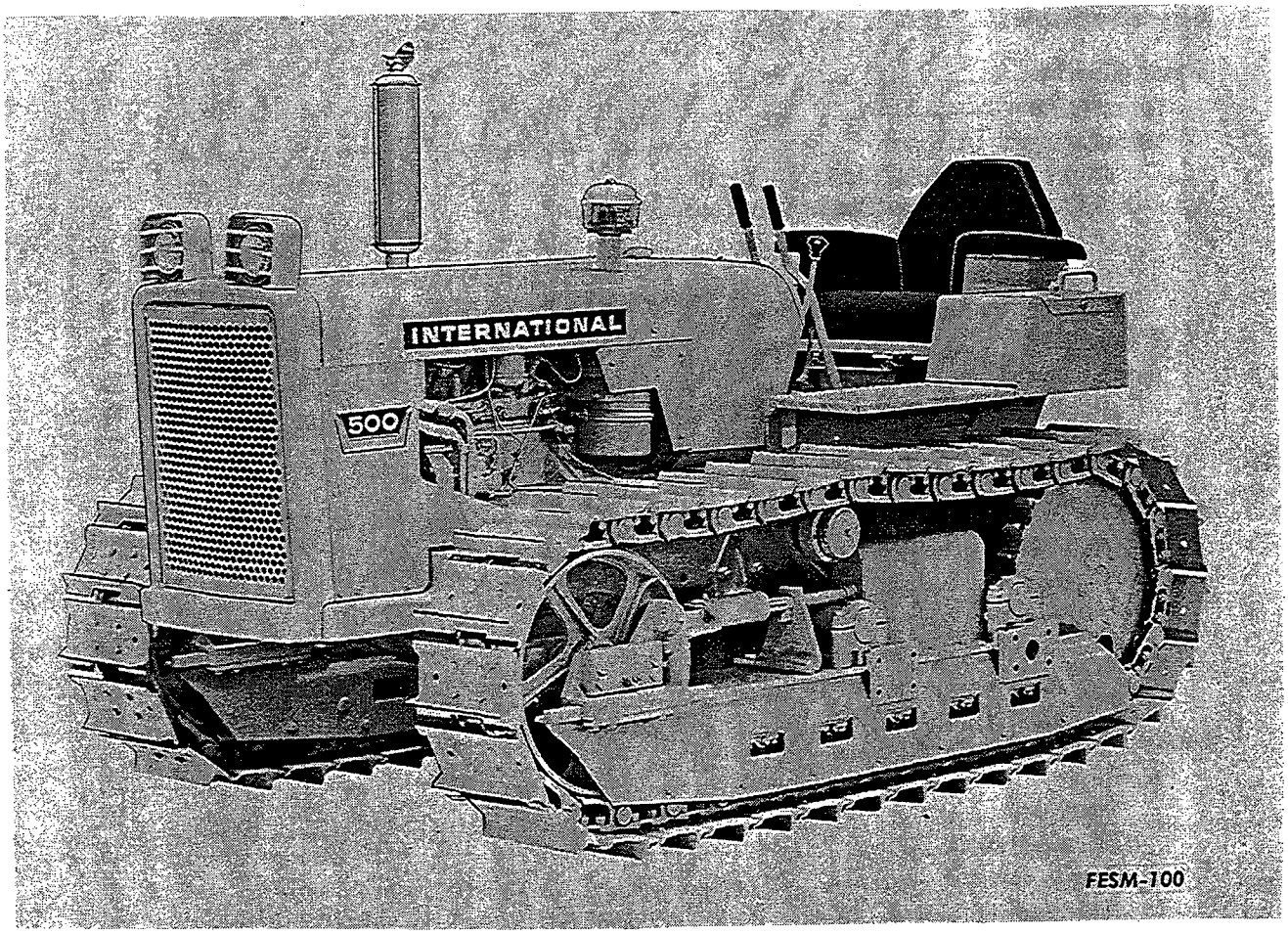
INTERNATIONAL HARVESTER

SERVICE MANUAL

500 CRAWLER



FOREWORD

The instructions and special tools shown in this Blue Ribbon Service Manual are for use by International Harvester dealers and their factory trained servicemen.

The specifications as listed in this manual are current as of the printing date. Due to changes and improvements in our products, dealers are periodically issued service bulletins to keep this manual up-to-date. We suggest you refer to the most recent information when performing service work on this equipment.

International Harvester Factory Trained servicemen are best qualified to service I.H. equipment.

INTRODUCTION

The purpose of this manual is to provide servicemen with the necessary information regarding overhaul and field adjustments for the C.A.V. (D.P.A. type) Fuel Injection Pump and Nozzle Service.

The "Principles of Operation" portion of the manual has been prepared to familiarize servicemen with the general function of the pump with specific detailed information covering the components which are affected by field adjustments.

Cleanliness cannot be overemphasized when performing service on any part of the diesel fuel system. Completely clean the injection pump and the surrounding area on the tractor before performing any service work.

LIBRARY FILING INFORMATION

1. File this manual in Book 10 after Divider Tab GSS-1326.
2. Enter the following information in the Service Manual Index. In the Tractor Fuel System Section on Page 7, Print or preferably Type in, the Manual Description, Form Number, and the Book filed in.

CONTENTS

SPECIFICATIONS

Injection Pump

Make	C.A.V.
Type	D.P.A.
Pump speed	1/2 engine speed
Drive	Gear in engine timing train
Rotation (viewed from drive end)	Clockwise
Injection timing	Mark on pump mounting flange and crankcase front cover plate

Transfer Pump

Type	Rotary vanes
Pressure at low idle	16-39 psi
Pressure at rated speed	38-51 psi
Pressure at cranking speed (fuel shut-off lever in off position)	Minimum of 5 psi
Vacuum (at full throttle)	10-15 inches Hg. before engine stalls

Feed Pump

Type	Diaphragm
Drive	Actuated from lobe on engine camshaft
Static fuel pressure (engine stopped)	6-10 psi

Governor

Type	Mechanical flyweight

Injection Nozzles

Type	Inward opening - Pintle No. BDN4SD6299
Nozzle opening pressure	2350 to 2425 psi
No face leakage (10 seconds)	150 psi below opening pressure
Nozzle back leakage	Back leakage should not allow pressure to exceed a fall from 1500 to 1100 psi in less than 10 seconds

Roller to roller dimension (for maximum fuel delivery)-inches	B-275 and TD-5 1.976	B-414 and 3414 1.978
Governor linkage length (measured from rear barrel surface of the stud to the rear end of the spring retainer) inches	2-1/16 ± 1/32	

Plungers

Diameter-inch	.275

End plate regulating valve spring

Free length-inches	....
Test length-inch	....
Test load-lbs.	....

Transfer pump liner I. D. -inches	1.094

Transfer pump vanes
- Length-inches ....
- Width-inch ....

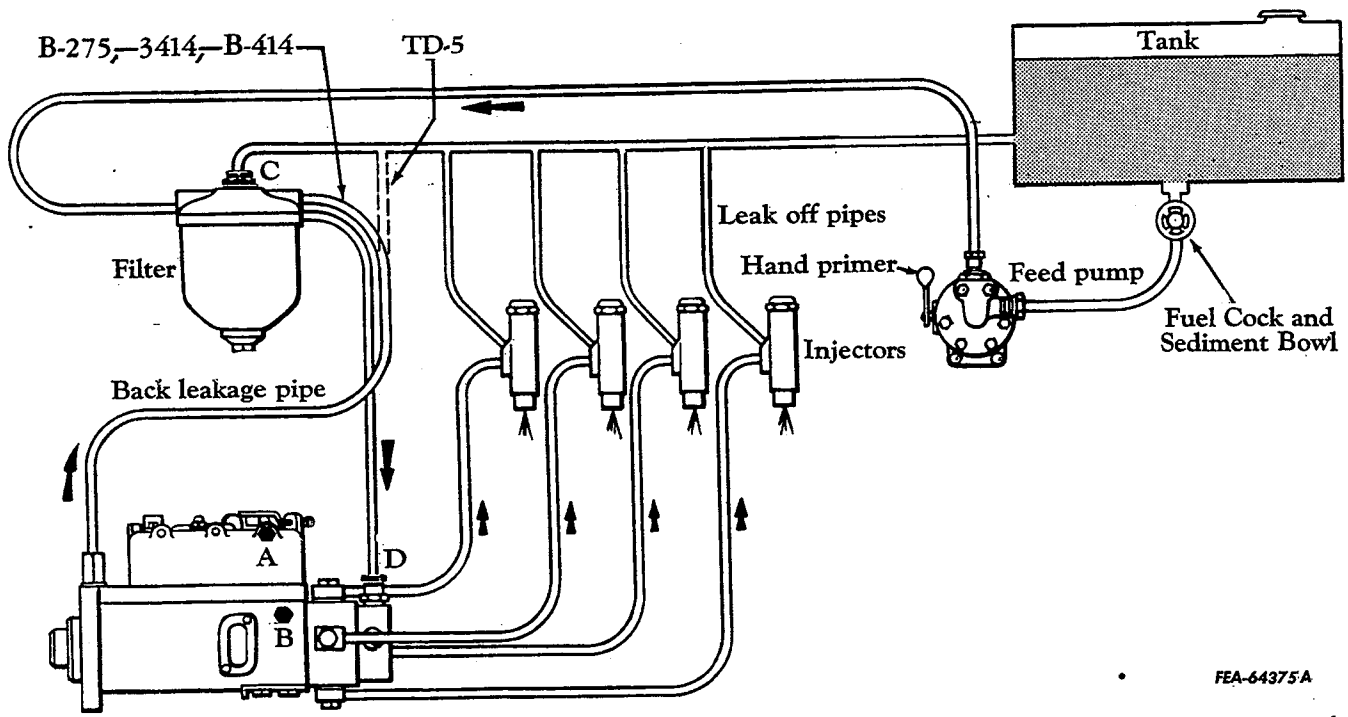
Hole location for idling spring guide ..... Center hole in control arm.

Hole location for governor spring in governor link ..... Front hole.

Torque Specifications
- Nozzle cap nut ..... 50 ft. lbs.
- Nozzle hold-down nuts ..... 40-50 ft. lbs.
- Drive hub securing screw ..... 285 inch lbs.
- Cam ring securing screw ..... 265 inch lbs.
- Drive plate screws ..... 160 inch lbs.
- Hydraulic head locating screw ..... 285 inch lbs.
- Hydraulic head locking screws ..... 170 inch lbs.
- Transfer pump rotor ..... 65 inch lbs.
- End plate fuel inlet connection ..... 360 inch lbs.
- End plate screws ..... 45 inch lbs.
- Acorn nuts ..... 30 inch lbs.

GENERAL INFORMATION

Fuel System



Illust. 1. Fuel system schematic.

As shown in Illust. 1, fuel flows by gravity from the fuel tank through the fuel cock and sediment bowl to the feed pump. The diaphragm type feed pump is actuated by a lobe on the engine crankshaft. A hand primer is incorporated in the feed pump to facilitate venting air and priming of the system with fuel. Fuel flows under low pressure from the feed pump to the fuel filter. The fuel filter has a replaceable element. A pressure relief valve or a reverse check ball and bleed orifice is incorporated in the filter cover to maintain proper, and relieve excess, fuel pressure. Filtered fuel, now under regulated low pressure, flows to the injection pump where a portion of the fuel is metered, increased in pressure and distributed to the injection nozzles. Fuel which is not injected is used to lubricate and cool the injection pump, then flows from the pump through the excess fuel return line to the fuel filter on the B-414, 3414 and B-275 or to the fuel tank on the TD-5 tractor.

Venting the Fuel System

(Refer to Illust. 1.)

1. Open the fuel cock on the sediment bowl.

2. Vent the sediment bowl.

3. Vent the inlet to the feed pump.

4. Operate the feed pump hand primer and while doing so, proceed as follows:

Note: It may be necessary, in some cases, to rotate the crankshaft approximately one revolution to permit hand operation of the priming pump.

(a) Vent the fuel filter. (Loosen the center capscrew in the filter cover.)

(b) Vent point "B" on the injection pump housing.

(c) Vent point "A" on the pump (governor housing).

5. Loosen two injector lines at the nozzle (1 and 4 are most convenient). Crank the engine until fuel spurts from these connections. Tighten the connections.

6. Engine is now ready to start and run. Further venting of the system or nozzles should not be necessary, however, smoother engine operation may be obtained sooner by venting each injector line at the nozzle fitting while the engine is running.

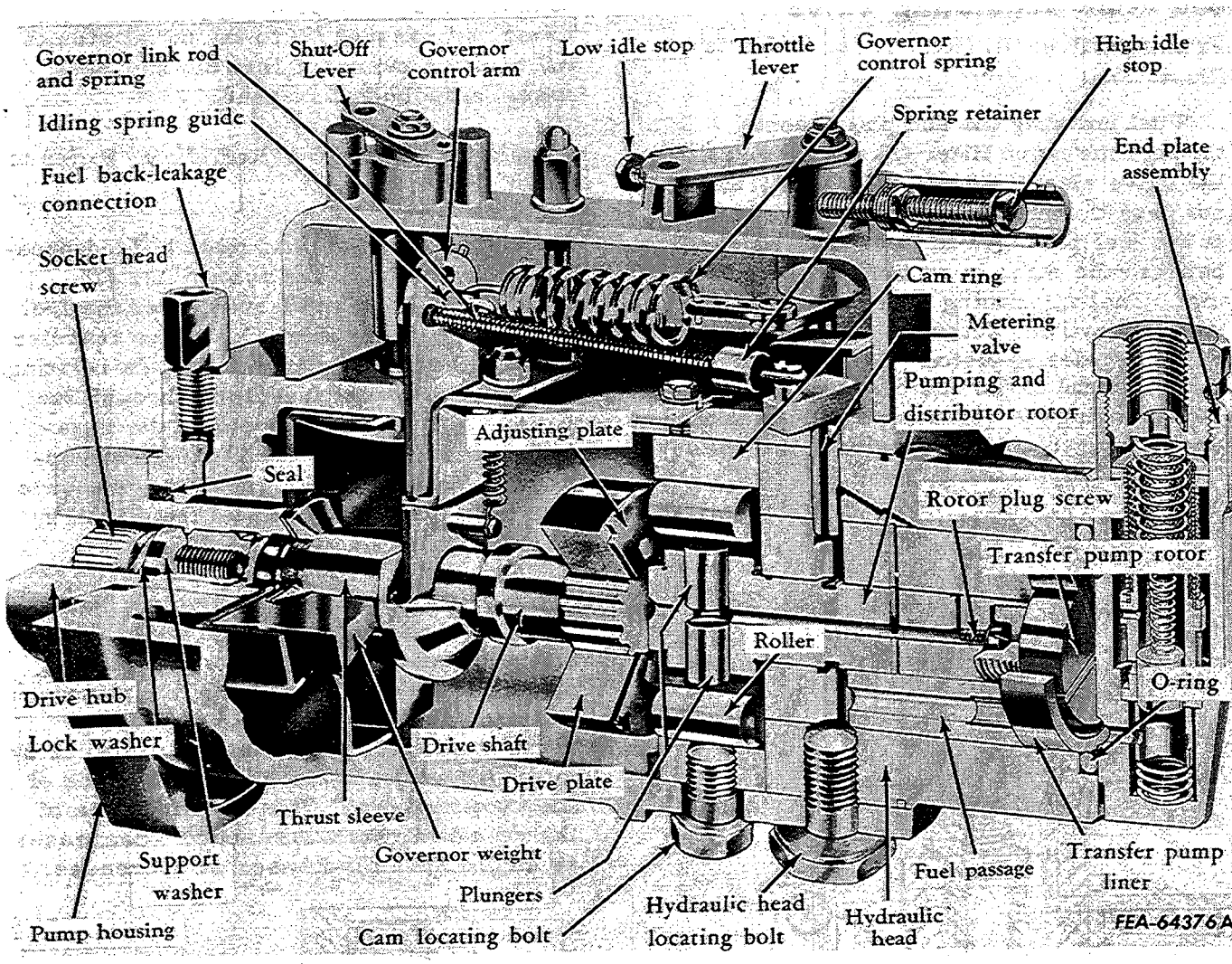
PRINCIPLES OF OPERATION

General

This injection pump is a single cylinder, opposed plunger, inlet metering, distributor type pump.

The function of the injection pump is to provide the engine with fuel in quantities exactly timed and proportioned to the amount of work it is required to do. Maximum efficiency can be possible only when these conditions are met.

A gear, dowel located on the pump drive shaft hub, is indexed to and driven from the idler gear of the engine timing gear train. The pump drive shaft, master spline - connected, drives the pumping and distributing rotor. A vane type transfer pump rotor is attached to and driven from the rear end of the pumping and distributing rotor. This transfer pump supplies fuel to the complete injection pump assembly for lubrication, cooling, metering and distribution to the nozzles. A metering valve, located in the hydraulic



Illust. 2. Cut-away of injection pump..

head, meters the fuel (within limits) for distribution to the nozzles. A piston sleeve type valve located in the end plate of the transfer pump permits venting and priming of the injection pump assembly and regulates the pressure of the fuel from the transfer pump. A cam ring having four opposite opposed lobes is located stationary in the pump housing. Attached to and rotating with the rotor shaft and within the cam ring are two movable opposed rollers and shoes which are in contact with the outer ends of the opposed plungers. The pumping action of this assembly increases the pressure of the fuel for injection. A flyweight type governor attached to and rotating with the drive shaft actuates linkage which in turn controls the rotary position of the metering valve.

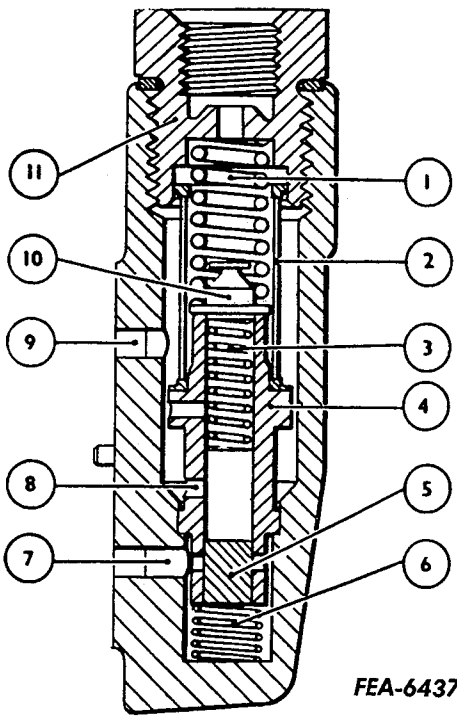
High idle and low idle adjustable stops restrict the movement of the throttle lever and shaft. A shut-off lever and linkage facilitates rotation of the metering valve to shut-off position regardless of throttle position.

There is no timing advance mechanism in this pump, therefore, end of injection is constant. Start of injection varies with the outward travel of the roller shoes and plungers. Due to the master spline connection of the drive shaft to the pumping and distributor shaft and the dowel location of the drive shaft hub to the injection pump drive gear, it is impossible, within limits, for the pump to be out of time with the engine.

End Plate Regulating Valve

Priming (Illust. 4) (Ref. No's. Refer to Illust. 3)

Fuel entering the end plate passes through the nylon filter (2) and surrounds the valve sleeve assembly (4). Fuel cannot pass through the transfer pump and into the fuel passages in the hydraulic head because the pump is stationary (not turning). Fuel at priming pressure enters the valve sleeve and acts against the upper face of the regulating piston (5). The piston is forced to the lower end of the valve sleeve, compressing the retaining spring (6) and uncovering the priming parts. Fuel then passes through the priming parts, the lower fuel passage (7) to the outlet side of the transfer pump and into the fuel passages in the hydraulic head.



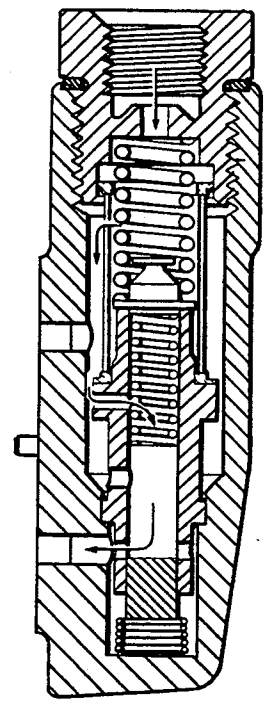
Illust. 3. Cut-away of end plate.

1. Sleeve retaining spring.
2. Nylon filter.
3. Regulating spring.
4. Valve sleeve.
5. Piston.
6. Retaining spring.
7. Fuel passage to transfer pump outlet.
8. Regulating port.
9. Fuel passage to transfer pump inlet.
10. Spring guide.
11. Fuel inlet connection.

Regulating (Illust. 5) (Ref. No's. Refer to Illust. 3)

Fuel entering the end plate at feed pressure flows through the nylon filter (2), surrounds the valve sleeve (4) out the fuel passage (9) to the inlet side of the transfer pump. The transfer pump rotor is rotating. Transfer pressure fuel flows through fuel passage (7) to the lower end of the regulating piston (5) and forces the piston upwards. This force is opposed by pressure exerted on the upper face of the piston by the regulating spring (3).

As transfer pressure increases, with increasing engine speed, the piston is forced upwards and the regulating spring is compressed. Movement of the piston progressively uncovers the regulating port (8) and regulates transfer pressure by by-passing excess fuel to the inlet side of the transfer pump. The effective area of the regulating port increases or decreases as engine speed increases or decreases.



Priming

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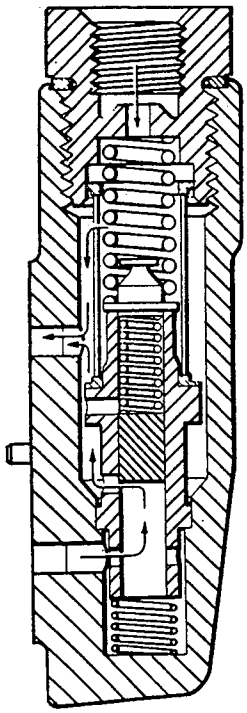
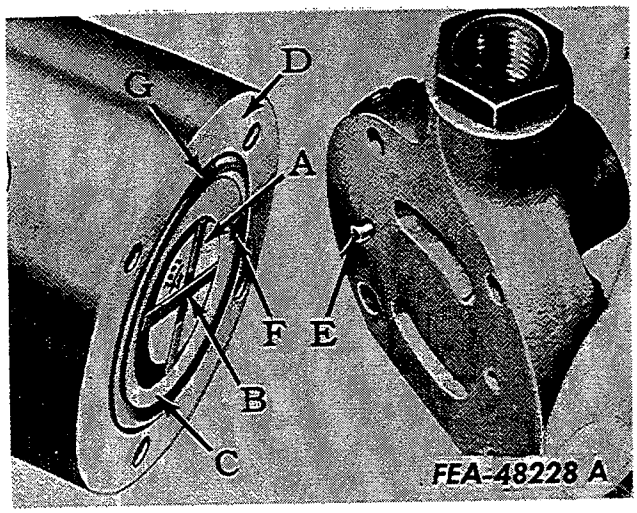
Illust. 4. Priming position of valve piston.



Illust. 5. Regulating position of valve piston.

Transfer Pump (Illust. 6.)

The transfer pump rotor "A" supports and rotates a pair of sliding vanes "B" in a liner "C".



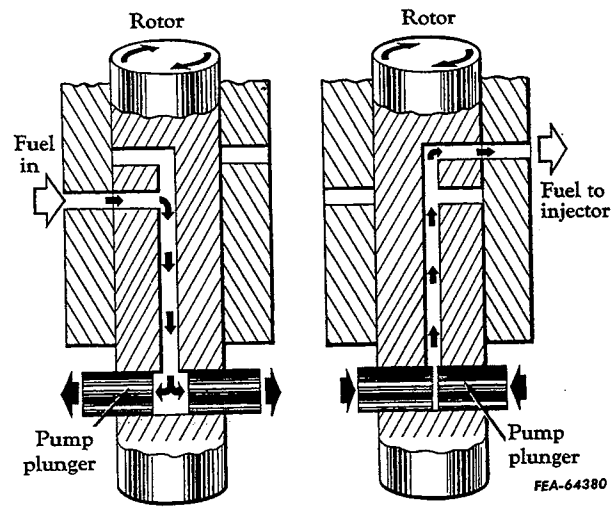
Illust. 6. Transfer pump assembly.

The liner is located and held in the hydraulic head "D" by a dowel "E" in the pump end plate. The dowel engages a slot "F" in the liner. An "O" ring "G" acts as a seal between the end plate and the hydraulic head.

Fuel Pumping and Distribution

Fuel Pumping (Illust. 7)

Transfer pressure fuel, metered by the metering valve, flows through a drilled passage in the hydraulic head to the rotor. When a charging port, drilled in the rotor, aligns with the drilled passage in the hydraulic head, as shown in Illust. 7, fuel is forced through the centrally drilled passage in the rotor and forces the pump plungers outward. As the rotor turns, the charging port in the rotor is closed. Further rotation of the rotor aligns the discharge port of the rotor with a discharge port in the hydraulic head. During this rotation the pump plungers are forced inward thus increasing the fuel pressure and forcing the fuel through the aligned discharge ports. A fuel line connected to the hydraulic head discharge port carries this high pressure fuel to the nozzle for injection.



Illust. 7. Charging and discharging principle.

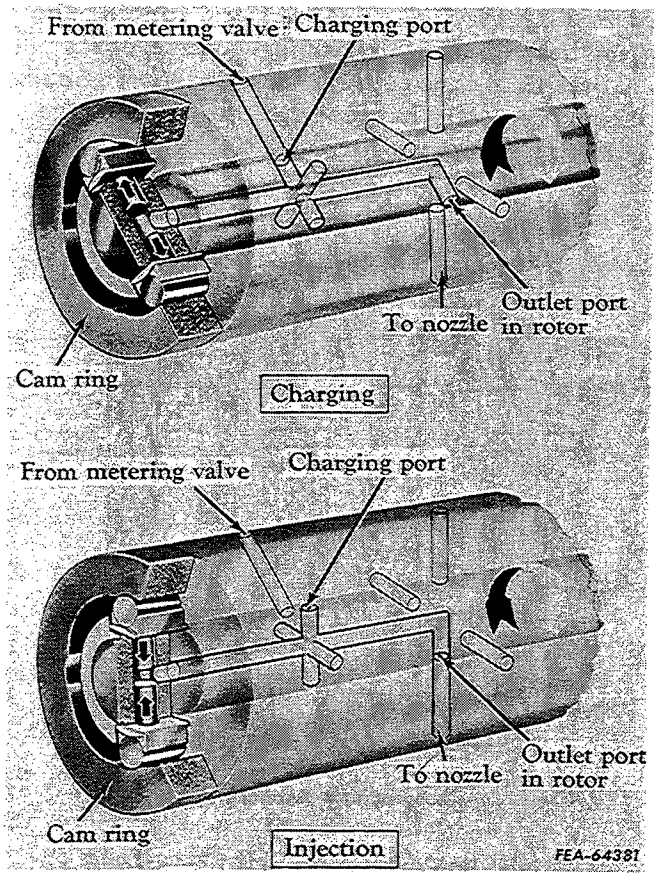
A stationary cam ring, having four opposite opposed internal lobes, is located in the injection pump housing. The front

end of the rotor has a cross bore containing two opposed plungers and carries with it a pair of rollers, roller shoes, and adjustable plates. As the rotor revolves the rollers ride over the lobes thereby forcing the plungers inward. Fuel is forced from between the plungers, through the central bore in the rotor and through the discharge ports of the rotor and hydraulic head.

Distribution (Illust. 8)

There is one charging port in the hydraulic head. There are four charging ports drilled crosswise through the rotor. Rotation of the rotor within the hydraulic head causes each rotor charging port to line up, in turn, with the charging port in the hydraulic head.

One discharge port is drilled in the rotor and four discharge ports are drilled in the hydraulic head. The centrally drilled passage in the rotor connects the plunger chamber and charging ports to the single discharge port. As the rotor turns, fuel is distributed to each of the four discharge ports in the hydraulic head.



Illust. 8. Fuel distribution.

The quantity of fuel, entering the pumping chamber and available for discharge, depends on the following factors:

1. Metering valve position.

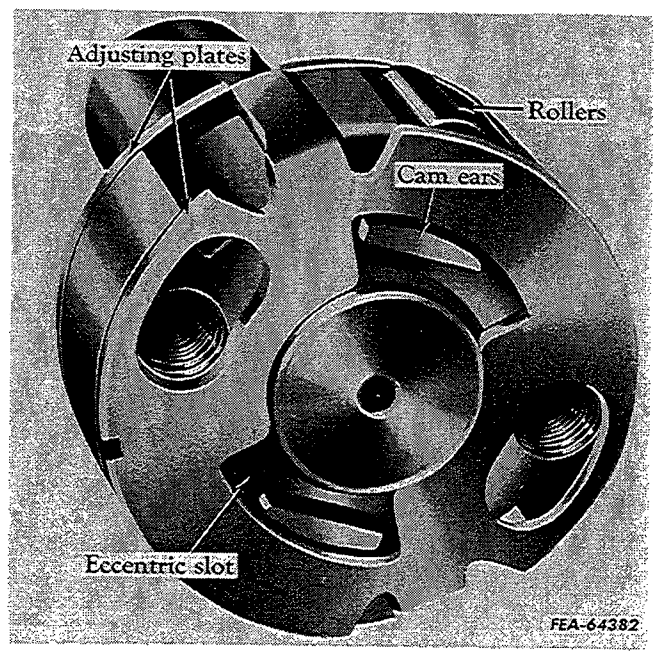
2. Fuel pressure at the charging ports.

3. Duration of time that the charging ports are in register.

4. Total plunger displacement available as limited by the roller shoe adjusting plates.

Maximum Fuel Control

Roller shoes have protruding cam ears at each end. Interlocking adjusting plates, having internal eccentric slots, are positioned at each end of the rollers and turn with the rotor. Two small locking screws secure the driving head and adjusting plates to the rotor. The outward travel of



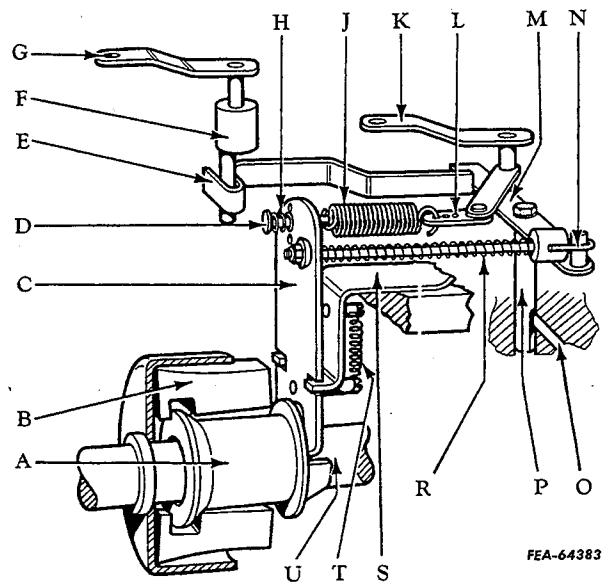
Illust. 9. Maximum fuel control. (Rotor assembly)

the rollers, shoes and plungers is restricted as the protruding cam ears of the shoes contact the eccentric slots of the plates. See Illust. 9.

Maximum fuel delivery required for high altitude operation is somewhat less than that for sea level. This coincides with altitude horsepower derating of the engine and must not be overlooked. Adjustments may be necessary to both service and production pumps.

Governor Control Linkage (Illust. 10)

Movement of the governor weights "B" causes the control sleeve "A" to move axially along the drive shaft "U". The governor control arm "C" is free to pivot about a fulcrum provided on the control bracket "S" and is held in contact with the end face of the thrust sleeve by spring tension. A spring-loaded hook rod "N" connects the upper end of the governor control arm with the lever "M" which is secured to the metering valve "P". Any movement of the governor weights in response to fluctuations of engine speed results in movement of the metering valve and a corresponding change of fuel quantity.



Illust. 10. Governor control linkage.

The "shut-off" shaft "F" is operated by movement of the lever "G". Movement of the shaft is transmitted to the control lever "M" on the metering valve by the "shut-off" bar "E", and rotates the metering valve to a position where the metering port "O" is completely closed. The hook rod "N" is spring-loaded so that this movement can be achieved without overcoming the resistance of the governor weights. When the "shut-off" control is operated, the light spring "R" is compressed and the front end of the hook rod passes through the governor control arm.

Speed selection is made by moving the throttle lever "K" which is mounted on the throttle shaft. A swivel link "L" is connected to a lever which is integral with the throttle shaft. The governor spring "J" connects the swivel link with the idling spring guide "D" which passes through a hole in the governor control arm. When the lever is moved to obtain increased engine speed, the light idling spring "H" is compressed as the guide is drawn through the control arm and tension is then applied to the main spring. Tension of the main spring acting on the control arm is transmitted to the control sleeve, and provides resistance to movement of the governor weights.

The application of the D. P. A. pump requires the idling spring guide "D" to be located through the center of the three holes in the upper end of the governor control arm "C". The governor spring "J" should be hooked in the front hole of the swivel link "L".

The metering valve "P" consists of a small shaft, slotted at one end. The valve is situated in a chamber in the hydraulic head, through which the fuel passes from the transfer pump to the inlet ports of the rotor. Rotation of the valve controls the effective area of the metering orifice, and regulates the fuel supply to the rotor by controlling the metering pressure in the passage "O".

TROUBLE SHOOTING CHART

Problem	Cause
Engine fails to start or is hard to start	1. Injection pump fuel shut-off arm and throttle lever not in the "run" position. 2. Air in fuel system. 3. Fuel does not meet specifications, or water is in fuel. 4. Cranking speed too slow. 5. Fuel not reaching transfer pump. 6. Glow plugs not hot. 7. Fuel return line plugged. 8. Injection pump not correctly timed to engine. 9. Faulty nozzles. 10. No fuel pressure to the injection pump plungers. 11. Piston rings or valves in poor condition. 12. No fuel injection occurring.
Engine starts, then stops	1. Insufficient fuel reaching the injection pump. 2. Water in fuel. 3. Air in fuel system. 4. Fuel return line restricted. 5. Engine seizure.
Engine surges	1. Air in fuel system. 2. Insufficient fuel reaching injection pump. 3. Improper governor action.

Problem	Cause
Rough and/or noisy engine operation (see also engine misfiring)	1. Injection pump timing not correct. 2. Air in fuel system. 3. Faulty nozzles. 4. Engine valves faulty. 5. Uneven engine compression.
Engine not developing full power	1. Restricted engine induction system. 2. Restricted exhaust system. 3. Throttle control does not move the throttle lever against high idle stop. 4. Timing of injection pump to engine not correct. 5. Fuel does not meet specifications. 6. Insufficient fuel reaching transfer pump. 7. Restriction in fuel return line. 8. Incorrect fuel transfer pump pressure. 9. Incorrect high idle speed. 10. Faulty nozzles. 11. Poor engine compression. 12. Insufficient fuel delivery.
Engine misfiring (also see rough and/or noisy engine operation and white exhaust smoke)	1. Injection pipes or fittings leaking. 2. Air lock in fuel system. 3. Faulty injection nozzle. 4. Incorrect engine valve lever adjustment, burned or stuck valve.
White exhaust smoke	1. Low engine temperature. 2. Air lock in fuel system. 3. Faulty nozzles. 4. Incorrect compression pressure.

Problem	Cause
Excessive black smoke at rated load speed	1. Restriction in engine induction system. 2. Low engine temperature. 3. Faulty nozzles. 4. Injection pump delivering excessive fuel.
Excessive black smoke during engine overload only	1. Injection pump delivering excessive fuel when engine is overloaded.
Blue smoke	1. Excessive oil consumption.
Incorrect vacuum	1. Loose or damaged inlet connections. 2. Unserviceable copper washer on inlet adaptor to end plate. 3. Regulating spring missing or broken. 4. End plate not tightened square to hydraulic head. 5. Faulty transfer pump seal. 6. Worn or damaged transfer pump blades. 7. Transfer pump liner improperly located. 8. Air leak in vacuum gauge connection.
Low transfer pressure	1. Regulating spring or piston missing. 2. Incorrect regulating spring. 3. Worn or damaged transfer pump blades. 4. Faulty transfer pump seal. 5. Loose or incorrectly tightened end plate. 6. Faulty washers on head locking and head locating screws. 7. Damaged seals on head locating fitting.
High transfer pressure	1. Sticking regulating piston. 2. Incorrect regulating spring - too strong.
Low and fluctuating transfer pressure	1. One transfer pump blade chipped or broken.

Problem	Cause
Incorrect maximum fuel delivery	1. Throttle not fully open. 2. Incorrect maximum fuel setting. 3. Faulty washer on rotor plug screw. 4. Loose rotor plug screw. 5. Sticking metering valve. 6. Air in system. 7. Sticking plungers or roller shoes. 8. Damaged washers on radial connections. 9. Incorrect transfer pressure. 10. Shut off mechanism fouling metering valve. 11. Governor link adjustment incorrect. 12. Governor spring linkage incorrectly assembled. 13. Cam ring reversed.
Low fuel delivery at cranking speed	1. Low transfer pressure. 2. Throttle not fully open. 3. Rotor plug screw washer damaged. 4. Rotor plug screw loose. 5. Sticking metering valve. 6. Sticking plungers and roller shoes. 7. Damaged washers on radial connections. 8. Plungers scored. 9. Outlet ports scored. 10. Excessive clearance, rotor to hydraulic head. 11. Air in system. 12. Scored metering valve.

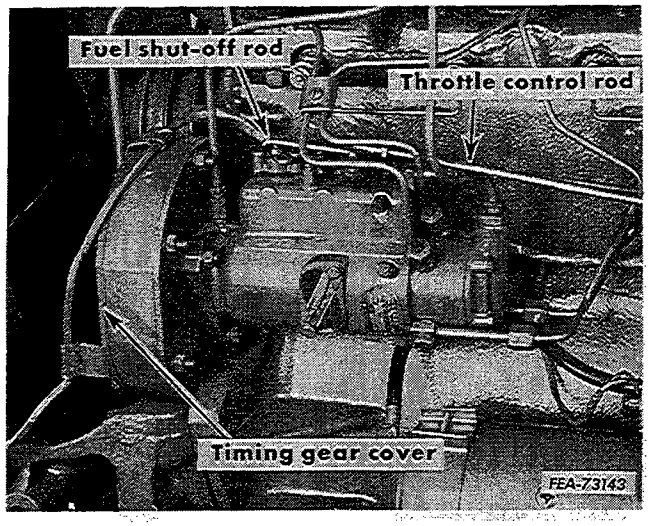
Problem	Cause
Fuel shut-off not working	1. Cut off lever fitted incorrectly to cut off shaft. 2. Cut off bar fouling control cover or control bracket. 3. Governor link binding in control arm. 4. Governor link length too long. 5. Excessive clearance, metering valve to hydraulic head. 6. Sticking metering valve.
Low fuel delivery at maximum speed	1. Maximum speed stop screw incorrectly adjusted. 2. Faulty or incorrect governor spring. 3. Governor spring linkage coupled to wrong holes. 4. Sticking metering valve.
Difficulty in obtaining proper fuel delivery setting	1. Governor spring damaged or of wrong type. 2. Governor link setting incorrect. 3. Governor spring linkage incorrectly coupled. 4. Drive hub securing screw loose. 5. Sticking metering valve. 6. Sticking governor thrust sleeve.

Removal (Illust. 11 and 12.)

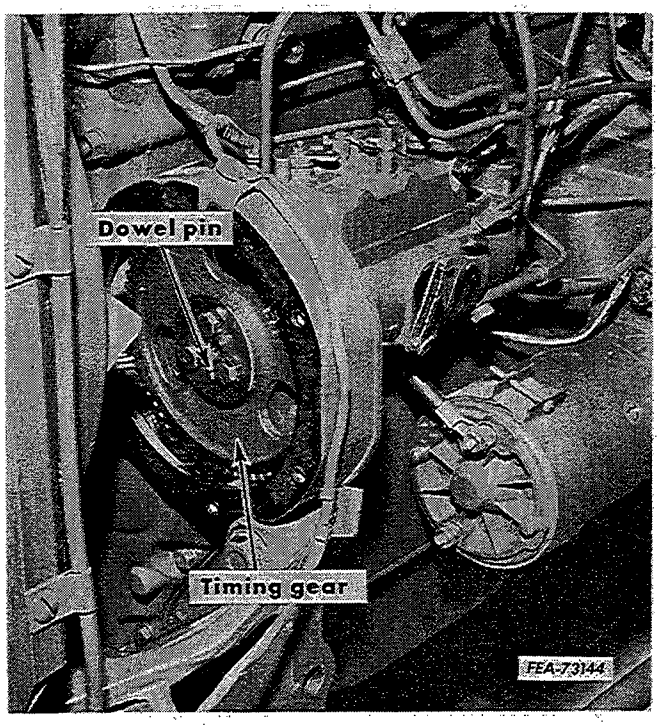
1. Completely clean the area surrounding the injection pump.

2. Close the fuel shut-off. Disconnect all fuel lines connected to the injection pump. Cap all fuel lines and plug all openings to prevent entry of dirt. Loosen the fuel inlet connection on the pump end plate.

3. Disconnect the throttle control rod and fuel shut off rod from their levers on the pump.



Illust. 11. Injection pump disconnects.



Illust. 12. Injection pump timing gear.

4. Remove the injection pump timing gear cover.

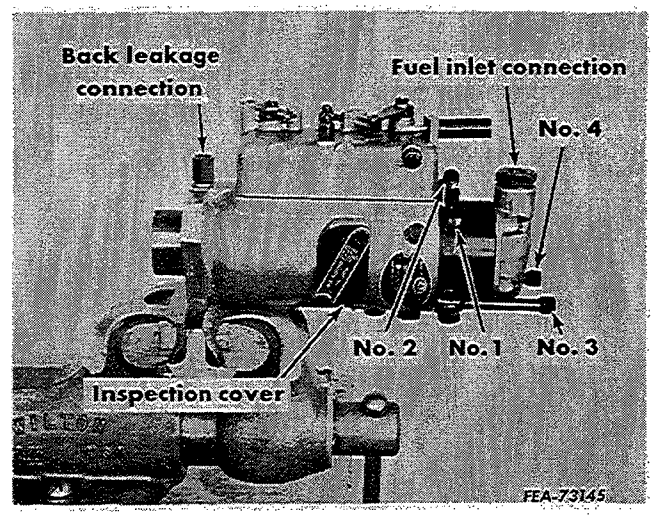
5. Remove the capscrews securing the timing gear to the pump flange.

6. Remove the nuts securing the injection pump to the crankcase front plate and remove the pump.

Disassembly

IMPORTANT: Before disassembling the pump, remove all external grease and dirt. Wash the pump with clean fuel oil and blow it dry with compressed air. Keep in mind that dirt, dust, and foreign matter are the greatest enemies of the fuel injection pump. As a precaution, keep all openings temporarily plugged.

The work bench and the area around it should be clean, as well as the tools to be used. A clean pan should be available in which all parts may be placed as disassembly proceeds, and also a pan of clean fuel oil, in which the parts may be washed.

