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23. R&R AND OVERHAUL UPPER PEDESTAL. To remove the upper pedestal, first remove the grille screens and the left side panel as shown in Fig. MF238. Loosen clamp bolt (B) retaining steering arm to lower end of pedestal shaft and disconnect the drag link at forward end. Remove the cap screws retaining upper pedestal to front support casting and remove pedestal assembly from tractor.

Remove the nut (26 - Fig. MF239) retaining steering arm (29) to pedestal shaft and remove the steering arm. Remove pedestal shaft (30), examine all parts and renew any which are damaged or show wear. Ream new bushings (32), after installation, to an inside diameter of 1.5005-1.5015. Pedestal shaft (30) should have a clearance of 0.0005-0.002 in the bushings.

POWER STEERING SYSTEM

Note: The maintenance of absolute cleanliness of all parts is of utmost importance in the operation and servicing of the hydraulic power steering system. Of equal importance is the avoidance of nicks or burrs on any of the working parts.

FILLING AND BLEEDING All Models So Equipped

24. Fluid capacity for the complete power steering system is 2/3 qt. for TO35, MF35 and MF50 and 1 qt. for other models.

Only automatic transmission fluid, Type A is recommended for use in the power steering system. Reservoir fluid level and the paper filter element in reservoir should be checked every 750 hours of operation or more often in severe dust conditions. Reservoir

fluid level should be maintained 1/4-1/2-inch above the filter element.

To bleed the system, fill reservoir, start engine and turn the steering wheel full right and full left several times to bleed air from the system; then, refill reservoir to the proper level.

TROUBLE SHOOTING All Models So Equipped

25. The accompanying table lists troubles which may be encountered in the operation of the power steering system. The procedure for correcting most of the troubles is evident; for those not readily remedied, refer to the appropriate subsequent paragraphs.

NOTE: Control valve on F40, MH50 and MF50 is not equipped with check valve. Turning steering wheel fully with engine not running will exhaust fluid in cylinder causing pressure build-up in reservoir which may rupture cover seal causing fluid loss. If this condition is encountered, caution operator against operating steering with engine not running.

POWER STEERING SYSTEM TROUBLE-SHOOTING CHART

	Loss of Power Assistance	Power Assistance in One Direction Only	Unequal Turning Radius	Erratic Steering Control	Fluid Foaming Out of Reservoir
Binding, worn or bent mechanical linkage.....	★		★	★	
Insufficient fluid in reservoir.....	★				
Low pump pressure.....	★				
Faulty or improperly installed control valve thrust bearing (TO35, MF35, MHF202, MF202 & MF204.....	★	★		★	
Valve thrust bearing nut improperly tightened (TO35, MF35, MHF202, MF202 & MF204.....	★			★	
Sticking or binding valve spool (TO35, MF35, MHF202, MF202 & MF204.....	★	★		★	
Faulty valve plungers and/or springs (TO35, MF35, MHF202, MF202 & MF204.....	★			★	
Check valve ball not seating (TO35, MF35, MHF202, MF202 & MF204.....	★				★
Damaged or restricted hose or tubing.....	★	★			★
Pump to valve hose lines reversed.....	★				
Wrong fluid in system.....	★			★	★
Improperly adjusted tie rods or drag links.....			★	★	
Steering arms not positioned properly.....			★		
Air in system.....				★	★
Plugged filter element.....					★
Internal leak in valve.....					★
Faulty cylinder.....	★			★	
Faulty linkage adjustment (F40, MH50, MF50).....				★	

of worn pistons and sleeves is when a 0.005 x 1/2 inch feeler gage requires less than 5 lbs. pull on the spring scale to withdraw it.

With the piston and connecting rod assembly removed from the cylinder block, use a suitable puller to remove the sleeve. Before installing the wet type sleeve, clean all cylinder block sealing surfaces. The top of the sleeve should extend 0.002-0.0045 above the top surface of the cylinder block. If this standout is in excess of 0.0045, check for foreign material under sleeve flange. Excessive standout will cause water leakage at cylinder head gasket. To facilitate installation of sleeves, use a lubricant (palm oil or vaseline) on the two neoprene sealing rings.

