DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DS, GS, AND DEPOT MAINTENANCE MANUAL

CRANE, TRUCK, WAREHOUSE, SLEWING BOOM, GASOLINE, FRONT WHEEL DRIVE, PNEUMATIC TIRES, 10,000 LB. CAPACITY, PETTIBONE-MULLIKEN MODEL 10F, ARMY MODEL MHE 195, FSN 3950-723-3295

HEADQUARTERS, DEPARTMENT OF THE ARMY
MAY 1965

SAFETY PRECAUTIONS

BEFORE OPERATION

When servicing battery, do not smoke or use frame in the vicinity. Batteries generate hydrogen, a highly explosive gas.

Check to be sure there is sufficient engine coolant and engine lubricant before starting engine.

Do not fill fuel tank while engine is running. Provide metallic contact between fuel container and fuel tank to prevent a static spark from igniting fuel.

Do not remove radiator cap from an overheated radiator; stop engine and allow radiator, otherwise there is danger of cracking cylinder head or block.

Check equipment logbook for record of proper servicing and maintenance.

DURING OPERATION

Do not shift directional shift lever while crane is in motion.

Be alert for other workers to be sure they are not in the way of the load or moving crane.

Be sure there is sufficient clearance overhead and on each side of crane.

Avoid sudden starting and stopping of crane. Reduce speed when making turn.

Know the rated capacity of crane and do not overload it. Never pick up a load until certain it can be carried safety.

Report any evidence of faulty crane performance.

AFTER OPERATION

Make sure boom is lowered and in front of whenever possible.

Raise hook block high enough so no one will walk into it.

Make sure hand brake is engaged firmly.

If engine cooling system or any lubricating oil sump is drained, make certain appropriate warning tags are attached to steering handwheel.

If crane is parked on an incline, block at least two wheels in the event of handbrake failure.

TECHNICAL MANUAL

No. TM 10-395020435

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C. *12 May, 1965*

DS, GS, AND DEPOT
MAINTENANCE MANUAL

CRANE, TRUCK, WAREHOUSE, SLEWING BOOM, GASOLINE, FRONT WHEEL DRIVE, PNEUMATIC TIRES, 10,000 LB. CAPACITY, PETTIBONE-MULLIKEN MODEL 10F, ARMY MODEL MHE 195, FSN 3950-723-3295

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual is published for use by personnel responsible for direct and general support and depot maintenance of Crane, Model 10F, (fig. 1) manufactured by Pettibone Mulliken Corporation, Rome, New York.

b. The direct reporting by the individual user, of errors, omissions and recommendations for improving this manual is authorized and encouraged. DA Form 2028 (Recommended changes to DA Publications) will be used for reporting these improvements. This form will be completed in triplicate using pencil, pen or typewriter. The original and one copy will be forwarded direct to Commanding General, U.S. Army Mobility Equipment Center, ATTN: SMOME-MMP, 4300 Goodfellow Blvd., St. Louis, Mo., 63120. One information copy will be provided to the individual's immediate supervisor (officer, noncommissed officer, supervisor, etc.)

2. Appendixes

Appendix I is a list of current references applicable to this manual. Appendix II, containing the maintenance allocation chart is published in TM 10-3950-204-20. Appendix III, repair parts and special tools lists authorized for direct and general support and depot maintenance, is published in TM 10-3950-204-25P.

3. Forms, Records, and Reports

The maintenance forms, records, and reports to be used in direct support, general support and depot maintenance of this equipment are listed and described in TM 38-750.

4. Orientation

Throughout this manual, the terms right, left, front and rear, with respect to engine or crane, indicate direction from viewpoint of operator sitting in seat of crane.

Section II. DESCRIPTION AND DATA

5. Description

a. Engine. The six-cylinder, four stroke cycle, L-head, water-cooled engine has a 37/16 inch bore and a 43/8 inch stroke for a displacement of 244 cubic inches. It develops a brake horsepower of 82.3 at 2800 rpm and has a compression ratio of 6.9 to 1. The crankshaft has four main bearings, and the engine is pressure lubricated by positive-displacement gear pump.

b. Drive System. The unitized drive system consists of a torque-converter; two speed forward and two speed reverse transmission; a differential with a pinion shaft directly driven by transmission output; and pinion shafts which engage the differential and transfer power to the front wheels to propel the vehicle. Final reduction is in the wheels.

c. Hydraulic System. The hydraulic system is powered by a hydraulic pump mounted on and driven by the transmission. The pump capacity is 31 gpm at 2200 rpm. The working pressure of the hydraulic system is 2000 psi maximum.

d. Steering System. The crane is steered by the rear wheels through the use of a hydraulic steering system. The steering system consists of a hydraulic unit, steering column, controlled by the steering hand wheel, steering cylinders, and steering axle and tie rods.

e. Electrical System. The positive grounded, 12volt electrical system employs a DC generator with a conventional three-unit voltage regulator. The starting circuit is actuated by the starter and ignition switch. The starting circuit is routed through the transmission neutral position switch to prevent cranking of the engine when the transmission is in

either drive position. By closing the circuit through the ignition switch and neutral position switch, the starting relay is energized which completes the circuit to the starter solenoid switch. As the solenoid energizes, it engages the Bendix with the flywheel ring gear and completes the circuit from the battery to crank the engine.

6. Tabulated Data

a. Engine.

Make ---------- Continental
Model ---------- FS--244
Number of cylinders -------- Six
Bore ---------- 37/16 inches
Stroke ---------- 43/8 inches
Displacement ---------- 244 cubic inches
Compression ratio ---------- 6.9 to 1
Brake horsepower ---------- 82.3 at 2800 rpm
Torque ---------- 192 ft. lb. at 1200 rpm
Firing order ---------- 1-5-3-6-2-4
Weight, bare engine -------- 516 lb.
Number of main bearings - four
Crankshaft:
- Main bearing journal diameter ---------- 2.3744 min.
- Connection rod journal diameter ---------- 2.1865 min.
- Clearance-main bearing journals to bearings 0.008 in. to 0.0028 in.
- End play ---------- 0.003 in. to 0.008 in.
- Clearance-crank pin bearing journals to connecting rod bearings 0.0007 in. to 0.0025 in.

Flywheel:
- Runout 0 ---------- 0.008 in. max.
- Eccentricity ---------- 0.008 in. max.

Flywheel housing:
- Face runout ---------- 0.008 in. max.
- Bore eccentricity ----- 0.008 in. max.

Camshaft:
- Front bearing journal diameter ---------- 1.8715 in. min.
- Intermediate front bearing journal diameter 1.8085 in. min.
- Intermediate rear bearing journal diameter -- 1.7457 in. min.
- Rear bearing journal diameter ---------- 1.2465 in. min.
- Clearance-camshaft journals to fan end and drive end bearings 0.002 in. to 0.004 in.
- End play ---------- 0.005 in. to 0.009 in.
- Clearance--camshaft gear to crankshaft gear 0.0015 in. max.

Valves:
- Intake valve stem diameter ---------- 0.3414 in. max.
- Exhaust valve stem diameter ---------- 0.3385 in. max.
- Valve guide bore diameter --intake ---------- 0.3448 in. to 0.3432 in
- Valve guide bore diameter exhaust ---------- 0.3468 in. to 0.3458 in.
- Valve spring tension-
  - Compressed to $1\frac{21}{32}$ in ---------- 42 pounds min.
  - Compressed to $1\frac{3}{8}$ in ---------- 93 pounds min.
- Clearance-valve lifter to bore ---------- 0.001 in. min. to 0.005 in. max.
- Valve seat angle-intake 30°
- Valve seat angle-exhaust 45°

Pistons:
- Piston pin hole diameter 0.8594 in. max.
- Piston ring gap -------- 0.007 in. min. to 0.017 in. max.
- Piston pin diameter -- 0.8591 in. min.
- Piston ring groove width:
  - Top groove -------- 0.1285 in. max.
  - Middle grooves --- 0.1285 in. max.
  - Bottom groove ---- 0.253 in. max.
- Piston ring width:
  - Top ring ---------- 0.123 in. min.
  - Middle rings ------- 0.123 in. min.
  - Bottom rings ------ 0.2485 in. min.
- Connecting rod:
  - Piston pin bushing diameter --------- 0.8597 in. max.

b. Starting Motor.

Make Prestolite
Model MDY-7013
Type of drive ---------- Bendix

c. Generator.

Make Prestolite
Model ---------- GJP-7402D

d. Main Hydraulic Pump.

Make Vickers
Model ---------- 2520V17A11-11DD-10L
Type ---------- Vane
Capacity 18 gpm and 31 gpm

e. Transmission.

Make Allison
Part number ---------- 6777122
Type ---------- Two-speed, iorward and reverse, torque converter-coupled.

Ratios:
- Hi forward ---------- 2.398 to 1
- Lo forward ---------- 6.590 to 1
- Hi reverse ---------- 2.321 to 1
- Lo reverse ---------- 6.380 to 1

f. Hydraulic Control Valve.

Make Vickers
Model ---------- CM11NO1-R20DDE-21

g. Hydraulic Control Valve.

Make ---------- Vickers
Model ---------- CM2NO2-R20D3D3R-20

h. Double Over-center Valve.
Make Fluid Controls
Part number ---------- 58102-4

i. Flow Regulator Valve.
Make Fluid Controls Valve
Part number ---------- 59401-D4

j. Pilot Check Valve.
Make Fluid Controls Valve
Part number ---------- 25300-6

k. Check Valve.
Make Kennedy
Part number ---------- 440

l. Hydraulic Winch Motor.
Make Gearmatic
Model ---------- 11 SECR

m. Hydraulic Steering Unit.
Make ---------- Orbitrol
Part number ---------- YP-11

n. Hook Block.
Make Upson-Walton
Model ---------- 265-D
Working load-tons ---------- 5—$6^{1}/_{2}$

o. Wheel Brakes.
Make Rockwell Standard
Part number ---------- A2-3736-Y-155
Type ---------- Dual primary brake, hydraulically actuated

p. Carburetor.
Make Zenith
Model ---------- 228BV10
Type ---------- Single-barrel down-draft float-type.

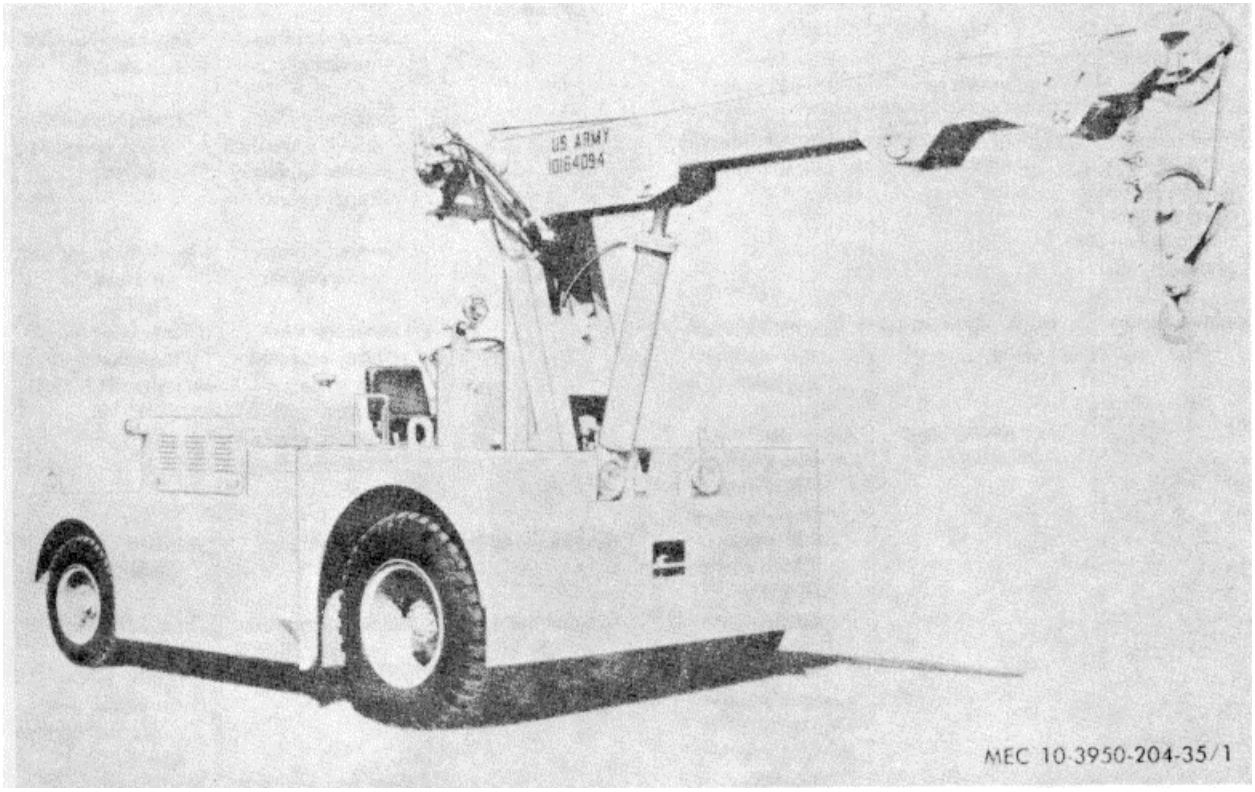


Figure 1. Crane, model 10F.

CHAPTER 2

MAINTENANCE INSTRUCTIONS

Section I. TROUBLESHOOTING

7. Purpose

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the crane or any of its components.

8. Troubleshooting Procedure

Possible troubles that may be encountered are listed in table I. Each trouble symptom stated is followed by a list of probable causes of the trouble. The possible remedy is described opposite the probable cause.

Table I. Troubleshooting Chart

Trouble	Probable cause	Remedy
Starting motor operates, but fails to crank engine when switch is engaged.	Defective starting motor or drive gear.	Overhaul starting motor (para. 21).
Engine will not start.	Sticking carburetor float.	Disassemble and clean carburetor. (para. 15).
	Low engine compression.	Set tappet clearance (TM 10-3950-2O20). Replace cylinder head gasket (TM 10-3950-204-20). Replace valve springs (para. 13). Replace valves (para. 13). Replace piston rings (para. 11).
Engine operates but backfires and spits	Low carburetor float level.	Adjust carburetor float (para. 15).
	Valve sticking, not seating properly, burned, or pitted.	Repair or replace defective parts (para. 13).
	Excessive carbon in cylinders.	Remove carboa from cylinders (paras. 11 and 12).
	Weak valve springs.	Replace defective parts (para. 13).
Engine misfires on one or more cylinders.	Valve tappet holding valve open.	Repair or replace tappets (para. 13).
	Low engine compression.	See "Engine will not start" above.
	Cracked cylinder block or broken valve tappet or tappet screw.	Replace defective parts (paras. 12 and 13).
Engine does not idle properly.	Uneven cylinder compression.	See"Engine will not start" above.
	Defective carburetor accelerating pump system, dirt in metering jets, or incorrect float level.	Clean and overhaul carburetor (para. 15).
Engine backfires	Valve holding open.	Repair or replace valve (para. 13).
Engine stalls on idle.	Carburetor choke valve sticking in closed position.	Free and lubricate valve (para. 15). Overhaul and clean carburetor (para. 15).
	Low engine compression.	See "Engine will not start" above.
Engine misses at high speeds	Sticking valves or weak or broken valve springs.	Replace defective parts (para. 13).

Table I. Troubleshooting Chart-Continued

Trouble	Probable cause	Remedy
	Uneven cylinder compression.	See "Engine will not start" above.
	Dirty or defective carburetor.	Overhaul and clean carburetor (para. 15).
Engine lacks power.	Low compression, broken valve springs, or sticking valves.	See "Engine will not start" above.
Engine overheats.	Low engine compression.	See "Engine will not start" above.
	Leaking cylinder block or head.	Replace defective parts (para. 12 and (TM 10-3950-204-20).
Fuel consumption is high	Worn or broken carburetor parts.	Overhaul carburetor (para. 15).
	Carburetor float level too high, accelerating pump not properly adjusted.	Adjust carburetor float (para. 15).
	Low engine compression.	See "Engine will not start" above.
	Loose engine mounts, permitting engine to shake and raising fuel level in carburetor.	Replace defective mounts, (para. 10).
Engine oil consumption is high.	Defective piston or rings, excessive side clearance of intake valves in guides, cylinder bores worn (scored), excessive bearing clearance, or misaligned connecting rods.	Repair or replace defective parts (paras. 11, 12, and 13).
Engine oil pressure is low.	Clogged oil pump screen. screen (para. 11).	Remove oil pan and clean pump
	Oil leaks.	Repair or replace defective parts (para. 11).
	Faulty oil pump, sticking or improperly adjusted pressure regulator, or broken spring.	Repair or replace defective parts (para. 11).
A heavy dull knock sounds in engine when accelerating under load.	Worn or damaged main bearings.	Replace main bearings (para. 11).
Engine knocks when loaded or unloaded.	Excessive end play in crankshaft.	Adjust crankshaft end play (para. 11).
A light metallic knock occurs when engine is at about two-thirds maximum speed.	Worn or damaged connecting rod bearings.	Replace connecting rod bearings (para. 11).
A persistent sharp clicking noise occurs at any engine speed.	Broken piston nng or pin.	Replace defective parts (para. 11).
Engine vibrates at any speed.	Engine loose on mountings.	Tighten engine mounts (para. 10).
	Flywheel or torque converter out of balance.	Repair or replace defective ports (para. 11).
Fuel reaches carburetor, but does not reach cylinders.	Clogged fuel passage in carb'uretor.	Overhaul and clean carburetor (para. 15).
	Carburetor float valve stuck in closed position.	Overhaul and clean carburetor (para. 15).
Cooling solution is low.	Leaking radiator.	Repair radiator (para. 18).
Starting motor cranks engine slowly.	Dirty commutator.	Clean commutator (para. 21).
	Insufficient brush surface contact.	Free or replace brush (para. 21)
	Defective starting motor.	Overhaul starting motor (para. 21).
Starting motor does not crank engine.	Faulty drive mechanism.	Overhaul drive mechanism (para. 21).

Table I. Troubleshooting Chart-Continued

Trouble	Probable cause	Remedy
Low or fluctuating generator output.	Insufficient brush surface contact.	Free or replace brush (para 20).
	Weak brush springs.	Replace spring (para. 20).
	Worn commutator.	Overhaul generator (para. 20).
	Dirty commutator.	Clean commutator (para. 20).
Generator is noisy.	Defective bearings or armature rubbing on field poles.	Repair or replace defective parts (para. 20).
	Improperly seated brushes.	Seat brushes (para. 20).
Continuous drive axle noise.	Badly worn parts.	Replace worn parts (para. 40).
Complete failure of drive axle to function.	Broken axle shaft	Replace axle shaft (para. 40).
	Broken teeth on drive gear or pinion gear.	Replace drive gear, pinion, and other parts of differential as necessary (para. 40). Adjust drive gear and pinion gear correctly (para. 40).
Drive axle noise occurs on drive or on coast only.	Differential, pinion gear and drive gear out of adjustment or worn.	Adjust, repair, or replace en-'tire unit if condition warrants (para. 40)
Excessive backlash in drive axle.	Loose axle shaft drive flange cap screws.	Tighten cap screws (para. 40).
	Loose flange on axle shaft.	Reweld flange to shaft (para. 40).
	Worn splines on axle shaft at differential end.	Replace drive flange and shaft assembly (para. 40).
	Differential drive pinion gear and drive gear out of adjustment or worn.	Adjust or replace as condition warrants (para. 40).
Steering wheel does not center.	Binding in linkage valve, or broken	Realign; repiace spring (para.
	centering 44). spring.	
No response.	Sleeve and spool locked.	Disassemble, repair or replace (para. 44).
Steering is difficult.	Tight steering system con nections.	Adjust linkage (para. 42).
	Misaligned wheels.	-Align and adjust steering axle (para. 42).
	Power steering cylinder defee-tive.	Replace cylinder (para. 43).
Crane wanders or weaves.	Improper toe-in, camber, or caster.	Repair and adjust axle (para. 42).
	Worn tie-rod end bushings.	Replace bushing (para. 42).
Brakes drag.	Broken or weak brake pedal return spring.	Replace spring (para. 46).
	Broken or weak brake shoe return spring.	Replace spring (para. 46).
	Scored or rough drums.	Repair or replace drum and brake shoe and lining assemblies (para. 46).
Brake pedal travel is excessive.	Scored brake drums.	Repair or replace drums (para. 46).
	Scored or distorted brake drum.	Repair or replace drums (para. 46).
Main hydraulic pump does not deliver oil.	Driven in wrong direction of rotation.	Reverse drive direction.
	Coupling or shaft sheared or disengaged.	Disassemble the pump and checl the shaft and cartridge for damage. (para. 55).
	Fluid intake pipe in reservoir restricted.	Check all strainers and filters for dirtand sludge. (para. 55).
	Fluid viscosity too heavy to pick up prime.	Drain the system and add new filtered fluid of the

Table I. Troubleshooting Chart-Continued

Trouble	Probable cause	Remedy
		proper viscosity. (para. 55).
	Air leaks at the intake. Pump not priming.	Tighten any loose connections. Check the minimum drive speed which may be too slow to prime the pump (para. 55).
Insufficient pressure buildup.	System relief valve set too low.	Adjust the relief valve (para. 55).
	Worn parts causing internal leakage of pump delivery.	Replace pump cartridge (para. 55).
Pump making noise.	Pump intake partially blocked.	Service the intake strainers. (para. 55).
	Air leaks at the intake or shaft seal. (Oil in reservoir would be foamy).	Check the inlet connections and seal to determine where air is being drawn in. Tighten any loose connections and replace the seal if necessary. See that the fluid in the reservoir is above the intake pipe opening (para. 55).
	Coupling misalignment.	Realign the coupled shafts (para. 55).
Hydraulic cylinders work slowly at rated engine rpm.	Defective control valves.	Overhaul control valves.(para. 56).
	Defective cylinder.	Overhaul defective cylinder (para. 43, 63, 65, and 67).
	Defective hydraulic pump.	Overhaul hydraulic pump (para. 55).
Hydraulic cylinders chatter when operating.	Defective cylinder.	Overhaul defective cylinder (paras. 43, 63, 65, and 67).
	Defective hydraulic pump.	Overhaul hydraulic pump (para. 55).
Oil leak at top of lift cylinder assembly.	Worn or damaged lift piston O-ring.	Replace cylinder O-ring, (para. 65).
	Scored cylinder wall.	Overhaul cylinder (para. 65).
Oil leak around piston rod at slewing cylinder.	Worn O-rings.	Replace cylinder O-rings (para. 63).
	Scored piston rod.	Overhaul piston (para. 63).
Low main pressure.	Low oil level.	Add oil to correct level. (TM 10-3950-204-20).
	Weak or broken main-pressure regulator valve spring.	Replace spring. (para. 38).
	Clutch cutoff control not releasing.	Check vehicle brake release. Rebuild control valve assembly (para. 38).
	Oil pump worn.	Rebuild oil pump (para. 37).
	Air leak at intake side of oil pump.	Check pump mounting bolts. Check oil pick-up tube and nut (para. 39).
	Internal oil leakage.	Overhaul transmission (paras. 27-38).
	External oil leakage.	Tighten bolts or replace gaskets.
Overheating.	High oil level.	Restore proper oil level. (TM 10-3950-204-20).
	Clutch failed.	Rebuild transmission. (TM 10-3950-204-20).
	Vehicle overloaded.	Reduce load.
Low clutch apply pressure.	Low main pressure.	Refer to "Low main pressure" above. (para. 38).
	Clutch piston seal rings failed.	Overhaul transmission. (paras. 27-38).
	Clutch cutoff valve sticking.	Rebuild control valve body as-

Table I. Troubleshooting Chart-Continued

Trouble	Probable cause	Remedy
		sembly. (para. 38).
	Internal oil leakage.	Overhaul transmission (paras. 27-38).
Vehicle will not travel.	Low main pressure.	Refer to "Low main pressure" above.
	Low clutch apply pressure.	Refer to above.
	Selector linkage broken or disconnected.	Repair or connect linkage (para. 23).
Vehicle travels in neutral when engine is accelerated.	Selector linkage out of adjustment.	Adjust linkage. (TM 10-3950 204-20).
	Clutch failed (won't release).	Overhaul transmission (paras. 27-38).
Vehicle lacks power and acceleration at low speed.	Low main pressure.	Refer to above.
	Low clutch apply pressure.	Refer to above.
	Turbine free-wheel clutch failed.	Overhaul transmission (paras. 27-38).
	Engine malfunction.	Check engine-refer to engine section of manual.
Stall speed too high.	Clutch slipping.	Overhaul transmission (paras. 27-38).
	Low main pressure.	Refer to above.
Stall speed too low.	Engine not producing full power.	Tune or repair engine. Refer to engine section of manual.
	Torque converter failed.	Rebuild converter. (paras. 27-38).
	Loss of engine power through accessories attached to engine.	Disconnect accessories which are absorbing power.
Winch will not pull maximum load.	Oil level in reservoir may be too low.	Check oil level in reservoir. (para. 51).
Considerable reduction in line speed.	Pump or winch motor may be worn.	Remove and inspect pump (para. 51).
Winch will not reverse at high speed.	Control valve may be restricted in its travel.	Check the travel of the control valve spool (para. 57).
	Oil may be too thick causing a high resistance to rotation at the brake plates and causing the relief valve to by pass.	Change to a lighter weight oil in the hydraulic system and primary housing. (TM 10-3950 204-20).
Brake will not hold when control valve is returned to neutral after pulling or lifting a load.	Control valve is not correct type. The correct control valve must have all ports open to tank when the spool is returned to neutral.	Remove hose lines from control valve and with the spool in neutral blow air through the cylinder or motor ports. The air should escape through the return port on the valve. If the motor ports in the valve are blocked by the spool when the spool is in neutral, remove the valve and re- · place with correct valve (para. 57).
Brake will not control or stop the load when lowering.	The trouble may be in the winch.	Disassemble the primary drire assembly (para. 51).

Section II. ENGINE

9. General

The engine is a six-cylinder, water-cooled, valvein-block, pressure-lubricated gasoline engine. It is mounted in the crane with the cooling fan facing the rear of the crane. The fan end of the engine is mounted on a single point support. The flywheel housing at the opposite end is secured to the transmission housing. The engine is shrouded by lift-off side panels and by a hood.

10. Engine Removal and Replacement

a. Removal.

(1) Drain engine oil, transmission oil and engine coolant (TM 10-3950-204-20).
(2) Disconnect parking brake linkage at parking brake cam lever (TM 10-3950-20420).
(3) Disconnect transmission shifting linkage at transmission (TM 10-3950-204-20).
(4) Disconnect electrical lead at micro switch on transmission housing.
(5) Remove air cleaner hood and clamp (TM 10-3950-204-20).
(6) Lift off and remove side panels and remove hood (TM 10-3950-204-20).
(7) Remove hood support and radiator from frame (TM 10-3950-204-20).
(8) Remove battery cables (TM 10-3950204-20).
(9) Tag and disconnect electrical leads at ignition coil, generator, solenoid switch (fig. 2)
(10) Remove air cleaner and mounting brackets (TM 10-3950-204-20).
(11) Disconnect fuel lines from. fuel pump (TM 10-3950-204-20).
(12) Disconnect accelerator linkage from governor control lever (TM 10-3950-204-20).
(13) Disconnect choke linkage from carburetor (TM 10-3950-204-20).
(14) Tag and disconnect electrical leads at voltage regulator (TM 10-3950-204-20).
(15) Tag and disconnect electrical leads from engine oil pressure and engine temperature sender. (TM 103950-204-20).
(16) Remove exhaust flange and pipe from exIhaust manifold (TM 10-3950-204-20).
(17) Remove solenoid switch and voltage regulator froin fire wall (TM 10-3950-20420).
(18) Remove both batteries (TM 10-3950-20420).
(19) Remove four capscrews (7, fig. 3), lockwashers (8) and flat washers (9) that secure sides of seat support to frame. Remove six capscrews (11) and lockwashers (10) that secure the front of seat support to frame.
(20) Remove four capscrews (3), lockwashers (4) and nuts (5) that secure the fire wall (1) to the brackets (2) mounted on frame. Remove fire wall with seat support (6) attached.
(21) Remove battery support at transmission (fig. 5).
(22) Tag and disconnect electrical leads from transmission oil pressure sender, transmission oil temperature sender and hourmeter sender (TM 10-3950-204-20).
(23) Disconnect hydraulic lines from transmission oil filter and drain lines into a suitable container (TM 10-3950-204-20).
(24) Disconnect and remove hydraulic lines at transmission and oil pump (fig. 6).
(25) Disconnect hose from sump tank return line filter and clear hose away from transmission; drain line into a suitable container (TM 10-3950-204-20).
(26) Remove drive shaft at transmission universal (fig. 8).
(27) Remove four capscrews, nuts, lockwashers, and flat washers that secure transmission support to cross member (fig. 7).
(28) Remove four capscrews (30, fig. 4), nuts (27), lockwashers (28) and flat washers (29), that secure flywheel housing supports (19) and pads (18) to frame.
(29) Remove cotter pin (17), slotted hex nut (16), flat washer (14) and rubber mount (13). Remove engine and assembled transmission with torque converter by lifting out of crane.
(30) Remove capscrew (5) and lockwasher (4) that secures inspection plate (3) to flywheel housing (20). Remove eight capscrews (2) and lockwashers (1) that secure flywheel (4, fig. 12) to flex disk drive (fig. 46)
(31) Remove twelve capscrews (25, fig. 4) and lockwashers (24) that secure torque con

verter (23) to flywheel housing (20). Separate by pulling torque converter from flywheel housing.

(32) Remove ignition coil and engine oil filter from mounting brackets (TM 10-3950204-20).

(33) Remove distributor (TM 10-3950-20420).

(34) Remove generator and starter (TM 103950-204-20).

(35) Remove carburetor, water pump and fuel pump (TM 10-3950-204-20).

(36) Remove engine oil pressure sender and engine temperature sender (TM 10-3950204-20).

(37) Remove front engine mounting stud (15), flat washers (7 and 14), rubber mounts (10 and 13) and cupped washer (12).

b. Replacement.

(1) Install front engine block mounting stud (15, fig. 4).

(2) Install engine oil pressure sender and engine temperature sender (TM 10-3950L' 204-20).

(3) Install carburetor, water pump and fuel pump (TM 10-3950-204-20).

(4) Install generator and starter (TM 103950-204-20).

(5) Install distributor (TM 10-3950-204-20).

(6) Install ignition coil and engine oil filter with mounting brackets to cylirder head (TM 10-3950-204-20).

(7) Position torque converter (23) to flywheel housing (20, fig. 4) and install twelve capscrews (25) and lockwashers (24) in torque converter and secure torque converter to flywheel housing.

(8) install eight capscrews (2) and lockwashers (1) to secure flywheel to flex-disk drive (fig. 45).

(9) Install flywheel inspection plate (3) with

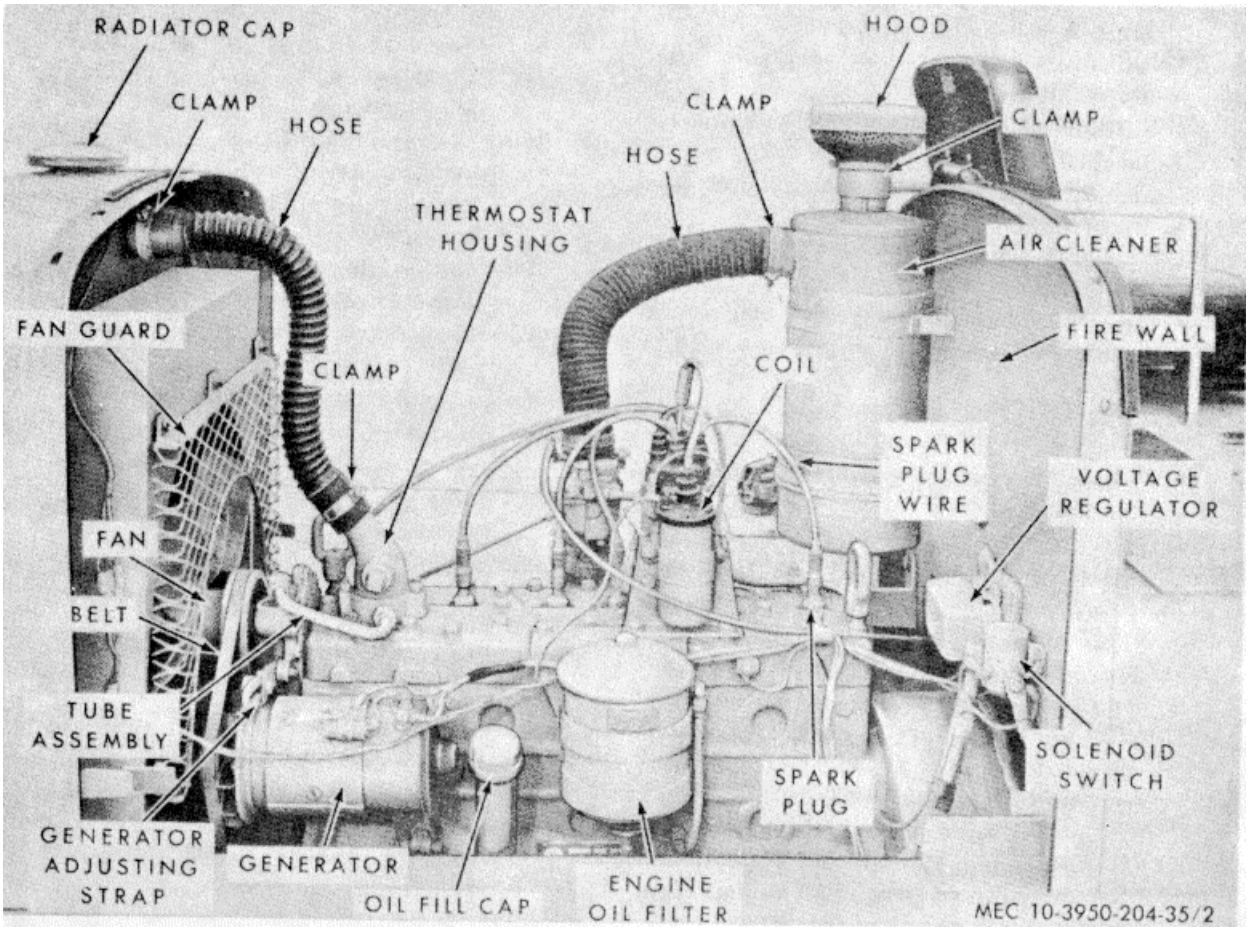
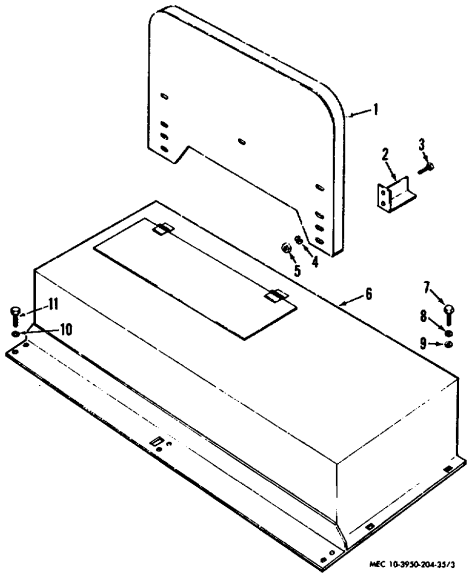


Figure 2. Engine compartment, right side view.



1 Fire wall
2 Support
3 Capscrew
4 Lockwasher
5 Nut
6 Seat support
7 Capscrew
8 Lockwasher
9 Flatwasher
10 Lockwasher
11 Capecrew

Figure 3. Seat support and fire wall, exploded view.

capscrew (5) and lockwasher (4) to flywheel housing (20).

(10) Install two washers (7, 8), rubber mount (10) and cupper washer (12) on stud (15) of engine; secure engine to frame cross member by installing rubber mount (13), flat washer (14), slotted hex nut (16) and cotter pin (17) to stud.

(11) Install four capscrews (30), flat washers (29), lockwashers (28) and nuts (27) to secure flywheel housing supports to crane frame.

(12) Install four capscrews, flat washers, lockwashers and nuts to secure transmission slupport to crioss member (fig. 7).

(13) Install four capscrews and two lock clips that secure drive shaft to universal (fig. 8).

(14) Connect hydraulic hose to sump tank return line filter (TM 10-3950-204-20).

(15) Connect hydraulic lines to transmission (fig. 6).

(16) Install four capscrews and lockwashers TAGO 8732-A that secures suction hose flange to main pump on transmission (fig. 6).

(17) Connect hydraulic hoses to transmission oil filter (TM 10-3950-204-20).

(18) Connect electrical leads to transmission oil pressure sender, transmission oil temperature sender and hourmeter sender (TM 10-3950-204-20).

(19) Install two capscrews and lockwashers to secure battery support to transmission (fig. 5).

(20) Install four capscrews (3, fig. 3), lockwashers (4) and nuts (5) that secure fire wall (1) and seat support (6) to frame. Install six capscrews (11) and lockwashers (10) to secure front of seat support to frame; install four capscrews (7), flat washers (9) and lockwashers (8) to secure seat support to frame.

(21) Install both batteries (TM 10-3950-20420).

(22) Install solenoid switch and voltage regulator to fire wall (TM 10-3950-204-20).

(23) Install exhaust flange and pipe to exhaust manifold (TM 10-3950-204-20).

(24) Connect electrical leads to engine oil pressure and engine temperature sender (TM 10-3950-204-20).

(25) Connect electrical leads to voltage regulator (TM 10-3950-204-20).

(26) Connect and adjust choke linkage to carburetor (TM 10-3950-204-20).

(27) Connect and adjust accelerator linkage to governor control lever (TM 10-3950-20420).

(28) Connect fuel lines to fuel pump and hoses to water pump (TM 10-3950-204-20).

(29) Install air cleaner and mounting brackets (TM 10-3950-204-20).

(30) Connect electrical leads at ignition coil, generator and solenoid switch (fig. 2).

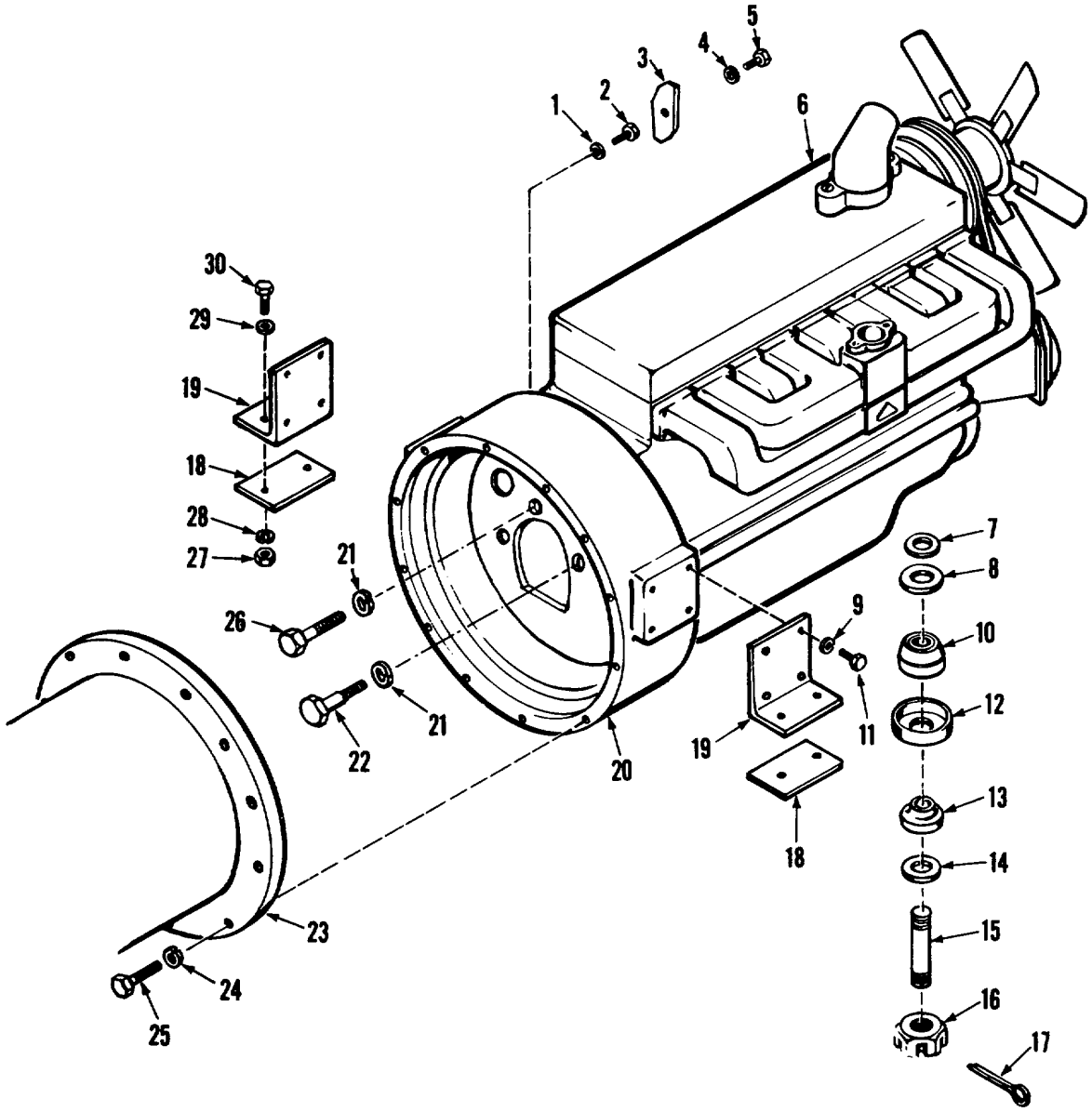
(31) Install battery cables (TM 10-3950-20420).

(32) Install hood support and radiator to frame (TM 10-3950-204-20).

(33) Fill engine crankcase, transmission and radiator to proper levels (TM 10-3950204-20).

(34) Install hood and side panels (TM 103950-204-20).

(35) Install air cleaner hood and clamp (TM 10-3950-204-20).



1	Lockwasher	11	Capscrew	21	Lockwasher
2	Capscrew	12	Cupped washer	22	Dowel bolt
3	Inspection plate	13	Rubber mount	23	Torque converter
4	Lockwasher	14	Washer	24	Lockwasher
5	Capscrew	15	Stud	25	Capscrew
6	Engine	16	Hex nut	26	Machine bolt
7	Washer	17	Cotter pin	27	Nut
8	Washer	18	Pad	28	Lockwasher
9	Lockwasher	19	Support	29	Washer
10	Rubber mount	20	Flywheel housing	30	Capscrew

Figure 4. Engine mount, flywheel housing and supports, exploded view.

Figure 5. Battery support removal.

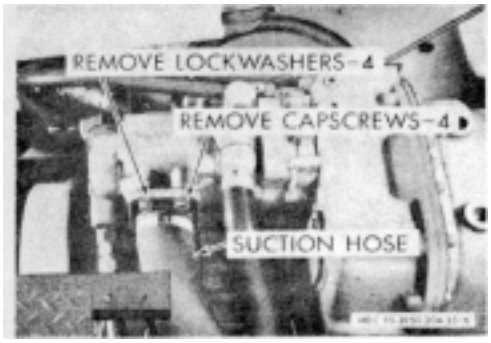


Figure 6. Disconnecting and connecting of hydraulic lines at transmission and oil pump.

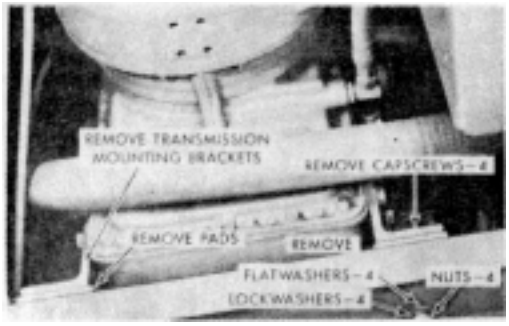


Figure 7. Transmission mounts.

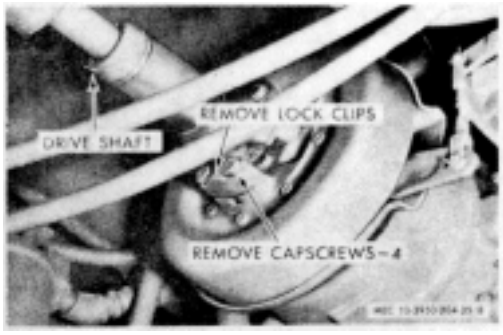


Figure 8. Removal of drive shaft at transmission universal.

(36) Connect electrical lead to micro switch on transmission housing.

(37) Connect and adjust transmission shifting linkage (TM 10-3950-2020).

(38') Connect and adjust parking brake linkage (TM 10-3950-204-20).

11. Engine Overhaul

a. Engine Removal. Remove engine (para. 10).

b. Oil Pan, Filler Block and Oil Pump Removal.

(1) Remove eighteen capscrews (9, fig. 9) that secures oil pan (6) and seals (5, 10) to engine block; remove oil pan and seals.

(2) Remove two capscrews (3) and lockwashers (2) that secures front filler block (4) to block; remove filler block.

(3) Remove two capscrews (11) and lockwashers (12) that secures rear filler block (13) and seal (14) to engine block; remove filler block and seal.

(4) Remove nut (7, fig. 10) and lockwasher (6) from stud (5) that secures oil pump body (22) to bearing cap (37. fig. 12). Remove oil strainer (17, fig. 10) from oil pump.

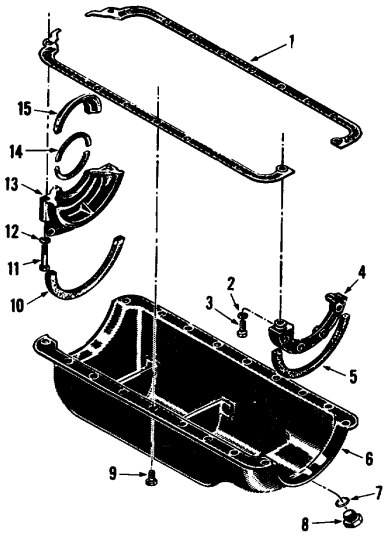
c. Cylinder Head Removal. Remove cylinder head (TM 10-3950204-20).

d. Gear Cover and Timing Gear Removal.

(1) Remove governor (par. 16a).

(2) Remove starting jaw (27, fig. 12), washer (26), plug (25) and key (22) that secure fan drive pulley (24) to crankshaft (19); remove pulley.

(3) Remove three nuts (1.1, fig. 24) and lockwashers (10) from engine block studs (9) at gear cover (20).



1	Gasket	9	Capscrew
2	Lockwasher	10	Seal
3	Capscrew	11	Capscrew
4	Filler block	12	Lockwasher
5	Seal	13	Filler block
6	Oil pan	14	Seal
7	Gasket	15	Guard

Figure 9. Oil pan, exploded view.

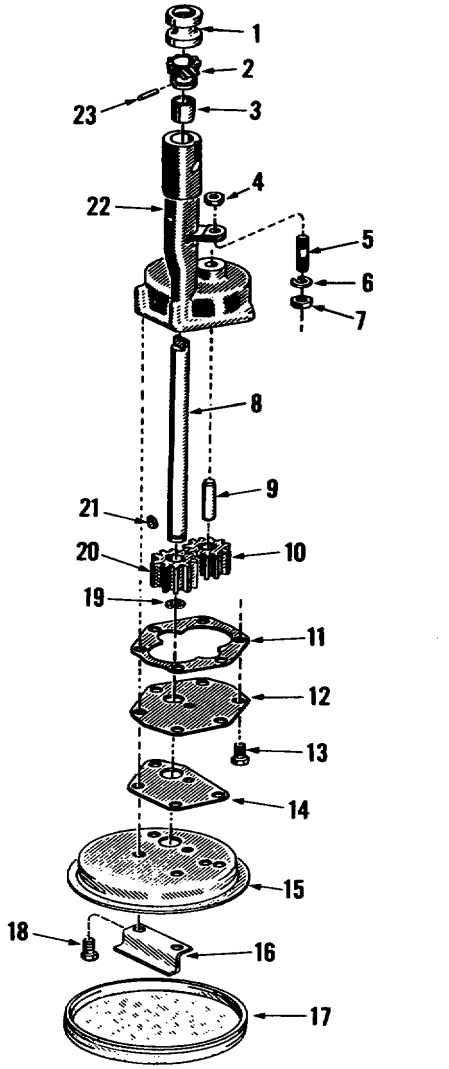
(4) Remove capscrew (13) and lockwasher (12) that secure gear cover to block; remove capscrew (15) and washer (14) that secure end plate (4) to gear cover. Remove capscrew (21), washer (7) and nut (8) that secures end plate to gear cover.

(5) Remove capscrews (17), two screw assembled washers (19), washers (18) that secure gear cover .(20) to front filler block (4, fig. 9). Remove gear cover (20, fig. 24) gasket (6), end plate (5) and gasket (3).

(6) Press seal (16) from gear cover.

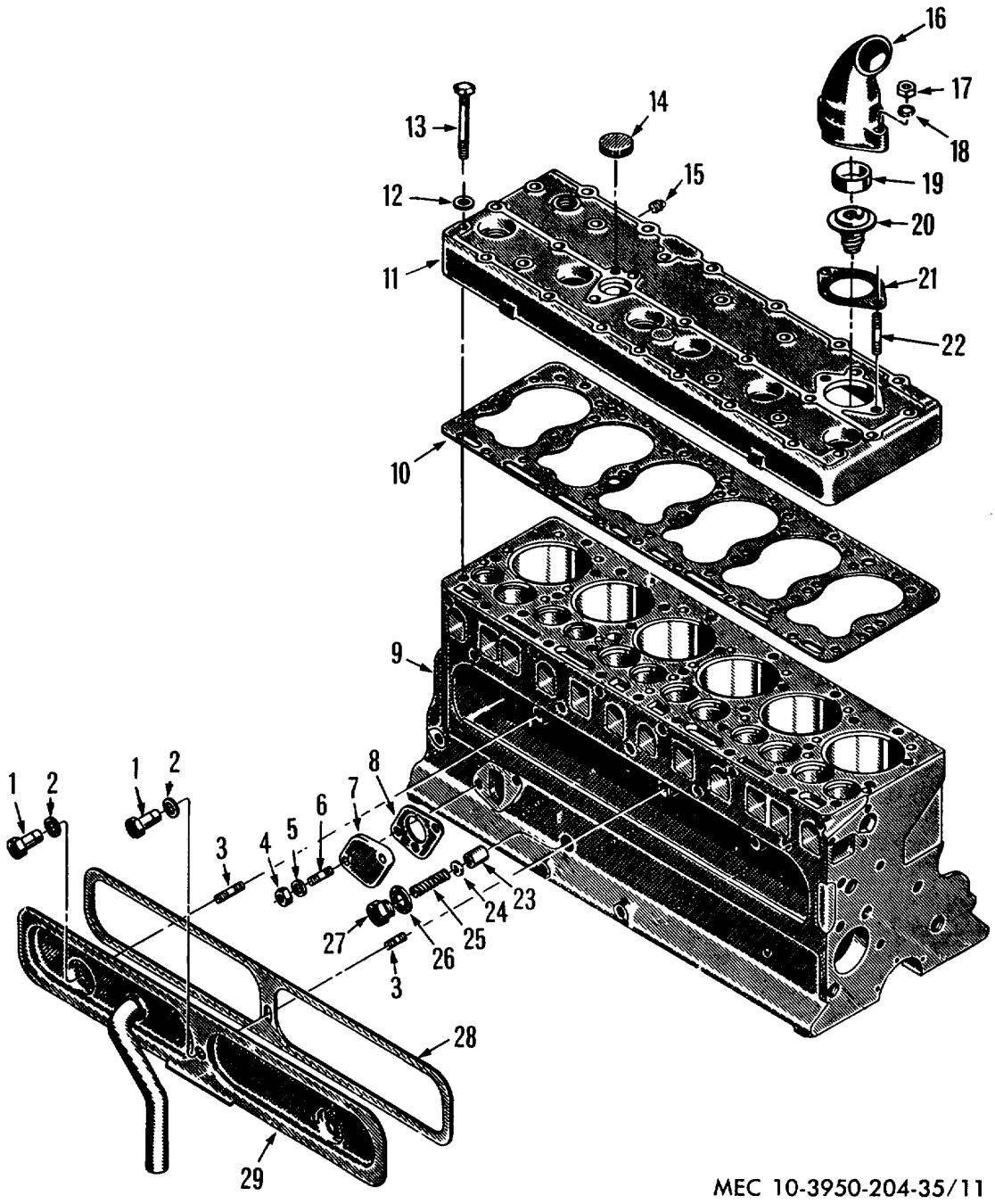
(7) Remove oil slinger (23, fig. 12), timing gear (21) and thrust plate (20) from crankshaft.

e. Flywheel and Flywheel Housing Removal.



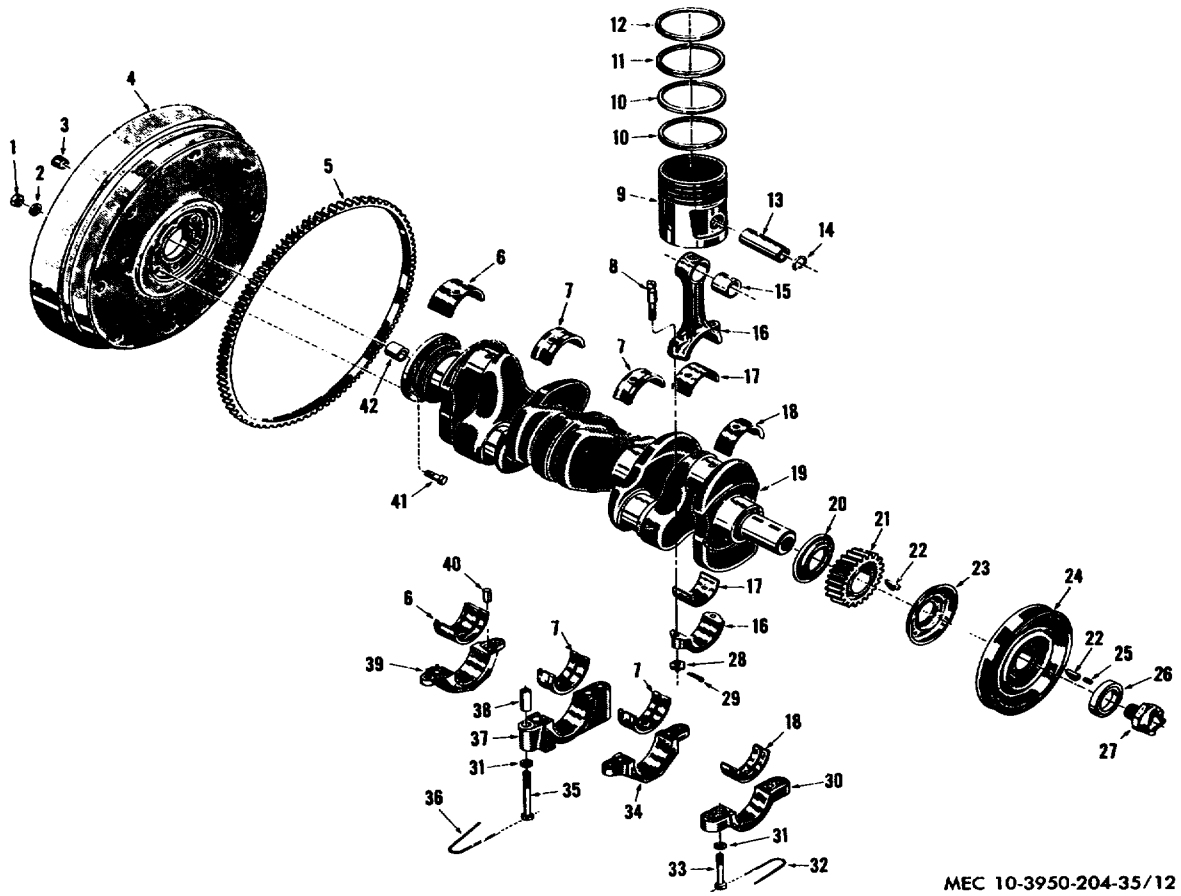
1	Sleeve	9	Stud	16	Spacer
2	Gear	10	Gear	17	Screen
3	Bushing	11	Gasket	18	Screw and lockwasher
4	Washer	12	Cover	19	Snapring
5	Stud	13	Screw and lockwasher	20	Gear
6	Lockwasher	14	Gasket	21	Key
7	Nut	15	Frame	22	Body
8	Shaft			23	Pin

Figure 10. Oil pump, exploded view.



1	Capscrew	9	Block	17	Nut	25	Spring
2	Washer	10	Gasket	18	Lockwasher	26	Gasket
3	Stud	11	Head	19	Ring	27	Plug
4	Nut	12	Washer	20	Thermostat	28	Gasket
5	Lockwasher	13	Screw	21	Gasket	29	Cover
6	Stud	14	Plug	22	Stud		
7	Cover	15	Plug	23	Relief valve		
8	Gasket	16	Elbow	24	Washer		

Figure 11. Engine, exploded view.



1	Nut	12	Piston ring	23	Slinger	34	Bearing cap
2	Lockwasher	13	Piston pin	24	Pulley	35	Capscrew
3	Plug	14	Retaining ring	25	Plug	36	Lockwire
4	Flywheel	15	Bushing	26	Washer	37	Bearing cap
5	Gear	16	Rod	27	Starting jaw	38	Dowel ring
6	Crankshaft bearing	17	Connecting rod bearing	28	Nut	39	Bearing cap
7	Crankshaft bearing	18	Crankshaft bearing	29	Cotter pin	40	Dowel
8	Connecting rod bolt	19	Crankshaft	30	Bearing cap	41	Capscrew
9	Piston	20	Thrust plate	31	Washer	42	Bushing
10	Piston ring	21	Timing gear	32	Lockwire		
11	Piston ring	22	Key	33	Capscrew		

Figure 12. Crankshaft and piston parts group, exploded view.

(1) Remove six nuts (1, fig. 12) and lockwashers (2) that secure flywheel to crankshaft (19); remove flywheel. Remove capscrews (41) from crankshaft.

(2) Remove three machine bolts (26, fig. 4), two dowel machine bolts (22), and five lockwashers (21) that secure flywheel housing (20) to block; remove flywheel housing.

f. Piston and Connecting Rod Removal and Disassembly.

(1) Ream the ridge of the top of each cylinder bore with a standard ridge reamer. Blow metal fragments from cylinder with compressed air.

(2) Remove two cotter pins (29, fig. 12) and nuts (28) that secures bottom connecting rod cap (16) to upper part of connecting;

rod (16) remove cap and connecting rod bearing (17).

(3) Push assembled piston (9) and connecting rod up through top of block.

***Caution*: While pushing piston and rod from block, be very careful connecting rod does not scratch cylinder wall.**

(4) Remove two retaining rings (14) from piston; push piston pin (13) from piston and rod.

***Note*, Disassemble pistons and piston rods in sets, and keep sets together. Also, be sure each piston and piston rod set is installed in cylinder from which it was removed.**

(5) Remove piston rings (10-12).

(6) Remove and disassemble five remaining piston and connecting rod assemblies.

g. Crankshaft Removal. Paragraph j(6) below contains instructions for main bearing replacement without removing crankshaft.

(1) Remove lockwire (32, fig. 12), two capscrews (33) and washers (31) that secure cap (30) to block; remove cap.

(2) Remove lockwire (32), two capscrews (33) and washers (31) that secure cap (34), to block; remove cap and two dowels (40).

(3) Remove lockwire (36), two capscrews (35) and washers (31) that secure cap /37) to block; remove cap and two dowels (38 and 40).

(4) Remove lockwire (36), two capscrews (33) and washer (31) that secure cap (39) to block; remove cap and two dowels (40).

(5) Remove bearings (18, 7, 6) from bearing caps.

(6) Lift crankshaft (19) from block.

(7) Remove bearings (18, 7, 6) from block.

(8) Remove guard (15, fig. 9) from block. Remove seal (14) from guard.

h. Valve and Camshaft Removal.

(1) Remove valves (par. 13d).

(2) Remove valve lifters (9, fig. 29). Note location of each valve lifter so it may be reinstalled in guide hole from which it -was removed.

(3) Remove nut (16) and locknut (15) that secures gear (13) to camshaft (10); remove key (14) and pull gear from camshaft.

(4) Remove two screw assembled washers TAGO 87A (12) that secure thrust plate (11); remove thrust plate.

i. Cleaning and Inspection.

(1) Clean all metal parts in an approved cleaning solvent. Dry with compressed air. Make sure that crankshaft, connecting rod, and cylinder block oil ports are open by blowing compressed air through each port.

(2) Inspect oil pan for dents, distorted sealing surfaces, cracks, damaged drain hole threads, or other defects.

(3) Inspect filler blocks for cracks, distortion, damaged sealing surfaces, or other damage.

(4) Inspect oil pump assembly for damaged drive gear, drive shaft play, body cracks, strainer distortion, or other defects.

(5) Inspect cylinder head (TM 10-.3950-20420).

(6) Inspect flywheel housing for cracks, damaged sealing surfaces, or other defects.

