

TOWMOTOR

SERVICE MANUAL

FORK LIFT TRUCKS *and* TRACTORS

MODEL 350



TOWMOTOR CORPORATION

18100 Euclid Avenue

Cleveland, Ohio 44112

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SERVICE TOWMOTOR MANUAL

When installing rollers, place thrust washer between bearing and carriage frame. Replace roller expansion plug if it shows signs of leaking grease.

Place carriage in operating position in mast inner channel, using a chain hoist. Install top cross bar. Raise cylinder plunger until pull-down rod engages hole at center of cross bar and secure rod with nut. Raise plunger until block at base of inner channel can be removed. Raise carriage with chain hoist until chain can be connected with ease, and block in this position. Connect chain to carriage. Remove carriage block and check chain adjustment.

CROSSHEAD

REPLACEMENT

Replace Crosshead. Raise carriage until mast inner slide is lifted about ten inches. Block carriage and inner slide in this position. Remove nut at top of pull-down rod. Operate lever to lower cylinder plunger. Disconnect lift chains. Remove screws fastening crosshead to plunger. Remove crosshead and lift rod assembly.

Before installing crosshead, insert pull-down rod through hole at center of crosshead. Then place crosshead on plunger and secure with screws. Place chains on rollers and connect to outer channel cross bar. Operate control lever to lift cylinder plunger until pull-down rod engages hole in top cross bar and secure pull-down rod with nut. Raise inner channel and carriage and remove blocks.

Replace Crosshead Rollers. Raise carriage until mast inner slide is lifted about 10 inches. Block carriage in this position. Operate lever to lower cylinder plunger. Disconnect lift chains. Remove snap rings and rollers, then bearings can be replaced. When installing bearings and rollers, place a thrust washer at each side of roller.

With bearings and rollers secured with lock rings, engage chains with rollers and connect to outer channel cross bar. Remove carriage block.

LIFT CHAINS

REPLACEMENT

Replace Lift Chains. Raise carriage approximately 1 foot. Block carriage in this position and lower cylinder plunger to release tension on chains. Disconnect chains at outer channel cross bar and remove nut from adjusting bolt.

To install chains, connect link to outer channel cross bar, engage chain with rollers, and connect adjusting bolt to carriage. Tighten lever nut on adjusting bolt about 1 inch, then check chain adjustment (See following paragraph).

ADJUSTMENT

Adjust Lift Chain Length. Lower carriage to the lowest point and tilt mast in a vertical position. Turn chain adjusting bolt nuts to raise or lower carriage until bottom of forks just clear the floor with all slack removed from chain. Secure lock nut after adjusting chain.

TOWMOTOR

SERVICE MANUAL

MODEL LT35

The Service Manual is divided into major sections which are listed on the right side of this page. Quick reference to these sections can be made by placing the right thumb on the arrow of the desired section, bending the book back, and thumbing the pages to the corresponding tab.

FOREWORD

The service and repair information contained in this manual covers the lift trucks being currently produced and sold by the Towmotor Corporation. In many instances you will find recommendations for use of new improved parts when replacement is necessary. These are included so that you may derive all the benefits that are incorporated in the newer lift trucks.

Older models have not been completely illustrated or described in detail. However, the service instructions will apply in general to these units as they are basically the same in construction and operation.

In making parts replacements, be sure to use genuine Towmotor Repair Parts. Use of substitute parts results in lower operating efficiency of the lift truck.

SERVICE DEPARTMENT
TOWMOTOR CORPORATION

GENERAL INFORMATION
AND LUBRICATION

ENGINE

CLUTCH

FUEL SYSTEM

EXHAUST SYSTEM

COOLING SYSTEM

ELECTRICAL SYSTEM

TRANSMISSION

UNIVERSAL JOINTS

DRIVE AXLE

STEERING AXLE

STEERING

BRAKES

SPRINGS

HYDRAULIC SYSTEM

MODEL LT35

GENERAL INFORMATION

DESCRIPTION

Your Model LT35 lift truck is designed and engineered with the knowledge of 30 years experience, and if properly maintained, will give you years of satisfactory service.

The Towmotor is so designed that assemblies are accessible and can be repaired or replaced easily and quickly, thus keeping operating and maintenance costs at a minimum.

The driving controls and operation are of the conventional type with the exception of the steering axle which is located at the rear of the truck. The vehicle is equipped with a mechanical band-type brake mounted on the transmission.

The lifting and driving controls are located so that they are easily manipulated from the operator's compartment.

A towing eye can be attached to the rear of the frame for towing purposes.

terial is removed from stuffing box, then install new packing.

When installing rings (one at a time in sequence listed in the following paragraphs), make certain that the ring lip is worked in smoothly and that ring is not twisted or distorted. Use a small screw driver to start rings into stuffing box. Then use a blunt-end tool to push the rings to the bottom of the stuffing box. A special packing tool can be made for this purpose (See Figure 75).

First, install the molded forming ring (flat side down). NOTE: This ring provides a seat for the succeeding rings. Then install 4 leather rings, one rubber ring, one leather ring, one rubber ring, in that sequence, and repack the remaining area in the stuffing box with leather rings until there is 0 to 1/16 compression after gland nut is tightened. Before installing gland nut, insert new wiper ring at inside of nut. This ring may be of the felt type or may consist of a rubber ring with or without an expander ring mounted beneath it. Figure 76 illustrates the type with rubber wiper ring. When installing rubber ring type wiper, eliminate the expander ring as use of this ring has been discontinued.

After cylinder is repacked, connect piston rod eye to lift cylinder with pin. Secure pin with cotter pins and install plate on cowl panel.

Replace Tilt Cylinder Piston Cups or Packing. If mast tilts too slowly, check tilt cylinder operation as follows: Tilt mast forward to the extreme forward tilt position. Disconnect hose at the tilt cylinder front connection. While holding lever in the forward tilt position, check for oil flow through the disconnected opening. If oil flows out of opening, remove tilt cylinder and replace piston cups or packing as follows:

Loosen set screw or clamp screw in pivot eye and unscrew eye from piston rod. Loosen packing gland nut, then unscrew stuffing box, using a spanner wrench. Withdraw complete piston assembly from cylinder tube. Place piston rod in soft-jawed vise, unscrew nut, and remove piston and cups or packing from rod.

To reassemble old type cylinder: Place gasket, piston half, cup, spacer, cup, piston half on rod in that order, then secure with nut. NOTE: Make certain cup friction lips point in opposite directions. On new type cylinder, place seal ring in piston, packing in recess of piston, and piston on rod, then secure with nut and cotter pin. Install new seal ring on stuffing box and make certain tube is thoroughly cleaned before assembling cylinder. Carefully start piston rod in tube, taking care not to distort piston cups or packing. A special tool has been designed to eliminate any trouble encountered when replacing packing (See Figure 75). It can either be put in the cylinder tube before assembling the piston or slid over the packing before assembly. Push

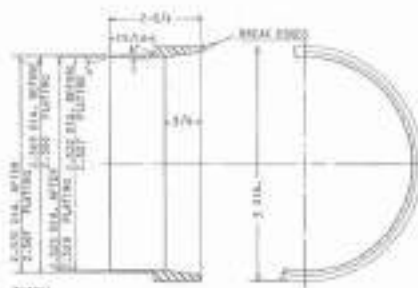


Fig. 75. Special Ring for Inserting Piston into Tilt Cylinder Tube

piston rod assembly all the way into cylinder. Install and tighten stuffing box. If gland nut leaks or if packing has been removed, repack cylinder as described in the preceding procedure. If repacking is not necessary, tighten gland nut securely.

MAST

REPLACEMENT

Replace Mast Assembly. Place receptacle under cylinder to catch oil that will drain from cylinder when oil line is disconnected. Disconnect oil line at lift cylinder. Remove pin to disconnect tilt cylinder. Remove lift forks. Remove mast support shaft pivot bolts. Remove mast assembly, using heavy lift equipment such as another TOWMOTOR or chain hoist.

Before installing mast assembly, coat mast support shaft with chassis lubricant. Install mast assembly, using heavy lift equipment. Install pivot bolts. Connect tilt cylinder to lift cylinder and connect oil line. Fill and bleed hydraulic system.

CARRIAGE

REPLACEMENT

Replace Carriage and Rollers. Raise carriage until mast inner channel extends about 5 inches. Block carriage and inner channel in this position, placing block at the bottom of inner channel so that top cross bar can be removed. Lower cylinder plunger to release tension on chains. Disconnect chains at carriage. Disconnect pull-down rod from top cross bar. Remove top cross bar. Fasten chain hoist to carriage and lift carriage out of inner channel.

The rollers and bearings can be replaced by unscrewing lubricant fitting and cotter pin lock nut.

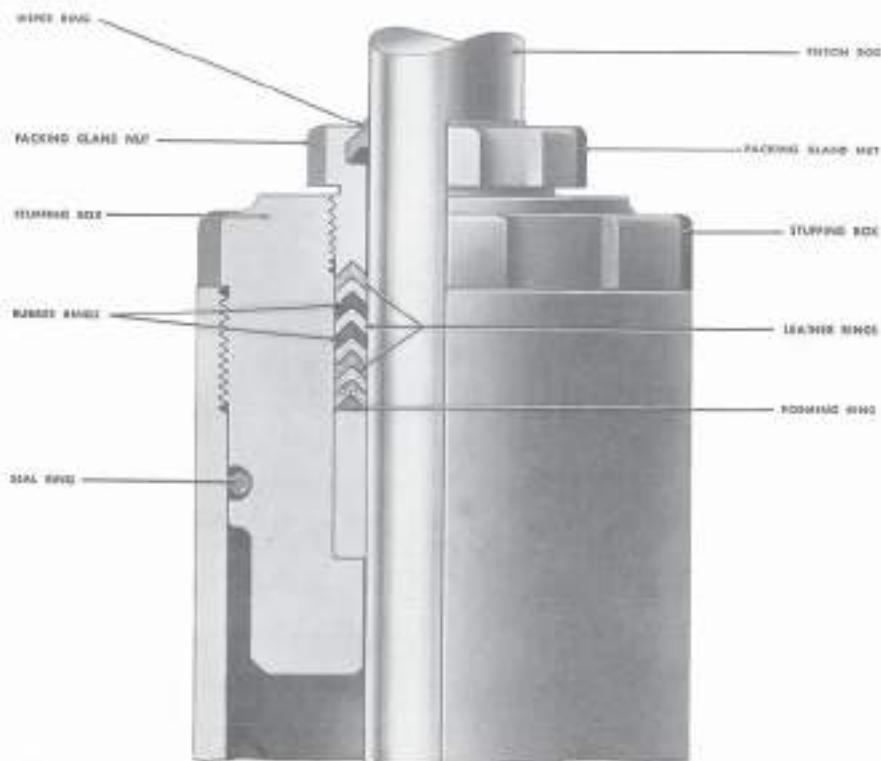


Fig. 28. Tilt Cylinder Packing Sequence

REPLACEMENT

Replace Tilt Cylinder. Remove left body side plate and plate at front of cowl panel so that tilt cylinder is more accessible. Disconnect all lines and remove pins fastening tilt cylinder to lift cylinder and to frame bracket. Remove tilt cylinder assembly.

Before reinstalling tilt cylinder, coat pivot pins with chassis lubricant. Place tilt cylinder in mounting position and connect to frame bracket and lift cylinder with pins. Secure pins with cotter pins. Connect oil lines. Bleed hydraulic system and fill to correct level.

TILT CYLINDER REPAIR

Repair Tilt Cylinder Oil Leak. If there is only a slight seepage of oil past the cylinder packing gland

out, tighten nut. If leak does not stop or is excessive, inspect cylinder as follows:

Tilt mast forward and inspect cylinder piston rod for scratches or scored condition. Remove scratches or scores, using a fine emery paper, then polish with crocus cloth. If rod will not clean up to a smooth finish, it is recommended that the cylinder assembly be replaced. **NOTE:** If a cylinder with a scratched or scored rod is repacked, the new packing will soon be cut and will leak oil. If piston rod is O.K., remove plate at front of cowl panel and re-pack cylinder as follows:

Tilt mast forward. Disconnect tilt cylinder at lift cylinder and compress piston rod. Remove packing gland nut, using a spanner wrench to prevent damaging nut. Pull out old packing rings, using a sharp pointed tool. Make certain old packing ma-

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GENERAL INFORMATION

SPECIFICATIONS AND PERFORMANCE DATA

For specifications and performance data on your TOWMOTOR, refer to the same plates mounted on the truck. For information items that are not covered on these plates, contact the TOWMOTOR CORPORATION at Cleveland, Ohio.

SERIAL NUMBER LOCATION

Battery - Embossed in connecting strap between cells.

Carburetor - Stamped on metal disk riveted to top of throttle body.

Distributor - Stamped in plate on distributor body.

Engine - Stamped in plate on cylinder block at oil filler.

Generator - Stamped in plate on inspection band.

Starting Motor - Stamped in plate on inspection band.

Vehicle - Stamped in plate on top of cowl.

CAPACITIES

Cooling System	8 qts.
Crankcase	3½ qts.
Fuel Tank	3½ gals.
Hydraulic System	3 gals.
Steering Gear	1½ pts.
Transmission - Differential	2 pts.

OPERATION

PLACING NEW TOWMOTOR INTO SERVICE

The TOWMOTOR is shipped with gasoline drained. Cooling system is filled with water in summer and anti-freeze in winter. Crankcase is filled with oil to correct level. One battery terminal is disconnected.

Because the above conditions may vary in some instances, it is imperative that the following items be checked before starting engine.

1. Check fuel in tank and fill if necessary.
2. Check water level in radiator (or anti-freeze in water).
3. Check crankcase oil level. (It is recommended that oil be changed after the first few days of operation).

CONTROLS AND INSTRUMENTS

Location and identity of the driving and lifting controls are illustrated in Figure 2.



Fig. 2. Driving and Lifting Controls

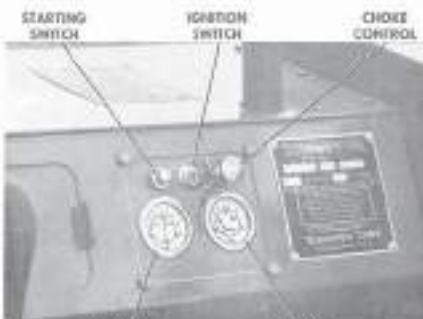


Fig. 3. Instrument Panel

The switches, instruments and carburetor choke control are mounted on the instrument panel as shown in Figure 2.

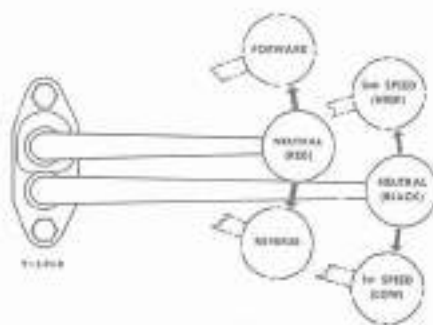


Fig. 3. Transmission Shift Lever Positions

OPERATING VEHICLE

The following instructions are based on past experience and should be helpful in getting fully acquainted with your TOWMOTOR.

Starting. Place transmission shift levers in neutral position (Figure 3). Depress brake pedal and engage ratchet. Pull choke button out half-way (full-out in cold weather). Depress accelerator pedal slightly. Turn key to 'on' position, depress clutch pedal, and press starting switch button to start engine. Before operating the lift equipment or driving the vehicle, allow engine to operate at a fast-idle, pushing the choke button in gradually as the engine warms up.

Driving. The vehicle is equipped with a four-speed transmission (two speeds, forward; two speeds, reverse). Figure 3 illustrates the shift lever positions for those various speeds. The short shift lever (red knob) determines direction of travel (forward and reverse). The long shift lever (black knob) determines speed ratio (high and low). **CAUTION: Always start vehicle in low (first) speed when carrying a load or ascending a grade.**

To drive vehicle forward, pull long lever to the rear and push the short lever forward, accelerate engine and release clutch pedal slowly. When sufficient speed has been reached in the low (starting) speed range, remove foot from accelerator pedal and depress clutch pedal. Then push long shift (black knob) lever forward, accelerate engine and release clutch pedal.

To operate vehicle in reverse, pull short lever (red knob) to the rear and follow same directions as outlined above. **CAUTION: Always stop vehicle completely when shifting short shift lever (red knob) in change direction of travel.**

Stopping. Release accelerator pedal and depress brake pedal gradually. Before truck comes to a complete stop, depress clutch pedal to release clutch and prevent engine from stalling.

Parking Brake. When the brake pedal is depressed, a ratchet engages a dog attached to the floor plate and holds the pedal in the applied position to provide a parking brake (Figure 1). To release pedal, tilt rear of pedal pad.

OPERATING LIFT EQUIPMENT

The levers that control lifting and tilting of the hoist mechanism are located in front of the operator within easy reach.

Lifting. Lifting and lowering action is controlled by the left-hand lever (black knob). Pull the lever back to lift or push the lever forward to lower. When the lever is released, it will automatically return to the intermediate position, which is neutral.

The speed of lifting is controlled by the speed of the engine and position of the lever. Slight acceleration of the engine and gradual movement of the control lever from neutral to lifting position will produce a slow lifting action. Increase speed of engine and pull lever back as far as possible to increase speed of lifting.



Fig. 4. Lift Equipment Operating Positions

TYLT CYLINDER

DESCRIPTION

Two types of tilt cylinders were used on Model LT35. Outwardly the appearance of each is similar, except for the pivot eye. On the old style a set screw holds the pivot eye to the piston rod, while on the new style a screw, nut, and lockwasher clamp the pivot eye to the rod. The inner parts differ greatly, the main difference being in the piston. On the old style the piston consists of two halves covered by leather cups, and separated by a spacer. On the new style the piston is one piece, and is sealed by a packing set in a recess provided for it.

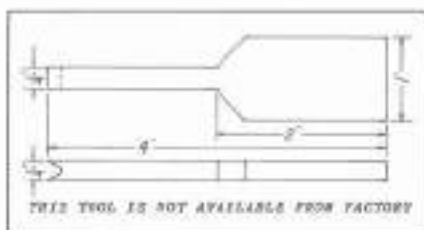


Fig. 15. Special Tool for Reworking Tilt and Lift Cylinders (Made from either hard wood or steel)

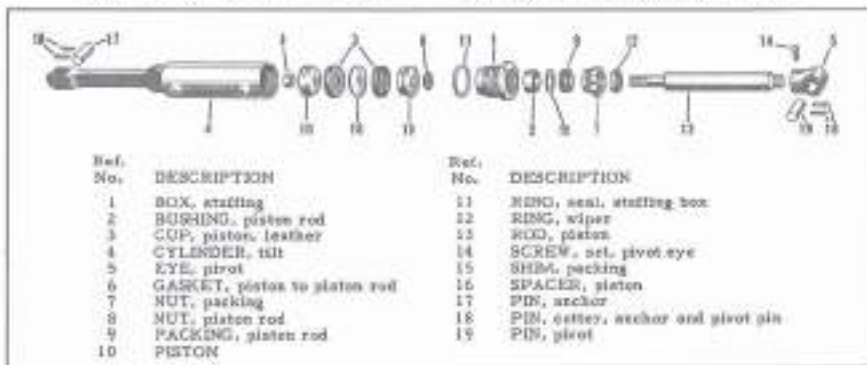


Fig. 16. Tilt Cylinder and Mounting (Old Type)



Fig. 17. Tilt Cylinder and Mounting (New Type)

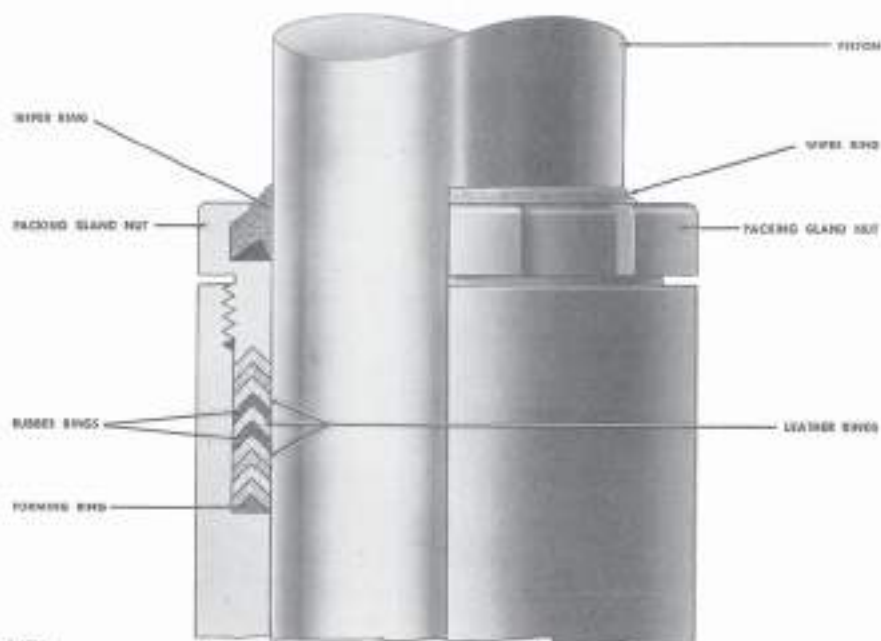


Fig. 14. Lift Cylinder Packing Sequence

Raise carriage until inner channel extends about 19 inches. Block these items in this position. Lower cylinder plunger just enough to release tension on lift chains. Disconnect lift chains. Remove screws fastening crosshead. Pry cylinder plunger down with a pry bar or wood block.

Remove packing gland nut, using a spanner wrench to prevent damaging nut. Pull out old packing rings, using a sharp pointed tool. Make certain all old packing material is removed from stuffing box, then install new packing.

When installing rings (one at a time in sequence listed in the following paragraphs), make certain that the ring lip is worked in smoothly and that ring is not twisted or distorted. Use a small screw driver to start rings into stuffing box. Then use a blunt-end tool to push the rings to the bottom of the stuffing box. A special packing tool can be made from either hard wood or steel as shown in Figure 15.

First, install the milled forming ring (flat side down). This ring provides a seat for the succeeding rings. Then install 4 leather rings, one rubber

ring, one leather ring, one rubber ring, in that sequence and repack the remaining area in the stuffing box with leather rings until there is "O" to "1/16" compression after gland nut is tightened.

Before installing gland nut, insert new wiper ring at inside of nut. This ring may be of the felt type or may consist of a rubber ring with or without an expander ring mounted beneath it. Figure 16 illustrates type with rubber wiper ring. When installing rubber ring type wiper, eliminate the expander ring as use of this ring has been discontinued.

With cylinder repacked, operate control lever until plunger reaches crosshead. Connect lower crosshead to plunger. Lower plunger until chains can be connected, then remove blocks.

NOTE: After a few days operation the cylinder packing may tend to swell, resulting in a growling noise when hoist is operated, or carriage may not operate correctly. If these difficulties are encountered, loosen the cylinder packing gland nut one-quarter turn until the plunger operates smoothly without noise.

The lowering speed is controlled by the weight of the load and the position of the control lever. Push the lever forward gradually and slowly to obtain smooth action. To increase speed of lowering, push the lever forward as far as possible. **CAUTION:** To avoid jarring the load, always move the lift control lever gradually and slowly.

Tilting. Tilting of the mast is controlled by the right-hand lever (red knob). Push lever forward for forward tilt or pull the lever back for backward tilt. Speed of the engine controls the speed of tilting action. **CAUTION:** Never tilt an elevated load unless the load is deposited on a stock pile.

Pickup of Load. (Figure 4). Align track with load and adjust fork position to balance the load to be picked up. With mast vertical or tilted backward slightly, lower forks and load. **NOTE:** If picking up a drum or cylindrical object flush with ground, tilt forks until tips touch the ground. Operate vehicle slowly forward until load touches carriage. Tilt mast backward, then raise carriage to lift load about 10 inches.

Transporting Load. (Figure 4). With lift and control levers in neutral position, drive vehicle to desired location. **CAUTION:** Watch for overhead obstruction that mast cannot clear.

Depositing Load. (Figure 4). When the desired location has been reached and the load is raised or lowered to the desired height, tilt mast slightly forward. Drive vehicle forward, placing load in final position, then lower forks until they are free and back vehicle away.

OPERATING SUGGESTIONS and CAUTIONS

For aid in handling your TOWMOTOR in a safe and efficient manner, memorize the following:

Load Capacity. Do not lift or carry loads beyond the rated capacity of the vehicle.

Mast Position. Always lift loads with the mast vertical or in a slightly backward tilt.

Load Position. Never transport loads in a high raised position.

Lift Operation. Do not raise or lower load while traveling. Wait until unloading location has been reached.

Ramp Operation. Always use low gear on down ramps with heavy loads. Always go down a ramp backward when carrying a load.

Stopping and Starting. Avoid sudden stops and starts.

Bulky Loads. Drive backwards when transporting bulky loads. This provides better driving vision.

Bumping. Do not bump loads into position.

Fork Position. Spread forks according to load width. Do not lift with one fork.

General Operation. Do not run over sharp objects, bumps, or curbs.

To Prevent Overturning. Never tilt heavy elevated loads forward except when directly over the unloading place with the load as low as possible.

PREVENTIVE MAINTENANCE

SOME MINUTES ARE WORTH HOURS AND DOLLARS

Repairs cost time and money. So does sluggish performance. Avoid them by giving your Towmotor a few minutes regular check-up and care every day. Don't neglect it just because it is built to grand hard service. Your Towmotor can "take it" . . . will stand up, and give good service even under abuse. But it deserves care. Make it a regular habit right from the start to give your Towmotor the care it deserves. You'll find it pays dividends over and over in many extra hours of dependable performance, twenty-four hours a day. It is very important that any new engine be operated with moderation until it has limbered up. Operate a cold engine under a light load until normal running temperature is reached. Refer to Preventive Maintenance Chart for points requiring periodical attention.