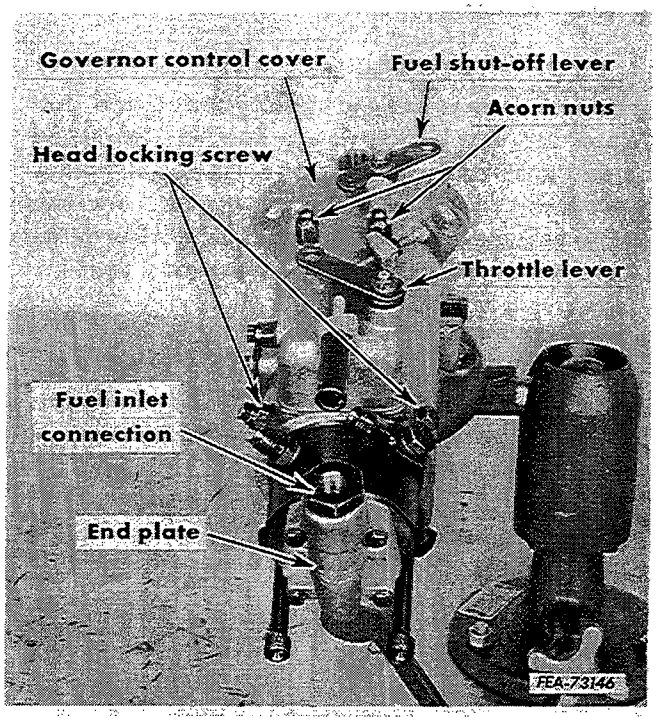


Illust. 13. Pump mounted in vise.

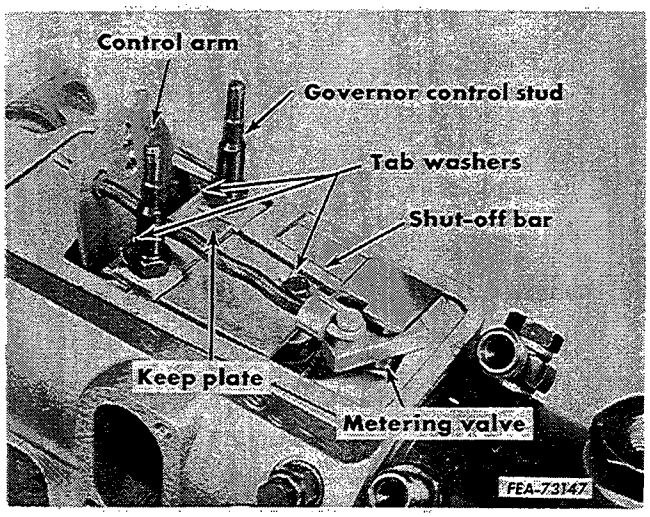
1. Mount the pump flange in a vise that has brass shields. (Illust. 13.) Remove the inspection cover and drain the fuel from the pump housing. Remove the injector lines and banjo bolts.

2. Remove the nuts securing the fuel shut-off and throttle levers to their shafts, (Illust. 14). Note the location of the star and plain washer to aid in reassembly. Remove the levers.

3. Remove the two acorn nuts and fiber washers securing the cover to the housing. (Illust. 14.)



Illust. 14. Fuel shut-off and throttle levers.

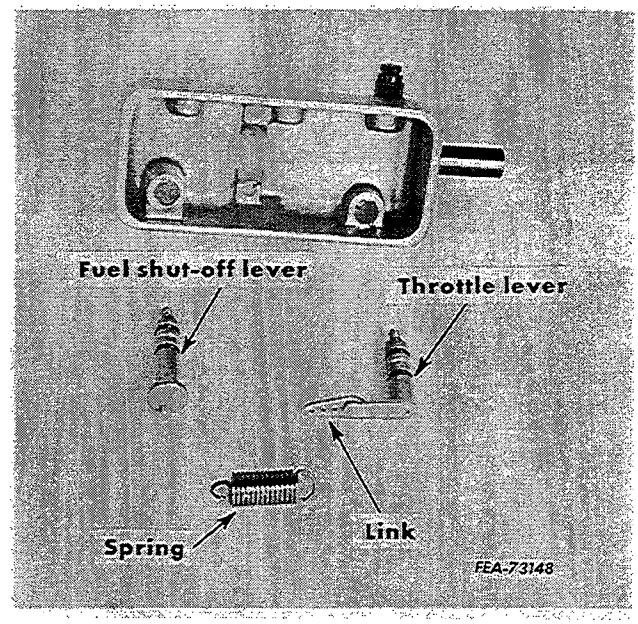


Illust. 15. Governor control linkage.

4. Lift the governor control cover and unhook the governor spring from the idling spring guide. Remove the governor control cover from the pump housing. Note the location of the spring guide in the control arm. Remove the idling spring guide and spring from the control arm, (Illust. 15).

5. Unlock the tab washers from the two governor control studs and the capscrew securing the linkage in the pump housing, (Illust. 15). Remove the studs and capscrew. Remove the keep plate shut-off bar. Remove the linkage assembly with metering valve from the housing.

6. Disconnect the metering valve from the hook lever and protect the precision ground surface from damage and corrosion by immersing it in clean fuel oil.



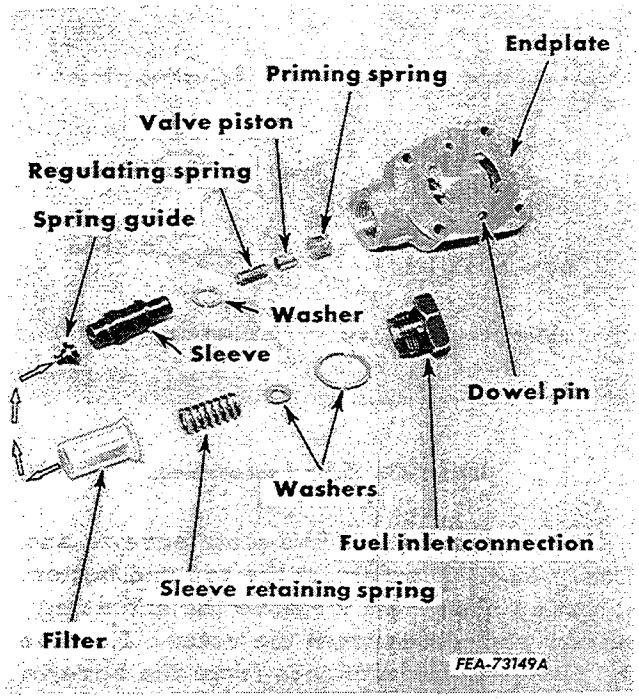
Illust. 16. Governor control spring location.

7. Remove the fuel shut-off and throttle levers from the governor control cover. Note the location of the spring hook up in the link. (Illust. 16.) Disconnect the control spring from the throttle lever link.

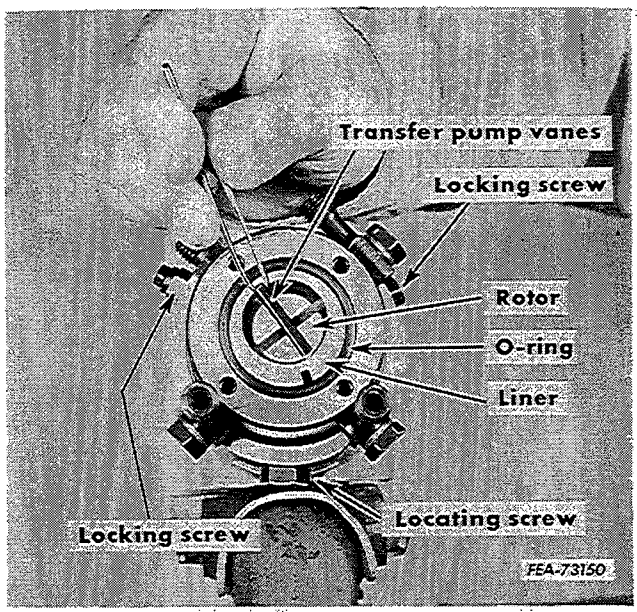
8. Remove the end plate from the pump housing (Illust. 14).

9. Remove the fuel inlet connection and remove the component parts from the end plate. (Illust. 17.)

10. Using a pair of tweezers, remove the transfer pump vanes from the slots in the rotor, (Illust. 18). Remove the O-ring and the transfer pump liner from the housing.

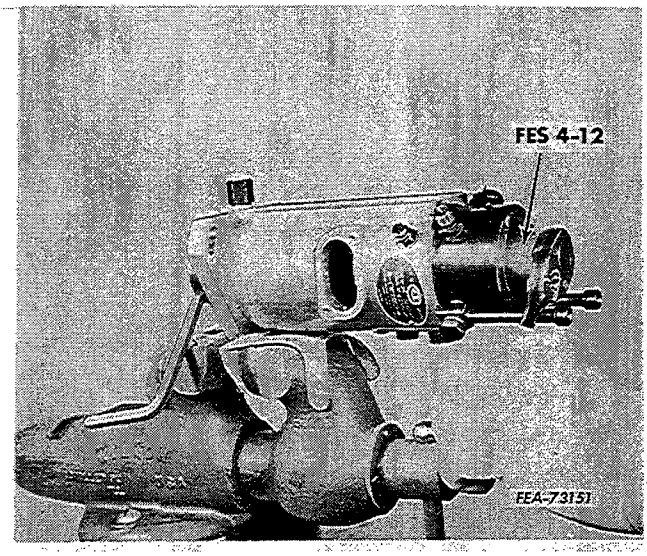


Illust. 17. End plate disassembled.

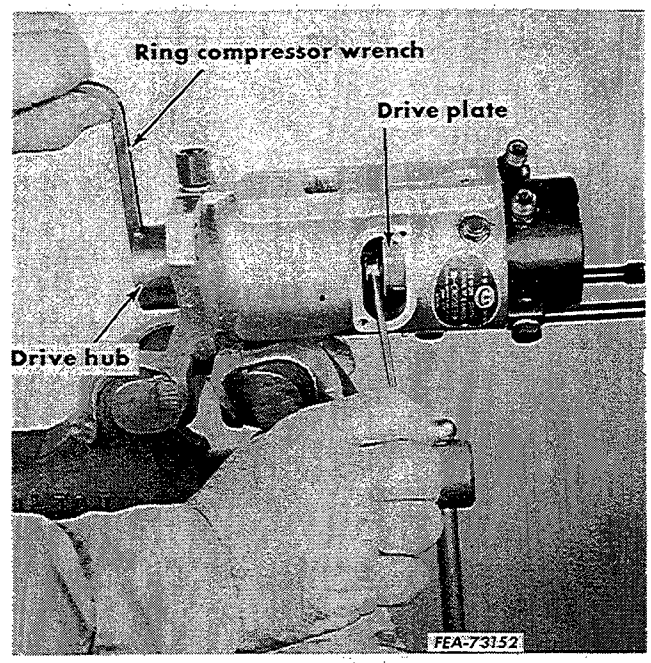


Illust. 18. Removing transfer pump vanes.

11. Hold the drive hub with the square key and loosen the transfer pump rotor, using the transfer pump rotor wrench (FES 4-12) (Illust. 19). The direction for rotor removal is indicated by an arrow on the face of the rotor. (Illust. 18.) Do not remove the rotor at this time.



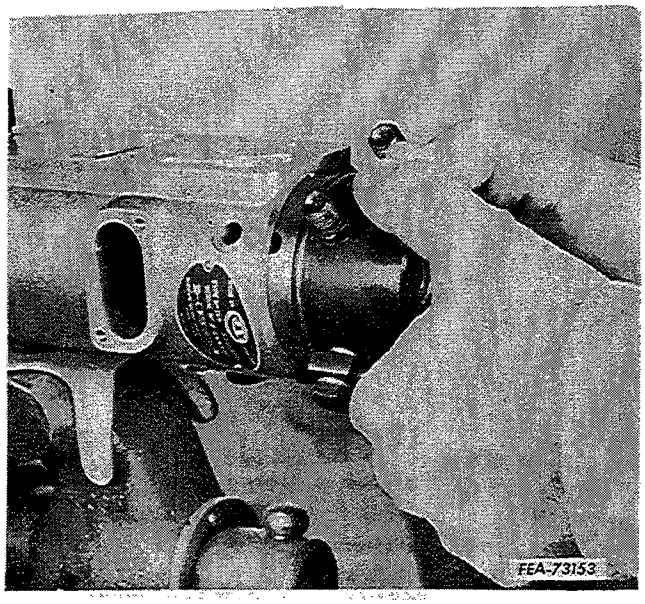
Illust. 19. Removing the transfer pump rotor.



Illust. 20. Loosening drive plate screws.

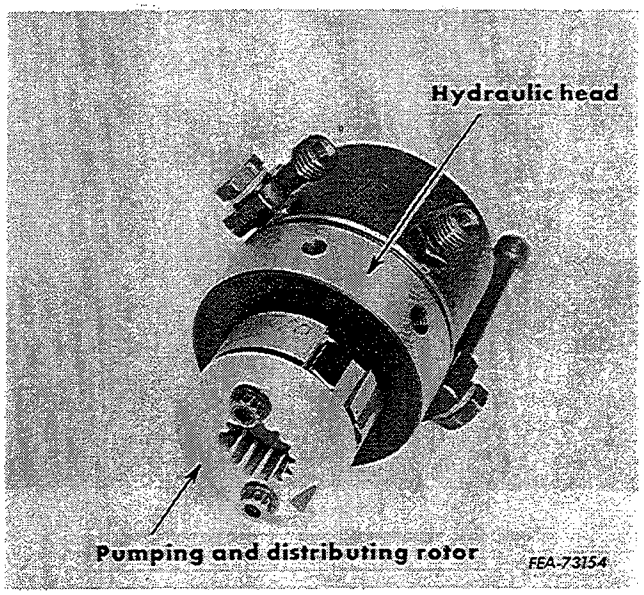
12. Loosen the two drive plate screws while holding the drive hub secure. (Illust. 20.)

13. Remove the three locking screws securing the hydraulic head in the pump housing. (Illust. 18.)



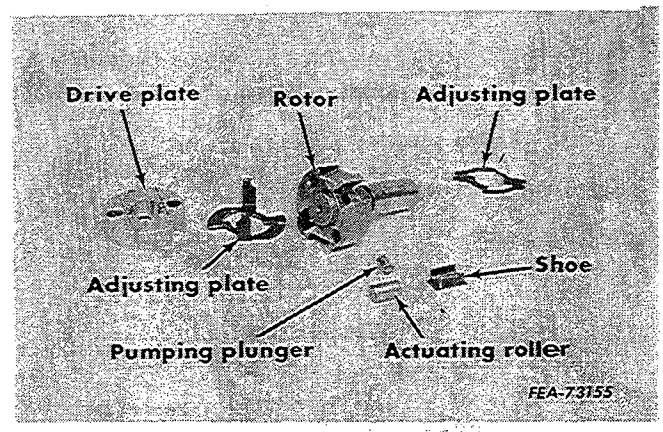
Illust. 21. Removing hydraulic head and rotor.

14. Remove the hydraulic head and rotor as an assembly. (Illust. 21.)



Illust. 22. Hydraulic head and pumping and distributing rotor.

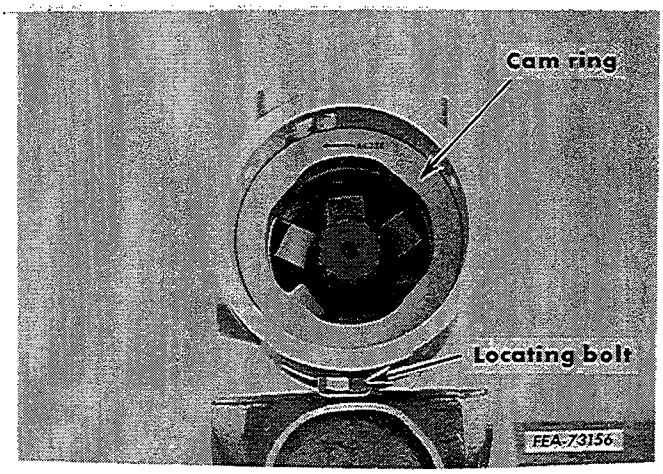
15. Remove the rotor. Separate the pumping and distributing rotor from the hydraulic head. (Illust. 22.) Note the position of the roller shoes and lock plates in the rotor as an aid in reassembly.



Illust. 23. Rotor disassembled.

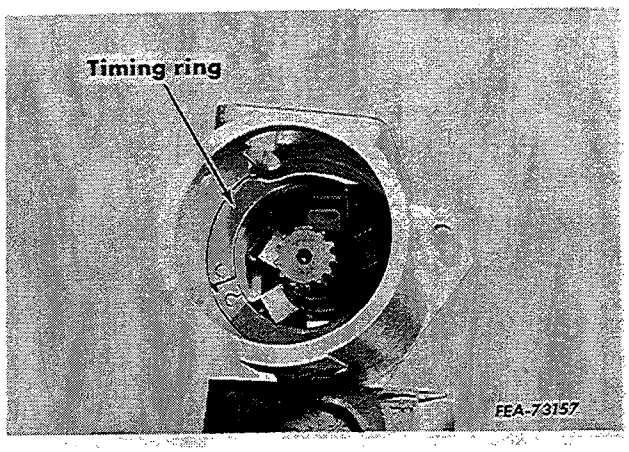
16. Remove the drive plate screws and drive plate. Disconnect the top and bottom adjusting plates and remove the actuating rollers and shoes from the rotor. Remove the two pumping plungers from the bore in the rotor (Illust. 23).

17. Remove the allen head setscrew and copper sealing washer from the transfer rotor and flush the rotor thoroughly in clean diesel fuel.



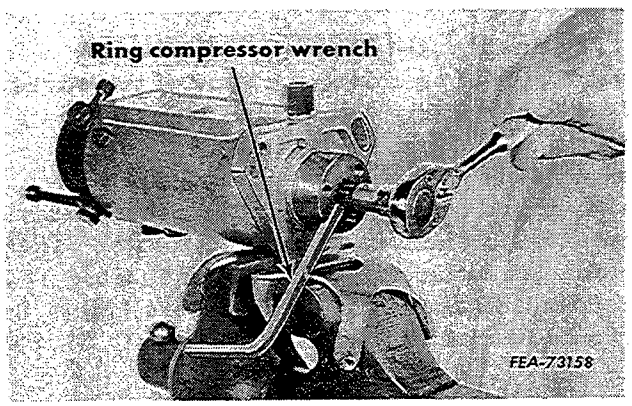
Illust. 24. Cam ring and locating bolt.

18. Remove the cam ring locating bolt and remove the cam ring (Illust. 24). The arrow on the cam ring corresponds to the arrow on the pump housing showing direction of pump rotation.



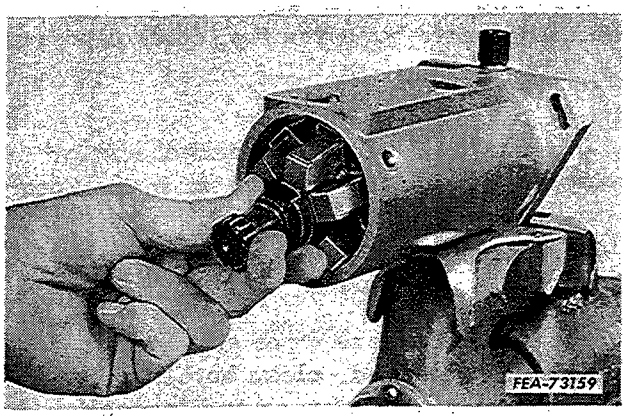
Illust. 25. Timing ring location.

19. On pumps equipped with a timing ring (Illust. 25), remove the timing ring from the housing and discard it as it is not needed.



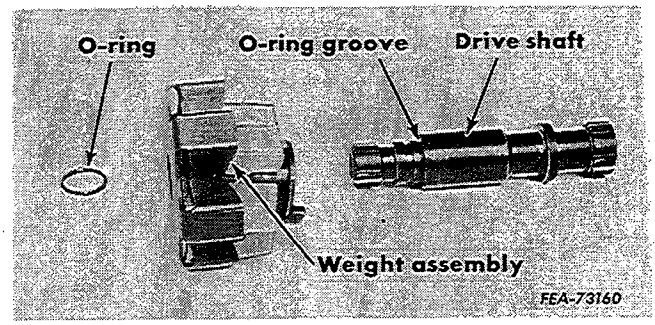
Illust. 26. Removing hub securing screw.

20. Lock the drive hub with the ring compressor wrench and remove the hub securing screw (Illust. 26).



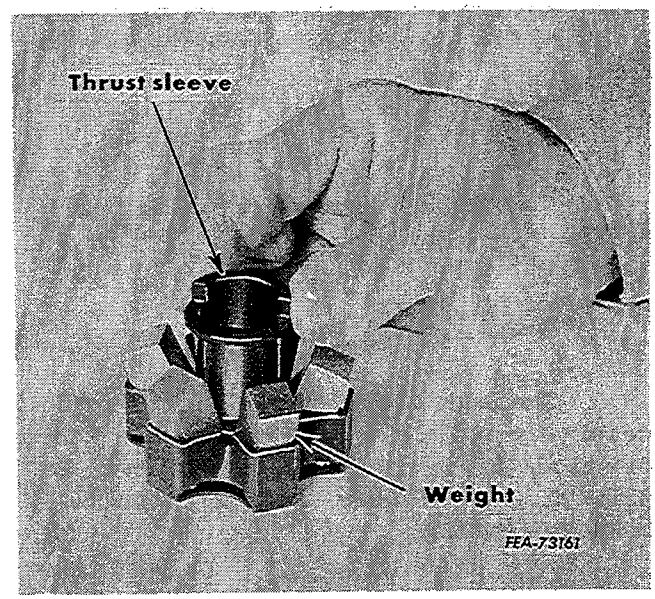
Illust. 27. Removing governor weight assembly.

21. Remove the governor weight assembly and splined shaft (Illust. 27).



Illust. 28. Governor weight and drive shaft.

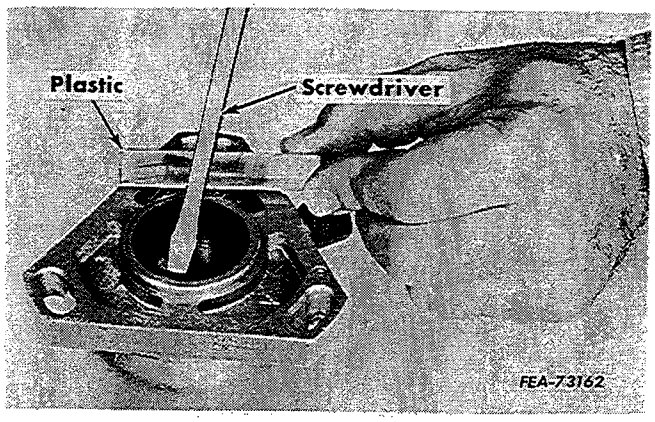
22. Remove the O-ring from its groove in the drive shaft. Pull the shaft out of the weight assembly (Illust. 28).



Illust. 29. Removing thrust sleeve and weights.

23. To remove the weights from their housing, lift out the thrust sleeve thereby allowing the weights to be removed with the thrust washer (Illust. 29).

24. Place a plastic or brass block on the flanged end of the housing, as shown in Illust. 30. Insert a dull screwdriver between the lower face of the seal and the bottom of the seal housing. Apply downward pressure on the screwdriver to pry out the oil seal. NOTE: The block keeps the screwdriver from contacting the housing.



Illust. 30. Removing housing oil seal.

Inspection and Repair

NOTE: Clean all parts of the injection pump in clean diesel fuel or solvent. All parts and drilled passages must be open and clean to assure proper operation of the pump.

End Plate (Illust. 17).

1. Check the pressure regulating valve sleeve for rust and the bypass port for clogging.

2. Check the regulating plunger for excessive wear, nicks or chipping, scratches or scores, and freedom of movement. Replace the part if there is any doubt as to its serviceability.

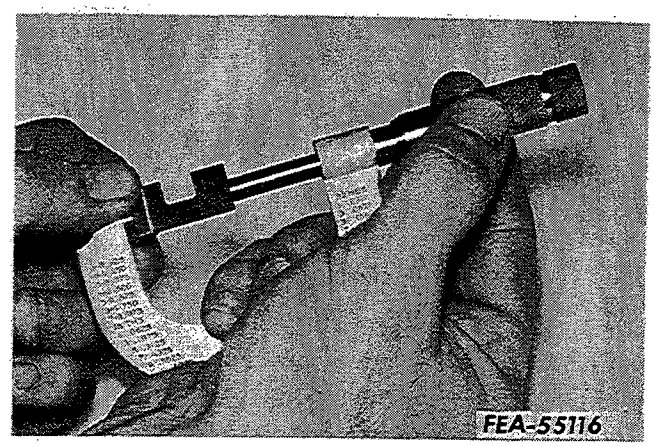
3. Inspect the end plate for wear from transfer pump end thrust; for rust, cracks or thread damage.

4. Check the bottom surface of the fuel inlet connection for rust and the threads for damage.

5. Inspect the inlet strainer for foreign material, or damage to the screen. Clean it thoroughly. Replace the strainer if it is damaged.

Transfer Pump

1. Inspect the pump liner for excessive wear, rust, nicks or chipping, scratches or scores on the inside diameter and flat surfaces.



Illust. 31. Measuring the blade length.

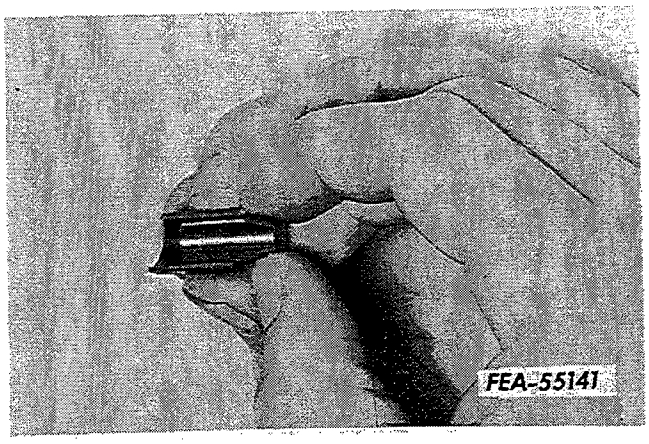
2. Inspect the blades for excessive wear, nicks or chipping of any of the edges. Check for pitting, embedded foreign particles or wear on the rounded ends. Determine this wear by measuring the length with a micrometer. Refer to "Specifications" on pages 5 and 6 for specified length. The blades are made of copper impregnated carbon and are brittle. Therefore, they should be handled with care. (Illust. 31.)

Hydraulic Head and Rotor

1. Inspect the head for excessive wear, rust, nicks or chipping, scratches or scores and thread damage. Inspect the metering valve bore and fuel control ports.

2. Inspect the plungers and check for complete freedom of movement in the rotor, then remove and examine them for scratches, nicks or signs of excessive wear.

3. If the plungers were sticking, but not visibly damaged, clean both plungers and bore with a soft brush and lacquer solvent such as lacquer thinner or acetone.



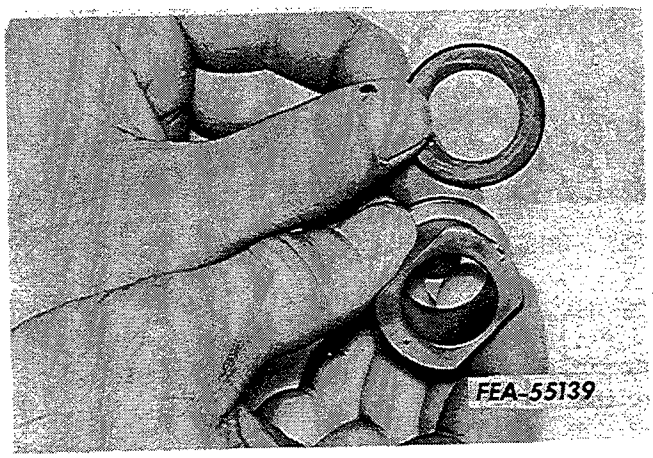
Illust. 32. Checking the cam roller and shoe.

4. Inspect each cam roller in its shoe for freedom of rolling and sliding, and the top edge of each shoe for chipping or excessive wear (Illust. 32).

5. Do not remove the rotor plug screw and sealing washer in the end of the rotor, as these parts are not serviced separately.

Governor

1. Examine the retainer sockets where the weights pivot, and the pivot points of all weights.



Illust. 33. Inspecting the governor sleeve and washer.

2. Inspect the thrust sleeve and washer for excessive wear, rust, nicks, scratches or scores, cracks or distortion; especially at points of contact with the governor arm. (Illust. 33.)

3. Inspect the pivot points of the governor arm and pivot bracket and the governor arm fork where it contacts the thrust sleeve.

4. Examine the metering valve linkage hook, the spring retainer, throttle shaft lever, shut-off cam, and the throttle and shut-off shaft assemblies for excessive wear.

5. Check the metering valve arm for looseness. The valve must be tight in the arm. Be sure the metering valve arm pin is tight in the arm.

Cam, Drive Shaft, Drive Hub and Pump Housing

1. Since only the working surfaces of the lobes on the cam I. D. are ground, the tool marks between the lobes should not be considered damaged. The cam finish is discolored from heat treatment rather than from operation. Carefully inspect the I. D. and edges of all flat surfaces. If there is evidence of excessive wear, rust, nicks, scratches or scores, cracks or distortion, or "flaking out," replace the cam.

2. Check the drive shaft for rust, excessive wear or nicks where the governor thrust sleeve slides. The drive hub seal grooves must be smooth for the seals to function properly.

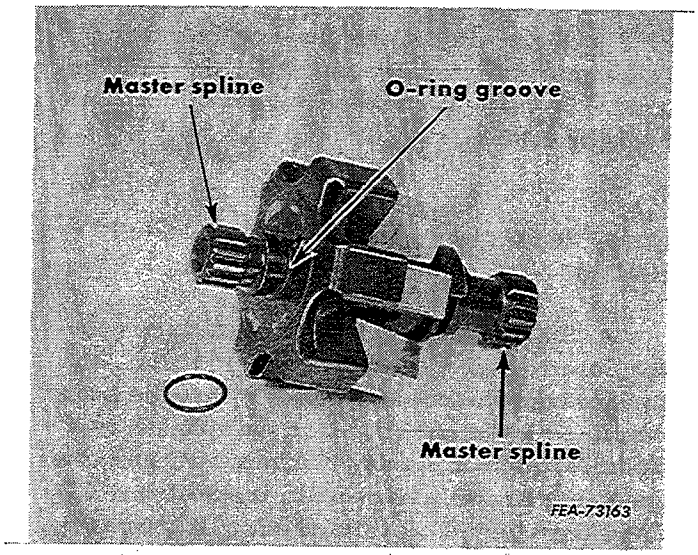
3. Inspect the pump housing internally for burrs or scratches and remove any found--carefully. A scratch at the point of contact with the seal could be a source of leakage. Inspect the drive shaft bore in the housing for excessive wear, scratches and nicks.

Reassembly

1. Use all new O-rings and oil seals when reassembling the injection pump. Dip all parts in clean diesel fuel.

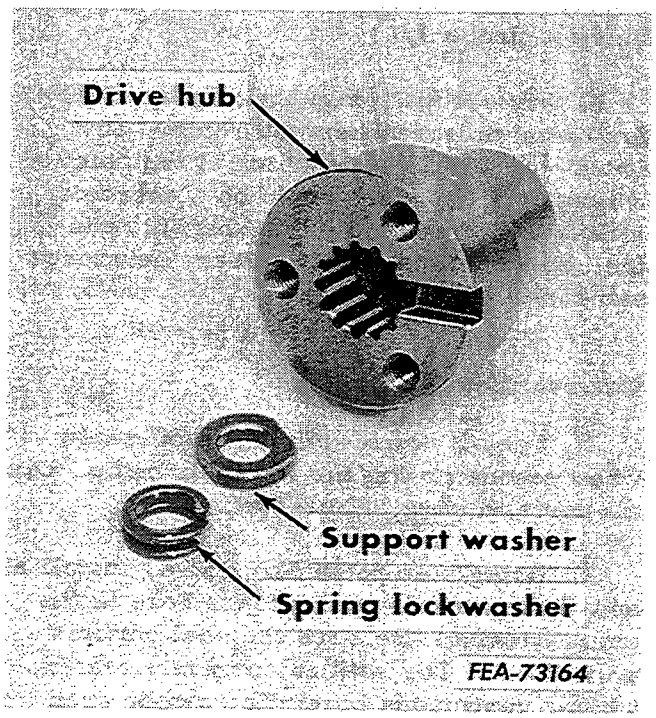
2. Using step plate No. 630-4, install a new drive hub oil seal into its bore in the pump housing. Be sure the seal bottoms on its seat. The seal is correctly seated, when a continuous black line can be seen when the seal is viewed through the flanged end of the pump housing.

3. Reassemble the weights in the carrier being sure the thrust washer and the flange of the thrust sleeve engage the slots of all the weights.



Illust. 34. Weight carrier assembly.

4. Install the splined drive shaft in the carrier and install a new O-ring in the shaft groove (Illust. 34).



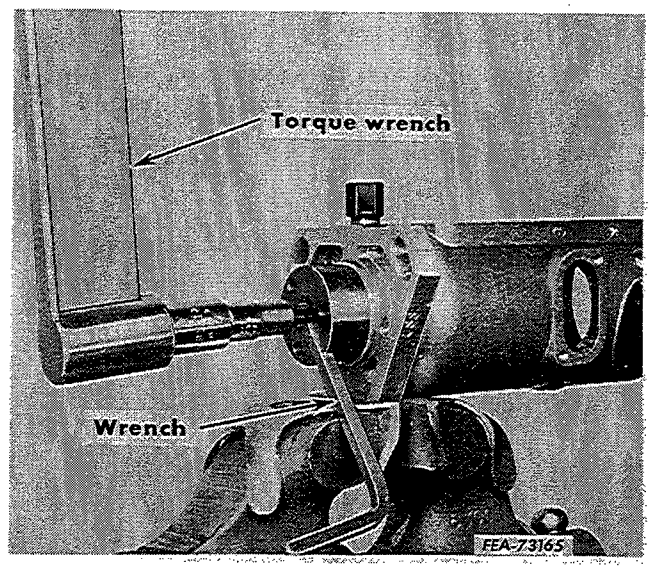
Illust. 35. Drive hub and support washer.

5. Install the drive hub support washer (Illust. 35), in the recess between the two sets of splines in the hub and install the hub in the oil seal and housing.

6. Install the drive shaft and weight carrier assembly into the pump housing (Refer to Illust. 27). Engage the drive shaft master spline with the master spline in the inner end of the drive hub.

NOTE: In this position the weight carrier is trapped between the end face of the drive hub and a shoulder on the drive shaft.

7. Install the drive hub spring lock washer and allen screw.



Illust. 36 Torquing drive hub allen screw.

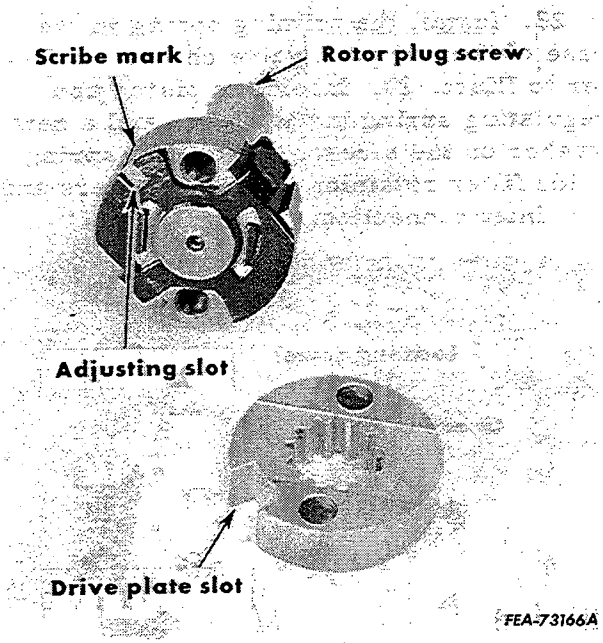
8. Using the piston ring compressor wrench to lock the hub, torque the allen screw to 285 inch lbs (Illust. 36).

9. Install the cam ring in the housing against the timing ring. The direction indicated by the arrow on the face of the cam ring should correspond with the arrow on the name plate showing direction of pump rotation (Illust. 24).

10. Install the cam ring locating bolt (Illust. 24).

11. Place the bottom adjusting plate in position on the pumping and distributor rotor so that the adjusting slot lines up with the scribe mark on the rotor head.

NOTE: Be sure to position the adjusting plate so the slots in the plate are in line with the roller shoe guides.



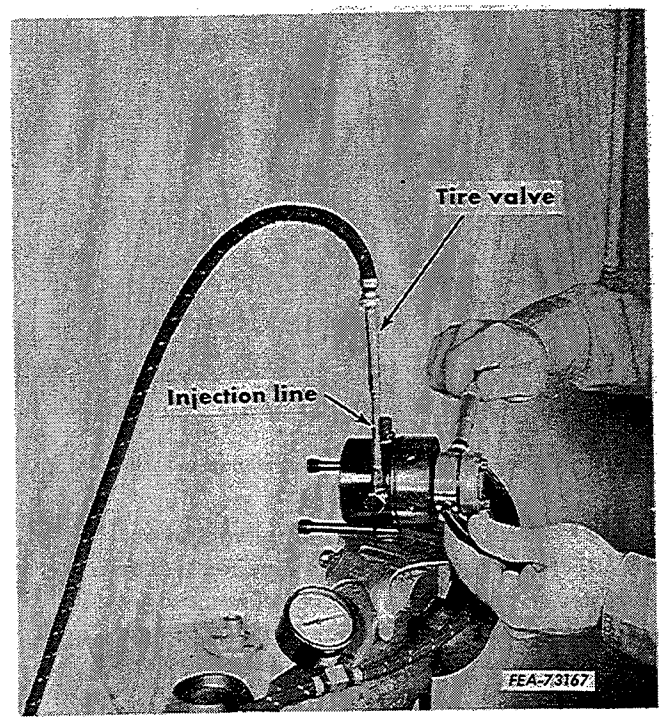
Illust. 37. Proper position of roller shoes and adjusting plates.

12. Install the twin plungers in their bore in the rotor, and install the roller and shoe assemblies in their guides in the rotor.

13. Install the top adjusting plate so the ears of the shoes engage the slots in the plates and the lugs of the top plate engage the slots of the bottom plate. (Illust. 32.)

14. Install the drive plate to the rotor, recessed side of the plate to the rotor, and install the plate capscrews finger tight. The slot in the drive plate should line up with the adjusting slot in the adjusting ring. (Illust. 37.)

15. Install the pumping and distributor rotor into its bore in the hydraulic head. Install the rotor, finger tight only at this time.

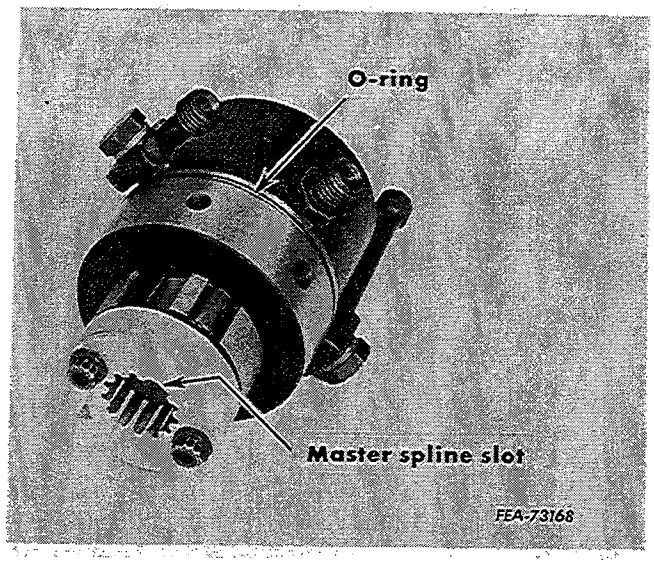


Illust. 38. Checking roller to roller dimension for maximum fuel adjustment.

16. Secure the hydraulic head and rotor assembly in a vise (Illust. 38). Be sure the machined circumference of the hydraulic head does not contact the vise. Apply air pressure (30 to 100 psi) to one of the fuel injector line connections. (Illust. 38.) Rotate the rotor until the plungers and roller shoes are forced to the maximum fuel position. Check the roller to roller dimension with a micrometer and if necessary, rotate the adjusting plate until the specified roller to roller dimension is obtained. Refer to "Specifications".

NOTE: The air pressure line installed on the hydraulic head can be made from an injection line with a tire valve brazed to it.

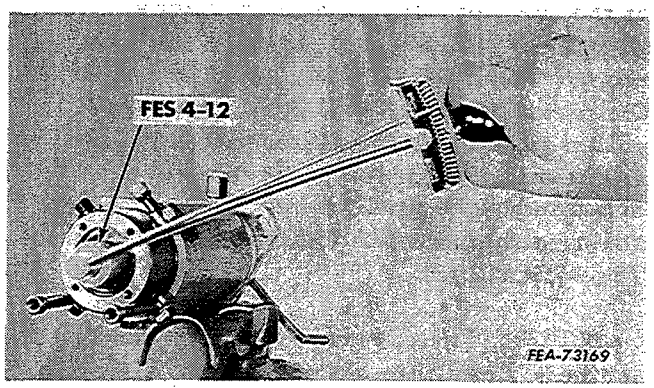
17. Disconnect the air pressure equipment.



Illust. 39. Drive plate master spline slot.

18. Install a new O-ring on the hydraulic head. Install the hydraulic head and rotor assembly into the housing, engaging the master spline on the inner end of the drive-shaft with the master spline slot of the drive plate (Illust. 39). Rotate the head to prevent damage to the O-ring as it enters the pump housing.

19. Locate and secure the head by installing the head locating screw. Tighten the screw to 285 inch lbs. torque. Install the two head locking screws and tighten them to 170 inch lbs. torque. Torque the cam ring locating bolt to 265 inch lbs.



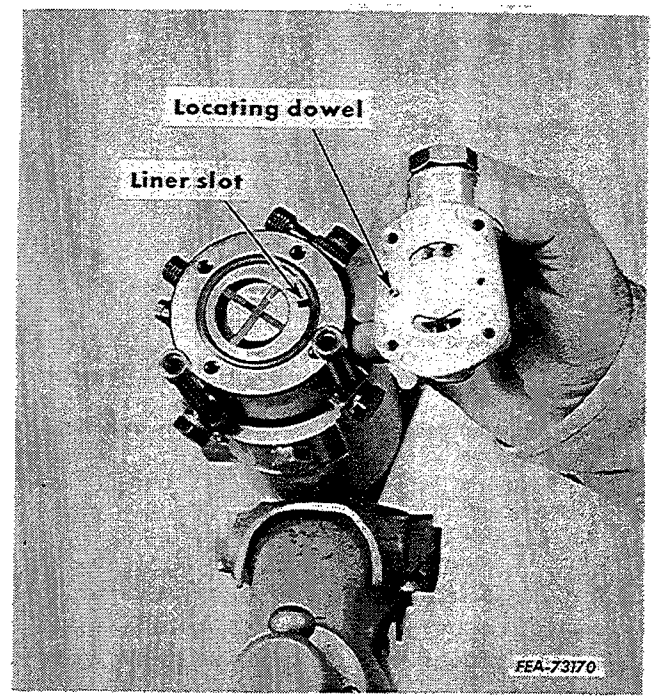
Illust. 40. Torquing transfer pump rotor.

