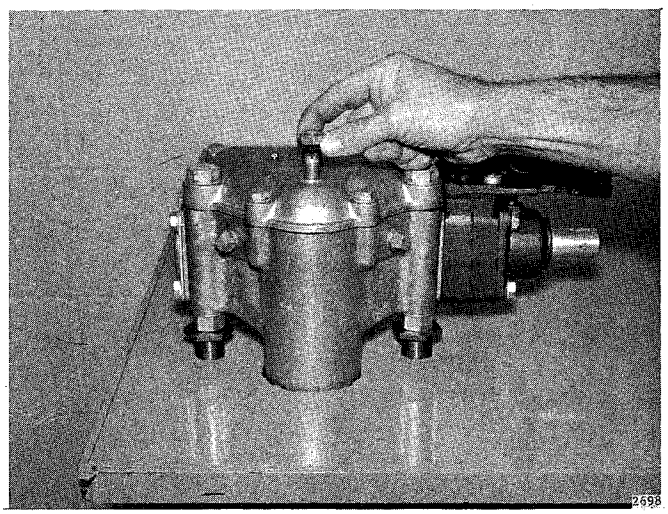
DISASSEMBLY:

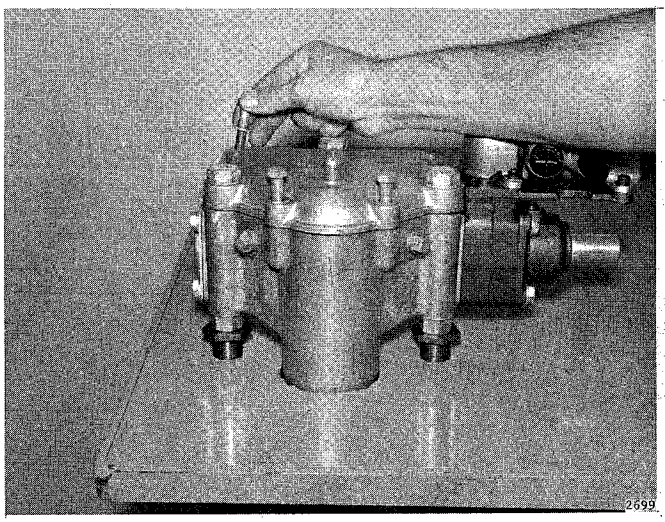
1

Remove adjusting screw lock nut.



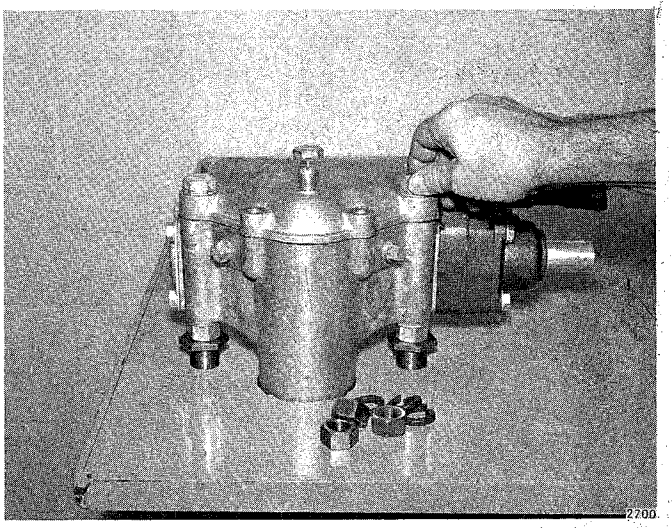
2

Remove small cap screws from cover.



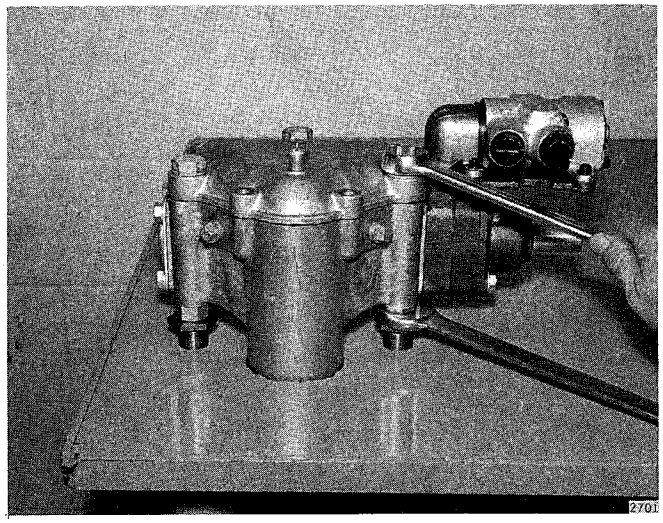
3

Remove nuts and washers from ends of larger cover bolts (beneath steering gear mounting pad), if so equipped.



4

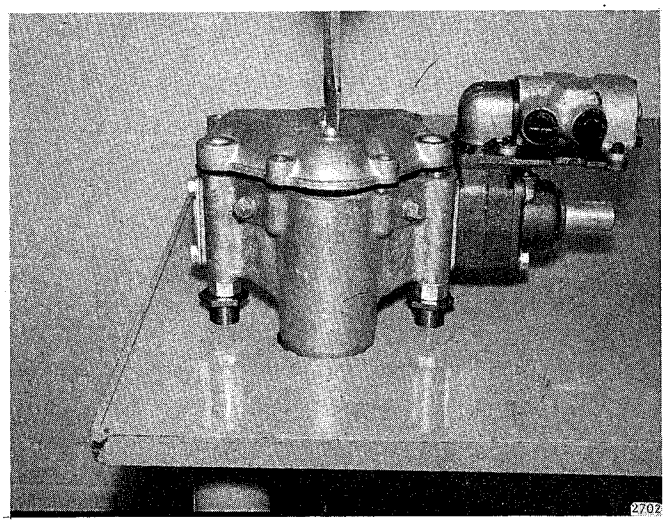
Remove large cover retaining bolts: if so equipped.



5

On previous models (with shim-adjusted lever shaft), cover may now be lifted off. Proceed to Step 9 on page 4.

On later models (with screw-adjusted lever shaft), use screwdriver to turn adjusting screw clockwise. This will lift cover from housing. Screw must be turned all the way through the housing. Proceed to Step 6 on page 3.

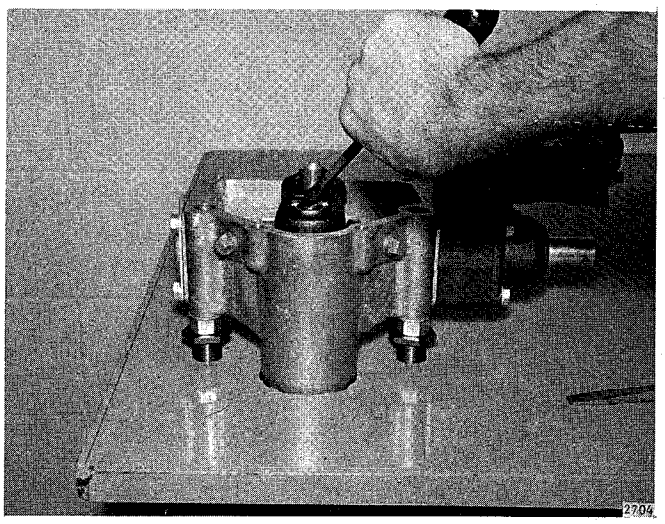


Some previous model motor graders and all rollers and cranes with the Ross unit are equipped with a one-piece steering shaft. The pitman arm is splined to the lower end of the lever shaft in these models.

To remove the pitman arm from the lever shaft, remove nut and washer from splined end. Raise lever shaft and insert wood block under splined end to raise stud roller bearing away from cam. This prevents damage to stud roller bearing and cam. Then drift pitman arm from shaft.

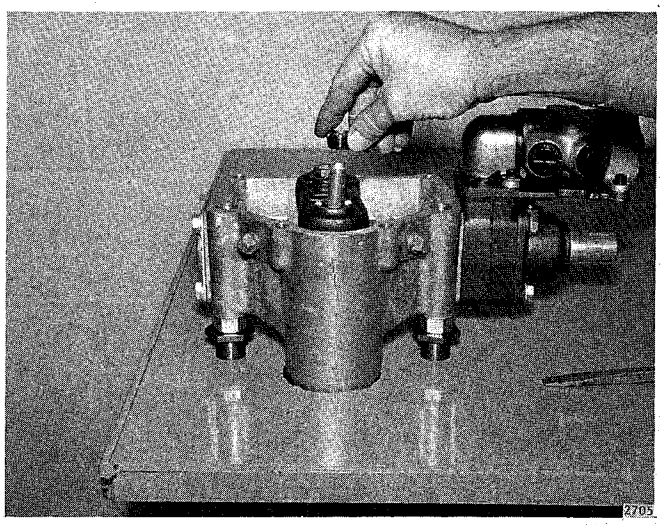
6

Pry staked portion of adjusting screw lock nut from slot in lever shaft.



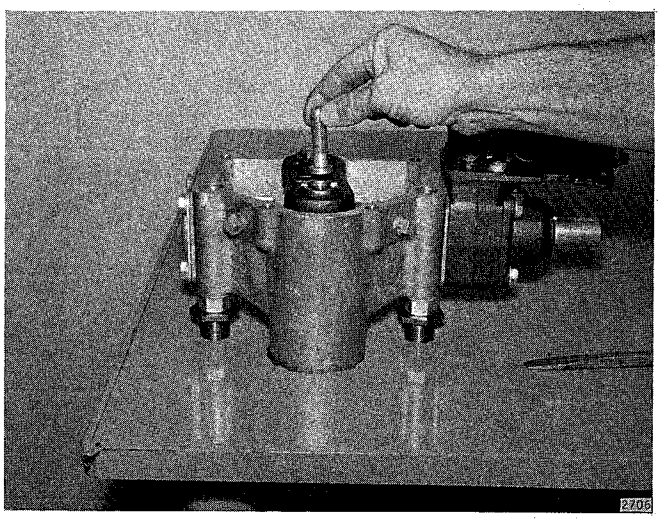
7

Remove adjusting screw lock nut.



8

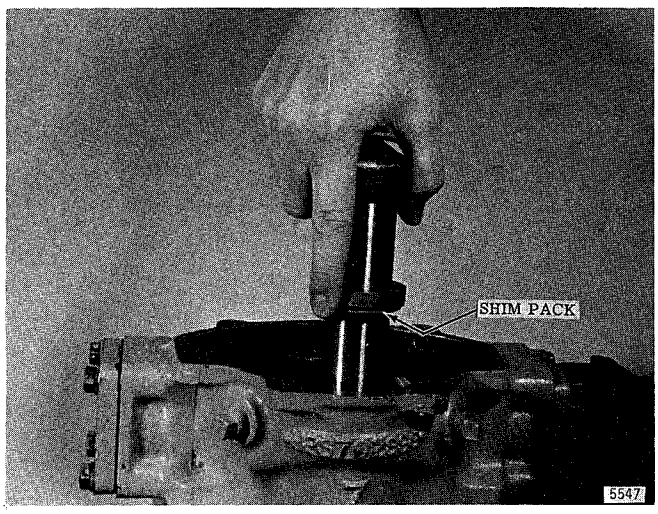
Lift adjusting screw from pocket in lever shaft.



