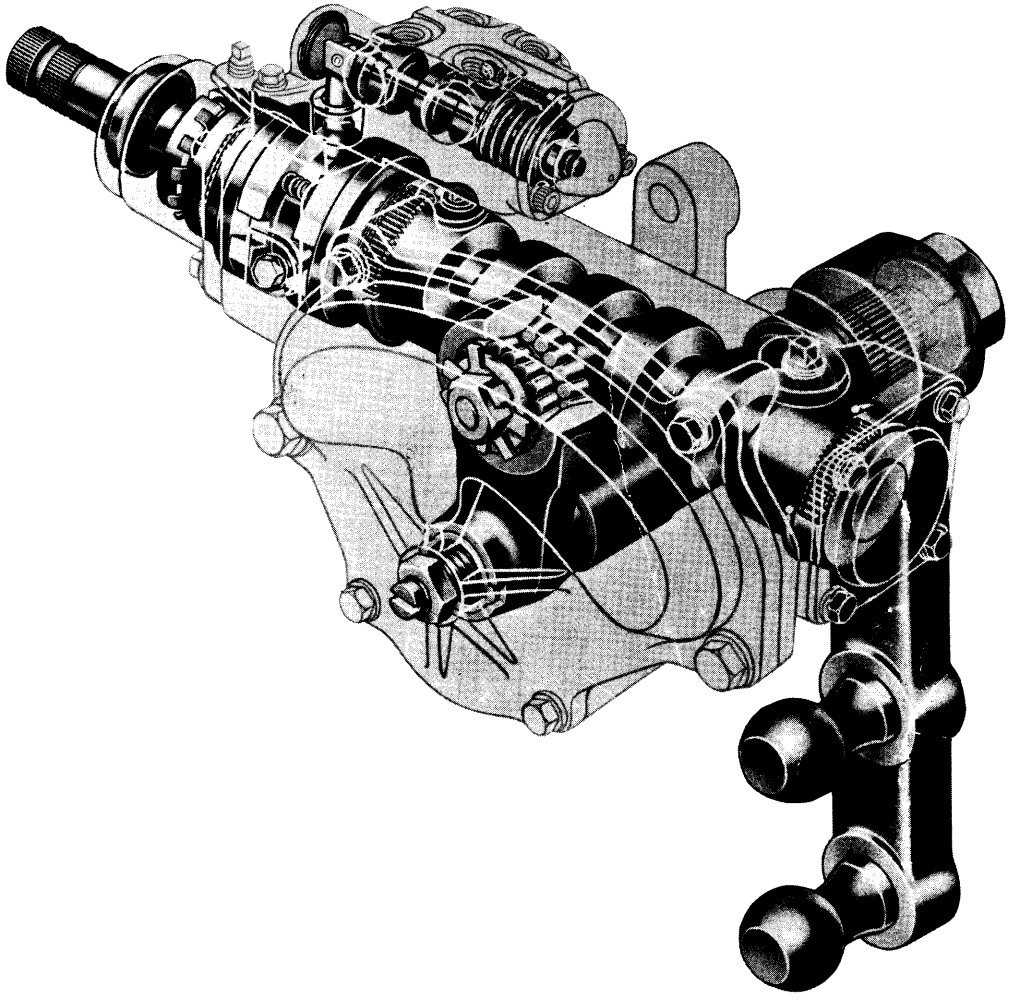
TRW

Hydrapower™
Hydraulic Power Steering Gear

HPS Series Service Manual



Heavy Duty Parts Division

Price $2.50

ROSS HYDRAPOWER®STEERING GEAR

HPS SERIES

WITH V14 AND HP70 VALVES

For over one half a century, Ross has anticipated and met the changing and increasing needs for better steering in the automotive, industrial and agriculture fields. This HYDRAPOWER®steering gear, incorporating the latest Ross Gear design, is further evidence of this fact.

The HPS type HYDRAPOWER®steering gear incorporates the latest Ross Cam and Lever Gear design with a control valve to provide fingertip control.

It is a compact semi-integral assembly, installed with the same type of mounting used with mechanical steering gears. A hydraulic cylinder is installed in the linkage to apply the power for steering.

This series offers effortless and fatigueless steering. It has the added factor of greater safety because it provides the same quality of road-sense steering obtained with the conventional manually operated steering gear.

HYDRAPOWER®steering enables the driver to maintain better control in the event of tire blowouts, soft ground, sand or snow, or road obstructions. The hydraulic response is used either for power assistance or resisting shocks- - -consequently, no tendency to over control.