OTHER IMPORTANT POINTS ARE LISTED BELOW:

KEEP GASOLINE FILTER CLEAN

Use Clean Gasoline From Clean Containers

KEEP CARBURETOR AIR CLEANER CLEAN

Check Once or Twice Daily if Air Is Full Of Dust

KEEP RADIATOR CLEAN

Outside As Well As Inside

CHANGE ENGINE OIL REGULARLY

Use A Good Grade

LUBRICATE ALL MOVING PARTS REGULARLY

KEEP CLUTCH PROPERLY ADJUSTED

KEEP ENGINE CLEAN

CHECK WATER LEVEL IN BATTERY AT

REGULAR INTERVALS

In general, if careful care and maintenance do not keep your Towmotor in satisfactory condition, consult the factory, 1224 East 122nd Street, Cleveland, Ohio. We will gladly make suggestions based on our experience.

In connection with the Hydraulic System, a periodic check should be maintained to see that no dirt clogs the Oil Tank Filler Cap. A plugged filler cap will cause the tank to collapse, due to the vacuum created when the oil flows into the cylinders.

TOWMOTOR PREVENTIVE MAINTENANCE

50 Hour Check

GASOLINE POWERED VEHICLES

1. Check oil level. Change oil and filter cartridge if necessary.
2. Clean or replace crankcase breather. Check outlet pipe.
3. Clean spark plugs, distributor points, check wires.
4. Check compression of each cylinder.
5. Tighten cylinder head bolts if loose.
6. Clean carburetor air cleaner (instruct operator or maintenance man in additional service if necessary).
7. Clean fuel bowl and strainer.
8. Check engine timing.
9. Check and adjust carburetor, idle speed, governor, degasser.
10. Check charging rate.
11. Check oil pressure.
12. Check sound of all units.
13. Check condition of gas and oil lines.
14. Check fan and accessory belts.
15. Check generator brushes and commutator.
16. Add water to battery and check connections.
17. Fill radiator and inspect cooling system for leaks.
18. Check engine and transmission for looseness.
19. Check clutch pedal adjustment.
20. Check brakes; condition, adjustment, fluid.
21. Check condition of gear shifting mechanism.
22. Lubricate machine thoroughly.
23. Check universal joints for wear.
24. Check springs, U bolts, clips, shackles bolts.
25. Check steering mechanism for wear, alignment, turning radius.
26. Check wheel bearings for wear.
27. Check tires, remove foreign objects, inflate pneumatics.
28. Clean outside of radiator.
29. Check hydraulic oil level and check system for leaks.
30. Clean hydraulic breather cap.
31. Check mast, chains, carriage, special equipment.
32. Operate hydraulic equipment, drive and check truck while in motion.

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RELIEF VALVE REPAIR

A relief valve "blows off" or unloads pressure when operating cylinders have reached their maximum extent of operation. On old type control valve, the relief valve is of a fixed type and requires no adjustment. The new type is adjustable through a set screw; however, the adjustment is correctly set at the factory and should not be changed unless the valve trips before the load is lifted, or if pressure is not unloaded when operating cylinders have reached their maximum extent of operation.

When adjustment is necessary, remove the screw nut, loosen lock nut, and turn set screw clockwise to increase or counter-clockwise to decrease spring tension. If valve "blows off" before load is lifted, using capacity load on lift forks, increase spring tension. If valve does not "blow off" when maximum lift or tilt has been reached, decrease spring tension. If all adjustment is taken up and the load still cannot be lifted, the relief valve should be taken apart and checked for worn or damaged parts.

NOTE: The relief valve should always be set to pick up capacity load, plus one additional turn for safety.

Disassemble Control Valve. To disassemble valve for cleaning purposes, remove hexagon cap at bottom of plunger and withdraw plunger assembly from housing. Remove both plungers in this manner. Each should be marked so that it will be returned to its original position.

To remove check valves on old type control valve, unscrew hexagon caps at lower ends of plungers and eyes at upper ends of plungers. To remove relief valve, unscrew the two hexagon caps located between the eye ends of the plungers.

On new-type control valve, unscrew hexagon caps at lower ends of plungers and eye at upper end of the plunger which is located next to the relief valve. To remove relief valve, unscrew hexagon cap located to the right of the eye ends of the plungers.

Clean and Inspect Valve. Wash all parts in a clean solvent. Blow out all passages in control valve housing with compressed air. Inspect valve balls for grooves or other defects that may indicate poor seating. Inspect for broken or distorted springs. Replace faulty parts. Inspect plungers for groove or wear. See that plungers fit in housing with a slight hand pressure. There should not be any perceptible side clearance. If plunger is loose or faulty in other respects, replace valve assembly. When reassembling valve, use all new seals.

Assemble Valve. To install relief valve on old type control valve, place ball and spring in seat channel and secure with cap and seal ring. The assembly is secured in control valve with large cap and gasket.

On new-type control valve, place plunger in seat, followed by spring and guide, then secure with seal ring and adjusting cap. Readjust relief valve after control valve is assembled.

To install check valve in eye end of plunger, drop ball and spring into inner channel and secure with eye end seal ring.

To install check valve in lower end of plunger, drop ball and spring into plunger channel, then place flat washer, plunger return spring, and another flat washer on lower end of plunger and secure all these items with a hexagon cap and seal ring.

Install plunger assembly from lower end of valve housing and secure in place with hexagon cap and gasket. Install plunger oil seal in housing.

LIFT CYLINDER

REPLACEMENT

Replace Lift Cylinder. Raise carriage until mast inner slide is lifted about 10 inches. Block carriage and inner slide in this position. Remove nut at top of pull-down rod. Lower cylinder plunger to release tension on chains. Disconnect chains. Remove block from carriage and lower carriage to the floor. Remove screws fastening crosshead to plunger, then remove crosshead and pull-down rod assembly. Remove pin to disconnect tilt cylinder. **NOTE:** If it is not desirable to drain hydraulic system oil, place receptacle under vehicle to catch oil which will drain from cylinder when the oil line is disconnected. Disconnect oil line at lift cylinder. Remove cylinder upper clamp and remove screws at base of cylinder. Remove cylinder assembly.

To install cylinder assembly, place cylinder in mounting position and secure with clamp and screws. Connect oil line and tilt cylinder to lift cylinder. Bleed hydraulic system. Install crosshead and pull-down rod assembly. Raise cylinder plunger and connect pull-down rod to top of cross bar. Lower inner channel and install chain.

LIFT CYLINDER REPAIR

Repair Lift Cylinder Oil Leak. If oil is seeping past gland nut, tighten nut. If leak does not stop or is excessive, inspect cylinder as follows:

Raise carriage and inspect cylinder plunger for scratches or scored condition. Remove scratches or scores, using a fine emery paper, then polish with cross cloth. If plunger will not clean up to a smooth finish, it is recommended that the cylinder be replaced. **NOTE:** If a cylinder with a scratched or scored plunger is repaired, the new packing will soon be cut and will leak oil. If plunger is O.K., reject cylinder as follows:

oil under pressure to the operating cylinder. For a detailed description of operation, refer to the beginning of this section.

CONTROL VALVE REPLACEMENT

Disconnect hydraulic hoses at valve. Remove clevis pins fastening control levers to valve plungers. Remove screws fastening valve to tank. Remove valve assembly.

When installing control valve, use new seal rings between valve and tank. (Old type uses 3 and new type uses 1.) Fasten valve assembly securely to tank, using either copper or lock washers on attaching screws, depending on which type washers were originally used. If replacing control valve on Serial No. 3548204 or below, substitute four lock washers for copper washers. Connect control levers and hydraulic lines.

CONTROL VALVE REPAIR

If the control valve assembly is faulty, it is recommended that you contact your Towmotor Factory Representative. The control valve requires no service other than cleaning if the valve should become inoperative due to dirt or foreign material in the oil system. To prevent this situation from occurring, the oil in the system must be kept free of all dirt or sediment.

Ref. No.	DESCRIPTION
1	CONTROL VALVE BODY and OPERATING PLUNGERS
2	BALL, check valve
3	CAP, check valve
4	CAP, operating plunger
5	CAP, relief valve adjusting
6	EYE, operating plunger
7	GASKET, operating plunger cap
8	GASKET, relief valve screw
9	GUIDE, relief valve spring
10	NUT, screw, relief valve adjusting screw
11	NUT, hex., relief valve adjusting screw
12	PLUG, pipe
13	PLUG, pipe
14	PLUG, pipe
15	PLUNGER, relief valve
16	RING, seal, check valve
17	RING, seal, relief valve cap
18	RING, seal, relief valve seat
19	SCREW, mach., relief valve seat set screw
20	SCREW, set, relief valve adjusting
21	SCREW, set, relief valve seat
22	SEAL ASSEMBLY, operating plunger
23	SEAT, relief valve
24	SPRING, check valve
25	SPRING, plunger return
26	SPRING, relief valve
27	WASHER, plunger return spring
28	RING, seal, control valve to tank
29	SCREW, cap, control valve to tank
30	WASHER, lock, control valve to tank screw

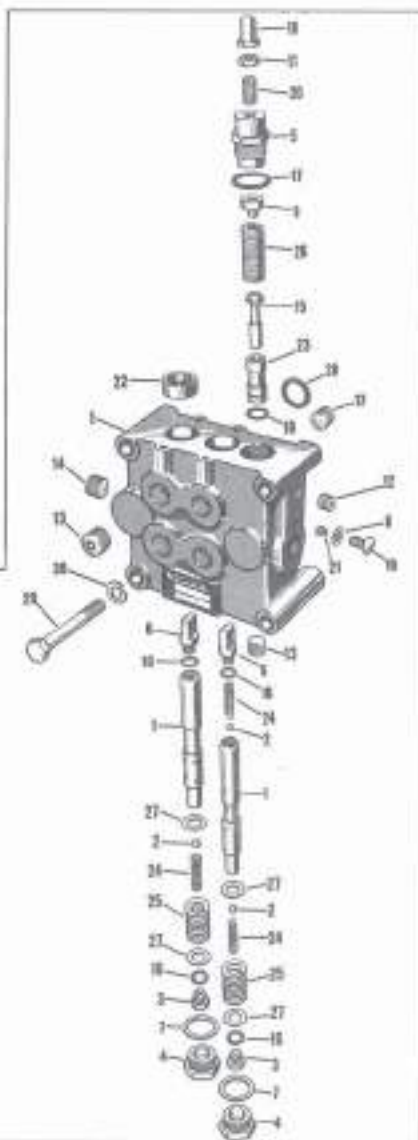




Fig. 12. Control Valve - Exploded View

LUBRICATION CHART

LUBRICATION

The chart below presents a ready reference to items that require lubrication and the frequency of lubrication. The item numbers are arranged clockwise in numerical sequence, starting from the front center of the TOWMOTOR. Items that have two or more points of lubrication on opposite sides of the vehicle carry the same number and are indicated by broken lines. For more detailed lubrication information, refer to same item number under heading Lubrication Data.

Frequency Key  - Lubricate every 50 hrs. operation.
 - Lubricate every 5,000.
 Items 23, 25, 26, 27 - Special Attention - See Lubrication Data.

LUBRICATION DATA

For Correct Lubrication, use the following or equivalent:

① LEFT CHAIN PINS AND ROLLERS

Clean and oil
 Engine oil SAE 10

② CROSSHAIR ROLLERS

Pressure gun
 Chassis lubricant

③ CARRIAGE ROLLERS

4 point
 Pressure gun
 Chassis lubricant

④ MAIN DRIVE SHAFT

Pressure gun
 Chassis lubricant

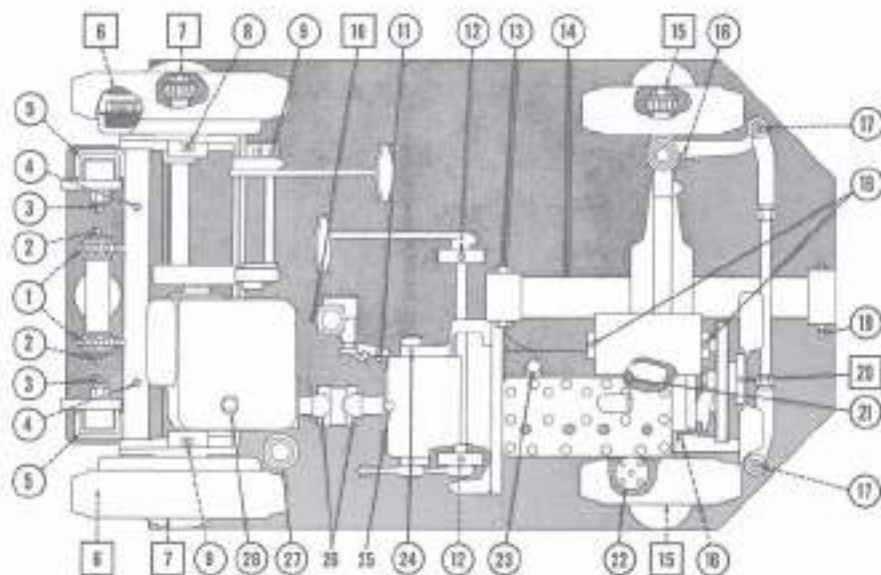


Fig. 5. Lubrication Chart

mounting screws and the screws fastening flanged coupling to crankshaft pulley. Remove pump, bracket, and coupling assembly. The pump end of the coupling is keyed to the pump shaft. For easier removal, disassemble coupling, then press or pull keyed coupling from shaft.

To remove coupling, pull ends of foot off couplings, spread lock rings and slide them off the couplings. Push bearing blocks and driving plate assembly from coupling.

Before installing pump, assemble bracket, fittings, and coupling to pump. Place pump in position on floating plate and connect flanged coupling to crankshaft pulley. Fasten bracket to floating plate, connect hydraulic hoses, and install muffler. Bleed system and inspect pump and connections for leaks. If pump installation is O.K., install radiator grille.

PUMP REPAIR

If tools and testing equipment are not available, it is recommended that an exchange pump be procured from your Towmotor Factory Representative. The following service procedures have been included to aid in the disassembly and inspection of the pump if there is indication that the pump may be faulty.

Disassemble Pump. Remove keyed coupling from pump shaft, using a puller. Remove key from shaft slot. Remove screws securing pump body to flanged cover. Tap body loose from cover and remove cover, gasket, and pressure-loading spring. Remove relief valve spring and ball from hole in cover. To remove seal in cover, use an arbor press. Remove the cover bearings, gear and shaft assemblies, and bearings from body.

Inspect Pump. Wash all parts in clean unleaded gasoline. Inspect gears for chipped, cracked, or worn teeth. Inspect bearing surfaces for grooves or wear. If faces of bearings adjacent to gears are scored slightly, they can be resurfaced, using crocus cloth placed on a flat surface plate. If the bearing face is to be resurfaced, care must be taken to keep the bearing flanges of equal thickness, so that they will be flat and parallel when installed in the body and cover.

If gears, bearings, and body appear to be visually satisfactory, inspect pump for correct clearances as follows:

Inspect gear tooth to body wall clearance by measuring inside diameter of body wall and outside diameter of the gear teeth. If this clearance exceeds .005 inch, replace worn parts or pump assembly.

Inspect bearing to gear journal clearance by measuring the outside diameter of the gear journal and the inside diameter of the bearings. If this clearance exceeds .005 inch, replace worn parts or pump assembly.

Assemble Pump. Install body bearings and inspect clearance between the flat sides of the bearings. If the clearance exceeds .0005 inch, both bearings should be replaced.

NOTE: When new bearings are installed, it may be necessary to dress the bearing flats so that the bearings can be installed in body without binding. Dressing can be accomplished by using crocus cloth placed on a flat surface plate. **CAUTION:** Remove only enough material to produce a sliding fit with clearance not exceeding .0005 inch after bearings are installed. Install gears in body bearings.

Install cover bearings on gear journals and check fit clearance. If the clearance exceeds .0005 inch, both bearings or pump assembly should be replaced.

NOTE: If new cover bearings are to be installed, it will be necessary to drill a hole (3/16 inch diameter, to a depth of 1/8 inch from the gasket surface of the body) in the intake side of the bearing flanges to accommodate the rubber pins. The bearings should be in mounting position and a guide template and flat bottom drill should be used when drilling this hole.

After drilling operation, remove the cover bearings, gears, and body bearings to clean out the drill chips, then remove the burrs formed on the cover bearing flanges during drilling operation. Recheck the fit clearance to make sure that the cover bearings are free to move on the gear journals.

With body bearings, gears, and cover bearings installed, install a new rubber pin in the hole at the corner of the flat sides of the bearings. Coat seal rings with oil and install them in the recessed bore of the cover. Place the pressure-loaded spring in the recessed bore of the cover. Drop ball into the unthreaded cover hole, then tap ball lightly with a brass rod to assure correct seating. Place spring over the ball. Place a new gasket on body, slitting hole in gasket with relief ball hole. Secure cover to body with screws and flat washers.

The adapter cover is equipped with two seal rings. If pump is disassembled, it is recommended that this adapter cover be removed and new seal rings installed.

CONTROL VALVE

DESCRIPTION

Two types of control valves were used on Model L725. The old type (fixed-pressure type valve) can be identified by the relief valve, which is located below and between the operating plungers. The relief valve on the new type is to the right and parallel with the operating plungers.

The control valve is mounted on the bottom side of the oil supply tank. Its function is to distribute

sively in this type pump. The oil pressure developed by this pump is used to maintain the correct clearance between the gears and bearings. This is accomplished by diverting oil, under pressure from the discharge port, to the under side of the bearings thus forcing the bearings against the faces of the gears. Rubber seal rings mounted on the cover bearings retain the oil pressure between body and bearings.

The small holes drilled in the cover connect the gear shaft ends with the drive shaft seal chamber. A channel leading from this chamber to the tank port is equipped with a relief valve which opens under a predetermined pressure and bypasses the oil to the intake port.

PUMP REPLACEMENT

The hydraulic pump is mounted on the engine mounting floating plate directly beneath the radiator. The pump is connected to the crankshaft pulley by a coupling (Figure 11).

Replace Pump and Coupling. Remove radiator and number. Disconnect hoses at pump. Remove bracket



Fig. 11. Hydraulic Pump - Installed View

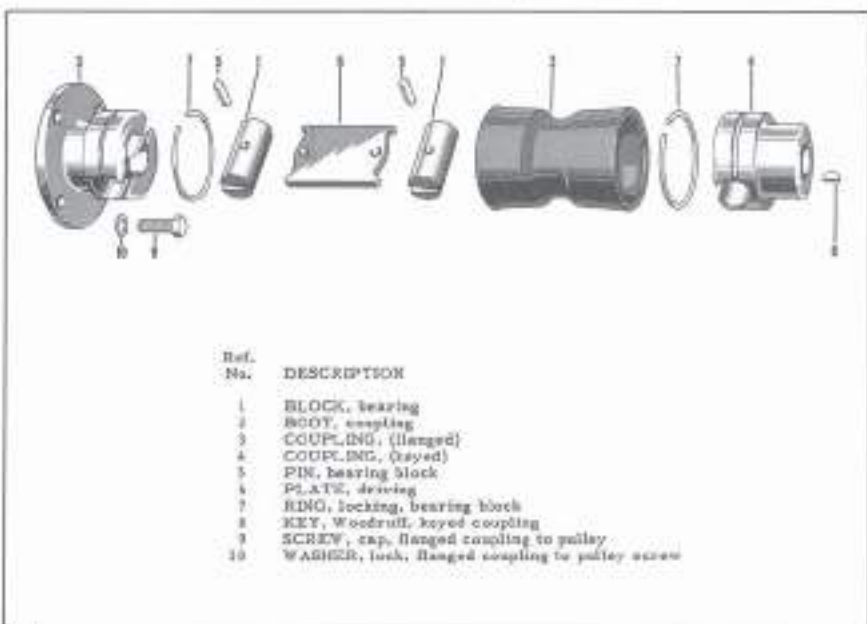


Fig. 12. Pump Coupling - Exploded View

3. MAST SLIDER

Apply with brush.
Lead soap (Lead-oxide) Extreme Pressure Grease having No. 6 consistency. (Approximate lead soap content 1%)

4. DRIVE GEAR

Clean & repack every 6 mos. or when replacing bearings.
Occasionally use lead soap grease. Dropping Point - 270° F.
ASTM worked penetration at 77° F. - 225-325 Viscosity of oil used in compounding - 285 S.U.S. at 210° F.

7. WHEEL BEARINGS

Clean and repack each 6 months operation.
Sodium base non-fibrous grease. Dropping Point - 425° F.
ASTM worked penetration at 77° F. - 225-325 Viscosity of oil used in compounding - 290 S.U.S. at 210° F.

8. JACKSHAFT BEARINGS

Pressure gas
Chassis lubricant

9. BRAKE PEDAL SHAFT

Pressure gas
Chassis lubricant

10. STEERING GEAR

Drain and refill
SAE 140 Gear or Transmission Oil (Water and Baseoil)
Capacity - 1 qt.

11. DRAG LINK

Pressure gas
Chassis lubricant

12. CLUTCH PEDAL SHAFT

Pressure gas
Chassis lubricant

13. SPRING SLIDES

Chassis lubricant

14. SPRING LEAVES

Spring 8000 Oil

15. WHEEL BEARINGS

Clean and repack each 6 months operation.
Sodium base non-fibrous grease. Dropping Point - 425° F.
ASTM worked penetration at 77° F. - 225-325 Viscosity of oil used in compounding - 290 S.U.S. at 210° F.

16. KING PIN

Pressure gas
Chassis lubricant

17. TIE ROD PIN

Pressure gas
Chassis lubricant

18. GENERATOR

4 drops engine oil SAE 10

19. SPRING BRACKLE BOLT

Pressure gas
Chassis lubricant

20. PAN PULLEY

Remove plug and fill hub half-fill engine oil SAE 10

21. DRAG LINK

Pressure gas
Chassis lubricant

22. DISTRIBUTOR

4 drops engine oil SAE 10

23. CRANKCASE

Check level each day, drain and refill each 50 hours operation.
Summer: SAE 30 engine oil
Winter: SAE 20W engine oil
Refill with 3-1/2 qts.

24. CLUTCH RELEASE SHAFT

10 drops engine oil in each of the two oil holes SAE 10

25. CLUTCH RELEASE BEARING

10 drops engine oil SAE 10 (every 50 hrs.)

26. UNIVERSAL JOINT

Repack only when joint has been disassembled for repair or other purposes.
Loq Fibre Sodium Base Grease conforming approximately to the following specification:

A.S.T.M. Worked Penetration at 77° F., 270 Viscosity of oil used in compounding, 150 S.U.S. @ 210° F.

27. AIR CLEANER

Clean and refill to indicated level.
NOTE: Under extremely dusty operating conditions, clean and refill once or twice daily.
SAE 10 engine oil - Summer
SAE 30 engine oil - Winter

28. TRANSMISSION

Check level each 50 hours operation
Drain and refill each 6 months.
Summer: SAE 50 engine oil
Winter: SAE 30 engine oil
Capacity: 3 qts.

POINTS NOT INDICATED ON CHART

CONTROL ROD PIVOT POINTS

Lubricate pivot points such as accelerator linkage, till cylinder pivot pins, clutch linkage, and brake linkage with oil can using engine oil.
Each 50 hours operation.

HYDRAULIC SYSTEM

Drain and refill each 6 months operation.
Use a premium grade SAE 10 conforming to the following specifications:

Gravity 31
Pour Point: -20° F.
Flash Point: 430° F.
Viscosity: 150 S.U.S. @ 100° F.
Viscosity Index: 100

Anti-Oxidant agent recommended.
Recommened Level: with all cylinders extended, there should be at least a 1-inch oil level in bottom of the tank.

HYDRAULIC SYSTEM OIL TANK CAP

Clean every 50 hours.

If oil flows out, the piston leather cups or packing are leaking and should be replaced. If no oil flow is present, tilt cylinder is O.K. Check for pressure loss due to leaks or wear-out pump.

BLEED HYDRAULIC SYSTEM

Air in the hydraulic system is indicated by uneven and humpy operation of the lift equipment. The system can be bled of air by loosening the bleeder screw at top of lift cylinder and operating control valve levers. Bleed system until air and foam are expelled and a clear stream of oil is apparent. Then close bleeder screw tightly. Check operation of lift equipment and repeat bleeding process if operation is not satisfactory.

After bleeding process is completed, make certain bleeder screw does not leak and recheck oil level in supply tank.

