperative fuel pressure relief valve or an inoperative fuel transfer pump as follows:

1. Remove the pipe plug from the pipe tee (Fig. 28) of the second stage fuel filter. Install a suitable pressure gage in the opening from which the plug was removed.

2. Start the engine and operate at approximately one-half throttle. Observe the fuel pressure indicated by the gage. The gage should indicate a pressure of 5 to 15 P.S.I. If the gage indicates a pressure below 5

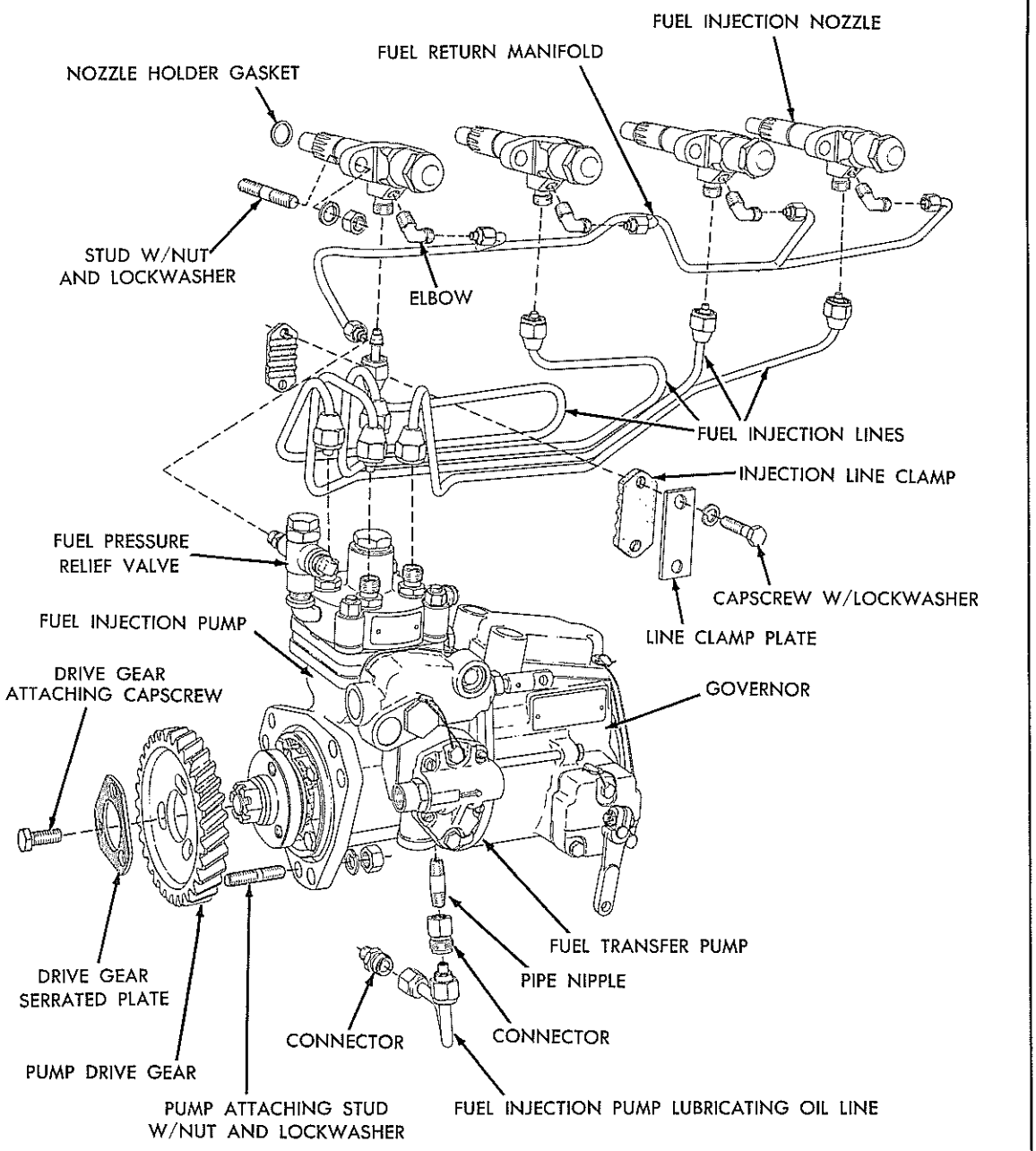

Fig. 2 — Fuel Injection Pump, Injection Nozzles, and Fuel Pressure Relief Valve

P.S.I., stop the engine and disconnect the fuel return line from the fuel pressure relief valve.

3. Start the engine and operate at approximately one-half throttle. If the gage indicates a pressure below 5 P.S.I. and a full flow of fuel is observed from the fuel pressure relief valve, this indicates that the relief valve is stuck in the open position and the valve must be replaced as a unit. However, if the gage indicates a pressure below 5 P.S.I. and little or no fuel is observed from the fuel pressure relief valve, this indicates an inoperative fuel transfer pump and the pump must be removed, inspected, and replaced as a unit if necessary.

4. If a pressure above 15 P.S.I. is indicated by the gage, the fuel pressure relief valve is inoperative and must be replaced as a unit.

5. Stop the engine and remove the pressure gage. Install and tighten the pipe plug. Connect the fuel return line to the fuel

pressure relief valve.

E. Check for Inoperative Fuel Injection Nozzles

"Missing" or uneven running of the engine and loss of power are an indication of an inoperative fuel injection nozzle or nozzles. Locate the faulty fuel injection nozzle or nozzles as follows:

Run the engine at low idle speed and "cut-out" each fuel injection nozzle in turn by loosening the fuel injection line nut attaching the fuel injection line (Fig. 2) to its corresponding fuel injection nozzle. NOTE: *KEEP THE HANDS AWAY FROM THE LOOSENED NUT WHILE PERFORMING THIS TEST.* A decrease in engine speed with the injection line nut loosened indicates that the nozzle for that cylinder is functioning properly. If the engine speed does not decrease, the nozzle is inoperative and should be replaced. The "faulty" nozzle should be taken to your nearest "Allis-Chalmers" Construction Machinery Dealer for repair, testing, and adjustment as a special nozzle tester is required.

F. Check for Inoperative Fuel Injection Pump

If all the above causes for insufficient fuel supply have been eliminated, and the engine still runs unevenly and normal engine performance is not obtained, the fuel injection pump will be considered at fault and should be replaced. The "faulty" fuel injection pump (with governor) should be taken to your nearest "Allis-Chalmers" Construction Machinery Dealer for repairs and testing. IMPORTANT: *Do not replace the fuel injection pump before making certain that all other possible causes for improper engine operation have been eliminated.*

3. FUEL TANK AND FUEL FILTERS

A. Service and Maintenance

Refer to "FUEL SYSTEM" in the HD-6 Tractor Operators Manual for descriptive information and service and maintenance instructions on these components.

B. Fuel Tank Removal and Installation

1. Removal

a. Remove the arm rest cushion from each battery box. Remove the two capscrews (located inside each battery box) attaching each side of the fuel tank to the rear of the corresponding battery box.

b. Close the fuel tank shut-off cock, located under the fuel tank. Thoroughly clean the shut-off cock and the connection of the fuel supply rear tube. Disconnect the fuel supply rear tube from the fuel tank shut-off cock and cover the end of the tube to prevent the entrance of dirt.

c. Thoroughly clean the connection on the rear of the fuel return rear tube, located under the left side of the fuel tank. Disconnect the fuel return rear tube from the tank and cover the end of the tube to prevent the entrance of dirt.

d. Remove the three bolts attaching each side of the fuel tank to the rear fenders.

e. Place a suitable chain or rope around the fuel tank and remove the tank from the tractor. When removing, keep the tank mounting shims separated so that they may be reinstalled in their original positions.

2. Installation

Install the fuel tank by a direct reversal of the removal procedure given above. Tighten the bolts attaching the fuel tank to the rear fenders to a torque of 70 to 90 lbs. ft.

4. FUEL INJECTION NOZZLES

A. General

Each cylinder of the engine is provided with a throttling pintle-type, differential-needle, hydraulically-lifted fuel injection nozzle. The function of each fuel injection nozzle is to direct the metered quantity of fuel, received from the fuel injection pump, into the corresponding combustion chamber of the engine in a highly atomized, pre-determined spray pattern and in such a manner as to produce the most efficient engine performance.

Each fuel injection nozzle consists of two assemblies; the injection nozzle holder assembly and the injection nozzle assembly. The holder assembly is used to hold the injection nozzle in its correct position in the cylinder head and to provide a means of conducting fuel, received from the fuel injection pump, to the nozzle. The holder consists of a steel holder body, spindle, spindle spring and spring seat, spring retainer nut, pressure adjusting screw, nozzle holder cap, and a nozzle retaining nut. The nozzle consists of a nozzle valve and a valve body. The nozzle valve is operated hydraulically within the valve body by the fuel delivered under pressure by the fuel injection pump.

B. Operation

The metered quantity of fuel under pressure, delivered by the fuel injection pump, enters the fuel inlet passage of the injection nozzle holder body, passes through the holder body fuel duct into the nozzle body fuel duct, via the annular groove in the top of the nozzle body, and then into the pressure chamber above the nozzle valve seat.

At the instant the pressure of the fuel in the pressure chamber exceeds the pressure exerted on the spindle and the nozzle valve by the spindle spring, the nozzle valve is lifted off its seat and the fuel is forced through the orifice in the end of the valve body and into the corresponding combustion chamber of the engine. The nozzle valve is returned to its seat by the pressure exerted by the spindle spring, as soon as the fuel injection pump has ceased to deliver fuel to the nozzle.

There is a certain amount of fuel seepage between the lapped surfaces of each nozzle valve and valve body, which is necessary for lubrication. This leakage of fuel accumulates around the spindle and in the spring compartment of the fuel nozzle, and is returned through the fuel return manifold to the fuel pressure relief valve, where it is returned to the fuel tank through the fuel return line extending from the relief valve to the fuel tank.

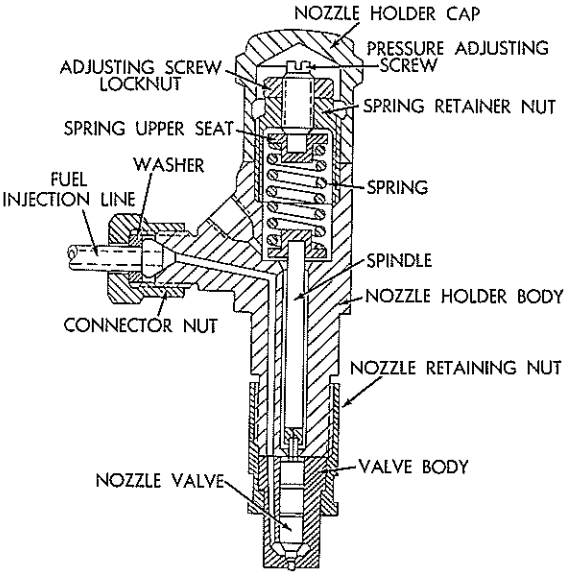

Fig. 3 — Fuel Injection Nozzle (Sectional View)

C. Service

The fuel injection nozzles should be removed after the first 50 to 75 hours of operation, tested for proper "popping" pressure, and adjusted if necessary. The above test and adjustments should again be made periodically thereafter (after approximately every 2000 hours of operation). The fuel injection nozzle when properly adjusted should require a pressure of 2000 P.S.I. to raise the nozzle valve from its seat. The opening pressure ("popping pressure") is adjustable by means of the pressure adjusting screw. Turning the adjusting screw counterclockwise decreases the opening pressure; turning the adjusting screw clockwise increases the opening pressure. NOTE: *A special nozzle tester, similar to the one shown in Fig. 5, is required for testing and adjusting the fuel nozzles.*

D. Removal of Fuel Injection Nozzles from Engine

1. Thoroughly clean the fuel injection nozzles and the surrounding area before removing the nozzles.

2. Disconnect the fuel return manifold and the fuel injection lines from the nozzles. CAUTION: *Do not bend the lines when disconnecting. Cover the ends of the disconnected lines to prevent the entrance of dirt.*

3. Remove the nozzle holder cap (Fig. 3) from the nozzle. Remove the two nuts and lockwashers securing the nozzle to the cylinder head.

4. A nozzle puller adapter and slide hammer puller (similar to the ones shown in Fig. 4) are used to pull the fuel injection nozzles.

   a. Turn the nozzle puller adapter onto the fuel injection nozzle as shown. NOTE: *Make certain that the puller adapter is turned onto the nozzle as far as possible, then tighten with a wrench.*

   b. Turn the end of the slide hammer into the puller adapter as shown. Before pulling the nozzle from the cylinder head, bump inward (lightly) on the nozzle with the slide hammer to loosen the nozzle, then pull the nozzle from the cylinder head. CAUTION: *Use care when removing a nozzle to prevent striking the nozzle tip against a hard object, which could result in damage to the tip.*

   c. Remove the slide hammer puller and nozzle puller adapter. Reinstall the nozzle holder cap in position on the nozzle. NOTE: *The special tools illustrated in Fig. 4 are available; contact your nearest "Allis-Chalmers" Dealer.*

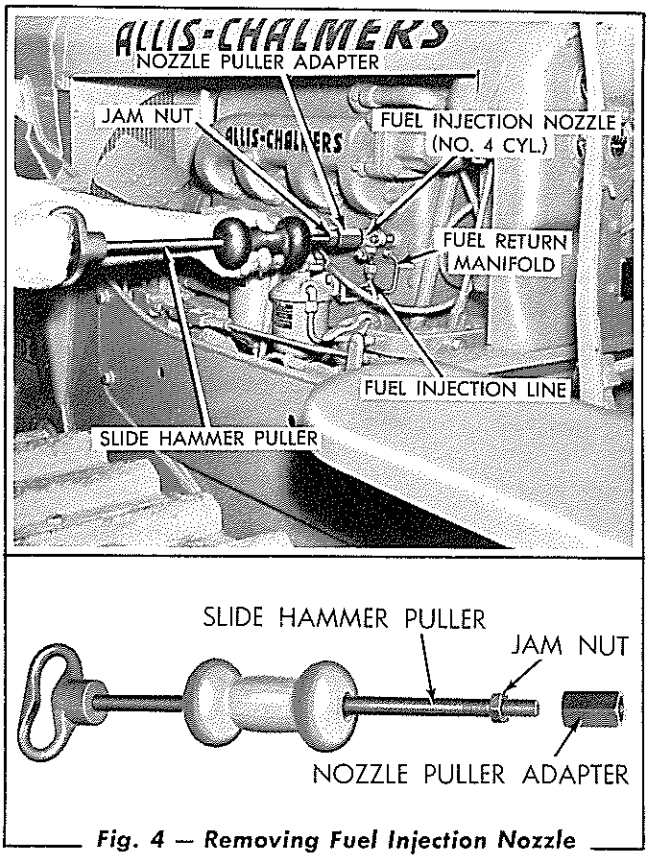

Fig. 4 — Removing Fuel Injection Nozzle

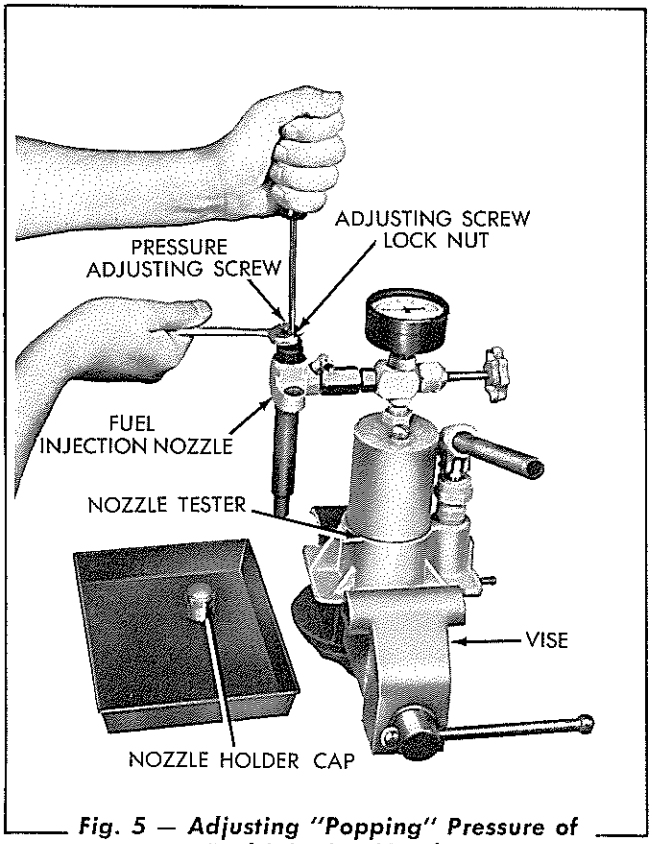

Fig. 5 — Adjusting "Popping" Pressure of Fuel Injection Nozzle

E. Testing and Adjusting

To pressure test and adjust the fuel injection nozzles, a special nozzle tester, similar to the one shown in Fig. 5, is required. Nozzle testers similar to the one shown are available; contact your nearest "Allis-Chalmers" Dealer. Test and adjust each nozzle as follows:

1. Bolt the nozzle tester to a work bench or clamp it in a vise as shown.

2. Turn the valve of the nozzle tester to the open position. Operate the tester handle until fuel flows from the tester outlet, then close the valve.

3. Install the fuel injection nozzle on the nozzle tester as shown.

4. Open the valve of the nozzle tester. Operate the tester handle a few quick strokes and observe the "popping" pressure of the fuel injection nozzle, indicated by the pressure gage of the nozzle tester. The specified "popping" pressure for a used nozzle is 2000 P.S.I. and for a new nozzle, or a nozzle having a new spindle spring, is 2100 P.S.I. If the specified "popping" pressure is not obtained, adjustment of the nozzle is necessary. Adjust as follows:

   a. Remove the nozzle holder cap and loosen the adjusting screw locknut.

   b. While operating the tester handle, turn the pressure adjusting screw *IN* to increase or *OUT* to decrease the pressure as necessary to obtain the specified "popping" pressure. When the specified "popping pressure" is obtained, hold the adjusting screw with a screwdriver and tighten the adjusting screw locknut. Install and tighten the nozzle holder cap.

   CAUTION: *ALWAYS KEEP THE HANDS AWAY FROM THE NOZZLE TIP WHEN "POPPING" A FUEL INJECTION NOZZLE, AS THE FINELY ATOMIZED FUEL FROM THE NOZZLE TIP IS EJECTED WITH SUCH FORCE THAT IT WILL PENETRATE THE SKIN AND MAY CAUSE BLOOD POISONING.*

5. After adjusting the fuel injection nozzle for the specified "popping" pressure, test the nozzle as follows:

   a. Operate the tester handle slowly so that the pressure is approximately 100 pounds below the "popping" pressure and observe the tip of the nozzle for fuel leakage. If the nozzle does not leak or dribble, the nozzle valve is seating properly on its seat in the valve body. If drops of fuel collect at a pressure less than 100 pounds below the "popping" pressure, the nozzle valve is not seating properly in the valve body and the valve body and valve must be removed for cleaning and inspection.

   b. If the fuel injection nozzle proved satisfactory when subjected to the leakage test above, operate the tester handle at a speed of approximately 100 strokes per minute and observe the nozzle spray pattern.

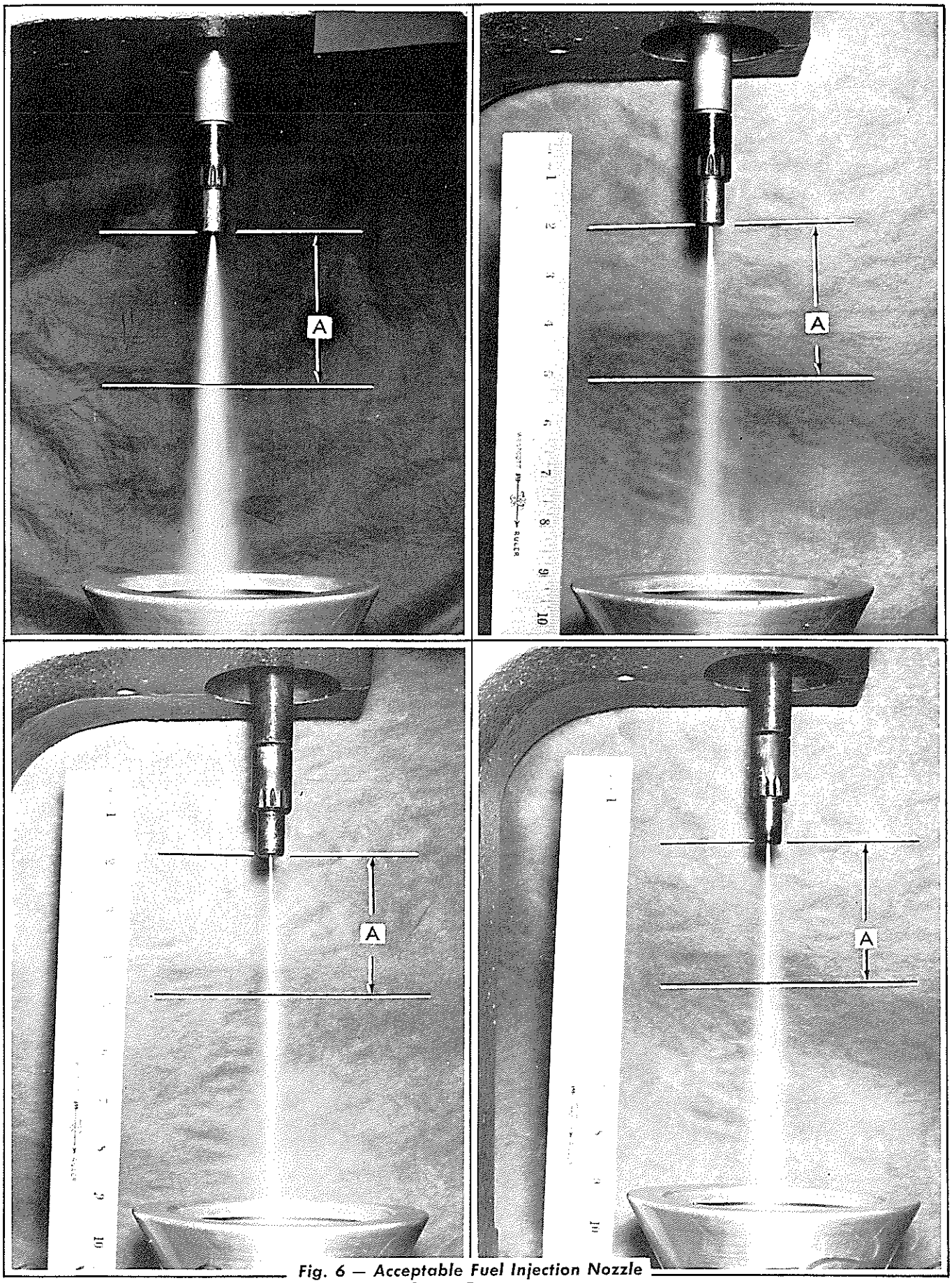

Fig. 6 — Acceptable Fuel Injection Nozzle Spray Patterns

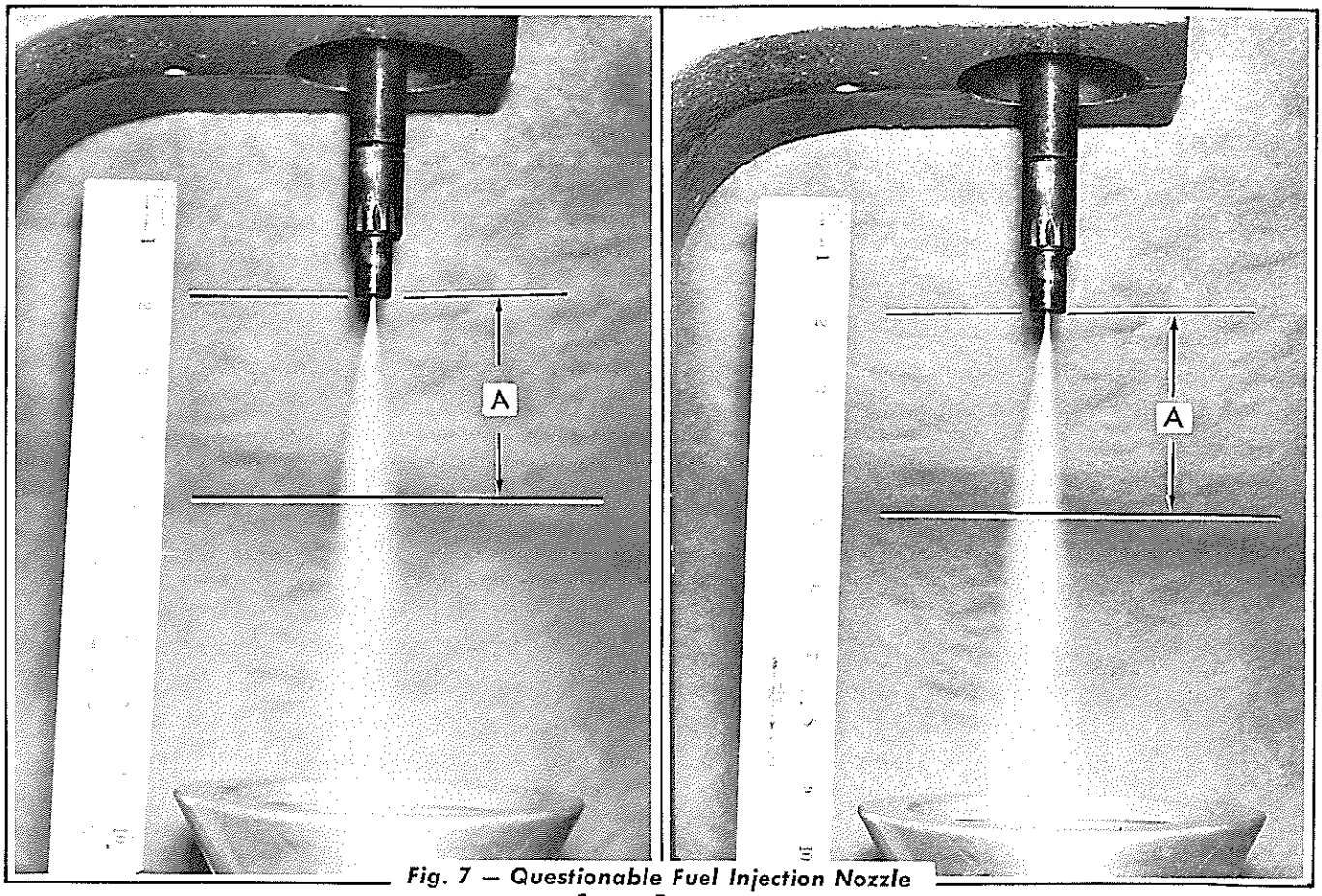

Fig. 7 — Questionable Fuel Injection Nozzle Spray Patterns

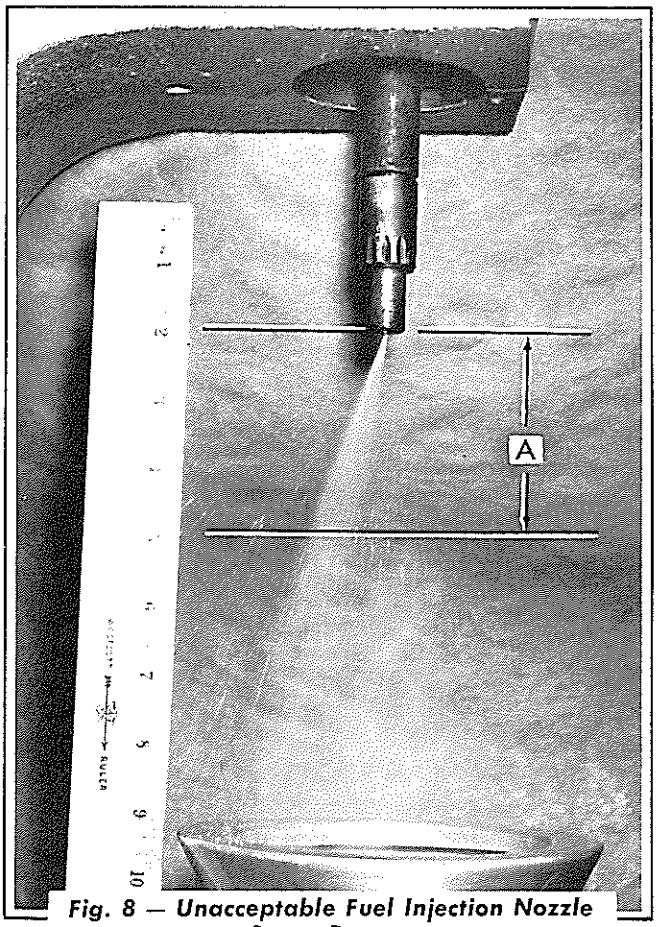

Fig. 8 — Unacceptable Fuel Injection Nozzle Spray Pattern

F. Fuel Injection Nozzle Spray Patterns

Acceptable spray patterns may vary greatly in appearance as shown in the following illustrations. The results so far as engine life and performance are concerned are not affected by the various *acceptable* spray patterns.

In determining whether or not a spray pattern is acceptable, the pattern within approximately the first 3 inches (indicated by "A" in the illustrations) from the nozzle tip is important. The spray pattern beyond the first 3 inches is not important for any practical purposes.

The spray patterns shown in Fig. 6 are acceptable and are considered very good.

The spray patterns shown in Fig. 7 are questionable as there is the possibility that an insufficient quantity of fuel will enter the opening of the energy cell, therefore causing early combustion in the main combustion chamber and detonation may result. The nozzle valve body and valve should be removed for cleaning and inspection.

Nozzles having a spray pattern similar to the one shown in Fig. 8 are unacceptable and the nozzle valve body and valve must be removed, inspected for damage, and replaced if necessary.

G. Installation of Fuel Injection Nozzles in Engine

1. Thoroughly clean each fuel injection nozzle recess in the cylinder head before inserting the nozzles. Make certain that no particles of carbon are present which would cause a nozzle to be cocked, thereby, permitting "blow-by" from the cylinder. Hard or sharp tools should not be used for cleaning; a round piece of wood or brass properly shaped is very effective.

   NOTE: *Under no circumstances should an engine be operated with a leaky or blowing-by nozzle holder, since this will cause a localization of heat which will distort the nozzle, thereby, causing serious damage.*

2. Always use a new nozzle holder gasket when installing a fuel injection nozzle. Place a new gasket in position on the end of each nozzle and carefully insert the nozzles into position in the cylinder head.

3. Install two lockwashers and hex-nuts to secure each fuel injection nozzle to the cylinder head; tighten the nuts evenly to a torque of 18 to 21 lbs. ft.

4. Connect the fuel injection lines and the fuel return manifold to the nozzles and tighten the connection nuts securely.

H. Disassembly of Fuel Injection Nozzle

Before starting the disassembly of a fuel injection nozzle, it is necessary to have an extremely clean work bench on which to work and to place the parts. Cleanliness is emphasized because most all injection nozzle service troubles are directly due to dirt, or other foreign matter, entering the nozzles. Use clean paper on the work bench, and after the nozzle has been disassembled, place the parts in a container of clean "DIESEL" fuel as protection against dirt and corrosion. Leave the parts in the clean fuel until needed for reassembly.

When more than one fuel injection nozzle is disassembled, keep the parts of each nozzle separate. Complete disassembly of the injection nozzle holder is seldom necessary. As the nozzle valve and the nozzle valve body are lapped together to become mated parts, they must be kept together; if replacement of either part is necessary, both parts must be replaced as matched sets.

1. Disassembly, Cleaning, and Assembly of Fuel Injection Nozzle Valve

In most cases where service to a fuel injection nozzle is necessary, the disassembly and cleaning of the nozzle valve and valve body only is required to place the nozzle in good operational condition. Disassemble and clean the injection nozzle valve and valve body as follows:

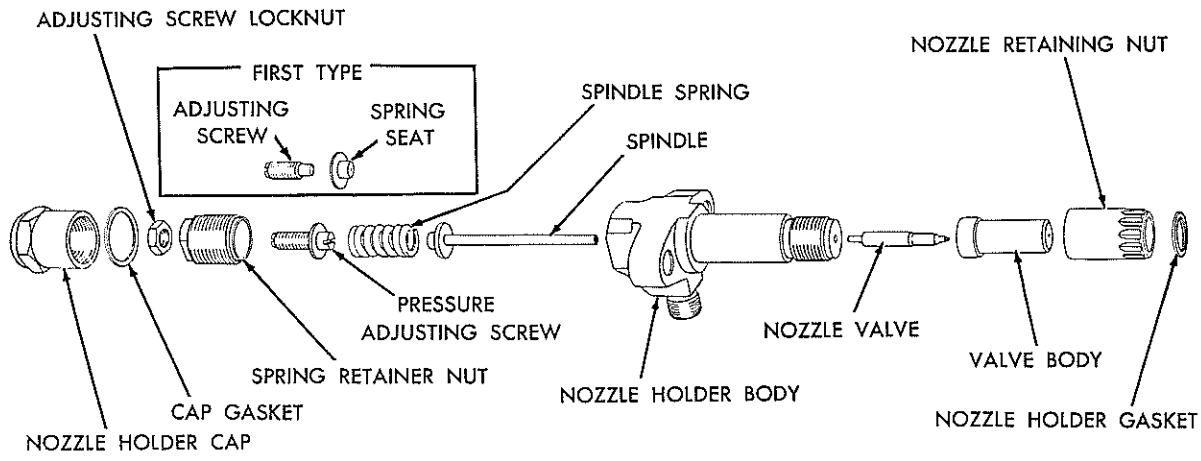

Fig. 9 — Fuel Injection Nozzle Details

a. Clean all dirt and loose carbon from the assembly, using a clean cloth free of lint.

b. Place the fuel injection nozzle in position in an injection nozzle holding fixture, similar to the one shown in Fig. 11, then clamp the holding fixture in a vise, with the nozzle end upward. Using a suitable socket, or box wrench, loosen and remove the nozzle retaining nut.

c. Remove the nozzle valve body and the nozzle valve. Normally the nozzle valve can easily be withdrawn from the valve body. However, in some cases, it may be necessary to soak the nozzle valve and valve body in "DIESEL" fuel, acetone, carbon-tetrachloride, or a similar carbon solvent before the valve can be withdrawn from the valve body.

d. Clean the nozzle valve with mutton tallow used on a soft cloth or a felt pad. The nozzle valve may be held by its upper stem portion in a revolving chuck while performing this cleaning operation. A piece of soft wood well soaked in oil, or a brass wire brush, is effective for removing carbon from the valve. CAUTION: *Do not use hard or sharp tools, emery cloth, crocus cloth, lapping compound, or abrasives of any kind to clean the nozzle valve or the valve body.*

e. Clean the inside of the valve body using a piece of soft wood (orange stick), having one end formed to correspond to the angle of the valve seat, and which has been well soaked in oil. Clean the orifice in the end of the valve body using a small piece of wood (orange stick) cut to the proper shape. The valve body may be held in a revolving chuck when performing the cleaning operation. Clean the outer surface of the valve body using a soft cloth soaked in carbon solvent. Do not attempt to scrape carbon from the surface around the orifice with a hard or sharp object as serious damage may result. NOTE: *A special cleaning kit is available for this purpose.*

f. Thoroughly rinse the valve body and the nozzle valve in clean fuel oil. The valve must fit free in the valve body. To check this fit, lift the valve about one-third of its length out of the body. The valve should slide down to its seat without aid when the assembly is held at a 45 degree angle. If the fit is unsatisfactory, work the valve in the body using clean mutton tallow. Using clean engine oil for a lubricant, lap the nozzle valve to its seat in the valve body by holding the stem of the valve in the hand and rotating the valve back and forth in the valve body. CAUTION: *Do not use abrasive materials for this operation as a very close tolerance must be maintained between these mating parts.*

g. After lapping the nozzle valve to its seat in the valve body, remove the valve from the valve body and rinse in clean fuel oil.

h. Examine the flat sealing surface of the valve body (surface which contacts the lower end of the holder body) and make certain the surface is clean and free from scratches. This surface should be lapped if necessary using a fine grain lapping compound and a lapping block as shown in Fig. 10. After lapping, remove all traces of the lapping compound with fuel and dry with filtered compressed air.

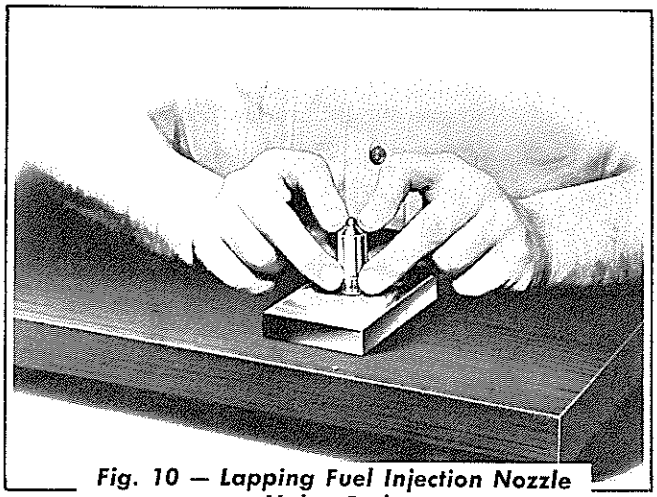

Fig. 10 — Lapping Fuel Injection Nozzle Valve Body

i. Make certain that the bottom flat sealing surface of the nozzle holder body is clean and in good condition. Rinse the nozzle valve and valve body in clean fuel, then insert the nozzle valve into position in the valve body. With the nozzle holder body and nozzle holding fixture clamped in a vise with the nozzle end upward, place the nozzle valve and valve body in position on the end of the nozzle holder body and center the valve body with the holder body. Lower the nozzle retaining nut into position over the valve body. NOTE: *It is essential that the valve body be perfectly centered in the nozzle retaining nut; a nozzle centering sleeve is available for this purpose.* Slide the centering sleeve over the valve body, with the tapered end centering in the retaining nut. Keep the sleeve free while tightening the retaining nut; tighten the nut to a torque of 50 to 55 lbs. ft. Remove the centering sleeve.

j. Remove the fuel injection nozzle from the holding fixture and test and adjust following the procedure in Paragraphs E. and F. above.

2. Disassembly, Cleaning, and Assembly of Fuel Injection Nozzle Holder

If the malfunction of the fuel injection nozzle was not corrected by the removal and cleaning of the nozzle valve and the valve body as in 1. above, disassemble and clean the injection nozzle holder as follows:

a. Remove the nozzle retaining nut, then remove the nozzle valve and valve body as in 1. above.

b. Remove the nozzle holder cap and gasket. Loosen and remove the adjusting screw locknut.

c. Using an injection nozzle spring retainer nut wrench and an injection nozzle holding fixture similar to those shown in Fig. 11, remove the spring retainer nut. Remove the spindle spring and the spindle from the holder body.

d. Place all the parts in clean "DIESEL" fuel. Using filtered compressed air, blow out the fuel passages in the holder body.

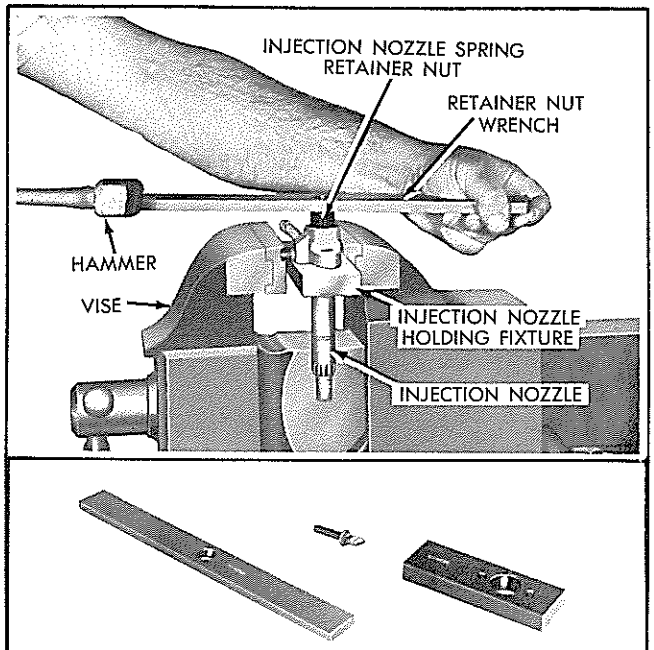

Fig. 11 — Removing Spring Retainer Nut from Fuel Injection Nozzle

e. Visually inspect the parts for damage or wear and replace the necessary parts. Examine the flat sealing surface of the holder body (surface which contacts the upper end of the valve body) and make certain the surface is clean and free from scratches. This surface should be lapped if necessary using a fine grain lapping compound and a lapping block as shown in Fig. 12. When lapping, use care to keep the lapping block square with the nozzle holder to assure contact with the entire area being resurfaced. After lapping, remove all traces of the lapping compound with fuel and dry with filtered compressed air.

Examine the spindle spring. If the spring is scratched or pitted, it must be replaced. Also, the spring must be replaced if the ends have worn from contact with the spring seats. Always replace questionable springs.

f. With the holder body and nozzle holding fixture clamped in a vise with the nozzle cap end upward, rinse the spindle in clean fuel and insert it into position in the holder body. Place the spindle spring in position on the spindle. NOTE: *If the nozzle being assembled has the early type pressure adjusting screw and upper spring seat (Fig. 9), place the spring seat in position on the spring.* Start the spring retainer nut (with pressure adjusting screw) into the holder body. Using an injection nozzle spring retainer nut wrench, similar to the one shown in Fig. 11, tighten the retainer nut securely (50 to 60 lbs. ft. torque).

g. Install the adjusting screw locknut and the nozzle holder cap (with gasket) but do not tighten at this time as the nozzle must be placed on a nozzle tester and adjusted for the proper "popping" pressure.

h. Install the nozzle valve, valve body, and the nozzle retaining nut following the procedure in 1. above.

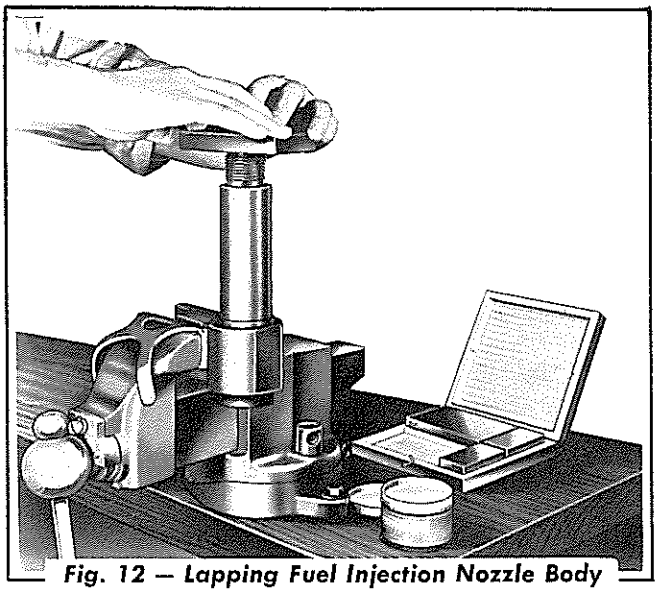

Fig. 12 — Lapping Fuel Injection Nozzle Body

i. Remove the fuel injection nozzle from the holding fixture and test and adjust following the procedure in Paragraphs E. and F. above. After testing and adjusting, tighten the nozzle holder cap to a torque of 50 to 60 lbs. ft.

5. FUEL INJECTION PUMP, GOVERNOR, AND FUEL TRANSFER PUMP

A. Description

The engine is equipped with an "American Bosch" (Type PSB 4A 90EH) heavy-duty fuel injection pump having a mechanical-centrifugal type (Type "C") governor. The fuel injection pump is of the constant stroke, multi-outlet, single and distributing-plunger, sleeve control type, the plunger being actuated by a cam and tappet arrangement which also carries the gearing for the distribution function. Its purpose is to meter the fuel accurately and deliver it precisely at a definite moment in the engine cycle and under high pressure to the fuel injection nozzles. The fuel injection pump is driven at crankshaft speed by the pump drive gear in mesh with the engine camshaft gear.

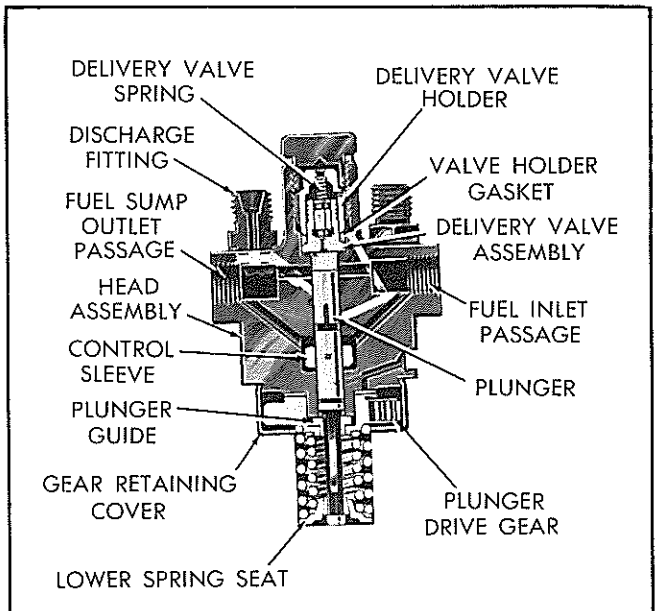

Fig. 13 — Fuel Injection Pump Hydraulic Head — Sectional View

The governor is of the mechanical-centrifugal type and is attached to the rear of the fuel injection pump as an integral unit. The governor is driven directly from the end of the fuel injection pump camshaft. The purpose of the governor is to serve as a means for pre-setting and maintaining within close regulation any desired engine speed within nominal idling and nominal maximum speed range, irrespective of engine load. The governor also controls the engine idling speed to prevent stalling

and the maximum speed to prevent racing.

The positive displacement, gear-type fuel transfer pump, attached to the left side of the fuel injection pump, is driven from the distributor drive gear of the fuel injection pump camshaft (the distributor drive gear is an integral part of the fuel injection pump camshaft). The purpose of the fuel transfer pump is to supply fuel under low pressure to the fuel sump of the fuel injection pump, where the fuel is then forced under high pressure by the fuel injection pump to the fuel injection nozzles.

The fuel injection pump and governor assembly receives lubrication from the engine lubricating system.

B. Operation

1. Pumping

Fuel from the fuel transfer pump passes through the second stage fuel filter, enters the fuel sump of the fuel injection pump, and fills, through two intake ports in the upper bore, that portion of the barrel cavity between the top of the fuel injection pump plunger and the bottom of the delivery valve, when the plunger is at the bottom of its stroke (A-Fig. 14). As the rotating plunger moves upward in its stroke under cam action, it passes and closes the intake ports, trapping and compressing the fuel, and the fuel under pressure opens the spring-loaded delivery valve located in the hydraulic head of the fuel injection pump. As the plunger continues its upward stroke, the fuel which is forced through the delivery valve, is conveyed through the communicating ducts to the annulus in the plunger and then through the vertical distributing slot on the plunger to the outlet duct with which the distributing slot is then registering as the plunger rotates (B and C — Fig. 14). After sufficient upward movement of the plunger, its lower annulus passes the edge of the control sleeve and the fuel under pressure escapes down the vertical hole in the center of the plunger and into the sump of the control sleeve, which is at fuel supply pressure (D — Fig. 14). With collapse of the pressure beneath it, the delivery valve closes and the piston portion of the valve blocks the passage before the valve reaches its function of reducing the residual pressure in the discharge system. This is the end of the pumping cycle.

2. Metering and Control

The quantity of fuel delivered per stroke is governed by variation of the position of the control sleeve in relation to the fixed port closing position (the point at which the top of the plunger covers the intake ports), for as the spill annulus on the plunger breaks over the top edge of the control sleeve, pumping pressure is relieved down through the center hole of the plunger and out into the sump surrounding the control sleeve, and delivery terminates despite the continued upward movement of the plunger.

If the control sleeve position is raised, the spill annulus on the plunger remains covered by the sleeve until relatively late in the plunger stroke, hence the effective fuel delivery stroke of the plunger is longer and more fuel is delivered (A — Fig. 15). If the control sleeve position is lowered, the spill annulus on the plunger is uncovered by the sleeve relatively sooner in the plunger stroke, hence the effective fuel delivery stroke of the plunger is shorter and less fuel is delivered (B — Fig. 15). The position of the control sleeve is controlled by governor movement transmitted by an internal control rod connecting the fulcrum lever of the governor to the sleeve control lever of the fuel injection pump.

When the control sleeve is lowered to its extreme point (C — Fig. 15), the spill annulus on the plunger is uncovered by the top edge of the sleeve before the upper end of the plunger can cover the intake ports. Under this condition, no pressure can build up even after the ports are closed, hence no fuel can be delivered by the plunger. This is the fuel shut-off position.

C. Service

In most cases, malfunctioning of the fuel injection equipment is the direct result of dirty fuel. Dirt in the fuel causes rapid wear on the precision parts, particularly the plunger, hydraulic head, control sleeve, delivery valves and seats, and the fuel injection nozzle valves and valve bodies. Therefore, extreme care should be used in the storage and handling of fuel to prevent the entrance of dirt, water, and abrasive particles. Any water or sediment should be drained from the fuel filters daily and the fuel filter elements must be changed

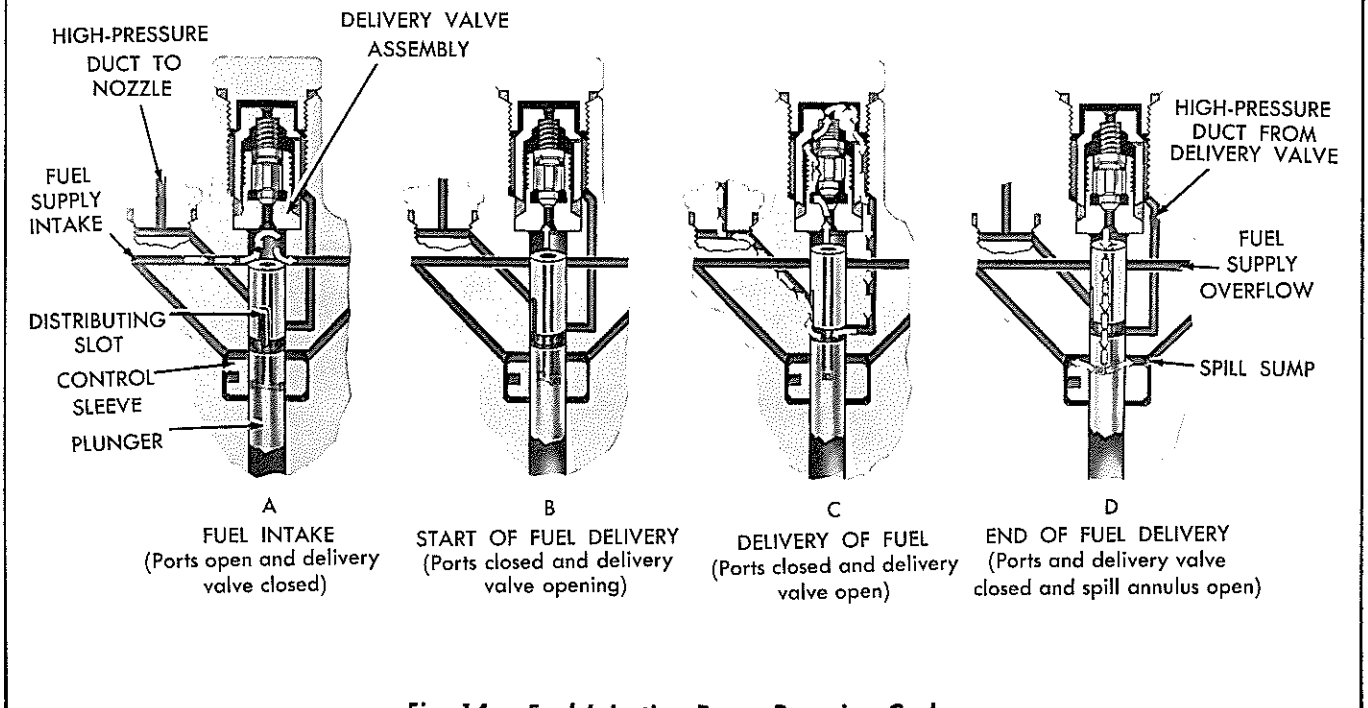

Fig. 14 — Fuel Injection Pump Pumping Cycles

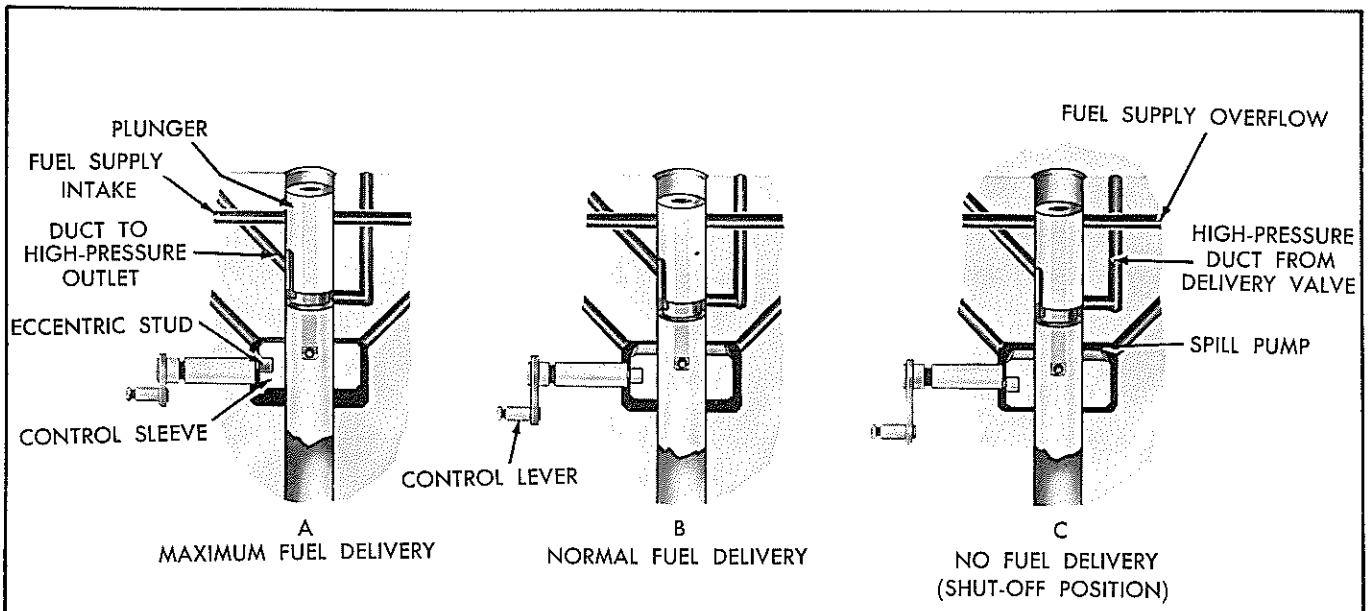

Fig. 15 — Fuel Injection Pump Control Sleeve Positions

after every 300 to 500 hours of operation (more often if conditions warrant).

As the fuel injection pump and governor assembly receive lubrication from the engine lubricating system, it is important that the engine lubricating oil and the lubricating oil filter be changed after every 100 hours of operation.

"Allis-Chalmers" Construction Machinery Dealers are equipped with Fuel Injection Pump Calibrating and Test Stands and the special tools required to test, adjust, and repair the fuel injection pump and governor assembly. Therefore, if at any time the fuel injection pump and governor assembly requires repairs or adjustment, the assembly should be removed and taken to your nearest

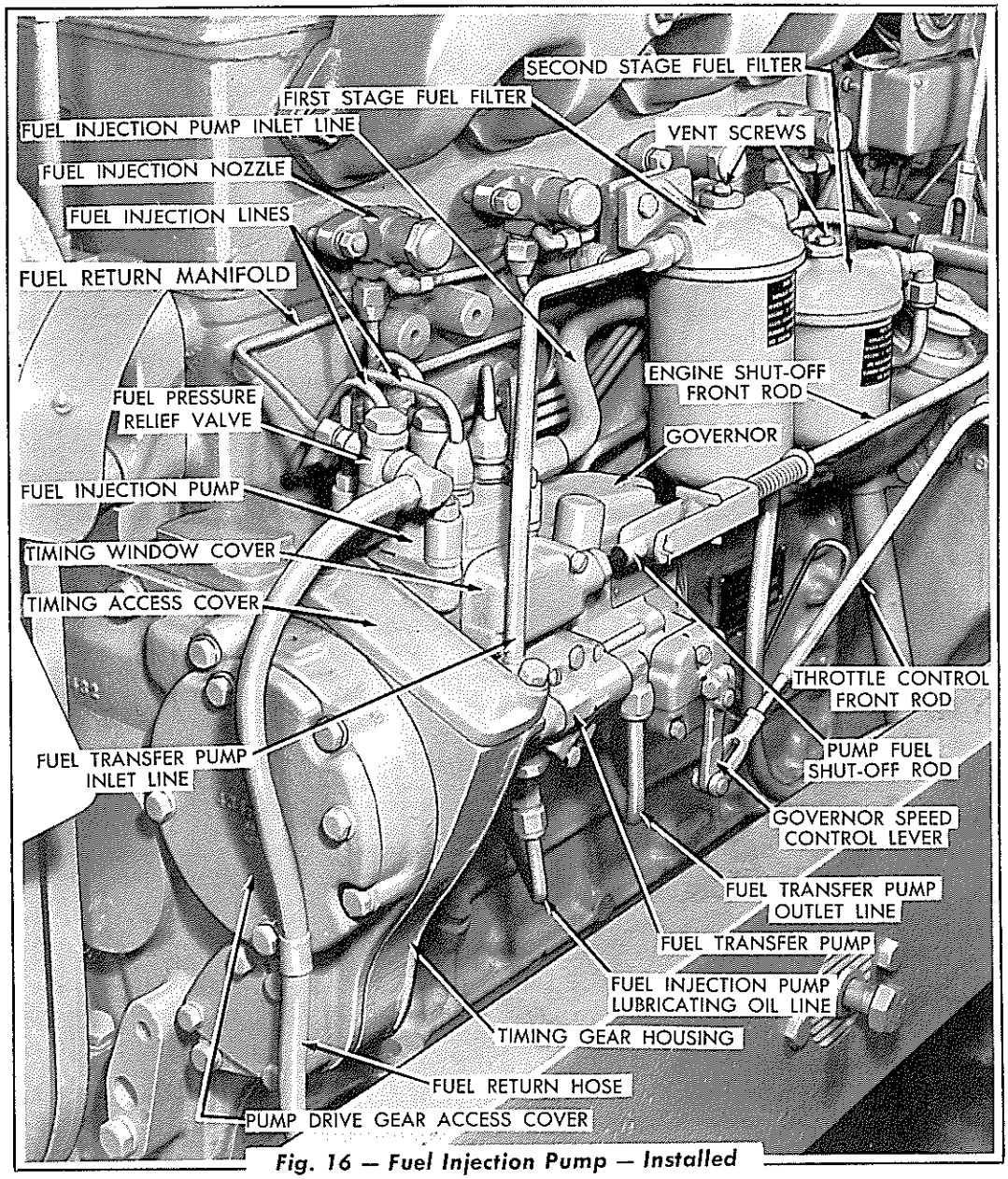

Fig. 16 — Fuel Injection Pump — Installed

"Allis-Chalmers" Construction Machinery Dealer.

D. Replacement and Timing of Fuel Injection Pump

1. General

The fuel injection pumps used on all Model HD-6 Tractors prior to Tractor Serial No. 5100 have a plunger diameter of 9 mm. and are timed for 28° B.T.D.C. (start of fuel injection into cylinders). These pump and governor assemblies are identified by the CUSTOMERS PART No. 4348453 or 4348454 stamped in the identification plate attached to the injection pump and governor assembly. The engine flywheel in these tractors is stamped for the 28° fuel injection pump timing.

Effective with Tractor Serial No. 5100, the fuel injection pump and timing was changed to provide an increase in horsepower. These fuel injection pumps are timed for 30° B.T.D.C. (start of fuel injection into cylinders); the plunger diameter is also 9 mm. in these pumps.

These later model fuel injection pumps are identified by the CUSTOMERS PART No. stamped in the identification plate attached to the fuel injection pump and governor assembly. These later fuel injection pumps for all Model HD-6 Tractors, excluding the HD-6G Models, carry the CUSTOMERS PART No. 4348761 or 4348773. The fuel injection pumps for all Model HD-6G Tractors (HD-6G's ONLY) carry the CUSTOMERS PART No.

4348762 or 4348774. The engine flywheel in all Model HD-6 Tractors Serial No. 5100 and above is stamped for the 30° fuel injection pump timing.

2. Removal of Fuel Injection Pump from Engine

Before removing the fuel injection pump from the engine, make certain that the No. 1 piston (piston nearest the cooling fan) is near the top on its compression stroke. CAUTION: *Make certain the engine shut-off knob is pulled back to the "STOP" position.*

a. Remove the engine air pre-cleaner assembly from the engine air cleaner. Remove the engine hood and the left front fender.

b. Thoroughly clean the valve rocker arm cover and the surrounding area, then remove the rocker arm cover from the engine.

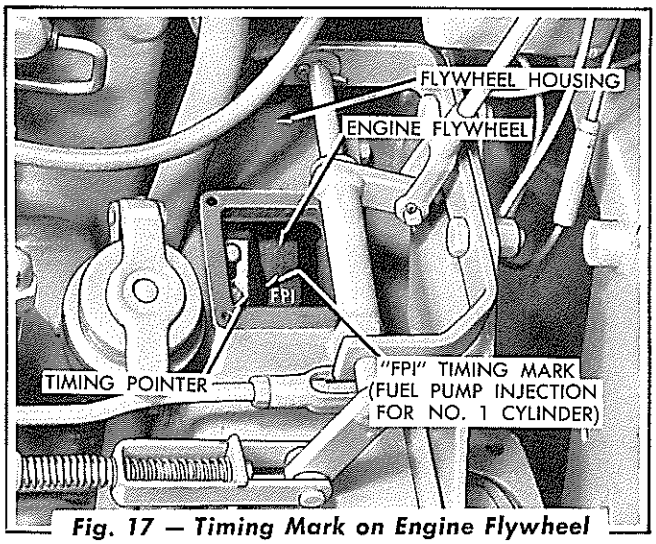

Fig. 17 — Timing Mark on Engine Flywheel

c. Remove the timing hole cover (Fig. 17) from the upper left side of the engine flywheel housing.

d. Crank the engine intermittently with the starter until the No. 1 piston is approaching top dead center on its compression stroke. This can be determined by observing the valves for the No. 1 cylinder. With both valves closed (valve push rods at the bottom of their travel), crank the engine by hand, by using a suitable socket wrench and extension on the crankshaft pulley retaining capscrew, until the F.P.I. mark (Fig. 17) stamped in the engine flywheel is aligned with the timing pointer. NOTE: *If the tractor is equipped with front mounted equipment, so that the engine cannot be cranked from the crankshaft pulley retaining capscrew, the engine may be cranked by hand using a suitable bar installed in the drive shaft universal joint as follows:*

(1) Remove the floor plate, move the gear shift lever to its neutral position, and pull the engine clutch operating lever back to its engaged position.

(2) Using a suitable bar, or similar tool, inserted into a yoke of the universal joint, turn the joint counterclockwise (viewed from the rear) until the F.P.I. timing mark (Fig. 17) is aligned with the timing pointer.

e. Remove the fuel injection pump timing access cover (Fig. 16) from the timing gear housing. With the F.P.I. timing mark on the engine flywheel aligned with the timing pointer as in step d. above, the fuel injection pump timing pointer should be in alignment with the center timing mark on the pump drive gear hub as shown in Fig. 18.

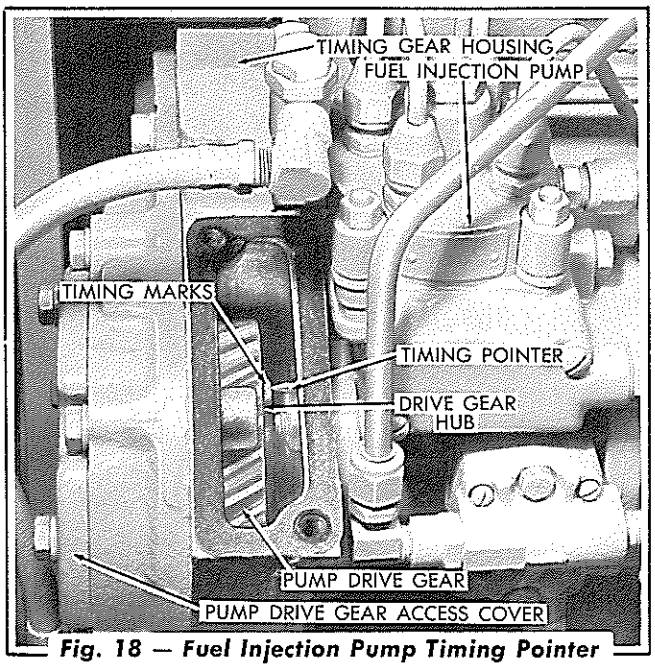

Fig. 18 — Fuel Injection Pump Timing Pointer

f. Turn the fuel tank shut-off cock to its closed position. Disconnect the throttle control front rod from the governor speed control lever. Disconnect and remove the engine

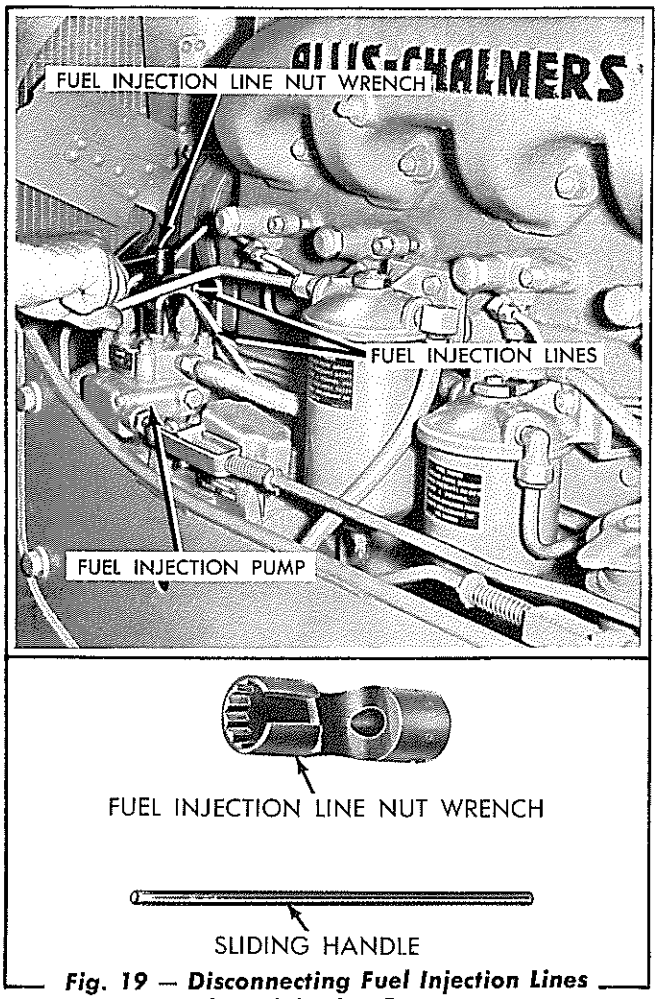

Fig. 19 — Disconnecting Fuel Injection Lines from Injection Pump

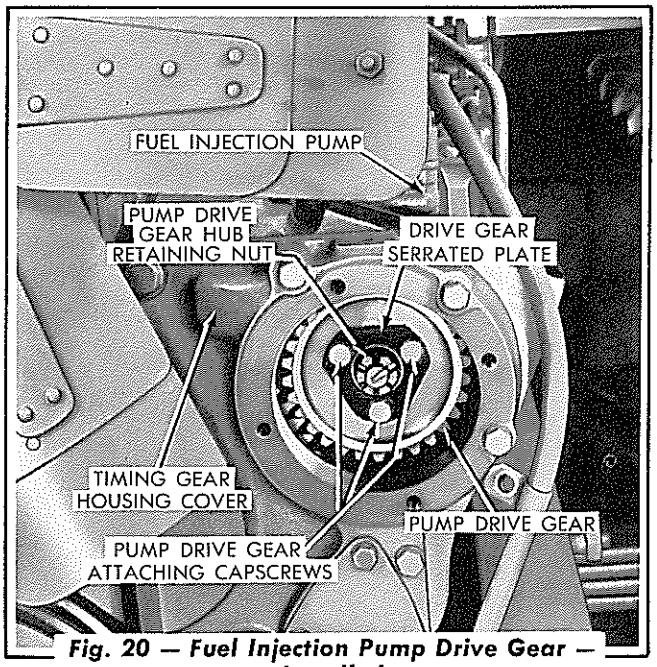

Fig. 20 — Fuel Injection Pump Drive Gear — Installed

shut-off front rod.

g. Disconnect and remove the fuel transfer pump inlet line. Disconnect the fuel transfer pump outlet line from the fuel transfer pump. Disconnect and remove the fuel injection pump lubricating oil line.

h. Disconnect and remove the fuel return hose. Disconnect the fuel injection pump inlet line from the fuel injection pump.

i. Disconnect the fuel return manifold from the fuel pressure relief valve. Disconnect all the fuel injection lines from the top of the fuel injection pump, using a fuel injection line nut wrench similar to the one shown in Fig. 19. IMPORTANT: *Tape or cover all the fuel openings to prevent the entrance of dirt.*

j. Remove the pump drive gear access cover (Fig. 16) from the timing gear housing cover. Remove the three pump drive gear attaching capscrews and remove the drive gear serrated plate (Fig. 20). Withdraw the pump drive gear.

k. Remove the three pump attaching stud nuts and lockwashers. Remove the fuel injection pump and governor as a unit as shown in Fig. 21.

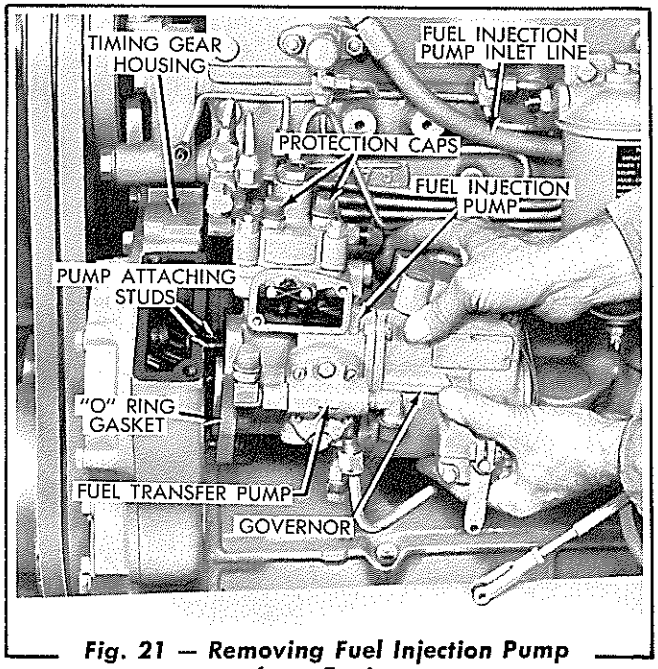

Fig. 21 — Removing Fuel Injection Pump from Engine

3. Installation and Timing of Fuel Injection Pump to Engine

Before starting the installation of the fuel injection pump, refer to the information in 1. above and

determine the tractor serial number and whether the fuel injection pump to be installed is for tractors prior to Serial No. 5100 or for tractors Serial No. 5100 and above.

The later model fuel injection pumps may be installed on tractors prior to Serial No. 5100 during fuel injection pump replacement, if desired. However, when this is done it is also necessary to re-mark the engine flywheel so that the later fuel injection pump may be timed properly. Re-mark the engine flywheel as follows:

a. **Procedure for Re-marking of Engine Flywheel on Tractors Prior to Serial No. 5100**

(1) With the No. 1 piston near the top on its compression stroke and the F.P.I. timing mark in alignment with the timing pointer as in 2. "REMOVAL OF FUEL INJECTION PUMP FROM ENGINE" (step d.) above, remove the generator drive belt adjusting link capscrew and lower the generator. NOTE: *On tractors having the later type generator mounting bracket, disconnect the battery-to-ground cable, remove the generator from its mounting bracket, and remove the mounting bracket from the engine.*

(2) Remove the two nuts and lockwashers securing the No. 1 cylinder energy cell clamp to the cylinder head.

(3) Using special tools similar to the ones shown in Fig. 22, pull the energy cell plug from the energy cell.

(4) Using special tools similar to the ones shown in Fig. 23, pull the energy cell from the cylinder head.

(5) It is necessary to insert a .512" thickness timing gage (Fig. 24) through the opening in the cylinder head for the No. 1 cylinder energy cell and position the gage between the top of the piston and the cylinder head, to properly position the engine flywheel for re-marking. Crank the engine slightly in the opposite direction (moving the flywheel in the clockwise direction when viewed from the rear) to lower the No. 1 piston so that the timing gage may be inserted.

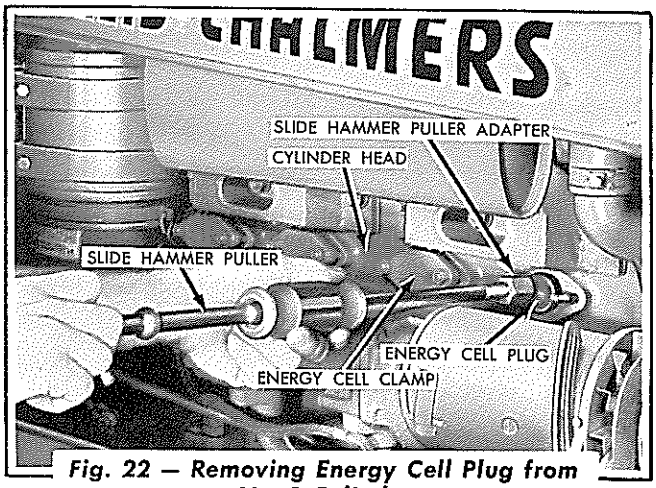

Fig. 22 — Removing Energy Cell Plug from No. 1 Cylinder

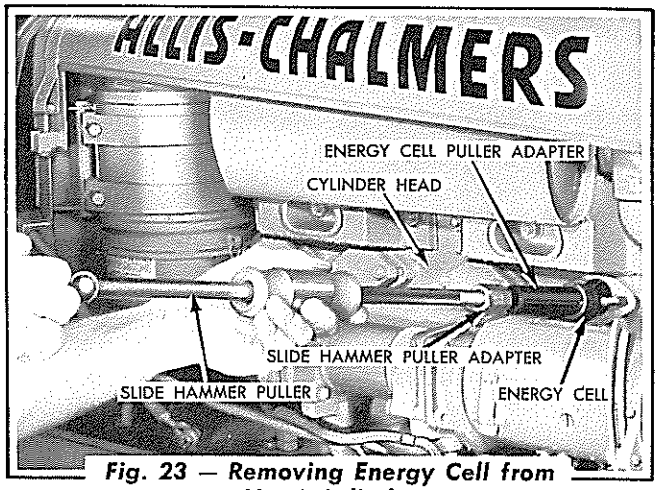

Fig. 23 — Removing Energy Cell from No. 1 Cylinder

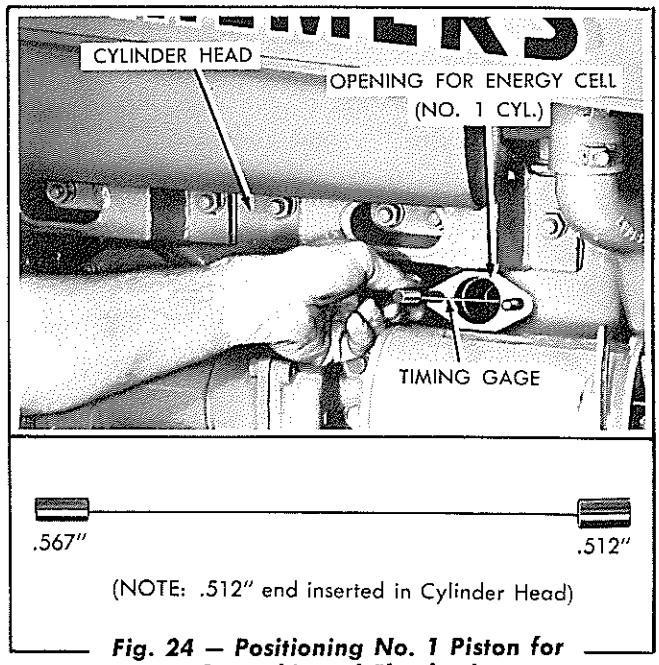

Fig. 24 — Positioning No. 1 Piston for Remarking of Flywheel

(6) Insert the .512" thickness end of the timing gage into the opening in the cylinder head as shown in Fig. 24, making certain the gage is located between the flat surface of the cylinder head and above the piston.

(7) Slowly crank the engine by hand, moving the flywheel in the counterclockwise direction when viewed from the rear, until the No. 1 piston just contacts the timing gage. CAUTION: *DO NOT USE THE STARTER TO CRANK THE ENGINE WHILE THE TIMING GAGE IS INSERTED.*

(8) Using a hammer and small chisel, carefully align the end of the chisel with the timing pointer (Fig. 17) and remark the flywheel for the 30° timing of the fuel injection pump.

(9) Crank the engine by hand, moving the flywheel in the clockwise direction when viewed from the rear, lowering the No. 1 piston enough to free the timing gage then withdraw the gage from the cylinder head.

(10) After withdrawing the timing gage, crank the engine by hand moving the flywheel in the counterclockwise direction until the new timing mark in the flywheel is properly aligned with the timing pointer.

(11) Install the No. 1 cylinder energy cell, energy cell plug, and the energy cell clamp (refer to Section 8, Topic No. 2, Paragraph E.).

b. Procedure for Installing and Timing the Fuel Injection Pump

(1) Remove the timing window cover (Fig. 16) from the fuel injection pump. One tooth of the plunger drive gear is marked (painted red) for timing the fuel injection pump for injection of fuel to the No. 1 cylinder. Referring to Fig. 25, turn the drive gear hub of the fuel injection pump until the marked tooth of the plunger drive gear is positioned approximately the distance of one tooth to the REAR of the timing pointer in the pump housing, then hold the drive gear hub stationary. While holding the drive gear hub in the above position, the center timing mark on the drive gear hub should be in alignment with the timing pointer as shown in Fig. 26. When the drive gear hub is released for the installation of the pump on the engine, the spring pressure on the cam of the pump camshaft will rotate the drive gear hub slightly in the counterclockwise direction.

(2) With the No. 1 piston near the top on its compression stroke (valve push rods at the bottom of their travel) and with the timing mark stamped in the engine flywheel aligned with its timing pointer, as in a., step 10 above, the engine is properly positioned for the installation of the fuel injection pump.

(3) Install the "O" ring gasket in position in the pump mounting flange. Install the fuel injection pump in position on the engine and secure the pump to the engine with three pump attaching stud nuts and lockwashers.

(4) Refer to Fig. 20 and install the pump drive gear in position on the pump drive gear hub. Install the drive gear serrated plate and start the pump drive gear attaching capscrews but do not tighten at this time. NOTE: *The attaching holes in the pump drive gear are elongated so that the pump drive gear hub can be turned slightly to properly time the fuel injection pump.*

(5) Insert a wrench in position on the pump drive gear hub retaining nut (Fig. 20) and turn the nut to align the CENTER timing mark on the drive gear hub with its timing pointer. While holding the CENTER timing mark on the drive gear hub in alignment with its timing pointer (Fig. 18), tighten the three pump drive gear attaching capscrews. Remove the

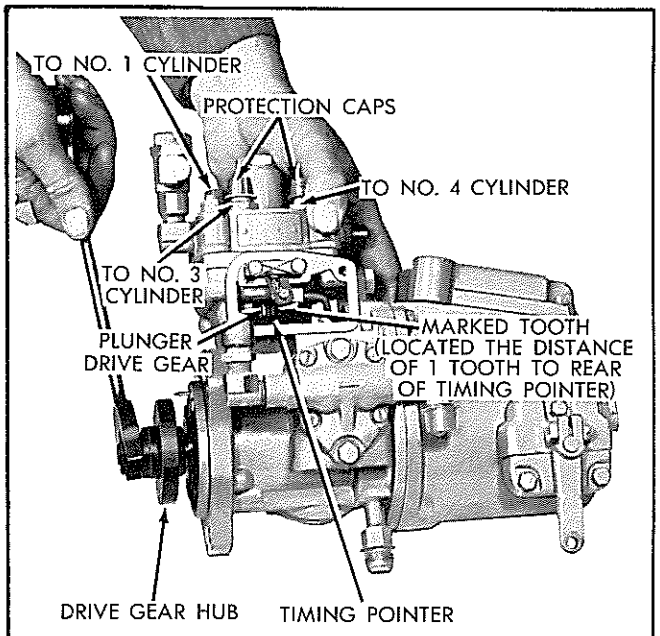

Fig. 25 — Fuel Injection Pump Plunger Drive Gear Properly Positioned for Installation of Pump on Engine

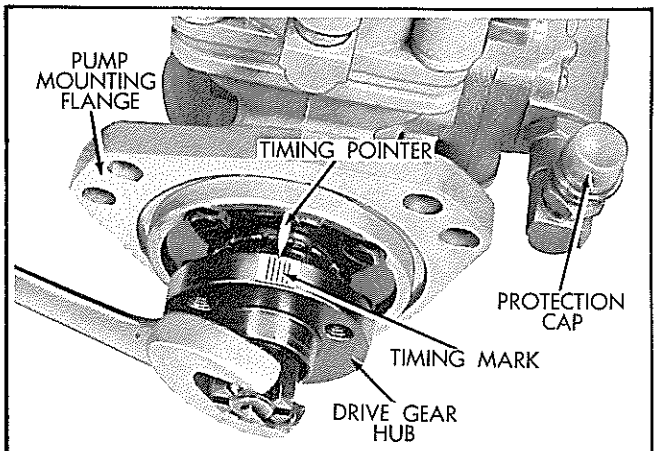

Fig. 26 — Timing Mark on Fuel Injection Pump Drive Gear Hub Properly Positioned with Timing Pointer

wrench used for turning the drive gear hub retaining nut.

(6) Install the pump drive gear access cover and gasket and the timing access cover and gasket (Fig. 16).

(7) Install the timing window cover and gasket (Fig. 16) in position on the fuel injection pump.

(8) Connect the fuel injection lines to their corresponding fittings in the top of the fuel injection pump. Tighten the fuel injection line nuts, using a fuel injection line nut wrench similar to the one shown

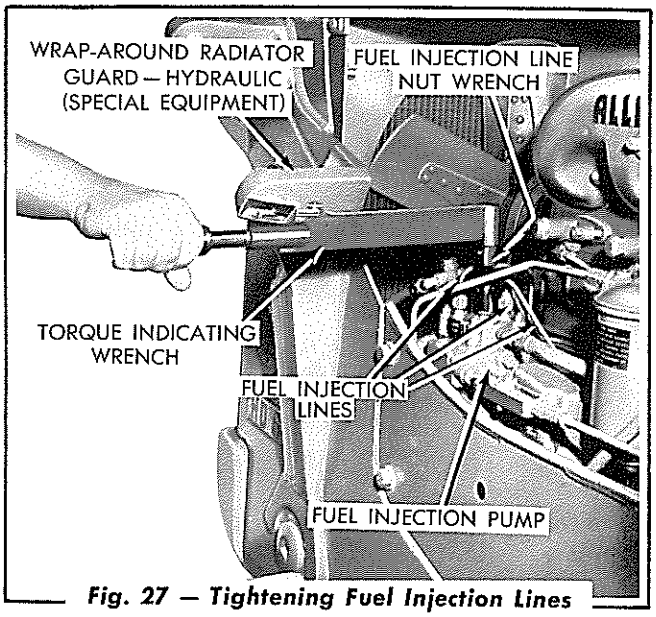

Fig. 27 — Tightening Fuel Injection Lines

in Fig. 27, to a torque of 25 to 27 lbs. ft. Connect the fuel return manifold to the fuel pressure relief valve.

(9) Connect the fuel injection pump inlet line to the fuel injection pump (Fig. 16).

(10) Install the fuel return hose. Install the fuel transfer pump inlet line and connect the outlet line to the fuel transfer pump. Install the fuel injection pump lubricating oil line.

(11) Connect the throttle control front rod to the governor speed control lever. Install the engine shut-off front rod.

(12) Install the valve rocker arm cover, making certain the gasket is in good condition. Install the engine hood and the engine air pre-cleaner. Install the left front fender.

(13) Install the timing hole cover in position on the engine flywheel housing. Install the floor plate.

(14) Turn the fuel tank shut-off valve to its open position. Vent the fuel system (refer to "VENTING OF FUEL SYSTEM," c. below).

c. Venting of Fuel System

(1) Venting of Fuel Injection Pump and Low

Pressure Fuel Lines

Vent the first stage and the second stage fuel filters and the low pressure fuel lines as follows:

(a) Loosen the vent screw, located in the shell retaining nut of the first stage fuel filter, and allow the filter to fill with fuel by gravity. When fuel flows (free of bubbles) from around the loosened vent screw, tighten the vent screw securely.

(b) Loosen the vent screw located in the shell retaining nut of the second stage fuel filter. Crank the engine with the starter until a full stream of fuel (free of bubbles) flows from around the loosened vent screw, then tighten the vent screw while continuing to crank the engine.

(2) Venting of High Pressure Fuel System

The high pressure fuel system is usually self-venting, due to the fact that any air trapped by the fuel injection pump is forced out through the fuel injection nozzles and into the engine combustion chambers. However, if the fuel lines have been removed, the engine has run out of fuel, or the unit has not been operated for some time, venting of the high pressure system may be necessary to facilitate starting of the engine.

Vent the high pressure fuel system as follows:

(a) Loosen the fuel line nut attaching each fuel injection line to its corresponding fuel injection nozzle.

(b) Pull the throttle operating lever back to the high speed position and push the engine shut-off knob to the run position.

(c) Crank the engine with the starter until fuel flows from the ends of all the fuel injection lines. Connect the fuel injection lines to the fuel injection nozzles and tighten the fuel line connector nuts.

E. Governor Adjustment

1. General

The governor on all Model HD-6 Tractors was adjusted to provide for the proper horsepower and a full governed engine speed (under load) of 1800 R.P.M. The specified low and high idle engine speeds for the Models HD-6A and 6B Tractors is 525 to 550 R.P.M. and 1930 (+ or — 25) R.P.M. respectively. The specified low idle and high idle engine speeds for the Model HD-6G Tractors is 525 to 550 R.P.M. and 2000 (+ or — 25) R.P.M. respectively.

WARNING: *The fuel injection pump and governor were adjusted and sealed at the factory to provide the proper horsepower and engine speed, should an adjustment become necessary while the tractor is in the warranty period, the adjustment MUST be made by your "Allis-Chalmers" Dealer.*

2. Checking Engine Speed

The governor very seldom gets out of working order. If the engine speed is irregular, check the fuel system and all other engine adjustments before changing the governor setting.

NOTE: *If equipment mounted on the front of the tractor prevents the use of a tachometer at the front end of the engine crankshaft, the engine speed may be checked from the rear of the generator shaft or from the rear of the transmission top shaft.*

The generator shaft is driven at 1.81 times engine crankshaft speed and the transmission top shaft turns .535 of engine crankshaft speed. The following table gives the specified crankshaft, top shaft, and generator R.P.M. for low idle and high idle engine speeds:

Tractor Model	Crankshaft Speed R.P.M.	Top Shaft Speed R.P.M.	Generator Speed R.P.M.
High Idle (HD-6A & 6B)	1930 (+ or − 25)	1032 (+ or − 15)	3493 (+ or − 45)
High Idle (HD-6G)	2000 (+ or − 25)	1070 (+ or − 15)	3620 (+ or − 45)
Low Idle (HD-6A, 6B, & 6G)	525 to 550	280 to 295	950 to 995

Move the transmission gear shift lever to NEUTRAL and engage the engine clutch. Operate the engine until normal operating temperature (160° to 185° F.) is indicated by the engine temperature gage. Move the throttle operating lever to its low and high speed positions and make certain that the throttle control linkage is properly adjusted so that the throttle control linkage moves the governor speed control lever through its full arc of travel.

If the transmission top shaft is to be used for checking the engine speed, remove the bevel gear compartment rear cover from the rear of the steering clutch and final drive housing and wipe the oil from the rear end of the top shaft. If the generator is to be used for checking the engine speed, remove the pipe plug at the rear end of the generator shaft. Make certain that the generator drive belt is properly adjusted.

Determine which shaft is to be used for checking the engine speed, use a tachometer with a suitable extension, refer to the above table and check the engine speed as follows:

a. Move the transmission gear shift lever to "NEUTRAL" and start the engine. Engage the engine clutch.

b. Move the throttle operating lever all the way forward (low idle position). Using a tachometer, check the speed of the accessible shaft.

c. Pull the throttle operating lever all the way back (high speed position). Using a tachometer, check the high idle speed. If the engine speeds are not within the specified ranges, it will be necessary to adjust the governor.

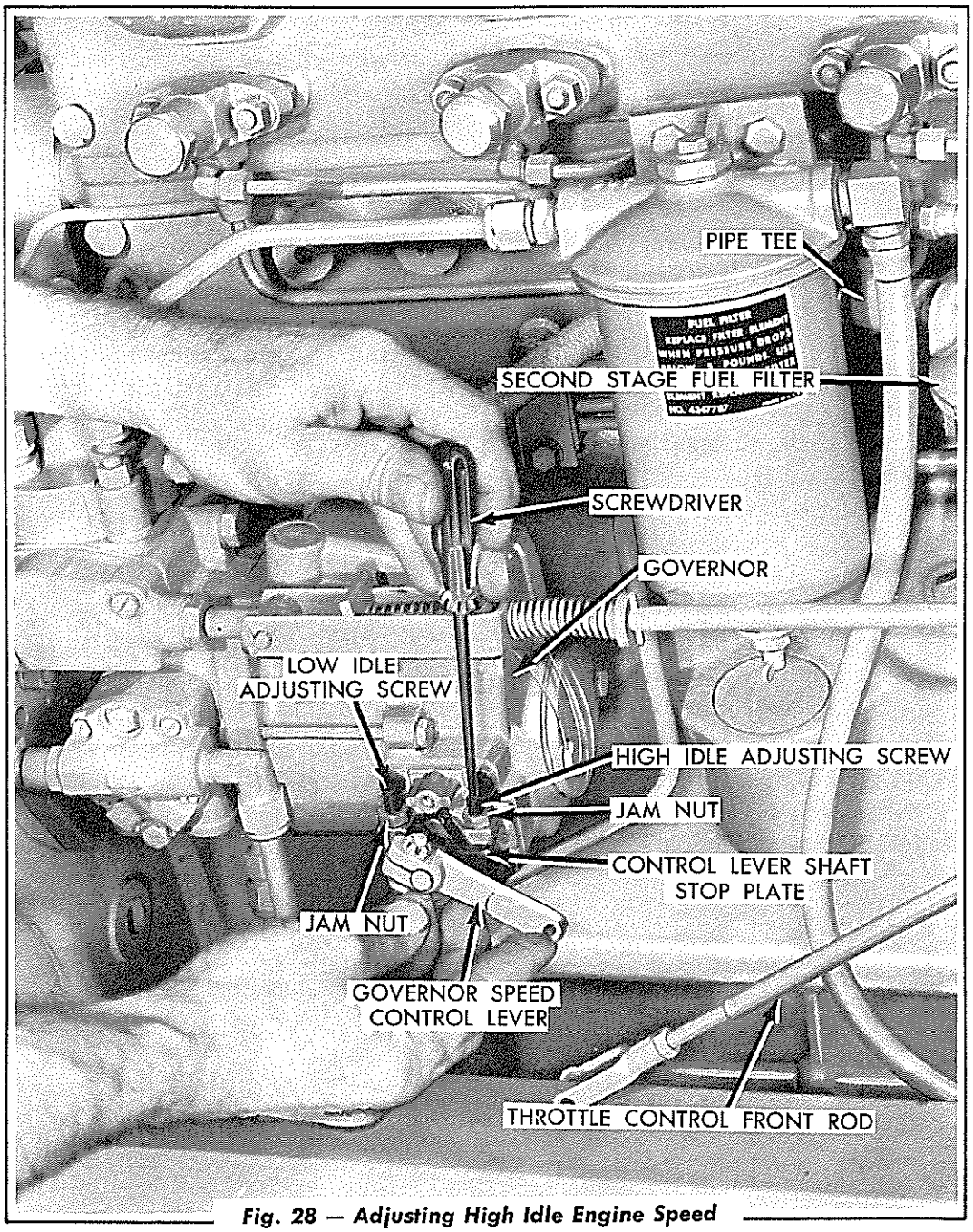

Fig. 28 — Adjusting High Idle Engine Speed

3. Low Idle and High Idle Engine Speed Adjustments

a. Remove the speed adjusting screw access cover from the governor.

b. Disconnect the throttle control front rod from the governor speed control lever, so that the lever may be moved by hand.

c. With the engine running, loosen the jam nut on the low idle adjusting screw. Hold the governor speed control lever toward the front so that the control lever shaft stop plate contacts the low idle adjusting screw. Turn the low idle adjusting screw IN as necessary to increase or OUT as necessary to decrease the low idle speed. When the low idle speed is within the specified range (refer to table in preceding paragraph), hold the low idle adjusting screw and tighten the jam nut.

d. With the engine running, loosen the jam nut on the high idle adjusting screw. Hold the governor speed control lever toward the rear so that the control lever shaft stop plate contacts the high idle adjusting screw.

Turn the high idle adjusting screw OUT as necessary to increase or IN as necessary to decrease the high idle speed. When the high idle speed is within the specified range (refer to table in preceding paragraph), hold the adjusting screw and tighten the jam nut.

e. Install the speed adjusting screw access cover in position on the governor.

f. Connect the throttle control front rod to the governor speed control lever.

F. Fuel Transfer Pump

1. General

The PSB fuel injection pump is equipped with a fuel transfer pump (Fig. 16) of the positive-displacement gear type. The transfer pump is mounted on the pad provided on the front side of the injection pump housing, and is driven by a gear which meshes with the injection pump integral camshaft gear.

A through-flow fuel system is required with this type of transfer pump, therefore a fuel pressure relief valve is installed in the hydraulic head opposite the fuel inlet connection and a fuel return hose is connected to the valve to return the excess fuel to the fuel tank.

2. Service

If the tests explained in "CHECKING OF SYSTEM" Topic 2, in this Section, indicate that the fuel transfer pump is inoperative, the fuel transfer pump must be removed, inspected, and replaced as a unit if necessary.

3. Removal and Installation

a. Close the fuel tank shut-off cock located under the fuel tank.

b. Remove the left front fender.

c. . Disconnect the fuel transfer pump inlet and outlet lines at the fuel transfer pump. Remove the two hex-head capscrews attaching the fuel transfer pump to the fuel injection pump and remove the fuel transfer pump and drive gear as an assembly.

d. The fuel transfer pump may be installed by a direct reversal of the removal procedure.

6. ENGINE CONTROLS

A. Description

The throttle operating lever is used to regulate the speed of the engine. Throttle control rods and linkage connect the throttle operating lever with the governor speed control lever on the governor. The engine runs at full governed speed when the throttle operating lever is pulled all the way back and runs at idling speed when the throttle operating lever is pushed all the way forward.

The throttle operating lever is located on the shaft of the throttle assembly, which is mounted on a bracket attached to the cowl with capscrews. The throttle assembly is connected to the governor speed control lever by two control rods having adjustable yokes. The throttle assembly consists of a drum and shaft, friction band assembly, housing, and covers. The friction band, which is assembled around the drum, acts as a brake and holds the throttle operating lever in any desired position, therefore, an infinite range of engine speed can be obtained between low idle and full governed speed. The throttle assembly is provided with an adjusting capscrew for adjusting the tightness of the band on the drum for ease of throttle operation.

The engine shut-off control is used to stop the engine. Shut-off control rods and linkage connect the engine shut-off knob, located on the cowl, to the injection pump fuel shut-off rod which actuates the control sleeve in the fuel injection pump hydraulic head. When the engine shut-off knob is pulled all the way back ("STOP" position), the control sleeve is lowered to the "no fuel delivery" position (c — Fig. 15). When the engine shut-off knob is pushed all the way in ("RUN" position), the control sleeve is released and actuated by the throttle controls.

Improper adjustment of the throttle operating lever linkage may result in loss of engine speed. Improper adjustment of the engine shut-off knob linkage may result in loss of engine speed or power, failure of engine to start with the shut-off knob pushed in, or failure of the engine to stop when the shut-off knob is pulled back.

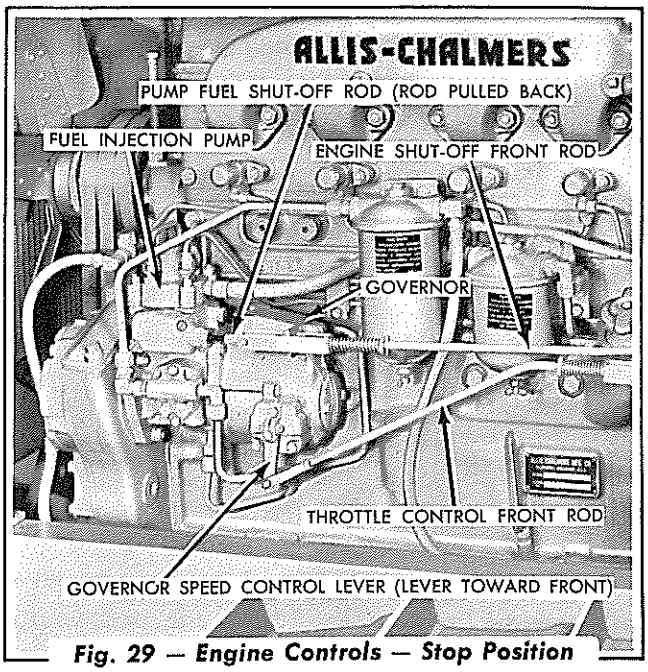

Fig. 29 — Engine Controls — Stop Position

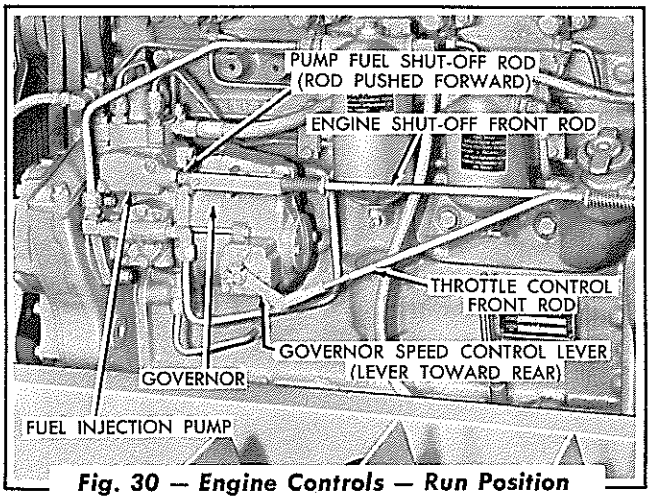

Fig. 30 — Engine Controls — Run Position

B. Adjustment of Engine Shut-Off Control Linkage

If the engine shut-off control fails to operate properly, make certain that the linkage and levers are properly lubricated and the condition is not due to binding in the linkage or to a broken spring. When replacing components of the engine control linkage, refer to Figs. 31 and 32 for the approximate lengths (center-to-center of yoke pins) of the various control rods, when reinstalling.

Adjust the shut-off linkage as follows:

1. Push the engine shut-off knob to the "RUN" position. Check the injection pump fuel shut-off rod (Fig. 30) to see if the rod is moved

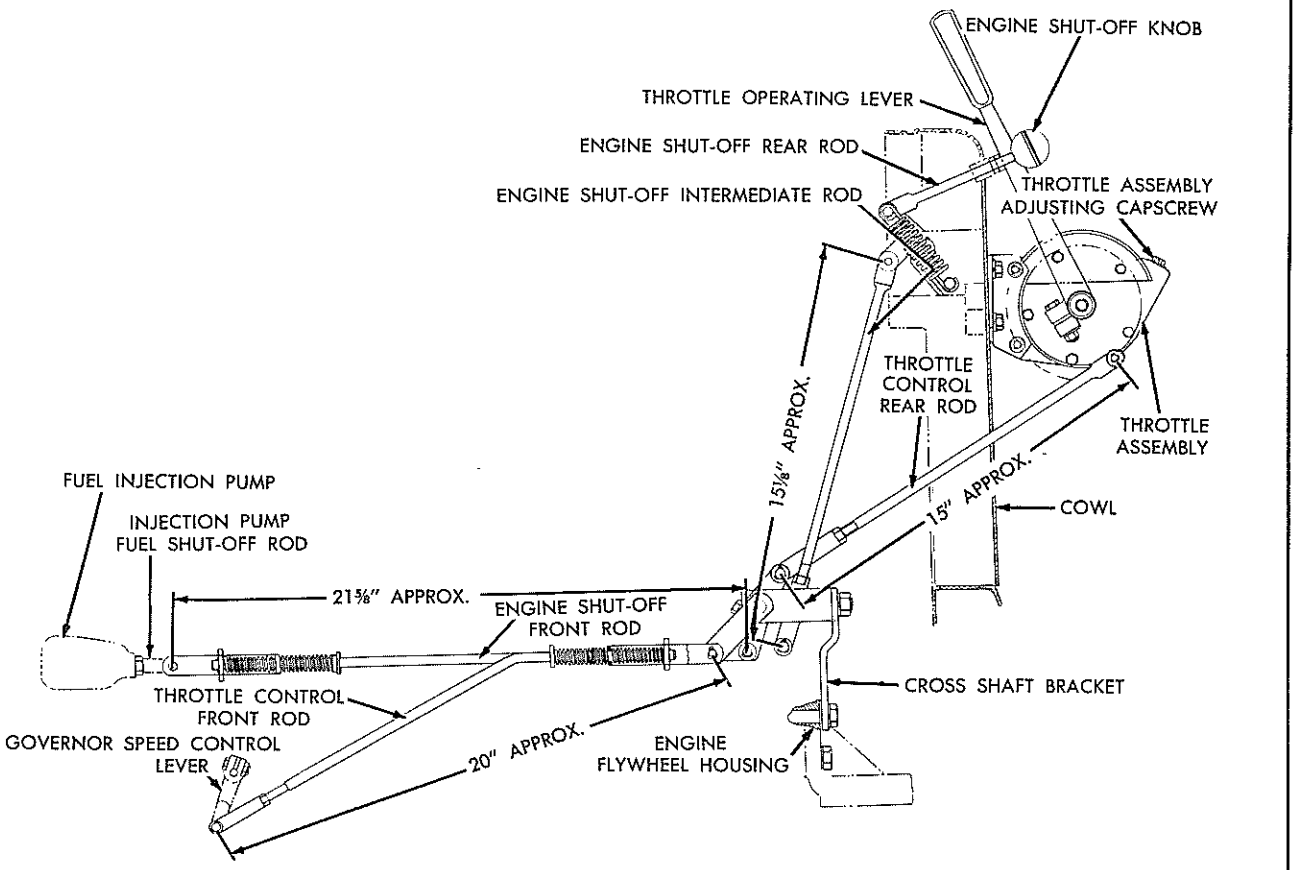

Fig. 31 — Engine Controls and Linkage (Models HD-6A and 6B Tractors)

to its extreme forward position (as far as it will go).

2. If the injection pump fuel shut-off rod is not in the extreme forward position, adjust the engine shut-off front rod as necessary to obtain full travel of the injection pump fuel shut-off rod.

C. Adjustment of Throttle Control Linkage

If the throttle controls fail to operate properly, make certain that the linkage is properly lubricated and the condition is not due to binding or to a broken spring. Adjust the throttle control linkage as follows:

1. Move the throttle operating lever forward as far as possible (low idle position). Check the governor speed control lever (located on the governor) to determine if the throttle linkage moves the lever forward as far as it will go (Fig. 29).

2. Pull the throttle operating lever all the way back (high idle position) and make certain the throttle linkage moves the governor speed control lever (located on the governor) rearward as far as it will go (Fig. 30); shorten or lengthen the throttle control front rod as necessary by turning the control rod yoke.

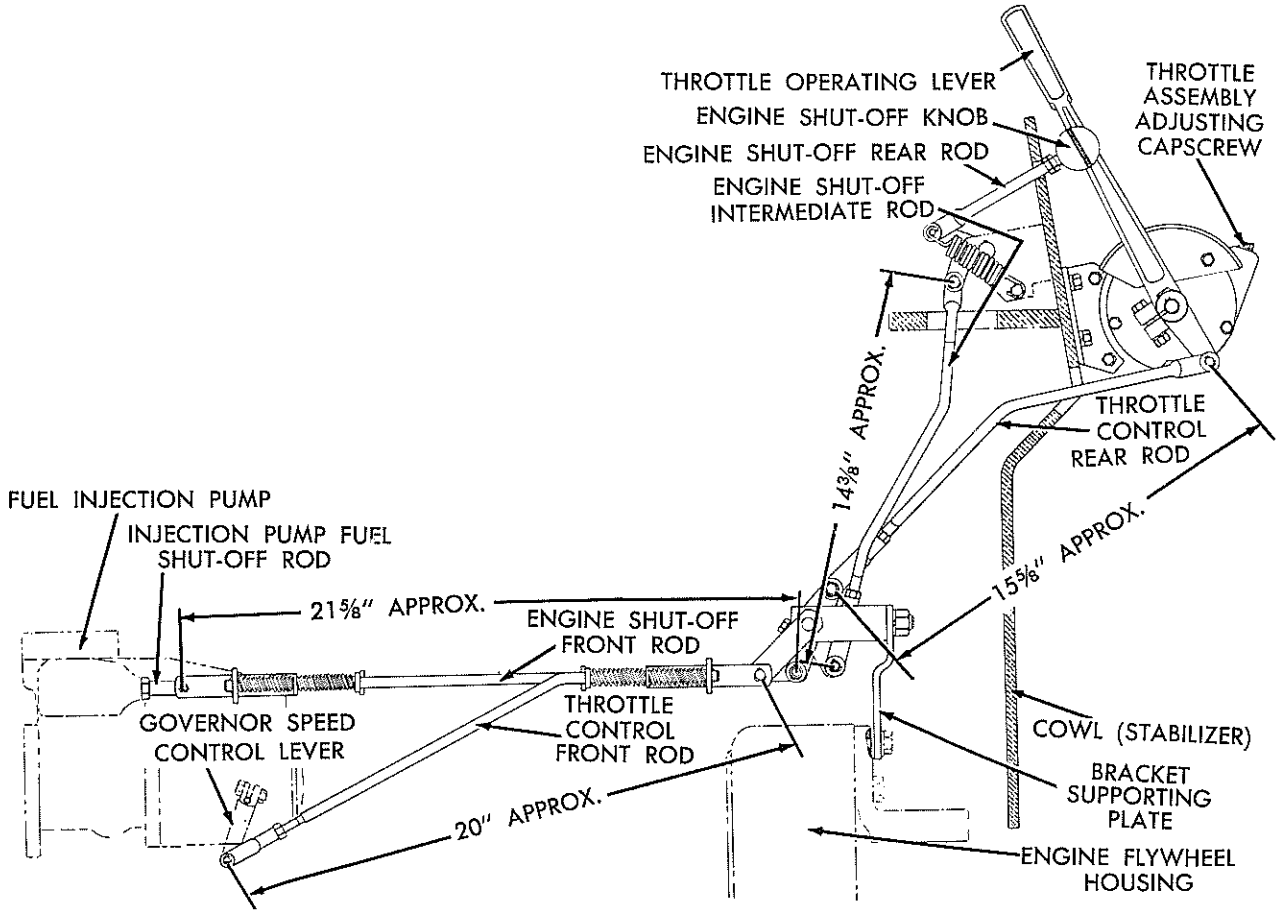

Fig. 32 — Engine Controls and Linkage (Model HD-6G Tractor)

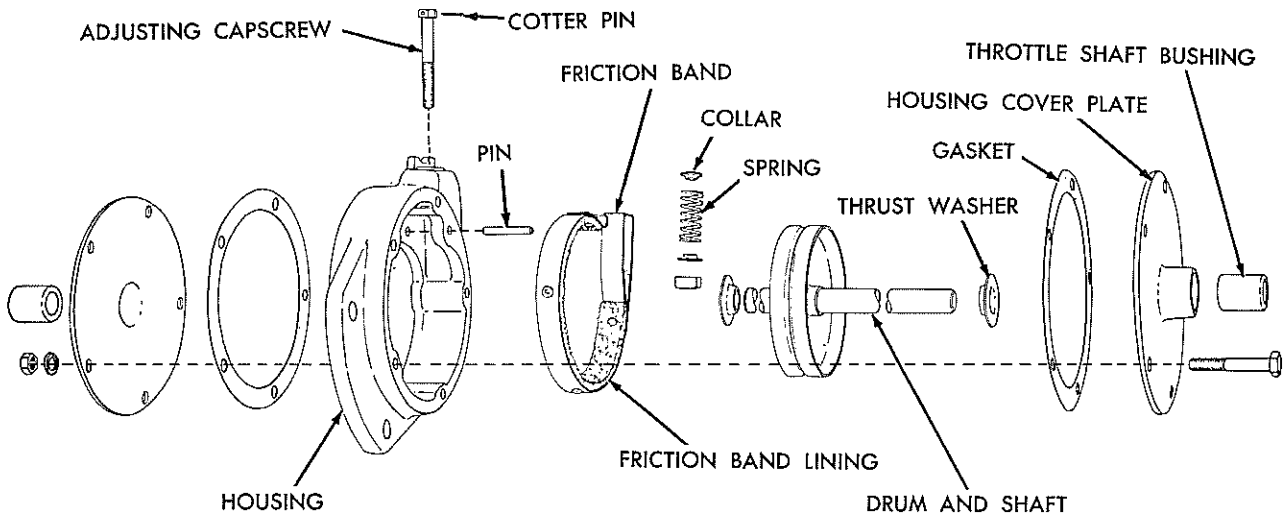

Fig. 33 — Throttle Assembly

3. A throttle assembly (mounted on the cowl) containing a friction band, is provided in the throttle control linkage for the purpose of holding the throttle operating lever in any desired speed position between low idle and high speed position. If the throttle operating lever will not remain stationary when moved to the desired speed position, adjustment of the throttle assembly (Fig. 33) is necessary. Remove the cotter pin from the throttle assembly adjusting capscrew and turn the capscrew IN to increase or OUT to decrease the friction band tension as necessary. Install the cotter pin in the throttle assembly adjusting capscrew.

SECTION III—ENGINE AIR INTAKE SYSTEM

1. DESCRIPTION OF SYSTEM

The engine air intake system includes the air pre-cleaner, air cleaner, and the air intake elbow. The purpose of the air pre-cleaner and the air cleaner is to remove dust and other foreign matter from the air used by the engine. The life of the engine depends largely upon the efficiency of the air pre-cleaner and the air cleaner. Rapid wear on cylinder sleeves, pistons, and rings will result if the air pre-cleaner and air cleaner are not kept in good condition and properly serviced.

In warm weather, sufficient heat is generated by compression of the air within the cylinders to ignite the fuel and start the engine within a very short cranking period. However, in cold weather the "drag" caused by cold oil between the pistons and cylinder walls and in the bearings, reduces the cranking speed of the engine. A large part of the heat generated by compression of the air is absorbed by the pistons and cylinder walls. This heat loss and the reduced cranking speed may reduce the temperature of the air in the cylinders to a point too low to ignite the fuel. A Cold Weather Engine Primer (Standard Equipment) or an Engine Air Heater (Special Equipment) is provided as an aid for starting the engine in cold weather.

2. AIR PRE-CLEANER

A. Description

Air for the engine enters through the air pre-cleaner mounted on top of the air cleaner pipe. The air pre-cleaner is designed to impart a rotary motion to the air; this causes the heavy particles of dust to be thrown to the outside of the pre-cleaner shell and deposited therein. A large percentage of the dust in the air drawn through the air pre-cleaner is thus removed before the air enters the air cleaner.

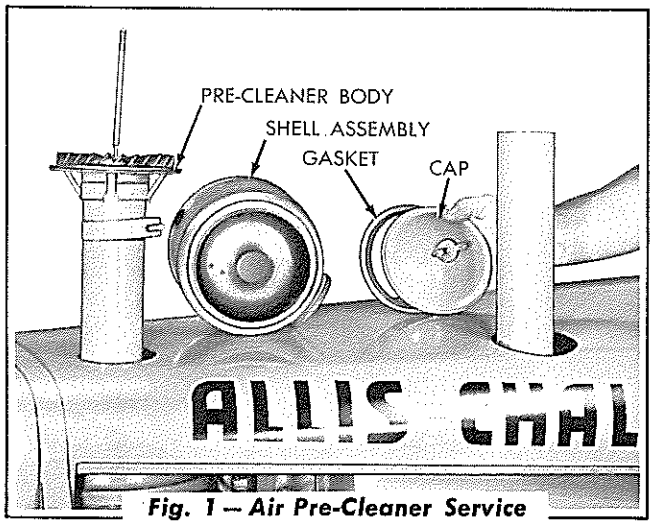

Fig. 1 — Air Pre-Cleaner Service

B. Air Pre-Cleaner Service

Empty the air pre-cleaner whenever the dust level reaches half-way up on the inspection glass located in the pre-cleaner shell assembly. Remove and clean as follows:

1. Unscrew the wing nut and remove the cap from the shell. Lift the shell from the pre-cleaner body.

2. Empty the dust from the shell and wipe the inside of the shell with a dry cloth. Make sure the fins in the pre-cleaner body are not bent, damaged, or clogged.

3. Wipe the dust off the cap and reassemble the pre-cleaner. Replace the cap gasket if it is not in good condition. Tighten the wing nut with the fingers; *DO NOT USE A WRENCH.*

3. AIR CLEANER

A. Description

After passing through the air pre-cleaner, the air enters the air cleaner through the pipe that extends down through the center of the air cleaner body. An oil cup filled to a specified level with engine oil is suspended on the lower end of the air cleaner body. As the air is drawn through the air cleaner, a portion of this oil is drawn up onto the rust-proof metallic matting in the main body of the air cleaner. Dust still remaining in the air is collected by the oily matting as the air passes through the matting. The oil, dripping back into the oil cup, carries this dust with it and deposits it in the cup. Thus, only clean air enters the engine air intake for delivery to the cylinders.

A damaged hose, loose hose clamp, damaged gasket, or leak of any kind that allows air to enter the engine cylinders without first passing through the air cleaner will defeat the purpose of the cleaner; therefore, extreme care should be taken to prevent leaks. Periodic inspection of the above parts and of the air cleaner body for dents, cracks, loosened solder connections, etc., should be made frequently. If any of the above mentioned conditions are found, they must be corrected immediately.