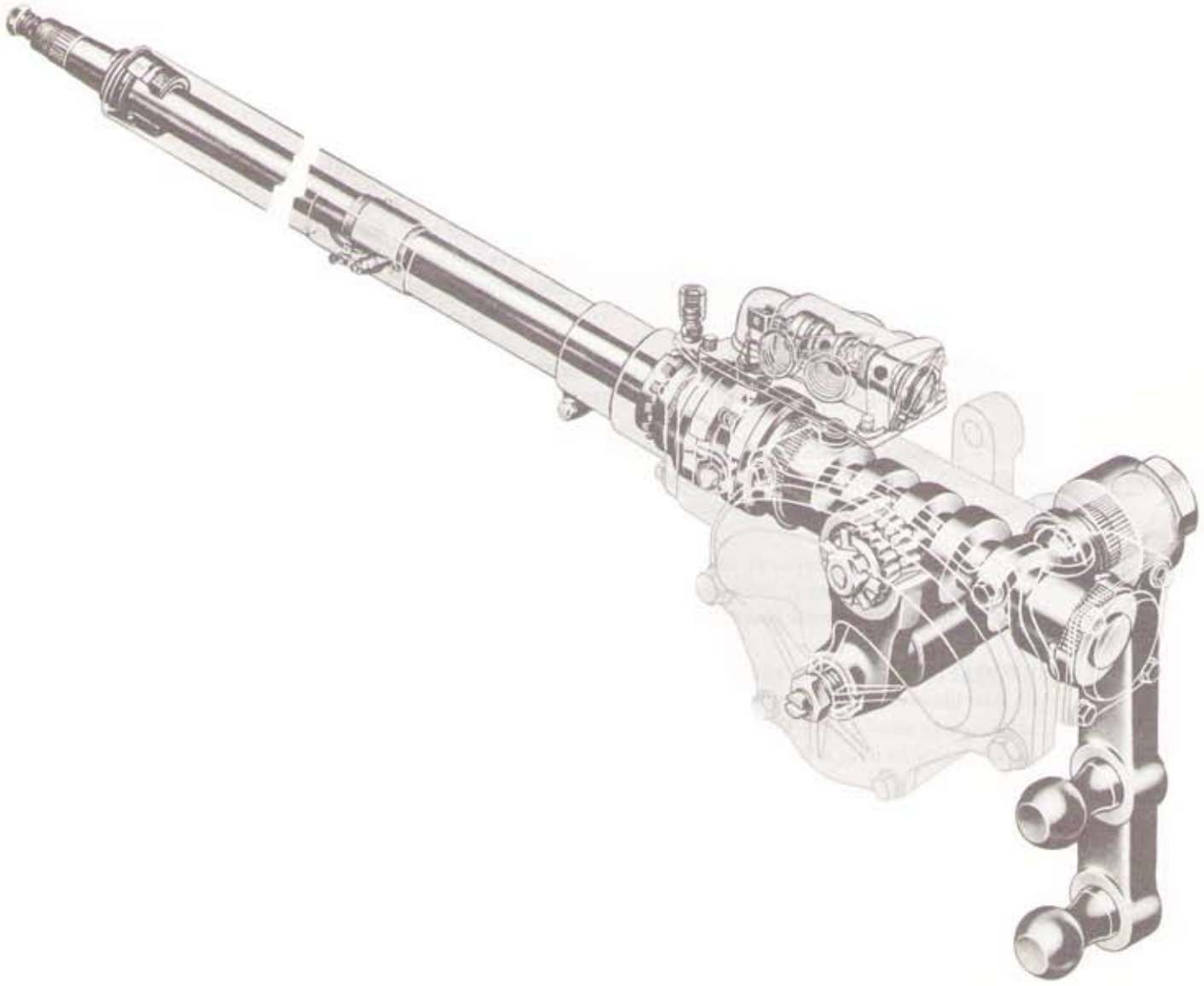
WARNING: ALL STEERING MECHANISMS ARE LIFE AND LIMB ITEMS. AS SUCH, IT IS IMPERATIVE THAT THE INSTRUCTIONS IN THIS BOOKLET ARE FOLLOWED TO THE LETTER. FAILURE TO OBSERVE THE PROCEDURES SET OUT IN THIS PAMPHLET MAY RESULT IN LOSS OF STEERING.