9

On previous models (with shim-adjusted lever shaft), remove lever shaft and shim pack from gear housing. Keep shim pack intact.

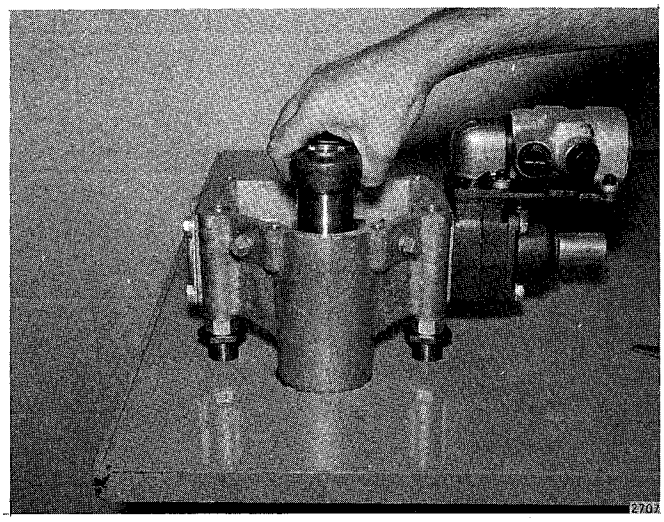
This step is normally done only if to replace shaft, bushings or seal. If none of these replacements are required, slide lever shaft up, rotate 180°, and rest lever on back of case.



10

On later models (with screw-adjusted lever shaft), no shim pack is used to adjust lever shaft stud roller to cam. Adjusting screw holds lever shaft in position.

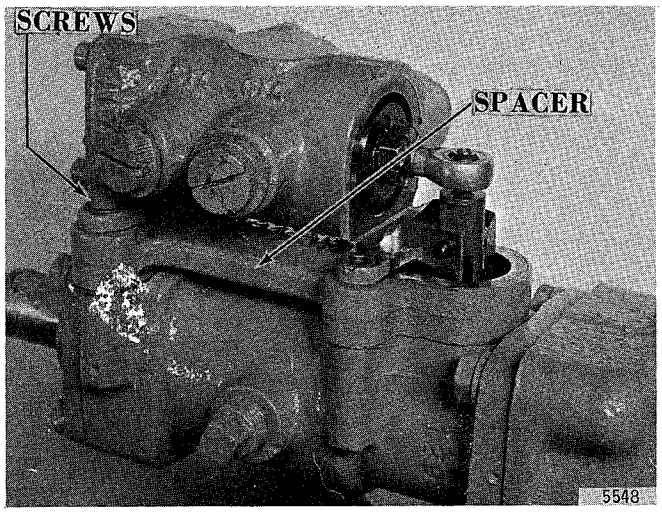
Remove lever shaft only if to replace shaft, bushings or seal. If not required, then slide lever shaft up, rotate 180°, and rest lever on back of case.



11

Remove four (4) socket head cap screws holding valve, valve spacer, and cover to control (or actuator) housing. Actuating lever, pin, seal and washer will be removed with the valve.

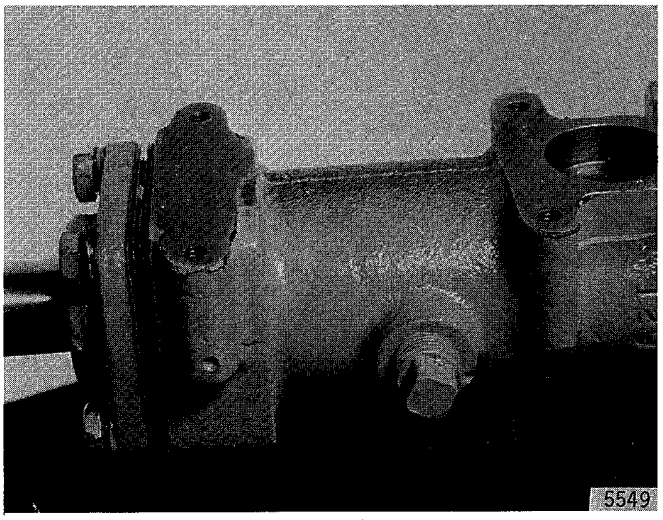
Previous valve configuration is pictured. Service to this assembly is illustrated on page 11.



12

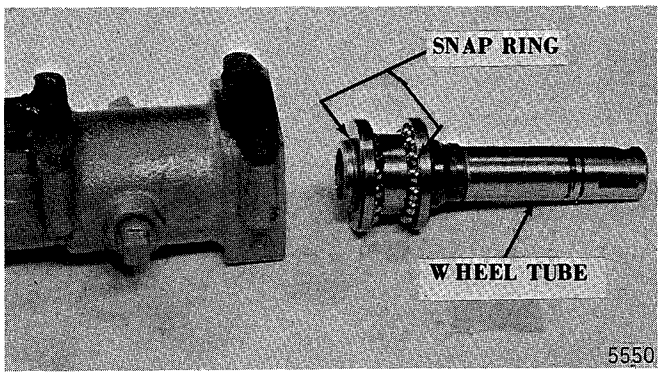
On previous models (with one-piece control or actuator housing) remove four (4) cap screws, cover, shims, and gaskets. Wheel tube can now be removed. Inspect bearings and splines for serviceability.

On models with two-piece (separate upper cover and actuator) actuator housing, proceed to Step 18 on page 7.



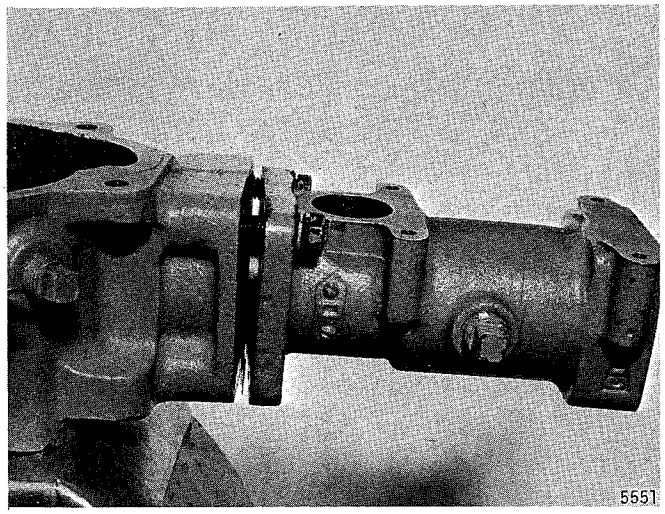
13

Wheel tube bearings can be replaced by removing retaining snap rings. It appears that each bearing is missing one ball--this is correct. Balls must be replaced by sets only.



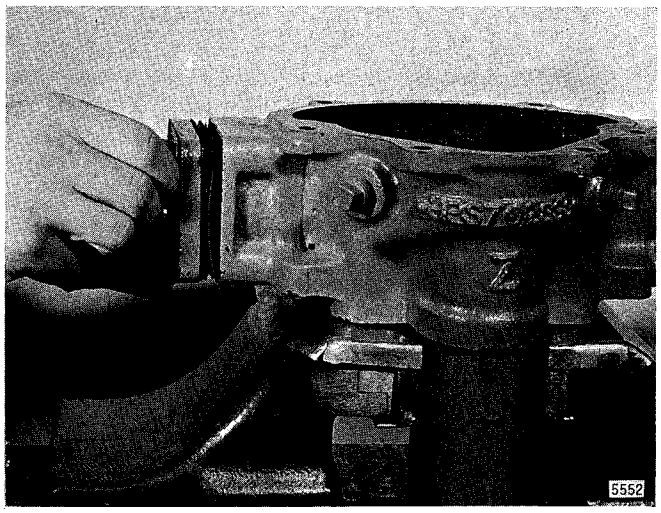
14

Remove cap screws, control housing, and gasket. Inspect control housing for internal bearing race wear.



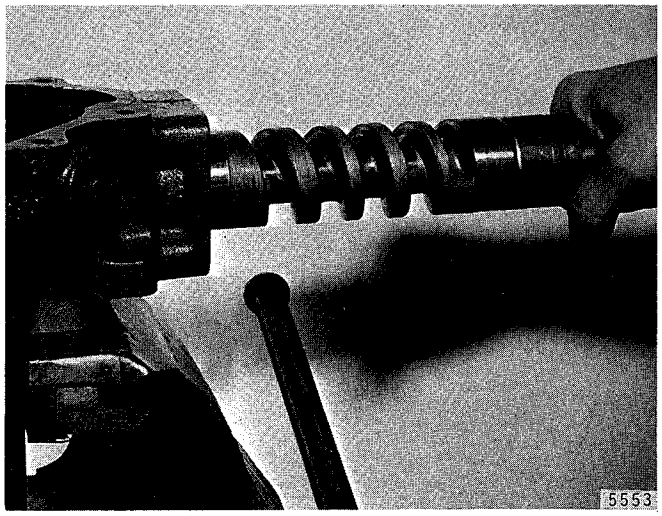
15

Remove cap screws, shims, gaskets, sleeve retainer, and end cover. Cam assembly can now be removed.



16

Remove cam assembly.

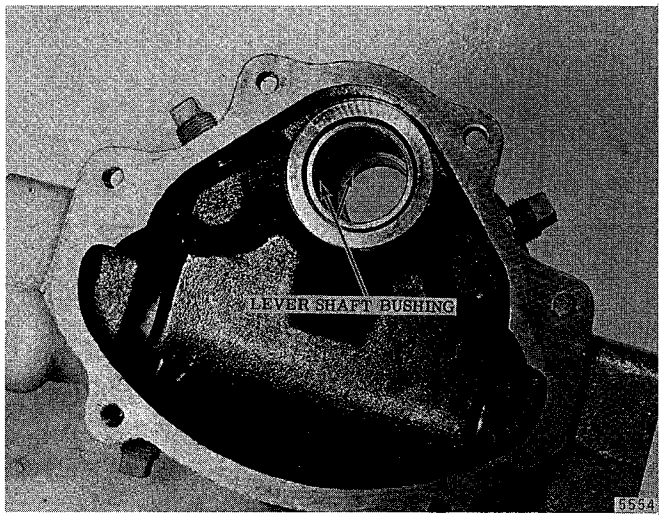


17

Inspect case at mounting for wear or breakage.

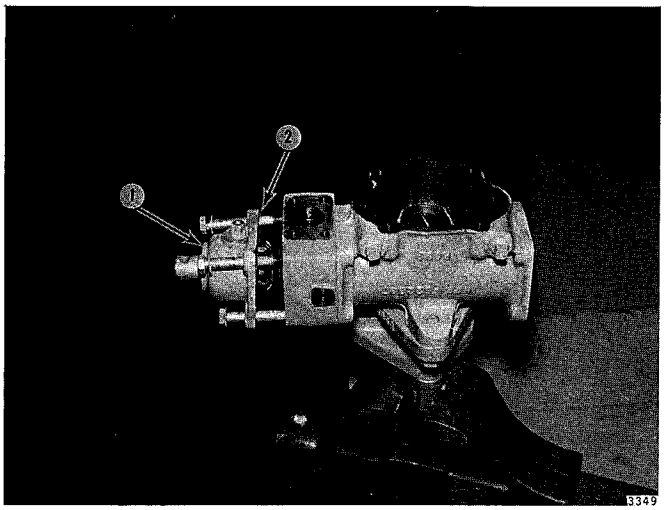
Inspect lever shaft bushing for wear or damage and replace as required.