20. Lock the drive hub from turning and tighten the rotor to 65 inch lbs. torque (Illust. 40).

21. Install the transfer pump liner in its bore in the hydraulic head. Install a new O-ring around the liner.

22. Install the pump vanes in the slots in the rotor. Refer to Illust. 18. Rotate the liner to be sure the vanes do not bind.

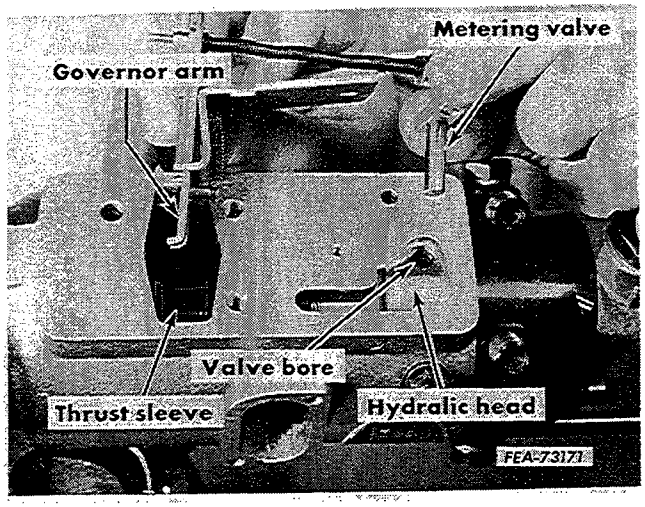
23. Install the priming spring in the base of the end plate valve chamber. Refer to Illust. 17. Insert the piston and regulating spring in the sleeve and a new washer on the sleeve. Install the spring guide filter retaining spring, washers and fuel inlet connection.



Illust. 41. End plate locating dowel.

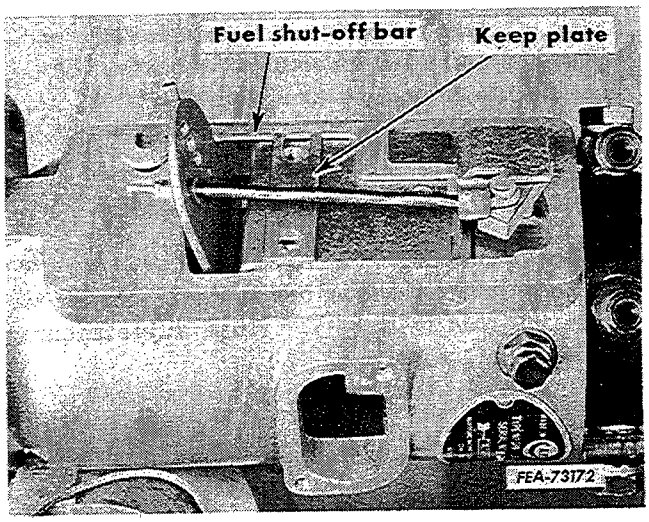
24. Install the end plate assembly on the pump housing, being sure the locating dowel on the face of the end plate engages the slot in the transfer pump liner (Illust. 41). Install the end plate capscrews and tighten them to 45 inch lbs. torque. Tighten the fuel inlet connection to 360 inch lbs. torque after the pump is installed on the engine.

25. Rotate the thrust sleeve so the seat for the governor arm is exposed and to the top. Install the governor control linkage



Illust. 42. Installing governor linkage.

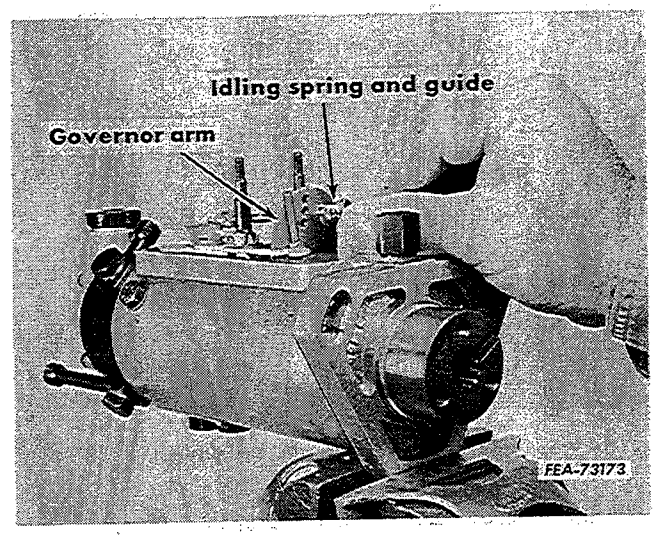
on the pump housing and engage the lower end of the governor arm with the thrust sleeve and position the metering valve in its bore in the hydraulic head (Illust. 42).



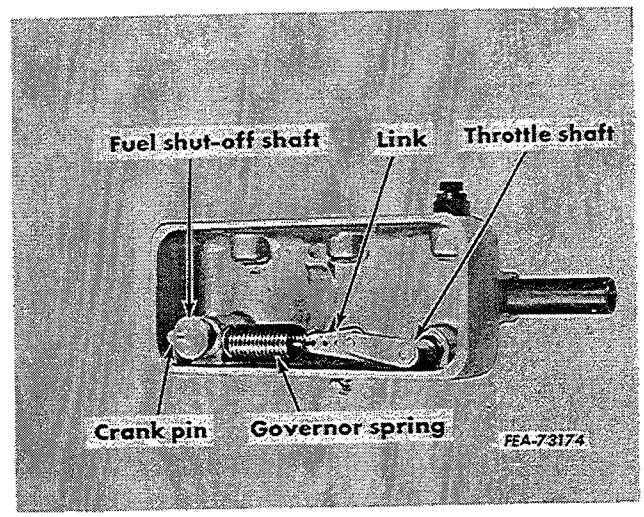
Illust. 43. Position of keep plate and fuel shut-off bar.

26. Install the keep plate in position on the governor control bracket (Illust. 43). Install the fuel shut-off bar. Install the governor control studs with new tab washers. Install the screw and tab washer at the end of the bracket near the metering valve. Tighten the screw and studs securely. Bend lock tabs up to lock screw and studs in place.

27. Install the idling spring and guide into the center of the three holes in the governor arm (Illust. 44).



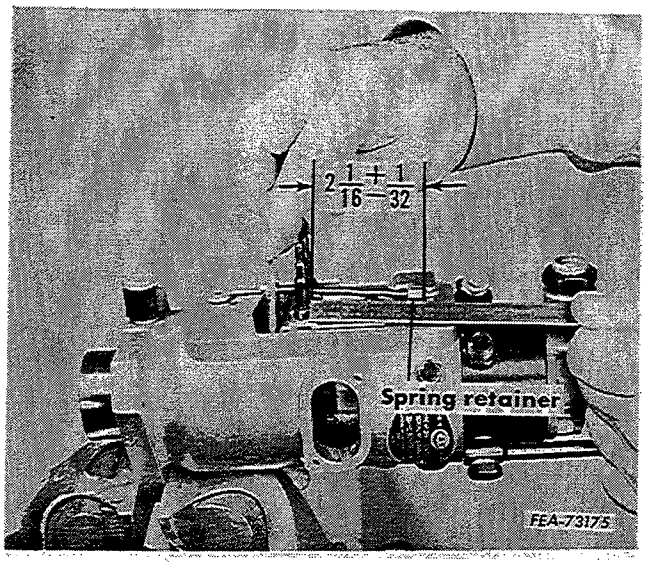
Illust. 44. Installing idling spring and guide.



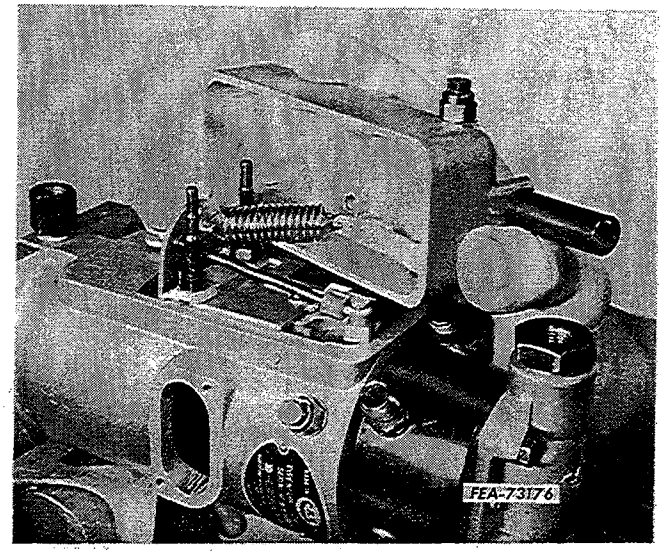
Illust. 45. Governor control housing assembled.

28. With new O-rings installed on the fuel shut-off and throttle shafts, press the shafts through their bores in the governor control housing. Install one end of the governor spring to the front hole in the link (Illust. 45).

29. Move the governor control arm to the full throttle position, (toward the rear



Illust. 46. Checking linkage setting.



Illust. 47. Installing governor control housing.

of the pump) and hold it in that position. Measure from the rear barrel surface of the stud (not the hex head) to the rear end of the spring retainer. Measurement should be 2-1/16 ± 1/32 inches (Illust. 46).

30. Install the governor control housing with new gasket on the pump housing, being sure to hook the governor spring to the idling spring guide and also being sure the fuel shut-off shaft crank pin engages the slot in the fuel shut-off bar. (Illust. 47.)

31. Install the acorn nuts with washers on the studs and tighten them to 30 inch lbs. torque.

32. Install the washers and levers on the throttle and fuel shut-off shafts. Secure the levers in place with the nuts.

Installation

The installation procedure is the reverse of the removal procedure. Refer to "Field Adjustments" for final adjustments on pages 29 to 32.

FIELD ADJUSTMENTS

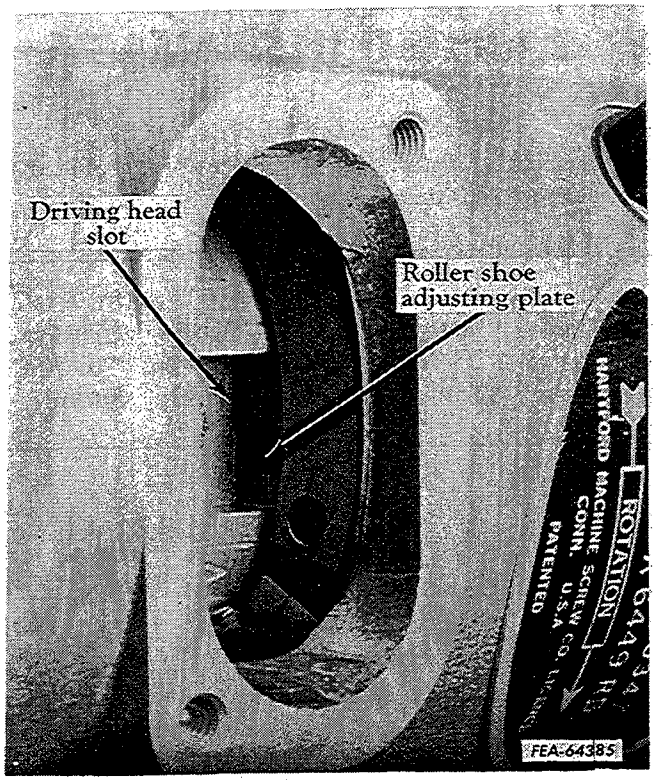
Maximum Fuel

1. Close the fuel cock at the fuel tank.

2. Remove the part number plate, inspection cover and gasket from the pump and drain the fuel.

3. Rotate the engine crankshaft clockwise as viewed from the front of the tractor, until the slot in the driving head is in position as shown in Illust. 48 (about 4 o'clock).

4. Loosen the two capscrews which secure the driving head to the rotor using a 5/16 inch 12 point straight shank, box end wrench.



Illust. 48. Rotor position for making maximum fuel adjustment.

NOTE: The roller shoe adjusting plates are now free and ready for adjustment.

5. Insert a small tool, such as a pin punch, screwdriver or allen wrench, through the inspection cover opening and engage the small slot in the roller shoe adjusting plate (inner black ring).

NOTE: Very small movement of the ring is required to change maximum fuel delivery.

Fuel delivery is increased by rotating the adjusting plate downward (direction of pump rotation as indicated by the arrow on the serial number plate). Decrease fuel delivery by rotating the plate in the opposite direction.

6. Tighten the drive plate capscrews to 125 inch pounds torque. (Approximately 31 lbs. pull on a spring scale hooked perpendicular to the end of a wrench 4 inches long.)

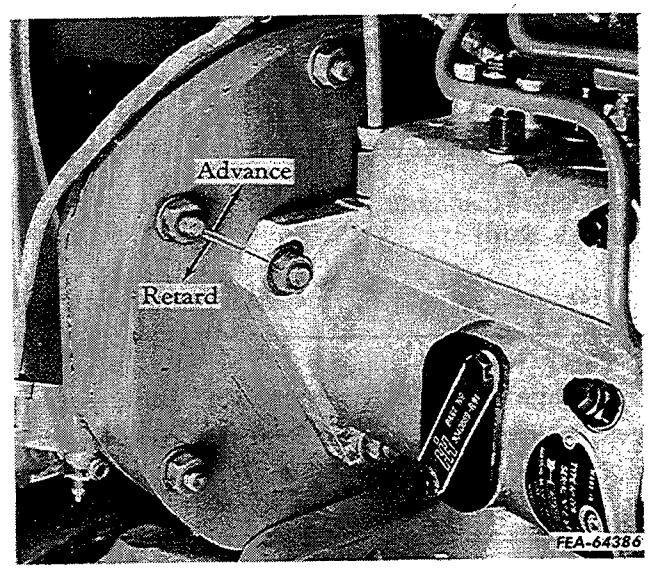
7. Install the gasket, inspection cover, part number plate and capscrews on the housing. Tighten the capscrews securely.

8. Vent the fuel system as outlined on page 7.

9. Start and operate engine to check results of adjustment. Readjust if necessary by repeating steps 1 through 8. Install and lock seal wire to the inspection cover capscrews.

10. Maximum fuel delivery is correct for existing conditions when medium exhaust smoke is visible when the engine is loaded to maximum torque speed.

Pump Timing to Engine



Illust. 49. Pump timing marks.

The injection pump has a single scribe mark on the pump mounting flange (Illust. 49). For normal timing this mark is located midway between two scribe marks on the engine front cover plate. Movement of the pump flange mark between the two marks on the front plate gives a variation of three (3) degrees. In some cases the scribe marks are not clear, therefore, should it be necessary to remove the injection pump from the tractor it is recommended that all three scribe lines be marked clearly before the pump is removed.

EFFECTS OF PUMP TIMING AND ADJUSTMENTS

Normal pump timing and adjustment results in a compromise between engine noise, power, color of exhaust and fuel consumption. The following chart shows the results of normal setting as well as results of deviating from the normal setting.

Settings	Engine Noise	Fuel Consumption	Horse Power at Rated Speed	Maximum Torque (Horse Power)	Smoke (At Rated Speed)	Smoke (At Max. Torque Speed)
Pump Timing						
Normal	normal	normal	normal	normal	light	medium
Advance (1-1/2°)	increase	slight decrease	slight decrease	decrease	light	medium
Retard (1-1/2°)	decrease	slight increase	increase	increase	light	medium
Governor Linkage (Hook Rod)						
Normal	normal	normal	normal	normal	light	medium
Longer (1/32")	normal	slight increase	increase	increase	medium light	medium
Shorter (1/32")	normal	slight decrease	decrease	decrease	very light	medium light
Maximum Fuel						
Normal	normal	normal	normal	normal	light	medium
Increase (1/32")	normal	no effect at rated	normal	increase	light	black
Increase (1/32")	normal	increase at max. torque	normal	increase	light	black
Decrease (1/32")	normal	no effect at rated	normal	decrease	light	medium light
Decrease (1/32")	normal	decrease at max. torque	normal	decrease	light	medium light

ENGINE—PTO RATIO CHART

The following chart is a guide to assist servicemen in performing proper Pre-delivery and Testing service.

SPEEDS	B-275	TD-5	B-414	3414
Maximum Idle Speed				
Engine crankshaft	2000	2200	2200	2200
Power take-off	593	1077	600	600
Rated Speed				
Engine crankshaft	1900	2000	2000	2000
Power take-off	563	979	545	545
Maximum Torque Speed				
Engine crankshaft	1300	1300	1400	1400
Power take-off	385	636	382	382
Minimum Idle Speed				
Engine crankshaft	550	550	550	550
Power take-off	163	269	150	150

The following formulas may be used to calculate speeds other than those shown above.

B-275	TD-5	B-414 and 3414
$\frac{\text{Crankshaft speed} \times 16}{54} = \text{PTO speed}$	$\frac{\text{Crankshaft Speed} \times 23}{47} = \text{PTO speed}$	$\frac{\text{Crankshaft Speed} \times 15}{55} = \text{PTO speed}$

TESTING

Transfer Pump Pressure

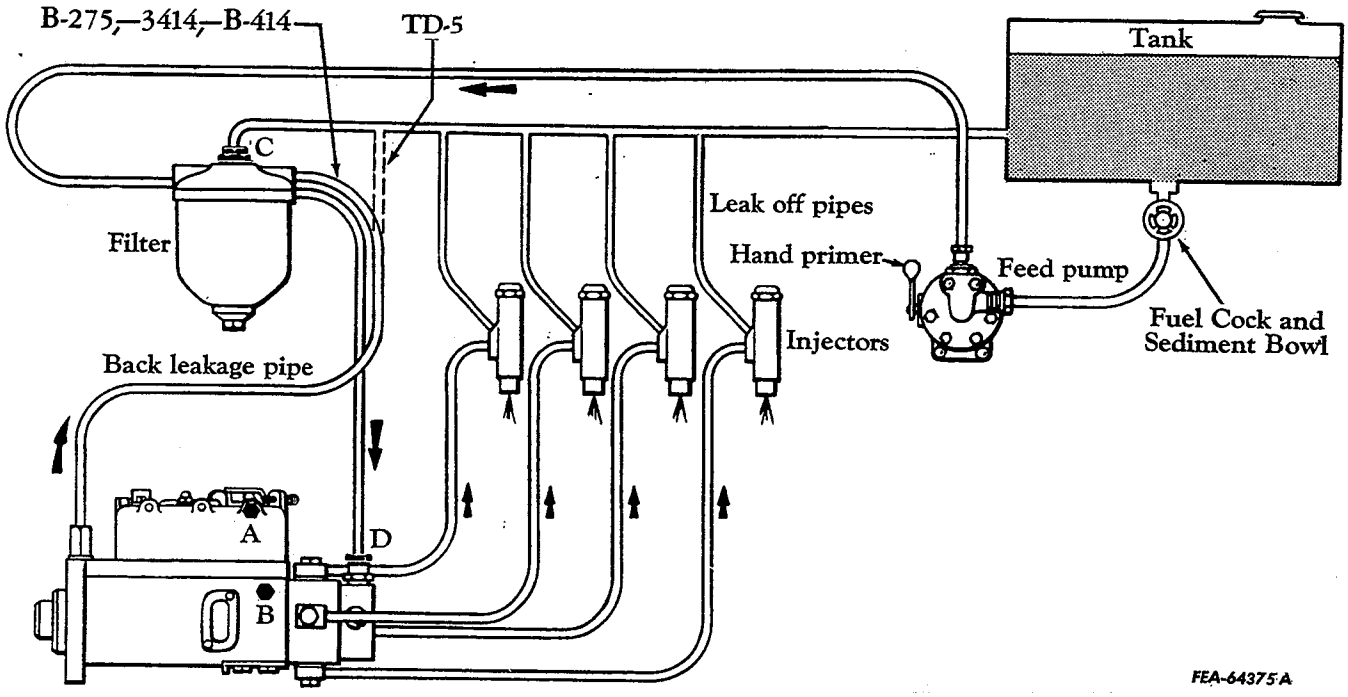
(Refer to Illust. 50.)

1. Remove the hydraulic head locking screw (with vent screw) "B" from injection pump housing.

2. Install adapter FES-4-16 with gasket and compound gauge. Vent air from pump before securing pressure gauge.

3. Vent governor cover at "A".

4. With hand throttle lever in low idle position and fuel shut-off lever in the off position, disengage engine clutch, crank engine and observe pressure reading on gauge. Specified pressure is a minimum of 5 psi.



Illust. 50. Fuel system schematic.

5. Leave hand lever in low idle position. Place fuel shut-off lever in run position. Start the engine and observe gauge reading. Specified reading is 16-39 psi.

6. Specified pressure at rated speed is 38-51 psi.

Feed Pump Static Pressure

1. Disconnect feed pump to filter fuel line at the feed pump.

2. Install adapter FES-4-15 with gaskets and low pressure gauge.

3. Vent fuel system. Refer to page 7.

4. Start and run engine for approximately one minute.

5. Stop the engine and observe static pressure reading on gauge. Specified pressure is 6-10 psi.

Transfer Pump Vacuum

This test to be performed only when transfer pump pressure test proves unsatisfactory.

1. Close the fuel cock at the fuel tank.

2. Remove the filter to transfer pump fuel line. Install a compound gauge and adapter FES-4-14 in the fuel inlet connection "D", (Illust. 1). Fuel line can be re-connected to filter for spill line.

3. With the hand throttle lever in the full throttle position and the fuel shut-off lever in the run position, disengage the engine clutch, start the engine and observe the reading on the gauge. A vacuum of 10-15 inches Hg. should be developed before engine stalls.

NOTE: Fuel system must be vented after completion of this test. Refer to page 7 for venting procedure.

NOZZLE SERVICE

Principles of Operation (Illusts. 51 and 52.)

The engine must receive each charge of fuel in such condition that it can be completely consumed. It is the function of the injection nozzle to meet this condition.

The injection nozzle is positioned in the cylinder head by the nozzle holder and injects fuel directly into the pre-combustion chamber. The pintle type nozzle has the desirable feature of being self-cleaning in action, which extends the injector service periods. The outer end of the valve is extended to form a pintle, the dimensions of which govern the spray form. The spray cone atomizes the diesel fuel, resulting in efficient combustion and maximum engine performance.

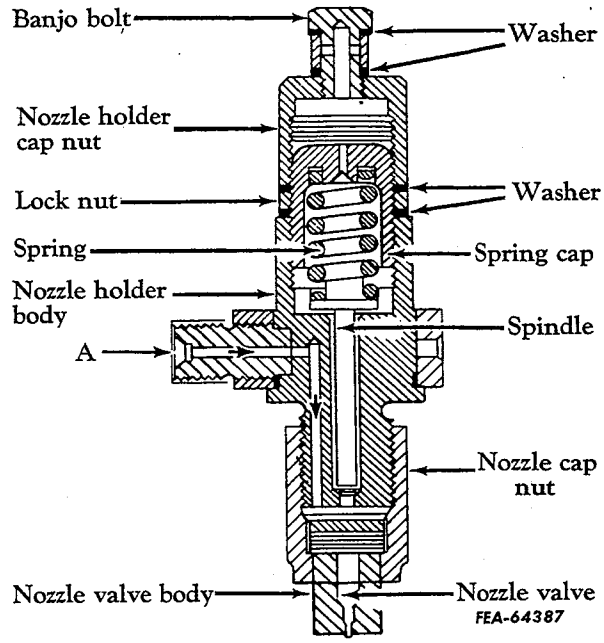
The pintle nozzle is closed after each injection.

An adjustable spring cap threaded into the nozzle holder body compresses the spring against the spindle which forces the nozzle valve against its seat in the nozzle valve body. This spring tension determines the opening pressure of the nozzle valve.

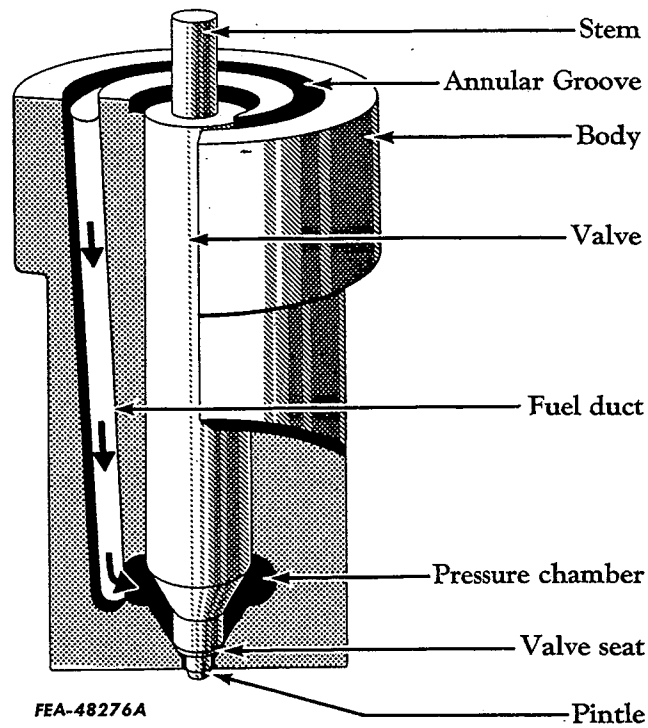
The lock nut secures the spring cap in its adjusted position.

The nozzle valve is precision lap fitted to the nozzle valve body. This close fit determines the back leakage of the nozzle valve and accurately guides the valve to its seat. The nozzle cap nut secures the nozzle valve body to the nozzle holder body.

The nozzle holder cap nut and banjo bolt receives and directs back leakage fuel to the return line. Copper washers provide a seal against fuel leakage and entry of foreign materials.



Illust. 51. Cross section of injection nozzle assembly.



Illust. 52. Cross section of injection nozzle.

Fuel is fed through the inlet connection "A" (Illust. 51) by way of drillings in the nozzle holder to the annular groove on the face of the nozzle body. The fuel is then fed through drillings in the nozzle body (fuel duct) to the pressure chamber just above the nozzle seat. The pressure of fuel from the injection pump, acting in the fuel already present in the annular groove, fuel duct and pressure chamber, exerts pressure on the nozzle valve, lifting it off its seat to allow fuel to be forced under high pressure into the pre-combustion chamber.

If the injection nozzle does not function properly, the fine adjustments and care given to the injection pump can be defeated at this stage of the fuel system.

Testing

NOTE: The isolating or check valve in the test equipment must be closed at all times except when taking pressure readings during the following tests. Sharp pressure fluctuations caused by pumping impose a high shock loading on the gauge mechanism.

CAUTION: When a nozzle is spraying during any of the following tests, the nozzle holder must be turned away from the operator. The spray has a very great penetrating power and the hands must not be brought into contact with it.

To be satisfactory a nozzle must have the following main characteristics.

1. Pressure tight seats.

2. Freedom from excessive back leakage.

3. Satisfactory spray form or atomization.

4. Correct opening pressure.

Before a nozzle is disassembled, it should be checked for the correct opening pressure range. After reassembly and before installation, the nozzle opening pressure should again be checked.

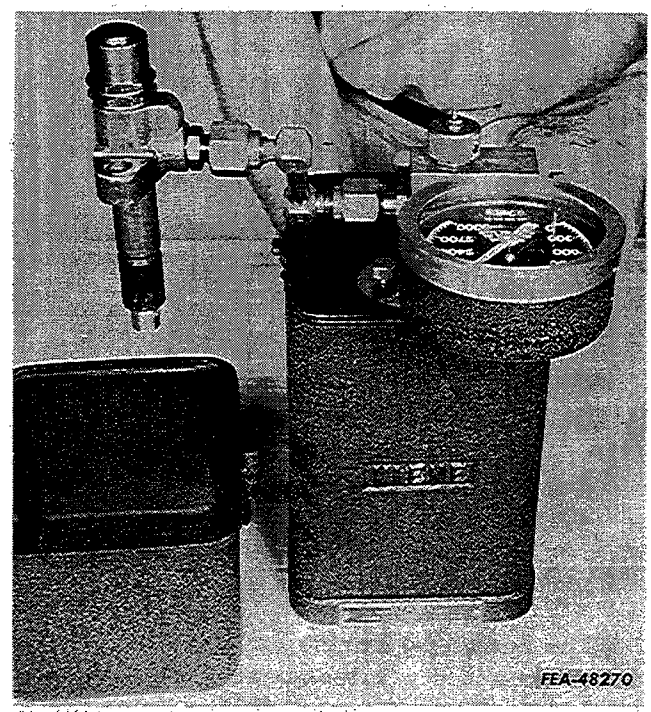
NOTE: To obtain a true indication of nozzle performance during the following tests, the fuel used in the test must be pure and clean.

Connect the nozzle to suitable hand operated equipment, one type shown in Illust. 53 using two C-4 nuts and a C-2 adapter, from the Kiene tester. The gauge must record up to 2500 psi.

With the nozzle connected and the check valve closed, pump several times quickly to flush out the nozzle passages and seat. Normally this will remove any small particles trapped between the valve and seat that might impair the efficiency of the nozzle.

Opening Pressure Test

After flushing the nozzle, open the check valve, allow the pressure to escape. Then pump the handle to raise the pressure steadily and observe the gauge pressure at which the valve opens. The opening pressure should be 2350 to 2425 psi.



Illust. 53. Testing nozzle opening pressure.

Seat Leakage Test

To check the tightness of the seat, first atomize the nozzle two or three times. Open the check valve and wipe the nozzle dry. Pump up the pressure to within 150 psi below the opening pressure and hold for 10 seconds and examine the face for leakage. There should be no leakage, however, a slight dampness will be present at the orifice due to the capillary action of the fuel below the seat.

Atomization and Dispersion

To check the spray formation and atomization efficiency with the hand lever type of equipment, operate the hand lever slowly. The nozzle should buzz or chatter with an evenly distributed spray free from irregular streaks. The spray must not be solid or streaky, and it must issue squarely from the nozzle face. As mentioned previously, this type of check gives only an approximate indication of nozzle performance.

Back Leakage Test

The test specifications for used injection nozzles may vary for back leakage. To check the back leakage, pump up the pressure to above 1500 psi and record the time required for the pressure to drop from 1500 psi to 1100 psi. A nozzle in good condition should not lose this pressure in less than ten seconds at 60°F. At higher temperatures a lower figure may be obtained.

Observe that no leakage occurs at the lapped pressure faces of the nozzle holder and nozzle. Leakage may be external (visible at the nozzle cap nut screw thread) or internal. In the latter case, it cannot be readily distinguished from excessive leakage past the journal and guide of the valve. Do not overtighten the cap nut to correct leakage at the lapped joint. Instead, remove the nozzle and recheck the pressure faces for signs of dirt or surface imperfections. Clean thoroughly and retest. If the pressure drop time is still low, excessive leakage past the journal and guide of the valve is indicated.

NOTE: Before removing the nozzle holder from the test equipment, slowly release the fuel pressure to prevent damage to the gauge due to a sudden pressure drop.

Disassembly (Ref. No's. Refer to Illust. 54.)

Cleanliness cannot be overstressed when working on any part of the fuel injection system. The close tolerances maintained in pumps and nozzles are to ensure long life and efficient operation. They become adversely affected by the entry of minute particles of grit, metal, or soft material which prevents the valve and other parts from functioning properly. A work bench suitable for nozzle maintenance should be absolutely free from dust, dirt, metal filings, grease, and acids. Cotton waste and fluffy rags should not be used around this bench. It should be provided with a small vise, with the jaws protected and a dust proof drawer for holding special nozzle cleaning tools.

1. Install the nozzle in a vise. Clamp the retaining flange only, being sure not to damage or distort the holder.

2. Remove the nozzle holder cap nut (3), lock nut (5) and spring cap (6).

3. Remove the spring (7) and spindle (8).

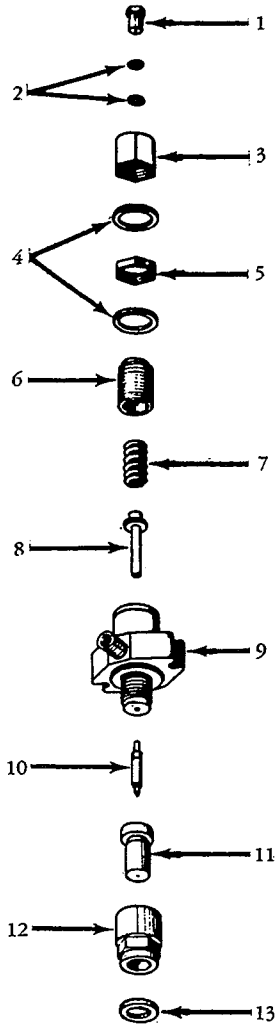
4. Remove the nozzle cap nut (12), nozzle valve body (11), and the nozzle valve (10) as an assembly.

5. Soak the nut, body and valve assembly in "Gunk" for several minutes to dissolve carbon and varnish.

6. Remove the valve from the valve body if it will slide out easily.

7. Remove the cap nut (12) from the body (11).

NOTE: If the valve body sticks to the cap nut, removal can be accomplished by additional soaking or by tapping the valve body from the nut using a plastic head hammer and driver (FES-5-4) as shown in Illust. 55. A wooden dowel or brass rod

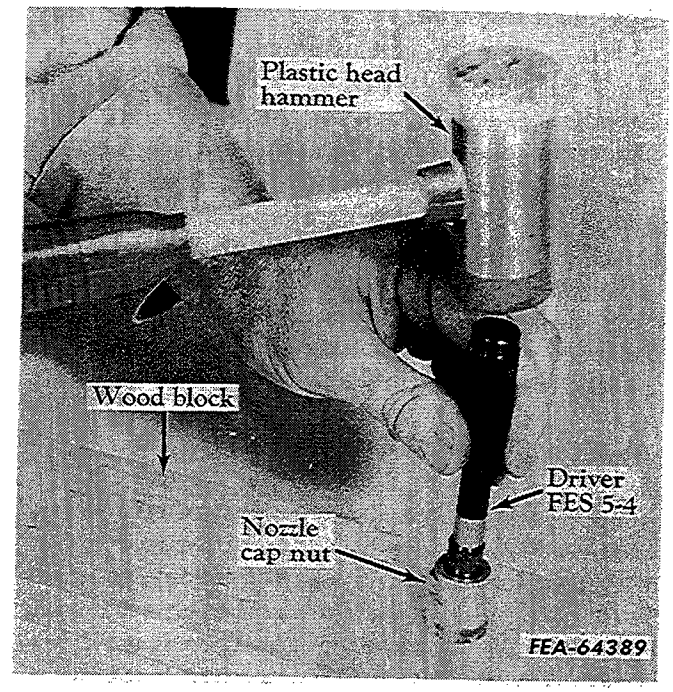


Illust. 54. Exploded view of injection nozzle.

1. Banjo bolt.
2. Washer.
3. Nozzle holder cap nut.
4. Washer.
5. Lock nut.
6. Spring cap.
7. Spring.
8. Spindle.
9. Nozzle holder body.
10. Nozzle valve.
11. Nozzle valve body.
12. Nozzle cap nut.
13. Washer

with recessed end can be used in place of the driver shown.

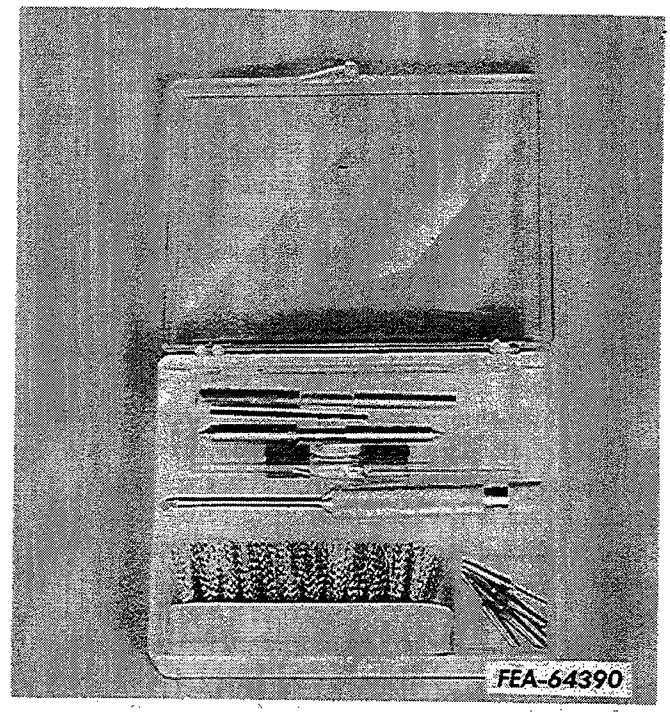
8. Place the valve and valve body on a clean cloth in a pan of clean diesel fuel.



Illust. 55. Driving valve body from nozzle cap nut.

Cleaning and Inspection

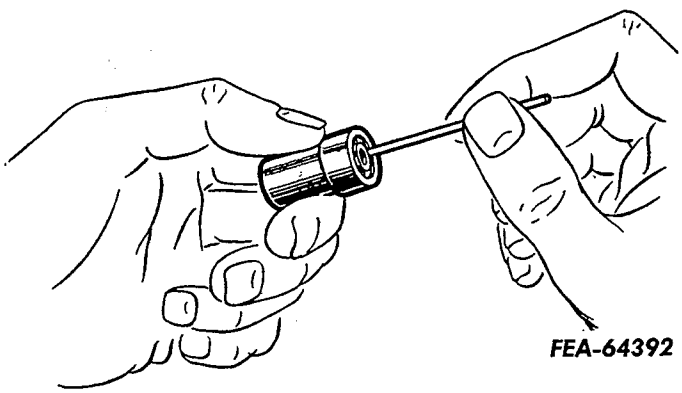
(Use Nozzle Cleaning Kit, Number FES-19-9.)



Illust. 56. Nozzle cleaning kit.

Illust. 57. Cleaning and polishing valve body (orifice end).

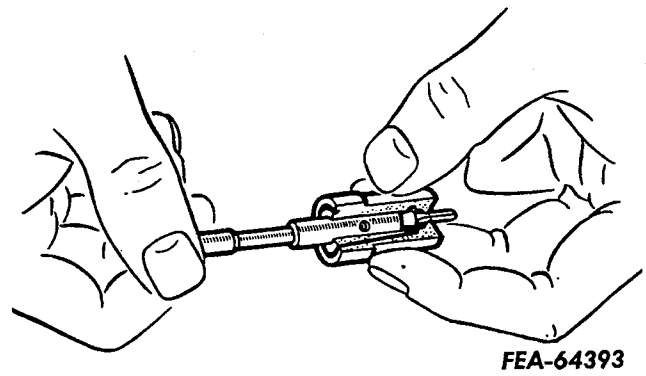
1. Rinse the pintle valve body in diesel fuel to remove gunk. Dip bristles of brass wire brush in diesel fuel. Brush valve body sufficiently to clean and polish it. (Illust. 57.) Particular attention is directed to the orifice end. Rinse in diesel fuel.



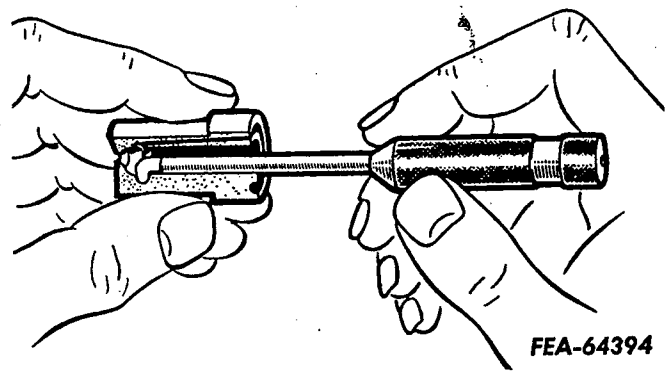
Illust. 58. Drill cleaning of fuel duct.

2. Clean the nozzle valve body bores with the drill provided in the Nozzle Cleaning Kit. These bores seldom become blocked. Rinse in diesel fuel. (See Illust. 58.)

3. Clean orifice in valve body using probe and holder as shown in Illust. 59. Turn holder and probe in a rotary motion until orifice is clean. Rinse in diesel fuel.

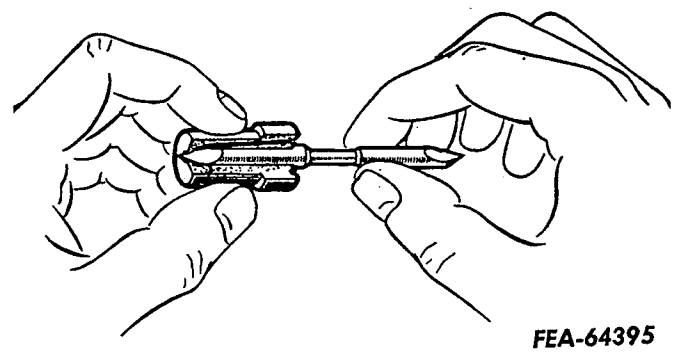


Illust. 59. Cleaning pintle orifice in valve body.



Illust. 60. Cleaning fuel pressure chamber.

4. Insert pressure chamber groove scraper into position as shown in Illust. 60. Press scraper against inside of valve body and rotate to remove carbon. Rinse in diesel fuel.

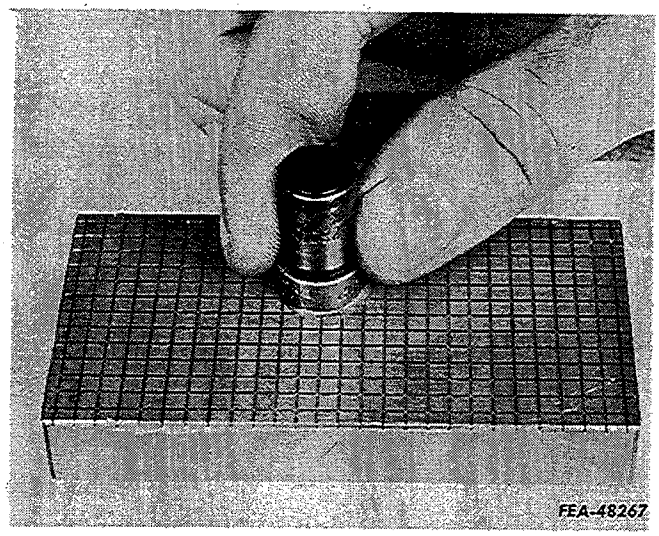


Illust. 61. Cleaning valve seat in valve body.

5. Insert seat cleaning tool against seat in valve body as shown in Illust. 61 and rotate to remove carbon. Rinse in diesel fuel.

6. If the upper end of the valve body and the lower end of the nozzle holder body require additional service to provide proper sealing proceed as follows:

(a) Use lapping plate No. FES-19-1 coated with mutton tallow.