B. Air Cleaner Service

The filtering oil in the air cleaner oil cup must be checked daily, or more often when operating under extremely dusty conditions. Keep the oil cup filled with clean engine oil to a level even with the top of the cone in the center of the oil baffle. Empty and wash the cup and the oil baffle whenever the oil becomes discolored, indicating a quantity of dirt has collected, then refill the cup to the proper level with clean engine oil. Use same viscosity oil as is used in the engine.

NOTE: *Some "diesel" engine lubricating oils may foam when used in the air cleaner. Do not use an oil that foams as it reduces air cleaner efficiency and in some cases allows the oil to be pulled over into the engine, causing serious damage.*

Service the air cleaner as follows:

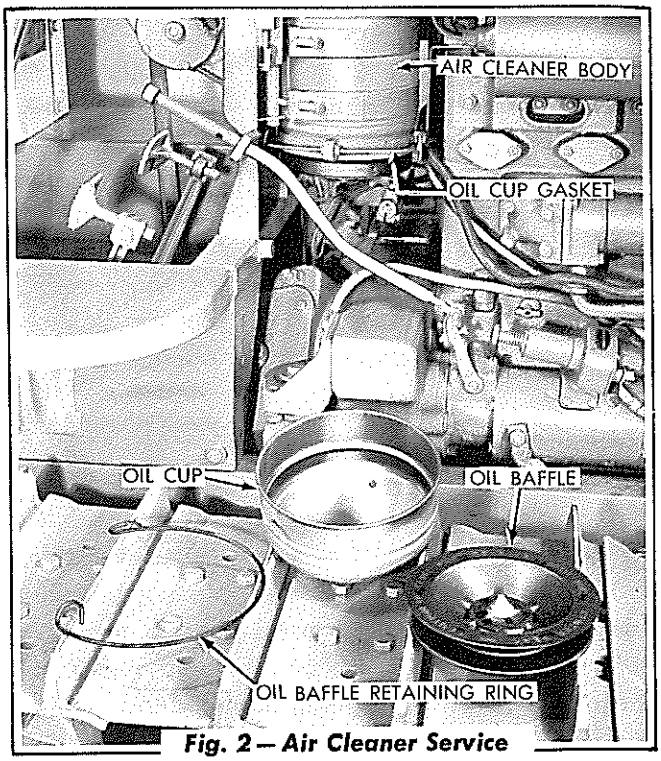

Fig. 2 — Air Cleaner Service

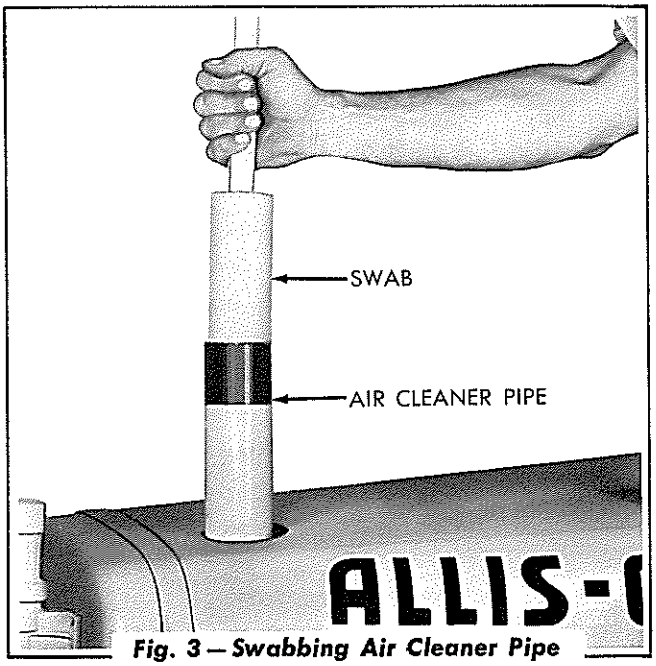

Fig. 3 — Swabbing Air Cleaner Pipe

1. Remove the oil cup from the bottom of the air cleaner body. Remove the oil baffle retaining ring and the oil baffle from the oil cup, then empty the oil from the cup.

2. Thoroughly wash the oil cup and the oil baffle with clean solvent or fuel. Remove the air pre-cleaner assembly from the top of the air cleaner pipe and swab out the inside of the air cleaner pipe that extends

from the pre-cleaner to the oil cup. Install the air pre-cleaner assembly.

3. Install the oil baffle and retaining ring in the oil cup and fill the cup to the proper level with clean engine oil.

4. Be sure that the oil cup gasket is in good condition, then install the oil cup in position on the bottom of the air cleaner body. Check the hose clamps on the air cleaner elbow hose and make certain the clamps are tight and the hose is not crimped, allowing air to enter the engine without passing through the air cleaner.

5. Once or twice a year, remove the air cleaner from its mounting. Remove the oil cup and immerse the cleaner in clean fuel, or non-combustible cleaning solvent, and rinse the dirt from the air cleaner matting. Allow sufficient time for the fuel or solvent to drain from the matting before reinstalling the air cleaner.

4. COLD WEATHER ENGINE PRIMER

A. Description

The cold weather engine primer consists of a cold weather starting fluid dispenser assembly, which holds and punctures a capsule containing ethyl ether starting fluid, a primer pump to force the starting fluid through a small nozzle and into the engine air intake elbow, a primer elbow assembly, and the necessary lines to complete the system. The dispenser is located on the cowl (to the right of the instruments) and the primer pump is mounted in the cowl with the instruments, as shown in Fig. 4. The starting fluid is forced through the primer elbow assembly and into the engine air intake elbow, where it mixes with the intake air before it enters the cylinders. Since the starting fluid is highly combustible it is easily ignited by the heat of the compressed air within the cylinders. The engine will start quickly at low ambient temperatures with the aid of the primer, even at a slow cranking speed. The starting fluid capsules, available in 7 c.c. and 17 c.c. sizes, can be obtained from "Allis-Chalmers" Dealers.

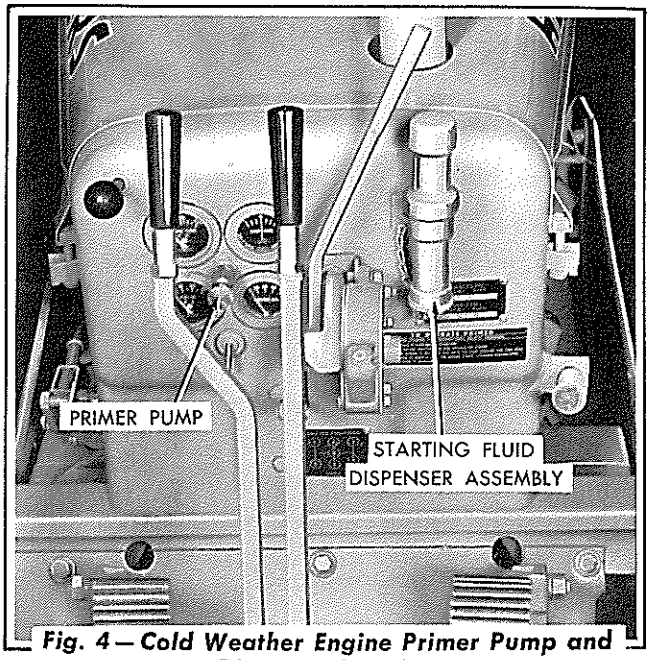

Fig. 4 — Cold Weather Engine Primer Pump and Dispenser Location

B. Engine Primer Operation

For instructions on how to operate the Cold Weather Engine Primer, refer to "STARTING AND STOPPING OF ENGINE" in the HD 6 Tractor Operators Manual.

C. Engine Primer Trouble Shooting

If the engine is cranked, with the throttle operating lever pulled all the way back and with the engine shut-off knob all the way forward, and does not start after several strokes of the primer pump, it is advisable to stop cranking and inspect the primer system for the following possible causes of failure:

1. Primer Elbow Assembly Clogged

This condition will usually be indicated by excessive resistance on the primer pump. A partially clogged primer elbow assembly will prevent the delivery of sufficient starting fluid to the engine air intake system. To clean the primer elbow assembly, remove the elbow assembly from the engine air intake elbow and remove the small nozzle from the primer elbow assembly. Remove and clean the nozzle swirl pin and open the hole in the end of the nozzle, if clogged. CAUTION: *Do not enlarge the hole in the end of the nozzle.*

After cleaning, reassemble the primer elbow as-

sembly and install the assembly in the engine air inlet elbow.

2. Inoperative Primer Pump

Failure of the primer pump to function properly may be due to worn or damaged pump piston rings, a clogged fluid dispenser strainer, clogged fluid lines, or "frozen" or worn pump check valve balls. The piston rings on the pump piston are made of a special rubber composition and must be replaced by duplicate parts if worn or damaged.

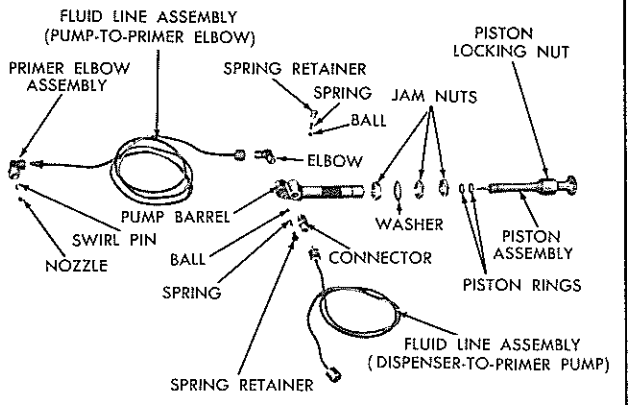

Fig. 5—Primer Pump and Primer Elbow Details

To replace the primer pump piston rings, unscrew the piston locking nut from the pump barrel and withdraw the piston assembly from the barrel. Remove the piston rings from the grooves in the piston assembly and install new rings. Lubricate the rings and piston with light engine oil, install the piston assembly in the pump barrel, and tighten the locking nut.

3. Ball Check Valves

The two spring loaded ball check valves, located in the inlet and outlet ports of the primer pump, are provided to close the pump ports at the proper time. When the pump piston is pulled out (suction stroke, drawing starting fluid from dispenser), the ball check valve at the inlet port opens, allowing the fluid to be drawn from the dispenser. When the pump piston is pushed in (delivery stroke, supplying starting fluid to the primer elbow assembly), the ball check valve at the outlet port opens, allowing the pump to force the fluid to the primer elbow assembly.

Worn or "frozen" ball check valves, or broken springs, will prevent the primer pump from operating properly. When this occurs, remove the spring retainers, springs, and balls from the inlet and outlet ports of the pump. Inspect the balls, ball seats, and springs for wear or damage. Clean the pump barrel and all components thoroughly and reassemble, using new parts where necessary.

4. Clogged Fluid Dispenser Strainer

A strainer is attached to the plug screwed into the bottom of the fluid dispenser body. If the starting fluid capsules are not removed soon after puncturing, the gelatine will melt and clog the strainer. To clean the strainer, refer to Fig. 6 and unscrew the plug from the dispenser body and wash the strainer and plug in hot water. The strainer may be removed for replacement if necessary, by removing the screw attaching the strainer to the plug.

The dispenser body may be washed without removing it from the cowl by removing the upper chamber, the line connector, and the plug.

Reassemble the dispenser assembly by a direct reversal of the disassembly procedure.

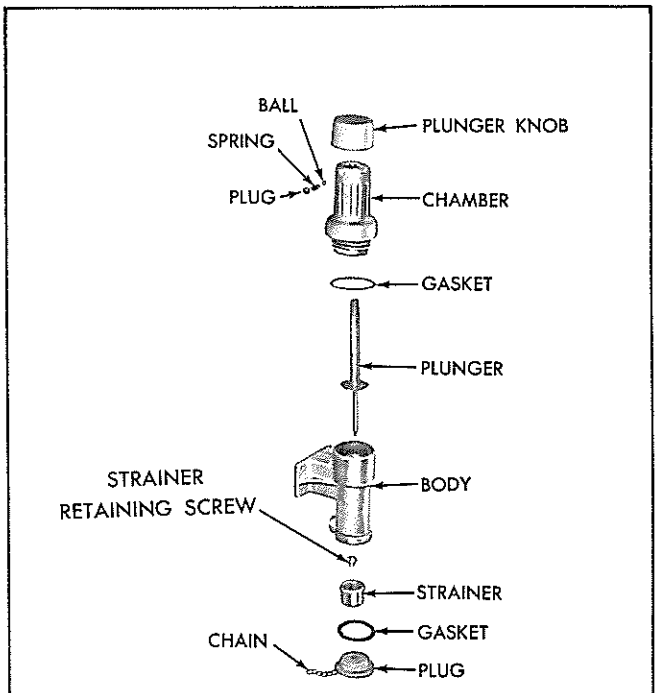

Fig. 6—Starting Fluid Dispenser Details

5. ENGINE AIR HEATER (SPECIAL EQUIPMENT)

A. Description

The engine air heater is essentially a small oil burner with electric ignition and is installed in a special engine air intake elbow which replaces the standard air intake elbow. Fuel is supplied to the heater by a hand operated pump mounted in the cowl. The heater fuel supply pump draws fuel from the second stage fuel filter and forces the fuel through a small spray nozzle installed in the air intake elbow. Electrodes, located in the air intake elbow and in front of the spray nozzle, ignite the fuel thus producing a flame which preheats the intake air to the engine. A push button type switch mounted in the cowl is provided to close the electric circuit to furnish electrical current to the coil which supplies high tension current to the electrodes.

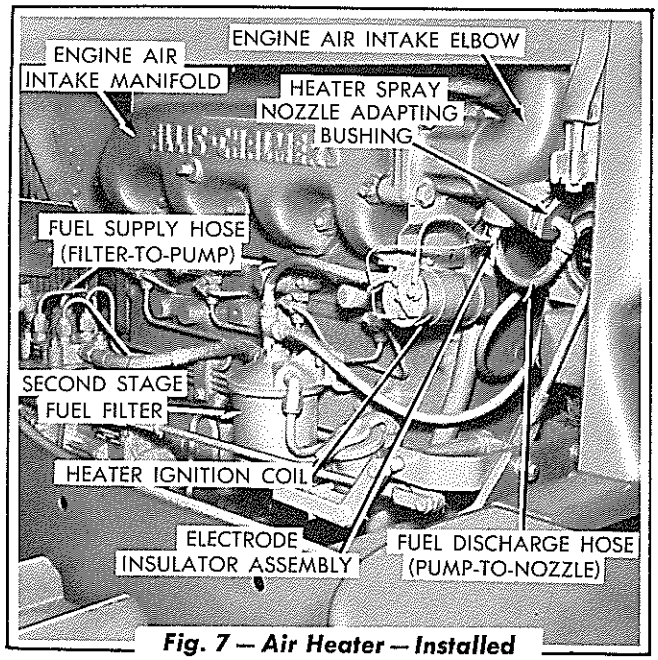

Fig. 7 — Air Heater — Installed

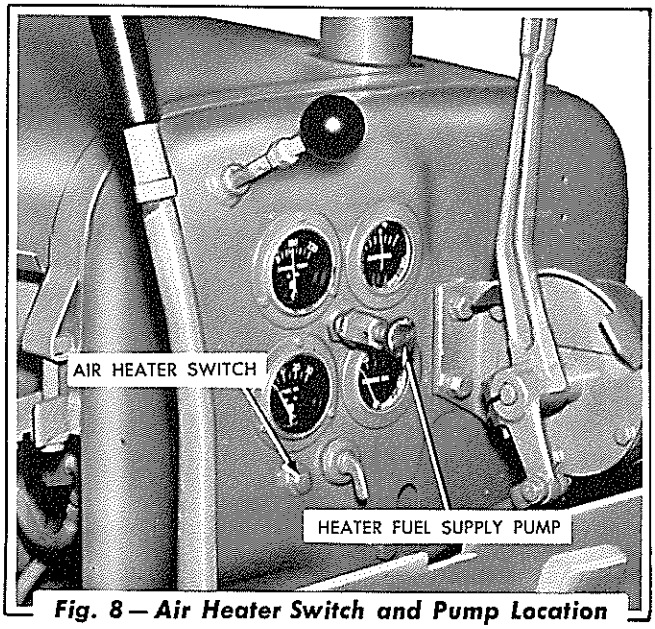

Fig. 8 — Air Heater Switch and Pump Location

B. Operation

In cold weather when it is necessary to use the engine air heater as an aid to start the engine, proceed as follows:

1. Disengage the engine clutch and move the gear shift lever to its neutral position.

2. Push the engine shut-off knob all the way forward (run position).

3. Pull the throttle operating lever all the way back (high idle).

4. Depress the starter operating rod to crank the engine. While the starter is cranking the engine, press in on the air heater switch button and at the same time operate the air heater fuel supply pump with smooth even strokes.

   CAUTION: *IF THE ENGINE DOES NOT START WITHIN 30 SECONDS, ALLOW THE STARTER TO COOL FOR 2 MINUTES BEFORE USING IT AGAIN.*

5. As soon as the engine starts, release the air heater switch button and push the air heater fuel supply pump plunger all the way in. Move the throttle operating lever to slow the engine to about ½ of full speed and allow the engine to warm up.

C. Trouble Shooting

If the engine is cranked with the throttle operating lever pulled all the way back (high idle) and fails to start after several strokes of the air heater fuel supply pump, it is advisable to stop cranking and inspect for possible causes of failure. If an adequate cranking speed is obtained and the cylinders are receiving fuel (usually indicated by a light blue smoke from the exhaust), the trouble is probably due to improper functioning of the air

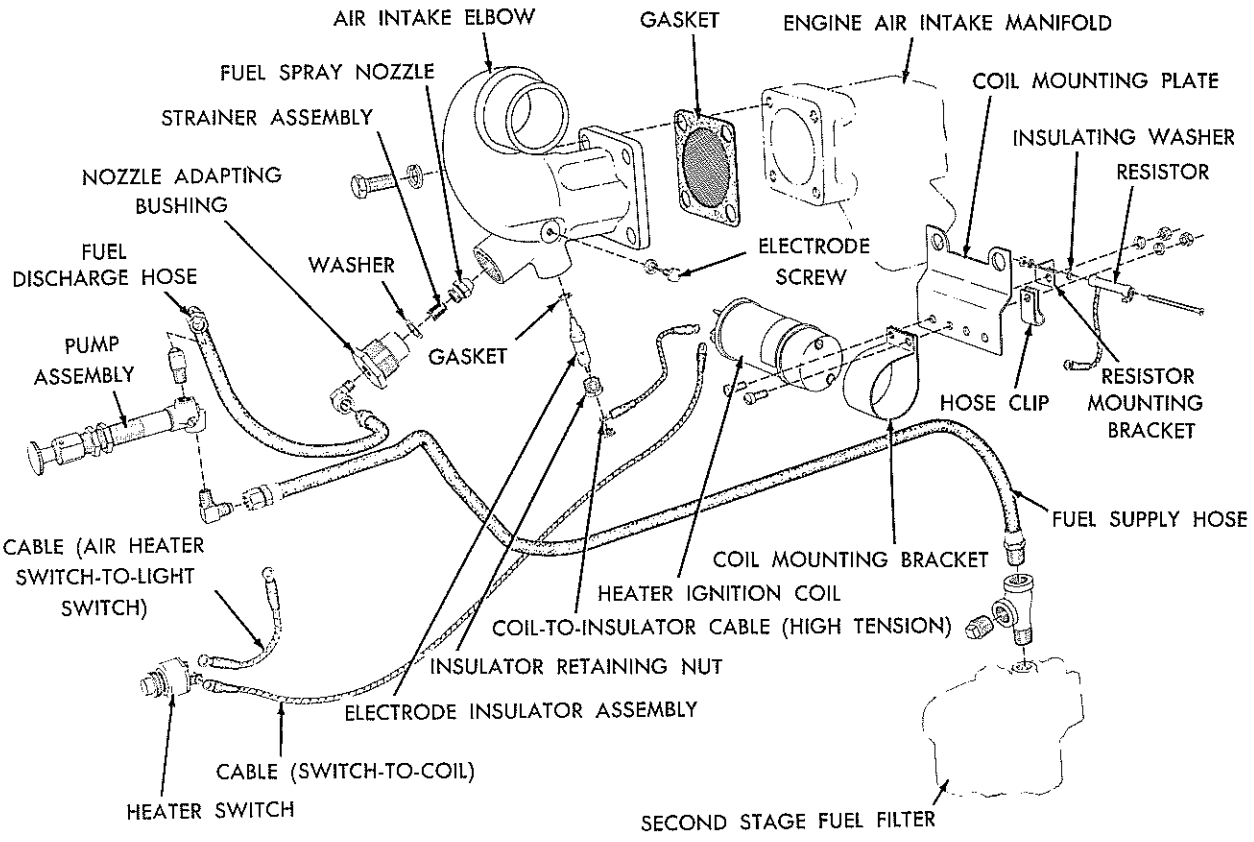

Fig. 9 — Air Heater System Details

heater.

The ignition system to the electrodes may be considered in working order if a "buzzing" sound is heard while pressing in on the air heater switch button. However, the same "buzzing" sound will be produced by a spark arcing across the insulator assembly instead of arcing at the electrodes as it should. To check the air heater, remove the four capscrews securing the air intake elbow to the engine air intake manifold. Position the air intake elbow so that the electrodes and spray nozzle may be observed through the opening in the flanged end of the elbow. Inspect the air heater for the following possible causes of failure:

1. Coil Points

Remove the cover from the end of the ignition coil. Observe the coil points and the electrodes while pressing on the switch button. The coil points should vibrate rapidly and continuous arcing should occur between the electrodes (Fig. 11). If arcing does not occur between the electrodes, and the coil points do not operate properly, inspect the heater switch and wiring for loose connections. Inspect the coil points for dirt and carbon. Clean the coil points with a clean, fine-cut contact file.

Never use sandpaper or emery cloth for cleaning the points as particles of emery or sand may embed and cause point burning. Reset the points after cleaning to provide .018" gap, with the vibrator arm held down against the coil body.

2. Electrodes

Check the gap between the electrodes; adjust for a ⅛" gap if necessary by bending the tip of the electrode screw. CAUTION: *DO NOT ATTEMPT TO BEND THE TIP OF THE ELECTRODE INSULATOR ASSEMBLY.* Scrape off any carbon that may have accumulated around the electrodes and if necessary remove the electrode insulator assembly for thorough cleaning.

3. Fuel Spray Nozzle Assembly

Check the air heater for a clogged fuel spray nozzle assembly. A clogged spray nozzle assembly will usually be indicated by excessive resistance on the heater fuel supply pump. A partially clogged spray nozzle will not properly "fog" the fuel for ignition and must be removed and cleaned. To remove the spray nozzle assembly for cleaning, disconnect the fuel discharge hose from the elbow in the nozzle adapting bushing. Unscrew and remove the nozzle adapting bushing from the air intake elbow. Unscrew the spray nozzle from the nozzle adapting bushing and remove the spray nozzle, spray nozzle strainer assembly, and washer. Thoroughly wash all parts in cleaning fluid and dry with compressed air. CAUTION: *Do not use a steel wire or a drill to clean the hole in the spray nozzle.* After cleaning, install the spray nozzle, spray nozzle strainer assembly, and washer in position in the nozzle adapting bushing and tighten the spray nozzle securely. Install the nozzle adapting bushing in position in the air intake elbow and tighten securely. Connect the fuel discharge hose to the elbow in the nozzle adapting bushing.

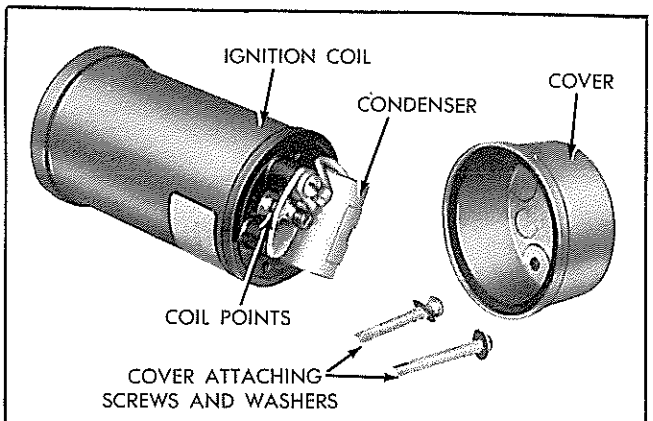

Fig. 10 — Air Heater Ignition Coil — Cover Removed

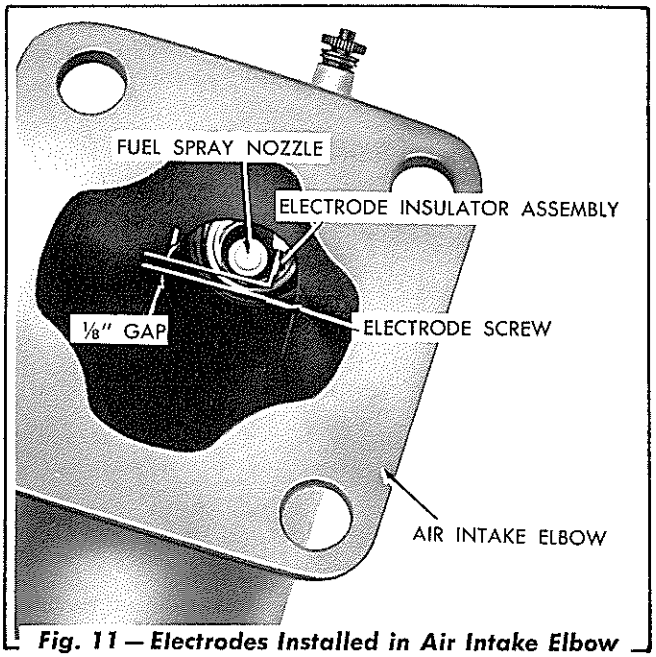

Fig. 11 — Electrodes Installed in Air Intake Elbow

4. Air Heater Fuel Supply Pump

Failure of the air heater fuel supply pump to function properly may be due to worn or damaged pump piston rings, clogged fuel lines, or "frozen" or worn pump check valve balls. The piston rings on the pump piston are made of a special rubber composition and must be replaced by duplicate parts if worn or damaged.

The air heater fuel supply pump is the same as the starting fluid pump used with the cold weather engine primer system. Refer to "ENGINE PRIMER TROUBLE SHOOTING" in this Section for pump repair instructions.

SECTION IV—ENGINE COOLING SYSTEM

1. DESCRIPTION OF SYSTEM

The engine cooling system includes the water pump, radiator, engine oil cooler, thermostat, engine temperature gage, cooling fan, and the water passages in the cylinder block and cylinder head. The water pump draws the coolant from the bottom of the radiator and circulates it through the engine oil cooler and through the water passages in the engine. The coolant is discharged from the cylinder head into the water outlet manifold and passes through the thermostat housing and the radiator inlet elbow to the upper part of the radiator. The coolant is cooled as it passes from the top to the bottom of the radiator core by air forced through the radiator core by the cooling fan.

The thermostat, located in the thermostat housing at the front of the water outlet manifold of the engine, operates automatically to maintain a normal coolant operating temperature of 160° to 185° F.

2. GENERAL MAINTENANCE

In warm weather, keep the cooling system filled with clean soft water or rain water whenever possible. If soft water is not available and hard water must be used, the hard water should first be treated with a water softener. A commercially reliable rust inhibitor should be added to the cooling system for warm weather operation. A rust inhibitor (soluble oil), available in half pint or quart containers, can be obtained from "Allis-Chalmers" Dealers and should be added to the cooling system in proportions of 1 pint of soluble oil to every 15 quarts of water. CAUTION: *NEVER ADD AN ANTI-FREEZE SOLUTION TO A COOLING SYSTEM THAT CONTAINS A RUST INHIBITOR.* Drain, flush, and refill the cooling system with clean water before adding an anti-freeze solution for cold weather operation.

In winter weather, use an ethylene glycol anti-freeze solution in the system to protect against damage from freezing. This type of anti-freeze has a much higher boiling point than water. After any addition of water or anti-freeze compound, test the solution after the added quantity has become thoroughly mixed to make sure it will withstand the prevailing or anticipated temperature. A mixture of 60% ethylene glycol and 40% water is recommended; the use of more than 64% ethylene glycol in the solution will raise the freezing point and provide less protection against freezing.

Keep the radiator air passages free from leaves, trash, and other material which will restrict the flow of air through the radiator. All leaks in the cooling system must be corrected as soon as they are evident. The fan drive belts and the water pump and generator drive belt must be kept properly adjusted.

The most efficient engine operation is obtained with the coolant operating temperature held within a range of 160° to 185° F. Operating the engine with the coolant temperature below this range will result in incomplete combustion of fuel, higher fuel consumption with less power, and will cause harmful deposits within the engine.

Maintaining the normal coolant operating temperature (160° to 185° F.) depends mostly on proper

functioning of the thermostat. If the coolant temperature remains consistently below normal, the thermostat should be removed, checked for proper operation, and replaced if necessary.

3. DRAINING AND FILLING OF SYSTEM

A. Draining of Cooling System

Remove the radiator filler cap and open the cylinder block drain cock, located on the right rear side of the cylinder block. Open the radiator drain, using the extension tool (included with tools furnished with the tractor) inserted through the hole in the lower right corner of the main frame. On later model tractors, open the thermostat housing vent cock (Fig. 7) located in the top of the thermostat housing.

CAUTION: *When draining the cooling system in freezing weather, make certain that the coolant flows freely from all drain cocks and that the system drains completely.*

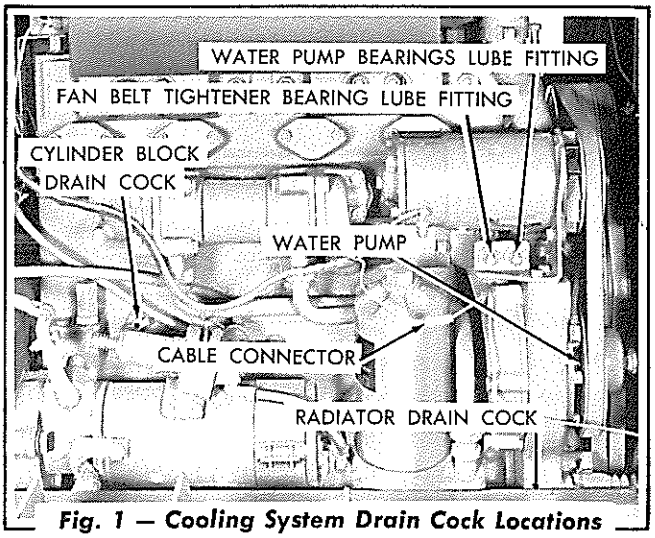

Fig. 1 — Cooling System Drain Cock Locations

B. Filling of Cooling System

Close the drain cocks which were opened to drain the system in paragraph A. above. Fill the cooling system through the radiator filler pipe until the coolant level is approximately 1 inch below the bottom of the radiator filler pipe. NOTE: *When filling the cooling system on later model tractors having a thermostat vent cock (Fig. 7), leave the vent cock open and fill the system until coolant flows from the vent cock, then close the cock and complete the filling of the system.* This allows air trapped in the engine by the closed thermostat to escape. Install the radiator filler cap.

4. CLEANING OF SYSTEM

It is recommended that the cooling system be cleaned at least twice a year, usually at the beginning of cold weather (before adding an anti-freeze solution) and again after the anti-freeze solution is removed. Cleaning at these intervals will reduce clogging and overheating and will minimize the necessity of removing the radiator for cleaning.

If hard water has been used, the necessity for cleaning is greater, since lime deposits, or scale, will form in the radiator, cylinder block, and the cylinder head. This lime deposit is detrimental to the engine and the radiator core. Flushing the radiator will remove obstructions in the radiator tubes and other water passages, which, if not removed, would eventually clog these passages. It is also important that the air passages through the radiator be kept free of obstructions and the exterior of the engine be kept free from thick deposits of dust and oil.

A. Cleaning Materials

Sal Soda is a very effective and safe solvent for the removal of lime, scale, and other foreign deposits from the cooling system. It should be used in the proportions indicated and according to the directions printed on the container in which it is purchased. Many other good cleaning solvents for this purpose are available; these should be used according to the Manufacturer's directions. After the solvent has been in the cooling system the prescribed length of time, the system should be completely drained, and, after the engine has cooled sufficiently, thoroughly flushed with clean water. The use of certain cleaning compounds requires the use of a neutralizer solution, which is usually packed and sold with the cleaning compound and should be used as directed. *CAUTION: Never mix anti-freeze solutions or inhibitors with any cleaning, neutralizing, or flushing compounds.*

B. Flushing

If the tubes in the radiator become clogged, the obstructions may sometimes be removed by reverse flushing of the radiator. When the clogging is caused by leaves or other trash, this material is usually deposited at the tops of the radiator tubes. Disconnect the radiator lower hose, and using a suitable adapter, connect a pressure water hose to the radiator water outlet elbow. Remove the radiator upper hose and plug the opening of the radiator. Remove the radiator cap and force water upward through the radiator. The trash will be loosened from the top of the tubes and will flow out through the top of the radiator with the water. CAUTION: *Do not use over 5 pounds pressure in this flushing operation as excessive pressure may cause the radiator tubes or tanks to rupture.*

C. Inspect for Leaks After Cleaning or Flushing

After the cooling system has been cleaned or flushed, and after the system is refilled, a complete inspection of the system should be made for coolant leaks. Correct all leaks to avoid foaming, loss of solution, and corrosion.

When servicing the cooling system for summer operation, it is recommended that a reliable rust inhibitor (soluble oil) be added to the coolant to keep the system free from rust. Use the inhibitor as directed on the container.

D. Cleaning Exterior of Radiator

Cleaning the fins of the radiator can best be accomplished by means of an air blast carrying a grease solvent, such as oleum spirits or carbon tetrachloride, directed at the front side of the core and passing through to the back, or the fan side. Never use gasoline, fuel, or kerosene. The radiator grille should be opened and the engine should be covered before performing this operation. CAUTION: *Provide adequate ventilation of the working area during this operation to avoid possible toxic effects of the cleaning spray.*

5. RADIATOR AND RADIATOR SHELL

A. Description

The radiator is of the conventional tubular type and is mounted in the radiator shell. The radiator shell is a heavy steel weldment consisting of a shell and fan shroud. A hinged radiator protecting guard is attached to the front of the shell for protection of the radiator and headlights.

B. Removal of Radiator and Radiator Shell

1. Drain the cooling system (refer to "DRAINING AND FILLING OF SYSTEM" in this Section).

2. Open the radiator protecting guard. Disconnect and remove the radiator inlet and outlet hoses. Refer to Fig. 2 and disconnect the headlight connecting cable at the cable connector.

3. Support the radiator and remove the capscrews, plain washers, radiator mounting washers, lockwashers, and nuts attaching the radiator to the radiator shell. Remove the radiator from the shell.

4. If it is necessary to remove the radiator shell, refer to Fig. 1 and disconnect the headlight cable from the main wiring harness at the cable connector. Loosen the two capscrews attaching the headlight cable clips to the water pump housing; spread the clips and pull the cable free.

5. Remove the engine air pre-cleaner and the engine hood.

6. Remove the capscrews, plain washers, lockwashers, and nuts attaching the right and left front fenders to the radiator shell.

7. Remove the four cotter pins, slotted nuts, plain washers, and capscrews attaching the radiator shell to the main frame and remove the radiator shell and guard as an assembly.

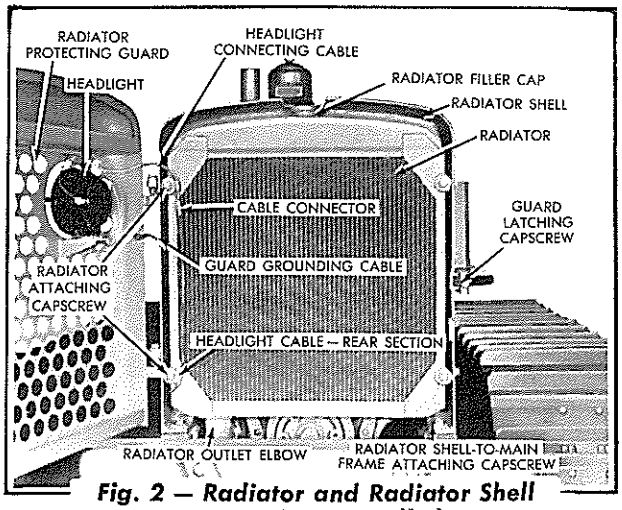

Fig. 2 — Radiator and Radiator Shell Assembly — Installed

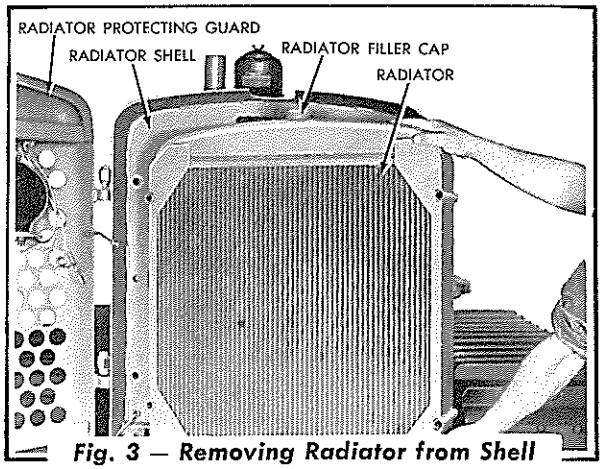

Fig. 3 — Removing Radiator from Shell

C. Inspection and Repair

Clean the air passages in the radiator core and test the core for clogging or leaks. Clean the core if clogging is evident and repair any leaks found. Straighten any bent cooling fins.

D. Installation of Radiator and Radiator Shell

1. Place the radiator shell and guard assembly in position on the main frame; install the four capscrews, plain washers, and slotted nuts to secure the radiator shell to the main frame, but do not tighten at this time.

2. Install the six capscrews, plain washers, lockwashers, and nuts to secure the front fenders to the radiator shell and tighten securely. Tighten the slotted nuts securing

the radiator shell to the main frame and secure with cotter pins.

3. Place the radiator in position in the radiator shell and install the capscrews, plain washers, radiator mounting washers, lockwashers, and nuts to secure the radiator to the radiator shell. When installing these capscrews, make certain they are inserted through the corresponding headlight cable clips.

4. Connect the radiator inlet and outlet hoses and tighten the hose clamps securely.

5. Install the engine hood and the engine air pre-cleaner. Connect the headlight connecting cable at the cable connector shown in Fig. 2.

6. Insert the headlight cable (rear section) through the two cable clips located at the rear of the water pump housing and connect the cable to the main wiring harness at the cable connector shown in Fig. 1. Tighten the two capscrews attaching the cable clips to the water pump housing. Close and fasten the radiator protecting guard.

7. Fill the cooling system (refer to "DRAINING AND FILLING OF SYSTEM" in this section).

6. WATER PUMP

A. Description

A centrifugal type water pump assembly is provided for circulating the coolant through the engine and radiator. The water pump is flange mounted on the front of the engine timing gear housing, as shown in Fig. 1, and is belt driven at 1.27 times crankshaft speed. The pump shaft is supported in the pump housing by two ball bearings.

The impeller in first type pump (Fig. 4), used on engines prior to Serial No. 77351, is retained on the pump shaft through a press fit. The bearings are shielded on both sides and packed for life with lubricant. A spring loaded type seal assembly is provided at the front of the impeller to prevent coolant from entering the bearing compartment side of the pump housing. The pump shaft and bearings are retained in the pump housing by a bearing retaining snap ring installed in the housing.

The impeller in the second type pump (Fig. 4), used on engines Serial Nos. 77351 through 96151, is retained on the tapered end of the pump shaft through a press fit and by means of a retaining nut and cotter pin. The bearings are shielded on one side only and the bearing compartment of the pump housing is packed with lubricant at assembly. A neoprene seal assembly and a water flinger are provided at the front of the impeller to prevent coolant from entering the bearing compartment side of the pump housing. The pump shaft and bearings are retained in the pump housing by a bearing retaining snap ring installed in the housing.

Effective with engine Serial No. 96152, a third type pump was used. The impeller, seal assembly, and shaft in the second and third type pumps are the same. A drilled and tapped lubricating passage is provided in the pump housing of the third type pump (Fig. 4) to accommodate a lubricating fitting for adding lubricant to the bearings periodically (after every 200 hours of operation). The pump shaft and bearings are retained in the pump housing by a sealing washer retainer threaded into the front of the pump housing; the retainer is locked in position in the pump housing by a snap ring.

B. Service

The construction of the water pump is conducive to long life with minimum attention, providing only clean water is added to the cooling system. Water containing alkali is especially harmful to the components of the water pump as alkali causes corrosion.

C. Removal of Water Pump

1. Drain the cooling system (refer to "DRAINING AND FILLING OF SYSTEM" in this section). Remove the radiator shell and radiator (refer to "RADIATOR AND RADIATOR SHELL" in this section).

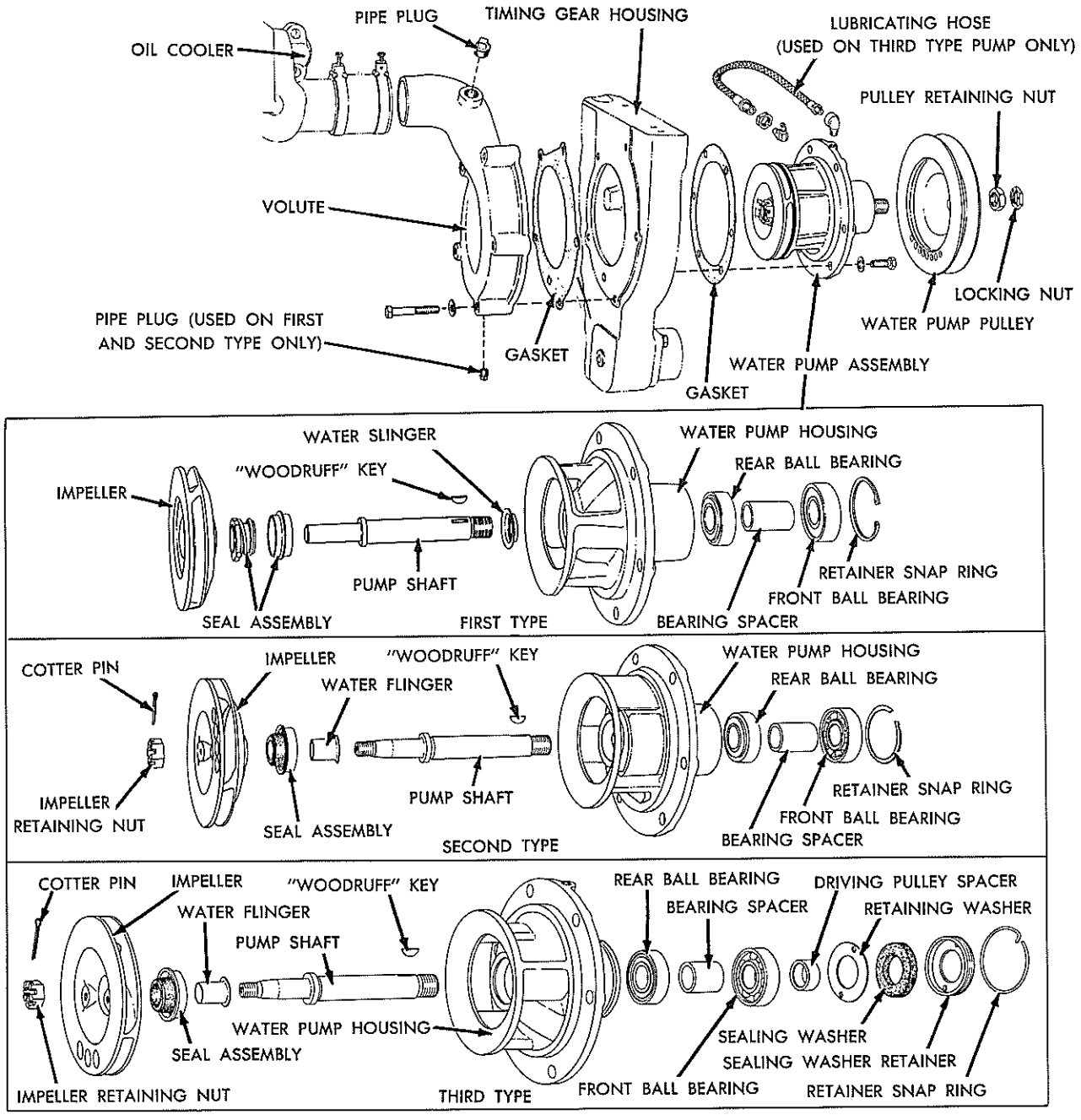

Fig. 4 — Water Pump Details

2. Disconnect the outer ends of the water pump and the fan belt tightener lubricating hoses from their supporting bracket located below the generator. Remove the capscrew attaching the fan belt tightener lubricating hose clip.

3. Remove the locking nut and pulley retaining nut from the water pump. Loosen the fan belt tightener lever locking clamp capscrew. Loosen the jam nut on the belt adjusting screw and turn the adjusting screw all the way out so the fan belt tightener pulley is lowered sufficiently for the removal of the water pump. Loosen the generator adjusting link capscrew, move the generator down, and slip the drive belt off the generator and water pump pulleys.

4. Using a suitable puller, remove the water pump pulley and remove the "WOODRUFF" key from the shaft.

5. Remove the six capscrews and lockwashers securing the water pump assembly to the timing gear housing. Remove the water pump assembly. NOTE: *It may be necessary to "jar" the pump assembly to free it from the timing gear housing.*

D. Water Pump Disassembly, Inspection, and Assembly

1. First Type Pump (Fig. 4)

a. Disassembly

(1) Remove the retainer snap ring from the pulley end of the water pump housing.

(2) Place the water pump assembly in position on a press with the impeller side up. NOTE: *If there is a pipe plug installed in the impeller end of the shaft, remove the pipe plug.* Press on the upper end of the shaft and remove the shaft and bearings from the pump housing and the impeller.

(3) Press the shaft from the bearings and remove the water slinger. Drive the seal assembly from the pump housing.

b. Inspection

(1) A new impeller, seal assembly, shaft, and water slinger should be installed when the pump is reassembled.

(2) Do not wash the bearings in cleaning solvent as the bearings were packed with lubricant for the life of the bearings by the bearing manufacturer. Check the bearings for looseness, roughness, and bind and replace if necessary.

(3) Thoroughly clean the pump housing and check the condition of the bore in the housing for the bearings; replace the housing if necessary.

c. Assembly (Fig. 4)

(1) Place the water slinger in position on the shaft and over the shoulder of the shaft. Press the rear bearing onto the shaft, making certain that the projecting shielded side of the bearing is next to the water slinger. Place the bearing spacer in position on the shaft. Press the front bearing onto the shaft, making certain that the projecting shielded side of the bearing is toward the pulley end of the shaft.

(2) Place the pump housing in position on a press, with the impeller side of the housing downward. Start the shaft (with bearings) into position in the pump housing. Pressing on the inner race of the front ball bearing, press the shaft (with bearings) into position in the housing. Install the retainer snap ring.

(3) Install the seal assembly in position on the impeller end of the shaft and into position in the housing, using

care to prevent damage to the seal assembly.

(4) Place the pump housing assembly in position on a press, supporting the assembly on the pulley end of the shaft. Place the new impeller in position on the upper end of the shaft. Using a suitable piece of tubing between the center of the impeller and the press, press the impeller into position on the shaft until there is a clearance of .015" to .020" between the impeller and the rear face of the housing.

2. **Second Type Water Pump** (Fig. 4)

a. **Disassembly**

(1) Remove the cotter pin and the impeller retaining nut from the shaft.

(2) NOTE: *Two 5/16" — 18 NC tapped holes are provided in the impeller for the use of a puller to remove the impeller from the shaft.* Using a suitable bar type puller, pull the impeller from the shaft. The seal assembly is now accessible. NOTE: *If a seal assembly replacement only is to be made, it will not be necessary to remove the shaft assembly from the pump.*

(3) Remove the retainer snap ring from pulley end of the pump housing. Place the pump assembly on a press, with the impeller end of the shaft up. Press on the upper end of the shaft and remove the shaft and bearings from the pump housing.

(4) Press the shaft from the bearings.

b. **Inspection**

Repair of the water pump will consist of the replacement of any worn or damaged parts.

(1) If the face of the impeller which is contacted by the seal assembly is scored or rough, a new impeller assembly must be installed. If the sealing face of the seal assembly is scored or rough, drive the seal assembly from the pump housing. NOTE: *The seal assembly is serviced only as a unit.*

(2) Clean and inspect the bearings for looseness, roughness, and bind and replace if necessary.

(3) Thoroughly clean the pump housing and check the condition of the bore in the housing for the bearings; replace the housing if necessary.

(4) Inspect the condition of the shaft and the water flinger and replace if necessary.

c. **Assembly** (Fig. 4)

(1) Install the water flinger on the shaft so that flanged end is located 5/16" from the front face of the shoulder on the shaft (refer to Fig. 5).

(2) Press the rear bearing onto the shaft, making certain that the shielded side of the bearing is towards the impeller end of the shaft. Place the bearing spacer in position on the shaft. Press the front bearing onto the shaft, making certain that the shielded side of the bearing is towards the pulley end of the shaft.

(3) Place the pump housing in position on a press, with the impeller side of the housing downward. Start the shaft (with bearings) into position in the pump housing. Pressing on the inner race of the front ball bearing, press the shaft (with bearings) into position in the housing. IMPORTANT: *While pressing the shaft into the housing, hand pack the area between the bearings with clean ball and roller bearing lubricant.* Install the retainer snap ring.

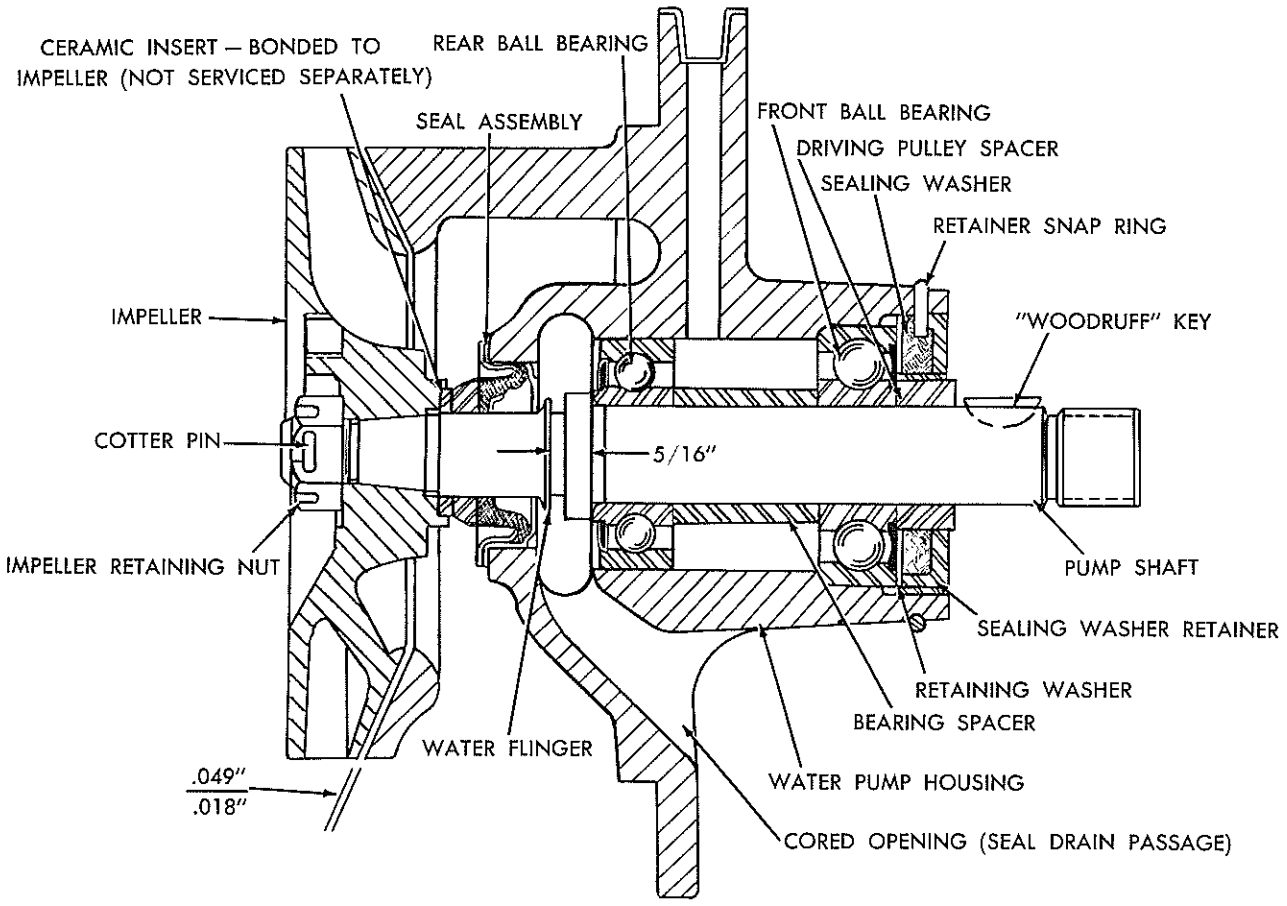

Fig. 5 — Water Pump (Third Type) Sectional View

(4) Install the seal assembly in position on the impeller end of the shaft and into position in the housing, using care to prevent damage to the seal assembly.

(5) Place the impeller in position on the shaft and start the impeller retaining nut. Tighten the retaining nut to a torque of 40 to 50 lbs. ft. NOTE: *Tightening of the retaining nut to the above torque should press the impeller onto the shaft so that a clearance of .018" to .049" is provided between the impeller and the rear face of the housing (refer to Fig. 5).*

3. **Third Type Water Pump** (Figs. 4 and 5)

a. **Disassembly**

(1) Remove the cotter pin and the impeller retaining nut from the shaft.

(2) NOTE: *Two 5/16" — 18NC tapped holes are provided in the impeller for the use of a puller to remove the impeller from the shaft.* Using a suitable bar type puller, pull the impeller from the shaft. NOTE: *The seal assembly is now accessible. If a seal assembly replacement only is to be made, it will not be necessary to remove the shaft assembly from the pump.*

(3) Remove the sealing washer retainer snap ring from the housing, turn the sealing washer retainer from the housing and remove the retainer, sealing washer, driving pulley spacer, and the retaining washer.

(4) Place the pump housing assembly in position on a press, with the impeller end of the shaft up. Press on the upper end of the shaft and remove the shaft and bearings from the pump housing.

(5) Press the shaft from the bearings.

b. **Inspection**

Repair of the water pump will consist of the replacement of any worn or damaged parts.

(1) If the ceramic insert for the seal assembly (bonded to the impeller) is scored or rough, a new impeller assembly must be installed. If the sealing face of the seal assembly is scored or rough, drive the seal assembly from the pump housing. NOTE: *The seal assembly is serviced only as a unit.*

(2) Clean and inspect the bearings for looseness, roughness, and bind and replace if necessary.

(3) Thoroughly clean the pump housing and check the condition of the bore in the housing for the bearings; replace the housing if necessary.

(4) Inspect the condition of the shaft and the water flinger and replace if necessary.

c. **Assembly** (Figs. 4 and 5)

(1) Install the water flinger on the shaft so that the flanged end is located 5/16" from the front face of the shoulder on the shaft.

(2) Press the rear bearing onto the shaft, making certain that the shielded side of the bearing is towards the impeller end of the shaft. Place the bearing spacer in position on the shaft. Press the front bearing onto the shaft, making certain that the shielded side of the bearing is towards the pulley end of the shaft.

(3) Place the pump housing in position on a press, with the impeller side of the housing downward. Start the shaft (with bearings) into position in the pump housing. Pressing on the inner race of the rear bearing, press the shaft (with bearings) into position in the housing. IMPORTANT: *While pressing the shaft into the housing, hand pack the area between the bearings with clean ball and roller bearing lubricant.*

(4) Install the driving pulley spacer in position on the shaft and against the inner race of the front bearing. Install the retaining washer. Insert a new sealing washer in position in the sealing washer retainer and turn the washer retainer into the pump housing until the hole in the retainer is aligned with the hole in the housing for the retainer snap ring. Install the retainer snap ring.

(5) Install the seal assembly in position on the impeller end of the shaft and into position in the housing, using care to prevent damage to the seal assembly.

(6) Place the impeller in position on the shaft and start the impeller retaining nut. Tighten the retaining nut to a torque of 40 to 50 lbs. ft. NOTE: *Tightening of the retaining nut to the above torque should press the impeller onto the shaft so that a clearance of .018" to .049" is pro-*

vided between the impeller and the rear face of the housing (refer to Fig. 5).

E. Installation of Water Pump

1. Place the water pump assembly in position in the timing gear housing, making certain that the gasket is in good condition and that the square cored opening (seal drain opening) in the pump housing is to the bottom. Secure the water pump to the timing gear housing with six capscrews and lockwashers.

2. Install the "WOODRUFF" key in position in the water pump shaft and start the water pump pulley on the shaft. Install the pulley retaining nut and tighten securely, then lock the retaining nut by installing the locking nut.

3. Make certain that the water pump and the fan belt tightener lubricating hoses (later models) are in good condition, then secure the outer ends of the hoses to the supporting bracket located below the generator. Install and tighten the capscrew to secure the fan belt tightener lubricating hose clip.

4. Install the water pump and generator drive belt and adjust (refer to "GENERATOR DRIVE BELT ADJUSTMENT," Section VI). Adjust the fan drive belts (refer to "FAN DRIVE BELT ADJUSTMENT" in this Section).

5. Install the radiator and radiator shell (refer to "RADIATOR AND RADIATOR SHELL" in this Section). Fill the cooling system (refer to "DRAINING AND FILLING OF SYSTEM" in this Section).

7. THERMOSTAT AND THERMOSTAT HOUSING

A. Description

The thermostat, located in the thermostat housing at the front of the water outlet manifold of the engine, operates automatically to maintain a normal coolant operating temperature of 160° to 185° F. The thermostat is so positioned, that when it is closed, the flow of coolant from the engine water outlet manifold to the radiator inlet is shut off. The flow of coolant is then directed from the water outlet manifold through the water by-pass pipe and back to the inlet side of the water pump.

Before the thermostat opens (below coolant temperature of approximately 165° F.), the coolant circulates through the engine circulating system only. When the thermostat opens (fully opened at approximately 185° F.), the coolant circulates through the radiator and the entire system.

B. Service

Replacement of the thermostat will be necessary when the thermostat becomes corroded, sticking in the open or closed position. The only service necessary on the thermostat housing is to make certain the housing is not cracked and the gaskets are in good condition.

C. Thermostat and Thermostat Housing Replacement

1. Drain the cooling system (refer to "DRAINING AND FILLING OF SYSTEM" in this Section).

2. Remove the engine hood. Loosen the hose clamps securing the upper hose to the radiator and the water outlet elbow and remove the two capscrews and lockwashers securing the water outlet elbow to the thermostat housing. Slide the outlet elbow forward until it is free of the thermostat housing.

3. Loosen the hose clamps securing the by-pass pipe hose to the thermostat housing and the by-pass pipe.

4. Remove the four capscrews and lockwashers securing the thermostat housing to the water outlet manifold and remove the thermostat housing, seal assembly, thermostat, thermostat housing spacer, and thermostat housing gaskets.

5. Clean and inspect the thermostat housing.

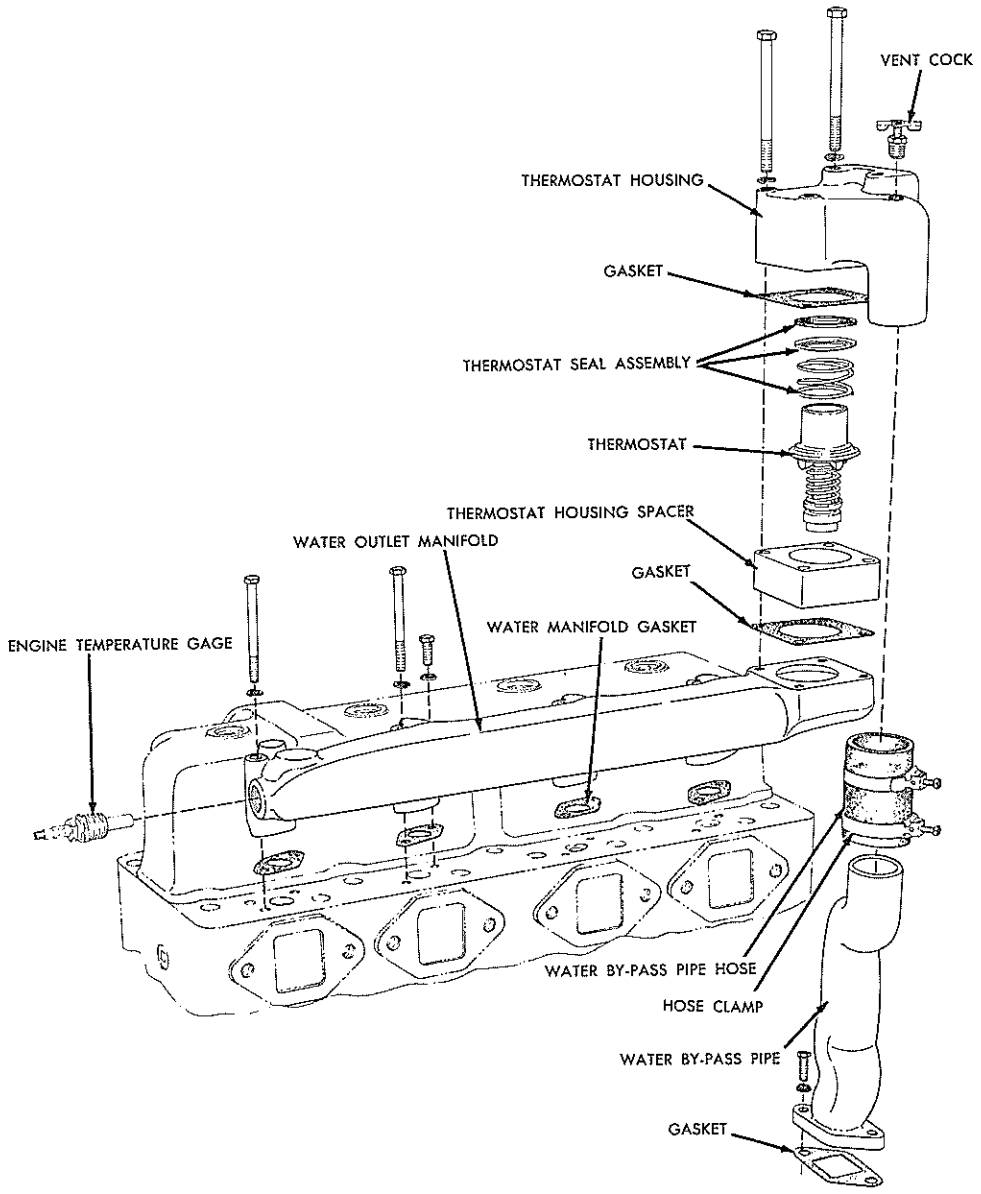

Fig. 6 — Water Outlet Manifold Details

Examine the thermostat seal assembly (serviced only as a unit) and replace if necessary. Examine the gaskets and replace if necessary.

6. Place a gasket in position on the water outlet manifold and place the thermostat housing spacer in position over the gasket.

7. Place a gasket in position on the thermostat housing spacer. Refer to Fig. 6 and install the thermostat and seal assembly as shown. Place the thermostat housing in position and secure with four capscrews and lockwashers.

8. Tighten the hose clamps securing the water by-pass pipe hose to the thermostat housing and the by-pass pipe. Slide the water outlet elbow rearward, making certain that the gasket is in place and secure the outlet elbow to the water outlet manifold with two capscrews and lockwashers.

9. Tighten the hose clamps securing the upper hose to the radiator and outlet elbow. Install the engine hood.

10. Fill the cooling system with coolant (refer to "DRAINING AND FILLING OF SYSTEM" in this Section).

8. FAN, FAN BELTS, AND FAN BELT TIGHTENER

A. Description

There are two types of fans available for the HD-6 Tractor, a suction type and a pusher type. NOTE: *The pusher type fan is standard equipment on all Model HD 6G Tractors.* The fan pushes or pulls (according to the type used) air through the radiator and helps cool the engine coolant as the coolant circulates from the top to the bottom of the radiator core. The fan hub assembly is mounted on a bracket, which is bolted to the front of the engine cylinder block. The fan is bolted to the fan hub assembly, which rotates on two ball bearings, and is driven by two V-belts from the crankshaft pulley, located on the front end of the crankshaft. A fan belt tightener assembly, mounted on the fan mounting bracket, is provided for adjusting the fan belts.

B. Lubrication

The fan hub assembly bearings and the fan belt tightener bearings must be lubricated after each 200 hours of operation.

C. Fan Drive Belt Adjustment

The fan drive belts are properly adjusted when the straight side of the belts can be pressed inward by hand approximately ½ to ¾ inch at a point half-way between the crankshaft and the fan pulleys. To adjust the drive belts, loosen the fan belt tightener lever locking clamp capscrew. Loosen the jam nut on the fan belt adjusting screw and turn the adjusting screw in or out as necessary to obtain the proper tension on the drive belts, then tighten the adjusting screw jam nut. Tighten the lever locking clamp capscrew.

D. Fan Hub and Fan Belt Tightener Removal (Figs. 7, 8, and 9)

1. Drain the cooling system (refer to "DRAINING AND FILLING OF SYSTEM" in this Section). Remove the radiator shell and radiator (refer to "RADIATOR AND RADIATOR SHELL" in this Section).

2. Disconnect the outer end of the fan belt tightener lubricating hose from the supporting bracket located below the generator.

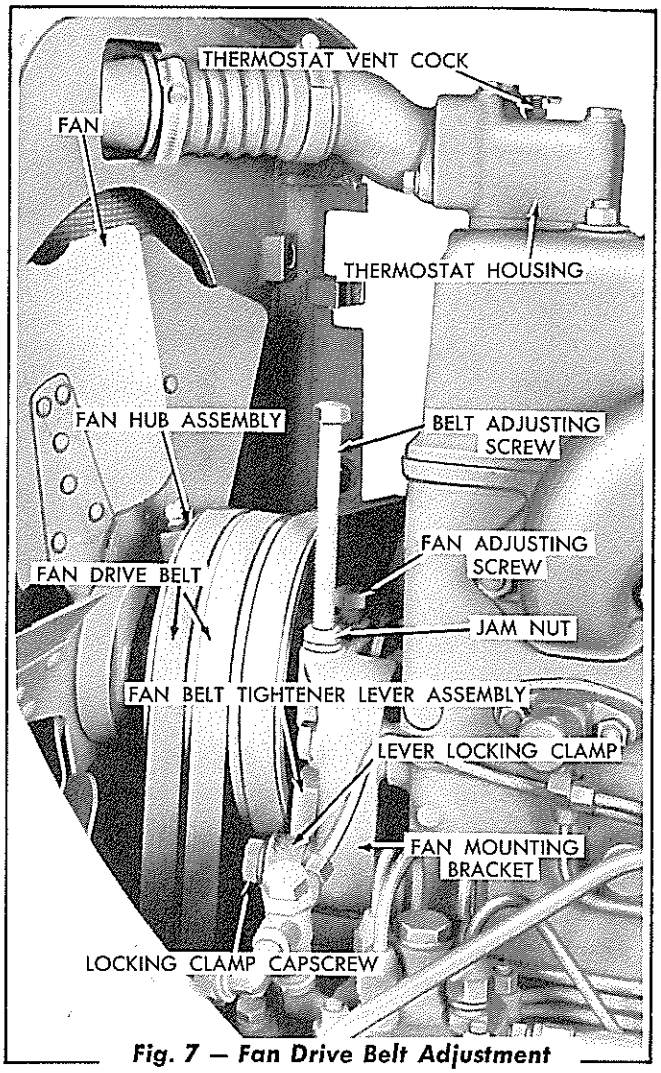

Fig. 7 — Fan Drive Belt Adjustment

Remove the capscrew attaching the fan belt tightener lubricating hose clip.

3. Remove the six capscrews and lockwashers attaching the fan and fan spacer to the fan hub assembly. Remove the fan and fan spacer. NOTE: *The spacer is not used on tractors equipped with a pusher type fan.*

4. Refer to "FAN DRIVE BELT ADJUSTMENT," Paragraph C, and loosen and remove the fan drive belts.

5. Refer to "GENERATOR DRIVE BELT ADJUSTMENT" in Section VI and loosen and remove the generator drive belt.

6. Remove the fan adjusting screw. Remove the roll pin used to lock the slotted jam nut in position on the rear end of the fan spindle. Loosen and remove the slotted

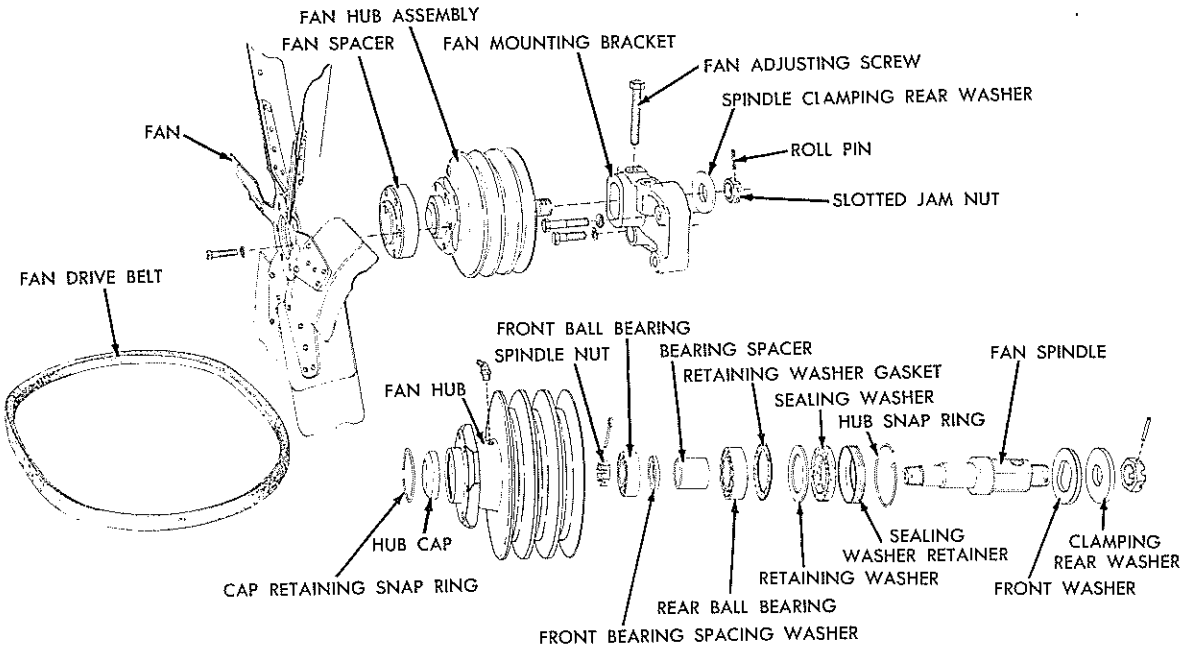

Fig. 8 — Fan Hub Assembly Details

jam nut from the fan spindle and remove the fan hub assembly from the mounting bracket.

7. Remove the fan belt tightener lever locking clamp capscrew and the lever locking clamp. Withdraw the fan belt tightener assembly from the mounting bracket.

8. The fan mounting bracket may now be removed if necessary.

E. Disassembly of Fan Hub (Fig. 8)

1. Remove the cap retaining snap ring and the hub cap from the fan hub assembly.

2. Remove the fan hub snap ring and turn the spindle sealing washer retainer out of the fan hub; remove the retainer, spindle sealing washer, rear bearing retaining washer, and the retaining washer gasket.

3. Place the fan hub assembly in a suitable press, with the fan end of the pulley upward, and press the spindle and bearings from the fan hub.

4. Remove the cotter pin and spindle nut from the spindle and press the spindle from the bearings.

F. Inspection of Fan Hub Assembly

Wash all parts thoroughly in clean solvent or fuel and inspect the parts for wear or damage. Rotate the bearings by hand and check for looseness, roughness, and binding and replace if necessary. Inspect the spindle and make certain it is not bent or worn and that the threads are not damaged beyond repair. Inspect the fan hub for wear and make certain that the pulley grooves are smooth and that the pulley is not chipped or cracked. Discard the spindle sealing washer and the retaining washer gasket and install new ones when assembling. Replace the generator drive belt and the fan drive belts if they are worn or frayed.

G. Assembly of Fan Hub (Fig. 8)

1. Press the rear ball bearing onto the spindle. Place the spindle bearing spacer and the front bearing spacing washer in position on the front end of the spindle. Press the front bearing onto the spindle.

2. Install the spindle nut, tighten securely, and install the cotter pin.

3. Place the pulley in position on a press, with the fan end of the pulley downward. Start the spindle (with bearings) into position

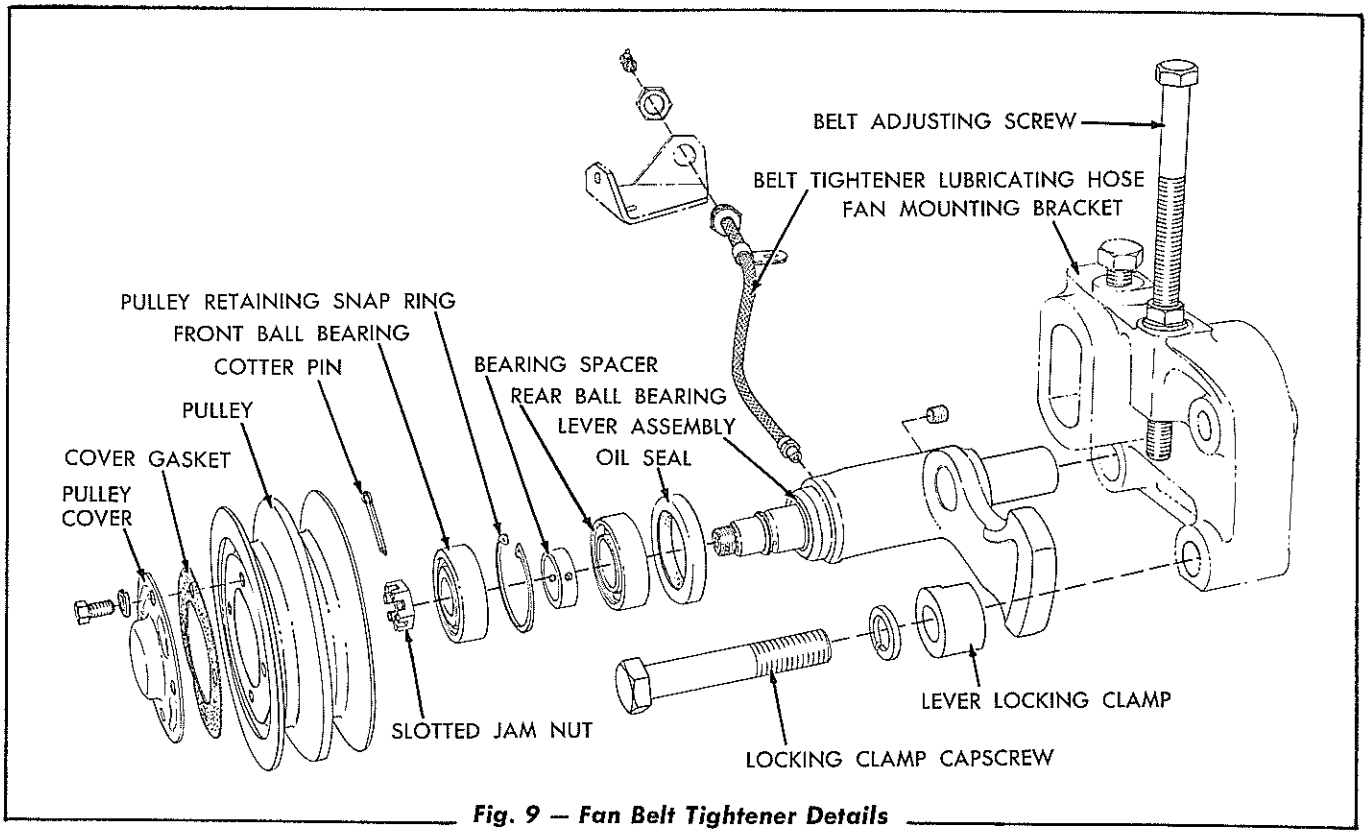

Fig. 9 — Fan Belt Tightener Details

in the pulley. Pressing on the rear end of the spindle, press the spindle (with bearings) into position in the pulley. NOTE: *While pressing the spindle into the pulley, hand pack the area between the bearings with clean ball and roller bearing lubricant.*

4. Install a new retaining washer gasket and the rear bearing retaining washer in position on the spindle. Insert a new spindle sealing washer into the spindle sealing washer retainer and turn the washer retainer into the pulley until the hole in the retainer is aligned with the hole in the pulley for the fan hub snap ring. Install the hub snap ring.

5. Install the hub cap and secure with the cap retaining snap ring.

H. Disassembly of Fan Belt Tightener (Fig. 9)

1. Remove the four capscrews and lockwashers attaching the pulley cover to the pulley and remove the pulley cover and pulley cover gasket.

2. Remove the cotter pin from the slotted jam nut located on the front end of the lever assembly and remove the nut.

3. Place the tightener assembly on a press, with the pulley end upward. Press on the front end of the lever assembly and press the lever assembly from the pulley.

4. Drive or press the front ball bearing from the pulley and remove the pulley retaining snap ring. Remove the bearing spacer, rear ball bearing, and the oil seal.

I. Inspection of Fan Belt Tightener

Wash all parts thoroughly in clean solvent or fuel and inspect the parts for wear or damage. Rotate the bearings by hand and check for looseness, roughness, and binding and replace if necessary. The bearings must fit snug in the pulley and on the lever assembly. Inspect the lever assembly and make certain it is in good condition and that the grease passage is clean. Make certain that the threads on the end of the lever assembly are not damaged beyond repair. Discard the oil seal and install a new one when assembling. Make certain that the grooves in the pulley are smooth and that the pulley is not chipped or cracked. Replace the generator drive belt and the fan drive belts if they

are worn or frayed. Replace the lubricating hose if necessary.

J. Assembly of Fan Belt Tightener (Fig. 9)

1. Install the pulley retaining snap ring in position in the groove in the pulley.

2. Press the rear ball bearing into the pulley, so that the rear of the bearing is flush with the counterbore in the pulley for the oil seal. Press the oil seal into the pulley, making certain that the lip of the oil seal is towards the rear. Lubricate the lip of the seal with clean oil.

3. Place the pulley in position on a press, with the rear of the pulley downward. Insert the bearing spacer into the pulley and down in position on the inner race of the rear bearing. Press the front bearing into position in the pulley.

4. Turn the pulley assembly over and place a suitable sleeve (or piece of tubing) between the inner race of the front bearing and the press, so that the lever assembly may be pressed into position in the pulley. Press the lever assembly into position in the pulley.

5. Install the slotted jam nut in position on the front end of the lever assembly and tighten securely. Install the cotter pin.

6. Install the cover gasket and the pulley cover. Fill the tightener assembly with ball and roller bearing lubricant.

K. Fan Belt Tightener and Fan Hub Installation (Figs. 7, 8, and 9)

1. Insert the rear end of the fan belt tightener lever assembly into position in the fan mounting bracket installed on the front of the engine. Install the lever locking clamp and locking clamp capscrew (with lockwasher), but do not tighten at this time.

2. Place the fan spindle clamping front washer in position on the fan spindle. Insert the rear end of the fan spindle into position in the fan mounting bracket, install the spindle clamping rear washer, and start the slotted jam nut onto the spindle. Do not tighten the jam nut at this time.

3. Insert the fan adjusting screw into position in the fan mounting bracket and start the screw into the threads in the fan spindle.

4. Place the generator drive belt and the fan drive belts in position on the pulleys. Do not adjust the belts at this time.

5. Install the fan and fan spacer in position on the fan pulley and secure with six capscrews and lockwashers. NOTE: *The fan spacer is not used on tractors equipped with a pusher type fan.*

6. Install the radiator and the radiator shell (refer to "RADIATOR AND RADIATOR SHELL" in this Section).

7. Turn the fan adjusting screw in or out as necessary to center the fan in the shroud of the radiator shell, then tighten the slotted jam nut securely on the rear of the fan spindle and install the roll pin to lock the jam nut.

8. Adjust the generator drive belt (refer to "GENERATOR DRIVE BELT ADJUSTMENT" in Section VI). Adjust the fan drive belts (refer to "FAN DRIVE BELT ADJUSTMENT," Paragraph C).

9. Secure the outer end of the fan belt tightener lubricating hose to the supporting bracket located below the generator. Install and tighten the capscrew to secure the lubricating hose clip.

10. Fill the cooling system (refer to "DRAINING AND FILLING OF SYSTEM" in this Section).

SECTION V — ENGINE LUBRICATION SYSTEM

1. DESCRIPTION OF SYSTEM

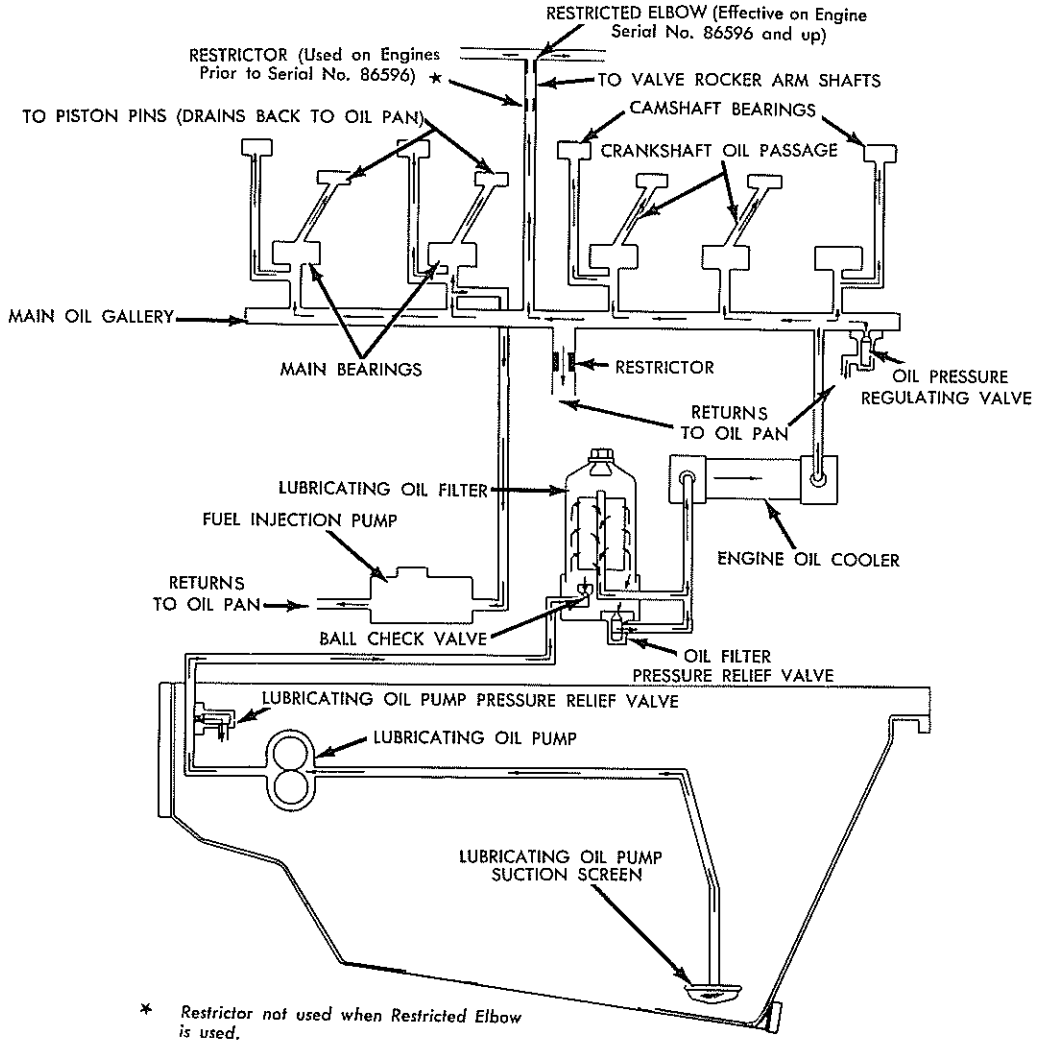

Fig. 1 — Lubricating Oil Flow — Schematic Diagram

The engine is pressure lubricated throughout by a gear-type lubricating oil pump, driven by the oil pump driving gear in mesh with the crankshaft gear.

The lubricating oil pump draws the oil from the crankcase through the oil pump suction screen which is submerged in the lubricating oil. The pump circulates the oil under pressure through the oil filter, engine oil cooler, and the main oil gallery of the engine which extends lengthwise through the cylinder block and parallel to the camshaft. Oil passages direct the oil from the main oil gallery to the camshaft and main bearings and through the rifle drilled connecting rods to the piston pins.

Stabilized oil pressure is maintained within the engine by an oil pressure regulating valve, located in the main oil gallery at the right rear corner of the cylinder block. Excess oil by-passed through this valve returns to the crankcase oil pan.

A horizontal oil passage through the center of the cylinder block extends from the main oil gallery to a cavity in the left side of the cylinder block. From this cavity there is an opening which extends to the rocker arm assemblies.

An external oil line, extending from the main oil gallery of the cylinder block to the fuel injection pump housing, is provided for lubrication of the fuel injection pump and governor assembly. The lubricating oil delivered to the fuel injection pump is returned to the engine crankcase through an oil return hole in the pump mounting flange.

The lubricating oil filter base contains two valves; an oil filter pressure relief valve and a ball check valve. Oil delivered under pressure by the lubricating oil pump holds the ball check valve in the open position, allowing the oil to circulate; whenever the engine is stopped, the ball check valve closes, preventing the oil in the filter from draining back to the crankcase. The oil filter pressure relief valve is provided to by-pass oil directly from the oil pump to the lubricating system in the engine if the oil filter becomes clogged, or if in cold weather the oil is too thick to circulate freely through the oil filter.

2. LUBRICATING OIL PUMP

A. Description

The engine lubricating system has been designed so that the engine can be operated at an angle of 45° in any direction. This system is known as a full pressure lubricating system. Oil pressure at normal operating temperature should be 30 to 55 P.S.I. at high idle engine speed.

The gear-type oil pump is mounted on the cylinder block below the front main bearing cap as shown in Fig. 2. The oil pump driving gear is a helical gear which meshes directly with the crankshaft gear and is driven at 1.5 times crankshaft speed.

The oil pump driving gear and the upper gear (internal) are keyed as well as pressed onto the upper shaft. The lower gear (internal), containing a bushing, rotates as an idler on a shaft pressed into the pump body and held by a retainer. Bushings are provided in pump housing and in the pump cover assembly for the upper shaft.

A plunger type pressure relief valve, located in the pressure side of the pump housing, by-passes excess oil to the inlet side of the pump when the discharge pressure exceeds 130 P.S.I. To protect the oil pump gears, a suction screen is attached to the oil pump suction pipe.

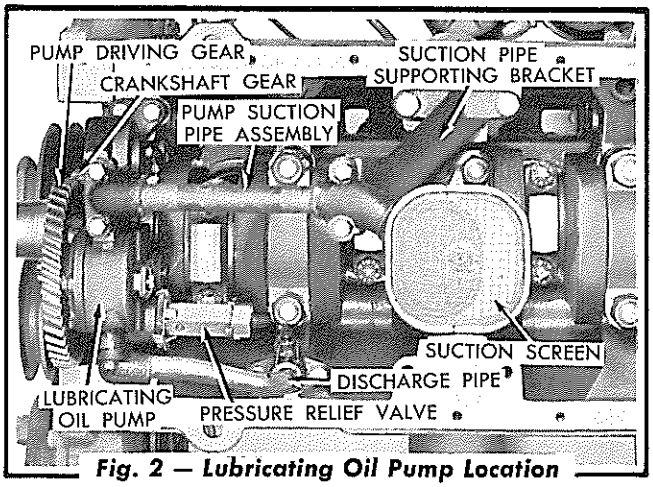

Fig. 2 — Lubricating Oil Pump Location

B. Oil Pump Removal

1. Remove the engine crankcase guard (refer to "MAIN FRAME AND EQUALIZING SPRING," Section XVII).

2. Drain the engine lubricating oil and remove the oil pan.

3. Remove the two capscrews and lockwashers securing the suction pipe to its supporting bracket.

4. Remove the two capscrews and lockwashers securing the discharge pipe to the cylinder block.

5. Remove the four capscrews and lockwashers securing the oil pump assembly to the cylinder block and remove the oil pump assembly.

6. Remove the two capscrews and lockwashers securing the suction pipe supporting bracket to the cylinder block and remove the bracket.

C. Disassembly of Oil Pump

Inspection of the pump is advisable when the engine is overhauled, or after a long period of service. To disassemble the pump, proceed as follows:

1. Thoroughly wash the pump assembly. Remove the two capscrews and lockwashers securing the suction pipe to the pump and remove the suction pipe.

2. Remove the two capscrews and lockwashers securing the discharge pipe to the pump and remove the discharge pipe.

3. Remove the cotter pin and slotted nut from the front end of the upper shaft. Using a suitable pulling tool, pull the oil pump driving gear and extract the "WOODRUFF"

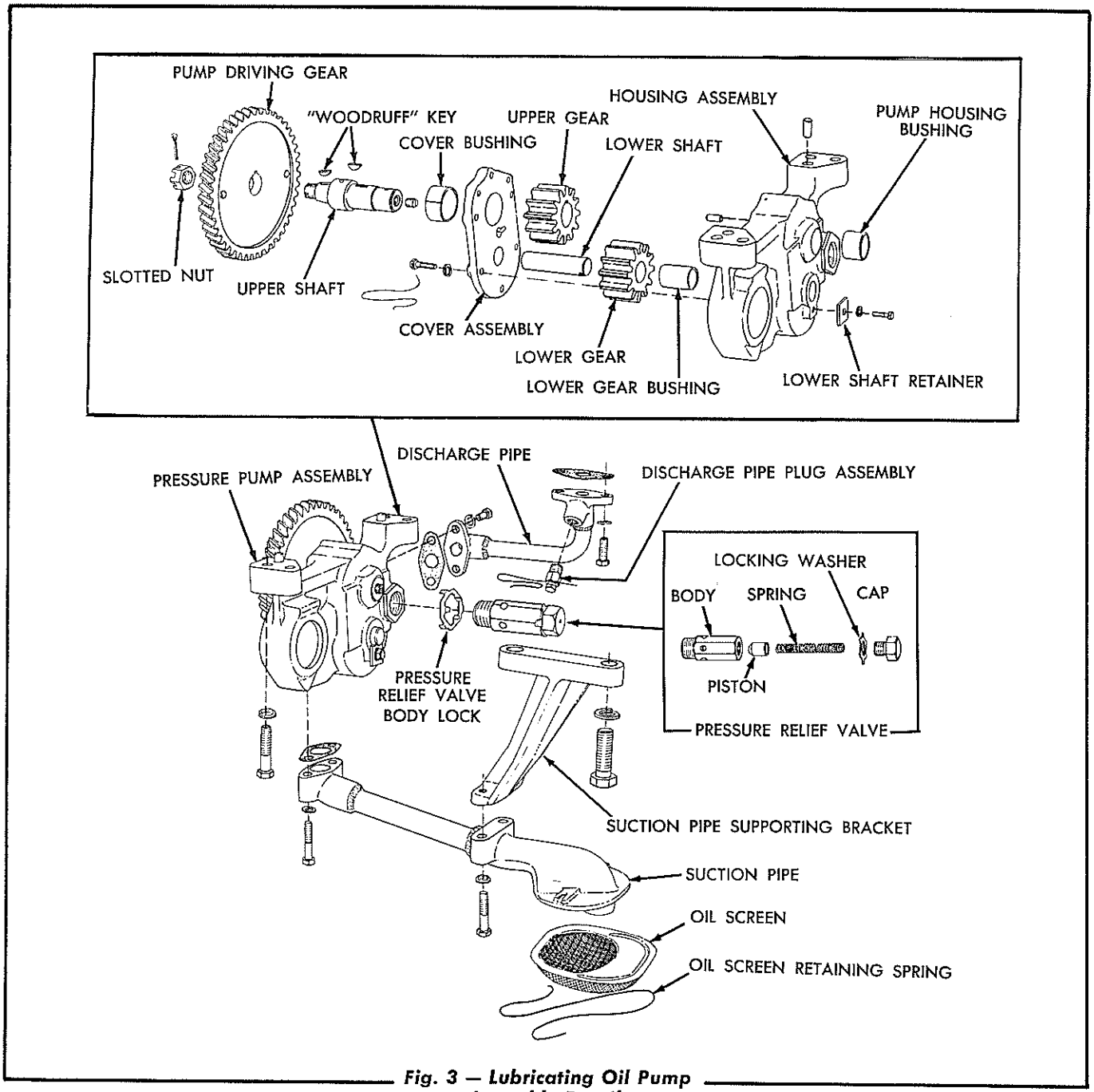

Fig. 3 — Lubricating Oil Pump Assembly Details

key from the shaft. File off any burrs on the shaft.

4. Remove the locking wires and six drilled head capscrews and lockwashers securing the cover assembly to the pump housing, then tap the cover lightly to loosen it from the dowel pins and remove the cover assembly.

5. Remove the upper shaft assembly with gear.

6. Slide the lower gear from the lower shaft.

7. Remove the pressure relief valve assembly from the pump housing.

8. Remove the capscrew and lockwasher securing the lower shaft retainer and remove the retainer and the lower shaft.

D. Cleaning and Inspection of Oil Pump Parts

1. Wash all the oil pump components in clean solvent and thoroughly inspect all the parts before reassembling the oil pump.

   The principal wearing parts of the oil pump are the upper and lower gears. If dirt and sludge have been allowed to accumulate in the lubricating system, oil pump gear wear may be rather pronounced in a comparatively short time. When the oil has been kept clean and the oil filter has been properly serviced, the wear on these parts should be very slight.

2. Inspect the pump gear teeth, the inside of the pump housing, and the inner face of the cover for wear and scoring. The gear teeth, the inside of the pump housing, and the inner face of the cover must be smooth, with no scratches, score marks, or rough spots.

   The radial clearance between the pump gears and the pump housing should be .0035" to .0055". The end clearance of the gears in the pump should be .002" to .004". When these clearances are exceeded, it will be necessary to replace the worn parts.

   If replacement of the oil pump gears is necessary, the oil pump upper gear must be pressed off the upper shaft. When installing the upper gear on the upper shaft, install the "WOODRUFF" key in the shaft and press the shaft into the gear (chamfered side of gear next to shoulder on shaft) until the gear is against the shoulder on the shaft.

3. Inspect the pump shafts and bushings for excessive wear or scoring and replace if necessary. The specified clearance between the upper shaft and the bushings located in the pump housing and pump cover is .0015" to .0035". After installing new bushings in the pump cover and in the pump housing, the bushings should be reamed to 1.2495" to 1.2505" and .937" to .9385" respectively. The specified diameter of the upper shaft at the cover bushing location is 1.247" to 1.248" and at the housing bushing location is .9350" to .9355".

   The specified clearance between the lower gear bushing and the lower shaft is .001" to .003". After pressing a new bushing into the lower gear, drill a ⅛" oil hole through the bushing (in line with the oil hole provided in the gear), then burnish or ream the bushing to .7495" to .7505". The specified diameter of the lower shaft is .7475" to .7485".

   Also, make certain that the oil holes and passage in the upper shaft and the oil hole in each gear are open before reassembling the pump.

4. Disassemble and inspect the pressure relief valve. The piston must slide smoothly in the bore of the valve body. When the piston or the bore of the valve body show excessive wear or roughness, a new valve assembly must be installed.

5. Remove the oil screen from the suction pipe, thoroughly clean, and reinstall.

E. Assembly of Oil Pump

The upper shaft has two keyways; one for the

driving gear and one for the upper gear. A #6 (5/32" x ⅝") "WOODRUFF" key is required for each keyway.

Lubricate the bushings and shafts with clean oil and assemble the oil pump as follows:

1. Install the pressure relief valve assembly and secure with the pressure relief valve body lock.

2. Install the lower shaft in position in the pump housing and secure with retainer, lockwasher, and capscrew. On later model pumps, secure the capscrew with locking wire.

3. Install the lower gear in position on the lower shaft.

4. Insert the upper shaft, with the upper gear in position on the shaft, into the pump housing.

5. Position the pump cover assembly over the dowel pins in the pump housing and secure with six drilled-head capscrews, lockwashers, and locking wires.

6. Install the "WOODRUFF" key in the upper shaft and press the pump driving gear into position on the shaft. Install and tighten the slotted nut and secure with the cotter pin.

7. Place the discharge pipe and new gasket in position on the pump and secure with capscrews and lockwashers.

8. Place the suction pipe and new gasket in position on the pump and secure with capscrews and lockwashers.

F. Oil Pump Installation

1. Place the suction pipe supporting bracket in position under the cylinder block and secure with capscrews and lockwashers. Install the oil pump in position on the cylinder block, inserting the dowel pins into the holes in the cylinder block, and secure the pump to the cylinder block with capscrews and lockwashers.

   NOTE: *The specified backlash between the oil pump driving gear and the crankshaft gear is .003" to .007" and should not exceed .020".*

2. Install a new gasket between the discharge pipe and the cylinder block. Secure the discharge pipe to the cylinder block with capscrews and lockwashers.

3. Secure the suction pipe to its supporting bracket with capscrews and lockwashers.

4. Install the engine oil pan, using a new oil pan gasket set. Fill the engine crankcase to the proper level with the specified lubricant.

5. Install the engine crankcase guard.

3. OIL PRESSURE REGULATING VALVE

A. Description

Stabilized oil pressure is maintained within the engine by an oil pressure regulating valve (Fig. 4), located in the main oil gallery at the right rear corner of the cylinder block. When conditions are such that the oil pressure at the regulating valve exceeds approximately 55 P.S.I., the valve piston is pushed off its seat and the excess oil is bypassed through this valve to the crankcase oil pan.

The pressure regulating valve should require very little attention under normal conditions. If the lubricating system is allowed to sludge, the valve may not work properly. If the valve sticks in the open position, a sharp drop in the engine oil pressure will occur; or if the valve sticks in the closed position, a sharp rise in the engine oil pressure will occur. If the oil pressure should rise or drop sharply, the regulating valve must be disassembled and checked for damage or sludge.

Whenever the oil pump or engine are disassembled, all the components of the oil pressure

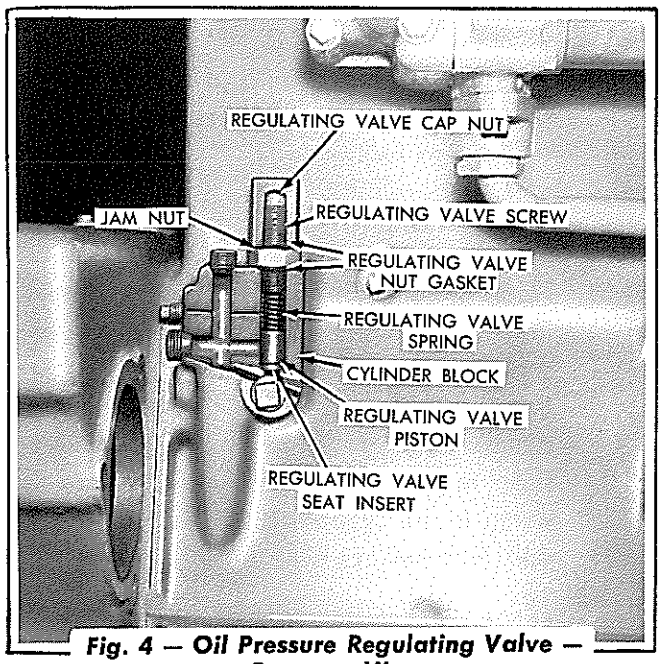

Fig. 4 — Oil Pressure Regulating Valve — Cutaway View

regulating valve assembly should also be removed, thoroughly cleaned, and inspected.

B. Disassembly of Oil Pressure Regulating Valve

1. Refer to Fig. 4 and remove the pressure regulating valve cap nut and valve nut gasket.

2. Remove the jam nut and valve nut gasket.

3. Remove the pressure regulating valve screw, *noting the number of turns required for removal.* Remove the valve spring, valve piston, and valve seat insert.

4. Wash all parts thoroughly and inspect. Replace all necessary parts.

C. Assembly of Oil Pressure Regulating Valve

1. Lubricate the valve seat insert and valve piston with clean oil. Install the oil pressure regulating valve seat insert, valve piston, and valve spring in position in the cylinder block (Fig. 4).

2. Install the pressure regulating valve screw. NOTE: *Turn the valve screw into the cylinder block the same number of turns as required for removal.*

3. Place a valve nut gasket in position over the pressure regulating valve screw and install the jam nut.

4. After the engine has been reassembled and is running, operate the engine until normal operating temperature (160° to 185° F.) is indicated by the engine temperature gage. Adjust the oil pressure regulating valve screw to obtain a maximum oil pressure of 55 P.S.I. at high idle engine speed, then tighten the jam nut. No further adjustment should be necessary.

5. Place a valve nut gasket in position over the pressure regulating valve screw and install the pressure regulating valve cap nut.

4. LUBRICATING OIL COOLER

A. Description

The lubricating oil cooler (Fig. 5), located on the right side of the engine, consists of a corrosion resistant cooling core and tank. The water pump circulates coolant through the cooling core tubes and the engine lubricating oil pump circulates oil through the tank, around the outside of the tubes of the cooling core, thereby controlling the oil temperature.

The cooling core consists of small copper tubes which dissipate heat from the oil to the engine coolant. If proper lubricating oil maintenance procedure is followed, the oil cooler will function efficiently. However, if the oil in the engine is not changed at the recommended intervals, impurities will be deposited in the oil cooler and will restrict the flow of oil around the tubes of the cooling core. Restriction of the flow of oil around the tubes of the cooling core is usually indicated by a drop in oil pressure, due to the oil overheating. If this occurs, the cooling core must be cleaned or a new one installed.

IMPORTANT: *IT IS ABSOLUTELY NECESSARY THAT THE OIL COOLER UNIT BE KEPT CLEAN FOR PROPER OIL COOLING.*

B. Removal of Oil Cooler

1. Drain the cooling system (refer to "ENGINE COOLING SYSTEM," Section IV).

2. Loosen the hose clamps on the water pump-to-oil cooler hose.

3. Remove the four capscrews and lockwashers attaching the two oil lines to the oil cooler.

4. Remove the six capscrews and lockwashers attaching the oil cooler to the cylinder block and remove the oil cooler.

C. Disassembly of Oil Cooler

1. Remove the four capscrews and lockwashers attaching the water inlet connector to the lubricating oil cooler and remove the connector.

2. Remove the four capscrews and lockwashers attaching the water outlet connection to the lubricating oil cooler and remove the connection.

D. Cleaning of Engine Oil Cooler

Cleaning the engine oil cooler requires the use of special solvents. The following solvents have been found effective when used according to the manufacturer's direction:

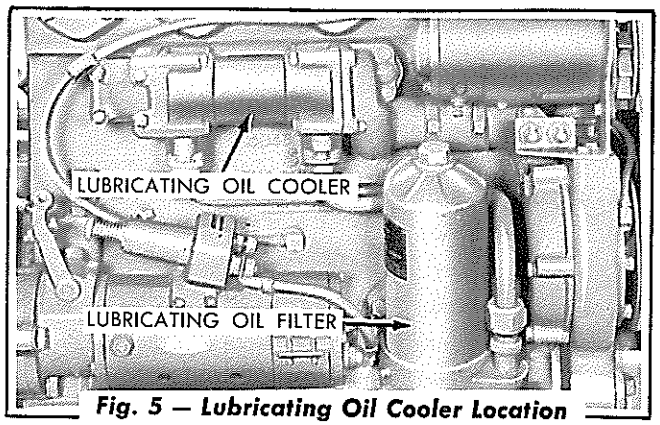

Fig. 5 — Lubricating Oil Cooler Location

Excello Floor Cleaning Compound
Turco Cleaning Compound
No. 70 Stripper
Mixture of 3 parts Oakite No. 7 and 5 parts fuel oil
Bendix Cleaning Compound

To use the last named solvent, merely submerge the oil cooler into the solution for a sufficient length of time to allow the chemical action of the solvent to dissolve or loosen the sludge or other foreign matter. Flush the oil cooler thoroughly with live steam or spirits after cleaning, regardless of type of cleaner used. NOTE: *If the oil cooler is badly clogged, a new oil cooler must be installed.*

E. Assembly and Installation of Oil Cooler

1. Using gasket cement, cement a new oil cooler gasket to the face of the lubricating

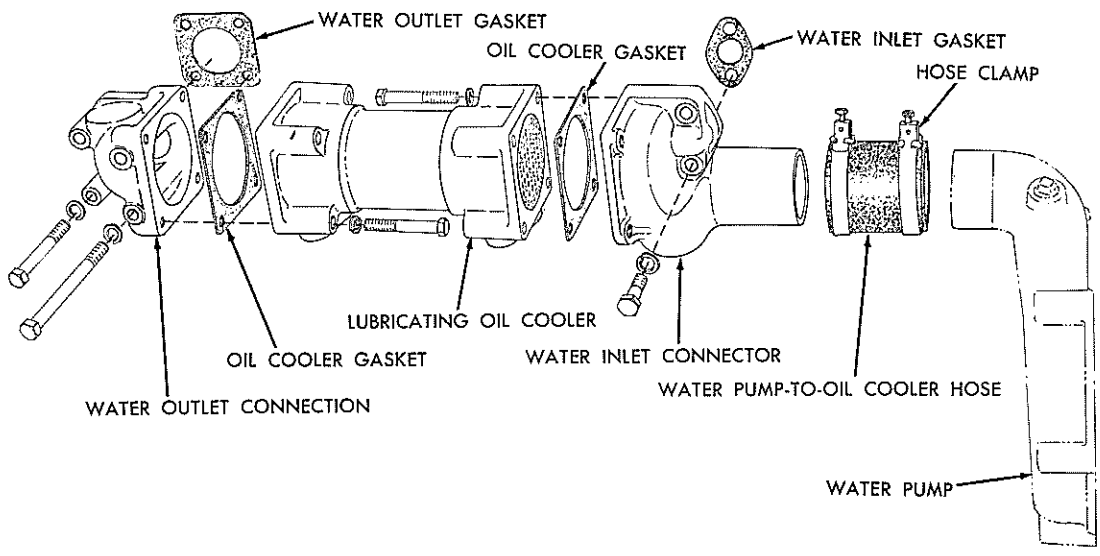

Fig. 6 — Lubricating Oil Cooler Assembly Details

oil cooler. Coat the other side of the gasket with gasket cement, then install the water outlet connection and secure with four capscrews and lockwashers.

2. Using gasket cement, cement a new oil cooler gasket to the face of the lubricating oil cooler. Coat the other side of the gasket with gasket cement, then install the water inlet connector and secure with four capscrews and lockwashers.

3. Place the oil cooler assembly in position on the cylinder block, using new gaskets, and secure with six capscrews and lockwashers.

   NOTE: *When installing the oil cooler assembly in position on the cylinder block, the water inlet connector can also be inserted into the end of the water pump-to-oil cooler hose.*

4. Tighten the water pump-to-oil cooler hose clamps securely.

5. Place the oil lines in position on the oil cooler, using new seal rings, and secure with four capscrews and lockwashers.

6. Close the cooling system drain cocks and open the thermostat vent cock. Fill the cooling system until coolant (free of bubbles) flows from the vent cock. Close the vent cock and continue filling the system until the coolant level is approximately 1 inch below the radiator filler pipe.

7. Operate the engine and check for oil and water leaks. Correct any leaks found.

5. LUBRICATING OIL FILTER

A. Description

The lubricating oil filter, located on the right side of the engine, is of the full-flow type and contains a replaceable type element. A new element must be installed each time the oil in the crankcase is changed, or more often if conditions warrant.

The oil filter base contains two valves, an oil filter pressure relief valve and a ball check valve. Oil delivered under pressure by the lubricating oil pump holds the ball check valve in the open position, allowing the oil to circulate; whenever the engine is stopped, the ball check valve closes, preventing the oil in the filter from draining back to the crankcase. The oil filter pressure relief valve is provided to by-pass oil directly from the oil pump to the lubricating system in the engine if the oil filter becomes clogged, or if in cold weather the oil is too thick to circulate freely through the oil filter.

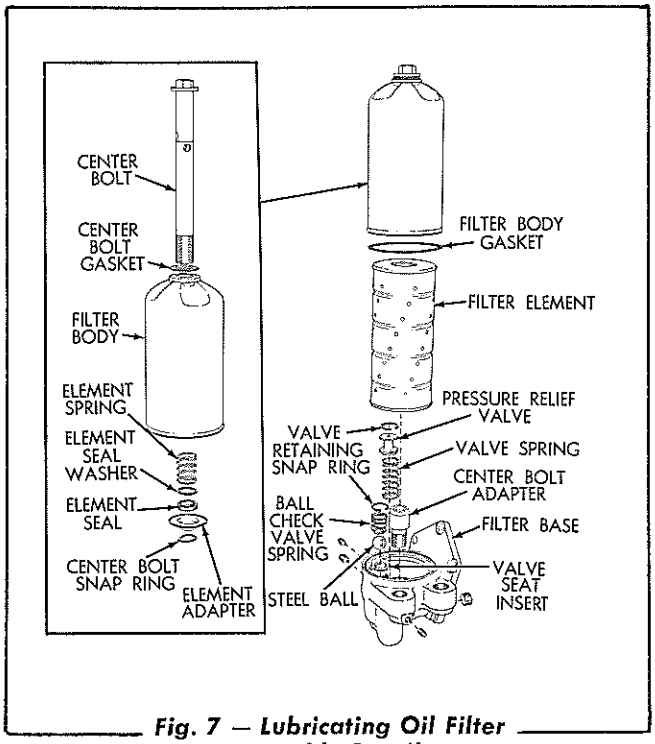

Fig. 7 — Lubricating Oil Filter Assembly Details

B. Service

Under normal conditions, the oil filter pressure relief valve and the ball check valve should require very little attention. If the lubricating system has been allowed to sludge, the valves may not work freely.

Whenever the engine is disassembled for repairs, the oil filter valve assemblies should also be removed, thoroughly cleaned in fuel oil, and inspected.

C. Removal and Installation of Lubricating Oil Filter Assembly

1. Remove the right front fender from the tractor.

2. Loosen the filter center bolt and remove the center bolt, oil filter body, and the filter element as a unit from the oil filter base.

3. Disconnect the oil lines from the oil filter base assembly.

4. Remove the three capscrews and lockwashers and the two nuts and lockwashers attaching the filter base assembly to the cylinder block and remove the filter base assembly.

5. Install the lubricating oil filter assembly by a direct reversal of the removal procedure, using a new gasket between the oil filter base and the cylinder block. Tighten the filter center bolt to a torque of 75 to 80 lbs. ft.

D. Removal of Oil Filter Pressure Relief Valve and Oil Filter Ball Check Valve

1. Loosen the filter center bolt and remove the center bolt, oil filter body, and the filter element as a unit from the oil filter base.

2. Using suitable snap ring pliers, remove the pressure relief valve retaining snap ring. Remove the valve and spring.

3. Using suitable snap ring pliers, remove the ball check valve retaining snap ring. Remove the spring and steel ball.

4. Wash the parts thoroughly and inspect for wear or damage. Replace the necessary parts.

E. Assembly of Oil Filter Pressure Relief Valve and Oil Filter Ball Check Valve

1. Place the steel ball in position on its seat in the oil filter base. Position the ball check valve spring on the steel ball (with the small end of the spring resting on the steel ball) and secure with the valve retaining snap ring.

2. Place the pressure relief valve spring in its seat in the oil filter base. Place the pressure relief valve in position on the valve spring and secure with the valve retaining snap ring.

3. Install the filter body assembly in position on the oil filter base, making certain the oil filter body gasket is properly installed in the base; tighten the filter center bolt to a torque of 75 to 80 lbs. ft.

F. To Replace Filter Element

1. Thoroughly clean the filter body and the surrounding area.

2. Loosen the filter center bolt and remove the center bolt, filter body, and the filter element as a unit from the oil filter base.

3. Remove the filter element from the filter body and discard the element.

4. Thoroughly wash and dry the interior of the filter body.

5. Install a new oil filter body gasket in position in the oil filter base. Install a new element in position in the filter body.

6. Install the filter body assembly in position on the oil filter base, making certain the body gasket is properly installed in the base; tighten the filter center bolt to a torque of 75 to 80 lbs. ft.

7. Start the engine and observe for oil leakage between the filter body and the oil filter base. Stop the engine and check the oil level of the engine crankcase; add oil as necessary to raise the oil level to the "FULL" mark on the oil level gage rod.

G. Heavy-Duty Lubricating Oil Filter (Special Equipment)

On tractors equipped with a Heavy-Duty oil filter, the filter element must be changed at each engine oil change.

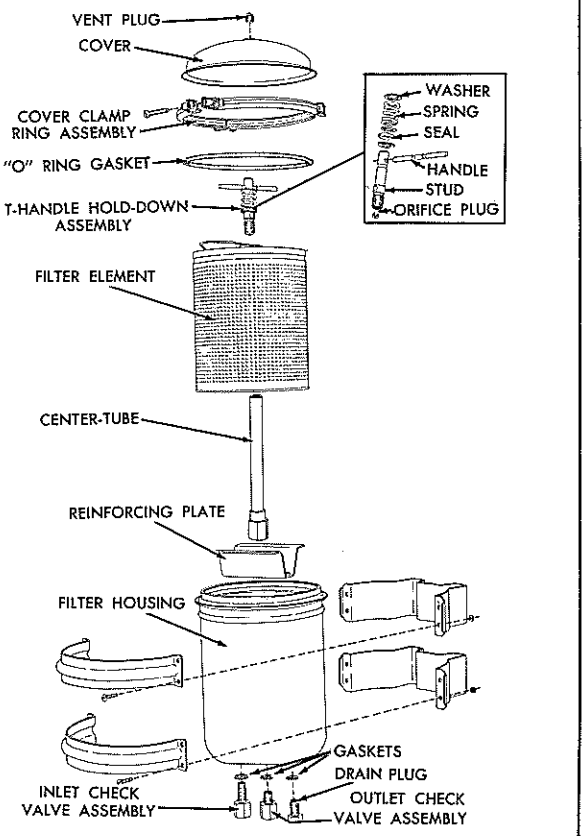

Fig. 8 — Heavy-Duty Lubricating Oil Filter Details

H. To Replace Heavy-Duty Lubricating Oil Filter Element

1. Thoroughly clean the filter cover and the surrounding area. Remove the drain plug (5/8" capscrew) from the bottom of the filter housing and allow the oil to drain. Remove the cover clamp ring assembly and lift the cover from the filter housing.