Proceed to Step 24 on page 9.



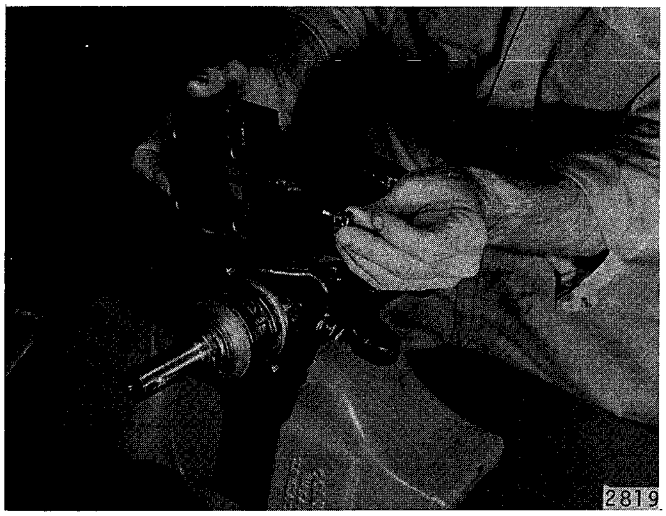
18

On models with two-piece (separate upper cover and actuator) actuator housing, remove cover (1) and gasket (2).



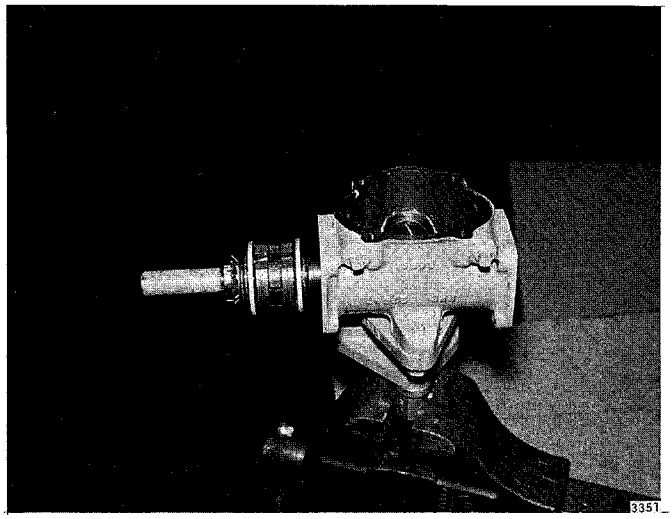
19

Remove actuator retainer screw and washer, then remove actuator housing and gasket.



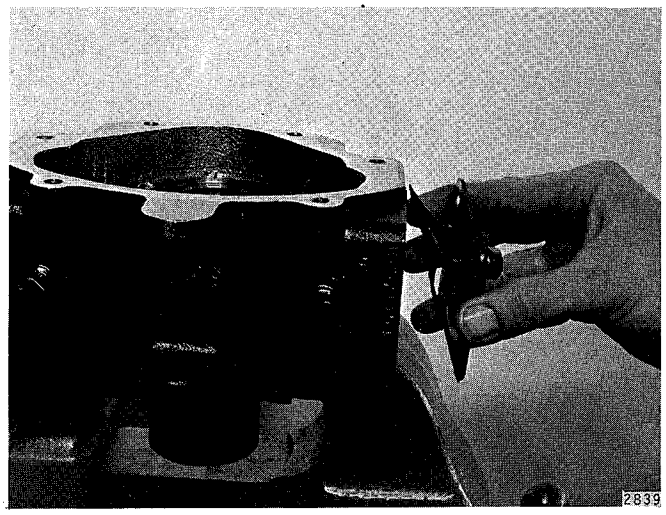
20

Remove cam and actuator assembly.



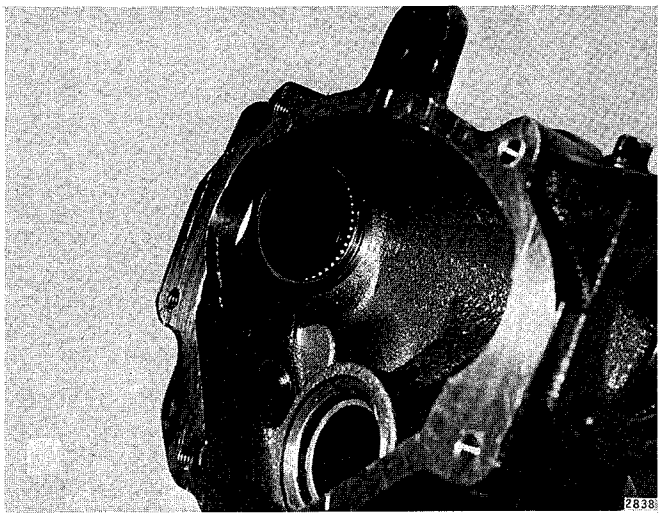
21

If cam assembly bearings require replacement, remove end cover and gasket.



22

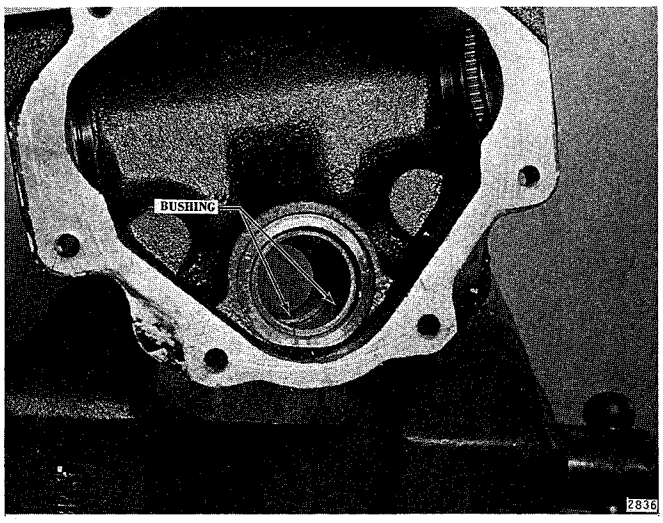
Reassemble needle bearings into housing. Press to locating ring with extreme care.



23.

Inspect case at mounting for wear or breakage.

Inspect lever shaft bushing for wear or damage and replace as required.

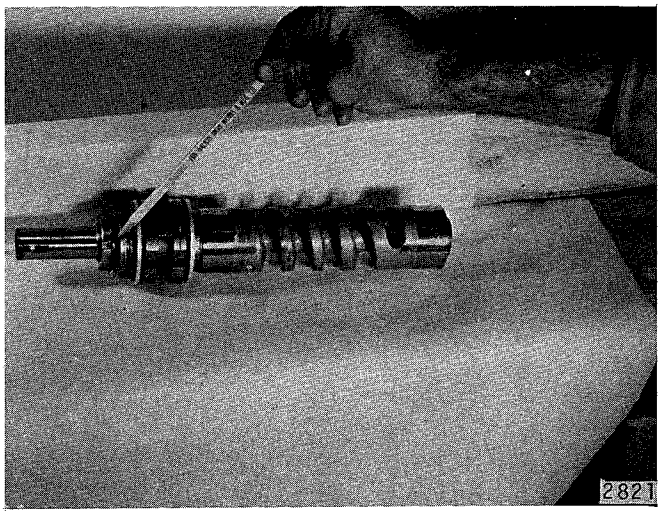


SERVICE TO CAM & ACTUATOR ASSEMBLY

24

Later models with two-piece actuator housing employ an actuator unit assembled on the cam.

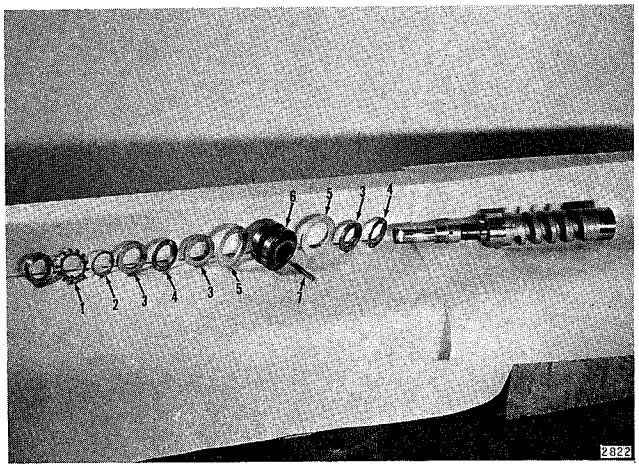
Remove adjusting nut after straightening bent prong on lock washer.



25

Remove lock washer (1), tongued washer (2), thrust washers (3), needle bearing (4), and upper centering washer (5) from above actuator. Do not lose springs (7) in actuator.

Remove lower centering washer (5), thrust washer (3), and needle bearing (4) after removing actuator (6).



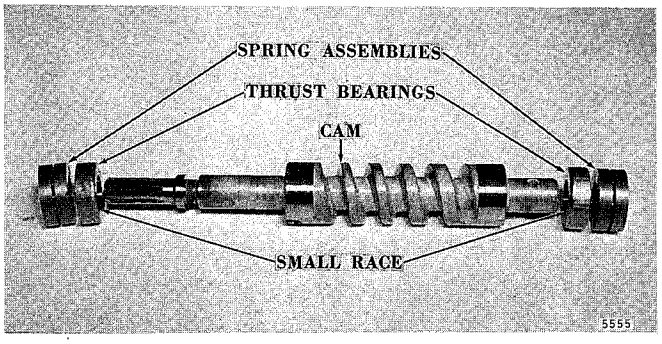
26

Inspect cam for damage and excessive wear. Check cam groove for chipping, scoring, or brinnelling. Check cam bearing surfaces and splines. Wearing away of copper plating is natural and will come in time to all cams.

Pictured is the cam assembly used in previous units with one-piece control housing. Spring assemblies are not adjustable. They are factory set. The smaller race of the thrust bearing should be located next to the cam.

On later models with two-piece actuator housing, reassemble actuator assembly on cam wheel tube assembly and adjust. Prior to assembly, make sure that threads are straight and that nut can be run down by finger torque all the way. Assemble in order shown in Step 25.

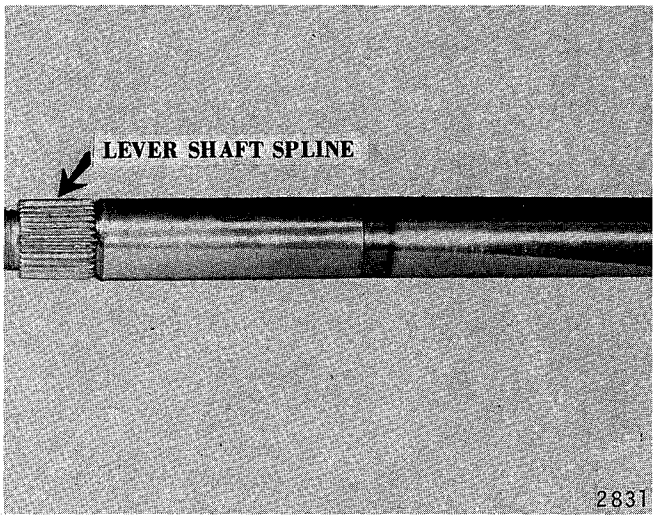
Tighten nut to 10 ft.-lbs. torque. Then back off nut 10° or 5/32" (the width of a lug on the locking washer). This adjustment must result in a light preload on bearings but allow NO end play of actuator on shaft.