(7) Inspect flywheel for damaged teeth, cracks, distortion or other defects.

(8) Inspect pistons for cracks, scoring, pitting, damaged ring grooves, or other defects.

(9) Inspect. piston rods for cracks, distortion, scoring, or other defects.

(10) Inspect crankshaft for cracks, scored or grooved bearing journals, damaged key slots and bolt holes, or other defects.

(11) Inspect valves and other pertinent parts (13b)

(12) Inspect tappets for scoring, pitting, cracks, or other defects.

(13) Inspect camshaft for cracks, pitting, worn or scored lobes or bearing journals, damaged threads or key slots, or other defects.

(14) Inspect engine block (para. 12d).

(15) Inspect parts listed in table II to be certain parts are not worn beyond limits given.

(16) Replace gaskets, seals, and repair or replace damaged or defective parts.

j. Crankshaft Repair and Installation.

(1) If gear (21, fig. 12) is damaged or defective, press gear from crankshaft (19). Position key (221 in keyway and press a replacement gear on to crankshaft. When gear is replaced, slinger (23) must also be replaced.

(2) Flatten seal (14, fig. 9) with a hammer

Table II. Wear Limits

Part	Point of measurement	Wear limits
Valve Guides.	Bore diameter	Intake-9.3448 in. max.
Intake Valve Stems.	Stem diameter	0.3414 in. max
Exhaust Valve Stems	Stein diameter	0.3385 in. max
Valve Springs	Tension when com-pressed to 121/32	42 pounds min.
	Tension when com-pressed to 1 3/8 in.	93 pounds min.
Crankshaft	Front bearing journal diameter.	1.8715 in min.
	Intermediate front bearing journal diameter.	1.8085 in. min.
	Intermediate rear bearing journal diameter.	1.7457 in. min.
	Rear bearing journal diameter.	1.2465 in. min.
Crankshaft	Connecting rot bearing journal diameter.	2.1865 in. min.
	Main bearing journal diameter.	2.3744 ill. min.
Piston Pins	Pin diameter	0.8591 in. min.
Connecting Rods	Piston pin bearing diameter.	0.8597 in. max.
Piston	Piston pin hole diameter.	0.8594 in. max.
	Piston ring groove width --top groove.	0.1285 in. max.
	Piston ring groove within--two middle grooves.	0.1285 in. max.
	Piston ring groove width- --bottom groove.	0.253 in. max.
Piston Rings	Piston ring width top ring.	0.123 in. min.
	Piston ring width two middle rings.	0.123 in. min.
	Piston ring width bottom ring.	0.2485 in. min.

or vice; install iii rear guard (fig 13)Trim seal flush with guard Install assembled seal and guard in block. Lubricate seal with engine oil.

(3) Position upper half of bearings (6, 7, and 18, fig. 12) in block. Install crankshaft (19) in block. Install lower half of bearings (6, 7. and 18) in bearing cal) (30, 34, 37 and 39).

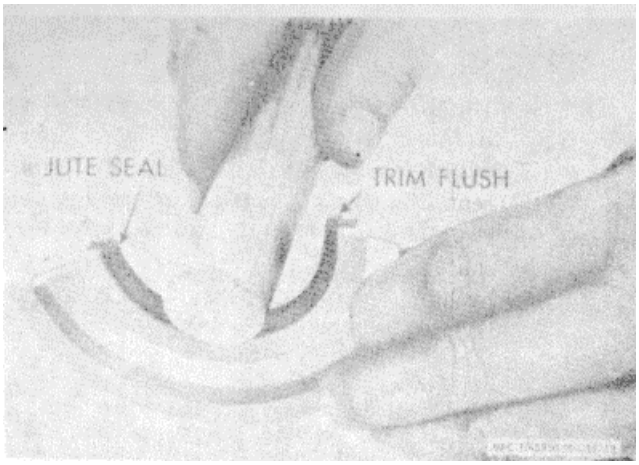


Figure 13. Installing top half of rear seal in guard.

(4) Check clearance between crankshaft bearing journals and bearings as follows:

(a) Place a piece of plastigage near oil hole of bearing cap.

(*b*) Position cap on block and secure with two screws and lockwashers. Tighten screws to 85-95 foot-pounds torque.

(*c*) Remove bearing and bearing cap. Check bearing journal-to-bearing clearance using plastigage (fig. 14).

(5) Clearance must be between 0.0008 and 0.0028 inch. If clearance is not within these limits replace bearings and recheck clearance.

(6) Remove and replace bearings as follows:

(*a*) Remove bearing cap; remove bearing from cap.

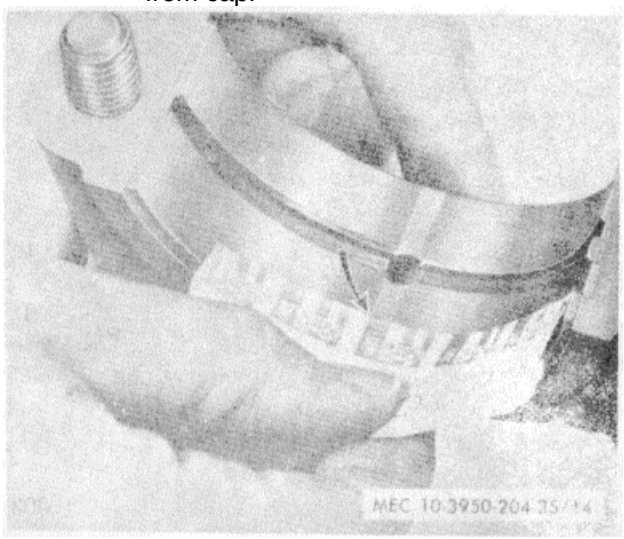


Figure 14. Checking bearing clearance with plastigage

(b) Install a pin with an angular head in oil hole in crankshaft bearing journal (fig. 15) (c) Rotate crankshaft by hand. The pin will force top bearing half out of its seat.

(d) Position replacement bearing on crankshaft bearing journal. Rotate crankshaft by hand. The pin will force bearing half into position.

(e) Install replacement bearing half in cap. Install cap.

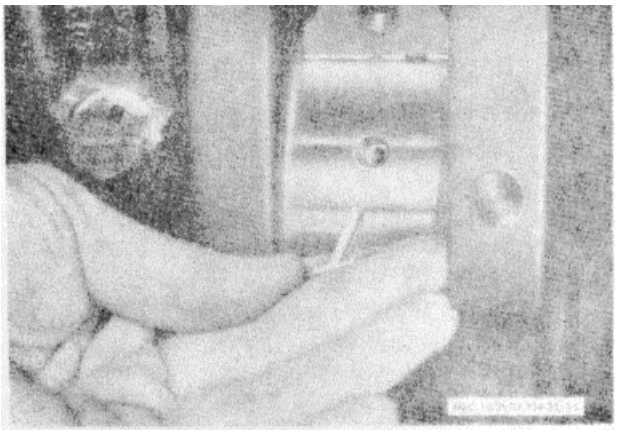


Figure 15. Removing main bearing vyith angular-headed pin.

(7) Check remaining bearing-to-bearing journal clearances and replace bearings as necessary.

(8) An alternate method of checking bearing clearance is as follows:

(a) Oil bearing and bearing journal with engine oil.

(b) Position a strip of 0.0028-inch feeler gauge, 1/2 inch long, on bearing cap. (fig. 16).

(c) Install cap on block; secure with screws and lock washers. Tighten screws to 85-95 foot-pounds torque.

(d) Try to turn crankshaft by hand. If crankshaft will not turn or a definite drag is felt, bearing-to-bearing journal clearance is within tolerance.

(9) After all main bearings have been installed, check crankshaft end play using a dial indicator. If end play is not between 0.003 and 0.008 inch, replace thrust plate (20, fig. 12) as follows:

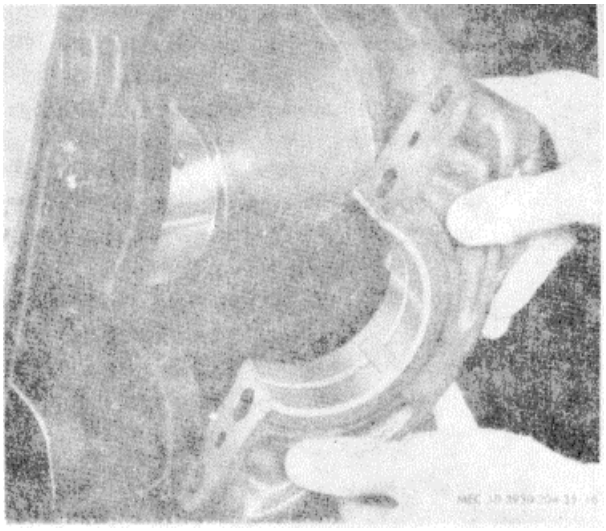


Figure 16. Checking bearing clearance with feeler stock

(*a)* Pull gear (21) from crankshaft. Remove thrust plate from crankshaft.

(*b)* Position new thrust plate and key (22) on crankshaft; drive gear onto shaft.

(*c)* Press gear into final position by installing oil slinger (23), pulley (24), washer (26), and starting jaw (27).

k. Camshaft and Valve Repair and Reassembly.

(1) Install crankshaft (10, fig. 29) in block. Check clearance between camshaft bearing journals and crankshaft bearings (fig.16) with feeler stock cut in strips 1/4 inch wide. Dress feeler stock with a stone to eliminate burs or feathered edges. Clearance between fan end and drive end bearings and journals must be between 0.002 and 0.004 inch and center journal must ha between 0.003 and 0.0047.

Caution: **Do not insert camshaft too far into block. If camshaft bumps expansion plug on drive end of engine, an oil leak could result.**

(2) If clearance exceeds tolerances, remove crankshaft from block and install new camshaft bearings. Camshaft bearings are presized and do not have to be honed after installation.

(3) Lubricate camshaft bearings with engine oil and install camshaft in block. Position thrust plate (11) on the camshaft; secure with two screw assembled washers (12).

(4) Position backing plate (4, fig. 24) and gasket (3) on block.

(5) Position key (14, fig. 29) on camshaft. Hold camshaft toward front of engine with a bar inserted into fuel pump hole. Align timing marks on crankshaft and crankshaft gears (fig. 17) and drive gear (13) onto camshaft. Position governor drive assembly against camshaft gear and secure with nut (16, fig. 29). Tighten nut to 85-90 foot pounds torque.

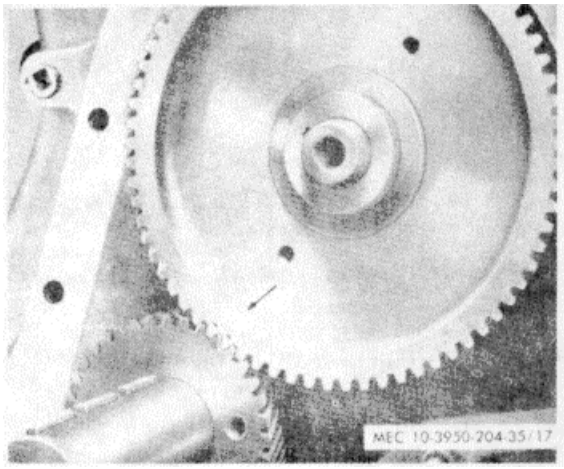


Figure 17. Timing gears installed with timing marks aligned

(6) Check camshaft end play with a dial indicator. If end play is not between 0.005 and 0.009 inch, remove camshaft timing gear and replace thrust]plate (11, fig. 29) by removing camshaft timing gear.

(7) Check clearance between crankshaft and crankshaft gears as follow:

(a) Force teeth of tile gears apart with a screwdriver. Attempt to insert a 0.0015inch feeler gauge into gap between gears. If gauge will enter, clearance is excessive.

(b) If gauge will not enter, place a finger at junction of the two gears and tap camshaft gear with a hammer (fig. 18). If vibrations can be felt in large gear, clearance is sufficient.

(8) If gear clearance is too great or too small, gears must be replaced. Replace gears only in sets. Gear sets are available in standard size (marked S), 0.002 and 0.004 inch undersized (marked U), and 0.002 and 0.004 inch oversized (marked O). Install a gear set marked the same as set removed. Check clearance as directed in (7) 22

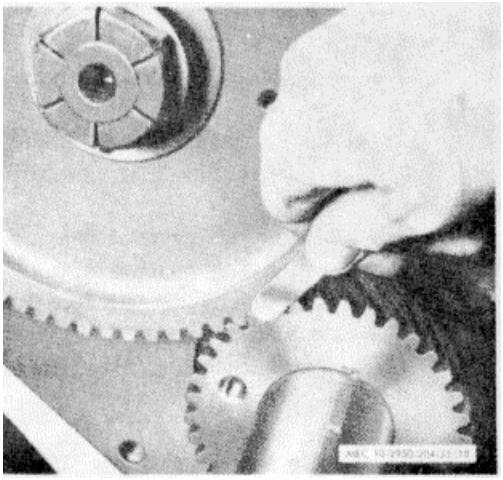


Figure 18. Checking gear clearance.

above. If clearance is too great, install next smaller size gear set. If clearance is insufficient, install next larger size set.

(9) Install each valve lifter (9, fig. 29) in its hole. Check clearance between lifter and bore. If clearance exceeds 0.005 inch, replace lifter.

(10) Install valves (para. 13c).

I. Piston and Connecting Rod Repair and Installation.

(1) Check piston fit (fig. 19) using a piece of 0.003-inch feeler stock cut 1/2 inch wide. Dress edges of feeler stock with a stone to remove burs and feathered edges. The block and pistons must be at room temperature when piston fit is tested. Position feeler stock midway between piston pin bosses. With piston inserted about 2 inches into block, feeler stock must pull from block with 5 to 10 pounds pull. If feeler stock does not offer enough resistance, perform same test with a new standard size piston. If sufficient resistance is still not obtained, rebore cylinders (para. 12e) and install oversize pistons.

(2) If new pistons (9, fig. 12) and piston pins (13) are being used, press a new bushing (15) into each connecting rod (16). Ream and hone bushing to 0.8597 to 0.8595-inch diameter.

(3) If pistons and pins are not being replaced, check clearance between piston pins and bushings. Clearance must be between 0.0006 and 0.0002 inch. If clearance is not within this tolerance, press new sleeve

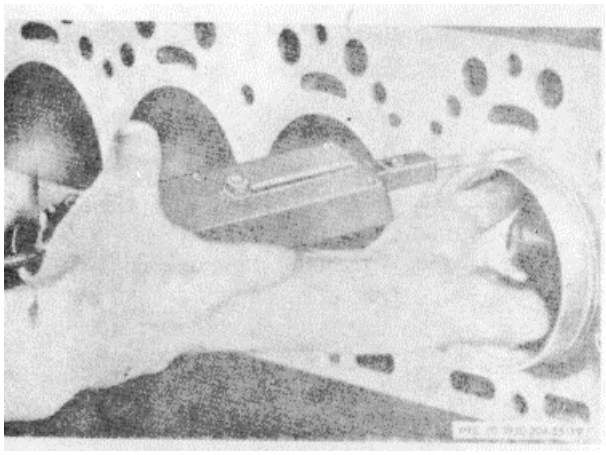


Figure 19. Checking piston fit in cylinder bore.

bearings into connecting rods and ream and hone to provide proper clearance. After honing, 75 percent of sleeve bearing surface must contact piston pin.

(4) When pins, bushings, and pistons of proper size have been found, assemble pistons to connecting rods as follows:

(a) Heat pistons and connecting rods in an oven or in water to a, minimum of 160° F.

(b) Position connecting rod in its piston. Install piston pin; secure with retaining rings (14)

(5) Slide piston rings (10-12) squarely into cylinders in which they will be used. Check ring gap with feeler gauge. If ring gap is not at least 0.007 inch, file rings to provide a larger gap. If ring gap exceeds 0.017 inch, rebore cylinders (para. .12e) and install oversize pistons and rings.

(6) Install piston rings on piston with a standard ring expander tool.

(7) Assemble remaining pistons, connecting rods, and piston rings.

(8) Install assembled pistons and connecting rods in same cylinders from which they were originally removed (para. 11*f*(4)). Use a ring compressor to compress piston rings. Lubricate pistons and cylinder walls with engine oil before installing pistons. Wrap bottom end of connecting rods with a cloth to prevent damage to cylinder walls during installation.

(9) Check crank pin bearing journal-to-connecting rod bearing clearance with plastigage as directed in j (4) above. Tighten connecting rod cap bolts to 35-40 foot-pounds torque. If clearance is not between 0.0007 and 0.0025 inch, replace connecting rod bearings and recheck clearance. If clearance is still not within tolerance, replace crankshaft.

(10) As an alternate method of checking crank pin bearing journal -.to-connecting rod bearing clearance, install a piece of 0.0025-inch thick feeler stock between bearing and journal and check clearance as directed in j (8) above. Tighten connecting rod cap bolts to 35-40 foot-pounds torque. Instead of rotating crankshaft to detect drag, try to slide connecting rod alternately toward the front and rear of engine. If clearance is within tolerance, a definite drag will be felt. If clearance is not within tolerance, a definite drag will be felt. If clearance is not within tolerance, replace connecting rod bearings and recheck clearance. If clearance is still not within tolerance, replace crankshaft.

(11) lubricate crank pin bearing journals and bearings with engine oil. Install cap (16, fig. 12) on its connecting rod and crank pin bearing journal, secure with two bolts (8) and nuts (28). Tighten nuts to 35-40 foot-pounds torque. Install cotter pins (29).

(12) Secure remaining connecting rods to crank pin bearing journal.

m. Flywheel and Flywheel Housing Installation.

(1) Position flywheel housing (20, fig. 4) on block (6); secure with three machine bolts (26), two dowel bolts (22), and five lockwashers (21).

(2) If teeth on flywheel ring gear (5, fig. 12) are damaged, replace ring gear as follows:

(a) Cut ring gear with a torch or hack saw and remove ring gear from flywheel (4).

Caution: When cutting ring gear, be extremely careful not to damage flywheel.

(b) Heat replacement ring gear in an oven and cool flywheel in water or a refrigerator.

(c) Position replacement ring gear on flywheel. As ring gear and flywheel approach the same temperature, ring gear will contract to a very tight fit on flywheel.

(3) Position assembled flywheel and ring gear on crankshaft (19); secure with six bolts (41), lockwashers (2) and nuts (1). Tighten nuts to 35-40 foot-pounds torque.

(4) Check flywheel runout by mounting a dial indicator (fig. 20) and rotating crankshaft through one full revolution. Hold pressure against flywheel to eliminate crankshaft end play. If flywheel runout exceeds 0.008 inch, remove flywheel and clean crankshaft flange and flywheel seat. Install flywheel and recheck runout. If runout still exceeds

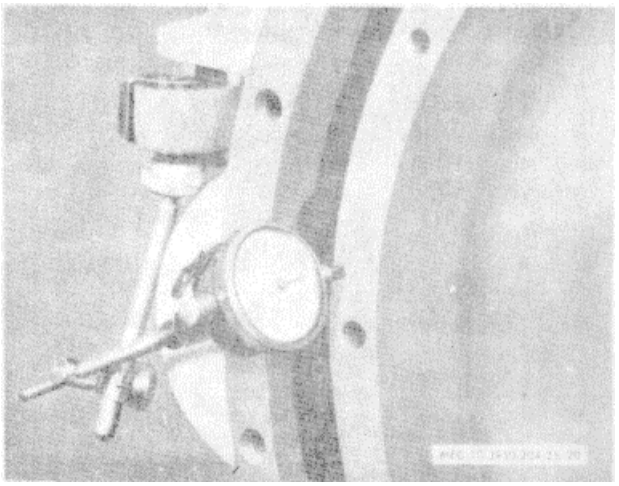


Figure 20. Checking flywheel runout.

(5) Check flywheel eccentricity by mounting a dial indicator (fig. 21) and rotating crankshaft through one revolution. If flywheel is eccentric more than 0.008 inch, loosen and retighten flywheel mounting

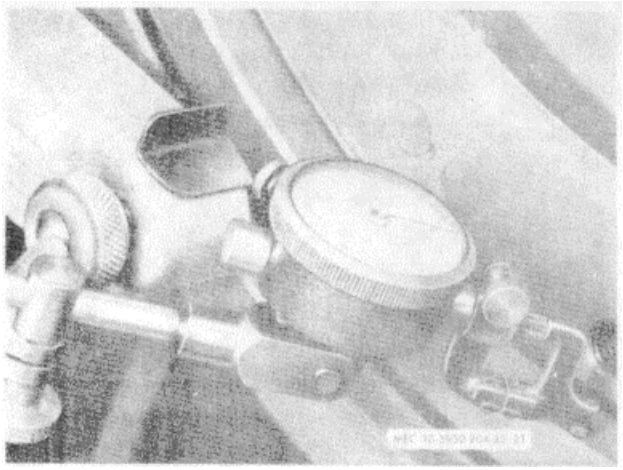


Figure 21. Checking flywheel counterbore for eccentricity.

bolts and recheck eccentricity. If eccentricity still exceeds 0.008 inch, replace flywheel.

(6) Check runout of flywheel housing face by mounting a dial indicator (fig. 22) and rotating crankshaft through one revolution. Hold pressure against flywheel to eliminate end play. If runout exceeds 0.008 inch, clean mounting surfaces of flywheel housing and block. Recheck flywheel housing runout. If runout is still not within limits, replace flywheel housing.

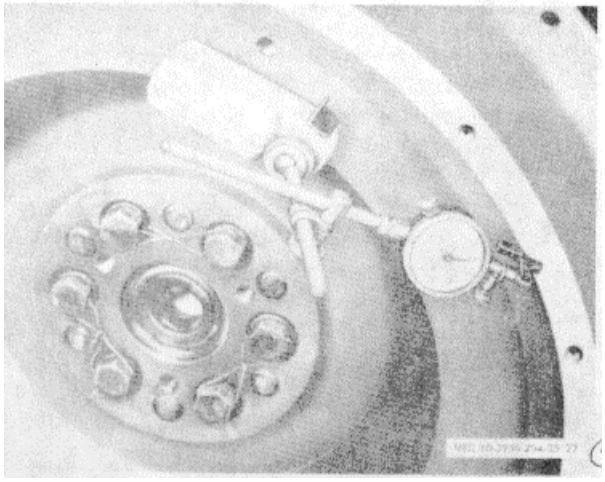


Figure 22. Checking flywheel housing runout.

(7) Check eccentricity of flywheel housing bore by mounting a dial indicator (fig. 23) and rotating engine through one revolution. If housing bore is eccentric more than 0.008 inch, loosen flywheel housing mount

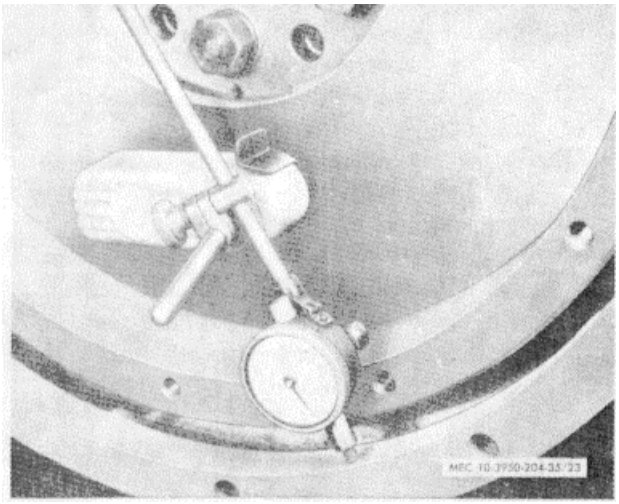


Figure 23. Checking of flywheel housing eccentricity.

ing bolts and tap housing into its proper position with a soft hammer. Tighten bolts and recheck eccentricity of housing bore. If housing can not be brought into true position, replace housing.

n. Gear Cover Reassembly and Installation.

(1) Install thrust plate (20, fig. 12) on to crankshaft (19).
(2) Lubricate timing gear (21) and crankshaft with engine oil. Install timing gear to thrust plate on crankshaft after key (22) has been placed on crankshaft.
(3) Install oil slinger (23) on to shaft.
(4) Press a new seal (16, fig. 24) into gear cover.
(5) Lubricate seal with engine oil.
(6) Install gear cover to engine block as follows:
(*a*) Install three nuts (11, fig. 24) and lockwashers (10) to engine block studs.
(*b*) Install cap screw (13) and lockwasher (12) that secures gear cover to block. Install capscrew (15) and washer (14) that secures end plate (4) to gear cover: install capscrew (21), lockwasher (7) and nut (8).
(*c*) Install capscrews (17), screw assembled washers (19) and washers (18) to secure

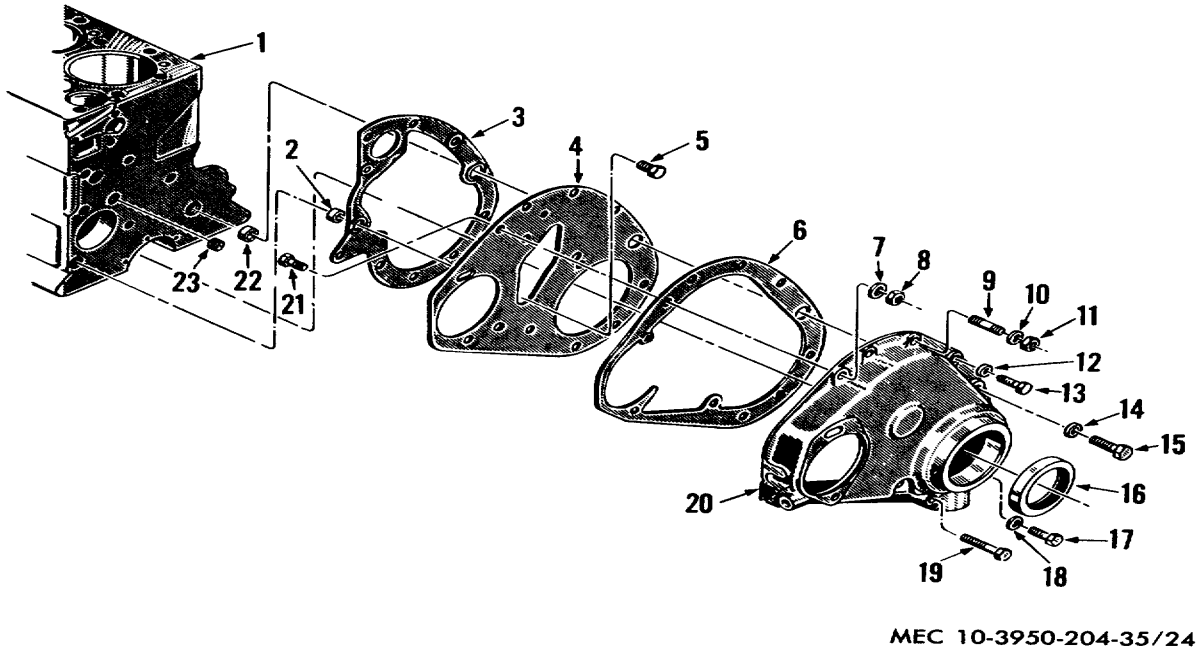


Figure 24. Gear cover, exploded view.

1	Engine block	9	Stud	17	Capscrew
2	Ring dowel	10	Lockwasher	18	Washer
3	Gasket	11	Nut	19	Screw assembled washer
4	End plate	12	Lockwasher	20	Gear Cover
5	Screw assembled washer	13	Capscrew	21	Capscrew
6	Gasket	14	Washer	22	Ring dowel
7	Washer	15	Capscrew	23	Plug
8	Nut	16	Seal		

gear cover to front filler block (4, fig. 9)

(7) Install key (22, fig. 12), slinger (23), pulley (24) and plug (25) to crankshaft; secure with washer (26) and starting jaw (27).

o. Cylinder Head Installation. Install cylinder head (TM 10-3950-204-20).

p. Oil Pump, Filler Block, and Oil Pan Installation.

(1) Position oil pump body (22, fig. 10) on engine block; secure with nut (7) and lockwasher (6). Install oil strainer (17) on oil pump assembly'

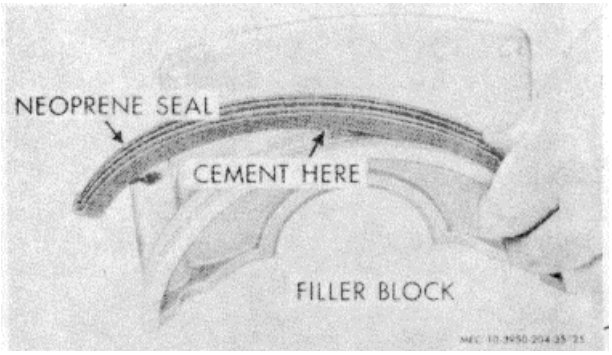


Figure 25. Install neoprene gasket in rear filler block.

(2) Install seal (10, fig. 9) on rear filler block (13) by placing a drop of nonhardening cement in the middle of the gasket and pressing gasket into groove in filler block (fig. 25).

(3) Install seal in rear filler block as follows:

(a) Flatten seal in a vise or with a hammer

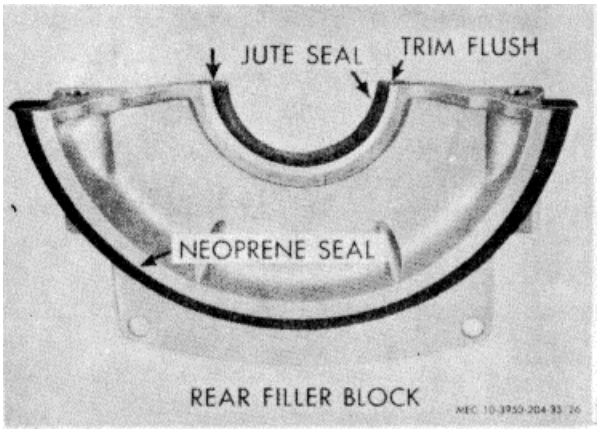


Figure 26. Lower half of ring seal installed in filler block.

until seal fits into groove in filler block.

(*b*) Roll seal flush with filler block groove with a round object (fig. 13).

(c) Trim seal flush with filler block (fig. 26).

(4) Install seal (5, fig. 9) on front filler block (4) by placing a drop of nonhardening cement in the middle of tie gasket and pressing gasket into groove in filler block(fig. 27).

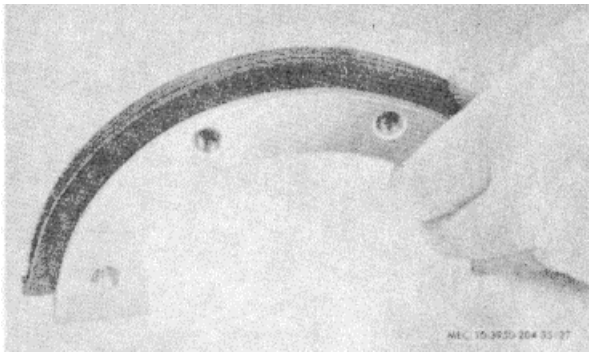


Figure 27. Installing neoprene gasket in Joint filler block.

(5) Lubricate seal with engine oil. Install assembled rear filler block (13, fig. 9), seal _f (10) and seal (14). Position oil pan gaskets (1) to engine block (fig. 28) and secure with two capscrews (11) and lockwashers (12). Tighten capscrews to 15-20 foot pounds torque.

(6) Install ,assembled seal (5, fig. 9) and front filler block (4) on engine and secure with two capscrews (3) and lockwashers (2'1.

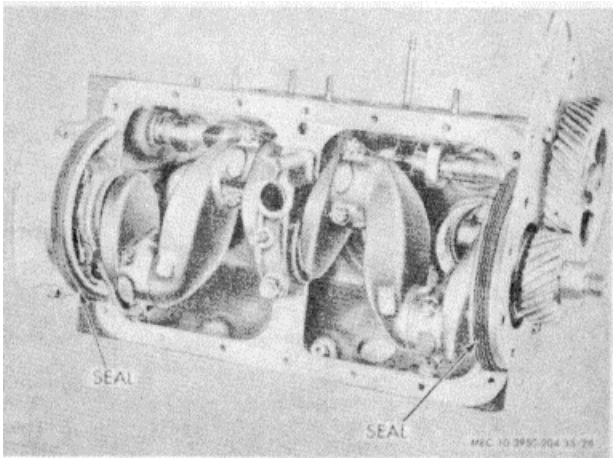


Figure 28. Filler block installed in engine block.

Tighten capscrews to 15-20 foot-pounds torque.

(7) Flatten oil pan gasket (1) surfaces with a block of wood and a hammer. Install oil pan (6) and gasket on engine block; secure with eighteen capscrews (9). Tighten capscrews to 15-20 foot-pounds torque.

q. Installation. Install engine according to replacement procedures in paragraph 10b.

12. Engine Block

a. Removal. Remove engine (para. 10a).

b. Disassembly. Disassemble engine (para. 11b-h)

c. Cleaning. Remove dirt and grease deposits from block with a putty knife. Steam-clean block. Remove greasy or gummy deposits with a cloth dampened in an approved cleaning solvent. Clean oil and water passages in block with compressed air. Remove varnish deposits with a wire brush.

d. Inspection.

(1) Inspect block for cracks, damaged sealing surfaces scored or damaged bearing seals, scored or scratched cylinder walls, damaged threads, loose or damage studs, corrosion in water jacket, or other defects.

(2) Check piston fit in cylinder bores (para. 11*l*(1)).

(3) Check cylinder bore wear with an inside micrometer. Measure cylinder bore at 45° intervals below the travel of lowest piston ring where cylinder is not worn. Compare this measurement with a measurement taken about 1.4 inch below top of cylinder. The maximum allowable cylinder wear difference between these two measurements) is 0.008 inch.

(4) Replace block if it is cracked, or defects cannot be repaired. Replace loose or darmaged studs. Retap damaged threads. If a proper piston fit cannot be attained (para. 11l (1)), cylinders are scratched or scored, or cylinder wear exceeds 0.008 inch, rebore cylinders as directed in e below.

e. Reboring. Rebore cylinders to 3.4575 to 3.4595-inch diameter (0.020 inch oversize). If this is not sufficient to elinminate cylinder wear or damage, rebore cylinders to 3.4775 to 3.4795-inch diameter (0.040 inch oversize). allowable overbore is 0.040 inch.

f. Reassembly. Reassemble engine (para. 11*l*--p).

g. Installation. Install engine according to replacement procedures in paragraph 10b.

13. Valves

a. Removal.

(1) Remove cylinder head (TM 10-3950-20420).

(2) Remove valve tappet cover (TM 10-3950204-20).

(3) Using a spring compressor, compress valve spring (4, fig. 29) at each valve (1) and remove spring retaining lock (6) from each valve that is in closed position. Rotate engine crankshaft to close remaining valves and remove remaining locks.

(4) Lift each valve from top of block. Place them in order in a rack to assure that each will be reassembled in same valve guide from which it was removed.

(5) Remove valve stem caps (7). Remove tappet (9).

(6) Do not remove valve guides (3) or valve seats (2) unless inspection indicates that they are faulty.

b. Cleaning, Inspection, and -Repair.

(1) Clean valves, valve-springs, valve lifters, and valve stem caps (fig. 29) with an approved cleaning solvent: dry thoroughly. Remove carbon deposits with a wire brush.

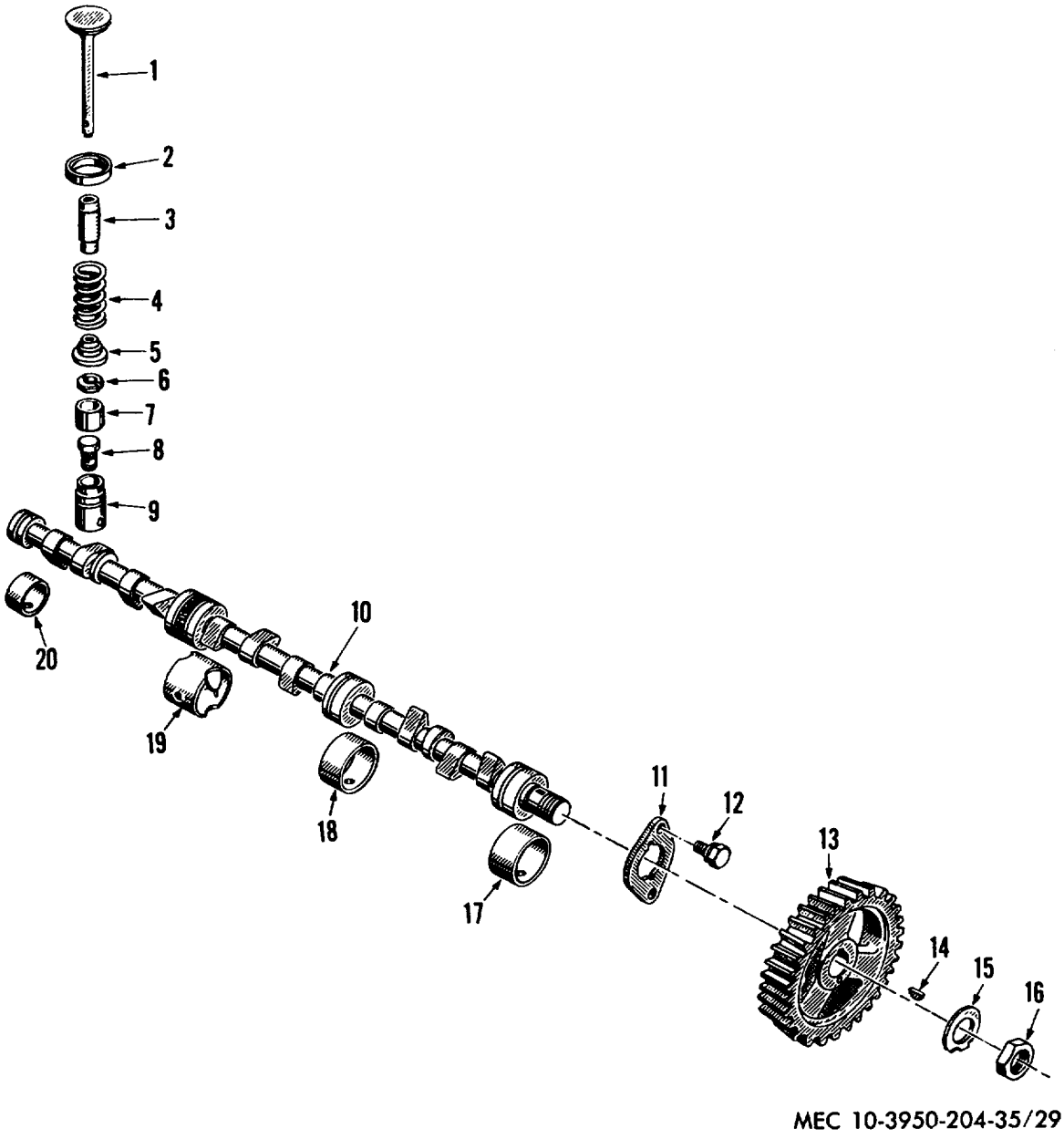
(2) Clean valve guides installed in block with a wire brush or a valve guide cleaner. Remove all lacquer and other deposits.

(3) Clean valve seats with a wire brush.

(4) Inspect valves for cracks, bent stems, distortion, and wear. If valves are not seriously damaged, regrind them. After grinding, valve head thickness must be at least 50 percent the thickness of a new valve. Replace valves if they are ground to less than this amount. Check reground valves on V-blocks with an indicator. The contact face must be true with the stem to within 0.002 inch. Repeat refacing operation if necessary.

(5) Check for loose or worn valve guides. Check internal diameter of valve guide with a telescope gauge and a micrometer. Replace guides that are worn to a bell-mouthed shape or guides that have a maximum diameter of more than 0.3447.

(6) If valve guides are worn or damaged, (drive out guides from combustion side, 27



1	Valve	8	Adjusting screw	15	Locknut
2	Valve seat	9	Tapper	16	Nut
3	Valve guide	10	Camshaft	17	Bushing
4	Spring	11	Thrust plate	18	Bushing
5	Retainer	12	Screw assembled washer	19	Bushing
6	Retaining lock	13	Gear	20	Bushing
7	Stem cap	14	Key		

Figure 29. Valve and camshaft group parts, exploded view.

using a driver that is slightly smaller than external diameter of guide (fig. 30)). With driver, drive in new guides from combustion side. When properly seated, valve guide tops will be 1 $^{15}/_{32}$, inches from top of block (fig. 31).

Caution: **Do not attempt to ream valve guides after seating them. Guides are pre-reamed and coated. Further reaming will remove coating.**

(7) Check exhaust valve seat inserts for cracks or loose mounting. Pull out faulty valve seats (fig. 32). Replace valve seats with new 0.010 inch oversized valves seats.

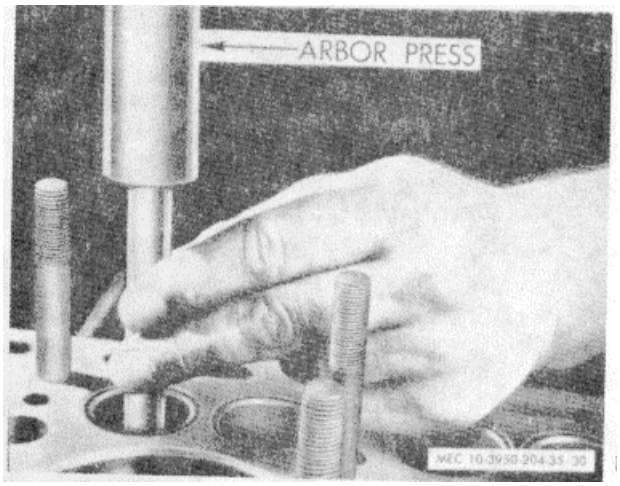


Figure 30. Removing valve guides.

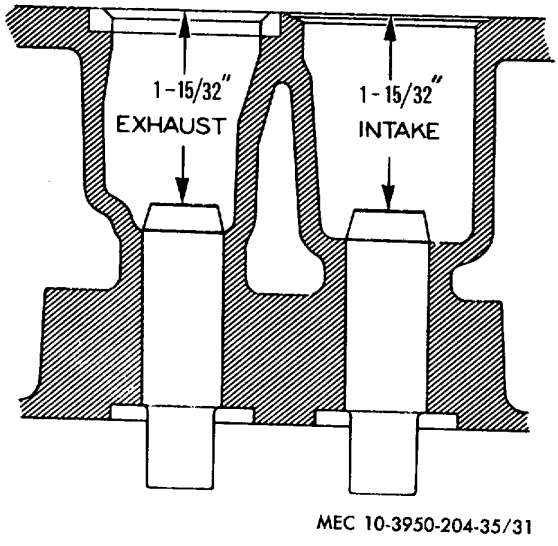


Figure 31. Valve guile location.

Counterbore valve seats to a diameter of 1.438 to 1.437 inches. This will provide a 0.003 to 0.005 inch press fit. Counterbore deeply enough so that boring tool will cleanup bottom of bore to assure proper heat conduction from valve insert. Chill valve seats in dry ice for 20 minutes. Install valve seat in place with a piloted driver using an arbor press or by applying light blows with a hammer until valve seat is resting against bottom of bore. Roll or peen valve seat in place.

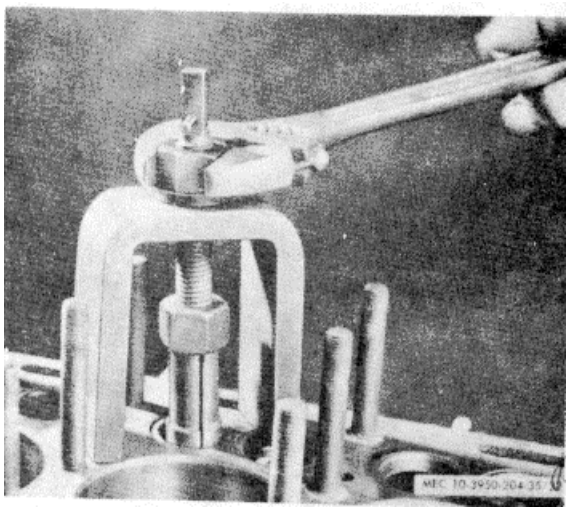


Figure 32. Removing valve seat insert.

(8) Check valve springs for cracks and distortion. Test compression strength with a spring tester. Compression strength must be as follows:

Length	Load (minimum)
1-21.32 in. (closed)	42 pounds
1 $^{3}/_{8}$ in. (open)	93 pounds

(9) Grind valve seats (fig. 33). The seat angle of intake valves is 30°. The seat angle of exhaust valve is 45°. Use a dial indicator (fig. 34) to check valve seat for runout. The total indicator reading must not exceed 0.002 inch. Clean valve seat and surrounding area thoroughly after grinding.

(10) After valves and seats have been refected and reground, coat seat lightly with Prussian blue and drop valve into place oscillating it slightly to transfer blue pattern to valve face. This should show a contact width of $^{1}/_{16}$ to $^{3}/_{32}$ inch, and should fall

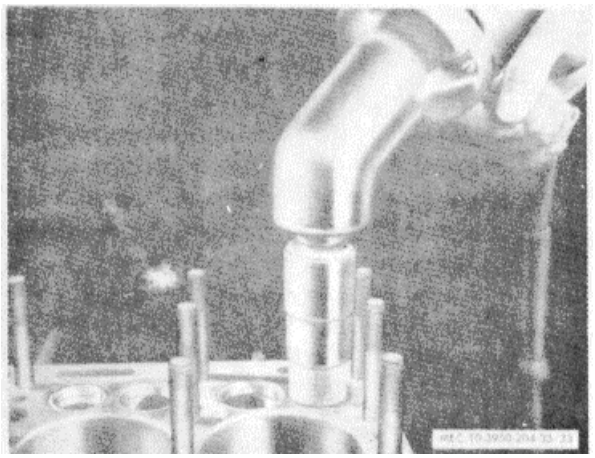


Figure 33. Grinding valve seat.

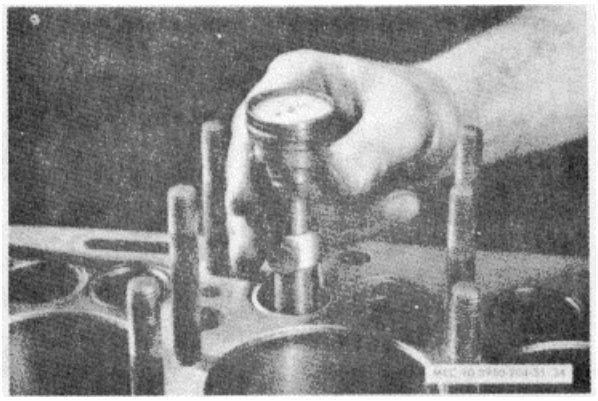


Figure 34. Checking valve seat for runout.

well within width of valve face, leaving at least $^{1}/_{64}$ inch on either side of contact area. If contact area is greater than $^{3}/_{32}$ inch, narrow contact area by grinding outside diameter of seat with a 15° stone or by grinding inside diameter of seat with a 60° or 75° stone (fig. 35). After seat area is corrected touch seat lightly with original grinding stone to remove burred or

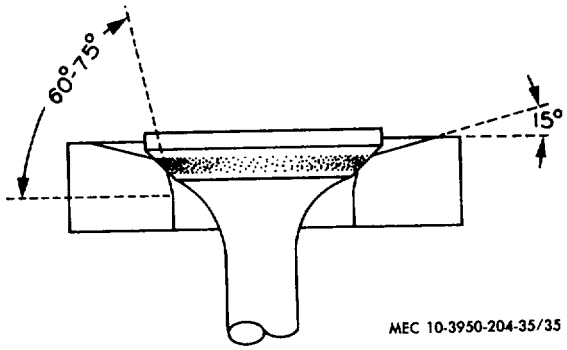


Figure 35. Narrowing valve seat.

(11) Inspect spring retainer seats, spring retaining locks, valve stem caps, and valve lifters for cracks, scoring, overheating, and wear. Replace damaged parts.

c. Installation.

(1) Position valve stem caps (7, fig. 29), adjusting screw (8) and tappet (9) in engine block.

(2) Assemble valves (1), valve springs (4), spring retainer seats (5), spring retaining locks (6), and valve stem caps (7). Compress valve springs with a spring compressor to install spring retaining locks. Turn engine over as necessary to allow each valve to move to closed position before attempting to install the valve parts. Make sure each valve is installed in guide from which it was removed.

(3) Temporarily set valve tappet clearance (TM 10-3950-204-20).

(4) Install cylinder head (TM 10-3950-20420).

(5) Operate engine until it reaches operating temperature. Adjust valve tappet clearance (TM 10-3950-204-20).

(6) Install valve tappet cover (TM 10-3950204-20).

Section III. FUEL SYSTEM

14. General

a. The fuel system consists of a fuel tank, fuel filter, fuel pump, supply line, carburetor, and a governor. All components of the fuel system are covered in (TM 10-3950-204-20) with the exception of the carburetor and governor.

b. The fuel is drawn from the fuel tank, through the supply line, by the fuel pump. The pump then delivers the fuel to the carburetor where it is mixed with the proper amount of air and vaporized. The fuel-air mixture leaves the carburetor and enters the intake manifold of the engine where it is drawn into the engine cylinders.

c. The carburetor is of downdraft, single-barrel design with a manual choke. The level of the fuel in the fuel chamber is regulated by a float which controls the fuel valve. The fuel valve does not close and open alternately, but assumes an opening regulated by the float, sufficient to maintain a proper level in the fuel chamber that is equal to the demand of the engine according to its speed and load.

d. The governor is a built-in, camshaft timing gear-driven, sealed, engine-lubricated, centrifugal, variable speed, flyball type that controls speed by adjusting the amount of travel of the control rod to the carburetor. As the tinting gear drives the governor, the drive assembly balls are pressed against the outer slant of the race assembly to push the race outward. The race assembly in turn presses against the lever and shaft assembly which is connected to the carburetor throttle control through a direct linkage. The throttle plate is closed by this action, slowing engine to governed speed. As engine slows, less pressure is exerted by the balls, and the race assembly moves inward. This movement is transferred through the linkage to the carburetor throttle control to increase fuel flow to the engine and increase engine speed. In this manner, engine speed is regulated.

15. Carburetor

a. Disassembly.

(1) Remove carburetor (TM 10-3950-20420).
(2) Remove filter head (10, fig. 36), fibre washer (11) and filter element (12) at top of air intake body (7).
(3) Remove cotter pin (76) and advance rod (74) from floating lever air shutter (73).
(4) Remove six screw assembled washers (13) and separate air intake assembly (7) and gasket (19) from fuel bowl (27).
(5) Remove float axle (18) and float (17) from air intake assembly.
(6) Remove fuel valve needle (16), seat (15) and fibre washer (14) from air intake assembly with tool, Zenith part No. C16185.
(7) Remove vacuum cylinder (68) and fibre washer (69) from air intake assembly with tool, Zenith part No. C161-10.
(8) Remove choke plate screw (9), choke plate (8), and air shutter lever and shaft (6). Make match marks with a file on air intake assembly and choke plate.
(9) Remove lower hex plug (32) and fibre washer (31) from bottom of fuel bowl assembly (27).
(10) Remove accelerating pump link retainer (35) and remove pump link (34).
(11) Remove accelerating pump and rod (20).
(12) Remove two screws and assemble washers (61) which secure fuel bowl assembly (27) to throttle body (33) using a screwdriver; separate fuel bowl assembly from throttle body.
(13) Remove venturi (59) and gasket (58).
(14) Remove idling jet (64) from top surface of fuel bowl assembly using a screwdriver.
(15) Remove well vent jet (23) from top surface of fuel bowl assembly with tool, Zenith Part No. C161-80.
(16) Remove main jet (25) and fibre washer (26) from inside bottom of fuel bowl using a screwdriver.
(17) Remove power jet valve assembly (22) from inside bottom of fuel bowl with tool, Zenith part No. C161-9.
(18) Remove main discharge jet (30) from passage in outside bottom of fuel bowl assembly (27) 'with tool, Zenith part No. C161-1.
(19) Turn back the "ears" of pump check valve (24) located in pump cylinder with small screwdriver. Turn fuel bowl over and allow check valve disc to fall out.
(20) Insert tapered thread end of tool, Zenith part No. C161-5 into check valve (24) and screw down, counterclockwise, until tool is firmly fastened into check valve body. Raise sliding weight sharply against stop bar a few times to remove check valve body.
(21) Remove air vent check valve (67) from passage in top surface of fuel bowl (27) by inserting tapered thread end of tool, Zenith part No. C161-5 into check valve and screw down, counterclockwise, until tool is firmly fastened into valve.
(22) There are three parts in the passage under air vent check valve (67). They are the pump refill check valve weight (65), ball (21) and retainer washer (66). Turn fuel bowl over and allow these parts to fall into your hand. Do not attempt to remove idle channel bushing (60) or nozzle bushing as these p)arts are pressed in at

the factory and need not be removed to service carburetor.

(23) Remove four lead channel plugs (28) and accelerating jet channel plug (63) by first making a center punch mark in center of each plug. Drill a #46 hole in center of plug.

(24) Insert tapered thread end of plug extractor, tool, Zenith part No. C161-21, into holes just drilled and screw down, counterclockwise, until tool is firmly fastened into plug. Then strike opposite end of tool sharply with light hammer drawing plugs out of casting. The threaded tip of extractor tool can easily break off unless casting and tool is held firmly and extractor driven away from casting without tipping. Use tool, Zenith part No. C161-15 for accelerating jet channel plug, (63).

(25) Remove pump level assembly nut (36), lockwasher (37) and pump lever (38).

(26) Remove two throttle plate screws (57), throttle plate (56) and throttle shaft and lever assembly (42).

(27) Remove idle adjusting screw (54) and spring (55) from throttle body (33).

b. Cleaning, Inspection, and Repair.

(1) Discard all washers, gaskets, accelerator check valve bearing ball, vacuum cylinder assembly, fuel valve and seat, idle and adjusting needle, float pin, piston pump, air shutter plate screw, throttle plate screw, pump lever spring, and check valve assembly. Replace these parts with new ones from repair kit.

(2) Clean all parts in an approved cleaning solvent; dry thoroughly with compressed air.

(3) Blow out all passages in air intake, fuel bowl, and throttle body with compressed air.

Caution: Do not clean by inserting a wire or drill into any openings or passages as this will destroy their fine calibration.

(4) Inspect all parts of carburetor for wear distortion, cracks, breaks, or other damage. Replace any worn or damaged parts.

c. Reassembly.

(1) Place choke plate (8, fig. 36) in air intake assembly (7) with poppet valve toward gasket surface.

(2) Insert shaft and lever assembly (6).

(3) Close choke plate (8) and observe that poppet valve spring faces air entrance.

(4) Center choke plate in a closed position and tighten screw (9).

(5) Install vacuum cylinder assembly (68) and new fibre washer (69) in air intake assembly (7) with tool, Zenith part No. C161-10.

(6) Install new fuel valve seat (15) and fibre washer (14) using tool, Zenith part No. C161-85.

(7) Install fuel value needle (16) in seat (15), followed by float (17) and float axle (18).

Note. Insert tapered end of float axle (18) into float bracket on side opposite slot and push through the other side. Press float axle (18) into slotted side until axle is centered in bracket.

(8) Set float level to specifications using a six inch standard depth gauge (fig. 37).

(9) Assemble parts in fuel howl by first driving each of the four lead channel plugs (28, fig. 36) into channels until plug heads are flush with surface of the casting using tool, Zenith part No. C161-19.

(10) Install accelerating jet channel plug (63) and drive in place with hammer.

(11) Install new accelerating pump check valve (24) in bottom of pump cylinder with tool, Zenith part No. C161-53.

(12) Install idling jet (64) in top surface of fuel bowl (27).

(13) Install pump refill check valve ball (21), weight (65), retainer washer (66) and air vent check valve (67) as follows:

(a) Drop steel ball (21) into vertical passage next to accelerating jet (62) in top surface of fuel bowl assembly (27).

(b) Drop square weight (65) on top of ball (21).

(c) Place brass retainer washer (66) in check valve counterbore on top of weight (65).

(d) Start air vent check valve (67) evenly into counterbore on top of retainer washer (66) with fingers. Flat head of valve must face top surface of fuel bowl casting.

(e) Fit machine end of stop bar, using check valve tool, Zenith part No. C161-5, into valve (67) and lightly drive check valve (67) into place as far as tool will permit.

(14) Install main jet (25) and fibre washer

(26) in bottom of fuel bowl (27) and seat firmly with light screwdriver.
(15) Install power jet valve assembly (22) with tool, Zenith part No. C161-9.
(16) Install main discharge jet (30) into passage in outside bottom of fuel bowl. (27) using tool, Zenith part No. C161-1.
(17) Install lower plug (32) and fibre washer (31) in passage on outside bottom of fuel bowl.
(18) Install well vent jet (23) in top surface of fuel bowl assembly using tool, Zenith part No. C161-80.
(19) Install accelerating pump piston and rod assembly (20) into pump cylinder.

Note. The pump guide rod has three grooves at the upper end to determine length of pump stroke. The pump is assembled with the hair pin cotter in the uppermost groove when a half stroke is required, in the second groove for a three-quarter stroke and in the bottom groove for a full stroke.

(20) Install throttle shaft and lever assembly (42) and throttle plate (56) in throttle body (33).
(21) Back out throttle stop screw (45) in throttle stop lever (43). Place throttle body assembly (33) on bench with mounting flange up and facing idling port plug on inside of throttle body bore.
(22) Insert throttle shaft and lever assembly (42) from the left side with throttle lever pointing down.
(23) Rotate throttle shaft (42) to face cutout section in center. The threaded ends of screw holes will then be facing idling port plug.
(24) Insert throttle plate (56) starting the side of the plate with the shortest distance between the screw holes and the between edge into the shaft first. Center it and then rotate shaft (42) counterclockwise to close.
(25) Turn throttle body (33) over and start screws (57) into shaft (42) loosely. Tap plate (56) lightly to center it and tighten screws (57) firmly.
(26) Install idling adjusting needle (54) and spring (55).
(27) Place venturi (59) in position in fuel bowl assembly (27).
(28) Place throttle body to fuel howl gasket (58) in position around venturi (59).
(29) Install pump lever (38), lockwasher (37), nut (36) and link (34).
(30) Assemble throttle body (33) to fuel bowl assembly (27).
(31) Place gasket on air intake (7), assemble same to fuel bowl (27) with six screws and assembled lockwashers (13).
(32) Install large hex plug (10) in top of fuel bowl cover.
(33) Install cotter pin (76) and advance rod (74) to floating lever air shutter (73).
(34) Install and adjust carburetor (TM 103950-204-20).

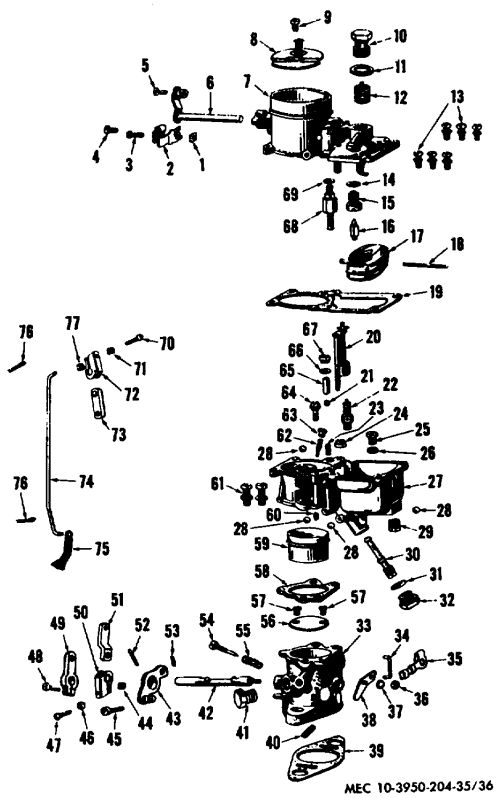
16. Governor

a. Removal and Disassembly.

(1) Remove radiator (TM 10-3950-204-20).
(2) Disconnect accelerator linkage from governor lever (TM 10-3950-204-20).
(3) Disconnect carburetor linkage at governor lever (fig. 38).
(4) Drain oil from crankcase.
(5) Remove governor (fig. 38).
(6) Remove screw (28, fig. 39) that secures base (3) to governor body (20).
(7) Remove shaft (1) and component parts to external ring (15) as an assembly from governor body (1 through 15).
(8) Remove external ring (15) from drive shaft (1).
(9) Remove washers (14 and 13), fork base (12), thrust bearing (11) and upper race (10) from drive shaft.
(10) Remove four balls (8) from driver (9).
(11) Remove plug (25) and fork pin (17) that secures fork (18) to body.
(12) Remove governor lever (fig. 38), oil seal (27, fig. 39) and needle bearing (21).

b. Cleaning, Inspection, and Repair.

(1) Clean all parts of governor in an approved cleaning solvent; dry with compressed air. Dip needle bearings and drive assembly in engine oil.
(2) Inspect race assembly for wear, scoring, distortion, cracks, breaks, or other damage; replace damaged parts. Remove burs and scoring by lapping with crocus cloth. If burs or scores are too deep to remove in this manner, replace part.