2. Unscrew and remove the T-handle hold-down assembly. Remove the filter element from the housing by lifting with the pull-out bail. Discard the filter element.

3. Clean the interior of the filter housing thoroughly and install the drain plug.

4. To assure leak-proof sealing, examine the center-tube seat at each end of the new filter element to see that the seats are in good condition and clean. Insert the new filter element into position in the filter housing and press the filter element down firmly.

5. Make certain that the hole in the orifice plug, located in the T-handle hold-down assembly, is open. Install the T-handle hold-down assembly and tighten securely. CAUTION: *When servicing the Heavy-Duty filters, make certain that the T-handle hold-down assemblies are reinstalled in their respective filter, as the T-handle hold-down assembly for the engine lubricating oil filter contains an orifice plug. The T-handle hold-down assembly for the fuel filter does not contain an orifice plug.*

6. If necessary, install a new cover gasket and place the cover in position on the filter housing. Install the cover clamp ring assembly and tighten securely.

7. Fill the crankcase to the proper level with the specified lubricating oil.

8. Remove the vent plug from the filter cover.

9. Start the engine and operate it at low idle speed until the oil flows from the vent plug opening in the filter cover, then stop the engine. Install and tighten the vent plug.

10. Check the oil level of the engine crankcase and add oil as necessary to raise the oil level to the "FULL" mark on the oil level gage rod.

    CAUTION: *Use only a "DIESELPAK" filter element in the Heavy-Duty filter.*

SECTION VI — ELECTRICAL SYSTEM

1. DESCRIPTION OF SYSTEM

The electrical system, which includes the starter, generator, generator regulator, batteries, headlights, and wiring, is a 24-volt system throughout. Current is supplied by two 12-volt, wet cell, storage batteries carried in the compartments at the ends of the seat.

Electrical energy drained from the batteries through the operation of the above named units is replaced by the generator. The output of the generator is controlled by the generator regulator to prevent overcharging of the batteries.

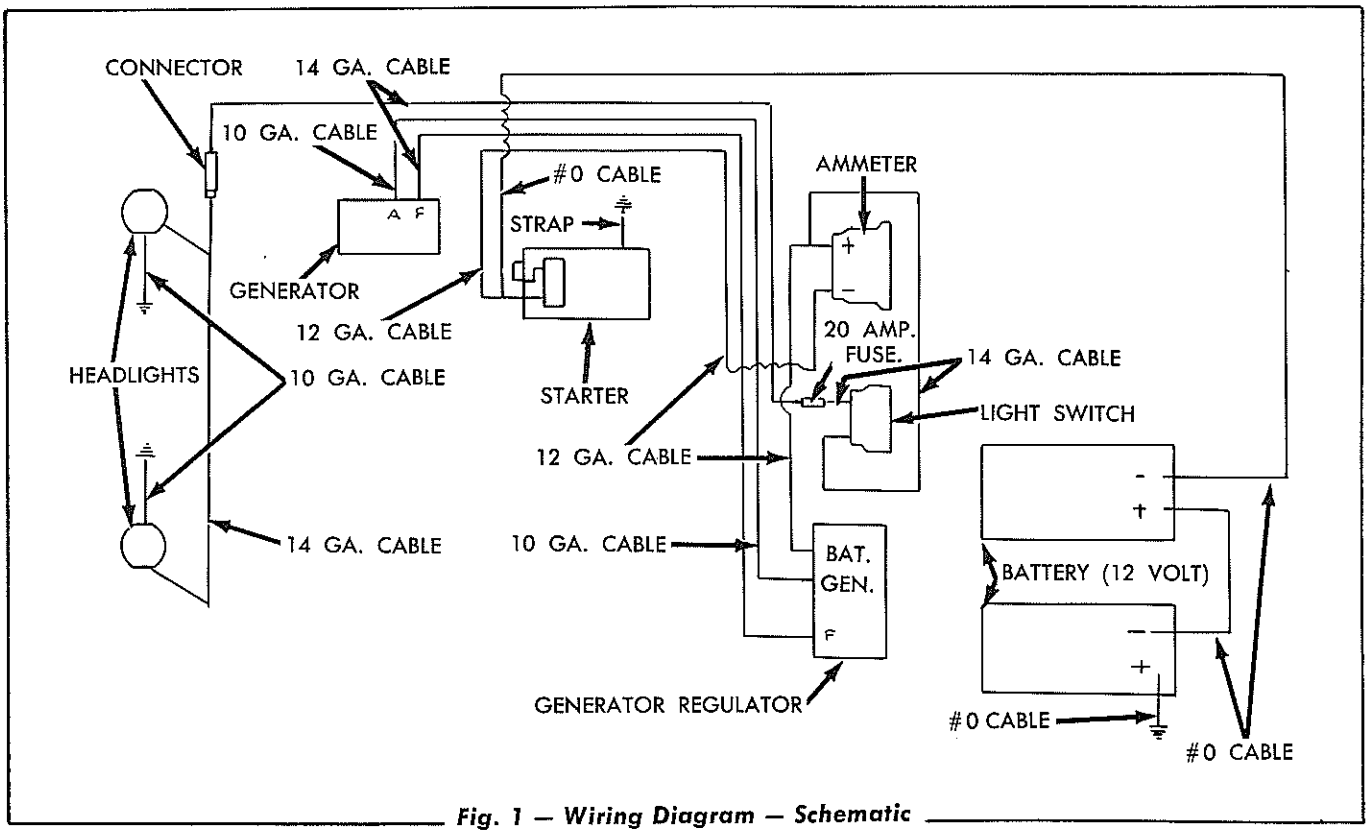

Fig. 1 — Wiring Diagram — Schematic

2. WARRANTY AND ADJUSTMENT POLICY

Manufacturers of the batteries, starter, generator, and generator regulator used on the tractor are responsible for this equipment during the warranty period. Any claim for replacement or repair of any of these units must be presented to the manufacturer, not to the Allis-Chalmers Manufacturing Company. Suppliers of such equipment are represented by distributors or dealers in nearly all cities; they are authorized to make reasonable adjustments or replacements for their respective companies. Always give the serial number of the tractor and the date the machine was delivered when presenting a claim of this nature.

3. WIRING SYSTEM

Heavy cables (#0) connect the batteries and the starter, 10 gage and 14 gage cables connect the generator and the generator regulator, a 12 gage cable connects the ammeter and the generator regulator, 14 gage cables connect the light switch and ammeter and the light switch and headlights. A 20 ampere fuse, connected into the cable extending from the light switch to the headlights, prevents burning out of the lights in the event of a short-circuit. A connector is installed in the headlight cable to permit the removal of the radiator guard without disturbing the headlights.

Inspect the wiring frequently to detect any loose connections or frayed insulation. Tighten the connections and wrap any frayed spots with friction tape to prevent short circuits. CAUTION: *To prevent the possibility of bodily injury, always disconnect the battery to ground cable before cleaning, repairing, disconnecting, or connecting any of the heavy electrical cables.*

4. BATTERIES

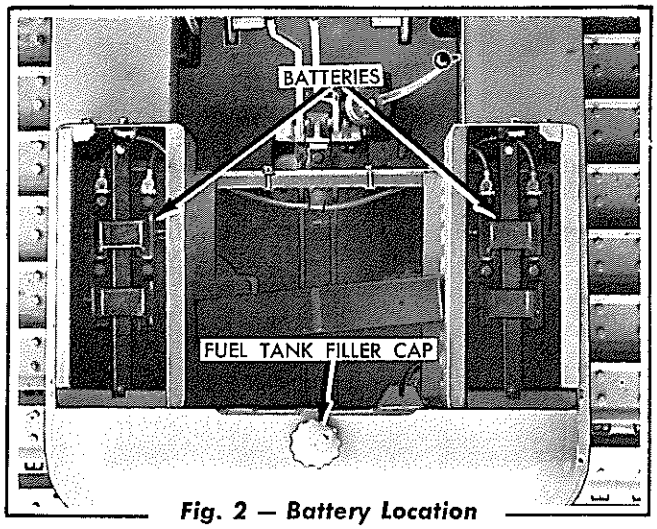

Fig. 2 — Battery Location

A. Description

The batteries are 12-volt, wet cell type, located in compartments at the ends of the seat (under the arm rests) and are held in position by special hold-down assemblies. The batteries are connected in series to provide 24 volt current and the positive post of the left battery is grounded to the steering clutch and final drive housing by the battery-to-ground cable.

B. Service

Check the level of the electrolyte in the batteries after every 10 hours of operation, or as often as operating conditions prove it necessary. Maintain the level of the solution ⅜" above the battery plates by the addition of clean distilled water. NOTE: *DO NOT OVERFILL.* Keep the battery and cable terminals tight and clean. If corrosion occurs, clean the battery posts and terminals with a strong soda solution and coat the terminals lightly with petroleum jelly before connecting them again. The petroleum jelly will prevent further corrosion. CAUTION: *To prevent the possibility of bodily injury, always disconnect the battery-to-ground cable before cleaning, repairing, disconnecting, or connecting any of the heavy electrical cables.*

When the atmospheric temperature is below the freezing point, special attention should be given to hydrometer readings of the batteries. A specific gravity of 1.270 to 1.215 at 80° F. is considered satisfactory for continued use. Specific gravity readings without correction for temperature are practically meaningless. For each 10 degrees that the temperature of the electrolyte is above 80° F., add 4 points to the hydrometer reading and for each 10 degrees below 80° F., subtract 4 points to get the true specific gravity. For example, if the hydrometer reading is 1.250 and the electrolyte temperature is 20° F. (60 degrees below 80° F.), 1.250 minus 24 points equals 1.226 — the true specific gravity.

If the corrected readings are below 1.215, the batteries are not receiving sufficient charge. This might indicate that the generator or the generator regulator requires attention. If these units prove satisfactory, inspect the system for short circuits and for loose or corroded connections. In zero weather there is danger of batteries freezing if the specific gravity is below 1.100. Batteries with a specific gravity of 1.100 will freeze at 18° F., batteries with a specific gravity of 1.220 will freeze at 31° below zero F. During freezing weather, any addition of water to the cells should be made

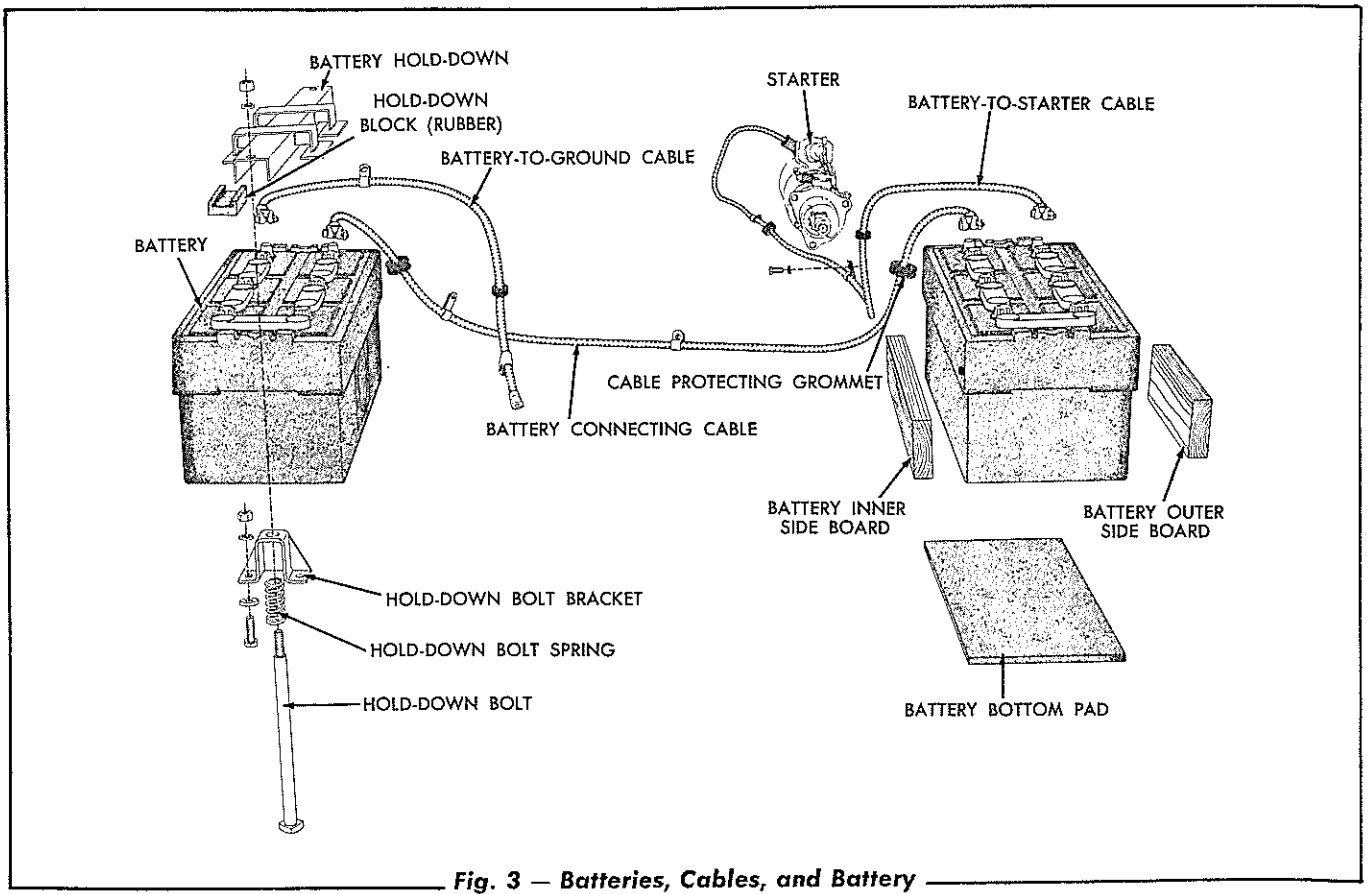

Fig. 3 — Batteries, Cables, and Battery Hold-Down Details

after the engine is started at the beginning of an operating period to make certain that the water and electrolyte solution will be thoroughly mixed; otherwise it may freeze. The filler caps must be kept tight at all times and the tops of the batteries kept clean and dry.

5. GENERATOR AND GENERATOR REGULATOR

A. Description

1. Generator

The generator is a two-brush, shunt wound unit, designed without openings in the field frame and without a cover band. The brush holders are mounted directly to the walls of the field frame in the extruded section. The brushes are mounted in reaction type brush holders and can be inspected through the openings in the commutator end frame. The spring tension on the brushes is set at 28 ounces. The armature shaft is supported at both ends by ball bearings. A ventilating fan draws air through the generator to prevent overheating.

The generator is hinged from a mounting bracket to the right side of the cylinder block. The generator and the water pump are driven by a single belt from the fan pulley. The generator is driven at approximately 1.81 times engine crankshaft speed.

The output of the generator when cold is 10 amperes at approximately 1800 R.P.M. and the output is controlled externally by the generator regulator. NOTE: *Tractors with engines prior to Serial Number 89347 were equipped with 18 amperes generators. In the event of field replacement, make certain the proper generator regulator is used.*

2. Generator Regulator

The generator regulator is a three unit regulator designed for use with generators which have the field circuit insulated in the

generator but grounded in the regulator. A field connection of this type is designated as Circuit "A." The regulator consists of a cutout relay, a voltage regulator, and a current regulator unit. The cutout relay closes the generator-to-battery circuit when the generator voltage is sufficient to charge the batteries, and it opens the circuit when the generator slows down or stops. The voltage regulator unit is a voltage limiting device that prevents the system voltage from exceeding a specified maximum and thus protects the batteries and other voltage sensitive equipment. The current regulator unit is a current limiting device that limits the generator output so as not to exceed its rated maximum.

B. General Maintenance and Inspection

Inspection of the generator brushes, commutator, and leads should be made periodically.

1. Brushes

A stop is provided to prevent the brush arm from touching and scoring the commutator. The brush should never be allowed to wear down until the brush arm actually touches the stop. The brush spring tension must be sufficient to give good clean contact of the brushes on the commutator and the brushes must be free to slide in their brush holders. The pig tail leads in the brushes must be tight and the lead clips fastened securely to the brush holders.

2. Commutator

The commutator must be smooth and round, without excessive roughness, dirt, gum, or burned areas. The slots between the segments must be open and not filled with carbon or copper dust. The mica between the segments should be undercut 1/32". The armature leads must be properly soldered to the commutator segments. If the condition of the commutator does not meet with the above requirements, the generator must be removed for repair.

3. Generator Drive Belt Adjustment

Keep the generator drive belt properly adjusted. The belt is correctly adjusted when it can be pressed inward by hand approximately ½ inch at a point half-way between the generator and water pump pulleys.

To adjust the drive belt, loosen the generator drive belt adjustment link capscrew (Fig. 4) and move the generator up or down to obtain the correct tension of the belt; tighten the adjustment link capscrew.

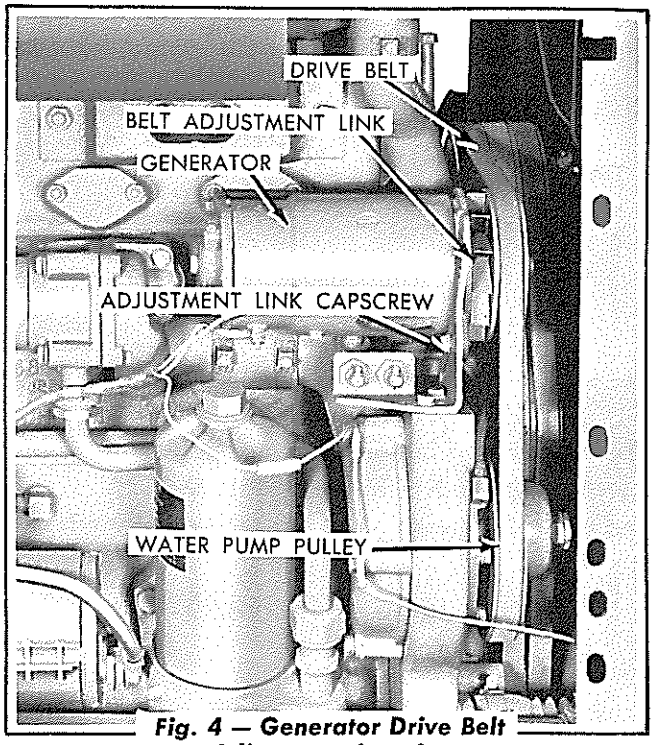

Fig. 4 — Generator Drive Belt Adjustment Location

4. Connections

The connections at the terminals should be checked to be certain they are tight and in good condition. If abnormal operation of the charging system is noted, it is necessary to determine whether it is the generator, generator regulator, or some other part of the electrical system which is at fault.

C. Testing and Adjustment of Generator and Generator Regulator

Testing and adjustment of the generator and the generator regulator should not be attempted without dependable testing equipment; therefore, it is recommended that these units be taken to a de-

pendable electrical repair shop when repair service is required. CAUTION: *DO NOT RUN OR TEST THE GENERATOR ON AN OPEN CIRCUIT.*

D. Removal and Installation of Generator and Generator Regulator

1. Removal of Generator

Disconnect the wiring harness from the generator. Remove the belt adjustment link capscrew. Remove the two capscrews attaching the generator to the generator mounting bracket and remove the generator from the engine.

2. Installation of Generator

Place the generator in position on the generator mounting bracket and install the two capscrews to attach the generator to the mounting bracket, but do not tighten them at this time. Install the belt adjustment link capscrew and adjust the drive belt tension for approximately ½ inch deflection at a point half-way between the generator and water pump pulleys. Tighten the adjustment link capscrew and the two capscrews attaching the generator to the mounting bracket. Connect the wiring harness to the generator (the smaller terminal to field, marked "F" on the generator).

3. Removal of Generator Regulator

Remove the two generator-to-regulator leads and the ammeter-to-regulator lead from the generator regulator and identify them so that they can be reinstalled in their original positions. Remove the four capscrews attaching the generator regulator to the regulator mounting bracket and remove the regulator.

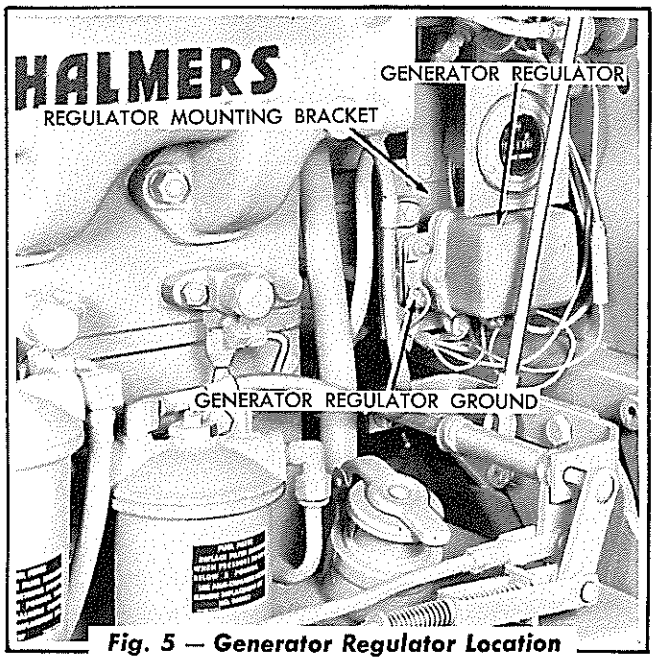

Fig. 5 — Generator Regulator Location

4. Installation of Generator Regulator

Attach the generator regulator to the regulator mounting bracket with four ¼" NF x 1½" capscrews, lockwashers, and nuts. Make certain that the generator regulator ground (Fig. 5) is attached to the lower left hand mounting capscrew. Connect the ammeter-to-regulator lead to the post on the regulator marked "BAT" (Battery). Connect the two generator-to-regulator leads to the proper posts on the regulator marked "GEN" (Generator) and "F" (Field).

IMPORTANT: *Whenever the generator has been removed for repairs or replacement, or when the generator regulator leads have been disconnected or reconnected, the generator must be polarized BEFORE the engine is started.* Polarizing causes the current to flow in the normal direction through the field coils and will prevent vibration, arcing, burning, and sticking of the regulator points.

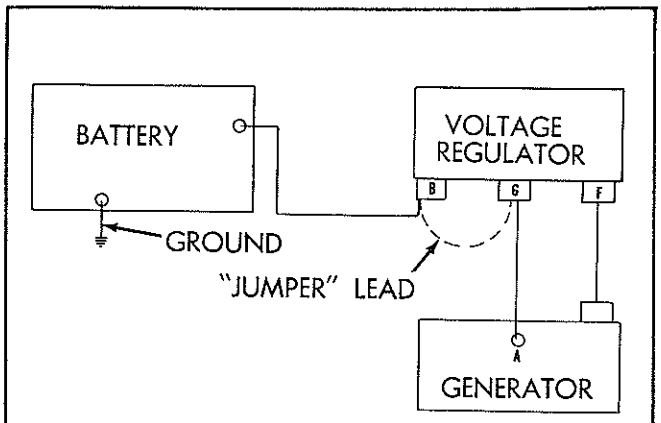

Fig. 6 — Polarizing Circuit Diagram

POLARIZE THE GENERATOR AS FOLLOWS:

a. With a screwdriver or similar tool, raise one of the generator brushes to break contact with the commutator.

b. Using a short "jumper" lead, momentarily touch the "jumper" to the "BAT" (Battery) and to the "GEN" (Generator) terminals of the generator regulator. NOTE: *Starting at the rear of the regulator (as installed on the tractor), the terminals are marked "F" (Field), "GEN" (Generator), and "BAT" (Battery).*

c. Lower the generator brush to make contact with the commutator.

CAUTION: *DO NOT OPERATE OR TEST THE GENERATOR ON AN OPEN CIRCUIT.* If it should become necessary to operate the generator without it being connected to the batteries, it should be short circuited. This can be done by disconnecting the lead connected to the "GEN" (Generator) terminal of the regulator and connecting the end of the lead to a convenient ground.

6. STARTER

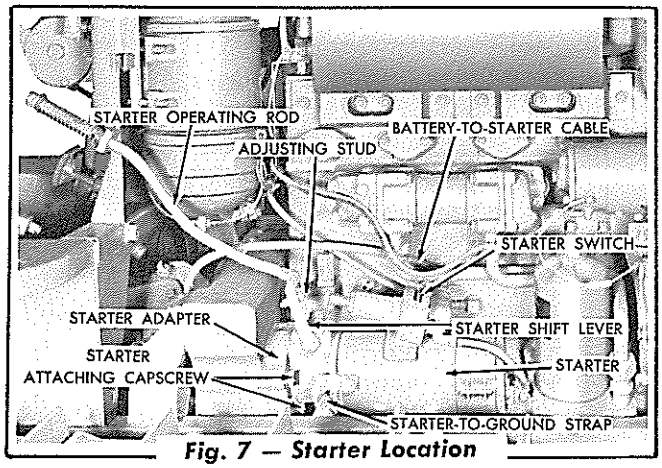

Fig. 7 — Starter Location

A. Description

The starter, mounted on the right side of the engine flywheel housing, is an 8-brush, 4-pole, 24 volt, heavy-duty unit. The armature is supported by bushings at the drive end, center, and commutator end.

The unit is equipped with a heavy duty starting motor switch. A "DYER" type drive is used to mesh the drive pinion of the starter with the flywheel ring gear for cranking the engine and to automatically disengage the drive pinion when the engine has started. The shift lever in the drive housing of the starter is connected by linkage to the starter operating rod. When the starter operating rod is depressed, it shifts the drive pinion of the starter into mesh with the flywheel ring gear and then actuates the switch that closes the circuit between the batteries and the starter.

B. Starter Service

Field service on the starter will be limited to cleaning of the starter, cleaning and adjustment of the drive assembly, cleaning of the commutator and replacement of the brushes, brush springs, or starter switch. All other adjustments or repairs require the use of special equipment. For this reason, it will be necessary to remove the starter and take it to a dependable electrical repair shop, when repair or adjustment is necessary. With fully charged batteries and an ambient temperature of 70° F., the starter will engage promptly and crank the engine at an adequate cranking speed. However, in cold weather the "drag" caused by cold oil between the pistons and cylinder walls and in the bearings of the engine causes the engine to crank harder and the cranking speed will naturally be decreased. IMPORTANT: *The starter must never be used for more than 30 seconds at any one time without a pause to allow it to cool. The starter must NEVER be used to move the vehicle. Failure to observe these rules may result in failure of the starter.*

1. If the starter fails to operate properly, remove the cover band from the starter and inspect the commutator and brush connections. The commutator should be clean, not out of round or excessively worn, and without high mica or burned bars. A glazed or blued commutator does not indicate a condition requiring service, as this is a normal and satisfactory condition on a used unit. All electrical connections should be kept clean and tight, the brush spring tension should be from 36 to 40 ounces, and the brushes must not be worn shorter than half their original length. The brush spring tension can be tested by attaching a small spring scale to each brush, directly under the head of the screw that holds the brush in the arm.

2. A dirty commutator should be cleaned with No. 00 sandpaper. IMPORTANT: *NEVER USE EMERY PAPER.* If dust and dirt have accumulated in the starter, it should be cleaned with compressed air as such accumulations are likely to interfere with the operation of both the starter and the starter drive assembly.

3. After extended use, the contact surfaces of the starter switch may become burned or corroded so that insufficient current is transmitted to the starter. A slow cranking speed or difficulty in keeping the batteries charged may indicate a faulty starter switch. The switch is easily disassembled for reconditioning of burned or corroded surfaces.

   a. Disconnect the battery-to-ground cable, then disconnect the battery-to-starter cable from the switch.

   b. Remove the switch from the starter and remove the bottom plate from the switch.

   c. Remove the contact disc from the plunger by removing the castellated nut.

   d. Clean and smooth the contacting surfaces with a file or sandpaper; be sure that the surfaces contact over the entire area when reassembled.

C. Starter Drive Assembly

1. Disassembly, Cleaning, and Reassembly

If hard dirt or grease accumulates on the splined part of the armature shaft or in the starter drive mechanism, the drive may "seize" while it is in mesh with the flywheel ring gear and damage to the starter may result. The drive assembly must be disassembled for cleaning or adjustment.

a. Remove the starter (refer to "REMOVAL AND INSTALLATION OF STARTER" in this Section).

b. Separate the drive housing from the starter field frame by removing the attaching capscrews; mark both housings before they are separated to establish relationship of one with the other.

c. Remove the cotter pin from the pinion stop and remove the pinion stop, pinion, spring, pinion guide, shift sleeve, cup washer and the spacer washer from the armature shaft.

d. Clean all parts thoroughly and inspect.

e. Reassemble as follows: Place the parts in the following sequence on the drive end of the armature shaft — plain spacer washer, cup washer (cup side away from field frame), and shift sleeve. Place the spring inside of the hollow pinion, with the drive pinion guide next to the spring and the ears on the outside diameter of the guide facing the pinion. Start the ears into the slots in the pinion and hold the guide approximately half the distance down the slots, then start the pinion guide and the spring assembly on the splines of the armature shaft. The pinion and guide assembly cannot be started on the shaft unless the ears on

the guide are held in the slots in the pinion. Install the pinion stop, with the cotter pin hole toward the end of the shaft. When the lugs on the stop enter the groove in the shaft, rotate the stop until the cotter pin holes align and install the cotter pin.

f. Place the drive end housing assembly over the end of the armature shaft and against the center bearing plate, guiding the finger of the shaft lever into the slot of the shift sleeve, and install the attaching capscrews.

2. Starter Drive Adjustments

The starter drive was properly adjusted at the factory and seldom requires readjustment. Failure of the drive to operate properly will usually be caused by dirt or damaged parts. When the starter shift lever is moved to where the starter switch contacts are closed, there should be 1/8" to 3/16" travel of the pinion against the spring pressure. This free travel adjustment can be checked with the starter removed by operating the shift lever until the starter switch is closed and then measuring the distance the pinion can be pushed back. Adjustment can be made by turning the adjusting stud located in the shift lever.

D. Removal and Installation of Starter

In order to remove the starter when the engine is installed in the tractor, it is necessary to remove the right front fender and the lubricating oil filter assembly (refer to "LUBRICATING OIL FILTER," Section V).

1. Disconnect the starter operating rod from the starter shift lever.

2. Remove the seat cushion. Disconnect the battery-to-ground cable from the steering clutch and final drive housing. Tape the disconnected end of the cable to prevent a short circuit in the electrical system when removing the battery-to-starter cable from the starter switch.

3. Disconnect the battery-to-starter cable and the wire extending from the wiring harness to the starter switch. Disconnect the starter-to-ground strap from the starter.

4. Remove the three capscrews attaching the starter to the flywheel housing and remove the starter and the starter adapter.

5. Install the starter by a direct reversal of the removal procedure.

SECTION VII — INSTRUMENTS

1. DESCRIPTION

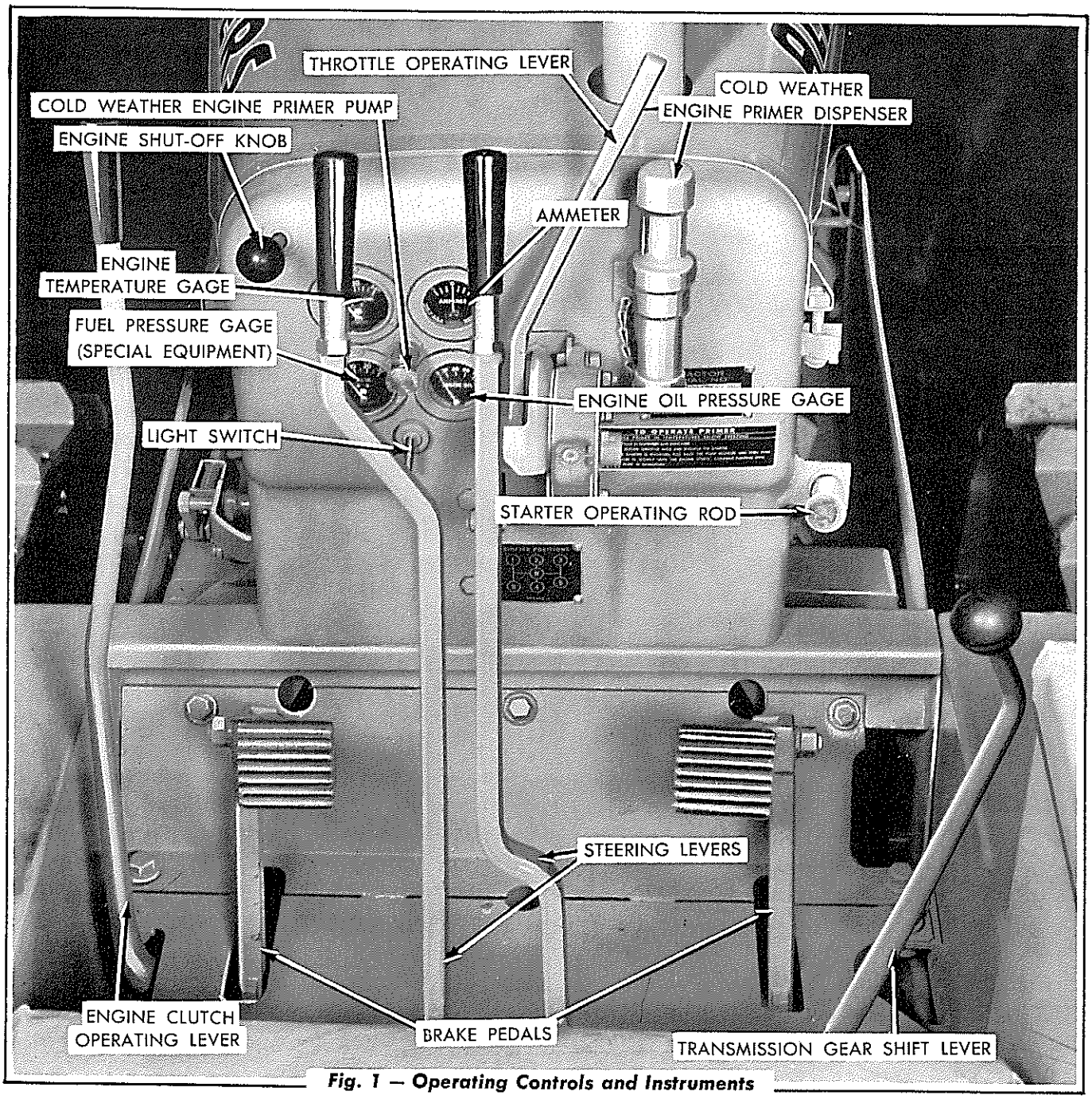

Fig. 1 — Operating Controls and Instruments

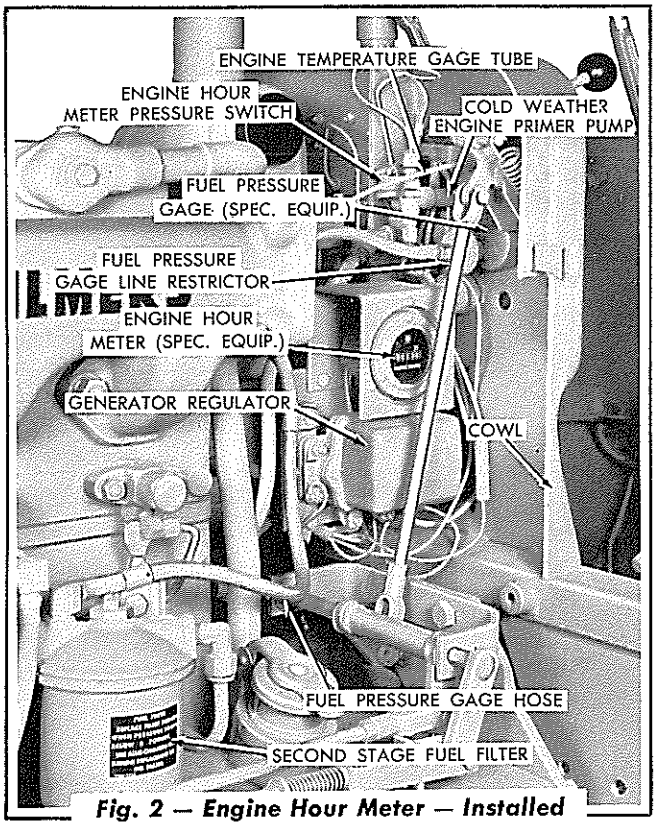

Fig. 2 — Engine Hour Meter — Installed

The instruments, which are standard equipment on the tractor, consists of the engine oil pressure gage, engine temperature gage, and the ammeter, mounted in the cowl.

The fuel pressure gage (special equipment) is also mounted in the cowl as shown in Fig. 1. When a tractor is purchased as a standard model, without the fuel pressure gage, a cover is installed over the hole in the cowl for the fuel pressure gage.

The engine hour meter (special equipment) is mounted in a shock resistant mounting bracket which is attached to the bracket for the generator regulator, located on the front side of the cowl as shown in Fig. 2.

2. ENGINE OIL PRESSURE GAGE

This gage indicates the pressure at which the oil is circulated through the engine. With the engine running at full throttle, the engine oil pressure should be between 30 and 55 pounds at normal engine operating temperature (160° to 185° F.). CAUTION: *If no oil pressure is indicated by the gage, the engine must be stopped immediately and the cause determined and corrected.*

3. ENGINE TEMPERATURE GAGE

This gage indicates the engine coolant operating temperature, which should be maintained between 160° and 185° F. at all times.

4. AMMETER

The ammeter indicates the charging rate of the generator. When the batteries are in a discharged condition, the ammeter should indicate a good rate of charge until the batteries approach a fully charged condition. When the batteries are fully charged, the ammeter will indicate nearly zero, except for a short time after the starter has been used.

5. FUEL PRESSURE GAGE (SPECIAL EQUIPMENT)

The fuel pressure gage indicates the pressure at which the fuel is circulated through the low pressure fuel system. The fuel pressure gage is mounted in the cowl (Fig. 1) and the gage hose is connected to the second stage fuel filter head as shown in Fig. 2. Under normal conditions, with the engine operating at full governed speed, the fuel pressure should be from 5 to 15 pounds.

6. ENGINE HOUR METER (SPECIAL EQUIPMENT)

The engine hour meter is an electrically energized clock which records the number of hours the engine has operated. Starting and stopping of the clock is controlled by the engine oil pressure through a pressure switch so that the meter can not record except when the engine is operating. Tractors Serial Numbers 1248 and above have the direct reading type hour meter shown in Fig. 3; for instructions on how to read the hour meters on Tractors prior to Serial Number 1248, refer to the HD 6 Tractor Operators Manual.

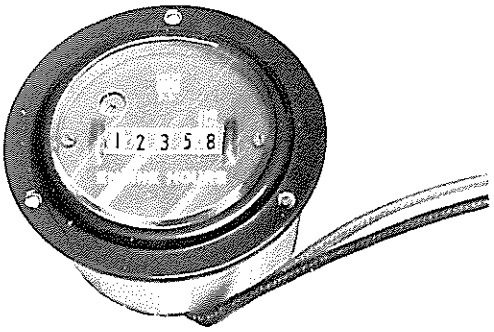

Fig. 3 — Engine Hour Meter

7. INSTRUMENT SERVICE

Any of the various instruments may be removed from the cowl for replacement by removing the attaching screws and disconnecting the instruments from the wiring, tubes, etc., to which they are connected.

Do not attempt to repair an engine hour meter. Return it to your "Allis-Chalmers" Construction Machinery Dealer for trade-in allowance on a new engine hour meter.

SECTION VIII — ENGINE

1. DESCRIPTION

A. General

The engine in all Model HD-6 Tractors is a four cylinder, four-stroke cycle, water cooled, internal combustion, "Allis-Chalmers" Diesel Engine, Model No. HD-344. Fuel is supplied to the engine by an "American Bosch," Type PSB, constant stroke distributing-plunger, sleeve controlled type, fuel injection pump. The fuel "injection pump" delivers accurately metered quantities of diesel fuel under high pressure through pintle-type fuel injection nozzles, and into the engine cylinders, at a definite timing in relation to the engine firing cycle. The fuel is compression ignited by the heat generated by the compression of the air within the cylinders. The expanding gases generated by the burning fuel are converted into mechanical energy in the cylinders of the engine. The engine is full-pressure lubricated by a gear type oil pump driven by a gear located on the front of the engine crankshaft.

B. The Four-Stroke Cycle Diesel Engine

In a four-stroke cycle engine, a power stroke is made by each piston for every two complete revolutions of the crankshaft. The sequence of the strokes are as follows: intake, compression, power, and exhaust.

1. Intake Stroke

As the piston moves downward on the first, or intake stroke, air enters the cylinder through the air intake manifold and the intake valve, which was opened a few degrees before the piston reached top dead center. A rocker arm, push rod, and camshaft are used in the conventional manner to actuate both the intake and the exhaust valves. The intake charge consists of air only, with no fuel mixture, and the volume of air trapped in the cylinder by the closing of the intake valve is the same regardless of throttle setting or engine load.

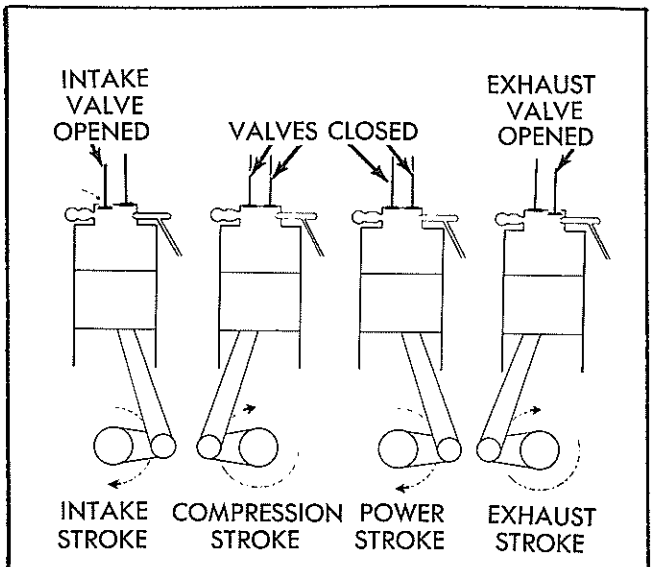

Fig. 1 — Four-Stroke Combustion Cycle

2. Compression Stroke

Shortly after the piston starts to move upward on the second, or compression stroke, the intake valve is closed by spring pressure and the exhaust valve

remains closed. The air is compressed in the cylinder to 1/15 of its original volume. Part of the air is forced into the energy cell located in the cylinder head and opposite the fuel injection nozzle. The compression of air raises the air temperature in the cylinder to approximately 1000° F. At the proper moment during the compression stroke, a metered quantity of fuel is injected into the combustion chamber under a pressure of approximately 2000 P.S.I. The finely atomized fuel is ignited by the heat of the compressed air and starts to burn immediately.

3. Power Stroke

Expansion of the burning gases forces the piston downward on its third, or power stroke. Both the intake and exhaust valves remain closed. The "follow through" combustion, resulting from the design of the energy cell, causes sustained combustion pressures which build up gradually and are held much longer, taking advantage of the most effective crankshaft leverage. Near the bottom of the power stroke the exhaust valve opens.

4. Exhaust Stroke

As the piston moves upward on the fourth, or exhaust stroke, the exhaust valve is open and the burned gases are forced out of the combustion chamber through the open exhaust valve port by the upward travel of the piston. A few degrees before the piston reaches top dead center, the intake valve opens to admit a fresh charge of air to the cylinder. A few degrees beyond top dead center the exhaust valve closes and the cycle is repeated.

C. "Follow-Through" Combustion Principle

The clearance volume above the piston consists of three chambers. The main combustion chamber (in cylinder head) is cylindrical and forms the housing for the exhaust valve. The energy cell, consisting of two auxiliary chambers, is located in the cylinder head and directly opposite the fuel injection nozzle. Figure 2 illustrates the cylinder head cut horizontally across at the energy cell and nozzle, showing the three chambers.

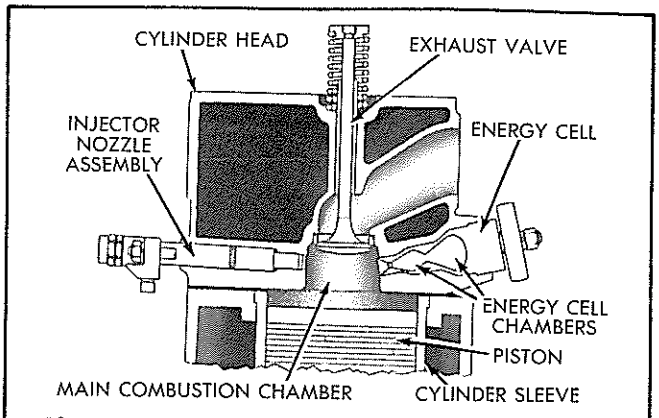

Fig. 2 — Combustion Chamber — Sectional View

As the piston comes up on the compression stroke, air is compressed in the main combustion chamber and a pre-determined volume of air is forced into the chambers of the energy cell. Just before the piston reaches the top of the compression stroke, and while air is being forced at high velocity through the opening into the energy cell, a metered quantity of fuel is injected into the main combustion chamber by the fuel injection nozzle. A predetermined portion of the fuel enters the energy cell where it mixes with the in-rushing air. Ignition begins in the main combustion chamber where the compression and consequently the air temperature is slightly higher than in the energy cell. The fuel mixture burns slowly in the main combustion chamber because it is not yet thoroughly mixed with the air. The ignition of the mixture in the energy cell is momentarily delayed, due to the pressure in the chambers of the cell being slightly less than the pressure within the main combustion chamber. As the piston starts down on the power stroke, ignition of the air-fuel mixture in the energy cell begins. Combustion in this small confined space of the energy cell creates an extremely rapid and sudden pressure rise, or pressure blast. This blast, rushing into the main combustion chamber causes "Tornado Turbulence" and thoroughly mixes the unburned fuel and air for complete "Follow-Through" combustion. With this controlled combustion, cylinder pressures build up slower and are held longer to give higher average working pressures, thus eliminating shock loading of engine parts caused by pressures which build up fast and fall off quickly.

2. CYLINDER HEAD AND ENERGY CELLS

A. Description

The cylinder head is a one-piece alloy iron casting which can be removed from the engine as an assembly containing the valves, valve guides, energy cells, and fuel nozzles. The cylinder head is securely held to the upper part of the cylinder block by heat treated alloy steel studs and nuts.

Located in the head above each cylinder are two valves, two valve guides, a fuel injection nozzle, an energy cell, and two rocker arms. One rocker arm is provided for the intake valve and the other for the exhaust valve. The valve guides are pressed into the cylinder head and hold the valve heads in accurate alignment with the valve seats. Cored passages are provided in the cylinder head for the intake of air and expulsion of exhaust gases and for the circulation of coolant. To seal the compression, a combination steel, asbestos, and copper cylinder head gasket is installed between the cylinder head and the top of the cylinder block. The top of the cylinder head is completely enclosed by a valve rocker arm cover, which is held in place with studs, nuts, plain washers, and rubber sealing washers.

B. Cylinder Head Service

Service on some of the parts contained in the head can be accomplished with the head installed; for others, the head must first be removed from the engine.

1. Operations Not Requiring the Removal of the Cylinder Head are:

   a. Replacement of fuel nozzles.

   b. Replacement of energy cells.

   c. Adjustment of valves.

   d. Replacement of rocker arms, or rocker arm shaft.

   e. Replacement of valve push rods.

   f. Replacement of valve lifters.

2. Operations Requiring the Removal of the Cylinder Head are:

   a. Grinding, reseating, or replacement of valves.

   b. Replacement of valve guides.

   c. Replacement of valve springs.

   d. Replacement of exhaust valve seat inserts.

C. Cylinder Head Removal

1. Remove the engine air pre-cleaner and the engine hood.

2. Drain the cooling system (refer to "DRAINING AND FILLING OF SYSTEM," Section IV).

3. Close the fuel tank shut-off cock located at the bottom of the fuel tank.

4. Disconnect the engine primer fluid line at the primer elbow assembly, located in the engine air intake elbow. Loosen the hose clamp attaching the air cleaner hose to the air cleaner and free the hose from the cleaner.

5. Disconnect and remove the engine temperature gage tube from the rear of the water outlet manifold.

6. Remove the nuts and lockwashers attaching the air intake manifold to the cylinder head and remove the intake manifold.

7. Remove the nuts and washers attaching the muffler to the cylinder head and remove the muffler.

8. Loosen the hose clamp attaching the water by-pass pipe to the thermostat housing. Loosen the hose clamp attaching the radiator upper hose to the water outlet elbow. Remove the capscrews and lockwashers attaching the water outlet manifold to the cylinder head and remove the water outlet manifold and the thermostat housing as an assembly.

9. Remove the capscrew attaching the breather tube to the rocker arm cover. Remove the nuts, washers, and sealing washers attaching the rocker arm cover to the cylinder head and remove the rocker arm cover.

10. Remove the bolt from the clip at the bottom of the hose supporting bracket located at the rear of the engine.

11. Disconnect the compression nuts connecting the fuel return manifold assembly and the fuel injection lines to the fuel injection nozzle assemblies. Cover the fuel line openings with shipping caps.

12. Disconnect the rocker shaft oil tube at the elbow in the cylinder head. Remove the nuts and lockwashers attaching the rocker shaft brackets to the cylinder head and remove the rocker shaft brackets, shaft, and rocker arms as an assembly.

13. Withdraw the push rods from the cylinder head and the block.

14. Remove the cylinder head stud nuts, and with a sling similar to the one shown in Fig. 3, remove the cylinder head.

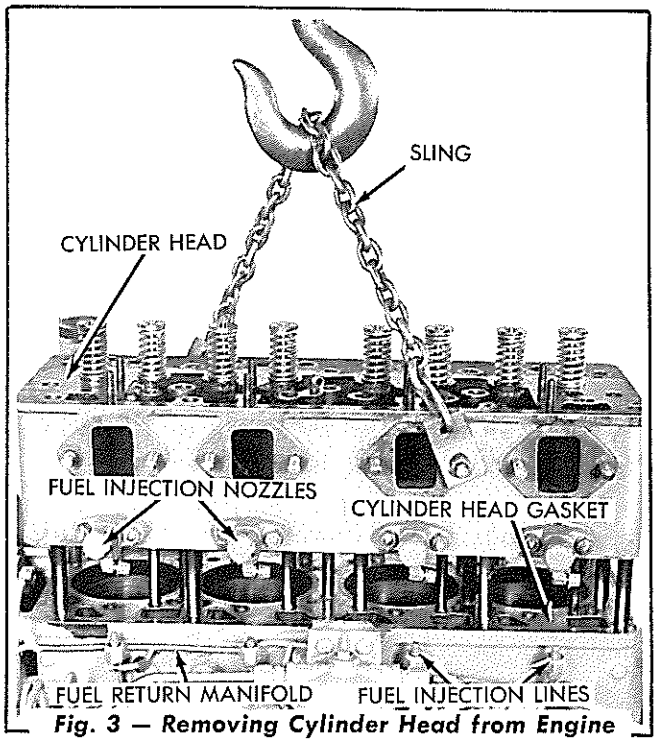

Fig. 3 — Removing Cylinder Head from Engine

D. Inspection

Inspect the cylinder head and component parts for wear or damage. Repair or replace any worn or damaged parts. If the cylinder head is to be replaced, the working parts removed from the old head must be thoroughly inspected before installing them in a new head. The proper procedure to be followed in making the inspection and installation of the various parts will be found under "VALVES" in this Section and "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II.

E. Energy Cell Removal, Inspection, and Installation

The energy cells, located in the right side of the cylinder head, are subject to intense heat and may become burnt and coated with carbon, therefore they should be removed periodically for inspection. To remove the energy cells, refer to "INSTALLATION AND TIMING OF FUEL INJECTION PUMP TO ENGINE," Section II.

After removing, note the condition of each energy cell. If a heavy coating of carbon is present on a cell, this is an indication of a faulty fuel injection nozzle and the corresponding injection nozzle should be removed and checked for proper operation. If an energy cell is badly burnt or has burnt spots, the cell must be replaced. Using a piece of hard wood and solvent, or fuel, clean the energy cells; do not use emery cloth or a metal object to remove carbon. CAUTION: *DO NOT CHANGE THE CONTOUR OF AN ENERGY CELL IN ANY MANNER.*

Make certain that the energy cell plugs, energy cells, and the cell openings in the cylinder head are clean. Using fine grain valve lapping compound, lap the seat of each energy cell with its corresponding seat in the cylinder head, then lap each energy cell plug with its corresponding seat in the energy cell. After lapping, remove the energy cell and clean the lapping compound from the cell, cell plug, and the cylinder head. Install the energy cells in position in the cylinder head. Install the energy cell plugs and secure with the energy cell clamps. Tighten the cell clamp retaining nuts evenly to a torque of 18 to 21 lbs. ft.

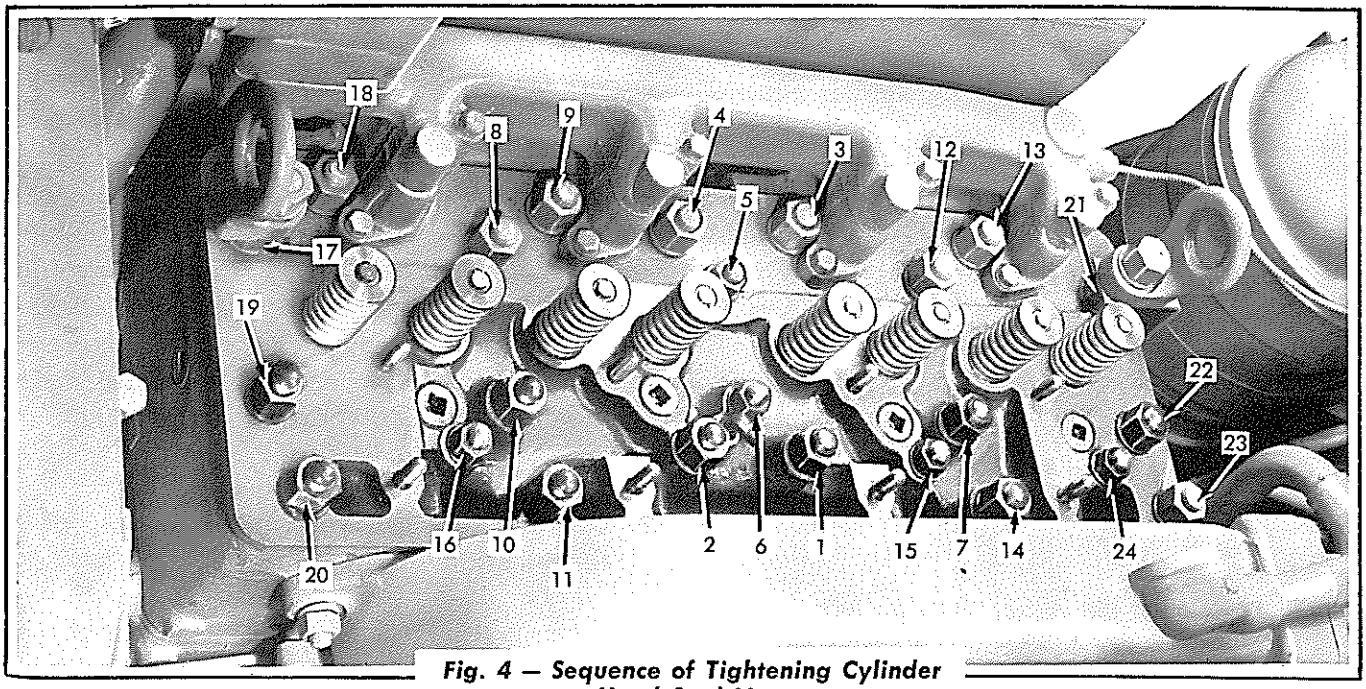

Fig. 4 — Sequence of Tightening Cylinder Head Stud Nuts

F. Cylinder Head Installation

Make certain that the machined surfaces of the cylinder block and cylinder head are thoroughly clean. Install the cylinder head by a direct reversal of the removal procedure, using new gaskets. IMPORTANT: *A new cylinder head gasket MUST be used when installing the cylinder head and make certain the gasket is installed with the proper side up, as stamped on the gasket.* When tightening the cylinder head stud nuts refer to Fig. 4 and tighten in the sequence shown. All ⅝" nuts must be tightened to a torque of 190 to 200 lbs. ft. and the ½" nuts to a torque of 95 to 105 lbs. ft. After the first 10 and 100 hours of operation, the tightness of the cylinder head stud nuts MUST again be checked.

Fill the cooling system (refer to "DRAINING AND FILLING OF SYSTEM," Section IV). Adjust the valves (refer to "VALVE ADJUSTMENT" in this Section for proper procedure).

Open the fuel tank shut-off cock, start the engine and inspect for fuel and oil leaks. Correct any leaks found.

3. VALVES

A. Description

The intake and exhaust valves are made of silichrome steel, carefully heat-treated to develop the special properties required for valve service. Each valve stem is accurately ground to size and hardened at the end to provide the extreme hardness needed.

The hardened valve seats, installed in the cylinder head, are accurately ground to very close limits and their freedom from warpage under ordinary working conditions reduces valve grinding to a minimum. The valve guides, made of special alloy cast-iron, are pressed into the cylinder head. Cylindrical valve springs are held in place, on the upper end of the valve stems, by valve spring retainers and tapered valve spring retainer locks.

The rocker arm assemblies, consisting of two rocker arms for each cylinder, are mounted on a common shaft supported by rocker shaft brackets attached to the cylinder head.

The push rods extend down through the cylinder head, cylinder block, and into valve lifters, which are held in valve lifter brackets. The valve lifters contact the lobes on the camshaft. The upper end of the push rods are concave to receive the ends of the valve lash adjustment screws threaded into one end of the rocker arms. The other end of the rocker arms actuate the valves through the action

of the push rod. When the push rod is forced upward by the camshaft lobe, the rocker arm is raised on one end and forces the other end down, opening the valve. The tension of the valve spring closes the valve when the push rod moves downward. Lubricating oil for the valve operating mechanism is pumped from the cylinder block through a line and into the hollow rocker arm shaft. The rocker arm shaft has holes drilled in it at each rocker arm location and oil is forced into the drilled passages of the rocker arm through the holes in the shaft. The oil spills down over the push rods and valve springs and returns to the oil pan.

B. Service

Several operations on the valve mechanism may be performed without removing the cylinder head, while the head must be removed for certain other operations. The operations not requiring removal of the head are:

1. Adjustment of valves
2. Replacement of valve push rods.
3. Replacement of valve lifters.
4. Replacement of valve lifter brackets.

The cylinder head must be removed to perform the following operations:

1. Replacement of valves.
2. Replacement of valve springs.
3. Replacement of valve guides.
4. Grinding or reseating valves.
5. Replacement of exhaust valve seat inserts.

C. Valve Adjustment

1. General

The correct clearance (lash) between the ends of the intake and exhaust valve stems and the rocker arms is very important in a "DIESEL" engine due to the high compression developed within the cylinders. Insufficient valve clearance will cause loss of compression, misfiring, and will eventually cause burning of the valves and valve seats. Excessi valve clearance will result in faulty engine operation, valve tappet noise, and cause rapid wear on the valve operating mechanism.

With the engine at normal operating temperature (160° to 185° F.), the proper valve lash is: intake valves .016" and exhaust valves .020". After any mechanical work has been done which would disturb the valve lash, the intake valves may be set "cold" at .018" and the exhaust valves at .022" clearance so that the engine may be run and allowed to warm up to normal operating temperature. After the engine has been "warmed up" to normal operating temperature, the valve lash should be checked for proper clearance. NOTE: *The firing order of the engine is 1 — 3 — 4 — 2.*

2. Valve Adjustment

Check the valve clearance periodically and adjust when necessary to obtain the specified lash of .016" for the intake valves and .020" for the exhaust valves as follows:

a. Operate the engine until it reaches normal operating temperature of 160° to 185° F., then stop the engine.

b. Remove the air pre-cleaner, engine hood, and the rocker arm cover.

c. Crank the engine with the starter until both valves for the No. 1 cylinder are closed and the valve push rods are at their lowest position.

d. Check the clearance between the valve stems and the rocker arms. Use a .016" feeler gage when checking the lash of the intake valve and a .020" feeler gage when checking the lash of the exhaust valve. The feeler gage should pass between the rocker arm and the corresponding valve stem with a slight drag when the valve lash is properly adjusted. Refer to Fig. 5 for location of the intake and exhaust valves.

e. Adjust each valve by loosening the lock nut on the adjusting screw and turning the screw clockwise to decrease the clearance or counterclockwise to increase the clear-

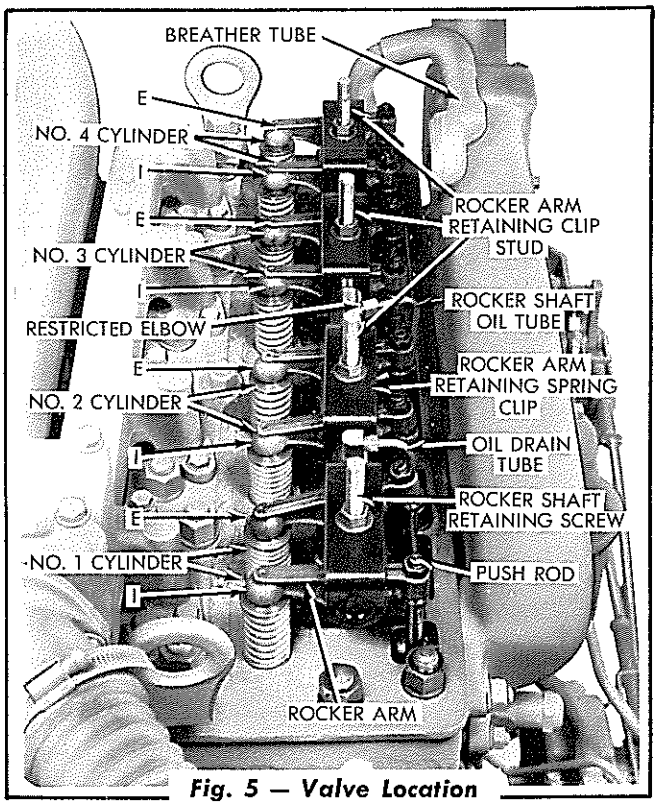

Fig. 5 — Valve Location

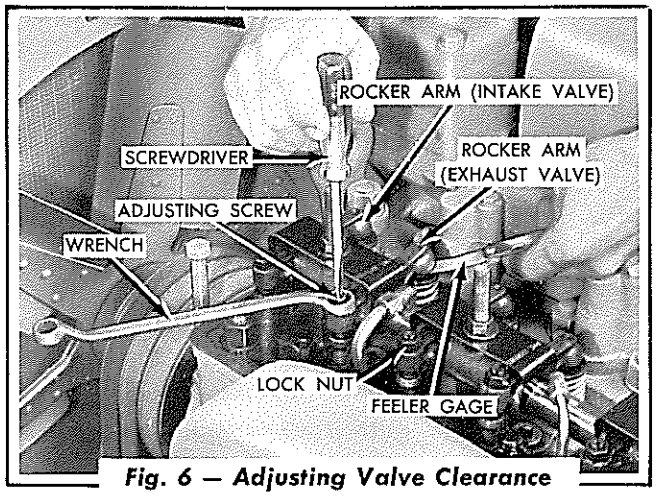

Fig. 6 — Adjusting Valve Clearance

ance as necessary (refer to Fig. 6). When the proper clearance is obtained, tighten the lock nut and recheck to make certain the clearance did not change when the lock nut was tightened.

f. Repeat the above operations on the valves for the other cylinders. Install the rocker arm cover, engine hood, and the air pre-cleaner.

D. Rocker Arm Removal, Inspection, and Installation (Fig. 5)

1. Thoroughly clean the rocker arm cover, remove the capscrew attaching the breather tube to the cover, and remove the rocker arm cover.

2. Disconnect the rocker shaft oil tube at the elbow in the cylinder head.

3. Remove the nuts and lockwashers attaching the rocker shaft brackets to the cylinder head and remove the rocker shaft brackets, shaft, and rocker arms as an assembly.

4. Remove the rocker shaft oil tube and the restricted elbow from the rocker arm shaft. Remove the oil drain tube and elbow from the rocker arm shaft.

5. Remove the nut and washer from the rocker shaft retaining screw (Fig. 5) and remove the rocker shaft retaining screw. Remove the nuts and washers from the remaining three rocker arm retaining clip studs.

6. Remove the rocker arm retaining spring clips and slide the rocker arms and brackets from the shaft.

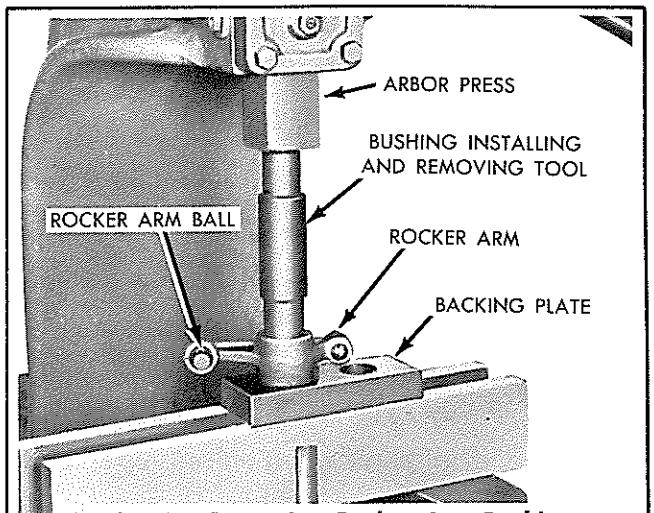

Fig. 7 — Removing Rocker Arm Bushing

7. Inspect the bushings inside the rocker arms for wear. Normal clearance between the shaft and bushings is .001" to .0025" and must not exceed .005". If the bushings are excessively worn, remove the bushings as shown in Fig. 7 and install new bushings as shown in Fig. 8. After a new bushing is installed, an oil hole must be drilled through the bushing, in line with the oil hole in the rocker arm, using a ⅛" drill. A burnishing

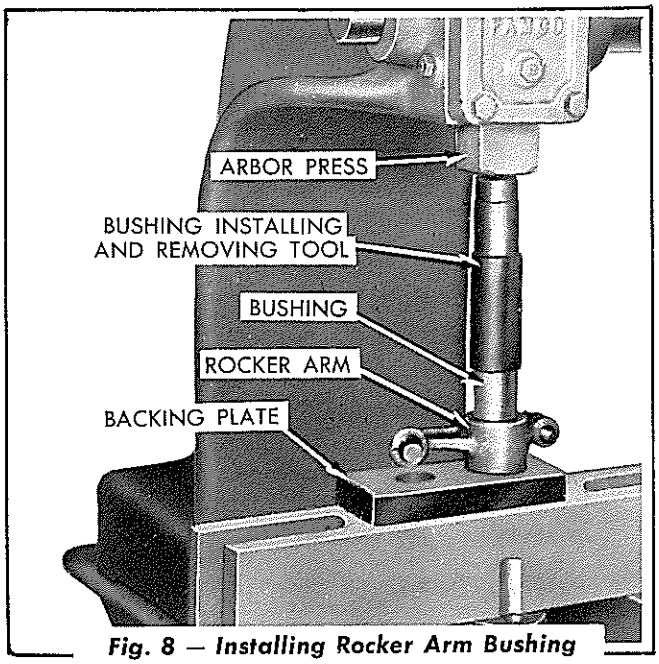

Fig. 8 — Installing Rocker Arm Bushing

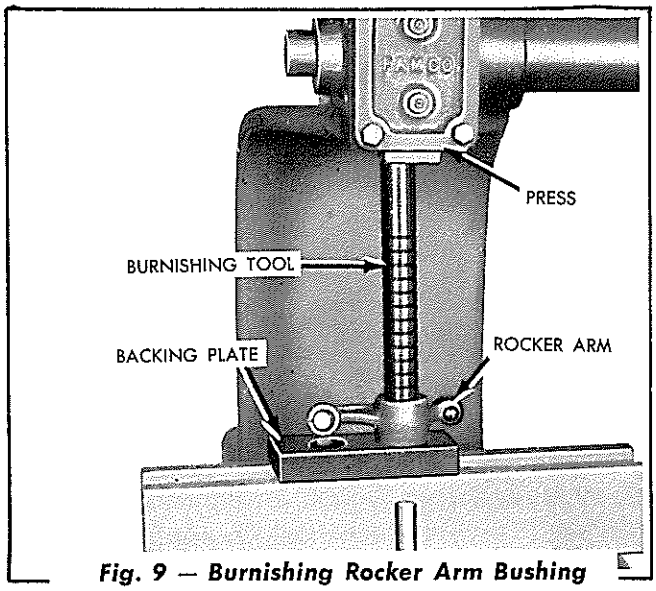

Fig. 9 — Burnishing Rocker Arm Bushing

tool, as shown in Fig. 9, must be pressed through the bushings to establish .001" to .0025" clearance with the shaft. Remove the rocker arm ball retainer and rocker arm ball. Check the ball for wear and replace if necessary. Inspect the rocker ball oiling wick in the rocker arm and if the wick has become hard, replace the wick. Inspect the rocker arm shaft for wear and replace if necessary. Clean the oil holes in the rocker arms and rocker arm shaft with solvent, a small wire, and compressed air.

8. Lubricate the rocker arm bushings and shaft with clean oil. Refer to Fig. 5 and install the rocker arms and rocker shaft brackets by reversing the sequence of operations for removal.

   IMPORTANT: *When installing the rocker arms and brackets, make certain that the exhaust valve rocker arms and intake valve rocker arms are installed in their proper positions as shown in Fig. 5. Make certain that the hole in the rocker arm shaft for the rocker shaft retaining screw is at the front (fan end) of the cylinder head, so that the oil holes in the rocker arm shaft will align with the oil holes in the rocker arms when installed.*

9. Tighten the rocker shaft bracket stud nuts to a torque of 25 to 35 lbs. ft. Place the rocker arm retaining spring clips in position and secure with plain washers and hex-nuts.

10. Install the restricted elbow in position in the rocker arm shaft and install the rocker shaft oil tube. Install the oil drain tube elbow in the rocker arm shaft and install the oil drain tube. Adjust the valves for proper clearance (refer to "VALVE ADJUSTMENT," Paragraph C. above).

11. Install the rocker arm cover, making certain the gasket is in good condition and properly positioned. Install the breather tube.

E. Valve Lifter and Push Rod Removal, Inspection, and Installation

1. Remove the rocker arm assembly (refer to "ROCKER ARM REMOVAL, INSPECTION, AND INSTALLATION," Paragraph D. above).

2. Withdraw the push rods. Inspect the ball and cup ends for signs of wear; polish out any nicks or scores. If the push rods are bent, twisted, or damaged, they must be replaced.

3. In order to remove the front valve lifter cover from the left side of the cylinder block, remove the fuel injection pump as explained in "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II. Remove the front and rear valve

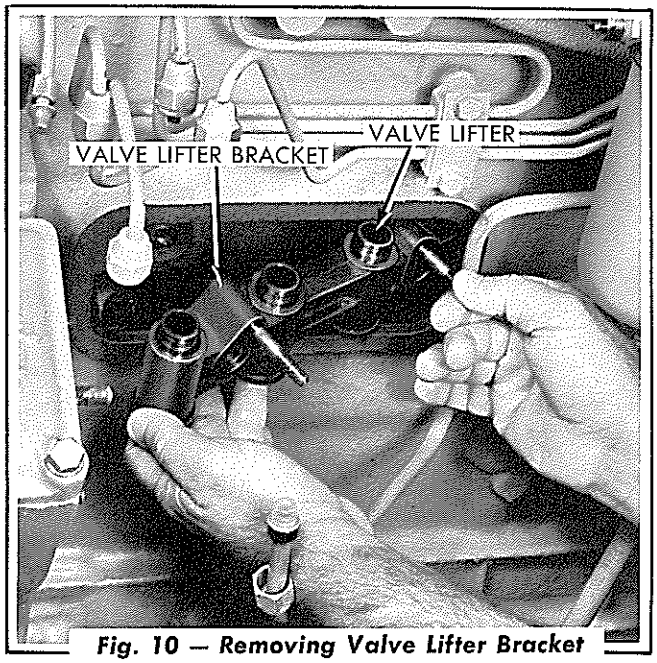

Fig. 10 — Removing Valve Lifter Bracket

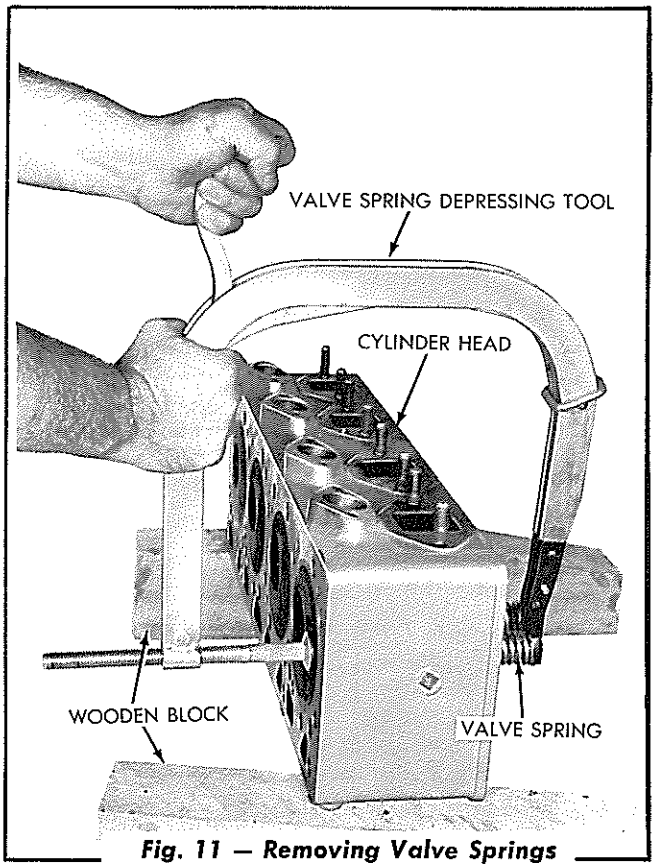

Fig. 11 — Removing Valve Springs

lifter covers. Remove the capscrews attaching the valve lifter brackets to the cylinder block, then remove the valve lifter brackets and valve lifters as shown in Fig. 10. When removing the valve lifter brackets and valve lifters, use care to prevent the lifters from falling into the crankcase. Inspect the flat surface of the valve lifters for wear and replace any worn valve lifters.

4. Lubricate the valve lifters with clean oil and install the lifters and lifter brackets by a direct reversal of the removal procedure.

5. Install the push rods with the cup end to the top. Make certain that the push rods are seated in the valve lifters.

F. Valve Spring Removal, Inspection, and Installation

1. Remove the cylinder head from the engine (refer to "CYLINDER HEAD REMOVAL" in this Section).

2. Place the cylinder head on blocks, depress the valve springs with a tool similar to the one shown in Fig. 11, and remove the valve spring retainer locks. Release the valve spring depressing tool and remove the valve spring retainer and the valve spring.

3. Inspect the valve springs for cracks. The valve spring when compressed to a length of $2\frac{5}{16}$" should have a load of 55 to 61 lbs. When the spring is compressed to a length of $1\frac{13}{16}$", it should have a load of 155 to 165 lbs. Replace the springs if they are cracked or weak.

4. Install the valve springs by a direct reversal of the removal procedure.

G. Valve, Valve Guide, and Exhaust Valve Seat Insert Removal, Inspection, and Installation

1. Remove the cylinder head from the engine (refer to "CYLINDER HEAD REMOVAL" in this Section).

2. Remove the valve springs (refer to "VALVE SPRING REMOVAL, INSPECTION, AND INSTALLATION," Paragraph F. above). Remove the valves from the cylinder head. Place the valves in a rack as they are removed from the cylinder head so they can be identified and reinstalled in their original positions.

3. Clean the carbon from the valves and valve seats. Clean the carbon from the valve guides with a valve guide cleaning tool as

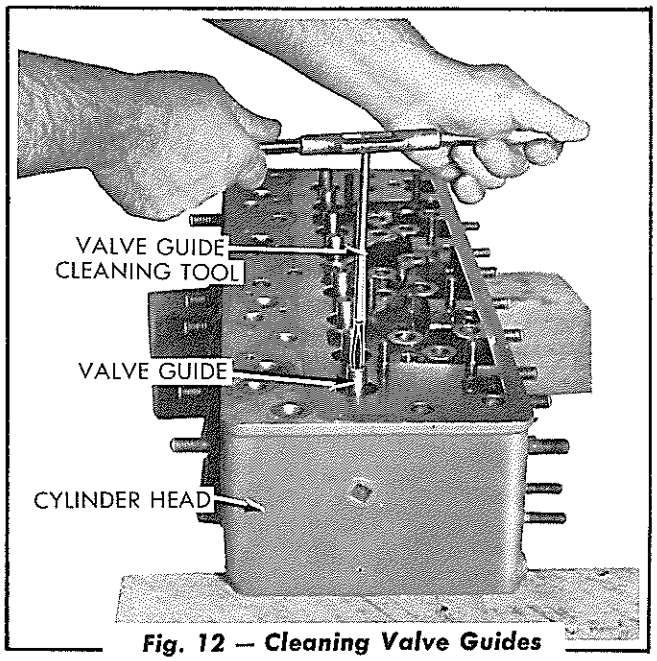

Fig. 12 — Cleaning Valve Guides

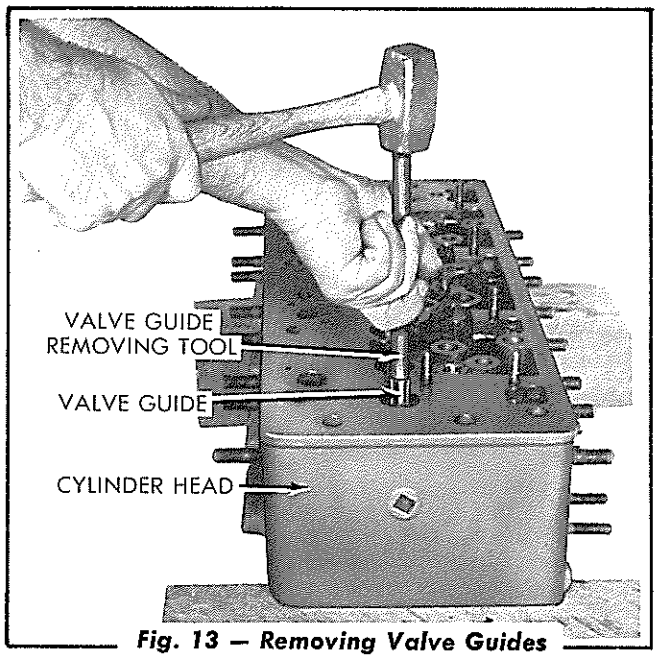

Fig. 13 — Removing Valve Guides

shown in Fig. 12.

4. Replace the valves if they are cracked, bent, or worn. The specified diameter of both the exhaust and intake valve stems is .3715" to .3725". The specified clearance of the stem in the guide is .002" to .004" and should not exceed .006".

5. The valve guides may be removed by driving them out through the bottom of the cylinder head, using a valve guide removing tool similar to the one shown in Fig. 13.

The valve guides are to be installed so that the upper end (spring end) is 1" above the flat surface of the counterbore in the cylinder head. New valve guides are installed by inserting the upper end of the guide into a valve guide installing tool as shown in Fig. 14 and driving the guide into the cylinder head until the end of the installing tool strikes the cylinder head. This locates the valve guide at the proper height. IMPORTANT: *Make certain that the longer valve guides are installed in the intake valve locations.*

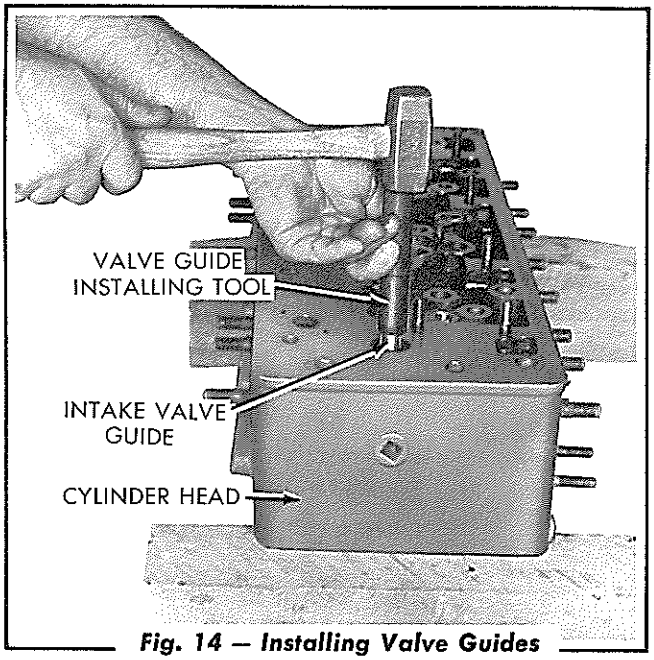

Fig. 14 — Installing Valve Guides

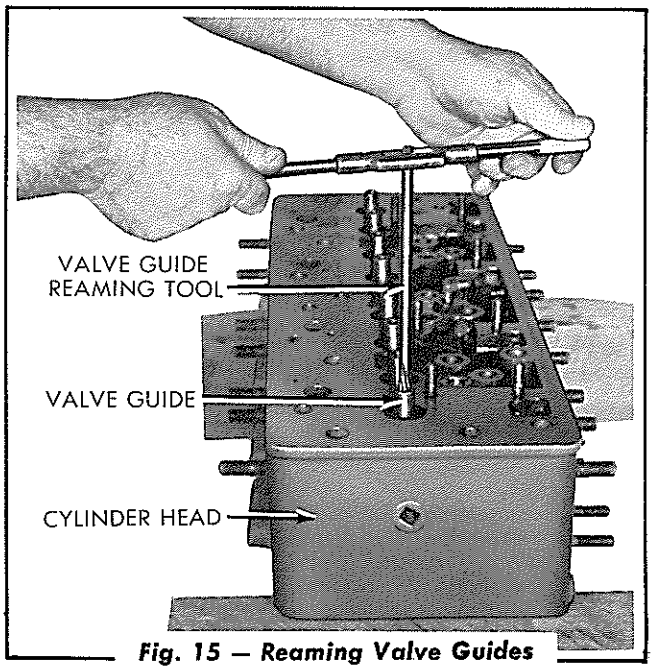

Fig. 15 — Reaming Valve Guides

6. After the valve guides have been installed, insert the valve stems into the guides to check for the proper clearance of .002" to .004" between the stems and the guides. If the clearance is less than .002", the guides must be reamed to obtain the proper clearance with a reamer as shown in Fig. 15.

7. Inspect the exhaust valve seat inserts. If they are loose, cracked, or pitted, new ones must be installed. The exhaust valve seat insert is a press fit in the cylinder head. NOTE: *The intake valve seat insert is an integral part of the cylinder head and is not replaceable.*

   Remove an exhaust valve seat insert by electric welding a bead around the inside circumference of the insert on the beveled portion. Allow the insert to cool then lift out. CAUTION: *Protect machined surfaces from arc splatter.*

8. Care must be exercised when installing new exhaust valve seat inserts. The inserts are installed into the cylinder head with a .002" to .004" press fit and must be started in place "true" with the counterbore in the cylinder head.

   Install the exhaust valve seat inserts as follows:

   a. Make certain the valve seat counterbores in the cylinder head are clean and free of burrs.

   b. Immerse the cylinder head for approximately 30 minutes in water heated to near boiling temperature, or thoroughly chill the inserts in a cold box or with dry ice.

   c. Place the cylinder head bottom side up on a bench. Thoroughly clean the counterbores for the inserts with compressed air and start an insert into the counterbore (valve side up).

   d. Using an exhaust valve seat insert installing tool similar to the one shown in Fig. 16, drive the insert down tightly into the counterbore. This operation must be done quickly, while the insert is cold.

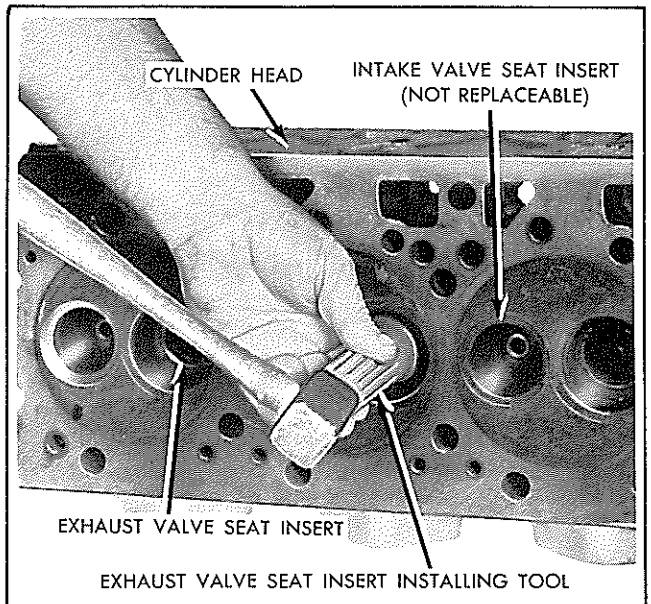

Fig. 16 — Installing Exhaust Valve Seat Insert

   e. It will be necessary to refinish the exhaust valve seat insert with a grinder (refer to "VALVE AND VALVE SEAT GRINDING," Paragraph H. below).

H. Valve and Valve Seat Grinding

Before installing either new valves or valves used previously, the valve seat inserts in the cylinder head should be inspected for proper valve seating. If previously used valves are to be reinstalled, the valve stem should be cleaned and the seat ground to an angle of 45°. When refacing valves, remove just enough to clean up the seat, removing all evidence of pitting and grooving. The valve guide should be cleaned with the valve guide cleaning tool as shown in Fig. 12. If the bore in the valve guide is worn oblong, or if the valve head is warped relative to the valve stem, the necessary parts must be replaced.

When new valve seat inserts are installed, or previously used inserts refaced, the work must be done with a valve seat grinder set similar to the one shown in Fig. 17. The ordinary method of grinding valve seats is ineffective because of the very hard valve seat insert material. NOTE: *It is very important that the valve grinder set be used according to the Manufacturer's directions.*

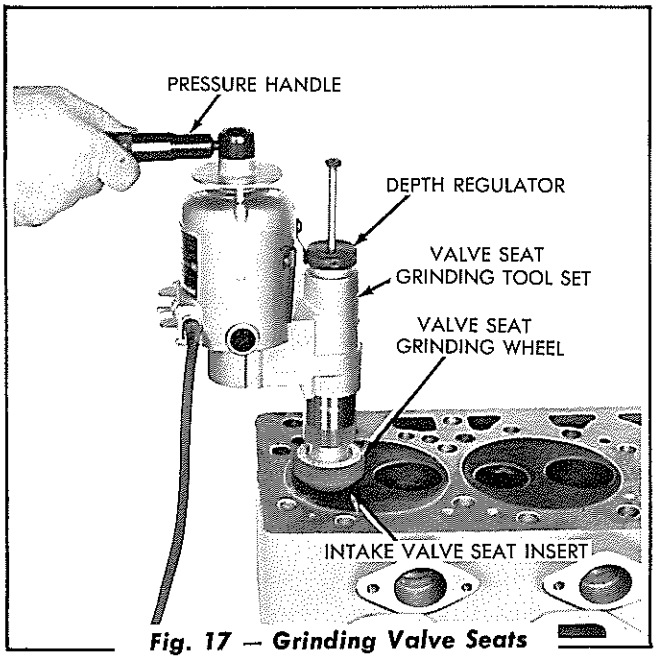

Fig. 17 — Grinding Valve Seats

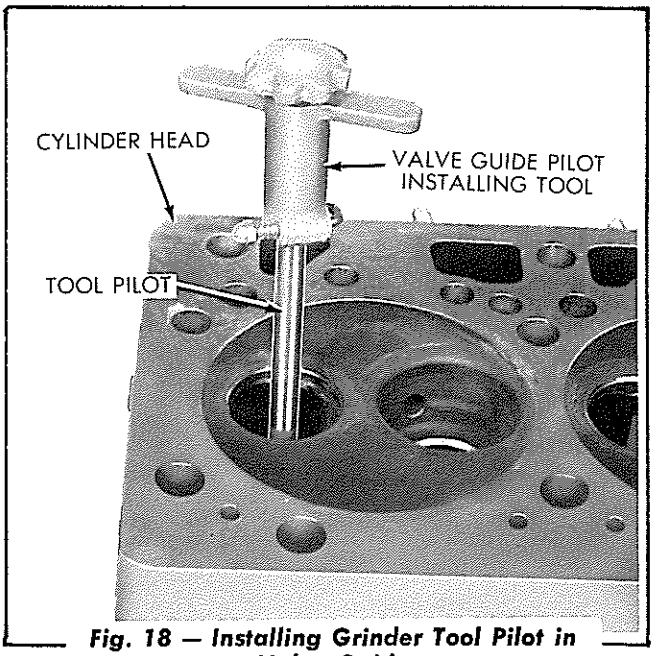

Fig. 18 — Installing Grinder Tool Pilot in Valve Guide

The usual equipment furnished with the valve seat grinder set includes the following items:

1. Valve seat grinder
2. Dial gage
3. Tool pilot
4. Three grinding wheels — 30° — 45° and 60°

Install the tool pilot in position in the valve guide as shown in Fig. 18. Use a 45° grinding wheel for refacing the valve seat and use the 30° and 60° grinding wheels for narrowing the seat to the recommended seat width of 5/64" to 7/64" for the exhaust valve seat and 5/64" to 9/64" for the intake valve seat. The 30° grinding wheel is also used to grind the intake valve seats to prevent the valve heads from protruding from the bottom face (flat surface) of the cylinder head. IMPORTANT: *THE INTAKE VALVES MUST NOT PROTRUDE FROM THE BOTTOM FACE (FLAT SURFACE) OF THE CYLINDER HEAD AS THE PISTON WILL STRIKE THE VALVE HEAD AND SERIOUS DAMAGE WILL RESULT.*

After a grinding wheel has been used several times, the cutting angle of the stone must be reground and made true to obtain the proper seat angle.

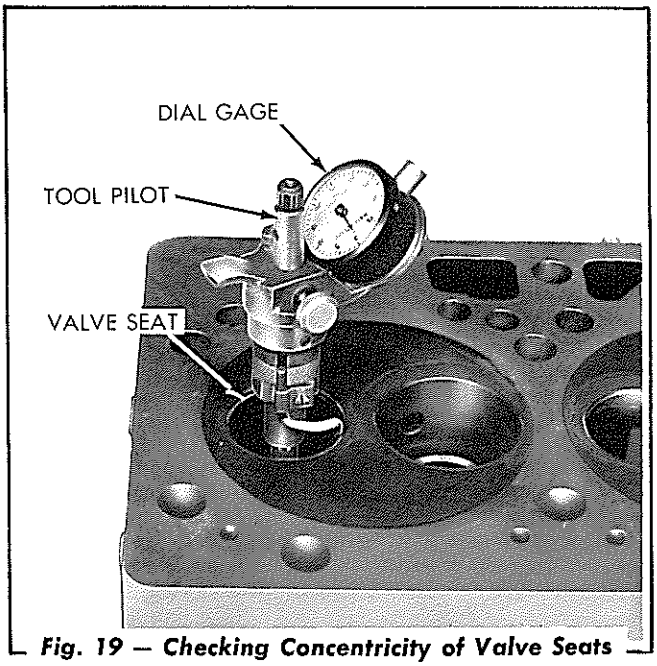

Fig. 19 — Checking Concentricity of Valve Seats

After the valve seats have been ground, use a dial gage as shown in Fig. 19, to check the concentricity of the valve seats relative to the valve guides. The total run out for a good valve seat should not exceed .0015".

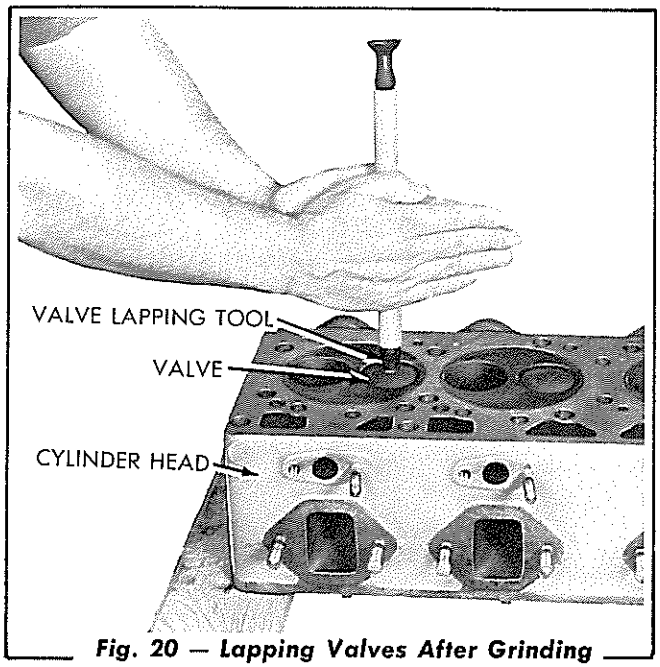

Fig. 20 — Lapping Valves After Grinding

After the valve seats have been ground, the valves may be inserted in position in the cylinder head and lapped in place, as shown in Fig. 20, using fine grain valve grinding compound. After lapping, the contact between the valves and the seats may be checked by wiping a thin film of Prussian Blue on each valve seat, setting the valves in place, and bouncing each valve on its seat. If the valve seats are properly ground, a continuous thin blue line will be evident around the face of the valve.

Assemble and install the cylinder head (refer to "CYLINDER HEAD INSTALLATION" in this Section).

4. CYLINDER BLOCK AND CYLINDER SLEEVES

A. Description

The cylinder block, which is the main structural part of the engine, is a one-piece casting made of alloy cast iron. Transverse members, cast integral, provide rigidity and strength, assuring perfect alignment of the crankshaft bearings and cylinder sleeves. The cylinder block is bored to receive removable "wet-type" cylinder sleeves. The cylinder sleeves are completely surrounded by water jackets which extend the full length of the cylinder walls for maximum cooling.

The cylinder block contains a main oil gallery which extends lengthwise through the cylinder block, parallel to the camshaft. Oil passages direct the oil from the mail oil gallery to the camshaft and main bearings and through the rifle drilled connecting rods to the piston pins. A horizontal oil passage through the center of the cylinder block extends from the main oil gallery to a cavity in the left side of the cylinder block. From this cavity there is an opening which extends to the rocker arm assemblies.

The cylinder block, when ordered for service, is furnished with main bearing caps and studs, and the necessary plugs.

The removable "wet-type" cylinder sleeves are made of alloyed cast iron. Two rubber packing rings, fitted into grooves in the lower outside circumference of the sleeve, prevent water leakage into the crankcase. The sleeve is sealed at the top by a flange which fits into a machined recess in the cylinder block. The cylinder head gasket is compressed between this flange and the cylinder head, holding the sleeve in place.

B. Cylinder Sleeve Removal

With the pistons removed, the cylinder sleeves may be removed with a cylinder sleeve remover similar to the one shown in Figs. 21 and 22.

C. Cylinder Sleeve Cleaning and Inspection

1. Remove all dirt, carbon, and grease from the cylinder sleeves and the machined recess and bore in the cylinder block. Replace the cylinder sleeves if they are scored, cracked, or worn beyond the allowable limits. Slightly scuffed cylinder sleeves, if not worn, may sometimes be made usable by polishing or lapping to remove the surface irregularities.

2. Check the cylinder sleeves for roundness by means of a gage similar to the one shown in Fig. 24. Using an inside micrometer, measure the cylinder sleeve for taper and

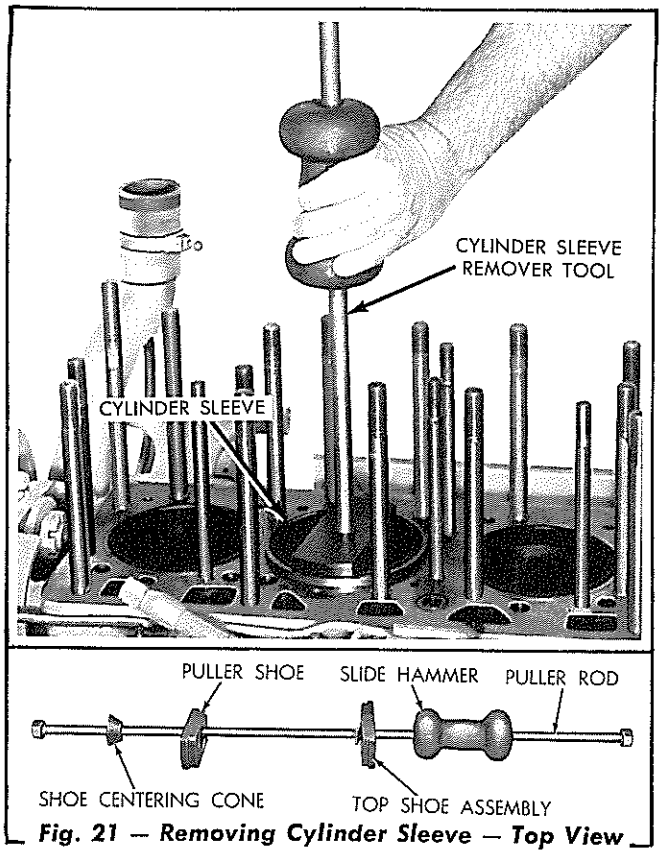

Fig. 21 — Removing Cylinder Sleeve — Top View

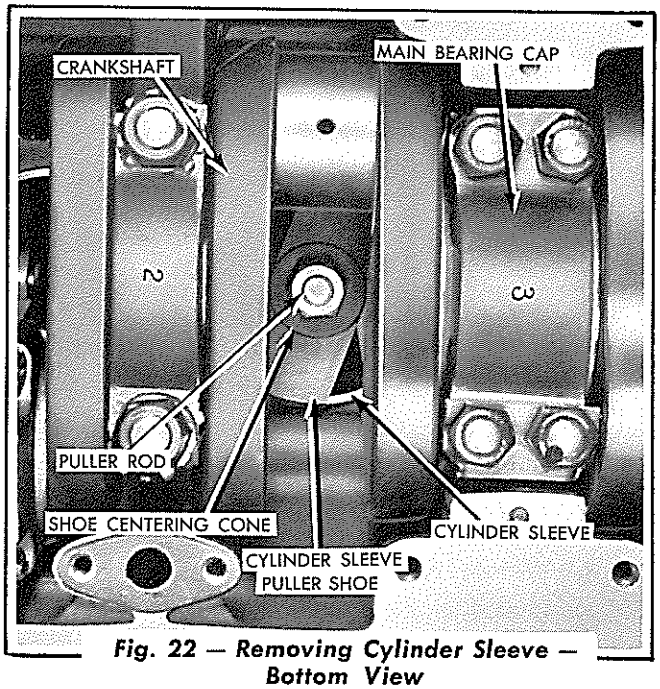

Fig. 22 — Removing Cylinder Sleeve — Bottom View

wear. The inside diameter of a new cylinder sleeve is 4.4370" to 4.4385". A cylinder sleeve should be round within .001" and have no more than .0015" taper. Cylinder sleeves that are more than .006" out of round or have more than .006" taper when installed must be replaced.

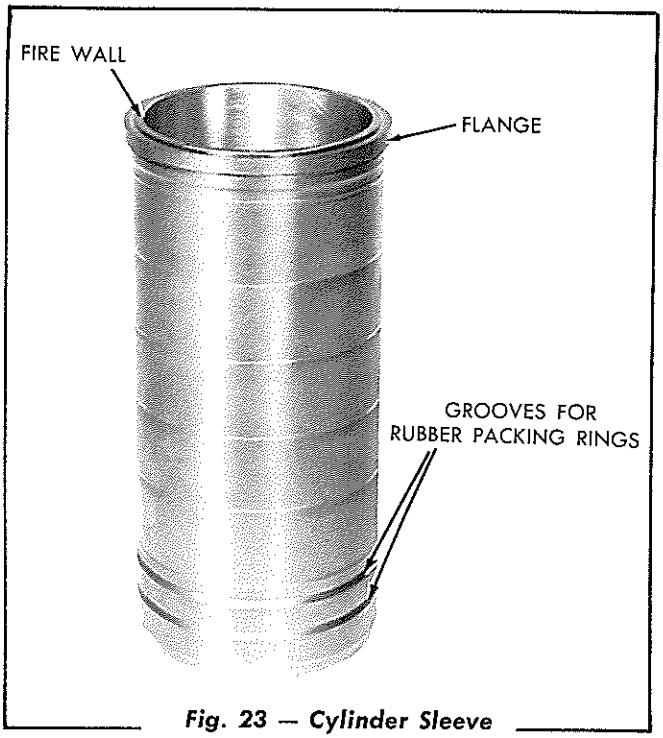

Fig. 23 — Cylinder Sleeve

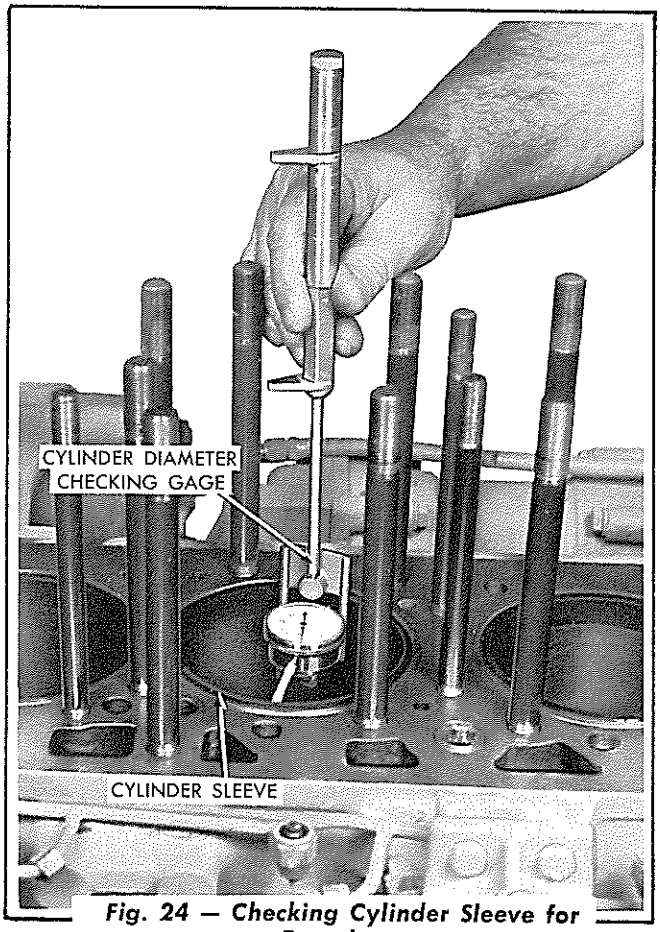

Fig. 24 — Checking Cylinder Sleeve for Roundness

NOTE: *When measuring the cylinder sleeves with an inside micrometer, first measure in a position parallel to the crankshaft and then at right angles to the crankshaft.*

These measurements should be taken at several locations within the area of piston ring travel.

3. If the cylinder sleeves are within above limits and are to be used again, there may be a slight ring travel ridge near the top of the sleeve. This ridge should be removed with a cylinder hone similar to the one shown in Fig. 25. Follow the tool Manufacturer's directions for proper use of the hone.

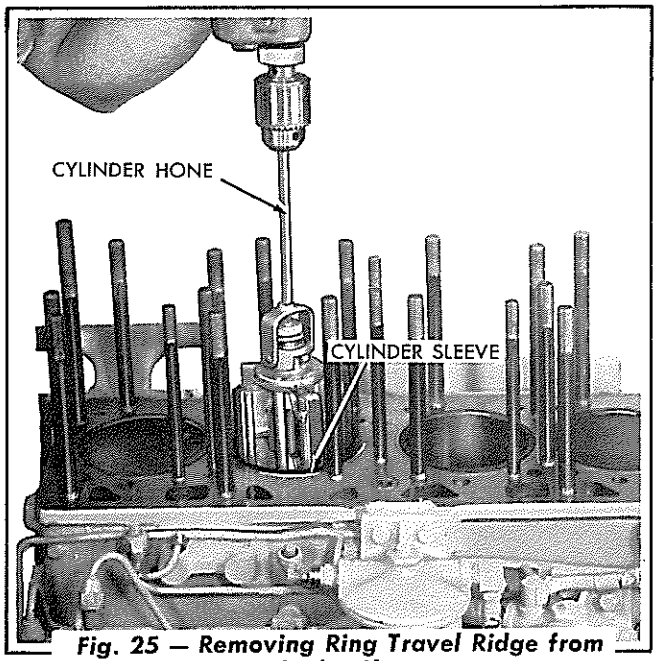

Fig. 25 — Removing Ring Travel Ridge from Cylinder Sleeve

4. Refer to "FITTING PISTONS WITH CYLINDER SLEEVES" in this Section, for fit of the pistons with the cylinder sleeves.

D. Cylinder Sleeve Installation

1. Thoroughly clean the cylinder sleeve and the bore in the cylinder block. Make certain that the bottom surface of the flange on the cylinder sleeve and the counterbore in the cylinder block are clean and free from nicks or burrs. Before installing the rubber packing rings on the sleeve, insert the sleeve into the bore of the cylinder block to make certain that the sleeve can be pushed down into place and turned in the bore by hand pressure. Withdraw the sleeve from the block. If sleeve cannot be inserted in the above manner, more cleaning is necessary.

2. Thoroughly clean the packing ring grooves in the cylinder sleeve. Lay the sleeve on its side and carefully roll the new packing rings over the lower end of the sleeve and into the grooves. Apply liquid soap (green soap) or hydraulic brake fluid to the packing rings before installing the cylinder sleeve into the cylinder block.

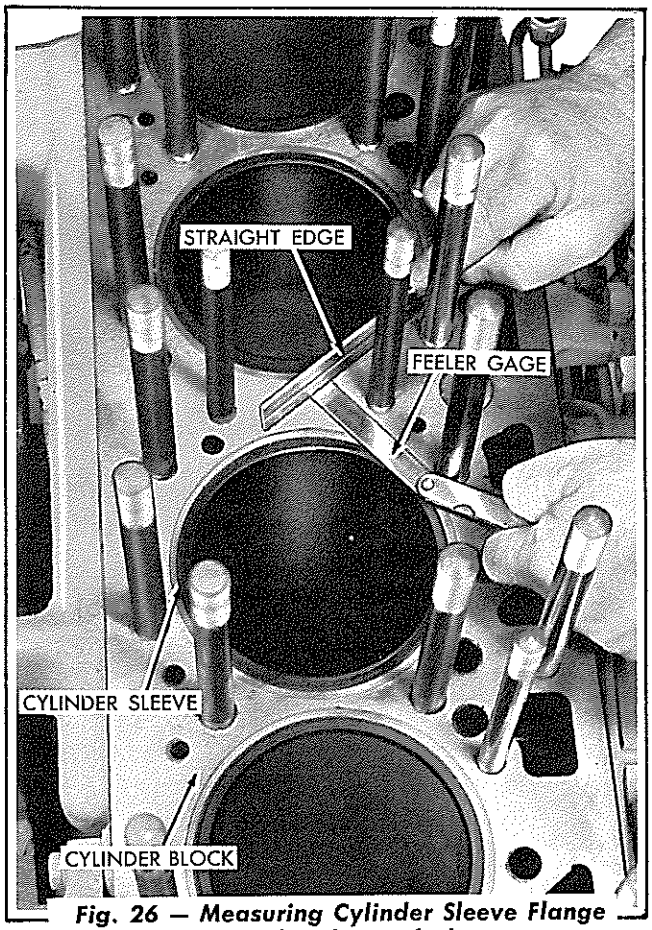

Fig. 26 — Measuring Cylinder Sleeve Flange Height Above Block

3. Install the cylinder sleeve in position in the cylinder block, using care to prevent damage to the packing rings.

4. With the flange of the cylinder sleeve firmly seated in the counterbore of the cylinder block, the top surface of the cylinder sleeve flange must be .006" to .009" above the top flat surface of the cylinder block and the difference between any two adjacent sleeves should not exceed .002".

   Hold a straight edge across the top of the cylinder sleeve flange and using a feeler gage as shown in Fig. 26, measure the standout of the cylinder sleeve flange above the cylinder block. CAUTION: *When meas-*

uring in the above manner, make certain that the straight edge is on the flange of the sleeve and not on the fire wall (refer to Fig. 23).

If the standout of the sleeve flange is not .006" to .009" above the top flat surface of the cylinder block, or if the difference between any two adjacent sleeves exceeds .002", the standout of the sleeve flange must be adjusted by the use of cylinder sleeve shims. Withdraw the cylinder sleeve and place the necessary shims between the bottom of the sleeve flange and the counterbore in the cylinder block.

E. Cylinder Block Cleaning and Inspection

Since the cylinder block is the main structural part of the engine, whenever the engine is being overhauled, the block should be thoroughly inspected for any conditions that would render it unfit for further use. Such inspection must be made after all the parts have been removed from the cylinder block and it has been thoroughly cleaned, with live steam or a suitable solvent, and dried with compressed air.

All the oil passages in the cylinder block must be cleaned before assembling the engine. Effective cleaning of these passages can be accomplished only with the use of high steam pressure, with a solvent used in the water to dissolve the sludge and foreign material that has collected. Remove the various plugs of the oil galleries to clean the passages. After cleaning, flush the passages in the cylinder block with clean water under pressure to remove all traces of the solvent.

NOTE: *Engines prior to Serial Number 86596 have an oil restrictor in the oil passage to the rocker arm assembly. This restrictor is located in the top of the cylinder block and the opening in the restrictor should be inspected and cleaned, to assure an oil supply to the rocker arm assembly. On engines Serial Number 86597 and above, the restrictor is located in the elbow on the rocker arm shaft.*

To clean the water jacket of the cylinder block, remove the plugs from the jacket. Apply high pressure steam and water through these openings; turn the block in various positions while this is being done so that the loose scale will be washed out.

IMPORTANT: *Note the location of the plugs removed for cleaning of the oil and water passages in the cylinder block and be sure all these plugs are reinstalled in their proper places after the block has been cleaned and dried. Coat the threads of all plugs with white lead to assure a tight seal. The plugs must be installed so that they do not project from the block to interfere with the fit of the attached parts.*

5. CRANKSHAFT, CRANKSHAFT PULLEY, FLYWHEEL, AND MAIN BEARINGS

A. Description

1. Crankshaft

The five bearing, counterbalanced crankshaft is a steel drop forging, carefully heat treated to assure utmost strength and durability. The crankshaft is balanced both statically and dynamically. The end thrust of the crankshaft is taken by the flanged center bearing.

A lubricating oiling wick assembly is installed in the rear of the crankshaft for lubricating the engine clutch shaft front bearing (pilot bearing).

2. Main Bearings

The main bearings consist of the front and two intermediate main bearings 1.452" long, one rear main bearing 2.095" long, and one flanged center main bearing 2.682" long. All the bearings are 3½" in diameter. The main bearings are of the precision type and are replaceable without machining.

The main bearing caps are attached to the cylinder block and line bored in position to receive the precision bearing shells. Each bearing cap is numbered and when removed should always be reinstalled in its respective position and with the numbers on the bearing cap facing the front (fan end) of the engine, and corresponding to the numbers stamped on the bottom edge of the cylinder block.

The upper halves of the main bearings shells are seated in the lower part of the cylinder block. The lower halves are held in place by the main bearing caps, each of which is attached to the cylinder block by studs and nuts. Each half of the bearing shell is prevented from radial movement by a tang at the parting line on one side of the bearing shell.

A spring loaded, lip type oil seal, pressed into the bore of the flywheel housing is used to seal the crankcase oil from the flywheel compartment.

A spring loaded, lip type oil seal, pressed into the timing gear housing cover, located on the front of the engine, is used to seal the crankcase oil from leaking out at front end of the crankshaft. The seal bears against an oil seal sleeve pressed onto the crankshaft. The sleeve is serviced separately and may be replaced if worn.

3. Flywheel

The flywheel is bolted securely to a flange on the rear end of the crankshaft and is doweled in two places. One of the capscrew holes is offset and the flywheel can be attached to the crankshaft flange in only one position. A starter ring gear made from heat-treated steel is shrunk on the rim of the flywheel.

B. Removal, Inspection, and Installation of Crankshaft

1. Inspection can be made of the crankshaft main bearings and journals by removing the oil pan and removing the bearing caps one at a time (refer to "REPLACEMENT OF CRANKSHAFT MAIN BEARINGS" in this Section). If the crankshaft has been damaged, removal of the engine will be required for its replacement.

   Remove the crankshaft as follows:

   a. Remove the engine (refer to "ENGINE REMOVAL AND INSTALLATION" in this Section).

   b. Remove the engine clutch (refer to "ENGINE CLUTCH REMOVAL," Section IX).

   c. Remove the flywheel (refer to "FLYWHEEL, RING GEAR, AND ENGINE CLUTCH SHAFT FRONT BEARING REMOVAL, INSPECTION, AND REPLACEMENT" in this Section).

   d. Remove the crankshaft pulley (refer to "REMOVAL OF CRANKSHAFT PULLEY" in this Section).

   e. Remove the capscrews attaching the fan to the fan hub and remove the fan and spacer.

   f. Loosen the two capscrews clamping the engine mounting bracket to the timing gear housing cover and slide the bracket from the housing cover.

   g. Remove the capscrews attaching the timing gear housing cover to the timing gear housing. Remove the capscrews attaching the timing gear housing cover to the oil pan and remove the timing gear housing cover.

   h. Using puller tools similar to the ones shown in Fig. 27, remove the front oil seal sleeve and sleeve spacer from the crankshaft.

   i. Using a puller similar to the one shown in Fig. 28, pull the crankshaft gear from the crankshaft.

   j. Drain the engine lubricating oil. Remove the remaining capscrews attaching the oil pan to the cylinder block and flywheel housing and remove the oil pan. Remove the flywheel housing.

   k. Refer to "OIL PUMP REMOVAL," Section V, and remove the oil pump and the oil pump suction pipe supporting bracket.

   l. Remove the four connecting rod bearing caps. Remove the five main bearing caps and the main bearing shells. Remove the crankshaft.