SERVICE TO LEVER SHAFT & STUD ASSEMBLY

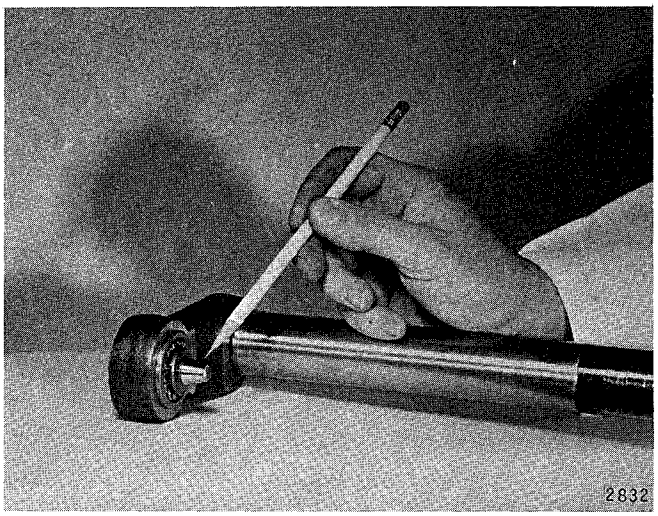
27

Check shaft splines and threads on lever shaft. Replace if needed.



28

Check stud for flat spots, nicks, or spalling.



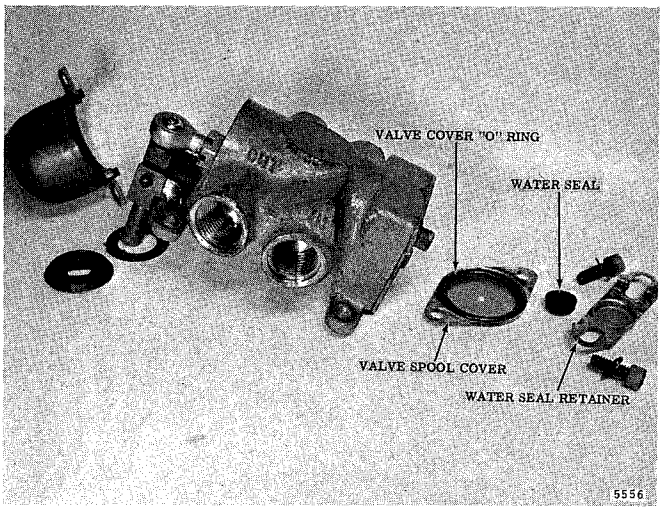
29

Adjustment of stud roller bearing must be set to three inch-pounds preload for correct operation.

SERVICE TO VALVE ASSEMBLY

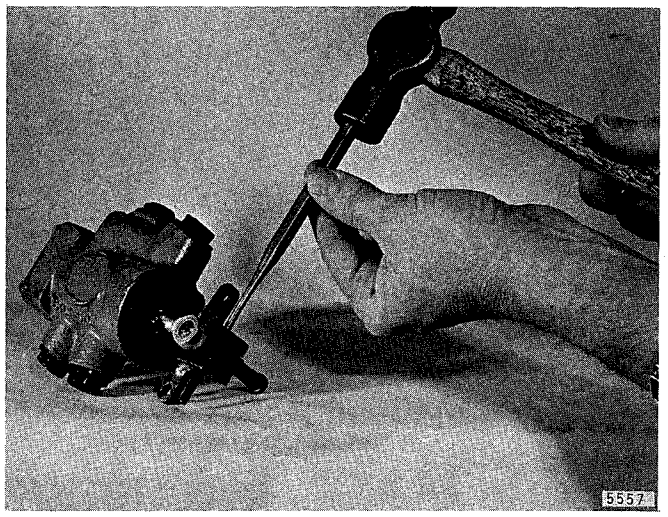
30

Remove water seal retainer, water seal, valve spool cover, and valve cover "O" ring by removing two(2) cap screws.



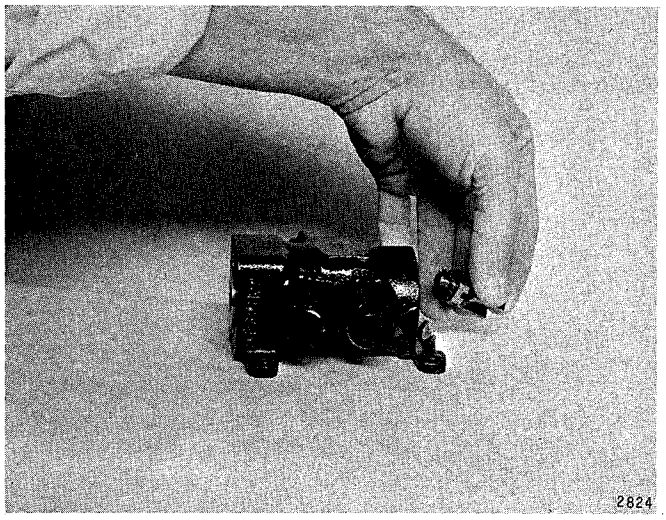
31

On some previous model valve assemblies, drift out pin with small punch and remove actuating lever from swivel bearing rod and valve body.



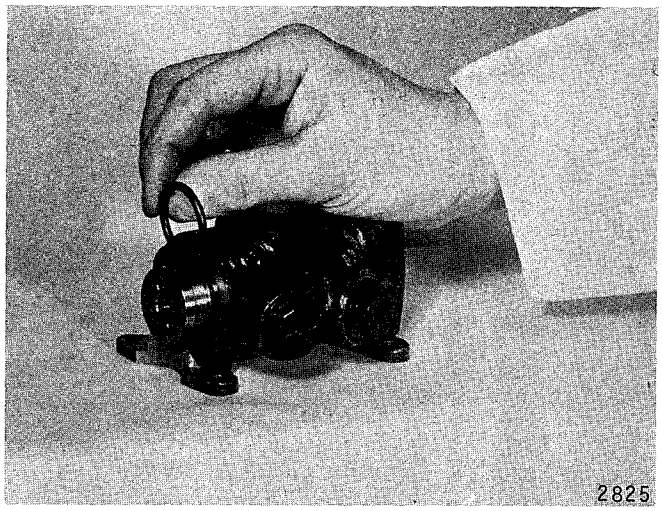
32

Remove clevis or swivel bearing rod from end of spool by removing cotter pin, loosening nut, and unscrewing rod from spool.



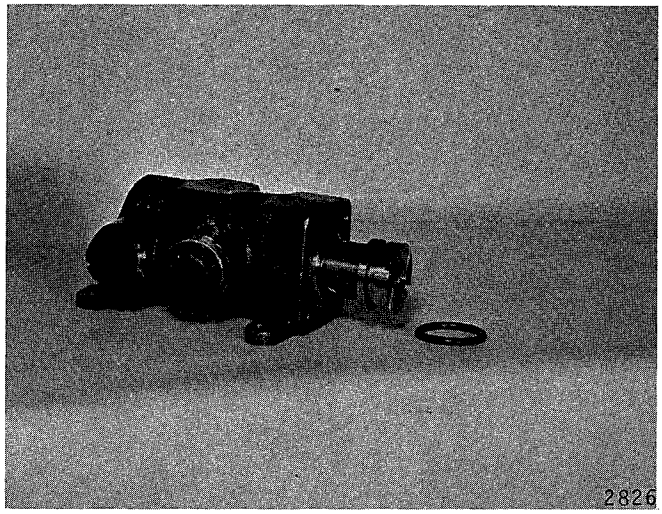
33

Push spool out clevis or swivel bearing rod end about 1/2" until "O" ring is exposed. Remove "O" ring.



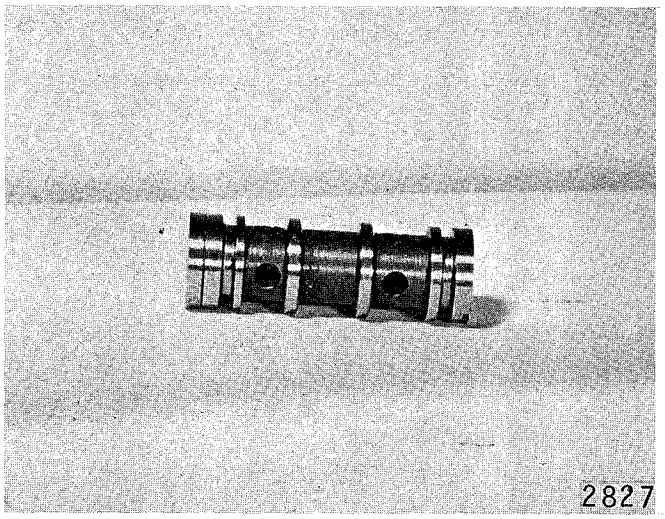
34

Push spool out other end to expose "O" ring. Remove "O" ring.



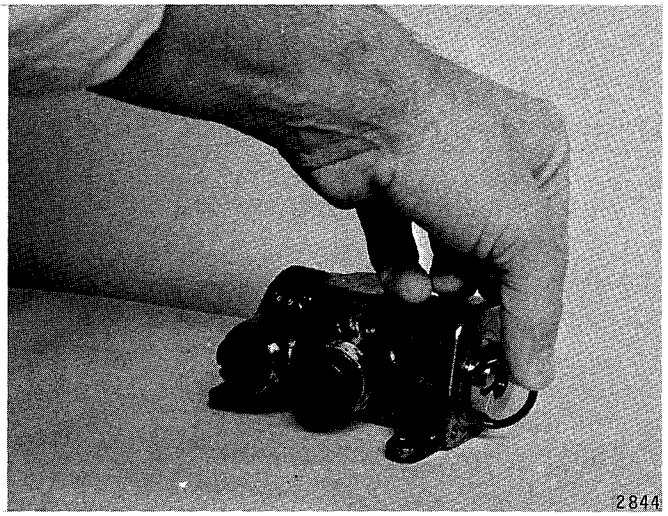
35

Remove spool and inspect for wear and scoring.



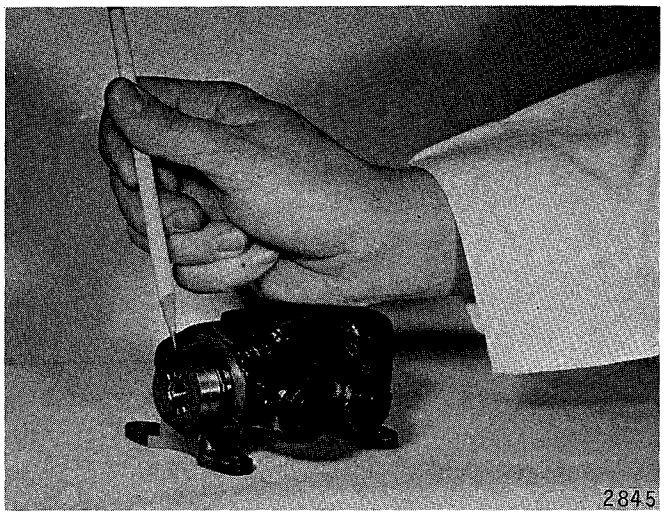
36

Install "O" ring on spool. Lubricate "O" ring with Dexron or Type A oil and then carefully insert spool in valve.