1 Nut
2 Bracket
3 Screw
4 Screw
5 Screw
6 Lever and support
7 Air intake body
8 Choke plate
9 Screw
10 Plug
11 Washer
12 Element
13 Screw and lockwasher
14 Washer
15 Seat
16 Valve needle
17 Float
18 Float axle
19 Gasket
20 Pump and rod
21 Ball
22 Power jet valve
23 Well vent jet
24 Check valve
25 Main jet
26 Washer
27 Fuel bowl
28 Plug
29 Plug
30 Discharge jet
31 Washer
32 Plug
33 Throttle body
34 Lever link
35 Clip
36 Nut
37 Lockwasher
38 Pump lever
39 Gasket
40 Screw
41 Plug
42 Throttle shaft
43 Stop lever
44 Nut
45 Screw
46 Washer
47 Screw
48 Screw
49 Lever
50 Stop
51 Lever
52 Pin
53 Roll pin
54 Idle adjusting screw
55 Spring
56 Throttle plate
57 Screw
58 Gasket
59 Venturi
60 Idle channel bushing
61 Screw and lockwasher
62 Accelerator jet
63 Plug
64 Idling jet
65 Weight
66 Washer
67 Check valve
68 Vacuum cylinder
69 Washer
70 Screw
71 Nut
72 Floating lever stop
73 Lever
74 Rod
75 Lever
76 Cotter pin
77 Nut

Figure 36. Carburetor, exploded view.

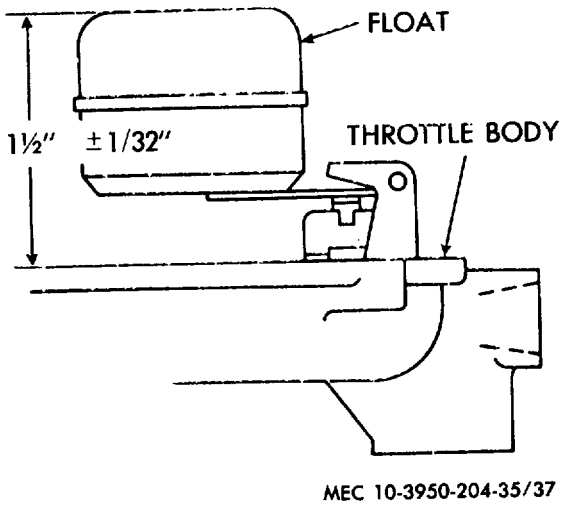


Figure 37. Checking installation of carburetor float.

(3) Inspect drive assembly for worn, pitted, or scored balls, distortion, or other damage. Replace if damaged.
(4) Check needle bearings for smooth operation. Replace sticking or rough operating bearings.
(5) Inspect shaft for wear, scoring, and distortion. Replace if damaged.

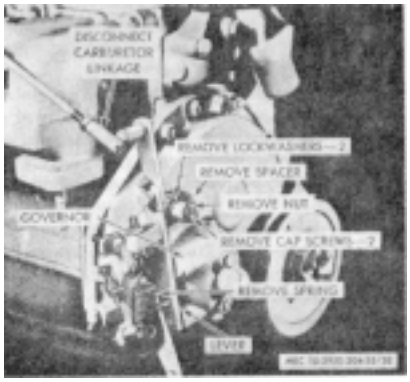


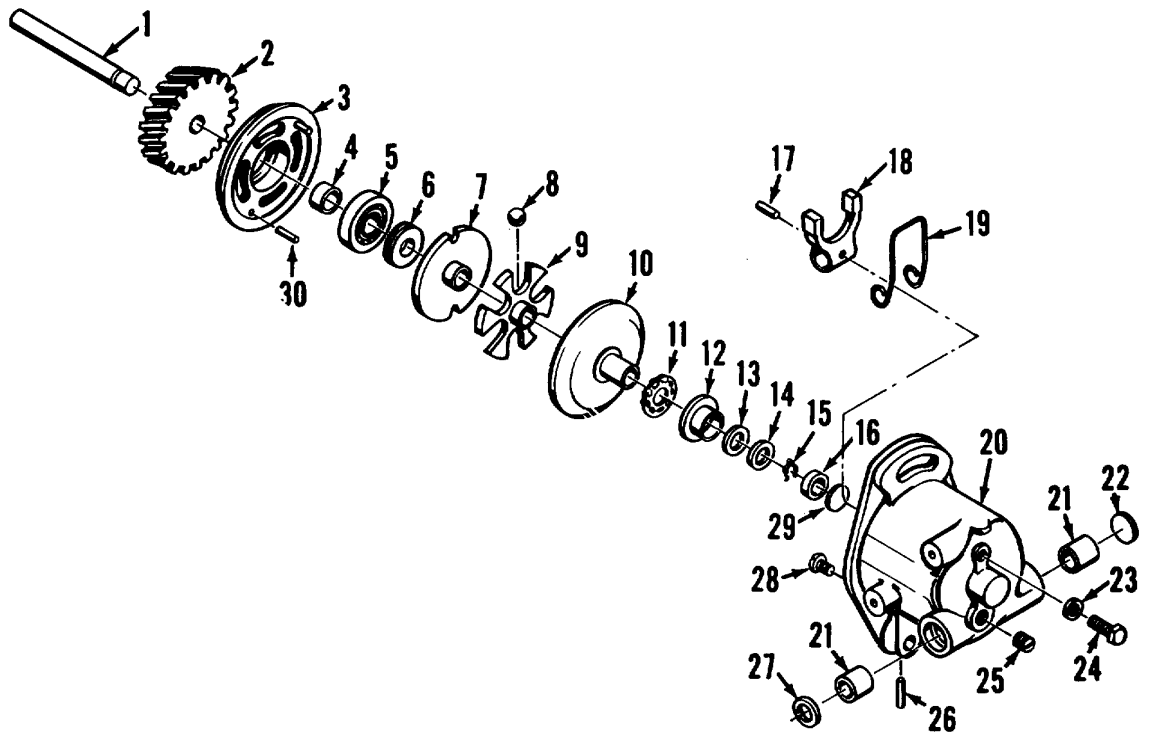
Figure 38. Governor removed.

(6) Inspect all other governor parts for cracks, scoring, wear or distortion. Replace damaged parts.

c. Reassembly and Installation.

(1) Install needle bearings (21, fig. 39), oil seal (27) and governor lever (fig. 38) into body assembly (20, fig. 39).
(2) Install fork (18), bumper spring (19), fork pin (17), and plug (25) into body.
(3) Replace four balls (8) into driver (9).
(4) Install upper race (10), thrust bearing (11), fork base (12) and washers (13 and 14) to drive shaft (1).
(5) Install external ring (15) to drive shaft.
(6) Install shaft (1) and component parts (115) as an assembly to governor body (20).
(7) Install screw (28) that secures base (3) to body.
(8) Install governor into gear cover.
(9) Fill crankcase (TM 10-3950-204-20).
(10) Connect carburetor linkage to governor lever.
(11) Connect accelerator linkage to governor lever (TM 10-3950-204-20).
(12) Install radiator (TM 10-3950-204-20).

d. Adjustment. Adjust governor linkage (TM 10950-204-20).



MEC 10-3950-204-35/39

1	Shaft	11	Thrust bearing	21	Needle bearing
2	Gear	12	Base fork	22	Plug
3	Governor base	13	Washer	23	Nut
4	Bushing	14	Washer	24	Screw
5	Bearing (ball	15	External ring	25	Plug
6	Washer	16	Bushing	26	Pin
7	Lower race	17	Pin	27	Seal
8	Ball	18	Fork	28	Screw
9	Driver	19	Spring	29	Washer
10	Upper race	20	Body	30	Pin

Figure 39. Governor, exploded view.

Section IV. COOLING SYSTEM

17. General

a. All components of the cooling system, except radiator, are covered in TM 10-3950-204-20.

b. The radiator consists of a series of tubes through which the coolant is circulated. Fins are attached to the tubes to give a more extended surface through which heat can be dissipated. For most effective use, these fins must be kept clean and free from accumulated dirt.

18. Radiator

a. Testing.

(1) Remove radiator (TM 10-3950-204--20).

(2) Place cap tightly on radiator and close drain cock. Block off upper hose connection; connect an air line to lower hose connection with an air pressure gauge in the line.

(3) Submerge radiator in a tank of water. Open air line to radiator and apply a pressure of not more than 8 to 10 psi.

(4) Watch radiator for signs of bubbles coming from core during pressure test. The pressure cap should rise at approximately this pressure. Shut off air to radiator and allow air to escape until safety cap seats. Hold pressure for 5 minutes. If no bubbles appear from core, radiator is good. If bubbles appear, mark origins of bubbles and remove radiator from tank.

b. Repair.

(1) Replace a defective drain cock.

(2) Solder any holes found in radiator.

(3) Solder all tubing connections that leak under pressure.

(4) Repair a badly damaged radiator. If radiator is still defective, replace it with a new radiator.

(5) Install radiator (TM 10-3950-204-20).

Section V. ELECTRICAL SYSTEM

19. General

Two 12-volt batteries provide the power necessary to operate the starting motor. When the starting switch is turned to the start position, and the transmission is in neutral, the circuit to the starting relay closes. The relay closes a circuit through the solenoid switch which, when energized, engages the pinion on the starter drive with the engine ring gear anti then closes the circuit to the starting motor to crank the engine. The ignition system, simultaneously energized through another circuit, fires the fuel mixture in the engine cylinders. When the engine is running, it drives the generator to recharge the batteries; the rate of charge is controlled y a voltage regulator which also provides reverse current protection.

20. Generator

a. Testing.

(1) Connect a voltmeter, amateur, load rheostat, and battery in the circuit (fig. 40).

(2) Drive generator at 1970 rpm. Adjust load rheostat until ammeter reads 25 amperes and voltmeter reads 14 volts. If these specifications cannot be obtained, disassemble generator for further testing.

b. Disassembly.

(1) Remove generator (TM 10 3950-204--20).

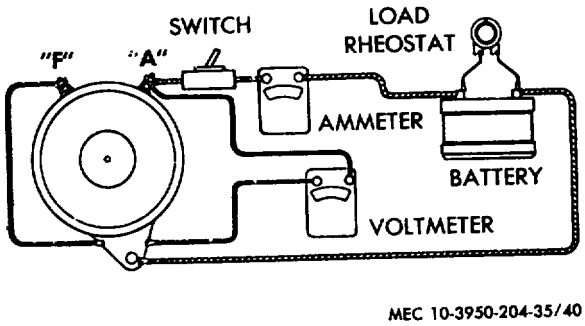


Figure 40. Circuit for testing generator output.

(2) Remove nit (23, fig. 41) and lockwasher (22) that secure pulley and fan (21) to armature shaft; remove pulley and fan, key (32) and spacer (24).

(3) Remove two bolts (34) and lock washers (35). Remove cover (1) from commutator end armature shaft bearing (2).

(4) Tap drive end frame (25) from body (11) remove assembled end frame and armature (33).

(5) Remove retainer (36) from bearing retainer (37). Remove three screws (31) and lockwashers (30) that attach retainer (37) to drive end frame; remove retainer, gasket

(29), bearing (28), felt retainer (27) and washer (26) from drive end frame (25).

(6) Position a scale on brush arm (10) and check brush tension. If brush tension is less than 28 ounces, remove brushes (8) by lifting arm off brush, sliding brush outside of holder and removing screws (6) and lockwashers (7) that attach brushes to body (11) and armature terminal stud.

(7) Remove arms (10) and springs (9) from brush holders; remove springs from arms and discard springs.

(8) Remove nuts (15), washers (13, 14) and bushings (12 and 16) at field and armature terminals; remove screws (20) that secure pole shoes (19) and field coil (18) to body (11).

Note. **Do not remove components at field and armature terminals unless obviously damaged or as may be necessary to replace missing parts. Do not remove field coil (18) before performing tests described in c (10) and (11) below.**

c. Cleaning, Inspection and Repair.

(1) Wipe all parts of generator, except brushes, with a cloth lightly dampened in an approved cleaning solvent; dry thoroughly with compressed air. Wipe brushes with a clean, dry cloth.

(2) Inspect armature bearing (28, fig. 41) for worn surfaces, looseness, cracked ring or race and a rough or catchy feeling. If it is necessary to remove bearing from armature shaft, use a suitable bearing puller and pull against inner race. If it is necessary to pull against outer race, use extreme care to avoid loading and damaging the balls. When remounting bearing, use an arbor press and press firmly and evenly against inner race only.

(3) Check size of brushes; replace them if they are less than one-half the length of a new brush.

(4) Inspect armature commutator for roughness, out-of-round or high mica. If any of these conditions exist, turn commutator down on a lathe and undercut mica $^{1}/_{32}$ inch. Remove only enough stock to make commutator smooth and round. After undercutting, finish commutator with No. 00 sandpaper. Clean all particles from commutator and armature using compressed air. Check armature for short circuits as described in (7) below.

Caution: **Always blow particles off commutator in the direction away from armature windings.**

(5) Check brush holders for distortion, cracks, breaks, or other damage; replace damaged brush holders.

(6) Replace brush springs if tension is less than 28 ounces.

(7) Check for short circuits in armature by rotating armature on a growler with a steel strip such as a hacksaw blade held firmly on armature. The steel strip will vibrate on the area of the short circuit. Short circuits are usually caused by particles between commutator bars. If short circuits are found, clean spaces between commutator bars using an undercutting tool and cleaning thoroughly with compressed air. If a short circuit cannot be removed, replace generator.

(8) Check for open circuits by inspecting for loose connections at points where conductors are connected to the commutator risers. Open circuits can be checked electrically by determining if continuity exists between adjacent commutator bars. Continuity must exist. Open circuits cause arcing and burning of commutator. If bars are not badly burned, resolder the leads and turn commutator down on a lathe. Undercut the mica and test for short circuits as described in (7) above. If open circuit cannot be cleared, replace generator.

(9) Check for grounds by checking armature with a test lamp. Place one probe of test lamp on armature core and the other on each commutator bar in turn. If test lamp lights, armature is grounded. If grounded, clean armature thoroughly and recheck for grounds. If ground cannot be repaired, replace generator.

(10) Check field coils for grounds by checking coils with a test lamp. Place one probe of test lamp on field body assembly and the other on the field coil leads. If test lamp lights, field coils are grounded. Replace generator if field coils are grounded.

(11) Check field coils for open circuits by checking with a test lamp. Connect probes of test lamp to the two leads from the coils. If lamp does not light, coil is open.

Replace generator if field coils are open.

d. Reassembly.

(1) Position washer (26, fig. 41), felt (27), bearing (28), gasket (29) and retainer (37) on drive end frame (25). Secure with three screws (31) and lockwasher (30). If removed, install bearing (2) on commutator end of armature shaft (33) using procedure prescribed in c(2) above.

(2) Position springs (9) and arms (10) on brush holders.

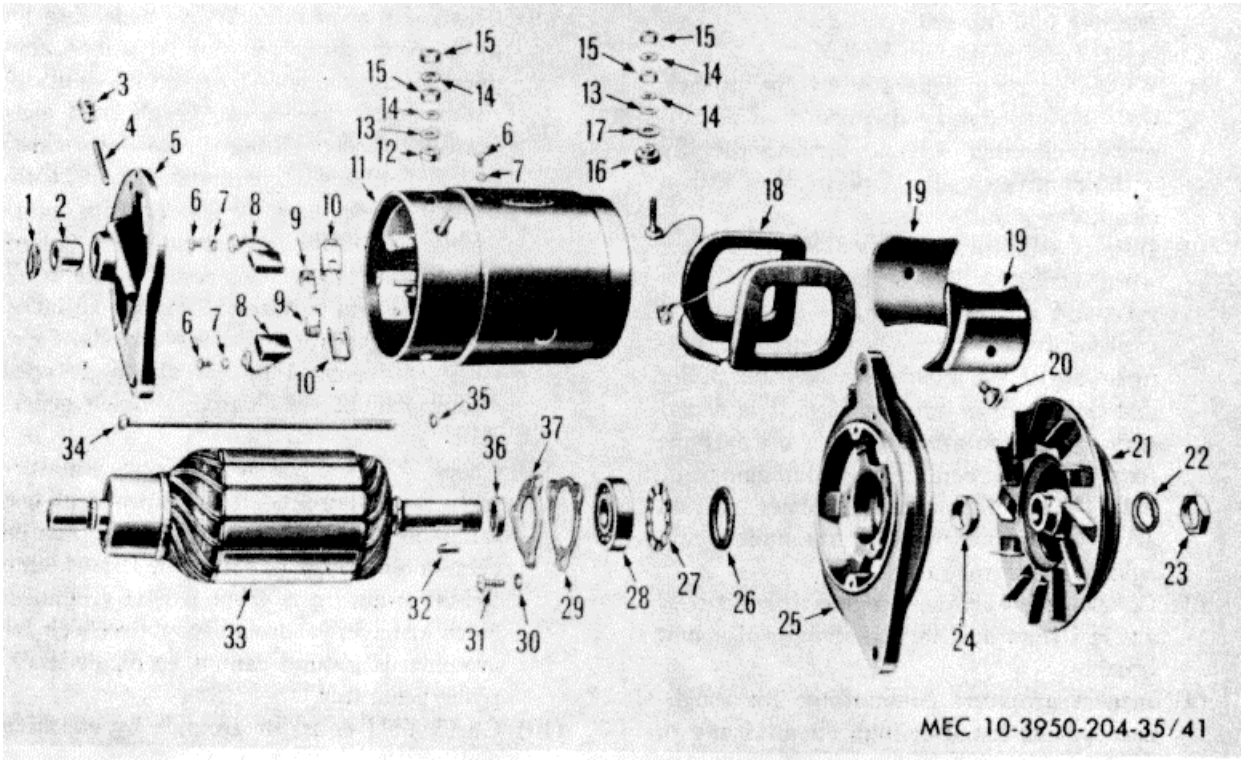
(3) Install armature (33) in body assembly (11). Install brushes (8) into brush holders and secure brush leads to body (11) and armature terminal stud, using screws (6) and lockwashers (7). Seat brushes using No. 00 sandpaper. Take care to blow brush particles from generator.

(4) Install retainer (36) into bearing retainer (37) of assembled drive end frame (25). Slide assembled drive end frame onto drive end of armature (33).

(5) Position commutator end frame (5) over bearing (2) of commutator end of armature (33). Carefully tap commutator end frame flush to body. Install cover (1) in end frame.

(6) Secure drive end frame assembly (25) and commutator end frame assembly (5) to body (11) using two thru bolts (34) and lockwashers (35).

(7) Install spacer (24) onto fan and pulley (21). Install key (32) into key slot in armature shaft. Position fan and pulley (21) on armature shaft over the key and secure with nut (23) and lockwasher (22).



1 Cover
2 Bearing
3 Oilier
4 Felt wick
5 Commutator end head
6 Screw
7 Lockwasher
8 Brush
9 Spring
10 Brush arm
11 Body
12 Insulated bushing
13 Washer
14 Lockwasher
15 Nut
16 Insulated bushing
17 Washer
18 Field coil assembly
19 Pole shoes
20 Screw
21 Pulley and fan
22 Lockwasher
23 Nut
24 Spacer
25 Drive end head
26 Washer
27 Felt retainer
28 Bearing
29 Gasket
30 Lockwasher
31 Screw
32 Key
33 Armature
34 Bolt
35 Lockwasher
36 Retainer
37 Bearing retainer

Figure 41. Generator, exploded view.

21. Starting Motor

a. Testing. Before starting motor is disassembled, perform the following test to determine if starting motor is operating properly.

(1) No-load test. Connect starting motor, a 12-volt battery, an ammeter, a variable resistor, and a voltmeter in a circuit (fig. 42). Close switch to drive starter. Vary the resistance until voltmeter reads 10.6 volts. The ammeter must read between 49 and 76 amperes and armature speed must be between 6200 and 9400) rpm as indicated on a tachometer held against the shaft. Disassemble starting motor for further tests (para. 20c) if it does not perform to specifications.

(2) Resistance test. Connect starting motor, a 12-volt battery, an ammeter, a voltmeter, and a variable resistor in the circuit (fig. 43). Lock pinion gear of drive assembly with a brake arm. Close switch and adjust voltage to read 4.3 volts using the variable resistor. The ammeter must read between 270 and 310 amperes. Disassemble starting motor for further tests (para. 20c) if it does not perform to specifications.

Caution: **Do not operate starting motor for more than 30 seconds at a time without pausing for 2 minutes to allow it to cool.**

b. Disassembly.

(1) Remove starting motor (TM 10-3950204-20).

(2) Match-mark end frame (1, fig. 44), pinion housing (18), and field frame assembly (11) to aid reassembly. Remove through bolts (27) and lockwashers (28) ; remove end frame and field frame assembly using a plastic hammer if necessary.

(3) Remove felt (2) and thrust washer (3) from armature (25).

(4) Remove felt screws that secure brush

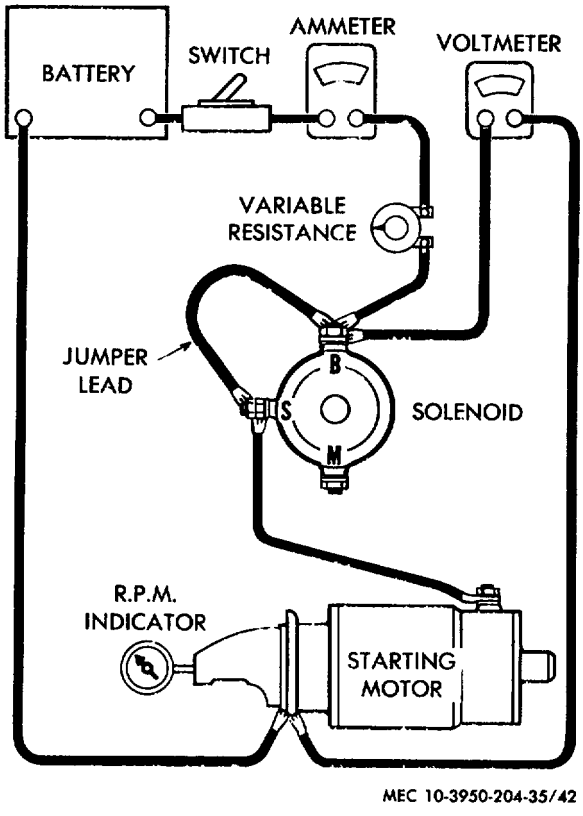


Figure 42. No-load test circuit.

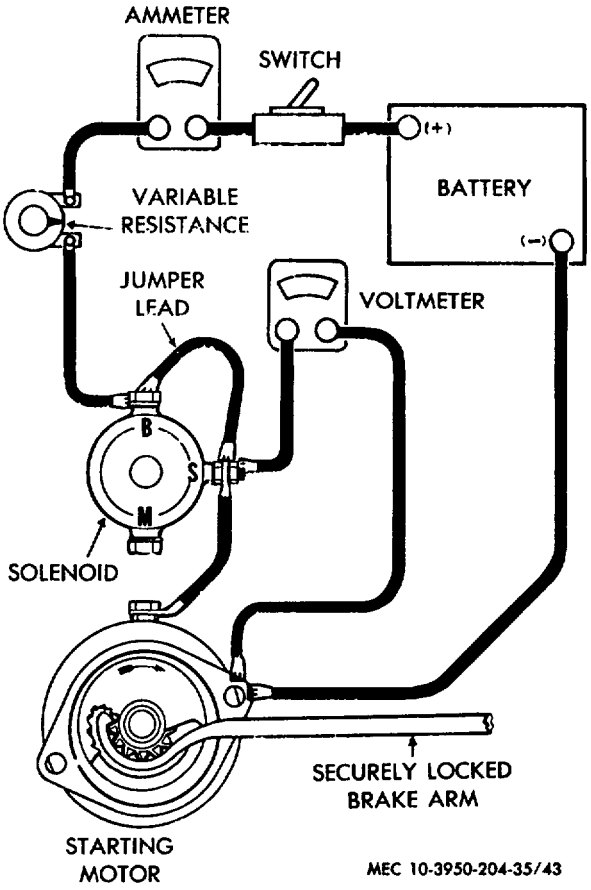


Figure 43. Resistance test circuit.

plate assembly (4) to field frame assembly (11).

***Note*. In order to remove brushes, the wire connections must be heated.**

(5) Remove screws (22) and lockwashers (21) in order to separate pinion housing (18) from intermediate bearing assembly (20). Remove bearing assembly and armature shaft.

(6) Pry Bendix drixe (24) off of armature shaft and remove thrust washer (26) and woodruff key (23).

(7) If bearing (19) is worn or damaged, press it from pinion housing.

(8) Remove screws (6) and lockwasher (7) that secure lead to field coil stud (8).

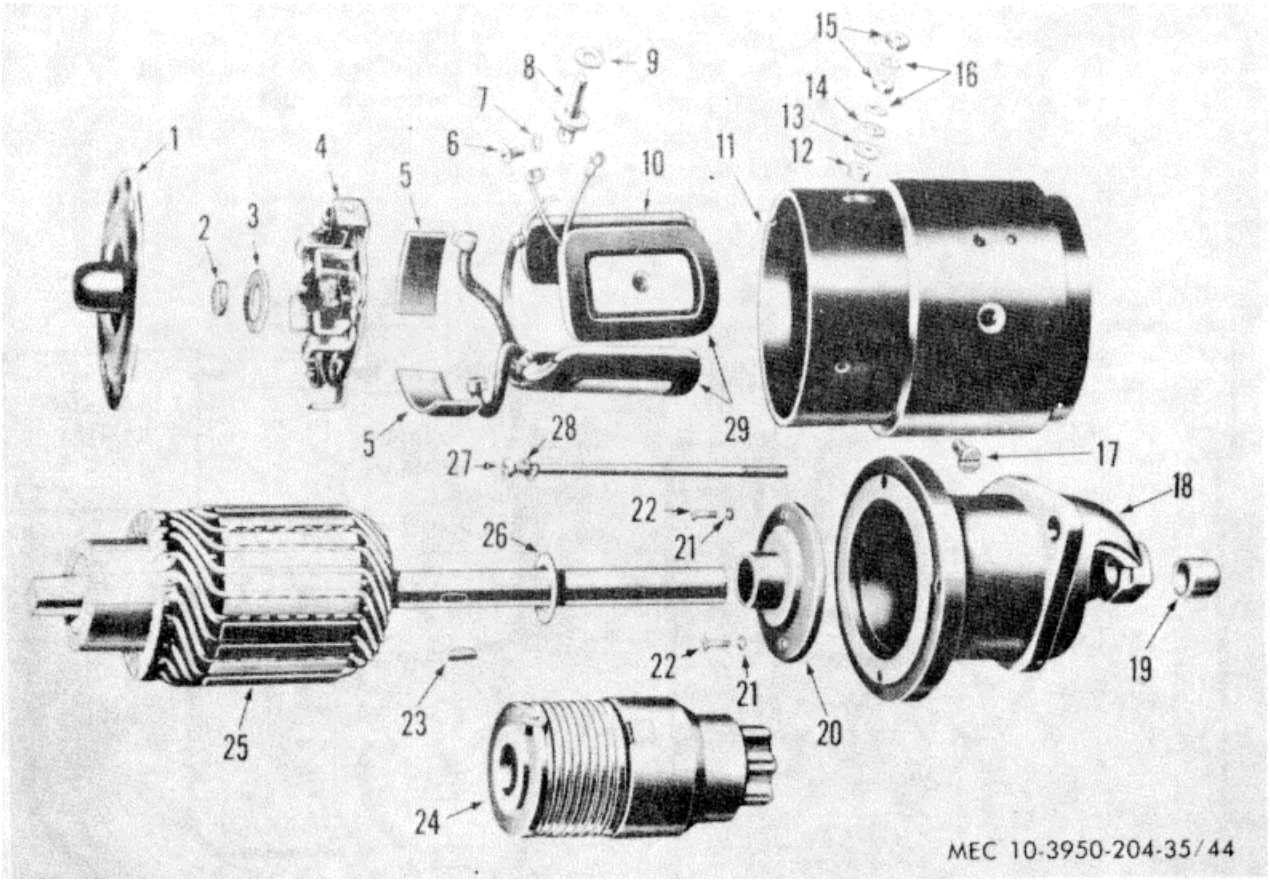
(9) Remove four screws (17) that secure field coil (10) to field frame assembly (11); remove field coil and insulators (5).

c. Cleaning, Inspection and Repair.

(1) Clean armature and field frame assembly with a cloth lighly dampened an approved cleaning solvent.

(2) Clean all other p)arts of starting motor, except brushes, in an approved cleaning solvent; dry thoroughly with compressed air.

(3) Check size of bushes; replace them if they



1	End frame	11	Field frame assembly	21	Lockwasher
2	Felt	12	Bushing	22	Screw
3	Thrust washer	13	Washer	23	Key
4	Brush plate assembly	14	Washer	24	Bendix drive
5	Insulation	15	Nut	25	Armature
6	Screw	16	Lockwasher	26	Thrust washer
7	Lockwasher	17	Screw	27	Thru bolt
8	Stud	18	Pinion housing	28	Lockwasher
9	Washer	19	Bearing	29	Pole piece
10	Field coil	20	Intermediate bearing assembly		

Figure 44. Starting motor, exploded view.

are less than one-half the length of a new brush.

(4) Inspect armature commutator for roughness, out-of-round, or high mica. If any of these conditions exist, turn commutator down on a lathe and undercut mica $^{1}/_{32}$ inch. Remove only enough stock to make commutator smooth and round. After undercutting, finish commutator with No. 00 sandpaper. Clean all particles off commutator using compressed air. Check armature for short circuits (para 20c).

Caution: **Always blow particles off commutator in the direction away from armature windings.**

(5) Check brush holders for distortion, cracks, breaks, or other damage; replace damaged brush holders.

(6) Inspect drive assembly for cracks, breaks, clutching action, or other damage; replace drive assembly if any parts are damaged.

(7) Check armature and field windings for short circuits, grounds, and open circuits using the same method described for generator parts (para. 20c). Replace starting motor if armature of field windings is shorted, grounded, or open.

(8) If removed, replace bushing in drive housing.

d. Reassembly.

(1) Position brush plate assembly (4) in field frame assembly (11); secure with three screws.

(2) Position field coil (10) and insulators (5); secure to field frame assembly (11) with four screws (17).

(3) Install screws (6) and lockwashers (7) that secure field coil lead to stud (8).

(4) If bearing (19) was remove from drive housing (18) press in a new bearing.

(5) Place thrust washer (26). key (23) and Bendix drive (24) onto armature shaft.

(6) Install screws (22) and lockwasher (21) that secure intermediate bearing assembly (20) to pinion housing (18).

(7) Install armature shaft into pinion housing (18) and slide field frame assembly (11) over shaft.

(8) Install felt (2) and thrust washer (3) onto armature shaft.

(9) Position end frame (1) on field frame assembly so that the match marks line u on end frame and field frame assembly; secure end frame with two thru bolts (27) and lockwashers (28).

(10) Test starting motor as directed in ca. above.

(11) Install starting motor (TM 10-3950-20420).

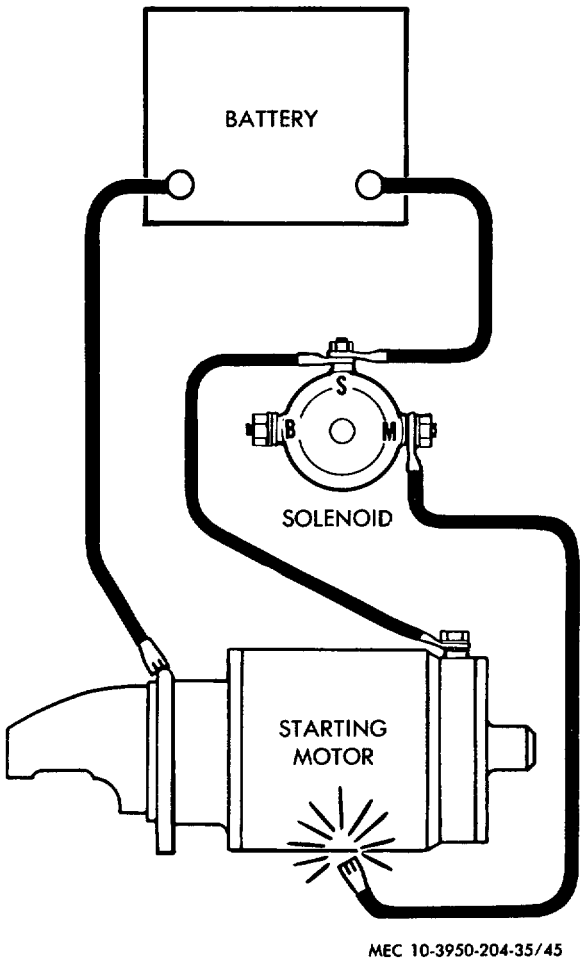


Figure 45. Circuit for checking pinion clearance.

Section VI. TRANSMISSION AND DRIVE SYSTEM

22. General

a. The torque converter, mounted on the flywheel of the engine, is directly coupled to the transmission main drive gear. Power flows through the transmission directional selectors and gears to provide the power to the front drive wheels. Trans

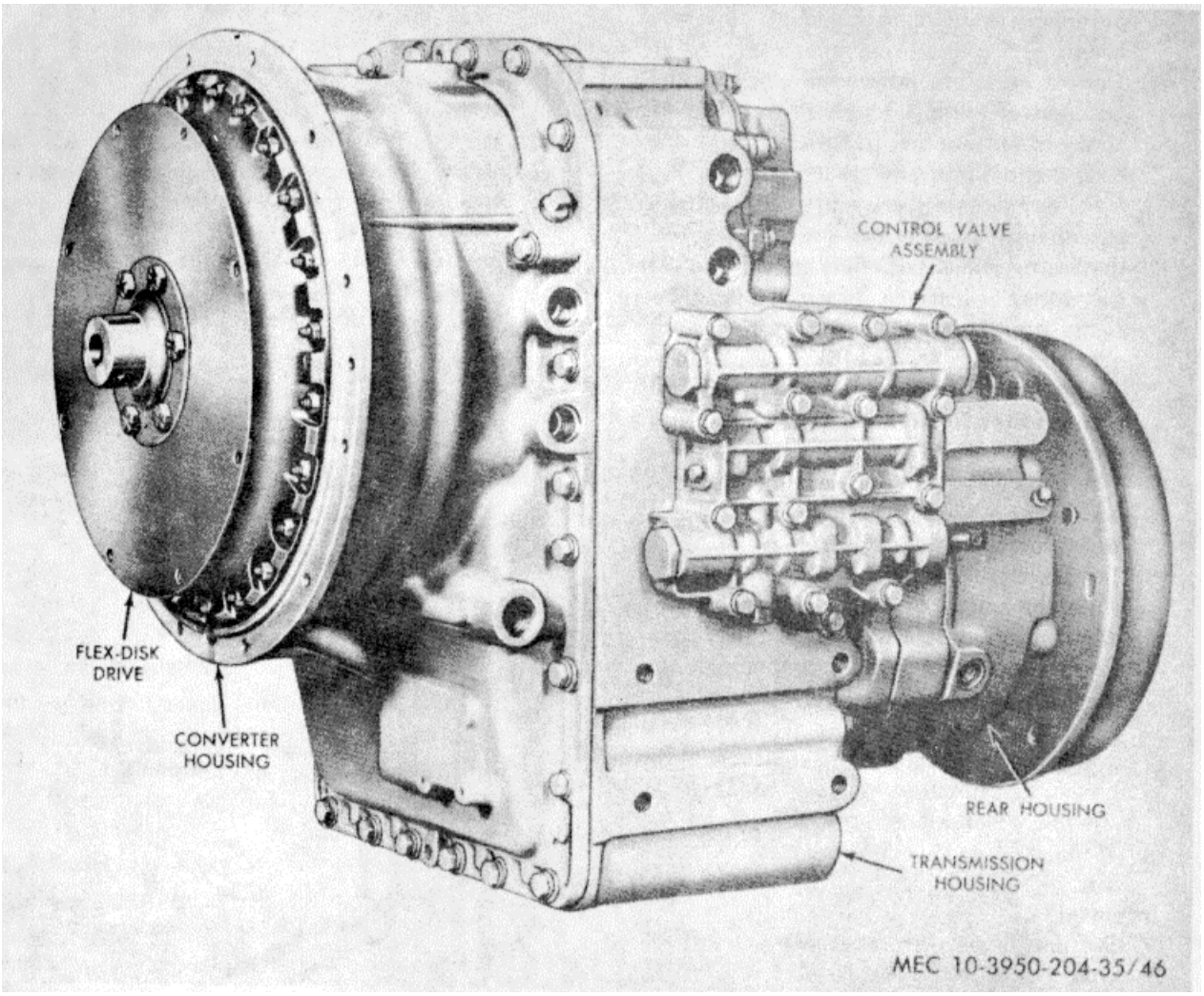


Figure 46. Transmission

mission ratios are: Hi forward-2.398 to 1, Lo forward-6.590 to 1, Lo reverse-6.380 to 1 and Hi reverse-2.321 to 1.

b. A constant drive, positive displacement pump is mounted within the transmission case. The pump supplies pressurized hydraulic oil to the directional selectors under control of the control valve.

c. The transmission is connected to the axle with a drive shaft. The wheel and axle assembly is directly mounted to the differential and has a drive ratio of 5.272 to 1.

23. Transmission Control Lever and Linkage

a. Removal and Disassembly.

(1) Remove cotter pin (19, fig. 47) and pin (18) that secures links (17) to range selector valve (29, fig. 77). Remove cotter pin (19, fig. 47) and pin (18) that secures links (17) to pivot lever (121.

(2) Remove cotter pin (19) an pin (9) that secures clevis (8) to pivot lever.

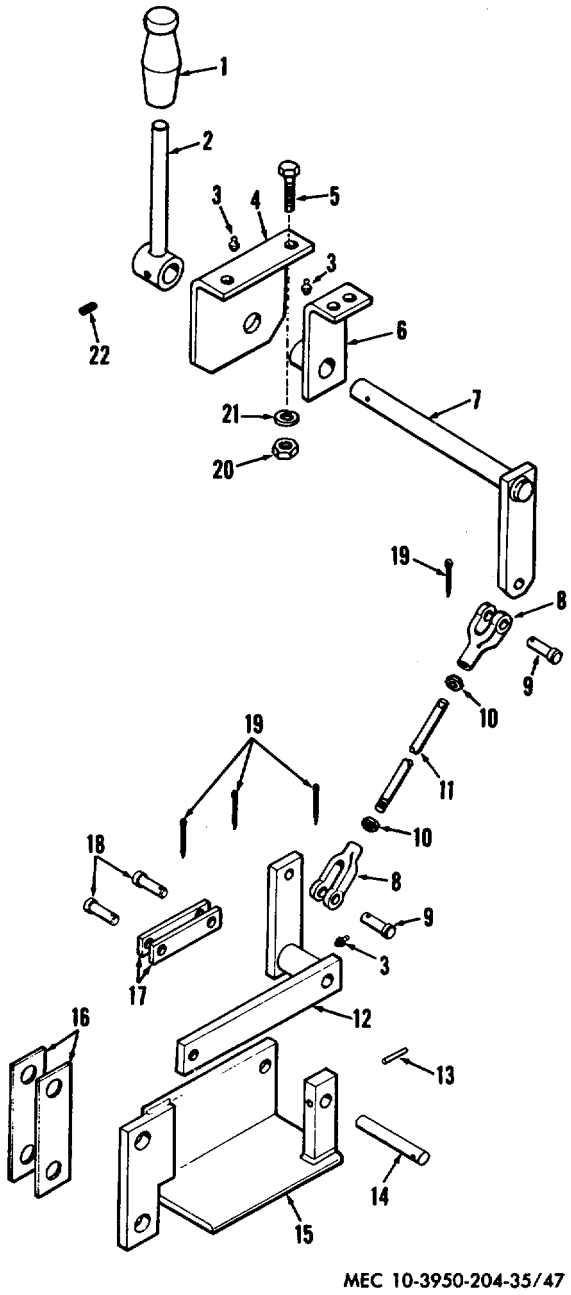
(3) Loosen pin (10) and turn clevis (8) off rod (11). Remove nut.

(4) Remove cotter in (19) and pin (9) that secures clevis (8) to 1pivot shaft (7).

(5) Loosen pin (10) and turn clevis (8) off rod (11). Remove nut and rod.

(6) Remove rubber grip (1) from shifting lever (2).

(7) Remove four capscrews (5) lockwashers



1	Rubber grip	12	Pivot lever
2	Shifting lever	13	Pin
3	Fitting	14	Pin
4	Support	15	Bracket
5	Capscrew	16	Spacer
6	Support	17	Link
7	Pivot shaft	18	Pin
8	Clevis	19	Cotter pin
9	Pin	20	Nut
10	Nut	21	Lockwasher
11	Rod	22	Setscrew

Figure 47. Transmission linkage, exploded view.

(21), and nut (20) that secure pivot shaft supports (4 and 6) to seat supports.

(8) Remove setscrew (22) from shifting lever; remove shifting lever and pivot shaft (7).

b. Cleaning, Inspection and Repair.

(1) Clean all parts of lever and linkage in an approved cleaning solvent; dry with compressed air or by wiping with a clean cloth.

(2) Inspect all parts of lever and linkage for cracks, breaks, distortion, wear or other damage; replace damaged parts.

c. Reassembly and Installation.

(1) Slide pivot shaft (7, fig. 47) through supports (4, 6) and secure shifting lever (2) to pivot shaft with set screw (22).

(2) Position shifting lever in hole of seat support and align holes in supports (4, 6) with holes in seat support.

(3) Install four capscrews (5), lockwashers (21) and nuts (20) that secure supports to seat support.

(4) Slide rubber grip (1) over shifting lever.

(5) Turn nuts (10) and clevises (8) onto rod (11).

(6) Position clevis (8) on pivot shaft arm (7) and secure in place with pin (9) and cotter pin (19).

(7) Position clevis (8) on pivot lever (12) and secure in place with pin (9) and cotter pin (19).

(8) Install links (17) to pivot lever and range selector valve (29, fig. 77) and secure with pins (18) and cotter pins (19).

(9) Adjust transmission control lever and linkage as described in (TM 10-3950-204-20).

24. Pressures, Temperatures

Figure 51 illustrates points where transmission temperature and pressures may be measured. The temperature gauge registers the converter-out (to cooler) temperature, and the pressure gauge registers clutch pressure. Clutch pressure during normal operation in any gear or in neutral is approximately equal to main pressure and may be regarded as main pressure. However, while the clutch cutoff control is being used, clutch pressure may fall to practically zero. This does hot indicate that main pressure has decreased. Therefore, when checking main pressure, the clutch cutoff control must not be activated.

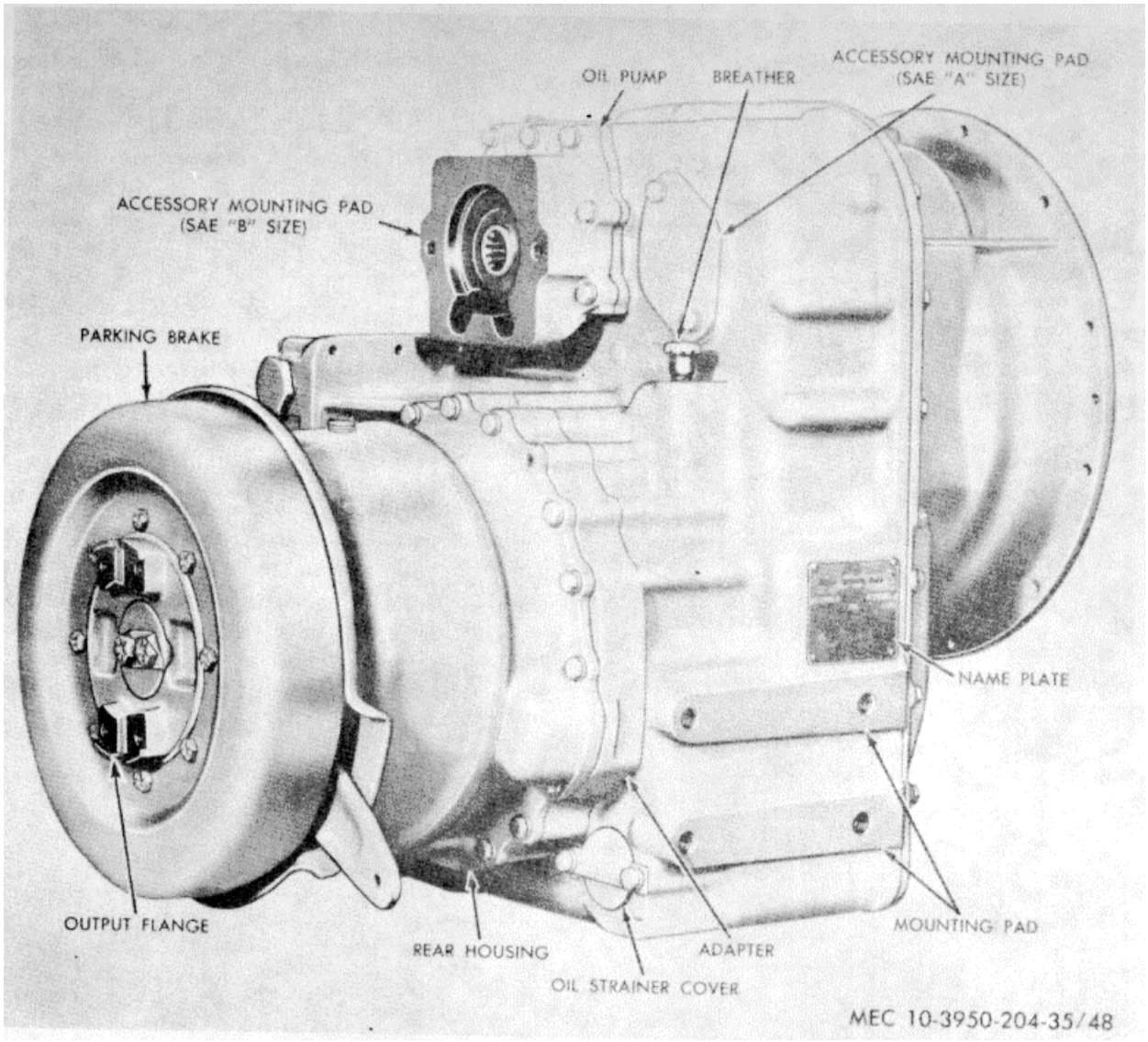


Figure 48. Transmission, right rear view.

25. Tools and Equipment Needed for Transmission Overhaul

In addition to ordinary mechanics hand tools, the following items should be available:

a. Chain hoist (at least ½-ton capacity).
b. Suitable disassembly and assembly table.
c. Press (for removal, installation of press-fit parts).
d. Supply of wood blocks.
e. Clean wiping cloths (do not use linty waste).
f. Torque wrenches.
g. Dry ice (for cooling press-fit spindles).
h. Hot plate or heating equipment to provide oil at 200° F. (for heating bearings before installation). Interference fit flanges have to be heated to 300° F. before installation.
i. A puller kit or improvised puller is required for removing the torque converter pump, bearing and accessory drive gear from the ground sleeve. If a pulley kit is not available, an improvised puller similar to that illustrated in (fig. 52) may be fabricated.

26. Cleaning and Inspection

a. General. All parts must be clean to permit effective inspection. At assembly it is very important that no dirt or foreign matter be allowed to enter transmission. Even minute particles can cause malfunction of close-fitting parts such as valves.

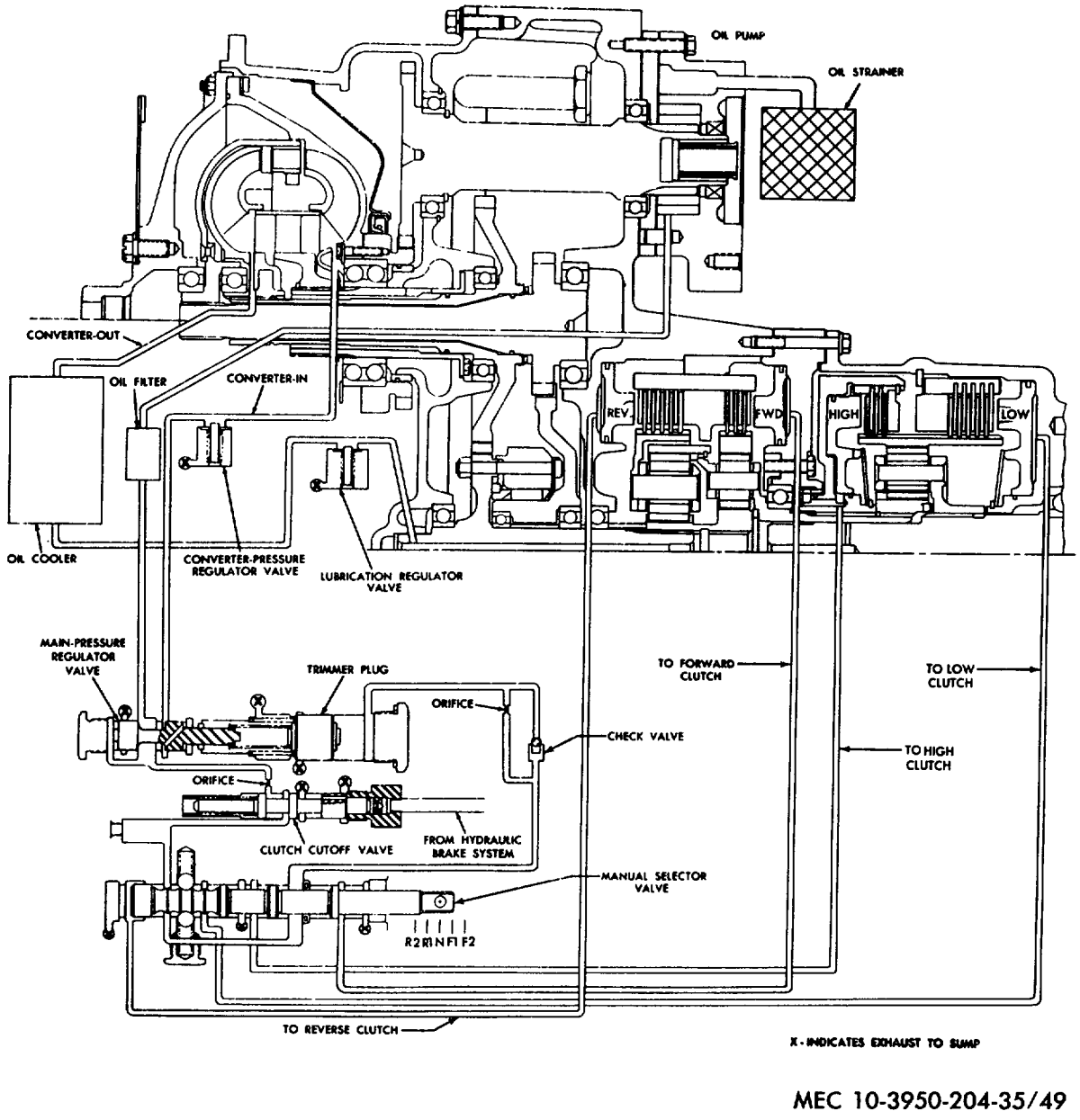


Figure 49. Transmission hydraulic system.

b. Cleaning Parts.

(1) All metallic parts of transmission except bearings should be cleaned thoroughly with volatile mineral spirits, or by steam-cleaning. Do not use caustic soda solution for steam cleaning.

(2) Parts should be dried with compressed air. Steam-cleaned parts should be oiled immediately after drying.

(3) clean oil passages by working a piece of wire back and forth through the passages and flushing with spirits. Dry passages with compressed air.

(4) Examine parts, especially oil passages, after cleaning, to make certain they are entirely clean. Reclean them if necessary.

c. Cleaning Bearings.

(1) Bearings that have been in service should

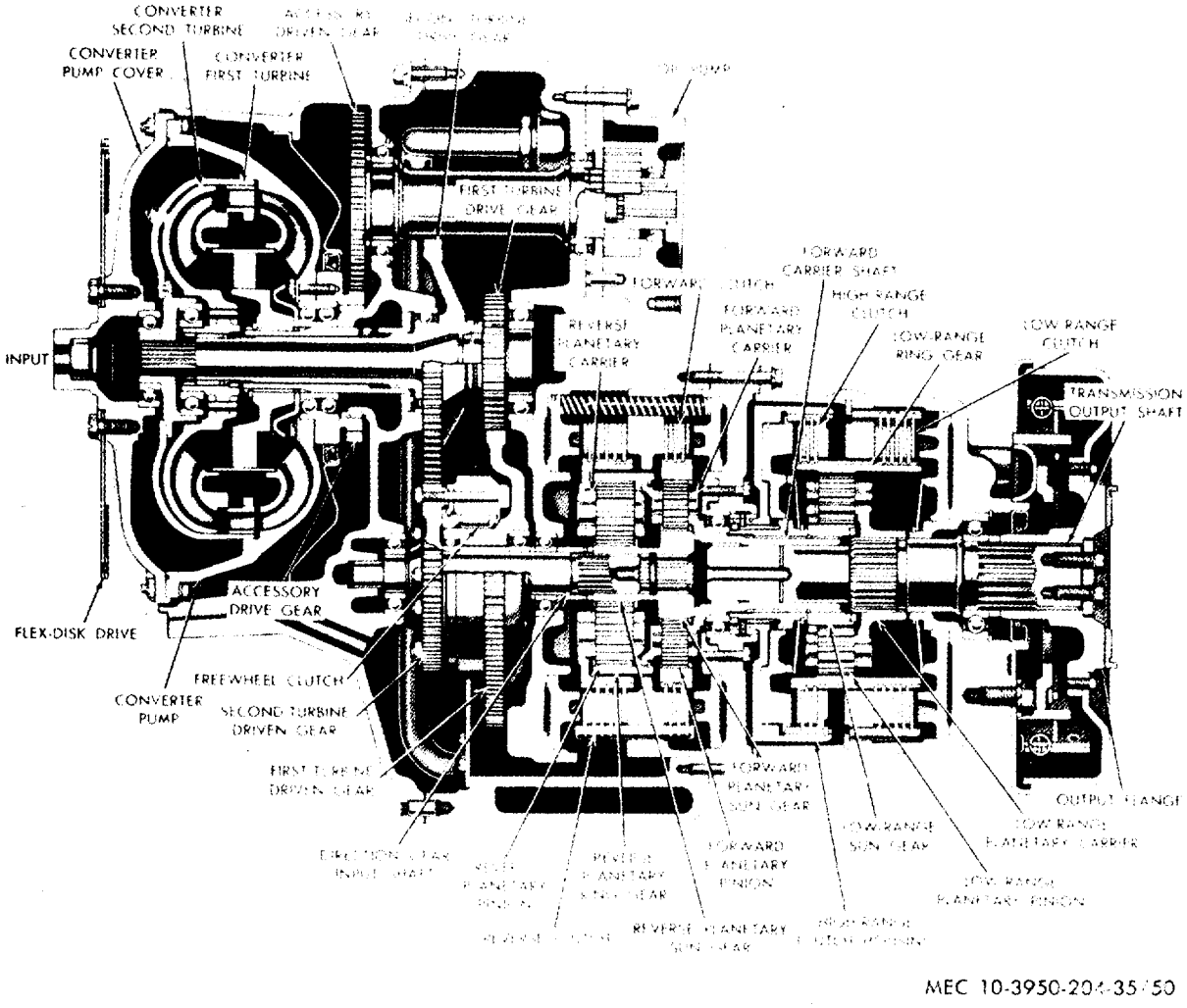


Figure 50. Transmission, showing power transmitting parts.

be thoroughly washed in volatile mineral spirits.

(2) If bearings are particularly dirty or filled with hardened grease, soak them in spirits before trying to clean them.

(3) Before inspection, oil bearings with, the same type of oil that will be used in transmission.

Note. Never dry hearings with compressed air. Do not spin bearings while they are not lubricated.

d. Keeping Bearings Clean. Sine the presence of dirt or grit in ball bearings is usually responsible for bearing failures, it is important to keep) bearings clean during installation and removal. Observance of the following rules will do much to insure maximum bearing life.

(1) Do not remove wrapper from new bearings until ready to install them.

(2) Do not remove grease in which new bearings are packed.

(3) Do not lay bearings on a dirty bench; place them on clean paper.

(4) If assembly is not to be completed at once, wrap or cover the exposed bearings with clean paper or cloth to keep out dust.

e. Inspecting Cast Parts, Machined Surfaces.

(1) Inspect bores for wear, grooves, scratches, and dirt. Remove scratches and burs with crocus cloth. Remove foreign matter. Replace parts that are deeply grooved or scratched.

(2) Inspect all oil passages for obstructions.

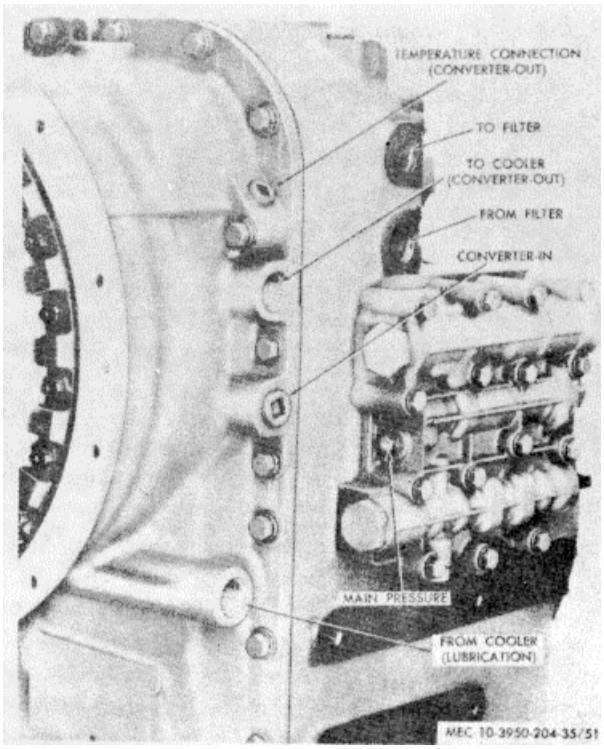


Figure 51. Pressure and temperature check points.

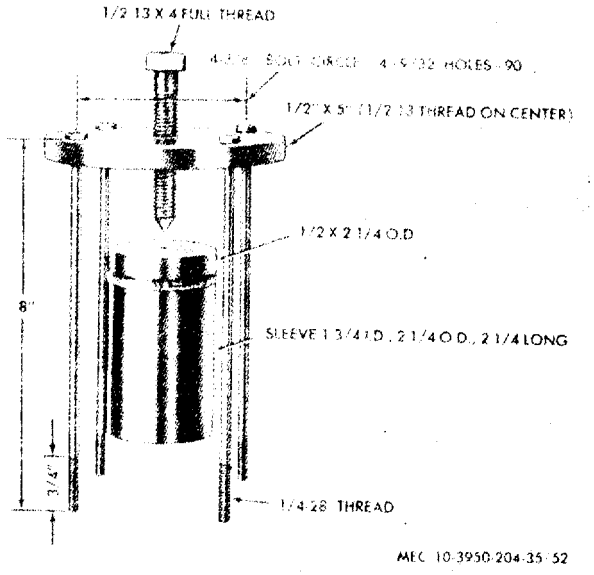


Figure 52. Improvised puller for converter pump assembly.

If an obstruction is found, remove it with compressed air, or by working wire back and forth through the passage and flush it out with cleaning solvent.

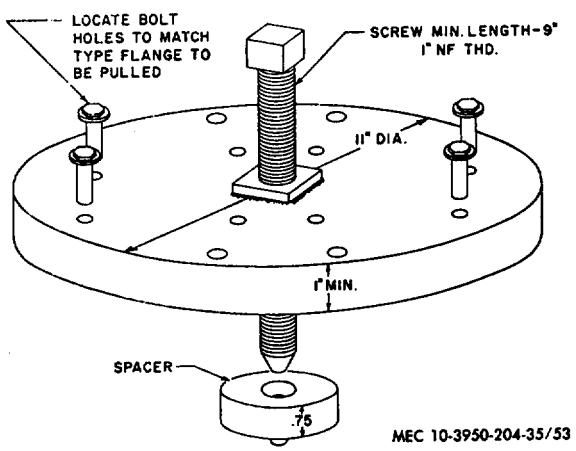


Figure 53. Improvised puller for interference-ft flanges.

nicks, and foreign matter. Remove such defects with crocus cloth or a soft stone. If scratches are deep, replace defective part.

(4) Inspect threaded openings for damaged threads. Chase damaged threads with correct size tap.

(5) Replace housings or other cast parts that are cracked.

(6) Inspect all machined surfaces for damage that could cause oil leakage or other malfunction of the part. Rework or replace defective parts.

f. Inspecting Bearings.

(1) Inspect bearings for roughness of rotation. Replace bearing if its rotation is still rough after cleaning and oiling.

(2) Inspect bearings for scored, pitted, scratched, cracked, or chipped races, and for indication of excessive wear of rollers or balls. If one of these defects is found, replace bearing.

(3) Inspect defective bearing's housing and shaft for grooved, burred or galled conditions that would indicate that bearing has been turning in its housing or on its shaft. If damage cannot be repaired with crocus cloth, replace defective part.

(4) When installing bearing on a shaft, heat bearing to 2000 F. on an electric hot plate or in an oil bath.

