MAINTENANCE MANUAL

for

Adams POWER Flow Motor Graders

ROAD ADAMS MACHINERY

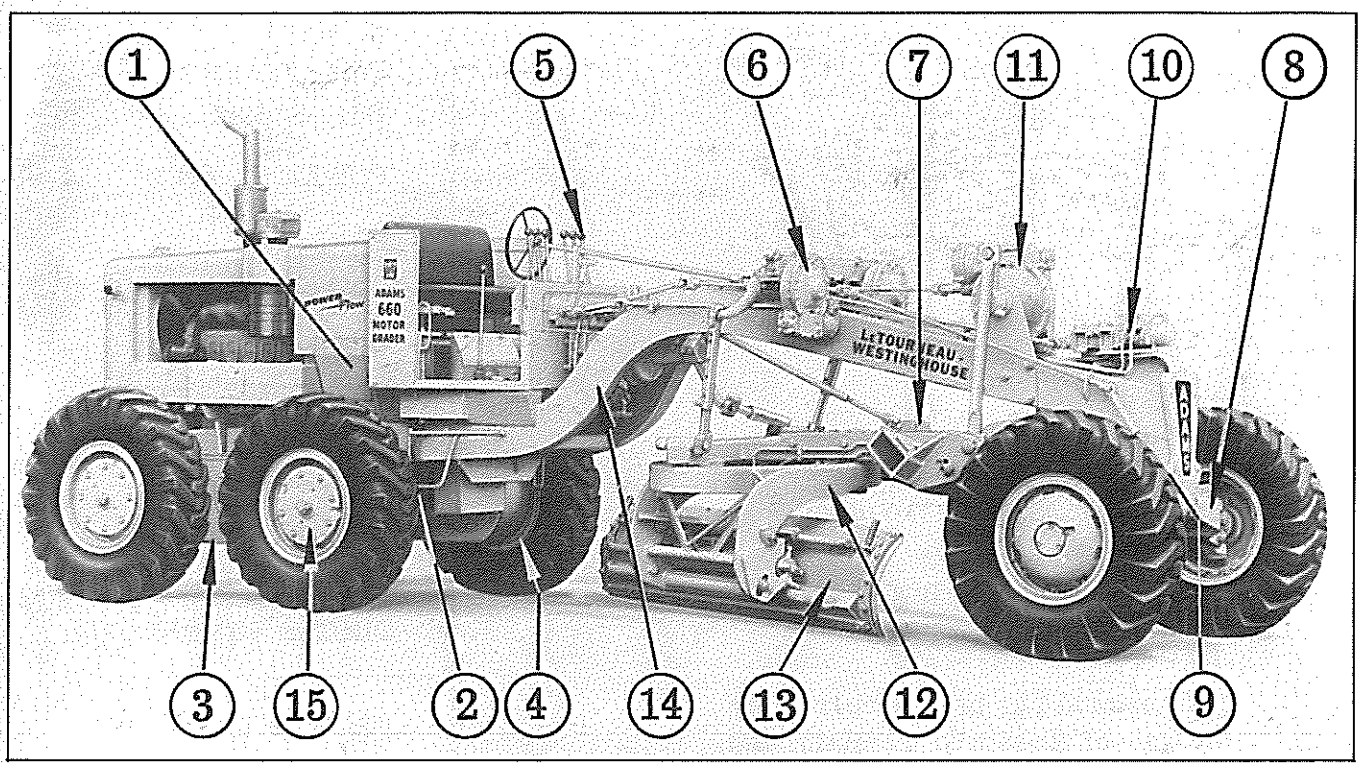
ADAMS DIVISION
LeTOURNEAU-WESTINGHOUSE COMPANY
INDIANAPOLIS 6, INDIANA, U. S. A.

HOW TO USE THIS BOOK

This manual has been prepared for the use of those who maintain and service the machine described on the front cover. It is divided into sections.

Each section has a numbered black tab which lines up with the corresponding section name and number on the right hand edge of this sheet. The black tabs are located quickly by bending the book back.

TORQUE CONVERTER
TRANSMISSION AND POWER CLUTCH
TANDEM
BRAKES
POWER CONTROLS
BLADE CONTROLS
CIRCLE REVERSE
FRONT AXLE
FRONT WHEEL LEAN
STEERING
SCARIFIER
CIRCLE
POWER SHIFT MOLDBOARD
FRAME
WHEELS
LUBRICATING INSTRUCTIONS
STARTING AND LIGHTING



This maintenance manual is intended for the instruction of those men or organizations who have the responsibility of repairing and maintaining this machine. The reference numbers in the illustration above, refer to the index below, showing sections in which will be found instructions for the assemblies pointed out in the illustration.

In each section instructions are given for disassembly, inspection and reassembly. When the method of disassembly and reassembly is obvious, instructions are given only for special points which should be watched.

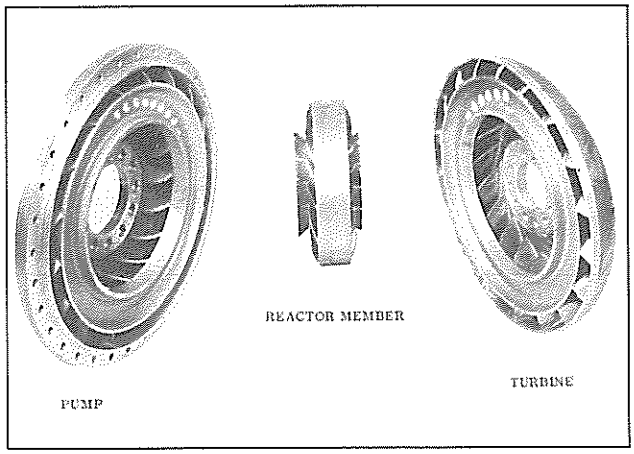
Section No.	Description of Assembly
1	Torque Converter
2	Transmission and Power Clutch
3	Tandem
4	Brakes
5	Power Controls
6	Blade Controls
7	Circle Reverse
8	Front Axle
9	Front Wheel Lean
10	Steering
11	Scarifier
12	Circle
13	Moldboard
14	Frame
15	Wheels
16	Lubricating Instructions
17	Starting and Lighting

PRINCIPLE OF OPERATION

The torque converter used in the Adams 660 power flow motor grader, is a 16 inch unit with features which adapt it to motor grader use, where hours of constant heavy load may be followed by long transport intervals, with the unit running at high speed under light load.

A short explanation of the operation of the Adams torque converter is as follows: The main parts of the converter are the pump, turbine and reaction member. These three parts are one piece aluminum castings and each one of them has a number of blades between the inner and outer shell, as shown in Illust. 1.

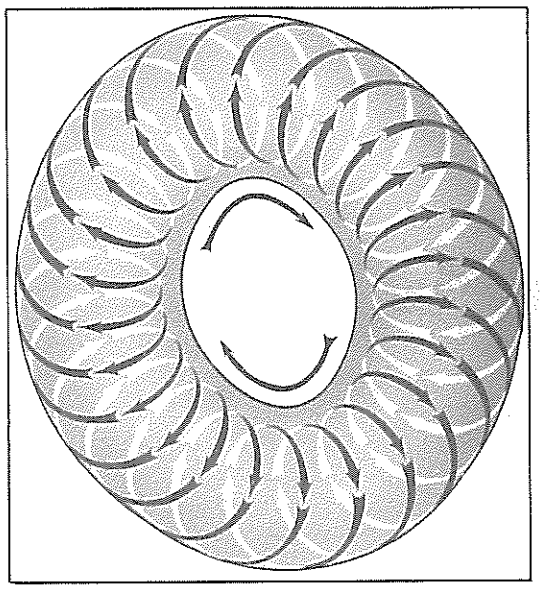
The pump is driven by the engine. The turbine drives the output shaft. The reaction member is supported (between the pump and turbine), by a sleeve shaft, attached to the converter housing.



ILLUST. 1

Thus we have: The pump, connected to and being driven by the engine. The turbine, connected to and driving the output shaft, but rotating free, (with no mechanical connection with the pump or engine). The reaction member located between the pump and turbine, but with no mechanical connection with either.

Action of the oil in the converter: The cast blades in the three parts are designed to move the oil in the unit from one part to another so that the engine driven pump will turn the turbine and output shaft.



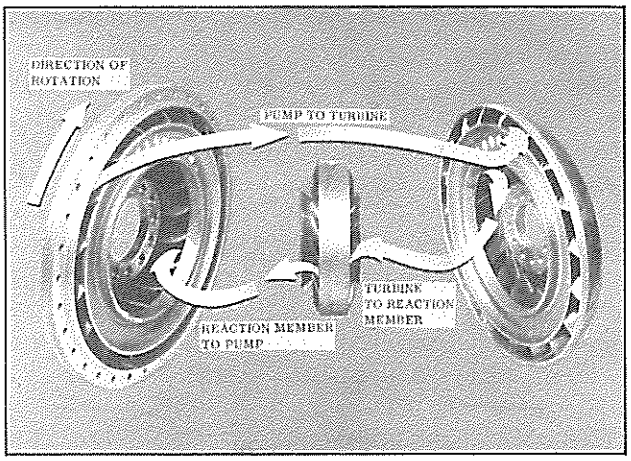
ILLUST. 2

In visualizing the operation of the unit, it should be remembered that the oil in the unit moves in two directions, as shown in Illust. 2. The oil moves around the engine drive shaft in the same direction as the rotation of the unit and around the "doughnut" formed by the turbine and pump castings.

When the pump turns, driven by the engine, the oil is thrown outward by centrifugal force. The curvature of the pump case and the angle of the blades in its outer

edge, turns the oil and directs it against the blades in the outer edge of the turbine with such force that it causes the turbine to turn in the same direction as the pump as shown in Illust. 3.

The angle of the turbine blades causes the oil to leave the blades traveling in a direction almost opposite to that in which the turbine is traveling, while the curvature of the turbine case moves the oil toward the center of the unit as shown in Illust. 3.



ILLUST. 3

The oil traveling through the turbine passes into the reaction member, whose blades are set at an angle which again turns the oil so that it is thrown into the pump, in the direction in which the pump is turning, as shown in Illust. 3.

From the description it may be seen that the oil constantly circulates through the three parts of the converter, from the pump through the turbine, through the turbine into the reaction member and back into the pump.

When the speed of the pump is increased, the turbine begins to move in the same direction as the pump, gradually increasing in speed. When its speed is approximately the same as that of the pump, centrifugal force in the turbine will then try to throw the oil outward toward the rim of the case. This reduces the amount of oil entering from the pump, so that the amount of oil moving between the two parts becomes smaller and the amount of torque declines, as the speed of the turbine increases.

Another effect of the increase in turbine speed is to reduce the amount and pressure of the oil striking the blades of the reaction member. During the time that the oil is exerting pressure, the reaction member is held in a locked stationary position on its shaft. As soon as the pressure drops the reaction member will turn on its shaft. At high turbine speeds the three converter members rotate together as a fluid coupling. Oil turbulence around and through the reaction member, stops and heating of the oil is greatly lessened. Any drop in turbine speed will again lock the reaction member on its shaft, causing it to again deliver oil into the pump.

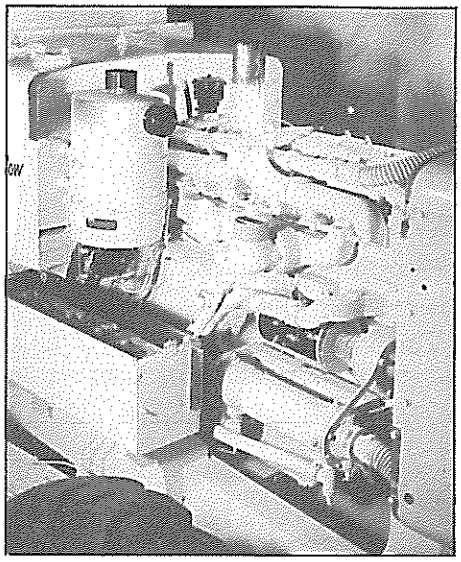
Every variation in speed between the turbine and pump, causes a similar

variation in the amount of power delivered to the wheels of the grader.

ENGINE REMOVAL

When necessary to remove the engine (Cummins or General Motors), the engine must be removed from the frame. Since the removal of the Cummins and General Motors engines are similar, the following instructions and illustrations will aid in the removal of the General Motors engine as well as the Cummins engine.

Illust. 1. Remove air cleaner cap or air pre-cleaner, muffler, hood and lower hood sides.



ILLUST. 1

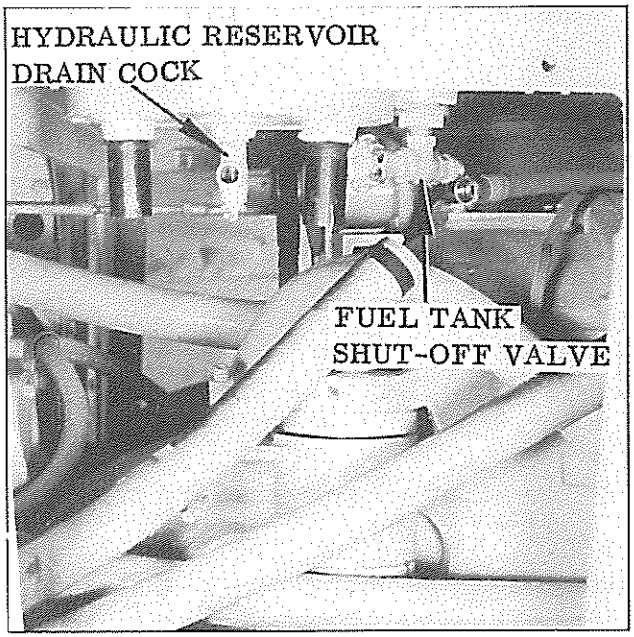
Remove air cleaner hose with elbow.

Disconnect battery ground cables from each side of engine. Remove each battery box lid. Next, remove battery cable from battery to solenoid and from battery to starter.

Disconnect wiring from voltage regulator, also heat indicator cable from engine.

Fuel Tank Removal

Illust. 2. Drain hydraulic reservoir. Install a suitable length of hose into drain cock. Open drain cock and drain oil into a container. When reservoir is empty, remove hose connection and close drain cock. Next, shut fuel off at fuel shut-off valve and disconnect fuel outlet line. Disconnect fuel return line. Next, disconnect vent pipe from top of tank.

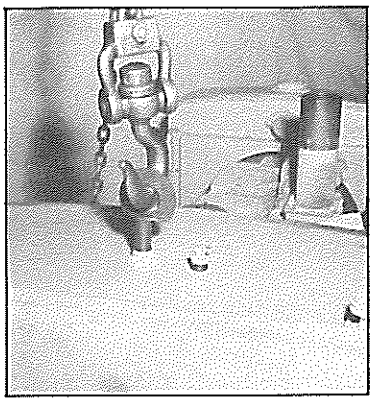


ILLUST. 2

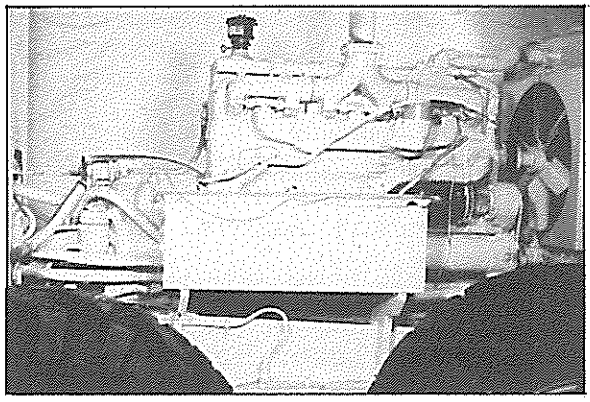
Remove ground wire clamp. Remove fuel tank support anchor cap screws, nuts and lock washers.

Remove reducer from top of tank. Install a lifting eye into reducer hole, as shown in Illust. 3. Lift fuel tank from frame, using a chain hoist.

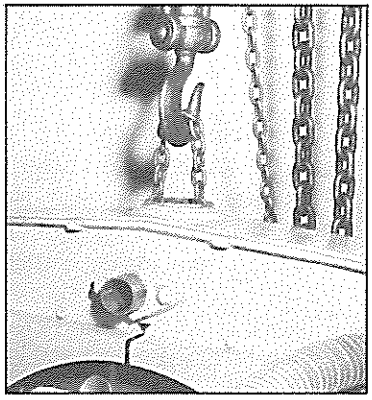
Disconnect wiring from generator and starter. Disconnect wiring clamp from motor. Illust. 4, is a view of



ILLUST. 3



ILLUST. 4



ILLUST. 5

the engine with wiring disconnected.

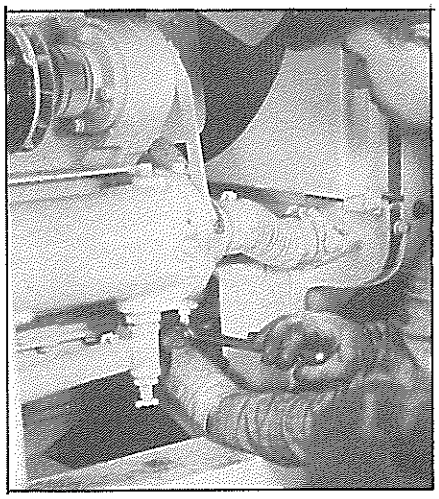
Radiator Removal

Drain radiator and disconnect both radiator hoses. Next, remove radiator cap and insert a tool, as shown in Illust. 5. Using a chain hoist, apply enough pressure on radiator to keep radiator from falling when radiator mounting bolts are removed.

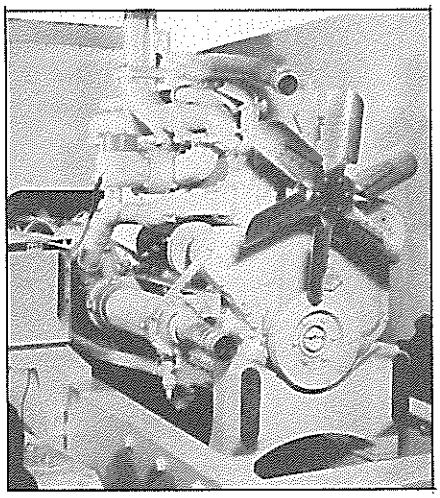
Remove radiator mounting cap screws, as shown in Illust. 6. Radiator can now be removed from engine, as shown in Illust. 7.

As shown in Illust. 8, loosen trunnion cap screws. Next, drain oil from heat exchanger by loosening drain cock, as shown in Illust. 9.

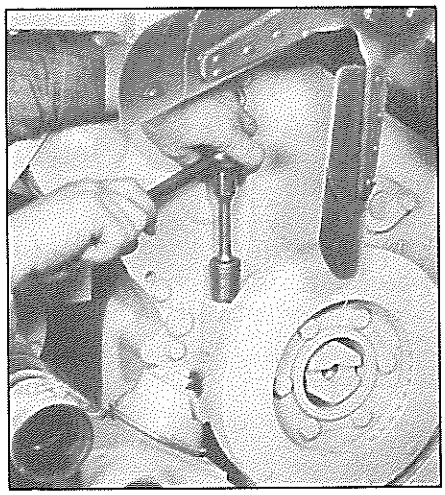
Remove temperature gauge line from heat exchanger, as shown in Illust. 10.



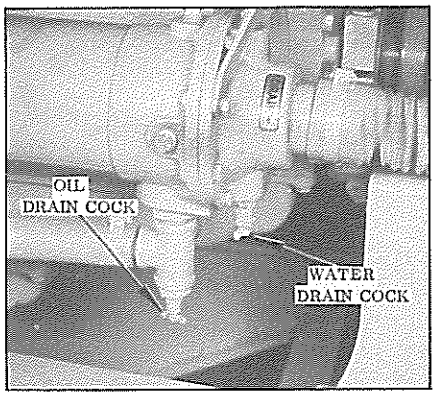
ILLUST. 6



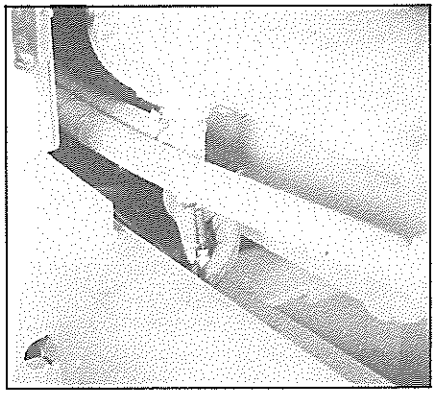
ILLUST. 7



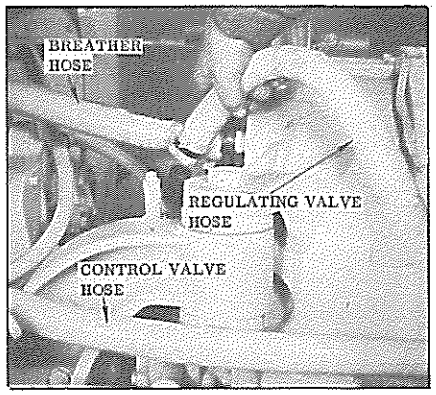
ILLUST. 8



ILLUST. 9



ILLUST. 10



ILLUST. 11

Loosen clamps and remove heat exchanger hose from left regulating valve and control valve, as shown in Illust. 11. Next, loosen clamp and remove breather hose from torque converter housing.

Loosen clamp and remove reservoir suction hose from pump nipple, as shown in Illust. 12.

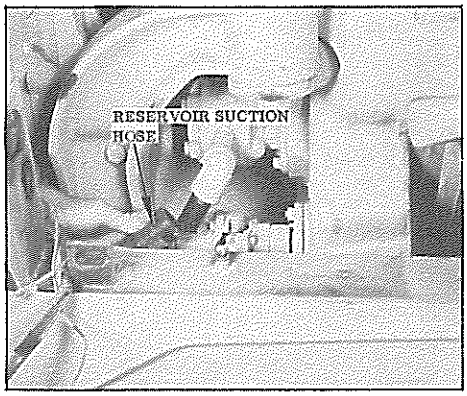
Loosen clamps and remove reservoir return hose from pipe tee located in lower portion of torque connecter housing, as shown in Illust. 13.

Disconnect control valve line from right regulating valve, as shown in Illust. 14.

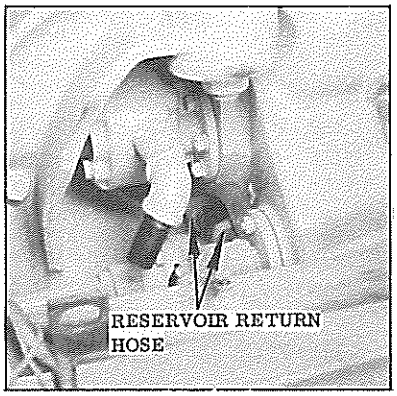
Remove rear engine mount cap screws, as shown in Illust. 15. When removing the cap screws and rubber bonded washers, be sure to note the amount of shims removed from top and bottom rubber bonded washers. Apply the same amount of shims to each washer when reassembling engine.

Disconnect throttle linkage from governor, as shown in Illust. 16.

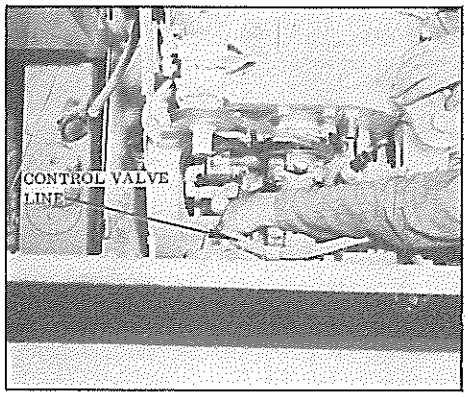
Center punch yoke fitting of universal joint and also on yoke stub,



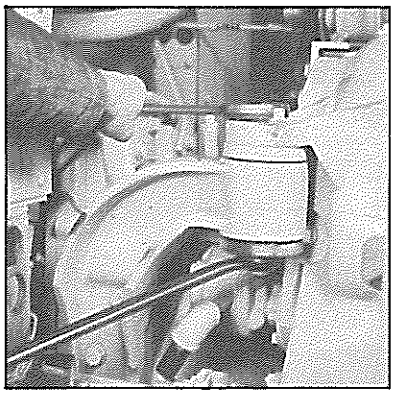
ILLUST. 12



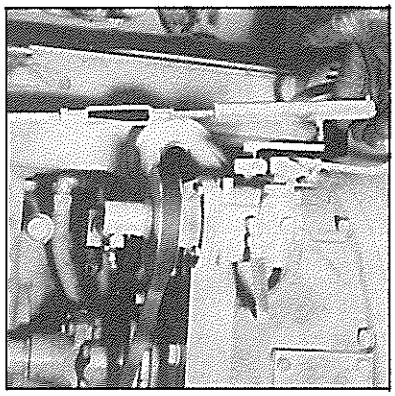
ILLUST. 13



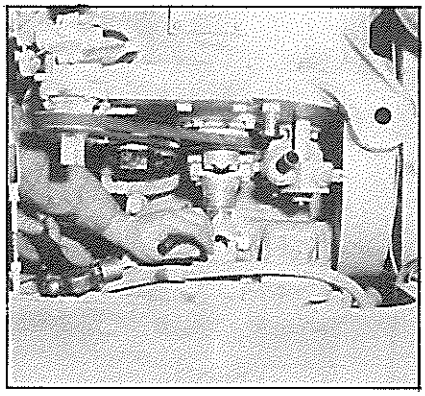
ILLUST. 14



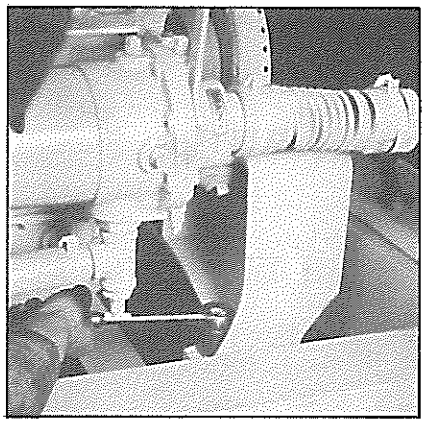
ILLUST. 15



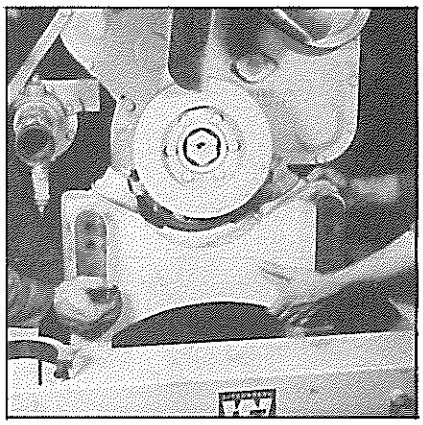
ILLUST. 16



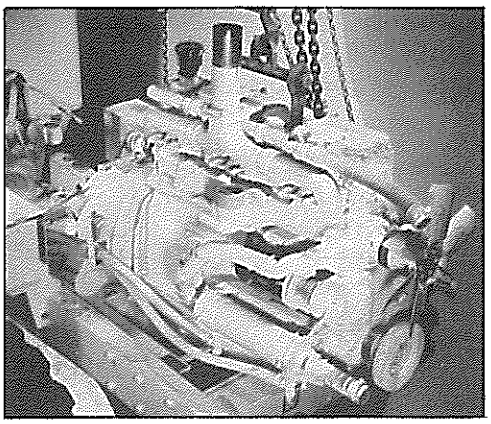
ILLUST. 17



ILLUST. 18



ILLUST. 19



ILLUST. 20

as shown in Illust. 17, for aligning of yoke fitting and stub when re-assembling engine.

Remove engine support cap screws, as shown in Illust. 18.

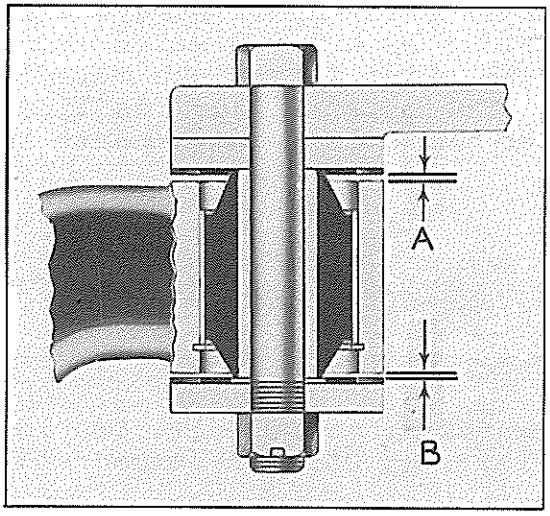
Using a lifting eye and hoist, raise engine enough to remove engine support, as shown in Illust. 19.

Illust. 20 shows engine being removed from machine. The power take-off shaft coupling will slide off splines of power take-off shaft in chain box.

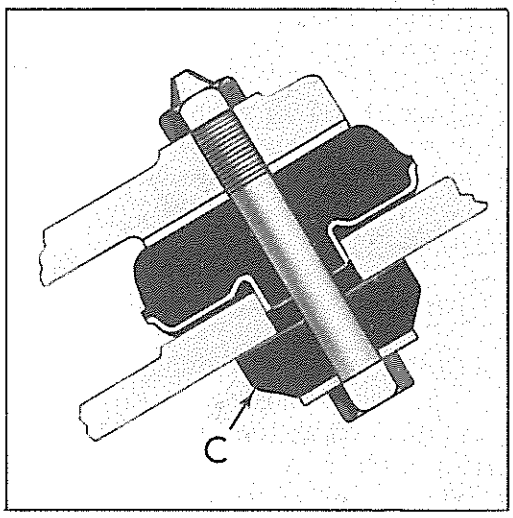
To install engine, reverse removal procedure.

MOTOR MOUNT GAP

When installing an engine, the rear mounts are to be tightened first.



ILLUST. 1



ILLUST. 2

If new motor mounts are installed, clearance (A) and (B), as shown in Illust. 1, are as follows:

A	B
.120 to .140	.000 to .020

If motor mounts are reused, clearance (A) and (B), as shown in Illust. 1, are as follows:

A	B
.060 MIN.	.1875 MAX.

Proper gap at (A) and (B) can be maintained by removing shims from gap (B) and reinstalling shims at gap (A), as the mount settles over a peroid of time. However, if the proper gap clearance cannot be maintained by use of shims, install new rubber mounts.

Front engine mounts are adjusted and tightened until biscuit, Ref. C. Illust. 2, can be turned with effort by hand, then tighten cap screw one (1) more round.

TORQUE CONVERTER (CUMMINS AND GENERAL MOTORS ENGINE)

Torque converter housings, used on machines equipped with General Motors or Cummins engines, are of the same design. The only difference being in the length of the mounting brackets. Machines equipped with General Motors engines require torque converter housing with short brackets. Machines equipped with Cummins engines require torque converter housing with long brackets. Parts going into the housing are the same.

Inspect all parts of torque converter for wear or damage. Always use new gaskets and seals when reassembling. NOTE: DO NOT USE WASTE OR SOFT CLOTH TO CLEAN PARTS OF TORQUE CONVERTER. Lint from these materials will clog hydraulic system. Use a lint free material such as linen. The best method of cleaning torque converter parts is to wash parts in a good cleaning solvent and dry with air.

Reassembly

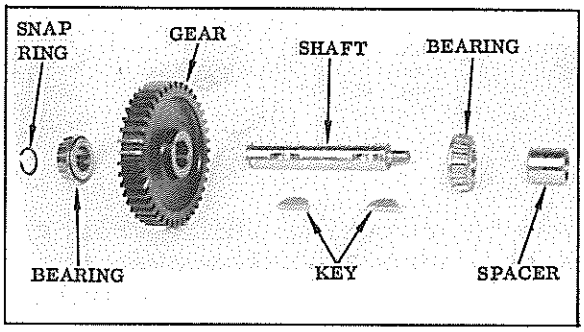
Illust. 1 is an exploded view of the power take-off shaft.

Insert key in keyway of P.T.O. shaft, as shown in Illust. 2.

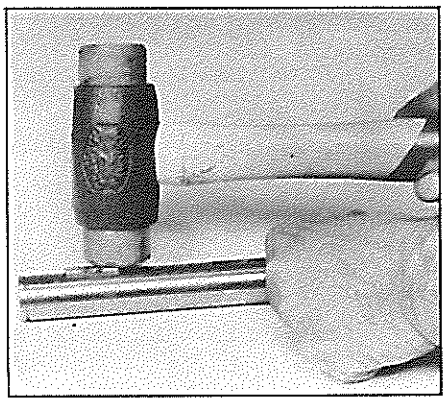
Install bearing onto shaft, as shown in Illust. 3. Next, drive bearing onto shaft and down to key, as shown in Illust. 4, using a hammer and a piece of pipe.

Install snap ring in groove of shaft, as shown in Illust. 5.

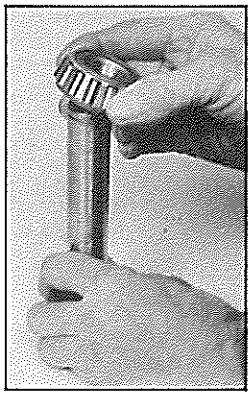
Install 41 tooth gear into housing, as shown in Illust. 6. Hold gear in place, as shown in Illust. 7, and insert shaft with bearing through bore of housing. Align key in shaft with keyway in gear and drive shaft through gear. Apply oil to shaft



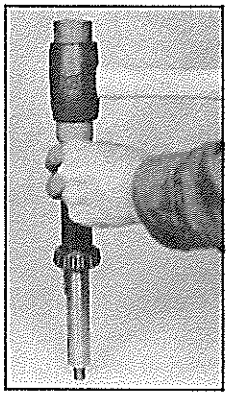
ILLUST. 1



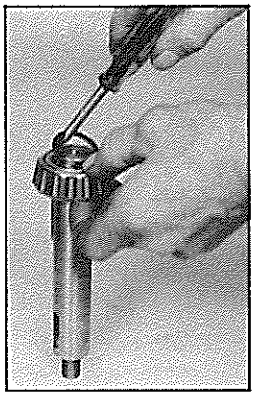
ILLUST. 2



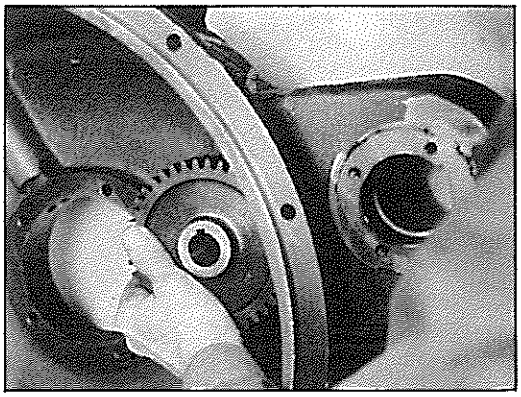
ILLUST. 3



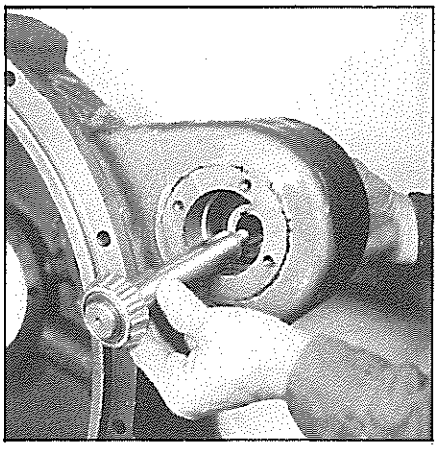
ILLUST. 4



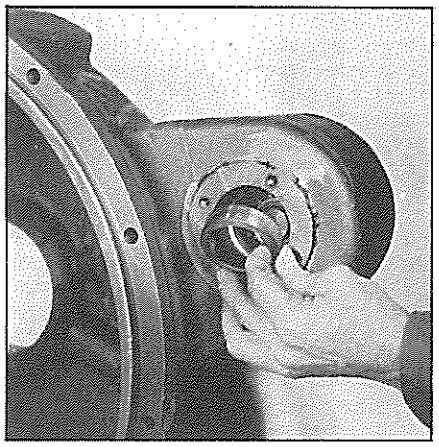
ILLUST. 5



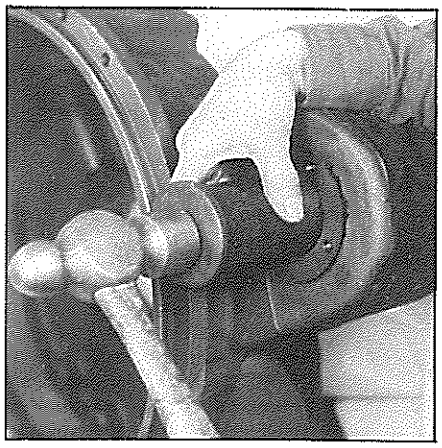
ILLUST. 6



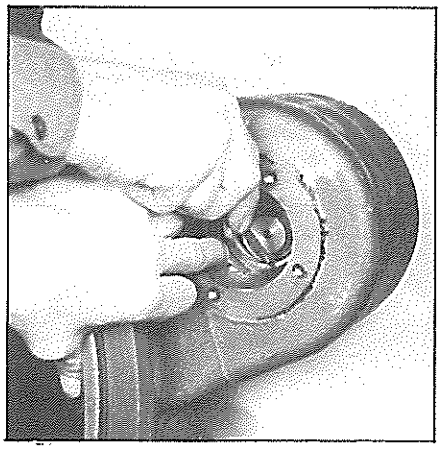
ILLUST. 7



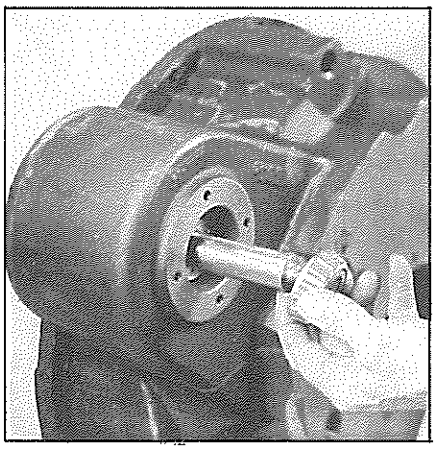
ILLUST. 8



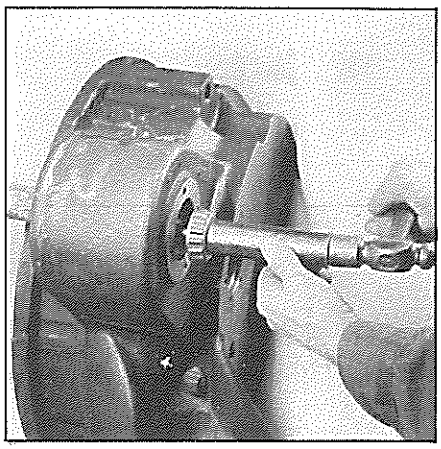
ILLUST. 9



ILLUST. 10



ILLUST. 11



ILLUST. 12

before driving through gear.

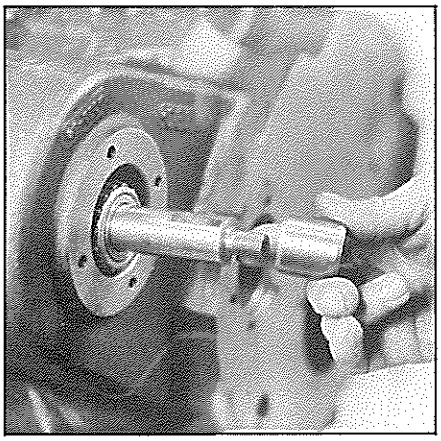
Insert bearing race into bore of housing, as shown in Illust. 8. Next, drive bearing race into bore of housing, as shown in Illust. 9, until the outer face of bearing race is under flush with snap ring groove.

Insert snap ring in groove of housing, as shown in Illust. 10.

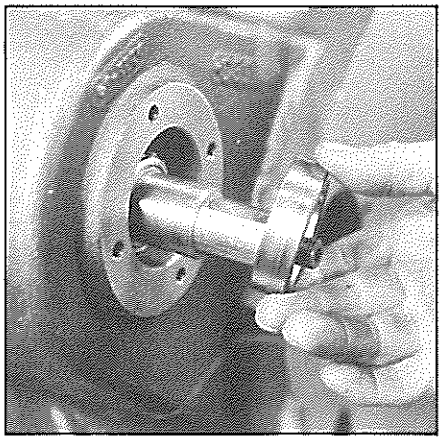
Install second bearing onto shaft, as shown in Illust. 11. Next, drive bearing onto shaft, as shown in Illust. 12. In driving bearing onto shaft, use a hammer handle or piece of wood against snap ring in groove of housing. This will prevent snap ring from coming out of groove. After bearing is seated on shaft, recheck snap ring.

Install spacer onto shaft, as shown in Illust. 13.

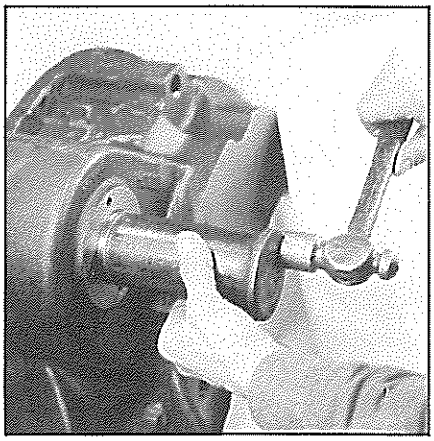
Install second bearing race into bore of housing, as shown in Illust. 14. Next, drive race into bore of housing, as shown in Illust. 15.



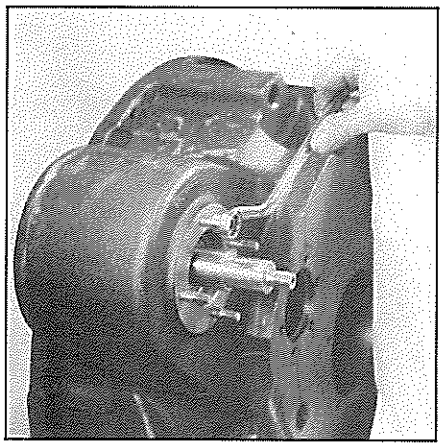
ILLUST. 13



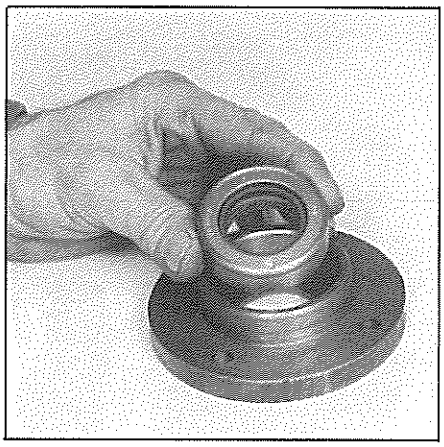
ILLUST. 14



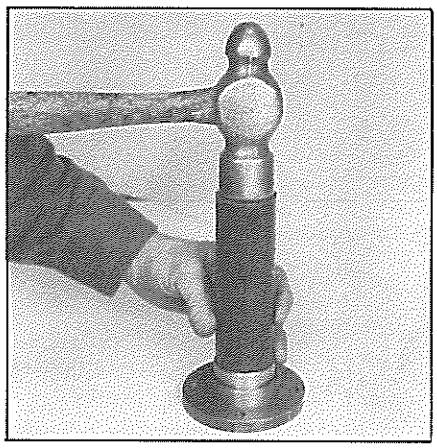
ILLUST. 15



ILLUST. 16



ILLUST. 17



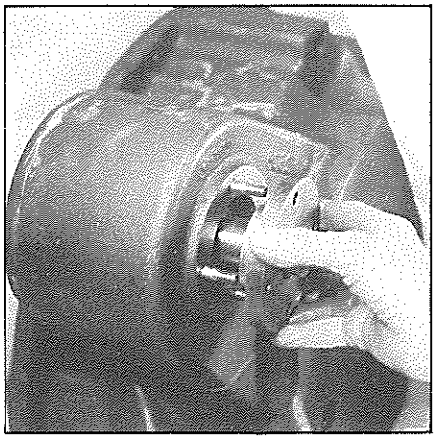
ILLUST. 18

Install and tighten coarse threaded end of studs in housing, as shown in Illust. 16. To install studs, use two (2) nuts on studs. Tighten one (1) nut against second nut. Using a wrench tighten studs into housing as illustrated.

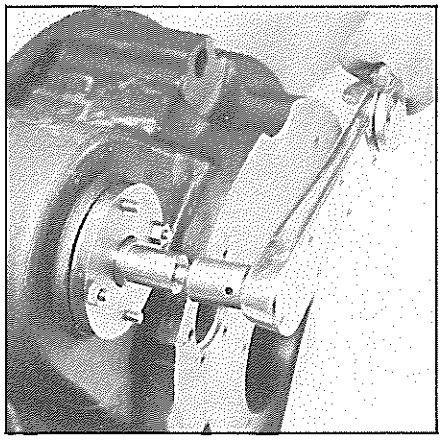
Install oil seal into cover, as shown in Illust. 17. Using a piece of pipe and hammer, drive seal into cover, as shown in Illust. 18.

Install cover with seal onto shaft and over spacer, as shown in Illust. 19. To protect seal, wrap a piece of shim stock around spacer. Insert cover over shim stock and over studs. When cover is installed, remove shim stock. Next, install two stud nuts. Snug nuts but do not tighten.

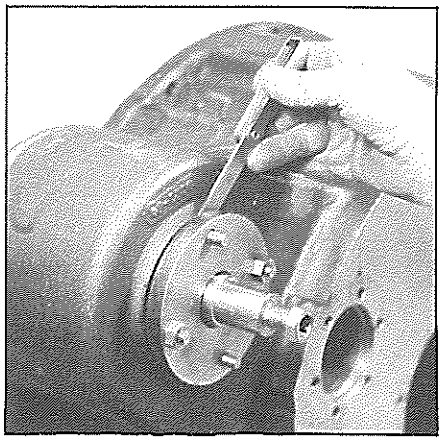
Using a torque wrench, pre-load bearings by tightening cover nuts until a reading of 4 to 8 inch pounds is obtained, as shown in Illust. 20. When this reading is obtained, use a feeler gauge to measure the gap between cover and housing, as shown in Illust. 21. Remove cover and install the correct amount of shims required to fill gap, as shown in



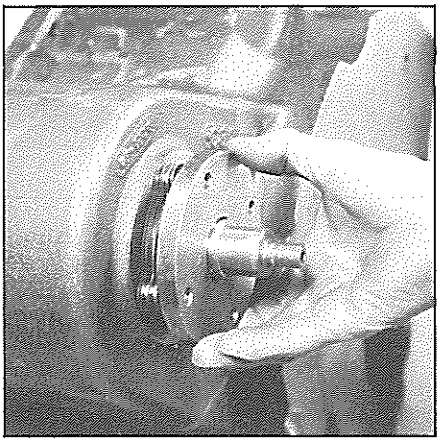
ILLUST. 19



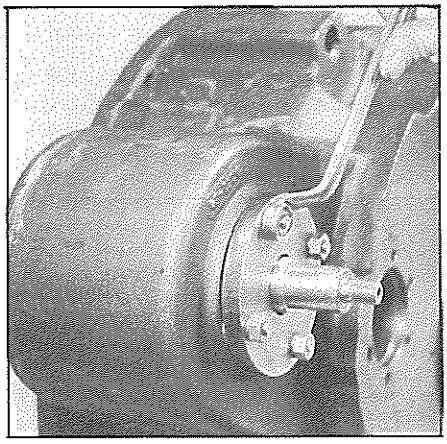
ILLUST. 20



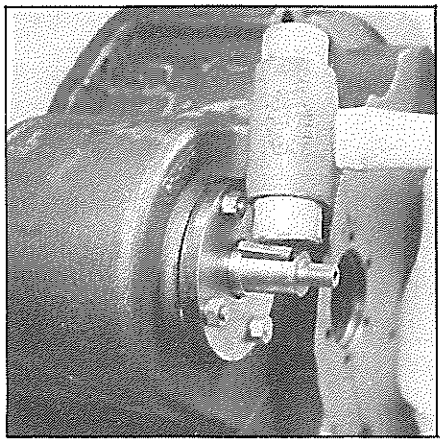
ILLUST. 21



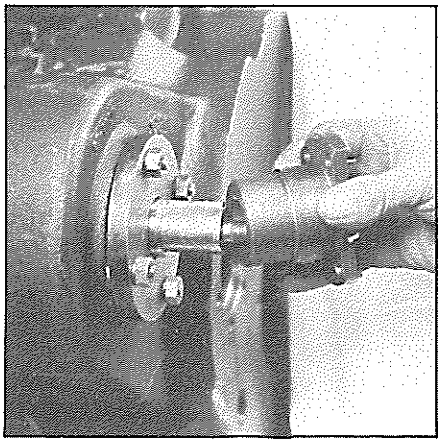
ILLUST. 22



ILLUST. 23



ILLUST. 24



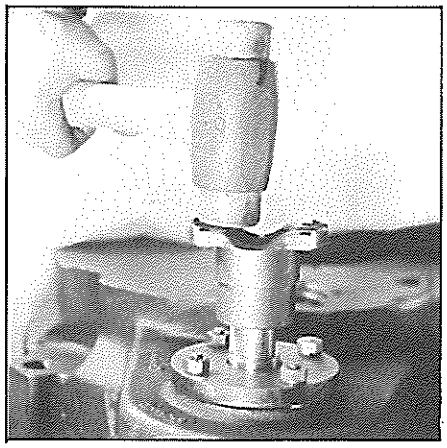
ILLUST. 25

Illust. 22. Reinstall cover. Next, install stud nuts and lock washers and tighten securely, as shown in Illust. 23. Recheck torque reading.

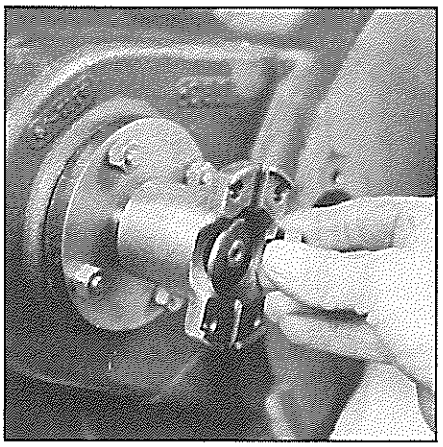
Install second key in keyway of P.T.O. shaft, as shown in Illust. 24.

Install coupling onto shaft, as shown in Illust 25. Align keyway in coupling with key of P.T.O. shaft. Using a rawhide mallet, drive coupling onto shaft and over key, as shown in Illust. 26. Apply oil to shaft before installing coupling.

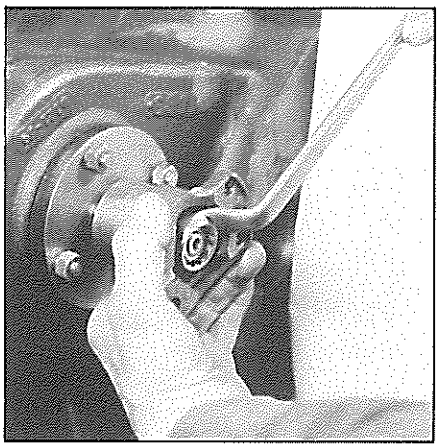
Install washer, lock washer and nut to shaft, as shown in Illust. 27.



ILLUST. 26



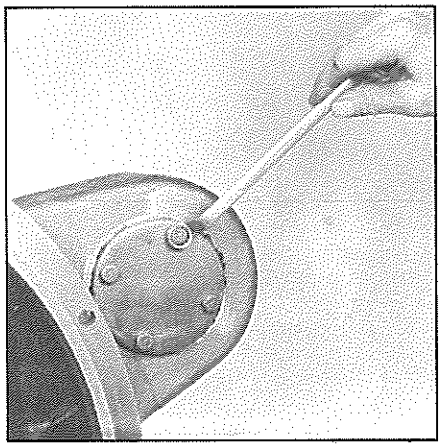
ILLUST. 27



ILLUST. 28

Tighten nut securely, as shown in Illust. 28.

Install cover and gasket to torque converter housing. Install cover cap screws with lock washers. Tighten cap screws securely, as shown in Illust. 29.



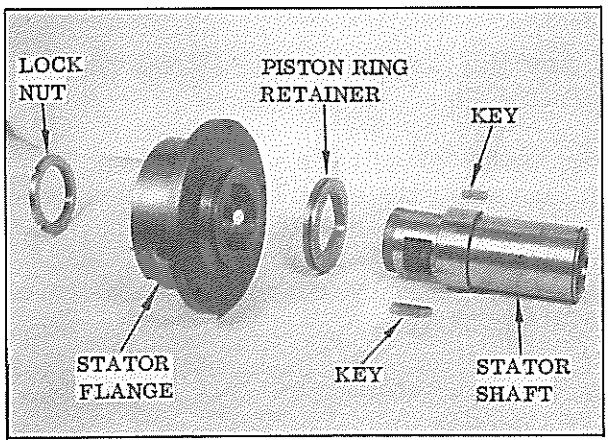
ILLUST. 29

STATOR SHAFT

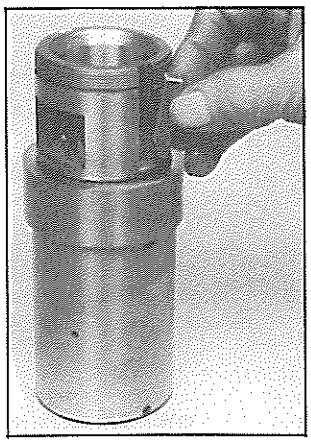
Illust. 1 is an exploded view of the stator shaft.

Insert long tapered key in keyway of stator shaft, as shown in Illust. 2.

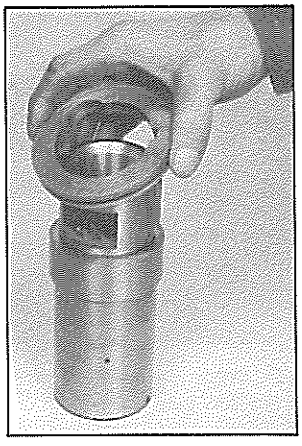
Align keyway in piston ring retainer with long tapered key in shaft and install ring retainer onto shaft, as shown in Illust. 3. Next, install second key in keyway of shaft, as shown



ILLUST. 1



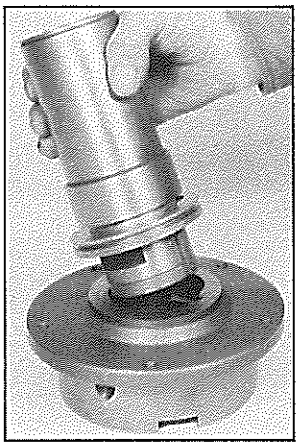
ILLUST. 2



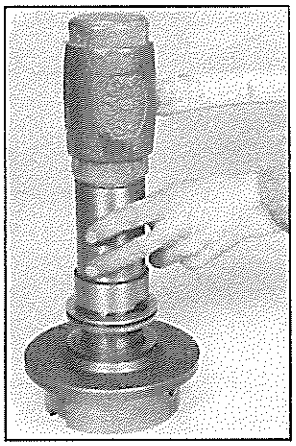
ILLUST. 3



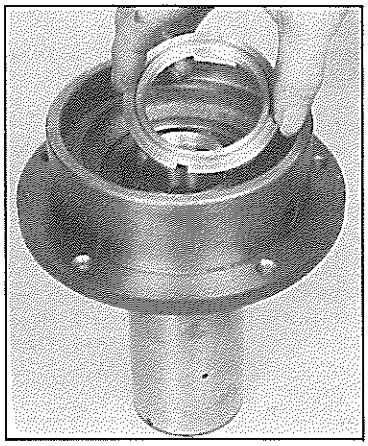
ILLUST. 4



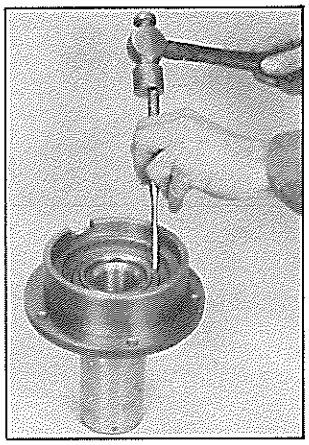
ILLUST. 5



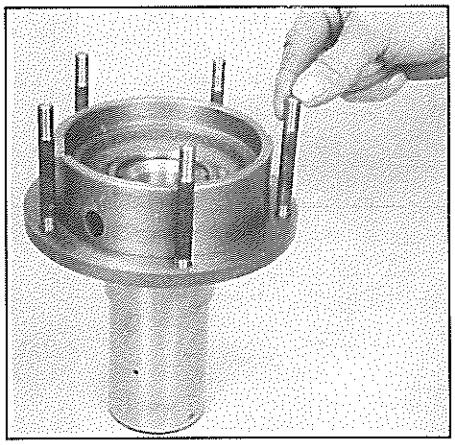
ILLUST. 6



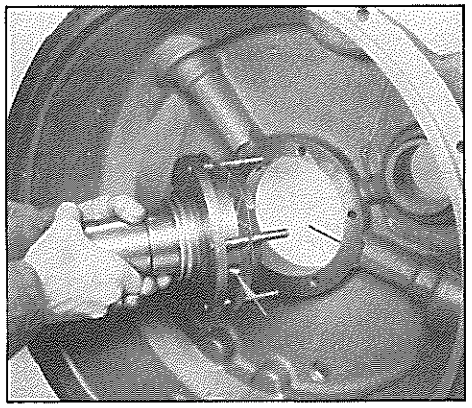
ILLUST. 7



ILLUST. 8



ILLUST. 9



ILLUST. 10

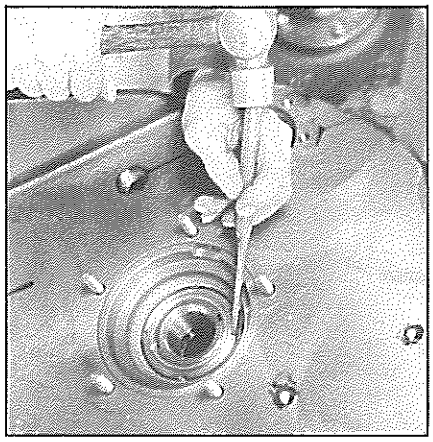
in Illust. 4.

Align keys in stator shaft assembly with keyways in stator flange, as shown in Illust. 5. Using rawhide mallet drive shaft into flange, as shown in Illust. 6. Apply oil to stator shaft before installing into flange.

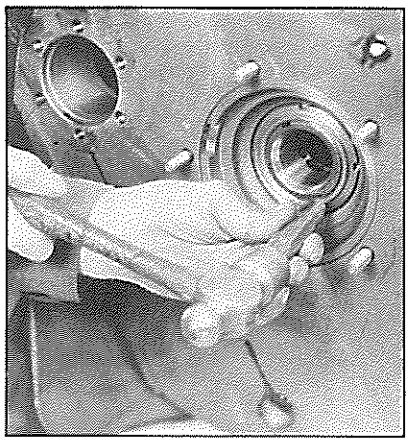
Install lock nut, as shown in Illust. 7. Snug lock nut, using a punch and hammer, as shown in Illust. 8. Next, install studs as flange, as shown in Illust. 9. Do not tighten studs.

Install gasket to stator shaft assembly. Next, install the assembly to housing, as shown in Illust. 10. Be sure holes in stator shaft flange aligns with holes in housing. Slot in flange to point toward small bore in housing.

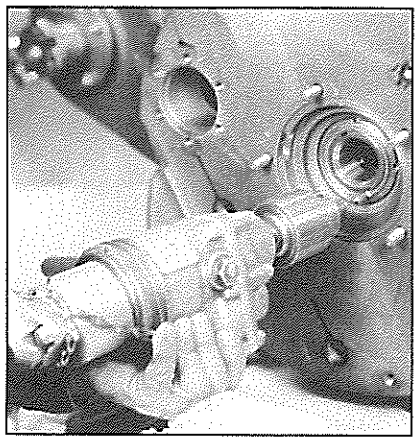
Tighten lock nut on stator shaft, using a hammer and punch, as shown in Illust. 11. Next, stake lock nut with a center punch, as shown in



ILLUST. 11



ILLUST. 12

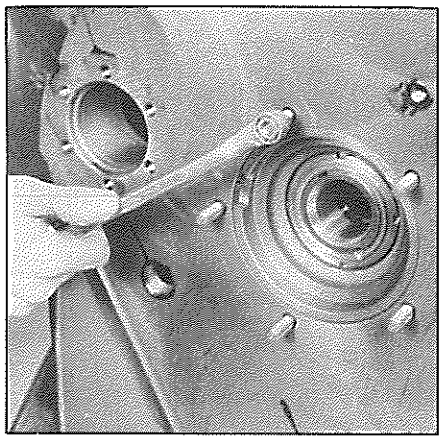


ILLUST. 13

Illust. 12.

To remove staked lock nut, use a drill to drill out stake, as shown in Illust. 13.

Tighten studs in flange, as shown in Illust. 14. To tighten studs, install two (2) nuts onto studs. Tighten one (1) nut against second nut. Using a wrench, as illustrated, tighten studs. When studs are tight, remove nuts.

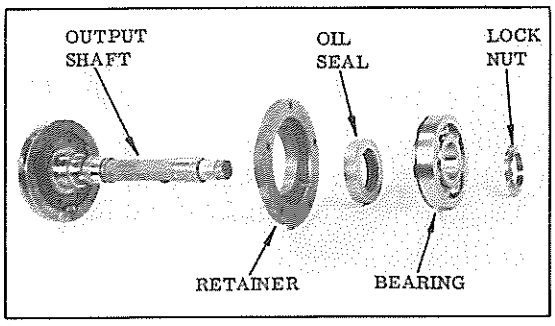


ILLUST. 14

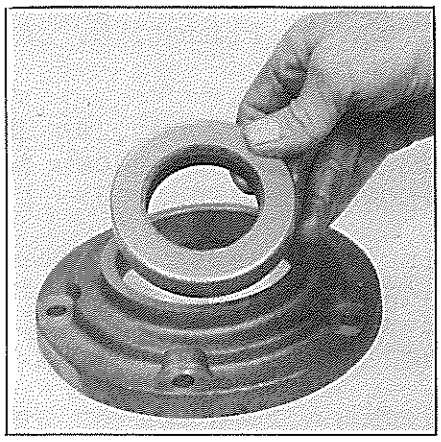
OUTPUT SHAFT

Illust. 1 is an exploded view of torque converter output shaft.

Install oil seal into retainer as shown in Illust. 2. Using a piece of pipe the same diameter as oil seal and mallet, drive seal into



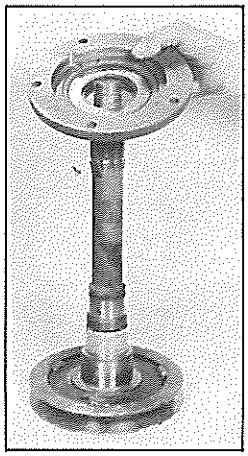
ILLUST. 1



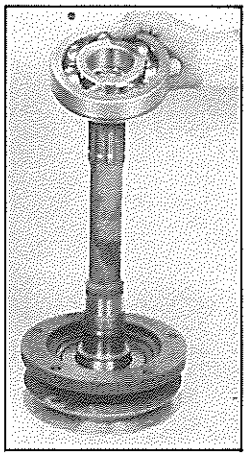
ILLUST. 2



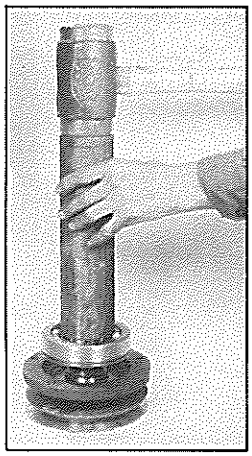
ILLUST. 3



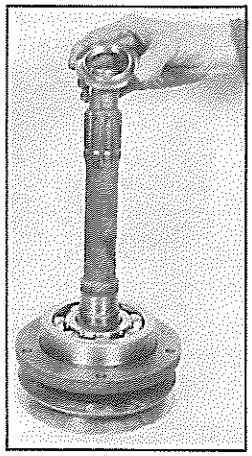
ILLUST. 4



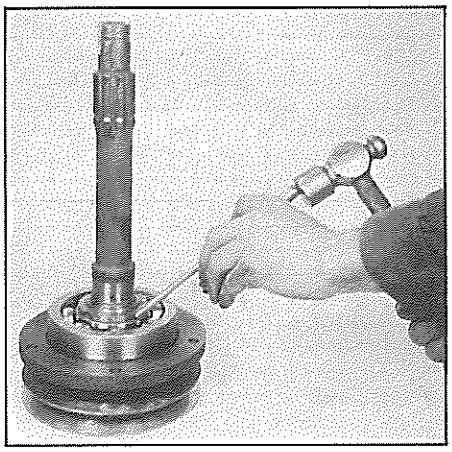
ILLUST. 5



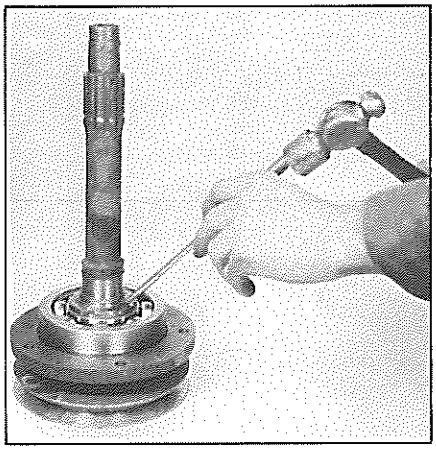
ILLUST. 6



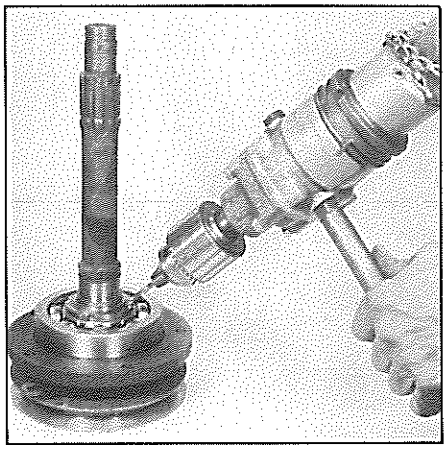
ILLUST. 7



ILLUST. 8



ILLUST. 9



ILLUST. 10

retainer, as shown in Illust. 3. Lip of seal toward inside of housing.

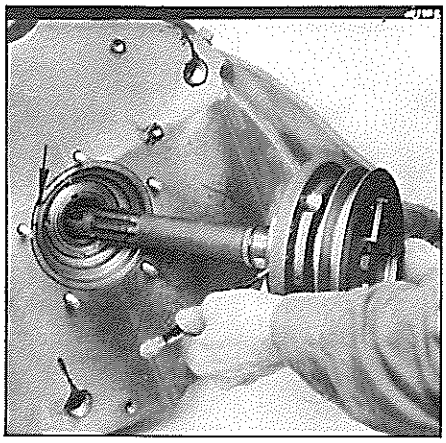
Install retainer with oil seal onto output shaft, as shown in Illust. 4.

Install bearing onto output shaft, as shown in Illust. 5. Using a long length of pipe same diameter as bearing, drive bearing onto shoulder of shaft and into retainer, as shown in Illust. 6.

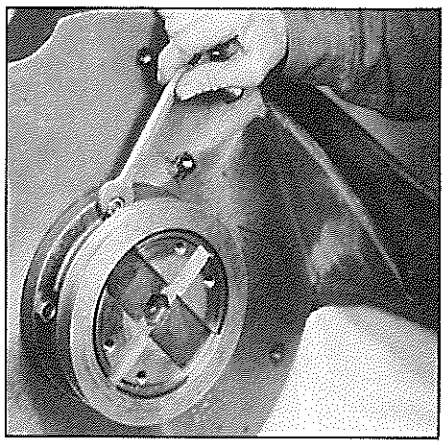
Install lock nut, as shown in Illust. 7. Using a hammer and punch, tighten lock nut securely, as shown in Illust. 8.

Stake lock nut, using a hammer and center punch, as shown in Illust. 9.

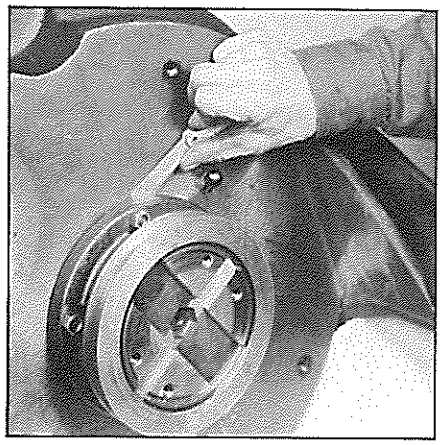
To remove staked lock nut, use a drill to drill out stake, as shown in Illust. 10.



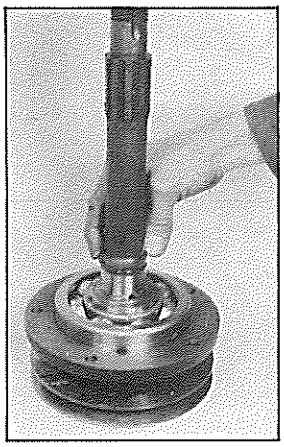
ILLUST. 11



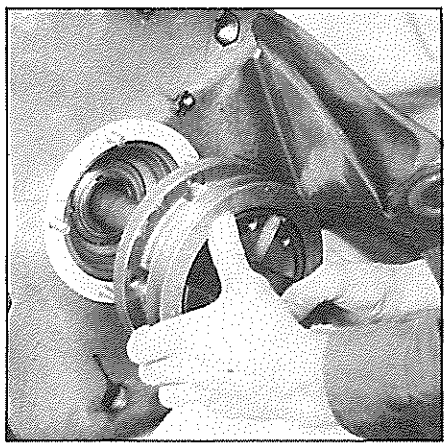
ILLUST. 12



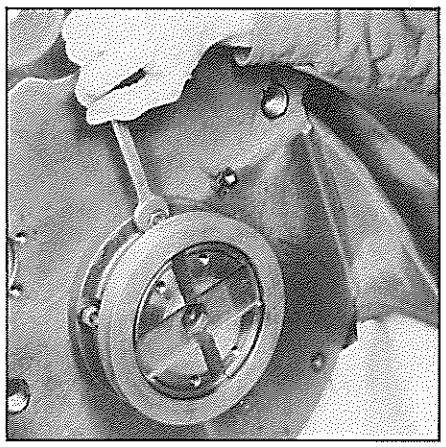
ILLUST. 13



ILLUST. 14



ILLUST. 15



ILLUST. 16

Insert output shaft through stator shaft and onto studs, less shims, as shown in Illust. 11. Be sure oil hole in output shaft retainer, as indicated by pencil, is in line with slot in stator shaft flange. Next, install stud nuts, less lock washer. Tighten stud nuts securely, as shown in Illust. 12. Measure gap between retainer and converter housing using a feeler gauge, as shown in Illust. 13. Remove output shaft and install piston ring in groove of shaft, as shown in Illust. 14.

Install required amount of shim gaskets to fill gap, then add one (1) more shim gasket. Next, insert output shaft into stator shaft, as shown in Illust. 15, using care not to break piston ring. Be sure oil hole in output shaft retainer (Illust. 11) is in line with slot of stator shaft flange. Apply a steady pressure to output shaft. Piston ring, as it enters chamfer of stator shaft, will compress. When retainer reaches studs, use a rawhide mallet and tap output shaft over studs. Install stud nuts with lock washers and tighten securely, as shown in Illust. 16.

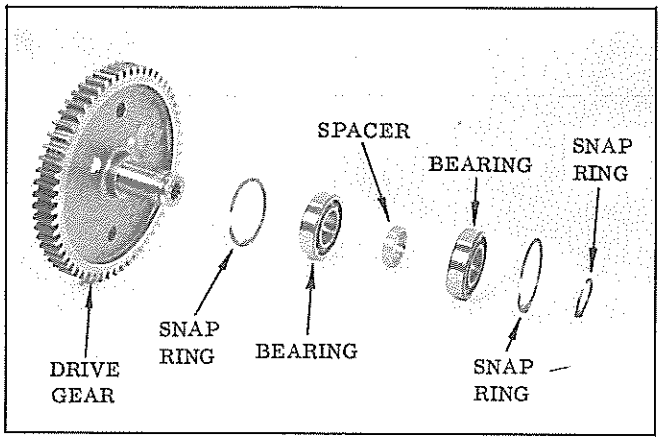
PUMP DRIVE GEAR

Illust. 1 is an exploded view of pump drive gear.

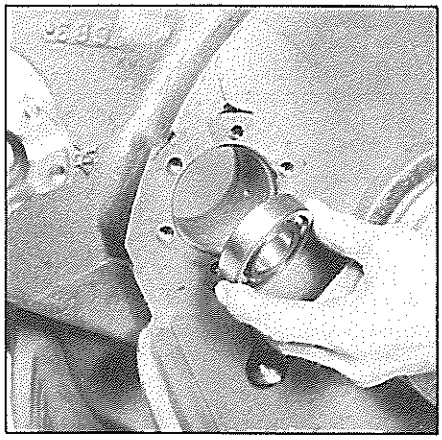
Install bearing into small bore of torque converter housing, as shown in Illust. 2. Drive bearing into housing using a hammer and a piece of pipe same diameter as that of bearing, as shown in Illust. 3. Bearring to be under flush with snap ring groove in bore. Next, insert snap ring in groove, as shown in Illust. 4.

Insert spacer into housing, as shown in Illust. 5, chamfered edge of spacer away from bearing.

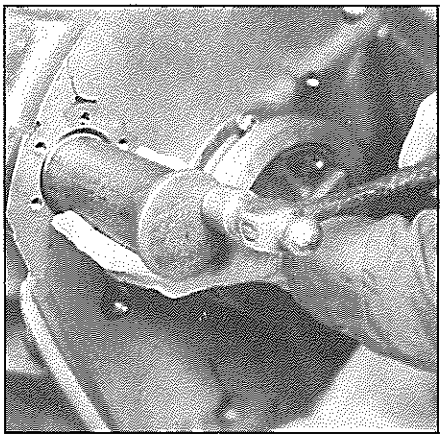
Insert second bearing into bore of housing, as shown in Illust. 6. Drive bearing into housing, using a hammer and a piece of pipe the same diameter as that of bearing, as shown in Illust.7. Bearing to be under flush with snap ring groove in bore.



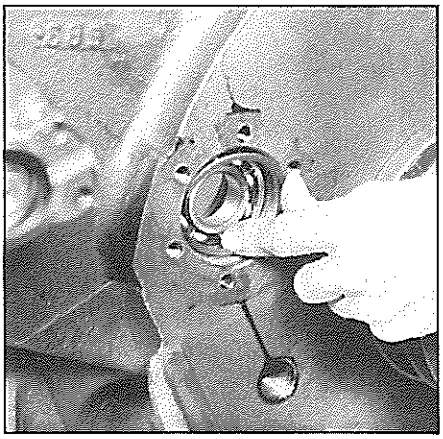
ILLUST. 1



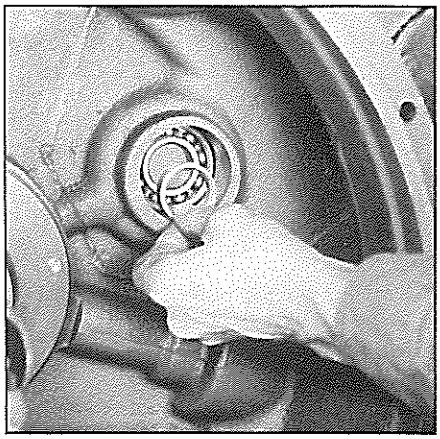
ILLUST. 2



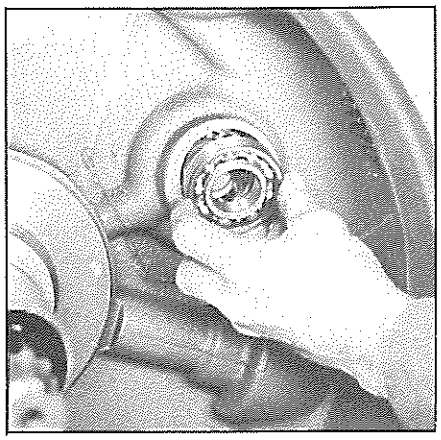
ILLUST. 3



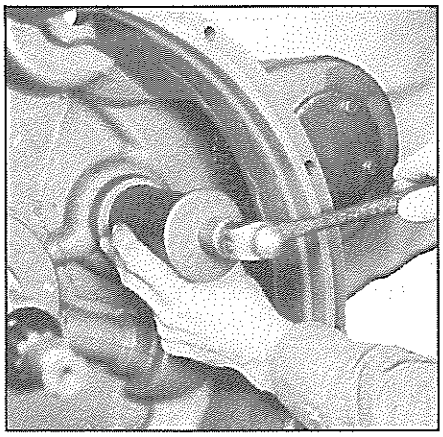
ILLUST. 4



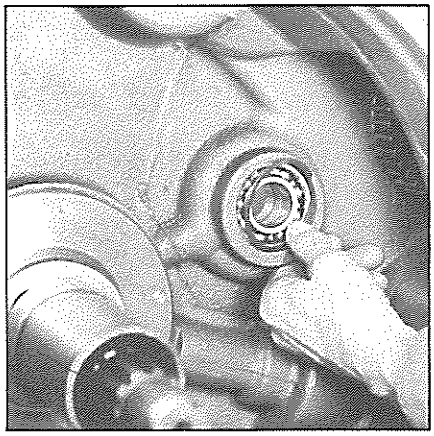
ILLUST. 5



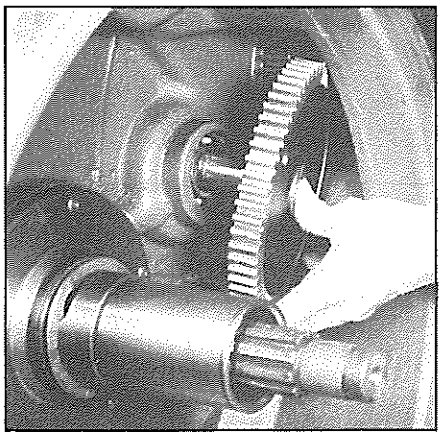
ILLUST. 6



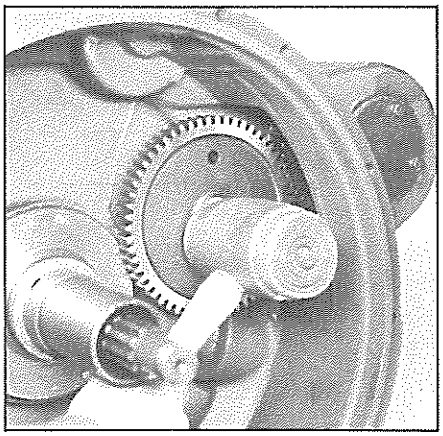
ILLUST. 7



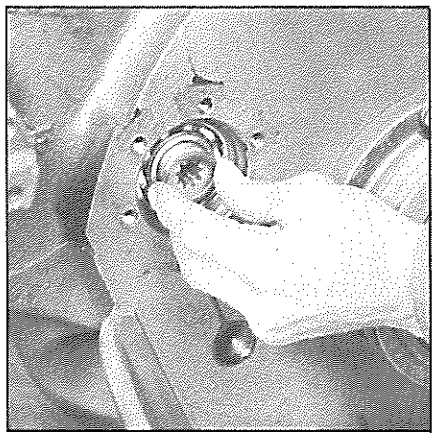
ILLUST. 8



ILLUST. 9



ILLUST. 10



ILLUST. 11

Insert second snap ring in groove of housing, as shown in Illust. 8.

Insert drive gear through bearing, spacer and second bearing, as shown in Illust. 9. Align spacer between bearings and drive hub of gear through bearing, spacer and second bearing, using a rawhide mallet, as shown in Illust. 10.

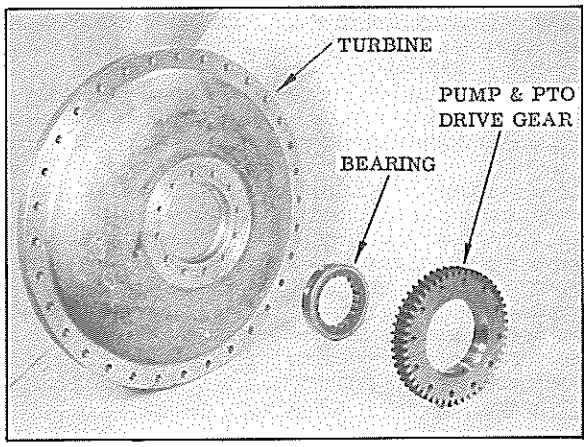
Install snap ring in groove of drive gear hub, as shown in Illust. 11.

TURBINE

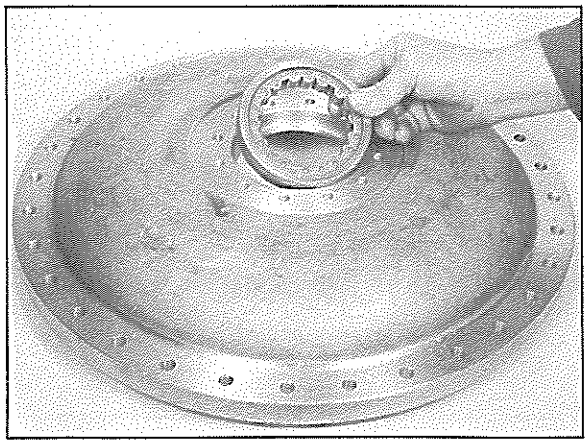
Illust. 1 is an exploded view of the turbine assembly.

Install bearing into turbine, as shown in Illust. 2. Using a rawhide mallet, tap bearing until seated in turbine, as shown in Illust. 3.

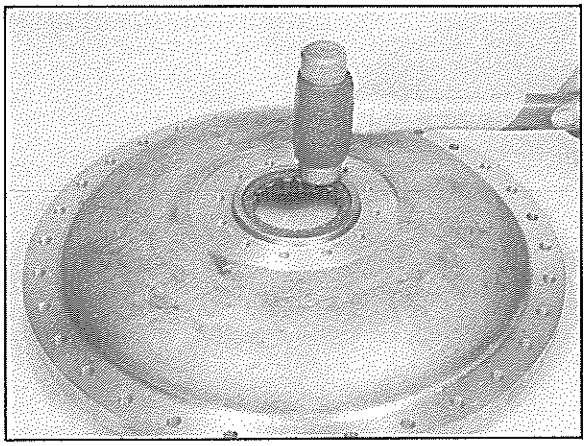
Install pump and P.T.O. drive gear over bearing and onto turbine, as



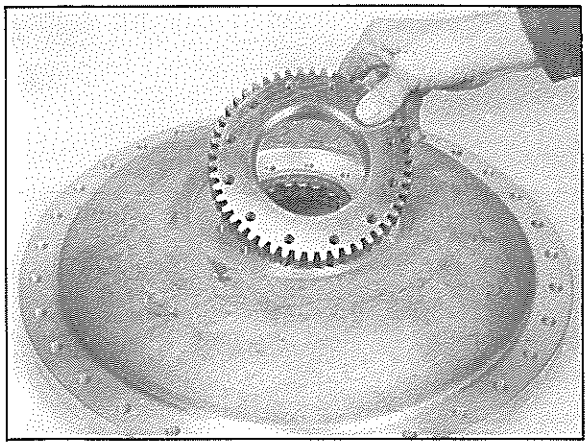
ILLUST. 1



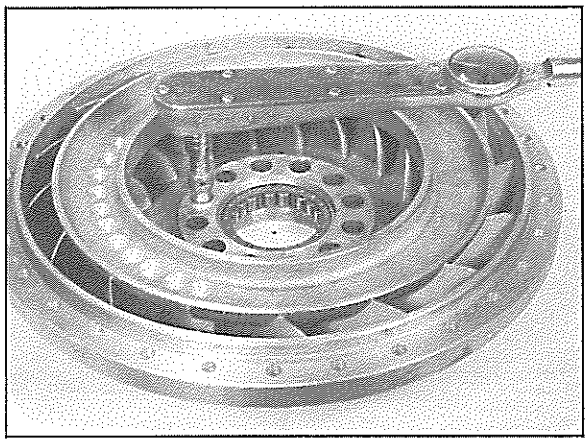
ILLUST. 2



ILLUST. 3



ILLUST. 4

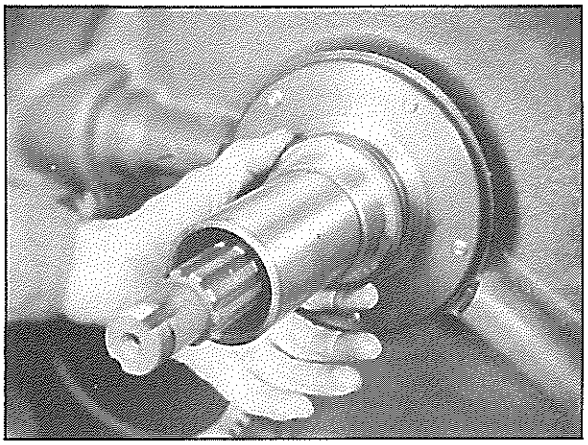


ILLUST. 5

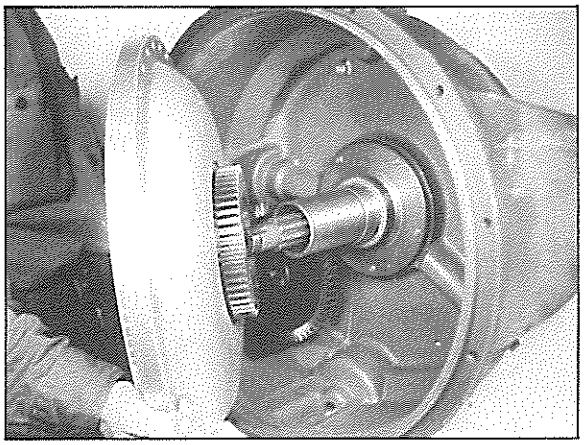
shown in Illust. 4.

Turn turbine over, as shown in Illust. 5, and install cap screws with shake-proof lock washers. Torque cap screws to a reading of 14 foot pounds.

Install piston ring in groove of piston ring retainer, as shown in Illust. 6. Apply oil to piston ring and install turbine assembly onto stator shaft and over ring, as shown in Illust. 7. By applying pressure to turbine, chamfer in pump and P.T.O. drive gear will compress piston ring and slide onto shaft.

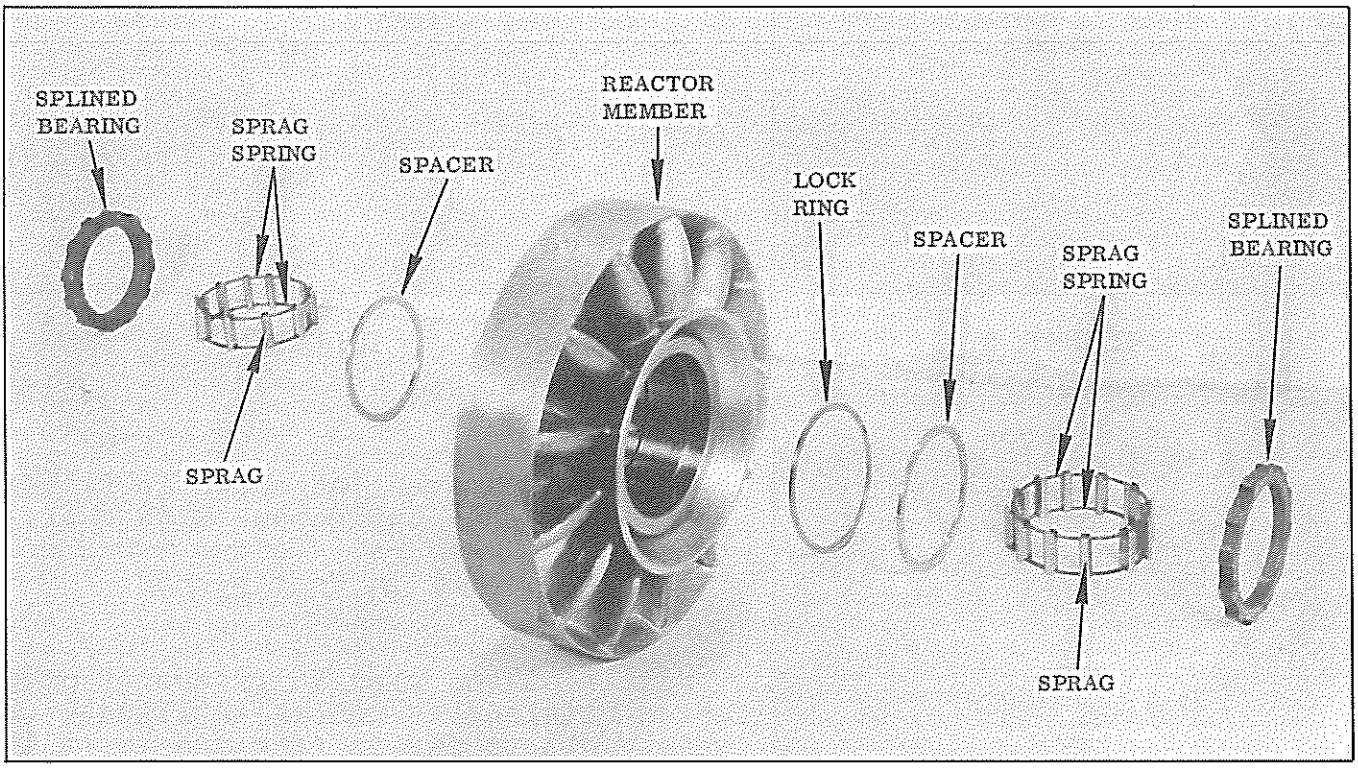


ILLUST. 6



ILLUST. 7

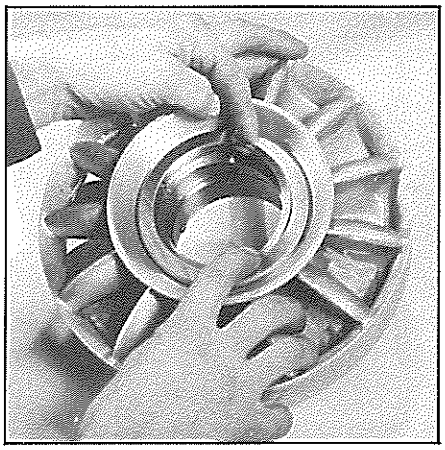
REACTOR MEMBER



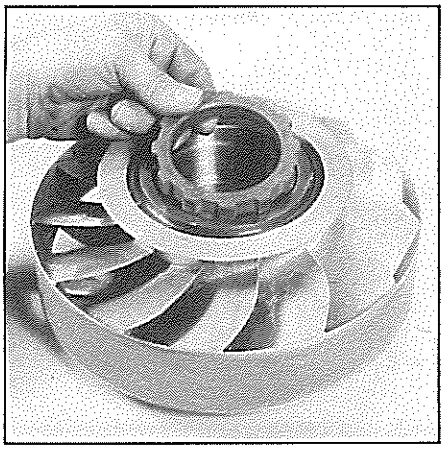
ILLUST. 1

Illust. 1 is an exploded view of the reactor member.

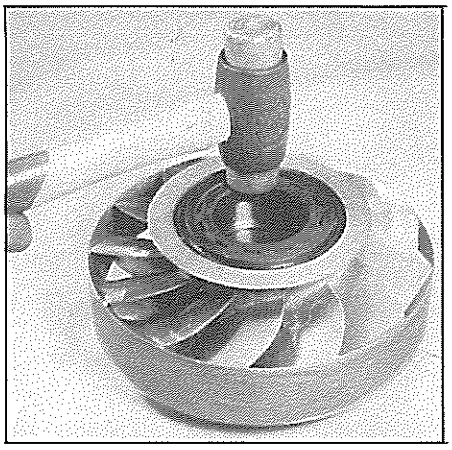
Install lock ring in center groove of reactor member, as shown in Illust. 2.



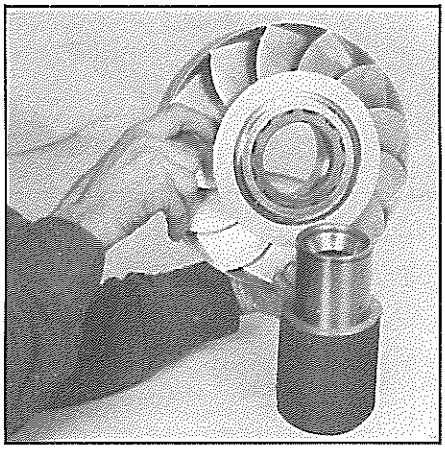
ILLUST. 2



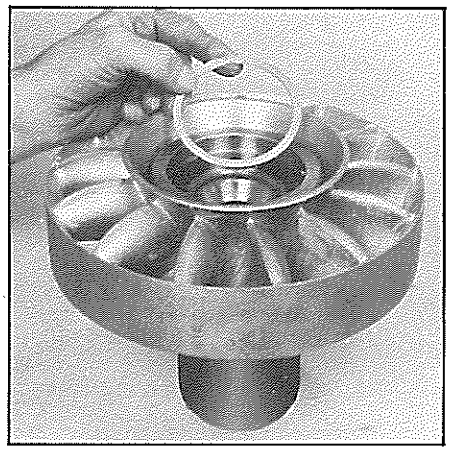
ILLUST. 3



ILLUST. 4



ILLUST. 5



ILLUST. 6



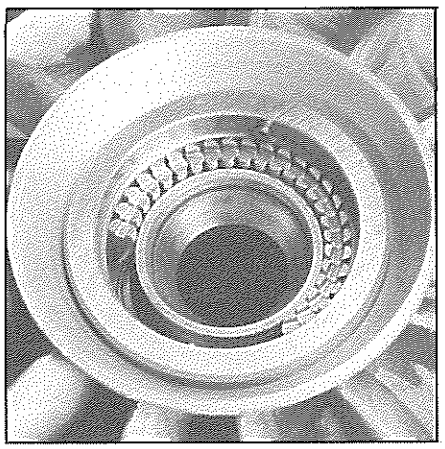
ILLUST. 7

Install thick splined bearing into reactor member, as shown in Illust. 3. Using a rawhide mallet, tap bearing into member until flush with member, as shown in Illust. 4.

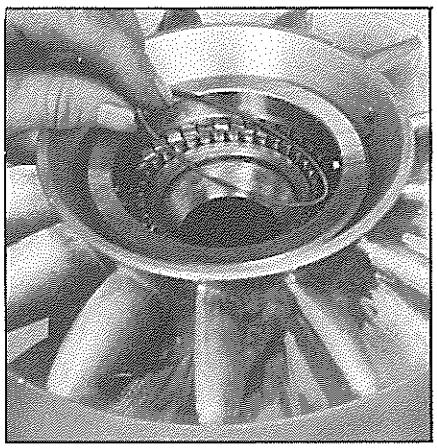
Insert reactor member onto a tool, as shown in Illust. 5. Next, install spacer, as shown in Illust. 6.

Install sprag spring onto spacer, as shown in Illust. 7.

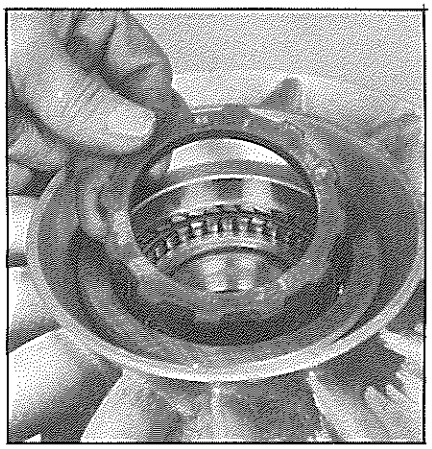
There are 72 sprags inserted into reactor member, 36 in each side. It is very important that the sprags are installed correctly. Improper installation will cause serious damage. When installing sprags, care must be taken to assure that the spring grooves are aligned, as shown in Illust. 8, with respect to the innner race (stator shaft). It will be noted that the smaller of the two (2) tangs forming the spring groove is always against the inner race. The tapered side of sprag points in the direction of free wheeling (clockwise). Care must be taken to assure that the sprag springs are entirely and completely within the grooves of sprags.



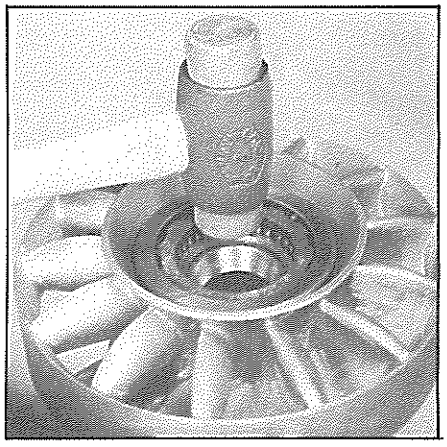
ILLUST. 8



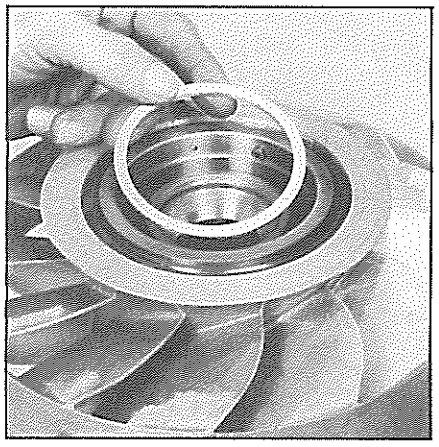
ILLUST. 9



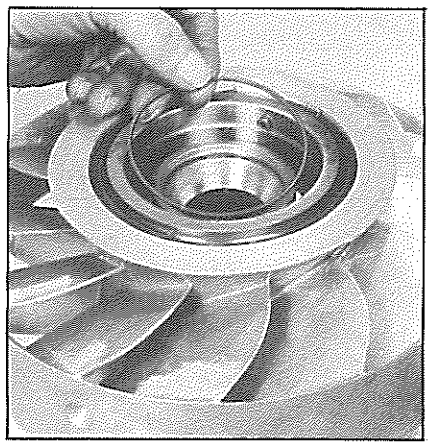
ILLUST. 10



ILLUST. 11



ILLUST. 12



ILLUST. 13

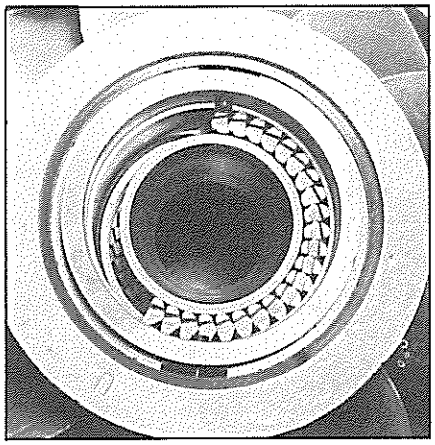
Install second sprag spring in grooves of sprags, as shown in Illust. 9.

Install thin splined bearing into reactor member, as shown in Illust. 10. Using a rawhide mallet, tap bearing down onto sprags, as shown in Illust. 11. Use care in tapping bearing, spring may come out of groove.

Remove reactor member from tool. Turn reactor member over, sharp edge of fins upward and install on tool. Remove thick splined bearing. Next, install second spacer, as shown in Illust. 12.

Install second sprag spring, as shown in Illust. 13.

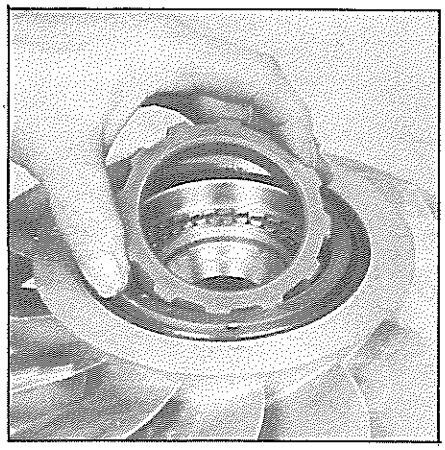
Install the last 36 sprags. Be sure the spring groove in sprags are over the spring, as shown in Illust. 14. The tapered side of sprag



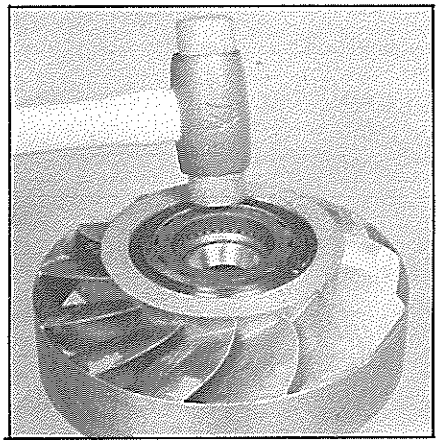
ILLUST. 14



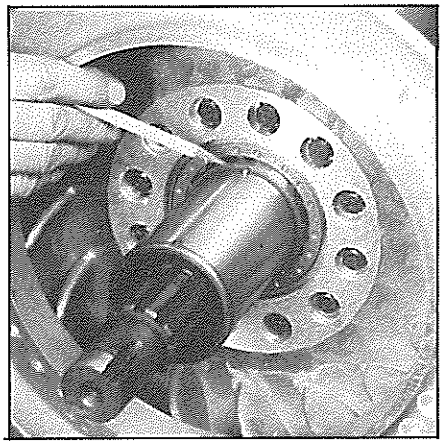
ILLUST. 15



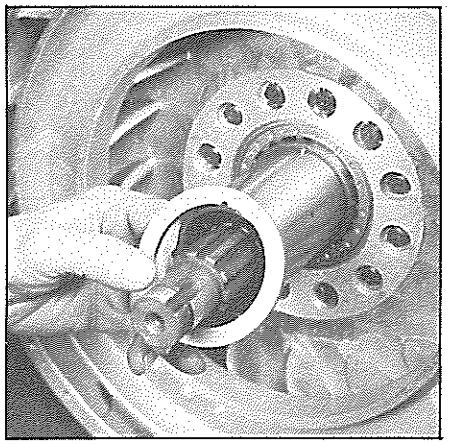
ILLUST. 16



ILLUST. 17



ILLUST. 18



ILLUST. 19

pointing toward the direction of free wheeling (counter clockwise).

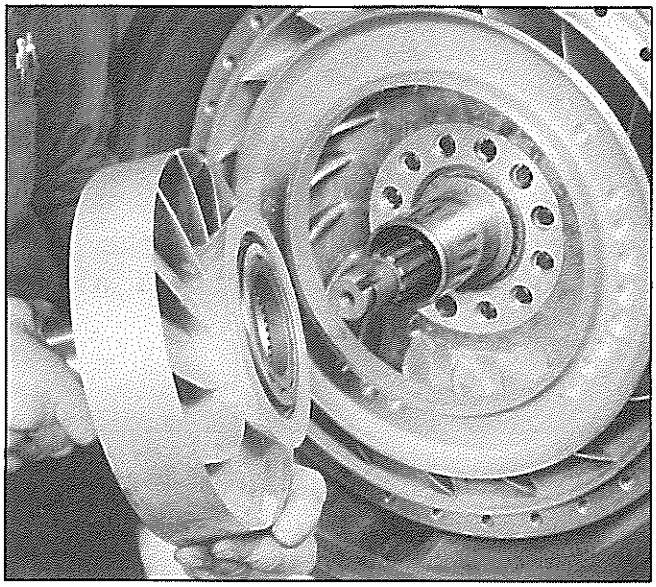
Install second sprag spring in groove of sprags, as shown in Illust. 15.

Install thick splined bearing into reactor member, as shown in Illust. 16. Using a rawhide mallet, tap bearing down onto sprags, as shown in Illust. 17. Use care in tapping bearing, spring may come out of groove.

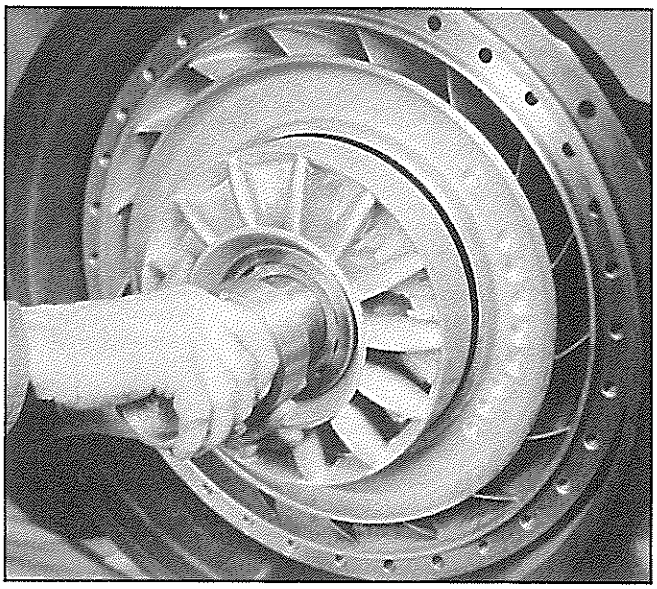
While reactor member is still on tool, rotate member in the direction of free wheeling (counter clockwise). Member should rotate freely. Should there be any binding, recheck sprags for improper installation.

Install ball as indicated by pencil, in hole of stator shaft, as shown in Illust. 18.

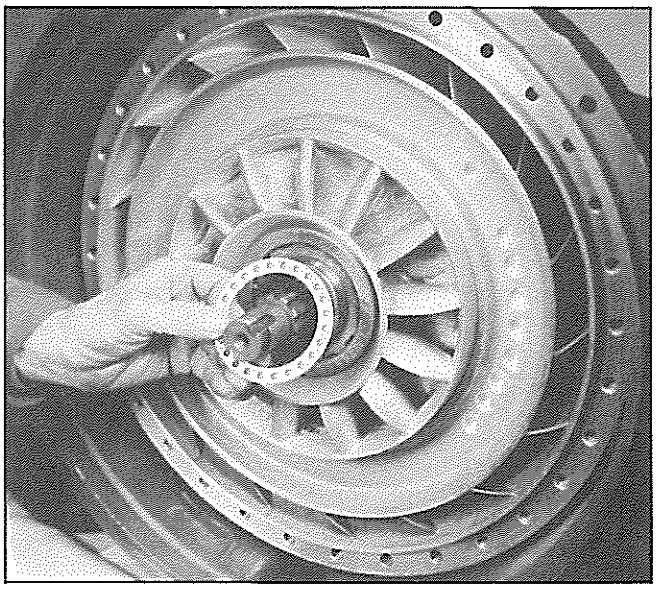
Install bronze thrust washer onto stator shaft, as shown in Illust. 19. Slot in spacer over ball in shaft.



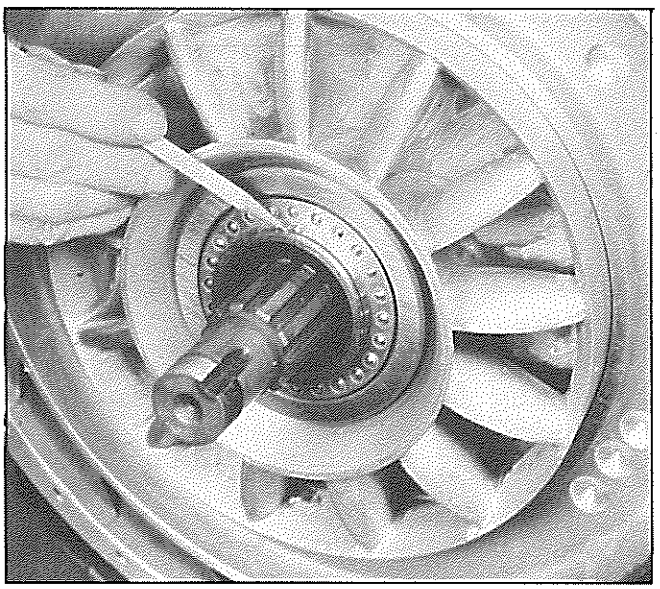
ILLUST. 20



ILLUST. 21



ILLUST. 22

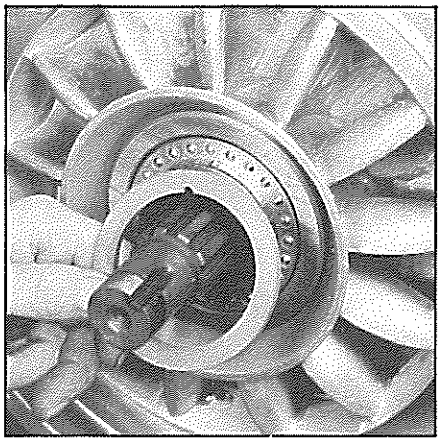


ILLUST. 23

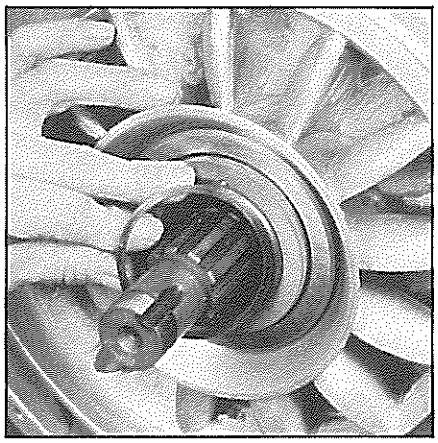
Apply oil to stator shaft and install reactor member onto shaft, as shown in Illust. 20. Align reactor member tool with stator shaft and slide member from tool to shaft, as shown in Illust. 21.

Install ball bearing assembly onto stator shaft, as shown in Illust. 22.

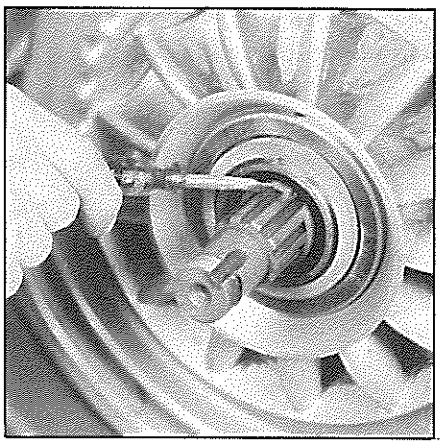
Install second ball, as indicated by pencil, in hole of stator shaft, as shown in Illust. 23.



ILLUST. 24



ILLUST. 25



ILLUST. 26

Install second bronze thrust washer, as shown in Illust. 24, onto shaft and over ball.

Install lock ring into groove of stator shaft, as shown in Illust. 25.

Insert snap ring in groove of output shaft, as shown in Illust. 26.

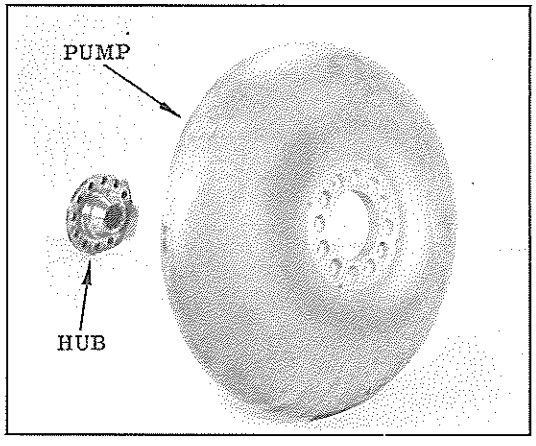
PUMP

Illust. 1 is an exploded view of the pump.

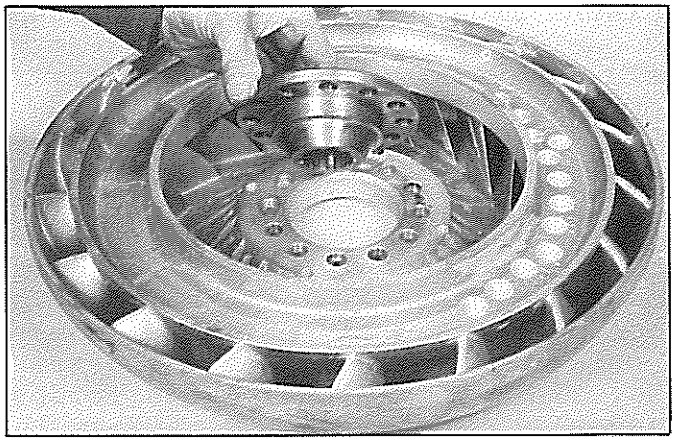
Install hub into pump, as shown in Illust. 2.

Install socket headed cap screws, as shown in Illust. 3. Tighten cap screws to a torque reading of 40 foot pounds, as shown in Illust. 4.

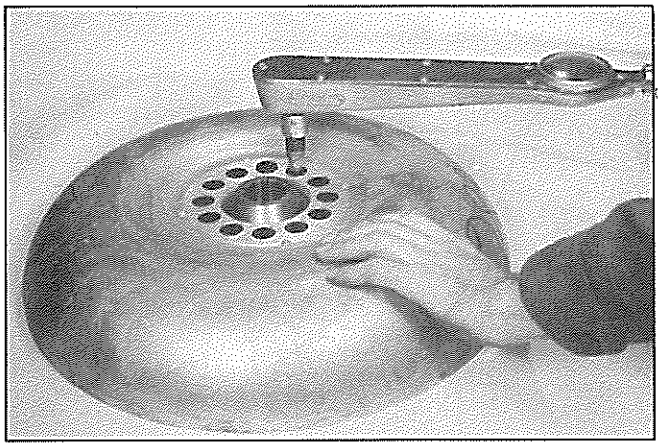
Using a hammer and punch, as shown in Illust. 4, stake cover in two (2)



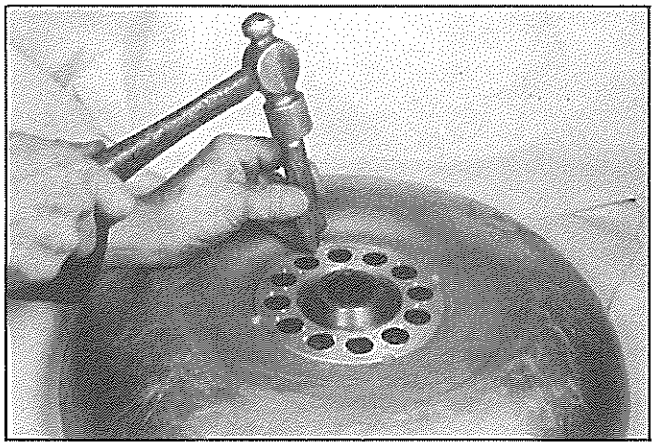
ILLUST. 1



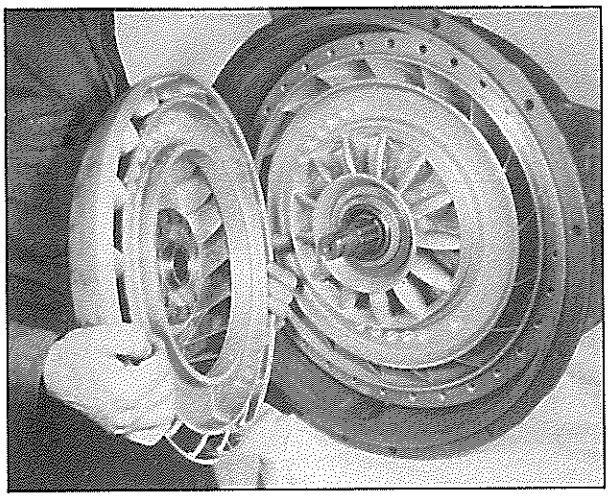
ILLUST. 2



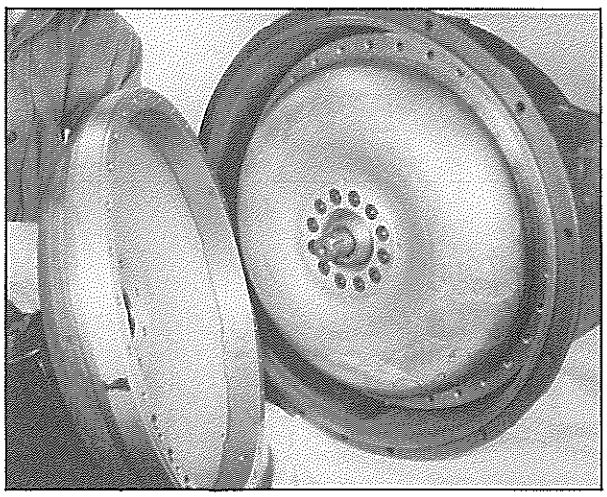
ILLUST. 3



ILLUST. 4



ILLUST. 5

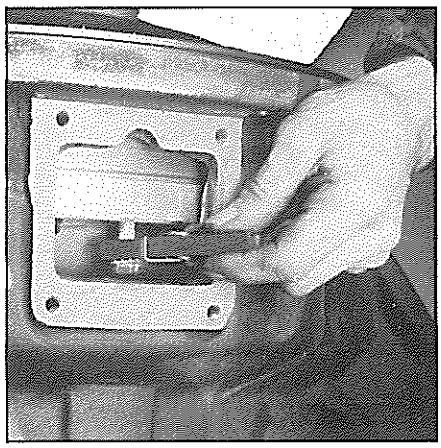


ILLUST. 6

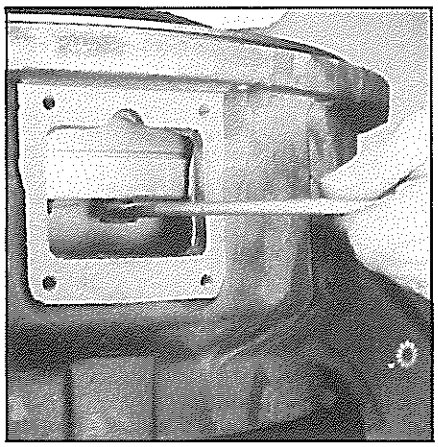
places around head of socket cap screws. Should cap screws become loose, this staking will prevent cap screw from coming out. To remove stake, apply pressure when removing cap screws.

Install pump onto output shaft, as shown in Illust. 5. Next, install pump cover as shown in Illust. 6.

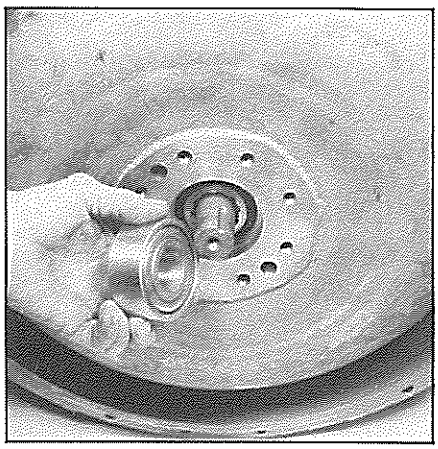
To install pump cover cap screws with shakeproof lock washers, insert cap screws through inspection cover hole in torque converter housing. Care must be taken not to drop cap screws into housing. If this should occur, disassembly of torque converter housing is necessary. For easy installation of cap screws, use a snap clothes pin, as shown in Illust. 7. Tie a piece of cord to clothes pin and attach to wrist. Clamp cap screw in clothes pin and insert through inspection hole and into turbine cap screw hole. After cap screw is started, snug but do not tight-



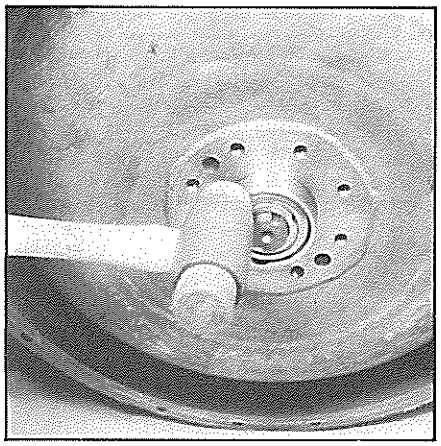
ILLUST. 7



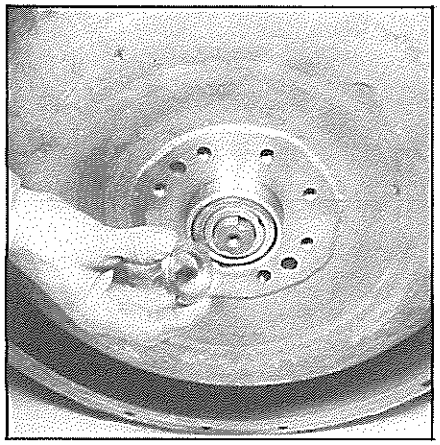
ILLUST. 8



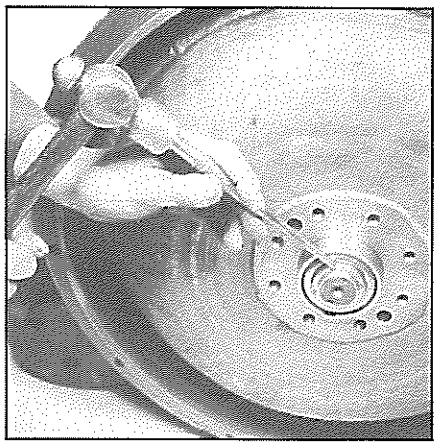
ILLUST. 9



ILLUST. 10



ILLUST. 11



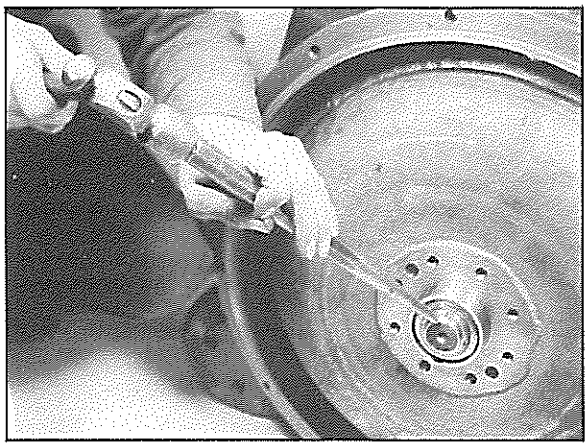
ILLUST. 12

en. Turn turbine 180 degrees, install and snug second cap screw. Continue this operation until all cap screws have been installed, then tighten securely, as shown in Illust. 8.

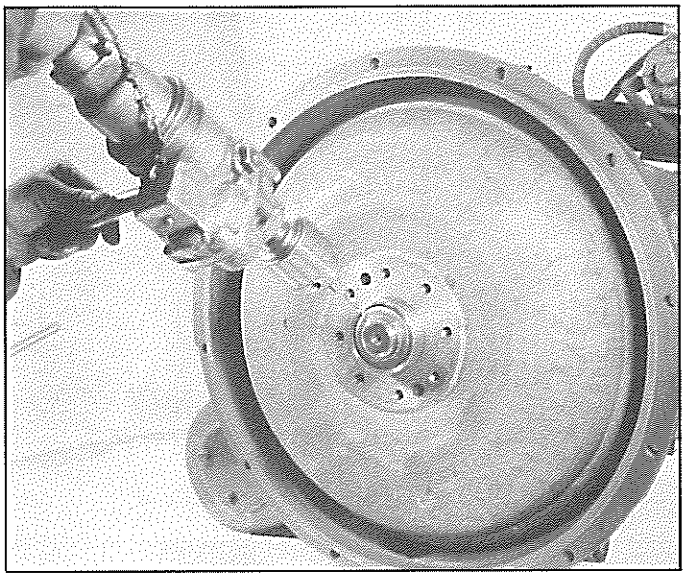
Install bearing onto output shaft, as shown in Illust. 9. Using a mallet tap bearing into pump cover to shoulder, as shown in Illust. 10.

Install lock nut onto shaft, as shown in Illust. 11. Using a hammer and punch, tighten nut securely, as shown in Illust. 12. Stake nut by using a hammer and punch, as shown in Illust. 13.

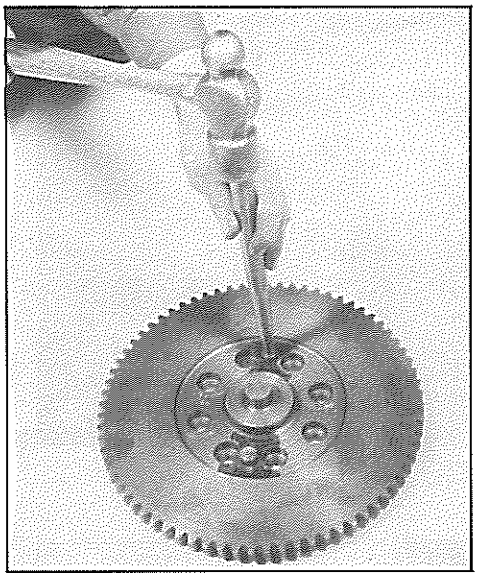
To remove staked nut from output shaft, as shown in Illust. 14, use a drill to drill out stake. Loosen nut



ILLUST. 13



ILLUST. 14

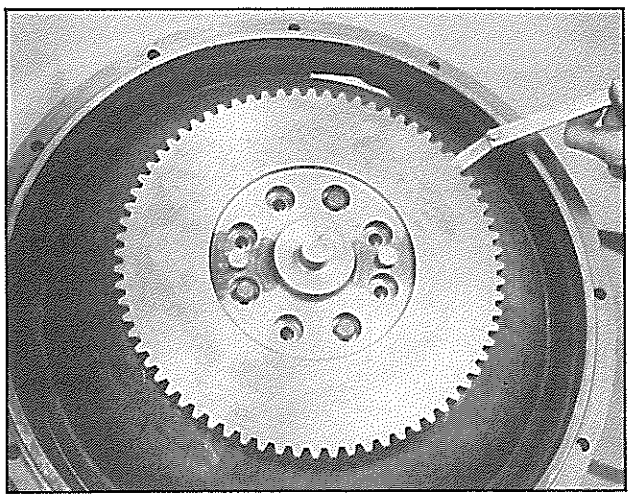


ILLUST. 15

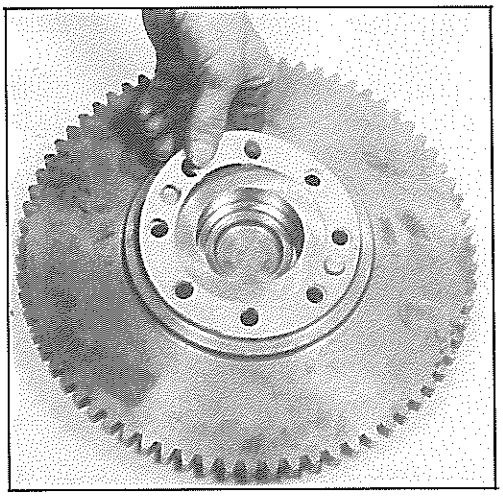
using a hammer and punch.

Drive dowel pins into drive gear, as shown in Illust. 15. Do not drive dowel pins through gear.

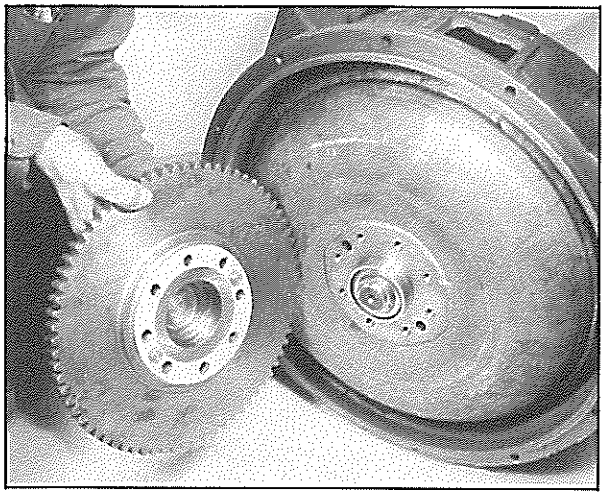
Install drive gear over bearing and onto pump cover. Use a mallet to tap gear over bearing. Install three (3) cap screws less lock washers and tighten. Next, using a feeler gauge, measure the gap between gear and cover, as shown in Illust. 16. Remove cap screws and gear. Drive dowel pins through gear only enough to hold shim gaskets. Install correct amount of shim gaskets required to fill gap, as shown in Illust. 17, then add one (1) more shim gasket.



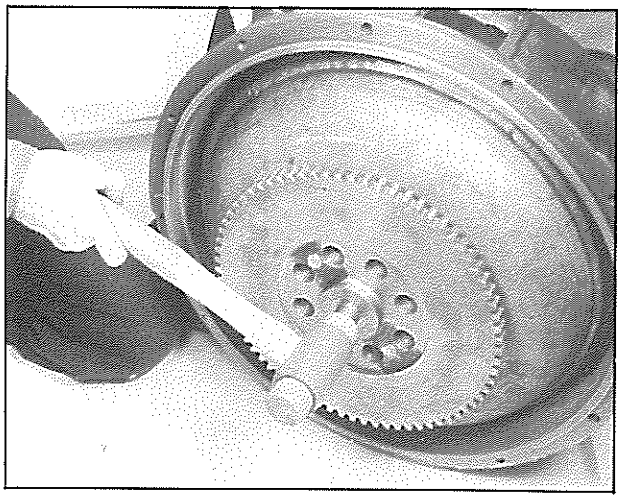
ILLUST. 16



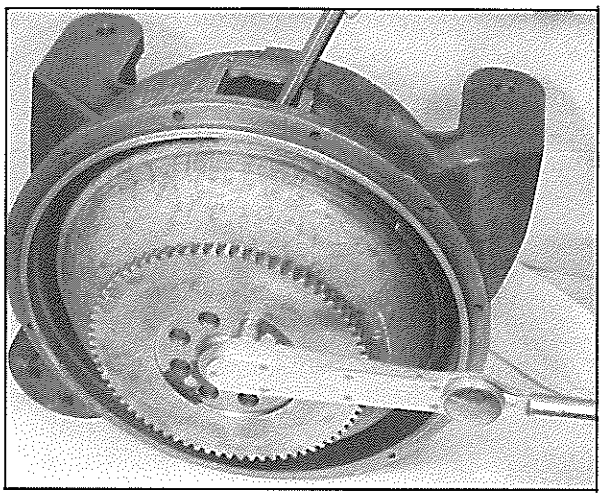
ILLUST. 17



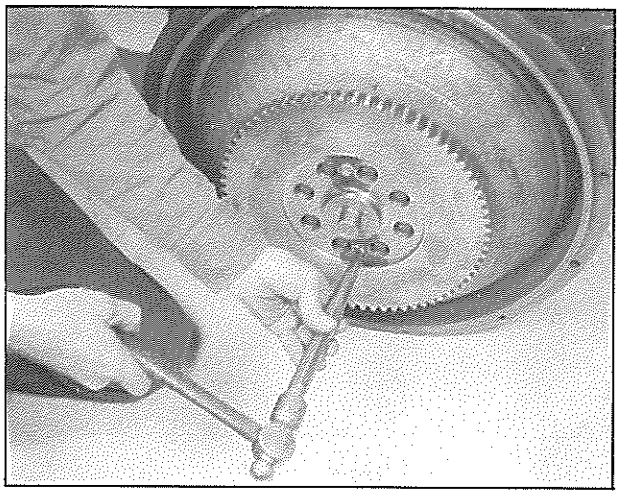
ILLUST. 18



ILLUST. 19



ILLUST. 20



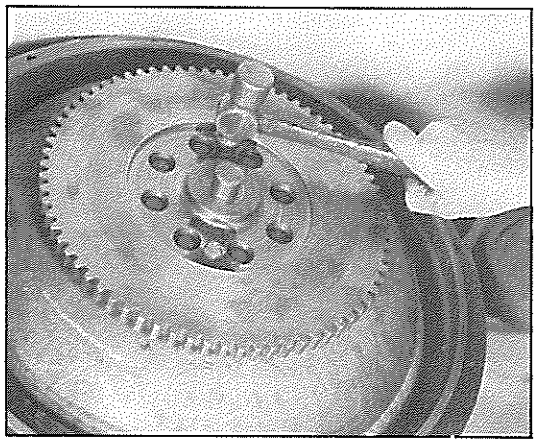
ILLUST. 21

Install drive gear with shim gaskets over bearing and onto pump cover, as shown in Illust. 18. Use a mallet to tap gear over bearing, as shown in Illust. 19.

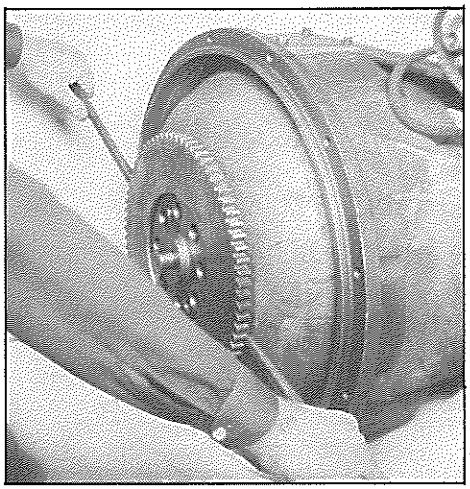
Install cap screws with shakeproof lock washers and tighten to a torque reading of 45 foot pounds,,as shown in Illust. 20.

Drive dowel pins into cover, as shown in Illust. 21.

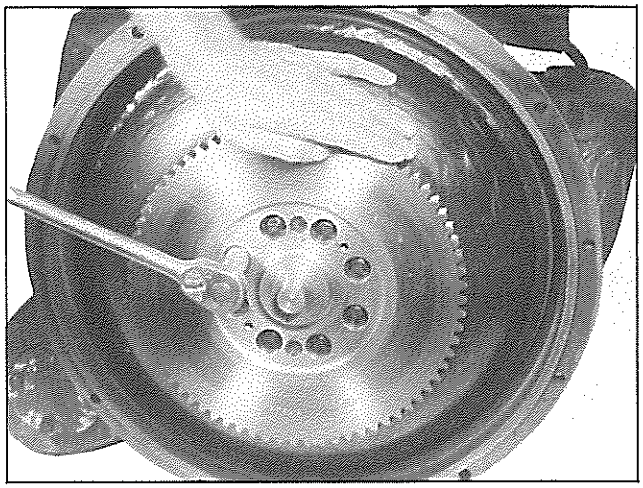
As shown in Illust. 22, batter edge of dowel pin holes in gear with a ball



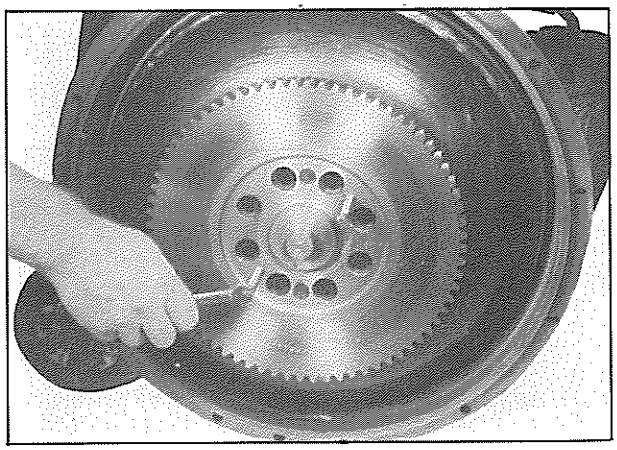
ILLUST. 22



ILLUST. 23



ILLUST. 24



ILLUST. 25

peen hammer as a safety precaution.

To remove drive gear from cover, remove cap screws. Next, using two (2) pry bars between gear and cover, as shown in Illust. 23, pry gear from cover.

On later machines, to remove drive gear, remove cap screws, as shown in Illust. 24. Next, install two (2) set screws in pull holes in gear. By tightening the set screws,as shown in Illust. 25, against cover, gear can be removed. Note: Use flat point set screws so as not to damage cover.

Relief Valve and Fittings (Clutch)

We do not recommend the disassembly of either the clutch or torque converter relief valve. This assembly must either be replaced or sent back to factory for repairs. Relief valve housing assembly can be removed from body without removing body from torque converter housing. The following instructions and illustrations will aid in the reassembly of either relief valve.

Insert relief valve housing with "O" rings into body, as shown in Illust. 1. Next, tighten valve housing into body., as shown in Illust. 2.

Illust. 3 is an exploded view of relief valve fittings for clutch relief valve. When install all fittings, apply a good pipe sealing compound to threads.

hydraulic system should be kept clean while in storage. Good oil should be used at all times. The hose and fittings should be checked daily for leakage or looseness.

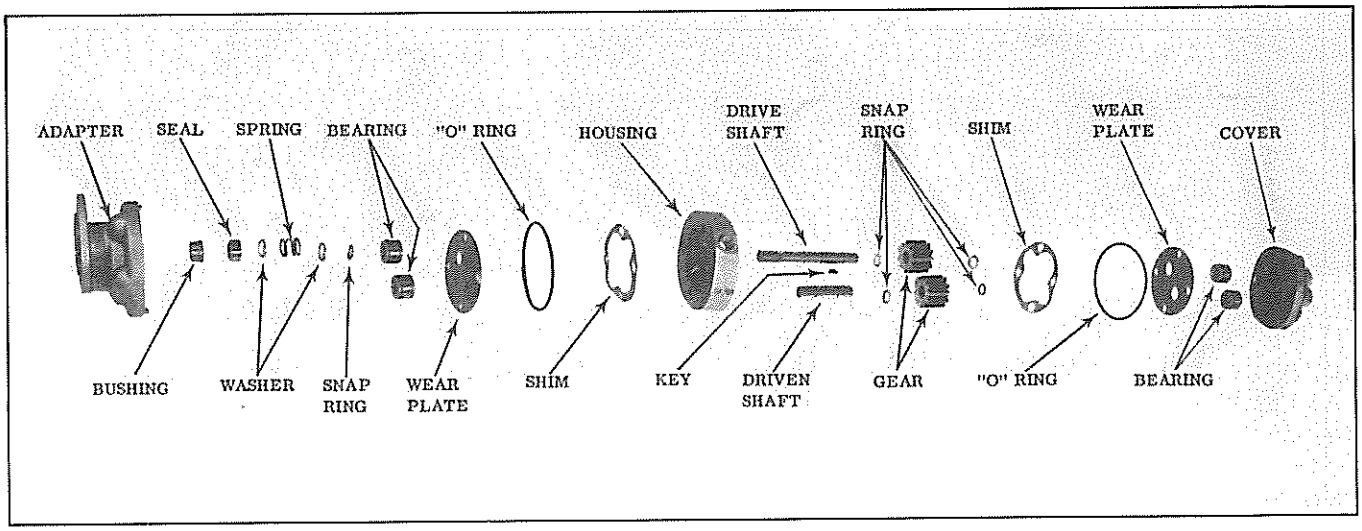
Disassembly

Clean the outside of the pump with an oil solvent, or similar fluid and dry thoroughly. Mark the sections of the pump with a prick punch to assure proper reassembly. The pump may be disassembled by reversing the assembly procedure.

Reassembly

Before installing the roller bearings into adapter and end cover, bearings should be inspected for freeness of rollers, pitted, broken and excessively worn rollers. If it is necessary to replace the bearings, do so only with the same make and type as were originally installed.

Illust. 1 is an exploded view of the hydraulic pump.

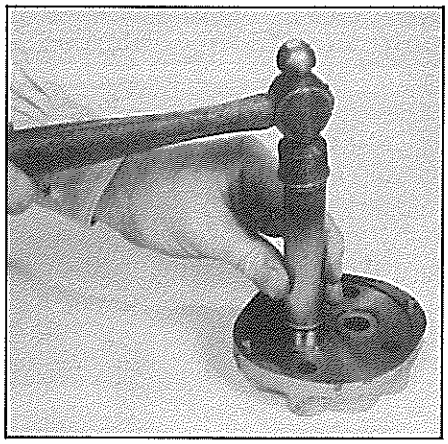


ILLUST. 1

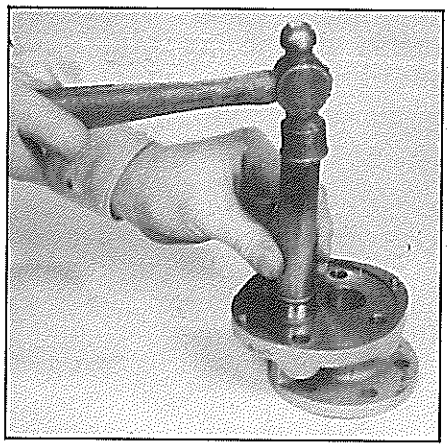
Press or drive bearings into cover and adapter, as shown in Illusts. 2 and 3. Press bearings if possible. If not, use a soft piece of tubing and drive bearings, taking care not to damage bearings.

Install bushing into adapter, as shown in Illust. 4. Shoulder of bushing to fit against shoulder in adapter. Using a soft tube, press or drive into adapter, as shown in Illust. 5.

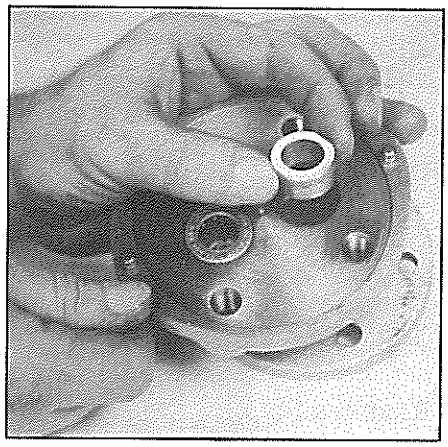
Inspect wear plate, as indicated by finger in Illust. 6, for scoring or excessive wear. Note: Do not turn wear plate, as the counter bore relief pocket is on gear side only. If wear plate is steel backed,



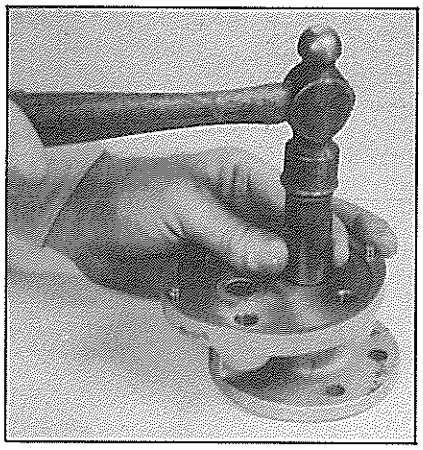
ILLUST. 2



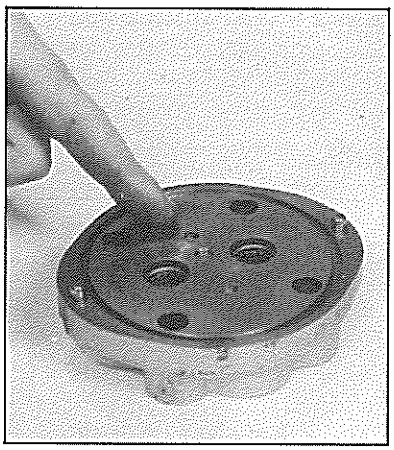
ILLUST. 3



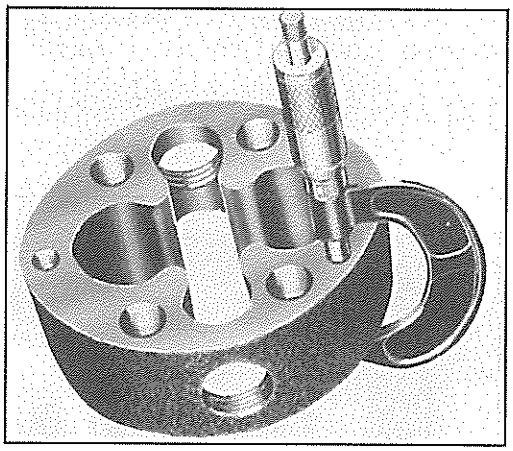
ILLUST. 4



ILLUST. 5



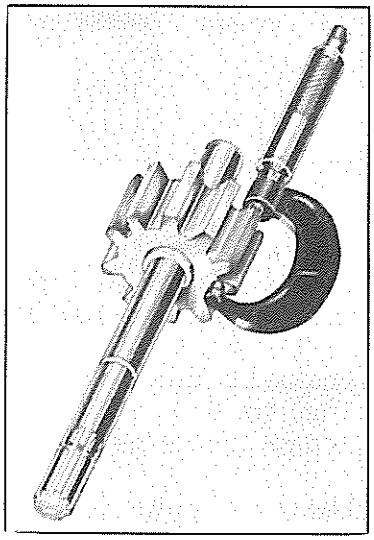
ILLUST. 6



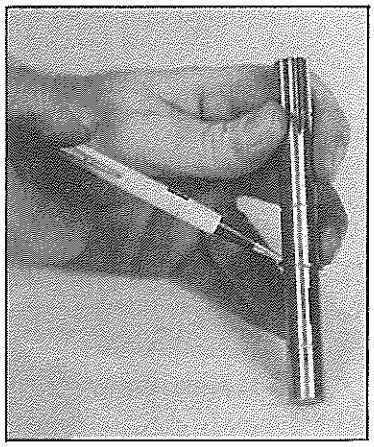
ILLUST. 7

bronze side should be next to gears. Even though slight wear is shown on gear pattern, inspect for erosion path in vicinity of relief pocket and replace if in evidence. The wear plate should be properly seated. If it has a slight roching motion, inspect the face of the cover or adapter for burrs. Be sure the counter bored relief pocket is up and in original position. Lubricate the contact surface of the plate with light oil.

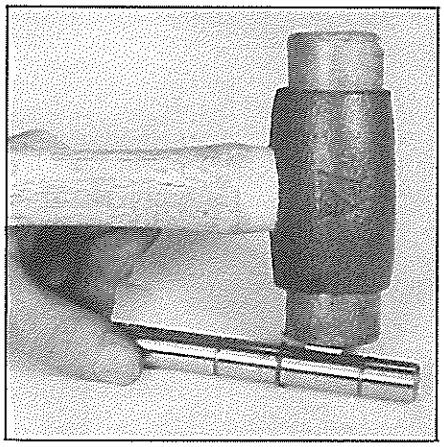
Proper clearance between the gear face and wear plate is provided by a plastic shim gasket between the housing and adapter and housing and cover. Using micrometers measure the width of the housing, as shown in Illust. 7 and the width of the gear, as shown in Illust. 8. If the gear width is (.002") greater than the housing width, a red shim (.002") should be installed on the adapter side and a red shim (.002") to the cover



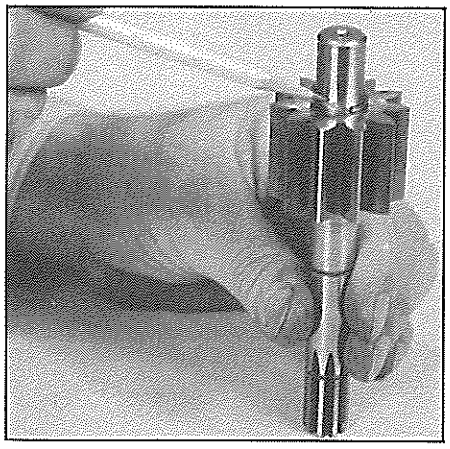
ILLUST. 8



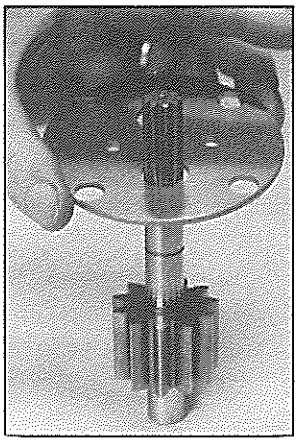
ILLUST. 9



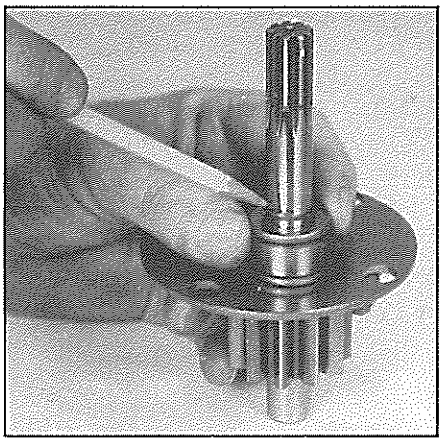
ILLUST. 10



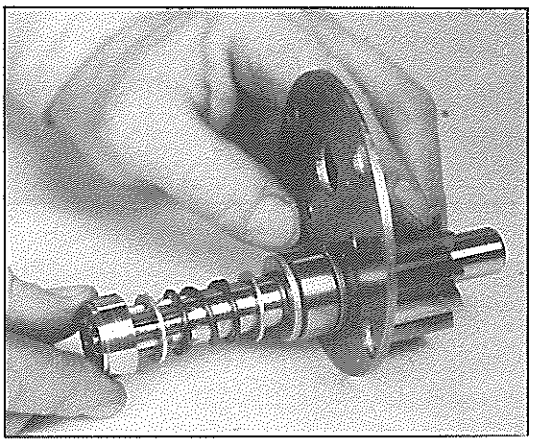
ILLUST. 11



ILLUST. 12



ILLUST. 13



ILLUST. 14.

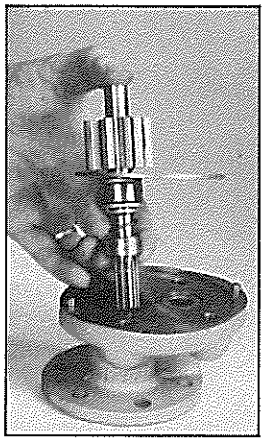
side. If the gear width is (.001") greater than the housing, an amber shim (.001") should be installed on the adapter side and a red shim (.002") to the cover side. If the housing and the gears are the same width, an amber shim (.001") should be installed on the adapter side and an amber shim (.001") to the cover side.

Install snap ring, as indicated by pencil in Illust. 9, into groove of drive shaft. Next, install key in keyway of shaft, as shown in Illust. 10.

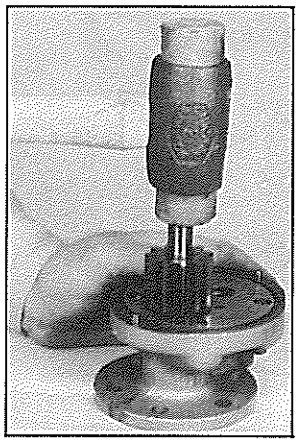
Press gear onto drive shaft to snap ring. Next, install second snap ring into groove of shaft, as shown in Illust. 11.

Install wear plate over splined end of drive shaft and down onto gear, as shown in Illust. 12.

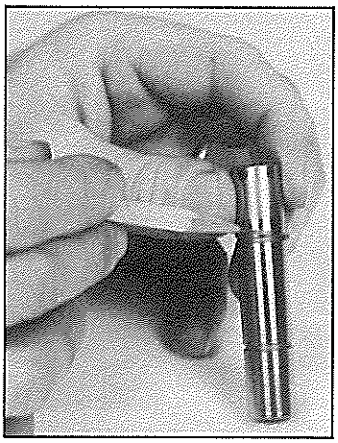
Press or drive bearing onto shaft and down onto wear plate. Next, in-



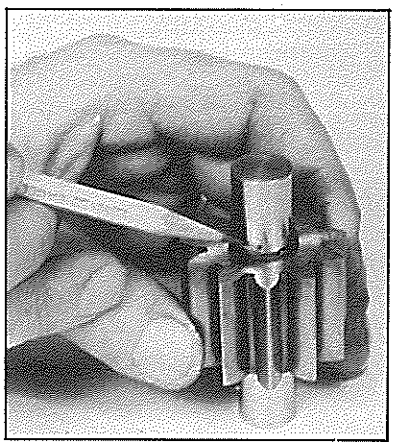
ILLUST. 15



ILLUST. 16



ILLUST. 17



ILLUST. 18

stall snap ring, as indicated by pencil in Illust. 13, into groove of shaft.