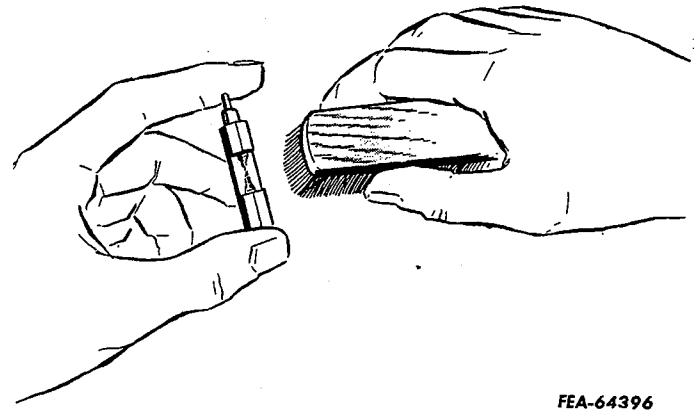


Illust. 62. Cleaning the lapped surface of the nozzle body.

(b) Place the lapped surface of the valve body on the lapping plate as shown in Illust. 62, and move in a circular motion being careful to hold even pressure on the valve body so that the entire surface will make contact. This cleaning operation will remove carbon or discoloration and leave a mirror finish. Scratches, nicks or pitting cannot be removed and may cause leakage.

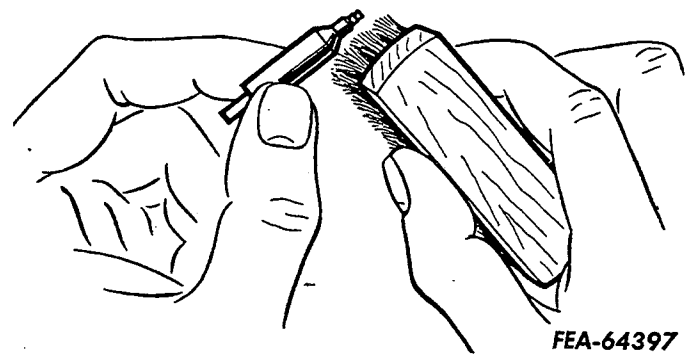
(c) The nozzle holder body can be lapped as described in step (b).

7. Dip the valve and valve holder tool in clean diesel fuel. Slide the valve into the holder tool and remove carbon from



Illust. 63. Removing carbon from valve.

the valve by brushing it with the brass wire brush. Rotate the valve in the holder while brushing until the entire pintle and seat on the valve is free of carbon.



Illust. 64. Cleaning and polishing valve and pintle.

8. Dip the valve and brass wire brush in diesel fuel. Gently polish the valve and pintle as shown in Illust. 64. It is important to be extremely careful with the valve and pintle to prevent damage. A scratch or burr may cause valve leakage or spray distortion. Clean in diesel fuel.

9. If additional cleaning and polishing of the valve and valve seat is required, proceed as follows:

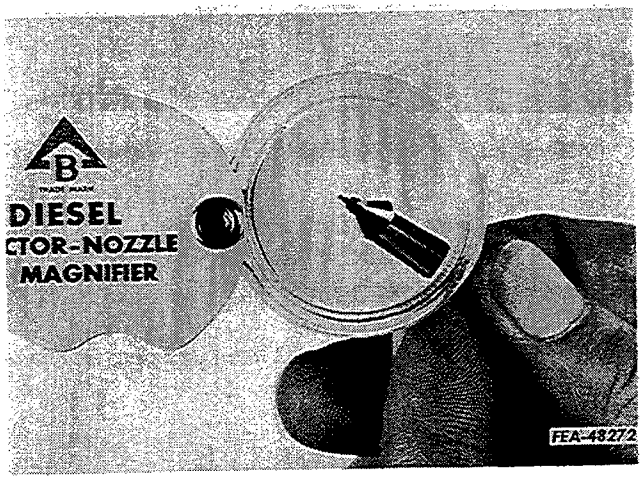
(a) Apply a very small amount of No. 400 lapping compound to the valve or seat.

(b) Insert the valve into the body against the seat.

(c) Rotate the valve against the seat while applying very light pressure.

NOTE: Be sure to keep lapping compound away from the pintle. Any lapping action to the pintle will destroy its fit.

(d) Remove the valve and thoroughly wash both parts in diesel fuel to remove all compound.

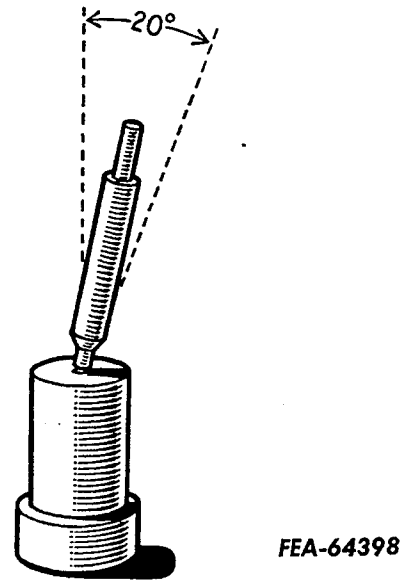


Illust. 65. Inspecting the nozzle under a magnifier.

10. Inspect the nozzle valve seat under a good magnifying glass for indication of a damaged seat. See Illust. 65. Check the lapped surface of the valve for scoring and scratches. If the valve seat is damaged the nozzle should be replaced. If the valve is satisfactory, place it on a clean cloth in a pan of clean diesel fuel.

11. Examine the fit of the nozzle valve stem to the guide bore in the nozzle valve holder.

NOTE: A good fit is essential as the clearance governs the degree of back leakage. The needle must be able to move freely yet not permit excessive back leakage. Too close a fit can result in seizure.



Illust. 66. Checking wear and alignment of the valve pintle.

Examine the clearance between the pintle and the spray hole. With the valve stem removed, reversed, and the pintle inserted into the spray hole, it should not tilt at greater than 20° from the axis of the spray bore.

If the nozzles meet the above inspection requirements, the nozzles can be reassembled.

Reassembly

Assemble the nozzle valve holder and nozzle valve after immersing in No. 2 diesel fuel to the nozzle holder body. Tighten the nozzle cap nut to a torque of 50 foot-pounds. Be careful not to overtighten as this may cause distortion and needle seizure.

Install the spindle assembly (8), spring (7), spring cap (6), new copper washer (4) and lock nut (5). See Illust. 54.

Adjustments and Final Testing

1. Connect the nozzle to the hand operated test pump as previously described.

2. Start with the spring cap screwed well out.

3. Thoroughly flush the nozzle assembly.

4. Slowly increase the opening pressure by screwing the spring cap clockwise while continuing the flushing. (Illust. 67.) This gradual buildup, to the specified opening pressure, aids in establishing a good sealing surface.

5. If the opening pressure is satisfactory, check the seat leakage, atomization and dispersion, and back leakage as previously described in the initial testing.

6. If the nozzle proves satisfactory complete the assembly by installing a new washer and nozzle holder cap nut.

Illust. 67. Adjusting nozzle opening pressure.

7. If the nozzle is to be stored, smear the orifice end of the valve body lightly with vaseline before packing.

8. Refer to GSS-1242 for proper installation of the nozzles.

GSS-1364

CHASSIS

500 Series Crawler Tractors

OCTOBER 1965

Includes Supplement
February 1967

FOREWORD

The instructions and special tools shown in this Blue Ribbon Service Manual are for use by International Harvester Dealers and their factory trained servicemen.

The specifications as listed in this manual are current as of the printing date. Due to changes and improvements in our products, dealers are periodically issued service bulletins to keep this manual up-to-date. We suggest you refer to the most recent information when performing service work on this equipment.

International Harvester Factory Trained servicemen are best qualified to service I.H. equipment.

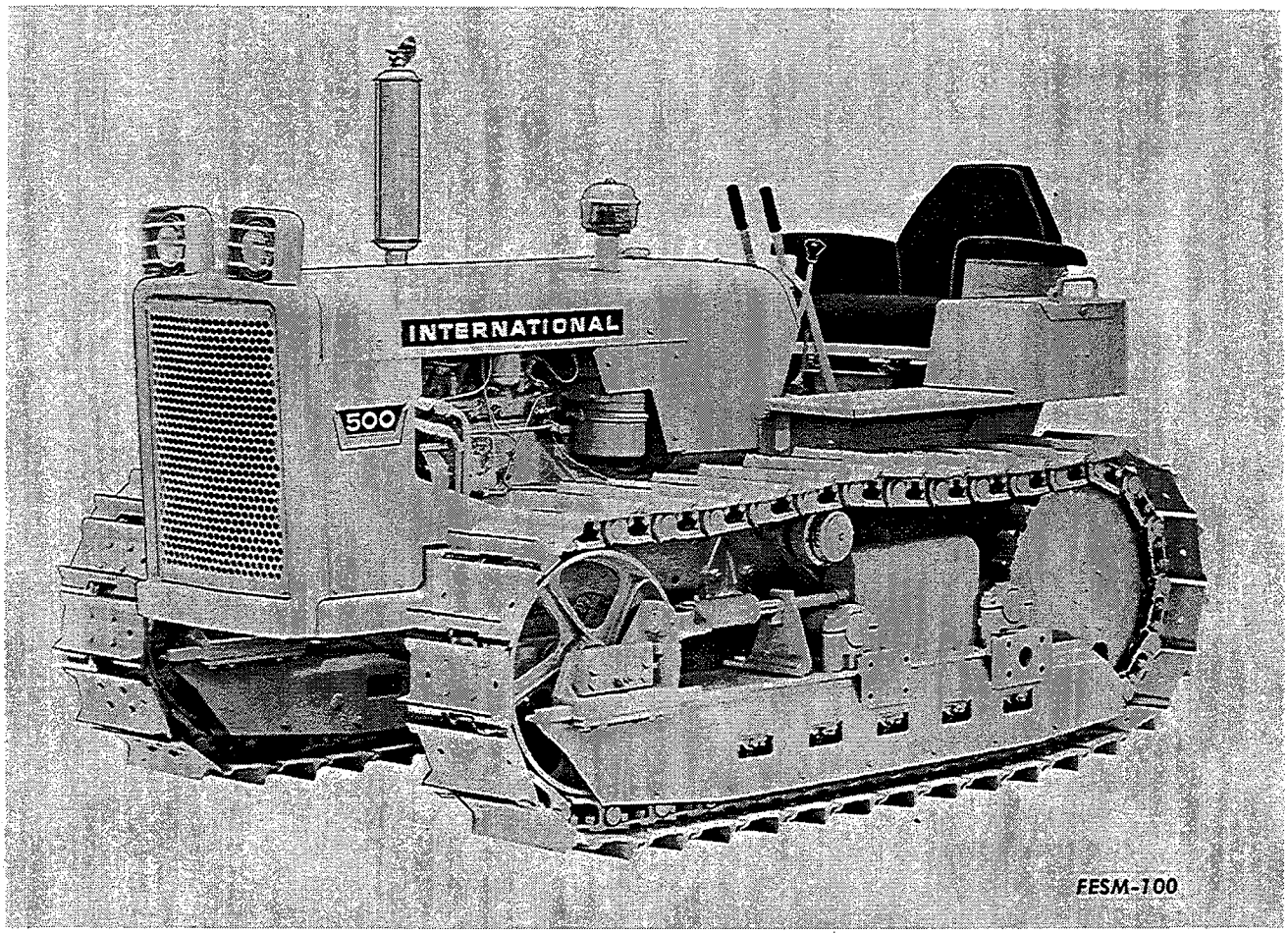
IMPORTANT NOTE

Always read each step in its entirety before starting to perform it. Necessarily, some vital information may come at the middle or end of the description of a step. Much time can be saved, and damage to parts avoided, if the procedure is studied before work commences.

LIBRARY FILING INFORMATION

1. File this Manual in Book 13 after Divider Tab GSS-1364.
2. Enter the following information in the Service Manual Index.

   In the Tractor Chassis Section, on page 23, print or preferably type in, the Manual Description, Form Number, and the Book filed in.



500 CRAWLER

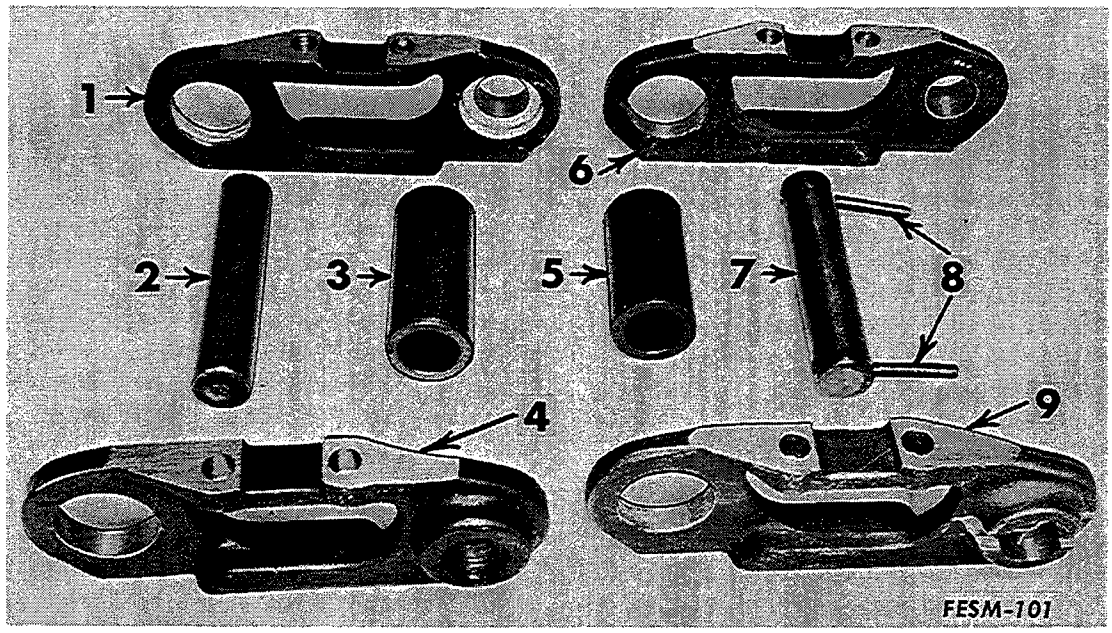
CONTENTS

CONTENTS

SPECIFICATIONS

Track Chain Sag	1.25" - 1.50"
Track Chain Link Pin Diameter	1.121" - 1.125"
Track Chain Link Master Pin Diameter	1.1095" - 1.111"
Track Chain Link Bushing:—	
O.D.	1.675" - 1.679"
I.D.	1.130" - 1.139"
Track Chain Pitch Length (distance between centre of pins)	6.000"
Maximum Permissible Pitch Length	6.100"
Side Clearance Between Track Links	.030"
Front Idler Shaft Diameter	1.981" - 1.982"
Front Idler Bushing I.D. (after assembly)	1.985" - 1.987"
Front Idler Running Clearance	.003" - .006"
Front Idler Thrust Washer Thickness	.185" - .220"
Front Idler Rolling Diameter	20.50"
Front Idler Support Rod Diameter	1.25"
Front Idler Rod Bore (in support)	1.01" - 1.02"
Track Idler Shaft Diameter	1.981" - 1.982"
Track Idler Bore Diameter	2.124" - 2.126"
Track Idler Thrust Washer Thickness	.185" - .220"
Track Roller Shaft Diameter	1.981" - 1.982"
Track Roller Bushing I.D. (after assembly)	1.985" - 1.987"
Track Roller Running Clearance	.003" - .006"
Track Roller Thrust Washer Thickness	.185" - .220"
Track Roller End Clearance	.011" - .020"
Track Springs:—	
Free Length	21.12"
Test Length	16"
Test Load (per Spring)	4717 lbs.
Special Torque Data (lubricated with SAE-30):—(Foot Pounds)	
Track Shoe Bolts	90
Front Idler Shaft Nut	500
Front Idler Support Bolts	320
Gauge Bar Mounting Pad Capscrew	180
Final Drive Gauge Bar Stop Bolts	90
Gauge Bar Bracket Nuts	180
Track Roller Bracket Bolts	85 - 95
Front Idler — Top Idler — Track Roller — Thrust Plate Capscrews	20 - 23

TRACK CHAINS



Illust. 1. Interlocking type track chain.

1. Regular link (left)
2. Regular link bushing
3. Regular link bushing
4. Regular link (right)
5. Master link bushing
6. Master link (left)
7. Master link pin
8. Roll pins
9. Master link (right)

Description

The track chain consist of drop-forged, heat-treated steel links which are held together by bushings and pins to form a continuous interlocking type chain as shown in Illust. 1. The pin locates the outer end of the links and the bushing the inner end of the links. The outer links are recessed to pocket the bushing. This recessing feature adds to chain life by adding rigidity to the assembly plus protecting the bushing from easy entrance of dirt into the area surrounding the pin.

The bushings and pins are a press fit in the links, with the pins pivoting inside the bushings. The left and right track chains are interchangeable. The track chains are easily removed. Each track chain has a master pin which can be identified by a roll pin. The track shoes are attached to the track links and they are held in place with special heat-treated capscrews and nuts.

Maintenance

The track links have only the rail or wearing surface which contact the track rollers, front idler and track idler. However, it usually becomes necessary to replace the pins and bushings before the links wear out, and it is a matter of judgment then whether the links are good enough to justify a new set of pins and bushings.

Only the wear on the outside of the bushings is visible. Wear on the pins and interior of the bushings is indicated by track chain "stretch" (forward adjustment of the front idler). The amount of wear can be determined by measuring the pitch length of the track (distance between

centers of pins) under tension and comparing it with the new pitch length 6.000 inch and the maximum allowable pitch length 6.100 inch.

Sprocket wear must also be considered in conjunction with track chain wear. Wear of pins and bushings increases the pitch length of the track chain. The results are, that the pitch lengths of the sprocket and track chain become more and more out-of-phase and the bushings ride higher on the sprocket. The track chains should never be allowed to reach this point, as spinning of the sprocket may result in serious breakage.

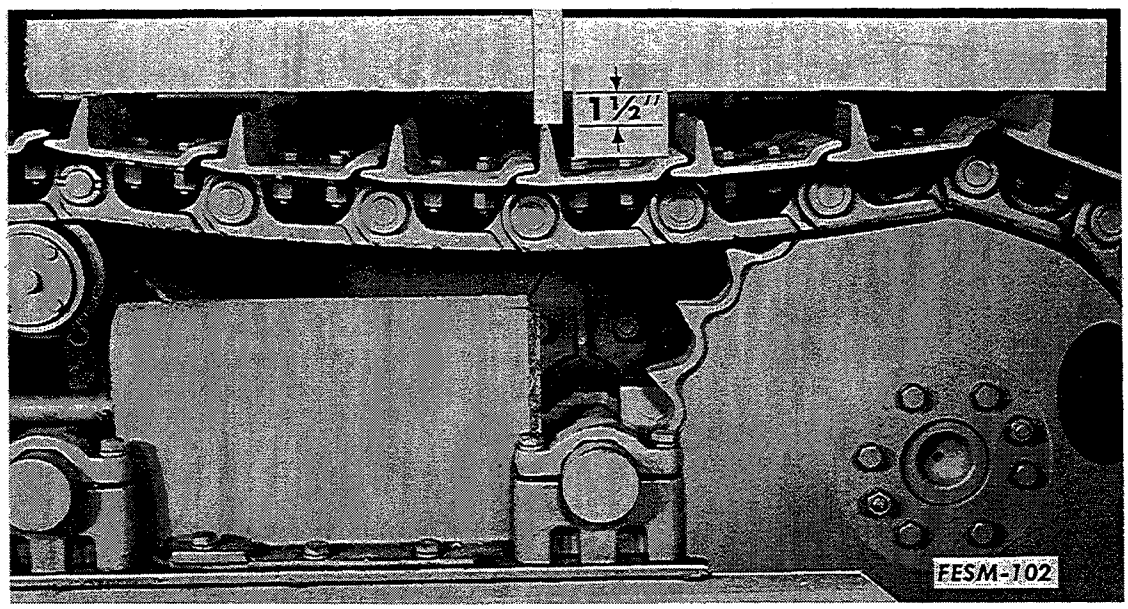
Whenever new or rebuilt track chains are installed, the sprockets should also be replaced or interchanged side for side to present the least worn side of the teeth to the bushing. Links should never be removed to bring a "stretched" track chain within the adjustable range. Pins and bushing may be turned - See page 12.

A track chain worn 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 offset the saving obtained by the small addition to the life of the track chain.

Checking Track Chain Tension

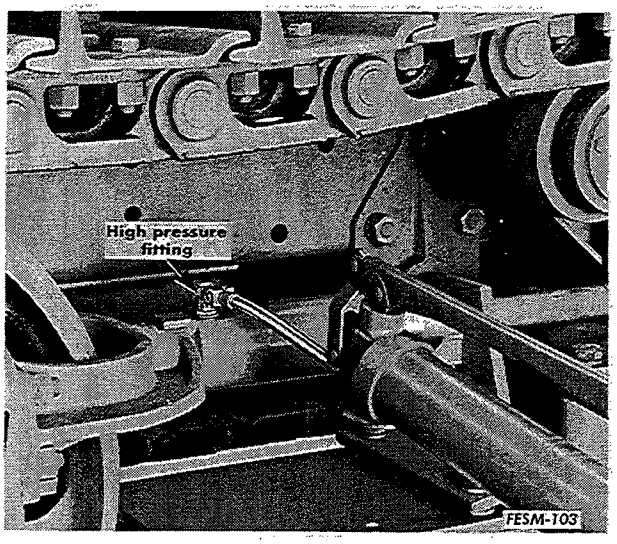
Place a wooden block, approximately one foot (1 ft.) in height, under the foremost track shoe grouser lug. Drive the tractor slowly forward until the track chain just starts to climb the block; then apply and lock the steering brakes and stop the engine. This will remove the slack from the bottom of the track chain. Push the top of the track chain down between the rear sprocket and the track idler.

Place a long straight edge or board on top of the track chain so each end of the straight edge rests on the track chain over the track idler and rear sprocket. With a rule, measure the clearance between the bottom of the straight edge and the top of the grouser nearest to the midway point between the track idler and rear sprocket. See Illust. 2. This clearance should be 1-1/4" to 1-1/2". If the clearance is more or less than this measurement, the track chain tension should be adjusted.



Illust. 2. Checking track chain tension.

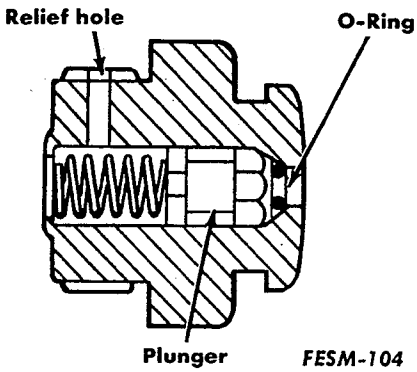
Adjusting Track Chain Tension



Illust. 3. Adjusting track chain tension.

Hydraulic

To adjust track chain tension, position a grease gun on the high pressure fitting which is located on the upperside of the hydraulic track adjuster cylinder, and force in sufficient lubricant to correct chain tension (Illust. 3). If the track chain is too tight loosen the fitting slightly. This will allow the fluid to escape through the relief hole in the threaded portion of the fitting (Illust. 4). Do not remove the fitting until the pressure is completely released.



Illust. 4. High pressure fitting.

Only a high pressure fitting with straight threads should be used in this track adjuster cylinder. Do not use a fitting from a roller or idler which is not a high pressure fitting, as it will destroy the threads in the adjuster cylinder. The tractor should be moved forward and back during adjustment. Recheck track chain tension.

Mechanical

Remove the capscrew which locks the adjuster in position. Screw the idler adjusting rod in or out which moves the front idler either tightening or loosening the chain.

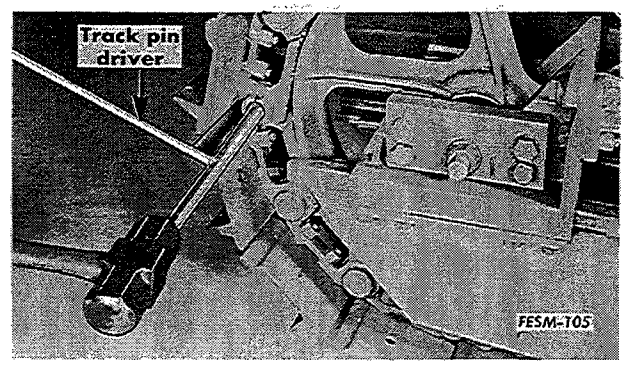
Track Shoe Capscrews

On a new track chain, the track shoe capscrew nuts must be checked after each day's operation until it becomes evident that the bolts have become permanently set. The track shoe capscrews torque setting is 90 ft. lbs. Strike the heads of the capscrews several heavy blows during torquing. The special capscrews are heat-treated to withstand strain. Do not attempt to use common capscrews in the track shoes.

Removal

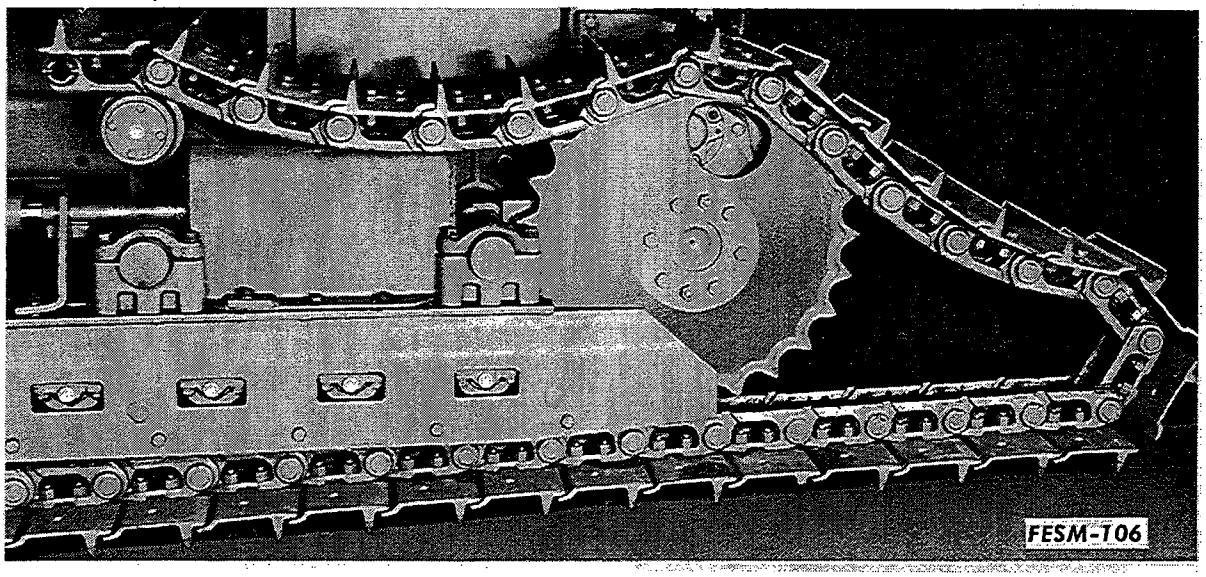
1. Drive the tractor forward on level ground until the master link pin (identified by a roll pin) is in front of the front idler.

2. Loosen the track chain tension. Refer to "Adjusting Track Chain Tension", on this page.

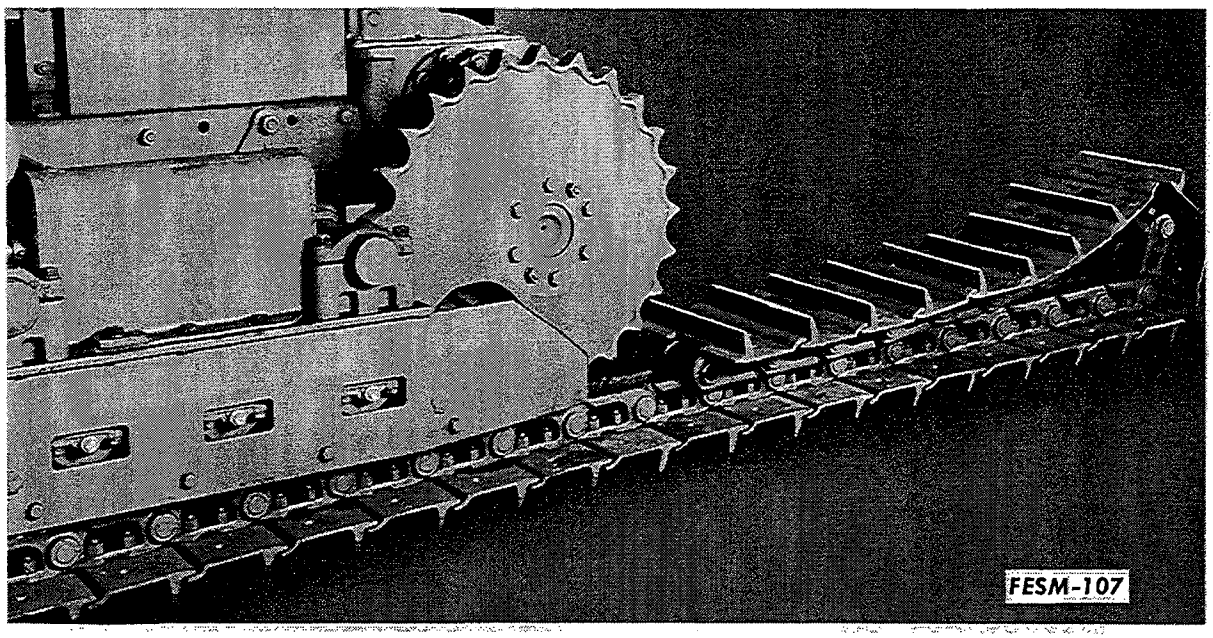


Illust. 5. Removing master pin.

3. Remove the roll pin from the master link pin and using a heavy track pin-driver and sledge, drive out the master link pin. (Illust. 5).



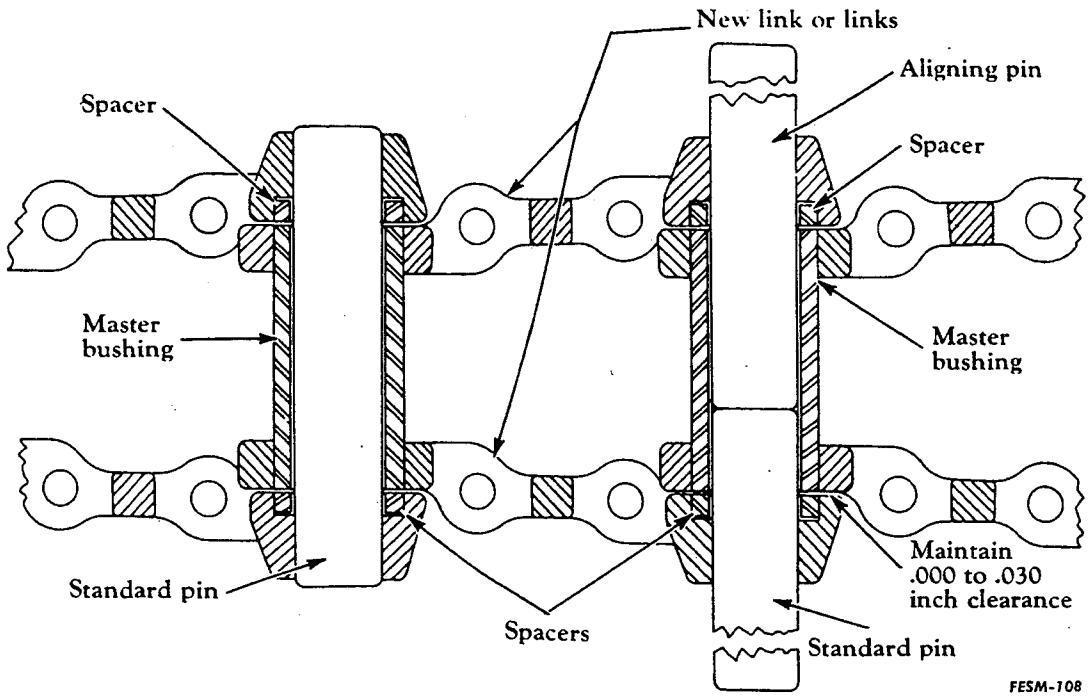
Illust. 6. Removing track chain assembly.



Illust. 6A. Removing track chain assembly.

4. Jack the tractor up until the rollers are clear of the chain. Place the tractor in reverse. Holding steering clutch back to brake position on the chain not being removed, slowly ease the clutch out feeding the chain off of the sprocket as shown in Illust. 6 and 6A, drag the track out from under the track frame.

Track Chain Repair



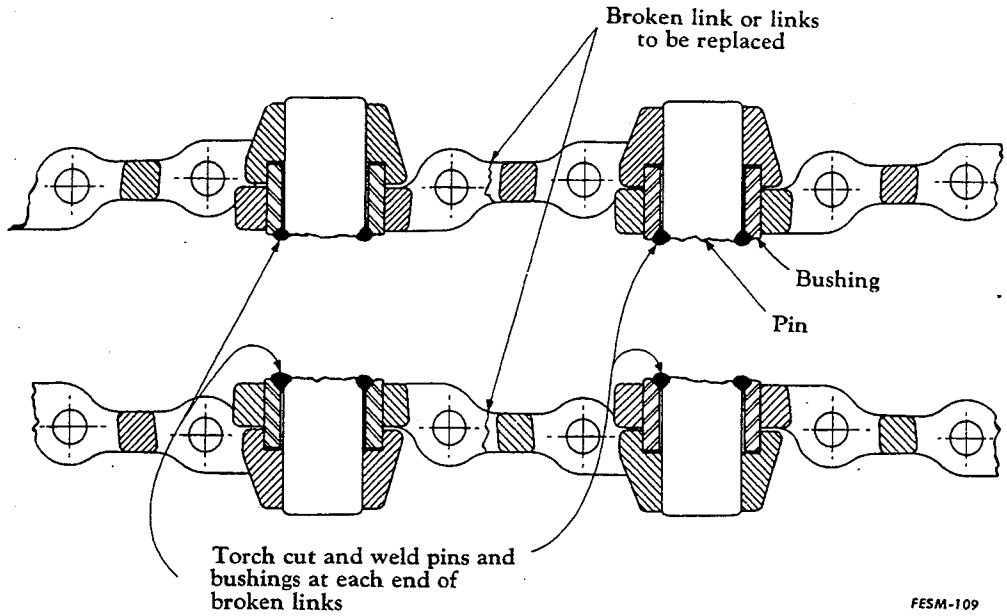
Illust. 7. Assembly of new links.

To repair or replace worn track pins, bushings or links, a hydraulic track chain press will be necessary. The 500 Crawler requires a press of 30 tons minimum capacity. The procedure and operational instructions for each track chain press will vary, so specific disassembly instructions will be found with the manufacturer's operational instructions.

NOTE: When assembling the track chain, be sure that the track shoe attaching holes align with the links. (Illust. 7).

1. To replace a damaged section of track chain, remove the track shoes and cut out the damaged section with a cutting torch. Remove the end links as outlined in Step, 2. Rebuild the section onto the track chain by pressing on individual standard links, link pins and bushings with a hydraulic track press. When joining track chain sections together, master links, master link bushings, special spacers, and a master link pin can be used in the coupling link or the section can be joined as outlined in Step 2.

2. To replace an individual link that is damaged, remove the track chain from the tractor. After the track chain is free and extended flat, remove three or four of the track shoes adjacent to the damaged part. Cut the pins and bushings off the damaged link with a torch.



Illust. 8. Removal of damaged links.

The cuts should be made as close to the inside faces of the inner links as possible, (Illust. 8) to provide sufficient clearance between the links for removal of the remaining pin and bushing sections.

NOTE: Be careful not to damage the inner faces of the links when cutting the bushings and pins.

The pieces of the pins and bushings remaining in the links must now be securely welded together at the cuts. It is important that the welds be strong enough to carry the bushing out with the pin. Press each of the pin and bushing assemblies (welded) out of the links. Remove and replace the damaged link or links.

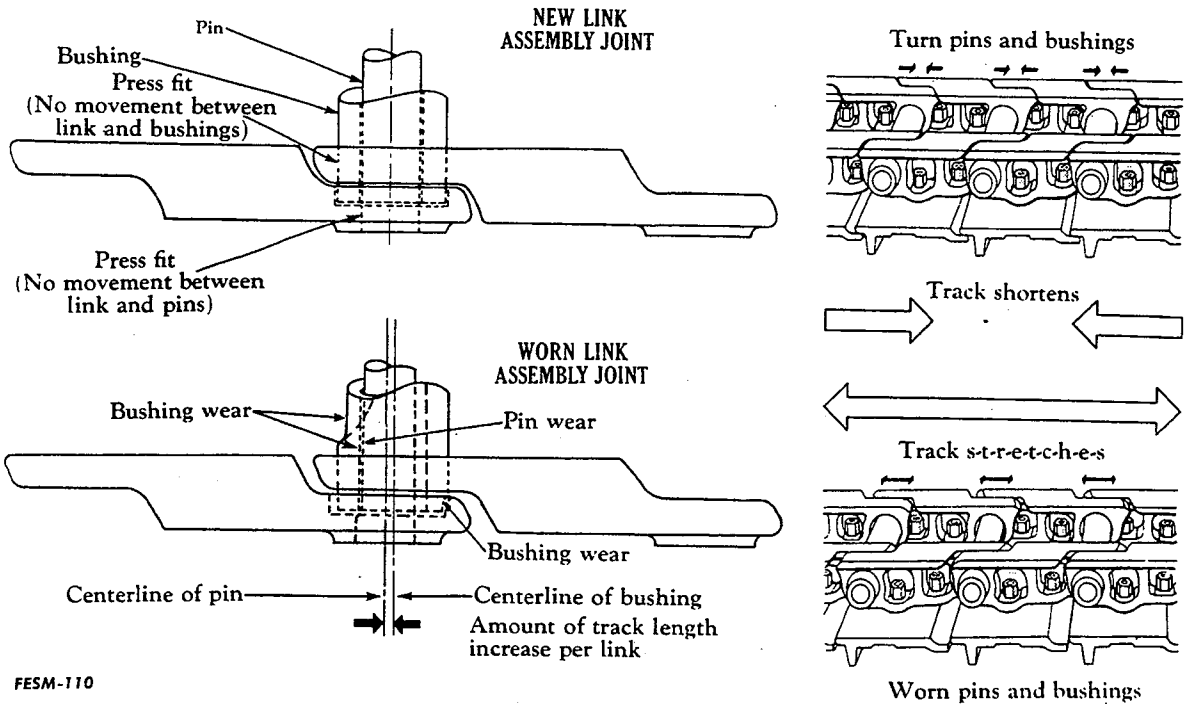
An aligning pin can be made from a track pin which has been ground down to a slightly smaller diameter than the regular pin. It is used to align the two ends of the track links prior to inserting the new pin.

Assemble the two new loose, right and left, track links using a master bushing. (Illust. 7). Place the master bushing spacers into the counterbore of the links. Place the bushing and links assembly onto the track and insert the aligning pin to hold the track link alignment while the new pin is pressed in position. Use the aligning pin again when joining the two sections of the track.

"Turning" the Pins and Bushings

As internal and external wear on track pins and bushings develop, the tracks actually become longer and the separation between the parting edges of the links becomes greater. This gradual wear produces excessive "stretch" in the track chain assembly and requires that the idler be adjusted forward to maintain the proper track chain tension.

Improperly adjusted track chains, either too tight or too loose, affect the rate of wear on all track parts such as pins, bushings, links, etc. Wear rate is unpredictable and dependent on terrain, climatic conditions, abrasiveness of soil and distances traveled. Improper selection of



Illust. 9. Showing effects of track pin and bushing wear.

track shoes or lack of suitable guards also promotes wear.

The actual operational hours at which the pins and bushings should be turned should be so spaced to perform this operation prior to reaching the maximum forward position of the front idler adjustment.

If the bushing is permitted to wear too thin where it contacts the sprocket teeth it will be susceptable to breakage on turning. A "turned" pin and bushing gives approximately half the original service life received.

It may not be economic to merely turn pins and bushings due to cost of labor involved. In these instances new pins and bushings would be installed.

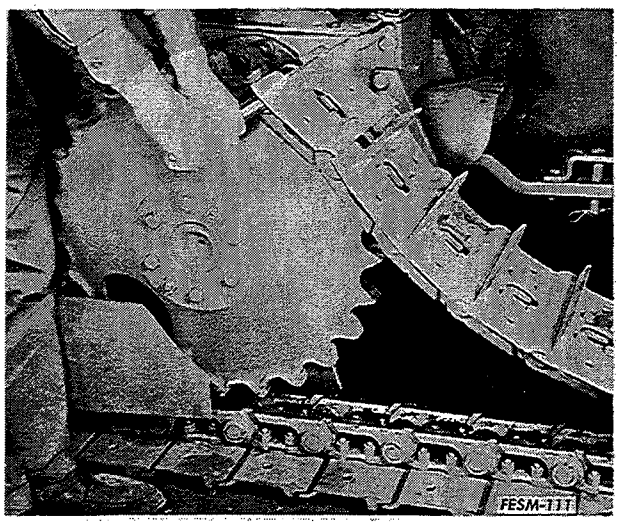
Since wear occurs on one side of the link pins and bushings (Illust. 9), the track pins and bushings can be reversed to obtain additional service from the track chain. To do this, remove the row of bolts from the track chain on the pin press adapter side. Leave all bolts intact on the ram side, but check the bolts for looseness.

Press out all the track pins and bushings, turn the bushings 180 degrees (one-half turn), and then reinstall them. Turn the pins one-half turn, and then reinstall them. By doing this, the unworn surface of each pin is operating against the unworn surface in its bushing, and the unworn outside surface of the bushing which contacts the sprocket. Install the track shoe bolts and nut torque them to the 90 ft. lb.

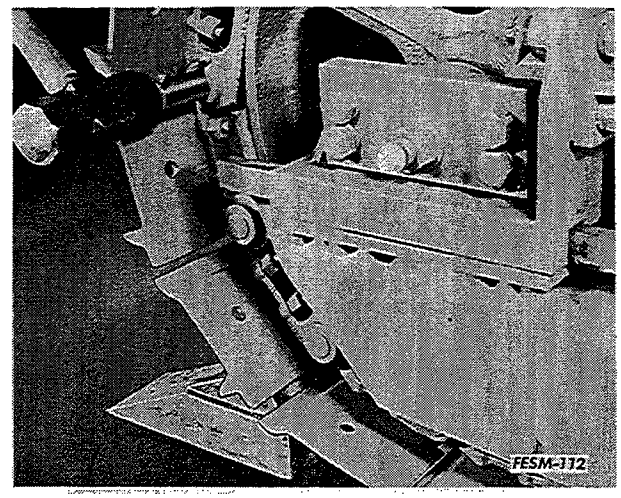
Installation

1. Slide track chain under track frame. The end without the bushing should be in the same position as that shown in Illust. 6.

NOTE: If the track chain is installed reversed from the position shown, severe wear on the sprocket teeth and track link bushings will result.



Illust. 10. Installing track chain.



Illust. 11. Installing master pin.

2. Locate the tractor on the track until the sprocket is slightly ahead of the rear end of the track chain.

3. Place a bar through the master link bushing hole (Illust. 10). Pull the track chain up around the sprocket and forward over the track idler or idlers, and the front idler as the tractor is driven forward.