Note. **Bearings must be heated for a sufficient period. The heating time will be determined by the size of bearing: 45 minutes is sufficient for largest bearing in this transmission. Coat mating**

surfaces with white lead and use proper size installation sleeve and an arbor press to seat bearing.

(5) If a bearing must be removed or installed without a sleeve, be careful to press only on the race which is adjacent to the mounting surface. If an arbor press is not available, seat bearing with a drift and a hammer, driving against supported race.

g. Inspecting Bushings, Thrust Washers.

(1) Inspect bushings for roundness, scores, burs, sharp edges, and evidence of overheating. Remove scores with crocus cloth. Remove burs and sharp edges with a scraper or knife blade. If bushing is out-of-round, deeply scored, or excessively worn, replace it, using proper size replacer.

Note. Sometimes it is necessary to cut out a defective bushing. Be careful not to damage bore into which bushing fits.

(2) Inspect thrust washers for distortion, scores, burs, and wear. Replace thrust washer, if it is defective or worn. It is much less expensive to replace such parts than to replace converter elements or transmission gearing, which can fail due to defective bearings, bushings, or thrust washers.

h. Inspecting Oil Seals, Gaskets.

(1) Inspect seal rings for cuts and hardness. Replace seal rings if these defects are found.

(2) When replacing lip-type seal rings, make sure springloaded side is toward oil to be sealed in (toward inside of unit). Use a nonhardening sealing compound on the outside diameter of seal to help prevent oil leaks.

(3) Replace all composition gaskets.

(4) Inspect hook-type seal rings for wear, broken hooks, and distortion.

(5) Install new hook-type seal ring if it is worn so much that there is no gap between the hooks of the seal ring when it is installed.

(6) The sides of the seal ring should be smooth (0.005-inch maximum side wear). The sides of the shaft groove (or bore) in which seal ring fits should be smooth (50 micro inches equivalent) and square with the axis of rotation within 0.002 inch. If the sides of ring grooves have to be reworked, install new seal ring.

i. Inspecting Gears.

(1) Inspect gears for scuffed, nicked, burred, or broken teeth. If defect cannot be removed with a soft stone, replace gear.

(2) Inspect gear teeth for wear that may have destroyed original tooth shape. If this condition is found, replace gear.

(3) Inspect thrust faces of gears for scores, scratches, and burs. Remove such defects with a soft stone. If scratches and scores cannot be removed with a soft stone, replace gear.

j. Inspecting Splined Parts. Inspect splined parts for stripped, twisted, chipped, or burred splines. Remove burs with a soft stone. Replace the part if other defects are found. Spline wear is not considered detrimental except where it affects tightness of fit of the splined parts.

k. Inspecting Threaded Parts. Inspect parts for burred or damaged threads. Remove burs with a soft stone or fine file. Replace damaged parts.

l. Inspecting Snaprings. Inspect all snaprings for nicks, distortion, and excessive wear. Replace the part if one of these defects is found. The snap must snap tight in its groove for proper functioning.

m. Inspecting Springs. Inspect all springs for signs of overheating, permanent set or wear due to rubbing adjacent parts. Replace spring if any one of these defects is found.

27. Disassembly of Transmission

a. General Instructions. Drain oil from the transmission before beginning disassembly. Secure necessary tools and equipment suggested in paragraph 25. For identification of parts and details of assembly, refer to illustration given.

b. Disassembly.

(1) Removal of minor components.

(*a*) Remove bolts (20, fig. 70), lockwashers (19) and remove oil strainer cover assembly (18) and seal ring (17) from lower-right rear of transmission.

(*b*) Remove oil strainer assembly (16).

(*c*) Remove bolts (13), lockwashers (12) and remove power takeoff cover (11) and gasket (10).

(*d*) Remove breather assembly (9).

(*e*) Remove coupling (4, fig. 76) from oil pump assembly (7).

(2) Removal of output flange and parking brake.

(*a*) Remove brake drum (19, fig. 75).

(b) Remove output flange attaching p)arts and flange (20, 21, 22, 23, and 25).
(c) Remove brake retracting springs (17) and shoes (16).
(d) Remove cam lever (18) and roller (15).
(e) Remove brake back plate (14).
(f) Remove spacer (8) from transmission output shaft.

(3) Removal of control valve assembly.
(a) Remove bolts (3 and 4, fig. 77) and washers (2).
(b) Remove control valve assembly (5) and gasket (1).

(4) Removal of oil pump assembly.
(a) Remove bolts (3, 5, fig. 76) and washers (2, 6).
(b) Remove pump assembly (7) and gaskets (1).

(5) Removal of flex-disk and torque converter cover.
(a) Remove bolts (1, fig. 66) and plate (2).
(b) Remove disks (3) and disk assembly (4).
(c) Remove nuts (5), cover assembly (6) and seal ring (9).

(6) Removal of torque elements.
(a) Using two screwdrivers, remove first and second turbine assembly (fig. 54).
(b) Using snapring pliers, remove snapring and stator from ground sleeve (fig. 55).
(c) Remove spacer (9, fig. 67) from ground sleeve.

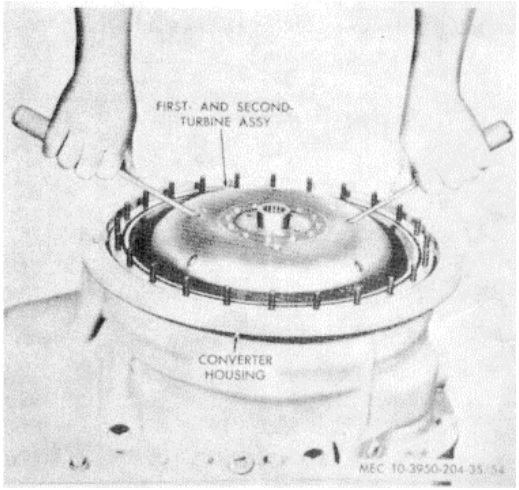


Figure 54. Removing first and second turbine assembly

(d) Remove four of the converter pump retaining bolts and install improvised puller shown in (fig. 52). Tightening center bolt in the tool will remove converter pump assembly (fig. 56).

Note. **The assembly removed will consist of items (10) through (17) (fig. 67).**

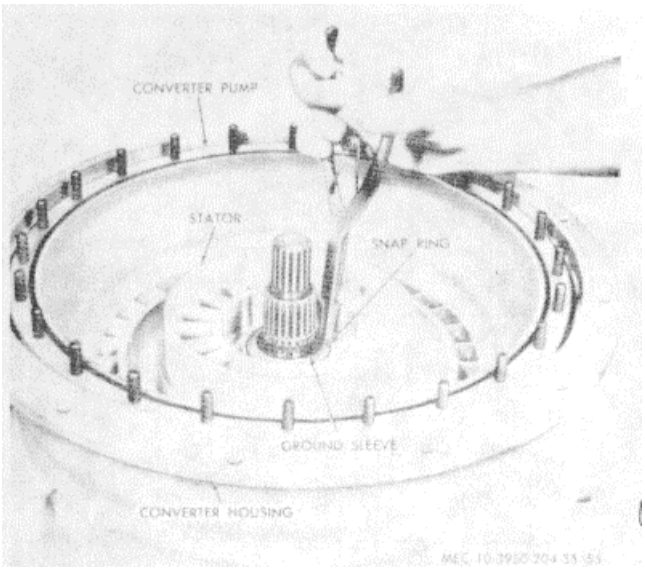


Figure 55. Removing snapring from converter ground sleeve.

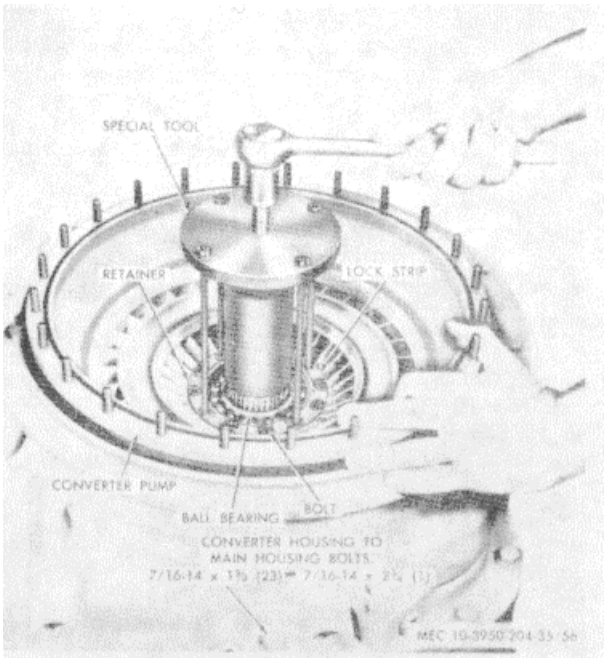


Figure 56. Removing converter pump, input accessory drive gear and bearing.

(7) Removal-oval of transmission rear housing and low-range clutch.
   (*a*) Remove bolts (4, fig. 75) and washers (3). Remove rear housing (2) and its attached parts.
      Note. Low-range carrier assembly (4, fig. 74) and sun gear assembly (1) may come off with housing or remain with transmission. Remove them both.
   (b) Remove gasket (1, fig. 75).
   (c) Remove oil seal (9) and snapring (7).
   (d) Drive shaft (5) and bearing (6) out rear of housing (2).
   (e) Remove snapring (10, fig. 74) and lift out of anchor assembly (11) and clutch plates (15) and (16). Remove anchor pin (10, fig. 75) from inside of housing.
   (f) Remove snapring (17, fig. 74) while depressing spring (18). Remove spring (18), piston (21), and seal rings (20) and (19) with expander.

(8) Removal of low-range ring gear and high-range clutch.
   (a) Remove snapring (15, fig. 73) and reaction plate (14).
   (b) Remove ring gear (13) and clutch plates (11 and 12).
   (c) Remove snapring (10) and lift high-range clutch housing assembly (2) and its attached parts off splines of forward planetary carrier.
      Note. The parts which are attached to housing assembly (2) are items (1) and (5 through 9, fig. 73).
   (d) Depress spring (8) and remove snapring (9).
   (e) Remove spring (8), piston (7), seal ring (6), seal ring (5) (with expander), and seal rings (1).

(9) Removal of rear-housing adapter.
   (a) Remove bolts (25, fig. 72) and two oppositely located bolts (24).
   (b) Install puller into holes from bolts (24) were removed and, pulling against rear end of splined shaft of forward carrier (5), remove adapter assembly (20) and its attached parts from carrier shaft.
      Note. The parts which will be removed with adapter assembly (20) are items (14-18) and four bolts (24).
   (c) Remove puller and remaining bolts (24)
   (d) Remove bearing (18) and retainer (17).
   (e) Remove piston (16) and seal rings (with expander) (14 and 15).
   (f) Remove gasket (19).

(10) Removal of forward clutch and planetary.
   (a) Remove pins (7, fig. 71) and springs (6).
   (b) Remove two clutch plates (11, fig. 72) and ring gear (13).
   (c) Remove forward carrier assembly (3) and remove thrust washer (2), snap ring (10) and ring gear (1) from carrier assembly.
   (d) Remove remaining clutch plates (11) and (12) and anchor assembly (8, fig. 71').
   (e) Remove anchor pin (27, fig. 70) from transmission housing.

(11) Removal of reverse clutch and planetary.
   (a) Remove clutch plates (11 and 12, fig. 71).
   (b) Remove sun gear (13).
   (c) Remove reverse planetary carrier assembly (14) and spacer (22).
   (d) Remove remaining clutch plates (23) and (24).
   (e) Remove clutch piston (1), seal rings (2) and (4), and expanders (3) and (5).

(12) Removal of torque converter housing.
   (a) Position transmission on its rear end and remove 23 bolts (12, fig. 68), bolt (1) and their washers (2, 3, 13, and 14).
   (b) Attach lifting sling and hoist to engine mounting flange of converter housing assembly (5).
   (c) Remove housing assembly and its attached parts.
      Note. The parts which will be removed with housing assembly (5) are items (4, 15-19), and 30-35, fig. 68) and items (10, 11, and 12), fig. 66).
   (d) Remove gasket (6, fig. 70).

(13) Removal of turbine gears and freewheel clutch.
   (a) Remove second-turbine drive gear (23, fig. 68) and its attached parts (20, 21, 22) Remove these parts if replacement is necessary.
   (b) Remove holt (33, fig. 70) and unscrew tube nut (4). Remove tube (1), nut assembly (3) and seal ring (2).
   (c) Remove bolts (32) and plate (31)
   (d) Remove turbine driven gears (3) and

(12) (fig. 69) and their attached parts. This will include items (1-16).

(e) Remove first-turbine drive gear (28, fig. 68) and its attached parts (24-27) and (29). Remove these parts if replacement is necessary.

c. Cleaning, Inspection and Repair. Refer to paragraph 26.

28. Rebuild of Subassemblies

a. Torque Converter.

(1) Disassembly. There is a **V**-groove in the mating rims of the first turbine and turbine support (fig. 57). Make sure that groove is clearly defined. Use a 3-corner file to deepen it to 0.040 inch maximum, if necessary.

(a) Drive each of six pins (4, fig. 67) toward center of turbine assembly far enough to disengage them from turbine support (outer shell.

(b) Remove first turbine (3) from support. Do not remove pins (4) unless replacement is necessary.

(c) Remove second turbine (5) and bearing (6). Do not separate bearing from turbine unless replacement is necessary.

(d) Do not separate bearing (1) from turbine support unless replacement is necessary.

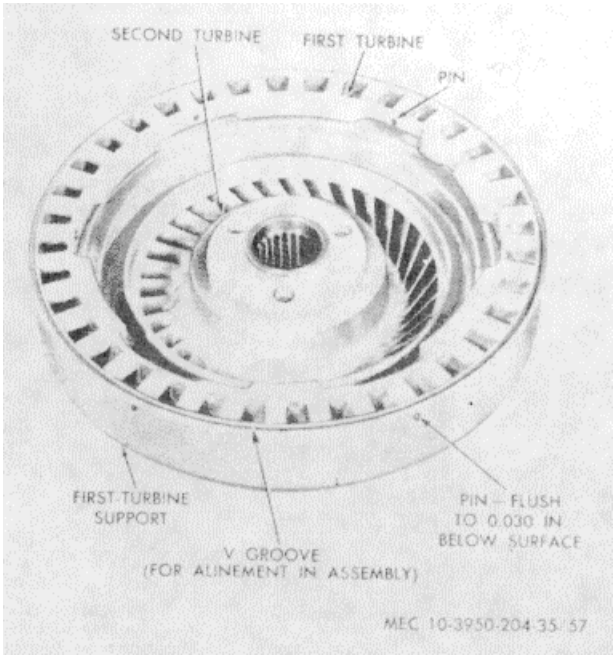


Figure 57. First and second turbine assembly.

(e) Remove bolts (10), lock strips (11) and retainer (12) from converter pump assembly.

(f) Remove accessory drive gear (17), bearing (16) and gasket (15). Do not remove bolts (14) from pump (13) unless replacement is necessary.

b. Cleaning and Inspection. Refer to paragraph 26.

c. Assembly.

(1) Replace any bolts (14, fig. 67) removed from pump (13).

(2) Install bearing (16) into gear (17) (bearing loader notch must be toward front of transmission, away from gear (17)). Install gasket (15) over bearing (16). Install gear (17) onto rear of pump assembly (13), aligning bolt holes in gear (17) with those in pump (13).

(3) Install retainer (12), six lock strips (11), and twelve bolts (10). Tighten bolts and lock them by bending a corner of each lock strip against each bolt head.

(4) If bearing (1) was removed, install it on turbine support hub. If bearing (6) was removed, install it on hub of turbine (5).

(5) Install turbine (5) into turbine support (2), seating bearing (6) in its bore.

6. Align the V-groove in outer rim of first turbine (3) with its matching groove in turbine support 12). Push first turbine (3) into support until pins (4) in turbine (3) align with their holes in the support.

(7) Tap pins (4) outward until they engage holes in the support. When properly installed, pins should be flush *with, to 0.030 inch below, outer surface of support.

29. Torque Converter Housing

a. Disassembly.

(1) Remove seal ring (18, fig. 67) from its groove in sleeve (6, fig. 68).

Caution: Do not dispose of discarded Teflon seals by burning. Toxic gases are produced.

(2) Do not disassemble housing assembly further unless parts replacement is necessary.

Note: Gear (4) and bearing (15) cannot be removed unless diaphragm (11, fig. 66) is first removed. Removal will destroy diaphragm and require new diaphragm (11) and seal (10).

(3) Remove any remaining items which require replacement.

b. Cleaning and Inspection. Refer to paragraph 26.

c. Assembly.

(1) If plug (12, fig. 66) was removed, install new plug, convex side first and seat it lightly against the shoulder in its bore.

(2) If plugs (7) and (11, fig. 68) were removed, install them. If plugs (9) were removed, install new plugs, convex side first. Position them flush with, or to 0.030 inch below the tops of their bores.

(3) If dowel pins (10) were removed, install new pins, letting them project 0.440 inch from housing mounting surface.

(4) If sleeve (6) was removed, install new sleeve, groove toward front of housing. Heat sleeve to 250° F and seat it square against shoulder on housing before it cools.

(5) If ground sleeve (18) was removed, cool it in "dry ice" for one hour and then install it. Be certain all bolt holes align with those in housing. Install bolts (19).

(6) If valve guide pin (30) was removed, install spring (31) and valve (32) onto pin. Install pin (30) flush with or to 0.030 inch below the housing near surface.

(7) If valve guide pin (33) was removed, install spring (34) and valve (35) onto pin. Install pin (33), letting it project 1.19 inches above valve seat surface of housing.

(8) If gear (4) was removed, install bearing away from gear teeth, and press it against gear shoulder.

(9) Install snapring (16), and press bearing (17) against its shoulder on gear (4).

(10) install gear (4) and its bearing into housing (8). Install snapring into groove in bearing (15).

(11) Install seal (10, fig. 66) into diaphragm (11). The spring-loaded tip of seal must be toward rear (convex) side of diaphragm.

(12) Coat outer rim of diaphragm (11) with a nonhardening sealer. Install diaphragm, convex side first, into torque converter housing. Seat diaphragm against shoulder in housing.

(13) Install sealing (18, fig. 67) into groove of sleeve (6, fig. 68). Use oil soluble grease to hold it in position.

Note: **This seal ring must be preformed by wrapping it into a circle so that one end overlaps the other about 180°. After** holding it in this position a few seconds, it will expand when released to approximately a circle in which the ends meet as they will when seal ring is installed.

30. Turbine Driven Gears and Freewheel Clutch

a. Disassembly.

(1) Do not disassemble gear and freewheel clutch unit unless failure or undue wear is evident or suspected. Should disassembly be required, proceed as follows.

(2) Position assembly as shown in (fig. 53) and press out gear (3, fig. 69). This will free bearing (14) and (16), and spacers (13) and (15). Remove these items and gear (12).

(3) Remove nuts (2), after which items (5) through (11) can be removed.

(4) Remove bearings (1) and (40 from gear (3) if replacement is necessary.

b. Cleaning and Inspection. Refer to paragraph 26.

c. Assembly.

(1) If bearings (1 and 4, fig. 69) were removed from gear (30, install by pressing them against shoulders on gear.

(2) Assemble earn (9), oil collector (10), and bolts (11) as shown in fig. 59.

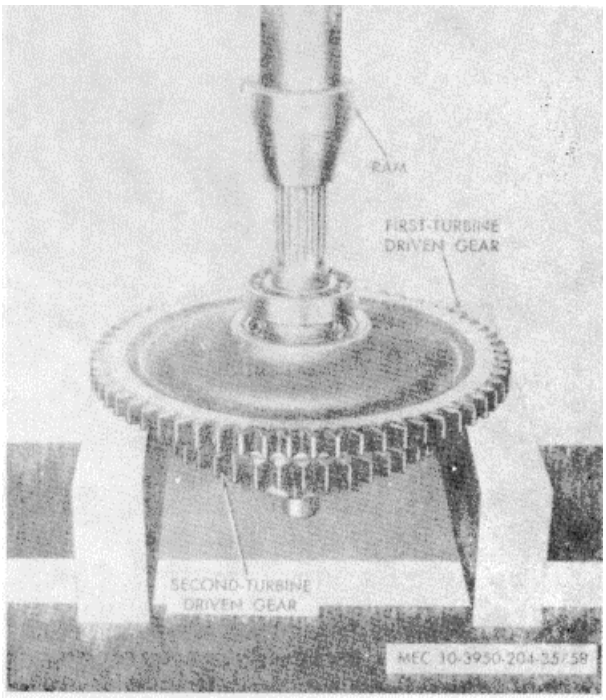


Figure 58. Pressing second turbine driven gear and freewheel unit out of first turbine driven gear.

(3) Install rollers (8, fig. 69) into pockets of roller cage (7), using oil-soluble grease to retain them. Align X on roller cage with X on freewheel cam (9) and install cage and rollers into cam (9), as shown in fig. 60.

(4) Stretch a rubber band around perimeter of bolt, (11, fig. 69) and push it down against cam (9) (fig. 60).

(5) Position gear (12, fig. 69), long hub upward, on a horizontal surface. Carefully lift assembly and install it on gear (12). Remove rubber band.

Note. Make sure that all bolts (11) are in their proper places and will net rotate.

(6) Install spring plate (6) and three springs (5). The X on spring plate must align with X markings on cage (7) and cam (9).

(7) Install gear (3) (with bearings 1 and 4), splined shaft first, into assembly as shown in fig. 61. Align bolt holes in gear (3, fig. 69) with bolts (11). Press gear on and retain it with nuts (2).

(8) Turn assembly over and install spacer (13), bearing (14), spacer (15), and bearing (16). Press them into place while supporting gear (3).

31. Transmission Housing

a. Disassembly.

(1) Plugs (8, 21, 22, 25, 26 and 30, fig. 70) may be removed for replacement or for cleaning oil passages in housing.

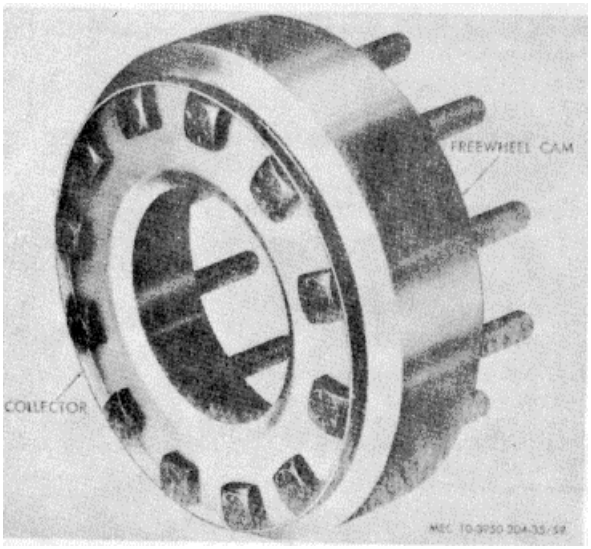


Figure 59. Collector installed on freewheel cam.

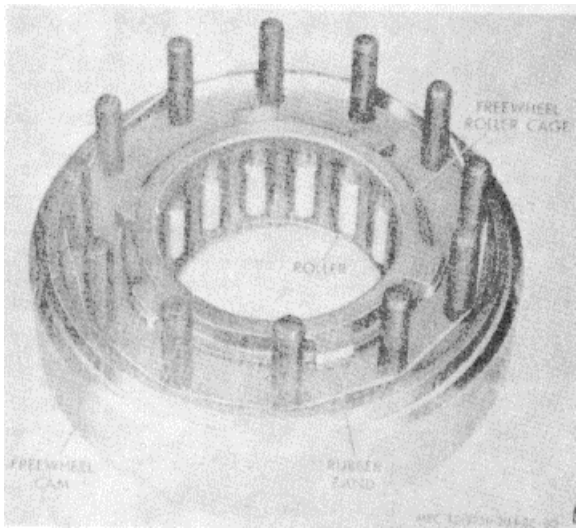


Figure 60. Roller cage and rollers installed in cam.

(2) Oil check tubes (23) and (24) may be removed for replacement or clearing.

(3) Plug (7) should not be removed except when its replacement is necessary. Record depth at which it is installed before removal.

Note: Plug (7) is used only when a remote-installed oil filter is used.

b. Cleaning and Inspection. Refer to paragraph 26.

c. Assembly.

(1) If plug (7, fig. 70) was removed, install

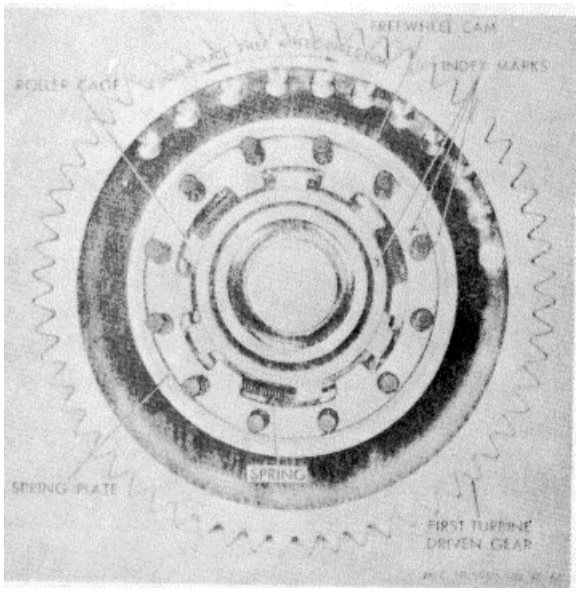


Figure 61. Freewheel clutch installed.

new plug to the depth from which original plug was removed.

(2) Install oil check tubes (23) and (24).

(3) Install plugs (8, 21, 22, 25, 26 and 30).

32. Planetary Carrier Assemblies

Note. **The reverse, forward, and low-range carrier assemblies are of similar construction. (Fig. 62, 63, and 64) illustrate their features. In the instructions below, the differences will be noted. Otherwise, instructions are general and applicable to all three assemblies. Disassemble carriers only if parts replacement is necessary.**

a. Disassembly.

(1) Support front of carrier assembly and press out pinion spindles after drilling the rear end of each spindle to weaken the swaging.

Caution: Do not drill into carrier.

(2) Remove pinion, roller, and thrust washer groups separately and place each in a separate container.

(3) Remove reverse carrier (20, fig. 71) from reverse-clutch hub (21).

(4) Remove bushing (4, fig. 72) from forward planetary carrier (5) only if replacement is necessary.

b. Cleaning and Inspection. Refer to paragraph 26.

c. Assembly.

Note. **Pinions must be replaced as matched sets, never individually, to assure even drive-load distribution and satisfactory service life. Chill spindles in "dry ice" for at least one hour before installation.**

(1) Install pinion thrust washer,., (15, fig. 71) on. an aligning tool.

(2) Coat bore of pinion (16) with oil-soluble grease and install pinion on aligning tool.

(3) Install rollers (17) in pinion, using quantities as follows: reverse pinion roller (22), forward pinion roller (20), and low-range pinion roller (16).

(4) Install remaining pinion thrust washer (19) onto pinion. Remove aligning tool. Assemble remaining pinion groups.

(5) Install assembled pinion groups into carrier (20).

(6) Position reverse carrier (20, fig. 71) in reverse clutch hub (21), aligning the spindle holes.

(7) Using aligning tool, align pinion groups with spindle bores in carrier. Remove tool.

(8) Press chilled spindles into carrier to depth 54 shown in applicable illustration (fig. 62, 63, and 64).

(9) While supporting opposite end of spindles (18), swage them against carrier, using an octagon-end punch.

(10) If bushing (4, fig. 72) was removed from carrier (5), install new bushing to dimension shown in fig. 63.

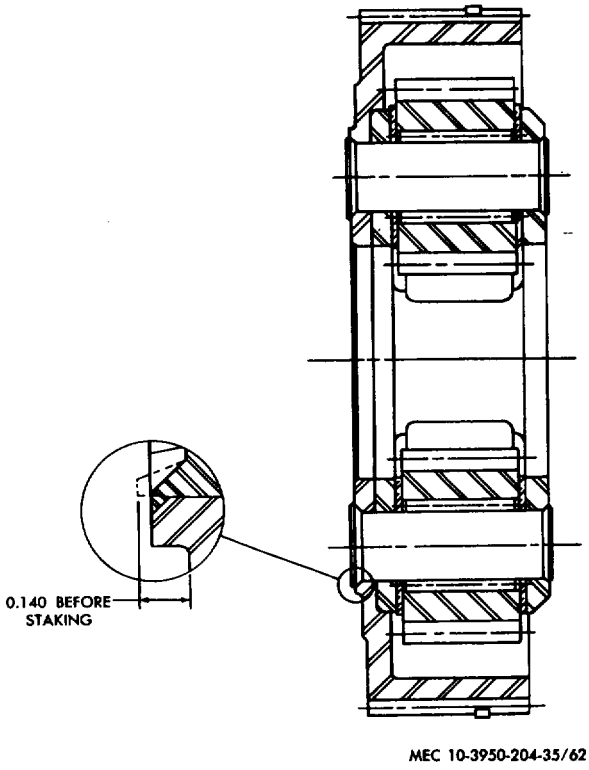


Figure 62. Reverse planetary carrier assembly, cross section, showing pin dimensions.

33. Forward, Reverse Clutch Anchor Assembly

a. Disassembly. Remove anchor pins (9, fig. 71) from anchor (10) only if replacement is necessary.

b. Assembly. Press pins (9, fig. 71) into flat side of anchor (10), letting them project 1.550 inches from flat side of anchor (10).

34. Low-, High-Range Clutch Anchor Assembly

a. Disassembly.

(1) Press pins (13, fig. 74) out of anchor (12) only if replacement is necessary.

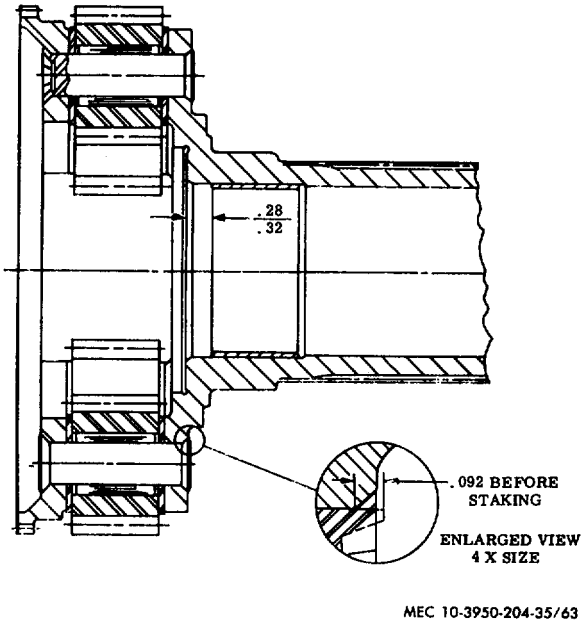


Figure 63. Forward planetary carrier assembly, cross section, showing spindle and bushing installation dimensions.

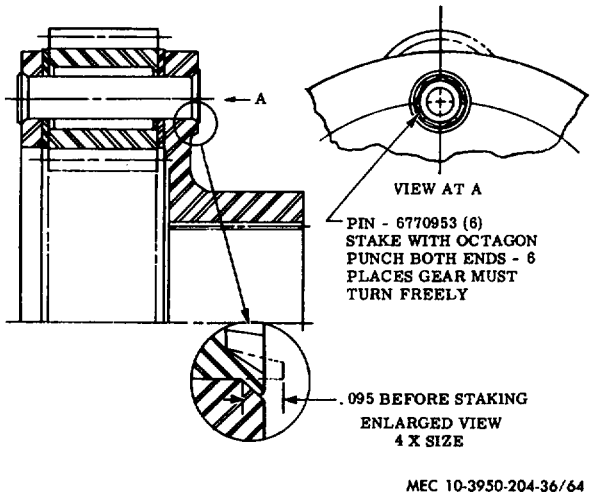


Figure 64. Low-range planetary carrier assembly, cross section, showing spindle dimensions.

(2) Press pins (14) out of anchor (12) only if replacement is necessary.

b. Cleaning and Inspection. Refer to paragraph 26.

c. Assembly.

(1) Press two pins (13, fig. 74) (shorter) into flat (rear) side of anchor (12), letting them project 1.56 from flat side of anchor (12). The shorter pins (13) must be installed in the two upper holes (opposite large cutout in outer circumference) of anchor.

(2) Press four pins (14) long) into remaining holes in anchor (12). These are also pressed into flat (rear side of anchor and are left projecting 1.56 inches from flat side of anchor).

35. Rear-Housing Adapter Assembly

a. Disassembly.

(1) Plugs (21, fig. 72) may be removed for cleaning or replacement.

(2) Sleeve (23) may be removed if replacement is necessary. Press it out toward rear of adapter (22).

b. Cleaning and Inspection. Refer to paragraph 26.

c. Assembly.

(1) If sleeve (23, fig. 72) was removed, install new sleeve. Coat it, and the bore into which it fits, with white lead. Press sleeve (23), chamfered end of sleeve bore first, into front (piston side) of adapter (22). Press sleeve rearward until its square (front) end is flush with or to 0.010 inch below rear of counterbore in which bearing (18) is installed.

(2) Install plugs (21).

36. Transmission Rear Housing

a. Disassembly.

(1) Plug (12, fig. 75) may be removed if necessary for cleaning or replacement.

(2) Anchor pin plug (11) should not be removed except for replacement.

b. Cleaning and Inspection. Refer to paragraph 26.

c. Assembly.

(1) If anchor pin plug (11, fig. 75) was removed, install new plug, convex side first and position it even with, or to 0.030 inch below, inner end of chamfer in pin bore of housing (2).

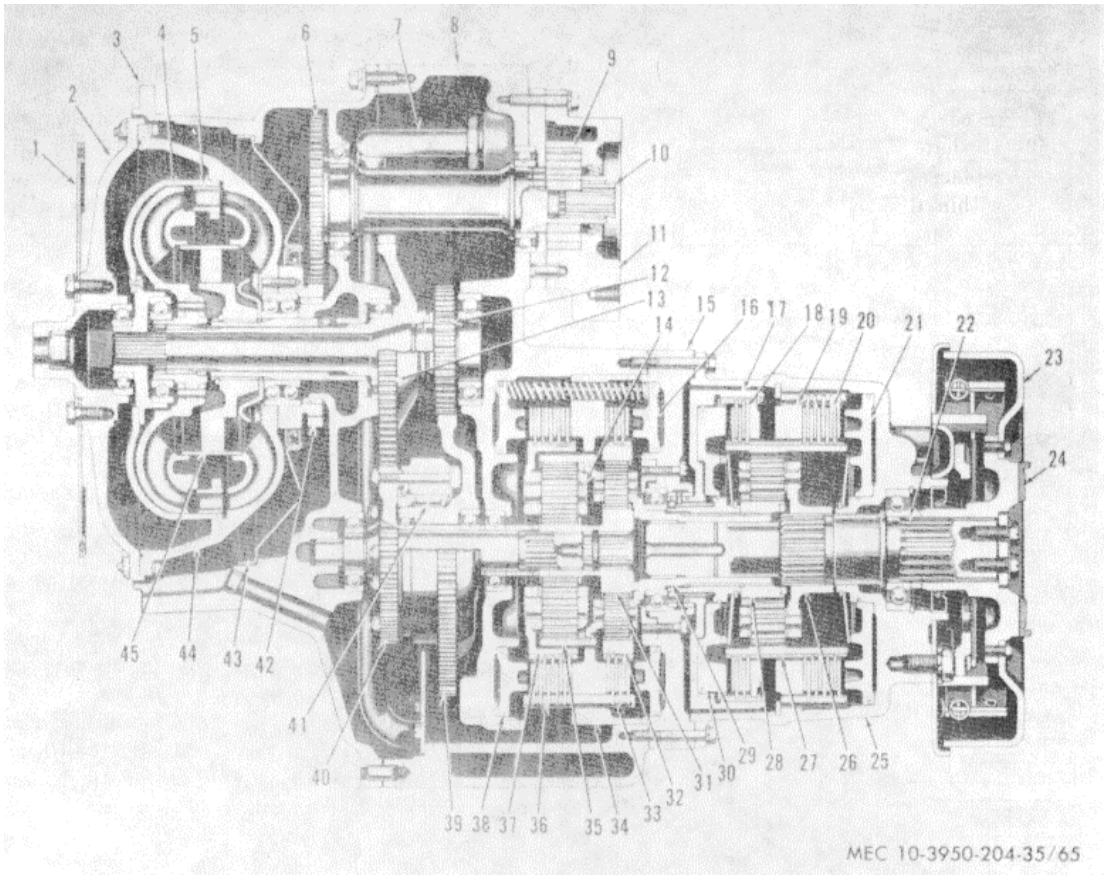
(2) If plug (12) was removed, install it.

37. Oil Pump Assembly

a. Disassembly.

(1) Remove pump cover (8, fig. 76) and gasket (9) from pump body (15).

(2) Remove drive gear (10).



1 Flex disk drive
2 Converter cover
3 Converter housing
4 Converter second turbine
5 Converter first turbine
6 Accessory driven gear
7 Oil suction tube
8 Transmission main housing
9 Oil pump drive gear
10 Accessory drive coupling
11 Accessory mounting pad
12 First-turbine drive gear
13 Second-turbine drive gear
14 Reverse planetary carrier
15 Rear output housing adapter
16 For clutch piston
17 High-range clutch housing
18 High-range clutch
19 Low-range clutch anchor
20 Low-range clutch
21 Low-range clutch piston
22 Transmission output shaft
23 Parking brake
24 Output flange
25 Rear output housing
26 Low-range planetary carrier
27 Low-range ring gear
28 Low-range sun gear
29 Forward planetary carrier
30 High-range clutch piston
31 Forward and reverse planetary sun gear
32 Forward planetary ring gear
33 Forward clutch
34 Forward and reverse clutch anchor
35 Reverse planetary ring gear
36 Reverse clutch
37 Reverse clutch hub
38 Reverse clutch piston
39 First-turbine driven gear
40 Second-turbine driven gear
41 Freewheel clutch
42 Accessory drive gear
43 Diaphragm
44 Converter pump
45 Converter stator

Figure 65. Powershift transmission, cross section.

(3) Remove driven gear assembly (11).
(4) Do not remove bearings (13) from gear (12) unless replacement is necessary. If necessary, remove bearings.
(5) Do not remove driven gear shaft (17) unless replacement is necessary. If necessary, remove shaft.
(6) Do not remove oil seal (18) unless replacement is necessary. If necessary, remove seal.
(7) Do not remove dowel pin (16) unless replacement is necessary. If necessary, remove pin.

b. Cleaning and Inspection. Refer to paragraph 26.

c. Assembly.

(1) If dowel pin (16, fig. 76) was removed from body (15), install new replacement. Press pin into body, to within 0.420 inch of cover-to-body split line surface.

(2) If shaft (17) was removed, install new replacement. Press shaft into body, to within 0.480 inch of cover-to-body split line surface.

(3) If oil seal (18) was removed, install new replacement. Install seal, spring side first, into body. Press seal until firmly seated.

(4) If bearings (13) ere removed from driven gear (12), install new replacements. Install each bearing into the gear, pressing against the numbered end of bearing cage, flush to or 0.010 below bearing bore surface of gear.

(5) Install driven gear assembly (11) into body (15).

(6) Install drive gear (10) into body (15).

(7) Install pump cover (8) and gasket (9) onto body (15)

38. Control Valve Body Assembly

a. Disassembly.

(1) Remove plug (31, fig. 77), gasket (32), one spring (33) and one ball (30) from bottom of valve body (9).

(2) Remove plug (35) and gasket (34) from front of valve body (9).

(3) Remove valve stop (13) from inner (mounting) side of valve body (9).

(4) Clean stem of selector valve (29) and push valve out through front of valve body (9).

(5) Remove remaining ball (30) and spring (33).

(6) Remove cutoff valve plug (26) and gasket (24). Items (22), (23), and (25) will come out with plug (26). Remove and separate these items.

(7) Remove valve (21) and spring (20).

(8) Remove plug (19), gasket (18), plug (17), springs (15) and (16), retainer (14), from rear of valve body (9).

(9) Remove plug (6), gasket (7), and valve (8) from front of valve body (9).

(10) Do not remove orifice plug (10), ball (11), ball retainer plug (12), and seal (28) from valve body (9) unless replacement of these items is required.

b. Cleaning and Inspection. Refer to paragraph 26.

c. Assembly.

(1) If seal (28, fig. 77) was removed from valve body (9), install new seal. The spring-loaded (larger) seal lip must face toward valve body. Press seal in until it is flush with or 0.030 inch below rear surface of valve body.

(2) If orifice plug (10) was removed, press new plug to flush with or 0.010 inch below, surrounding surface (3) If ball (11) and retainer (12) were removed, install new ball and retainer. Press retainer until it is flush with or 0.010 inch below, valve body mounting face.

(4) Install valve (8), gasket (7), and plug (6) in to upper-front of valve body (9).

(5) Install retainer (14), springs (15 and 16), plug (17), gasket (18) and plug (19) into upper-rear of valve body (9).

***Note*. Concave (cupped) side of retainer (14) must face toward valve (8) and front of valve body (9).**

(6) Install spring (20) and valve (21) into center-rear of valve body (9).

(7) Install seal ring (23) and cup (25) onto plug (22). Install these parts, cup (25) first, into front of plug (26).

(8) Install gasket (24) and plug (26) into center-rear of valve body (9).

(9) Install one spring (33) and one ball (30) into valve body (9).

(10) Depress ball and spring and install valve (29), stem first, into lower-front of valve body (9). Be careful to prevent damaging seal (28) when stem of valve (29) enters it. Push valve (29) rearward until its front end is one inch or more within valve body.

(11) Install gasket (34) and plug (35).

(12) Install remaining ball (30) and spring (33). Install plug (31) with gasket (32).

(13) Install valve stop (13), at inner (mounting) side of valve body (9).

***Note*. Valve stop (13) clips around manual selector valve at a point approximately 2½ inches from rear of valve body.**

39. Assembly of Transmission

a. Installation of Turbine Gears and Freewheel Clutch.

(1) Position transmission main housing, rear

downward, and block it so that its front surface is level.

(2) Install bearing (29, fig. 68) onto gear (28). Install thrust race (flat) (27), thrust bearing (26) and thrust race (25), cupped side outward, onto gear (28).

(3) Install seal ring (24) into the groove of the shaft of gear (28).

(4) Install gear (28) and its attached parts into its bearing bore in transmission main housing.

(5) Install bearing (22) and seal ring (21) onto gear (23). Install snap ring (20).

(6) Install gear (23) onto the shaft of gear (28).

(7) Install assembled freewheel clutch and turbine driven gears (items 1 through 16, fig. 69) into transmission main housing.

(8) Install plate (31, fig. 70) and three bolts (32), leaving right-side bolt hole open.

(9) Install nut (4) and seal ring (5) onto upper-end of suction tube (1).

(10) Install seal ring (2) onto lower-end of suction tube (1).

(11) Install suction tube (1) into housing (29). Tighten nut (4) and install bolt (33).

b. Installation of Torque Converter Housing.

(1) Install gasket (6, fig. 70) onto housing (29).

(2) Install assembled torque converter housing (items 4 through 11, 15 through 19, and 30 through 35, fig. 68).

(3) Install 23 bolts (12), washers (13) and (14), one bolt (11), and washers (2) and (3).

c. Installation of Reverse Clutch and Planetary.

(1) Position transmission, converter housing downward, and block it in a level position.

(2) Install expanders (3 and 5, fig. 71) into grooves of piston (1).

Note. **Ends of expanders must bend away from seals (toward bottoms of grooves) to avoid cutting into seal.**

(3) Install seal rings (2) and (4), being careful to not stretch or distort them.

(4) Install piston (1), flat side first, into housing.

(5) Alternately install four each of clutch plates (24) and (23), beginning with plate (24).

Note. **All faced internal-spline clutch plates (such as (23)) should be soaked for at least two minutes in transmission oil before installation.**

(6) Install spacer (22) and planetary carrier assembly (14).

(7) Install clutch plates (12 and 11) (refer to note following (5) above).

(8) Align slots in plates (12 and 24) to receive pins (9) in anchor assembly (8).

(9) Install anchor assembly (8), engaging the longer ends of pins (9) with slots in plates (12) and (24). Rotate anchor assembly until its outer slot is aligned with anchor pin hole at left side of housing.

Note. If control valve body is in place at this time, anchor pin should be installed (from inside the housing) prior to installation of anchor assembly (8).

(10) Install sun gear (13), smaller end first.

(11) Install twelve springs (6) and pins (7).

d. Installation of Forward Clutch and Planetary.

(1) Install ring gear (1, fig. 72) onto carrier assembly (3), retaining it with snap ring (10).

(2) Install thrust washer (2) into carrier assembly (3), using oil-soluble grease to retain it.

(3) Install ring gear (1) into carrier assembly (3). Rotate carrier during installation to engage the gear teeth.

(4) Alternately install two clutch plates (11) and two plates (12), beginning with plate (11) (refer to note following (5) above).

(5) Install ring gear (13), long ends of teeth downward.

(6) Install two remaining clutch plates (11 and 12) (refer to note following c (5) above).

(7) Install bearing (18) into adapter assembly (20). Install retainer (17) and six bolts (24).

(8) Install expanders and seal rings (14) and (15) as described in c(2) and (3) above, into piston (16).

(9) Install piston (16), flat side first, into adapter assembly (20).

(10) Install gasket (19) and adapter assembly (20) onto transmission housing. Align bolt holes and drive inner race of bearing (18) onto hub of carrier assembly (3).

(11) Install two bolts (25).

e. Installation of High-range Clutch.

(1) Install expander and seal ring (5, fig. 73) into piston (7). Install seal ring (6) into housing (4).

(2) Install piston (7) and spring (8), cupped side first into housing (4).
(3) Depress inner circumference of spring (8) and install snap ring (9).
(4) Install one each clutch plates (11) and (12) (refer to note following c(5) above).
(5) Install ring gear (13), short ends of teeth first.
(6) Install remaining two plates (11) with plate (12) between them.
(7) Install reaction plate (14), flat side first, and retain it with snapring (15).
(8) Install seal rings (1) into grooves in hub of housing assembly (2).
Note. **These are Teflon seals which must be coiled, when new, to form a circle. Retain with oil soluble grease.**
(9) Install assembled high-range clutch onto protruding shaft of forward planetary carrier assembly.
(10) Install snapring (10).

f. Installation of Low-range Clutch and Transmission Rear Housing.

(1) Install bearing (6, fig. 75) onto shaft (5). Install shaft (5) into rear of housing (2), pressing on outer race of bearing.
(2) Install snapring (7).
(3) Install oil seal (9), lip inward, pressing it to flush with, or just below, rear housing (2).
(4) Position housing (2), rear downward.
(5) Install seal ring (20, fig. 74) into housing.
(6) Install expander and seal (19) onto piston (21) (refer to note following c(2) above).
(7) Install piston (21), flat side first, into housing.
(8) Install spring (18), cupped side first. Depress its inner circumferences and install snapring (17).
(9) Install alternately five each of clutch plates (15 and 16), beginning with plate (16).
(10) Install (from inside of housing) anchor pin (10, fig. 75).
(11) Align slots in plates (16, fig. 74) to engage pins (13 and 14) in anchor assembly (11).
(12) Install anchor assembly (11), pins first, engaging pins with slots in plates (16). Also, engage milled slot in anchor with anchor pin.
(13) Install snapring (10).
(14) Install sun gear assembly (1), flat side first, onto protruding shaft of forward planetary in transmission.
(15) Install carrier assembly (4, fig. 74) hub upward, onto sun gear assembly (1) in transmission.
(16) Install gasket (1, fig. 75) onto adapter assembly on transmission.
(17) Install assembled housing (2) and lowrange clutch onto transmission.
(18) Install 15 bolts (4) with washers (3).

g. Installation of Parking Brake and Output Flange.

(1) Install brake backplate assembly (14, fig. 75) and retain it with three bolts (26) and washers (27).
(2) Install roller (15) and cam lever (18).
(3) Install brake shoes (16) and springs (17).
(4) Install spacer (8) onto output shaft (5).
(5) Install output flange (25) and seat it against spacer (8) by installing washer (21).
(6) Measure depth from the washer contact surface in flange (25) to the rear end of output shaft (5). Subtract 0.008 to 0.012 inch from this measurement. The result is the thickness of shims (20) required.
(7) Select combination of shims (20) required. Install shims, washer (21),.lock strip (22) and bolts (23). Tighten bolts and lock them by bending lock strip (22) against one flat on each bolt head.
(8) Install brake drum (19) and retain it with eight bolts (24).

h. Installation of Torque Converter Elements.

(1) Position transmission in an upright position.
(2) Install assembled converter pump (10-17, fig. 67). It may be necessary to tap inner race of bearing (16) to seat it on converter ground sleeve. Mesh the teeth on accessory drive gears.
(3) Install spacer (9), flat side first.
(4) Install converter stator (8), hub first, and retain it with snapring.
(5) Install assembled converter turbines (items 1-4).

i. Installation of Converter Cover Assembly and Flex-disk Drive.

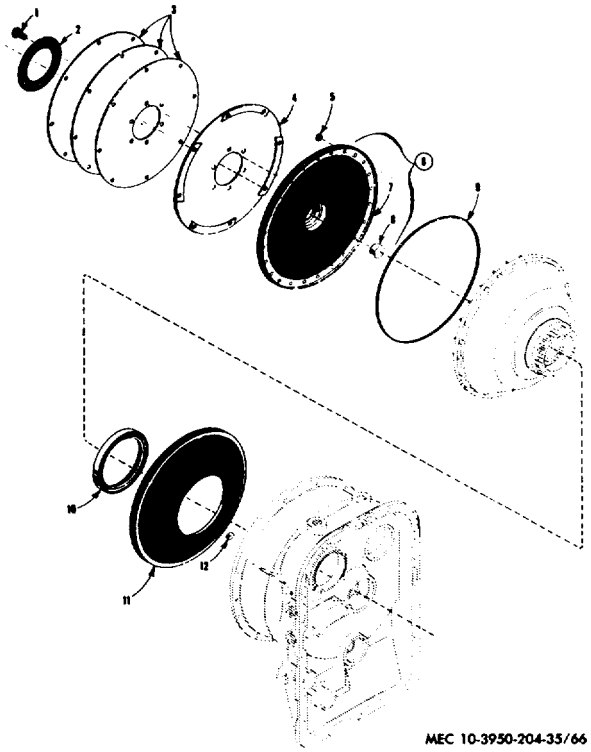
(1) Install seal ring (9, fig. 66) into groove in converter pump.
(2) Install converter cover assembly (6) and

retain it with 24 nuts (5) Tighten nuts evenly to avoid pinching seal ring (9).

(3) Install disk and washer assembly (4), washer segments toward cover assembly (6).

(4) Install three disks (3), matching their cone with that of disk and washer assembly (4).

(5) Install plate (2) and six bolts (1).



1	Hexagon-head, self-locking bolt	7	Cover
2	Flex disk plate	8	Plug
3	Flex disk	9	Seal ring
4	Flex disk assembly	10	Oil seal
5	Hexagon nut	11	Diaphragm
6	Cover assembly	12	Plug

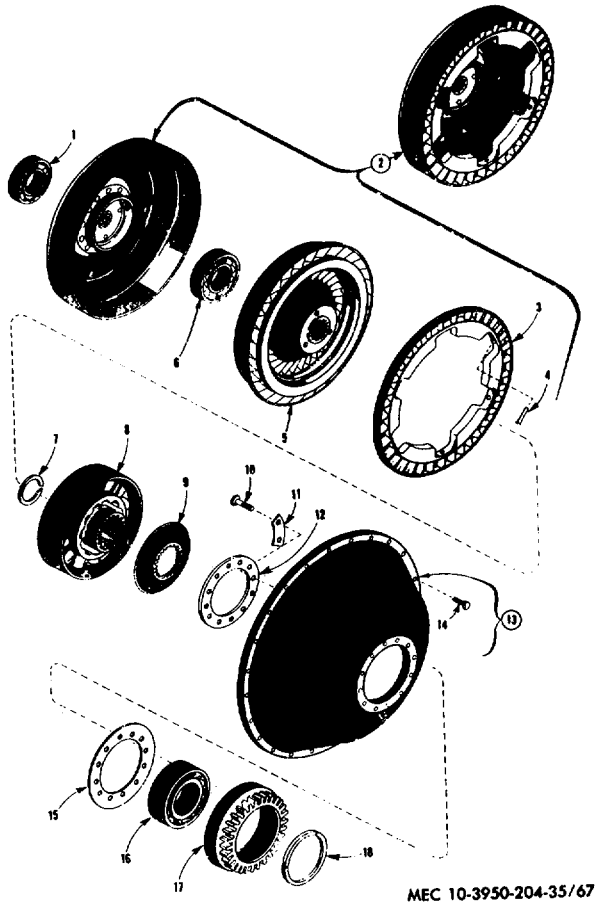
Figure 66. Flex disk, converter drive and dry converter type housing, exploded view.

j. Installation of Control Valve Assembly.

(1) If not previously installed, install clutch anchor pin (27, fig. 70) seating its flatmilled end in slot in forward-reverse clutch anchor assembly.

(2) Install washers (2, fig. 77) onto bolts (3 and 4).

(3) Install bolts (3 and 4) into bolt holes in control valve assembly (5).



1	Single-row ball bearing	10	Hexagon-head, self-locking bolt
2	First-turbine assembly	11	Lock strip
3	First turbine	12	Bearing retainer
4	Pin	13	Pump assembly
5	Second turbine	14	Bolt
6	Single-row ball bearing	15	Pump gasket
7	Snap ring	16	Double-row ball bearing
8	Stator	17	Accessory drive gear
9	Spacer		
18	Seal ring		

Figure 67. Torque converter, exploded view.

(4) Install gasket (1) onto bolts protruding through valve body.

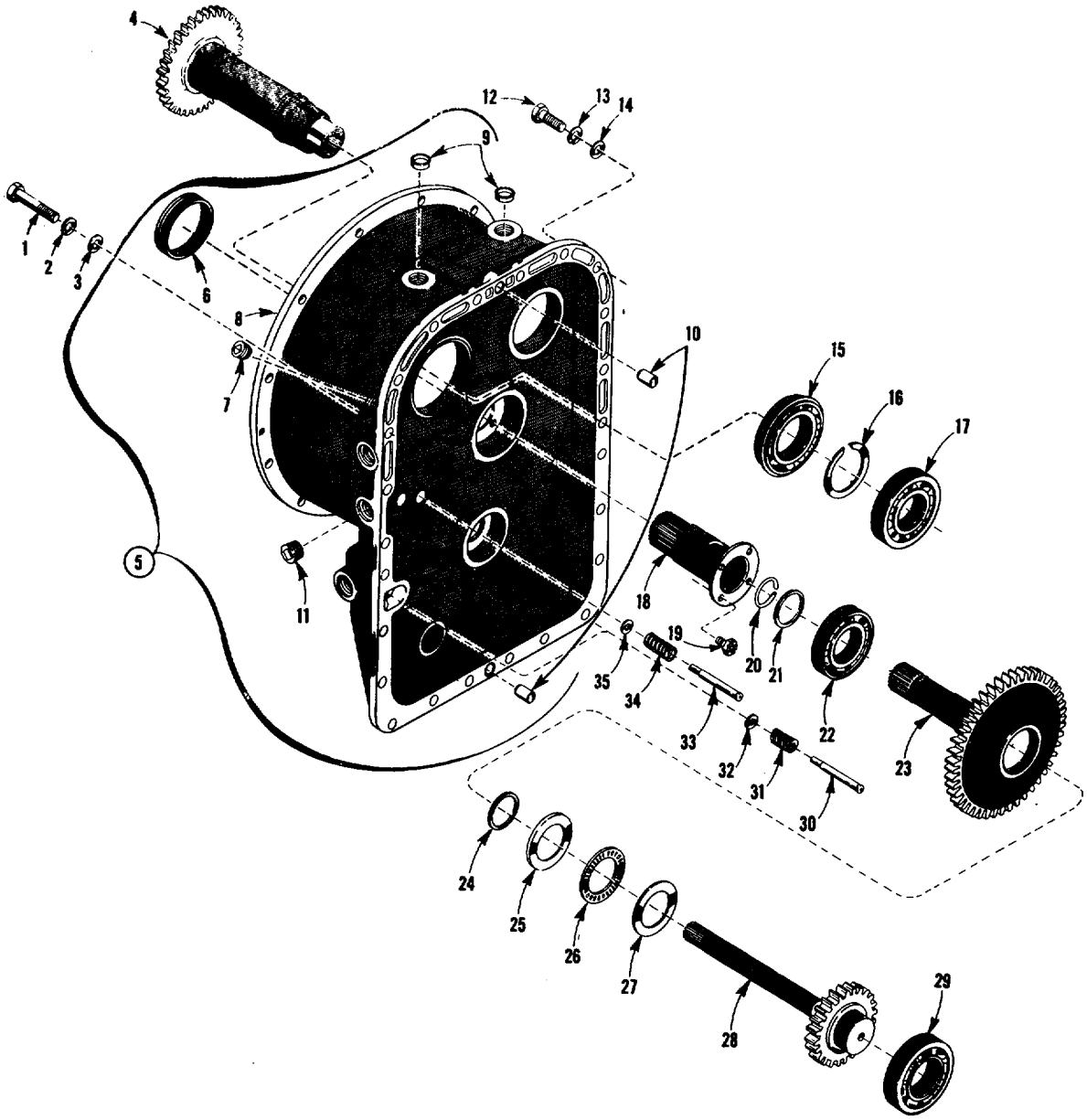
(5) Install complete assembly onto transmission housing.

k. Installation of Oil Pump Assembly.

Note. **To insure lubrication and rapid initial pickup of oil when transmission is operated first time after rebuild, fill oil pump with transmission oil before installing it.**

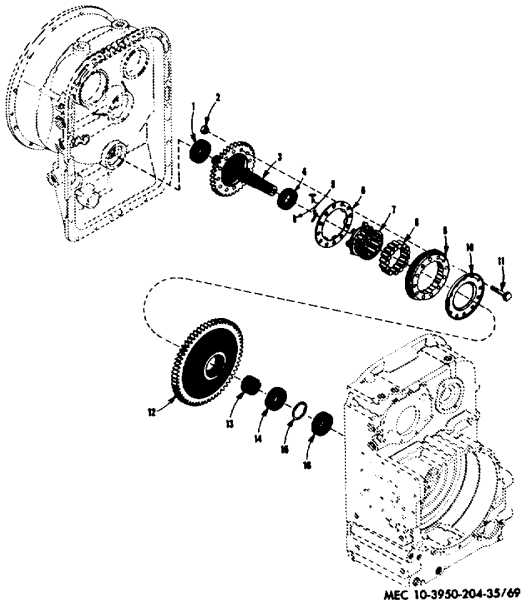
(1) Install washers (2 and 6, fig. 76) onto bolts (3) and (5).

(2) Install bolts (3) and (5) into' oil pump assembly (7). The longer bolts (5) go into the two recessed holes.



1 Hexagon-head bolt
2 Lockwasher
3 Flatwasher
4 Accessory driven gear
5 Converter housing assembly
6 Sleeve
7 Plug
8 lousing
9 Plug
10 Dowel pin
11 Plug
12 Hexagon-head bolt
13 Lockwasher
14 Flatmasher
15 Single-row ball healing
16 Snapring
17 Single-row ball bearing
18 Ground sleeve
19 Hexagon-head, self-locking bolt
20 Snapring
21 Seal ring
22 Single-row ball bearing
23 Second-turbine drive gear
24 Seal ring
25 Thrust bearing race
26 Thrust bearing
27 Thrust bearing race
28 First-turbine drive gear
29 Single-row ball bearing
30 Valve guide pin
31 Lubrication pressure regulator valve spring
32 Lubrication pressure regulator valve
33 Valve guide pin
34 Converter pressure regulator valve spring
35 Converter pressure regulator valve

Figure 68. Torque converter housing, exploded view.



1 Single-row ball bearing
2 Hexagon nut
3 Second-turbine driven gear
4 Singlerow ball bearing
5 Freewheel spring
6 Spring plate
7 Freewheel roller cage
8 Freewheel roller
9 Freewheel cam
10 Lubrication collector
11 Square-head bolt
12 First-turbine driven gear
13 Spacer
14 Single-row ball bearing
15 Spacer
16 Single-row ball bearing

Figure 69. Turbine driven gears and freewheel unit, exploded view.

(3) Install gasket (1) over bolts in pump.
(4) Install pump assembly.
(5) Install coupling (4). If accessory pump is to be installed immediately, proceed with its installation. Otherwise, put a strip of tape across rear mounting face of oil pump to retain coupling (4).

l. Installation of Minor Components.

(1) Install breather assembly (9, fig. 70).
(2) Install gasket (10), cover (11), washers (12) and bolts (13).
(3) Install oil strainer assembly (16), open end first.
(4) Install seal ring (17), cover assembly (18), washers (19), and bolts (20).
(5) If not previously installed, install oil drain plug (25).

40. Differential

a. Remove Differential Carrier from Housing.