Install washer, spring, second washer and seal onto shaft, as shown in Illust. 14.

Insert shaft assembly through adapter, as shown in Illust. 15. Tap shaft to seat bearing against bushing, as shown in Illust. 16.

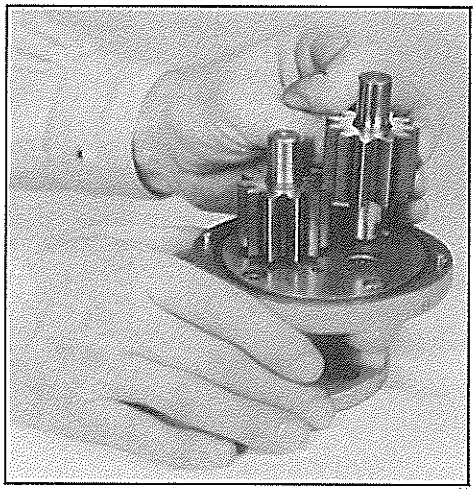
Install snap ring, as indicated by pencil in Illust. 17, in groove of driven shaft.

Press gear onto driven shaft. Next, install second snap ring, as indicated by pencil in Illust. 18, into groove of shaft.

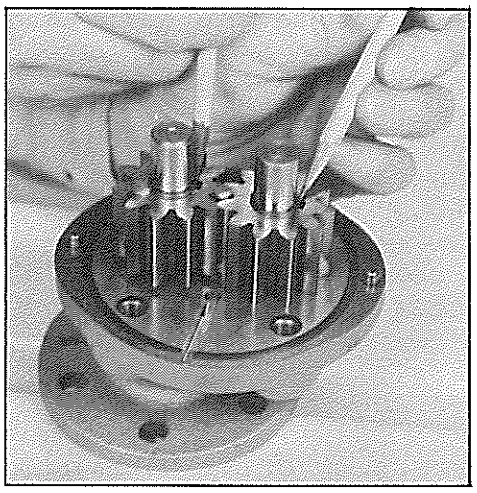
Install driven shaft assembly into adapter, as shown in Illust. 19. Make sure the gears are in their original position and the relief pocket, as indicated by arrow in Illust. 20, is in its original position on the pressure side. Be sure keyways in gears, as indicated by pencils in Illust. 20, are 180 degrees apart.

Install "O" ring between wear plate and adapter, as shown in Illust. 21.

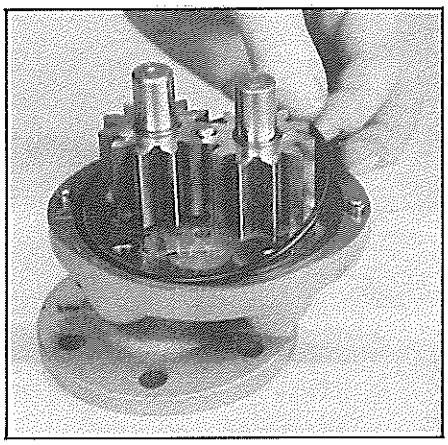
Install gasket shim which was determined to be used between adapter and housing. Install housing onto adapter, as shown in Illust. 22. NOTE: Be sure punch marks on housing align with punch marks on adapter.



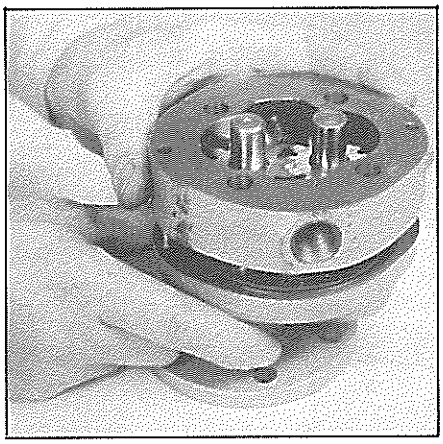
ILLUST. 19



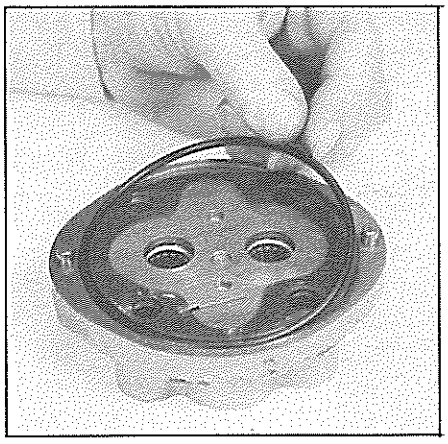
ILLUST. 20



ILLUST. 21

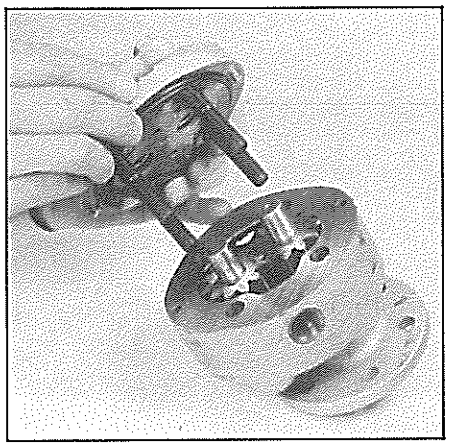


ILLUST. 22

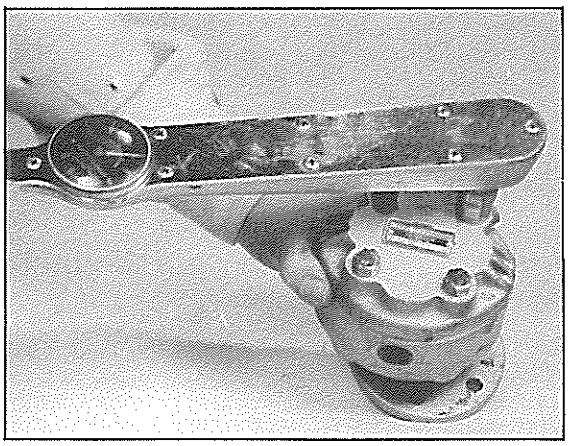


ILLUST. 23

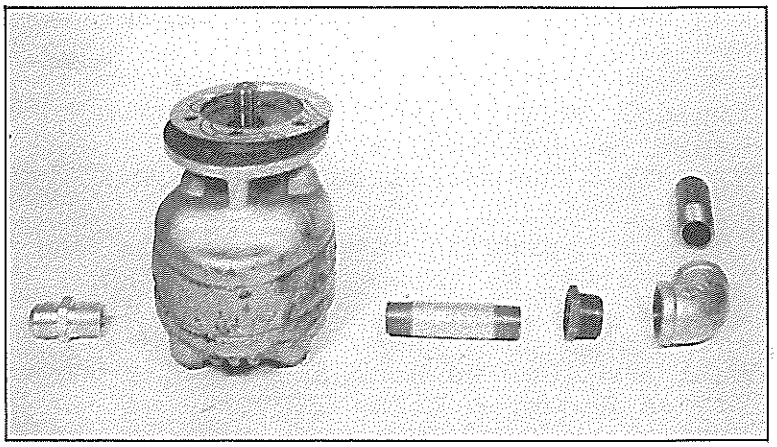
Install wear plate to cover with the relief pocket side toward gears, as shown in Illust. 23. Next, install gasket shim which was determined to be used between cover and housing, as indicated with arrow in illustration. Install "O" ring between wear plate and cover, as shown in Illust. 23. Lubricate the face of the wear plate with clean oil. Install four cap screws with lock washers into cover and install cover onto housing, as shown in Illust. 24. Be sure to align punch marks in cover with those in housing gradually tighten opposite cap screws. Torque cap screws to a reading of 60 foot pounds, as shown in Illust. 25. After the hydraulic pump assembly has been completed, turn the shaft. Shaft should turn with a slight drag. If shaft is too tight or too free, add or remove as many shims as necessary.



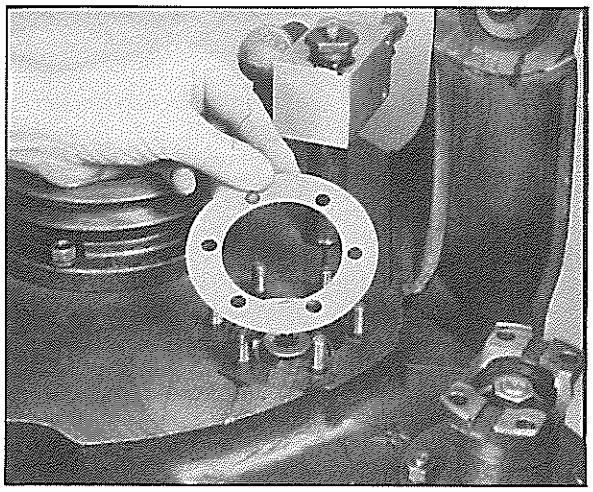
ILLUST. 24



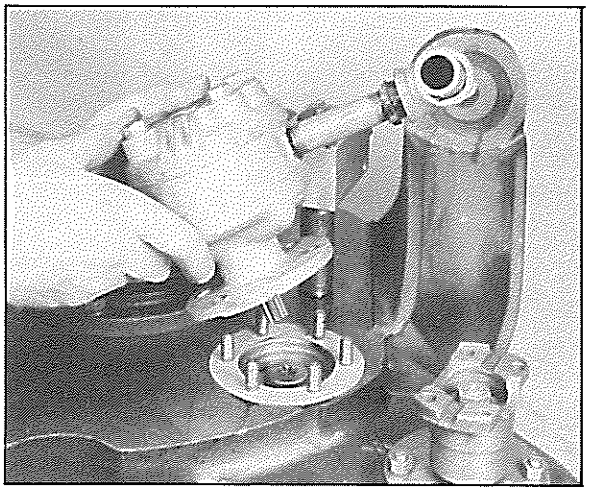
ILLUST. 25



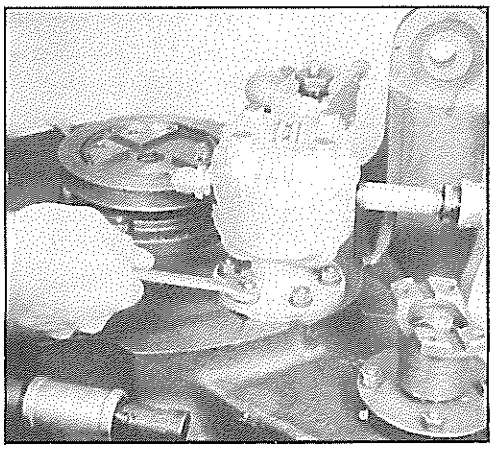
ILLUST. 26



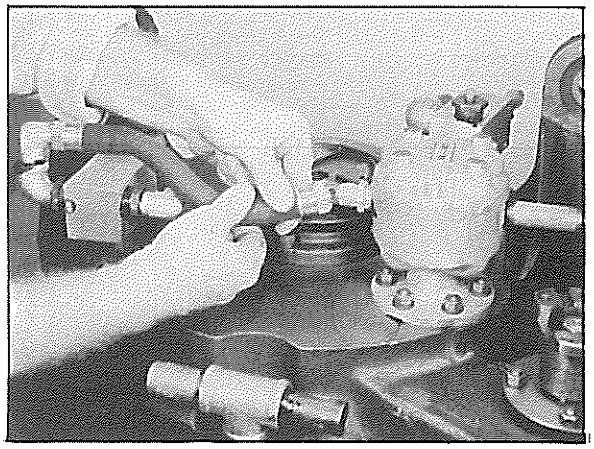
ILLUST. 27



ILLUST. 28



ILLUST. 29

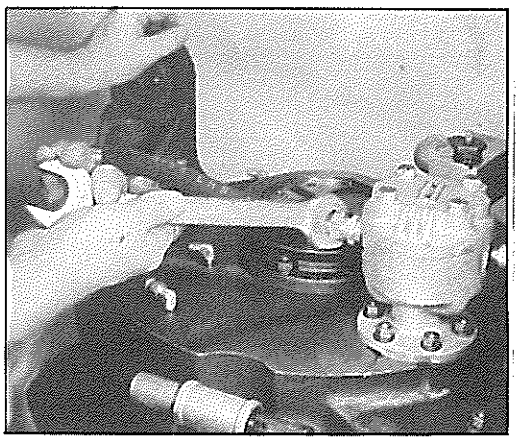


ILLUST. 30

Install pipe fittings into pump housing, as shown in Illust. 26. Apply pipe sealing compound to all threads before installing.

Install gasket over studs and onto torque converter housing, as shown in Illust. 27. Shellac gasket to housing.

Install hydraulic pump over studs and onto housing, as shown in Illust. 28. Splines on shaft of pump to fit into splines in pump gear. Next, install stud nuts and lock washers and tighten securely, as shown in Illust. 29.

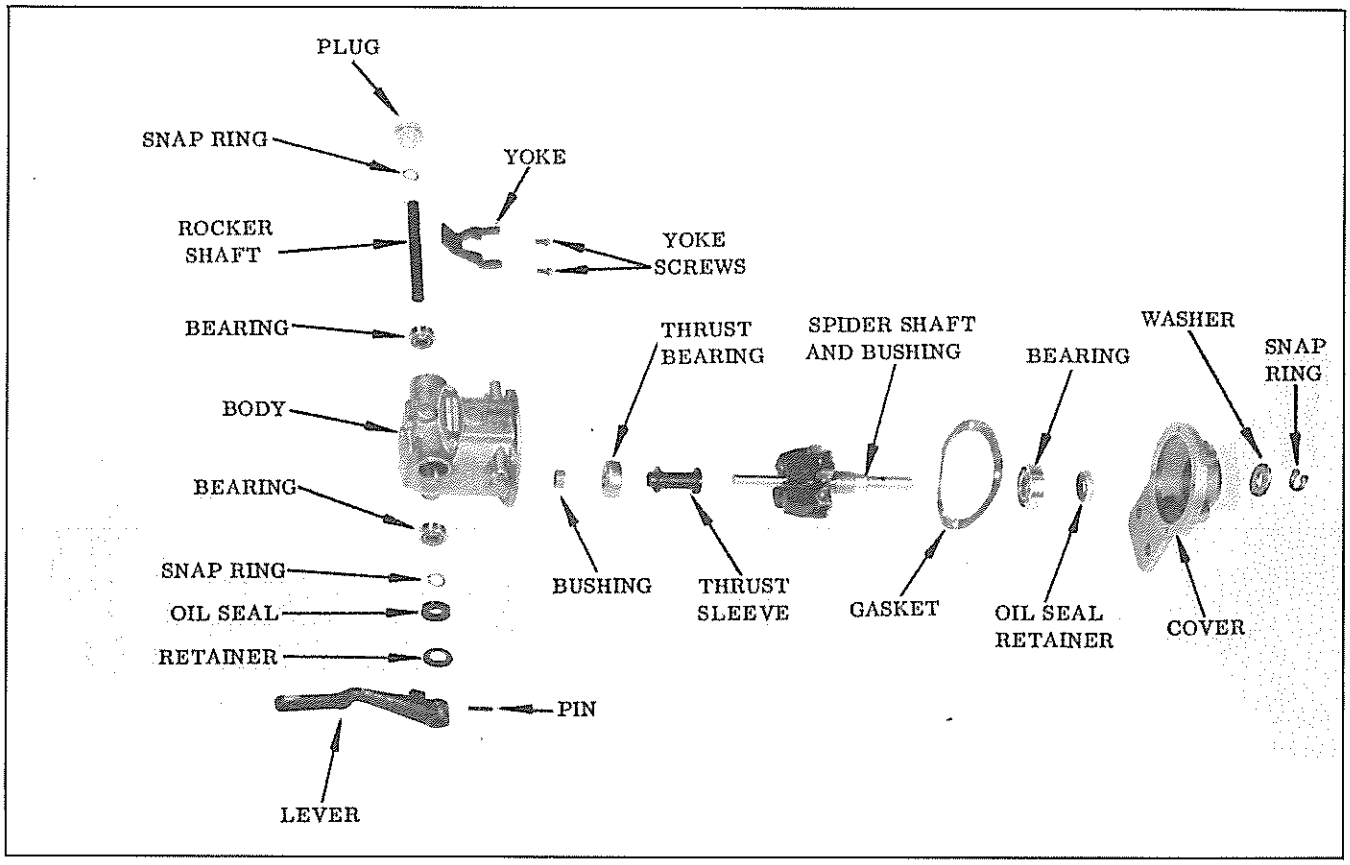


ILLUST. 31

Install hose from relief valve to pump,

as shown in Illust. 30. Tighten hose fitting securely, as shown in Illust. 31.

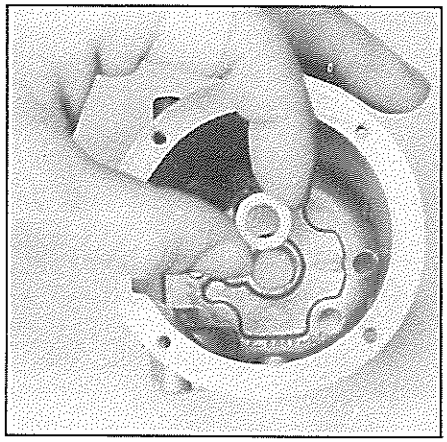
TAIL SHAFT GOVERNOR (CUMMINS)



ILLUST. 1

Illust. 1 is an exploded view of governor.

Install bushing into housing, as shown in Illust. 2.

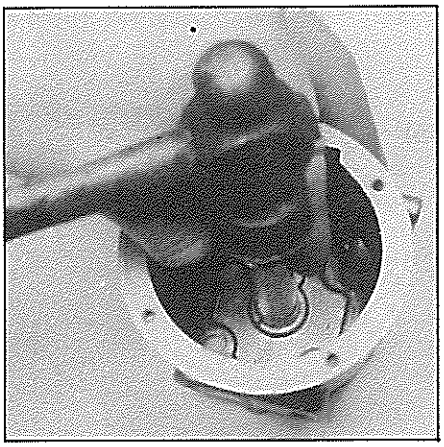


ILLUST. 2

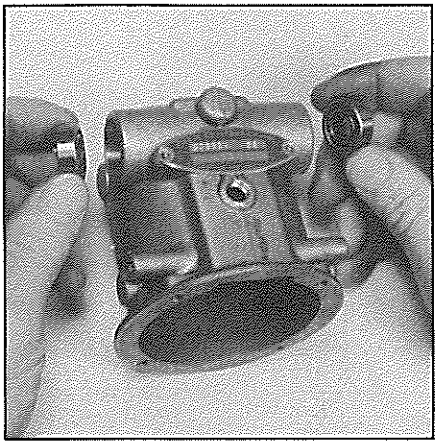
Tap bushing into housing bore, as shown in Illust. 3. Note: Use care to prevent damage to housing.

Install bearings into cross bore of housing, as shown in Illust. 4. Note: No tools are necessary to install these bearings.

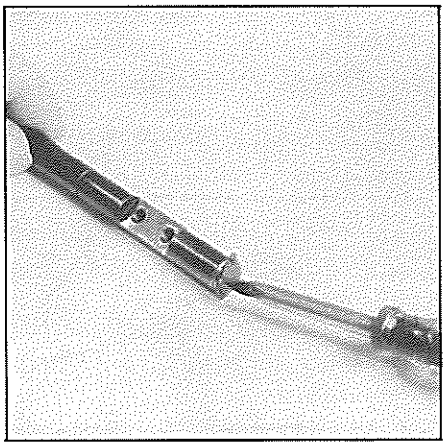
Install snap ring into groove in end of rockshaft, as shown in Illust. 5.



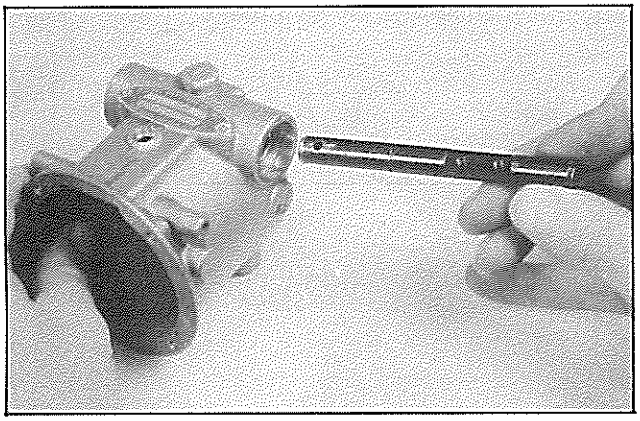
ILLUST. 3



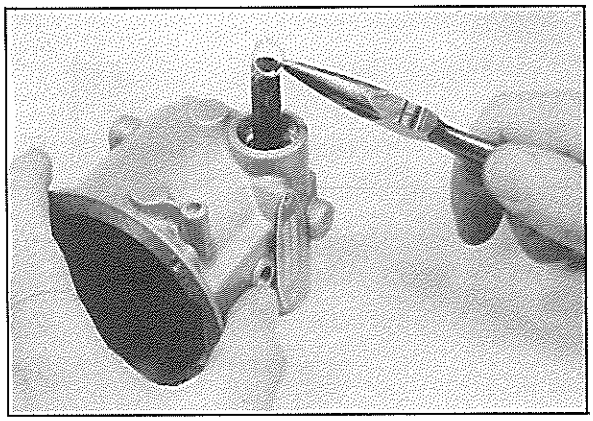
ILLUST. 4



ILLUST. 5

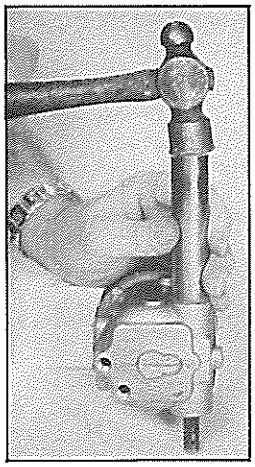


ILLUST. 6

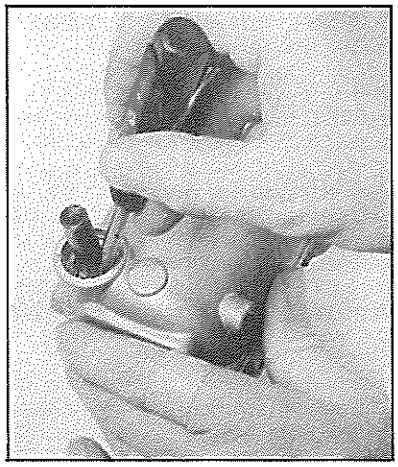


ILLUST. 7

Install rocker shaft into cross bore bearings, as shown in Illust. 6.



ILLUST. 8



ILLUST. 9

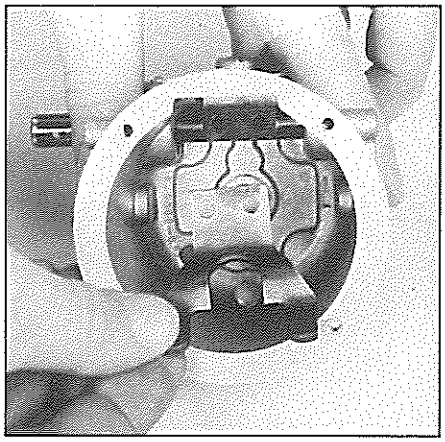
Install second snap ring over end of rocker shaft, as shown in Illust. 7.

Install snap ring into groove in rocker shaft, as shown in Illust. 8.

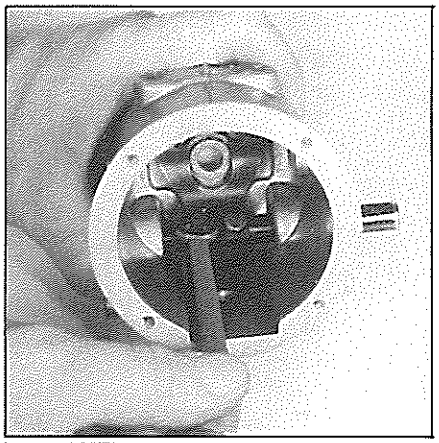
Install rocker shaft cover plug into counterbore of housing, as shown in Illust. 9. Note: Apply sealing compound to plug before assembly.

Install yoke on rocker shaft, as shown in Illust. 10.

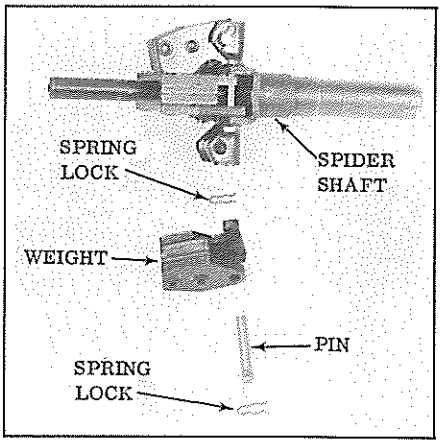
Install yoke bolts and tighten, as shown in Illust. 11.



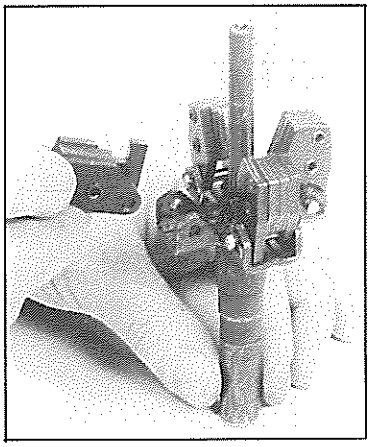
ILLUST. 10



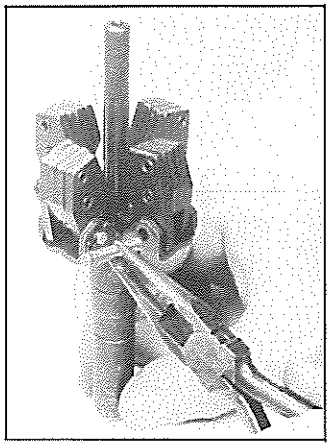
ILLUST. 11



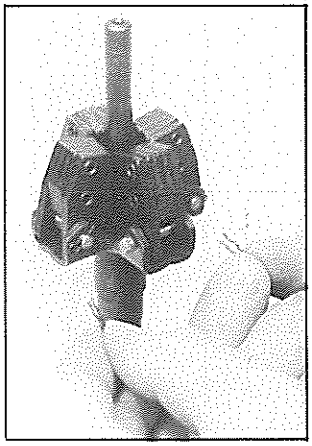
ILLUST. 12



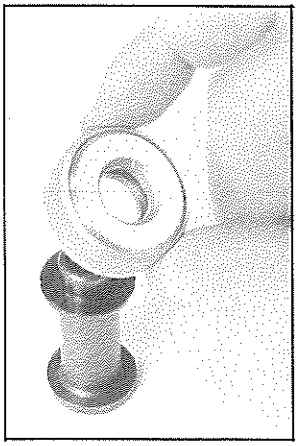
ILLUST. 13



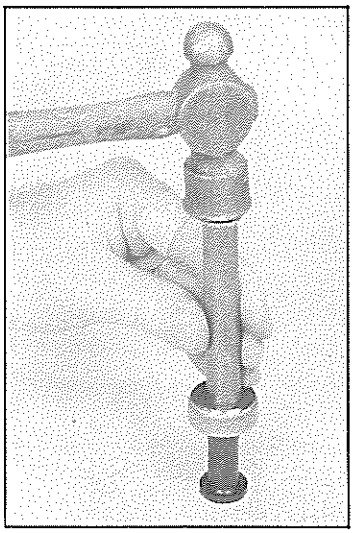
ILLUST. 14



ILLUST. 15



ILLUST. 16



ILLUST. 17

Illust. 12 is an exploded view of spider shaft.

Install centrifugal weights on mounting brackets, as shown in Illust. 13.

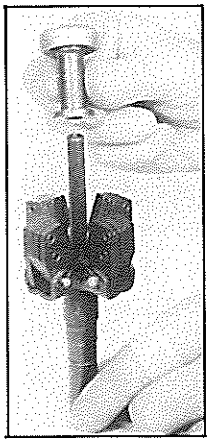
Install pins holding weights in brackets, as shown in Illust. 14.

Install a spring lock in groove at each end of pins, as shown in Illust. 15.

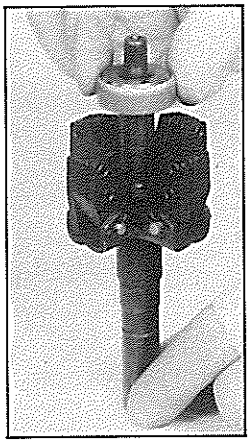
Install thrust bearing on sleeve, as shown in Illust. 16.

Tap thrust bearing into place on sleeve,.as shown in Illust. 17.

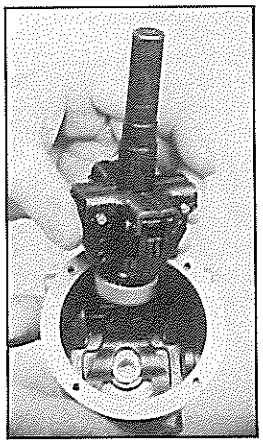
Install thrust bearing and sleeve onto shaft, as



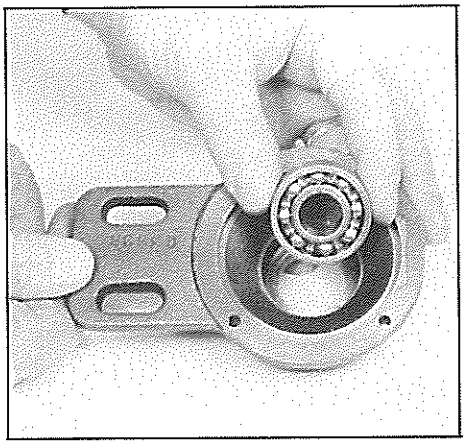
ILLUST. 18



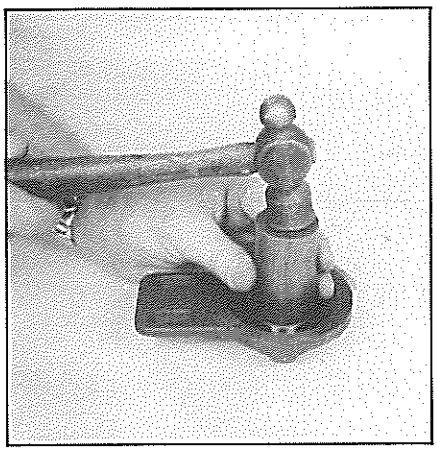
ILLUST. 19



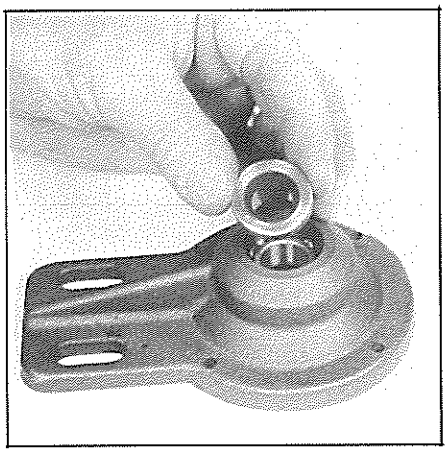
ILLUST. 20



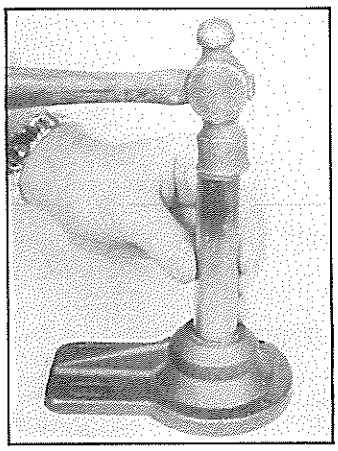
ILLUST. 21



ILLUST. 22



ILLUST. 23



ILLUST. 24

shown in Illust. 18.

Slip thrust bearing and sleeve into contact with centrifugal weights, as shown in Illust. 19.

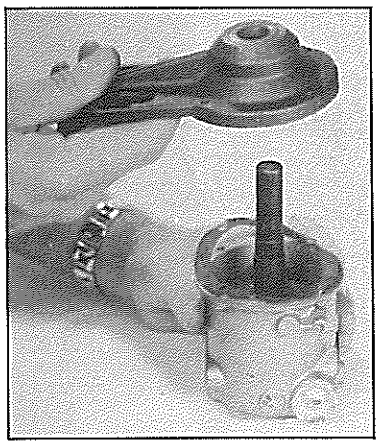
Install spider shaft assembly into governor housing, as shown in Illust. 20.

Install ball bearing into governor housing cover, as shown in Illust. 21.

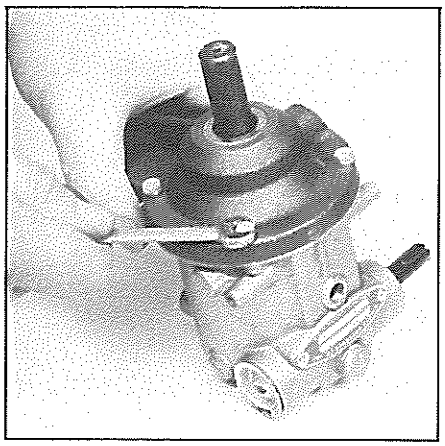
Tap bearing into place, as shown in Illust. 22.

Install grease seal into housing cover, as shown in Illust. 23.

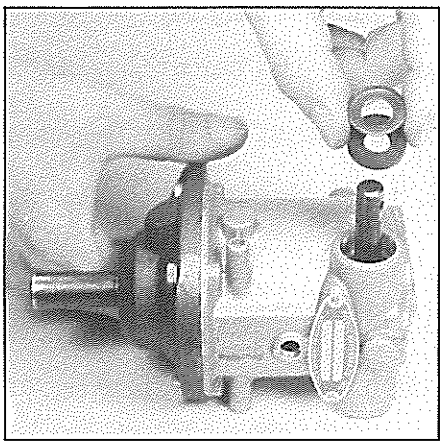
Drive grease seal into position, as shown in Illust. 24.



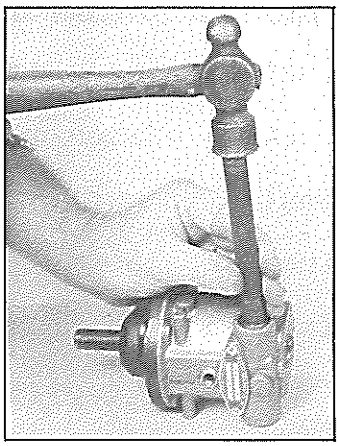
ILLUST. 25



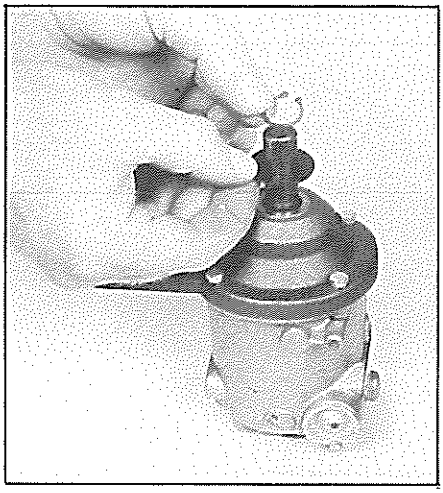
ILLUST. 26



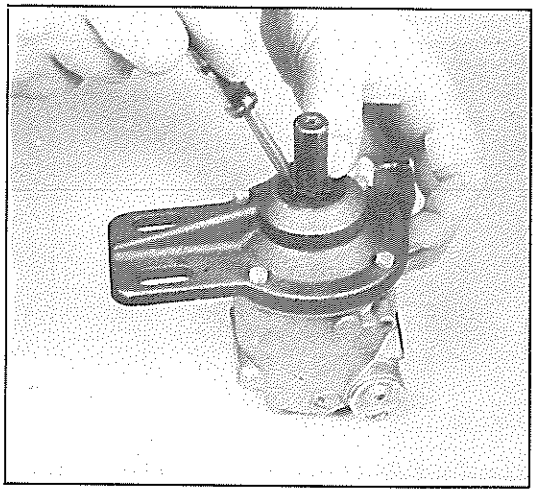
ILLUST. 27



ILLUST. 28



ILLUST. 29



ILLUST. 30

Install cover gasket onto face of governor housing. Apply oil to grease seal in cover and install cover over spider shaft, as shown in Illust. 25.

Install and tighten machine screws and lock washers in cover, as shown in Illust. 26.

Install seal and retainer washer over rocker shaft, as shown in Illust. 27.

Tap retainer washer into place, as shown in Illust. 28.

Install washer and snap ring over end of shaft, as shown in Illust.29.

Install snap ring in groove, as shown in Illust. 30.

Tail Shaft Governor Linkage (Cummins Engine)

Install snap ring in groove in throttle shaft, as shown in Illust. 1.

Install washer or throttle shaft, as shown in Illust. 2.

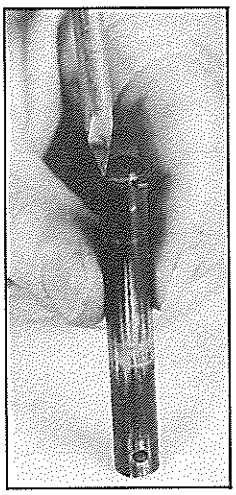
Install throttle shaft into cast bracket, as shown in Illust. 3.

Install snap ring over end of throttle shaft, as shown in Illust. 4.

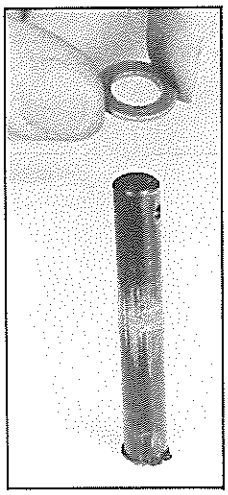
Install snap ring into groove, as shown in Illust. 5.

Install bracket and shaft onto governor housing, as shown in Illust. 6.

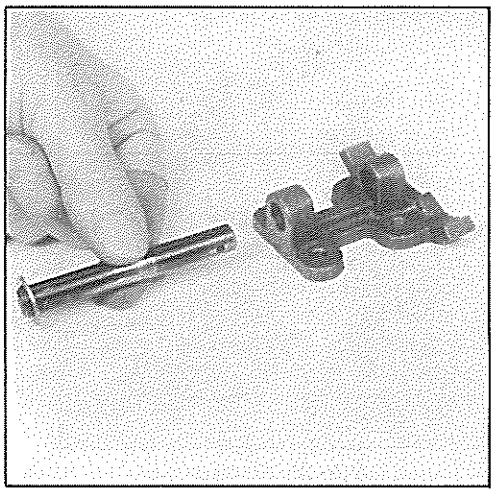
Install hollow head cap screws with lock washers and bolt bracket securely to governor housing, as shown in Illust. 7.



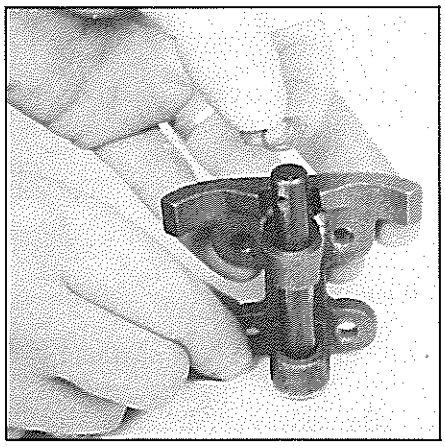
ILLUST. 1



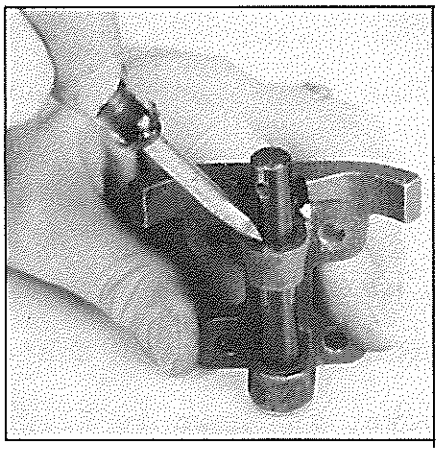
ILLUST. 2



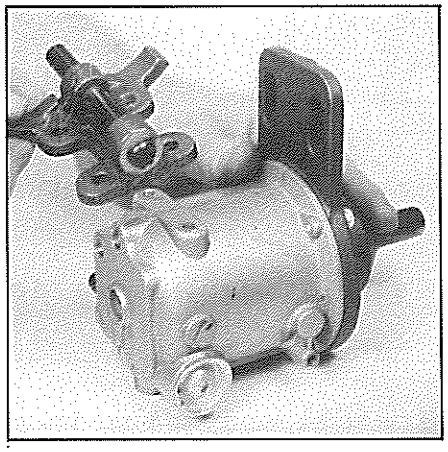
ILLUST. 3



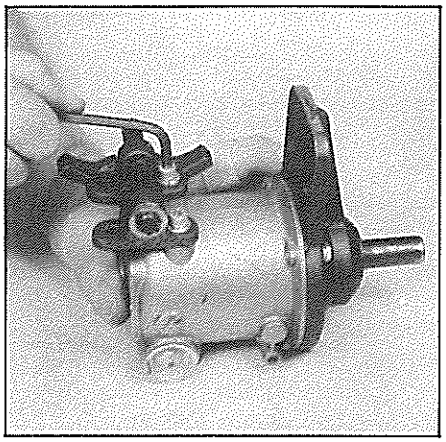
ILLUST. 4



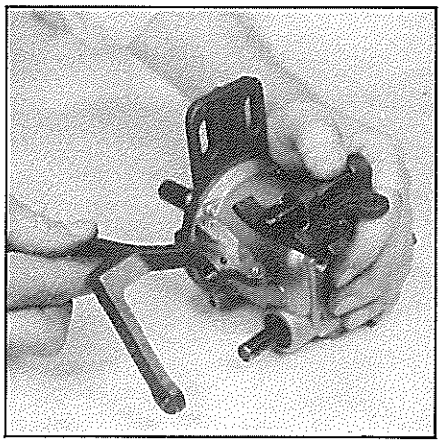
ILLUST. 5



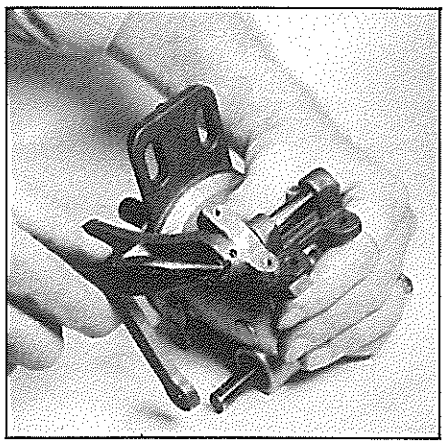
ILLUST. 6



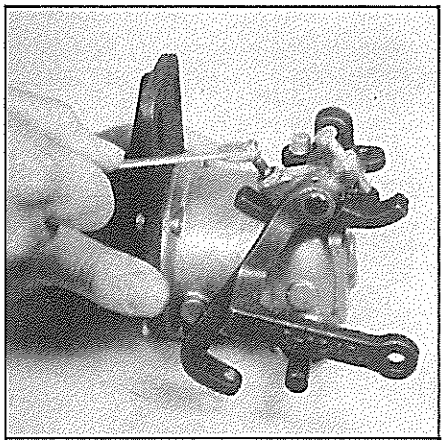
ILLUST. 7



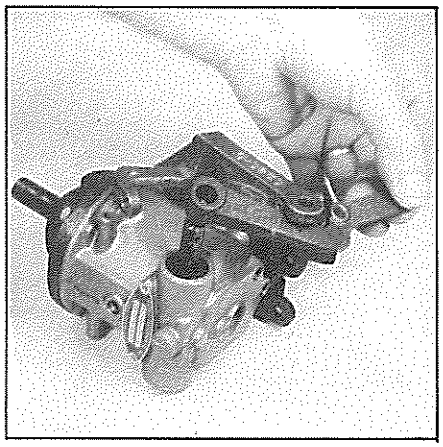
ILLUST. 8



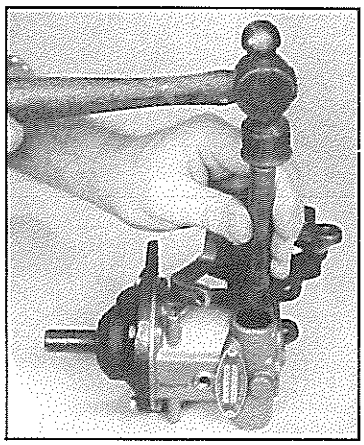
ILLUST. 9



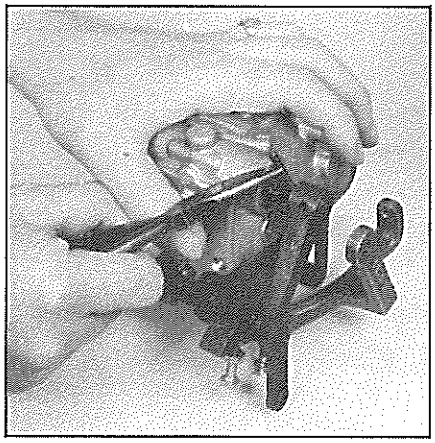
ILLUST. 10



ILLUST. 11



ILLUST. 12



ILLUST. 13

Install throttle lever onto shaft, as shown in Illust. 8.

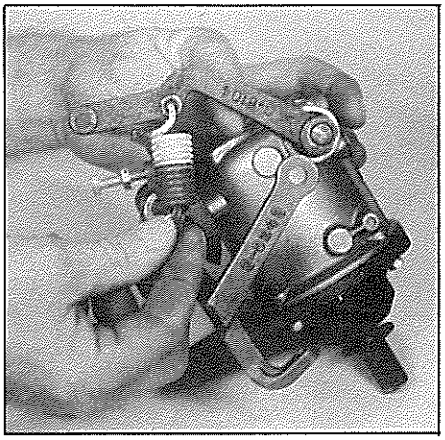
Install pin attaching lever to shaft, as shown in Illust. 9. Drive pin flush with lever hub.

Install throttle stop adjusting bolts with jam nuts, as shown in Illust. 10. Do not tighten nuts.

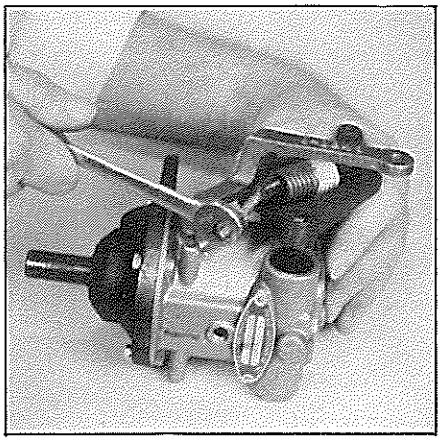
Install governor lever onto rocker shaft, as shown in Illust. 11.

Locate governor lever on rocker shaft to line up hole for pin, as shown in Illust. 12.

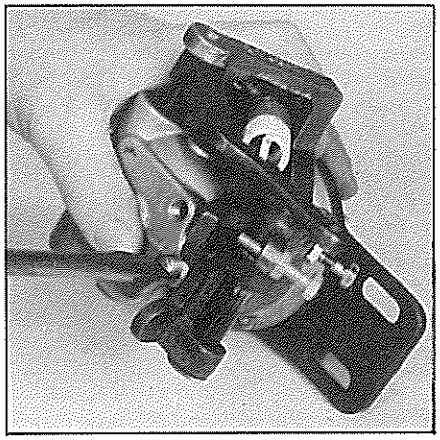
Install pin attaching governor lever to rocker shaft, as shown in Illust. 13.



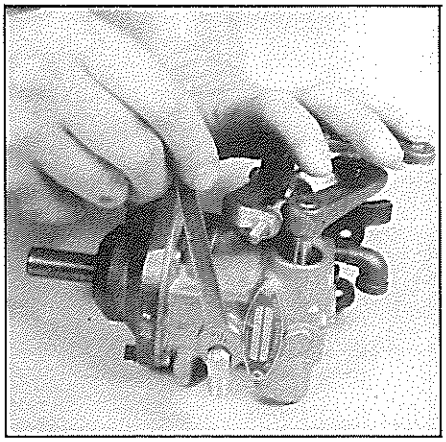
ILLUST. 14



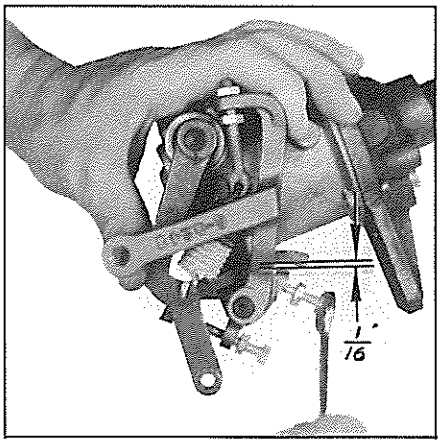
ILLUST. 15



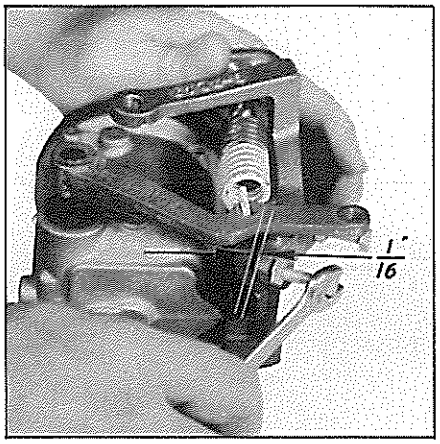
ILLUST. 16



ILLUST. 17



ILLUST. 18



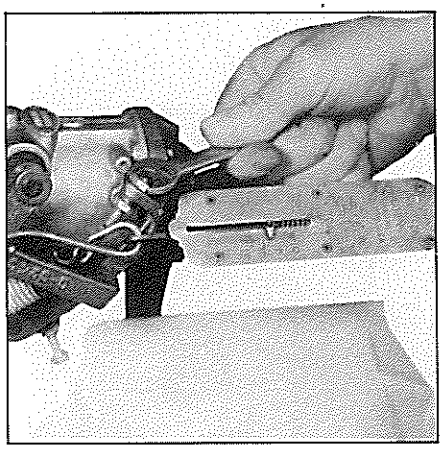
ILLUST. 19

Install one end of spring into hole in governor lever, as shown in Illust. 14.

Install eye bolt with nut on end of spring. Place end of eye bolt thru hole in throttle lever and add nut, as shown in Illust. 15. Do not tighten nut.

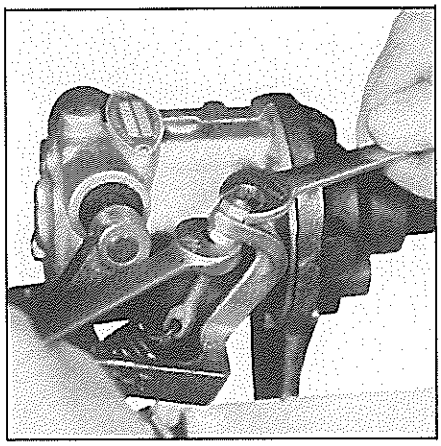
Install plug in governor housing, as shown in Illust. 16. Note: Apply sealing compound to plug before assembling.

Install a 90 degree street ell and a 90 degree flare type elbow in the governor housing, as shown in Illust. 17.

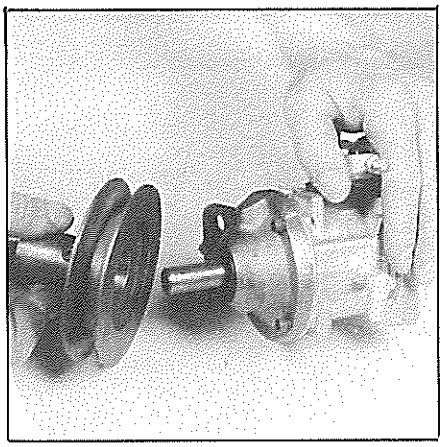


ILLUST. 20

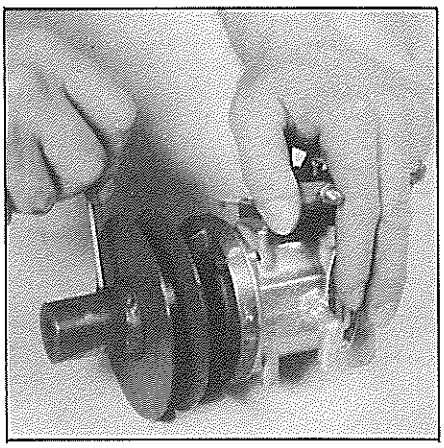
To adjust tail shaft governor, adjust speed change lever set screw to a 1/16" dimension between bracket and lever, as shown in Illust. 18 and 19. When this dimension is obtained, tight-



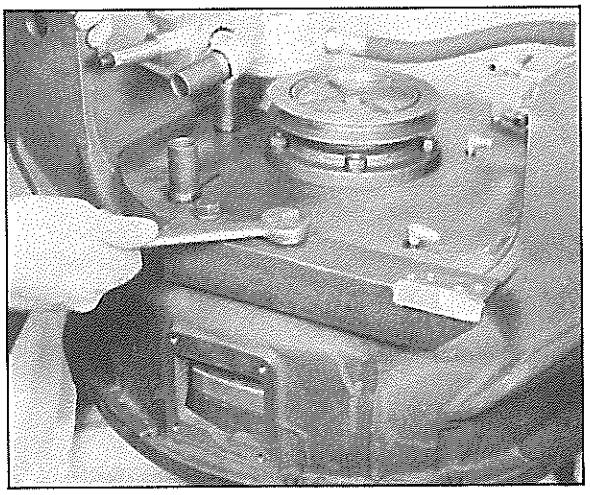
ILLUST. 21



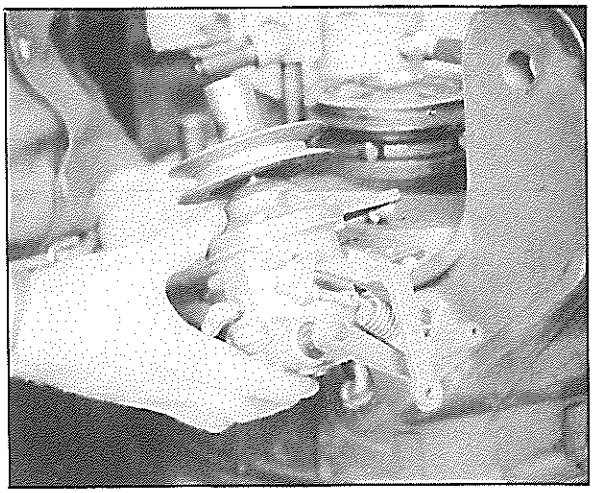
ILLUST. 22



ILLUST. 23



ILLUST. 24



ILLUST. 25

en set screw jam nuts.

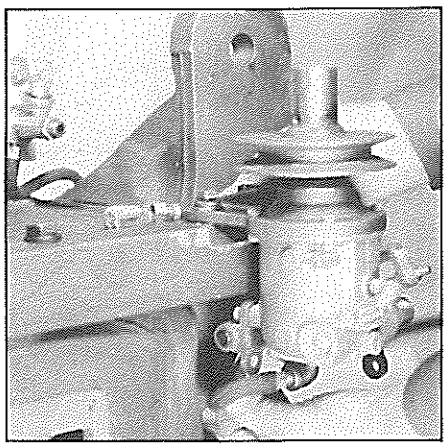
Adjust spring by tightening or loosening nuts on eye bolt until a pull poundage of 9 pounds is obtained, as shown in Illust. 20. When this pull poundage is obtained, tighten nuts securely, as shown in Illust. 21.

This tail shaft governor adjustment is merely a preliminary adjustment. Additional adjustments will be necessary when setting engine speed.

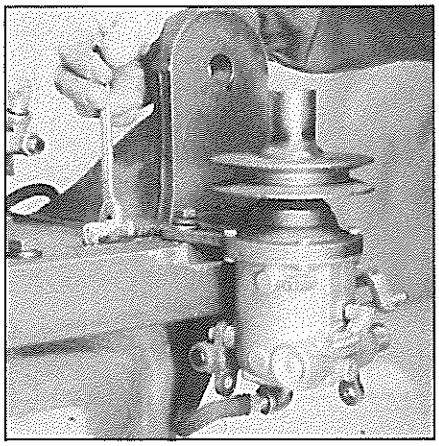
Install "V" belt pulley on governor shaft, as shown in Illust. 22. Tighten set screws, as shown in Illust. 23.

Install governor mounting angle on converter housing, as shown in Illust. 24.

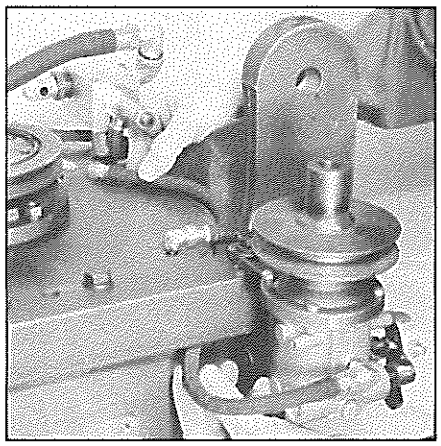
Install governor on mounting angle, as shown in Illust. 25. Use cut washers over slotted holes in governor, then install lock washers and



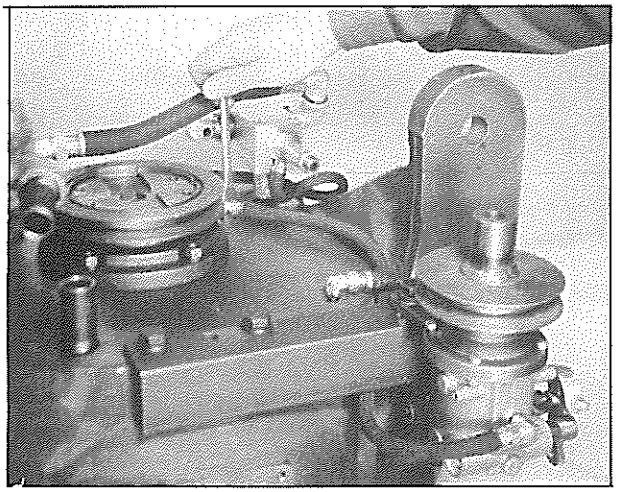
ILLUST. 26



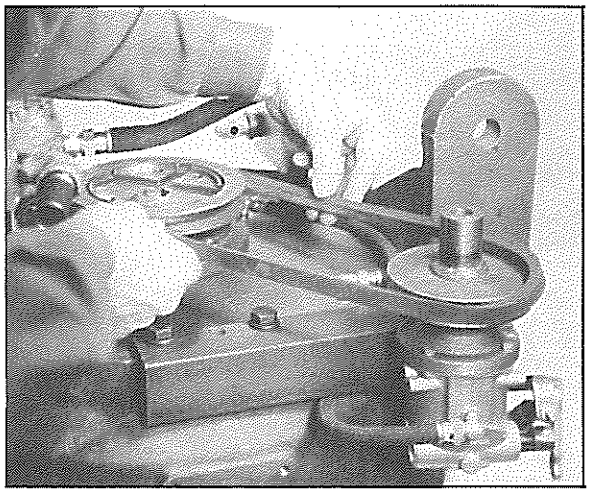
ILLUST. 27



ILLUST. 28



ILLUST. 29



ILLUST. 30

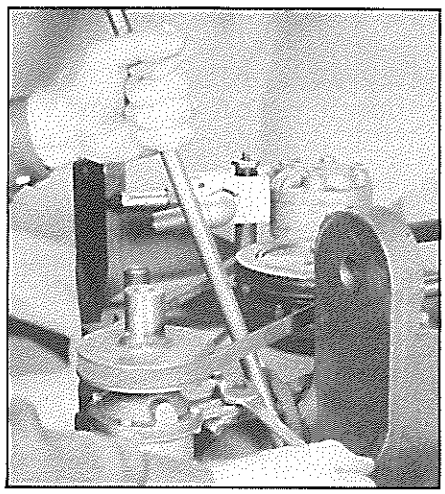
cap screws. Do not tighten cap screws.

Install flexible oil hose into street ell in governor housing, as shown in Illust. 26. Tighten this fitting before attaching other end of hose. Note: It is not necessary to use sealer compound on threads.

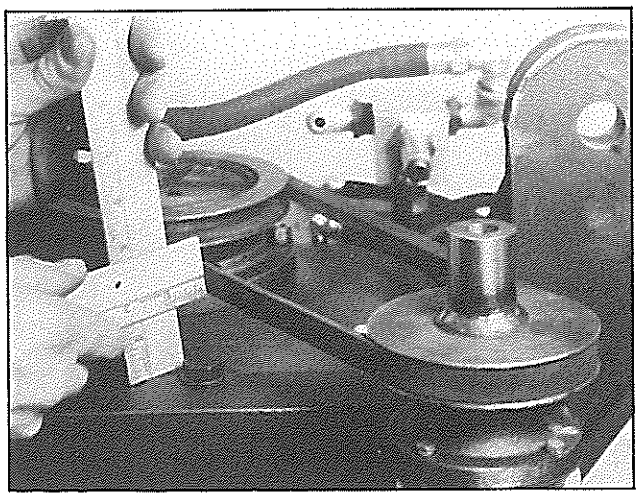
Install flexible oil hose from governor to converter housing, as shown in Illust. 27. Attach the swivel type hose fitting to the flare type elbow and tighten.

Install flexible oil hose onto flare type elbow in governor, as shown in Illust. 28.

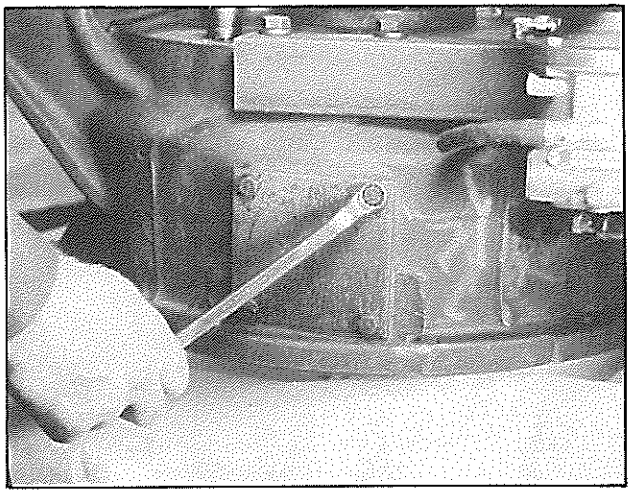
Tighten hose fittings, as shown in Illust. 29.



ILLUST. 31



ILLUST. 32



ILLUST. 33

Note: Fittings on both ends of this hose are of the swivel type and either may be tightened first.

Install "V" belt over converter and governor pulleys, as shown in Illust. 30.

Move governor to establish belt tightness, as shown in Illust. 31.

Adjust belt tightness to provide 3/4 inch of slack at a point halfway between the two pulleys, as shown in Illust. 32.

Install cover plate and gasket on converter housing, as shown in Illust. 33.

TAIL SHAFT GOVERNOR (GENERAL MOTORS ENGINE)

Illust. 1 is an exploded view of governor.

Install bushing into housing, as shown in Illust. 2.

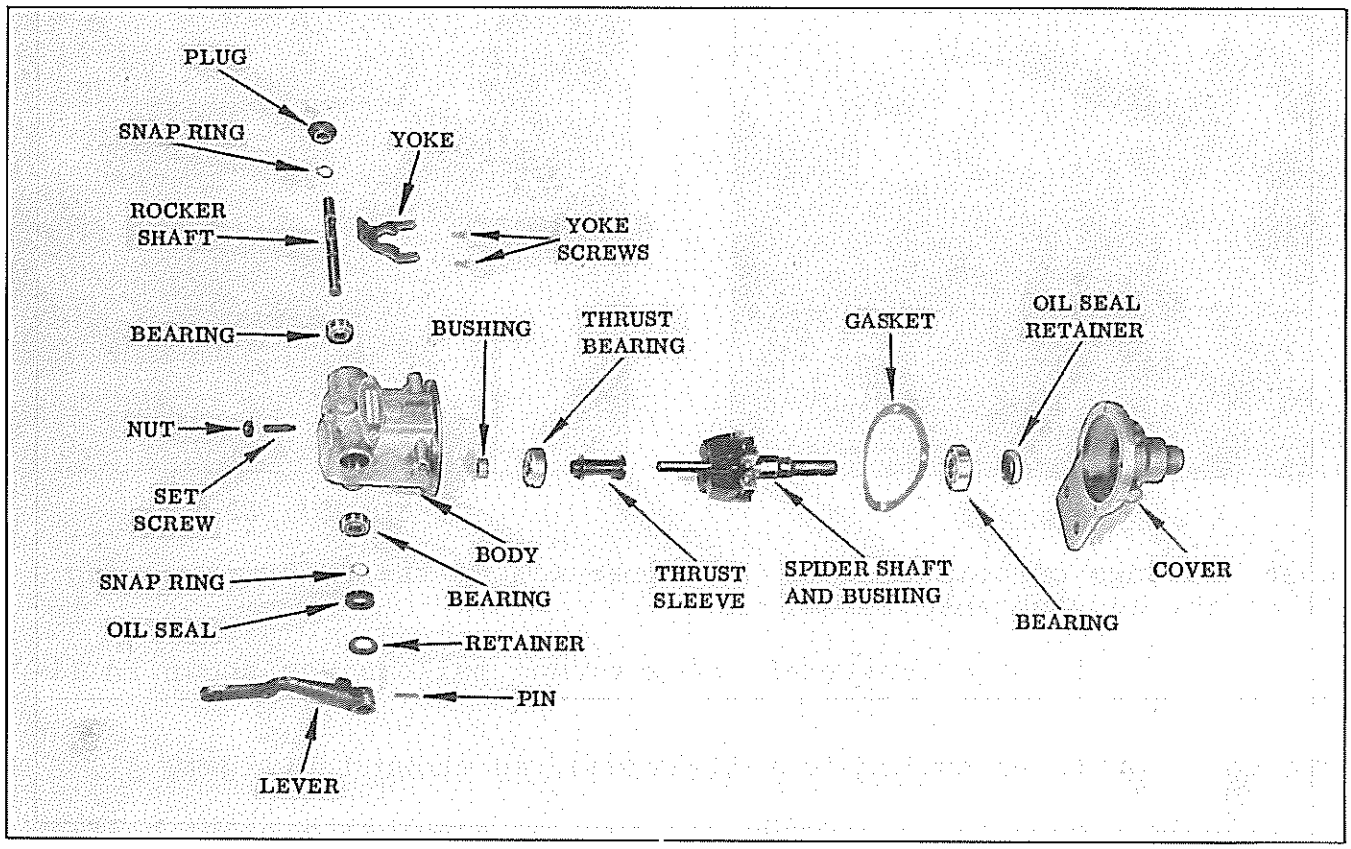
Tap bushing into housing bore, as shown in Illust. 3. Note: Use care to prevent damage to housing.

Install bearings into cross bore of housing, as shown in Illust. 4. Note: No tools are necessary to install these bearings.

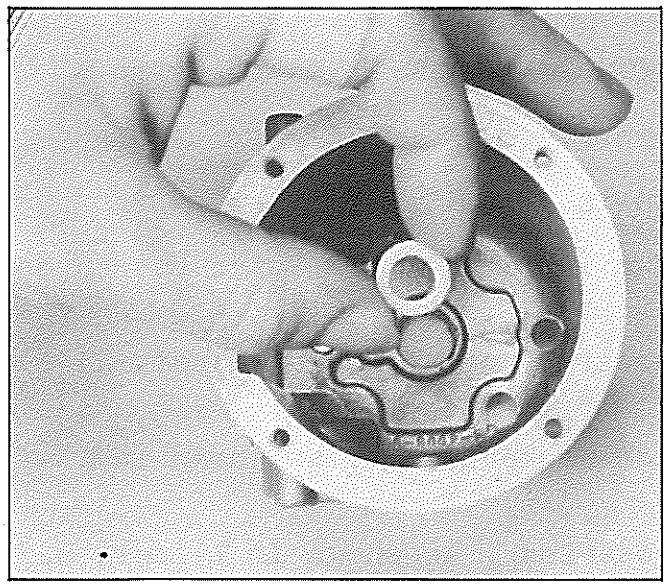
Install snap ring into groove in end of rocker shaft, as shown in Illust. 5.

Install rocker shaft into cross bore bearings, as shown in Illust. 6.

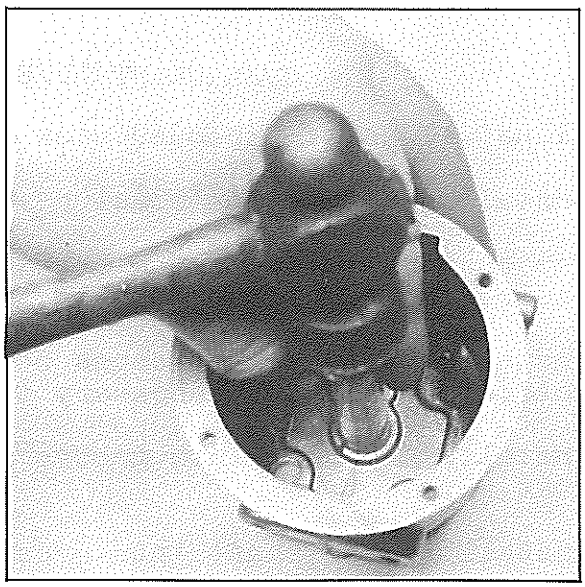
Install second snap ring over end of rocker shaft, as shown in Illust. 7.



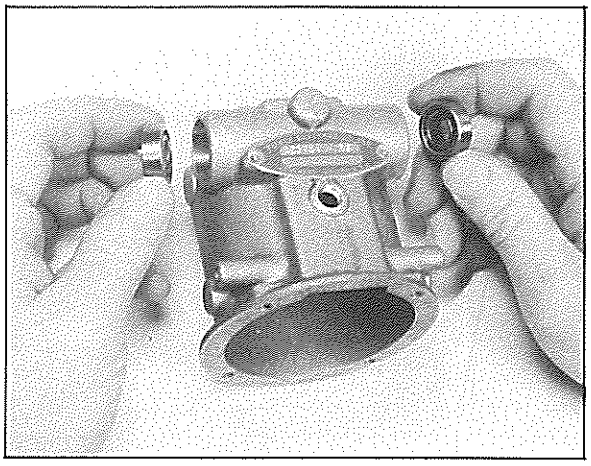
ILLUST. 1



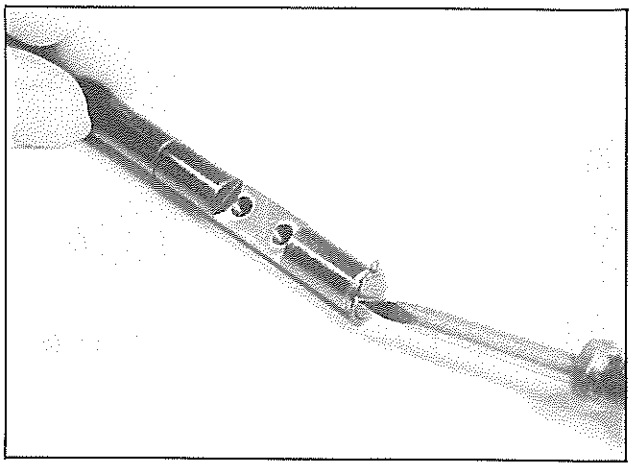
ILLUST. 2



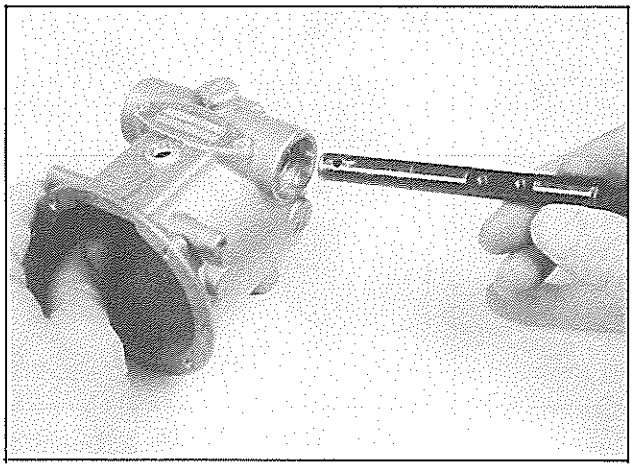
ILLUST. 3



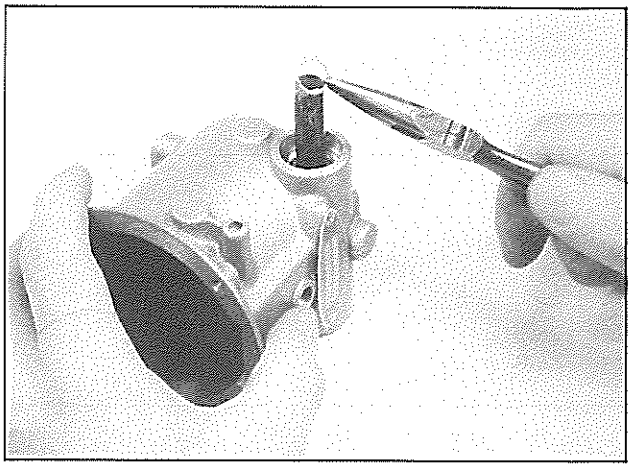
ILLUST. 4



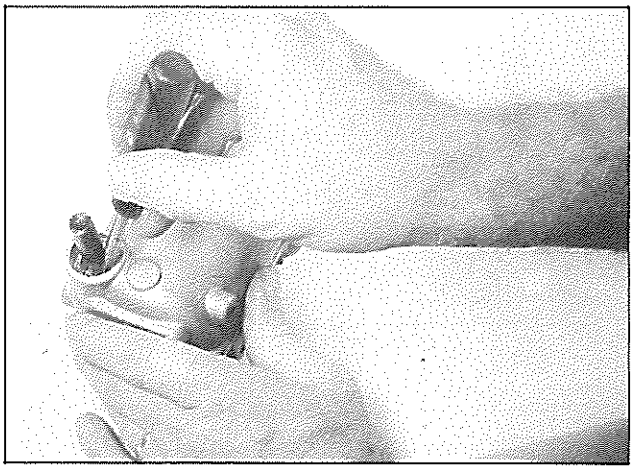
ILLUST. 5



ILLUST. 6



ILLUST. 7



ILLUST. 8

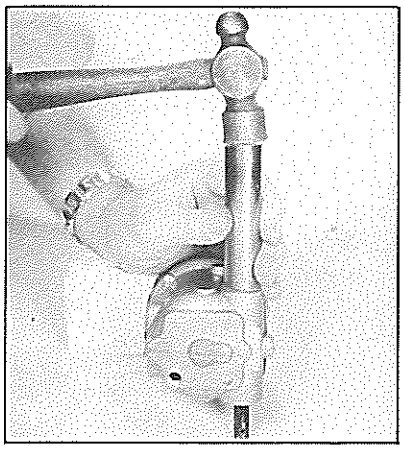
Install snap ring into groove in rocker shaft, as shown in Illust. 8.

Install rocker shaft cover plug into counter bore in housing, as shown in Illust. 9. Note: Apply sealing compound to plug before assembly.

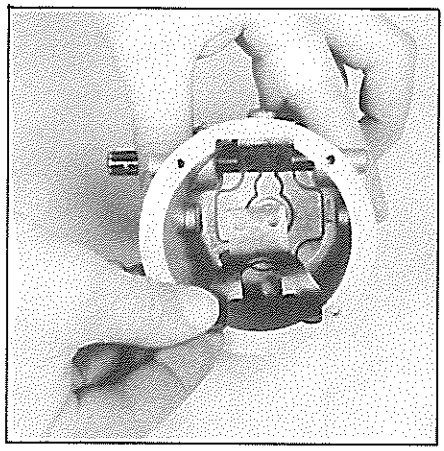
Install yoke on rocker shaft, as shown in Illust. 10.

Install yoke bolts and tighten, as shown in Illust. 11.

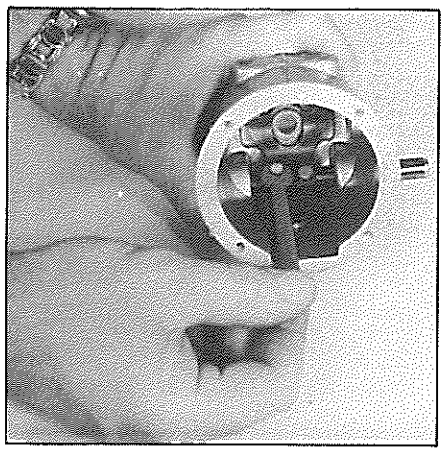
Illust. 12 is an exploded view of spider shaft.



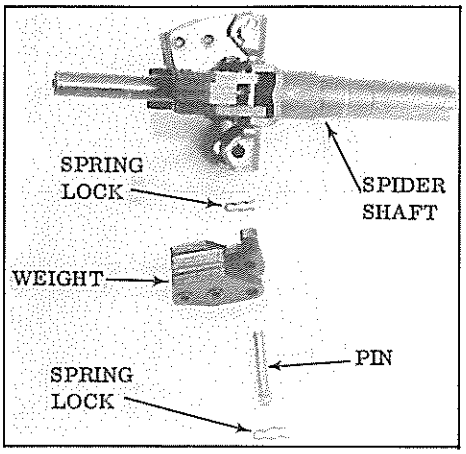
ILLUST. 9



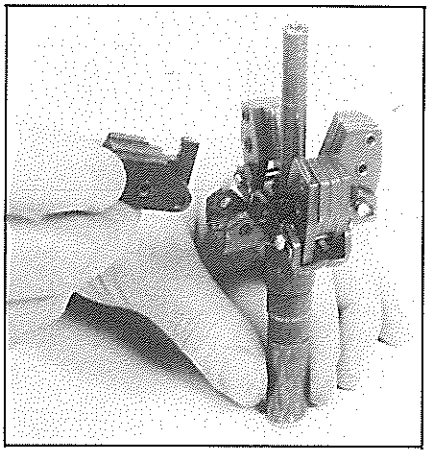
ILLUST. 10



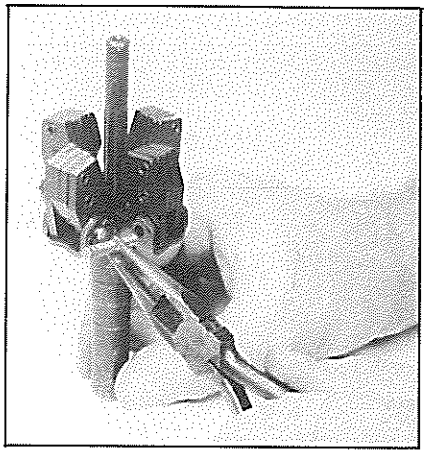
ILLUST. 11



ILLUST. 12



ILLUST. 13



ILLUST. 14

Install centrifugal weights on mounting brackets, as shown in Illust. 13.

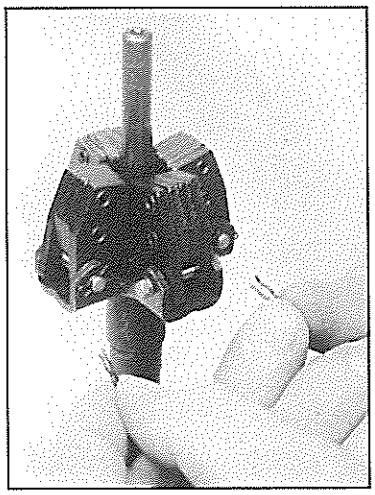
Install pins holding weights in brackets, as shown in Illust. 14.

Install a spring lock in groove at each end of pins, as shown in Illust. 15.

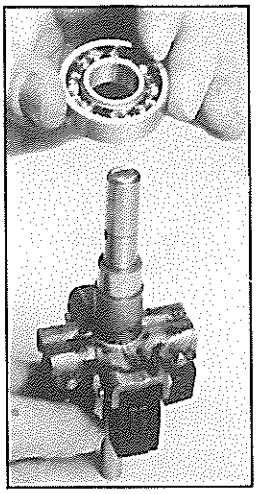
Install ball bearing on shaft, as shown in Illust. 16.

Tap bearing into place on shaft, as shown in Illust. 17.

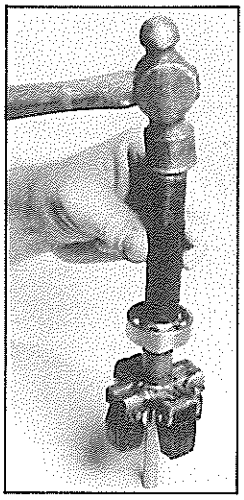
Install thrust bearing on sleeve, as shown in Illust. 18.



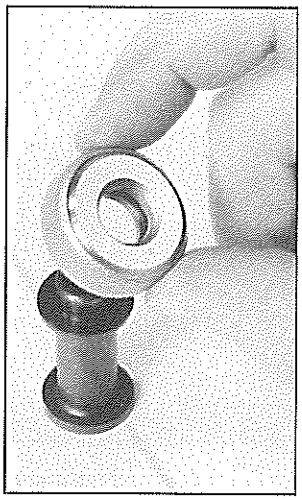
ILLUST. 15



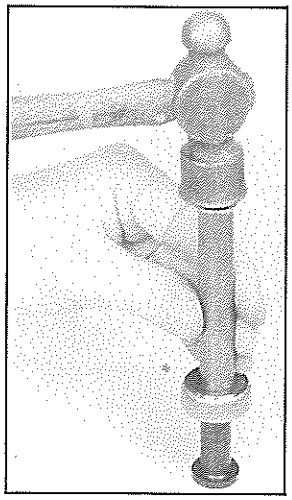
ILLUST. 16



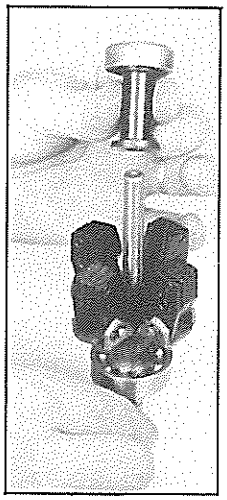
ILLUST. 17



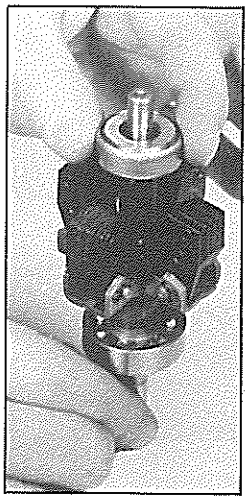
ILLUST. 18



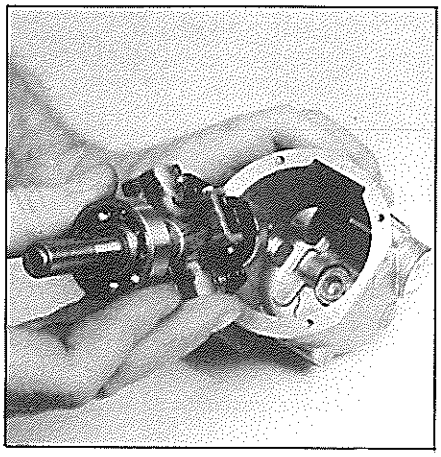
ILLUST. 19



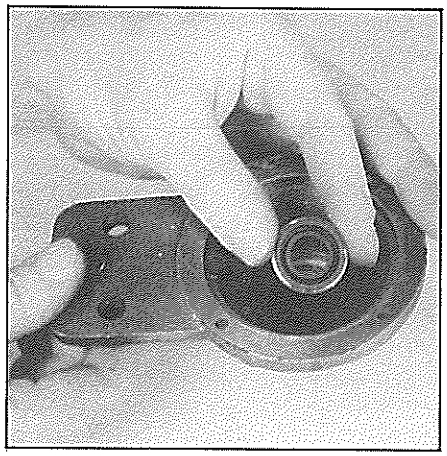
ILLUST. 20



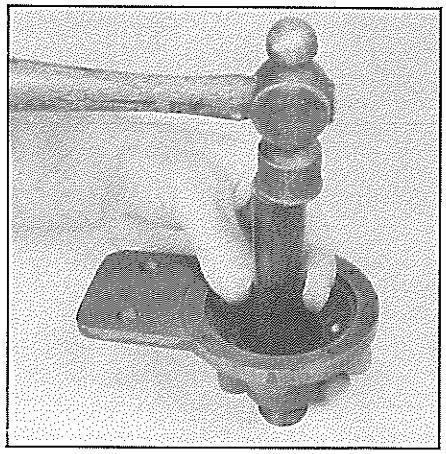
ILLUST. 21



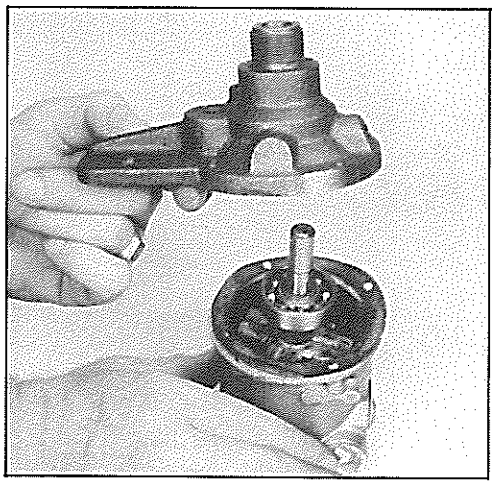
ILLUST. 22



ILLUST. 23



ILLUST. 24



ILLUST. 25

Tap thrust bearing into place on sleeve, as shown in Illust. 19.

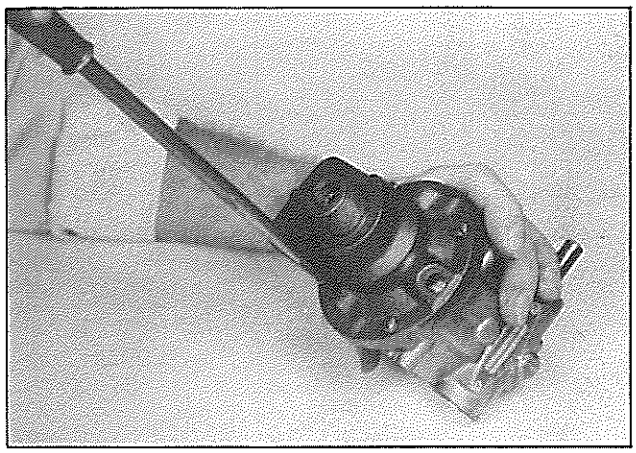
Install thrust bearing and sleeve onto shaft, as shown in Illust. 20.

Install thrust bearing and sleeve into contact with centrifugal weights, as shown in Illust. 21.

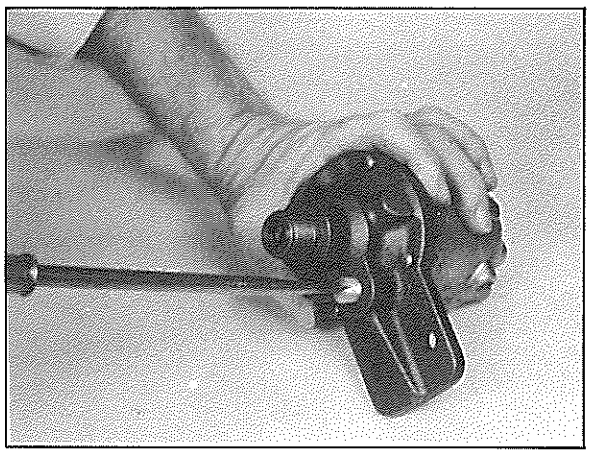
Install spider shaft assembly into governor housing, as shown in Illust. 22.

Install grease seal into governor housing cover, as shown in Illust. 23.

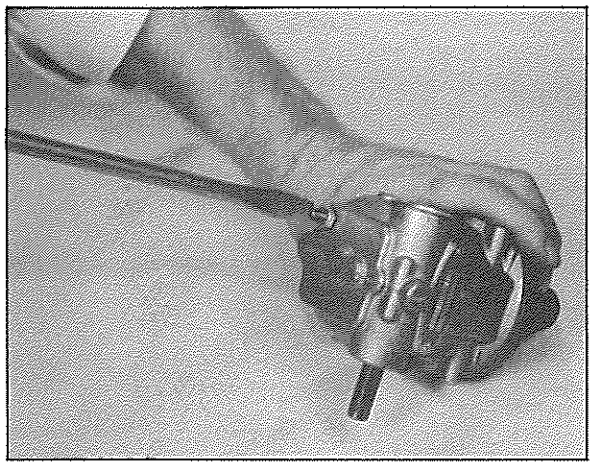
Tap grease seal into place in cover, as



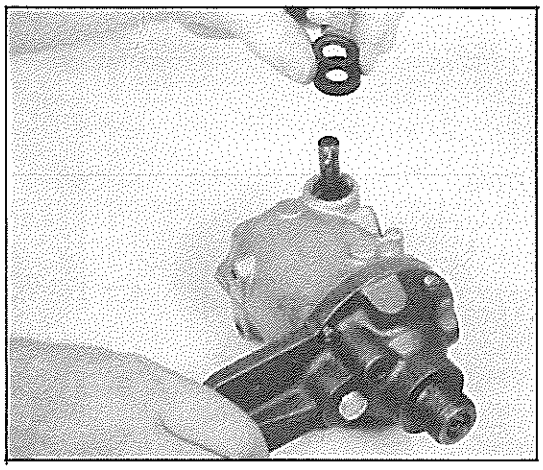
ILLUST. 26



ILLUST. 27



ILLUST. 28



ILLUST. 29

shown in Illust. 24.

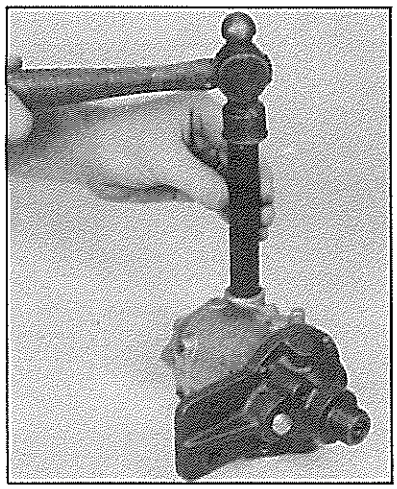
Install cover gasket onto face of governor housing. Apply oil to grease seal in cover and install cover onto housing, as shown in Illust. 25.

Install and tighten machine screws and lock washers in cover, as shown in Illust. 26.

Install and tighten plug in cover, as shown in Illust. 27. Note: Apply sealing compound to threads on plug.

Install yoke adjusting screw and lock nut, as shown in Illust. 28. Note: Do not tighten.

Install seal and retainer washer over rocker shaft, as shown in Illust. 29.



ILLUST. 30

Tap retainer washer into place, as shown in Illust. 30.

Tail Shaft Governor Linkage (General Motors Engine)

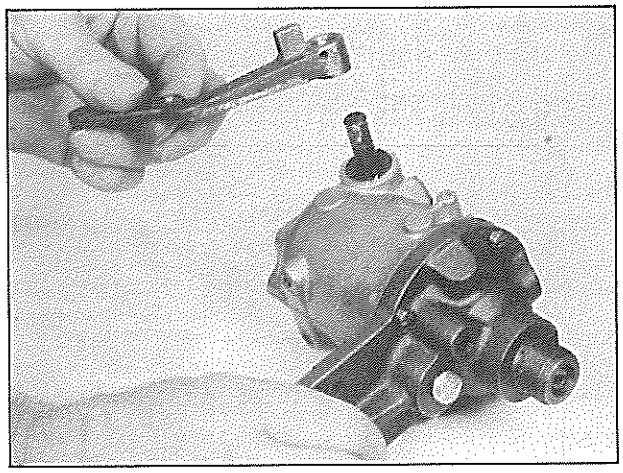
Install lever on rocker shaft, as shown in Illust. 1.

Install pin attaching lever to rocker shaft, as shown in Illust. 2.

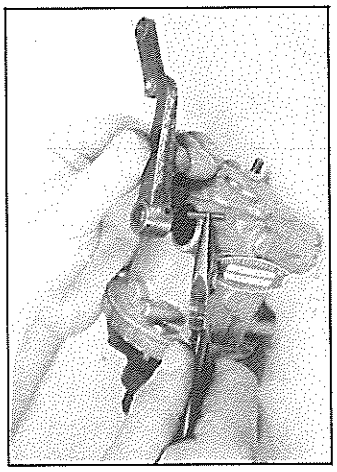
Drive pin flush with lever hub, as shown in Illust. 3.

Place cast bracket on bolting pad on governor housing, as shown in Illust. 4.

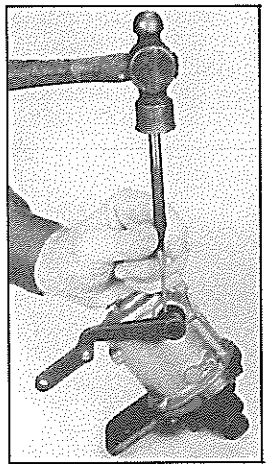
Install two hollow head cap screws with lock washers into cast bracket and tighten securely, as shown in Illust. 5.



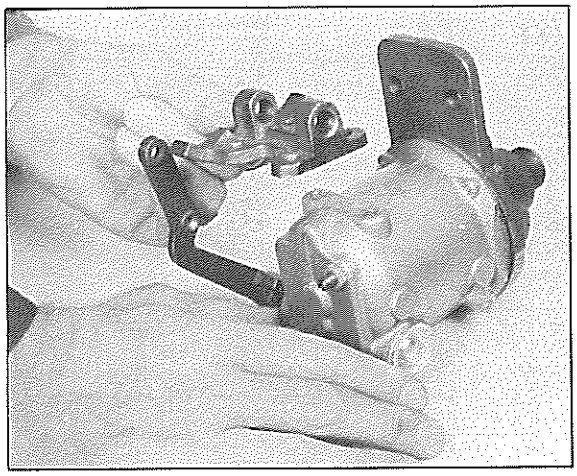
ILLUST. 1



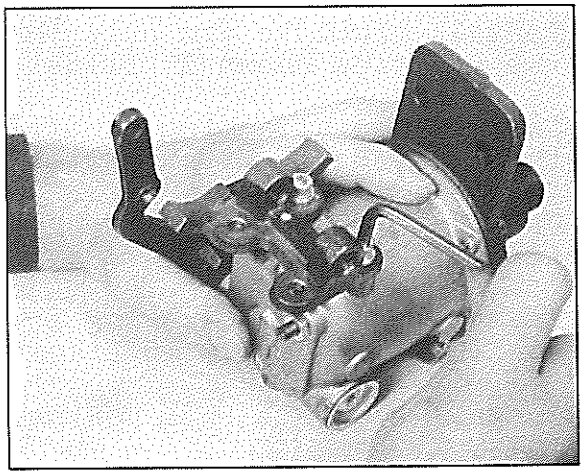
ILLUST. 2



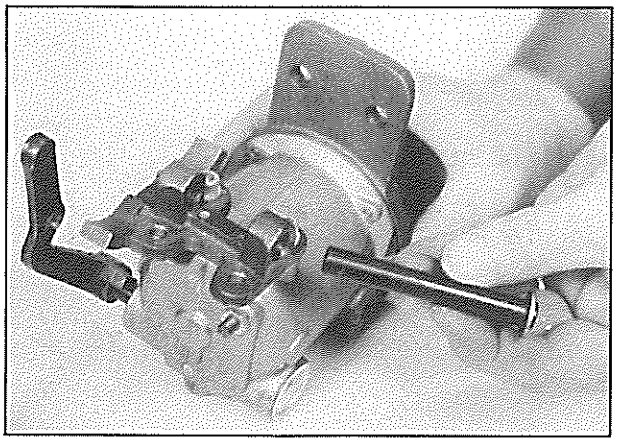
ILLUST. 3



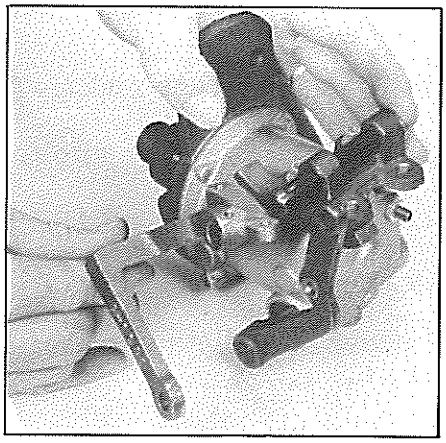
ILLUST. 4



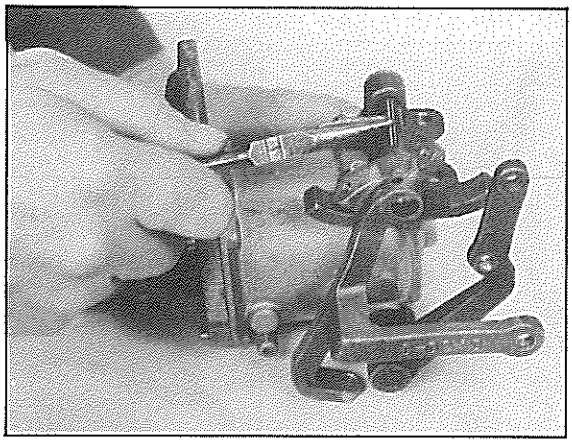
ILLUST. 5



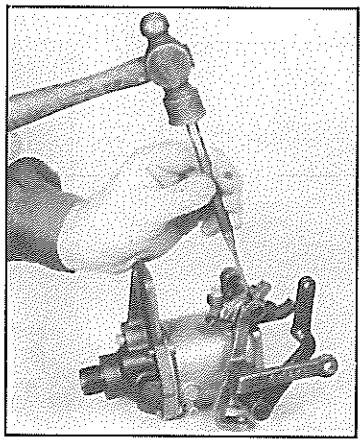
ILLUST. 6



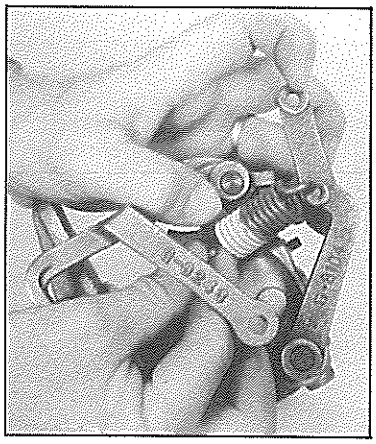
ILLUST. 7



ILLUST. 8



ILLUST. 9



ILLUST. 10

Install snap ring into groove in end of throttle shaft, slip washer onto shaft and install shaft into cast bracket, as shown in Illust. 6.

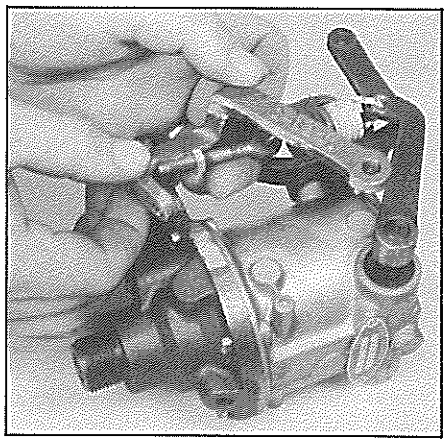
Install throttle arm onto throttle shaft in the position shown in Illust. 7.

Install pin attaching throttle arm onto throttle shaft, as shown in Illust. 8.

Drive pin flush with lever hub, as shown in Illust. 9.

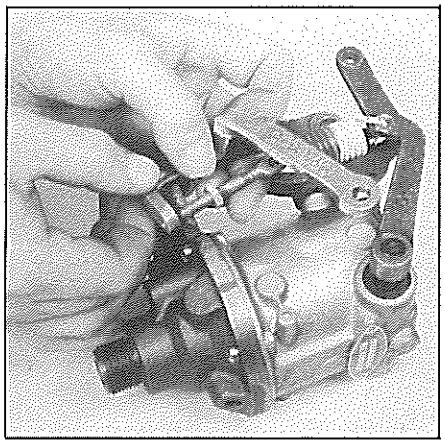
Install one end of spring into hole in governor lever, as shown in Illust. 10.

Install eye bolt onto spring, as shown in Illust. 11.

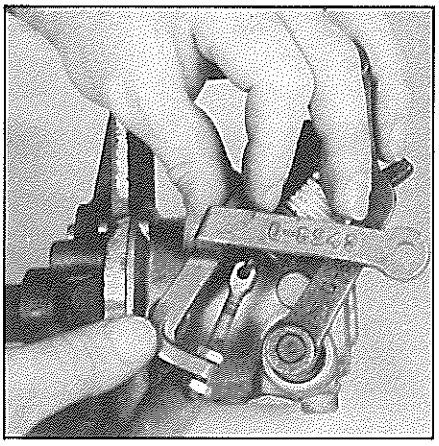


ILLUST. 11

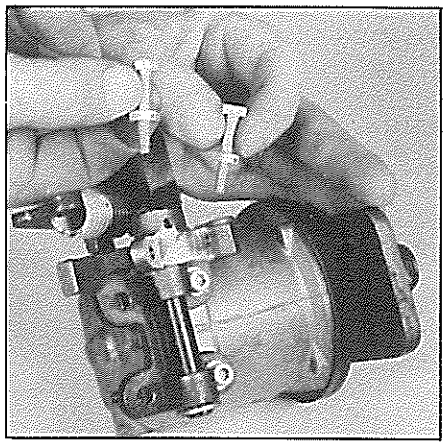
Insert threaded end of eye bolt into hole in



ILLUST. 12



ILLUST. 13



ILLUST. 14

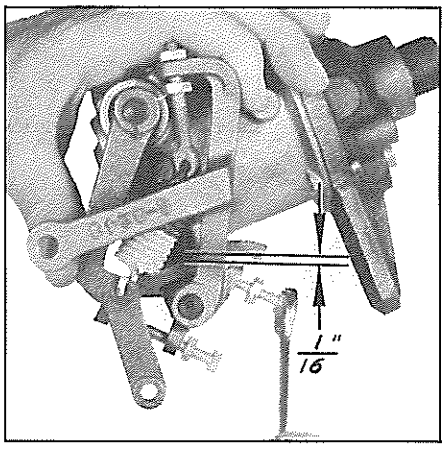
throttle arm, as shown in Illust. 12.

Install nut on outer end of eye bolt, as shown in Illust. 13. Note: Do not tighten nut.

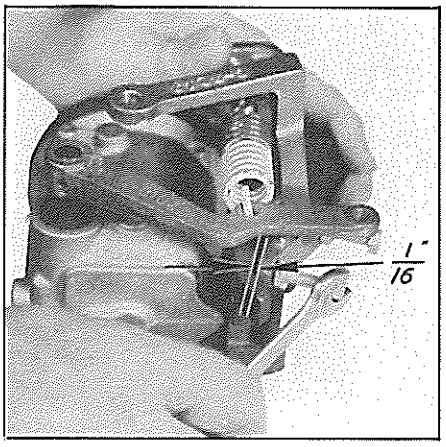
Install throttle arm stop bolts with drilled lock nuts, as shown in Illust. 14.

To adjust tail shaft governor, adjust speed change lever set screws to a 1/16 inch dimension between bracket and lever, as shown in Illust. 15 and 16. When this dimension is obtained, tighten set screw jam nuts.

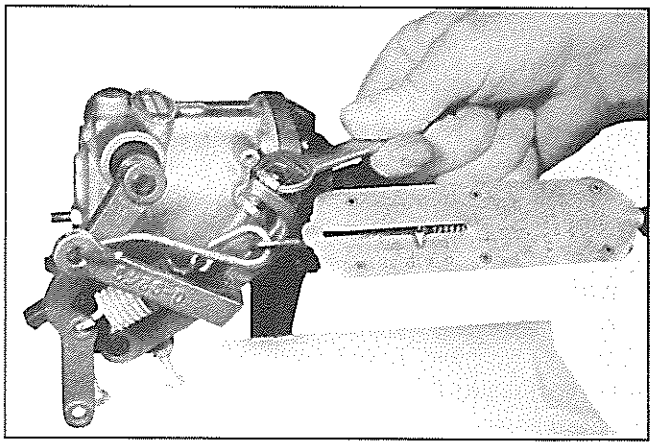
Adjust spring by tightening or loosening nuts on eye bolt until a pull poundage of 9 pounds is obtained, as shown in Illust. 17. When the pull poundage is obtained, tighten nuts securely, as shown in Illust. 18.



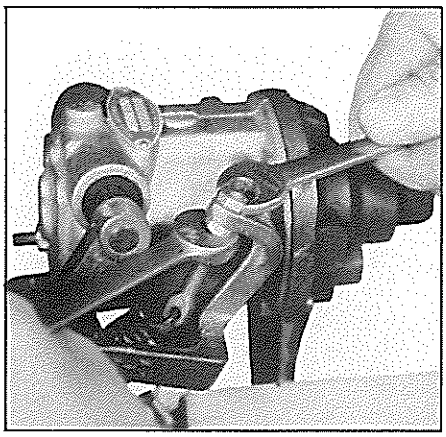
ILLUST. 15



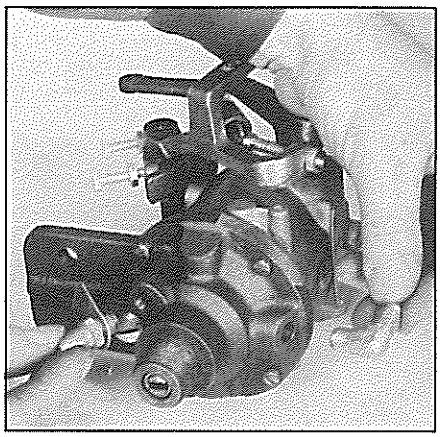
ILLUST. 16



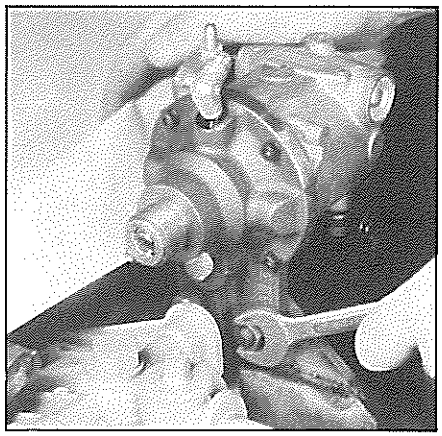
ILLUST. 17



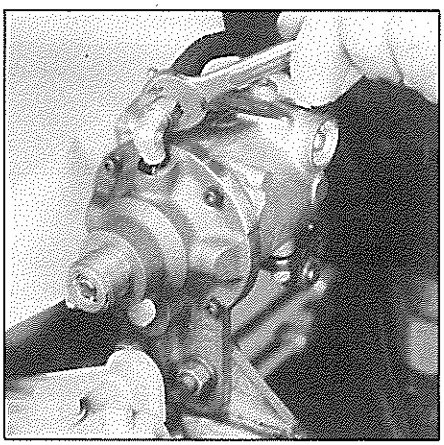
ILLUST. 18



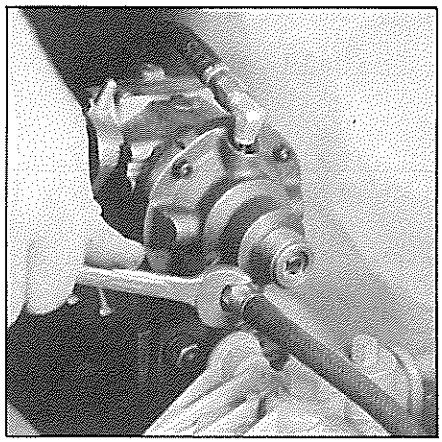
ILLUST. 19



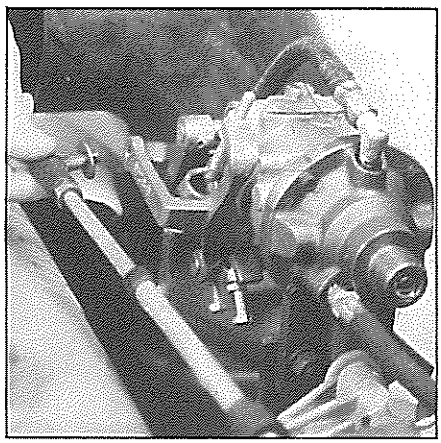
ILLUST. 20



ILLUST. 21



ILLUST. 22

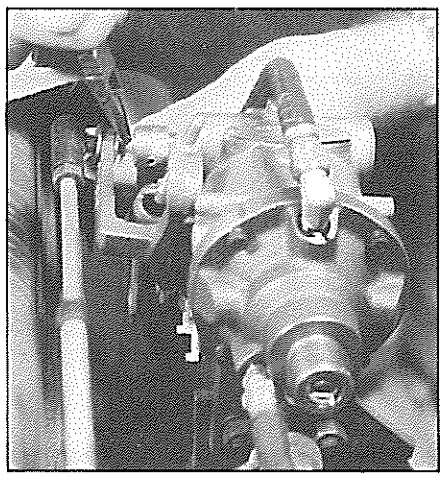


ILLUST. 23

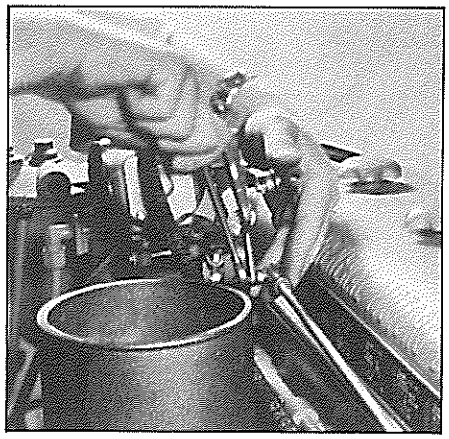
This tail shaft governor adjustment is merely a preliminary adjustment. Additional adjustments will be necessary when setting engine speed. Note: Set screw on back of tail shaft governor body is not an adjustment. If ever set screw is removed, replace it so there is a few threads holding it in place, then tighten jam nut. Never attempt to tighten set screw all the way into body. Governor will not operate properly.

Install elbow and adapter into threaded holes in governor cover, as shown in Illust. 19. Note: Apply sealing compound to fittings before installing.

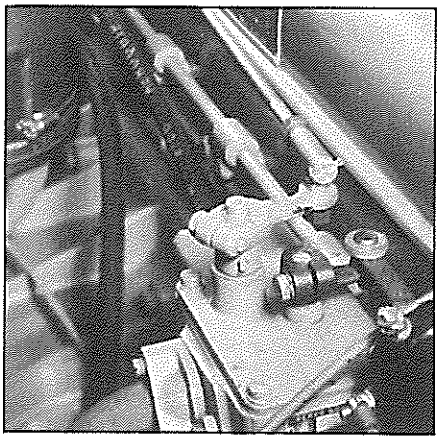
Install governor onto bracket on engine. In-



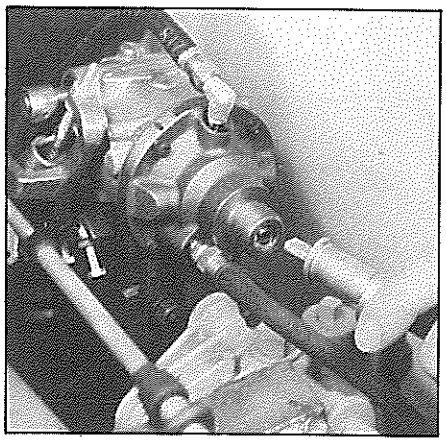
ILLUST. 24



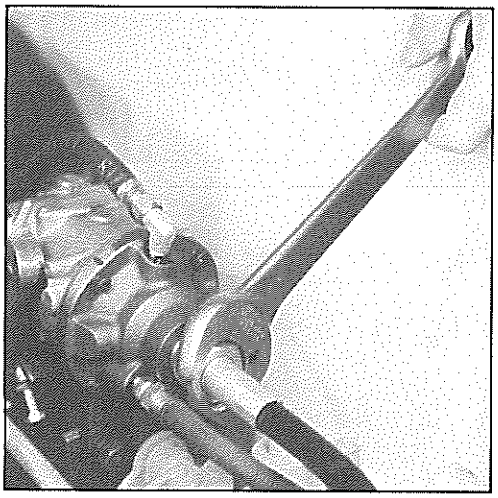
ILLUST. 25



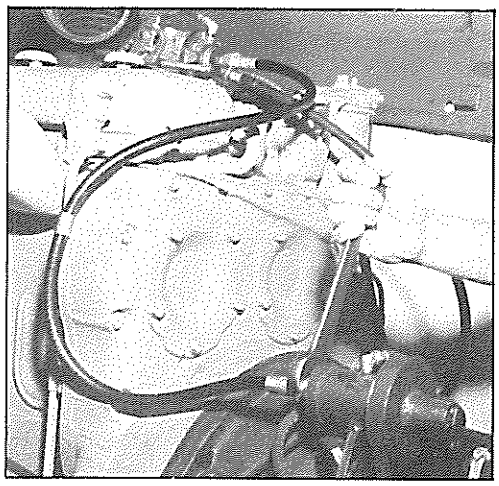
ILLUST. 26



ILLUST. 27



ILLUST. 28



ILLUST. 29

stall cap screws, lock washers and nuts, as shown in Illust. 20. Tighten nuts securely.

Install and tighten pressure line to elbow of governor, as shown in Illust. 21.

Install and tighten drain line to adapter, as shown in Illust. 22.

Install cut washer to throttle body and insert through speed change lever, as shown in Illust. 23. Next, install second cut washer and cotter pin. Spread cotter pin, as shown in Illust. 24.

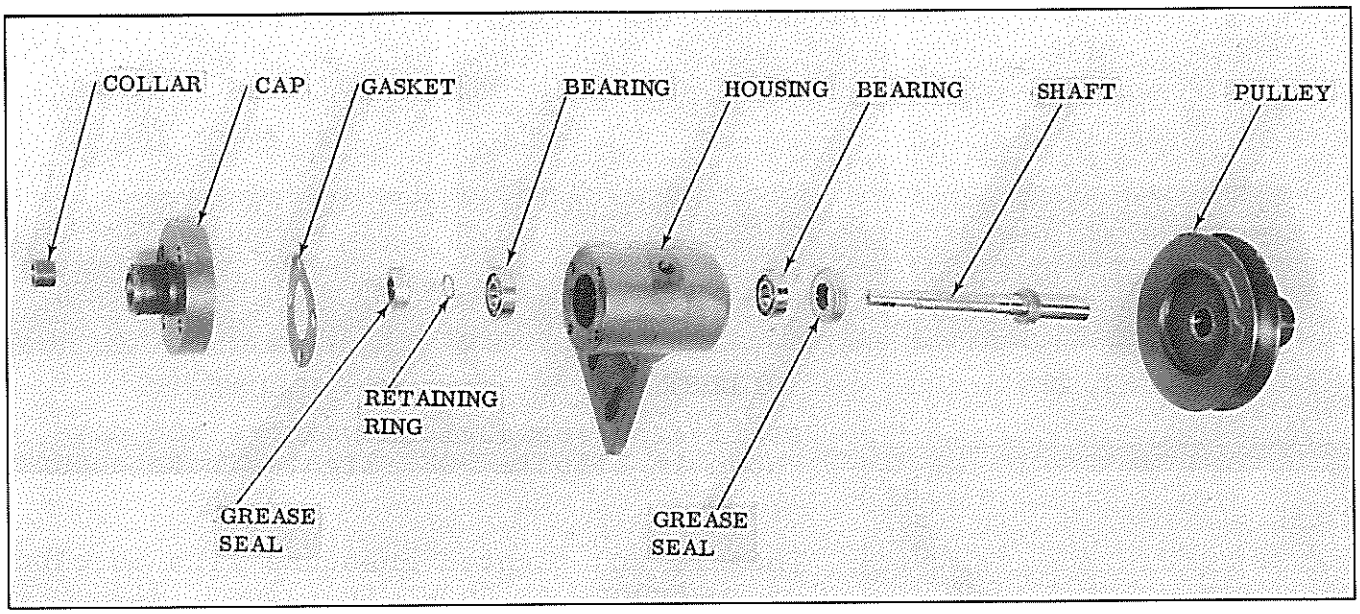
Install governor control rod ball joint through throttle lever. Install lock washer and nut. Tighten nut securely, as shown in Illust. 25.

Install ball joint on other end of governor control rod, through governor speed lever of governor. Install lock washer and nut. Tighten nut securely, as shown in Illust. 26.

Insert flat surface of flexible shaft into slot of governor shaft, as shown in Illust. 27. Tighten nut securely, as shown in Illust. 28.

Insert the other flat surfaced end of flexible shaft into slot of governor pulley shaft, and tighten nut securely, as shown in Illust. 29.

GOVERNOR PULLEY (GENERAL MOTORS ENGINE)



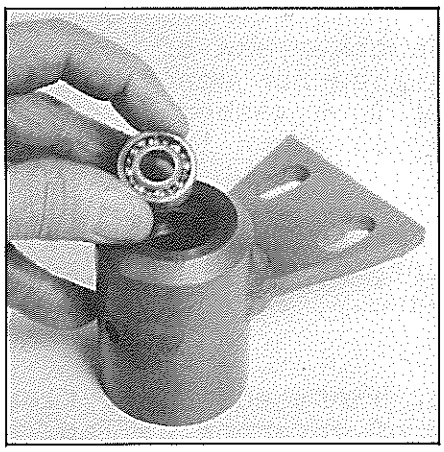
ILLUST. 1

Illust. 1 is an exploded view of governor pulley and housing assembly.

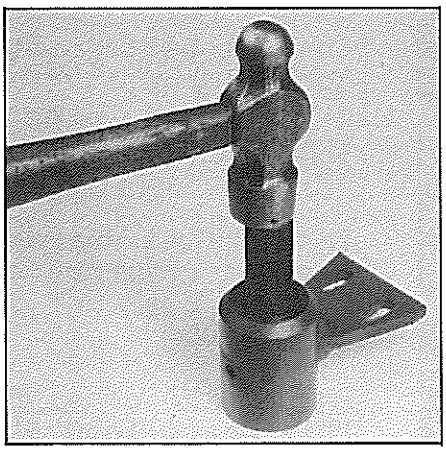
Install ball bearing into chamfered end of housing, as shown in Illust. 2.

Drive bearing into place, as shown in Illust. 3. Note: Keep dirt out of bearing.

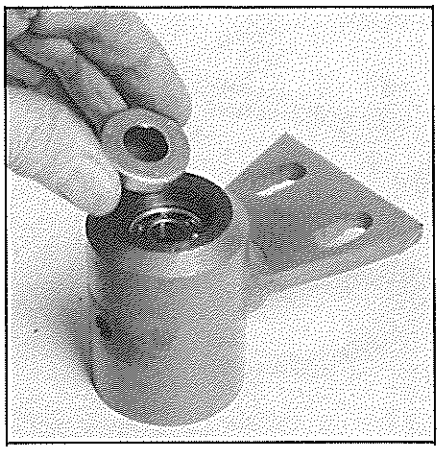
Install grease seal with lip toward bearing, as shown in Illust. 4.



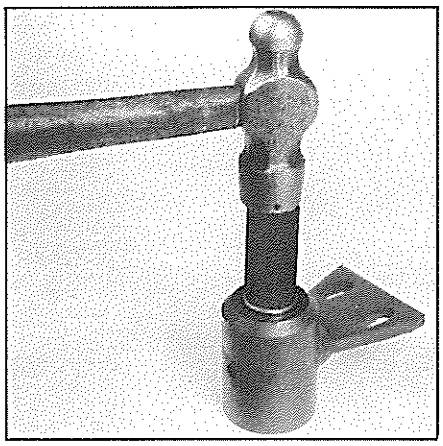
ILLUST. 2



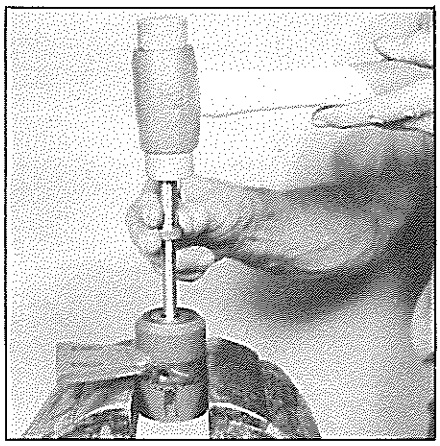
ILLUST. 3



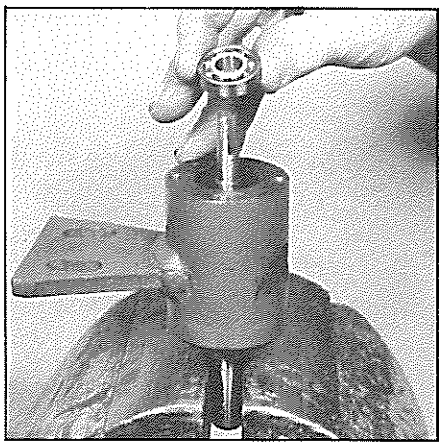
ILLUST. 4



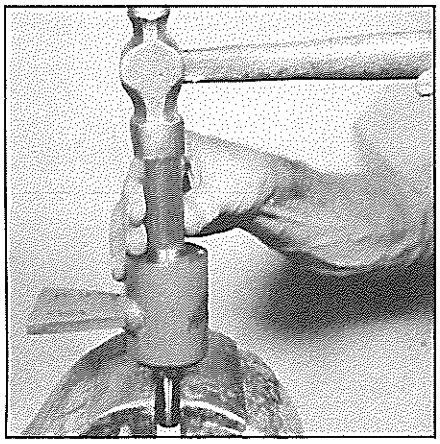
ILLUST. 5



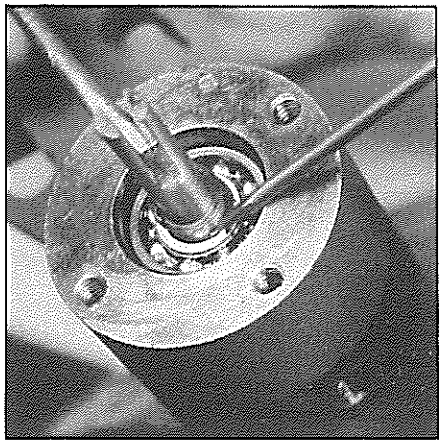
ILLUST. 6



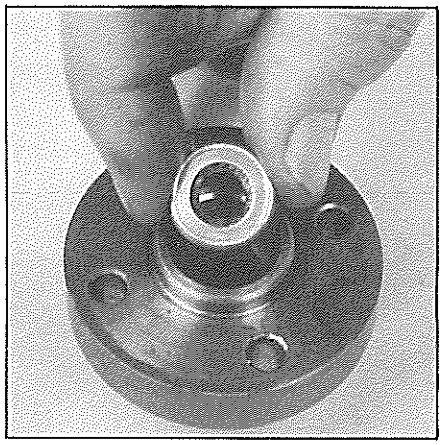
ILLUST. 7



ILLUST. 8



ILLUST. 9



ILLUST. 10

Drive seal into place, as shown in Illust. 5. Note: Use care to prevent damage to seal leather.

Install shaft, as shown in Illust. 6. Do not clamp too tightly on housing. Apply oil to grease seal to prevent damage to the leather.

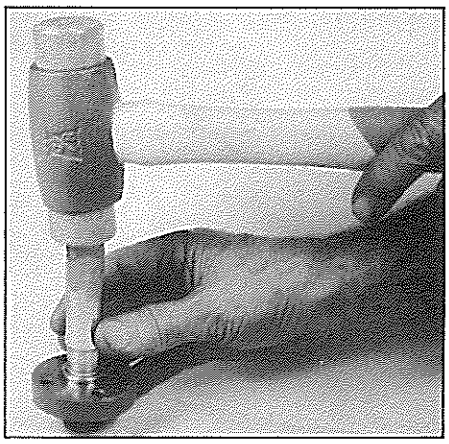
Install second ball bearing over small end of shaft, as shown in Illust. 7. Note: Protect shaft by use of soft jaws in vise.

Drive second ball bearing into place, as shown in Illust. 8.

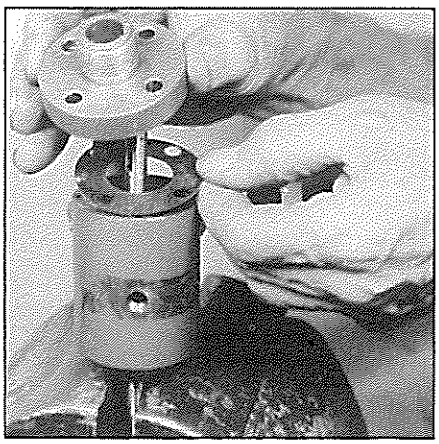
Install bearing retainer ring into groove in shaft, as shown in Illust. 9.

Install grease seal into cap with lip turned toward housing, as shown in Illust. 10.

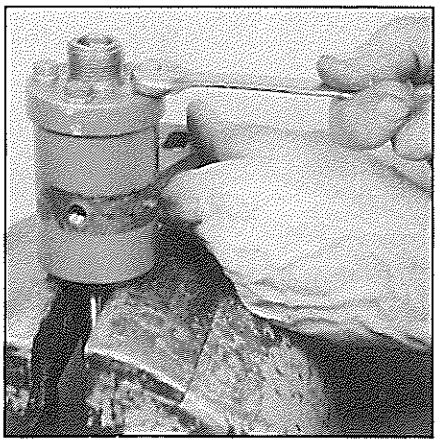
Drive grease seal into position, as shown in Illust. 11. Note: Use



ILLUST. 11



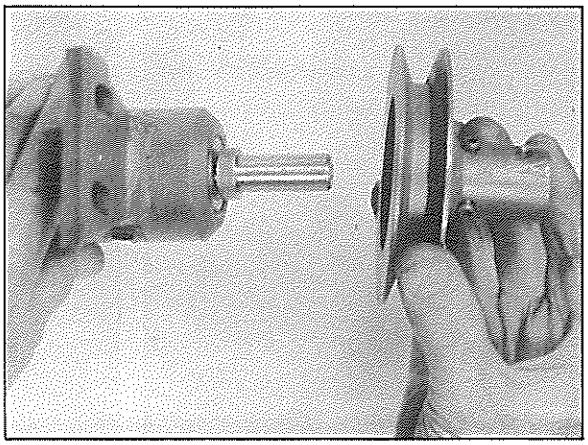
ILLUST. 12



ILLUST. 13



ILLUST. 14



ILLUST. 15

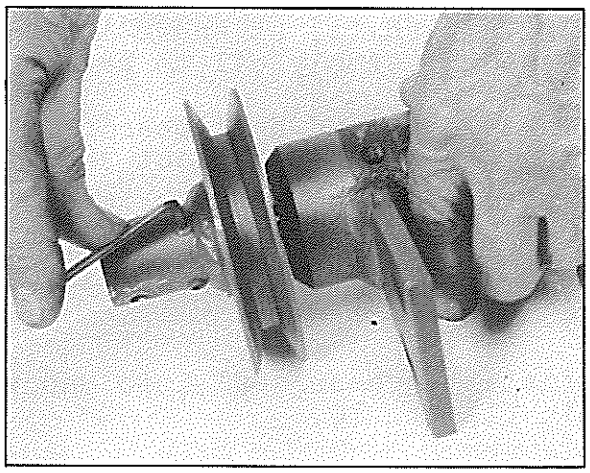
care to prevent damage to seal leather.

Install gasket and cover onto end of housing, as shown in Illust. 12. Note: It is not necessary to use sealing compound with this gasket.

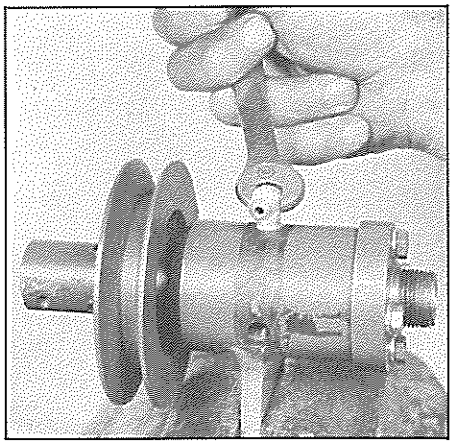
Install lock washers and cap screws. Bolt cover tightly to housing, as shown in Illust. 13.

Install collar over slotted end of shaft, as shown in Illust. 14, until collar is flush with end of shaft.

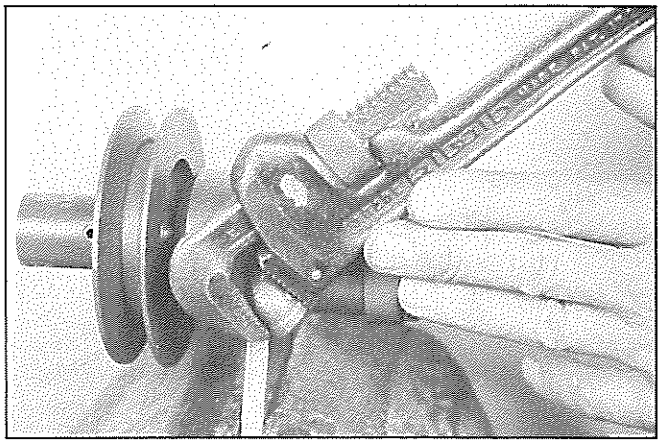
Install pulley onto shaft as far as it will go, with pulley itself nearest housing, as shown in Illust. 15.



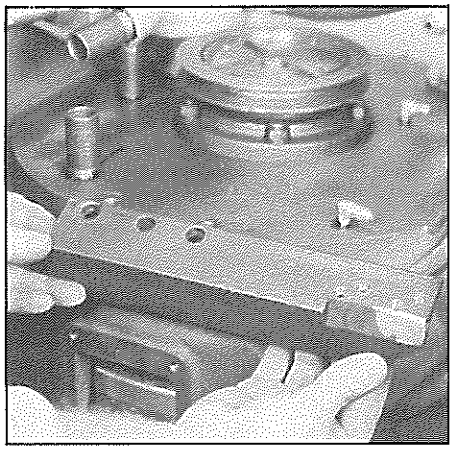
ILLUST. 16



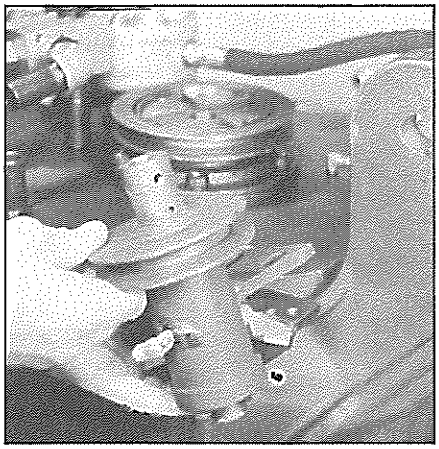
ILLUST. 17



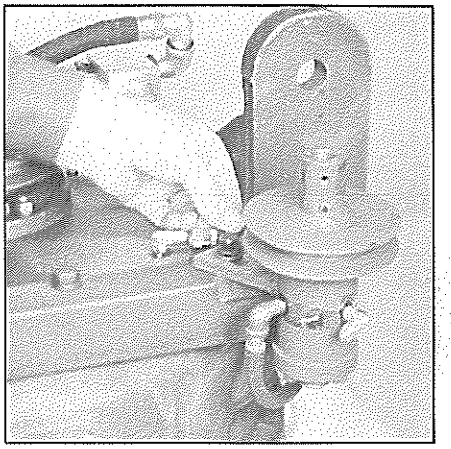
ILLUST. 18



ILLUST. 19

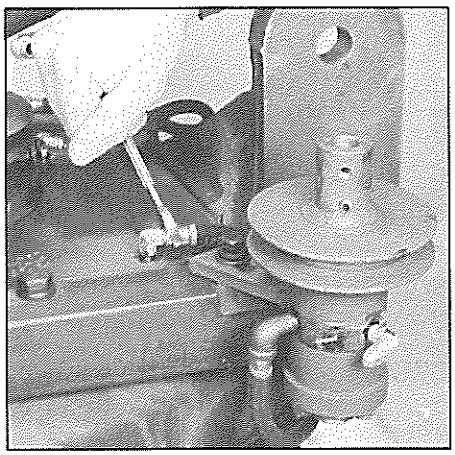


ILLUST. 20



ILLUST. 21

Install two hollow head set screws into the two holes nearest the pulley and tighten securely, as shown in Illust. 16.

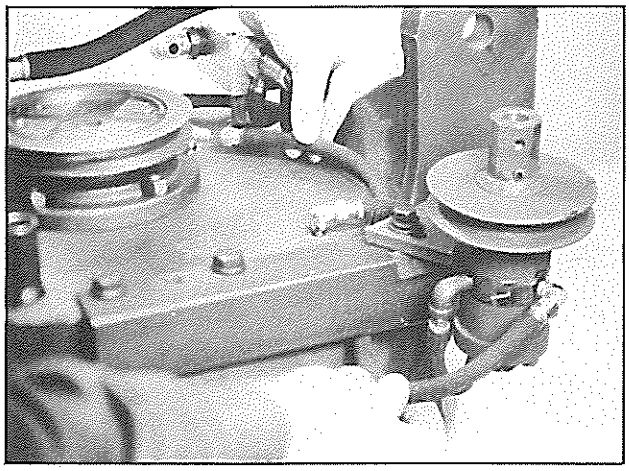


ILLUST. 22

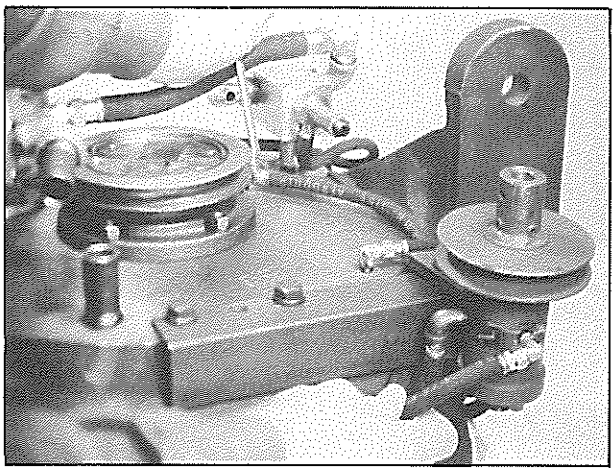
Install flare type elbow into housing, as shown in Illust. 17. Use sealing compound on threads. Tighten elbow so that its open end is crosswise to the housing.

Install street ell into housing, as shown in Illust. 18. Use sealing compound on threads. Tighten elbow so that its open end is turned away from the pulley at an approximate 45 degree downward angle.

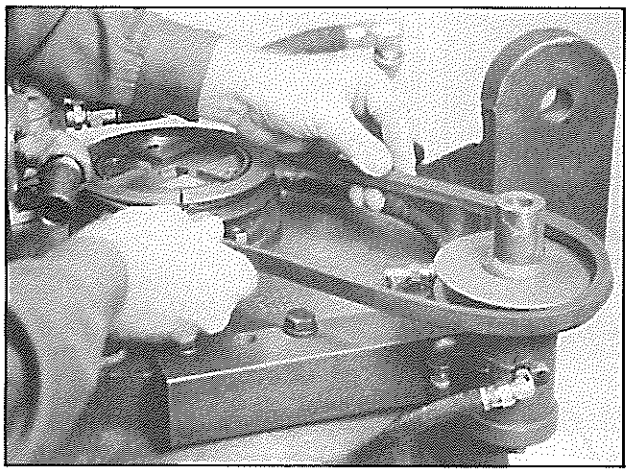
Install mounting angle on converter housing, as shown in Illust. 19. Install lock washers and cap screws. Tighten cap screws securely.



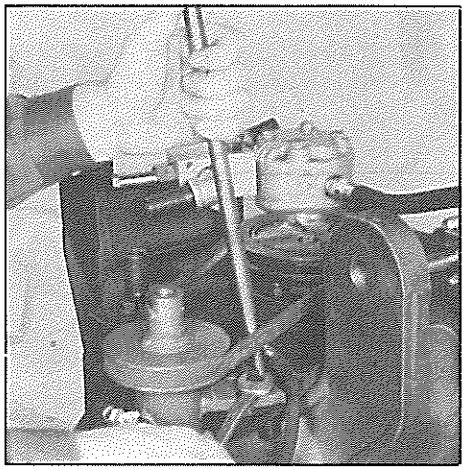
ILLUST. 23



ILLUST. 24



ILLUST. 25



ILLUST. 26

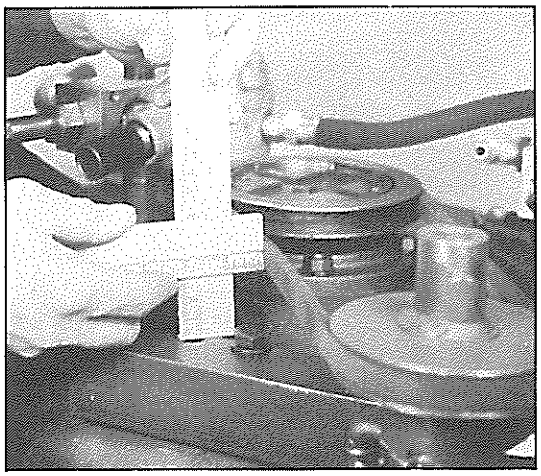
Install housing on mounting angle, as shown in Illust. 20. Use cut washers over the slotted holes in the housing, then add lock washers and cap screws. Do not tighten cap screws.

Install flexible oil hose into street ell, as shown in Illust. 21. Tighten the fitting securely. Note: No sealing compound is necessary.

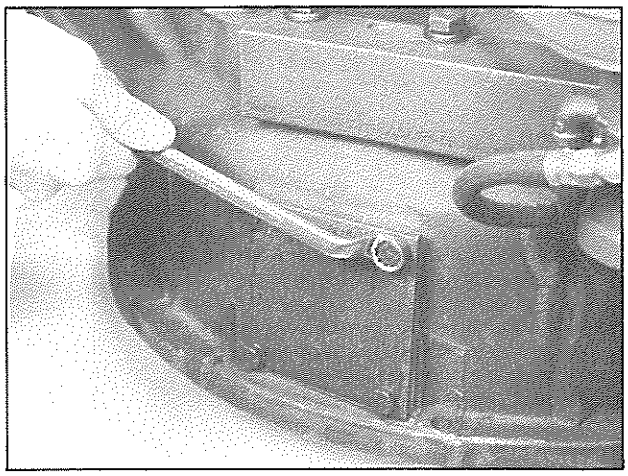
Install flexible oil hose swivel fitting onto flare type elbow in converter housing and tighten, as shown in Illust. 22.

Install flexible oil hose swivel fitting onto flare type elbow in pulley housing, as shown in Illust. 23.

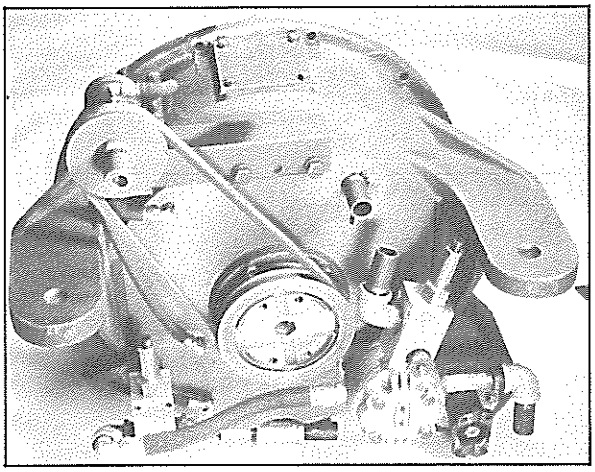
Install flexible oil hose swivel fitting onto flare type elbow in converter housing, as shown in Illust. 24. Tighten fittings on both ends of hose.



ILLUST. 27



ILLUST. 28



ILLUST. 29

Install "V" belt over pulleys as shown in Illust. 25.

Move pulley housing outward to tighten belt, as shown in Illust. 26.

Adjust belt tightness to provide 3/4 inch of slack, at a point half way between the two pulleys, as shown in Illust. 27. Tighten pulley housing mounting bolts securely.

Install gasket and cover plate to top of converter housing. Use lock washers and tighten cap screws securely, as shown in Illust. 28.

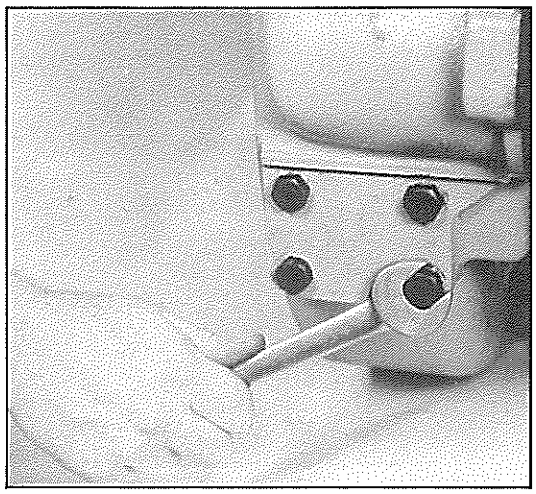
Illust. 29 is a view of the converter housing as it appears after installation of pulley housing. Converter housing is now ready for installation to engine.

TORQUE CONVERTER INSTALLATION (CUMMINS AND GENERAL MOTORS ENGINES)

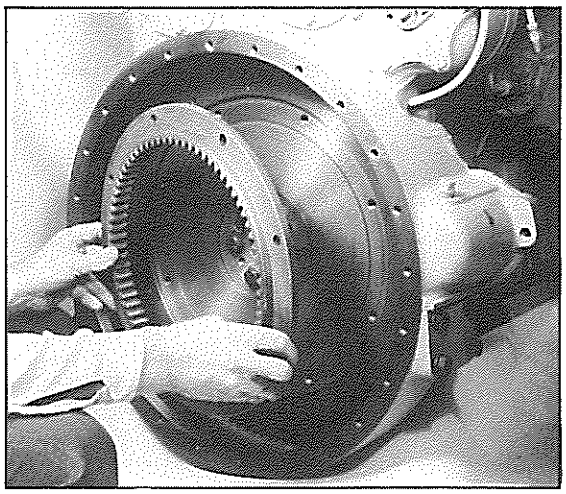
The following instructions and illustrations show the installation of the torque converter to the Cummins engine. These instructions and illustrations can also be followed for installation of the torque converter to the General Motors engine.

Reassembly

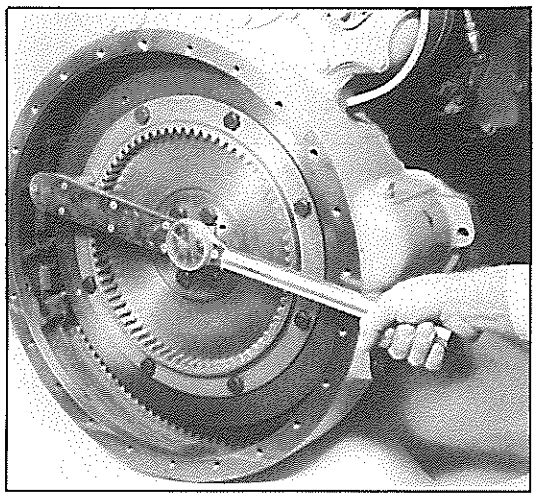
Install cap screws with copper washers into side of flywheel housing and tighten securely, as shown in Illust. 1. Cap screw holes are drilled through flywheel housing. By using cap screws to seal holes, dirt and grit will be unable to get into housing.



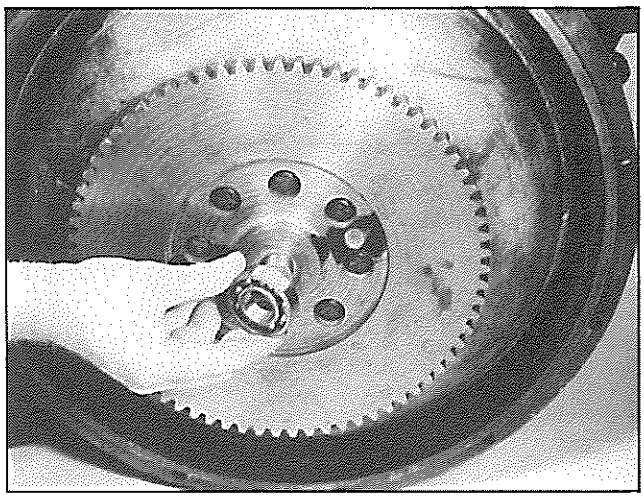
ILLUST. 1



ILLUST. 2



ILLUST. 3



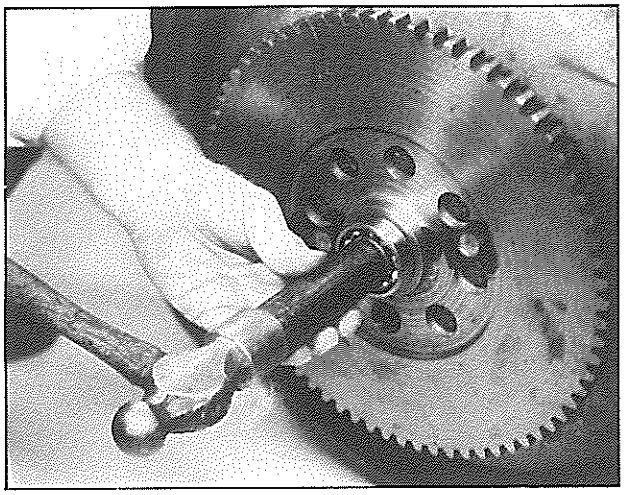
ILLUST. 4

Install ring gear to flywheel, as shown in Illust. 2. Install cap screws with shake-proof lock washers. Tighten cap screws to a torque reading of 50 foot pounds, as shown in Illust. 3.

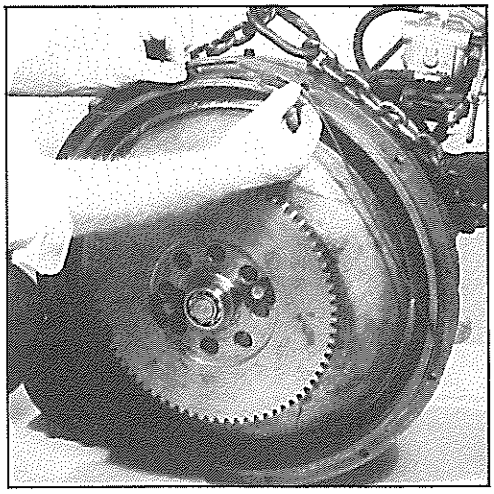
Install bearing on to hub of pump drive gear, as shown in Illust. 4. Using a tube and hammer, drive bearing to within 1/16 inch of large hub, as shown in Illust. 5.

Install "O" ring in groove of torque converter housing, as shown in Illust. 6. Apply shellac to open ends of "O" ring and also into top portion of groove. Hold ends of "O" ring together in groove until shellac is set.

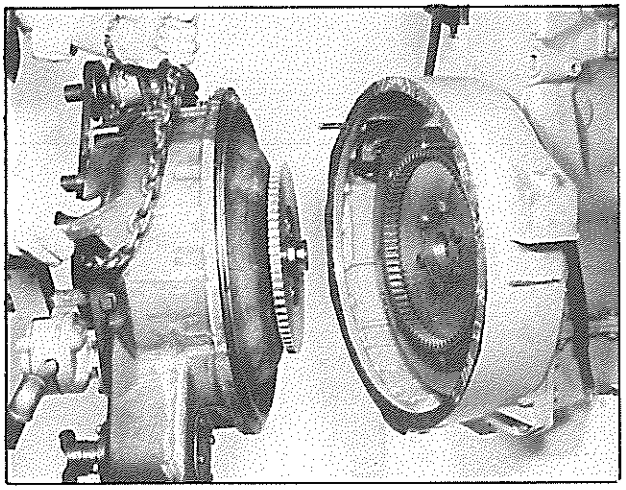
Shellac gasket to flywheel housing. Next, install two studs into flywheel housing, as shown in Illust. 7. Use the studs as a guide to



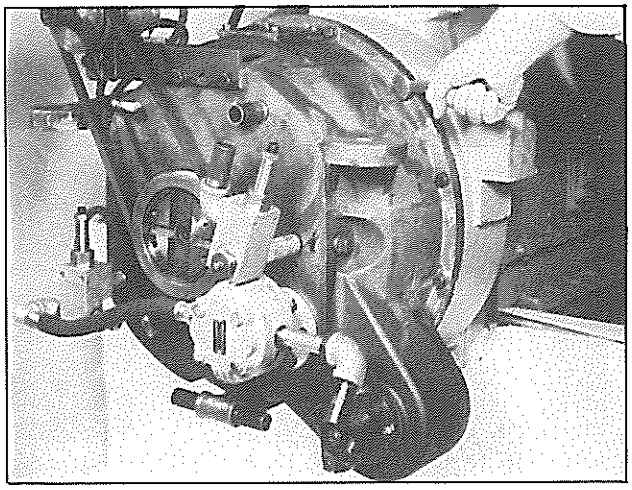
ILLUST. 5



ILLUST. 6



ILLUST. 7



ILLUST. 8

install torque converter to flywheel housing.

Install torque converter housing over guide studs and against flywheel housing. Apply white lead to "O" ring to prevent damage to "O" ring when installing torque converter housing. Be sure "O" ring remains in groove while installing torque converter housing. Bump torque converter housing, using a rawhide mallet, to seat bearing in pilot of flywheel.

Remove guide studs and install cap screws with lock washers. Tighten cap screws securely, as shown in Illust. 8.

TROUBLE SHOOTING

TROUBLE	CAUSE	REMEDY
Torque converter overheating.	Torque converter reactor stuck. To check this, drive machine with no load on it, in any gear with engine operating at top RPM. If torque converter oil temperature rises excessively, this will indicate that sprag cams in the hub of the reactor are stuck, preventing reactor from free wheeling.	Repair torque converter as necessary.
	Insufficient oil. Check by first removing hose from oil outlet end of heat exchanger and putting it in a large container. Start engine and run at 600 RPM, oil should flow at the rate of 2 1/2 gals. per minute, or 1 gal. in 24 seconds. If oil does not flow at this rate, check for:	
	A. Plugged oil line or oil screen.	Clean line or unplug oil screen.
	B. Control valve not functioning properly.	Clean, repair or replace valve.
	C. Internal leakage in torque converter.	Check torque converter and make necessary repairs or replacements.
	D. Internal leakage in power shift clutch assembly.	Check for worn or broken rings on clutch assembly pistons and upper shaft rotary seal.
	E. Low oil level.	Add oil to bring oil in hydraulic tank up to proper level.

TROUBLE SHOOTING (CONT'D)

TROUBLE	CAUSE	REMEDY
	F. Oil pump function.	Repair or replace oil pump.
	G. Power shift clutches dragging and heating oil.	Refer to "Clutches Overheating" further along in Trouble Shooting.
Torque converter overheating. (con't)	Overloading machine.	Drop down to lower gear.
Lack of power to drive wheels.	Power shift clutches slipping. Check this, start the engine and shift lower transmission into 3rd or 4th gear. Set the wheel brakes and rev engine up. If the output shaft from the torque converter turns, the clutches are slipping. Check this in both forward and reverse, so as to check both clutches.	Check the power shift clutch assembly for: A. Low oil pressure at clutches. B. Excessively worn or broken discs or other components. C. Restricted or broken lines to clutches. D. Relief or control valve not functioning properly. E. Oil pump not functioning properly. Repair or replace parts not functioning properly.
	Torque converter not working properly. To check this, make same test	Check the torque converter assembly for:

TROUBLE	CAUSE	REMEDY
	made for clutch slippage. If the torque converter output shaft does not turn, and the engine does not labor, torque converter is not delivering power to power shift clutches.	A. Internal leakage in torque converter assembly. B. Restricted or broken oil lines to torque converter. C. Relief valve not functioning properly. D. Oil pump not functioning properly. E. Reactor sprag cams not holding. This could be caused by worn or damaged sprag cams, or parts they work in conjunction with.
	Output shaft governor not functioning properly.	Refer to "Output shaft governor not functioning properly" further along in Trouble Shooting.
Clutches fail to release.	Broken piston return spring.	Replace spring.
	Broken seal rings.	Replace seal rings.
	Ball check valve damaged.	Replace ball check valve.
	Oil return line to valve restricted.	Free return line.