2. Inspect the crankshaft journals for scoring, chipping, cracking or signs of overheating. If the crankshaft has been overheated (usually indicated by discolored or blue bearing

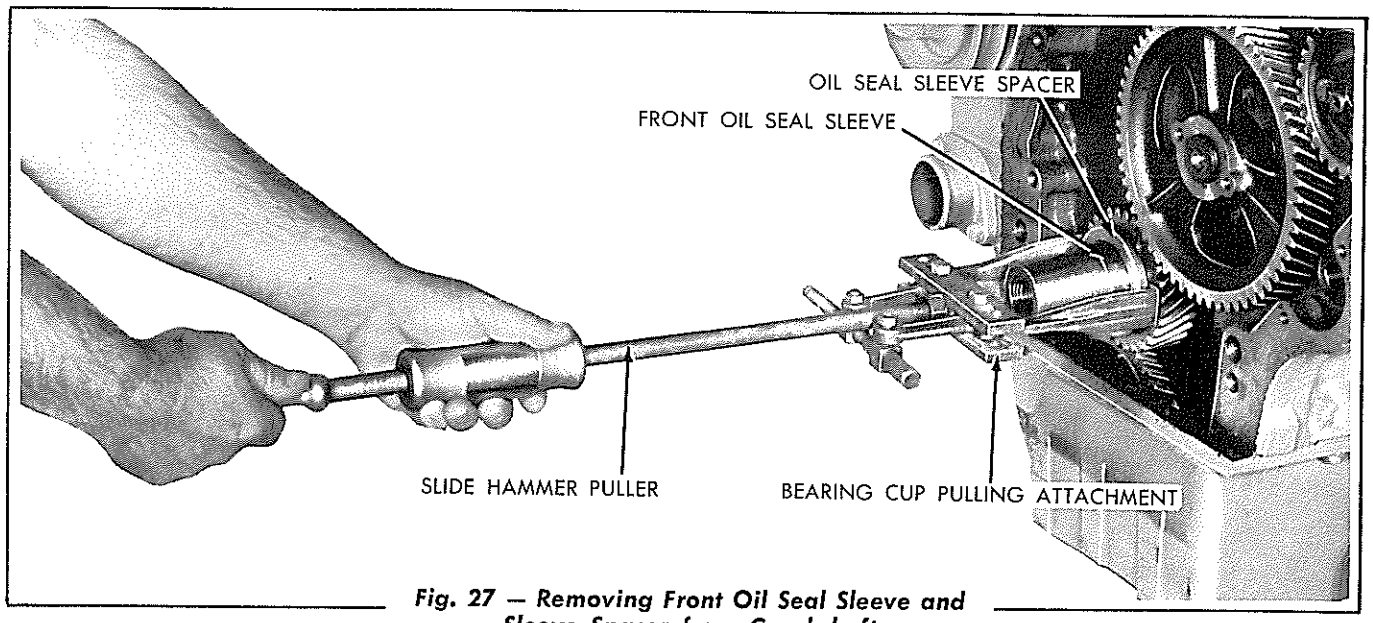

Fig. 27 — Removing Front Oil Seal Sleeve and Sleeve Spacer from Crankshaft

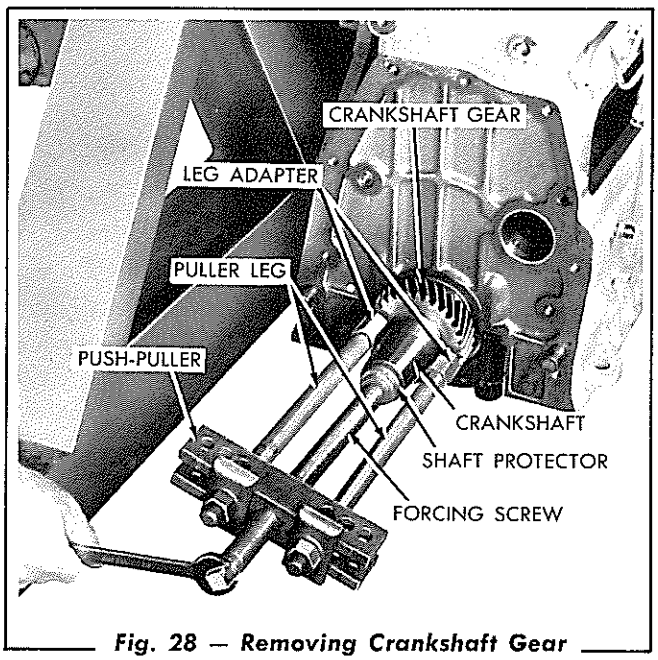

Fig. 28 — Removing Crankshaft Gear

journal surfaces), or is scored or excessively worn, reconditioning or replacement will be required. Examine the bearing journals for cracks if overheating has occurred.

3. Measure the crankshaft main bearing and connecting rod journals at several places on their diameter to check for roundness. The original diameter of the main bearing journals is 3.498" to 3.499"; the connecting rod journals is 2.7715" to 2.7725".

4. All main and connecting rod bearing surfaces of the crankshaft are hardened to a depth of approximately .070". If regrinding of the crankshaft journals becomes necessary, the work should be done by a reputable machine shop that has suitable equipment to handle precision work of this type. Main bearing shells and connecting rod bearing shells of .010", .020", .030", and .040" undersize are available, and if the crankshaft is ground, the diameter of the journals should be reduced in steps of .010", .020", .030", or .040" below 3.499" to fit the undersize main bearing shells, and below 2.7725" to fit the undersize connecting rod bearing shells.

5. Remove the hex-socket pipe plugs from the crankshaft and blow out all the oil passages in the crankshaft with compressed air. Coat the threads of the plugs lightly with white lead when reinstalling and tighten them securely.

6. If the crankshaft front oil seal sleeve shows signs of excessive wear, it can be turned end for end on the crankshaft to provide a new sealing surface for the crankshaft oil seal, or it may be replaced.

7. Install the crankshaft by a direct reversal of the removal procedure. Refer to "MAIN BEARING INSPECTION" and "MAIN BEARING REPLACEMENT" in this Section for the specified bearing clearances.

C. Main Bearing Inspection

1. Any bearing shells that are scored, chipped, pitted, or worn beyond the specified limits given below must be replaced. Inspect the backs of the shells for bright spots. Bright spots on the backs of the shells indicate they have shifted in their supports and are unfit for further use.

2. The specified clearance between the main bearing shells and the crankshaft journals is .002" to .0047" at the front, intermediate, and rear main bearings and is .0025" to .0052" at the center main bearing. New bearing shells must be installed when this clearance exceeds .0065". The amount of wear on the bearing shells may be determined by measuring each shell with micrometers as shown in Fig. 29. New shells, measured at the point "C" in Fig. 30 are .155" thick, and any variation from .155" will show the amount of wear on the particular shell being measured. Bearing shells less than .152" thick are worn beyond the allowable limits and must be replaced.

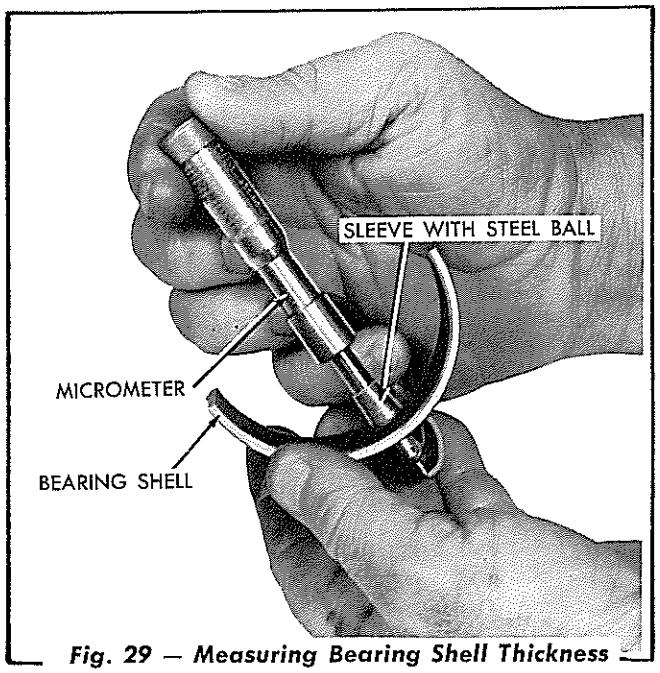

Fig. 29 — Measuring Bearing Shell Thickness

3. As shown in Fig. 30, the bearing shells (when in place) are .001" larger in diameter at the parting line than they are 90° from the parting line. The two shells do not form a true circle when not installed, and when measured for inside diameter, they should

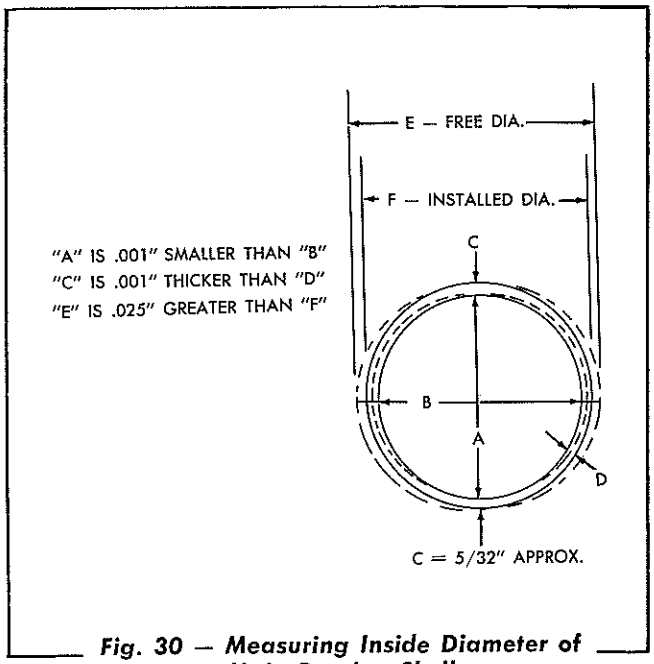

Fig. 30 — Measuring Inside Diameter of Main Bearing Shell

be installed in the cylinder block and the bearing caps tightened to the specified torque (crankshaft removed). The two halves of the shells have a squeeze fit in the seat and bearing cap, and must be tight when the cap is drawn down. Tighten the front, intermediate, and rear main bearing caps to 210 to 230 lbs. ft. torque. Tighten the center main bearing cap to 160 to 170 lbs. ft. torque.

4. A recommended method of determining the running clearance between the bearings and journals is to insert a 1/32" diameter soft lead wire, or foil, across the center of each lower bearing shell by removing and replacing one bearing cap at a time. When the lead wire, or foil, insertions have been made, tighten the bearing cap stud nuts on the ¾" studs used in the front, intermediate and rear main bearing caps to 210 to 230 lbs. ft. torque and 160 to 170 lbs. ft. on the ⅝" stud nuts used in the center main bearing cap, thus "crushing" the wire or foil to shim thickness between the shells and the crankshaft journals. Remove the bearing caps and measure the thickness of the lead shims; the clearance between the shells and the journals should be .002" to .0047" at the front, intermediate, and rear main bearings and .0025" to .0052" at the center main bearing.

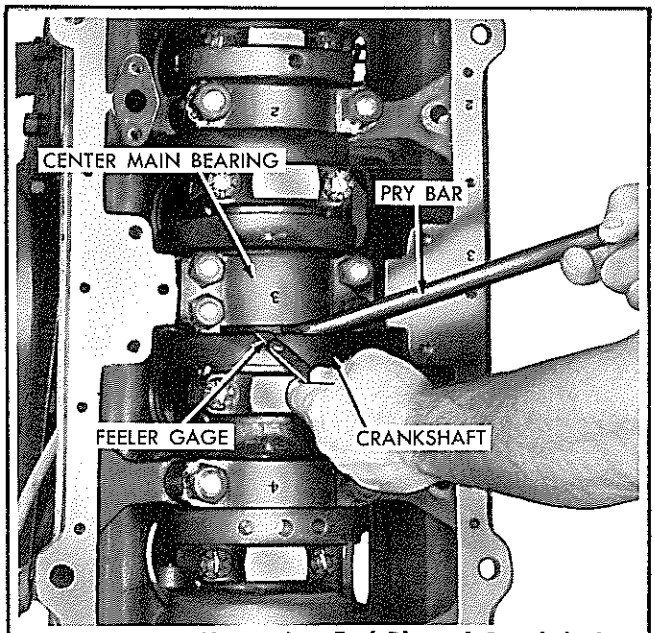

Fig. 31 — Measuring End Play of Crankshaft

5. Check the end thrust of the crankshaft, which is taken by the flanges on the center main bearing. The end play may be measured as shown in Fig. 31. The specified clearance is .006" to .012" and should not exceed .020"; replace the center main bearing if necessary.

D. Main Bearing Replacement

The main bearings may be replaced with the engine in the tractor as explained in "REPAIR OF ENGINE WHILE INSTALLED" in this Section. However, it is not advisable or recommended that the work be done in that manner except in emergency cases.

Remove the main bearings as follows:

1. Remove the crankshaft (refer to "REMOVAL, INSPECTION, AND INSTALLATION OF CRANKSHAFT" in this Section).

2. Using a small wooden block and a hammer, remove the main bearings from the crankcase and the main bearing caps.

After the main bearings have been removed and inspected as outlined above, they may be reinstalled or new bearings installed as follows:

1. Install the upper halves of the main bearing shells in position in the crankshaft bearing seats of the cylinder block. Make certain that the bearing shells are in their proper location and the tangs on the bearing shells are properly located in the corresponding slots in the bearing seats of the cylinder block.

2. Lubricate all the crankshaft main bearing journals and lower the crankshaft into position in the cylinder block, with the flywheel flange end of the shaft toward the rear.

3. Place the lower halves of the main bearing shells in position in the main bearing caps, inserting the tangs of the shells into the slots in the caps. The bearing caps are number 1, 2, 3, etc., indicating their respective positions. Install the caps with the numbers facing the front (fan end) of the engine and corresponding to the number stamped on the lower left edge of the cylinder block, as shown in Fig. 32, and install the main bearing cap lockwashers and stud nuts. Use a torque indicating wrench and tighten the nuts to a torque of 210 to 230 lbs. ft. on the ¾" nuts used on the front, intermediate, and rear main bearings; tighten the ⅝" nuts used on the center main bearing to a torque of 160 to 170 lbs. ft.

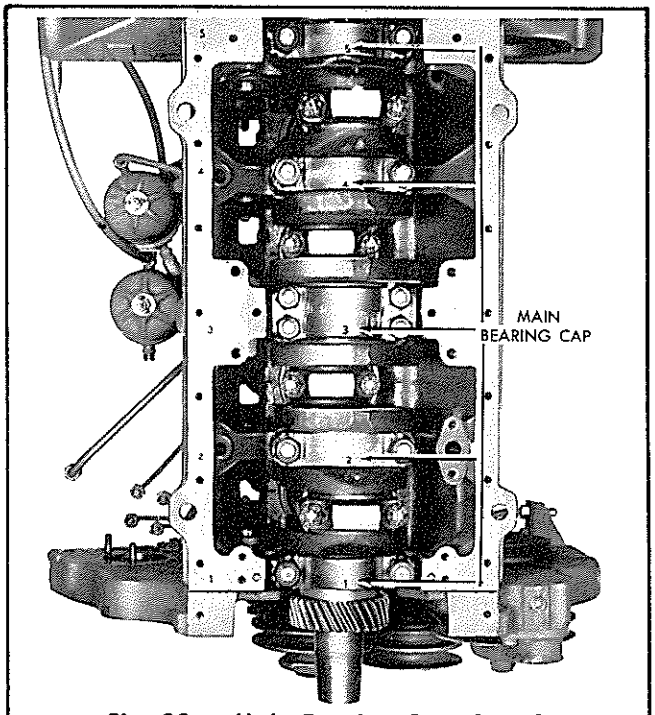

Fig. 32 — Main Bearing Caps Location

CAUTION: *Do not overtighten the main bearing stud nuts.* If these nuts are over-

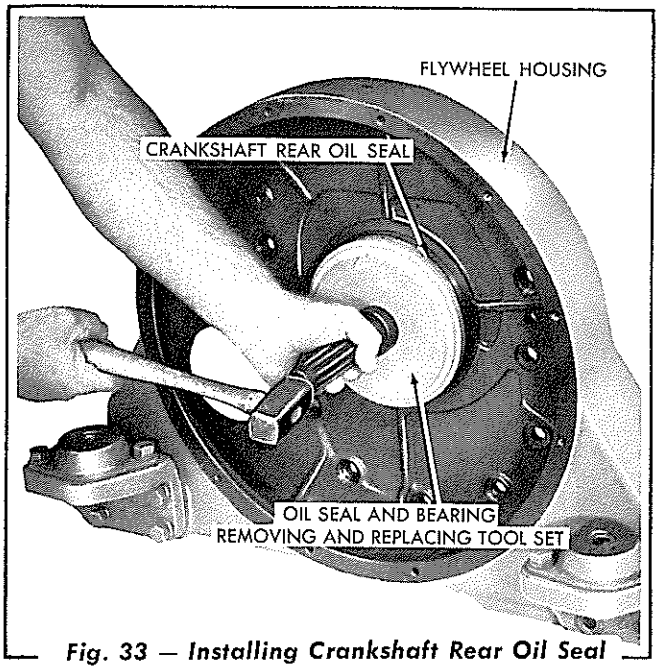

Fig. 33 — Installing Crankshaft Rear Oil Seal

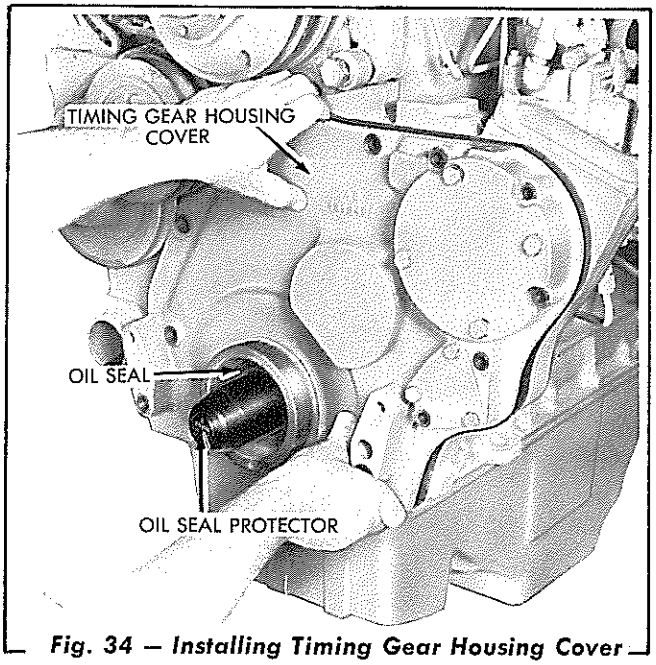

Fig. 34 — Installing Timing Gear Housing Cover

tightened, the bearing caps may be distorted, causing the bearings to be drawn tight against the crankshaft and premature failure will result. The crankshaft should turn freely after all the nuts are properly torqued. Never file or shim a bearing cap to make the bearing shell fit; install new bearing shells if the fit on the crankshaft is unsatisfactory.

E. Replacement of Crankshaft Oil Seals

Drive the oil seals from the flywheel housing and the timing gear housing cover and install new oil seals each time the engine is disassembled. To prevent damaging the seals, use a tool similar to the one shown in Fig. 33 to drive the new seals into place. The sealing lip side of each seal must be toward the inner side of the housing or the cover (lips must face each other when the housing and the cover are installed on the engine). When installing the timing gear housing cover, a crankshaft housing oil seal protector similar to the one shown in Fig. 34 should be used to prevent damage to the seal lip.

F. Replacement of Engine Clutch Shaft Front Bearing Oiling Wick

If the clutch shaft front bearing (pilot bearing) in the flywheel shows lack of lubrication, or if the wick has allowed too much oil to pass through (which can be determined by inspecting the engine

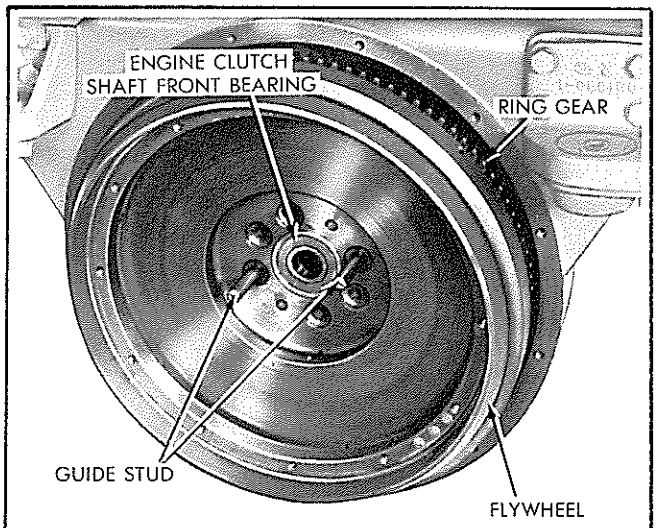

Fig. 35 — Removing Flywheel from Crankshaft

clutch compartment for oil accumulation), a new oiling wick assembly must be installed.

Turn the wick holder out of the crankshaft and remove the oiling wick assembly.

Install a new oiling wick assembly as follows:

1. Saturate the wick with clean engine oil. Coat the threads of the wick holder with a sealing compound.

2. Insert the end of the wick into the hole in the crankshaft and engage the threads of the wick holder with the threads in the crankshaft. Tighten the wick holder securely.

CAUTION: *The wick was carefully installed in the holder without twisting and with ¼" of the wick protruding from the rear of the holder. When a new wick assembly is received, do not twist the wick in the holder as this will leave a groove around the wick and will allow too much oil to pass through.*

G. Flywheel, Ring Gear, and Engine Clutch Shaft Front Bearing Removal, Inspection, and Replacement

To remove the flywheel from the engine with it assembled in the tractor, it is necessary to remove the engine clutch and clutch housing (refer to "ENGINE CLUTCH REMOVAL," Section IX).

Remove the capscrews and lockwashers attaching the flywheel to the crankshaft flange. Refer to Fig. 35 and insert two ½" NF x 6" guide studs with slotted ends into the crankshaft flange to act as guides and prevent damage to the flywheel on removal. It may be necessary to remove the flywheel housing timing hole cover and pry the flywheel loose with a suitable bar.

1. **Flywheel.** Inspect the clutch wearing surface of the flywheel and make certain that the surface is flat and smooth. If the surface is scored or heat checked it may be machined smooth; replace the flywheel if more than 1/16" stock must be removed.

   It is very important that all burrs and nicks be removed from the front surface of the flywheel that fits against the flange of the crankshaft. If this surface is not smooth and true, the flywheel may have a slight wobble which will result in improper clutch operation, clutch wear, and engine vibration. It is advisable to attach a dial indicator to the flywheel housing and check the flywheel for run out.

2. **Ring Gear.** Inspect the flywheel ring gear for general condition and wear. Replace the ring gear if it is not in good condition. Remove the ring gear from the flywheel by grinding a notch through the ring at the root of one of the teeth, then expand the ring and drive it from its position. Do not attempt to remove the ring gear without first expanding it. To install a flywheel ring gear, proceed as follows:

   a. The ring gear is shrunk on the flywheel by uniformly heating the gear to approximately 400° F. (red heat visible in the dark), then placing it in position on the flywheel which is at room temperature. NOTE: *Do not heat the ring gear to a bright red as the heat-treatment of the gear will be destroyed.*

   b. After heating, start the ring gear on the flywheel so that, when the flywheel is installed, the chamfered ends of the teeth on the ring gear will face the cylinder block; these ends of the teeth engage with the pinion of the starter. Drive the ring gear down tight against the shoulder on the flywheel. Allow the ring gear to cool slowly; do not cool it by using water.

3. **Engine Clutch Shaft Front Bearing.** Replace the bearing in the flywheel if the balls or the races are worn, corroded, or rough, or if the bearing does not roll freely and smoothly. Remove the bearing with a bearing puller as shown in Fig. 36. Start the bearing into position (shielded side of bearing toward rear), then using a driver or tube that will provide for driving against the outer race, drive the bearing into place.

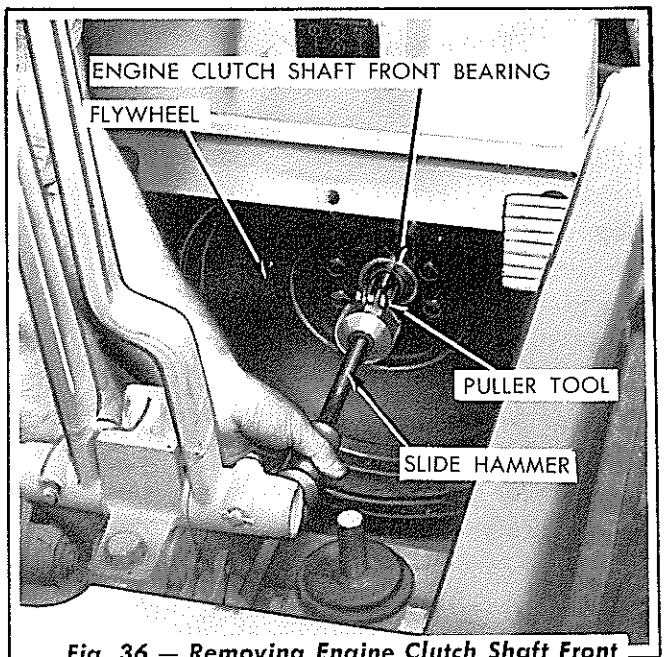

Fig. 36 — Removing Engine Clutch Shaft Front Bearing — Engine Installed

H. Removal of Crankshaft Pulley

1. Remove the radiator (refer to "REMOVAL OF RADIATOR AND RADIATOR SHELL," Section IV).

2. Release the tension on the fan belts and remove the belts from the crankshaft pulley.

3. Remove the crankshaft pulley capscrew and washer. Using a puller similar to the one shown in Fig. 37, remove the crankshaft pulley from the crankshaft and remove the pulley key.

I. Installation of Crankshaft Pulley

1. Install the pulley key in position in the crankshaft. Install the crankshaft pulley, washer, and the crankshaft pulley capscrew. Tighten the crankshaft pulley capscrew to a torque of 290 to 310 lbs. ft.

2. Place the fan belts in the grooves of the crankshaft pulley, then adjust the belts (refer to "FAN DRIVE BELT ADJUSTMENT," Section IV).

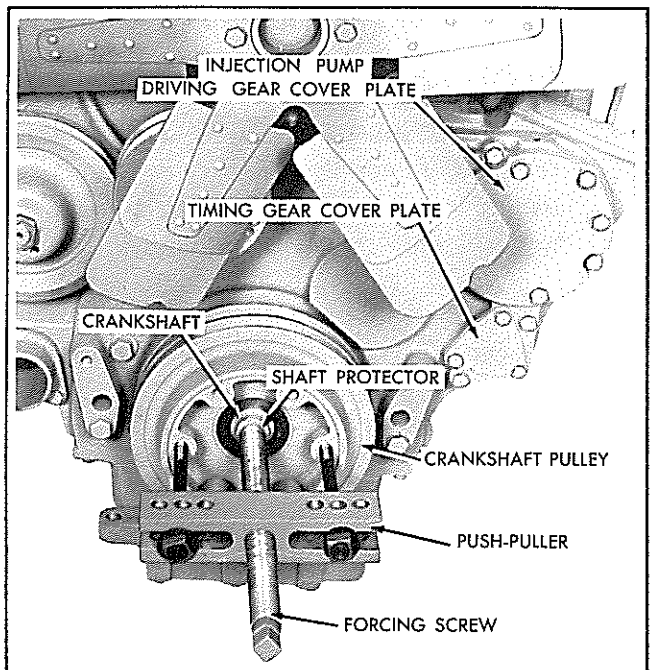

Fig. 37 — Removing Crankshaft Pulley — Engine Removed

3. Install the radiator (refer to "INSTALLATION OF RADIATOR AND RADIATOR SHELL," Section IV).

6. PISTONS AND CONNECTING RODS

A. Description of Pistons

The precision-machined and balanced pistons are cast aluminum alloy, cam ground, and anodized. Each piston is fitted with three compression rings and two oil control rings of the conventional cut-joint type, all located above the piston pin. The compression ring installed in the uppermost groove is "Chromium Plated." The bottom two rings are ventilated oil control rings with ring expanders located between the rings and the piston. Holes are drilled through the walls of the piston at the oil ring grooves to allow any excess oil that collects in the ring grooves to return to the crankcase. The piston pins are of the full floating type and are held in place in the piston by two retainer rings fitted into grooves in the pin boss of the piston. The pins are full floating but normally the movement is between the pin and the bushing in the connecting rod.

B. Description of Connecting Rods

Each connecting rod is made of drop-forged, heat treated steel, and forged to an "I" section with a closed hub at the upper end and an integral cap at the lower end. The rod is rifle-drilled for pressure lubrication of the piston pin. Each connecting rod is electronically balanced.

The connecting rod bearings are the precision type, replaceable without machining. Each half of the bearing shell is prevented from radial movement by a tang at the parting line on one side of the bearing shell and is equipped with an oil hole to allow oil to be pumped, through the crankshaft, to the upper end of the connecting rod. The bearing shells are held in place by the bearing cap which is attached to the connecting rod with two special bolts, castellated nuts, and cotter pins.

The upper end of the connecting rod contains a bushing with an oil hole and a radial oil groove

to allow the oil, pumped through the connecting rod, to flow around the piston pin.

The removal and installation of pistons and connecting rods and the replacement of connecting rod bearing shells is described in "REPLACEMENT OF PISTON AND CONNECTING ROD," also, in "DISASSEMBLY OF ENGINE" and "ASSEMBLY OF ENGINE" in this Section.

C. Removal of Connecting Rod and Rings from Pistons

1. Using a pair of pliers, remove the piston pin retainer at each end of the piston pin.

2. Using tools similar to those shown in Fig. 38, drive the piston pin from the piston. If a suitable driver tool is not available, immerse the piston in water (not oil) heated to 180° F. for approximately five minutes and remove the piston pin while the piston is still hot. NOTE: *The characteristic of an aluminum alloy piston is for the piston pin bore in the piston to expand as the piston heats, therefore the piston pin is a tight fit in the piston when the piston is at room temperature.*

3. To avoid breaking the piston rings, the use of a ring remover and installer, similar to the one shown in Fig. 39, is recommended when removing or installing piston rings. Care must be taken not to overstress the piston rings by spreading the ends more than is necessary to remove the rings from the piston. Before removing the rings from the pistons, they should be inspected for wear and for the amount of side clearance in the grooves. However, their removal will be necessary in most cases in order to clean the carbon from the grooves.

D. Piston and Piston Ring Inspection

As gummy deposits are not always easily removed from the piston walls and ring grooves with fuel, these parts may be cleaned by using a solvent and then blowing off with dry compressed air. After cleaning, the piston skirt, the piston rings, and the ring grooves should be thoroughly inspected.

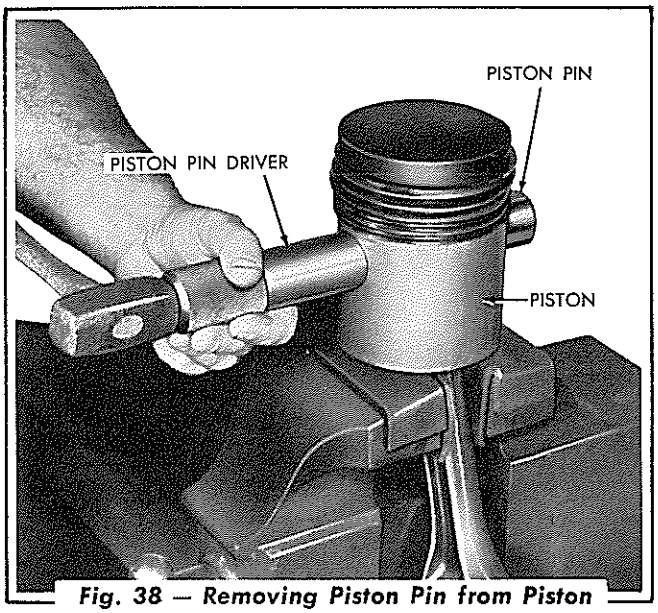

Fig. 38 — Removing Piston Pin from Piston

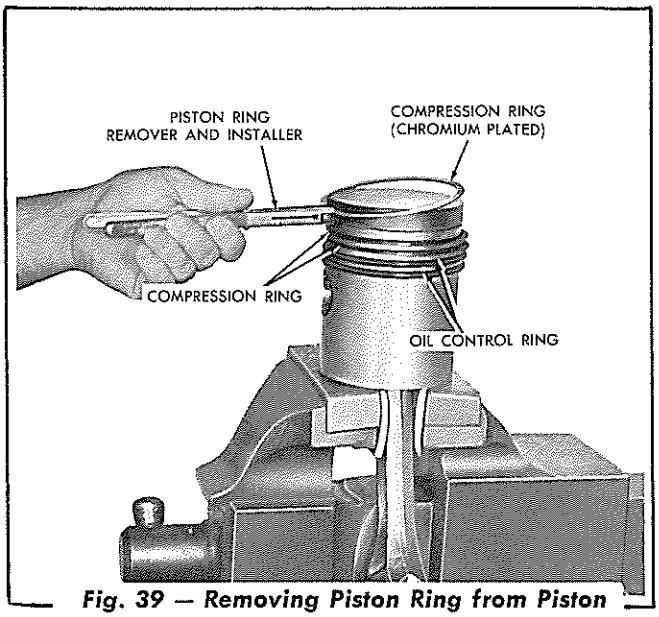

Fig. 39 — Removing Piston Ring from Piston

The skirt of the piston should be carefully inspected for score marks or other indications of improper piston clearance. Any scored pistons should be replaced.

Inspect the inside of the piston for cracks. Any cracks in the piston make it unfit for further use. Make certain that the drilled holes in the piston walls are open and clean.

Check the piston for wear by inserting the piston into the cylinder sleeve and measuring the clearance between the piston and the cylinder sleeve as shown in Fig. 40; the specified clearance is from .0055" to .008". IMPORTANT: *When measuring the clearance between a used piston and cylinder*

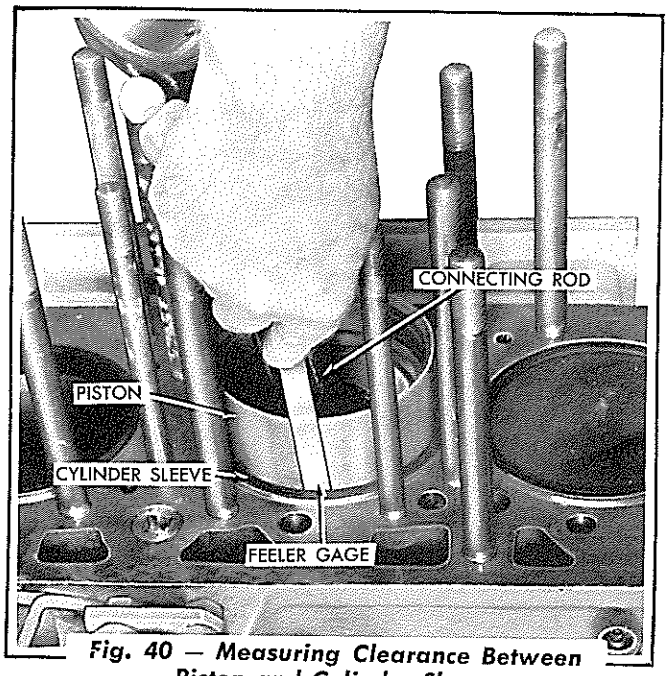

Fig. 40 — Measuring Clearance Between Piston and Cylinder Sleeve

sleeve, make certain that the piston is inserted into the sleeve far enough so that the measurement is taken in the area of the ring travel. The piston skirt diameter of a new piston is 4.4305" to 4.4315"; the inside diameter of a new cylinder sleeve is 4.4370" to 4.4385". Deviations from these measurements will indicate the amount of wear on the piston or the cylinder sleeve. The piston or the cylinder sleeve, or both, must be replaced if the clearance exceeds .011".

New piston rings should always be used with new pistons. If the engine has been in service for some time, even though the same pistons are again used, it is advisable to use new rings when the engine is again assembled.

E. Inspection of Connecting Rod Assembly

Wash the connecting rod assembly in clean solvent or fuel.

1. Measure the outside diameter of the piston pin to determine the wear. The specified diameter of a new piston pin is 1.5015" to 1.5017".

2. The specified inside diameter of the bushing in the connecting rod is 1.5027" to 1.5032". These dimensions of the pin and bushing provide a clearance of .001" to .0017"; clearances up to .003" are permissible. If the wear is close to or beyond this limit, replace the connecting rod bushing (see "REPLACEMENT OF CONNECTING ROD BUSHING" in this Section).

3. Blow dry compressed air through the oil passage in the connecting rod. IMPORTANT: *Be sure that all oil passages are open.*

4. Inspect the connecting rod bearing shells for scoring, chipping, corrosion, cracking, or signs of overheating; discard the bearing shells if any of these conditions are apparent. The backs of the bearing shells should be inspected for bright spots and discarded if any bright spots are found, as this condition indicates that the bearing shells have been moving in their supports.

5. Inspect the bearing shells for wear. The specified inside diameter of the bearing shells when installed and the nuts tightened to the specified torque is 2.7745" to 2.7760". This provides a running clearance of .002" to .0045"; new bearing shells must be installed when this clearance exceeds .006". The thickness of the bearing shells should be measured for wear in the same manner as the main bearing shells (refer to Fig. 29). Connecting rod bearings that measure less than .122" at the center should be discarded and new ones installed. In the event that the crankshaft is worn and damaged and must be reground, bearing shells .010", .020", .030", and .040" undersize are available.

F. Fitting Pistons with Cylinder Sleeves

Measurement of the pistons and the cylinder sleeves and running clearances between the pistons and the cylinder sleeves should be taken at room temperature (70° F.). IMPORTANT: *PISTONS MUST BE FITTED TO THEIR RESPECTIVE CYLINDER SLEEVES, BEFORE THE PISTON RINGS ARE INSTALLED, TO PROVIDE A RUNNING CLEARANCE OF NOT LESS THAN .0055".* Insufficient clearance will result in premature failure of these parts.

Measure the cylinder sleeves as described in "CYLINDER SLEEVE CLEANING AND INSPECTION"

in this Section.

Use a .004" feeler ribbon 12" to 18" long to measure the clearance between the pistons and the cylinder sleeves. The ribbon must be perfectly flat and free of nicks or scratches. Hold the feeler ribbon along the side of the cylinder sleeve wall, then, with the rod connected to the piston, insert the piston into the cylinder sleeve (cylinder sleeve installed in the cylinder block). With a .0055" clearance between the piston and the cylinder sleeve, the .004" feeler ribbon (Fig. 40) can be withdrawn with a slight pull (approximately 2 to 3 lbs.). Inspect for slight burrs on the piston or the cylinder sleeve if binding exists. Remove all burrs with a honing stone or fine emery paper.

NOTE: *Pistons and cylinder sleeves are available in standard size only.*

G. Fitting Piston Rings

The gap between the ends of the piston rings should be measured before the rings are installed on the pistons. Select the rings that are to be used on each piston and insert them one at a time into the cylinder sleeve in which they are to operate. Use a piston to push the ring squarely into the cylinder sleeve so that it is parallel with the cylinder head. Push the ring far enough down in the bore of the cylinder sleeve to be on the ring travel area. Check the ring gap with a feeler gage as shown in Fig. 41.

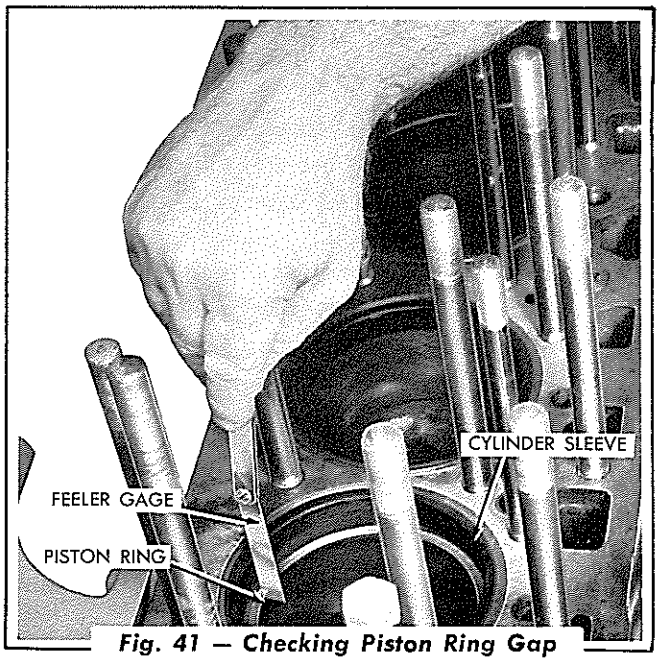

Fig. 41 — Checking Piston Ring Gap

The specified ring gap of the three compression and two oil rings is .015" to .023". CAUTION. *The chromium plated compression ring should never be filed to open the gap because the plating might be loosened by the file and later distributed through the engine, causing damage or scoring of the piston and the cylinder sleeve.*

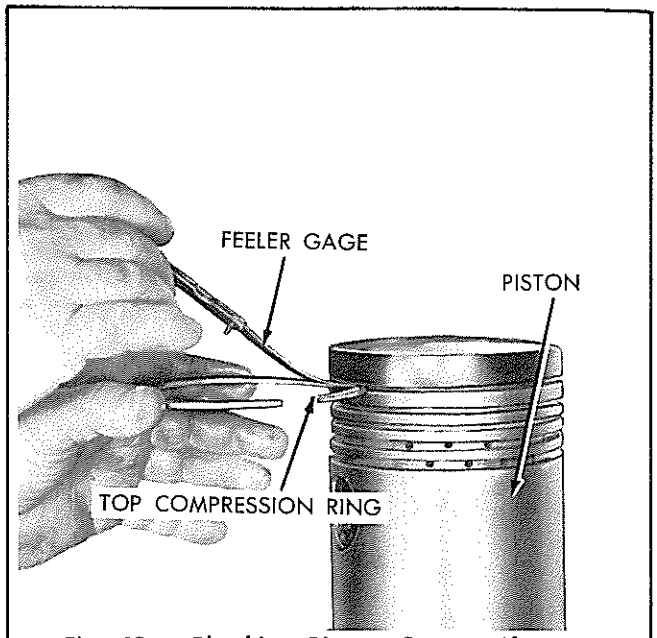

Fig. 42 — Checking Ring-to-Groove Clearance

Measure the ring-to-groove clearances (top of ring to top of groove in piston) as shown in Fig. 42. The specified clearances using a new piston and new rings are as follows:

Top Ring (Chromium Plated Compression Ring)	.0045" to .006"
2nd and 3rd Rings (Compression Rings)	.0015" to .0035"
4th and 5th Rings (Oil Control Rings)	.002" to .004"

After the rings have been properly fitted, install them on the piston (with side marked "TOP" toward top of piston) using a piston ring remover and installer as shown in Fig. 39. NOTE: *When installing the rings on the pistons, do not spread the rings more than necessary.* The oil control rings must be installed in the two lower grooves in the piston. The oil control ring expanders must be installed first, then the ring, with the scraper edges down and the chamfered edges toward the top of the piston. This is important to control piston lubrication properly.

Stagger the ring gaps evenly around the piston and apply oil to the rings and the pistons before installing them in the cylinder sleeves.

H. Replacement of Connecting Rod Bushing

If the connecting rod bushing is worn, it may be replaced. The old bushing may be pressed out of and a new bushing pressed into the connecting rod. When new bushings are installed, make sure that the oil hole in the bushing lines up with the rifle drilled oil hole in the connecting rod. The specified diameter of a new piston pin is 1.5015" to 1.5017" and the inside diameter of the bushing is 1.5027" to 1.5032"; this provides a clearance of .001" to .0017" between the pin and bushing. It will be necessary to ream the connecting rod bushing to obtain this clearance. NOTE: *Whenever it is necessary to replace a connecting rod bushing, it is recommended that the work be done by a reputable machine shop suitably equipped, as the connecting rod should be checked for alignment and the bushing reamed to the specified dimension given above.*

I. Assemble Connecting Rods and Pistons

1. Install one of the piston pin retainers in one end of the piston pin hole in the piston.

2. Insert the upper end of the connecting rod into the piston. Lubricate the piston pin with clean oil and with a driver tool similar to the one shown in Fig. 38, drive the piston pin into position in the piston and the connecting rod. If a suitable driver tool is not available, immerse the piston in water heated to 180° F. for approximately five minutes, then insert the piston pin into the piston. CAUTION: *Do not heat the piston in oil.*

3. Install the other piston pin retainer at the opposite end of the piston pin.

7. CAMSHAFT AND CAMSHAFT BEARINGS

A. Description

The one piece camshaft is drop forged, open-hearth steel, case hardened at the cams and journals, and is located in the lower half of the cylinder block on the left hand side of the engine. The camshaft is rigidly supported in the cylinder block by four precision type bronze bearings. A smoothly ground hardened steel camshaft thrust collar is provided at the front (gear) end of the camshaft.

B. Lubrication

Lubrication is supplied to the camshaft from four oil passages drilled through the cylinder block from the front, intermediate, and rear main bearings.

C. Removal and Installation of Camshaft

Removal of the camshaft requires the removal of the engine from the tractor.

1. Remove the engine (refer to "ENGINE REMOVAL AND INSTALLATION" in this Section).

2. Remove the push rods and the valve lifters (refer to "VALVE LIFTER AND PUSH ROD REMOVAL, INSPECTION, AND INSTALLATION" in this Section).

3. Remove the crankshaft pulley (refer to "REMOVAL OF CRANKSHAFT PULLEY" in this Section).

4. Remove the capscrews attaching the fan to the fan hub and remove the fan and spacer.

5. Loosen the two capscrews clamping the engine mounting bracket to the timing gear housing cover and remove the bracket.

6. Remove the capscrews attaching the timing gear housing cover to the timing gear housing. Remove the five capscrews attaching the timing gear housing cover to the oil pan and remove the timing gear housing cover.

7. Remove the three capscrews attaching the capscrew locking plate and the camshaft thrust collar to the cylinder block. Remove the capscrew locking plate. Using care to prevent the cams from damaging the bush-

ings, remove the camshaft and camshaft gear as an assembly. Slide the thrust collar from the camshaft.

NOTE: *Before removing the camshaft and camshaft gear, rotate the crankshaft until the timing marks (Fig. 48) on the crankshaft gear and the camshaft gear are aligned. It is also advisable to mark the camshaft gear and the fuel injection pump drive gear at this time so that fuel injection pump gear teeth may be engaged with the same teeth of the camshaft gear when the camshaft is reinstalled.*

8. Remove the gear retaining snap ring from the end of the camshaft and press the camshaft from the camshaft gear. Remove the "WOODRUFF" key.

To install the camshaft gear, install the "WOODRUFF" key in position in the camshaft. Heat the gear in oil to a temperature of approximately 240° F. and press the gear onto the camshaft, making certain that the rear face of the gear hub contacts the shoulder of the shaft. Install the gear retaining snap ring. After the gear has cooled, place the camshaft thrust collar in position on the camshaft and measure the clearance between the thrust collar and the camshaft using a feeler gage as shown in Fig. 43. The clearance (end play) should be .003" to .009". The specified thickness of a new thrust collar is .205" to .206"; install a new thrust collar if necessary.

The camshaft may be installed by a direct reversal of the removal procedure. When installing, make certain that the oil grooved side of the thrust collar is toward the camshaft gear. NOTE: *Make sure that the timing marks (Fig. 48) on the camshaft gear and the crankshaft gear are aligned when installing the camshaft.*

D. Removal and Installation of Camshaft Bearings

The clearance between the camshaft bearings and the camshaft journals should be .0019" to .0055". If the clearance is .0075" or more, new camshaft

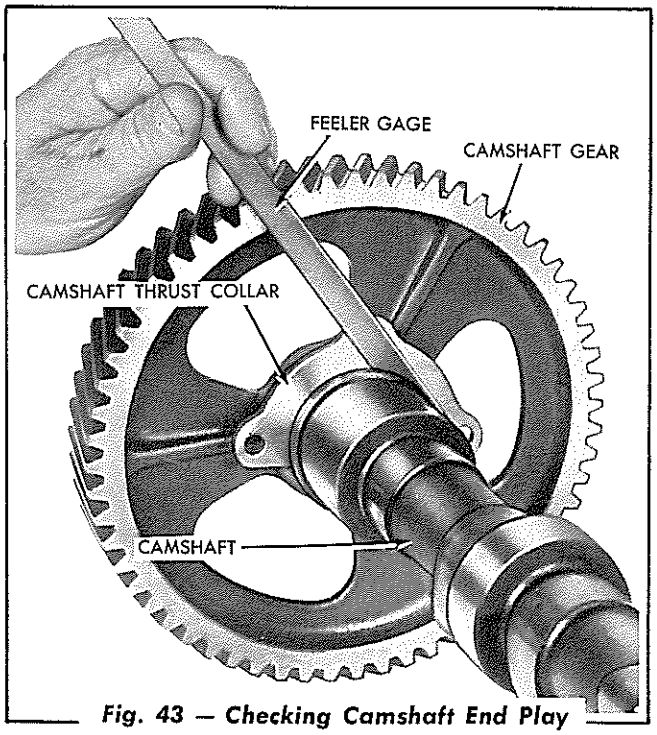

Fig. 43 — Checking Camshaft End Play

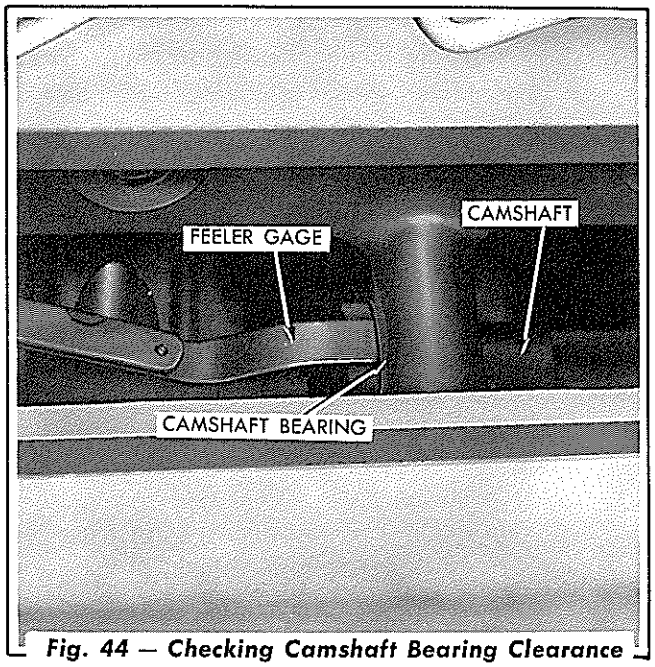

Fig. 44 — Checking Camshaft Bearing Clearance

bearings must be installed. The specified diameter of the camshaft bearing journals is 2.2465" to 2.2475" and the inside diameter of new camshaft bearings when installed is 2.2494" to 2.2520". To install new camshaft bearings, proceed as follows:

1. Remove the camshaft as outlined in Paragraph "C" above.

2. Remove the fan belt tightener lubrication hose from the support on the generator belt adjustment link. Remove the capscrew at-

taching the hose supporting clip to the water by-pass pipe.

3. Remove the capscrews and the locking clamp capscrew attaching the fan mounting bracket to the cylinder block and remove the bracket, fan hub assembly, and fan belt tightener assembly as a unit.

4. Loosen the hose clamp attaching the water by-pass pipe to the water by-pass tube hose. Remove the capscrew attaching the generator to the belt adjustment link.

5. Remove the capscrews attaching the timing gear housing to the cylinder block and remove the timing gear housing, water pump, and the water by-pass pipe as an assembly.

6. Remove the engine clutch (refer to "ENGINE CLUTCH REMOVAL," Section IX).

7. Remove the flywheel (refer to "FLYWHEEL, RING GEAR, AND ENGINE CLUTCH SHAFT FRONT BEARING REMOVAL, INSPECTION, AND REPLACEMENT" in this Section).

8. Remove the capscrews attaching the throttle cross shaft bracket supporting plate to the flywheel housing and remove the throttle control assembly. Remove the capscrews attaching the flywheel housing to the cylinder block and remove the flywheel housing and starter as an assembly.

9. Remove the 2¾" expansion plug from the rear end of the cylinder block, at the camshaft rear bearing location.

10. It is possible to remove and install the camshaft bearings without removing the oil pan, however, to prevent dirt from falling into the crankcase and to facilitate the camshaft bearing removal and installation, it is advisable to drain the engine oil and remove the oil pan.

11. With a camshaft bearing removing and installing set similar to the one shown in Fig. 45, proceed as shown in Figs. 46 and 47 to remove and install new camshaft bearings. NOTE: *When installing new camshaft bearings with the puller set illustrated, make certain that the hex nut on the puller shaft is turned onto the shaft until the "C" Washer (Stop Plate) on the front of the puller shaft contacts the front machined surface of the cylinder block.* The notches in the puller shaft are accurately located so that when the "C" Washer (Stop Plate) contacts the front face of the cylinder block, the oil grooves in the new bearings are automatically located with the oil holes in the cylinder block.

IMPORTANT: *All four camshaft bearings have one end beveled. The bearings MUST be installed with the beveled end facing the rear (flywheel) end of the engine.* The camshaft front bearing, which is 1.560" long, has an oil groove machined into the outer circumference and has one large and two small oil holes drilled through the bearing. Determine and mark the location of the oil hole in the cylinder block so that when the new front bearing is installed, the large oil hole in the bearing is aligned with the oil hole in the cylinder block. The two camshaft intermediate bearings are .935" long and have an oil groove machined into the outer

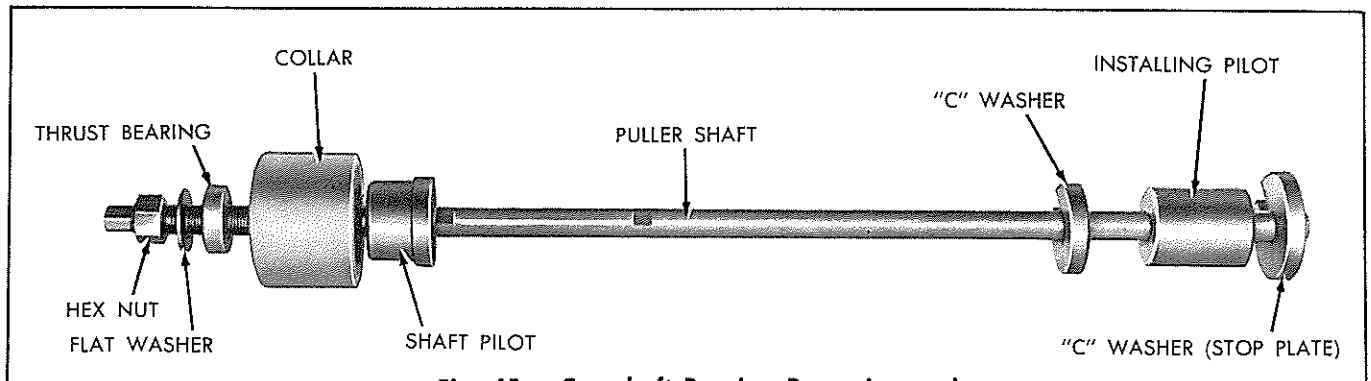

Fig. 45 — Camshaft Bearing Removing and Installing Tool Set

circumference. The camshaft rear bearing, which is 1" long, may or may not have an oil groove. If the new bearing has no oil groove, extreme care must be used to make certain that the oil hole in the bearing is aligned with the oil hole in the cylinder block. After installing the bearing, use a piece of wire to check and make certain that the oil hole is properly located. The camshaft bearings are of the precision type and do not require reaming after installation.

Install a new 2¾" plug in the rear bore of the cylinder block, at the camshaft rear bearing location. Install the camshaft and assemble the engine by a direct reversal of the removal procedure outlined above.

Check the fuel injection pump timing (refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II).

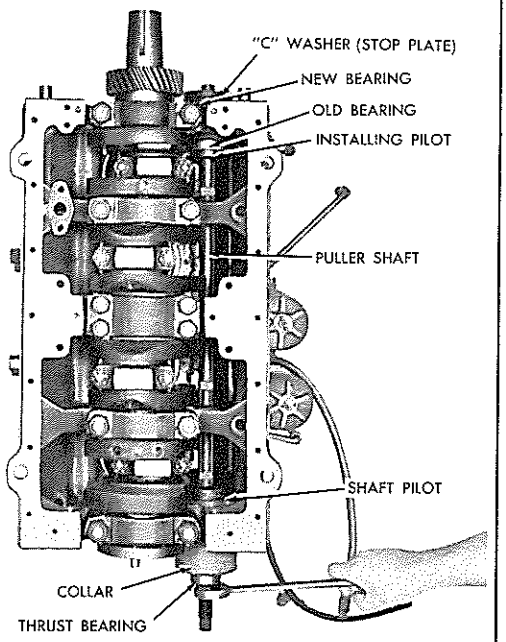

Fig. 46 — Removing and Installing Camshaft Bearing

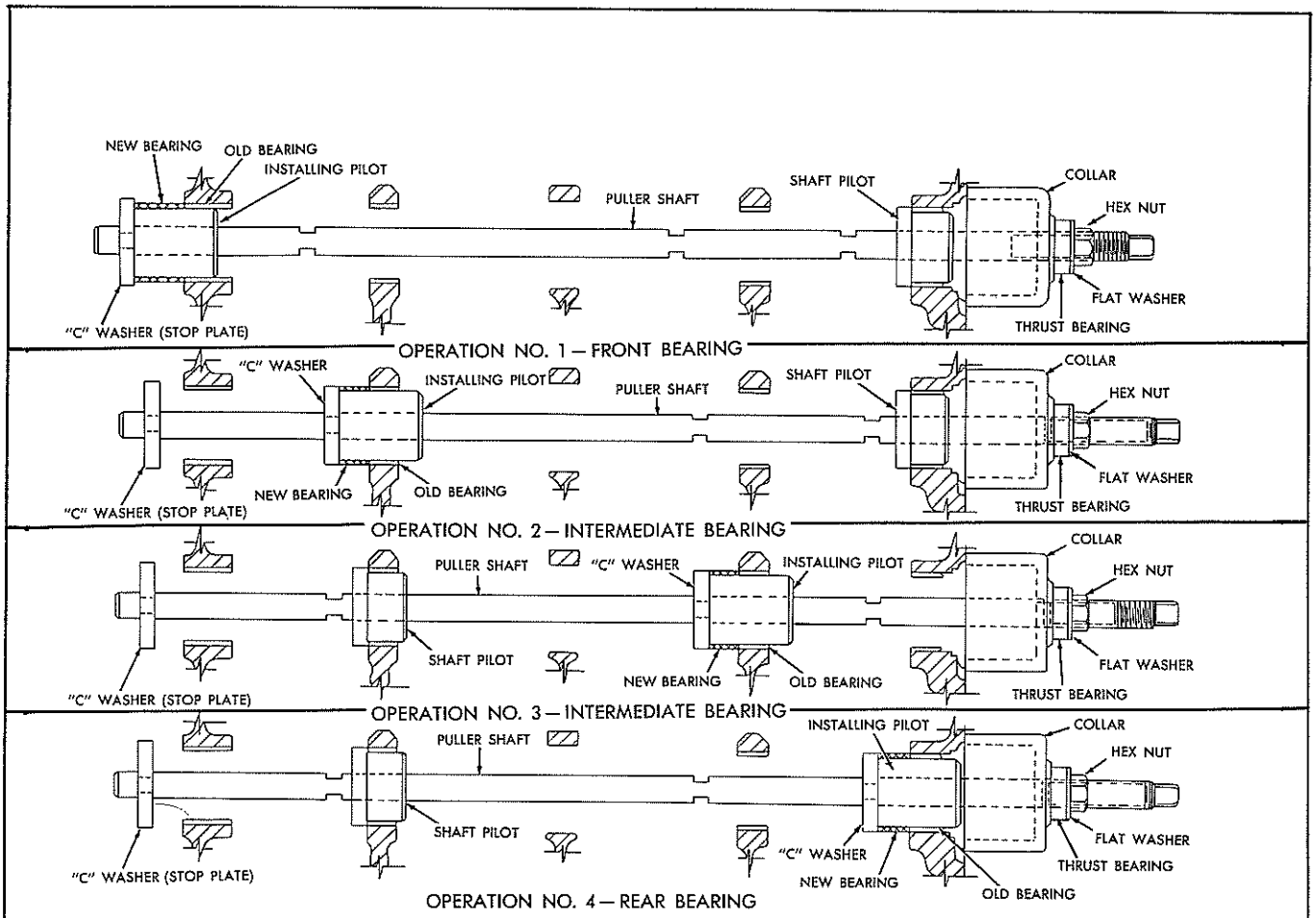

Fig. 47 — Sequence of Operations for Removing and Installing Camshaft Bearings

8. GEAR TRAIN

A. Description

Located in the timing gear housing at the front end of the engine is a completely enclosed train of four helical gears as shown in Fig. 48. A crankshaft gear, pressed and keyed onto the crankshaft, drives the oil pump and the camshaft gears. The camshaft gear in turn drives the fuel injection pump drive gear.

The gear train is splash lubricated by oil thrown by the gears and by oil being returned to the crankcase from the lubricating oil return passage of the fuel injection pump.

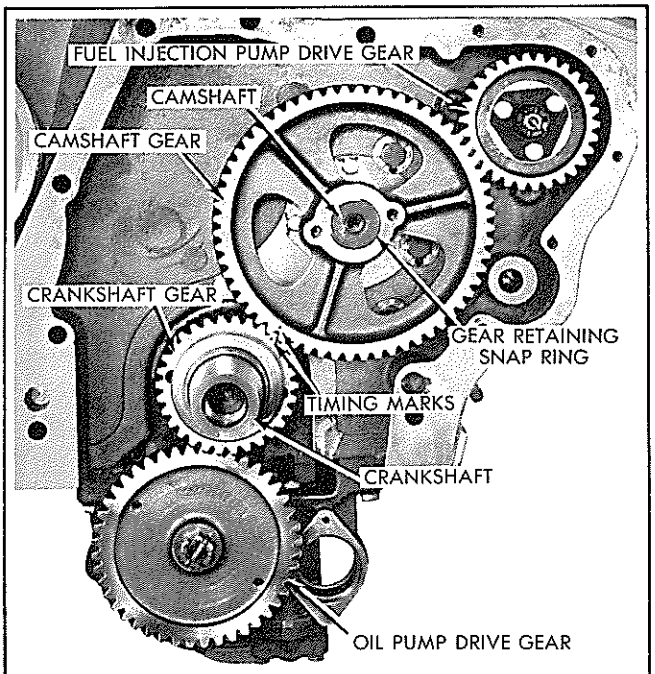

Fig. 48 — Gear Train

B. Service

The helical gear train will run quietly if the gears and bearings are in good condition. The specified backlash between any of the mating gears is from .003" to .007". As the gears or the bearings become worn, the backlash will be increased and the gear train may become noisy.

The gear train may be exposed for inspection by removing the timing gear housing cover as follows:

1. Remove the engine (refer to "ENGINE REMOVAL AND INSTALLATION" in this Section).
2. Remove the crankshaft pulley (refer to "REMOVAL OF CRANKSHAFT PULLEY" in this Section).
3. Remove the capscrews attaching the fan to the fan hub and remove the fan and spacer.
4. Loosen the two capscrews clamping the engine mounting bracket to the timing gear housing cover and remove the bracket.
5. Remove the capscrews attaching the timing gear housing cover to the timing gear housing. Remove the five capscrews attaching the timing gear housing cover to the oil pan and remove the timing gear housing cover.

   Inspect the gears for nicked, scored, or broken teeth. Replace any worn or damaged gears.

C. Camshaft Gear Removal and Installation

1. Removal of Camshaft Gear

Remove the gear retaining snap ring from the camshaft. With a puller similar to the one shown in Fig. 49, remove the camshaft gear. NOTE: *Before removing the camshaft gear, rotate the crankshaft until the timing marks on the crankshaft gear and the camshaft gear are aligned as shown in Fig. 48. It is also advisable to mark the camshaft gear and the fuel injection pump drive gear at this time so that the fuel injection pump gear teeth may be engaged with the same teeth of the camshaft gear when the camshaft gear is reinstalled.*

2. Installation of Camshaft Gear

a. Make certain the "WOODRUFF" key is in position in the camshaft.

b. Heat the camshaft gear in oil to a temperature of approximately 240° F. and with a suitable driving collar or a hard wooden block, drive the camshaft gear onto the camshaft.

   NOTE: *Make certain that the timing marks on the camshaft gear and the crankshaft*

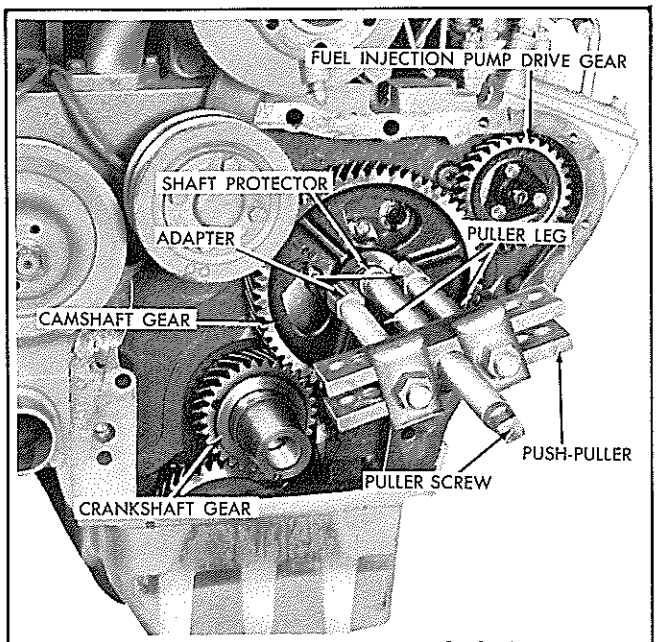

Fig. 49 — Removing Camshaft Gear

gear are aligned when the camshaft gear is installed.

c. Install the gear retaining snap ring (Fig. 48) in position on the camshaft.

D. Crankshaft Gear Removal and Installation

1. Removal of Crankshaft Gear

a. With puller tools similar to the ones shown in Fig. 27, remove the front oil seal sleeve and spacer from the crankshaft.

b. With a puller tool similar to the one shown in Fig. 28, pull the crankshaft gear from the crankshaft.

2. Installation of Crankshaft Gear

a. Make certain the "WOODRUFF" key is in position in the crankshaft.

b. Heat the crankshaft gear and the front oil seal sleeve in oil to a temperature of approximately 240° F. and with a suitable driving collar or a hard wooden block, drive the crankshaft gear onto the crankshaft. Place the front oil sleeve spacer on the crankshaft with the beveled side toward the gear and with a suitable driving collar, drive the front oil seal sleeve onto the crankshaft.

NOTE: *Make certain that the timing marks on the crankshaft gear and the camshaft gear are aligned as shown in Fig. 48 when the crankshaft gear is installed.*

E. Injection Pump Drive Gear Removal and Installation

Refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II.

F. Oil Pump Driving Gear Removal and Installation

In order to remove the oil pump driving gear, it is necessary to remove the oil pan.

1. Removal of Oil Pump Driving Gear

a. Drain the engine lubricating oil.

b. Remove the remaining capscrews attaching the oil pan to the cylinder block and the flywheel housing and remove the oil pan.

c. Remove the cotter pin and the slotted nut from the end of the oil pump upper shaft.

d. Using a puller tool similar to the one used on the camshaft and crankshaft gears, pull the oil pump driving gear from the shaft.

2. Installation of Oil Pump Driving Gear

a. Make certain the "WOODRUFF" key is in position in the oil pump upper shaft.

b. Heat the oil pump driving gear in oil to a temperature of approximately 240° F. and drive the gear onto the shaft. Install the slotted nut on the end of shaft and tighten the nut securely. Install the cotter pin.

Install the oil pan and the timing gear housing cover, using new gaskets, by a direct reversal of the removal procedure. NOTE: *A new crankshaft oil seal should be installed in the timing gear housing cover (refer to "REPLACEMENT OF CRANKSHAFT OIL SEALS" in this section).*

9. REPAIR OF ENGINE WHILE INSTALLED

A. General

Repair or replacement of the crankshaft, camshaft and camshaft bearings, camshaft gear, crankshaft gear, and crankshaft front oil seal requires the removal of the engine from the tractor. Practically all other parts can be removed and new parts installed with the engine in the tractor. IMPORTANT: *It is unwise to replace the cylinder sleeves, pistons and connecting rods, or the main and connecting rod bearings without removing the engine and taking it into a clean shop where it can be disassembled and all parts thoroughly cleaned and inspected before new parts are installed. There are several reasons why this should not be done in the open, namely:*

1. It is impossible to keep the engine and parts clean and free from dust or foreign material if the repair work is performed in the open.

2. Failure of the parts needing replacement may be due to clogged or restricted oil passages or gritty substances in the engine. If the oil passages are not properly cleaned, or if all abrasive material is not removed by thorough cleaning, failure may again occur within a short period of operation after the new parts are installed.

3. If some parts have become worn or damaged to the point where replacement of these parts is required, it is only reasonable to assume that other parts may also be worn, and, if not replaced at the same time, will result in further shut-down within a short time.

The following procedures describe the replacement of the pistons and the connecting rods, and the main and connecting rod bearings. These instructions are given to provide for emergency repairs when it is impractical to move the tractor to a shop.

B. Replacement of Pistons and Connecting Rods

1. Remove the cylinder head (refer to "CYLINDER HEAD REMOVAL" in this Section). Cover the cylinder head and the top of the engine to prevent dust from blowing onto the exposed parts.

2. Remove the engine crankcase guard. Drain the oil from the crankcase and remove the oil pan.

3. Remove the oil pump from the cylinder block (refer to "OIL PUMP REMOVAL," Section V).

4. Pull the cotter pins and remove the nuts and the bearing cap from each connecting rod in turn and push the piston and the connecting rod assembly out through the top of the cylinder block. Reassemble the bearing caps on their respective connecting rods as they are removed.

5. Inspect, disassemble, and reassemble the pistons and connecting rods as required (refer to "PISTONS AND CONNECTING RODS" in this Section).

6. Inspect the bearing journals of the crankshaft for scoring, checking, or signs of overheating. If any of these conditions exist, the crankshaft will require reconditioning or replacement.

7. Install the pistons and the connecting rods as explained in "ASSEMBLY OF ENGINE" in this Section. Be sure that all parts are clean and lubricated before they are installed.

8. Install the oil pump assembly and the oil pan (refer to "OIL PUMP INSTALLATION," Section V). Fill the engine crankcase to the proper level with the specified oil.

9. Install the cylinder head and the engine hood (refer to "CYLINDER HEAD INSTALLATION" in this Section).

10. Check the engine oil pressure immediately after starting the engine and be sure that the pressure is within the normal range before operating the tractor.

C. Replacement of Crankshaft Main Bearings

1. Remove either the four energy cell plugs, or the four fuel injection nozzle assemblies (refer to "ENGINE FUEL SYSTEM," Section II), in order to relieve the compression and allow free turning of the crankshaft.

2. Remove the engine crankcase guard. Drain the oil from the crankcase and remove the oil pan.

3. Remove the oil pump assembly from the cylinder block (refer to "OIL PUMP REMOVAL," Section V).

4. Remove the main bearing caps one at a time and install new bearing shells. Do not fully tighten the bearing caps until all the bearing shells have been installed. The lower bearing shell can be removed from the bearing cap after the cap is removed. Remove the upper bearing shell as follows:

   a. Insert a ¼" x 1" capscrew, with the head ground down to a thickness of approximately 3/32", into the crankshaft main bearing oil hole as shown in Fig. 50, then rotate the crankshaft in the direction that will turn the head of the bolt against the end of the bearing shell that has no locking tang. Continue rotating the crankshaft until the shell has been pushed out.

   b. The upper half of the rear main bearing shell may be rolled out of place by driving on the edge of the bearing shell with a small curved rod as shown in Fig. 51, while rotating the crankshaft.

5. Inspect the crankshaft and each bearing shell as explained in "CRANKSHAFT, CRANKSHAFT PULLEY, FLYWHEEL, AND MAIN BEARINGS" in this Section. If the crankshaft is unfit for use, it must be reconditioned or replaced before new bearings are installed. NOTE: *The halves of the main bearing shells are identical, therefore they may be installed in either the upper or lower positions.*

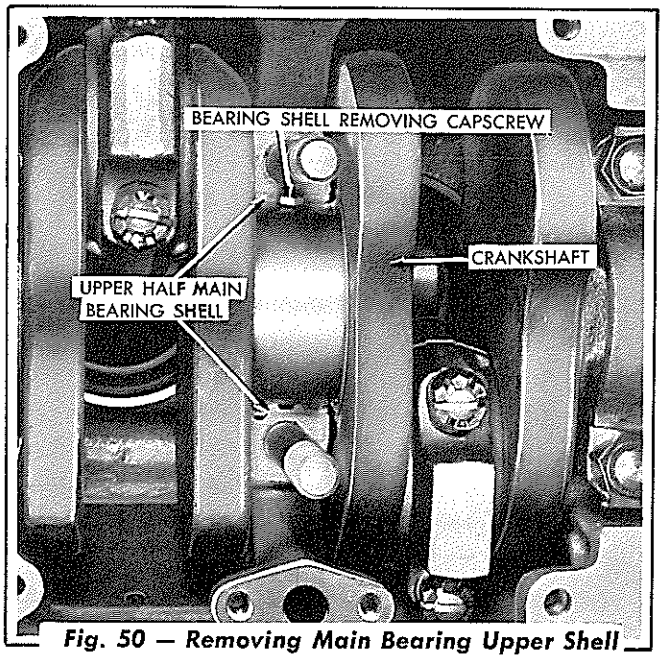

Fig. 50 — Removing Main Bearing Upper Shell

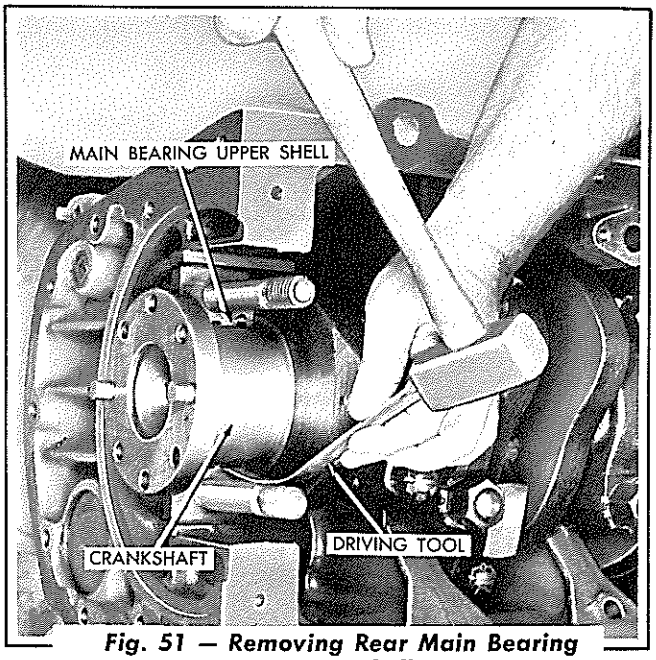

Fig. 51 — Removing Rear Main Bearing Upper Shell

6. Install the upper half of each main bearing shell as follows: Lubricate the bearing shell and start the end of the bearing shell (end having no tang) around the crankshaft bearing journal, so that when the bearing shell is in place, the tang will fit into the slot in the shell seat.

7. After the upper bearing shell has been installed, place the lower bearing shell in the bearing cap, with the tang of the shell in the corresponding slot in the cap. Lubricate with clean engine oil and install the bearing cap. NOTE: *The main bearing caps are*

numbered 1, 2, 3, etc., indicating their respective positions. Install the bearing caps with the numbers facing the front (fan end) of the engine and corresponding to the number stamped on the lower left edge of the cylinder block (refer to Fig. 32).

8. After all the bearing shells have been installed, tighten the main bearing stud nuts using a torque indicating wrench. Tighten the ¾" stud nuts, used on the front, intermediate, and rear main bearings to a torque of 210 to 230 lbs. ft.; tighten the ⅝" stud nuts used on the center main bearing to a torque of 160 to 170 lbs. ft. CAUTION: *Do not overtighten the main bearing stud nuts.* If these nuts are overtightened, the bearing caps will be distorted, causing the bearings to be drawn tight against the crankshaft journals and premature failure will result. The crankshaft should turn freely after all the nuts are tightened to the specified torque.

9. Install the oil pump, oil pan, and the crankcase guard (refer to "OIL PUMP INSTALLATION," Section V). Fill the engine crankcase to the proper level with the specified oil.

10. Install the energy cell plugs or the fuel injection nozzle assemblies, whichever was removed (refer to "ENGINE FUEL SYSTEM," Section II).

11. After the new bearings have been installed, the engine should be operated on a run-in schedule as outlined in "ASSEMBLY OF ENGINE" in this Section.

10. ENGINE REMOVAL AND INSTALLATION

A suitable hoist, cable or chain, and a sling spacing bar, or equivalent equipment will be needed to lift the engine from the tractor.

An engine stand, or suitable blocks, to support the engine after it is removed should also be provided, along with an ample supply of cleaning solvent, clean wiping rags, and at least 6 to 8 boxes or pans to hold the bolts and small parts removed from the engine and tractor.

It is recommended that the tractor, particularly the engine, be washed before the engine is removed. This will not only prevent dirt from getting on the exposed parts at disassembly, but will make the work much quicker and more easily done.

A. Engine Removal

1. Remove the engine air pre-cleaner and the engine hood. Remove the front fenders and the floor plate.

2. Drain the cooling system (refer to "DRAINING AND FILLING OF SYSTEM," Section IV). Loosen the front hose clamps on the radiator upper and lower hoses.

3. Disconnect the headlight cable at the cable connector located just below the generator. Loosen the capscrews attaching the headlight cable clips to the water pump housing. Spread the clips and pull the cable through them.

4. Use a suitable rope, cable, or chain to lift the radiator and shell assembly. Remove the four bolts attaching the radiator shell to the main frame. Raise the radiator and shell assembly slightly and move it forward to clear the engine fan. Remove the radiator and shell assembly from the main frame. Loosen the hose clamp at the rear of the lower hose and remove the lower hose from the inlet pipe.

5. Remove the capscrew attaching the battery-to-ground cable to the top of the steering clutch housing. Tape the end of the ground cable to prevent a ground when disconnecting other cables. Close the fuel tank shut-off cock located at the bottom of the fuel tank.

6. Disconnect the wiring harness from the starter and generator. Remove the bolt attaching the cable clip to the hose supporting bracket at the rear of the engine and the capscrew attaching the cable clip to the oil cooler.

7. Remove the battery cable from the starter. Remove the capscrew attaching the cable supporting clip to the right rear engine mounting bracket. Remove the starter-to-ground strap from the starter.

8. Disconnect the fuel supply line at the union located at the lower left side of the engine, near the main frame.

9. Disconnect the fuel return line at the elbow located in the fuel injection pump pressure relief valve. Remove the capscrew attaching the fuel line hose clip to the fuel injection pump driving gear cover plate.

10. Remove the yoke pin connecting the starter operating rod to the starter lever. Remove the yoke pin connecting the engine shut-off intermediate rod to the lower lever on the cross shaft in the throttle control cross shaft bracket. Remove the yoke pin connecting the throttle control rear rod to the throttle cross shaft lever.

11. Disconnect the engine primer fluid line from the primer elbow assembly located in the engine air intake elbow. Loosen the hose clamp attaching the air cleaner hose to the air cleaner and free the hose from the air cleaner.

12. Disconnect the fuel pressure gage hose at the fuel pressure gage restrictor. Remove the bolt attaching the fuel pressure gage hose clip to the voltage regulator bracket. Disconnect the oil pressure gage hose at the oil pressure gage.

13. Loosen and remove the engine temperature

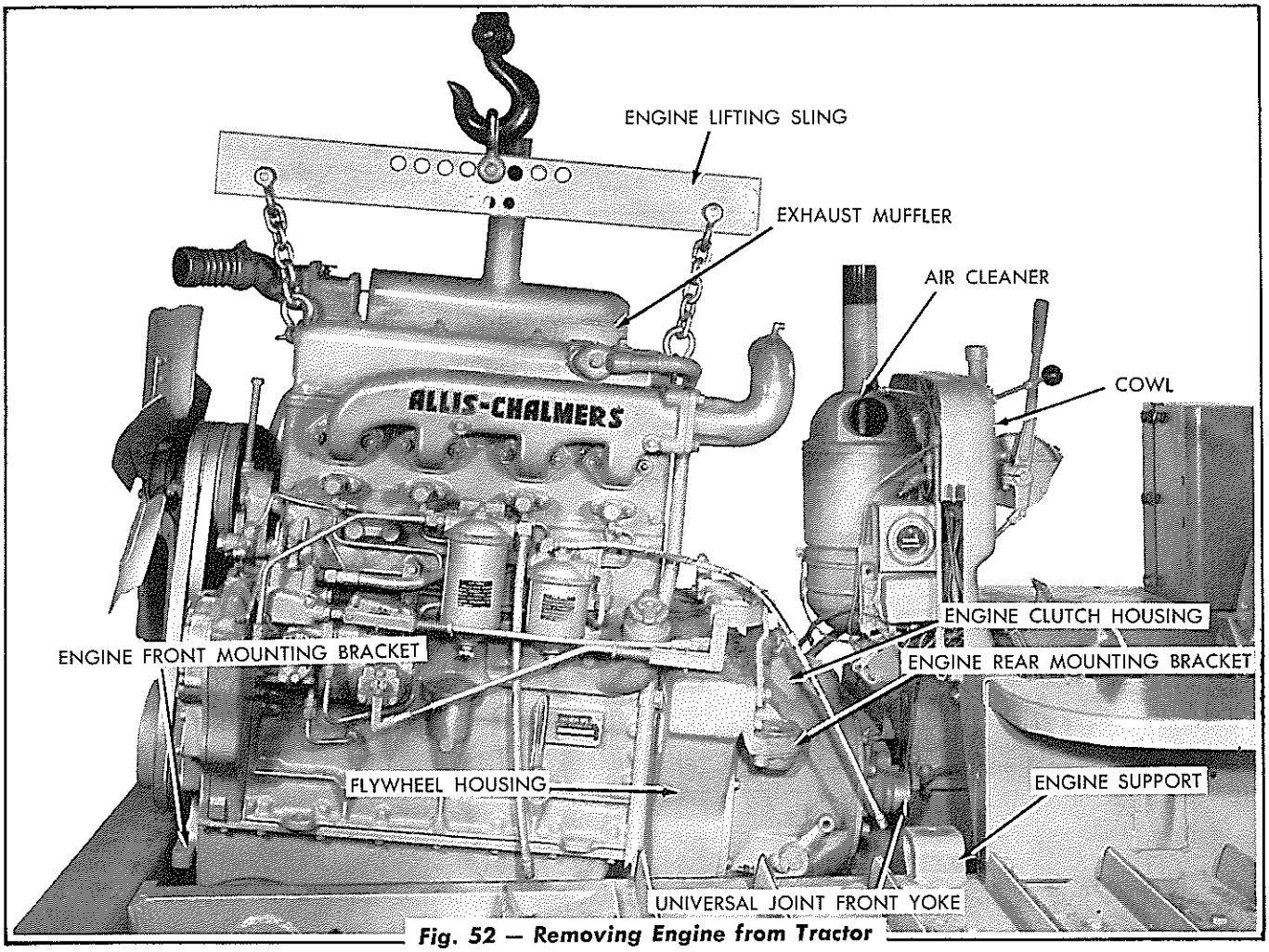

Fig. 52 — Removing Engine from Tractor

gage tube from the rear of the water outlet manifold.

14. Remove the pin connecting the gear shift locking plunger rod to the locking plunger end. Remove the capscrew clamping the shift lock lever to the clutch shifting yoke shaft and remove the shift lock lever.

15. Remove the engine clutch operating rod yoke pin attaching the operating rod yoke to the engine clutch control lever.

16. Remove the locks and capscrews attaching the universal joint assembly to the front and rear yokes and remove the universal joint assembly.

17. Remove the two capscrews attaching the engine front mounting bracket to the engine supporting front hanger. Remove the two rear mounting capscrews attaching the rear mounting brackets to the main frame.

18. The engine is now ready for removal from the tractor. Using an engine lifting sling assembly similar to the one shown in Fig. 52 and with the proper lifting facility, raise the engine enough so that the weight is off the engine supports. Move the engine forward and raise it as necessary until the clutch housing is clear of the cowl; raise and remove the engine from the main frame. CAUTION: *Use care when removing the engine; make certain that all necessary wiring, lines, linkage, etc. is disconnected and that no parts are damaged by careless handling.*

B. Engine Installation

The installation of the engine is practically a reversal of the removal procedure, except that certain inspections and adjustments must be made when installing.

NOTE: *Inspect the four rubber shock mounts for*

the engine. If the rubber has deteriorated or if the hole in the rubber is enlarged, the mountings must be replaced.

1. Using an engine lifting sling similar to the one shown in Fig. 52, and with suitable hoisting equipment, install the engine in position in the main frame of the tractor. Install the four engine mounting attaching capscrews and tighten securely.

2. Install the universal joint and tighten the attaching capscrews securely. Lock the capscrews with the capscrew locks.

3. Connect the engine clutch operating rod yoke to the engine clutch control lever. Check the adjustment of the engine clutch linkage and of the engine clutch (refer to "ENGINE CLUTCH AND CLUTCH BRAKE," Section IX).

4. Install the transmission shift lock lever on the clutch shifting yoke shaft and tighten the capscrew securely. Connect the transmission gear shift locking plunger rod to the locking plunger end with the yoke pin and cotter pin.

5. Insert the engine temperature gage tube into position in the rear of the water outlet manifold and tighten securely.

6. Connect the oil pressure gage hose to the oil pressure gage. Connect the fuel pressure gage hose to the fuel pressure gage restrictor. Install the bolt attaching the fuel pressure gage hose line clip to the voltage regulator bracket.

7. Position the air cleaner hose on the air cleaner and the air intake elbow then tighten the hose clamps. Connect the engine primer fluid line to the primer elbow assembly located in the air intake elbow.

8. Connect the throttle control rear rod to the throttle cross shaft lever. Connect the engine shut-off intermediate rod to the lever on the throttle control cross shaft. Connect the starter operating rod to the starter lever.

9. Connect the fuel return line to the elbow located in the fuel injection pump pressure relief valve. Install the capscrew attaching the fuel line hose clip to the fuel injection pump driving gear cover plate.

10. Connect the fuel supply line to the union located at the lower left side of the engine.

11. Connect the starter-to-ground strap to the starter. Connect the battery cable to the starter. Attach the cable supporting clip to the right rear engine mounting bracket.

12. Connect the wiring harness to the starter and generator (the smaller terminal to the field, marked "F" on the generator). Install the capscrew attaching the cable clip to the oil cooler and the bolt attaching the cable clip to the hose supporting bracket at the rear of the engine.

13. Remove the tape from the end of the battery-to-ground cable and install the capscrew attaching the cable to the top of the steering clutch housing. Open the fuel tank shut-off cock.

14. Use a suitable rope, cable, or chain and install the radiator and shell assembly in position on the main frame. Install the four capscrews attaching the radiator shell to the main frame.

15. Insert the headlight cable through the clips attached to the water pump housing. Connect the headlight cable at the cable connector located below the generator. Tighten the cable clip attaching capscrews.

16. Install the lower radiator hose on the inlet pipe. Install the upper and lower radiator hoses and tighten the hose clamps.

17. Fill the cooling system (refer to "ENGINE COOLING SYSTEM," Section IV).

18. Check the adjustment of the engine control linkage (refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS, Section II).

19. Check the valve lash (refer to "VALVE

ADJUSTMENT" in this Section).

20. Check the fuel injection pump timing (refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II).

21. Fill the engine crankcase to the proper level with the specified lubricant. If the engine has been rebuilt, or a new engine has been installed, remove the valve rocker cover, and pour approximately 2 quarts of oil over the rocker arm assemblies and cylinder head components when filling the crankcase. This will assure initial lubrication of the various components within the engine.

22. Polarize the generator (refer to "GENERATOR," Section VI).

23. Loosen the vent plug in the top of the second stage fuel filter. With the engine shut-off control knob pulled back to the stop position, crank the engine with the starter several times and allow the second stage fuel filter to fill with fuel. Tighten the filter vent plug when fuel emerges from around the loosened vent plug.

24. Install the floor plates, front fenders, engine hood, and the air pre-cleaner. Check to make certain that all linkage, lines, hoses, etc. are properly connected and that all capscrews, bolts, etc. are securely tightened.

25. If the engine has been rebuilt, or if a new engine has been installed, the engine should be operated on a run-in schedule as outlined in "ASSEMBLY OF ENGINE" in this Section.

11. DISASSEMBLY OF ENGINE

A. Removal of Accessories from Engine

After the engine has been removed from the tractor, the engine may be disassembled as follows:

Enough pans or boxes should be available so that each of the various components removed from the engine can be placed in them and kept separated. Keeping the components and their capscrews separated will make the reinstalling easier and quicker.

The following procedure gives a logical sequence for the removal of the accessories, starting at one side and working around the engine. Refer to Figs. 53 and 54 when removing the accessories.

1. With the engine suspended from a hoist, or supported on blocks, remove the following parts from the right side of the engine so that the engine can be mounted to an engine stand, if a stand is available:

   Remove the muffler, generator, and the generator mounting bracket. Drain the oil from the lubricating oil filter. Remove the oil cooler, oil filter, and oil filter base. Remove the starter and the oil pressure gage hose elbow.

2. With the above accessories removed, the engine can be mounted on a stand similar to the one shown in Fig. 55. With this stand, the right side of the engine is bolted to a heavy engine stand adapter plate using the two oil filter base studs and two ½" NC x 1¼" capscrews and six ⅜" NC x 1½" capscrews in the tapped holes provided for the oil cooler. The engine may be rotated on the stand for convenience in assembly or disassembly.

3. Drain the engine lubricating oil.

4. Remove the capscrews attaching the clutch shaft rear bearing retainer to the clutch housing and remove the clutch shaft and clutch shaft rear bearing retainer as an assembly. Remove the engine clutch inspection cover from the clutch housing. Remove the jam nut from the clutch shifter bearing lubricating hose. Push the outer end of the lubricating hose into the clutch housing.

5. Remove the capscrews and lockwashers attaching the engine clutch housing to the flywheel housing and remove the engine clutch housing. Remove the capscrews attaching the engine clutch to the engine flywheel and remove the engine clutch. The clutch driven plate can now be removed.

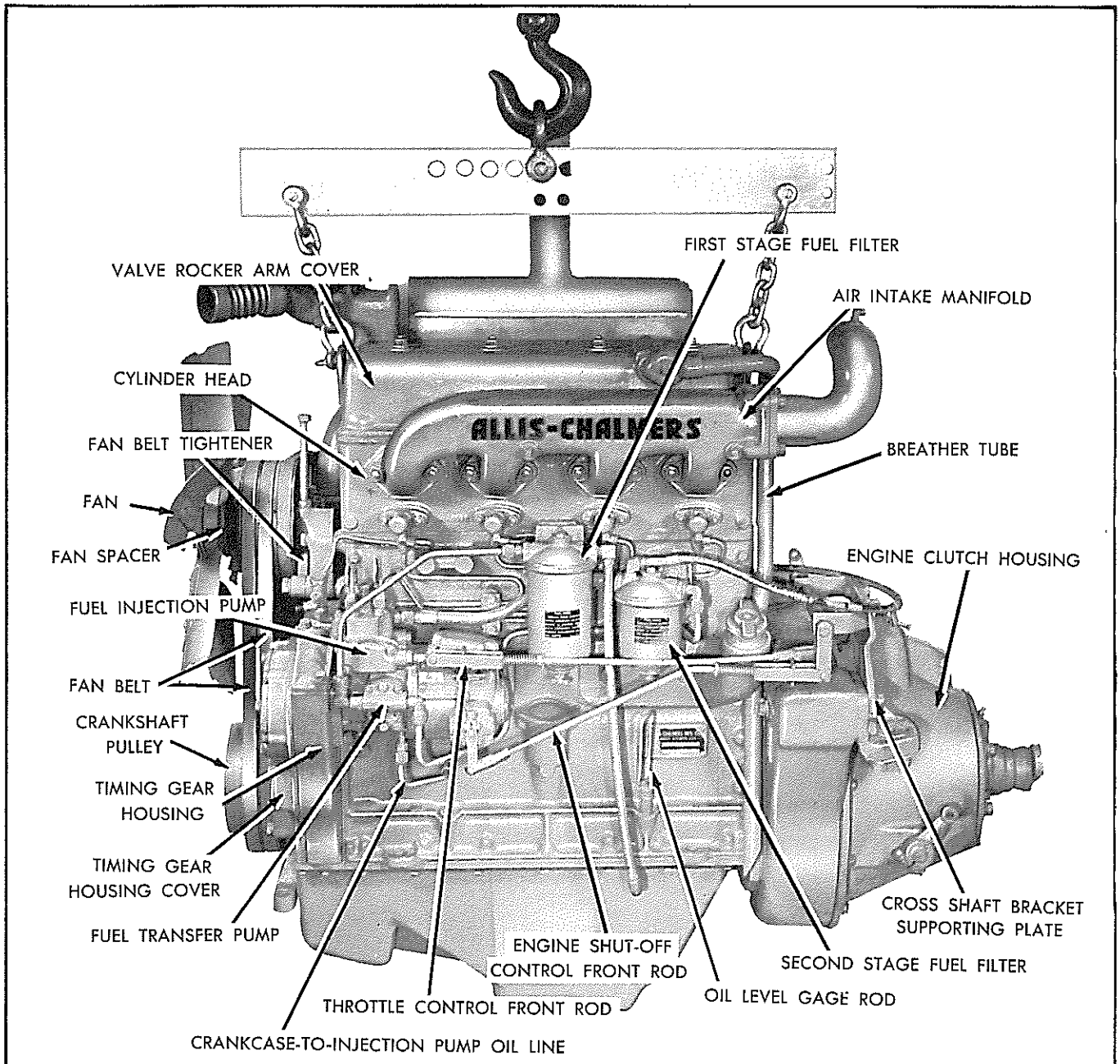

Fig. 53 — Left Side of Engine

6. Remove the yoke pin attaching the throttle control front rod to the fuel injection pump. Remove the yoke pin attaching the engine shut-off control front rod to the fuel injection pump. Remove the two capscrews attaching the cross shaft bracket supporting plate to the left rear mounting bracket and remove the cross shaft, throttle control front rod, and shut-off control front rod as an assembly.

7. Disconnect the first stage fuel filter-to-fuel transfer pump line from the transfer pump. Remove the first stage fuel filter and mounting bracket. Disconnect the fuel transfer pump-to-second stage fuel filter line from the fuel transfer pump. Disconnect the second stage fuel filter-to-fuel injection pump hose from the fuel injection pump. Remove the second stage fuel filter and mounting bracket. Disconnect the crankcase-to-injection pump oil line from the connector in the cylinder block and remove the connector from the cylinder block.

8. Remove the air intake manifold and elbow as an assembly. Remove the breather tube and the oil level gage rod.

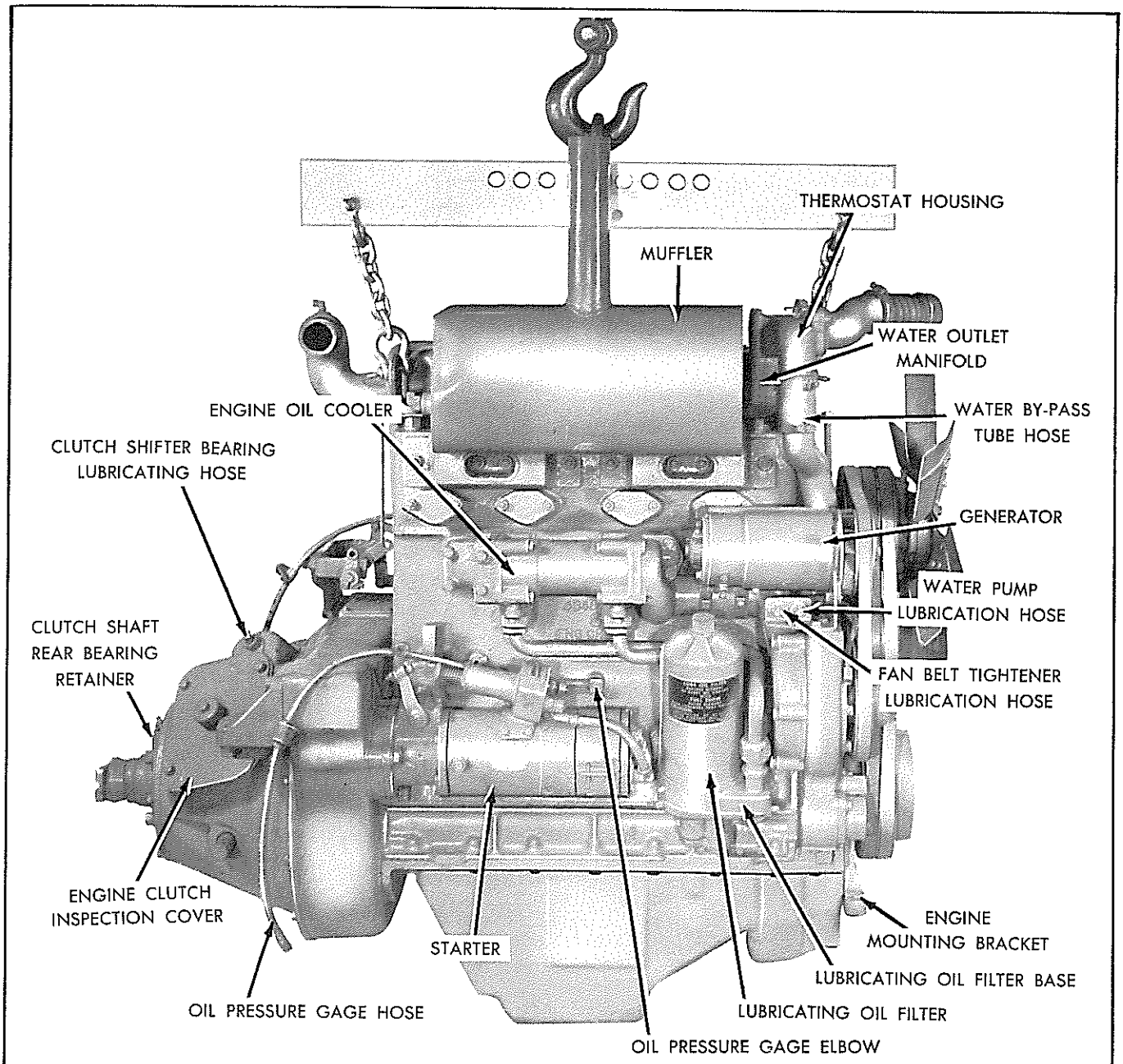

Fig. 54 — Right Side of Engine

9. Remove the capscrews attaching the fan to the fan hub and remove the fan and spacer. Loosen the tension on the fan belts and remove the fan belts.

10. Remove the fan belt tightener lubrication hose from the generator belt adjustment link and remove the capscrew attaching the hose supporting clip to the water by-pass pipe. Remove the three capscrews and the locking clamp capscrew attaching the fan mounting bracket to the cylinder block and remove the bracket, fan hub assembly, and fan belt tightener assembly as a unit.

11. Remove the crankshaft pulley (refer to "REMOVAL OF CRANKSHAFT PULLEY" in this Section). Loosen the two capscrews clamping the engine mounting bracket to the timing gear housing cover and remove the bracket.

12. Loosen the hose clamp attaching the water by-pass tube hose to the thermostat housing. Remove the capscrews and lockwashers attaching the water outlet manifold to the cylinder head and remove the water outlet manifold and the thermostat housing as an assembly.

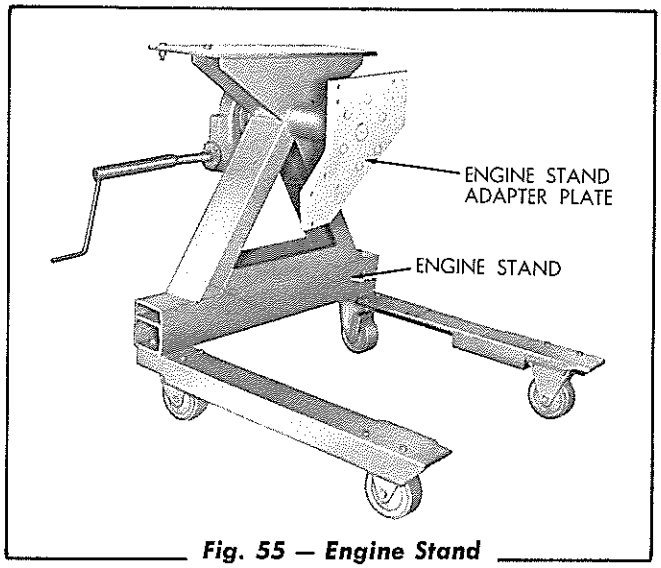

Fig. 55 — Engine Stand

B. Disassembly of Engine into Sub-Assemblies

Refer to pertinent sections of this manual for detailed information on the various engine sub-assemblies. If the engine is mounted on an engine stand, turn the engine to the position most convenient for removal of the sub-assemblies.

1. Remove the cylinder head from the cylinder block.

2. Remove the capscrews and lockwashers attaching the flywheel to the crankshaft flange. Turn two ½" NF x 6" guide studs (Fig. 35) into the crankshaft flange to act as guides and prevent damage to the flywheel on removal. It may be necessary to tap the flywheel loose by using a wooden block inserted through the starter opening.

3. Remove the oil pan. Remove the capscrews attaching the flywheel housing to the cylinder block and remove the flywheel housing.

4. Remove the capscrews attaching the timing gear housing cover to the timing gear housing and remove the cover.

5. Disconnect the fuel injection lines from the fuel injection pump. Disconnect the fuel return manifold from the fuel return pressure relief valve. Remove the fuel injection lines clamp and plate from the cylinder block and remove the fuel injection lines and the fuel return manifold.

6. Remove the three capscrews attaching the fuel injection pump drive gear to the injection pump hub and remove the drive gear plate and the drive gear. Remove the three nuts and lockwashers attaching the fuel injection pump to the injection pump attaching studs and remove the fuel injection pump.

7. Remove the front and rear valve lifter covers. Remove the valve lifters and the valve lifter brackets.

8. Remove the oil pump (refer to "OIL PUMP REMOVAL," Section V). Remove the oil pressure regulating valve (refer to "REMOVAL OF OIL PRESSURE REGULATING VALVE," Section V).

9. Remove the camshaft and camshaft gear as an assembly. Remove the capscrews attaching the timing gear housing to the cylinder block and remove the timing gear housing, water pump, and water by-pass pipe as an assembly.

10. Remove the cotter pins and nuts from each of the connecting rod bearing caps. Remove each piston and connecting rod assembly from the engine by pushing the assembly out through the top of the cylinder. Install each bearing cap on its respective connecting rod as they are removed.

11. Remove all the main bearing caps and lift the crankshaft from the cylinder block.

12. Remove the camshaft bearings.

13. Remove the cylinder sleeves from the cylinder block. Remove all the plugs from oil and water passages so that the cylinder block can be thoroughly cleaned. CAUTION: *Note the location of all plugs removed so that they can be reinstalled in their original positions.*

14. Wash and inspect all parts thoroughly, including the cylinder block. Refer to pertinent sections of this manual for instructions

on disassembly, cleaning, and inspection of the various sub-assemblies removed from the engine.

15. If a new cylinder block is to be installed, remove the cylinder head studs from the old block.

12. ASSEMBLY OF ENGINE

A. General

Make sure that all the parts are thoroughly cleaned before they are installed in or on the engine. Use new gaskets where gaskets are required. It is not necessary to cement gaskets used to seal against water leaks, on the other hand, BOTH SIDES of gaskets used to seal against oil or air leakage should be coated with gasket cement.

Lubricate all bearings or bearing surfaces with clean engine oil as parts are assembled.

Before any parts are installed in the cylinder block, make certain that all the plugs which were removed to clean the oil and water passages in the cylinder block have been coated with sealing compound, installed, and securely tightened.

1. If a new cylinder block is to be used, install the cylinder head studs at this time. Make certain that the threads of the studs are clean, dry, and in good condition. Turn the studs into the cylinder block to obtain the following stud heights above the flat machined surface of the cylinder block: The five ½" x 7⅝" studs should be driven to 6$^{11}/_{16}$" height; the seventeen ⅝" x 8" studs should be driven to 6⅞" height; the two ⅝" x 9$^{7}/_{16}$" studs used at the engine lifting eye locations should be driven to 8¼" height.

2. Turn the cylinder block upside down and install the upper halves of the main bearing shells in position in the crankshaft bearing seats of the cylinder block; the tangs of the bearing shells must engage in the corresponding slots in the bearing seats.

3. Lubricate all the crankshaft main bearing journals and lower the crankshaft into position in the cylinder block, with the flywheel flange of the shaft toward the rear end of the block.

4. Place the lower halves of the main bearing shells in position in the main bearing caps, making certain the tangs of the bearing shells are engaged in the corresponding slots in the bearing caps. The bearing caps are numbered 1, 2, 3, etc., indicating their respective positions. Install the caps with the numbers facing the front (fan end) of the engine and corresponding to the number stamped on the lower left edge of the cylinder block as shown in Fig. 32. Install the main bearing cap lockwashers and stud nuts. Use a torque indicating wrench and tighten the nuts to a torque of 210 to 230 lbs. ft. on the ¾" nuts used on the front, intermediate, and rear main bearings and tighten the ⅝" nuts used on the center main bearing to a torque of 160 to 170 lbs. ft. Check the end thrust of the crankshaft which is taken by the flanges of the center main bearing; the end play may be measured as described in "MAIN BEARING INSPECTION" in this Section. The specified clearance is .006" to .012" and should not exceed .020".

   CAUTION: *Do not overtighten the main bearing stud nuts.* If these nuts are overtightened, the bearing caps will be distorted, causing the bearings to be drawn tight against the crankshaft and premature failure will result. The crankshaft should turn freely after all the nuts are tightened to the specified torque. Never file or shim a bearing cap to make the bearing shell fit; install new bearing shells if the fit on the crankshaft is unsatisfactory.

5. Install the crankshaft gear and the front oil seal sleeve and spacer on the crankshaft (refer to "CRANKSHAFT GEAR REMOVAL AND INSTALLATION" in this Section). The front oil seal sleeve is serviced separately and should be replaced if worn.

6. Install the camshaft bearings in the cylinder block. All four camshaft bearings have one

end beveled. The bearings must be installed with the beveled end facing the rear (flywheel end) of the engine. Refer to "REMOVAL AND INSTALLATION OF CAMSHAFT BEARINGS" in this Section.

7. Turn the cylinder block on end, or lay it on its side, for installation of the cylinder sleeves. Before installing the cylinder sleeve, new packing rings must be installed. If the old sleeves are to be installed, remove the old packing rings and clean any rust or scale from the packing ring grooves in the cylinder sleeve. Lay the sleeve on its side and carefully roll the packing rings over the lower end of the sleeve and into the grooves. Apply green soap (liquid soap) or hydraulic brake fluid to the packing rings before installing the cylinder sleeve into the cylinder block. Use care to prevent damage to the packing rings and install the cylinder sleeve in the cylinder block. When the flange of the cylinder sleeve is firmly seated in the counterbore in the cylinder block, the surface of the cylinder sleeve flange should protrude above the cylinder block .006" to .009". Cylinder sleeve shims are available to obtain this dimension (refer to "CYLINDER BLOCK AND CYLINDER SLEEVES" in this Section).

8. Install the pistons with rings and connecting rods as an assembly. The lower end of each rod, as well as the bearing caps, are numbered 1, 2, 3, etc., on one side. These numbers identify the bearing caps with the rods and show the particular cylinder with which each rod is used. The connecting rods should be installed with the numbered side of the rod opposite the camshaft side of the cylinder block.

   a. Stagger the piston ring gaps evenly around the piston and apply clean engine oil to the pistons and rings. With a piston inserter, similar to the one shown in Fig. 56, install the piston and connecting rod in the cylinder sleeve by tapping on the upper end of the piston with the wooden handle of a hammer. Make certain that the identification

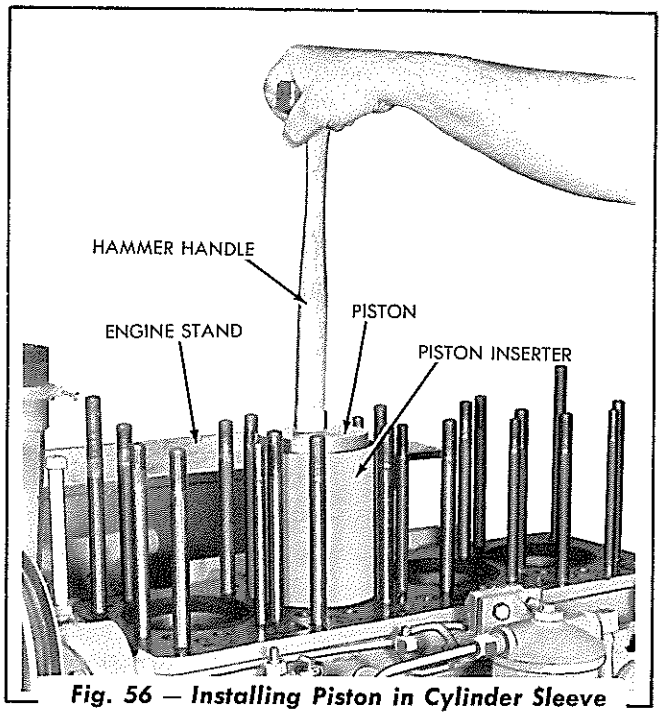

Fig. 56 — Installing Piston in Cylinder Sleeve

number stamped on the lower end of the connecting rod faces away from the camshaft side of the cylinder block and that the number corresponds with the cylinder number. Number one cylinder is the first cylinder at the front, or fan end, of the engine. Align the lower end of the connecting rod with the crankshaft before inserting the piston into the cylinder.

   b. Lubricate and install a bearing shell in position in the connecting rod, with the tang of the bearing shell in the corresponding slot in the connecting rod, and position the rod on the crankshaft journal.

   c. Lubricate and install a bearing shell in position in the connecting rod bearing cap, with the tang of the bearing shell in the corresponding slot in the bearing cap. Install the bearing cap and shell.

   d. Install the connecting rod nuts and, using a torque indicating wrench, tighten the nuts to a torque of 120 to 130 lbs. ft. Secure the nuts with cotter pins.

   NOTE: *Never file or shim the bearing caps to make the bearings fit; install*

new bearing shells if the fit is unsatisfactory. The crankshaft must turn freely after all of the connecting rod nuts have been tightened to the specified torque.

e. Check to see that there is sufficient side clearance between the connecting rods and the crankshaft journals. The specified clearance is .004" to .009".

9. Using gasket cement, cement a new timing gear housing gasket to the front end of the cylinder block and coat the outer surface of the gasket with gasket cement. Install the timing gear housing assembly in position on the cylinder block and attach with three ½" NC x 1 1/16" capscrews and lockwashers.

10. Install the camshaft gear on the camshaft (refer to "CAMSHAFT GEAR REMOVAL AND INSTALLATION" in this Section). Install the camshaft and gear assembly into the cylinder block using care not to damage the camshaft bearings. Install the camshaft thrust collar (with the oil grooves facing the gear) and install the capscrew locking plate and the three 5/16" NC x ¾" capscrews. Tighten the capscrews securely and lock with the locking plate.

    CAUTION: *Make sure that the timing marks on the camshaft gear and the crankshaft gear are aligned when the camshaft is installed.*

11. Install a new crankshaft rear oil seal in the flywheel housing (refer to "REPLACEMENT OF CRANKSHAFT OIL SEALS" in this Section). Install a new flywheel housing to crankcase sealing ring and attach the flywheel housing to the cylinder block with nine ½" NC x 1¼" capscrews and lockwashers.

12. Turn two ½" NF x 6" guide studs into the crankshaft flange to serve as guides for installing the flywheel and to prevent damage to the oil seal as shown in Fig. 35. Install the flywheel in position on the crankshaft flange. Remove the guide studs and attach the flywheel to the crankshaft flange with six ½" NF x 1¼" capscrews and lockwashers. NOTE: *One of the capscrew holes is offset and the flywheel can be attached to the crankshaft flange in only one position.*

13. Inspect the engine clutch shaft front bearing oiling wick (refer to "REPLACEMENT OF ENGINE CLUTCH SHAFT FRONT BEARING OILING WICK" in this Section). Install the engine clutch shaft front bearing as outlined in "ENGINE CLUTCH SHAFT FRONT BEARING" in this Section.

14. Install the valve lifters and valve lifter brackets. Use new gaskets and install the front and rear valve lifter covers (refer to "VALVE LIFTER AND PUSH ROD REMOVAL, INSPECTION, AND INSTALLATION" in this Section).

15. Install the oil pump assembly and the suction pipe supporting bracket (refer to "OIL PUMP INSTALLATION," Section V).

16. Using gasket cement, cement a new oil pan gasket to the cylinder block and coat the outer surface of the gasket with gasket cement. Attach the oil pan to the cylinder block.

17. Install and time the fuel injection pump as outlined in "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II. Install the crankcase-to-injection pump oil line connector in the cylinder block and connect the crankcase-to-injection pump oil line to the pump and to the cylinder block.

18. Install a new crankshaft front oil seal in the timing gear housing cover (refer to "REPLACEMENT OF CRANKSHAFT OIL SEALS" in this Section). Cement a new timing gear housing cover gasket to the timing gear housing. Using an oil seal protector as shown in Fig. 34, install the timing gear housing cover and secure the cover to the housing with the proper size capscrews shown in Fig. 57. NOTE: *Make certain that the ½" copper washer is in the proper location, as this capscrew extends into the water jacket in the cylinder block.*

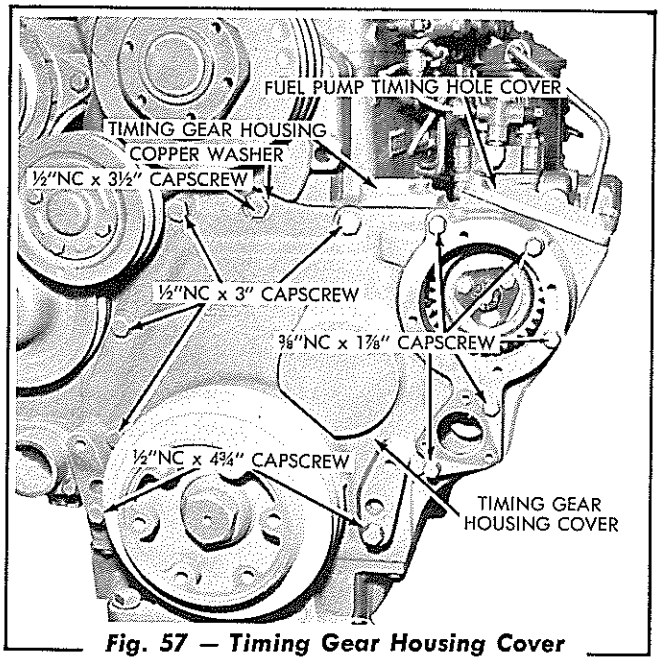

Fig. 57 — Timing Gear Housing Cover

Install the five capscrews attaching the oil pan to the timing gear housing. Cement a gasket to the timing gear housing cover and attach the injection pump driving gear cover plate (Fig. 37) to the timing gear housing cover with four ⅜" NC x ⅞" capscrews and lockwashers. Cement a new timing hole cover gasket to the timing gear housing and attach the fuel pump timing hole cover (Fig. 57) to the timing gear housing with two ⅜" NC x 1⅜" capscrews and lockwashers. Cement a new cover plate gasket to the timing gear housing cover and attach the timing gear cover plate (Fig. 37) with three 5/16" NC x ⅝" capscrews and lockwashers.