There are three 1/8 inch wide compression rings and one 3/16 inch wide oil control ring per piston. Recommended end gap is 0.010-0.018 for the oil ring, 0.010-0.020 for the compression rings. Recommended side clearance for all compression rings is 0.0035-0.005; for the oil control ring, 0.002-0.0035.

Standard size cylinder bore is 3.313-3.315.

PISTON PINS

55. The 0.8591-0.8593 diameter floating type piston pins are retained in piston bosses by snap rings and are available in standard and 0.003 and 0.005 over-size. The bushing in the upper end of connecting rod has a very thin wall and if sized by reaming, do so only with a fluted type, taking very light cuts. Be sure oil hole in bushing registers with oil hole in top end of the connecting rod and clean same thoroughly after sizing the bushing. Pin should be fitted to a 0.0002-0.0006 clearance in the rod and a minus .0001 to plus .0003 clearance in the piston.

CONNECTING RODS AND BEARINGS

56. Connecting rod bearings are of the shimless, non-adjustable, slip-in precision type renewable from below after removing oil pan. When installing new bearing shells, be sure that the projection engages milled slot in rod and cap and the rod and rod cap correlation marks are in register. Replacement rods are not marked and should be installed with the oil spray hole facing away from camshaft side of engine. Bearings are available in 0.002, 0.010 and 0.020 undersize, as well as standard.

Crankpin diameter 1.9365-1.9375
 Diametral clearance 0.0015-0.0025
 Renew if clearance exceeds .. 0.0045
 Side clearance 0.005-0.011
 Renew if side clearance exceeds 0.014
 Rod length C to C 6.373-6.377
 Cap screw torque 35-40 ft. lbs.

CRANKSHAFT AND BEARINGS

57. Crankshaft is supported on 3 shimless, non-adjustable, slip-in, precision type main bearings, renewable from below without removing the crankshaft. The rear main bearing cap contains packing (33—Fig. MF258) on each side of the filler block to prevent oil leakage into the clutch housing. This packing is in addition to the separate crankshaft rear seal (18). To remove the rear main bearing cap and filler block, first remove the two cap screws which retain the crankshaft rear oil seal retainer to the bearing cap and then remove two bearing cap retaining screws.

Bearing inserts are available in standard, 0.002, 0.010 and 0.020 undersizes.

Normal crankshaft end play of 0.002-0.006 is controlled by the flanged center main bearing.

To remove crankshaft it is necessary to remove engine, clutch, flywheel, rear oil seal, timing gear cover, oil pan, and bearing caps.

Check the crankshaft journals for wear, scoring and out-of-round condition against the values listed below:
 Journal diameter 2.249-2.250
 Diametral clearance 0.0015-0.0025
 Cap screw torque 85-95 ft.-lbs.

CRANKSHAFT REAR OIL SEAL

58. Crankshaft rear oil seal (18—Fig. MF258) is contained in a one piece retainer and serviced only as an assembly. To renew the seal, first separate the engine from the transmission case as in paragraph 174 or 190, and remove the flywheel and oil pan. Remove the three seal retainer to crankcase cap screws and the two seal retainer to rear main bearing retaining cap screws.

FLYWHEEL

59. To remove flywheel, separate tractor as outlined in paragraph 174 or 190, and remove clutch unit (or torque converter) from the flywheel. The starter ring gear can be renewed after removing the flywheel. To install a new ring gear, heat same to 500 deg. F. and install on flywheel with beveled end of teeth facing timing gear end of engine. One flywheel mounting bolt hole is off-center.

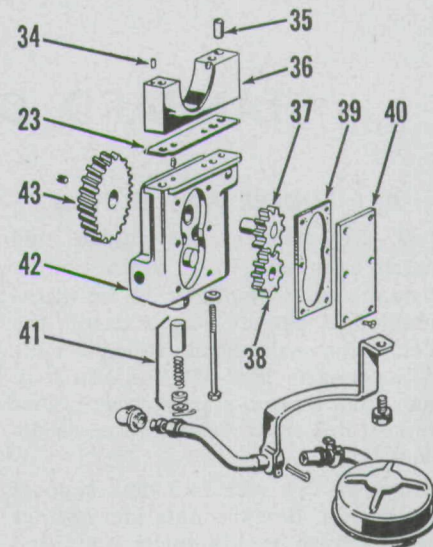


Fig. MF259—Engine oil pump on all except TO35 & MF35 Diesel is mounted on bottom side of the crankshaft front main bearing cap. Shims (23) control backlash between oil pump gear and crankshaft gear.