(1) Remove plug from bottom of axle housing and drain lubricant (fig. 78).
(2) Remove axle shaft drive stud nuts (11, fig. 79) and lockwashers (10 and 12).
(3) Rap axle shafts sharply in center of flange with heavy steel hammer on drift to free dowels (9). Remove taper dowels and axle shafts.

Caution: **Prying shafts loose will damage hubs and oil seals.**

(4) Disconnect universal at pinion shaft (fig. 80).
(5) Remove carrier to housing stud nuts and washers. Loosen two top nuts and leave on studs to prevent carrier from falling (fig. 80).
(6) Break carrier loose from axle housing with rawhide mallet.
(7) Remove top nuts and washers and work carrier free using puller screws in holes where provided. A small pinch bar may be used to straighten carrier in housing bore. However, the end must be rounded to prevent indenting carrier flange. A roller jack may be used to facilitate removal of carrier.

b. Disassemble Carrier. Place carrier in suitable holding fixture.

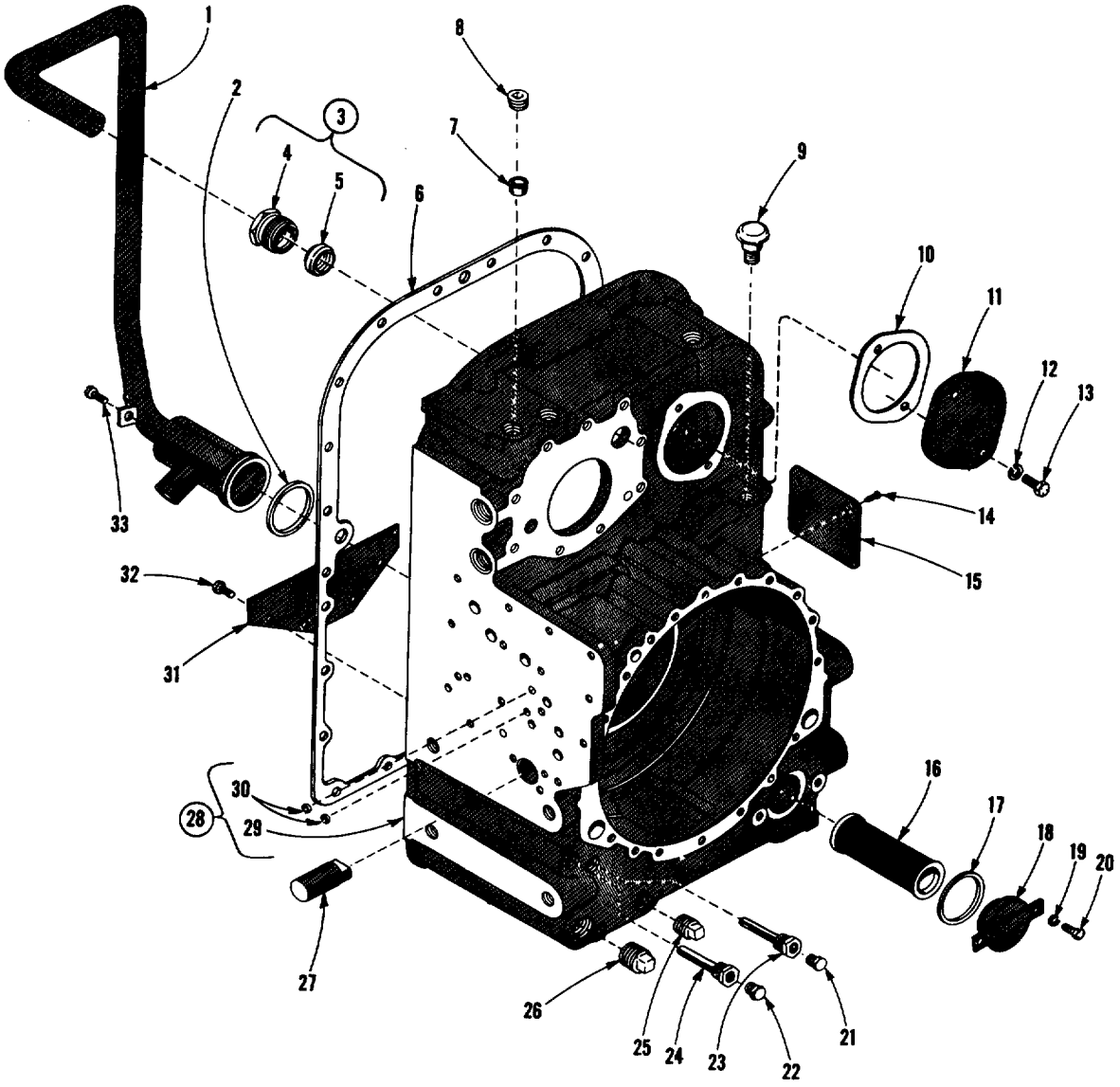
Note. **If initial inspection indicates that drive gear is not going to be replaced, it is recommended the established backlash be measured and noted for reference and used at reassembly.**

c. Remove Differential and Gear Assembly.

(1) Loosen jam nut and back off thrust block adjusting screw (fig. 81).
(2) Center punch one differential carrier leg and bearing cap to identify for properly reassembling (fig. 81).
(3) Cut lock wire. Remove capscrews and adjusting nut locks (fig. 83).
(4) Remove bearing cap, capscrews, bearing caps and adjusting nuts (fig. 83).
(5) Lift out differential and gear assembly (fig. 83).
(6) Remove thrust block from inside of carrier housing (fig. 83).

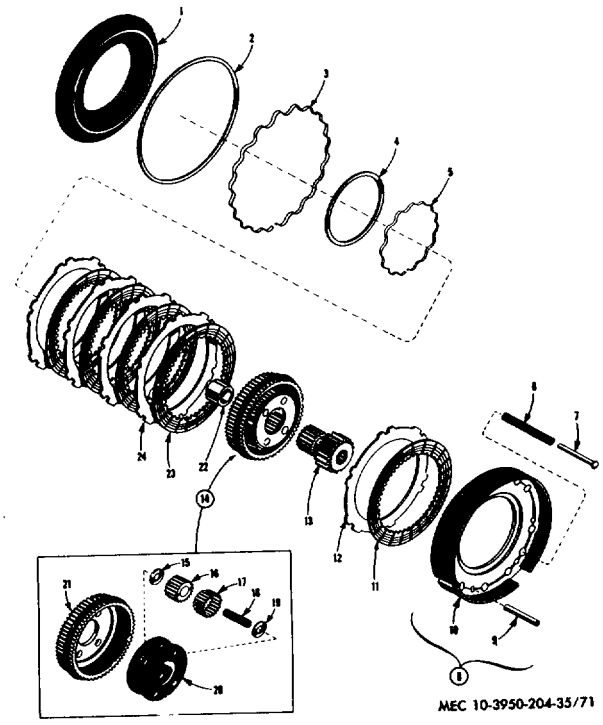
d. Disassemble Differential Case and Gear Assembly.

(1) If original identification marks are not clear, mark differential case halves with a punch or chisel for correct alignment on reassembling (fig. 85).



1 Oil suction tube
2 Seal ring
3 Nut assembly
4 Nut
5 Seal
6 Gasket
7 Remote filter plug
8 Plug
9 Breather
10 Gasket
11 Cover
12 Lockwasher
13 Hexagon-head bolt
14 Drive screw
15 Name plate
16 Oil strainer
17 Seal ring
18 Strainer cover assembly
19 Lockwasher
20 Hexagon-head bolt
21 Oil check plug (lower)
22 Oil check plug (upper)
23 Oil check tube (lower)
24 Oil check tube (upper)
25 Oil drain plug
26 Oil filler opening plug
27 Clutch anchor pin
28 Main housing assembly
29 Housing
30 Plug
31 Baffle plate
32 Hexagon-head, self-locking bolt
33 Hexagon-head, self-locking bolt

Figure 70. Transmission housing, exploded view.



1	Reverse clutch piston	13	Forward and reverse sun gear
2	Piston external-seal ring	14	Reverse planetary carrier assembly
3	External-seal ring expander	15	Thrust washer
4	Piston internal-seal ring	16	Pinion
5	Internal-seal ring expander	17	Roller
6	Piston return spring	18	Pinion spindle
7	Return spring pin	19	Thrust washer
8	Forward and reverse clutch anchor assembly	20	Carrier
		21	Reverse clutch hub
		22	Spacer
9	Pin	23	Internal-spliced clutch plate
10	Anchor		
11	Internal-splined clutch plate	24	External-tanged clutch plate
12	External-tanged clutch plate		

Figure 71. Reverse clutch and planetary, exploded view.

(2) Cut lock wire, remove bolts and separate case halves (fig. 83).

(3) Remove spider, pinions, side gears and thrust washers (fig. 83).

(4) If necessary, remove rivets and separate gear and case.

(5) If necessary to replace differential bearings, remove with a suitable puller (fig. 86).

e. Remove Gear Rivets.

(1) Carefully center punch rivets in center of head.

(2) Use drill 1/32" smaller than body of rivet to drill through head (fig. 87).

(3) Press out rivets.

f. Remove Pinion and Cage Assembly.

(1) Hold yoke with suitable tool and remove pinion shaft nut and washer (fig. 83).

(2) Remove yoke with a suitable puller.

(3) Remove pinion cage capscrews (fig. 83).

(4) Remove bearing cover and oil seal assembly (fig. 83).

(5) Remove bearing cage using puller screws in holes provided.

Caution: **The use of a pinch bar will damage shims. Driving pinion from inner end with a drift will damage bearing lock ring groove (fig. 88).**

(6) Wire shim pack together to facilitate adjustment on reassembling (fig. 83).

g. Disassemble Pinion and Cage Assembly. Splined pinion shafts are used in single reduction carriers. Adjustment is secured with a selective spacer or spacer combination.

(1) Tap shaft out of cage with soft mallet or press shaft from cage (fig. 83).

(2) Remove outer bearing from cage (fig. 83).

(3) Remove spacer or spacer combination from pinion shaft (fig. 83).

(4) If necessary to replace rear thrust bearing or radial bearing, remove with suitable puller (fig. 89).

(5) Remove oil seal assembly from bearing cover (fig. 83).

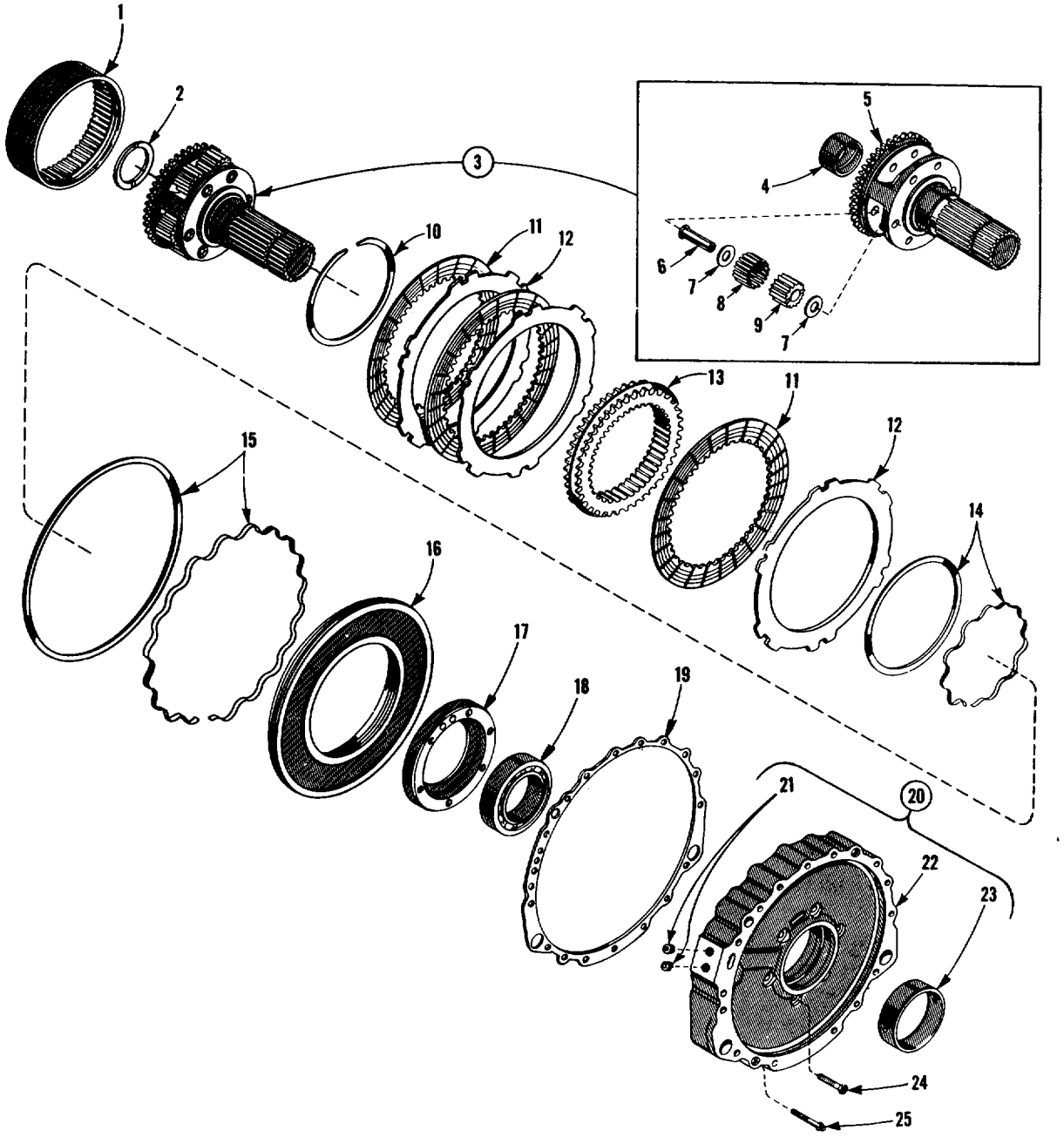
h. Cleaning, Inspection, and Repair.

(1) Discard all seals, and other unserviceable parts.

(2) Clean all other parts of differential assembly in an approved cleaning solvent; dry thoroughly with compressed air. Coat all parts with clean lubricating oil.

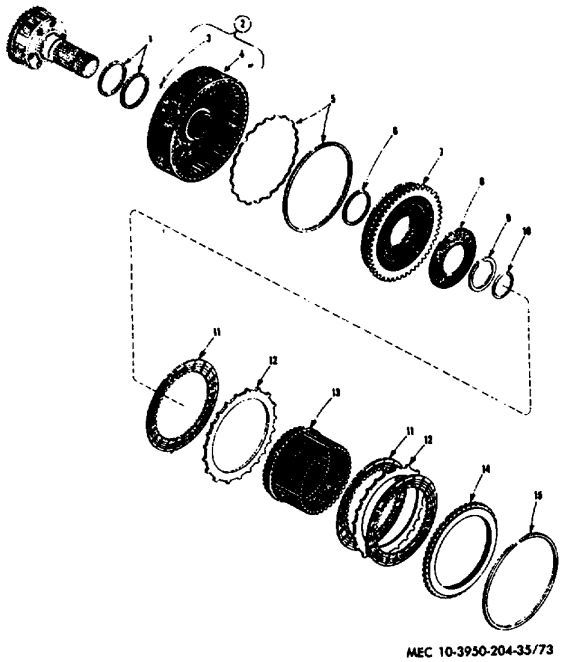
(3) Inspect all bearings, cups and cones, including those not removed from parts of drive unit, and replace if rollers or cups are worn, pitted or damaged in any way. Remove parts needing replacement with a suitable puller or in a press with sleeves. Avoid the use of drifts and hammers. They may easily mutilate or distort component parts.

(4) Inspect hypoid gears for wear or damage. Gears which are worn, ridged, pitted or scored, should i)e replaced. When necessary to replace either the pinion or gear of hypoid set, the entire gear set should be replaced.



1	Reverse ring gear	8	Roller	13	Forward ring gear	20	Adapter assembly
2	Thrust washer	9	Pinion	14	Expander and seal ring	21	Plug
3	Forward planetary carrier assembly	10	Snap ring	15	Expander and seal ring	22	Adapter
4	Bushing	11	Internal-splined clutch plate	16	Forward clutch piston	23	Sleeve
5	Carrier	12	External-tanged clutch plate	17	Bearing retainer	24	Hexagon-head bolt
6	Pinion spindle			18	Single-row ball bearing	25	Hexagon-head bolt
7	Thrust washer			19	Gasket		

Figure 72. Forward clutch and planetary, exploded view.



1 Seal ring
2 High-range clutch housing assembly
3 Plug
4 Housing
5 Expander and seal ring
6 Seal ring
7 High-range clutch piston
8 Clutch release spring
9 Snapring
10 Snapring
11 Internal-splined clutch plate
12 External-tanged clutch plate
13 Low-range ring gear
14 High-range clutch backplate
15 Snapring

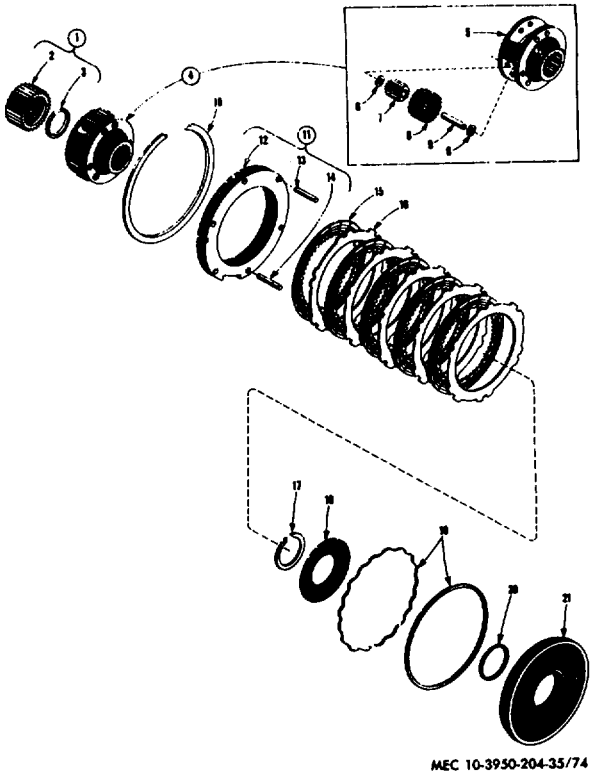
Figure 73. High-range clutch, exploded view

(5) Inspect differential assembly for the following:
  (a) Pitted, scored or worn thrust surfaces of differential case halves, thrust washers, spider trunions and differential gears. Thrust washers must be replaced in sets. The use of a combination of old and new washers will result in premature failure.
  (b) Wear or damage e to differential pinion and side gear teeth. Always replace differential pinions and side gears in sets.

(6) Inspect, axle shafts for signs of torsional fracture or other indication of impending failure.

(7) Replace all worn or damaged parts. Hex nuts with rounded corners, all lockwashers, oil seals and gasket should be replaced at time of overhaul.

(8) Remove nicks, nails and burrs from machined or ground surfaces. Threads must



1 Low-range sun gear assembly
2 Low-range sun gear
3 Thrust washer
4 Low-range planetary carrier assembly
5 Carrier
6 Thrust washer
7 Pinion
8 Roller
9 Pinion spindle
10 Snapring
11 Low-range clutch anchor assembly
12 Anchor
13 Pin
14 Pin
15 Internal-splined clutch plate
16 External-tanged clutch plate
17 Snapring
18 Clutch release spring
19 Expander and seal ring
20 Seal ring
21 Low-range clutch piston

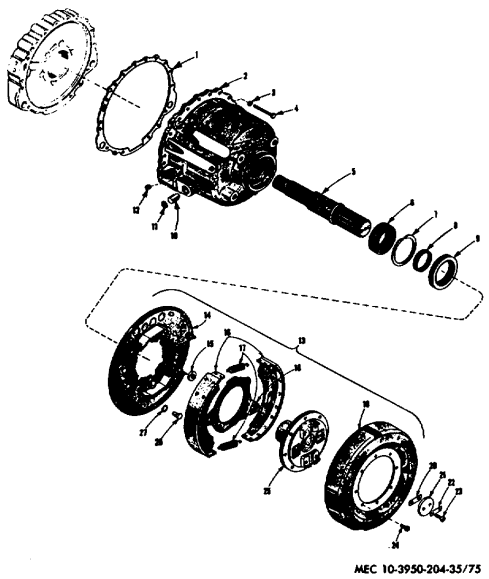
Figure 74. Low-range clutch, exploded view.

be clean and free to obtain accurate adjustment and correct torque. A fine mill file or India stone is suitable for this purpose. Studs must be tight prior to reassembling the parts.

(9) All bronze bushed differential pinions should be ball burnished after bushing installation. Install bushing with a small stepped drift. The small OD should be .010 inch smaller than bushing burnished I.D. and 1 1/2 times bushing length. Always install bushings so end is even with I.D. chamber or about 1/16 inch below spherical surface.

(10) When assembling component parts use a press where possible

(11) Tighten all nuts to specified torque. Use



1 Gasket
2 Rear housing
3 Lockwasher
4 Hexagon-head bolt
5 Output shaft
6 Single-row ball bearing
7 Snapring
8 Spacer
9 Oil seal
10 Anchor pin
11 Plug
12 Plug
13 Brake assembly
14 Back plate
15 Roller
16 Brake shoe
17 Spring
18 Cam lever
19 Drum
20 Shim
21 Retaining washer
22 Lock strip
23 Hexagon-head bolt
24 Hexagon-head bolt
25 Output flange
26 Hexagon-head bolt
27 Lockwasher

Figure 75. Rear housing and parking brake, exploded view.

soft iron locking wire to prevent possibility of wire breakage.

(12) The burrs, caused by lockwashers, at the spot face of stud holes of cages and covers should be removed to assure easy reassembly of these parts.

i. Reassemble Pinion and Cage Assembly.

(1) If new cups are to be installed, press firmly against pinion bearing cage shoulders (fig. 83).

(2) Lubricate bearings and cups with light machine oil.

(3) Press rear thrust and radial bearings firmly against pinion shoulders with a suitable sleeve that will bear only on bearing inner race.

(4) Install radial bearing lock ring and squeeze ring into pinion shaft groove with pliers.

(5) Insert pinion and bearing assembly in pinion cage and position spacer or spacer combination over pinion shaft (fig. 83).

(6) Press front bearing firmly against spacer.

(7) Rotate cage several revolutions to assure normal bearing contact.

(8) While in press under pressure, check bearing preload torque. Wrap soft wire around cage and pull on horizontal line with pound scale. If a press is not available, pinion nut may be tightened to correct torque and preload checked (fig. 90). If rotating torque is not within 5 to 15 pound inches, use thinner spacer to increase or thicker spacer to decrease preload.

Example: Assuming pinion cage diameter to be 6 inches, the radius would be 3 inches and with 5 pounds pull would equal 15 pound inches preload torque.

(9) Press yoke against forward bearing and install washer and pinion shaft nut (fig. 83).

(10) Place pinion cage assembly over carrier studs, hold yoke and tighten pinion shaft nut to correct torque. The flange must be held with a suitable tool or fixture to tighten nut.

(11) Recheck pinion bearing preload torque. If rotating torque is not within 5 to 15 pound inches, repeat the foregoing procedure.

(12) Hold flange and remove pinion shaft nut and yoke.

(13) Lubricate pinion shaft oil seal and cover outer edge of seal body with a nonhardening sealing compound. Press seal against cover shoulder with seal driver (fig. 90).

(14) Install new gasket and bearing cover.

(15) Press flange against forward bearing and install washer and pinion shaft nut (fig. 83).

(16) Tighten to correct torque and install cotter key.

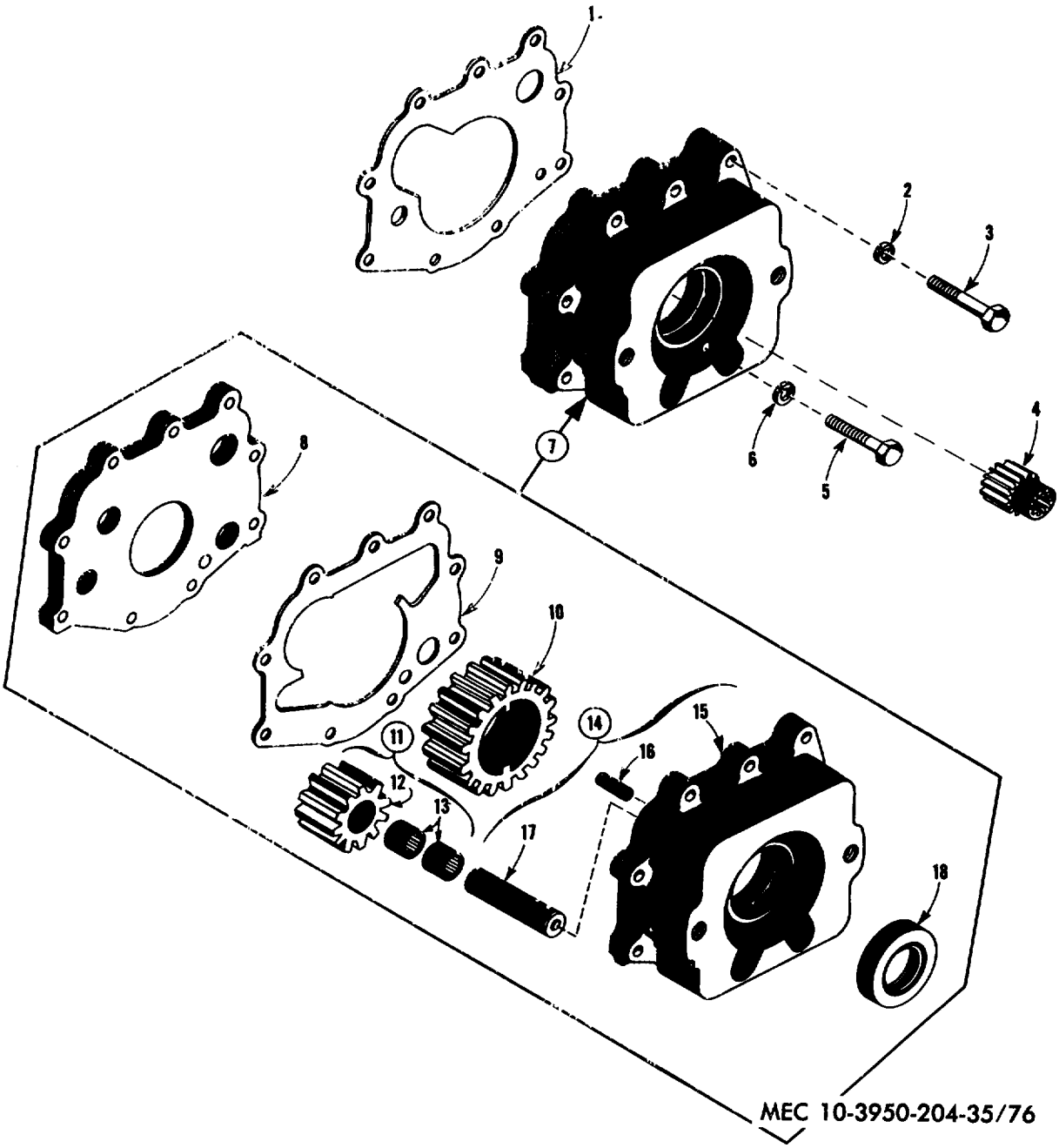
***Caution*: Do not back off nut to align cotter key holes.**

j. Install Pinion and Cage Assembly.

(1) Install correct shim pack. Locate thin shims on both sides for maximum sealing ability (fig. 83).

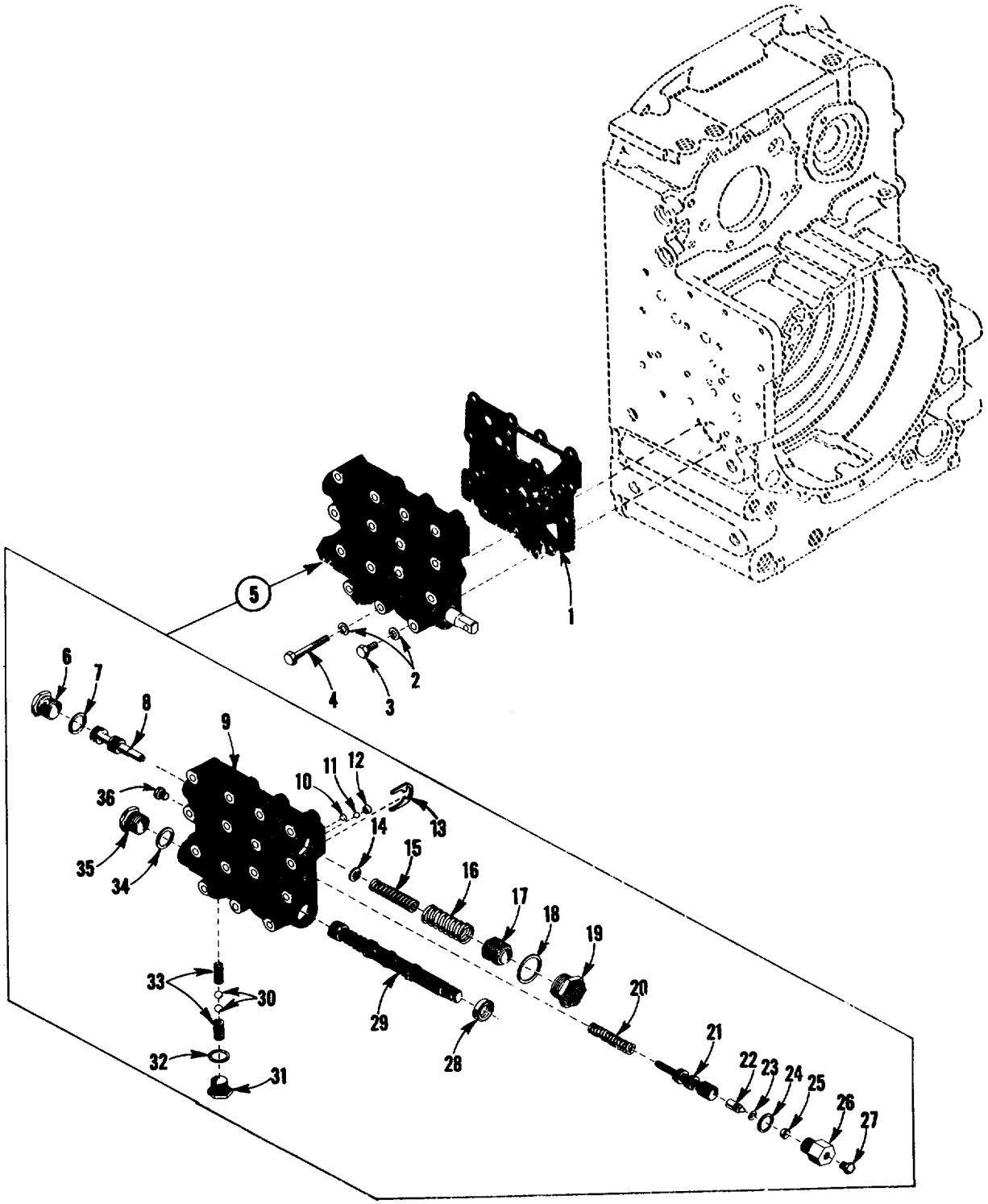
(2) Position pinion and cage assembly on carrier assembly and tap into position with soft mallet.

(3) Install capscrews: tighten to correct torque.



1	Gasket	6	Lockwasher	11	Driven gear assembly	16	Dowel
2	Lockwasher	7	Oil pump assembly	12	Driven gear	17	Driven-gear shaft
3	Hexagon-head bolt	8	Pump cover	13	Roller bearing	18	Oil seal
4	Adapter coupling	9	Gasket	14	Pump body assembly		
5	Hexagon- head bolt	10	Drive gear	15	Pump body		

Figure 76. Oil pump assembly, exploded view.



1	Gasket	6	Plug	10	Orifice plug	14	Spring retainer
2	Lockwasher	7	Gasket	11	Ball	15	Main-pressure regulator spring
3	Hexagon-head bolt	8	Main-pressure regulator valve	12	Ball retainer	16	Trimmer spring
4	Hexagon-head bolt	9	Control valve body	13	Manual selector valve stop	17	Trimmer plug
5	Control valve assembly						

TAGO 8732-A

18 Gasket
19 Plug
20 Clutch cutoff valve spring
21 Clutch cutoff valve
22 Plug
23 Seal ring
24 Gasket
25 Cup
26 Plug
27 Plug
28 Oil seal
29 Manual selector valve
30 Detent ball
31 Plug
32 Gasket
33 Detent spring
34 Gasket
35 Plug
36 Plug

Figure 77. Control valve assembly, exploded view.

k. Assemble Differential and Gear.

(1) Rivet hypoid gear to case half with new rivets. Rivets should not be heated, but always upset cold. When correct rivet is used, the head being formed will be at least /8 inch larger in diameter than rivet hole. The head will then be approximately the same height as the preformed head. Excessive pressure will cause distortion of case holes and result in gear eccentricity. Differential case and gear bolts are available for service replacement of rivets. The use of bolts greatly facilitates servicing these units in the field and eliminates need for special equipment necessary to correct cold upset rivets.

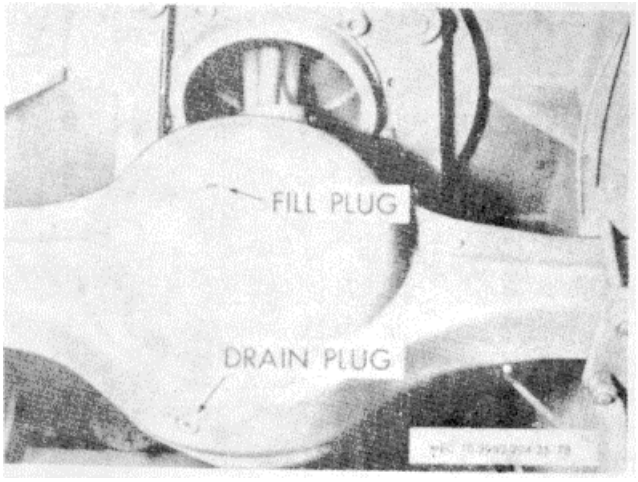
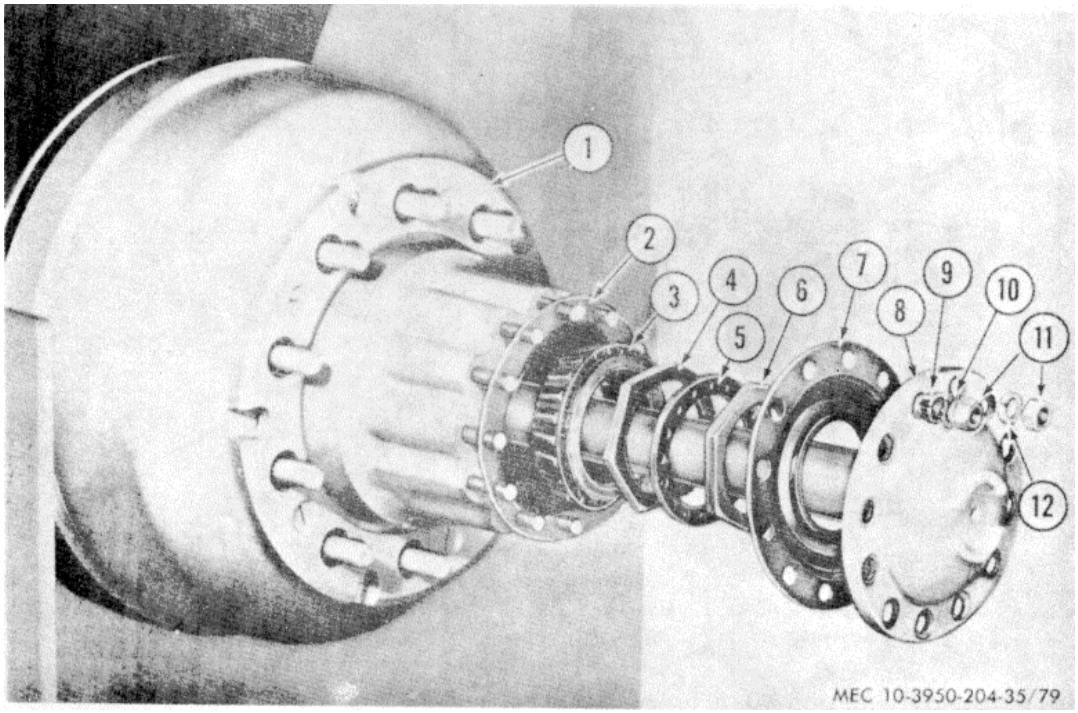


Figure 78. Drain and fill plug on axle housing.



1 Hub
2 Gasket
3 Bearing cone
4 Locknut
5 Lockwasher
6 Locknut
7 Seal
8 Axle
9 Tapered locks
10 Star washers
11 Nuts
12 Washers

Figure 79. Drive axle shaft and trunnion.

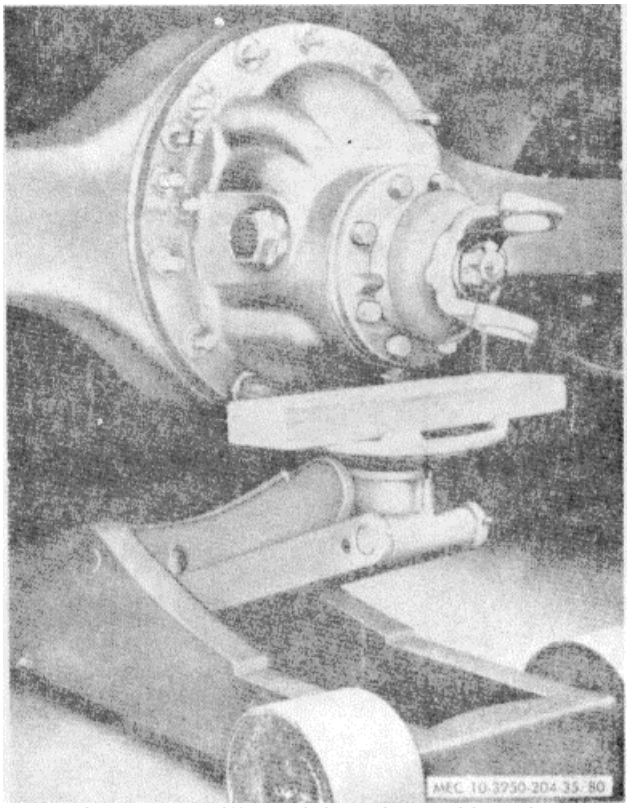


Figure 80. Differential carrier and housing.

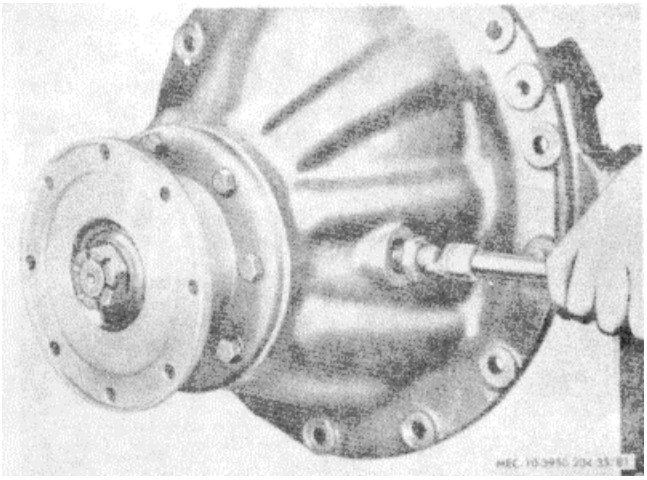


Figure 81. Loosening jamnut and backing off thrust block adjusting screw.

(2) Lubricate differential case inner walls and all component parts with axle lubricant.

(3) Position thrust washer and side gear in bevel gear and case half assembly (fig. 83).

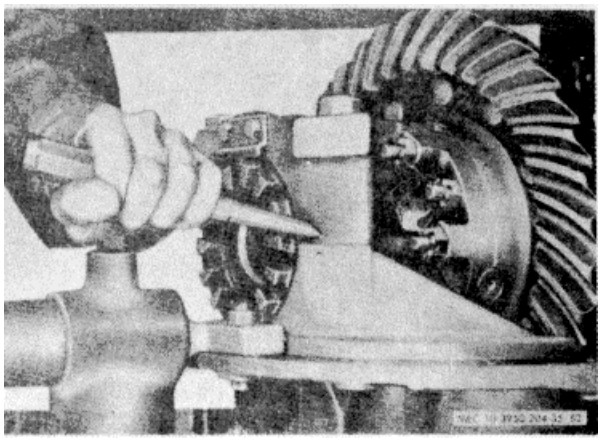


Figure 82. Center punch for identification.

(4) Place spider with pinions and thrust wash ers in position (fig. 83).

(5) Install component side gear and thrust washer (fig. 83).

(6) Align mating marks, position component case half and draw assembly together with four bolts or capscrews equally spaced.

(7) Check assembly for free rotation of differential gears and correct if necessary.

(8) Install remaining bolts and capscrews, tighten to correct torque and lock wire (fig. 83).

(9) If bearings are to I)e replaced, press squarely and firmly on differential case halves.

l. Install Bearing Cups in Carrier Leg Bores.

(1) Temporarily install bearing cups, threaded adjusting rings where employed and bearing caps. Tighten capscrews to proper torque.

(2) The bearing cups must be of a hand push fit in bores, otherwise bores must be reworked with a scraper or some emery cloth until a hand push fit is obtained. Use a bearing cup as a gauge and check the fit as work progresses. Once cups fit properly, remove bearing caps.

m. Install Differential and Gear Assembly.

(1) After checking related parts, coat dif-

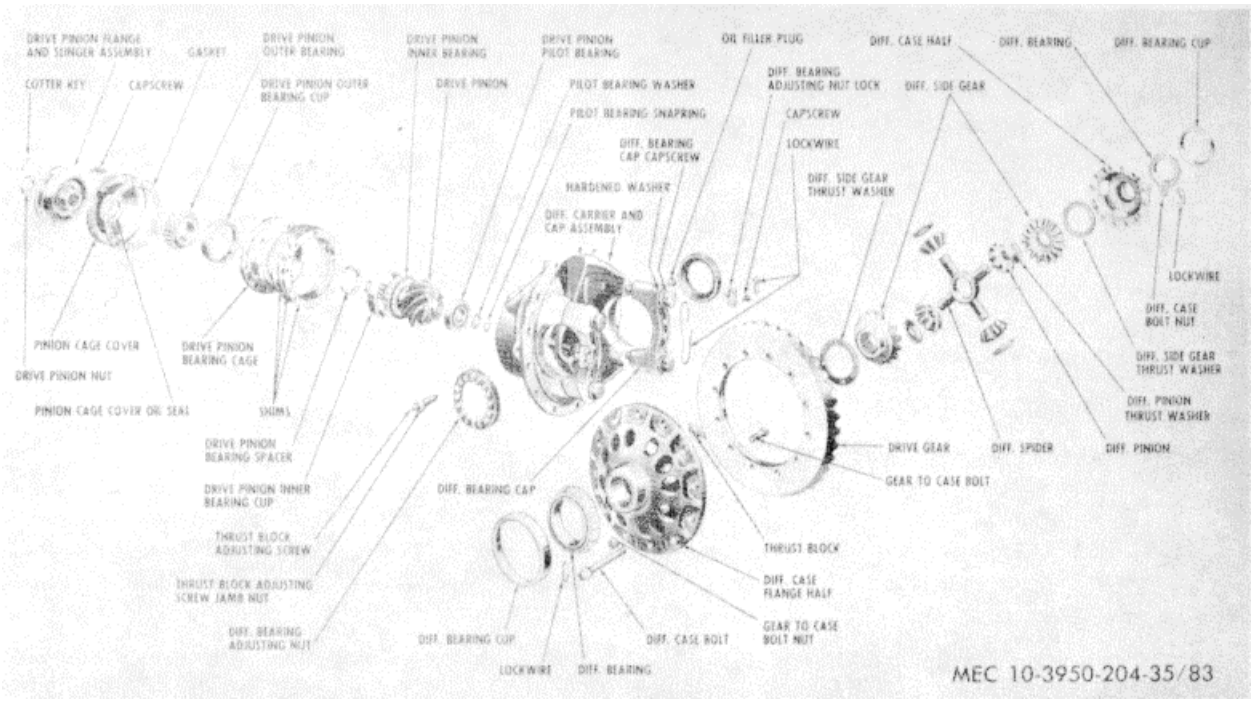


Figure 83. Differential carrier, exploded view.

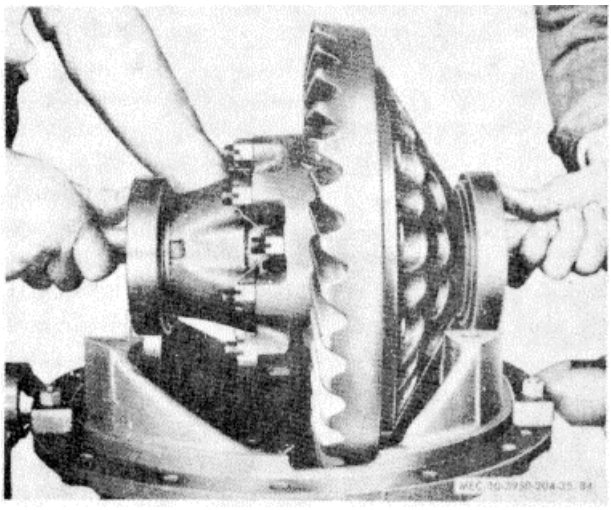


Figure 84. Differential and gear assembly.

ferential bearing cones and cups with specified rear axle lubricant.

(2) Place bearing cups over assembled differential bearing cones, then position differential assembly in carrier (fig. 92).

(3) Insert bearing adjusting nuts and turn hand-tight against bearing cups (fig. 83).

(4) Install bearing caps in correct location as marked and cap lightly into position.

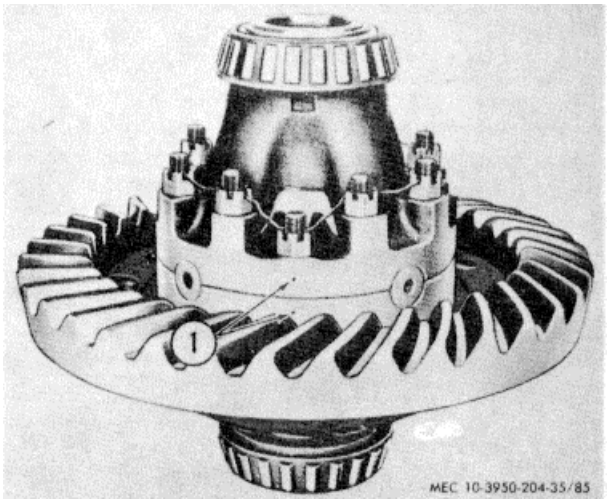


Figure 85. Identification marks on case halves.

Caution: **If bearing caps do not position properly, adjusting nuts may be cross threaded. Remove caps and reposition adjusting nuts. Forcing caps into position will result in irreparable damage** to **carrier housing or bearing caps.**

(5) Install flat washers where used and cap screws. Tighten cap screws to correct torque (fig. 83).

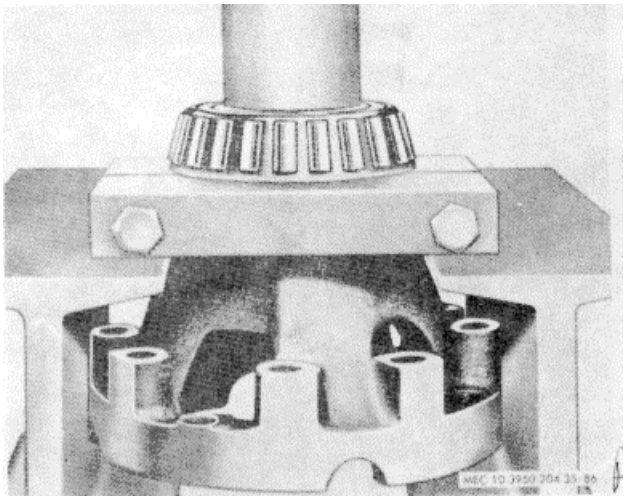


Figure 86. Pulling differential bearings..

n. Adjust differential Bearing Preload

(1) Using dial indicator at backface of gear, loosen bearing adjusting nut on side opposite gear only sufficient to notice end play on indicator.

(2) Tighten same adjusting nut only sufficient to obtain .000 end play.

(3) Check gear for runout. If runout exceeds .008 inch, remove differential and check for cause.

(4) Tighten adjusting nuts one notch each from .000 end play to preload differential bearings.

o. Check Hypoid Gear Backlash

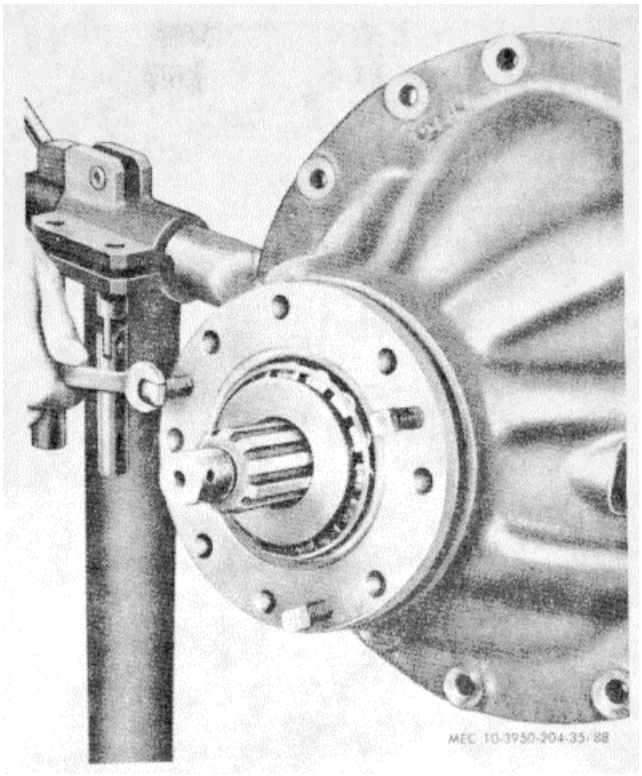


Figure 88. Removing bearing cage with puller screw.

(1) If drive gear is not going to be replaced, it is recommended the established backlash recorded before disassembly be used. For new gears backlash should be initially set at .010 inch. Adjust backlash by mov

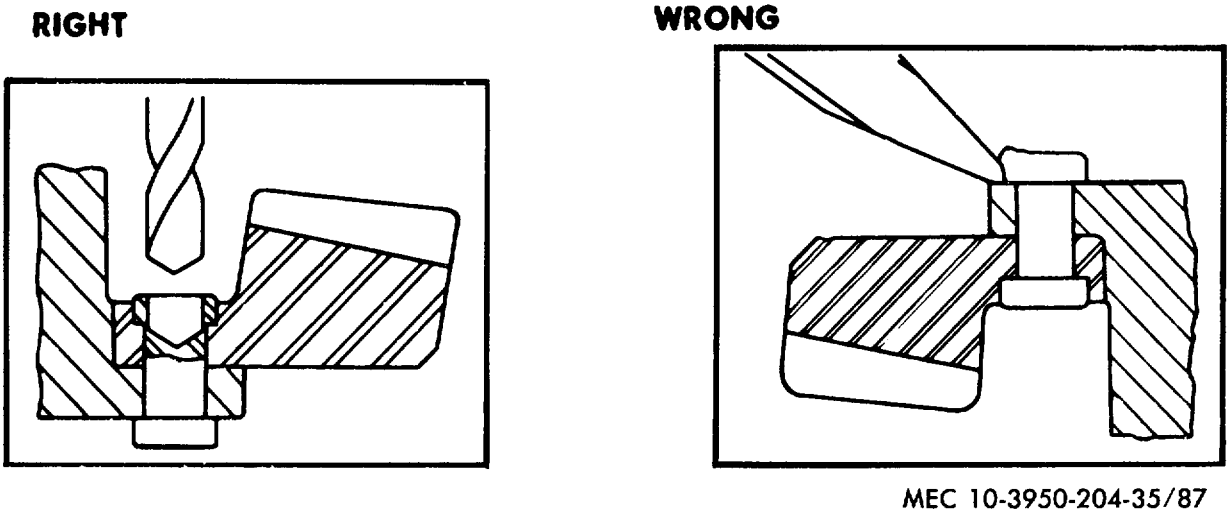


Figure 87. Removing gear rivets.

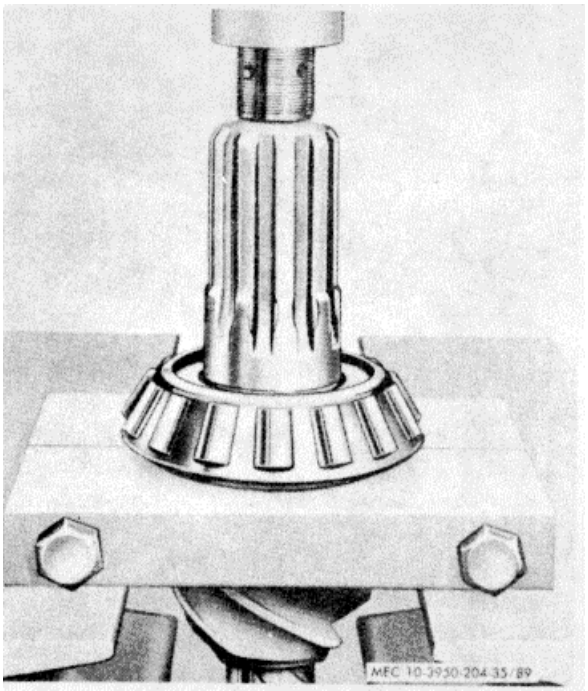


Figure 89. Replacing rear thrust bearing or radial bearing.

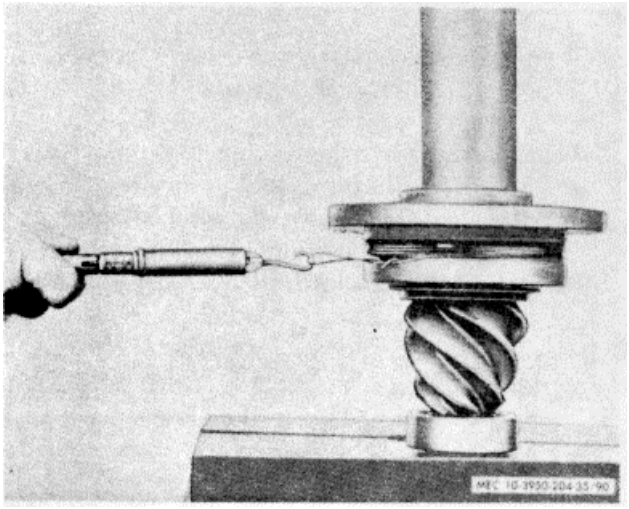


Figure 90. Checking bearing preload torque.

ing gear only. This is done by backing off one adjusting ring and advancing opposite ring the same amount (fig. 94).

(2) Apply oiled red lead lightly to hypoid gear teeth. When pinion is rotated, red lead is squeezed away by contact of the teeth, leaving bare areas the exact size, shape, and location of contacts (fig. 95).

(3) Sharper impressions may be obtained by applying a small amount of resistance to the gear with a flat steel bar and using a wrench to rotate pinion. When making adjustments, check drive side of gear teeth. Coast side should be automatically correct when drive side is correct. As a rule, coating about twelve teeth is sufficient for checking purposes.

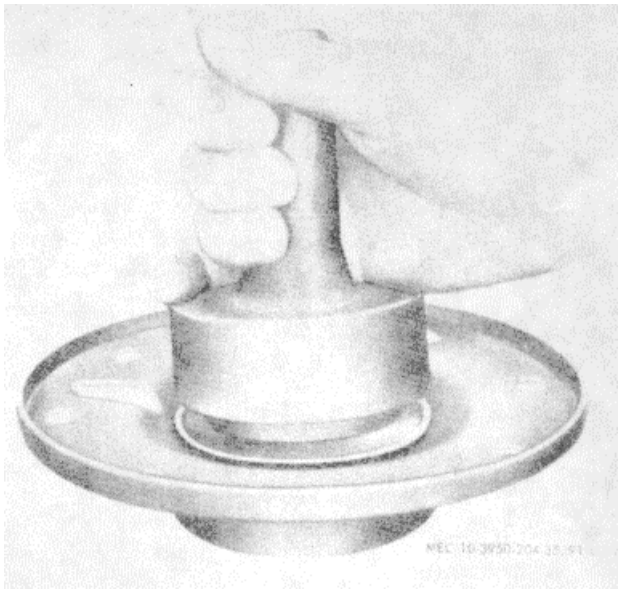


Figure 91. Pressing seal.

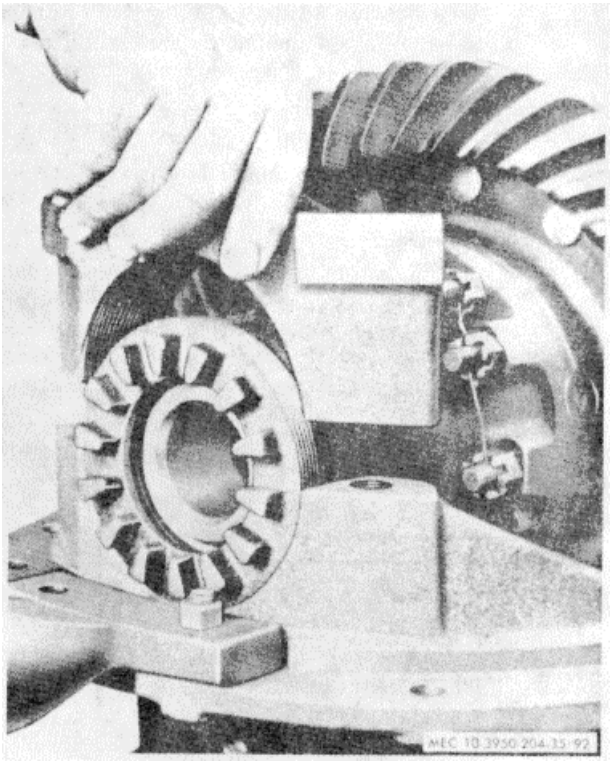


Figure 92. Bearing caps over assembled differential.

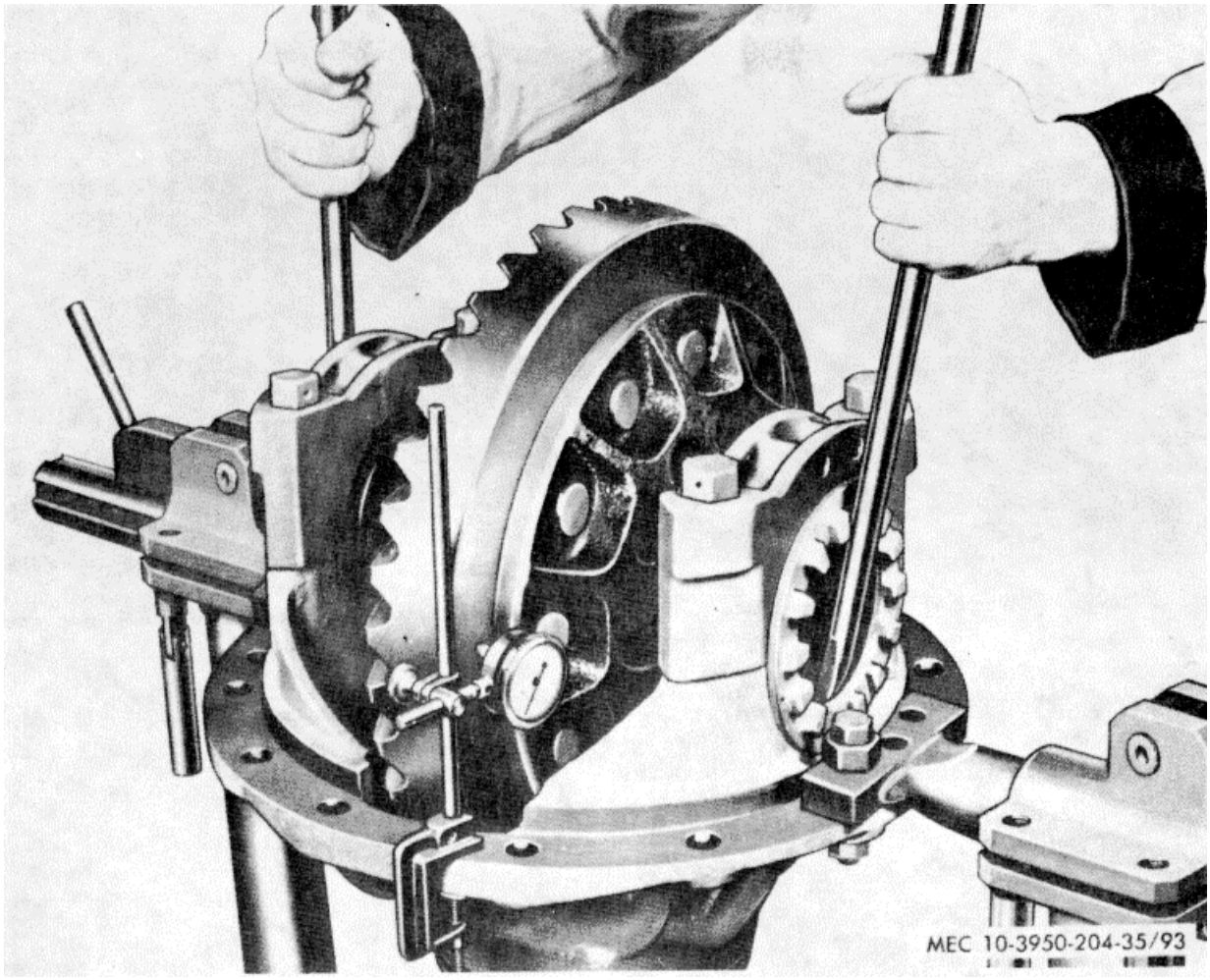


Figure 93. Adjusting differential bearing preload.