TROUBLE SHOOTING (CONT'D)

TROUBLE	CAUSE	REMEDY
Only one clutch works satisfactorily.	Oil leaking past clutch piston.	Repair clutch assembly to correct leakage.
	Low oil pressure to clutch.	First check individual oil lines to both clutches to determine that oil pressure is normal to clutch that is operating satisfactorily. Check oil lines, fittings and passages to clutch. Replace or repair broken lines or fittings and remove any restrictions present.
	Ball check valve in piston not holding pressure.	Inspect ball and ball seat. Replace ball or make any other corrections required to permit ball to seat correctly.
	Other possible internal damage.	Remove power clutch assembly and make necessary correction.
Power shift clutch assembly overheating. (Note: An indication of clutch overheating is high torque converter oil temperature. Before removing clutches check to determine	Clutch discs or other parts binding. To check this, set rear of grader on chocks with all four wheels off floor. Set engine at 600 RPM and run with machine in neutral for 5 minutes to warm up torque converter oil. Put lower transmission in gear and engage forward clutch, then disengage it and halt wheels in neutral. Repeat this five times for both forward and	Replace damaged or broken parts.

TROUBLE SHOOTING (CONT'D)

TROUBLE	CAUSE	REMEDY
if torque converter is causing overheating of oil.)	reverse and then place both transmission and power shift clutch in neutral and shut off engine. Measure the inch pounds required to turn the clutch assembly lower shaft, which in turn will rotate the upper shaft and clutch assemblies. To do this, turn the nut on the end of the small brake, which is located under the cam, with a torque wrench. It should not require over 80 inch pounds to turn the shaft. (If clutch assembly has been removed, rotate each side by the gears on each end. Both sides should rotate easily by hand.)	
Hard shifting of lower transmission.	Power shift clutch assembly clutches dragging.	Remedy dragging of clutches.
	Improper use of clutch brake.	Co-ordinate use of brake with shifting.
	Clutch brake out of adjustment.	Adjust brake so that it functions properly.
Output shaft governor not functioning properly.	Output shaft governor out of adjustment.	Adjust governor.
	Governor weights stuck.	Free governor weights.
	Broken V belt.	Replace V belt.
	On GM engine equipped machines, flex shaft that runs from the	Replace flex shaft.

TROUBLE SHOOTING (CONT'D)

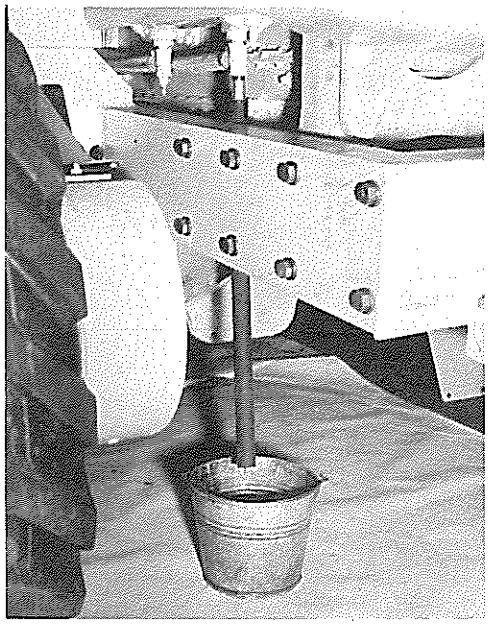
TROUBLE	CAUSE	REMEDY
	output shaft governor adaptor to the output shaft governor broken or damaged.	
	Linkage from output shaft governor to engine governor binding at tourek joints.	Adjust tourek joints so there is no friction or drag present. Do not replace tourek joints with the spring loaded type, as they will cause drag on linkage and consequently poor engine response and performance.
Output shaft governor overheating.	Too much lubricating oil.	Check to see that restricted fitting is in output shaft governor lubricating oil line. On Cummins engine equipped machines this is located at the face of converter housing where lubricating oil line for the output shaft governor attaches. On GM engine equipped machines, it is located on the engine block where the output shaft governor lubricating oil line attaches. If missing, install restricted fitting.

TROUBLE SHOOTING (CONT'D)

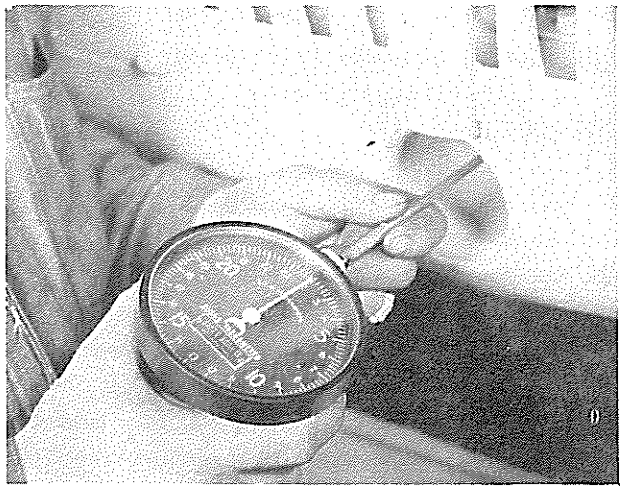
TROUBLE	CAUSE	REMEDY
	Too little lubricating oil.	Check output shaft governor lubricating oil line and fittings for restrictions, breaks or leaks. Repair or replace line or fittings as necessary.

transmission into 4th gear and stall torque converter tail shaft by applying brakes. Pressure gauge should read 20-35 P.S.I. Engine speed should increase from 800 r.p.m. to 1275-1325 r.p.m.

Set engine speed at 1000 r.p.m. Shift transmission into 4th gear and stall torque converter tail shaft by applying brakes. Engine speed should increase from 1000 r.p.m. to 1575-1625 r.p.m.



Illust. 3



Illust. 1

Set engine speed at maximum r.p.m. Shift transmission into 4th gear and stall converter tail shaft by applying brakes. Pressure gauge should read 30-45 P.S.I. Engine speed for the 66GMT should be 1825-1900 r.p.m. Engine speed for the 55GMT should be 1725-1825 r.p.m.

Release load on torque converter by returning clutch foot lever to neutral position at maximum speed. Pressure gauge should read 35-50 P.S.I.

Stop engine. Remove hose and gauge from reducer in valve body. Next, install 1/8 inch pipe plug. Install cover to fuel tank support.

OIL CIRCULATION TEST

Remove pipe bushing with drain cock from heat exchanger. Replace with nipple and length of hose (Illust. 3). Set a suitable container under heat exchanger. Start engine. Run unit at 600 r.p.m. When a steady flow of oil is obtained through hose and into container, time the amount of oil. The time to fill a 2-1/2 gal. container should be less than 1 minute or 1 gal. in 24 seconds.

CLUTCH RELIEF VALVE ADJUSTMENTS (55CT and 66CT)

Clutch relief valve adjustments must be checked after repairs or replacements are made to either clutch relief valve or power clutch.

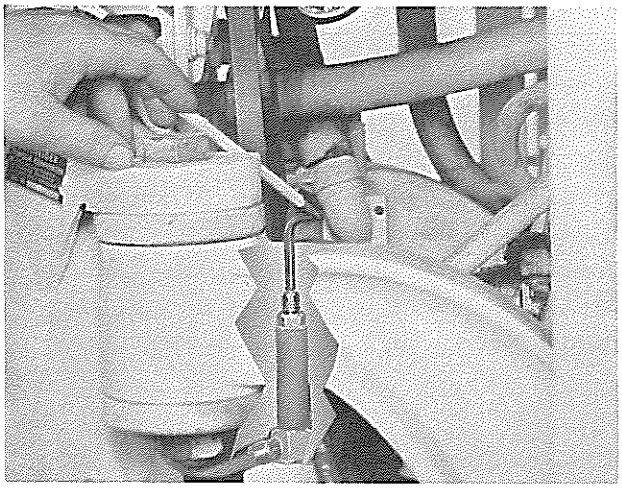
Checks may be made while torque converter oil temperature gauge reads above or below 180 degrees F.

To adjust clutch relief valve, start engine. Run unit in neutral at 600 RPM, no load, for approximately 5 minutes. Tachometer must be used to obtain 600 RPM (Illust. 1).

Watch pressure gauge for radical malfunctions, such as, gauge registering no pressure, pressure above scale and rapid temperature rise of converter oil temperature gauge. NOTE: Gauges are located in instrument panel.

Clutch relief valve is located on right side of torque converter housing under fuel tank. (To determine left and right side, stand at rear of motor grader facing toward front).

While engine is running at 600 RPM, loosen jam nut on relief valve. Insert Allen wrench into adjusting screw (Illust. 2) and turn until pressure gauge reads 65-75 PSI when converter oil temperature gauge reads above 180 degrees F.; 75-85 PSI below 180 degrees F.



Illust. 2

Hold Allen wrench in position and tighten jam nut securely. Recheck gauge reading.

Shift transmission into 4th gear and stall tail shaft by applying brakes. Pressure gauge must read 75-100 PSI when converter oil temperature gauge reads above 180 degrees F.; 85-110 PSI below 180 degrees F.

Engine speed will increase from 600 RPM to 1125-1175 RPM.

Run engine at 1000 RPM tachometer reading. Shift transmission into 4th gear and stall tail shaft by applying brakes. Engine speed will increase from 1000 RPM to 1525-1575 RPM.

Run engine at maximum RPM. Shift transmission into 4th gear and stall tail shaft by applying brakes. Pressure gauge must read 75-100 PSI when converter oil temperature gauge reads above 180 degrees F.; 85-110 PSI below 180 degrees F.

Release load by returning clutch pedal to neutral position at maximum RPM. Pressure gauge must read 80-125 PSI when converter oil temperature gauge reads above 180 degrees F.; 90-135 PSI below 180 degrees F.

Stop engine when adjustments have been made.

CLUTCH RELIEF VALVE ADJUSTMENTS (55GMT and 66GMT)

Clutch relief valve adjustments must be checked after repairs or replacements are made to either clutch relief valve or power clutch.

Checks may be made while torque converter oil temperature gauge reads above or below 180 degrees F.

To adjust clutch relief valve, start engine. Run unit in neutral at 600 RPM, no load, for approximately 5 minutes. Tachometer must be used to obtain 600 RPM (Illust. 1). Watch pressure gauge for radical malfunctions, such as, gauge registering no pressure, pressure above scale and rapid temperature rise of converter oil temperature gauge. NOTE: Gauges are located in instrument panel.

SERVICING UPPER TRANSMISSION

The upper transmission can be serviced without removing the complete transmission unit from frame. The following instructions and illustrations will aid in the disassembling of the upper transmission.

Disassembly

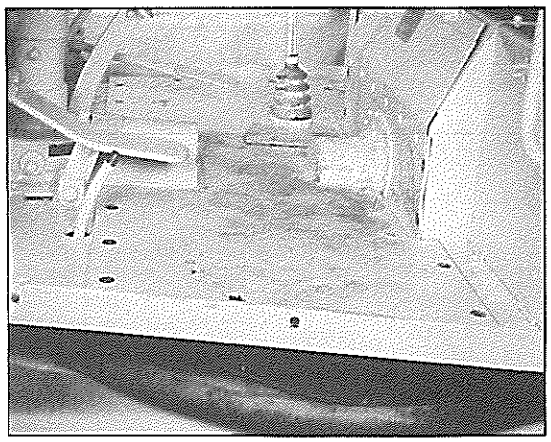
Remove both cab closure plates. Next, remove floor plate cap screws, shifter lever cover cap screws and clutch brake pedal pad, as shown in Illust. 1.

Remove clutch brake lever from shaft, as shown in Illust. 2. Disconnect clutch brake linkage from brake arm. Disconnect return spring from frame. Remove lever with linkage and spring, from bracket on floor plate, as shown in Illust. 3.

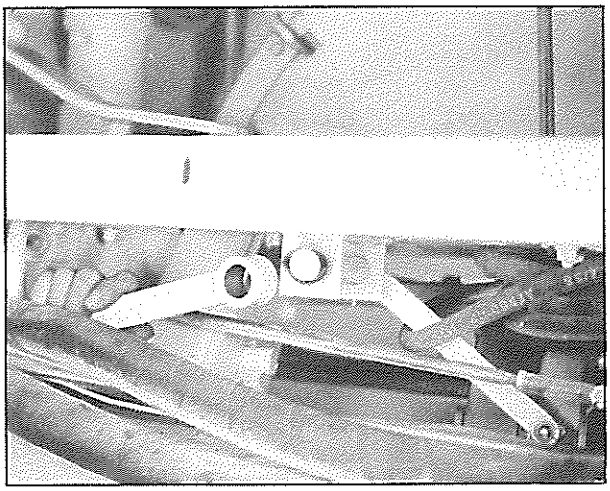
Remove foot brake pedal pad. Next, disconnect brake lever return spring from frame. Remove pin from foot brake lever and master cylinder yoke. Pull shaft from bracket, as shown in Illust. 4.

Remove shifter ball cap cap screws from shifter housing. Lift shifter lever through floor, as shown in Illust. 5. Remove shims.

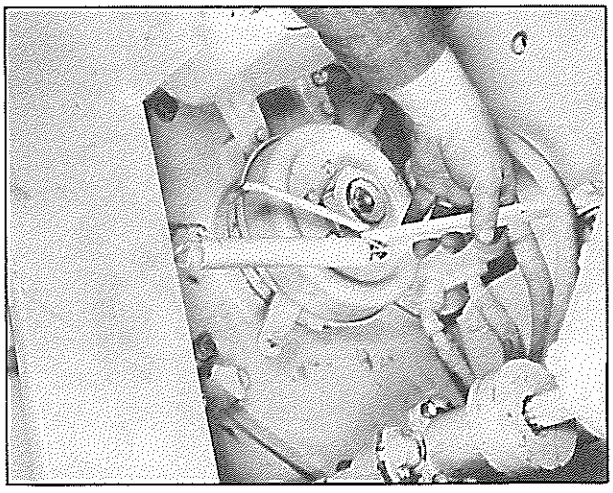
As shown in Illust. 6, disconnect foot feed lever at control body link. Using a piece of wire, wire foot feed lever in an upward position. Tilt rear of floor plate in an upward position and lift



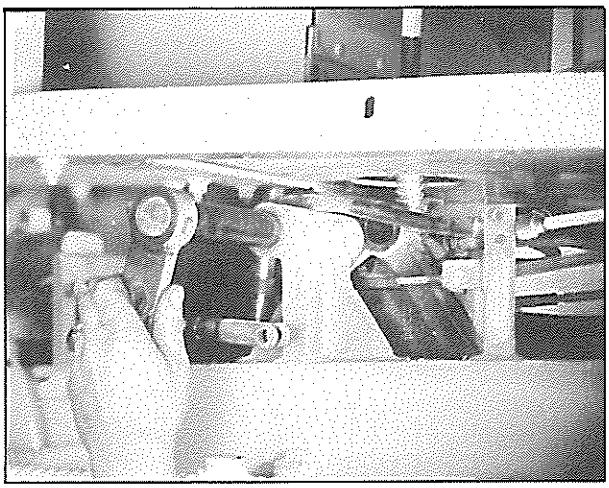
ILLUST. 1



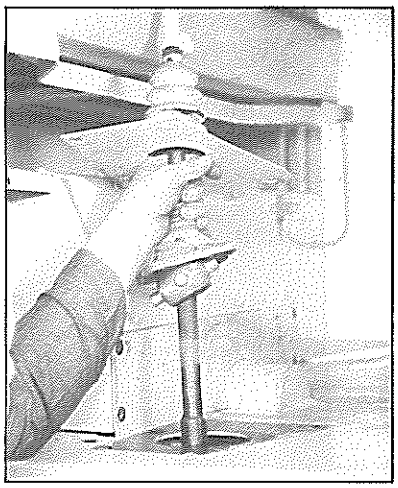
ILLUST. 2



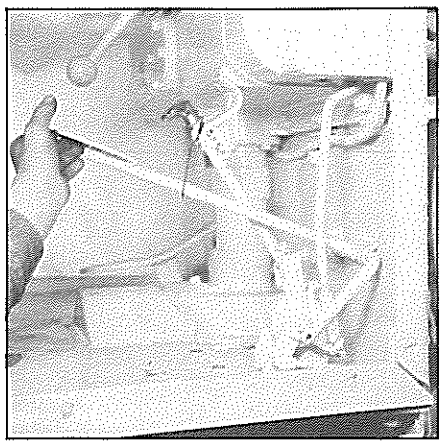
ILLUST. 3



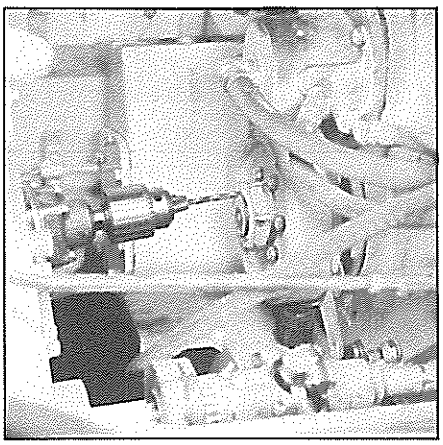
ILLUST. 4



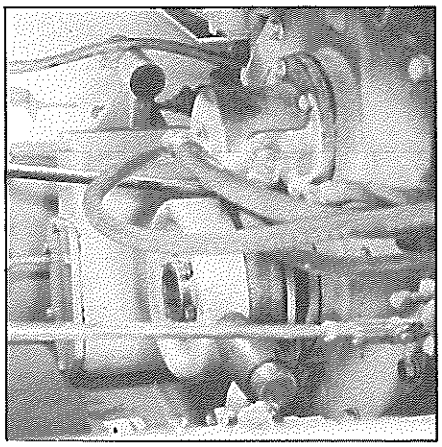
ILLUST. 5



ILLUST. 6

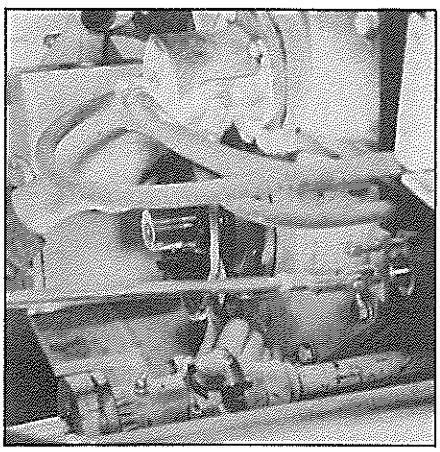


ILLUST. 7



ILLUST. 8

from cab.

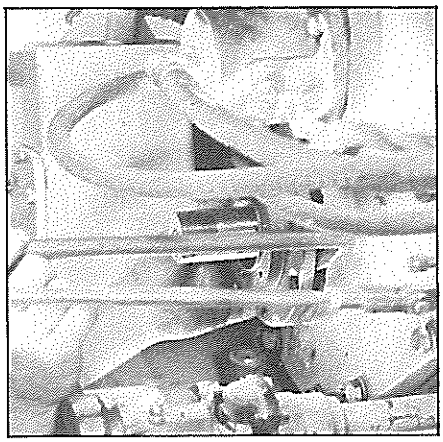


ILLUST. 9

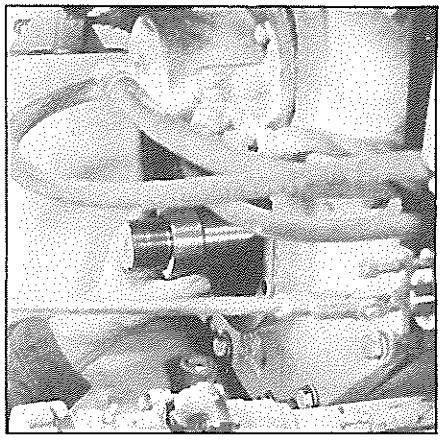
To remove nut from lower shaft of upper transmission, drill out stake, as shown in Illust. 7. Next, remove nut. Using a pry bar, remove clutch brake drum, as shown in Illust. 8. Tap brake drum with a mallet while using pry bar.

Disconnect springs from clutch brake shoes. Next, remove brake arm. Remove backing plate cap screws and backing plate, as shown in Illust. 9.

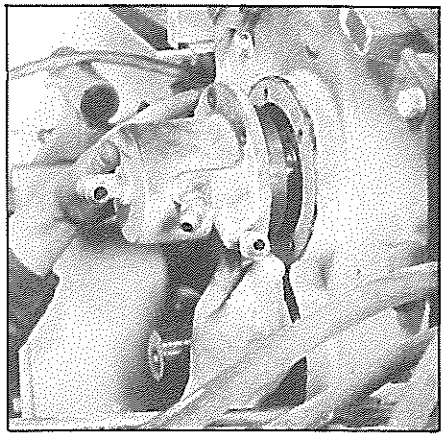
Remove retainer cap screws. Using a pry bar, remove retainer, as shown in Illust. 10.



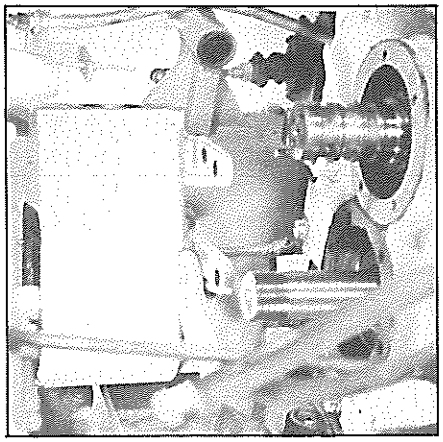
ILLUST. 10



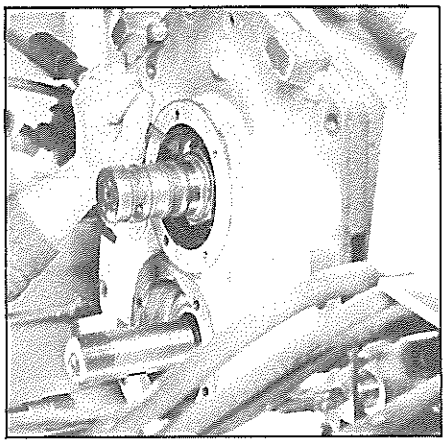
ILLUST. 11



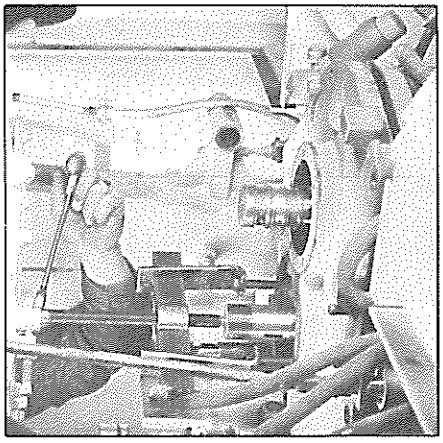
ILLUST. 12



ILLUST. 13



ILLUST. 14



ILLUST. 15

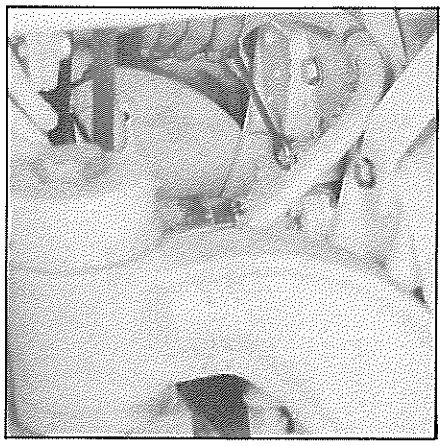
Remove key from keyway of lower shaft. Next, remove spacer, as shown in Illust. 11.

As shown in Illust. 12, disconnect flexible hose from upper shaft cap. Next, remove cap screws and cap.

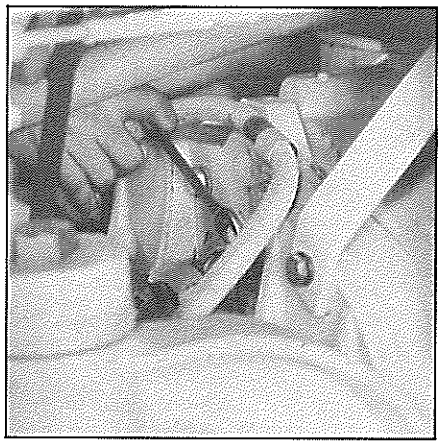
To remove shifter housing from upper transmission housing, remove shifter housing,cover. Next, remove cotter pin, nut and arm from shifter shaft. Remove shifter housing cap screws and housing, as shown in Illust. 13.

As shown in Illust. 14, remove upper shaft snap ring from groove in upper transmission cover.

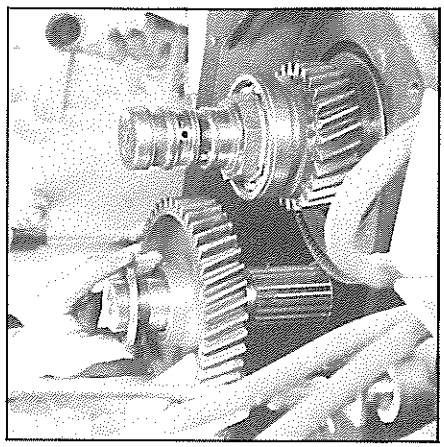
Remove upper transmission cover cap screws. Next, install two (2) guide or pivot cap screws. Using a puller, as shown in Illust. 15, pull cover from housing and over guide or pivot cap screws. Tap cover occasionally with a mallet while using puller. After cover is removed,



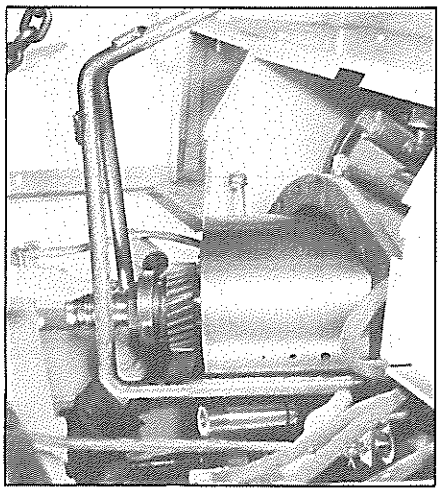
ILLUST. 16



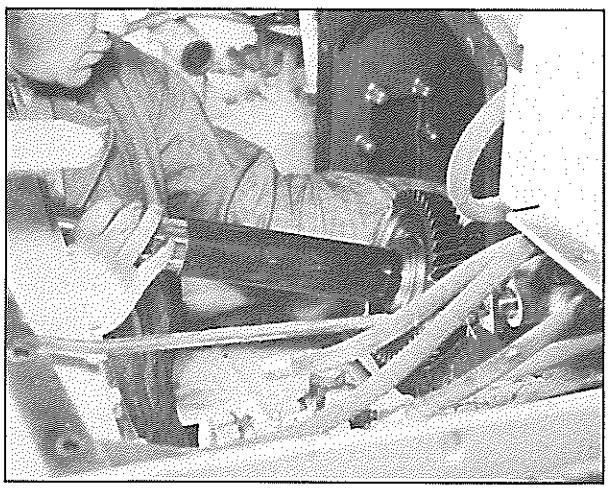
ILLUST. 17



ILLUST. 18



ILLUST. 19



ILLUST. 20

remove guide or pivot cap screws.

As shown in Illust. 16, disconnect drive coupling by removing cap screws. When cap screws are removed, slide coupling on splines toward engine. Note: When reassembling coupling, tighten cap screws to a torque reading of 65 foot pounds.

Remove upper shaft lock cap screw, as shown in Illust. 17.

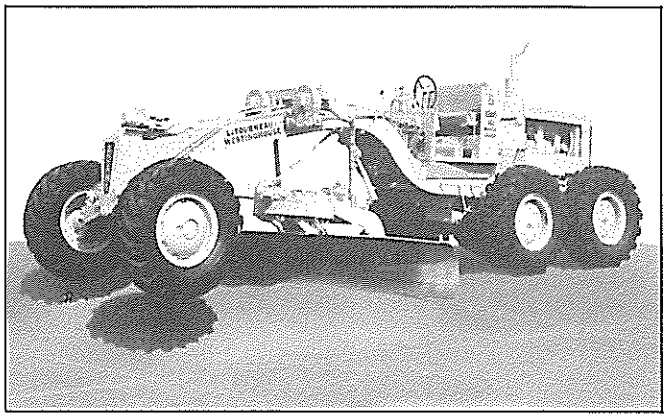
As shown in Illust. 18, remove spacer and gear from lower shaft.

Using a hoist and lifting tool, clutch shaft assembly can now be removed from upper transmission, as shown in Illust. 19. Now that the clutch shaft assembly has been removed, remove lower shaft, as shown in Illust. 20.

To reassemble upper transmission, merely reverse disassembly procedure.

Whenever repairs to the transmission become necessary, the complete transmission and tandem assemblies must be removed. The following instructions and illustrations may be used for machines equipped with either Cummins or General Motors engines.

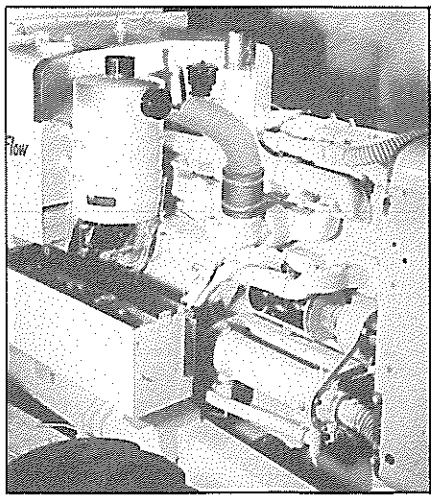
As shown in Illust. 1, turn the moldboard of the grader crosswise to the center line of the frame and lower it to the ground. Raise front end of grader, with lift power control levers, until front wheels are approximately 10 inches above the ground.



ILLUST. 1

Illust. 2. Remove muffler, air cleaner cap or air pre-cleaner, hood and lower hood sides. Next, remove air cleaner hose between air cleaner and elbow.

Fuel Tank Removal

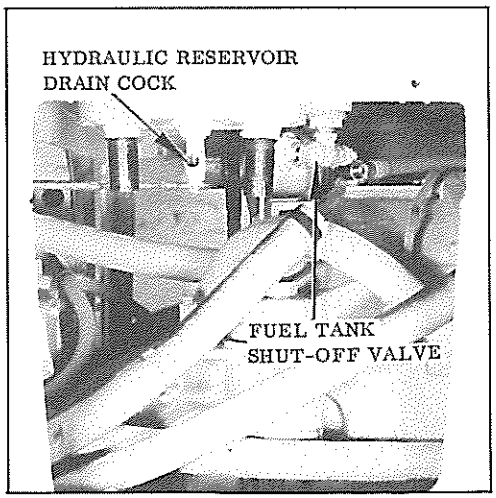


ILLUST. 2

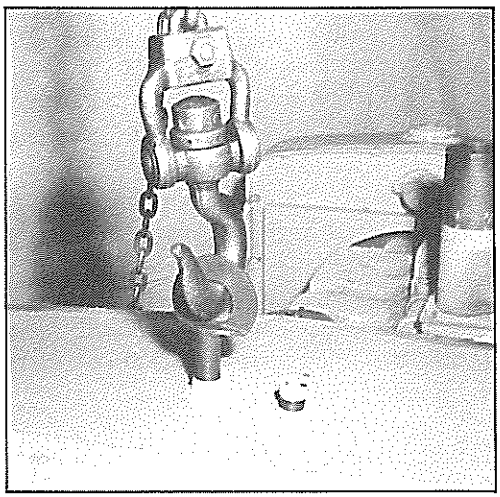
Illust 3. Drain hydraulic reservoir. Install a suitable length of hose into drain cock. Open drain cock and drain oil into container. When reservoir is empty, close drain cock and remove hose. Next, shut fuel off at fuel shut-off valve. Disconnect fuel outlet line and return line. Disconnect vent pipe from top of tank.

Remove ground wire clamp. Remove fuel tank support anchor cap screws, nuts and lock washers.

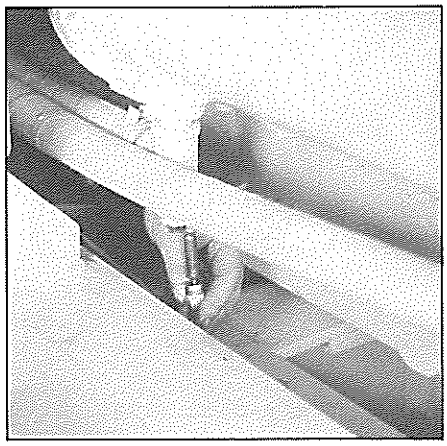
Remove reducer from top of fuel tank. Install a lift eye into reducer hole, as shown in Il-



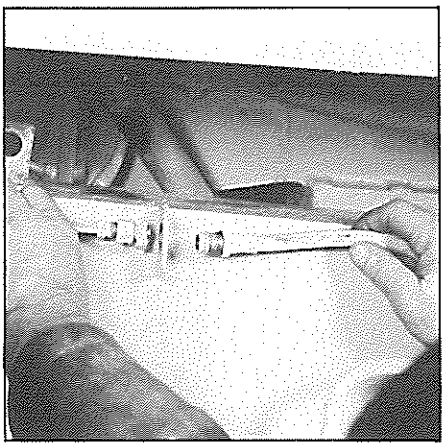
ILLUST. 3



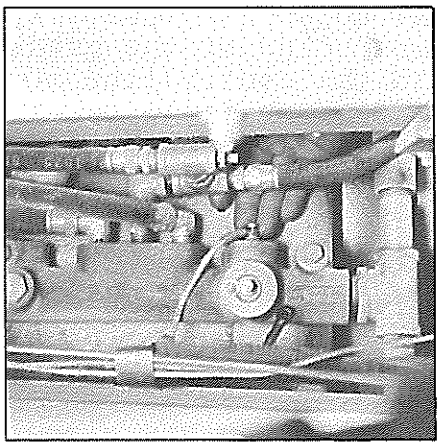
ILLUST. 4



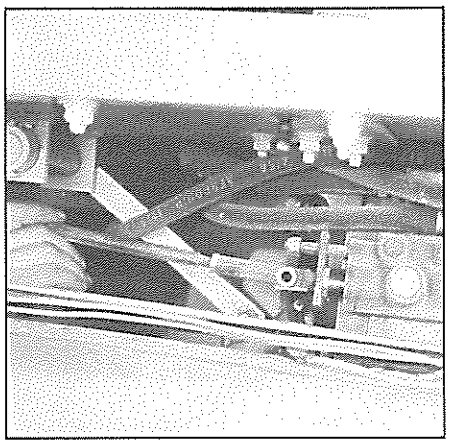
ILLUST. 5



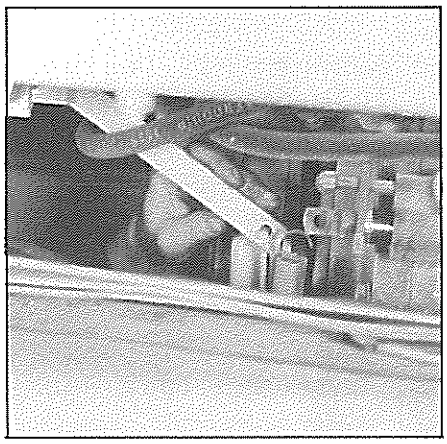
ILLUST. 6



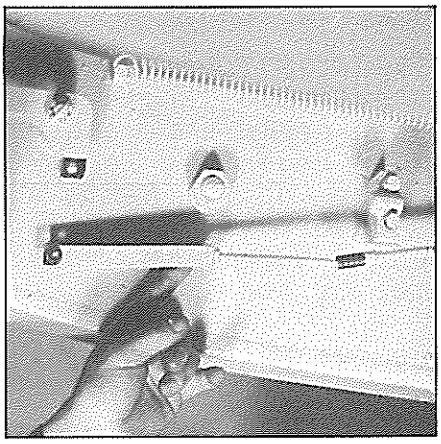
ILLUST. 7



ILLUST. 8



ILLUST. 9



ILLUST. 10

lust. 4. Lift fuel tank from frame, using a chain hoist.

Remove temperature gauge line from heat exchanger, as shown in Illust. 5.

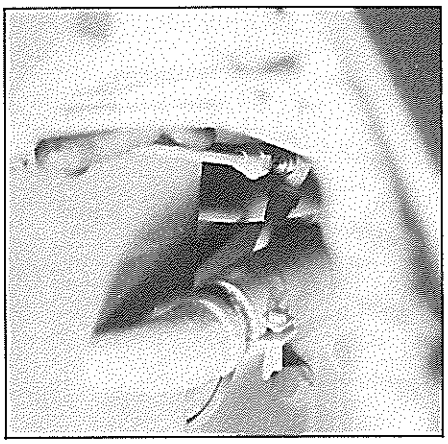
Disconnect brake lines, as shown in Illust. 6.

Remove both cab closure plates. Next, disconnect wires from control valve switches, as shown in Illust. 7.

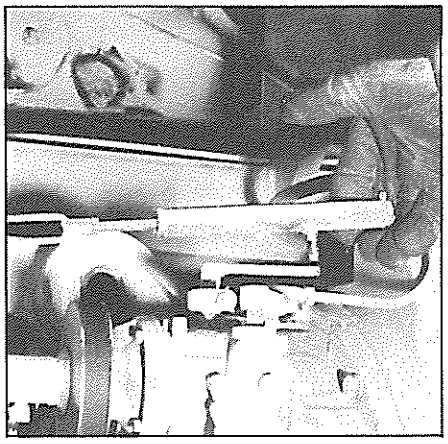
Disconnect control valve assembly linkage, as shown in Illust. 8.

Remove clutch brake spring from clutch brake foot lever, as shown in Illust. 9.

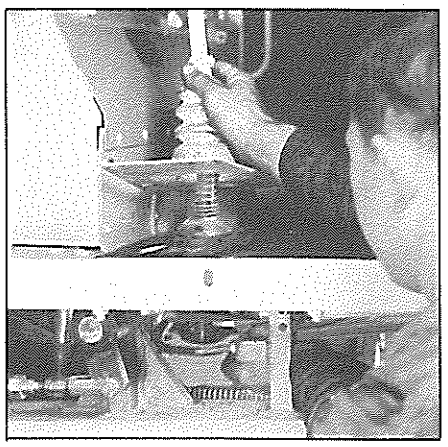
Disconnect parking brake cable from frame bracket and arm, as shown in Illust. 10.



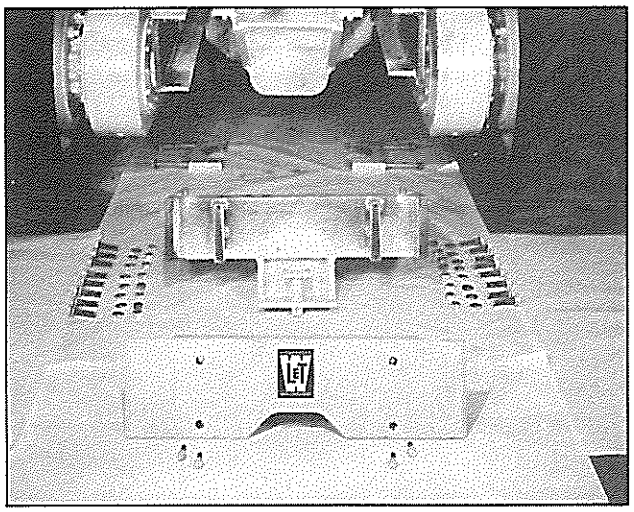
ILLUST. 11



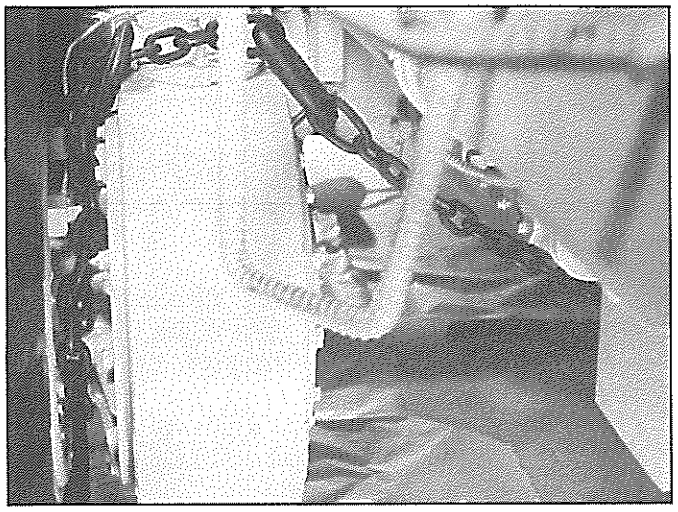
ILLUST. 12



ILLUST. 13



ILLUST. 14



ILLUST. 15

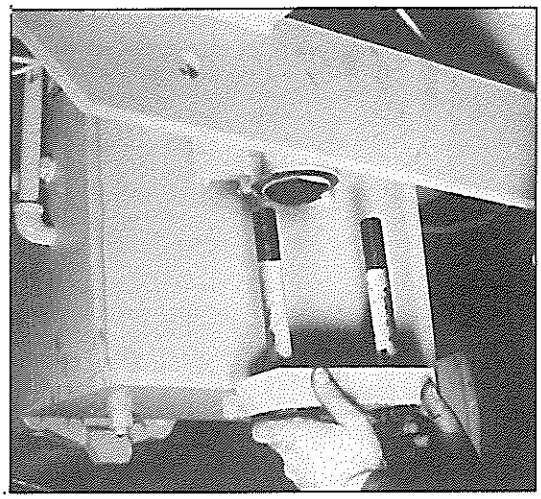
Disconnect parking brake hydraulic line, as shown in Illust. 11.

Disconnect throttle linkage from tail shaft governor (Cummins engine), as shown in Illust. 12.

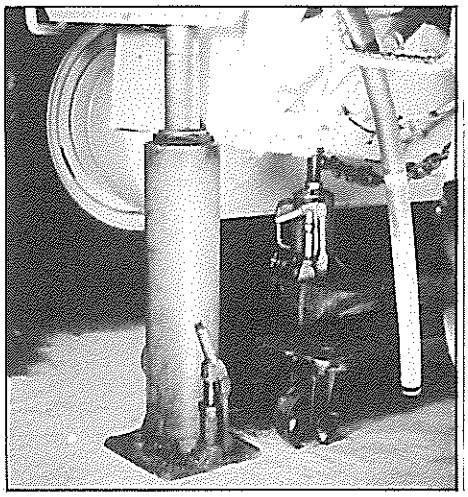
To disconnect throttle linkage on General Motors engine, remove throttle cable U clamp from bracket. Next, disconnect throttle linkage from tail shaft governor.

Remove shifter lever floor plate cap screws and shifter housing cover cap screws. Remove shifter lever, as shown in Illust. 13.

Note: Heat exchanger must be removed from the General Motors engine. To remove heat exchanger, drain radiator and heat exchanger. Disconnect battery cables. Remove batteries and battery box. Next, remove hose and temperature gauge line from exchanger. Remove heat exchanger cap screws and lift exchanger from engine.



ILLUST. 16

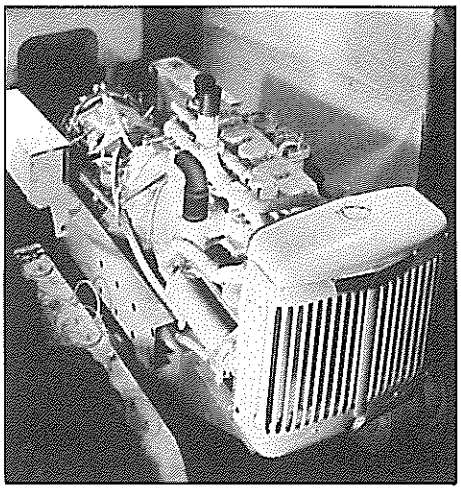


ILLUST. 17

Remove rear closure plate cap screws and rear closure plate from rear cross member. Next, remove rear cross member cap screws from frame and slide rear cross member from frame. Remove rear axle cap screws and caps, as shown in Illust. 14.

Attach a chain around front portion of each tandem, using care not to crush brake line. Bring chain under front end of transmission, as shown in Illust. 15. The chain will act as a safety measure preventing the unit from pivoting forward as unit is rolled from frame.

As shown in Illust. 16, remove transmission support clamp bar.



ILLUST. 18

Use two (2) hydraulic jacks, one (1) on a dolly under front end of transmission and the other jack under moldboard stop angle on frame, as shown in Illust. 17. Alternate the raising of frame and front of transmission until there is clearance between shifter housing and moldboard stop angle, axle carriers and frame. When clearance is obtained, at these points, roll unit from frame, as shown in Illust. 18. The power take-off shaft will slide off chain housing splined shaft. Anchor power take-off shaft to upper transmission housing with wire, to prevent shaft universal from catching on frame.

To install unit into frame, reverse removal procedure.

TRANSMISSION

Assuming the transmission has been completely torn down, the following instructions and illustrations will aid in the reassembly of the transmission.

Inspection

Inspect all parts for damage and wear. Always replace gaskets.

Reassembly

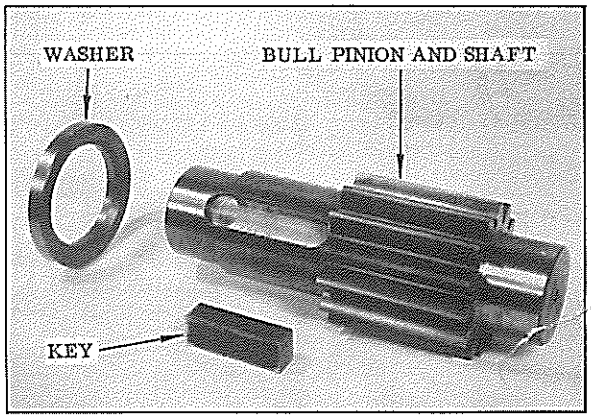
As you will note throughout this section, certain parts must be heated sufficiently in oil before assembling. The oil should be heated to a temperature of approximately 350° F.

Final Drive

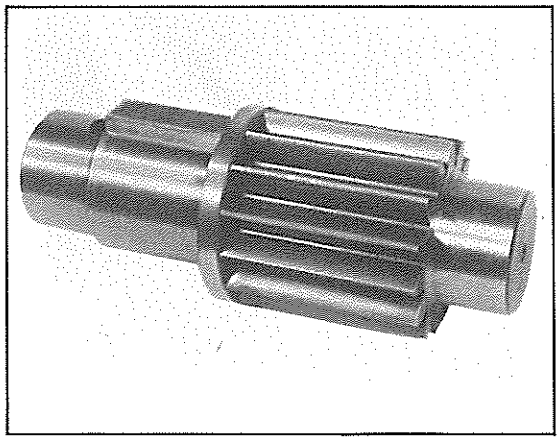
Illust. 1 is an exploded view of the bull pinion and shaft.

Illust. 2. Heat washer in oil and press onto bull pinion shaft. Inside chamfered edge of washer against pinion. Next, insert key in keyway.

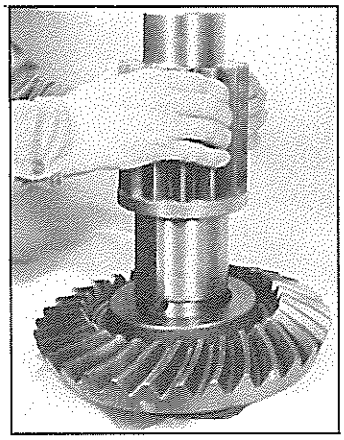
Heat spiral bevel gear in oil. Press bull pinion shaft through spiral bevel gear, as shown in Illust. 3. Hold in press until gear is set. Note: Be sure gear is tight against washer.



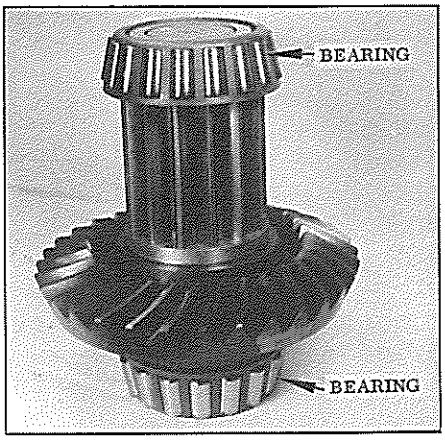
ILLUST. 1



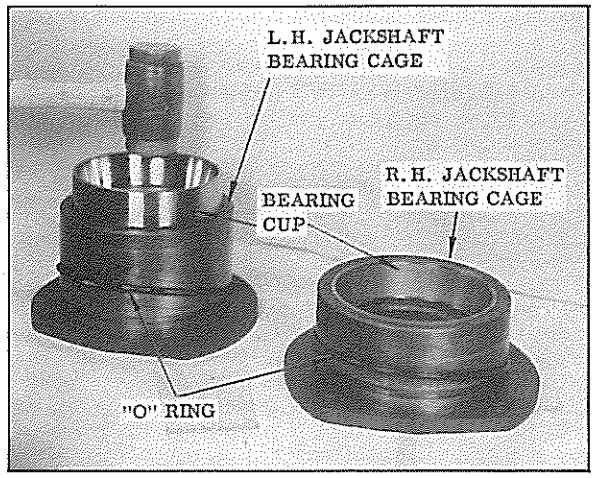
ILLUST. 2



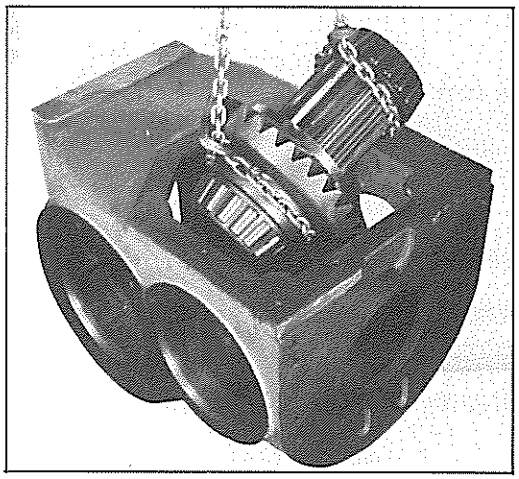
ILLUST. 3



ILLUST. 4



ILLUST. 5



ILLUST. 6

To remove spiral bevel gear from bull pinion and shaft, use a 100 ton press.

Illust. 4. Heat bearings in oil and press onto bull pinion and shaft. Hold bearings until set.

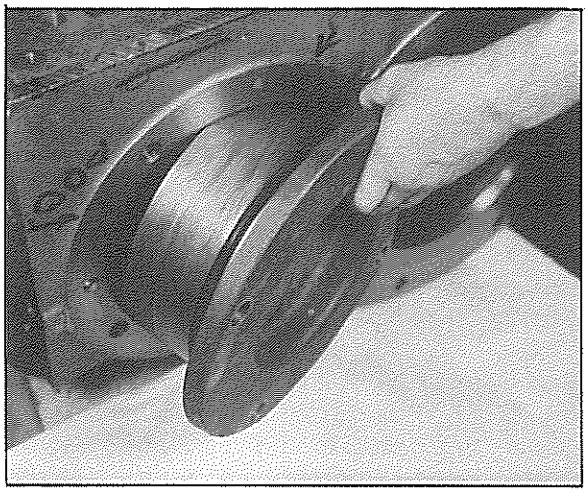
Drive bearing cups into L.H. and R.H. jackshaft bearing cages, as shown in Illust. 5. Next, install "O" rings in grooves of jackshaft bearing cages.

Install bull pinion and shaft assembly into final drive housing, as shown in Illust. 6.

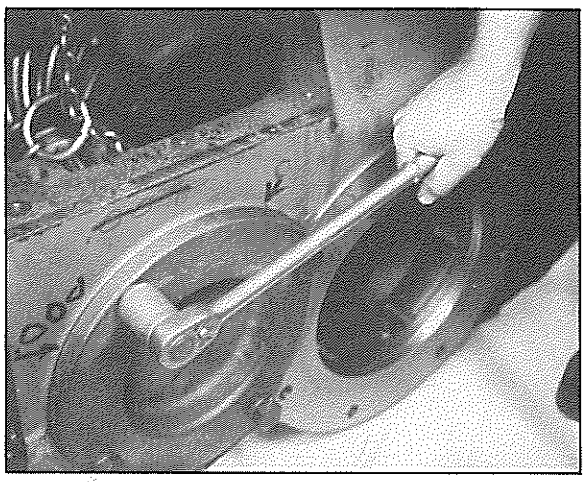
Insert left hand jackshaft bearing cage less shims (cage with long hub) onto left side of final drive housing and over bearing of bull pinion and shaft, as shown in Illust. 7.

To determine the left and right side of final drive, stand in rear of machine and look toward the front of machine, Next, install cap screws and lock washers. Tighten cap screws, as shown in Illust. 8.

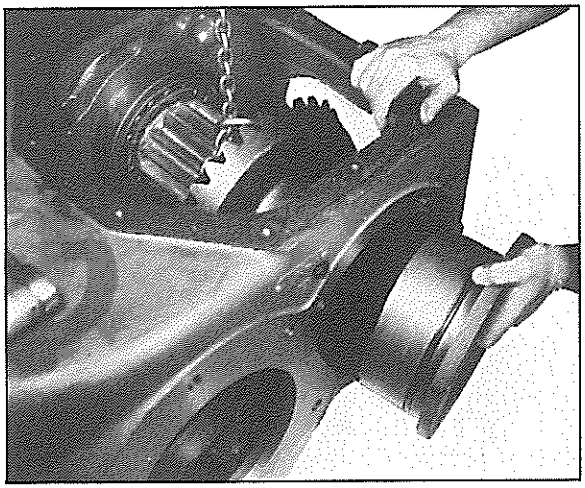
Insert right hand jackshaft bearing cage less shims (cage with short hub) onto right side of final drive housing and over bearing of bull pinion and



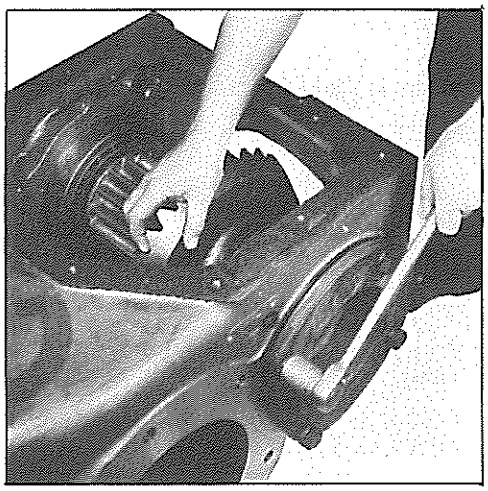
ILLUST. 7



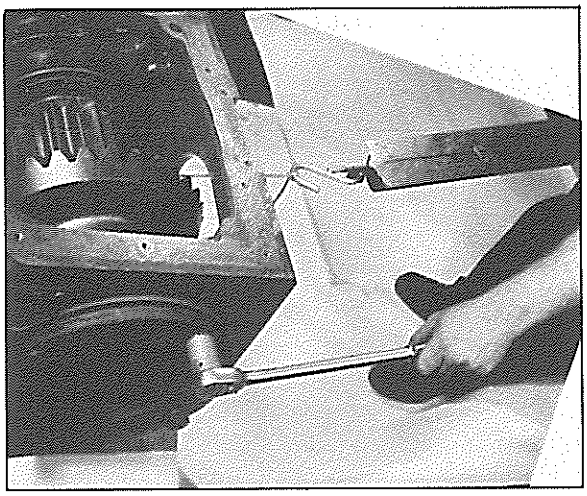
ILLUST. 8



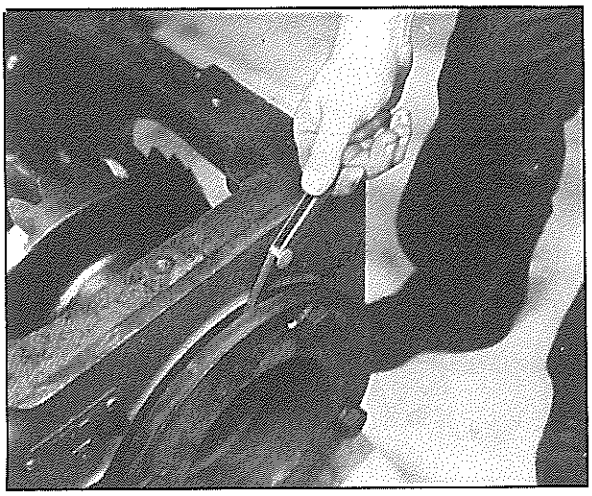
ILLUST. 9



ILLUST. 10



ILLUST. 11



ILLUST. 12

shaft, as shown in Illust. 9. Install cap screws and lock washers. While tightening cap screws, rotate bevel gear, as shown in Illust. 10. This will seat bearings in bearing cups. Continue tightening cap screws until a slight drag is noted on pinion shaft assembly. The next step is to pre-load the bearings.

To pre-load the bearings, use a piece of rope and fish scale. Wrap one end of rope around pinion teeth. Attach a fish scale to the other end of rope. Pull on fish scale and at the same time tighten jackshaft bearing cage cap screws, as shown in Illust. 11, until a reading of 14-1/2 to 18 pull pounds is obtained. After this reading is obtained, use a feeler gauge, as shown in Illust. 12, to measure the gap between bearing cage and final drive housing. Next, remove bearing cage and install correct amount of shims required to fill gap. Install bearing cage with shims. Install and tighten cap screws with lock washers securely. Recheck pull poundage.

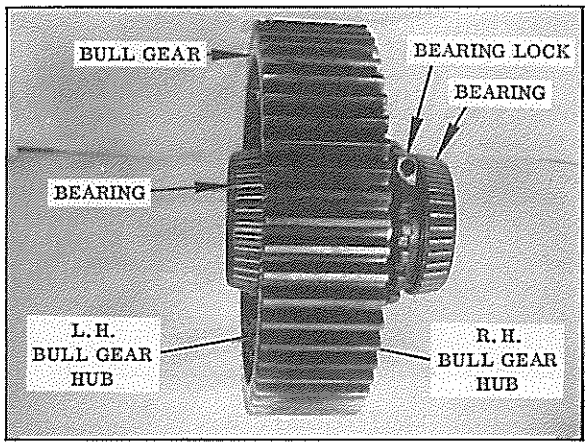
Bull Gear

Illust. 1 is an assembly view of bull gear.

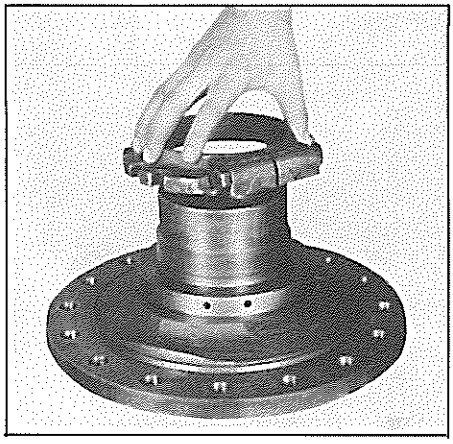
Install bearing lock to right hand bull gear hub, as shown in Illust. 2. Screw bearing lock on hub until lock has passed the bearing seat. Next, heat bearing in oil and press onto bull gear hub, as shown in Illust. 3. Hold until bearing is set.

Heat bearing in oil and press onto left hand bull gear hub, as shown in Illust. 4.

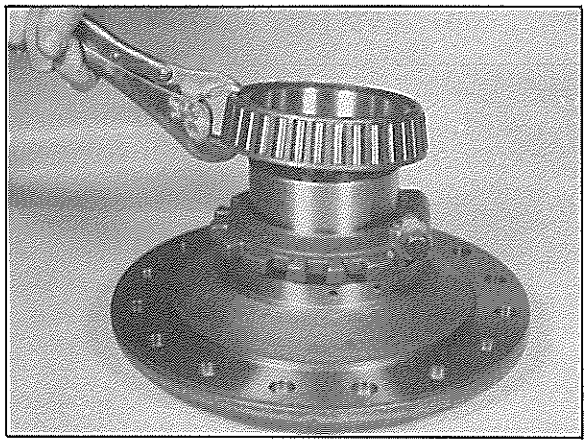
Install left and right hand hub as-



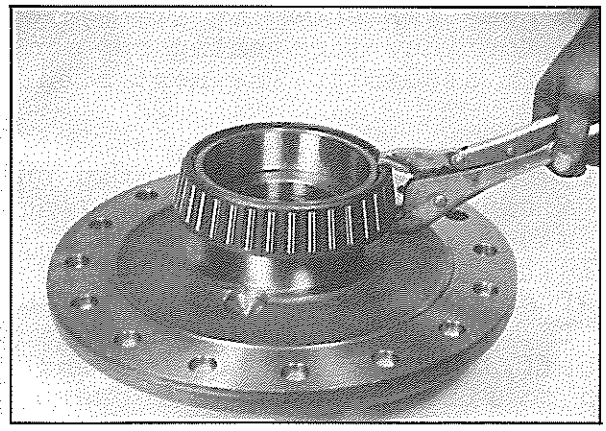
ILLUST. 1



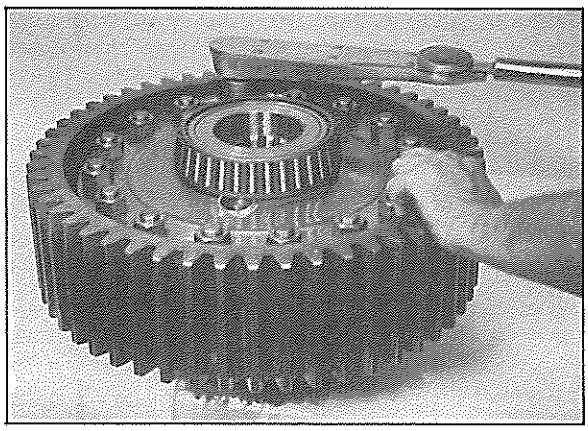
ILLUST. 2



ILLUST. 3



ILLUST. 4



ILLUST. 5

semblies to bull gear. Align cap screw holes and insert heat treated cap screws through right hand hub, bull gear and left hand hub. Apply white lead or a sulphur based oil to prevent gaulding of locking nuts. Install locking nuts and tighten to a torque reading of 265 foot pounds, as shown in Illust. 5.

Axle Carriers

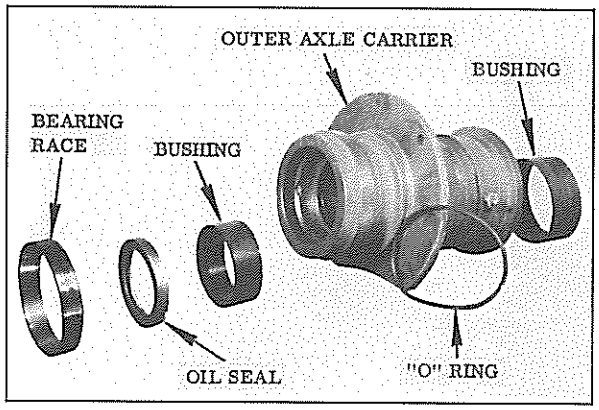
Illust. 1 is an exploded view of the outer axle carrier.

Press or drive large bushing into outer axle carrier. Groove in I.D. of bushing to align with groove in axle carrier, as shown in Illust.2. Lubricate bushing with oil before pressing or driving into axle carrier. Next, install "O" ring into groove of outer axle carrier.

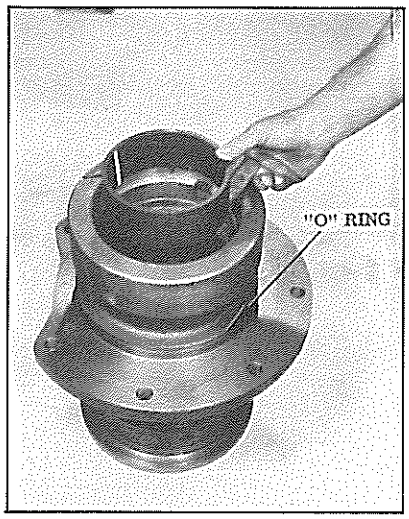
Press or drive grease seal into outer axle carrier, as shown in Illust. 3. Lip of seal away from bushing. When driving grease seal into axle carrier, use a soft drift pin so as not to damage seal.

Press or drive bearing race into outer axle carrier, as shown in Illust. 4. Use a mallet, when driving bearing cups, so as not to damage race.

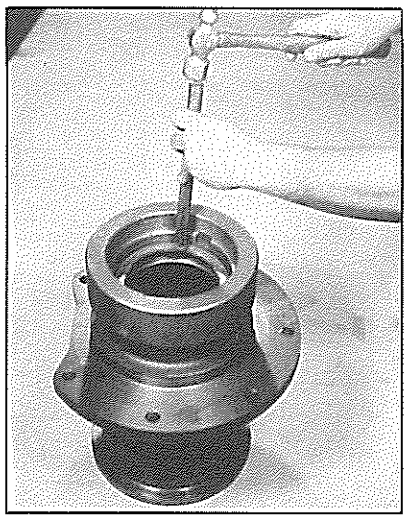
Turn outer axle carrier over. Press or drive small diameter bushing into outer axle carrier, flush with inside shoulder of carrier, as shown in Illust. 5. Lubricate bushing with oil, before driving or pressing into axle carrier.



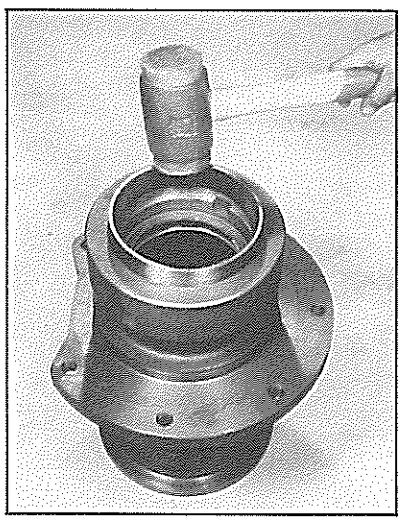
ILLUST. 1



ILLUST. 2



ILLUST. 3

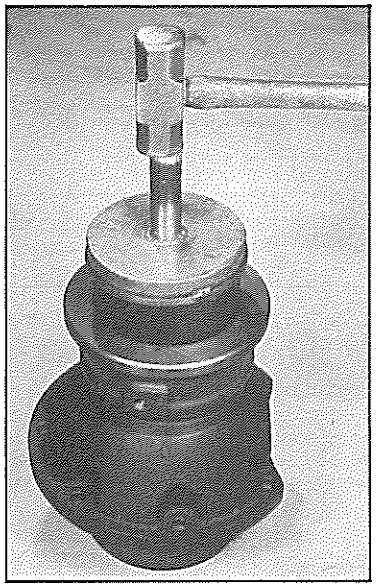


ILLUST. 4

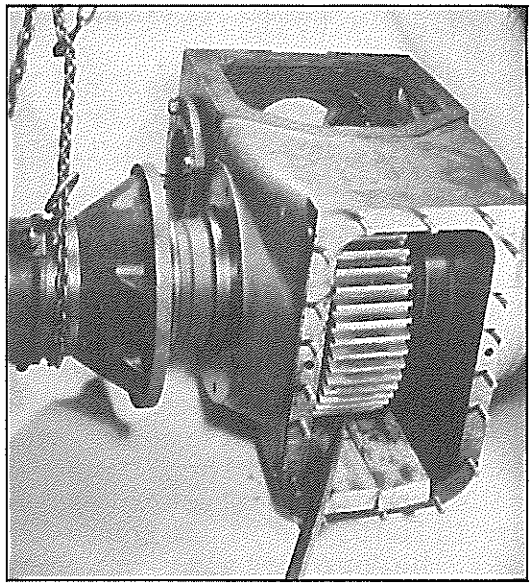
Roll bull gear assembly into position in final drive housing, with bearing lock to the right side. Align bull gear assembly with axle carriers, by using blocks. Install left hand outer axle carrier to final drive housing, as shown in Illust. 6. Install cap screws with lock washers and tighten to a torque reading of 275 foot pounds, as shown in Illust. 7. Install right hand outer axle carrier in the same manner.

Install oil seal and split thrust ring on outer axle carrier, as shown in Illust. 8.

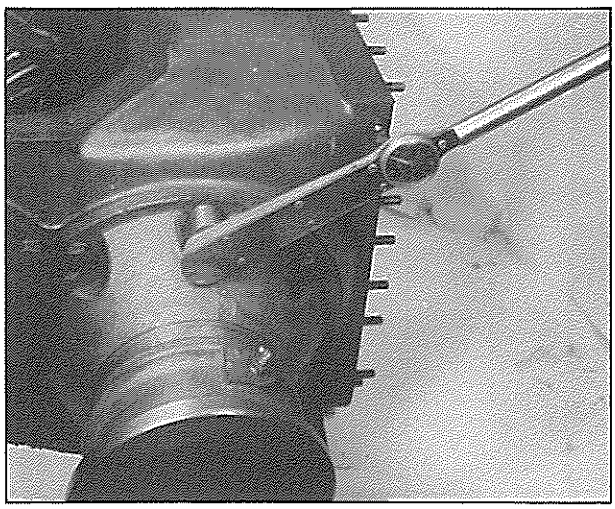
Press or drive oil seal into inner axle carrier, as shown in Illust.9. Lip of seal toward long hub of carrier. When driving seal into car-



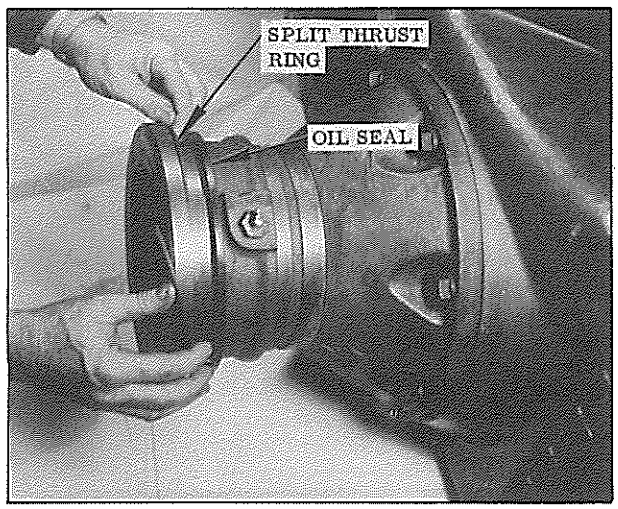
ILLUST. 5



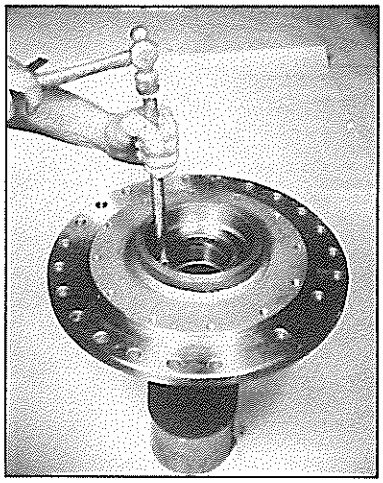
ILLUST. 6



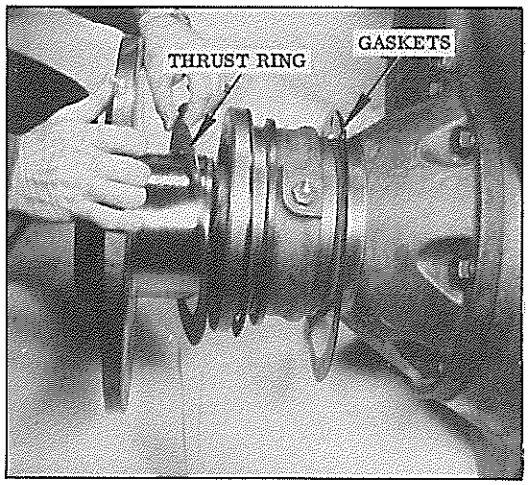
ILLUST. 7



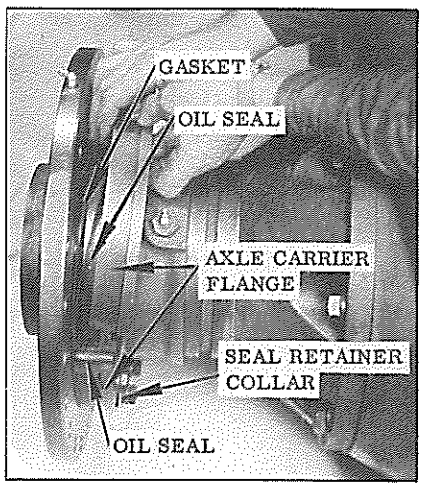
ILLUST. 8



ILLUST. 9



ILLUST. 10



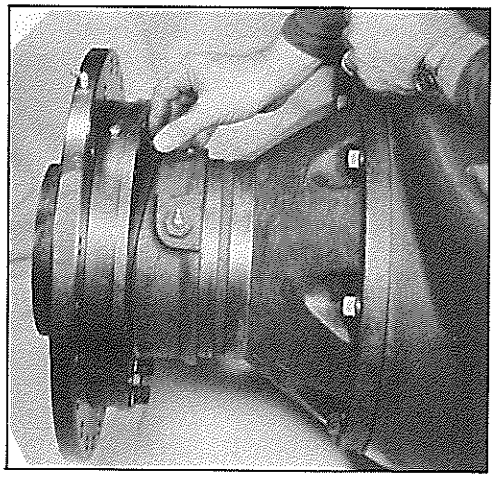
ILLUST. 11

rier, use a soft drift pin so as not to damage seal.

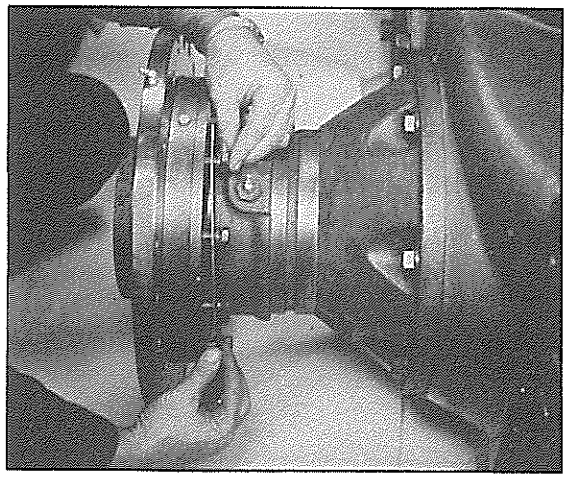
Install gaskets onto outer axle carrier. Next install thrust ring onto inner axle carrier and insert inner axle carrier into outer axle carrier, as shown in Illust. 10.

Install lower half of axle carrier flange and one section of seal retainer collar on outer axle carrier and over oil seal, as shown in Illust. 11. Oil seal to fit in groove of lower flange. Install cap screws with lock washers through seal retainer collar, axle carrier flange and into inner axle carrier to hold in place. Next, install the two (2) small oil seals, as illustrated, one on each end of lower flange.

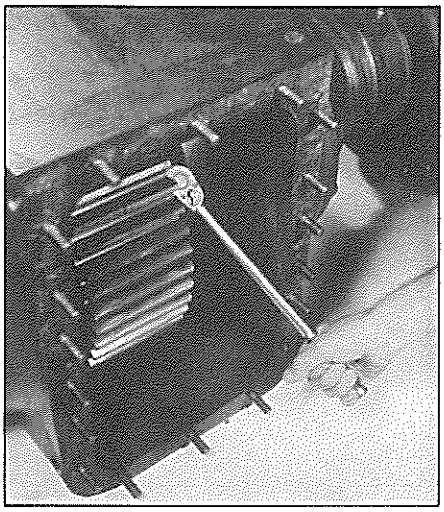
Install upper half of flange to outer axle carrier and over the small oil seals on each end of lower flange. Groove of upper flange over large oil seal, as shown in Illust. 12. Next, install the other two (2)



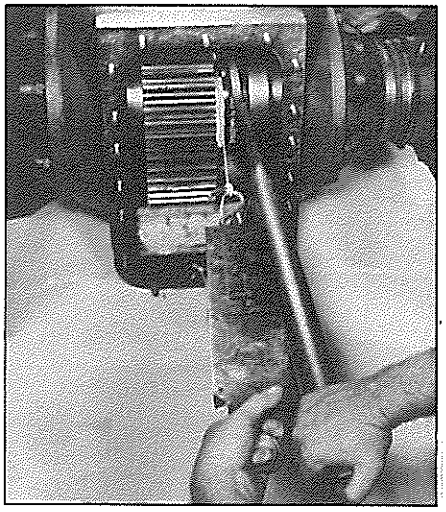
ILLUST. 12



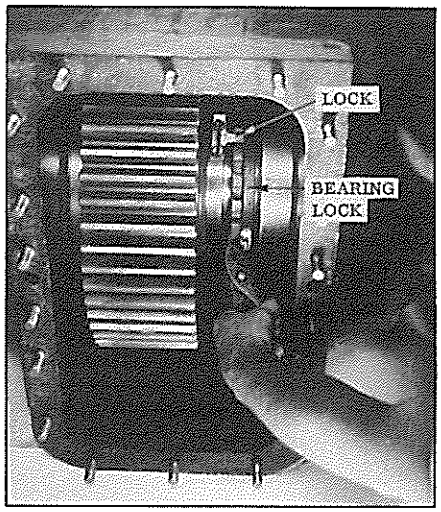
ILLUST. 13



ILLUST. 14



ILLUST. 15



ILLUST. 16

oil seal retainer collars. Insert cap screws with lock washers, through seal retainer collars, axle carrier flange and into inner axle carrier, as shown in Illust. 13. Tighten all cap screws securely.

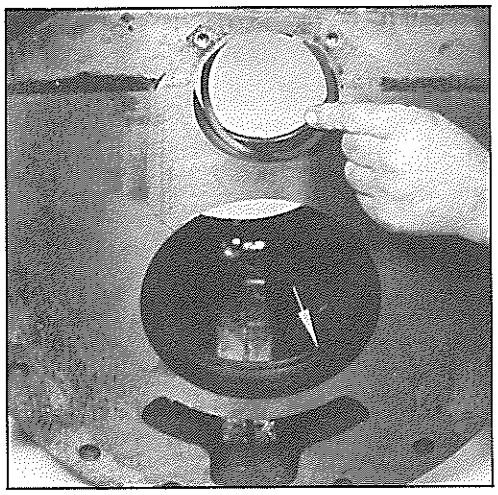
Rotate inner axle carrier and check for drag and end play in carrier. If inner axle carrier is not free to rotate, add sufficient amount of shims between the upper and lower flange and inner axle carrier. If inner axle carrier has end play, replace thrust ring.

Tighten bearing lock cap screw securely, as shown in Illust. 14. After cap screw is tightened, loosen cap screw 1-1/2 rounds. Next, pre-load the bull gear by first wrapping one end of a piece of rope around bull gear hub, as shown in Illust. 15. Attach a fish scale to the other end of the rope. Now, by using a spanner wrench and pulling on the fish scale, tighten the bearing lock until a rolling torque reading of 19-1/2 to 25 pounds is obtained. After the rolling torque is obtained, install lock and lock cap screws. Tighten cap screws securely. Insert wire through heads of cap screws and twist wire to lock. Next, tighten bearing lock cap screw securely. Insert a piece of wire through head of bearing lock cap screw and through ear of bearing lock. Lock wire by twisting, as shown in Illust. 16.

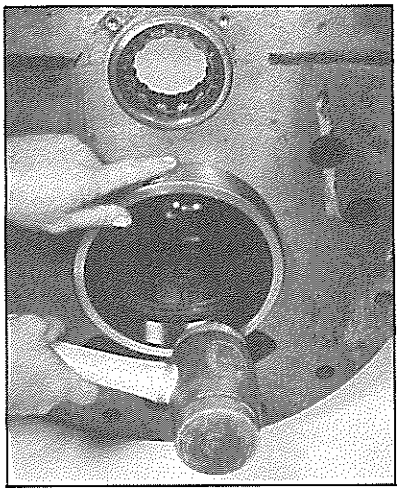
LOWER TRANSMISSION

Install snap rings in grooves of large and small bore of lower transmission housing, as shown in Illust. 1.

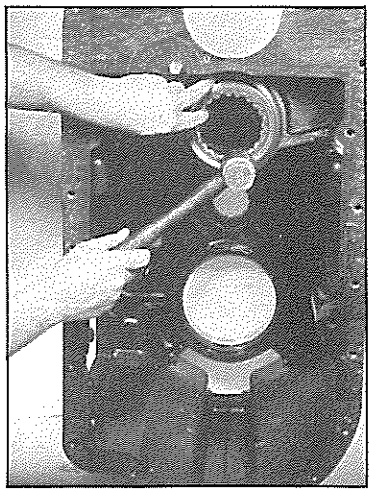
Press or drive bearing into small bore of lower transmission housing, as shown in Illust. 2. Note: This bearing may extend slightly over the face of the housing. Next press or drive bearing race into large bore of housing. Note: This race must be flush or under flush with face of housing.



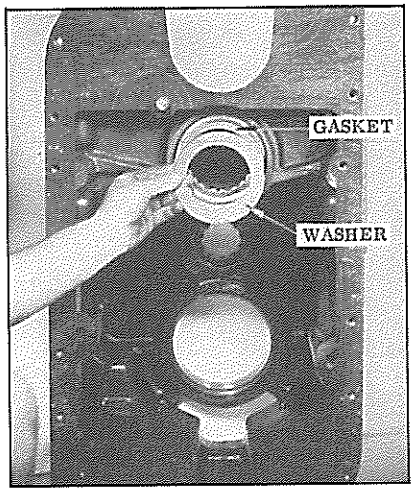
ILLUST. 1



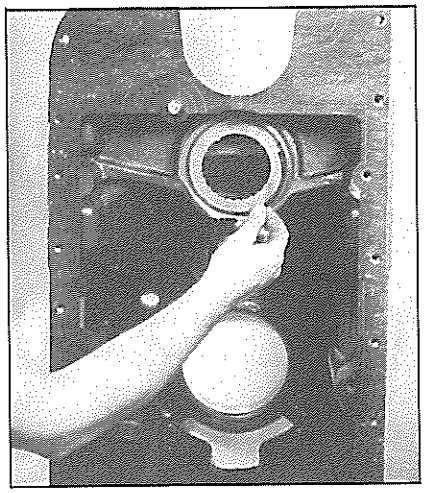
ILLUST. 2



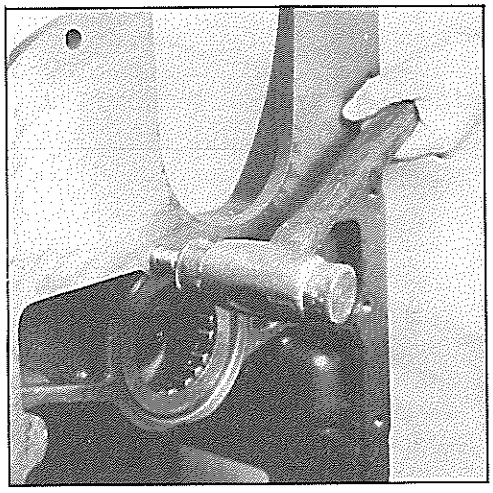
ILLUST. 3



ILLUST. 4



ILLUST. 5



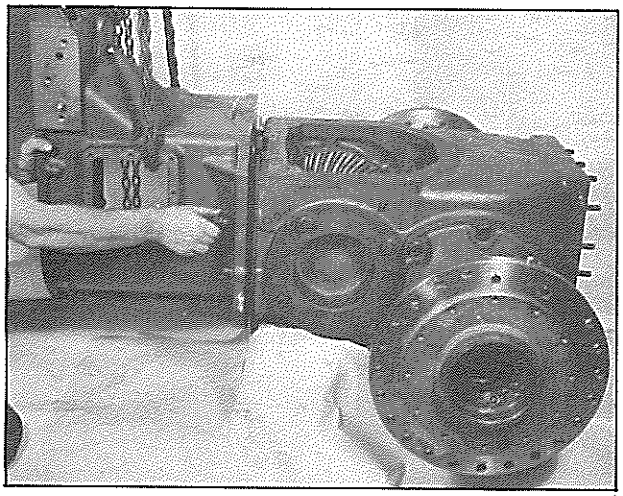
ILLUST. 6

Press or drive upper shaft bearing into housing, as shown in Illust. 3. Next, install one or more gaskets and washer into bore, as shown in Illust. 4. Note: Use only enough gaskets behind washer to fill gap between washer and snap ring groove. Next, install snap ring in groove of bore, as shown in Illust. 5.

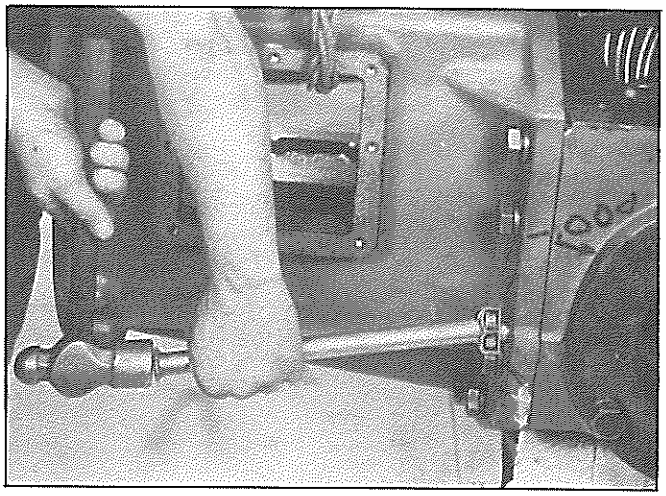
Drive dowel pin into housing, as shown in Illust. 6.

Insert dowel pins in lower transmission housing. Do not drive pins through housing. Next, shellac gasket surface of final drive housing and install gasket.

Install lower transmission housing to final drive housing, as shown in Illust. 7. Install cap screws with lock washers. Do not tighten cap screws.



ILLUST. 7



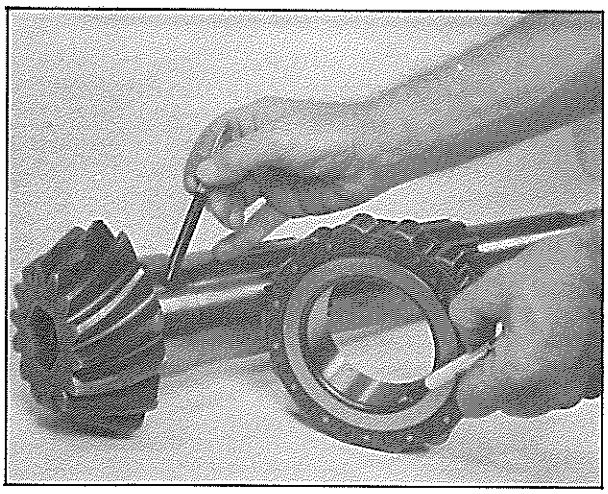
ILLUST. 8

Drive dowel pins through lower transmission housing and into final drive housing, as shown in Illust. 8. To prevent damage to dowel pin threads, install a nut on threads. Use a soft drift pin or mallet in driving pin. Remove nut when dowel pins are seated. Tighten cap screws to a torque reading of 190 foot pounds.

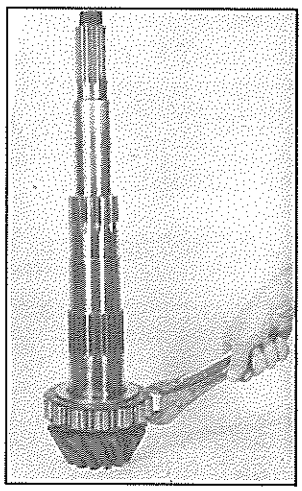
Spiral Pinion Shaft

Heat spiral pinion shaft bearing in oil. Press or drive bearing onto shaft with the radius of bearing against spiral pinion, indicated with pencils in Illust. 1. Hold pinion until set, as shown in Illust. 2.

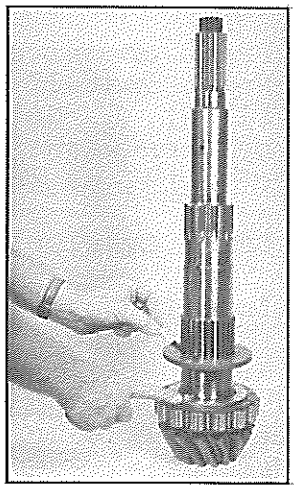
Insert pin in pinion shaft, as indicated with finger, in Illust. 3. Next, install spacer. Slot in spacer, as indicated with pencil, over head of pin and against bearing.



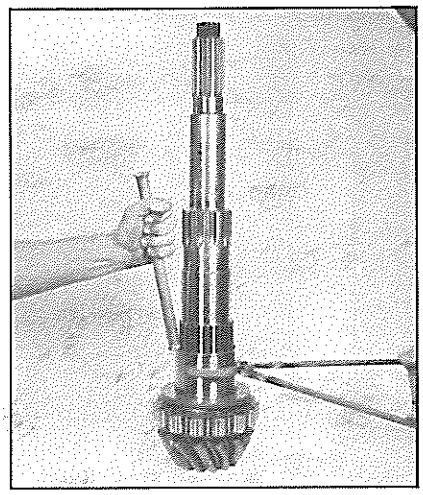
ILLUST. 1



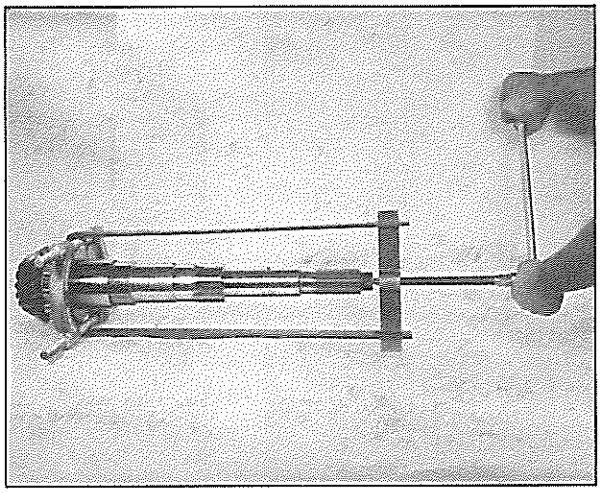
ILLUST. 2



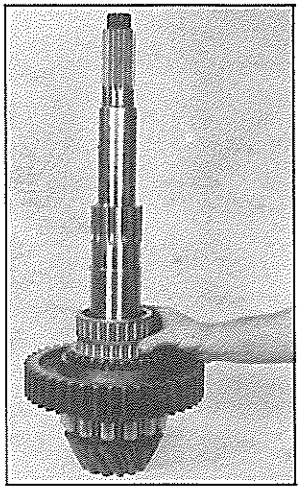
ILLUST. 3



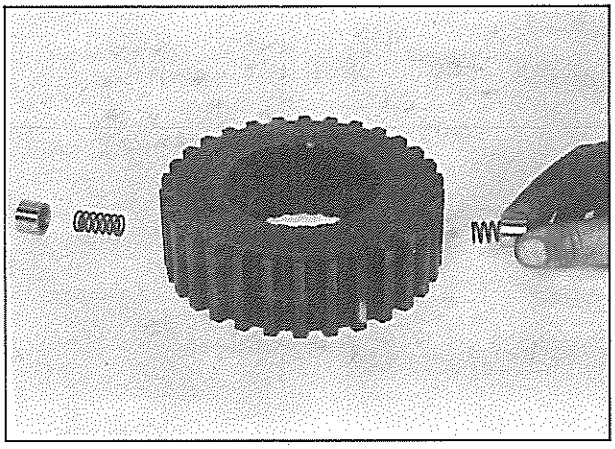
ILLUST. 4



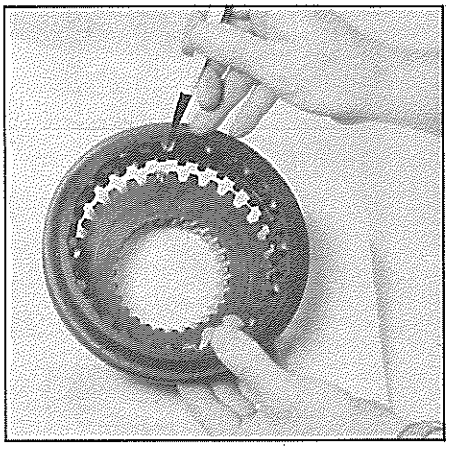
ILLUST. 5



ILLUST. 6



ILLUST. 7



ILLUST. 8

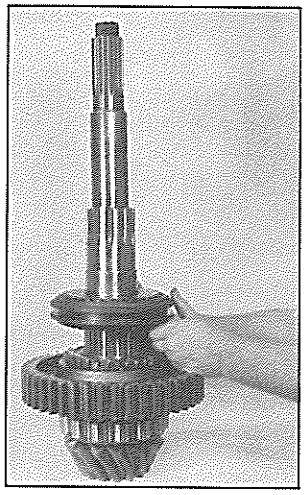
Heat inner race in oil and install onto pinion shaft, as shown in Illust. 4. Hold inner race until set.

To prevent breakage of pin and removal of spacer and bearing race, use a puller as shown in Illust. 5.

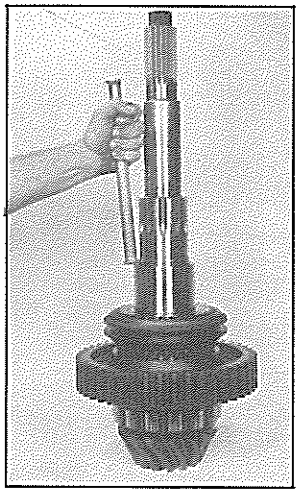
Install 44 tooth gear (1st gear) onto pinion shaft with chamfered end of gear hub against spacer, as shown in Illust. 6. Next, insert the two (2) bearings into gear, as illustrated.

Insert poppet springs and poppets into shifter gear, as shown in Illust. 7.

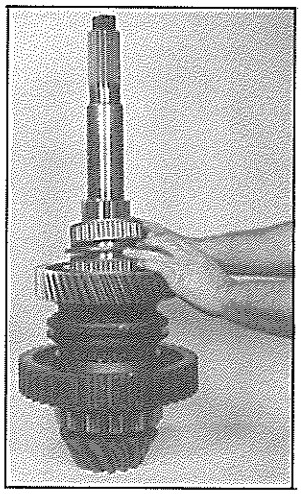
Install shifter collar over poppets and onto shifter gear, as shown in Illust. 8. Note that shifter collar has four (4) tapered teeth. Two (2) to each side of collar. Install collar so as two (2) tapered teeth slide over poppets and the poppets fall in groove in collar.



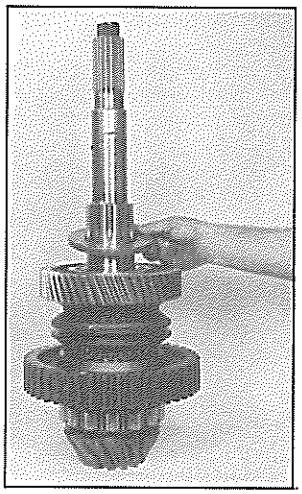
ILLUST. 9



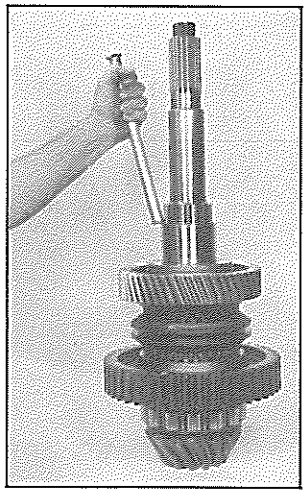
ILLUST. 10



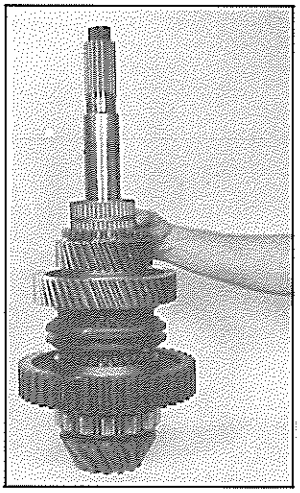
ILLUST. 11



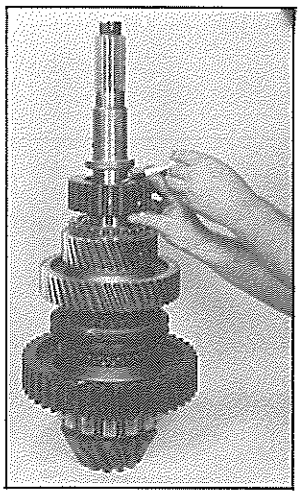
ILLUST. 12



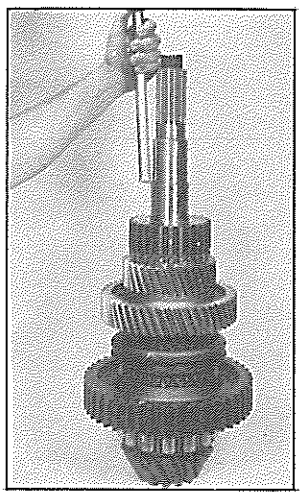
ILLUST. 13



ILLUST. 14



ILLUST. 15



ILLUST. 16

Install shifter gear with collar onto pinion shaft, as shown in Illust. 9.

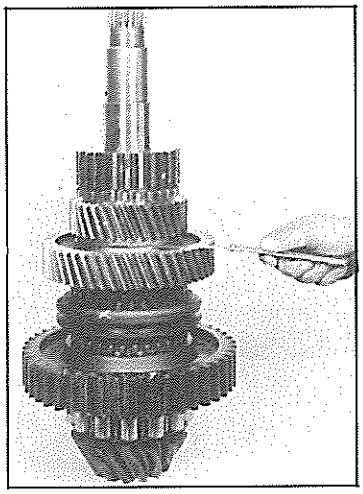
Heat inner race in oil and install onto pinion shaft, as shown in Illust. 10.

Install 49 tooth gear (2nd gear) onto pinion shaft. Next, insert bearing, spacer and second bearing into gear, as shown in Illust. 11.

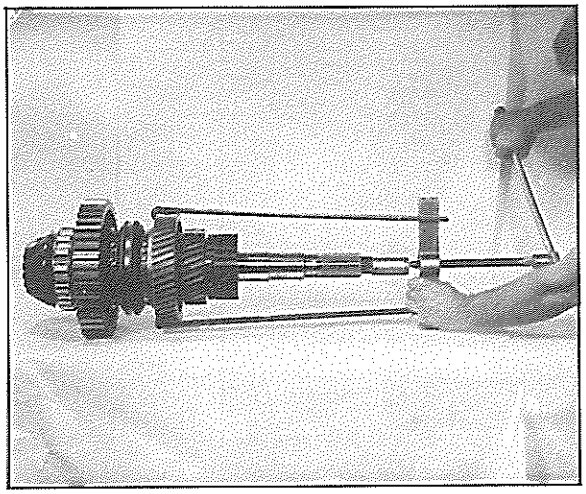
Insert pin in pinion shaft. Next, install spacer, as shown in Illust. 12. Slot in spacer to fit over head of pin.

Heat inner race in oil and install onto pinion shaft, as shown in Illust. 13. Hold race until set.

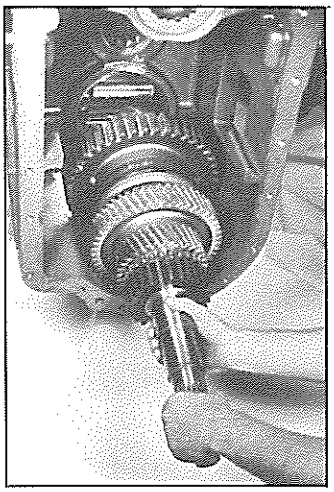
Install 33 tooth gear (3rd gear) onto pinion shaft. Insert bearings into gear, as shown in Illust. 14.



ILLUST. 17



ILLUST. 18



ILLUST. 19

Install 26 tooth shifter gear onto pinion shaft. Counter bore in gear, as indicated by pencil in Illust. 15, away from 33 tooth gear. Next, install spacer onto pinion shaft and into sliding gear. Chamfered edge of spacer next to counter bore of gear. Note: This gear does not have poppets.

Heat inner race in oil and install onto pinion shaft, as shown in Illust. 16. Hold race until set.

Check clearance between the 49 tooth gear and 33 tooth gear, with a feeler gauge, as shown in Illust. 17. The clearance should read .005 to .025.

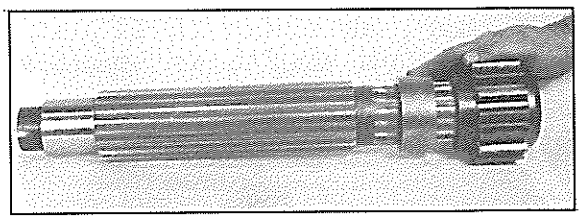
To prevent breakage of pin and removal of gears, use a gear puller, as shown in Illust. 18.

Insert spiral pinion shaft assembly into lower bore of lower transmission housing, as shown in Illust. 19.

Upper Shaft (Lower Transmission)

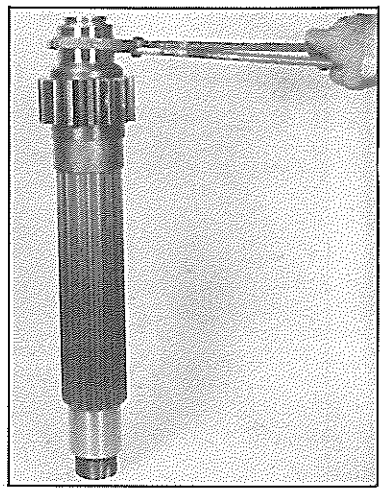
Install spacer and 15 tooth gear (1st gear) onto upper shaft of lower transmission, as shown in Illust. 1. Chamfered end of gear toward snap ring groove in shaft.

Heat inner race in oil and install race onto shaft. Inside chamfer of race toward gear. Hold race until set, as shown in Illust. 2. Next, install snap ring in groove of shaft, as shown in Illust. 3.

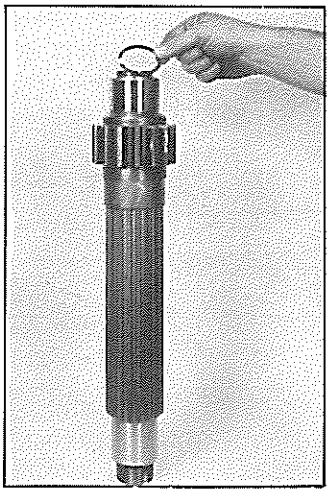


ILLUST. 1

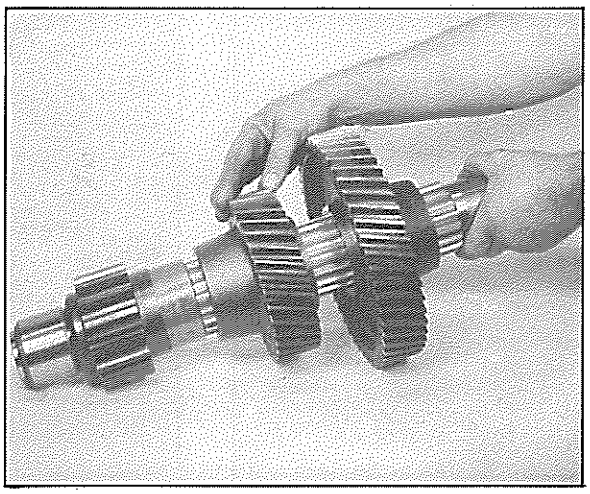
Install 34 tooth gear (2nd gear) onto



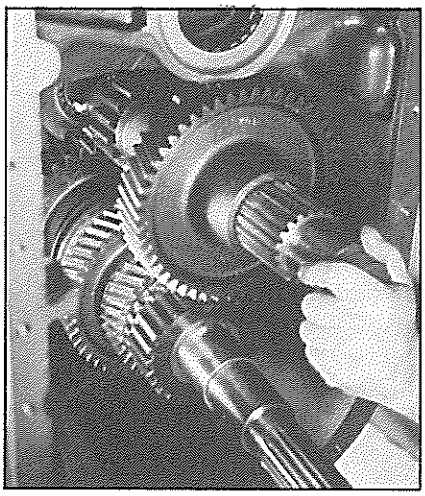
ILLUST. 2



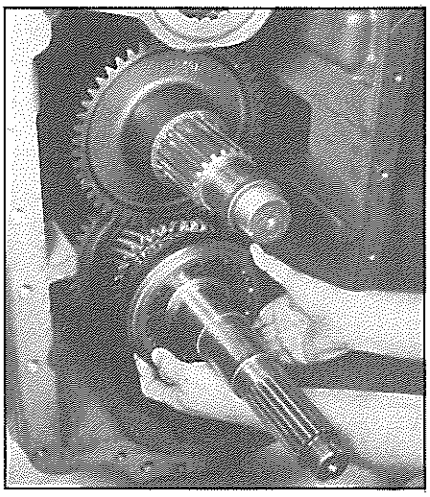
ILLUST. 3



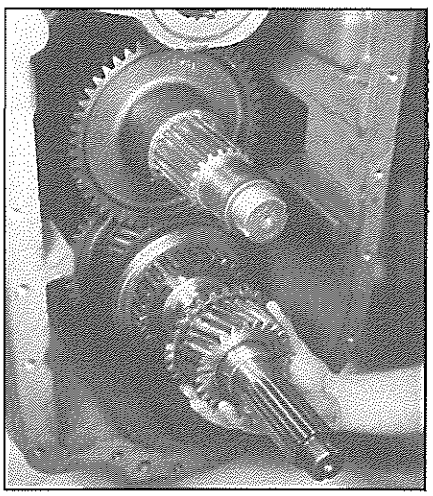
ILLUST. 4



ILLUST. 5



ILLUST. 6



ILLUST. 7

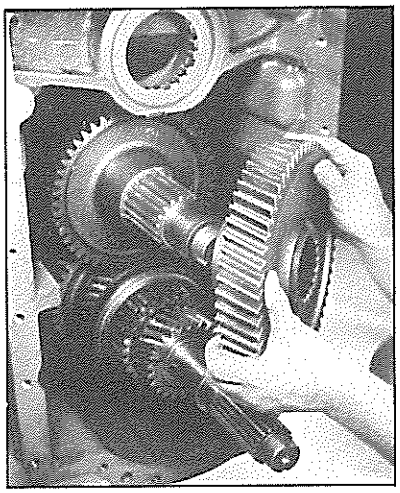
shaft, long end of hub toward spacer. Next, install 50 tooth gear (3rd gear) onto shaft, long hub of gear toward threaded end of shaft, as shown in Illust. 4.

Insert upper shaft assembly into lower transmission, as shown in Illust. 5.

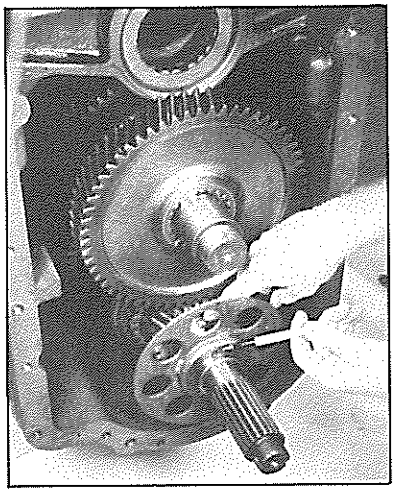
Install shifter collar onto spiral pinion shaft and over 26 tooth sliding gear, as shown in Illust. 6. Next, install 24 tooth gear (4th gear) onto pinion shaft, as shown in Illust. 7.

Install 59 tooth all speed gear onto upper shaft, as shown in Illust. 8. Long hub of gear away from threaded end of shaft.

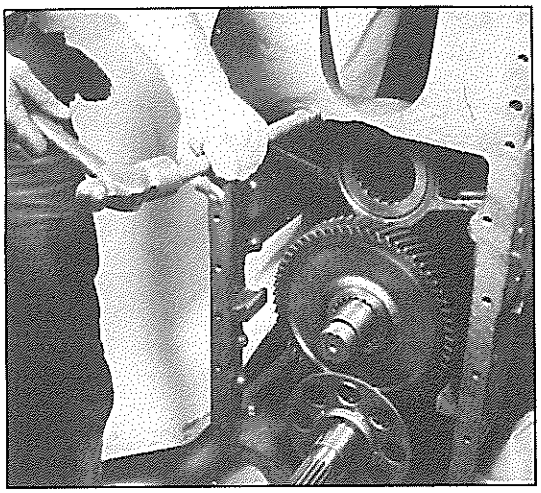
Insert pin into lower shaft, as shown in Illust. 9. Next, install



ILLUST. 8



ILLUST. 9



ILLUST. 10

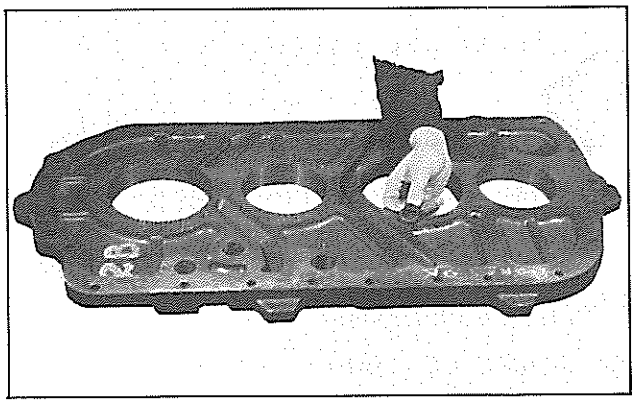
slinger. Square notch in slinger, as indicated by pencil, over head of pin.

Drive shouldered dowel pin into lower transmission housing, as shown in Illust. 10. Long end of dowel pin going into housing. Use a soft drift pin or mallet to drive dowel pin.

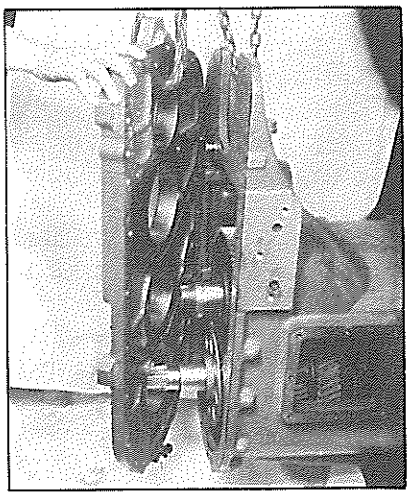
Intermediate Plate

Install bearing lock in bore of intermediate plate, as shown in Illust. 1. Next, drive dowel pin into lower dowel pin hole. Install nut on threads of dowel pin so as not to damage threads when driving. Do not drive dowel pin through intermediate plate.

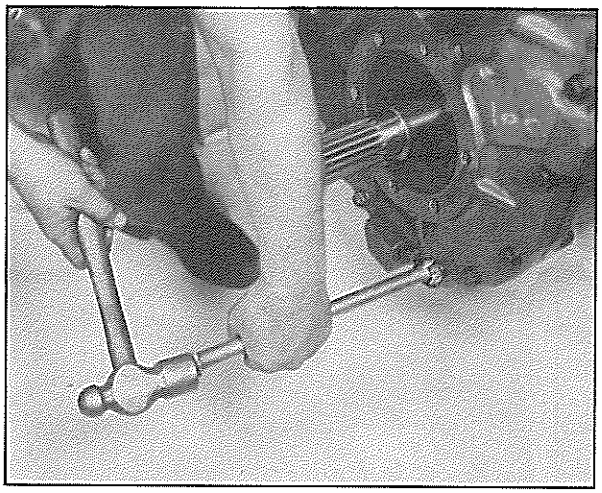
Shellac gasket surface of lower transmission housing and install gasket. Align dowel pin hole in intermediate plate with shouldered dowel pin in lower transmission housing and install intermediate plate,



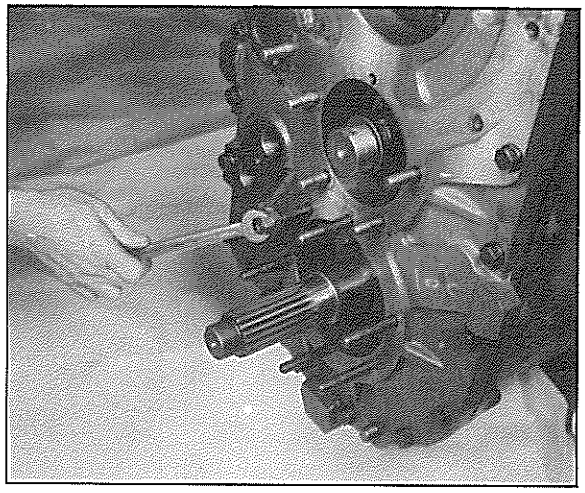
ILLUST. 1



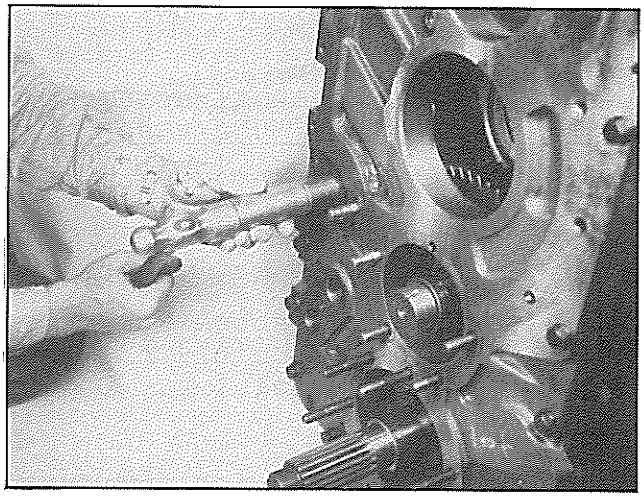
ILLUST. 2



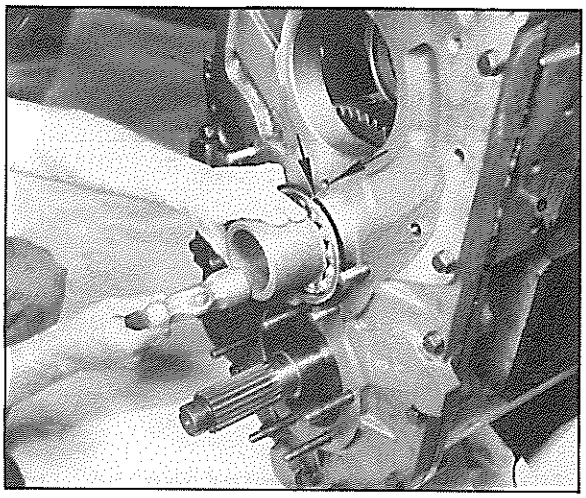
ILLUST. 3



ILLUST. 4



ILLUST. 5



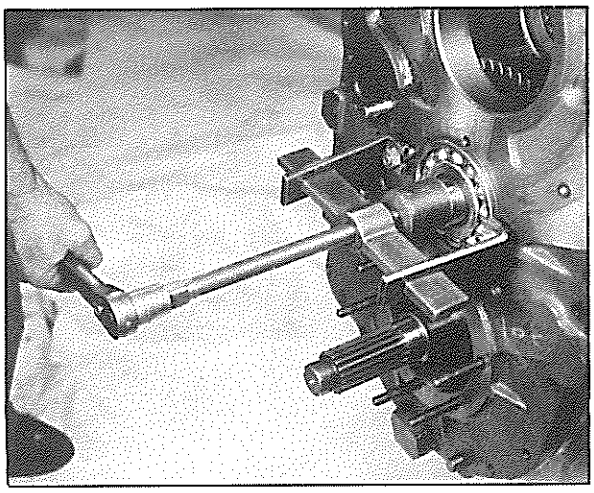
ILLUST. 6

as shown in Illust. 2. Install cap screws with lock washers but do not tighten. As shown in Illust. 3, using a soft drift pin or mallet, drive dowel pin through intermediate plate and into lower transmission housing. When dowel pin is seated, remove nut. Tighten cap screws to a torque reading of 190 foot pounds.

Install studs in intermediate plate, as shown in Illust. 4. By use of two (2) nuts locked together on stud, tighten studs into intermediate plate.

Using a hammer and a piece of pipe or similar tool, drive bushing into rocker shaft bore in intermediate plate, as shown in Illust. 5.

Drive bearing with snap ring over upper shaft of lower transmission and into bore of intermediate plate, as shown in Illust. 6. Open ends of snap ring to be in line with oil hole in intermediate plate as il-



ILLUST. 7

lustrated by arrows.

To remove intermediate plate from lower transmission, remove cap screws. Next, install two (2) stud nuts on studs, one (1) nut on each side of bearing. Now, by using a puller, as shown in Illust. 7, pull intermediate plate with bearing from lower transmission.

Bearing Cage and Adapter

Illust. 1 is an exploded view of bearing cage and adapter assembly.

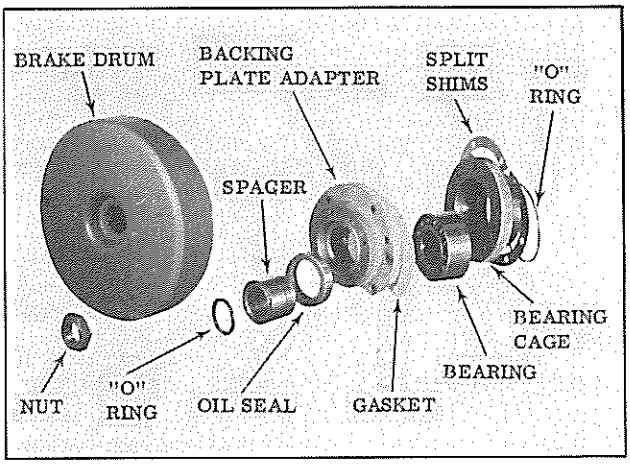
Install "O" ring in groove of bearing cage and install bearing cage over lower shaft studs and into intermediate plate, as shown in Illust. 2. Apply white lead to "O" ring to prevent damage when inserting bearing cage.

Place a block of wood between spiral pinion and spiral bevel gear in final drive, as shown in Illust. 3. This block of wood will prevent lower shaft assembly from being driven back into the spiral bevel gear when bearing is driven into bearing cage.

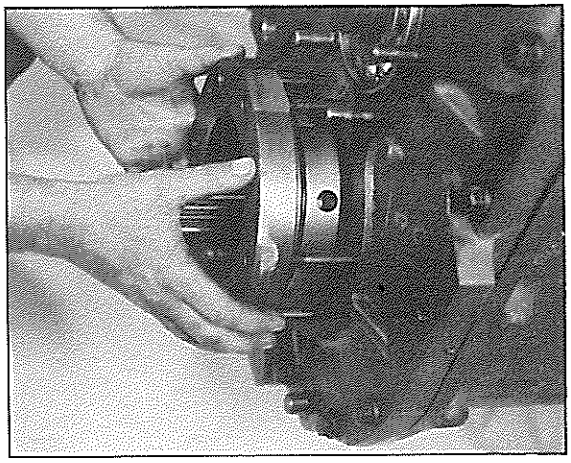
Drive bearing into bearing cage less split shims, as shown in Illust. 4. After bearing is driven into bearing cage, remove block.

To remove bearing cage assembly, install two (2) bolts in pull holes of bearing cage. Next, install a puller, as shown in Illust. 5.

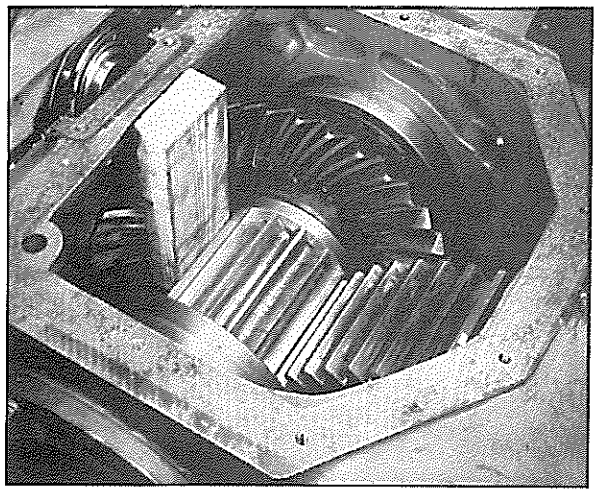
Press or drive oil seal into backing plate adapter, as shown in Illust.



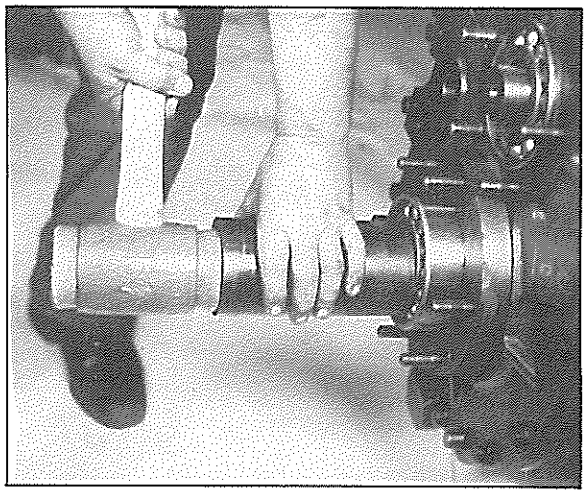
ILLUST. 1



ILLUST. 2



ILLUST. 3

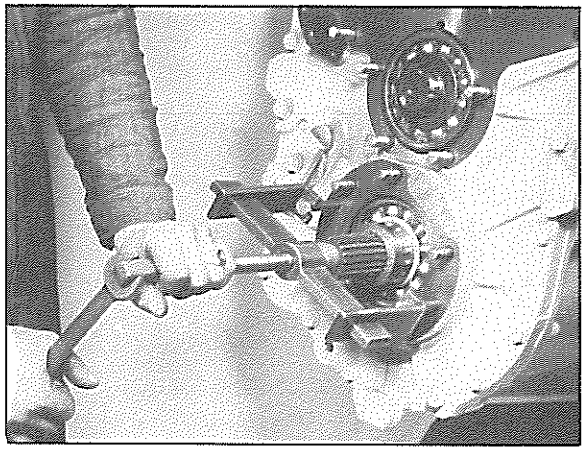


ILLUST. 4

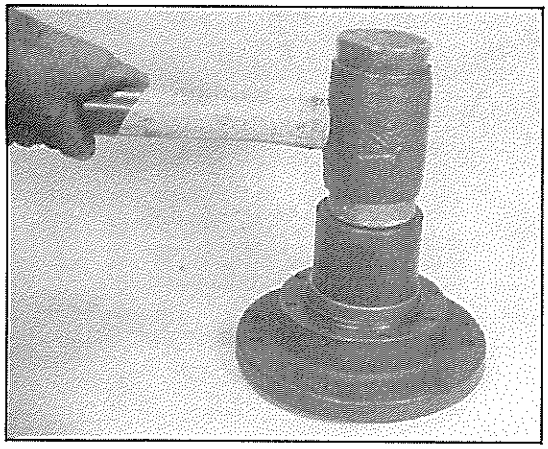
6. Lip of seal away from hub of adapter.

Install backing plate adapter gasket and backing plate adapter over lower shaft and onto studs, as shown in Illust. 7. Install stud nuts with lock washers and tighten.

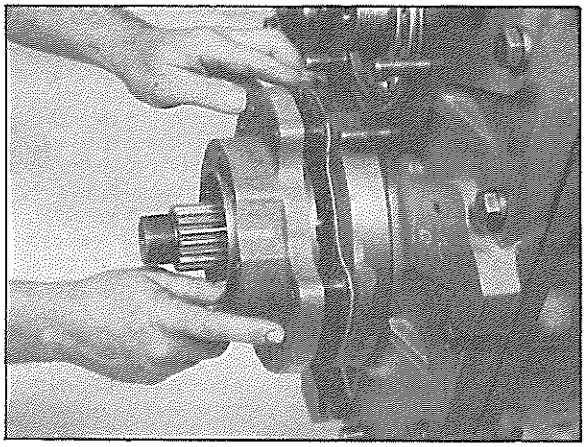
Install nut to upper shaft of lower transmission. Shift transmission into two (2) gears and tighten nut to a torque reading of 600 foot pounds. After nut has been tightened, stake nut as shown in Illust. 8, using a drift pin and hammer.



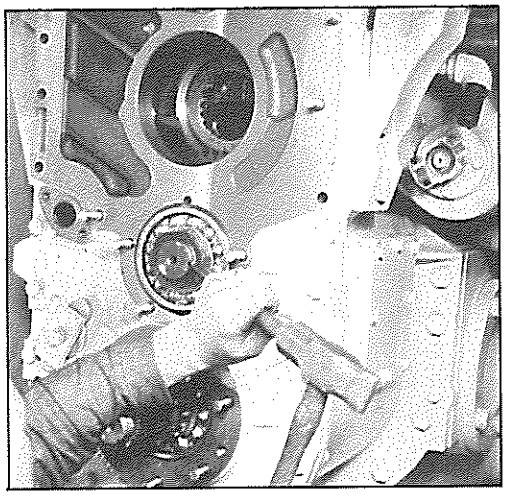
ILLUST. 5



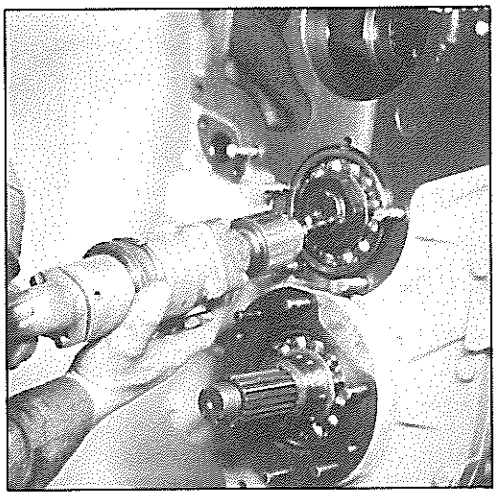
ILLUST. 6



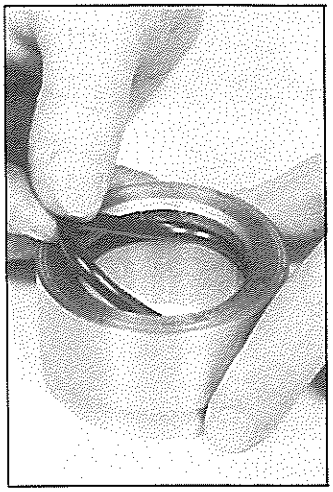
ILLUST. 7



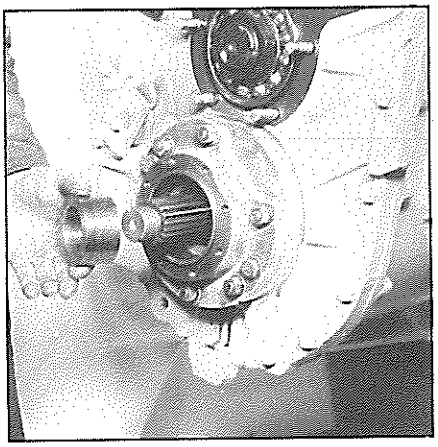
ILLUST. 8



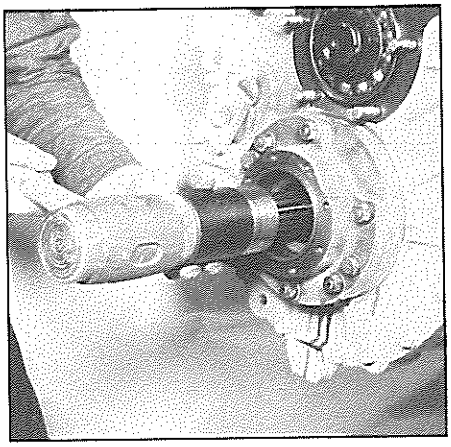
ILLUST. 9



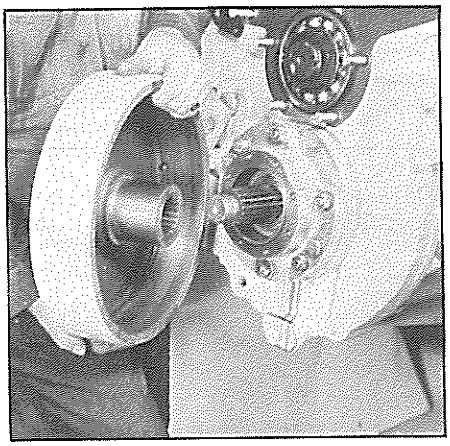
ILLUST. 10



ILLUST. 11



ILLUST. 12



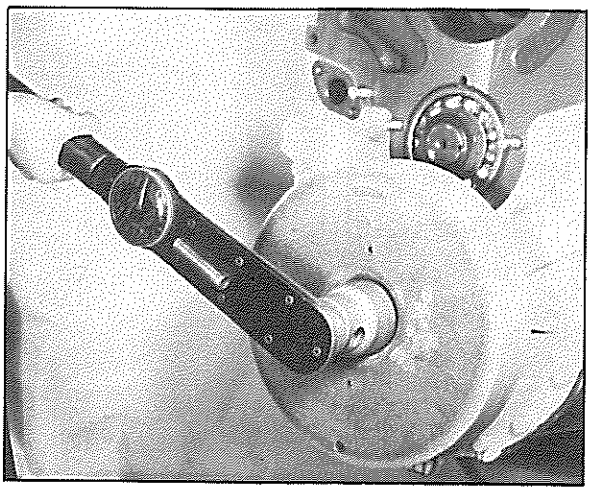
ILLUST. 13

To remove staked nut from upper shaft, use a drill as shown in Illust. 9.

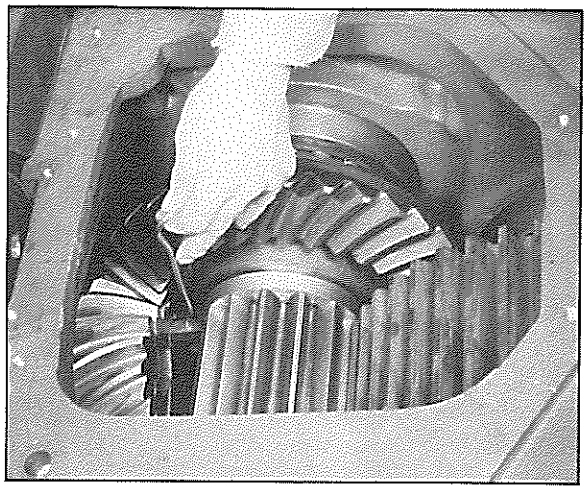
Install "O" ring in grove of spacer, as shown in Illust. 10. Apply white lead to "O" ring and install onto lower shaft, as shown in Illust. 11. White lead will prevent damage to "O" ring. Next, drive spacer onto lower shaft and into adapter, as shown in Illust. 12, end of spacer with "O" ring against bearing.

In order to obtain the pinion depth setting, install brake drum as shown in Illust. 13. Next, install nut and tighten to a torque reading of 600 foot pounds, as shown in Illust. 14.

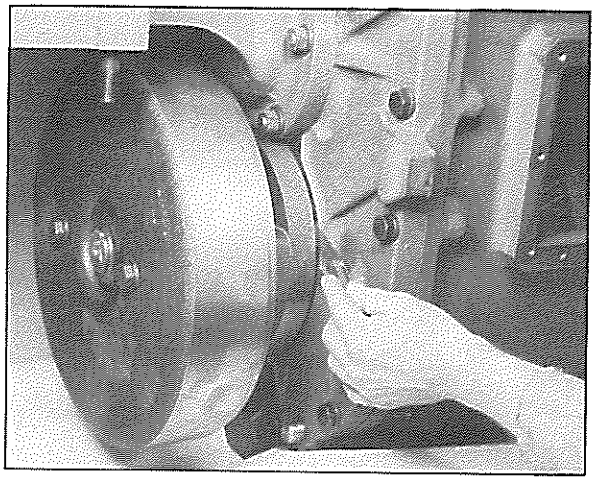
A special gauge block, Adams No. 723017, is required to obtain the correct pinion setting. Insert this gauge between the spiral gear setting disc and pinion, as shown in Illust. 15. Bump pinion shaft assembly back towards setting disc until a reading of 1.325 (gauge block length)



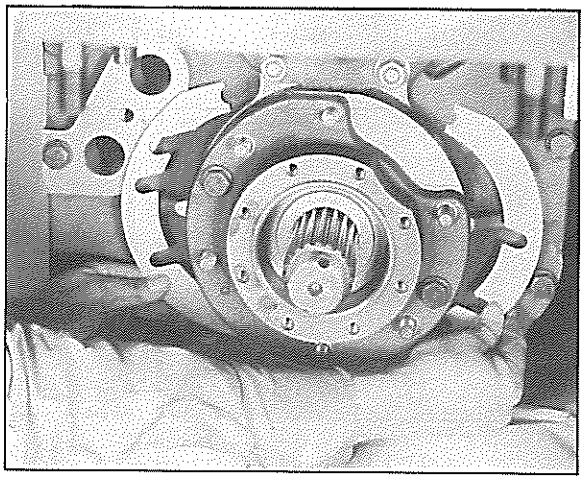
ILLUST. 14



ILLUST. 15



ILLUST. 16

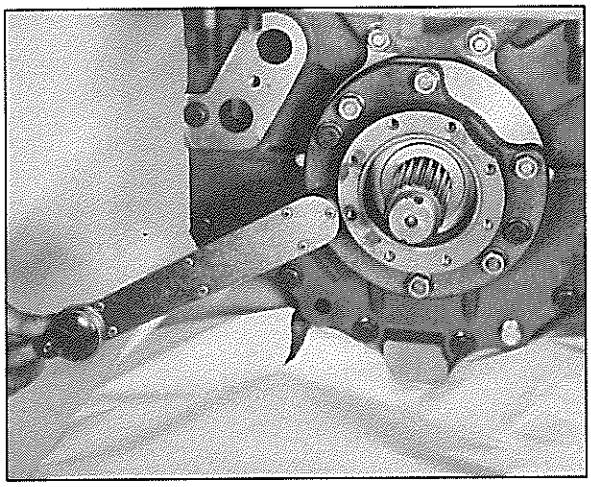


ILLUST. 17

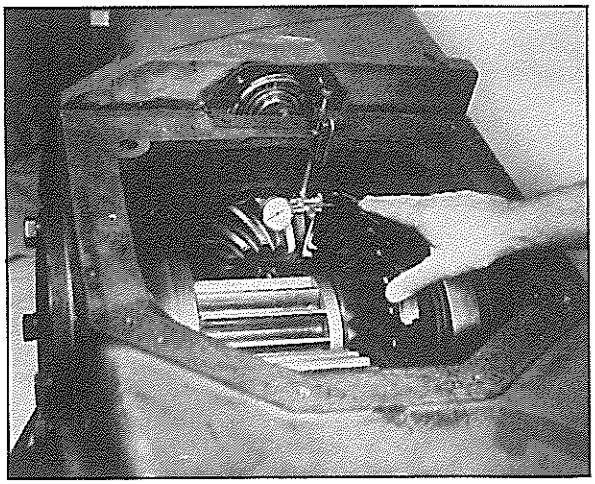
to 1.330 is obtained.

When pinion depth setting is obtained, use a feeler gauge and measure the gap between bearing cage and intermediate plate, as shown in Illust. 16. Next, remove brake drum. Insert correct amount of split shims required to fill gap, as shown in Illust. 17. Install bearing cage stud nuts with lock washers and tighten to a torque reading of 65 foot pounds, as shown in Illust. 18. Recheck pinion depth setting. If the required setting is not correct, repeat the operation,,adding or removing split shims. When setting is correct, shift gears into neutral.

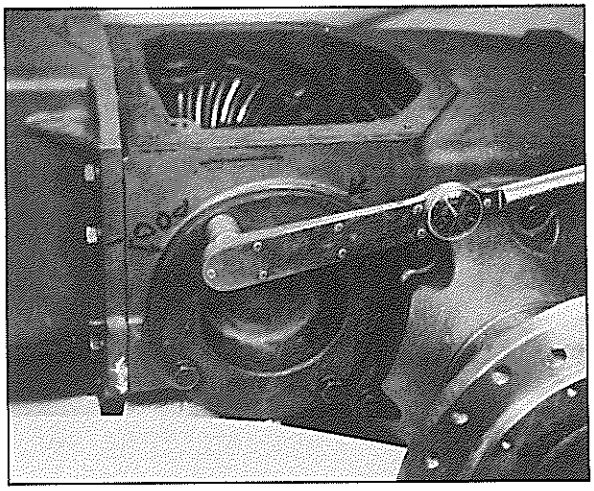
To adjust the backlash between the spiral bevel gear and pinion, use a dial indicator, as shown in Illust. 19. To obtain the backlash, remove shims as needed, from right hand jackshaft bearing cage and install to left hand jackshaft bearing cage until a reading of between



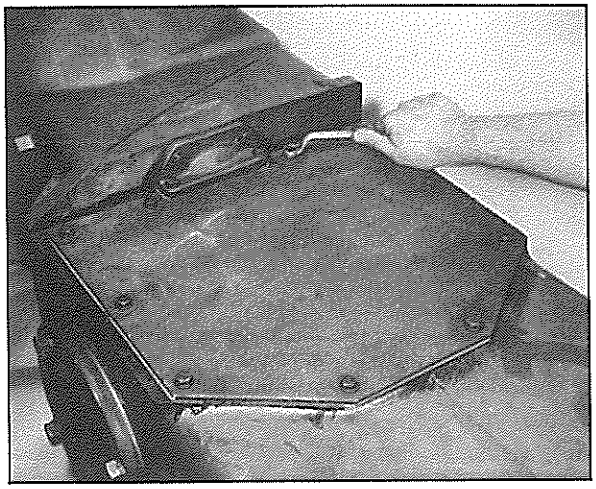
ILLUST. 18



ILLUST. 19



ILLUST. 20



ILLUST. 21

.010 to .014 is obtained on dial indicator. To assure accuracy, the reading should be taken from three (3) or more positions on the bevel gear. After the correct reading is obtained, tighten jackshaft bearing cages cap screws to a torque reading of 275 foot pounds, as shown in Illust. 20.

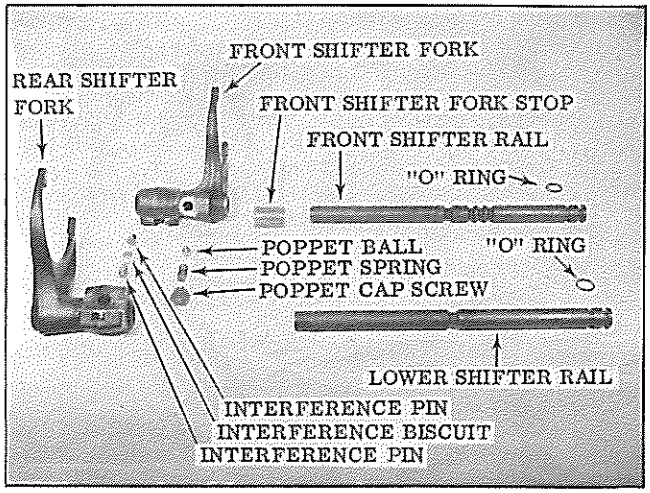
Shellac around top opening of final drive housing and opening in rear of lower transmission housing. Next, install closure cap gasket and cap. Install cap screws with lock washers and tighten securely. Install final drive housing cover gasket and cover. Install cap screws with lock washers and tighten securely, as shown in Illust. 21.

Shifter Rails and Forks

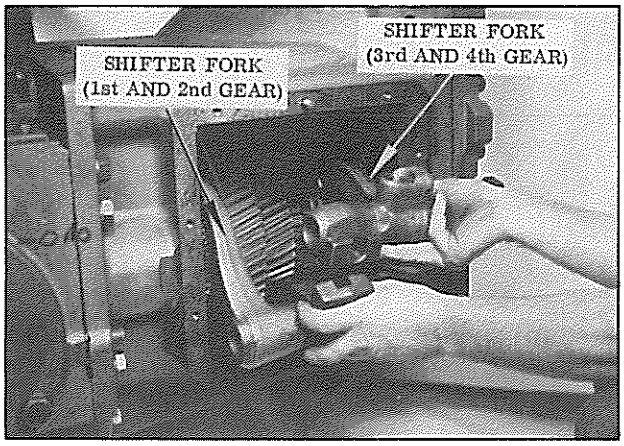
Illust. 1 is an exploded view of shifter rails and forks.

Insert shifter forks into lower transmission and over shifter collars, as shown in Illust. 2. Next, insert upper shifter rail through intermediate plate and through stop, as shown in Illust. 3. Insert upper shifter rail into 3rd and 4th gear shifter fork enough to hold fork upward, as shown in Illust. 4. Next, insert lower shifter rail through intermediate plate and 1st and 2nd gear shifter fork, as shown in illustration.

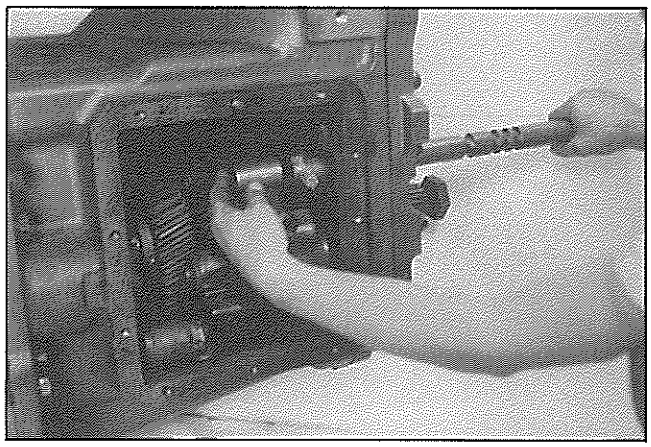
Install "O" rings in groove of upper and lower shifter rails, as shown in Illust. 5.



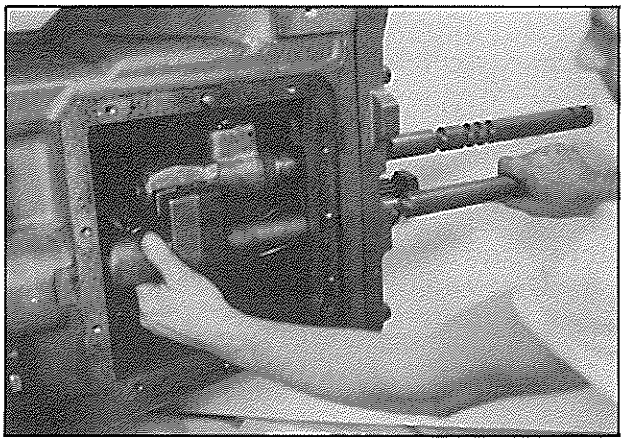
ILLUST. 1



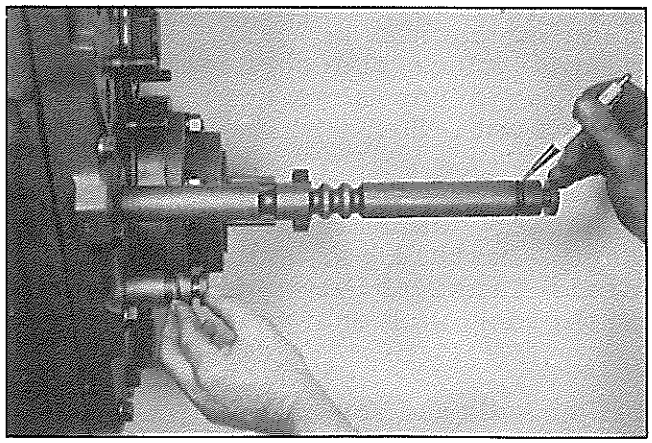
ILLUST. 2



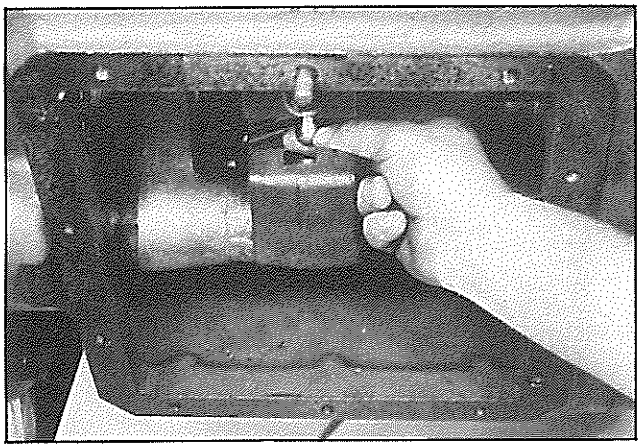
ILLUST. 3



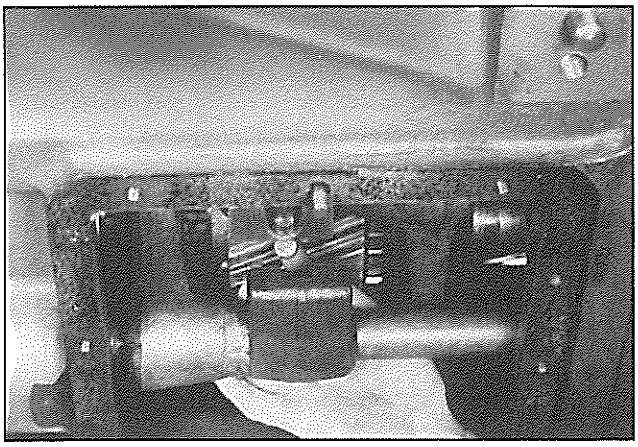
ILLUST. 4



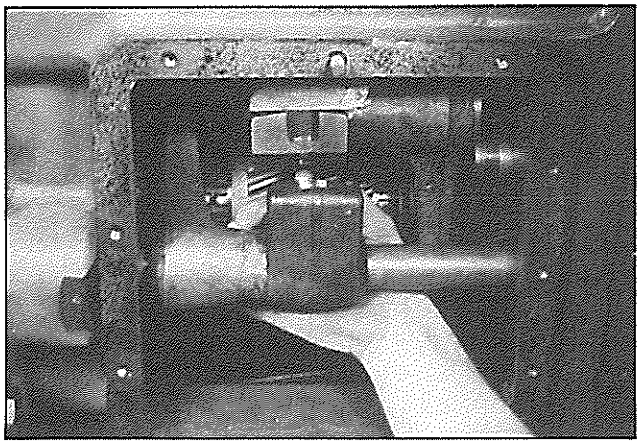
ILLUST. 5



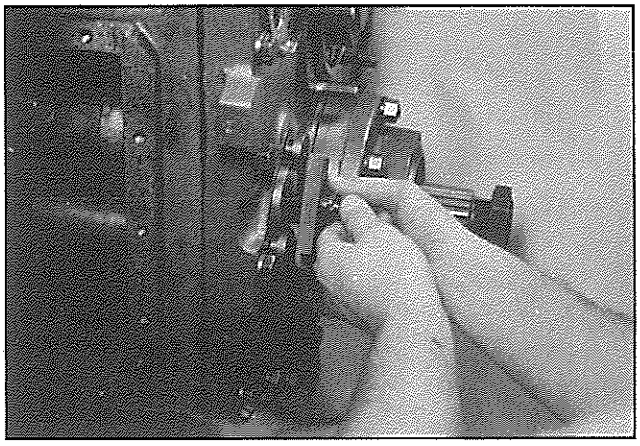
ILLUST. 6



ILLUST. 7



ILLUST. 8

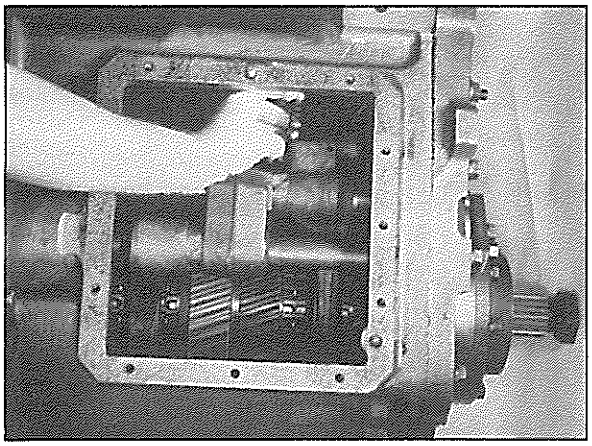


ILLUST. 9

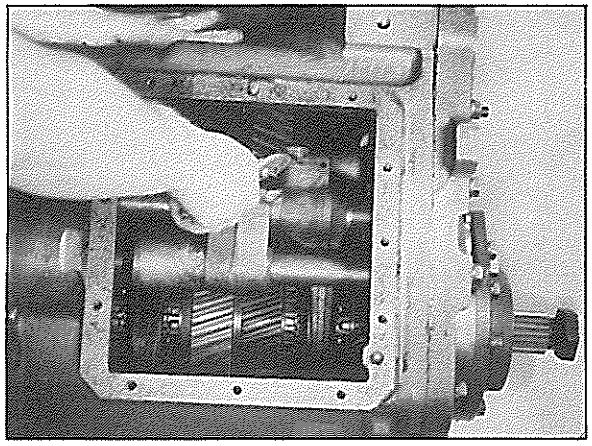
Pull top rail out of front fork only enough to allow front fork to be raised. Now, insert interference pin into hole of 1st and 2nd gear shifter fork, round head of pin toward lower rail, as shown in Illust. 6. Push lower shifter rail through fork and into lower transmission housing until interference pin seats itself in groove of shifter rail. Next, insert interference biscuit into hole of shifter fork, as shown in Illust. 7. Insert second interference pin into hole of shifter fork, as shown in Illust. 8. Round head of interference pin in an upward position. Use grease on each part before installing into shifter fork to hold parts in place. To protect "O" rings from damage, use white lead.

Insert upper shifter rail through 3rd and 4th gear shifter fork and into lower transmission housing. Next, insert locking disc into grooves of upper and lower shifter rails. Install clamp bar with cap screw and lock washer, as shown in Illust. 9. Tighten cap screw securely.

Install poppet ball and spring into 3rd and 4th gear shifter fork, as shown in Illust. 10. Next, install poppet cap screw and tighten securely. Insert a piece of wire through head of cap screw and through



ILLUST. 10



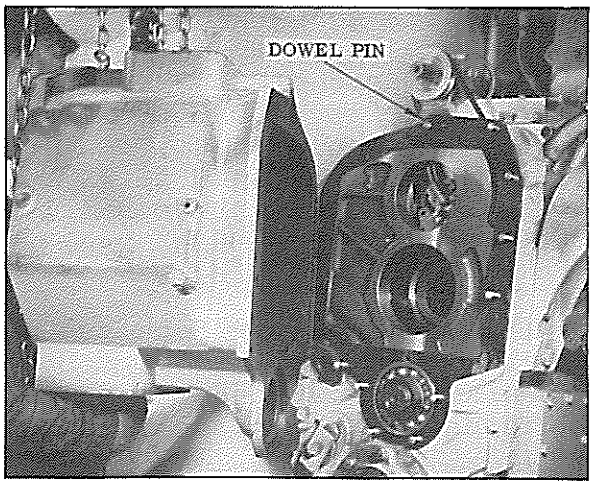
ILLUST. 11

hole of shifter fork, as shown in Illust. 11. Lock wire by twisting.