35. Dowel pin	39. Gasket
36. Main bearing cap, front	40. Cover
37. Driven gear and shaft	41. Oil pressure relief valve
38. Idler gear	42. Pump body
	43. Pump drive gear

OIL PUMP

60. Gear type pump, shown in Fig. MF259, is bolted to bottom of number one main bearing cap and is gear driven from crankshaft pinion. Pump is accessible after oil pan is removed. Shims (23) interposed between pump body and main bearing cap are varied to obtain the desired 0.005-0.010 backlash between the crankshaft pinion and the aluminum gear on the pump shaft.

Check the pump internal gears for backlash, which should not exceed 0.007. The recommended diametral clearance between the gears and pump body is 0.003-0.004. Gear side clearance is 0.004-0.008. A lead gasket, 0.007 thick, is placed between pump body and cover to control side clearance (end play). Presized pump shaft bushings are available for service and have a running clearance of 0.0035-0.0065.

RELIEF VALVE

61. Plunger type relief valve (41—Fig. MF259) is located in oil pump body and can be adjusted with spacers inserted under the spring so as to maintain a pressure of 20-30 psi at 2200 engine rpm. At idle speed, pressure should be not lower than 15 psi. The plunger type valve should fit in its bore with a 0.003-0.005 clearance. The relief valve spring should have a free length of 2 inches and should check 7 3/4-8 1/4 pounds at a working length of 1 3/8 inches.

Remove water pump and fan assembly and unstack and remove starting jaw and crankshaft pulley. Disconnect and remove the generator and brackets then, unbolt and remove the timing gear cover. The crankshaft front oil seal, located in timing gear cover, can be renewed at this time and should be installed with a suitable driver so that lip faces rear of cover.

TIMING GEARS

92. The timing gear train consists of the crankshaft gear, camshaft gear, pump drive gear and an idler gear connecting the other three gears of the train.

Before attempting to remove any of the timing gears, first remove fuel tank, rocker arm cover and rocker arms assembly to avoid the possibility of damage to the pistons or valve train if either the camshaft or crankshaft should be turned independently of the other.

Timing gear backlash should be 0.003-0.006 between the idler gear and any of the other gears in the timing train. Replacement gears are available in standard size only. If backlash is not within recommended limits, renew the idler gear, idler gear shaft and/or any other gears concerned.

To remove the timing gears or time the engine, unstack and remove the idler gear retaining bolt and slip the gear off the idler shaft. The shaft has a light press fit in the engine block and is further positioned by the locating pin shown in Fig. MF286. Pry the shaft from its place in the block if renewal is indicated.

The crankshaft gear is keyed in place and fits the shaft with 0.001 press fit to 0.001 clearance. If the old gear is a loose fit, it may be possible to pry it off the shaft with a heavy screw driver or pry bar. If a puller is needed, it will first be necessary to remove the oil pan and the small lower section of timing gear housing.

The camshaft gear and injection pump drive gear can be removed by removing the securing cap screws and withdrawing the gears.

To install the gears and time the engine, refer to the appropriate following paragraphs:

93. **CAMSHAFT GEAR.** The gear is attached to the camshaft by cap screws through three equally spaced holes in the gear flange. It is possible to install the gear in three positions, only one of which is correct. One of the attaching holes is marked with a letter "D" stamped on the front face of the gear. The camshaft is marked with a stamped letter "D" on the hub flange near one of the three cap screw holes. The camshaft gear is correctly installed when the two "D" marks are aligned as shown at (X), Fig. MF287.

94. **INJECTION PUMP DRIVE GEAR.** The injection pump drive gear bolts directly to the pump adapter and is carried by the injection pump shaft bearings. To remove the gear after the timing gear cover has been removed, back out the three retaining cap screws and lift off the gear. When reinstalling, align the timing marks as outlined in paragraph 96 and install the pump gear with the idler gear and pump drive gear timing marks aligned.