TRW®

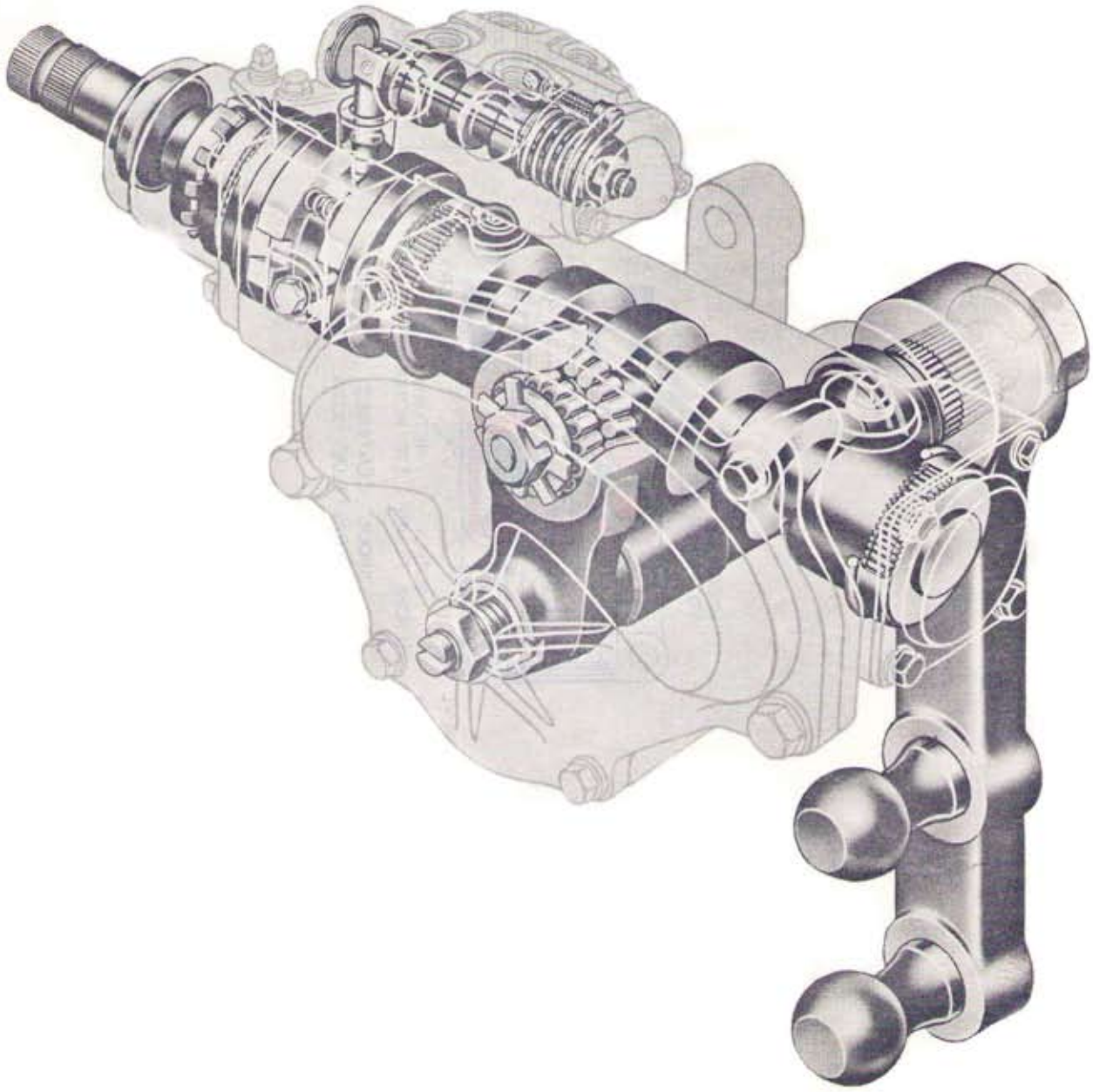
ROSS GEAR DIVISION

LAFAYETTE, INDIANA 47902

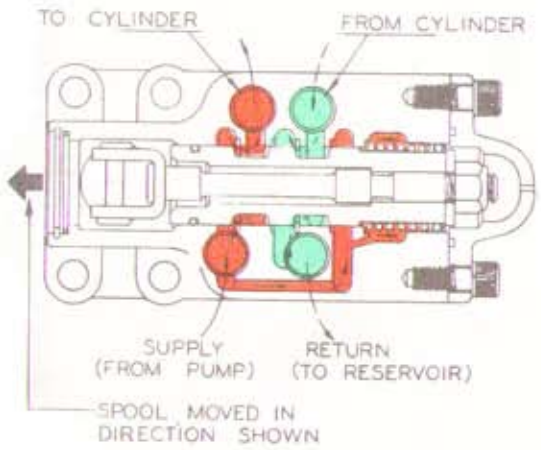
MANUAL NO. HPS-100-8



PHANTOM VIEW – HPS70 STANDARD COLUMN GEAR
WITH HP70 VALVE – UNIT ACTUATOR



PHANTOM VIEW – HPS52 STUB SHAFT GEAR
WITH V14 VALVE – UNIT ACTUATOR



FLUID FLOW WHEN SPOOL IS POSITIONED AS SHOWN ABOVE

FIG. C

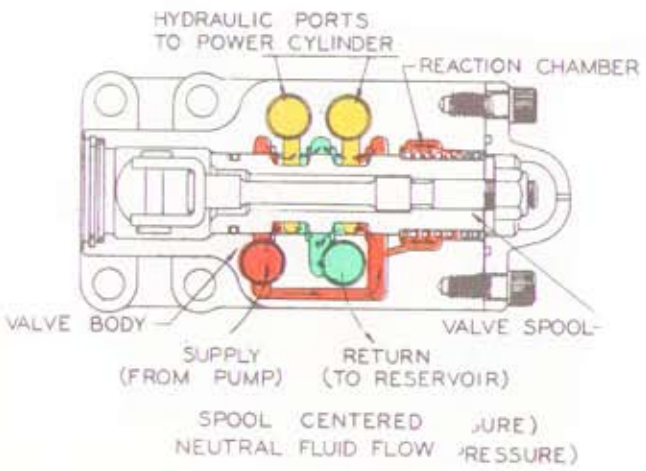
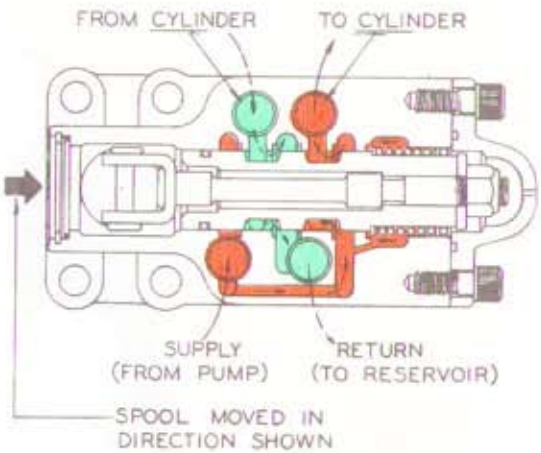
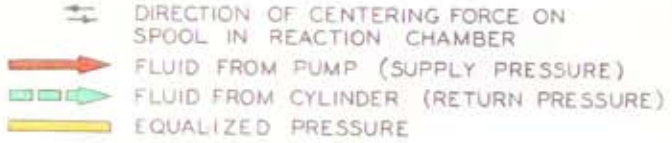


FIG. A



FLUID FLOW WHEN SPOOL IS POSITIONED AS SHOWN ABOVE

FIG. B



TYPE V14 VALVE – PICTORIAL ILLUSTRATION OF FLUID FLOW

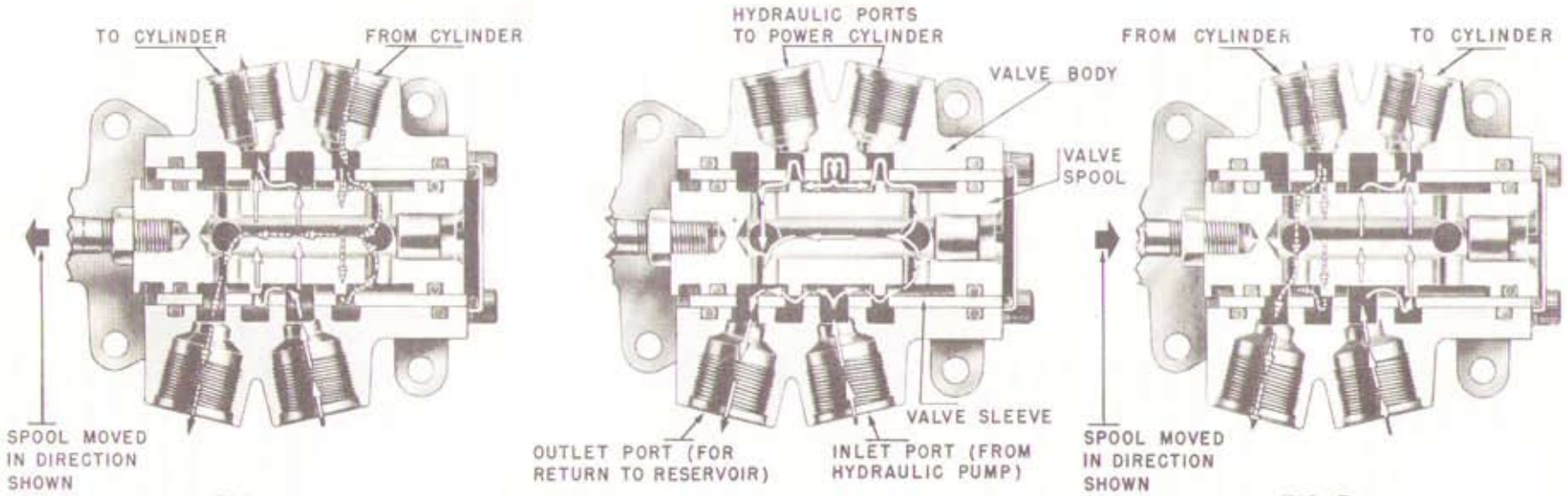


FIG. C

FLUID FLOW WHEN SPOOL IS POSITIONED AS SHOWN ABOVE

FIG. A

NEUTRAL SPOOL POSITION AND FLUID FLOW

FIG. B

FLUID FLOW WHEN SPOOL IS POSITIONED AS SHOWN ABOVE

TYPE HP70 VALVE – PICTORIAL ILLUSTRATION OF FLUID FLOW

DESIGN

This Ross HPS type is a semi-integral hydraulic steering gear which incorporates a hydraulic control valve on a single stud cam-and-lever mechanical steering gear. Steering effort applied to the steering wheel actuates the valve which, in turn, directs hydraulic fluid from an engine-driven pump to a power cylinder located in the linkage.