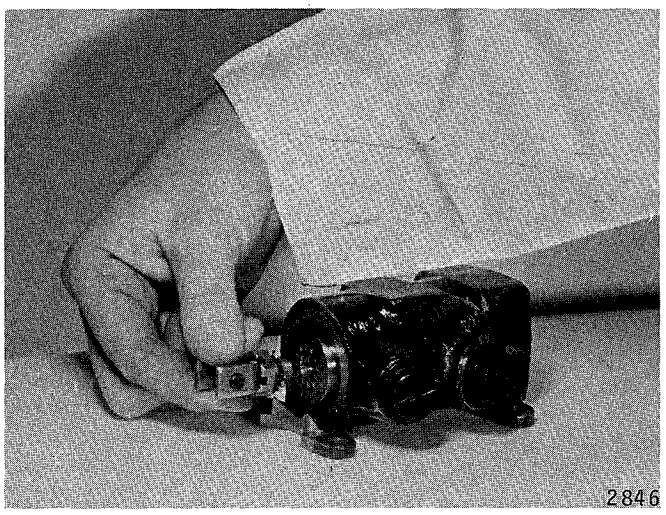
37

Push spool through the valve body until "O" ring groove on clevis or swivel bearing rod end is exposed. Install "O" ring in groove and lubricate with Dexron or Type A oil. Push into valve with care until "O" ring just enters body of valve.



38

Screw nut onto clevis or swivel bearing rod assembly, then place lock washer next to nut and screw clevis rod into threaded end of spool. Do not tighten.



REASSEMBLY

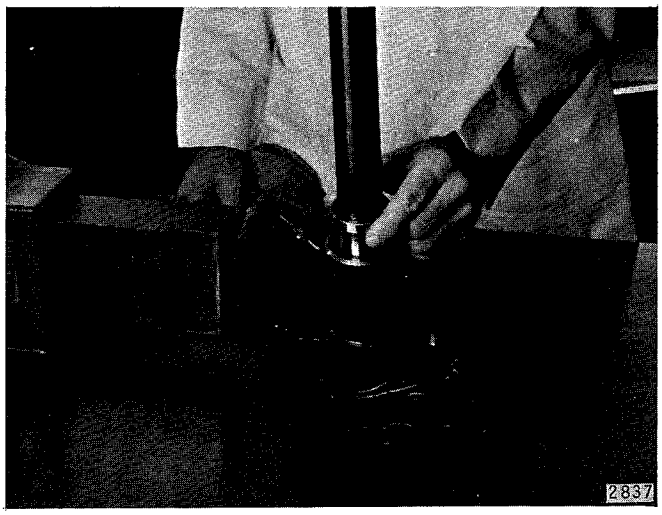
39

Clean housing thoroughly.

Check housing oil seal for damage or leakage. Replace if necessary.

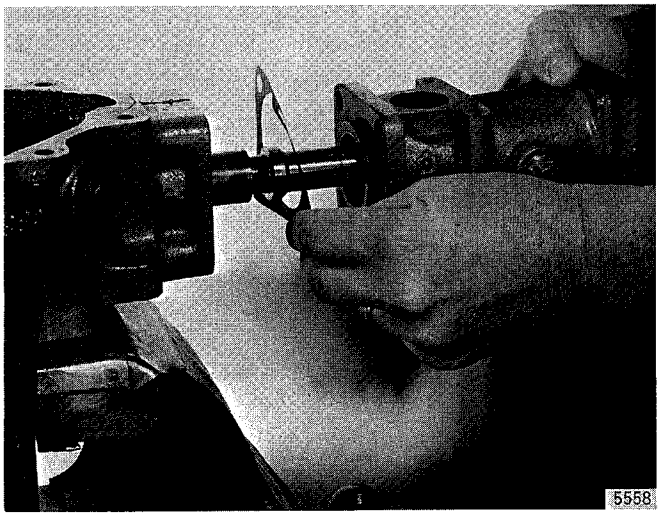
When replacing, install seal over shaft as shown.

If gear is equipped with two-piece actuator housing, proceed to Step 47 on page 16.



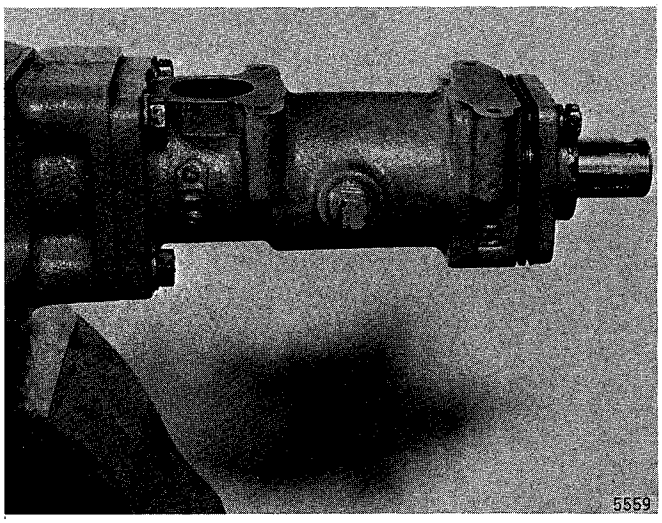
40

On previous models with one-piece control housing, install new gasket and control housing. Torque cap screws to 25 foot-pounds.



41

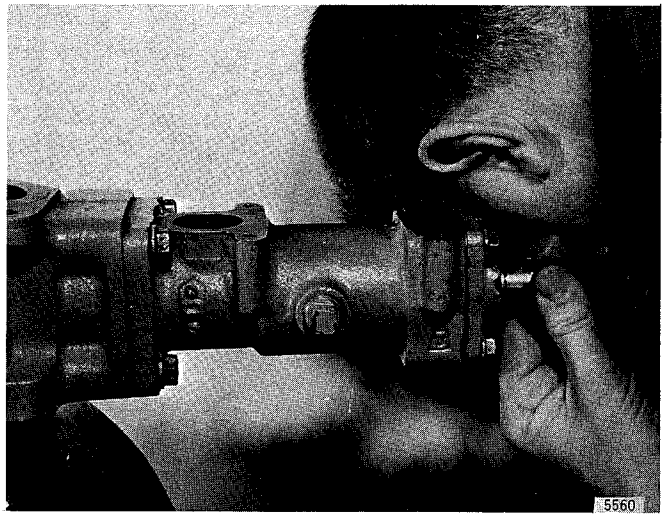
Install wheel tube assembly and replace cover. Care must be exercised during installation so as not to damage seal in cover.



42

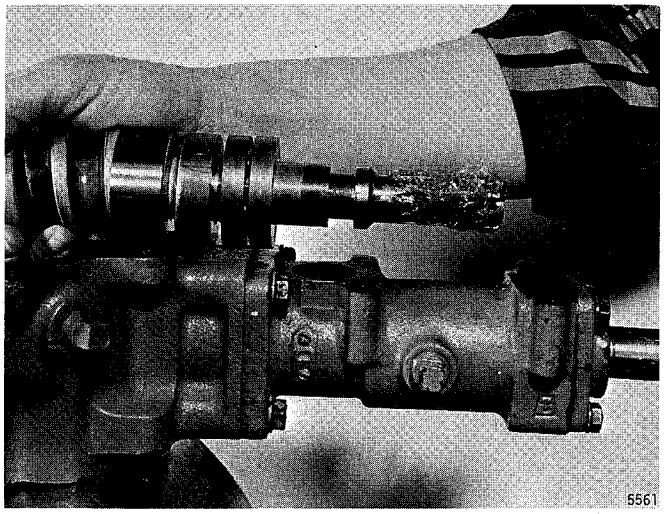
A shim pack is used between two gaskets to establish a mild preload on the wheel tube bearings.

Adjust by adding or removing shims until the bearings do not rattle as the wheel tube is slowly turned. Wheel tube must, however, turn freely without excessive drag. (Shims .002", and .010". Gasket .010" thick available.)



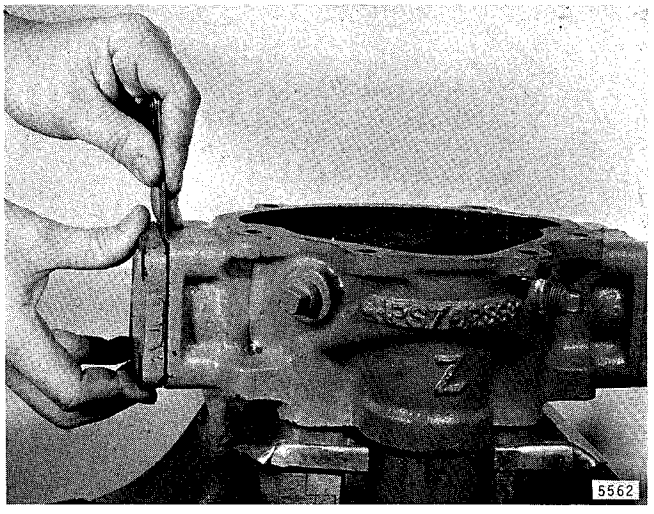
43

Coat cam shaft spline with grease and insert assembly into gear case.



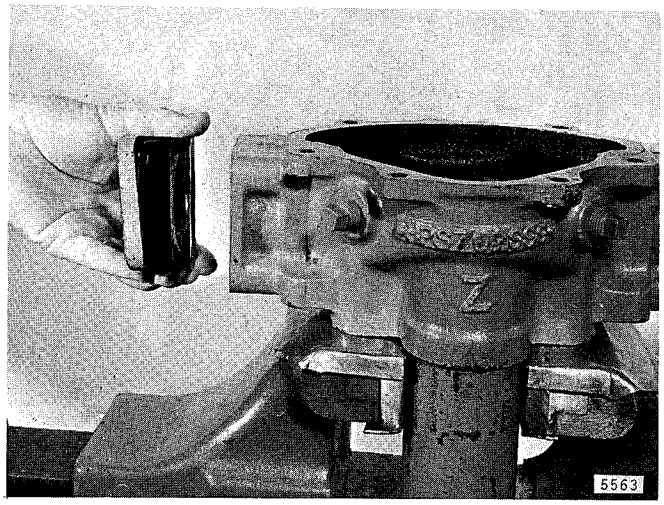
44

Place cover in position and measure gap with feeler gauge or shims. (This measurement will indicate the amount of shims necessary to eliminate end play of cam assembly.)