95. **IDLER GEAR AND HUB.** The idler gear should have 0.001-0.0035 diametral clearance on the 2.123-2.1238 idler hub. The idler gear is retained by the retaining washer and long cap screw which passes through the center of the renewable hub stud and threads into the engine block.

Idler gear is marked with three timing marks which align with the timing marks on camshaft gear, crankshaft gear and injection pump drive gear.

96. **TIMING THE GEARS.** Due to the odd size of the idler gear, the timing marks will align only once in 18 crankshaft revolutions. To time the engine after the gears are removed, rotate the crankshaft until the keyway and timing mark are in a vertical position, then rotate the camshaft and injection pump drive gears until their timing marks are approximately aligned with the center of the idler gear hub. Install the idler gear so that the three timing marks on the idler gear are meshed with the marks on the camshaft, crankshaft and injection pump drive gears. When proper alignment has been obtained, secure the idler gear with the retaining washer and cap screw. Fig. MF287 shows a view of the engine with the timing marks in proper alignment.

TIMING GEAR HOUSING

97. After removal of the timing gears as outlined in paragraph 92, the injection pump as outlined in paragraph 137, and the power steering pump on tractors so equipped, the timing gear housing can be removed as follows:

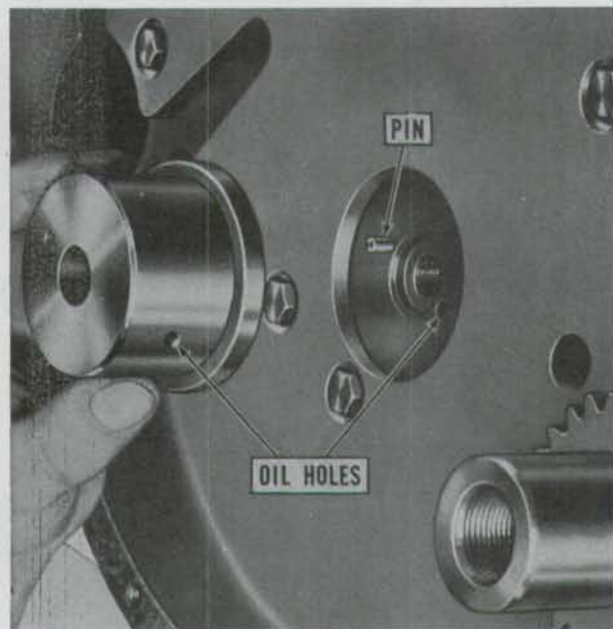


Fig. MF286—Timing gear idler stud removed, showing locating pin and oil feed holes in block and stud.

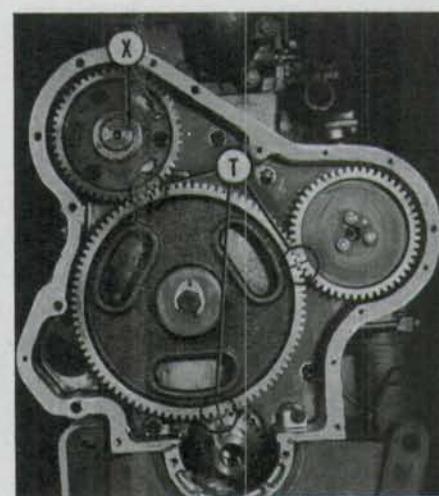


Fig. MF287 — Timing gear train showing timing marks (T) properly aligned. Camshaft gear is correctly installed when stamped "D" marks are in register as shown at (X).

DIESEL SYSTEM TROUBLE-SHOOTING CHART

	Sudden Stopping of Engine	Lack of Power	Engine Hard to Start	Irregular Engine Operation	Engine Knocks	Excessive Fuel Consumption
Lack of fuel	★	★	★	★		
Water or dirt in fuel.....	★	★	★	★		
Clogged fuel lines	★	★	★	★		
Inferior fuel	★	★	★	★	★	
Faulty primary pump.....	★	★	★	★		
Faulty injection pump timing.....		★	★		★	★
Air traps in system.....	★	★	★	★		
Clogged fuel filters.....		★	★	★		
Deteriorated fuel lines.....	★					★
Faulty nozzle		★	★	★	★	★
Faulty injection pump.....		★	★	★	★	★

until air-free fuel comes out the filter vent. Tighten the vent plug securely. Loosen the vent on the second stage filter; operate the primary pump lever until air-free fuel comes out the vent. Tighten the vent plug.