(4) After obtaining a satisfactory tooth contact, especially in relation to the top and bottom of the tooth, backlash can be altered within the limits of .005 inch--.015 inch to obtain a better contact position relative to the length of the tooth.

(5) A high backlash setting can be used to keep the contact from starting too close to the toe, and a low backlash setting can be used to keep the contact from starting too far away from the toe.

(6) After correct tooth contact has been established, install adjusting nut locks and capscrews. Tighten caps)crews and lock wire to bearing cap capscrews.

p. Correct Tooth Contact Assures Longer Gear Life.

(1) With adjustments properly made (pinion at correct depth and backlash set at .010 inch) the above contacts will be procured. The area of contact favors the toe and is centered between the top and bottom of the tooth.

(2) The hand rolled pattern (gears unloaded) will result in a pattern centered in the length of the tooth when the gears are under load. The loaded pattern will be almost full length and the top of pattern will approach the top of the gear tooth.

(3) The pattern on the coast side of teeth will appear the same width as the drive side, however, the over-all length will be centered between the toe and heel of gear tooth.

(4) Set used hypoid gear to have the tooth contacts to match wear patterns. Hand rolled patterns of used gears will be smaller

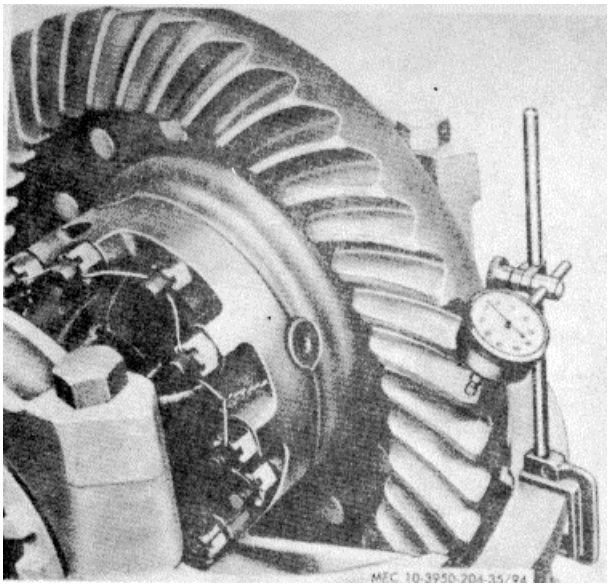


Figure 94. Checking hypoid gear backlash.

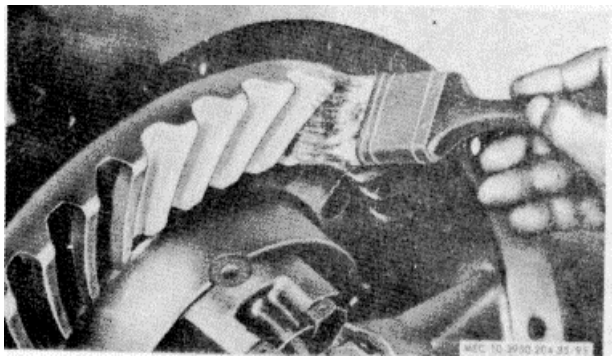


Figure 95. Checking tooth contact.

in area and should be at the toe end of wear patterns.

q. Incorrect Tooth Contact.

(1) A high contact indicates pinion is too far out. Set pinion to correct depth by removing shims under pinion cage. Slight outward movement of hypoid gear may be necessary to maintain correct backlash.

(2) A low contact indicates pinion is too deep. Set pinion to correct depth by adding shims under pinion cage. Slight inward movement of hypoid gear may be necessary to maintain correct backlash.

r. Install Thrust Block.

(1) Remove carrier from stand and position with back face of hypoid or spiral bevel gear upward.

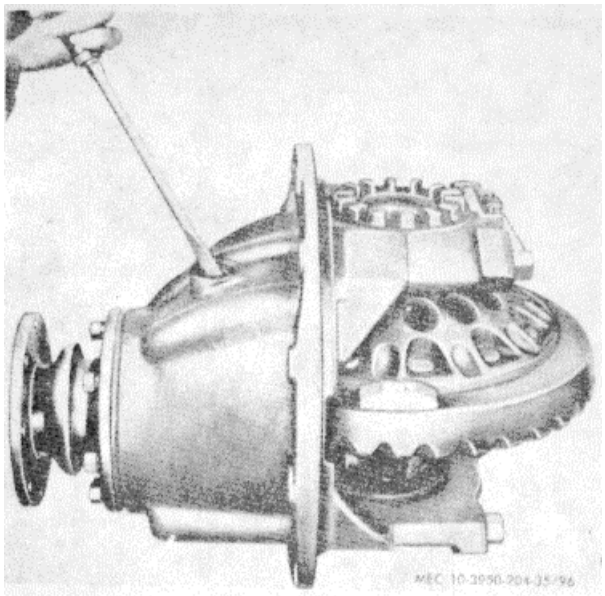


Figure 96. Aligning thrust block hole with adjusting screw hole.

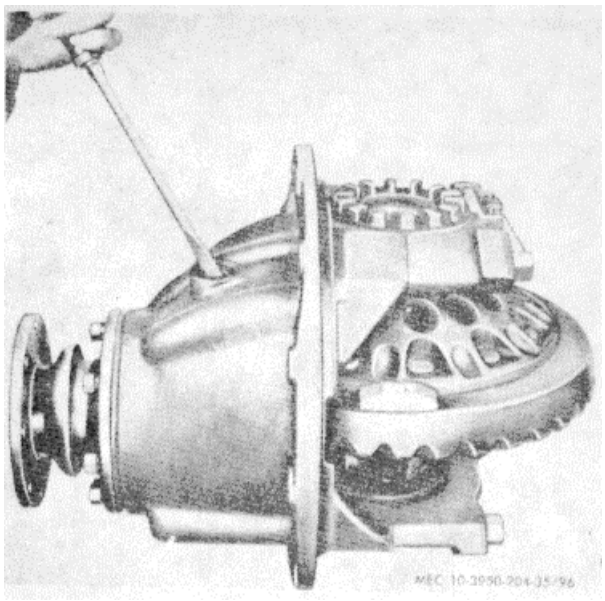


Figure 97. Installing adjusting screw and locknut.

(2) Remove adjusting screw and locknut (fig. 82).

(3) Place thrust block on rear face of hypoid gear and rotate gear until hole in thrust

block is aligned with adjusting screw hole (fig. 96).

(4) install adjusting screw and locknut and tighten adjusting screw sufficient to locate thrust [lock firmly against back face of hypoid gear (fig. 97).

(5) To secure correct adjustment of .010 inch .-..015 inch clearance, loosen adjusting screw 14 turn and lock securely with nut.

(6) Recheck to assure minimum clearance of .010 inch during rotation of bevel gear.

s. Clean and Inspect Housing, Assemble Drive Unit.

(1) Remove any accumulation of dirt, grit or gum from housing bowl and sleeves. Clean housing thoroughly with solvent and dry with compressed air.

(2) Inspect housing for cracks, loose studs, nicks, and burrs at machined surfaces. Remove nicks and burrs with stone or file. Make all necessary repairs or parts re placement before installing drive unit in housing.

(3) Install new drive unit to housing gasket over housing studs. Roll carrier into position on roller jack. Start carrier into housing with four flat washers and nuts equally spaced.

Note. **Do not drive carrier into housing with a hammer at the carrier stud flange. The flange may easily be distorted and cause severe oil leakage. Install lockwashers and stud nuts on any studs under carrier housing offsets. It is impossible to start these nuts after carrier is drawn into housing.**

(4) Tighten the four nuts over flat washers alternately to draw carrier squarely into axle housing.

(5) If necessary, remove nuts and flat washers and install taper dowels, lockwashers and stud nuts. Tighten to correct torque.

(6) Connect universal at pinion shaft.

(7) Install axle shafts.

Section VII. STEERING SYSTEM

41. General

The steering system consists of a hydraulic unit at the bottom of the steering column, controlled by the steering hand wheel. Hydraulic lines, from the steering unit to the hydraulic cylinder at the rear axle, actuate the cylinder to obtain desired direction. The steering unit has a built in manual control which reverts to emergency manual control automatically in the event of engine failure or power loss.

42. Steering Axle

a. Removal.

(1) Disconnect hydraulic hoses at steering cylinder (TM 10-395(204-20).

(2) Block drive wheels of crane and jack steering wheels clear of floor. Remove wheels.

(3) Remove eight bolts (17, fig. 98), lockwashers (21) and nuts (20) that secure pillow blocks (18) to crane frame. This allows complete rear axle to be removed from crane.

b. Disassembly.

(1) Remove setscrew (22, fig. 98) to remove pillow blocks (18) from axle pivot shaft. Remove pillow blocks (18) from axle.

(2) Remove grease fitting (23).

(3) Remove cotter pin (27), slotted nut (28) and pin (12) that secures rod end of steering cylinder (15) to spindle (11).

(4) Remove setscrew (19) and pin (39) that secures cylinder (15) to axle (24). Remove steering cylinder from axle.

(5) Remove grease fitting (23) from pin (39).

(6) Remove cotter pins (27), slotted nut, (28) and tie rod pins (12) that secures tie rod end to spindle.

(7) Remove roll pins (33) and pins (32). Remove tie rods from axle.

(8) Loosen jamnuts (35) that secure tie rod end (36) to tie rod (34); remove tie rod end (36) and nut (35). Disassemble other tie rod assembly in same manner.

(9) Remove grease fittings (23) from tie rod ends (36) and tie rods (34). Press out bushings (37 and 38) from tie rod ends and tie rods.

(10) Remove cotter pin (27) and nut (28). Remove grease fitting (23) from link pivot (31).

(11) Remove pin (16) that secures link pivot (31') to axle; remove link pivot. Press out bushing (30).

(12) Remove cotter pin (27) and nut (28). This allows pin (16) to be removed. The

spindle and complete hub may be removed at this time.

(13) Remove thrust washers (14 and 29).

(14) Remove three capscrews (1) and lockwashers (2) that secure dust cover (3) to hub (8). Remove dust cover and gasket (4).

(15) Remove cotter pin (25), slotted nut (5) and washer (6) that secures hub (8) to spindle (.11). Remove outer bearing (7), hub (8), inner bearing (9) and dust seal (10).

(16) Press out spindle bushing (13) and remove grease fitting (23).

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts of steering axle assembly; except bearings, in an approved cleaning solvent; dry thoroughly with compressed air.

(2) Clean bearings by placing them in a wire basket and agitating them in an approved cleaning solvent. Dry thoroughly with compressed air, taking care that air pressure does not spin dry bearings.

(3) Inspect all parts for cracks, breaks, distortion, or other damage; replace damaged parts.

(4) Inspect bearings for scoring or wear; replace damaged bearings.

(5) Inspect pins (12, 16, 32, and 39, fig. 98) for wear, scoring, or distortion; replace damaged pins.

(6) Inspect axle mounting blocks for cracks, distortion, worn pivot shafts, and damaged threads, replace damaged blocks.

(7) Clean grease fittings with a fine wire to dislodge any hardened grease accumulations.

d. Reassembly.

(1) Press spindle bushing (13) into spindle (11) and install grease fitting (23).

(2) Install onto spindle dust seal (10), inner bearing (9), hub (8), outer bearing (7), and washer (6); secure with slotted nut (5) and cotter pin (25).

(3) Position dust cover gasket (4) to hub (8) and secure with dust cover (3), lockwashers (2) and capscrews (1'.

(4) Install thrust washer (14) on pin (16) and secure spindle (11) to axle (24) with pin. Install thrust washer (29), slotted nut (28) and cotter pin (27).

(5) Press bushing (30) into link pivot (31). Install pin (16), nut (28) and cotter pin (27) that secures link pivot to axle.

(6) Install grease fitting (23).

(7) Press bushings (37 and 38) into tie rod ends (36) and tie rods (34).

(8) Install jam nuts (35) onto tie rods (34). Install grease fittings (23).

(9) Position tie rod assemblies in link pivot (31) and secure tie rods with pins (32) and roll pins (33).

(10) Position tie rod end assemblies in spindle (11) and secure with pins (12), slotted nuts (28) and cotter pins (27).

(11) Install grease fitting (23).

(12) Position steering cylinder (15) in axle (24) and secure with pin (39) and setscrew (19).

(13) Position steering cylinder rod end in spindle (11) and secure with pin (12), slotted nut (28) and cotter pin (27).

(14) Install grease fitting (23).

(15) Install pillow blocks (18) on axle pivot shaft and secure with set screw (22).

e. Installation.

(1) Raise steering axle assembly so that pillow blocks line up with holes in crane frame. Secure axle to frame by installing eight bolts (17, fig. 98), lockwashers (21) and nuts (20).

(2) Connect hydraulic hoses to steering cylinder (TM 10-3950-20420).

(3) Replace wheel assemblies.

f. Tie Rod Adjustment.

(1) Place steering wheels in straight ahead position. The steering wheels should track squarely with drive wheels with no toe-in or toe-out. If adjustment is necessary, adjust alignment of steering wheels by loosening locknuts (fig. 99) and turning tie rods until wheels are in alignment.

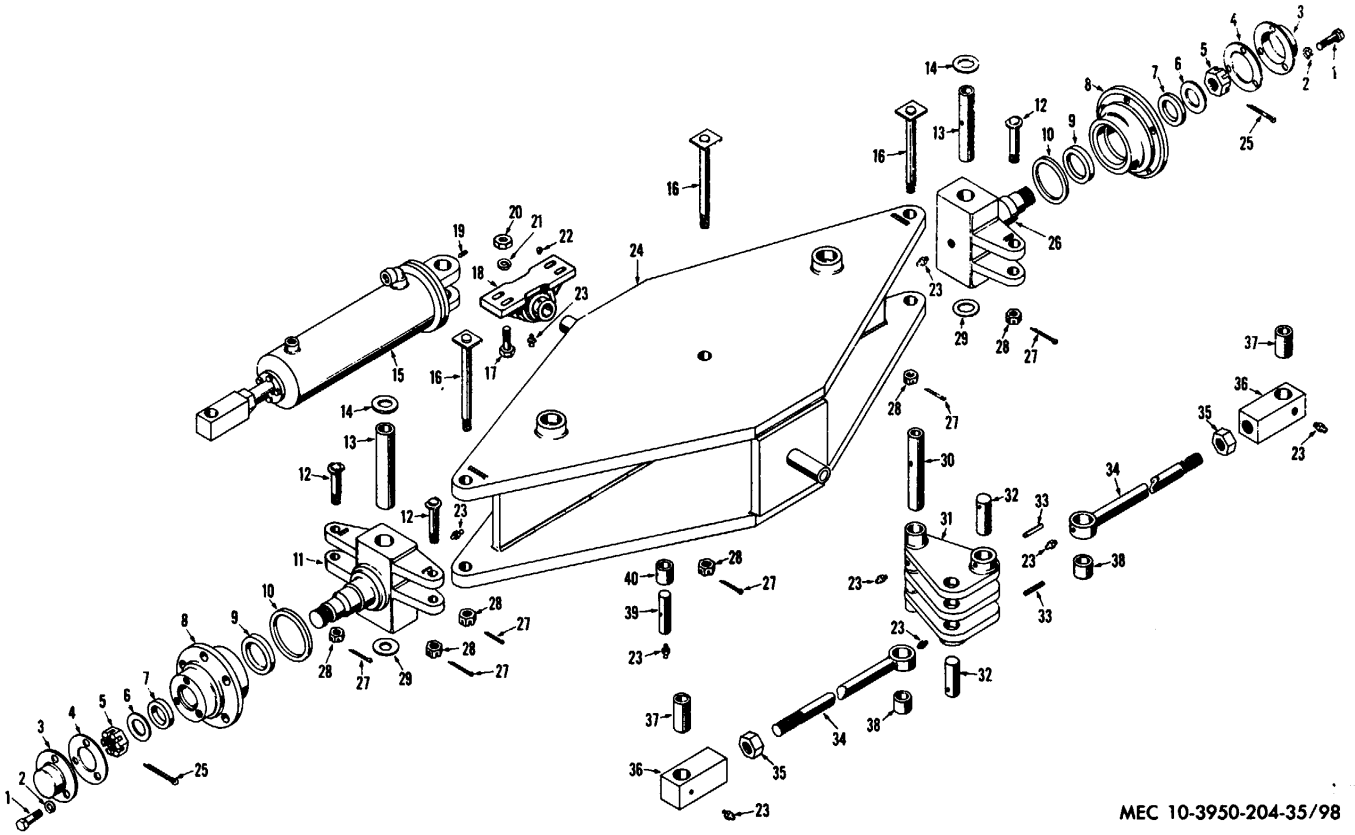
Note. **Tie rods should be adjusted the same length. Adjust both tie rods until wheels are in alignment; then tighten locknuts to secure adjustment.**

43. Steering Cylinder

a. Removal and Disassembly.

(1) Remove steering cylinder (para. 42b).

(2) Remove capscrews (12, fig. 100) and lockwashers (13) that secure cylinder end (10) to cylinder (9). Remove cylinder end. ,



1	Capscrew	11	Spindle	21	Lockwasher	31	Link pivot
2	Lockwasher	12	Pin	22	Setscrew	32	Pin
3	Dust cover	13	Bushing	23	Fitting	33	Roll pin
4	Gasket	14	Thrust washer	24	Axle	34	Tie rod
5	Slotted nut	15	Steering cylinder	25	Cotter pin	35	Jamnut
6	Washer	16	Pin	26	Spindle	36	Tie rod end
7	Outer bearing	17	Bolt	27	Cotter pin	37	Bushing
8	Hub	18	Pillow block	28	Slotted nut	38	Bushing
9	Inner bearing	19	Setscrew	29	Thrust washer	39	Pin
10	Duet seal	20	Nut	30	Bushing	40	Bushing

Figure 98. Steering axle, rear, exploded view.

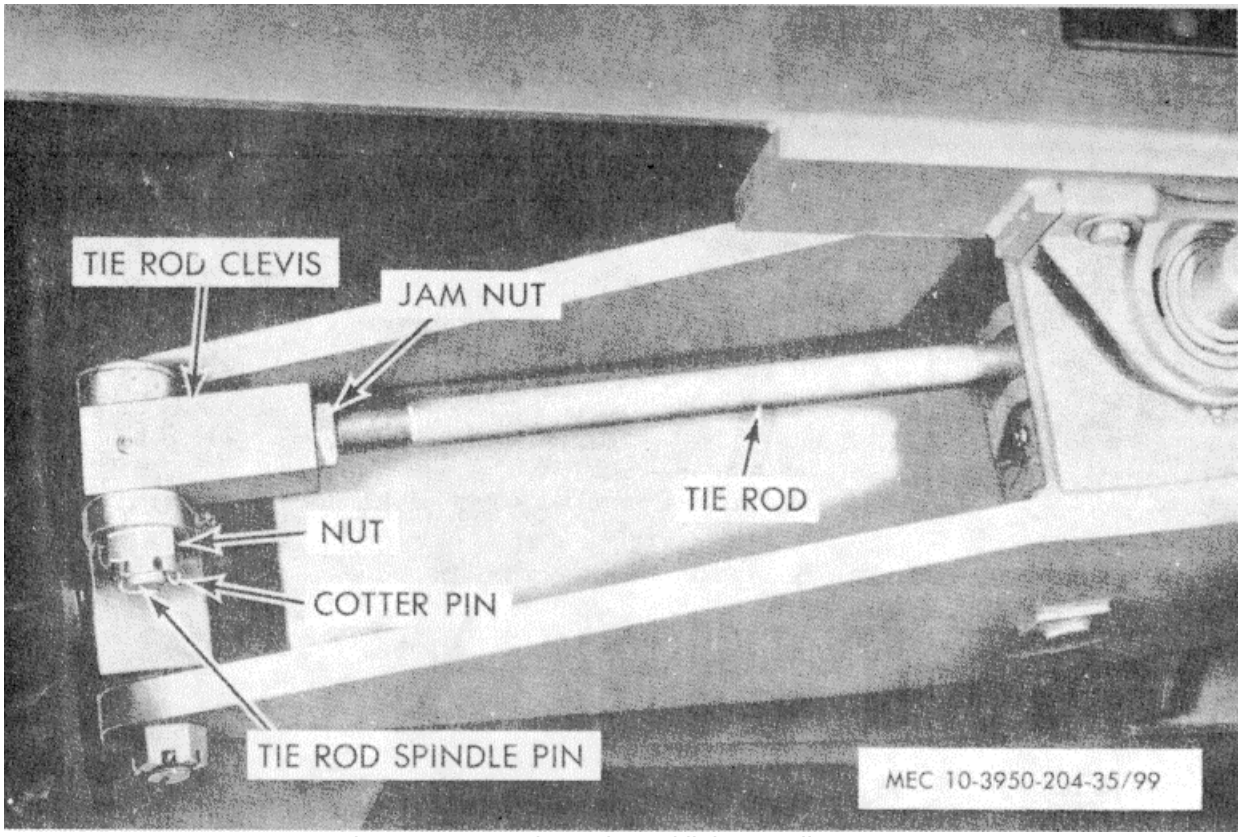


Figure 99. Steering axle and linkage adjustment.

(3) Remove O-ring (14) from cylinder end.
(4) Remove cotter pin (15) from slotted nut (16). Remove nut from piston rod (20).
(5) Remove piston assembly (17) from cylinder and remove piston O-rings (18 and 19).
(6) Loosen jamnut (2) and remove rod end (1) from piston rod (20). Remove jamnut and press out bushing (22) from rod end.
(7) Remove capscrews (3) and lockwasher (21) that secure cylinder head (5) to cylinder (9). Remove cylinder head assembly and piston rod.
(8) Remove from cylinder head the rod wiper (4). Press out bushing (6), and remove packing gland (7). Press out bushing (8).

b. Cleaning, Inspection, and Repair.

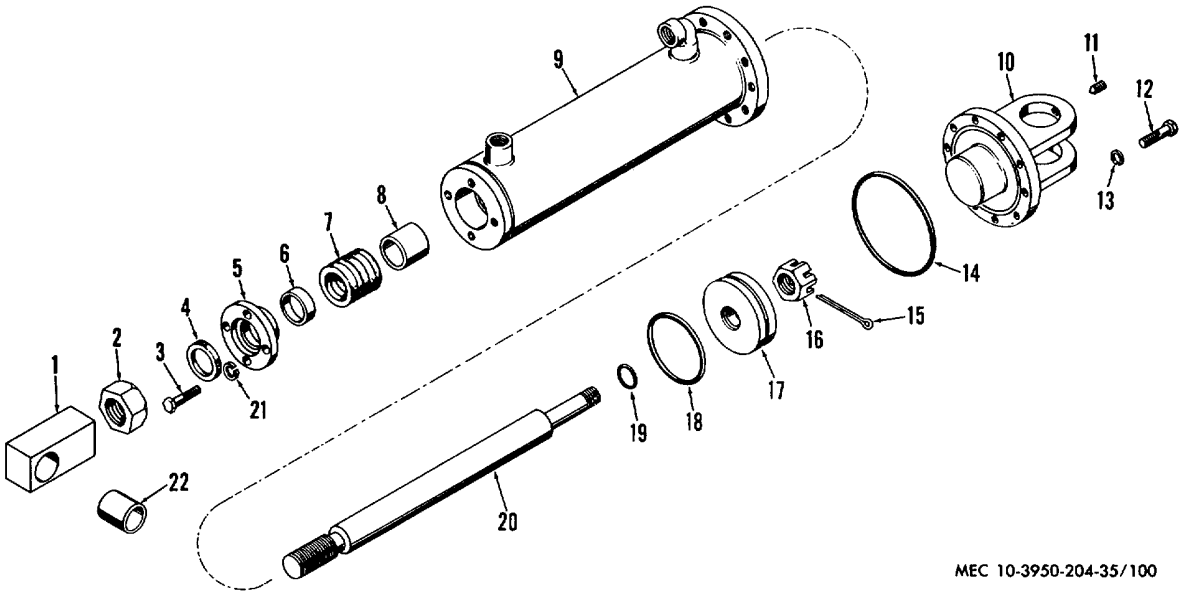
(1) Clean all metal p)arts thoroughly in an approved cleaning solvent. Dry thoroughly with compressed air.

Caution: **Do not allow dirt to get on disassembled parts after cleaning.**

(2) Check all metal parts for cracks, burs, rust, distortion, scores, or other damage. Remove burs with a fine stone. Replace damage parts.
(3) Replace all seals, wipers and other unserviceable parts.

c. Reassembly.

(1) Install O-rings (18, 19, fig. 100) onto piston (17). Position piston on piston rod (20) and secure piston to rod with slotted nut (16) and cotter pin (15).
(2) Install piston and rod into cylinder tube (9).
(3) Press bushing (8) into cylinder head (5), install packing (7) and press bushing (6) into head (5). Install rod wiper (4).
(4) Place cylinder head assembly onto piston rod. Secure head to cylinder tube (9) with capscrew (3) and lockwasher (21).
(5) Press bushing (221 into rod end (1).
(6) Install jamnut (2) onto rod (20) and turn rod end (1) into rod.
(7) Install O-ring (14) onto cylinder end (10)



1	Rod end	7	Packing	13	Lockwasher	19	O-ring
2	Jamnut	8	Bushing	14	O-ring	20	Rod
3	Capscrew	9	Cylinder tube	15	Cotter pin	21	Lockwasher
4	Rod wiper	10	Cylinder end	16	Slotted nut	22	Bushing
5	Cylinder head	11	Setscrew	17	Piston		
6	Bushing	12	Capscrew	18	O-ring		

Figure 100. Steering cylinder, exploded view.

and secure cylinder end to cylinder with capscrew (12) and lockwasher (13).

(8) Install steering cylinder into axle (TM 10-3950-204-20).

44. Steering Column with Wheel and Hydraulic Unit

a. Removal.

(1) Remove four capscrews and lockwashers that secure floor plate to frame; remove floor plate.

(2) Disconnect wire terminal (20, fig. 101) from connector (19).

(3) Disconnect hydraulic hoses from hydraulic unit (8, fig. 102).

(4) Remove two capscrews and lockwashers that secure steering column (16, fig. 101) and hydraulic steering unit to floor plate; remove steering column assembly from crane.

b. Disassembly

(1) Remove weather cover (1, fig. 101) from horn button (2). Twist horn button in order to release horn button (2) with base plate (6). Remove horn button (2), contact cup (3), spring (4), and contact cap (5).

(2) Remove three screws (24) that secure base plate in wheel hub (8). Remove capscrew (25) and base plate.

(3) Remove nut (7) that secures steering wheel (8) to column. Remove steering wheel.

(4) Separate steering column from hydraulic unit by removing two capscrews (23, fig. 101).

(5) Clamp unit in vise across mounting plate edges and remove seven cap screws (7 fig. 102).

(6) Grip entire assembly. Hold cap (6) and plate (3) together, lift off as a unit.

(7) Place clean wooden block across vise throat to support spool parts and clamp unit across port face with control end up. Remove and set aside four capscrews (23).

(8) Hold spool assembly down against block in vise and lift off mounting plate (21).

(9) Remove cap locator bushing (19).

(10) Remove spool-sleeve assembly (14) from the 14 hole end of housing. Be extremely

careful to prevent these parts from binding as they are very closely fitted and must generally be rotated slightly as they are withdrawn.

(11) Use a small bent tool or wire to remove valve seal plug (12) from housing.

(12) Place housing in vise, control end up, and unscrew check valve seat (11). Remove check valve seat, ball (10) and spring (9).

(13) In spool assembly, push cross pin (15) to loosen from spool sleeve assembly. Remove cross pin.

(14) Push inside lower edge of spool (17) so that spool moves towards splined end and remove carefully from sleeve (14).

(15) Push centering spring set (16) out of spring slot in spool.

c. Cleaning, Inspection and Repair.

(1) All parts should be rinsed carefully in clean solvent, even such exterior parts as all capscrews and all seals that appear to be reusable. It is good policy to replace all seals with new seals when unit is reassembled.

(2) Inspect all moving surfaces to insure that they have not been scored or abraded by dirt particles or otherwise disrupted. Smooth, burnished surfaces are normal in many areas. Slightly scored parts can be cleaned with 600 grit abrasive paper by hand rubbing only.

d. Reassembly.

(1) Place housing (8, fig. 102) with control end up.). Drop check valve spring (9) into check hole with large end down.

(2) Drop check ball (10) into check hole and insure that it rests on top of small end of spring (9) within hole. Place check valve seat (11) on hex wrench and screw into threads within check hole so that machined counter bore of check seat is towards ball.

(3) Tighten check seat to 150 inch pounded torque. Test check ball action by pushing ball with small clean pin against spring force. Ball need not be snug against seat for proper function.

(4) Install spool (17) within sleeve (14) carefully so that spring slots of both parts will be at same end. Rotate while sliding parts together. Test for free rotation.

(5) Bring spring slots of both parts in line and 82 stand parts on end of bench. Position 3 pairs of centering springs (16) on bench so that extended edge is down and arched center section is together. In this position, compress extended end of centering spring set (16)

(6) Install cross pin (15) through spool assembly.

(7) Position housing on a solid surface with port face down. Start spool assembly so that splined end of spool enters the 14 hole end of housing first. Be extremely careful that parts do not cock out of position while entering. Push parts gently into place with slight rotating motion. Bring spool assembly entirely within housing bore until parts are flush at the 14 hole end of housing. Do not pull spool assembly beyond this point to prevent cross pin (15) from dropping into discharge groove of housing. With spool assembly in this flush position, check for free rotation within housing by turning with light finger force at splined end.

(8) Hold parts in this flush position and rest the 14 hole end of assembly on protective block on vise throat and clamp lightly across port face with vise.

(9) Check condition of O-ring seal (13) on check plug (12) and replace if necessary. Install check plug in check hole with a steady pressure while rocking it slightly so that O-ring feeds in smoothly without cutting.

(10) Position cap locator bushing (19) with large OD chamfer UP partly into end of housing. Insure that it seats against spool assembly flat and smooth by rotating with finger tips.

(11) Check mounting plate (21) and shaft seal (20) carefully to insure that they are clean and in good condition. Insure that mounting plate seal grooves are clean and smooth. Each of these seals (20 and 22) is lightly larger than its seal groove so that they will be adequately retained in service. Push each gently into place and smooth down into seal groove with finger tip.

(12) Thin oil seal (22) at exterior of mounting plate (21) is a dirt exclusion seal and (’.,’ not generally need replacement. If this is

replaced it should be pressed into counterbore so that lip is directed away from unit.

(13) Place mounting plate subassembly (21) over spool shaft (17) and slide down into place over cap locator bushing (19) smoothly so that seals will not be disrupted in assembly. Align bolt holes with tapped holes. Be certain that mounting plate rests fairly flush against end of housing assembly so that cap locator bushing is not cocked and install four mounting plate cap screws (23). Tighten these evenly and gradually to a torque setting of 250 inch pounds.

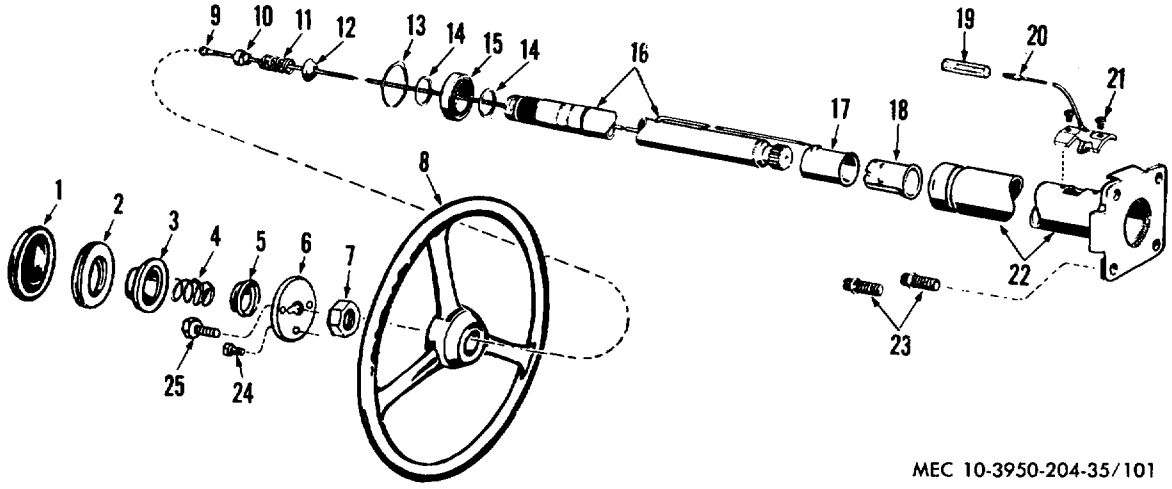
(14) Reposition in vise and clamp across edges of mounting plate (21). Check to insure that spool (17) and sleeve (14) are flush or slightly below the 14 hole surface of control housing.

(15) Place plate (3) over this assembly so that bolt holes in plate align with tapped holes in housing (8). Place meter gear ring (5) on assembly so that bolt holes align.

(16) Place splined end of drive (1) within meter gear star (4) so that slot at control end of drive is in alignment with valleys between meter gear teeth. Push splined end of drive through gear so that spline extends about one half its length beyond meter gear star (4) and hold it in this position while installing into unit. Note position or direction of cross pin (15) within unit. Enter meter gear star into meter gear ring (5) and wiggle parts slowly in position so that drive does not become disengaged from meter gear star. Hold plate (3) and meter gear ring (5) in position on assembly while star (4) is being installed. Rotate meter gearstar slightly to bring cross slot of drive into engagement with cross pin and splined end of drive will drop down against plate.

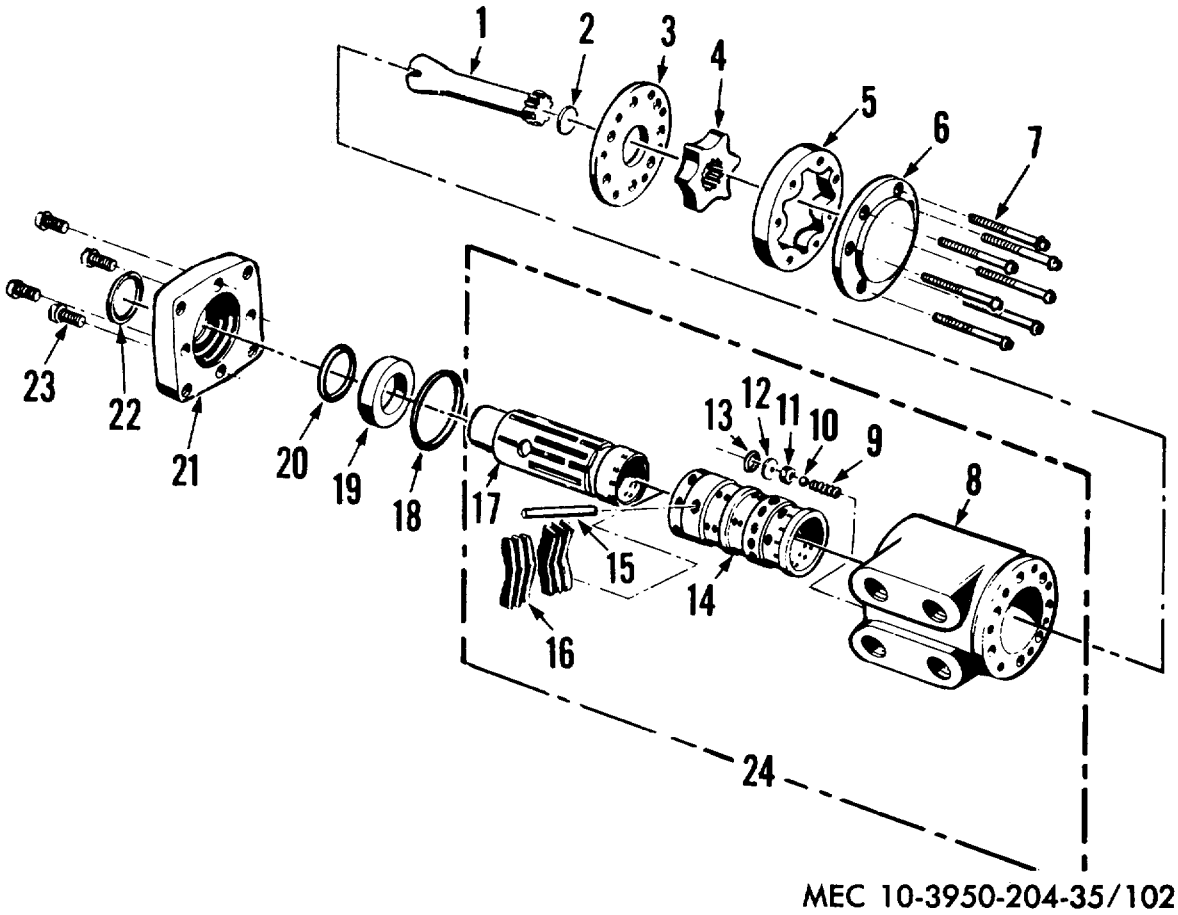
(17) Place spacer (2) in position within end of meter gear star. If spacer does not drop flush with gear surface, drive has not properly engaged cross pin. Recheck. Place meter end cap over assembly and install two capscrews (7) finger tight, to maintain alignment of parts. Install all seven cap screws (7) and bring them gradually and evenly to 150 inch pounds torque.

(18) Check condition of column assembly (16, fig. 101), clean it, and replace on unit with two cap screws (23) oriented as before. Rotate steering shaft while bringing sur-



1 Weather cover
2 Horn button
3 Contact cup
4 Spring
5 Contact cap
6 Base plate
7 Nut 13
8 Steering wheel
9 Terminal and wire
10 Insulator
11 Spring
12 Washer
Retaining ring
14 Snapring
15 Bearing
16 Steering shaft
17 Contact ring
18 Insulator
19 Connector
20 Terminal
21 Screw
22 Tube
23 Capscrew
24 Screw
25 capscrew

Figure 101. Steering column and wheel, exploded view.



1	Drive	7	Capscrew	13	O-ring seal	19	Cap locator bushing
2	Spacer	8	Housing	14	Sleeve	20	Seal
3	Plate	9	Spring	15	Centering pin	21	Mounting plate
4	Star gear	10	Ball	16	Spring	22	Oil seal
5	Gear ring	11	Check seat	17	Spool	23	Capscrew
6	End cap	12	Seal plug	18	O-ring seal	24	Control parts assembly

Figure 102. Hydraulic steering unit, exploded view.

faces into contact to allow splines to engage. If in doubt, follow orientation as shown. Tighten capscrews to 280 inch pounds torque. The unit is now ready to be returned to service.

(19) Position steering wheel (8, fig. 101) to the column and secure with nut (7).

(20) Install base plate (6) and capscrew (25) into wheel hub (8) and secure base plate with three screws (24).

(21) Seat weather cover (1) into horn button (2). Rest contact cup (3) and spring (4) together and insert button assembly (1 and 2).

(22) Place contact cap (5) on base plate (6) 84 and turn button assembly clockwise to engage base plate.

(23) Install steering column assembly in crane and secure assembly to floor plate with two capscrews and lockwashers.

(24) Connect hydraulic hoses to unit (8, fig. 102).

(25) Connect w ire terminal (20, fig. 101) to connector (19).

(26) Install floor plate to crane frame and secure with four capscrews and lockwashers.

45. Wheel and Tire

a. Disassembly.

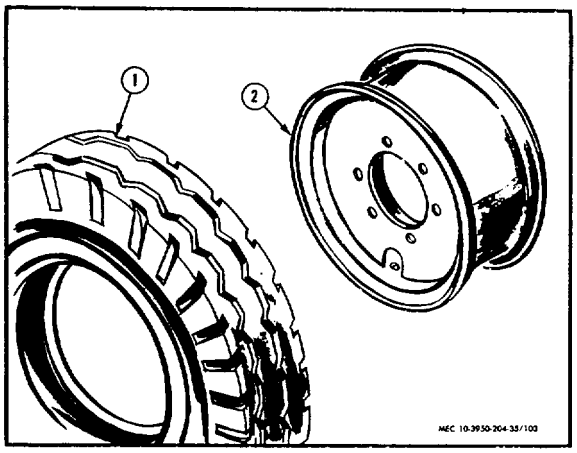
(1) Remove wheel and tire assembly (TM 103950-204-20).
(2) Remove valve core from valve stem to release air from tire tube.
(3) With valve stem opening down, drive curved end of tire tool between wheel (2, fig. 103) and tire bead; pry bead loose. Work around wheel repeating this operation.
(4) Pry curved end of tire tool between lock ring and wheel, work around wheel and remove lock ring.
(5) Turn tire (1) and wheel over. Drive curved end of tire tool between wheel and tire bead, pry bead loose. Work around wheel repeating this operation. Remove wheel from tire; remove tube from tire.

b. Cleaning, Inspection and Repair.

(1) Clean wheels with an approved cleaning solvent and dry with compressed air.
(2) Inspect wheels for cracks, breaks, and elongated mounting holes.
(3) Inspect tires and tubes for wear, cracks, and breaks.

c. Reassembly.

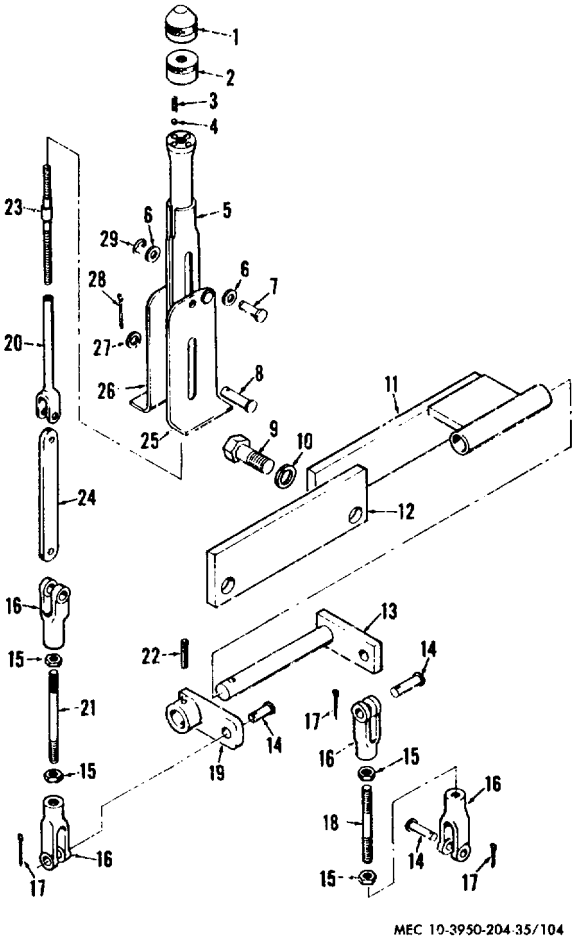
(1) Insert tube into tire. Align valve stem with wheel valve slot. Insert wheel (2, fig. 103) into tire (1).
(2) Place lock ring on wheel base. Once lock ring is started, walk ring into place.



1 Tire assembly 2 Wheel

Figure 103. Wheel and tire, exploded view.

(3) Insert valve core into valve stem. Inflate tire partially and check lock ring to insure it is seated properly. Inflate to recommended operating pressure.
(4) Install wheel and tire assembly (TM 103950-204-20).



1	Adjusting knob cap	16	Clevis
2	Spring and ball housing	17	Cotter pin
3	Spring	18	Rod
4	Ball	19	Lever
5	Lever body assembly	20	Adjustingtube assembly
6	Spring washer	21	Rod
7	Pin	22	Roll pin
8	Pin	23	Adjusting screw
9	Bolt	24	Link
10	Lockwasher	25	Mounting bracket
11	Lever	26	Mounting bracket
12	Support bracket	27	Flat washer
13	Lever	28	Cotter pin
14	Pin	29	Snapring
15	Nut		

Figure 104. Handbrake mechanism, exploded view.

46. Service Brakes

a. Disassembly.

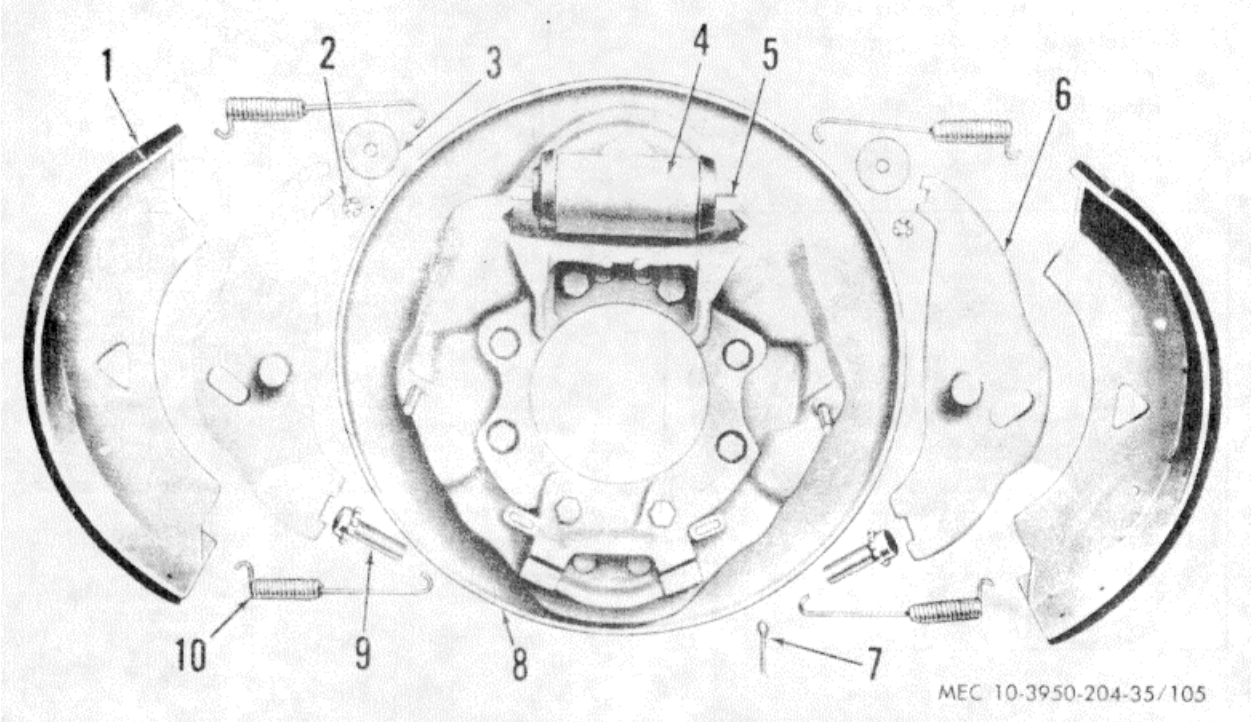
(1) Remove brake assemblies (TM 10-3950204-20).
(2) Remove cotter key (7, fig. 105) from guide bolts.
(3) Holding shoe (1) against brake backing plate (8) with one hand, remove guide bolt nut (2) and washer (3) with other hand.
(4) Allow springs (10) to rotate shoe abutment end until spring tension is released.
(5) Unhook return springs (10) from backing plate (8), adjustment bolt (9) and shoes (1). Remove springs, adjustment bolts, shoes and brake levers (6).
(6) Remove two capscrews and lockwashers that secure wheel cylinder (5, fig. 106) and backing plate (8, fig. 105); remove wheel cylinder.

b. Cleaning, Inspection and Repair.

(1) Wire-brush brake shoes. Remove oil or grease with an approved cleaning solvent.
(2) Clean all other parts of service brake in an approved cleaning solvent; dry thoroughly with compressed air.
(3) Inspect all metal parts of service brake for cracks, breaks, distortion, or other damage; replace damaged parts.
(4) Inspect brake lining for wear, scoring, distortion, or other damage; replace worn or damaged linings.
(5) Inspect brake drum for scoring, overheating, out-of-round, wear, or other damage; replace badly worn or scored brake drum. Turn down drum to repair other damage.
(6) Remove any glazed spots from brake lining by rubbing with a hard wire brush.

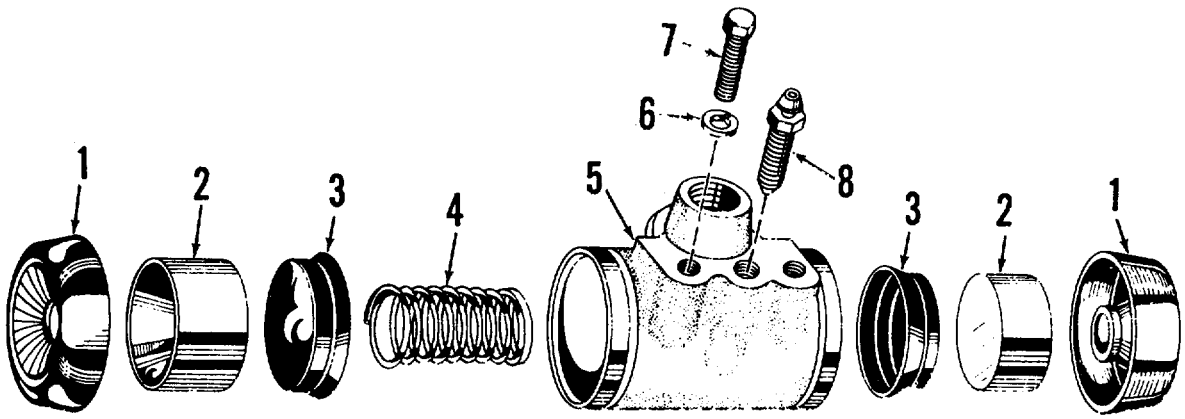
c. Reassembly.

(1) Install wheel cylinder (4, fig. 105) and secure to backing plate (8) with two capscrews and lockwashers.
(2) Install adjusting bolts (9) and turn in fully.
(3) Place lever (6) on guide bolts and posi-



1 Brake shoe and lining assembly
2 Nut
3 Washer
4 Wheel cylinder
5 Push rod
6 Lever
7 Cotter key
8 Backing plate
9 Adjusting bolt
10 Spring

Figure 105. Service brake assembly, exploded view.



1	Boot	3	Piston cup	5	Cylinder	7	Capscrew
2	Piston	4	Spring	6	Lockwasher	8	Bleeder valve

Figure 106. Brake cylinder, exploded view.

tion lever so that ends mate with pushrod at top and adjusting bolt (9) at bottom.

(4) Hook short ends of both springs (10) into brake shoe (1) *web holes.

(5) Hook long end of upper spring on hacking plate (8) and long end of lower spring in adjusting bolt (9) end. Lean abutment end of shoe web against spider abutment and adjusting bolts.

(6) With both hands rotate slide and liner assembly (1) over lever pressure bottom and guide bolt into position against lever (6).

(7) Hold shoe and liner assembly (1) against lever (6) with one hand and install washer (3) and nut (2) on guide bolt with the other.

(8) Tighten guide bolt nut (2) so that shoe and lever will have clearance of .015 inch.

(9) Lock guide bolt nuts with cotter key (7) and connect hydraulic lines.

(10) Bleed hydraulic system after ill brakes have been reassembled (TM 10-3950204--20).

(11) Install brake assemblies (TM 10.-3950204-20).

47. Brake Master Cylinder]

a. Disassembly.

(1) Remove brake master cylinder (TM 103950-204-20).

(2) Remove cotter pin (9, fig. 108) clevis pin (5) and clevis (4) from push rod (1. fig. 107).

(3) Slide hoot 12 off of housing (9).

(4) Using a small screwdriver. pry lockwire (3) and stop plate (4) from housing (9). Remove lockwire.

(5) Remove push rod (1), boot (2) and stop plate (4) from housing.

(6) Remove piston assembly (6) and primary cup (7) from piston assembly.

(7) Remove cap (11) and gasket (10) from filling opening in housing (9).

(8) Remove cylinder head (13), gasket (12) and pipe plug (14).

b. Cleaning, Inspection and Repair.

(1) Discard piston, cup, and boot.

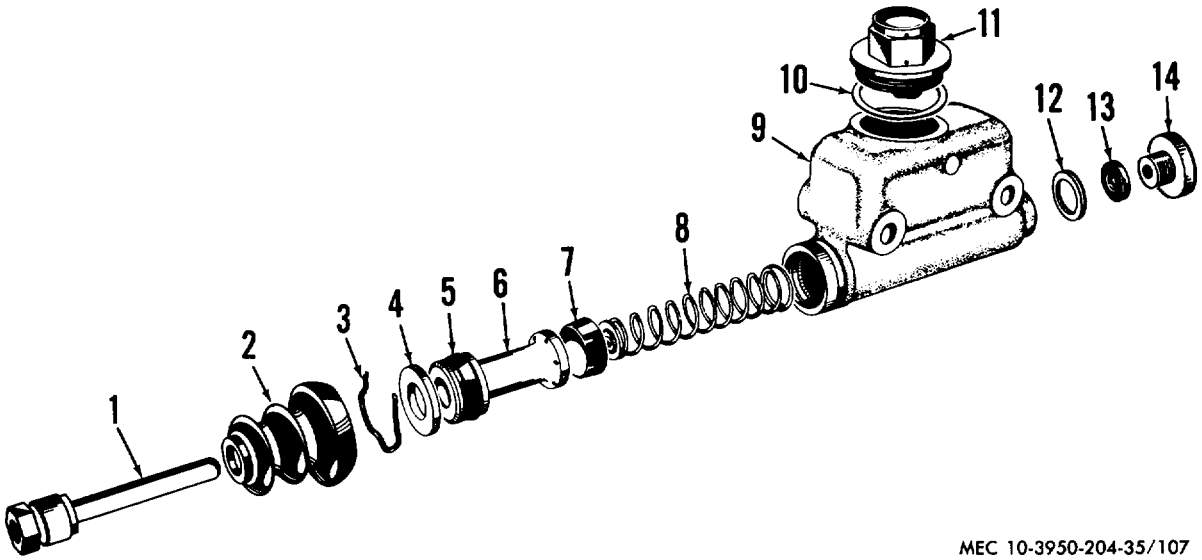
(2) Clean all other metal parts of brake master cylinder in an approved cleaning solvent: dry thoroughly with compressed air.

(3) Inspect housing for cracks, distortion, and damaged threads. Check bore of housing for pitting or scoring. Replace if damaged.

(4) Inspect piston for cracks, wear, or scoring; replace if damaged.

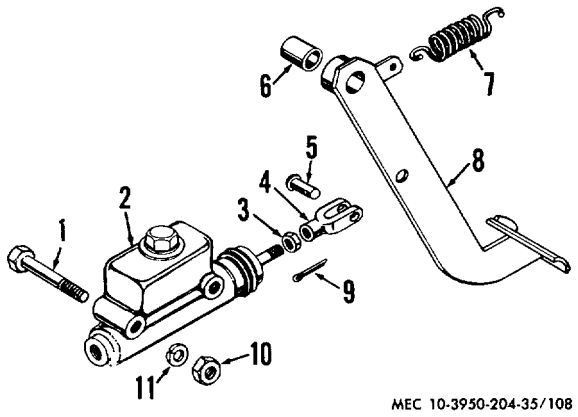
c. Reassembly.

(1) Install gasket (12, fig. 107), cylinder head (13) and pipe plug (14) into housing (9).



1	Push rod	5	Secondary cup	9	Housing	13	Cylinder head
2	Boot	6	Piston	10	Gasket	14	Plug
3	Lockwire	7	Primary cup	11	Cap		
4	Stop plate	8	Spring	12	Gasket		

Figure 107. Brake master cylinder, exploded view.



1	Capscrew	4	Clevis	7	Spring	10	Nut
2	Master cylinder	5	Pin	8	Pedal	11	Lockwasher
3	Nut	6	Bushing	9	Cotter pin		

Figure 108. Brake pedal, exploded view.

(2) Install cap (11) and gasket (10) into filling opening in housing.
(3) Place secondary cup (5) and primary cup (7) on piston assembly(6).
(4) Position spring (8) and piston assembly in housing (9!. Place push rod (1), boot 88
(2) and stop plate (4) into housing and secure with lockwire (3).
(5) Slide boot (2) onto housing.
(6) Turn clevis (4, fig. 108) onto push rod and secure clevis to brake pedal (8) with pin (5) and cotter pin (9).

(7) Install and adjust brake linkage (TM 103950-204-20).

48. Wheel Cylinder

a. Removal and Disassembly.

(1) Remove brake assemblies (TM 10-3950204-20).

(2) Disconnect springs (10, fig. 105) from brake shoes (1); spread brake shoes apart so that wheel cylinder is clear. Remove two capscrews and lockwashers that secure wheel cylinder (4) to backing plate (8); remove wheel cylinder.

(3) Pull boots (1, fig. 106) from cylinder (5) and push pistons (2), piston cups (3), and spring (4) out of cylinder. Turn bleeder screw (8) out of cylinder.

b. Cleaning, Inspection and Repair.

(1) Discard boots and pistons.

(2) Clean all parts of wheel cylinder with hydraulic brake fluid; dry thoroughly.

(3) Inspect cylinder for scoring, pits, burs, or wear by holding cylinder up to a strong light and looking through it; replace cylinder if damaged.

(4) Inspect all other parts of wheel cylinder for cracks, breaks, distortion, burs, scoring, or other damage; replace damaged parts.

(5) Remove any cleaning residue with crocus cloth or jeweler's rouge.

(6) Check for proper clearance between piston and cylinder by sliding piston into cylinder and checking with a wire feeler gauge. Replace cylinder and piston if clearance is greater than 0.005 inch.

c. Reassembly and Installation.

(1) Insert spring (4, fig. 106), two piston cups (3), and pistons (2) into cylinder (5). Position boots (1) on cylinder and pistons.

(2) Place assembled cylinder on backing plate (8, fig. 105); secure with two capscrews (7, fig. 106) and lockwashers (6).

(3) Insert bleeder screw (8) into cylinder.

49. Brake Pedal and Linkage

a. Removal.

(1) Remove cotter pin (9, fig. 108) and clevis pin (5) that secure brake master cylinder push rod clevis (4) to brake pedal (8).

(2) Remove spring (7) from brake pedal (8).

(3) Using a drift pin, drive pin out of pedal bushing (6).

(4) Remove pedal from crane, and press bushing (6) from brake pedal.

b. Cleaning and Inspection.

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

(2) Inspect all parts of brake pedal for cracks, breaks, distortion, or other damage; replace damaged parts.

c. Installation.

(1) Position brake pedal (8, fig. 108) into bracket provided; drive pin into bracket and pedal to secure them together.

(2) Attach clevis (4) on brake master cylinder push rod to pedal; secure with clevis pin (5) and cotter pin (9). Connect spring (7) to bracket provided on pedal.

50. Hydrovac

a. Removal.

(1) Remove capscrew and lockwasher that secures air cleaner (1, fig. 110) to frame (fig. 111).

(2) Remove tube nut (15, fig. 110) from bolt type fitting (14).

(3) Remove tube nut (8) from adapter (6).

(4) Disconnect stop light wires from stop light switch (10).

(5) Loosen clamp (2) and remove hose (9) from hose adapter (7).

(6) Remove nut that secures bolt cylinder hook to bracket (fig. 111).

(7) Remove two capscrews and lockwashers that secure hydrovac bracket to frame (fig. 111). Remove hydrovac.

b. Disassembly.

(1) Loosen clamp (2, fig. 110) and remove air cleaner (1) from hose (3). Loosen clamp (2) and remove hose (3) from tube and cover (2, fig. 109).

(2) Remove stop light switch (10, fig. 110) from adapter (12), and remove adapter (12), brass washer (13) and bolt type fitting (14) from cap end (60, fig. 109).

(3) Remove adapter (6, fig. 110) and washer (5) from end plate (62, fig. 109). Remove hose adapter (7, fig. 110) from end plate.

(4) Remove nut and lockwasher (fig. 111) that secures bracket to hydrovac.

(5) Loosen wire hose clamp (22, fig. 109) and

remove hose (23) from elbow and tube (10).

(6) Remove four nuts (28, fig. 109) and lockwashers (27) that secure bolt hook (26) to hydrovac; remove bolt hooks.

(7) Separate unit.

(8) Remove snapring (1) from valve body (9) and remove tube and cover (2), gasket (3) and spring (4).

(9) Remove nut (5) and washer (6) that secures valve (7) and valve (8) to vacuum poppet and shaft (13).

(10) Remove five self tapping screws (68) that secure body (9) to end plate (62); remove. body, valve seat spring (12) and vacuum poppet and shaft (13).

(11) Remove diaphragm (14) and gasket (15).