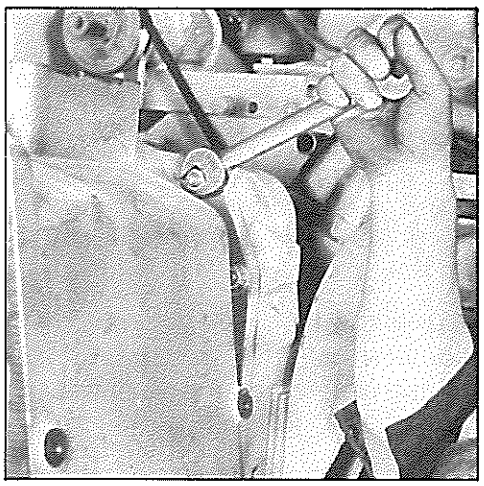
UPPER TRANSMISSION

Lower Shaft

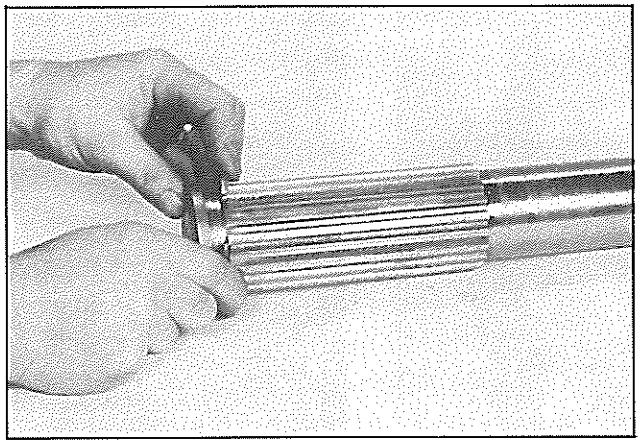
To install upper transmission housing onto intermediate plate, first install dowel pin and studs. Use a rawhide mallet to drive dowel pin until seated. To install studs, install two (2) nuts onto threads of studs. Lock one (1) nut against the other. Studs can now be tightened, into intermediate plate. When studs are tightened, remove nuts. After these operations have been accomplished, shellac upper surface of intermediate plate and install gasket. Install upper transmission over dowel pin and studs, as shown in Illust. 1. If necessary bump housing onto dowel pin using a rawhide mallet. Install stud nuts with lock washers. Tighten nuts securely, as shown in Illust. 2.



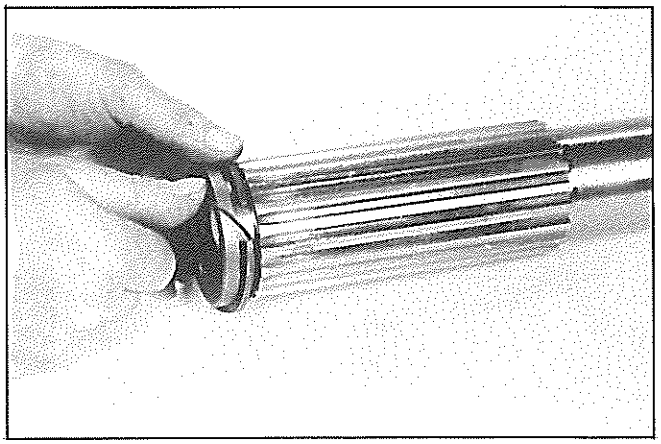
ILLUST. 1



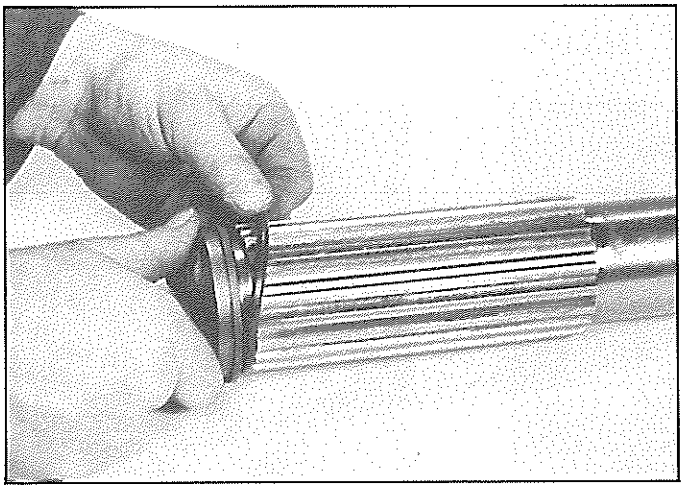
ILLUST. 2



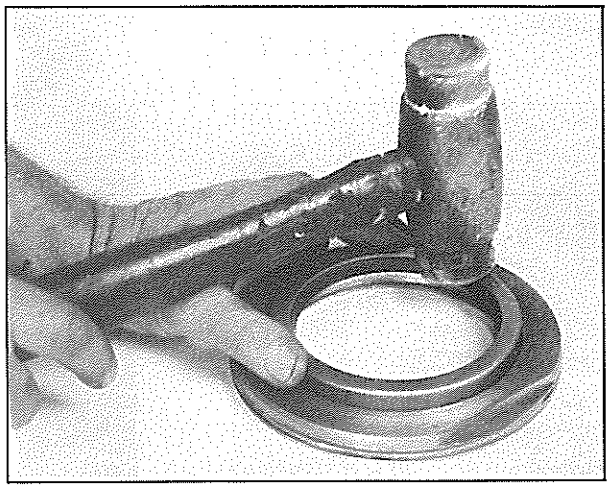
ILLUST. 3



ILLUST. 4



ILLUST. 5



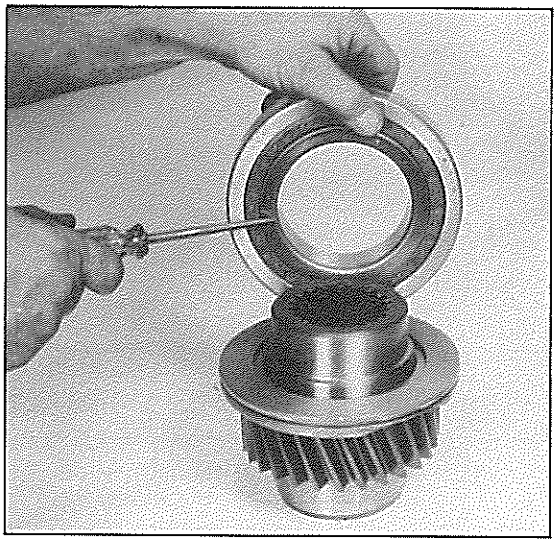
ILLUST. 6

Install snap ring in groove of lower shaft, as shown in Illust. 3. Next, install second snap ring in groove, as shown in Illust. 4. Note: Be sure second snap ring does not go beneath first snap ring. Also second snap ring to be between first snap ring and splines of shaft.

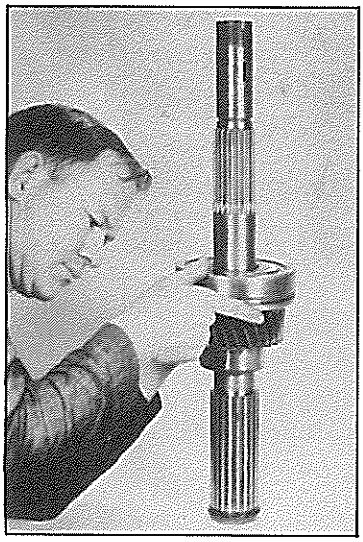
Install "O" ring in groove of shaft, as shown in Illust. 5. "O" ring to fit against second snap ring.

Press or drive oil seal into retainer, as shown in Illust. 6. Lip of seal away from milled flat of retainer. Install "O" ring in groove of retainer.

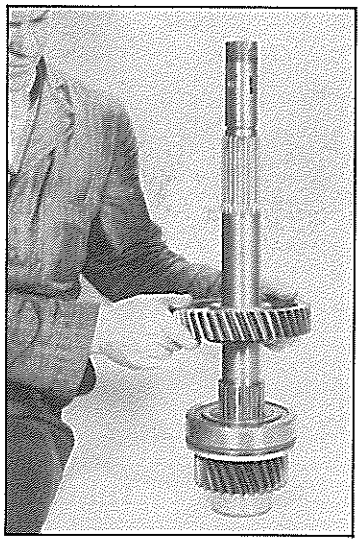
Install retainer, with "O" ring and oil seal, into gear, as shown in Illust. 7. Milled flat of retainer toward gear. Next, heat bearing in oil (350 degree F) and install onto gear. Radius of bearing as indicated by screw driver, toward retainer. Hold bearing until set.



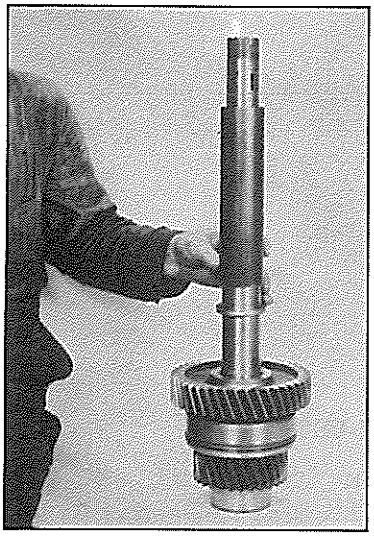
ILLUST. 7



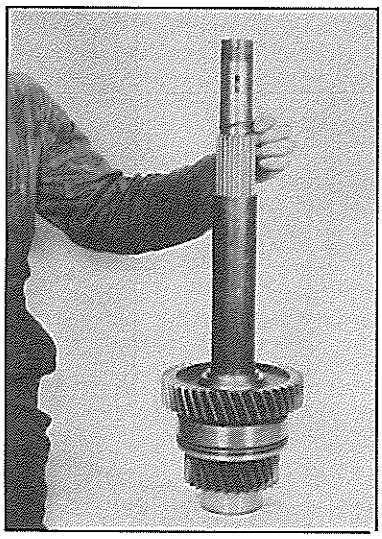
ILLUST. 8



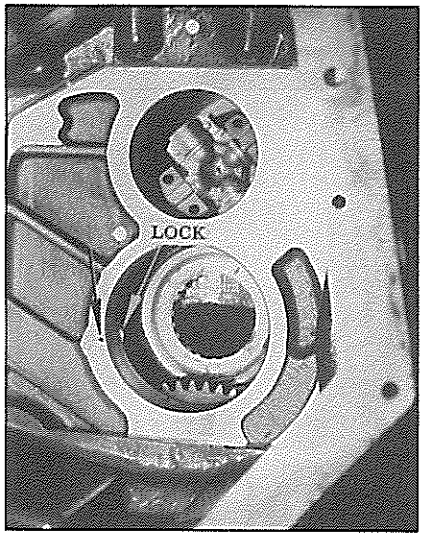
ILLUST. 9



ILLUST. 10



ILLUST. 11



ILLUST. 12

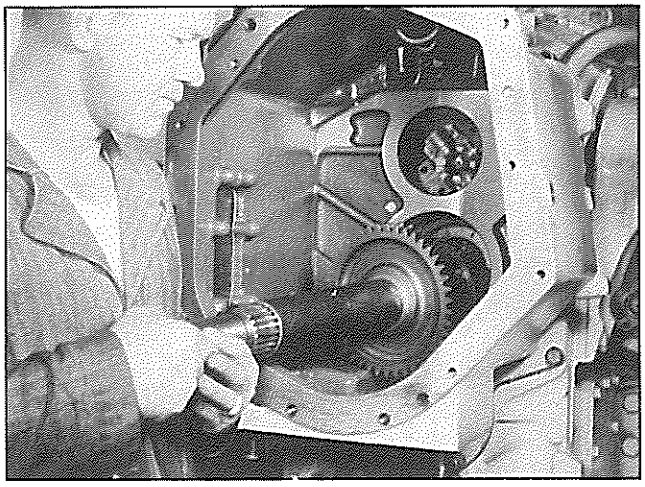
Install gear assembly onto shaft, as shown in Illust. 8. Hub of gear over "0" ring and snap rings in shaft. To prevent damage to "0" ring, apply white lead.

Install 42 tooth gear onto shaft, as shown in Illust. 9.

Install small spacer and long spacer onto shaft, as shown in Illust. 10.

Install "0" ring in groove of shaft, as shown in Illust. 11.

Before inserting lower shaft assembly into housing, center punch a mark in line with lock in intermediate plate, as shown by arrow in Illust.



ILLUST. 13

12. Be sure that milled flat of retainer aligns with punch mark on intermediate plate. Insert lower shaft assembly into bore of upper transmission housing, as shown in Illust. 13. Milled flat of retainer will lock against washer of lock.

HYDRAULIC CLUTCH

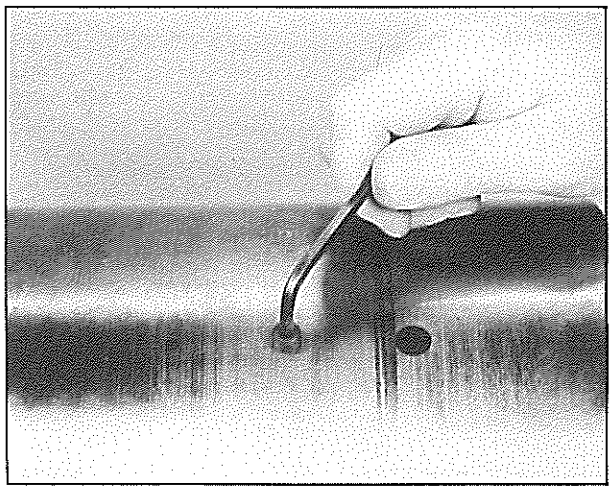
When reassembling hydraulic clutch, all parts must be free from dirt. Wash parts thoroughly in a good cleaning solvent, then use air to dry. Never use a cloth of soft material, such as cotton or waste, to dry parts. Lint from the soft cloth will clog small hydraulic oil holes in parts causing damage. A hard material such as linen may be used. Gloves should never be used in the reassembly of hydraulic clutch.

Reassembly

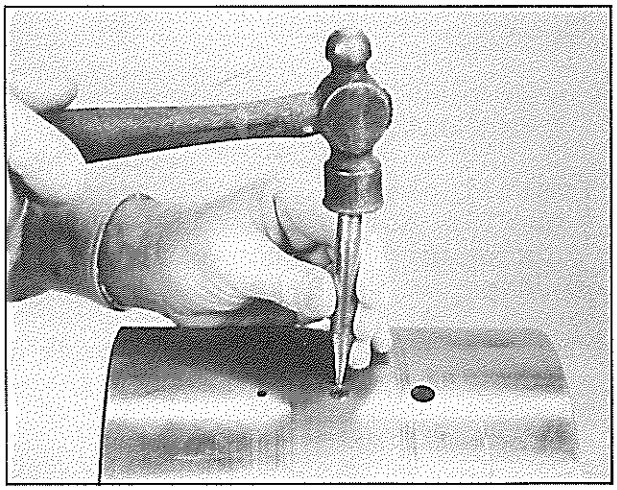
Install Allen head cap screw into drum, as shown in Illust. 1. Tighten securely. Lock Allen head cap screw by staking, as shown in Illust. 2.

Illust. 3, is an exploded view of the hydraulic clutch.

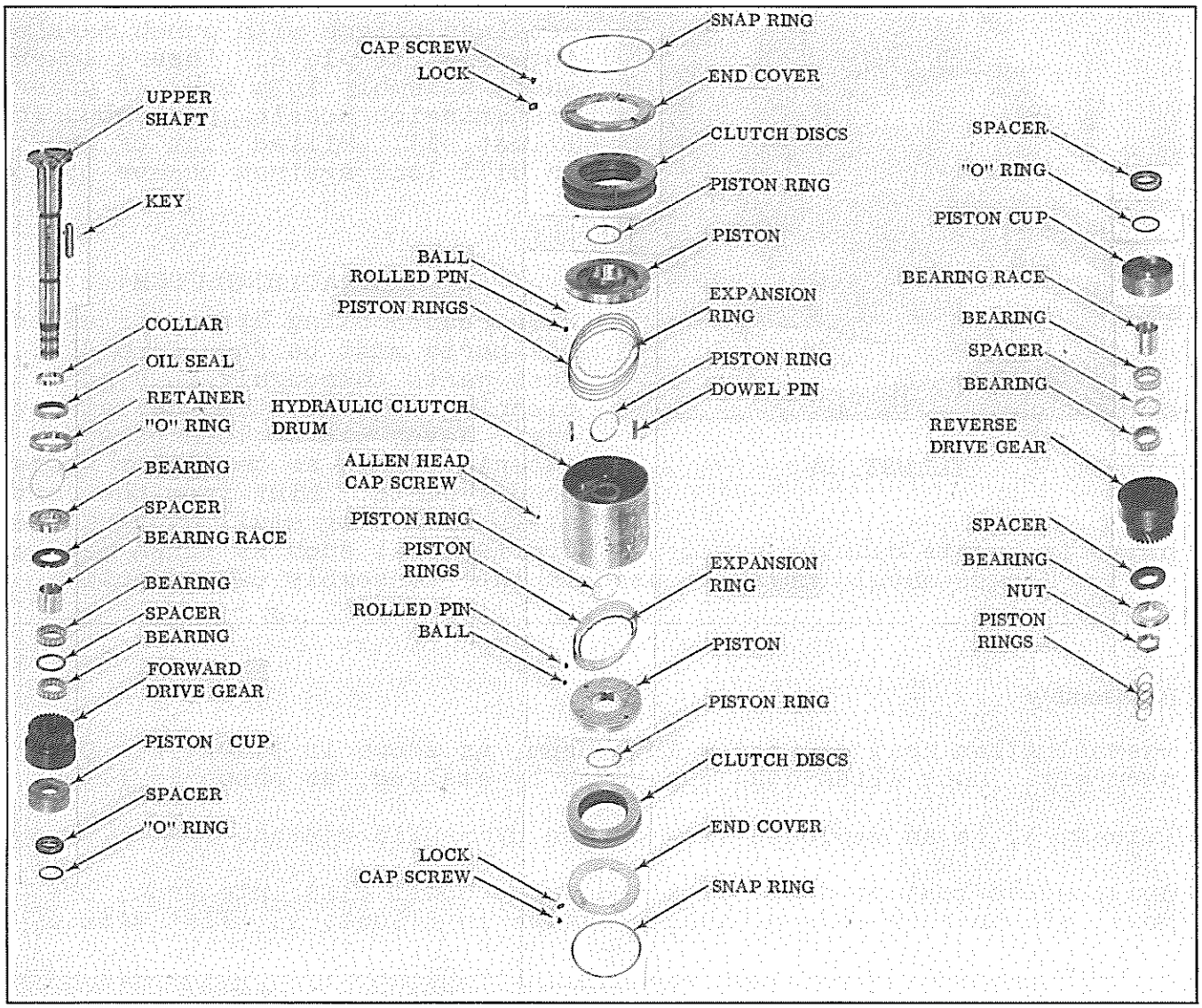
Apply white lead to dowel pins and drive dowel pins into drum, one dowel pin on each side of hub, as shown in Illust. 4. Flat side of



ILLUST. 1



ILLUST. 2

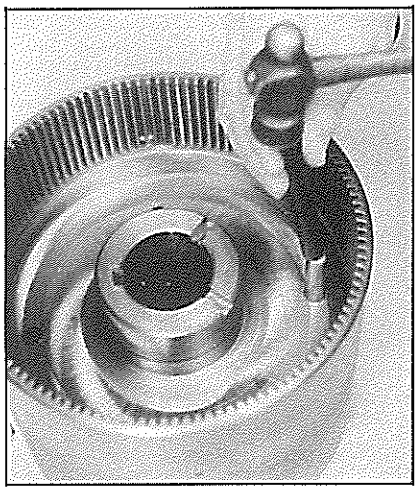


ILLUST. 3

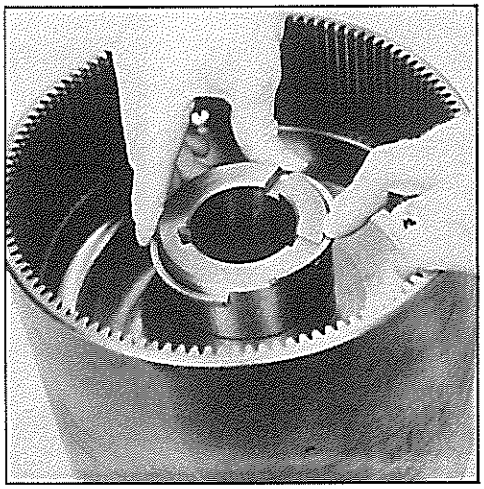
toward outside of drum. Dowel pins to be centered in drum.

Install piston ring in groove of drum hub, as shown in Illust. 5. As you will note, the piston ring has a notch on each end. In order to lock ends of piston ring, use a pry bar to hold ring from turning in groove, as illustrated in Illust. 6. Next, use a feeler gauge between hub and piston ring to force end of ring from groove. By using fingers, force piston ring into groove until open ends of piston ring are together then remove feeler gauge. Ends of piston ring will lock, as shown in Illust. 7.

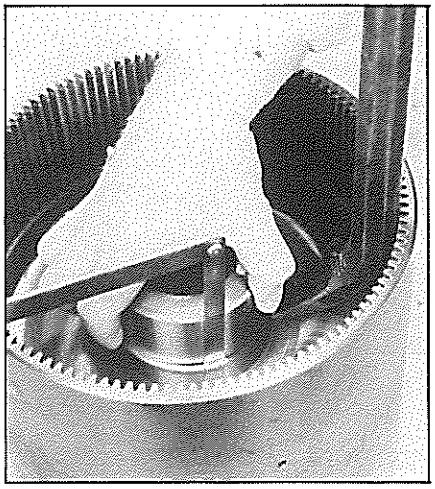
Insert ball into hole in piston, as shown in Illust. 8. Ball to be in line with bleed hole in piston. Tap ball, serval times using a hammer



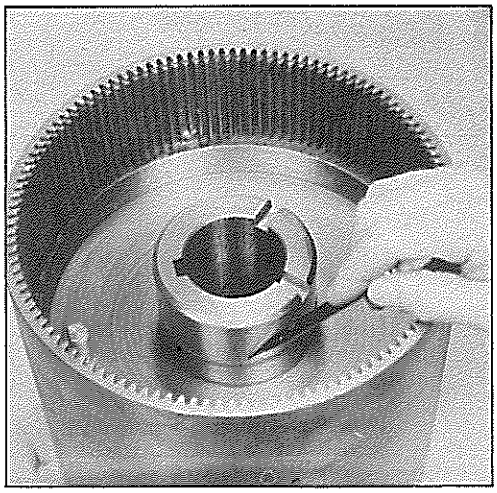
ILLUST. 4



ILLUST. 5



ILLUST. 6

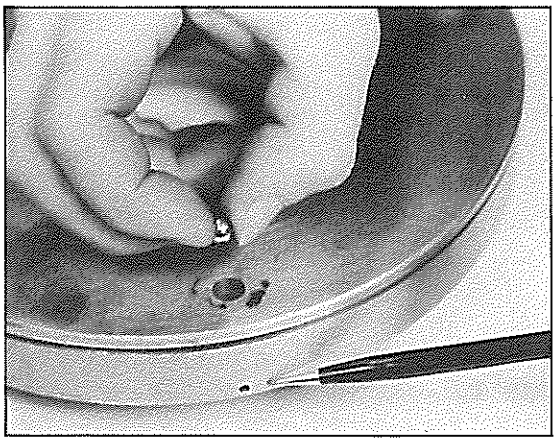


ILLUST. 7

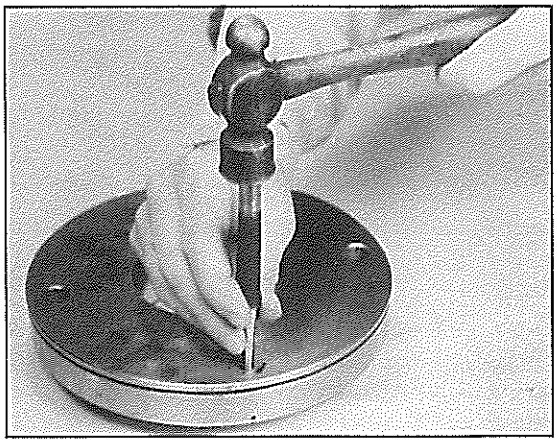
and soft punch, to seat ball, as shown in Illust. 9.

After ball has been tapped, apply air into ball hole and check for leakage through bleed hole. If leakage appears, insert punch and tap punch with hammer. Next, insert rolled pin, as shown in Illust. 10. Tap rolled pin flush with face of piston. Shake piston. Ball should be free in piston.

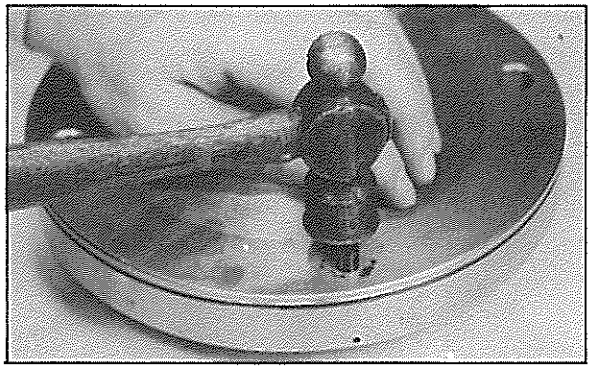
To remove ball and rolled pin from piston, insert a small punch in bleed hole of piston. Tap punch until rolled pin is above flush with face of piston. Pin can now be pulled from piston. Remove ball by tipping piston.



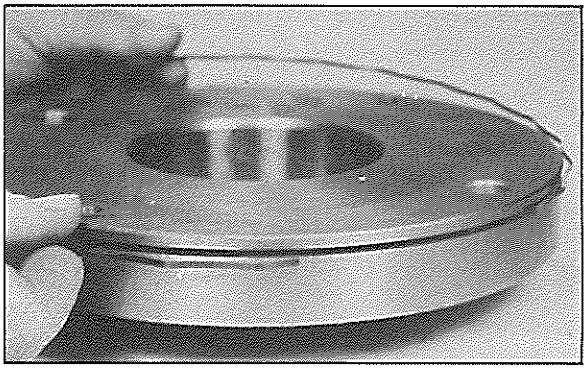
ILLUST. 8



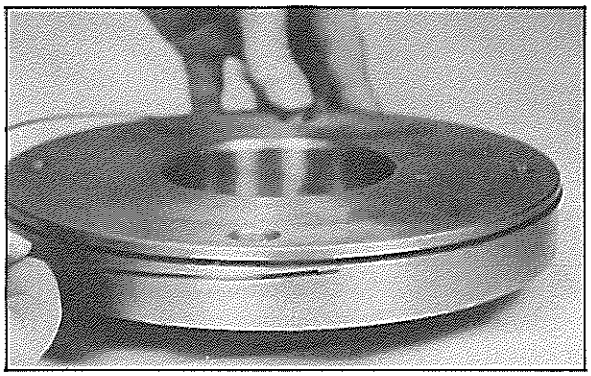
ILLUST. 9



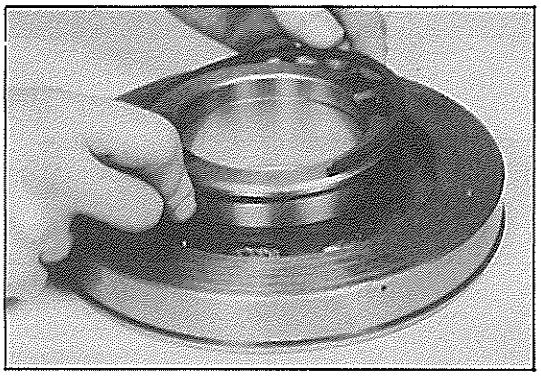
ILLUST. 10



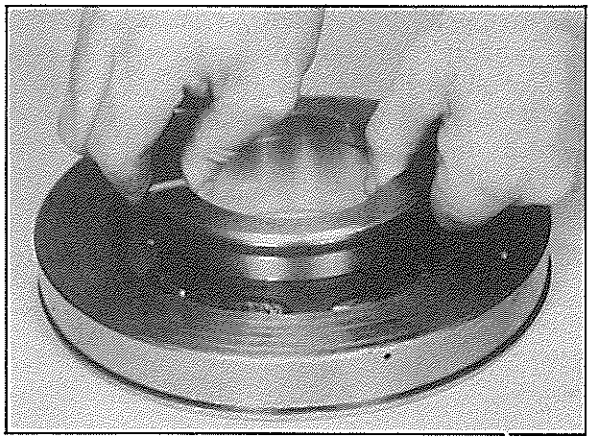
ILLUST. 11



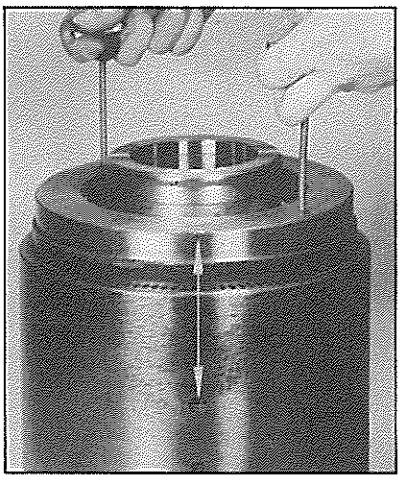
ILLUST. 12



ILLUST. 13



ILLUST. 14



ILLUST. 15

Insert expansion ring in groove of piston, as shown in Illust. 11. Next, install 4 piston rings, as shown in Illust. 12. Open ends of first piston ring to be 180 degrees from open ends of expansion ring. Open ends of second piston ring to be 180 degrees from open end of first piston ring. Open ends of third piston ring to be 90 degrees from open

ends of second piston ring. Open ends of fourth piston ring to be 180 degrees from open ends of third piston ring.

Insert piston ring in groove of piston, as shown in Illust. 13. Apply pressure to piston ring until ends of piston ring lock together, as shown in Illust. 14.

Install piston ring depresser into drum. Next, install piston into piston ring depresser, as shown in Illust. 15. Bleed hole in piston to align with large hole in hydraulic clutch drum. When piston is seated, remove piston ring depresser.

Upper Shaft

Press or drive oil seal into retainer, as shown in Illust. 1. Lip of seal away from milled flat of retainer.

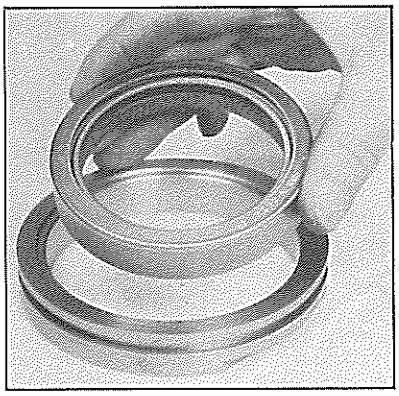
Install "O" ring in groove of retainer, as shown in Illust. 2.

Heat collar in oil (350 degrees F) and install on upper shaft, as shown in Illust. 3. Chamfer in collar towards threads on shaft. Hold collar until set

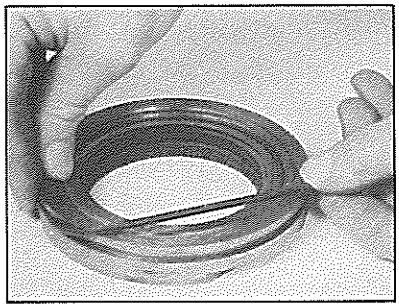
Install retainer onto shaft and over collar, as shown in Illust. 4. Milled flat of retainer, away from threads of shaft.

Heat bearing in oil and install onto upper shaft, as shown in Illust. 5. Hold bearing until set.

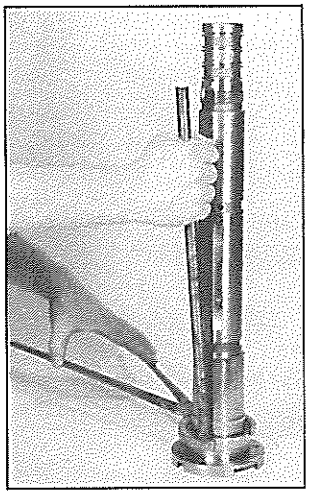
Install spacer onto shaft, as shown in Illust. 6. Shoulder of spacer to fit against bearing.



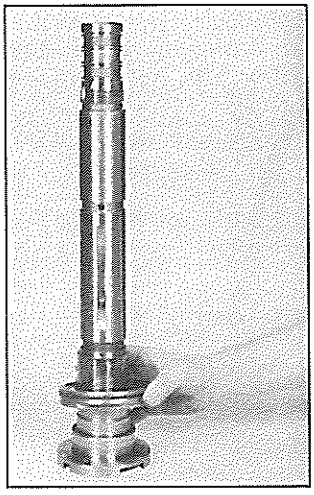
ILLUST. 1



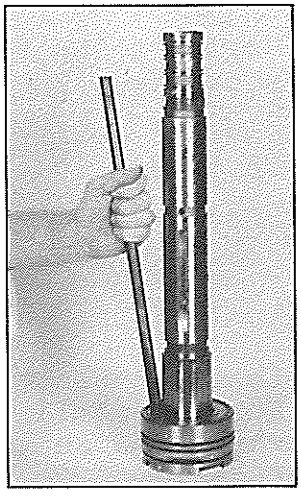
ILLUST. 2



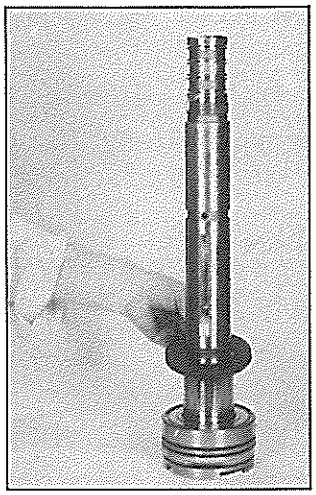
ILLUST. 3



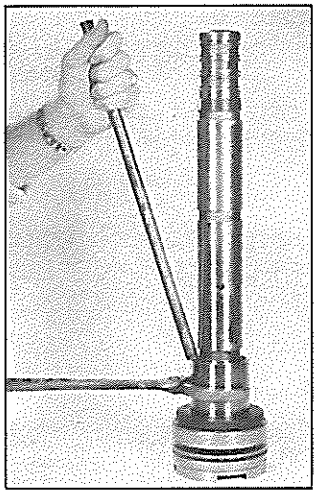
ILLUST. 4



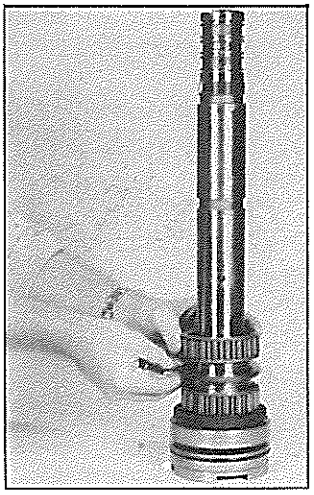
ILLUST. 5



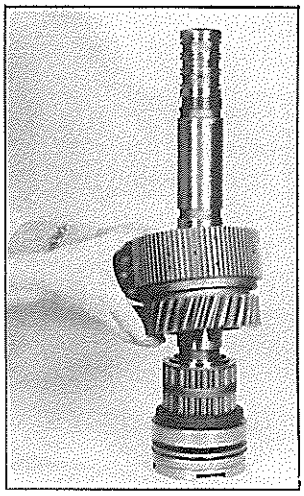
ILLUST. 6



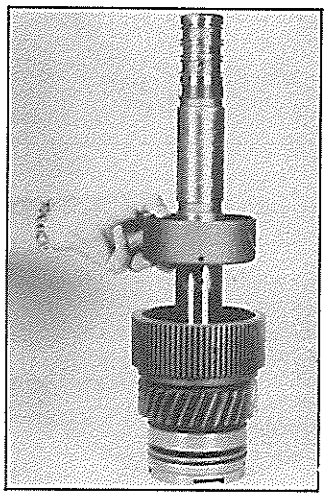
ILLUST. 7



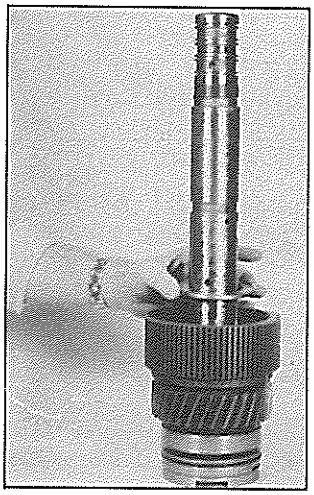
ILLUST. 8



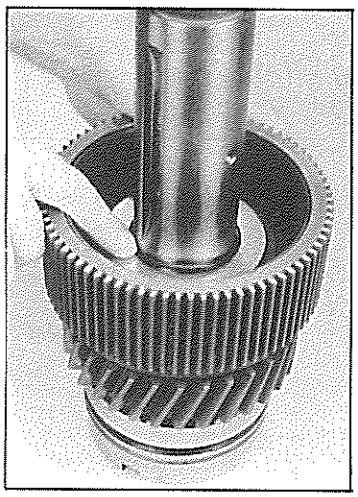
ILLUST. 9



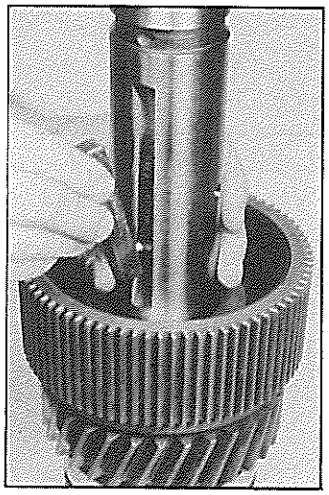
ILLUST. 10



ILLUST. 11



ILLUST. 12



ILLUST. 13

Heat bearing race in oil and install onto shaft and down on spacer, as shown in Illust. 7. Hold race until set.

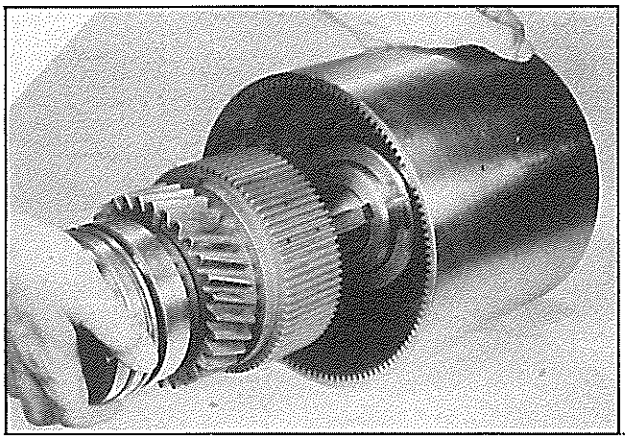
Install bearing, spacer and second bearing onto bearing race, as shown in Illust. 8.

Install forward drive gear onto shaft and over bearings, as shown in Illust. 9. Apply a heavy grade of oil into gear and over bearings.

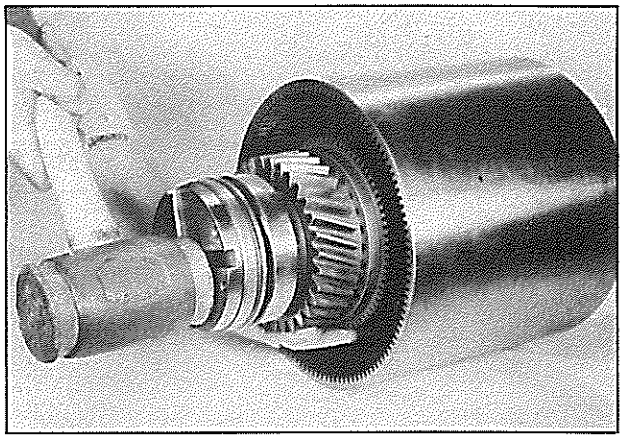
Install piston cup onto shaft and into gear, as shown in Illust. 10.

Install spacer onto shaft and into piston cup, as shown in Illust. 11. Next, install "O" ring onto shaft. Insert "O" ring between spacer and shaft, as shown in Illust. 12.

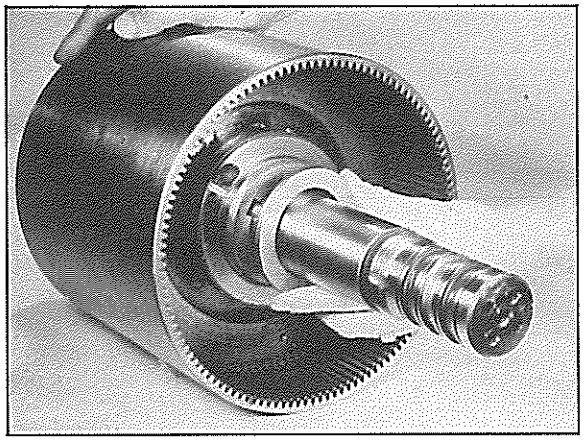
Install key in keyway, as shown in Illust. 13.



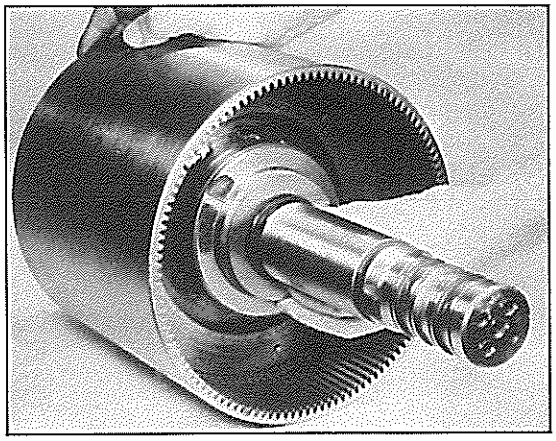
ILLUST. 14



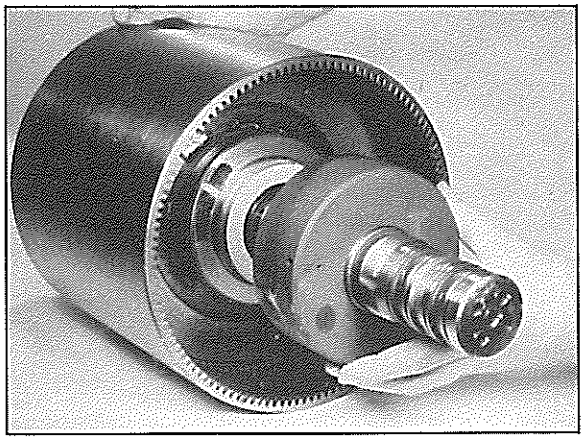
ILLUST. 15



ILLUST. 16



ILLUST. 17



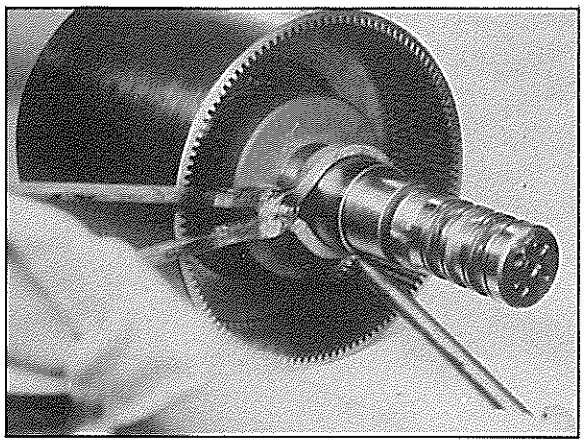
ILLUST. 18

Insert upper shaft through hydraulic clutch drum, as shown in Illust. 14. Using a rawhide mallet, tap shaft until piston cup goes over piston ring in drum hub, as shown in Illust. 15.

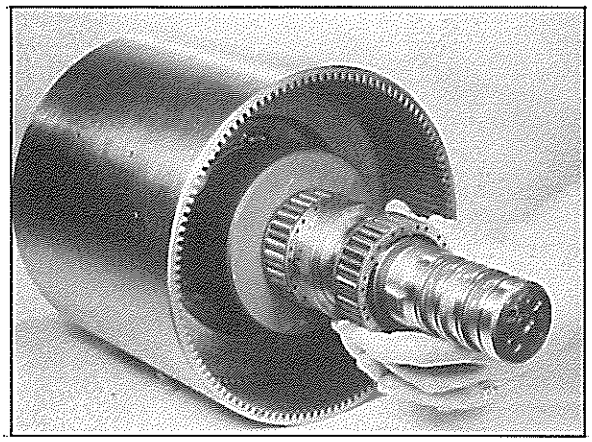
Install spacer onto shaft and against hub of drum, as shown in Illust. 16. Next, install "O" ring onto shaft and insert between spacer and shaft, as shown in Illust. 17.

Install piston cup onto shaft, over piston ring and against spacer, as shown in Illust. 18. Use finger pressure to compress piston ring enough to allow cup to slide over ring.

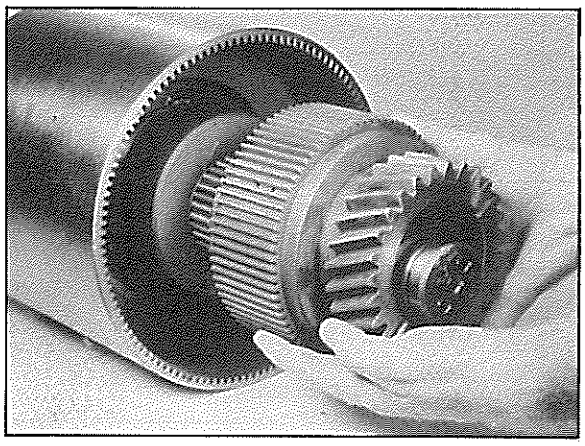
Heat bearing race in oil and install on shaft and against piston cup,



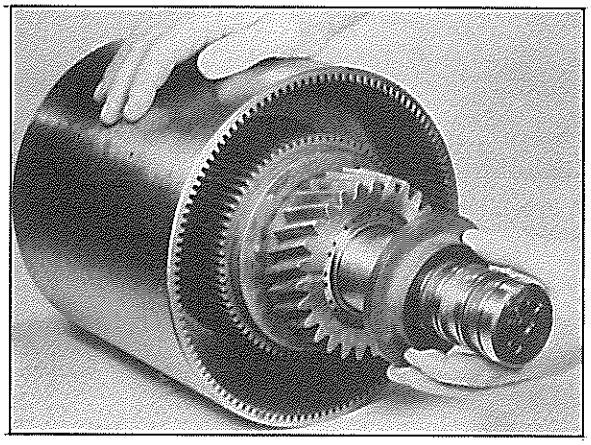
ILLUST. 19



ILLUST. 20



ILLUST. 21



ILLUST. 22

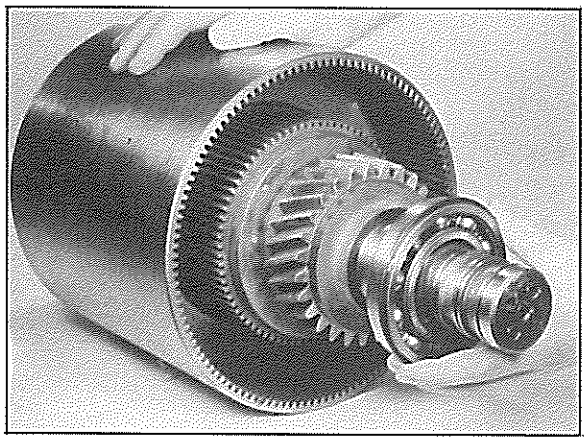
as shown in Illust. 19. Hold race until set.

Install bearing, spacer and second bearing onto shaft and over bearing race, as shown in Illust. 20.

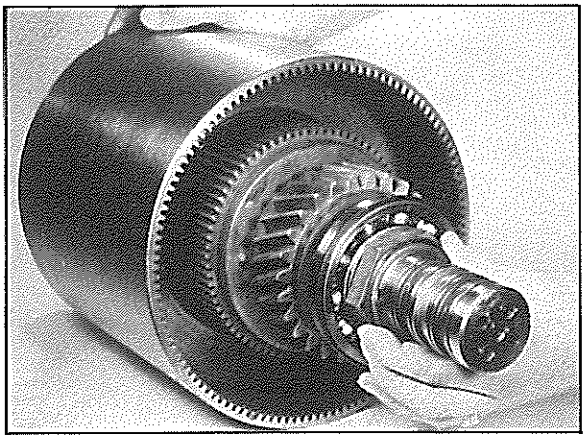
Install reverse drive gear onto shaft and over bearings, as shown in Illust. 21. Apply a heavy grade of oil on bearings and to inside of gear before installing.

Install spacer onto shaft, as shown in Illust. 22. Shoulder of spacer away from gear.

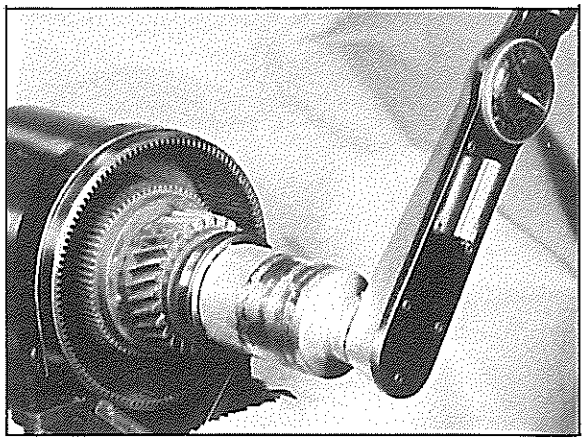
Illust. 23 shows bearing going onto shaft. The bearing must first be



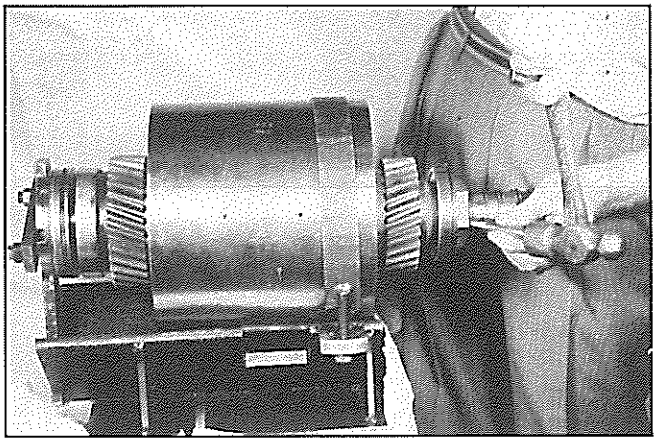
ILLUST. 23



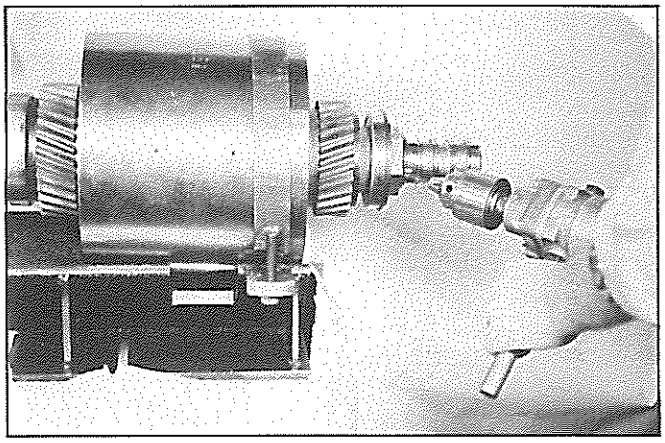
ILLUST. 24



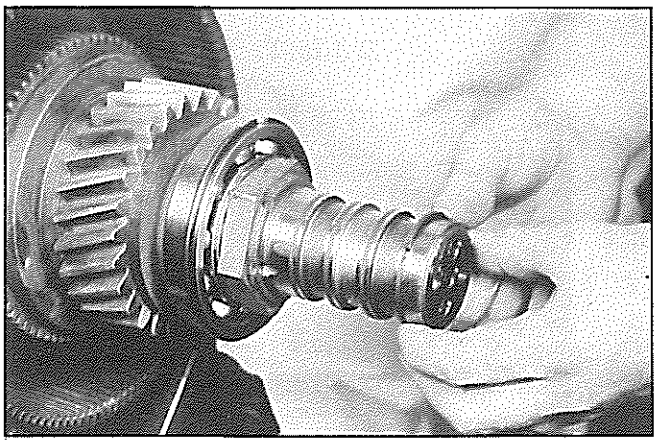
ILLUST. 25



ILLUST. 26



ILLUST. 27



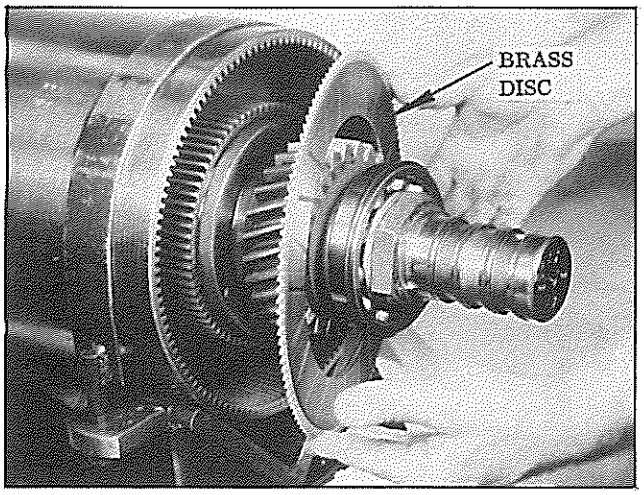
ILLUST. 28

heated in oil at 350 degrees F. After bearing is heated properly, install and hold until set. Snap ring in bearing away from spacer.

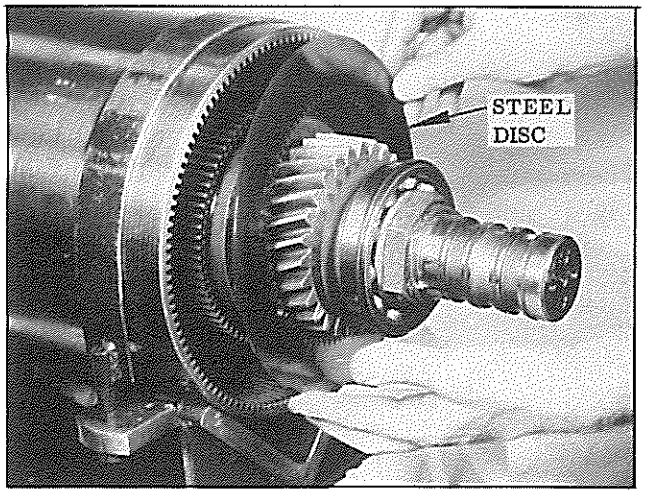
Install nut, as shown in Illust. 24. Torque nut to a reading of 650 foot pounds, as shown in Illust. 25. Stake nut, as shown in Illust. 26, using a drift pin and hammer.

To remove nut, drill out stake, as shown in Illust. 27.

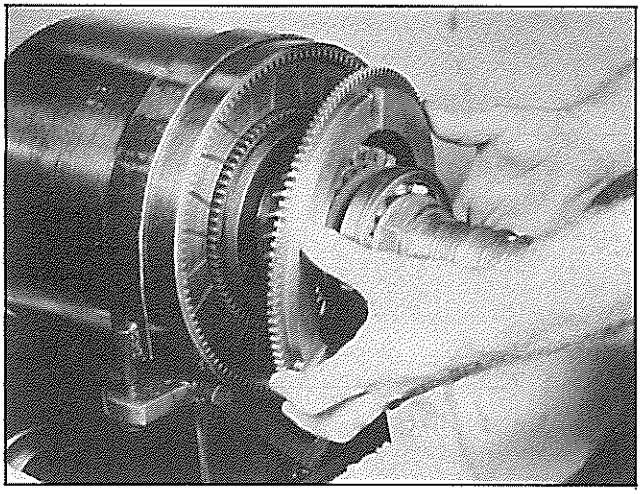
Install 4 piston rings in grooves of shaft, as shown in Illust. 28. Compress piston rings with fingers until ends lock, then rotate rings



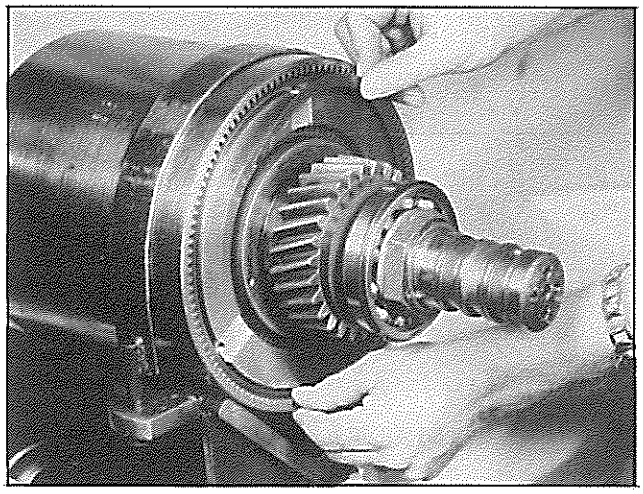
ILLUST. 29



ILLUST. 30



ILLUST. 31

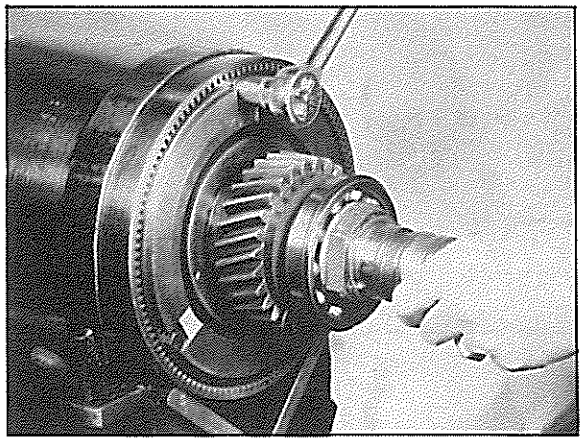


ILLUST. 32

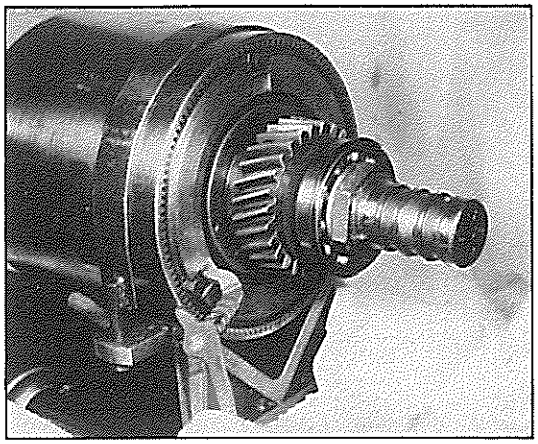
until locked ends are 90 degrees from each other.

Insert clutch discs into drum, as shown in Illust. 29. "IMPORTANT: Insert a brass disc first, then a steel disc, as shown in Illust. 30. Alternate brass and steel discs until there is 10 brass disc and 9 steel discs into one side of hydraulic clutch drum. Next, install end cover to drum, as shown in Illust. 31.

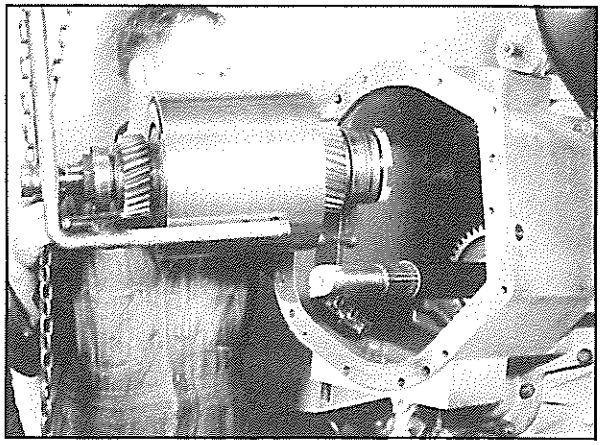
Install snap ring in groove of drum, as shown in Illust. 32. Now install three (3) locks and cap screws, as



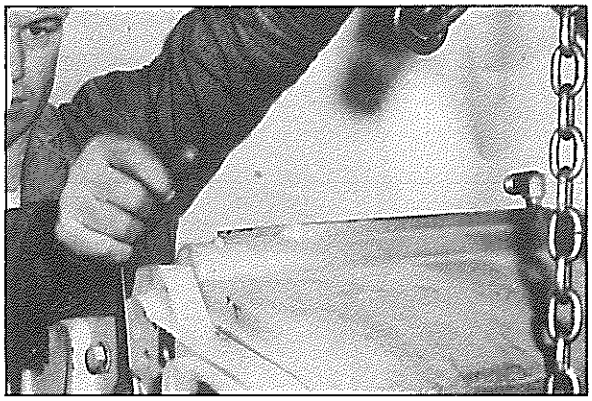
ILLUST. 33



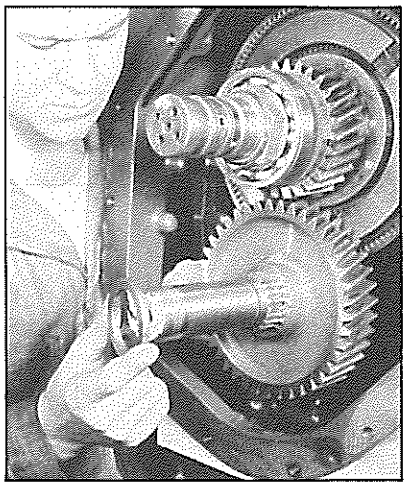
ILLUST. 34



ILLUST. 35



ILLUST. 36



ILLUST. 37

shown in Illust. 33 and tighten securely. Bend inside edge of locks against cap screw heads, as shown in Illust. 34.

Insert clutch discs into other end of hydraulic clutch drum in the same manner as illustrated in Illust. 29.through 34.

Insert hydraulic clutch drum assembly into upper transmission housing, as shown in Illust. 35. Milled flat of oil seal retainer in an upward position. Drive the assembly into upper bore of intermediate plate, using a mallet, until milled flat of oil seal retainer is flush with intermediate plate. When this has been accomplished, install lock with cap screw and lock washer. Tighten cap screw securely, as shown in Illust. 36.

Install 41 tooth gear and spacer onto lower shaft of upper transmission, as shown in Illust. 37.

Cover

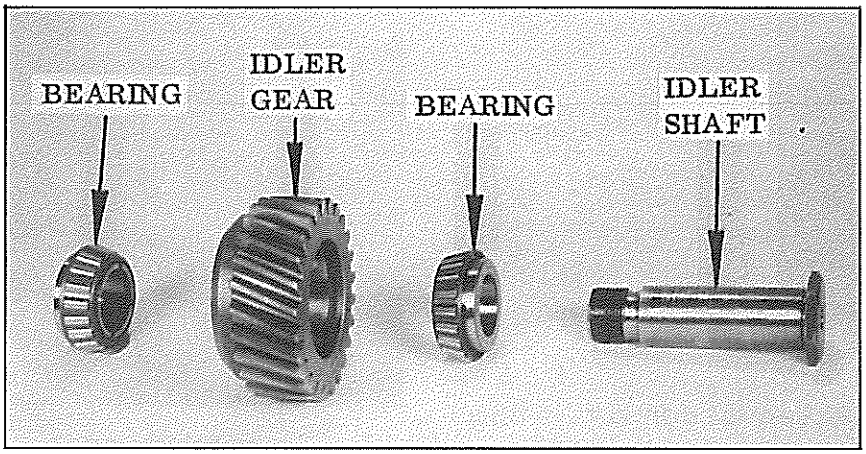
Illust. 1 is an exploded view of idler shaft.

Install idler gear with bearings onto shaft, as shown in Illust. 2.

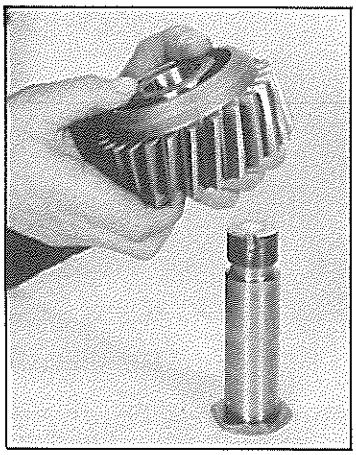
Install dowel pins in cover. Do not drive dowel pins through cover. Next, install idler shaft with gear through cover, as shown in Illust. 3. Install nut onto shaft, as shown in Illust. 4. Do not tighten.

Shellac gasket to upper transmission housing and install cover, as shown in Illust. 5.

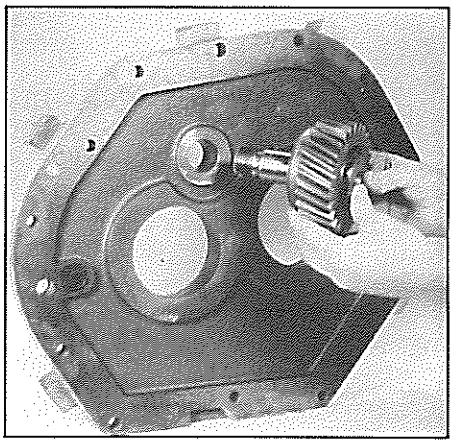
Install cap screws with lock washers. Do not tighten cap screws. Next, using a soft drift pin and hammer, drive dowel pins through cover and into upper transmission housing, as shown in Illust. 6. Tighten cover cap screws securely, as shown in Illust. 7.



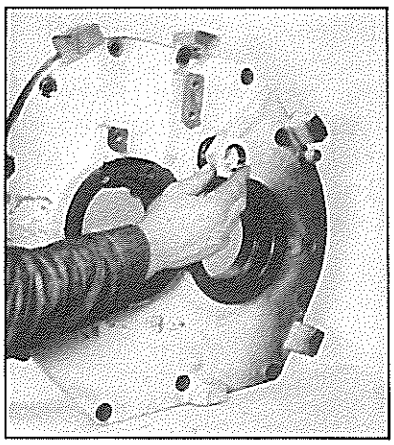
ILLUST. 1



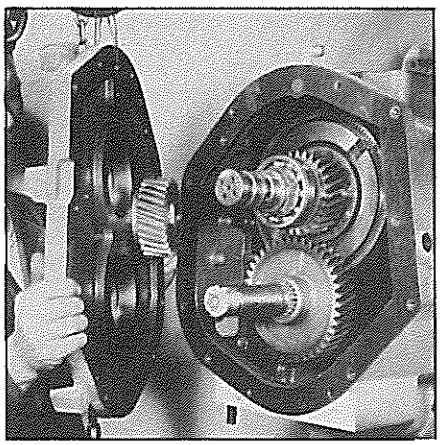
ILLUST. 2



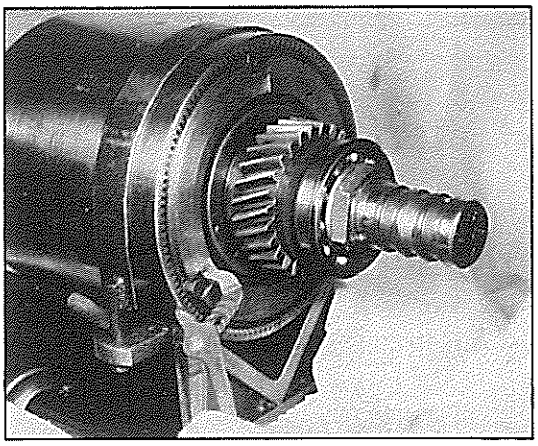
ILLUST. 3



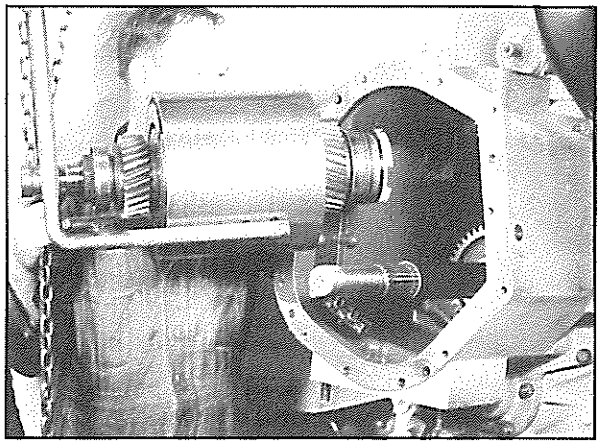
ILLUST. 4



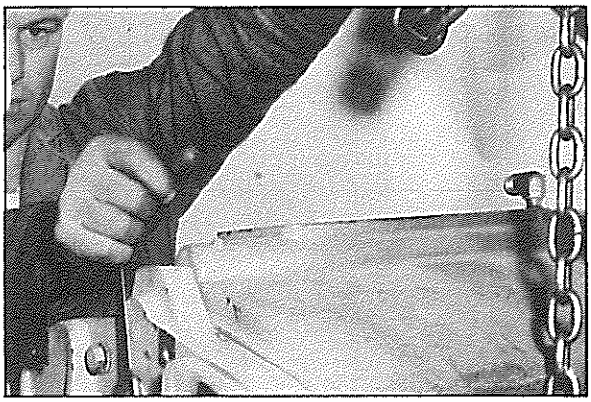
ILLUST. 5



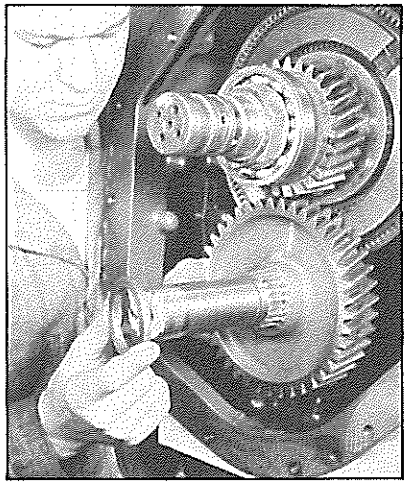
ILLUST. 34



ILLUST. 35



ILLUST. 36



ILLUST. 37

shown in Illust. 33 and tighten securely. Bend inside edge of locks against cap screw heads, as shown in Illust. 34.

Insert clutch discs into other end of hydraulic clutch drum in the same manner as illustrated in Illust. 29.through 34.

Insert hydraulic clutch drum assembly into upper transmission housing, as shown in Illust. 35. Milled flat of oil seal retainer in an upward position. Drive the assembly into upper bore of intermediate plate, using a mallet, until milled flat of oil seal retainer is flush with intermediate plate. When this has been accomplished, install lock with cap screw and lock washer. Tighten cap screw securely, as shown in Illust. 36.

Install 41 tooth gear and spacer onto lower shaft of upper transmission, as shown in Illust. 37.

Cover

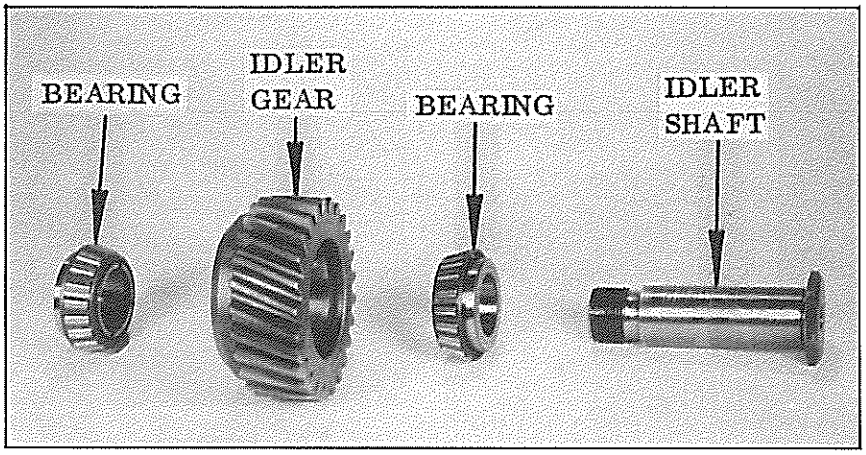
Illust. 1 is an exploded view of idler shaft.

Install idler gear with bearings onto shaft, as shown in Illust. 2.

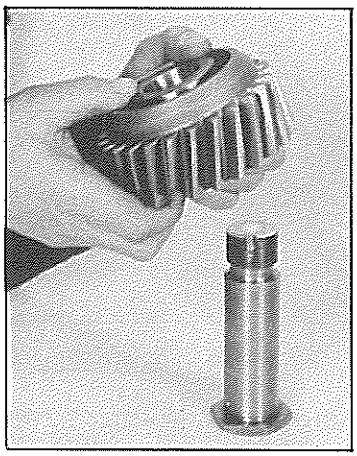
Install dowel pins in cover. Do not drive dowel pins through cover. Next, install idler shaft with gear through cover, as shown in Illust. 3. Install nut onto shaft, as shown in Illust. 4. Do not tighten.

Shellac gasket to upper transmission housing and install cover, as shown in Illust. 5.

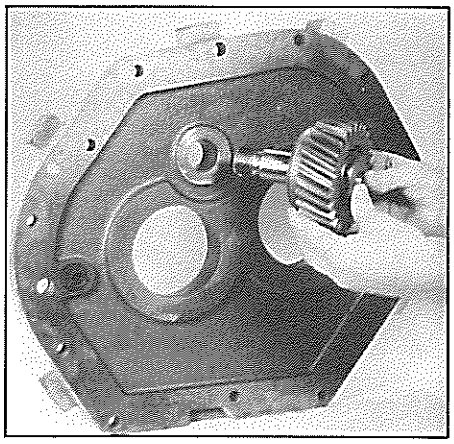
Install cap screws with lock washers. Do not tighten cap screws. Next, using a soft drift pin and hammer, drive dowel pins through cover and into upper transmission housing, as shown in Illust. 6. Tighten cover cap screws securely, as shown in Illust. 7.



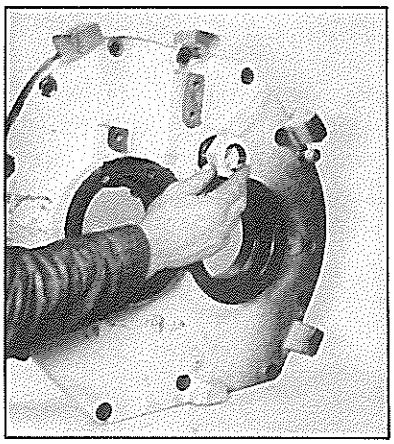
ILLUST. 1



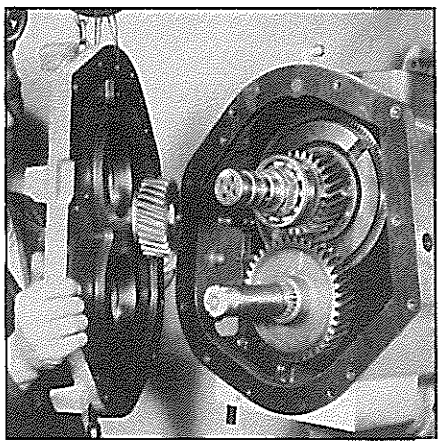
ILLUST. 2



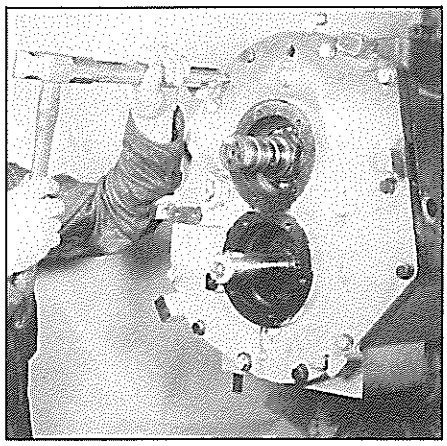
ILLUST. 3



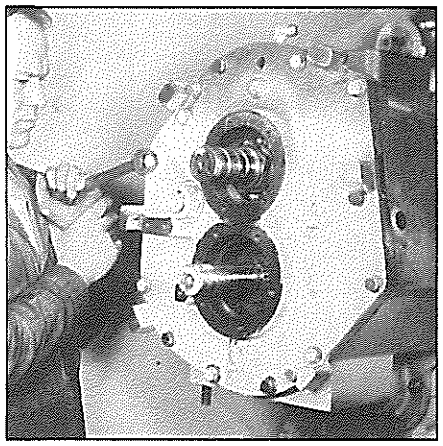
ILLUST. 4



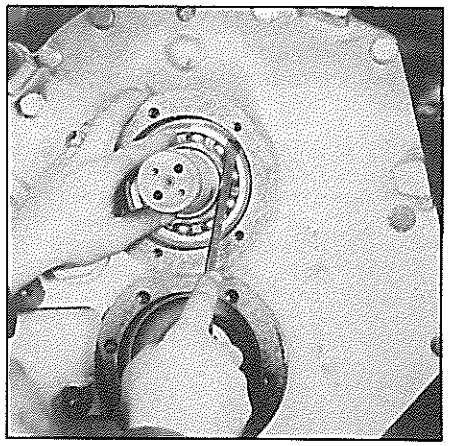
ILLUST. 5



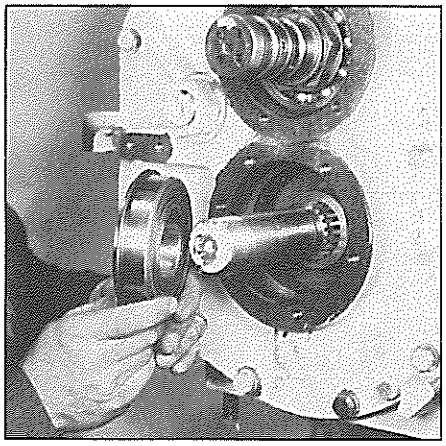
ILLUST. 6



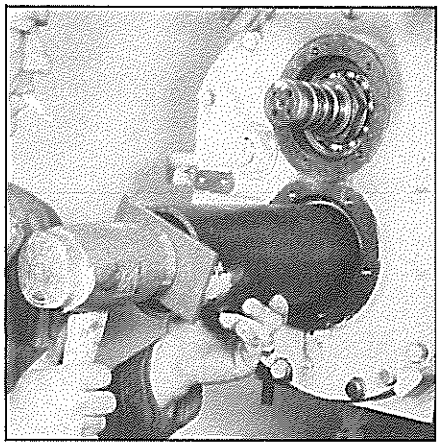
ILLUST. 7



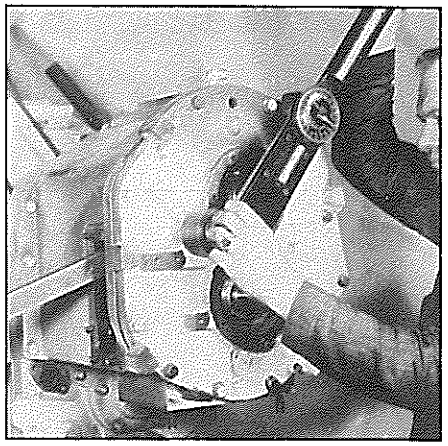
ILLUST. 8



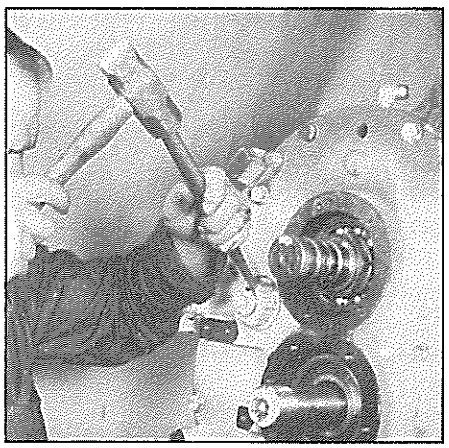
ILLUST. 9



ILLUST. 10



ILLUST. 11



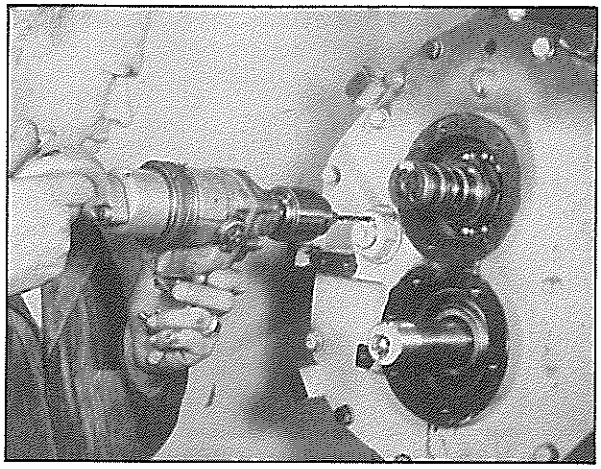
ILLUST. 12

Install snap ring in groove of upper bore of cover, as shown in Illust. 8.

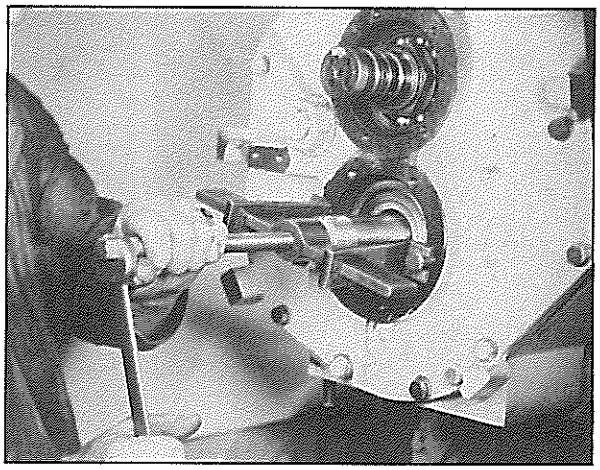
Install bearing with snap ring onto lower shaft and into cover, as shown in Illust. 9. Snap ring toward outside of cover. Drive bearing against shoulder in bore, as shown in Illust. 10.

Insert a wrench through side cover hole in upper transmission housing and over head of idler shaft. Using a torque wrench, torque shaft nut to reading of 600 foot pounds, as shown in Illust. 11. After reading is obtained, remove wrench from head of idler shaft.

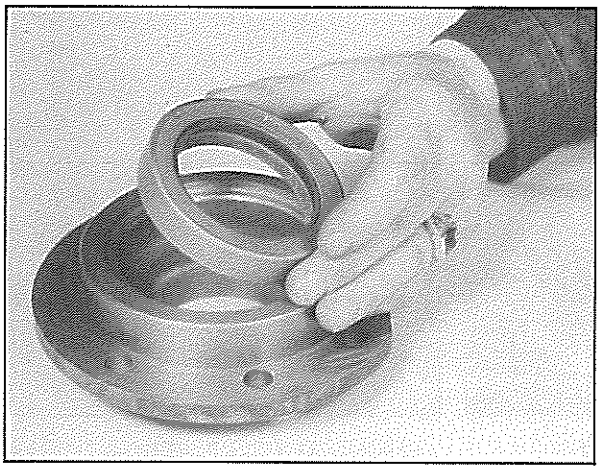
Stake idler shaft nut by using a drift pin and hammer, as shown in Illust. 12.



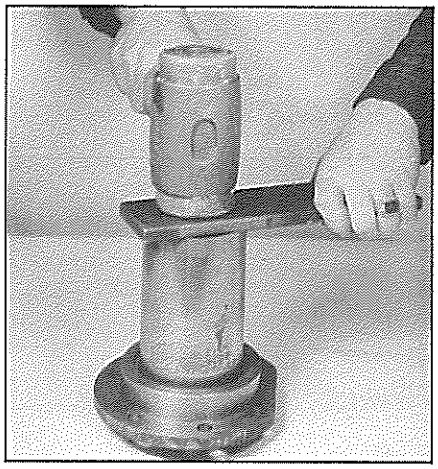
ILLUST. 13



ILLUST. 14



ILLUST. 15



ILLUST. 16

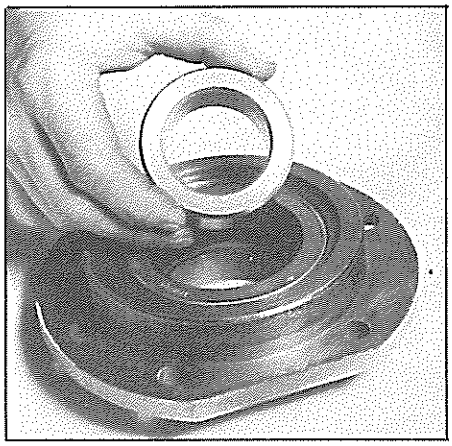
To remove stake from nut, use a drill, as shown in Illust. 13.

To remove cover, remove all cap screws. Install two (2) cap screws, less lock washer, one (1) on each side of lower shaft bore in cover. By using a puller, as shown in Illust. 14, cover can be removed. Bump cover occasionally on lugs to aid in the removing.

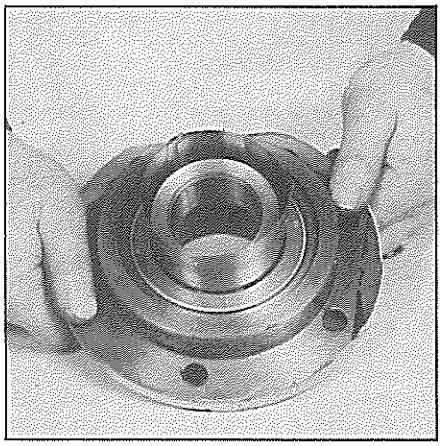
The installation of side ocvers to upper transmission are not illustrated. Install gaskets over studs, then install side covers. Magnets on cover to point toward bottom of housing. Next, install stud nuts with lock washers and tighten nut securely.

Install oil seal into retainer, as shown in Illust. 15. Lip of seal away from shoulder of retainer. As shown in Illust. 16, drive seal down to shoulder of retainer.

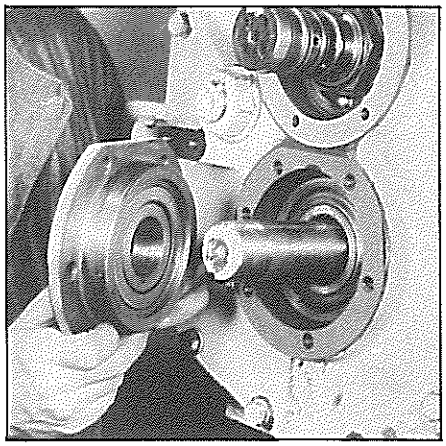
Install bushing into oil seal of retainer, as shown in Illust. 17.



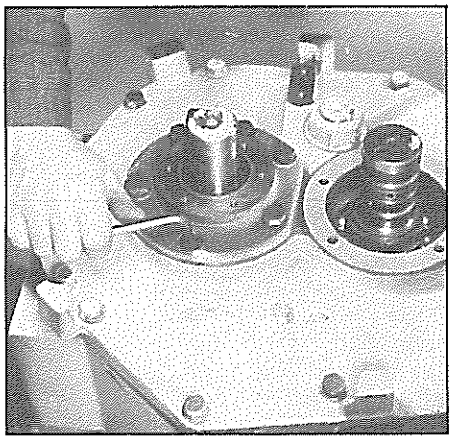
ILLUST. 17



ILLUST. 18



ILLUST. 19



ILLUST. 20

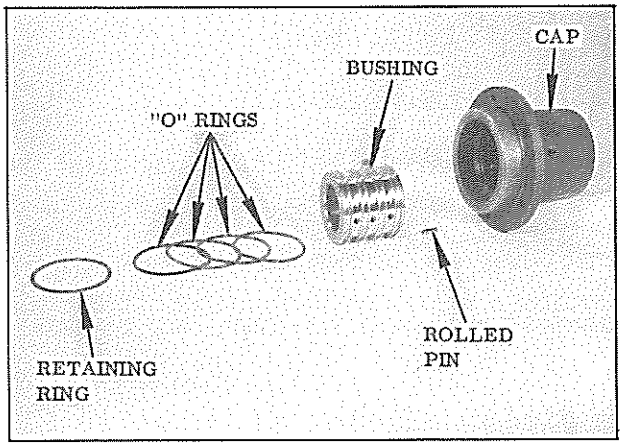
Using a piece of shim stock, as shown in Illust. 18, press bushing into oil seal and against shoulder of retainer. Shim stock will prevent damage to leather in seal. Remove shim stock.

Install retainer onto lower shaft, as shown in Illust. 19. Install cap screws with lock washers. Tighten cap screws securely. Next, install Allen head cap screw and tighten securely, as shown in Illust. 20.

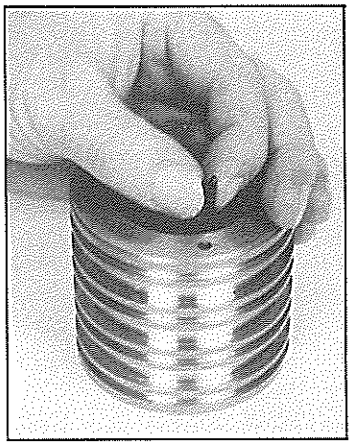
Cap

Illust. 1 is an exploded view of cap assembly.

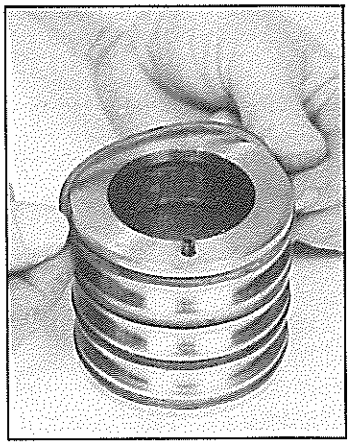
Install rolled pin into bushing, as shown in Illust. 2. Tap pin into bushing, using a hammer until seated.



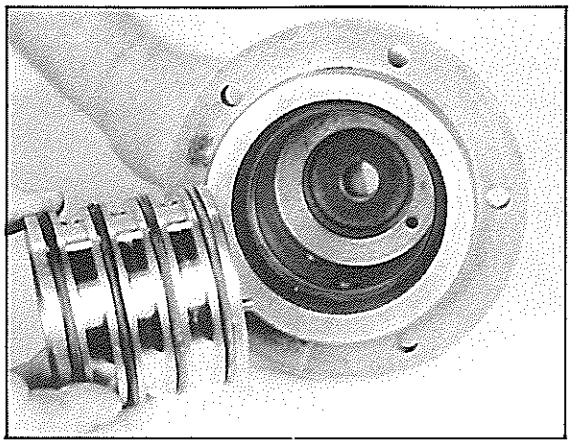
ILLUST. 1



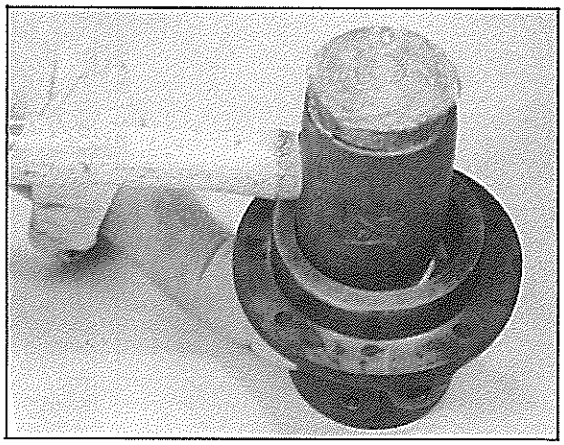
ILLUST. 2



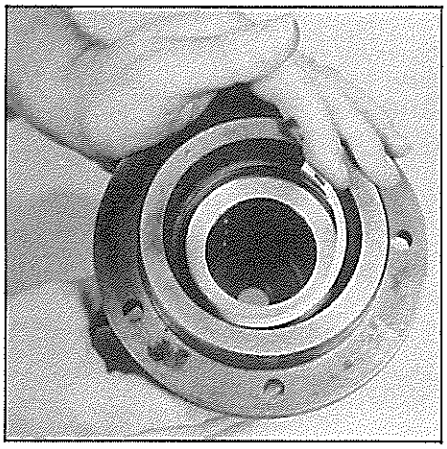
ILLUST. 3



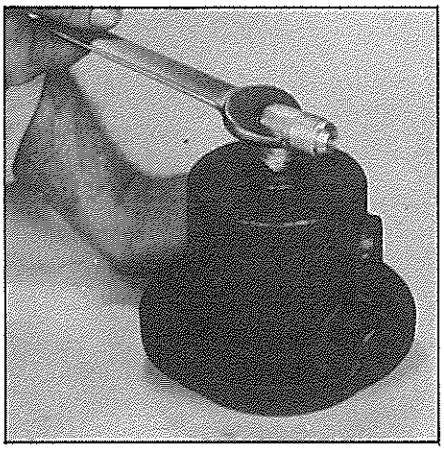
ILLUST. 4



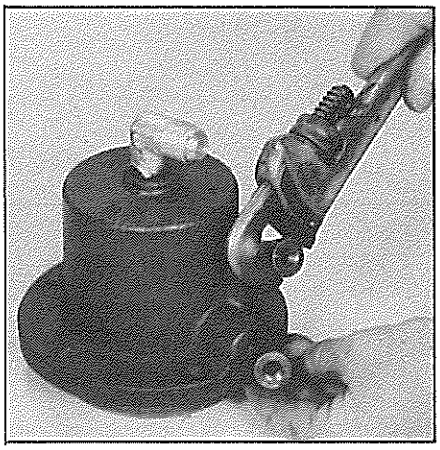
ILLUST. 5



ILLUST. 6



ILLUST. 7



ILLUST. 8

Install four (4) "O" rings in grooves of bushing, as shown in Illust. 3.

Apply white lead on "O" rings and insert bushing into cap, as shown in Illust. 4. Align rolled pin in bushing with pin hole in cap. Use a mallet to tap bushing into cap, as shown in Illust. 5.

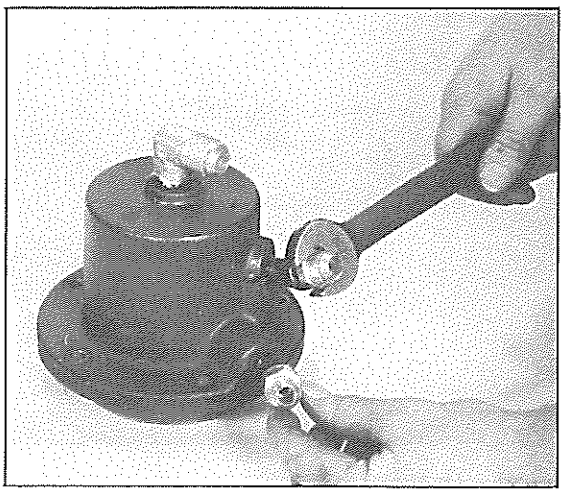
Insert retaining ring into groove of cap, as shown in Illust. 6.

When installing pipe fittings to cap, apply a pipe sealing compound to threads.

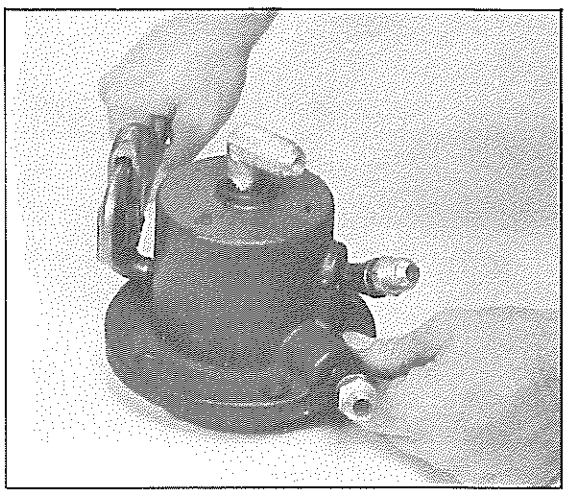
Install and tighten adapter elbow into cover, as shown in Illust. 7.

Install and tighten two (2) 45 degree street elbows in cap, as shown in Illust. 8.

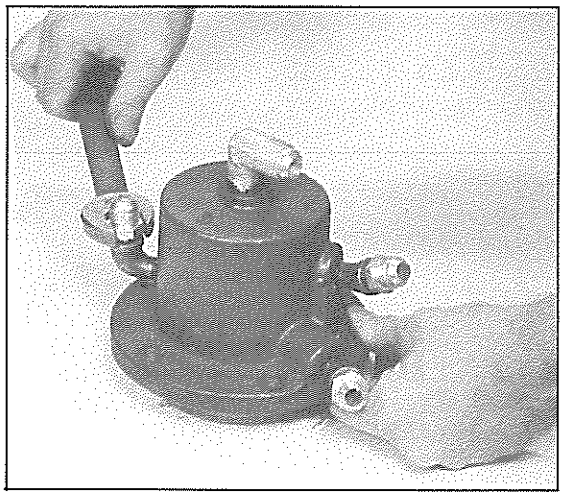
Install two (2) adapters into 45 degree street elbows, as shown in Illust. 9.



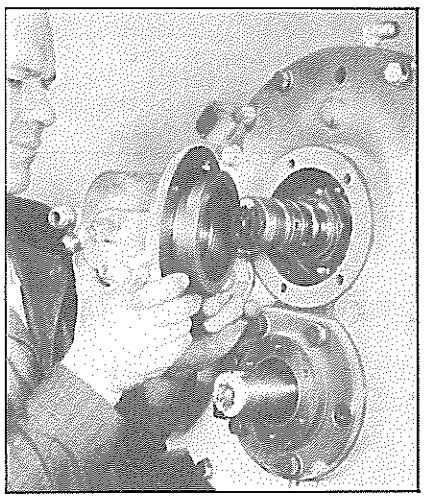
ILLUST. 9



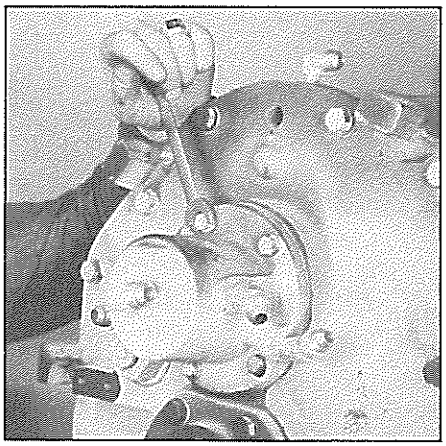
ILLUST. 10



ILLUST. 11



ILLUST. 12



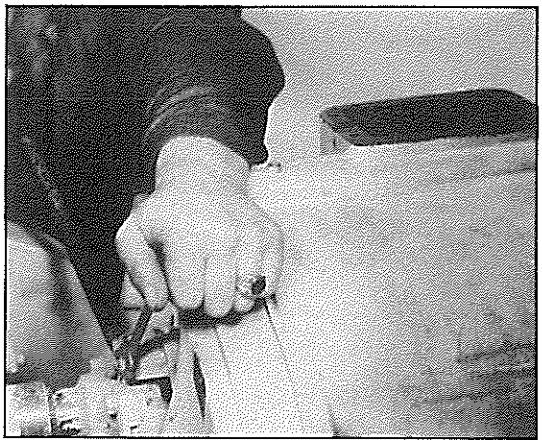
ILLUST. 13

Install 90 degree street elbow into cap, as shown in Illust. 10.

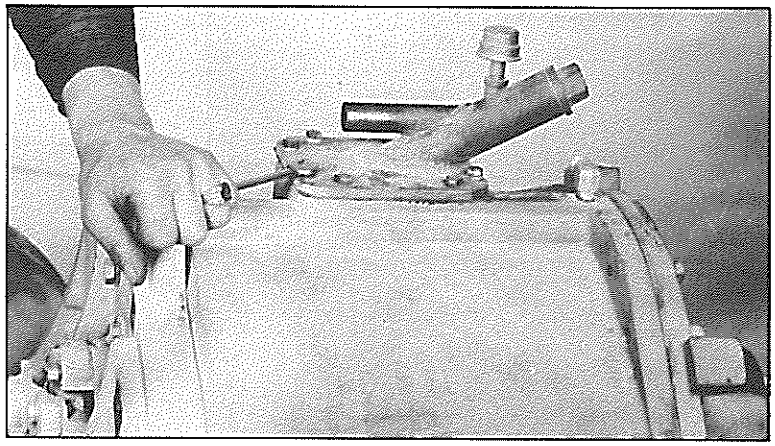
Install adapter into 90 degree street elbow, as shown in Illust. 11.

Before installing cap over piston rings on hydraulic clutch shaft, be sure piston ring openings are 90 degree from each other.

Install cap over shaft and onto cover, as shown in Illust. 12. Install cap screws with lock washers, as shown in Illust. 13. Tighten cap screws securely.



ILLUST. 14



ILLUST. 15

Install drive coupling to hydraulic clutch shaft, as shown in Illust. 14. Install drive coupling cap screws with lock washers and tighten to a torque reading of 65 foot pounds.

Install filler cap cover and gasket, as shown in Illust. 15. Install cover cap screws with lock washers and tighten securely.

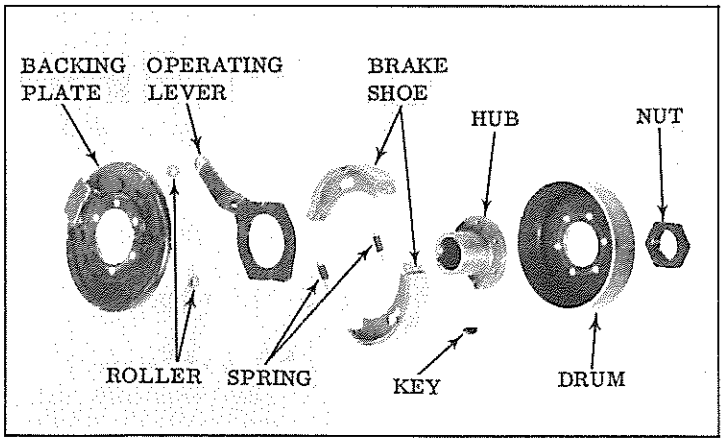
Clutch Brake

Illust. 1 is an exploded view of clutch brake assembly.

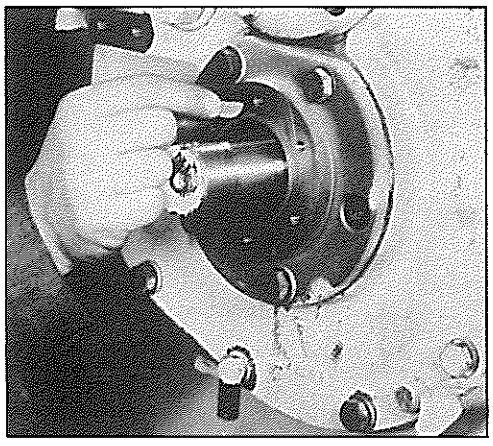
Insert key in keyway of lower shaft, as shown in Illust. 2.

Install clutch brake backing plate over shaft and onto retainer, as shown in Illust. 3. Next, install cap screws with lock washers and tighten securely, as shown in Illust. 4.

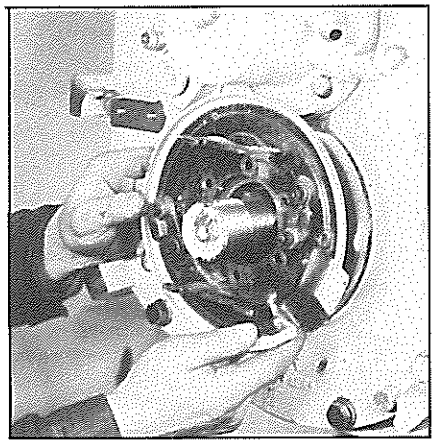
Install rollers onto rocker arms of backing plate, as shown in Illust. 5.



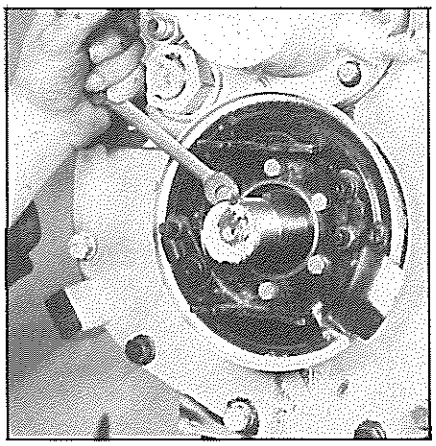
ILLUST. 1



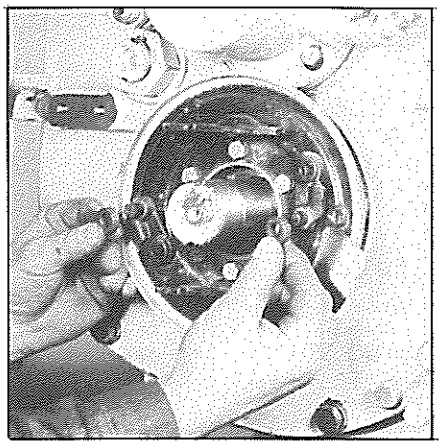
ILLUST. 2



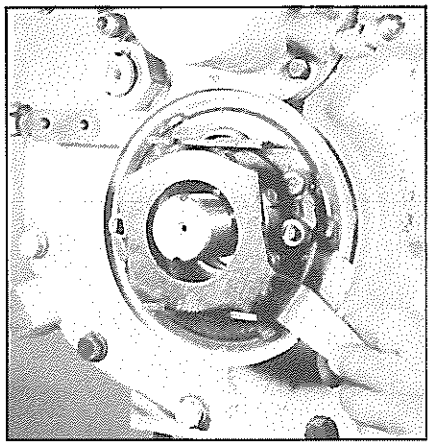
ILLUST. 3



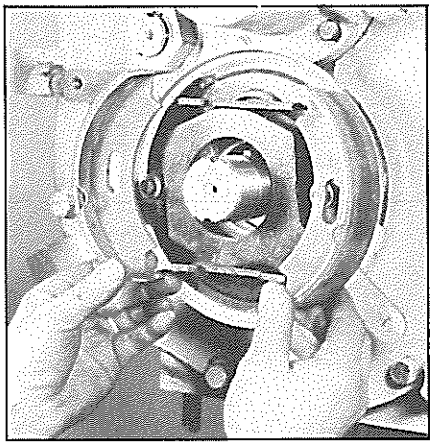
ILLUST. 4



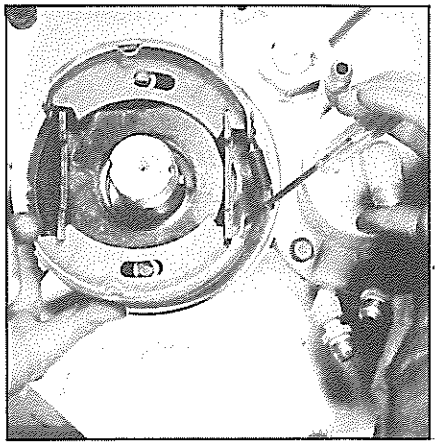
ILLUST. 5



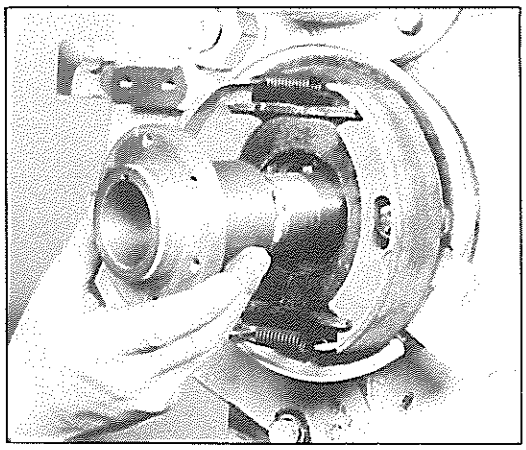
ILLUST. 6



ILLUST. 7



ILLUST. 8



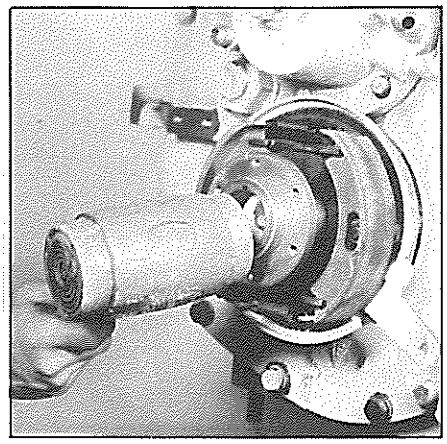
ILLUST. 9

Install brake operating lever onto backing plate, as shown in Illust. 6.

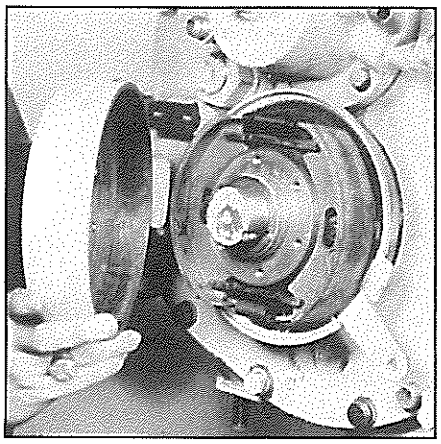
Install brake shoes onto rocker arms, as shown in Illust. 7. Next, install top spring, as shown in Illust. 8. Hook one (1) end of spring in front hole of shoe. Using a small screw driver or punch, hook the other end of spring in front hole of opposite shoe. Repeat same installation of lower spring.

Install brake drum hub onto lower shaft, as shown in Illust. 9. Keyway in hub to slide over key in shaft.

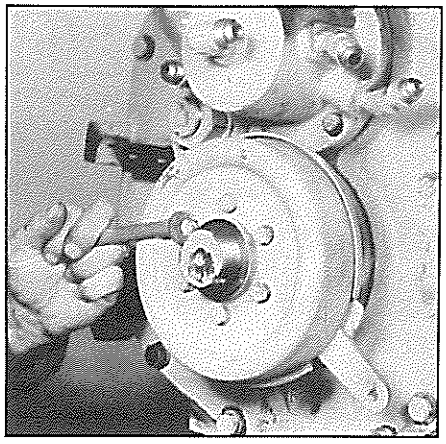
Use a rawhide mallet to bump hub onto shaft, as shown in Illust. 10.



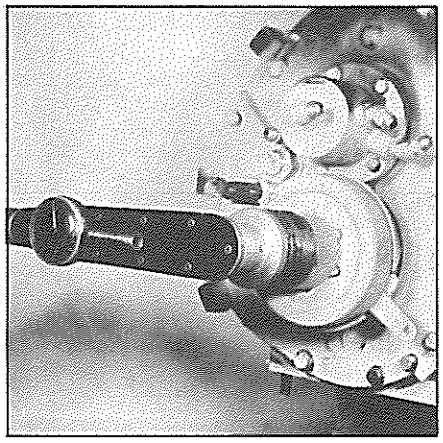
ILLUST. 10



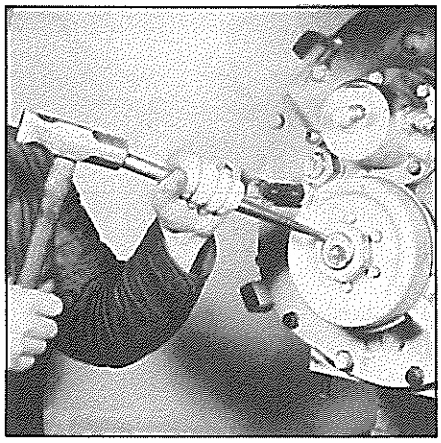
ILLUST. 11



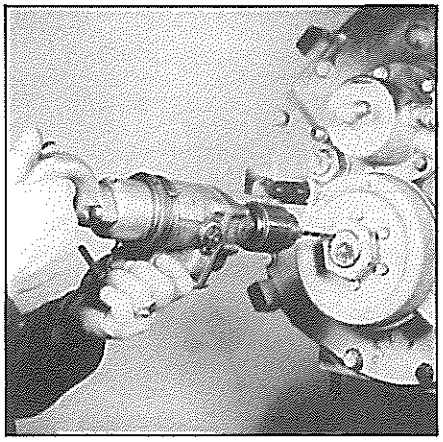
ILLUST. 12



ILLUST. 13



ILLUST. 14



ILLUST. 15

Install brake drum onto hub, as shown in Illust. 11.

Install cap screws with lock washers and tighten securely, as shown in Illust. 12.

Install nut onto shaft and tighten to a torque reading of 750 foot pounds, as shown in Illust. 13.

When torque reading is obtained, stake nut using a drift pin and hammer, as shown in Illust. 14.

To remove staked nut, use a drill to drill out stake, as shown in Illust. 15.

Parking Brake

The parking brake has both mechanical and hydraulic action. The mechanical phase is operated by the hand brake and the hydraulic phase

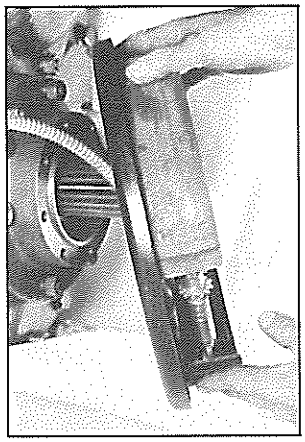
by the brake pedal. The hydraulic phase aids the slowing down of the transmission simultaneously with the wheels, when the brake pedal is depressed.

Reassembly

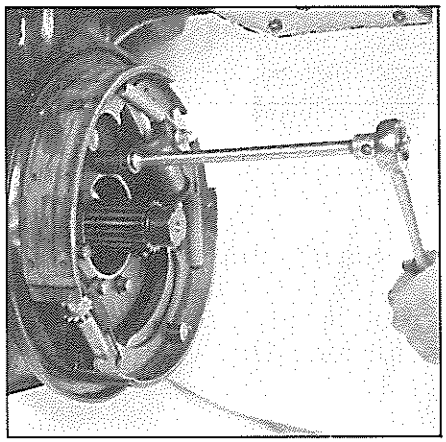
Install brake backing plate assembly onto adapter plate, as shown in Illust. 1. Install cap screws with lock washers and tighten securely, as shown in Illust. 2.

Install strut and spring, as shown in Illust. 3. Using a screw driver, pry down on brake shoe to install strut and spring.

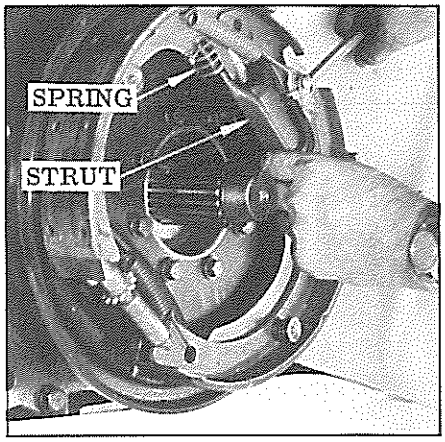
Install brake drum onto splined shaft and over brake shoes, as shown in Illust. 4. Install lock nut, as shown in Illust. 5. Tighten lock nut to a torque reading of 600 foot pounds, as shown in Illust. 6. After torque reading is obtained, stake lock nut, using a drift pin and



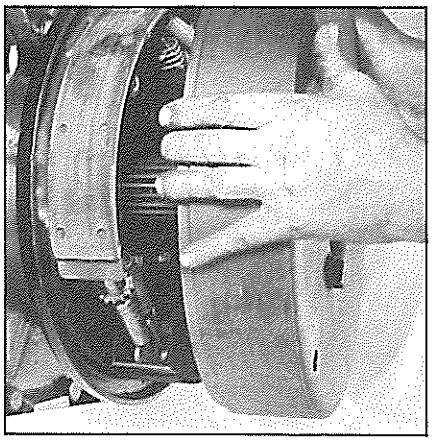
ILLUST. 1



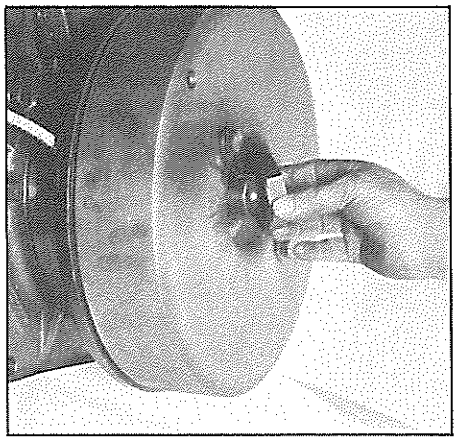
ILLUST. 2



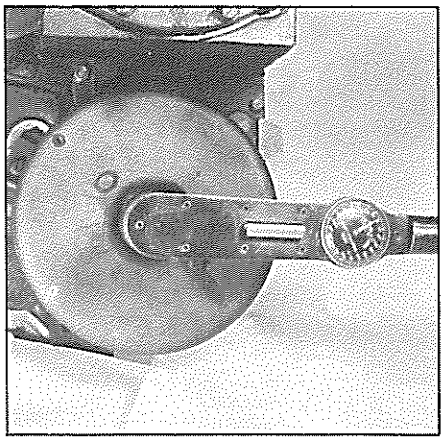
ILLUST. 3



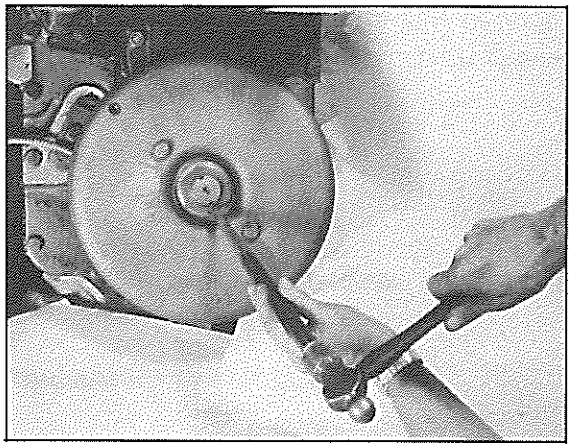
ILLUST. 4



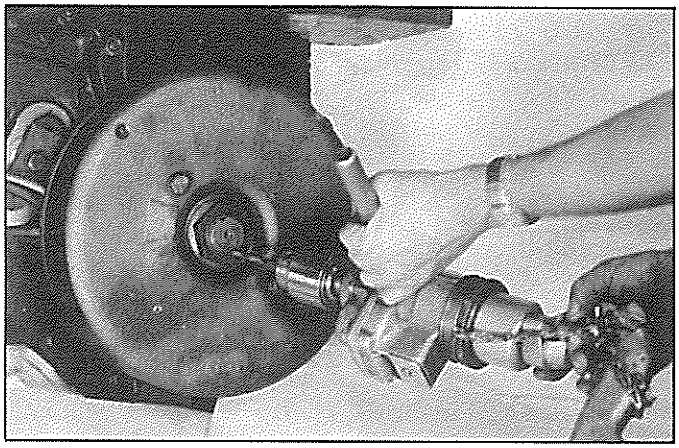
ILLUST. 5



ILLUST. 6



ILLUST. 7



ILLUST. 8

hammer, as shown in Illust. 7.

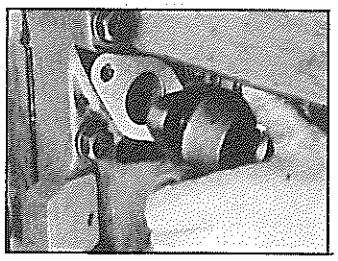
In order to disassemble parking brake, first disconnect hose from reservoir. Next, remove reservoir from upper transmission housing. Using a drill, drill out stake in lock nut, as shown in Illust. 8. Disassembly procedure can now be accomplished by reversing the reassembly procedure.

Shifter Housing

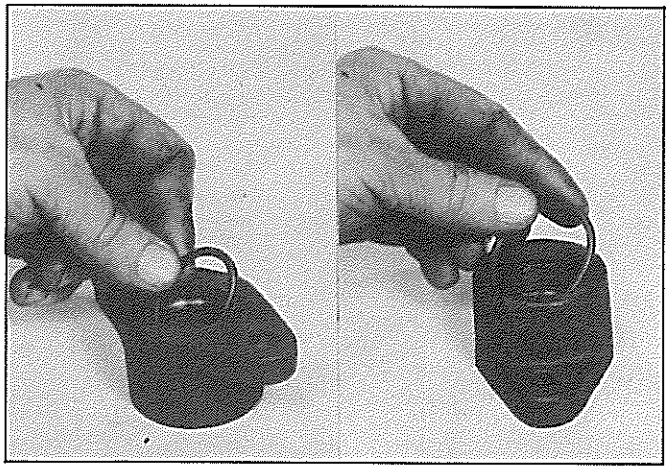
Install "O" rings in rocker shaft end, as shown in Illust. 1.

Install rocker shaft end onto intermediate plate with gasket, cap screws and lock washers, as shown in Illust. 2. Note: Do not tighten cap screws.

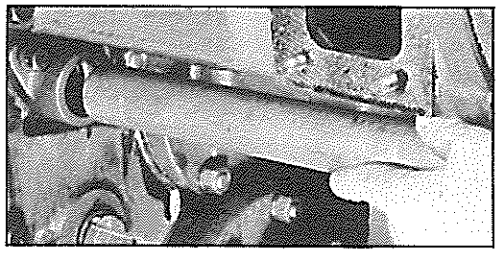
Insert rocker shaft tube into rocker shaft end, as



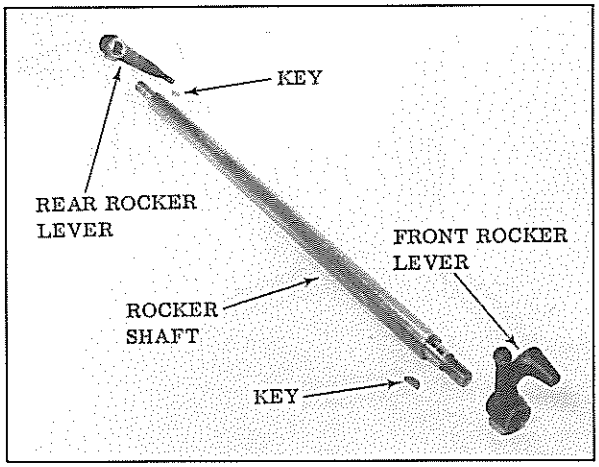
ILLUST. 2



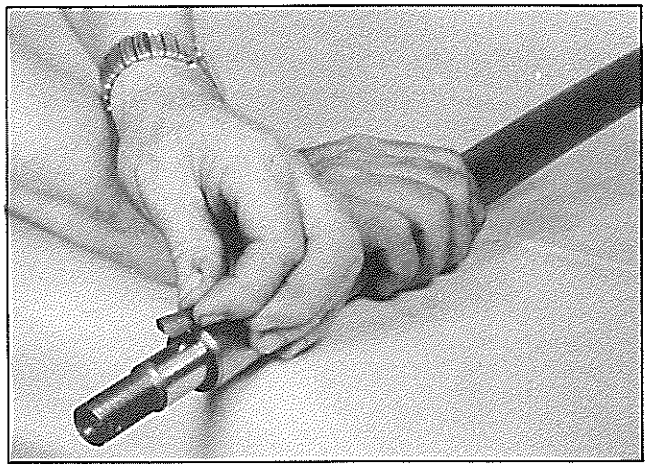
ILLLUST. 1



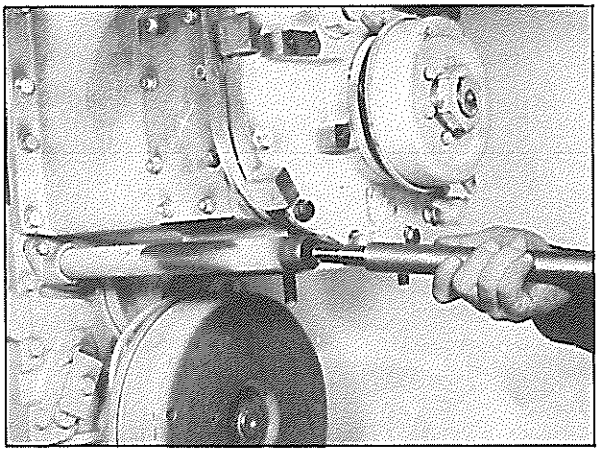
ILLUST. 3



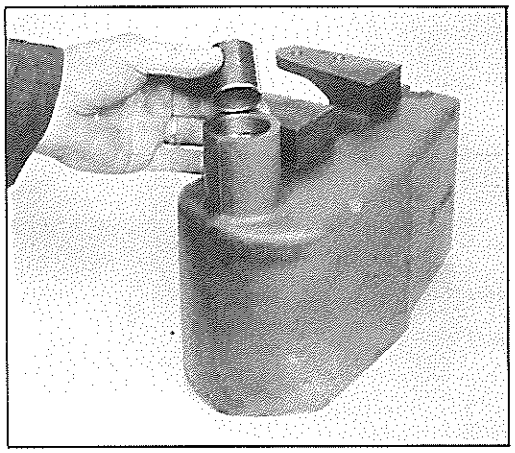
ILLUST. 4



ILLUST. 5



ILLUST. 6



ILLUST. 7

shown in Illust. 3. Note: See that the "O" rings in the rocker shaft end are oiled and insert the tube carefully, to prevent damage to the "O" rings.

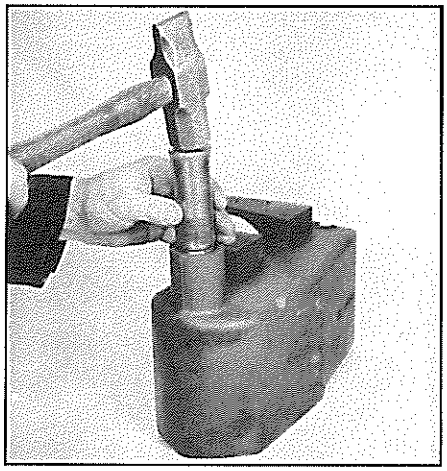
Illust. 4 is an exploded view of the rocker shaft.

Install key in keyway, at each end of rocker shaft, as shown in Illust. 5.

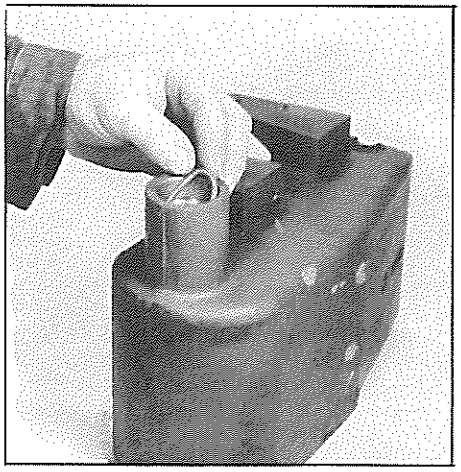
Insert rocker shaft with keys into tube, as shown in Illust. 6.

Install steel backed bronze bushing, into rocker arm tube hole in shifter housing, as shown in Illust. 7. Drive bushing into housing, as shown in Illust. 8.

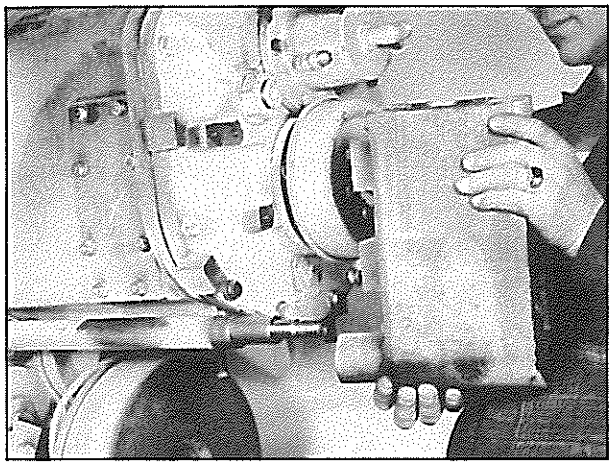
Install "O" ring into groove of rocker arm tube hole in shifter housing, as shown in Illust. 9.



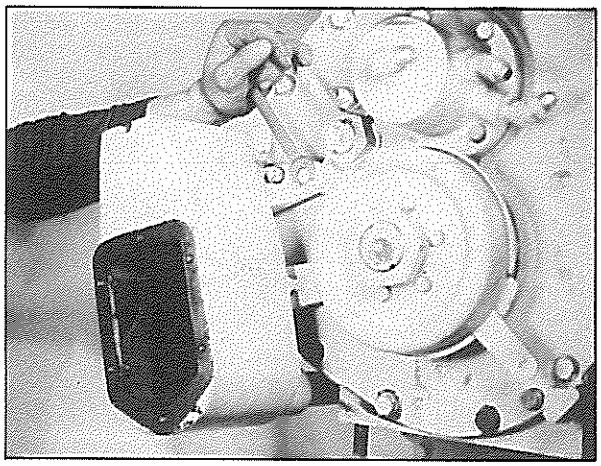
ILLUST. 8



ILLUST. 9



ILLUST. 10

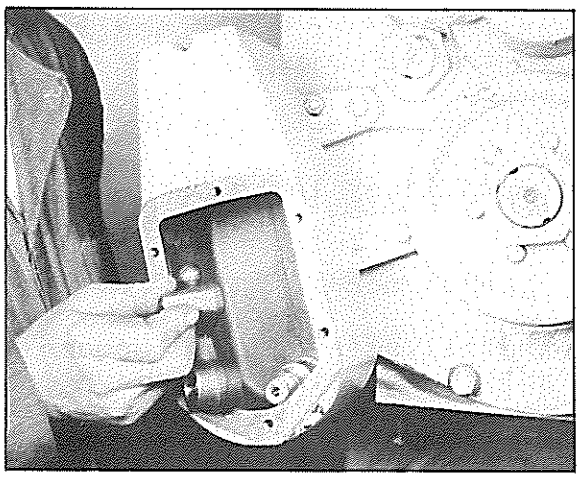


ILLUST. 11

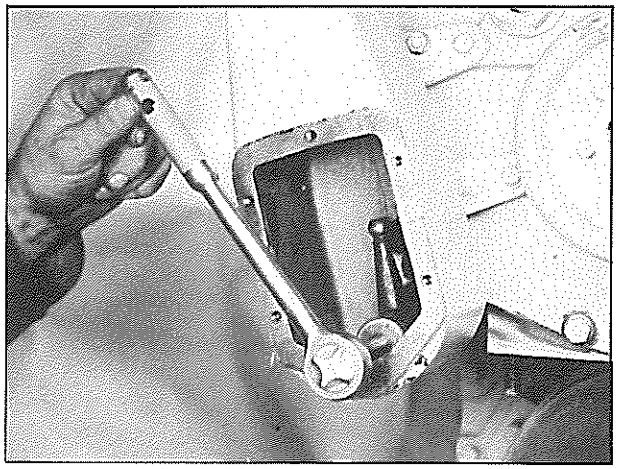
Install shifter housing onto rocker shaft and tube, as shown in Illust. 10. Note: See that the "O" ring in the shifter housing is oiled. Install the housing on the tube carefully, to prevent damage to "O" ring.

Install shifter housing to upper transmission case cover. Install cap screws and lock washers. Tighten cap screws securely, as shown in Illust. 11.

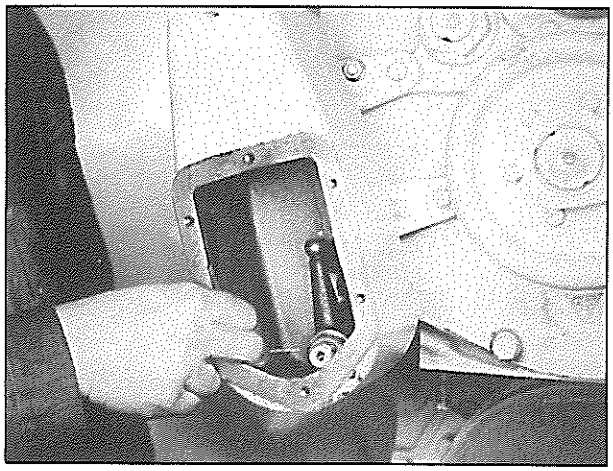
Install front rocker lever, over key in rocker shaft, as shown in Illust. 12. Next, install nut on rocker shaft



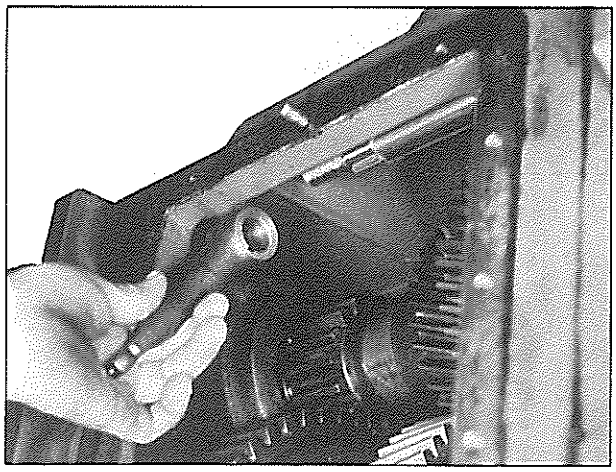
ILLUST. 12



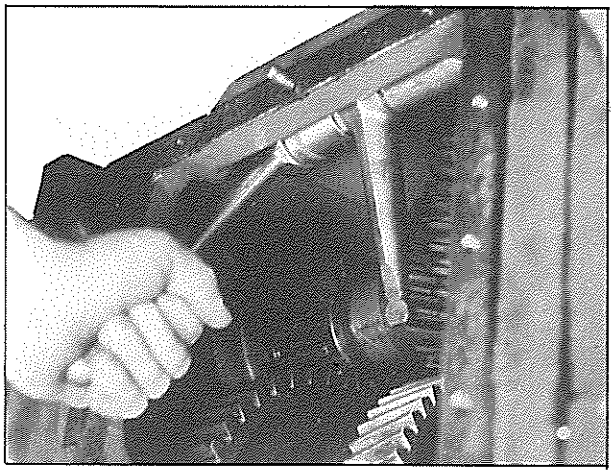
ILLUST. 13



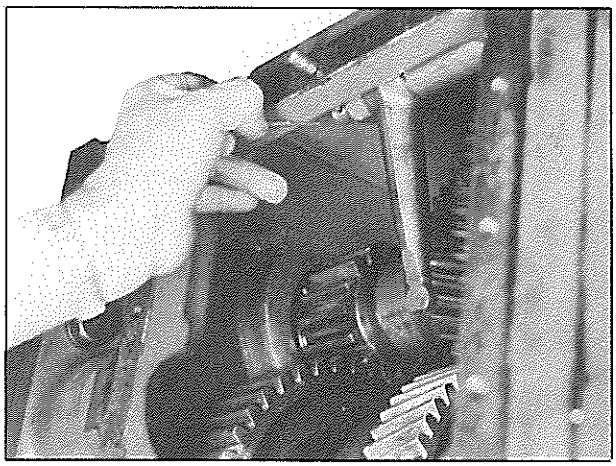
ILLUST. 14



ILLUST. 15



ILLUST. 16



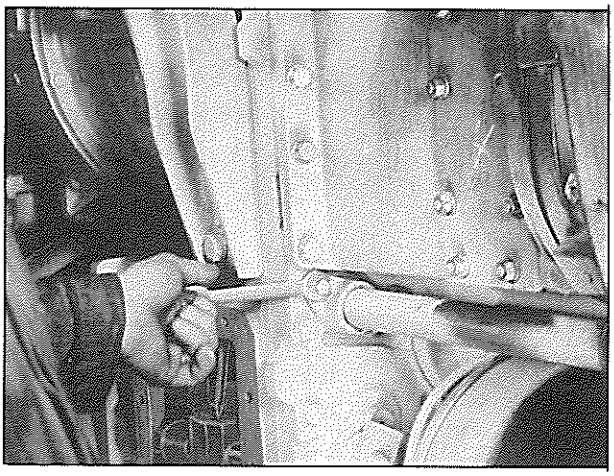
ILLUST. 17

and tighten securely, as shown in Illust. 13.

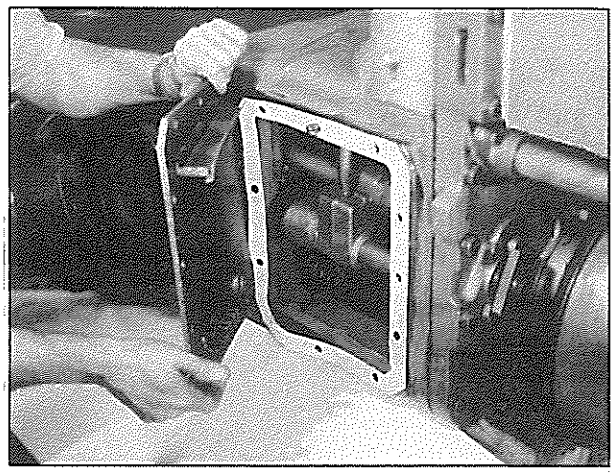
Install and spread cotter pin in rocker shaft, as shown in Illust. 14.

Install rear rocker lever, over key in rocker shaft, with ball of lever in a downward position in the shifter fork slots. Keyway in lever toward the interior of housing, as shown in Illust. 15. Next, install and tighten rear lever nut, as shown in Illust. 16.

Insert and spread cotter pin in rocker shaft, as shown in Illust. 17.



ILLUST. 18



ILLUST. 19

Tighten rocker shaft end cap screws, as shown in Illust. 18. Note: The rocker shaft must rotate freely and the rear lever must move from fork to fork without interference after these cap screws have been tightened.

Install cover plate with gasket, cap screws and lock washers, as shown in Illust. 19. Tighten cap screws securely.

Hydraulic Reservoir

It is seldem necessary to repair hydraulic reservoir other than replacing the filter or pipe fittings. Assuming the reservoir has been completely disassembled, the following instructions and illustrations will aid in the reassembly procedure.

Reassembly

Illust. 1 is an exploded view of the hydraulic reservoir.

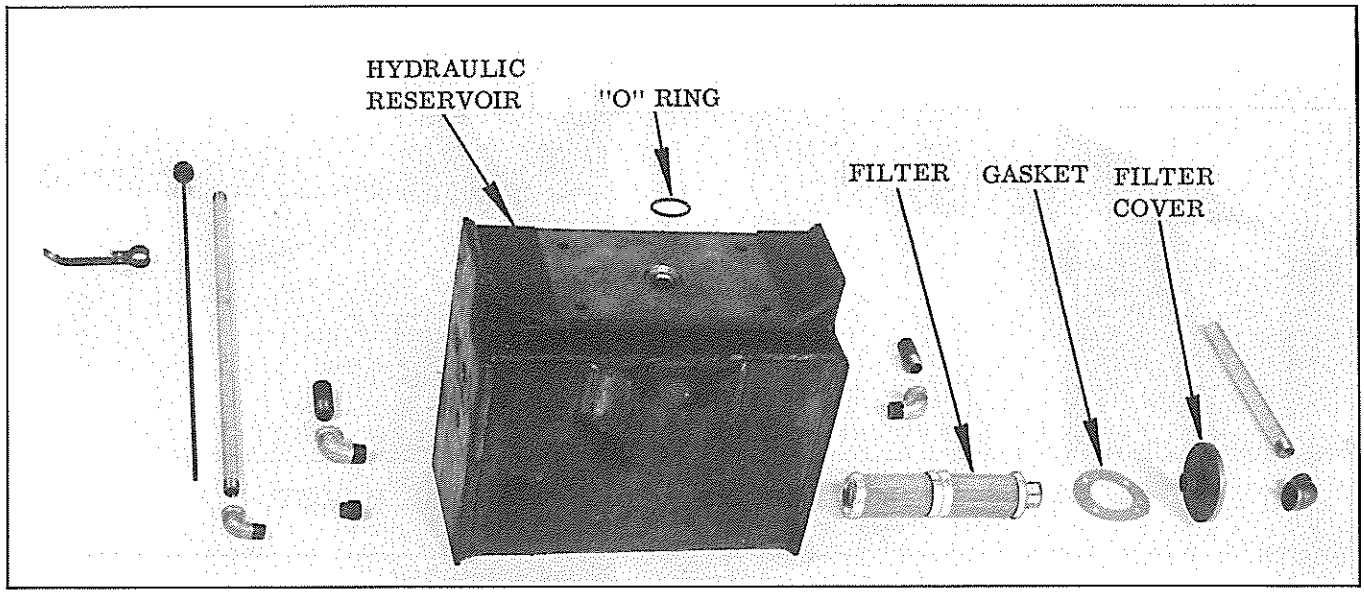
Install studs into reservoir, as shown in Illust. 2, by using two nuts locked together on stud. Tighten studs securely. Remove nuts.

Install filter onto filter cover and tighten securely, as shown in Illust. 3.

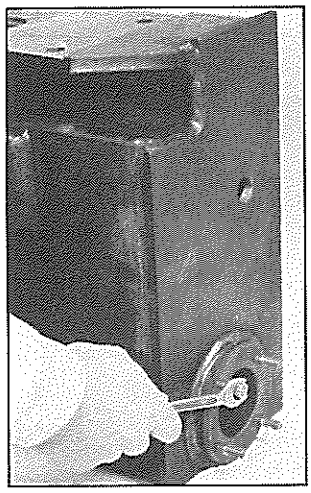
Install gasket onto studs and insert filter cover with filter into reservoir and over studs, as shown in Illust. 4. Install stud nuts with lock washers and tighten securely, as shown in Illust. 5.

Before installing pipe fittings, coat threads of fittings with a good pipe sealing compound to prevent leaks.

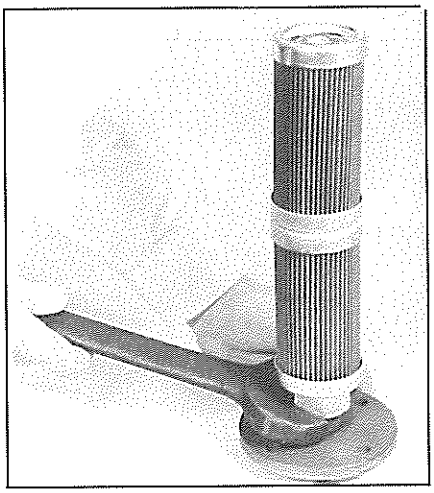
Install elbow onto filter cover and tighten securely, as shown in Illust. 6.



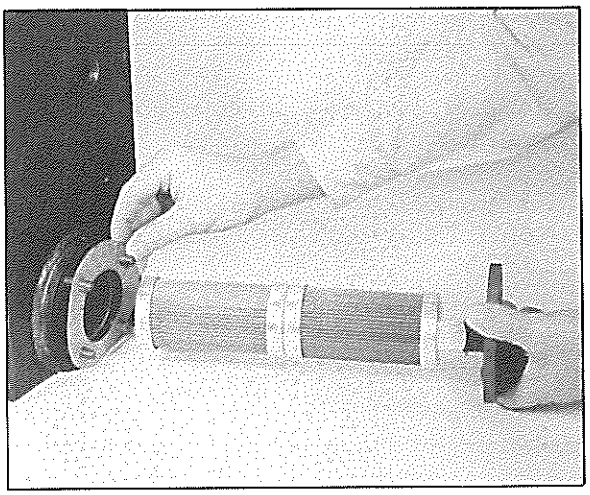
ILLUST. 1



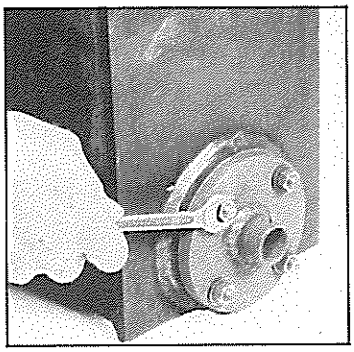
ILLUST. 2



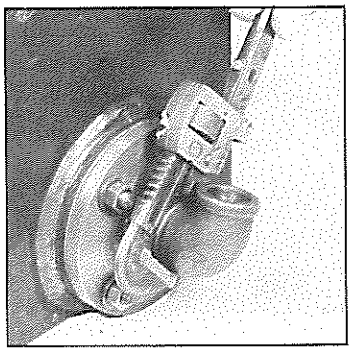
ILLUST. 3



ILLUST. 4



ILLUST. 5

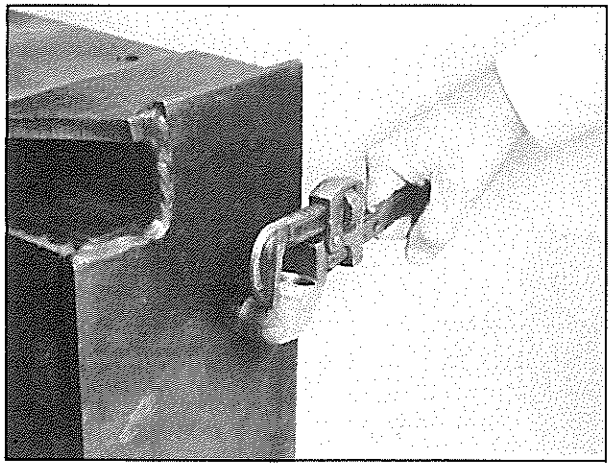


ILLUST. 6

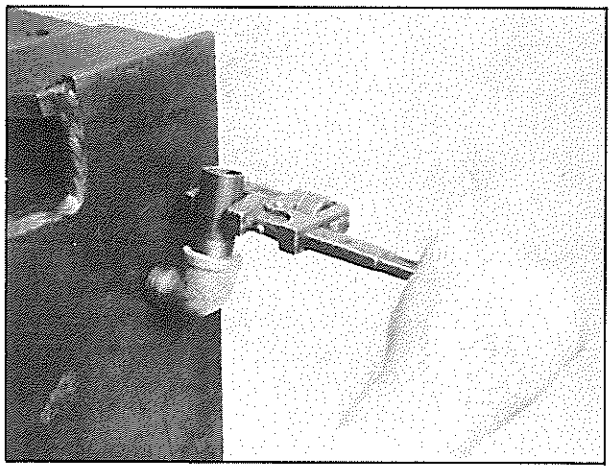
Install elbow into reservoir and tighten securely, as shown in Illust. 7.

Install nipple into elbow and tighten securely, as shown in Illust. 8.

Install nipple into filter cover elbow and tighten, as shown in Illust. 9.



ILLUST. 7



ILLUST. 8

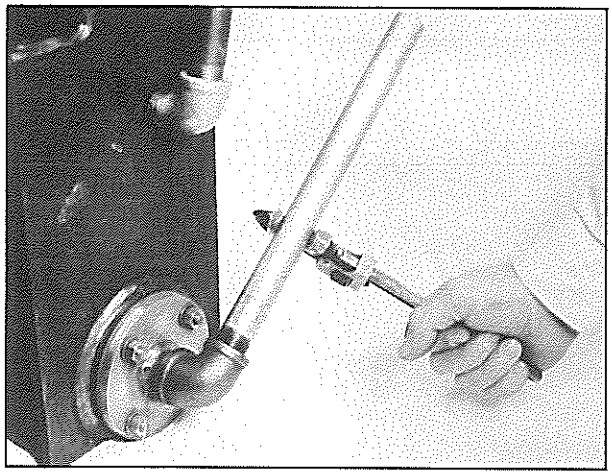
Install plug into reservoir and tighten securely, as shown in Illust. 10.

Install elbow into reservoir and tighten securely, as shown in Illust. 11.

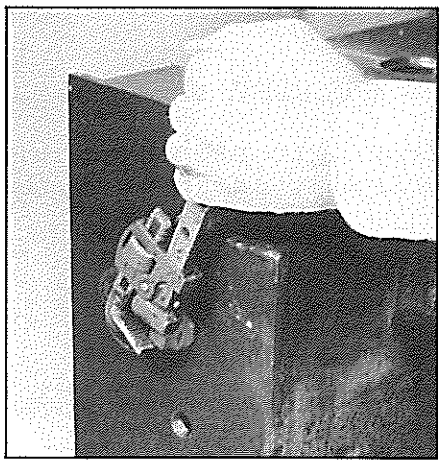
Install nipple into elbow and tighten securely, as shown in Illust. 12.

Install elbow into reservoir, as shown in Illust. 13 and tighten securely.

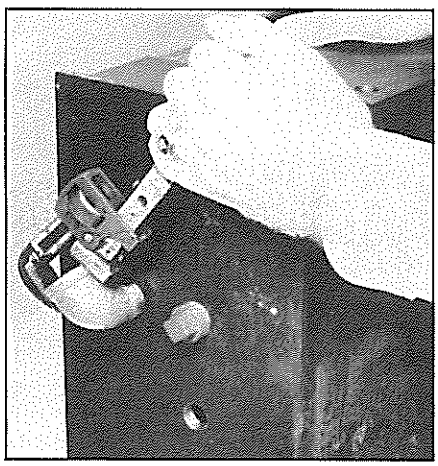
Install dip stick pipe into elbow



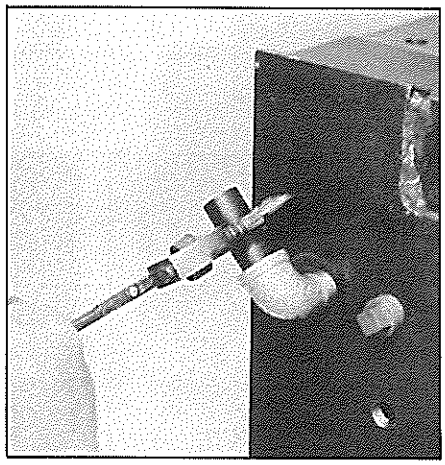
ILLUST. 9



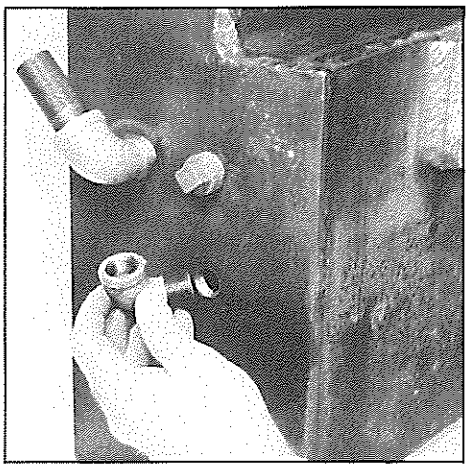
ILLUST. 10



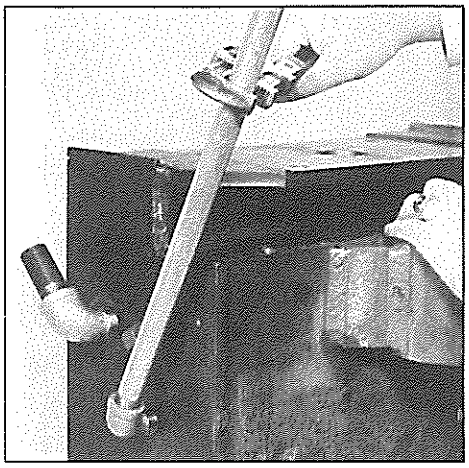
ILLUST. 11



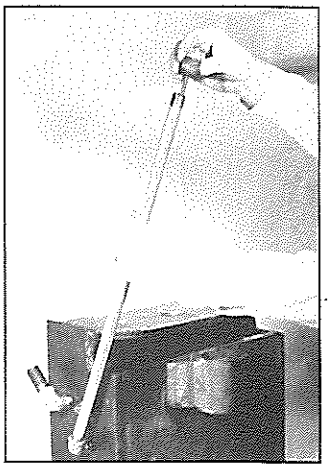
ILLUST. 12



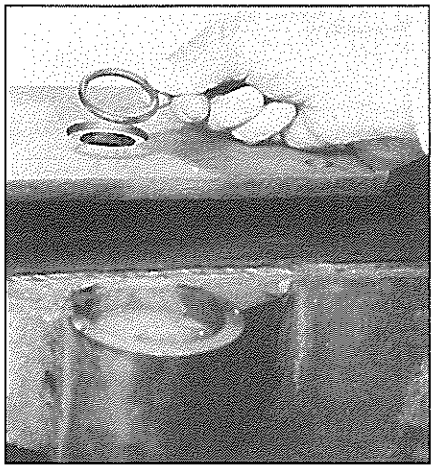
ILLUST. 13



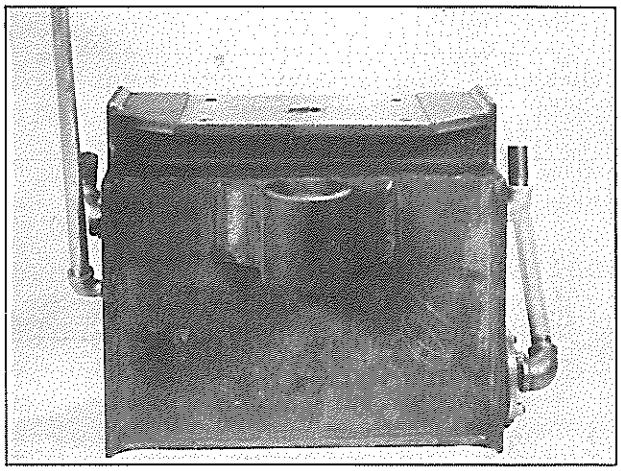
ILLUST. 14



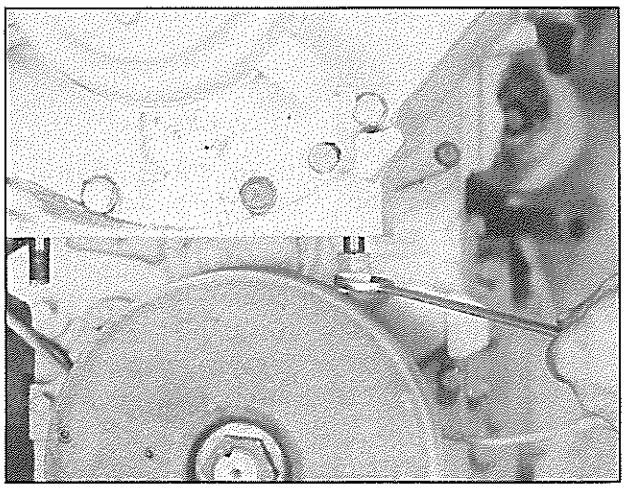
ILLUST. 15



ILLUST. 16



ILLUST. 17



ILLUST. 18

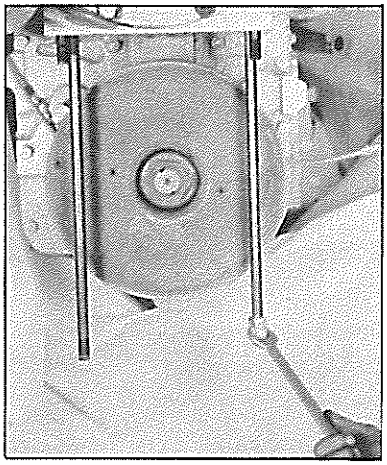
and tighten securely, as shown in Illust. 14.