HYDRAULIC SYSTEM OIL LEVEL

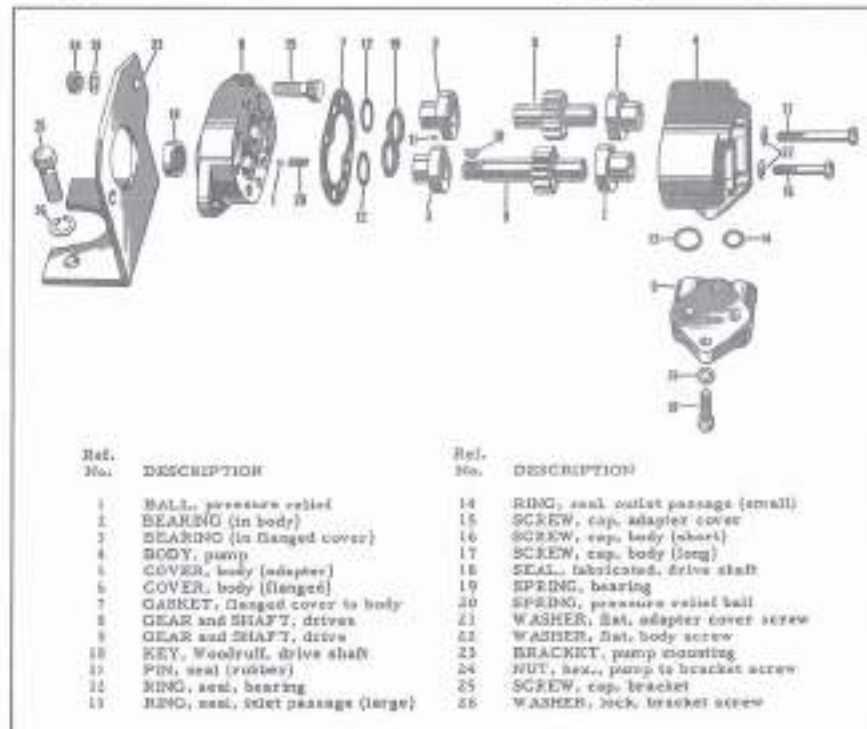
To inspect oil level, operate control levers until all cylinders are fully extended, then check level of oil in tank. There should be at least a 1-inch oil level in bottom of tank.

HYDRAULIC PUMP

DESCRIPTION

The pump used in the LT35 hydraulic system is of the pressure-loaded gear type, consisting of aluminum alloy body and covers, steel gears, lead-bronze bearings, oil relief valve, and accessory seals.

The pressure-loaded principle used in construction of this pump is a patented design used exclu-



7-10

Fig. 10. Hydraulic Pump - Exploded View

When the lift control lever is pulled back, oil is pumped through the control valve and lift cylinder connection. Oil pressure, applied to the bottom of the lift cylinder piston, raises the piston and lifts the mast carriage and load.

When the lift control lever is pushed forward, oil pressure on the lift cylinder is released and the mast carriage is lowered under the pressure of the load and the weight of the lift equipment itself.

When the control valve tilt lever is pushed forward, oil is pumped through the control valve and rear tilt cylinder connection. Oil pressure, applied to the rear of the piston, pushes the piston rod forward and tilts the mast forward.

When the lift control lever is pulled back, oil is pumped through the control valve and front cylinder connection. Oil pressure, applied to the front of the piston, pushes the piston rod back. The piston rod pulls the mast back to a vertical position or lifts mast backwards if desired.

Control Valve Operation. There are two plungers in the control valve: One controls the tilting action and the other controls the lifting action. Check valves are mounted within each plunger. These check valves retain mast in the desired tilt position and mast carriage in the desired lift position when the control levers are returned to the neutral position.

A relief valve, also located in the control valve, "blows off" when mast reaches maximum tilt or when carriage reaches maximum lift position.

TROUBLE SHOOTING

HOIST WILL NOT LIFT LOAD

Load Too Heavy. Do not exceed maximum load limits. See rated capacity on Serial Number plate adjacent to Instrument Panel.

Pump Inoperative. Check pump as follows: Start engine. Remove hydraulic oil tank cap. Operate lift control lever. If no surging action of the oil is noted, oil pump is not working. If surging action is present, inspect relief valve as outlined below.

Oil Tank Outlet Clogged. Drain and inspect outlet for obstruction.

Relief Valve Sticking Open. Remove relief valve and inspect for dirt or other foreign substance that may cause valve to stick.

Broken Lift Chain. If lift cylinder plunger and cross-head rises and carriage remains stationary, inspect for broken lift chain.

Damaged Lift Cylinder. Inspect lift cylinder outer case for dents or damage which would interfere with movement of the plunger.

HOIST LIFTS LOAD TOO SLOWLY

Engine Speed Governed Too Low. Inspect governor controls and adjustment (See Fuel Section).

Misalignment of Mast and Carriage. Inspect for broken bolts, dents, or defects in mast and carriage structure.

Seized Rollers. Operate lift equipment and inspect rollers for sliding or rolling.

Hydraulic System Oil Pressure Weak. Inspect for leaks that would cause loss of pressure.

Oil Tank Outlet Clogged. Drain and inspect for obstruction.

Faulty Relief Valve Parts. The valve seat may be worn or the spring may be broken or weak. Remove and inspect these parts.

Worn Hydraulic Pump. Remove and inspect pump as described in Hydraulic Pump Section.

LOAD NOT HELD IN RAISED POSITION

Check Valve Sticking Open. Remove check valve (in control valve plungers) and inspect for dirt or other foreign substance that may cause check valve to stick.

LOAD CREEPS DOWN SLOWLY

Hydraulic System Leaks. Inspect oil lines, fittings, and cylinder packing for leaks. Repair leaky connections. See Hydraulic Section for instructions on repacking cylinders.

Check Valve Sticking Open. Remove check valve (in control valve plungers) and inspect for dirt or other foreign substance that may cause check valve to stick.

HOIST OPERATES UNEVENLY

Air in Hydraulic System. Inspect oil level in tank. With all cylinders extended, there should be at least a 3-inch oil level in bottom of tank. If level is low, air will enter the hydraulic system. Inspect for leaks at pump to tank intake connections. If leaks are present in the intake line, air will enter the system. After cause of air entering system has been remedied, bleed system by loosening bleeder screw at top of lift cylinder. Recheck oil tank level.

MAST TILTS TOO SLOW

Tilt Cylinder Piston Cups or Packing Leaking. Check as follows: Tilt mast to the extreme forward tilt position. Disconnect hose at the tilt cylinder front connection. While holding the control lever in the forward tilt position, check for oil flow through the disconnected end.

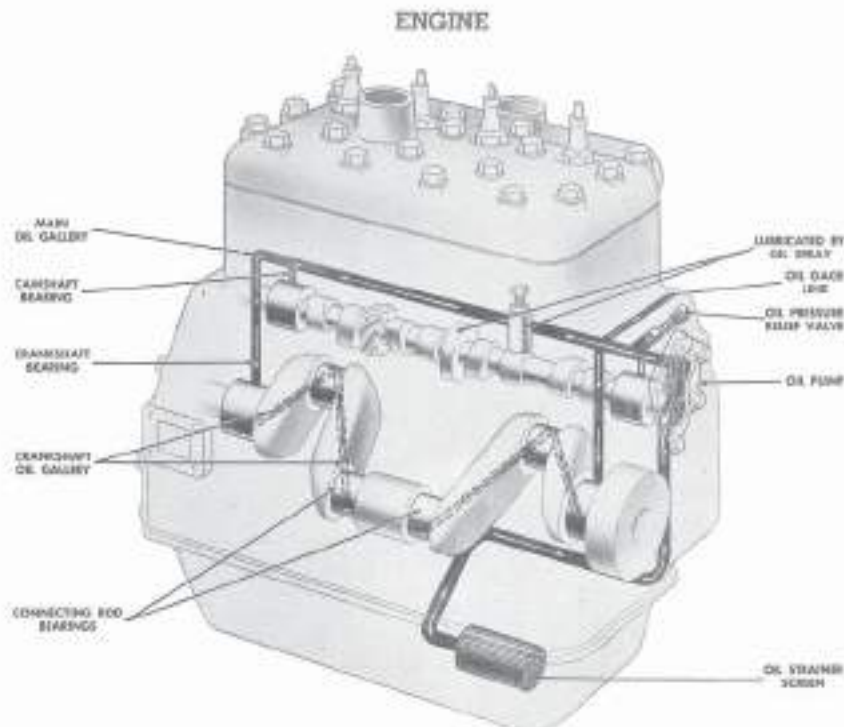


Fig. 6. Diagrammatic View of Engine Lubrication

DESCRIPTION

The engine used on Model LT35 is a four-cylinder, L-head gasoline type that develops 15.6 BHP at 2000 R.P.M. (3.25 horsepower, SAE rating for license). The cylinders and upper half of the crankcase are cast as a unit. The crankshaft is supported by two shell-inset type bearings.

The pistons are cast iron or aluminum and are fitted with one oil ring in the bottom groove and two compression rings in the top grooves.

The camshaft is supported by three bearings which are machined directly in the crankcase (no serviceable bearings are required). The oil pump is mounted at the rear of the crankcase and is driven by the camshaft. An automatic governor which requires no internal adjustment is recessed in the camshaft timing gear.

The distributor is driven by a gear integral with the camshaft. The governor and fan are driven by a fan belt and a pulley mounted on the front end of the crankshaft.

Full pressure lubrication (Figure 6) is provided for crankshaft bearings, connecting rod bearings, and front and rear camshaft bearings. Oil is carried to these items through holes drilled in cylinder block, crankcase, and crankshaft. Other engine parts, including center camshaft bearing and valve tappets, are lubricated by oil spray from the crankshaft and connecting rods.

A hydraulic pump is mounted on the engine mounting flange and is driven by a coupling attached to the crankshaft pulley.

The firing order of the engine is 1-3-4-2.

SPECIFICATIONS

ENGINE

Make	Continental
Type	L-head
Model	882
Number of cylinders	4
Bore	2-3/8"
Stroke	3-1/2"
Displacement	82 cu. in.
SAE horsepower rating (license date)	9.35 HP
Brake horsepower at 2000 RPM	15.6 BHP
Compression ratio	6.40:1
Governor speed	2200 to 2500 rpm
Compression pressure	Approx. 95 lbs. Maximum variation between cylinders . . . 10 lbs.

Crankshaft

Journal Diameter	
Front	1.7450 to 1.7455
Center	1.7440 to 1.7455
Rear	1.3450 to 1.3455

Connecting Rod

Bearing type	Shell insert
Bearing clearance	.0015 to .002
Bearing bore	1.499 to 1.500

Crankshaft

End thrust	.0025 to .005
Main bearing clearance	.0015 to .002
Main bearing journal diameter	1.999 to 2.000
Connecting rod journal diameter	1.499 to 1.500

Cylinders

Bore	2-3/8"
Bore out-of-round	(See "Inspect Cylinder" page 14)
Taper within	(See "Inspect cylinder" page 14)
Oil capacity	3-1/2 qts.

Oil Pressure

At normal operating speed	15 to 20 lbs.
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Pistons

Cast Iron	
Piston to cylinder clearance	.0010 to .0015
Pull on .002" feeler for checking clearance	10 to 15 lbs.

Aluminum

Piston to cylinder clearance	.0020 to .0025
Pull on .003" feeler for checking clearance	10 to 15 lbs.

Piston Pin

Pin to cast iron piston clearance	.0002 to .0003 (loose)
-----------------------------------	------------------------

Pin to aluminum piston clearance	.000 to .0001 (tight)
----------------------------------	-----------------------

Pin to rod bushing clearance	.0000 to .0003 (loose)
------------------------------	------------------------

Piston Rings

Compression (top rings)	
Number per piston	2
Type	Taper
Width	.0325 to .0335
End gap	.007 to .015
Side clearance	.0015 to .003

Oil (lower ring)

Number per piston	1
Type	slotted
Width	.180 to .185
End gap	.007 to .015
Side clearance	.001 to .0025

Valves

Intake	
Type	Conventional Poppet
Tappet clearance	.012 (hot)
Seat angle	45 deg.
Guide room	.3150 to .3187
Guide to stem clearance	.0035
Exhaust	
Type	Noto
Tappet clearance	.012 (hot)
Seat angle	45 deg.
Guide room	.3150 to .3187
Guide to stem clearance	.0035

Breaker point gap	.020
Spark plug gap	.030
Clutch free pedal travel	1"

HYDRAULIC SYSTEM

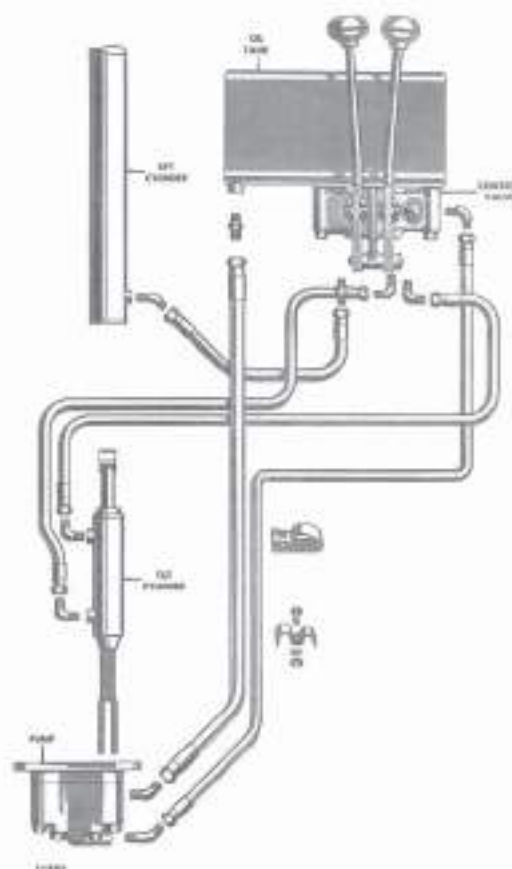


Fig. 48. Hydraulic Lines & Fittings

DESCRIPTION

Description. The Lift equipment is operated by means of hydraulic pressure. The system consists of an oil supply tank, oil pump coupled to the crankshaft pulley, control valve, single acting lift cylinder, double acting tilt cylinder, mast and carriage assembly, and necessary hydraulic connections. The lift

cylinder is attached to a bracket at the center of the frame and to the lift cylinder. The mast assembly pivots on a shaft mounted on the drive axle carrier.

OPERATION

Lift and Tilt Operation. In operation, the oil pump maintains a constant hydraulic pressure at the control valve.

TROUBLE SHOOTING

This section is included to assist in the location and correction of troubles that may be encountered in operation of the engine. The trouble symptoms are shown as main headings. Under each heading the probable causes are listed in a recommended sequence of checking.

ENGINE WILL NOT START

Make certain ignition switch is turned "on", that fuel shut-off valve is opened, and that the tank contains fuel. If these items are O.K., check for faulty ignition.

Faulty Ignition. Disconnect one spark plug wire and hold end of wire 3/8 inch from any convenient ground. With ignition switch "on", crank engine with starting motor and check for spark. If spark occurs, check fuel system as outlined below. If no spark occurs, check distributor as follows:

Remove distributor cap and inspect cap for moisture or cracks and rotor for defects. Replace defective items. Inspect points for burned condition and correct gap clearance. If points are burned, replace points and condenser. If points are O.K., turn ignition switch on, break contact points and check for spark. If no spark occurs, check wiring to distributor. If spark occurs, distributor is O.K. Reassemble distributor and check coil as follows:

Remove coil wire at center of cap. Hold wire 3/8 inch from convenient ground and crank engine with starting motor. If weak or no spark occurs, replace coil. If spark occurs, remove and check spark plugs. If entire ignition system is O.K., check for faulty fuel systems.

Faulty Fuel System. Disconnect fuel line at carburetor. If fuel does not flow, check fuel shut-off valve to make sure it is open, then check lines for clogged condition. If fuel flows freely, remove filter bowl and check for water or other foreign substance which may be in the fuel. If foreign substance is present in fuel system, drain and clean entire fuel system and add clean gasoline.

ENGINE MISFIRES

Check all wiring and battery cables for loose connections. Check fuel system for leaks. If these items are O.K., check vehicle as outlined below:

FAULTY ENGINE PARTS OR IGNITION SYSTEM. Tune engine as outlined in the engine section of this manual. If misfiring still occurs, check for faulty fuel system.

FAULTY FUEL SYSTEM. Disconnect fuel line at carburetor and check for free fuel flow. If flow is erratic, blow out lines. Clean fuel filter and note whether water or other foreign substance is present.

If fuel is dirty or contains foreign substance, drain and clean entire fuel system and refill with clean gasoline.

ENGINE DOES NOT DEVELOP FULL POWER

Engine Speed Governed Too Low. Inspect governor controls and adjustment (See Fuel Section).

Engine Parts or Ignition System Faulty. Tune engine (See Engine Tune-up Section directly following this Trouble Shooting Section).

Incorrect Engine Timing. Check distributor setting (See Ignition Timing Adjustment in Ignition System Section).

Fuel System Faulty. Disconnect fuel line at carburetor and check for full and free fuel flow. Check carburetor float level (See Fuel Section).

Incorrect Valve Timing. Check valve timing (See Engine Section).

ENGINE OVERHEATS

Lack of Water in Cooling System. Be sure that radiator is filled with water. Inspect for leaks that have caused water level to fall.

Loose Fan Belt. Check for loose fan belt (belt should have 1/2 inch sag or deflection between pulley centers).

Restricted Core Air Passages. Blow dirt out of radiator fins.

Clogged Cooling System. Clean cooling system (See Cooling Section).

ENGINE USES TOO MUCH OIL

Oil Leaks. Inspect for oil leaks. Pay particular attention to oil pressure gauge flexible hose.

Excessive Wear of Piston Rings. Inspect engine condition with compression test. (See Engine Tune-Up Section).

Excessive Wear of Valve Guides. Inspect valve guides for excessive wear. Excessive clearance between intake valve stem and guide will cause the vacuum in the intake port to suck oil through the excessive clearance and into the combustion chamber where it will burn and cause excessive oil consumption. Replace worn guides.

REPAIR AND REPLACEMENT**ENGINE TUNE-UP**

The following tune-up procedures are designed and recommended as a guide to maintain peak engine performance (at a high standard of efficiency). They include simple adjustments, inspections, and tests and are outlined in a recommended sequence for performing an engine tune-up.

Clean and Adjust Spark Plugs. Blow dirt from spark plug wells, then remove plugs. Clean carbon deposits from inside of plugs by sand blasting and wipe off porcelains with clean cloth. Inspect for cracked or broken porcelain insulators, burned electrodes, or excessive carbon deposits. Replace faulty plugs. Adjust electrode gap to .030 inch, using round feeler gage. Test compression before re-installing plugs.

Test Compression. Make compression test with all spark plugs removed, and with choke and throttle wide open. Insert compression gage in a spark plug hole and rotate engine with starting motor until the maximum compression reading is obtained. Repeat this process for each cylinder. If the readings do not vary more than 10 pounds, compression pressures may be considered normal. If the readings vary more than 10 pounds or are extremely low, the valves, pistons, or rings may be faulty. An extremely low reading in two adjacent cylinders may indicate a blown-out cylinder head gasket.

Clean and Adjust Distributor Points. Remove distributor cap and rotor. Wipe dirt from cap and inspect cap and rotor for cracks. Clean points with file. Replace point set if points are pitted or burned. **NOTE:** If points are burned or badly pitted, replace the condenser as it is probably the cause of these conditions.

After cleaning or replacing points, be sure point contacts are in perfect alignment, then adjust gap to .020 inch with a flat feeler gage.

Adjust Ignition Timing. Adjust ignition timing to fire No. 1 cylinder at T.D.C. (indicated on flywheel by T.D.C.). See Ignition System.

Inspect Wiring. Inspect wiring for chafed or frayed insulation and loose connections.

Clean and Inspect Battery and Cables. Wash battery and cable terminals with clean water. Remove corrosion from cable terminals and battery posts with wire brush. Inspect cable insulation for defects and terminals for looseness. Replace faulty cables and tighten loose connections. Inspect battery electrolyte level and test battery charge.

Tighten Cylinder Head and Manifold. Tighten manifold nuts. Tighten cylinder head nuts evenly and in correct sequence. (See Cylinder Head Gasket in this section).

Clean Fuel Filter. Remove and clean filter bowl. Remove filter element with fingers and clean with compressed air. **NOTE:** Do not use pliers when removing or installing element or it will be damaged.

Clean and Lubricate Air Cleaner. See Lubrication Section.

Inspect and Adjust Valve Clearances. Inspect and adjust valve clearances if necessary. Recommended clearances for both intake and exhaust valves are .012 inch (hot).

Adjust Carburetor. With all the above items completed, start engine and operate until hot. Adjust carburetor.



Fig. 7. Powering Engine



Fig. 8. Front Department of Chassis with Engine Mounted

SPRINGS

DESCRIPTION

The vehicle is equipped with one spring mounted at the steering axle (Figure 62). The front end of the spring is attached to the frame with a shackle bolt and the rear end is pivoted in a bracket welded to the frame.

REPAIR AND REPLACEMENT

Replace Springs. To remove spring, raise vehicle frame until wheels just rest on floor, then remove shackle bolt. Raise vehicle higher, remove spring U-bolts, and withdraw spring from hanger.

Before installing spring, apply lubricant to hanger

with a brush. Insert spring leaf end in hanger. Align spring eye with bracket and install shackle bolt. Align spring center bolt with hole in axle beam, then install U-bolts.

Replace Main Leaf. Clamp spring leaves at center in arbor press, leaving center bolt and nut in the clear. Remove center bolt. Spread ears of spring clips enough to permit removal of main leaf. Release press slowly and remove leaves. The main leaf bushing can be removed, using an arbor press.

To assemble spring, position leaves in arbor press and align center bolt holes with a punch. Compress leaves, remove punch and install center bolt and nut. Bend ears of clips securely over spring leaves.

Remove Engine Assembly. (See Figures 7 and 8 for identification of items listed below).

1. Drain oil and water.
2. Remove seat.
3. Disconnect battery cable and remove battery.
4. Remove left side hood panel and tie plate.
5. Disconnect steering column upper bracket.
6. Close shut-off valve at filter then disconnect and remove fuel line.
7. Disconnect horn wire from starting motor solenoid switch.
8. Disconnect clutch linkage.
9. Disconnect accelerator linkage.
10. Disconnect air cleaner hose at carburetor.
11. Disconnect upper radiator hose at engine.
12. Remove muffler and pipe as an assembly.
13. Remove screws from bottom of hydraulic pump mounting bracket and slide pump as far as possible away from pump coupling.
14. Remove screws holding fan bracket to engine block and slide fan and belt assembly away from engine.
15. Remove one screw from coil bracket and pivot coil to one side.
16. Remove screws fastening instrument panel to center partition.
17. Remove lower center partition.
18. Disconnect lower radiator hose at engine.
19. Remove No. 4 spark plug and install an eye-hook in this hole. Connect chain hoist to eye hook. The engine will be correctly balanced if lifted from this point.
20. Remove screws fastening engine to floating plate.
21. Raise engine slightly and move it towards radiator to disconnect universal joint splined yoke from clutch shaft. Raise engine up and out of chassis.

Install Engine Assembly.

1. With eyehook installed in No. 4 spark plug hole and attached to a chain hoist, lower engine into chassis enough so that clutch shaft will engage into universal joint splined yoke. With yoke connected to clutch shaft, lower engine completely and fasten to the floating plate.
2. Connect lower radiator hose.
3. Install lower center partition.
4. Fasten instrument panel to center partition.
5. Fasten coil to engine.
6. Engage hydraulic pump shaft with coupling and fasten bracket to floating plate.

7. Install fan assembly and belt. Adjust belt deflection.
8. Install muffler and pipe assembly.
9. Connect upper radiator hose.
10. Connect air cleaner hose.
11. Connect clutch linkage and adjust pedal free play.
12. Connect accelerator linkage.
13. Connect horn wire to starting motor solenoid switch.
14. Install fuel line and open shut-off valve.
15. Connect upper steering column bracket.
16. Install tie plate and left side hood panel.
17. Install battery and connect cables.
18. Install seat.
19. Fill crankcase with 3-1/2 quarts of engine oil. Fill cooling system with water or antifreeze solution. Before starting engine, read the following paragraphs on "Break-in Procedure after Engine Overhaul".

BREAK-IN PROCEDURE AFTER ENGINE OVERHAUL.

Make certain oil and water levels are correct, then start engine and accelerate it to a fast-idle (approximately 1000 rpm). Immediately after starting, check for correct oil pressure (15 to 20 pounds) and listen for any unusual noise which may indicate faulty operation of engine parts.

Keep engine operating at fast-idle speed during the warm-up period. Reset choke during the warm-up period to assure smooth engine operation and prevent over-choking.

Operating an engine at idle speed will not provide adequate lubrication for the newly fitted cylinders, rings and pistons and may result in scuffing. Over-choking will wash the lubricating oil off the pistons and rings and will cause oil dilution.

New engines can be subjected to normal load after the engine temperature is up to normal. Overhauled engines should be operated at fast idle speed for a period of 2 hours before the lift truck is used for carrying loads.

On both new or overhauled engines, change engine oil after the first 25 hours operation. Thereafter change the engine oil each 50 hours of operation.

CYLINDER HEAD GASKET

A faulty cylinder head gasket may be indicated by the following troubles: engine misfiring, extremely low compression pressures in adjacent cylinders, loss of water from radiator, or passing of water through muffler.

Replace faulty gasket as described below.

Remove. Drain water from cooling system. Remove upper hose and spark plugs. Remove screws and washers securing cylinder head. Remove cylinder head and gasket.

Clean Carbon and Inspect. Clean carbon from cylinder head and block, using carbon scraper and wire brush. Inspect head and block for cracks or excessive erosion of water passages. Always install new gasket when head has been removed.



Fig. 9. Sequence for Tightening Cylinder Head Nuts

Install. Place head gasket on block with side marked TOP up. If gasket is not marked, install with seams on top. Install cylinder head, washers, and nuts. Using a torque wrench, tighten head nuts evenly and in correct sequence (Figure 9) at 60 to 65 foot-pounds pressure.

Clean, adjust, and install spark plugs. Connect plug wires. Install upper hose, close drain cock, and fill cooling system with water or anti-freeze. Start engine, then inspect for water leaks and observe engine performance. Retighten cylinder head nuts when engine is hot.

VALVES

This engine is equipped with conventional poppet-type intake valves which are secured to the springs with pins. The exhaust valves are of the Roto type. This requires a special valve, retainer, and a cap that slips over the end of the valve stem. With this construction the valve stem makes no contact with the tappet screw; contact is between valve and cap and between cap and adjusting screw. The use of this type construction results in a rotary movement of the exhaust valve as it opens, helping to keep valve seat free of carbon and to prevent valves from sticking in the guides.