4. Position a block (8 to 10 inches high) under the grouser of the shoe on the second from last link of the tractor. This will hold the track chain against the front idler.

5. Apply just enough power in the forward speed by slipping the clutch to take the slack out of the bottom part of the track chain. Install the master pin into place (Illust. 11), and secure it with a roll pin. Be sure that the roll pin hole in the master pin has not collapsed due to difficult removal. Resize if necessary with a twist drill. If tractor has inside front mounted equipment, it may be necessary to turn the master pin to the rear sprocket, by moving the tractor forward, to install roll pin.

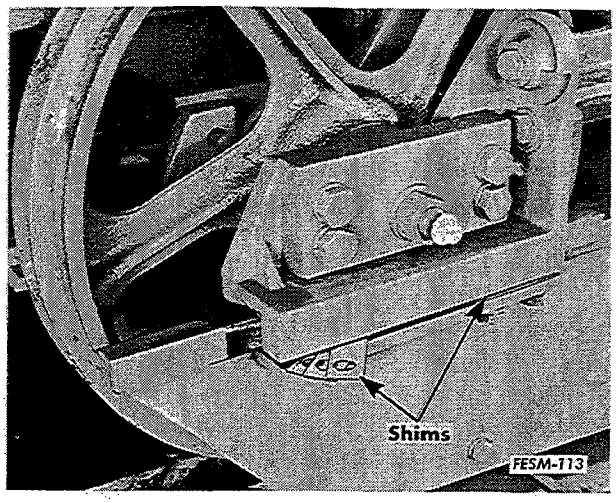
6. Adjust track chain tension. (Refer to "Adjusting Track Chain Tension", page 9.)

FRONT IDLERS

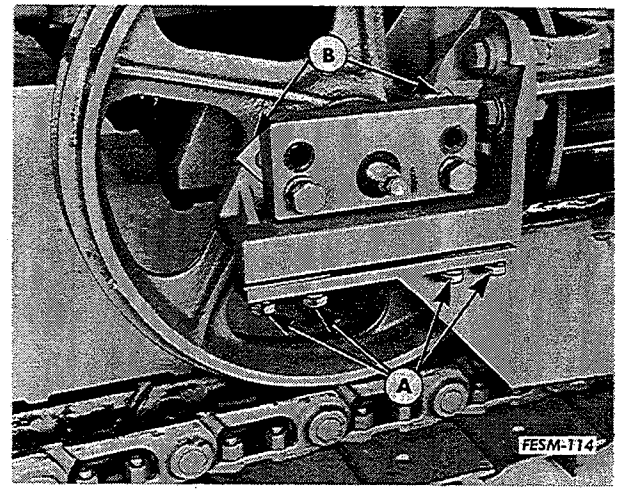
Description

The front idlers provide a rotating guide for the track chains, and also provide stability to the front end of the tractor. Being spring cushioned they take up shock at this point. The springs have a preset tension.

The idlers are fitted with bronze bushings and run on steel shafts. These bushings are replaceable. The replacement bushings are of a precision type and require no reaming when properly pressed into place. The ends of the idler shaft are fastened to the idler carrying brackets which are free to slide on the track frame. Locking nuts hold the shaft in position and also prevent it turning.



Illust. 12. Support bracket shims.



Illust. 13. Removing front idler.

The brackets supporting the front idlers slide on runners on the track frame. Shims are provided for taking up wear between the front idler support brackets and the runners on the track frame. (Illust. 12).

Lubrication of the idler is provided by external means through a grease fitting in the end of the drilled idler shaft. A reservoir in the hubs of the idlers maintains a reserve of lubrication. Lubrication is sealed in with bellows type oil seals, similar to those used in the regular track rollers and the top idlers. For details of these seals, refer to oil seal section, page 24. See Operator's Manual for lubrication details.

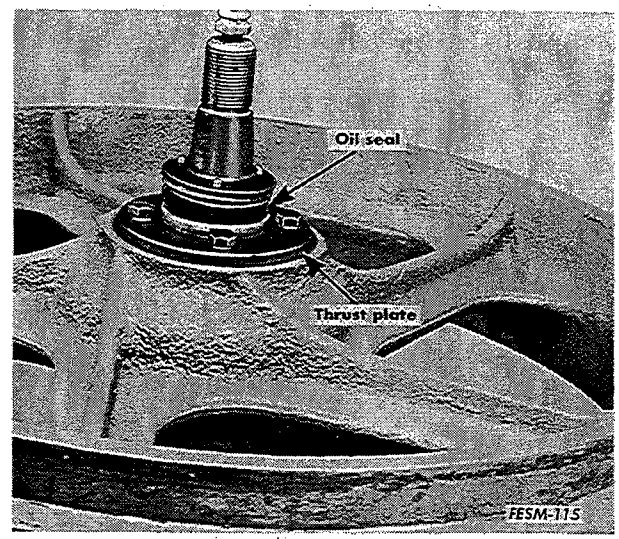
Removal

To remove the front idler as a unit, split the track chain as described on page 9, and pull the unit forward (Illust. 13). It will be easier to pull the unit forward if the bolts indicated "A" are first loosened inside and out.

If it is necessary to completely disassemble the front idler, remove the nuts on the idler shaft, then remove the capscrews that hold the plate to the nuts on the idler shaft, then remove the capscrews that hold the plate to the bracket while the bracket is still on the track frame.

NOTE: Do not lose shims that are between the plate and the bracket indicated "B".

Disassembly



Illust. 14. Removing front idler shaft.

Disassemble the front idler assemblies, the oil seals, the thrust plate and bolts, the thrust plate gasket and the front idler shaft (Illust. 14). If the adjusting plate is tight on the shaft, strike the plate with a hammer over the mounting bolt holes.

Inspection

Inspect the parts of the front idler, assembly for the following:

1. Excessive wear on the outer faces of the idler.

2. Broken or damaged surfaces where the chain contacts the idler.

3. Check hub for cracks.

4. Check condition of front idler shaft.

5. Check idler shaft and bushing for fit. Replace if necessary.

6. Check threads on idler shaft for burring or stretching.

7. Check the condition of the oil seals. (Refer to oil seal section on page 24.)

8. Check idler bracket slides on track frame for wear. Wear at this point is the natural result of operation. Worn runners may be built up and ground to original shape if wear is considered sufficient to interfere with free movement of the mounting brackets.

9. Check thrust plates on both sides of the idlers for wear, both inside and outside. If signs of galling appear between the shaft and the plates, polish both surfaces with fine emery cloth, or replace if galling is severe.

Reassembly

1. Place the front idler shaft in the front idler with spokes pointing forward and grease fitting facing away from the tractor.

2. Using sufficient thrust plate gaskets to give a minimum of . 010 to a maximum of . 020 end play to the front idler shaft. Bolt the thrust plate to the front idler with the four 5/16 x 3/4" hex head capscrews and lock washers. The smooth side of the thrust plate must be toward the oil seal.

3. Place the oil seal as provided on the oil seal cover cap using a small amount of "Lubriplate" No. 5555 (see Operator's Manual) to hold the seal pins in the holes provided in the cover. Place them on the shaft next to the thrust plate using a small amount of "Lubriplate" No. 5555 (see operator's manual) between the seal and plate.

Install the adjusting plate on the shaft turning the oil seal cover to make sure the holes in the cover line up with the roll pins in the plate.

Install washer and nut then tighten by hand. Place the idler with adjusting plates on the idler brackets and install the two capscrews that are in line with the shaft finger tight.

4. Shims are provided between the idler adjusting plate and the idler bracket to control the clearance between the bracket and the track frame idler bracket slides. These must be installed in equal increments front to rear of the plate. Do not tighten bolts at this time. See Illust. 13.

5. Be sure the two idler bracket capscrews are in finger tight as instructed in Step 3. Then torque the idler shaft nuts to 500 ft. lbs. Torque the two idler bracket capscrews in line with the shaft to 320 ft. lbs. The two remaining idler bracket capscrews are to be wrench tight.

6. On the standard upper position, the mounting plate has the three center line holes at the top and the lower position plate has the three center lines holes at the bottom. The idler assembly must slide freely on the track slides.

Accurately measure to be sure that the idler is centrally located between the track frame guides. Change shims from side to side to ensure this. Tractors equipped with idlers in the raised position Part No. 636 384 R1 can be changed to the

lower position by removing all from idler adjusting plates and replacing these with Part No. 636 385 R1. If the idlers are in the lower position reverse the procedure. Completely lubricate the front idler with "Lubriplate" No. 555 (See Operator's Manual).

NOTE: After an initial run in period of approximately eight hours, check the mounting plate bolts and the idler shaft nuts for the proper torque and retighten if necessary.

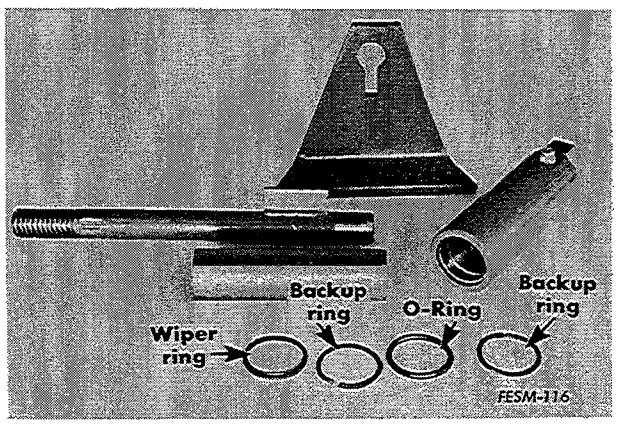
TRACK CHAIN ADJUSTER

Hydraulic

Removal

Remove track chain (Refer to page 9), Slide the front idler forward sufficient distance so that the "Hydraulic Adjuster" may be removed from the support rod which fits into the counter-bore of the piston. Remove the two bolts which hold the rod bracket; then remove the bracket. Now the support rod which is threaded into the "Recoil Spring Seat" may be removed if necessary.

Disassembly



Illust. 15. Hydraulic adjuster disassembled.

Remove the "Button Type" grease fitting from the cylinder to allow air to get in while the piston is being pulled out. If the piston will not come out, place the grease fitting back in and force out with grease gun. On the inside of the cylinder is an "0" ring with a back-up washer on either side of it. The "0" ring does the sealing. Next to it is a "wiper ring" which prevents dirt from reaching the "0" ring. (Refer to Illust. 15). These parts may be removed with a small screw driver.

Inspection

Replace "O" ring and Wiper Ring with new ones each time of disassembly. Scuffs or indentations on piston or cylinder will cause failure of "O" ring.

	Maximum	Minimum
Cylinder Bore	2. 002	2. 000
Piston Diameter	1. 999	1. 997

Reassembly

The two "back-up washers", new "O" ring, and "Wiper ring" should be installed. NOTE: When assembling the adjuster make sure that all internal parts are lubricated with a light oil before assembly. Also make sure the wiper ring has the tapered or lip edge out.

Installation

Is the reverse of removal.

Mechanical

Removal

Remove track chain (page 9). Remove front idler (page 15). Now the "adjusting rod" which is threaded into the "recoil spring seat" may be removed.

Installation

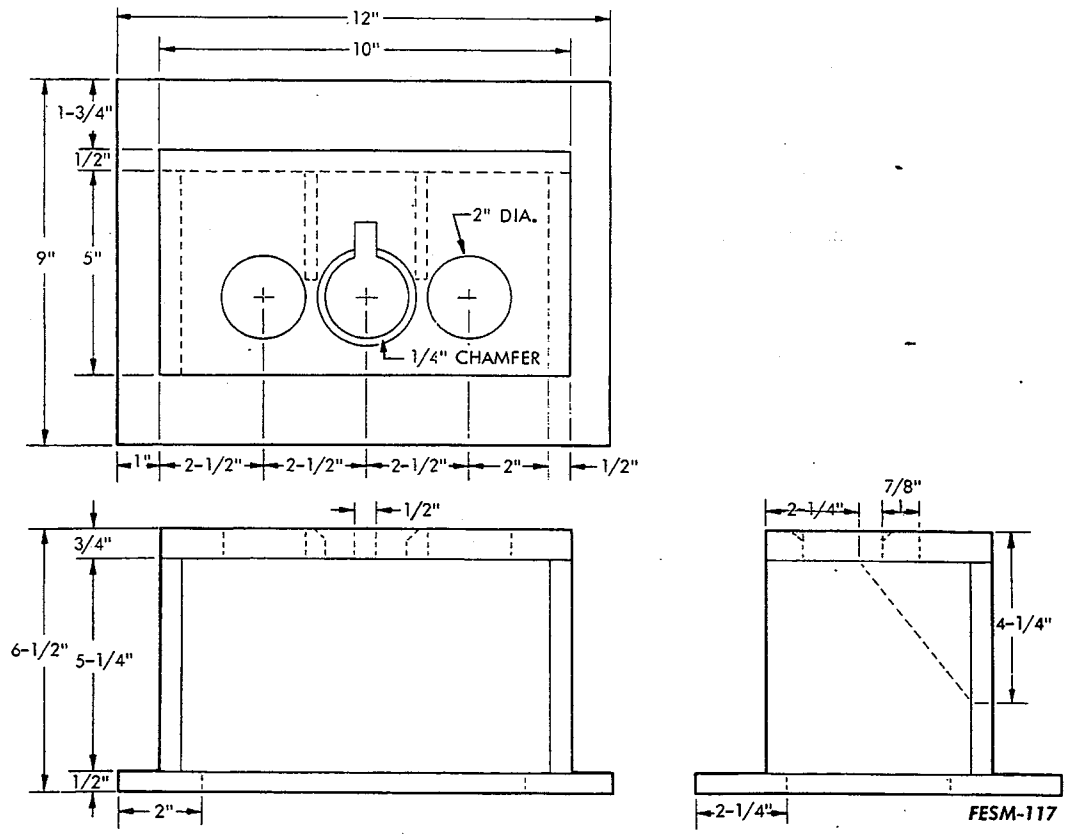
Is the reverse of removal

TRACK RECOIL SPRINGS

General

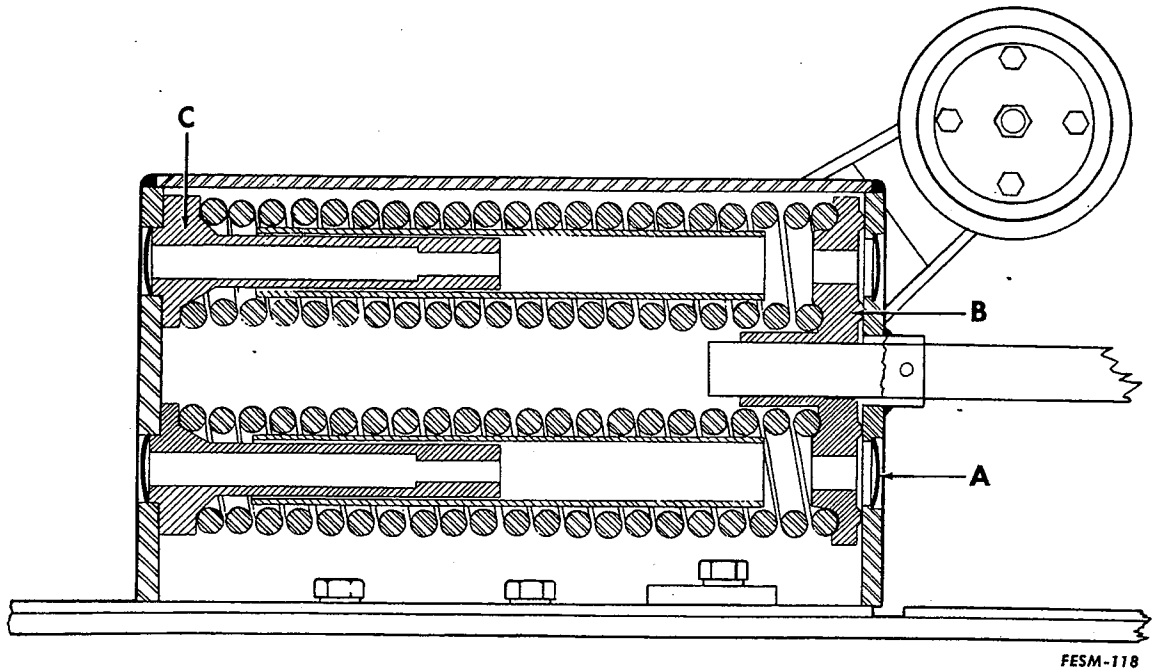
The working length of the spring is preset by the spring recoil housing. It is necessary to make the stand, shown in Illust. 15A, before the unit can be disassembled.

NOTE: EXTREME CARE MUST BE TAKEN WHEN DISMANTLING THIS UNIT. THE INSTRUCTIONS GIVEN MUST BE FOLLOWED EXACTLY. FAILURE TO DO SO CAN RESULT IN A SERIOUS ACCIDENT.



Illust. 15A. Track recoil spring disassembly stand.

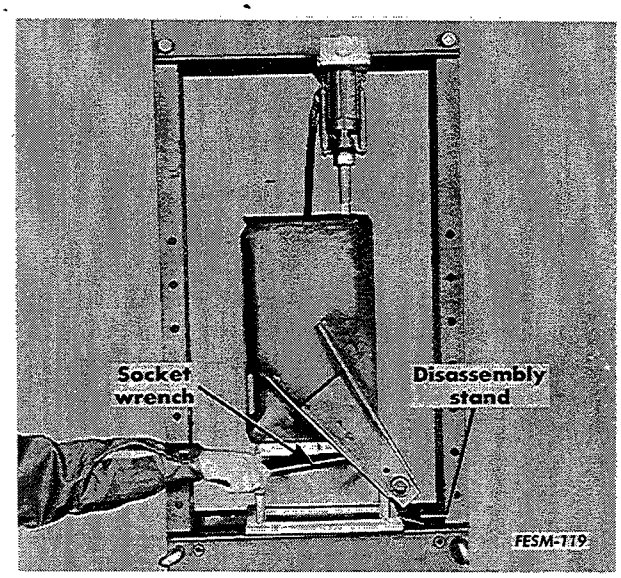
Removal



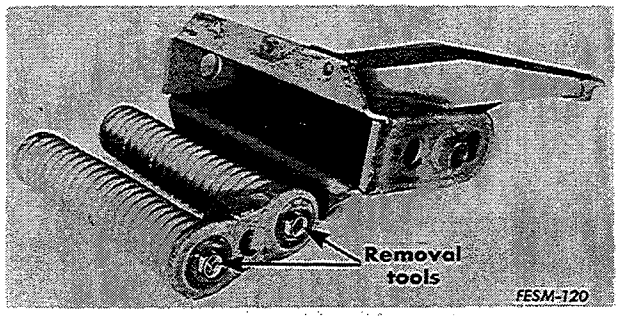
Illust. 16. Track recoil springs.

Remove track chain (See page 9). Move front idler forward on track frame. Remove track adjusting mechanism (hydraulic or manual). Remove top idler. Remove six capscrews holding "Spring Recoil Housing" to the track frame, then remove housing complete. The two long holdown capscrews are at the front of the housing. With a cape chisel remove the two welsh plugs from each end of the Housing. (See"A" in Illust. 16). Place the complete housing on the disassembly stand, in the press with the front side down (Illust. 17). From the front of the housing insert a spring removal bolt (Tool No. 4 301 004 R1) into each spring and screw it into the rear spring retainer ("C" Illust. 16) until it is snug.

Using the press push the spring down, at the same time tighten up on the removal bolt. When one spring is fully compressed change unit to other spring and repeat operation.

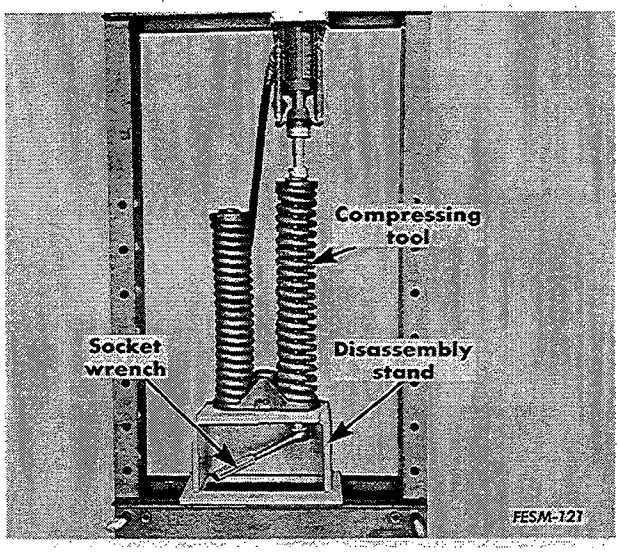


Illust. 17. Compressing recoil springs.



Illust. 18. Recoil springs compressed.

Remove spring assembly from housing (Illust. 18).

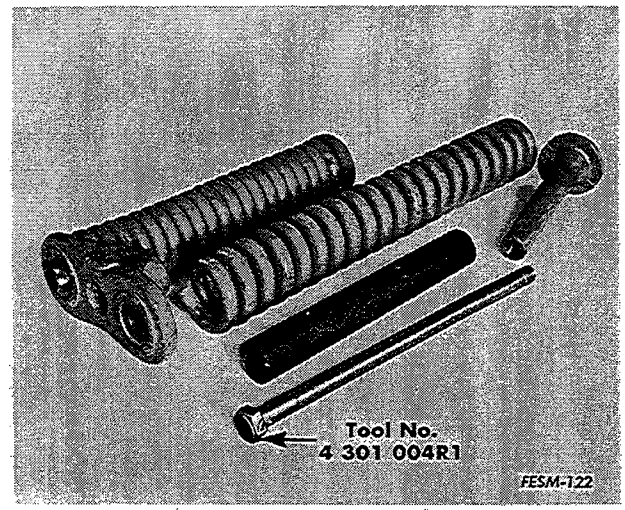


Illust. 19. Removing compressing tool.

Place spring assembly in press, apply just enough pressure to free the bolt. Back off on bolt, at the same time slowly release the press until spring is free, (Illust. 19). Repeat this on other spring. Remove the bolts.

NOTE: THE MOVEMENT OF THE BOLT AND THE PRESS MUST BE SYNCHRONIZED SO THAT A LARGE AMOUNT OF SPRING PRESSURE IS NOT ON THE PRESS ALONE.

Installation



Illust. 20. Recoil spring and tool removed.

Assemble springs, end plates and spring removing bolts (Illust. 20), place unit in the press with bolts down; one spring directly under the press. Using the press to collapse spring, at the same time tighten up on removing bolt until spring is almost completely collapsed. Repeat on other spring.

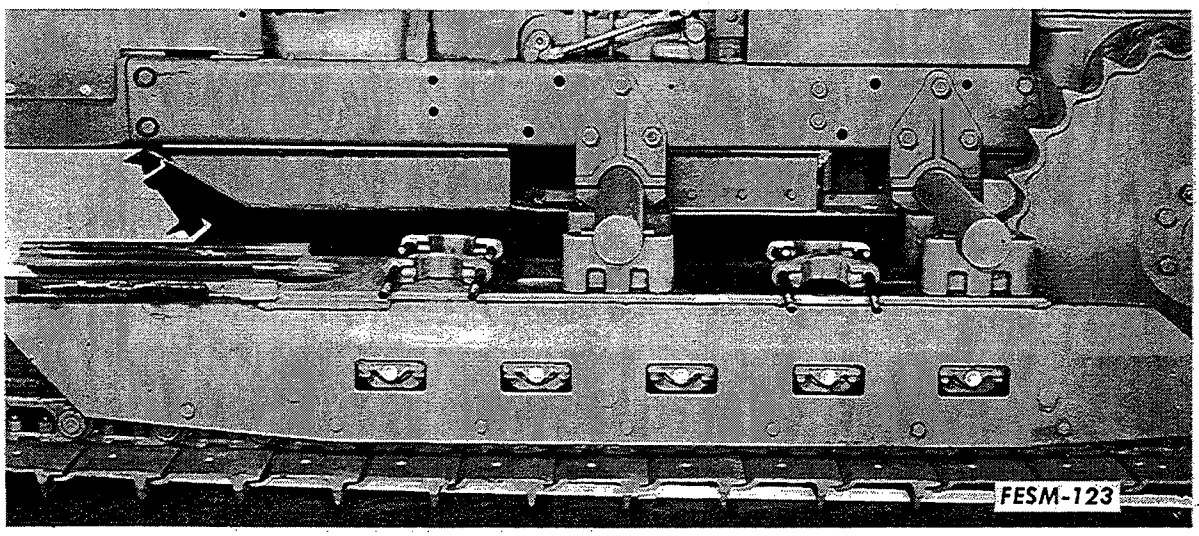
Install spring assembly in the housing. See (Illust. 18).

Install manual adjusting bolt or hydraulic push bar through the housing and thread it into the front spring retainer ("B" Illust. 16). This will align retainer with opening in the housing.

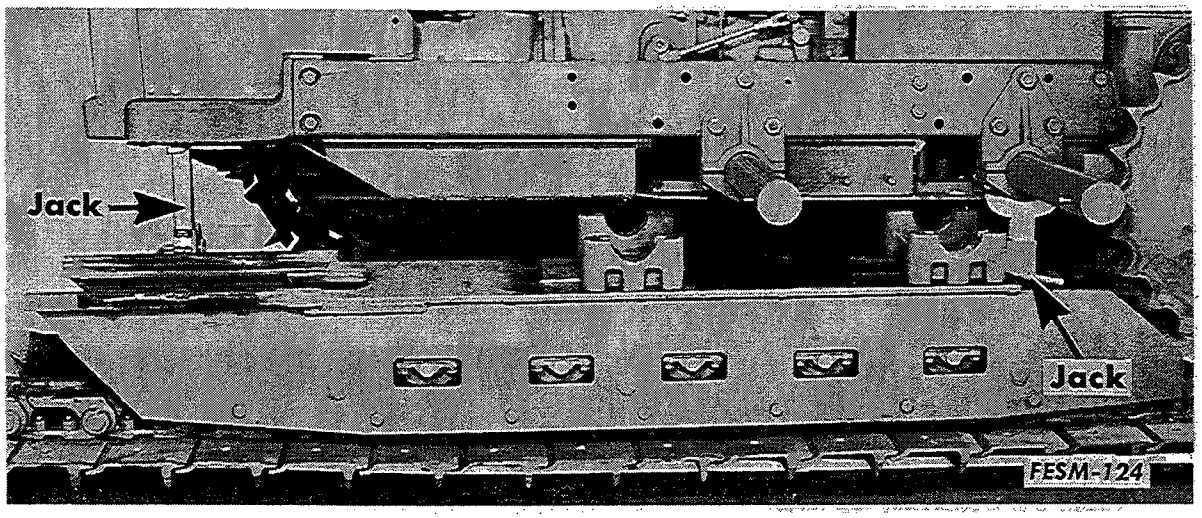
Install assembly in the press and using press to release bolt, back off bolt and release press at same time. Repeat on other spring.

Install spring box on track frame and install removed components. Check and if required, adjust track chain.

TRACK FRAME COMPLETE



Illust. 21. Removing gauge bar caps.



Illust. 22. Sliding track frame out.

Removal

Remove track chains. (See page 9)

Remove front idler. (See page 14)

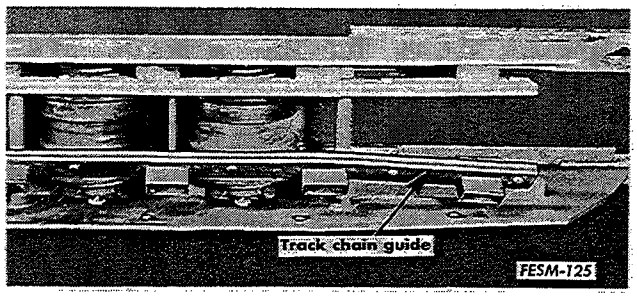
Remove track adjusting mechanism, Hydraulic or Manual (See page 17)

Remove track recoil spring box, (See page 19).

Remove four gauge bar mounting pad caps. (See Illust. 21).

Jack up the tractor using stands to hold tractor under front member and under rear gauge bar.

Slide the track frame to the front on the track rails. (See Illust. 22.)



Illust. 23. Removing track chain guide.

Turn the track frame over and remove the track chain guides. (See Illust.23.)

Installation

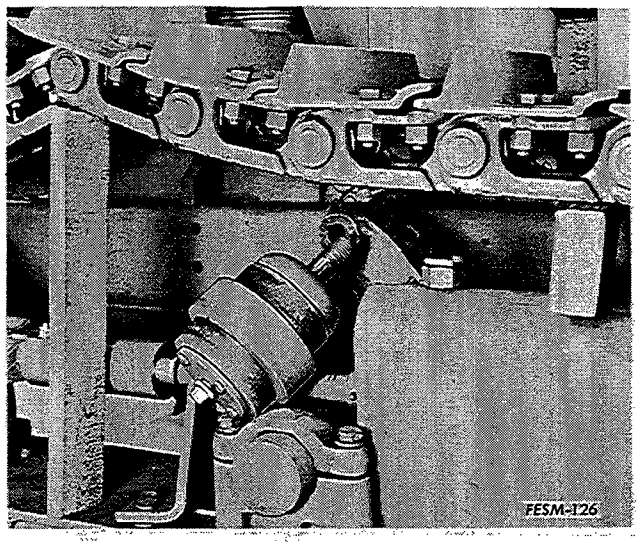
To install reverse this procedure.

Torque gauge bar mounting pad caps to 180 ft. lbs.

TOP IDLERS AND TRACK ROLLERS

Top Idlers

Removal



Illust. 24. Removing top idler.

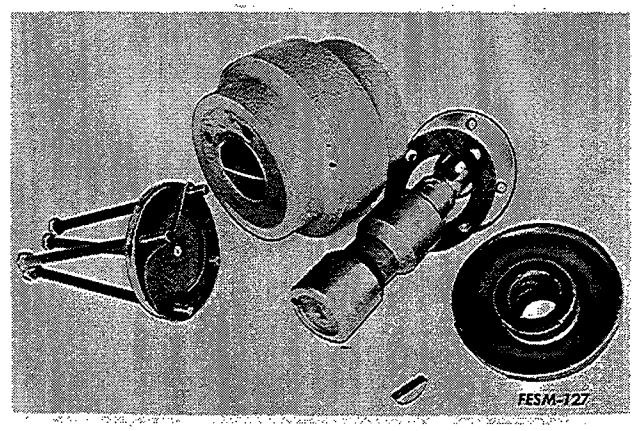
The top idler can be removed without removing the track chain by releasing the chain and raising it up to clear the top idler (Illust. 24).

Loosen the nut off on the inside of the shaft. Turn it off until it is flush with the end of the shaft to prevent damage of the threads while striking with a lead hammer.

Striking the shaft several times while pulling on the idler should remove it.

Disassembly

Remove the key from the shaft then slide the oil seal cover and the oil seal off.



Illust. 25. Top idler disassembled.

Remove the bolts which will allow the thrust plate to be removed and then the shaft (Illust. 25).

Inspection

(Covered under "Track Rollers", page 23.)

Reassembly

(Covered under "Track Rollers", page 23.)

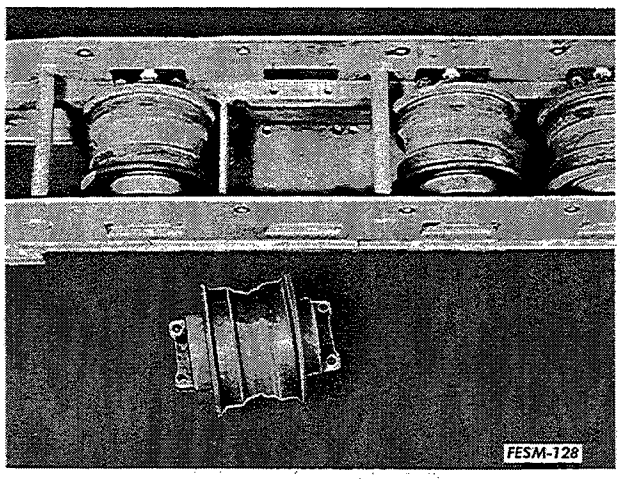
Installation

Line up the key in the shaft in line with the keyway in the bracket. Install the lock washer and nut on the shaft. Then while tightening nut, tap the inside of the bracket to assist in the tightening of the shaft. Be sure that holes in the seal cover and engaged with pins in seal. Re-adjust track chain.

Track Rollers

Removal

Remove track frame complete. Turn frame upside down, remove track chain guides.



Illust. 26. Track roller removed.

Remove capscrews from roller bracket - remove roller (Illust. 26).

Disassembly

Remove oil seal cover and seal. Then remove thrust plates, both ends, and shaft.

Inspection

Check the wearing surfaces of the shafts and bushings.

Check for wear or galling at the ends of the shaft and the end plates. If signs of galling exist, polish the surfaces with emery cloth, or replace the part if necessary. Check the outer circumference for flat spots in the areas where the track chain makes contact. Replace if there are any well defined flat spots. Check the condition of the oil seals and replace if required.

Reassembly

Assembly of the rollers and idlers in generally the reverse of removal. Lubricate the contact surfaces of the bushings and the shaft with light engine oil when installing the shaft. If any binding is detected at this time, it must be eliminated before going further.

If new bushings have been pressed into the rollers or idlers, high spots may develop which can cause binding. Such high spots can be removed in most cases by pushing the shaft into place (use hand pressure only) and tapping the shaft with a soft hammer from all sides. If more than hand pressure is required to force the shaft into place, the bushing should be removed and replaced with a new one.

When assembling the thrust plates on the "Top Idler" and "Track Rollers" make certain the chamfer on the inner thrust place is toward the idler.

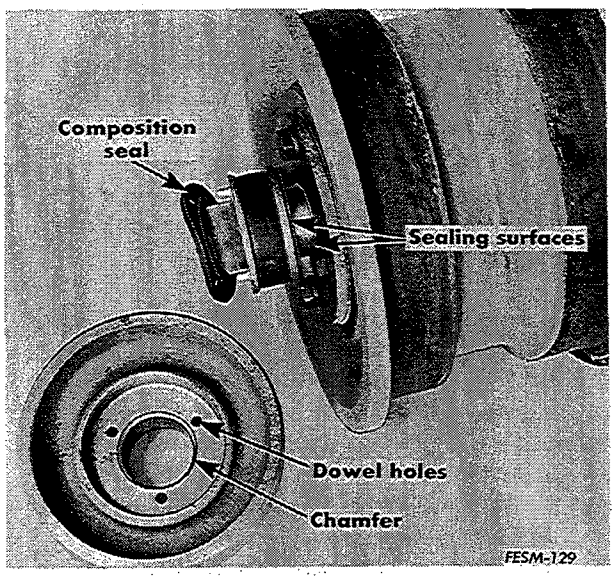
Gaskets may be added or deleted behind all thrust plates to arrive at the proper end clearance of .010 to .020". It is important that the shafts turn freely in the bushings when the end plates are torqued to 25 ft. lb.

When assembling the top idler a little heavy grease on the sealing surface of the seal will help hold it in place while installing the seal cover.

Installing the rollers in the track frame is the reverse of removing. The track roller shaft brackets (caps) can be properly installed on a bench with the seals in place. The caps can then be forced together by hand and the unit thus set in place in the track frame. Install the four capscrews and torque to 85 - 95 ft. lbs.

OIL SEALS

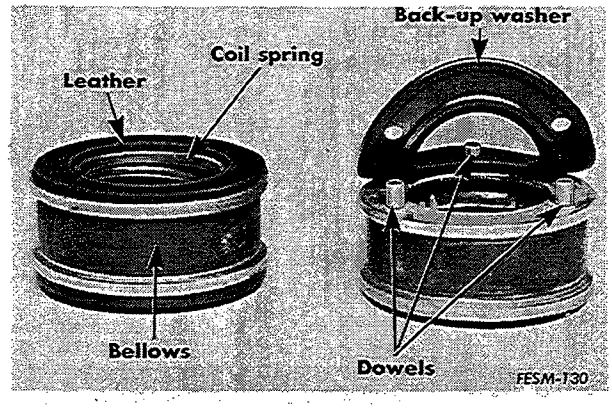
Track roller, top idler and front idler seals are all of similar design .. roller and top idler seals are identical in size. The front idler seal is of larger size.



Illust. 27. Track roller and seal.

The oil seal has two sealing surfaces; one (See Illust. 27) is of leather, and is held against the thrust plates under spring pressure. This is the only part of the seal that meets with rotation for movement and normally the only part that will wear. With lubricant constantly present, and the relatively slow movement of the thrust plate across this surface, these seals have an excellent service life.

The second sealing surface does not move or rotate, so once properly installed there is little possibility of failure. (See Illust. 28.) This composition back-up washer serves two purposes - it acts as a gasket between the seal and the outer cap in which the seal is located, and also serves as a relief valve if the pressure becomes excessive during lubrication. The small holes in the bellows portion (6 of them) also serve this purpose.



Illust. 28. Oil seal.

Between these two surfaces is a coil spring which applies pressure to load both. The spring is covered and sealed by composition bellows. This bellows keeps the lubricant in, and dirt out without interfering with the action of the spring.

The back-up washer side of the seal has three dowels. These dowels must be properly located in the holes provided, shown in Illust. 27. The back-up washer (Illust. 28) must be installed with the ribs contacting the seal and the flat smooth side out against the locating surface. It will be noted in Illust. 27, that the track roller shaft bracket has a chamfer. Seal acovers on front and top idlers are similarly relieved.

This chamfer improved the unloading characteristics of the knife edge, reducing the possibility of imposing excessive pressure on the seal when lubricating.

The operator in the field will find that seals can leak when lubricating the rollers, etc. Leakage at the time of lubricating is natural. It should be kept in mind that in some cases an operator may be able to force lubrication in faster than it can escape, particularly in cold weather. This could lead to a premature failure.

CRANKCASE GUARD

Removal

Place a jack under the centre of the guard with just enough force to hold the guard in position.

Remove the four bolts holding the guard to the front member, the two bolts on the left hand side holding the guard to the side channel and the four bolts on the right hand side holding the guard to the side channel.

Lower the jack and remove the guard.

Installation

Place the guard on the jack and raise into position.

Install all bolts finger tight first, then tighten all bolts and remove jack.

TRANSMISSION GUARD

Removal

Place a jack under the centre of the guard with just enough force to hold the guard in position.

Remove three bolts holding transmission guard to crankcase guard.

Remove six horizontal bolts holding guard to brackets on each side.

Lower jack and remove guard.

Installation

Raise the front end of the transmission guard forward until it rests on the rear of the crankcase guard.

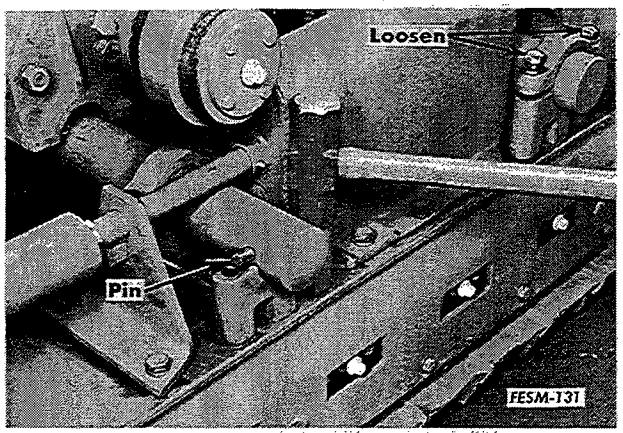
Place the jack under the rear of the guard and lift into position.

Install all bolts finger tight then torque bolts and remove jack.

FRONT GAUGE BAR

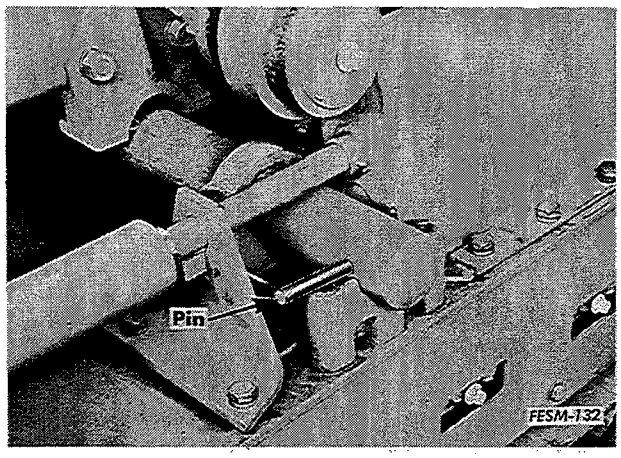
Removal

Remove front gauge bar bracket caps both sides. Loosen rear gauge bar bracket capscrews. Jack up the front of the tractor until the brackets are about 1 inch off of the gauge bar. Place two jack stands under the front of the tractor. Remove the outside gauge bar mounting pad caps on each side. Loosen off the inside caps on each side as far as possible. They cannot be removed due to the "Top Idler Support Bracket" on the "Recoil Spring Housing".



Illust. 29. Remove alignment pin.

Rotate the gauge bar which should be free, by striking the aligning pin on one end as shown in Illust. 29. This permits the aligning pin to be removed at both ends. (Illust. 30.)

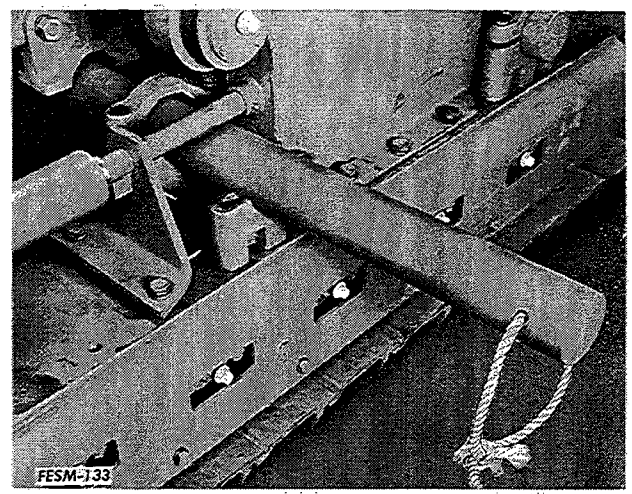


Illust. 30. Pin removed.

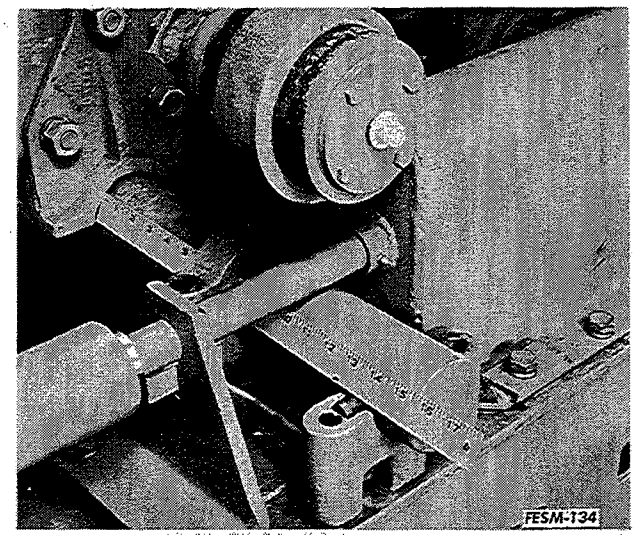
With a rope through the aligning pin hole pull the gauge bar out. (Illust. 31.) The opposite end should be supported to prevent it from dropping.