Install dip stick into pipe, as shown in Illust. 15.

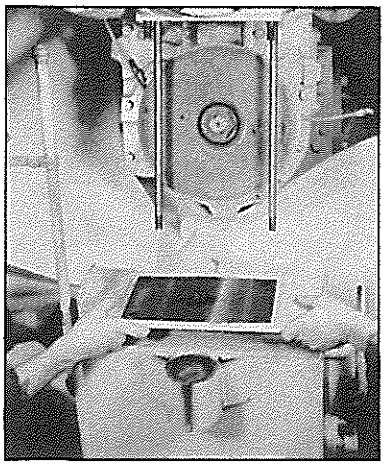
Install "O" ring in top of reservoir, as shown in Illust. 16.

Illust. 17 shows the hydraulic reservoir complete and ready for installation to upper transmission.

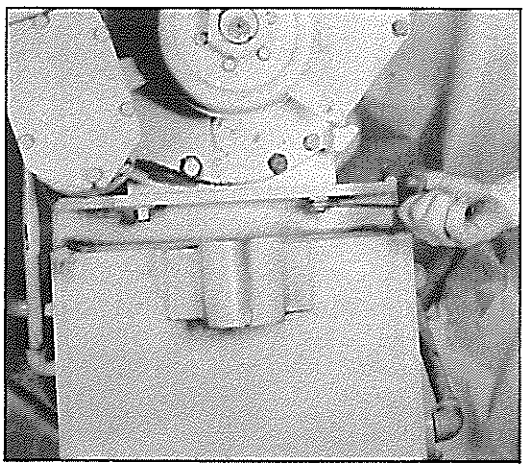
Install short studs into front holes in bottom of upper transmission housing. Using two nuts locked together on studs, tighten studs into housing



ILLUST. 19



ILLUST. 20



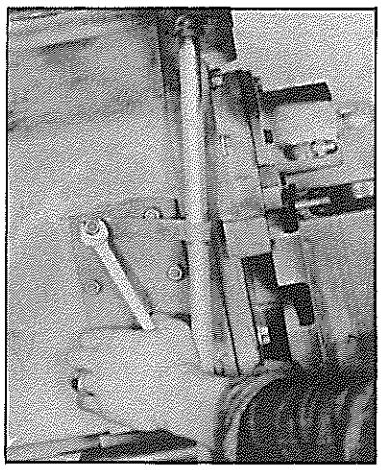
ILLUST. 21

securely, as shown in Illust. 18. Remove two nuts from studs.

Install long studs into rear holes in bottom of upper transmission housing. Using two nuts locked together on studs, tighten studs into housing securely, as shown in Illust. 19. Remove two nuts from studs.

Install hydraulic reservoir onto studs and against bottom of upper transmission as shown in Illust. 20. Next, install stud nuts with lock washers and tighten securely, as shown in Illust. 21.

Install dip stick pipe bracket around pipe and onto upper transmission cover stud. Install stud nut with lock washer and tighten securely, as shown in Illust. 22.



ILLUST. 22

CONTROL VALVE

The control valve is built to provide long life and trouble free service. Wear between the parts is negligible. However, if dirt or other foreign material causes damage to the piston and valve body, both parts must be replaced. Never install a new piston into an old valve body.

Cleanliness in all operations is highly important when working on the control valve. Parts should be cleaned in CLEAN solvent and blown dry with air. IMPORTANT: Rags or waste should not be used to clean parts. Ends of hoses should be plugged to keep dirt out.

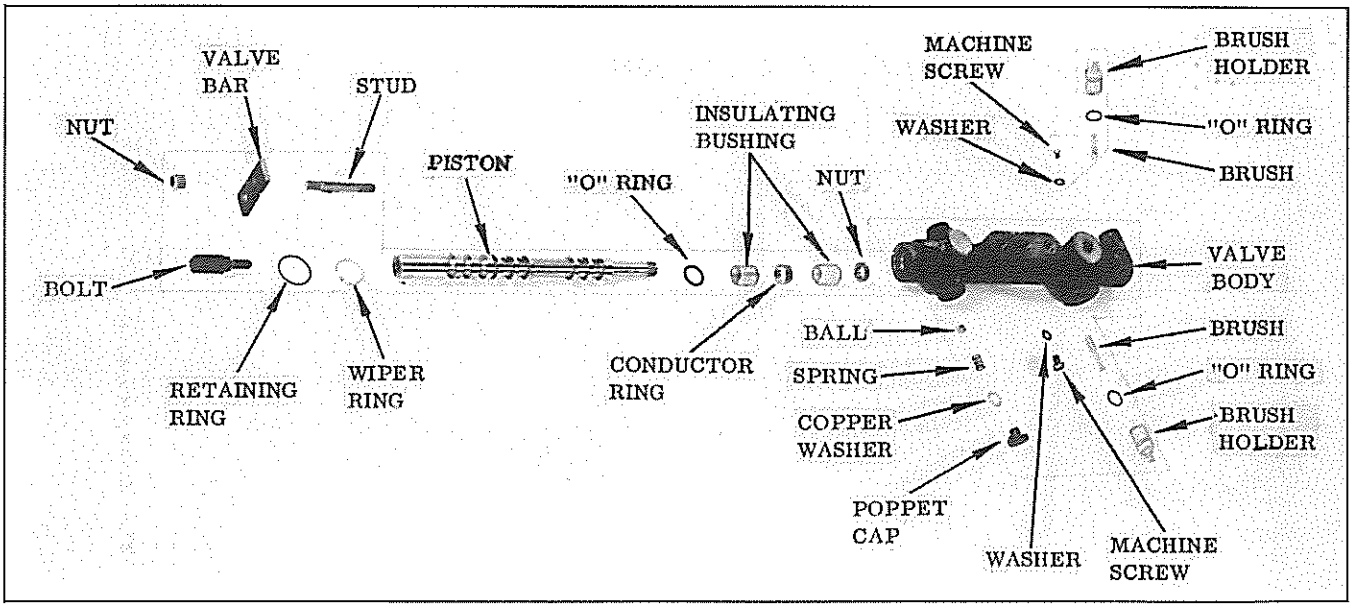
Reassembly

Illust. 1 is an exploded view of the control valve.

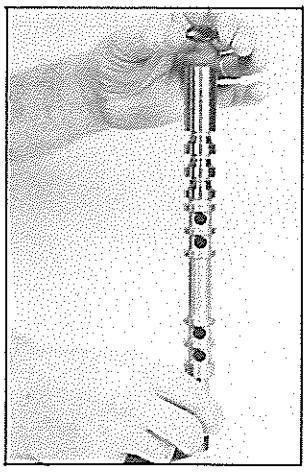
Install "O" ring over end of piston, as shown in Illust. 2, and into groove, as shown in Illust. 3.

Install insulation bushing, conductor ring and second insulation bushing onto small end of piston, as shown in Illust. 4.

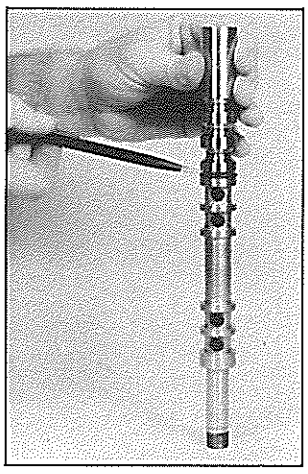
Install nut on threaded end of piston, as shown in Illust. 5. Tighten nut, as shown in Illust. 6.



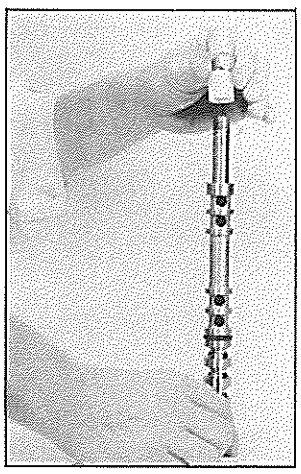
ILLUST. 1



ILLUST. 2



ILLUST. 3



ILLUST. 4



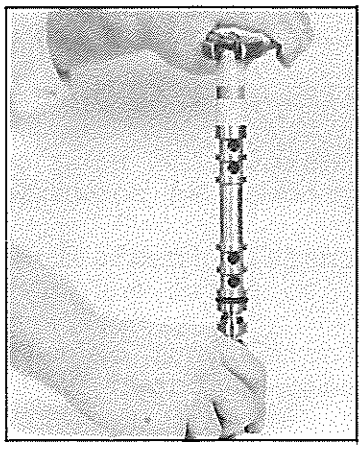
ILLUST. 5

Install stud in valve body, using a double nut, as shown in Illust. 7. Nuts should be removed after stud is tight.

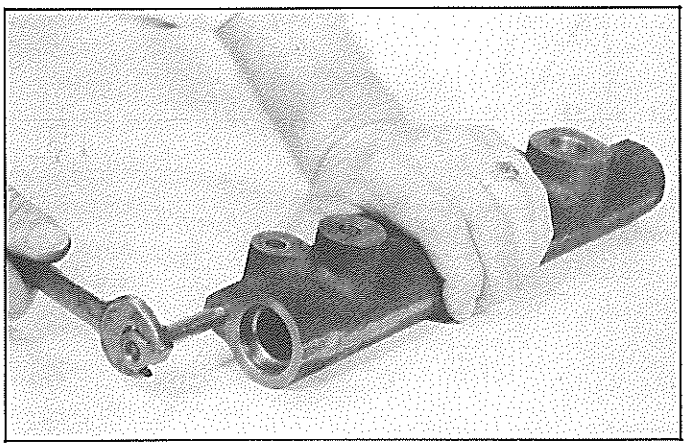
To install piston, first oil piston and bore in valve body heavily to prevent nicks or scratches. Next, insert piston, as shown in Illust. 8, until neutral groove is under the poppet ball and spring bore in valve body, as shown in Illust. 9. Install poppet ball and spring.

Install copper gasket and poppet cap, as shown in Illust. 10. Use care in tightening cap so as not to damage copper washer. If washer is damaged, leakage will occur.

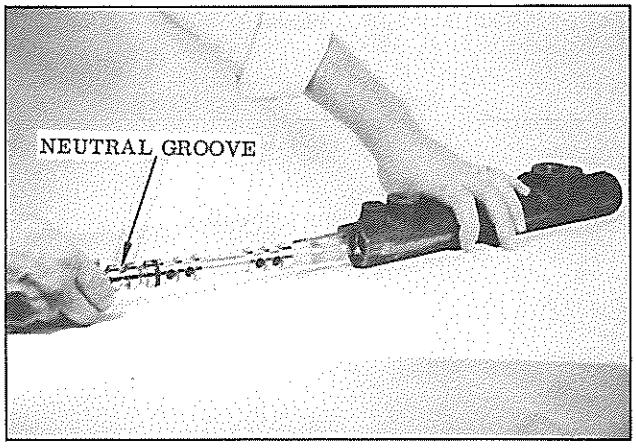
Install "O" rings in brush holders, as shown in Illust. 11.



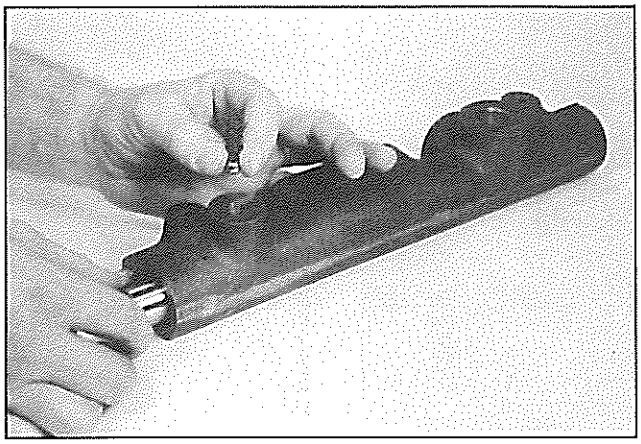
ILLUST. 6



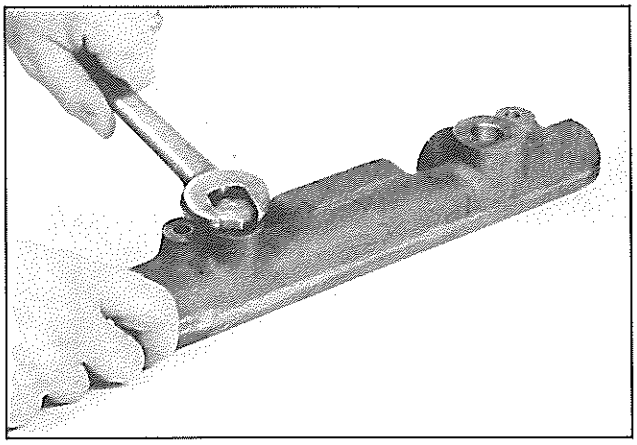
ILLUST. 7



ILLUST. 8

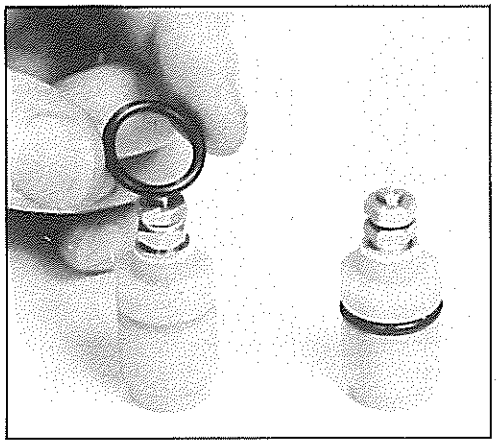


ILLUST. 9



ILLUST. 10

Install brush in brush holder and insert brush holder into top bore of valve body, as shown in Illust. 12. Note: "O" ring to be oiled to prevent damage.



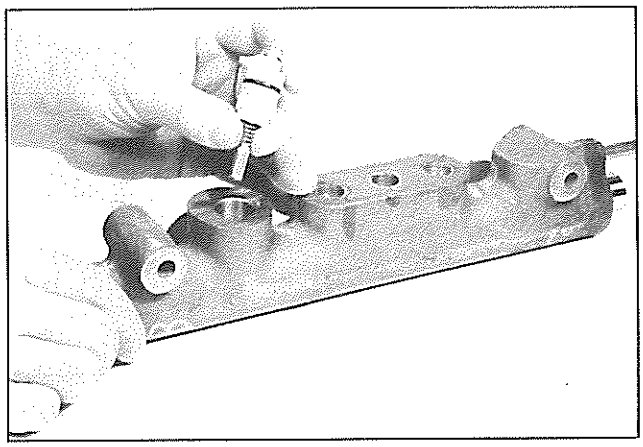
ILLUST. 11

Install machine screw, cut washer and lock washer. Tighten machine screw securely, as shown in Illust. 13.

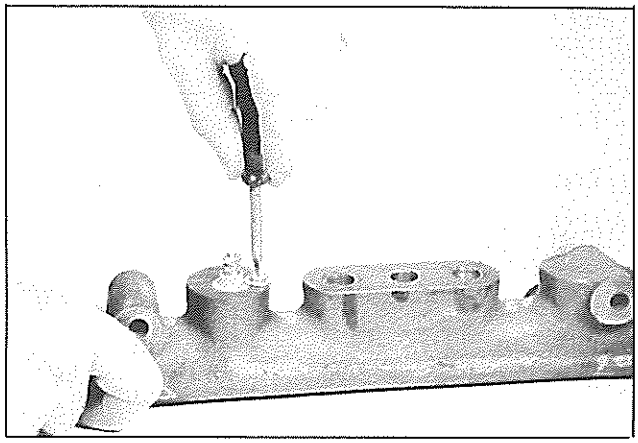
Install brush in second brush holder and insert brush holder into side bore of valve body, as shown in Illust. 14. Note: "O" ring to be oiled to prevent damage.

Install machine screw, cut washer and lock washer. Tighten machine screw securely, as shown in Illust. 15.

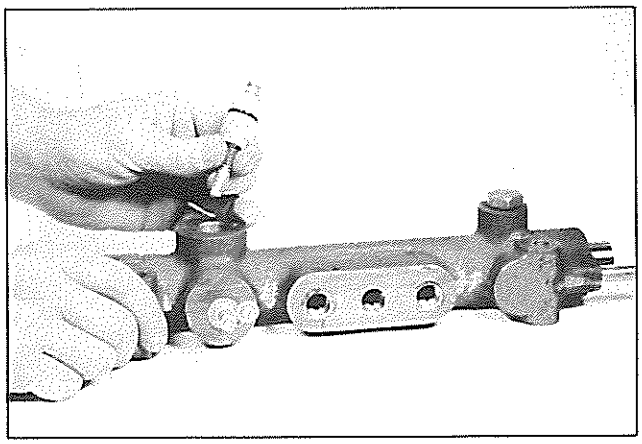
Install wiper ring over end of piston, as shown in Illust. 16. Flat side of ring to



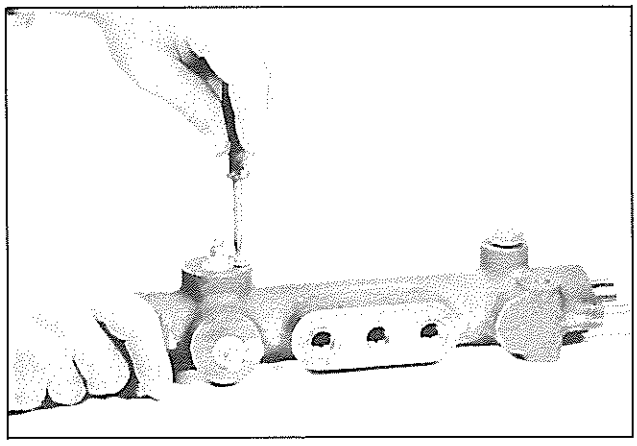
ILLUST. 12



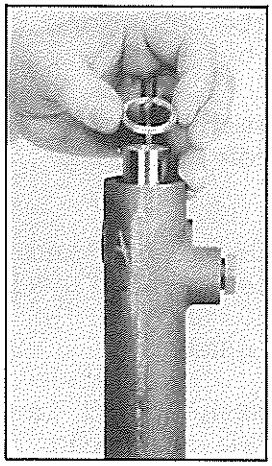
ILLUST. 13



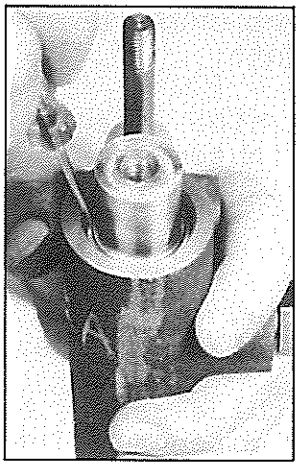
ILLUST. 14



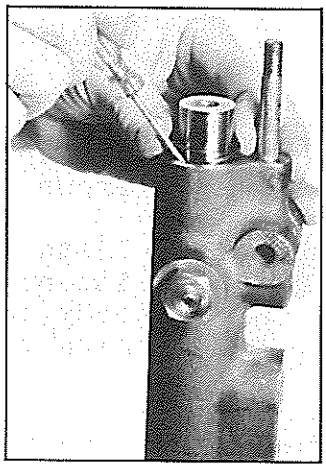
ILLUST. 15



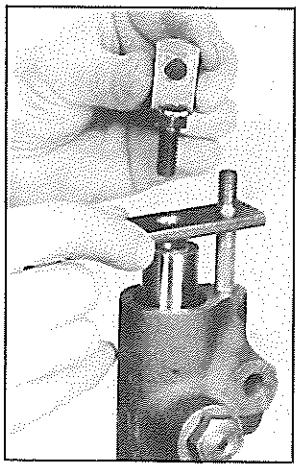
ILLUST. 16



ILLUST. 17



ILLUST. 18



ILLUST. 19

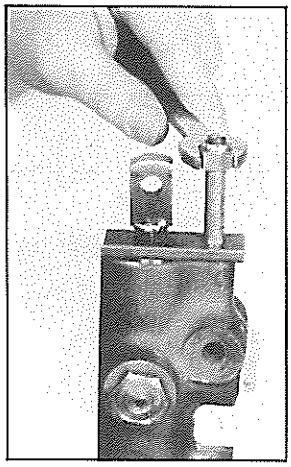
be toward valve body.

Install wiper ring into counter bore of valve body, as shown in Illust. 17. Ring to be moved back along piston until it clears retainer ring groove in valve body.

Install retainer ring, as shown in Illust. 18.

Install valve bar and bolt, as shown in Illust. 19.

Install lock nut on stud, as shown in Illust. 20. Locate nut on stud, so that moving piston to it's outer poppet controlled position will move the valve bar against the lock nut.



ILLUST. 20

Piston Removal

To remove piston from valve body, remove self-locking nut from stud.

Remove bolt from end of piston.

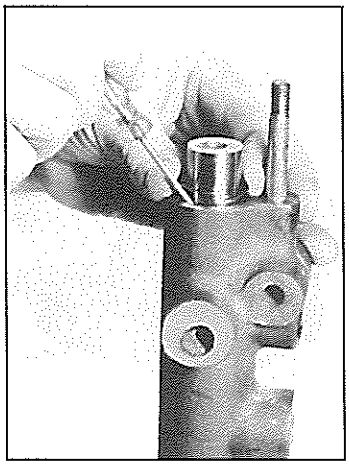
Remove valve bar.

Remove poppet cap, spring and ball.

Remove brush holder assemblies.

Remove piston retainer ring, as shown in Illust. 21.

Install bolt back into threaded hole in end of

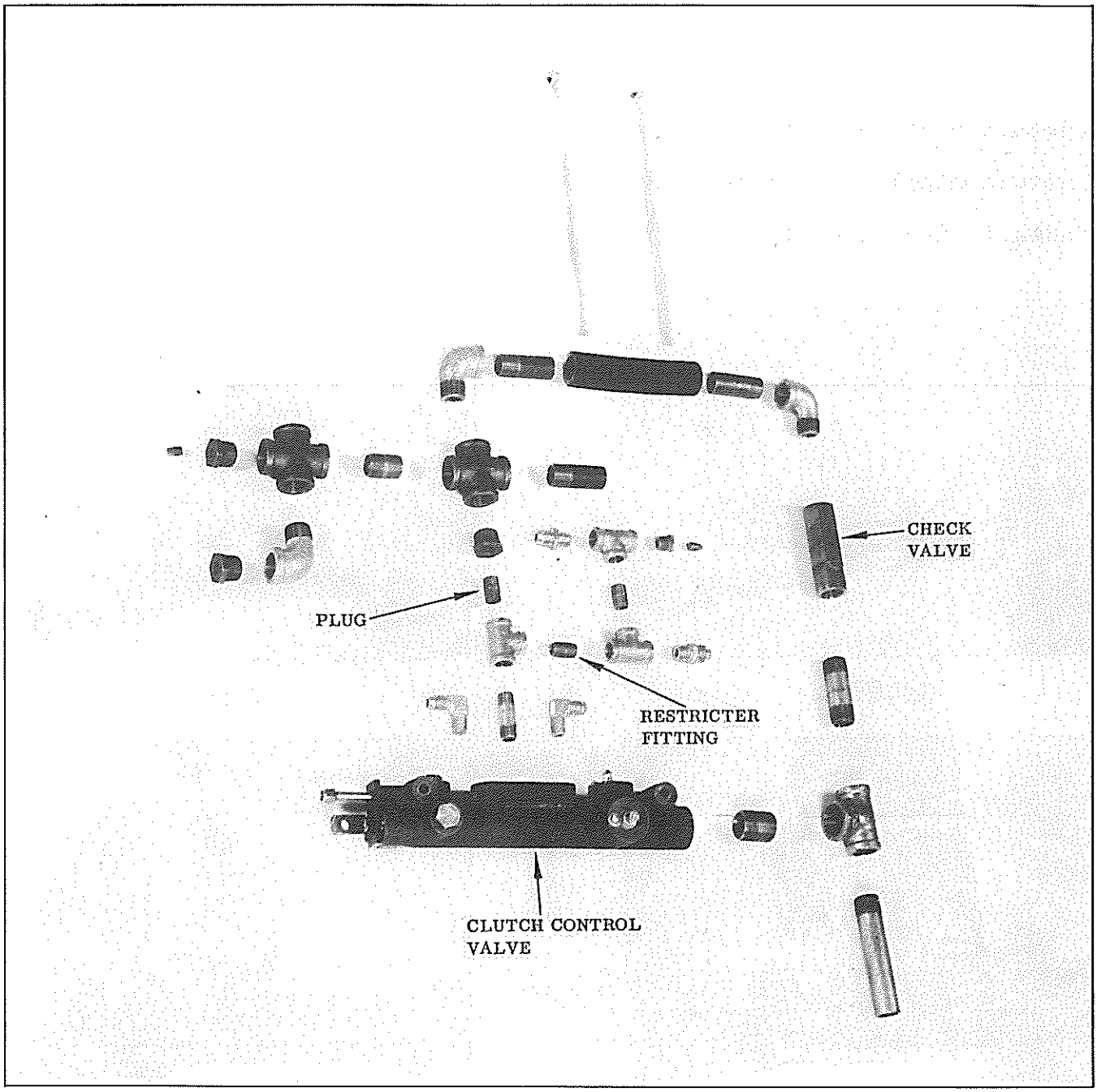


ILLUST. 21

valve.

Insert a pin through hole in bolt and pull piston from valve body. Wiper ring will come out of body on piston.

Pipe Fitting Installation



ILLUST. 1

Do not clamp on the tube portion of the valve body. Always clamp on bolting pads to prevent distortion of the bored hole in the valve body.

Use a sealing compound on all pipe threads. All pipe fittings must be installed tightly to prevent leaks.

Illust. 1 is an exploded view of the control valve pipe fittings.

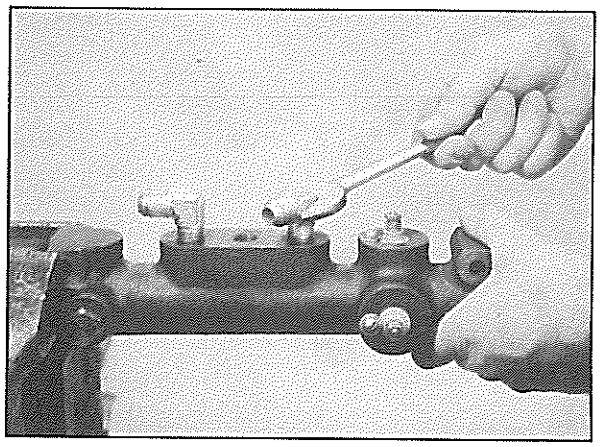
Install the two flare type elbows into valve body, as shown in Illust. 2.

Install nipple and tee into valve body, as shown in Illust. 3.

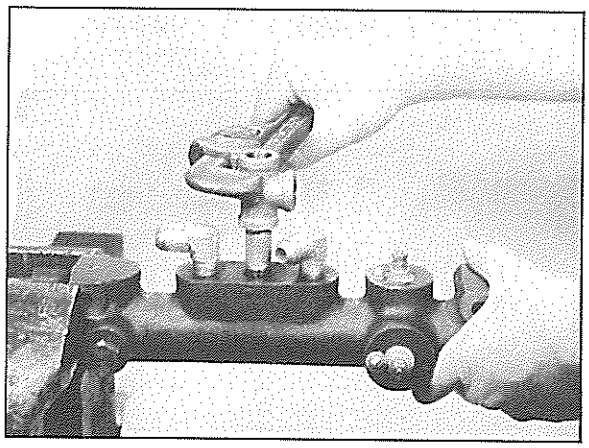
Install restricter fitting and second tee, as shown in Illust. 4.

Install nipple and third tee, as shown in Illust. 5.

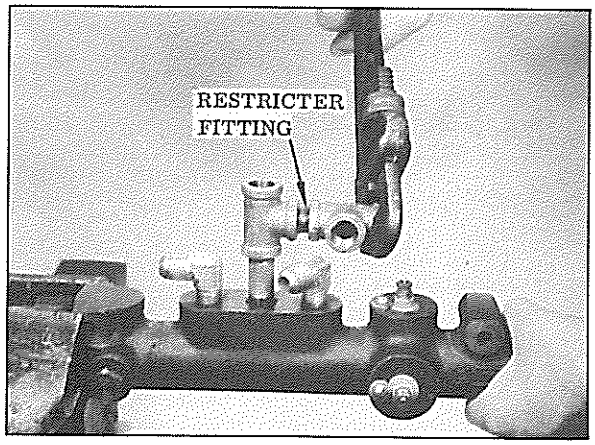
Install flare type fitting into second tee, as shown in Illust. 6.



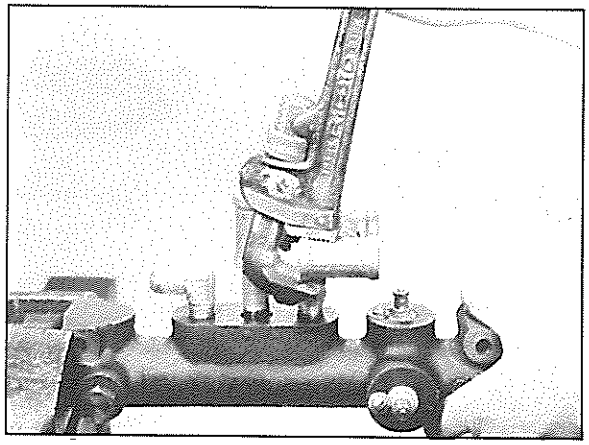
ILLUST. 2



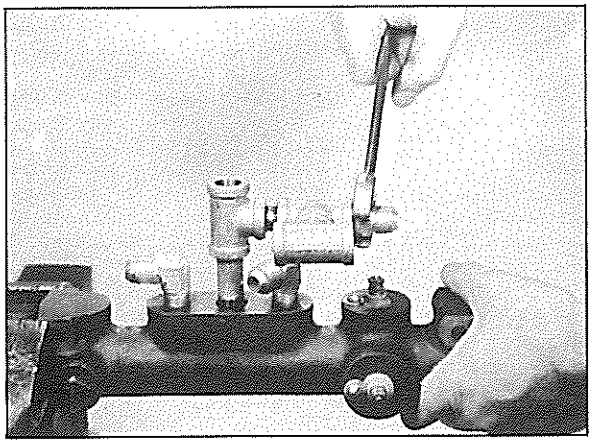
ILLUST. 3



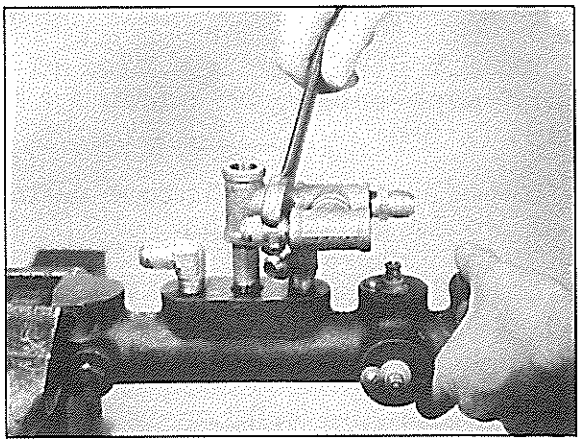
ILLUST. 4



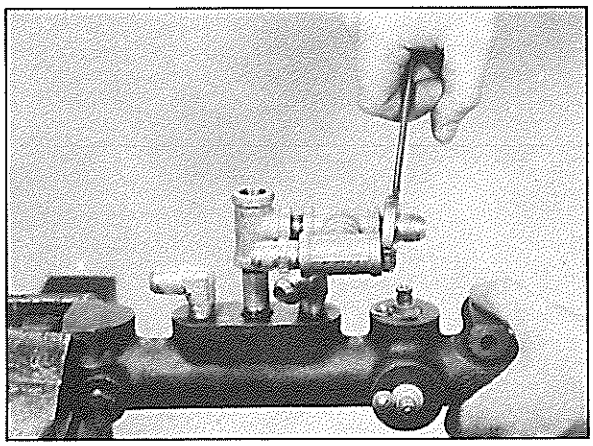
ILLUST. 5



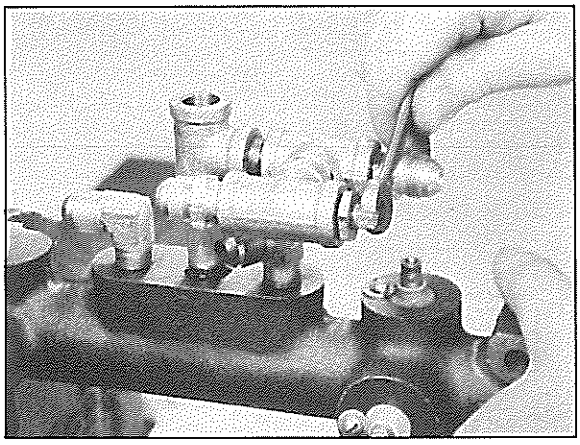
ILLUST. 6



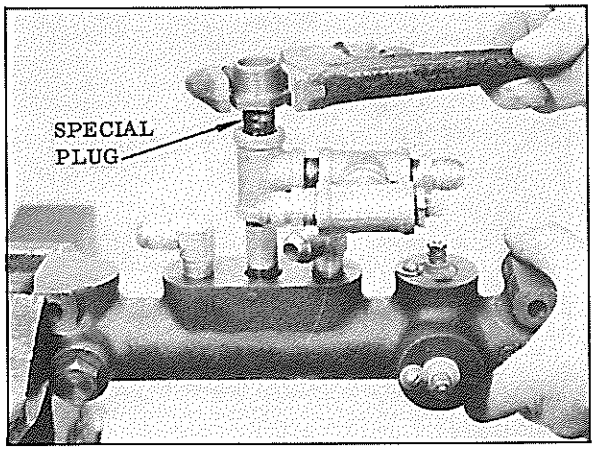
ILLUST. 7



ILLUST. 8



ILLUST. 9



ILLUST. 10

Install flare type fitting into third tee, as shown in Illust. 7.

Install bushing into third tee, as shown in Illust. 8.

Install pipe plug into bushing, as shown in Illust. 9.

Install special plug and bushing into top of first tee, as shown in Illust. 10.

Install first pipe cross, as shown in Illust. 11.

Install nipple and second pipe cross,

as shown in Illust. 12.

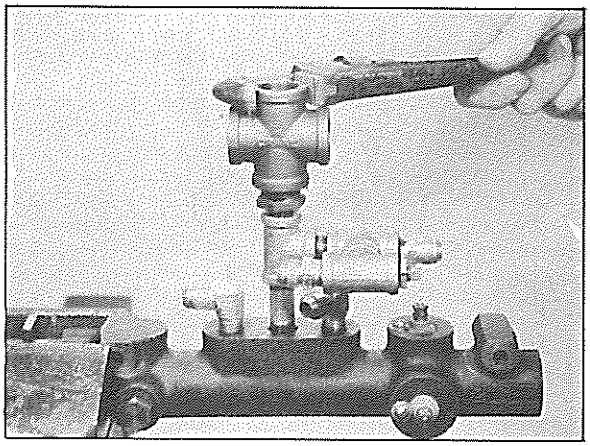
Install pipe bushing into side of second pipe cross, as shown in Illust. 13.

Install pipe plug into bushing, as shown in Illust. 14.

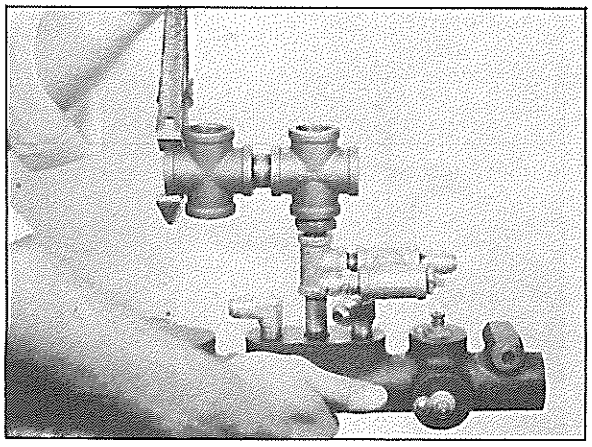
Install street elbow into bottom of second pipe cross, as shown in Illust. 15.

Install pipe bushing into street elbow, as shown in Illust. 16.

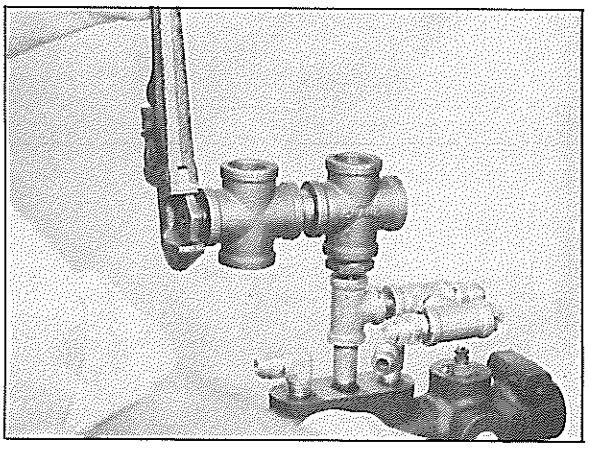
Install pipe bushing into top of sec-



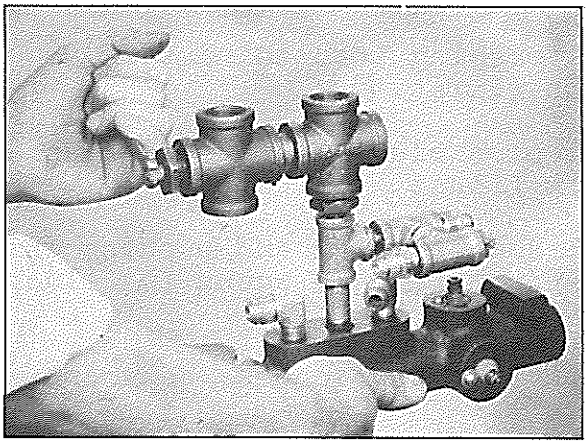
ILLUST. 11



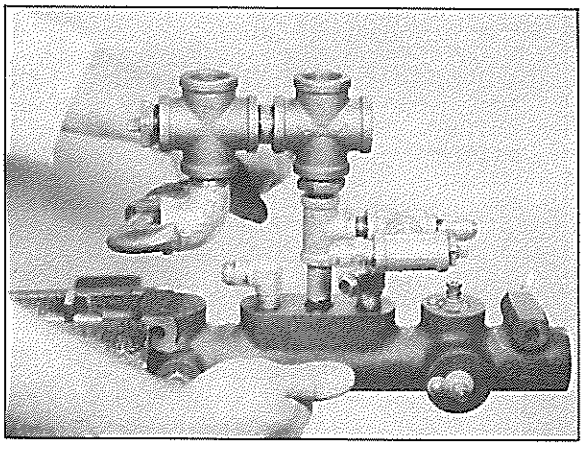
ILLUST. 12



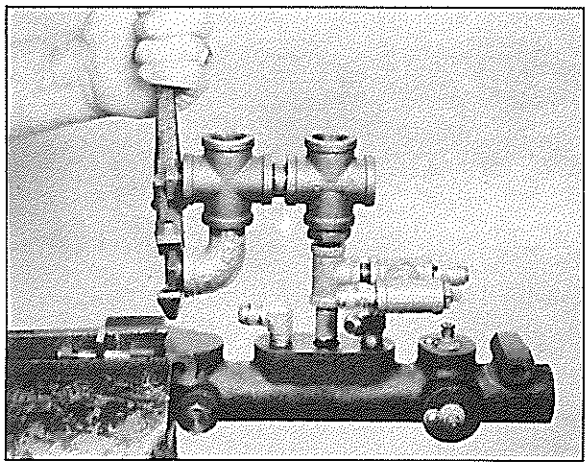
ILLUST. 13



ILLUST. 14



ILLUST. 15



ILLUST. 16

ond pipe cross, as shown in Illust. 17.

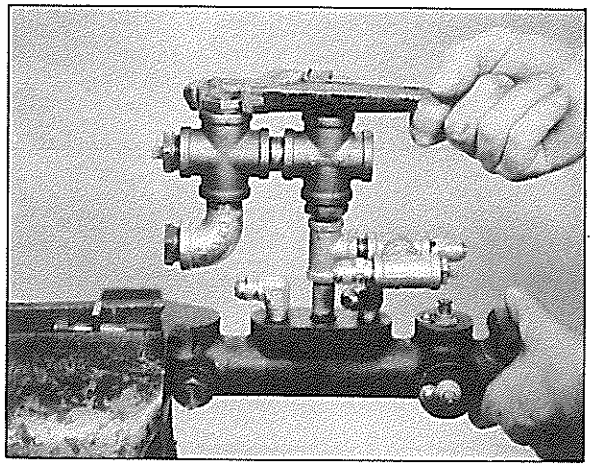
Install plain end nipple,into side of first pipe cross, as shown in Illust. 18.

Install street elbow into top of first pipe cross, as shown in Illust. 19.

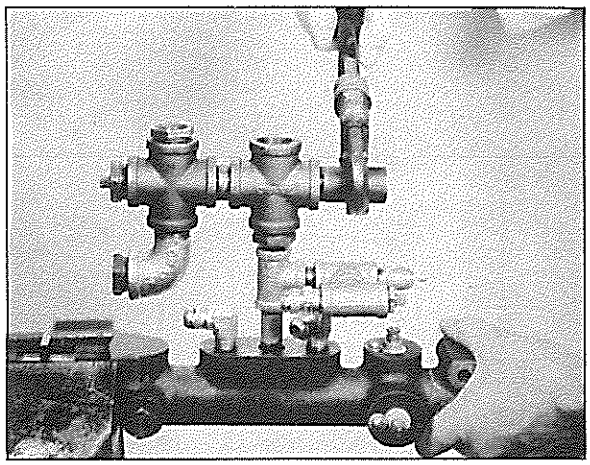
Install nipple and tee into end of valve body, as shown in Illust. 20.

Install plain end nipple into bottom of tee, as shown in Illust. 21.

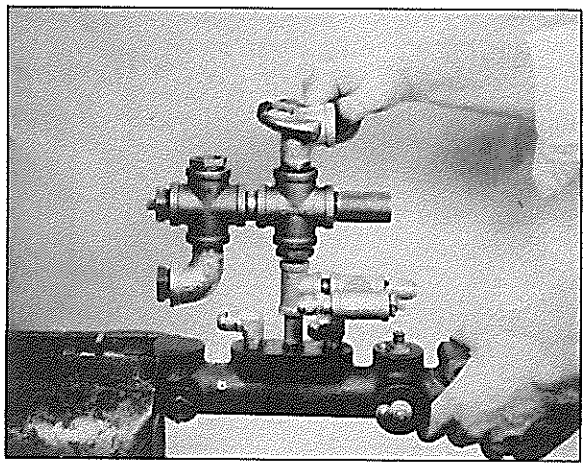
Install nipple and check valve into top of elbow, as shown in Illust. 22.



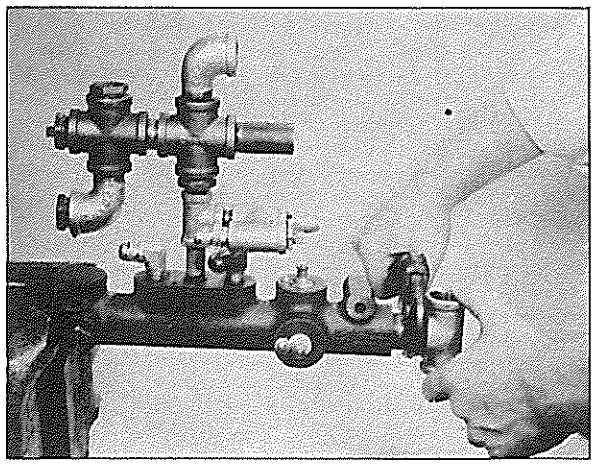
ILLUST. 17



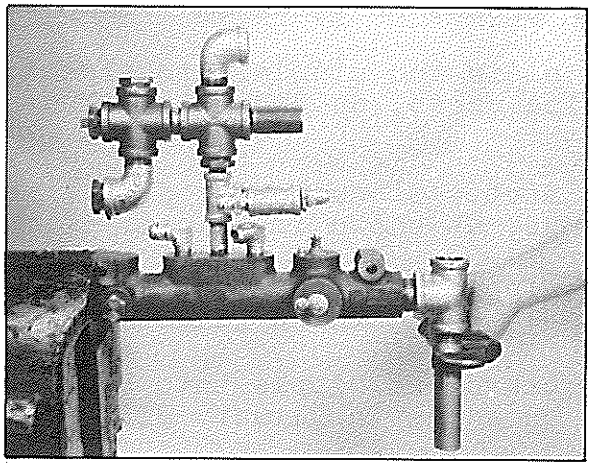
ILLUST. 18



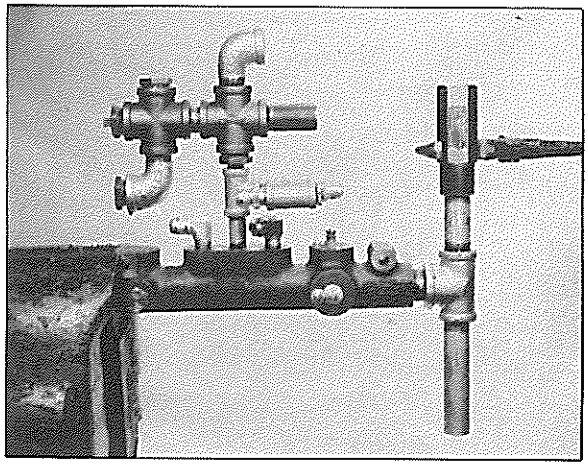
ILLUST. 19



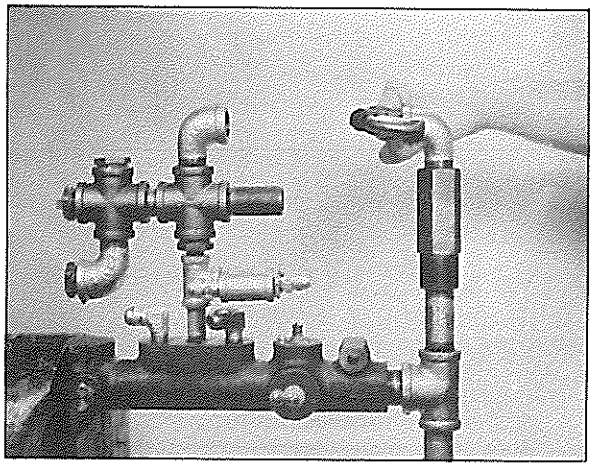
ILLUST. 20



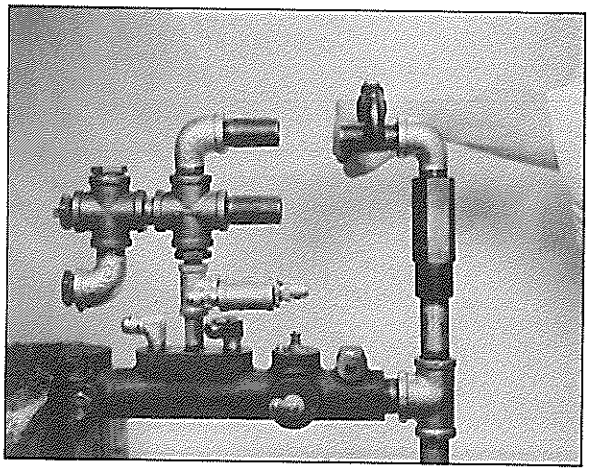
ILLUST. 21



ILLUST. 22



ILLUST. 23

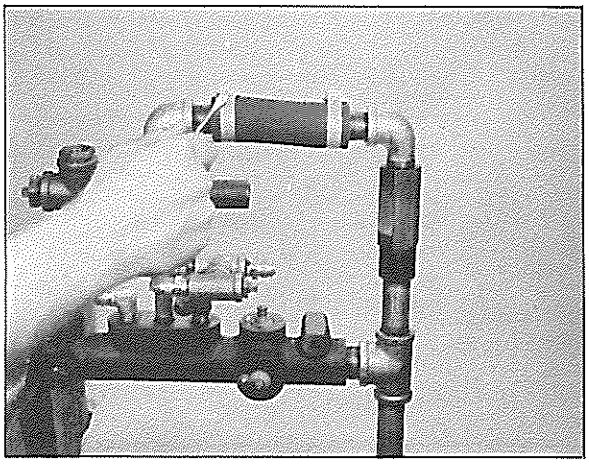


ILLUST. 24

Install street ell into check valve, as shown in Illust. 23.

Install plain end nipples into two street ells, as shown in Illust. 24.

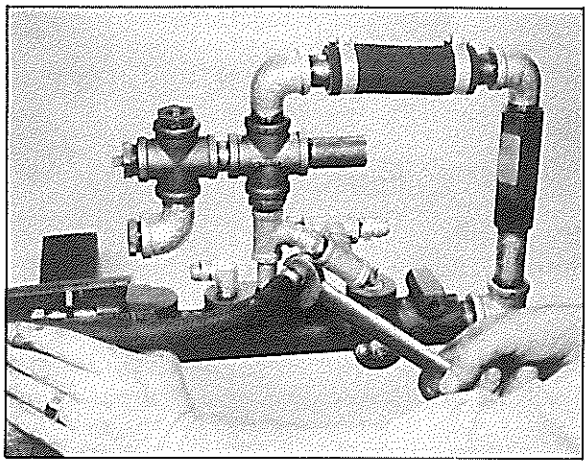
Install hose onto nipples and add hose clamps. After clamps are tight, cut off unused portion of clamp bands, as shown in Illust. 25.



ILLUST. 25

Control Valve Hydraulic Hoses

Hose end should be kept covered to ex-



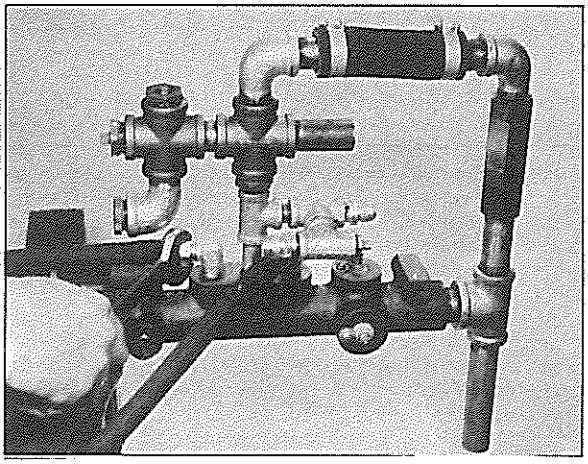
ILLUST. 1

clude all foreign matter.

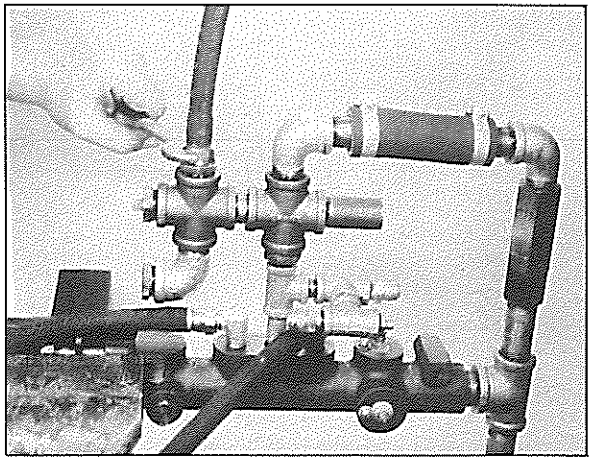
Install 17-3/4 inch long hose onto rear flare type elbow and tighten securely, as shown in Illust. 1. The pipe tee must be turned at an angle to permit this hose to be installed. After installation, the tee should be straightened.

Install 14-3/4 inch long hose onto front flare type elbow and tighten securely, as shown in Illust. 2.

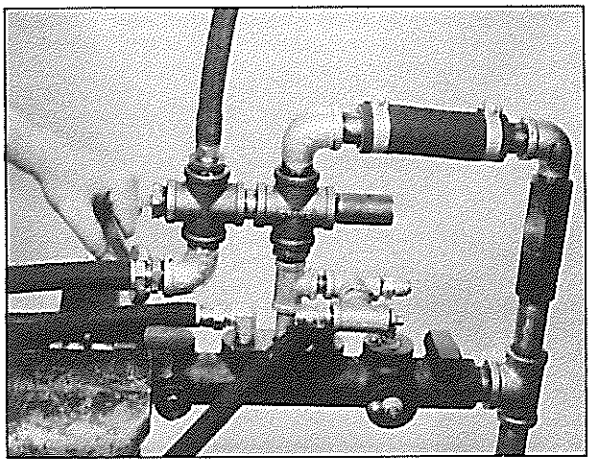
Install 11 inch long hose into bushing in top of pipe cross and tighten



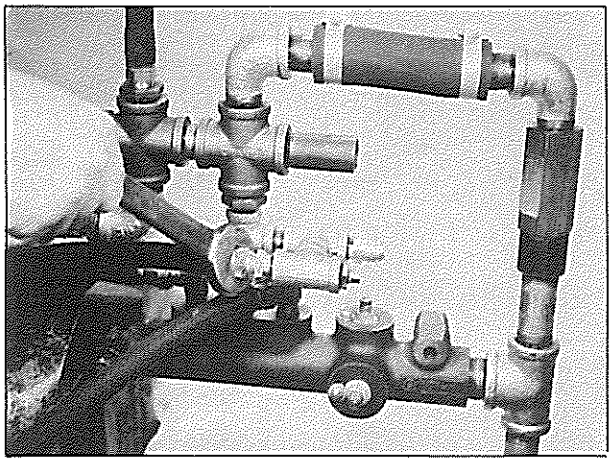
ILLUST. 2



ILLUST. 3



ILLUST. 4



ILLUST. 5

securely, as shown in Illust. 3.

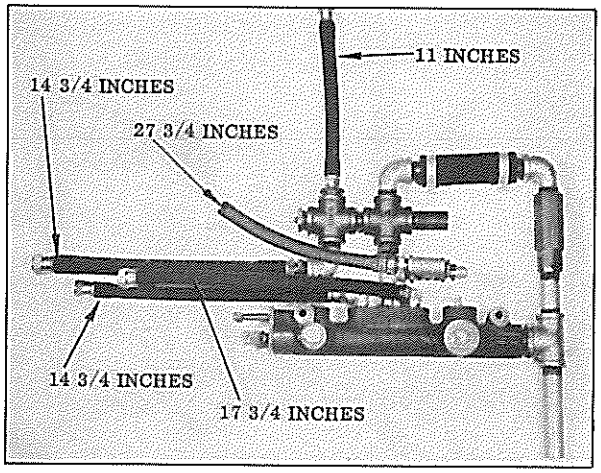
Install 14-3/4 inch long hose into bushing in street elbow and tighten securely, as shown in Illust. 4.

Install 27-3/4 inch long hose onto pipe tee and tighten securely, as shown in Illust. 5.

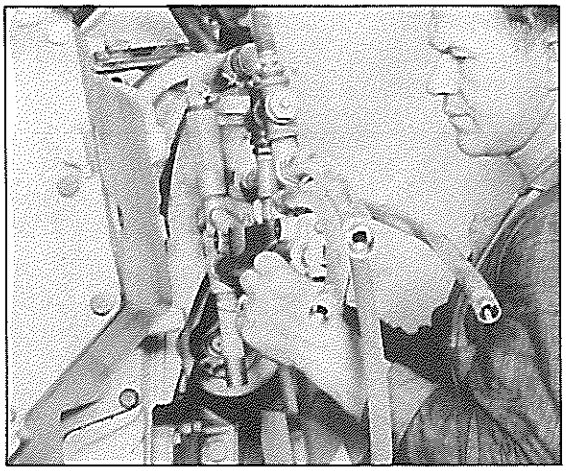
Illust. 6 is a complete assembly of control valve. Valve is now ready for installation to upper transmission housing.

Install valve assembly onto left side of upper transmission housing, as shown in Illust. 7. Install cap screws with lock washers and tighten securely, as shown in Illust. 8.

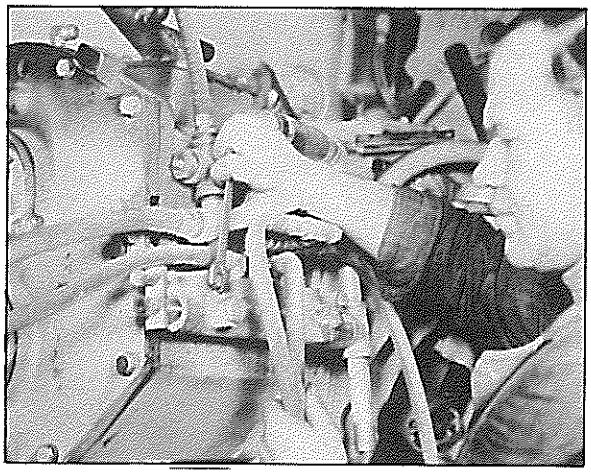
Install hoses to fittings, as shown in Illust. 9. Note: Use care not to tighten hose fittings to tight or damage to threads will occur.



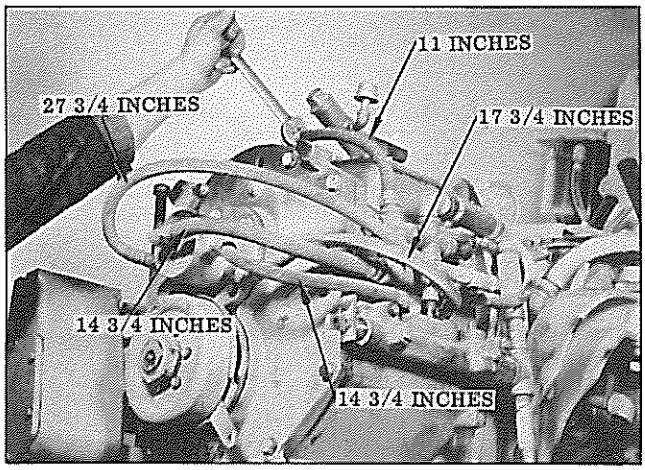
ILLUST. 6



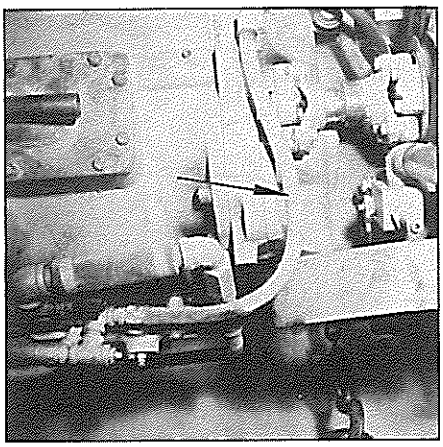
ILLUST. 7



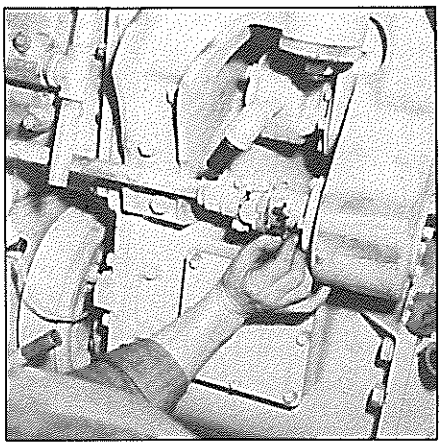
ILLUST. 8



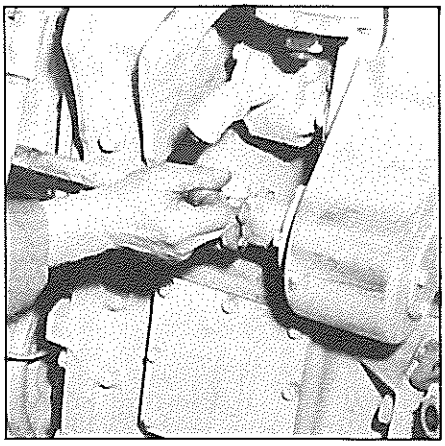
ILLUST. 9



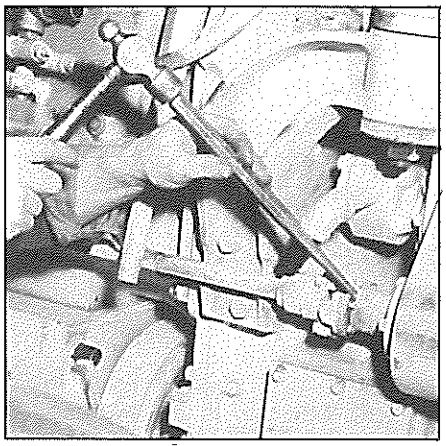
ILLUST. 10



ILLUST. 11



ILLUST. 12

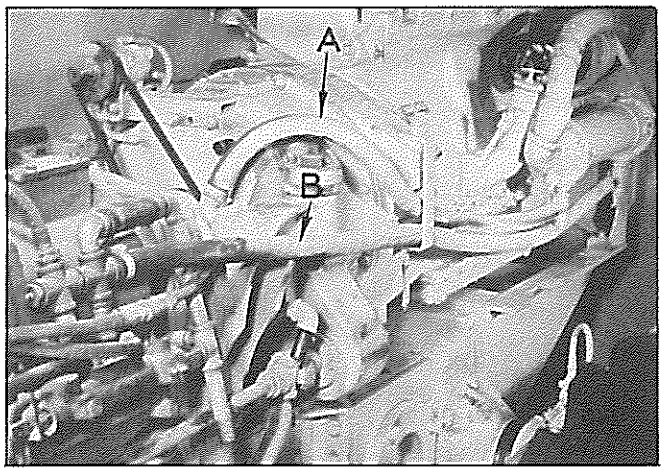


ILLUST. 13

Install hose from adapter in tee of control valve to right regulating valve elbow, as shown in Illust. 10. Next, install hose clamps around hose and install to lower transmission cap screws.

Install P.T.O. shaft, as shown in Illust. 11. Install cap screws into locks and install into universal. Tighten cap screws securely, as shown in Illust. 12. Using a drift pin, bend ears against heads of cap screws, as shown in Illust. 13.

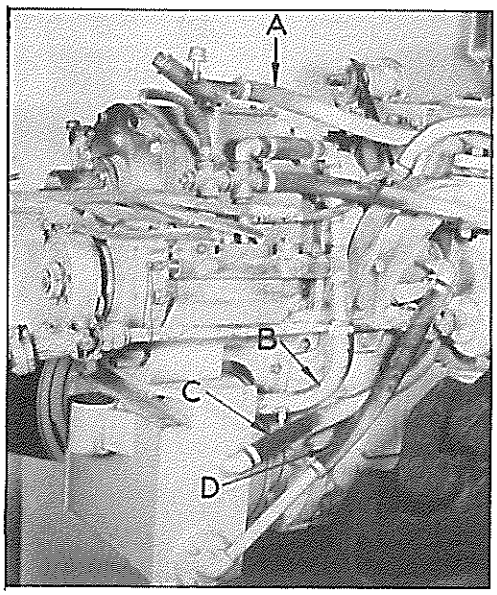
Install short hose "A" from heat exchanger to left regulating valve plain nipple. Install long hose "B" from heat exchanger to plain nipple in control valve, as shown in Illust. 14. Install hose clamps and tighten securely. Remove excess clamp material.



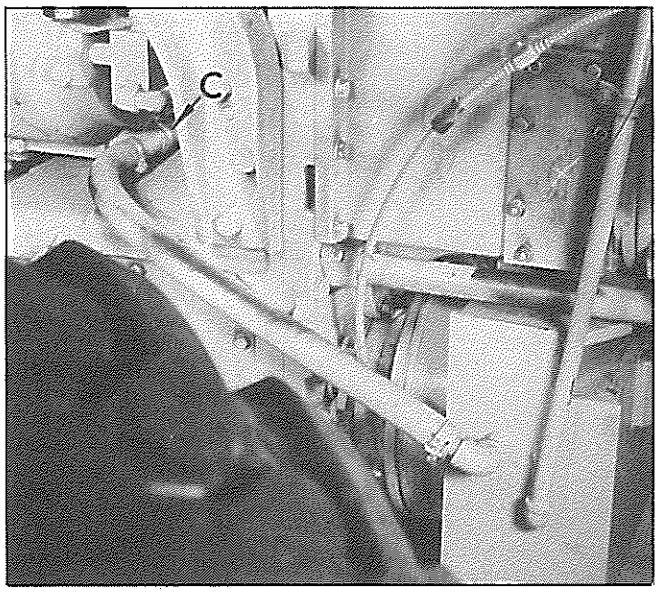
ILLUST. 14

Illust. 15. Install hose "A" from upper transmission filler pipe to upper plain nipple in torque converter housing. Install hose clamps and tighten securely. Remove excess clamp material.

Install hose "B" (Illust. 15) from long nipple of control valve to nipple on rear of hydraulic reservoir. Install hose clamps and tighten. Remove excess clamp material.



ILLUST. 15



ILLUST. 16

Install hose "C" (Illust. 15) from upper nipple in left side of hydraulic reservoir to left nipple in tee, located on bottom of torque converter housing ("C" Illust. 16). Install hose clamps and tighten securely. Remove excess clamp material.

Install hose "D" (Illust. 15) from lower nipple in left side of hydraulic reservoir to nipple in hydraulic pump. Install hose clamps and tighten securely. Remove excess clamp material.

Install hose from nipple in right side of hydraulic reservoir to right nipple in tee located on bottom of torque converter housing, as shown in Illust. 16.

HEAT EXCHANGER (CUMMINS ENGINE)

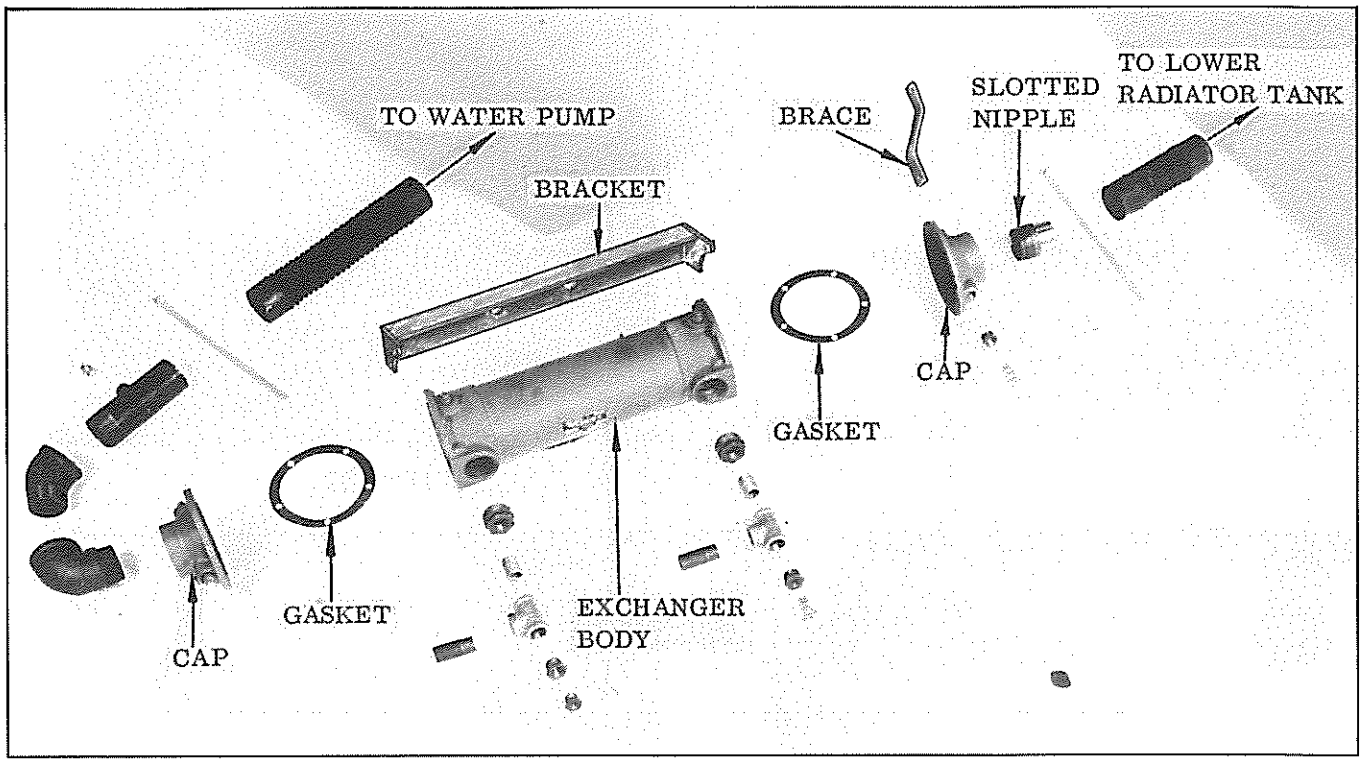
It is seldom necessary to service the heat exchanger. In event servicing is required, these instructions and illustrations will aid in the disassembly and reassembly of exchanger. To disassemble, reverse the reassembly procedure.

Water should be drained from heat exchanger and flushed out whenever radiator is serviced.

Reassembly

When installing pipe fittings to heat exchanger, coat threads of fittings with a sealing compound.

Illust. 1 is an exploded view of the heat exchanger.



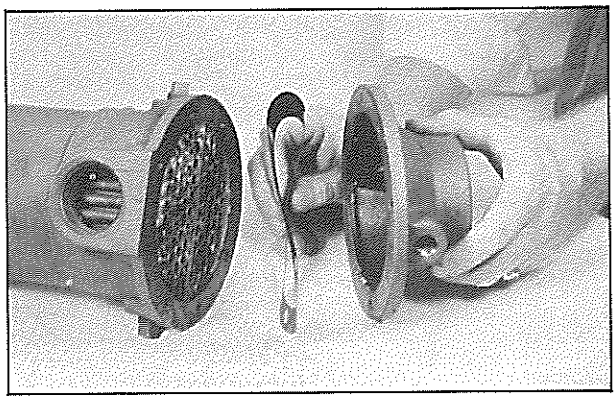
ILLUST. 1

Install cap with gasket on radiator end of exchanger body, as shown in Illust. 2.

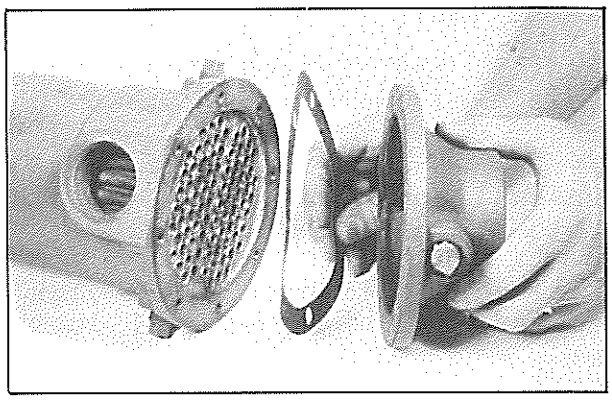
Install cap with gasket on flywheel end of exchanger body, as shown in Illust. 3.

Install and tighten cap screws with lock washers in caps at both ends of exchanger body, as shown in Illust. 4.

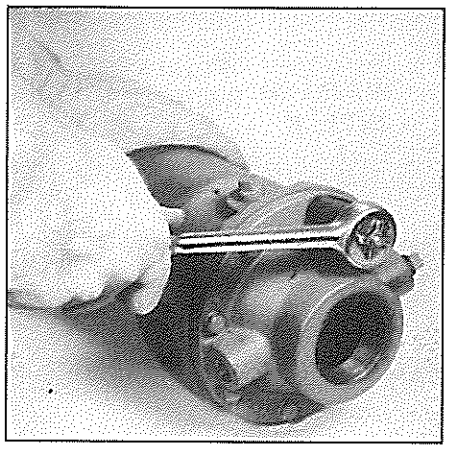
Install and tighten pipe bushing in cap, as shown in Illust. 5.



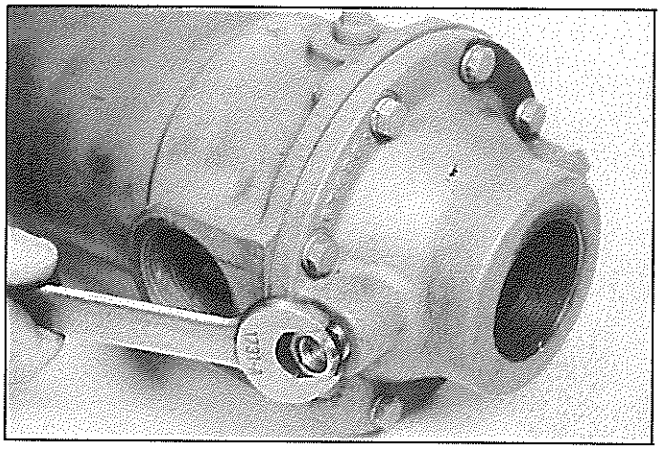
ILLUST. 2



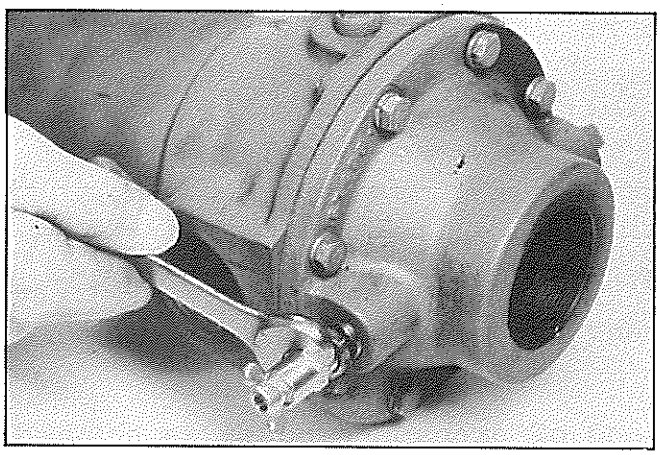
ILLUST. 3



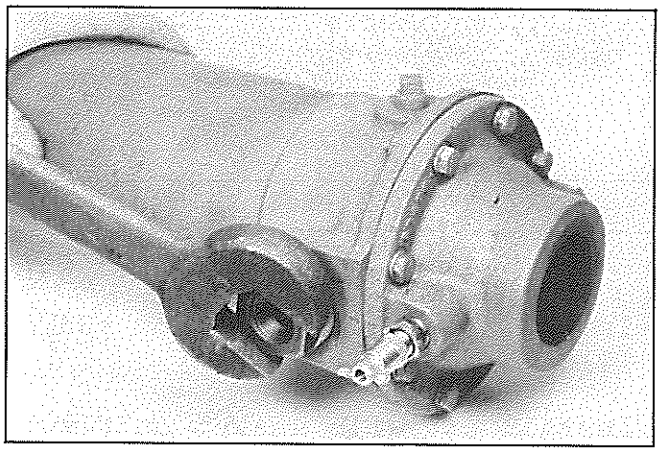
ILLUST. 4



ILLUST. 5



ILLUST. 6



ILLUST. 7

Install and tighten drain cock in bushing, as shown in Illust. 6.

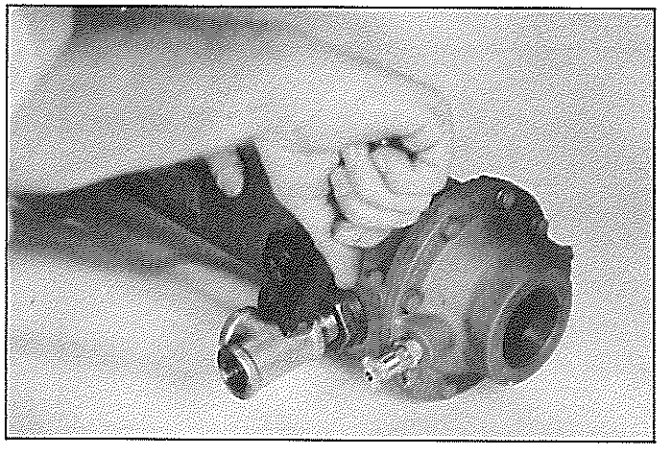
Install and tighten pipe bushing into exchanger body, as shown in Illust. 7.

Install and tighten nipple and tee into pipe bushing, as shown in Illust. 8.

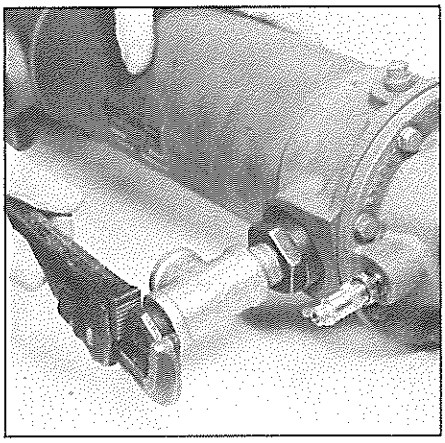
Install and tighten pipe bushing into tee, as shown in Illust. 9.

Install and tighten drain cock into bushing, as shown in Illust. 10.

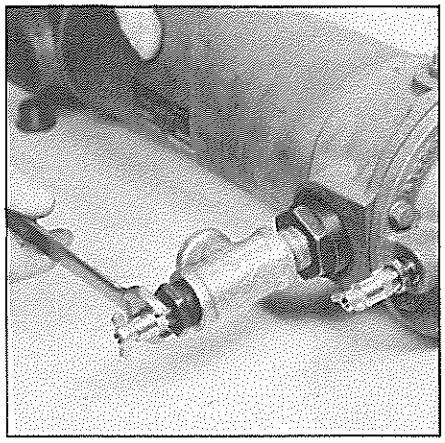
Install and tighten plain end nipple into tee, as shown in Illust. 11.



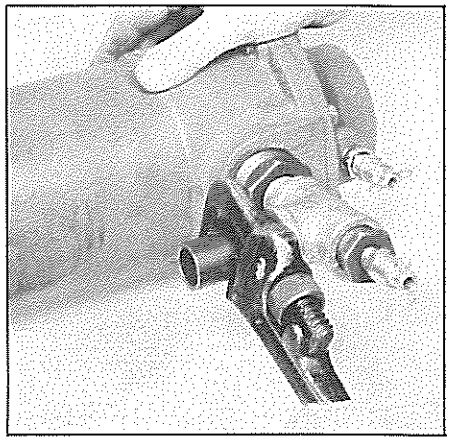
ILLUST. 8



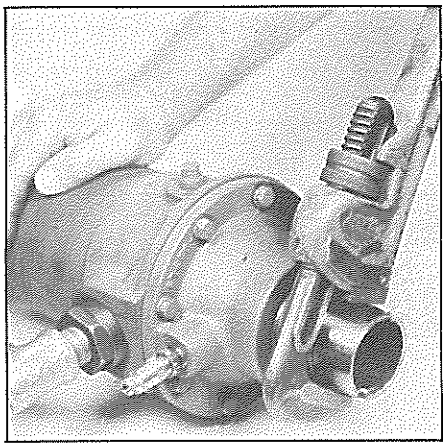
ILLUST. 9



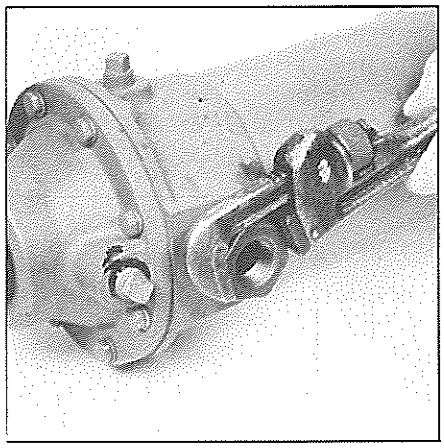
ILLUST. 10



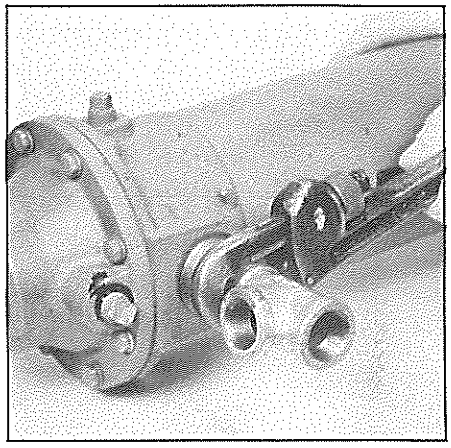
ILLUST. 11



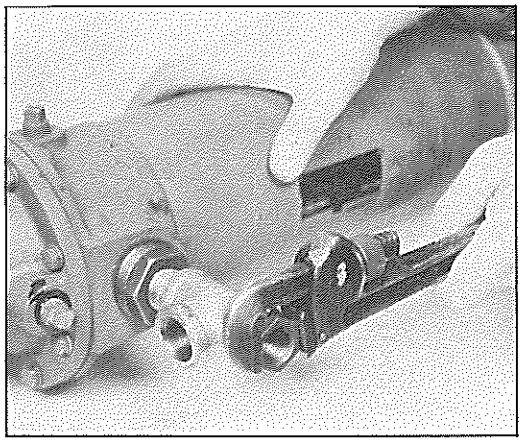
ILLUST. 12



ILLUST. 13



ILLUST. 14



ILLUST. 15

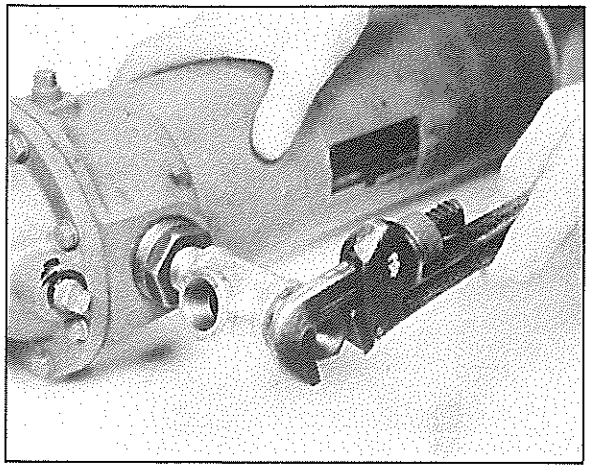
Install and tighten slotted nipple into cap, as shown in Illust. 12.

Install and tighten bushing into exchanger body, as shown in Illust. 13.

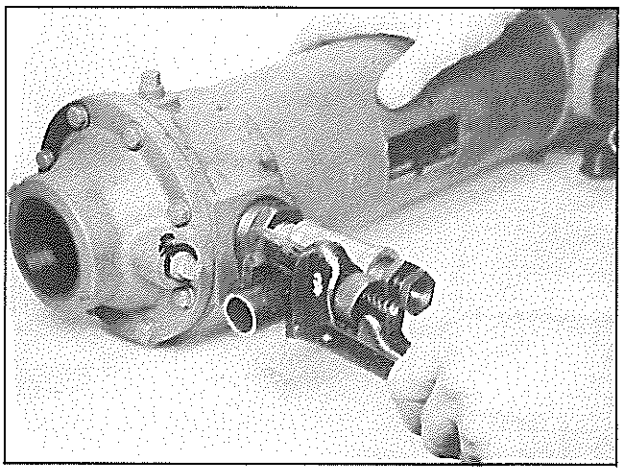
Install and tighten nipple and tee into bushing, as shown in Illust. 14.

Install and tighten bushing into tee, as shown in Illust. 15.

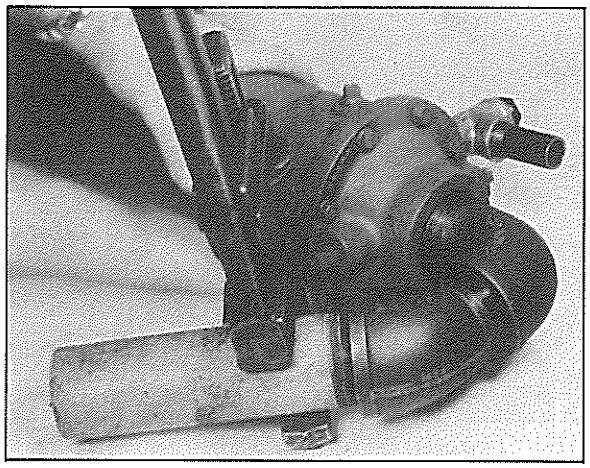
Install and tighten second bushing, as shown in Illust. 16.



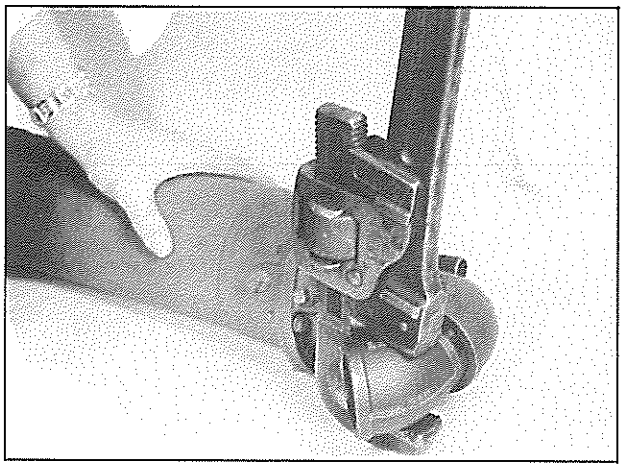
ILLUST. 16



ILLUST. 17



ILLUST. 18



ILLUST. 19

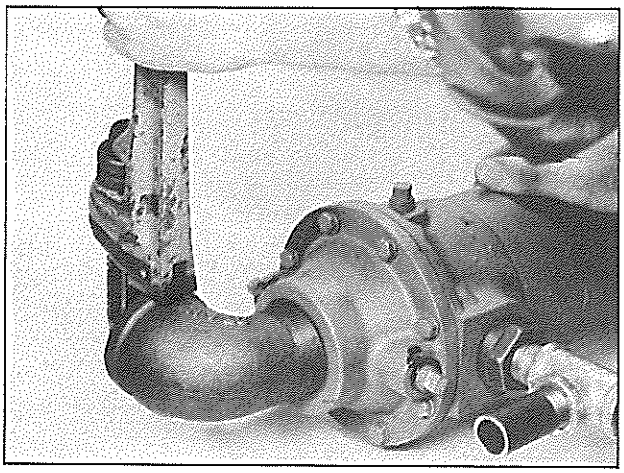
Install and tighten plain end pipe nipple into tee, as shown in Illust. 17.

Install and tighten 90 degree street elbow into cap, as shown in Illust. 18.

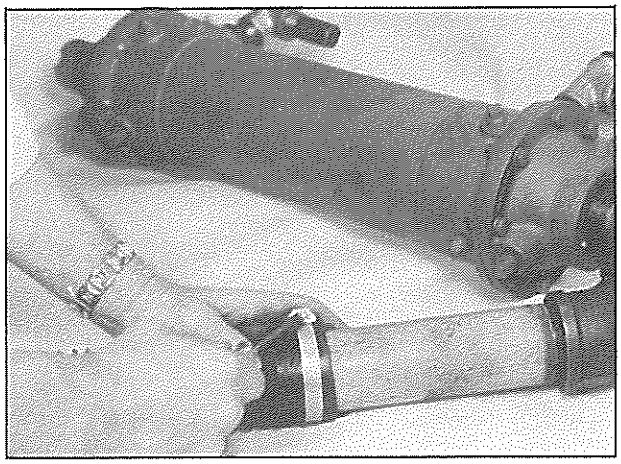
Install and tighten 45 degree street elbow into 90 degree street elbow, as shown in Illust. 19.

Install and tighten pipe nipple into 45 degree street elbow, as shown in Illust. 20.

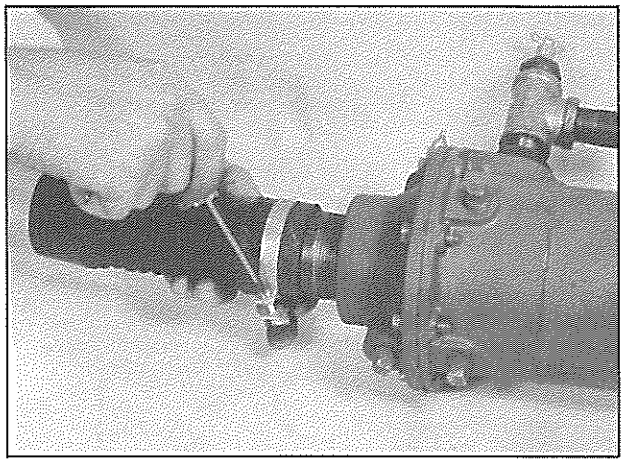
Install long flexible hose and clamp



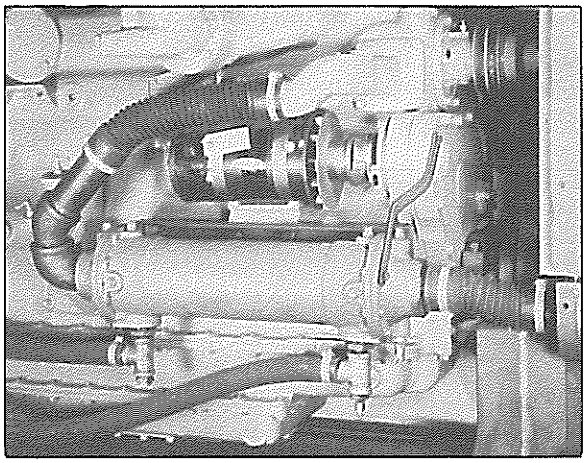
ILLUST. 20



ILLUST. 21



ILLUST. 22



ILLUST. 23

onto nipple. Tighten clamp cap screw securely, as shown in Illust. 21. Remove excess clamp material.

Install short flexible hose and clamp. Tighten clamp cap screw securely, as shown in Illust. 22. Remove excess clamp material.

Install bracket onto motor block. Next, install heat exchanger into mounting bracket. Install brace to radiator end of exchanger. Connect both flexible hose with clamps, as shown in Illust. 23. Tighten clamp cap screws securely. Remove excess clamp material.

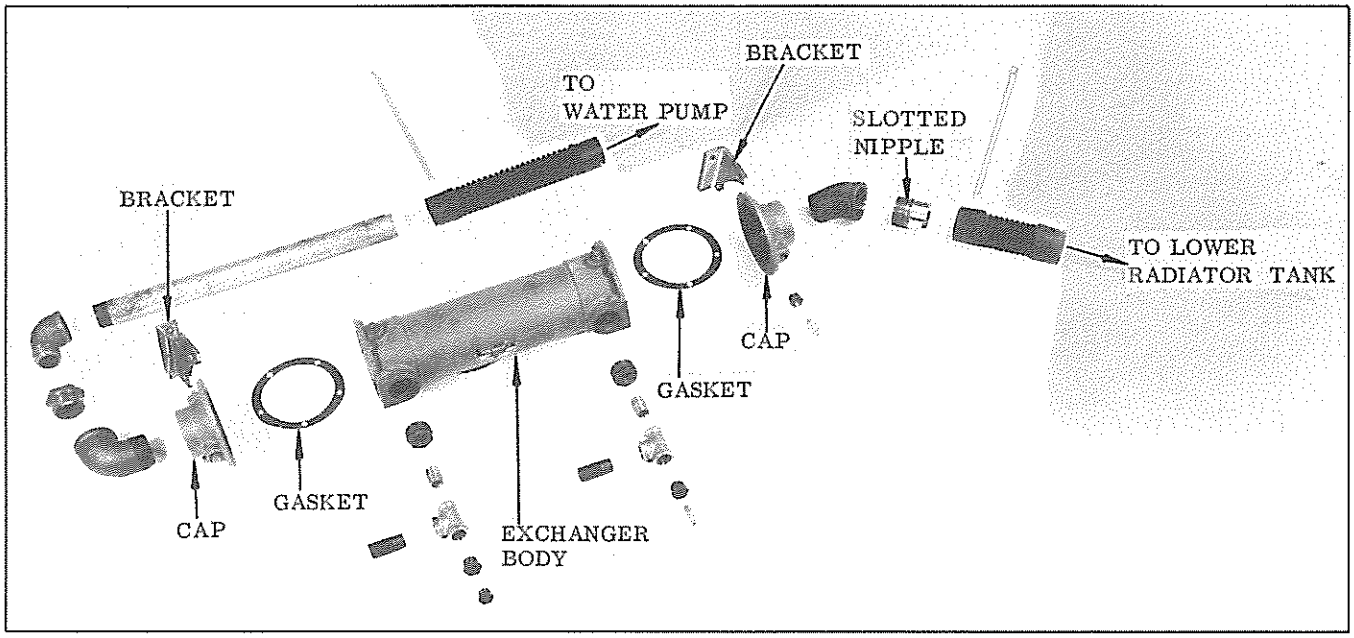
HEAT EXCHANGER (GENERAL MOTORS ENGINE)

It is seldom necessary to service the heat exchanger. In event servicing is required, these instructions and illustrations will aid in the disassembly and reassembly of exchanger. To disassemble, reverse the reassembly procedure.

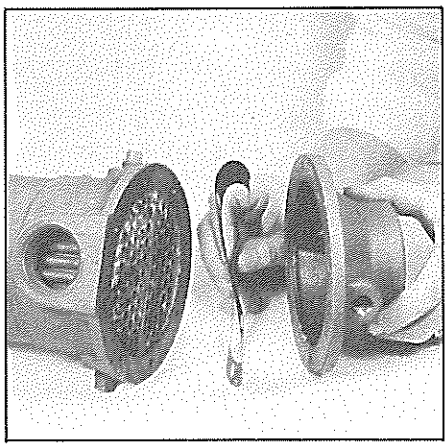
Water should be drained from heat exchanger and flushed out whenever radiator is serviced.

When installing pipe fittings to heat exchanger coat threads of fittings with a sealing compoung.

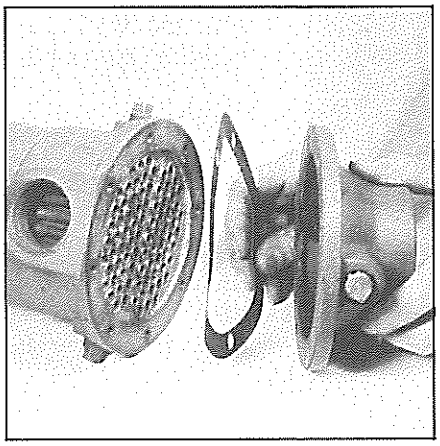
Reassembly



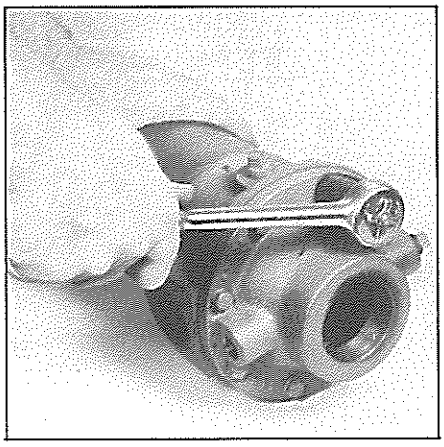
ILLUST. 1



ILLUST. 2



ILLUST. 3



ILLUST. 4

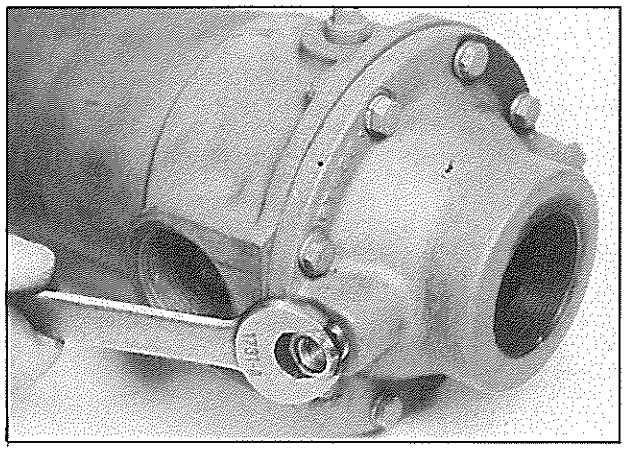
Illust. 1 is an exploded view of the heat exchanger.

Install cap with gasket on radiator end of exchanger, as shown in Illust. 2.

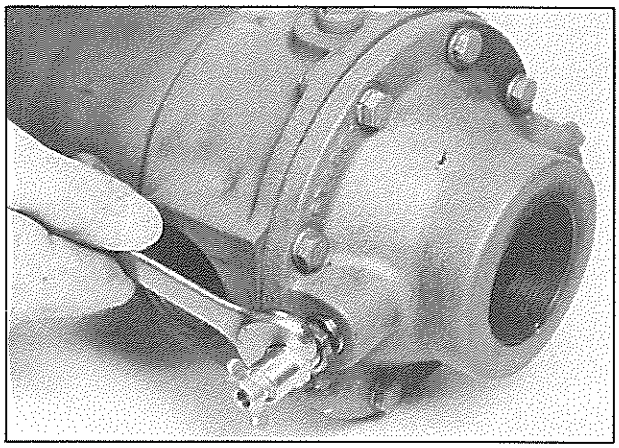
Install cap with gasket on flywheel end of exchanger, as shown in Illust. 3.

Install and tighten cap screws with lock washers in caps at both ends of exchanger, as shown in Illust. 4.

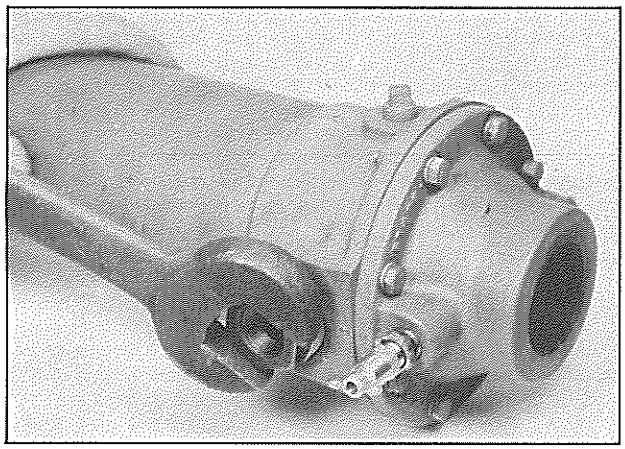
Install and tighten pipe bushing in cap, as shown in Illust. 5.



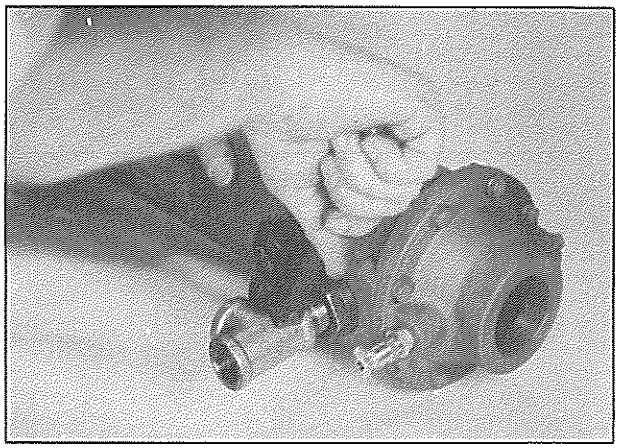
ILLUST. 5



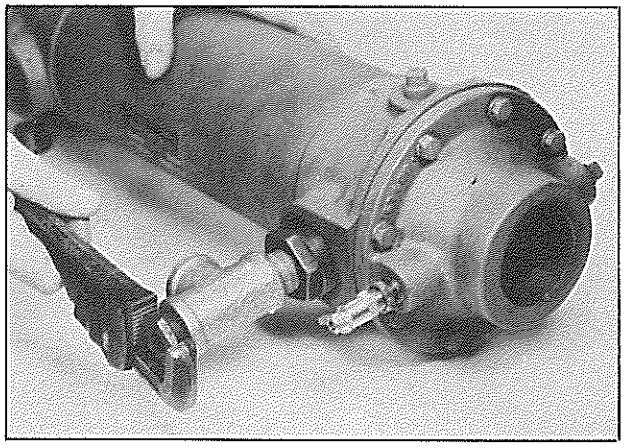
ILLUST. 6



ILLUST. 7



ILLUST. 8



ILLUST. 9

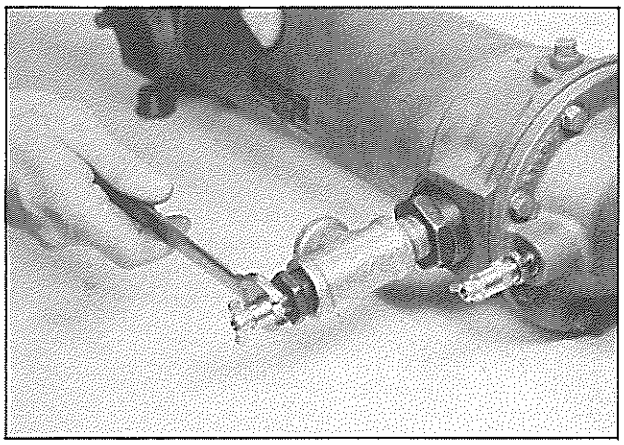
Install and tighten drain cock into bushing, as shown in Illust. 6.

Install and tighten pipe bushing into exchanger body, as shown in Illust. 7.

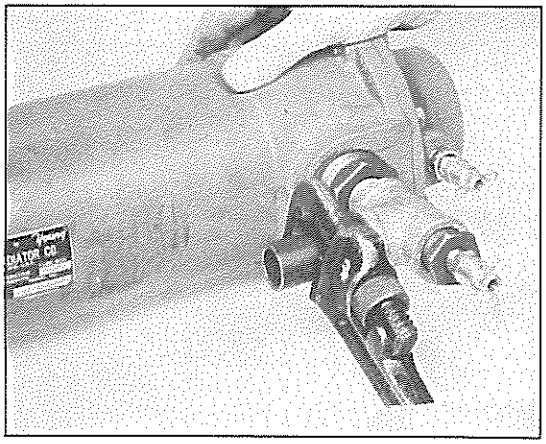
Install and tighten nipple and tee into pipe bushing, as shown in Illust. 8.

Install and tighten pipe bushing into tee, as shown in Illust. 9.

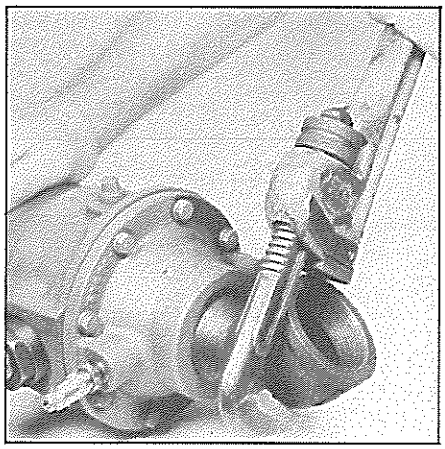
Install and tighten drain cock into bushing, as shown in Illust. 10.



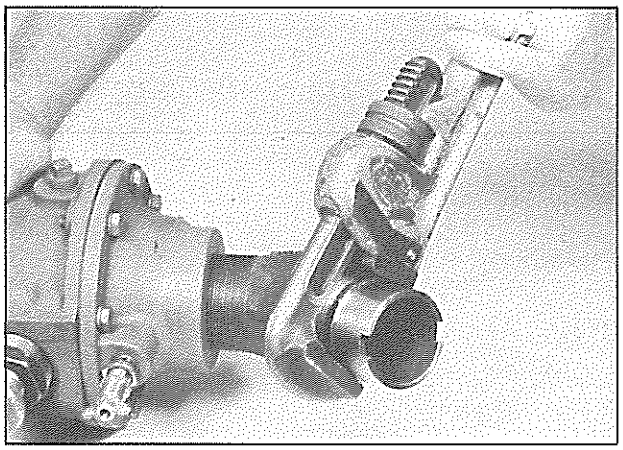
ILLUST. 10



ILLUST. 11



ILLUST. 12



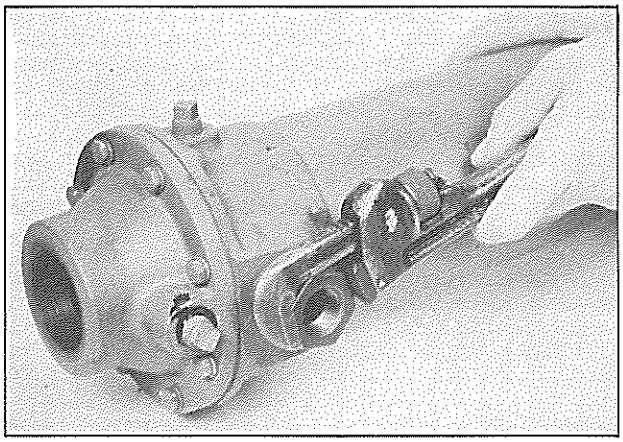
ILLUST. 13

Install and tighten plain end nipple into tee, as shown in Illust. 11.

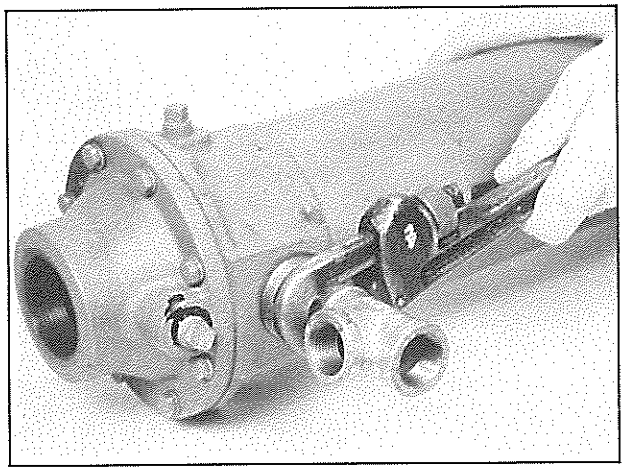
Install 45 degree street elbow into cap, as shown in Illust. 12.

Install and tighten nipple into 45 degree street elbow, as shown in Illust. 13.

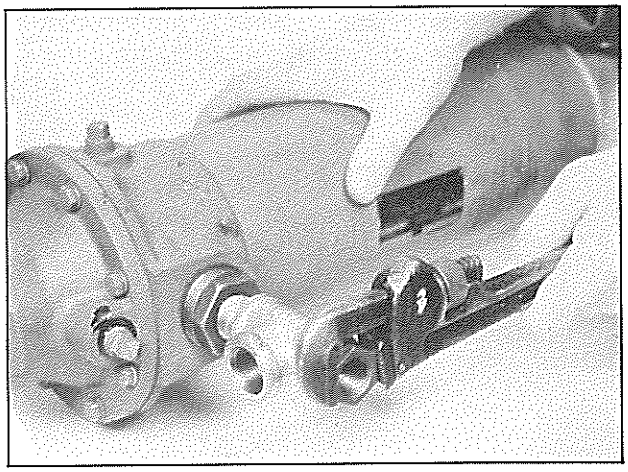
Install and tighten bushing into exchanger body, as shown in Illust. 14.



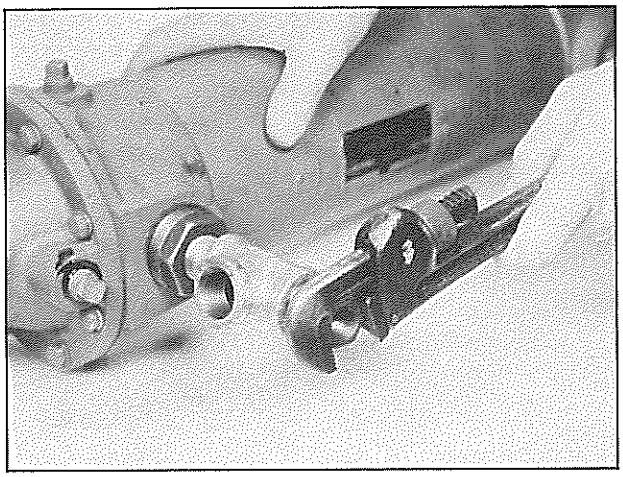
ILLUST. 14



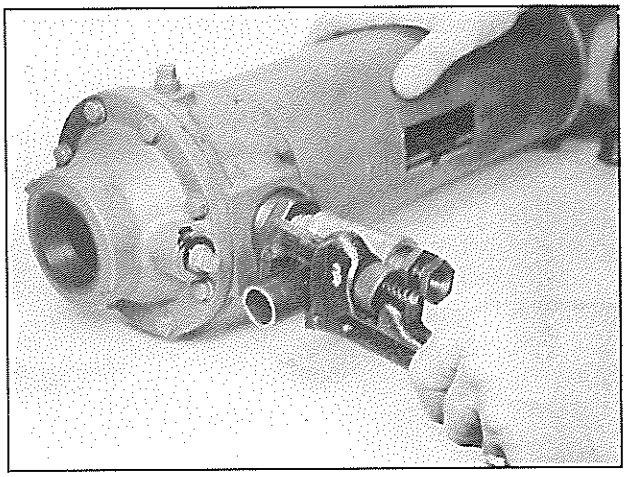
ILLUST. 15



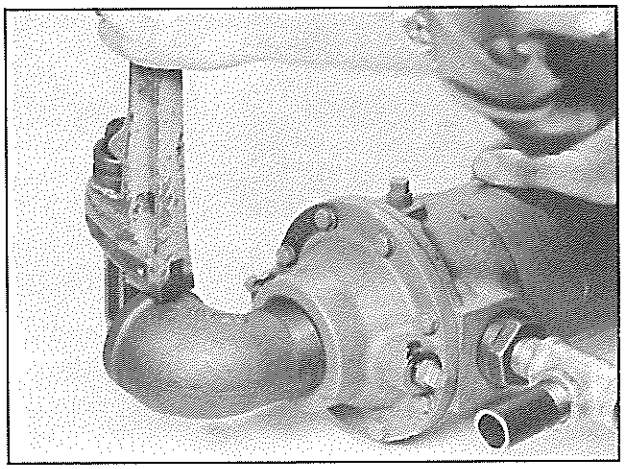
ILLUST. 16



ILLUST. 17



ILLUST. 18



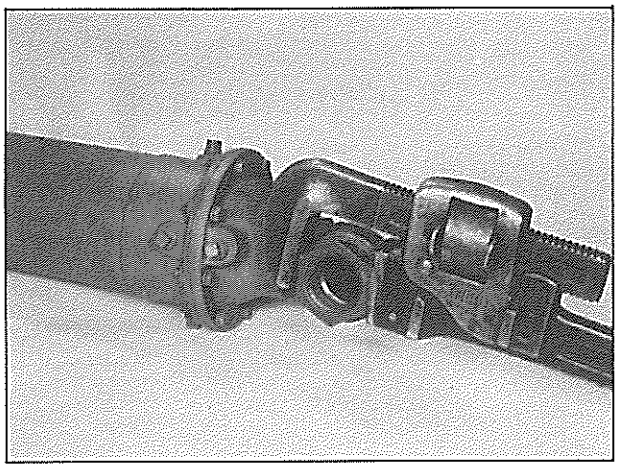
ILLUST. 19

Install and tighten nipple and tee into bushing, as shown in Illust. 15.

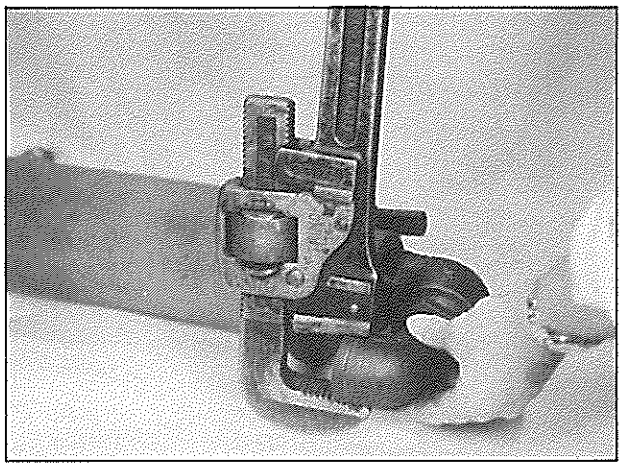
Install and tighten bushing into tee, as shown in Illust. 16.

Install and tighten second bushing, as shown in Illust. 17.

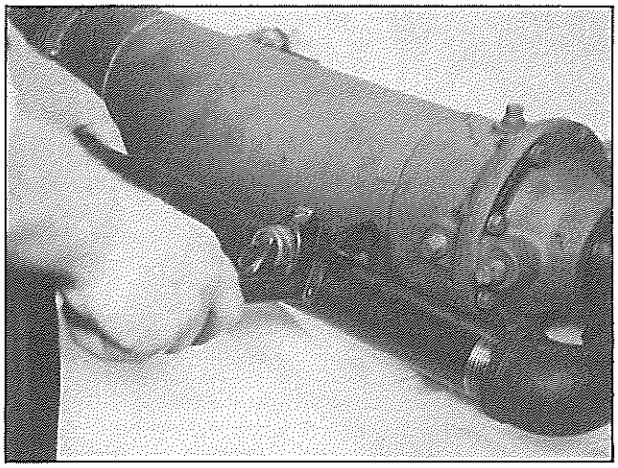
Install and tighten plain end nipple into tee, as shown in Illust. 18.



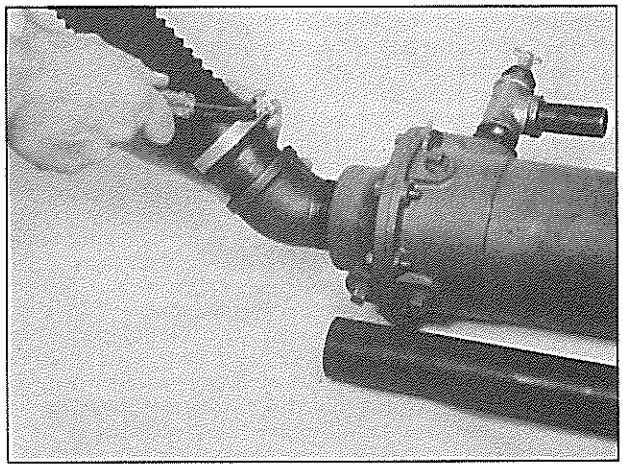
ILLUST. 20



ILLUST. 21



ILLUST. 22



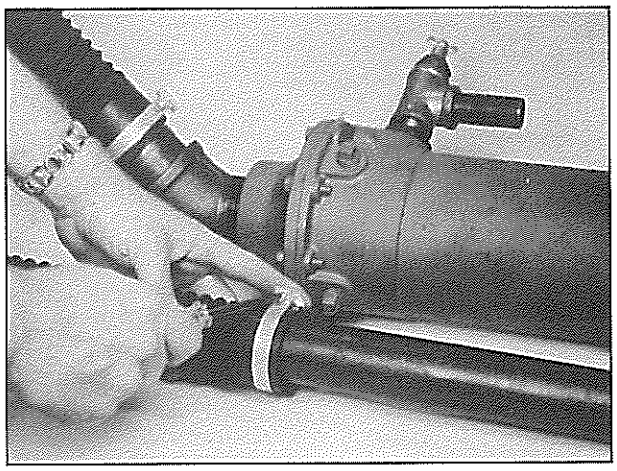
ILLUST. 23

Install and tighten 90 degree street elbow into flywheel end of exchanger body, as shown in Illust. 19.

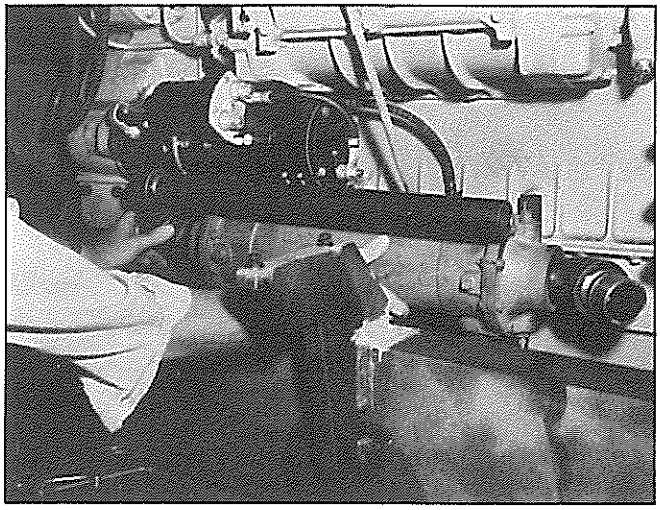
Install and tighten bushing into 90 degree street elbow, as shown in Illust. 20.

Install and tighten 90 degree street elbow into bushing, as shown in Illust. 21.

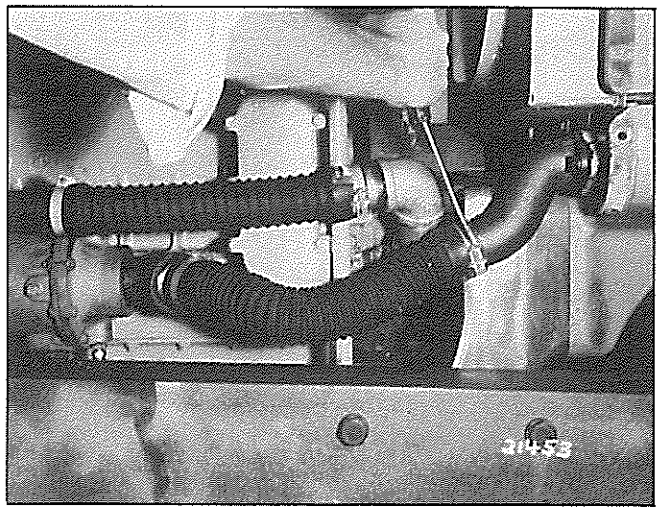
Install and tighten long pipe nipple into 90 degree street elbow, as shown in Illust. 22.



ILLUST. 24



ILLUST. 25



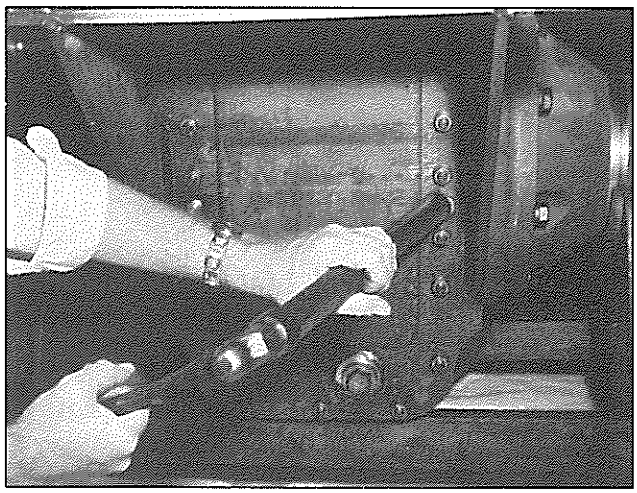
ILLUST. 26

Install long flexible hose and clamp onto nipple. Tighten clamp cap screw securely, as shown in Illust. 23. Remove excess clamp material.

Install short flexible hose and clamp onto nipple. Tighten clamp cap screw securely, as shown in Illust. 24. Remove excess clamp material.

Install mounting brackets on each end of heat exchanger. Install exchanger onto engine, as shown in Illust. 25. Connect flexible hose and hose clamps. Tighten hose clamps securely, as shown in Illust. 26. Remove excess hose clamp material.

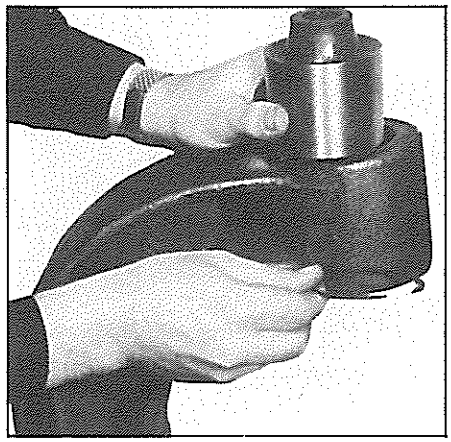
MOTOR MOUNTS



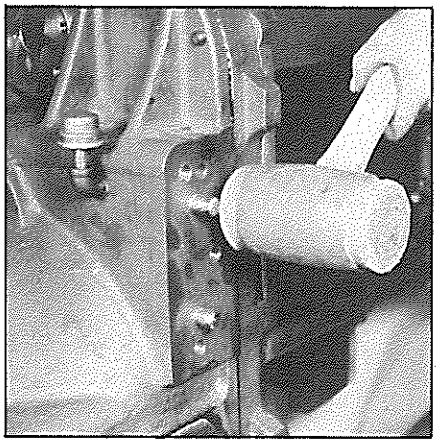
ILLUST. 1

Install motor support to rear of final drive housing. Install lock washers and nuts. Do not tighten nuts. Next, install two nuts to threaded ends of dowel pins. Using a piece of pipe or drift pin drive dowel pins through support and into final drive housing, as shown in Illust. 1. Remove nuts from dowel pins. Nuts on dowel pins will protect threads from damage while driving. Tighten all nuts securely.

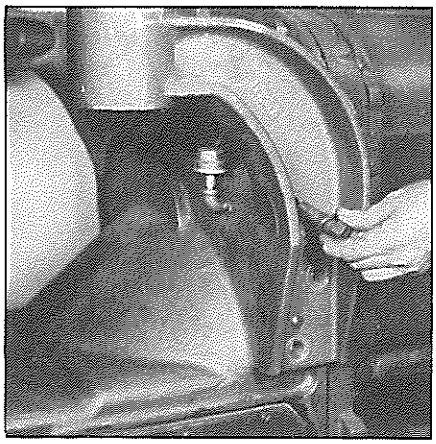
Install snap ring into groove in bottom of left and right hand flywheel motor mounts. Next, press or drive tubular motor supports into



ILLUST. 2



ILLUST. 3

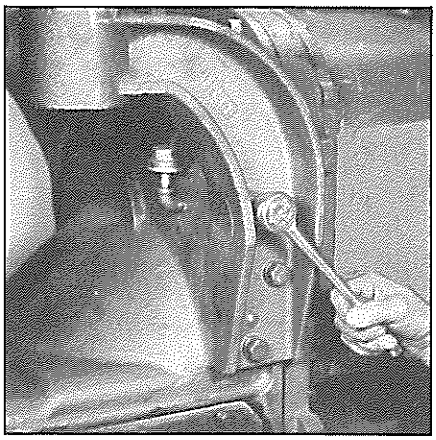


ILLUST. 4

mounts, as shown in Illust. 2.

Drive dowel pins into both sides of lower transmission, as shown in Illust. 3.

Install both flywheel motor mounts over dowel pins and install cap screws with lock washers, as shown in Illust. 4. Tighten cap screws securely, as shown in Illust. 5.



ILLUST. 5

MOTOR MOUNT GAP

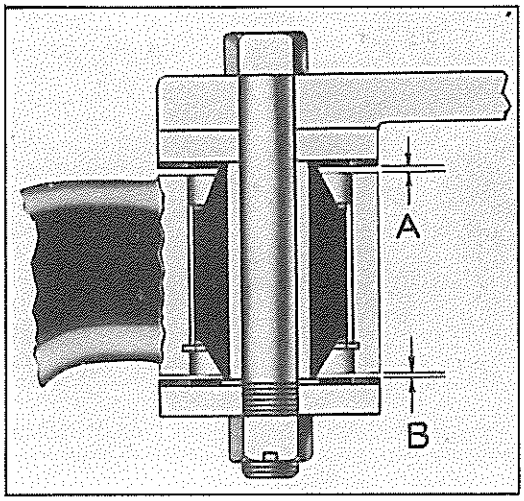
When installing an engine, the rear mounts are to be tightened first.

If new mounts are installed, clearance (A) and (B), as shown in Illust. 1, are as follows:

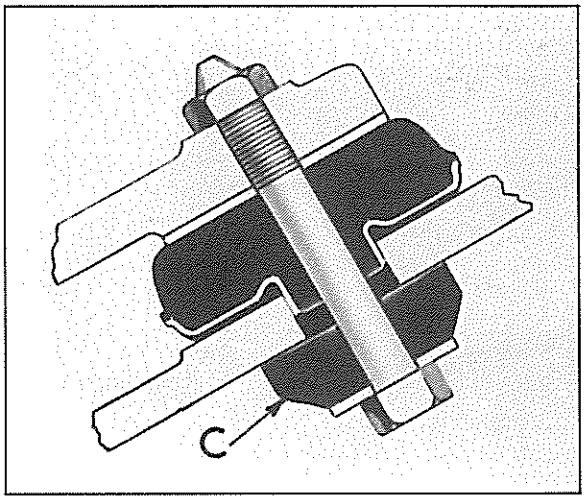
A	B
.120 to .140	.000 to .020

If motor mounts are reused, clearance (A) and (B), as shown in Illust. 1. are as follows:

A	B
.060 MIN.	.1875 MAX.



ILLUST. 1



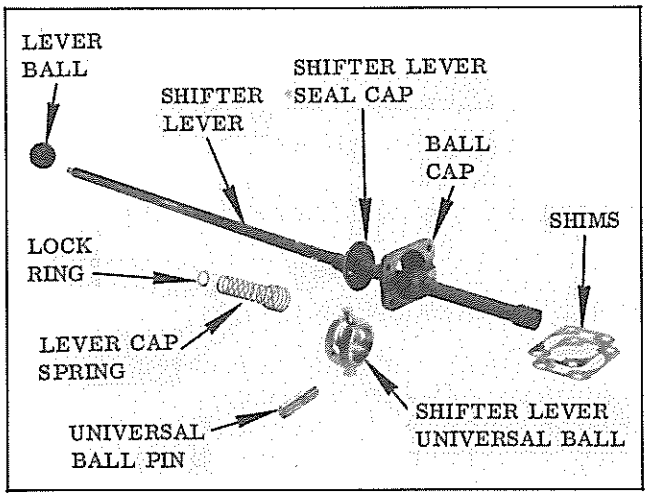
ILLUST. 2

Proper gap at (A) and (B) can be maintained by removing shims at gap (B) and reinstalling shims at gap (A), as the mount settles over a period of time. However, if the proper gap clearance cannot be maintained by the use of shims, install new mounts.

Front engine mounts are adjusted and tightened until biscuit, Ref. C., Illust. 2, can be barely turned by hand, then tighten bolt one (1) more turn.

SHIFTER LEVER

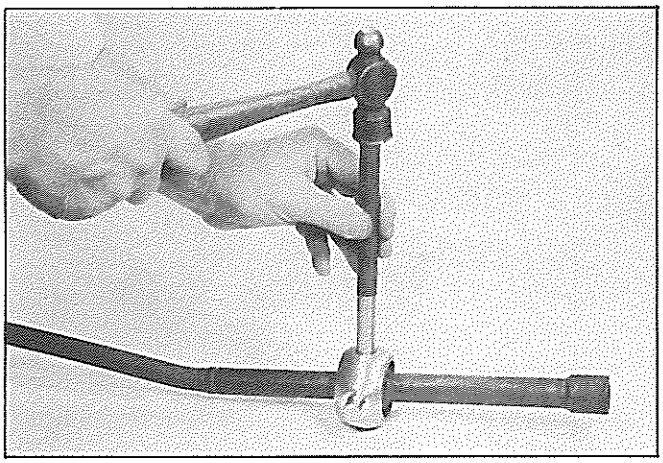
Illust. 1 is an exploded view of the shifter lever.



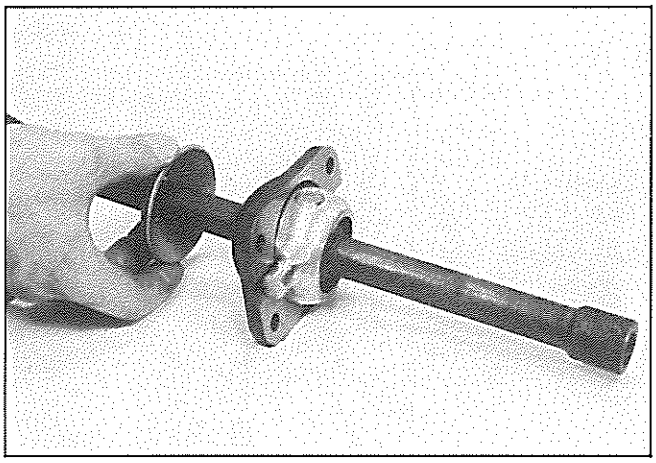
ILLUST. 1

Install universal shifter lever ball onto shifter lever and over ball of lever. Align pin hole in universal shifter lever ball with hole in lever ball. Insert and drive or press universal ball pin through both universal shifter lever ball and lever ball until flush on opposite side, as shown in Illust. 2. Apply grease to pin. Use care in driving or pressing so as not to gauld pin.

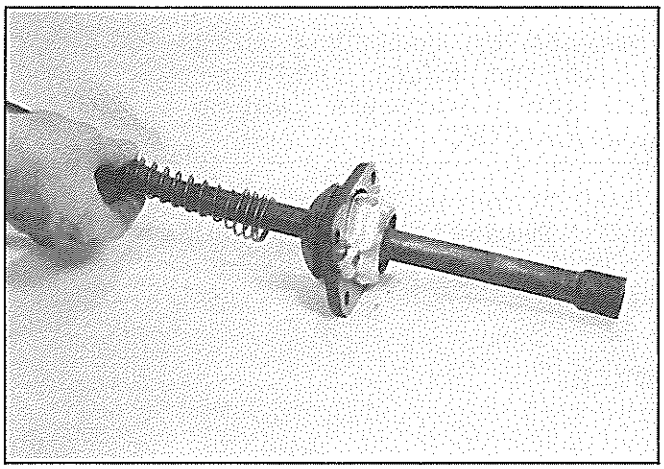
Install ball cap and shifter lever seal cap onto shifter lever, as shown in Illust. 3.



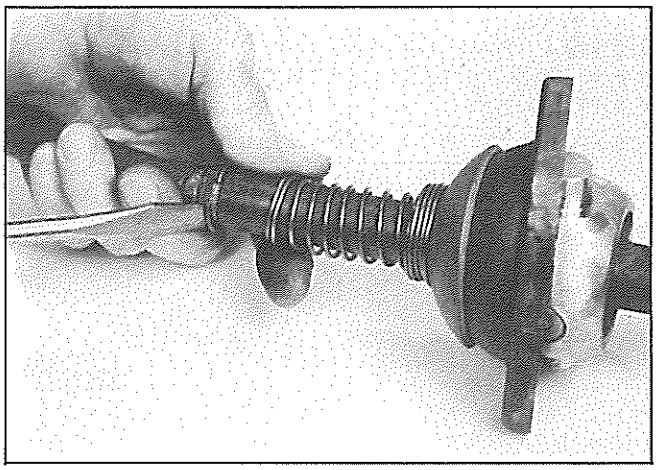
ILLUST. 2



ILLUST. 3



ILLUST. 4



ILLUST. 5

Install lever cap spring onto lever and down against shifter lever seal cap, as shown in Illust. 4.

Install lock ring onto shifter lever. Compress lever cap spring enough to install lock ring in groove of shifter lever, as shown in Illust. 5.

The shifter lever is now ready to be installed to shifter housing.

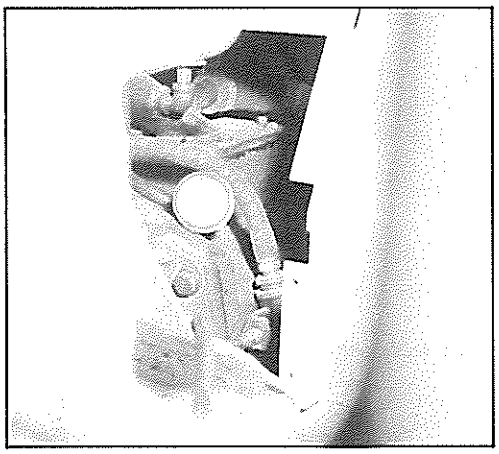
CONTROL VALVE ADJUSTMENT (CUMMINS ENGINE)

After any repairs or replacements have been made on the torque converter, power shift clutch assembly or engine of the machine, the unit should be thoroughly tested to make certain that all components are functioning properly. The procedure that is given here has been established to help determine if the torque converter, power shift clutches and engine are working correctly. The procedure can also be used to help determine what may be the cause of mechanical performance

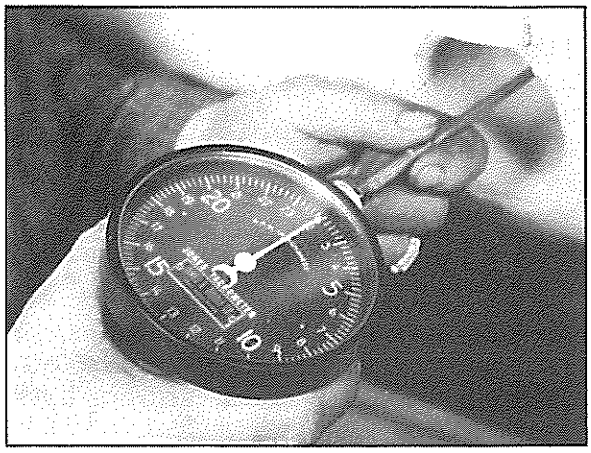
of a machine, before adjustments or repairs are attempted.

Clutch Control Valve

To adjust clutch control valve, first remove left cab closure plate and both side covers on fuel tank support. Remove 1/8 inch pipe plug from reducer located in the tee of clutch control valve, as shown in Illust. 1. Install an adapter with a hose into reducer in tee. Next, install an accurate pressure gauge, graduated from 0 to 150 P.S.I., in the other end of hose.



ILLUST. 1



ILLUST. 2

Start engine, and run unit in neutral at 600 R.P.M. for a period of 5 minutes to warm the oil. Use a tachometer, as shown in Illust. 2, to obtain 600 R.P.M. Watch pressure gauge carefully for radical malfunctions such as gauge registering no pressure, pressure above scale and rapid temperature rise on converter oil temperature gauge located on instrument box.

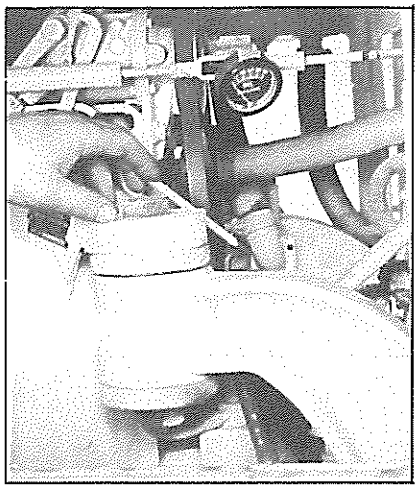
The regulating valve, regulating the P.S.I. of clutch control valve, is located on the right side of converter housing under fuel tank. (Standing in the rear of machine, facing toward the front, will determine the left and right side of machine.) With engine running at 600 R.P.M., loosen jam nut on adjusting screw on top of valve. Using an Allen wrench, turn adjusting screw until pressure gauge has a reading of 65-75 P.S.I., as shown in Illust. 3. When this reading is obtained, hold Allen wrench in place and tighten jam nut securely. Recheck gauge. Shift transmission into 4th gear and stall torque converter tail shaft by applying brakes. Pressure gauge should read 75-100 P.S.I. Engine speed should increase from 600 R.P.M. to 1125-1175 R.P.M.

Using a tachometer, set engine speed at 1000 R.P.M. Shift transmission into 4th gear and stall torque converter tail shaft by applying brakes. Engine speed should increase from 1000 R.P.M. to 1525-1575 R.P.M.

Set engine speed at maximum R.P.M. Shift transmission into 4th gear and stall torque converter tail shaft by applying brakes. Pressure gauge should read 75-100 P.S.I. Engine speed should by 1725-1800 R.P.M.

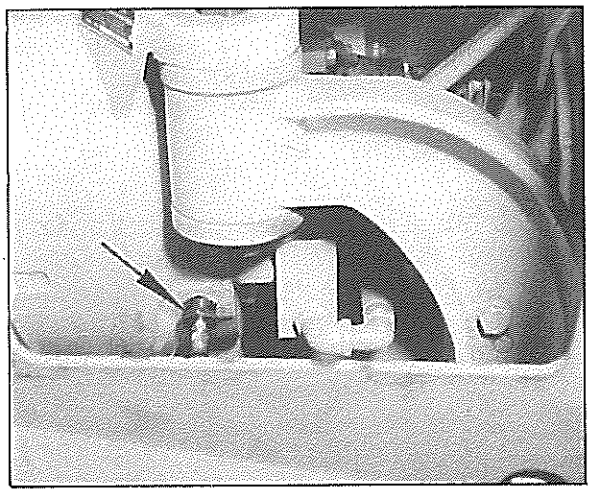
Release load on torque converter by returning clutch foot lever to neutral position at maximum speed. Pressure gauge should read 80 to 125 P.S.I.

Stop engine. Remove hose with adapter and gauge from tee reducer. Install 1/8 inch pipe plug in reducer. Install left cab closure plate and both side covers of fuel tank support.



ILLUST. 3

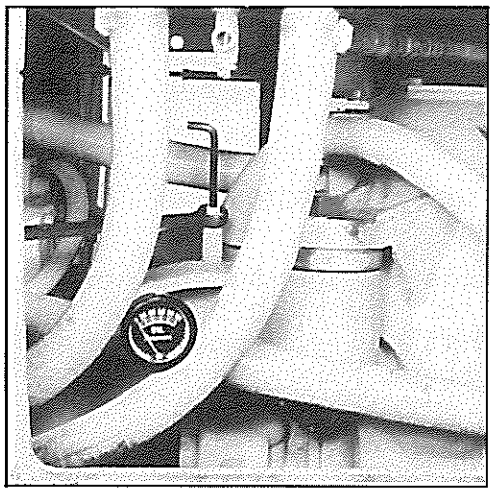
To adjust the torque converter regulating valve, first remove both side covers on fuel tank support. Next, remove pipe plug on right side of torque converter housing and install a reducer. Install an adapter with a hose into reducer, as shown in Illust. 4. next, install an accurate pressure gauge, graduated from 0 to 150 P.S.I., on the other end of hose.



ILLUST. 4

Start engine. Run unit in neutral at 600 R.P.M. for a period of 5 minutes to warm the oil. Use a tachometer, as shown in Illust. 2, to obtain 600 R.P.M. Watch pressure gauge carefully for radical malfunctions such as gauge registering no pressure, pressure above scale and rapid temperature rise on converter oil temperature gauge located on instrument box.

The regulating valve, regulating the P.S.I. of torque converter, is located on the left side of torque converter housing, under fuel tank. (Standing in rear of machine, facing toward the front, will determine the left and right side of machine.) With engine running at 600 R.P.M., loosen jam nut on adjusting screw on top of valve. Using an Allen wrench, turn adjusting screw until pressure gauge has a reading of 20-30 P.S.I., as shown in Illust. 5. When this reading is obtained, hold Allen wrench in place and tighten jam nut securely. Recheck gauge. Shift transmission into 4th gear and stall torque converter tail shaft



ILLUST. 5

by applying brakes. Pressure gauge should read 25-35 P.S.I. Engine speed should increase from 600 R.P.M. to 1125-1175 R.P.M.

Using a tachometer, set engine speed at 1000 R.P.M. Shift transmission into 4th gear and stall torque converter tail shaft by applying brakes. Engine speed should increase from 1000 R.P.M. to 1525-1575 R.P.M.

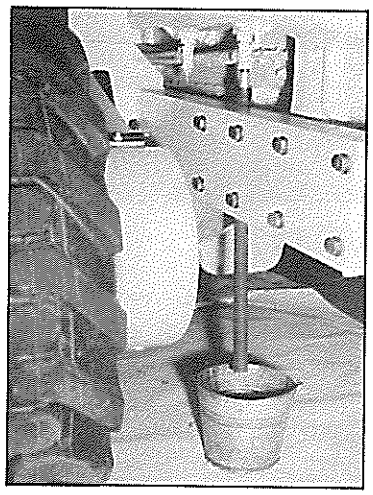
Set engine speed at maximum R.P.M. Shift transmission into 4th gear and stall torque converter tail shaft by applying brakes. Pressure gauge should read 35-45 P.S.I. Engine speed should be 1725-1800 R.P.M.

Release load on torque converter by returning clutch foot lever to neutral position at maximum speed. Pressure gauge should read 50-50 P.S.I.

Stop engine. Remove hose with adapter and gauge from reducer. Next, remove reducer from torque converter housing and install pipe plug. Install both covers to fuel tank support.

Check Valve

The check valve is located on right side of clutch control valve. There is no adjustment to this valve. To check this valve, loosen wing fasteners on front cover of seat support tool box. Remove 1/8 inch pipe plug from reducer in cross tee, as shown in Illust. 1. Install an adapter with hose into reducer. Next, install a gauge, graduated from 0 to 150 P.S.I. on other end of hose. Run engine at 600 R.P.M., 1000 R.P.M. and at maximum R.P.M. Gauge reading at these speeds should be 2-15 P.S.I. If reading is not within 2-15 P.S.I., replace check valve. When reading is obtained, remove adapter with hose and install pipe plug. Tighten wing fasteners on front cover to seat support tool box.



ILLUST. 6

Oil Circulation Test

Remove pipe bushing with drain cock from heat exchanger. Replace with nipple and a length of hose, as shown in Illust. 6. Set a suitable container under heat exchanger. Start engine. Run unit at 600 R.P.M. When a steady flow of oil is obtained through hose and into container, time the

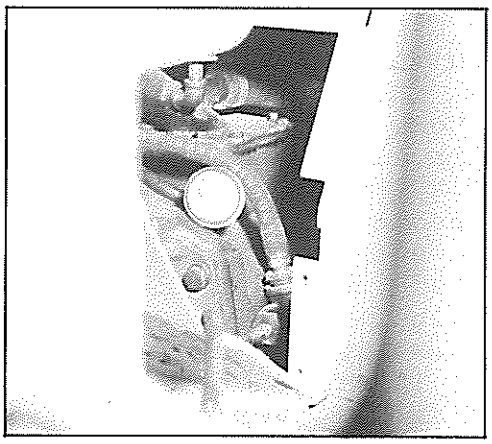
amount of oil. The time to fill a 2 1/2 gal. container should be less than 1 minute or 1 gal. in 24 seconds.

VALVE ADJUSTMENTS (GENERAL MOTORS ENGINE)

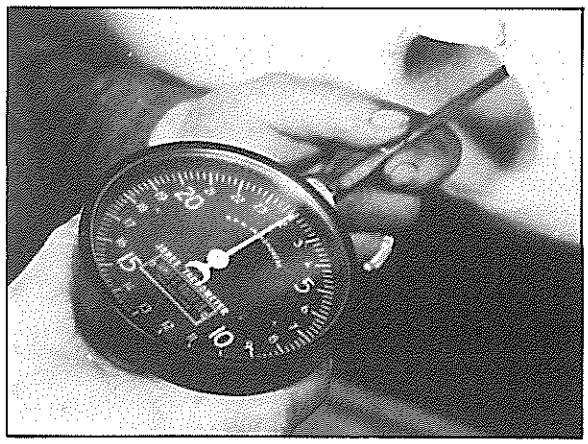
After any repairs or replacements have been made on the torque converter, power shift clutch assembly or engine of the machine, the unit should be thoroughly tested to make certain that all components are functioning properly. The procedure that is given here has been established to help determine if the torque converter, power shift clutches and engine are working correctly. The procedure can also be used to help determine what may be the cause of mechanical performance of a machine, before adjustments or repairs are attempted.

Clutch Control Valve

To adjust control valve, first remove left cab closure plate and both side covers on fuel tank support. Remove 1/8 inch pipe plug from reducer, located in the tee of clutch control valve, as shown in Illust. 1. Install an adapter with a hose into reducer in tee. Next, install an accurate pressure gauge, graduated from 0 to 150 P.S.I., in the other end of hose.



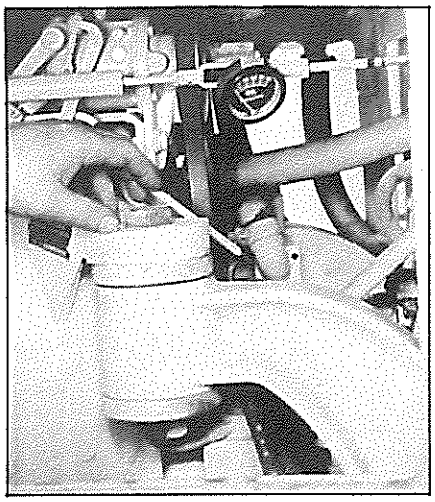
ILLUST. 1



ILLUST. 2

Start engine. Run unit in neutral at 600 R.P.M. for a period of 5 minutes to warm the oil. Use a tachometer, as shown in Illust. 2 to obtain 600 R.P.M. Watch pressure gauge carefully for radical malfunctions such as gauge registering no pressure, pressure above scale and rapid temperature rise on converter oil temperature gauge located on instrument box.

The regulating valve, regulating the P.S.I. of clutch control valve, is



ILLUST. 3

located on the right side of converter housing under fuel tank. (Standing in the rear of machine, facing toward the front, will determine the left and right side of machine.) With engine running at 600 R.P.M., loosen jam nut on adjusting screw on top of regulating valve. Using an Allen wrench, turn adjusting screw until pressure gauge has a reading of 65-75 P.S.I., as shown in Illust. 3. When this reading is obtained, hold Allen wrench in place and tighten jam nut securely. Recheck gauge.

Increase engine speed to 800 R.P.M., using a tachometer. Shift transmission into 4th gear and stall torque converter tail shaft by applying brakes. Pressure gauge should read 75-100 P.S.I. Engine speed should increase from 800 R.P.M. to 1275-1325 R.P.M.

Using a tachometer, set engine speed at 1000 R.P.M. Shift transmission into 4th gear and stall torque converter tail shaft by applying brakes. Engine speed should increase from 1000 R.P.M. to 1575-1625 R.P.M.

Set engine speed at maximum R.P.M. Shift transmission into 4th gear and stall torque converter tail shaft by applying brakes. Pressure gauge should read 75-100 P.S.I. Engine speed should be 1825-1900 R.P.M.

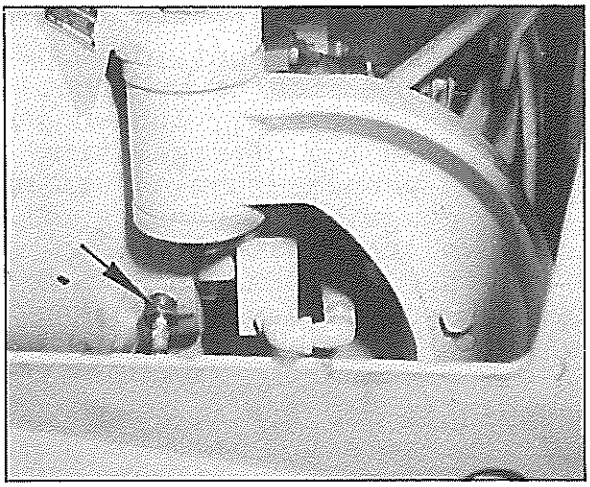
Release load on torque converter by returning clutch foot lever to neutral position at maximum speed. Pressure gauge should read 80-125 P.S.I.

Stop engine. Remove hose with adapter and gauge from tee reducer. Install 1/8 inch pipe plug in reducer. Install left cab closure plate and both side covers on fuel tank support.

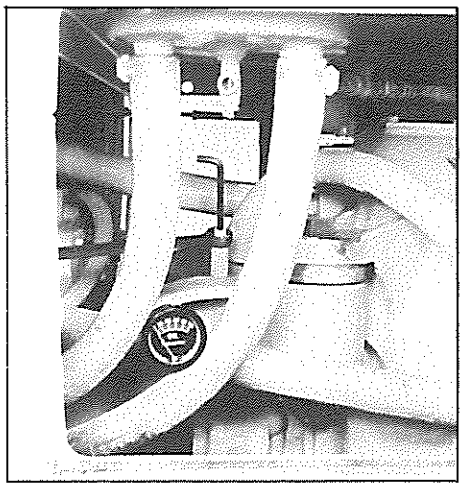
Converter Valve

To adjust the torque converter regulating valve, first remove both side covers on fuel tank support. Next, remove pipe plug on right side of torque converter housing and install a reducer. Install an adapter with a hose into reducer, as shown in Illust. 4. Next, install an accurate gauge, graduated from 0 to 100 P.S.I., on the other end of hose.

Start engine. Run unit in neutral at 600 R.P.M. for a period of 5 minutes to warm the oil. Use a tachometer, as shown in Illust. 2 to obtain 600 R.P.M. Watch pressure gauge carefully for radical malfunctions such as gauge registering no pressure, pressure above scale



ILLUST. 4



ILLUST. 5

and rapid temperature rise on converter oil temperature gauge located on instrument box.

The regulating valve, regulating the P.S.I. of torque converter, is located on the left side of torque converter housing, under fuel tank. (Standing in rear of machine, facing toward front, will determine the left and right side of machine.) With engine running at 600 R.P.M., loosen jam nut on adjusting screw on top of valve. Using an Allen wrench, turn adjusting screw until pressure gauge has a reading of 20-30 P.S.I., as shown in Illust. 5. When this reading is obtained, hold Allen wrench in place and tighten jam nut securely. Recheck gauge.

Increase engine speed to 800 R.P.M., using a tachometer. Shift transmission into 4th gear and stall torque converter tail shaft by applying brakes. Pressure gauge should read 25-35 P.S.I. Engine speed should increase from 800 R.P.M. to 1275-1325 R.P.M.