Loosen the top vent plug (TP) on the injection pump and repeat pumping procedure until air-free fuel flows out the port. Tighten the vent plug. Repeat the procedure with the lower vent plug (SP).

Operate the primary pump lever 10 extra strokes to provide fuel in the bleed back lines to the second stage filter.

Loosen two pressure lines to the injectors and turn the engine over with the starting motor until fuel escapes from the line ends. Tighten the two pressure lines and repeat the procedure with the remaining two pressure lines.

If engine fails to start, it may be necessary to air bleed the system again.

INJECTOR NOZZLES

The 23C Standard diesel engine is equipped with C.A.V. injector assemblies which include Pintaux type nozzle units. Starting with engine No. 86046, a heat shield was added at the combustion chamber end of nozzle. Purpose of shield is to aid in keeping nozzle tip cool to reduce possibility of carbon stoppage of auxiliary hole. Injectors designed for use with heat shields can be installed in earlier engines without shields, but earlier type nozzles cannot be used in later engines.

The Perkins 3A152 engine is equipped with C.A.V. injector assemblies having a closed type nozzle with two 0.013 holes which inject fuel into the combustion area above the piston and into a pre-combustion chamber located in the cylinder head.

WARNING: Fuel leaves the injector nozzles with sufficient pressure to penetrate the skin. When testing, keep your person clear of the nozzle spray.

128. TESTING AND LOCATING A FAULTY NOZZLE. If the engine does not run properly and the quick checks outlined in paragraph 125 point to a faulty injector, locate the faulty unit as follows:

If one engine cylinder is misfiring, it is reasonable to suspect a faulty injector. Generally, a faulty injector can

be located by loosening the high pressure line fitting to each injector nozzle in turn, thereby allowing fuel to escape at the union rather than enter the cylinder. As in checking spark plugs in a spark ignition engine, the faulty unit is one which, when its line is loosened, least affects the running of the engine.

Remove the suspected injector unit from the engine as outlined in paragraph 134. If a suitable nozzle tester is available, check the unit as in paragraph 129. If a tester is not available, reconnect the fuel line to the injector assembly and with the nozzle tip directed where it will do no harm, crank the engine with the starting motor and observe the nozzle spray pattern.

If the spray pattern is ragged, unduly wet, streaky and/or not symmetrical or, if nozzle dribbles, the nozzle valve is not seating properly. Send the complete nozzle and holder assembly to an authorized diesel service station for overhaul.

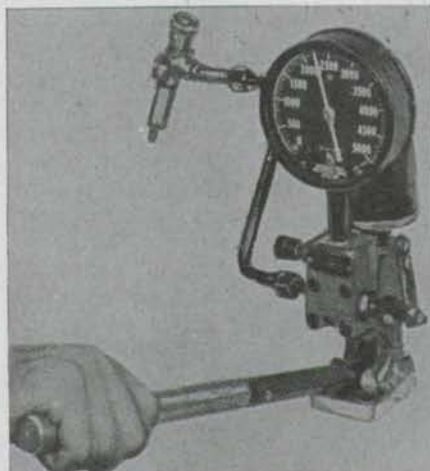


Fig. MF318A.—To completely test and adjust an injector nozzle requires the use of a special tester.

129. NOZZLE TESTER. A complete job of testing and adjusting the injector requires the use of special testing equipment. Only clean, approved testing oil should be used in the tester tank. The nozzle should be tested for opening pressure, seat leakage, back leakage and spray pattern. When tested, the nozzle should open with a sharp popping or buzzing sound and cut off quickly at end of injection with a minimum of seat leakage and controlled amount of back leakage as outlined in the following paragraphs:

Lock test

Volts	5.8
Amperes	435
Torque (ft.-lbs.)	10.5

12-Volt, Diesel

159. Delco-Remy electrical units are used. Test specifications are as follows:

Generator—D-R 1101005

Brush spring tension (oz.)	16
Field draw	
Volts	12.0
Amperes	2.0-2.14
Output (hot)	
Maximum amperes	10-12
Volts	14.0
RPM	2800