45

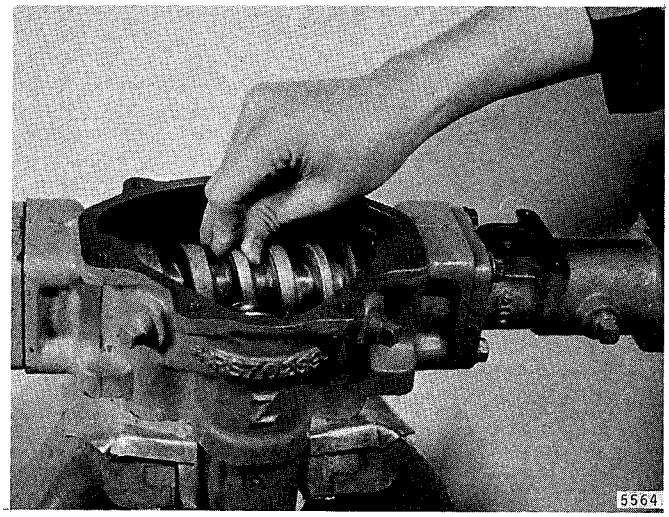
Install shims and gaskets (use a gasket on each end of shim assembly). Gaskets are .010" thick but each become only .006" when compressed. Shims are available in .002", .003", and .010" thickness. Torque cap screws to 25 foot-pounds.



46

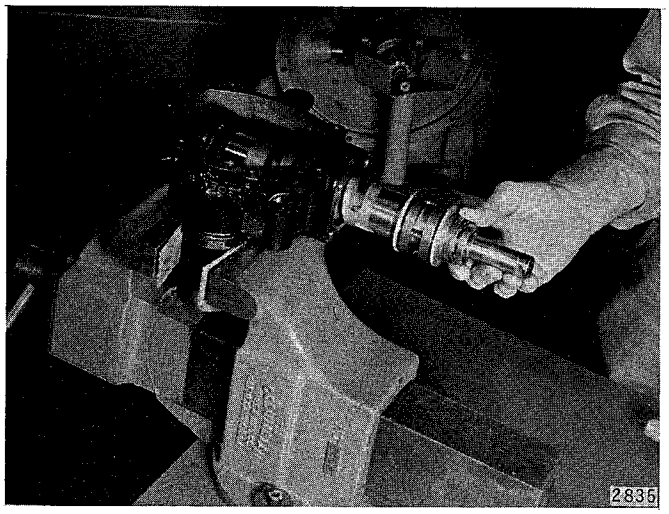
Cam should turn freely in housing by finger pressure. If it does not turn freely, add shims to end cover. Cam should have no end movement by finger pressure. If it does have end movement, remove shims from end cover.

Proceed to Step 50 on page 17.



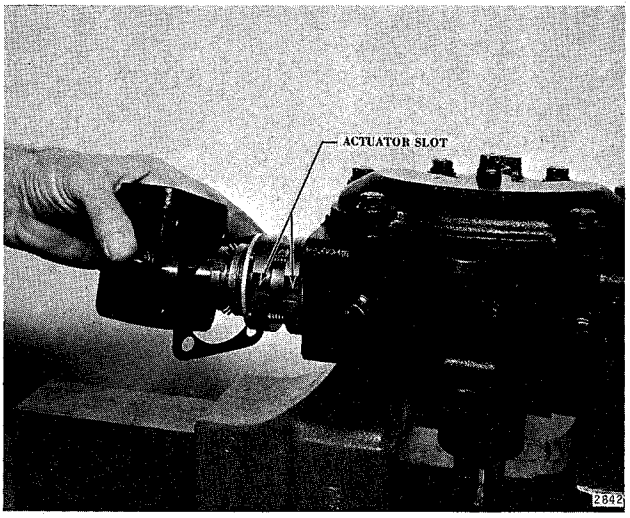
47

If steering gear is equipped with two-piece actuator housing, assemble cam in housing. Be certain that cam rotates and oscillates freely in housing.



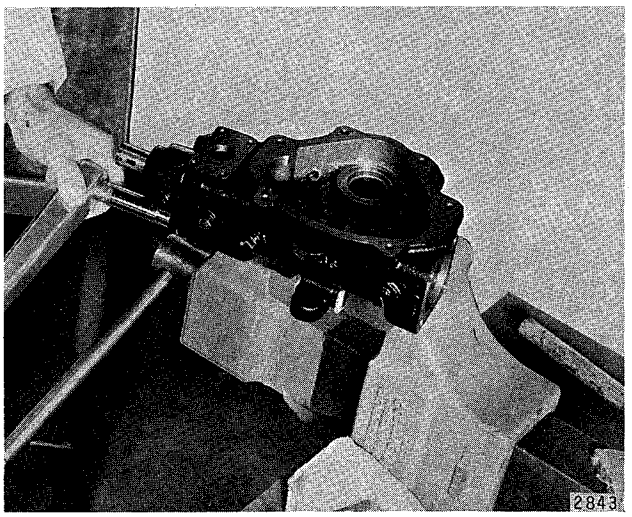
48

Position gasket and actuator housing. Be certain that slot in actuator is horizontal to take retainer screw.



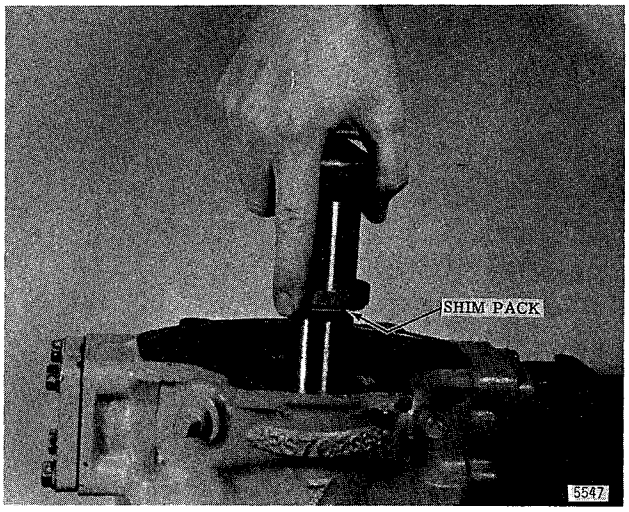
49

Install gasket, retainer washer, retainer screw and cover. Use care not to damage seal in cover during installation. Torque cap screws to 25 foot-pounds.



50

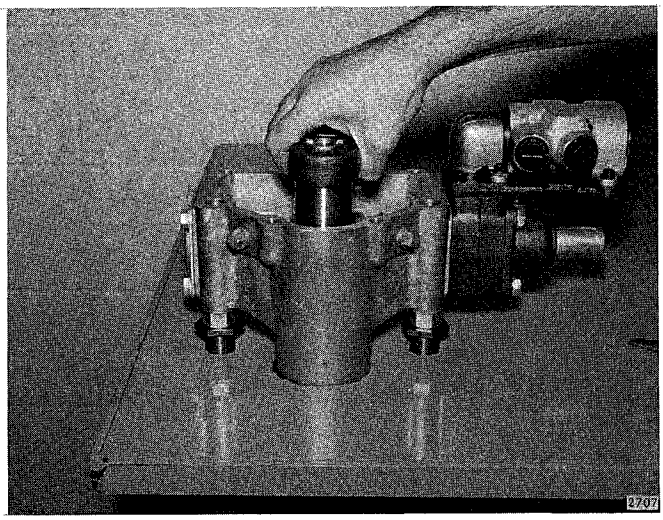
On previous models with shim adjusted lever shaft, if shaft has been removed from case, install shim pack on lever shaft and lower shaft into place in case.



51

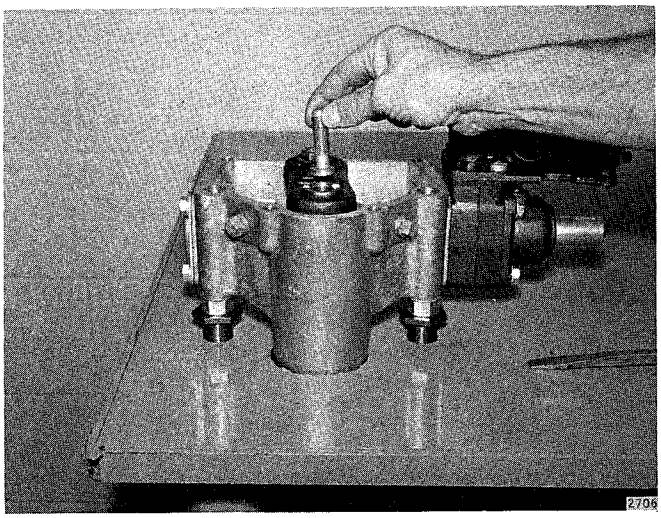
Position lever shaft in position with stud roller in center of cam.

If lever shaft is shim adjusted, proceed to Step 57 on page 20.



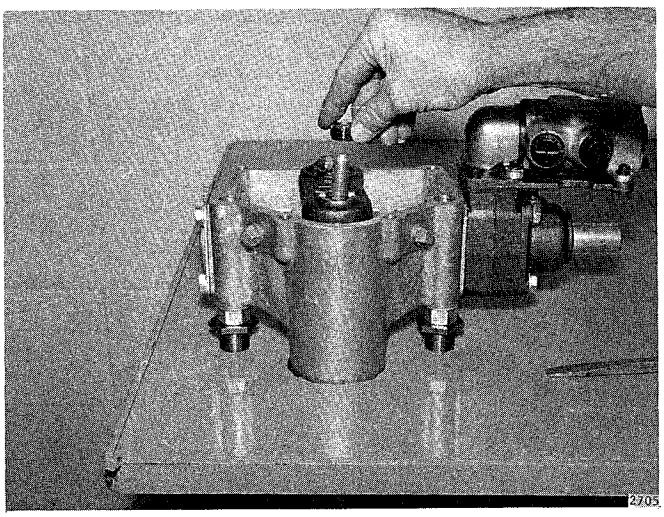
52

If lever shaft is screw-adjusted, place adjusting screw in pocket of lever shaft.



53

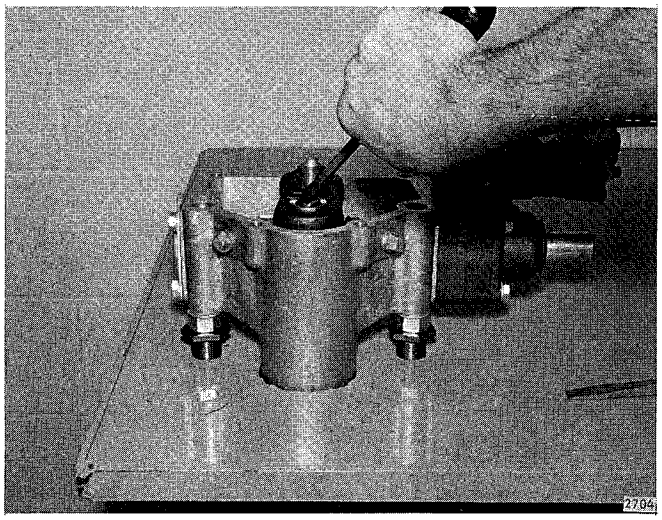
Install adjusting screw lock nut.



54

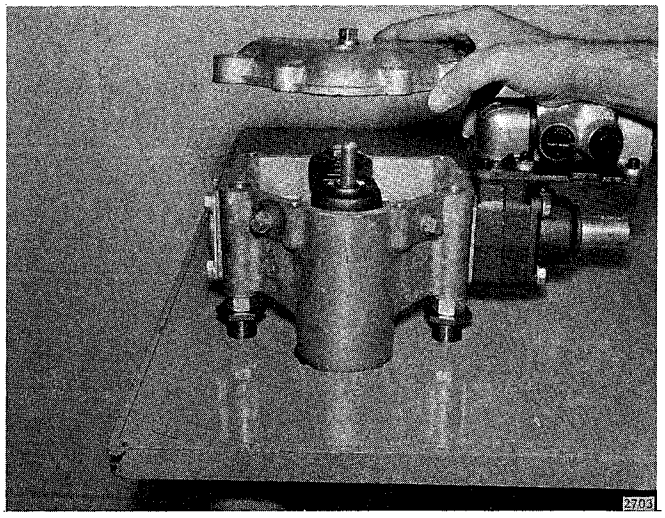
Tighten lock nut and stake portion of nut flange in slot on lever shaft.