Using a tachometer, set engine speed at 1000 R.P.M. Shift transmission into 4th gear and stall torque converter tail shaft by applying brakes. Engine speed should increase from 1000 R.P.M. to 1575-1625 R.P.M.

Set engine speed at maximum R.P.M. Shift transmission into 4th gear and stall converter tail shaft by applying brakes. Pressure gauge should read 35-45 P.S.I. Engine speed should be 1825-1900 R.P.M.

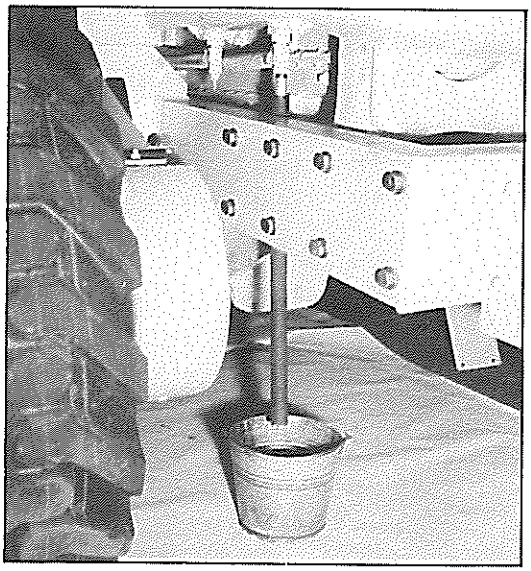
Release load on torque converter by returning clutch foot lever to neutral position at maximum speed. Pressure gauge should read 50-60 P.S.I.

Stop engine. Remove hose with adapter and gauge from reducer. Next, remove reducer from torque converter housing and install pipe plug. Install both covers to fuel tank support.

Check Valve

The check valve is located on right side of clutch control valve. There is no adjustment to this valve. To check this valve, loosen wing fasteners on front cover of seat support tool box. Remove 1/8 inch pipe plug from reducer in cross tee, as shown in Illust. 1. Install an adapter with hose into reducer. Next, install a gauge, graduated from 0 to 150 P.S.I. on other end of hose. Run engine at 600 R.P.M., 1000 R.P.M., and a maximum R.P.M. Gauge reading at these speeds should be 2-15 P.S.I. If reading is not within 2-15 P.S.I., replace check valve. When reading is obtained, remove adapter with hose and install pipe plug. Tighten wing fasteners on front cover to seat support tool box.

Oil Circulation Test



ILLUST. 6

Remove pipe bushing with drain cock from heat exchanger. Replace with nipple and length of hose, as shown in Illust. 6. Set a suitable container under heat exchanger. Start engine. Run unit at 600 R.P.M. When a steady flow of oil is obtained through hose and into container, time the amount of oil. The time to fill a 2 1/2 gal. container should be less than 1 minute or 1 gal. in 24 seconds.

In the following illustrations and description instructions are given for assembly of the left hand tandem drive. However, the assembly of the right hand tandem drive is exactly the same with the exception that each part is assembled on the opposite side from which it is shown in the illustrations.

Although in the following illustrations the tandem drive assembly is shown being repaired while it is removed from the grader; most repairs can be made without removing the tandem from the grader. Either front or rear axle assembly can be removed, disassembled, inspected, repaired and reassembled without removing the tandem drive from the grader. Even the driving axle can be removed as shown in Illust. 24, without the removal of the tandem assembly.

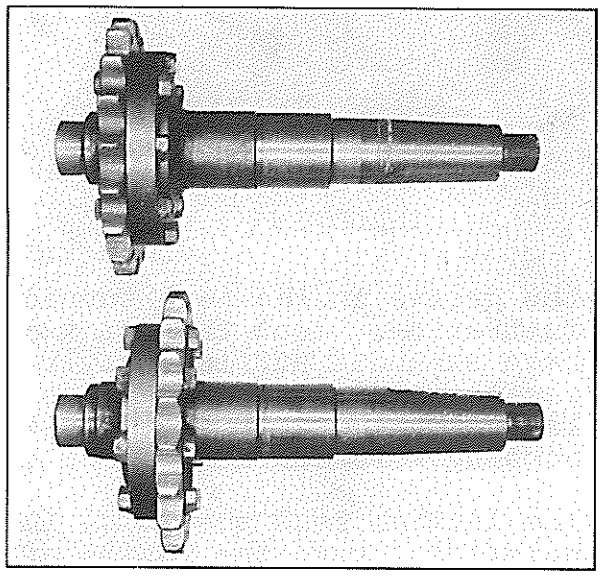
Disassembly

Due to the fact that during the reassembly operation all adjustment and settings must be accomplished, a detailed description is given under that heading. The disassembly procedure is merely the reverse of the reassembly and, therefore, no detailed description is necessary. If the tandem assembly is not completely disassembled as shown, only that portion of the instructions which apply need be carried out.

However, before disassembling the tandem, the reassembly instructions should be read in order to determine any points which should be watched. Naturally, such settings as shim adjustments, etc. should be noted during the disassembly procedure as this will materially help during the reassembly operation.

Inspection

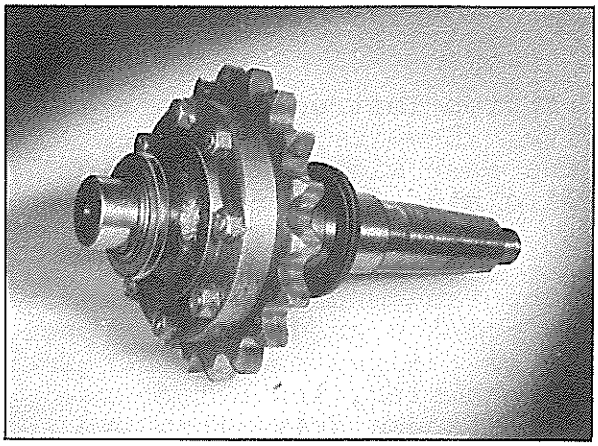
Inspect all parts for excessive wear or other damage. Bearings, shafts, etc., will sometimes seize and score due to insufficient lubricant or improper lubricant being used. Any parts which are defective should be repaired or replaced. Replace all gaskets and grease seals when reassembling.



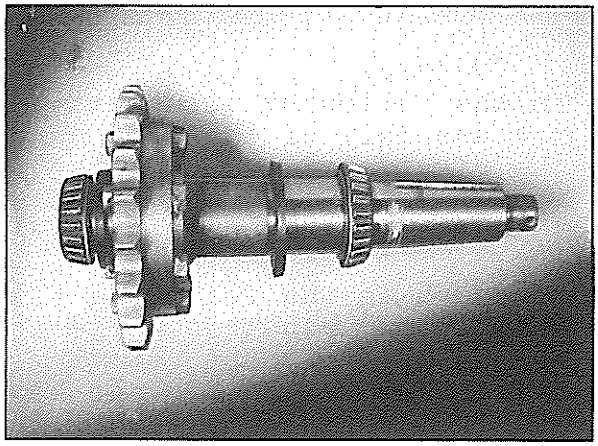
ILLUST. 1

Reassembly

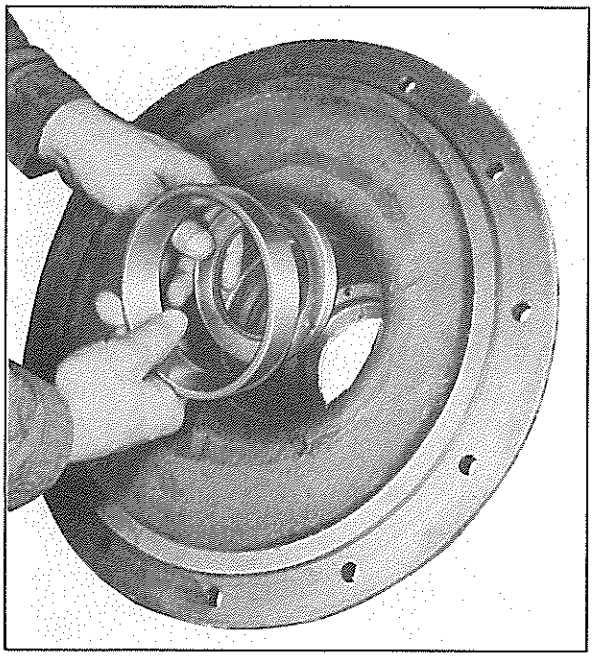
Assuming that the unit has been completely disassembled, the first step



ILLUST. 2



ILLUST. 3

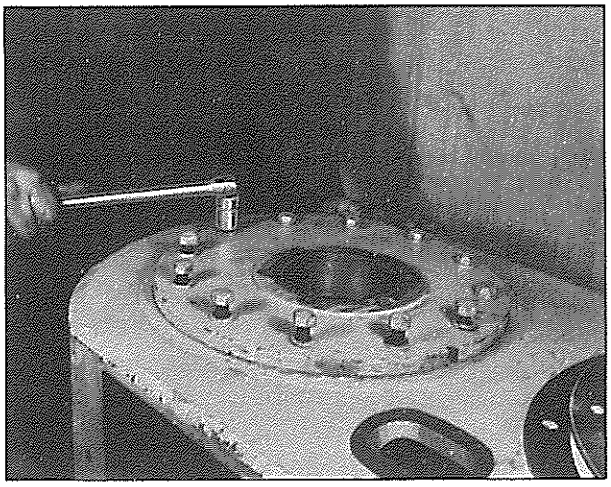


ILLUST. 4

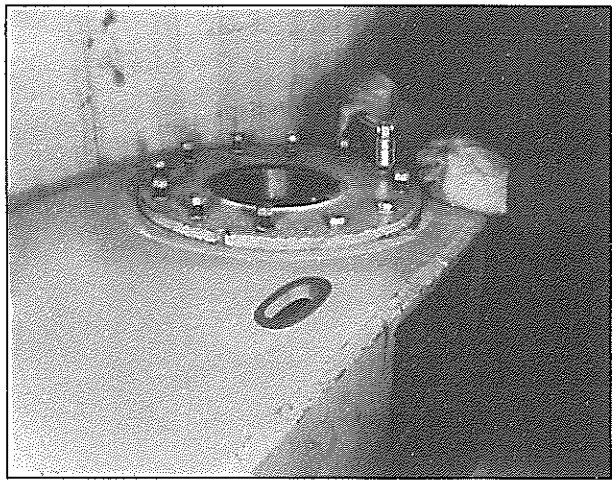
is to mount the driven sprockets on the driven axles, as shown in Illust. 1. Note that the sprockets are mounted on the opposite side of the driven axle flange for front and rear installation. The driven axle assembly at the top of Illust. 1, is assembled for the front of the tandem and the assembly at the bottom of the illustration is assembled for the rear. Earlier machines were equipped with flat locks under the nut as well as the head of the bolt. This was later changed to a self-locking nut. If the nut has flat locks, as shown, replace all bolts and discard the locks.

Install the two seals on each of the driven axle shafts as shown in Illust. 2. When installing these seals be sure to install them with the sharp edge of each seal pointing toward the sprocket, i.e., with the groove in the seal turned toward the sprocket as shown in the illustration. Heat the two tapered roller bearings in oil until they have expanded sufficiently to allow easy installation on the axle shaft. Install the bearings on the axle shaft as shown in Illust. 3. Install the grease seal and the bearing cup in each outer eccentric housing as shown in Illust. 4.

The leather seal should be installed with the sharp edge of the seal pointing toward the inside of the housing as shown in the Illustration, i.e., install as a grease seal. Shellac all gaskets to the tandem housing. Note: There is no gasket used between the tandem



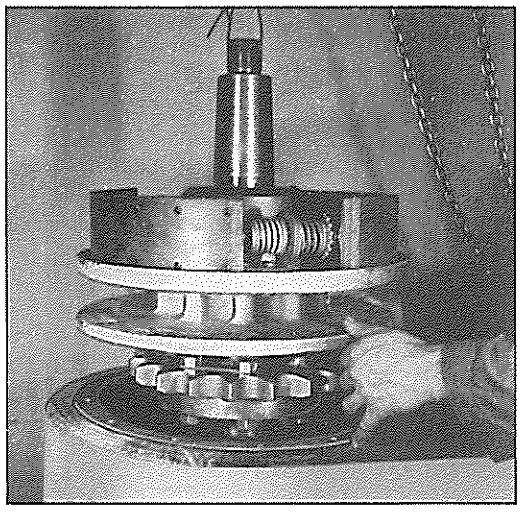
ILLUST. 5



ILLUST. 6

housing and the welded inner axle carrier which is shown being installed in Illust. 11. Install the inner eccentric housings as shown in Illusts. 5 and 6. When installing these housings be sure to install them as shown in the illustrations with the notch in the edge of the housing (which indicates the short side of the eccentric) turned toward the center of the tandem housing. This will position the driven axle assemblies as close to the driving axle assembly as possible thereby allowing the maximum amount of adjustment on the chains.

Assemble the brake shoe and backing plate assembly to the front outer eccentric housing, slide the front driven axle assembly into the housing taking care not to damage the leather seal and install the complete assembly in the tandem as shown in Illust. 7. Be sure that the notch in the edge of the outer eccentric housing is turned toward the center of the tandem housing so that the eccentric action of the housing will match the eccentric action of the inner housing. You will notice in the illustration that the front driven axle assembly is the one which has the driven sprocket mounted on the outside of the flange of the driven axle.

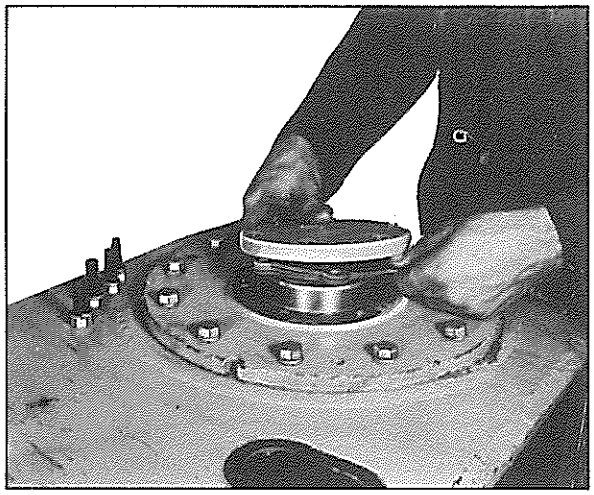


ILLUST. 7

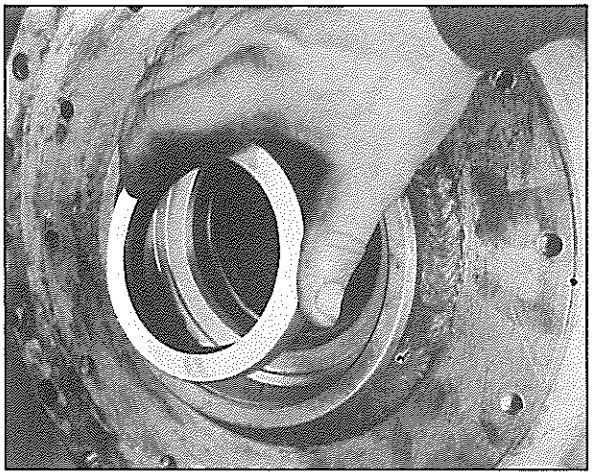
Install the rear driven axle assembly in the rear outer eccentric housing taking care not to damage the leather seal and install this assembly in the tandem housing as shown in Illust. 8. You will notice in the illustration that the rear driven axle is the one which has the driven sprocket mounted on the inside surface of the driven axle flange. Be sure that the notch in the edge of the



ILLUST. 8



ILLUST. 9

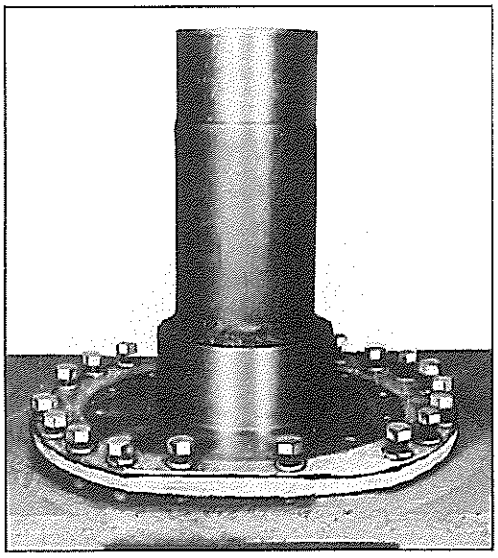


ILLUST. 10

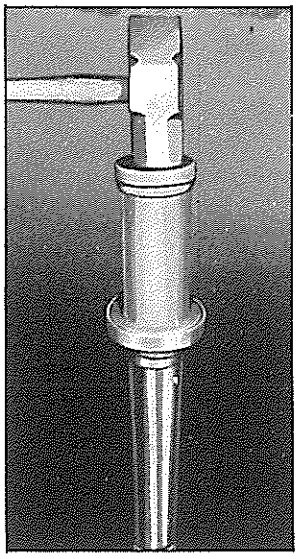
outer eccentric housing matches the position of the notch in the edge of the inner eccentric housing.

Using a soft hammer or piece of brass, drive in the inner bearing cup and install the hub cap with no shims under it. Draw down the cap screws until a slight pre-load is placed on the bearings. Check by turning the sprocket by hand. Both bearings should be clean and dry of oil when making the adjustment. Be sure hub cap is drawn down evenly all the way around. Determine the number of shims to be installed so that with new bearings a .005" to .010" pre-load will exist and with used bearings a snug fit will exist. Remove hub cap, install shims and hub cap as shown in Illust. 9, tighten the cap screws and recheck the pre-load by turning on the sprocket by hand. Repeat this operation on the other driven axle assembly.

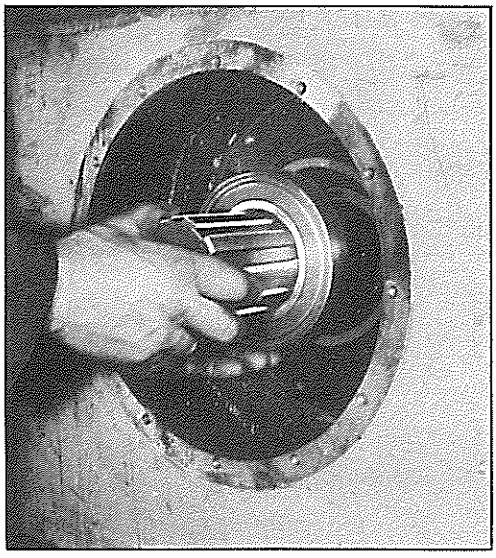
Install the grease seal in the inner axle carrier as shown in Illust. 10, with the sharp edge of the seal pointing toward the transmission or inner end of the carrier. Install the carrier assembly on the tandem housing as shown in Illust. 11. Do not use a gasket between the carrier assembly and the tandem housing but coat the surfaces with gasket shellac or similar compound.



ILLUST. 11



ILLUST. 12



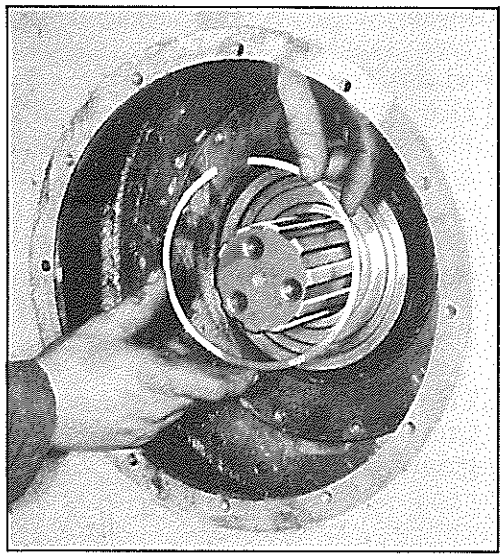
ILLUST. 13

Install the ball bearing on the outer end of the driving axle with the shielded side turned toward the outer end of the axle as shown in Illust. 12. When driving the bearing into place, a piece of pipe or similar tool should be used so that the driving force is transmitted only to the inner race of the bearing. Drive the bearing down onto the axle until it is tight against the shoulder of the axle.

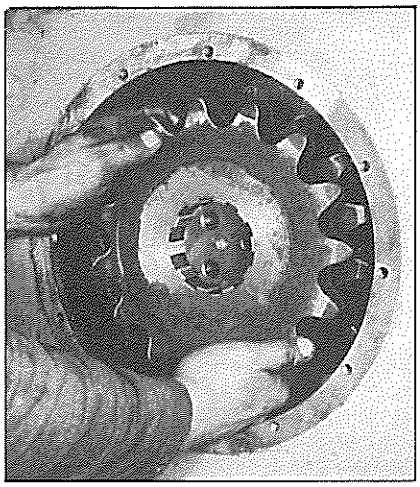
Slide the axle and bearing assembly into the inner axle carrier as shown in Illust. 13, taking care not to damage the leather grease seal. Install the snap ring in the inner axle carrier as shown in Illust. 14.

Install the driving hub and sprockets on the driving axle as shown in Illust. 15, with the long end of the hub on the inside. Install the axle bolting plate and cap screws. Tighten securely and insert a wire through the drilled heads of the three cap screws as shown in Illusts. 16 and 17.

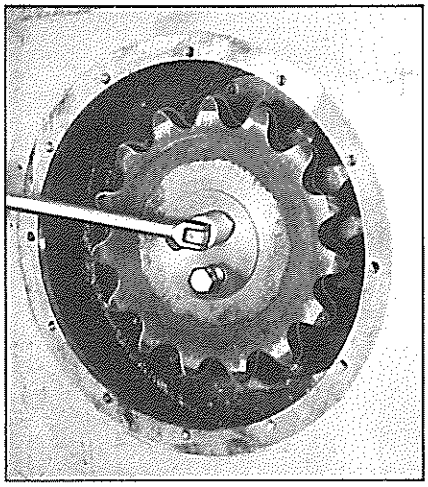
Install the drive chains as shown in Illust. 18, by running a soft wire down through the hole in the top center of the tandem housing, around the hub of the double driving sprockets, through the lower inside of the tandem housing, around the driven axle and out of the inspection hole



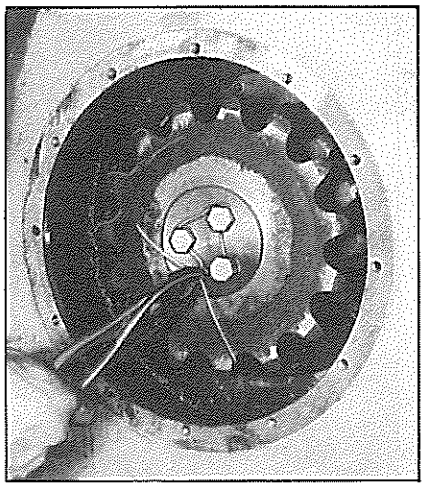
ILLUST. 14



ILLUST. 15



ILLUST. 16

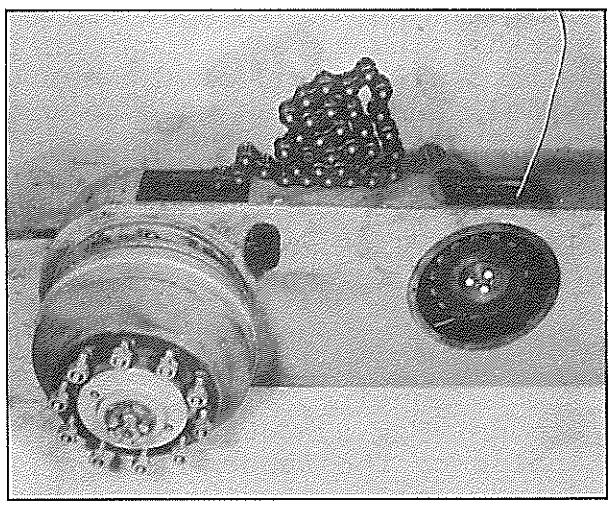


ILLUST. 17

above the driven axle. Attach the wire to the drive chain and leaving the chain coiled up on top of the tandem housing, guide the end of the chain into the housing, over the driven sprocket, through the bottom of the housing, around the driving sprockets, and back to the driven sprocket. Pull the chain up tight and insert the connector link and bar as shown in Illust. 19. Drive the connecting bar onto the connector link by backing up the chain through the small inspection hole on the side of the tandem housing and driving on the connector bar through the inspection hole on the opposite side of the housing as shown in the illustration. Install and spread the cotter keys in the ends of the connector links. Install the other drive chain in a similar manner.

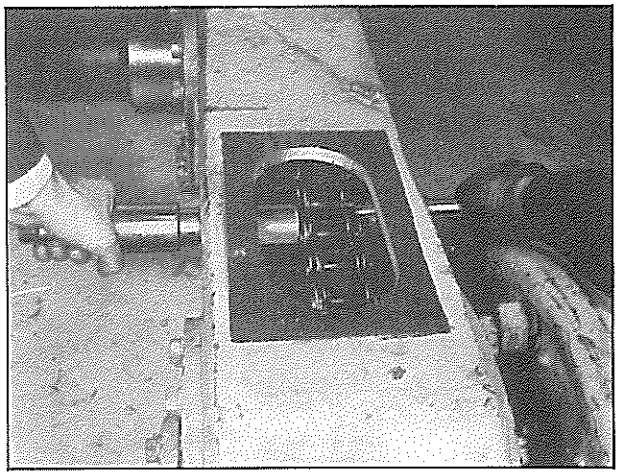
NOTE: When installing the drive chains be sure to install them so the inside chain has the cotter key side turned toward the center of the grader and the outside chain has the cotter key side turned toward the outside of the grader. In other words, install the chains so that as they pass over the double driving sprockets the cotter key sides of the chains will be turned away from each other.

Install all inspection covers and install the tandem assembly on the grader.



ILLUST. 18

Removal

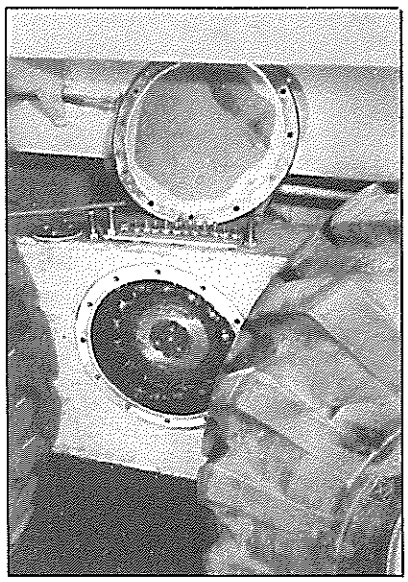


ILLUST. 19

There are three basic types of removal in connection with the tandem drive assembly. The choice between these three types of removal depends entirely upon the work to be done. These three types of removal can be classified as follows:
1. Removal of the tandem housing assembly leaving the driving axle and inner axle carrier on the machine. 2. Removal of the complete tandem assembly with driving axle and inner axle carrier. 3. Removal of the driving axle without the removal of the tandem or inner axle carrier.

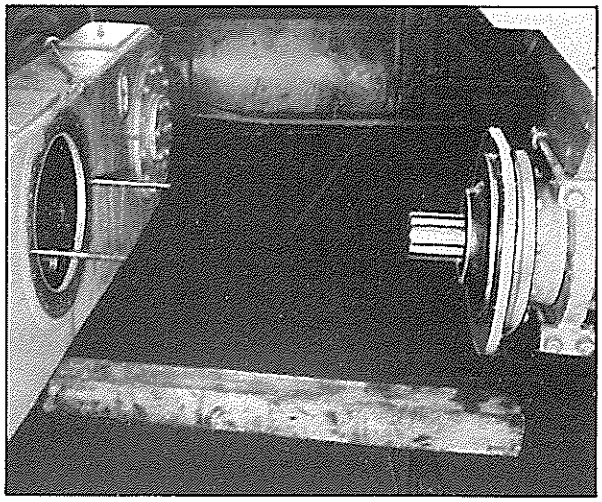
These three types of removal will be discussed in the order listed.

The first type of removal is shown in Illust. 20 and 21. The first step to be taken in this type of removal is to remove the center cover plate and axle bolting plate as shown in Illust. 20. Next, start the engine and rotate the blade until the point of the blade points toward the tandem to be removed, lower the blade to the ground and continue to lower until the weight of the grader is removed from the tandem assembly. If jacks and blocking are available the grader can be raised and blocked in a similar manner. Remove the cap screws which hold the inner axle carrier to the tandem housing, disconnect the hydraulic brake hose, install two studs to aid in guiding the tandem housing assembly as it is removed, place a long beam under the center of the tandem housing and slide the complete assembly out as shown in Illust. 21. The tandem assembly is replaced by reversing the above outlined procedure.

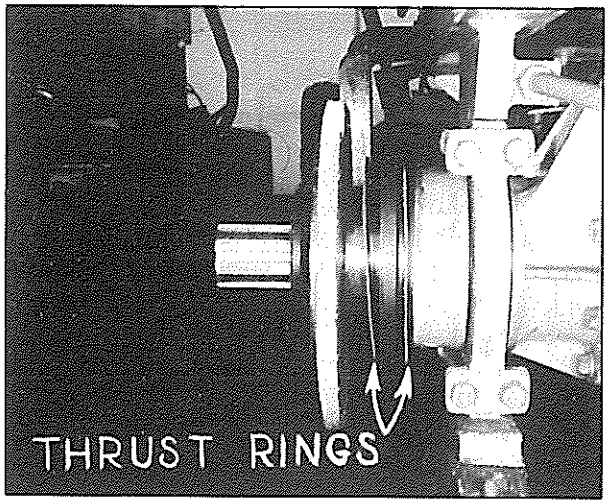


ILLUST. 20

The second type of tandem removal, that of removing the tandem assembly with driving axle assembly and inner axle carrier, becomes necessary when the inner axle carrier or the bushings between the inner axle carrier and the outer axle carrier are to be replaced. This type of removal is also necessary when rebuilding the transmission assembly. However, when the transmission and tandem drive assemblies are removed from the grader as a unit and the tandems are then removed from the transmission assembly.



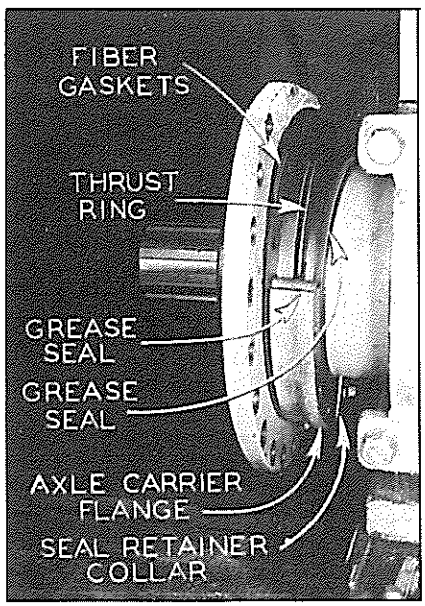
ILLUST. 21



ILLUST. 22

In any one of the above listed cases, it is only necessary to disconnect the hydraulic brake hose leading from the main frame of the grader to the tandem assembly and remove the three seal retainer collars and two axle carrier flanges. The complete assembly then can be slid out from the outer axle carrier and disassembled separately.

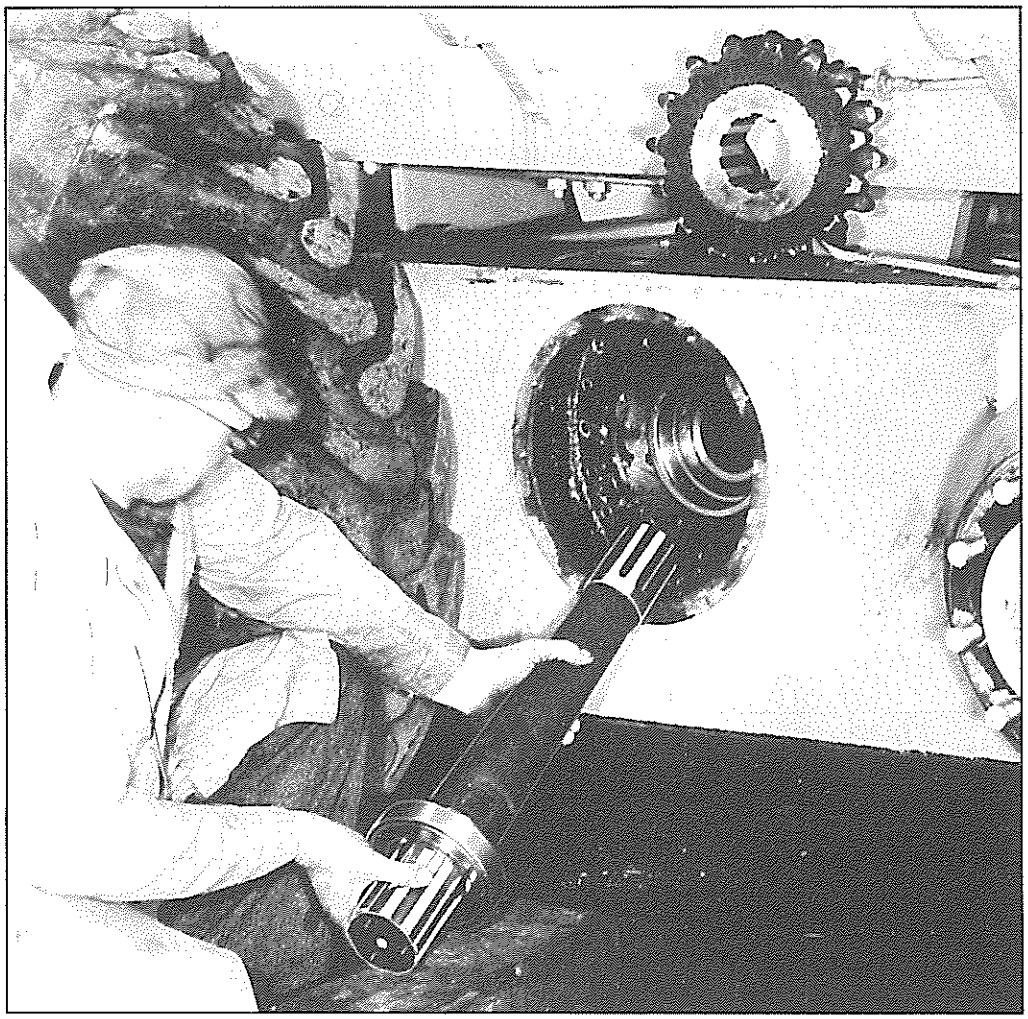
The weight of the rear end of the grader can be supported in the same manner as that described for the first type of removal. When replacing the assembly, be sure to install the thrust rings pointed out in Illust. 22. Install the grease seals as shown in Illust. 23. The fiber gaskets pointed out in the illustration are split to provide easy removal and installation when adjusting the running clearance at this point. Sufficient fiber gasket should be installed or removed as needed to provide the minimum amount of clearance and yet eliminate all binding. The inner axle carrier should oscillate freely.



ILLUST. 23

Although Illusts. 22 and 23, show the tandem housing assembly removed from the inner axle carrier previous to its removal from the machine, this is not necessary since the complete unit can be removed as one assembly.

The third type of removal is shown in Illust. 24. In this illustration is shown the method of removing the driving axle assembly while the tandem housing remains assembled to the grader. The weight of the grader is relieved



ILLUST. 24

from the tandem assembly in the same manner as that outlined for the first and second types of removal. The first step to be taken in this type of removal is to remove the center cover plate and axle bolting plate. Next, uncouple both front and rear drive chains and fold them back into the tandem housing out of the way. Next, remove the driving hub and sprockets and the snap ring which holds the driving axle bearing into the inner axle carrier. The driving axle with bearing may then be withdrawn as shown in the illustration.

NOTE: It is necessary to remove the front wheel from the tandem assembly in order to provide clearance for backing up the tandem drive chain when assembling the chain and driving on the cross bar of the chain link.

The three types of removals outlined above all cover any and all cases and the type of removal which should be used in any particular case depends entirely upon the work to be done. As outlined previous-

ly, it is not necessary to remove the tandem assembly in order to rebuild either front or rear driven axle assembly. This work can be done with the tandem assembly mounted on the grader.

FOOT BRAKES

The brake assemblies are of the two shoe internal expansion type with primary and secondary shoes. Both primary and secondary shoes should be equipped with molded linings.

Disassembly

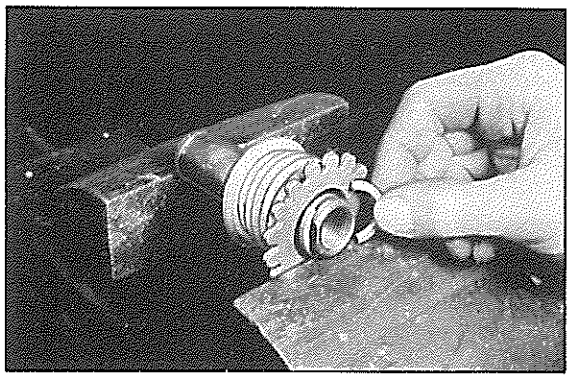
Detailed instructions on disassembly are not necessary due to the simple design of the brakes. Therefore, the only instructions given here is for reassembly. If difficulty is experienced in disassembling - read the reassembly instructions and reverse the procedure outlined.

Inspection

Inspect all parts carefully for excessive wear and scoring. Replace or repair all badly worn or damaged parts.

Reassembly

Assuming that the brake mechanism has been completely disassembled, the first step in reassembly is to install the inner retainer on the adjusting nut, being sure to slide it over the end of the adjusting nut which has the flatted sides and installing it so that the countersunk portion of the retainer fits properly against the shoulder in the center of the adjusting nut. Install the spring and adjusting nut wheel on the adjusting nut, and after compressing the spring sufficiently, install the two locks as shown in Illust. 1.



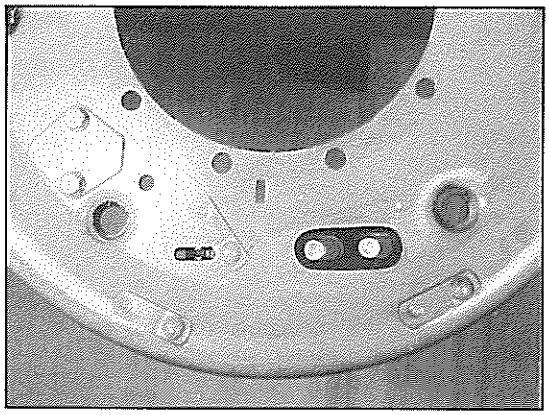
ILLUST. 1

Install the centralizer bracket over the adjusting nut with the end of the bracket having the studs pointing toward the opposite end of the adjusting nut from the adjusting nut wheel. Install the other retainer on the adjusting nut, spring and spring seat, compress the spring and install the locks, as shown in Illust. 2.

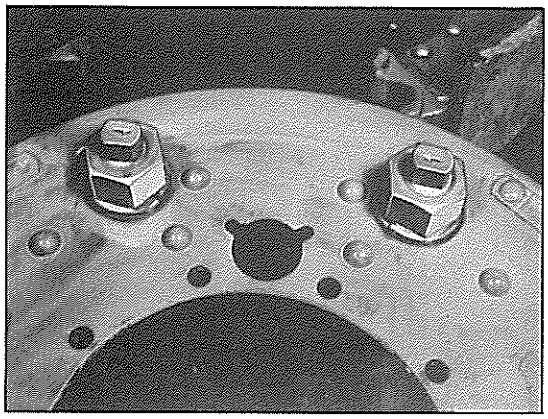
Install the right and left hand adjusting screws in the centralizer assembly.



ILLUST. 2



ILLUST. 3



ILLUST. 4



ILLUST. 5

The adjusting screws should be turned back into the adjusting nut as far as possible. Be sure that both adjusting screws are turned into the adjusting nut an equal amount.

The centralizer assembly is now ready for installation on the backing plate. Install it as shown in Illust. 3, with the two studs through the slotted holes in the backing plate. Install the centralizer plate, two lock washers, and two nuts, but do not tighten the nuts as yet.

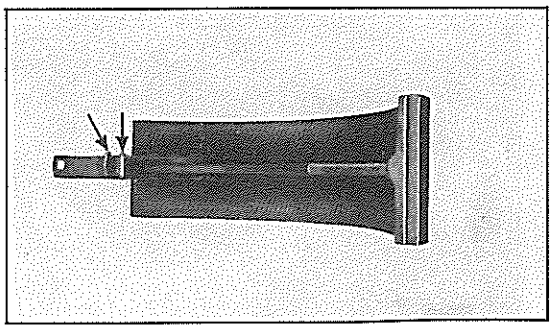
Install the two anchor pins in the backing plate and install the lock washers and hex nuts, but do not tighten the nuts. Turn the anchor pins so that the arrows on the outside ends of the anchor pins point directly toward each other as shown in Illust. 4. The anchor pins are made eccentric and by positioning them in this manner the brake adjustment is slacked off to its minimum, therefore, giving the minimum circumference around the brake shoes.

Install the four shoe hold down pins and shoe spacers as shown in Illust. 5. The shoe spacers are slightly smaller on one end than on the other. The large end is machined out concave to fit onto the convex shape of the backing plate around each of the shoe hold down pins. Be sure that each of the shoe spacers is mounted with the concave end against the backing plate.

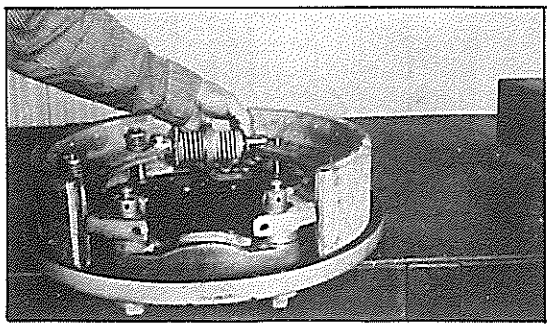
If the linings show excessive wear, they should be replaced. There are several fundamentals necessary in properly relining brake shoes.

Snug fit between liners and shoes. Selection of proper rivets. Removal of high spots on lining.

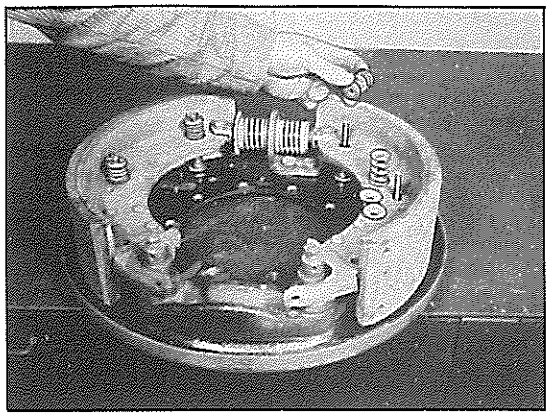
Snug fit is absolutely necessary between liners and shoes if maximum efficiency is expected. Loosely applied liners contact only a small part of their area due to the humps between rivets.



ILLUST. 6



ILLUST. 7



ILLUST. 8

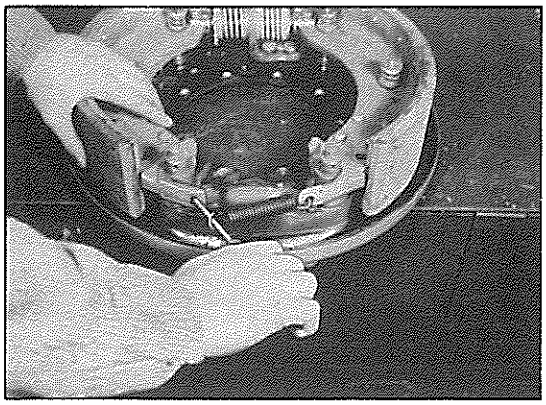
There are several lining stretchers on the market that pull the liners tightly to the shoe before riveting. Stretchers are not necessary if care is used and the center rivets are set first. The operator then works toward both ends of the lining.

Proper selection of rivets is necessary to insure a close fit between rivet shank and drilled hole in liner and shoe. Rivets with small shank permit the liner to shift on shoe under pressure. This shifting gradually loosens liners and sometimes shears all rivets. The rivet should be long enough to properly upset the end, securely binding the lining. Should the rivet shank be too long, the upset end will split, materially weakening the job. Aluminum rivets should not be used.

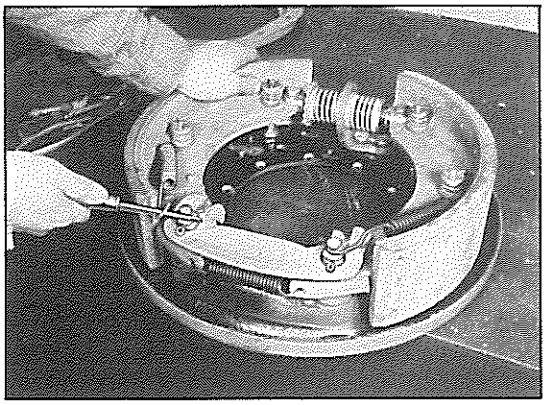
If the brake drum is scored or out of round it should be turned on a lathe. Do not remove any more metal from the drum than necessary to "true" it.

When installing the brake shoe assemblies on the backing plate be sure to mount each shoe with the projecting fingers (see arrows Illust. 6) turned toward the backing plate. This is extremely important as the brake shoes will not operate satisfactorily if it is mounted in a reverse manner.

Install the brake shoes with the primary shoe on the side of the backing plate which will be toward the front of the machine, and the secondary shoe on the rear side of the plate. The shoe assemblies shown being installed in Illust. 7, are for the right hand side and, therefore, the primary shoe is mounted to the left in the illustration, and the secondary shoe is mounted to the right. Be sure that all shoe hold down pins enter the brake shoes properly and install the brake shoe pivot pin from the inside out as shown in illustration. Install



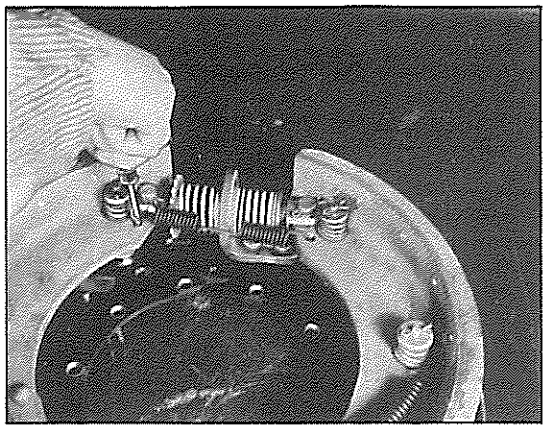
ILLUST. 9



ILLUST. 10

and spread a 5/32" x 1-1/8" cotter pin through the end of the pivot pin. Note: The only obvious difference will be the shape of the shoes and the location of the projecting finger shown in Illust. 6.

Install the four shoe hold down spring cups, four shoe hold down springs and four shoe hold down spring cups, compress the springs sufficiently to install a 5/32" x 5/8" x 5/8" cotter key through the end of the shoe hold down pins as shown in Illust. 8. Spread the cotter keys sufficiently to prevent their falling out during operation.



ILLUST. 11

Install the primary to secondary shoe spring as shown in Illust. 9. Be sure that the ends of the spring are hooked securely in the holes in the ends of the primary and secondary shoes. Install the anchor pin reinforcement plate and install and spread a 3/16" x 1-1/8" cotter pin in each anchor pin.

Install the primary and secondary anchor to shoe springs as shown in Illust. 10. The front or primary shoe spring is lighter than the rear or secondary shoe spring. Be sure they are installed with the light spring on the front shoe.

Install the adjusting screw spring as shown in Illust. 11. This spring is made with two coils and a straight section which is in the middle. Make sure that the spring is installed with the straight center section clearing the centralizer bracket. If this spring is installed backward it will rub on the centralizer bracket thus causing the spring to bind and, therefore, work improperly. The coils of the spring act as an adjustment lock by riding down against the adjusting nut wheel.

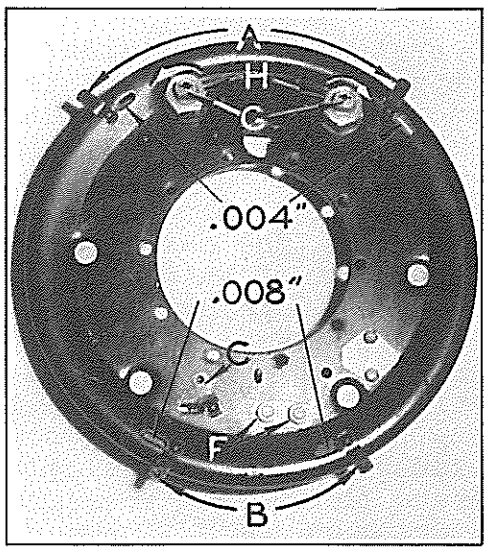
The brake shoe assembly is now ready for installation on the tandem housing.

Install the assembly so that it is at a slight angle toward the front from vertical, the exact position can be determined by locating the brake cylinder in relation to the end of the hydraulic brake tubing on top of the tandem housing. The four top cap screws which hold the brake shoe backing plate to the eccentric housing are of the type which have a very thin head while the remainder are of the standard type. The reason for the thin heads is to provide clearance.

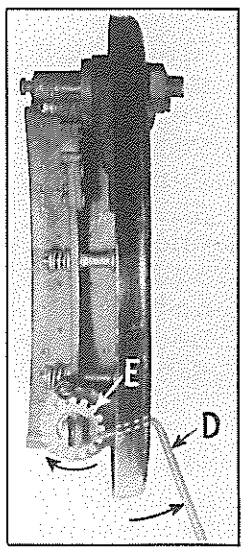
Adjustment

Never attempt to adjust the brake shoes with the wheel raised clear of the ground. The full weight of the machine should be supported on the wheels in order to assure proper centering of the brake drum around the brake shoe assemblies. Be sure that all adjustments, locks, and nuts, are loose. Brakes and brake drums should be approximately room temperature when making adjustments. If brakes are adjusted when drums are hot and expanded, the shoes may drag when the drums cool and contract. Turn the spring clips (A), (B) and (C), Illust. 12 off from the holes in the backing plate. Insert the adjusting tool (D), Illust. 13 and turn the adjusting wheel (E) in the direction shown by arrow until the lower end of both brake shoes are expanded tightly against the drum. Tap the backing plate near the centralizer with a light hammer to insure centralizer taking correct position between shoe ends. Tighten the two nuts (F) securely. The centralizer assembly is now properly located in the slotted holes in the backing plate which was shown in Illust. 3. Loosen the wheel centralizer adjustment by turning the wheel (E) Illust. 13 in the opposite direction. Insert a .008" feeler gauge through each of the slots in the backing plate at (B) Illust. 12. Insert a .004" feeler gauge through each one of the slots (A). Be sure that the feeler gauges have entered between the brake lining and the drum at all four points. Turn the anchor pins (G) in the direction of the arrows until a barely perceptible drag is felt on each of the feeler gauges inserted through the slots (A).

Turn the adjusting wheel (E) with the adjusting tool (D)



ILLUST. 12



ILLUST. 13

Illust. 13, in the direction of the arrow until a barely perceptible drag is felt on the feeler gauges inserted through the slots (B) Illust. 12. Check all four feeler gauges at (A) and (B) to be sure that none are too tight. Hold the anchor pins (G) in their positions and tighten the lock nuts (H) securely. Check the feeler gauges again to see if the adjustments have changed. Due to the possibility of having drum distorted slightly or off center, it is best to revolve the wheel 180°and check all clearances again. This is especially true if drums have not been trued on a lathe. If any clearances have changed, adjust the shoes to a minimum of .004" and .008" as described above. Remove all four feeler gauges and turn all spring covers over the slots (A), (B) and (C).

Road test the grader. The brakes either may or may not be "run-in" depending on the desired results. If it is necessary to meet certain braking requirements which necessitate a 100% brake lining contact with the drum, then it will be necessary to "run-in" the brakes. However, if this is not necessary, it is better to allow the brakes to wear in normally and readjust them after they have become seated to the drums.

If it is decided to run in the brakes, run them in as follows: With the grader operating at half throttle in low gear apply the brakes firmly for 10-second intervals releasing them completely for 15 seconds between each application. Apply the brakes 25 or 30 times. If the brakes tend to overheat; increase the time between applications to 20 or 30 seconds. Readjust the brakes after running them in and allowing them to cool.

HYDRAULIC BRAKE SYSTEM

The hydraulic system used to actuate the brake mechanism consits of a compensating type master cylinder in which the hydraulic pressure is originated; individual wheel cylinders in which the hydraulic pressure is applied, which serve to actuate the brake shoes against the brake drum of each wheel; and the "line" consisting of steel tubing, flexible hose, brackets and unions, interconnecting the master cylinder and wheel cylinders. The master cylinder and wheel cylinders are fitted with pkstons, all of which are provided with cup packing which act as a seal to maintain pressure and prevent loss of brake fluids. Depressing the brake pedal moves the piston within the master cylinder, thus displacing the brake fluid from the master cylinder through its outlet orifices, tubing and flexible hose connections into wheel cylinders. The brake fluid being non-compressible, enters each of the wheel cylinders, causing the cylinder pistons to move outward and actuate the brake shoes. As pressure on the pedal is increased, greater hydraulic pressure is built up within the wheel cylinders, and consequently greater force is exerted against the shoes.

When the pressure on the pedal is released, the brake shoe retracting springs return the brake shoes to their normal or released position. The return movement of the brake shoes, in turn, causes movement of the wheel cylinder pistons toward their released position, thus forcing the fluid back through the tubing into the master cylinder.

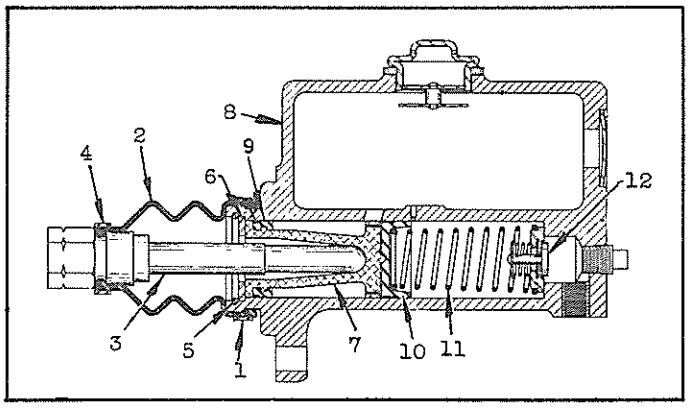
Always use hydraulic brake fluid in the hydraulic brake system. The introduction of mineral based oil into the system will cause rubber parts to swell and become inoperative.

Master Cylinder

The combination type master cylinder shown in Illust. 14, consists of a barrel and tank casting (8), double check valve (12), piston cup return spring (11), primary piston cup (10), secondary piston cup (9), piston (7), piston stop (6), piston stop wire (5), boot (2) and connecting link (3). The boot straps (1) and (4) hold the boot in place on the barrel and tank casting (8) and the connecting link (3). The fluid reservoir or supply tank is cast integral over the master cylinder barrel. A combination filler and breather plug permits atmospheric pressure on the reserve fluid at all times.

Depression of the pedal causes piston (7) and cups (9) and (10) to move forward in the cylinder barrel. A very small forward movement of the cup (10) closes the by-pass port above the cup and pressure stroke commences. Actual pressure is not built up until the fluid displaced has caused all shoes to go into contact with their drums. Additional pressure on the pedal produces hydraulic pressure within the brake system.

Removal of the operator's foot from the brake pedal after each brake application permits the brake pedal and push rod (3) to return independently to their off position.



ILLUST. 14

The return of piston (7) and cups (9 and 10) is accomplished by the piston return spring (11). The piston for this type of unit is designed to carry a primary cup (10) and a secondary cup (9). The construction of the piston is such that reserve fluid from the tank passes through the vent between cups (9 and 10) into the recessed area in the piston (8). Thus, we have fluid on both sides of the primary cup. The secondary cup (9) is merely a

seal to prevent loss of reserve fluid into the boot (2).

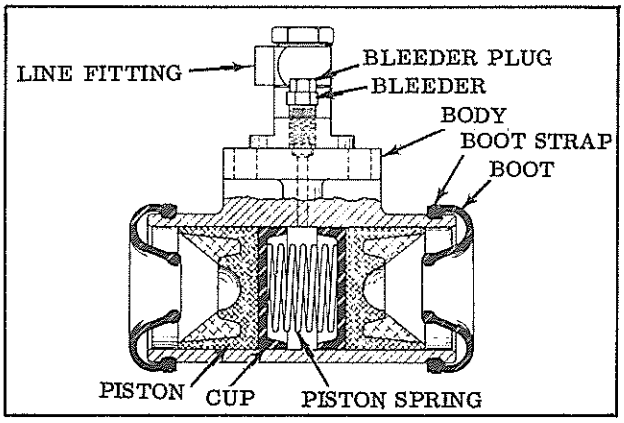
The combination type master cylinder is also known as a compensating type. Its primary compensating function is to maintain a constant volume of fluid in the system at all times, regardless of expansion (heat) or contraction (cold). The secondary compensating function is the replacement of additional fluid into the system to counter-balance any loss due to gravity.

The return to off position of piston (7) and cup (10) is much faster in displacing volume than the return of the fluid through the "line" into the master cylinder. A momentary vacuum is created in the cylinder barrel and additional fluid is drawn into the system through the drilled holes in piston (7) and past the lip of cup (10). The operating fluid returns more slowly from the wheel cylinders and lines back into the master cylinder barrel. Any excess is by-passed by the port ahead of the primary cup into the reservoir. Thus, we have a cylinder full of fluid for the next brake application.

Wheel Cylinders

Shown in Illust. 15, is the assembly of the wheel cylinder which is the unit that changes the applied hydraulic pressure into mechanical force to actuate the brake shoes.

It is possible to rehone the majority of wheel cylinders when they become worn and place them in good working condition; however, this requires the use of up-to-date honing equipment and plug gauges. If this equipment is not available the cylinders may be taken to the nearest Wagner service branch or authorized service station for repairing. Cylinders and the parts must not be washed in gasoline, kerosene or oil. Use high grade denatured alcohol for all cleaning.



ILLUST. 15

Keep all lubricant and brake fluid away from the brake linings. Do not allow any mineral based oil to come in contact with any of the hydraulic brake parts.

Adjustments

When the brake control system is in release position, the push rod (3) Illust. 14, should travel approximately 1/32" before moving the piston (7). This free travel is required to prevent blocking of the by-pass port in the master cylinder. The brakes will drag if the by-pass port becomes blocked due to pressure building up in the system. Should all brakes drag, pressure may be relieved by screwing the push rod (3) back onto the yoke on the brake pedal linkage.

Bleeding

Any air inside the hydraulic system must be removed. Whenever a line has been disconnected at master cylinder, the entire system must be bled at both wheels until all air is completely expelled. When a line has been disconnected at any wheel or if the hose leading to the tandem assembly has been disconnected the cylinder on that side must be bled. Air in the system will cause a springy, rubbery action of the brake pedal. Should a sufficient quantity be introduced into the system, the brake pedal will go to the floor board under normal pressure.

Fill the master cylinder supply reservoir with brake fluid and see that it is kept at least half full during entire bleeding operation.

Remove the bleeder plug from the end of the bleeder (See Illust. 15), and attach the bleeder tube. Allow the tube to hang into a clean container, such as a glass jar. Unscrew the bleeder connection 3/4 of a turn and depress the brake pedal, using half strokes, close bleeder connection on return stroke. Pumping brake pedal forces fluid out into the glass jar, and carries with it any air which might be present in the system. Watch flow of fluid from tube, the end of which should be kept below surface of fluid in glass jar, and when all air bubbles cease to appear or when stream is a solid fluid mass, close bleeder connection. Remove bleeder tube and install bleeder plug.

Fluid withdrawn in bleeding operation should not be used again, unless absolutely certain that it does not contain impurities. Fluid of which cleanliness is questionable should never be used. Fluid should be replenished in supply reservoir after each cylinder is bled. Should supply reservoir be drained during bleeding operation, air will enter the system and rebleeding will then be necessary.

Trouble Shooting

Pedal Goes to Floor Board

Normal wear of lining
Leak in system
Air in system
Pedal improperly set
Insufficient fluid in supply tank

All Brakes Drag

Mineral oil in system
Pedal improperly set

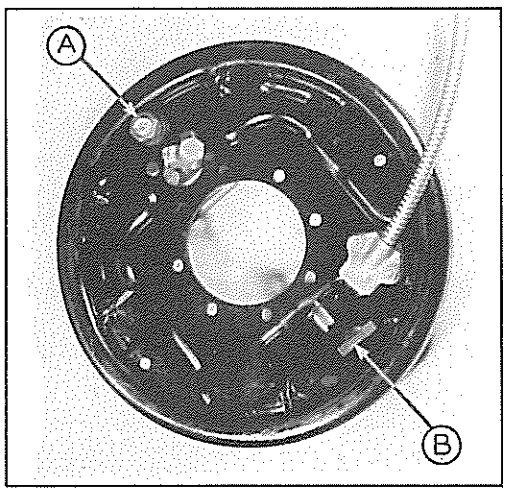
One Wheel Drags

Weak brake shoe return spring
Brake shoe set too close to drum
Cups distorted

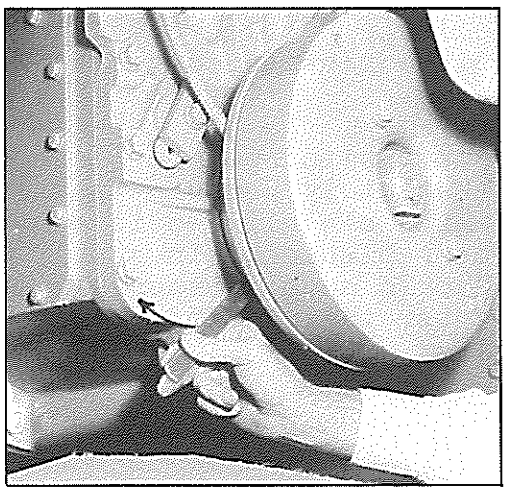
Parking Brake

The parking brake is operated by a hand lever at the operator's right. It is an internal band expanding type brake. It operates in a drum mounted on the lower shaft of the transmission.

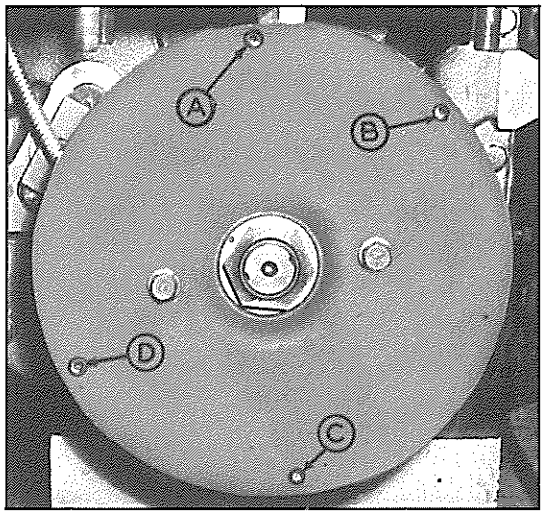
The brake has both mechanical and hydraulic action. It is activated mechanically by use of the hand brake lever. It is hydraulically activated by use of the foot brake. This helps slow down the machine by braking the transmission simultaneously with the wheels when the foot brake is depressed.



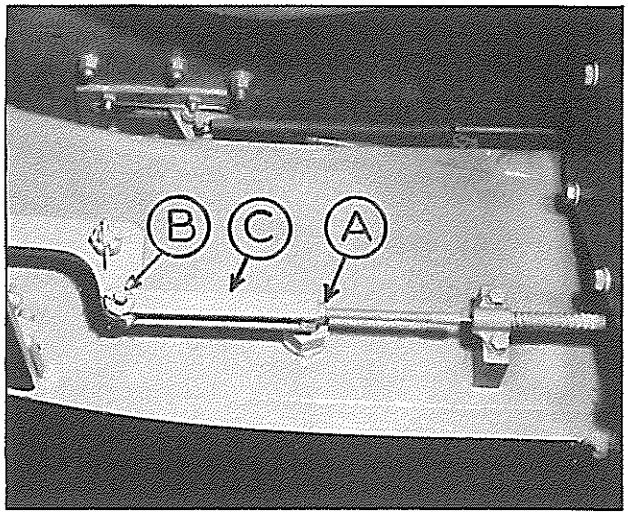
ILLUST. 1



ILLUST. 2



ILLUST. 3



ILLUST. 4

Adjustment:

When brake adjustment becomes necessary always adjust shoe contact to drum first before attemtping to adjust cable length.

To adjust shoe contact, loosen lock nut on anchor pin (A) Illustration 1. Remove clip (B) and insert brake adjusting tool in slot, until it makes contact with the adjusting wheel.

Move tool in direction of arrow, Illustration 2, to move brake shoes toward the drum. Move the shoes out as far as possible. With a hammer, tap around the outer edge of the brake drum to centralize the brake shoes.

Tighten lock nut on anchor pin (A) Illustration 1. Rotate adjusting wheel in the opposite direction approximately eight (8) notches.

Remove the socket head plug from the brake drum. Rotate brake drum until the hole is in position (A) Illustration 3. The clearance at this point and point (B) should be .004". If this clearance is less than .004", loosen anchor pin lock nut, with a hammer tap anchor pin down until a .004" clearance is obtained, at point (A) and (B). Tighten lock nut. Rotate brake drum around to point (C) Illust. 3.

Insert an .008" feeler gauge at this point. Adjust brake shoes until the .008" feeler gauge is a snug fit at point (C) and (D).

To adjust the parking brake cable, remove cotter key and pin, (B) Illust. 4. Loosen lock nut (A), turn yoke (C) clockwise to shorten. By exerting a normal pull, the brake shoes should make holding contact with the drum before the parking brake lever is half out of its holder.

POWER CONTROLS

Power Box Vertical Drive

It seldom is necessary to completely overhaul the power control box. Usually it is only necessary to repair an individual unit in the box. If a complete overhaul is to be attempted, the procedure outlined below should be followed. Due to the fact that during the reassembly operation all adjustments and settings must be established, a detailed discussion is given here only of the reassembly operation.

The following description and illustrations, are with complete power control box removed from the grader.

Reassembly

The first step in reassembly, after all parts are cleaned and ready for installation, is to install the leather grease seal in the top end of the power box drive housing, as shown in Illust. 1. Lip of seal toward top of housing. Drive the seal into the housing as far as it will go, using a soft hammer. Lubricate the leather in the seal with machine oil, before installing.

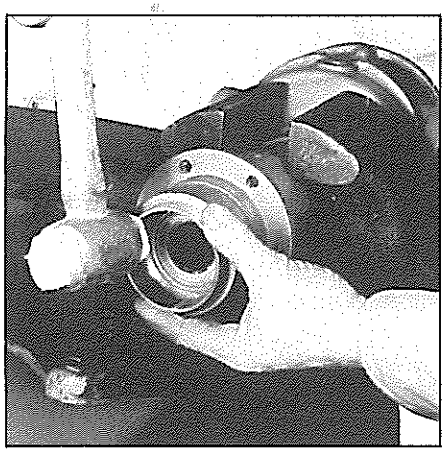
Install bearing cup into the top end of the power box drive housing, making sure that the small end of the taper goes to the inside. Use a soft hammer and drive the cup in as far as it will go, as shown in Illust. 2.

Install bearing cup into the bottom end of the power box drive housing, making sure that the small end of the taper goes to the inside. Use a soft hammer and drive cup in as far as it will go, as shown in Illust. 3.

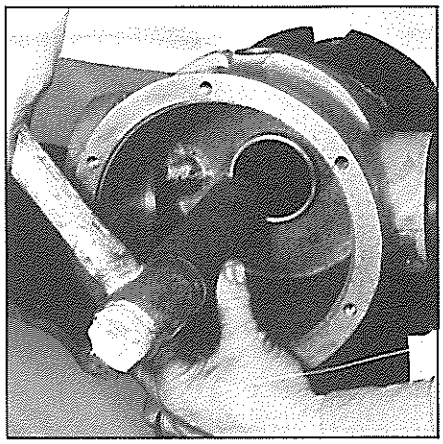
Install tapered roller bearing on vertical drive shaft, as shown in Illust. 4. Be sure that the large diameter of the bearing is driven up against the shoulder, behind the bevel drive gear. All bearings should be lubricated with machine oil before installing.



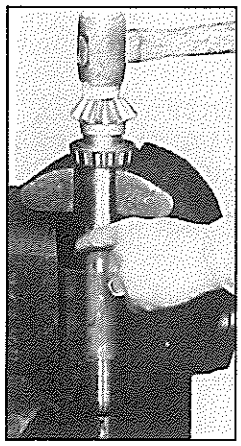
ILLUST. 1



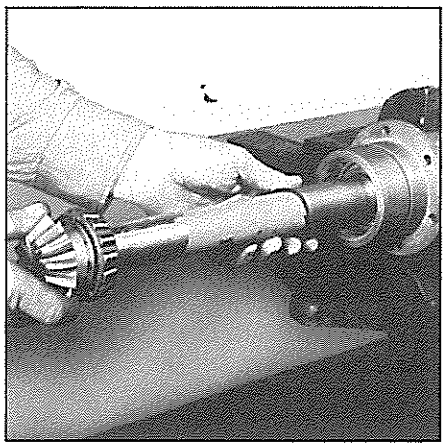
ILLUST. 2



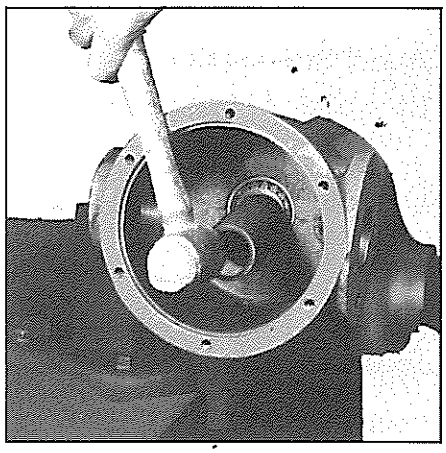
ILLUST. 3



ILLUST. 4



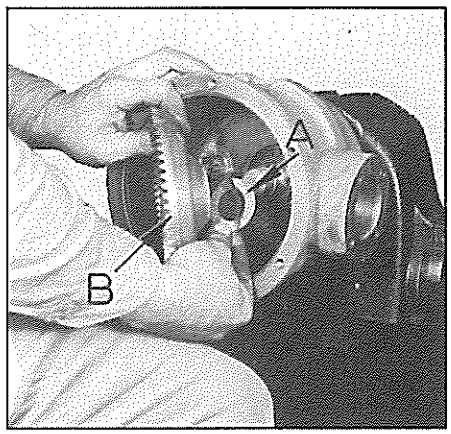
ILLUST. 5



ILLUST. 6

The vertical drive shaft with bearing may now be installed in the housing. When sliding the shaft through the leather seal in the top end of the housing, be sure not to damage the seal. One way of expanding the leather seal over the shoulder of the shaft, is by wrapping a strip of thin shim stock around the shaft in a funnel shape. Shown in Illust. 5 is the installation of the drive shaft through the seal with the use of shim stock.

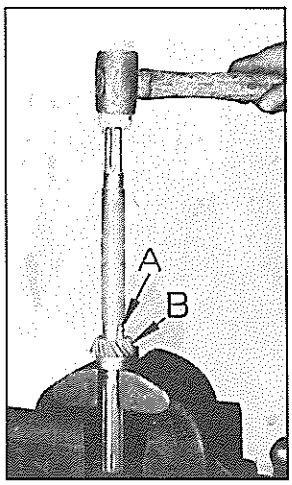
The lower bearing may now be installed on the shaft, as shown in Illust. 6. When driving the bearing into place, use a piece of pipe or similar driver which will fit against the inner race of the bearing.



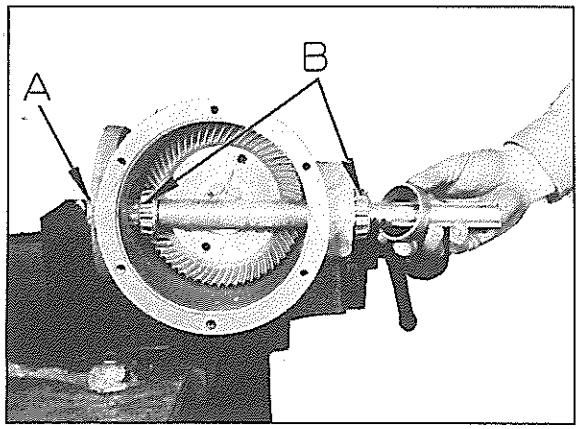
ILLUST. 7

Install the two (2) laminated spiral gear shims "A", Illust. 7. Install spiral bevel gear "B". Install hex slotted nut and tighten securely. Back hex slotted nut off one (1) slot. Install and spread cotter key. Using a block of wood or a soft drift, bump the shaft sharply. The bearings should now be pre-loaded. The specifications on the pre-load of these bearings is 4-8 inch pounds. If it should be necessary to remove the bevel gear for any reason, the reassembly would be the same as the above mentioned procedure.

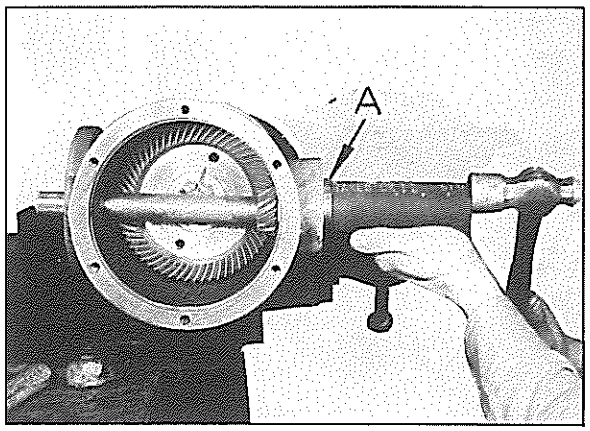
Install Woodruff key "A", Illust. 8, to the spiral pinion drive shaft. Install spiral pinion "B" to shaft, as shown in Illust. 8, with hub of gear toward the end of the shaft.



ILLUST. 8



ILLUST. 9



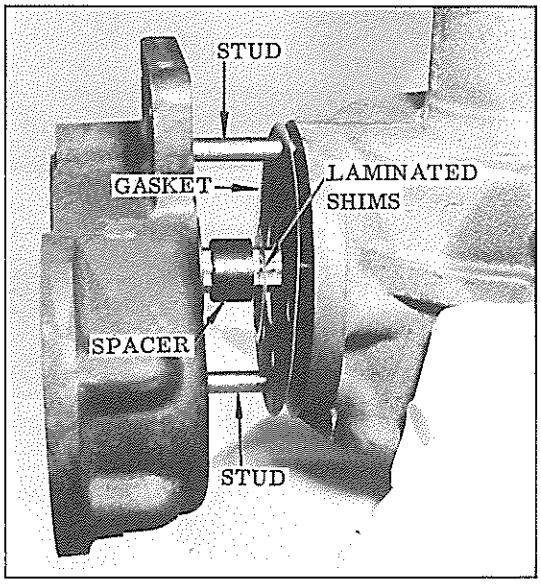
ILLUST. 10

Use a soft hammer or piece of pipe to drive gear to shoulder of shaft.

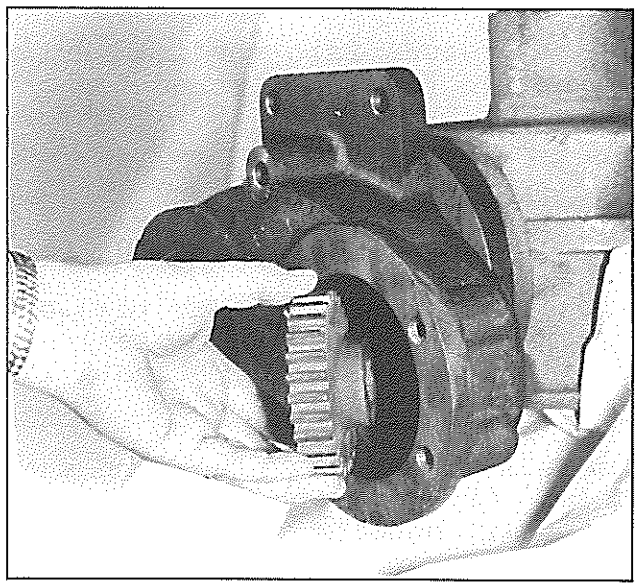
Install bearing cup into pump opening housing "A", Illust. 9, using a soft hammer or piece of pipe. Assemble bearing cones "B" on spiral pinion drive shaft, with the smaller tapered ends of cones facing ends of shaft. Insert spiral pinion drive shaft, with short splined end of shaft first, as shown in Illust. 9.

Install bearing cup "A", Illust. 10, using a soft hammer or piece of pipe.

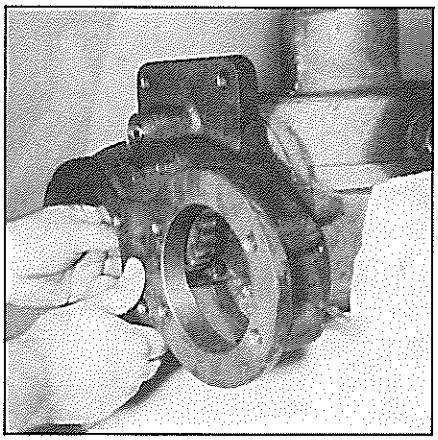
Spiral pinion gear and bevel pinion gear to run flush at toe end of gears.



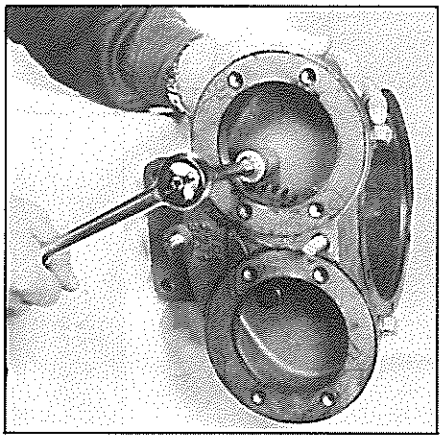
ILLUST. 11



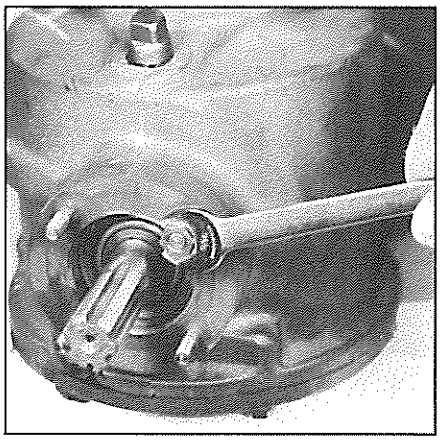
ILLUST. 12



ILLUST. 13



ILLUST. 14



ILLUST. 15

Install studs into vertical drive housing. Next, shellac gasket onto housing. Install laminated shims and spacer onto spiral shaft, as shown in Illust. 11.

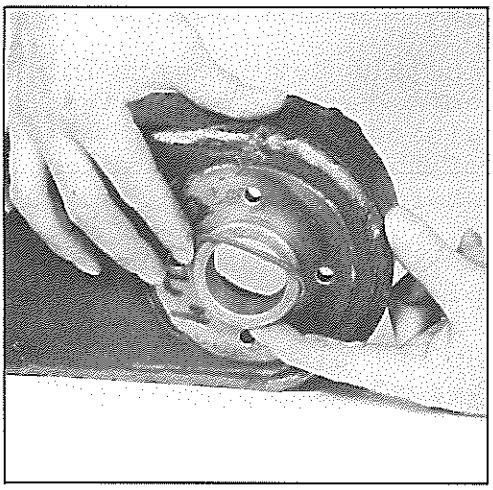
Install adapter housing onto studs, just far enough to hold housing in position while installing gear to splined shaft in housing, as shown in Illust. 12. After the gear is started on splined shaft, slid gear and adapter simultaneously, until the housing is against vertical drive housing, as shown in Illust. 13. Install cap screws with lock washers and tighten securely, as shown in Illust. 14.

Install studs into vertical drive housing, using two (2) nuts locked together on studs, as shown in Illust. 15. Tighten studs securely, then remove nuts.

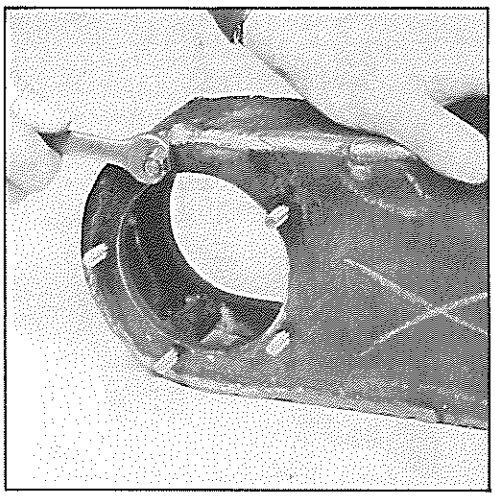
Install "O" ring into groove of power take off chain housing, as shown in Illust. 16.

Install studs into power take-off chain housing, using two (2) nuts locked togethe on studs, as shown in Illust. 17. Tighten securely.

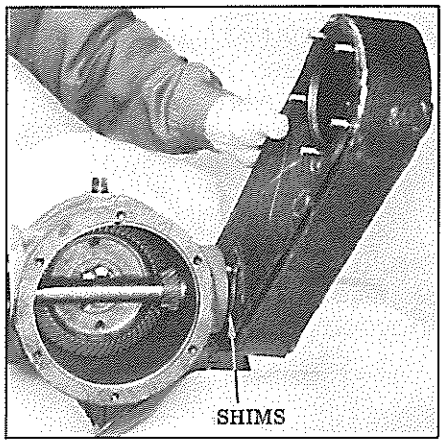
Install shims over studs and against vertical drive housing. Install power take-off chain housing over studs and against shims, as shown in Illust. 18. Install stud nuts with lock washers and tighten



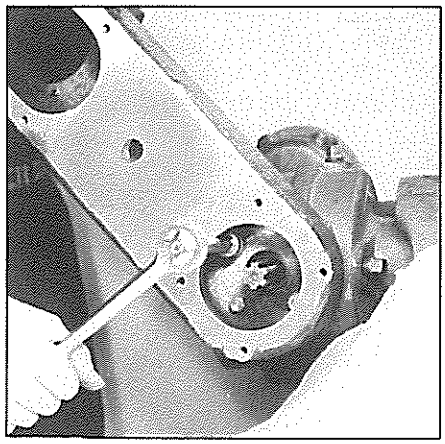
ILLUST. 16



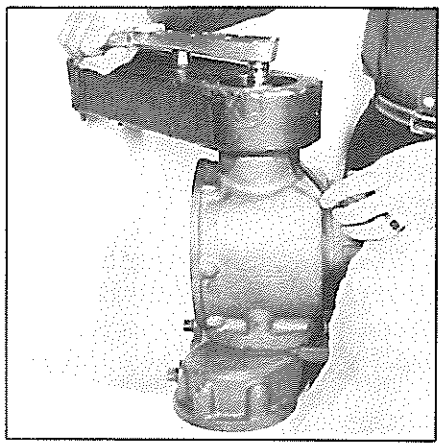
ILLUST. 17



ILLUST. 18



ILLUST. 19



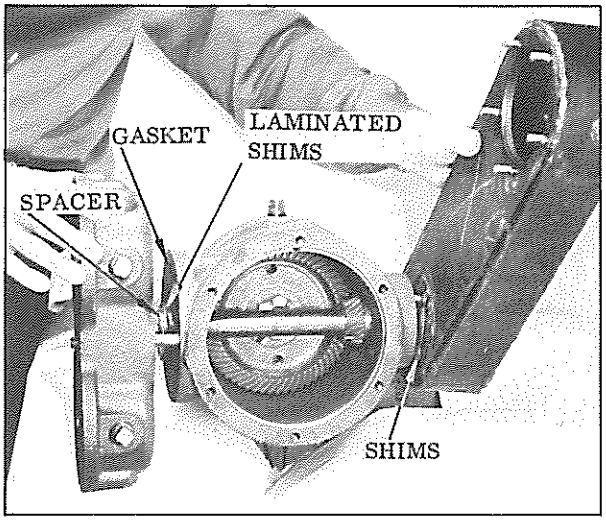
ILLUST. 20

securely, as shown in Illust. 19.

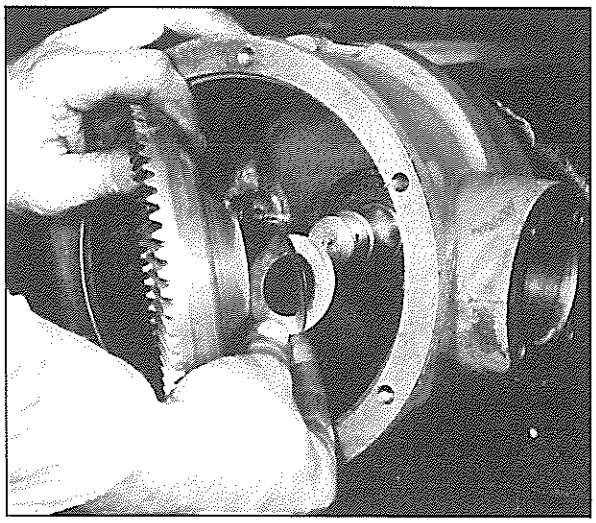
Pre-load bearings to a torque reading of 4-8 inch pounds. To obtain this reading, remove or add required amount of shims from power take-off chain housing side, as shown in Illust. 20. If reading still cannot be obtained, remove or add required amount of shims from adapter housing side.

Illust. 21. To obtain the pinion depth setting, set toe of spiral gear flush with toe of bevel gear, remove required amount of shims from one side and add the same amount of shims required to the opposite side.

To obtain the backlash between spiral pinion gear and bevel gear, use a dial indicator. Remove or add required amount of shims under bevel gear, as shown in Illusts. 21 and 22, until a reading of .004" to .012" is obtained. Backlash should be measured at the tightest point.



ILLUST. 21



ILLUST. 22

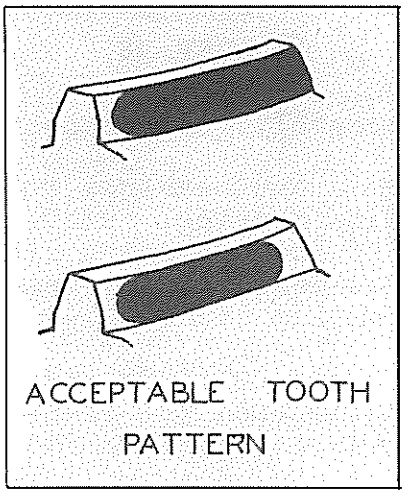
In order to be sure that the spiral pinion and spiral bevel gears are in proper mesh, it is necessary to make a surface pattern check. This may be done by mixing powdered red lead with any light machine oil and applying it to the working surfaces of the gear teeth with a brush, to obtain clearly the tooth contact. Prussian blue may also be used. The gears are to be cleaned and free from oil.

Revolve the gears several revolutions in the forward speed direction. Inspect the teeth of the gears for portions where the paint has been removed by the contact of the two (2) gears and compare the results with the surface patterns shown in Illust. 23.

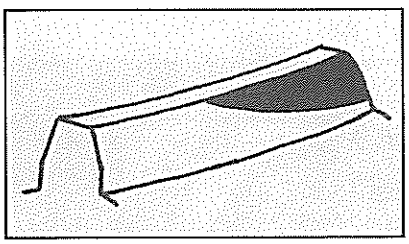
When the tooth pattern appears, as in Illust. 24, it is necessary to remove shims from the power take-off chain housing side and add the same amount of shims to the adapter side, until the proper tooth pattern is obtained.

When the tooth pattern appears, as in Illust. 25, it is necessary to remove shims from the adapter side and add the same amount of shims to the power take-off chain housing side, until the proper tooth pattern is obtained.

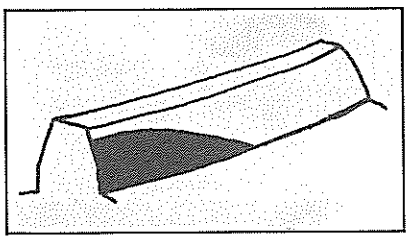
Install oil seal onto shaft, using a piece of shim stock around shaft to prevent damage to leather of seal, as shown in Illust. 26. Lip of seal toward bearing. Using a piece of pipe, drive seal into housing, as shown in Illust. 27.



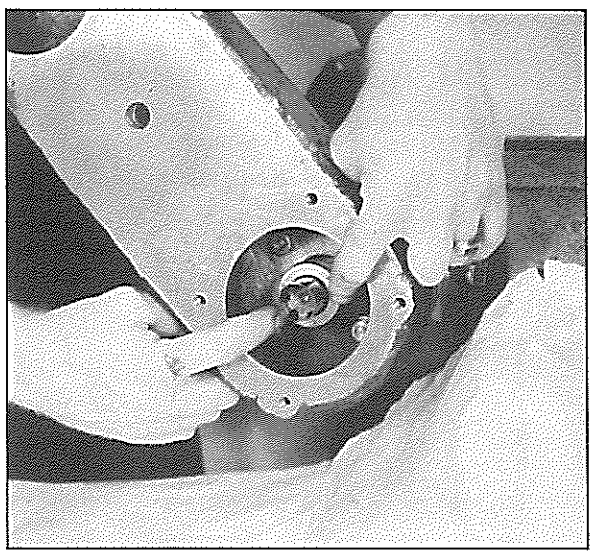
ILLUST. 23



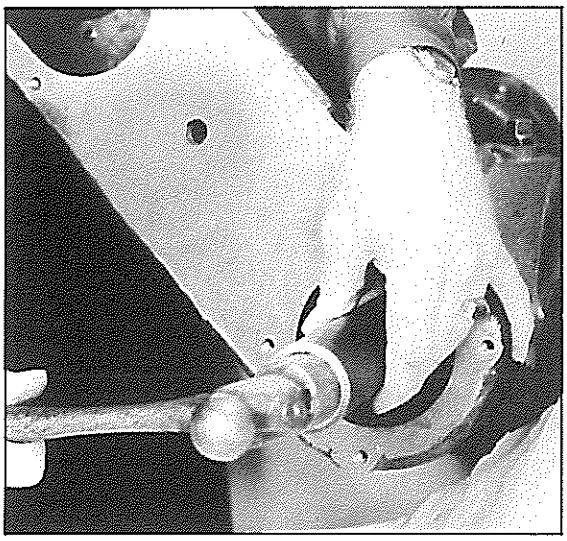
ILLUST. 24



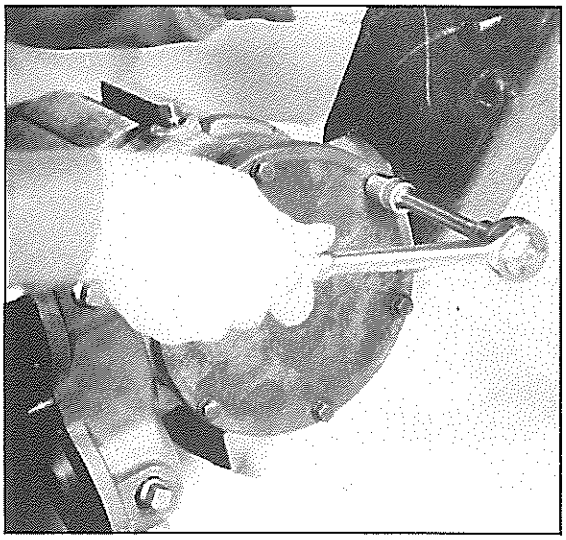
ILLUST. 25



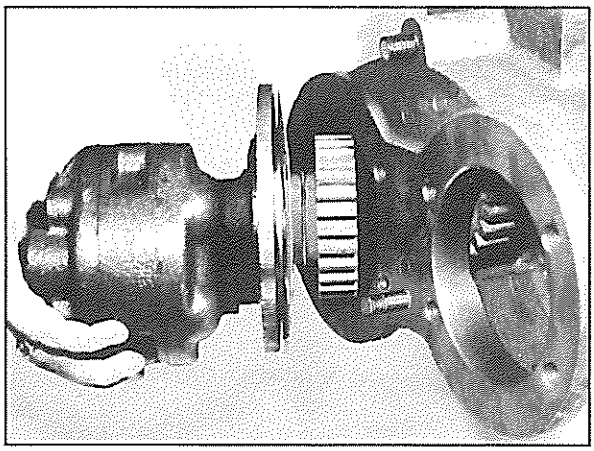
ILLUST. 26



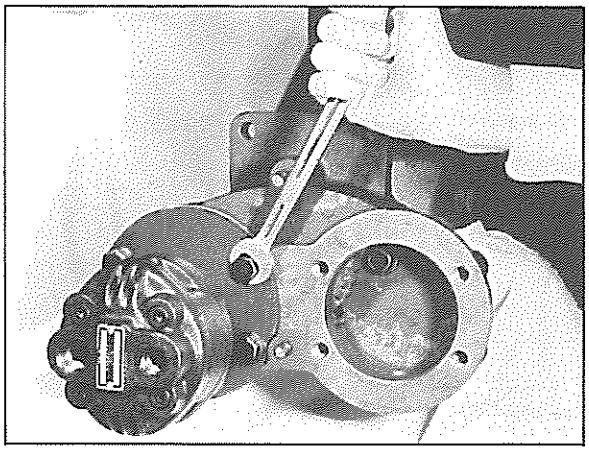
ILLUST. 27



ILLUST. 28



ILLUST. 29

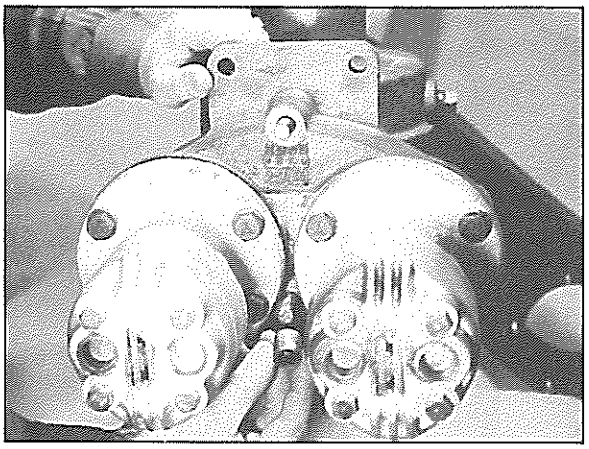


ILLUST. 30

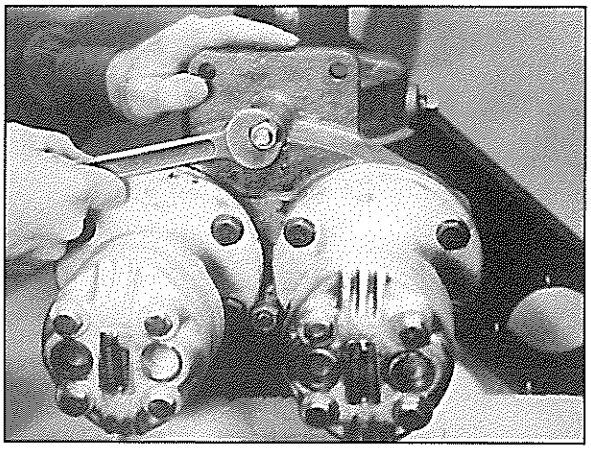
Remove shim stock.

Shellac cover gasket to vertical drive housing and install cover. Install cap screws with lock washers and tighten securely, as shown in Illust. 28. Next, install drain plugs into cover and adapter housing.

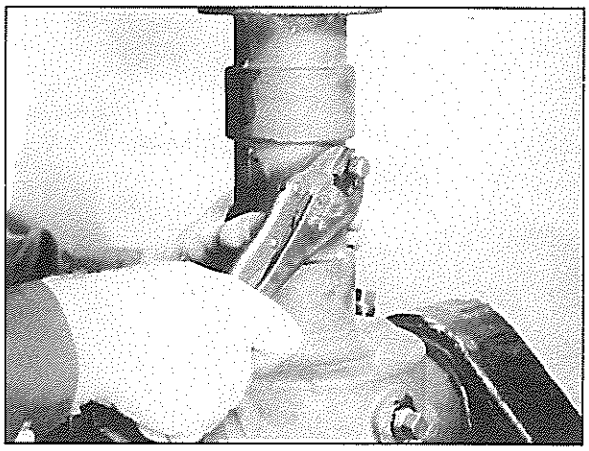
Install hydraulic pumps to adapter housing, as shown in Illust. 29. Next, install cap screws with lock washers and tighten securely, as shown in Illust. 30.



ILLUST. 31



ILLUST. 32



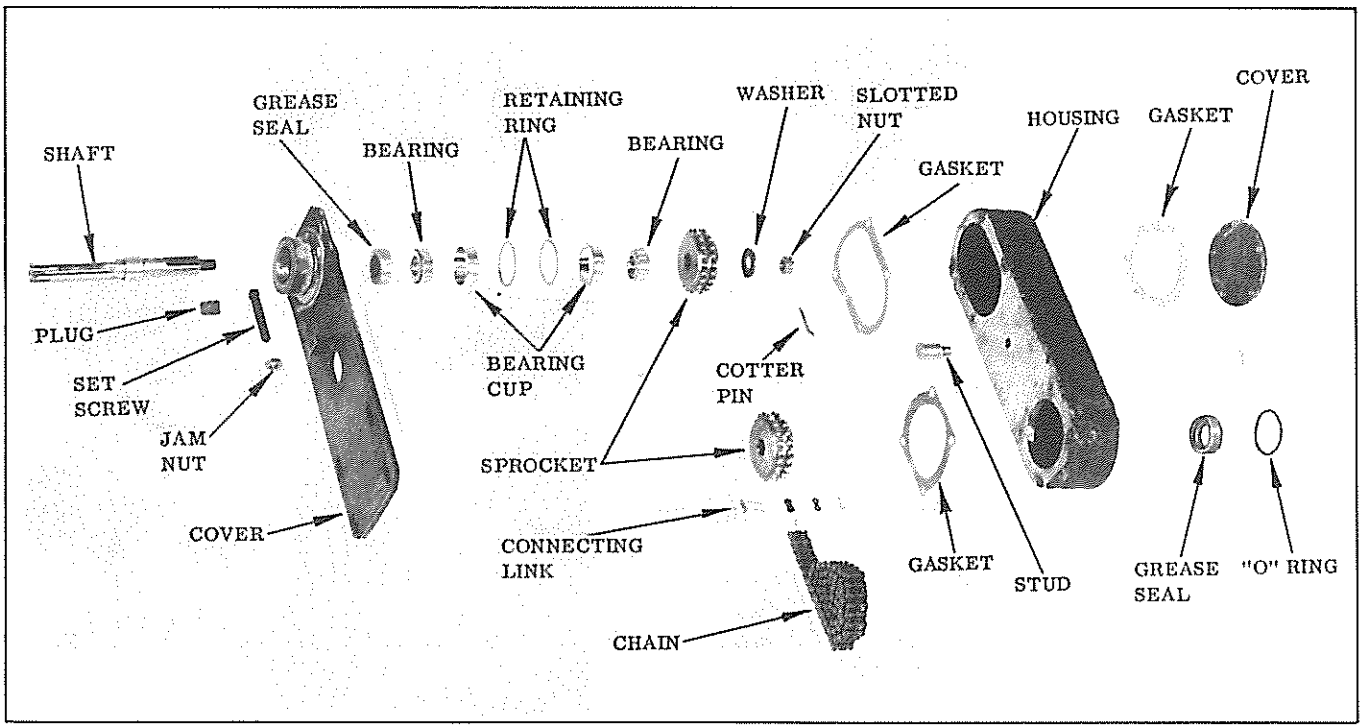
ILLUST. 33

Install spacer onto stud, as shown in Illust. 31. Next, install stud nuts with lock washers and tighten securely, as shown in Illust. 32.

Install breather into vertical drive housing, as shown in Illust. 33.

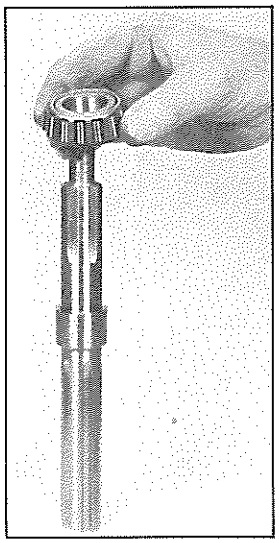
Power Take-Off Chain Housing

Illust. 1 is an exploded view of power take-off chain housing.

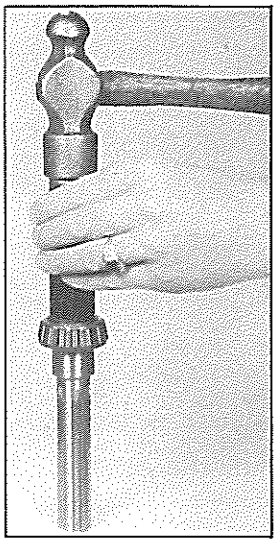


ILLUST. 1

Install bearing onto shaft, as shown in Illust. 2. Using a piece of pipe, drive bearing to shoulder of shaft, as shown in Illust. 3.



ILLUST. 2



ILLUST. 3

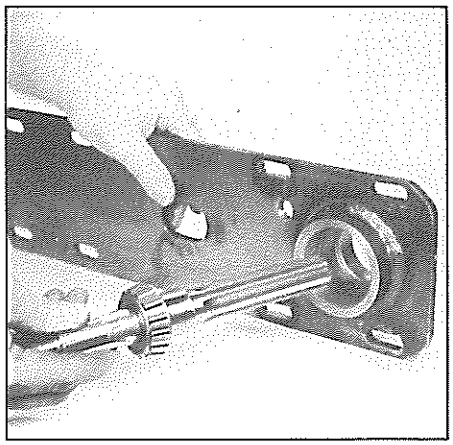
Insert shaft with bearing through cover, as shown in Illust. 4.

Insert bearing race into cover, as shown in Illust. 5. Using a piece of pipe, as shown in Illust. 6, drive bearing into cover and over bearing. Bearing to be under flush with second snap ring groove in bore.

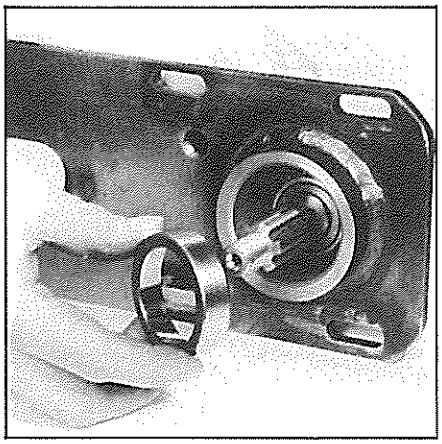
Install snap ring in groove of cover, as shown in Illust. 7.

Install second snap ring in groove of cover, as shown in Illust. 8.

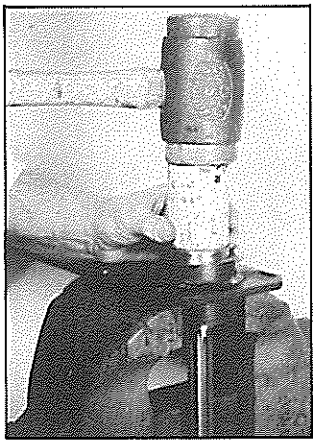
Install second bearing race into cover, as shown in Illust. 9. Using a piece of pipe, drive race into cover to snap ring, as shown in Illust. 10.



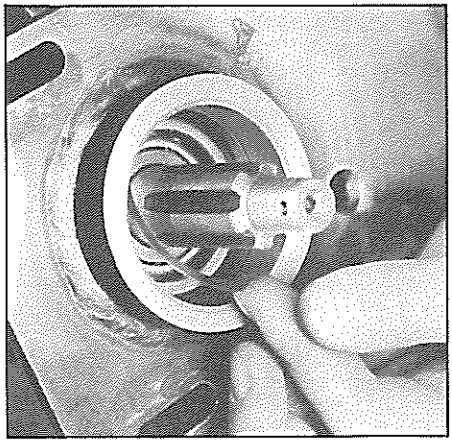
ILLUST. 4



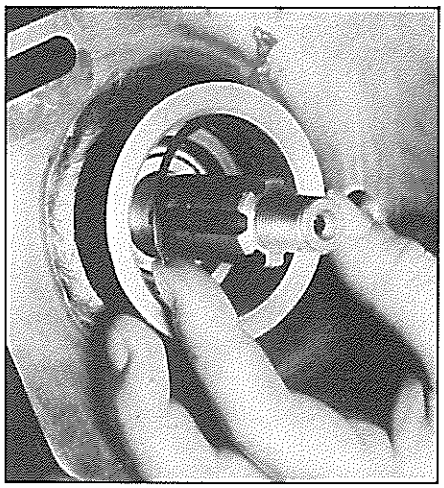
ILLUST. 5



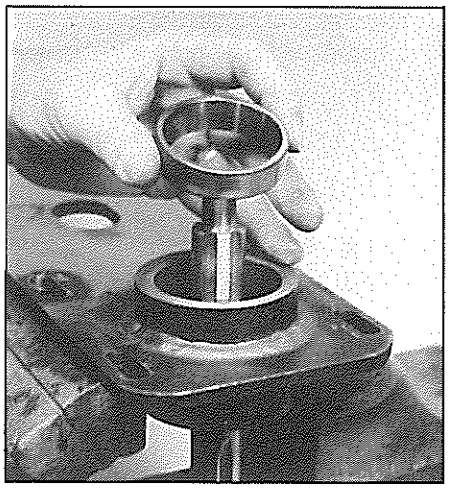
ILLUST. 6



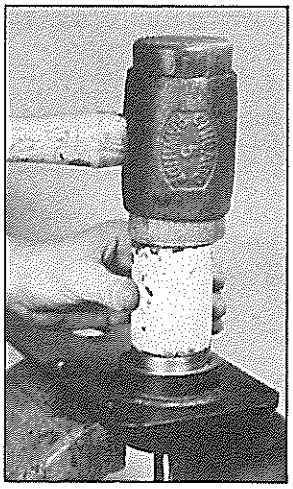
ILLUST. 7



ILLUST. 8



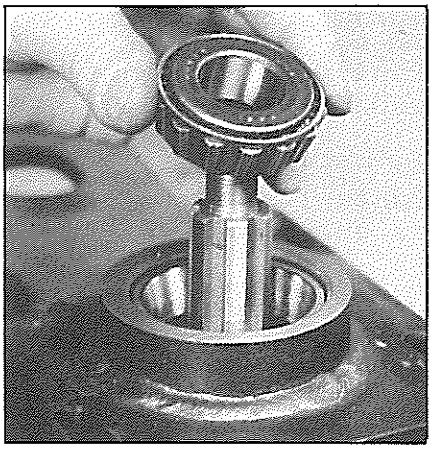
ILLUST. 9



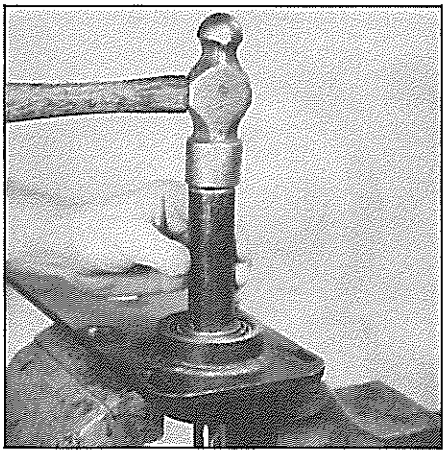
ILLUST. 10

Install second bearing onto shaft, as shown in Illust. 11. Using a piece of pipe, drive bearing into race, as shown in Illust. 12.

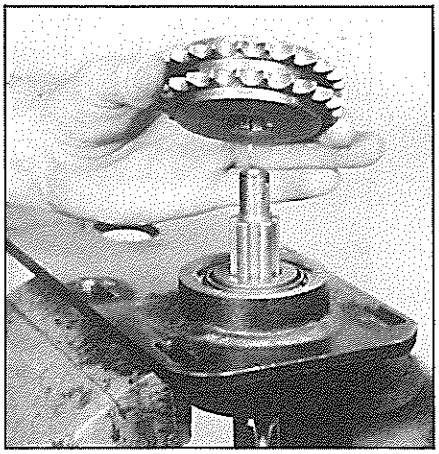
Install sprocket onto splines of shaft, as shown in Illust. 13. Install washer and slotted nut to shaft. Pre-load the bearings by tightening slotted nut, as shown in Illust. 14 and at the same time, rotate shaft until bearings are tight. Use a mallet and bump both ends of shaft to seat bearing races against snap rings. Loosen or tighten slotted nut until a slight drag is felt. Install cotter pin and spread, as shown in Illust. 15.



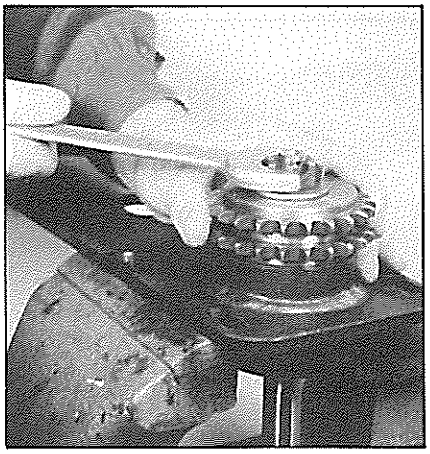
ILLUST. 11



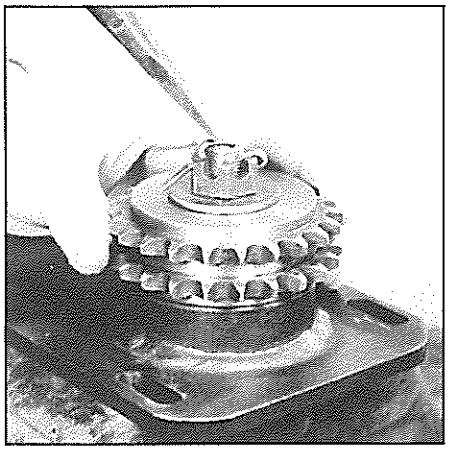
ILLUST. 12



ILLUST. 13



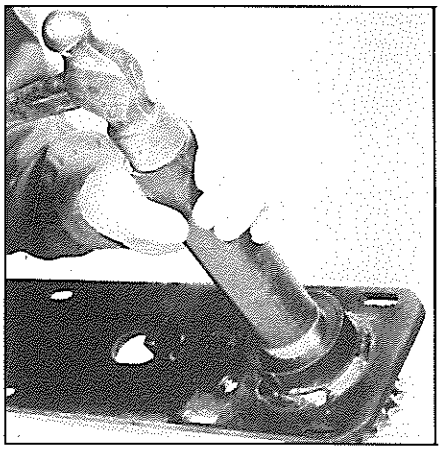
ILLUST. 14



ILLUST. 15



ILLUST. 16



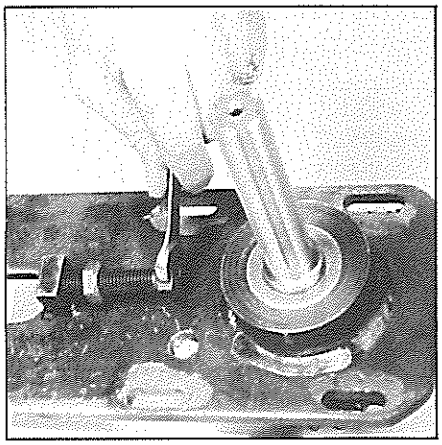
ILLUST. 17

Insert a piece of shim stock into oil seal to protect leather in seal from damage. Install oil seal over shaft and into bore of cover, as shown in Illust. 16. Lip of seal towards inside of bore. Using a piece of pipe, drive seal into bore, as shown in Illust. 17. When seal is seated, remove shim stock.

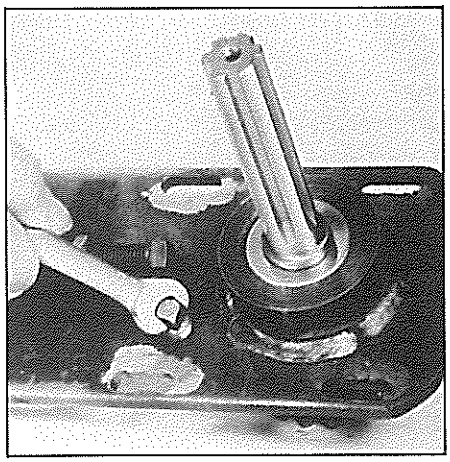
Install set screw and jam nut to cover, as shown in Illust. 18. Next, install drain plug to cover, as shown in Illust. 19.

Install and tighten stud into power take-off chain housing, as shown in Illust. 20.

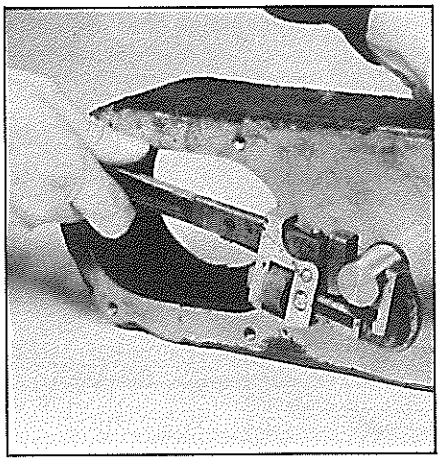
Install sprocket into power take-off chain housing and onto spiral pinion shaft, as shown in Illust. 21.



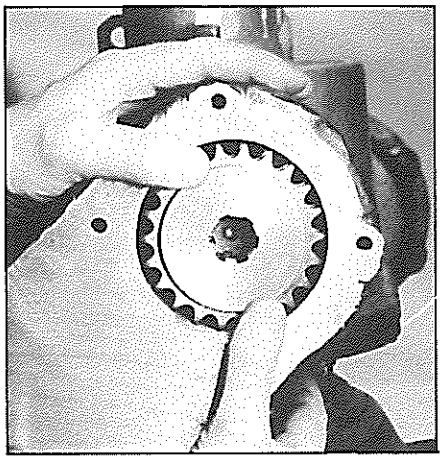
ILLUST. 18



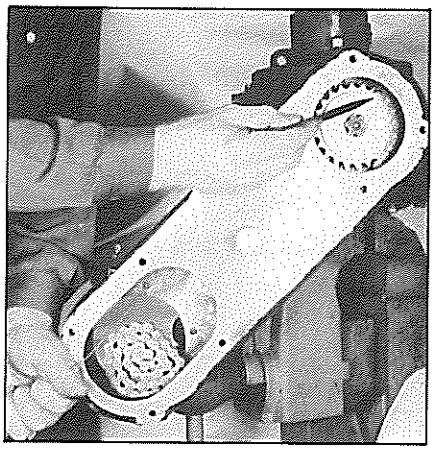
ILLUST. 19



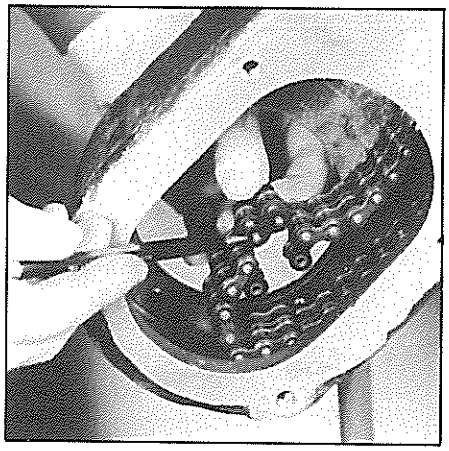
ILLUST. 20



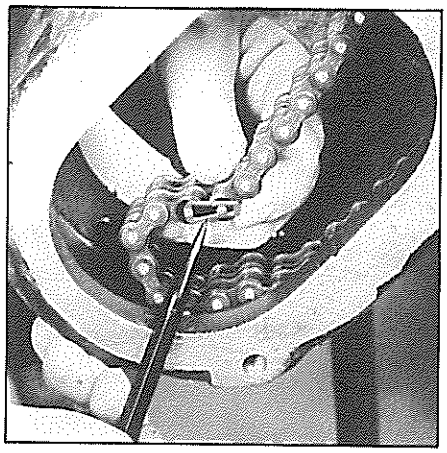
ILLUST. 21



ILLUST. 22



ILLUST. 23



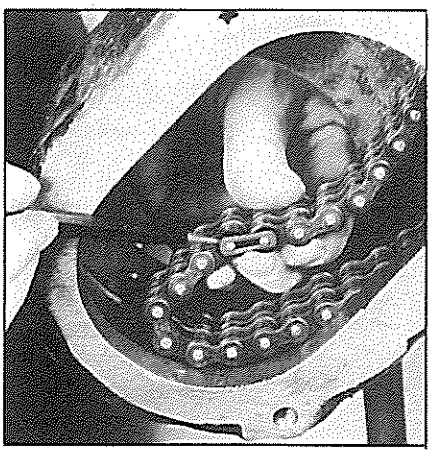
ILLUST. 24

Roll chain, as shown in Illust. 22 and insert into chain housing. Using a piece of wire, hook one (1) end of wire into link of chain, as illustrated by the pencil. Roll the other end of wire over sprocket. Now, by pulling on wire the chain will roll over the teeth of the sprocket.

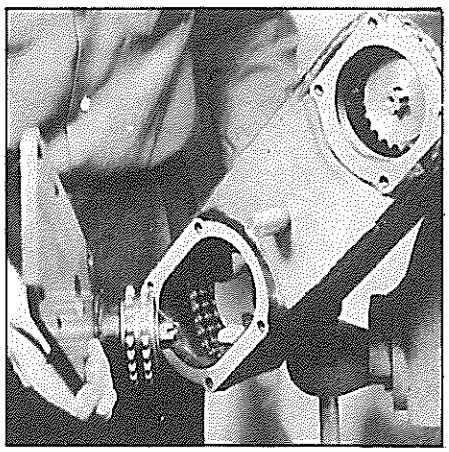
Insert patent link through first end section of chain. Next, insert patent link through center section and second end section, as shown in Illust. 23.

Install lock into grooves of patent link, as shown in Illust. 24 and lock, as shown in Illust. 25.

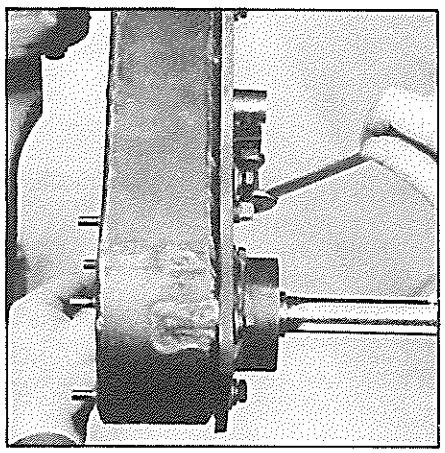
Shellac the two (2) gaskets and install onto chain housing. To install cover assembly, as shown in Illust. 26, spread chain with one hand and at the same time insert teeth of sprocket into links of chain. Hold cover at a slight angle until teeth insert into links. Install cap screws with cut and lock washers. Do not tighten cap screws.



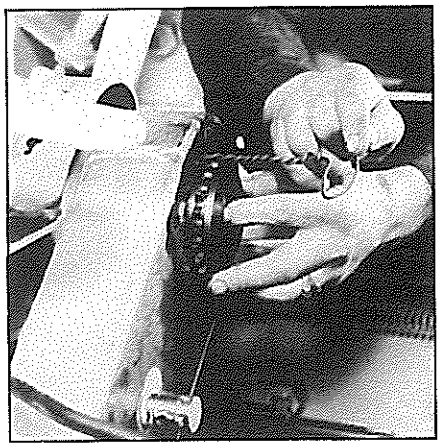
ILLUST. 25



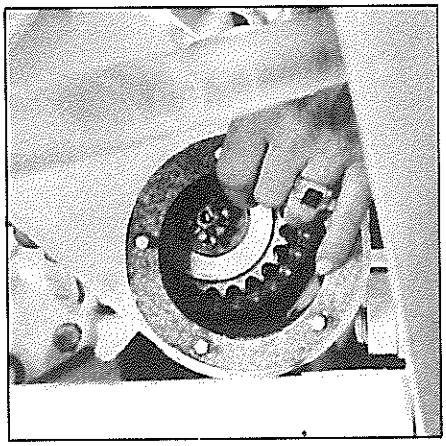
ILLUST. 26



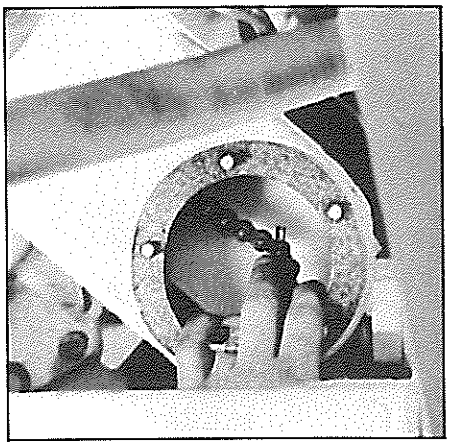
ILLUST. 27



ILLUST. 9



ILLUST. 10



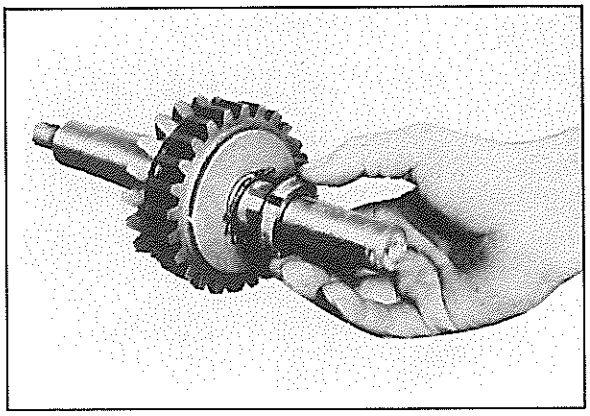
ILLUST. 11

To reassemble the chain over the upper sprocket, roll chain as illustrated in Illust. 10 and insert into power take-off housing. Use a piece of cord or small gauged wire. Hook one end of cord or wire into chain link. Bring the other end of cord or wire over upper sprocket and down through bottom opening in housing. By pulling on cord or wire, chain will roll over sprocket.

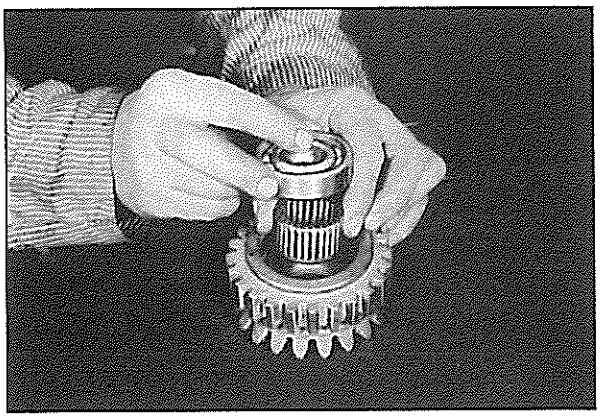
Install patent link, as shown in Illust. 11, through chain links and lock.

POWER BOX

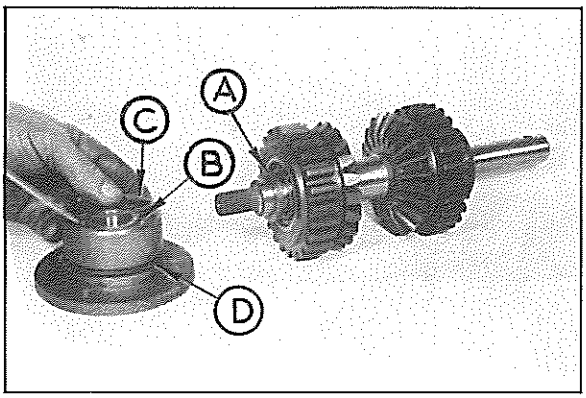
Install the Woodruff key in the center shaft and install the front bevel gear by supporting the gear in a press and pressing on the shaft. Install the lock washer, being sure that the inside lip of the lock washer enters the keyway in the shaft. Install lock nut, as shown in Illust. 1, and tighten securely. Bend ears into slots of lock nut.



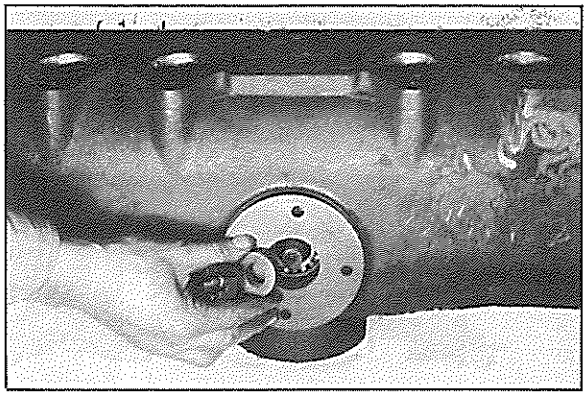
ILLUST. 1



ILLUST. 2



ILLUST. 3



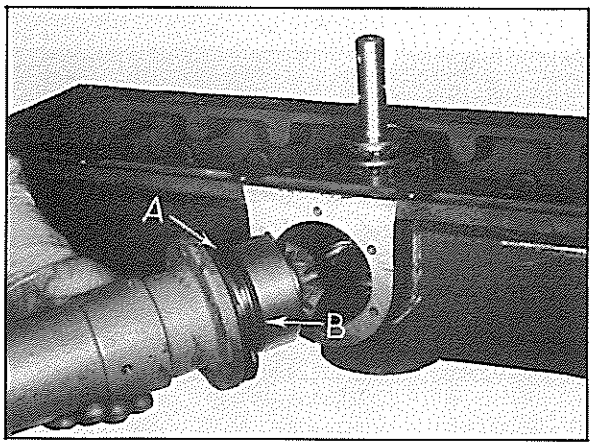
ILLUST. 4

Install a roller bearing and ball bearing in the rear bevel drive gear and assemble it on the opposite end of the center drive shaft. The proper assembly of the bearings in the rear bevel drive gear is shown in Illust. 2.

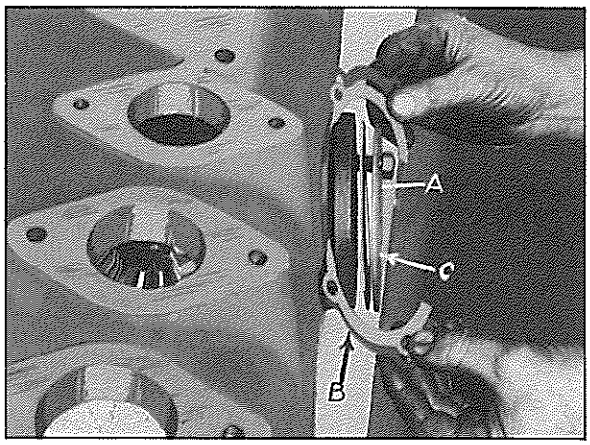
Install the spacer, Ref. A, on the shaft and install the ball bearing, Ref. B, in the rear bearing carrier. Install the snap ring, Ref. C, and "O" ring, Ref. D, in the rear bearing carrier shown in Illust. 3.

Assemble the rear bearing cage with "O" ring, as shown in Illust. 4, into the power box. Be sure and apply a small amount of machine oil to the "O" ring. This will help prevent damage to the "O" ring when installing the cage to the housing. Slide the threaded end of the center shaft into the bearing in the rear bearing cage. Install spacer and hex slotted nut as shown in Illust. 4. Tighten hex slotted nut securely, being sure the ball bearing is pressed securely against the shoulder on the center shaft.

In order to properly adjust bevel gear and drive pinion, it will be necessary to assemble the bearings and gears on the center shaft and install in power box with cover in place. This will hold the center



ILLUST. 5



ILLUST. 6

shaft in operating position while the gears are being adjusted.

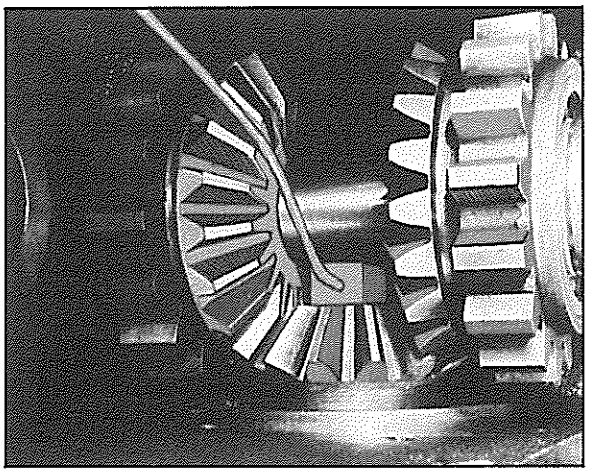
Install drive housing in power box. Maneuver gauge into power box through lever hole on right of center shaft. Place in position between center shaft and drive pinion gear, as shown in Illust. 7. Push drive housing into power box until gear and gauge are tight against center shaft. Use feeler gauge to measure clearance between bottom of power box and drive housing bolting flange. The reading obtained is the amount of shims required. Insert shims "A" and "O" ring "B", Illust. 5, in groove at top of housing and assemble to power box. Tighten securely.

Adjust bevel gears by tightening nut "A", Illust. 6, until there is no backlash in either gear. Use feeler gauge to meauure clearance between bearing cage "B", Illust. 6, and power box body. Back-off nut "A" two (2) constellations plus whatever is necessary to align pin hole in shaft with nut. Install cotter pin. Add .010 to feeler gauge reading taken above and install the equivalent in shims as in Illust. 6. Now install cover "C", Illust. 6, making sure all cap screws have lock washers. Tighten cap screws securely. Backlash will now be approximately .008 to .010.

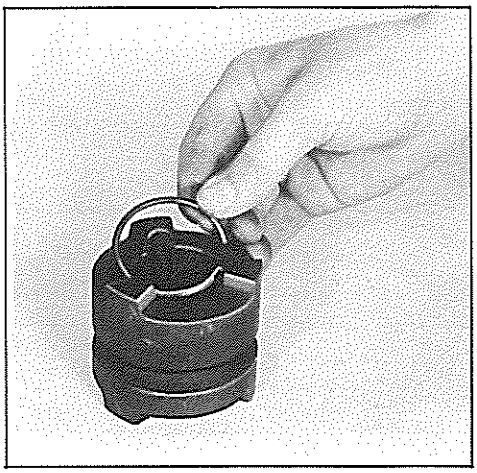
Install the notched end of the snap ring in the groove at the base of the clutch jaws, as shown in Illust. 8. NOTE: The ring is to be hooked on the clutch jaws to prevent rotating.

Place the clutch on the clutch shaft, with the broad side of the clutch facing the long end of the clutch shaft, as shown in Illust. 9 and 11.

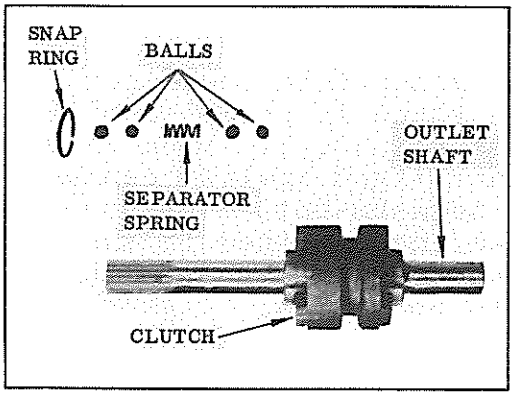
Before installing the second snap ring, place 4 steel balls and one separator spring in each of the 3 designated spots in the clutch spline. Then place the second snap ring, as shown in Illust. 9. However, the second control from the right, used to control the front leaning wheel housing, will be assembled with 15 balls, 5 balls and no springs in each of the 3 grooves.



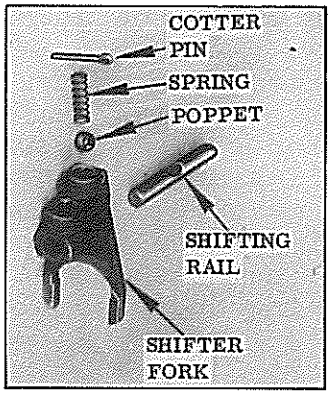
ILLUST. 7



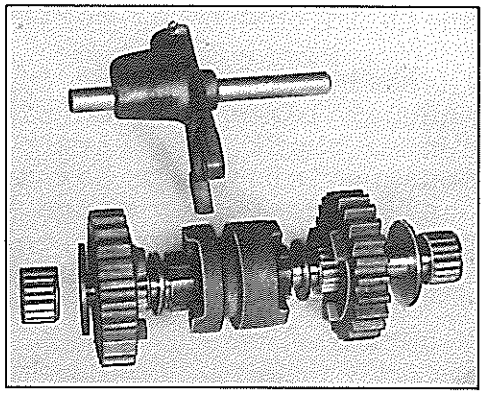
ILLUST. 8



ILLUST. 9



ILLUST. 10



ILLUST. 11

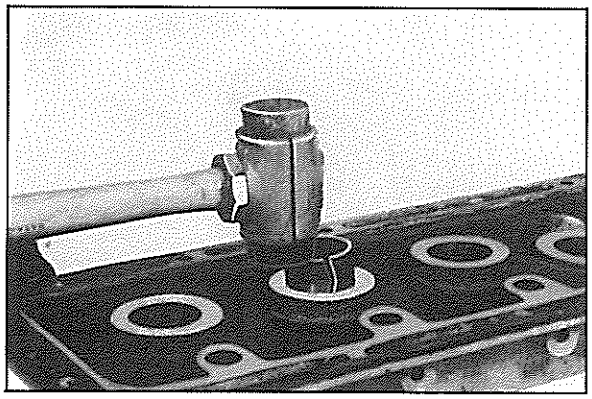
In installing the shifter fork, place the countersunk end of the shifter rail extending out from the flat side of the shifter fork. Line up the poppet seats in the shifter rail, with the poppet, compression spring and cotter pin. See Illust. 10 and 11.

To assemble the clutch shaft, start at each end of the splined shoulder by placing one small beveled thrust washer, one roller bearing, one clutch gear, one large thrust washer and one roller bearing. NOTE: Be sure to place the beveled side of the small thrust washer against the spline shoulder. Note assembly in Illust. 11.

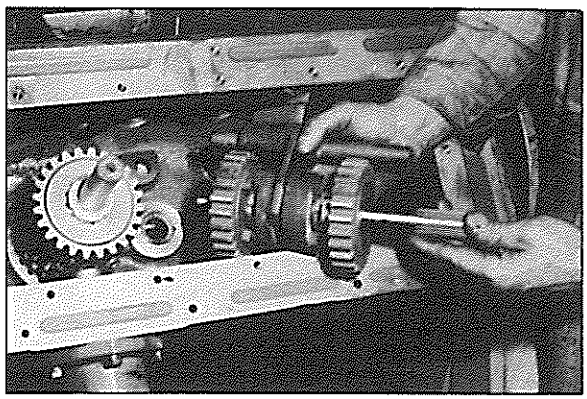
Install the roller bearing outer races in the power box housing and power box housing cover, as shown in Illust. 12. These races should be driven into the housing and cover so that the edge of the race is flush with the inside surface of the housing. Thrust washers are installed before the bearing race is driven into the housing. No thrust washers are used in the cover.

In installing the clutch shaft and shifter fork, start from the center shaft first and work toward the ends of the power control box.

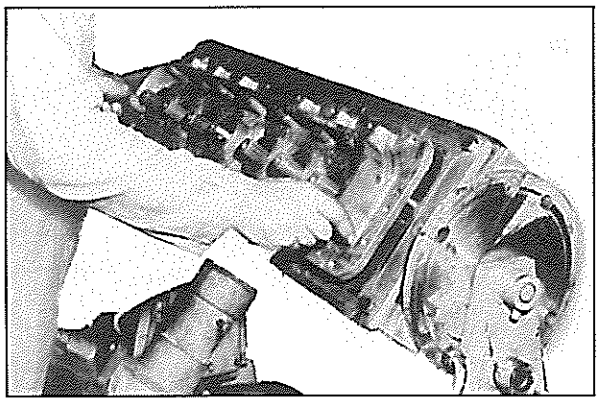
Install with the long end of the shaft extending out from the open side



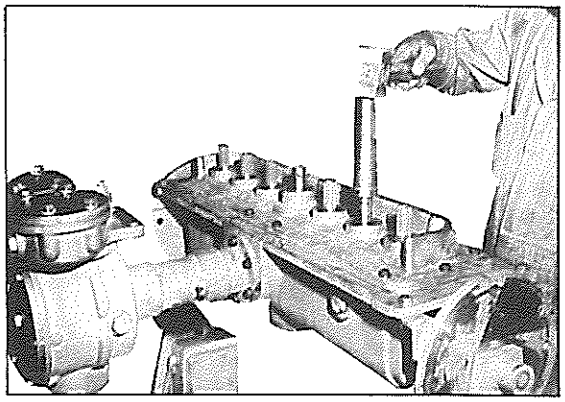
ILLUST. 12



ILLUST. 13

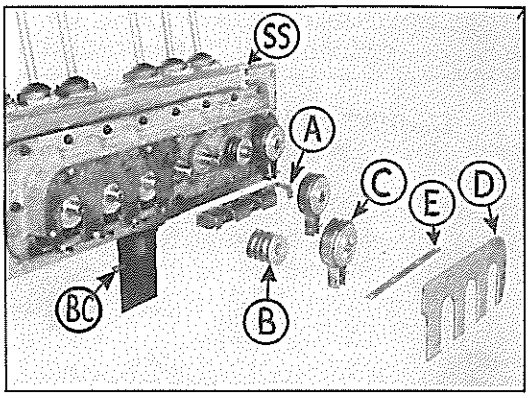


ILLUST. 14



ILLUST. 15

of the housing. Illust. 13 shows this and also shows the complete unit of the clutch shaft and shifter fork being installed in the housing. (The roller bearing, large thrust washer and clutch gear can be left off all six clutch shafts. This allows less weight to handle, more visibility in lining the clutch shaft and shifter fork shaft in their bosses and less chance to have slippage between the clutch and spline shaft which often causes loss of steel balls.)



ILLUST. 16

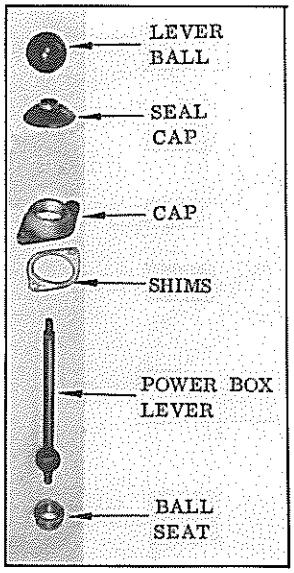
When installing the housing cover, be sure that the gasket is held firmly in position and that the cover fits over the two dowel pins in the housing. (See Illust. 14.) Install and tighten the cap screws in the housing cover.

Install the grease seals on the clutch shaft with the sharp edge of the leather seal pointing toward the inside of the housing, i.e., install as a grease seal. Expand the seal over the end of the shaft by wrapping the shaft with a piece of thin shim stock shaped like a funnel, as shown in Illust. 15. CAUTION: Be sure the edge of the seal does not drop into the pin hole in the shaft, thus damaging the seal. Drive the seal in with a piece of pipe that will fit the seal.

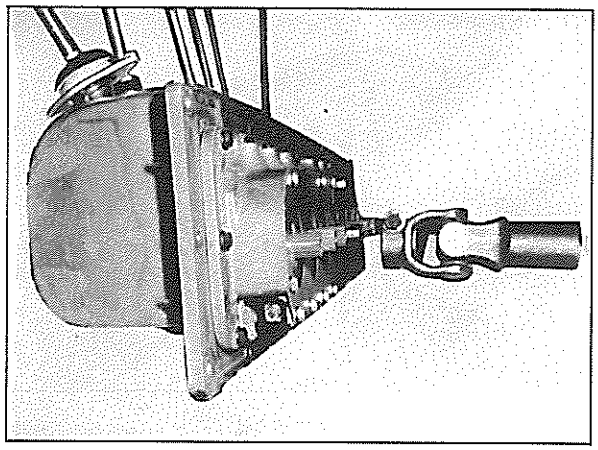
After installing the housing cover, adjust the shifter fork assembly by sliding the shifter fork rail back and forth until the countersunk end of the shifter fork rail indexes with the hole in the housing cover. Then, install the set screws (SS), as shown in Illust. 16.

NOTE: Install the cone point set screw first, followed by the cup point set screw.

Install the brake assembly, as shown in Illust. 16. First, install the anchor plate (A). Then install the amount of shims (B) that are



ILLUST. 17



ILLUST. 18

necessary to give a maximum clearance of 1/32" between the knuckle and brake drum, as shown in Illust. 18.

If outlet shaft is splined, shims are not used. Then install the brake drum and brake band assemblies (C), as shown. Install the drum shield (D). Installing the locking bar (E), place the bar back of the fingers on the anchor plate (A), then align the holes of the locking bar (E) with the holes in the anchor plate (A) and the drum shield (D).

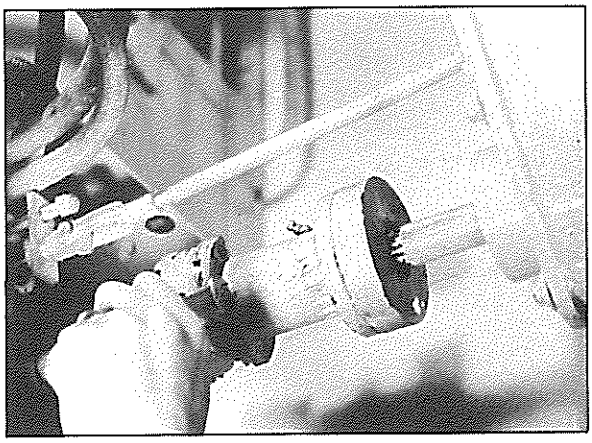
To install the control levers that have been disassembled, reassemble them by installing the ball seat, power box lever arms, laminated shims, power box lever caps, lever seal caps and lever balls as shown from right to left in Illust. 17. NOTE: Apply the amount of shims necessary so there will be a maximum of 1/32" vertical free movement on the lever arm assemblies. The lever seal cap is pressed on the lever arm. Illust. 18 shows the lever arm assembly being installed.

Install the Universal joints on the front of the power control shafts in the manner shown in Illust. 18. NOTE: With knuckle or Universal joint installed, there should be a maximum of 1/32" between the knuckle and brake drum.

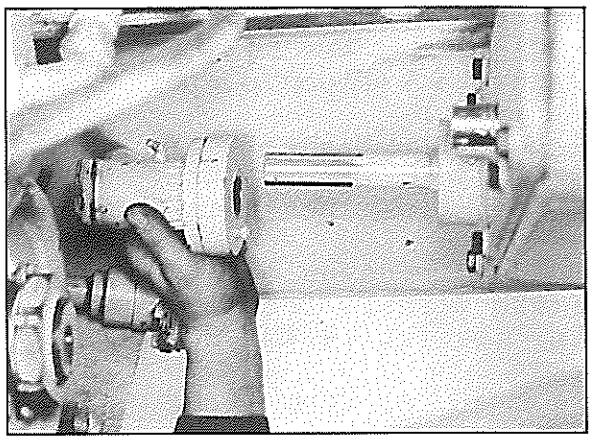
Removal

There are two ways of removing the power box assembly. First, by removing the complete unit with front sheet attached. Secondly, by removing the power box from front sheet and vertical drive housing.

To remove the power box unit with front sheet attached, first remove power take-off coupling. Bend ears of lock from cap screw heads and remove cap screws, as shown in Illust. 19. Break coupling and slide



ILLUST. 19



ILLUST. 20

from chain housing splined shaft, as shown in Illust. 20. Remove cap from steering post and swing steering shaft with steering wheel to one side.

If machine is equipped with cab enclosure, remove windshield frame, top and uprights.

Remove both cab closure plates.

Remove stay rods from front sheet.

Disconnect hydraulic hoses from pumps. If machine is equipped with a power-shift moldboard, disconnect hydraulic hoses from control valve. Also, remove power-shift moldboard operating lever.

Remove control shafts from power box.

Remove horn and head lights if so equipped.

Remove throttle linkage at floor.

Remove foot feed lever from front sheet.

Remove hand brake lever.

Remove brake pedal pad from pedal, also remove clutch brake pad. Next, remove clutch pedal

Disconnect wiring.

Disconnect heat indicator cable from engine.

Disconnect heat indicator cable from heat exchanger.

Remove knob from shifter lever and also shifter lever boot.

Remove cab floor plate.

Remove front sheet to floor angle cap screws.

Remove power box unit from cab.

To remove power box from front sheet and vertical drive housing remove control shaft from power box. Remove power take-off shaft, as shown in Illusts. 19 and 20.

Remove cap from steering post and swing steering shaft with steering wheel to one side. Next, remove stay bars.

Remove hand brake bracket from power box.

Remove both instrument boxes from front sheet and lay on floor.

Disconnect and lower vertical drive housing from power box.

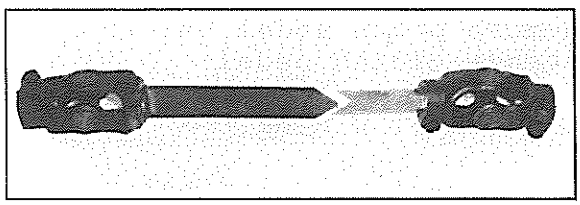
Remove all power box to front sheet cap screws. Remove power box from front sheet.

In reassembly, tighten stay bars to a point where the front sheet is 90° to the floor angle.

POWER CONTROL SHAFTS

The power control shafts should be maintained in good condition at all times. A close inspection of all Universal joints should be made occasionally to determine if any of the joints are worn to the point where efficiency of the controls is impaired. Any Universal joints found to be badly worn at the bearings or on the ends, should be immediately straightened or replaced.

Inspect all telescopic shafts for excessive wear or other damage. When assembling the square shaft into the hollow square on the telescopic unit, be sure to assemble it so that the fingers of the Universal joint lie in the same relative plane. The proper assembling of the square shaft into the hollow square is shown in Illust. 1, with exception of front tilt square shaft and Universal. If the shafts are assembled otherwise, it may cause excessive vibration of the control rods, thus causing difficult operation.



ILLUST. 1

The power box outlet shafts have serrations on them. The "U" joint has

matching serrations inside the "U" joint, on one end, to match those of outlet shafts and keyway on the other end. The end which is slid over the Woodruff key should be free to slide lengthwise on the shaft.

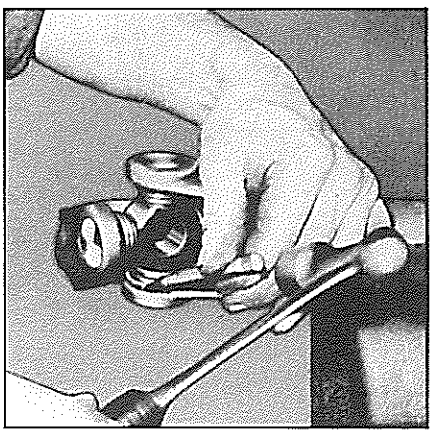
Universal Joint

The Universal joints are of the roller bearing, anti-friction design. The roller bearing type of joint has many advantages over the old type joints. Some of the advantages are; each bearing is individually sealed against loss of grease or the entrance of dirt or moisture; the bearings are lubricated for life; the joints are smaller in size, lighter in weight, compared to their torque capacity; component parts of the roller bearing joints may be ordered for repairs, which in most cases will eliminate replacement of the complete joint.

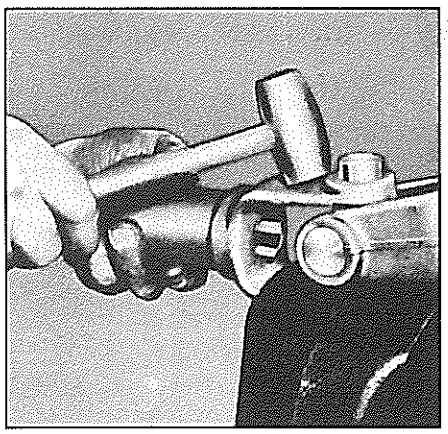
No special tools being required, a hammer, punch, screw driver and a vice with brass jaw protectors are all that are needed for the disassembly and assembly of this roller bearing joint.

The following procedure can be followed in the disassembly of the joint. Remove the four snap rings, as shown in Illust. 2, by means of a punch placed against an end of the snap ring loop and then tapping the end of the punch with a hammer until the ring comes off. After removal of the snap rings, the assembly can be placed in the vice, as shown in Illust. 3. By striking the suspended yoke as shown, the yoke member will be driven down until it comes in contact with the cross. When one bearing has been partly removed, clamp the protruding end of the bearing in the vice, as shown in Illust. 4 and remove the bearing completely by driving against the yoke.

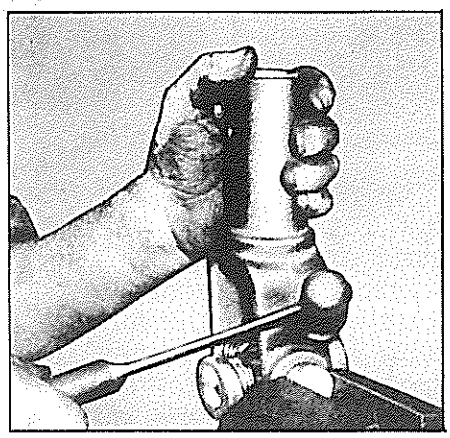
Next, turn the assembly over and remove the opposite bearing. The yoke member can be removed from the cross. Proceed to remove the other bearings, placing the assembly in the vice, as shown in Illust. 5.



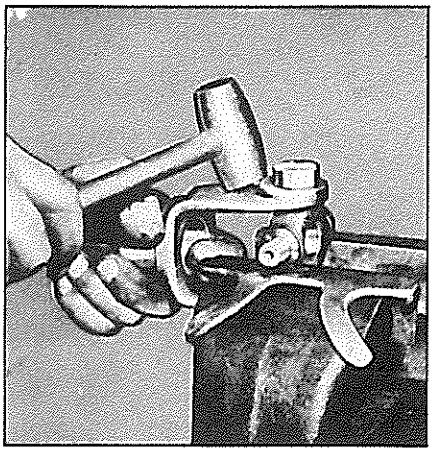
ILLUST. 2



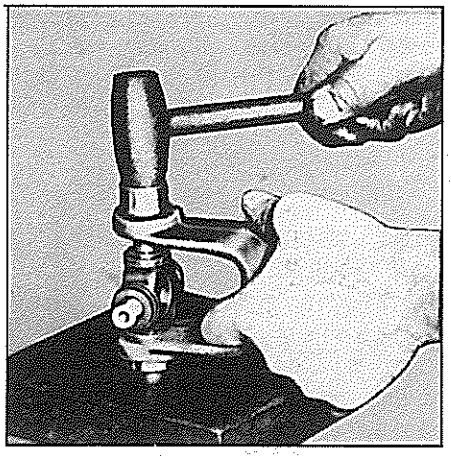
ILLUST. 3



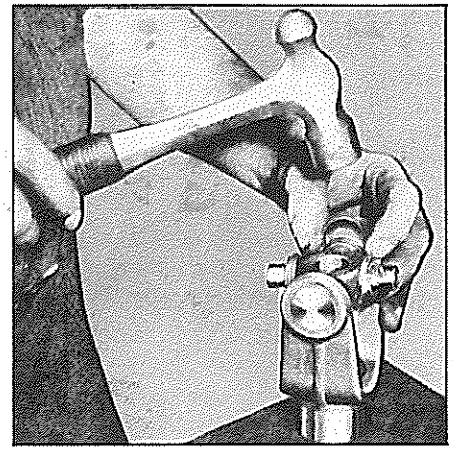
ILLUST. 4



ILLUST. 5



ILLUST. 6



ILLUST. 7

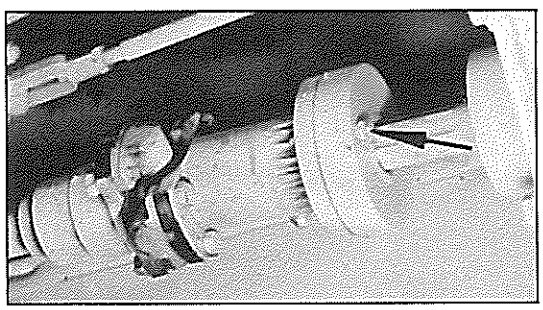
The disassembled parts should be inspected, any worn working parts should be replaced by a new cross and 4 new complete bearing assemblies. Care should be taken to see that the trunnions are clean, that each bearing contains lubricant. It is advisable to replace the cork sealing washers on each trunnion to prevent ingress of dirt and to retain the lubricant in the bearings.