Generator—D-R 1100383

Brush spring tension (oz.)	28
Field Draw	
Volts	12.0
Amperes	1.58-1.67
Output (cold)	
Maximum amperes	20.0
Volts	14.0
RPM	2300

Regulator—D-R 1118981

Cutout relay	
Air gap	0.020
Point gap	0.020
Closing voltage (range)	11.8-14.0
Adjust to	12.8

Voltage regulator

Air gap	0.075
Voltage range	13.6-14.5
Adjust to	14.0

Starting Motor—D-R 1108649
or D-R 1108662

Brush spring tension (oz.)	24
No-load test	
Volts	11.8
Amperes	40-70
RPM	6800-9200

Lock test

Volts	5.85
Amperes	615
Torque (ft.-lbs.)	29

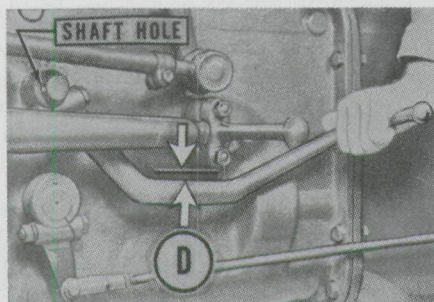
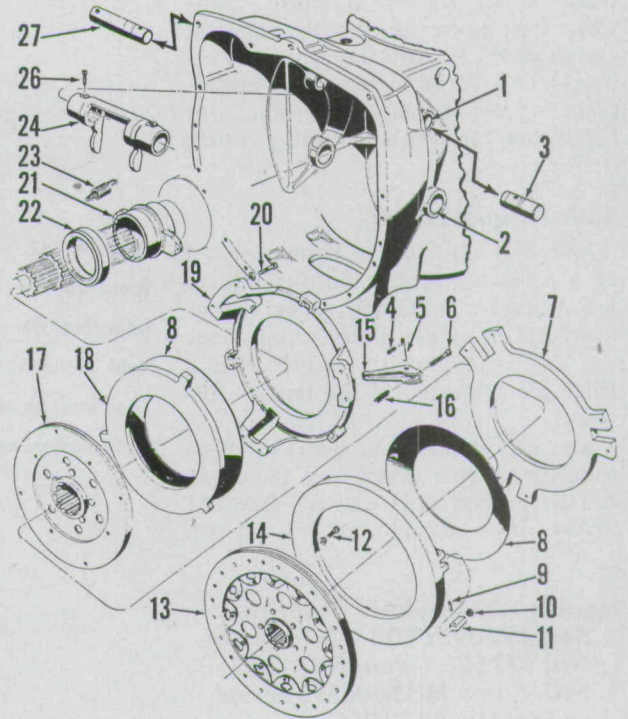


Fig. MF339—Checking the pedal free play adjustment. Free travel (D) is measured between pedal and its stop.

Fig. MF340 — Exploded view of the dual clutch and associated parts used on models TO35 Deluxe, F40 and some MH50 and MF50 models.

1. Clutch release shaft bushing
2. Brake shaft bushing
3. Release pivot shaft
4. Roll pin
5. Release lever pin
6. Adjusting screw
7. Inner pressure plate
8. Belleville clutch spring
9. End rod pin
10. Jam nut
11. Clutch end rod
12. Cap screw
13. Primary lined disc
14. Inner pressure plate
15. Release lever
16. Anchor cup spring
17. Secondary lined disc
18. Outer pressure plate
19. Clutch cover
20. Cover cap screw
21. Release bearing carrier
22. Release bearing
23. Return spring
24. Release fork
26. Set screw
27. Clutch pedal shaft



CLUTCH

This section covers the various clutches used on all models except MF204. Model MF204 is not equipped with a master clutch; instead, a Borg-Warner torque converter is attached to the engine flywheel, and the transmission is equipped with hydraulically activated forward and reverse multiple disc clutches. Service on the torque converter and reversing clutches is covered in the Revers-O-Matic transmission section, paragraphs 187 to 195.