OPERATION

The action of the steering gear is both manual and hydraulic in effect. When the cam is turned to the left or right, by the driver's effort on the steering wheel, the stud of the inner lever is moved through the groove of the cam (worm), thus rotating the lever-shaft and providing angular movement of the steering gear pitman arm. Whenever the driver's effort at the steering wheel exceeds the combined preload of the centering springs and "hydraulic reaction," as in the V14 (or springs only in the case of the HP70), the control valve is actuated and the hydraulic power is applied to provide the driver with power steering.

Hydraulic reaction is the feedback force due to inlet port pressure acting on a small area of the valve spool which resists the driver's effort. As the pressure in the hydraulic cylinder builds up, the hydraulic centering force increases. Thus, the driver's effort on the steering wheel in turning a corner is greater than in a straightahead road correction condition. Because the hydraulic pressure is low in the straight ahead driving conditions, it is necessary to add centering springs to assist the hydraulic reaction in giving the system "road feel."

The feel and steering effort created by the centering springs when used alone as in the HP70 valve are constant for any steering condition and are generally tailored to suit the vehicle application by changing the spring load to give the degree of steering effort desired.

When the valve is in the center position, the oil pressure at its two cylinder ports is low and equal and produces ineffective forces in the cylinder. This results in no movement of the piston and no circulation of oil in the lines to the cylinder, however, oil is circulating from the pump through the control valve to the reservoir with sufficient pressure only to overcome friction of lines and fittings.

Whenever the driver's effort at the steering wheel overcomes the centering effect of the springs and/or hydraulic reaction, the valve spool is moved axially restricting one of the return passages to the outlet port thus causing an immediate increase in pressure at one of the cylinder ports and in one end of the cylinder. At the same time, the other return passage is enlarged, allowing the oil from the discharging end of the cylinder free passage to the outlet port and return to the reservoir. The immediate effect is increased pressure in one end of the cylinder to actuate the piston which applies hydraulic power directly to the steering gear pitman arm or linkage part to which the cylinder is attached. Full pressure is obtained with a spool travel of about sixty-five thousandths of an inch. The slightest movement results in a pressure differential.

NOTE: To eliminate pump heat and belt squeal problems, the power cylinder should have unloading or poppet valves incorporated as a part of the cylinder piston assembly. In order that these valves will function correctly a correct installation must be made of the unit to allow the poppet to unseat in each direction of piston travel.

Whenever the effort at the steering wheel is released, the valve spool is returned to the center position.

If the steered wheels are subjected to shock loads, the pitman arm, acting through the inner lever of the gear, shifts the cam and control valve spool axially in the appropriate direction thus directing the fluid to the proper side of the piston to resist the shock forces. This blocking action prevents kickbacks at the steering wheel.

INSTALLATION

Depending upon the installation requirement, this gear can be furnished with the valve located at either end of the housing and positioned as customer desires.

PUMP

The pump requirements are determined by the steering speed desired. Steering speed is the time required in seconds to turn the steered wheels from one extreme to the other at a given engine speed, usually idle speed. Normal desired speed of steering can be accomplished in one to two wheel turns per second.

A typical example of this calculation is given below:

$$\text{Pump volume required (GPM)} = \text{Piston area} \times \text{stroke} \times \frac{1}{\text{steering speed}} \times .26$$

(.26 is a conversion factor to obtain answer in GPM).

For a cylinder of 2-3/4 dia. (5.94 sq. in. piston area) with a stroke of 8" and a desired steering speed of 4 seconds.

Pump volume required $= 5.94 \times 8 \times 1/4 \times .26 = 3.1$ gallons per minute.

To provide for loss due to leakage in the various components a pump with a displacement of 3.5 to 4 GPM would be selected for the above example.

The oil flow capacity of each of the valves is as follows:

Type V14 Valve - 6GPM
Type HP70 Valve - 12 GPM

ENGINEERING DATA

NOTE: The type HP70 valve is available with flow rate higher than 12 GPM.

A flow control valve should be provided in the pump or pressure line to limit the flow to this volume. Excessive oil flow may cause an oil heating problem and produce other undesirable effects.

A pressure relief valve must be provided in the system. Maximum pressure of 1000 p.s.i. is permissible for V14 valves and 1500 p.s.i. for HP70 valves.

RESERVOIR: The oil reservoir should be of sufficient capacity to avoid heating and provide some air space for oil rise and expansion. A breather and/or air filter may be necessary as well as an oil filter element.

PLUMBING: Valve port bosses are machined as follows: Type V14 valve -- All port bosses are tapped to receive SAE-JIC "O" ring type fittings in 9/16-18 UNF2b size for 3/8" O.D. tube.

Type HP70 -- Port bosses are machined to conform to AN010050 and can be used with AN fittings or SAE-JIC "O" ring type fittings. Cylinder ports are tapped 3/4-16 NF3 for 1/2" O.D. tube size. Inlet and outlet ports are tapped 7/8-14 NF3 for 5/8" O.D. tube size. (Note: Special HP70 valves have ½ size, 4-bolt split flange connections on all ports.)

LUBRICATION

Refer to page 14.

RATIO DATA

The HPS type HYDRAPOWER gear is produced in two models: HPS52 and HPS70.

Ratio - Model HPS52 - 16:19:16
Model HPS70 - 17:19:24:19:17

Angular Arm Travel - 80 degree (either model)

Wheel turns - Model HPS52 - 3.65
Model HPS70 - 4.33

Ross will be pleased to recommend which gear is required for specific installations.

MAINTENANCE DATA

ADJUSTMENTS

(Reference numbers in parenthesis can be identified from exploded views, pages 15 and 16).

On the Manual section, there are two principal adjustments on this HPS type gear and a supplemental adjustment on the stud-roller bearing unit in the lever-shaft. Neither of the adjustments is indexed, but can be set at the most desirable point. The principal adjustments are:

1. Adjustment of needle thrust bearings on the cam shaft on each side of the valve actuator.
2. Adjustment of tapered stud in cam groove for backlash.