(12) Remove retainer ring (16) that secures stop washer (17) in fitting (18).

(13) Remove fitting (18), seal (19) cups (20) and piston (21).

(14) Remove end cap (60) from tube (54). Remove residual check valve (59), spring (58), washer (57), snapring (56) and gasket (55).

(15) Loosen nut (53) and remove tube (54) from end plate (62).

(16) Remove seals (37 and' 52) and snapring (38) that secure retainer (51), spring (39), ball (50) and cup (40). Remove items (40, 50, 39 and 51).

(17) Remove gasket (63) and spring (65).

(18) Remove pin (48) and piston (49) from push rod (66).

(19) Remove snapring (41), washer (47), spring (42), retainer sleeve (46), seal (43), cup (45) and washer (44) from push rod.

(20) Remove push rod nut (29) that secures (items 30-36, and 67); remove these items.

c. Cleaning, Inspection and Repair.

(1) Discard all seals and preformed packings; replace with new parts.

(2) Clean all metal parts in an approved cleaning solvent; dry thoroughly with compressed air.

(3) Inspect retainers and springs for distortion, cracks, breaks or other damage; if parts are damaged replace with new ones.

(4) Inspect diaphragm for cracks, distortion or other damage; replace with new ones.

d. Reassembly.

(1) Install washer (67), plate (36), seal (35), packing (34), plate (33), wick (32), ring (31), and plate (30) on push rod (66). g Secure with nut (29).

(2) Install washer (44), cup (45), seal (43), retainer sleeve (46), spring (42), washer (47) and secure these items on push rod (66) with snapring (41).

(3) Install piston (49) on push rod and secure with pin (48).

(4) Install cup (40), ball (50), spring (39), and retainer (51); secure to end plate (62) with snapring (38).

(5) Install seals (37 and 52). Turn nut (53) on to tube (54) and turn tube into end plate.

(6) Position spring (65) and gasket (63) over push rod. Secure end plate (62) to shell (24) with bolt hook (26), lockwasher (27) and nut (28).

(7) Install residual check valve (59) in end cap (60). Install spring (58), washer (57) and secure with snapring (56). Place gasket (55) to end cap and turn onto tube (54).

(8) Install cup (20), piston (21), cup (20) in end plate; secure with fitting (18).

(9) Install stop washer (17) and secure with retainer ring (16).

(10) Position gasket (15), diaphragm (14) against end plate. Place spring (12) and vacuum poppet and shaft (13) in body (9); secure body assembly to end plate with five self tapping screws (68).

(11) Place valves (8 and 7) on vacuum poppet shaft (13) and secure with washer (6) and nut (5).

(12) Position spring (4) and gasket (3) in body (9), put tube and cover (2) against gasket and secure with snapring (1).

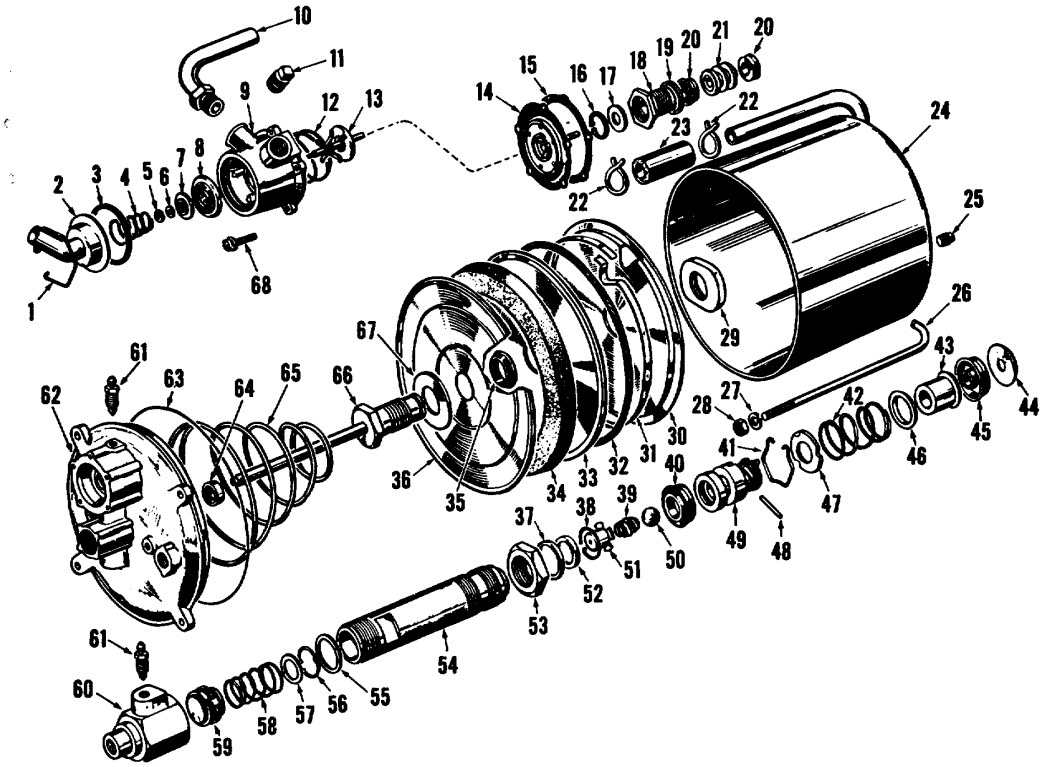
(13) Open wire clamp (22) and slide hose (23) over tube (2). Close clamp over hose and tube.

(14) Place bracket against shell (24) and secure with nut and lockwasher (fig. 111).

(15) Install adapter (6, fig. 110) and washer (5) to end plate; install tube nut (8) into adapter.

(16) Install bolt type fitting (14), brass washer (13), adapter (12), and stop light switch to end cap (60, fig. 109).

(17) Connect wires to switch.



1	Snapring	17	Washer	34	Packing	51	Retainer
2	Tube and cover	18	Fitting	35	Seal	52	Seal
3	Gasket	19	Seal	36	Plate	53	Nut
4	Spring	20	Cup	37	Seal	54	Tube
5	Nut	21	Piston	38	Snapring	55	Gasket
6	Washer	22	Wire clamp	39	Spring	56	Snapring
7	Valve	23	Hose	40	Cup	57	Washer
8	Valve	24	Shell	41	Snapring	58	Spring
9	Body	25	Plug	42	Spring	59	Valve
10	Elbow and tube	26	Bolt hook	43	Retainer seal	60	End cap
11	Plug	27	Lockwasher	44	Washer	61	Bleeder valve
12	Spring	28	Nut	45	Cup	62	End plate
13	Vacuum poppet and shaft	29	Nut	46	Retainer sleeve	63	Gasket
14	Diaphragm	30	Retainer plate	47	Washer	64	Seal
15	Gasket	31	Ring	48	Pin	65	Spring
16	Retainer plug	32	Piston wick	49	Piston	66	Push rod
		33	Plate	50	Ball	67	Washer
						68	Screw

Figure 109. Hydrovac, exploded view.

(18) Install tube (11, fig. 110) and tube nut (15) into bolt type fitting (14).

(19) Install hose adapter (7) into end plate and secure hose (9) to hose adapter (7) with clamp (2).

(20) Connect hose (3) to tube (2, fig. 109) and secure with clamp (2, fig. 110).

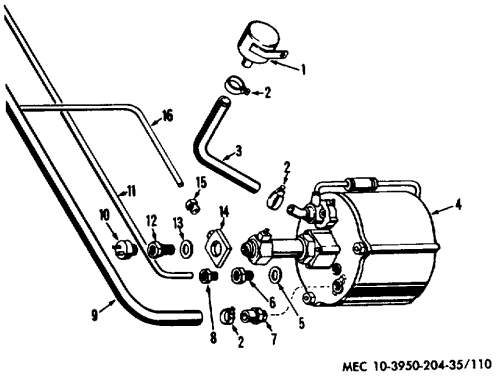
e. Installation.

(1) Secure hydrovac frame with two capscrews and lockwashers (fig. 111).

(2) Place both bolt hooks (26, fig. 109) into slots in bracket on frame. Secure bolt hooks to bracket with nuts (fig. 111).

(3) Secure air cleaner (1, fig. 110) to frame with capscrew and lockwasher .(fig. 111).

(4) Connect hose (3, fig. 110) to air cleaner (1) and secure with clamp (2).



1	Air cleaner	9	Hose
2	Clamp	10	Stop light switch
3	Hose	11	Tube
4	Hydrovac	12	Adapter
5	Washer	13	Washer
6	Adapter	14	Bolt type fitting
7	Hose adapter	15	Tube nut
8	Tube nut	16	Tube

Figure 110. Hydrovac with fittings, exploded view.

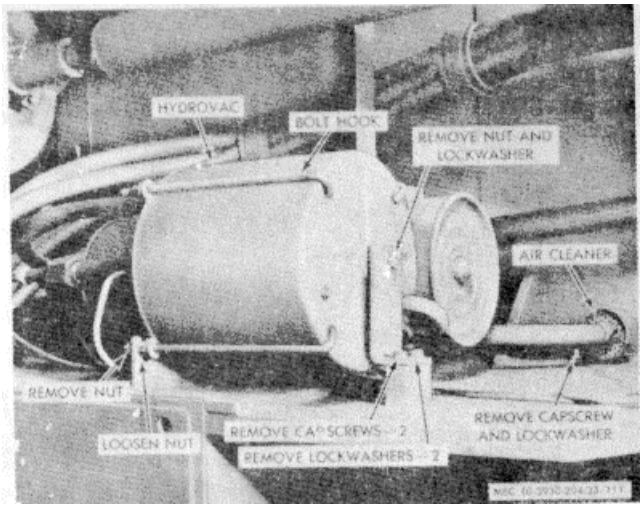


Figure 111. Hydrovac removal.

Section IX. WINCH

51. Winch

a. General. The following service instructions have been arranged to provide the best methods for assembly and disassembly of the Gearmatic Model 11 Winch. It is suggested that before any work is done on this unit, all the steps for disassembly and assembly should be read and understood. Expendable parts such as oil seals, backup washers, O-rings, and pocket seals should never be reused even though inspection may show these items as being serviceable for future use. The cost of these items is negligible compared to the labor involved in replacing such items if they do not function properly. All replacement parts should be given your final inspection to insure that no damage has resulted after the final factory inspection was made. Cleanliness is of prime importance when any part of this winch is to be assembled or disassembled. Before commencing disassembly be sure that a clean work area with a dust and grit free work bench is available.

b. Removal.

(1) Clean all dust and dirt away from motor ports and vent port and disconnect the three hydraulic hoses.

(2) Drain oil from primary housing (2, fig. 113) by removing one capscrew (21) with its seal washer (20) from lowest point of spring cover (19). Remove one pipe plug " (1) from top of housing (2) to allow air to enter housing.

(3) Remove winch assembly from winch mounting bracket by removing four capscrews, lockwashers and nuts.

c. Disassembly.

(1) Removal of final drive assembly.

(a) Remove snap ring (2, fig. 117).

(b) Remove end cover (4) using a heel bar under lug provided below filler plug boss. Remove and discard O-ring (3) from end cover (4).

(c) Remove thrust plate (5) from final planet assembly.

(d) Remove final planet assembly (6). Using two pinch bars under rim of planet hub and against end of final housing (11), pull final planet assembly (6) off splined end of drum. Care must be taken not to damage pilot bore in final housing (11) that carries end cover (4).

(e) Remove sun gear shaft (7) and remove and discard O-ring (9) from sun gear shaft (7).

(f) Remove the six nuts (19, fig. 112) and washers (18) from final drive end of winch.

(*g*) Using two ½ inch N.F. x 2 inch capscrews as jacks in the two tapped holes provided in flange of final housing, pull housing off dowel bolts (17).

(2) Removal of primary drive assembly.

(a) Mark location of spring cover (19, fig. 113) with respect to housing (2) and location of spring cover (19) with respect to motor assembly (14). This will insure that motor ports and vent port are located correctly on reassembly.

(b) Remove spring cover (19, fig. 113) using the following procedure. Remove remaining capscrews (21) with washers (20) by slackening each capscrew half a turn at a time, progressively around in a clockwise or counterclockwise direction. Care must be used to insure that spring cover (22) is removed evenly as it carries full spring load for brake. When all spring load has been removed from spring cover it can be withdrawn from winch.

(c) Remove O-ring (17) from spring cover (19) and discard.

(d) In most cases there will be a spring (18) in every hole, but in certain applications fewer springs are required and it is important that they be located symmetrically when they are replaced. Note and mark any hole that does not contain a spring and then remove all springs.

(e) Remove and discard O-ring (15) from motor assembly (14).

(f) Remove snapring (16) and motor assembly (14).

(*g*) Remove snapring (10, fig. 113) and remove brake hub assembly (12) from primary planet assembly (8).

(*h*) Remove brake ring (22) and brake plate (9).

(i) Remove primary planet assembly (8), O-ring (7), oil seal (6), seal ring (5), and snapring (4) from primary housing (2).

***Note*: Do not remove this assembly as a unit as damage may be caused to the tapered seal diameter of primary planet hub (1, fig. 114).**

(j) Once primary drive assembly has been disassembled, remove hex nuts (19, fig. 112) and washers (18).

(*k*) Remove drum (7). Support drum under center of barrel and drive it off primary housing by tapping inside face of drum flange opposite to primary housing.

(3) Inspection of parts for final drive assembly.

(*a*) Discard O-rings (3 and 9, fig. 117).

(*b*) Wash all parts in a suitable solvent and dry thoroughly with compressed air or clean cloths.

***Warning:* Do not dry final planet assembly (6) with compressed air as this may drive particles of dirt into needle bearings which carry the planet gears.**

(*c*) Check snap rings (2) and (10) for flatness and that they form a true circle; if they are bent or damaged replace with new parts.

(d) Check for wear at center of thrust plate (5). The original thickness at center of thrust plate was .500 inch, if wear is greater that $^{3}/_{32}$ inch replace thrust plate.

(e) Check that planet gears run freely in final planet assembly (6). For disassembly instructions and inspection of parts in final planet assembly (6) see page 315.

(f) Inspect gear teeth in final housing (11). If wear is greater than .015 inch when compared to unworn part of teeth, replace final housing. Check large pilot bore at end of final housing used to carry end cover (4). Remove all roughness and scores carefully using a scraper and extra fine emery cloth so that O-ring (3) will seal on this diameter.

(*g*) Inspect sun gear shaft (7). Check gear teeth for wear by comparing tooth thickness at worn area of teeth with the tooth thickness at unworn end. If the wear is greater than .012 inch replace sun gear shaft.

(*h*) Inspect taper seal ring (8), if tapered diameter has any roughness or scratches remove taper seal ring from shaft by using a punch between gear teeth to drive ring off shaft. Replace with new taper seal ring.

Note. **If any one of the gears in this assembly requires to be replaced because of tooth wear all gears in assembly should be replaced.**

(4) Inspection of parts for primary drive assembly.

(a) Discard all O-rings.

(b) Wash all parts in a suitable solvent and dry thoroughly with compressed air or clean cloths.

Warning: **Do not dry primary planet assembly (8, fig. 113) with compressed air as this may drive particles of dirt into needle bearings which carry the planet gears.**

(*c*) Inspect bore in spring cover (19) for scores or bruises. If possible, smooth out scores or bruises with a scraper and extra fine emery cloth in order that O-ring (15) will seal effectively.

(d) Check snap ring (16) for flatness and that it forms a true circle, if bent or damaged replace.

(e) If motor requires inspection see disassembly instructions for motor assembly (12) below.

(f) Check that primary gears run freely in primary planet assembly (8). For disassembly and inspection instructions of parts in primary planet assembly see (9) below.

(g) Inspect teeth in brake ring (22). Replace if wear is excessive.

(h) Inspect friction surfaces of brake plate (9), if wear has removed the grooves, replace plate.

(i) Check seal ring (5) on countersunk seal face. If any marks or imperfections exist, remove if possible by polishing with extra fine emery cloth. Replace seal ring if all marks cannot be removed.

(5) Disassembly of bearings and seals, etc. from drum.

(a) Remove bearing (14, fig. 112) from drum (7) using a puller to grip in groove provided in the O.D. of bearing. Support puller screw on plug located in bore of drum (7).

(b) Remove small seal ring (12) which contains oil seal (13) and O-ring (11). Remove and discard O-ring and oil seal.

(c) Remove drum bushing (10) with a bearing puller only if it requires to be replaced.

(d) To remove bearing (3) first remove snapring (2) from its O.D. Using same puller as used in step (a) above, place a plug located in bore of drum and pull bearing by gripping in snapring groove on O.D. of bearing.

(e) Remove large seal ring (5) which contains oil seal (6) and O-ring (4). Remove and discard O-ring and oil seal.

(6) Inspection of drum and bearings, etc.

(*a*) Discard all O-rings and oil seals.

(*b*) Wash all parts in a suitable solvent and dry thoroughly using compressed air or clean cloths.

Warning: **Do not dry or spin bearings with compressed air. Allow bearings to air dry after they are properly cleaned.**

(c) Check seal diameters at each end of drum (7, fig. 112) for rust or roughness. Clean and polish seal diameters using extra fine emery cloth. Check bearing hub diameters for scores and wear, possibly caused by a seized bearing, drum will require to be replaced.

(d) Inspect O-ring seal face in bore of drum (7) at splined end. This face must have a smooth finish and be free from scratches, etc. Polish if necessary with extra fine emery cloth. If this surface is damaged drum will require to be replaced.

(e) Inspect drum bushing (10) for bruises, scores and wear. Remove all high spots from bruises or scores using a scraper. The original inside diameter of this bushing was 1.752 inch, if wear is greater than .010 inch in diameter remove bushing and replace it with new part.

(*f*) Inspect ball bearings (14 and 3) for wear and pitting at balls and ball grooves. Replace bearings if worn or pitted.

(7) Disassembly of final planet assembly.

(*a*) Using a ¼ inch diameter pin punch, drive pin (4, fig. 118) completely into final planet pin (3).

(*b*) Remove final planet pin (3) by tapping it out of planet hub (5) so that it is removed from plined bore side of planet hub. Remove pin (4) from planet pin (3).

(*c*) Remove planet gear (1).

(*d*) Press needle bearing (2) out of the planet gear using an arbour that is $1^{23}/_{32}$ inch diameter.

(8) Inspection of parts for final planet assembly.

(*a*) Wash all parts in a suitable solvent and dry thoroughly using compressed air or clean cloths.

Warning: **Do not dry needle bearings with compressed air, allow them to air dry after they are properly cleaned.**

(*b*) Inspect planet pin bores in planet hub (5, fig. 118) for scores or bruises which may have been caused in removing planet pins. Remove high spots of any scores or bruises carefully with a scraper, sufficiently to allow planet pin to be pressed into each bore by hand.

(c) Inspect planet pin (3) for excessive wear at bearing area. It wear exceeds .001 inch on the diameter, pins should be replaced.

(d) Check planet gears (1) for wear and damage on gear teeth. If wear is excessive or if items (7 and 11, fig. 117) are being replaced because of gear tooth wear, replace planet gears (1, fig. 118).

(*e*) Inspect needle bearings (2) for freeness of rollers. Check for pits, broken rollers or excessive wear, and replace if any of these conditions exist.

Note. If either planet pins (3) or needle bearings (2) are replaced because of wear, both the pins and bearings should be replaced. Replacement of one part and not the other will cause premature wear on new part.

(9) Disassembly of primary planet assembly. It is recommended that if this assembly does not function properly or is worn, it should be replaced by a new assembly. If assembly is to be disassembled do so only if a clean, dust free work bench is available.

(a) Remove bushing, (4, fig. 114).

(b) Using a ¼ inch diameter pin punch drive pin (5) through planet hub (1) until it can be removed through the bore which carried bushing (4).

(c) Remove primary planet pin (6) by tapping it out of planet hub (1) so that it is removed from the side of planet hub that carried bushing (4).

(d) Remove planet gear (8) with care so that needle bearing (7) does not drop off gear when removed.

(e) Remove needle bearings (7) and place on a perfectly clean surface.

(f) After all planet gears have been removed, thrust pad (3) and O-ring (2) can be removed from planet hub. Remove and discard O-ring (2).

(10) Inspection of parts for primary planet assembly.

(*a*) Discard O-ring.

(*b*) Wash all parts in a suitable solvent and dry thoroughly using compressed air or clean cloths.

Warning: **Do not dry needle bearings with compressed air, allow them to air dry after they are properly cleaned.**

(*c*) Check planet hub (1, fig. 114). Inspect the tapered diameter which carried O-ring for scores or roughness. Try removing roughness with extra fine emery cloth. If roughness cannot be removed completely in this way replace planet hub. Inspect planet pin bores for scores and bruises which may have been caused in removing planet pins (6). Remove high spots of any scores or bruises carefully with a scraper sufficiently to allow planet pin (6) to be pressed into each bore by hand.

(d) Inspect pins (5) for damage. If they are bent or distorted discard them.

(e) Inspect planet pins (6) for excessive wear at bearing area. If wear at bearing area is greater than .001 inch on the diameter when compared with unworn areas, planet pins should be replaced.

(*f*) Inspect bore of plant gears (8) for ridges in center area of bore and for wear at center and ends of bore. If there are definite ridges at center of bore or wear at any part of bore is greater than .001 inch in diameter gears will require to be replaced. The original bore diameter was 1.7852 inch.

(*g*) Inspect needle bearings (7) for freeness of rollers. Check for pits, broken rollers or excessive wear and replace bearings if any of these conditions exist.

(*h*) Check thrust pad (3) for wear on slotted

face, if wear exceeds 1/8 inch replace. Original thickness of thrust pad was .500 inch.

(i) Check bushing (4) for wear on bore and flange. If flange has worn more than .010 replace bushing. Original bore was 2.127 inch.

Note. If planet pins (6), gears (8), or bearings (7) require to be replaced, all these parts must be replaced at the same time.

(11) Disassembly of brake hub assembly.

(a) Remove primary sun gear (1, fig. 115) from brake hub assembly with care.

(b) Remove roller bearing (3), garter spring (6) and cam locks (7); place them on a perfectly clean surface.

(*c)* Remove snapring (4) from bore of brake hub grooves to the plain end.

***Note*. Do not remove both snaprings unless they are to be replaced.**

(*d)* Remove gear spacer (2) from primary sun gear.

(12) Disassembly of motor assembly. It is recommended that if this assembly is found to be faulty it should be replaced with a new unit. Before disassembling this unit be sure to have new O-rings, back up washers and pocket seals on hand. It is important to install new O-rings and pocket seals once the oil parts have been disturbed. This assembly should be disassembled only if trouble has been traced to the motor, and only if a clean, dust free work bench is available. The motor assembly must be removed from primary drive assembly according to instructions on page 309 before disassembly of motor is started.

(a) Remove five capscrews (23, fig. 116) from port end cover (21).

(b) Lift off port end cover (21) items (6, 7, 8, 9, 10, 11, 12, 24, and 25) inclusive will be removed with port end cover. For disassembly of these parts see step (i).

(c) Remove snapring (26) and sleeve (27) from motor shaft (1).

(d) Remove capscrews (20) and O-ring (28). Discard O-ring.

(e) Remove gear set (18) and keep together as they are a match set. Note which end of gears were next to port end cover (21) for reassembly the same way.

(f) Remove key (19) from motor shaft (1); remove gear housing (17); remove second O-ring (28) from other side of gear housing (17). Discard O-ring.

(*g)* Remove motor shaft (1) and remove and discard O-ring (2) from motor shaft.

(*h)* Remove brake piston (15) from shaft end cover (5); remove and discard O-rings (13) and (4) and back up washers (14) and (3). Remove pins (16) from brake piston (15) only if replacement is required because of damage or wear.

(i) Turn port end cover (21) and the shaft end cover (5) over so that thrust plates (11) are up. Pry off thrust plates with a knife blade or thin screw driver taking care not to mark face next to end covers (21) and (5). Remove and discard pocket seals (12) and (25).

(j) Pull bearing (10) with a bearing puller from end covers (21) and (5) only if they are being replaced.

(*k)* Remove and discard O-rings (7) and back up washers (6) from bushings (24) and (29).

(l) If bearings (10) have been removed, remove bushings (24) and (29); remove and discard O-rings (9) and back up washers (8). If bearings are not being replaced it is unlikely that bushings will require to be replaced.

(13) Inspection of parts for motor assembly.

(*a)* Discard all O-rings, back up washers and pocket seals.

(*b)* Wash all parts in a suitable solvent. Dry thoroughly with compressed air or clean cloths.

Warning: Do not dry bearings with compressed air, allow them to air dry after they are properly cleaned.

(*c)* Inspect needle bearings (10, fig. 116) for freeness of rollers. Check for pits, broken rollers or excessive wear and replace if any of these conditions exist.

(*d)* Inspect gears (18), check edges of gear teeth and faces for scoring or roughness. If possible, remove roughness or scoring with a fine hone. Also inspect gear hubs for excessive wear at bearing points. If wear exceeds .001 inch on hub diameter, gears should be replaced. When replacing gears, they should be replaced in sets

since they are matched at the time of manufacture.

(e) Stone machined surfaces of port end cover (21), gear housing (17), and shaft end cover (5) to remove any roughness. If roughness is excessive, components will have to be replaced. Measure gear housing bore and replace if radial wear is in excess of .006 inch. A new gear housing bore measures 2.6705 inches.

(f) Replace thrust plates (11) that show an erosion path at center or excessive wear on running surfaces. Excessive wear can be caused by using contaminated oil in hydraulic system.

(g) Rewash all parts that have been stoned and dry thoroughly.

Note. If either gears (18) or needle bearings (10) are replaced because of excessive wear, it is good practice to replace both the gears and bearings. Replacement of one part and not the other will cause premature wear of new part because of its attempt to conform to wear pattern of old part. Also if gears and bearings are replaced due to excessive wear, carefully check side of gear housing bore which has most wear. In most cases gear housing will also have to be replaced along with gears and bearings.

d. Assembly.

(1) To assemble bearings and seals, etc. to drum.

(*a)* Install oil seal (13, fig. 112) in small seal ring (12) so that lip of oil seal is at end of seal ring farthest from O-ring groove. Lubricate' O-ring (11) with grease and install it in the groove on the outside diameter of seal ring. Lubricate oil seal, give O-ring an additional coat of grease and install this seal assembly on the nonsplined end of drum (7) so that lip of oil seal is towards drum. Be careful not to damage lip of oil seal as it is pressed over the taper on the seal diameter of drum. Pack seal with grease around seal diameter of drum.

(b) Install oil seal (6) in large seal ring (5) so that lip of seal is at that end of seal ring which has the projecting diameter at the bore. Lubricate O-ring (4) with grease and install it in groove on outside of seal ring. Lubricate oil seal, give O-ring an additional coat of grease and install this assembly on splined end of drum (7) so that lip of oil seal is towards drum. Be careful not to damage lip of oil seal as it is pressed over the taper on the seal diameter of drum. Pack seal with grease around seal diameter of drum.

(c) Install bearing (14) on nonsplined end of drum (7) so that groove on outside diameter of bearing is installed towards drum. Pack bearing thoroughly with good quality ball bearing grease.

(d) Install bearing (3) on splined end of drum (7) so that snapring on outside diameter of bearing is installed towards drum.

(e) Install hondu (9) in its slot in drum (7) so that small end of hondu enters wide end of slot. Secure in place with capscrew (8).

(f) Press bushing (10) into drum (7) using a sizing mandrel that is 1.752 inch diameter. Install bushing so that end of bushing is flush with end of drum.

(2) To assemble winch completely from subassemblies.

(a) Place winch base (15, fig. 112) on work belch so that side which is to be the final drive end of winch is facing up.

(b) Attach final housing (1) to the winch base using six dowel bolts (17), washers (18) and nuts (19).

(c) Turn this assembly over so that it rests on the end of final housing (1). Take drum (7) which has previously been assembled with seals and bearings and pilot bearing on splined end of drum into bore of final housing. Tap drum assembly down until snapring on bearing at splined end of drum is properly seated on end of final housing bore. There will be approximately /163 inch clearance between final housing and end of drum flange when bearing snapring is seated.

(d) Take primary housing (16) and install snapring (4, fig. 113) in snapring groove that is closest to large open end of housing. Now pilot primary housing over bearing, on plain end of drum (nonsplined end) so that dowel bolts (17, fig. 112) will locate in flange of primary housing. Tap primary housing on until its flange contacts winch base and secure it to winch base using six washers (18) and nuts (19) on dowel bolts (17).

(*e*) Torque load nuts to 75 ft. lbs.

(f) Assemble primary drive assembly according to assembly instructions given in (3) below.

(*g*) Assemble final drive assembly according to assembly instructions given in (4) below.

(*h*) When winch has been assembled, secure winch to its mounting base.

(i) Connect hydraulic hoses to motor ports.

(j) Run winch in reverse rotation, before running it in forward rotation. This will centralize brake ring (22, fig. 113) which is held in place by brake plate (9).

(3) To assemble primary drive assembly. Before starting this assembly, drum must be mounted between final and primary housings, secured to winch base according to instructions given in (2) (a) through (d) above.

(a) Whenever possible set partly completed winch on end so that it rests on the end of final housing (1, fig. 112). Check that drum bearing which is carried in primary housing has been thoroughly packed with grease.

(b) Lubricate O-ring (7, fig. 113) with grease and install it in its groove in seal ring (5). Give O-ring an additional coat of grease and install seal ring in bore of primary housing so that countersunk seal face is out towards open end of housing. Tap seal ring into place with a soft hammer so that it locates against snapring (4) which was previously installed. Do not hit on countersunk seal face.

(c) Install primary planet assembly (8) so that projecting boss locates in bushing (10, fig. 112) at en(d of drum. When this assembly is in place rotate it by hand to make sure that it is free to turn. Check that bushing (4, fig. 114) is in place in primary planet assembly (8, fig. 113).

(d) Install brake hub assembly (12) into brake ring (22) and lock in place with snapring (10).

(e) Position brake plate (9) over brake ring (22).

(f) Place brake hub assembly (12) with brake ring and brake plate attached into motor assembly (14).

(*g*) Take motor assembly (14) and place it on work bench with motor shaft end up. Check that brake piston (15, fig. 116) is located 3/8 inch away from gear housing (17). If necessary, tap brake cylinder down with a soft hammer, or pry it up by using two heel bars until the 3/8 inch gap is obtained.

(*h*) Install motor assembly (14, fig. 113) in primary housing (2) by holding it square with end of primary housing as it enters housing. The gear at the end of motor shaft (1, fig. 112) will engage with gears in primary planet assembly (8, fig. 113) and motor will pilot into planet hub bushing (4, fig. 114). It may be necessary to rotate motor assembly (14, fig. 113) slightly so that gear at the end of motor shaft will engage with gears in primary planet assembly (8). The motor assembly will assemble into primary housing easily by tapping outside of motor assembly lightly with a copper drift until snapring (16) can be installed. Do not use force to install motor assembly (14). If there is interference remove motor assembly and investigate.

(i) Once motor assembly is in place, install snapring (16) and make sure that it is properly seated in bottom of snapring groove all the way around housing (2). When snapring (16) has been installed, rotate motor assembly in primary housing to locate motor ports at required angle for the particular installation.

(j) Lubricate O-ring (15) with grease and install it in its groove on motor assembly (14). After O-ring is installed lubricate it again with grease.

(k) Install brake springs (18) in same symmetrical pattern as they were in before disassembly. In most cases there will be a spring for every hole but in some installations fewer springs are used and it is important that springs be installed in a symmetrical pattern for an even load on the brake.

(l) Lubricate O-ring (17) with grease and install it in its groove in spring cover (19). Once O-ring is installed lubricate it again.

(*m*) Install spring cover over motor assembly so that vent port is located in

correct position for the particular installation.

(n) Install capscrews (21) with washers (20). Screw in all capscrews to be finger tight and then tighten them evenly by one half turn at a time progressively around in a clockwise or counterclockwise direction. Care must be used to insure that spring cover (19) remains parallel to end of primary housing (2) as it is tightened into place. Torque load capscrews to 35 foot pounds.

(4) To assemble final drive assembly.

(a) Lubricate O-ring (9, fig. 117) with grease and install it over taper seal ring (8) which is installed on sun gear shaft (7).

(b) Check that snapring (10) is in place on sun gear shaft (7) and install sun gear shaft in winch so that. it engages in splined bore of primary planet hub. Slide sun gear shaft (7) in until snapring (10) contacts end of primary planet hub, at same time O-ring (9) will contact seal face on end of drum and be pushed up tapered diameter of tapered seal ring (8).

(c) Install final planet assembly (6) so that planet gears engage in internal teeth of final housing (11) and splined bore of planet hub locates over splined end of drum. Tap planet assembly (6) into place until it contacts bearing that carries drum in final housing (11).

(d) Install thrust plate (5) in end of final planet assembly (6).

(e) Lubricate O-ring (3) with grease and install in its groove in end cover (4). Give O-ring an additional coat of grease and install end cover in final housing (11) so that filler boss will be located at bottom of final housing when winch is mounted. Make sure that end cover is properly seated against end of gear teeth in final housing.

(f) Install snapring (2) and make sure that it is properly seated in bottom of snapring groove all the way around housing (11).

(g) Fill final housing (11) in accordance with current lubrication order and install filler plug (1).

(5) To assemble final planet assembly.

(a) Press needle bearing (2, fig. 118) into final planet gear (1) so that ends of bearing are flush or slightly below side of gear at each end.

(b) Place final planet gear (1) into final planet hub (5) so that bore of bearing lines up with planet pin hole.

(c) Install final planet pin (3) in final planet hub (5) so that it passes through needle bearing (2) in planet gear and drilled hole in final planet pin lines up with hole in rim of final planet hub.

(d) Install pin (4), drive pin in until outer end of pin is flush with outside diameter of final planet hub (5).

(e) Repeat above for remaining two final planet gears (1) and check that all gears run freely.

(f) Fit sun gear and retainer ring to sun gear shaft (7, fig. 117) by following assembly instructions for final drive assembly, (4) above.

(6) To assemble primary planet assembly.

(a) Lubricate O-ring (2, fig. 114) and install in its groove in thrust pad (3). Give O-ring an additional coat of grease and install thrust pad in its recess in inside wall of primary planet hub (1) so that slotted face of thrust pad it outwards.

(b) Press needle bearing (7) into primary planet gear (8) so that ends of bearing are flush or slightly below side of gear at each end.

(c) Place primary planet gear into primary planet hub (1) so that bore of bearing lines up with planet pin hole.

(d) Install primary planet pin (6) in primary planet hub (1) so that it passes through the needle bearing (7) in planet gear and drilled hole in primary planet pin lines up with hole in rim of primary planet hub.

(e) Install pin (5). Drive pin in until outer end of pin is flush with outside diameter of primary planet hub (1).

(f) Repeat above for remaining two primary planet gears (8) and check that all gears run freely.

(7) To assemble brake hub assembly.

(a) Place primary sun gear (1, fig. 115), gear end down, on a clean work bench.

(b) Install gear spacer (2) over primary sun

gear (1) so that slotted spacer is up away from gear case.

(*c*) Place roller bearing (3), flange down, under primary sun gear (1) so that it rests against slotted face of gear spacer (2) Check to see that there is a snapring (4) in bore of brake hub then place brake hub (5) over primary sun gear shaft (1) and roller bearing (3) so that they rest end up on roller bearing flange.

(d) Assemble cam locks (7) so that they bend on and between primary sun gear (1) and bore of brake hub (5).

(e) When all earn locks have been assembled, install one garter spring (6) so that it engages under protecting spring end of cam lock (7) to force them into engagement with primary hub gear (1) and bore of brake hub (5).

(f) Install remaining snapring (4) in groove of bore of brake hub next to cam lock end.

(*g*) Now install roller bearing (3) over end of sun gear (1) so that it enters bore of brake hub and rests with its flange on end of brake hub.

(*h*) Install sun gear (1) with a twisting motion in direction of free rotation.

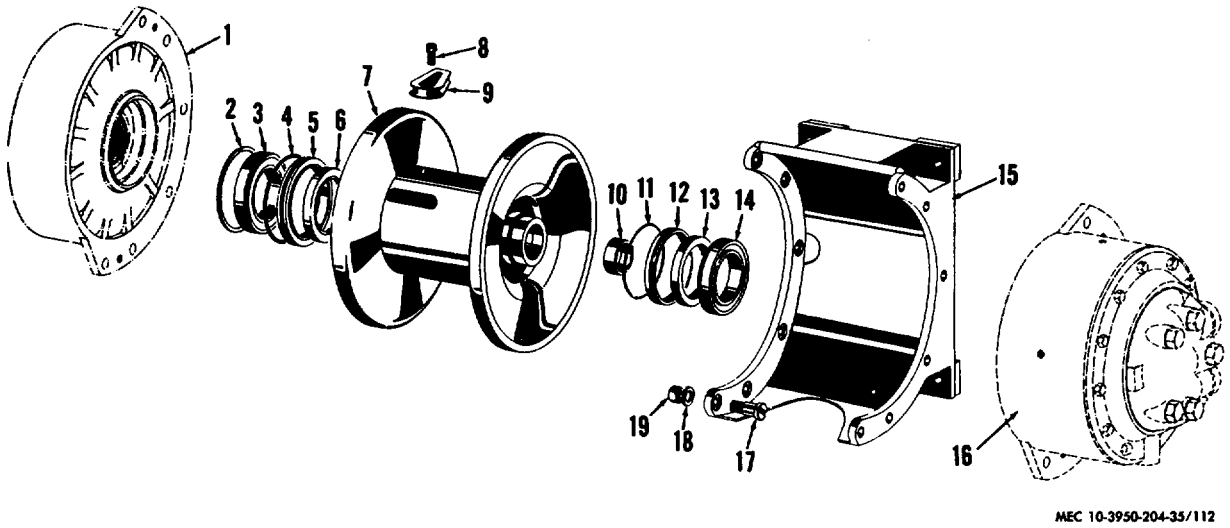
(i) Install roller bearing that was assembled next to gear spacer (2).

(j) Install gear spring into protecting end as before. Now replace roller bearing (3) and sun gear with same twisting motion used for removal.

(8) To assemble motor assembly.

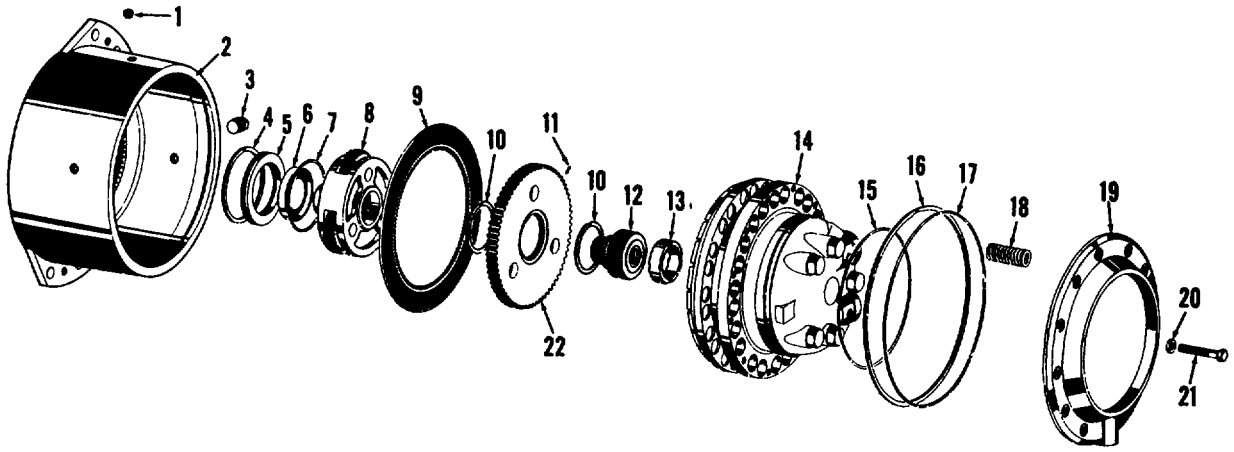
(a) Install two backup washers (6, fig. 116) in inside groove in short bushing (24) and backup washer (8) in outside groove. Lubricate all O-rings (7) and (9) with grease and install one O-ring (7) in inside groove of short bushing (24) so that both backup washers (6) are together at thick wall side of groove; install O-ring (9) in outside groove so that it is at same end of bushing as O-ring (7) installed in inside groove. Give all O-rings an additional coat of grease.

(b) Install a backup washer (8) and two backup washers (6) in long bushing (29). Also install O-rings (7) and (9) in long bushing so that backup washers (6) are together and both O-rings (7) and (9) are towards large end of bushing. Give all O-rings an additional coat of grease.



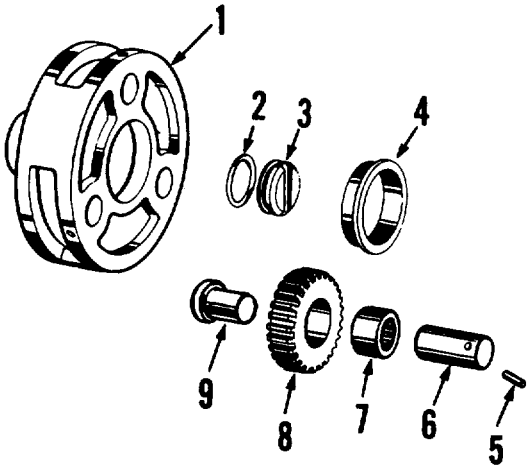
1	Final drive assembly	6	Oil seal	11	O-ring	16	Primary drive assembly
2	Snapring	7	Drum	12	Seal ring, small	17	Dowel bolt
3	Ball bearing	8	Capscrew	13	Oil seal	18	Washer
4	O-ring	9	Hondu	14	Ball bearing	19	Hex nut
5	Seal ring, large	10	Bushing	15	Winch base		

Figure 112. Drum and which base assembly, exploded view.



1 Plug
2 Primary housing
3 Plug
4 Snapring
5 Seal ring
6 Oil seal
7 O-ring
8 Primary planet assembly
9 Brake plate
10 Snapring
11 Pin
12 Brake hub assembly
13 Thrust spacer
14 Motor assembly
15 O-ring
16 Snapring
17 O-ring
18 Brake spring
19 Spring cover
20 Seal washer
21 Capscrew
22 Brake ring

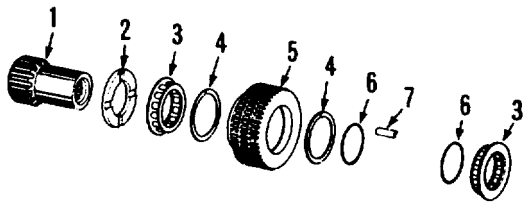
Figure 113. Primary drive assembly, exploded view.



MEC 10-3950-204-35/114

1 Primary planet hub
2 O-ring
3 Thrust pad
4 Bushing
5 Pin
6 Primary planet pin
7 Needle bearing
8 Primary planet gear
9 Thrust plug

Figure 114. Primary planet hub assembly, exploded view.

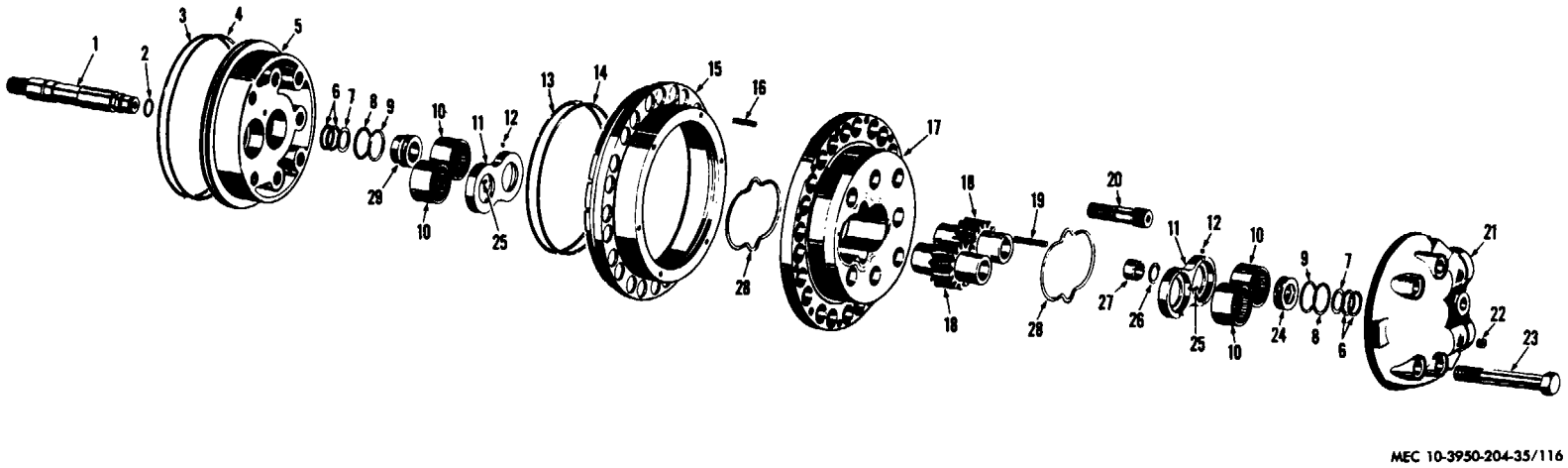


MEC 10-3950-204-35/115

1 Sun gear
2 Gear spacer
3 Roller bearing
4 Snapring
5 Brake hub
6 Garter spring
7 Cam lock

Figure 115. Brake hub assembly, exploded view.

(c) Place port end cover (21) and shaft end cover (5) on work bench with bearing bores facing up. Install short bushing (24) in center bore in port end cover (21) so that backup washers (6) and (8) enter before O-rings (7) and (9). Install long bushing (29) in center bore of shaft end cover (5) so that small diameter end of bushing enters first. Press both bushings in until they seal on end



1	Motor shaft	7	O-ring	13	O-ring	19	Key	25	Small pocket seal
2	O-ring	8	Backup washer	14	Backup washer	20	Capscrew	26	Snapring
3	Backup washer	9	O-ring	15	Brake piston	21	Port end cover	27	Sleeve
4	O-ring	10	Needle bearing	16	Pin	22	Pipe plug	28	bring
5	Shaft end cover	11	Thrust plate	17	Gear housing	23	Capscrew	29	Long bushing
6	Backup washer	12	Large pocket seal	18	Matched gear set	24	Short bushing		

Figure 116. Motor assembly, exploded view.

of each bore. Be sure that all O-rings (7) and (9) are installed toward gear side of end covers (21) and (5).

(d) Check that bearing bores are clean and install needle bearings (10) so that they bottom at end of bearing bores.

(e) Place a small amount of heavy grease into middle slot in open face of each thrust plate (11) and insert small pocket seal (25) in each thrust plate.

(f) Place thrust plate (11) with pocket seal slots towards end cover (21) or (5) and install over bearings. Check to see that pocket seal (25) in center slot is still in place and tap thrust plate into position with a soft hammer until approximately 1/32 inch clearance is left between thrust plate (11) and end cover (21) or (5).

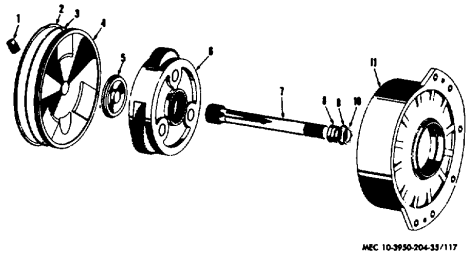
(g) Into each of four open slots in thrust plate (11) insert large pocket seal (12). Be sure to push each seal all the way into slots so that hidden end is always in contact with needle bearing race. Then tap assembled thrust plate (11) into position against face of end cover (21) or (5). Trim away excess from exposed ends of pocket seals (12) with a razor blade. Be sure to trim exposed ends of pocket seals square and flush with thrust plate.

(h) Install backup washer (3) in outside groove of shaft end cover (5). Lubricate O-ring (4) and install it next to backup washer (3) so that it is on the side of backup washer nearest to thrust plate (11) end of shaft end cover. Give O-ring and backup washer an additional coat of grease.

(i) Install backup washer (14) in inside groove in brake piston (15). Lubricate O-ring (13) and install it next to backup washer (14) so that it is on the side of backup washer nearest to large bore of brake piston (15). Give O-ring and backup washer an additional coat of grease.

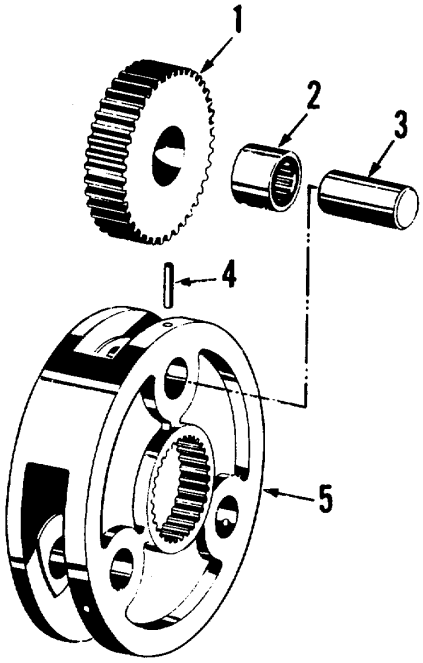
(j) Check that pins (16) are installed in brake piston (15). Assemble brake piston to shaft end cover (5) taking care that backup washers (14) and (3) do not extrude and get pinched between mating diameters of brake piston (15) and shaft end cover (5).

Note. The brake piston referred to in (j) above and gear housing (17) referred to in (c)



1 Pipe plug
2 Snapring
3 O-ring
4 End cover
5 Thrust plate
6 Final planet assembly
7 Sun gear shaft
8 Taper seal ring
9 O-ring
10 Snapring
11 Final housing

Figure 117. Final drive assembly, exploded view.



MEC 10-3950-204-35/118

1 Final planet gear
2 Needle bearing
3 Final planet pin
4 Pin
5 Final planet hub

Figure 118. Final planet assembly, exploded view.

below are drilled for one pin (16) in units up to serial number 11-40. These parts are drilled for six pins (16) in units after serial number 11-410. Parts drilled for one or six pins (16) are interchangeable.

(9) To assemble motor assembly with port end cover and shaft end cover subassemblies.

(a) Install motor shaft (1, fig. 116) in shaft end cover (5) through long bushing (29) and place shaft end cover, thrust plate up, on parallel bars on work bench so that it does not rest on motor shaft.

(b) Lubricate O-rings (28) and install one in each side of gear housing (17). Give O-rings an additional coat of grease.

(c) Assemble gear housing over thrust plate (11) on shaft end cover so that gear housing and shaft end cover are concentric and pins (16) locate in gear housing. Place large diameter end of gear housing next to shaft end cover and tap gear housing into place with a soft hammer. Be careful not to pinch the O-ring during this assembly.

(d) Install key (19) in motor shaft.

(e) Take match gear set (18) and install gear with keyed bore over drive shaft. Install mating gear so that it pilots into its bearing in shaft end cover.

(f) Lubricate O-ring (2) and install in grove at end of motor shaft.

(g) Install sleeve (27) on end of motor shaft so that it covers O-ring and contacts shoulder at end of motor shaft.

(h) Install snapring (26) on end of motor shaft and make sure that it is properly seated in bottom of snapring groove.

(i) Install two capscrews (20) and torque load to 250 foot pounds.

(j) Install port end cover (21) previously assembled, onto gear housing so that hubs of gears (18) pilot into needle bearings (10) and thrust plate (11) pilots into gear housing. Use a soft hammer to seat port end cover taking care that O-ring does not get pinched during this assembly.

(k) Install five capscrews (23) and tighten evenly in stages to a torque of 250 foot pounds.

Section X. SEAT

52. General

The crane is equipped with an adjustable (front to rear) seat comprised of a frame, seat cushion and backrest cushion. The seat and backrest cushions are removable (TM 10-3950204-20).

53. Seat and Backrest Cushions

a. Removal. Remove seat and backrest cushions (TM 10-3950204-20).

b. Installation. Inspect seat and backrest cushions for cracks, tears, loose or missing staples and damaged mounting boards.

c. Repair. Patch small tears with a suitable tape and replace loose or missing staples. Reupholster if excessive amount of cushion filler is missing.

Section XI. HYDRAULIC SYSTEM

54. General

a. The hydraulic system consists of a tandem hydraulic pump, oil reservoir, two control valves, two single acting cylinders (lift and slewing), double action crowd cylinder, pilot check valve, check valve, flow regulator valve and a double over-center valve. Also various lines and connections. The hydraulic oil is drawn from the reservoir by a pump mounted on the transmission. The oil is forced through the high pressure lines to the control valves. When control levers are in neutral position, 104 oil flows through the control valve and back to the reservoir. When one of the control levers is moved, oil is diverted through various lines and connections to the corresponding cylinder or cylinders to perform desired motion.

b. The single-action lift cylinder and slewing applies force in one direction only and is returned to its position by the weight of the boom or the motion of another cylinder when the control lever is moved.

c. The double-action crowd cylinder extends the boom or retracts it.

55. Hydraulic Pump Assembly

a. Removal.

(1) Disconnect hydraulic fittings and suction line flange at pump (fig. 6).

(2) Remove two capscrews and lockwashers that secure body (22, fig. 119) to transmission; remove pump.

b. Disassembly.

(1) Match-mark cover (2, fig. 119), housing (9) and body (22) with a prick pencil to assure proper reassembly of pump.

(2) Remove four bolts (1) that hold cover to housing; remove cover from housing with cartridge assembly.

(3) Remove the following parts off of pressure plate (6). Slide backup ring (3), O-ring (37), O-ring (4), backup ring (36) and seal ring (5) from pressure plate.

(4) Remove two screws (31) from face of wear plate (32) that secure wear plate (32), ring (33) and pressure plate (6) together.

(5) Lift off wear plate. Note position of ring (33), rotor (35), and vanes (34) for correct reassembly. Separate ring, rotor, vanes, location pins (8), and pressure plate (6).

(6) Remove four bolts (7) which attach inlet housing (9) to body (22). Lift off housing.

(7) Turn shaft (20) to free cartridge, consisting of items (10 thru 17 and 26 thru 30). Pull cartridge from body.

(8) Remove snapring (18) and pull shaft and bearing (19) from body.

(9) Drive shaft seal (21), wiper (23) and washer (24) out from opposite end.

(10) If it is necessary to remove shaft bearing (19), first remove snapring (25) and then press shaft out of bearing, supporting the inner race.

(11) Remove two screws (30) from face of wear plate (29) that secure wear plate, ring (12) and pressure plate (14) together.

(12) Lift off wear plate. Note position of ring (12), rotor (13), and vanes (28) for correct reassembly. Separate ring, rotor, vanes, locating pins (10) and pressure plate.

(13) Remove following parts off of pressure plate. Slide backup ring (27), O-ring (16), seal ring (15), backup ring (26) and O-ring (17).

(14) If bushing (11) needs to be replaced, press bushing out of wear plate.

c. Cleaning, Inspection and Repair.

(1) Discard shaft seal and all O-rings and backup rings.

(2) Thoroughly clean all parts of pump assembly, except bearing, in an approved cleaning solvent; shake excess solvent from parts and dry with compressed air.

(3) Inspect seal and bushing mating surfaces on shaft for scoring or wear. Replace shaft if marks cannot be removed by light polishing.

(4) Clean bearing by placing in a wire basket and agitating in clean solvent. Dry with compressed air taking care not to spin dry bearing. Dip in engine oil to lubricate bearing.

Caution: Do not use a cloth to wipe pump parts because lint trapped in parts can enter hydraulic system at reassembly.

(5) Inspect ring, rotor, and vanes for wear, scoring, distortion, or other damage. Replace ring, rotor, and vanes in complete sets only, if damaged.

Note. No side play is allowable in vane movement in rotor slots.

(6) Inspect face of pressure plate that rides on vanes for scoring. Lap out scores with clean crocus cloth. Replace pressure plate if scores cannot be removed.

(7) Inspect bearing for wear, pitting, and looseness; replace damaged bearings.

d. Reassembly.

(1) Install bushing (11, fig. 119) into wear plate (29).

(2) Place rotor (13) on pressure plate (14) with arrow on rotor pointing in direction of rotation. Place inserts in vanes (28) and install both in rotor slots. Be sure sharp edges are toward direction of rotation.

(3) Install locating pins (10) in pressure plate and place ring (12) over them with ring arrow pointing in correct direction of rotation.

(4) Install wear plate and screws (30).

(5) Install new shaft wiper (23) and seal (21). Clamp body (22) in a vise and place bearing washer (24) against seal (21). Press shaft (20) into bearing (19) in an arbor press, supporting the inner race.

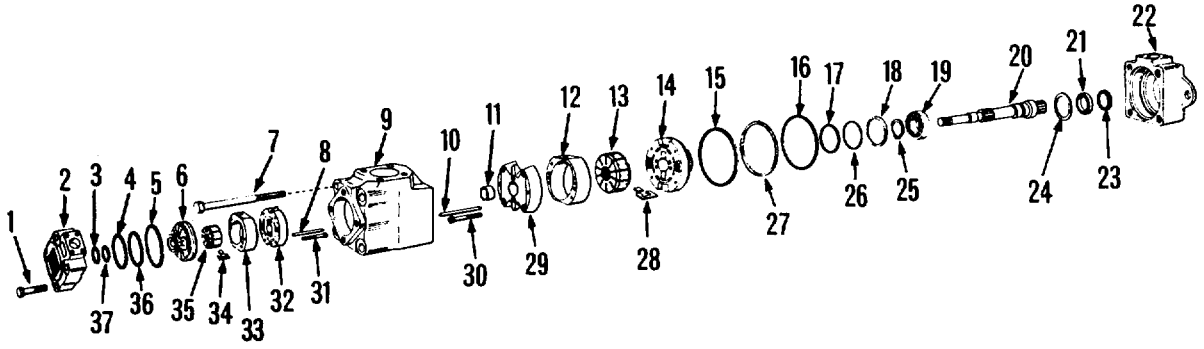
(6) Install snap ring (25). Tape end of shaft and lubricate seal lip with grease or petroleum jelly to protect seal. Tap shaft and bearing gently into body and install snapring (18).
(7) Install seal ring (15), backup ring (27) and O-ring (16) on pressure plate (14).
(8) Install smaller O-ring (17) and backup ring (26) on pressure plate hub.
(9) Carefully install cartridge in body so one of the flats on ring will align with inlet port when inlet housing (9) is installed.
(10) Install four bolts (7) and torque down to 75 foot pounds.
(11) Place rotor (35) on pressure plate (6). Place inserts in vanes (34) and install both in rotor slots.
(12) Install locating pins (8) into pressure plate and place ring (33) over them with ring arrow pointing in correct direction of rotation.
(13) Install wear plate (32) and screws (31).
(14) Install seal ring (5), backup ring (36) and O-ring (4) on pressure plate.
(15) Install smaller O-ring (37) and backup ring (3) on pressure plate hub.
(16) Install cover (2) to housing and secure with four bolts (1), torque bolts to 50 foot pounds.

e. Installation.
(1) Install two capscrews and lockwashers that secure body (22, fig. 119) to transmission.
(2) Connect hydraulic hoses and fittings into pump ports.

56. Crowd and Slewing Hydraulic Control Valve

a. Removal.
(1) Remove hydraulic control levers and linkage (para. 62).
(2) Remove seven hydraulic connections from control valve. Cover lines to prevent entry of dirt.
(3) Remove three capscrews, nuts and lockwashers that secure control valve to crane.

b. Disassembly.
(1) Remove four nuts (10, fig. 120) and bolts (22) that hold valve bodies (9 and 19) together, separate valves.
(2) Remove four screws (1) that hold retainers (2) and sleeves (3) to valve bodies; remove retainers and sleeves, O-rings (4), quad rings (5), and springs (6). Slide



1	Bolt	11	Bushing	21	Seal	31	Screw
2	Cover	12	Ring	22	Body	32	Wear plate
3	Backup ring	13	Rotor	23	Wiper	33	Ring
4	O-ring	14	Pressure plate	24	Washer	34	Vane
5	Seal ring	15	Seal ring	25	Snapring	35	Rotor
6	Pressure plate	16	O-ring	26	Backup ring	36	Backup ring
7	Bolt	17	O-ring	27	Backup ring	37	O-ring
8	Pin	18	Snapring	28	Vane		
9	Housing	19	Bearing	29	Wear plate		
10	Pin	20	Shaft	30	Screw		

Figure 119. Hydraulic pump assembly, exploded view.

spools (8) out of valves. Tag spools so that they can be replaced in same valve body at reassembly. Grip stem of plug (27) with pliers and pull out of valve. Remove backup ring (26), O-ring (25), spring (24) and ball (23) from valve.

(3) Remove plug (14), O-ring (13), spring (12) and relief valve (11) from valve body (9). Remove seals (15, 16 and 17) and retainer (18) from valve bodies; remove quad ring 5 and backup ring (21) from spools.

c. Cleaning, Inspection and Repair.

(1) Discard all seals and O-rings; replace with new parts.

(2) Clean all metal parts in an approved cleaning solvent; dry thoroughly with compressed air.

(3) Inspect the two spools of control valve for distortion, cracks, wear, or scoring; replace entire valve assembly if spool is damaged.

(4) Inspect all parts of hydraulic control valves for burs; remove burs with crocus cloth.