Installation

Install the gauge bar and place the alignment pins in their holes by the same manner they were removed. If the pins do not enter the grooves in the track pads properly, the track frame must be moved to allow entry.



Illust. 31. Front gauge bar removal.



Illust. 32. Measuring track alignment.

Remove jack stands and lower the tractor onto the gauge bar. Measure from the side channel bracket to the aligning pin on each side of the tractor. Make sure the bar projects equally on both sides. (Illust. 32.) If the measurement is not equal on both sides, slide the tractor on the gauge bar.

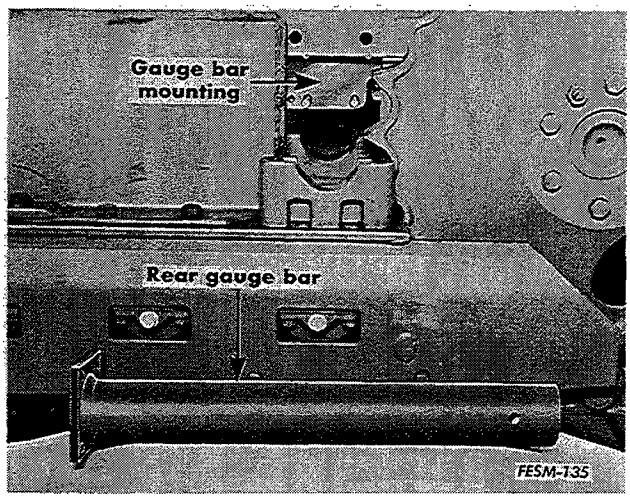
Install bracket caps and track frame pad cap.

Torque all the bolts including the rear gauge bar pad cap to 180 ft. lbs.

NOTE: Transmission Guard and Crankcase Guard may be left on while removing front gauge bar.

REAR GAUGE BAR

Removal



Illust. 33. Rear gauge bar removed.

Have the opening in the sprocket in line with the Final Drive Gauge Bar Stop Bolts. Remove the Final Drive Gauge Bar Stop and the Rear Gauge Bar Caps on the track frame and side channel brackets. Loosen front gauge bar cap capscrews.

Remove the transmission guard.

Jack up the tractor, placing a stand under the steering clutch housing to take the weight off of the rear gauge bar.

Remove the side channel bracket.

Remove the four nuts that hold the gauge bar to the transmission housing and remove the gauge bar. (Illust. 33).

Installation

Place the gauge bar in position with the aligning pins in place. Tighten the nuts on the transmission finger tight.

Install the side channel bracket in place, torquing the bolts to 180 ft. lb. Now torque the transmission studs to 180 ft. lb.

Remove jack stand and lower the gauge bar onto the pads.

Install the bracket cap and the track frame pad caps, torquing all pad capscrews to 180 ft. lbs.

NOTE: The track chain does not have to be removed when taking the gauge bars off, but was done for illustrative reasons.

MAIN FRAME SIDE CHANNEL

Removal

Remove transmission and crankcase guard.

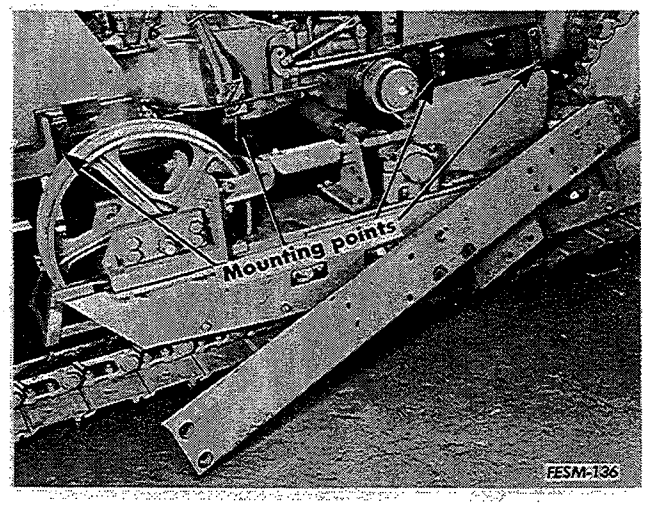
Remove caps from side channel brackets.

Jack up the tractor and place stands under the front member and steering clutch housing to take the weight.

Remove the brackets.

Remove all bolts holding sheet metal to the side channel.

Remove the bolts holding the side channel to the tractor and remove the side channel. (Illust. 34).



Illust. 34. Chassis bar removed.

Installation

Installation is reverse procedure of removal.

FUEL TANK

Removal

Drain fuel from tank.

Remove muffler, air intake pipe, and hood.

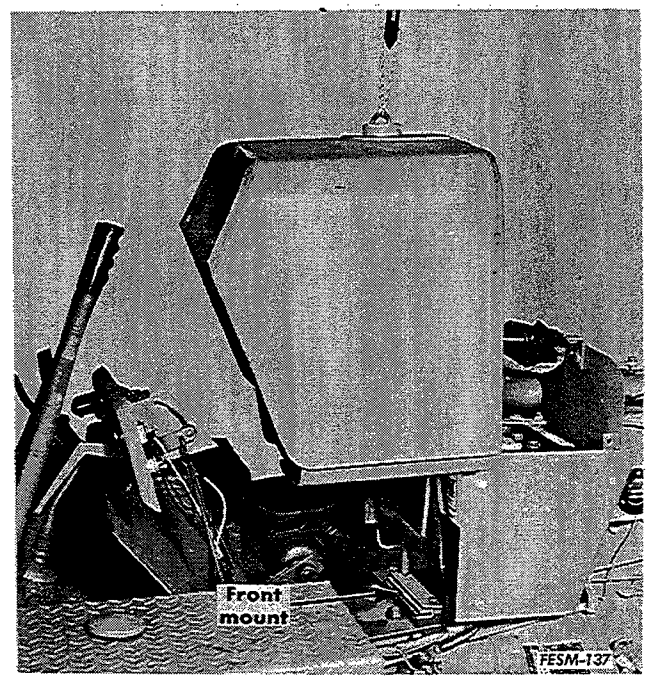
Disconnect battery.

Remove 7 filister head screws from dash and fire wall, move dash and fire wall back.

Remove fuel and return lines from tank.

Remove 4 capscrews and 2 plates from rear tank hold down plate.

Loosen left battery box hold down capscrew, and the capscrew on the front fuel tank hold down plate.



Illust. 35. Fuel tank removed.

Loosen upper rear side plate cap-screws and turn the bracket on the inside away from fuel tank.

Remove tank by sliding rearward out of the front rubber mount and lifting up. (Illust. 35).

Installation

When installing tank it will be much easier if the front mounting pad is removed from its bracket and placed on the tank first. Install tanks by lowering and slide into place. Reverse removal procedure.

STANDARD TORQUE DATA FOR NUTS AND BOLTS

Recommended torque, in foot pounds, for all Standard Application Nuts and Bolts, provided:

A. All thread surfaces are clean and lubricated with SAE-30 engine oil. (See NOTE.)
B. Joints are rigid, that is, no gaskets or compressible materials are used.
C. When reusing nuts or bolts use minimum torque values.

NOTE: Multiply the standard torque by:

.65 when finished jam nuts are used.
.70 when Molykote, white lead or similar mixtures are used as lubricants.
.75 when parkerized bolts or nuts are used.
.85 when cadmium plated bolts or nuts are used.
.90 when hardened surfaces are used under the nut or bolt head.

Bolt or Stud Diameter	Type 1 Studs Only		Type 1 Bolts 6" length or less		Type 1 Bolts longer than 6"		Type 2 (all lengths)		Type 3 (all lengths)		Type 4 (all lengths)			
											Only when used in cast (gray) iron		All other applications	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1/4	5	6	5	6	3	3	9	10	11	13	11	13	12	14
5/16	12	13	12	13	6	7	19	21	24	27	24	27	27	30
3/8	21	24	21	24	11	13	33	37	43	47	43	47	45	50
7/16	35	38	35	38	19	21	53	60	69	76	69	76	75	85
1/2	52	58	52	58	29	32	80	90	104	117	104	117	115	130
9/16	70	80	70	80	41	46	115	130	150	170	150	170	165	185
5/8	98	110	98	110	57	63	160	180	210	230	210	230	220	250
3/4	174	195	174	195	100	112	290	320	350	390	350	390	400	450
7/8	300	330	162	181	162	181	420	470	570	630	570	630	650	730
1	420	470	250	270	250	270	630	710	850	950	850	950	970	1090
1-1/8	600	660	350	380	350	380	850	950	1200	1350	1200	1350	1380	1550
1-1/4	840	940	490	540	490	540	1200	1350	1700	1900	1700	1900	1940	2180
1-3/8	1100	1230	640	710	640	710	1570	1760	2300	2500	2300	2500	2600	2800
1-1/2	1470	1640	850	940	850	940	2000	2300	3000	3300	3000	3300	3300	3700
1-3/4	2350	2450	1330	1490	1330	1490	3300	3700	4700	5200	4700	5200	5300	6000
2	3500	3900	2000	2200	2000	2200	5000	5500	7000	7800	7000	7800	8000	9000

BOLT TYPE IDENTIFICATION CHART

IH TYPE	S.A.E. GRADE	DESCRIPTION	BOLT HEAD MARKING*
1	Equivalent 1 or 2	WILL HAVE IH STANDARD MONOGRAM IN THE CENTER OF THE HEAD Low or Medium Carbon Steel Not Heat Treated	
2	5	WILL HAVE AN IH AND 3 RADIAL LINES Quenched and Tempered Medium Carbon Steel	
3	6	WILL HAVE AN IH AND 4 RADIAL LINES No longer used in production. For replacement, use Type 4 if Type 3 is not available.	
4	8	WILL HAVE AN IH AND 6 RADIAL LINES Quenched and Tempered Special Carbon or Alloy Steel	

* The center marking identifies the bolt manufacturer. The IH monogram is currently used. Some bolts may still have a raised dot which previously identified IH bolts.

SERVICE BULLETIN RECORD

Important: Information in this manual section is subject to change or supplementing from time to time as a result of field experience and engineering modifications. As Service Bulletins are received, record them on this page for handy reference whenever this manual is to be used. . .Print entries in ink.

Bulletin No.	Date Issued	Book No.	Topic or part of machine involved.

NOTES

SUPPLEMENT TO
GSS-1364

DUAL FUNCTION SEALS

500 Crawler Tractor

CONTENTS

SPECIAL SERVICE TOOLS REQUIRED

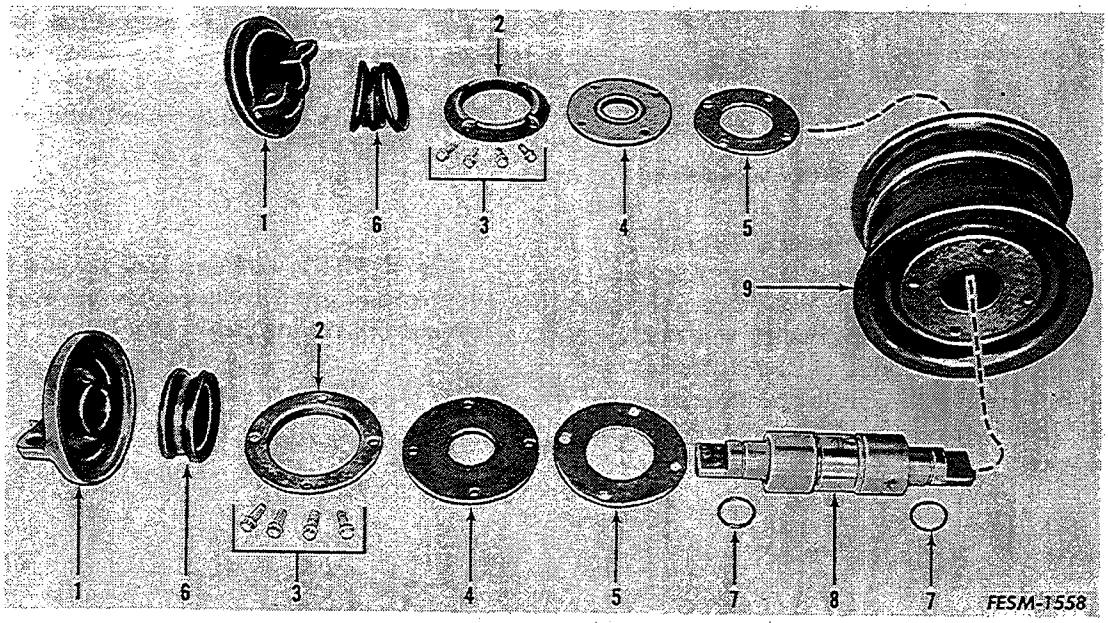
676 489 R11 Roller filling tool
order from Local Parts Depot

SPECIFICATIONS

Track Roller Bushing I.D.	1.985 - 1.987 in.
Track Roller Shaft O.D.	1.981 - 1.982 in.
Track Roller Shaft End Play	.010 - .020 in.
Torque on Thrust Plate Capscrews	19 - 21 ft. lbs.

ROLLER OR FRONT IDLER OVERHAUL

General

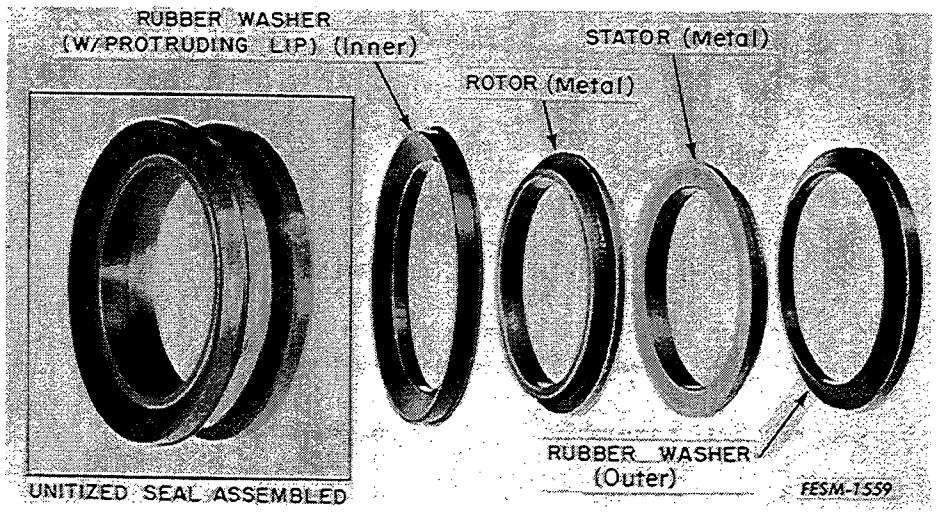


Illust. 1. Parts for one roller.

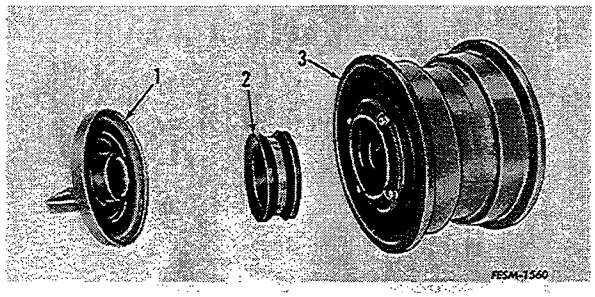
1. Bracket, track roller
2. Retainer
3. Bolts (5/16-12 pt., 1/4 in. drive)
4. Thrust plate
5. Gasket
6. Seal assembly
7. O-ring
8. Shaft
9. Roller

Illust. 1 shows the parts making up one roller assembly. Each of these parts are serviceable.

The D/F seal assembly consists of four (4) specific parts (Illust. 2). The metal faced seal is supplied as a matched set only.



Illust. 2. D/F seal assembly.

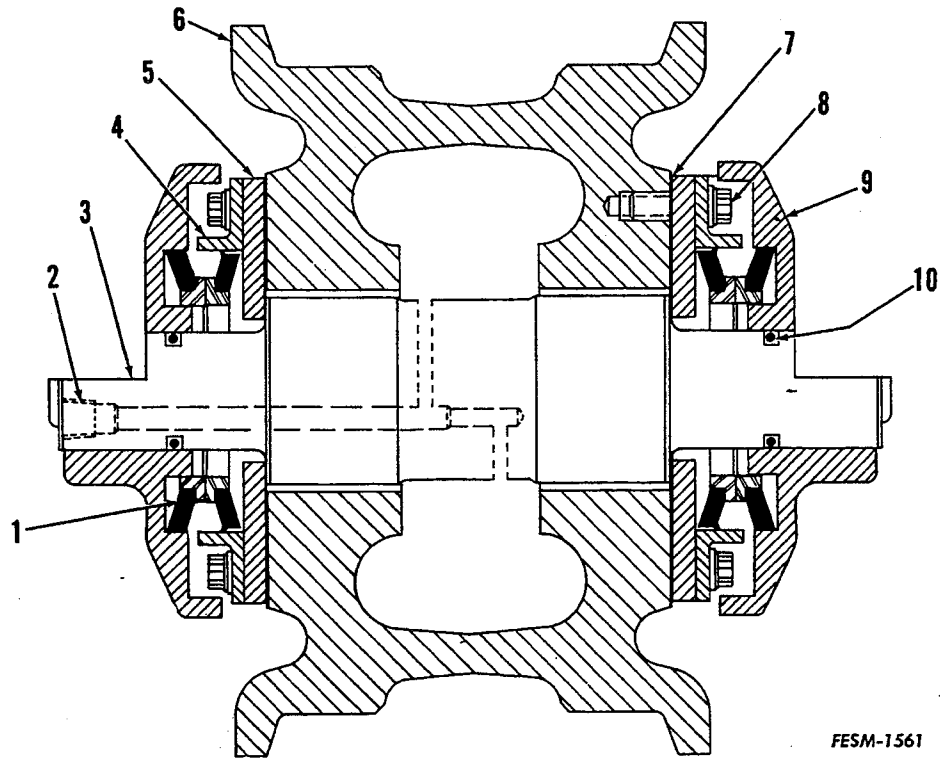


Illust. 3. End of roller with bracket removed.

The roller shell and bracket (Illust. 3) are so designed to hold and locate the rubber washers which in turn hold and position the metal faced seals. Actually the rubber washers serve the function of retaining, locating and providing suitable pressure to maintain the metal faces in positive contact. The front idler is similar.

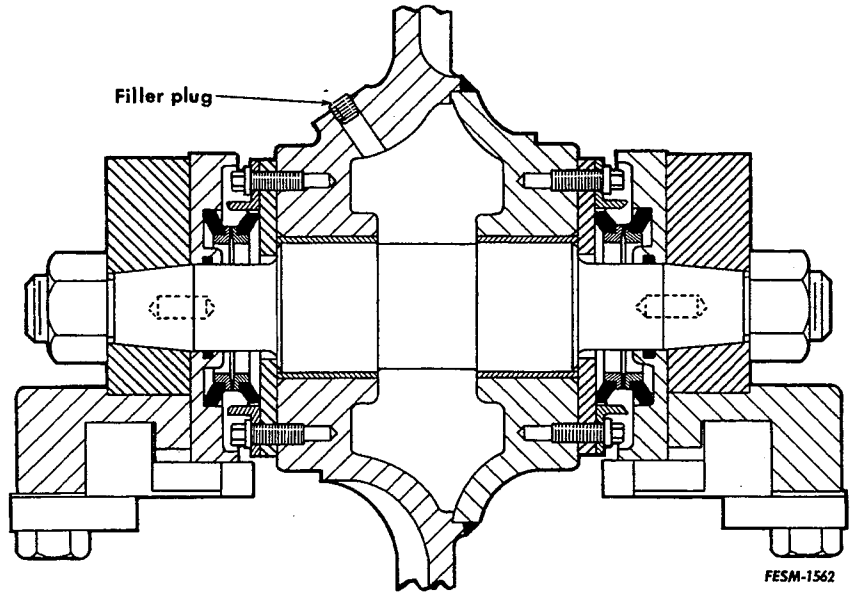
The reader will by referring to Illust. 4 for the roller, and Illust. 5 for the front idler, more clearly understand the positioning and function of the rubber washers. The inner washer at each end is known as the rotor washer, and its companion half of the metal seal is known as the rotor seal. The outer washer at each end and its companion metal seal is the stator seal and washer.

The D/F (Dual Function) metal faced seal is designed to keep the lube oil "in" and external contaminants "out".



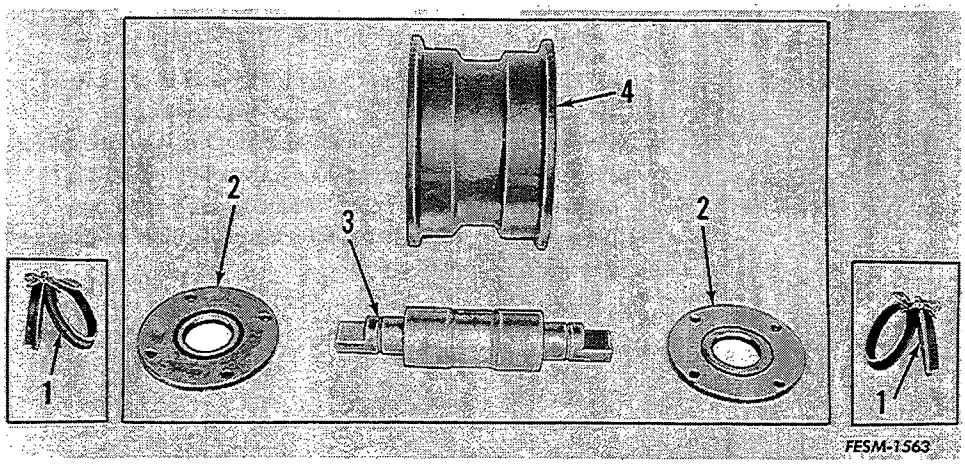
Illust. 4. Cross section of the track roller.

1. Seal assembly
2. Filler plug
3. Shaft
4. Retainer
5. Thrust plate
6. Roller shell
7. Gasket
8. Capscrew
9. Bracket, track roller
10. O-ring



Illust. 5. Cross section of the front idler.

Disassembly



1. Metal seal
2. Thrust plate
3. Shaft
4. Roller shell

Illust. 6. Parts in each box must remain together.

The metal seal rings as removed must remain as a set. Altering a set by intermixing the metal seal rings on any one or more rollers renders each of these mixed sets unserviceable. Each set of the metal seal rings can be shifted from one roller to another without affecting their performance. However, the shaft, thrust plates and roller must remain as a unit. See Illust. 6.

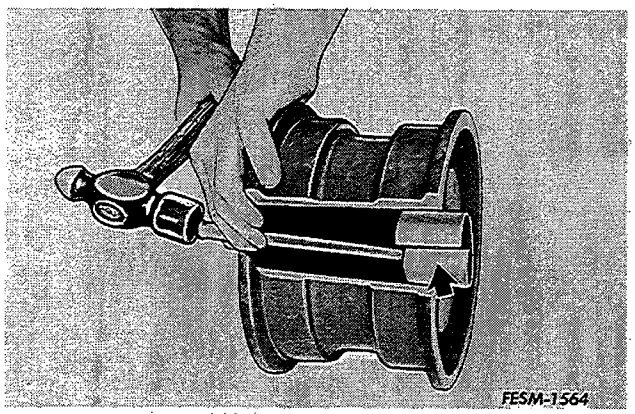
As the metal seal rings are removed, they should be tied together to prevent an inadvertent mix up. See Illust. 6.

The roller thrust plate retainers should not be switched from side to side and should be returned to the exact location from which they were removed. Failure to do so alters the original wear pattern and can reduce the service life of these parts.

Overhaul of Roller Shell

All parts are serviceable. Roller shells can be salvaged by building up, if suitable equipment is available. The economics of this operation on a small roller is doubtful and in the vast majority of instances a new roller provides lower invested maintenance cost.

Removal of Worn Bushing



Illust. 7. Removing the roller bushing.

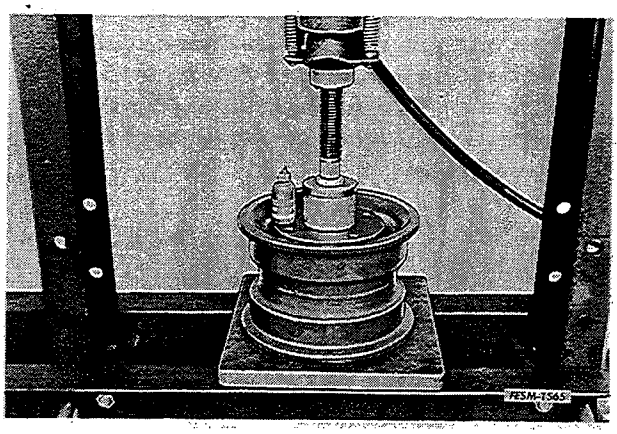
Illust. 7 shows the only satisfactory method of removing the pressed in bushing. Any other method can result in damage to the roller thrust plate mounting surface. This could increase the roller end play and result in roller failure due to the hammering effect.

The bushing is formed bronze on steel and has a "seam". Using a chisel, as shown in Illust. 7, drive out the bushing far enough so that the chisel can be used to collapse the exposed end of the bushing. Use a pair of pliers to remove the collapsed bushing.

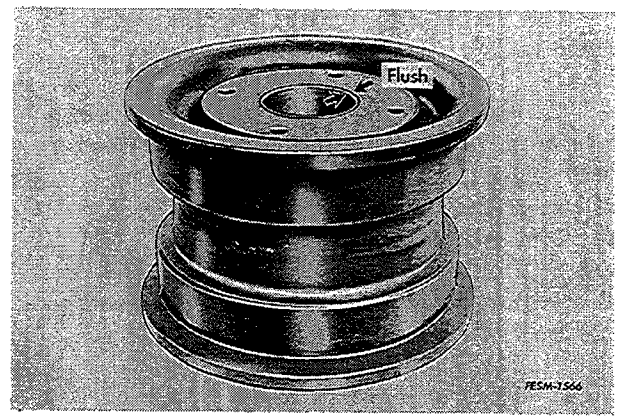
Cleaning the Roller Shell

The roller shell internal surfaces can only be cleaned with a thorough washing, using steam, soap and hot water to flush. Dry the shell thoroughly. Do not deemphasize this cleaning procedure in any manner.

Installing the Bushing



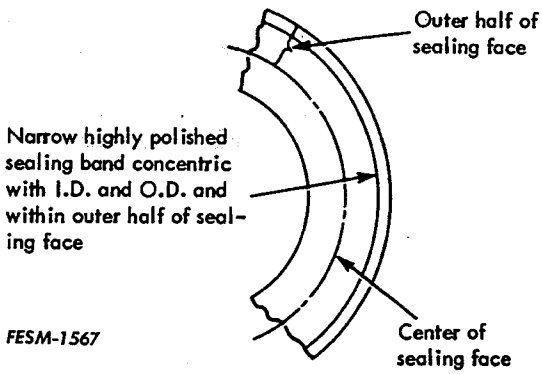
Illust. 8. Installing roller bushing.



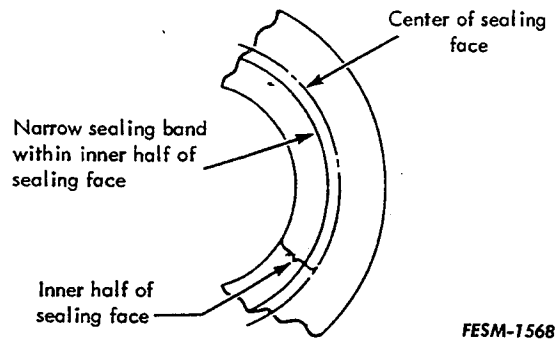
Illust. 9. Roller bushing installed.

Installation of the bushing is accomplished by coating the bushing back as well as the roller surface with IH Loctite (Part No. 999 568 R91) and pressing the bushing into position, as shown in Illust. 8. The bushing is located so that it is exactly flush with the roller thrust plate mounting surface (Illust. 9).

D/F Seal Inspection and Overhaul



Illust. 10. Acceptable wear pattern.



Illust. 11. To be discarded.

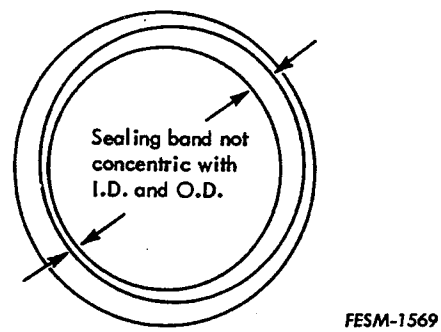
NOTE: You must have a seal overhaul package for each set of metal seal rings.

Inspection

Inspect the metal seal rings for:

1. The narrow, highly polished sealing band must be within the outer half of the sealing face. See Illusts. 10 and 11.

2. The narrow band (see step 1. above) must be uniform and concentric with the ID and OD. See Illust. 12.



Illust. 12. To be discarded.

Overhaul

The metal rings must be cleaned as follows:

1. Remove corrosion or other foreign material existing on surface described as "A" (Illust. 13). Use a pocket knife, scraper and/or any stiff bristled brush to facilitate this operation. DO NOT TOUCH OR SCRATCH THE SEALING BAND. If it is corroded, nicked or otherwise damaged, discard the set.

2. Wash the metal rings in a non-flammable solvent to remove all traces of oil or grease.

3. Apply a thin coat of Series 3 Grade 30 oil to one seal face only.

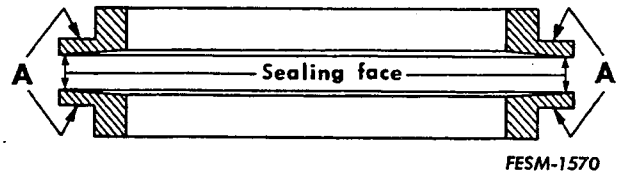
4. Rotor and stator are now "wrapped" with the special unitization band (found in overhaul package) as follows:

a. Soak the unitization band in water (lukewarm) not hot--not cold until it is pliable.

b. Slide the faces of the two metal sealing rings together. (Remember, only one surface coated with oil.)

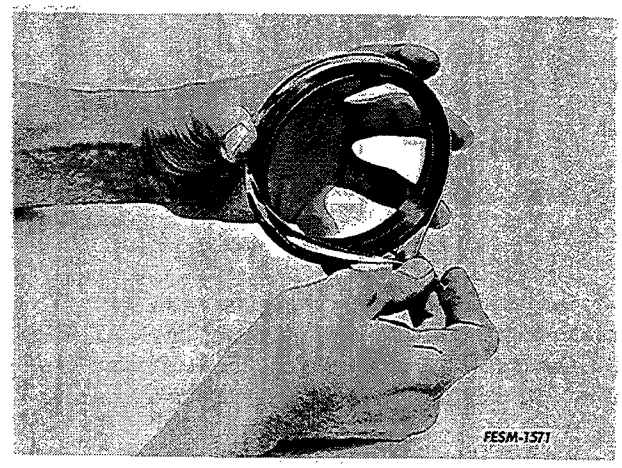
c. Hold the rings in one hand (see Illust. 14) using the other hand to thread and stretch the band around the OD of the seal rings.

d. Carefully, using a small dowel (similar to a "cotton swab" stick approximately 1/8" dia.) thread the plastic into position to hold the rotor and stator halves during assembly.



Illust. 13. One set of metal seal rings.

e. Lay the D/F rotor and stator assembly aside and prepare the next assembly. When all the seals are "wrapped" in this fashion, the first will be "dry" for assembly into the roller. On individual jobs the unitization band must dry for at least 30 minutes. The unitization band will dissolve during the course of the first few hours operation.



Illust. 14. Installing unitization band.

Installation of the seals is accomplished as follows: These seals cannot be installed in any roller other than one made specifically for this seal and as such any conversion must utilize an entire roller assembly. Subsequent service when required will utilize these instructions.

Installing Seal in Roller

1. Inspect the shaft, thrust retainers, and supports for excessive wear. These parts must meet these specifications.

a. Bushings (635 226 R1) in roller = 1.985" to 1.987".

b. Shaft (676 418 R1) = 1.981" to 1.982".

c. Running clearance bushing to roller shaft = .003" to .006".

d. Maximum wear factor permitted bushing to roller shaft prior to replacement of parts .0175 running clearance.

2. Assemble into the roller shell, the shaft, gaskets, thrust plates and retainers. Evenly tension the retainer bolts.

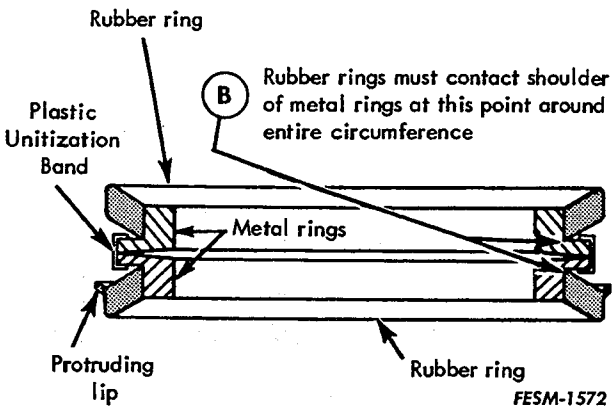
Then:

a. With the roller secured in a vise or by other means determine end clearance. If it exceeds the dimensions of .010 min. to .020" max. Replace parts as required.

3. Items a. and b. below should be replaced.

a. Roller shaft O-rings (2).

b. D/F seal rubber washers set (2).

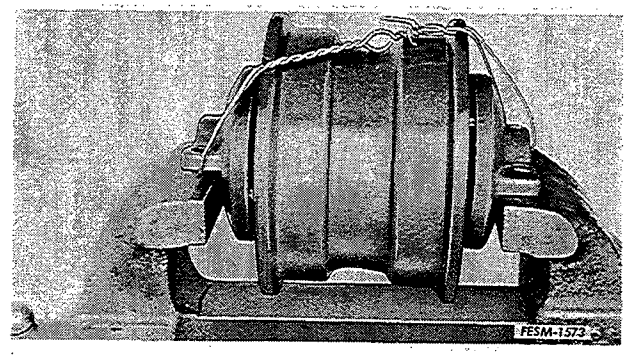


Illust. 15. Rubber washers correctly positioned on metal seal rings.

4. Place the roller shell in a vise or other suitable support. Coat the operating parts (roller shaft, thrust plate, bushings) with SAE No. 30 Series 3 oil prior to assembly. If roller is to be placed in storage coat with petroleum jelly. Assemble shaft, gaskets, thrust plate retainers and bolts. Torque to 19 to 21 ft. lbs. The D/F seal assembly is then positioned.

NOTE: The washer with the protruding lip must be placed into the roller cavity. This will center the seals during reassembly, and hold them securely in position during assembly.

Drawing the Roller to Operating Position



Illust. 16. Drawing roller into operating position.

Position the seal assemblies and the roller brackets in place. Carefully draw this assembly together, either by means of a large "C" clamp or any vise as shown in Illust. 16. Hold the roller together with a piece of wire as described under "Storage".

Roller Storage

If the roller is to be stored, a double strand of suitable soft iron wire is to be inserted through opposite holes in the roller brackets and wound up in such a fashion that the roller assembly will remain compressed exactly as it is at the completion of the operation described. See Illust. 16.

Roller Mounting Surface

Thoroughly scrape the roller bracket mounting area to insure positive metal to metal contact of the bracket and frame mounting area.

Roller Installation

The roller can be installed by inserting bolts through the opposite bracket retainer holes with the wire in position. As soon as these bolts are started securely into the threads, cut and remove the positioning wire. Insert the two remaining bolts using due caution to draw them down evenly. Tighten the mounting bolts to 50 ft. lbs, and then to final torque. Final torque is 85 to 95 ft. lbs.

Lubrication

Field Service

The D/F roller uses only Series 3 SAE 30 engine oil.

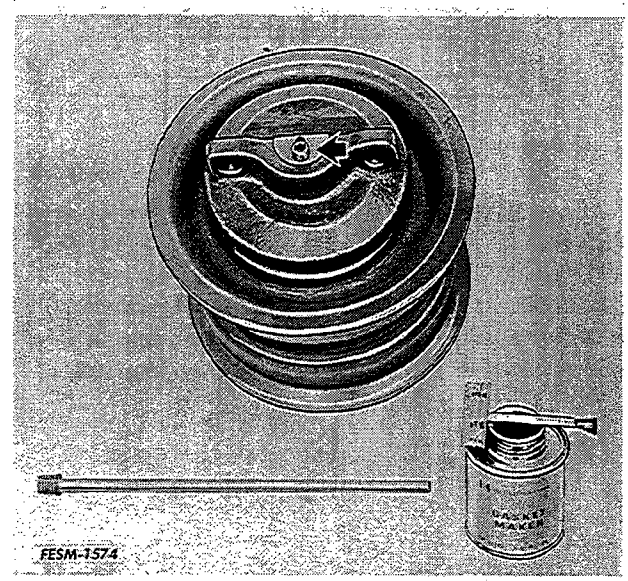
The recommended lube cycle is each 1000 hours, or yearly.

If leakage becomes apparent continued service (refilling) must be made as required until the roller can be repaired.

DO NOT CHECK LUBE LEVEL AT ANY OTHER TIME THAN ON 1000 HOUR OR YEARLY INTERVAL.

Use extreme care in removing the plug to see that no contaminants enter the roller. Checking under any conditions other than with positive cleanliness is more detrimental than if checks are ignored.

Filling the Roller



Illust. 17. Filling the roller.

A special tool 676 489 R11 is provided as shown in Illust. 17 to fill the roller cavity. Filling is actually a filling and flushing operation.

Remove the plug shown in Illust. 17, insert the filling tool in the roller shaft and pump sufficient lubricant into the roller to "flush" out any possible contaminants. Look for "golding" of the lubricant which is an indication of bushing wear. If "golding" is evident, run the tractor onto a block of wood to release the chain from the roller in question and check immediately. Excessive end clearance necessitates removal and correction of the problem.

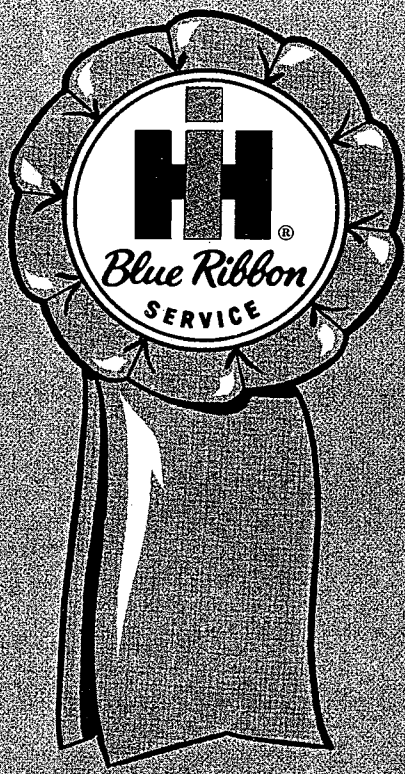
D/F roller seals if properly cared for will out wear the roller shells themselves.

After the roller has been filled, coat the plug with IH gasket maker and install the plug.

Filling the Idler

Position the idler so that the fill plug is 45° from the vertical (12 o'clock position). This will leave an air space in the idler when it is filled. Fill the idler with Series 3 SAE 30 engine oil, until the oil runs out the fill plug hole. After the idler has been filled, coat the plug with IH gasket maker and install the plug.

NOTES



Blue Ribbon Service

GSS-1373

POWER TRAIN

500 Series Crawler Tractors

Price $1.50

INTERNATIONAL HARVESTER COMPANY
401 NORTH MICHIGAN AVE. CHICAGO, ILLINOIS 60611, U.S.A.

FOREWORD

The instructions and special tools shown in this Blue Ribbon Service Manual are for use by International Harvester Dealers and their factory trained servicemen.

The specifications as listed in this manual are current as of the printing date. Due to changes and improvements in our products, dealers are periodically issued service bulletins to keep this manual up-to-date. We suggest you refer to the most recent information when performing service work on this equipment.

International Harvester Factory Trained servicemen are best qualified to service I.H. equipment.

IMPORTANT NOTE

Always read each step in its entirety before starting to perform it. Necessarily, some vital information may come at the middle or end of the description of a step. Much time can be saved, and damage to parts avoided, if the procedure is studied before work commences.

LIBRARY FILING INFORMATION

1. File this Manual in Book 14 after Divider Tab GSS-1373.
2. Enter the following information in the Service Manual Index.

   Print, or preferably type in, the Manual Description, Form Number, and the Book Filed in, on the following pages:

CONTENTS

SPECIFICATIONS

Engine

	Gasoline	Diesel
Model	C-146	BD-154-T
Number of cylinders	4	4
Bore (inch)	3-3/8	3-1/2
Stroke (inch)	4-1/16	4
Displacement (cubic inches)	146	154
Engine speeds		
Low idle	425 RPM	550 RPM
High idle	2200 RPM	2200 RPM
Rated load	2000 RPM	2000 RPM
Horsepower		
Flywheel (SAE Net)	40	38
PTO (est.) (2000 RPM) Power shift	30	28
Standard or TA	36	30

Engine Clutch

NOTE: For complete servicing and specifications, refer to the clutch manual, GSS-1281-D.