Adjusting screw must be free to turn after lock nut is tightened.



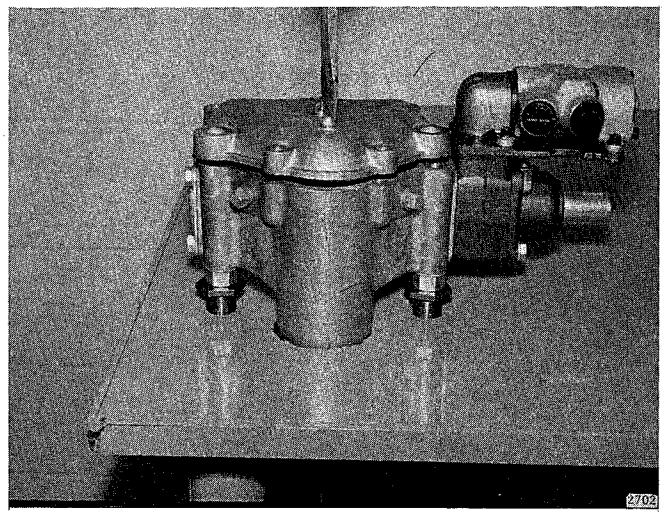
55

With new gasket on cover, place cover in position over housing and adjusting screw.



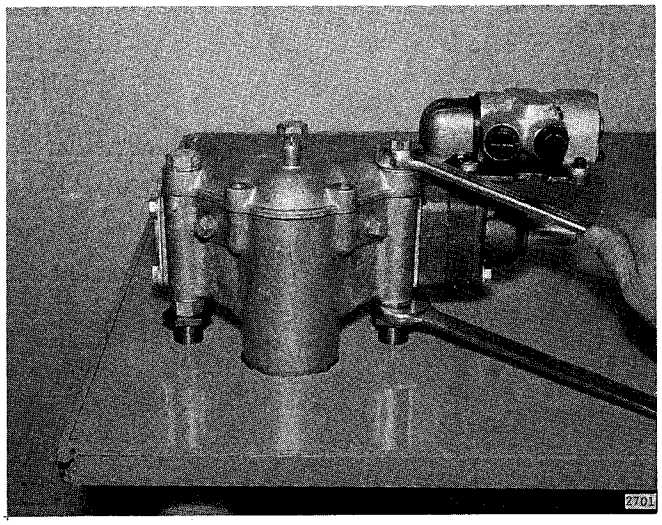
56

Screw adjusting screw counter clockwise until cover fits tight in place on housing.



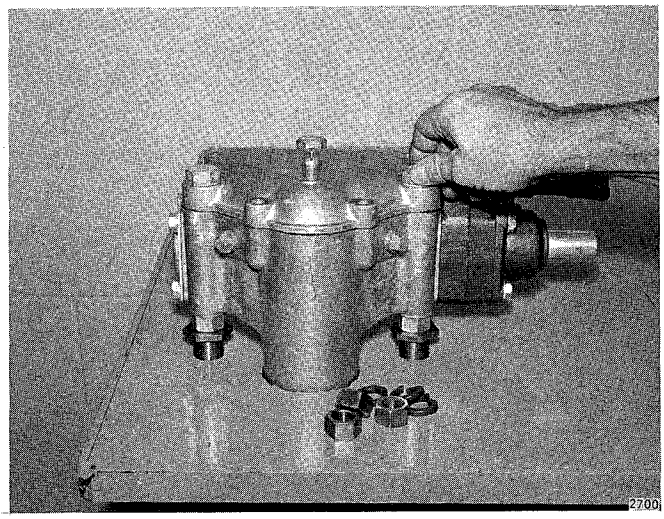
57

On previous models with shim-adjusted lever shaft, replace cover and gasket. Install three large cover retaining bolts, if used, and tighten securely.



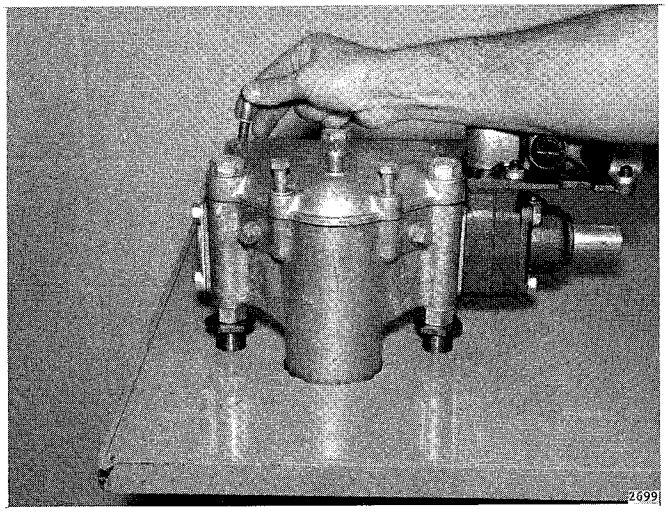
58

Install large cover bolt lock washers and nuts, if used, beneath steering gear mounting pad.



59

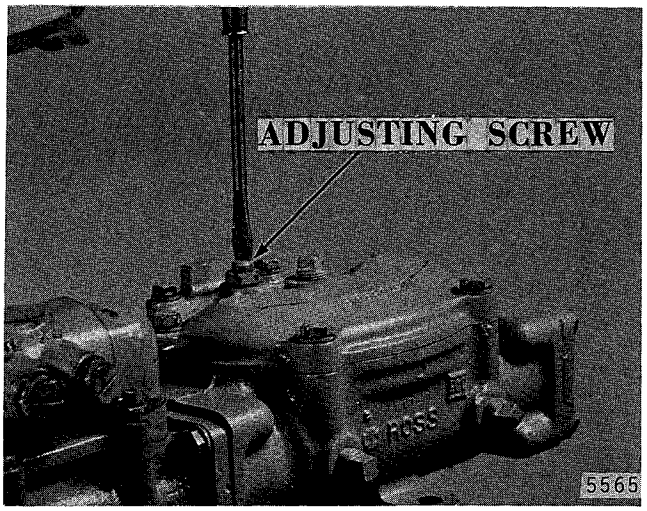
Install small cover retaining cap screws. Torque to 25 foot-pounds.



60

On previous models with shim-adjusted lever shaft, assemble adjusting screw and jam nut and tighten screw until a very slight drag is felt when turning gear through mid position.

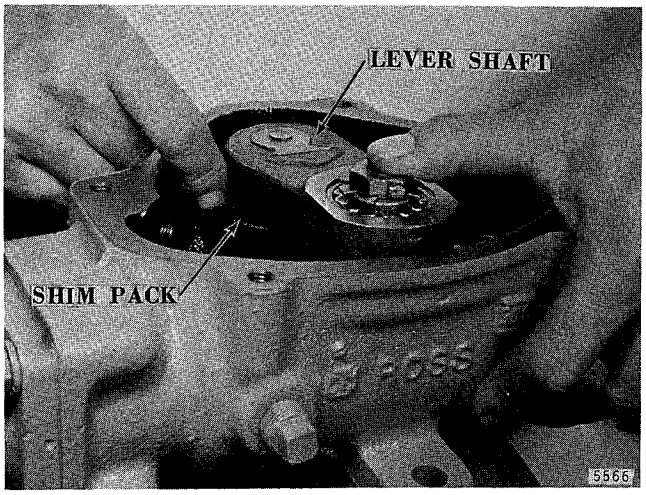
When adjustment is obtained at the positive high spot in center of cam and while holding screw with screw driver, tighten jam nut. Turn gear through complete travel to check adjustment.



61

If high spot cannot be felt in above adjustment, then remove one or more shims from the shim pack. (These shims will be found in .003", .010" and .020" between two washers) until drag can be felt.

Repeat Step 60 above until correct adjustment is obtained.

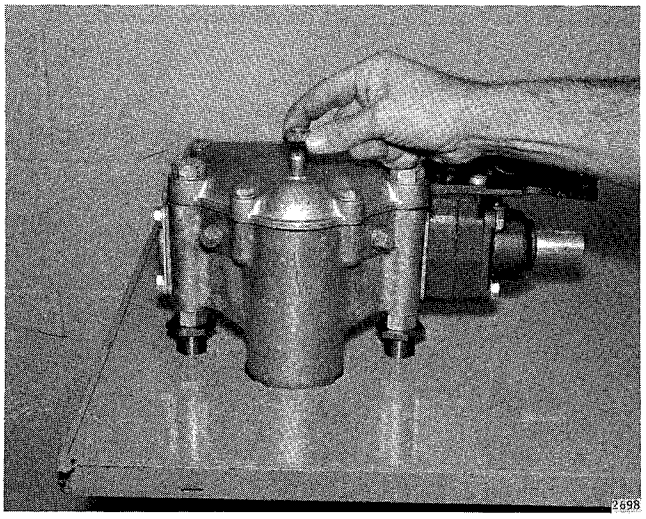


62

If later model with screw-adjusted lever shaft, install lever shaft adjusting screw lock nut.

To adjust lever shaft to cam, screw adjusting screw clockwise until tight, then counter clockwise one half turn.

Hold in position and tighten lock nut.



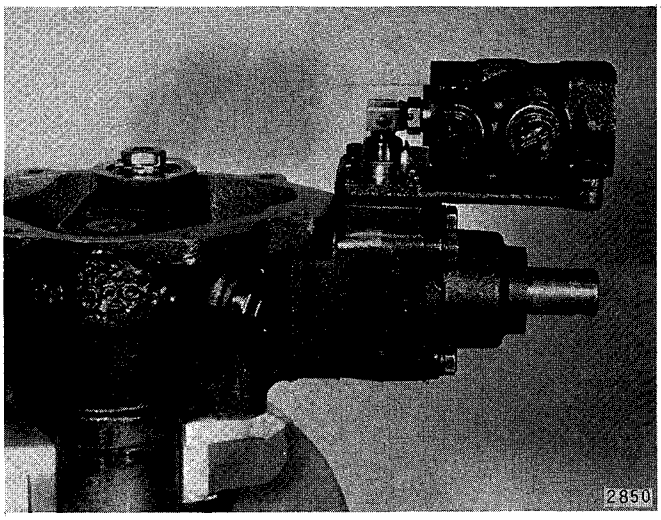
INSTALLATION & ADJUSTMENT OF VALVE ASSEMBLY

63

Assemble rubber seal on actuating lever. Pictured is later configuration. Previous configurations have actuating lever pinned to valve. Reinstall actuating lever on swivel bearing rod and valve body at this time.