Remove Valves. Remove carburetor air cleaner, carburetor, cylinder head, and valve covers. To remove intake valve, compress spring and tap valve down with a wood block or hammer handle, then remove retainer pin. To remove exhaust valve, compress spring to raise the valve, then remove valve cap. Tap valve down with a wood block or hammer handle, and remove keys.

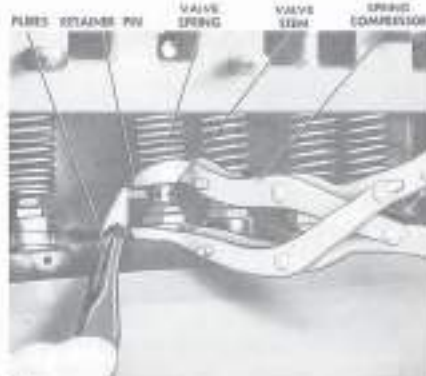


Fig. 10. Removing or Installing Intake Valve Retainer Pin

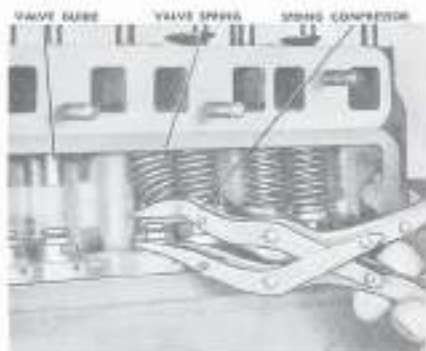


Fig. 11. Removing or Installing Valve Spring

To remove spring, compress spring until the retainer clears tappet screw. Slide spring and retainer off lifter (Figure 11) and remove spring.

Clean and Inspect Valves. Clean carbon deposits from cylinder head, valves, top of pistons, and cylinder block. Inspect valve seat and valve facing; if pitted or burned, reface valves and seats. Inspect for bent valve stem or incorrect fit of stem in guide. Recommended stem to guide clearance is .003 inch. Replace defective parts. If a new valve is used, and stem to guide clearance is excessive, install a new guide. When new guide is installed, reface valve seat.

Reface Valve and Seat. Recondition valves on a valve reface machine. Set machine at 45-degree angle for intake and exhaust valves. Do not burn face of valve or remove more material than is

BRAKES

DESCRIPTION

Model LT35 is equipped with a band type brake mounted on the transmission. The brake is operated through levers and a cam, by a foot pedal. A ratchet, attached to the foot pedal, engages a pawl and holds the pedal down in the applied position to provide a parking brake for the vehicle.

ADJUSTMENT

Adjust Brakes. Adjust band to drum clearance by loosening pedal to operating lever bolt and nut, and changing position of pedal on lever.

REPAIR AND REPLACEMENT

Replace Brake Band and Drum. Disconnect pedal return spring. Remove cotter pins from band clamp pins. Remove pins and clamps. Remove cotter pins and strap from anchor pins, then remove brake band.

The early model vehicles were equipped with metallic brake lining which was later changed to a molded lining bonded to the brake band. If lining is worn, replace band assembly using the new style molded band assembly. If the vehicle was originally equipped with metallic lining, other parts must be replaced to make the molded brake band interchangeable (Refer to Parts List Brake Section).

Do not retine. If lining is worn, replace brake band assembly. With brake band removed, inspect drum for scoring. Replace a scored drum.

Before installing band, apply a light coating of grease to anchor pin and clamp-to-band contact surfaces. Install band and secure to anchor pins with strap and cotter pins. Compress ends of brake band and install clamps and pins. Secure pins with cotter pins. Connect pedal return spring and adjust band to drum clearance.

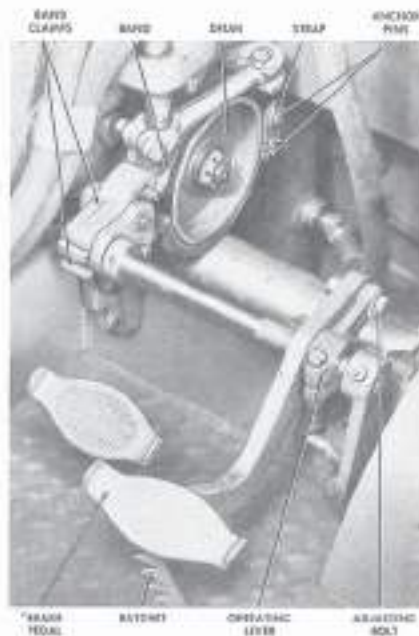


Fig. 12. Brake Assembly

Lubricate Brake Linkage. All friction surfaces in brake linkage should be lubricated with a few drops of engine oil each week of operation.

necessary to eliminate burned or pitted areas. Cut the valve seats with a seat cutter as grinder (40 deg.). If cutting enlarges the valve seat to more than $3/32$ inch, grind or cut top surface of valve seat, using a 15-degree stone, to narrow the seat to width of $5/32$ inch. After conditioning the valve and seat, inspect run-out, using a dial indicator; run-out should not exceed .002 inch. Remove emery dust from cylinder block, valve guides, and parts with clean, dry compressed air.

Grind Valves. Lap valves lightly to seats, using a good valve grinding compound. If a true seat contact is not accomplished by turning grinder a few turns, inspect valve and seat run-out and angle. After grinding, be sure to remove all compound from valves, seats, and cylinder block.

Replace Valve Guides. Before removing valve guides, measure the distance from the top of the guide to the top surface of the cylinder block for identification upon reinstallation. Tap guides out of cylinder block with a pilot drill. **NOTE:** If guide is to be removed with camshaft and lifters installed, and suitable puller is not available, break the guide as it is driven out of the cylinder block.

Drive guide, small outside diameter end down, in cylinder block, using a pilot drill. Drive guide until the distance between top surface of cylinder block and top of valve guide is $25/32$ inch. After installing guides, inspect valve stem fit in guide, and ream if necessary. Recommended guide to stem clearance is .0015 inch.

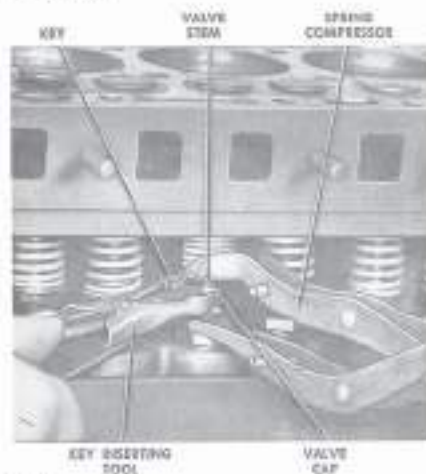


Fig. 15. Installing Exhaust Valve Pin

Install Valves. With tappet in the closed valve position, and retainer in place on spring, position valve spring on stem guide. Compress and slide spring on tappet, using a valve spring compressor (Figure 11). Coat valve stem with engine oil and install intake valves in their correct valve guides in cylinder block.

To install intake valve, compress spring and insert retainer pin in stem (Figure 10). Be sure that the spring seats correctly on guide, and that pin engages retainer fully.

To install exhaust valve, compress spring and position valve cap on tappet screw as shown in Figure 12. Tap the valve down until groove in valve stem is between cap and spring retainer. Place key in a key inserting tool similar to that shown in Figure 13, then install key and release the valve spring. Adjust tappet clearance (par. below) and install cylinder head, valve covers, carburetor, and air cleaner.

Adjust Tappet Clearance. Adjust both intake and exhaust valve tappet clearance to .013 (both). Loosen tappet screw lock nut and adjust as shown in Figure 13.

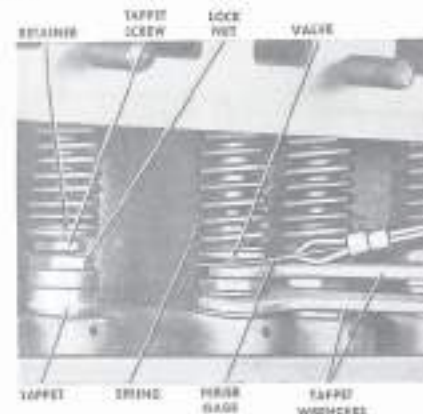


Fig. 12. Releasing and Adjusting Tappet Clearance

PISTON AND RINGS

Engines Serial No. N62-13098 or below are equipped with cast iron pistons. Engines Serial No. N62-13099 or above are equipped with special cam and taper ground aluminum pistons. Both pistons are equipped with three rings (one oil ring in the bottom groove - two compression rings in the two top grooves); rings for cast iron and aluminum pistons are interchangeable.

The aluminum and cast iron pistons are interchangeable as a complete set. When replacing pistons, it is recommended that aluminum be used. When using aluminum pistons as replacement, it is recommended that standard or specific oversize be ordered and that the piston and pin assembly be used. It is difficult to find a source that can correctly "cut and taper grind" a semifinished piston to the desired specifications and the size of the piston pin (.5835 - .5845 diameter) warrants use of an uncommon size pilot reamer for fitting pin to piston.

If engine uses an excessive amount of oil, it is recommended that the engine assembly be removed and repaired as outlined below.

Remove Piston and Connecting Rod Assembly. Remove cylinder head and oil pan. Remove connecting rod caps and push piston and connecting rod assembly out bottom of cylinder.

Disassemble Piston and Connecting Rod. Remove rings from piston. Remove pin lock rings and push pin out of piston. If pin fits tightly, tap pin out, using pilot drill.

Inspect Pistons, Pins and Rings. If pistons are scored, cracked, or excessively worn, recondition cylinder walls and install correctly fitted pistons and rings. Inspect for broken rings. Inspect for loose pin fit.

Inspect Cylinder Walls. Inspect cylinder walls for scoring or excessive wear. Inspect for out-of-round or taper, using a dial indicator. Rotate indicator in cylinder bore, and note the highest and lowest readings; the difference between the readings is the amount cylinder is out-of-round. Slide indicator up and down in cylinder, and note highest and lowest readings; the difference between the readings is the taper of the cylinder. If tapered or out-of-round, cylinder walls should be reconditioned or service rings installed (see the two following paragraphs).

Recondition Cylinder Walls. If removal of .004 inch (cylinder bore diameter) of material will clean the worn cylinder satisfactorily, recondition it with a cylinder hone. If necessary to remove more than .004 inch from cylinder wall, recondition it with a boring tool and polish it with a finishing hone. If boring or honing operation is performed with crankshaft and camshaft installed, cover these units to protect them from chips and emery dust. After reconditioning cylinder walls, clean engine block and parts thoroughly. When reconditioning cylinder walls, remove enough material to clean and true up, then hone or bore until the next oversize piston that is available fits correctly.

Remove Cylinder Ring Ridge. If cylinder walls are not more than .010 inch tapered, or not more than .005 inch out-of-round, and cylinder reconditioning is not desired, install rings listed in Parts Book. Before installing rings, remove ring ridge from top

of cylinder wall with a cylinder ridge cutter. When cutting the ridge, rotate engine until valves adjacent to cylinder are closed, then insert a clean cloth in bottom of cylinder to protect lower units mounted in crankcase and cylinder block from chips and emery dust. After removing ridge, remove cloth, clean cylinder block and bore.

NOTE: Specifications for tolerances and clearances in the following procedures are for units heated to room temperature (70°).

Fit Pistons. Inspect piston fit by inserting a feeler ribbon (.002 for cast iron pistons - .003 for aluminum pistons) between cylinder wall and piston at thrust (camshaft) side. Attach a spring scale to feeler ribbon and remove ribbon. If ribbon can be removed with 10 to 15 pounds pull on the spring scale, the piston fit is correct.

FE Piston Pin. Cast Iron Piston - Recommended pin fit to piston is .0002 to .0003 inch (loose). Aluminum Piston - With the piston heated in water (212°F) the pin should enter the piston with a thumb push.

Pin fit to connecting rod bushing should be .0000 to .0003 inch (loose) so that it requires light hand pressure to insert pin in bushing. If pin fit is loose, install new pin.

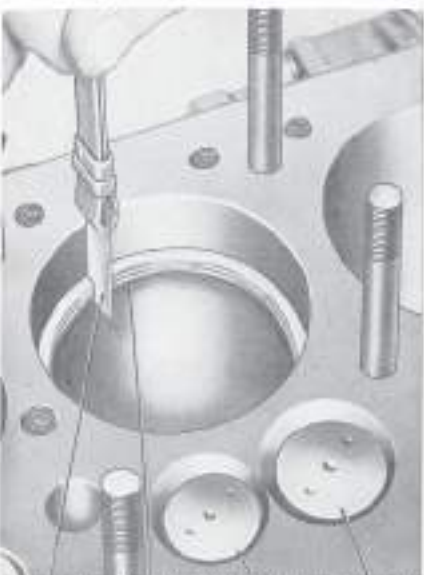


Fig. 24. Measuring Ring Gap

Replace Levershaft Oil Seal and Bushing. (Figure 66). Pry old oil seal out of housing. Press bushings out of housing, using an arbor press.

When installing bushings, place bushing with partial oil groove in outer end of housing, and with groove open and pointing toward inside of housing. Inner bushing has oil groove completely across bushing surface. Press bushings in housing, using arbor press. Line rear bushings until levershaft rotates freely and clearance between bushing and levershaft does not exceed .002 inch.

Before installing oil seal, make certain leather is soft and pliable. Place oil seal gasket in housing, then press seal in housing until it is firmly seated on gasket.

Install Cam and Wheel Tube. Coat bearings with lubricant and insert cam in housing. Install shim, cover, and screws. Rotate wheel tube as the screws are tightened to correctly position the bearing balls. Adjust cam bearings and install jacket and clamp. Do not install steering wheel until steering gear assembly has been installed in vehicle.

Install Levershaft. Insert levershaft in bushings, meshing studs with cam threads. Loosen adjusting screw in housing side cover, then install gasket and

side cover, and secure with screws and copper washers. Adjust levershaft stud to cam locklash.

Install Steering Gear and Wheel. Position steering gear assembly for mounting in chassis and install mounting bolts and nuts. Install top body cover and fasten jacket clamp to cover. Place jacket bearing spring seat and spring on wheel tube. Install steering wheel and secure with nut. Place spring seat and spring on wheel tube and install horn button base plate and retaining screws.

With insulating ferrule assembled to horn cable, insert cable through hole in wheel tube.

With contact cup, spring, and cap correctly positioned in horn button, place button in steering wheel. Depress and twist button until rubber lips on base plate engage horn button legs. Connect drag link to Pittman arm.

DRAG LINK

Adjust Drag Link. Remove cotter pin from end of drag link. Tighten slotted plug firmly against ball, back off one-half turn, then to nearest cotter pin hole. Install cotter pin. Adjust both ends of drag link in the same manner.

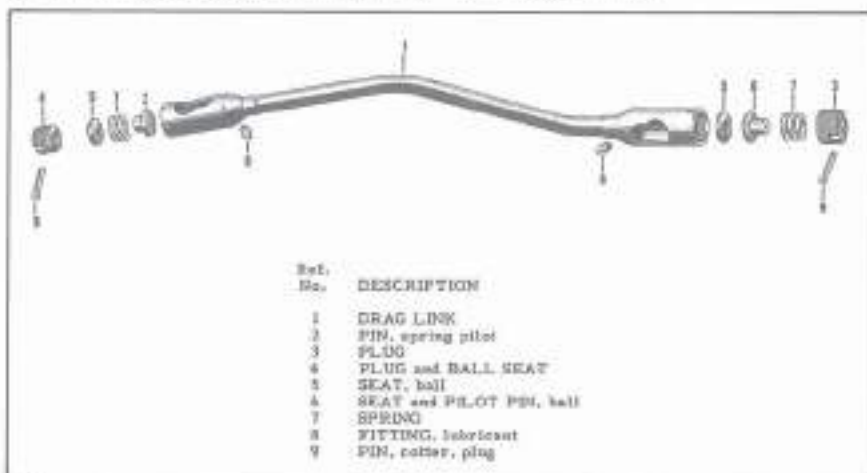


Fig. 27. Drag Link - Exploded View



Fig. 64. Steering Gear Assembly

when rotating wheel with thumb and forefinger.

Adjust Levershaft Backlash. Turn steering gear wheel until steering axle wheels are in a straight-ahead position. Loosen adjusting screw lock nut at gear side cover (Figure 64). Tighten adjusting screw until there is a slight finger drag when turning steering gear wheel slowly from one extreme to the other. Tighten lock nut after correct adjustment is obtained.

STEERING GEAR REPAIR AND REPLACEMENT

Remove Steering Wheel and Gear. Disconnect horn button cable and remove terminal at end of cable. Depress and twist horn button, then lift button out of steering wheel. Withdraw horn cable from wheel tube. Remove screws fastening horn button base plate and remove plate, spring, and spring seat. Unscrew steering wheel nut and remove wheel, using a puller.

Remove top and side body plates. Disconnect drag link. Remove bolts and nuts fastening steering gear housing, then remove steering gear assembly.

Remove Levershaft. Remove Pitman Arm. Remove side cover screws and washers. Remove cover

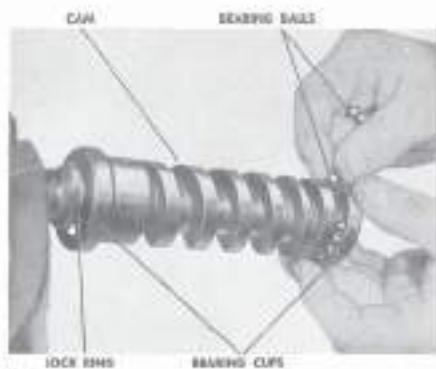


Fig. 65. Installing Cam Bearings

and gasket. Turn wheel until levershaft engages center of cam, then remove levershaft.

Remove Cam and Shaft. Remove steering wheel. Loosen jacket clamp bolt and slide jacket off upper cover and wheel tube. Remove upper cover screws and lift cover and stumps off housing and wheel tube. Pull cam and wheel tube assembly out of gear housing.

Replace Cam Bearings. To remove bearings, remove lock rings and lift off bearing cup. Bearing balls will drop out.

To install bearings, hold lower bearing cup at edge of cam with one hand and drop 14 balls in place in cup with other hand. Rotate cup to correctly position the cup and balls on cam bearing surface. Turn cam upside down so that balls will not drop out and install lock ring.



Fig. 66. Oil Seal and Bushing - Installed View

Fit Piston Rings. Insert ring in cylinder, square the ring in the cylinder with head of piston; then measure gap with a flat feeler gage (Figure 14). Clearance of .007 to .015 inch is recommended for both compression and oil rings. If clearance is excessive, replace ring. If clearance is under specification,



Fig. 14. Filing Ring Gap

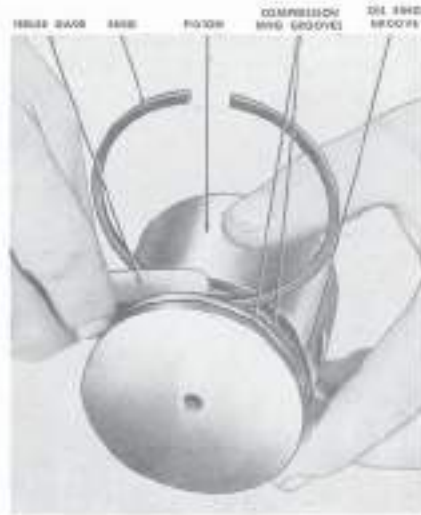


Fig. 15. Measuring Ring Groove Clearance

fit rings by filing edges, using a mill file (Figure 15). Measure ring side clearance in piston groove with a flat feeler gage (Figure 16). Recommended clearance is .0015 to .003 inch. If ring does not fit correctly, replace ring or piston. Be sure ring groove is clean and free of carbon when measuring groove clearance.

Assemble Piston and Connecting Rod. Before assembling piston and connecting rod, inspect ring fit and clearance, pin fit, and connecting rod alignment. Items to be assembled should be heated to room temperature (70°).

With connecting rod positioned in piston, install pin and lock rings. Inspect for free movement of rod and piston on pin. Connecting rod should turn on pin under its own weight. Place oil ring in piston bottom groove and compression rings in two top grooves.

Install Piston and Connecting Rod Assembly. Before installing, make certain all parts and cylinder walls are clean. Dip assembled piston into can of good grade engine oil and coat cylinder wall with clean engine oil.

The pistons must be installed from the bottom of the cylinder. The bottom of the cylinder is clamped, eliminating compressing of the rings with an additional tool.

To install piston, square piston with cylinder, shake piston sideways slightly, at the same time applying slight pressure to push piston into cylinder (Figure 17). Position bearing inserts (lags engaging slots and oil hole aligned with connecting rod oil hole) in cap and rod. Install bearing cap and tighten out at 25 to 40 foot-pounds pressure, using a torque wrench. Set out locks. Install cylinder head and oil pan.



Fig. 17. Installing Piston and Ring Assembly

CONNECTING RODS AND BEARINGS

The connecting rods are provided with shell insert type bearing. These bearings are easily replaced by removing the oil pan and bearing caps. New bearings do not require reaming. The following procedures deal with replacement of connecting rods and bearings with engine removed.

Remove Connecting Rod and Bearings. See Piston and Ring Section.

Inspect Connecting Rod and Bearings. Inspect for pitting, scoring, or excessive wear of crankshaft journals and connecting rod bearings. Inspect crankshaft journals for out-of-round or taper. Taper or out-of-round should not exceed .001 inch. Inspect connecting rod alignment, using correct fixture. Recommended maximum twist and bend of rod is .002 to .003 inch.

Inspect Connecting Rod Bearing Clearance. Connecting rod bearings are shell inserts, and should not be altered to obtain correct fit. Replace bearings if clearance is not within specifications. Recommended clearance is .0015 to .003 inch. Inspect clearance by placing a well oiled .003 inch brass shim (1/4 inch wide x 1 inch long) between bearing and journal. Tighten connecting rod cap at 25 to 40 foot-pounds; rotate crankshaft. If there is stiff resistance to turning, bearing clearance is not excessive. Use undersize bearings of the correct size if clearance is excessive.

Install Connecting Rod and Bearings. See Piston and Ring Section for installation of connecting rod. Before installing bearings, be certain connecting rod

bearing seats are clean, and also wipe off back side of bearings. When installing bearings, make certain that bearing lugs engage slots and that oil holes are aligned. (See Figure 17). Tighten bearing cap screws at 25 to 40 foot-pounds pressure, using a torque wrench. Bearing caps should not be filed or distorted in any way.

CRANKSHAFT and MAIN BEARINGS

The crankshaft is supported by two shell insert type main bearings. When replacing bearings, use undersize bearings of the correct size. Do not file cap or bearing to obtain correct fit. The following procedures cover replacement of crankshaft and bearings with engine removed.

Remove Crankshaft and Main Bearings. Remove engine assembly (see Section on Engine Assembly), oil pan, clutch, flywheel and housing, crankshaft pulley, timing gear cover. Remove connecting rod and main bearing caps. Remove crankshaft gear, thrust plate, and thrust washer from front of crankshaft. Remove retainer and seal from rear of crankshaft. Then lift crankshaft out of crankcase.

Inspect Crankshaft and Main Bearings. Inspect for scoring or excessive wear of crankshaft journals and bearings, and for plugged oil holes in crankshaft. Inspect journals for out-of-round or taper. Taper or out-of-round should not exceed .001 inch.

Install Crankshaft and Main Bearings. Place upper crankshaft bearings in their correct positions in cylinder block. Be sure bearing oil holes are aligned with the holes in cylinder block. Bearing lugs should rest in slots in cylinder block. Coat bearings with

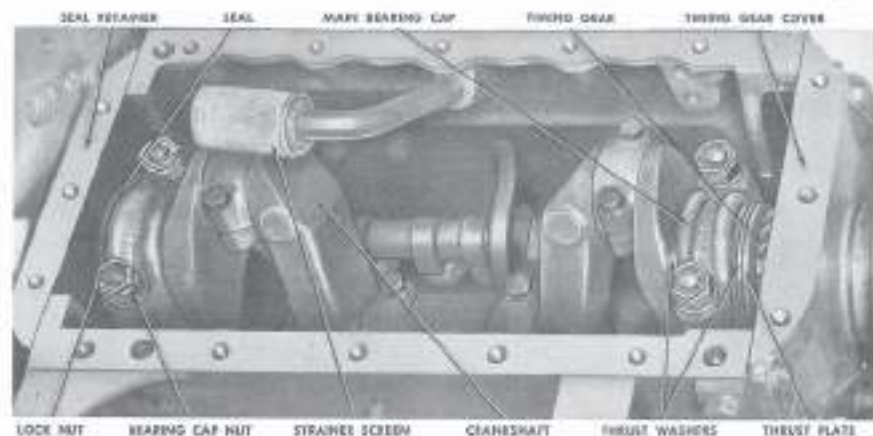


Fig. 18. Crankshaft - Exploded View

STEERING GEAR

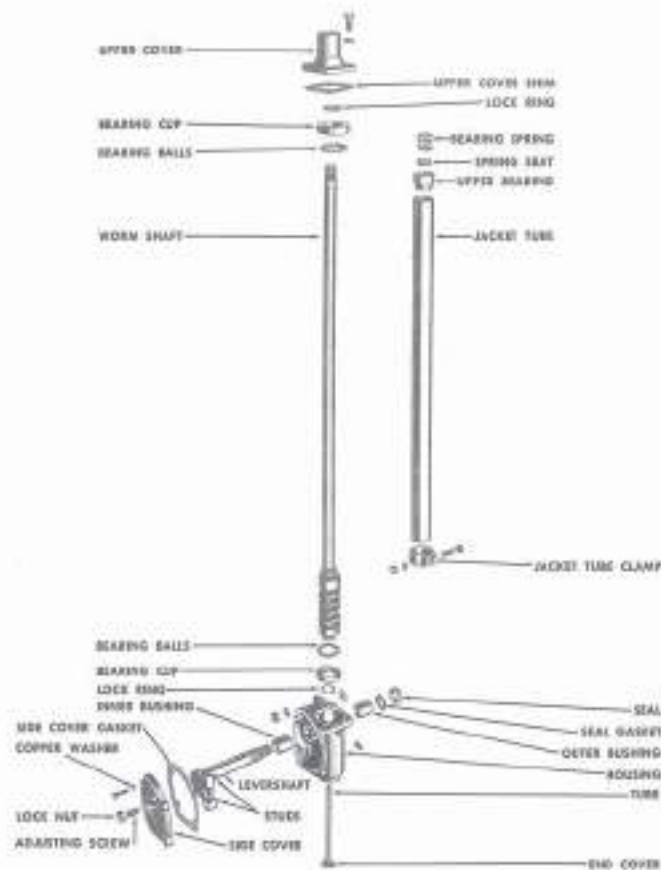


Fig. 52. Steering Gear - Exploded View

DESCRIPTION

The steering gear is the cam and lever type. The cam pivots on ball bearings at top and bottom. The lever is mounted on two bushings and is provided with two machined studs that slide back and forth in the cam threads.