The following procedure can be followed for the assembly on the joint, rest one of the yoke forks on a flat piece of iron, leaving the fork member freely suspended below, then drive one of the bearings in, stop when the open end comes flush with the inside of the fork member. Then insert the cross through the opposite hole without the bearing and swing into place and down into the partially assembled bearing. Next, turn the assembly over, resting the above partially assembled bearing on the flat surface and drive in the other bearing. See Illust. 6.

It is possible there will be some off center condition between the cross and the yoke after the bearings are driven flush with the outside of the yokes. However, you will find this an advantage and permits driving in the snap ring on the side that gives the most clearance. See Illust. 7.

Power Take-Off Coupling

The power take-off coupling shear pin, as illustrated by arrow in Illust. 8, makes it possible to use the positive connection between torque converter output shaft and power take-off chain housing shaft. To replace shear pin, align holes in coupling and insert pin. Install lock washer and nut. Tighten nut securely.

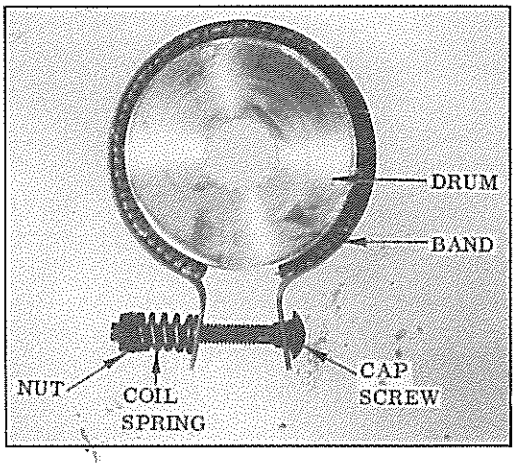


ILLUST. 8

POWER BOX ANTI-COAST BRAKE

The anti-coast brake, shown in Illust. 9, is furnished for all motor graders.

Assuming that the anti-coast brake band has been removed, which it should be periodically to remove any dust or foreign matter that may have accumulated on the lining, the first step of reassembly should be to install the band onto the drum.



ILLUST. 9

Install the bolt through the band as shown in the illustration. Install the coil spring and nut and tighten until proper adjustment is obtained.

NOTE: The thrust bearings in the gear housings must be properly adjusted before the anti-coast brakes, in order to insure the maximum of efficiency of the two adjustments in controlling coasting.

When adjusting the brake, the adjusting nut should be tightened until a 12 ft. lb. pull is necessary to turn the drum within the band. There may be some instances when it will be necessary to vary the adjustment to obtain the desired results.

If the band is too tight, the lever may not work smoothly, there may be an excessive amount of chatter in the lever and the lining will wear excessively.

If the band is too loose, the brake will not be effective, therefore, it will not serve its purpose in eliminating coasting.

You will note that in the installation of the drum shields and locking bars that the holes in the locking bar are tapped. The locking bars mounted behind the anchor plates serve as the locking agent for the cap screws used in securing the drum shields, anchor plates and locking bar assembly.

BLADE CONTROL ASSEMBLIES

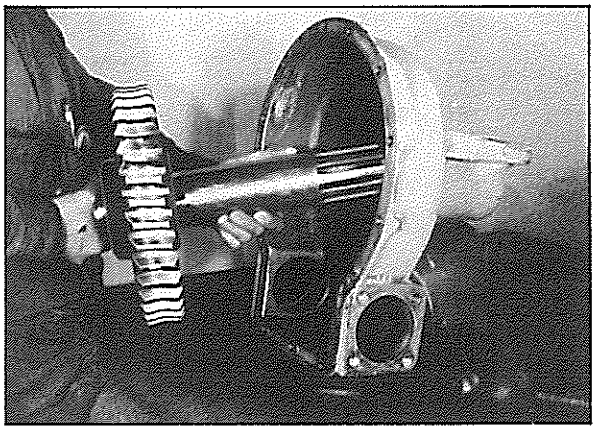
Due to the fact that the two blade lift housings and the lateral shift housing are so much alike it is not necessary to describe the repair of all three. Therefore, in the following paragraphs, instructions are given for the repair of the right hand blade lift housing. The other assemblies are repaired in a similar manner. All points of wear in the housing are equipped with replaceable bushings, which require no reaming after installation.

Disassembly

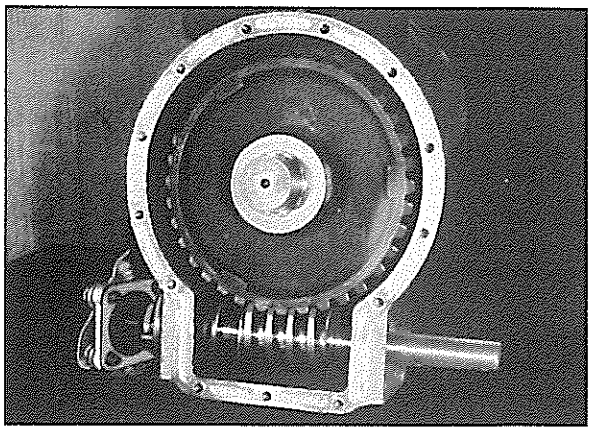
The extent of disassembly of a blade control assembly depends on the work to be done. If a complete disassembly and repair of the assembly must be made, it is best to remove the complete unit from the frame of the grader and disassemble it on a bench. Due to the fact that during the reassembly operation all adjustments and settings must be established, a detailed description is given here of the reassembly operation only. However, the disassembly is merely the reverse of the assembly procedure.

Inspection

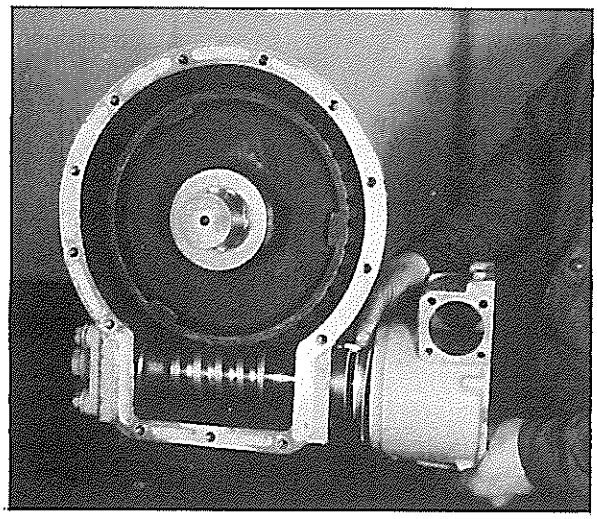
Inspect all parts for excessive wear, breakage or other damage. Gears, bearings and shafts will sometimes score, due sometimes to insufficient lubricant or improper lubricant being used. Parts which are damaged in this manner should be replaced. Inspect "O" rings for mars or cuts. Replace with new ones if damaged. If any of the bushings are being replaced they should be installed by supporting the housing in a press and pressing in the bushing. No reaming is necessary on any of the bushings before installation.



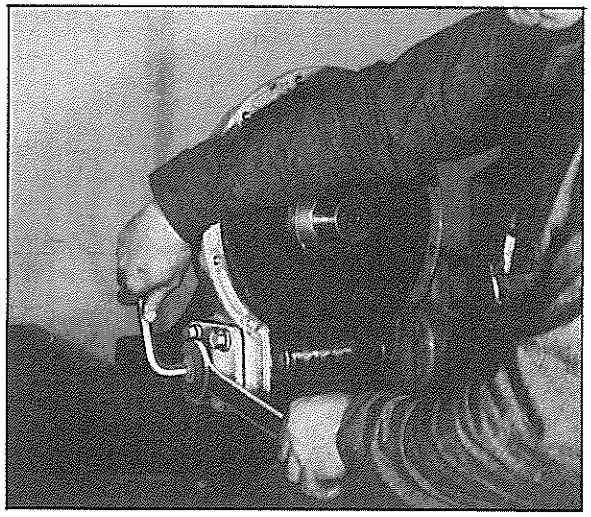
ILLUST. 1



ILLUST. 2



ILLUST. 3



ILLUST. 4

Reassembly

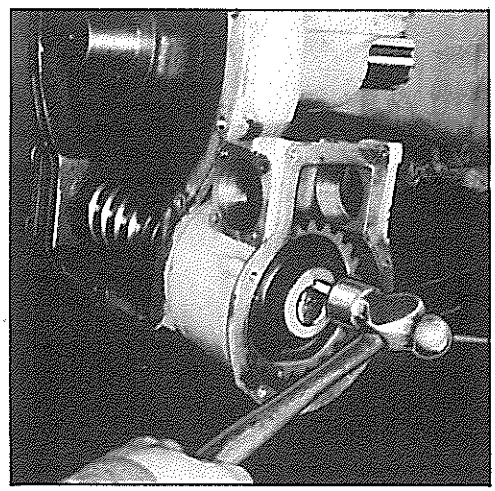
The first step in the assembly operation is to install the worm gear on the shaft with the long end of the hub turned toward the end of the shaft as shown in Illust. 1. Install the gear on the shaft by supporting the gear in a press and pressing in the shaft until the shoulder on the spline of the shaft comes up solid against the hub of the gear. Install the shaft and gear assembly in the housing as shown in the illustration.

Install the worm on the worm shaft by supporting the worm in a press and pressing the shaft until the end of the shaft without keyway extends out of the worm 2-1/32". Install the worm and shaft assembly in the housing and install the worm thrust bearing, the shoulder spacer, dowel pin, and bearing cap with gasket as shown in Illust. 2.

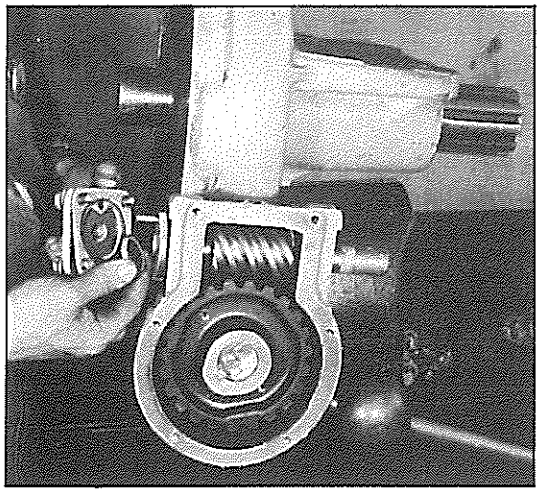
Install the thrust bearing, square key and and reduction housing with "O" ring as shown in Illust. 3.

Install the adjusting screw, and hex jam nut in the bearing case. Adjust the thrust bearings by turning the adjusting screw until it comes up solid. Then back the screw off about 1/16" of a revolution, hold in this position and tighten the jam nut securely as shown in Illust. 4.

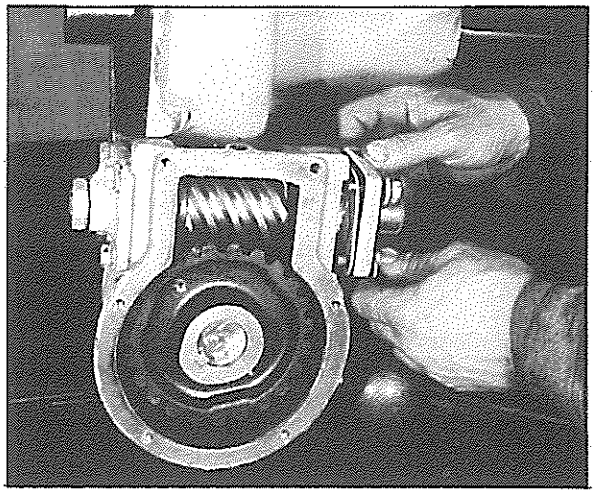
NOTE: As mentioned above the housing which is shown being assembled is the right hand blade lift. The left hand blade lift housing is assembled in a similar manner.



ILLUST. 5



ILLUST. 6



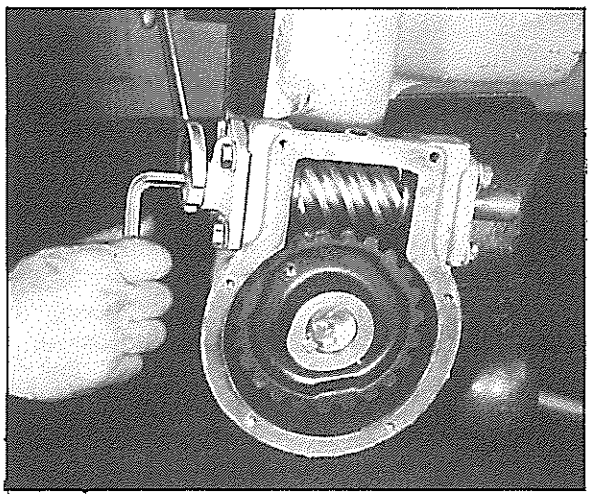
ILLUST. 7

But the reduction housing is mounted on the opposite side than that shown in the illustration. The lateral shift housing is assembled in a similar manner to the right hand blade lift housing with the exception that the reduction housing is mounted the other side up.

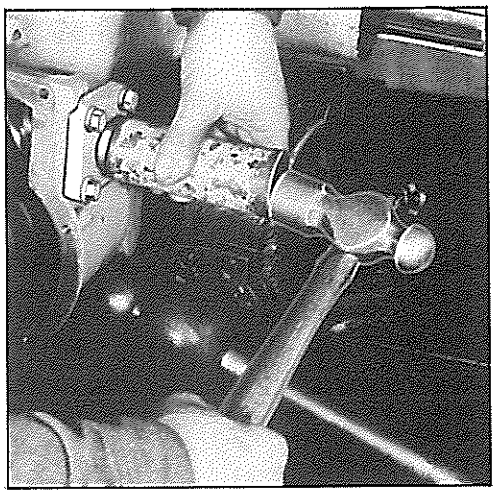
Install the spiral gear on the end of the worm shaft with the long hub side of the gear turned toward the outside of the reduction housing. Install the gear on the shaft by driving on the hub of the gear with a rawhide hammer, piece of wood or other soft object. When installing the spiral gear on the shaft be sure to line up the keyway to permit the installation of the square key as shown in Illust. 5. The spiral gear is equipped with two puller holes which have 5/16" N.C. thread to provide an easy method of removal.

Install the spiral pinion on the shaft by supporting the pinion in a press and pressing on the shaft until the shaft extends out of the pinion 1".

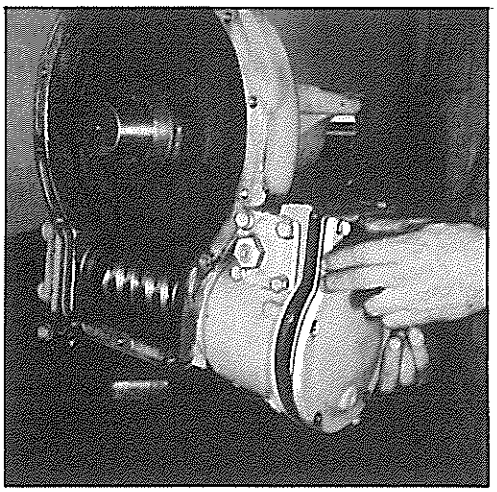
Install the pinion and shaft assembly in the reduction housing and install the thrust bearing adjusting spacer, dowel pin and bearing adjusting cap with gasket as shown in Illust 6. Be sure that the dowel pin enters the hole in the adjusting cap and thrust bearing. Install the adjusting screw and hex jam nut in the bearing cap. Install the other bearing cap with gasket as shown in Illust. 7.



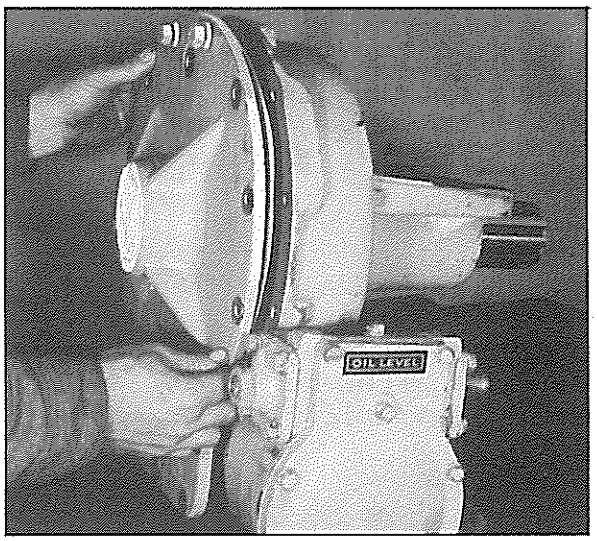
ILLUST. 8



ILLUST. 9



ILLUST. 10



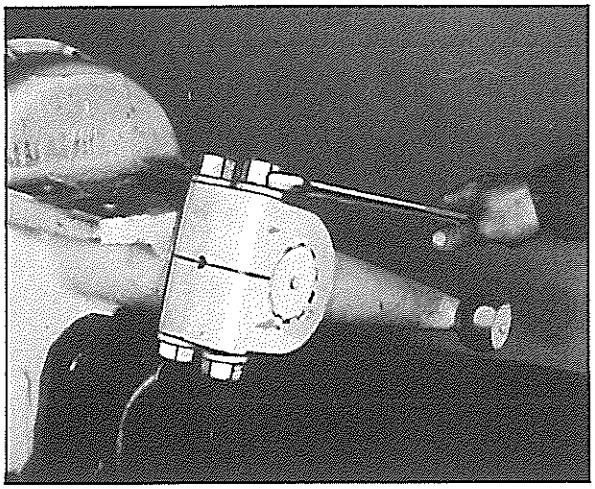
ILLUST. 11

Adjust the thrust bearing by turning in on the adjusting screw until it comes up solid, then back it off about 1/16" of a revolution, hold in this position and tighten the jam nut securely as shown in Illust. 8. Install the grease seal as shown in Illust. 9, using a piece of pipe to drive it into place in the bearing cap. Install the seal as a grease seal with the sharp edge of the seal pointing toward the inside of the housing. Use great care when expanding the seal over the shaft not to damage the seal in any way and also do not allow the edge of the seal to catch in the universal joint pin hole through the end of the shaft.

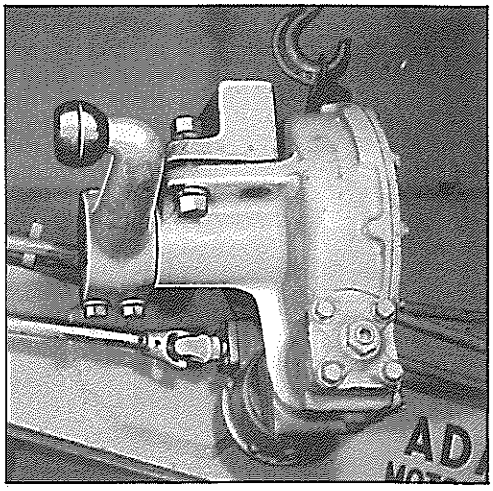
Install the housing cover, using new gaskets as shown in Illust. 10 and 11.

NOTE: On lateral shift housing, it is necessary at this point to install the grease seal around the main lift shaft. Install this seal as a grease seal with the sharp edge of the seal toward the inside of the housing. Use great care in installing the seal not to damage it in any way.

Install the arm with bolts and lock washers. Tighten the bolts securely, as shown in Illust. 12. Tighten all attaching bolts securely, as shown in Illust. 13.



ILLUST. 12



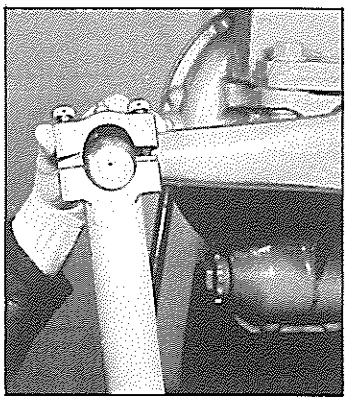
ILLUST. 13

Adjustable Ball and Socket

The ball and socket joints on the lift links and the lateral shift control are adjustable for wear. Illust. 14 shows the laminated shims provided to take care of the wear at these points. In order to make this adjustment the two clamp cap screws and cap should be removed as shown.

The laminated shims on each side of the cap can be removed from the clamp cap screws and layers of shims peeled off with a knife. Care should be taken to remove approximately the same amount of shims on each side of the cap to keep the cap straight.

Do not remove any more shims than necessary to remove the free play in the joint. The joint should never bind but should always work freely. It will be found that these joints wear egg-shaped. Therefore, they should be adjusted in the position in which they will operate.



ILLUST. 14

CIRCLE REVERSE MECHANISM

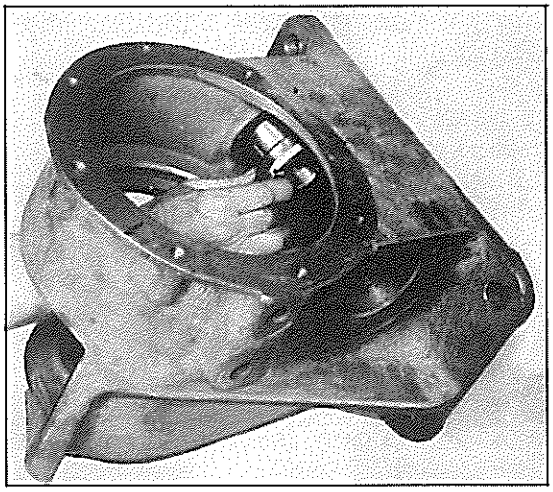
The circle reverse mechanism is contained in two separate housings consisting of the circle reverse housing and the transfer housing. Whenever repair to either of these housings becomes necessary, the complete assembly should be removed from the machine. Although minor repairs can be made on the circle reverse and transfer housing assembly without removal from the drawbar, major repairs require their removal. It is not necessary to remove the circle from the drawbar in order to remove the circle reverse housing. The reverse is also true.

Disassembly

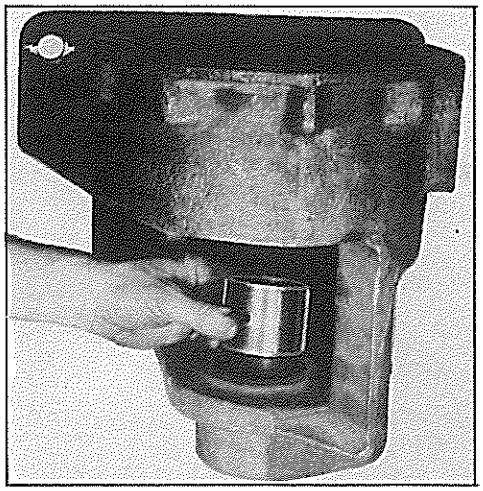
The extent to which the circle reverse housing is disassembled depends upon the work to be done. In the following description and illustrations, it is assumed that the mechanism is completely disassembled. The disassembly of this unit is so simple that no detailed instructions are needed. In the disassembly of the worm thrust bearing, pinion and gear shaft assembly, care should be taken not to distort or damage the "O" rings if they must be reused.

Inspection

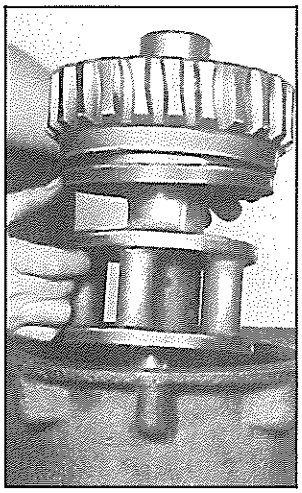
When removing the cover from the transfer housing as shown in Illust. 11, it is necessary to drive the dowel pins out of their holes to remove the cover. This is necessary due to the angle with which the upper shaft enters the bore in the cover. Inspect all parts for excessive wear or damage. Bearings, gears, and shafts will sometimes score due to insufficient lubricant or improper lubricant being used. Parts that are damaged in this manner should be replaced with new ones. All gaskets, seals and "O" rings should be replaced when reas-



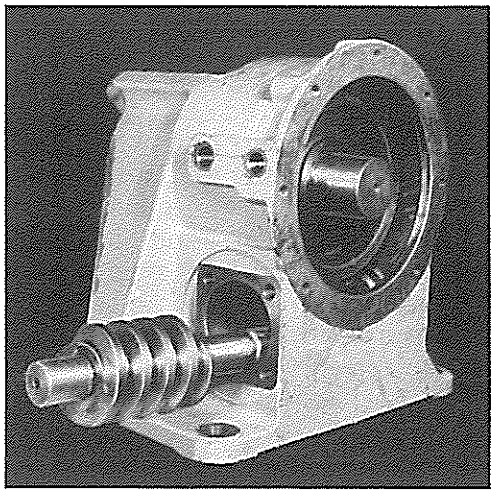
ILLUST. 1



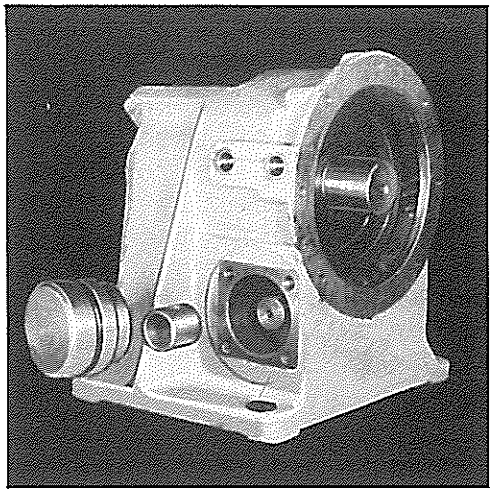
ILLUST. 2



ILLUST. 3



ILLUST. 4

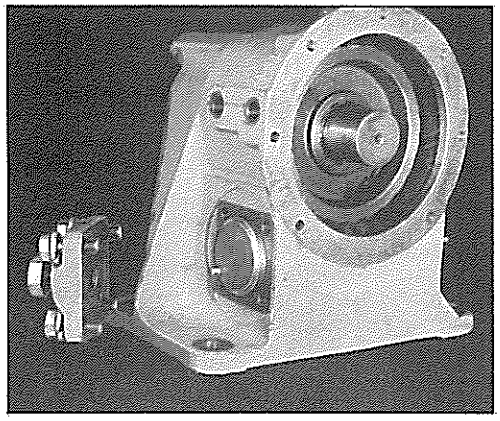


ILLUST. 5

sembling the housing. When installing the bushings care should be taken to prevent distortion or damaging during assembly. They should be installed with a press or wood block and hammer and care should be taken that the bushings enter the bore squarely and do not cock to one side.

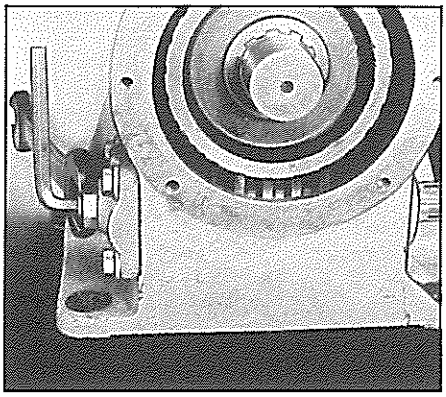
Reassembly

The first step in reassembly is the installation of the worm thrust bearing with dowel pin as shown in Illust. 1. Drive this bearing into position using a wood block and hammer. The lower bushing can be installed as shown in Illust. 2, and again it may be installed with either a press or driving it into place with a wood block and hammer. Use great care not to distort the bushing. It is not necessary to line up the grease hole in the bushing due to the fact that there is a recess cast in the housing to carry the grease fitting to hole in the bushing.

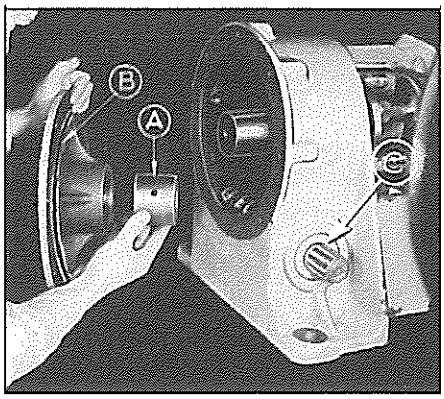


ILLUST. 6

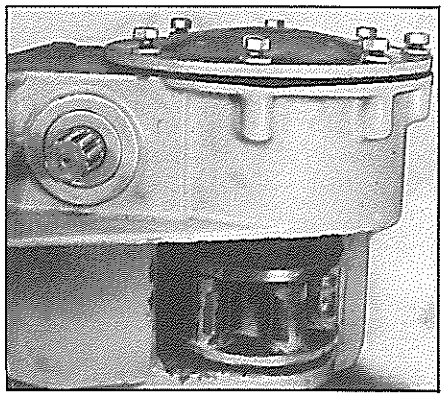
If the gear and pinion assembly has been disassembled, reassemble it by placing the worm gear on the pinion assembly making sure that the "O" ring is properly installed prior to pressing the worm gear onto the shaft. Install the worm gear with the flange side of the gear turned toward the pinion. Install the complete assembly with grease seal as shown in Illust. 3. The grease seal should be lubricated thoroughly before being installed.



ILLUST. 7

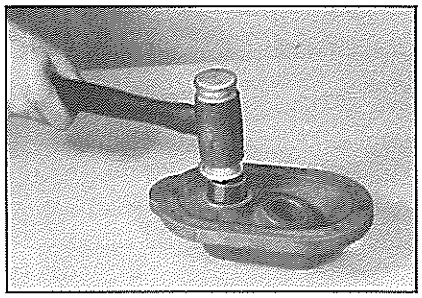


ILLUST. 8



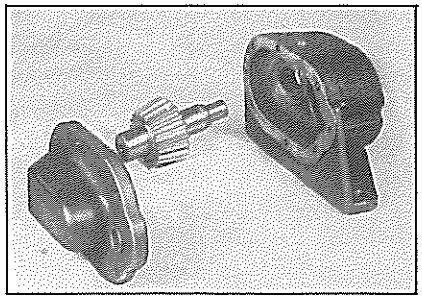
ILLUST. 9

Press the worm onto the worm shaft to a position so that the splined end of the shaft extends out from the end surface of the worm 5-13/32". Install the worm and shaft assembly in the housing as shown in Illust. 4. Shown in Illusts. 4 and 5 is an exploded view of the worm thrust bearing, bushing (which is replaceable) and "O" ring. These parts are assembled into the housing as illustrated. Use great care not to damage the "O" ring when assembling the thrust bearing into the housing.



ILLUST. 10

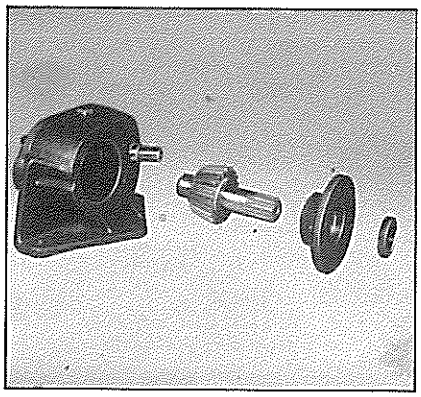
Install the thrust bearing cap and dowel pin as shown in Illust. 6. The dowel pin is for the purpose of preventing the thrust bearing from rotating during operation of the machine. No gasket is used at this point as the "O" ring is the seal which prevents the oil from leaking out. Draw the cap screws up tight.



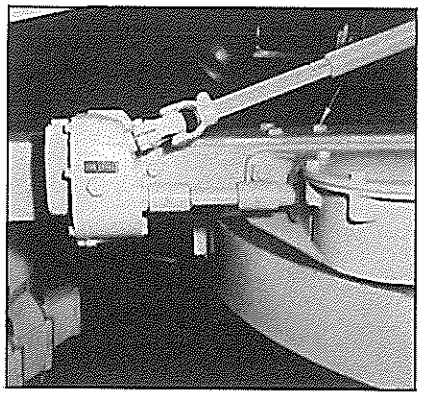
ILLUST. 11

Adjust the worm thrust bearing as shown in Illust. 7, by turning in on the adjusting screw until it comes up solid and then back it off approximately 1/16 of a revolution. Hold in this position and tighten the locking nut. If trouble is experienced with coasting, the worm thrust bearing may be tightened more than the above specified amount to prevent this coasting from occurring. In addition to this, there is a brake on the front of the power control box which may be tightened to further prevent a coasting condition on the circle reverse gear assembly.

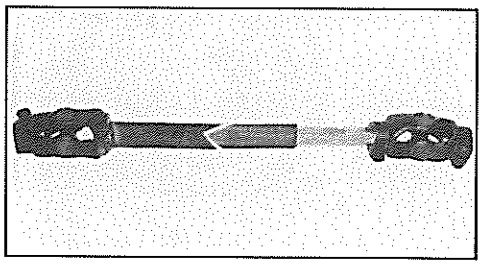
Install bushing, Ref. A, and "O" ring, Ref. B to the housing cover, and install the cover, as shown in Illust. 8. The grease seal "C" should be driven into the housing with the sharp edge pointing toward



ILLUST. 12



ILLUST. 13



ILLUST. 14

the inside of the housing to prevent grease leakage around the shaft. Use great care when installing this seal not to damage it.

Illust. 9, shows the assembly almost complete and ready for installation on the drawbar of the machine. Shown in Illust. 10 is the bushings in the transfer housing cover. These bushings are shown being installed by the use of a rawhide hammer. This is also a satisfactory method of installing this type of bushing.

After installing the bushing in the transfer housing, assemble the upper pinion shaft and cover using a new gasket as shown in Illust. 11. After bolting the cover in position drive the dowel pins in place.

Install the bushings in the gear cover and assemble the gear cover, lower pinion and the grease seal to the housing as shown in Illust. 12. The grease seal should be installed with sharp edge pointing toward the housing to prevent grease leakage around the shaft.

The completed assemblies are now ready for installation on the drawbar of the motor grader. When installing the main circle reverse gear housing, it will be necessary to remove the rear bolt in the front retainer plate, (see arrow) Illust. 13, in order to tighten the bolts which holds the gear housing to the drawbar. When installing these bolts check to be sure that when the bolts are tightened the housing is not drawn out of shape. In other words, the housing being held to the drawbar at four points could be warped slightly and hence, placed in a bind when the bolts are tightened. To prevent this, install shims as needed at one of the four points of bolting to prevent any distortion.

After the transfer housing has been installed on the drawbar, the couplings and shaft can be installed by sliding the couplings toward the center of the coupling shaft and after inserting between the transfer case and gear housing slide the coupling back onto the mating

shafts until the drilled pins can be installed. There should be a slight amount of end clearance on the coupling shaft after it has been installed.

When installing the universal joint on the upper pinion shaft, assemble the hollow and square shaft so that the form of the universal joints lie in the same relative plane as shown in Illust. 14.

FRONT AXLE

In order to better understand the problems involved in maintaining the front axle of a motor grader, and proper wheel alignment, it is well to have a thorough understanding of the alignment angles involved. The most important and better known alignment angles are:

1. TOE-IN OF THE WHEELS.
2. CASTOR OF THE AXLE.
3. CAMBER OF THE WHEELS.

A brief description and discussion of the purposes of each of these angles should prove of assistance in properly servicing the axle.

1. TOE-IN OF THE WHEELS. Toe-in is the setting of the front wheels closer together at the front of the axle than at the rear. The purpose of toe-in is to offset the effect of wheel camber and the resultant tire wear due to lateral slippage.

2. FRONT AXLE CASTOR. Castor is the inclination of the spindle fork toward the rear or toward the front of the grader. Positive castor is an inclination of the top of the spindle toward the rear; negative or reverse castor is an inclination of the top of the spindle fork toward the front of the grader. The purpose of castor is to provide stability in steering.

3. WHEEL CAMBER. Camber is the inclination of the wheel from a vertical plane. The primary object of camber is to offset the wear of spindle bearings and bushings and wheel bearings, and the deflection or sagging of front axle parts, thereby preventing the wheel from going into a reverse camber position after long mileage. Positive camber is an outward inclination of the wheel at the top. Negative or reverse camber is an inclination of the top of the wheel toward the center of the axle.

The factors effecting steering are so closely related and interdependent that any specific complaint may be caused by a number of different items. It will usually be found that not one but several factors are out of line and so all must be corrected before the motor grader can be expected to operate satisfactorily.

In regard to castor, there is no adjustment. The castor is a fixed dimension maintained by the axle pivot pin in relation to the front bolster. Should the machine be worn at this point, no serious damage to the tires can result. Improper castor has no serious effects on the wear of front tires on units of this type when traveling at their governed speed. However, bushings are provided at these points in the axle which are replaceable when wear becomes excessive.

Therefore, the only two dimensions which need to be checked are camber and toe-in. Before attempting to correct improper camber or toe-in, by adjustment, always check the spindle and spindle shanks, to determine if excessive wear has occured on the bearings and bushings in these parts. If excessive wear has occured they should be adjusted or removed and new parts installed.

Disassembly

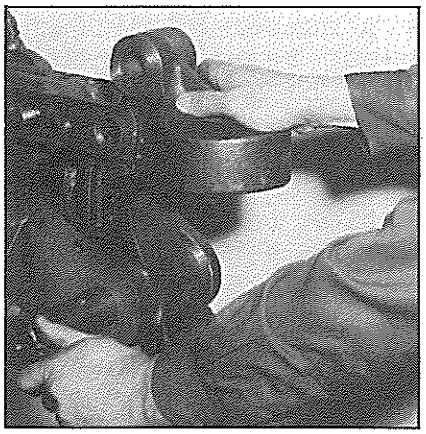
The extent to which the front axle assembly is disassembled depends upon the parts which must be repaired or replaced and, therefore, the work to be done. All points of wear are equipped with replaceable bushings which require no reaming after installation. A detailed description is given here only of the reassembly operation since it is at this time that all adjustments must be established. The disassembly is merely the reverse of the assembly procedure and is so simple that it requires no detailed explanation.

Inspection

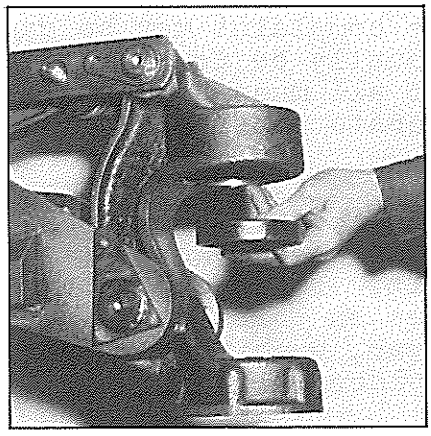
Inspect all parts for excessive wear, breakage or other damage. A close inspection should be made of the holes in the ends of the vibrating link to determine if they have become elongated. Occasionally, it will be found that after long usage or severe operating conditions these holes will become elongated thus allowing the front wheels to go into a reverse camber position. If this occurs the complete vibrating link must be either repaired or replaced before reinstalling it on the machine.

Reassembly

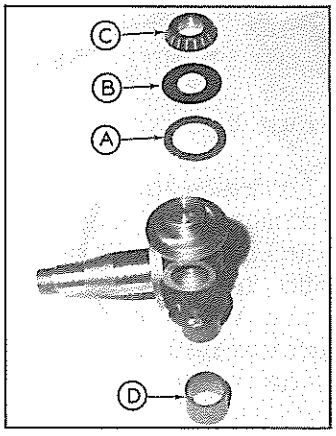
Install the spindle fork in the front axle, as shown in Illust. 1.



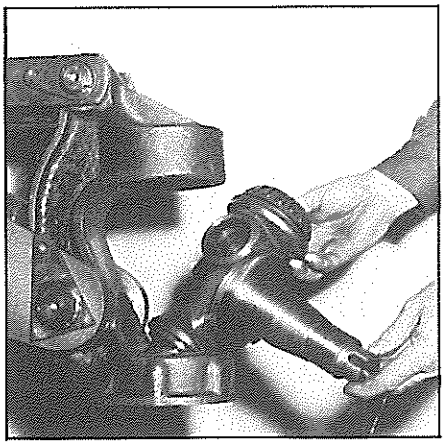
ILLUST. 1



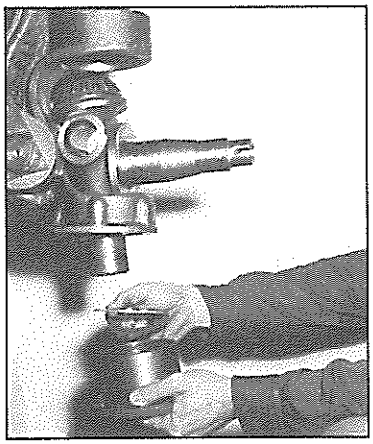
ILLUST. 2



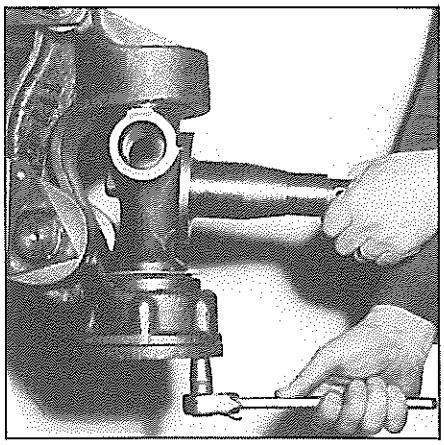
ILLUST. 3



ILLUST. 4

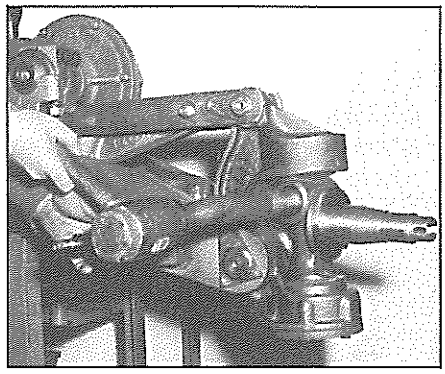


ILLUST. 5



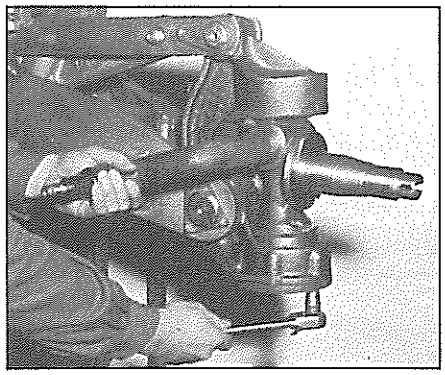
ILLUST. 6

Install the pins in the axle and vibrating link, being sure to install the bolts through the ear of each pin, to prevent any danger of the pin revolving during operation of the machine. Install the hex slotted nuts, tighten securely and install and spread cotter pins. Install bearing cup into the spindle fork, as shown in Illust. 2.



ILLUST. 7

Install the upper spindle fork seal washer, closure washer and tapered roller bearing on the spindle. Install the bushing on the lower end of spindle, as shown in Illust. 3. To install the bearing and the bushing on the spindle, they should be heated in oil until they have expanded sufficiently to allow their easy installation on the ends of the spindle.



ILLUST. 8

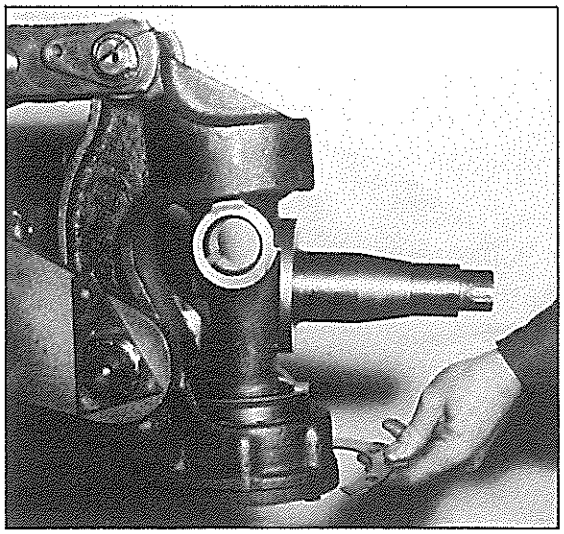
Install the spindle assembly in the spindle fork as shown in Illust. 4. Install the spindle lower seal wahser, closure washer and bearing cap less shims as shown in Illust. 5. When installing these parts be sure that the lug on the closure washer engages properly on the flat side of the spindle. This is extremely important as the parts will not fit properly if the closure washer is assembled in any other way.

Install the six cap screws, as shown in Illust. 6. Install the steering arm as shown in Illust. 7. Pre-load the spindle king pin bearings by tightening the lower bearing cap, as shown in Illust. 8, until the spindle cannot be turned by pulling the steering arm by hand.

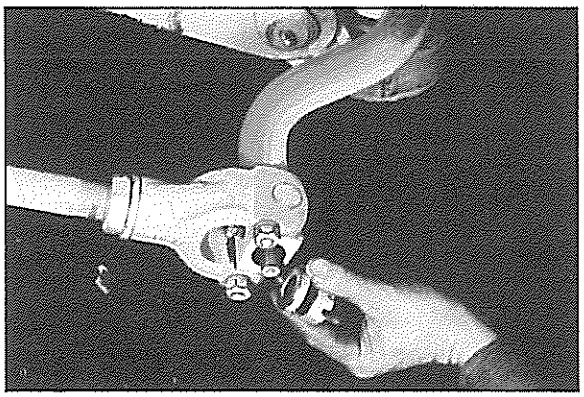
Then use the required amount of shims, as in Illust. 9, to obtain the following measured torque pre-loading. Hook a spring scale into the cotter pin hole in steering arm. Pull the scale at right angles to the steering arm and in a plane at right angles to the vertical center line of the spindle. Tap the spindle with a rawhide hammer until the pull of 4 to 8 lbs. is obtained.

Although it is not necessary to remove the steering arm from the spindle in order to disassemble the front axle, it is shown being installed in Illust. 7, to indicate that this removal is possible. Couple up the tie rod assembly to the steering arm as shown in Illust. 10. If the tie rod assemblies have been disconnected from the steering ball, reassemble them as shown in Illust. 11. This ball and socket joint is equipped with shims to provide an accurate adjustment and also to take up any free play which may occur due to wear in the joints. The joint should never bind but should always work freely. Never remove any more shims than necessary to remove the free play in the joints.

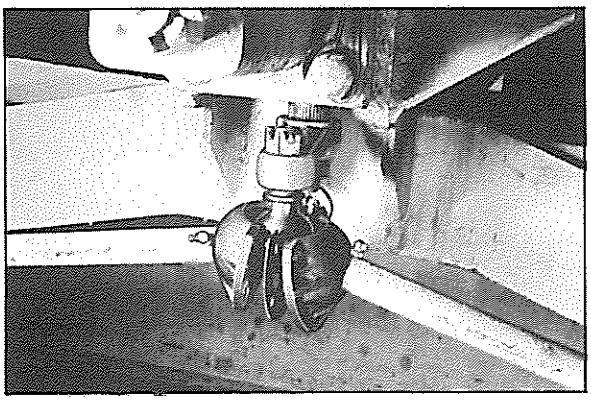
After the joint has been assembled install the boot and lace it securely, as shown in Illust. 12. Install the wheels as described under "Wheels".



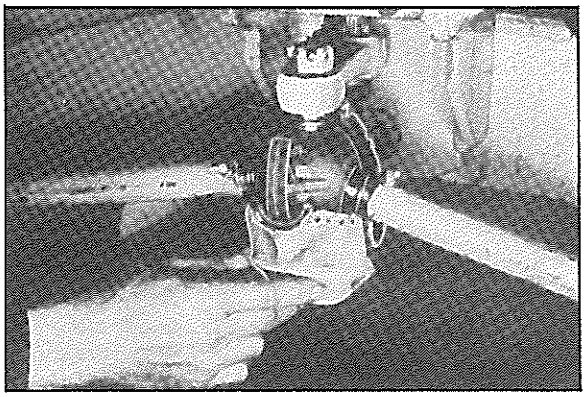
ILLUST. 9



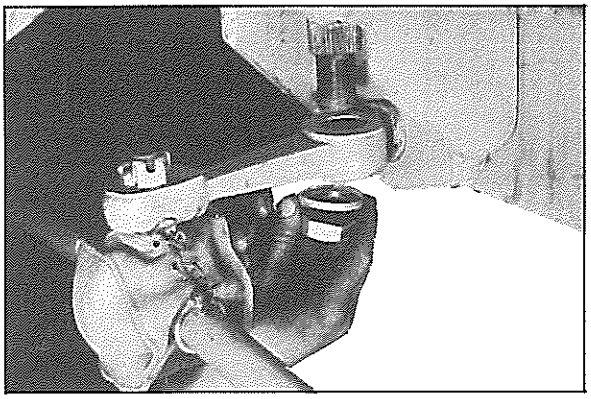
ILLUST. 10



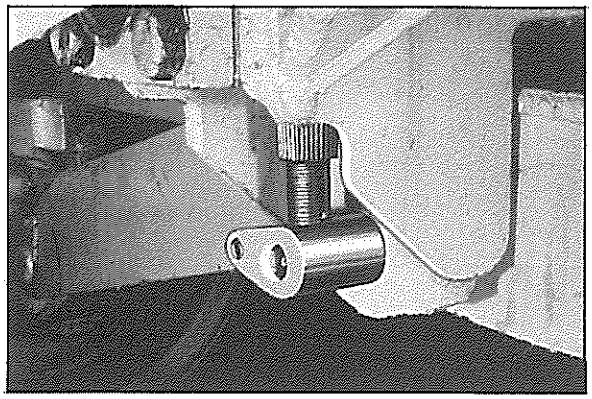
ILLUST. 11



ILLUST. 12



ILLUST. 13



ILLUST. 14

Although the front axle assembly can be completely rebuilt while it is still attached to the grader, there are occasions when it is desirable to remove it as an assembly from the frame of the grader. An example of such removal would be the replacement of the bushings in the front axle assembly which fit around the bolster pin.

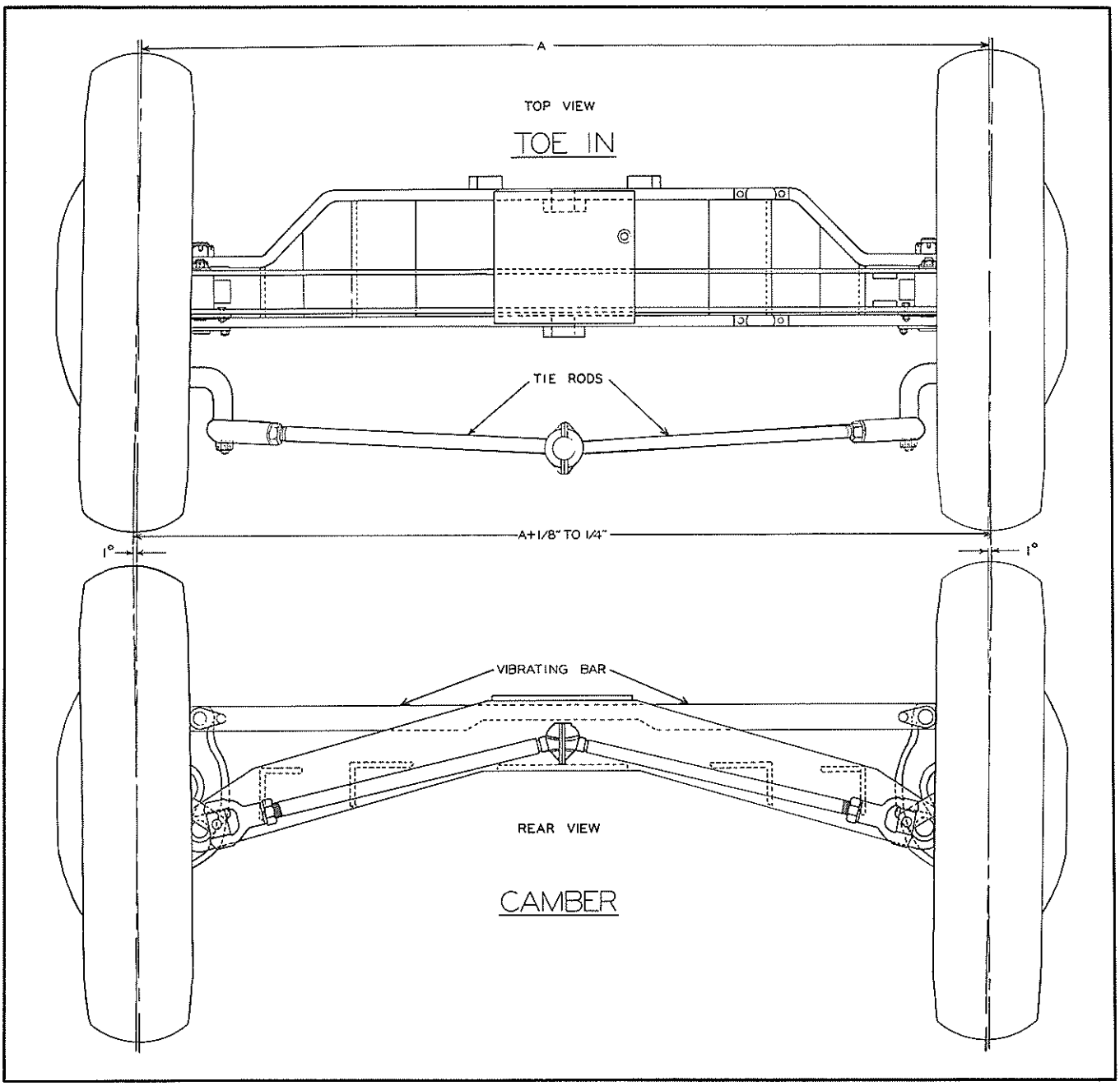
When such removal becomes necessary, the first step is to turn the moldboard crossways to the grader and lower it to the ground. Continue lowering on the moldboard until the front axle is raised slightly. Place blocks under the front axle to support its weight thereby preventing any danger of its turning over accidently during the removal procedure.

Remove the nut and lock washer from the lower end of the steering gear and remove the steering arm as shown in Illust. 13. If the steering arm does not slide off the tapered serrations easily, support the shaft and drive down on the arm using light hammer blows. Do not drive with excessive force on the steering arm as damage to the steering gear mechanism might result.

Remove the cap screw which holds the bolster pin in place and drive the pin out towards the rear as shown in Illust. 14. There are shims located between the axle and the front and rear front bolster plate which should be kept track of so that they may be replaced in their original position.

The frame of the grader can now be raised clear of the axle by continuing to lower the moldboard through the use of the power controls.

If it becomes necessary to replace the bushings around the bolster pin, they can be driven into place through the use of a wooden block. No reaming is necessary on these bushings after they have been replaced. When reinstalling the front axle assembly on the grader, install the shims on front or rear sides of the axle as needed to



ILLUST. 15

provide proper clearance for free oscillation of the axle in the front bolster assembly. Install sufficient shims to remove all free play between the axle and bolster. Be sure to install the tube over the bolster pin between the front and rear bars of the axle.

When reassembling the telescopic shaft on the front wheel lean housing, be sure to assemble it so that the forks of the universal joints are

in the same relative plane as described under "Front Leaning Wheel Gear Assembly". Install the steering arm on the tapered splines of the steering gear shaft as described under the heading "Steering Gears".

Adjustment

Whenever the front axle is reconditioned as described above, the toe-in and the camber should be checked. If it becomes necessary to adjust the toe-in, the locking nuts on the ends of the tie rods should be loosened. The tie rods can then be turned in or out of the tie rod yokes to decrease or increase its total length, thereby changing the toe-in of the wheels. Both tie rods should be adjusted an equal amount in order to keep the steering ball centered.

Shown in Illust. 15, is a sketch of the front axle assembly with toe-in and camber dimensions. In order to properly measure toe-in, a line should be drawn down the center of each tire in order to compensate for any "run-out" of the tires. To do this raise both front wheels clear of the ground and revolve each one rapidly by hand. As the wheel is revolved, hold a piece of chalk against the center of the tread so as to draw a true center line completely around each tire. Now lower the wheels to the ground so that they support the full weight of the front end of the grader. Next, measure the distance between the lines at the front and at the rear of the axle. The distance between these lines should be from 1/8" to 1/4" greater at the rear than at the front; i.e., 1/8" to 1/4" toe-in. Both front wheels should have one degree positive camber (outward inclination of the wheel at the top). This dimension should not be confused with the front leaning wheel feature. It is suggested that to make sure of the dimensions the front leaning wheel control be operated until one of the front wheels assumes a one-degree lean toward the outside. Then check the opposite wheel which should also have a one-degree lean toward the outside. Incorrect camber may be due to worn bushings, bent spindle forks, bent front axle, or elongated holes in the vibrating link. NOTE: It is important that the weight of the grader be supported by the front wheels when any measurements are taken so that the wheels will be in their normal operating position.

FRONT LEANING WHEEL GEAR ASSEMBLY

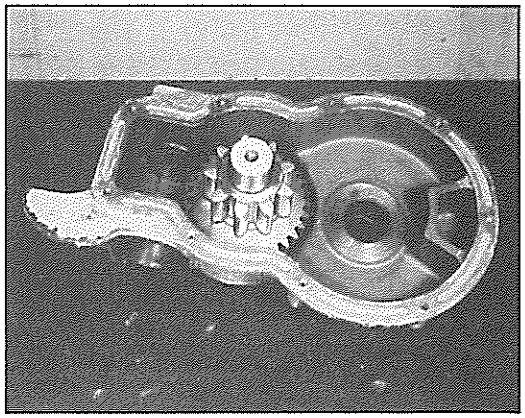
Aside from proper lubrication and occasional adjustment of the worm thrust bearings the front leaning wheel gear assembly require very little attention. However, if repair to this assembly becomes necessary the following instructions will be of help.

Disassembly

The extent to which the front leaning wheel gear assembly is disassembled depends upon the work to be done. The disassembly operation is so simple that no detailed explanation is necessary but should trouble be experienced the mechanism can be disassembled by reversing the reassembly procedure. It is always necessary to completely remove the front leaning wheel gear assembly from the front axle when disassembly of the unit becomes necessary.

Inspection

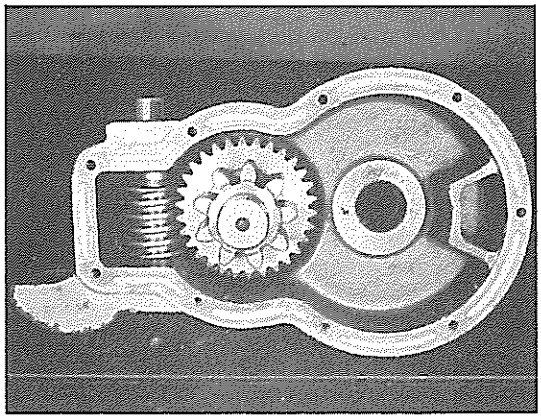
Inspect all parts for excessive wear or other damage. Bearings, gears, and shafts will sometimes seize and score due to insufficient lubricant or improper lubricant being used. Parts damaged in this manner should be replaced.



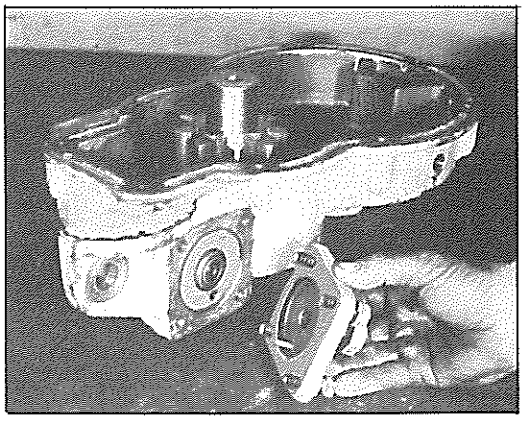
ILLUST. 1

Reassembly

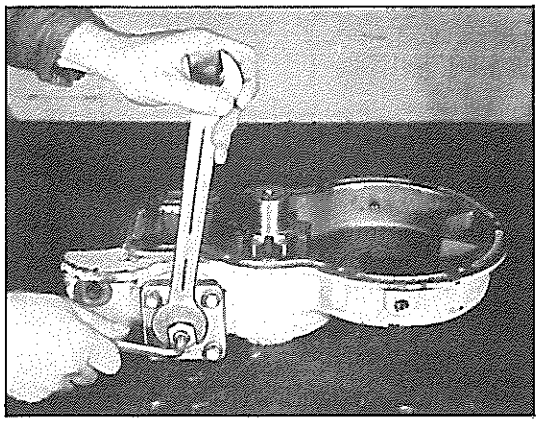
Assuming that the unit has been completely disassembled the first step in the reassembly operation is to install the welded worm gear and pinion in the housing as shown in Illust. 1. Next, install



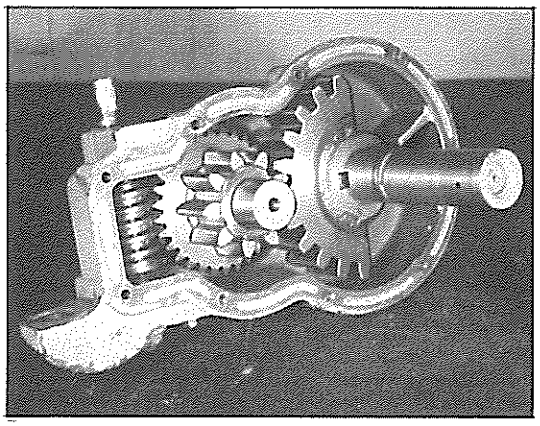
ILLUST. 2



ILLUST. 3



ILLUST. 4

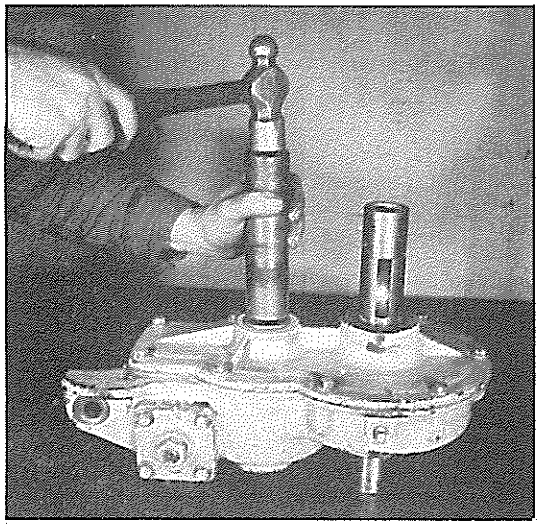


ILLUST. 5

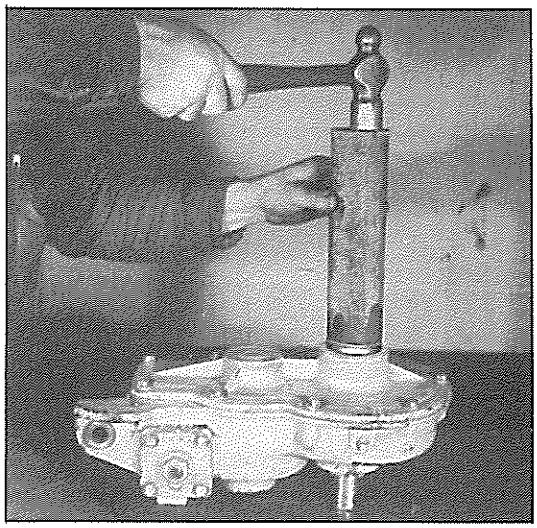
the worm on the shaft by supporting the worm in a press and pressing in the shaft until the lower end of the shaft extends out below the worm 1-7/16". Install the worm and shaft assembly in the housing as shown in Illust. 2.

Install worm thrust bearing, dowel pin, and cap as shown in Illust. 3. The thrust bearing has a rubber seal "O" ring and no gasket is used. Install screw and jam nut in cap and adjust the thrust bearing by turning on adjusting screw until it comes up solid, back if off about 1/16 of a revolution, hold in this position and tighten the jam nut as shown in Illust. 4.

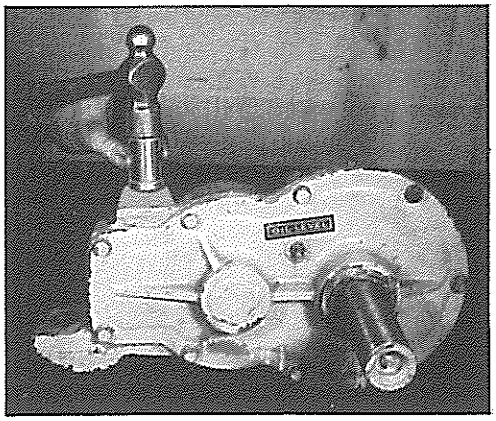
Install the welded half gear on the shaft by supporting the gear in a press and pressing in the shaft until the front end of the shaft extends out past the hub of the gear 4-5/16". Install the gear and shaft assembly in the housing as shown in Illust. 5.



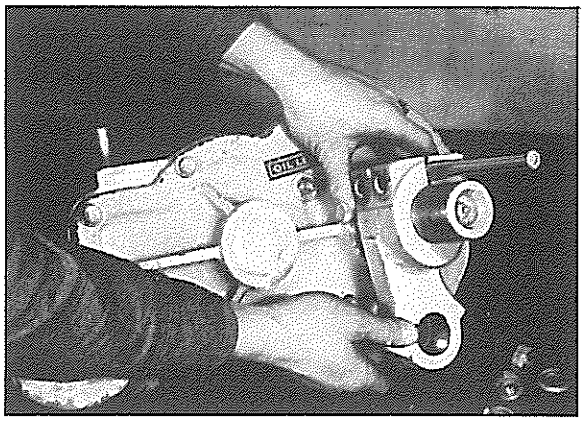
ILLUST. 6



ILLUST. 7



ILLUST. 8



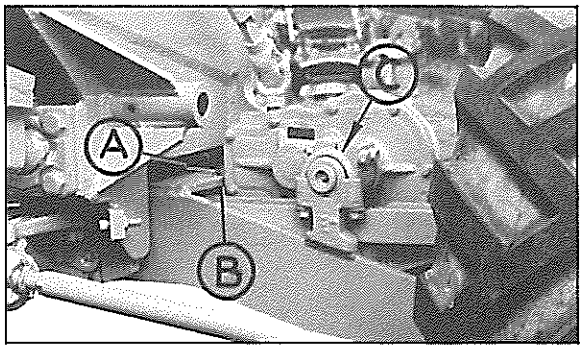
ILLUST. 9

Install the housing cover with gasket and tighten all cap screws securely. If the welch plugs have been removed they should be installed as shown in Illust. 6. Before installing the welch plugs the edge of each plug should be coated with gasket shellac or similar compound. Expand the plug in position by placing a shaft of slightly smaller diameter against the plug and driving it on with a hammer as shown in the illustration. Install the grease seals with the sharp edge of the seal toward the inside of the housing. Drive the seals in place with a piece of pipe as shown in Illusts. 7 and 8.

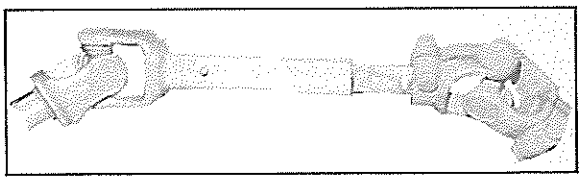
Install the welded tilting crank as shown in Illust. 9. In order to ease the installation of the crank assembly a cold chisel should be driven into the sawed slot as shown in the illustration.

The complete assembly is now ready for installation on the front axle, as shown in Illust. 10.

Insert connecting link pin through yoked end of connecting link and through crank assembly. Tighten crank assembly clamp bolt. Install spherical bearings on ends of gear shaft. Slide flanged end of front tilt housing under front axle plate. Install plow bolt, Ref. A., from top. Next install spacer, Ref. B., and tighten nut. Install spherical bearing "U" clamps, Ref. C., and tighten nuts to a torque reading of 55 ft. lbs. Next, install connecting link pin through vibrating



ILLUST. 10



ILLUST. 11

bars and connecting link. Install connecting link pin bolt, lock washer, and tighten nut on rear of front axle. Install washer and slotted nut on front of front axle. Tighten slotted nut, then loosen 1/6 to 1/3 turn. Install cotter pin and spread. Tighten tilt crank assembly clamp bolts. Next, install telescopic shaft into the hollow square shaft and assembly onto the worm shaft. Tighten universal clamp bolt securely.

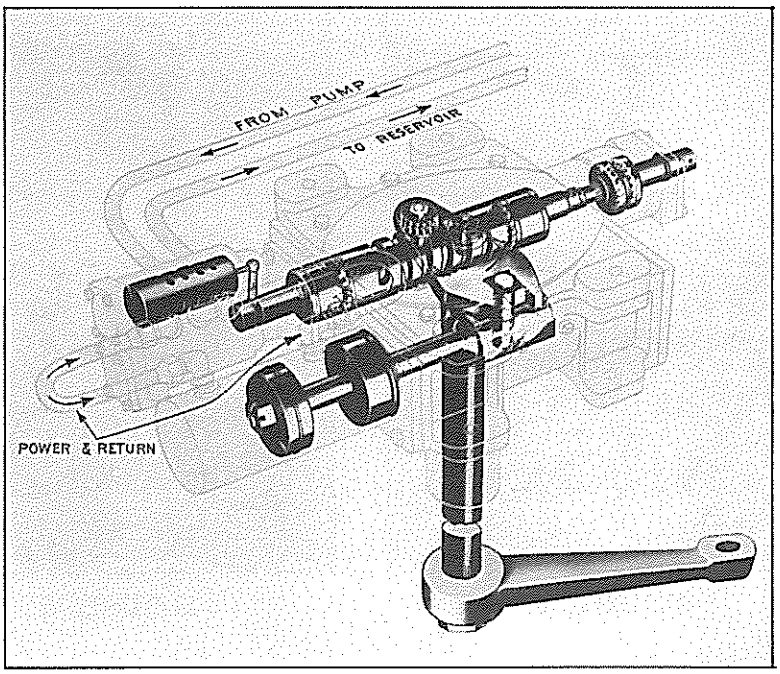
NOTE: The tilt housing connecting link must not rub on vibrating bars.

The telescopic and hollow square shaft universals do not lie in the same relative plane, as shown in Illust. 11.

STEERING GEAR

Shown in Illust. 1, is a phantom view of the power steering gear assembly. This view shows all of the important parts and their relationship to each other.

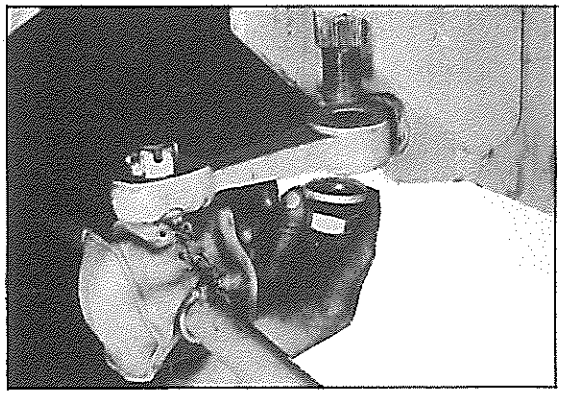
All minor repairs and adjustments to the steering gear can be made without removing it from the grader. However, if it becomes necessary to remove the assembly, follow the procedure outlined below.



ILLUST. 1

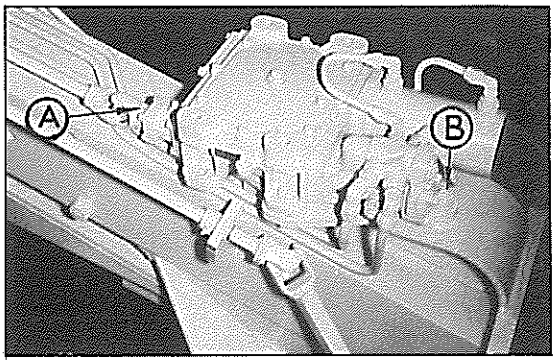
Removal

As shown in Illust. 2, the nut and lock washers should be removed from the end of the shaft and the arm removed from the shaft. When driving the arm from the shaft, the end of the shaft must be supported or serious damage to the steering gear will result. Use light hammer blows to remove the arm.

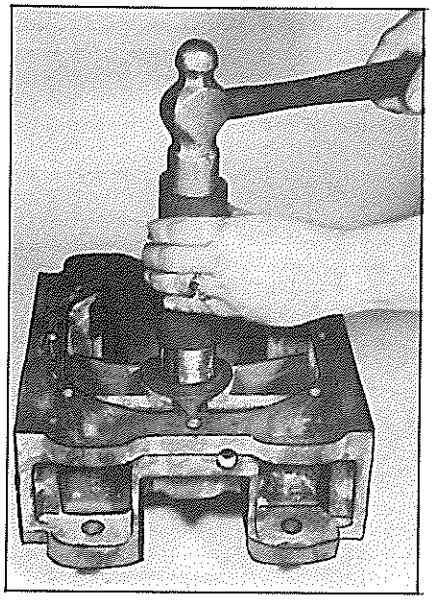


ILLUST. 2

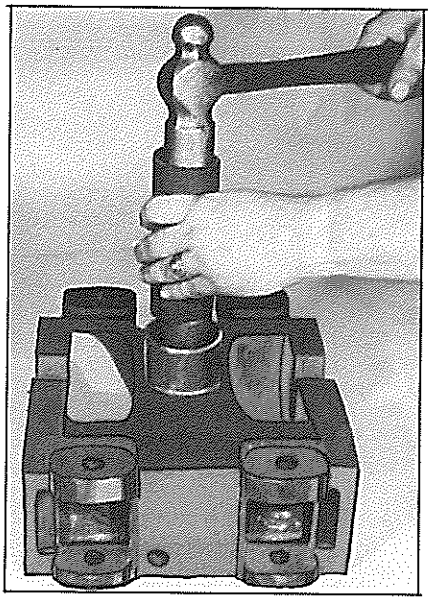
Remove the pin (A) in the universal joint, Illust. 3 and slide the universal joint off the shaft. Disconnect all hydraulic lines leading to the steering gear. CAUTION: Extreme care must be used to keep all dirt and foreign material out of steering assembly, connections and internal parts, as this will cause possible serious damage to the operation of the assembly. Plug all openings, both in the hydraulic lines which are disconnected and the fittings in the steering gear assembly. Remove the torque bolt (B) and remove complete steering gear from the grader.



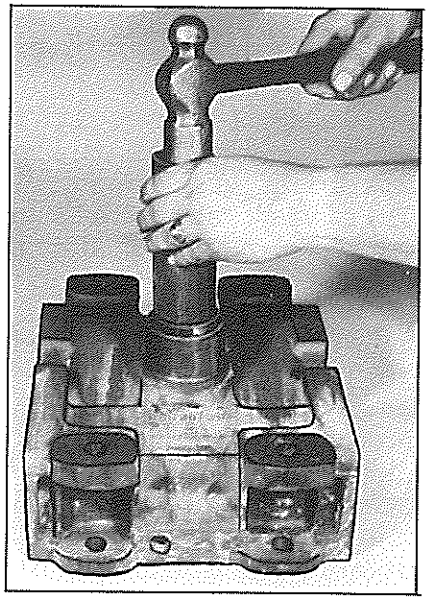
ILLUST. 3



ILLUST. 4



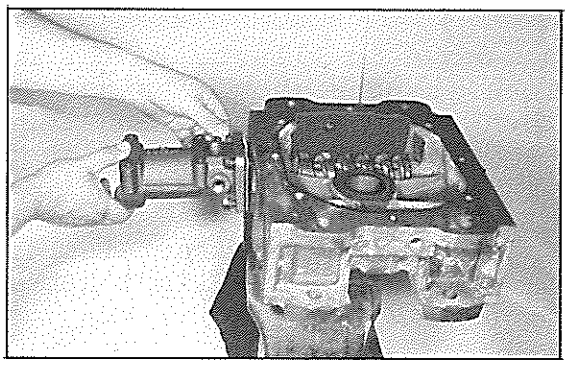
ILLUST. 5



ILLUST. 6

Reassembly

The first step in reassembly is to install the bushing into the top of the gear housing as shown in Illust. 4. When driving the bushing into place, use a piece of pipe or similar driver. Install the bushing into the bottom of the housing as shown in Illust. 5. The grease seal shown in Illust. 6 should now be installed.



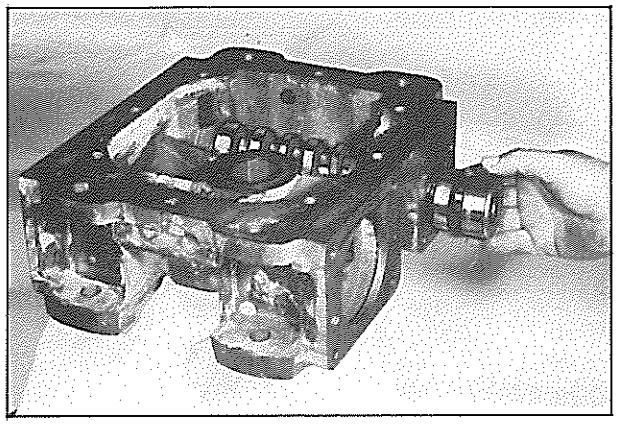
ILLUST. 7

Install cam into gear housing. Assemble a thrust bearing and spring assembly on the valve end of the cam, making sure that the smaller race of the thrust bearing is placed against the shoulder of the cam.

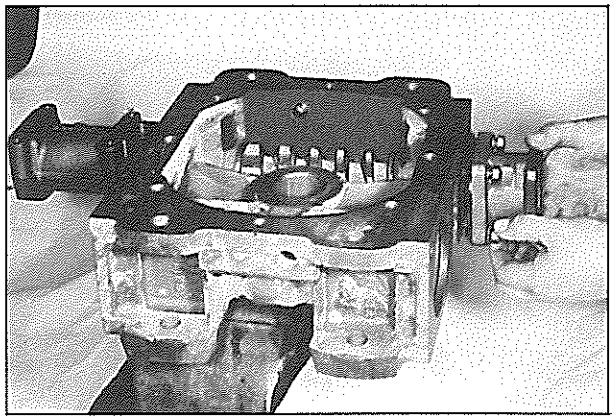
Assemble the control housing and vellumoid gasket to the housing as shown in Illust. 7. Install the cap screws and lock washers and tighten securely.

Assemble the other thrust bearing and spring assembly and install to the other end of the cam (the splined end) as shown in Illust. 8.

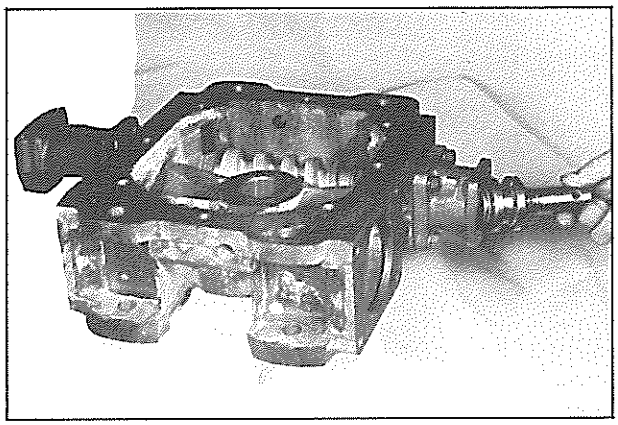
Install wheel tube bearing housing to the gear housing without using the shims or gaskets. Measure the gap between the gear housing and bearing housing with a feeler gauge or shims. This distance will be equal to the amount of shims necessary for proper adjustment. The metal shims are of .002", .003" and .010" thickness. The vellumoid



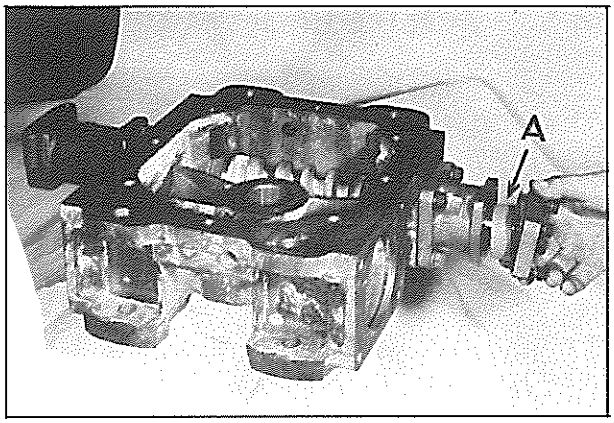
ILLUST. 8



ILLUST. 9



ILLUST. 10

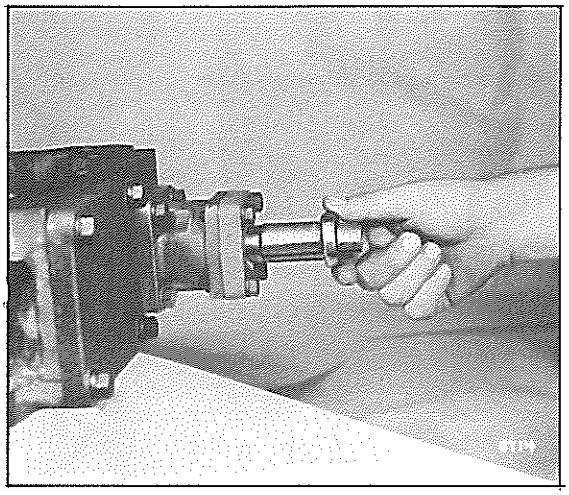


ILLUST. 11

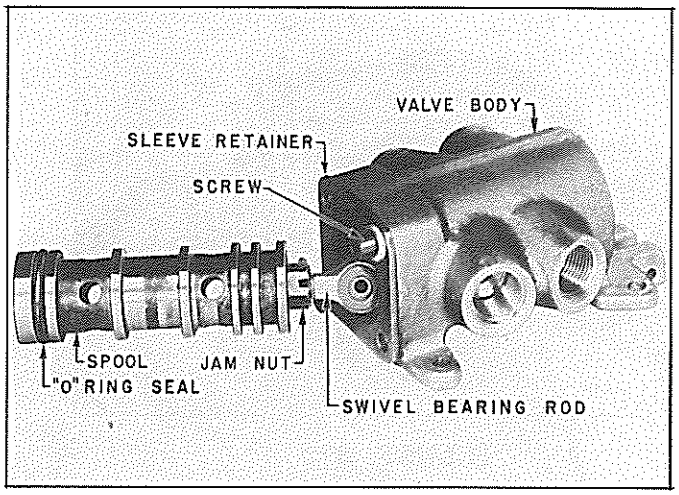
gaksets are of .010" material but are only .006" when compressed. Therefore, they are to be figured at .006" when compressed. Remove the bearing housing and reinstall with the proper amount of shims and gaskets as shown in Illust. 9. In doing this the metal shims are to go between the two vellumoid gaskets. This will allow the vellumoid gaskets to seat the machined surfaces of the gear housing and bearing housing. Install cap screws and lock washers. Tighten securely.

You should be able to turn the cam freely with your fingers. If the cam is hard to turn, not enough shims have been used. If it has end play, too many shims have been used.

Assemble the bearings to the wheel tube and secure them with snap rings as shown in Illust. 10. Coat end of shaft with a light grease and install the assembly to the splined end of the shaft. Install the spacer "A" (Illust. 11). Determine the amount of shims necessary to go between the bearing housing and the end cover by the same procedure as used between the gear housing and bearing housing. Install



ILLUST. 12



ILLUST. 13

the shims and end cover with the metal shims between the vellumoid gaskets. Install lock washers and cap screws and tighten securely. Install the grease seal around the wheel tube being sure not to damage the seal. One way of expanding the leather seal over the end of the shaft is by wrapping a thin piece of shim stock around the shaft in a funnel shape as shown in Illust. 12.

It should be noted that if either the valve body (Illust. 13) the sleeve or the spool should require replacement, the entire valve assembly must be replaced. The parts of the valve are not furnished individually for repair. The "O" rings between the valve spool and the sleeve, the swivel rod bearing and nut and the valve spool cover "O" ring are the only internal parts of the valve that can be serviced.

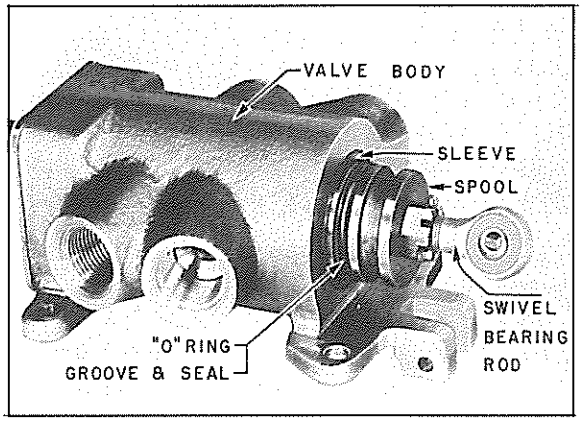
Place the "O" ring seal in groove on end of valve spool, opposite the swivel bearing rod end Illust. 13. Push the spool through the sleeve far enough to uncover second groove in swivel bearing rod end of spool, Illust. 14.

Assemble "O" ring seal in second groove, Illust. 14 and push this end of spool back into sleeve until "O" ring seal has just entered the sleeve. Slip snap ring into first groove in spool and push on spool at the same time, pressing snap ring into groove in valve body. Tighten the two screws holding the sleeve retainer, Illust. 13.

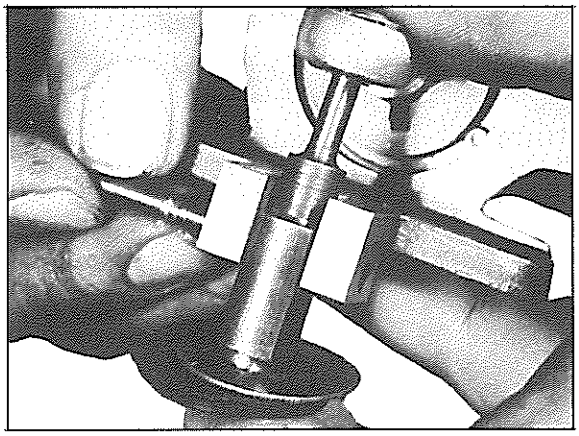
Assemble the swivel bearing rod and jam nut to spool, Illust. 13. Insert the actuating lever in swivel bearing, then insert pivot pin through valve body clevis and actuating lever, Illust. 15.

Assemble the steel washer, then rubber seal over rounded portion of actuating lever, Illust. 15.

Place the valve assembly in position on control housing and start the four mounting screws, making sure the rounded portion of the valve actuating lever fits into its groove in the steering gear cam. THIS IS IMPORTANT: If actuating lever has not entered the groove in the steering cam before the mounting screws are tightened, it will result in breaking the swivel bearing rod and lever brackets, Illust. 14. Make sure the steel washer is centered over the rubber washer, Illust. 15. Tighten the mounting screws holding valve body to control housing. With the jam nut loose turn valve spool with screw driver until face of spool is flush with face of sleeve, Illust. 16.



ILLUST. 14



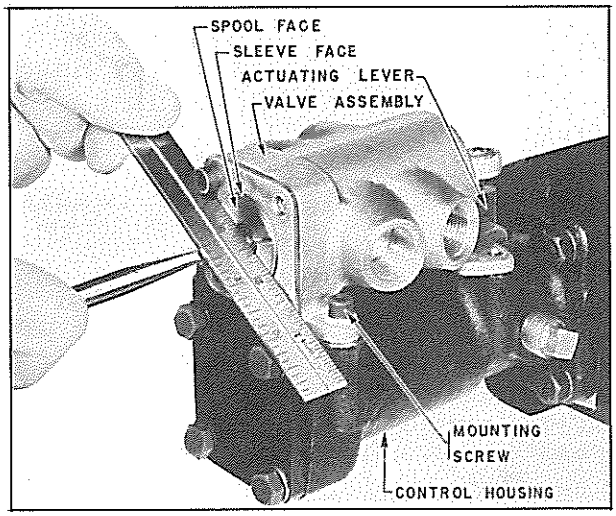
ILLUST. 15

Connect all power steering hydraulic lines and check oil level in power steering supply tank. Start engine and turn steering wheel to right and left several times. This will bleed the air from the hydraulic system and will determine if valve spool is properly adjusted. It may be necessary to change adjustment a little one way or the other to equalize the steering effort. Tighten the jam nut approximately 25 ft. lbs.

Assemble gasket and dust cover over swivel rod bearing and actuating lever. Install the valve spool cover and "O" ring and secure with Allen head screws and lock washers.

Install the rubber seal, vellumoid gasket and steel washer in the order named, into the adapter as shown in Illust. 17. Be sure and place the lip of the seal toward the inside of the adapter. Install the snap ring "A" and "O" ring as shown in Illust. 18.

Install adapter "A" (Illust. 19) to

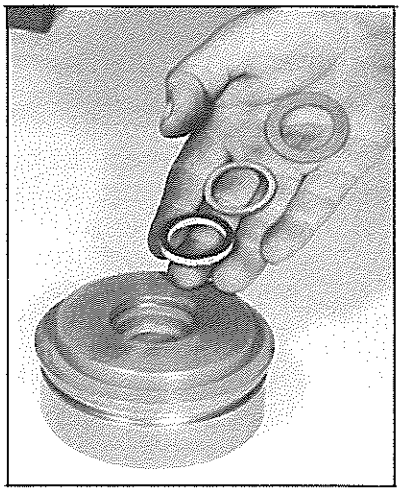


ILLUST. 16

slide bar "B" with the end containing the seal going on first. Install piston ring "C" to piston "D" and place piston on the slide bar with the taper of the piston mating with the taper of the rod. Place the washer on the threaded end of the shaft.

Install locking nut and tighten to a torque reading of 75 foot pounds.

Install cylinder adapter "E" and snap ring "F" to cylinder. Complete the assembly by placing piston and adapter in the cylinder. Take care while installing the adapter into the cylinder that the "O" ring is not damaged. Slide bar should move freely through the cylinder and adapter.

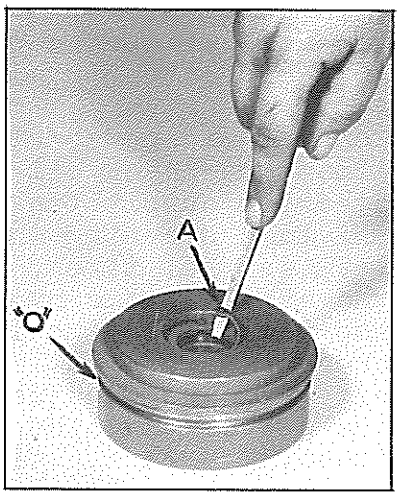


ILLUST. 17

Install gasket "A" and install the cylinder assembly to the gear housing as shown in Illust 20. Install hex head cap screws and lock washers and tighten securely.

Assemble the lever block pin, lever block, washer and snap ring as shown in Illust. 21 and install them in the slide bar.

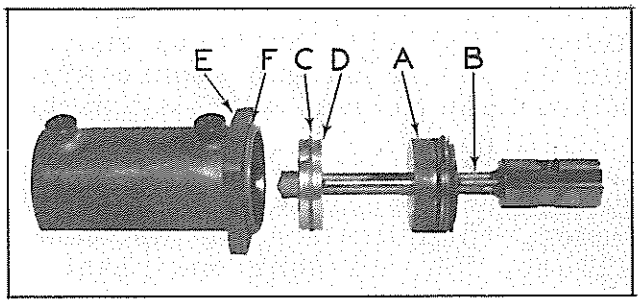
As shown in Illust. 22, install the set screw and lock nut in end of slide bar and tighten securely. Make sure the lever block is free to rotate on the pin and that the slide bar and piston are free to move back and forth in the housing and cylinder.



ILLUST. 18

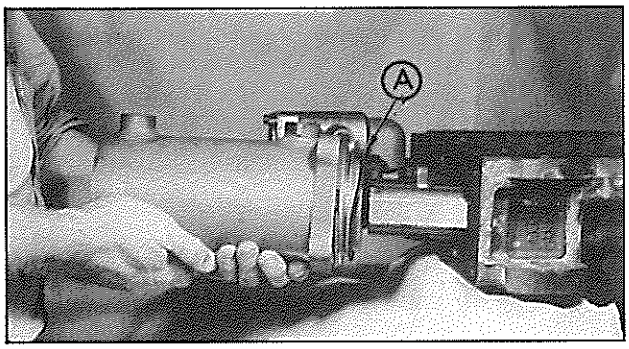
Install gasket "A" and cover "B" (Illust. 23). Install hex head cap screws and lock washers. Tighten securely.

Assemble the stud roller bearing unit (shown in Illust. 24), in the lever shaft.

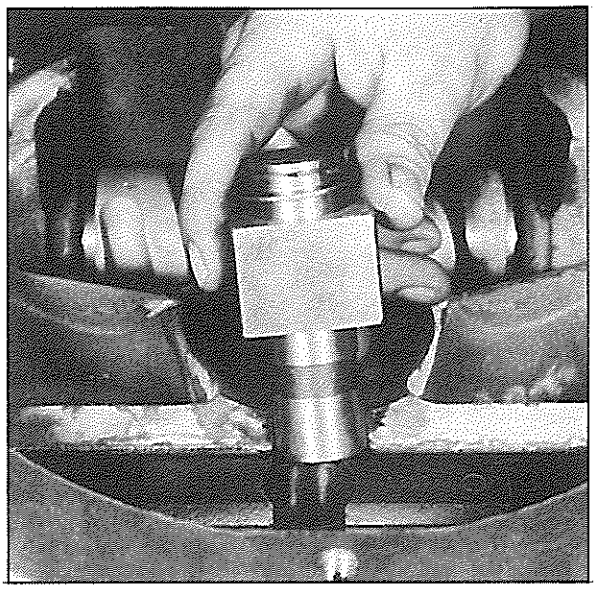


ILLUST. 19

The roller bearing should be pre-loaded at all times. Adjust to a noticeable drag. NOTE: Operation of a correctly adjusted unit may feel rough to the hands but under steering load it will operate smoothly and the load will be properly distributed. The unit should be adjusted to a minimum of three (3) inch lbs. of torque to revolve the stud, never below. Care should be



ILLUST. 20

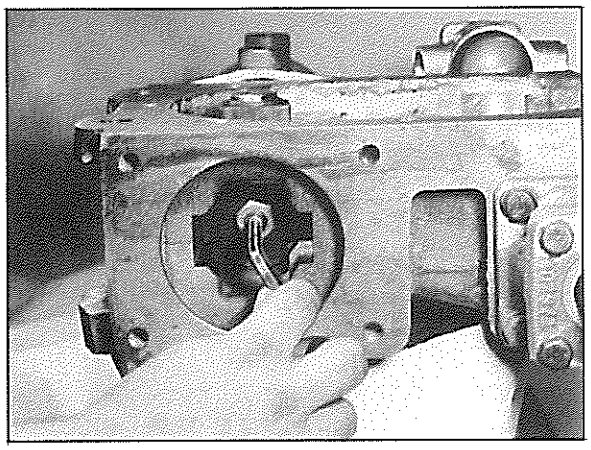


ILLUST. 21

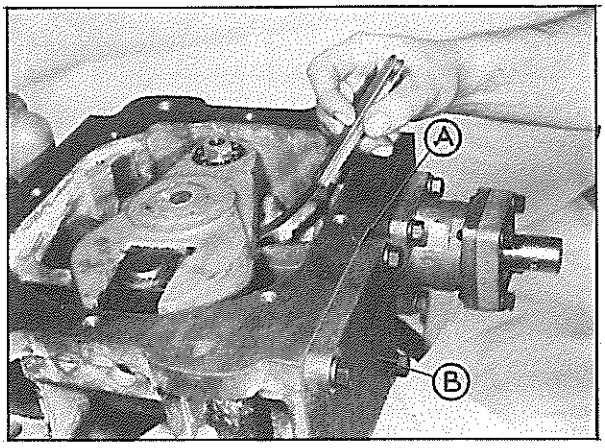
taken not to burr the surface of the stud. Lock the adjustment by bending the washer prong against a side of the nut.

Omitting the spacer washer, spring washer, and shims place the lever shaft in the gear housing as shown in Illust. 23. First make sure there are no burrs on the shaft that would damage the bushing. With the stud centered on the cam as shown in the illustration, measure the distance between the face of the lever and the face of the trunnion. Subtract .219" (which is the thickness of the spacer and spring washer in their compressed state) from the measurement. If there is no difference, no shims are needed. If there is a difference add the .010" shims as necessary. NOTE: The shims should be installed to the closest .010". For example, a difference of .024", you should add two shims and for a .026" difference, add three shims.

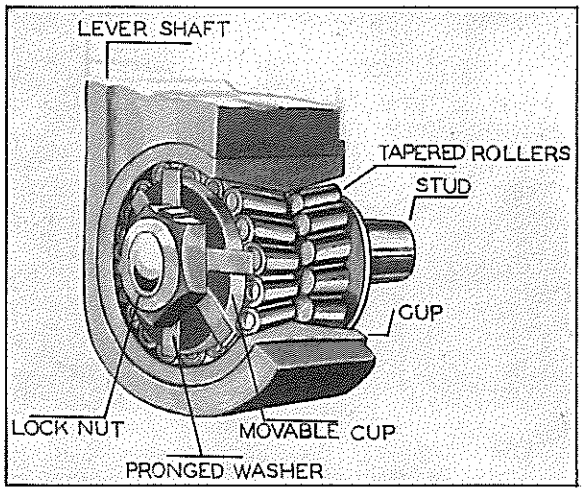
After the necessary shims have been determined, remove the lever shaft from housing and install the spring washer, spacer washer and the



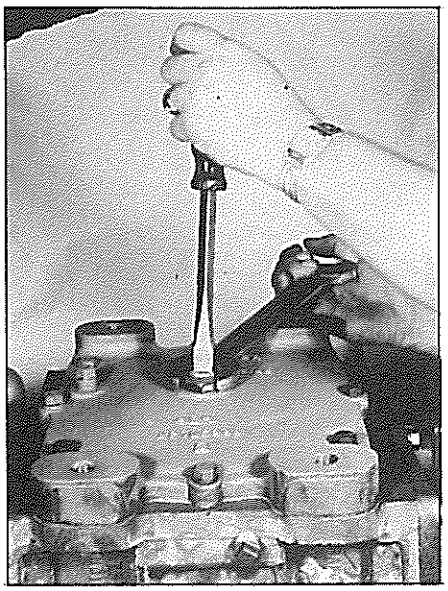
ILLUST. 22



ILLUST. 23



ILLUST. 24



ILLUST. 25

shims if necessary to the shaft and reinstall the shaft to the gear housing. Install the cover using a new gasket and fasten securely in place with the lock washers and cap screws.

Install adjusting screw and jam nut as shown in Illust. 25. NOTE: The backlash of the stud in the cam groove shows up as backlash at the steering wheel and at ball on steering arm.

The groove in the cam is cut narrower in the mid-position range of stud travel to provide close adjustment where the straight ahead driving takes place.

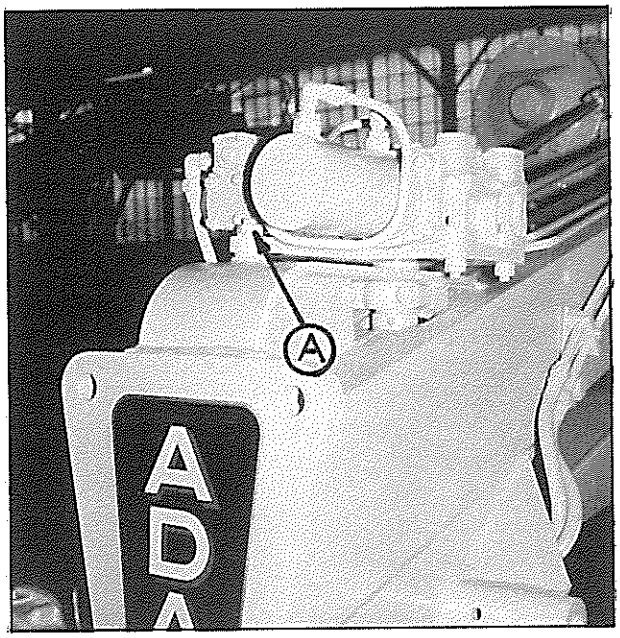
Adjust through the mid-position. Do not adjust in the end positions. Backlash in the end positions is normal and not objectionable.

When making the adjustment tighten the adjusting screw until a slight drag is felt when turning the gear through mid-position. While holding the adjusting screw, tighten the lock nut. Recheck the drag at the wheel through full travel of gear.

Installation

The main point to watch when the unit is being installed to the grader is that the vertical lever is not placed in a bind due to tightening down on the torque bolt. The spacer washer should be placed over the lever shaft before lowering the gear in position and then before tightening the torque stud "A" Illust. 26, check the unit closely to be sure tightening the stud will not draw the plate down, thereby, placing the complete unit in a bind. If necessary use shims to prevent this condition.

When installing the steering arm on the serrations on the lower end of the lever shaft, it must be mounted so the front spindles will strike the stops before the steering gear reaches its maximum position. This is important as improper mounting of the steering gear may result in a broken steering gear. To determine the proper position for mounting the steering arm, turn the steering gear to the left as far as it will go. Then turn the front wheels to the left until they strike their stop. Turn the steering gear back to the right slowly until the first set of serrations on the lever shaft line up properly to allow the steering arm to become mounted. Install and tighten the lock washer and nut on the end of the lever shaft.



ILLUST. 26

Install the grease tube and fitting for the lower bearing of lever shaft. Remove plugs and reconnect the hydraulic lines. Install universal joint, and secure with pin and cotter pins.

Hydraulic Pump

The hydraulic steering booster pump will give good service with the proper care.

It is necessary to keep the whole system free from dirt. The oil used in the hydraulic system should be kept clean while in storage. The filter screen should be checked often. It is No. 200 wire mesh and should not be allowed to become clogged. Good oil should be used at all times. (Use a premium grade S.A.E. #10 in cold weather and S.A.E. #20 in warm weather.) Do not use hydraulic brake fluid, or low viscosity naphtha base motor oils. The hose and fittings should be checked daily for breakage or looseness.

Disassembly

Clean the outside of the pump with an oil solvent, or similar fluid and dry thoroughly. Using a file or oil stone, remove the sharp edges or burrs from the shaft splines, drill point, keyway or shaft end before disassembly. Mark the sections of the pump with a prick punch to insure proper reassembly. The pump may be disassembled by reversing the assembly procedure.

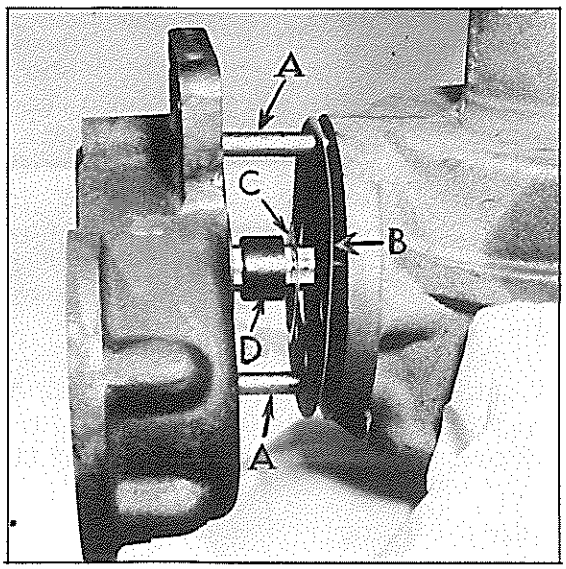
Reassembly

The first step in reassembly is to install stud bolt "A" (Illust. 27) to the vertical drive housing as shown in illustration. Now install gasket "B", shims "C", and spacer "D" in order named.

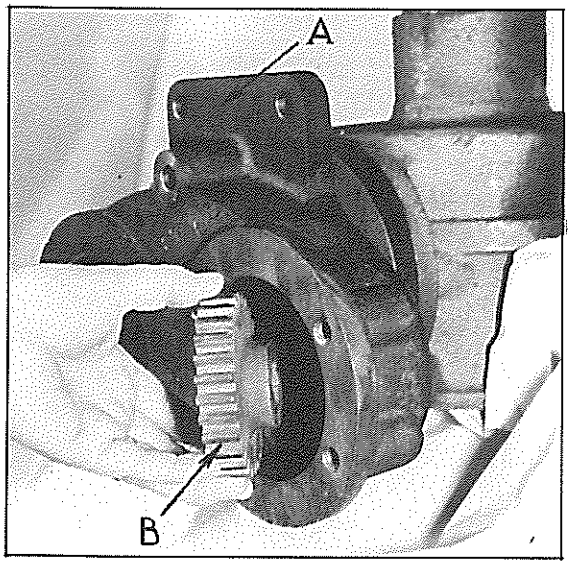
Install adapter housing "A" on studs (as shown in Illust. 28) just far enough to hold the housing in position while installing gear "B" to splined shaft in the housing. After the gear is started on the splined shaft, you may then slide the gear and housing simultaneously, until the adapter housing is up against the vertical drive housing, as shown in Illust. 29. Install lock washers and cap screws and tighten securely, as shown in Illust. 30.

Before installing the needle bearings in the adapter and end cover, the bearings should be checked for freeness of rollers and pitted, broken or excessively worn rollers. The bearing should be replaced if it is possible to insert a .020" feeler between the rollers. If it is necessary to replace the bearings, do so only with the same make and type as were originally installed.

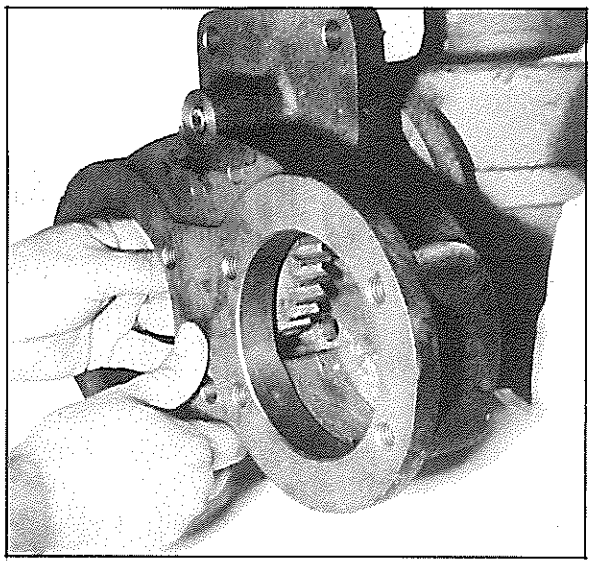
Install the needle bearings to the end cover and adapter, as shown in Illusts. 31 and 32. Always apply pressure to



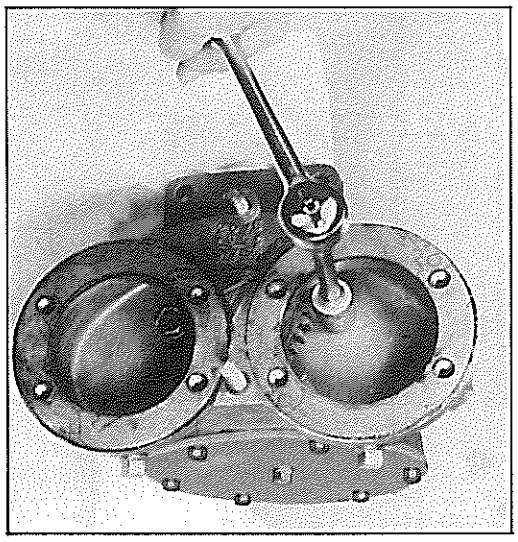
ILLUST. 27



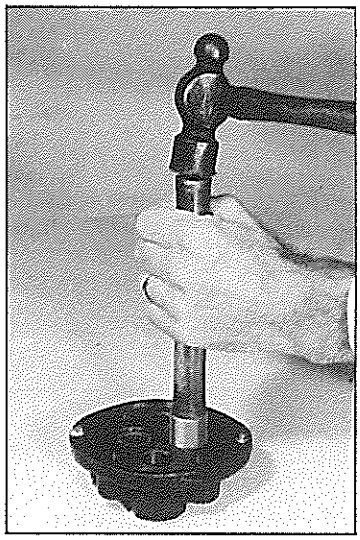
ILLUST. 28



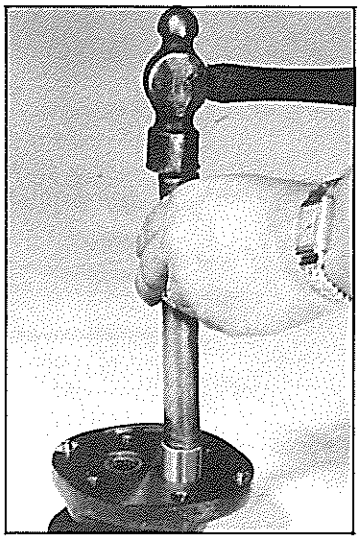
ILLUST. 29



ILLUST. 30



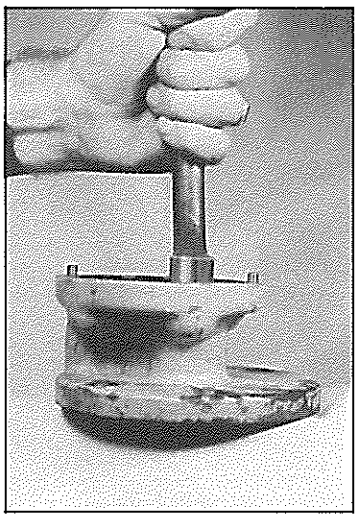
ILLUST. 31



ILLUST. 32

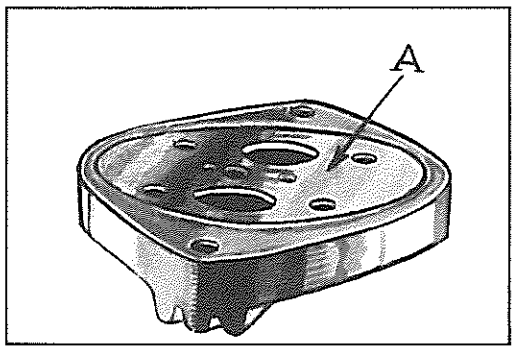
lettered end of bearing. It is better to press them in if possible. If not, use a soft piece of tubing or drift and take care not to damage the bearing. The bearings should be lubricated with a light grease.

Press or drive seal into adapter and against shoulder of adapter, as shown in Illust. 33. When driving seal seat into adapter, use a soft drift pin as illustrated.



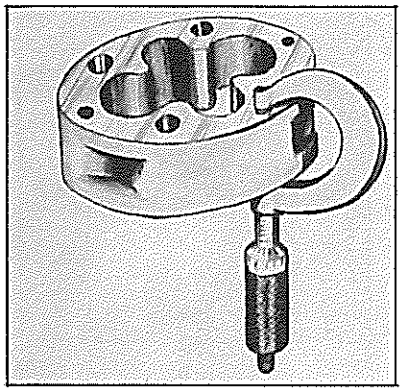
ILLUST. 33

Check the wear plate "A", Illust. 34, for scoring or excessive wear. NOTE: Do not turn wear plate as the counter-bored relief pocket is on gear side only. If wear place is steel backed, bronze side should be next to gears. Even though slight wear is shown on gear pattern, check for erosion path in vicinity of relief pocket and replace if in evidence. Also the wear place should be properly seated. If it has a slight rocking motion, check the face of the end cover or adapter for a burr. Be sure that the counter-bored relief pocket is up and in original position. Lubricate the contact surface of the plate with light oil.

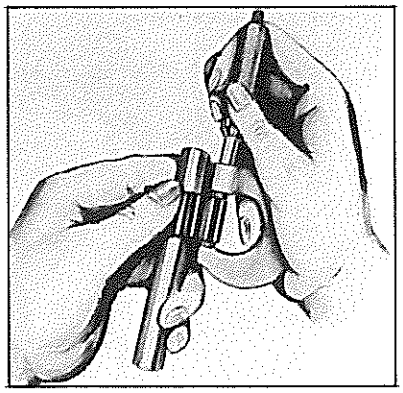


ILLUST. 34

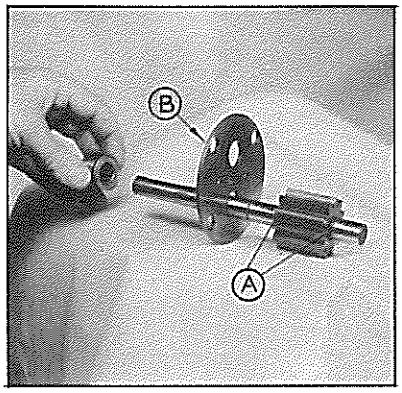
Proper clearance between the gear face and wear plate is provided by the plastic shim gasket between the housing and adapter and the housing and end cover. Using micrometers, measure the width of the hou-



ILLUST. 35



ILLUST. 36

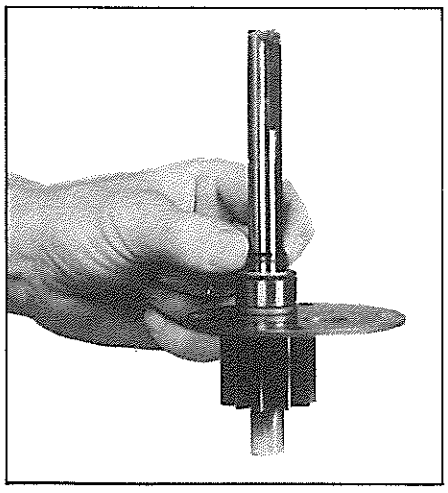


ILLUST. 37

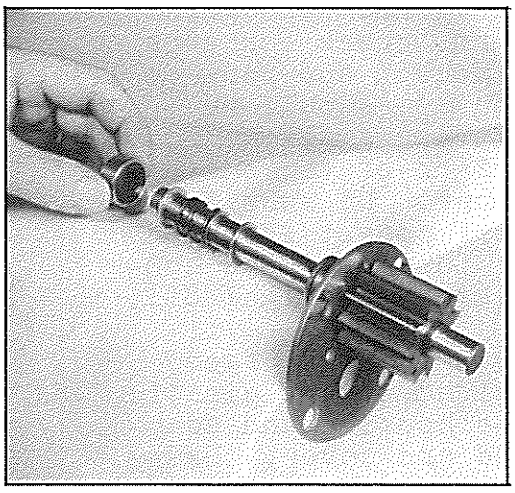
sing, shown in Illust. 35 and the width of the gears, as shown in Illust. 36. If the gear width is .002" greater than the housing width, a red shim (.002") should be installed on the adapter side and a red shim (.002") to the end cover side. If the gear width is .001" greater than the housing, an amber shim (.001") should be installed on the adapter side and a red shim (.002") to the end cover side. If the housing and the gears are the same width, an amber shim (.001") should be installed on the adapter side and an amber shim (.001") to the end cover side.

Press gear onto shaft and center gear between the two (2) snap ring grooves in shaft. Next, install the snap rings, Ref. A, one (1) on each end of gear. Now, install plate, Ref. B, onto pump shaft. Next, install bearing, as shown in Illust. 37.

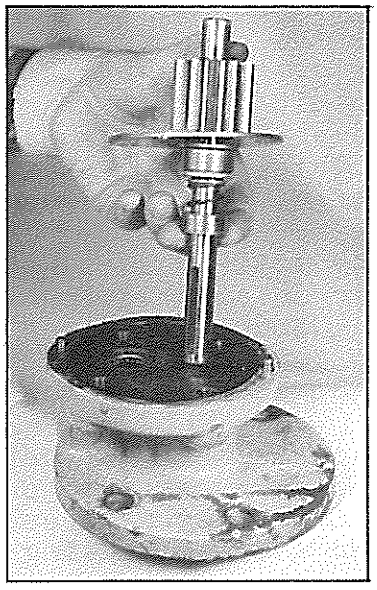
Install snap ring into groove on pump shaft, as shown in Illust. 38.



ILLUST. 38



ILLUST. 39



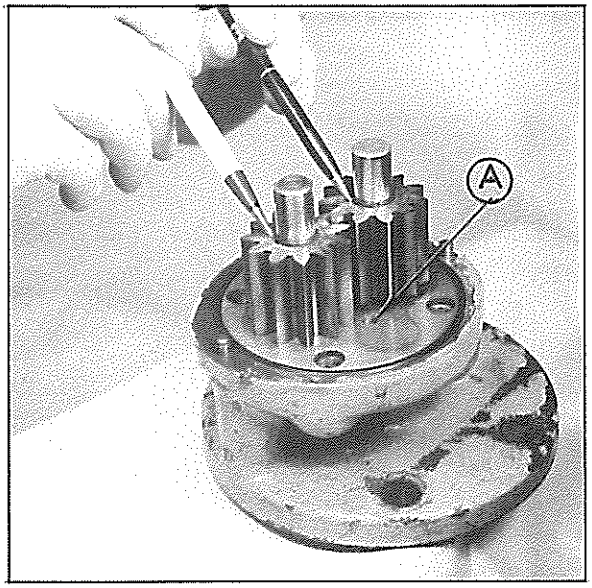
ILLUST. 40

Install washer, spring, 2nd washer and seal on shaft, as shown in Illust. 39. Next, insert shaft through housing, as shown in Illust. 40.

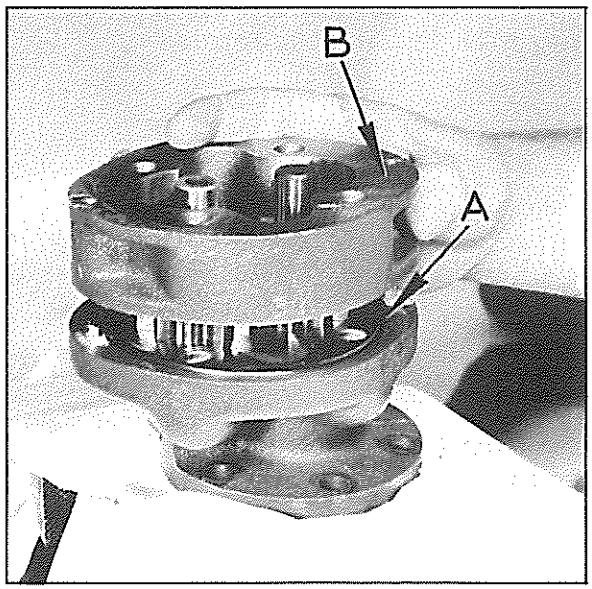
Install the gears, as shown in Illust. 41. Make sure that they are in their original position and that the relief pocket, "A", is in its original position, on the pressure side and that the edge of the teeth and the gear face is not scored. If new gears are installed, keep the keyways 180° apart, as illustrated. Install "O" ring, "A", in groove outside of the wear plate as shown in Illust. 42. Install the gasket shim that was determined to be used between the adapter and the housing. Line up the punch marks and place the pump housing, "B", over gears and gasket. Be sure that the dowel pins fit into the holes in the housing. Tap the housing with fibre hammer to secure.

Install the wearing plate to the end cover, with the relief pocket side toward the gears and on the same side of the gears as the relief pocket wear plate in the adapter. Be sure that the bleed hole in the wear plate is lined up with the corresponding size bleed hole in the cover. Install the "O" ring, "A", Illust. 43, as shown in illustration. Install the proper gasket shim "B". Lubricate the face of the wear plate with clean oil. Install dowel pins, "C", in cover. Line up the punch marks previously made on the housing and cover. Install cover to housing and tap with fibre hammer until cover is tight against the housing. Be careful not to damage the "O" ring and check to make sure that the bleed backhole in the cover is on the intake side of the pump.

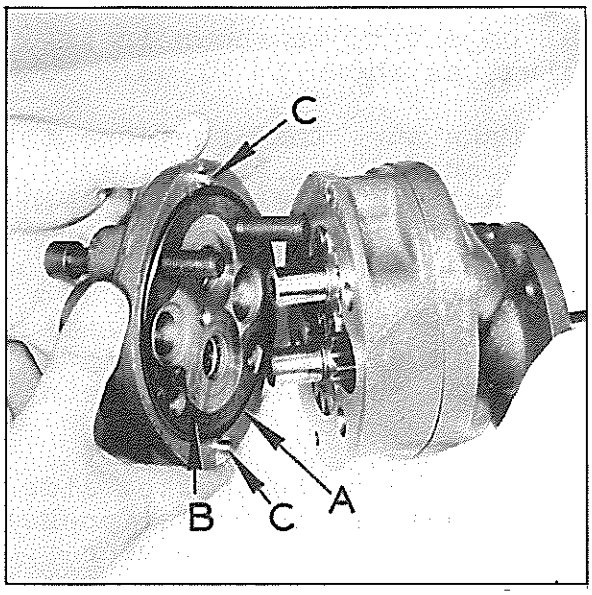
Install the four Allen head cap screws and lock washers. Gradually tighten opposite cap screws. Tighten them to a 60 ft. lbs. torque. After the assembly has been completed, turn the shaft with a six inch



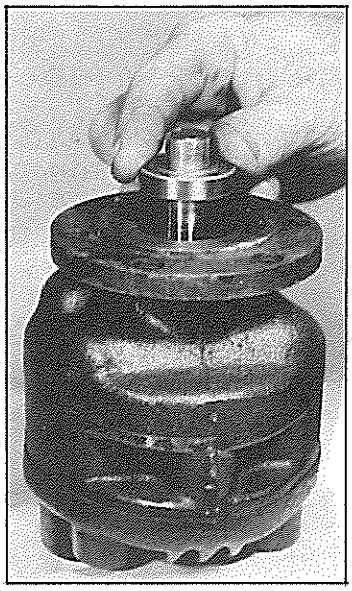
ILLUST. 41



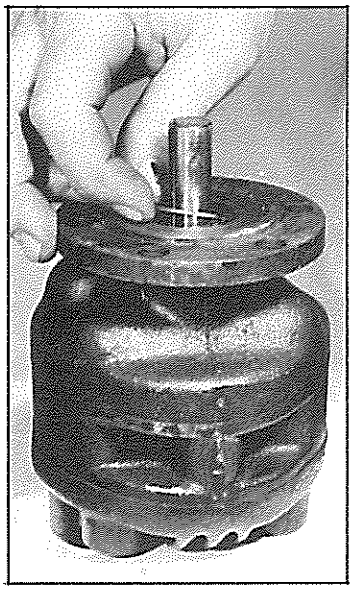
ILLUST. 42



ILLUST. 43



ILLUST. 44

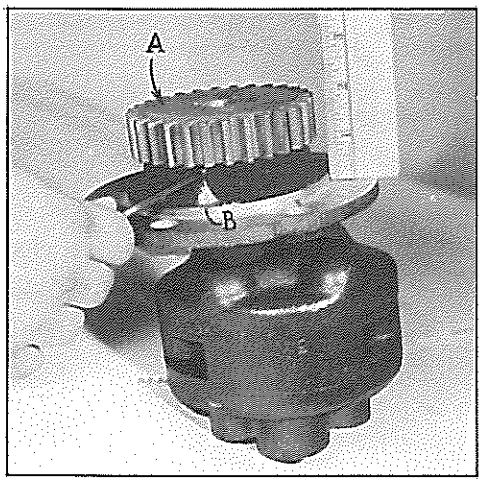


ILLUST. 45

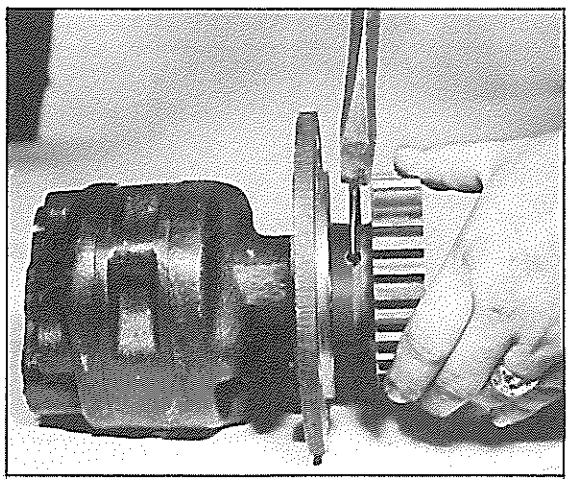
wrench. If the shaft will turn with a slight drag and not too freely, you will have the proper clearances. If the shaft is too tight or too free, add or remove as many gaskets as necessary for proper clearance.

Install bearing over drive shaft, as shown in Illust. 44 and install snap ring into groove, as shown in Illust. 45.

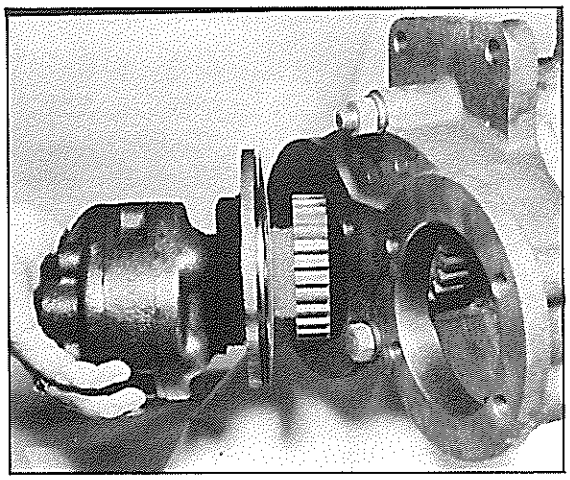
Install key in keyway on pump shaft and install the driven gear, "A", Illust. 46, using a fibre hammer or similar tool. The distance between the flange of the pump adapter to the bottom edge of the gear should be 15/16" as shown in the illustration. Install Allen head set screw, "B", and tighten securely.



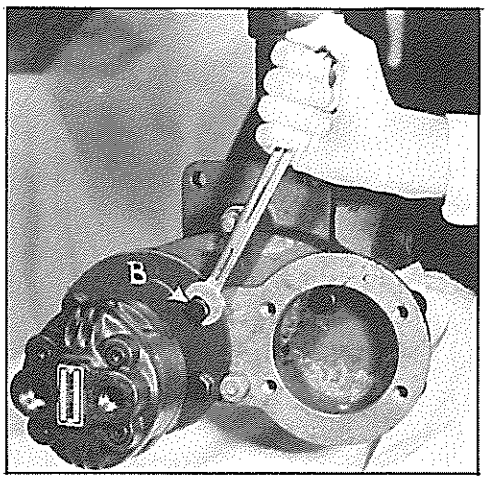
ILLUST. 46



ILLUST. 47



ILLUST. 48



ILLUST. 49

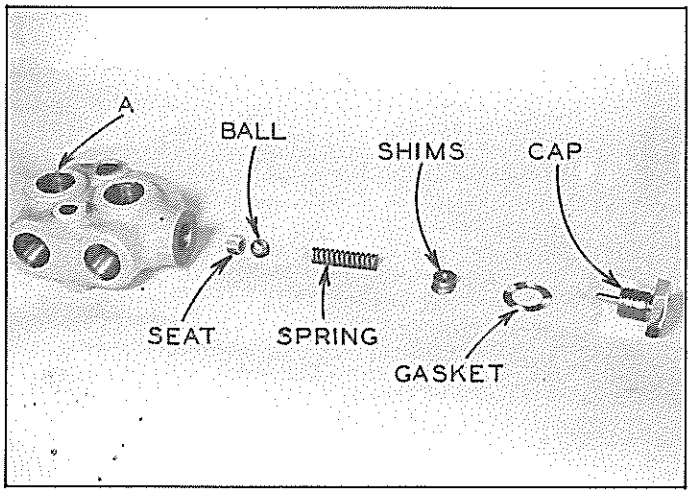
Install snap ring making sure that the end of the snap ring is in the set screw hole, as shown in Illust. 47.

Using a new gasket, install the pump to the adapter housing, as shown in Illust. 48. Install cap screws and lock washers, "B", Illust. 49 and tighten securely.

Install the pump opening cover and gasket. Secure with four cap screws and lock washers.

Relief Valve

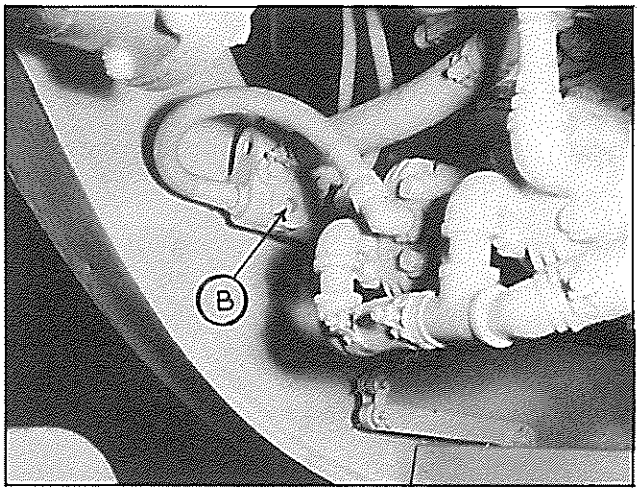
Illust. 1 is an exploded view of the pressure relief valve. The valve is adjusted and sealed at the factory and we do not recommend disassembly of the valve in the field. The valve is set at 1000 P.S.I. This pressure must be maintained. If there is any doubt as to the valve setting, the pressure may be checked by removing the socket head pipe plug and installing a pressure gauge at the point designated as, "B", in Illust. 2.



ILLUST. 1

Disassembly

If it should become necessary to remove the valve from the grader for cleaning or repair, importance



ILLUST. 2

in cleanliness in disassembly and assembly cannot be over-emphasized. Even a minute particle of foreign matter may cause improper seating of the relief ball.

After the valve has been completely disassembled, as shown in the illustration, it should be washed completely with a good solvent and all parts inspected for wear and pitting or corrosion.

Any parts showing wear should be replaced. If the spring should become weakened enough to effect the pressure, it should be replaced.

Reassembly

When reassembling the valve, extreme care should be exercised to prevent dirt from entering the valve. Be sure nine shims are used between the spring and the valve cap, also use a new gasket when reassembling the valve.

As shown in Illust. 1, install seat, ball, spring and shims, into body, Ref. A, as illustrated. Next, install gasket on cap and tighten cap. Install fittings, then tighten valve assembly to frame. Install hose and lines to valve.

Be sure to check oil level in hydraulic reservoir before starting engine. Check for oil leaks while engine is running.

SCARIFIER LIFT

The scarifier lift will often take tremendous shock loads so there will be an occasional repair on this mechanism.

Disassembly

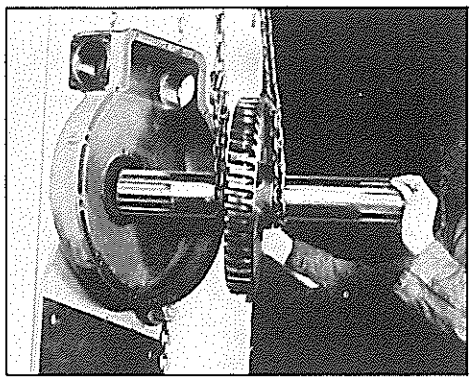
Whenever it becomes necessary to completely disassemble the scarifier lift, it is necessary to remove the complete assembly from the frame of the grader. Although complete disassembly is very seldom necessary, the instructions outlined here cover such a procedure. In case of only partial disassembly, only that portion of the instructions which apply need be followed. All points of wear in this assembly are equipped with replaceable steel-backed bushings. If there is excessive wear, they can be removed and new bushings installed by supporting the housing in a press and pressing in the bushing. These bushings require no reaming after installation.

Inspection

Inspect all parts for excessive wear or other damage. Bearings, shafts, and gears will sometimes seize and score due to insufficient or improper lubricant being used. Parts damaged in this manner should be replaced.

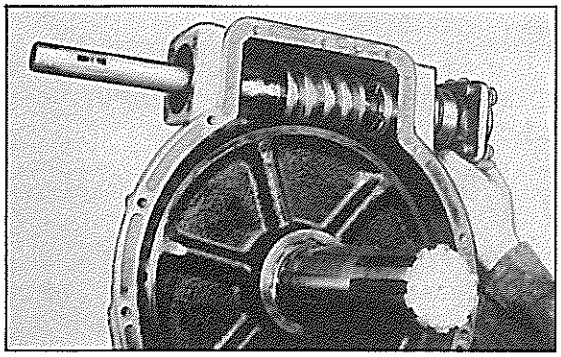
Reassembly

If the lift mechanism has been completely disassembled, the first step in reassembly procedure is to install the worm gear on the shaft. Install by supporting the gear in a press and pressing in the shaft. The gear should be centered over the center spline and installed with the long hub side of the gear turned toward the long end of the shaft. It is best when installing the gear, to first heat it in oil to expand it slightly before pressing in place. Install the worm gear and shaft assembly in the housing as shown in Illust. 1, with the long hub side of the gear turned toward the cover side of the housing.



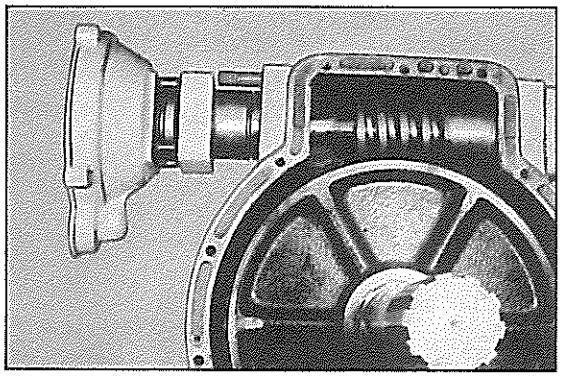
ILLUST. 1

Install the worm on the end of the worm shaft. Install by supporting the worm in a press and pressing in the shaft until the rear end of the shaft extends out from the rear surface of the worm 9-17/32".



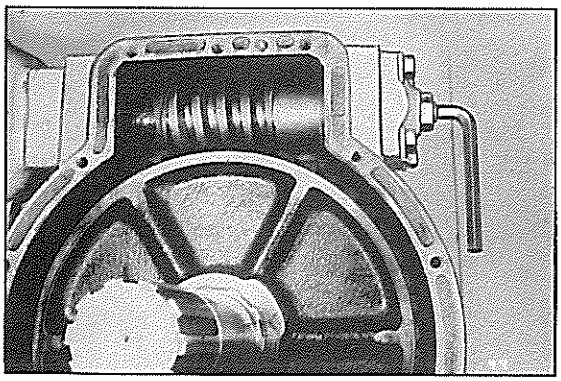
ILLUST. 2

Install the bushing within the worm thrust bearing, then install the "O" ring on the bearing. Grease the bearing and "O" ring, then install. This will enable you to slide the thrust bearing into the housing without damaging the "O" ring. When installing the bearing cap, first align the dowel pin in the end of the bearing in a diagonal line across the cap screw holes in the housing, then install the bearing cap with cap screws as shown in Illust. 2. Also shown is the front end of the lift worm shaft extended into the worm thrust bearing.



ILLUST. 3

Install 4 studs in housing for reduction housing. Install the worm thrust bearing with "O" ring. Then install gasket on reduction housing Illust. 3, and insert the key into the thrust bearing and match keyway on reduction housing with that on the thrust bearing and tighten reduction housing securely with four nuts.



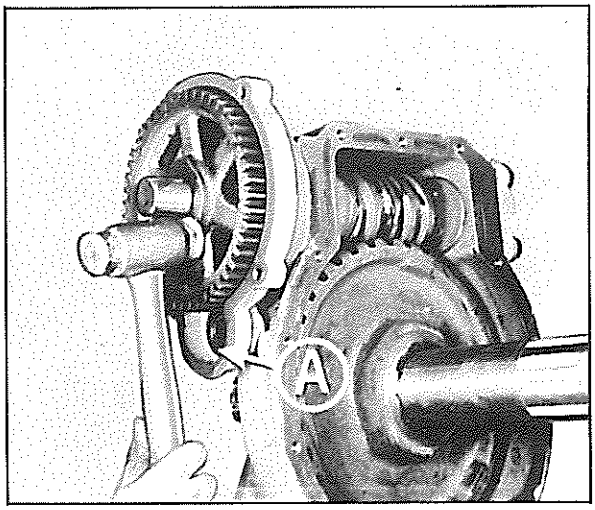
ILLUST. 4

Install the adjusting screw and hex jam nut in the bearing cap as shown in Illust. 4. Tighten the set screw until all of the play has been taken out. Then back the set screw off 1/16 of a turn, hold in this position and tighten the jam nut securely.

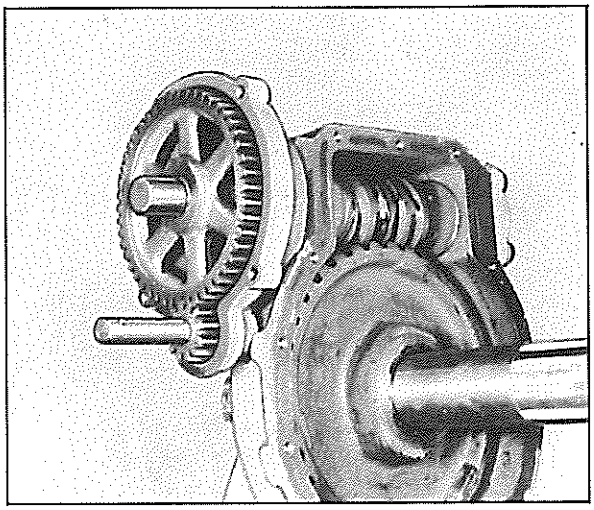
Install as shown in Illust. 5, bushing (A) for the spur pinion shaft. Press or drive the bushing in place with a block of wood and hammer. Now install the spur gear on the lift worm shaft by driving it into position as shown. Drive the gear in until it lines up with the driving pinion. It will be necessary to assemble the pinion to the shaft and place the assembly in the reduction housing to check this alignment.

Install the spur pinion and shaft assembly in the reduction housing as shown in Illust. 6.

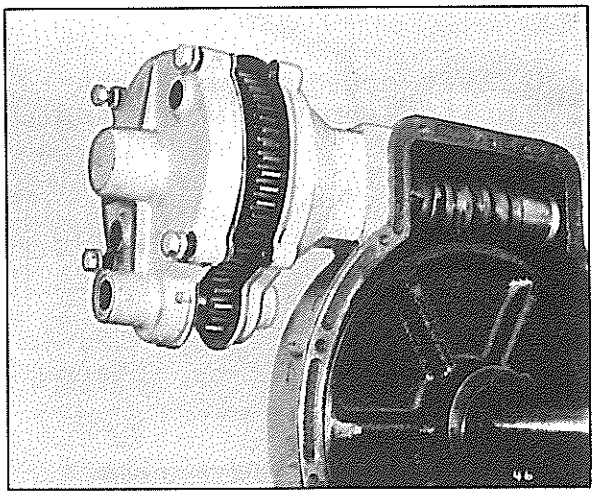
After checking the gear alignment, install the reduction housing cover, using a new gasket. Coat the gasket with gasket shellac or simi-



ILLUST. 5



ILLUST. 6



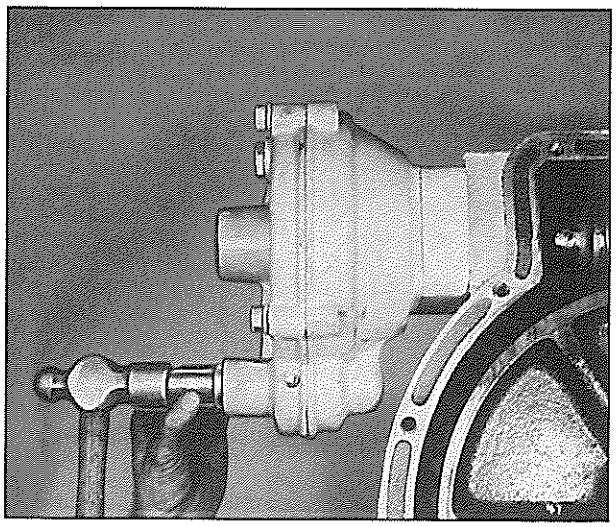
ILLUST. 7

lar sealing compound before installing. Install the four cap screws with lockwashers and tighten securely as shown in Illust. 7. Install the drain plug then install the filler and level plugs with gaskets.

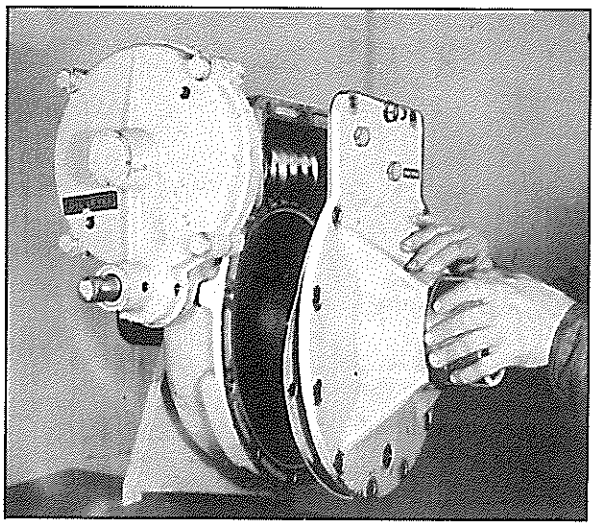
Install the grease seal around the pinion shift with the sharp edge of the seal facing toward the inside of the housing. Use great care when sliding the seal over the end of the shaft not to turn the edge of the seal down or damage it in any way. Drive the seal into the cover with a piece of pipe and hammer as shown in Illust. 8.

Install the lift housing cover with gasket as shown in Illust. 9. Be sure to line the dowel pins in the top and bottom of the cover up with the dowel pin holes in the housing. Install the filler plug, level plug, and drain plug. NOTE: The filler plug is equipped with a vent hole.

Install grease seals on each end of the scarifier lift shaft. Place shim stock around the splined end of the shaft to prevent damage to the grease seals. Now install the grease seals with the sharp edge facing toward the inside of the housing. Use care when sliding these seals over the shaft, so as not to turn the edge of the seals down or damage them in any way. Then drive the seals into the housing cover with a piece of pipe and hammer as shown in Illust. 10.



ILLUST. 8



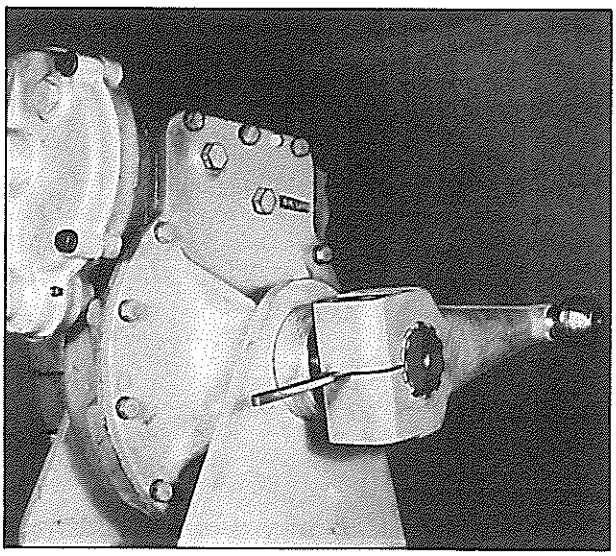
ILLUST. 9

Slide the right hand support plate onto the lift housing cover and install lift arm as shown in Illust. 11. The lift arm can be expanded to ease installation by driving a cold chisel into the sawed slot in the arm as shown in the illustration. Slide the lift arms in until they are flush with the ends of the shaft. Be sure that they are both mounted in the same position on the shaft. Then install and tighten the clamping bolt securely.

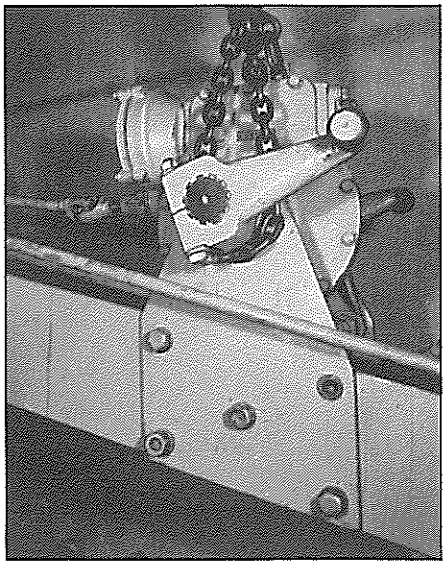
The completed assembly is now shown being installed in Illust. 12. It is well to pass the bolts through the frame of the grader on alternate



ILLUST. 10



ILLUST. 11



ILLUST. 12

sides as shown in the illustration in order to prevent either right or left hand support plate riding exclusively on the threads of the bolts.

The ball and socket joints of the lift links are equipped with laminated shims and are adjusted in the same manner as that described for the blade lift mechanism.

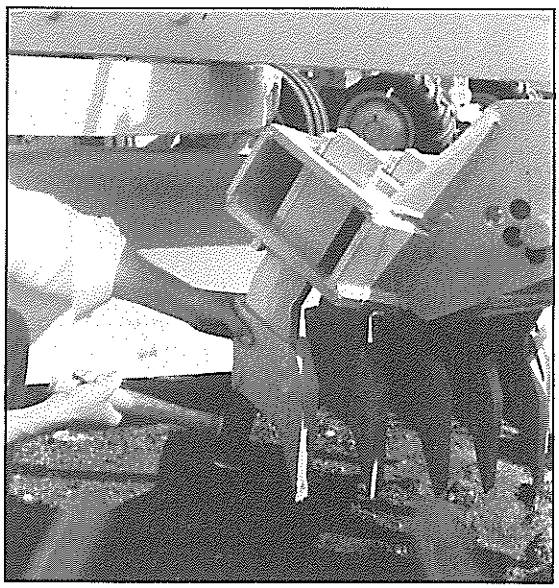
Scarifier Block

The scarifier block requires very infrequent repairs. The replacement of scarifier teeth, when worn, can be made without replacement of the scarifier shanks, as shown in Illust. 13. Shanks can be easily removed when necessary, as shown in Illust. 14.

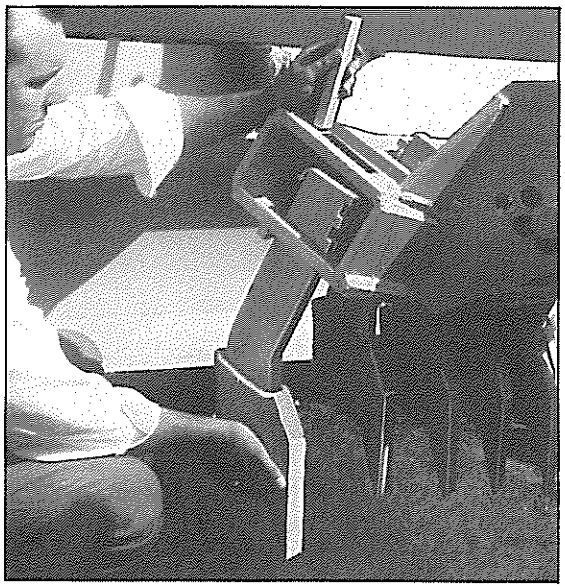
Occasionally the drawbars may be bent by turning the machine, while the scarifier teeth are imbedded in hard ground.

Inspection of the scarifier should include checking for holes worn in the block.

The pitch of the teeth can be adjusted to working conditions through the shifting of the bolts in the drawbars. There are five positions available through this adjustment.



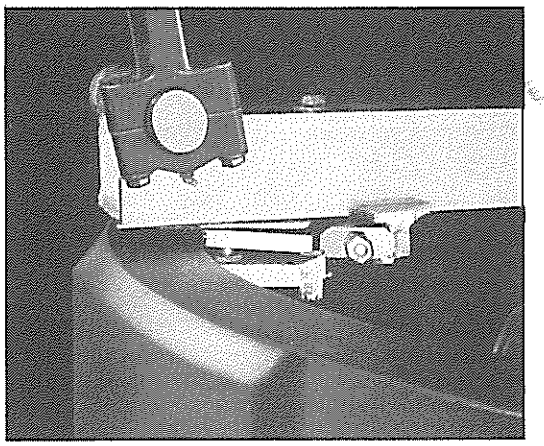
ILLUST. 13



ILLUST. 14

CIRCLE (Slide-Shift and Power Shift Moldboard)

The drawbar and circle assemblies require very infrequent repairs or adjustments. Occasionally, the circle may become bent slightly due to misuse or accident. It is important that the circle be true within certain limits in order to maintain proper operating efficiency. The two dimensions on the circle which should be checked are for out of plane and out of round. The circle should not be out of round more than 3/32" as measured on the inside diameter. The top surface of the circle should not be out of plane in excess of 5/32". A circle is attached to the drawbar at three points by three sets of adjusting and wearing plates. Shim washers are provided between the lower or retaining plate and the center of adjusting plate of each set for adjustment to compensate for wear. Illust. 1, shows one of three sets of adjusting and wearing plates. The upper or wearing plate and the lower or retaining plate are reversible. In other words, when these plates become worn badly on one side, they can be removed and turned over to provide a new wearing surface.

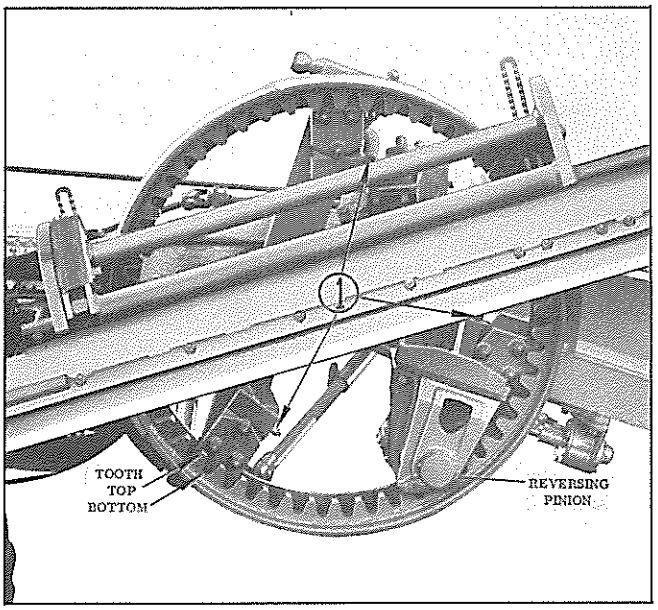


ILLUST. 1

Adjustment

The vertical clearance between the circle and the upper or wearing plate of each set should be 1/16" when blade is suspended clear of ground. When all shims have been removed and the vertical clearance is greater than 1/16", the lower or retaining plate of each set should be turned over with the unworn side against the circle, and sufficient shim washers replaced between it and the center or adjusting plate of each set to obtain the 1/16" clearance between the circle and the top or wearing plate.

The center or horizontal adjusting plate of each set can be adjusted by wedge blocks (1) in Illust. 2, against the inside edge of circle to remove horizontal side clearance due to wear. The clearance at these points should be 1/16".