19. Inspect the liners located in the engine front mounting bracket. If the material has deteriorated or become too hard, the liners must be replaced. New liners may be installed as follows:

    a. Remove the two capscrews attaching the cap to the engine mounting bracket.

    b. Remove the old liners and carefully clean the grooves in the engine mounting bracket and cap.

    c. Install new liners making certain that the ends of the liners are flush with the ends of the grooves in the engine mounting bracket and cap. Place the cap in position on the engine mounting bracket and start the two capscrews but *DO NOT* use any shimming washers between the cap and bracket at this time.

    d. Install the engine mounting bracket in place on the engine and tighten the capscrews evenly to a torque of 50 lbs. ft. Using a feeler gage, measure the gap between the ends of engine mounting bracket and the cap.

    e. Remove the capscrews attaching the cap to the engine mounting bracket and install shimming washers between the bracket and cap equal to the thickness indicated by the feeler gage.

    f. Install and tighten the capscrews to a torque of 50 lbs. ft.

20. Install the crankshaft pulley key in position in the crankshaft. Install the crankshaft pulley, crankshaft pulley bolt washer, and the crankshaft pulley capscrew; tighten the crankshaft pulley capscrew to a torque of 290 to 310 lbs. ft.

21. Install the water pump (refer to "INSTALLATION OF WATER PUMP," Section IV). If the volute has been removed from the timing gear housing, install the volute using a new gasket and five ⅜" NC x 2¼" capscrews and plain washers.

22. Install the oil pressure regulating valve (refer to "ASSEMBLY OF OIL PRESSURE REGULATING VALVE, Section V).

23. Install the cylinder head (refer to "CYLINDER HEAD INSTALLATION" in this Section).

24. Install the valve push rods and the rocker arm assembly (refer to "ROCKER ARM REMOVAL, INSPECTION, AND INSTALLATION" in this Section). Install the rocker arm cover.

25. Connect the fuel return manifold to the fuel injection nozzle assemblies and to the fuel return pressure relief valve on the

fuel injection pump. Connect the fuel injection lines to the fuel injection nozzle assemblies and to the fuel injection pump. Attach the fuel injection line clamp and clamp plate to the cylinder block with two 5/16" NC x 1¼" capscrews and lockwashers.

26. Refer to Fig. 53 and install the first and second stage fuel filters, filter mounting brackets, and fuel filter lines and hose as shown.

27. Install the fan, fan belt tightener, generator and water pump drive belt, and fan belts (refer to "FAN BELT TIGHTENER AND FAN HUB INSTALLATION," Section IV).

28. Install the generator belt adjustment link on the timing gear housing and install the upper ends of the water pump and fan belt tightener lubrication hoses in the link.

29. Using a new gasket, install the water by-pass pipe. Install the water outlet manifold and thermostat housing as an assembly, using new gaskets.

30. Using new gaskets, install the engine air intake manifold and elbow as an assembly. Install the muffler, using new gaskets. Install the breather tube and the oil level gage rod.

31. Install the engine clutch, engine clutch housing, clutch shaft, and clutch shaft rear bearing retainer (refer to "INSTALLATION OF ENGINE CLUTCH," Section IX).

32. Attach the throttle cross shaft bracket supporting plate to the left rear mounting bracket with two ½" NC x 2" capscrews and lockwashers. Attach the engine shut-off control front rod and the throttle control front rod to the injection pump with yoke pins and cotter pins as shown in Fig. 53.

33. If the engine is mounted on an engine stand, it must now be removed in order to install the various parts on the right side of the engine.

34. Attach the generator mounting bracket to the cylinder block with three 3/8" NC x 1⅛" capscrews and lockwashers. Install the generator and adjust the drive belt (refer to "REMOVAL AND INSTALLATION OF GENERATOR," Section VI).

35. Install the oil pressure gage elbow and hose (Fig. 54). Install the starter in position on the flywheel housing.

36. Install the oil cooler, lubricating oil filter base and cooler-to-filter oil lines, and the filter assembly (Fig. 54). IMPORTANT: *New elements must be installed in the lubricating oil and the fuel filters when overhauling the engine.*

37. The engine may now be installed in the tractor (refer to "ENGINE REMOVAL AND INSTALLATION" in this Section).

B. Engine Run-In Schedule

After installation of new cylinder sleeves or piston rings, the engine must be run-in to allow the rings to seat and avoid the possibility of cylinder sleeve scoring and excessive oil consumption. When an engine is first started after installation of cylinder sleeves or piston rings, excessive smoking and raw fuel and lubricating oil may appear in the exhaust. This condition will correct itself as the engine is run-in.

Before starting the engine after overhaul, inspect the levels of the engine oil, fuel oil, and cooling system and see that the air cleaner has been properly serviced.

Start the engine and allow it to run at ½ throttle. See that all of the instrument gage readings are normal.

The most important factor in running-in a new engine, or one which has just been rebuilt, is OPERATING TEMPERATURE. The thermostat must function properly to maintain a normal operating temperature of 160° to 185° F. Temperatures of 150° F. and below are conducive to the formation of gum and sludge, both highly detrimental to an engine.

The following run-in schedule is recommended:

2 hours operation under light load at ½ throttle.

2 hours operation under light load at ¾ throttle.

2 hours operation under full load at full throttle.

After the run-in, inspect the engine crankcase oil level and all points of adjustment, making any necessary corrections.

NOTE: *After the first 10 and 100 hours of operation, the tightness of the cylinder head stud nuts MUST be checked (refer to "CYLINDER HEAD INSTALLATION" in this Section).*

SECTION IX — ENGINE CLUTCH AND CLUTCH BRAKE

1. ENGINE CLUTCH

A. Description

NOTE: *The HD 6A, 6B, and 6E Model Tractors prior to Tractor Serial No. 3006 may be equipped with either an "AUBURN" or a "ROCKFORD" engine clutch. Effective with Tractor Serial No. 3006 the "AUBURN" clutch was used exclusively. The HD 6G Model Tractors prior to Tractor Serial No. 1697 may be equipped with either an "AUBURN" or a "ROCKFORD" engine clutch. All HD 6G Tractors Serial Nos. 1697 and above have an "AUBURN" clutch.* The following description pertains to the "AUBURN" clutch.

The engine clutch is a single plate, dry clutch with an over center engaging action. A shifting sleeve and bearing mechanism, carried on the clutch shaft and connected by linkage to the clutch actuating levers, is operated by the engine clutch operating lever to engage and disengage the clutch. The operating lever and the clutch shifting yoke shafts are assembled on needle bearings that are grease packed and sealed for life at assembly. The clutch shifting sleeve ball bearing and engine clutch shaft rear ball bearing are the only parts that require periodic lubrication. An adjusting ring provides a means of maintaining the necessary adjustment to compensate for normal wear on the clutch facings.

The main components of the clutch assembly are: the driven plate, pressure plate, pressure springs, pressure ring, adjusting ring, back plate, shifting sleeve and yoke assembly, clutch brake, and the clutch housing. The clutch back plate is bolted to the rear face of the engine flywheel and carries most of the clutch weight, thus adding to the flywheel effect. The pressure plate is driven by lugs which engage in slots in the clutch back plate. The clutch driven plate, which is splined to the clutch shaft, is friction engaged between the pressure plate and the rear face of the flywheel by pressure exerted against the back of the pressure plate by springs in the pressure ring. The pressure ring is actuated by the over center action of the clutch actuating levers when the clutch operating lever is pulled into its engaged position. When the clutch is disengaged, the friction between the pressure plate, driven plate, and flywheel is relieved and the clutch brake stops rotation of the driven plate and the clutch shaft. The other clutch parts continue to turn with the engine flywheel and the clutch shifting sleeve bearing turns on the clutch shifting sleeve.

The front end of the clutch shaft is supported by the clutch shaft front ball bearing (pilot bearing) installed in the counterbore of the engine flywheel; the rear end of the clutch shaft is supported by the clutch shaft rear ball bearing, installed in the clutch shaft rear bearing retainer. The clutch shaft is connected to the transmission top shaft by a universal joint assembly. By removal of the universal joint assembly, the engine clutch can be removed without disturbing the engine or transmission.

A clutch brake assembly, consisting of a stationary lined plate attached to the clutch shifting sleeve yoke assembly and clutch brake disc bolted to the clutch shaft, is provided for stopping the rotation of the clutch shaft and transmission shafts when shifting gears. The clutch brake is applied by pushing forward on the clutch operating lever after disengaging the clutch.

B. Engine Clutch Service

Specified time intervals between clutch adjustments can not be established due to the variable operating conditions which determine the amount of clutch facing wear. Keep the clutch adjusted so that a pull of 25 to 30 pounds is required on the clutch operating lever to engage the clutch (engine stopped). As the clutch wears, the pull on the clutch operating lever diminishes. When the pull on the lever diminishes to 15 pounds, an adjustment is necessary. IMPORTANT: *Do not*

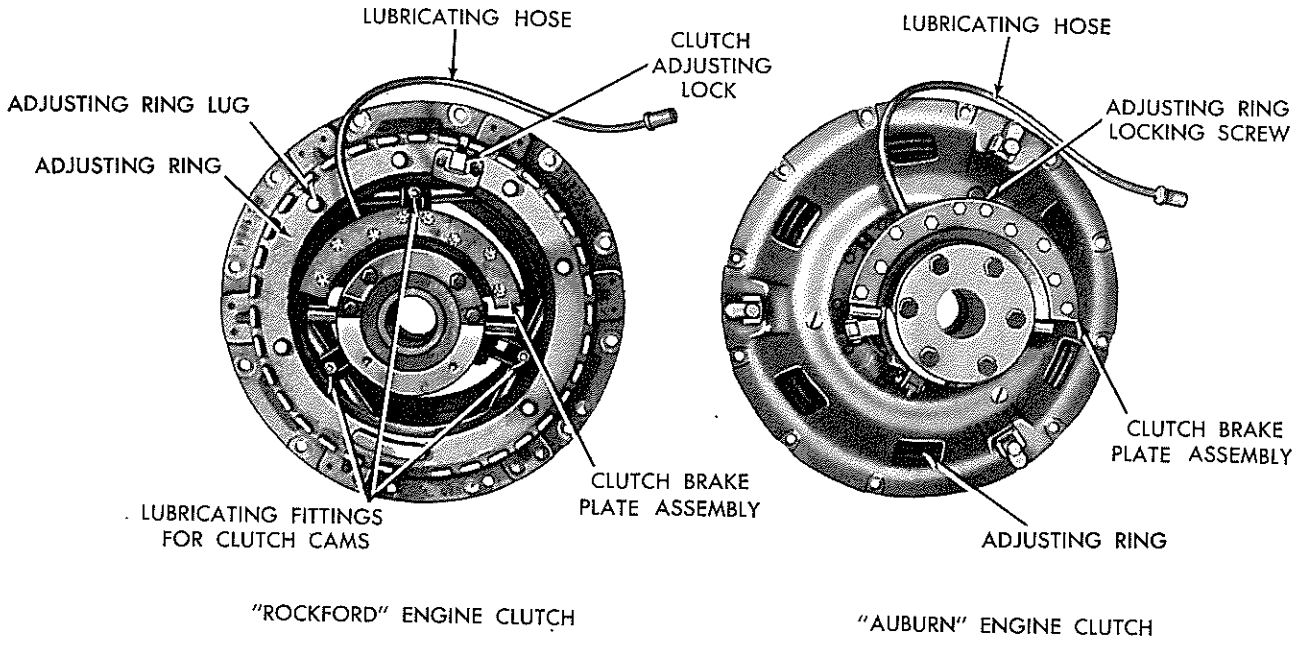

Fig. 1 — Engine Clutch Assemblies

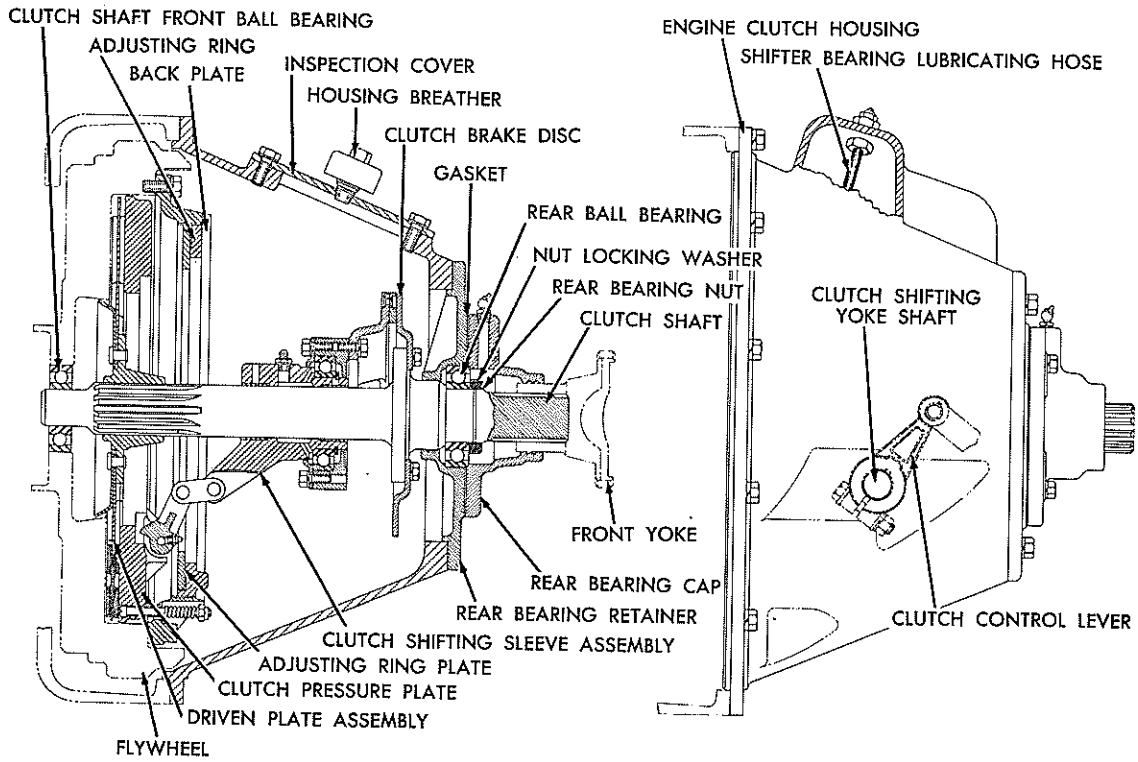

Fig. 2 — Engine Clutch and Housing — Sectional View ("Rockford" Clutch)

operate the tractor when the pull on the clutch operating lever is less than 15 pounds.

Frequent adjustments may be an indication that the facings on the driven plate are worn excessively and the driven plate must be replaced. The driven plate and facings are serviced as an assembly and can not be purchased separately.

IMPORTANT: *SINCE MOST CLUTCH FAILURES*

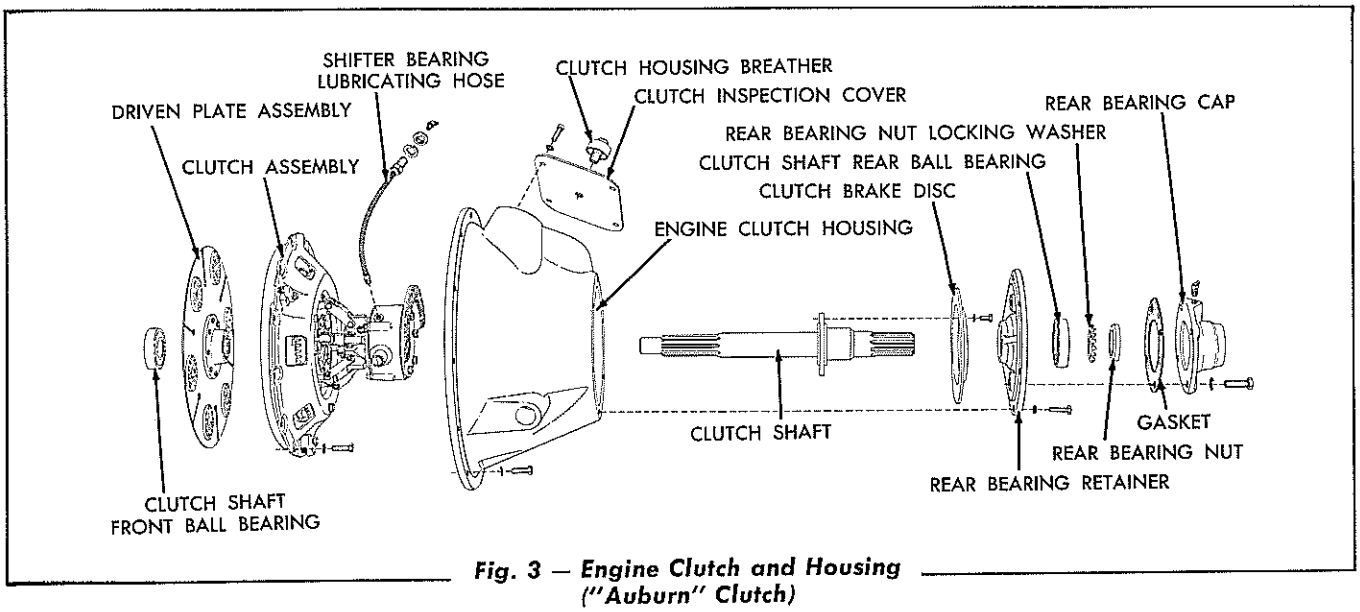

Fig. 3 — Engine Clutch and Housing ("Auburn" Clutch)

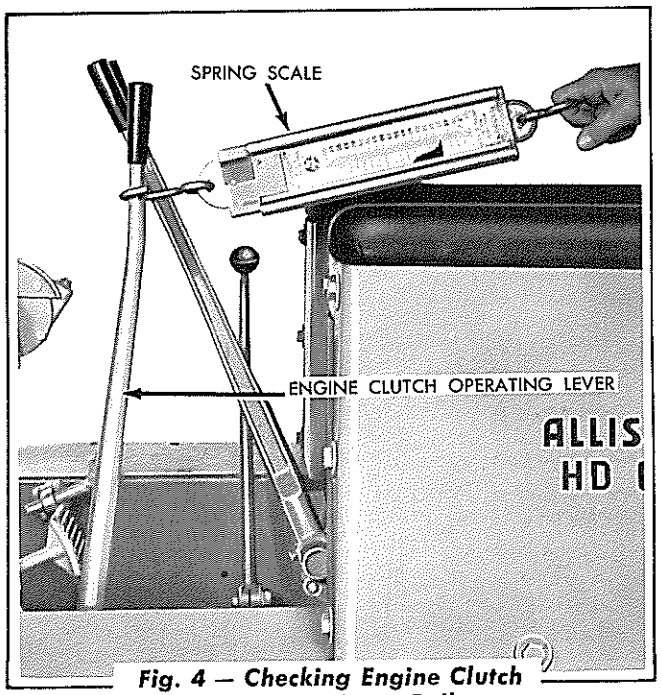

Fig. 4 — Checking Engine Clutch Operating Lever Pull

ARE THE RESULT OF IMPROPER MAINTENANCE, IT IS VERY IMPORTANT THAT THE CLUTCH AND CLUTCH BRAKE ARE KEPT PROPERLY ADJUSTED AT ALL TIMES AND THAT THE CLUTCH COMPONENTS ARE LUBRICATED AS RECOMMENDED. DO NOT SLIP THE CLUTCH EXCESSIVELY WHEN ENGAGING.

C. Engine Clutch Adjustment

Attach a spring scale to the engine clutch operating lever (attach scale just below the hexagon-nut on the lever hand grip as shown in Fig. 4) and weigh the pull required to engage the clutch. When the clutch is properly adjusted, a pull of 25 to 30 pounds (30 pounds maximum) is required on the engine clutch operating lever to engage the clutch (engine stopped). The clutch should engage with a distinct over-center snap.

D. To Adjust the "Rockford" Engine Clutch

1. Remove the floor plate. Remove the clutch inspection cover from the upper right side of the engine clutch housing.

2. With the clutch disengaged, crank the engine with the starter until the clutch adjusting lock (Figs. 1 and 5) may be reached through the inspection hole.

3. Disengage the clutch adjusting lock from the slot in the clutch back plate.

4. Using a hammer and punch, or a suitable pry bar, drive or pry against one of the adjusting ring lugs and turn the adjusting ring clockwise as necessary to tighten the clutch. Turning the adjusting ring 1 or 2 notches is generally sufficient.

5. Attach a spring scale to the clutch operating lever (attach scale just below hand grip) and weigh the pull required to engage the clutch. When the clutch is properly adjusted, a pull of 25 to 30 pounds (30 pounds maximum) is required on the clutch operating lever to engage the clutch (en-

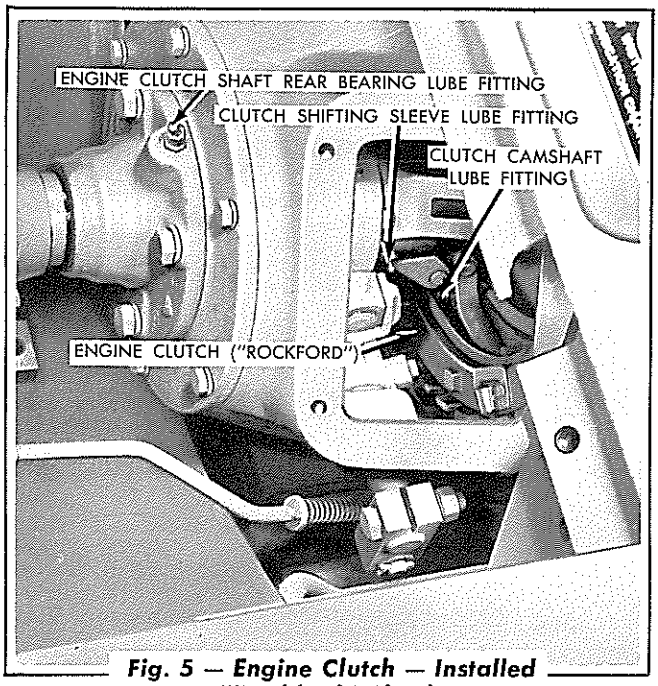

Fig. 5 — Engine Clutch — Installed ("Rockford" Clutch)

gine stopped).

6. Engage the clutch adjusting lock with the nearest slot in the clutch back plate.

7. After each adjustment of the engine clutch, inspect the clutch brake plate facing and replace the facing when badly worn.

8. Clean and install the clutch inspection cover and tighten the capscrews securely. Install the floor plate.

E. To Adjust the "AUBURN" Engine Clutch

1. Remove the floor plate. Remove the clutch inspection cover from the upper right side of the engine clutch housing.

2. Disengage the clutch and crank the engine with the starter until the clutch adjusting ring locking screw (Figs. 1 and 6) may be reached through the inspection hole. NOTE: *The adjusting ring locking screw is the one having a hexagon-head.*

3. Loosen the adjusting ring locking screw (Fig. 6) just enough so that the clutch adjusting ring can be turned. CAUTION: *Do not remove the clutch adjusting ring locking screw. Do not loosen the two slotted head screws.*

4. Tighten the clutch by turning the "notched" clutch adjusting ring clockwise with a screwdriver, or a short pry bar, until the proper adjustment is obtained. Moving the adjusting ring 1 or 2 notches is generally sufficient. Tighten the clutch adjusting ring locking screw securely.

5. Attach a spring scale to the clutch operating lever (just below lever hand grip) and weigh the pull required to engage the clutch. When the clutch is properly adjusted, a pull of 25 to 30 pounds (30 pounds maximum) is required on the operating lever to engage the clutch (engine stopped).

6. Inspect the clutch brake plate facing and replace the facing when badly worn.

7. Clean and install the clutch inspection cover and tighten the capscrews securely. Install the floor plate.

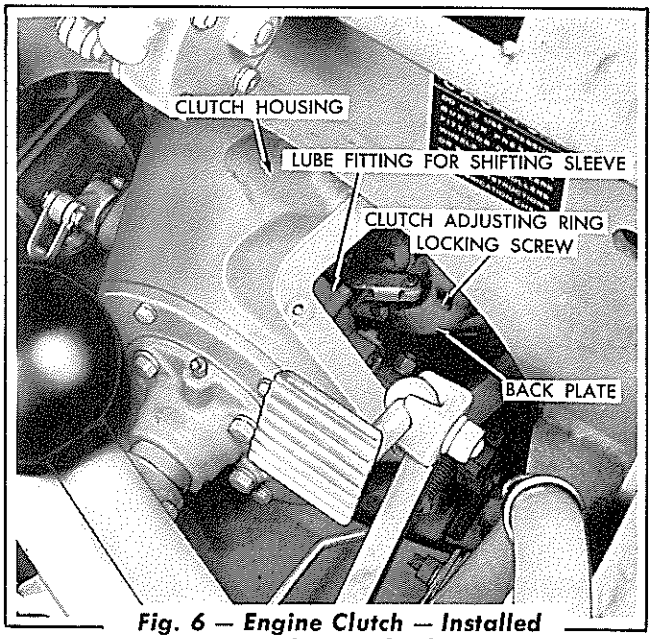

Fig. 6 — Engine Clutch — Installed ("Auburn" Clutch)

F. Engine Clutch Linkage Adjustment

The engine clutch operating rod should be adjusted to provide a clearance of approximately 1" between the front of the engine clutch operating lever (lever in its disengaged position) and the floor plate supporting bracket.

Adjust the engine clutch operating rod by turning

the operating rod yoke, (lengthening or shortening the rod as necessary) to obtain 1" clearance between the front of the engine clutch operating lever and the floor plate supporting bracket.

G. Washing Engine Clutch

Oil leaks or over-lubrication of the clutch components may cause the clutch facings to become coated with oil or grease. This will cause the clutch to slip even though it is properly adjusted. In this event, the clutch must be washed.

Two drain holes are provided in the bottom of the engine flywheel housing; install two ¼" drain plugs (furnished with tractor) in the drain holes and remove the clutch inspection cover. Pour about 1 gallon of cleaning solvent into the clutch housing. Reinstall the clutch inspection cover and operate the engine at low idle speed for approximately 5 minutes with the clutch disengaged. Stop the engine, remove the drain plugs to drain the solvent, and if the solvent is excessively "oily," repeat the washing process using clean solvent.

IMPORTANT: *THOROUGHLY LUBRICATE THE CLUTCH SHIFTING BEARING, SHIFTING SLEEVE, AND IF THE TRACTOR IS EQUIPPED WITH A "ROCKFORD" CLUTCH, LUBRICATE THE CLUTCH CAMS (3 POINTS) AFTER THE CLUTCH HAS BEEN WASHED AS THE LUBRICANT MAY HAVE WASHED OUT OF THESE COMPONENTS DURING THE WASHING PROCESS.*

Operate the tractor with a light load in low gear for a short period until the clutch dries, to prevent slippage due to the presence of solvent on the clutch parts.

H. Engine Clutch Removal

The engine clutch and engine clutch housing can be removed from the tractor without removing the cowl as follows:

1. Remove the gear shift lever and the floor plate.

2. Remove the universal joint (refer to "DRIVE SHAFT UNIVERSAL JOINT," Section X).

3. Remove the six capscrews attaching the clutch shaft rear bearing retainer to the clutch housing. Remove the clutch shaft and clutch shaft rear bearing retainer as an assembly as shown in Fig. 7.

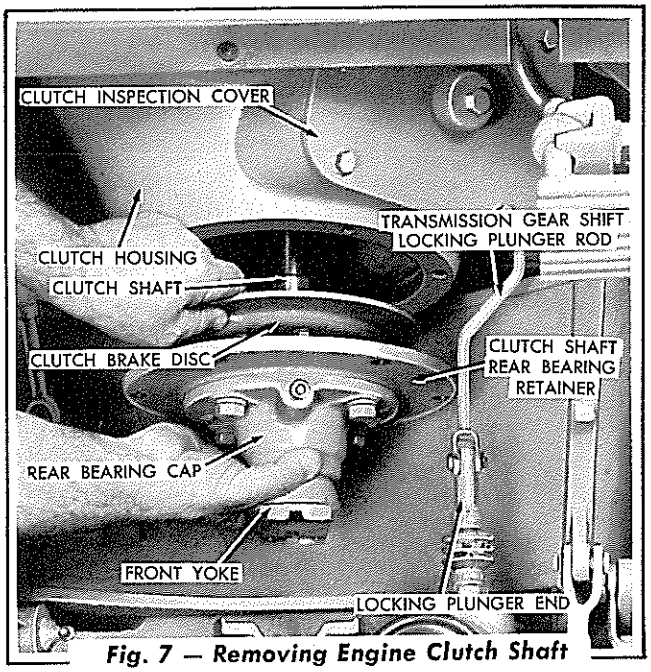

Fig. 7 — Removing Engine Clutch Shaft

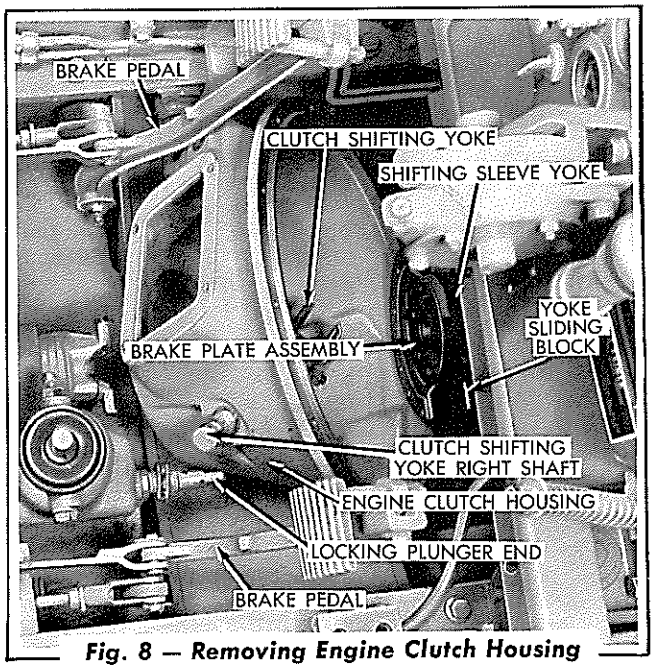

Fig. 8 — Removing Engine Clutch Housing

4. Remove the clutch inspection cover from the clutch housing. Remove the jam nut from the clutch shifter bearing lubricating hose. Push the upper end of the lubricating hose into the clutch housing.

5. Disconnect the front yoke of the clutch operating rod from the clutch control lever by removing the yoke pin. Disconnect the

transmission gear shift locking plunger rod from the locking plunger end (Fig. 7) by removing the yoke pin. Remove the gear shift lock lever from the clutch shifting yoke right shaft.

6. Remove the capscrews and lockwashers attaching the engine clutch housing to the flywheel housing and remove the engine clutch housing. As the clutch housing is removed, the clutch shifting yoke will disengage from the shifting yoke sliding blocks and will be removed with the clutch housing.

7. Remove the capscrews attaching the engine clutch assembly to the flywheel and remove the engine clutch. The clutch driven plate can now be removed. CAUTION: *When removing the clutch assembly, use care and do not drop or damage the clutch driven plate.*

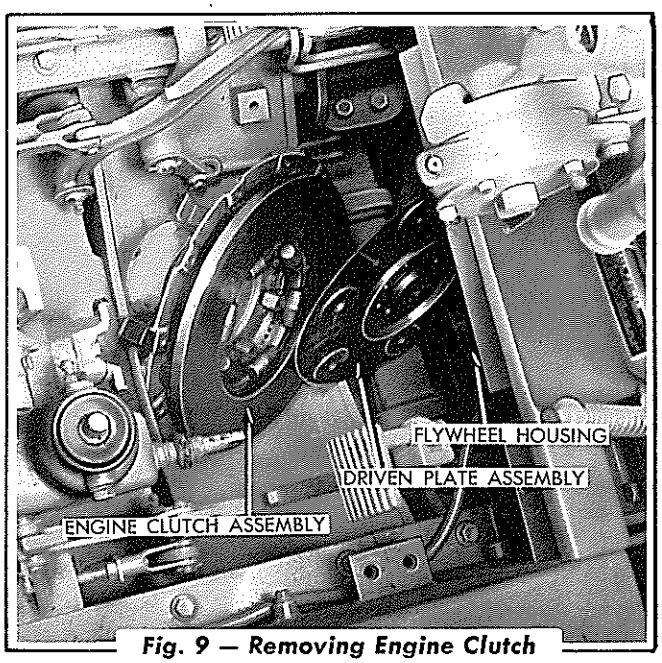

Fig. 9 — Removing Engine Clutch

I. Disassembly of Engine Clutch

1. "ROCKFORD" Clutch

Refer to Fig. 12 and disassemble the clutch as follows:

a. Place the engine clutch assembly on a clean work bench, with the pressure plate side of the clutch downward.

b. Remove the capscrews attaching the clutch brake plate to the shifting sleeve bearing carrier and remove the brake plate.

c. Remove the three connecting link pins attaching the shifting sleeve assembly to the connecting links and remove the shifting sleeve and shifting sleeve bearing carrier as a unit.

d. Remove the shifting sleeve bearing retaining ring from the shifting sleeve and press the shifting sleeve out of the bearing. Remove the bearing retaining plate from the bearing carrier; remove the bearing.

e. Unlock the clutch adjusting ring and turn the adjusting ring out of the back plate. Remove the adjusting ring plate from the back plate.

f. Remove the nuts from the three retracting spring screws and remove the retracting springs. Remove the back plate from the pressure plate.

g. Remove the connecting link pins from the camshafts and connecting links and remove the connecting links.

h. Remove the screws attaching the cam blocks to the pressure plate and remove the cam blocks and the camshafts. Remove the three retracting spring screws.

i. Remove the rear bearing cap from the clutch shaft rear bearing retainer (Fig. 3). Unlock and remove the rear bearing nut and locking washer. Drive or press the clutch shaft out of the rear ball bearing and rear bearing retainer.

j. Remove the clutch shaft rear ball bearing from the rear bearing retainer.

2. "AUBURN" Clutch

Refer to Fig. 13 and disassemble the clutch as follows:

a. Place the engine clutch on a clean work bench, with the pressure plate side of the clutch downward. Remove

the capscrews holding the pressure plate retracting springs and remove the retracting spring retainers and retracting springs. Remove the pressure plate and pressure ring as a unit.

b. Remove the capscrews, lockwashers, and guiding spacers attaching the pressure ring to the pressure plate. Remove the pressure ring from the pressure plate. Remove the pressure springs and the pressure spring cups.

c. Remove the pins connecting the actuating lever links to the actuating levers.

d. Remove the adjusting ring locking screw and the adjusting ring locking plate. Remove the two adjusting ring retaining screws and the retaining screw spacers, then remove the adjusting ring from the back plate.

e. Remove the pins attaching the actuating lever links to the shifting sleeve.

f. Remove the capscrews attaching the grease shield and the clutch brake plate to the shifting sleeve yoke and remove the shield and the brake plate.

g. Remove the capscrews attaching the bearing retainer to the front of the shifting sleeve yoke. Press the shifting sleeve and the shifting sleeve ball bearing out of the shifting sleeve yoke.

h. Remove the shifting sleeve bearing locking ring from the shifting sleeve and remove the bearing, bearing retainer, and the sealing ring (felt).

i. Remove the rear bearing cap from the clutch shaft rear bearing retainer (Fig. 3). Unlock and remove the rear bearing nut and locking washer. Drive or press the clutch shaft out of the rear ball bearing and rear bearing retainer.

j. Remove the clutch shaft rear ball bearing from the rear bearing retainer.

J. Engine Clutch Inspection and Repair

1. Thoroughly wash all clutch components and inspect for worn or damaged parts.

2. Inspect the friction discs of the driven plate assembly for wear and looseness. The specified thickness (including facings) of the driven plate for the "AUBURN" clutch when new is .451" to .475"; the specified thickness of the driven plate for the "ROCKFORD" clutch when new is .448" to .478". Measure the thickness of the clutch driven plate being inspected and if it is worn to a thickness of .326" or less, a new driven plate assembly must be installed. Check the splines in the hub of the driven plate for wear. NOTE: *The above driven plates are interchangeable and may be used with either clutch.*

3. Inspect the face of the pressure plate for roughness, heat cracks, and warpage. If the face of the pressure plate is in a rough condition, it may be machined smooth; replace the pressure plate if more than 1/16" stock must be removed.

4. Inspect the actuating lever link pins and actuating levers for wear. Inspect the link pin holes in the clutch shifting sleeve, actuating lever links, and the actuating levers for wear or elongation and replace if necessary.

5. On the "ROCKFORD" clutch, inspect the camshafts and the rollers in the camshafts for wear and make certain that the rollers are free to rotate. Also check to see that the lubricant when applied to the lubricating fitting in each camshaft emerges from around the camshaft rollers. Inspect the six camshaft blocks, attached to the back of the pressure plate, for wear and replace if necessary. NOTE: *If it is necessary to replace any of the camshaft blocks, it is recommended that all six blocks be replaced at the same time.*

6. Inspect the bushings in the shifting sleeve for wear and roughness and replace the

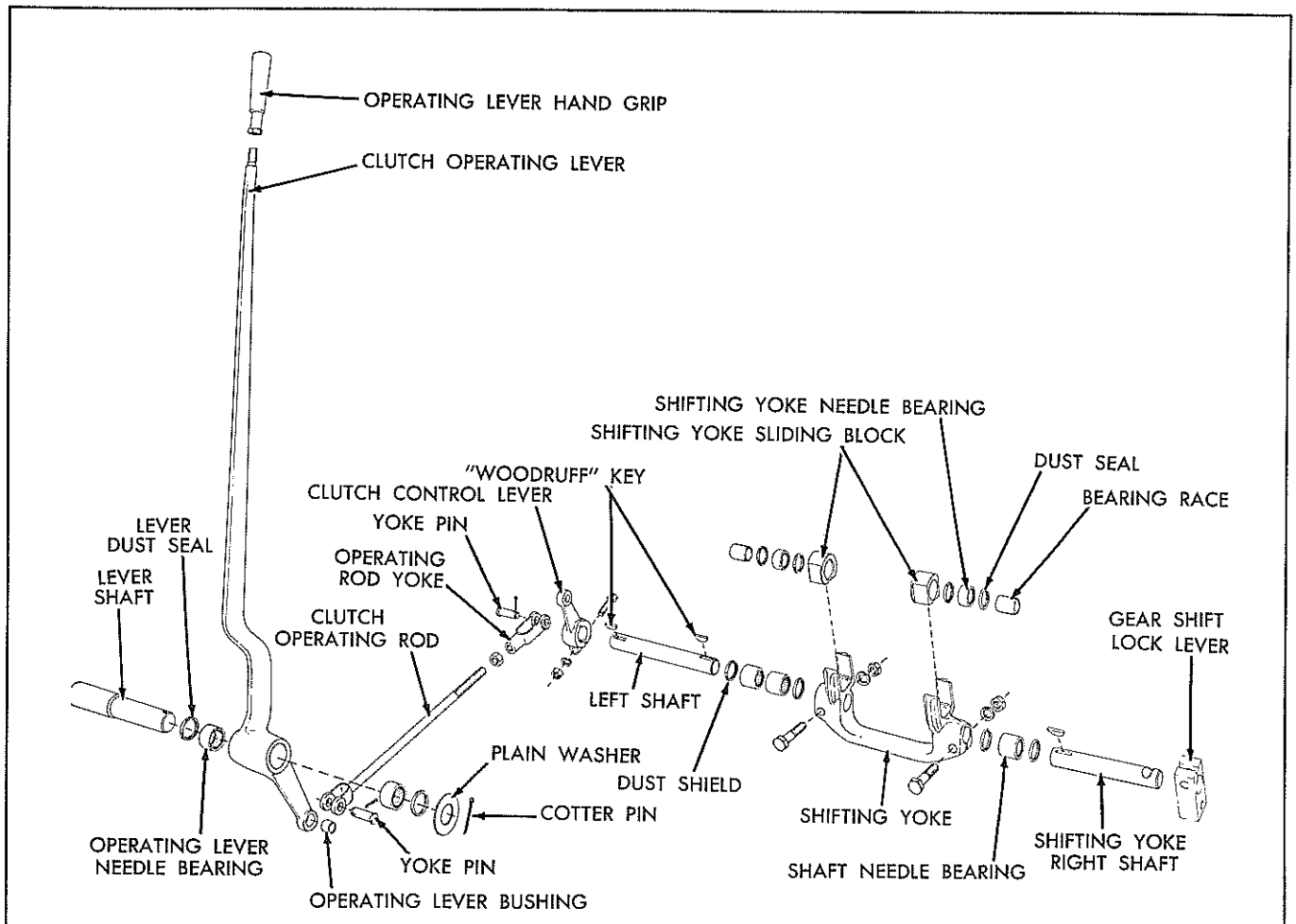

Fig. 10 — Engine Clutch Shifting Yoke Details

sleeve if necessary. NOTE: *Replaceable steel bushings are provided in the link pin holes in the shifting sleeve for the "AUBURN" clutch.*

7. Check the back plate for cracks and replace if necessary.

8. Inspect the shifting sleeve ball bearing for wear and roughness. Replace the bearing if it is worn excessively or if it does not turn smoothly when rotated by hand.

9. Remove the two shifting yoke sliding blocks. Inspect the shifting yoke needle bearings, needle bearing races, dust seals, and the shifting yoke for wear and damage and replace the necessary parts.

10. Inspect all springs for breakage and replace if necessary. *NOTE: The free length of the pressure springs for the "AUBURN" clutch is approximately 1.074" when new.*

11. Inspect the face of the flywheel and make certain the surface is flat and smooth. If the face is scored or "heat checked," the flywheel may be machined smooth; replace the flywheel if for than 1/16" stock must be removed.

12. Inspect the clutch shaft front ball bearing (pilot bearing) for wear and lubrication. If the bearing shows signs of improper lubrication, install a new oiling wick assembly in position in the rear of the crankshaft (refer to "CRANKSHAFT, CRANKSHAFT PULLEY, FLYWHEEL, AND MAIN BEARINGS," Section VIII).

13. Inspect the clutch shaft rear ball bearing for wear and roughness. Replace the bearing if it is worn excessively or if it does not turn smoothly when rotated by hand.

14. Inspect the clutch shaft. If the shaft is excessively worn at the location of the clutch shifting sleeve, or if the splines of the shaft show excessive wear, the shaft must be replaced.

15. Inspect the lubricating hose for the clutch shifting sleeve bearing and replace the hose if necessary.

16. Inspect the clutch brake assembly. If the brake plate facing is worn to the extent that the rivets may score the clutch brake disc, the facing must be replaced. Inspect the clutch brake disc for wear and scoring. Slight scoring or uneven wear can be removed by machining, however, if the disc is worn or scored excessively, replacement of the disc is necessary.

K. Assembly of Engine Clutch

1. "ROCKFORD" Clutch

Refer to Figs. 1 and 12 and assemble the engine clutch by direct reversal of the disassembly procedure.

IMPORTANT: *When installing the pins to connect the connecting links to the clutch camshafts and the shifting sleeve, install the pins so that the heads of the pins are to the left when the pins are located at the top and viewed from the rear of the clutch.*

When installing the three retracting spring nuts, turn the nuts onto the retracting spring screws until the threaded ends of the screws protrude approximately 1/32". Lubricate the clutch camshafts, clutch shifting sleeve, shifting sleeve ball bearing, and clutch shaft rear bearing thoroughly when assembly of clutch is completed. Lubricate the connecting link pins sparingly.

2. "AUBURN" Clutch

Refer to Figs. 1 and 13 and assemble the engine clutch by direct reversal of the disassembly procedure.

IMPORTANT:

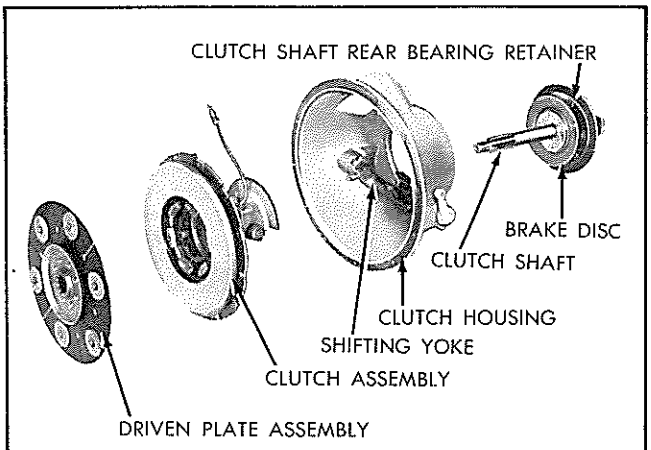

Fig. 11 — Engine Clutch Sub-Assemblies in Relative Position

a. When assembling the pressure ring to the pressure plate, position the pressure ring so that the hole marked "X" is aligned with the tapped hole in the pressure plate which is on the same center line as one of the driving lugs. This line-up assures that the actuating levers will be located at the lower end of the cam rails on the pressure ring, allowing maximum adjustment.

b. When installing the pins used to connect the actuating levers to the adjusting ring, make certain that the pins are installed so that the heads are to the right when the pins are located at the top of the clutch and viewed from the rear. When installing the pins used to connect the actuating lever links, make certain that the pins are installed so that the heads are to the left when the pins are located at the top of the clutch and viewed from the rear.

c. When installing the shifting sleeve ball bearing in position in the shifting sleeve yoke, make certain that the shielded side of the bearing is toward the rear. Lubricate the clutch linkage sparingly when assembling the clutch.

L. Inspection and Installation of Clutch Shifting Yoke

1. With the engine clutch removed, place each shifting yoke sliding block in position in the clutch shifting yoke. If there is exces-

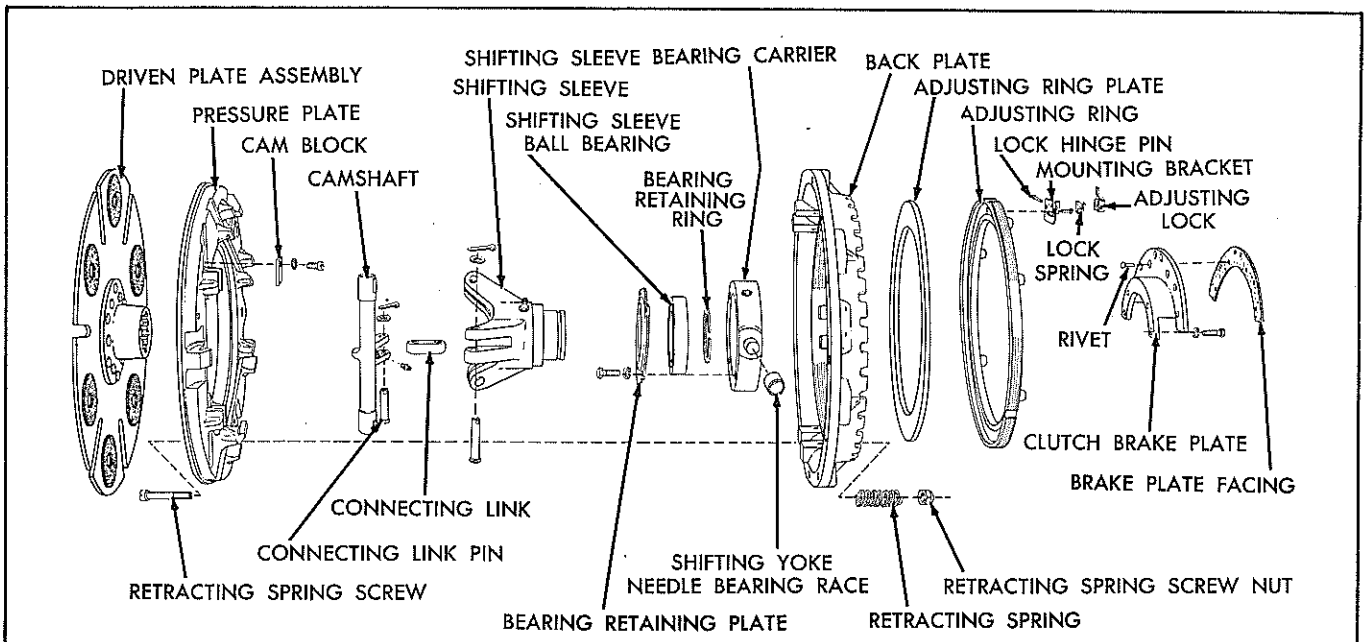

Fig. 12 — Engine Clutch Details "Rockford"

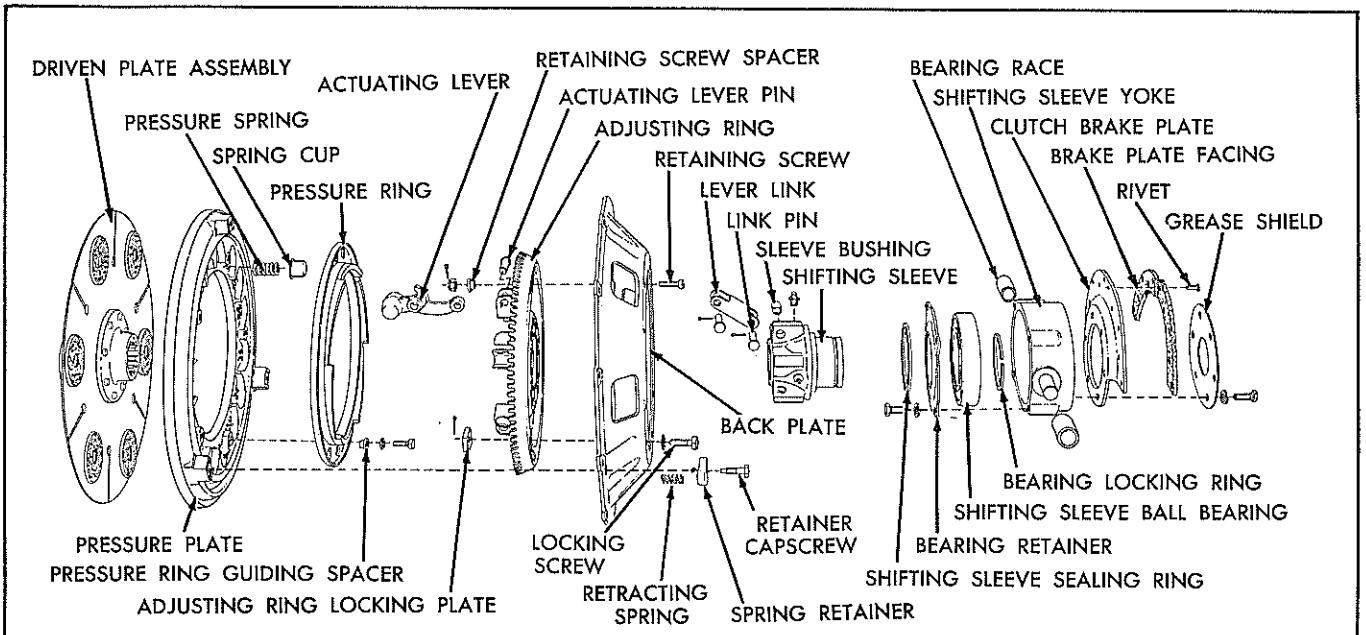

Fig. 13 — Engine Clutch Details "Auburn"

sive looseness between the parts due to wear, replace the yoke and the shifting yoke sliding blocks.

2. Refer to Fig. 10 and replace the clutch shifting yoke as follows:

   a. Remove the capscrew, nut, and lockwasher clamping the clutch control lever to the clutch shifting yoke left shaft. Spread the slot in the lever, using a broad faced chisel or similar tool, and remove the lever and "WOODRUFF" key from the shaft.

   b. Remove the two capscrews, nuts, and lockwashers clamping the clutch shifting yoke to the shifting yoke shafts and spread the slots in the shifting yoke to free the yoke on the shafts.

   c. Drive the shifting yoke shafts in (toward the center of the shifting yoke) until the "WOODRUFF" key in the inner end of each shaft can be removed. Remove the "WOODRUFF" keys.

d. Pull or drive the clutch shifting yoke shafts out of the shifting yoke (toward the outside) and remove the shifting yoke shafts and shifting yoke from the clutch housing.

e. Inspect the shifting yoke shaft needle bearings (two on the left shaft and one on the right) and dust seals (two on each shaft) in the engine clutch housing and replace any worn or damaged parts.

f. Pack the shifting yoke shaft needle bearings with grease. Install the longer shaft into position in the left side of the clutch housing. Install the shorter shaft into position in the right side of the clutch housing.

g. Hold the clutch shifting yoke in position in the clutch housing and drive the shifting yoke shafts through the shifting yoke far enough so that a "WOODRUFF" key can be installed in the inner end of each shaft. Install the "WOODRUFF" keys.

h. Drive the clutch shifting yoke shafts back (toward the outside) until the ends of the shafts are flush with the inner faces of the clutch shifting yoke. Install the capscrews, lockwashers, and nuts used to clamp the shifting yoke to each shaft and tighten the nuts securely.

i. Install the "WOODRUFF" key in the outer end of the clutch shifting yoke left shaft and position the clutch control lever on the shaft. Install the capscrew, lockwasher, and nut used to clamp the clutch control lever to the shaft and tighten the nut securely.

M. Installation of Engine Clutch

1. Make certain that the face of the flywheel is clean. Place the clutch driven plate assembly in position against the flywheel, making certain that the oil slinger faces the flywheel.

2. Place the engine clutch assembly in position on the flywheel. Start all the attaching capscrews, with lockwashers, and tighten the capscrews evenly so that the clutch back plate enters the recess in the flywheel. NOTE: *The "ROCKFORD" engine clutch is attached to the flywheel with ⅜" NC x 1¼" capscrews. The "AUBURN" engine clutch is attached to the flywheel with ⅜" NC x 1" capscrews. Make certain the proper length capscrews are used when installing the engine clutch.*

3. Install two ⅜" x 6" guide studs in the flywheel housing to align and to hold the clutch housing when the clutch housing is being installed. Remove the clutch brake plate assembly from the clutch assembly before installing the clutch housing; with the clutch brake plate assembly removed, the shifting yoke sliding blocks can be lined up and started into position in the shifting yoke more easily.

4. Pack the needle bearings in the shifting yoke sliding blocks with grease and place the blocks in position on the shifting sleeve yoke making certain the bearing dust seals are in good condition and properly installed. Start the engine clutch housing in position on the guide studs, start the sliding blocks in position in the shifting yoke, then push the clutch housing forward against the flywheel housing. Install and tighten the clutch housing attaching capscrews. Reinstall the clutch brake plate assembly in position on the clutch assembly.

5. Turn the clutch adjusting ring counterclockwise as necessary so that the clutch driven plate is free. Install the clutch shaft assembly (complete with its components) in the clutch housing and the clutch, inserting the front end of the clutch shaft through the shifting sleeve until the front end of the shaft engages in the splines of the driven plate hub. Tap lightly on the rear end of the shaft to drive the shaft into position in the clutch shaft front bearing (pilot bearing). Position the clutch shaft rear bearing retainer so that the lubricating fitting is to

the top, then install the attaching capscrews to secure the rear bearing retainer to the clutch housing.

6. Reach through the clutch inspection cover opening in the clutch housing and insert the upper end of the clutch shifter bearing lubricating hose into the hole in the clutch housing. Install the jam nut on the end of the lubricating hose to hold the hose in position.

7. Install the gear shift lock lever in position on the outer end of the clutch shifting yoke right shaft and secure the lever to the shaft with a capscrew, lockwasher, and nut. Install the yoke pin to connect the transmission gear shift locking plunger rod to the locking plunger end (Fig. 7). Connect the front yoke of the clutch operating rod to the clutch control lever, located on the outer end of the clutch shifting yoke left shaft.

8. Install the universal joint (refer to "DRIVE SHAFT UNIVERSAL JOINT," Section X).

9. Adjust the engine clutch (refer to "ENGINE CLUTCH ADJUSTMENT" in this Section).

10. Make certain that the clutch and clutch shaft components are lubricated thoroughly before operating the tractor.

11. Install the clutch inspection cover, floor plate, and gear shift lever.

2. CLUTCH BRAKE

A. Description

The clutch brake is designed to stop the rotation of the engine clutch shaft when the engine clutch is disengaged; stopping the rotation of the clutch shaft permits easier shifting of the transmission gears. The clutch brake is applied by pushing forward on the engine clutch operating lever after the clutch has been disengaged.

The clutch brake plate is attached to the rear of the shifting sleeve yoke. The brake plate has a friction material facing that contacts the clutch brake disc (attached to the flange on the clutch shaft) when the brake is applied. The brake assembly is not adjustable.

B. Service Inspection and Repair

Keep the engine clutch operating rod properly adjusted to provide a clearance of 1" between the front of the engine clutch operating lever (lever in its disengaged position) and the floor plate supporting bracket. If the rod is not adjusted properly, the front of the clutch operating lever, when in the disengaged position, will strike the floor plate supporting bracket and will not allow the clutch brake plate on the shifting sleeve yoke to move back far enough to contact the clutch brake disc on the clutch shaft.

In the event the clutch brake does not function properly when shifting gears, remove the clutch inspection cover from the clutch housing and inspect the clutch brake assembly. Whenever the facing on the clutch brake plate is worn down to the rivets, the facing must be replaced. Inspect the clutch brake disc for wear and scoring; slight scoring or uneven wear can be removed by machining, however, if the disc is worn or scored excessively, it must be replaced.

C. Removal of Engine Clutch Brake Plate Assembly

1. Remove the gear shift lever and the floor plate.

2. Remove the universal joint (refer to "DRIVE SHAFT UNIVERSAL JOINT," Section X).

3. Engage the engine clutch. Remove the capscrews attaching the clutch shaft rear bearing retainer to the clutch housing. Pull back on the clutch shaft (complete with its components and remove the assembly from the housing.

4. Remove the capscrews attaching the clutch brake plate assembly to the engine clutch assembly and remove the plate assembly.

D. Installation of Engine Clutch Brake Plate Assembly

The clutch brake plate assembly may be installed by a direct reversal of the removal procedure. When installing the clutch shaft assembly and universal joint assembly, refer to "INSTALLATION OF ENGINE CLUTCH" in this Section. After installation of the clutch brake plate assembly is complete, adjust the engine clutch (refer to "ENGINE CLUTCH ADJUSTMENT" in this Section).

SECTION X — TRANSMISSION AND BEVEL GEAR

1. GENERAL DESCRIPTION

Power from the engine is transmitted through the engine clutch and the universal joint assembly to the transmission. From the transmission, power is transmitted to the bevel gear, and from the bevel gear through the steering clutches, to the final drives and the track sprockets.

The transmission case is attached to the front of the steering clutch and final drive housing with capscrews. The transmission case is piloted into the steering clutch and final drive housing by a boss, located on the rear of the transmission case. This boss also serves as a bearing retainer for the bevel pinion shaft rear ball bearing.

A fixed gear reduction is made between the bevel pinion shaft and the bevel gear to the final drive gears; further reduction for power or speed change is obtained by shifting the transmission gears.

2. TRANSMISSION

A. Description

The transmission is, in effect, a speed reduction unit to provide the proper ratio for the required speed or power for operation of the tractor. The transmission in the Standard Model HD-6A and HD-6B Tractors provides one reverse and five forward speeds. The transmission in the Model HD-6G Tractor (optional for the HD-6A and HD-6B) provides two reverse and four forward speeds. The speed changes of the transmission are obtained by the use of sliding gears on the bevel pinion shaft. Reversal of direction is accomplished by meshing the low speed and reverse gear on the bevel pinion shaft with the reverse gear on the reverse gear shaft.

The sliding gears on the bevel pinion shaft are shifted into mesh by shifting forks actuated by the gear shift lever. They are located for proper mesh by detent notches in the gear shifting shafts and detent balls (steel balls) in the transmission case.

The sliding gears are locked in mesh by a locking mechanism consisting of a plunger attached to, and actuated by a lever located on the engine clutch shifting yoke shaft. The gears are locked in mesh when the engine clutch is fully engaged and cannot be shifted out of mesh until the engine clutch is disengaged.

The transmission top shaft is supported by a ball bearing at the front end and a roller bearing at the rear end. The front end of the bevel pinion shaft is supported by a roller bearing, located inside the transmission input shaft, and is supported at the rear end by a double row ball bearing.

The transmission input shaft is supported by two ball bearings, one located in the gear shift lever housing attached to the front of the transmission case, and the other retained in the rear bore of the transmission case. The transmission input shaft is connected to the engine clutch shaft by a universal joint assembly.

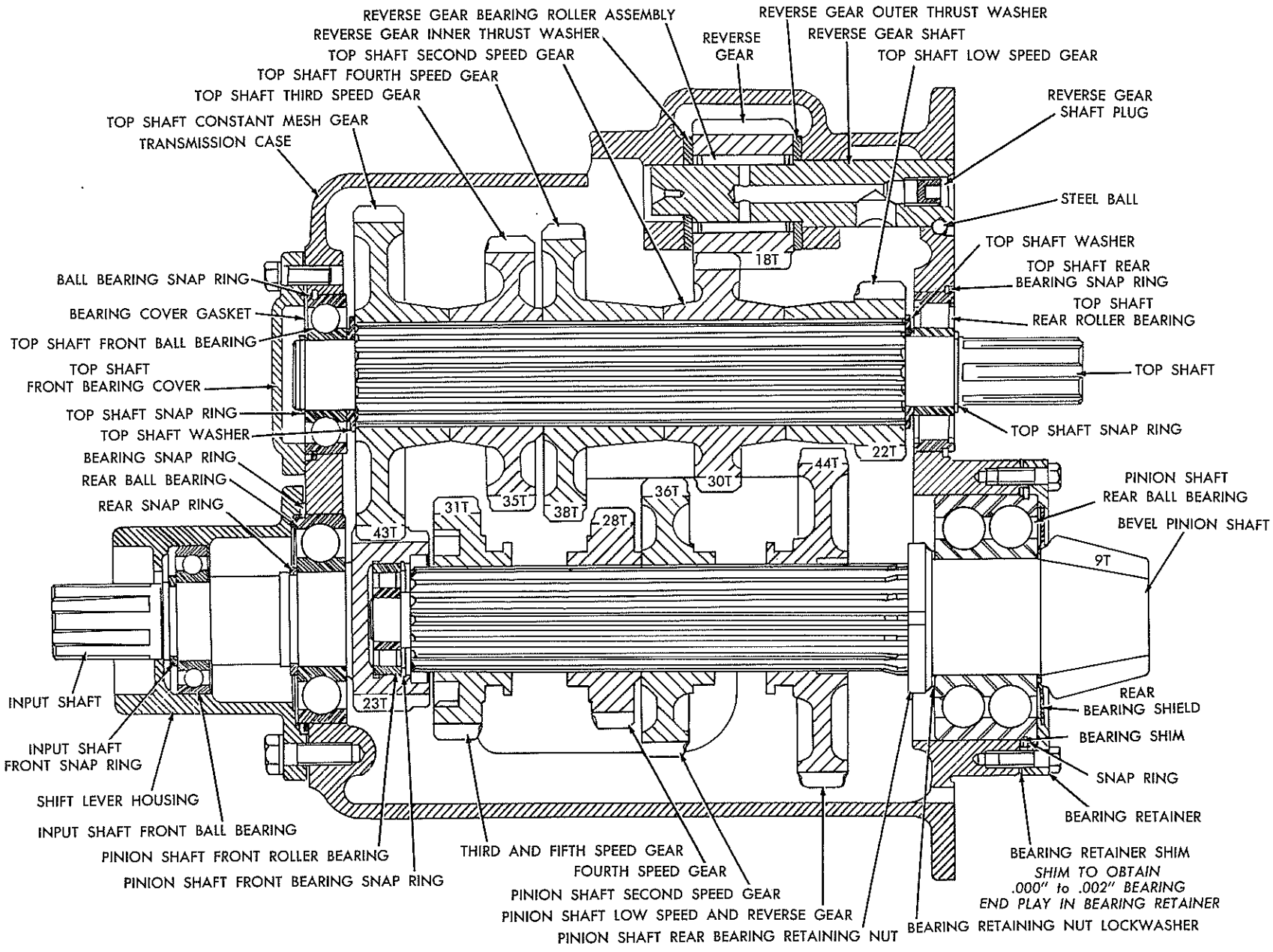

Fig. 1 — Transmission — Sectional View
(Standard — One Speed Reverse)

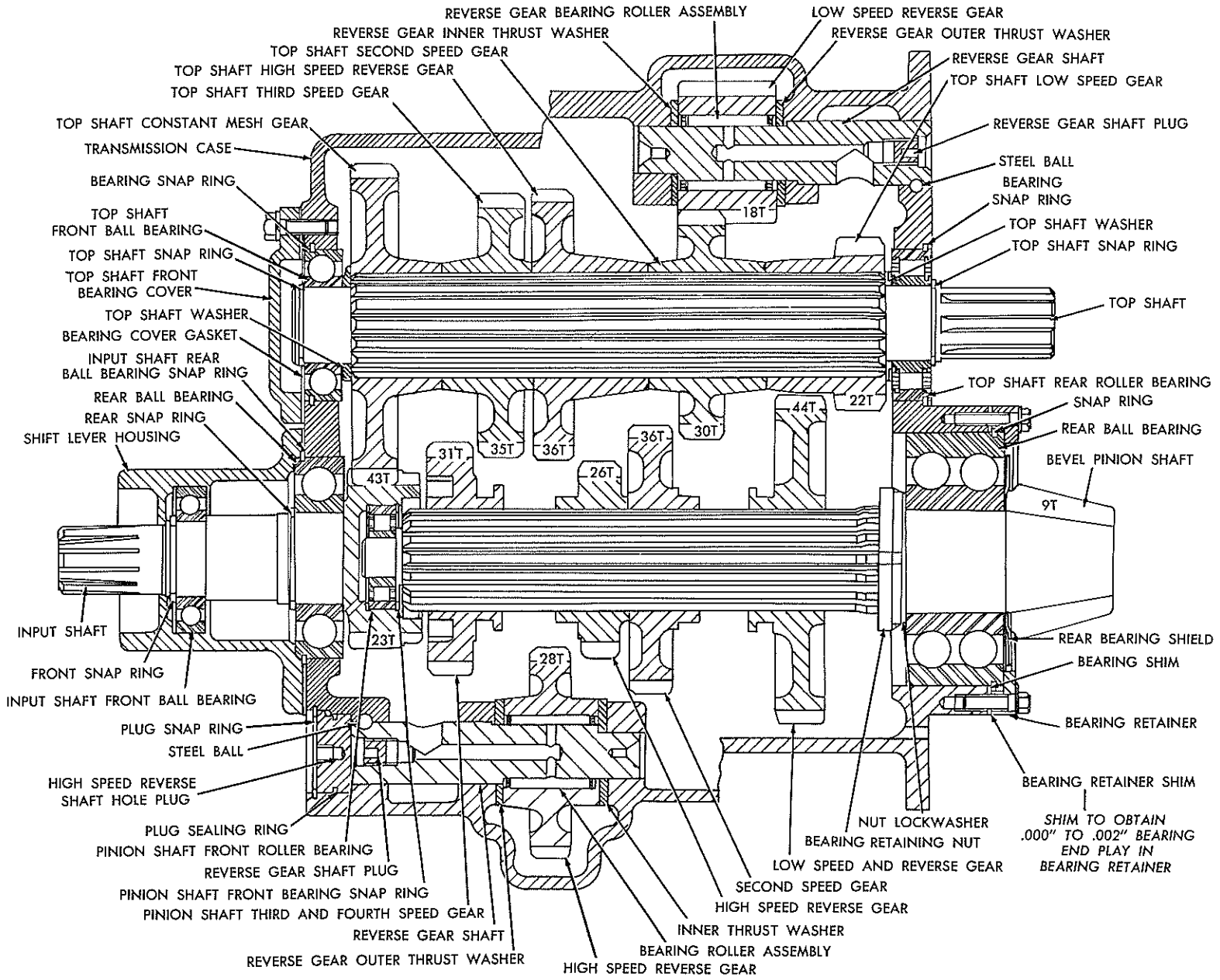

Fig. 2 — Transmission — Sectional View (Optional Two Speed Reverse — Standard on HD-6G Only)

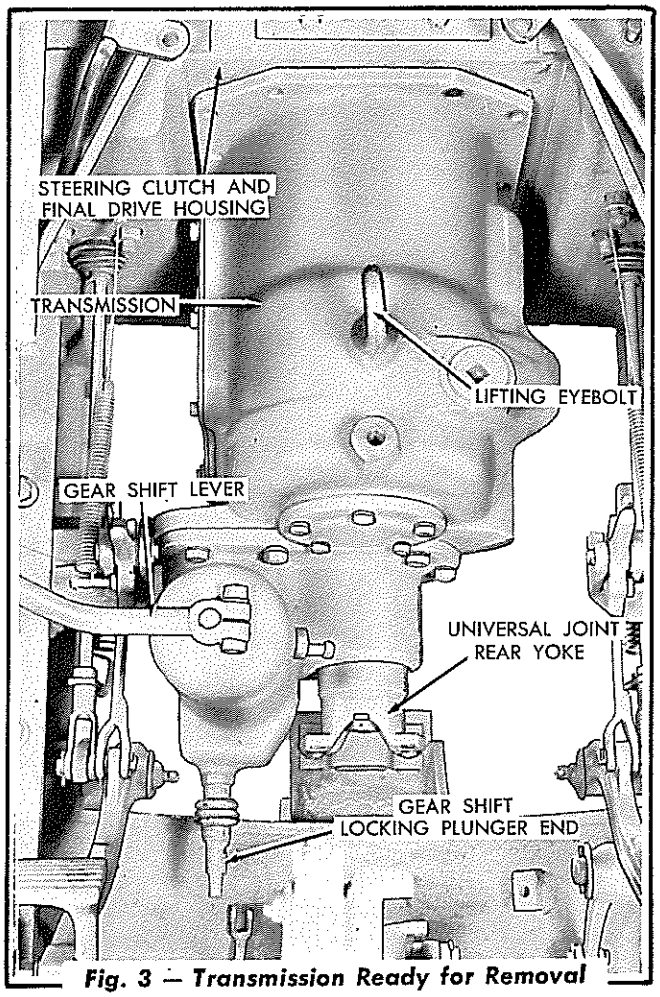

Fig. 3 — Transmission Ready for Removal

B. Transmission Removal

1. Remove the oil drain plug from the bottom of the bevel gear compartment of the steering clutch and final drive housing and allow the oil to drain.

2. Remove the floor plates, seat cushion, back cushion, and seat cushion support. Remove the main frame closure plate located below the transmission.

3. Remove the yoke pins connecting the steering clutch control rod yokes to the steering clutch operating levers, then move the rods over to each side as far as possible.

4. Remove the capscrews attaching the steering clutch operating lever bracket to the top of the transmission case and remove the bracket and levers as an assembly.

5. Unlock and remove the capscrews and locks attaching the front and rear yokes to the universal joint assembly and remove the universal joint.

6. Remove the yoke pin connecting the gear

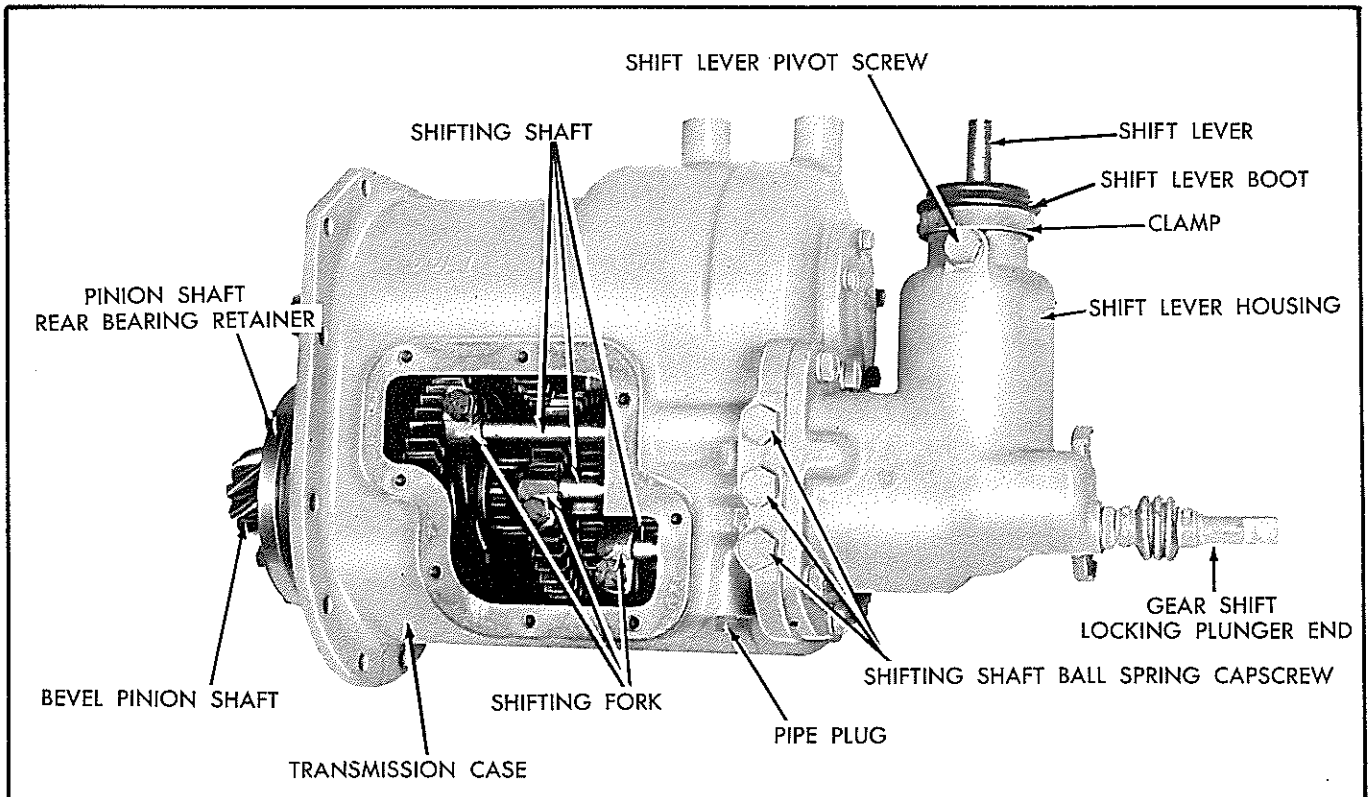

Fig. 4 — Transmission Assembly — Side Cover Removed

shift locking plunger rod to the locking plunger end.

7. Install a ⅝" NC eyebolt in the tapped hole of the transmission case as shown in Fig. 3 and remove the capscrews attaching the transmission case to the steering clutch and final drive housing.

8. Using a suitable hoist, move the transmission forward until the rear boss of the transmission case is free of its bore in the steering clutch and final drive housing, then raise and remove the transmission. NOTE: *Keep the transmission in alignment (straight), when removing, to prevent the boss of the transmission case from binding in the bore of the steering clutch and final drive housing.*

C. Transmission Disassembly

1. Thoroughly clean the transmission case before disassembly.

2. Place the transmission assembly on a clean work bench (top side up). Remove the transmission case side cover and gasket.

3. Remove the capscrew clamping the gear shift lever to the shift lever and remove the gear shift lever.

4. Loosen the clamp holding the shift lever boot in position on the shift lever housing and remove the clamp and boot.

5. Remove the two shift lever pivot screws and lift the shift lever out of the shift lever housing.

6. Remove the locking wire, universal joint yoke retaining capscrew, washer, and seal from the transmission input shaft.

7. Remove the capscrews attaching the shift lever housing to the transmission case. Use a slide hammer puller, with an adapter having ⅝" NF threads, inserted in the end of the input shaft as shown in Fig. 5, and pull the shift lever housing assembly from the transmission case. Remove the universal joint rear yoke from the input shaft.

8. Press or drive on the front end of the input shaft to remove the assembly from the shift lever housing. NOTE: *The input shaft rear seal ring, seal spring assembly, and boot will remain in the shift lever housing as they are cemented in place in the housing.* CAUTION: *USE CARE AND DO NOT DAMAGE THE SEAL RINGS.*

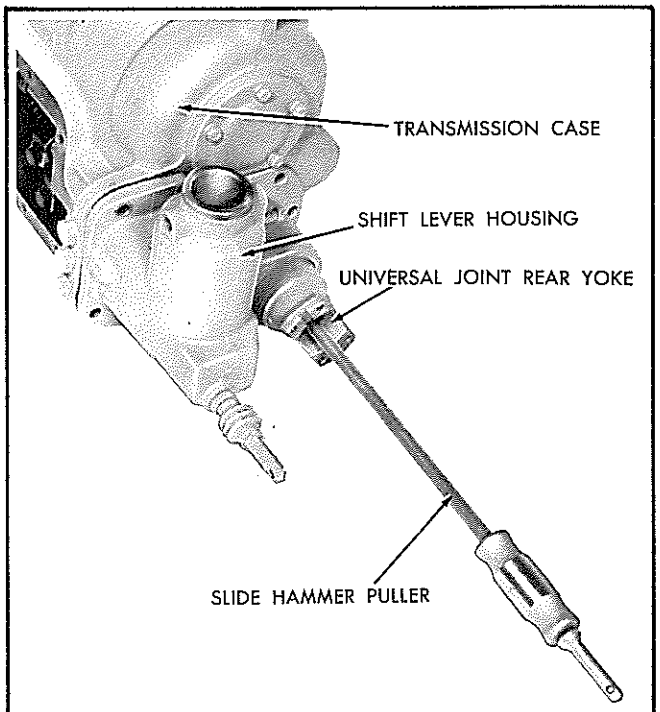

Fig. 5 — Removing Shift Lever Housing from Transmission Case

9. Unlock and loosen the capscrews clamping the shifting forks to the shifting shafts.

10. Remove the three shifting shaft ball spring capscrews (Fig. 4), located in the right front side of the transmission case, and remove the three shifting shaft ball springs. Tilt the case and allow the three steel balls to fall out of the holes.

11. Remove the pipe plug (Fig. 4), located under the right front corner of the transmission case. Hold the lower shaft shifting fork and pull the lower shifting shaft out of the fork and the transmission case. Catch the two steel balls (detent balls) when removing the shaft and also the shifting shaft interlock pin if it falls out of the intermediate shifting shaft.

12. Hold the intermediate shaft shifting fork and pull the shifting shaft out of the fork and the transmission case. Catch the two steel balls when removing the intermediate shifting shaft.

13. Hold the upper shaft shifting fork and pull the shifting shaft out of the fork and the transmission case. Remove and keep the shifting forks with the shafts from which they were removed.

14. Unlock and remove the capscrews attaching the pinion shaft rear bearing retainer to the transmission case. Remove the bearing retainer and the bearing retainer shims. Tie the shims to the retainer to prevent loss.

15. Using tools similar to those shown in Fig. 6, press the bevel pinion shaft out of the case (towards the rear). Remove the gears as they are freed from the shaft.

16. Remove the top shaft front bearing cover. Remove the snap ring from the front end of the top shaft. Drive the shaft out of the case (towards the rear). Remove the gears as they are freed from the shaft.

17. Remove the reverse gear shaft plug and using a slide hammer puller with an adapter having 5/8" NC threads, insert the puller into the end of the shaft and pull the shaft out of the transmission case. Catch the steel locking ball used in the shaft, as the shaft is removed. Remove the reverse gear, bearing roller assembly, and the thrust washers.

    NOTE: *On tractors having (optional) two speed reverse transmission, refer to Fig. 2. Remove the reverse shaft hole plug snap ring, reverse shaft hole plug, and plug sealing ring. Remove the reverse gear shaft plug and using a slide hammer puller with an adapter having 5/8" NC threads, insert the puller into the end of the shaft and pull the shaft out of the case. Catch the steel locking ball, used in the shaft, as the shaft is removed. Remove the high speed reverse gear bearing roller assembly and the thrust washers.*

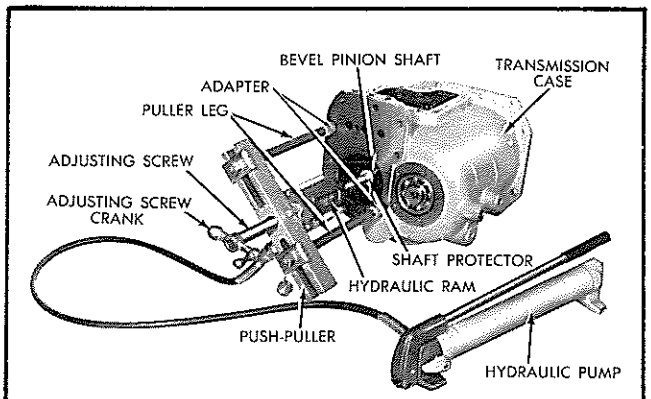

Fig. 6 — Removing Pinion Shaft from Transmission Case

18. The bearings that remain in the transmission case or on the shafts, and the snap rings that remain on the input shaft and on the rear of the top shaft should now be removed, cleaned, inspected, and replaced if necessary.

D. Cleaning and Inspection of Parts

Clean and inspect all the transmission parts thoroughly as described in pertinent pages of "GENERAL MAINTENANCE INSTRUCTIONS," Section XX. Replace or recondition the worn or damaged parts.

E. Assembly of Transmission

1. Installation of Low Speed Reverse Shaft Assembly (Figs. 1 and 7)

a. Stand the transmission case on its front end, place the bearing roller assembly in the low speed reverse gear and place the reverse gear and the inner and outer thrust washers in position in the case. The inner thrust washer can be distinguished from the outer thrust washer by having the smaller hole. IMPORTANT: *Install the reverse gear so that the chamfered ends of the teeth are towards the rear of the transmission case.*

b. Turn the thrust washers so that the flat surfaces, in the inside diameter of the washers, are to the top of the transmission case and in line.

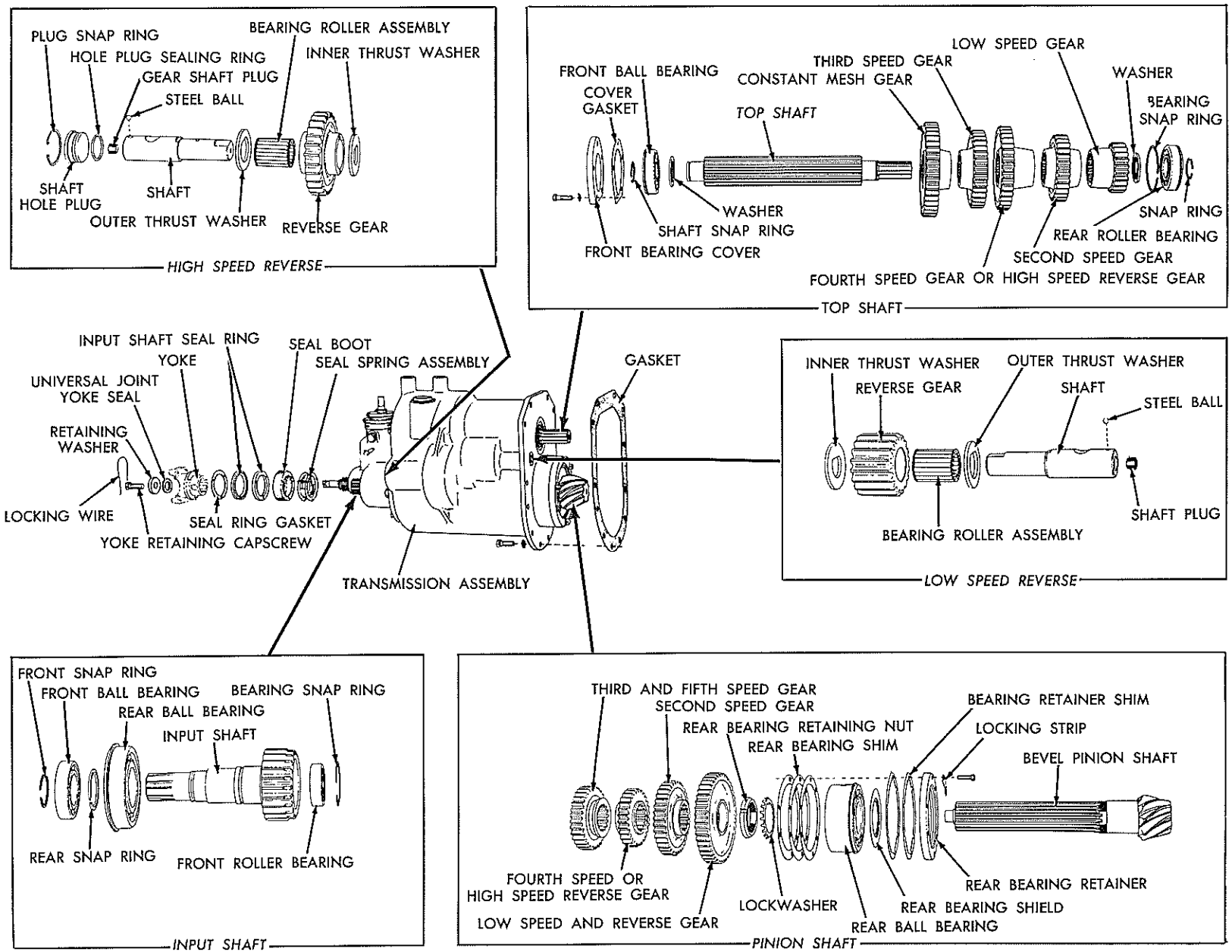

Fig. 7 — Transmission Details

c. Position the reverse gear shaft so that the hole for the steel ball is in line with the notch in the transmission case. Start the shaft in the transmission case, install the steel ball in the shaft, then drive the shaft into position. Install the reverse gear shaft plug in the end of the reverse gear shaft.

d. Use a feeler gage and check the clearance between the reverse gear and one of the thrust washers; the specified clearance is .008" to .025". If the clearance is not within the specified limits, remove the shaft and replace the necessary parts.

NOTE: *When assembling transmissions having two speed reverse, the assembly procedure is the same as that of the one speed reverse explained above, with the exception that the high speed reverse gear shaft (Figs. 2 and 7) is installed from the front end of the transmission case. After the high speed reverse gear shaft plug is installed, install the reverse shaft hole plug, seal ring, and the snap ring.*

2. Installation of Top Shaft and Gears

If the inner race of the top shaft rear roller bearing has not been removed from the shaft, stand the shaft on end and install one of the gears on the shaft. Using the gear as a slide hammer, drive against the top shaft washer to remove the bearing race.

a. Install the top shaft washer on the front end of the top shaft, with the flat side of the washer against the shaft splines. Install the top shaft front ball bearing on the shaft, then install the top shaft snap ring.

b. Turn the transmission case on its side (side cover opening up).

c. Insert the rear end of the top shaft through the front bore of the transmission case. Refer to Figs. 1 and 7 and install the top shaft gears in order and with the hubs in the direction shown. After the gears are installed on the shaft, hold the shaft in position and install the top shaft front ball bearing in the bore of the transmission case.

d. Install the top shaft front bearing cover and gasket.

e. Install the top shaft washer on the rear of the top shaft, with the flat side of the washer against the shaft splines. Install the inner race of the top shaft rear ball bearing on the shaft (chamfered end next to the washer), then install the rear roller bearing. Install the top shaft snap ring on the rear of the top shaft.

f. The specified clearance (total clearance) between the gear hubs is .020" to .025"; check the clearance and if it is not within the specified limits remove the top shaft and replace or rework the necessary parts.

3. Installation of Bevel Pinion Shaft and Gears

a. Install the rear bearing shield on the bevel pinion shaft with the large diameter of the shield toward the rear. Install the pinion shaft rear ball bearing on the shaft, then install the bearing retaining nut lockwasher and retaining nut. Tighten the retaining nut securely and lock with the lockwasher.

b. Install the inner race of the pinion shaft front roller bearing on the pinion shaft (chamfered end next to the shaft splines).

c. Refer to Figs. 1 and 7 and place the pinion shaft gears in the transmission case in order and with the hubs in the direction shown. Insert the bevel pinion shaft through the rear bore of the case and into the gears. Hold the bevel pinion shaft in place and install the rear bearing in position in the bore of the case. Drive the bevel pinion shaft in

until the snap ring on the rear bearing is against the case. NOTE: *On tractors equipped with the two speed reverse transmission, refer to Figs. 2 and 7 and see that the proper gears are installed on the shaft in the proper order.*

d. Using a depth gage, measure the depth of the recess in the rear bearing retainer and lock the depth gage. Place the depth gage against the rear face of the rear bearing, then, using a feeler gage measure the clearance between the depth gage and the rear face of the transmission case. Make up a shim pack of pinion shaft bearing retainer shims .002" thicker than the feeler gage measurement; this will provide .000" to .002" bearing end play when the rear bearing retainer is installed. Keep the shim pack with the bearing retainer.

e. Drive the bevel pinion shaft back approximately 1/16" and remove the snap ring from the pinion shaft rear ball bearing. Install a .054" shim pack of rear bearing shims in place on the bearing. Reinstall the snap ring and drive the bevel pinion shaft forward until the bearing snap ring is tight against the shims.

Reinstall the rear bearing retainer with the correct amount of bearing retainer shims as determined in Step "d." Tighten the attaching capscrews securely.

f. If the bevel pinion has a mounting distance dimension marked on the toe end, subtract this dimension from 9.258" which is the specified dimension from the rear face of the transmission case to the center of the bevel gear hub. The difference between these two dimensions, is the distance the toe end of the bevel pinion teeth should extend from the rear face of the transmission case. EXAMPLE: *Dimension marked on the toe end of pinion 4.816" from 9.258" equals 4.442", the distance the toe end should extend from the rear face of the transmission case.*

g. If the bevel pinion does not have a mounting distance dimension marked on the toe end, measure the distance (with pinion installed as outlined in step "e" above), from the toe end of the pinion to the rear face of the transmission case. This distance should be 4.435". Add or remove rear bearing shims as necessary to obtain this measurement (refer to Fig. 9).

NOTE: *The above specified dimensions in steps "f" and "g" allow for the thickness of the gasket used between the transmission case and steering clutch housing when assembled.*

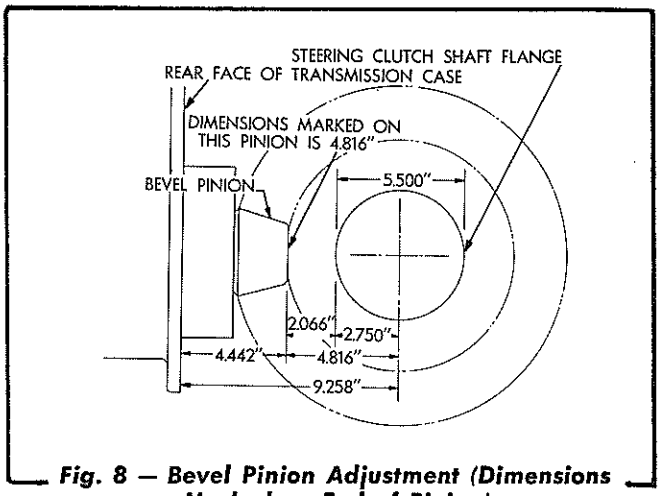

Fig. 8 — Bevel Pinion Adjustment (Dimensions Marked on End of Pinion)

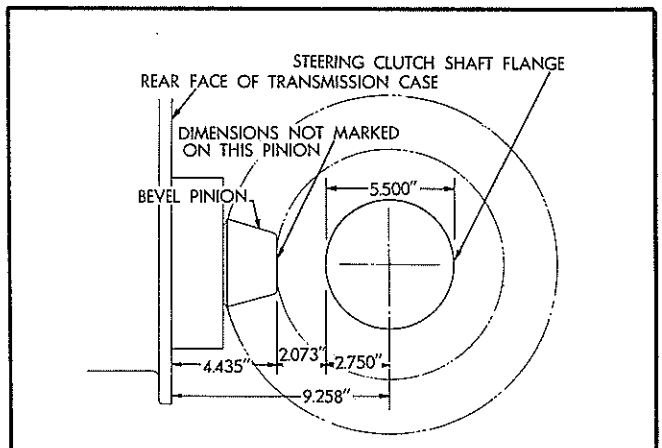

Fig. 9 — Bevel Pinion Adjustment (Dimensions Not Marked on End of Pinion)

h. Install the rear bearing retainer and the correct amount of bearing retainer shims as determined in step "d." Install

the attaching capscrews and locking strips. Tighten the capscrews securely and lock in position with the locking strips.

4. **Assembly of Input Shaft**

a. Install the input shaft rear ball bearing on the input shaft and install the rear snap ring on the shaft.

b. Install the input shaft front ball bearing on the input shaft and install the front snap ring on the shaft.

c. Install the pinion shaft front roller bearing in the input shaft and install the snap ring.

d. Place the shift lever housing on a clean bench with the machined face of the housing down. Make certain the input shaft seal spring assembly, boot, and rear seal ring (bronze) are clean and dry. Install the boot on the spring assembly. Hold each lip of the boot away from the spring assembly and coat the inside of the lips and the sides of the spring assembly with "NEOPRENE" cement. Press the lips back in place against the spring assembly.

e. Coat the outer face of one lip of the boot and coat the machined face in the bottom of the counterbore in the shift lever housing with "NEOPRENE" cement. Immediately place the boot and spring assembly in the housing, inserting the ends of the pins into the corresponding holes in the housing.

f. Coat the outer lip of the boot and the back face of the rear seal ring (bronze) with "NEOPRENE" cement. Immediately place the seal ring on the boot assembly, inserting the ends of the pins into the holes in the seal ring. Place a weight on the seal ring, using a clean cloth between the weight and the seal ring, and allow the "NEOPRENE" cement to dry and set thoroughly.

g. Cement the input shaft seal ring gasket to the universal joint rear yoke with "NEOPRENE" cement, then cement the front seal ring (steel) to the gasket. Place a weight on the seal ring, using a clean cloth between the weight and the seal ring. Allow the "NEOPRENE" cement to dry and set thoroughly. NOTE: *When coating the above parts with "NEOPRENE" cement, do not use an excessive amount.* The "NEOPRENE" cement and solvent used for thinning can be purchased from your "Allis-Chalmers" Construction Machinery Dealer.

h. After the "NEOPRENE" cement has dried and set thoroughly, install the input shaft in the shift lever housing. Lubricate the front and rear seal rings with clean oil and install the universal joint rear yoke on the input shaft.

i. Place the universal joint yoke seal and the yoke retaining washer in position, then install the retaining capscrew. Tighten the capscrew to a torque of 168 to 178 lbs. ft. and lock with locking wire.

5. **Installation of Input Shaft and Gear Shift Controls**

a. Turn the transmission case on the bench so that the top of the case is up.

b. Refer to Fig. 10, insert the lower shifting shaft into position in the transmission case. Insert two of the steel balls in place in the transmission case and on top of the lower shifting shaft. Make certain the shaft is positioned so that the lower steel ball is in the center notch of the three notches in the shaft.

c. Refer to Fig. 10, install the shifting shaft interlock pin in the hole in the intermediate shifting shaft, then insert the shaft into position in the transmission case. Position the shaft so that the interlock pin in the shaft is located in line with the steel balls. Insert two of the

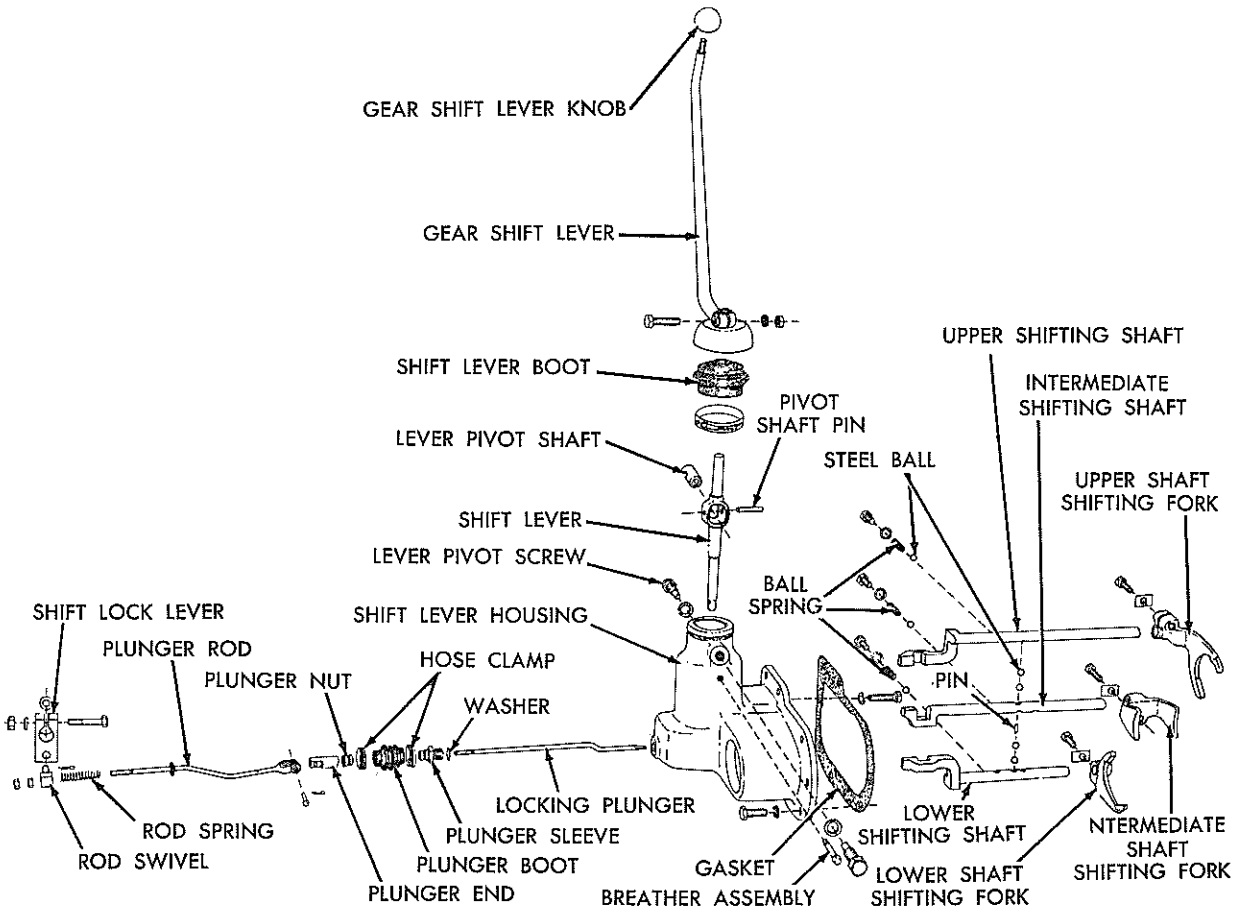

Fig. 10 — Transmission Controls Details

steel balls in place in the transmission case and on top of the intermediate shifting shaft.

d. Refer to Fig. 10, insert the upper shifting shaft into position in the transmission case. Position the shaft so that the upper steel ball is in the center notch of the three notches in the shaft.

e. Install a steel ball in each of the three holes in the right front side of the transmission case, then insert a shifting shaft ball spring in each hole. Start the three shifting shaft ball spring capscrews with copper washers (Fig. 4) in the case. Tighten the capscrews enough to compress the springs slightly.

f. Refer to Fig. 10, install the upper shaft shifting fork in place on the low speed and reverse gear and on the upper shifting shaft. Install the lower shaft shifting fork in place on the 3rd and 5th speed gear and on the lower shifting shaft. Slide the 4th speed and the 2nd speed gears together, then install the intermediate shaft shifting fork in place on the gears and on the intermediate shifting shaft. NOTE: *When assembling transmissions having two speed reverse, the lower shaft shifting fork will engage the 3rd and 4th speed gear and the intermediate fork will engage the 2nd speed gear and the high speed reverse gear.* Move the shifting shafts as necessary to install the shifting forks. After moving the shifting shafts, return them to the neutral position (steel balls located in the center notch in the shafts).

g. Position the shaft shifting forks so that the rear sides are flush with the ends of

the shifting shafts, then tighten the shifting fork capscrews slightly. Shift each shaft and check to see if the forks are located so that the sliding gears mesh properly with their mating gears. Reposition the forks on the shafts if necessary and tighten the shifting fork capscrews to a torque of 70 to 90 lbs. ft. Lock the capscrews with the capscrew locks. Tighten the three shifting shaft ball spring capscrews in the right front side of the case.

h. Install the gear shift locking plunger sleeve with washer (Fig. 10) in the front of the shift lever housing, then insert the locking plunger through the rear of the shift lever housing and in place in the sleeve.

i. Cement the shift lever housing gasket in place on the transmission case. Install the shift lever housing and input shaft assembly in place on the transmission case, inserting the locking plunger in position in the transmission case. Tighten the attaching capscrews securely.

j. Coat the inside diameter (at each end) of the locking plunger boot with "NEOPRENE" cement and install it (with hose clamps) on the locking plunger sleeve. Install the locking plunger nut and turn it on the plunger to the end of the threads. Install the locking plunger end on the plunger and lock it in position with the plunger nut. Install the plunger boot in place on the plunger nut and tighten the hose clamps.

k. Install the shift lever in position in the notches of the shifting shafts (shifting shafts in neutral position). Install the two shift lever pivot screws.

l. Place the clamp for the shift lever boot in place on the shift lever housing, then install the boot in place on the housing and shift lever. Position the clamp on the boot and tighten securely.

m. Install the gear shift lever on the shift lever. Position the gear shift lever so that the machined surface of the shift lever protrudes through the clamping boss of the gear shift lever. Tighten the lever clamping capscrew securely.

n. Install the transmission case side cover and gasket. Install the pipe plug in the lower right front corner of the transmission case.

F. Transmission Installation

The transmission is now ready to be installed in the tractor. Use a new gasket between the transmission case and the steering clutch and final drive housing and install the transmission by a direct reversal of the removal procedure. After the transmission has been secured in position, check the backlash between the bevel gear and pinion teeth and the tooth contact pattern (refer to "INSTALLATION OF BEVEL GEAR" (Step 10) in this Section).

Adjust the nuts on the front end of the gear shift locking plunger rod (Fig. 10) so that the distance between the center of the locking plunger rod swivel and the center of the plunger rod yoke pin is approximately 10¾".

Install the oil drain plug in the bevel gear compartment, then fill the transmission and bevel gear compartment to the proper level using the specified lubricant.

3. BEVEL GEAR

A. Description

The bevel gear, located in the center compartment of the steering clutch and final drive housing, is bolted to the flange of the steering clutch shaft. The steering clutch shaft is supported at each end by tapered roller bearings contained in removable bearing retainers. The bevel gear is driven by the bevel pinion; an approximate 5 to 1 speed reduction is made through the bevel gear and pinion. Power from the bevel gear is delivered through the steering clutches to the final drives.

B. Removal of Bevel Gear

1. Remove both steering clutches (refer to "STEERING CLUTCH REMOVAL," Section XI). Remove the steering clutch throwout yoke and bearing assemblies (refer to "STEERING CLUTCH THROWOUT BEARING ASSEMBLIES," Section XI). Remove the brake drum hub from the right final drive pinion shaft (refer to "REMOVAL OF FINAL DRIVE PINION SHAFT," Section XIII).

2. Remove the bevel gear compartment cover.

3. Remove the high nuts and nut locks securing the bevel gear to the bolting flange of the steering clutch shaft.

4. Remove the capscrews attaching the steering clutch shaft bearing retainer assemblies to the inner walls of the steering clutch compartments and remove the bearing retainers.

5. Place suitable wooden blocking between the right side of the bevel gear and the compartment wall to hold the bevel gear stationary (refer to Fig. 11). Install a puller similar to the one shown and tighten the puller screw hex nut to pull the steering clutch shaft from the bevel gear.

6. Remove the puller assembly and the wooden blocks. Remove the bevel gear and the steering clutch shaft. Remove the steering clutch shaft left bearing cone from the housing.

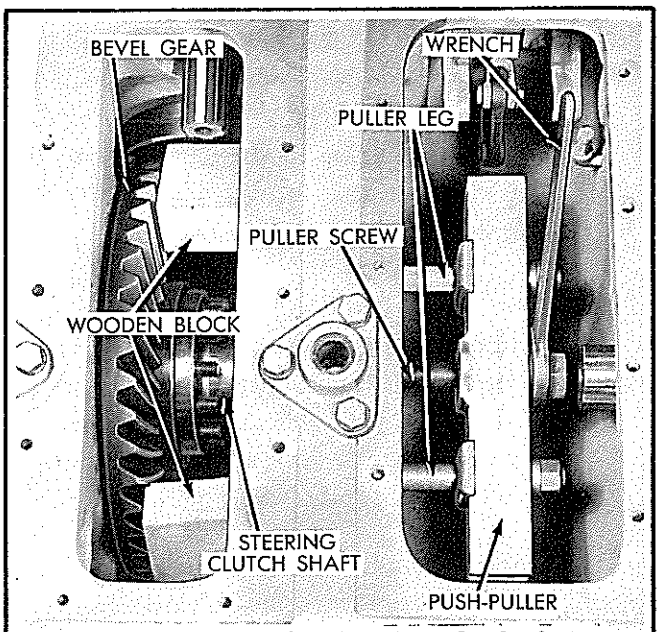

Fig. 11 — Removing Steering Clutch Shaft

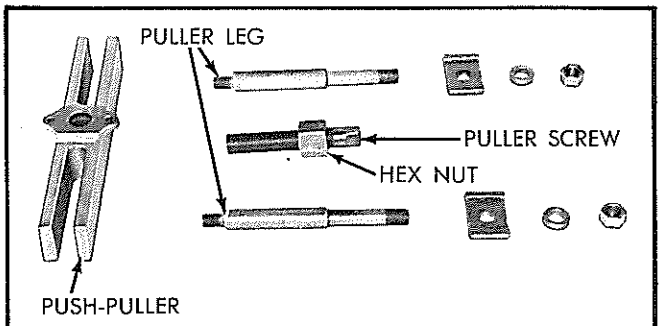

Fig. 12 — Special Tools Used for Removing Steering Clutch Shaft

7. Remove the right bearing cone from the steering clutch shaft and the bearing cups from the bearing retainer assemblies. Tie the bearing adjustment shims to their respective bearing retainers.

C. Cleaning and Inspection of Parts

Clean and inspect all the parts as described in pertinent pages in "GENERAL MAINTENANCE INSTRUCTIONS," Section XX. Replace or recondition any damaged parts. Replace the two sleeves located on the steering clutch shaft if they are grooved from contact with the oil seals. Install new oil seals when assembling.

D. Installation of Bevel Gear

1. When installing the bevel gear and components, refer to Fig. 7, Section XI. Press the bearing cone into position on the right

end (long end) of the steering clutch shaft, with the large diameter of the bearing against the shoulder of the shaft. Install the bevel gear attaching capscrews in position in the gear. NOTE: *When installing the capscrews, position the capscrew heads so that the capscrew locking collar may be installed.*

2. Place the bevel gear in position in the housing, with the teeth of the gear toward the right side when viewed from the rear. Start the steering clutch shaft into the bevel gear and start the flange of the shaft onto the attaching capscrews.

   Bump or drive the steering clutch shaft into the bevel gear. Place the nut locks in position on the attaching capscrews and start the high nuts. Tighten several of the high nuts evenly until the gear is properly located on the shaft. Install the capscrew locking collar in position, making certain that the heads of the capscrews are positioned so that the locking collar will contact the bevel gear when installed.

3. Lubricate the remaining bearing cone and start it on the left end of the steering clutch shaft, with the large diameter of the bearing toward the bevel gear. Using special tools similar to the ones shown in Fig. 13, install the puller screw (used in removal) in the tapped hole in the left end of the shaft. Place a bearing installing sleeve (having an O.D. the size of the inner race of the bearing cone) over the puller screw and against the inner race of the bearing cone. Install a sleeve plate against the installing sleeve and install a hex nut on the puller screw. Tighten the hex nut to press the bearing cone tight against the shoulder on the shaft, then remove the installing tools.

4. Press the bearing cups into position in the bearing retainer assemblies. Lubricate the bearing cones with clean oil and insert one retainer and cup assembly into each bore of the housing, using the shims removed at disassembly between each retainer and the wall of the housing. CAUTION: *Make certain that each bearing retainer is installed in the bore from which it was removed.*

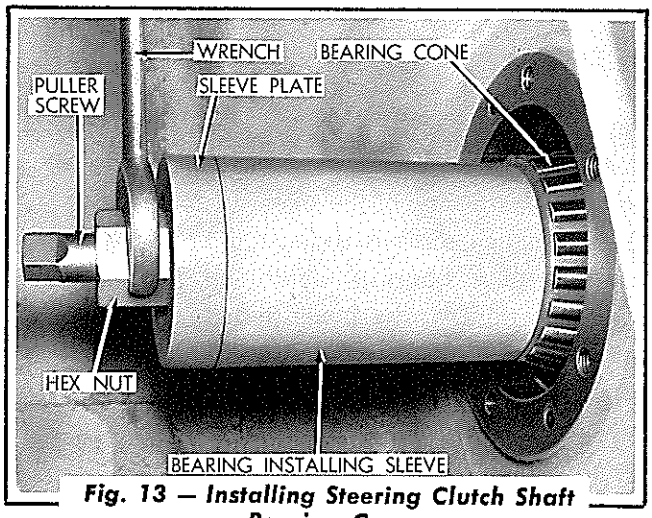

Fig. 13 — Installing Steering Clutch Shaft Bearing Cone

5. Make certain that the wear pin in each bearing retainer is toward the bottom as installed, then start the attaching capscrews but do not tighten.

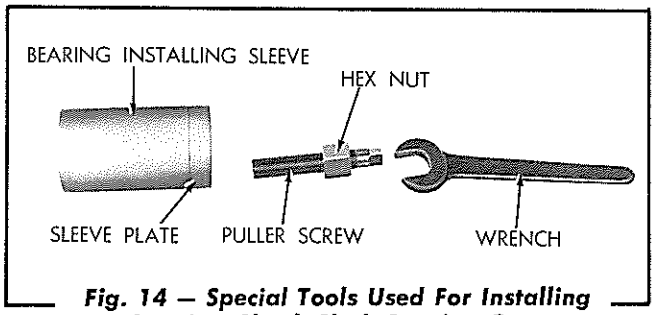

Fig. 14 — Special Tools Used For Installing Steering Clutch Shaft Bearing Cone

6. Tighten all the high nuts of the bevel gear attaching capscrews to a torque of 70 to 90 lbs. ft. and lock the high nuts in position with the nut locks.

7. Tighten the bearing retainer attaching capscrews and bump the bearing retainers to make certain the bearing cones are properly seated, then check the bearing pre-load. NOTE: *THE BEARING PRE-LOAD MUST BE CHECKED WITHOUT THE OIL SEALS IN POSITION IN THE BEARING RETAINERS AND WITH THE TRANSMISSION REMOVED, IN ORDER TO DETERMINE THE PROPER PRE-LOAD OF THE STEERING CLUTCH SHAFT BEARINGS.*

8. The steering clutch shaft bearings are properly adjusted when they have a pre-load of

10 to 20 pounds inch or when they are adjusted .003" to .004" tight. If a pound inch torque wrench is available, install a steering clutch driving hub retaining capscrew in the shaft, then using the torque wrench, turn the shaft to check the bearing pre-load. Add or remove bearing adjustment shims as necessary to obtain the correct 10 to 20 pounds inch pre-load.

9. Install the transmission assembly in position on the steering clutch and final drive housing and tighten the attaching capscrews.

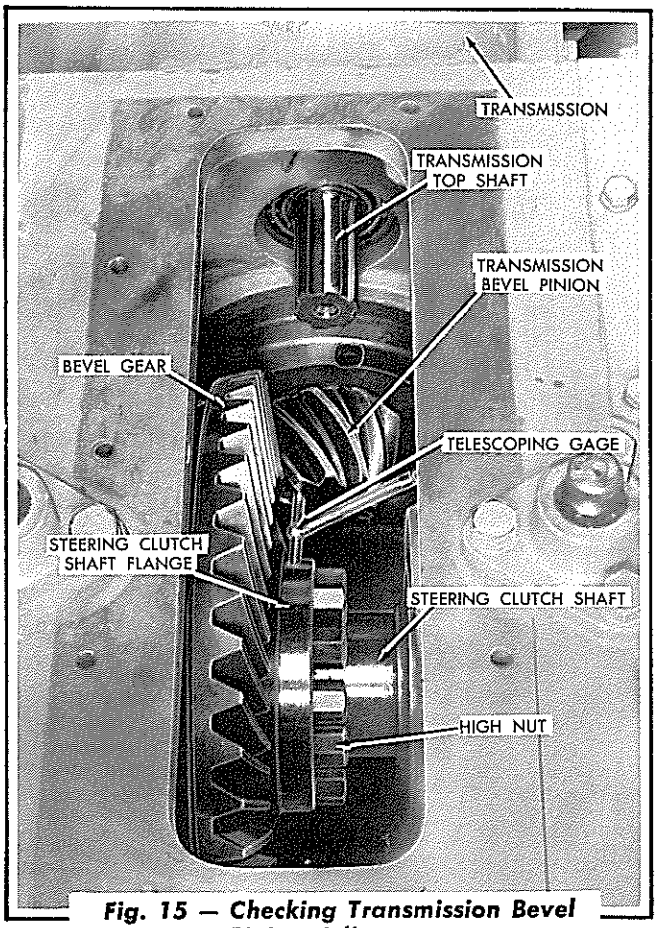

Fig. 15 — Checking Transmission Bevel Pinion Adjustment

10. Refer to Fig. 15 and adjust the bevel pinion depth (or mounting distance) as follows:

    a. Using a telescoping gage, or an inside caliper, measure the distance from the flat surface on the toe end of the bevel pinion to the machined surface of the steering clutch shaft flange. Lock the telescoping gage in position, use an outside micrometer to measure the telescoping gage, and record this measurement.

    b. Measure the diameter of the steering clutch shaft flange.

    c. To calculate the mounting distance, divide the diameter of the steering clutch shaft flange by two and subtract this distance from the mounting distance marked on the toe end of the bevel pinion.

    EXAMPLE: *The diameter of the steering clutch shaft flange is 5.500" and the mounting distance marked on the end of the bevel pinion is 4.816".*

    $5.500" \div 2 = 2.750"$
    $4.816" - 2.750" = 2.066"$

    Therefore, 2.066" is the proper mounting distance from the toe end of the bevel pinion to the machined surface of the flange of the steering clutch shaft.

    NOTE: *If the bevel pinion has no mounting distance marked on the toe end, the pinion should be adjusted so that the rear face (toe end) of the bevel pinion stands out approximately 4.435" from the rear face of the transmission case before the transmission is installed (see Fig. 9).*

    d. Check the backlash between the bevel gear and the bevel pinion teeth. The specified backlash is .006" to .012". If the backlash is excessive, remove adjustment shims from under the steering clutch shaft bearing retainer on the left side and add these shims to those under the bearing retainer on the right side. If the backlash is insufficient, remove adjustment shims from the right side and add them to the left side. In this manner, the bevel gear is moved without disturbing the adjustment of the steering clutch shaft bearings. NOTE: *Moving a .005" shim will change the backlash approximately .0035". After the backlash has been set, the tooth contact pattern must be checked.* The tooth contact pattern can be determined by painting the pinion teeth with a marking compound or bluing, then ro-

tate the gear and the tooth contact pattern will show plainly (refer to Figs. 16 and 17). Note the tooth contact pattern should start 3/16" to 5/16" from the toe end of the tooth. The contact pattern should be broad and distinct at the start of contact and should "feather out" as it progresses toward the heel end of the tooth. When the gears are placed under load, the tooth contact will lengthen toward the heel end and will cover a larger area.