When making adjustments, free the steering gear of all load, preferably by disconnecting the drag link from the steering gear arm and, loosen the instrument board bracket clamp on steering gear column to make sure the steering column is not binding, which prevents the valve from centering. Loosen any clamp on column that is located over the bearing in upper end of column tube.

On gears with type HP70 valve there is an adjustment on the valve. (Refer page 9.)

ADJUSTMENT NO. 1
THRUST BEARINGS (23, 24)

(It is preferable to have the gear removed from the vehicle, but if the gear is readily accessible on the vehicle it may only be necessary to disassemble those parts which will permit the removal of the upper cover (37) so that the adjusting nut (35) on the cam shaft (22) is accessible. If the valve is mounted on the bottom end of gear, the upper cover need not be removed because this adjustment is made on the lower end after removal of lower end cap.)

NOTE: If gear is stub-shaft type or gear has control valve mounted on bottom end, DISREGARD paragraphs B, C, F and K and references to jacket tube.

A. Before adjusting thrust bearings turn gear off its center position to free the stud (6) in the cam groove (22).

B. Remove steering wheel (per paragraph A and B, page 10, under "Removal of Gear from Chassis.")

C. Remove contact brush (39).

D. Remove cap screws holding upper cover (37) and remove cover and jacket tube assembly.

E. Reassemble screws in actuator housing (27) with 3/8" thick spacers under heads of screws. This is to hold the actuator and cam assembly in the gear when making the adjustment.

F. Remove contact ring (36).

G. Straighten prong of lock washer (34). Remove adjusting nut (35), tongued washer (33), and upper thrust washers and thrust bearing (23, 24).

H. Insure that the threads of the nut and cam shaft are free of interference by running the nut onto the cam shaft using only the fingers to drive the nut. If the nut cannot be driven all the way with finger-torque, the threads are fouled and must be cleared with a thread file or other means until the nut goes on freely.

1. Reassemble thrust washers and thrust bearings (23, 24), tongued washer (33, with internal lug), and pronged washer (34, with thirteen external prongs), and adjusting nut (35).

Adjust as Follows:

J. Drive on nut (35) and tighten to 10 foot pounds torque. Back off nut 10^{o} - 20^{o} which can be done by moving the nut relative to the pronged washer approximately 1 1/2 width of a lug. Observe lug nearest in alignment with a notch in the adjusting nut and bend the lug tight against the notch root.

(If torque wrench is not available, adjustment may be made with 10" Multi-Slip Joint pliers. Avoid use of long handled wrench as too much torque can be easily applied. This adjustment is similar to a wheel bearing adjustment and should provide a light preload of the needle thrust bearings without lash or heavy drag.)

K. Reassemble contact ring (36) and connect horn cable.

L. Reassemble upper cover (37) and jacket tube assembly and other parts to the gear.

ADJUSTMENT NO. 2

STUD IN CAM GROOVE

NOTE: Backlash of the stud in the cam groove shows up as backlash at steering wheel and at ball on steering arm.

The groove of the cam is purposely cut shallower, therefore, narrower in the mid-position range of stud travel to provide close adjustment where usually the straight ahead driving action takes place.

Adjust through mid-position to the high spot. Do not adjust in an end position. Backlash in the end posi- is normal and not objectionable.

NOTE: In some installations, external forces on the levershaft (5) pulls the taper stud into the cam groove and creates a bind. In order to prevent this, in some gears a shim pack (items 7, 8, 9) is used between the lever and housing (11) and some gears have a push-pull adjuster shown as item 1A in illustration on page 15. Follow adjustment instructions for the type used.

Shim Pack Type Adjustment

The shim pack consists of .003", .010", .020" (8) shims between two washers (7, 9). When compressed solid, the shim pack should be of sufficient thickness to hold the taper stud out of the cam groove but not so thick as to prevent adjusting to the high spot.

To Adjust:

A. Turn adjusting screw (1) clockwise in side cover (3) until a very slight drag (high spot) is felt when turning the gear through mid-position. If the high spot cannot be felt, remove shims from shim pack until it can.
(Note: Remove only enough shims to permit feel of high spot.) When adjusted to positive high spot, back off adjusting screw 1/16 turn and lock adjustment with lock nut. Hold adjusting screw with screw driver while tightening nut.

B. If the high spot can be felt without removal of shims, additional shims may be needed in the shim pack. The only positive way of knowing is to add shims until high spot cannot be felt then remove shims and adjust as directed in paragraph A.

Push-Pull Type Adjustment

The adjusting screw is assembled into adjusting screw retainer (1A) which is threaded into levershaft (5A) and double staked. (Retainer must be screwed in far enough to eliminate play between adjusting screw and levershaft but screw must be free to rotate.) The external threads on the adjusting screw retainer are threaded into side cover (3) and lock nut (2A) is assembled into position on outside of cover.

To Adjust:

A. Turn adjusting screw clockwise in side cover (3) until a very slight drag (high spot) is felt when turning the gear through mid-position.

After making this adjustment by either method and adjusting screw locked with lock nut (2, 2A), turn gear through full travel (extreme left turn to extreme right turn, or vice versa) to check adjustment.

After this adjustment, reconnect the gear at all points loosened prior to making the adjustment. Before reclamping the upper column bracket, refer to "Column Alignment" instructions, page 9. Also check tightness of mounting flange bolts and nuts, steering arm on levershaft, and nut on the levershaft.

ADJUSTMENT OF STUD ROLLER BEARING UNIT (6)

The foregoing adjustments will suffice in nearly every instance, but in some cases it may be necessary to adjust the stud-roller bearing unit in the levershaft. In order to make this adjustment the shaft must be removed from the gear.

The roller bearing should be preloaded at all times. Adjust to a noticeable drag.

Factory adjustments on new units are set to 1 to 4 inch pounds of torque to revolve stud. Used or replacement units should be set to same inch pounds torque.

NOTE: Operation of a correctly adjusted unit may feel rough to the hands but under steering load it will be smooth, which will assure normal service life. The stud should be rotated several full turns and reversed before checking rolling torque.

A. Wash bearings in clean solvent and lubricate with oil recommended for lubrication of gear.

Should any roller be damaged or lost, replace with a complete new set or bearing unit. Do not make a partial replacement.