STEERING GEAR ADJUSTMENT

Adjust Cam End Play. Adjust cam bearings by removing or installing shims between upper cover and gear housing. If bearings are loose, remove shims. If bearings are too tight, install shims. Adjust bearings until there is a slight drag present

STEERING AXLE WHEELS

Adjust Wheel Bearings. Remove hub cap and bearing nut cotter pin. Tighten bearing nut as much as possible, turn nut back one slot, then to nearest cotter pin slot and install cotter pin. Rotate wheel while adjusting bearings.

Lubricate Wheel Bearings. Each six months the wheels should be repacked with new grease. Remove

hub cap, cotter pin, bearing nut, key washer, and outer bearing cone from wheel hub. Remove wheel. Tap inner bearing cone and oil seal out of hub, using a brass drift. Remove old lubricant, then repack bearing cone and hub with a good grease (See Lubrication Section).

Place inner bearing cone in hub and install new oil seal. Install wheel, outer bearing cone, key washer, bearing nut, and adjust bearings. Install cotter pin and hub cap.

engine oil, slide one thrust washer on end of crankshaft, then position crankshaft in bearings and cylinder block. With lower bearings in caps, lugs correctly aligned with cap slots, install bearing caps and inspect fit of bearings to crankshaft journal (par. below). Tighten bearing cap nuts evenly at 100 to 110 foot-pounds pressure, using a torque wrench. Install lock nuts, positioned as shown in Figure 18.

Slide thrust washer on end of crankshaft and position washer on dowel pins. Insert key in crankshaft slot and install skims, thrust plate (hub out), crankshaft gear, oil slinger, and pulley on front end of crankshaft. Secure pulley with screw and washer and inspect crankshaft end play (See par. below). With crankshaft end play correct, remove pulley.

Coat connecting rod bearings with oil and install bearings and caps. Install a new oil seal in timing gear cover, then install cover. Before tightening cover screws, install pulley to assure correct alignment between pulley and oil seal. Tighten cover and pulley screws. Install a new oil seal in crankshaft rear seal retainer, then install retainer and gasket.

Install strainer screen, oil pan and gasket, flywheel and housing, and clutch. Install engine assembly in vehicle.

Inspect Crankshaft Main Bearing Clearances. Crankshaft bearings are shell inserts. The caps and bearings should not be altered to obtain correct fit. Replace bearings if fit is not within specifications. Recommended clearance is .0015 to .002 inch.

Inspect clearance by placing a well oiled .002 inch brass shim (1/4 inch wide x 1 inch long) between bearing and journal. Tighten crankshaft bearing cap at 100 to 110 foot-pounds, using torque wrench. Rotate crankshaft. If there is a stiff resistance to turning, bearing clearance is not excessive.

Inspect and Adjust Crankshaft End Play. Crankshaft end thrust is taken by the front bearing shoulder, thrust washers, and plate, and is adjusted by removing or installing shims between timing gear and crankshaft shoulder. To inspect crankshaft end play, pry crankshaft toward flywheel, using a flat feeler gage inserted between journal and bearing shoulder. End play of .0025 to .003 inch is recommended.

CAMSHAFT and TIMING GEARS

The camshaft is supported by three bearings machined directly into the crankcase (No serviceable bearings are required). Two helical timing gears are used, one on the camshaft and one on the crankshaft. The camshaft gear is recessed and an automatic governor is mounted in this recess (Figure 19). No internal adjustment of this governor is necessary (See Fuel Section for external governor adjustment).



Fig. 19. Timing Gears - Installed View

Remove Timing Gear Cover. Disconnect hydraulic pump coupling, remove pulley screw and pull pulley off crankshaft. Remove gear cover screws, then remove cover.

Remove Timing Gears and Governor. To remove crankshaft timing gear, use pulley. To remove governor, unarrow weight plate screws and lift governor assembly out of gear. Unscrew nut at end of camshaft and pull gear off camshaft.

Remove Camshaft. Remove cylinder head, valves, springs, and distributor. Turn block upside down so that tappets fall away from cams. Remove thrust plate screws. Remove plate, camshaft, and tappets.

Install Camshaft and Gears. With cylinder block upside down and tappets installed in block, install camshaft. Install thrust plate and secure with screws and lockwashers. Install crankshaft gear. Install key and camshaft gear as follows:

One crankshaft gear tooth is punch-marked; two camshaft gear teeth are marked. Mesh gears so that punch-marked tooth on crankshaft gear mates between the two punch-marked teeth on camshaft gear (Figure 19). Install nut and washer on camshaft. Install governor on camshaft gear.

Install Timing Gear Cover. Before installing cover, be sure oil slinger is installed on crankshaft with small open end toward gear. When cover has been removed, it is recommended that a new oil seal be installed in cover. Install cover. Before tightening cover screws, install crankshaft pulley to assure correct alignment between pulley and oil seal. Tighten cover and pulley screws and connect hydraulic pump coupling.

Inspect and Adjust Valve Timing.

If the timing gears are removed, valve action must be timed in relation to piston position when reinstalling gears. Two teeth on camshaft gear and one tooth on crankshaft gear are punch-marked. Install timing gears so that marked tooth on crankshaft gear engages the two marked teeth on camshaft gear. If assembled in this manner, the camshaft is timed correctly.

To inspect gear marks or adjust camshaft timing when gears are not marked, adjust No. 4 cylinder tappet clearances so that a .028 feeler will pass freely and a .021 feeler will be tight. Rotate crankshaft until "T.D.C." mark on flywheel aligns with pointer. Rotate camshaft counter-clockwise until No. 4 cylinder exhaust valve is open; continue to rotate camshaft slowly until valve just closes. With crankshaft and camshaft in these positions, the marked gear teeth should match. With crankshaft and camshaft in these positions, No. 1 cylinder is at T.D.C. on the compression stroke, so distributor may be set to fire No. 1 cylinder.

OIL PUMP and STRAINER

A gear type oil pump is mounted on the rear of the cylinder block and is coupled to the end of the cam-

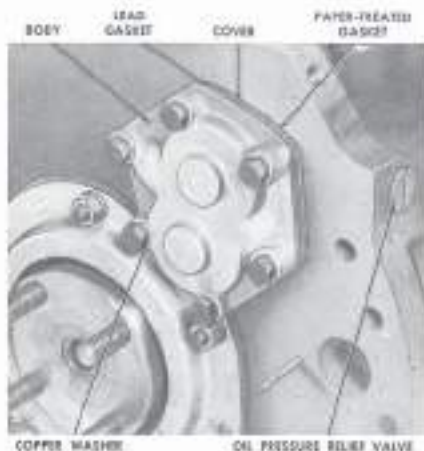


Fig. 21. Oil Pump - Installed View

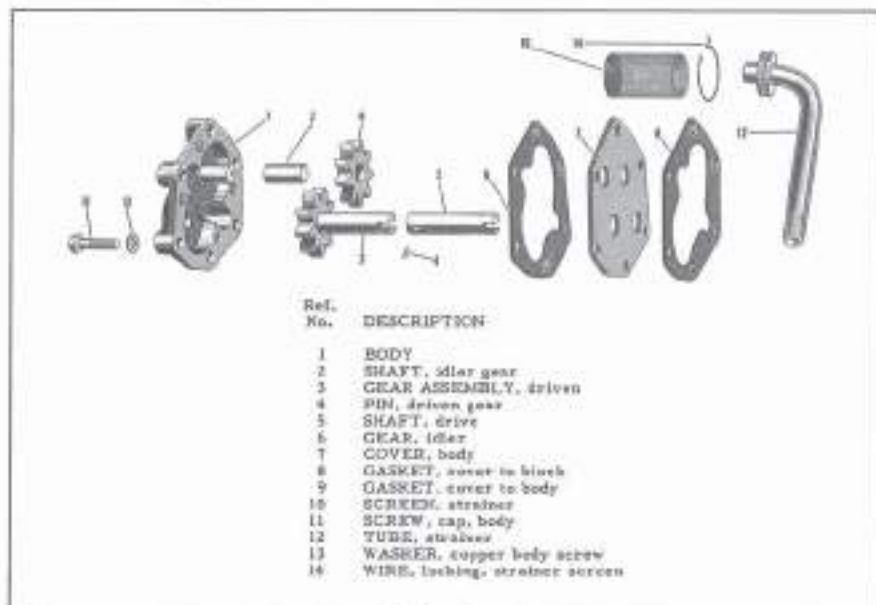


Fig. 20. Oil Pump - Exploded View

STEERING AXLE and WHEELS

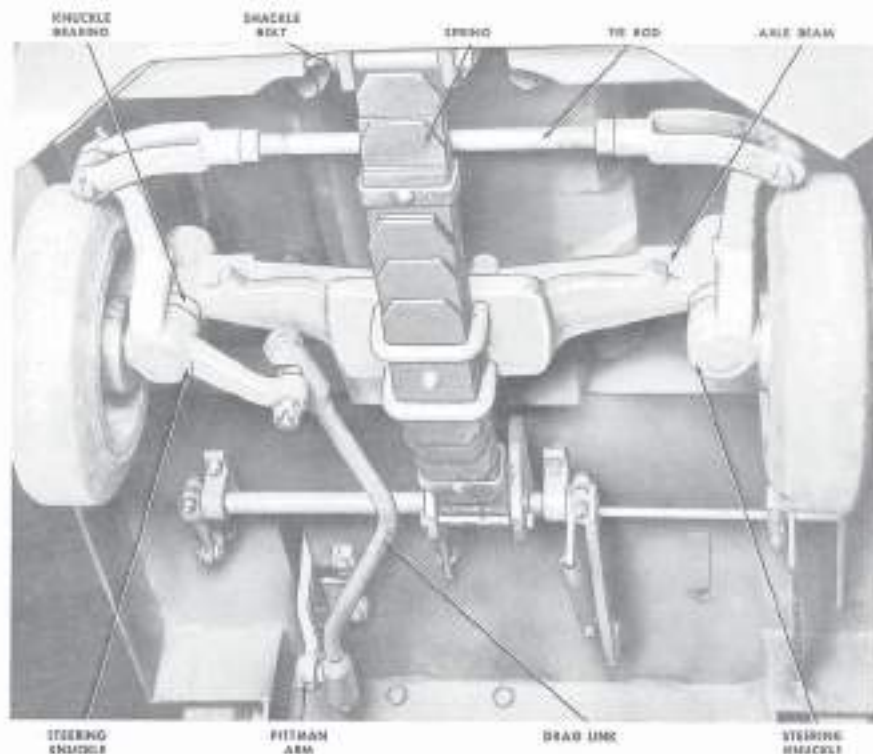


Fig. 44. Steering Axle - Installed View

DESCRIPTION

The steering axle is located at the rear of the vehicle and is attached to the chassis with a spring (Figure 42). Steering control points are pivoted on roller and needle bearings. The steering axle wheels are mounted on tapered roller bearings.

REPAIR AND REPLACEMENT

Replace Axle Assembly. Raise vehicle frame until wheels just rest on floor. Remove shockle bolt. Disconnect drag link at steering knuckle arm. Raise vehicle higher and remove axle and spring assembly.

To install axle, raise vehicle, position flat end of

spring in bracket. Lower vehicle, align spring eye with shockle bracket, and install shockle bolt. Connect drag link.

Replace Steering Knuckle and King Pins. On early model axles, the steering knuckles are attached to the king pins with a self-locking nut. On later models, the knuckles are welded to the king pin. The king pin and knuckle assembly can be removed by unscrewing the flat head screw at the top of the king pin.

ADJUST TOE-IN

Adjust Toe-In. Adjust wheel toe-in to 0 to 1/8 inch by loosening lock nuts and turning tie rod.

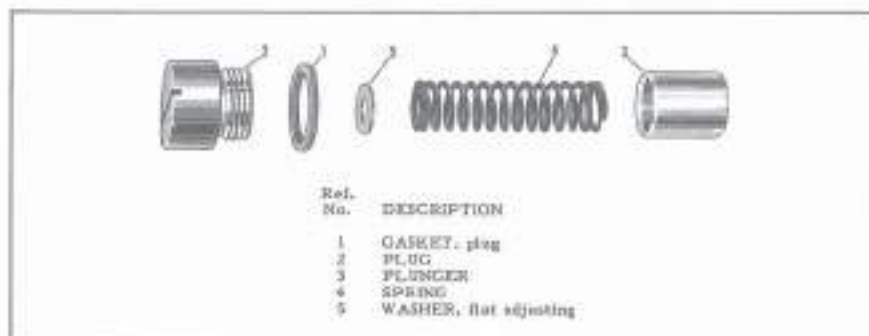


Fig. 22. Oil Pressure Relief Valve - Exploded View

shaft (Figure 21). The strainer for the oil pump is attached to the bottom of the crankcase as shown in Figure 18. The oil pump draws oil through this strainer and through oil holes drilled in crankcase, then pumps it through other passages to the various moving parts.

Remove and Disassemble Pump.

To remove the pump, it is necessary to remove clutch and flywheel. Then remove screws fastening body to block.

Inspect Pump

Inspect gears and surfaces on which gear faces contact for wear and scoring. Inspect shafts and bushing for scoring and wear. Replace defective parts. The bushing in the pump body is serviced only with the pump body assembly.

Assemble and Install Pump. When installing pump, use a lead gasket between body and cover and a "treated-paper" gasket between cover and cylinder block

(Figure 21). Use copper washers on body screws. Tighten screws alternately and evenly to prevent damage to pump body.

OIL PRESSURE RELIEF VALVE

The oil pressure relief valve (Figure 22), which automatically controls maximum engine oil pressure, consists of a plunger and calibrated spring, and is located at the right rear of cylinder block adjacent to oil pump (Figure 21).

To remove relief valve, unscrew plug from cylinder block and remove spring and plunger. If oil pressure is higher than normal, valve plunger may be sticking. Remove plunger, clean thoroughly, and inspect for correct fit in crankcase hole. Replace defective parts. If oil pressure is lower than normal, pressure may be increased by installing small flat washers between plug and spring. Normal operating oil gauge pressure is 15 to 20 pounds.

DRIVE AXLE

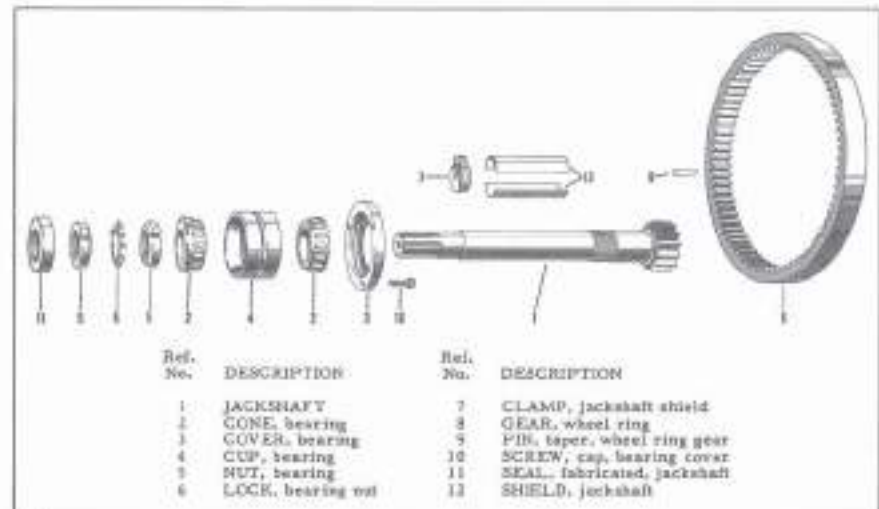


Fig. 82. Jackshaft - Exploded View

The drive axle differential is incorporated in the transmission assembly. For description and service procedures, see Transmission Section.

DRIVE AXLE WHEELS

Adjust Wheel Bearings. Remove hub cap and bearing nut cotter pin. Tighten bearing nut as much as possible to make certain bearing is seated correctly, then turn nut back to nearest cotter pin slot and install cotter pin. Rotate wheel while adjusting bearings.

Lubricate Drive Gears and Wheel Bearings. Each six months the wheel bearings and drive gears should be cleaned and repacked with new grease. Remove hub cap, cotter pin, bearing nut, key washer, and outer bearing cone from wheel hub. Remove wheel. Tap inner bearing cone and oil seal out of hub, using a brass drift. Remove oil lubricant from bearings and drive gears, clean parts thoroughly; then repack cones and wheel hub with grease and coat gears with grease (See Lubrication Section).

Place inner bearing cone in hub and install new oil seal. Install wheel outer bearing cone, key

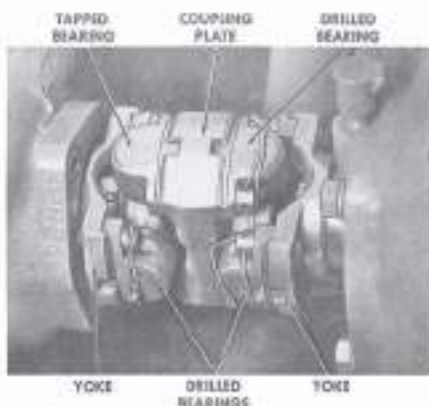
washer, bearing nut, and adjust bearings. Install cotter pin and hub cap.

JACKSHAFT

Replace Jackshaft. Remove wheel assembly. Remove the screws fastening bearing cover and withdraw jackshaft assembly. Before reinstalling jackshaft, pack bearings with chassis lubricant. When reinstalling jackshaft, rotate shaft to align splines with transmission gear. Secure jackshaft with cover screws and wheel.

Replace Jackshaft Bearings. The gear end of the jackshaft is supported by two tapered roller bearing cones and one double cap. To replace bearings, straighten ears of nut lock, unscrew lock nut and bearing adjusting nut, then remove bearing cap, cones, and cover.

To install bearings, place bearing cover, one bearing cone, double cap, other bearing cone on jackshaft. Install and tighten bearing nut as much as possible to seat bearing, using a spanner wrench. Loosen nut until bearing can rotate on jackshaft by hand and no end play is present. Install lock and lock nut, then secure lock nut by bending lock over nut.



T-1000

Fig. 21. Universal Joint - Installed View

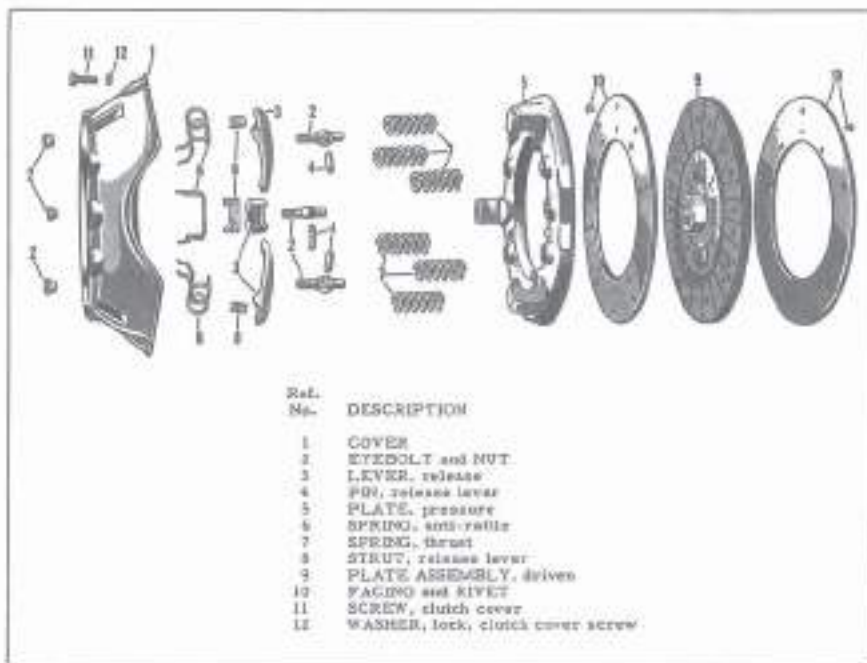
REPAIR AND REPLACEMENT

Disassemble and Remove Universal Joint. Remove lock wires and screws fastening 4 transion bearings to the coupling plate. Carefully pry bearings out of coupling plate retaining lugs and slide bearings off spider journals. Remove coupling plate.

To remove spider, remove screws fastening bearings to yoke. Pry bearing out of retaining lugs and remove spider and bearing assembly.

Assemble and Install Universal Joint. Pack the bearings with grease and place them temporarily on spider journals to remove excess lubricant. Remove the bearings and install new cork gaskets. Slide drilled bearings on spider journals and install assemblies on yokes. Insert coupling plate between the two spiders. Slide two tapped bearings on spider adjacent to transmission and two drilled bearings on spider adjacent to clutch shaft. Install screws through drilled bearings and coupling plate and into tapped bearings. After tightening retaining screws, secure them with lock wires.

CLUTCH



T-1000

Fig. 22. Clutch - Exploded View

Ref. No.	DESCRIPTION
1	COVER
2	EYEBOLT and NUT
3	LEVER, release
4	PD, release lever
5	PLATE, pressure
6	SPRING, anti-rattle
7	SPRING, thrust
8	STRUT, release lever
9	PLATE ASSEMBLY, driven
10	FACING and RIVET
11	SCREW, clutch cover
12	WASHER, lock, clutch cover screw

DESCRIPTION

The clutch (Figure 22) is a single plate, dry-disk type, self-compensating for facing wear; no adjustment within the unit is necessary unless clutch is disassembled. A clutch pedal adjustment is required (as the facing wears) to prevent the release bearing from riding on the levers and causing clutch to slip.

When the clutch pedal is depressed, the release bearing moves toward the clutch, contacts release levers, and releases the spring pressure on the driven plate, thus permitting the flywheel to spin freely. When the pedal is released, the bearing moves away from the levers, thus allowing spring pressure to be applied to the pressure and driven plates. This engages the entire clutch and power train with the engine flywheel.

REPAIR AND REPLACEMENT

CLUTCH PEDAL ADJUSTMENT

The clutch pedal should have 1 inch for travel before the release bearing contacts clutch release levers. Adjust pedal for travel by removing clevis pin, loosening lock nut, and turning yoke at release shaft lever.

CLUTCH REPLACEMENT

Remove Clutch. Remove left body plate and disconnect clutch linkage. Remove universal joint assembly and slide yoke off clutch shaft. Remove screws fastening bearing carrier to clutch housing. The clutch shaft assembly and release bearing can

RELEASE CLUTCH
YORK HOUSING CLUTCH COVER



7-189 Fig. 24. Sweeping Clutch Shaft

now be removed. Slide clutch shaft and carrier assembly away from clutch, then allow shaft and clutch release bearing to drop down as shown in Figure 24.

Remove clutch cover screws and allow clutch cover and driven plate to drop out bottom of clutch housing.

Install Clutch. Before installing clutch, be sure flywheel and pressure plate surfaces are clean. Then assemble clutch shaft, cover, and driven plate outside the vehicle. Proceed as follows: Temporarily remove bearing carrier from clutch shaft. Place driven plate (extended hub toward pressure plate) on pressure plate and insert clutch shaft through cover and into driven plate splines. The assembly is now ready to install. When installing, the clutch shaft will keep the driven plate aligned with cover and flywheel. Install clutch cover through bottom of clutch housing, align clutch shaft pilot and with bearing in flywheel, then push shaft into correct mounting position. Install cover screws. Before tightening screws, shake clutch shaft back and forth to make sure driven plate is correctly aligned. Then tighten screws alternately a few turns each until cover is secured to flywheel.

Remove clutch shaft and reinstall bearing carrier on this shaft. Hold release bearing in approximate mounting position, and insert clutch shaft part way into bearing (Figure 24). Raise shaft, at the same time aligning release bearing collar with release yoke pins until shaft is parallel with driven plate splines.

Push shaft into driven plate until pilot end engages bearing in flywheel and bearing carrier is in correct mounting position in clutch housing. Fasten carrier with screws. Operate release lever by hand and check release bearing for operating freely until it contacts clutch release levers.