IMPORTANT: *The dimensions in the above examples are given as an aid for locating the bevel pinion in respect to the bevel gear, and the dimensions may vary slightly from tractor to tractor, therefore, THESE DIMENSIONS ARE NOT TO BE USED FOR FINAL ADJUSTMENT PURPOSES.* It is very important that the tooth contact pattern be checked after the transmission bevel pinion and bevel gear have been adjusted in the above manner and to change the location of the bevel pinion by adding or removing pinion shaft rear bearing shims as necessary to obtain the desired tooth contact pattern. If it was necessary to change the location of the bevel pinion, be sure to readjust the bevel gear to obtain the specified .006" to .012" backlash.

11. After the backlash of the bevel gear and bevel pinion has been properly adjusted, remove the steering clutch shaft bearing retainers (keep the adjustment shims with their respective retainers) then lubricate and install the oil seals in position in the bearing retainers. Install the oil seals in the bearing retainers so that the sealing lips of the seals are toward the bevel gear when installed. Lubricate the steering clutch shaft and reinstall the bearing retainers (with shims), using care so that the lips of the seals are not crimped or damaged. IMPORTANT: *When installing the bearing retainers, make certain they are positioned so that the wear pins for the clutch throwout yokes are located at the bottom when installed.*

12. Install each steering clutch throwout ball bearing, throwout yoke, and steering clutch driving hub in position on the steering clutch shaft as an assembly. Install the steering clutch driving hub retaining washers, locking washers, and retaining capscrews and tighten the retaining capscrews to a torque of 300 lbs. ft. Lock the capscrews in position with the locking washers. Connect the upper end of each lubricating hose for each steering clutch throwout bearing.

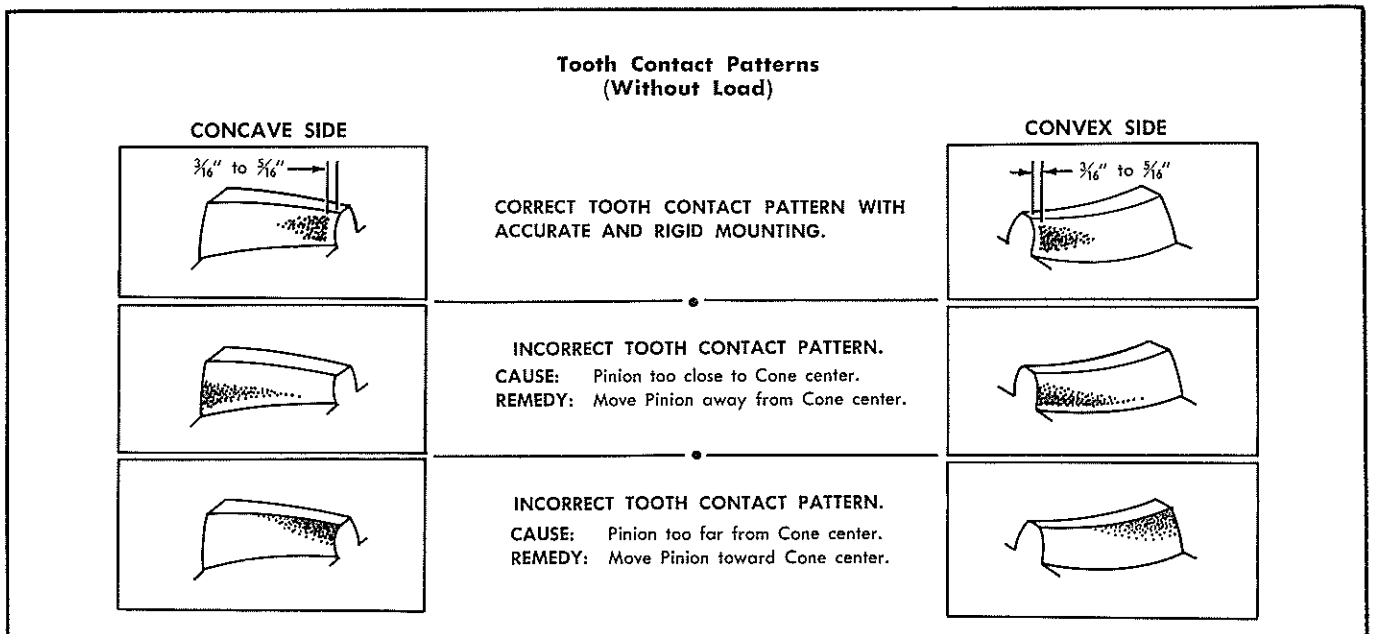

Fig. 16 — Tooth Contact Pattern Diagram

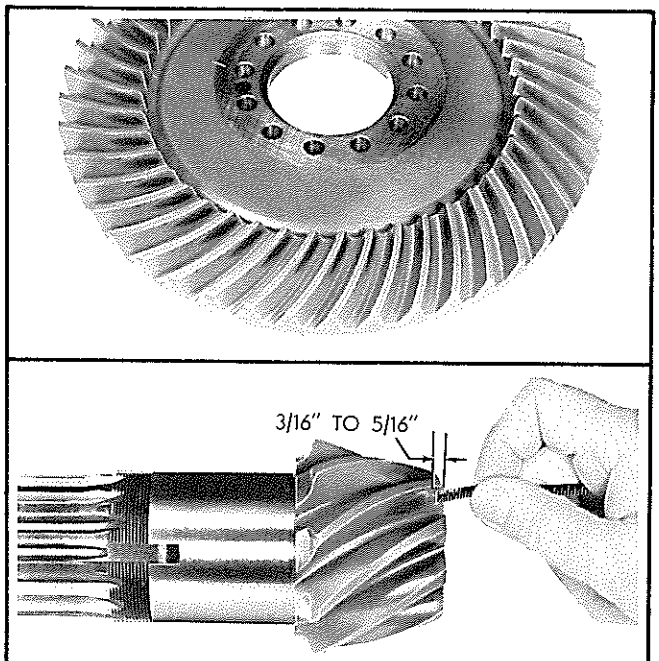

Fig. 17 — Bevel Gear and Pinion Tooth Contact Pattern — Without Load

13. Install the bevel gear compartment cover, using a new gasket.

14. Install both steering clutches and brake assemblies (refer to "STEERING CLUTCH INSTALLATION," Section XI).

15. Install the oil drain plug in the bevel gear compartment, then fill the transmission and the bevel gear compartment to the proper level with the specified lubricant.

4. DRIVE SHAFT UNIVERSAL JOINT

A. Description

Power is transmitted from the engine through the engine clutch and to the transmission by the drive shaft universal joint assembly. The main parts of the universal joint assembly are: front and rear yokes, connecting yoke, and the spider assemblies. By disconnecting the universal joint at the front and rear yokes, either the transmission or the engine clutch can be removed without disturbing the bevel gear, steering clutch assembly, or the engine.

B. Lubrication

The universal joint assembly is provided with two lubricating fittings; one in each spider assembly. Lubricate after each 400 hours of operation when operating under severe conditions; under normal operating conditions, lubricate after every 1000 hours of operation.

C. Removal, Disassembly, and Inspection

1. Remove the capscrews attaching the floor plate to the main frame and remove the floor plate.

2. Remove the capscrews and capscrew locks attaching the front and rear yokes to the universal joint assembly. Pry forward on

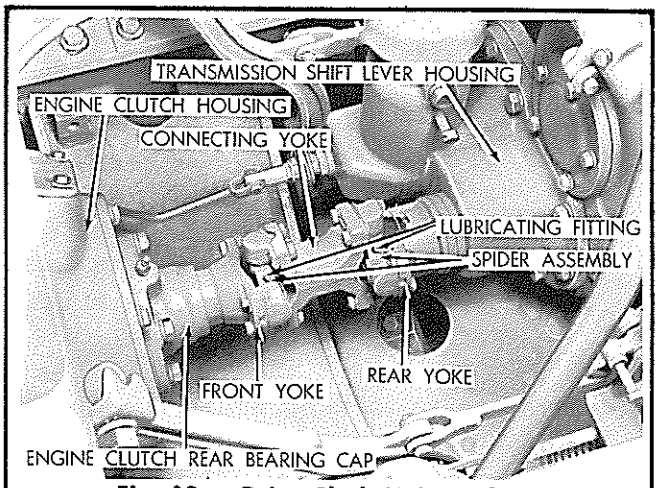

Fig. 18 — Drive Shaft Universal Joint Assembly — Installed

the front yoke, moving it forward on the splines of the clutch shaft, and remove the universal joint assembly. CAUTION: *Care must be taken to prevent loss of or damage to the needle bearings during removal.*

3. Remove the capscrews and capscrew locks attaching the spider assemblies to the connecting yoke and remove the spider assemblies.

4. Remove the locking wire, the yoke retaining capscrew, washer, and seal from the rear

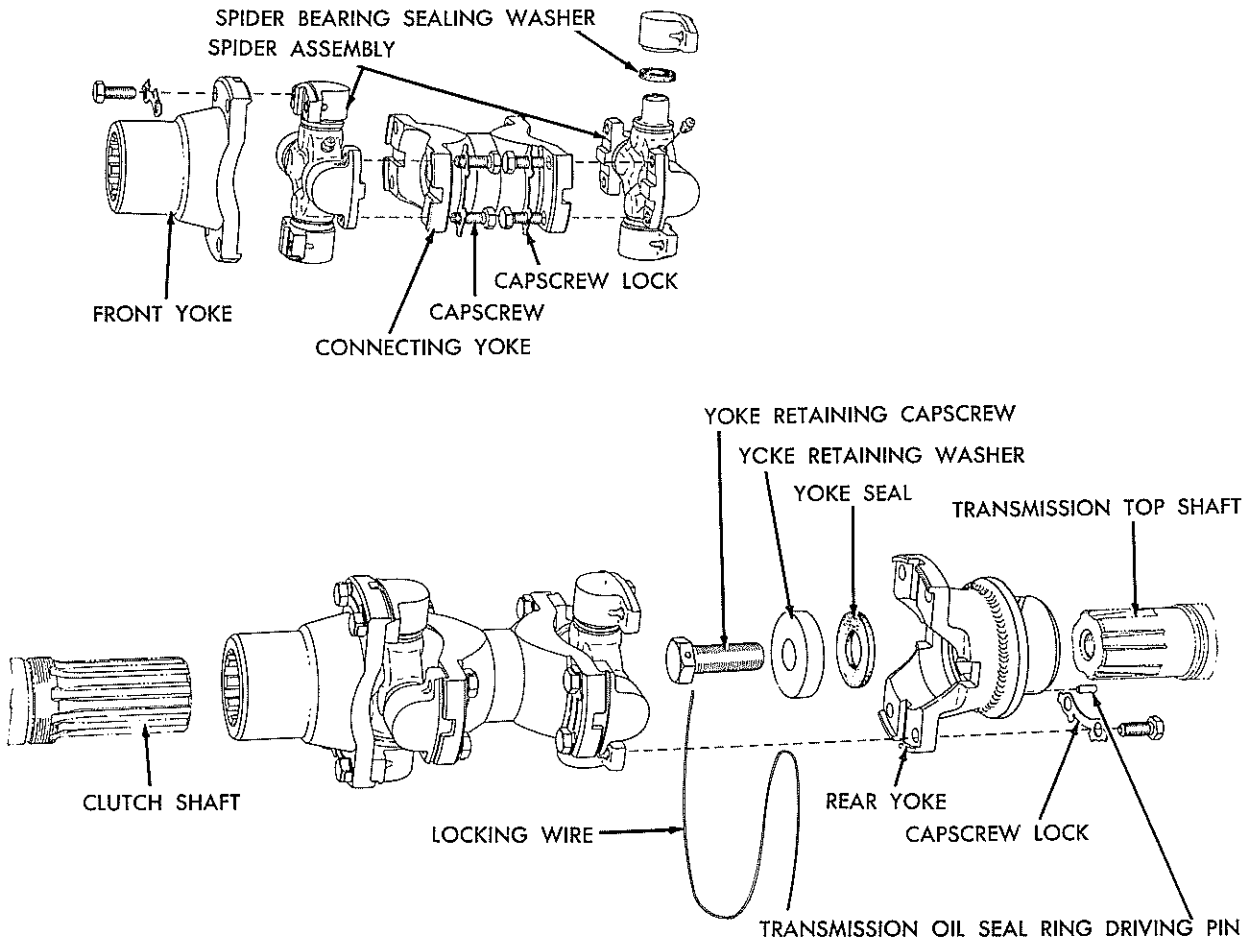

Fig. 19 — Drive Shaft Universal Joint Details

yoke and remove the yoke from the transmission input shaft. Remove the front yoke from the clutch shaft.

5. Wash the parts thoroughly in clean solvent. Inspect the components for damage and wear and replace any worn or damaged parts found.

D. Assembly and Installation

1. The universal joint assembly may be reassembled and installed by a direct reversal of the removal and disassembly procedure. When installing the spider assemblies, install them so that both lubricating fittings are in line. Install the rollers in position in the bearing retainers. Pack with grease to hold the rollers in position and install the bearing assemblies in position on the spider assemblies.

2. Install the floor plate.

SECTION XI — STEERING CLUTCHES AND CONTROLS

1. GENERAL DESCRIPTION

The two steering clutch assemblies, one located at each end of the steering clutch shaft, are used for steering the tractor. Each steering clutch assembly is enclosed in a brake drum which acts in conjunction with the steering clutch for steering. Each steering clutch is actuated by a steering clutch operating lever connected by linkage to the steering clutch throwout yoke assembly.

The steering controls and linkage mechanism for each clutch consists of an operating lever, control rod, intermediate lever shaft with a lever at each end, clutch yoke assembly, and an intermediate shaft bearing cage. The operating lever and intermediate shaft are mounted on needle bearings that are grease packed and sealed for life at the time of assembly.

2. STEERING CLUTCHES AND CONTROLS

A. Description

Two multiple disc steering clutch assemblies, one located at each end of the steering clutch shaft, are provided for steering the tractor. Each steering clutch assembly is enclosed in a brake drum; each drum is bolted to a brake drum hub which is connected to the corresponding final drive pinion. When the steering clutches are disengaged, the brake drums serve in conjunction with the steering clutches by stopping the rotation of the final drives when the steering brakes are applied. Each clutch assembly contains 10 friction discs and 10 steel discs, assembled alternately, with pressure springs holding the steel and friction discs tightly together. Pulling back on a steering clutch operating lever disengages the corresponding steering clutch by forcing a throwout sleeve against a throwout plate in the steering clutch assembly, further compressing the steering clutch pressure springs. Compressing the steering clutch pressure springs allows the steel discs and friction discs to separate, therefore, no power is delivered to the corresponding final drive and track drive sprocket.

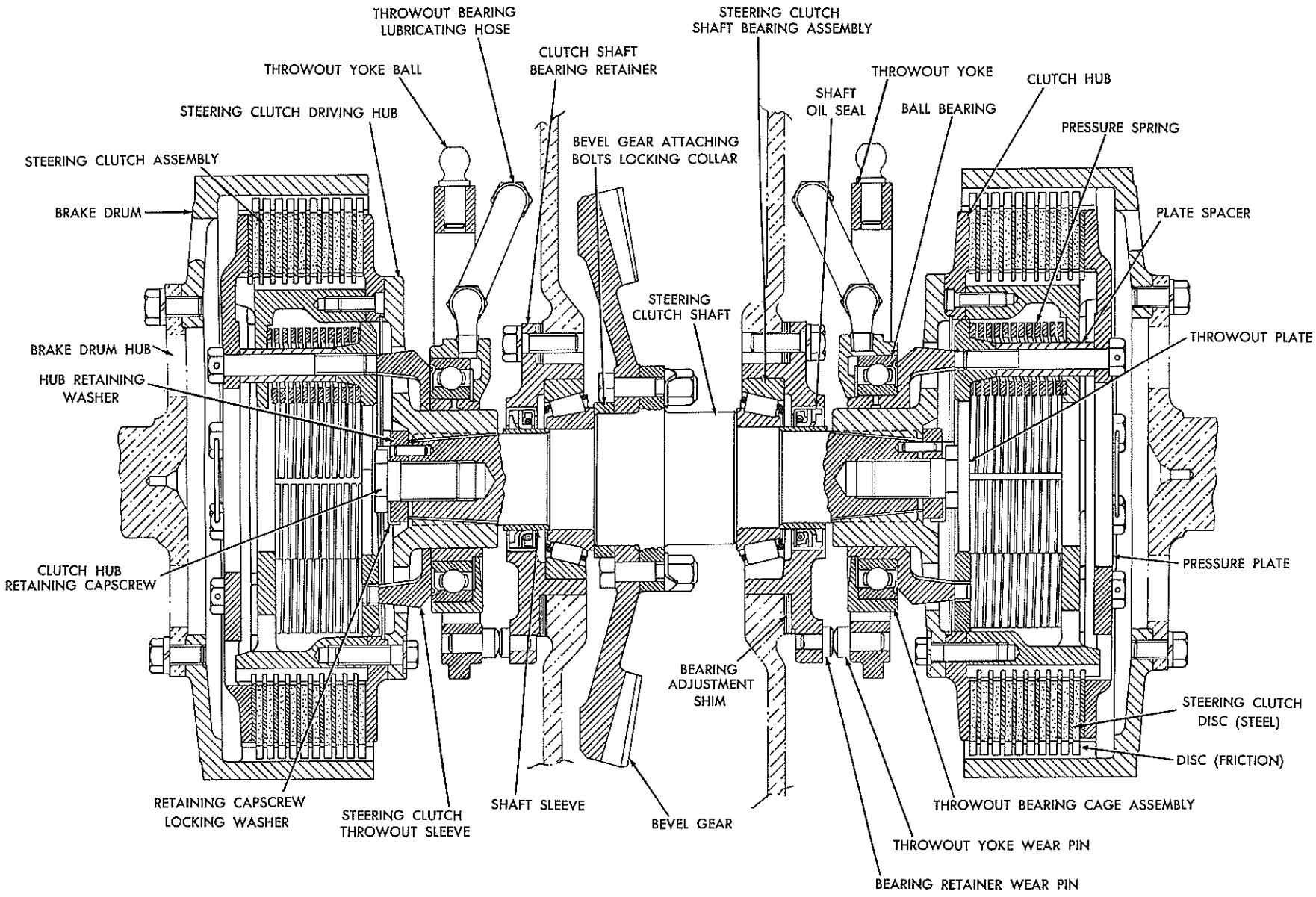

Fig. 1 — Steering Clutch and Bevel Gear Assembly

B. Steering Clutch Service

Specified time intervals between steering clutch linkage adjustments can not be established because of the variable operating conditions which determine the amount of steering clutch disc wear. The steering clutch control linkage is properly adjusted when the steering clutch operating levers each have 3" of free travel, measured at the tops of the levers (just below operating lever hand grip). As the clutch discs wear, this free travel becomes less and an adjustment is required when the free travel has decreased to less than 1". Free travel of the steering clutch operating levers is necessary to assure clearance between the clutch throwout sleeve and the clutch throwout plate and to assure full engagement of each clutch.

C. Measuring Steering Clutch Operating Lever Free Travel

1. Place one end of a ruler or scale against the cowl so that it projects horizontally past the top of the steering clutch operating lever as shown in Fig. 2.

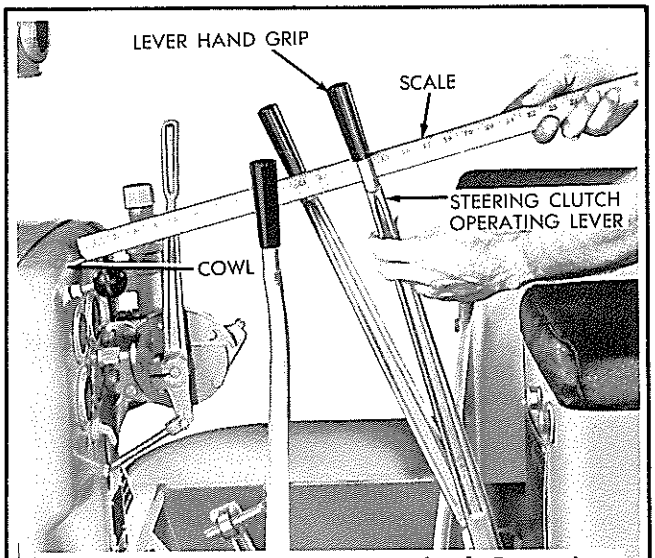

Fig. 2 — Measuring Steering Clutch Operating Lever Free Travel

2. With the steering clutch operating lever forward against its stop, measure the distance from the cowl to the top of the lever.

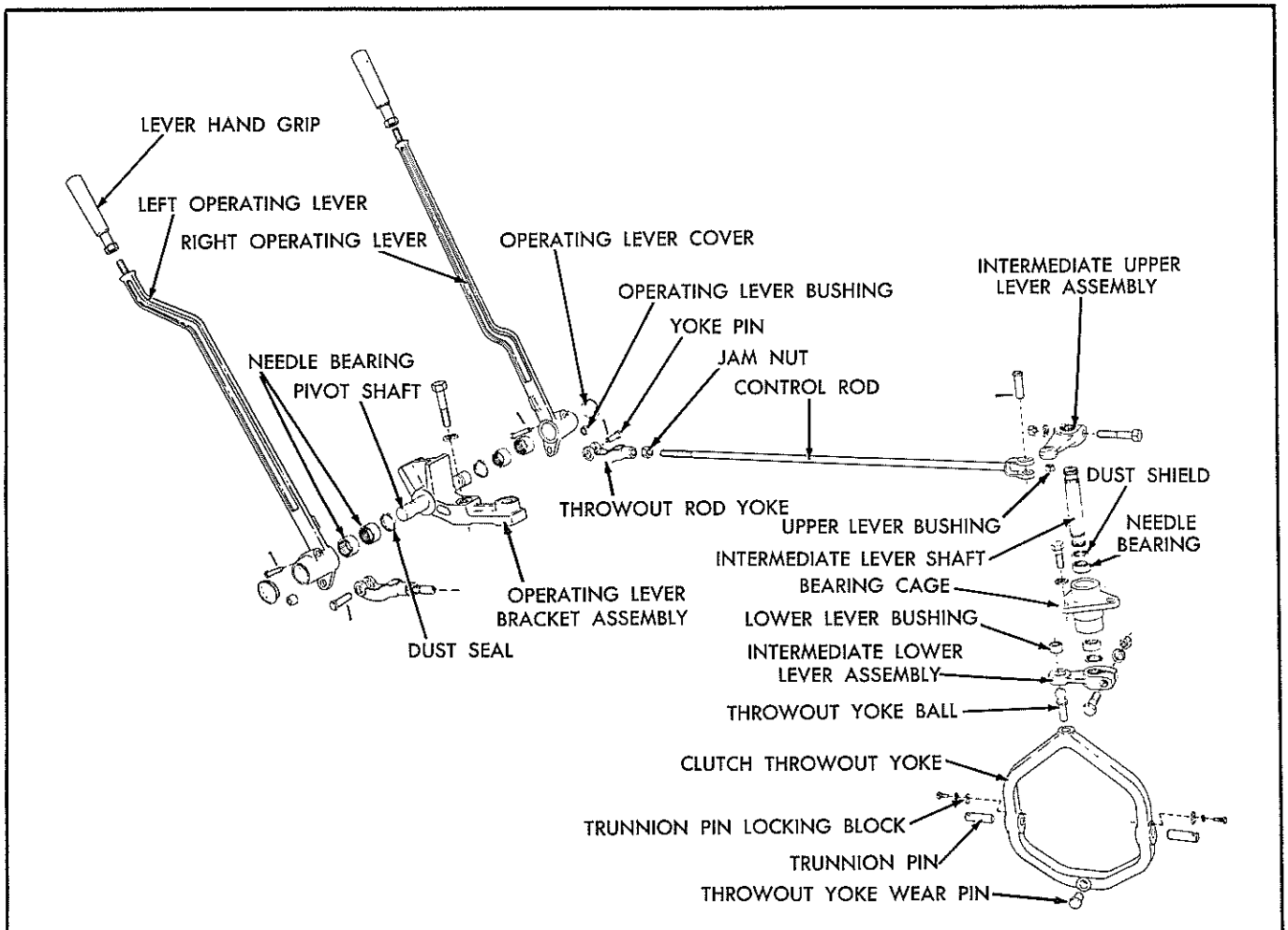

Fig. 3 — Steering Clutch Operating Lever and Linkage Details

3. Pull the steering clutch operating lever back until pressure is felt, which is the point where disengagement of the clutch begins. Note the distance between the cowl and the top of the lever. The difference between the two measurements is the free travel of the lever. If this distance is less than 1" or more than 3", adjustment of the steering clutch control linkage is necessary.

   NOTE: *There is only a limited amount of adjustment in each control rod. When this has been used, it will be necessary to change the position of the intermediate upper lever assembly (Fig. 3) on the intermediate lever shaft as follows:*

   a. Remove the upper lever assembly from the intermediate lever shaft.

   b. Turn the intermediate lever shaft (right shaft clockwise, left shaft counterclockwise) so that the clutch throwout yoke moves the throwout sleeve (Fig. 1) over and the sleeve is contacting the steering clutch throwout plate (Fig. 1).

   c. With the throwout sleeve contacting the throwout plate, install the upper lever assembly on the serrations of the intermediate lever shaft so that the center of the yoke pin hole in the lever is 11/16" to the rear of an imaginary line drawn through the centers of the two intermediate lever shafts.

A change of one serration between the upper lever assembly and the intermediate lever shaft amounts to approximately ⅜" travel at the end of the upper lever assembly, consequently it may not be possible to obtain the 11/16" measurement exactly, but do not position the levers any closer to the imaginary line than 11/16".

After changing the position of the upper lever assembly on the intermediate lever shaft (as described above), it will then be necessary to lengthen the control rod to obtain the specified 3" free travel of the steering clutch operating lever.

D. Adjusting Steering Clutch Control Linkage

1. Remove the seat cushion.

2. Loosen the jam nut of the throwout rod yoke at the front end of the steering clutch control rod.

3. Remove the yoke pin connecting the throwout rod yoke of the steering clutch control rod to the steering clutch operating lever, then turn the yoke to lengthen or shorten the rod as necessary to obtain 3" free travel at the top of the operating lever. When the correct adjustment is obtained, connect the yoke to the operating lever, then tighten the jam nut.

E. Washing Steering Clutches

Refer to "STEERING CLUTCHES" Paragraph E, in the HD-6 Tractor Operators Manual.

F. Steering Clutch Removal

NOTE: *The following removal procedure applies to either steering clutch.*

1. Remove the fuel tank (refer to "FUEL TANK REMOVAL AND INSTALLATION," Section II).

2. Remove the capscrew attaching the battery ground cable to the steering clutch and final drive housing and tape the end of the cable. Remove the bolts attaching the battery box to the fender and move the box outward on the fender to provide clearance for the removal of the steering clutch.

3. Remove the steering clutch compartment cover.

4. Turn the brake band adjuster counterclockwise until it is loosened from the band adjustment fork.

5. Remove the two pipe plugs (Fig. 4) located in the side of the steering clutch housing, in line with the brake band assembly end pins. Using a long 5/16" NC capscrew, insert the capscrew through the lower hole and turn it into the tapped hole in the end of the band adjustment fork end pin. Pull the end pin out, as shown in Fig. 4, and remove the band adjustment fork. Insert the long 5/16" NC capscrew through the upper hole in the steering clutch housing and remove the end pin attaching the lower half of the band assembly to the bellcrank. Do not remove the brake band assembly at this time as it will be used to lift the steering clutch and brake drum assembly out of the steering clutch compartment.

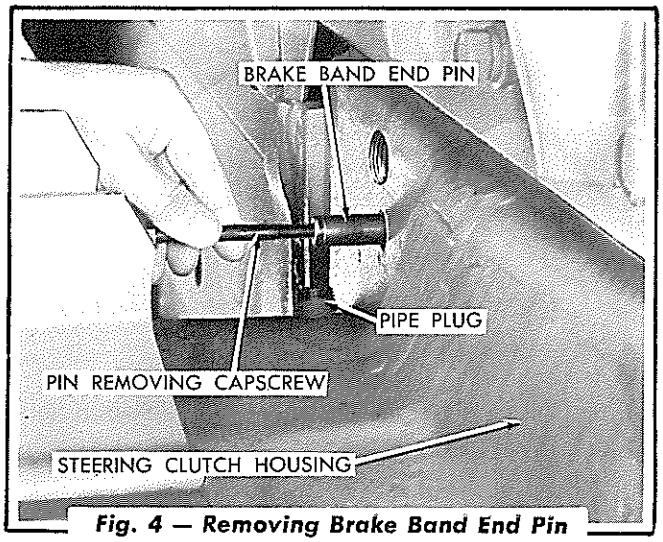

Fig. 4 — Removing Brake Band End Pin

6. Remove the capscrews attaching the brake drum hub to the brake drum. Remove the capscrews attaching the steering clutch assembly to the steering clutch driving hub. This will necessitate turning the clutch assembly and brake drum, which can be accomplished by either using a jack under a track shoe grouser and moving the tractor or turning the track sprocket with a heavy bar.

7. Attach a chain to the brake band, as shown in Fig. 5, and lift the steering clutch and brake drum assembly from the steering clutch compartment.

G. Disassembly of Steering Clutch

NOTE: *The following disassembly procedure applies to either steering clutch.*

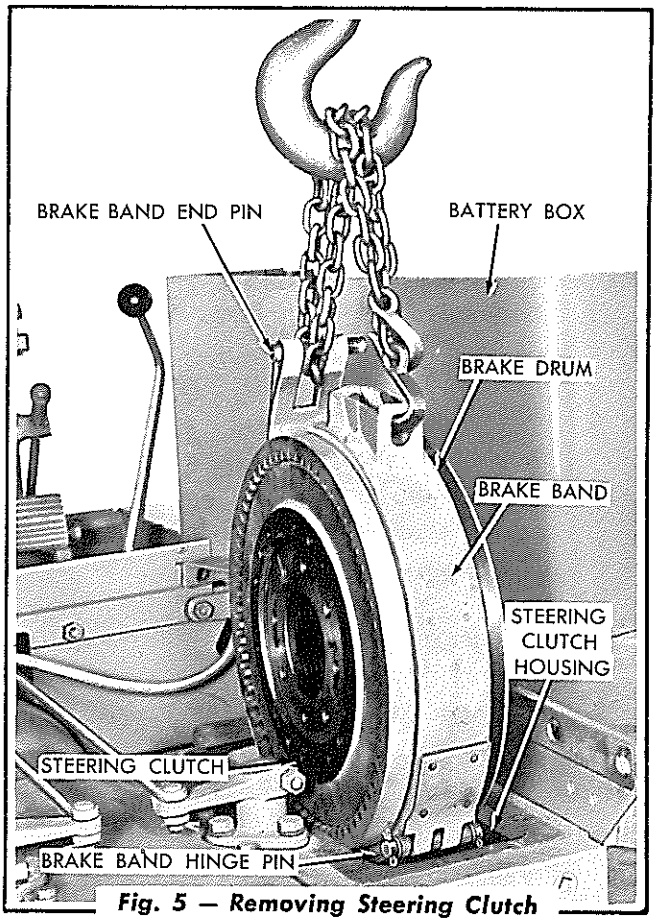

Fig. 5 — Removing Steering Clutch

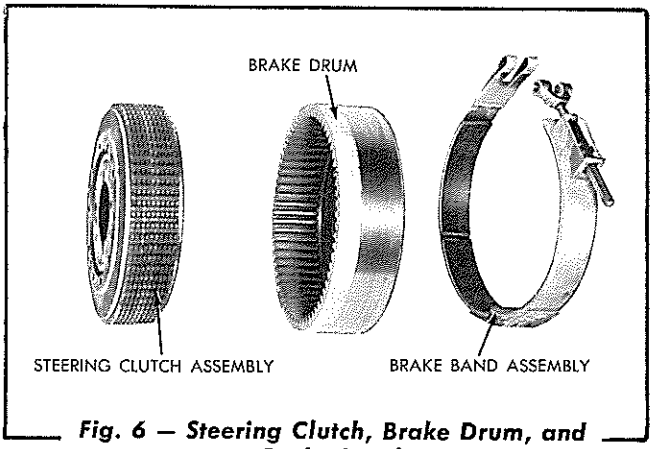

Fig. 6 — Steering Clutch, Brake Drum, and Brake Band

1. Remove the brake drum from the steering clutch assembly, using care to prevent damage to the clutch disc teeth.

2. Before disassembling the steering clutch, refer to Fig. 7 and center punch or mark the pressure plate, clutch hub, and throw-out plate so that they may be reassembled in the same position.

3. It will be necessary to use three special

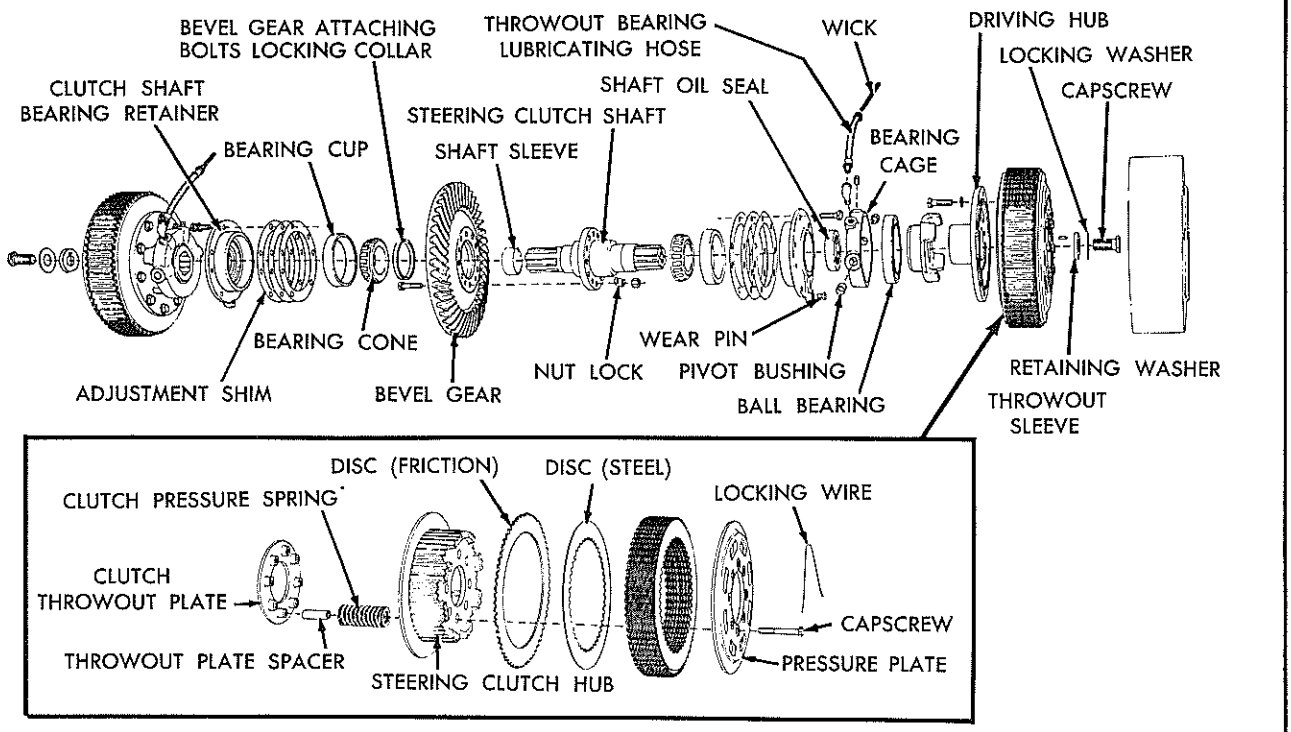

Fig. 7 — Bevel Gear and Steering Clutches

studs to hold the load of the compressed springs when disassembling the steering clutch. Each stud should be ½" diameter by 6" long, having one end threaded ½" NC for a distance of approximately 1". The other end should be machined square for a wrench hold, or slotted for a screwdriver, and threaded ½" NF for a distance of approximately 3¾".

4. Refer to Fig. 8, remove the locking wires and three of the eight throwout plate capscrews, install the three special studs with the NC threaded end into the throwout plate, and install flat washers and hex nuts on the NF threaded end of the studs. Screw the nuts down tightly against the pressure plate until the tension of the springs is held by the three studs.

5. Remove the remaining capscrews and loosen the stud nuts evenly until all tension is off the clutch pressure springs.

6. Remove the pressure plate, steel and friction discs, throwout plate, throwout plate spacers, and pressure springs from the clutch hub.

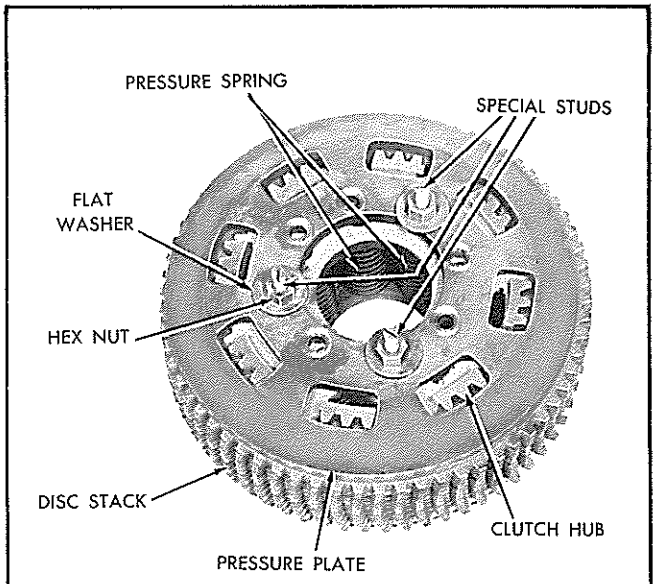

Fig. 8 — Steering Clutch Springs Compressed to Remove Capscrews

H. Steering Clutch Inspection and Repairs

When the steering clutch has been disassembled, inspect the following:

1. Steel Discs

The specified thickness for a new steel disc is .084" to .096". Inspect the discs for wear

and scoring. The discs must be flat within .015".

2. Friction Discs

The specified thickness for a new friction disc is .182" to .187". Inspect the discs for wear, condition of teeth, and oil saturation. If the thickness of the disc is less than .150", or if the teeth are in bad condition, a new disc must be installed.

3. Pressure Springs

Each pressure spring, when new, exerts a pressure of 240 to 260 pounds when compressed to 2-21/64". If a spring does not check reasonably close to this tolerance, it is an indication that it has lost its tension and a new spring should be installed.

4. Steering Clutch Hub

Inspect the teeth of the steering clutch hub for wear. Heavy grooving may cause binding with the teeth of the steel discs.

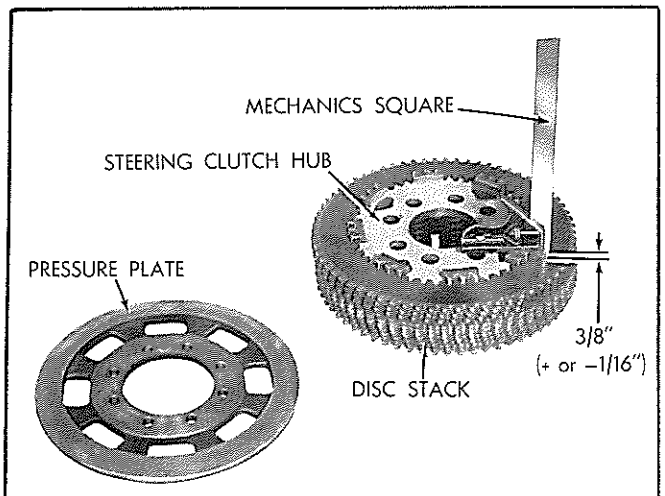

Fig. 9 — Measuring Steering Clutch Disc Stack Height

I. Assembly of Steering Clutch

1. Lubricate the clutch hub teeth sparingly.

2. Place the throwout plate on a bench or flat surface with the pressure spring bosses up.

3. Install a pressure spring over each boss and install a throwout plate spacer in each spring.

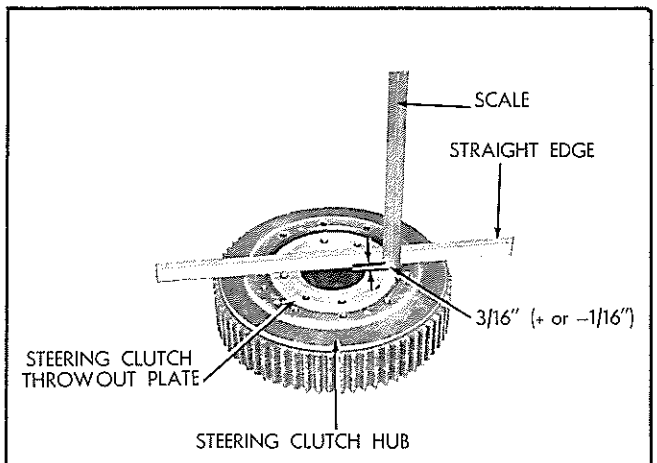

Fig. 10 — Measuring Distance Between Steering Clutch Hub and Throwout Plate

4. Place the clutch hub in position over the pressure springs making certain that the punch marks on the hub and throwout plate are aligned.

5. Stack the discs (10 friction and 10 steel) alternately on the hub beginning with a friction disc. Align the external teeth as evenly as possible. Check the stack height of the discs as shown in Fig. 9; the top disc should be 3/8" (+ or — 1/16") below the top of the steering clutch hub.

6. Place the pressure plate in position, making certain that the punch mark on the pressure plate lines up with the punch marks on the throwout plate and the clutch hub. Install the three special studs in position in the throwout plate.

7. Place the brake drum over the disc stack, and run the nuts down on the special studs, forcing the pressure plate down until the assembly is securely bolted together. Remove the brake drum from the clutch.

8. Using a suitable straight edge and scale, measure the distance between the machined end of the steering clutch hub and the machined face of the throwout plate as shown in Fig. 10. The throwout plate must extend *IN* from the face of the hub 3/16" (+ or — 1/16"). If the distance is less than 1/8", add steel discs as required to obtain

the correct measurement, placing the steel disc next to the pressure plate.

9. Install five throwout plate capscrews and tighten them securely. Remove the three special studs and install the three remaining capscrews. Tighten the capscrews securely and install the locking wires.

J. Steering Clutch Installation

The installation of either steering clutch may be made by the direct reversal of the procedure outlined under "STEERING CLUTCH REMOVAL" in this Section. Refer to "ADJUSTING STEERING CLUTCH CONTROL LINKAGE" in this Section, and adjust the steering clutch control linkage. NOTE: *The approximate assembled length of the steering clutch control rods is 28¾" (from center-to-center of yoke pin holes) when the clutch is new or when new clutch discs have been installed.*

3. STEERING CLUTCH THROWOUT BEARING ASSEMBLIES

A. Description

Each steering clutch throwout bearing assembly consist of the following parts: throwout ball bearing, throwout bearing cage, throwout sleeve, throwout yoke assembly, and a throwout bearing lubricating hose. The throwout bearing is a press fit in the throwout bearing cage and on the hub of the throwout sleeve. The assembly of the throwout sleeve and bearing is carried by the steering clutch driving hub. The bore in the throwout sleeve is machined to allow a sliding fit of the throwout sleeve on the driving hub. The clutch throwout yoke is attached to the throwout bearing cage with two trunnion pins. Both the throwout ball bearing and the bore of the throwout sleeve are lubricated from the bevel gear compartment by means of a lubricating hose and wick assembly.

B. Removal

The steering clutch throwout bearing assemblies should be removed and the parts inspected whenever the steering clutches are removed.

NOTE: *The following removal procedure applies to either throwout bearing assembly. Refer to Fig. 7 showing the components in their relative position.*

1. Remove the steering clutch (refer to "STEERING CLUTCH REMOVAL" in this Section).

2. Disconnect the upper end of the lubricating hose for the clutch throwout bearing.

3. Unlock the clutch hub retaining capscrew and remove the capscrew, locking washer, and the hub retaining washer. Using puller tools similar to the ones shown in Fig. 11, pull the steering clutch driving hub from the steering clutch shaft. Remove the steering clutch driving hub, throwout sleeve, throwout ball bearing, and throwout yoke as an assembly.

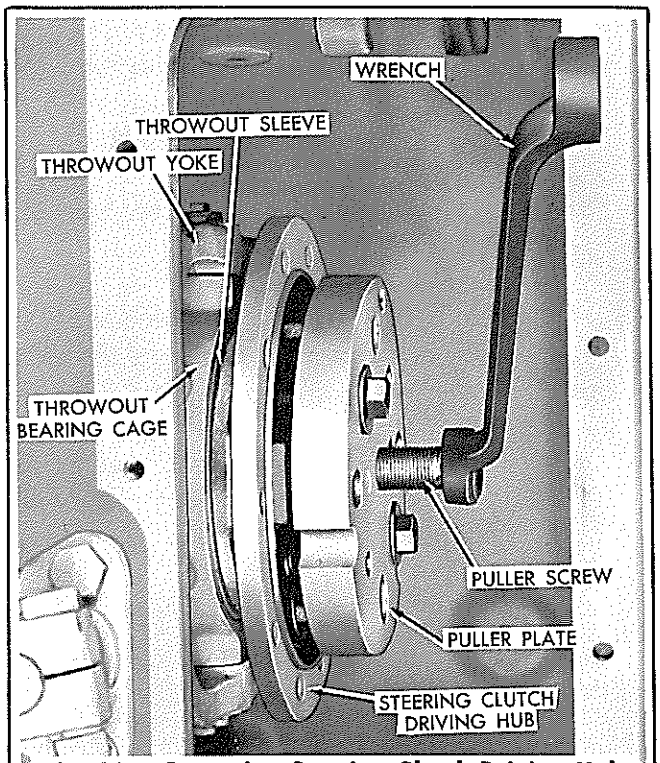

Fig. 11 — Removing Steering Clutch Driving Hub

C. Disassembly

1. Remove the steering clutch driving hub from the clutch throwout sleeve.

2. Remove the capscrews, lockwashers, locking blocks, and the throwout yoke trunnion

pins and remove the throwout yoke (Fig. 3).

3. Remove the throwout bearing lubricating hose.

4. Place the throwout bearing cage assembly in a press and remove the throwout sleeve and throwout ball bearing from the bearing cage.

D. Inspection and Repairs

1. Check the steering clutch throwout ball bearing for wear, indicated by looseness.

2. Check the components for wear and the lubricating hose for oil leakage; replace the necessary parts. If the lubricating wick, in the lubricating hose has become hard, it must be replaced.

3. The wick in the lubricating hose may be replaced as follows:

   a. Run a fine wire through one end of the wick ⅜" from the end, lap the wire back, and twist it to hold the wick.

   b. Soak the wick in light oil until it is completely saturated; heat the oil if necessary.

   c. Run the wire through the lubricating hose, and pull the wick through the hose until ½" of the wick protrudes from the fitting in the upper end of the hose, then remove the wire. CAUTION: *Do not attempt to twist the wick into place as this will change the density and also put a spiral in the wick, changing the amount of oil flow.*

E. Assembly

The throwout ball bearing and throwout sleeve assembly may be assembled by a direct reversal of the disassembly procedure. However, the throwout ball bearing and the hub portion of the clutch driving hub, where the throwout sleeve fits, must be lubricated before assembling.

F. Installation

Install the steering clutch throwout ball bearing, throwout yoke, and steering clutch driving hub on the steering clutch shaft as an assembly. When installing, insert the throwout yoke ball (located in the top of the steering clutch throwout yoke) into position in the intermediate lower lever. Install the steering clutch hub retaining washer, locking washer, and capscrew. Tighten the retaining capscrew to 300 lbs. ft. torque, and lock the capscrew in position with the locking washer. Connect the upper end of the throwout bearing lubricating hose.

SECTION XII — STEERING BRAKES

1. GENERAL DESCRIPTION

The two steering brakes are of the foot operated, mechanically controlled, self-energizing type. The brake band assemblies are of the wrap around, two-piece type with replaceable linings. The brake band assemblies operate on brake drums which enclose the steering clutches.

Pressure applied on the brake pedals is transmitted through linkage to the brake band bellcrank. Action of the brake band bellcrank pulls the ends of the brake band assembly together causing the brake band assembly to tighten around the brake drum.

The steering brakes are used as an aid in steering when use of the steering clutches alone will not provide adequate steering. Do not attempt to use a steering brake for steering without first disengaging the proper steering clutch.

Steering brakes may be used singly or together as service brakes to slow or stop the tractor when working on a grade.

Each steering brake is provided with a parking brake lock to provide a means of holding the brake pedal in the applied position for parking purposes.

Brake pedal pads, clamped to the brake pedals with eye-bolts, are adjustable within limits. The brake pedal shafts are supported by bushings and require only periodic lubrication (refer to 200-Hour Service in "LUBRICATION CHART" for Model HD-6 Tractor). Adjustable brake operating rods connect the brake pedal assemblies to the brake band bell-

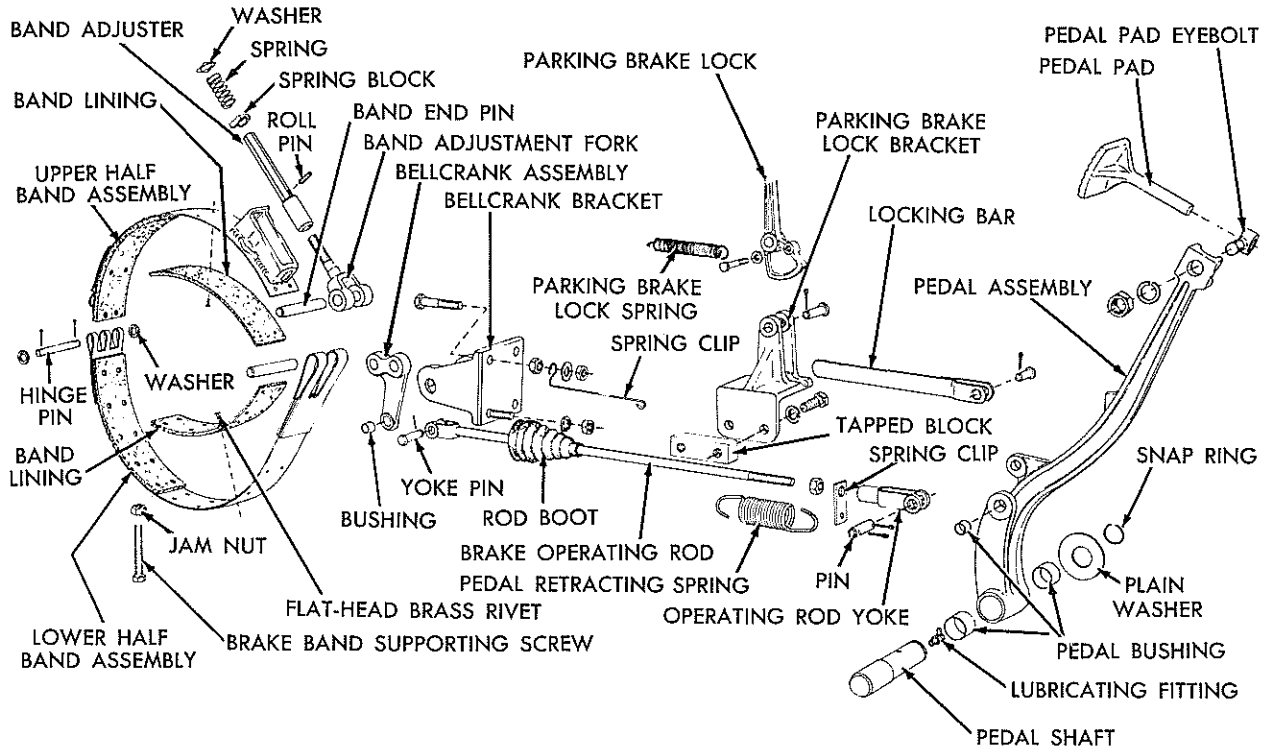

Fig. 1 — Steering Brake Details

crank assemblies. Each brake band bellcrank assembly is attached to both ends of the brake band. A brake pedal retracting spring is attached to the brake operating rod to return the brake pedal assembly to the normal (released) position.

The brake band assembly is made up of two sections to permit easy removal and installation. Each section of the brake band is serviced separately with lining attached, or the lining alone may be replaced.

2. STEERING BRAKE SERVICE

Due to variable operating conditions, specific time intervals for brake service are not given. Each brake will require adjusting before the brake is loose enough to allow the brake pedal to strike the floor plate when the brake is fully applied. Each brake pedal shaft lubricating fitting should be lubricated and the brake linkage oiled when necessary for ease of operation.

When frequent brake adjustments have been necessary, remove the steering clutch compartment cover located over each brake, and inspect the brake band linings for wear. The linings must be replaced before they are worn to a point where the lining retaining rivets will contact and score the brake drum.

A. Steering Brake Adjustment

The steering brakes are properly adjusted when each brake pedal has 1¾" to 2" of free travel before the brakes are applied. Brakes require adjustment before they are loose enough to allow the brake pedal to strike the floor plate when the brakes are fully applied. Brakes adjusted too tightly will cause heating, unnecessary brake wear, and loss of power. When brakes are too loose they will not hold properly and will wear rapidly because of excessive slipping. To adjust each of the steering brakes, proceed as follows:

1. Remove the brake band adjuster access cover from the steering clutch compartment cover.

2. Turn the brake band adjuster clockwise until the brake pedal has 1¾" to 2" free travel. NOTE: *When adjusting the brakes, it is necessary to turn the brake band adjuster in ½ turn increments so that the roll pin in the adjuster will center in the grooves of the adjuster spring block (Fig. 1).*

3. Loosen the brake band supporting screw jam nut (Fig. 3) and tighten the brake band supporting screw until the brake band contacts the brake drum. Back the supporting screw out ½ turn to provide clearance between the brake band and the brake drum, then tighten the jam nut.

4. Install the brake band adjuster access cover.

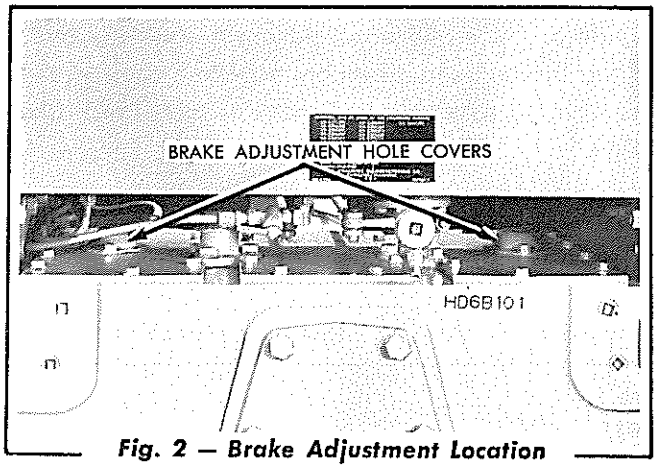

Fig. 2 — Brake Adjustment Location

B. Steering Brake Linkage Adjustment

The approximate assembled length (measured from center-to-center of the yoke pin holes) of the brake operating rods is 22-17/32". When the brake operating rods are correctly adjusted, there should be 1/16" to 1/4" between the rear of the brake pedals and floor plate (brake pedals in fully released position). Adjust the brake operating rod length as necessary to obtain the proper clearance.

C. Washing Steering Brakes

When the steering brakes are properly adjusted, yet fail to hold because of oil on the linings, they may be washed as outlined in "WASHING STEERING CLUTCHES" in HD-6 Tractor Operators Manual.

D. Steering Brake Band Removal

NOTE: *The following removal procedure applies to either brake band.*

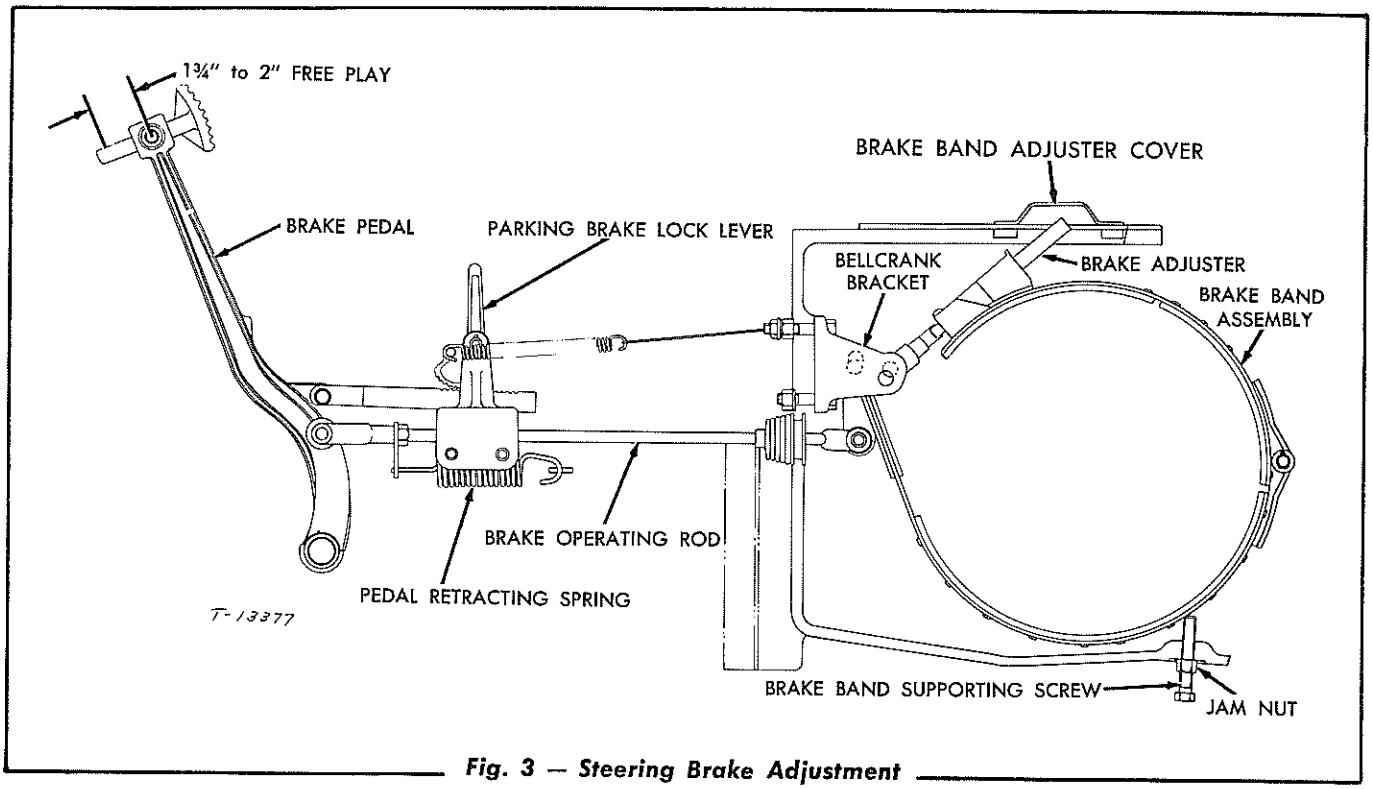

Fig. 3 — Steering Brake Adjustment

1. Remove the seat cushion and the tool box.

2. Close the fuel shut-off cock located at the bottom of the fuel tank and disconnect the fuel supply line. NOTE: *Disconnecting this fuel line is only necessary when removing the left hand brake band.*

3. Remove the steering clutch compartment cover.

4. Turn the brake band adjuster counter-clockwise until it is loosened from the brake band adjustment fork.

5. Remove the brake band supporting screw (Fig. 1).

6. Remove the two pipe plugs, located in the side of the steering clutch housing, in line with the brake band end pins. Using a long 5/16" NC capscrew inserted through the lower hole in the steering clutch housing (Fig. 4, Section XI), turn the capscrew into the tapped hole in the end of the band adjustment fork end pin and remove the end pin. Remove the band adjustment fork. Remove the lower half band assembly end pin through the upper hole by the same method.

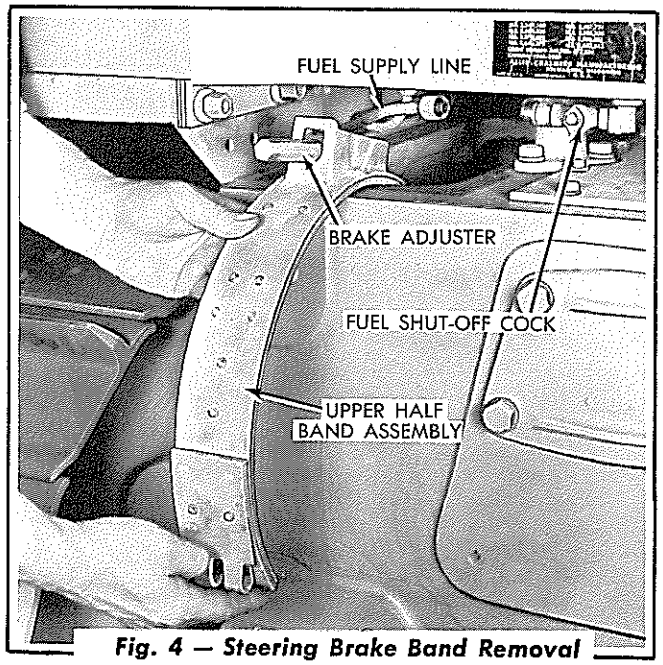

Fig. 4 — Steering Brake Band Removal

7. Turn the brake band assembly forward on the brake drum so that the brake band hinge pin (Fig. 1) can be reached for removal.

8. Remove the cotter pin and the washer from the inner end of the brake band hinge pin and remove the hinge pin.

9. Remove the upper half band assembly as shown in Fig. 4, then remove the lower half band assembly.

E. Steering Brake Inspection and Repair

1. The brake band linings must be replaced, or new brake bands installed, before the linings are worn to a point where the lining retaining rivets will contact and score the brake drums.

2. If the steering brake drum is worn, scored, or grooved excessively, it must be removed and replaced (refer to "STEERING CLUTCH REMOVAL," Section XI).

3. Inspect the brake band end pins, yokes, yoke pins, and bellcrank bushings for wear; replace the necessary parts.

4. Actuate each brake pedal to make certain that the pedal shaft bushings are in good condition.

5. Before installing the steering brake band, particularly after relining, the brake band should be checked for roundness. Place the steering brake band on the steering brake drum and form the band, if necessary, with a soft hammer to make it fit uniformly around the brake drum.

6. All pins and bushings should be lubricated sparingly when reinstalled.

F. Steering Brake Band Installation

Steering brakes may be installed by a direct reversal of the steering brake removal procedure and must be properly adjusted (refer to "STEERING BRAKE ADJUSTMENT" and "STEERING BRAKE LINKAGE ADJUSTMENT" in this Section).

SECTION XIII — FINAL DRIVES

1. DESCRIPTION

The final drives are of the double reduction type, each consisting of a pinion shaft and pinion, intermediate shaft with gear and pinion, track sprocket shaft and gear, and component parts. The final drives are assembled in a combination "one-piece" steering clutch and final drive housing. Since the final drive housings are an integral part of the steering clutch housing, they are line bored, thus eliminating misalignment of the bearing bores.

The final drive pinion shafts are mounted on straight roller bearings. The final drive intermediate shafts and the track sprocket shafts are mounted on tapered roller bearings which are adjustable by means of shims. The pinion shaft bearings and the intermediate shaft bearings are lubricated by oil thrown by the gears.

The final drive outboard bearings of the track sprocket shafts are located in bearing cages which attach to the truck frames. The outboard bearings absorb thrust in both directions.

The two oil seal assemblies (inner and outer) installed in each final drive assembly are of the positive type.

Each final drive pinion is driven by the bevel gear through the steering clutches; each pinion drives the gear and pinion on the corresponding intermediate shaft; the pinion on each intermediate shaft drives the corresponding sprocket shaft gear, which in turn drives the track sprocket.

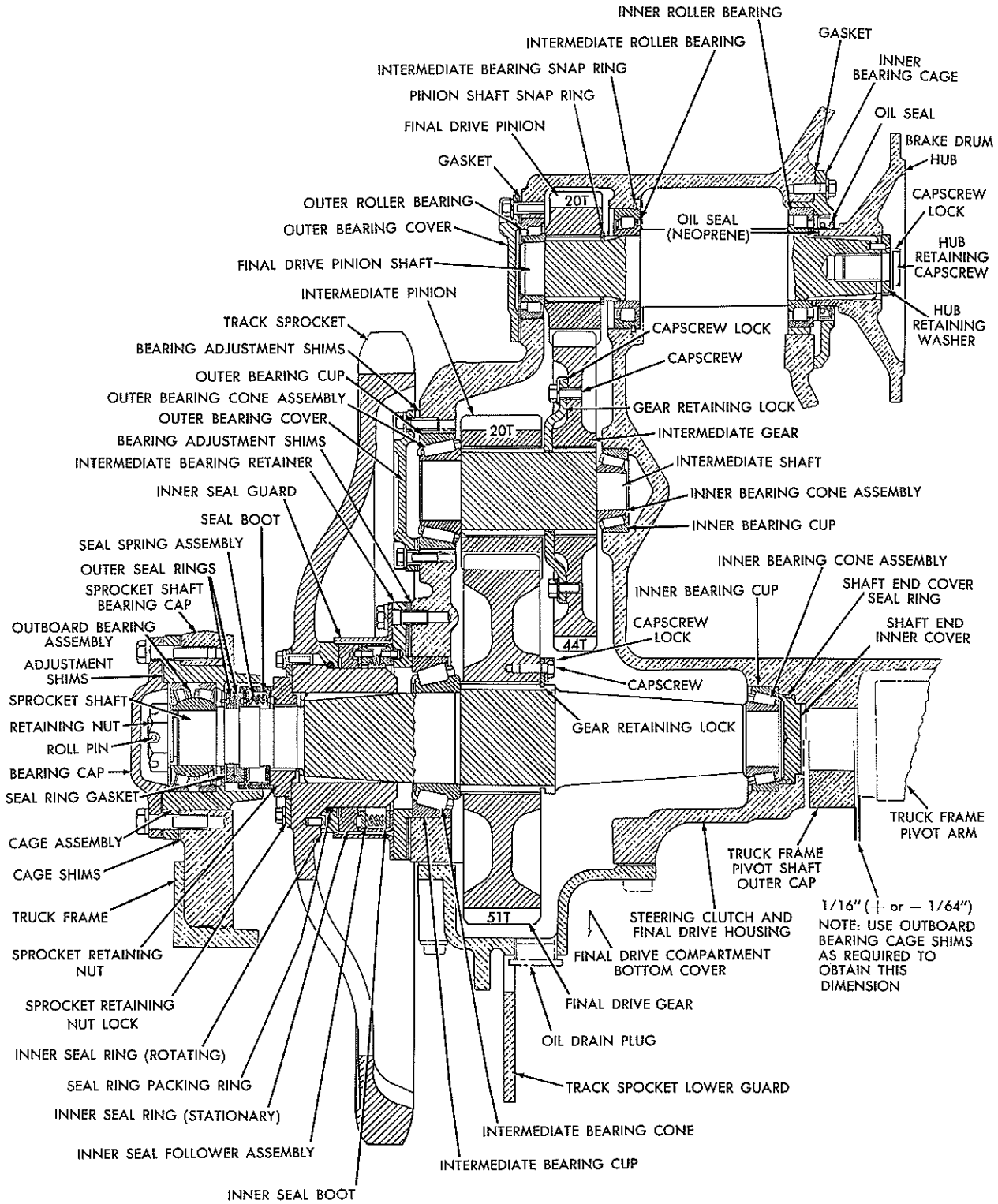

Fig. 1 — Final Drive Assembly — Sectional View (60" Tread Model)

2. DISASSEMBLY

NOTE: *The disassembly procedure for each final drive is the same.*

A. Removal of Track Sprocket and Shaft

1. Uncouple the track by removing the track master pin (refer to "TRACK REMOVAL," Section XVI). Move the tractor backward until the top of the track is off the track sprocket.

2. Drain the oil from the final drive compartment.

3. Remove the truck frame pivot shaft caps, located directly under the steering clutch compartment. Remove the capscrews attaching the outboard bearing cap and remove the cap and bearing adjustment shims; tie the shims to the cap so that they will not be lost. Remove the two capscrews attaching the sprocket shaft bearing cap to the truck frame and remove the cap. Remove the two capscrews attaching the equalizing spring seat to the truck frame.

4. Raise the tractor off the truck frame, using a jack and suitable cribbing under the drawbar supporting plate and the equalizing spring. Raise the tractor high enough so that the truck frame can be tipped outward to clear the equalizing spring when removing.

5. Remove the roll pin and the outboard bearing retaining nut.

6. Using puller tools similar to the ones shown in Fig. 2, pull the final drive outboard bearing cage and bearing from the track sprocket shaft. Use care in handling and prevent damage to the oil seal rings, seal spring assembly, and the seal boot.

7. Remove the two capscrews attaching the track sprocket retaining nut lock, then remove the lock and sprocket retaining nut. Using puller tools similar to the ones shown in Fig. 3, pull the track sprocket and remove it from the track sprocket shaft. Use care and do not damage or scratch the seal ring cemented to the sprocket, and do not damage the threads of the track sprocket shaft.

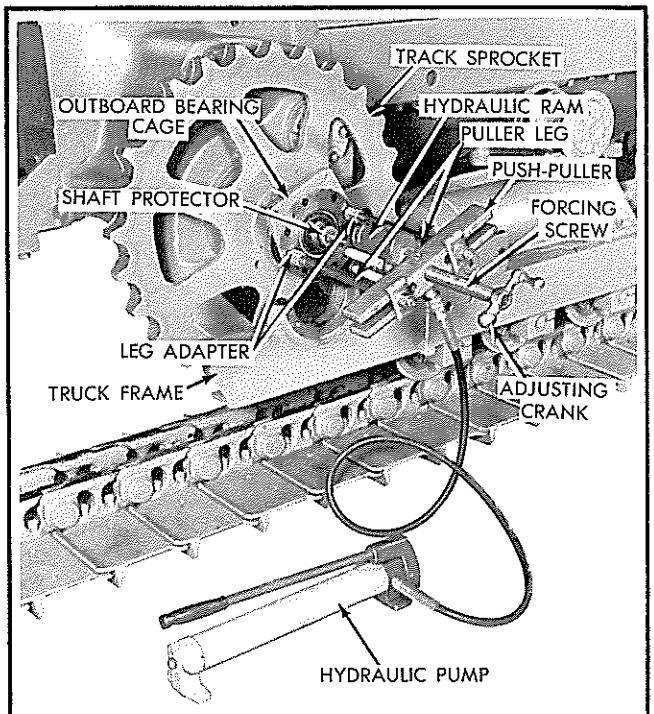

Fig. 2 — Removing Final Drive Outboard Bearing

8. Remove the capscrews attaching the sprocket shaft intermediate bearing retainer and the inner seal guard to the housing and remove the seal guard, bearing retainer, and the sprocket shaft bearing adjustment shims. Tie the adjustment shims to the retainer so that they will not be lost.

9. Remove the capscrews attaching the final drive compartment bottom cover and remove the cover. Unlock and remove the capscrews attaching the sprocket shaft gear retaining lock and remove the lock. NOTE: *To rotate the track sprocket shaft to the correct position for removal of the gear retaining lock, it is necessary to tie the corresponding steering lever back in the disengaged position.* This will hold the steering clutch in the disengaged position and the sprocket shaft gear may then be rotated to the desired position for removal of the gear retaining lock.

10. Place suitable blocking under the sprocket shaft gear, as shown in Fig. 4, to prevent

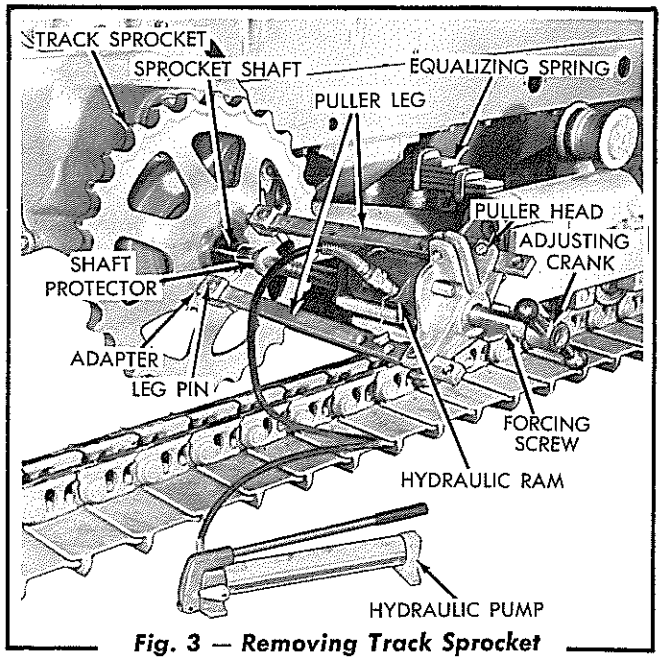

Fig. 3 — Removing Track Sprocket

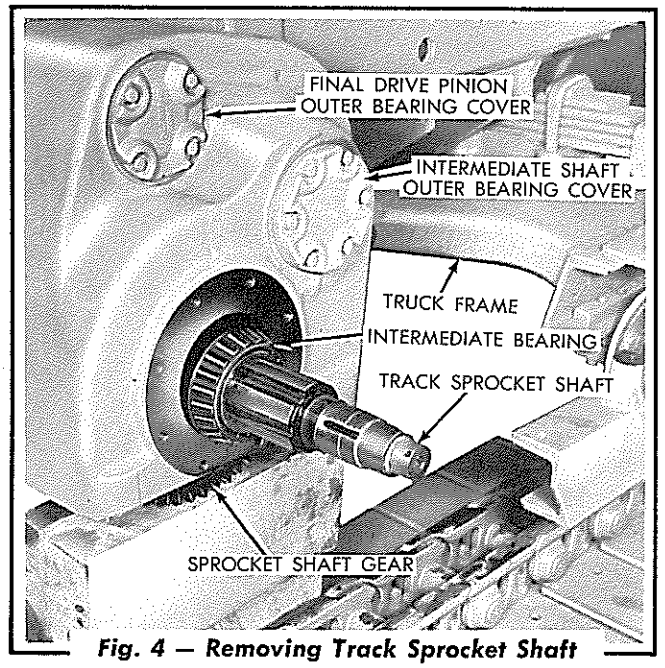

Fig. 4 — Removing Track Sprocket Shaft

the gear from dropping when the sprocket shaft is removed.

11. Using a sliding hammer type puller, pull the sprocket shaft and bearings. IMPORTANT: *Avoid damaging the bearing by holding the shaft out as far as possible so that the bearing is tight against the bearing cup.* Remove the sprocket shaft gear.

12. If it is necessary to remove the sprocket shaft inner bearing cup, the cup may be removed by driving out (toward the final drive gears) on the sprocket shaft end inner cover. Remove the inner bearing cup, inner cover, and cover seal ring.

B. Removal of Final Drive Intermediate Shaft

To remove the intermediate gear lock capscrews, it will be necessary to turn the intermediate gear; this is accomplished by tying the corresponding steering lever in the disengaged position as outlined previously under track sprocket removal in this Section.

1. Unlock the capscrews attaching the two intermediate gear retaining locks to the gear. Remove the capscrews, capscrew locks, and the gear retaining locks.

2. Remove the outer bearing cover and bearing adjustment shims. Tie the shims to the cover so that they will not be lost. Hold or block the intermediate gear and pinion, then pull the intermediate shaft and bearings using a slide hammer puller as shown in Fig. 5. Remove the intermediate gear and the pinion.

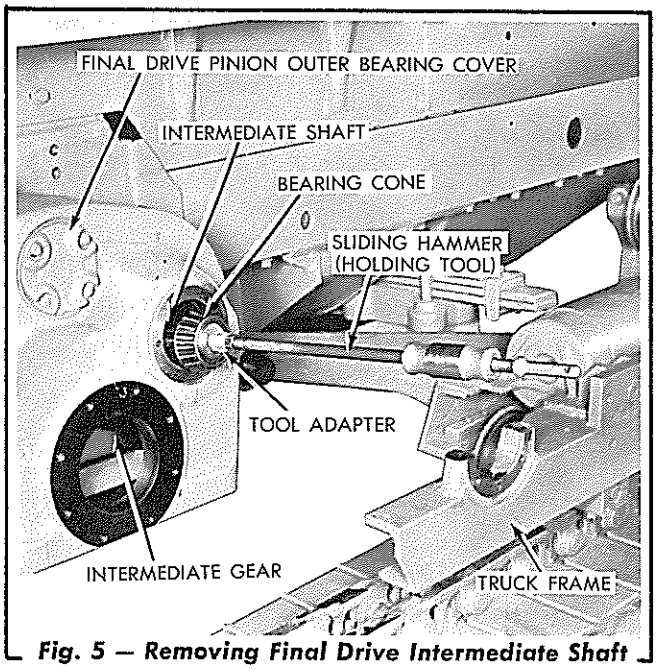

Fig. 5 — Removing Final Drive Intermediate Shaft

3. If it is necessary to remove the intermediate shaft inner bearing cup, use a puller similar to the one shown in Figs. 6 and 7. Insert the puller expander through the cup so that the shoulder of the expander will lock against the back side of the cup then

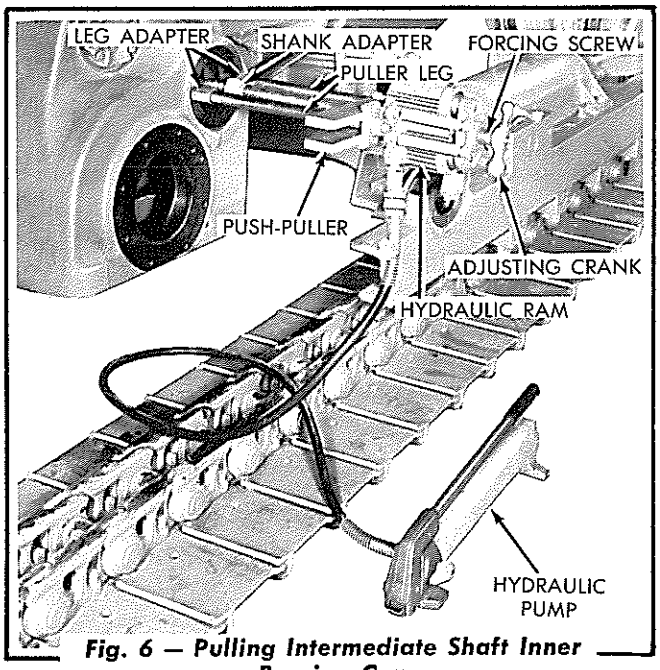

Fig. 6 — Pulling Intermediate Shaft Inner Bearing Cup

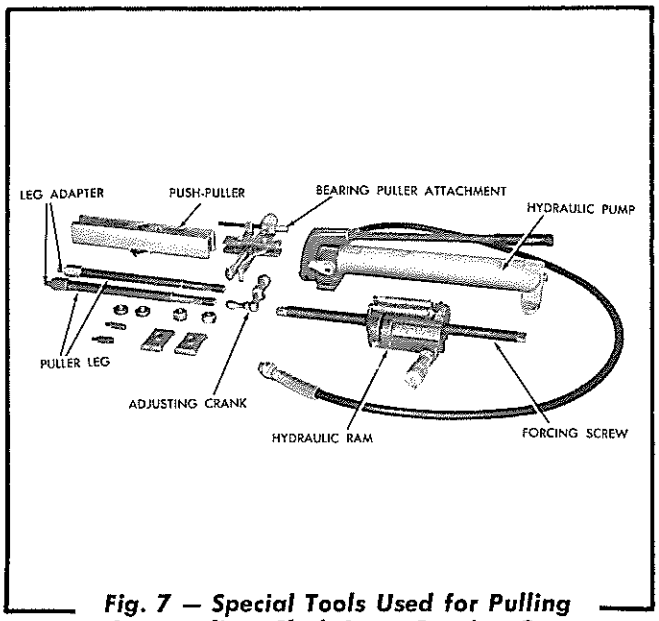

Fig. 7 — Special Tools Used for Pulling Intermediate Shaft Inner Bearing Cup

remove the cup.

C. Removal of Final Drive Pinion Shaft

With the final drive sprocket shaft and the intermediate shaft removed, the pinion shaft may be removed as follows:

1. NOTE: *The pinion shaft can only be removed through the steering clutch compartment; therefore, the corresponding steering clutch must be removed.* Remove the steering clutch (refer to "STEERING CLUTCH REMOVAL," Section XI).

2. Remove the final drive pinion shaft as follows:

60" Tread Model

a. Unlock and remove the brake drum hub retaining capscrew, then remove the capscrew lock and the hub retaining washer. Turn the hub retaining capscrew back into the inner end of the pinion shaft and using a puller, similar to the one shown in Fig. 8, pull and remove the brake drum hub.

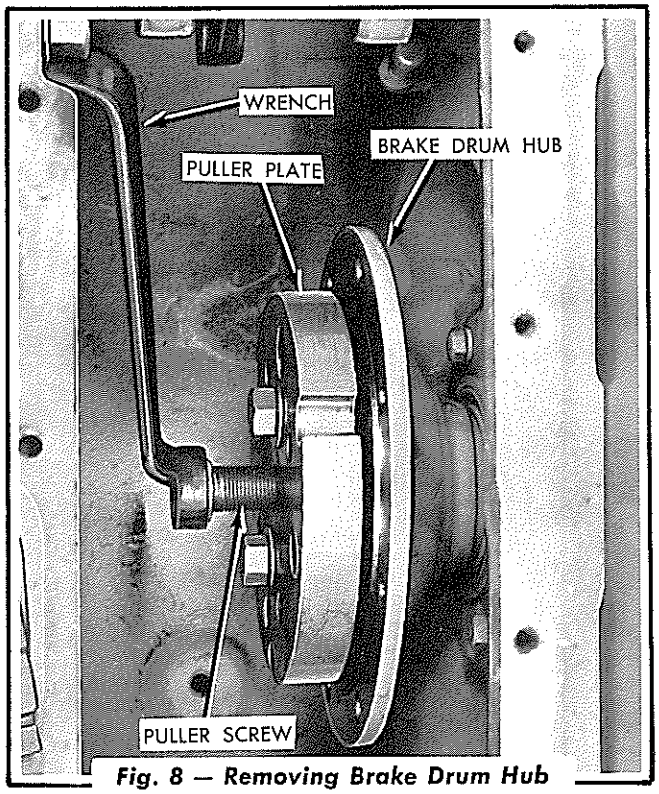

Fig. 8 — Removing Brake Drum Hub

b. Remove the capscrews attaching the pinion shaft inner bearing cage to the housing. Using three ½" NC pusher screws in the tapped holes in the bearing cage, remove the bearing cage and the inner bearing from the housing as shown in Fig. 9. Remove the final drive pinion shaft outer bearing cover and gasket. Hold or block the pinion in place, then drive in on the pinion shaft to remove it from the housing. When removing the pinion shaft, the inner race of the inner bearing, the inner race of the intermediate bearing, and the shaft snap ring will be removed with the shaft; the intermediate bearing and

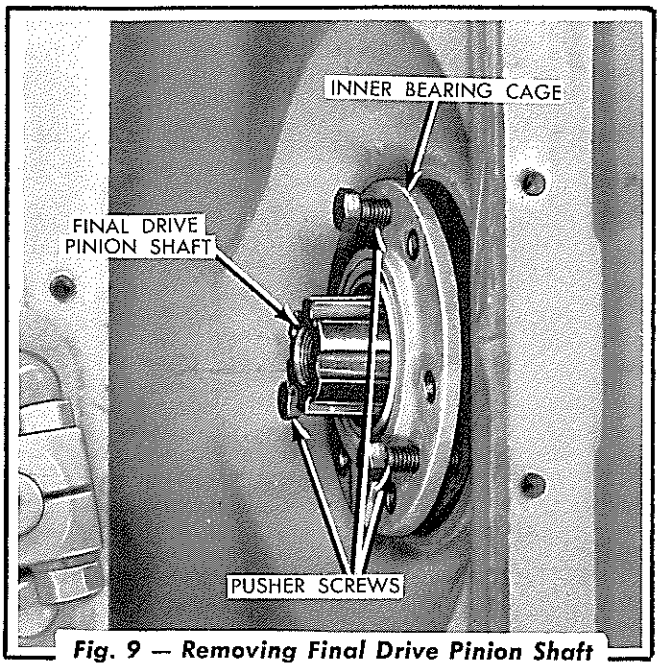

Fig. 9 — Removing Final Drive Pinion Shaft Inner Bearing Cage

outer bearing will remain in the housing.

c. Remove the final drive pinion. Using a driving bar or punch, drive the intermediate and the outer bearings out of the housing.

44" Tread Model

a. Remove the capscrews attaching the pinion shaft inner bearing cage to the housing. NOTE: *Two holes are provided in the brake drum hub for removal of these capscrews.*

b. Remove the pinion shaft outer bearing cover and gasket. Hold or block the pinion in place, then drive in on the shaft to remove it from the housing. When removing the shaft, the inner bearing cage, inner bearing, and shaft snap ring will be removed with the shaft; the outer bearing will remain in the housing.

c. Remove the final drive pinion. Using a driving bar or punch, drive the outer bearing out of the housing.

3. CLEANING AND INSPECTION

Clean and inspect all parts thoroughly as described in pertinent pages of "GENERAL MAINTENANCE INSTRUCTIONS," Section XX. Replace or recondition any damaged parts before assembling the final drive. IMPORTANT: *When installing the final drive bearings on their respective shaft, make certain the bearings are pressed tightly against the shoulders on the shafts.*

If replacement of the final drive outboard bearing is necessary, use tools similar to the ones shown in Fig. 10 to pull the bearing from the cage.

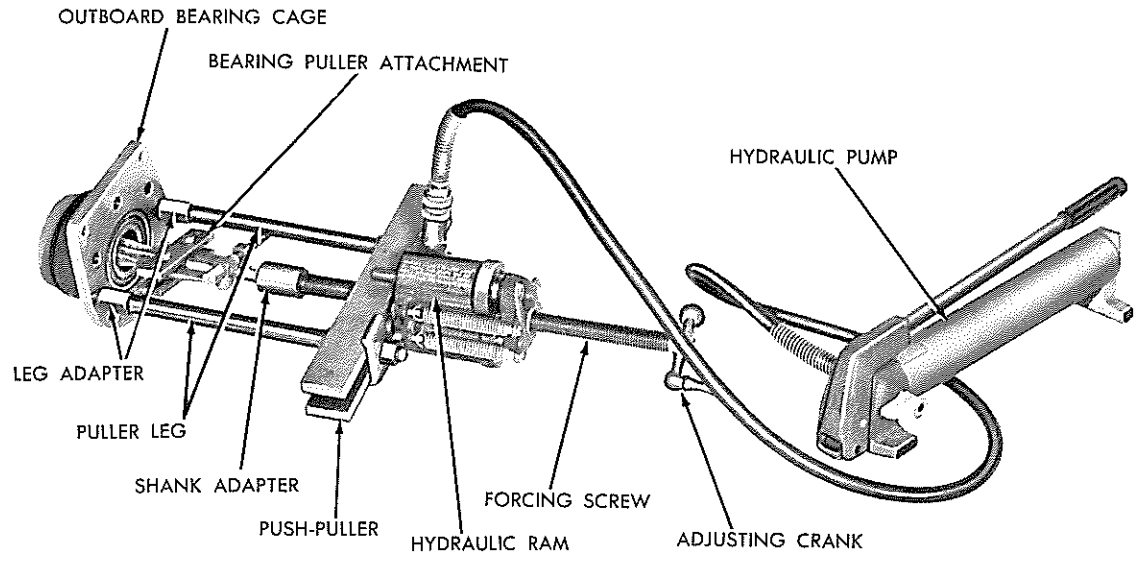

Fig. 10 — Pulling Final Drive Outboard Bearing from Bearing Cage

If replacement of the bearings on the final drive pinion shaft or the intermediate shaft is necessary, use tools similar to the ones shown in Fig. 11 to remove and install the bearings.

If replacement of the bearings on the track sprocket shaft is necessary, use tools similar to the ones shown in Fig. 12 to remove and install the bearings.

If the track sprocket inner bearing cup and the shaft end inner cover were removed for replacement of the inner bearing cup, use tools similar to the ones shown in Fig. 13 and install the shaft end inner cover (with end cover seal ring) and the inner bearing cup in position in the final drive housing.

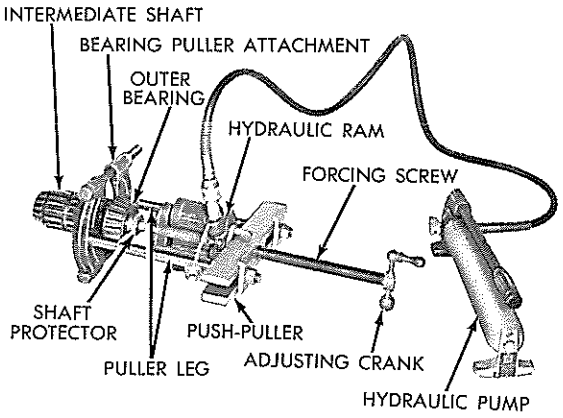

Fig. 11 — Removing Outer Bearing from Intermediate Shaft

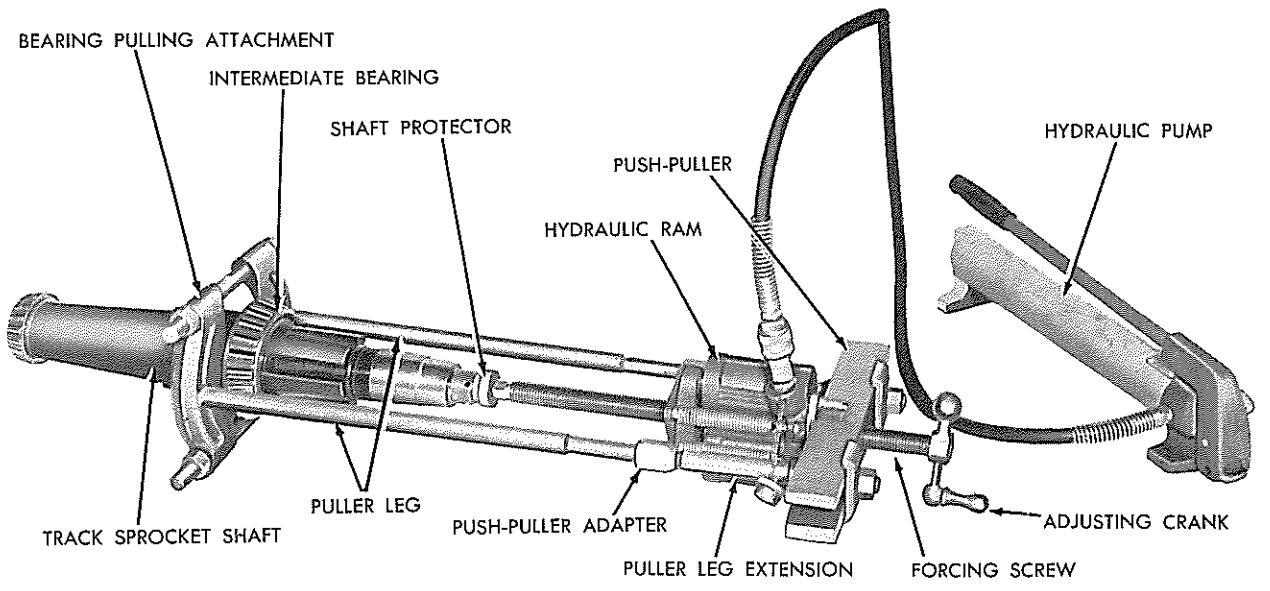

Fig. 12 — Removing Intermediate Bearing from Track Sprocket Shaft

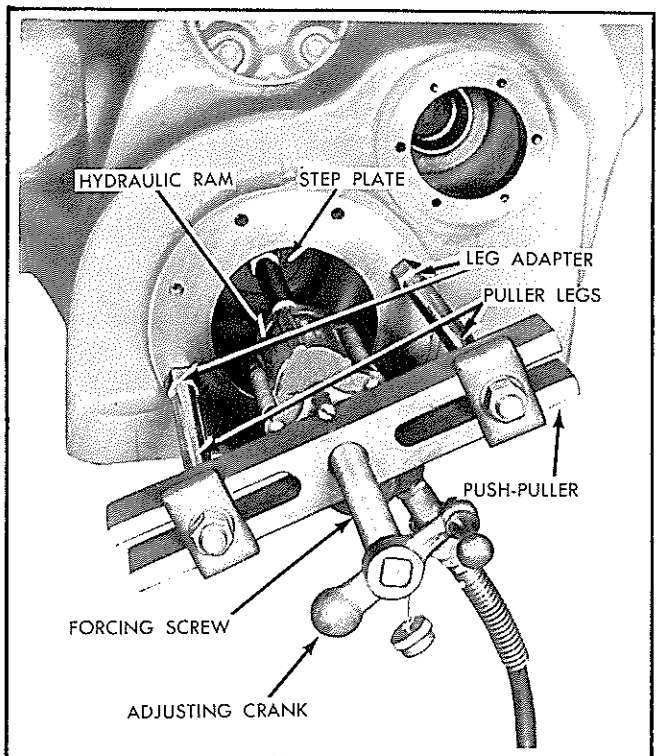

Fig. 13 — Installing Track Sprocket Shaft Inner Bearing Cup

4. ASSEMBLY

Before assembling the final drive, the track sprocket shaft bearings and the intermediate shaft bearings should be adjusted correctly without the gears installed. Proceed as follows:

A. Adjustment of Final Drive Intermediate Shaft Bearings

1. Install the intermediate shaft inner bearing cup in position in the housing. Install the bearings on the intermediate shaft using tools similar to those shown in Fig. 11.

2. Lubricate the bearings with clean oil and insert the intermediate shaft (without the gears) into position in the housing, then install the outer bearing cup. Procure an extra outer bearing cover and drill a 1 inch hole through the center of the cover. Install the drilled cover using the original amount of bearing adjustment shims. Install a ⅝" NC capscrew into the end of the intermediate shaft through the hole in the cover so that a torque indicating wrench can be used to check the bearing pre-load as shown in Fig. 14.

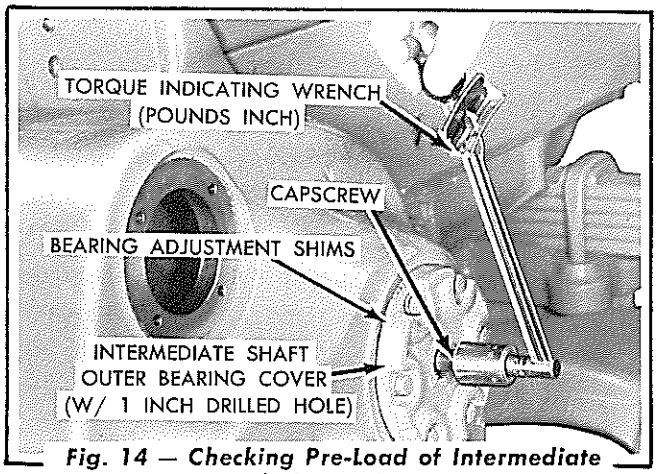

Fig. 14 — Checking Pre-Load of Intermediate Shaft Bearings

3. The intermediate shaft bearings are correctly adjusted when they have 10 to 20 pounds inch pre-load, or when they are adjusted .003" to .004" tight. Add or remove bearing adjustment shims to obtain the proper pre-load. When adjusting, bump the outer bearing cover to make certain the bearings are properly seated. NOTE: *If a torque wrench and an extra outer bearing cover are not available, add or remove bearing adjustment shims until a very slight pre-load (start of pre-load) is noted when turning the intermediate shaft by hand, then*

substitute the combination of shims to reduce the total shim pack thickness .003" to .004" to obtain the proper pre-load.

4. Remove the 5/8" capscrew from the end of the intermediate shaft. Remove the drilled outer bearing cover and adjustment shims. Place the adjustment shim pack with the original outer bearing cover. Pull the intermediate shaft and bearings using a slide hammer puller as shown in Fig. 5.

B. Adjustment of Track Sprocket Shaft Bearings

1. Make certain the sprocket shaft end inner cover, cover seal ring, and the inner bearing cup are properly installed in the housing.

2. Install the inner bearing and the intermediate bearing in position on the sprocket shaft using tools similar to those shown in Fig. 12. Lubricate the bearings with clean oil and insert the sprocket shaft (without the gear) into position in the housing, then install the intermediate bearing cup. Install the bearing retainer with the original amount of bearing adjustment shims.

3. Procure an extra sprocket shaft outboard bearing retaining nut and weld a small plate and a high nut to the outer face of the bearing retaining nut, so that a torque indicating wrench may be used to check the bearing pre-load as shown in Fig. 15. The sprocket shaft bearings (inner and intermediate) are correctly adjusted when they have 10 to 20 pounds inch pre-load, or when they are adjusted .002" to .003" tight. Add or remove bearing adjustment shims to obtain the proper pre-load. NOTE: *If a torque wrench and an adaptor nut are not available, add or remove bearing adjustment shims until a very slight pre-load (start of pre-load) is noted when turning the shaft by hand, then substitute the combination of shims to reduce the total shim pack thickness .002" to .003" to obtain the proper pre-load.*

4. Remove the adaptor nut. Remove the sprocket shaft bearing retainer and adjustment shims. Keep the adjustment shim pack with the bearing retainer. Pull the sprocket shaft and bearings using a slide hammer puller.

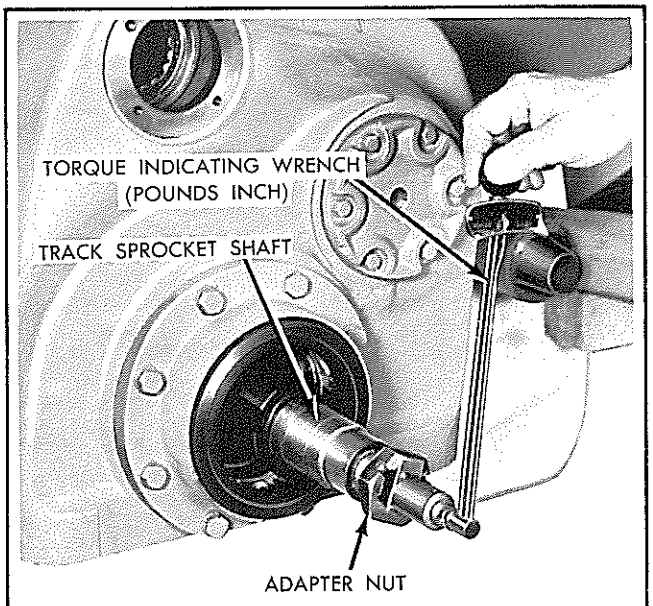

Fig. 15 — Checking Pre-Load of Sprocket Shaft Bearings

C. Installation of Track Sprocket Shaft Seal Assembly

If the seal assemblies for the track sprocket shaft were removed, the seal assemblies should be installed at this time so that the "NEOPRENE" cement, used for cementing the seal assemblies in place, will have sufficient time to dry.

To Install the Inner Seal Assembly:

1. Place the sprocket shaft intermediate bearing retainer on a clean bench, with the flat face of the retainer up.

2. Make certain the inner seal follower assembly, inner seal boot, and the inner seal ring (stationary ring) are clean and dry. Install the seal boot on the seal follower assembly, lining up the holes in the boot with the protruding pins of the follower assembly. Hold each lip of the seal boot out and coat the inside of the lips and the sides of the follower assembly with "NEOPRENE" cement. Press the boot lips back in place against the follower assembly.

3. Coat the outer face of one lip of the inner seal boot and the machined face of the intermediate bearing retainer with "NEOPRENE" cement. Immediately place the inner seal boot and inner seal follower assembly in position on the bearing retainer, inserting the ends of the pins into the corresponding holes in the retainer.

4. Coat the face of the outer lip of the inner seal boot and the back face of the inner seal ring (stationary ring) with "NEOPRENE" cement. Immediately place the inner seal ring on the seal boot and follower assembly, inserting the ends of the follower pins into the corresponding holes in the inner seal ring.

5. Place a weight on the inner seal ring, using a clean cloth between the weight and the seal ring, and allow the "NEOPRENE" cement to dry and set thoroughly. NOTE: *When coating the above parts with "NEOPRENE" cement, do not use an excessive amount.* The "NEOPRENE" cement and solvent for thinning can be purchased from your "Allis-Chalmers" Construction Machinery Dealer.

6. Install the seal ring packing ring (rubber) in place in the inner seal ring (rotating ring), then install the inner seal ring in position on the sprocket hub with the chamfered side of the ring next to the sprocket.

To Install the Outer Seal Assembly:

1. Place the outboard bearing cage assembly on a clean bench, with the cover attaching side of the cage downward.

2. Make certain the seal boot, seal spring assembly, and the outer seal rings are clean and dry. Install the seal boot on the seal spring assembly, lining up the holes in the boot with the protruding pins of the seal spring assembly. Hold each lip of the boot out and coat the inside of the lips and the sides of the spring assembly with "NEOPRENE" cement. Press the lips back in place against the spring assembly.

3. Coat the outer face of one lip of the seal boot and coat the machined face in the bottom of the counterbore in the sprocket retaining nut with "NEOPRENE" cement. Immediately place the boot and spring assembly in the retaining nut, inserting the ends of the pins into the corresponding holes of the nut.

4. Coat the face of the outer lip of the boot and the back face of the seal ring with "NEOPRENE" cement. Immediately place the seal ring on the boot assembly, inserting the ends of the pins into the corresponding holes in the seal ring.

5. Place a weight on the seal ring using a clean cloth between the weight and the seal ring and allow the "NEOPRENE" cement to dry and set thoroughly.

6. Coat one side of the seal ring gasket and coat the machined surface in the bottom of the counterbore of the outboard bearing cage with "NEOPRENE" cement. Immediately place the seal ring gasket in the bearing cage, inserting the ends of the pins into the corresponding holes in the gasket.

7. Coat the face of the seal ring gasket and the back face of the outer seal ring with "NEOPRENE" cement and immediately place the seal ring on the gasket, inserting the ends of the pins into the corresponding holes in the seal ring.

8. Place a weight on the seal ring using a clean cloth between the weight and the seal ring and allow the "NEOPRENE" cement to dry and set thoroughly.

   NOTE: *When coating the above parts with "NEOPRENE" cement, do not use an excessive amount.* The "NEOPRENE" cement and solvent for thinning can be purchased from your "Allis-Chalmers" Construction Machinery Dealer.

D. Installation of Final Drive Pinion Shaft

60" Tread Model

1. Install the inner race of the intermediate roller bearing and the inner race of the inner roller bearing in place on the shaft, if they were removed. Install these bearing races so that the shoulders of the races are next to the shoulders on the shaft. Install the pinion shaft snap ring in position on the shaft.

2. Lubricate and install the intermediate roller bearing in position in the final drive housing.

3. Hold or block the final drive pinion (with hub side towards the outer bearing bore) in position in the final drive housing, then insert the pinion shaft (from the inside of the steering clutch compartment) into position in the intermediate roller bearing and the pinion.

4. Install the inner roller bearing and the pinion shaft oil seal (lip type) in the inner bearing cage. NOTE: *Install the oil seal in the cage so that the lip of the seal is towards the roller bearing.*

5. Lubricate the inner roller bearing and the oil seal with clean oil and install the bearing cage, with bearing cage gasket, in position in the housing. IMPORTANT: *Make certain that the oil hole in the bearing cage and the gasket are positioned in line with the oil hole in the housing.* Tighten the attaching capscrews securely.

6. Install the oil seal ("NEOPRENE") on the inner end of the pinion shaft and push the seal into position. Install the brake drum hub on the shaft, then install the brake drum hub retaining washer, capscrew lock, and the retaining capscrew. Tighten the capscrew to 300 lbs. ft. torque, then lock the capscrew in position with the capscrew lock.

7. Install the inner race of the pinion shaft

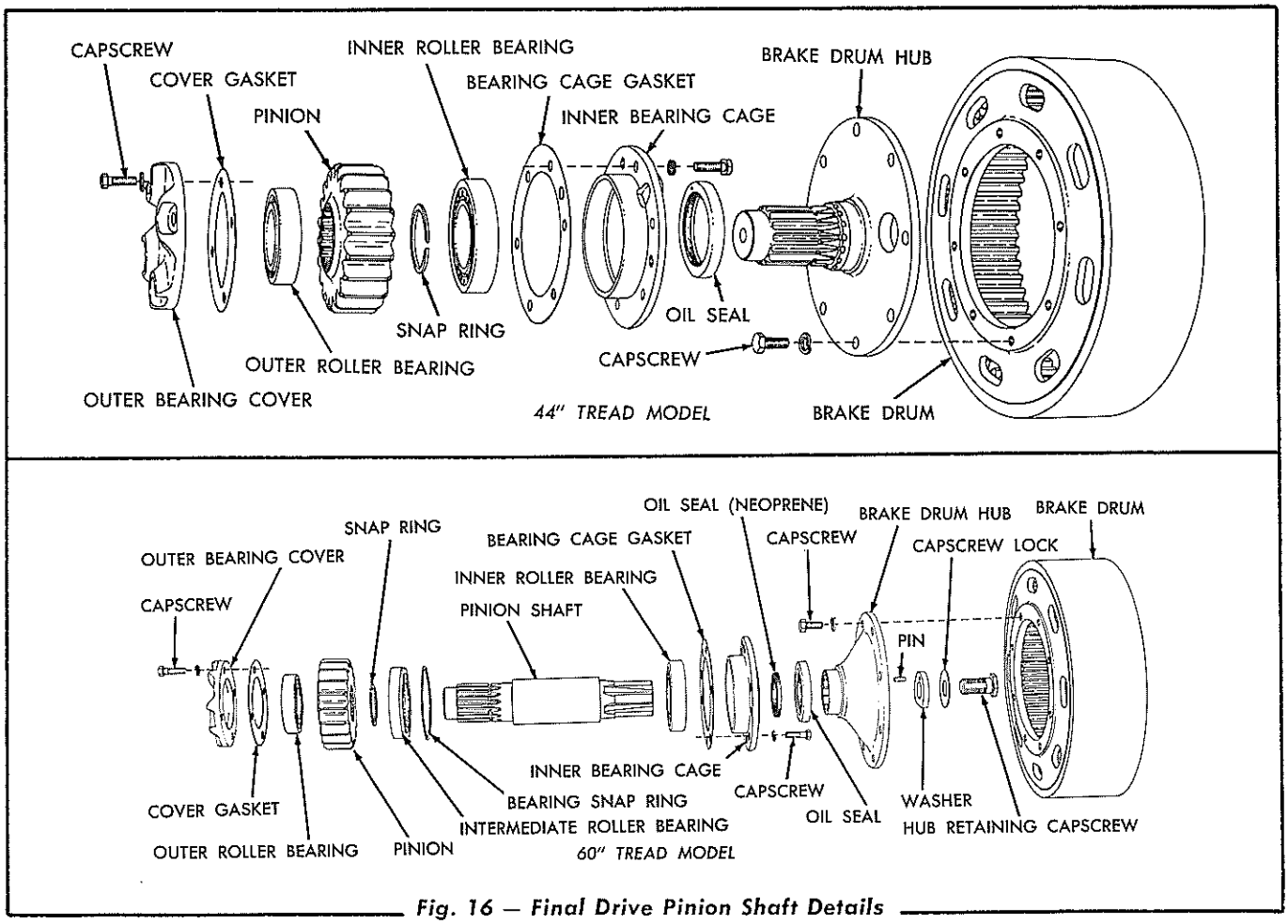

Fig. 16 — Final Drive Pinion Shaft Details

outer roller bearing onto the shaft (shoulder of the race next to the shaft splines), then install the outer bearing. Lubricate the outer bearing and install the outer bearing cover and gasket.

44" Tread Model

1. Install the inner roller bearing and the pinion shaft oil seal in the inner bearing cage. NOTE: *Install the oil seal in the cage so that the lip of the seal is towards the roller bearing.*

2. Lubricate the inner roller bearing and oil seal with clean oil, then install the bearing cage in position on the shaft of the brake drum hub. Place the inner race of the inner roller bearing on the shaft with the shoulder of race towards the outer end of the shaft. Drive or press the race into position on the shaft. Install the snap ring in position on the shaft. Place the bearing cage gasket in position on the cage.

3. Hold or block the final drive pinion (with hub side towards the outer bearing bore) in position in the final drive housing, then insert the brake drum hub, with the bearing cage assembly, into position in the housing and final drive pinion. Install the bearing cage attaching capscrews and tighten securely.

4. Install the inner race of the outer roller bearing onto the shaft (shoulder of race next to the pinion), then install the outer bearing. Lubricate the outer bearing with clean oil and install the outer bearing cover and gasket.

E. Installation of Final Drive Intermediate Shaft

1. With the intermediate shaft bearings and the inner bearing cup installed (as in "ADJUSTMENT OF FINAL DRIVE INTERMEDIATE SHAFT BEARINGS," Par. A above), refer to Fig. 5 and turn a holding tool into the outer end of the intermediate shaft as shown. Hold the intermediate pinion in position in the housing and start the intermediate shaft. Hold the intermediate gear in position in the housing (with lock side of gear towards the intermediate pinion) and start the intermediate shaft into the gear.

2. Hold the gears and shaft so that the inner bearing is in position in the inner bearing cup, then install the outer bearing cup in position in the housing.

3. Install the outer bearing cover and the correct amount of bearing adjustment shims as determined in Step 3 of "ADJUSTMENT OF FINAL DRIVE INTERMEDIATE SHAFT BEARINGS," Par. A above. Tighten the attaching capscrews securely.

4. Position the intermediate gear on the shaft so that the gear retaining locks may be installed on the gear and into the machined groove in the shaft. Install the two gear retaining locks, attaching capscrews, and capscrew locks. Tighten the capscrews securely and lock in position with the cap-

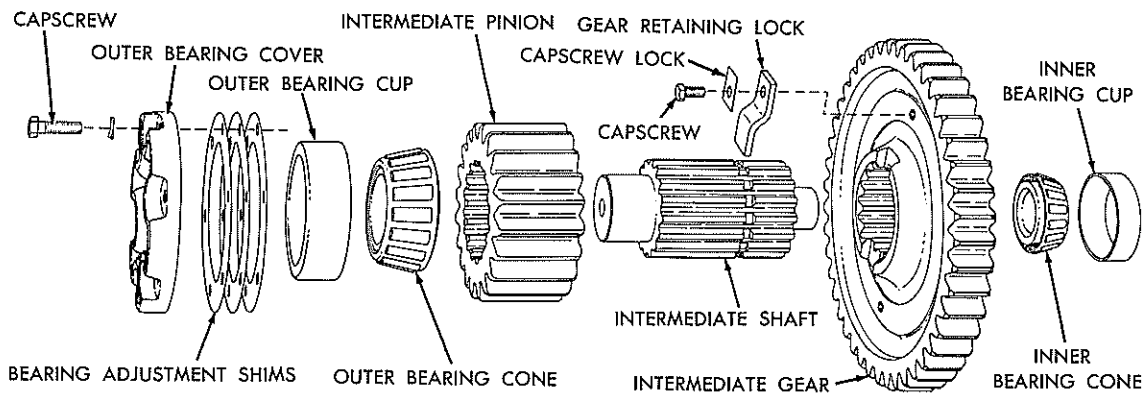

Fig. 17 — Final Drive Intermediate Shaft Details

screw locks.

F. Installation of Track Sprocket Shaft and Sprocket

1. With the sprocket shaft inner and intermediate bearings and the inner bearing cup installed (as in "ADJUSTMENT OF TRACK SPROCKET SHAFT BEARINGS," Par. B above), install the final drive gear (with the tapped holes for the gear retaining lock capscrews toward the inner bearing cup) in position in the housing and block the gear in position so that the track sprocket shaft may be inserted.

2. Insert the sprocket shaft into the housing and the final drive gear, push the shaft in so that the inner bearing is in position in the inner bearing cup, then install the sprocket shaft intermediate bearing cup in position in the housing.

3. Install the intermediate bearing retainer (with the inner seal assembly attached) and the inner seal guard in position on the housing, using the correct amount of bearing adjustment shims as determined in Step 3 of "ADJUSTMENT OF TRACK SPROCKET SHAFT BEARING," Par. B above. Tighten the attaching capscrews securely.

4. Position the sprocket shaft gear so that the gear retaining lock may be installed on the gear and into the machined groove in the sprocket shaft. Install the gear retaining lock, attaching capscrews, and capscrew locks. Tighten the capscrews securely and lock in position with the capscrew locks.

5. Install the final drive compartment bottom cover and gasket. Tighten the attaching capscrews securely.

6. Lubricate the mating surfaces of the inner seal rings, then install the track sprocket (with the inner seal ring in place) on the track sprocket shaft. Install the sprocket retaining nut and tighten to a torque of 2200 to 2300 lbs. ft. This may be accomplished as follows:

   a. Place a wooden block against the track sprocket to keep it from turning.

   b. Use a suitable wrench with a ten foot extension on the handle and tighten the nut "snugly" by hand. Measure the distance of ten feet from the center of the track sprocket shaft to a point on the wrench handle extension and mark this location. Attach a weight of 220 to 230 lbs. at the 10 foot mark on the wrench handle extension to obtain the specified torque on the nut.

   NOTE: *If a longer or shorter extension is used on the wrench handle, the num-*

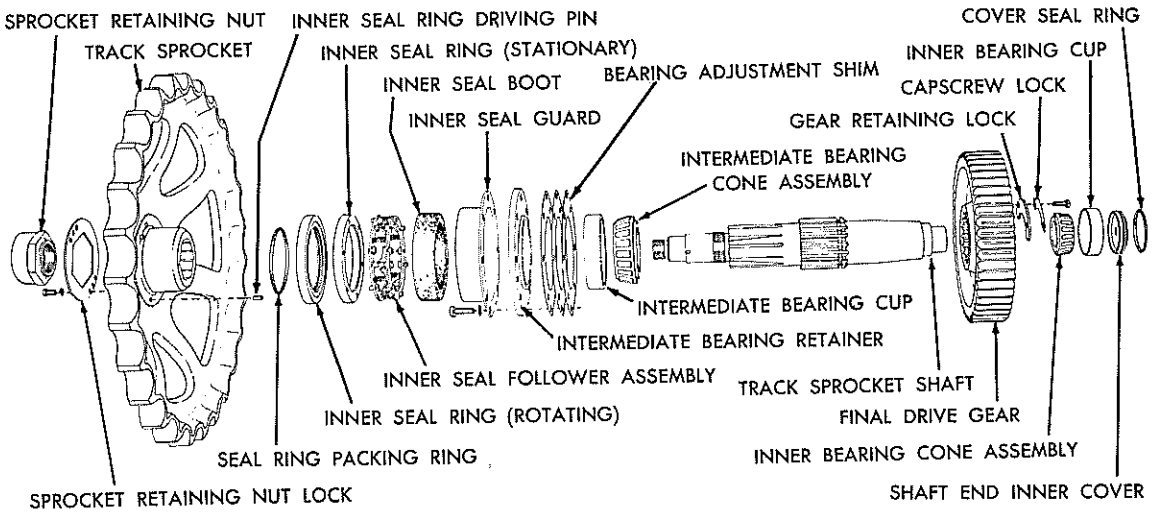

Fig. 18 — Final Drive Sprocket, Shaft, and Gear Details

ber of lbs. required at the point where the weight is attached may be obtained by measuring the distance from the center of the sprocket shaft to the point where the weight is attached and dividing 2300 by this measurement in feet.