B. Use new locking washer. (If old washer must be used, break off bent prong to prevent using again.)

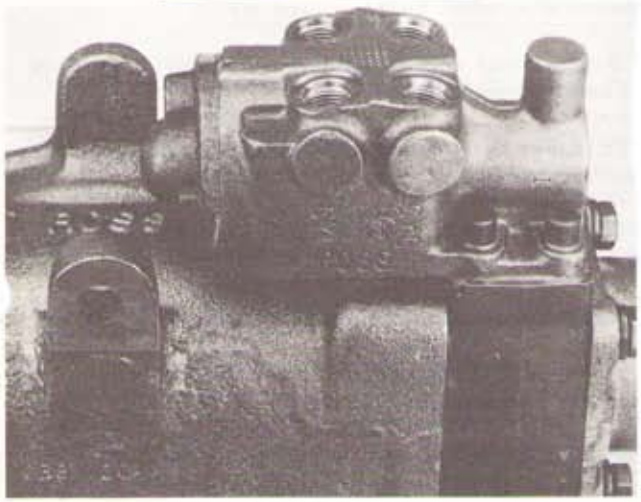
C. Tighten nut as required. (Hold stud from turning by using spanner wrench on washer.)

D. Revolve stud several complete turns and reverse and test adjustment.

E. Lock adjustment by bending over locking washer prong that is at right angle to a side of the nut. Do not use the washer twice unless the prong used has been removed.

F. Lubricate with lubricant used in gear.

ADJUSTMENT OF VALVE



Type V14 Valve

There is no adjustment on this control valve (59), however, when clamped to the actuator housing (27), the valve spool must not be pulled off center. See Page 13, paragraphs G, H, I under Control Valve Reassembly Type V14, for correct mounting procedure.

To be sure valve spool actuates (moves axially in both directions) properly, remove end cover (48) and follow paragraph I. Replace cover.

Type HP70 Valve -- Adjustment of Valve Spool.

The purpose of this adjustment is to center the valve spool in the valve (80). This adjustment should be made each time the valve is removed from its position on the gear and at any other time the valve seems to be maladjusted. The adjustment must be made when the valve is mounted on the gear.

To Adjust:

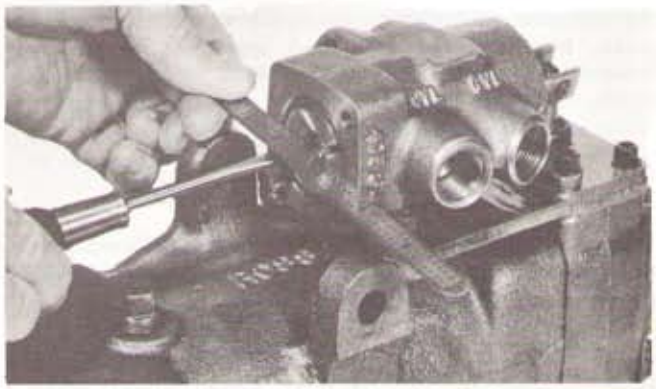
A. Remove cover (86) and seal (85) from lever end of valve.

B. Remove, from other end of valve, water seal cover (72), rubber water seal (73), cover (74), and seal (75).

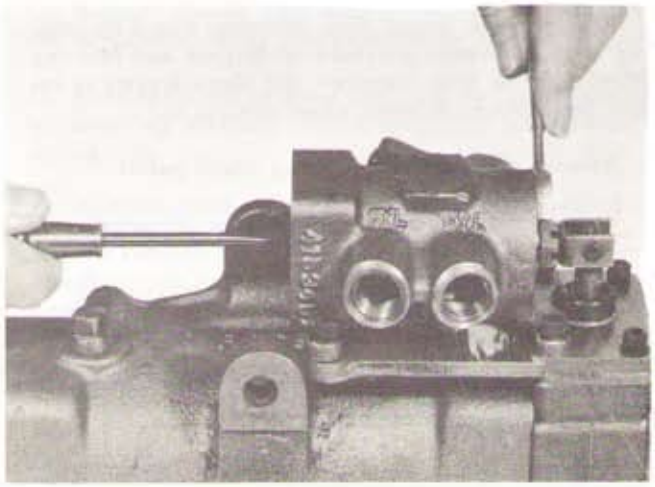
C. Remove cotter pin (83), then loosen slotted nut (82) on clevis rod (84).

Center spool in valve as follows:

D. Using screw driver in slot on valve spool, thread spool in or out until the slotted end of spool is flush with end of valve body (70). See following picture. Also, see note on next page.



E. Tighten slotted nut (82) but maintain position of valve spool in relation to clevis rod by keeping screw driver in slot as the slightest change will affect adjustment. Lock adjustment with cotter pin (83). See following picture.



F. Be sure spool actuates (moves axially in both directions) before assembling end covers. This can be done as follows: (a) Place steering gear arm on lever shaft; (b) Place steering wheel on wheel tube; (c) Turn steering wheel to move steering arm against a stop; (d) Apply sufficient effort to actuate spool; (e) Reverse arm against an opposite stop to actuate spool in other direction.

G. Replace seal (75), cover (74), water seal (73) and cover (72).

H. Replace cover (86)and seal (85).

NOTE: In the event of steering drift (self steering to left or right) adjust valve off center slightly to overcome it.

COLUMN ALIGNMENT

Alignment of the column is of paramount importance. THE STEERING COLUMN MUST NOT BE SPRUNG IN ANY DIRECTION FROM ITS FREE POSITION. A bind in the wheel tube, due to column misalignment, will prevent centering the control valve in neutral position. It can cause wheel tube failure due to bending stresses. (This does not apply to stub-shaft type gears, however, the stub-shaft must not be sprung either.)

RECONDITIONING PROCEDURE

REMOVAL OF GEAR FROM CHASSIS

The variations in methods used by the different vehicle manufacturers to install a gear will require variations in procedure to remove the gear.

Before removing a gear, note the hookup of hydraulic lines. Identify by tagging lines and noting the ports each connect to.

The following is a general procedure outline. (Note: Paragraphs A, B, and F do not apply to stub-shaft type gears.)

A. Remove horn button from steering wheel by gripping with downward pressure of fingers and twisting either right or left. Unscrew the three screws to remove base plate. Remove wheel nut (22A).

B. Remove steering wheel, using wheel puller.

C. Remove steering gear arm (14) from levershaft (5). Use arm puller if possible. Do not hammer off arm without using support against the end of the shaft and use light blows as they are more effective. Heavy blows may cause brinelling of the cam lead.