Single Clutch Models

160. Standard model TO35 tractors, some utility model MH50 tractors and some MF50 tractors are factory equipped with a 9 inch Rockford model 9RM, spring loaded, single dry plate clutch which is fitted with a Borg-Warner 165267 cover assembly. Model MHF202 and MF202 tractors are factory equipped with a heavy-duty, 9-inch Rockford spring loaded, single dry plate clutch which is fitted with a Borg-Warner 165385 cover assembly; this same heavy-duty clutch is available for service installation on TO35 Std. tractors, MH50 tractors and MF50 tractors originally equipped with light-duty clutches.

161. **ADJUSTMENT.** Adjustment to compensate for lining wear is accomplished by adjusting the clutch pedal linkage, not by adjusting the position of the release levers on the clutch cover assembly.

To make the adjustment, loosen the bolt clamping the clutch pedal to the clutch release shaft. Insert a rod through the hole provided in the extended end of the clutch release shaft and turn the shaft clockwise until the release bearing just contacts the clutch release fingers. While holding the release shaft in this position, move the clutch pedal with respect to the shaft until there is a distance (D—Fig. MF339) of 3/4-inch between pedal and its stop as shown. Tighten the pedal clamp bolt.

162. **R&R AND OVERHAUL.** The procedure for removing the clutch is conventional after splitting the tractor as outlined in paragraph 174 or 175.

To overhaul the single clutch cover assembly, first mark cover and pressure plate to assure reassembly in same relative position, place cover in a suitable press and remove release lever adjusting screws and pins. Inspect the pressure plate for wear, scoring, or heat cracks on pressure surface and the remainder of clutch parts for wear or damage. Check the spring tension against the values listed below:

Standard duty clutch: Pounds test and test length, 180-190@1 1/8 inches.

Heavy duty clutch: Pounds test and test length, 140-150@1 3/8 inches.

To adjust the clutch, reassemble by reversing the disassembly procedure and attach clutch cover to a surface

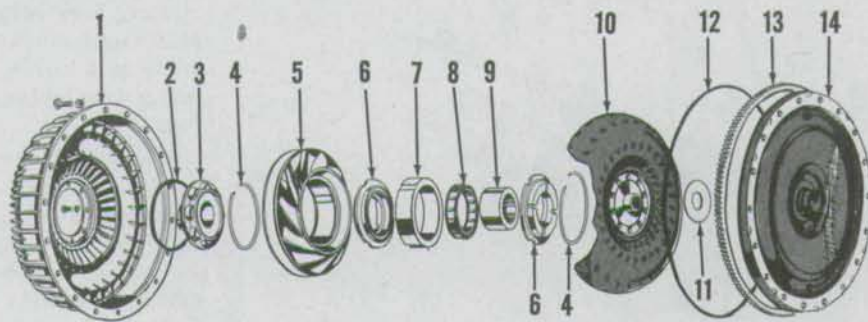


Fig. MF361—Exploded view of early torque converter unit. On late models, starter ring gear (13) is carried on flywheel rather than converter front cover (14).

- | | | |
|-----------------|---------------------------|-----------------------|
| 1. Impeller | 6. Thrust washer | 10. Turbine |
| 2. Hub seal | 7. Outer clutch race | 11. Thrust washer |
| 3. Impeller hub | 8. One-way "sprag" clutch | 12. Sealing ring |
| 4. Snap ring | 9. Inner race | 13. Starter ring gear |
| 5. Stator | | 14. Front cover |

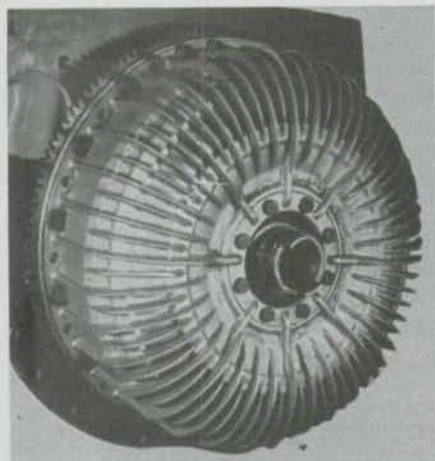


Fig. MF361A — Torque converter assembly attached to engine flywheel. Note the pump driving lugs on impeller hub. When reassembling tractor, check impeller hub for run-out with dial indicator. Runout should not exceed 0.020.