Single Stage

Standard - 10 inch

Back plate to pressure plate (inch)	.356
Release lever height (inch)	1.644

Heavy duty - 10 inch

Back plate to pressure plate (inch)	.317
Release lever height (inch)	1.620

Dual Stage

Main - 11 inch
PTO - 9 inch

Back plate to pressure plate (inch)	.819
Release lever height to top of release ring (inch)	3.475
PTO clutch release (inch)	.080

Torque Amplifier

Type	Planetary gear reduction manually actuated
Type of planetary system	Compound planet gears
Gear ratio	1.482 to 1
Clutch type	Spring loaded, single plate, dry disc
Clutch size (inch)	7
Over-running clutch type	Ramp and roller
Number of over-running clutch rollers	8
Primary Sun Gear and Shaft	
Outside Diameters	
Oil seal surface (inch)	1.555 to 1.565
Bearing areas (inch)	1.7495 to 1.7500
Total gear backlash (inch)	.0013 to .0038
Maximum backlash variation not to exceed (inch)	.0015
Planet Carrier, Gears and Bearings	
Planet Carrier Outside Diameters	
Oil seal surface (inch)	2.937 to 2.943
Front bearing (inch)	2.9527 to 2.9533
Rear bearing (inch)	2.8787 to 2.8793
Clutch roller surface (inch)	2.8740 to 2.8750
Planet Carrier Inside Diameter	
Needle bearing area (inch)	2.1245 to 2.1255
Planet gear shaft bore (inch)	.596 to .597
Spline fit with mating parts (inch)	.001T to .0025L
Total gear backlash (inch)	.0013 to .0038
Maximum backlash variation not to exceed (inch)	.0015
Planet gear inside bore (inch)	.7834 to .7839
Planet Gear Spacer	
Length (inch)	.615 to .620
Inside diameter (inch)	.597 to .600
Outside diameter (inch)	.690 to .700

Planet Gear Shaft
Diameter (inch) . . . . . .5952 to .5955

Planet Gear Bearing Needle Roller
Diameter (inch) . . . . . .0936 to .0938

Over-Running Clutch

Over-Running Clutch Roller
Length (inch) . . . . . .583 to .588
Diameter (inch) . . . . . .2938 to .2960

Over-Running Clutch Pin
Length (inch) 1.00
Diameter (inch) . . . . . .168 to .174

Over-Running Clutch Spring
Test load (lbs) 50
Test length (inch) 25/32
Free length (inch) 1-13/32

Over-running clutch spacer thickness (inch) . . . . . .828 to .830

Secondary Sun Gear and Transmission Drive Shaft

Inside Diameter
Pilot bearing bore (inch) . . . . . 2.1288 to 2.1293

Outside Diameters
Front bearing (inch) . . . . . .7495 to .7500
Rear bearing (inch) . . . . . 2.1654 to 2.1660

Total Backlash with Mating Gear
Fifth speed gear and PTO gear (inch) . . . . . .003 to .007
Secondary sun gear (inch) . . . . . .004 to .006

Primary and secondary sun gear thrust washer thickness (inch) . . . . . .092 to .094

TA Clutch and Release Assembly

Clutch Spring
Free length (inch) 2-1/32
Test length (inch) 1-1/4
Test load (lbs) . . . . . 161 $\pm$ 8

Back plate to pressure plate dimension (inch) 593

Release lever height (inch) 1.625

Power Shift Transmission

Type - Hydraulically Actuated Clutches

Charge Pump

Tooth nose clearance (inch)	.008
Inner gear end clearance (inch)	.0025
Gear thickness - matched set - inner and outer (inch)	.3800 max. .3795 min.
Housing bore depth (inch)	.3825 max. .3815 min.
Drive Shaft Rubber Seal Length	
Front (inch)	1.19
Rear (inch)	.70

Clutch Shaft

Diameter of shaft at pocket bearing area (inch)	1.6250 max. 1.6245 min.
Rolling end clearance (inch)	.003 max. .001 min.
Number internally splined (bronze) discs	14 (7 per pack)
Number externally splined (steel) discs	12 (6 per pack)

Countershaft

End clearance (inch)	.010 max. .006 min.

Transmission Drive Shaft Assembly

Rolling end clearance (inch)	.003 max. .001 min.

Control Valve

Rolling Torque

Power control spool (in. lbs)	5
Control valve spool (ft. lbs)	10

Pressures

Apply (in drive) at dash, 175°F. lube temp. at 2000 rpm	75 ± 2 psi
Lube (in neutral) at dash, 175°F. lube temp. at 2000 rpm	44 - 46 psi

Torque Values

Clutch gear retaining nut (rear) (ft. lbs)	70
Reverse idler shaft nut (ft. lbs)	450

Spring Specifications

Spring Description	Free Length (inches)	Total Number of Coils	Test Length (inches)	Test Load (pounds)
Apply pressure	4 ± 1/8	15-3/4	2-3/32	48-1/2
Cooler relief	3-53/64	22	1-3/16	10
Lube pressure				
Detent	1-7/16	20	1-3/64	22
Piston return	1-9/64	7-3/4	13/16	8

Rear Frame

Pinion shaft bearing - Pre-load to obtain rolling torque of 5 to 7 lbs.

Bevel gear carrier assembly - Pre-load to obtain a rolling torque of:
3 lbs. without seals installed
4 lbs. with seals installed

Backlash on bevel gear set - See lash stenciled on bevel gear

Carrier to bevel gear bolt torque (ft. lbs) 55

Steering Clutch

Back plate to pressure plate (inch) 851
Release lever height (inch) 2.367

For complete specifications and servicing, refer to the clutch manual GSS-1281-D.

Final Drive

Run-Out
T.I.R. at outer bearing bore (inch) . . . . . .000 to .005

Torque
Final drive bull gear shaft nut (ft. lbs) . . . . . 170 to 200 max.
Reduce as necessary to align key.

Backlash - Bull gear to pinion (inch) (new) . . . . . .010 to .018

STANDARD TORQUE DATA FOR NUTS AND BOLTS

Recommended torque, in foot pounds, for all Standard Application Nuts and Bolts, provided:

A. All thread surfaces are clean and lubricated with SAE-30 engine oil. (See NOTE.)
B. Joints are rigid, that is, no gaskets or compressible materials are used.
C. When reusing nuts or bolts use minimum torque values.

NOTE: Multiply the standard torque by:

.65 when finished jam nuts are used.
.70 when Molykote, white lead or similar mixtures are used as lubricants.
.75 when parkerized bolts or nuts are used.
.85 when cadmium plated bolts or nuts are used.
.90 when hardened surfaces are used under the nut or bolt head.

Bolt or Stud Diameter	Type 1 Studs Only		Type 1 Bolts 6" length or less		Type 1 Bolts longer than 6"		Type 2 (all lengths)		Type 3 (all lengths)		Type 4 (all lengths) Only when used in cast (gray) iron		Type 4 (all lengths) All other applications	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1/4	5	6	5	6	3	3	9	10	11	13	11	13	12	14
5/16	12	13	12	13	6	7	19	21	24	27	24	27	27	30
3/8	21	24	21	24	11	13	33	37	43	47	43	47	45	50
7/16	35	38	35	38	19	21	53	60	69	76	69	76	75	85
1/2	52	58	52	58	29	32	80	90	104	117	104	117	115	130
9/16	70	80	70	80	41	46	115	130	150	170	150	170	165	185
5/8	98	110	98	110	57	63	160	180	210	230	210	230	220	250
3/4	174	195	174	195	100	112	290	320	350	390	350	390	400	450
7/8	300	330	162	181	162	181	420	470	570	630	570	630	650	730
1	420	470	250	270	250	270	630	710	850	950	850	950	970	1090
1-1/8	600	660	350	380	350	380	850	950	1200	1350	1200	1350	1380.	1550
1-1/4	840	940	490	540	490	540	1200	1350	1700	1900	1700	1900	1940	2180
1-3/8	1100	1230	640	710	640	710	1570	1760	2300	2500	2300	2500	2600	2800
1-1/2	1470	1640	850	940	850	940	2000	2300	3000	3300	3000	3300	3300	3700
1-3/4	2350	2450	1330	1490	1330	1490	3300	3700	4700	5200	4700	5200	5300	6000
2	3500	3900	2000	2200	2000	2200	5000	5500	7000	7800	7000	7800	8000	9000

BOLT TYPE IDENTIFICATION CHART

IH TYPE	S.A.E. GRADE	DESCRIPTION	BOLT HEAD MARKING *
1	Equivalent 1 or 2	WILL HAVE IH STANDARD MONOGRAM IN THE CENTER OF THE HEAD Low or Medium Carbon Steel Not Heat Treated	
2	5	WILL HAVE AN IH AND 3 RADIAL LINES Quenched and Tempered Medium Carbon Steel	
3	6	WILL HAVE AN IH AND 4 RADIAL LINES No longer used in production. For replacement, use Type 4 if Type 3 is not available.	
4	8	WILL HAVE AN IH AND 6 RADIAL LINES Quenched and Tempered Special Carbon or Alloy Steel	

* The center marking identifies the bolt manufacturer. The IH monogram is currently used. Some bolts may still have a raised dot which previously identified IH bolts.

GENERAL DESCRIPTION

The standard model 500 crawler is designed with a five speed forward, one speed reverse transmission and a conventional clutch assembly. The standard tractor can be supplemented by the addition of a power shift transmission, or a torque amplifier.

Changes in the ground speed are accomplished by selection of one of the five gear ranges in the main transmission or actuation of the torque amplifier, either in a specific gear or in anyone of the five main gears.

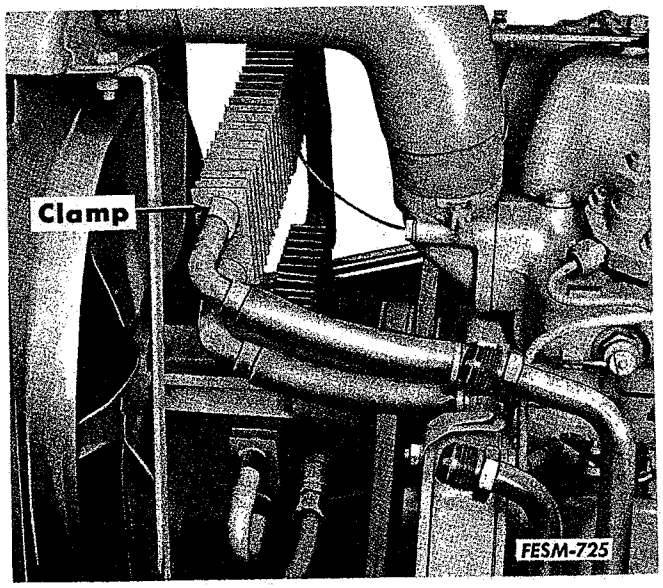
The Power Take-Off in the standard and power shift tractors runs off the transmission countershaft. The PTO drive is engaged through a sliding collar actuated by a shifter fork and hand control on the left side of the transmission housing.

NOTE: A torque amplifier equipped tractor may have either a transmission driven PTO or a constant running PTO with an independent clutch.

The tractor has a high degree of "maintainability", such as identical and easily interchangeable steering clutches, and wrap around steering brakes. The tractor is equipped with a foot operated emergency brake.

OIL COOLER

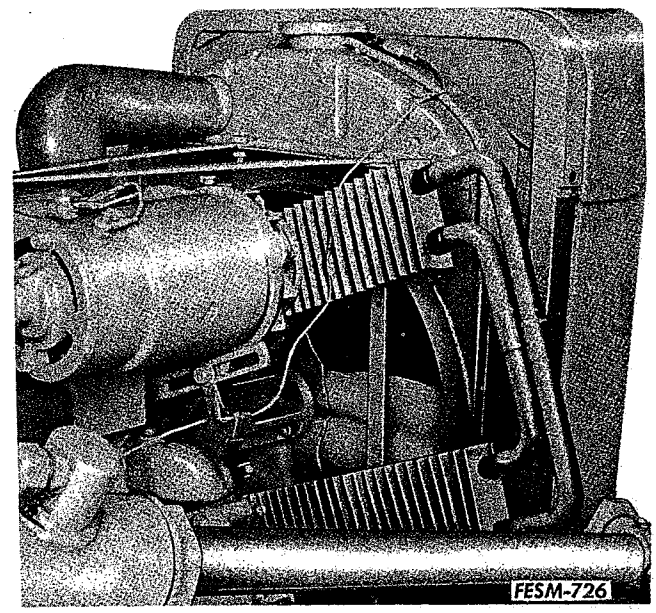
Removal



Illust. 1. Oil cooler lines disconnected (diesel model shown).

1. Loosen the two lines at the oil cooler but do not remove. Remove the four clamps holding the oil cooler to the oil cooler support brackets. See Illust. 1. Note: Do not lose rubber vibration strips.

NOTE: Exercise extreme care in separation of the rubber hoses from the steel lines to prevent distortion of the cooler inlet and outlet tubes.



Illust. 2. Oil cooler removal (diesel model shown).

2. Remove the two lines. Use a drip pan to catch the fluid in these lines. See Illust. 1.

3. Remove the oil cooler by working it out past the fan hub. See Illust. 2.

NOTE: On diesel tractors, it will facilitate removal if the hood is removed.

Installation

Installation of the oil cooler is the reverse of removal.

FRONT SECTION SPLIT

Removal of Engine

1. Remove the exhaust pipe, air intake pipe, hood and side panels.

2. Disconnect and remove the battery.

3. Drain the fuel from the tank.

4. Remove the screws from the dash and fire wall. Move the dash and fire wall back.

5. Remove the lines from the fuel tank.

6. Remove the capscrews and two plates from the rear tank hold down plate.

7. Loosen the left battery box hold down capscrew, and the capscrew on the front tank hold down plate.

8. Loosen the upper rear side plate capscrews and turn the inside bracket away from the tank.

9. Remove the tank by sliding it rearward out of the front rubber mounts and lifting up. See Illust. 3.

10. Remove the crankcase guard.

11. Disconnect all necessary wiring, cables and linkage.

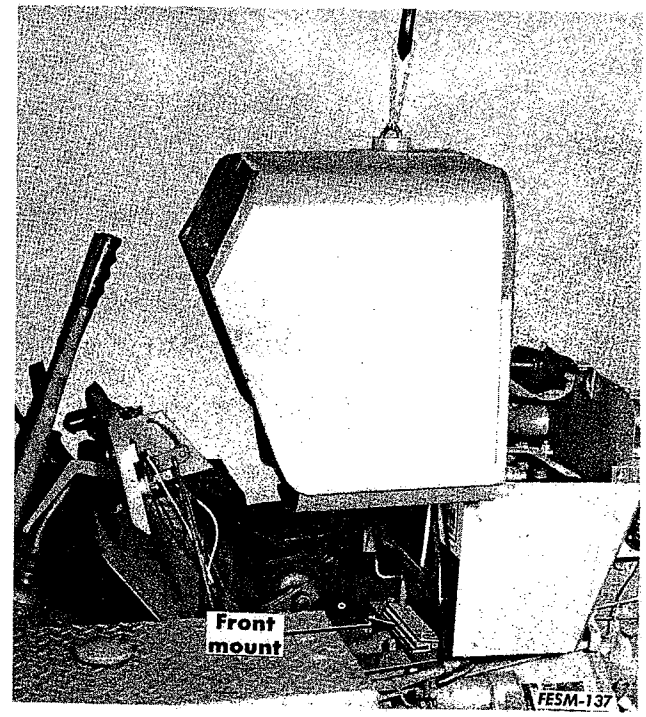
12. Disconnect the oil cooler to power shift lines (if so equipped) at the power shift and plug the openings.

NOTE: These lines can be disconnected at the oil cooler instead, if the left cooler mounting bracket is loosened and slid ahead to prevent damage to the cooler inlet and outlet tubes.

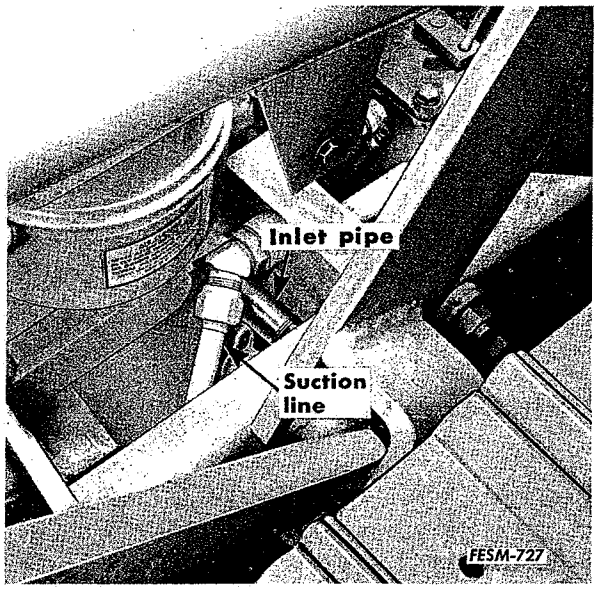
13. Disconnect the hydraulic pump suction and pressure lines and plug the openings.

14. On standard tractors, disconnect the drive line as necessary.

15. On power shift or TA equipped tractors, drain the rear frame.



Illust. 3. Removing fuel tank.



Illust. 4. Removing charge pump inlet pipe (power shift transmission only).

16. On power shift tractors, remove the charge pump suction hose and remove the inlet pipe. See Illust. 4.

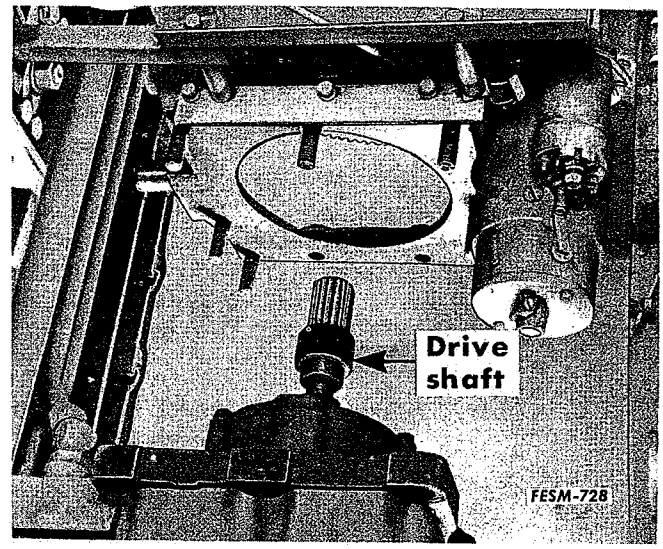
17. On TA or power shift equipped tractors, disconnect the flywheel housing from the TA or power shift unit.

NOTE: Two of the bolts must be reached by removing the bottom flywheel housing cover.

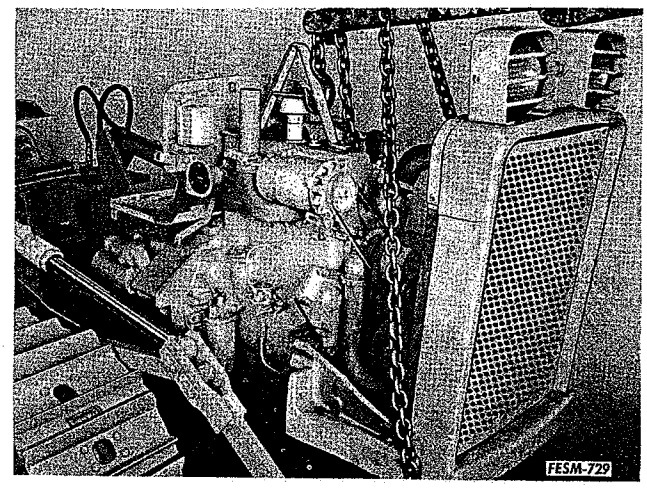
18. Place a floor jack or suitable support under the front bolster and remove the mounting bolts from the side rails.

19. Slide the engine ahead on the side rails. See Illust. 5.

NOTE: If the engine is to be serviced, it should be removed. If the engine clutch, power shift or TA unit is being serviced, it will not be necessary to completely remove the engine as sliding it ahead will allow enough clearance for the removal of



Illust. 5. Engine slid ahead on side rails.



Illust. 6. Engine and grille housing removal.

the TA or power shift unit. Illust. 6 shows the complete engine, radiator and grille housing being removed.

NOTE: The control valve or charge pump on the power shift unit can be serviced without removing the power shift unit. The control valve may be removed if the connecting pipes are left in the housing. After the control valve is removed, the charge pump inlet pipe can be removed to allow charge pump removal.

Installation of Engine

1. Position the complete engine, radiator and grille housing on the side rails. Place a floor jack or suitable support under the front bolster and slide the engine rearward on the side rails.

2. Align the clutch shaft splines with the splines in the driven member (charge pump drive with coupling on power shift) and slide the engine into position.

NOTE: On power shift tractors, inspect the rubber spacers (seals) after installation. If the spacers are compressed excessively (the center should be bulged no more than 3/32 inch) the smaller (rear) spacer should be removed and trimmed so both spacers are loaded, but are not bulged excessively when installed. The length of the front spacer should be 1.19 inch and the length of the rear .70 inch.

3. Install the mounting bolts in the side rails and the bolts in the flywheel housing.

4. On standard tractors, connect the drive line.

5. On power shift tractors, install the charge pump inlet pipe, with new O-rings. Install the suction hose.

6. Connect the hydraulic pump suction and pressure lines.

7. On power shift tractors, connect the oil cooler lines.

8. Connect all linkage, wiring and cables removed during disassembly.

9. Install the fuel tank, hold down brackets and battery box, if removed.

10. Install the fuel lines, dash and fire wall.

11. Install the battery and connect the cables.

12. Install the side panels, hood, exhaust pipe and air intake pipe.

13. Install the crankcase guard and transmission guard.

14. Refill the transmission and rear frame.

REAR SECTION SPLIT

Removal

NOTE: This is only practical if extensive work is required on rear frame or final drives. Do not use for clutch, transmission TA or Power Shift Service.

1. Split the track chains and remove them from the top of the sprockets. Refer to page 80.

2. Remove the transmission guard, clutch covers and crankcase guard.

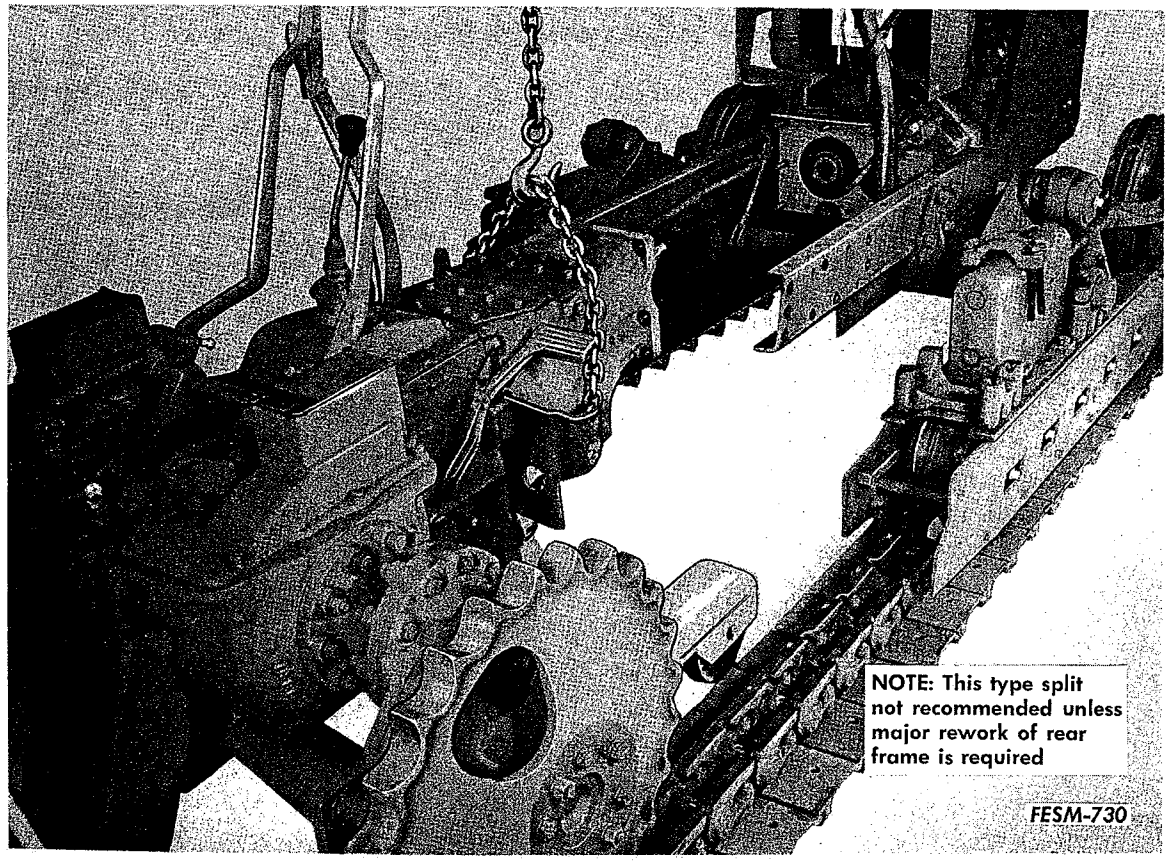
3. Remove the two studs between the clutch housing and the torque amplifier or power shift housing located at the bottom of the housing.

4. Drain the Hy-Tran from the transmission.

5. Remove both final drive pinion shafts. See page 81.

6. Remove the hood, side panels, seat, fenders and floor boards.

7. Remove the battery and fuel tank. Refer to page 11.



Illust. 7. Rear section split.

8. Loosen the front gauge bar clamps.

9. Jack up the rear of the tractor and remove the two rear gauge bars leaving the brackets on the gauge bars.

10. Remove the jack, allowing the rear sprockets to rest on the track chain.

11. Place a jack under the front of the tractor applying just enough pressure to carry the weight.

12. Remove the bolts from the side rail at the transmission support and steering clutch housing.

13. Remove the control linkage at the TA lever and clutch pedal, or power shift control linkage.

14. Remove seven bolts holding the TA or power shift housing to the clutch housing.

15. Remove the hydraulic pump suction line from the transmission housing and permit it to slide through the transmission bracket.

16. Block the front idler at the track to prevent the front end of the tractor from rolling forward.

17. Place a chain around the TA or power shift housing and fasten it to a hoist for support when splitting. See Illust. 7.

18. Split the TA (or power shift) transmission, and final drive as a unit from the clutch housing by rolling the sprockets back on the track chain.

19. Place jack under transmission housing and remove the hoist.

Installation

1. Complete reassembly of the power train. Place a chain around the TA or power shift housing and fasten to a movable hoist.

2. Move the unit forward on the track chains.

3. By adjusting the jack under the front of the tractor and the hoist, make sure the clutch shaft and retainer enter the bearing retainer evenly.

4. The unit should move easily until it is approximately two inches from being in place.

NOTE: Align the splines in the clutch plate and on the clutch shaft by turning the crankshaft. Note the location of the studs as compared to the locating holes in the housing. This will facilitate aligning the splines.

5. Using a bar at each sprocket, push the unit into place.

6. Install nuts on TA or power shift to flywheel housing studs.

7. Install capscrews in the side rails.

NOTE: On power shift tractors, inspect the rubber spacers (seals) after installation. If the spacers are compressed excessively (the center should be bulged no more than 3/32 inch). The smaller (rear) spacer should be removed and trimmed so both spacers are loaded, but are not bulged excessively when installed. The length of the front spacer should be 1.19 inch and the length of the rear spacer .70 inch.

8. Install rear gauge bars.

9. Install shafts and bearing retainers.

10. Install steering clutch housing covers.

11. Tighten the front gauge bar clamps.

12. Install the fuel tank and connect the lines.

13. Install the battery and connect the cables.

14. Install the floor boards, fenders, seat, side panels, and hood.

15. Refill the transmission and rear frame.

16. Install the transmission and crankcase guards.

17. Install the track chains. Refer to page 88.

ENGINE CLUTCH

General

Tractors equipped with the power-shift reverser do not utilize an engine clutch inasmuch as the power shift clutch pack duplicates the function of the engine clutch. Tractors equipped with torque amplifier can be equipped with either a single stage or dual stage clutch. The standard tractor is equipped with the single stage clutch only. The clutches are of conventional design.

Removal

On Standard Tractors

1. Remove transmission and crankcase guards.

2. Remove clutch housing cover.

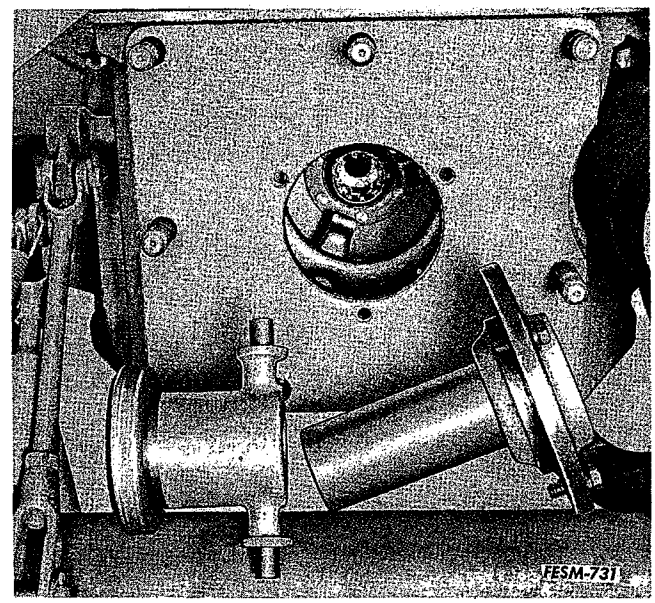
3. Remove drive shaft.

4. Remove clutch shaft and bearing retainer.

5. Remove and check the clutch release bearing. See Illust. 8.

6. Remove clutch assembly through bottom of housing.

7. Check the rear engine oil seal.



Illust. 8. Clutch release bearing removed.

On TA Tractors

1. Perform a front or rear section split. Refer to page 11 or 13.

2. Remove clutch shaft seal retainer.

3. Remove clutch release bearing. See Illust. 8.

4. Remove clutch assembly.

5. For clutch service, refer to Clutch Manual GSS-1281-D.

6. Check clutch shaft bearing.

7. Check rear engine oil seal.

Installation

On Standard Tractors

1. Install the clutch assembly, using the clutch shaft to align the clutch plates.

2. Install the clutch release bearing, retainer and clutch shaft.

3. Install the drive shaft.

4. Install the clutch housing cover.

5. Install the transmission and crankcase guards.

On TA Tractors

1. Slide the engine and transmission together until the clutch shaft enters the flywheel housing.

2. Place the release bearing, retainer and clutch assembly on the clutch shaft as the engine and transmission are slid together.

3. When the clutch shaft is started in the pilot bearing, bolt the clutch assembly to the flywheel.

4. Refer to page 13 or 15 for further installation.

TORQUE AMPLIFIER SERVICE

Removal

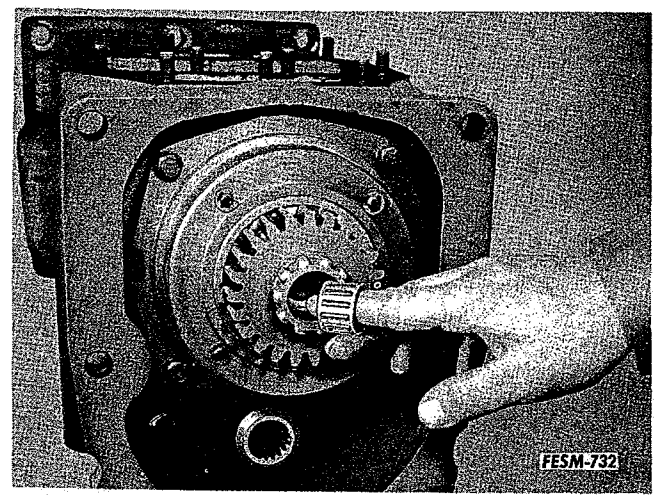
NOTE: The TA unit may be removed from the front or rear of the tractor. The procedure used will be determined by any servicing required on the engine or transmission and rear frame. If the engine is to be removed, refer to page 11. If the transmission and rear frame are to be removed, refer to page 13. Do not attempt removal of rear frame unless major work is required on this component.

1. If the TA unit is being removed from the front, the front gauge bar must be removed (except on loader tractors). To remove the gauge bar, loosen the hold down clamps. See Illust. 45. Position a jack under the frame to take the weight off the bar. See Illust. 46. Remove the aligning pins, Illust. 47, and pull the gauge bar from the tractor. (Refer to Illust. 48.) (Install the gauge bar after the TA unit is removed to support the weight.)

2. Disconnect the linkage and drain the fluid from the housing.

3. Remove the mounting bolts and remove the TA unit from the rear frame.

NOTE: Do not lose the pilot bearing from the top transmission shaft which may come off with the TA. See Illust. 9.

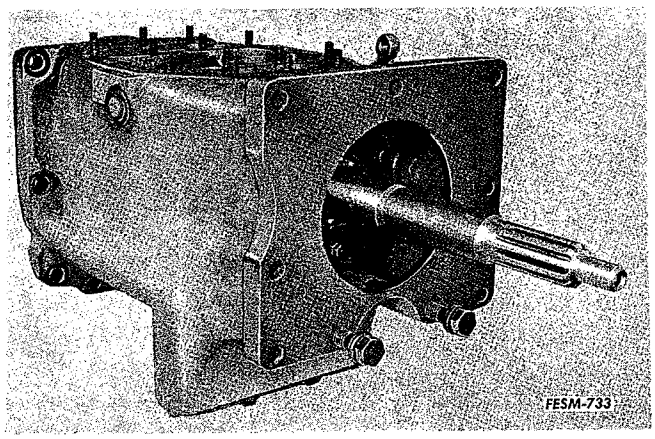


Illust. 9. Pilot bearing at rear of TA unit.

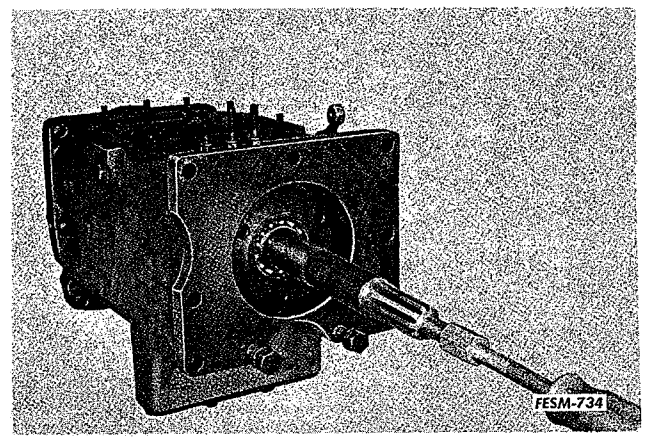
Special Tools Required

FES 10-6	Driving collar
FES 10-9	Oil seal protector sleeve
FES 10-10	Oil seal protector sleeve
FES 10-11	Pin punch
FES 10-12	Spanner wrench
FES 10-15	Dummy shaft
FES 10-16	Allen wrench
FES 10-23	Driving mandrel
FES 10-29	Pilot bearing driver
FES 10-30	Pilot bearing puller

Disassembly



Illust. 10. Torque amplifier housing.



Illust. 11. Removing clutch shaft.

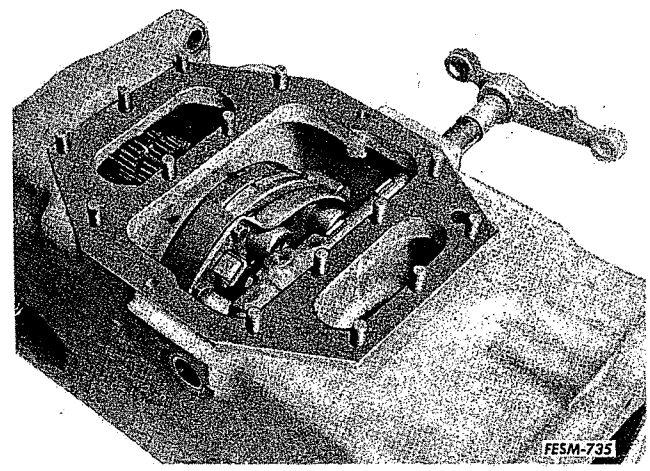
NOTE: A cross section of the torque amplifier is shown in Illust. 44.

1. Remove the top cover and gasket. See Illust. 10.

NOTE: The servicing procedure will be the same whether the tractor is equipped with standard or constant running PTO.

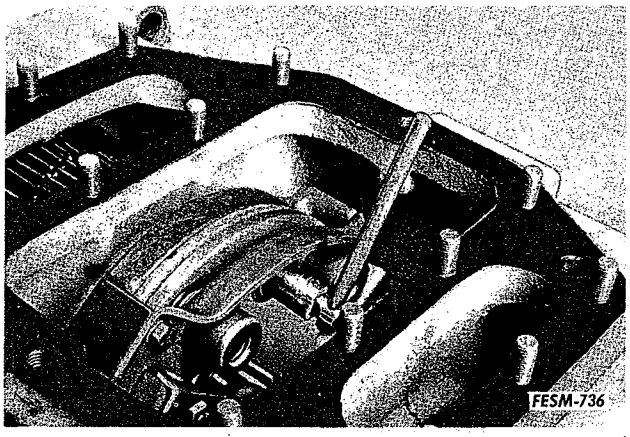
2. Remove the capscrews from the clutch shaft bearing retainer or constant running PTO drive shaft bearing retainer. Remove the constant running PTO drive shaft and bearing retainer.

3. Remove the clutch shaft assembly, using a slide hammer and correct adapter. See Illust. 11.

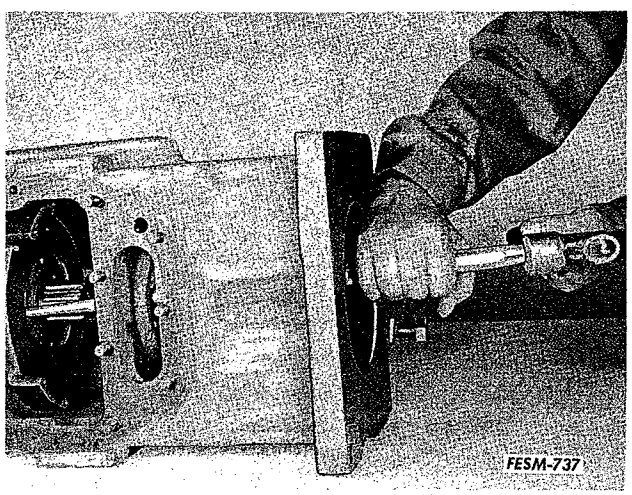


Illust. 12. Removing clutch release shaft.

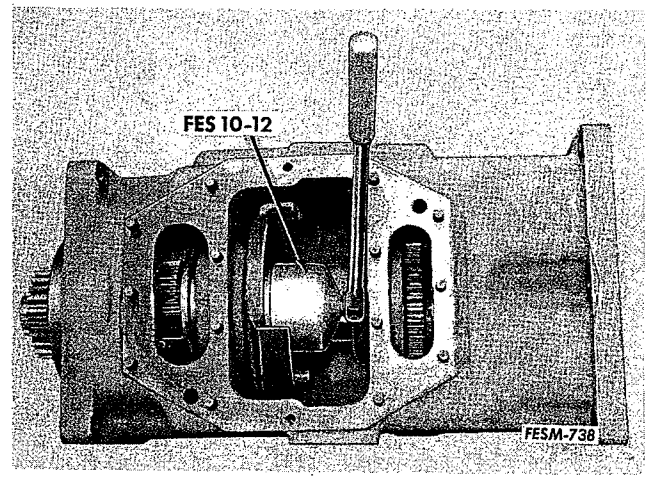
4. Remove TA clutch release units by removing snap ring and thrust washer from right side of release fork. Remove locking screw from release bearing housing. Slide shaft to the side, removing the keys as they appear from release bearing fork. Remove release bearing. See Illust. 12.



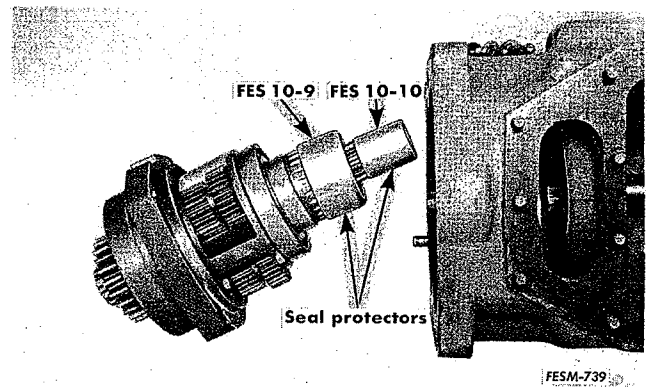
Illust. 13. Installing compression capscrews.



Illust. 14. Unlocking TA carrier nut.



Illust. 15. Removing the TA carrier nut.



Illust. 16. Removing TA assembly.

5. Install three 5/16 inch x 1/2 inch capscrews with large washers to hold the clutch in a compressed state for removal. See Illust. 13. Remove six bolts from clutch cover. Remove clutch cover and driven disc assembly.

6. Drive lock washer back from planet housing nut. See Illust. 14.

7. Remove the TA carrier nut using FES 10-12 socket. See Illust. 15.

8. Remove four capscrews holding planet housing bearing retainer to the main case. If one stud is left in the case with about two threads engaged, the planetary unit can be moved to rear to allow clutch backing plate to be removed.

9. Install seal protectors on splines in planetary housing, remove last bolt and slide planetary unit to rear and remove. See Illust. 16.

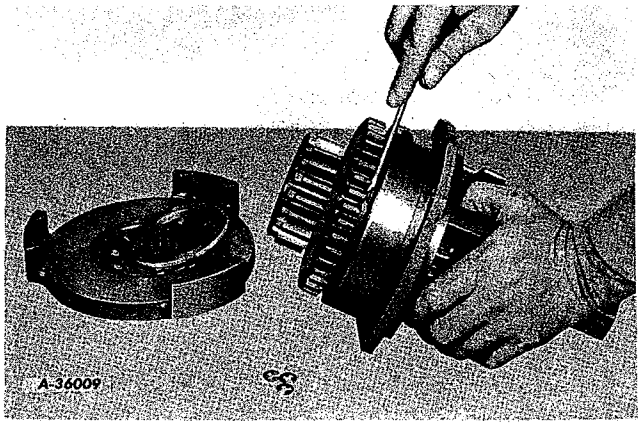
PTO Drive Assembly

1. Remove front plate cover from power take-off shaft.

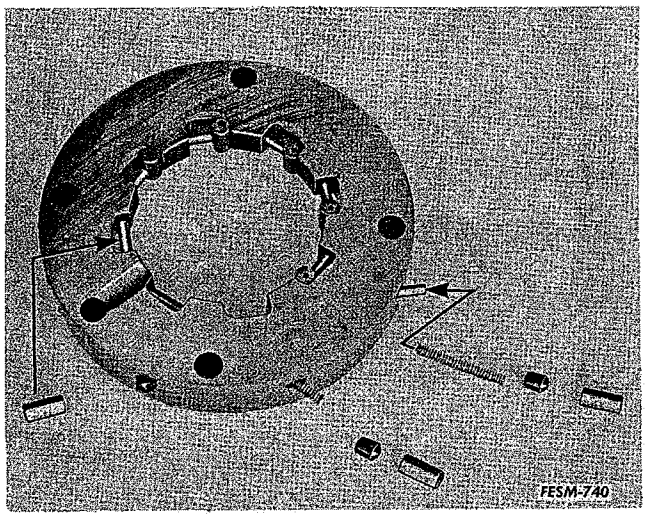
2. Remove lock ring and shims and slide shaft to rear.

3. Remove bottom cover on main housing and remove power take-off driven gear.

Planet Assembly



Illust. 17. Removing the retaining rings from the bearing carrier capscrews.



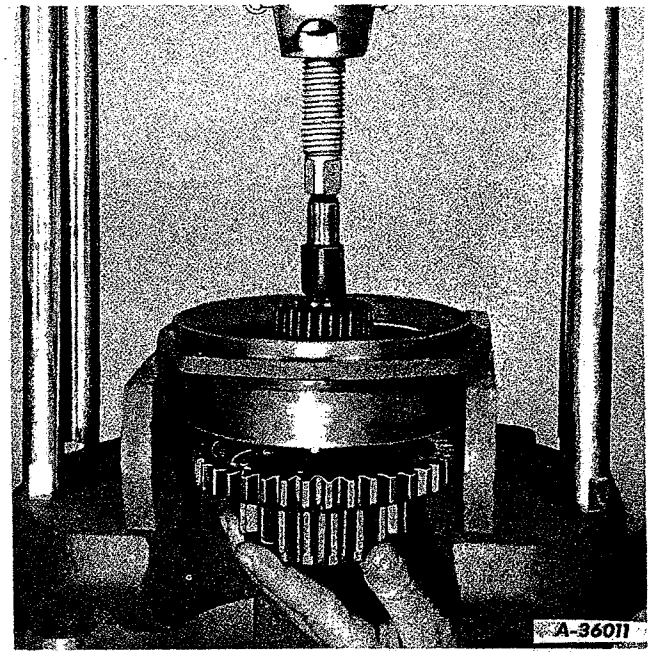
Illust. 18. Overrunning clutch partially disassembled.