(5) Inspect valve bores for burs and scoring; if scores and burs are not deep, remove them with crocus cloth. If burs and scores are deep, replace valve assembly.

(6) Inspect retainers and spring for distortion, cracks, breaks, or other damage; if parts are damaged, remove retainers from spool and replace with four new retainers.

(7) Coat parts lightly with hydraulic oil. Check spools, relief valve, and ball for freedom of movement in their bores. If spool is not free to move; replace entire valve assembly. If relief valve or ball is not free to move, replace relief valve and ball.

d. Reassembly.

(1) Immerse all parts of hydraulic control valve in clean hydraulic oil before reassembly.

(2) If retainers (7, fig. 120) were removed; position one retainer on spool (8) so that it overlaps on both prongs. Slide spring (6) over spool and position other retainer in a similar manner on spool to retain spring. Position quad ring (5) on spool and position backup ring (21) against ring. Assemble other spool in similar manner.

(3) Slide assembled spools into valve bodies (9 and 19). Install balls (23), springs (24), quad rings (25), backup rings (26) and plugs (27) in valve bodies.

(4) Position O-ring (4) on sleeve (2), and quad ring (5) on spool (8); position sleeve (3) and retainer (2) on valve bodies; secure spools and plugs in valve bodies by securing retainers with four screws (1).

Caution: **Replace spools in same valve body from which they were removed.**

(5) Slide relief valve (11) and spring (12) into valve body (9); position O-ring (13) on plug (14) and secure spring and relief valve in valve body with plug.

Caution: Do not over-tighten plugs as they are easily stripped.

(6) Position seals (15, 16 and 17) and retainer (18) on valve bodies; secure the two valve bodies together with four bolts (22) and nuts (10). Torque nuts evenly to 15-foot pounds.

e. Installation.

(1) Position hydraulic control valve on crane and secure with three capscrews, nuts, and lockwashers.

(2) Connect hydraulic lines to hydraulic control valve using new preformed packings.

(3) Install control levers and linkage (par. 62).

(4) Start engine and operate control levers in both positions. Inspect connections, plugs, and mating surfaces of hydraulic control valve for leaks. Tighten nuts and plugs as required to stop leaks.

57. Winch and Lift Hydraulic Control Valve

a. Removal.

(1) Remove hydraulic control valves and linkage (par. 62).

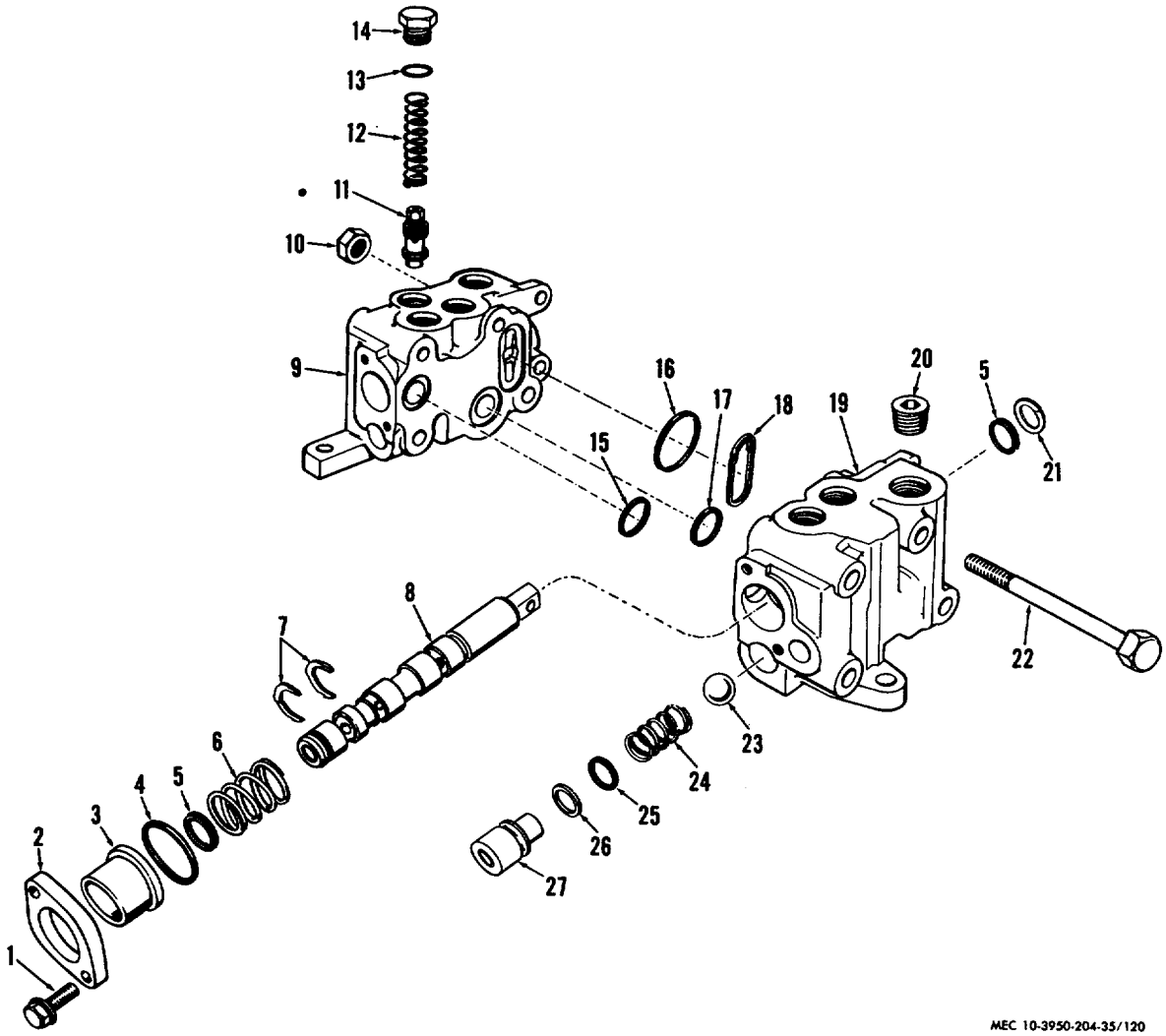
(2) Remove six hydraulic connections from control valve. Cover lines to prevent entry of dirt.

(3) Remove three capscrews, nut and lockwashers that secure control valve to crane.

b. Disassembly.

(1) Remove five nuts (20, fig. 121) and studs (19) that hold valve bodies (10 and 17) together; separate valves.

(2) Remove four screws (1) that hold caps (2)



1	Screw	8	Spool	15	Seal	22	Bolt
2	Retainer	9	Valve body	16	Seal	23	Ball
3	Sleeve	10	Nut	17	Seal	24	Spring
4	O-ring	11	Relief valve	18	Retainer	25	Quad ring
5	Quad ring	12	Spring	19	Valve body	26	Backup ring
6	Spring	13	O-ring	20	Plug	27	Plug
7	Retainer	14	Plug	21	Backup ring		

Figure *120. Crowd and slewing hydraulic control valve, exploded view.*

to bodies; remove caps, screws (3) guides (4), retainers (5), springs (6), retainers (5 and 7) and O-rings (8). Tag spools so that they can be replaced in same valve body at assembly. Grip stem of plug (25) with pliers and pull it out of valve. Remove backup ring (24), O-ring (23), spring (22) and poppet (21).

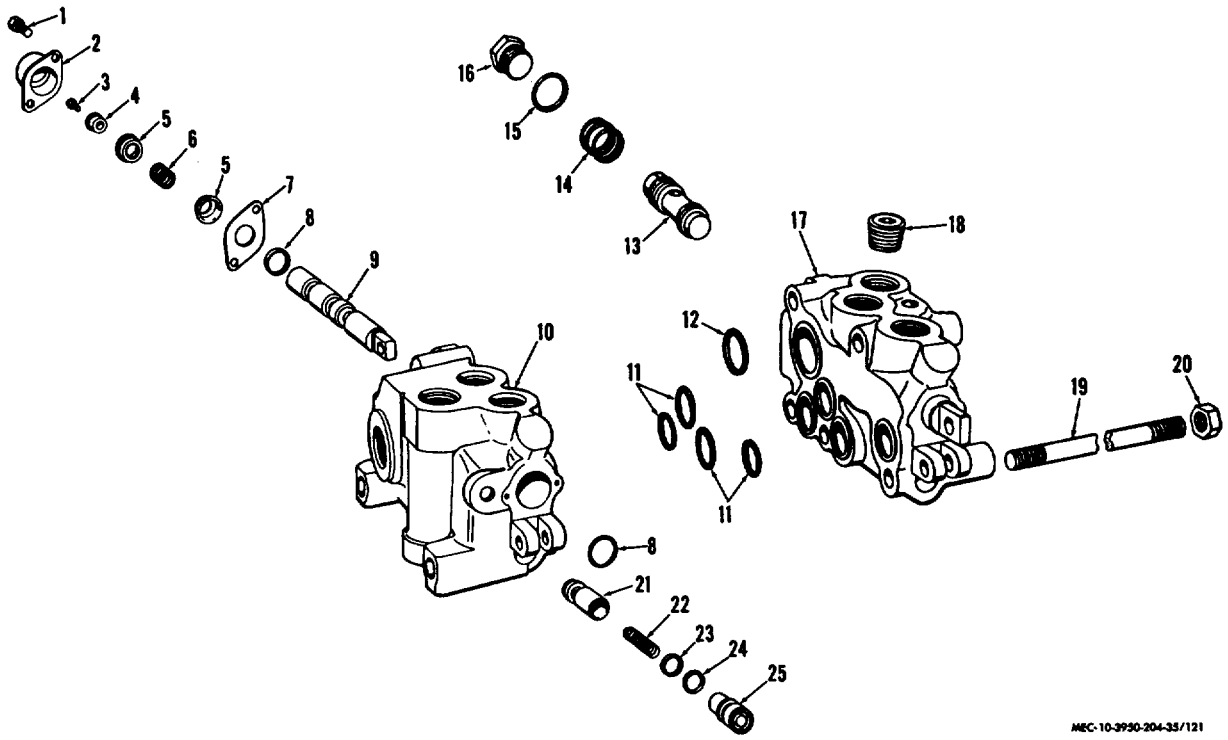
(3) Remove plug (16), O-ring (15), spring (14), and relief valve (13) from valve 108 body (17). Remove seals (11 and 12) from valve bodies.

c. Cleaning, Inspection and Repair. Refer to paragraph 56c.

d. Reassembly.

(1) Position O-rings (8, fig. 121) retainer (5 and 7), spring (6), retainer (5), guide (4) and screws (3) to spool (9).

(2) Slide assembled spools into valve bodies



1	Screw	7	Retainer	13	Relief valve	19	Stud
2	Cap	8	O-ring	14	Spring	20	Nut
3	Screw	9	Spool	15	O-ring	21	Poppet
4	Guide	10	Valve body	16	Plug	22	Spring
5	Retainer	11	Seal	17	Valve body	23	O-ring
6	Spring	12	Seal	18	Plug	24	Backup ring
						25	Plug

Figure 121. Winch and lift hydraulic control valve, exploded view.

(10 and 17) secure caps (2) over spools to bodies with screws (1).

(3) Slide relief valve (13) and spring (14) into valve body (17); position O-ring (15) on plug (16) and secure spring and relief valve in valve body with plug.

(4) Install poppet (21), spring (22), O-ring (23) and backup ring (24); secure to body (10) with plug (25).

(5) Position seals (11 and 12) on valve bodies; secure two valve bodies together with five studs (19) and nuts (20). Torque nuts evenly to 15-foot pounds.

e. Installation.

(1) Position hydraulic control valve on crane and secure with three bolts, nuts, and lockwashers.

(2) Connect hydraulic lines to hydraulic control valve using new preformed packings.

(3) Install control levers and linkage (para. 62).

(4) Start engine and operate control levers in both positions. Inspect connections, plugs, and mating surfaces of hydraulic control valve for leaks. Tighten nuts and plugs as required to stop leaks.

58. Pilot Check Valve

a. Removal.

(1) Disconnect two hydraulic line connections from pilot check valve. Cover lines to prevent entry of dirt.

(2) Turn check valve off of lift cylinders.

b. Disassembly.

(1) Remove reducer (1, fig. 122), O-ring (2) and piston (3) from body (4).

(2) Turn screw nut (8) out of body and remove guide (7), spring (6) and valve (5).

c. Cleaning, Inspection and Repair.

(1) Discard O-ring and replace with new one.
(2) Clean all metal parts in an approved cleaning solvent; dry with compressed air.
(3) Inspect spring for distortion, cracks, or other damage.

d. Reassembly.

(1) Place spring (6, fig. 122) over valve (5) and guide (7); position valve, spring and guide in body (4) and secure with screw nut (8).
(2) Position piston (3) into body (4). Place O-ring (2) over reducer (1) and install reducer in body.

e. Installation. Turn check valve into lift cylinder port nipple and connect two hydraulic lines.

59. Check Valve

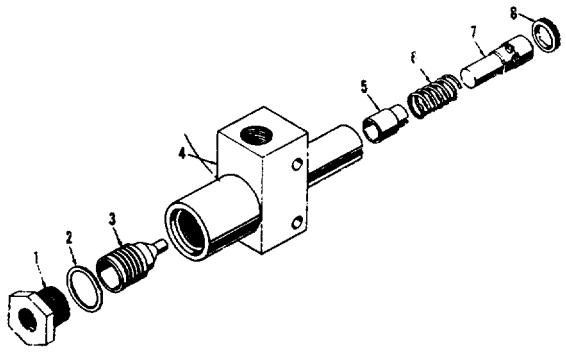
a. Removal. Disconnect hydraulic fittings at check valve.

b. Disassembly.

(1) Loosen and remove plugs (2, fig. 123) that secure pin (3) and valve (5) in body (6); remove pin.
(2) Loosen and remove plug (1). Turn body (6) over and let snap ring (7), arm (4) and valve (5) fall into your hand. Separate snapring (7) and remove valve (5) from arm (4).

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in an approved cleaning solvent; dry thoroughly with compressed air.
(2) Inspect valve surface for cracks, burs, pits or other damage. If damage is not deep remove with crocus cloth.



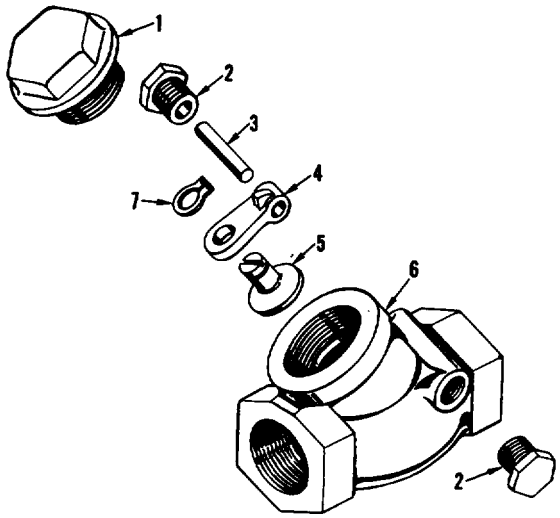
1 Reducer
2 O-ring
3 Piston
4 Body
5 Valve
6 Spring
7 Guide
8 Screw nut

Figure 122. Pilot check valve, exploded view.

d. Reassembly.

(1) Place valve (5, fig. 123) in arm (4) and secure valve to arm with snapring (7).
(2) Position valve and arm in body (6); place pin (3) through body and arm (4).
(3) Secure pin and valve assembly in body with plugs (2). Install plug (1).

e. Installation. Connect hydraulic fittings to check valve.



1 Plug
2 Plug
3 Pin
4 Arm
5 Valve
6 Body
7 Snapring

Figure 123. Check valve, exploded view.

60. Flow Regulator Valve

a. Removal.

(1) Disconnect three hydraulic line connections from flow regulator valve. Cover lines to prevent entry of dirt.
(2) Remove two nuts and lockwashers that secure valve to crane.

b. Disassembly.

(1) Remove cap (1, fig. 124) and gasket (2) from body (9).
(2) Turn out plug (3) and remove spring (4) piston (6), and seat (8). Remove O-ring (5) from piston and O-ring (7) from seat.

c. Cleaning. Inspection and Repair.

(1) Discard gasket and replace with new one (2) Clean all metal parts in an approved cleaning solvent; dry thoroughly with compressed air.

(3) Inspect spring for distortion, cracks, or other damage.

d. Reassembly.

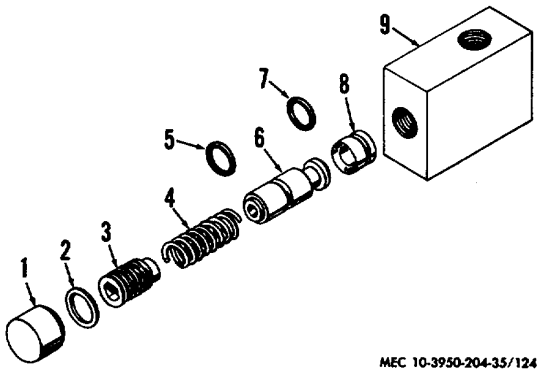
(1) Slide O-ring (7, fig. 124) over seat (8); slide O-ring (5) over piston (6).

(2) Place seat into body (9). Slide spring (4) onto piston and plug (3). Position plug, spring and piston into body. Place gasket (2) over plug and insert cap (1).

e. Installation.

(1) Secure valve to crane with two nuts and lockwashers.

(2) Connect three hydraulic lines to flow regulator valve using new packings.



1 Cap
2 Gasket
3 Plug
4 Spring
5 O-ring
6 Piston
7 O-ring
8 Seat
9 Body

Figure 124. Flow regulator valve, exploded view.

61. Double Over-Center Valve

a. Removal.

(1) Remove four hydraulic line connections from double over-center valve. Cover lines to prevent entry of dirt.

(2) Remove two nuts and lockwashers that secure valve to frame. Remove valve.

b. Disassembly.

(1) Remove nuts (20, fig. 125), screw (19) and plugs (18) from body (6) as an assembly.

(2) Remove gaskets (17), spring ends (16), O-rings (15), springs (14 and 13), pistons (12), leather backups (11), O-rings (10), seats (9), O-rings (8) and teflon backups (7) from body.

(3) Remove plugs (25), that secure O-rings (24), springs (23) and poppets (22) in body.

(4) Remove plug (1) that secures piston (3) in body. Remove O ring (2) from plug and O-ring (4) from piston. Remove roll pin (5) from body (6).

c. Cleaning, Inspection and Repair.

(1) Discard all seals and preformed packing; replace with new parts.

(2) Clean all metal parts in an approved cleaning solvent; dry with compressed air.

(3) Inspect springs for distortion, breaks or other damage.

d. Reassembly.

(1) Place teflon backups (7, fig. 125) and O-rings (8) on seats (9). Place leather backups (11) and O-rings (10) on piston (12). Insert pistons (12) in springs (13 and 14). Insert O-ring (15) on spring end (16). Join piston assemblies with gaskets (17) and spring ends.

(2) Install valve seat assemblies (9), piston and spring end assemblies into body (6) and secure in place with nut (20), screw (19) and plug (18).

(3) Place O-rings (2) over plugs (1) and O-rings (4) on pistons (3). Insert roll pins (5) in pistons. Place piston assemblies in body and secure with plugs (1).

(4) Place O rings (24) on plugs (25) and slide springs (23) on plugs and poppets (22); place in body and secure with plugs.

e. Installation.

(1) Install assembled valve in crane and secure with two nuts and lockwashers.

(2) Connect four hydraulic connections to valve.

62. Controls Levers and Linkage

a. Removal and Disassembly.

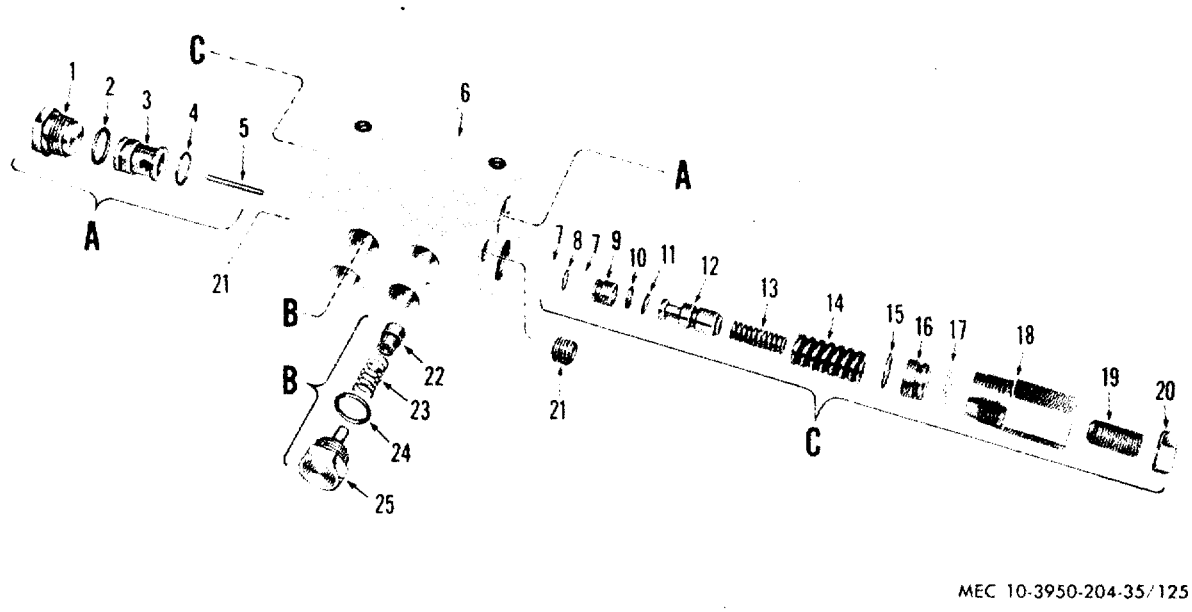
(1) Turn four knobs (1, fig. 126) from levers (2, 4, 14 and 19); remove knobs.

(2) Remove cotter pins (9 and 11) and clevis pin (8 and 10) that secures levers to control rods (5 and 18).

(3) Remove cotter pins (9 and 11) and clevis pins (8 and 10) that secure control rods to control valves. Remove control rods with clevis's (7 and 12) and nuts (6) attached.

b. Cleaning, Inspection and Repair.

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



1	Plug	7	Teflon backup	13	Spring	19	Screw
2	O-ring	8	O-ring	14	Spring	20	Nut
3	Piston	9	Seat	15	O-ring	21	Plug
4	O-ring	10	O-ring	16	Spring end	22	Poppet
5	Roll pin	11	Leather backup	17	Gasket	23	Spring
6	Body	12	Piston	18	Plug	24	O-ring
						25	Plug

Figure 125. Double over-center valve, exploded view.

(2) Inspect all parts for cracks, breaks, wear, distortion, or other damage; replace damaged parts.

c. Reassembly and Installation.

(1) Position four control rods (5 and 18, fig. 126) on control valves; secure with pins (8 and 10) through control valve arms and clevis's (7 and 12). Lock pins in place with cotter pins (9 and 11).

(2) Secure control rods to lever arms with pins (8 and 10) and cotter pins (9 and 11). Turn knobs (1) onto control levers.

63. Hydraulic Slewing Cylinder

a. Removal and Disassembly.

(1) Remove hydraulic slewing cylinder (TM 10-3950-204-20).

(2) Remove ten capscrews (19, fig. 127) and lockwasher (18) that secures cylinder head (8) to cylinder tube (17). Remove cylinder head assembly and piston (13) and rod (10) assembly from tube.

(3) Remove cotter pin (15) and slotted nut (14) that secures piston to rod; remove piston and two O-rings (11 and 12).

(4) Slide cylinder head assembly off of piston rod. Remove O-ring (9) from cylinder head.

(5) Remove four capscrews (21) and lockwashers (20) that secure packing gland (4) to cylinder head. Remove packing gland.

(6) Remove rod wiper (3) and press bushing (5) out of packing gland.

(7) Remove packing ring set (6) and press bushing (7) out of cylinder head.

(8) Loosen jamnut (2) and remove rod end (1) from rod. Press out bushing (22).

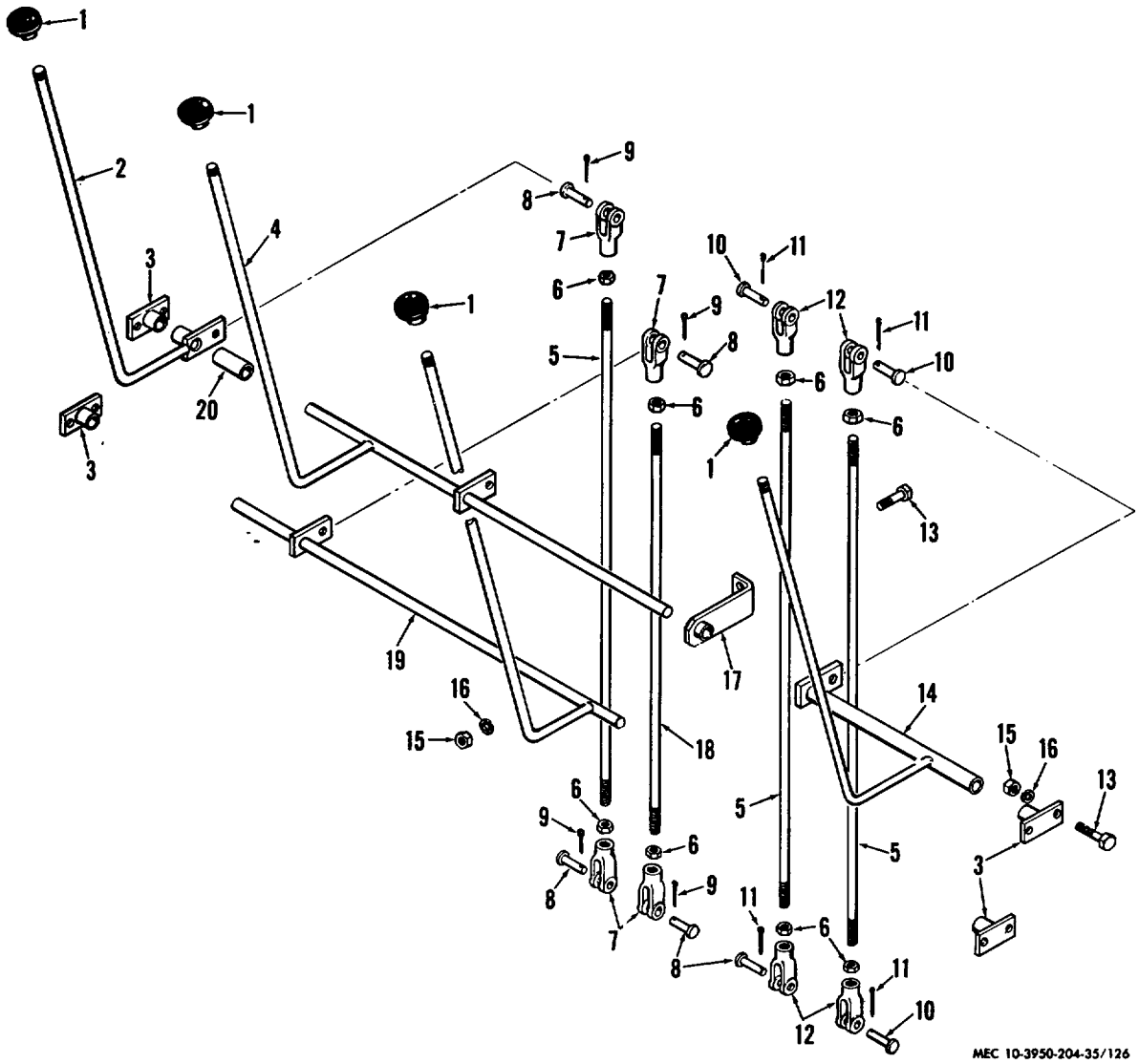
b. Cleaning, Inspection and Repair.

(1) Discard all unserviceable parts.

(2) Clean all metal parts thoroughly in an approved cleaning solvent; dry thoroughly with compressed air.

(3) Check all metal parts for corrosion, cracks, burs, breaks, distortion, or other damage. Check contact areas for scoring or wear. Remove burs with a fine stone. Replace all damaged parts.

(4) Replace all seals, packings, and other unserviceable parts.



1	Knob	6	Nut	11	Cotter pin	16	Lockwasher
2	Control lever	7	Clevis	12	Clevis	17	Support
3	Support	8	Pin	13	Capscrew	18	Rod
4	Control lever	9	Cotter pin	14	Control lever	19	Lever
5	Rod	10	Pin	15	Nut	20	Spacer

Figure 126. Controls and linkage, exploded view.

c. Reassembly.

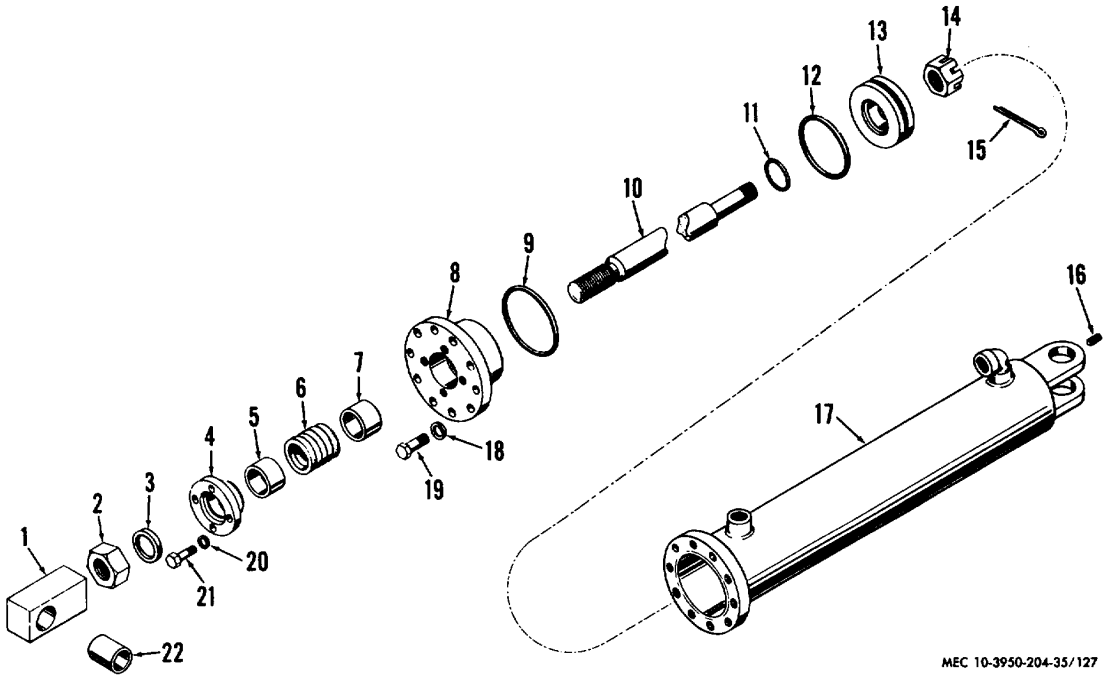
(1) Immerse all parts in clean hydraulic oil for lubrication before reassembly.

(2) Press new bushing (7, fig. 127) into cylinder head (8). Install packing ring set (6). Press new bushing (5) into packing gland (4).

(3) Position packing gland against cylinder head and secure together with four cap screws (21) and lockwashers (20). Install tile rod wiper (3).

(4) Position two O-rings (11 and 12) on piston (13); slide piston onto rod (10) and secure piston to rod with slotted nut (14) and cotter pin (15).

(5) Position O-ring (9) onto cylinder head and slide cylinder head assembly onto rod. Push rod, piston end first, into tube (17) as far as it will go. Position cylinder head



1	Rod end	7	Bushing	13	Piston	19	Capscrew
2	Jamnut	8	Head	14	Nut	20	Lockwasher
3	Rod wiper	9	O-ring	15	Cotter pin	21	Capscrew
4	Packing gland	10	Rod	16	Setscrew	22	Bushing
5	Bushing	11	O-ring	17	Cylinder tube		
6	Packing ring set	12	O-ring	18	Lockwasher		

Figure 127. Hydraulic siewing cylinder, exploded view.

assembly against tube and secure with ten capscrews (19) and lockwashers (18).

(6) Press new bushing (22) into rod end (1) and turn rod end onto rod (10), tighten jamnut (2).

(7) Install hydraulic slewing cylinder into crane (TM 10-3950-204-20).

64. Turntable and Shipper Support

a. Removal and Disassembly.

(1) Disconnect hydraulic hoses going up and through shipper support (1, fig. 128).

(2) Remove hydraulic lift cylinder (TM 103950-204-20).

(3) Remove shipper and boom (para. 66).

(4) Disconnect hydraulic slewing cylinder at turntable connecting arm (TM 10-3950204--20).

(5) Remove socket head capscrews that secure shipper support to inner race of bearing (2). Remove shipper support.

(6) Remove roll in (6) that secures connect 114 ing arm (8) to pin in slewing bottom plate (3). Remove collar (5) and connecting arm.

(7) Remove socket head capscrews (4) that secure bottom plate (3) to inner race of bearing. Remove bottom plate.

(8) Remove socket head capscrews (11) that secure the outer race of the bearing to frame. Remove bearing.

b. Cleaning, Inspection and Repair.

(1) Clean all metal parts with an approved cleaning solvent. Wipe off dirt, dust, and grease and oil deposits.

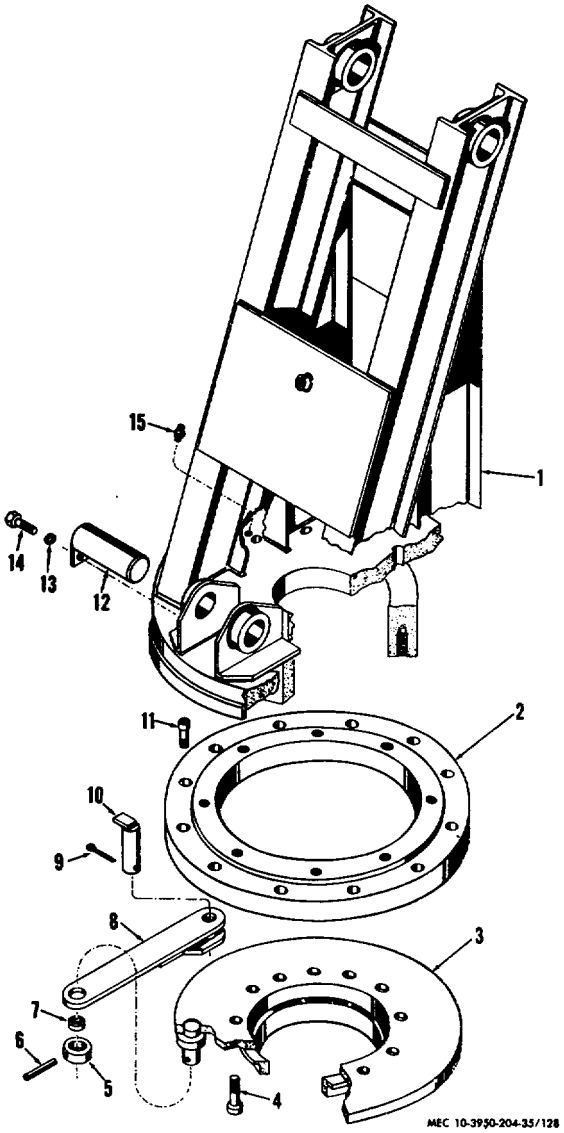
(2) Inspect all part for wear, distortion, or other damage; replace defective parts.

c. Reassembly and Installation.

(1) Install socket head capscrew (1, fig. 128) that secure outer race of hearing (2) to frame.

(2) Position bottom plate (3) to inner face of bearing and secure with socket head capscrews (4).

(3) Position connecting arms (8) on bottom plate pins and secure arms to pins with collar (5) and roll pin (6).
(4) Install socket head capscrews that secure shipper support (1) to inner race of bearing.
(5) Connect hydraulic slewing cylinder to connecting arm (TM 10395-204-20).



1 Shipper support
2 Bearing
3 Bottom plate
4 Capscrew
5 Collar
6 Roll pin
7 Bushing
8 Connecting arm
9 Cotter pin
10 Pin
11 Capscrew
12 Pin
13 Lockwasher
14 Capscrew
15 Fitting

Figure 128. Turntable and shipper support, exploded view.

(6) Install shipper and boom on shipper support (para. 66).
(7) Install hydraulic lift cylinder (TM 103950-204-20).
(8) Connect hydraulic hoses.

65. Hydraulic Lift Cylinder

a. Removal and Disassembly.
(1) Remove hydraulic lift cylinder (TM 103950-204-20).
(2) Remove twelve capscrews (19, fig. 129) and lockwashers (18) that secure cylinder head (6) to cylinder tube (17). Remove rod (1), cylinder head assembly and piston assembly (9 thru 13) from cylinder tube.
(3) Remove cotter pin (15) and slotted nut (14) that secure piston assembly to rod. Remove cup follower (13), piston cup (12) and piston (10). Remove O-ring (9) from piston and press bushing (11) off of piston.
(4) Remove cylinder head (6) from piston rod. Remove O-ring (8), four capscrews (3) and lockwashers (4) that secure seal (5) to cylinder head. Remove seal and press off bushing (7).
(5) Remove alemite fittings (2) and press off bushings (16) from rod end (1) and tube end (17).

b. Cleaning, Inspection and Repair.
(1) Discard all unserviceable parts.
(2) Clean all metal parts in an approved cleaning solvent; dry thoroughly with compressed air.
(3) Check all metal parts for corrosion, cracks, burs, breaks, distortion, or other damage. Check contact areas for scoring or wear. Remove burs with a fine stone. Replace all damaged parts.

c. Reassembly and Installation.
(1) Immerse all parts in clean hydraulic oil for lubrication before reassembly.
(2) Install alemite fittings (2, fig. 129) and press bushings (16) into rod end (1) and tube end (17).
(3) Position seal (5) in head (6) and secure with four capscrews (3) and lockwashers (4). Press bushing (7) into cylinder head and install O-ring (8). Slide cylinder head assembly onto piston rod (1).
(4) Press bushing (11) onto piston (10) and install O-ring (9) into piston.
(5) Slide piston onto rod and position piston cup (12) and cup follower (13) against

piston. Secure piston, piston cup, and cup follower to rod with slotted nut (14) and cotter pill (15).

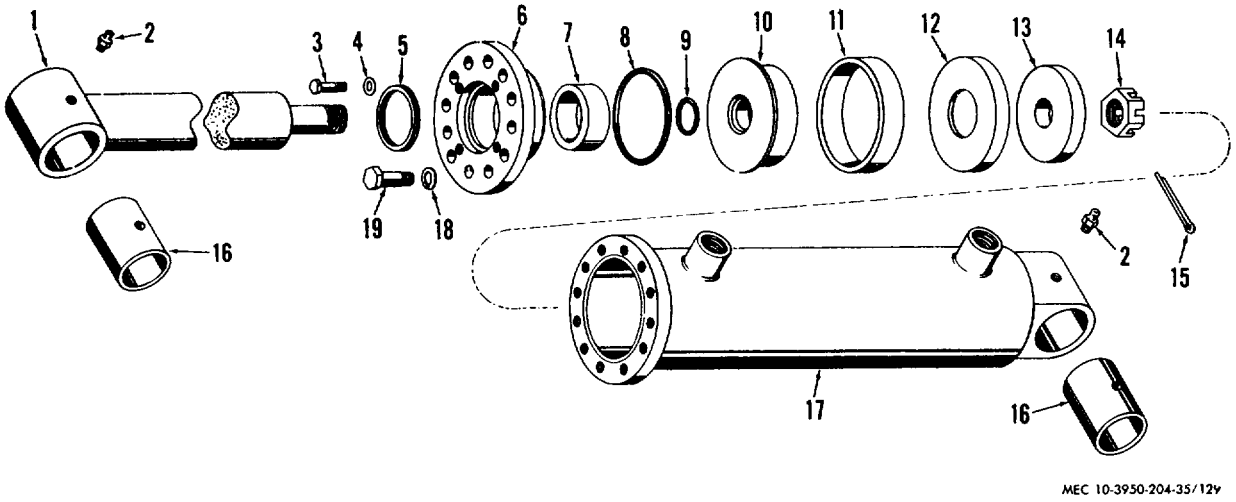
(6) Slide rod assembly into cylinder tube (17) and secure head (6) to tube with twelve capscrews (19) and lockwashers (15).

(7) Install hydraulic lift cylinder to crane (TM 10-3950-204-20).

(2) Remove two capscrews (52), lockwashers (49) and nut (45) that secure sleeve (50) and spacer (51) to boom point. Remove sleeves and spacers.

(3) Remove hydraulic crowd cylinder (TM 10-3950-204-20). This allows boom (4) to separate from shipper (20).

(4) Remove capscrews (12) and lockwashers



1	Rod	6	Head	11	Bushing	16	Bushing
2	Fitting	7	Bushing	12	Piston cup	17	Cylinder tube
3	Capscrew	8	O-ring	13	Cup follower	18	Lockwasher
4	Lockwasher	9	O-ring	14	Nut	19	Capscrew
5	Seal	10	Piston	15	Cotter pin		

Figure 129. Hydraulic lift cylinder, exploded view.

66. Shipper and Boom

a. Removal.

(1) Disconnect hydraulic hose connections at crowd cylinder winch motor.

(2) Remove capscrew (16, fig. 130) and lockwasher (15) that secures pin (14) to shipper. Remove pin. This allows lift cylinder to be removed from shipper.

(3) Remove cable from hook block (para 68).

(4) Remove capscrew (17) and lockwasher (18) that secures pivot pin (19) in shipper and shipper support. Remove pivot !in and shipper and boom.

b. Disassembly.

(1) Remove capscrews (1, fig. 130) and lockwashers (20 that secure sheave pin (3) in boom point. Remove sheave pin, sheave (46), and thrust washers (48). Remove grease fitting (31) and bearing (47) from sheave (46).

(13) that secure boom adjusting shaft (11) in shipper. Remove capscrews (12) and lockwasher (13) that secure shim (26) and cap (27) to shipper; remove cap and shim.

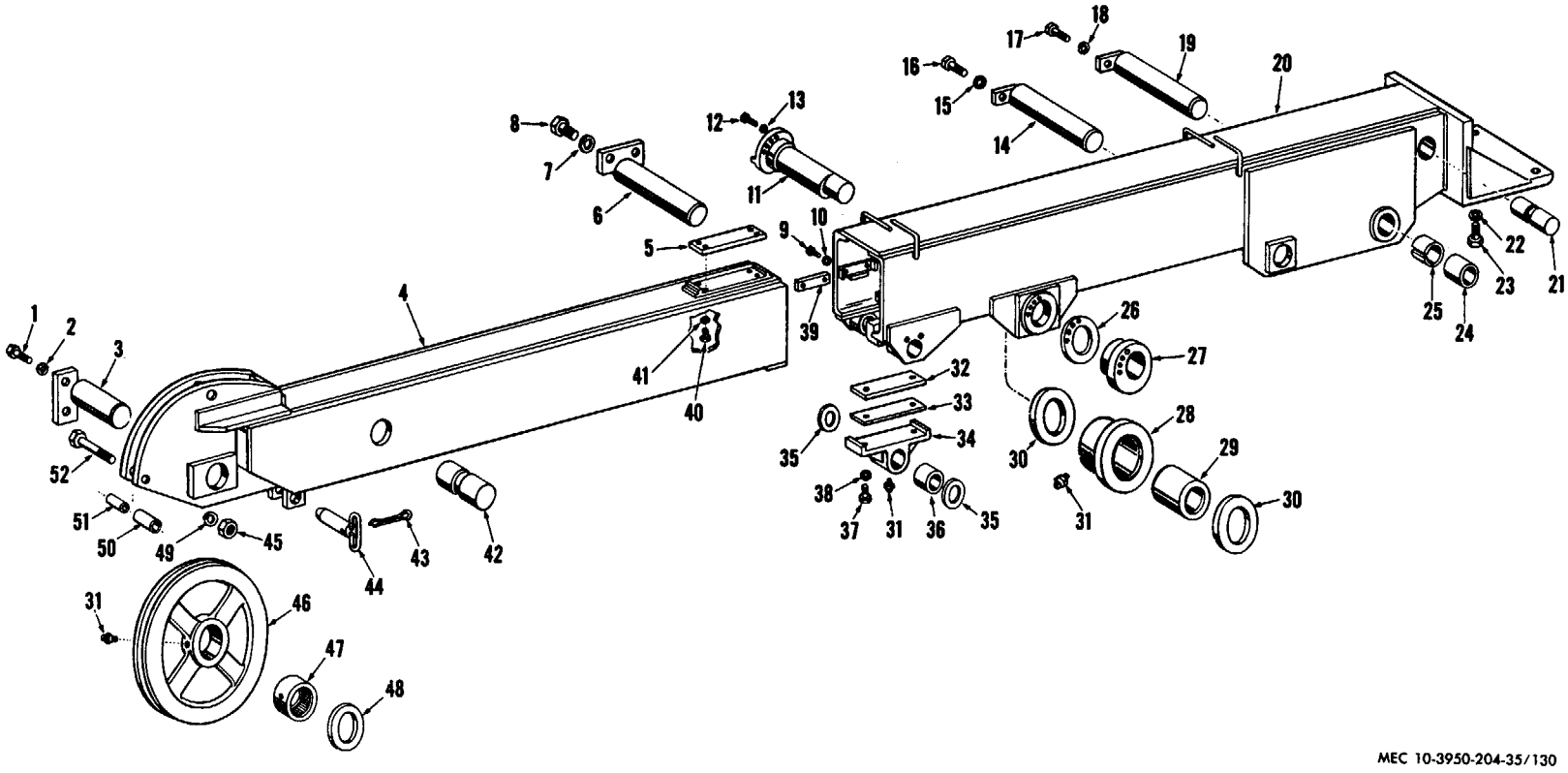
(5) Remove boom adjusting shaft (11), thrust lockwasher (30), adjusting rollers (28) and press out bushings (29) from adjusting rollers after removing fittings (31).

(6) Remove cap)screws (8) and lockwashers (7) that secure wear shoe shaft (6) in shipper. Remove two thrust washers (35) and shoes (34).

(7) Remove capscrews (37) and lockwashers (38) that secure wear shoe plates (32) and shims (33). Remove fitting (31) from wear shoes (34) and press out bushing (36).

(8) Remove capscrews (9) and lock nut (10) that secure side wear plates (39) to shipper. Remove plates.

(9) Remove capscrews (40) and lockwire (41)



1	Capscrew	12	Capscrew	23	Capscrew	34	Wear shoe	45	Nut
2	Lockwasher	13	Lockwasher	24	Bushing	35	Thrust washer	46	Sheave
3	Sheave pin	14	Pin	25	Bushing	36	Bushing	47	Needle bearing
4	Boom	15	Lockwasher	26	Shim	37	Capscrew	48	Thrust washer
5	Wear plate	16	Capscrew	27	Roller cap	38	Lockwasher	49	Lockwasher
6	Wear shoe shaft	17	Capscrew	28	Adjusting roller	39	Plate	50	Sleeve
7	Lockwasher	18	Lockwasher	29	Bushing	40	Capscrew	51	Spacer
8	Capscrew	19	Pivot pin	30	Thrust washer	41	Lockwire	52	Capscrew
9	Capscrew	20	Shipper	31	Fitting	42	Pin		
10	Locknut	21	Pin	32	Plate	43	Clinch pin		
11	Adjusting shaft	22	Lockwasher	33	Shim	44	Cable eye pin		

Figure 130. Shipper and boom, exploded view.

that secure top wear plate (5) Remove plate.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts with an approved cleaning solvent. Wipe off dirt, dust, grease and oil deposits.

(2) Inspect all metal parts for wear, distortion, or other damage; replace defective parts.

(3) Inspect bushings for wear, scoring, distortion, or other damage; replace bushing if damaged.

d. Reassembly.

(1) Install top wear plate (5, fig. 130) to boom and secure with capscrews (40) and lockwire (41).

(2) Install side wear plates (39) to shipper and secure with capscrews (9) and locknut (10).

(3) Press bushings (36) into wear shoes (34) and install fittings (31). Place wear shoe plates (32) and shims (33) on wear shoes (34) and secure with capscrews (37) and lockwashers (38).

(4) Place wear shoe shaft (6) thru one side of shipper and install wear shoe assemblies. Push shaft thru other side and secure shaft to shipper with capscrews (8) and lockwashers (7).

(5) Press bushings (29) in adjusting rollers (28) and install grease fittings (31). Push boom adjusting shaft (11 thru one side of shipper and install thrust washers (30(; and adjusting rollers (28i. Pus:,, shaft thru other side and secure shaft :,. shipper with shim (26). cap (27). ca:)screws (12) and lockwashers (13).

(6) Install hydraulic crowd cylinder (TM 103950-204-20).

(7) Install sleeve (50) and spacer '51); secure them to boom point with capscrews (52) lockwashers (49) and nuts (45).

(8) Press needle bearing (47) in sheave (46) and install grease fitting (31).

(9) Push sheave pin (3) thru one side of boom point and slide thrust washers (48) and sheave assembly onto pin; push pin through other side and secure with capscrews (1) and lockwashers (2).

e. Installation.

(1) Install shipper and boom on shipper support and secure with pivot pin (19). Secure pin to shipper with capscrews (17) and lockwashers (18).

(2) Install lift cylinder and secure cylinder to shipper with pin (14), capscrew (16) and lockwasher (15).

(3) Install cable over sheave on boom point and hook block (par. 68).

(4) Connect hydraulic hose to crowd cylinder and winch motor.

67. Hydraulic Crowd Cylinder

a. Removal and Disassembly.

(1) Remove hydraulic crowd cylinder (TM 10-3950-204-20).

(2) Remove ten capscrews (20, fig. 131) and lockwashers (19) that secure cylinder head (8) to cylinder tube (18).

(3) Remove cotter pin (17) and slotted nut (16) that secure piston assembly to rod (10). Remove cup followers (11), piston cups (12), pistons (13), from rod. Separate piston halves (13) and remove bushing (15) and O-ring (14).

(4) Remove roll pin (22) and turn rod end (1) off of rod (10).

(5) Slide cylinder head assembly off of rod.

(6) Remove O-ring (9) from head (8). Remove four capscrews (23) and lockwashers (21) that secure packing gland (4) to head. Remove rod wiper (3), and press bushing (5) out of packing gland. Remove packing (6) and press bushing (7) out of head.

b. Cleaning, Inspection and Repair.

(1) Discard all unserviceable parts.

(2) Clean all metal parts in an approved cleaning solvent; dry thoroughly wit, compressed air.

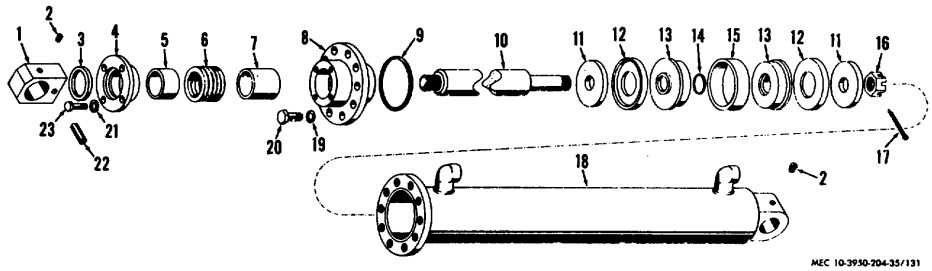
(3) Check all metal parts for corrosion, cracks, burs, breaks, distortion, or other damage. Check contact areas for scoring or wear. Remove burs with a fine stone. Replace all' damaged parts.

(4) Replace all seals, packings, and other unserviceable parts.

c. Reassembly and Installation.

(1) Press bushing (7, fig. 131) into cylinder head (8). Press bushing (5) into packing gland (4). Insert packing (6) into head and secure packing gland (4) into head with four capscrews (23) and lockwashers (21). Install rod wiper (3) and O-ring (9).

(2) Slide cylinder head assembly on to rod (10).



1	Rod end	7	Bushing	13	Piston	19	Lockwasher
2	Setscrew	8	Head	14	O-ring	20	Capscrew
3	Rod wiper	9	O-ring	15	Bushing	21	Lockwasher
4	Packing gland	10	Rod	16	Nut	22	Roll pin
5	Bushing	11	Piston follower	17	Cotter pin	23	Capscrew
6	Packing	12	Piston cup	18	Tube		

Figure 131. Hydraulic Crowd Cylinder, Exploded View.

(3) Turn roll end (1) on rod and secure wit]i roll pin (22).

(4) Press bushing (15) into one half of piston (13) and install O-ring (14). Press other half of piston (13) into bushing (15). Place piston cups (12) piston followers (11) on both sides of piston assembly. Install piston assembly on rod and secure with slotted nut (16) and cotter pin (17).

(5) Place piston rod assembly into cylinder tube (18) and secure head to tube with ten capscrews (20) and lockwashers (19).

(6) Install hydraulic crowd cylinder in boom and shipper (TM 10-3950-204-20)

Section XII. HOOK BLOCK

68. Hook Block

a. Removal.

(1) Remove clinch pin (43, fig. 130) from cable eye pin (44).

(2) Remove nuts and U-bolts that hold cable eye to cable. Remove cable eye pin and pull cable through sheave (9, fig. 132) in hook block until it is free of hook block.

b. Disassembly.

(1) Remove set screws (1, fig. 132) and adjusting nuts (2).

(2) three nuts (21) and spacer bolt (13) that secure side shells (3).

(3) Remove cotter pins (14) that secure trunnion (18) to side shells. Remove roll pin (4), washers (15), spacer (16) and side shells 93).

(4) Remove filler piece (6), becket (12), becket spreader (7) and center pin (5). Remove oil shields (8) and press bearing (11) out of sheave (9). Remove fitting (10) from sheave and remove sheave.

(5) Remove fitting (10) from thrust collar (20) and turn hook (17) out of collar. Press bearing (19) out of trunnion (18).

c. Cleaning, Inspection and Repair

(1) Clean all metal parts of the hook block with an approved cleaning solvent. Wipe off dirt, dust, grease and oil deposits.

(2) Inspect all metal parts for wear, distortion, or other damage; replace defective parts.

d. Reassembly.

(1) Press bearing (19, fig. 132) into trunnion (18). Place hook (17) into trunnion and bearing and secure with thrust collar (20). Install fitting (10) into collar.

(2) Press bearing (11) into sheave (9) and install fitting (10) into sheave.

(3) Install center pin (5) into sheave bearing (11) and place oil shields (8) on bearing (11). Slide becket (12) and filler piece (6) on pin (5).

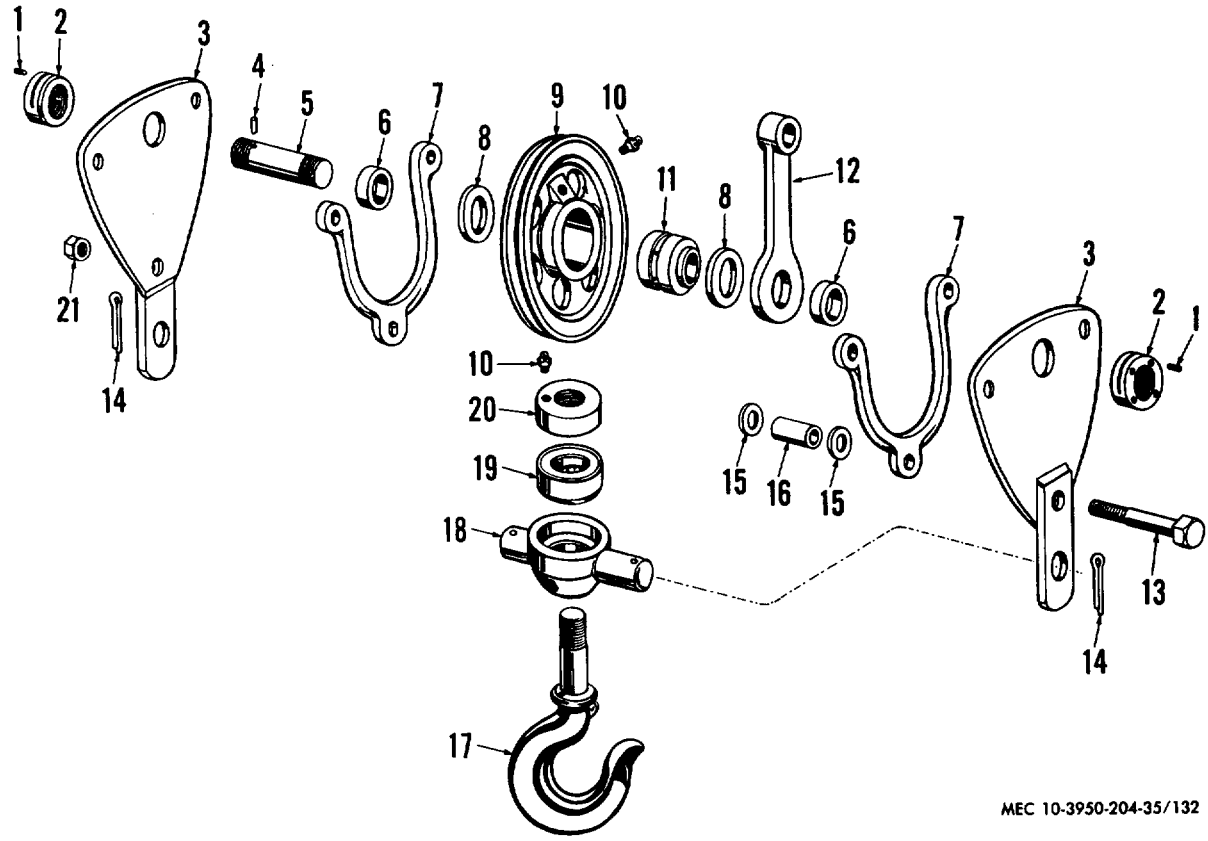
(4) Install trunnion (18) and pin (5) into side shells (3) and secure with cotter pin (14).

Place becket spreader (7) against side shells and install top two spacer bolts (13) and nuts (21). Secure side shells to pin with roll pin (4), adjusting nut (2) and setscrews (1).

(5) Install bottom spacer bolt (13), washers (15) and spacer (16); secure with nut (21).

e. Installation.

(1) Install cable eye pin (44, fig. 130) in boom point and lock in place with clinch pin (43). Position cable on sheave (9, fig. 132) in hook block and tie cable down at cable eye pin with U-bolts and nuts.



1	Setscrew	6	Filler piece	11	Bearing	16	Spacer
2	Adjusting nut	7	Becket spreader	12	Becket	17	Hook
3	Side shell	8	Oil shields	13	Spacer bolts	18	Trunnion
4	Roll pin	9	Sheave	14	Cotter pin	19	Bearing
5	Center pin	10	Fitting	15	Washer	20	Thrust collar
						21	Nut

Figure 132. Hook block, exploded view.

APPENDIX I

REFERENCES

1. Dictionaries of Terms and Abbreviations

AR 320-5	Dictionary of United States Army Terms.
AR 32050	Authorized Abbreviations and Brevity Codes.

2. Fire Protection

SB 5-111	Supply of DA Approved Fire Extinguishers to Army Troop Users.
TM 5-687	Repair and Utilities: Fire Protection Equipment and Appliances: Inspections, Operations and Preventive Maintenance.

3. Lubrication

LO 10-3950-204-20

4. Operating Instructions

	Operator's Manual:
TM 10-3950-204-10	Crane, Truck, Warehouse, Slewing, Boom, Gasoline, Front Wheel Drive, Pnuematic Tires, 10,000 Lb. Capacity, Pettibone-Mulliken Model 10F, Army Model MHE 195, FSN 3950-723-3295.

5. Painting

TM-9-213	Painting Instructions for Field Use.

6. Preventive Maintenance

AR 750-5	Organization, Policies and Responsibilities for Maintenance Operation.
TB ENG 347	Winterization Techniques for Engineer Equipment.
TM 5-764	Electric Motor and Generator Repair.
TM 9-207	Operation and Maintenance of Army Materiel in Extreme Cold Weather (0° to 650 F.).
TM 9-6140-200-15	Operation and Organizational Field and Depot Maintenance: Storage Batteries, Lead-Acid Type.
TM 38-750	Army Equipment Record Procedures.

7. Publications Indexes

DA Pam 108-1	Index of Army Motion Pictures, Filmstrips-Slides, Tapes, and Phono-Recordings.
DA Pam 310-1	Index of Administrative Publications.
DA Pam 310-2	Index of Blank Forms.
DA Pam 310-3	Index of Training Publication.
DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Order.
DA Pam 310-5	Index of Graphic Training Aids and Devices.

8. Radio Interference Suppression

TM 11-483	Radio Interference Suppression.

9. Shipment and Limited Storage

AR 743-505	Limited Storage of Corps of Engineers Mechanical Equipment.
TM 38-230	Preservation, Packaging, and Packing of Military Supplies and Equipment.

10. Supply Publications

C-9100IL	FSC Group 91; Fuels, Lubricants, Oils and Waxes.

11. Training Aids

FM 21-5	Military Training.
FM 21-6	Techniques of Military Instruction.
FM 21-30	Military Symbols.

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NG: State AG (3).

USAR: None.

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

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