D. Disconnect the hydraulic lines at control valve. Tag to identify ports each connects to.

E. Plug all ports to keep out dirt.

F. Release column from upper support bracket.

G. Remove mounting flange bolts and remove gear from chassis.

DISASSEMBLY OF GEAR

The following procedure applies to complete disassembly of gear after removal from chassis. For partial disassembly the procedure may differ depending upon the parts involved.

Removal of Levershaft:

A. Loosen lock nut (2, 2A) and unscrew adjusting screw (1, 1A) a few turns.

B. Remove housing side cover (3).

C. Slide levershaft (5) from housing (10) having first made sure there are no burrs on the outer end of shaft to damage the bushing (12) and seal (13) in the housing. If shim pack (7, 8, 9) is used, keep intact.

Removal of Control Valve -- Type V14:

A. Remove four screws holding valve (59) to actuator housing (27) and remove valve.

NOTE: For disassembly of valve see inspection instructions, page 12, paragraphs A to E.

B. Pull out actuator lever (29).

Removal of Control Valve -- Type HP70:

A. Remove four screws holding valve (80) to bracket (70) and remove valve.

NOTE: For disassembly of valve see inspection instructions, page 11, paragraphs A to E.

B. Remove rubber seal (71) from actuator lever (29) and pull out lever.

C. Remove two remaining mounting screws and remove bracket (70).

Removal of Jacket Tube Assembly:

NOTE: Disregard if gear is stub-shaft type and refer to next heading.

A. Remove screws holding contact brush (39) to jacket tube (38) and remove brush.

B. Remove screws holding upper cover (37) and actuator housing (27) to gear housing (10).

C. Slide jacket tube and upper cover off wheel tube (22) taking care not to damage contact ring (36) on wheel tube.

D. Remove contact ring (36).

For Stub-Shaft Type Gear:

A. Remove screws holding upper cover (37) and actuator housing (27) to gear housing (10).

B. Slide cover (37) off cam shaft (22), taking care not to damage oil seal in counterbore of upper cover.

Removal of Cam and Tube Assembly:

A. Unlock actuator retainer screw (25) and remove actuator housing (27).

B. Remove whole assembly of cam and wheel tube and valve actuator assembly as a unit from housing (10) or remove after further disassembly.

Further disassembly of actuator and bearings can be made as follows:

C. Remove adjusting nut (35) after straightening bent prong of lock washer (34). Remove tongued spacer washer (33) and upper thrust washers and needle bearing (23, 24).

D. Remove upper centering washer (30) from end of actuator (31) and remove actuator taking care not to lose springs (32) that are in the actuator.

E. Remove lower centering washer (30), thrust washer (24) and needle bearing (23)

INSPECTION

Clean all parts thoroughly in cleaning fluid.

INSPECTION PROCEDURES:

Careful visual inspection of the steering gear parts is very important. These visual checks may uncover conditions not evident during operation.

Cam and Shaft (22)

Check the cam groove for chipping, scoring or brinelling.

Check condition of bearing surface on O.D. at each end of cam.

Check condition of splines and threads on tube.

Levershaft (5)

Check for burrs on splines, twisted splines, wear on bearing surfaces.

Check levershaft stud for nicks, flat spots or spalling.

Check adjustment of stud roller bearing.

Housing (11):

Check for strain at mounting flanges.

Check condition of needle bearing (19) in each end of housing.

Check fit of cam in needle bearings.

Check bushings (12) in housing for wear or out-of-round.

Check levershaft oil seal(13).

Control Valve (59 or 80).

NOTE: The valve is the control center of the hydraulic system. The major parts, which are the body and spool, are machined to very close limits and with precision machined edges. The spool and valve body are selectively fitted at the factory according to size of O.D. of spool and I.D. of body, therefore, these two parts are not separately replaceable. If either needs replacing, the whole valve assembly must be replaced. Good performance of power steering is not assured if "mismatched" spool and body are used.

Care should be exercised in the handling of the parts to prevent damage. Sealing edges of the valve sleeve and the spool should not be broken. The result would be excessive leakage and reduced hydraulic power.

For Internal Inspection of Type V14 Valve. Disassemble as Follows:

A. Remove retainer ring (64), cover plate (63), and O-ring seal (62).

B. Remove end cover (48) and O-ring seals (58) from valve body.

C. Remove elastic stop nut (49) and washer (50) from end of flexure rod (61) and pull flexure rod out of spool.

D. Push spool out in same direction to permit removal of centering washers (51), O-ring (52), and centering spring (53).

E. Remove O-ring (57) from spool. (Use pointed instrument but be careful not to damage seal.)

F. By-pass valve parts, plug assembly (54), spring (55), and ball (56), may be removed, if desired.

G. Inspect spool. Inspect body internally. Check for scoring by dirt in system. It is impractical for a field service station to measure wear. Wear should be negligible because the spool operates in circulating oil. Performance determines useability.

For Internal Inspection of Type HP70 Valve, Disassemble as Follows:

A. Remove water seal cover (72), rubber water seal (73), spool cover (74), and seal (75) from valve.

B. Remove clevis-rod (84) from end of valve spool as follows:

(a) Take out cotter pin (83), (b) Loosen nut (82), (c) Unscrew clevis-rod from spool.

C. Push spool out clevis-rod end (about 1/2 inch) until O-ring (76) is exposed and removable. Remove O-ring. (Use pointed instrument but be careful not to damage seal).

D. Push spool in opposite direction to expose O-ring for removal from that end of spool.

E. Remove spool and inspect. Inspect body internally. Check for scoring by dirt in system. It is impractical for a field service station to try to measure wear. Wear should be negligible because the spool operates circulating oil. Performance determines useability.

Other Parts:

Check steering arm ball and splines in arm.
Make general inspection of all external parts.

Cleaning:

Cleanliness is of paramount importance.

Use dry-cleaning solvent or volatile mineral spirits to clean or wash grease, oil, or dirt from all metal parts of the steering gear.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA MAXIMUM AIR PRESSURE REQUIREMENTS.

CAUTION: Never steam or high pressure wash hydraulic components. Do not force or abuse closely fitted parts.

After parts are cleaned, dry the parts, except bearings, with dry compressed air.

NOTE: Some cleaning solvents or volatile mineral spirits will deteriorate rubber parts.