189. **PRESSURE CHECK.** To check the control oil pressure install a 0-300 psi pressure gage in the fitting (1—Fig. MF360) at the top of transmission housing. Set the hand throttle to obtain an engine speed of 1500 rpm, and observe gage reading. Gage pressure should be at least 150 psi. Set hand throttle to obtain an engine speed of

1800 rpm and engage each clutch in turn by depressing the pedals only enough to activate the control valve without changing engine speed. Pressure should drop to 100 psi momentarily, then return to within 5 psi of neutral reading. Failure to respond as indicated would indicate leakage in piston or shaft seals, gasket or "O" rings, or a worn pump.

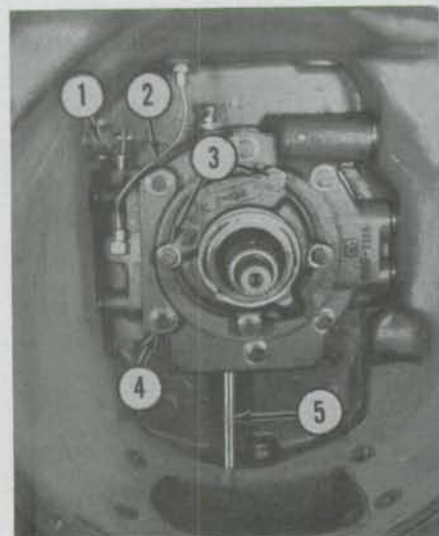


Fig. MF361B — Front view of transmission housing showing "Revers-O-Matic" oil pump, input shaft and distributor assembly.

- | | |
|--------------------------|-------------------------------|
| 1. Control valve linkage | 3. Pump mounting bolts |
| 2. Pressure line | 4. Distributor mounting bolts |
| | 5. Stand pipe |

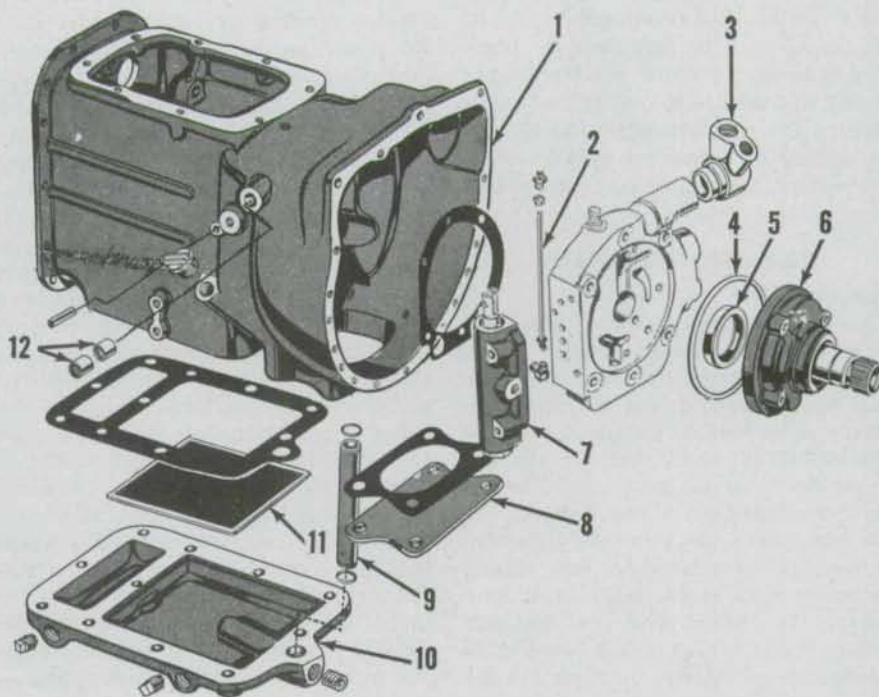


Fig. MF362 — Exploded view of transmission housing used on MF204 tractor. External dimensions are identical to housing used on MF202 and MF35 tractors.

- | | | |
|------------------|---------------------|--------------------|
| 1. Housing | 5. Pump shaft seal | 9. Stand pipe |
| 2. Pressure line | 6. Oil pump | 10. Oil pan |
| 3. Banjo fitting | 7. Control valve | 11. Oil screen |
| 4. Gasket | 8. Inspection plate | 12. Needle bearing |

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