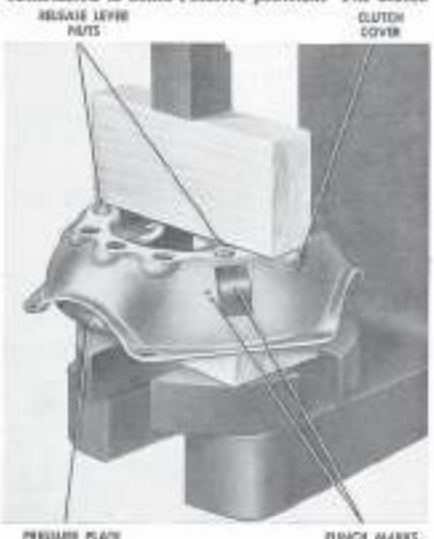
Install yoke and universal joint. Connect clutch linkage and adjust yoke until pedal has 1 inch free travel.

CLUTCH REPAIR

Inspect and Repair Driven Plate. Inspect driven plate facings for excessive wear (down to the rivet heads). Inspect driven plate for warpage, loose hub rivets or broken cushion springs. If driven plate is faulty, replace assembly. If driven plate is O.K. and facings are worn, the facings may be replaced. When refacing clutch driven plate, use new rivets and new facings of correct thickness, size, and material. Variation in thickness of facings will result in faulty clutch operation.

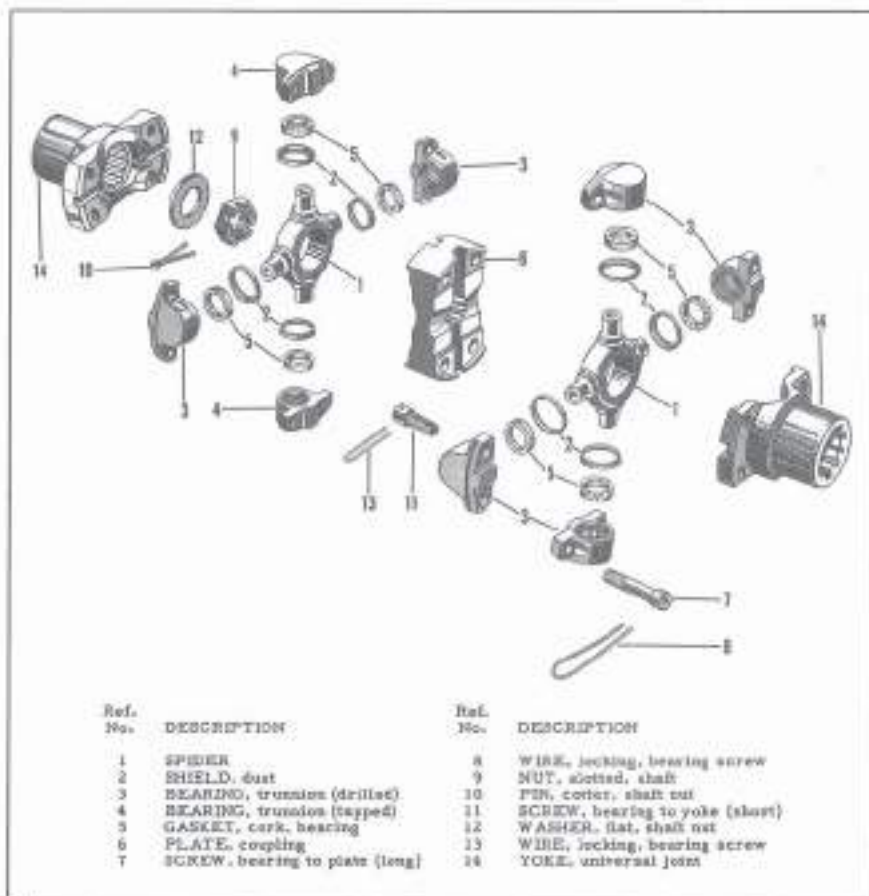
CAUTION: Drill out facing rivets to remove them. Punching them out will distort clutch driven plate cushion springs. Contact friction surfaces of clutch bearings must be free of all oil and grease, otherwise clutch may "grab" or "chatter" in operation.

Disassemble Clutch Cover. Punch mark pressure plate lugs and cover so that cover and plate can be reinstalled in same relative position. The clutch



7-189 Fig. 22. Compressing Clutch Cover

UNIVERSAL JOINT



7-189 Fig. 29. Universal Joint - Exploded View

DESCRIPTION

The drive between the transmission and clutch shaft consists of two cross and transion bearing universal joints coupled by a steel plate. The transion

bearing is an assembly of steel rollers and a cup. Cork washers mounted in the cup prevent lubricant leakage and dust shields mounted on the spider journals keep out dirt. The universal joint must be disassembled for lubrication or repair.

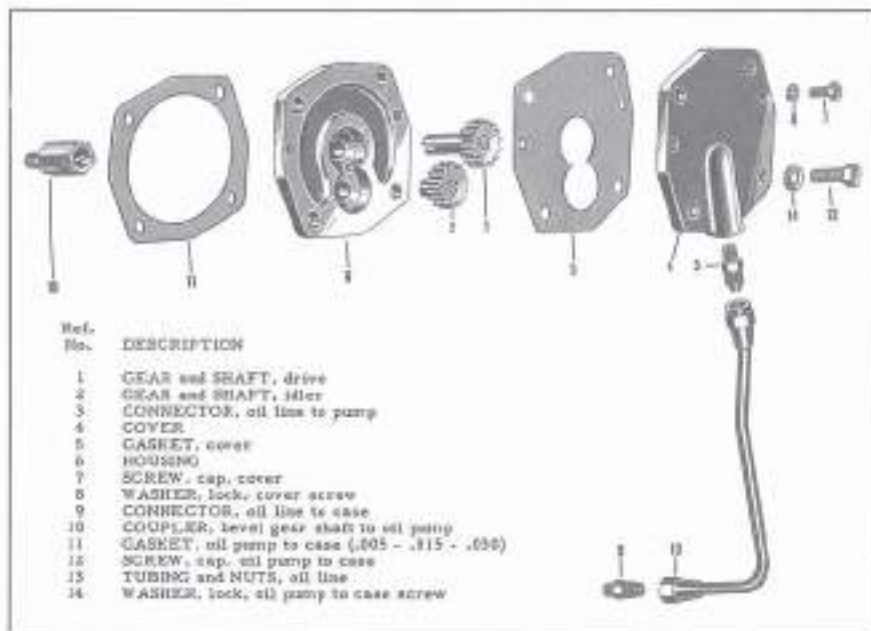


Fig. 26. Transmission Oil Pump (Lone Model) - Exploded View

Repair Oil Pump. To disassemble pump, remove cover screws and lift off cover and gasket. Remove gear and shaft assemblies from housing. Inspect gears and housing for wear. Replace worn gears. If housing is worn, replace pump assembly.

Before assembling pump, make certain oil passages are clean and free from any obstruction. Dip gears in oil when assembling pump. Install gear and shaft assemblies. Install gasket and cover and secure with screws.



Fig. 28. Removing and Installing Release Levers



Fig. 25. Locking Release Lever Adjusting Nuts



Fig. 27. Assembling Clutch Cover

cover must be compressed for disassembly. Place cover assembly in an arbor press with a block under the pressure plate so positioned that the cover can move down freely. Place a block on the cover as shown in Figure 28. Compress cover and hold compressed while release lever adjusting nuts are removed. Release press slowly until spring pressure is released. Then remove cover and pressure springs.

Remove Release Levers. Grasp the lever and eyebolt between thumb and fingers. With other hand, raise strut, tilt outward, and lever strut as shown in Figure 28. Then maneuver lever and eyebolt from strut and lug.

Inspect Clutch Cover Parts. Inspect all parts for wear. Replace worn parts. Inspect for weak or broken springs. Place pressure springs on a flat surface and inspect for uniform height. Replace faulty springs.

Install Release Levers. Coat eyebolt base and floating pin with a thin layer of grease. Install pin in eyebolt and position assembly in lever socket. Place strut in lug ridge, grasp eyebolt and lever between thumb and fingers, and install in pressure plate lug as shown in Figure 28.

Assemble Clutch Cover. Make certain anti-rattle springs are fastened to clutch cover and that release levers are installed correctly. Place pressure springs on pressure plate bosses arranged as shown in Figure 27. Position cover on springs so that punch marks on lever lug and cover are aligned. Place cover assembly in arbor press with pressure plate positioned squarely on a block and with a wood block or bar across cover (Figure 25). Be sure that clutch cover eyebolt holes are clear. Compress cover slowly, keeping lever lugs and eyebolts aligned with their respective openings in the clutch cover. Install eyebolt nuts and tighten until they are flush with tops of eyebolts. Release press. Remove clutch cover assembly from press and adjust release levers. After levers are adjusted, punch nuts to lock them in place (Figure 28).

NOTE: Correct operation of the clutch depends upon adjustment of the release levers. These levers must all be adjusted equal-distant from the pressure plate machined surface. Use a clutch assembly picture for adjusting clutch cover.

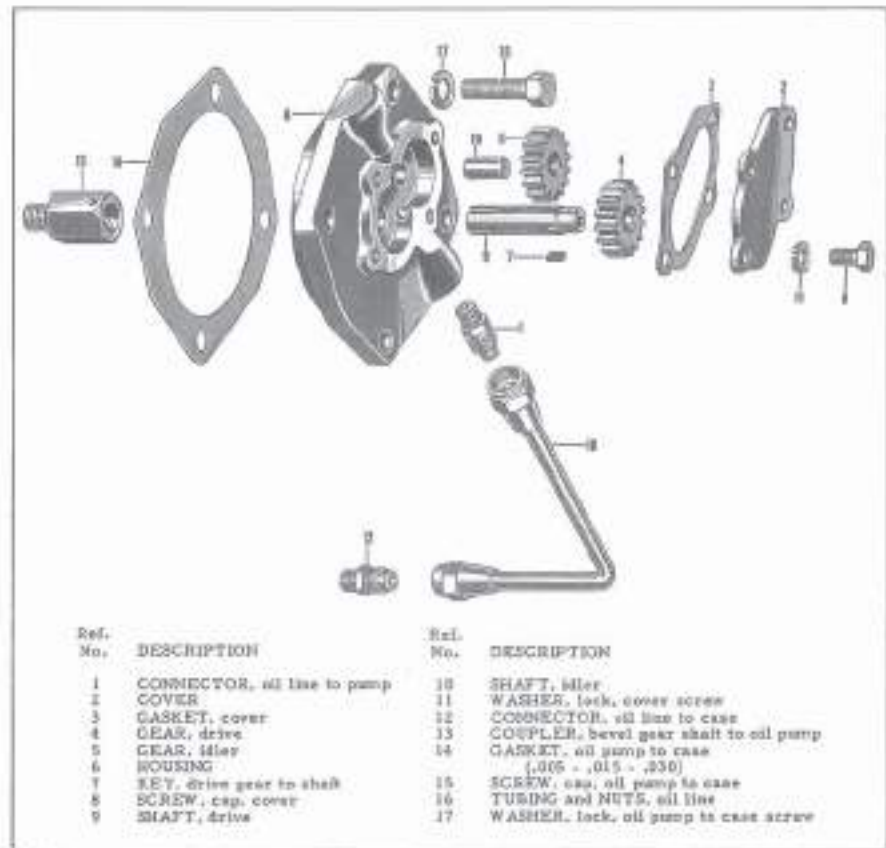


Fig. 57. Transmission Oil Pump (Early Model) - Exploded View

in case, engaging gears as shown in Figure 56. Install shafts and secure with set screws and lock wires. Install transmission cover and gasket.

Install Transmission Assembly. Position transmission assembly on drive axle carrier and secure with screws. Install gear shift levers, brake band, and connect universal joint. Fill transmission with three pints of engine oil (SAE 50, summer; SAE 30, winter).

TRANSMISSION OIL PUMP

The transmission is equipped with a gear-type

oil pump mounted at the top of the transmission case (at side opposite gear shift levers). The pump is driven by a coupler which is threaded into the end of the bevel drive gear.

Two styles of pumps have been used - (See Figures 57 and 58). When replacing pump, use the late model assembly and new style oil line.

Replace Pump Assembly. To replace the pump assembly, disconnect oil line and remove the screws fastening pump housing to the transmission case. The coupler can be replaced by unscrewing it from the bevel drive gear.

carrier on brake drum side of case and wide carrier on oil pump side of case (Figure 50). Secure bearing carriers with screws and check differential for rotating freely without end play. Adjust bearing and play by removing or installing bearing carrier gaskets.

Install Reverse Idler and Countershaft Gears. Place reverse idler gear (small gear end toward oil pump) in transmission case. Insert spacers between each side of gear and case. Install packing rings in shaft groove and install shaft in case from brake drum side of case. Place countershaft gear (small gear end away from oil pump) in transmission case. Install shaft lock engaging lock ends with slots in reverse idler gear shaft and countershaft. Secure lock with screw.

Install First and Second Speed Sliding Gear. Install lock ring and tap bearing cone on pin end of shaft. Place gear (large gear end toward brake drum) in case and insert shaft in gear from oil pump side of case as follows: Place gear partially on shaft splines and insert spring and two lock balls in shaft hole. Hold spring compressed with two fingers and slide gear over balls and on shaft. Tap bearing cap in case, then install gasket and bearing cover on oil pump side of case. Install lock ring and tap bearing cone on threaded end of shaft. Tap bearing cap and install cover on case. Check bearing adjustment. Shaft should rotate freely without end play. Adjust bearings by removing or installing bearing cover gaskets. Insert key in shaft slot, install brake drum, and secure with nut.

Install Bevel Drive Gear and Adjust Bearings. Install same shims that were removed when bearing was removed. This will assure correct tooth contact of gear and pinion. Press inner bearing cone

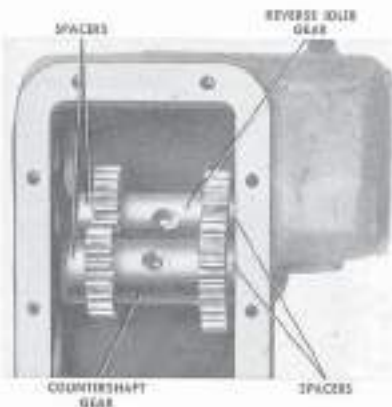


Fig. 50. Reverse Idler and Countershaft Gears - Installed View

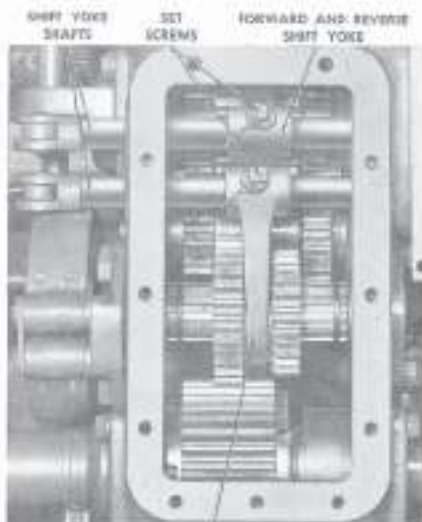


Fig. 51. Shift Yokes - Installed View

on bevel gear shaft. Install bearing lock ring on shaft. Tap both bearing caps in case. Position forward and reverse sliding gear (large gear end away from oil pump) in case and insert bevel gear shaft splines partially into gear. Insert spring and two lock balls in bevel gear shaft hole. Hold spring compressed with two fingers and slide forward and reverse gear over balls and on shaft splines. Install lock ring, shims, and outer bearing cone on threaded end of shaft and secure with nut. Check bearing adjustment. Bevel gear shaft should rotate freely without end play. Adjust bearings by removing or installing shims between outer bearing cone and shaft splines. After bearings are correctly adjusted, install gear shift lever bracket and gasket. Do not install oil pump assembly until bevel pinion is installed. (See paragraph below.)

Install Bevel Drive Pinion Assembly and Adjust Backlash. Install shims, gasket, and pinion assembly. Secure pinion sleeves to case and check pinion to gear backlash which should be from .006 to .008 inch. The pinion assembly can be moved in or out to adjust backlash by removing or installing shims between transmission case and pinion bearing sleeve. These shims are available in sizes of .001, .003, .005 and .020 inches.

Install Shift Yokes. Install new shift yoke shaft oil seals in transmission case. Place shift yokes

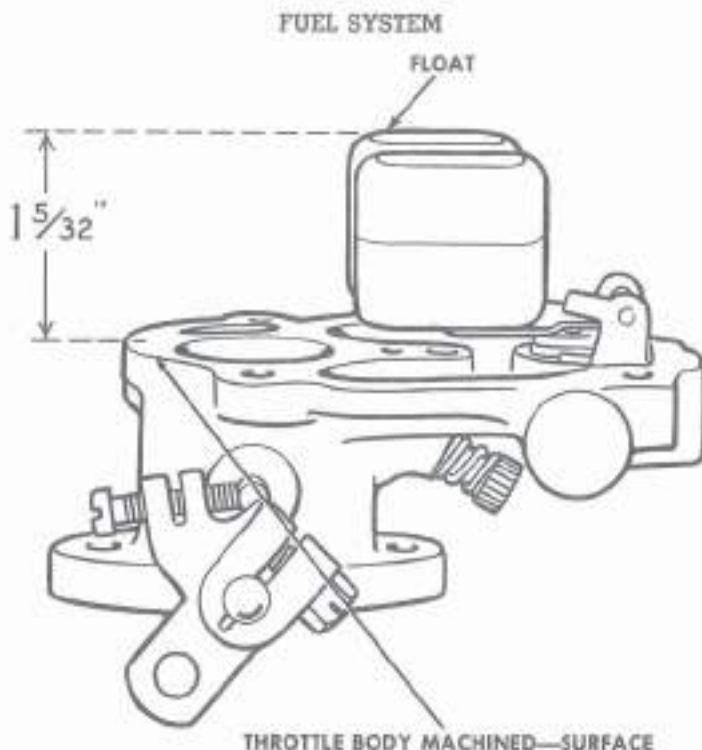


Fig. 52. Carburetor Float Adjustment

TOWMOTOR L18 Trucks are equipped with gravity-feed type fuel systems. The fuel tank is mounted on the cool panel at a level higher than the carburetor. A laminated washer type fuel filter is mounted at the base of the tank and is used as a protection against dirt and foreign particles entering carburetor. The filter is equipped with a shut-off valve so that fuel flow may be shut off when desired.

CARBURETOR

Description. The carburetor used in this fuel system is single-barrel up-draft type with fixed jets covering all speeds except idle. The flow of fuel through the main jet system is controlled by the size of the main jet. The idle adjusting screw controls the fuel mixture for the idle system.

CARBURETOR SPECIFICATIONS

Jet Sizes	
Discharge jet.....	No. 35
Fuel valve.....	No. 20
Idle jet.....	No. 12
Main jet.....	No. 19
Venturi.....	No. 13
Well vent jet.....	No. 23

Float adjustment	
1-4/32".....	Top of float to machined surface of body.

CARBURETOR ADJUSTMENTS

Adjust Engine Idle. The idle adjusting screw controls the fuel mixture for the idling system. Turning the screw clockwise produces a leaner mixture and counter-clockwise produces a richer mixture. Adjust idle with engine warm. To adjust idle, turn adjusting screw clockwise until engine idles "rough", then turn screw slowly counter-clockwise until engine idles smoothly. The idle speed is adjusted by turning the throttle stop screw.

Adjust Carburetor Float Level. The carburetor must be disassembled to adjust float level. For correct float level, there should be 1-5/32 inch distance from the machined surface of the throttle body to the highest point at top side of float, with the throttle body in an inverted position (See Figure 29).

CARBURETOR REPAIR

Repair kits are available for repairing a carburetor or reconditioning one after it has been subjected to a long period of service. It is recommended that the carburetor be disassembled, inspected and repaired as outlined below.

Disassemble Carburetor. Remove screws fastening bowl to body. Carefully separate bowl from

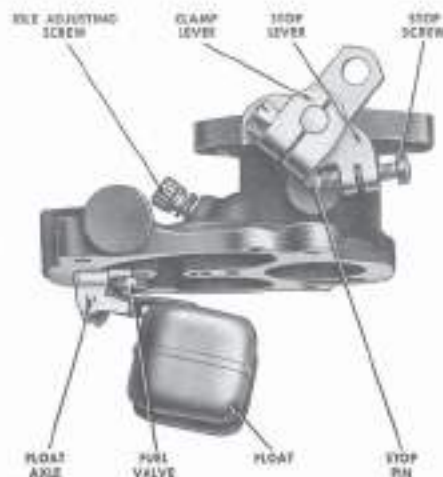


Fig. 29. Throttle Body - Side View

body as follows: Raise throttle body slightly, loosen gasket from the bowl, then lift throttle body and gasket assembly off bowl. Remove venturi.

Remove Float and Fuel Valve (Figure 30). Remove float axle, using a screw driver. First, push axle out slotted end of bracket, then remove axle with fingers. Remove float and fuel valve needle. Unscrew fuel valve seat and gasket.

Remove Idle Screw and Jet. Unscrew idle adjusting screw from body and remove spring (Figure 30). The idle jet is located in a passage at center of the machined surface of the throttle body (Figure 31). Remove idle jet with small screw driver.

Remove Throttle Plate (Figure 30). Do not remove throttle plate and shaft unless parts are faulty. Remove screws fastening plate, then withdraw plate from shaft and start from body. Remove shaft packing retainer, using a screw driver or small pair of pliers.

NOTE: Do not remove identification disk, priming plug, throttle stop pin, float hinge bracket or brass plugs from throttle body.

Remove Fuel Bowl Jet (Figure 32). The discharge jet is located in the fuel bowl air passage and may be removed by unscrewing.

To remove main jet, unscrew plug at side of fuel bowl, then remove jet from this passage, using a screw driver.

The wall vent jet is located in a passage, at the



Fig. 30. Throttle Body - Bottom View

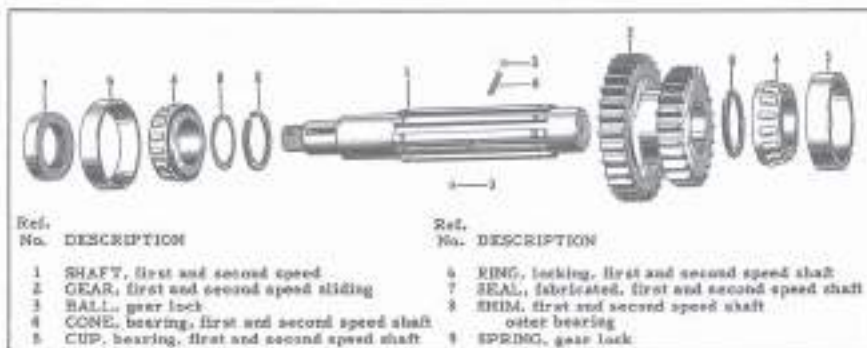


Fig. 32. First and Second Speed Sliding Gear - Exploded View

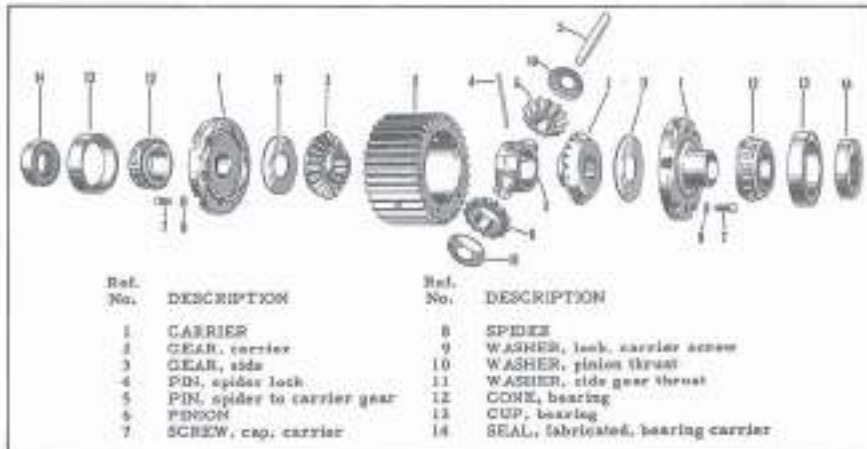


Fig. 33. Differential - Exploded View

pin. Pivot pinions and spider in carrier gear bore to remove pinions and spider (Figure 54).

Assemble Differential. Place spider, pinions, and thrust washers in their relative mounting positions and install this assembly in carrier gear bore with a pivoting action (See Figure 54). Install spider pin and secure in place with lock pin. Place side gears and thrust washers on each side of carrier gear and secure assembly with carriers and screws.