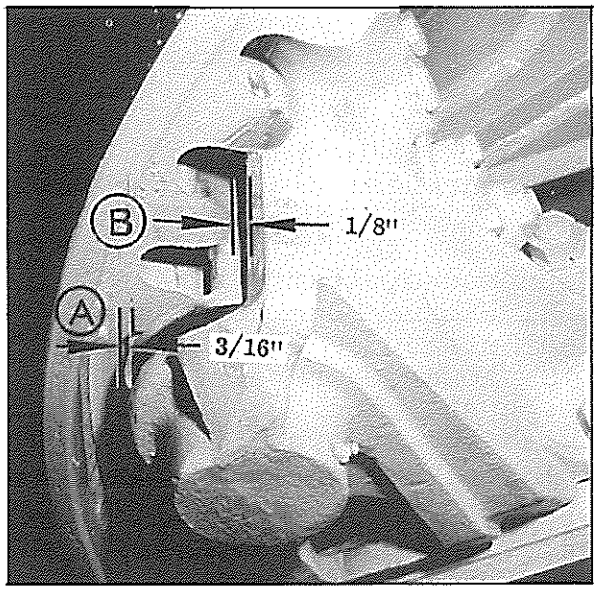
ILLUST. 2

12

When any new parts are installed or adjustments made on the circle, the circle must be checked and centered, if necessary to get the correct mesh of the circle reverse pinion and the gear rack on the inside of the circle.

Set horizontal adjusting blocks so the circle can be rotated; then turn circle, and by sight, note where the pinion meshes deepest in the gear rack. With the circle in this position, push it in so that it contacts the front and the left adjusting plate, or adjust plate to meet circle, being sure to leave a minimum clearance of 3/16" between the top of the pinion tooth and the bottom of the tooth in the gear rack, as shown in Illust. 3, Ref. A.

This minimum clearance can be checked by making two right angle bends in a 3/16" rod so that it can be placed between the top and bottom of the teeth. Set the adjusting blocks to obtain the correct clearance.



ILLUST. 3

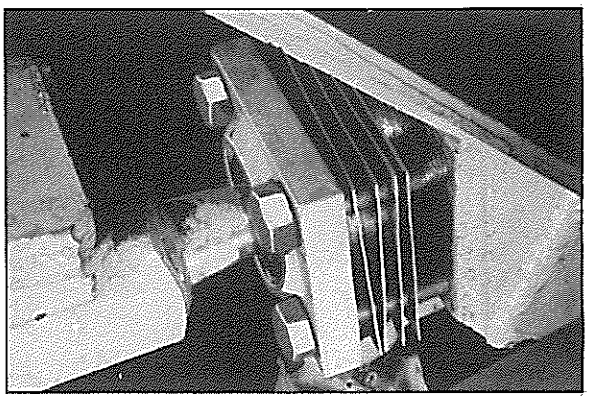
NOTE: There must be at least 1/8" clearance between tooth on the gear rack and the left side of the circle reverse housing, Ref. B. To increase this clearance the two rear adjusting blocks should be adjusted. The right rear block should be slacked back toward the center and the left rear block pushed out. This will cause a side shifting of the circle in relation to the drawbar. It will then be necessary to readjust the pinion mesh with the circle rack.

Rotate circle and check the clearance between the top of each pinion tooth and the bottom of the tooth in the rack. This clearance should run from 3/16" minimum to 3/8" maximum. Under no condition should the circle be operated under load when the maximum clearance between the teeth is more than 3/8" as this will damage the circle gear mechanism.

Keep Circle Oiled

Clean the dirt off circle flange daily or oftener, if necessary. Lubricate the circle flange daily with a light motor oil. Use fuel oil in extremely dusty conditions.

The ball and socket joint which attaches the drawbar assembly to the



ILLUST. 4

frame of the grader is equipped with shims which can be removed to compensate for wear. Two different thicknesses of shims are provided at this point and when looseness becomes excessive, the four cap screws which hold the drawbar bearing cap to the main frame, should be removed as shown in Illust. 4, and sufficient shims removed from the joint to remove the free play in the ball joint. The joint should never bind but should always work freely. After reassembling and tightening the four cap screws, a soft wire should be passed through the drilled heads of the cap screws and twisted tight, to prevent their working loose during operation of the machine.

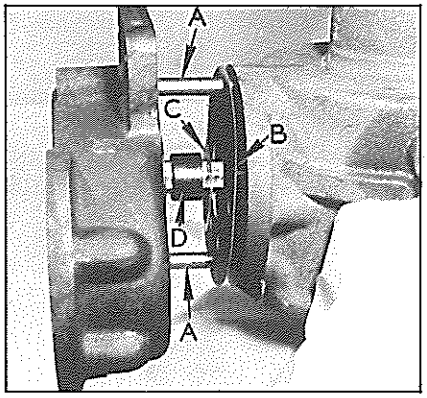
HYDRAULIC PUMP

The hydraulic power shift moldboard pump will give good service with the proper care.

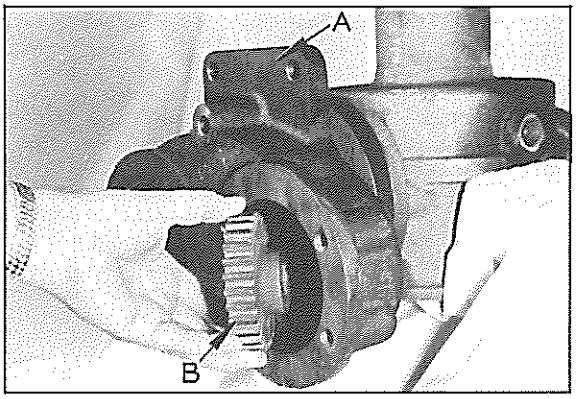
It is necessary to keep the whole system free from dirt. The oil used in the hydraulic system should be kept clean while in storage. The filter screen should be checked often. It is No. 200 wire mesh and should not be allowed to become clogged. Good oil should be used at all times. (Use a premium grade S.A.E. #10 in cold weather and S.A.E. #20 in warm weather). Do not use hydraulic brake fluid, or low viscosity naphtha base motor oils. The hose and fittings should be checked daily for breakage or looseness.

Disassembly

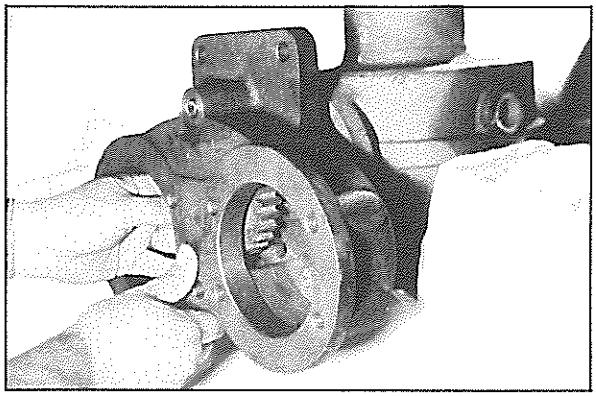
Clean the outside of the pump with an oil solvent, or similar fluid and dry thoroughly. Using a file or oil stone, remove the sharp edges or burrs from the shaft splines, drill point, keyway or shaft end before disassembly. Mark the sections of the pump with a prick punch to insure proper reassembly. The pump may be disassembled by reversing the assembly procedure.



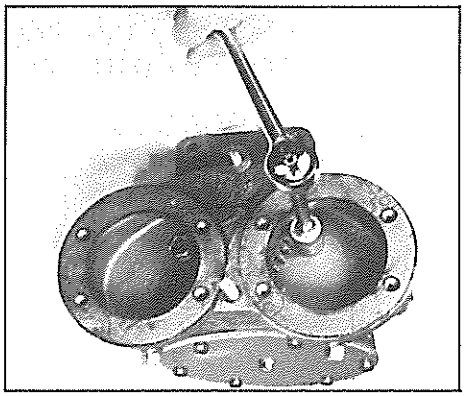
ILLUST. 1



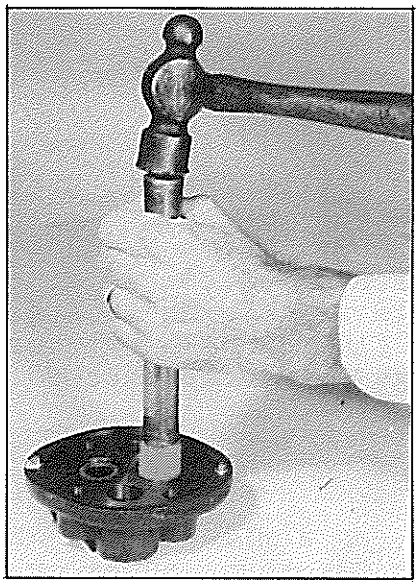
ILLUST. 2



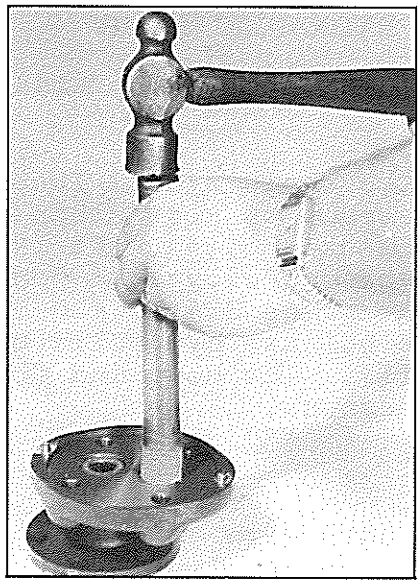
ILLUST. 3



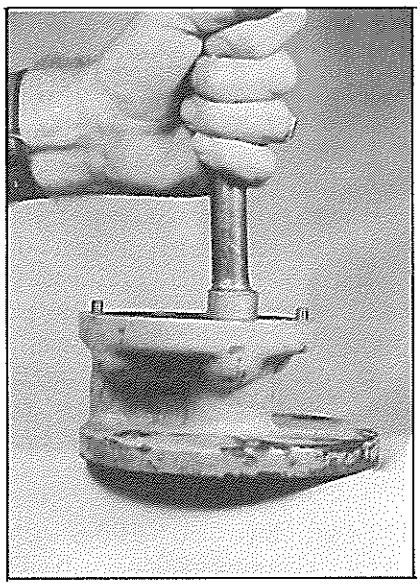
ILLUST. 3A



ILLUST. 4



ILLUST. 5



ILLUST. 6

Reassembly

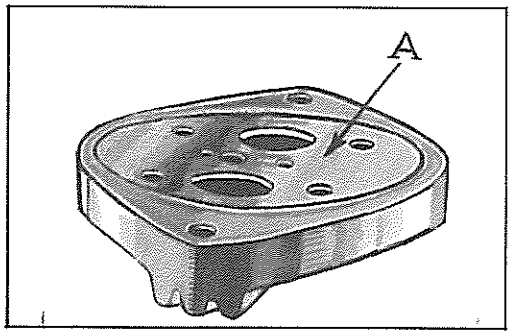
The first step in reassembly is to install stud bolt "A" (Illust. 1) to the vertical drive housing as shown in illustration. Now install gasket "B", shims "C", and spacer "D" in order named.

Install adapter housing "A" on studs, as shown in Illust. 2, just far enough to hold the housing in position while installing gear "B" to splined shaft in the housing. After the gear is started on the splined shaft you may then slide the gear and housing simultaneously until the adapter housing is up against the vertical drive housing, as shown in Illust. 3. Install lock washers and cap screws and tighten securely, as shown in Illust. 3A.

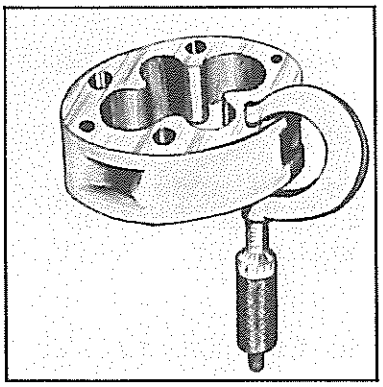
Before installing the roller bearings to the adapter and end cover, the bearing should be checked for freeness of rollers and pitted, broken or excessively worn rollers. The bearing should be replaced if it is possible to insert a .020 feeler between the rollers. If it is necessary to replace the bearings, do so only with the same make and type as were originally installed.

Install the roller bearings to the end cover and adapter as shown in Illust. 4 and 5. It is better to press them in if possible. If not, use a soft piece of tubing or drift and take care not to damage the bearing. The bearings should be lubricated with a light grease.

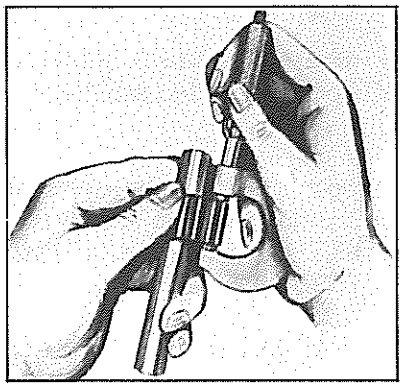
Press or drive seal seat into housing and against shoulder of housing, as shown



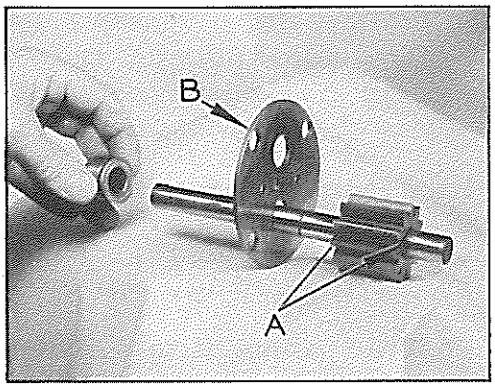
ILLUST. 7



ILLUST. 8



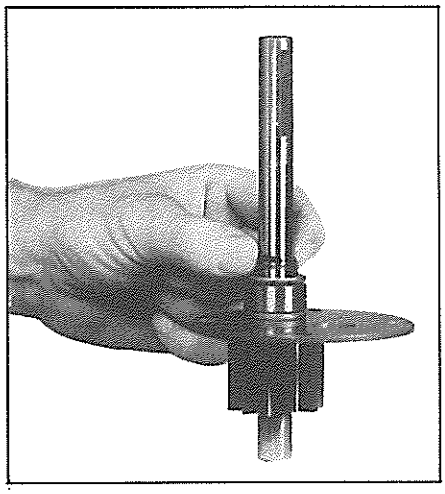
ILLUST. 9



ILLUST. 10

in Illust. 6. When driving seal seat into housing, use a soft drift pin as illustrated.

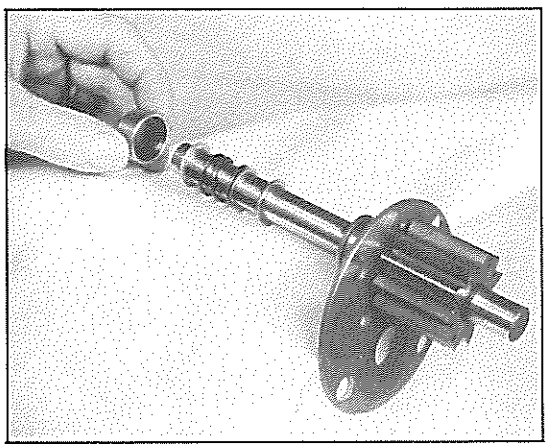
Check the wear plate "A", Illust. 7 for scoring or excessive wear. NOTE: Do not turn wear plate as the counterbored relief pocket is on gear side only. If wear plate is steel backed, bronze side should be next to gears. Even though slight wear is shown on gear pattern, check for erosion path in vicinity of relief pocket, and replace if in evidence. Also the wear plate should be properly seated. If it has a slight rocking motion, check the face of the end cover or adapter for a burr. Be sure that the counterbored relief pocket is up and in original position. Lubricate the contact surface of the plate with light oil.



ILLUST. 11

Proper clearance between the gear face and wear plate is provided by the plastic shim gasket between the housing and adapter and the housing and end cover. Using micrometers measure the width of the housing shown in Illust. 8 and the width of the gears as shown in Illust. 9.

If the gear width is .002 greater than the housing width, a red shim (.002) should be installed on the adapter side and a red shim (.002) to the end cover side. If the gear width is .001 greater than the housing, an amber shim (.001) should be installed on the adapter side and red shim (.002) to the end cover side



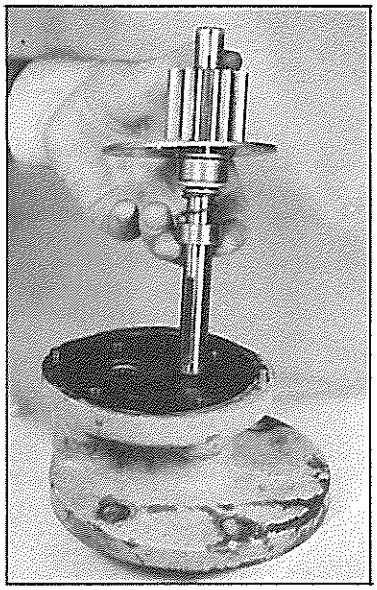
ILLUST. 12

If the housing and the gears are the same width, an amber shim (.001) should be installed on the adapter side and an amber shim (.001) to the end cover side.

Press gear onto shaft and center gear between the two (2) snap ring grooves in shaft. Next install the snap rings, Ref. A, one (1) on each side of gear. Now, install brass plate onto pump shaft. Next, install bearing, as shown in Illust. 10.

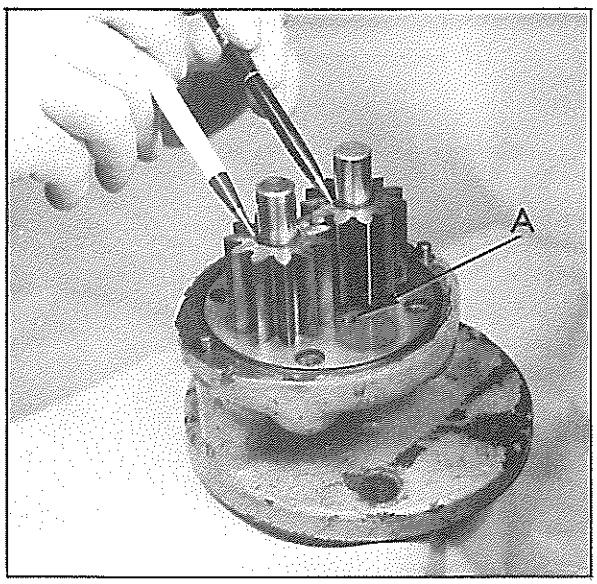
Install snap ring into groove on pump shaft, as shown in Illust. 11.

Install washer, spring, 2nd washer and seal on shaft, as shown in Illust. 12. Next, insert shaft through housing, as shown in Illust. 13.

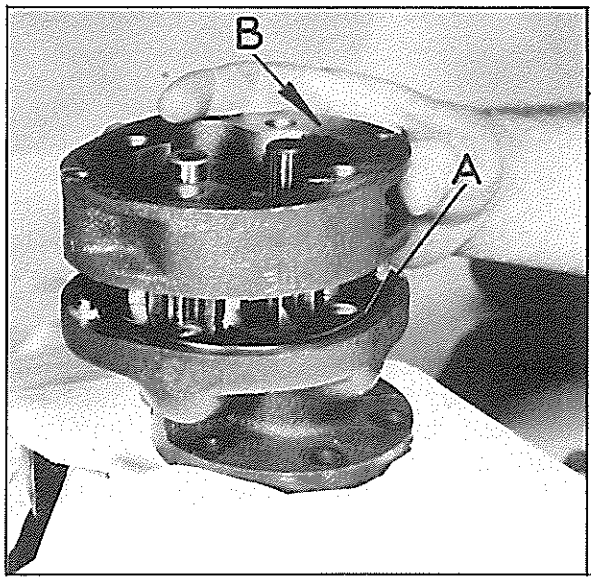


ILLUST. 13

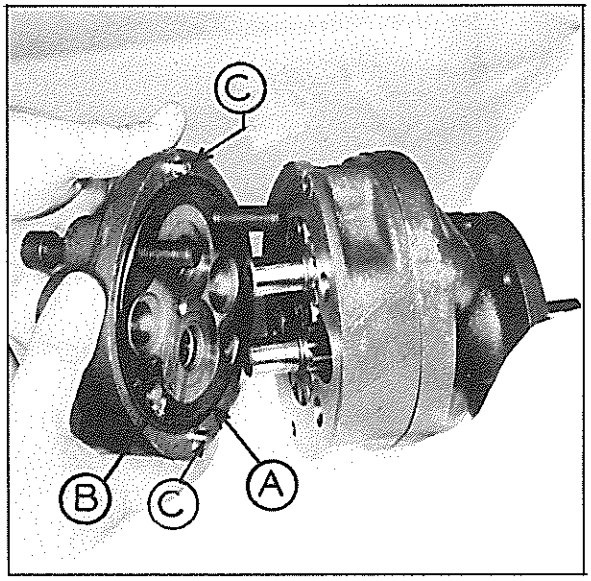
Install the gears as shown in Illust. 14. Make sure that they are in their original position and that the relief pocket "A" is in its original position on the pressure side and that the edges of the teeth and the gear face is not scored. If new gears are installed keep the keyways 180° apart, as shown in illustration. Install "O" ring "A" in groove outside of the wear plate as shown in Illust. 15. Install the gasket shim that was determined to be used between the adapter and the housing. Line up the punch marks and place the pump housing "B" over gears and gasket. Be sure that the dowel pins fit into the holes in the housing. Tap the housing with a fibre hammer to secure.



ILLUST. 14



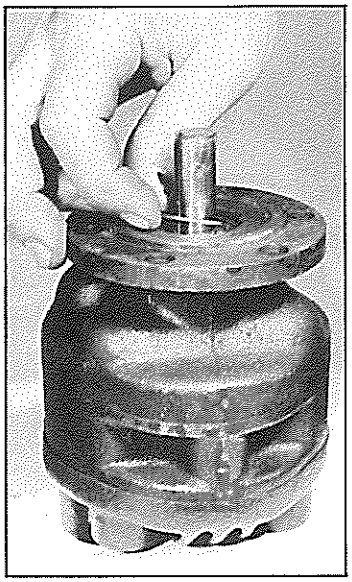
ILLUST. 15



ILLUST. 16

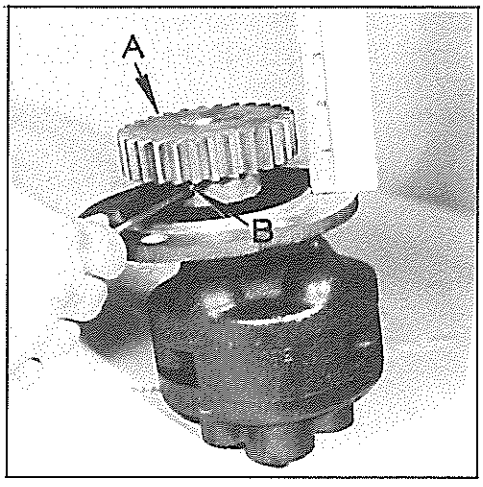


ILLUST. 17

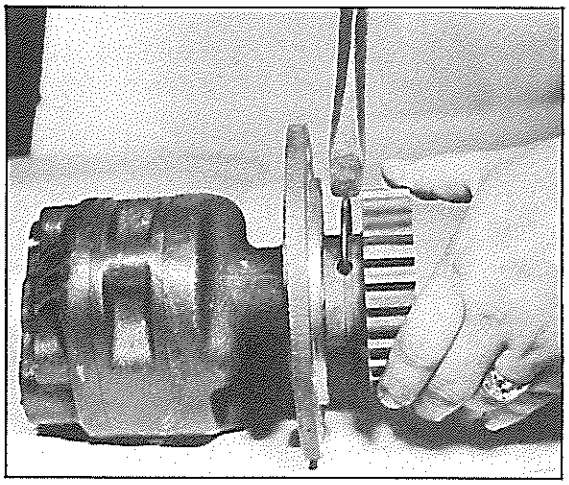


ILLUST. 18

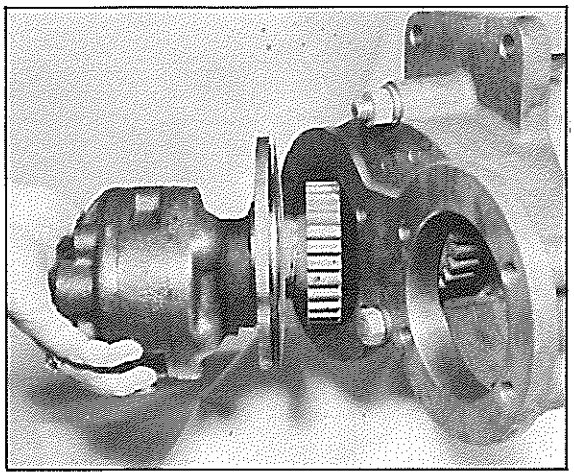
Install the wearing plate to the end cover with the relief pocket side toward the gears and on the same side of the gears as the relief pocket wear plate in the adapter. Be sure that the bleed hole in the wear plate is lined up with the corresponding size bleed hole in the cover. Install the "O" ring "A" Illust. 16 as shown in illustration. Install the proper gasket shim "B". Lubricate the face of the wear plate with clean oil. Install dowel pins "C" in cover. Line up the punch marks previously made on the housing and cover. Install cover to housing and tap with fibre hammer until cover is tight against the housing. Be careful not to damage the "O" ring and check to make sure that the bleed backhole in the cover is on the intake side of the pump.



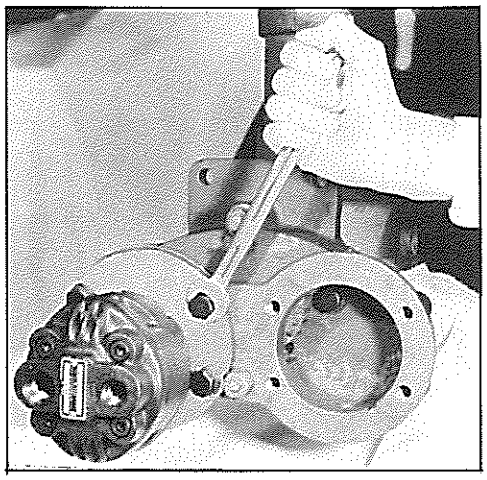
ILLUST. 19



ILLUST. 20



ILLUST. 21



ILLUST. 22

Install the four Allen head cap screws and lock washers. Gradually tighten opposite cap screws. Tighten them to a 60 ft. lbs. torque. After the assembly has been completed, turn the shaft with a six inch wrench. If the shaft will turn with a slight drag and not too freely, you will have the proper clearances. If the shaft is too tight or too free add or remove as many gaskets as necessary for proper clearance.

Install bearing over drive shaft as shown in Illust. 17 and install snap ring into groove as shown in Illust. 18.

Install key in keyway on pump shaft and install the driven gear "A" Illust. 19 using a fibre hammer or similar tool. The distance between the flange of the pump adapter to the bottom edge of the gear should be 15/16" as shown in the illustration. Install Allen head set screws "B" and tighten securely.

Install snap ring making sure that the end of the snap ring is in the set screw hole as shown in Illust. 20.

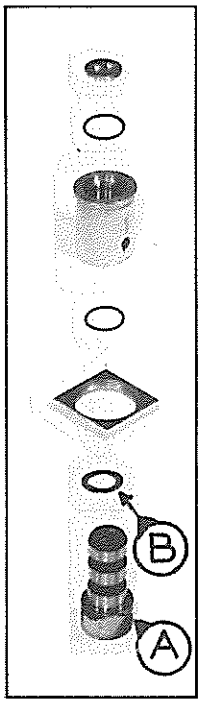
Using a new gasket, install pump to adapter housing, a shown in Illust. 21. Install cap screws with lock washers, as shown in Illust. 22, and tighten securely.

Install the pump opening cover and gasket. Secure with four cap screws and lock washers.

ROTARY CONTROL VALVE

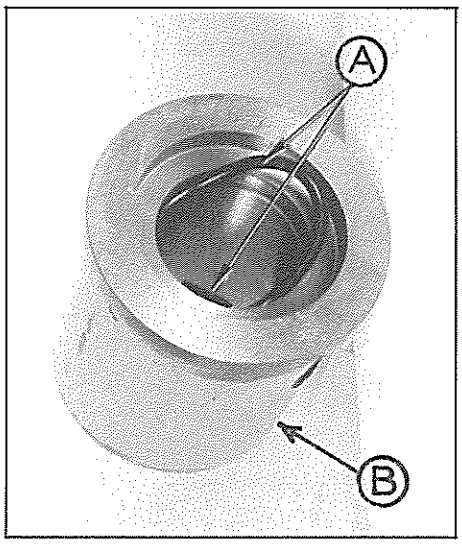
As shown in Illust. 23, install felt washer, Ref. B, onto rotor, Ref. A.

Install two (2) "O" rings, Ref. A, in grooves of body, Ref. B, as shown in Illust. 24. One (1) "O" ring at bottom of body and the second at top.



ILLUST. 23

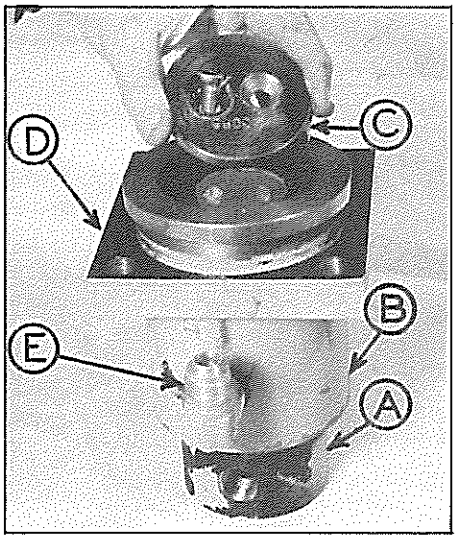
Apply oil to rotor and inside of body, then insert rotor, Ref. A, into body, Ref. B. Install bolting plate Ref. C, and tighten flat head bolts with shakeproof lock washers. Next install base, Ref. D, and elbows, Ref. E, as shown in Illust. 25.



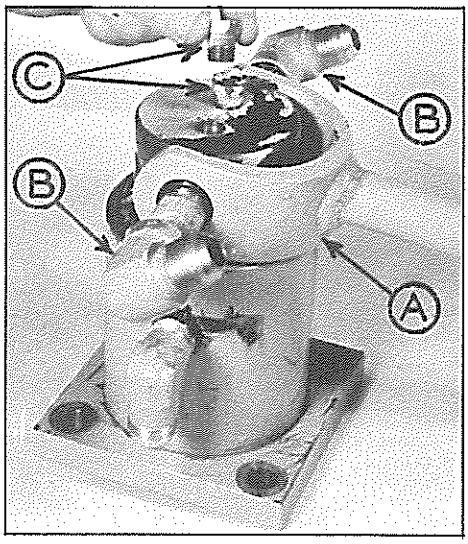
ILLUST. 24

To install drive link, Ref. A, align drive link holes with tapped holes in rotor, then insert and tighten elbows, Ref. B, as illustrated. Inser t plugs, Ref. C, and tighten, as shown in Illust. 26.

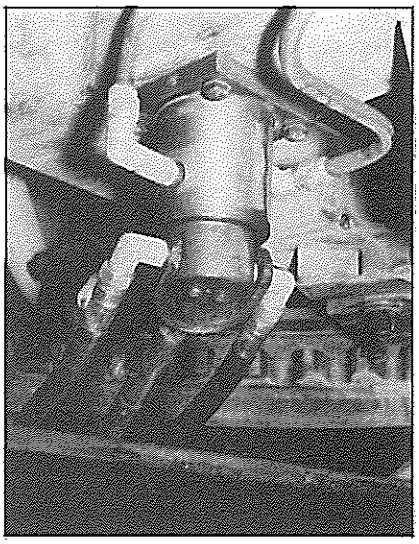
To assemble rotary control valve assembly to circle drawbar, insert the drive link through the circle leg tie rod drive link anchor. Next, bolt the rotary control valve assembly to circle drawbar, as shown in Illust. 27.



ILLUST. 25



ILLUST. 26



ILLUST. 27

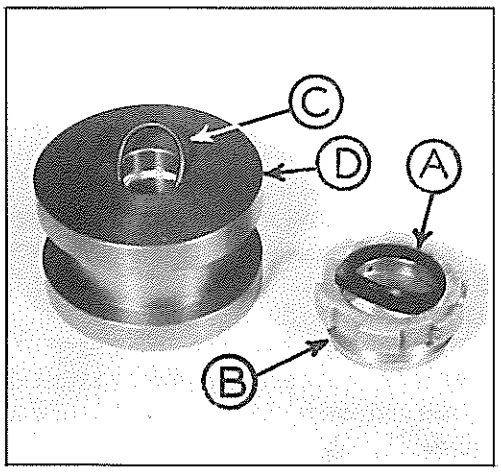
Power Moldboard Ram

Install lip seal, Ref. A, into nut, Ref. B, with sharp edge of seal toward outer edge of nut. Next, insert "O" ring, Ref. C, into piston, Ref. D, as shown in Illust. 28.

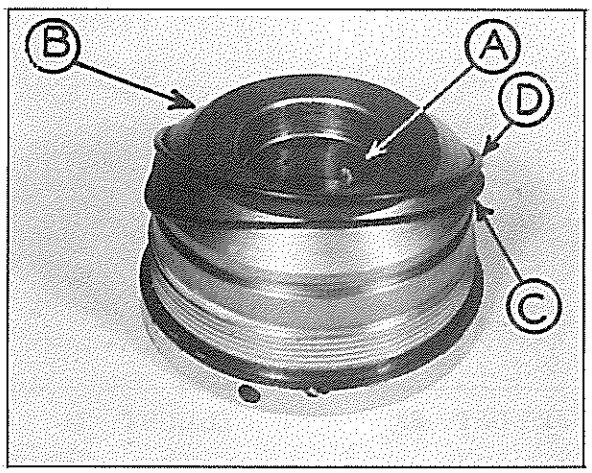
Press bushing, Ref. A, into cylinder end, Ref. B. Install back-up ring, Ref. C, and seal ring, Ref. D, as shown in Illust. 29.

As shown in Illust. 30, install nut, Ref. A, packing, Ref. B, and cylinder head, Ref. C, onto piston rod, as illustrated. Next, install piston, Ref. D, with "O" ring end away from threaded end of piston rod. Install nut, Ref. E, tighten and stake with center punch.

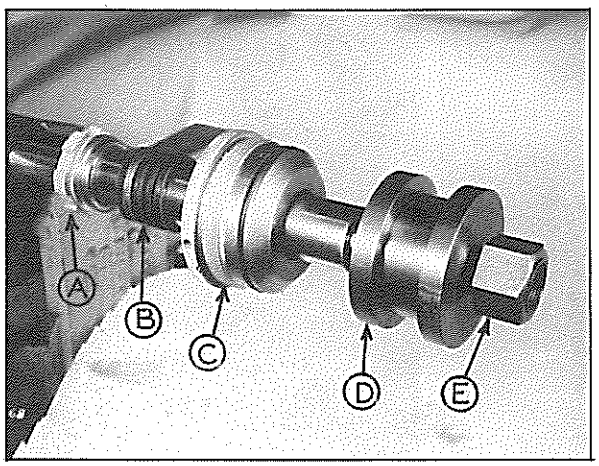
Install packing, Ref. A, with lip of seals toward nut, as shown in Illust. 31.



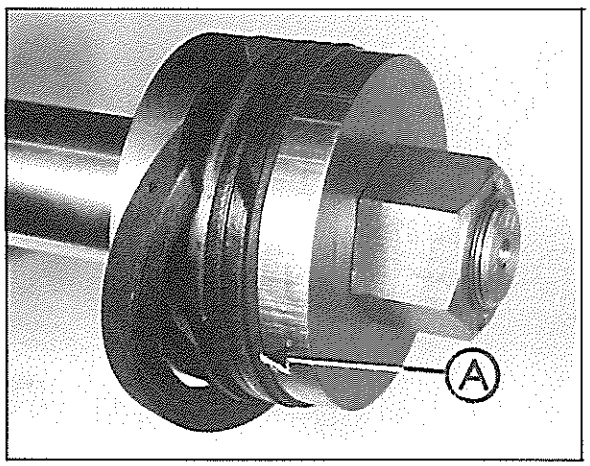
ILLUST. 28



ILLUST. 29



ILLUST. 30

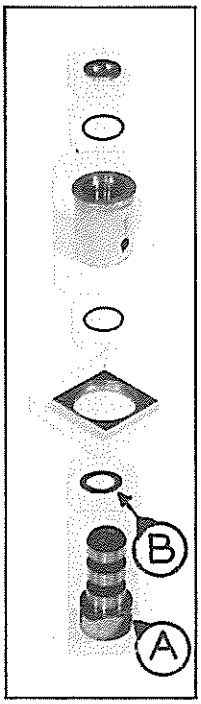


ILLUST. 31

ROTARY CONTROL VALVE

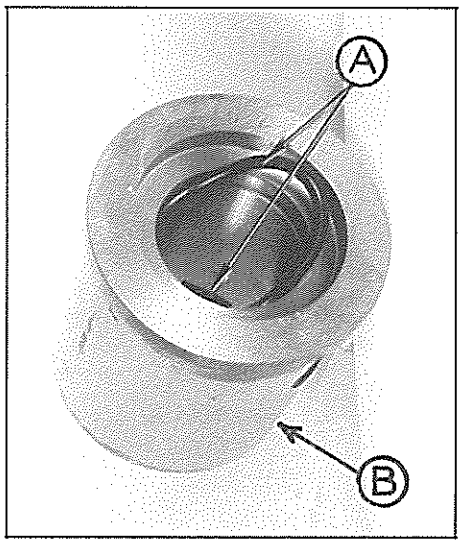
As shown in Illust. 23, install felt washer, Ref. B, onto rotor, Ref. A.

Install two (2) "O" rings, Ref. A, in grooves of body, Ref. B, as shown in Illust. 24. One (1) "O" ring at bottom of body and the second at top.



ILLUST. 23

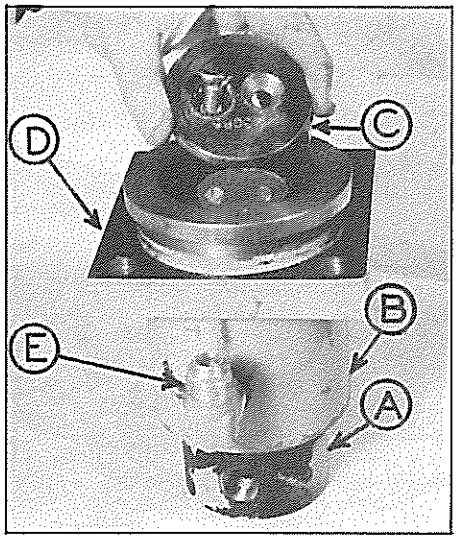
Apply oil to rotor and inside of body, then insert rotor, Ref. A, into body, Ref. B. Install bolting plate Ref. C, and tighten flat head bolts with shake-proof lock washers. Next install base, Ref. D, and elbows, Ref. E, as shown in Illust. 25.



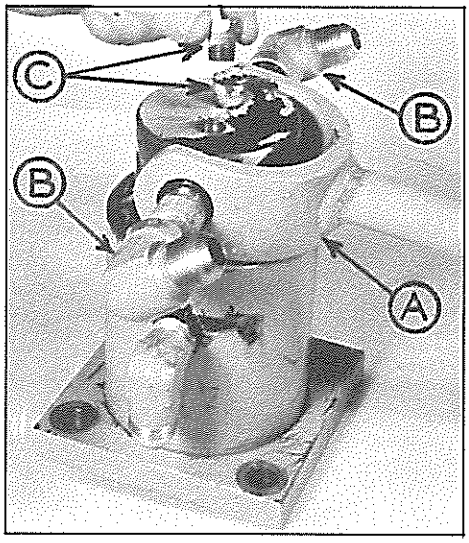
ILLUST. 24

To install drive link, Ref. A, align drive link holes with tapped holes in rotor, then insert and tighten elbows, Ref. B, as illustrated. Inser t plugs, Ref. C, and tighten, as shown in Illust. 26.

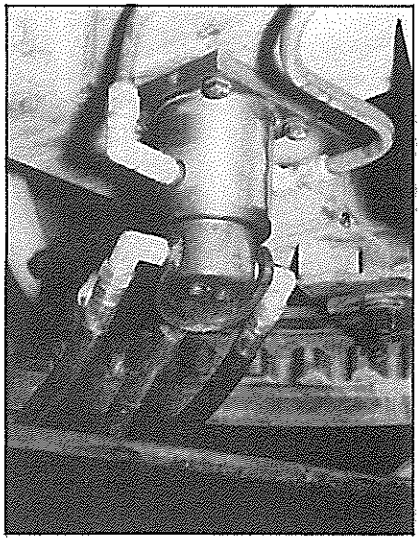
To assemble rotary control valve assembly to circle drawbar, insert the drive link through the circle leg tie rod drive link anchor. Next, bolt the rotary control valve assembly to circle drawbar, as shown in Illust. 27.



ILLUST. 25



ILLUST. 26



ILLUST. 27

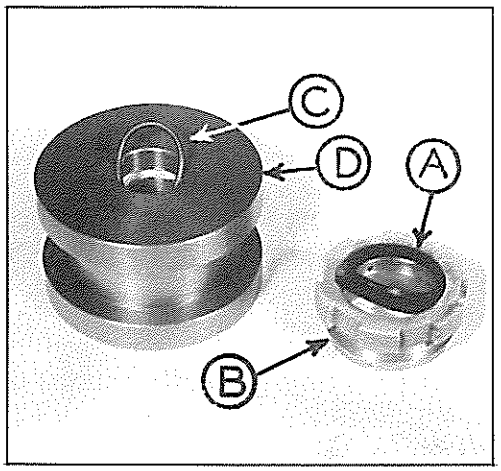
Power Moldboard Ram

Install lip seal, Ref. A, into nut, Ref. B, with sharp edge of seal toward outer edge of nut. Next, insert "O" ring, Ref. C, into piston, Ref. D, as shown in Illust. 28.

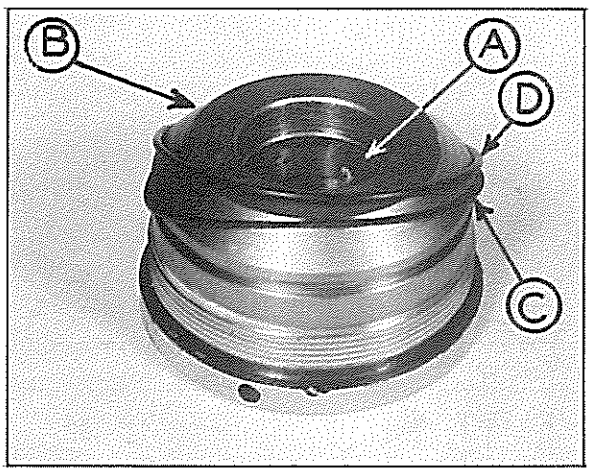
Press bushing, Ref. A, into cylinder end, Ref. B. Install back-up ring, Ref. C, and seal ring, Ref. D, as shown in Illust. 29.

As shown in Illust. 30, install nut, Ref. A, packing, Ref. B, and cylinder head, Ref. C, onto piston rod, as illustrated. Next, install piston, Ref. D, with "O" ring end away from threaded end of piston rod. Install nut, Ref. E, tighten and stake with center punch.

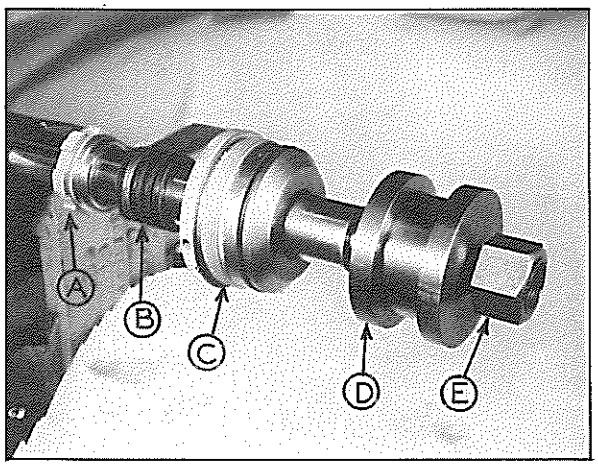
Install packing, Ref. A, with lip of seals toward nut, as shown in Illust. 31.



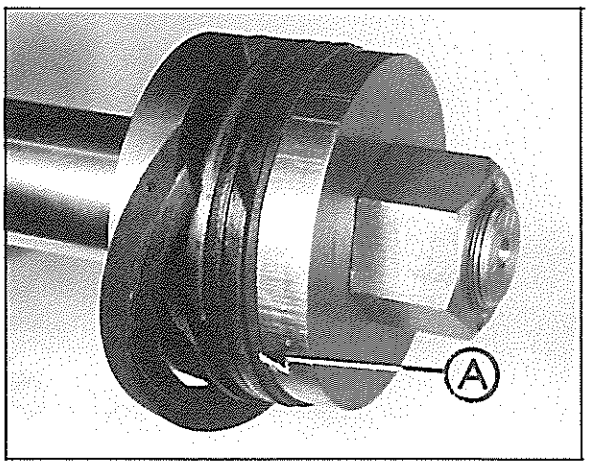
ILLUST. 28



ILLUST. 29



ILLUST. 30



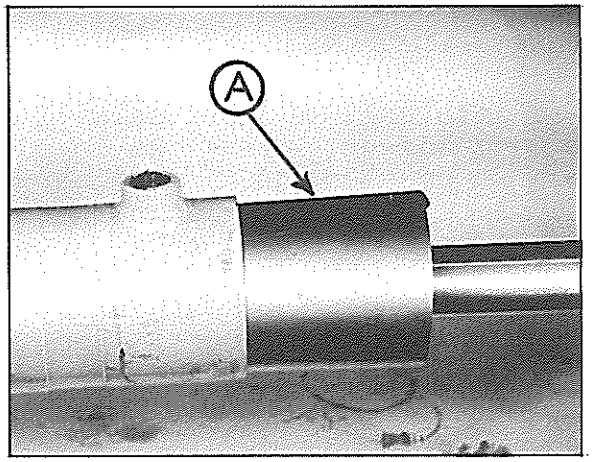
ILLUST. 31

Install piston head into cylinder. Use a piece of .010 shim stock, Ref. A, to protect lips of packing from being damaged, as shown in Illust. 32.

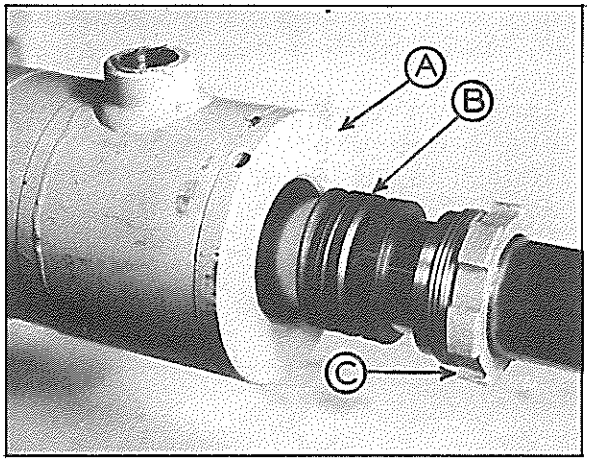
As shown in Illust. 33, install cylinder end, Ref. A, into cylinder and tighten. Install packing, Ref. B, and nut, Ref. C, into cylinder end. Tighten nut only enough to prevent oil leakage.

As shown in Illust. 34, install reducers, Ref. A, and elbows, Ref. B, into ram. Next, install pipes, Ref. C, and elbows, Ref. D. Clamp pipes with clamps, Ref. E.

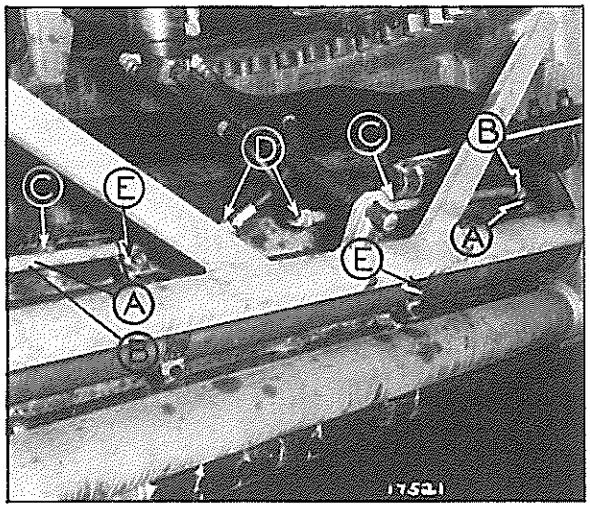
As shown in Illust. 35, assemble R.H. tilt plate, Ref. A, to circle leg. Do not tighten bolts. Install ram, Ref. B, between circle leg and moldboard and onto ball tilt plate. Install cap with shims, Ref.



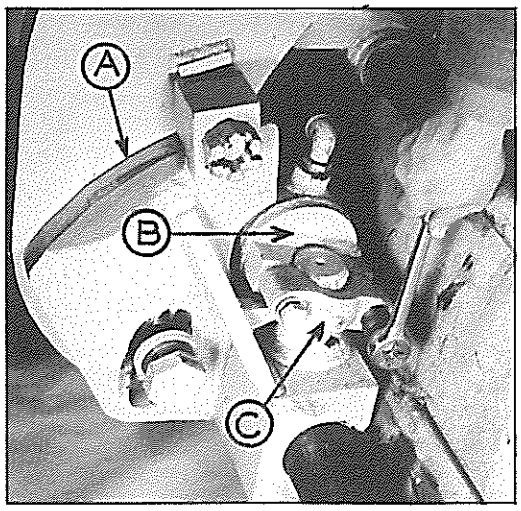
ILLUST. 32



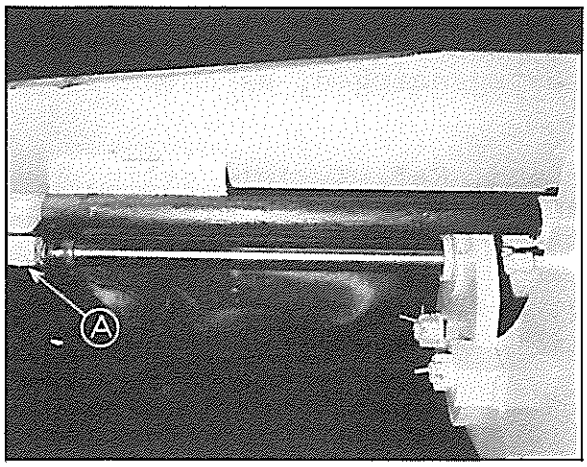
ILLUST. 33



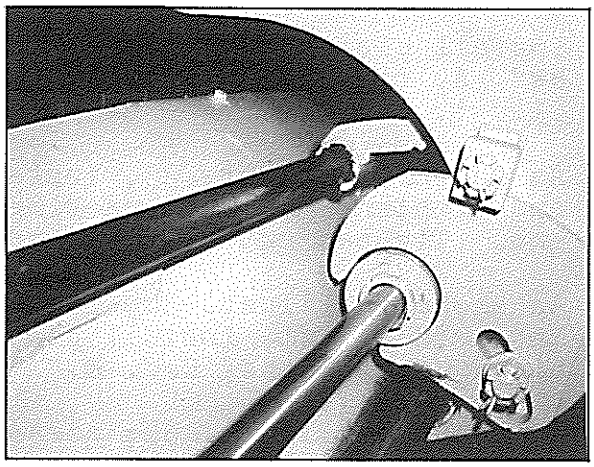
ILLUST. 34



ILLUST. 35



ILLUST. 36



ILLUST. 37

C, and tighten cap screws.

As shown in Illust. 36, install piston rod onto ball of moldboard. Install cap with shims, Ref. A, and tighten cap screws. As shown in Illust. 36, adjust R.H. tilt plate so as ram is parallel with moldboard, as shown in Illust. 37, then tighten tilt plate bolts, as shown in Illust. 35. Install and spread cotter pins.

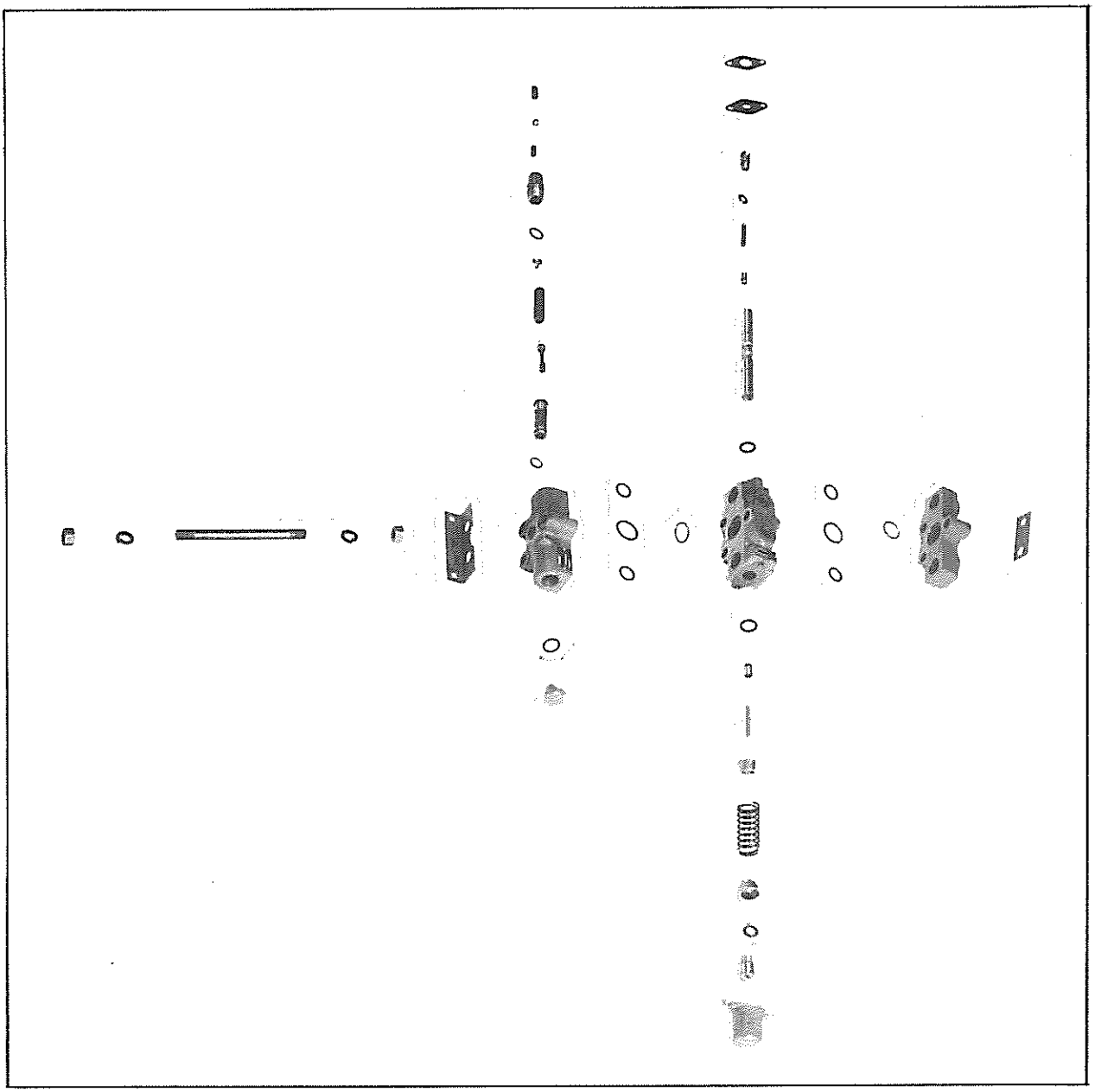
Install L.H. tilt plate, as shown in Illust. 37, being sure there is clearance around ram. Then install and tighten bolts. Install and spread cotter pins.

POWER SHIFT CONTROL VALVE

Illust. 38, is the exploded view of the power shift control valve. Very little trouble should be experienced with this valve, providing that the hydraulic system is kept clean. The various parts are replaceable as separate items. However, when such replacement is made, the surrounding parts should be examined very carefully to determine whether they will work satisfactorily with the new parts.

Disassembly

Clean the outside of the power shift control valve with an oil solvent, or similar fluid and dry thoroughly. The control valve may be disassembled by reversing the reassembly procedure.

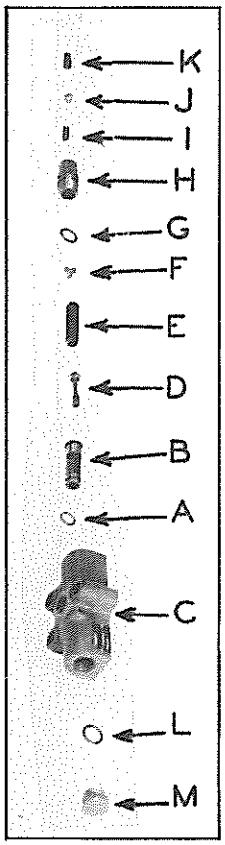


ILLUST. 38

Reassembly

Install seal ring, Ref. A, onto relief valve seat, Ref. B, and insert into body, Ref. C. Install relief valve plunger, Ref. D, spring, Ref. E, spring guide, Ref. F, seal ring, Ref. G, cap, Ref. H, adjusting screw, Ref. I, jam nut, Ref. J, and acorn nut, Ref. K, into body, Ref. C. Next, install seal ring, Ref. L, and cap, Ref. M, into body, Ref. C, as shown in Illust. 39.

Center Section Valve

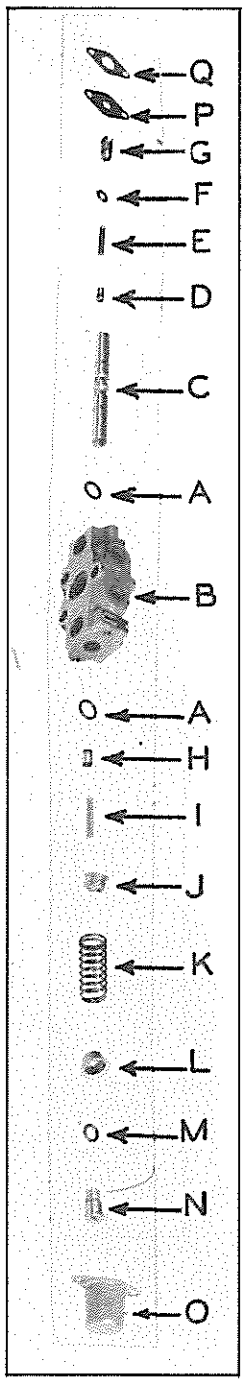


ILLUST. 39

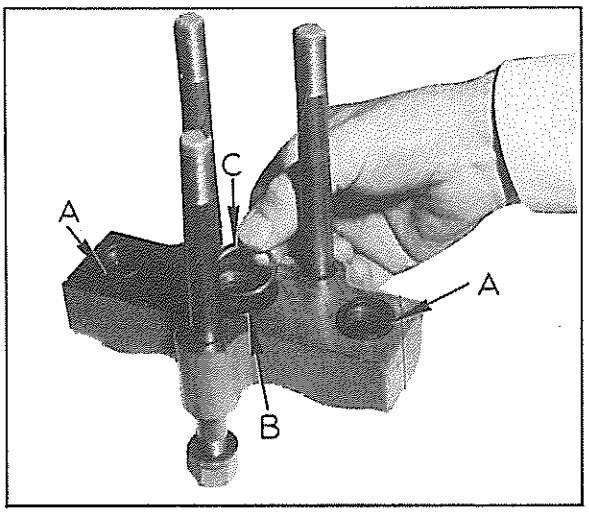
As shown in Illust. 40, insert seal ring, Ref. A, into body, Ref. B. Insert check plunger, Ref. D, spring, Ref. E, seal ring, Ref. F, and plunger eye, Ref. G, into plunger, Ref. C. Next, insert plunger assembly into body, Ref. B. Insert check plunger, Ref. H, spring, Ref. I, spring guide, Ref. J, spring, Ref. K, spring guide, Ref. L, seal ring, Ref. M, and cap, Ref. N, onto plunger, Ref. C. Install spring cover with bolts, Ref. O, to body and tighten bolts. To complete the assembly of the center section valve, install wiper, Ref. P, and retainer plate with bolts, Ref. Q, and tighten bolts.

End Section Housing

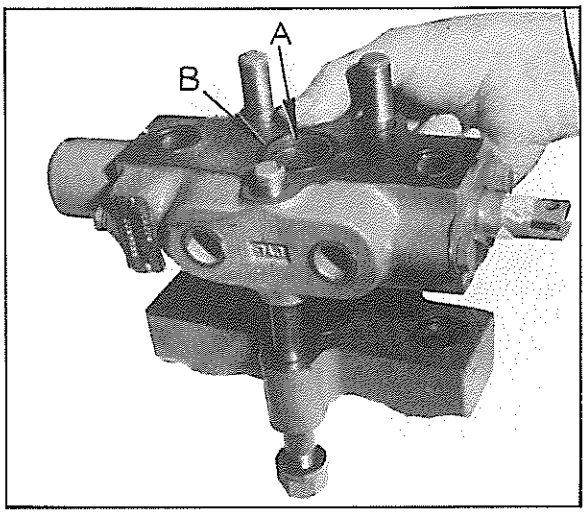
Install mounting bracket on studs with lock washers and nuts. Install housing on studs. Next, insert "O" rings, Ref. A, and Ref. B, into housing. Insert spacer, Ref. C,



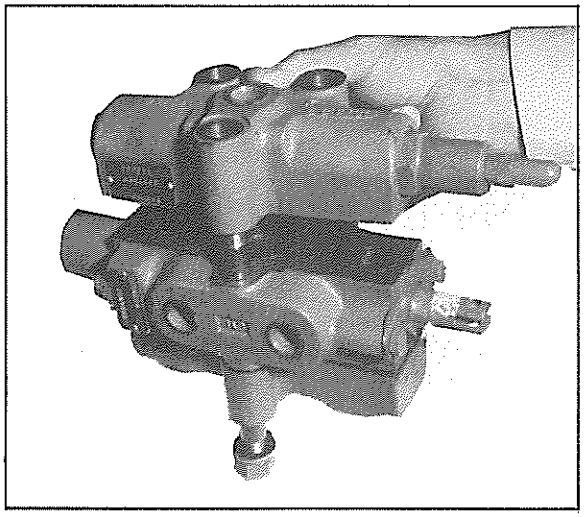
ILLUST. 40



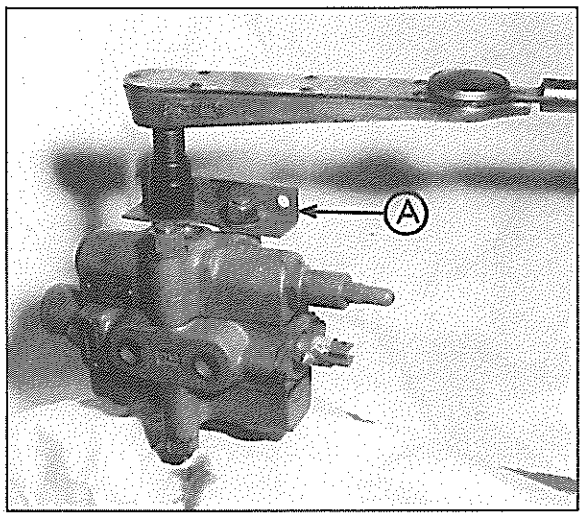
ILLUST. 41



ILLUST. 42



ILLUST. 43



ILLUST. 44

in "O" ring, Ref. B, as shown in Illust. 41.

As shown in Illust. 42, install center section valve with "O" rings over studs and onto end section housing. Insert spacer, Ref. A, in "O" ring, Ref. B.

Install relief valve section over studs and onto center section housing, as shown in Illust. 43.

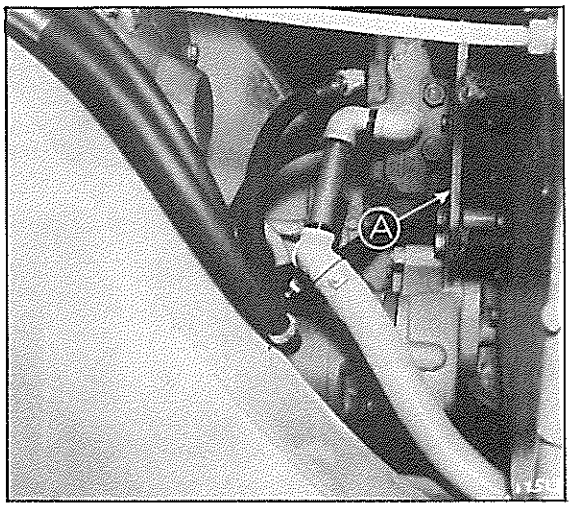
Install mounting bracket, Ref. A, onto studs. Install lock washers and nuts to studs and tighten nuts to a torque reading of 50 ft. lbs., as shown in Illust. 44.

Install valve base, Ref. A, Illust. 45, to front cab panel. Next, install hydraulic control valve to valve base. Install bolts and tighten. Install fittings as illustrated in 44 and 45.

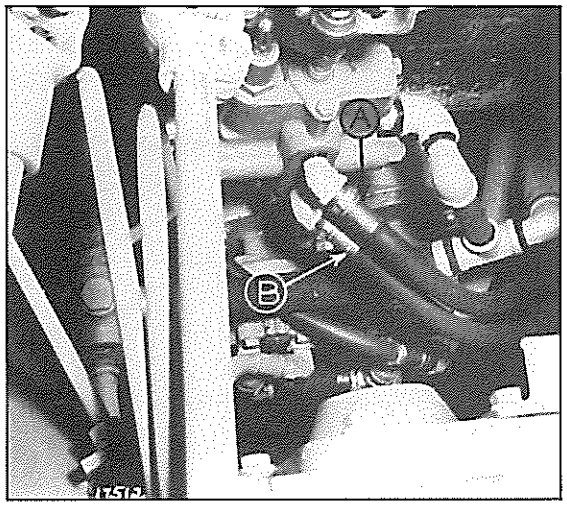
Hydraulic Lines

Hydraulic tubes and lines should be cleaned with a cleaning solvent and blown out with air before assembling to remove any dirt or foreign matter from inside tubes and lines.

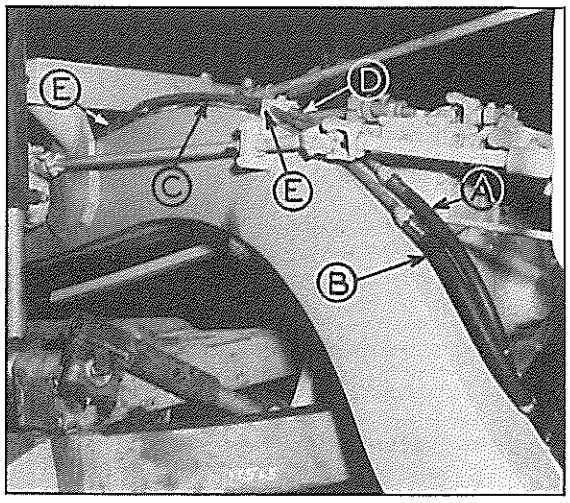
Install pressure hose, Ref. A, and Ref. B, into elbows as shown in Illust. 46.



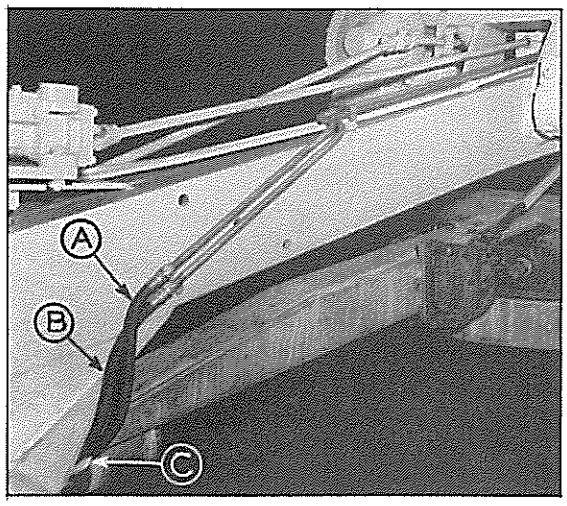
ILLUST. 45



ILLUST. 46



ILLUST. 47



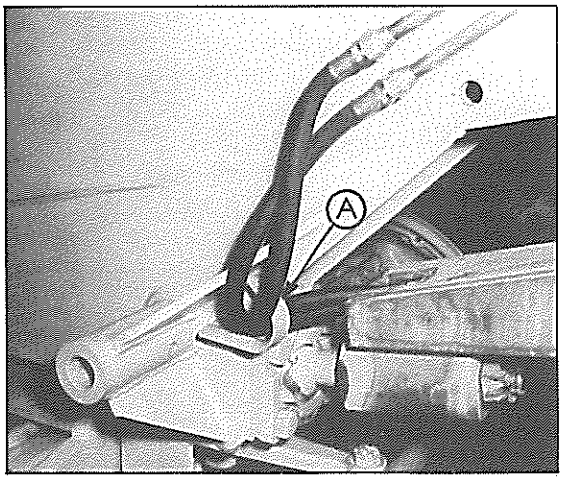
ILLUST. 48

Install hydraulic tubes with nuts, Ref. C, and Ref. D, over frame and clamp to frame with tube clamps, Ref. E. Next, install pressure l se, Ref. A, and Ref. B, to tubes with nuts, as shown in Illust. 47, ar.. tighten tube nuts.

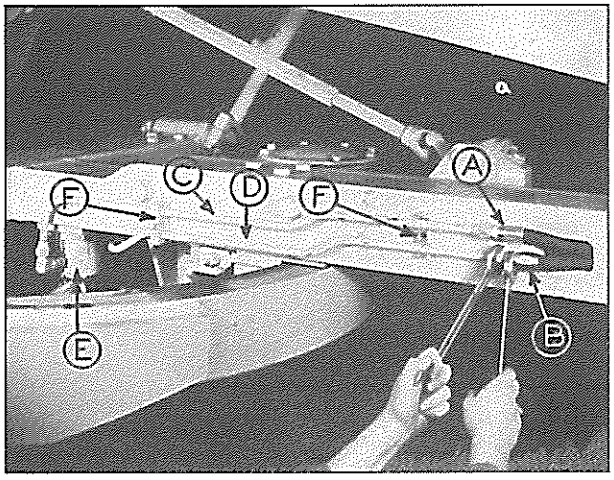
As shown in Illust. 48, install pressure lines, Ref. A, and Ref. B, to hydraulic tubes with nuts, and tighten nuts.

Insert pressure lines through eye, Ref. A, and into end of circle drawbar, as shown in Illust. 49.

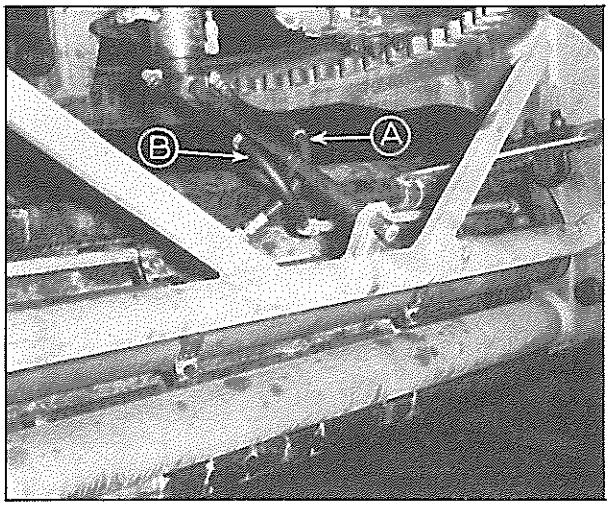
As shown in Illust. 50, push pressure lines, Ref. A, and Ref. B, through end of circle drawbar and out slot on right side of circle



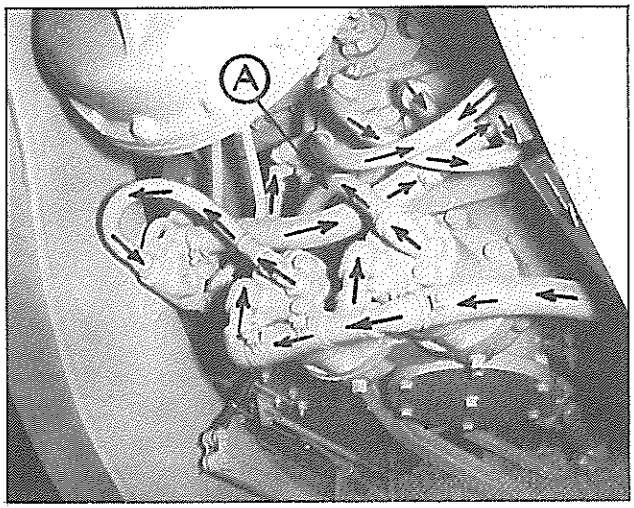
ILLUST. 49



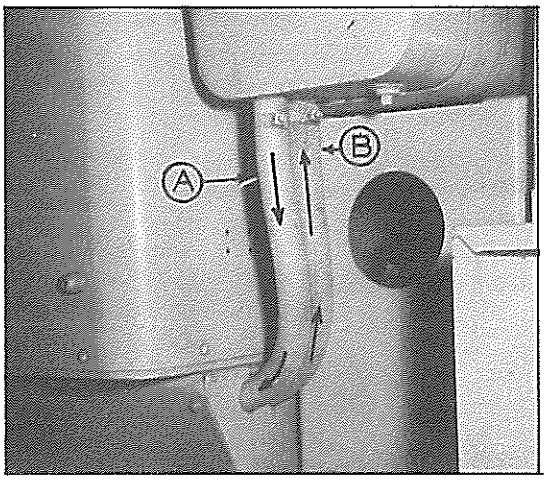
ILLUST. 50



ILLUST. 51



ILLUST. 52



ILLUST. 53

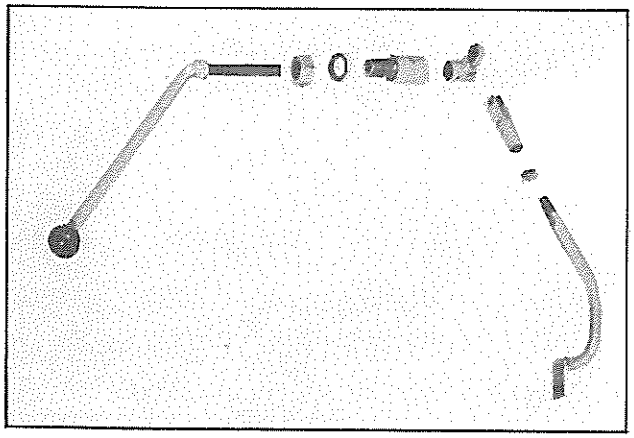
drawbar. Next, install hydraulic tubes with nuts, Ref. C, and Ref. D, to rotary control valve body fittings, Ref. E. Do not tighten hydraulic tube nuts tight on fittings. Tighten pressure lines, Ref. A, and Ref. B, to hydraulic tubes, Ref. C, and Ref. D, as illustrated, then tighten hydraulic tube nuts on rotary control valve body fittings. Next, clamp hydraulic tubes to circle drawbar with clamps, Ref. F, and tighten clamp bolts.

As shown in Illust. 51, install pressure lines, Ref. A, and Ref. B, to hydraulic ram pipe elbows and tighten. Next, install pressure lines to rotor fittings and tighten. Pressure line, Ref. A to be connected to left pipe and pressure line Ref. B, to be connected to right pipe.

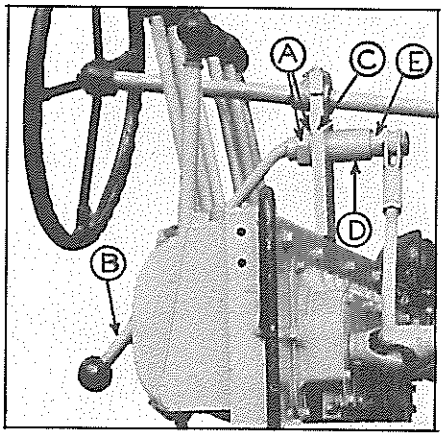
Install pressure line, Ref. A, Illust. 52, from hydraulic pump to hydraulic control valve. Also shown in Illust. 52 is the flow of oil, as illustrated by arrows, from hydraulic reservoir, through pump, through control valve, and into lines.

As shown in Illust. 53, install and clamp hydraulic reservoir outlet hose, Ref. A, and return hose, Ref. B, to reservoir. Next, insert hose through holes in cab bracket, as illustrated. Run hose along top of frame and clamp hose to frame. Install and clamp outlet hose, Ref. A, to pump. Install and clamp hose, Ref. B, to control valve.

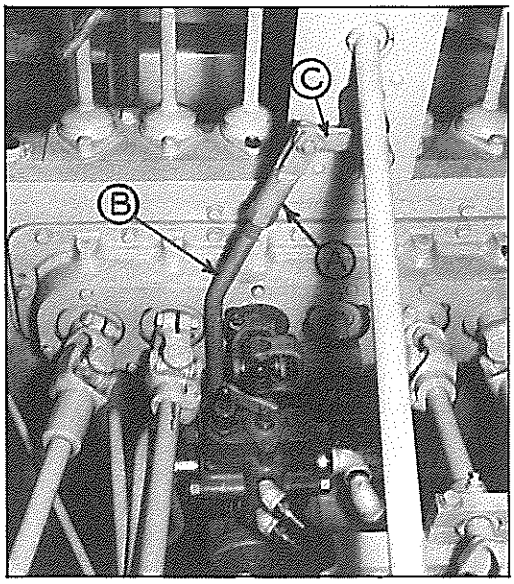
Control Lever



ILLUST. 54



ILLUST. 55



ILLUST. 56

Illust. 54, is an exploded view of the power shift moldboard control rod and linkage.

Install nut and lock washer, Ref. A, to lever, Ref. B. Next, insert lever with nut and lock washer through steering post, Ref. C. Install bearing, Ref. D, onto lever and tighten nut, Ref. A. Install lever, Ref. E, and insert pin, as shown in Illust. 55.

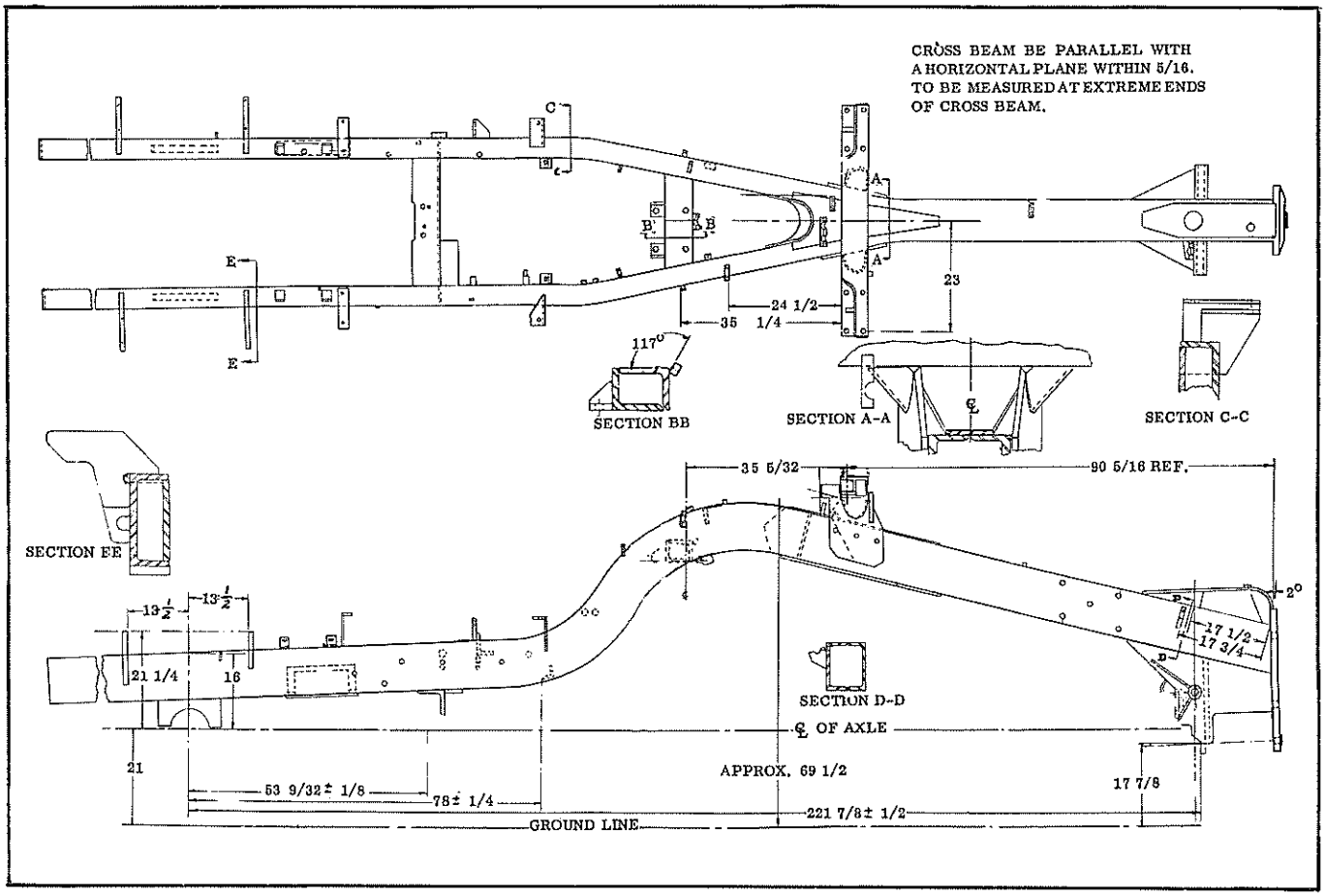
Install nut and yoke, Ref. A, on pull rod, Ref. B, as shown in Illust. 56. Install yoked end of pull rod to lever, Ref. C. Insert pin and lock with cotter pin. Next insert lower end of pull rod in control valve plunger. Insert pin and lock with cotter pin.

Power shift moldboard control lever should be centered in cab. To center control lever, remove pin, loosen yoke nut, and adjust yoke. Then insert pin, cotter pin and tighten jam nut.

Fill hydraulic reservoir with specified oil (See Lubrication Section) to level shown on dip stick. Start engine and shift moldboard to left and right to fill lines and ram with oil. Shut engine off and recheck hydraulic reservoir oil level. Add oil if necessary.

Start engine and shift moldboard to both extremes, then inspect all line connections for leakage.

The moldboard should operate to the right when the operating lever is operated to the right, and to the left when the operating lever is operated to the left. If moldboard shifts in the opposite direction of the operating lever, reverse the pressure hose, Ref. A, and Ref. B, as shown in Illust. 48.



ILLUST. 1

Little or no trouble should be experienced with bending or breakage of the main frame or attaching parts. However, if the machine should be subjected to excessive strains such as falling off a flat car or truck while the machine is in transit, the parts which sustain the shock of the fall should be inspected for breakage or misalignment. Shown in Illust. 1 is a drawing of the main frame of the grader with all basic dimensions for checking misalignment. These dimensions will also be of help when replacing some of the welded parts on the main frame. Little or no trouble should be experienced with breakage of welds. All welds are sufficiently strong to withstand all normal working and shock loads. To inspect welds, clean them thoroughly with a steel brush. Weld breakage will first appear as a hair line crack and will progress into ultimate breakdown. Repair welds when the first hair line crack appears to prevent further damage.

If weld breakage occurs, the old weld should be completely trimmed out with a cold chisel or acetylene torch down to the old metal. Reweld with a 1/8" shielded electrode, peening the weld after each pass until it has been built up to its original height. Under no circumstances should an electrode larger than 5/32" be used.

WHEELS

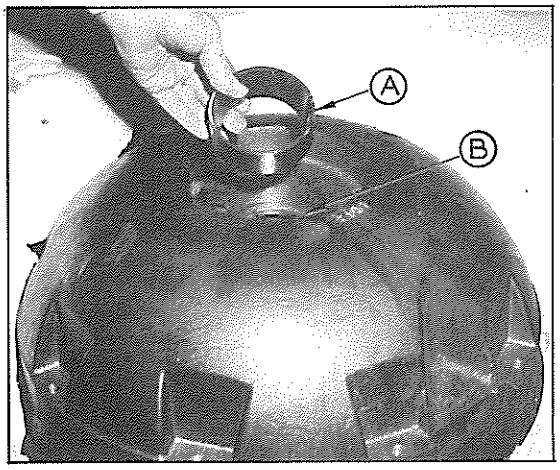
The wheels of a motor grader require very infrequent repair, due to their design and construction. The front wheels require more attention than the rear, due to the necessity of cleaning, repacking and readjusting the front wheel bearings at regular intervals. The frequency with which these operatins are carried out depends upon the working conditions.

Disassembly

When it becomes necessary to clean, repack and adjust the front wheels bearings, the front wheels must be completely removed from the spindles. To remove the wheels, remove the hub caps, drilled bolt through wheel nut, wheel bearing nut and outer wheel bearing.

Inspection

Inspect all parts for excessive wear, chipping or other damage.

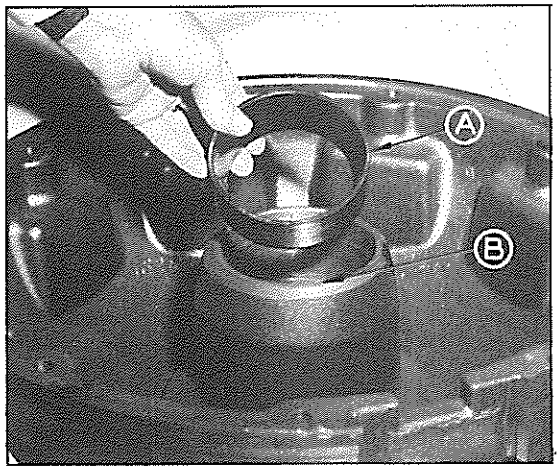


ILLUST. 1

Reassembly

As shown in Illust. 1, drive outer bearing cup, Ref. A into wheel with the thin edge of cup towards the outsideof wheel. Using a piece of pipe the same diameter as cup, drive cup against snap ring, Ref. B.

As shown in Illust. 2, turn the wheel over and drive inner bearing cup, Ref. B, into wheel with the thin edge of cup away from the snap ring, Ref. B. Using a piece of pipe the same diameter as cup, drive cup against snap ring.



ILLUST. 2

Illust. 3. Drive retainer into wheel using care as not to damage edge of retainer. The wheel is now ready to be installed to the spindle.

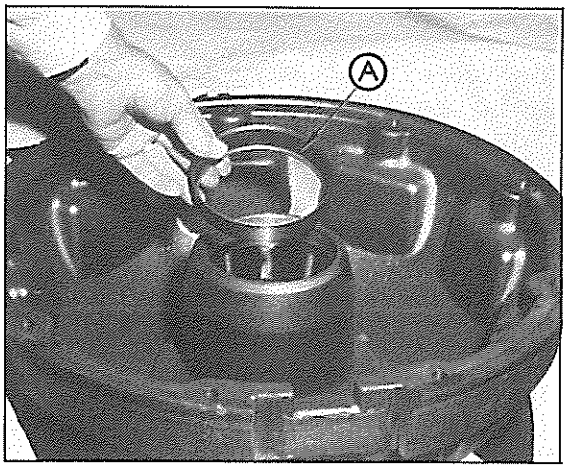
When reassembling, be sure that the felt washer, Ref. A, and spacer, Ref. B, are properly installed on the spindle. The felt washer fitting on

the spacer. The dowel pin hole in spacer, Ref. C to fit over dowel pin, Ref. D, in spindle, as shown in Illust. 4.

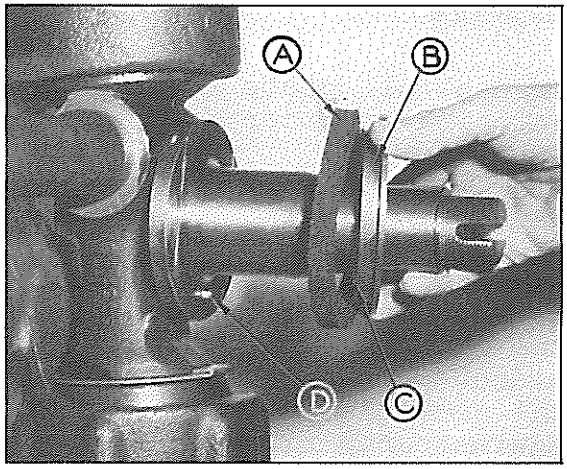
Install the inner bearing, Ref. A, onto spindle, with the tapered end of bearing away from the spacer. Using a hammer and a piece of pipe, drive bearing against spacer, as shown in Illust. 5.

As shown in Illust. 6, install the wheel onto the spindle and inner bearing. Next, install outer bearing, Ref. A, onto spindle with the tapered end of bearing toward the inside of wheel. Using a piece of pipe and hammer, drive bearing onto spindle and into outer cup.

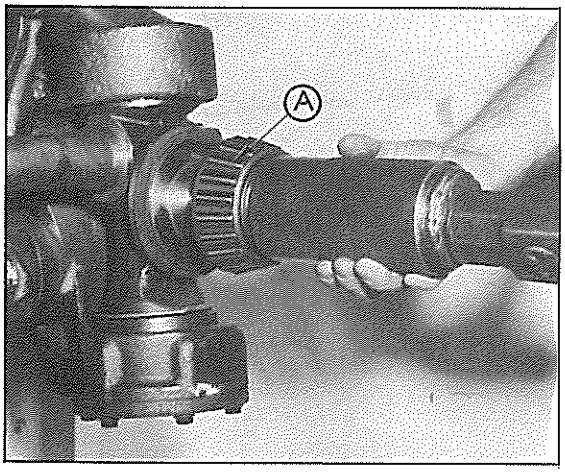
Install nut, as shown in Illust. 7. Tighten nut until 10 to 20 pounds is required to turn wheel, using a scale attached to rim stud, as shown in Illust. 8. Scale should always be pulled in a line at 90° to center of wheel. If hole in nut is not in line with spindle slot, loosen nut to nearest hole. Insert drilled pin, Ref. A, Illust. 9. Install and tighten slotted nut. Install and spread cotter pin. Install gasket, hub cap and bolts. Tighten bolts securely.



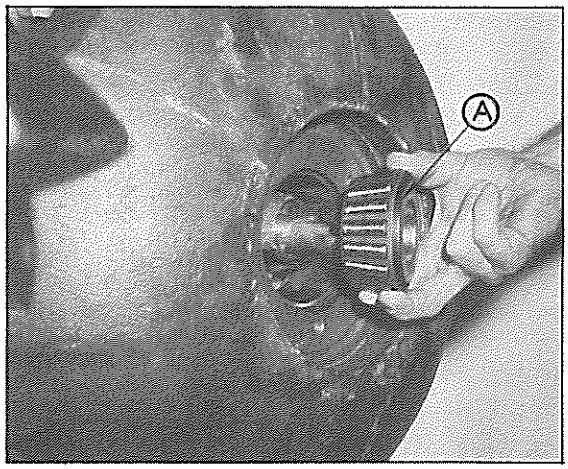
ILLUST. 3



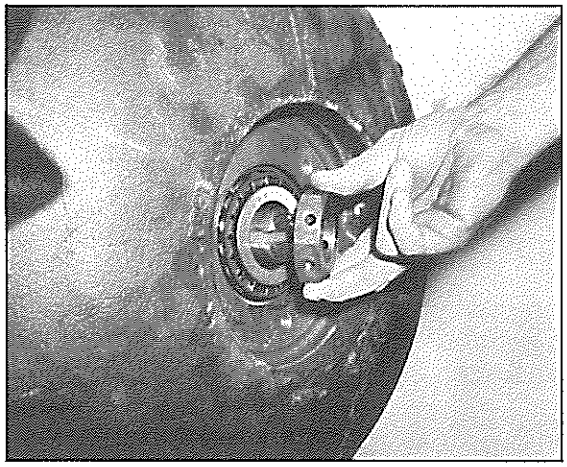
ILLUST. 4



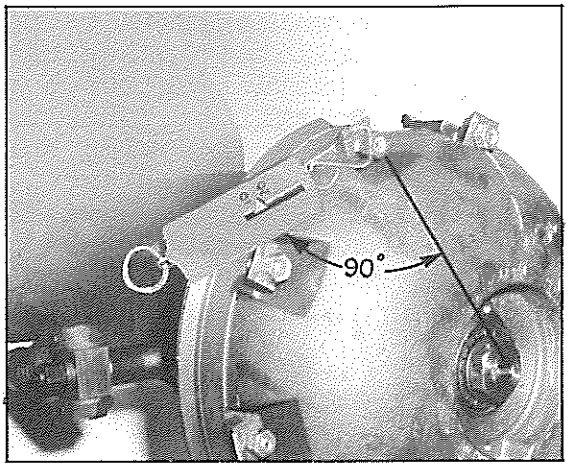
ILLUST. 5



ILLUST. 6



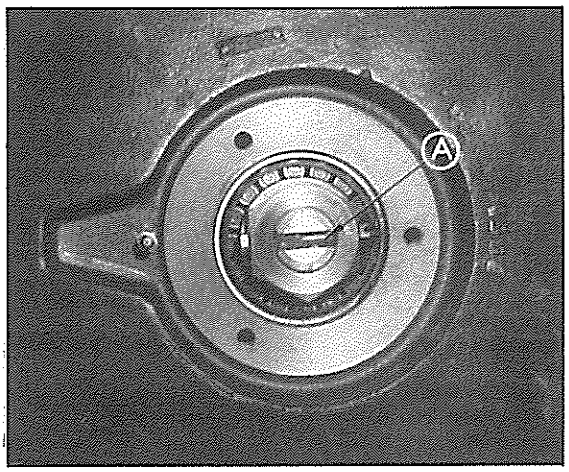
ILLUST. 7



ILLUST. 8

Installation of a front tire is similar to that of the rear. In the following description and illustrations a tire is shown being mounted on a rim.

Note and follow any mounting instructions molded onto the side wall of the tire. Most "tractor type" treads must be mounted to run one way for traction or driving and the opposite way for free rolling wheels. Be sure to mount each tire to run in the proper direction for the individual wheel on which the tire will be used.



ILLUST. 9

Install the inner tube with the valve stem off center in the manner shown in Illust. 10. The tube is molded and the valve stem mounted to one side. Be sure that the tube and stem are not placed in a strain by pulling the valve into place on the wrong side. Lay the rim on a frame or blocks as shown in the illustration and lower the tire onto the rim. The rim must be supported high enough to prevent the tire from resting on the ground.

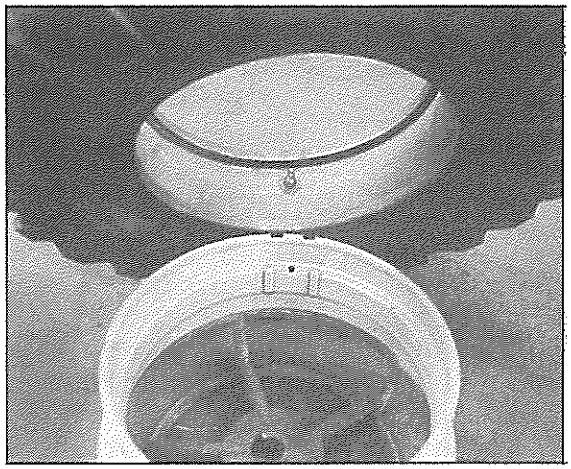
As the tire is lowered onto the rim it will be necessary to draw the valve stem into the valve hole in the rim. A variety of tools are available for this purpose, the usual one being a chain and cap which screws onto the end of the valve stem. This type of tool is shown being used in Illust. 11.

Taking care not to loose the valve stem back through the hole in the rim, slide the outside bead of the tire over the rim. It will be found much easier if the bead is pressed down to the center of the rim

on one side while it is being worked over the rim on the opposite side. Install the lock ring as shown in Illust. 12. Care should be taken when installing the lock ring not to spring it more than necessary to install it. Be sure the lock ring is properly seated and that the lugs on the ring enter into the notches in the rim.

Inflate the tire, as shown in Illust. 13, to the pressure specified in the tire inflation chart. When inflating the tire always take precautions against possible injury by the lock ring snapping off due to pressure. If the lock ring has been properly installed, it should not snap off. However, to prevent any danger of possible serious injury, roll the tire and rim into a frame before inflating. NOTE: Do not over inflate.

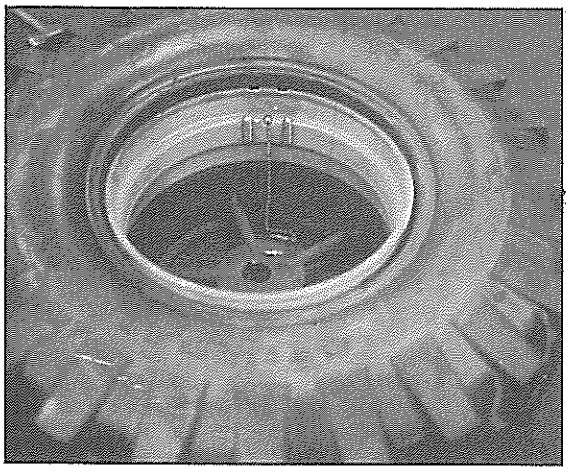
When mounting tires and wheels on the grader be sure that they run true within 1/4" on front wheels and 1/2" on rear wheels. If the tires run out of true (wobble) more than this maximum it will cause excessive tire wear. This dimension should not be confused with camber or tow-in which is described under front axle. "Wobble" of a front wheel can be corrected by proper tightening of the lug nuts. The rear wheels should not run out of true unless they have been sprung. "Wobble" of the rear wheels can be corrected only by inserting shims between the wheel and the hub.



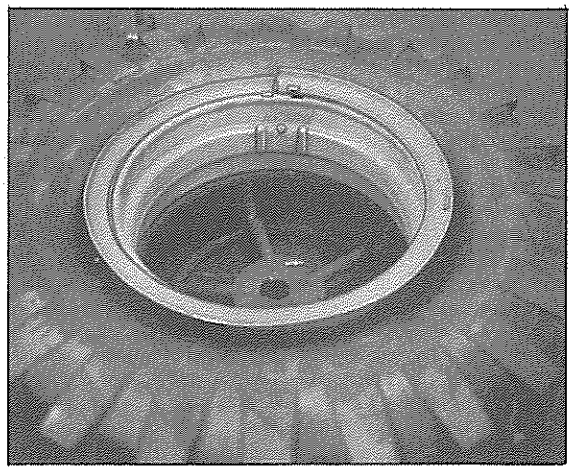
ILLUST. 10

Always keep valve caps on valve stems. If a tire is operated without the valve cap installed, dirt and water will enter the valve causing it to leak.

When operating the grader on black

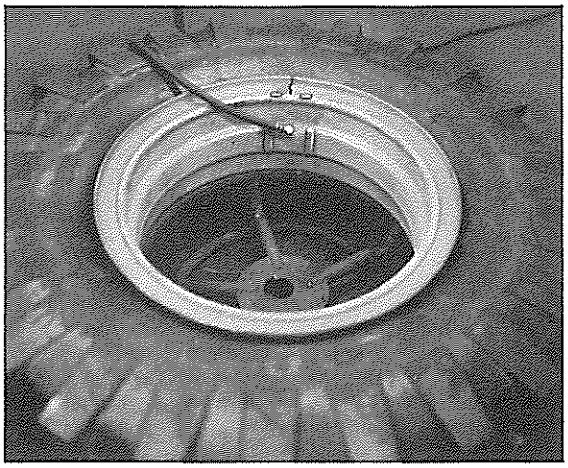


ILLUST. 11



ILLUST. 12

top work, clean all oil and dirt from the tire daily. Oil will cause rubber to become spongy and will bring about short tire lift. For the proper method of removing oil from tires, see your local authorized dealer for the tires which are being used.



ILLUST. 13

Tire Inflation (Chart)

Tire Inflation

Front Wheels	(11.00 x 24) (10 ply)	----------	45 Lbs.
Front Wheels	(14.00 x 24) (8 ply)	----------	35 Lbs.
Rear Wheels	(14.00 x 24) (10 ply)	----------	35 Lbs.
Rear Wheels	(14.00 x 24) (12 ply)	----------	35 Lbs.

NOTE: For maintenance work on established highways, inflation pressures may be increased 25% if desired.

Keep tires properly inflated at all times. Over inflation will cause excessive wear in the center of the tread, while under inflation will break down the side walls and cause tread separation.

TABLE OF HOUSING CAPACITIES

Picture Letter	Housing	Capacity U.S. Measure	Lubricant Recommended S.A.E. Weights
A	Tandem	4 Gals.	10 M.O.
B	Air Cleaner	10-1/2 Pts.	Same weight as in Engine
C	Power Shift Transmission w/Torque Converter	8-1/2 Gals.	Automatic Transmission Fluid Type "A"
D	Lateral Shift Housing	15-1/2 Pts.	E.P.S. 140
D	Lateral Shift Reduction Housing	3-1/2 Pts.	E.P.S. 140
E	Blade Lift Housing	3 Pts.	E.P.S. 140
E	Blade Lift Reduction Housing	3-1/2 Pts.	E.P.S. 140
F	Circle Reverse Housing	2-1/2 Qts.	E.P.S. 140
F	Circle Reverse Transfer Housing	2/3 Pts.	90 T.O.
**G	Steering Gear (Power)	2-1/2 Qts.	140 T.O.
**G	Power Steering Gear Valve Housing	1/2 Pt.	140 T.O.
**G	Hydraulic System (Power Steering)	12 Gals.	See Hyd. System Chart
**G	Hydraulic System (Power Shift Mold.)	12 Gals.	See Hyd. System Chart
I	Front Wheel Lean Housing	2 Qts.	E.P.S. 140
J	Scarifier Housing	24-1/2 Pts.	E.P.S. 140
J	Scarifier Reduction Housing	1-1/2 Pts.	E.P.S. 140
K	Power Box Housing	7 Pts.	30 M.O.
**K	Power Box Drive Housing w/Pump Gear Housing	7-3/4 Pts.	E.P. 90
**L	P.T.O. Chain Housing	3 Pts.	E.P. 90
**M	Gear Shift Housing	1 Pt.	E.P. 90
N	Master Cylinder	2-1/2 Pts.	Lockheed #21
**O	Lower Transmission & Final Drive	13 Gals.	E.P. 90

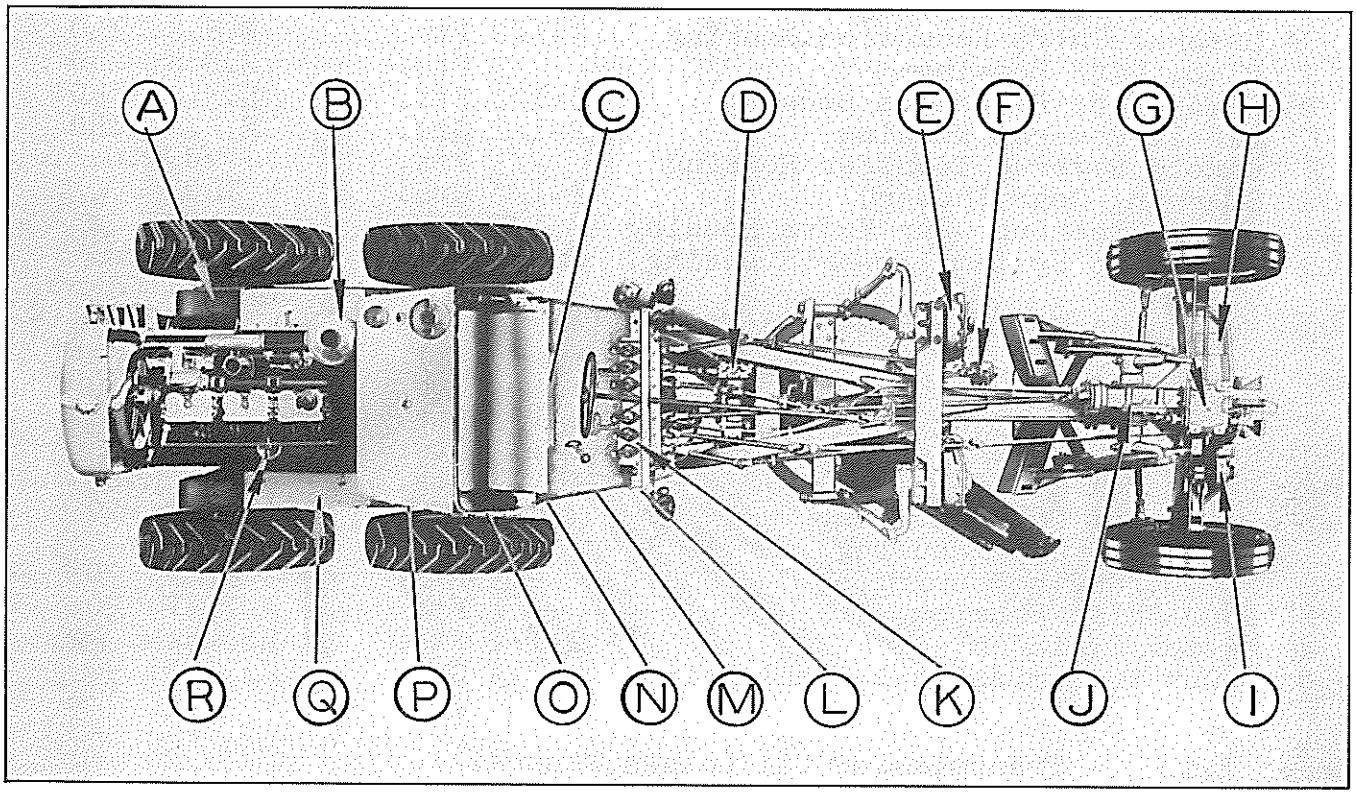
KEY: T.O. - Transmission Oil (plain Mineral)
M.O. - Motor Oil
E.P. - Extreme Pressure Lub. (mild)
E.P.S. - Extreme Pressure Lub. (strong Hypoid type)

** Air Temperature	Transmission	Power Box Drive	Steering Gear
Above 20° F.	E.P. 90	E.P. 90	140 T.O.
20° F. to 0° F.	E.P. 90	E.P. 90	90 T.O.
Below 0° F.	4 parts SAE-90 1 part Diesel fuel	4 parts SAE-90 1 part Diesel fuel	4 parts SAE-90 1 part Diesel fuel

NOTE: "U" joints, with exception of steering shaft, are sealed for life and are not to be greased.

LUBRICATING FITTING (HAND LUBRICATOR) GREASE

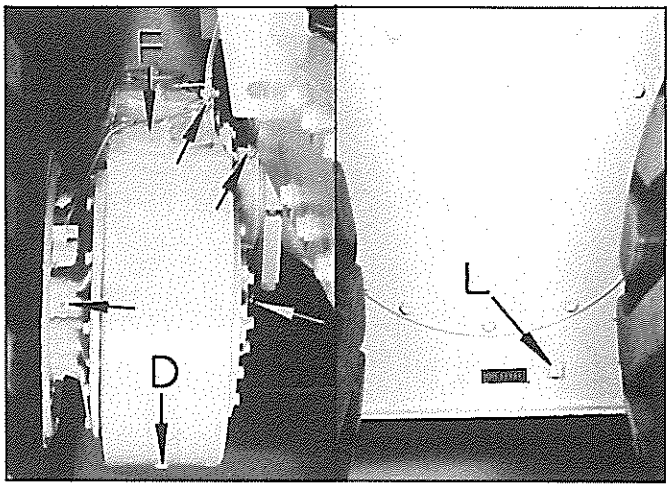
Use pressure gun grease (chassis lub.) for lubricating fittings on which hand lubricator (pressure gun) is applied. In the lubrication instructions which follow, the letter "D" indicates drain plug. the letter "L" indicates oil level plug. The letter "F" indicates filler plug. The letters "LF" indicates oil level and filler plug. In each case they refer to the plug to which the arrow points. All plain arrows refer to pressure gun lubricating fittings.



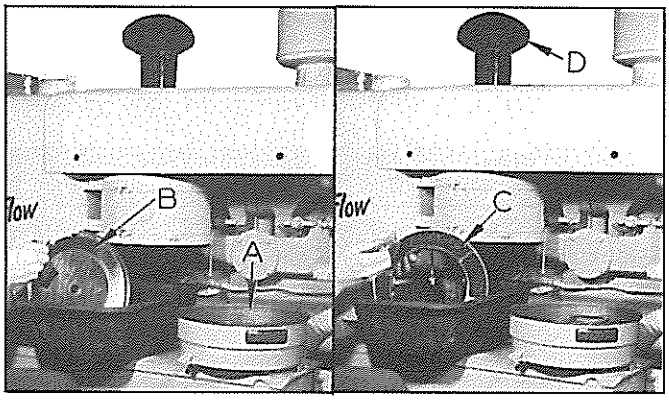
ILLUST. 1

LUBRICATION REFERENCE CHART

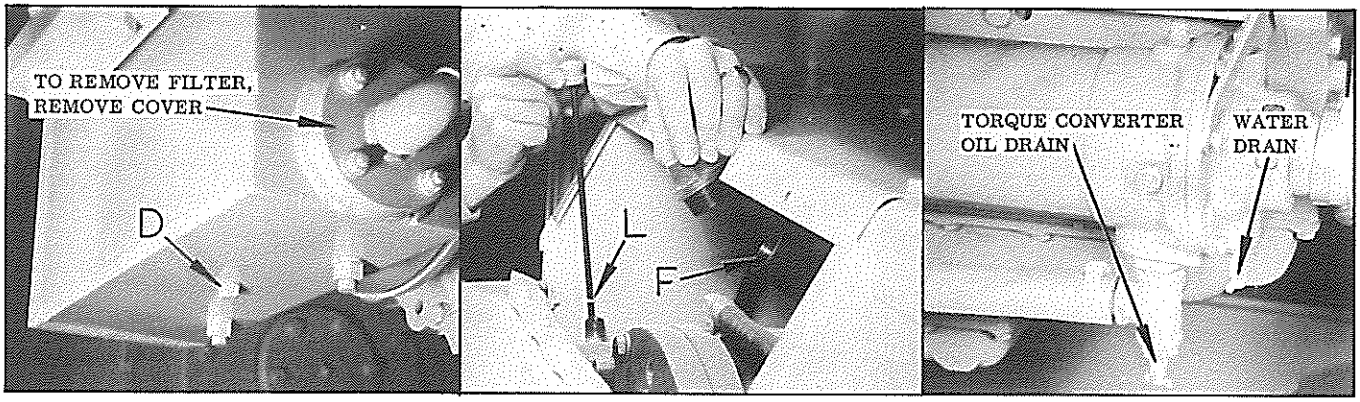
ILLUST. 1 - Familiarize yourself as soon as possible with all points on the grader which should be lubricated. The reference chart above will help you. The letters on the chart indicate general locations of lubricating points - for detailed instructions, see illustrations on following pages which are identified by corresponding letters. For type of lubricant to be used in each gear housing, refer to "Table of Housing Capacities" on preceding page.



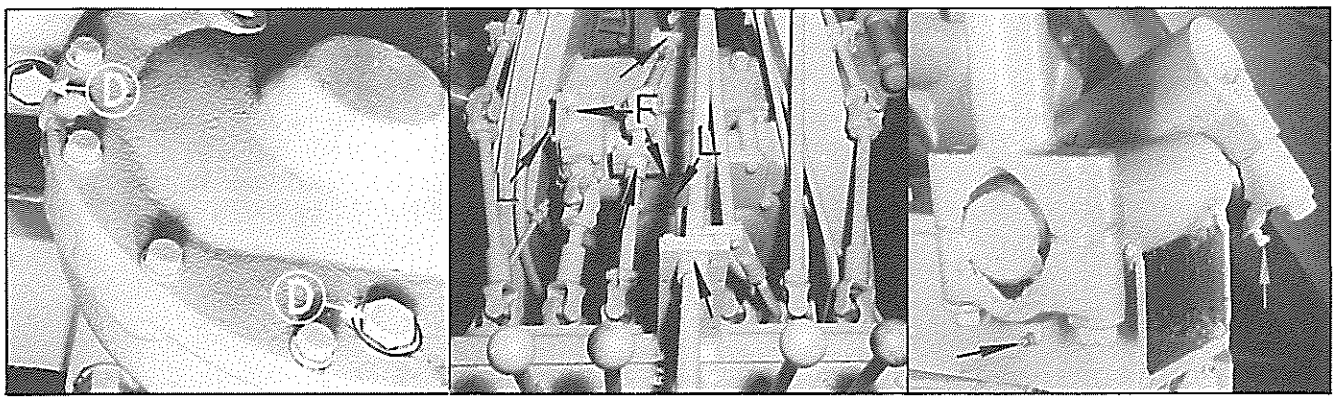
(A) TANDEMS: Drain at (D). Fill at (F) to level (L). Check oil level every 60 hours. Note: Tandem housing must be level when checking oil level. Give each fitting five (5) strokes of pressure gun grease every 60 hours.



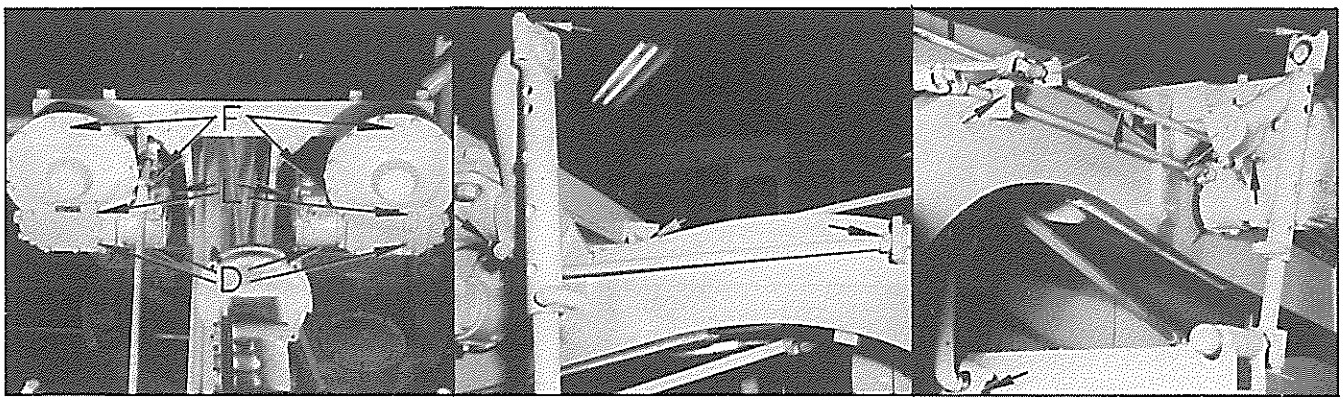
(B) AIR CLEANER: Remove oil cup (A) daily. Clean and refill. Disc (B), pre-filter (C) and air intake cap (D) should be kept clean at all times.



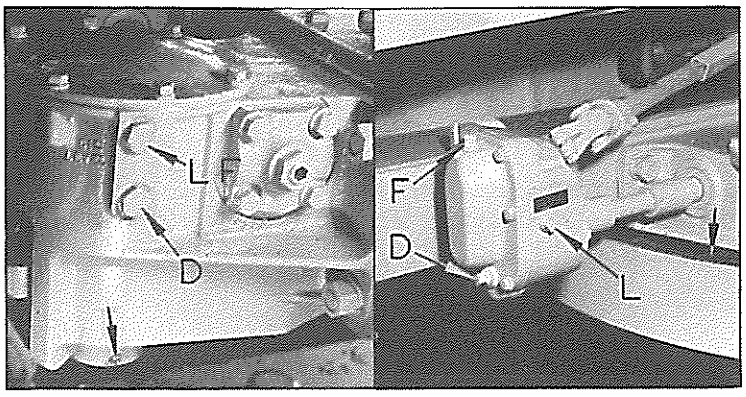
(C) POWER SHIFT TRANSMISSION WITH TORQUE CONVERTER: Drain at (D). Fill at (F) to level (L) on dip stick. Check level every 60 hours. OIL TANK: Clean filter once a year or oftener. Flush tank once a year or oftener. HEAT EXCHANGER: Drain heat exchanger whenever power-shift transmission with torque converter is drained.



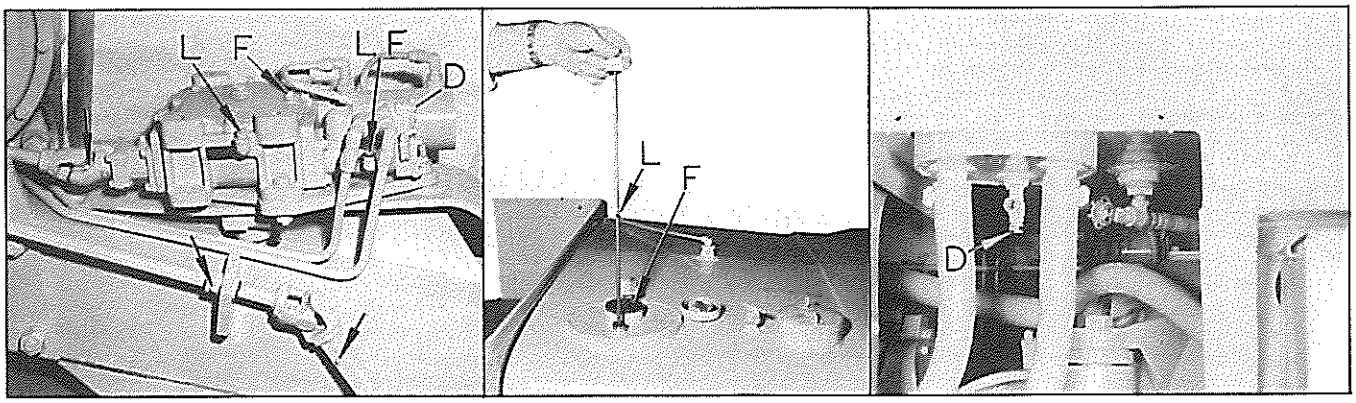
(D) LATERAL SHIFT: Flush fittings every 10 hours. Drain housings at (D). Fill at (F) to oil level (L). Check oil level every 60 hours.



(E) BLADE LIFTS: Drain housings at (D). Fill at (F) to oil level (L). Check oil levels every 60 hours. Flush fittings every 10 hours. Give fitting five (5) strokes of pressure gun grease every 60 hours.

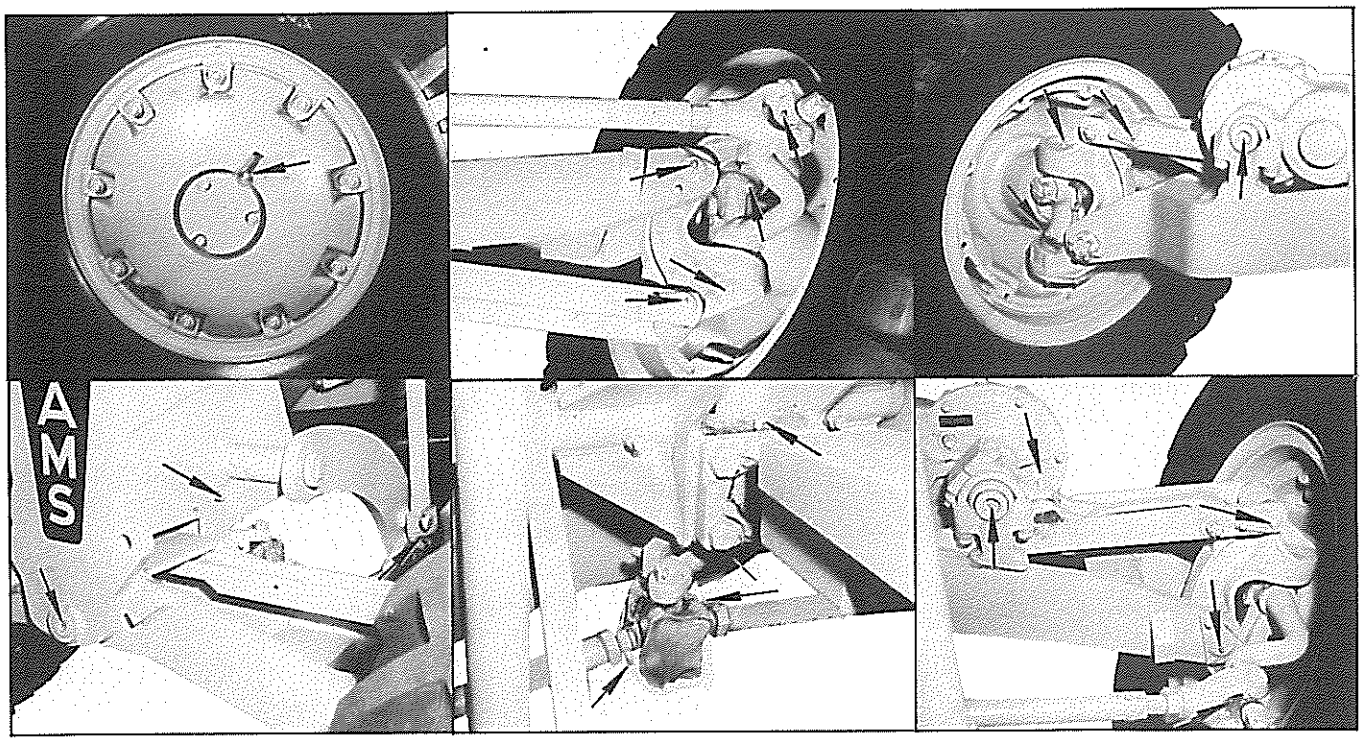


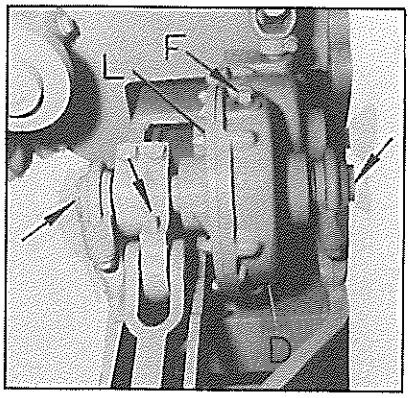
(F) CIRCLE REVERSE: Drain housing at (D). Fill at (F) to level (L). Check oil levels every 60 hours. Flush circle flange every 10 hours with a solution of 50% Diesel fuel and 50% Motor oil.



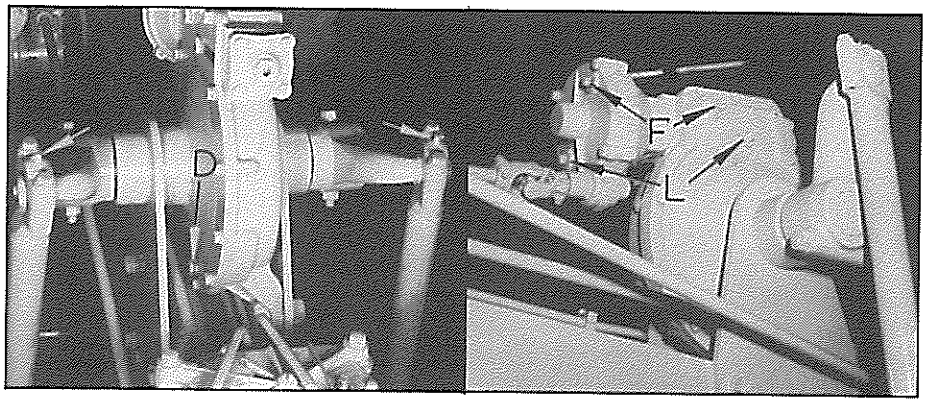
(G) POWER STEERING GEAR: Fill steering gear at (F) to level (L). Fill valve housing at (LF). Drain at (D). Fill reservoir at (F) to level (L) on dip stick. Drain at (D). Check level every 60 hours.

(H) FRONT AXLE: Flush fittings every 10 hours. Give fittings five (5) strokes of pressure gun grease every 60 hours.

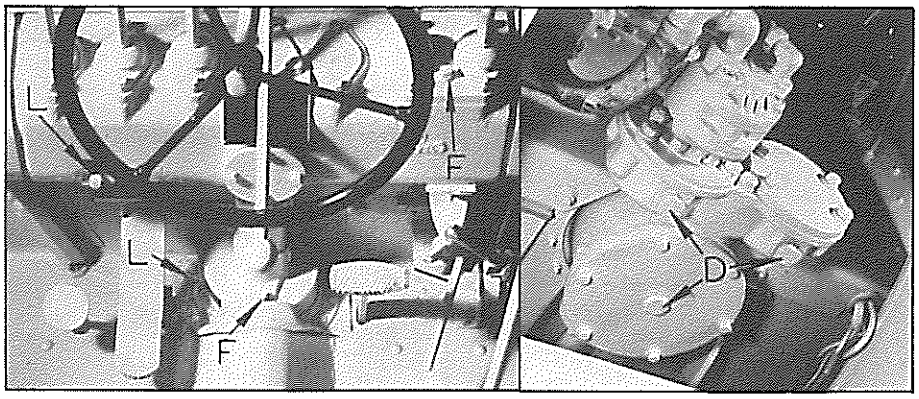




(I) FRONT WHEEL LEAN: Drain at (D). Fill at (F) to oil level (L). Check oil every 60 hours. Flush fittings every 10 hours. Give fittings five (5) strokes of pressure gun grease every 60 hours.

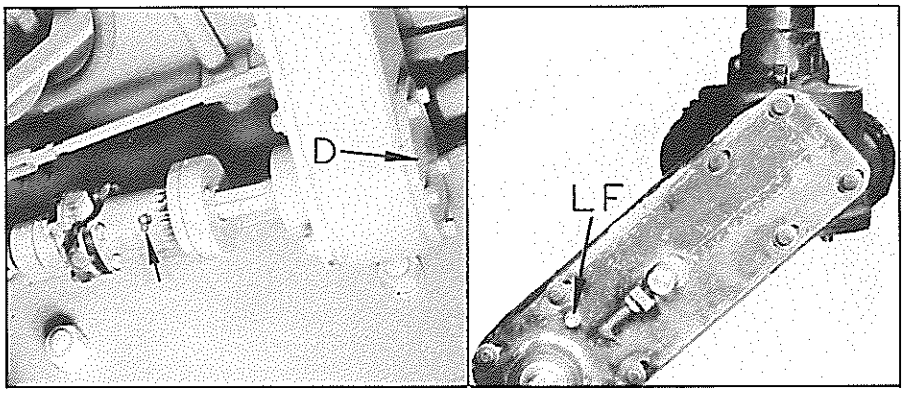


(J) SCARIFIER: Drain at (D). Fill at (F) to oil levels (L). Check oil levels every 60 hours. Flush fittings every 10 hours. Give fittings five (5) strokes of pressure gun grease every 60 hours.



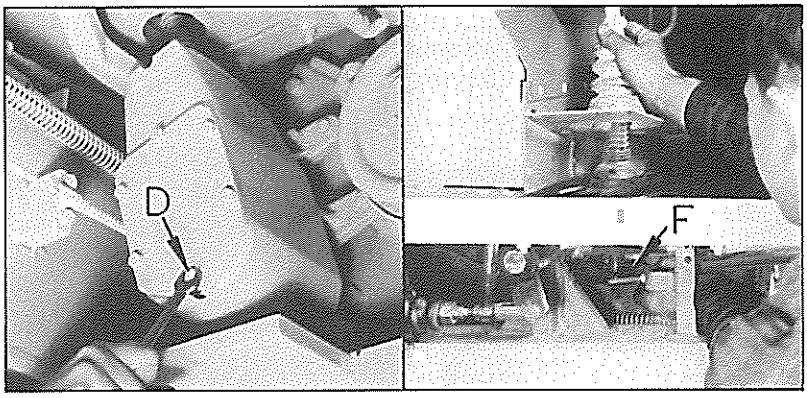
(K) POWER BOX: Drain at (D). Fill at (F) to oil level (L).

POWER BOX DRIVE WITH PUMP HOUSING: Drain at (D). Fill at (F) to oil level (L). (See power box illustration.) Check oil level every 60 hours.

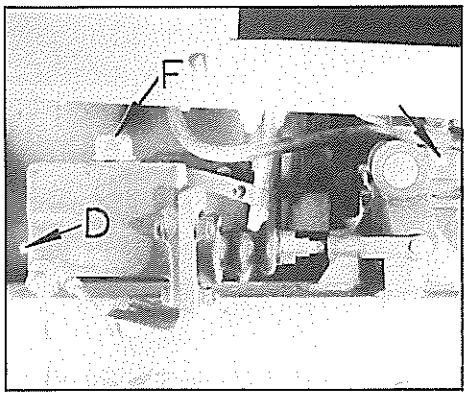


(L) P.T.O. CHAIN HOUSING: Drain at (D) (Remove cover to drain.) Fill at (LF). Flush fittings every 10 hours. Give fittings five (5) strokes of pressure gun grease every 60 hours.

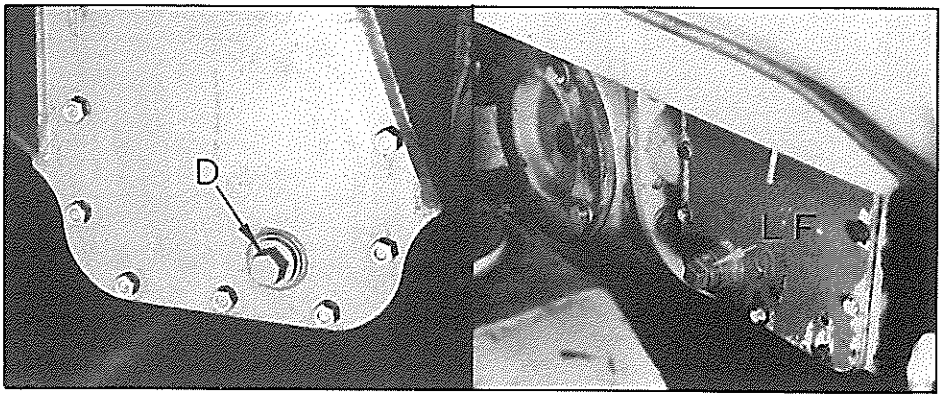
Every 1000 hours disassemble Universal Joints. Clean and repack bearings with high temperature wheel bearing grease.



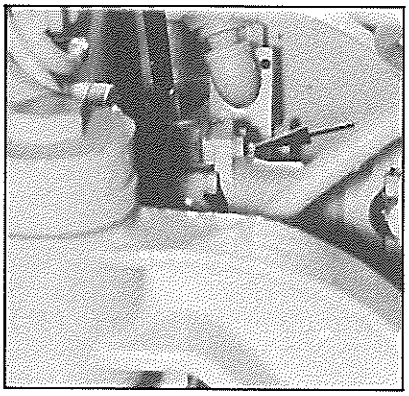
(M) GEAR SHIFT HOUSING: Drain at (D). Fill at (F).



(N) BRAKE CYLINDER: Fill at (F) as needed. Drain at (D). Flush fitting every 10 hours. Give fitting five (5) strokes of pressure gun grease every 60 hours.

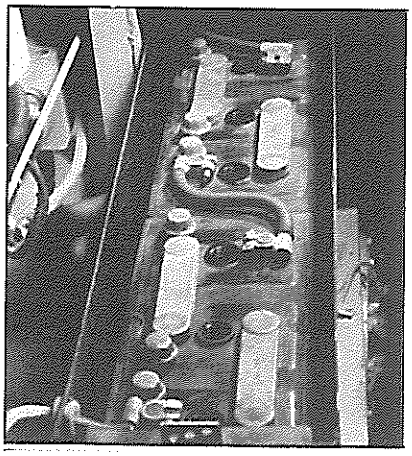


(O) TRANSMISSION: Drain at (D). Fill at (LF). Check oil every 60 hours.



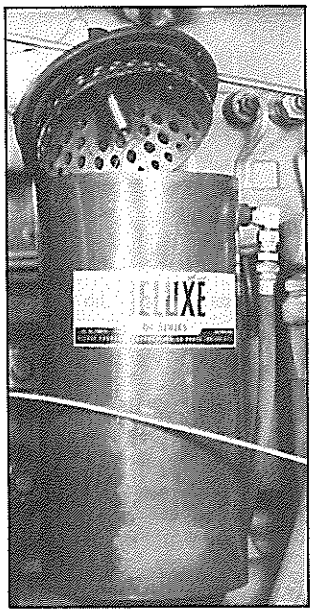
(P) UNIVERSAL JOINT: Flush fitting every 10 hours. Lubricate at fitting every 10 hours.

Every 1000 hours disassemble Universal Joint. Clean and repack bearings with high temperature wheel bearing grease.



(Q) BATTERIES: Keep filled with distilled water to 1/2 inch above plates. Check every 60 hours.

AUXILIARY OIL FILTER (CUMMINS ENGINE ONLY)



(R) To change "Deluxe" filter as shown, remove cover and lift element out by using the bail on element. Wash interior of case with a clean cloth saturated with fuel oil. DO NOT USE WASTE. Wipe case dry with a clean cloth. Install new element and assemble cover and draw down tight. This element should be replaced every 1000 gallons of fuel consumed or more often if necessary to keep the lubricating oil clean.

NOTE: After replacing oil filter element, extra oil must be added to the crankcase to replace the oil absorbed by the new filter.

Be sure to check filter case for leaks each filter change.

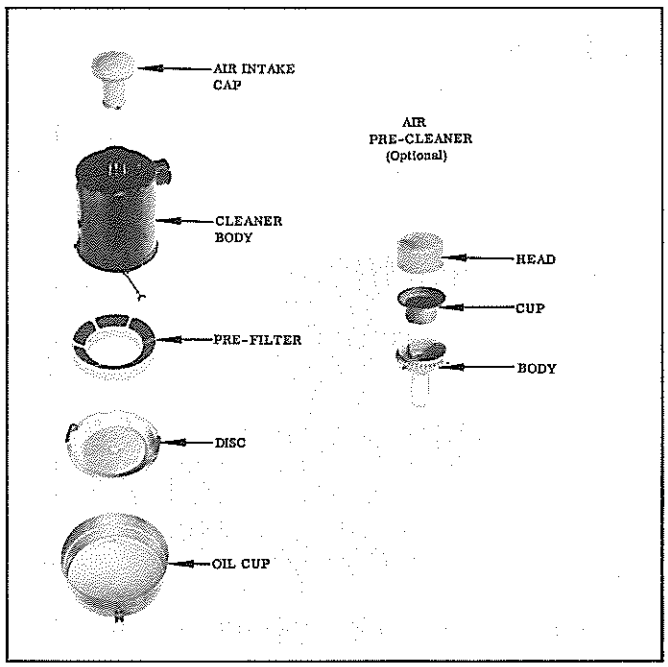
AIR CLEANING SYSTEM (CUMMINS AND GENERAL MOTORS ENGINES)

The Cummins and General Motors Engine is equipped with an oil bath air cleaner, as shown in Illust. 1.

The cleaner may be equipped with an air pre-cleaner. If a pre-cleaner is used, the head must be emptied daily or oftener if necessary.

Air Intake Cap and Screen

If the cleaner is not equipped with a pre-cleaner it will have an air intake cap and screen to prevent large particles such as chaff, leaves, etc., from entering the air stream. Keep the screen in the cap free from dirt at all times. Water or oil and dust may collect on the screen and clog the holes enough to restrict the flow of air to the



ILLUST. 1

engine. Restricted air flow will result in reduced horsepower delivered by the engine.

SERVICE AIR CLEANER OIL CUP DAILY (or more frequently when operating under severe dust conditions). Remove, wash and refill oil cup to the indicated oil level with the same grade of oil used in the crankcase.

Washing Air Cleaner Pre-Filter

Inspect the pre-filter often enough to insure a clean pre-filter.

To remove the pre-filter for cleaning, remove oil cup then press upward and turn pre-filter to the left until locking tabs line up with the vertical slots, then pull downward. Wash the pre-filter in a good cleaning solvent and dry with compressed air.

The entire air cleaner must be removed from the grader and cleaned after each 500 gallons of fuel consumed. After removing the air cleaner from the grader, remove the air intake cap or pre-cleaner. Clean the entire cleaner in solvent and dry with compressed air.

When reassembling air cleaner to the machine make sure all connections between the cleaner body and manifold are air tight.

Refill oil cup with proper viscosity of oil and reassemble to air cleaner.

An oil of the same grade used in the crankcase should be used in the air cleaner, however, in extremely cold weather a lighter grade may be necessary. Some detergent or additive oils tend to foam in the air cleaner. The additives are of no advantage in the air cleaner and for these reasons it is recommended that a straight mineral oil be used. See "Lubrication Section " for Engine in Engine Manufacturer's Operator's and Maintenance Manual.

General Precautions

To prevent entrance of dirt into the engine, it is absolutely essential that frequent inspections be made on flexible rubber hose connections between the manifold and air cleaner. Hose connections should be replaced before they deteriorate. To eliminate any undue strain on the connections, all pipes must line up. See that all joints between the air cleaner and the cylinder head are air tight. This includes the flexible connections, manifold joints and gaskets. All gaskets must be in good condition and cap screws drawn tight.

Warning: Never use crankcase drainings.

STARTING AND LIGHTING EQUIPMENT

If grader is equipped with electric starting or starting and lighting, the following instructions will be of help in maintaining this equipment. If the grader is equipped with either starting or starting and lighting it will be of the 12-volt (General Motors) or 24-volt (Cummins) type.

Generator

The only care that is needed in the daily operation of the generator is to keep the connections on the generator clean and tight, to lubricate, and to maintain proper adjustment of the generator belt.

If the generator belt becomes loose, loosen the bolt in the adjustment slide bar, pull the generator out away from the motor until proper belt tension is obtained and retighten the bolt in the adjustment bar. Do not operate the belt tighter than absolutely necessary to drive the generator. Excessive belt tightness will result in rapid belt wear and overloading of the bearings in the generator.

Never attempt to adjust or repair the generator in the field. If repair or adjustment of the generator is needed, remove the complete assembly and take it to your and take it to your Adams Division, LeTourneau-Westinghouse Distributor for service.

Voltage Regulator

The only maintenance needed on the voltage regulator is to be sure that all connections are clean and tight. Never attempt to adjust or regulate the voltage regulator in the field. If repair or adjustment of the voltage regulator becomes necessary, remove the complete assembly and take it to your Adams Division, LeTourneau-Westinghouse Distributor for service.

Starter and Solenoid

Aside from keeping all connections tight and clean the only other point which should be watched is the proper lubrication of the starting motor. If repair to either of these units becomes necessary, remove the complete assembly and take it to your Adams Division, LeTourneau-Westinghouse Distributor for service.

Batteries

Motor graders equipped with General Motors engines and with starting or starting and lighting equipment have two 6-volt batteries. These batteries are located in the battery box on the right side of the frame next to the engine.

Motor graders equipped with Cummins engines and with starting and starting or lighting equipment have four 6-volt batteries. These batteries are located in two battery boxes, one battery box on the right side of the frame next to the engine and one battery box on the left side of the frame next to the engine. Each lead acid storage battery used with General Motors or Cummins engines, are of the 6-volt type, consisting of three cells of two volts each connected in series. Each cell is composed of two groups of plates, positive and negative, with separators between the positive and negative plates. This element is immersed in Electrolyte (sulphur acid and water) and sealed in place.

The battery should be checked every two weeks, whether the grader is operating or not, using a hydrometer. The hydrometer will determine the specific gravity of the electrolyte which in turn indicates the condition of the battery Specific gravity reading 1275 indicates full charge. Specific gravity reading 1225 indicates half charge. Specific gravity reading of 1150 indicates complete discharge.

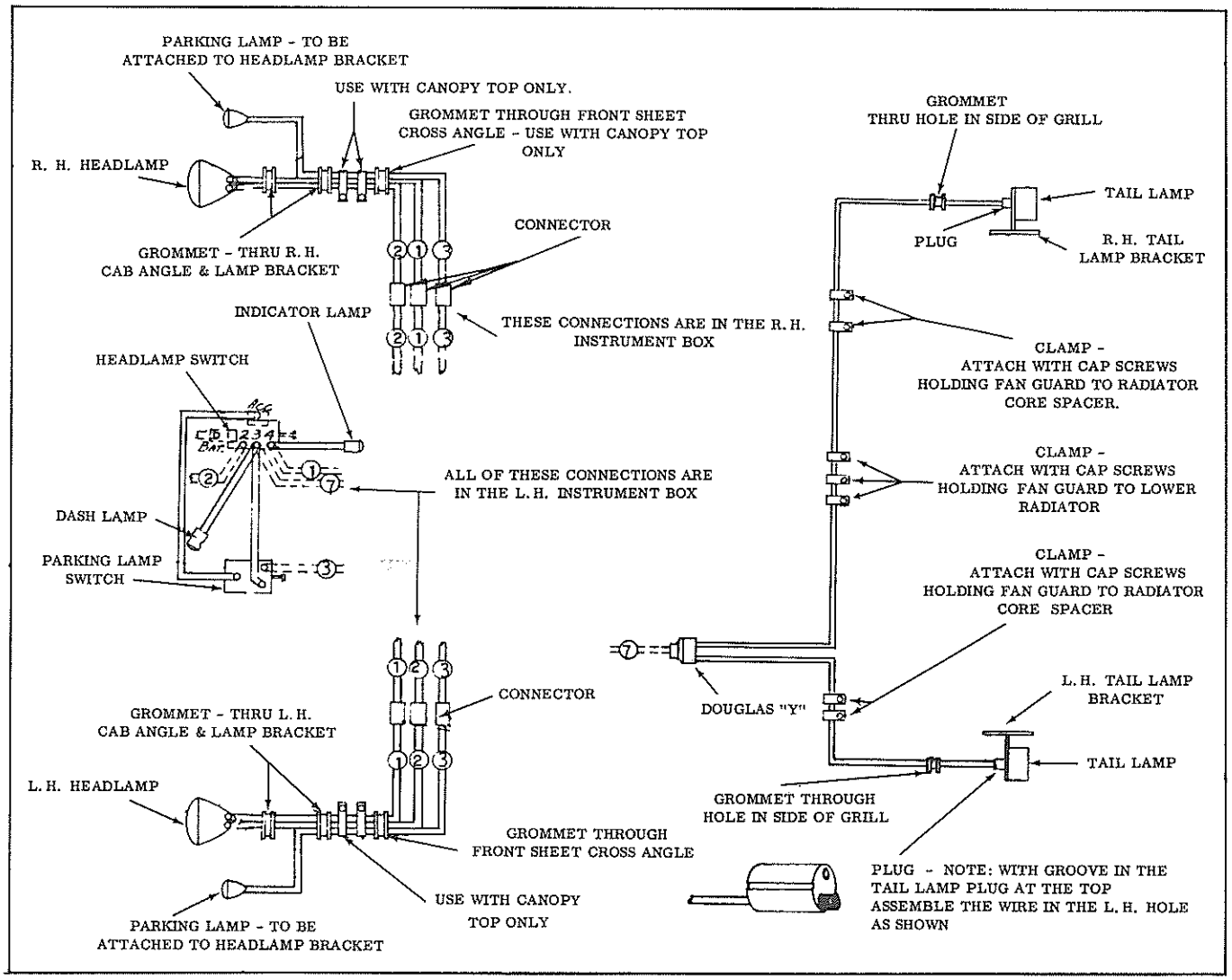
Wiring

Keep all wiring connections tight and clean. Occasionally, inspect the wiring for breaks or for worn places which might cause shorts. Defective wiring should be repaired or replaced immediately. Should it become necessary to either reinstall the old wiring or install new wiring, connect all wires and cables as shown in the wiring diagrams.

Warning

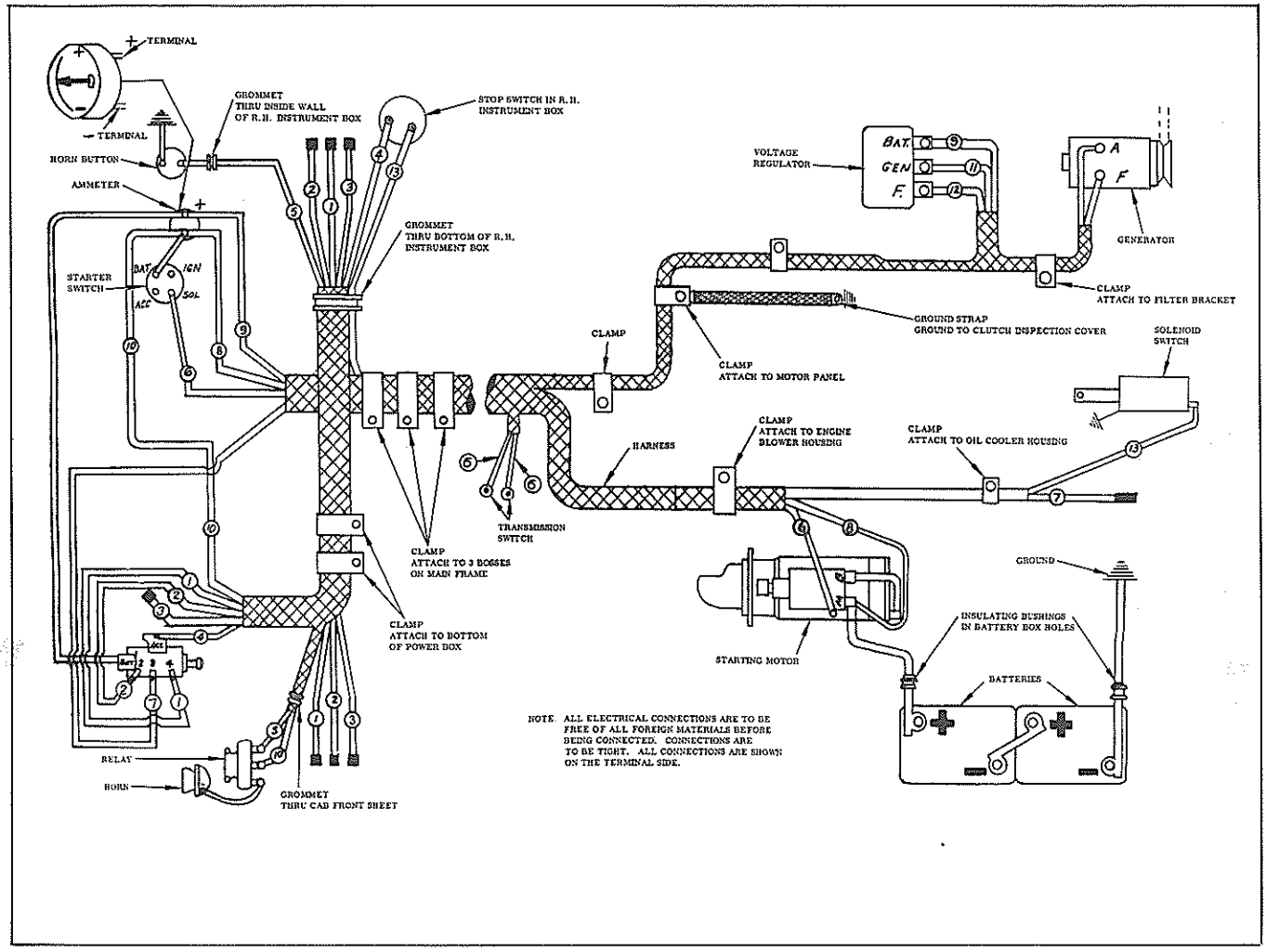
If the generator or voltage regulator have been disconnected any reason, the generator must be correctly polarized again before operating the units. After connecting all wires and before starting the engine always connect momentarily with a bumper lead between the generator armature terminal and the battery terminal of the regulator. This allows a momentary surge of the battery current to flow into the generator which correctly polarizes the generator with respect to the battery it is to charge.

Wiring Diagram For Lights Only (General Motors and Cummins Engines)



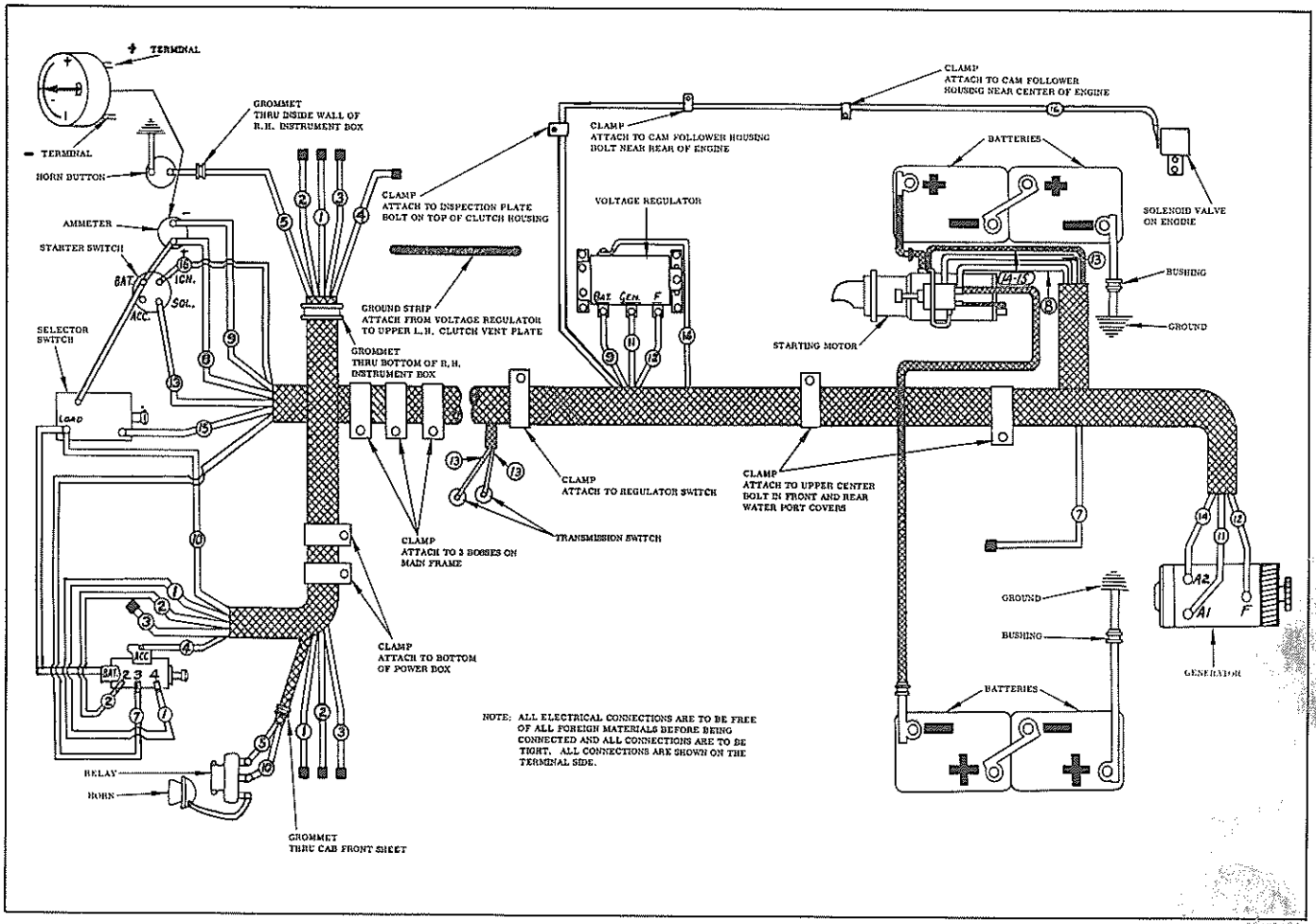
ILLUST. 1

Wiring Diagram For Starting (For General Motors Engine Only)



ILLUST. 2

Wiring Diagram For Starting (For Cummins Engine Only)



ILLUST. 3