64

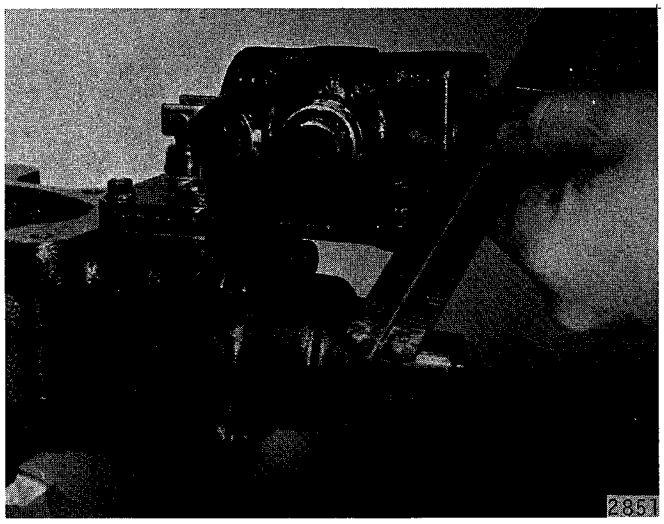
Assemble valve to mounting bracket and make certain that slot of actuator lever engages pin in clevis.



65

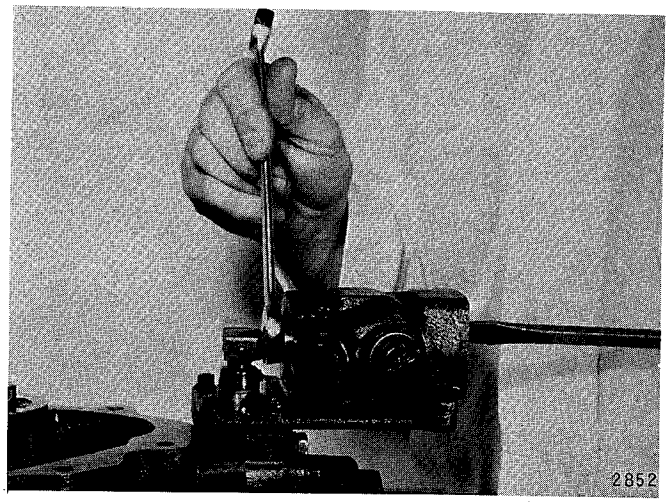
Center spool in valve.

Hold straight edge across valve housing and with screw driver, turn spool in or out until spool and housing are flush.



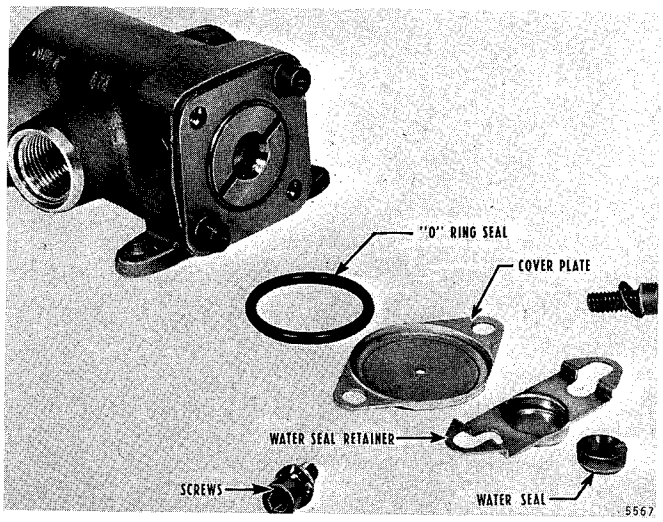
66

Holding spool securely in aligned position with screw driver, straighten the clevis or swivel bearing rod to a horizontal position and lock in place with jam nut. Replace cotter pin.



67

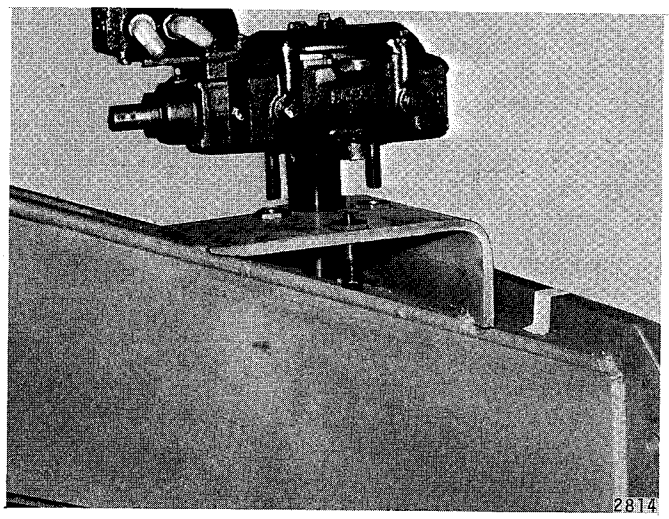
Reassemble water cover and seal. (Cup of water seal toward valve.)



68

Place steering gear on machine sending lever shaft through lower bearing. Use adjusting screws to align gear. Alignment must be checked by removing cover and picking lever shaft up. If lever shaft is free and floats back in place, no misalignment exists.

Reconnect steering universal to case shaft.



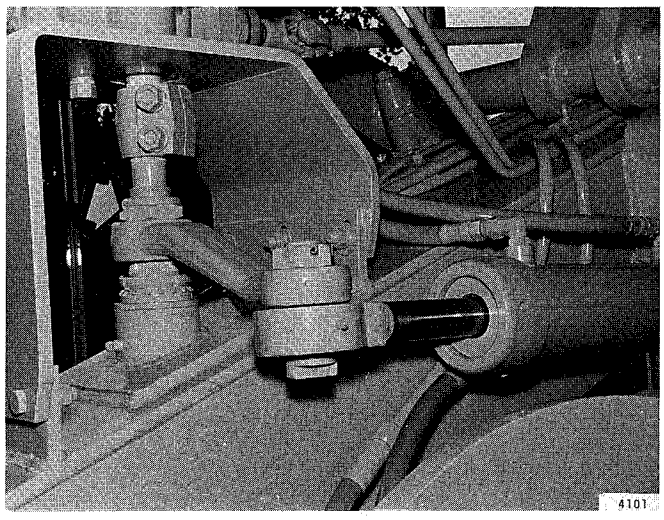
69

Center steering gear by moving through full travel and counting turns of the steering wheel. Turn the wheel back half this number to mid position.

Reconnect steering (pitman) arm to lever shaft with wheels straight ahead at this position.

70

On motor graders, tighten upper and lower vertical shaft nuts to 450 foot-pounds.



71

Fill actuating lever cover with a good grade of lubricant meeting the specifications on page 25.

STEERING GEAR LUBRICANT SPECIFICATIONS

Meeting the following specifications:

NLGI	0
Soap Base	Calcium or Lithium
Penetration @ 77°F.	355-385
Drop point	295°F.
Texture	Tacky
Water	Trace
Oil viscosity: 100°F.	600 SUS
210°F.	60 SUS

Most major oil companies have a product meeting these specifications. Some example brands are:

Citgo H-O	Cities Service Oil Co.
Factran EP-O	Standard Oil Co.(Ohio)
Alvania EPRO	Shell Oil Co.
Lidok EP-O	Humble Oil & Refining Co.
Sun Prestige 740 EP	Sun Oil Co.
Multifak EPO	Texaco Inc.

TROUBLE SHOOTING

HYDRAULIC SYSTEM TROUBLE SHOOTING - Refer to File E Section 15 for Crane
Refer to File E Section 17 for Grader

TROUBLE	CAUSE	REMEDY
Hard Steering	1. Pump belt slipping (if pump is belt driven)	Tighten belt. Replace belt if worn.
	2. Insufficient pump pressure.	Refer to Hydraulic Trouble Shooting.
	3. Sticky relief valve (Prevents pressure build up.)	Replace relief valve - Refer to Hydraulic Trouble Shooting
	4. Low fluid level. (Loss of hydraulic oil due to leaks or damaged lines).	Repair to eliminate leaks and refill system and reservoir.
	5. Valve out of adjustment.	Check Adjustment of Thrust Bearing, then check Adjustment of Valve Spool.
	6. Spool in valve sticking.	Disassemble valve and inspect for sticking. Clean. Reassemble valve or replace and reinstall on gear, check Adjustment of Thrust Bearings. Make Adjustment of Valve Spool. Check for equal amount of an end movement of spool each way from center.
	7. Wear of actuator lever in bushing of valve mounting bracket or of actuator.	Replace actuator lever and possibly bracket with bushing or actuator with bushing.
	8. Wheel tube bent or sprung.	Replace bent parts and correct column alignment.

Cont'd.

TROUBLE SHOOTING (Cont'd)

TROUBLE	CAUSE	REMEDY
	9. Bind in steering wheel tube bearing or shaft bearings.	Eliminate cause of bind such as a bracket clamped tight over jacket tube where bearing is located.
	10. Improper front end alignment.	Align to specifications.
	11. Taper stud adjusted too tight in cam groove.	Adjust.
	12. Broken piston or piston rings in hydraulic cylinder.	Refer to Hydraulic Trouble Shooting.
	13. Lack of steering gear lubricant.	Add lube to proper level.
	14. Valve loose on mounting.	Tighten, then check adjustment.
	15. Low tire pressure.	Inflate to proper pressure.
	16. Jacket tube ends interfering with axial movement of wheel tube.	Relocate jacket tube in upper cover to provide necessary clearance between jacket tube and adjusting nut at lower end and between it and steering wheel at upper end.
No Recovery From Turn to Straight-ahead	1. Insufficient caster.	Increase caster.
	2. Tight ball socket connections and other linkage connections.	Loosen connections but keep them snug.
	3. Tight front axle spindles.	Make free.
	4. Bind in wheel tube (Prevents centering of valve).	Eliminate bind.
	5. Bind in wheel tube bearing (Prevents centering of valve).	Eliminate cause of bind such as a bracket clamped tight over jacket tube where bearing is located.
	6. Spool in valve sticking (Prevents centering of valve).	Disassemble valve and inspect for sticking. Clean. Reassemble valve or replace and reinstall on gear, check Adjustment of Thrust Bearings. Make Adjustment of Valve Spool. Check for equal amount of end movement of spool each way from center.
	7. Stud adjusted too tight in cam groove	Adjust.
Shimmy	1. Loose ball socket connections or other linkage connections.	Tighten.
	2. Wheels out of balance.	Balance.
	3. Badly worn and unevenly worn tires.	Replace.
	4. Excessive caster.	Correct and have front alignment checked to specifications.
	5. Looseness in steering gear.	Adjust gear, and perhaps repair gear.
	6. Air in system.	Bleed system.

Cont'd.

TROUBLE SHOOTING (Cont'd)

TROUBLE	CAUSE	REMEDY
Lost Motion at Steering Wheel	1. Loose ball socket connections or other linkage connections.	Tighten.
	2. Loose thrust bearing adjustment	Adjust.
	3. Excessive back lash of taper stud in cam groove.	Adjust.
	4. Steering wheel loose.	Tighten wheel nut.
	5. Pitman arm loose on lever shaft.	Tighten lever shaft nut.
Noise	1. Pump belt out of adjustment.	Adjust.
	2. Low level of hydraulic oil.	Check for leaks; maintain proper level of oil.
	3. Air in system.	Check all connections for tightness. Operate several minutes to bleed from system.
	4. Dirt and sludge in pump.	Drain system and clean.
	5. Pump worn.	Refer to Hydraulic Trouble Shooting.