Install Transmission Differential. Place differential assembly in transmission case. Install bearing caps and new oil seals in bearing carriers. Install carrier assemblies and gaskets on case with narrow



Fig. 34. Removing or Installing Pinions and Spider

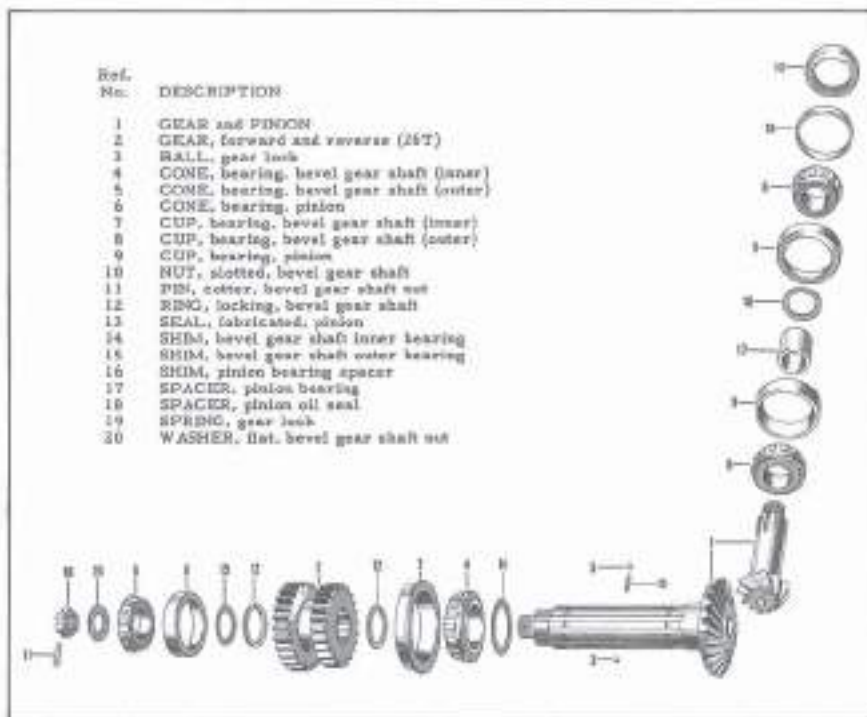


Fig. 21. Bevel Drive Pinion and Gear - Exploded View

Ref. No.	DESCRIPTION
1	GEAR and PINION
2	GEAR, forward and reverse (25T)
3	WALL, gear lock
4	CONE, bearing, bevel gear shaft (inner)
5	CONE, bearing, bevel gear shaft (outer)
6	CONE, bearing, pinion
7	CUP, bearing, bevel gear shaft (inner)
8	CUP, bearing, bevel gear shaft (outer)
9	CUP, bearing, pinion
10	NUT, slotted, bevel gear shaft
11	PIB, collar, bevel gear shaft nut
12	RING, locking, bevel gear shaft
13	SEAL, fabricated, pinion
14	SHIM, bevel gear shaft inner bearing
15	SHIM, bevel gear shaft outer bearing
16	SHIM, pinion bearing spacer
17	SPACER, pinion bearing
18	SPACER, pinion oil seal
19	SPRING, gear lock
20	WASHER, flat, bevel gear shaft nut

shaft), withdraw bevel gear, and lift forward and reverse sliding gear out of case. **CAUTION:** Balls and spring will fly out when bevel gear shaft is withdrawn from forward and reverse sliding gear.

Remove inner bearing and shim using a puller.

CAUTION: The gear to pinion tooth contact is adjusted when the transmission is assembled at the factory. This is accomplished by placing shims between inner bearing cone and gear. Be certain to tag the shims when removing bearing so that the same shims can be reinstalled on the old or new gear. This will assure correct tooth contact when transmission is reassembled.

Remove First and Second Speed Sliding Gear. Remove collar pin, nut, and brake drum. Remove bearing covers and gaskets. Remove lock rings from shaft. Note: These lock rings will be distorted upon removal and should be replaced with new rings when

assembling transmission. Slide first and second speed sliding gear on shaft and catch lock balls and spring which will fly out. With gear braced squarely against the transmission case, tap shaft out of bearing cone (the cone at plate end of shaft). Then remove shaft from gear and gear from case.

Remove Reverse Idler and Countershaft Gears. Remove screw and shaft lock. Withdraw shafts from gears and lift gears out of case.

Remove Differential Assembly. Remove bearing carriers and gaskets, then lift differential assembly out of case.

Disassemble Differential. Remove screws fastening differential gear carriers. Remove carriers, thrust washers, and side gears. The spider pin is held in position by a lock pin. Rotate spider until solid side of spider is lined with carrier gear opening and tap lock pin out of spider. Withdraw spider

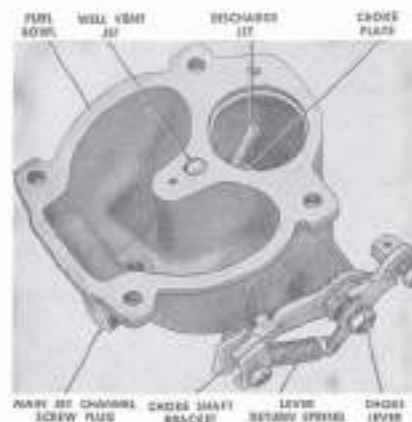


Fig. 22. Fuel Bowl - Internal View

center of the machined surface of the fuel bowl and may be removed with a small screw driver.

Remove Choke (Air Shutter). Unhook choke lever return spring, then unscrew lever retaining nut from shaft end. Remove two screws from choke plate and lift plate out of fuel bowl air passage. Withdraw choke shaft. To remove choke shaft bracket, unscrew nut retaining bracket to bowl.

NOTE: Do not remove air vent channel bushing, choke plate stop pin, or choke bracket locating pin from fuel bowl.

Clean and Inspect Carburetor. Clean fuel bowl, throttle body, and jets with a solvent and blow through each passage and jet with clean dry compressed air.

Inspect float for leaks. Inspect fuel valve needle for ridges caused by heavy tightening of needle in seat. Replace all gaskets when carburetor is disassembled. Replace all parts furnished with Repair Kit (See Parts Book).

Install Choke Plate (Figure 22). Position fuel bowl with machined surface up and facing choke plate opening. Insert choke shaft in body and rotate until flat surface faces down. Insert choke plate, poppet valve first, with valve spring facing down. Center the plate in the bore, rotate shaft to close plate, and install retaining screws. Install choke shaft bracket and retaining nut. Hold plate wide open, and install lever on choke shaft so that lever leg contacts bracket leg. Install lever retaining nut and lock washer. Operate lever to check choke plate for free movement and for opening and closing correctly. Connect return spring at lever and bracket.

Install Fuel Bowl Jets (Figure 22). Install discharge jet and fibre washer in fuel bowl air passage. Install well vent jet and fibre washer in counter-bored passage at center of machined surface of fuel bowl. Install main jet and fibre washer in passage at side of fuel bowl. Install main jet passage screw plug over main jet.

Install Idle Screw and Jet. Install idle jet in passage at center of throttle body machined surface (Figure 20). When installing idle adjusting screw, tighten lightly and carefully, then loosen one turn.

Install Throttle Plate and Shaft (Figure 21). Install shaft packing and retainer as an assembly, using a light hammer. If old shaft is used, install shaft with stop lever assembled to shaft. If new shaft is used, assemble shaft and plate to throttle body, then install stop lever. Proceed as follows:

Insert new throttle shaft in body and place throttle plate in position in air passage. Install plate retaining screws, centering plate in bore before the screws are tightened. Install stop lever on throttle shaft. With plate in the straight up-and-down position in bore, rotate stop lever on shaft until the lever is resting against the stop pin, then drill stop lever, using a No. 45 drill. Secure lever with taper pin.

Install Float and Fuel Valve (Figure 20). Install fuel valve seat and gasket. Place body-in-bowl gasket on throttle body. Install fuel valve needle and float. Install float axle in solid end of bracket, then tap end of axle to force it into the slotted end of the bracket, using the handle of a screw driver. Test float action to make sure that float moves freely on axle. Adjust float level as described under heading Carburetor Adjustments at beginning of this section.

Assemble Carburetor. Place venturi in position in the throttle body. Carefully place fuel bowl on throttle body, taking care to avoid altering float adjustment or damaging float and gasket. Install assembly screws and tighten them evenly and securely.

GOVERNOR

The governor is mounted in a recess in the camshaft gear and is automatic in action. Flyweights, which are linked to the carburetor throttle shaft by levers and rods, control the opening of the carburetor throttle plate.

There is no solid connection between accelerator pedal and throttle plate. The engine speed is controlled by means of spring tension, as shown in Figure 23. The higher the spring tension, the lower the engine speed; the lower the spring tension, the higher the engine speed. The spring tension is changed by loosening lock nut and turning adjusting nut. After correct speed adjustment is obtained, a

remove filler plugs and attach plugs to cell vents. Fill each cell to the top of the filler plug opening with distilled water. Remove plug from vent and the electrolyte level will automatically drop to its correct level. Be sure filler plugs are replaced tightly, otherwise they may work loose. Also make certain vents are not plugged.

Battery Charge Condition. Check specific gravity of the electrolyte to determine battery charged con-

dition. The following hydrometer readings indicate battery charge conditions:

1.275 to 1.300	Fully Charged
1.225	Half Charged
1.150	Very Low

If specific gravity reading is 1.200 or below, charge battery. Be sure electrolyte is at correct level and that filler plugs are removed when charging battery.

EXHAUST SYSTEM

The exhaust system consists of a manifold, flexible asbestos-packed exhaust pipe and muffler.

On early models, the muffler is threaded into the top surface of the floating plate. A nipple, with elbow attached, is threaded into the opposite side of the floating plate. This elbow and nipple serve as a tail pipe. To remove muffler, disconnect flexible pipe and unscrew muffler from floating plate.

On later models, the muffler is clamped to a nipple

screwed into the floating plate. When replacing any parts, loosen clamp at bottom of muffler, disconnect bracket, then remove muffler, pipe and bracket assembly.

The muffler for the early models has been discontinued. Therefore, when ordering old mufflers you will be furnished a new muffler, two clamps and one nipple to revise muffler installation to current specifications.

REPAIR AND REPLACEMENT

It is recommended that the distributor be removed each six months of vehicle operation and inspected as outlined below:

Clean or Replace Points. Inspect breaker point contact faces. If they show a greyish color and are only slightly pitted, clean them with a point file or No. 00 sandpaper. If they do not clean up easily or are pitted and burned, replace them. **NOTE:** If breaker points are burned, replace condenser as it is probably the cause of this condition.

Adjust Breaker Point Gap. After cleaning or replacing points, be sure contact faces are in perfect alignment, then adjust gap to .020 inch (Figure 49). Always recheck gap after tightening point screw locknut.

Inspect Condenser. When checking distributor, the condenser should always be tested for both leakage and capacity with a condenser tester. The function of a condenser is to prevent excessive arcing at the contact points. The condenser must be in good condition and of correct capacity (.30 to .25 microfarads) to assure good performance and to protect the life of the contact points.

Inspect Distributor Cap and Rotor. Clean distributor cap and rotor thoroughly, using carbon tetrachloride. Inspect cap for cracks, carbon runovers, and corroded or burned terminals. If defects cannot be removed by cleaning, replace cap. Inspect rotor for cracks and check metal strap for burning. Replace a faulty rotor.

Replace Distributor. Before removing distributor, rotate engine until rotor is in position to fire No. 1 cylinder. This will assure correct position of rotor when reinstalling distributor. Remove distributor cap and disconnect coil wire. Remove hold-down screw and lift out distributor.

Install distributor so that rotor is in position to fire No. 1 cylinder. If engine has been rotated after distributor was removed, install as follows: Remove No. 1 spark plug and rotate engine slowly until No. 1 piston is coming up on its compression stroke. Continue to rotate engine slowly until timing mark (T, D.C.) on the flywheel aligns with pointer. Then install distributor so that rotor is in position to fire No. 1 cylinder.

SPARK PLUGS

To insure efficient engine operation, clean spark plugs frequently with a sand-blast type of cleaner. Replace a plug that cannot be thoroughly cleaned. Change spark plugs after each 500 hours of operation. Always use original equipment type of plug for replacement (See Parts Book). Before removing plugs, make certain all dirt is removed from cylinder

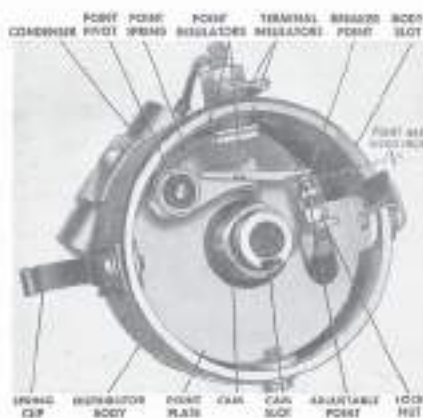


Fig. 49. Distributor Point Adjustment

head wall. The spark plug gap should be set at .030 inch.

IGNITION COIL

When ignition trouble is evident, do not condemn the coil without making certain all electrical connections are clean and tight. Then check condition of coil with testing equipment. If testing equipment is not available, test coil as follows: With coil and distributor installed, rotate engine with ignition switch on, holding coil high tension cable close to cylinder block. If spark is shorter than 1/2 inch or if no spark occurs, coil is faulty.

BATTERY and CABLES

The battery for Model LT35 TOWMOTOR is mounted on a counterweight directly below the driver's seat and is easily accessible by lifting the seat cushion. The battery positive post is connected to the side terminal of the solenoid switch. The negative post is grounded at the clutch housing mounting screw.

After each week of operation the battery should be checked as outlined below.

Clean Battery. Keep battery and cable terminals clean. Corrosion can be removed from battery posts and cable terminals, using a wire brush. Wash battery and cable terminals with ammonia and rinse with clean water. After cleaning, coat terminals and posts lightly with grease to prevent corrosion.

Electrolyte Level. Check electrolyte level. If the level is below 3/8 inch above top of plates, re-

IGNITION SYSTEM



from spark plug terminal and connect one lead of neon light to wire and the other to the plug terminal. Start engine and operate at idle speed; direct neon light flash at hole in flywheel housing and inspect position of flywheel painted mark in relation to pin in flywheel housing hole. Loosen distributor advance arm clamp screw and rotate distributor until mark and pin are correctly aligned. Tighten clamp screw to lock distributor in place.

Inspect Automatic Spark Advance. After adjusting timing correctly and with neon light connected as described above, accelerate engine rapidly from idle speed and watch flywheel mark movement. If the spark advances is working correctly, the mark will move counterclockwise on the flywheel when accelerating the engine. It will drop back to its original position when engine is decelerated to idling speed.

DISTRIBUTOR

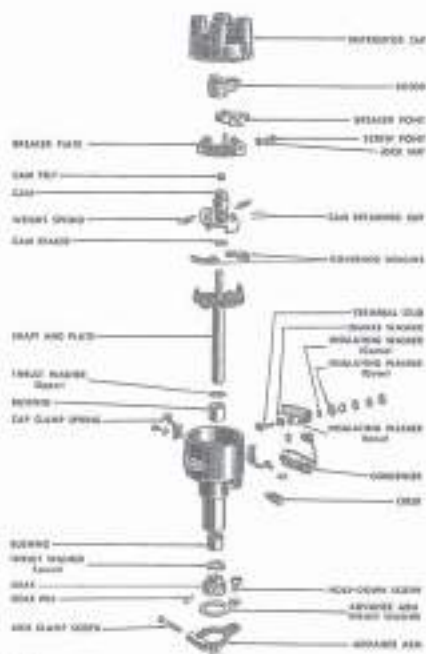


Fig. 48. Distributor - Exploded View

IGNITION TIMING ADJUSTMENT

General Method. Ignition timing should be set to fire No. 1 cylinder at T.D.C. Remove No. 1 spark plug and rotate engine slowly until timing mark (T.D.C.) on flywheel aligns with pin in flywheel housing (Figure 47). Distributor rotor should be in the position for firing No. 1 spark plug. Turn cam counterclockwise to remove backlash and adjust position of distributor so that breaker points begin to open at a slight clockwise movement of the cam.

Adjust distributor position by loosening advance arm clamp screw. Rotate distributor body counterclockwise to advance the timing; rotate clockwise to retard the timing. Tighten advance arm clamp screw to lock distributor in position. If test lamp is available, connect to terminal post and ground on distributor body. The lamp will light when points are closed and will go out as soon as points open.

Neon Light Method. The neon light, when connected in series with No. 1 spark plug, should flash each time No. 1 cylinder is fired. When No. 1 cylinder is fired, the flywheel painted mark (T.D.C.) should align with pin in flywheel housing. With the engine operating at idle speed, the light flash should synchronize with the alignment of the painted mark and pin.

Adjust ignition timing as follows: Remove wire

COOLING SYSTEM

The cooling system consists of the radiator, water connections, fan blade, fan mounting, fan belt, and water jackets in the cylinder head and block. Water is circulated by the thermosyphon system. The cooling system capacity is 8 qts.

CLEAN COOLING SYSTEM

General Flushing. Operate engine until hot. Open radiator drain cock. Attach hose to radiator filler pipe and run water continually through cooling system with engine operating. Continue this operation until water runs clear. Close drain cock, fill system with clean water and add rust inhibitor.

Reverse Flushing. Reverse flush radiator and engine separately. To flush radiator, remove upper and lower radiator hoses. Install radiator cap. Attach a lead hose to top and bottom radiator elbows. Force water with a pulsating action through radiator lower elbow, using a flushing gun or water hose. This pulsating action will loosen rust and scale accumulated in the core passages. Flush engine in the same

manner with gun nozzle in cylinder head water connection.

Clogged Radiator. If flushing does not clean radiator, it is recommended that radiator be removed and boiled out by a reliable radiator shop.

Open Radiator Core Air Passages. Clean radiator core air passages by blowing out with dry compressed air or steam from outside toward engine.

FAN BELTS

It is very important to inspect the fan belt occasionally, making certain no oil or grease is accumulating on it and that belt tension is adjusted properly. Replace an oil or grease-soaked belt.

Replace Belts. Loosen belt tension, slide belt off generator and crankshaft pulleys, then thread belt from fan. Thread new belt on fan pulley and install on generator and crankshaft pulleys.

Adjust Belt Tension. Adjust belt tension to 1/2 inch finger-pressure deflection between pulley centers,

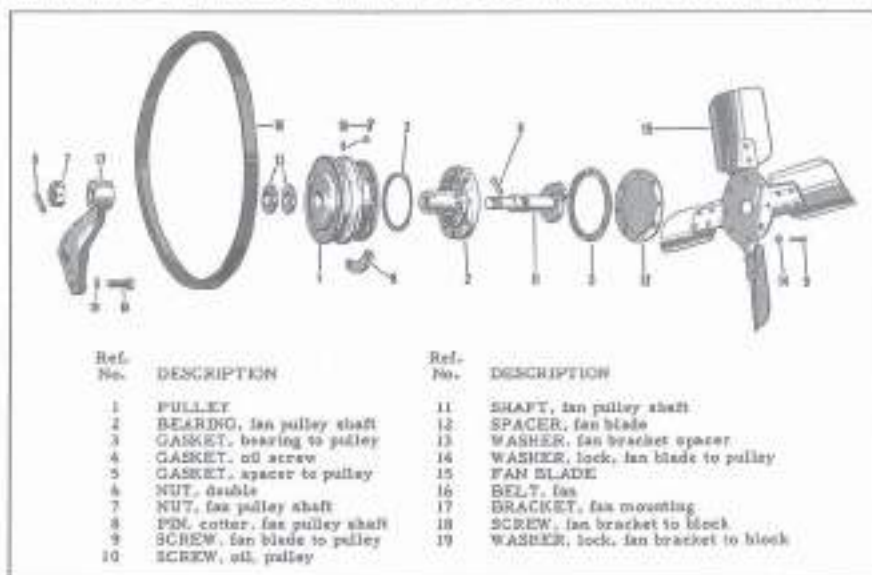


Fig. 49. Fan and Bearing - Exploded View

Ref. No.	DESCRIPTION	Ref. No.	DESCRIPTION
1	PULLEY	11	SHAFT, fan pulley shaft
2	BEARING, fan pulley shaft	12	SPACER, fan blade
3	GASKET, bearing to pulley	13	WASHER, fan bracket spacer
4	GASKET, oil screw	14	WASHER, lock, fan blade to pulley
5	GASKET, spacer to pulley	15	FAN BLADE
6	NUT, double	16	BELT, fan
7	NUT, fan pulley shaft	17	BRACKET, fan mounting
8	FOU cotter, fan pulley shaft	18	SCREW, fan bracket to block
9	SCREW, fan blade to pulley	19	WASHER, lock, fan bracket to block
10	SCREW, oil pulley		

Loosen generator brace screw and pivot generator on its mounting to adjust belt deflection.

FAN and MOUNTING

The fan and pulley assembly is mounted on a bracket at the front of the engine. The blades are designed and mounted so that air will be blown out through the radiator core instead of being drawn in. This type fan is usually called a "pusher" fan.

The fan blade itself is mounted on the pulley which rotates on a stationary spindle. This pulley is hollow and contains oil, which serves as a lubricant for the spindle bearing.

Remove Fan Mounting. Remove body side plate and fan belt. Remove cotter pin and slotted nut at rear of bracket. Move fan and pulley assembly toward radiator until spindle is removed from bracket, then maneuver fan assembly until it can be removed.

Disassemble Fan Mounting. Remove screws fastening fan blade, then remove fan spacer, gasket, and double nuts. Remove cotter pin at threaded end of spindle and withdraw spindle and bearing assembly.

Assemble Fan Mounting. Place gasket on bearing support and insert bearing and spindle in pulley. Place gasket, spacer, and fan blade on bearing and secure with screws and double nuts.

Install Fan Mounting. Maneuver fan and mounting assembly into mounting position and secure to bracket with slotted nut and cotter pin. Install fan belt and adjust deflection to 1/2 inch.

Lubricate Fan Spindle Bearings. Remove slotted pipe plug from hub and fill half fill with engine oil.

The level can be checked by turning fan until plug hole in hub is halfway between top and bottom of hub. Oil should level with the plug hole with hub in this position.

RADIATOR

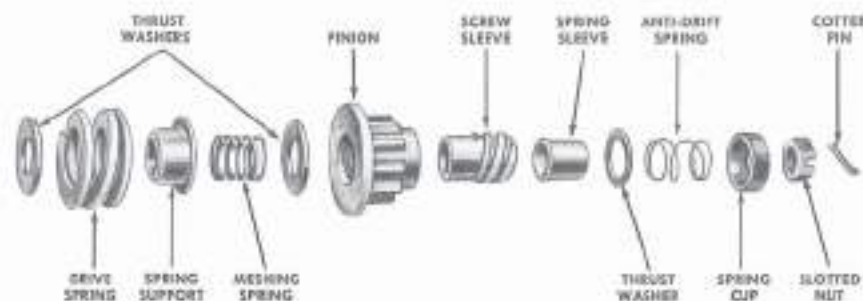
Remove Radiator. Remove radiator filler cap, cover, and grille. Remove fan belt and fan mounting assembly. Disconnect upper and lower radiator hoses. Remove screws at top and bottom of radiator, then lift radiator and shroud assembly from vehicle.

Inspect and Repair Radiator. Inspect radiator for damp or rusty areas which indicate leakage. Solder radiator to repair leaks. If leaks are numerous, install a new radiator assembly.

Inspect for heat fins. If fins are badly bent, straighten carefully with a blunt instrument. When performing this operation, be careful not to puncture tubes.

Inspect for obstructions in core tubes, looking through inlet and outlet passages. Seal upper water passage and fill radiator with water. Inspect for a steady and full stream of water flowing out of lower passage. If stream is small or erratic, the core tubes are restricted. It is recommended that radiator be boiled out by any reliable radiator shop.

Install Radiator. Place radiator assembly in mounting position in vehicle and secure with screws at top and bottom. Connect radiator hoses. Install fan and mounting assembly and fan belt. Fill cooling system with water and inspect for leaks. If installation is O.K., install radiator grille and cover.



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Fig. 44. Bendix Drive - Exploded View

Replace Field Coils (Figure 45). Remove solenoid switch connector. Remove nuts and washers from field terminal stud. Remove screws fastening pole shoes and lift shoes out of coils. Disengage terminal stud from frame and withdraw coil assembly from frame.

To install coil, place insulating washer on field terminal stud and insert field assembly in frame, engaging terminal stud with hole in frame. Install insulating strip between field coil connections and frame. Install field pole shoes and secure with screws. Place insulating bushing, insulating washer, plain washer, and lock washer on terminal stud and secure with nut. Install solenoid switch connector.

Inspect and Replace Brushes. If brushes are oil soaked or are worn to one-half or less of their original length, replace them.

To remove brushes connected to field coil lead, heat terminal with soldering iron and spread connector loop. To install brush, clinch loop securely around brush lead, then solder the connection.

To remove brushes connected to commutator and lead, drill out rivets fastening brush holder. Remove holder and brush. When installing new brushes, make certain rivets are staked securely to assure a good electrical connection.

Inspect Brush Holders. Inspect brush holders for damage or loose rivets. Inspect for poor connection or short-circuit with test lamp as follows: Connect test lamp to grounded brush holder and end lead. If lamp does not light, holder has faulty ground connection. Repair grounded brush holder if ground connection is faulty. Connect test lamp to insulated brush holder and end lead. If lamp lights, the brush holder is shorted. Replace end head assembly if holders are faulty.

Test Brush Springs. Hook a five-pound scale to the brush spring and pull until brush just leaves surface of the commutator. Reading on the scale is the brush spring tension, which should be 38 to 61

ounces for the old type starting motor; 42 to 53 ounces for the new type. To adjust spring tension, twist the slotted hinge at the point where spring is attached.

Inspect and Replace Bendix Drive. To remove Bendix drive, remove cotter pin and slotted nut, then lift Bendix drive parts and drive end head off armature.

Clean Bendix drive parts thoroughly and inspect for wear. Check for distorted springs. Replace faulty parts.

To install Bendix drive, place drive end head on armature. Install large thrust washer, drive spring, spring support, meshing spring, and large thrust washer on armature shaft. Insert screw sleeve in pinion and install this assembly on shaft. Install anti-drift spring sleeve, small thrust washer, anti-drift spring, and spring cap, on shaft and secure Bendix drive with nut and cotter pin.

Assemble Starting Motor. With Bendix drive assembled to armature and field coil installed in frame, assemble starting motor as follows: Install armature assembly in frame. Temporarily pull brushes from holders and through frame openings. Position commutator and head on frame and pull brushes through adjacent frame openings. Install screws holding starting motor assembly together. Before inserting brushes in holders, inspect armature end play for a clearance of 1/16" inch, and adjust if necessary by installing thrust washers on commutator and end of armature.

With a hooked end tool, pull out on brush spring (Figure 44) and insert brushes in their respective holders. Install inspection band.