EXAMPLE: If the distance from the center of the sprocket shaft to the weight is 8 ft., 2300 ÷ 8 = 287.5 lbs. which is the weight required on the handle extension to impose a torque of 2300 lbs. ft. on the track sprocket retaining nut.

7. Install the sprocket retaining nut lock and tighten the lock attaching capscrews securely.

G. Installation of Track Sprocket Shaft Outboard Bearing Cage and Outboard Bearing

1. With the outboard bearing installed in the cage, install the cage on the sprocket shaft to a position allowing .050" to .060" clearance between the outer seal rings. Lubricate the outboard bearing with clean oil. IMPORTANT: *Do not allow the outer seal rings to contact each other, as this will cause a drag between the rings, thus a false reading will be obtained when checking the adjustment of the outboard bearing.*

2. Install the sprocket shaft outboard bearing cap using the original amount of outboard bearing adjustment shims.

3. The outboard bearing is correctly adjusted when it has 5 to 9 pounds inch pre-load. Using tools similar to those shown in Figs. 20 and 21, check the bearing pre-load as follows: Turn the outboard bearing cage so that the extended portion of the flange, used for attaching the track sprocket guard, is down. Install the outboard bearing cage torque wrench adapter in position on the outboard bearing cap and using a pounds inch indicating torque wrench on the ½" high nut of the adaptor, revolve the outboard bearing cage approximately 30° in either direction and note the maximum reading indicated on the torque wrench. Add or remove outboard bearing adjustment shims until the correct outboard bearing pre-load of 5 to 9 pounds inch is obtained. Make certain that the mating surfaces of the outer seal rings are not in contact and that the outboard bearing is not cramped on the sprocket shaft, while the bearing pre-load is being checked.

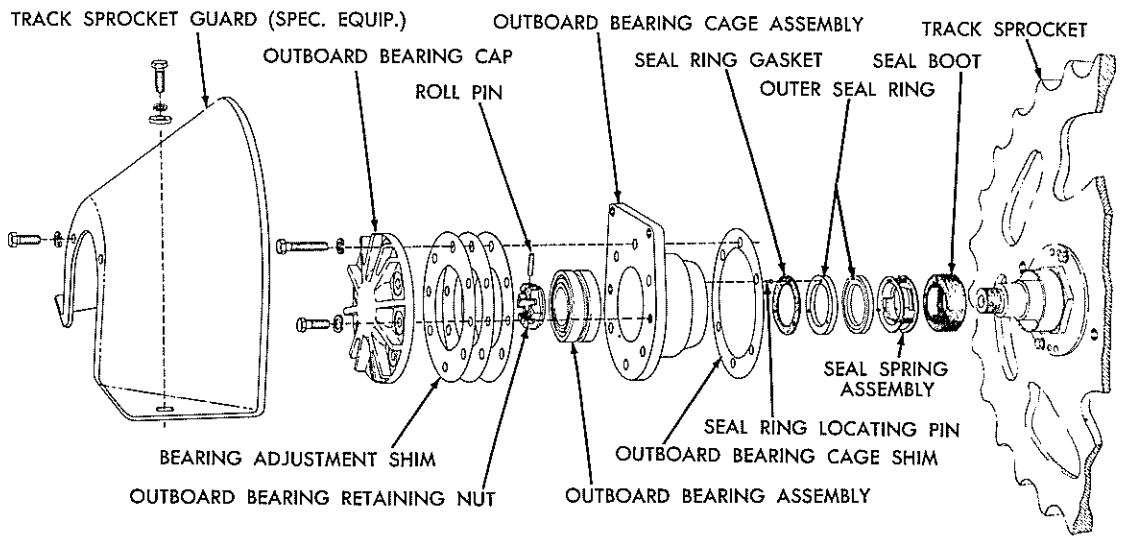

Fig. 19 — Final Drive Outboard Bearing and Seal Details

NOTE: *The outboard bearing cage torque wrench adaptor illustrated in Fig. 20 can be made from a steel strap following the dimensions shown in Fig. 21.*

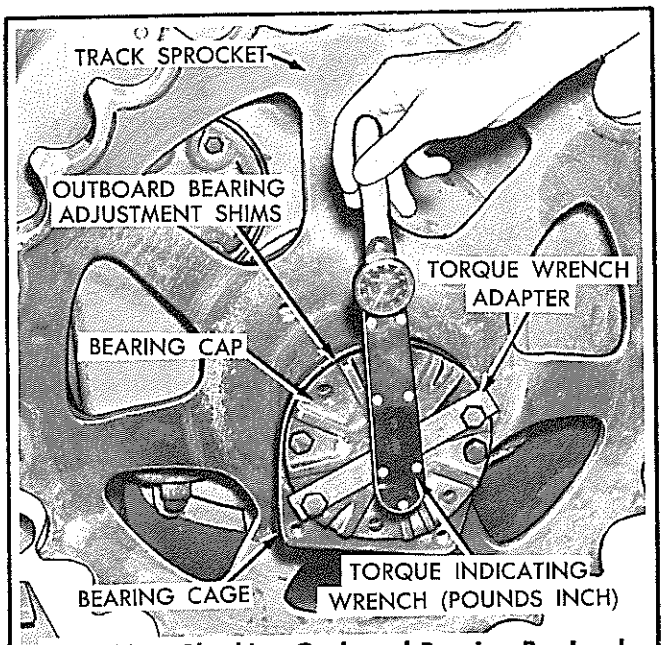

Fig. 20 — Checking Outboard Bearing Pre-Load Using Torque Wrench

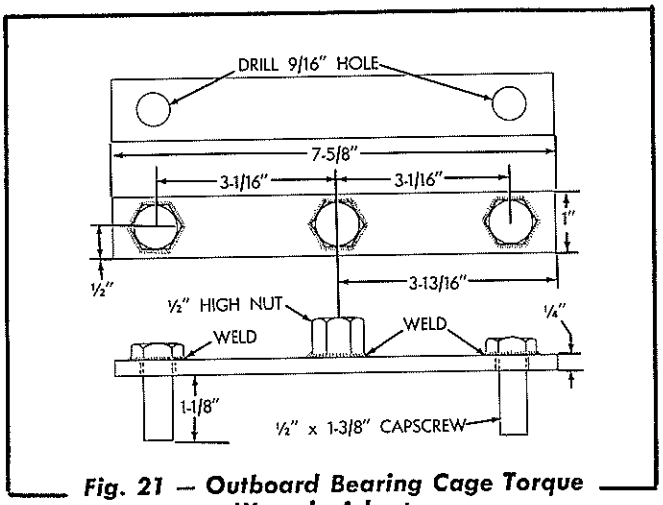

Fig. 21 — Outboard Bearing Cage Torque Wrench Adapter

4. After the correct amount of bearing adjustment shims have been determined, remove the sprocket shaft outboard bearing cap and the bearing adjustment shims. Lubricate the mating surfaces of the outer seal rings, then install the outboard bearing retaining nut and tighten it securely. When tightening the nut, the bearing cage will be pressed onto the shaft the remaining distance. Install the roll pin to lock the retaining nut.

5. Install the sprocket shaft outboard bearing cap and the correct amount of bearing adjustment shims determined in Step 3 above. Tighten the attaching capscrews securely.

H. Installation of Truck Frame and Track

1. Install the steering clutch and steering brake (refer to "STEERING CLUTCH INSTALLATION," Section XI).

2. Install the fuel tank and connect the fuel lines.

3. Using a pry bar, tip the truck frame out far enough so that the track support roller bracket will clear the end of the equalizing spring, then roll the truck frame back into position under the tractor. Lower the tractor onto the truck frame, making certain that the truck frame is properly positioned under the tractor so that the dowel pin for the truck frame pivot shaft enters the hole in the inner end of the pivot shaft.

4. Start the two ¾" NF x 3¾" capscrews which attach the sprocket shaft bearing cap (Fig. 1) to the truck frame but do not tighten at this time.

5. The truck frame pivot shaft caps are center punched one (1), two (2), three (3), and four (4) so that they may be reinstalled in their original positions to match the center punch marks in the case itself. Install the caps, making certain that they are installed in their original position. Tighten the attaching capscrews to 130 to 150 lbs. ft. torque.

6. Tighten the capscrews attaching the outboard bearing cage and cap to the truck frame and to the sprocket shaft bearing cap. Tighten the two capscrews attaching the sprocket shaft bearing cap to the truck frame.

7. Check the clearance between the truck frame pivot arm and the pivot shaft outer cap; a clearance of 1/16" (+ or — 1/64") should be obtained at this point (.010" to .0625" clearance on the HD-6G only). If the proper clearance is not obtained at this

point, add or remove outboard bearing cage shims (Fig. 1), between the outboard bearing cage and the truck frame, to obtain the specified clearance.

8. Install the capscrews which attach the equalizing spring seat to the truck frame and tighten securely.

9. Install the oil drain plug in the final drive compartment bottom cover and fill the final drive compartment to the proper level using the specified lubricant.

10. Refer to "TRACK INSTALLATION" in Section XVI and install and adjust the track.

SECTION XIV — TRUCK FRAMES

1. DESCRIPTION

The major components of a truck assembly are: truck frame, truck wheels, track support roller, track release, and track idler.

The truck frame is made of steel sections welded into a rigid "A" frame assembly. Each truck frame pivots at the rear on a pivot shaft and a sprocket shaft outboard bearing. The pivot shaft is secured to the bottom of the steering clutch and final drive housing by pivot shaft caps. The sprocket shaft outboard bearing is installed in the sprocket shaft outboard bearing cage and the truck frame is attached to the outboard bearing cage by capscrews. The truck frames support the tractor main frame by the use of an equalizing spring, except on the HD-6G; this model is supported by a rigid beam in place of the equalizing spring.

Each truck frame assembly on the HD-6A and HD-6B Models incorporates four single flange truck wheels, the HD-6E has five, and the HD-6G has six. The truck wheels revolve on tapered roller bearings, have positive type grease seals and 1000 hour recommended lubrication periods. The truck wheels are attached to the truck frames by capscrews inserted through the wheel attaching brackets and threaded into replaceable tapped blocks. NOTE: *Heavy duty truck wheels (Fig. 10) are available as Special Equipment.* The tractor may be ordered with heavy duty wheels factory installed. The heavy duty truck wheels are also available for field service.

The track support roller and track idler assemblies contain tapered roller bearings and positive type grease seal assemblies. Internally, their construction is much the same as that of the truck wheels.

The track release is a direct acting coil spring mechanism with a protecting guard. The track support roller bracket also serves as the front bracket for the track release spring and the rear bracket for the release spring is welded to the truck frame. The track idler brackets are guided on the truck frames by replaceable slide bars and are actuated by the track release springs.

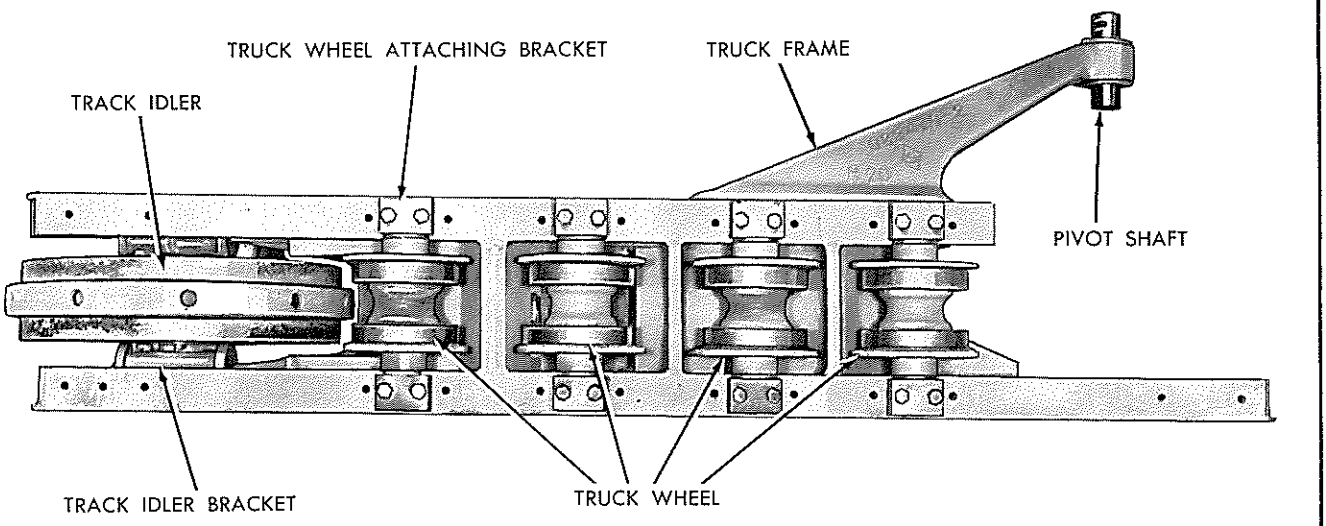

Fig. 1 — HD-6 Truck Frame Assembly

2. TRUCK FRAME

A. Maintenance

Maintenance of the truck frames consist of periodic inspection and the necessary corrections to obtain proper operating conditions. Truck frames sprung or twisted "out-of-line" will contribute to rapid wear of the truck wheels, track idlers, support rollers, track sprockets, and track assemblies and should be repaired or replaced. Excessively worn pivot shaft bushings and shafts, or excessively worn sprocket shaft outboard bearings, may also cause misalignment of the truck frames and should be replaced immediately.

B. Truck Frame Removal

1. Uncouple the track by removing the track master pin (refer to "TRACK REMOVAL," Section XVI). Move the tractor backward until the top of the track is off the track sprocket.

2. Remove the track idler, track release yoke, truck frame pivot shaft caps, and remove the six capscrews attaching the outboard bearing cap to the truck frame and sprocket shaft bearing cap. Remove the two capscrews attaching the sprocket shaft bearing cap to the truck frame and remove the cap. Remove the two capscrews attaching the equalizing spring seat to the truck frame.

3. Raise the tractor off the truck frame using a jack and suitable cribbing under the drawbar supporting plate and the equalizing spring. Raise the tractor high enough so that the truck frame can be tipped outward to clear the equalizing spring when removing.

4. Use a pry bar in the truck frame to tip the truck frame assembly outward as shown in Fig. 3, then roll it forward on the track.

   NOTE: *To remove a truck frame from an HD-6G, it will be necessary to raise the tractor high enough to pull the truck frame from the side.*

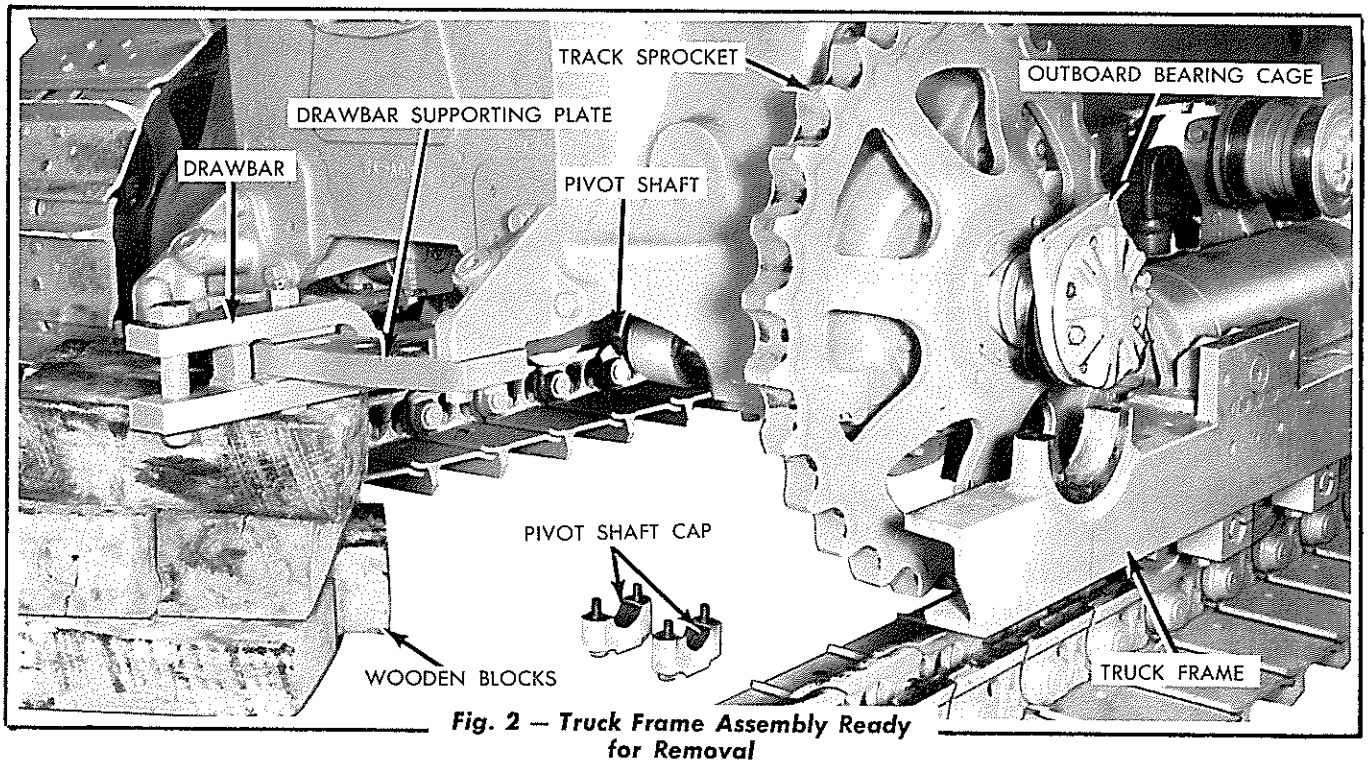

Fig. 2 — Truck Frame Assembly Ready for Removal

C. Pivot Shaft, Pivot Shaft Bushing, and Pivot Shaft Seals

1. Maintenance

The pivot shaft and pivot shaft bushing are lubricated with oil from the bevel gear compartment by a lubricating wick assembly. No maintenance is necessary other than periodic checks to be certain that the truck frame pivot shaft attaching capscrews are tight (130 to 150 lbs. ft. torque) and that the bushing and the shaft are not excessively worn.

2. Removal of Pivot Shaft, Pivot Shaft Bushing, and Pivot Shaft Seals

a. With the track uncoupled, the sprocket shaft outboard bearing cage loosened from the truck frame, and with the truck frame pivot shaft caps removed, the pivot shaft may be driven or pressed from the truck frame.

b. Pry the pivot shaft seals from the frame. Remove the pivot shaft bushing using special tools similar to the ones shown in Figs. 4 and 5.

3. Installation of Pivot Shaft Bushing, Pivot Shaft, and Pivot Shaft Seals

a. Lubricate the outer diameter of the pivot shaft bushing and start the bushing into place in the bore, making certain that the bore and the bushing are smooth and free of burrs.

b. Using special tools similar to the ones shown in Fig. 6, install the bushing into position in the bore of the truck frame. When installed, make certain that the bushing is centered in the bore (each end of the bushing being an equal distance from the outer ends of the bore in the truck frame).

c. Install a new pivot shaft seal at each end of the pivot shaft bushing, as shown in Fig. 7, making certain the sealing lips of the seals are toward the outside.

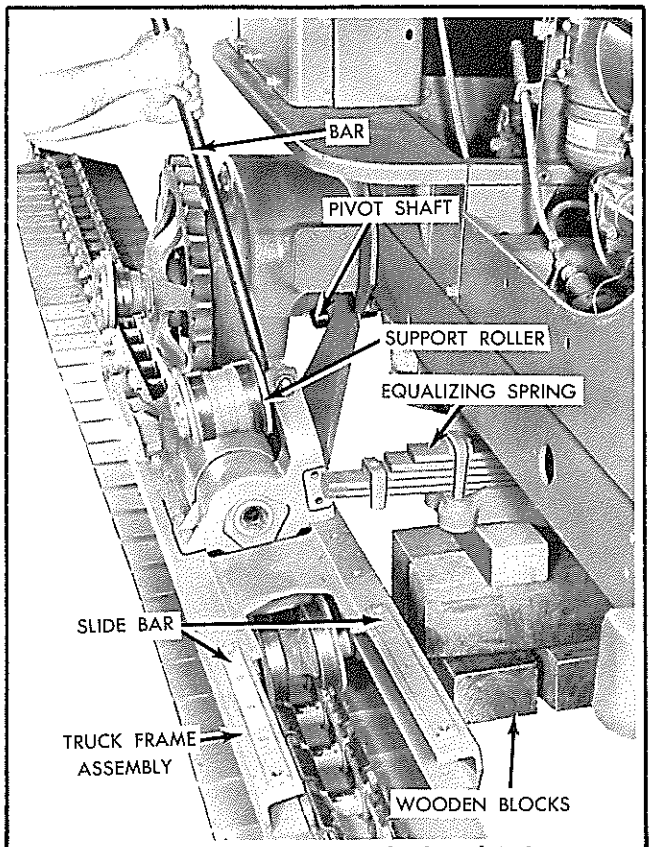

Fig. 3 — Truck Frame Tilted and Being Rolled Forward

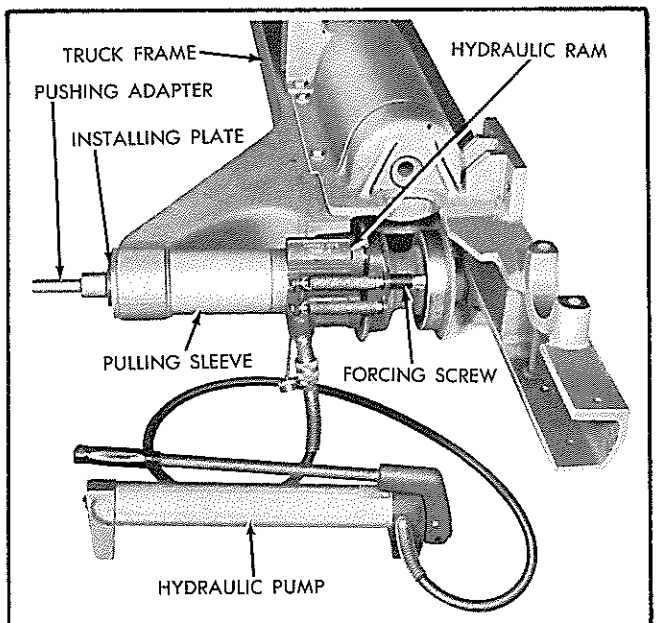

Fig. 4 — Removing Pivot Shaft Bushing

Lubricate the pivot shaft and start it into the bushing, making certain the oil hole in the shaft will be to the inside of the tractor and positioned on the top as installed. Drive or press the pivot shaft into position.

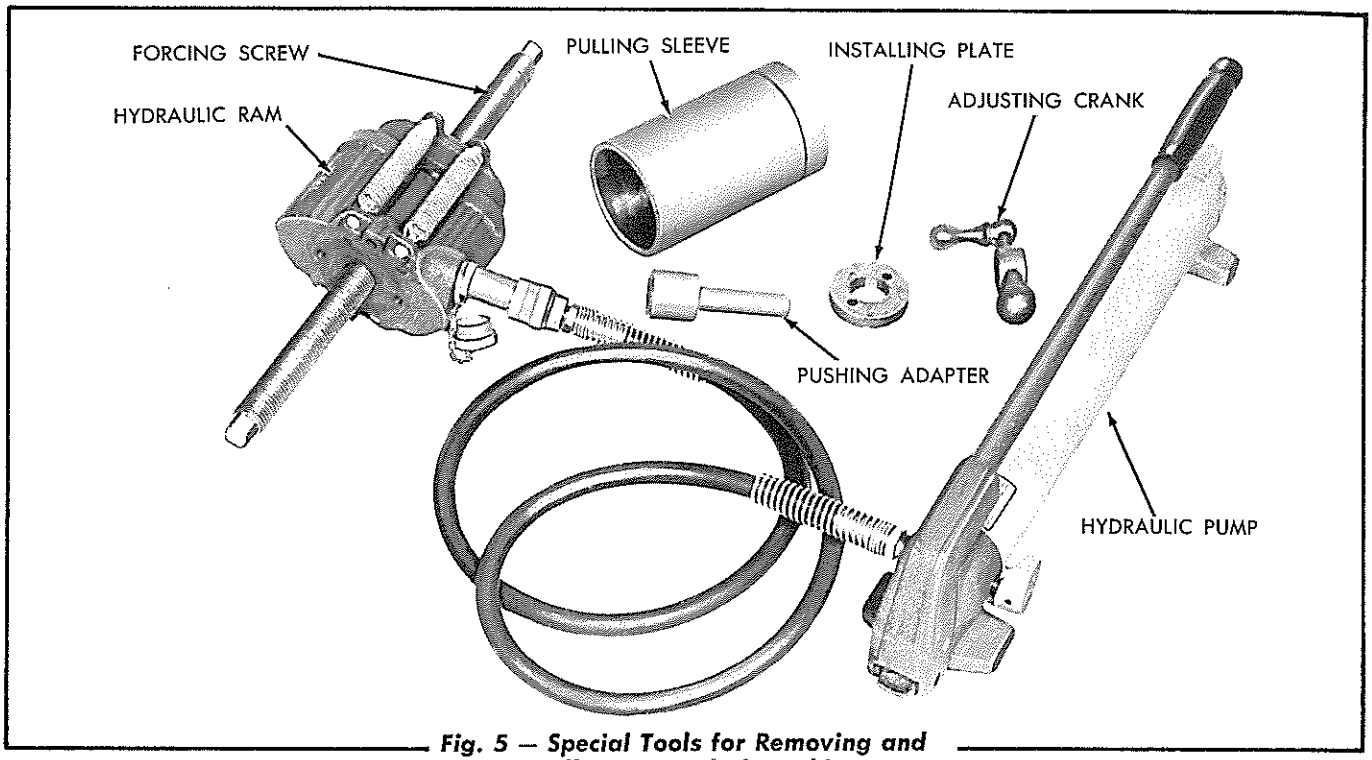

Fig. 5 — Special Tools for Removing and Installing Pivot Shaft Bushing

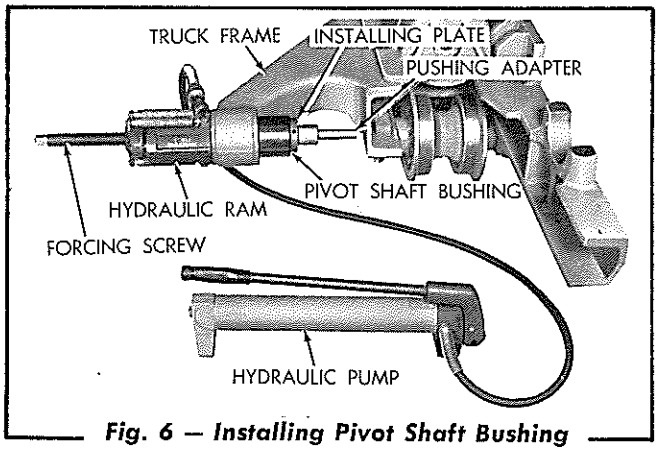

Fig. 6 — Installing Pivot Shaft Bushing

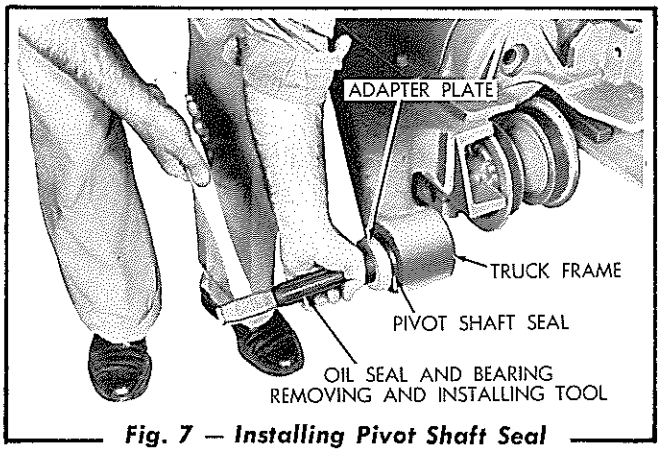

Fig. 7 — Installing Pivot Shaft Seal

D. Truck Frame Installation

Install the truck frame by direct reversal of the removal procedure. CAUTION: *The truck frame pivot shaft and bushing are lubricated by a wick assembly that also serves as a dowel for locating the pivot shaft to the steering clutch and final drive housing. When lowering the tractor onto the pivot shaft, care MUST be used to prevent damaging the lubricating wick holder. Misalignment of the truck frame and abnormal wear of the pivot shaft and bushing will result from a damaged lubricating wick assembly.*

The truck frame pivot shaft caps and the pivot shaft brackets (welded to the housing) are center punched on the rear side for identification, as the caps *MUST* be installed in their original positions.

Install each pivot shaft cap in its original position, making certain the pivot shaft dowels are properly inserted, then tighten the cap attaching capscrews to 130 to 150 lbs. ft. torque.

Check the clearance between the truck frame pivot arm and the pivot shaft outer cap as described in "INSTALLATION OF TRUCK FRAME AND TRACK," Section XIII.

3. TRUCK WHEELS

A. Maintenance

Maintenance of truck wheels consists of a 1000 hour lubricating period and a periodic check for loose bearings, grease leakage, and excessive wear.

B. Checking and Removal of Truck Wheels

The truck wheels may be checked or removed without uncoupling the track or removing the truck frame. To check or remove a truck wheel assembly without uncoupling the track, loosen the capscrews in the track adjusting screw lock and turn the adjusting screw into the track release yoke as far as possible. Place blocks, approximately one foot high in front of the track and move the tractor forward until the blocks are under the first truck wheel. Then place blocks approximately one foot high just to the rear of the track and move the tractor backward until the weight is being carried by the track drive sprocket and the track idler. Lock the brake pedals in their applied position. With the tractor in this position the slack will be at the bottom of the track (refer to Fig. 8). Check the truck wheels for bearing end play; if there is end play or indication of grease leakage, the truck wheel must be removed and inspected. If the truck frame is removed, it should be turned over for the removal of truck wheels. NOTE: *The truck wheels are attached to the truck frames by capscrews inserted through the attaching brackets and threaded into replaceable tapped blocks.*

C. Disassembly of Truck Wheels

1. With the tractor placed on blocks as explained above, remove the capscrews attaching the truck wheel to the truck frame and remove the truck wheel from the tractor. NOTE: *Do not remove the tapped blocks from the truck frame.*

2. To remove the attaching bracket from each end of the truck wheel shaft, use a hammer and chisel to spread the slot in the bracket, then pull the bracket from the shaft.

3. Clean the outside of the truck wheel thoroughly.

4. IMPORTANT: *When disassembling the truck wheel, keep the parts separated so that*

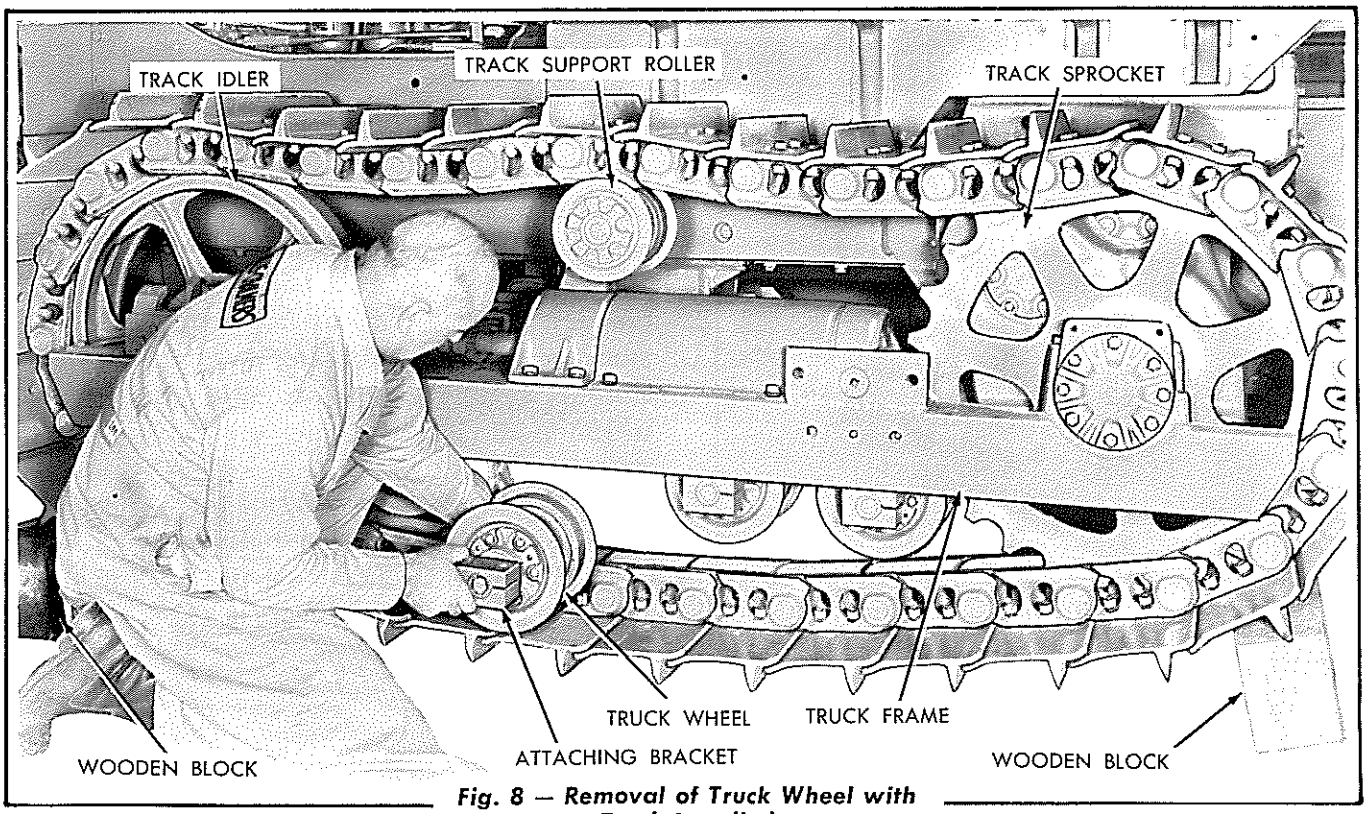

Fig. 8 — Removal of Truck Wheel with Track Installed

they can be reassembled in their original positions. Remove the capscrews attaching the bearing retainers to the truck wheel.

5. Three equally spaced tapped holes are provided in each bearing retainer for a means of removal. Using special tools similar to the ones shown in Fig. 18, pull each bearing retainer (with seal assembly components) from the shaft. Tie the bearing adjustment shims to their respective retainer. CAUTION: *Use care to avoid scratching and damage to the seal rings.*

6. Drive or press on one end of the truck wheel shaft to remove the bearing cup from the opposite end. Drive or press on the opposite end of the shaft and remove the other bearing cup and the shaft.

7. Using special tools similar to the ones shown in Fig. 25, remove the bearings from the shaft.

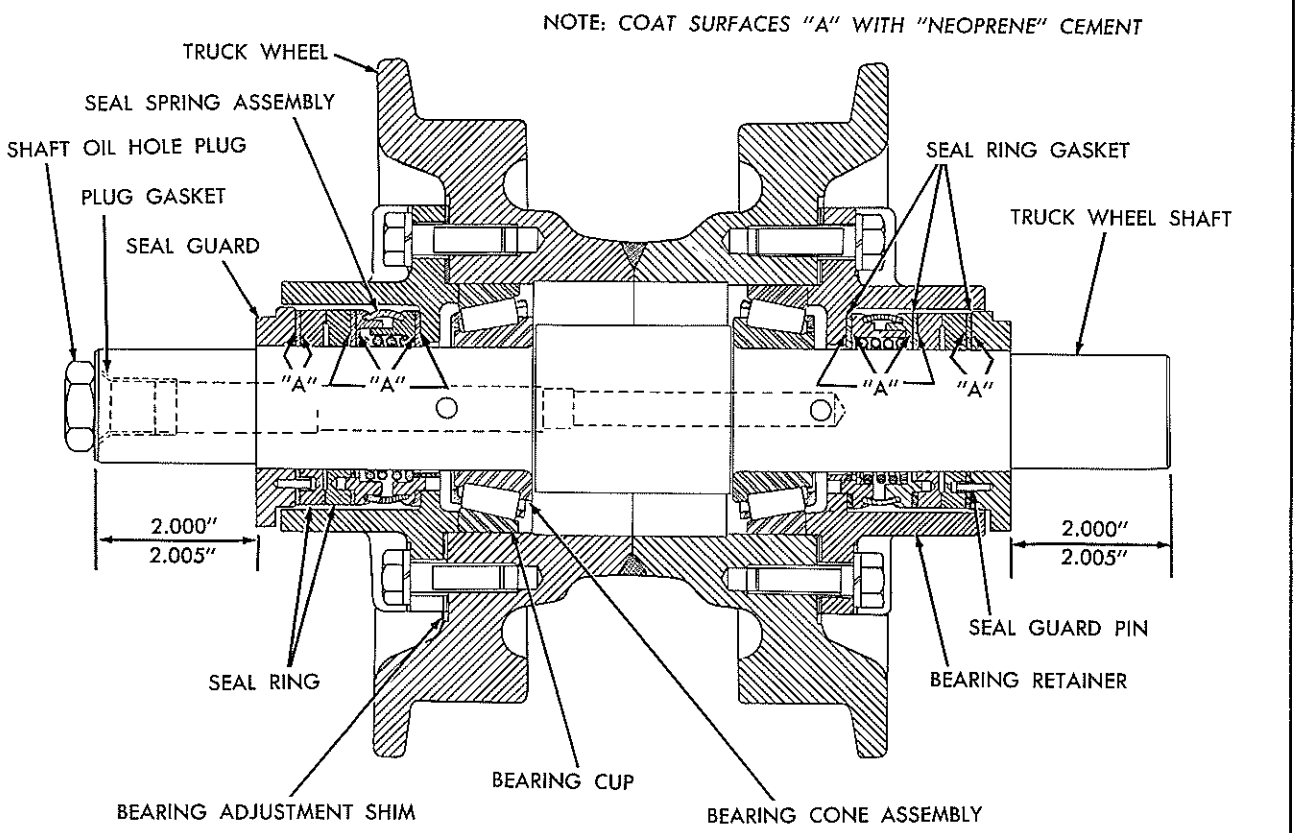

Fig. 9 — Standard Truck Wheel — Sectional View

D. Inspection of Truck Wheels

1. Wash all parts thoroughly before inspection. Make certain that the grease passage in the truck wheel shaft is clean.

2. Make a visual inspection of the shaft and bearings. If the bearings or the cups show excessive wear, or if they are pitted, they must be replaced. If the bearing cups are found to be loose in the bore of the truck wheel, replace the necessary parts.

3. Inspect the sealing surfaces of the mating seal rings for scratches, nicks, or burrs as these surfaces *MUST* be smooth and flat. If the sealing surfaces are scratched or damaged in any way, both mating seal rings must be replaced.

4. On the standard truck wheels (Fig. 9), examine the seal spring assemblies and make certain that the rubber is bonded tightly to the end pieces and that the rubber is pliable and in good condition. Make certain that the surfaces "A," Fig. 9, of the seal assembly components are firmly cemented together, to avoid grease leakage.

   On the heavy duty truck wheels (Fig. 10), examine the seal spring boot (rubber) of each seal spring assembly and make certain that the surfaces "A," Fig. 10, of the boot are firmly cemented to the seal spring assembly. Make certain that the rubber is pliable and each boot is in good condition. Also make certain that the other surfaces "A," Fig. 10, of the seal assembly components are firmly cemented together, to avoid grease leakage. Remove the inner seal rings from the bearing retainers and examine the seal packing rings. Replace the seal packing rings if the rings are not in good condition.

E. Assembly and Installation of Truck Wheels

1. Make certain that all parts are clean, par-

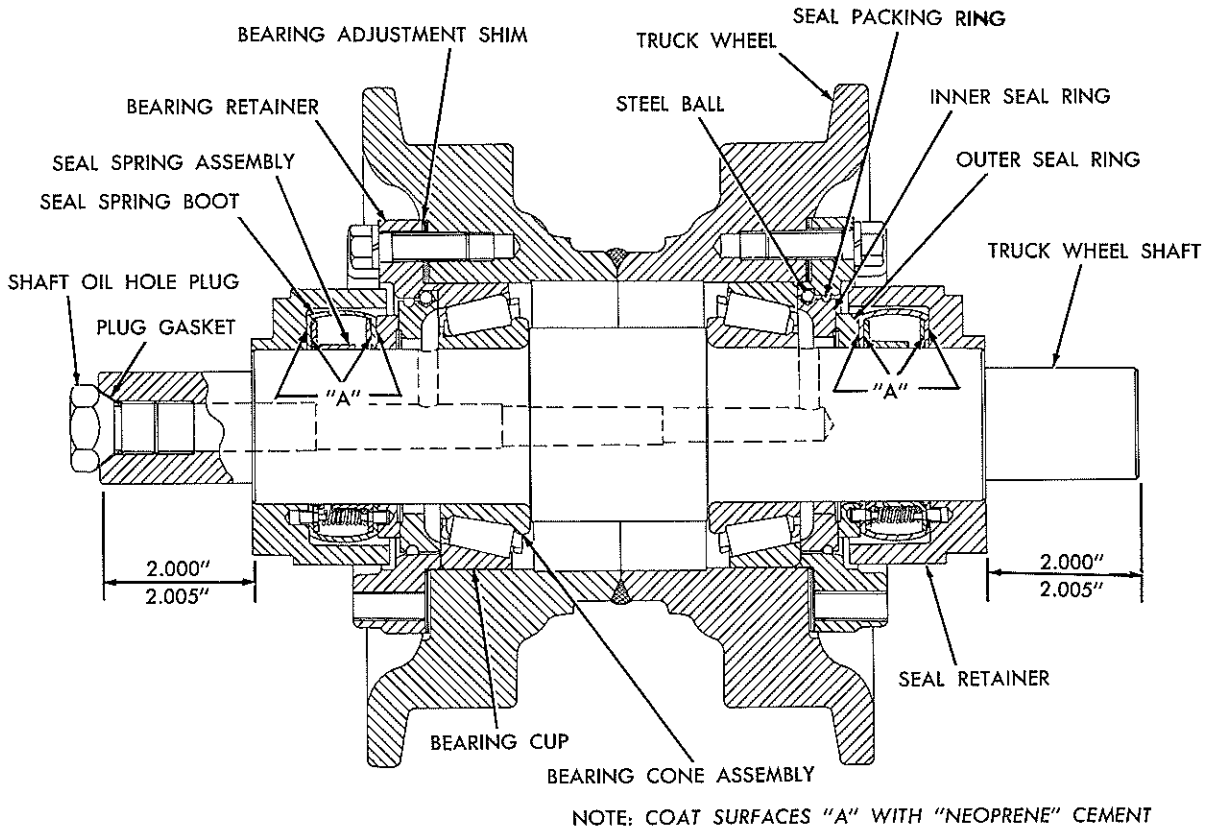

Fig. 10 — Heavy Duty Truck Wheel — Sectional View

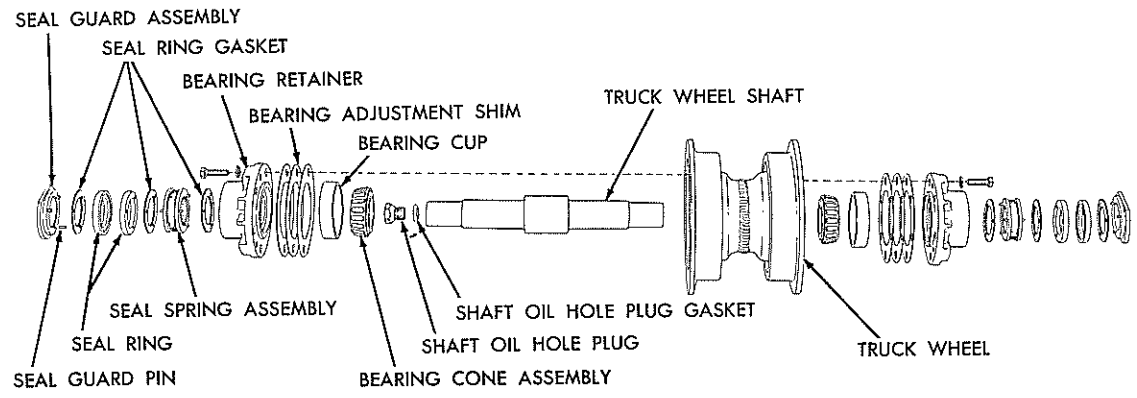

Fig. 11 — Standard Truck Wheel Details

ticularly the seal rings and surfaces to be cemented.

2. If new seal assemblies are to be installed, the seal components should be installed at this time so that the "NEOPRENE" cement, used for cementing the assemblies in place, will have sufficient time to dry.

To Install Seal Components in Standard Truck Wheel (Figs. 9 and 11)

a. Place the bearing retainer on a clean bench with the machined face down.

b. Make certain that the seal spring assemblies, seal gaskets, and seal rings are clean and dry. Cement the seal gaskets

to each side of the seal spring assemblies. Coat the outside faces of the gaskets with "NEOPRENE" cement and install the seal spring assemblies in the bearing retainers, then install the seal rings in place on the spring assemblies.

c. Place a weight on the seal ring, using a clean cloth between the weight and the seal ring, and allow the "NEOPRENE" cement to set and dry thoroughly.

d. Clean the seal guard. Coat one side of the gasket with "NEOPRENE" cement and place the gasket on the seal guard. Coat the other side of the gasket and the back of the seal ring with "NEOPRENE" cement and place the ring on the guard and gasket immediately.

e. Place a weight on the seal ring, using a clean cloth between the weight and the seal ring, and allow the "NEOPRENE" cement to dry and set thoroughly. NOTE: *When coating the above parts with "NEOPRENE" cement, do not use an excessive amount.* The "NEOPRENE" cement and solvent for thinning can be purchased from your "Allis-Chalmers" Construction Machinery Dealer.

To Install Seal Components in Heavy Duty Truck Wheel (Figs. 10 and 12)

a. Place the seal retainer, outer face downward, on a clean bench.

b. Make certain the seal spring assembly, seal spring boot, and the outer seal ring are clean and dry. Install the boot on the seal spring assembly, lining up the holes in the boot with the protruding pins in the spring assembly. Hold each lip of the boot out away from the side of the spring assembly and coat the inside of each lip and each side of the seal spring assembly with "NEOPRENE" cement. Press the lips back in place against the seal spring assembly.

c. Coat the outer face of one lip of the boot and coat the machined face in the seal retainer (face in retainer that lip of boot contacts) with "NEOPRENE" cement. Immediately place the boot and spring assembly in position in the seal retainer, inserting the ends of the pins into the corresponding holes in the seal retainer.

d. Coat the face of the outer lip of the boot and the outer face of the outer seal ring with "NEOPRENE" cement. Immediately place the outer seal ring in position on the boot and spring assembly, inserting the ends of the pins into the corresponding holes in the seal ring.

e. Place a weight on the outer seal ring, using a clean cloth between the weight and the seal ring, and allow the "NEOPRENE" cement to dry and set thoroughly. NOTE: *When coating the above parts with "NEOPRENE" cement, do not use an excessive amount.* The "NEOPRENE" cement and solvent for thinning can be purchased from your "Allis-Chalmers" Construction Machinery Dealer.

f. Install the seal packing ring in position in the ring groove of the inner seal ring. When installing, make certain that the seal packing ring is not "rolled" into position, thus twisting the ring in its groove.

g. Clean the bore in the bearing retainer. Place the steel ball in the ball recess in the seal ring, hold the steel ball in position, and install the inner seal ring (with seal packing ring) in position in the bearing retainer. When installing, start the side with the packing ring into the bore first and align the steel ball with the ball slot in the bearing retainer.

3. Press the bearings onto the shaft until they are seated against the shaft shoulders.

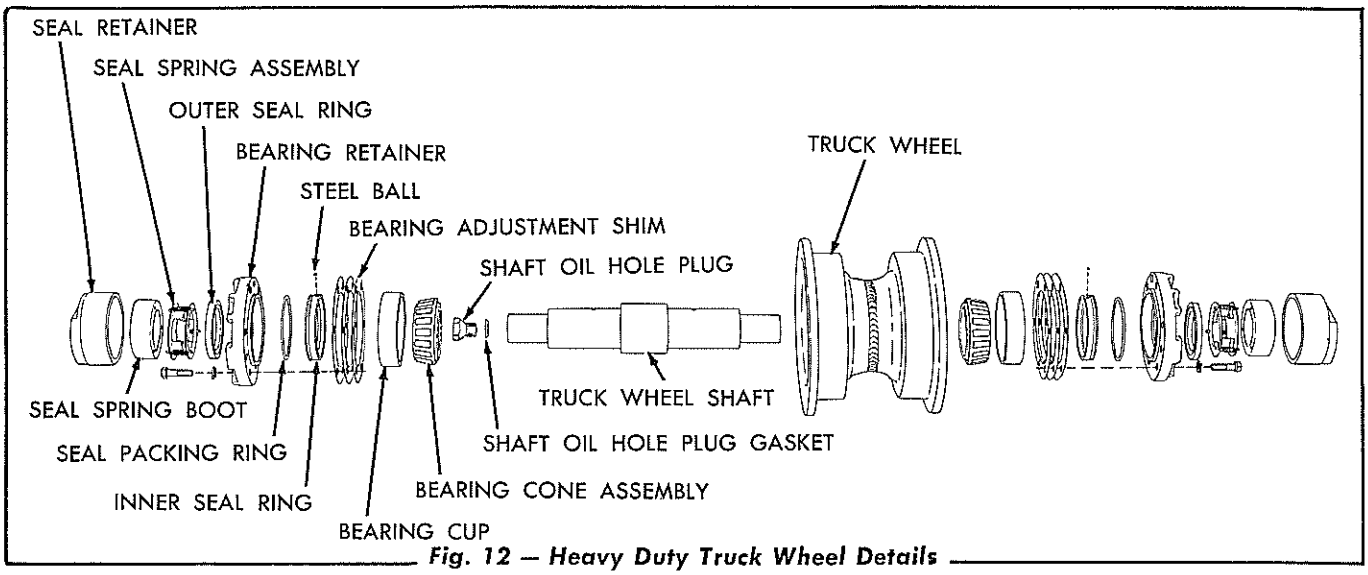

Fig. 12 — Heavy Duty Truck Wheel Details

4. Install a bearing cup in one end of the truck wheel. Insert the shaft, with the bearings, into the truck wheel and install the remaining bearing cup.

5. Install one of the bearing retainers, complete with seal components and the original amount of bearing adjustment shims, on the truck wheel and tighten the attaching capscrews securely.

6. Install the other bearing retainer, complete with seal components and the original amount of bearing adjustment shims, on the truck wheel. When tightening the attaching capscrews, turn the shaft occasionally to make certain that an excessive pre-load is not being placed on the bearings. The bearings are properly adjusted when a slight drag (15 to 45 lbs. in. pre-load) can be felt when turning the shaft by hand.

If the bearings are too tight or too loose, it will be necessary to add or remove the necessary adjustment shims. To do this, remove the bearing retainers, then add or remove the estimated number of shims required and re-assemble. Follow this procedure until the proper pre-load of the bearings is obtained.

IMPORTANT: *When adding or removing shims, do not add or remove shims on one side only. The total thickness of the shims required to adjust the bearings should be divided as evenly as possible between the two sides.*

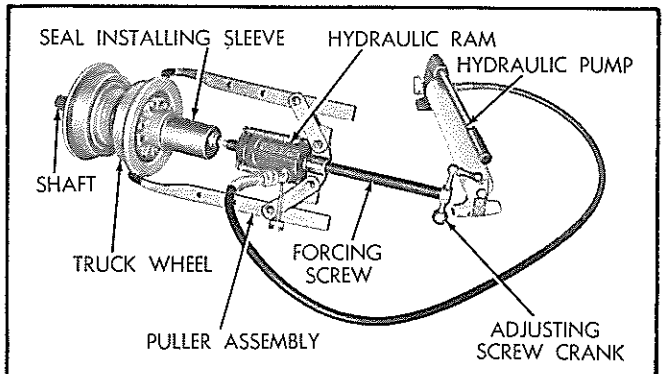

Fig. 13 — Installing Truck Wheel Seal Guard

7. Coat the mating surfaces of the seal rings with oil. Press the seal guards (standard truck wheels) or seal retainers (heavy duty truck wheels) with seal components, on each end of the shaft as shown in Fig. 13.

   IMPORTANT: When pressing the seal guard or seal retainers onto the shaft, make certain that the flat machined surfaces on the guards or retainers are aligned with each other so that flat surfaces will seat properly against the bottom of the truck frame. Also, when installing the seal guards on the standard truck wheel shaft, make certain that the chisel mark on the outer end of the shaft is parallel to the flat machined surface of the seal guard. When installing the seal retainers on the heavy duty truck wheel shaft, make certain that the chisel mark on the outer end of the shaft is either parallel to the flat machined surface of the seal retainer, or is to the top when the wheel is installed on the truck frame. The chisel mark in the outer end of the shaft is in line with the two ¼" grease outlet holes in the shaft. Press the guards or retainers onto the shaft until the outer faces of the guards or retainers are 2.000" to 2.005" in from the end of the shaft (Figs. 9 and 10).

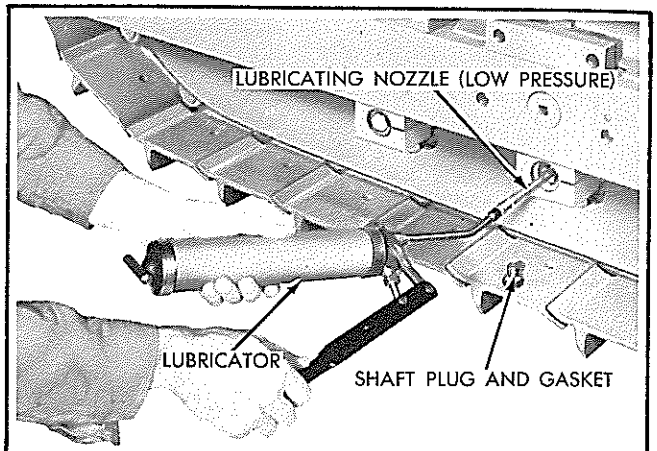

Fig. 14 — Lubricating Truck Wheel

8. Drive or press the truck wheel attaching brackets onto the shaft.

9. Using a hand lubricator and special lubricating nozzle as shown in Fig. 14, fill the truck wheel assembly with the specified grease. Pump the grease in slowly, while holding the nozzle firmly against its seat in the shaft, until grease is forced out the end of the shaft around the nozzle. This will indicate the truck wheel is full. Approximately 1 pound of grease is required to fill each truck wheel. Install the shaft plug and gasket and tighten the plug to a torque of 100 lbs. ft.

10. Install the truck wheel in its proper location on the truck frame, making certain that the shaft plug in the end of the truck wheel shaft is to the outside.

11. Drive the tractor forward until the blocks used under the rear of the track can be removed. Back the tractor off the blocks used under the front of the track. Adjust the track (refer to "TRACK ADJUSTMENT," Section XVI).

4. TRACK RELEASE

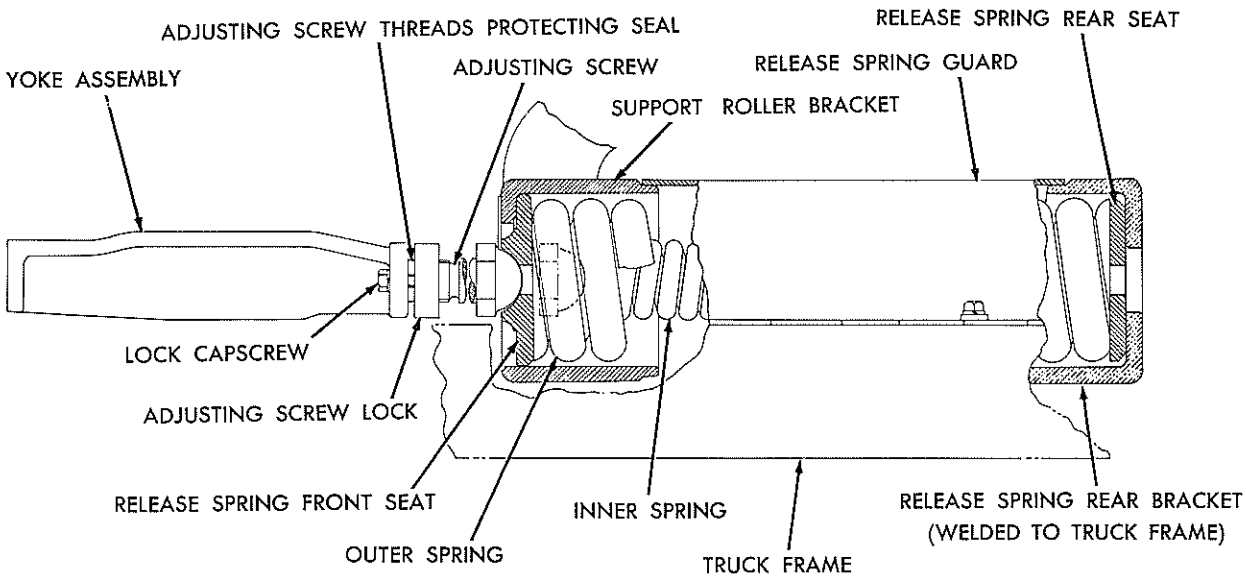

Fig. 15 — Track Release — Sectional View

A. Maintenance

The track release springs are not lubricated. The track release is provided with a bottom guard (integral with truck frame) and has a removable release spring guard (upper guard) to keep out debris. The release spring guard (upper guard) should be removed periodically and the release springs cleaned and inspected.

B. Removal

1. Uncouple the track, remove the track idler, and loosen the truck frame from the tractor and roll it forward on the track (refer to "TRUCK FRAME REMOVAL" in this Section).

2. Remove the release spring guard.

3. Special tools necessary for the removal of the track release consist of:

   a. One 1" hardened steel bolt approximately 30" long with 6 inches of threads and a hex nut. A longer bolt may be used, but it must have no more than approximately 24" of unthreaded length.

   b. A heavy spacing washer approximately ½" thick and having a 3¼" outside diameter.

4. Insert the bolt through the release spring assembly from the rear and install the heavy washer and hex nut. Turn the nut onto the bolt and compress the release springs enough to relieve the spring tension on the track support roller bracket.

5. Remove the four capscrews attaching the support roller bracket to the truck frame and remove the support roller bracket. CAUTION: *Do not lose the support roller bracket alignment shims.*

6. Remove the track release spring assembly from the truck frame.

C. Installation

1. If new track release springs are to be installed, assemble the inner and outer track release springs, with the release spring seats, and the compressing bolt and spacing washer used for removal. Compress the springs and seats to an assembled length of approximately 24¾ inches.

2. Place the spring assembly and the support roller bracket, with the original amount of support roller bracket alignment shims, in position on the truck frame.

3. Install the four capscrews to secure the support roller bracket to the truck frame and tighten the capscrews securely.

4. Remove the spring compressing bolt and spacing washer.

5. Install the release spring guard.

6. Refer to "TRACK IDLER" in this Section and install and adjust the track idler.

7. Couple and adjust the track as outlined in "TRACKS," Section XVI.

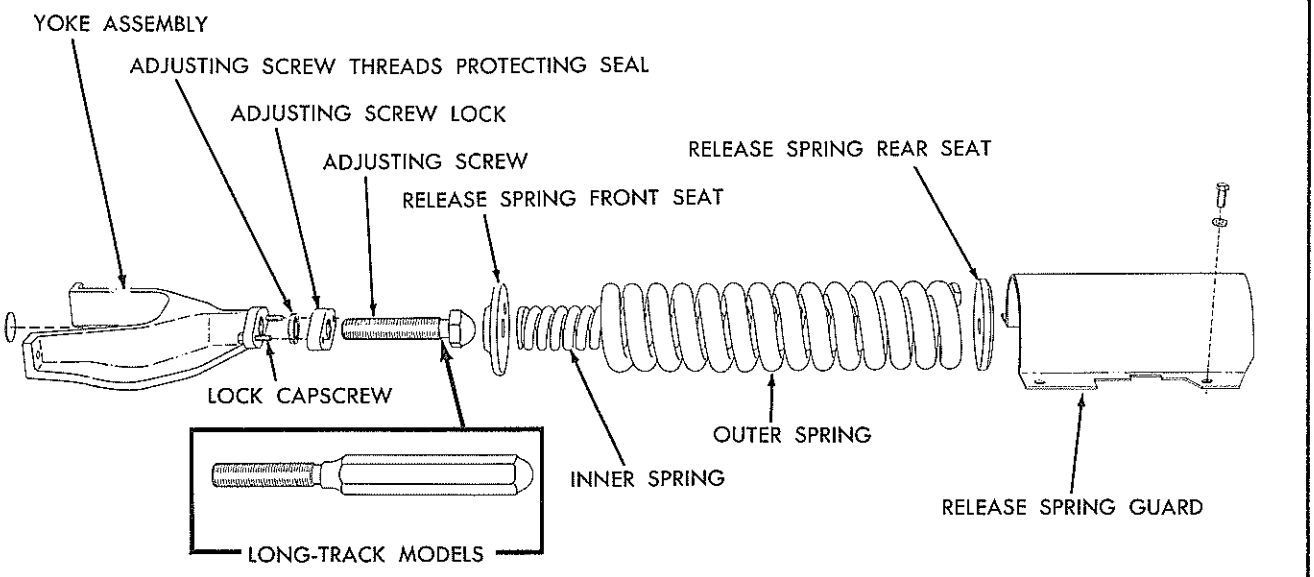

Fig. 16 — Track Release Details

5. TRACK SUPPORT ROLLERS

A. Maintenance

Maintenance of track support rollers consists of a 1000 hour lubricating period and a periodic check for loose bearings, grease leakage, and excessive wear.

The following checks should be made after each 1000 hours of operation:

1. Raise the track off of the support roller.

2. Grasp the roller and check for end play. If end play is found, the roller assembly should be removed immediately and disassembled, inspected, and repaired.
   NOTE: *If grease leakage through the seal assembly is noted, the support roller should be removed, disassembled, and inspected. Grease leakage is an indication of loose bearings.*

B. Removal of Track Support Roller

1. Raise and block the track so that it clears the support roller.

2. Remove the bolt clamping the support roller shaft in position in the bore of the support roller bracket. Drive a broad faced chisel, or similar tool, into the clamping slot of the bracket to open the bracket thus freeing the support roller shaft. Remove the support roller assembly.

C. Disassembly of Track Support Roller

1. Thoroughly clean the outside of the support roller assembly.

2. Remove the capscrews attaching the inner bearing retainer to the roller. Using special tools similar to the ones shown in Fig. 18,

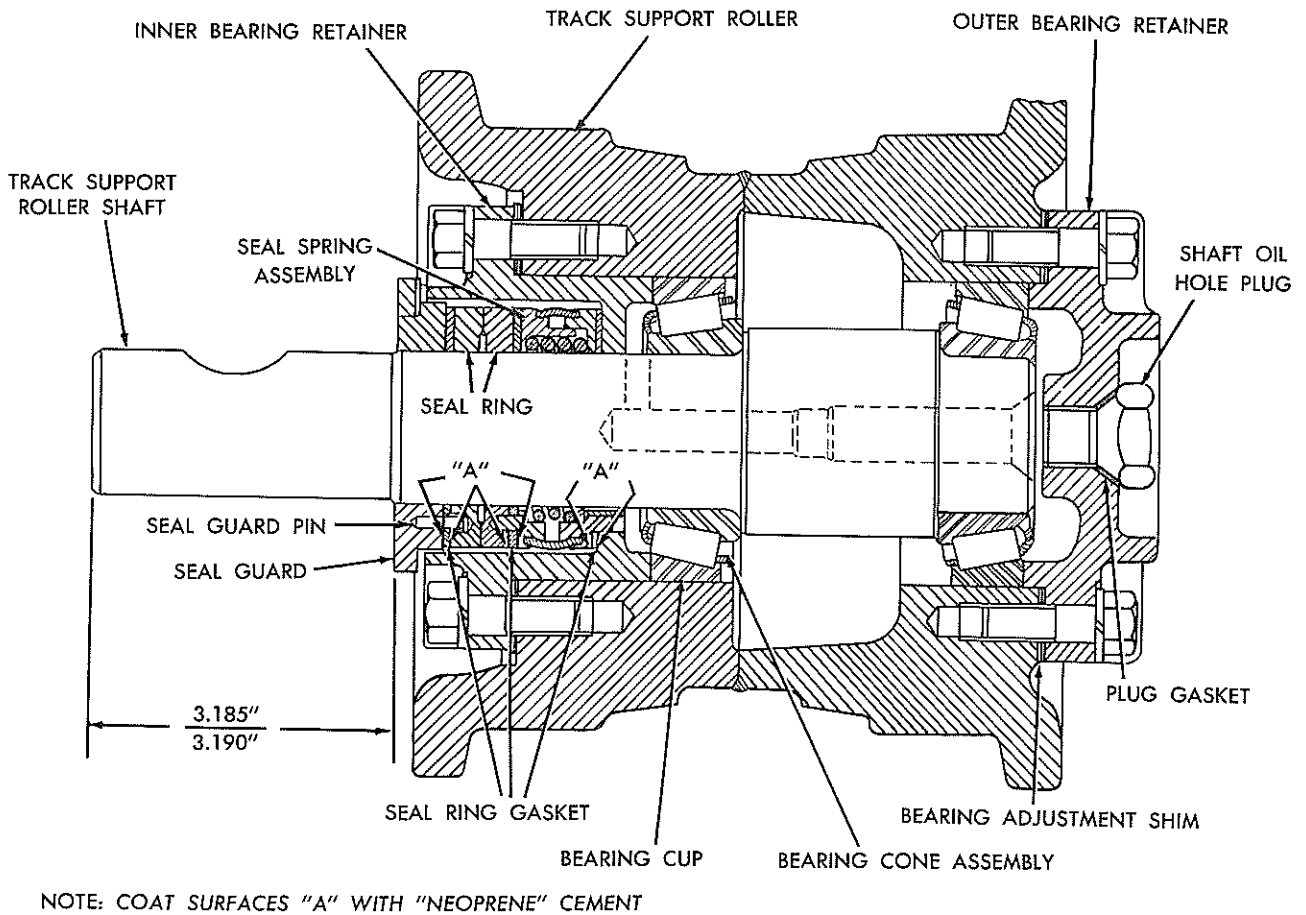

Fig. 17 — Track Support Roller — Sectional View

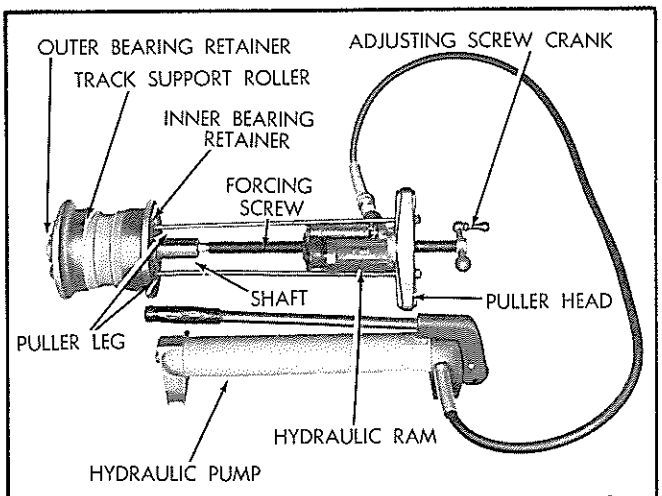

Fig. 18 — Removing Inner Bearing Retainer and Seal Guard from Track Support Roller

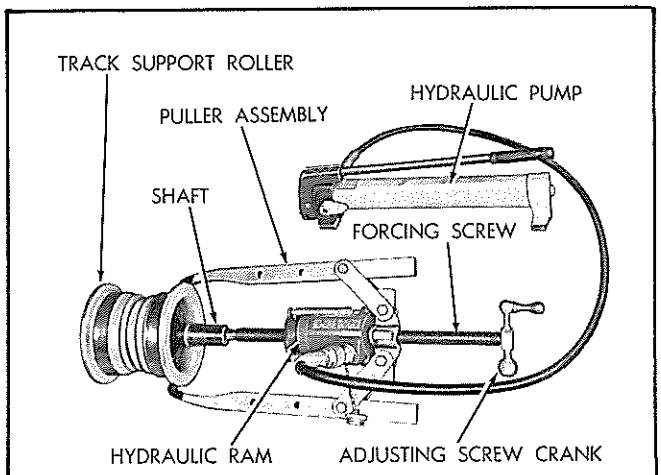

Fig. 19 — Removing Outer Bearing Retainer and Outer Bearing Cup from Track Support Roller

pull the inner bearing retainer and seal guard from the shaft. Tie the bearing adjustment shims to the bearing retainer to prevent loss.

3. Remove the capscrews attaching the outer bearing retainer to the roller. Using special tools similar to the ones shown in Fig. 19, press on the inner end of the shaft to remove the outer bearing retainer and outer bearing cup. Tie the bearing adjustment shims to the bearing retainer to prevent loss.

4. Place the shaft back into position in the roller and press on the outer end of the shaft to remove the inner bearing cup. Remove the shaft from the roller.

   CAUTION: *When disassembling the track support roller, keep the parts separated so that they can be reinstalled in their original positions.*

5. Using tools similar to the ones shown in Fig. 25, remove the bearings from the shaft.

D. Inspection of Track Support Roller

1. Thoroughly wash and clean the track support roller components before inspecting. Make certain that the grease passages in the shaft are open.

2. Make a visual inspection of the shaft and bearings. If the bearings and cups show excessive wear, or if they are pitted or chipped, they must be replaced. If the bearing cups are found to be loose in the bearing bores of the support roller, replace the necessary parts.

3. Inspect the sealing surfaces of the seal rings for scratches, nicks, or burrs, as these faces *MUST* be smooth and flat. If the sealing surfaces are scratched or damaged, both seal rings must be replaced.

4. Inspect the seal spring assembly and seal ring, located in the inner bearing retainer, and make certain that they are firmly cemented in place. Inspect the seal spring assembly and make certain that the rubber is pliable and in good condition. If the seal spring assembly and seal ring are in good condition and are firmly cemented in place, do not remove.

E. Assembly of Track Support Roller

1. Make certain that all the parts are clean.

2. If a new seal spring assembly and seal ring is to be installed in the inner bearing retainer, they should be installed at this time so that the "NEOPRENE" cement, used for cementing the assembly in place, will have sufficient time to dry.

3. Make certain that the seal spring assembly and the seal ring gaskets are clean and dry. Coat one face of the seal spring assembly with "NEOPRENE" cement and immedi-

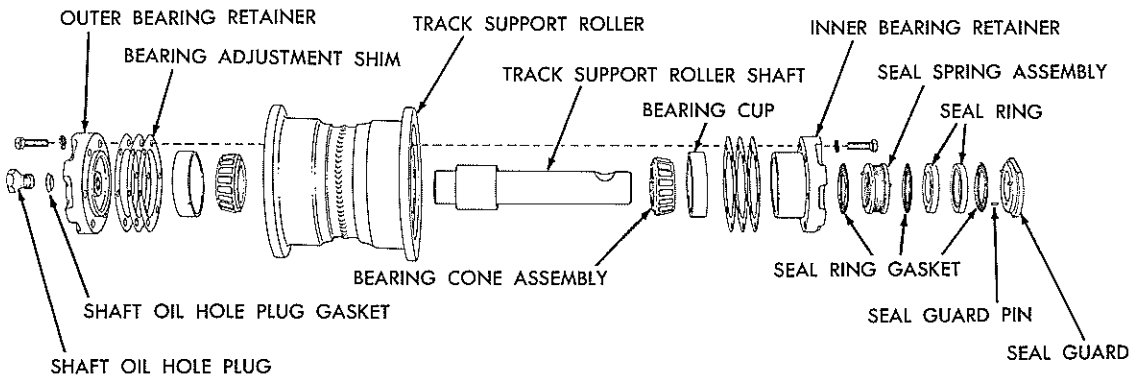

Fig. 20 — Track Support Roller Details

ately place a seal ring gasket in position on the seal spring assembly, inserting the pins through the holes in the gasket. Coat the other side of the seal ring gasket and the machined surface in the inner bearing retainer with "NEOPRENE" cement and immediately install the seal spring assembly in the inner bearing retainer, inserting the ends of the pins into the corresponding holes in the retainer.

4. Coat the outer face of the seal spring assembly with "NEOPRENE" cement and immediately install a seal ring gasket in position on the seal spring assembly. Coat the back face of the seal ring and the seal ring gasket with "NEOPRENE" cement and immediately install the seal ring on the seal spring assembly, inserting the pins into the corresponding holes in the seal ring.

5. Place a weight on the seal ring, using a clean cloth between the weight and the seal ring, and allow the "NEOPRENE" cement to dry and set thoroughly.

6. Coat the pin side of the seal guard with "NEOPRENE" cement and immediately install a seal ring gasket on the seal guard. Coat the back face of the seal ring with "NEOPRENE" cement and immediately install the seal ring in position on the gasket and seal guard, inserting the pins into the corresponding holes in the seal ring.

7. Place a weight on the seal ring, using a clean cloth between the weight and the seal ring, and allow the "NEOPRENE" cement to dry and set thoroughly. NOTE: *When coating the above parts with "NEOPRENE" cement, do not use an excessive amount.* The "NEOPRENE" cement and solvent for thinning can be purchased from your "Allis-Chalmers" Construction Machinery Dealer.

8. Using special tools similar to the ones shown in Fig. 26, press the bearings onto the shaft until they are seated against the shoulders of the shaft.

9. Install a bearing cup into one end of the bore of the track support roller. Insert the shaft (with the bearings) into the support roller and install the other bearing cup. Lubricate the bearings with clean oil.

10. Install the inner bearing retainer and the original amount of bearing adjustment shims in position on the support roller and tighten the attaching capscrews securely.

11. Install the outer bearing retainer and the original amount of bearing adjustment shims in position on the track support roller. When tightening the attaching capscrews, turn the shaft occasionally to be certain that an excessive pre-load is not being placed on the bearings. The bearings are properly adjusted when a slight drag (15 to 45 lbs. in. pre-load) can be felt when turning the shaft by hand.

    If the bearings are too tight or too loose, it will be necessary to add or remove adjust-

ment shims as needed. To do this, remove the bearing retainer, then add or remove the estimated number of shims required and reassemble. Follow this procedure until the proper pre-load of the bearings is obtained. IMPORTANT: *When adding or removing shims, do not add or remove shims on one side only. The total thickness of the shims required to adjust the bearings should be divided as evenly as possible between the two sides.*

12. Coat the mating surfaces of the seal rings with clean oil. Using tools similar to those shown in Fig. 13, press the seal guard (with the outer seal ring cemented in place) onto the shaft until the outer face of the seal guard is 3.185" to 3.190" in from the end of the shaft (Fig. 17).

13. Use a hand lubricator and the special lubricating nozzle as shown in Fig. 14 and fill the support roller assembly with the specified lubricant. Pump the lubricant in slowly, while holding the nozzle firmly against its seat in the shaft, until grease is forced out the end of the shaft around the nozzle; this will indicate the roller is full. Approximately one pound of grease is required to fill the track support roller assembly. Install the shaft oil hole plug and gasket and tighten the plug to a torque of 100 lbs. ft.

14. The track support roller may now be installed on the tractor by a direct reversal of the removal procedure.

6. TRACK IDLERS

A. Maintenance

Maintenance of the track idlers consists of a 1000 hour lubricating period and a periodic check for loose bearings, grease leakage, and excessive wear.

The following checks should be made after each 1000 hours of operation:

1. Loosen the capscrews in the track adjusting screw lock and turn the adjusting screw into the track release yoke to loosen the track.

2. Place a block of wood in front of the track and move the tractor forward until the block is under the first truck wheel. This will assure that no load is being carried on the track idler, other than the section of track which it supports.

3. Using a bar approximately five feet long, pry against the track idler bearing retainer and check for end play. If any end play is found, the idler assembly must be removed from the tractor, disassembled, inspected, and repaired.

   NOTE: *If at any time grease is noted leaking from the seals, the track idler should be removed, disassembled, inspected, and repaired. Grease leakage is an indication of loose bearings.*

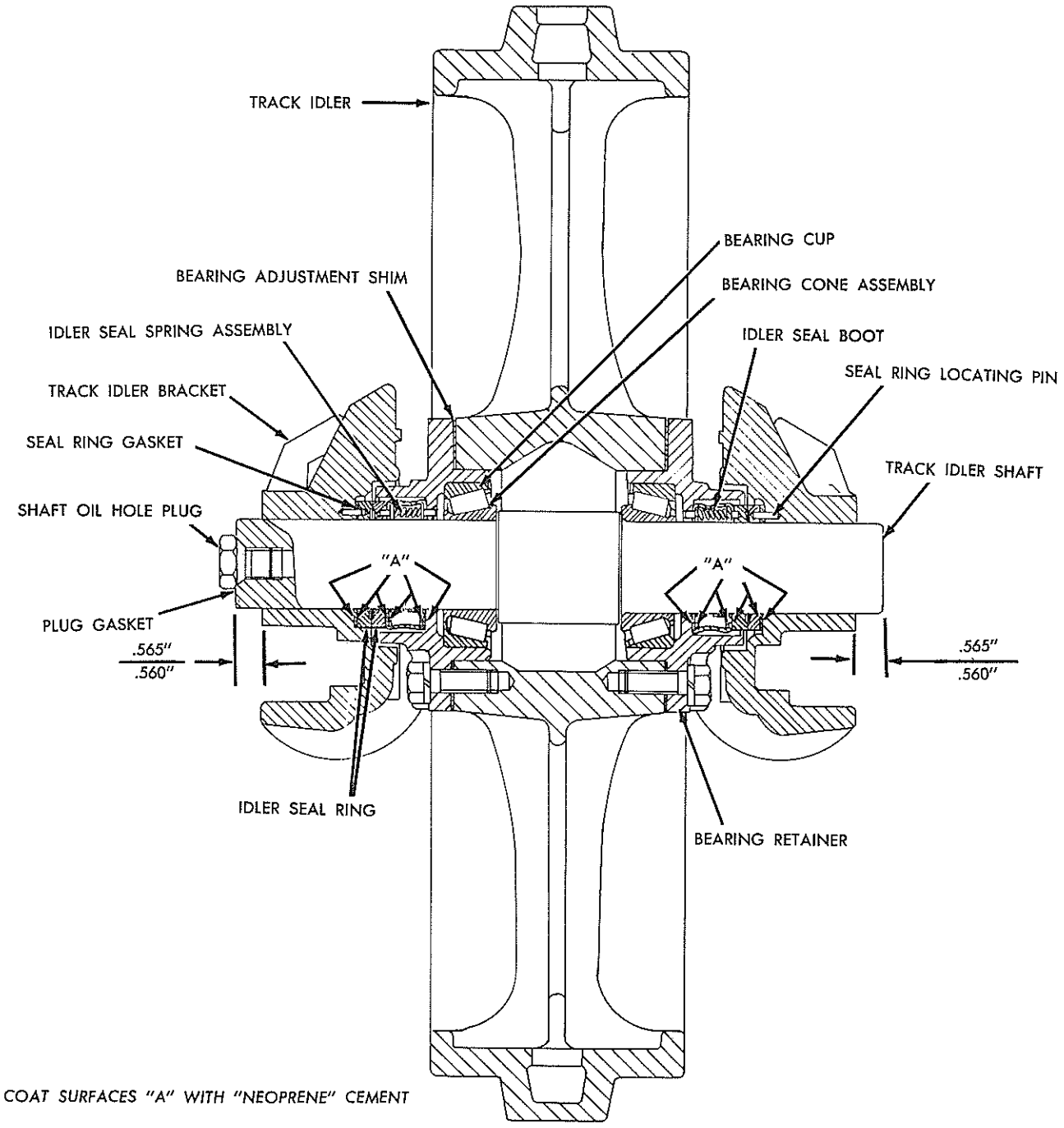

Fig. 21 — Track Idler — Sectional View

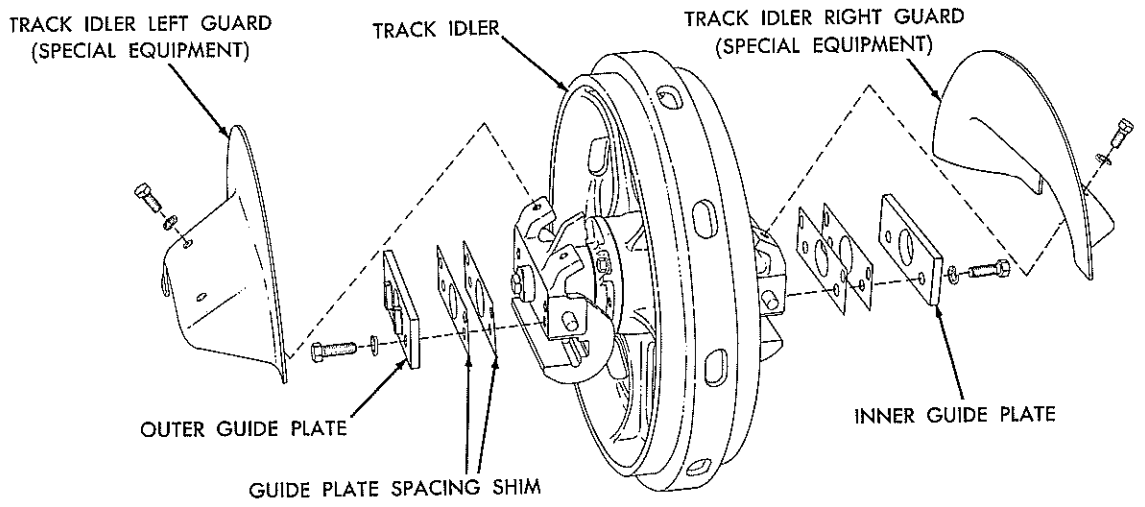

Fig. 22 — Track Idler Guide Plate Details

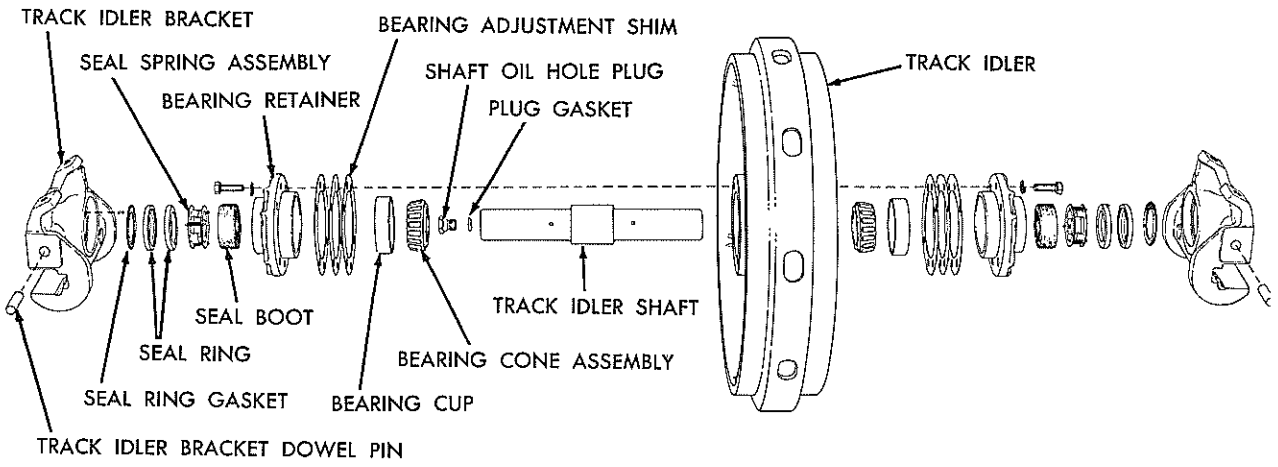

Fig. 23 — Track Idler Details

B. Track Idler Slide Bars and Alignment

1. Inspect the upper track idler slide bars, bolted to the truck frames. If they are worn excessively, they must be turned bottom side up or end for end to present an unworn surface to the track idler brackets. Inspect the lower slide bars and if they are worn excessively, they must be replaced. Add or remove slide bar adjusting shims, between the lower slide bars and the truck frames, to provide a sliding fit between the track idler brackets and the slide bars.

2. If the track idler flange is wearing unevenly or cutting on one side, because it is not centered in the track rail assembly, adjustment is necessary. Remove the track idler guide plates and move sufficient guide plate spacing shims from the side which shows no wear to the side which shows excessive wear. Reinstall the guide plates.

C. Removal of Track Idler

1. Uncouple the track as outlined in "TRACK REMOVAL," Section XVI. Move the tractor backward until the top of the track is free of the track idler.

2. Remove the capscrew and nut from the front end of each idler slide bar and slide the track idler assembly from the truck frame.

D. Disassembly of Track Idler

1. Thoroughly clean the outside of the track idler assembly.

2. Remove the track idler guide plates and tie the guide plate spacing shims to the plates to facilitate alignment of the track idler when reinstalled.

3. Place the track idler assembly in a horizontal position on blocks. Using special tools similar to the ones shown in Fig. 24, pull the track idler bracket from the track idler shaft. Turn the track idler over and remove the other track idler bracket in the same manner.

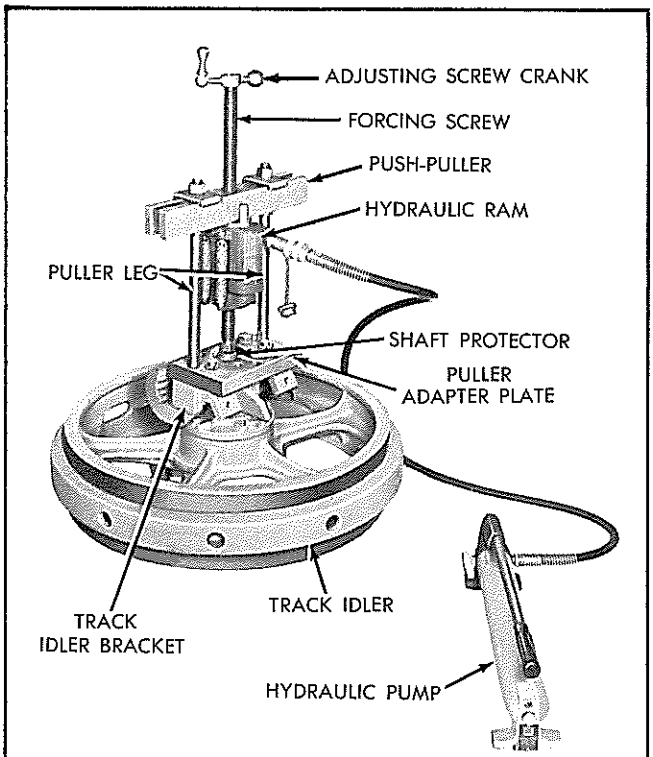

Fig. 24 — Removing Track Idler Bracket

4. Remove the attaching capscrews from each bearing retainer and remove the shaft oil hole plug and gasket. Using a soft hammer, tap on one end of the track idler shaft to remove one bearing cup, seal assembly components, and bearing retainer from the track idler. Place the shaft back into position in the track idler and tap on the opposite end of the shaft to remove the other bearing cup, seal assembly components, and bearing retainer from the track idler. Tie the bearing adjustment shims to their respective bearing retainer.

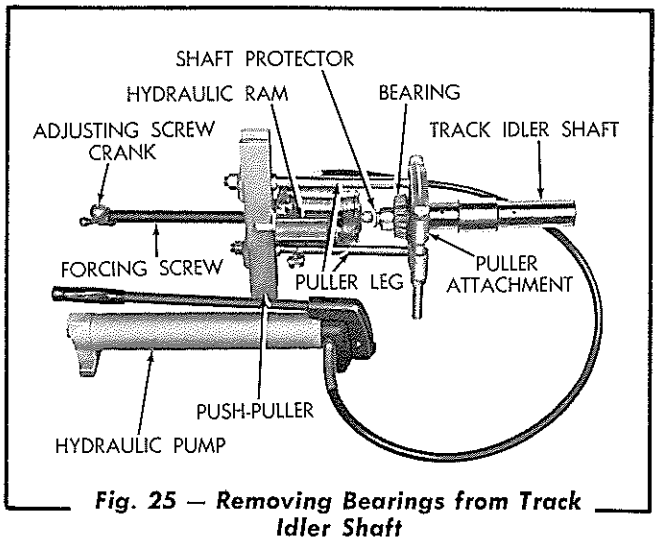

Fig. 25 — Removing Bearings from Track Idler Shaft

5. Using tools similar to the ones shown in Fig. 25, remove the bearings from the track idler shaft.

E. Inspection of Track Idler

1. Thoroughly wash all parts before inspection. Make certain that the grease passage in the track idler shaft is clean.

2. Make a visual inspection of the shaft and bearings. If the bearings or the bearing cups show excessive wear or if they are pitted, they must be replaced. If the bearing cups are found to be loose in the bearing retainers, replace the necessary parts.

3. Inspect the sealing surfaces of the seal rings for scratches, nicks, or burrs, as these surfaces *MUST* be smooth and flat. If the sealing surfaces are scratched or damaged, both seal rings must be replaced.

4. Inspect the idler seal boot in each bearing retainer and make certain that it is firmly cemented in place and forms an oil proof bond between mating parts. The inner faces of the seal boot lips should be firmly cemented to the ends of the seal spring assembly. The outer face of one boot lip should be firmly cemented to the bearing retainer and the outer face of the other lip

should be firmly cemented to the seal ring. No cement is used on the I.D. or O.D. of the boot as it is necessary that the outer part remain flexible to follow the action of the springs in the seal spring assembly. Inspect the idler seal boot and make certain the rubber is pliable and the boot is in good condition. If the boot and seal ring are in good condition and firmly cemented in place, do not remove.

5. Make certain that the seal ring is firmly cemented in place in each track idler bracket.

F. Assembly of Track Idler

1. Make certain that all parts are clean.

2. If a new seal assembly is to be installed in the bearing retainers, the seals should be installed at this time so that the "NEOPRENE" cement, used for cementing the assembly in place, will have sufficient time to dry.

To Install the Seal Assembly:

a. Place the bearing retainer on a clean bench with the machined face down.

b. Make certain the seal spring assembly, idler seal boot, and seal ring are clean and dry. Install the seal boot on the seal spring assembly, lining up the holes in the boot with the protruding pins in the spring assembly. Hold each lip of the boot out and coat the inside of the lips and the sides of the spring assembly with "NEOPRENE" cement. Press the lips back in place against the spring assembly.

c. Coat the outer face of one lip of the idler seal boot and coat the machined face in the bottom of the counterbore in the bearing retainer with "NEOPRENE" cement. Immediately place the idler seal boot and spring assembly in the bearing retainer, inserting the ends of the pins into the corresponding holes in the retainer.

d. Coat the face of the outer lip of the idler seal boot and the back face of the seal ring with "NEOPRENE" cement. Immediately place the seal ring on the boot and spring assembly, inserting the ends of the pins into the corresponding holes in the seal ring.

e. Place a weight on the seal ring, using a clean cloth between the weight and the seal ring, and allow the "NEOPRENE" cement to dry and set thoroughly.

f. Coat one side of the seal ring gasket with "NEOPRENE" cement and place the gasket in position in the track idler bracket. Coat the back face of the seal ring with "NEOPRENE" cement and place the seal ring in position in the bracket, inserting the ends of the pins into the corresponding holes in the seal ring.

g. Place a weight on the seal ring, using a clean cloth between the weight and seal ring, and allow the "NEOPRENE" cement to dry and set thoroughly.

NOTE: *When coating the above parts with "NEOPRENE" cement, do not use an excessive amount.* The "NEOPRENE" cement and solvent for thinning can be purchased from your "Allis-Chalmers" Construction Machinery Dealer.

3. Using special tools similar to the ones shown in Fig. 26, press the bearings onto the shaft until they are seated against the shoulders of the shaft. NOTE: *The ends of the shaft are marked with a chisel mark in alignment with the cross drilled grease holes in the shaft. If a new shaft is installed, mark the location of the grease holes in a similar manner so that their location can be determined after the shaft is installed in the track idler.*

4. Install a bearing cup in each bearing retainer. Insert the track idler shaft (with the bearings) into place in the track idler and lubricate the bearings with clean oil.

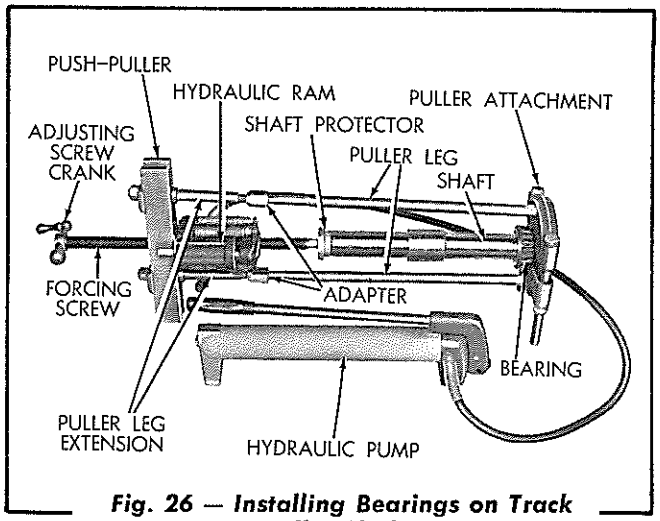

Fig. 26 — Installing Bearings on Track Idler Shaft

5. Install one of the bearing retainers, with the original amount of bearing adjustment shims, in position on the track idler and tighten the attaching capscrews securely.

6. Install the other bearing retainer, with the original amount of bearing adjustment shims, in position on the idler. When tightening the attaching capscrews, turn the shaft occasionally by hand to be certain that an excessive pre-load is not being placed on the bearings. The bearings are properly adjusted when a slight drag (15 to 45 lbs. in. pre-load) can be felt when turning the shaft by hand.

   If the bearings are too tight or too loose, it will be necessary to remove or add the necessary adjustment shims. To do this, remove the bearing retainer, add or remove the estimated number of shims required, and reassemble. Follow this procedure until the proper pre-load of the bearings is obtained.

   IMPORTANT: *When adding or removing bearing adjustment shims, do not add or remove shims on one side only. The total thickness of the shims required should be divided as evenly as possible between the two sides.*

7. Coat the mating surfaces of the seal rings with clean oil. Determine on which side of the tractor the idler is to be used so that the shaft oil hole plug will be to the outside and the dowel end of the idler brackets will be toward the rear when the idler is installed on the truck frame.

8. Start one of the track idler brackets in position on the shaft, making certain that the chisel mark on the end of the shaft is toward the top of the idler when the bracket is installed. Using special tools similar to the ones shown in Fig. 27, press the bracket onto the shaft so that the distance from the end of the shaft to the outer face of the bracket is .560" to .565" (Fig. 21). CAUTION: *The bracket MUST not be pressed onto the shaft more than the specified distance of .565" as damage to the seal rings will result.*

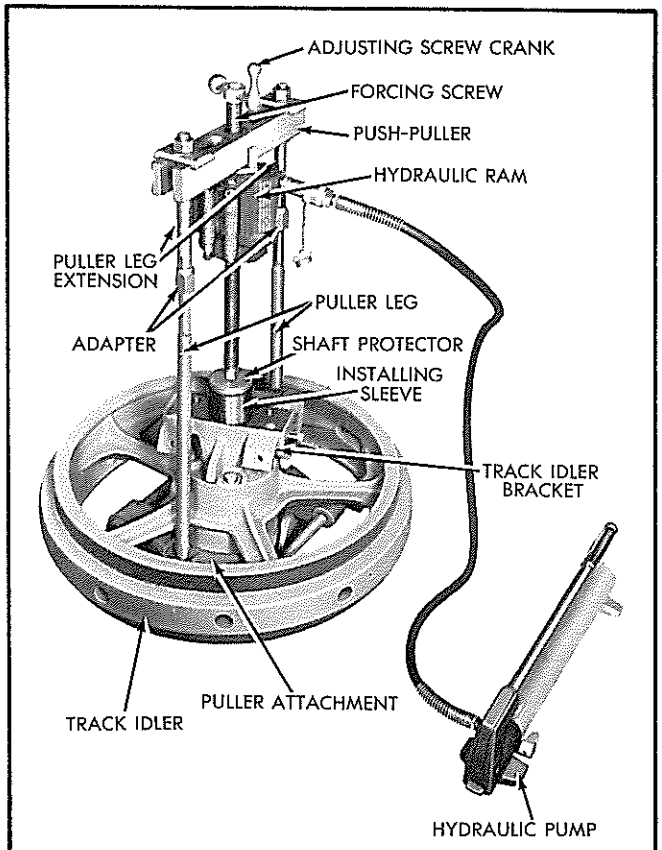

Fig. 27 — Installing Track Idler Bracket on Shaft

9. Install the other track idler bracket on the shaft in the same manner as above. IMPORTANT: *When installing this bracket, make certain that the lower machined surfaces of the brackets are parallel to each other.*

10. Using a hand lubricator and special nozzle, fill the track idler assembly with the speci-

fied lubricant. Pump the lubricant in slowly, while holding the nozzle firmly against its seat in the shaft, until lubricant is forced out the end of the shaft around the nozzle; this will indicate the track idler is full. Approximately 1¾ pounds of lubricant is required to fill the track idler. Install the shaft oil hole plug and gasket and tighten the plug to a torque of 100 lbs. ft.

G. Installation of Track Idler

1. Install the track idler on the truck frame. Install the capscrew and high nut in the front end of each idler slide bar.
2. Install the track idler guide plates in their original positions, using the original guide plate spacing shim pack. Sufficient slide bar adjusting shims should be added or removed to provide a sliding fit between the track idler brackets and the slide bars. If necessary, the track idler may be aligned with the track by moving guide plate spacing shims from one track idler guide plate to the other guide plate as explained in "TRACK IDLER SLIDE BARS AND ALIGNMENT" in this Section.
3. Couple the track and adjust (refer to "TRACKS," Section XVI).

SECTION XV — DRAWBAR

1. DESCRIPTION

The drawbar assembly consists of a drawbar, hinge pin, hinge pin retaining plate, coupling pin, locking capscrew, supporting plate, and two supporting plate brackets.

The front end of the drawbar attaches by means of a hinge pin, to a bracket welded to the rear face of the cross member of the main frame assembly.

The rear end of the drawbar, which incorporates the locking capscrew and coupling pin, is supported by a drawbar supporting plate. The supporting plate is attached to drawbar plate brackets, which are attached to the rear face of the steering clutch and final drive housing.

The drawbar is of the swinging type and can be swung from side to side on the supporting plate, or can be held in various positions by a series of holes provided in the supporting plate and the use of the drawbar locking capscrew. The drawbar locking capscrew is held in position by a hex nut and cotter pin.

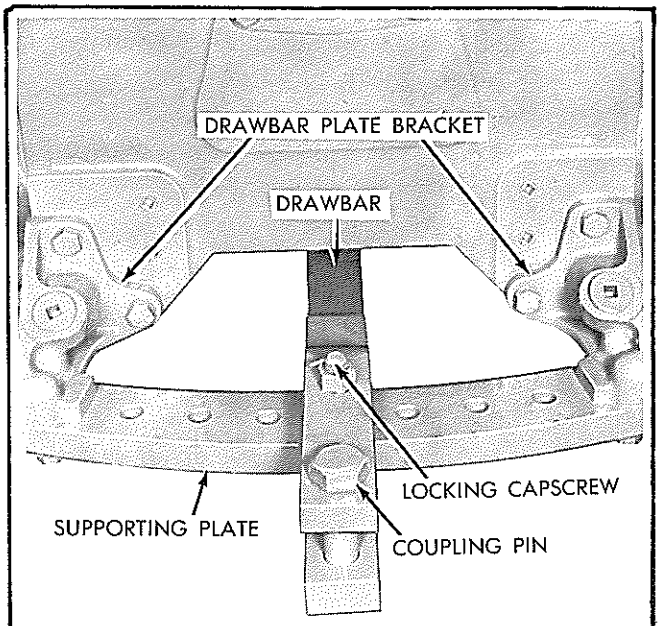

Fig. 1 — Drawbar Assembly

2. SERVICE

The capscrews attaching the drawbar components should be checked periodically and tightened securely.

A. Removal and Inspection

1. Disconnect the drawbar from the hinge pin bracket by removing the hinge pin retaining plate and the hinge pin.

2. Remove the drawbar and the supporting plate by removing the capscrews attaching each end of the supporting plate to the brackets. Replace or repair any parts that show excessive wear.

B. Installation

The drawbar assembly may be installed by a direct reversal of the removal procedure outlined under "REMOVAL AND INSPECTION."

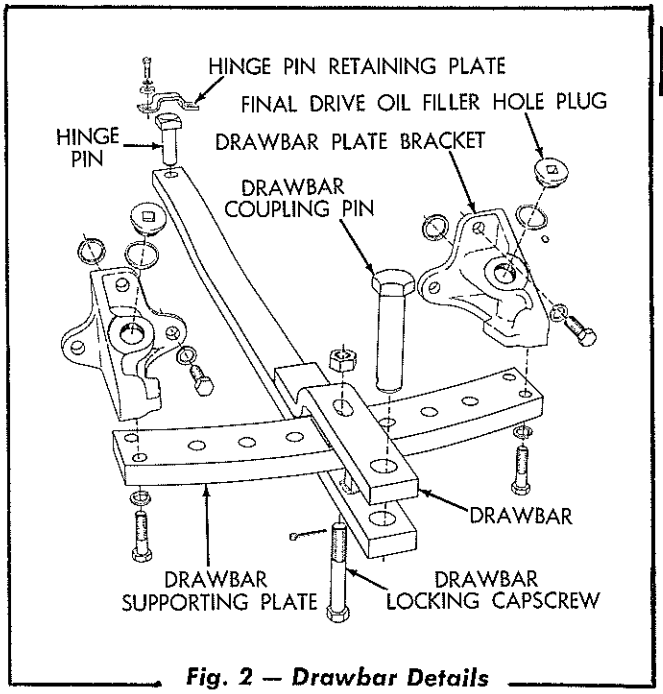

Fig. 2 — Drawbar Details

SECTION XVI — TRACKS

1. DESCRIPTION

The track rail assemblies for the various HD-6 Tractor Models consist of the following number of track links (each track):

Model HD-6A and B .....33 Links
(Prior to Tractor Serial No. 5100)

Model HD-6A and B .....34 Links
(Effective with Tractor Serial No. 5100)

Model HD-6E .....37 Links

Model HD-6G .....39 Links

Each track rail assembly is made up of side bars (right and left), pins, bushings, and shoes. The master link, for coupling the track, has a ¾" shorter master bushing with a ⅜" spacer at each end; a master pin, which is ⅜" longer and has a smaller diameter than the other pins, has been provided to facilitate the coupling and uncoupling of the track.

Several different types and widths of track shoes are available, each adapted to a particular application. The most common or standard shoe is essentially a flat plate, having one cleat, or grouser, rolled integral with the plate and extending its full width.

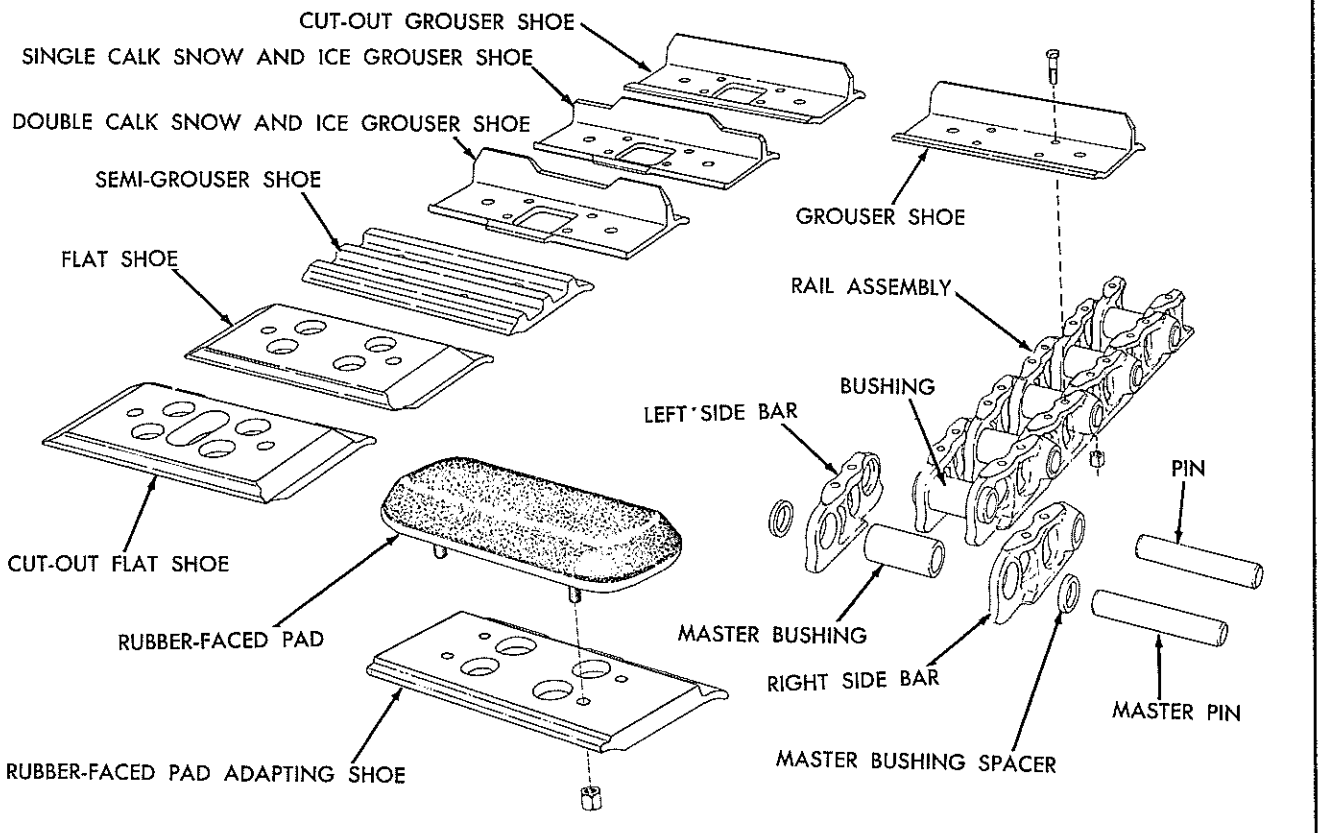

Fig. 1 — Track Details

2. SERVICE AND INSPECTION

Periodic care of the tracks will materially prolong their useful life. Because of the simplicity of the track, the average owner and operator gives very little thought to the factors that tend to affect its life.

Of utmost importance is the matter of keeping the track properly adjusted and the track shoe bolts properly tightened; the bolts should be tightened to a torque of 100 to 110 lbs. ft.

The side bars have only one wearing surface, that being the surface which contacts the truck wheels, track idler, and the track support roller. Usually it becomes necessary to replace the pins and bushings before the rail assemblies wear out, and it is a matter of judgment then as to whether or not the side bars are good enough to justify the installation of a new set of pins and bushings.

The pins and bushings, and their relation to each other and to the sprockets, constitute the most important factor in track life. Since only the external wear on the bushings is apparent, some means other than casual inspection must be used to determine the amount of wear on the pins and on the bore of the bushings. The amount of "stretch" in the track, as indicated by the take-up in the track adjusting screw, is usually regarded as an index to the condition of the interior wear on the bushings and the wear on the pins. However, this must be considered in connection with the external wear on the bushings in order to determine the proper time for turning the pins and bushings.

When the pins and bushings are pressed out of the track, turned 180 degrees and reinstalled, new contact surfaces are brought into play between the pin and the bushing, and between the bushing and the sprocket. If this operation is performed at the right time, track life will be prolonged.

As the tracks wear and the pitch length (distance between centers of adjacent track pins) increases, the point of contact of the bushings on the sprocket teeth changes. Any appreciable wear at the base of the sprocket tooth tends to decrease its pitch, whereas, the wear on the track increases its pitch length. As a result, the bushing is inclined to ride higher on the sprocket tooth. In such case, the sprocket will finally spin in the track. Under no condition should a combined wear of the sprocket and track be allowed to reach the stage where such spinning of the sprocket can occur. This causes severe repeated shock to the tractor and may result in serious damage. New sprockets should always be installed with new track. However, if the sprockets are not too badly worn, the right and left sprockets may be interchanged, thus presenting the better side of the sprocket teeth to the track bushings.

The pitch length (distance between center of pins) of a new track is 6½" and the maximum allowable pitch length for a used track is 6⅝".

Some owners have erroneously adapted the practice of removing one track link in order to bring the track again within the range of the adjusting screw. This should never be done, as a track worn

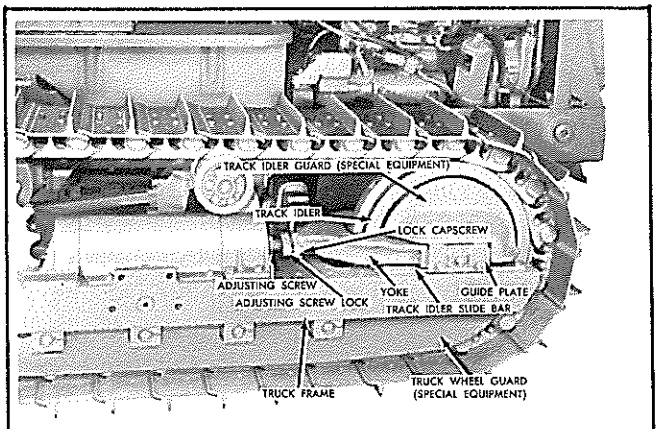

Fig. 2 — Track and Track Idler Adjustment

badly enough to take up the length of one link will be so far out of pitch that the increased wear on the sprocket will more than counteract the savings that may be obtained by further life of the track. Under extreme abrasive conditions, the sprocket teeth may wear deep enough into the bushings to justify turning the pins and bushings before appreciable wear shows on the inside of the bushings and on the pins. In other words, the pitch length of the track may only slightly exceed the pitch length when new. In any case, the remaining thickness of the bushings is the determining factor. Pins and bushings must be turned before the bushing wears through and the pin is destroyed, or before the bushing becomes thin enough to allow it to crack in service.

A. Track Adjustment

The tracks are correctly adjusted when the upper part of the tracks can be lifted 1½" to 2" above the support rollers with the use of a bar. IMPORTANT: *Run the tractor backward and forward a few times before checking the adjustment of the track.* Proper adjustment is important because rapid wear of the tracks and other affected parts will occur if the tracks are too tight or too loose.

To adjust each track, loosen the lock capscrews in the adjusting screw lock, then turn the adjusting screw out of the track release yoke as necessary to force the track idler ahead and tighten the track, or turn the screw into the yoke as necessary to loosen the track. Drive the tractor forward and backward a few times then check the adjustment of the track. When the correct adjustment of the track is obtained, tighten the lock capscrews in the adjusting screw lock.

B. Track Removal

1. Uncoupling of Track Using Special Tools

a. Move the tractor until the master pin is at the front face of the track idler. The master pin can be identified as being longer than the standard pins and protrudes approximately 3/16" beyond the boss in the side bar.

b. Loosen the lock capscrews in the adjusting screw lock and turn the adjusting screw into the track release yoke until the track is loose.

c. Using special tools similar to the ones shown in Figs. 3 and 4, remove the master pin from the track as follows:

(1) Attach the two puller legs to the push-puller with two nuts.

(2) Insert the push-puller with one leg through the track idler and one leg to the outside of the track as shown in Fig. 3.

(3) Install the press plate aligning bushing into the end of the press plate.

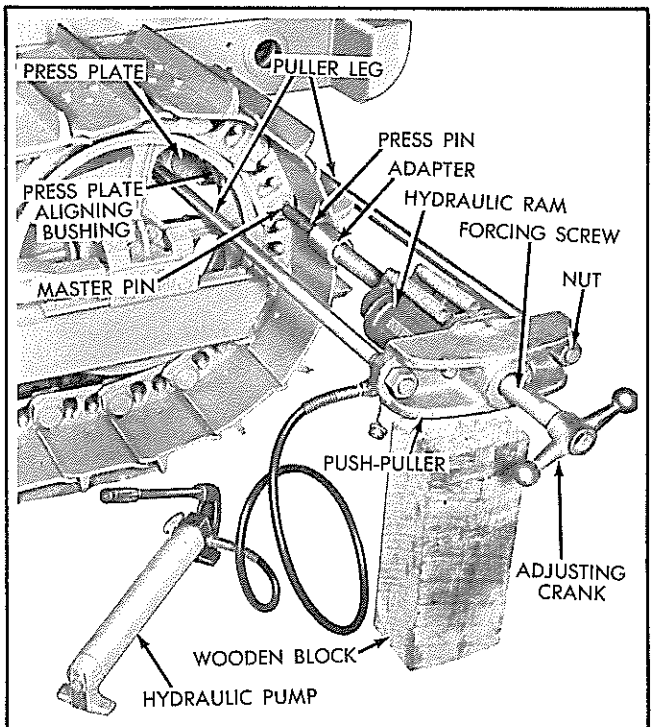

Fig. 3 — Pressing Master Pin from Track

Install the press plate on the inner end of the two puller legs and attach with two nuts, making certain the aligning bushing is centered around the inside end of the master pin.

(4) Attach the hydraulic ram to the push-puller with the two attaching capscrews.

(5) Turn the adapter onto the inner end of the forcing screw and turn the press pin into position in the adapter.

(6) Using the adjusting crank, turn the forcing screw in until the press pin contacts the end of the master pin. Support the outer end of the press assembly on blocks as shown in Fig. 3.