1. Remove lock rings from four bearing carrier capscrews. See Illust. 17. Move the planetary housing until the slot in the housing uncovers the head of one screw.

2. Remove the capscrews, using a 12 point socket. Usually the retainer can be removed, however, if it is tight, a press can be used.

NOTE: Do Not lose the eight overrunning clutch rollers. See Illust. 18.

3. Separate the transmission drive shaft with secondary sun gear and bearing cage assembly from the planet carrier.



Illust. 19. Pressing the transmission drive shaft from the bearing.

4. Remove the snap ring in front of the bearing on the transmission drive shaft with snap ring pliers and lift from the groove with an offset screwdriver.

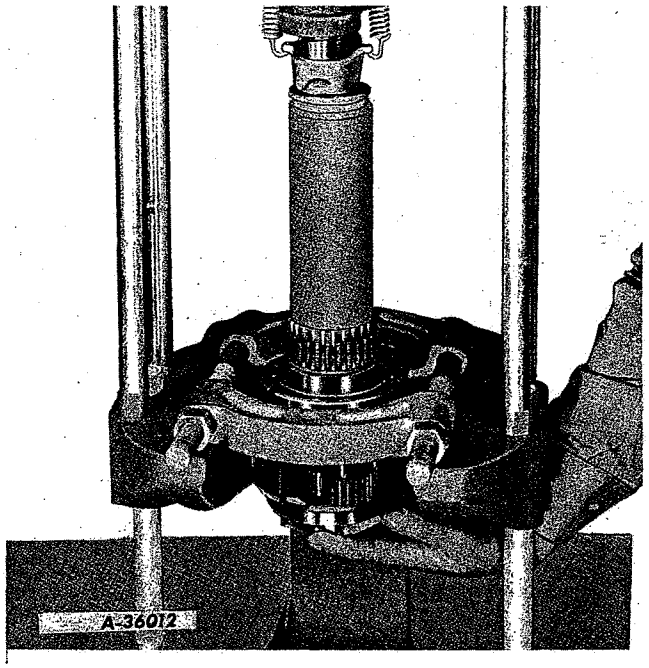
5. Press the transmission drive shaft out of the bearing. See Illust. 19. The bearing can now be tapped or pressed forward out of the cage.

6. Remove the overrunning clutch rollers with a small screwdriver or needle nose pliers. Tap the overrunning clutch ramp off the planet carrier rear bearing.

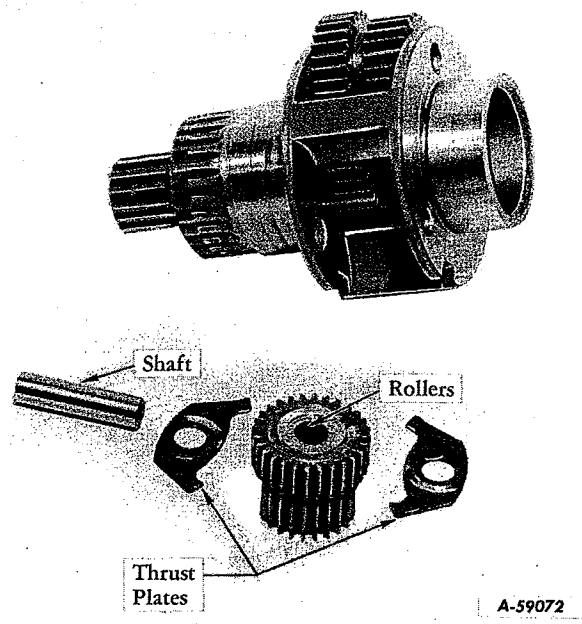
7. Press the front and rear bearings from the planet carrier. See Illust. 20.

NOTE: When removing the front bearing, do not press directly on the sun gear shaft. Use a block or 3 x 16-1/2 inch pipe to avoid damaging the planet carrier.

8. Remove the roll pins securing the planet gear shaft, using FES 10-11 punch. Push the planet gear shafts out. Dummy



Illust. 20. Removing the planet carrier front bearing.



Illust. 21. Planet gear components.

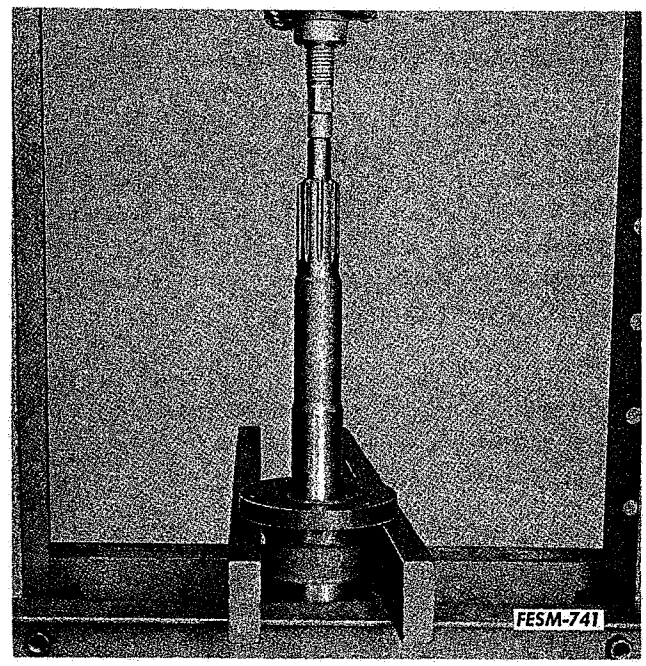
shaft FES 10-15 should be used, thereby allowing the needle rollers to remain in the gears. See Illust. 21.

NOTE: Avoid damaging the spacers or thrust plates.

9. Install seal protector on sun gear shaft and remove shaft.

NOTE: Do not lose thrust washer between sun gear shaft and output shaft.

10. Press the clutch shaft from the front bearing cage. See Illust. 22. Press the bearing from the cage if it is to be replaced.



Illust. 22. Removing bearing from clutch shaft.

Cleaning, Inspection and Repair

Primary Sun Gear and Shaft

1. Check the splines at the forward end for roughness and wear.

2. Inspect the oil seal surface for roughness and wear.

3. Check the bearing areas on the shaft for wear and brinelling.

4. Examine the sun gear teeth for chipping and wear.

5. Inspect the secondary sun gear pilot bearing for roughness and wear and replace if necessary, using FES 10-30.

NOTE: Except for replacement of the pilot bearing, if any of the inspected items are found unsatisfactory, the primary sun gear and shaft should be replaced with a new part complete with pilot bearing.

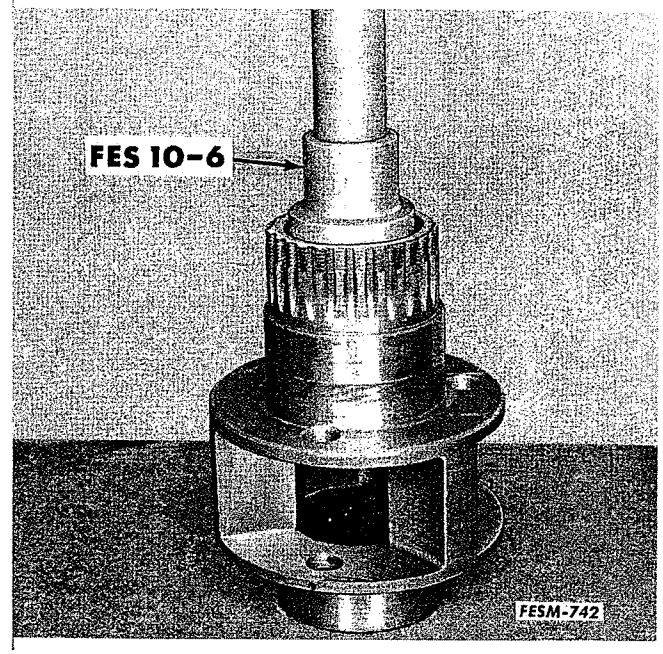
Planet Carrier, Gears and Bearings

1. Check the sun gear shaft bearings in the planet carrier for wear and roughness. Also check the oil seal for damage and wear. If either the seal or the bearings are to be replaced, use a press to remove these parts so as to prevent damage to the planet carrier. See Illust. 23.

2. Inspect the planet carrier for rough oil seal surface, elongated planet gear shaft holes and worn or damaged overrunning clutch roller surface.

3. Check the planet gears for worn or damaged gear teeth. Also check the bearing spacers, thrust plates and shafts for wear.

NOTE: Torque amplifier planet gears are manufactured in matched sets of three so that each gear will have equal backlash when installed, thereby eliminating the possibility of any one gear carrying more than its share of the load. These gears are available only in sets of three for service,



Illust. 23. Removing sun gear shaft bearings and seal.

and under no circumstances should they be installed except in matched sets of three. For the same reason it is recommended that all planet gear shafts and bearings should also be replaced with new at the same time.

4. Clean and inspect the planet carrier front and rear bearings. If the bearings are not to be discarded, oil and wrap them in oil-proof paper.

5. Inspect the planet carrier oil seal (located in the TA housing) for wear or damage and evidence of leakage.

Overrunning Clutch

1. Inspect the rollers for damage and wear. All rollers showing uneven wear should be replaced. See Illust. 18.

2. Pull the rubber plugs and remove the springs and pins from the ramp. Check the pins for damage or wear. Check the springs for free length. See Illust. 18.

3. Check the ramp for brinelling or wear at the point of contact with the roller.

Secondary Sun Gear and Transmission Drive Shaft

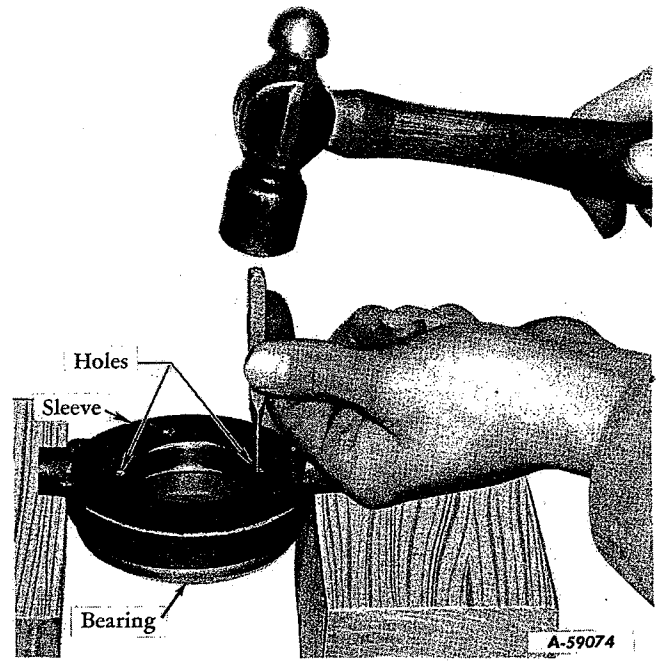
1. Clean and inspect the ball bearing.

2. Inspect the pilot bearing surface for wear and brinelling.

3. Check all gear teeth for wear and chipping.

4. Check the sun gear thrust washer for wear and scuffing.

5. Inspect the pilot bearing bore in the transmission driving gear for wear and roughness.



Illust. 24. Removing the clutch release bearing.

TA Clutch and Release Assembly

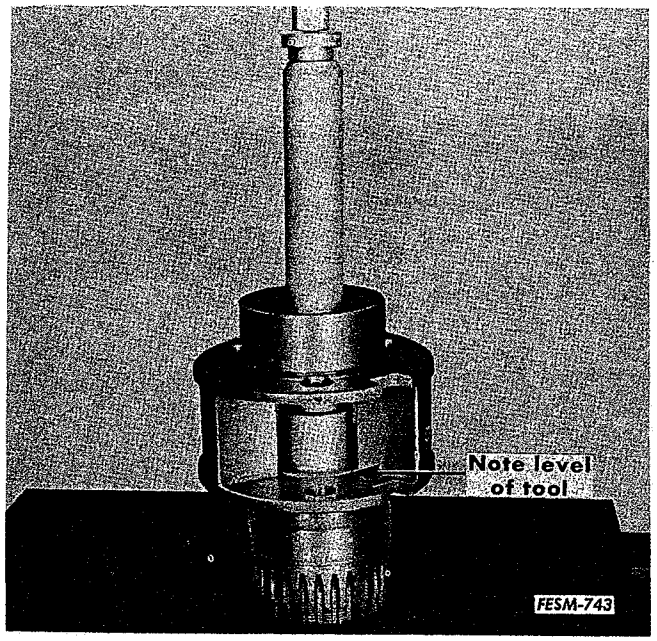
1. Check the clutch carrier for cracked or scored surfaces.

2. Examine the friction plate for loose or worn lining, loose hub rivets, worn splines and warpage.

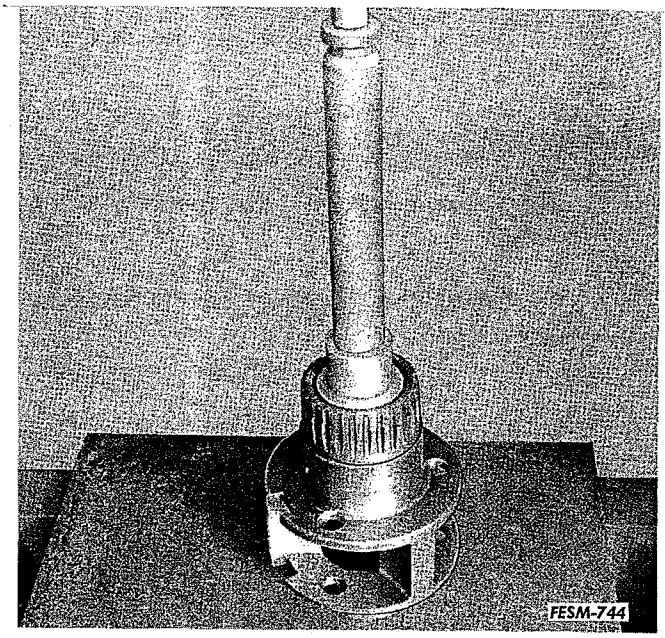
3. Disassemble the clutch pressure plate assembly. Check for worn release levers, inspect the pressure plate for cracks or scoring and inspect and test the springs.

4. Assemble the TA clutch and adjust the release levers following procedure in GSS-1281-D clutch manual.

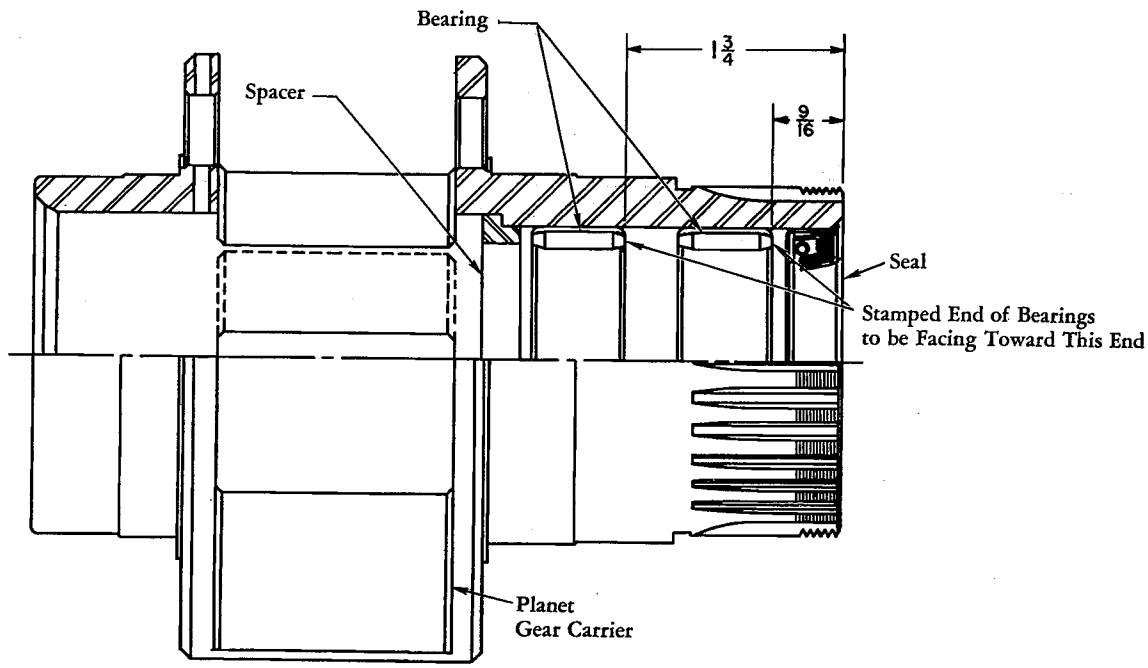
5. Check the release bearing for roughness and wear. Also examine the release fork and shaft for wear. If the bearing must be replaced, remove it from the release sleeve by tapping the bearing out of the sleeve with a small punch. See Illust. 24.



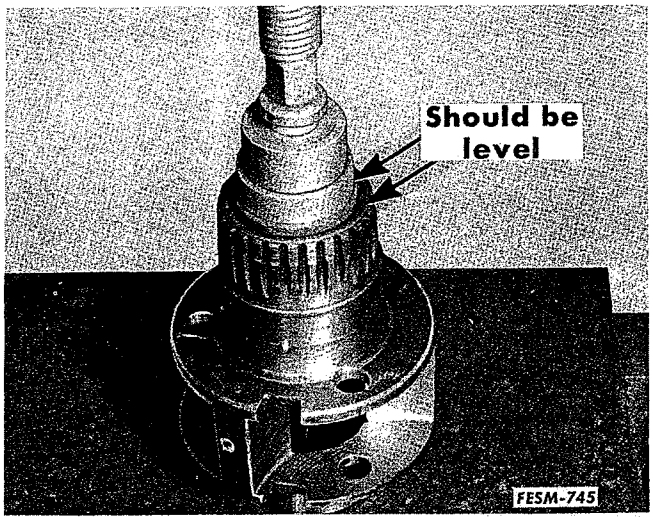
Illust. 25. Installing primary sun gear rear bearing.



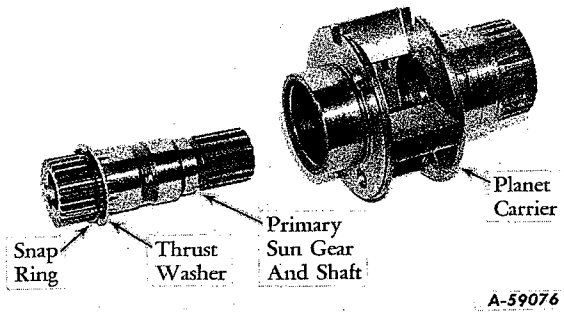
Illust. 26. Installing primary sun gear front bearing.



Illust. 27. Proper primary sun gear bearing and seal location.



Illust. 28. Installing primary sun gear shaft seal.



Illust. 29. Installing the primary sun gear snap ring and thrust washer.

NOTE: A cross section of the torque amplifier is shown in Illust. 44.

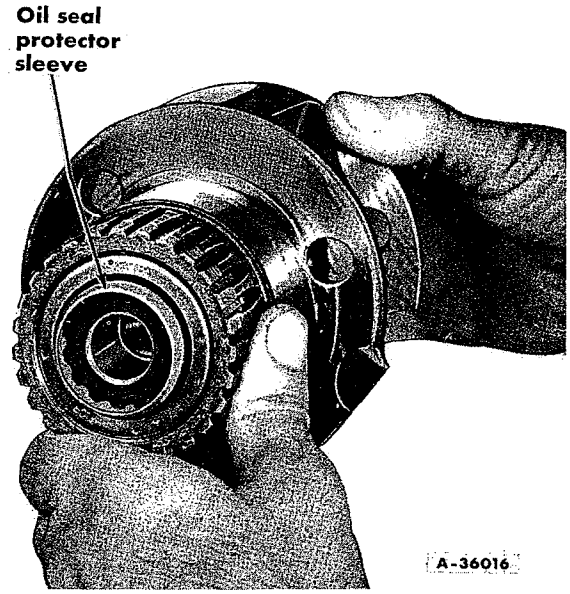
1. Install the primary sun gear roller bearings in the planet carrier. See Illusts. 25 and 26. Position the bearings as shown in Illust. 27. Special driving collar FES 10-6 is designed for both installing and locating these needle bearings.

NOTE: It is important that these bearings be pushed only from the end showing the manufacturer's marking.

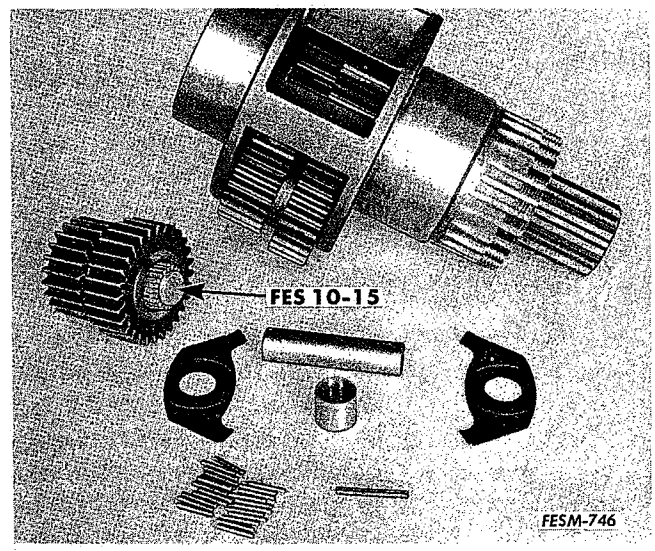
2. Press the primary sun gear oil seal into the planet carrier. See Illust. 28. Position the seal as shown in Illust. 27.

3. Install the secondary sun gear pilot bearing in the primary sun gear, using special driver FES 10-29.

4. Place the snap ring and thrust washer on the primary sun gear as shown in Illust. 29.



Illust. 30. Installing the primary sun gear and shaft into the planetary carrier.

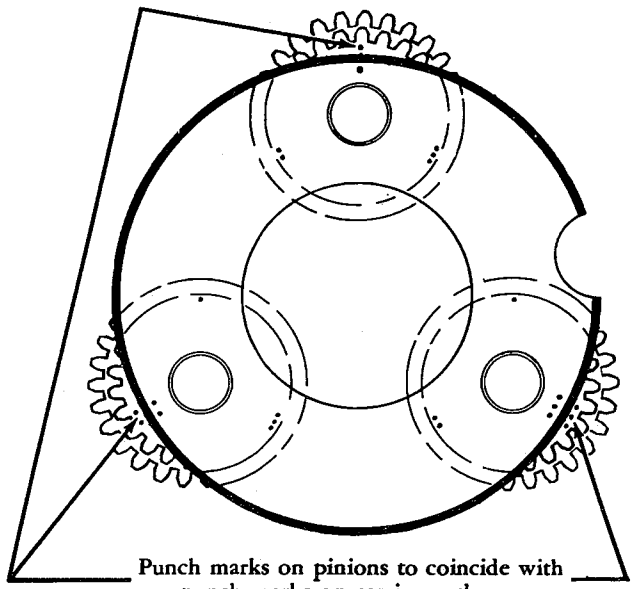


Illust. 31. Installing the planet gear needle bearings.

5. Install the primary sun gear and shaft in the planet carrier, using the oil seal protector sleeve FES 10-10. See Illust. 30.

6. Assemble the needle bearing rollers in the planet gears. The dummy shaft FES 10-15 should be used. Use petroleum jelly to hold the needle rollers in place during assembly. See Illust. 31.

NOTE: Be certain to place the spacer between the two rows of bearings when assembling the bearing rollers.



Illust. 32. Planet carrier and gears with timing marks properly indexed. (Viewed from the rear.)

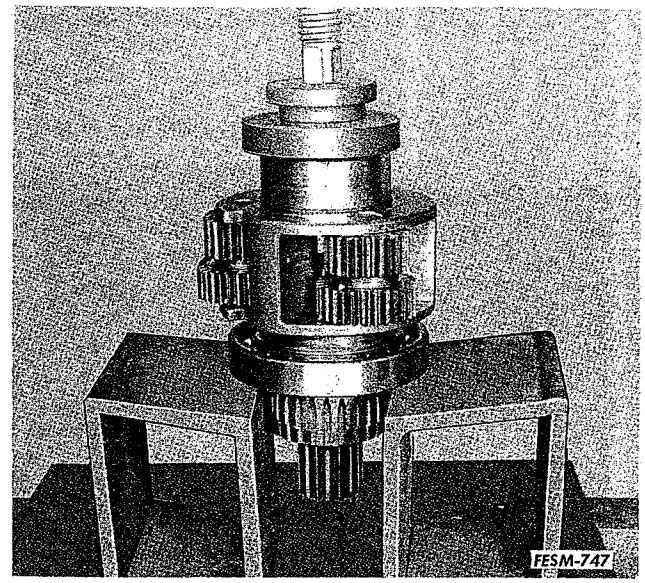
7. Assemble the planet gears into the planet carrier. The planet carrier has timing marks on the rear surface at each planet gear location. These are marked consecutively counterclockwise from 1 to 3. The planet gears are marked at three points, 120 degrees apart on the back side of the gear.

These gears are also marked consecutively counterclockwise from 1 to 3. Therefore, the planet gears are interchangeable within a matched set of three. When assembled, the timing marks on the planet gears must be indexed with the marks on the carrier as shown in Illust. 32.

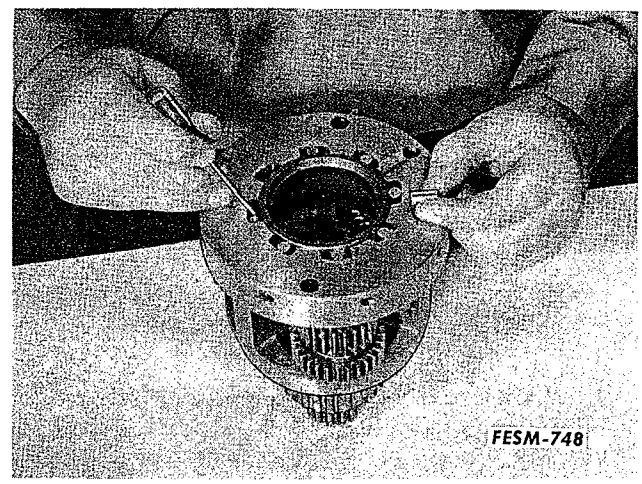
With the thrust plates in position, install the planet gear into the carrier and push the shaft into the carrier and gear. The dummy shaft will be pushed out when installing the regular shaft. Secure the planet gear shaft with the roll pin. Assemble and install the two remaining planet gears.

8. Install planet housing bearings using press. See Illust. 33.

NOTE: Do not press against the primary sun gear and shaft.



Illust. 33. Installing planet housing bearing.



Illust. 34. Installing overrunning clutch rollers.

9. Install clutch washer (small) against rear bearing.

10. Assemble ramp by installing pins, springs and plugs. See Illust. 34. A small screwdriver will aid in installation.

11. Pushing the pin back against the spring, install rollers. See Illust. 34.

12. Install overrunning clutch washer (large) against the ramp.

13. Install transmission drive shaft and bearing.

NOTE: Be certain thrust plate is in place between sun gear shaft and transmission drive shaft.

14. Install retainer being sure that lube opening in ramp lines with lube opening in retainer. Turn planet gear housing until opening lines up with hole for the capscrews.

15. Install each screw in turn. Tighten screws and install retainer rings.

16. Place seal protector FES 10-9 on splined end of planet housing.

17. Install assembly with lube opening to left hand side of housing. Install one capscrew two turns.

18. Remove seal protector, install clutch backup plate. Install balance of screws in retainer and torque to 40 ft. lbs.

19. Install lock and nut on planet gear shaft. Tighten up solidly and lock nut with washer using FES 10-12.

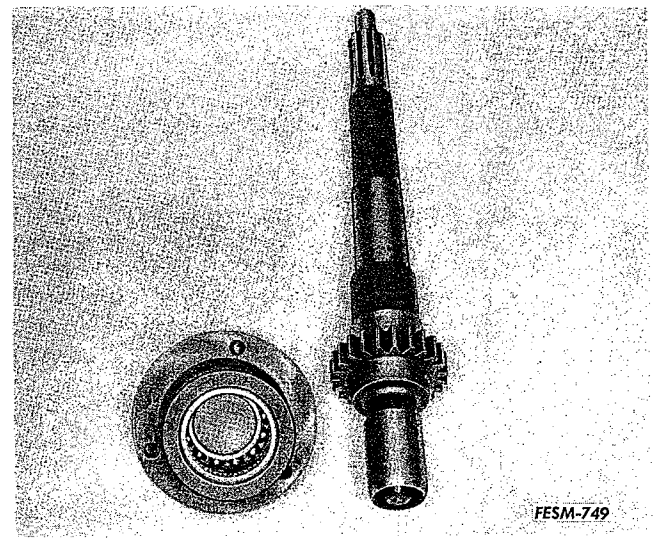
20. Install TA clutch plate and pressure plate to clutch backup plate with six capscrews.

21. Remove three hold down capscrews and washers from pressure plate.

22. Install release bearing and shaft making sure to install Woodruff keys in shaft.

23. Install special lock screw, thrust washer and snap ring on shaft.

NOTE: If the clutch shaft needle bearing and/or front ball bearing were removed, reinstall as follows.



Illust. 35. Clutch shaft and bearing retainer.

24. Install engine clutch shaft needle bearing by pressing into the rear of retainer. Bearing should be installed until it is in line with counterbore on retainer. See Illust. 35.

NOTE: Press this bearing only from the end with manufacturer's markings.

25. Install front ball bearing in retainer and install snap ring.

26. Place retainer in a press supporting the inner race of the ball bearing. Press in shaft and install snap ring.

27. Install the clutch shaft and bearing retainer. (Constant running PTO shaft, if so equipped.)

28. Install the PTO driven gear, PTO shaft, shims and lock ring.

29. Install the front plate cover and bottom cover with gasket.

30. Install the top cover with gasket using nuts and lock nuts.

Installation

1. Install the pilot bearing in the transmission driving shaft.

2. Install the TA on the transmission housing with the use of alignment dowels.

3. Connect the linkage and refill the housing and rear frame.

4. If the TA was removed from the front, refer to page 13 for the remaining installation. If the TA was removed from the rear, refer to page 15.

POWER SHIFT TRANSMISSION

Principles of Operation

The transmission consists basically of hydraulically applied oil clutches to achieve instantaneous forward or reverse operation. In order to accomplish this the following components are required: hydraulic fluid reservoir, pressure pump, full flow filtration, oil cooler, oil cooler by-pass valve, "apply" system relief valve, "lube" pressure relief valve, hand lever directional control valve, power control pedal valve, check valve, and the two hydraulic clutch packs (one forward and one reverse). IH Hy-Tran Fluid (suffix R4) is used in the power shift transmission, a supply of 12 gallons is contained in an integral reservoir formed by the rear frame and sliding gear transmission cases. The same reservoir and fluid provides the hydraulic system supply for any mounted attachments and provides lubrication for the sliding gear transmission, pinion and bevel gear.

In order to describe the operation and circuits, it will be necessary to divide the operation into four distinct phases. We will term these operation phases the NEUTRAL, FORWARD, REVERSE, and POWER CONTROL PEDAL DEPRESSED CIRCUITS. Following this, a detailed description of the action within the clutch packs is discussed.

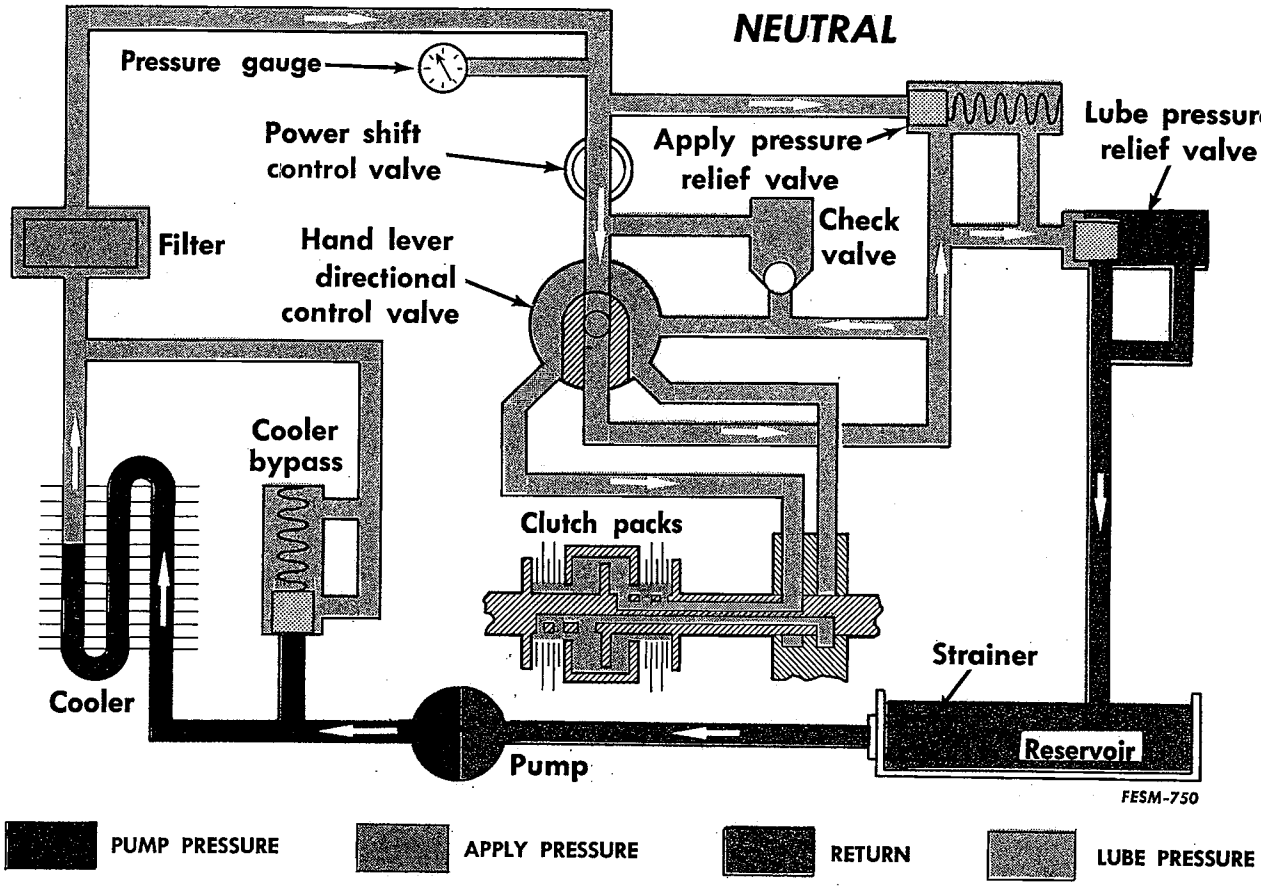
Neutral Circuit

Refer to Illust. 36. Fluid is drawn from the 12 gallon supply reservoir by a pump at the rate of 12 gallons per minute at rated engine speed. The pump is protected by a 100 mesh suction strainer located within the reservoir.

The pump output is filtered through a full flow paper filter cartridge of 1 to 10 microns filtering capacity. The filter is conveniently located under the LH deck plate. A by-pass valve inside of the filter protects the filter from "blockage" of fluid on event of a restriction of major proportions.

The entire pump flow is circulated through a cooler to maintain the fluid temperature at a safe level (under 235° F.) An oil cooler bypass valve provides protection to the cooler and other circuits from the pump to cooler in event that the cooler oil flow is restricted due to low ambients (high oil viscosity). This action takes place anytime the pressure differential across the oil cooler exceeds 10 psi thereby diverting fluid as necessary to maintain the pump output through the circuit.

The pressure delivered by the pump at rated speed is restricted to and held at 75 $\pm$ 2 psi by means of an "apply" pressure relief valve located in the circuit. The 75 psi valve represents the "safe" pressure necessary to maintain positive engagement of the clutch packs at maximum torque. In event of extremely cold viscous fluid, the pressure can and will rise above 75 $\pm$ 2 psi until the temperature reaches the operating range.



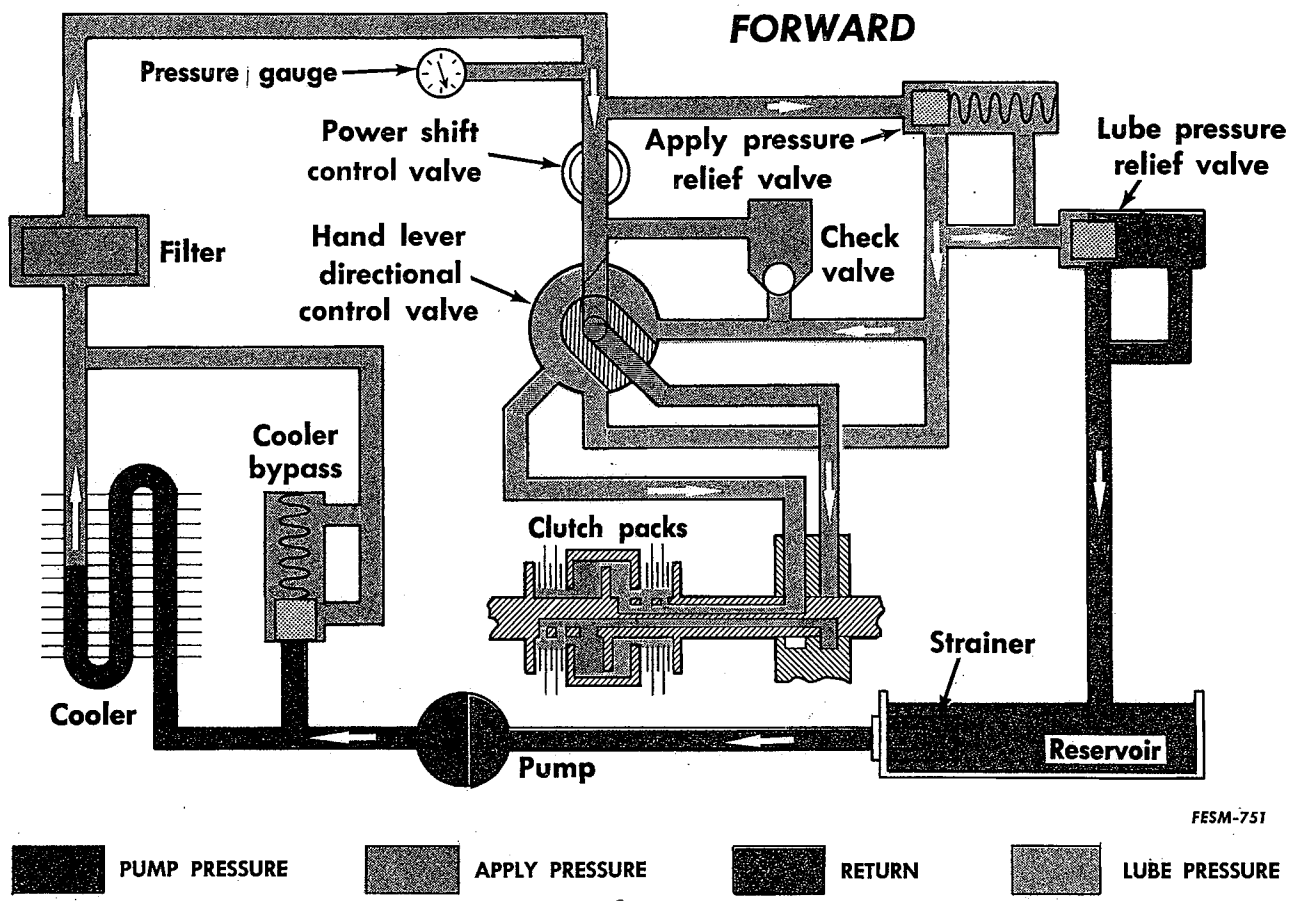
Illust. 36. Schematic circuit in neutral.

A "lube" pressure relief valve is located in the same circuit for the purpose of maintaining a pressure of 22 psi at rated engine speed in the clutch packs or pack that is in a non-engaged position. This occurs anytime the engine is running and the selector is in neutral (both packs disengaged), the tractor is moving (one pack will be disengaged) or the power control pedal is actuated. See power control pedal depressed Illust. 40.

The lube pressure relief valve regulates the pressure in the "lube" circuit to 22 psi. The fluid in excess of that required will return to the reservoir via the "lube" relief valve return to reservoir line. Fluid in the "lube" circuit passes into the hand lever control valve housing which in a neutral position permits fluid to flow to both the forward and reverse clutch packs. This supplies lubrication for the spinning clutch packs, which revolve anytime the engine is running. The fluid not required for engaging the activated clutch pack and for lubrication of the entire power shift assembly is returned to the reservoir. A check valve located in the circuit plays no part in this phase and remains seated due to equal pressure on both sides of the ball check. Both lube and apply circuits are set at rated load speed and at least 175°F. temperature.

Forward Circuit

In the diagram, Illust. 37, the fluid flow is identical to the neutral circuitry up to the hand lever directional control valve. This valve has now been positioned by the operator to permit fluid at 75 psi to pass through this valve and into the forward drive clutch pack, thereby engaging the forward drive. The lube pressure circuit is now supplying fluid at 22 psi to the reverse drive clutch pack, through the passages provided in the directional control valve. Any fluid from



Illust. 37. Schematic circuit in forward.

the 12 gallon supply that does not leak off from the clutch pack returns to the main supply via the lube valve return line. The check valve is seated due to the 75 psi pressure imposed on the check valve ball and as such plays no part in the forward circuitry.

Reverse Circuit

A review of Illust. 38 will indicate the fluid flow is identical with the forward circuitry except the hand lever directional control valve is positioned to direct the 75 psi "apply" pressure to the reverse drive clutch pack. The check valve is inoperative and seated as in the forward circuit. The lube circuit lubricates the forward drive clutch pack.

Power Control Pedal Depressed

The circuit diagram in Illust. 39 shows the hand lever directional control valve in the forward position (it could be in the reverse position with identical results). The power control pedal valve, foot actuated by the operator, blocks the "apply" pressure circuit into the directional control valve. This blockage results in immediate drop in apply pressure (75 psi) to lube pressure (22 psi) on both clutch packs and as such forward motion ceases. The lube circuit controlled at 22 psi pressure by the lube pressure relief valve now supplies both the forward and reverse clutch packs which are spinning but not engaged. This is accomplished in the instance shown by means of the lube circuitry through the directional control valve which is supplying the reverse pack and through the check valve which now has a pressure of 22 lbs. raising the ball check (the usual 75 psi holding the ball seated is now non-existent) permitting the lube circuit fluid to flow through the forward pack circuit. Excess fluid not leaking off at the clutch packs is returned to the main supply via the lube pressure relief valve return. The power control circuit does not allow slippage of the clutch packs. The clutch packs are either engaged or disengaged.