Install Starting Motor. Place starting motor in mounting position and secure with bolts and nuts. Connect battery cable, horn wire, and ammeter wire to switch side terminal. Connect push button starting switch wire to upper terminal. Connect cable to battery.

STARTING MOTOR

DESCRIPTION

All LTR TOWMOTORS Serial No. 3049147 or above are equipped with a new type of starting motor. The new type starting motor is also used for replacement on all machines Serial No. 3049146 or below.

The starting motor consists of four field coils, two grounded brushes, two insulated brushes, armature, compression spring type drive, and a solenoid switch. Electrical connection to battery is made through the solenoid switch mounted on the starting motor frame and push-button switch mounted on the instrument panel. Depressing push-button switch operates solenoid switch which, in turn, connects starting motor to the battery.

STARTING MOTOR SPECIFICATIONS

Voltage	6 V
Poles	4
Brushes	4
Direction of Rotation	Counter-clockwise at drive end
Brush Spring Tension	
Old Type Starting Motor	38 to 61 ounces
New Type Starting Motor	42 to 55 ounces
Armature End Play	1/16-inch maximum
Drive	Left Hand Outboard Bands.

STARTING MOTOR REPAIR AND REPLACEMENT

Periodically, the starting motor should be removed, disassembled, and inspected as recommended below.



Fig. 44. Removing Brush from Holder



Fig. 45. Field Coil Insulation

Remove Starting Motor. Disconnect positive cable at battery, then disconnect wires at solenoid switch. Remove bolts and nuts fastening starting motor to clutch housing and remove starting motor.

Disassemble Starting Motor. Remove inspection board. Remove insulated brushes from holders as shown in Figure 44. Remove commutator and head screws. Remove commutator end head and withdraw armature assembly from frame.

Inspect and Repair Armature. Inspect armature for visual mechanical defects. If commutator is dirty or gummed, clean with No. 00 sandpaper. If the commutator is rough or worn, turn down in a lathe.

Test Armature. After armature commutator has been cleaned, test for grounded windings or commutator bars with a test lamp connected to bars and armature shaft. If lamp lights, a ground is indicated. Test for short-circuit in windings by placing armature in a growler (Figure 39). Hold a hack-saw blade over armature as armature is revolved in growler. If a magnetic or vibrating effect is created on the blade, the armature is short-circuited. Replace a faulty armature.

Inspect and Test Field Coils. To test coils for ground, connect one lead of test lamp to the frame and the other to the insulated brush. If a ground is present, the lamp will light. Replace a grounded field coil.

ELECTRICAL SYSTEM
"GENERATING SYSTEM"

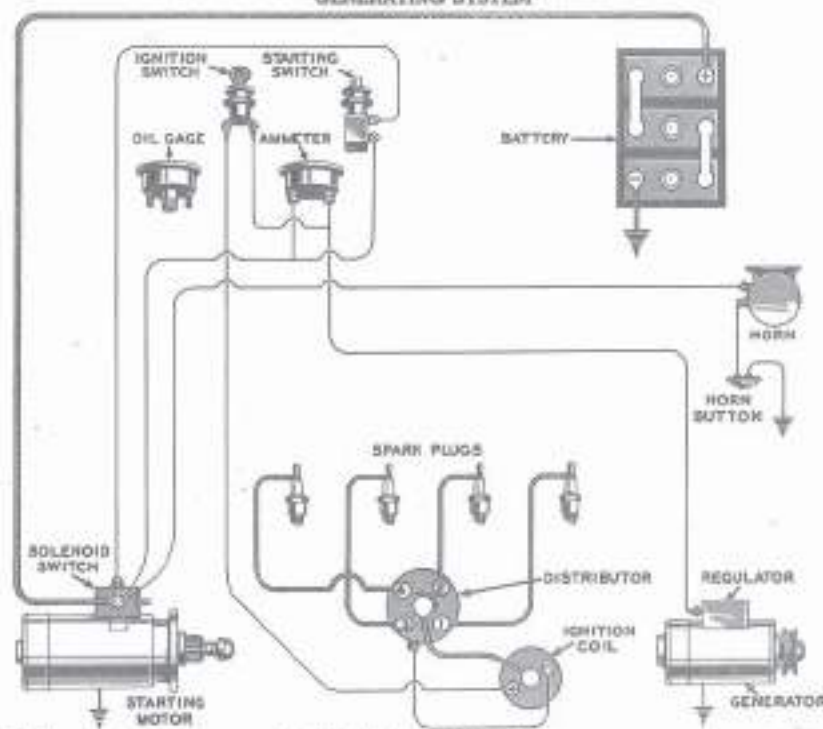


Fig. 38. Electrical System Diagram

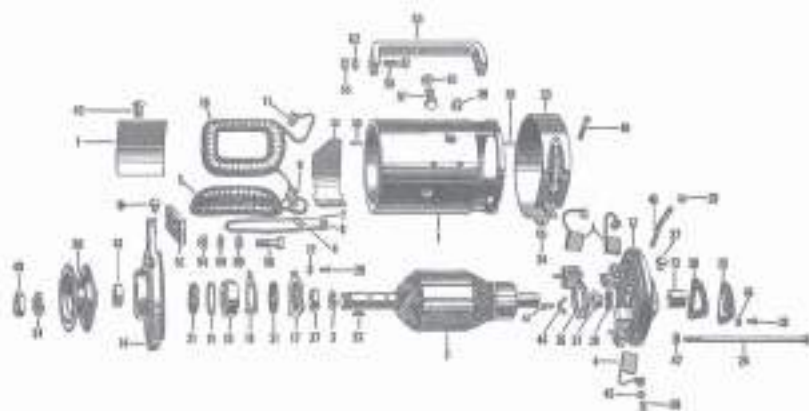
output is registered by the ammeter on the instrument panel.

GENERATOR

The generator is the third brush type with a ball bearing in the drive end and brushes bushing in the commutator end. The generator employs two main brushes (one insulated and the other grounded at the brush holder), and one third brush. The third brush, (thinnest of the three), controls the generator output at any particular voltage. Voltage is controlled by a voltage regulator mounted on top of the generator. Movement of the brush toward adjacent main brush increases charging rate; movement of the brush away from adjacent brush decreases charging rate. An approximate measurement of generator

GENERATOR SPECIFICATIONS

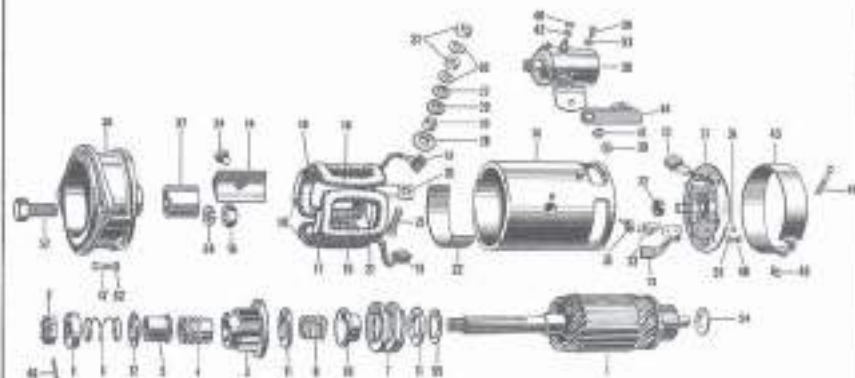
Voltage	6 V
Poles	2
Brushes	3
Control	Third Brush and Regulator
Rotation	Clockwise at drive end
Brush spring and cushion	50 to 60 lbs.
Armature End Play	.003 to .010
Maximum safe output	8 Amperes



Ref. No.	DESCRIPTION	Ref. No.	DESCRIPTION
1	FRAME and POLE SHOE	32	INSULATION, field connection
2	ARMATURE	33	KEY, Woodruff, pulley
3	RING, locking	34	NUT, eq., inspection band screw
4	BRUSHES	35	PIN, end head
5	COIL ASSEMBLY (left)	36	PLATE, third brush
6	WIRE and TERMINALS, generator to regulator	37	RETAINER, felt seal (on armature shaft)
7	TERMINAL (at generator)	38	SCREW, mach., brush lead terminal
8	TERMINAL (at regulator)	39	SCREW, mach., bushing screw
9	TERMINAL, field coil lead	40	SCREW, mach., inspection band
10	COIL ASSEMBLY (right)	41	SCREW, mach., third brush retaining spring
11	TERMINAL, field coil lead	42	SCREW, pole shoe
12	HEAD ASSEMBLY, commutator and bushing, armature	43	SPACER, pulley
13	BUSHING, armature	44	SPRING, third brush plate retaining
14	HEAD, drive end	45	WASHER, lock, brush lead screw
15	BEARING, ball, armature	46	WASHER, lock, bushing cover screw
16	CUP, oil, end head	47	WASHER, lock, thru-bolt
17	RETAINER, bearing	48	WICK, felt
18	RETAINER, felt seal (inner)	49	NUT, pulley
19	RETAINER, felt seal (corrugated)	50	PULLEY
20	SCREW, mach., bearing retainer	51	WASHER, lock, pulley nut
21	SEAL, felt, ball bearing	52	BRACE, generator adjusting
22	WASHER, lock, bearing retainer screw	53	BRACKET, generator mounting
23	BAND, inspection	54	LOCK, brace to generator screw
24	BOLT, thru, generator	55	NUT, hex., bracket to generator screw
25	COVER, bushing	56	SCREW, cap, brace to generator
26	COVER, wick	57	SCREW, cap, bracket to block
27	CUP, oil, end head	58	SCREW, cap, bracket to generator
28	GASKET, bushing cover	59	WASHER, flat, brace to generator screw
29	GASKET, oil guard	60	WASHER, lock, brace to generator screw
30	GROMMET, generator to regulator wire	61	WASHER, lock, bracket to block screw
31	GUARD, oil, end head	62	WASHER, lock, bracket to generator screw

Fig. 36. Generator - Exploded View

STARTING SYSTEM



Ref. No.	DESCRIPTION	Ref. No.	DESCRIPTION
1	ARMATURE	30	WASHER, lock, terminal stud
2	NUT, castle, Bendix drive	31	HEAD and BRUSHES, commutator end
3	PINION, drive	32	FELT, oiler
4	SHAFT, pinion	33	HOLDER, brush (grounded)
5	SLEEVE, anti-drift spring	34	RIVET, brush holder
6	SPRING, anti-drift	35	SPRING, brush
7	SPRING, drive	36	HEAD, drive end
8	SPRING, meshing	37	BUSHING
9	STOP, drive	38	SWITCH, solenoid
10	SUPPORT, drive spring	39	NUT, hex., side terminal
11	WASHER, thrust, Bendix drive	40	NUT, hex., upper terminal
12	WASHER, thrust, pinion	41	WASHER, lock, side terminal
13	BRUSHES	42	WASHER, lock, upper terminal
14	FRAME and POLE SHOE	43	BAND, inspection
15	COIL, field (upper left)	44	CONNECTOR, solenoid switch
16	COIL, field (upper right)	45	NUT, eq., inspection band screw
17	COIL and BRUSH, field (lower left)	46	PIN, collar, Bendix drive nut
18	COIL and BRUSH, field (lower right)	47	SCREW, drive end head
19	CONNECTOR, field coil	48	SCREW, mach., commutator end head
20	BUSHING, insulating, terminal stud	49	SCREW, mach., inspection band
21	EQUALIZER	50	SCREW, mach., solenoid switch mounting
22	INSULATION, field connection	51	WASHER, lock, commutator end head screw
23	NUT, hex., terminal stud	52	WASHER, lock, drive end head screw
24	SCREW, pole shoe	53	WASHER, lock, solenoid switch mounting screw
25	STUD, field terminal	54	WASHER, thrust, armature (commutator end)
26	TERMINAL, field coil	55	WASHER, thrust, armature (drive end)
27	WASHER, flat, terminal stud	56	NUT, hex., starting motor mounting screw
28	WASHER, insulating, terminal stud (inner)	57	SCREW, cap, starting motor mounting
29	WASHER, insulating, terminal stud (outer)	58	WASHER, lock, starting motor mounting screw

Fig. 37. Starting Motor - Exploded View

and electromagnet core and adjust to .020 inch clearance by bending armature stop. After adjusting, be sure stop does not rub against side of armature.

Adjust Circuit Breaker Point Gap. (Figure 40). Check point gap using a .050-inch flat gage. Insert gage between points and adjust gap to .030-inch clearance by contracting or expanding stationary point bridge by contracting or expanding stationary point bridge, using needle-nose pliers. Expand for less clearance and contract for more clearance. Keep points in perfect alignment while adjusting. After adjusting, inspect points for closing before armature contacts core.

Adjust Circuit Breaker Point Closing Voltage. Connect a voltmeter across armature wire (grey) terminal marked "A" and ground on regulator base. Adjust closing voltage by bending lower spring hanger to vary tension on circuit breaker armature (Figure 41). Increasing spring tension raises closing voltage; decreasing spring tension lowers closing voltage. The circuit breaker should close at 5.50 to 7.25 volts.

Adjust Voltage Regulator Armature Air Gap. (Figure 41). Check air gap using a 0.045-inch flat gage. With regulator points closed, insert gage between armature and electromagnet core and adjust gap to 0.045-inch clearance by contracting or expanding stationary point bracket, using needle-nose pliers.

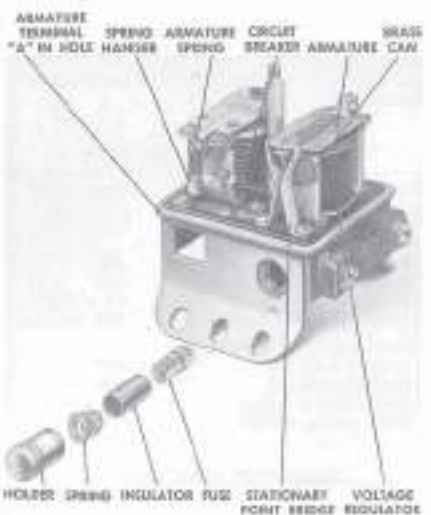


Fig. 41. Generator Regulator (Point side)



Fig. 42. Generator Regulator Electrical Connections

Adjust Voltage Regulator Point Gap. (Figure 41). Check point gap, using a .050-inch flat gage. Insert gage between points and adjust gap to .030-inch clearance by turning brass cam located under armature at contact point end.

Adjust Voltage Regulator Point Opening Voltage. (Figure 40). Adjust opening voltage of the regulator by bending lower spring hanger to vary the tension on voltage regulator armature. Connect a voltmeter to battery terminal marked "B" and to ground on regulator base. Increase spring tension to raise voltage and decrease spring tension to lower voltage. The closing voltage is controlled by the armature air gap. The voltage regulator should open at 8.00 to 8.75 volts (variations due to temperatures) and should close at 1.2 to 1.4 volts below opening voltage.

REGULAR REPLACEMENT

Remove. Disconnect positive cable at battery and ammeter cable at regulator. Remove screws fastening regulator to generator and disconnect wires at connection in base of regulator. Remove regulator.

Install. Connect wires in base of regulator; connect insulated main brush wire (grey) terminal to terminal marked "A", field wire (red) terminal to terminal marked "F". With regulator base pointing away from engine, install and tighten regulator mounting screws. Be sure to use screws of the correct length; if screws are too long, they will enter in the field coils and cause a short-circuit.

ADJUSTMENT

Adjust Third Brush. The third brush holder is mounted on a movable plate secured by two spring clips. These spring clips hold the plate in position and permit movement of brush and plate by finger pressure. Movement of brush toward adjacent (insulated) main brush increases charging rate; movement of the brush away from adjacent brush decreases charging rate. To obtain the highest safe output of the generator, adjust the third brush position until there are two commutator bars exposed between third brush and adjacent main brush.

GENERATOR REPAIR

Inspect and Repair Generator. It is recommended that the generator be removed, disassembled and inspected as outlined below.

Remove. Disconnect positive cable at battery. Disengage fan belt from generator pulley. Disconnect cable at regulator terminal. Remove cap screw fastening adjusting brace to generator and cap screws fastening generator mounting bracket to cylinder block. Then remove generator and regulator assembly.

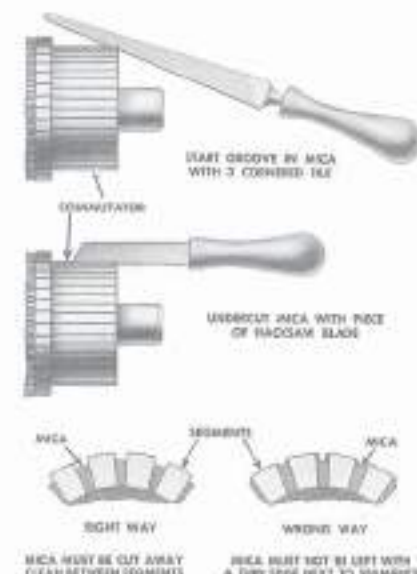


Fig. 27. Undercutting Commutator Mica

Disassemble Generator. Remove mounting bracket, regulator, and inspection head from generator. Remove screws fastening and leads to generator frame. Remove armature and drive and head assembly. Disconnect wires at brush holders and remove commutator and head assembly.

NOTE: With generator disassembled into major subassemblies, it is recommended that the following inspections and tests be made:

Inspect and Repair Armature. Inspect armature for visual mechanical defects. If commutator is dirty or gummed, clean with No. 00 sandpaper. If it is rough or worn, turn down in a lathe. Replace armature if removal of 1/32 inch is not sufficient to clean commutator correctly. After turning commutator, undercut mica to a depth of 1/32 inch.

Undercut Commutator Mica. To undercut high mica condition, use a special undercutting tool and machine or a hand tool made by grinding a fine-tooth back-saw blade to fit the exact mica width; wrap friction tape around one end to provide a handle. Undercut mica square, 1/32 inch deep the full length of the commutator bars as shown in Figure 27. After this operation, remove bars from commutator bar edges with No. 00 sandpaper and blow dust out with compressed air.

Test Armature. After armature has been cleaned, test for grounded windings or commutator bars with a test lamp connected to bars and armature shaft. If lamp lights, a ground is indicated and armature should be repaired. Test armature for short-circuit by placing in a growler (Figure 28). Hold a back-saw blade over armature as it is revolved in growler.



Fig. 28. Testing Armature in a Growler

If a magnetic or vibrating effect is created on the blade, the armature is short-circuited and should be replaced. Be sure commutator slots are clean and inspected for visual defects in winding insulation. If windings appear satisfactory, do not make additional repairs. Reinstall armature.

Inspect and Test Field Coils. To check coils for open circuit, connect a test lamp to the two leads of each coil. If lamp fails to light, the coil circuit is open and coil should be replaced.

To check for grounds, connect one lead of test lamp to the frame and the other to the field coil terminals. If a ground is present, the lamp will light. Replace coil when a ground is indicated.

Replace Field Coils. Pry rubber grommet out of frame hole and remove screws fastening pole shoes. Lift shoes out of coils and slide field coil assembly out of frame.

To install coil, place assembly in frame. Insert regulator and field wire through frame hole, then install grommet. Insert insulating strip between field connections and frame (Figure 39). Install field pole shoes and secure with screws.

Inspect and Replace Brushes. If brushes are oil-soaked or worn to one-half or less of their original length, replace them.

When replacing brushes, the new brushes should have 100 per cent surface contact with the commutator. To accomplish this, use a brush setting stone or No. 00 sandpaper. Proceed with the latter method as follows: Place armature in soft-jawed vise and wrap two layers of No. 00 sandpaper tightly around commutator (abrasive side out) in such a manner that revolving brushes will rub over projecting edge

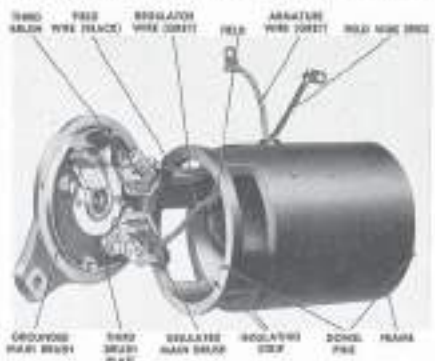


Fig. 39. Generator Electrical Connections

of paper. Place commutator end head and brushes in normal position on commutator. Hold sandpaper in place and revolve end head clockwise until brushes are seated correctly. Remove dust and dirt with clean dry compressed air. Do not use sandpaper method to excess as this will shorten life of brushes.

Inspect and Test Brush Holders. Inspect brush holders for damage or loose mounting rivets. Inspect for poor connection or short-circuit with a test lamp as follows: Connect test lamp to grounded brush holder and end head. If lamp does not light, holder has faulty ground connection. Connect test lamp to insulated brush holder and end head. If lamp lights, the brush holder insulation is shorted. Replace end head assembly if holders are faulty.

Test Brush Springs. If generator is disassembled, assemble commutator end head and brushes temporarily to test brush spring tension. Hook a five-pound spring tension scale to the brush spring arm and pull until brush just leaves surface of the commutator. Reading on the scale is the brush spring tension, which should be 50 to 60 ounces. Replace end head assembly if springs are faulty.

Inspect and Replace Armature Bushing. Inspect bushing for wear, scoring, and press fit in commutator end head. If faulty, replace as follows: Remove screws and lock washers securing cover. Remove cover and gasket. Press bushing, oil guard, and gasket out of head.

To install bushing, start lashing (oil slot aligned with oiler felt) in end head with soft-nosed hammer. Press bushing to end head until bushing edge is flush with outer edge of head. Place gasket on oil guard and tap this assembly into end head. Install bushing cover and screws.

Inspect and Replace Armature Ball Bearing. Inspect bearing for free rotation. Replace a binding bearing. If bearing has evidence of having operated with lack of lubricant, replace it.

To remove bearing, unscrew pulley nut and press pulley off armature, using arbor press. Remove key and spacer from shaft, then press end head and bearing off shaft. Remove screws fastening bearing retainer, then lift retainers, felt seals and bearing from end head.

Before installing bearing, pack it with a high melting point grease and soak the felts in medium oil. Place felt seal and corrugated retainer, ball bearing, inner seal retainer, felt seal, and bearing retainer in end head. Be sure oil holes are aligned. Secure bearing retainer with screw. With small felt seal retainer and lock ring on armature shaft, place drive end head assembly on armature. Press head assembly on shaft and install pulley spacer and

key. Press pulley on shaft and secure with nut and lock washer.

Assemble Generator. With regulator and field wires extending out of the frame brush openings, position commutator end head and armature assembly on frame. Install frame screws; be sure they do not contact field coils or connections. Inspect armature end play before installing brushes. If in excess of 0.010 inch, adjust by inserting thrust washers on commutator end of armature shaft.

When installing brushes, place lead wire connections toward armature, insert thin brush in movable third brush holder, and insert thick brushes in main brush holders. Raise tension spring arm with a hooked-end tool and insert brushes (Figure 44). Connect grounded main brush terminal to holder. Connect regulator wire (gray) and main brush wire to insulated main brush holder (Figure 39). Connect field wire (black) and third brush wire terminal to third brush holder. Be sure wires do not rub the armature; otherwise, insulation will be torn, causing a short circuit. Install inspection band and tighten retaining screw.

Position mounting bracket on end plates and install bolts and nuts. Tighten nuts until there is a slight resistance when attempting to pivot generator on its bracket.

Install Generator. Position generator and bracket on engine block and secure bracket with cap screws. Install fan belt on pulley, and secure drive end head to fan belt adjusting brace. Adjust fan belt to 1/2 inch deflection. Connect armature wire to regulator terminal marked "B". Connect positive battery cable. Start engine and inspect generator charging rate. If necessary, adjust generator third brush.

Polarize Generator. After installing generator and before starting engine, correctly polarize the generator. Connect a jumper cable momentarily to starting switch battery connection and regulator armature terminal marked "A". This momentary surge of current from battery to generator will correctly polarize the generator with respect to the battery.

GENERATOR REGULATOR

DESCRIPTION

The regulator assembly contains two units; the circuit breaker and voltage regulator. The circuit breaker is an automatic switch which closes the charging circuit when the generator is charging, and opens the circuit when the generator is not charging. This prevents the battery from discharging back into the generator.

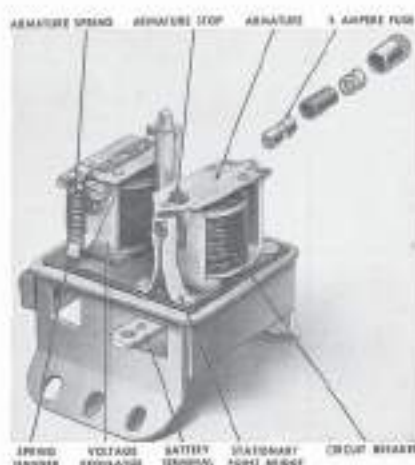


Fig. 40. Generator Regulator (Battery terminal side)

The voltage regulator maintains a constant voltage and limits output of the generator. When the output reaches a predetermined maximum, the regulator points open and place a resistance in the generator field coil, thus reducing the output. When the output drops, the points close, the resistance is removed, and the output rises. These cycles occur rapidly, thus holding the output constant at a predetermined maximum.

REGULATOR SPECIFICATIONS

Type	Two-charge
Fuse Capacity	5 amps
Circuit Breaker Tolerances	
Armature air gap	.030"
Contact point gap	.030"
Point closing voltage	8.5 to 7.25V
Point opening current	.5 to 2.5 amp.
Voltage Regulator Tolerances	
Armature air gap	.045"
Contact point gap	.045"
Point opening voltage	8 to 8.75 V
Point closing voltage	6.5 to 7.5 V

REGULATOR ADJUSTMENTS

Adjust Circuit Breaker Armature Air Gap. (Figure 40). Check air gap, using a 0.030 inch flat gage. With the points open, insert gage between armature