(7) Connect the hydraulic pump to the hydraulic ram and actuate the pump handle until the ram has extended its full length. Slowly release the pressure from the hydraulic pump and at the same time, turn the adjusting crank to move the forcing screw forward until the pis-

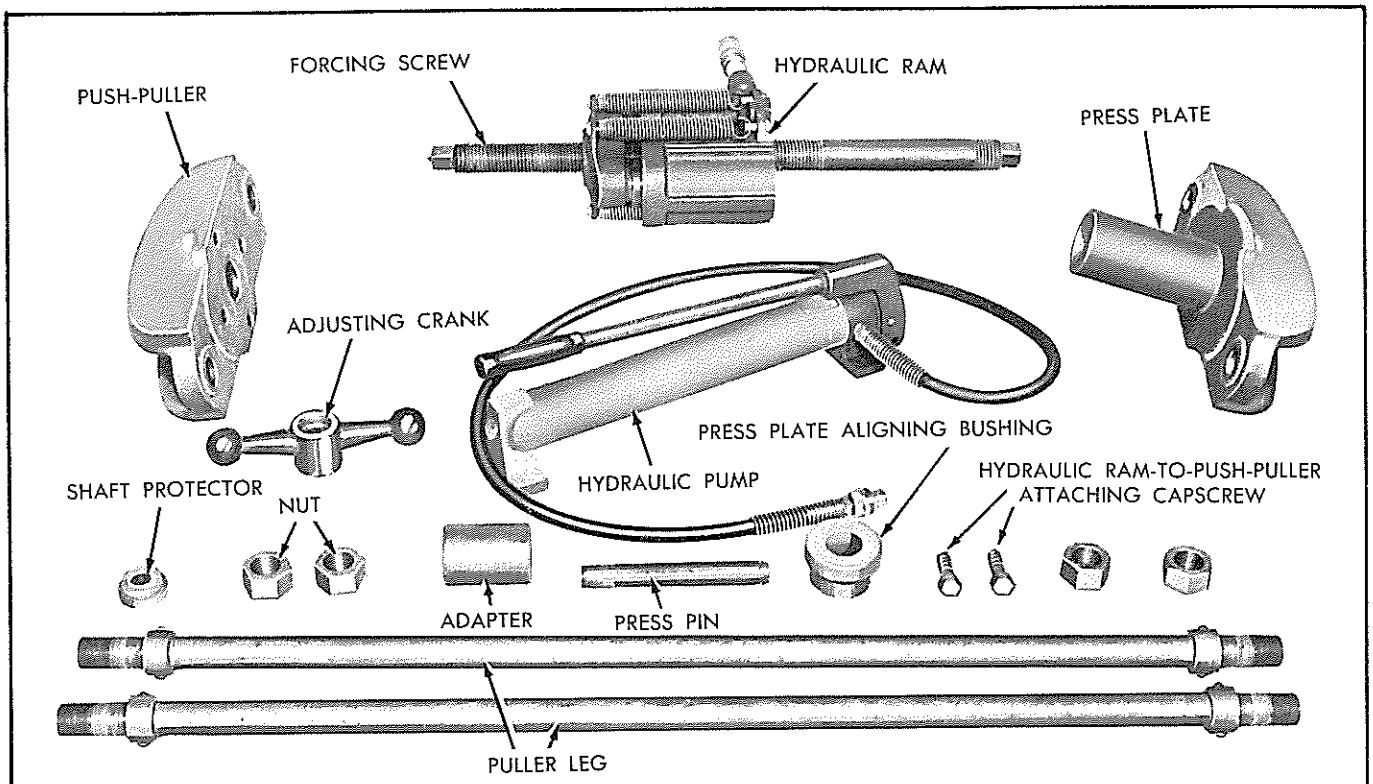

Fig. 4 — Track Master Pin Press Details

tons are fully retracted into the ram cylinders. Close the actuating valve on the hydraulic pump and continue the above operation until the master pin is pressed out of the track rail assembly. Remove the press assembly.

2. Uncoupling of Track Without Use of Special Tools

If special tools are not available, follow steps a. and b. in the preceding paragraph and proceed as follows:

a. Hold a "bucking bar" against the inner side bar, close to the master pin.

b. Drive the master track pin out using a sledge hammer and a suitable driving bar. CAUTION: *Necessary precaution should be taken to protect the eyes from chips of steel, which might dislodge when striking the master pin.*

3. Removal of Track from Under Truck Frame

a. Uncouple the track and move the tractor backward until the track is free of the track sprocket.

b. Using a suitable hoist, raise the truck frame free of the track and pull the track out from under the truck frame.

C. Track Installation

1. Place the track under the truck frame with the bushing end of the track links to the front of the tractor.

2. Place an 8" block under the first track shoe.

3. Place a bar in the track pin hole in the rear end of the track.

4. Move the tractor backward until the bar may be hooked over a tooth of the track sprocket. Move the tractor forward, holding the bar firmly in place on a sprocket tooth, so that the track will follow the sprocket.

5. Hold the end of the track up so it will pass over the track support roller and the track idler as the tractor is moved forward.

6. Remove the bar and line up the track pin holes in both ends of the track; make certain that the master bushing spacers (used at each end of the master bushing) are in position, with the chamfered side of the spacer toward the counterbore in the side bars.

7. Using special tools similar to the ones shown in Figs. 4 and 5, install the master pin as follows:

   a. Attach the two puller legs to the push-puller with two nuts.

   b. Refer to Fig. 5 and insert the push-puller with one leg through the track idler and one leg to the outside of the track.

   c. Insert the press plate aligning bushing into the end of the press plate. Install the press plate on the inner end of the two puller legs and attach with two nuts, making certain the hole in the aligning bushing is aligned with the hole in the side bar.

   d. Attach the hydraulic ram to the push-puller with the two attaching capscrews.

   e. Hold a shaft protector in position on the inner end of the forcing screw. Using the adjusting crank, turn the forcing screw in until the shaft protector contacts the end of the master pin, making certain that the master pin is properly positioned for installation. Support the outer end of the press assembly on blocks as shown in Fig. 5.

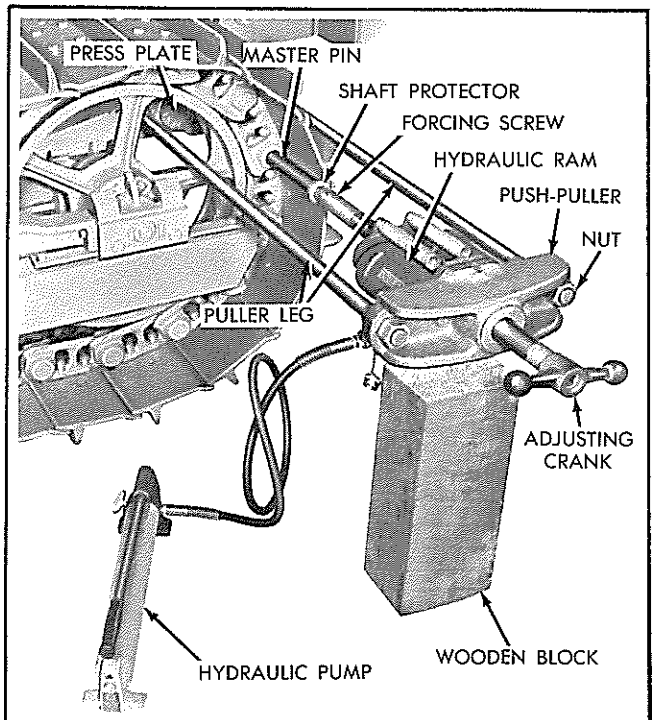

Fig. 5 — Pressing Master Pin into Track (Side View)

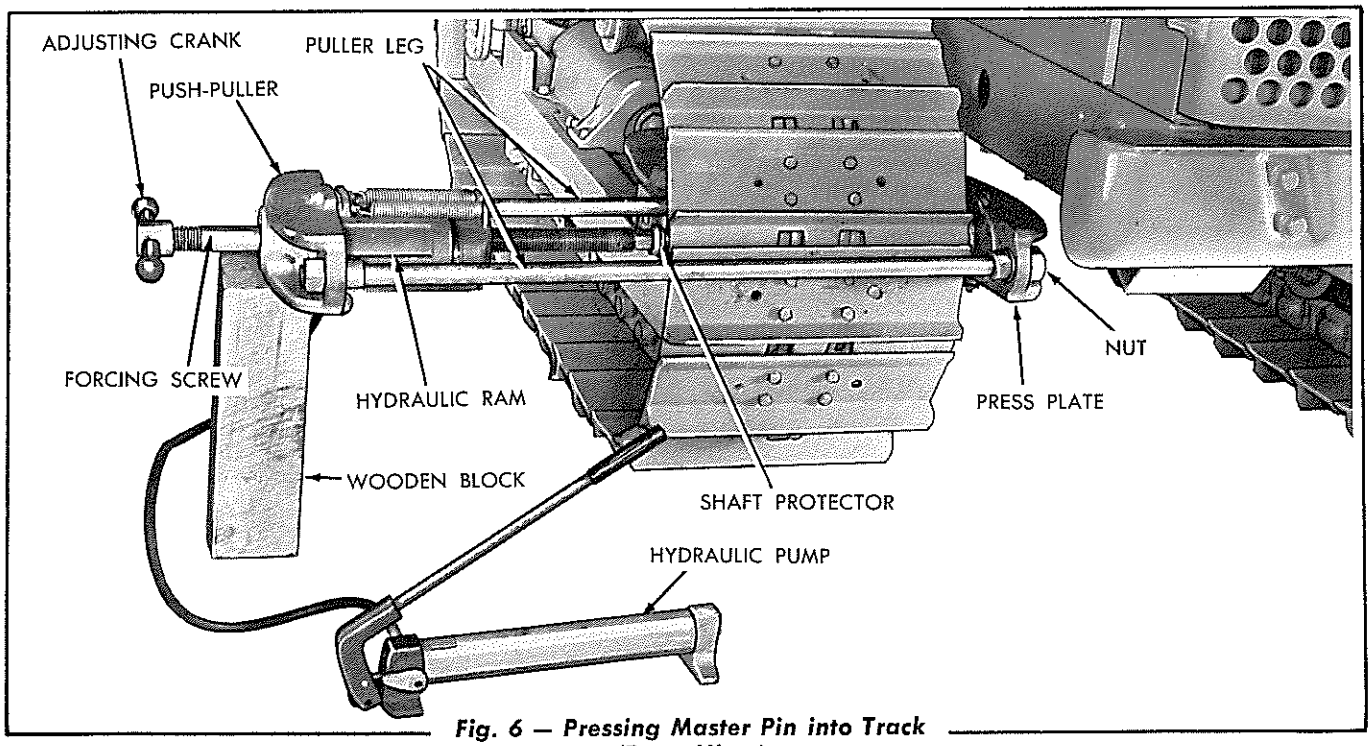

Fig. 6 — Pressing Master Pin into Track (Front View)

f. Connect the hydraulic pump to the hydraulic ram and actuate the pump handle until the ram has extended to its full length. Slowly release the pressure from the hydraulic pump, and at the same time, turn the adjusting crank to move the forcing screw forward until the pistons are fully retracted into the ram cylinders. Close the actuating valve on the hydraulic pump and continue the above operation until the master pin is pressed into position and the master pin is centered in the track rail assembly.

Remove the press assembly.

8. If special tools are not available, drive the master pin into place using a sledge hammer and a suitable driving bar, until the master pin is centered in the track rail assembly. CAUTION: *Necessary precautions should be taken to protect the eyes from chips of steel, which might dislodge when striking the master pin.*

9. Adjust the track (refer to "TRACK ADJUSTMENT" in this Section).

SECTION XVII — MAIN FRAME AND EQUALIZING SPRING

1. GENERAL DESCRIPTION

A. Main Frame

The main frame is a one piece welded steel structure. The rear end of the main frame is bolted to the steering clutch and final drive housing, and is attached to and supported by, an equalizing spring.

B. Crankcase Guard

The engine crankcase guard is a pressed steel plate bolted to the main frame for protection of the engine crankcase and the underside of the tractor. A removable access plate is provided in the guard for draining the engine lubricating oil.

C. Equalizing Spring

The equalizing spring is a leaf type spring which pivots on a saddle pin installed in the bottom of the main frame. The weight of the front end of the tractor is transmitted to the truck frames through the equalizing spring.

The spring stabilizes the tractor and its mounted equipment by permitting the truck frames to oscillate. Oscillating truck frames provide more uniform traction and minimize the shock imposed on the tractor when operating over rough terrain. The HD-6A Tractor has a 44" tread and requires a 34" spring. The HD-6B and HD-6E has a 60" tread and requires a 50" spring.

D. Rigid Beam

A rigid beam is used in place of the equalizing spring on the Model HD-6G Tractors which have longer truck frames and are specially designed for mounting front end equipment. The rigid beam tends to stabilize the tractor and is used where truck frame oscillation is not required.

The rigid beam assembly consists of a welded beam, saddle, saddle pin, and the necessary hardware to complete the assembly. Each end of the beam welded assembly is bolted securely to the top of the truck frames. Shims are provided for use between the top of the rigid beam stop and the bottom of the main frame side members.

2. MAIN FRAME

A. Maintenance and Inspection

The main frame should be checked periodically for loose bolts, cracked welds, bending and misalignment. Any of the above conditions should be corrected immediately.

B. Repair

If the main frame becomes cracked or broken because of unusually rough work, it may be practical to weld and reinforce the frame with suitable steel plates. Before welding the frame, it should be checked for alignment and straightened if necessary.

If it is not practical or desirable to straighten or weld the frame, it must be replaced. The main frame-to-steering clutch housing capscrews must be tightened to a torque of 580 to 590 lbs. ft.

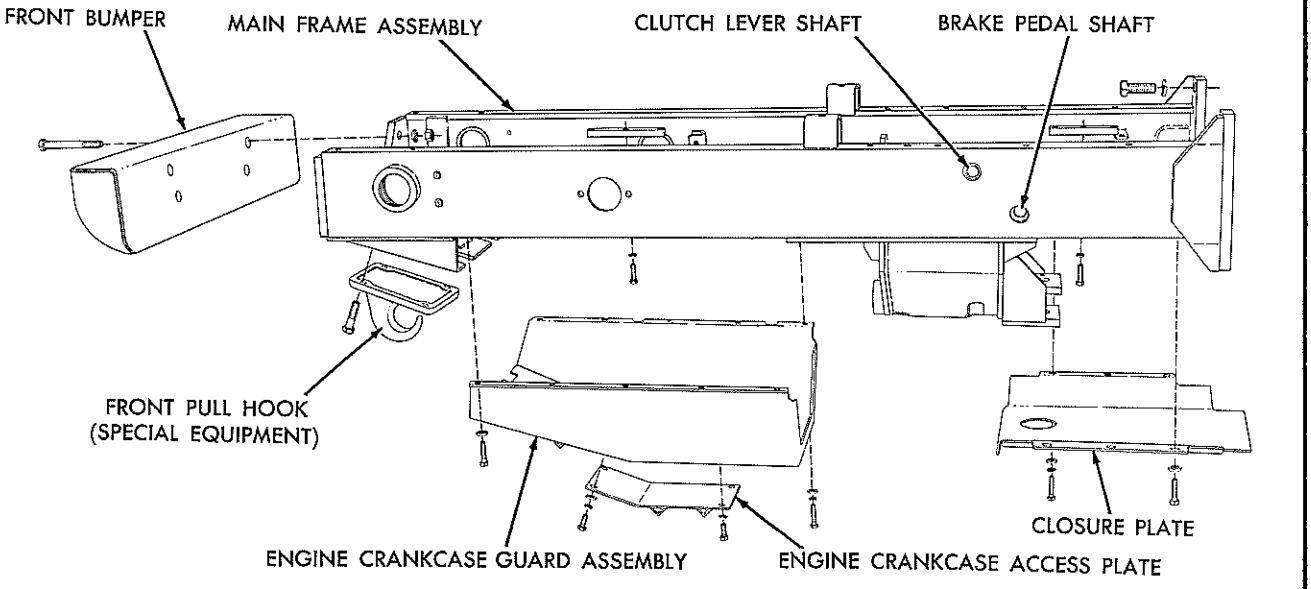

Fig. 1 — Main Frame and Guards Details

3. CRANKCASE GUARD

A. Maintenance and Inspection

The crankcase guard should be checked periodically for loose bolts and dents which may cause damage to the engine crankcase. If the crankcase guard becomes dented, it should be removed and straightened or replaced. Never operate the tractor without the crankcase guard in place, as it is essential that the oil pan be guarded at all times against obstructions.

B. Removal

1. Support the crankcase guard with suitable cribbing or jacks, then remove the attaching capscrews.
2. Remove the crankcase guard.

C. Installation

1. Support the crankcase guard in position for installation. Install the attaching capscrews, plain washers, lockwashers, and nuts and tighten securely.
2. Remove the cribbing or jacks used to support the crankcase guard.

4. EQUALIZING SPRING

A. Maintenance and Inspection

Maintenance of the equalizing spring consists of periodic checks for loose bolts and excessive wear of the equalizing spring seats and the saddle assembly. If the saddle U-bolts are broken or will not tighten, they must be replaced. Broken spring leaves must be replaced immediately. The spring assembly must be removed to install a new spring leaf.

B. Removal

1. Remove the crankcase guard (refer to "CRANKCASE GUARD REMOVAL" in this Section).

2. Remove the capscrews attaching the spring seats to the truck frame. Remove the saddle pin locking pin.

3. Apply the brakes and lock them in position.

4. Using a chain hoist or jack, raise the front end of the tractor and block the main frame so that the weight of the tractor is removed from the spring seats.

5. Support one end of the equalizing spring on a suitable block. A 7/8" N.F. tapped hole is provided in the front end of the saddle pin to facilitate removal. Using a slide hammer puller, pull the saddle pin from the main frame and saddle assembly.

6. Remove the spring assembly.

C. Disassembly

1. Remove the bolts from the rebound clips.

2. Remove the nuts from the saddle U-bolts and remove the U-bolts and seats.

3. Remove the spring from the saddle assembly and place the spring in a suitable vise or press.

4. Compress the spring and remove the centerbolt. Disassemble the spring.

5. Clean all the mating surfaces of the spring leaves, U-bolt seats, and saddle assembly with a wire brush. Do not lubricate the spring leaves. Inspect the saddle pin and spring saddle bushings for wear and replace if necessary.

D. Assembly

1. Using a guiding pin in place of the centerbolt, assemble the spring leaves in a suitable vise or press and compress the spring leaves.

2. Remove the guiding pin and install the centerbolt and tighten securely.

3. Install the rebound clip bolts, compressing the spring as necessary.

4. Remove the assembled spring from the vise and assemble the spring with the saddle assembly, making certain the saddle assembly is properly positioned on the spring. Install the U-bolts and seats and tighten the U-bolt nuts securely.

E. Installation

1. Place the spring assembly and spring seats in position on the truck frames.

2. Install the saddle pin, locking pin, and cotter pin.

3. Remove the hoist or jacks and blocking from under the tractor.

4. Install the capscrews and lockwashers to attach the spring seats to the truck frames and tighten securely.

5. Install the crankcase guard (refer to "CRANKCASE GUARD INSTALLATION," in this Section). NOTE: *Periodically check the tightness of the nuts on the saddle U-bolts.*

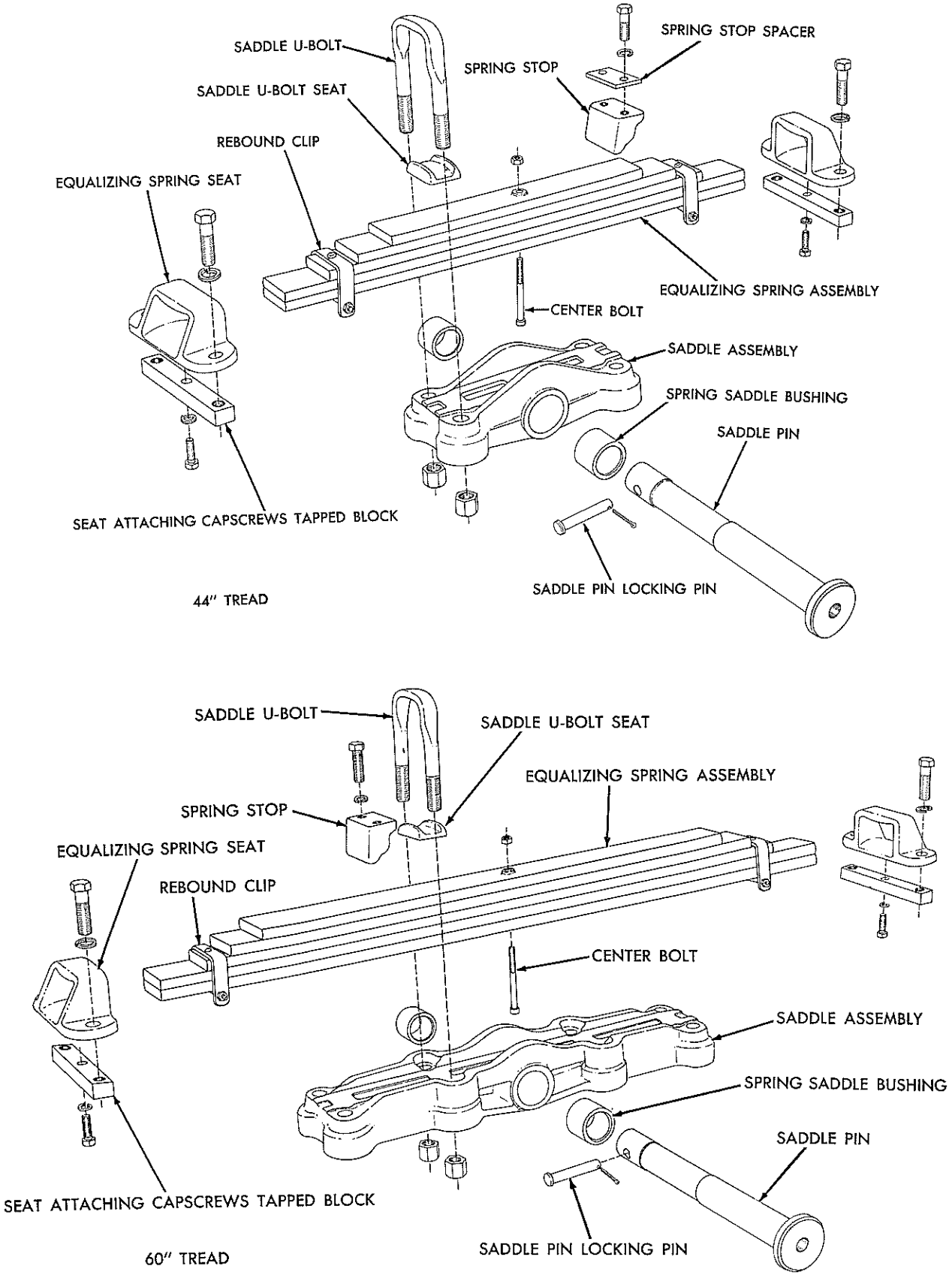

Fig. 2 — Equalizing Spring Details

5. RIGID BEAM

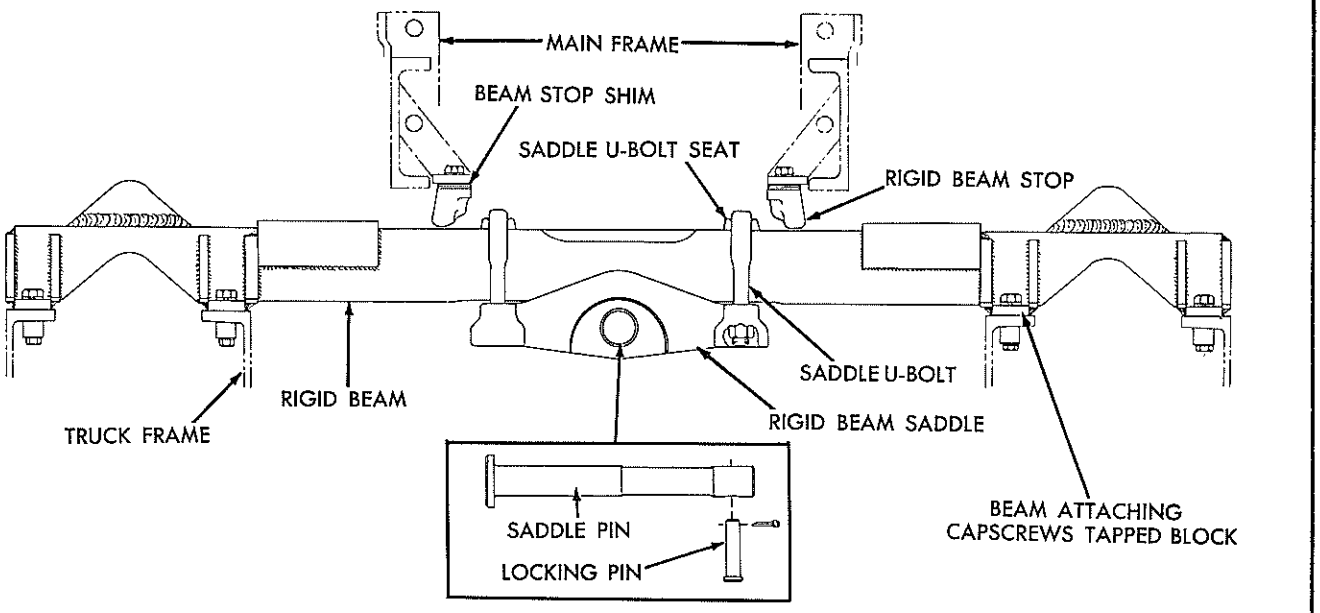

Fig. 3 — Rigid Beam Details

A. Maintenance and Inspection

The rigid beam must be checked periodically for loose bolts, cracked welds, bending, and misalignment. Should any of the above conditions exist, they must be corrected.

B. Removal

1. Remove the crankcase guard (refer to "CRANKCASE GUARD REMOVAL" in this Section).

2. Remove the capscrews attaching the rigid beam to the truck frame.

3. Apply the brakes and lock them in position.

4. Remove the saddle pin locking pin.

5. Using a suitable hoist or jack, raise the front end of the tractor and block the main frame securely so that the rigid beam is raised off the truck frames. Place blocks between the tops of the truck frames and the rigid beam.

6. A 7/8" N.F. tapped hole is provided in the front end of the saddle pin to facilitate removal. Using a slide hammer puller, pull the saddle pin from the main frame and saddle.

7. Raise the main frame off the rigid beam and remove the rigid beam.

C. Disassembly

Remove the saddle assembly from the rigid beam if it presents interference with any straightening or welding operation on the rigid beam.

D. Assembly and Installation

Assemble and install the rigid beam by a direct reversal of the removal and disassembly procedure, making certain that the saddle assembly is properly centered on the rigid beam. Tighten the saddle U-bolt nuts to a torque of 350 to 400 lbs. ft.

SECTION XVIII — FENDER AND SEAT GROUP

1. FENDERS

A. Front Fenders

Two front fenders are provided to protect the lower sides of the engine. The front fenders may be removed by removing the capscrews attaching the fenders to the cowl and the radiator shell.

B. Rear Fenders

The rear fender group protects the operator, seat, fuel tank, and battery boxes from debris carried by the tracks. The fenders serve as a mounting for the cowl, battery boxes, fuel tank, and seat.

With the fuel tank removed, the rear fenders may be removed with or without the battery boxes attached, or, the rear fenders, battery boxes, and the fuel tank may be removed as a unit.

2. SEAT

The tractor is provided with removable seat and back cushions. Arm rest cushions are provided which also serve as battery box covers. The seat cushion, back cushion, and arm rest cushions are replaceable and are covered with weather resistant material.

Reasonable care should be taken to avoid damaging the cushions with sharp or heavy objects, unnecessary exposure, battery acids, oil, and greases.

SECTION XIX — SPECIAL EQUIPMENT

1. GENERAL

Most of the special equipment, mentioned in this section, may be purchased separately for field installation, or the tractor may be ordered with the equipment factory installed. For a more complete list and additional information concerning special equipment, contact your "Allis-Chalmers" Construction Machinery Dealer.

2. GUARD EQUIPMENT

The standard tractor is equipped with a full width crankcase guard, front bumper, and a hinged type radiator guard.

A. Additional Guard Equipment

The following guard equipment is available as added protection for moving or exposed parts.

1. Wrap-Around Radiator Guard

A wrap-around radiator guard in both plain and hydraulic mounting types is available to provide heavy duty protection for the radiator on the Models HD-6A and 6B Tractors. The wrap-around radiator guard is standard equipment on the Model HD-6G Tractor.

2. Truck Frame Guard Equipment (Standard or Heavy-Duty)

Truck frame guard equipment for the Models HD-6A and 6B Tractors includes the following three groups, which may be ordered as separate items. They are standard equipment on the Model HD-6G Tractor.

a. Track Idler Guards

b. Truck Wheel and Inner Final Drive Guards

c. Sprocket Guards

3. Fuel Tank and Seat Guard

The fuel tank and seat guard is a heavy steel guard which bolts to the fenders and to the steering clutch and final drive housing. It is designed to protect the fuel tank. NOTE: *This guard cannot be used on tractors equipped with heavy-duty filters.*

4. Bottom Guard Group

The bottom guard group consists of a heavy, full width front guard (bolted to the main frame in place of the standard crankcase guard), for protecting the area in front of the equalizing spring. It also includes a full width rear guard for protecting the transmission and the steering clutch and final drive housing. The bottom guard group gives the tractor a smooth underside and the tractor is less likely to hang up on stumps or rocks. The bottom guard group is available for the Model HD-6B Tractor only and cannot be used on tractors equipped with track shoes over 18" wide.

B. Radiator Screen

There are three types of radiator screens available for the Model HD-6 Tractors.

1. **First type** — A fine mesh screen for use on Model HD-6A and 6B Tractors equipped with a suction type fan. The screen mounts on the front of the radiator.

2. **Second type** — A fine mesh screen for use on Model HD-6A and 6B Tractors equipped with a pusher type fan. The screen mounts on the rear of the radiator and is standard equipment on the Model HD-6G Tractor.

3. **Third type** — A heavy mesh screen that fits on the outside of the Wrap-Around Radiator Guard. This screen is not for use on tractors equipped with a pusher type fan.

3. COLD WEATHER EQUIPMENT

A. Hood Side Plates

Hood side plates to fit all Model HD-6 Tractors are available for cold weather use. The hood side plates hook to the engine hood and fasten to the front fenders with spring loaded fasteners.

B. Radiator Curtain.

A radiator curtain to fit all Model HD-6 Tractors is available for cold weather use. The curtain can not be used on tractors equipped with a pusher type fan.

C. Engine Air Heater

An engine air heater is available and may be substituted for the cold weather engine primer which is provided on the tractor as standard equipment. For a description of the air heater, refer to "ENGINE AIR HEATER," Section III.

4. HEAVY DUTY TRUCK WHEELS

Heavy duty truck wheels are available for all Model HD-6 Tractors, either as a factory substitution or for field service. The heavy duty truck wheels are for use where severe operating conditions are encountered.

5. PUSHER AND SUCTION TYPE FANS

Models HD-6A and HD-6B Tractors are equipped with a suction type fan as standard equipment; Model HD-6G Tractors are equipped with a pusher type fan. Either type of fan may be used, depending upon operating conditions. The fans are interchangeable except a spacer and longer capscrews are required for attaching the suction type fan to the fan hub.

6. ENGINE HOUR METER

The engine hour meter is an electrically energized clock which records the number of hours the engine has operated, up to 10,000 hours then repeats. Starting and stopping of the clock is controlled by the engine oil pressure so that the meter will record only when the engine is operating. The engine hour meter is mounted on a shock-proof bracket attached to the generator regulator mounting bracket, located on the front side of the cowl.

7. LIGHTS

Either a rear flood light or a tail light may be installed at the rear of the left rear fender, where two mounting holes are provided for attaching the light mounting bracket. Since different mounting brackets are used, both lights can not be installed at the same time.

8. POWER PULLEY AND POWER TAKE-OFF

A. Power Pulley

The power pulley is applicable to all Model HD-6 Tractors. The power pulley is mounted at the rear of the steering clutch and final drive housing and is driven by the transmission top shaft. The pulley is 12" in diameter by 8¾" wide and rotates clockwise (viewed from left side of tractor) at 963 R.P.M. at 1800 R.P.M. engine speed. NOTE: *The power pulley is also available without the pulley.*

B. Straight Rear Power Take-Off

The straight rear power take-off is applicable to all Model HD-6 Tractors. The shaft rotates clockwise (viewed from rear of tractor) at 963 R.P.M. at 1800 R.P.M. engine speed. A power take-off shaft guard is also available.

C. Reversible Reduction Power Take-Off

The reversible reduction power take-off is applicable to all Model HD-6 Tractors. The power take-off is mounted at the rear of the steering clutch and final drive housing and is driven by the transmission top shaft. The power take-off output shaft rotates either clockwise or counterclockwise at 539 R.P.M. at 1800 R.P.M. engine speed. A power take-off shaft guard is also available.

9. FUEL PRESSURE GAGE

The fuel pressure gage indicates the pressure at which the fuel is circulated through the low pressure fuel system. The gage mounts in the covered hole in the cowl.

10. TRANSMISSION GROUP

A transmission, having two reverse and four forward speeds, is available either as a factory substitution or for field service for the Models HD-6A and 6B Tractors. This transmission is standard in the Model HD-6G Tractors.

The transmission group provides the following tractor speeds at rated engine speed:

1st Gear	1.5 M.P.H.
2nd Gear	2.4 M.P.H.
3rd Gear	3.3 M.P.H.
4th Gear	5.5 M.P.H.
1st Reverse	2.0 M.P.H.
2nd Reverse	4.1 M.P.H.

11. MISCELLANEOUS

In addition to the items listed above, the following special equipment is also available.

A. Engine Air Pre-Cleaner Extension

The engine pre-cleaner extension is for use when the tractor is operated under extremely dusty or sandy conditions. It extends the engine air cleaner intake pipe 70" above the cowl.

B. Odometer

The odometer, which is gear driven from the bevel gear, registers miles or kilometers the tractor has traveled.

C. Front Pull Hook

The front pull hook is mounted on the underside of the main frame at the front end of the tractor.

D. Skeleton Sprocket

The skeleton sprocket is designed to help prevent excessive packing when the tractor is operating in mud or snow.

E. Exhaust Deflector and Rain Shield

The exhaust deflector and rain shield is an exhaust pipe extension incorporating an elbow.

F. Exhaust Rain Cap

The exhaust rain cap is a hinged cap attached to the top of the exhaust pipe.

G. Heavy Duty Filters

This special equipment consists of large capacity engine lubricating oil and fuel filters. The required attaching bracket(s) must be ordered separately from repair stock.

SECTION XX — GENERAL MAINTENANCE INSTRUCTIONS

1. BEARINGS AND BUSHINGS

A. Ball Bearings

Clean and inspect all ball bearings to see that they roll freely and are free from cracked, pitted, or worn balls and races.

Badly worn bearings can be detected by the presence of excessive end play between the outer and inner races. This condition can be detected by holding one race steady and moving the other race endwise, comparing the difference in movement of the races of the used bearing and a new bearing.

Check the outer and inner races for indications of bearing creepage. This can be detected by marks on the bearing races or on the bearing area of the bore or shaft where the bearing has been used.

Always lubricate a bearing at assembly with clean lubricant.

B. Tapered Roller Bearings

1. Thoroughly clean and inspect the bearings for worn and pitted rollers and races.

2. Inspect the outside of the bearing cup (outer race) and the inside of the cone (inner race) for marks which indicate creepage.

3. Always set up a tapered roller bearing in accordance with the specifications. IMPORTANT: *DO NOT EXPERIMENT*. A properly set up tapered roller bearing will give satisfactory service for a very long time, while a bearing pre-loaded too much or set up too loose may fail in a comparatively short time.

4. Lubricate the bearings at assembly with clean lubricant.

C. Needle Bearings

Needle bearings are used primarily in place of bushings where an oscillating motion is present. They are seldom used on a revolving part.

1. Thoroughly clean and inspect the rollers for wear or damage.

2. Inspect the needle retaining cage for dents which may interfere with the free rolling of the needles.

3. Be sure that the needles or rollers are not "cocked" in the cage and rotate each needle individually to be sure that it will turn.

4. Lubricate or pack the bearings at assembly with clean lubricant.

D. General

1. Do not use a bearing which is in bad condition, except in emergencies.

2. Keep all bearings spotlessly clean and well lubricated to prevent rusting. When installing new bearings, do not remove the bearings from package until ready for assembling.

3. Use a press and a suitable sleeve or driver when installing bearings. If these are not available, a cold rolled soft steel rod and hammer may be used to drive the bearings into position.

   Bearing inner races may be heated to expand the bore, thus facilitating the installation of the bearing on a shaft. One method of transferring heat to bearings is through the use of hot oil. The bearings should never be placed directly on the bottom of a tank or container, but should be suspended in the oil on hooks or laid on a screen so that they may be heated uniformly. A light or medium grade of clean lubricating oil should be used and the temperature must never exceed 300° F.

4. When installing a bearing on a shaft, drive or press on the inner race; when installing it in a bore, drive or press on the outer race.

5. Be careful not to strike the shield, snap ring, or balls when using a rod and hammer to install the bearings.

6. When using a sliding hammer type puller to remove or install an assembly containing tapered roller bearings, be sure that the pull is evenly distributed on the bearing. Do not allow the cup and the cone of the bearings to become separated, as each blow of the sliding hammer, with the cup and cone separated, would cause the cup and the cone to be rammed together and damage to the bearing would result.

E. Bushings

1. Do not remove the bushings for inspection unless the bushings are loose in their bores or are excessively worn, then they must be removed and replaced.

2. Use a press and a suitable sleeve or driver to install the bushings. Ream the bushings to the specified dimensions when reaming is required.

2. SHAFTS AND SPLINES

A. Shafts

Inspect all shafts for worn areas and make certain they are not twisted or bent.

B. Splines

1. Inspect the splines of all shafts for roughness, burrs, and wear. Remove all burrs and roughness from the splines with a stone or a mill file.

2. Be sure the splines of all shafts are smooth and try all the sliding gears on their respective shafts to be sure that they slide freely on the splines.

C. Detents

Inspect the detent notches in the transmission shifting fork shafts. Make certain the detent balls have been entering the detent notches. Remove any burrs or roughness on the shifting fork shafts with a stone or mill file.

3. SHIFTING FORKS

Check the transmission shifting forks for tightness and proper location on the shifting fork shafts and make certain the forks are not bent as indicated by uneven wear. Observe the side faces of the forks for wear and roughness; also, check the shifting grooves in the gears in which the forks operate. Remove any roughness on these parts with a stone or mill file. Refer to "FITS AND TOLERANCES," Section XXI, for tolerances when new.

4. OIL SEALS

A. Lip Type

1. When any work has been done which involves the removal of a shaft from an oil seal or the removal of an oil seal from its bore, the sealing lip of the seal must be carefully examined.

2. The sealing lip must not be scratched, folded over, torn, or charred from heat. The lip must be flexible and the spring, located inside the lip, must have the proper tension to return the lip to its proper position when the lip is pressed in by hand.

3. Be sure that the surface of the shaft contacted by the lip of the oil seal is smooth and free from tool marks or burrs.

4. When installing an oil seal on a shaft, or a shaft through an oil seal, be sure to protect the sealing lip from damage which might be caused from a keyway, splines, threads, or a hole through the shaft. A small scratch or cut, or a fold in the lip of the seal, will render the seal useless.

   Use an oil seal installing bushing, or a thin sheet of stiff paper wrapped around the sharp portion of the shaft, then slide the seal over the bushing or paper.

5. Use an oil seal installing tool or a press when installing seals into their bores, to prevent damage to the outer case of the seals. If the proper installing tools are not available, a smooth piece of metal or a block of wood can be placed flat against the face of the seal and the seal can be driven into position with a hammer.

6. When a new oil seal is to be installed, always soak it in warm engine oil for about 1 hour before installing. This will lubricate the sealing lip and make the lip pliable.

B. Positive Type

1. The sealing surfaces of the seal rings (positive type) must be smooth and flat. Scratches on the sealing surface, no matter how slight, may be conducive to leakage of lubricant. If replacement of a seal ring is necessary, its mating ring must also be replaced. When assembling, make certain that the sealing surfaces are clean and lubricate the sealing surfaces with clean engine oil.

2. Check the seal boot (rubber) for cracks and be sure that it is securely cemented to the seal spring follower assembly and the seal ring.

3. Check the seal spring follower assembly and make certain the springs are in good condition and that the follower is exerting an even pressure on its entire periphery.

5. GASKETS

1. When a gasket is removed from the tractor, clean the gasket and inspect it for damage. If it is in good condition, and is to be used again, immerse it in a container of oil and keep it in the container until it is needed.
2. Do not use a gasket which is torn, hardened, or shrunken out of shape.

6. GEARS

1. Thoroughly clean and inspect all gears for worn, pitted, chipped, or cracked teeth.
2. Check the internal splines for galling, roughness, and wear.

7. HOSES

Inspect all water and air hoses, fuel lines, and lubricating oil lines for leaks and signs of collapsing and deterioration of the rubber on the inside of the hoses. Replace if necessary.

8. WIRING

1. Do not allow the insulation of the cables to become soaked with fuel or lubricating oil.
2. Wrap all frayed spots of the insulation with tape.
3. Keep all terminals and connections clean and tight.

9. BATTERIES

1. Keep the batteries clean and maintain the level of the electrolyte solution 3/8" above the battery plates by the addition of clean distilled water.
2. Be sure that the battery hold-down assemblies are tight so that the batteries do not shift around in their compartments.
3. Periodically, clean the battery terminals and apply a light coating of petroleum jelly to the terminals.

10. RADIATOR

1. Keep the radiator filled to the proper level with clean coolant. Only clean water free from lime or other minerals should be used. A permanent type (ethylene glycol) antifreeze solution should be used in freezing weather.
2. Remove all leaves and other debris from the air passages of the radiator. IMPORTANT: *DO NOT PAINT THE RADIATOR CORE.*
3. Keep the radiator and the radiator shell mounting bolts properly tightened.

11. FILTERS

1. Fuel filter elements should be changed after every 300 to 500 hours of operation (more often if conditions warrant) or when the filters become clogged. Engine oil filter elements should be changed each time the oil in the crankcase is changed.
2. When installing new filter elements be sure that all gaskets are in place and are in good condition.
3. Check all filter connections for leaks after an element has been replaced.

12. PIPING

1. Tighten fittings only tight enough to prevent leakage. If the fittings are drawn up too tight they will be damaged and must be replaced.
2. Always be sure that the ferrules and nuts are clean before tightening.

13. FASTENERS

1. Keep all nuts, bolts, hose clamps, etc., tight at all times. A periodic check of these parts does not take long and may prevent the occurrence of a major failure.
2. Inspect and tighten the track shoe bolts frequently, especially if operating over rough hard terrain.
3. Replace any broken or missing capscrews, nuts, or lockwashers.

14. MISCELLANEOUS

1. Keep the outside of the engine free from deposits of oily dust, which acts as an insulation material and prevents cooling by radiation.
2. Make all adjustments as specified in this manual.
3. Use only genuine "Allis-Chalmers" parts for replacement.

SECTION XXI — FITS AND TOLERANCES

1. GENERAL

This section has been prepared to provide those responsible for the maintenance of the tractor with the proper fits and tolerance information for the various assemblies.

The information herein deals with the fits and tolerances of parts when they are new and the amount of wear permissible before the parts must be replaced.

When making repairs to the tractor, refer to this section for the proper fits and tolerance information.

2. ENGINE

Description	Size of New Parts	Install New Parts When Clearance Exceeds
A. Cylinder Sleeve		
1. Type	Replaceable wet	
2. Inside diameter	4.4370" — 4.4385"	
3. Diameter of sleeve at machined area just below flange	5.030" — 5.032"	
4. Diameter of cylinder sleeve at packing ring location	4.967" — 4.969"	
5. Sleeve flange outside diameter	5.249" — 5.253"	
6. Cylinder block-to-sleeve clearance at sleeve lower diameter	.001" — .005"	
7. Cylinder block-to-sleeve clearance at machined area just below flange	.0005" — .0045"	
8. Cylinder block-to-sleeve clearance at sleeve flange	.003" — .012"	
9. Clearance of piston skirt with sleeve	.0055" — .008"	.011"
10. Fire wall height above cylinder sleeve flange	.042" — .045"	
11. Top surface of cylinder sleeve flange above cylinder block with sleeve installed	.006" — .009"	
12. Maximum allowable sleeve flange stand-out variation between adjacent sleeves (controlled by shims)	.002"	
13. Flange height adjusting shims available	.005", .008", .010", .015", and .020"	
14. Allowable taper	.0015"	.006"
15. Allowable out of round (when installed)	.001"	.006"

Description	Size of New Parts	Install New Parts When Clearance Exceeds
B. Cylinder Block		
1. Counterbore diameter in cylinder block for cylinder sleeve flange	5.256" — 5.261"	
2. Depth of counterbore for cylinder sleeve flange	.3125" — .3135"	
3. Bore in cylinder block for cylinder sleeve	4.970" — 4.972"	
4. Bore in cylinder block for camshaft bearings	2.4975" — 2.4985"	
C. Piston		
1. Material	Aluminum alloy	
2. Length	5.728" — 5.732"	
3. Diameter between top and second ring groove	4.406" — 4.410"	
4. Diameter at bottom of skirt measured at right angle to piston pin	4.4305" — 4.4315"	
5. Bore for piston pin	1.5014" — 1.5016"	
6. Measurement from center of piston pin bore to top of piston	3.103" — 3.107"	
7. Clearance of piston skirt with sleeve	.0055" — .008"	.011"
D. Piston Pin		
1. Type	Full floating	
2. Piston pin length	3.798" — 3.813"	
3. Diameter of pin	1.5015" — 1.5017"	
4. Fit of pin in piston at room temperature	.0001" — .0003" Tight	
5. Inside diameter of connecting rod bushing	1.5027" — 1.5032"	
6. Piston pin-to-connecting rod bushing clearance	.001" — .0017"	.003"
E. Piston Rings		
1. Number of rings on each piston	5	
2. Location of rings	3 Compression and 2 Oil Control Above Piston Pin	
3. Gap between ends — fitted	.015" — .023"	
4. Clearance of rings in grooves:		
Top compression ring (chromium plated)	.0045" — .006"	
2nd and 3rd (compression rings)	.0015" — .0035"	
4th and 5th (oil control rings)	.002" — .004"	
F. Crankshaft		
1. Journal diameter for connecting rods	2.7715" — 2.7725"	
2. Journal diameter for main bearings	3.498" — 3.499"	
3. Width between connecting rod journal cheeks	1.750" — 1.754"	
4. Width of main bearing journals:		
a. Front bearing	2.250" — 2.255"	
b. Intermediate bearings	1.623" — 1.627"	
c. Center bearing	2.688" — 2.692"	
d. Rear bearing	2.229" — 2.239"	
5. Crankshaft end clearance	.006" — .012"	.020"
6. Crankshaft journals may be ground	.010", .020", .030", or .040" Undersize	

Description	Size of New Parts	Install New Parts When Clearance Exceeds
7. Fit of crankshaft gear on crankshaft	.0005" — .0025" Tight	

G. Main Bearings

1. Number used	5	
2. Type	Replaceable precision	
3. Inside diameter of front, intermediate, and rear bearing	3.501" — 3.5027"	
4. Inside diameter of center bearing	3.5015" — 3.5032"	
5. Diameter of crankshaft main bearing journals	3.498" — 3.499"	
6. Bearing-to-journal clearance at front, intermediate, and rear bearings	.002" — .0047"	.0065"
7. Bearing-to-journal clearance at center bearing	.0025" — .0052"	.0065"
8. Overall length of main bearings:		
Front and Intermediate	1.442" — 1.452"	
Center	2.680" — 2.682"	
Rear	2.085" — 2.095"	
9. Undersize bearings available for service	.010", .020", .030", and .040"	
10. Front, intermediate, and rear bearing wall thickness (standard bearing)	.1549" — .1554"	.152"
11. Center bearing wall thickness (standard bearing)	.1546" — .1551"	.152"
12. Bearing bore in cylinder block (without bearing, cap in place, and nuts tightened to specified torque)	3.8118" — 3.8125"	
13. Torque for tightening main bearing cap nuts:		
⅝ N.F.	160 — 170 lbs. ft.	
¾ N.F.	210 — 230 lbs. ft.	

H. Connecting Rod Bearings

1. Type	Replaceable precision	
2. Inside diameter of bearing	2.7745" — 2.776"	
3. Diameter of crankshaft connecting rod journals	2.7715" — 2.7725"	
4. Connecting rod bearing-to-journal clearance	.002" — .0045"	.006"
5. Overall length of connecting rod bearings	1.457" — 1.467"	
6. Undersize bearings available for service	.010", .020", .030", and .040"	
7. Bearing wall thickness (standard bearing)	.1247" — .1252"	.122"
8. Side clearance	.004" — .009"	

I. Connecting Rods

1. Type	Balanced forging	
2. Bolts used per rod	2	
3. Connecting rod length (center-to-center)	10.998" — 11.002"	
4. Inside diameter of connecting rod bushing (finished bore)	1.5027" — 1.5032"	
5. Outside diameter of connecting rod bushing	1.690" — 1.691"	
6. Bearing bore (without bearing, cap in place, and nuts tightened to specified torque)	3.025" — 3.0255"	
7. Connecting rod bearing-to-crankshaft journal clearance	.002" — .0045"	.006"
8. Connecting rod width at lower end	1.745" — 1.746"	
9. Piston pin diameter	1.5015" — 1.5017"	

Description	Size of New Parts	Install New Parts When Clearance Exceeds
10. Piston pin bushing length in connecting rod	1.625"	
11. Piston pin-to-connecting rod bushing clearance	.001" — .0017"	.003"
12. Torque for tightening connecting rod cap nuts	120 — 130 lbs. ft.	

J. Exhaust Valves

1. Valve lift (at valve)	.478"	
2. Valve lift (at cam)	.327"	
3. Seat angle	45°	
4. Valve seat width	.0883"	
5. Valve lash (cold)	.022"	
6. Valve lash (engine coolant at normal operating temperature)	.020"	
7. Head diameter	1⅝"	
8. Overall length	6.812"	
9. Stem diameter	.3715" — .3725"	
10. Inside diameter of valve guide	.3745" — .3755"	
11. Stem-to-guide clearance	.002" — .004"	.006"
12. Valve spring free length	2 21/32"	
13. Valve spring length (valve closed)	2 5/16"	
14. Valve spring length (valve open)	1 13/16"	
15. Spring load at 2 5/16" length	55 — 61 lbs.	
16. Spring load at 1 13/16" length	155 — 165 lbs.	
17. Refacing stone angles	30°, 45°, 60°	

K. Intake Valve

1. Valve lift (at valve)	.429"	
2. Valve lift (at cam)	.292"	
3. Seat angle	45°	
4. Valve seat width	.1425"	
5. Valve lash (cold)	.018"	
6. Valve lash (engine coolant at normal operating temperature)	.016"	
7. Head diameter	1.839" — 1.849"	
8. Overall length	8.063"	
9. Stem diameter	.3715" — .3725"	
10. Inside diameter of valve guide	.3745" — .3755"	
11. Stem-to-guide clearance	.002" — .004"	.006"
12. Valve spring free length	2 21/32"	
13. Valve spring length (valve open)	1 13/16"	
14. Valve spring length (valve closed)	2 5/16"	
15. Spring load at 2 5/16" length	55 — 61 lbs.	
16. Spring load at 1 13/16" length	155 — 165 lbs.	
17. Refacing stone angles	30°, 45°, 60°	

L. Exhaust Valve Seat Insert

1. Seat angle	45°	
2. Seat width	5/64" — 7/64"	

Description	Size of New Parts	Install New Parts When Clearance Exceeds
M. Exhaust Valve Guide		
1. Length	$3\frac{9}{16}$"	
2. Inside diameter	.3745" — .3755"	
3. Stem-to-guide clearance	.002" — .004"	.006"
4. Guide stand-out above flat surface of counterbore in cylinder head	1"	
N. Intake Valve Guide		
1. Length	$4\frac{15}{16}$"	
2. Inside diameter	.3745" — .3755"	
3. Stem-to-guide clearance	.002" — .004"	.006"
4. Guide stand-out above flat surface of counterbore in cylinder head	1"	
O. Rocker Arms		
1. Bore in rocker arm for bushing	1.061" — 1.062"	
2. I.D. of rocker arm bushing (finished bore)	1.001" — 1.0015"	
3. Fit of rocker arm bushing in rocker arm bore	.004" — .0065" tight	
4. O.D. of rocker arm shaft	.999" — 1.000"	
5. Rocker arm shaft-to-bushing clearance	.001" — .0025"	.005"
6. Rocker arm ratio	1.522:1	
7. Concave expansion plug size	¾"	
P. Camshaft		
1. Number of bearings used	4	
2. I.D. of camshaft bearings (when installed)	2.2494" — 2.252"	
3. O.D. of camshaft journals	2.2465" — 2.2475"	
4. Camshaft bearing-to-journal running clearance	.0019" — .0055"	.0075"
5. O.D. of camshaft bearings	2.5005" — 2.5015"	
6. Bearing bore in cylinder block	2.4975" — 2.4985"	
7. Fit of camshaft bearings in bore of cylinder block	.002" — .004" tight	
8. Overall width of camshaft bearings:		
Front bearing	1.560" — 1.564"	
Intermediate bearings	.935" — .939"	
Rear bearing	1"	
9. Camshaft end clearance	.003" — .009"	
10. Camshaft gear width	1.3125"	
11. Fit of camshaft gear on camshaft	.0005" — .002" tight	
12. Specified thickness of thrust collar	.205" — .206"	

Description	Size of New Parts

Q. Gear Train

Backlash between mating gears	.003" — .007"

R. Cylinder Head

1. I.D. of combustion chamber	2.124" — 2.126"
2. Depth of combustion chamber	1.348" — 1.350"
3. Throat diameter of energy cell	.201" — .202"
4. Energy cell plug depth	.895" — .897"
5. Valve sequence — front-to-rear	Intake — Exhaust
6. Cylinder head gasket thickness (compressed)	.057" — .067"

S. Lubricating Oil Pump

1. Radial clearance — gears-to-pump body	.0035" — .0055"
2. End clearance — pump gears	.002" — .004"
3. I.D. of gear shaft bushings (finished bore):	
Front cover	1.2495" — 1.2505"
Housing	.937" — .9385"
4. Clearance — upper shaft-to-shaft bushings	.0015" — .0035"
5. Capacity at engine speed of 1800 R.P.M.	13.5 G.P.M.
6. I.D. of lower gear bushing	.7495" — .7505"
7. Clearance — lower gear bushing-to-shaft	.001" — .003"

T. Engine Torque Wrench Specifications

Description	Lbs. Ft.
1. **Capscrews**	
Air intake elbow-to-manifold capscrews	35 — 45
Crankshaft pulley capscrew	290 — 310
Engine mounting bolts	100 — 115
Flywheel capscrews	95 — 105
Flywheel housing capscrews	18 — 21
Oil cooler-to-water inlet and outlet connection capscrews	18 — 21
Oil cooler water inlet connector-to-cylinder block capscrews	18 — 21
Oil cooler water outlet connection-to-cylinder block capscrews	18 — 21
Oil pan capscrews — 5/16"	7 — 8
Oil pan capscrews — 3/8"	18 — 21
Oil pump cover capscrews	5 — 8
Oil pump-to-cylinder block capscrews	18 — 21
Oil pump suction pipe supporting bracket capscrews	35 — 45
Thermostat housing capscrews	18 — 21
Timing gear housing cover capscrews — 3/8"	18 — 21
Timing gear housing cover capscrews — 1/2"	45 — 50
Valve lifter bracket capscrews	18 — 21
Water outlet manifold capscrews	7 — 8
Water pump mounting capscrews	18 — 21
Water pump volute capscrews	18 — 21

Description	Lbs. Ft.

2. Nuts

Connecting rod bolt nuts	120 — 130
Cylinder head stud nuts — ½"	95 — 105
Cylinder head stud nuts — ⅝"	190 — 200
Energy cell clamp stud nuts	18 — 21
Fan spindle clamping nut	290 — 320
Fuel filter retaining nut	35 — 40
Fuel injection nozzle holder stud nuts	18 — 21
Fuel injection pump mounting stud nuts	36 — 38
Intake manifold stud nuts	45 — 50
Main bearing cap stud nuts — center	160 — 170
Main bearing cap stud nuts — front, intermediate, and rear	210 — 230
Muffler stud nuts	85 — 95
Rocker arm retaining clip stud nuts	25 — 35
Rocker arm shaft bracket stud nuts	25 — 35
Valve lifter cover nuts	7 — 8

3. Stud Gage Heights

Description	Ga. Ht.
Cylinder head studs (½" x 7⅝")	6 11/16"
Cylinder head studs (⅝" x 8")	6⅞"
Cylinder head lifting eye studs (⅝" x 9 7/16")	8¼"
Energy cell clamp studs (⅜" x 2⅜")	1¾"
Fuel injection nozzle holder studs (⅜" x 2¼")	1⅝"
Fuel injection pump attaching studs (⅜" x 1⅝")	1 1/32"
Intake manifold studs (½" x 2⅛")	1⅜"
Main bearing cap studs — center (⅝" x 4 15/16")	3½"
Main bearing cap studs — front (¾" x 5 7/16")	3¾"
Main bearing cap studs — intermediate and rear (¾" x 5⅞")	4 3/16"
Muffler studs (½" x 2⅛")	1⅜"
Rocker arm retaining clip studs (7/16" x 2⅝")	2⅛"
Valve lifter cover studs (5/16" x 2 7/16")	1 27/32"

3. ENGINE CLUTCH

Description	Size of New Parts	Install New Parts When Clearance Exceeds
1. Thickness of driven plate assembly (including facings):		
"AUBURN" clutch	.451" — .475"	.326"
"ROCKFORD" clutch	.448" — .478"	.326"
2. Pressure springs — free length — "AUBURN" clutch	1.074"	

4. TRANSMISSION AND BEVEL GEAR

A. TRANSMISSION

1. Case

a. Bore diameter for reverse gear shaft (front end of shaft)	1.250" — 1.2515"
b. Bore diameter for reverse gear shaft (intermediate location)	1.499" — 1.5005"
c. Bore diameter for reverse gear shaft (rear end of shaft)	1.504" — 1.510"
d. Bore diameter for top shaft front bearing	3.5427" — 3.5437"
e. Bore diameter for top shaft rear bearing	3.5431" — 3.5441"
f. Counterbore diameter for top shaft rear bearing snap ring	3.844" — 3.850"
g. Bore diameter for input shaft rear bearing	4.7236" — 4.7246"
h. Bore diameter for pinion shaft rear bearing	5.5113" — 5.5123"
i. O.D. of pilot (at rear of case)	7.120" — 7.122"
j. Pilot length	1.556" — 1.561"
k. Fit of pilot into steering clutch and final drive housing bore	.002" — .006" loose
l. Length (from front face-to-bolting flange face)	14.745" — 14.755"

2. Top Shaft

a. Front bearing O.D.	3.5427" — 3.5433"
b. Front bearing I.D.	1.5743" — 1.5748"
c. Diameter of shaft at front bearing location	1.5749" — 1.5754"
d. Washer thickness (front and rear)	.193" — .197"
e. Number of splines	16
f. Length overall	$17\frac{15}{16}$"
g. Diameter across splines (using .2469" pins)	2.592" — 2.595"
h. Diameter of shaft at rear bearing location	1.5752" — 1.5758"
i. Rear bearing I.D.	1.5743" — 1.5748"
j. Rear bearing O.D.	3.5425" — 3.5433"
k. Clearance between gear hubs in assembly (total clearance)	.020" — .025"

3. Shift Lever Housing

a. Bore diameter for input shaft front bearing	3.3463" — 3.3471"
b. Bore diameter for input shaft rear bearing	4.7236" — 4.7266"

4. Input Shaft

a. Front bearing O.D.	3.3465"
b. Front bearing I.D.	1.7717"
c. Diameter of shaft at front bearing location	1.7718" — 1.7723"
d. Rear bearing O.D.	4.7236" — 4.7244"
e. Rear bearing I.D.	2.1648" — 2.1654"
f. Diameter of shaft at rear bearing location	2.1655" — 2.1661"
g. Bore diameter for pinion shaft front bearing	2.4404" — 2.4414"
h. Number of teeth	23
i. Width (including bearing shoulder)	$1\frac{29}{32}$"
j. O.D. across .288" pins	4.2100" — 4.2145"
k. Backlash	.004" — .006"
l. Torque for universal joint yoke retaining capscrew	168 — 178 lbs. ft.

5. Bevel Pinion Shaft

a. Front bearing O.D.	2.4403" — 2.4409"
b. Front bearing I.D.	.9839" — .9843"
c. Diameter of shaft at front bearing location	.9845" — .9850"
d. Number of splines	16
e. Length overall	$17\frac{23}{32}$"
f. Diameter across splines (using .2469" pins)	2.592" — 2.595"
g. Diameter of shaft at rear bearing location	2.5592" — 2.5598"
h. Rear bearing I.D.	2.5585" — 2.5591"
i. Rear bearing O.D.	5.5110" — 5.5118"
j. Rear bearing-to-retainer end play (controlled by shims)	.000" — .002"
k. Bevel pinion-to-bevel gear ratio	4.888:1
l. Number of pinion teeth	9
m. Backlash with mating gear (indicated from bevel gear)	.006" — .012"

6. Gears

a. Low speed reverse gear

(1) Number of teeth	18
(2) Width (at hub)	2.255" — 2.260"
(3) Bore diameter	1.750" — 1.751"
(4) O.D. across .288" pins	3.3840" — 3.3885"
(5) Backlash	.004" — .006"
(6) Clearance between reverse gear and thrust washers	.008" — .025"

b. Top shaft constant mesh gear

(1) Number of teeth	43
(2) Width (at hub)	2.137" — 2.140"
(3) O.D. across .288" pins	7.551" — 7.556"
(4) Number of splines	16
(5) Backlash	.004" — .006"

c. Top shaft third speed gear

(1) Number of teeth	35
(2) Width (at hub)	2.137" — 2.140"
(3) O.D. across .288" pins	6.2155" — 6.2205"
(4) Number of splines	16
(5) Backlash	.004" — .006"

d. Top shaft fourth speed gear

(1) Number of teeth	38
(2) Width (at hub)	2.747" — 2.750"
(3) O.D. across .288" pins	6.722" — 6.727"
(4) Number of splines	16
(5) Backlash	.004" — .006"

e. Top shaft second speed gear

(1) Number of teeth	30
(2) Width (at hub)	2.747" — 2.750"
(3) O.D. across .288" pins	5.387" — 5.392"
(4) Number of splines	16
(5) Backlash	.004" — .006"

f. Top shaft low speed gear

(1) Number of teeth	22
(2) Width (at hub)	2.747" — 2.750"
(3) O.D. across .288" pins	4.0520" — 4.0565"
(4) Number of splines	16
(5) Backlash	.004" — .006"

g. Bevel pinion shaft third and fifth speed gear

(1) Number of teeth	31
(2) Width (at hub)	$1\frac{25}{32}$"
(3) O.D. across .288" pins	5.5475" — 5.5525"
(4) Number of splines	16
(5) Backlash	.004" — .006"
(6) Shifting fork groove width	.432" — .442"

h. Bevel pinion shaft fourth speed gear

(1) Number of teeth	28
(2) Width (at hub)	1.718" — 1.723"
(3) O.D. across .288" pins	5.0535" — 5.0585"
(4) Number of splines	16
(5) Backlash	.004" — .006"
(6) Shifting fork shoulder width	.495" — .505"

i. Bevel pinion shaft second speed gear

(1) Number of teeth	36
(2) Width (at hub)	1.654" — 1.659"
(3) O.D. across .288" pins	6.388" — 6.393"
(4) Number of splines	16
(5) Backlash	.004" — .006"
(6) Shifting fork shoulder width	.495" — .505"

j. Distance (in assembly) from bevel pinion shaft fourth speed gear shifting shoulder face-to-bevel pinion shaft second speed gear shifting shoulder face	2.362" — 2.392"

k. Bevel pinion shaft low speed and reverse gear

(1) Number of teeth	44
(2) Width (at hub)	1.841" — 1.846"
(3) O.D. across .288" pins	7.7225" — 7.7275"
(4) Number of splines	16
(5) Backlash	.004" — .006"
(6) Shifting fork groove width	.432" — .442"

l. Shifting forks

(1) I.D. of jaws — forks located on upper and lower shifting shafts	3.010" — 3.035"
(2) Jaw width — forks located on upper and lower shifting shafts	.415" — .425"
(3) Width between jaws of fork located on intermediate shifting shaft	2.405" — 2.410"
(4) Jaw width — fork located on intermediate shifting shaft	$\frac{27}{64}$"
(5) Torque for shifting fork clamping capscrews	70 — 90 lbs. ft.

B. BEVEL GEAR

1. Bevel Gear

a. Backlash with bevel pinion (indicated from bevel gear)	.006" — .012"
b. O.D. of gear	14.241" — 14.246"
c. Bore diameter	3.249" — 3.250"
d. Number of teeth	44
e. Torque for bevel gear attaching capscrews	70 — 90 lbs. ft.

2. Steering Clutch Shaft

a. Length	12 7/16"
b. Diameter of bolting flange hub	5½"
c. Bolting flange width	⅝"
d. Diameter at bevel gear location	3.247" — 3.248"
e. Diameter at bearing locations	2.5015" — 2.5025"
f. Bearing I.D.	2.5000" — 2.5005"
g. Cup O.D.	4.875" — 4.876"
h. Bearing pre-load	10 — 20 lbs. in. or .003" — .004" tight
i. Diameter at shaft sleeve locations	2.2495" — 2.2500"

3. Locking Collar

a. O.D.	3.710" — 3.720"
b. I.D.	3.253" — 3.258"
c. Width	.420" — .430"

4. Shaft Sleeve

a. I.D.	2.2470" — 2.2485"
b. O.D.	2.490" — 2.496"
c. Width	1 3/32"

5. Shaft Bearing Retainer

a. Bore diameter at bearing location	4.873" — 4.874"
b. Bore diameter at oil seal location	3.499" — 3.501"
c. Retainer O.D. at steering clutch and final drive housing bore location	5.620" — 5.621"
d. Steering clutch and final drive housing bore diameter at retainer location	5.624" — 5.626"

5. STEERING CLUTCHES AND BRAKE DRUMS

A. Steering Clutch Throwout Intermediate Lever Shaft Bearing Cages

1. Height	3.146" — 3.166"
2. Bore diameter	1.1245" — 1.1255"
3. O.D. at steering clutch final drive housing location	1.870" — 1.872"
4. Steering clutch and final drive housing bore diameter at cage location	1.874" — 1.876"
5. Diameter of lever shaft	.8750" — .8755"
6. Lever shaft length	5¼"

B. Throwout Bearing Cage Assembly

1. Bore diameter for throwout sleeve	3.815" — 3.819"
2. Bore diameter at throwout ball bearing	5.9043" — 5.9058"
3. Width across trunnion bosses	7.557" — 7.567"

C. Throwout Ball Bearing

1. O.D.	5.9055"
2. I.D.	3.9370"

D. Throwout Sleeve

1. O.D. at ball bearing location	3.9368" — 3.9386"
2. Bore diameter	3.376" — 3.378"

E. Driving Hub

1. Hub O.D. at throwout sleeve location	3.367" — 3.369"
2. O.D. of pilot flange for clutch hub	7.808" — 7.810"
3. Torque for driving hub retaining capscrew	300 lbs. ft.
4. Torque for driving hub-to-clutch capscrews	90 — 100 lbs. ft.

F. Steering Clutch

1. Throwout plate O.D.	7.540" — 7.545"
2. Throwout plate spacer length	2.375" — 2.380"
3. Spring-free height	3.836"
4. Spring-assembled height	2.322"
5. Spring load at assembled height	240 — 260 lbs.
6. Steering clutch hub width	3.245" — 3.250"
7. Bore diameter at pressure plate end	3.624" — 3.626"
8. Bore diameter for throwout plate	7.625" — 7.630"
9. Friction discs	
a. Number of external teeth	67
b. O.D.	13.604" — 13.614"
c. I.D.	10.090" — 10.110"
d. Thickness	.182" — .187"
e. Must be straight and flat within	.015"
f. Specified standout — face of steering clutch hub to face of clutch throwout plate (adjustable with steel discs)	3/16" + or — 1/16"
10. **Steel Disc**	
a. Number of internal teeth	48
b. O.D.	12.800" — 12.805"
c. I.D.	9.310" — 9.315"
d. Thickness	.084" — .096"
e. Must be straight and flat within	.015"
11. Pressure plate O.D.	12.875" — 12.885"
12. Pressure plate outer machined face must be flat within (total indicator reading)	.015"
13. Torque for pressure plate-to-throwout plate capscrews	60 — 75 lbs. ft.

G. Brake Drum

1. Number of internal teeth	67

2.	O.D.	14¾"
3.	Bore for brake drum hub	7.502" — 7.504"
4.	Torque for brake drum-to-hub capscrews	90 — 100 lbs. ft.
5.	Torque required for brake drum hub retaining capscrew	300 lbs. ft.

6. FINAL DRIVES

A. PINION SHAFT

1. Brake Drum Hub

a.	O.D. of pilot boss for brake drum	7.498" — 7.500"
b.	Hub O.D.	2.749" — 2.751"
c.	Torque for hub retaining capscrew	300 lbs. ft.

2. Inner Bearing Cage

a.	Bore diameter for oil seal	3.7505" — 3.7525"
b.	Bore diameter for inner bearing	4.3300" — 4.3312"

3. Inner Bearing

a.	O.D.	4.3307"
b.	I.D.	2.3622"

4. Pinion Shaft

a.	Length	12½"
b.	O.D. at inner and intermediate bearing locations	2.3628" — 2.3635"
c.	Number of splines	16
d.	Diameter across splines (using .2469" pins)	2.592" — 2.595"
e.	O.D. at outer bearing location	1.9690" — 1.9696"

5. Intermediate Bearing

a.	O.D.	4.3301" — 4.3307"
b.	I.D.	2.3616" — 2.3622"

6. Outer Bearing

a.	O.D.	3.5433"
b.	I.D.	1.9685"

7. Pinion

a.	Number of teeth	20
b.	O.D. across .432" pins	5.5885" — 5.5925"
c.	Width	1.932" — 1.937"
d.	Backlash	.004" — .006"

B. INTERMEDIATE SHAFT

1.	Inner bearing cup O.D.	3.000" — 3.001"
2.	Inner bearing I.D.	1.3750" — 1.3755"

3. Intermediate Shaft

a.	Number of splines	16
b.	Spline length	4.745" — 4.755"
c.	Diameter across splines (using .360" pins)	3.544" — 3.547"
d.	O.D. at inner bearing location	1.3760" — 1.3765"

e. O.D. at outer bearing location	2.1260" — 2.1265"
f. Pre-load of intermediate shaft bearings	10 — 20 lbs. in. or .003" — .004" tight

4. **Gear**

a. Number of teeth	44
b. O.D. across .432" pins	11.594" — 11.598"
c. Width	1.868" — 1.870"
d. Backlash	.004" — .006"

5. **Pinion**

a. Number of teeth	20
b. O.D. across .432" pins	5.5885" — 5.5925"
c. Width	2.860" — 2.870"
d. Backlash	.004" — .006"

C. SPROCKET SHAFT

1. Inner bearing cone I.D.	2.0000" — 2.0005"
2. Inner bearing cup O.D.	3.6718" — 3.6728"
3. Intermediate bearing cup O.D.	5.750" — 5.751"
4. Intermediate bearing cone I.D.	3.250" — 3.251"

5. **Shaft**

a. O.D. at inner bearing location	2.0015" — 2.0020"
b. Number of splines	16
c. Diameter across splines (using .432" pins)	4.3835" — 4.3865"
d. O.D. at intermediate bearing location	3.2525" — 3.2535"
e. Sprocket retaining nut thread size	2⅜" 12N-3 Thd.
f. Sprocket retaining nut torque	2200 — 2300 lbs. ft.
g. O.D. at outboard bearing location	1.9688" — 1.9693"
h. Outboard bearing retaining nut thread size	1½" 12N-3 Thd.
i. Overall length	22 11/32"
j. Pre-load of sprocket shaft bearings (inner and intermediate)	10 — 20 lbs. in. or .002" — .003" tight

6. **Gear**

a. Number of teeth	51
b. O.D. across .432" pins	13.3385" — 13.3425"
c. Width	2¾"
d. Backlash	.004" — .006"

7. **Outboard Bearing Cage**

a. Cage O.D. at truck frame location	5.246" — 5.248"
b. Bore diameter for outboard bearing	3.9373" — 3.9383"
c. Bearing O.D.	3.937" — 3.938"
d. Bearing I.D.	1.9680" — 1.9685"
e. Pre-load of outboard bearing	5 — 9 lbs. in. or .000" to .001" tight

7. STEERING CLUTCH AND FINAL DRIVE HOUSING

A. Width	58.370" — 58.380"

B. Height ..... 25½"

C. Length ..... 24¼"

D. Bore Diameters

1. Transmission boss ..... 7.124" — 7.126"
2. Transmission top shaft ..... 3 3/16"
3. Power take-off ..... 4.499" — 4.501"
4. Steering clutch shaft bearings ..... 5.624" — 5.626"
5. Steering clutch throwout intermediate lever shaft bearing cages .... 1.874" — 1.876"
6. Pinion shaft inner bearing cages ..... 4.749" — 4.751"
7. Pinion shaft intermediate bearings ..... 4.3300" — 4.3312"
8. Pinion shaft outer bearings ..... 3.5428" — 3.5438"
9. Intermediate shaft inner bearing cups ..... 2.997" — 2.999"
10. Intermediate shaft outer bearing cups ..... 4.125" — 4.126"
11. Sprocket shaft inner bearing cups ..... 3.6688" — 3.6708"
12. Sprocket shaft intermediate bearing retainers ..... 5.750" — 5.752"
13. Truck frame pivot shafts (caps installed and properly shimmed) .... 2.249" — 2.252"
14. Torque for truck frame pivot shaft capscrews ..... 130 — 150 lbs. ft.

E. Bore Diameter Center Locating Dimensions

1. **Vertical References**

   a. Center of sprocket shaft bore-to-final drive compartment bottom surface (less cover) ..... 4.498" — 4.502"
   b. Vertical center-to-center of intermediate shaft bore-to-sprocket shaft bore ..... 6.169" — 6.173"
   c. Vertical center-to-center of pinion shaft bore-to-sprocket shaft bore (on common center line) ..... 10.998" — 11.002"

2. **Horizontal References**

   a. Center of sprocket shaft bore-to-machined face of the main frame mounting pad ..... 10.498" — 10.502"
   b. Center of intermediate shaft bore-to-common center line of sprocket shaft and pinion shaft bores ..... 6.376" — 6.380"
   c. Center of pinion shaft bore-to-machined face of the main frame mounting pad ..... 10.498" — 10.502"

F. Bores having common center lines must be concentric within (total indicator reading) ..... .003"

8. TRUCK WHEELS

A. Shaft

1. Projection beyond seal guard at bracket locations ..... 2.000" — 2.005"
2. O.D. at bracket locations ..... 1.434" — 1.438"
3. O.D. at bearing cone, seal ring, and seal guard locations ..... 1.564" — 1.565"
4. Bearing cone I.D. ..... 1.5625" — 1.5630"
5. Seal ring I.D. ..... 1.568" — 1.575"
6. Seal guard I.D. ..... 1.558" — 1.560"
7. Length ..... 13.500" — 13.510"

B. Bearing Retainers

1. O.D. at wheel location	3.120" — 3.122"
2. I.D. at shaft location	1.605" — 1.610"
3. Bore depth at seal assembly location	1.760" — 1.775"
4. I.D. at seal ring location	$2\frac{19}{32}$"

C. Bearing Preload ..... 15 — 45 lbs. in.

D. Wheel

1. Bore diameter for bearing cups	3.123" — 3.124"
2. Bearing cup O.D.	3.125" — 3.126"

E. Seal Spring Assembly

1. Free width	$\frac{7}{8}$"
2. Normal operational width	$\frac{3}{4}$"
3. Load at operational width	25 lbs.
4. Maximum solid width	$\frac{5}{8}$"

9. TRACK SUPPORT ROLLERS

A. Shaft

1. Projection beyond seal guard at bracket location	3.185" — 3.190"
2. O.D. at bearing cone, seal ring, and seal guard locations	1.564" — 1.565"
3. Length	9.714" — 9.724"
4. Bearing cone I.D.	1.5625" — 1.5630"
5. Seal ring I.D.	1.568" — 1.575"
6. Seal guard I.D.	1.558" — 1.560"

B. Inner Bearing Retainer

1. O.D. at roller location	3.120" — 3.122"
2. I.D. at shaft location	1.605" — 1.610"
3. Bore depth at seal assembly location	1.765" — 1.770"
4. I.D. at seal ring location	$2\frac{19}{32}$"

C. Outer bearing retainer O.D. at roller location ..... 3.120" — 3.122"

D. Bearing preload ..... 15 — 45 lbs. in.

E. Roller

1. Bore diameter for bearing cups	3.123" — 3.124"
2. Bearing cup O.D.	3.125" — 3.126"

F. Seal Spring Assembly

1. Free width	$\frac{7}{8}$"
2. Normal operational width	$\frac{3}{4}$"
3. Load at operational width	25 lbs.
4. Maximum solid width	$\frac{5}{8}$"

10. TRACK IDLERS

A. Shaft

1. Projection beyond bracket assembly	.560" — .565"
2. O.D. at bearing cone, seal ring, and bracket location	2.0015" — 2.0025"

3. Bearing cone I.D.	2.0000" — 2.0005"
4. Seal ring I.D.	2.005" — 2.012"
5. Bracket I.D.	1.995" — 1.997"

B. Bearing Retainer

1. O.D. at idler location	4.278" — 4.279"
2. Bore diameter for bearing cup	3.669" — 3.670"
3. Bore at shaft location	2.042" — 2.047"
4. I.D. at seal ring location	3 1/32"
5. Bearing cup O.D.	3.6718" — 3.6728"

C. Bearing Pre-load — 15 — 45 lbs. in.

D. Idler

1. Bore diameter for bearing retainers	4.280" — 4.281"
2. Hub width	4.670" — 4.680"
3. Wheel width	5 5/8"
4. O.D. at side bar location	22 3/4" + or — 1/16"

E. Seal Spring Assembly

1. Free width	7/8"
2. Maximum solid width	11/16"

11. TRACKS

A. Master Link

1. Master Bushing	
a. O.D.	2.000" — 2.005"
b. I.D.	1.395" — 1.405"
c. Length	4.010" — 4.040"
2. Master Pin	
a. Diameter	1.373" — 1.374"
b. Length	7.175" — 7.210"
3. Master Bushing Spacer	
a. O.D.	2.000" — 2.010"
b. I.D.	1.395" — 1.405"
c. Thickness	.333" — .348"

B. Standard Links

1. Standard Bushing	
a. O.D.	2.000" — 2.005"
b. I.D.	1.395" — 1.405"
c. Length	4.693" — 4.733"
2. Standard Pin	
a. Diameter	1.374" — 1.378"
b. Length	6.890" — 6.925"

C. Side Bars

1. Bore for track pin	1.366" — 1.368"
2. Bore for bushing	1.993" — 1.995"
3. Counterbore for bushing	2.108" — 2.118"
4. Center-to-center of bores	6.495" — 6.506"

5. Assembled width between side bars (Center-to-center of track shoe bolt holes)
   a. Bushing end ..... 3.998" — 4.003"
   b. Track pin end ..... 4.248" — 4.253"

D. Pitch Length (Center-to-Center of Track Pins in Assembly) ..... 6½"

E. Maximum Allowable Pitch Length (Center-to-Center of Track Pins in Assembly) — Used Track ..... 6⅝"

F. Torque for Track Shoe Bolts ..... 100 to 110 lbs. ft.

12. MAIN FRAME, SPRING SADDLE, AND TRUCK FRAMES

A. Main Frame

1. Length ..... 86 1/16"
2. Bore for spring saddle pin ..... 1.863" — 1.865"

B. Spring Saddle, Saddle Pin, and Bushings

1. Bore in spring saddle for bushings ..... 2.499" — 2.501"
2. O.D. of spring saddle pin bushings ..... 2.503" — 2.504"
3. I.D. of spring saddle pin bushings ..... 1.860" — 1.865"
4. Diameter of saddle pin at bushing locations ..... 1.859" — 1.861"

C. Truck Frames

1. Bore for sprocket shaft outboard bearing cage (cap in place) ..... 5.248" — 5.250"
2. Bore for pivot shaft bushing ..... 2.985" — 2.986"
3. O.D. of pivot shaft bushing ..... 2.990" — 2.991"
4. I.D. of pivot shaft bushing ..... 2.257" — 2.258"
5. Diameter of pivot shaft ..... 2.249" — 2.250"
6. Length of pivot shaft bushing ..... 2 5/16"
7. Length of pivot shaft ..... 7"

SECTION XXII — TROUBLE SHOOTING

This section contains trouble shooting information and outlines tests which can be made to determine some of the troubles that may develop in the tractor when the tractor is used under average working conditions. Each symptom of trouble is recorded under the individual unit or system of the tractor and is followed by a list of the possible causes of the trouble. The tests necessary to determine which of the possible causes is responsible for the trouble are explained after each possible cause, with reference to where instructions for their correction may be found.

1. ENGINE

A. Engine Will Not Turn

1. Engine is Locked or Seized

This can be due to extended idle or storage periods, or to the improper preparation of the engine for storage, in which case the parts may have rusted or corroded and seized. Broken piston rings, gears, etc., may also cause locking. The engine should be disassembled to determine the cause and the necessary parts replaced.

2. Starter or Starter Switch Inoperative

Refer to "ENGINE STARTING SYSTEM," Topic 2, in this Section.

3. Incorrect Oil Viscosity

Refer to "SPECIFICATIONS OF LUBRICANTS," Section I for specified lubricant.

4. Batteries Weak

Recharge the batteries or replace them with fully charged batteries (refer to "ELECTRICAL SYSTEM," Section VI).

B. Engine Fails to Start

1. Slow Cranking Speed

The specific gravity of the batteries may be too low or the starter may not be delivering its maximum

torque to provide adequate cranking speed (approximately 200 R.P.M.). Cold weather starting requires the use of the cold weather engine primer or the engine air heater (refer to "ENGINE AIR INTAKE SYSTEM," Section III).

2. Engine Shut-Off Controls Out of Adjustment

Make certain the throttle operating lever is pulled all the way back (high idle) and the engine shut-off knob is pushed all the way forward (run position) then check the control linkage for proper adjustment (refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II).

3. Insufficient Supply of Fuel to Fuel Injection Nozzles

Refer to "ENGINE FUEL SYSTEM, " Topic 3, in this Section.

4. Fuel Injection Pump Improperly Timed

This condition is possible after the engine has been rebuilt or fuel injection pump removed and re-installed (refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II).

C. Loss of Power

1. Insufficient Fuel Supply to Fuel Transfer Pump

Refer to "ENGINE FUEL SYSTEM," Topic 3, in this Section.

2. Inoperative Fuel Injection Pump or "Faulty" Fuel Injection Nozzles

Refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II.

3. Cylinder Cutting Out

Locate a "missing" cylinder as follows: Run the engine at low idle speed and "cut-out" each fuel injection nozzle in turn by loosening the fuel injection line nut attaching the fuel injection line to its corresponding fuel injection nozzle. NOTE: *Keep hands away from loosened nut while performing this test.* A decrease in engine speed with the injection line nut loosened indicates that the nozzle for that cylinder is functioning properly. If the engine speed does not decrease, the nozzle is inoperative and should be replaced (refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II).

4. Loss of Compression

This may be due to leaking valves or worn pistons, rings, or cylinder sleeves. Use a suitable compression tester and check each cylinder as follows: (NOTE: *Engine should be at normal operating temperature.)*

a. Start with No. 1 cylinder when checking the compression. Disconnect the fuel injection line and the fuel return manifold from the fuel injection nozzle.

b. Remove the fuel injection nozzle (refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II) and install the compression tester in the same manner as the fuel injection nozzle was installed.

c. Close the vent valve of the compression tester, start the engine, run it at approximately 600 R.P.M., and take several readings on the tester gage. NOTE: *Do not check the compression by cranking the engine with the starter.*

d. Reinstall the fuel injection nozzle and connect the fuel lines.

e. Perform this same operation on the remaining cylinders. The compression of any one cylinder ,should not be below 345 P.S.I. (normal average pressure on a new engine is 370 P.S.I.) nor should the pressure of any one cylinder vary more than 25 P.S.I. above or below the reading on the other cylinders, as for example:

Cylinder Number	Test Gage Reading
1	365 P.S.I.
2	370 P.S.I.
3	360 P.S.I.
4	330 P.S.I.

Note that the compression pressure in the No. 4 cylinder falls more than 25 P.S.I. below the pressure in the other cylinders, indicating a compression leak in the No. 4 cylinder. In this case, the cylinder head must be removed, the valves and valve seats inspected for leaks, the valve stems for wear and sticking, and the cylinder head gasket for leaks. If these parts are found to be in good condition, the leakage is taking place past the piston rings. The piston must then be removed, all the parts inspected, and the necessary parts replaced.

NOTE: *When using a compression tester to check the compression, make certain that the gage has been properly tested to give an accurate pressure reading. In no case should an engine be rebuilt only because a compression tester registers readings below 345 P.S.I., unless the compression tester is known to be accurate. A loss of power or excessive oil consumption also indicates the need of repair.*

5. Air in Fuel System

Refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II.

6. Improper Governor Adjustment

Refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II.

7. Improper Valve Lash Adjustment

Adjust valves (refer to "ENGINE," Section VIII).

D. Engine Stalls Frequently

1. Idling Speed Too Low

Adjust idling speed for 525 to 550 R.P.M. (refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II).

2. Restricted Fuel Filter, Air in Fuel System, or Malfunctioning Fuel Injection Nozzle

Refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II.

E. Uneven Running and Excessive Vibration

1. Faulty Fuel Injection Nozzles or Injection Pump Improperly Timed

Refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II.

2. Fuel Supply Erratic or Insufficient

Refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II.

3. Improper Governor Adjustment

Check and adjust the governor and linkage (refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II).

4. Valves in Bad Condition

Recondition valves (refer to "ENGINE," Section VIII).

5. Engine Temperature Too Low

An operating temperature of 160° to 185° F. should be maintained. Check the thermostat and replace if necessary (refer to "ENGINE COOLING SYSTEM," Topic 5 in this Section).

6. Cylinder Cutting Out

Refer to "LOSS OF POWER," Topic No. 1, Paragraph 3 in this Section.

F. Engine Detonates

If a hard metallic knock indicates detonation in one or more cylinders, the engine must be stopped immediately to prevent serious damage due to the excessive pressures accompanying the detonation. Detonation is caused by the presence of fuel or lubricating oil in the charge of air that has been delivered to the cylinder during the compression stroke. Check for leaky fuel injection nozzles, improper timing of the fuel injection pump, and oil pull over from the air cleaner.

G. Black Smoke Exhaust

1. Poor Grade of Fuel

Refer to "SPECIFICATIONS OF FUEL," Section I.

2. Faulty Fuel Injection Nozzles or Injection Pump Improperly Timed

Refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II.

3. Air Cleaner Pipe Clogged

Remove the oil cup, swab the obstruction from the pipe and service the air cleaner (refer to "ENGINE AIR INTAKE SYSTEM," Section III).

H. Blue Smoke Exhaust

1. Engine Operating Temperature Too Low

An operating temperature of 160° to 185° F. should be maintained. Check the thermostat and replace if necessary (refer to "ENGINE COOLING SYSTEM," Topic 5 in this Section).

2. Fuel Injection Nozzles "Popping" Pressure Improperly Adjusted

Refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II.

3. Cylinder Cutting Out

Refer to "LOSS OF POWER," Topic No. 1, Paragraph 3, in this Section.

4. Lubricating Oil Entering Combustion Chambers

This can be caused by worn or stuck piston rings, oil level being too high in the air cleaner, or oil level being above "FULL" mark on crankcase oil level gage rod.

I. Engine Overheats

1. Insufficient Coolant In Cooling System

Fill the cooling system with clean coolant.

2. Radiator Core Clogged

Clean and flush radiator (refer to "ENGINE COOLING SYSTEM," Section IV).

3. Fan Drive Belts Loose

Adjust the drive belts (refer to "ENGINE COOLING SYSTEM," Section IV).

4. Water Pump Inoperative

Repair or replace the water pump (refer to "ENGINE COOLING SYSTEM," Section IV).

5. Engine Oil Cooler Clogged

Clean or replace the engine oil cooler (refer to "ENGINE LUBRICATING SYSTEM," Section V).

6. Thermostat Inoperative

Remove and test the thermostat for proper operation (refer to "ENGINE COOLING SYSTEM," Topic 5 in this Section).

7. Tractor Overloaded

Lighten load on tractor.

J. Rapid Wear On Engine Parts

1. Oil of Unsuitable Grade, Composition, or Viscosity

Use the specified oil (refer to "SPECIFICATIONS OF LUBRICANTS," Section I).

2. Dirt in Oil

Use only clean oil in the engine. Keep the oil supply in clean storage containers and use clean containers when filling the crankcase. Keep the valve rocker arm cover tight.

3. Oil Used Longer Than Recommended Time

Change oil at the intervals recommended in the HD-6 Tractor Operators Manual.

4. Insufficient Oil

Maintain the crankcase oil level to the "FULL" mark on the oil level gage rod.

5. Air Cleaner Not Serviced Properly or Damaged

Refer to "ENGINE AIR INTAKE SYSTEM," Section III.

6. Lubricating Oil Filter Not Serviced Properly

Replace filter element at the intervals recommended (refer to "ENGINE LUBRICATING SYSTEM," Section V).

2. ENGINE STARTING SYSTEM

(Refer to "ELECTRICAL SYSTEM," Section VI, for more detailed information on the following procedures.)

A. Starter Will Not Crank the Engine

1. Batteries Weak

Test the batteries and recharge if necessary.

2. Cables or Connections Loose or Corroded

Make certain that the cables are in good condition and the terminals and ground connections are secure.

3. Starter Armature Shaft Bushings Worn

This allows the armature to drag on the field pole pieces; inspect and replace all worn parts.

4. Brushes Not Making Good Contact

If the brushes are not seating properly, they may be fitted to conform to the contour of the commutator in the following manner: Place a strip of No. 00 sandpaper between the brushes and the commutator (rough side toward the brushes) and work the sandpaper back and forth around the commutator until each brush is "seated in." After this is done, clean and polish the commutator as explained in Item 6 below.

5. Brush Arms Sticking or Brush Springs Weak

Free the bind in the arms or replace the springs. Weak springs will cause poor brush contact. The brush spring tension should be from 36 to 40 ounces. Test the spring tension with a small spring scale. Attach the scale to each brush directly under the head of the screw that attaches the brush to the arm. If less than 36 ounces pull will raise the brushes off the commutator, the springs have lost tension and new springs must be installed.

6. Commutator Dirty or Worn

Inspect the commutator by removing the cover band. If it is dirty or slightly grooved, polish it by placing a strip of No. 00 sandpaper around the commutator and under the brushes (rough side toward the commutator and rotating the armature). Blow the dust from the commutator after polishing. If the commutator is badly worn and has high mica, it must be turned true in a lathe and the mica undercut.

7. Armature Burned Out

Replace the armature.

8. Starter Switch Inoperative

Switch contact surfaces may be burned or corroded. Disassemble, clean the contacts, reassemble, and adjust the starter shift lever (refer to "ELECTRICAL SYSTEM," Section VI).

B. Starter Pinion Does Not Engage with the Flywheel Ring Gear

1. Grease and Dirt in Starter Drive Mechanism

Disassemble and clean the drive assembly.

2. Shift Lever Out of Adjustment

Adjust the starter shift lever.

3. Broken Parts

Replace broken or excessively worn parts.

3. ENGINE FUEL SYSTEM

(Refer to Section II for full details on components of the fuel system.)

Checking of Fuel Supply System

The function of the fuel injection pump is to meter the fuel and deliver it, under high pressure, to the fuel injection nozzles at the proper interval in the engine cycle. Uneven running of the engine, excessive vibration, stalling when idling, and loss of power are symptoms of low fuel pressure or insufficient supply of fuel; check the following possible causes.

a. Insufficient fuel in fuel tank.

b. Air being drawn into the system on the suction side of the fuel transfer pump.

c. Clogged fuel filter elements and fuel lines.

d. Inoperative fuel return pressure relief valve or inoperative fuel transfer pump.

e. Inoperative fuel injection nozzle(s).

f. Inoperative fuel injection pump.

To check the above mentioned symptoms, refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II.

4. ENGINE AIR INTAKE SYSTEM

(Refer to "ENGINE AIR INTAKE SYSTEM," Section III, for full details on the components of the air system.)

A. Insufficient Air Supply to Cylinders

This condition will be indicated by black smoke from the exhaust, loss of power, and hard starting.

1. Air Cleaner Pipe Clogged

Remove the oil cup, swab the obstruction from the pipe, and service the air cleaner (refer to "ENGINE AIR INTAKE SYSTEM," Section III).

2. Loose Hose Clamp, Damaged Gasket, or Damaged Hose

Tighten all hose clamps and replace damaged gasket and hose (refer to "ENGINE AIR INTAKE SYSTEM," Section III).

B. Rapid Wear On Engine Parts

1. Dirt Admitted with Intake Air

Inspect the engine air cleaner body and the air cleaner pipe and connections *THOROUGHLY*, to detect any cracks or openings which would allow air to enter the engine, without first passing through the air cleaner.

2. Dirty Lubricating Oil

Change engine oil and the lubricating oil filter element at the intervals recommended. Keep oil clean when filling engine.

3. Improper Fuel

Use the proper fuel (refer to "SPECIFICATIONS OF FUEL," Section I).

5. ENGINE COOLING SYSTEM

(Refer to "ENGINE COOLING SYSTEM," Section IV, for full details on the components of the cooling system.)

A. Engine Overheats

1. Overheating with Ample Coolant in System

Inspect for debris in the air passages of the radiator, for clogged water passages, inoperative water pump, loose or broken fan drive belts.

Check the thermostat for proper operation. Remove the thermostat (refer to "ENGINE COOLING SYSTEM," Section IV) and check as follows: Suspend the thermostat in a pan of clean water so that the thermostat is completely immersed. Use an accurate thermometer to check the water tem-

perature and gradually heat the water. As the temperature of the water approaches 165° F., observe the thermostat. If the thermostat is functioning properly, it should start to open at 165° F. and be fully opened at 180° F. plus or minus 5°. The amount of travel between the closed and open position is approximately 5/16". Stir the water to obtain an accurate check. The thermostat is not adjustable and if it does not open and close within the above limits, it must be replaced.

In some cases, lime will be deposited in the water passages of the radiator, cylinder block, and cylinder head in sufficient quantities to restrict the water flow and cause overheating. Refer to "ENGINE COOLING SYSTEM," Section IV, for cleaning of the system and for repair or replacement of inoperative units.

2. Overheating Due to Loss of Coolant

a. After the engine has been allowed to cool to normal operating temperature, fill the radiator. Inspect for, and repair all external leaks found, such as hoses, gaskets, etc. Remove the radiator for repair if it is leaking.

b. If no external leaks are present, a cracked cylinder head or block, leaking cylinder head gasket, or a ruptured engine oil cooler core may be the cause for the loss of coolant. If oil is present in the coolant of the cooling system, remove and inspect the engine oil cooler core. If water is present in the engine crankcase oil, inspect for a cracked cylinder head or engine block. Inspect the cylinder head gasket and cylinder sleeve packing rings (refer to "ENGINE," Section VIII). Repair or replace necessary parts.

B. Engine Does Not Reach Operating Temperature

1. Operation in Arctic Temperatures

It is very important that the operating temperature of the engine be maintained at 160° to 185° F. In extremely cold weather, it may be necessary to cover the radiator and the openings at the sides of the engine, to maintain the correct operating temperature.

2. Thermostat Stuck in Open Position

Remove and check the thermostat for proper operation (refer to Paragraph A. above).

6. ENGINE LUBRICATING SYSTEM

(Refer to "ENGINE LUBRICATING SYSTEM," Section V, for full details of the engine lubricating system.)

A. Low or No Oil Pressure

1. Insufficient Oil in Crankcase

Maintain the oil level to the "FULL" mark on the oil level gage rod.

2. Crankcase Oil Diluted by Fuel

Inspect for fuel leaking into the crankcase resulting from worn or damaged gaskets within the fuel injection pump. The injection pump must be removed and the necessary parts replaced (refer to "ENGINE FUEL SYSTEM, GOVERNOR, AND ENGINE CONTROLS," Section II).

3. Improper Lubricant

Use the specified lubricant (refer to "SPECIFICATIONS OF LUBRICANTS," Section I).

4. Worn Bearings

Worn main bearings or connecting rod bearings will cause oil pressure to drop; replace the bearings (refer to "ENGINE," Section VIII).

5. Lubricating Oil Pump Relief Valve or Oil Pressure Regulating Valve Stuck Open

Inspect these valves (refer to "ENGINE LUBRICATING SYSTEM," Section V).

6. Engine Oil Cooler Clogged

A clogged oil cooler causes the lubricating oil to overheat. Inspect and clean the oil cooler (refer to "ENGINE LUBRICATING SYSTEM," Section V).

7. Lubricating Oil Pump Screen Clogged

Remove the oil pan. Remove and clean the oil pump screen (refer to "ENGINE LUBRICATING SYSTEM," Section V).

8. Lubricating Oil Pump Inoperative

Inspect the pump drive and the pump (refer to "ENGINE LUBRICATING SYSTEM," Section V). Also inspect for clogged oil lines or passages, ruptured gaskets, or loose connections. Clogged oil lines, oil passages, and screen are the result of dirty and sludging oil; if this condition exists, clean the interior of the engine thoroughly before resuming operation.

9. Inoperative Oil Filter By-Pass Valve

Refer to "ENGINE LUBRICATING SYSTEM," Section V.

10. Inoperative Oil Pressure Gage

Test the accuracy of the gage by installing a test gage.

11. Worn Camshaft Bearings

Replace worn parts (refer to "ENGINE," Section VIII).

B. Excessive Oil Pressure

1. Oil Pressure Regulating Valve Stuck Shut

Refer to "ENGINE LUBRICATING SYSTEM," Section V.

2. Inoperative Oil Pressure Gage

Test the accuracy of the gage by installing a test gage.

C. Oil Overheating

1. Insufficient Oil in Crankcase

Maintain the oil to the "FULL" mark on the oil level gage rod.

2. Engine Oil Cooler Clogged

Clean or replace the oil cooler (refer to "ENGINE LUBRICATING SYSTEM," Section V).

D. Excessive Oil Consumption

1. Pistons, Rings, and Cylinder Sleeves Worn

Examine the engine to determine if these parts are worn, or if the rings are stuck or have excessively wide gaps. Blue smoke, loss of power, and hard starting are indications of this condition. Inspect and replace all necessary parts.

2. Oil Leaks

Inspect for loose connections and damaged or leaking gaskets.

3. Crankshaft Oil Seals Worn or Damaged

Observe the front end of the engine while running the engine with the tractor standing still. Oil leaking through the crankshaft front oil seal can then be seen. Inspect the engine clutch housing for an accumulation of oil. The presence of oil will indicate the crankshaft rear oil seal is leaking (refer to "ENGINE," Section VIII).

4. Oil Too Light

Use the specified oil (refer to "SPECIFICATIONS OF LUBRICANTS," Section I).

5. Oil Level Carried Too High

Do not fill the crankcase above the "FULL" mark on the oil level gage rod.

6. Valve Guides Worn

Replace valve guides (refer to "ENGINE," Section VIII).

7. GENERATOR, GENERATOR REGULATOR, LIGHTS, AND WIRING

(Refer to "ELECTRICAL SYSTEM," Section VI, for full details on the electrical system.)

A. Generator Not Charging

1. Generator Drive Belt Loose or Broken

Tighten or replace the drive belt. The belt is correctly adjusted when it can be pressed inward by hand approximately ½ inch at a point half-way between the generator and water pump pulleys.

2. Cables Broken or Loose

Repair or replace the cables or tighten the connections.

3. Generator Regulator Stuck or Generator Inoperative

Testing and adjustment of the generator and the generator regulator should not be attempted without dependable testing equipment; therefore, it is recommended that these units be taken to a dependable electrical repair shop for service.

B. Lights and Wiring

1. Lights

If the headlight switch is turned to the on position and the headlights or tail light fail to light, look for a burned out fuse, loose connections, discharged batteries, burned out bulbs, or a damaged switch; make the necessary corrections. Dim lights may be due to low batteries or poor ground connections.

2. Wiring

Refer to "ELECTRICAL SYSTEM," Section VI, for a wiring diagram of the tractor. When replacing any cables, connect them as shown in the diagram. The batteries must be kept charged and all connections must be kept clean and tight, including the battery terminals and cables.

8. INSTRUMENTS

Refer to "INSTRUMENTS," Section VII, for information on the mechanical operation of the various instruments. If any of the instruments fail to register proper readings while the tractor is in operation, the system to which the instrument applies should be thoroughly checked as outlined in the preceding parts of this section to determine the cause. If failure of the instrument is suspected, test by installing a new tested instrument in its place. Replace any inoperative instruments.

9. ENGINE STARTING AIDS (COLD WEATHER ENGINE PRIMER OR ENGINE AIR HEATER)

(Refer to "ENGINE AIR INTAKE SYSTEM," Section III, for full details on these units.)

A. Cold Weather Engine Primer

Failure of the cold weather engine primer to function properly can be caused by an inoperative pump or clogged fluid lines and strainer (refer to "ENGINE AIR INTAKE SYSTEM," Section III).

B. Air Heater (Special Equipment)

Failure of the air heater to function properly can be caused by failure of the ignition or by a poor oil spray (refer to "ENGINE AIR INTAKE SYSTEM," Section III).

10. ENGINE CLUTCH AND CLUTCH BRAKE

(Refer to "ENGINE CLUTCH AND CLUTCH BRAKE," Section IX, for full details of the clutch group.)

A. Clutch Slips

1. Clutch in Need of Adjustment

Adjust clutch (refer to "ENGINE CLUTCH," Section IX).

2. Clutch Facings Worn Out

Replace the driven plate.

B. Clutch Hard to Engage

1. Clutch Adjusted Too Tight

Adjust clutch (refer to "ENGINE CLUTCH," Section IX).

2. Clutch Linkage Binding

Unless due to bent or broken parts, binding will in most cases be relieved by lubricating the clutch components as recommended.

C. Gears Clash When Shifting

1. Clutch Brake Worn

Replace the clutch brake plate facing.

2. Warped Pressure Plate

This condition causes the clutch to drag, thereby not allowing the gears to stop turning. The affected parts cannot be inspected unless removed (refer to "ENGINE CLUTCH," Section IX).

3. Clutch Will Not Release Completely

Adjust clutch and clutch linkage (refer to "ENGINE CLUTCH," Section IX).

11. TRANSMISSION AND GEAR SHIFT

(Refer to "TRANSMISSION AND BEVEL GEAR," Section X, for further detailed instructions on repairs.)

A. Gears Hard to Shift

1. Transmission Oil Too Heavy

Use the specified lubricant (refer to "SPECIFICATIONS OF LUBRICANTS," Section I).

2. Worn Shifting Controls

Remove gear shift mechanism and inspect for worn parts; repair or replace any worn parts (refer to "TRANSMISSION AND BEVEL GEAR," Section X).

3. Burred Gears

Remove burrs or install new gears (refer to "TRANSMISSION AND BEVEL GEAR," Section X).

4. Rough or Worn Splines

Smooth the splines or replace the worn or rough parts (refer to "GENERAL MAINTENANCE INSTRUCTIONS," Section XX, Topic 2).

5. Gear Shift Locking Plunger Rod Improperly Adjusted

Adjust the linkage (refer to "TRANSMISSION AND BEVEL GEAR," Section X).

B. Gears Slip Out of Mesh in Operation

1. Shifting Lever Locking Mechanism Worn

Inspect for worn or broken locking plunger or springs, or edges rounded off detent notches in shifter shafts (refer to "TRANSMISSION AND BEVEL GEAR," Section X).

2. Incorrect Positioning of Shifter Forks on Shafts

Reset forks (refer to "TRANSMISSION AND BEVEL GEAR," Section X).

3. Shifter Forks Worn

Remove and repair or replace forks (refer to "TRANSMISSION AND BEVEL GEAR," Section X).

4. Worn Gears, Bearings, or Shafts

This condition will allow misalignment of gears and cause them to slip out of mesh. Remove and repair or replace worn parts (refer to "TRANSMISSION AND BEVEL GEAR," Section X).

C. Noise in Transmission

1. Broken or Worn Gears, Bearings, or Shafts

Replace worn or damaged parts (refer to "TRANSMISSION AND BEVEL GEAR," Section X).

2. Bevel Gear and Pinion or Bearings Improperly Adjusted

Adjust as explained in "TRANSMISSION AND BEVEL GEAR," Section X.

3. Insufficient Oil Supply

Check oil level. Fill to the proper level with the specified lubricant.

12. STEERING BRAKES

(Refer to "STEERING BRAKES," Section XII, for further adjustment and repair of the brakes.)

A. Brakes Do Not Hold

1. Brake Lining Worn

Install new lining (refer to "STEERING BRAKES," Section XII).

2. Improper Adjustment

Adjust the brakes (refer to "STEERING BRAKES," Section XII).

3. Oil on Brakes

Wash brakes and repair oil leak (refer to "WASHING STEERING CLUTCHES" in the HD-6 Tractor Operators Manual).

4. Brake Band Broken

Install new band and adjust (refer to "STEERING BRAKES," Section XII).

5. Broken Controls

Install new parts (refer to "STEERING BRAKES," Section XII).

B. Brakes Overheating

1. Brakes Adjusted Too Tight

Adjust the brakes (refer to "STEERING BRAKES," Section XII).

2. Steering Clutches Not Disengaging Completely

Adjust steering clutches (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

3. Oil on Brakes

Wash brakes and repair oil leak (refer to "WASHING STEERING CLUTCHES" in the HD-6 Tractor Operators Manual).

4. Brake Linkage Binding

Free linkage and lubricate.

5. Improper Use of Brakes

Refer to HD-6 Tractor Operators Manual for instructions on proper use of brakes.

C. Lining Wears Rapidly

1. Improper Adjustment

Adjust brakes (refer to "STEERING BRAKES," Section XII).

2. Linkage Binding

Free linkage and lubricate.

3. Improper Use of Brakes

Refer to HD-6 Tractor Operators Manual for instructions on proper use of brakes.

D. Brake Pedals Move When Tractor Is in Motion

1. Brake Drum Hub to Brake Drum Attaching Capscrews Loose

Tighten capscrews (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

2. Erratic Brake Band Contact

Adjust brakes (refer to "STEERING BRAKES," Section XII).

3. Final Drive Pinion Shaft Bearings Worn or Broken

Install new bearings (refer to "FINAL DRIVES," Section XIII).

4. Brake Drum Hub Loose on Pinion Shaft

Tighten and lock hub retaining capscrew (refer to "FINAL DRIVES," Section XIII).

5. Warped Brake Drum Hub

Repair or install new parts (refer to "FINAL DRIVES," Section XIII).

6. Worn or Damaged Brake Drums

Repair or install new brake drums (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

13. STEERING CLUTCHES

(Refer to "STEERING CLUTCHES AND CONTROLS," Section XI, for adjustments and repairs of the steering clutches.)

A. Clutches Slip

1. Friction Discs Worn

Install new discs (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

2. Steel Discs Warped

Install new discs (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

3. Oil on Discs

Wash clutches (refer to "WASHING STEERING CLUTCHES" in the HD-6 Tractor Operators Manual).

4. Improper Adjustment

Adjust clutch control linkage (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

5. Springs Weak

Install new springs (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

B. Clutches Shift Sideways

1. Clutch Driving Hub Retaining Capscrew Loose

Tighten and lock capscrew (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

2. Steering Clutch Shaft Bearings Improperly Adjusted

Adjust bearings (refer to "TRANSMISSION AND BEVEL GEAR," Section X).

C. Unable to Disengage Clutches

1. Improper Adjustment

Adjust clutch control linkage (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

2. Throwout Yoke Ball Broken

Install new ball or new yoke assembly (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

3. Throwout Yoke Trunnion Pin Broken or Out of Yoke

Replace pin(s) (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

D. Steering Clutches Wear Rapidly

1. Improper Use of Clutches

Refer to HD-6 Tractor Operators Manual for instructions on proper use of the clutches.

2. Improper Adjustment

Adjust clutch control linkage (refer to "STEERING CLUTCHES AND CONTROLS," Section XI).

14. EQUALIZING SPRING

(Refer to "MAIN FRAME AND EQUALIZING SPRING," Section XVII, for repairs on the spring.)

A. Front End of Tractor Too Low

1. Spring Leaves Broken

Replace broken spring leaves (refer to "MAIN FRAME AND EQUALIZING SPRING," Section XVII).

2. Spring Saddle Pin Worn or Broken

Replace saddle pin (refer to "MAIN FRAME AND EQUALIZING SPRING," Section XVII).

3. Spring Saddle Bushings Worn

Replace bushings (refer to "MAIN FRAME AND EQUALIZING SPRING," Section XVII).

15. FINAL DRIVES

(Refer to "FINAL DRIVES," Section XIII, for full details on the components of the final drives.)

A. Seal Rings Leak

1. Bearings Out of Adjustment

Adjust bearings (refer to "FINAL DRIVES," Section XIII).

2. Seal Boot Torn Loose

Remove and repair or replace the boot (refer to "FINAL DRIVES," Section XIII).

3. Seal Rings Worn or Damaged

Install new seal rings (refer to "FINAL DRIVES," Section XIII).

4. Seal Rings Not Contacting

Remove and inspect the seal spring assembly and replace if necessary (refer to "FINAL DRIVES," Section XIII).

B. Noise in Final Drive Assembly

1. Bearings Out of Adjustment

Adjust bearings (refer to "FINAL DRIVES," Section XIII).

2. Final Drive Gears and Pinions Badly Worn or Broken

Install new gears and pinions (refer to "FINAL DRIVES," Section XIII).

3. Insufficient Oil Supply

Check oil level and fill to the proper level with the specified lubricant.

C. Excessive Wear on Track Sprockets

1. Tracks Improperly Adjusted

Adjust tracks (refer to "TRACKS," Section XVI).

2. Tracks Worn Out

Replace worn parts or install new tracks (refer to "TRACKS," Section XVI).

3. Truck Wheels Badly Worn

Repair or install new truck wheels (refer to "TRUCK FRAMES," Section XIV).

4. Truck Frame Twisted, Loose, or Broken

Remove and repair or replace (refer to "TRUCK FRAMES," Section XIV).

5. Track Idler Out of Line

Adjust idler (refer to "TRUCK FRAMES," Section XIV).

6. Sprocket Shaft Bearings Out of Adjustment or Damaged

Replace or adjust bearings (refer to "FINAL DRIVES," Section XIII).

7. Sprocket Loose on Shaft

Tighten sprocket retaining nut to 2200 to 2300 lbs. ft. torque.

16. TRUCK WHEELS, SUPPORT ROLLERS, AND TRACK IDLERS

A. Excessive Wear on Flanges

1. Truck Frame Out of Line

Repair or replace (refer to "TRUCK FRAMES," Section XIV).

2. Track Idler Out of Line

Adjust idler (refer to "TRUCK FRAMES," Section XIV).

3. Track Rail Assembly Badly Worn

Repair or install new tracks (refer to "TRACKS," Section XVI).

4. Tracks Improperly Adjusted

Adjust tracks (refer to "TRACKS," Section XVI).

B. Bearing Failure

1. Foreign Material in Lubricant

Keep lubricant and lubricating equipment clean. Use clean containers and care when servicing.

2. Improper Lubricant

Use the specified lubricant (refer to "SPECIFICATIONS OF LUBRICANTS," Section I).

3. Not Serviced at Proper Intervals

Service after each 1000-hours of operation (refer to HD-6 Tractor Operators Manual for instructions on servicing).

4. Improper Lubricator Used

Use proper lubricator and special nozzle furnished with tractor (refer to HD-6 Tractor Operators Manual for instructions).

5. Lubricant Leakage

Repair or replace seals (refer to "TRUCK FRAMES," Section XIV).

C. Lubricant Leakage

1. Damaged or Worn Seals

Install new seals and other necessary parts (refer to "TRUCK FRAMES," Section XIV).

2. Loose or Badly Worn Bearings

Remove and inspect. Replace the necessary parts (refer to "TRUCK FRAMES," Section XIV).

3. Bond (Cement) of Seal Assemblies Torn or Broken Loose

Remove and repair (refer to "TRUCK FRAMES," Section XIV).

17. TRACKS

(Refer to "TRACKS," Section XVI, for further detailed instructions on repairs.)

A. Excessive Wear on Pins, Bushings, and Rails

1. Track Idler Out of Line

Adjust idler by shimming (refer to "TRUCK FRAMES," Section XIV).

2. Badly Worn Truck Wheels, Support Rollers, or Track Idlers

Repair or replace (refer to "TRUCK FRAMES," Section XIV).

3. Truck Frames Out of Line

Repair or replace (refer to "TRUCK FRAMES," Section XIV).

4. Track Sprocket Teeth Badly Worn

Replace sprocket (refer to "FINAL DRIVES," Section XIII).

5. Tracks Improperly Adjusted

Adjust tracks (refer to "TRACKS," Section XVI).

B. Parts of Tracks Worn

1. Pins and Bushings Worn, but Rails in Good Condition

Pins and bushings may be turned. If pins and bushings are excessively worn, new pins and bushings should be installed (refer to "TRACKS," Section XVI).

2. Badly Worn Pins, Bushings, and Rails

Install new track rail assembly (refer to "TRACKS," Section XVI).

18. TRACK RELEASE

Release Mechanism Does Not Function Properly

1. Dirt Packed in Coils of Springs

Remove spring guard and clean dirt from springs.

2. Release Springs Broken

Replace springs (refer to "TRUCK FRAMES," Section XIV).

3. Improper Fit of Track Idler Brackets on Track Idler Slide Bars

Adjust by shimming between the slide bars and the truck frame (refer to "TRUCK FRAMES," Section XIV).

4. Tracks Improperly Adjusted

Adjust tracks (refer to "TRACKS," Section XVI).

19. TRUCK FRAMES

Truck Frames Out of Line

1. Bent or Twisted Frames

Repair or install new frames (refer to "TRUCK FRAMES," Section XIV).

2. Truck Frame Pivot Shaft and Bushing Worn

Install new parts (refer to "TRUCK FRAMES," Section XIV).

3. Loose Capscrews Attaching Sprocket Shaft Outboard Bearing Cage to Truck Frame

Tighten capscrews.

4. Sprocket Shaft Outboard Bearing Badly Worn or Broken

Replace the necessary parts (refer to "FINAL DRIVES," Section XIII).

SECTION XXIII – SPECIAL TOOLS

In most cases, the use of special tools for disassembly, repairs, and assembly are required to perform the particular operation and to obtain the best results. The use of special tools also helps the serviceman, or mechanic, to make the necessary repairs in the least amount of time.

Special tools similar to the ones illustrated in this manual are manufactured by various tool manufacturers. Contact your "Allis-Chalmers" Construction Machinery Dealer for information regarding availability of the special tools.