REASSEMBLY OF GEAR

A. Replace all gaskets and seals.

B. If needle bearings (19) in ends of housing (10) have been removed, replace them. Take care not to press bearing too hard against retaining ring.

C. Pre-assemble actuator assembly on cam and wheel tube assembly and adjust.

(a) First insure that the threads of the nut and cam shaft are free of interference by running the nut on to the cam shaft using only the fingers to drive the nut. If the nut cannot be driven all the way with finger-torque, the threads are fouled and must be cleared with a thread file or other means until the nut goes on freely.

(b) Assemble needle bearing (23) over wheel tube and seat against upper end of cam.

(c) Assemble other parts in this order:

1. Thrust washer (24).
2. Centering washer (30).
3. Actuator (31).
4. Springs (32) in actuator.
5. Centering washer (30).
6. Thrust washer (24).
7. Needle bearing (23).
8. Thrust washer (24).
9. Tongued washer (33).
10. New lock washer (34, with thirteen external lugs).
11. Adjusting nut (35).
12. Contact ring (36) on wheel tube. (Disregard if gear is stub-shaft type.)

(d) Adjust per Adjustment No. 1 - Thrust Bearings, page 7, paragraph J, page 8.

D. Assemble cam (22) in housing (10). Be certain cam rotates and oscillates freely in housing.

E. Assemble gasket (21) to top of housing (10).

F. Assemble actuator housing (27) over actuator.

G. Position actuator housing for location of valve mounting. Assemble retainer screw and washer (25, 26). Be sure screw engages horizontal slot in actuator.

H. Assemble gasket (21) to upper face of actuator housing.

I. Assemble upper cover (37) and jacket tube (38) assembly.

J. Fasten upper cover (37) and actuator housing (27) to gear housing (10) with long mounting screws.

K. Assemble contact brush (36) to jacket tube (38). (Disregard if gear is stub-shaft type.)

L. Assemble shim pack (7,8,9), if used, to levershaft (5) and install shaft in housing (10). Use care not to damage oil seal (13) in end of housing trunnion (10).

M. Assemble gasket (4) and side cover (3) to housing (10).

N. Assemble adjusting screw (1, 1A) and lock nut (2).

O. Adjust per Adjustment No. 2 - Stud in Cam Groove, on page 8.

Control Valve Reassembly - Type V14:

NOTE: refer to caution note under Control Valve, Page 11.

A. Assemble O-ring (57) on spool.

B. Assemble spool in valve body, being sure end with O-ring is toward clevis end of valve. When assembling spool in body a twisting motion applied to the spool will be helpful. Before assembling, be sure all parts have been thoroughly cleaned. Light lubricating oil should be applied to spool and O-rings.

C. Assemble into the body: centering washer (51), spring (53), centering washer (51), O-ring (52), centering washer (51).

D. Assemble flexure rod (61) in spool.

E. Assemble washer (50) and nut (49) to flexure rod and tighten nut to 125-150 inch pounds torque.

F. If by pass valve parts were removed, replace O-ring on plug (54) before reassembling in body. Assemble ball (56), spring (55) and plug (54)in body.

G. Assemble actuator lever (29) in actuator housing (27) making sure stud end of lever seats in groove of actuator (31) and position slot in other end of lever so that pin in clevis of flexure rod will fit freely into it when mounting the valve.

H. Mount valve on actuator housing making sure clevis pin fits freely into slot of actuator lever. Start all four mounting screws and tighten lightly in rotation before applying the final tightening torque of 10-15 foot pounds. Careless tightening may cause valve spool to be pulled off center by actuator lever interference with clevis pin.

I. Be sure spool actuates (Moves axially in both directions) before assembling end covers. This can be done as follows: (a) Place steering gear arm on lever shaft; (b) Place steering wheel on wheel tube; (c) Turn steering wheel to move steering arm against a stop; (d) Apply sufficient effort to actuate spool; (e) Reverse arm against an opposite stop to actuate spool in other direction.

NOTE: Valve spool travel, each direction, should be minimum of .065 for full flow.

J. Assemble O-rings (58) on end of body and assemble end cover (48) and tighten to valve body.

K. Assemble O-ring (62), cover plate (63), and retaining ring (64) to clevis end of valve.

Control Valve Reassembling - Type HP70:

NOTE: Refer to caution note under CONTROL VALVE, page 11.

A. Assemble spool in valve body, being sure spool end for clevis-rod is in right end of valve. When assembling spool in body a twisting motion applied to the spool will be helpful. Before assembling, be sure all parts have been thoroughly cleaned. Light lubricating oil should be applied to valve spool and O-ring seals.

B. Place "O" ring seal (76) in groove on end of valve spool that is slotted (not the clevis-rod end).

C. Assemble spool in valve body by pushing the clevis-rod end through. Push spool through far enough to uncover O-ring groove in clevis-rod end of spool.

D. Assemble "O" ring seal (76) in this groove and push spool back into body until "O" ring seal just enters the body.

E. Screw nut (82) onto clevis-rod (84) and assemble lock washer (81) next to nut, then screw clevis-rod into threaded end of spool.

F. Assemble valve mounting bracket (70) to top of actuator housing (27).

G. Assemble actuating lever (29) in bushing in bracket (70) making sure that stud end of lever seats in circular groove of actuator (31).

H. Assemble rubber seal (71) on top end of actuating lever, anchoring seal around shoulder of bushing in bracket (70).

I. Assemble valve to mounting bracket (70) making certain slot of actuator lever engages pin in clevis.

J. Make adjustment of valve spool per Adjustment of Valve Spool, page 9.

K. Assemble seal (75) in spool cover (74), water seal (73), cupped end towards spool, and against cover (74), then end cover (72) and attach to valve with two screws.

L. Assemble cover and seal (86, 85).

INSTALLATION IN CHASSIS

A. Place gear in chassis and clamp securely.

NOTE: Disregard next paragraph if gear is stub-shaft type, however, stub-shaft must not be sprung either.

Do not spring column to upper bracket. FREE ALIGNMENT OF THE COLUMN IS OF PARAMOUNT IMPORTANCE. Column must be mounted in the instrument panel bracket in free position. Do not force the column

into a position of misalignment. This will cause binding of the wheel tube and prevent centering of the control valve. (Cam and actuator assembly must be free to oscillate axially.) Column alignment also can cause wheel tube failure due to bending stresses.

B. Install steering wheel. Draw nut tight. Suggested torque setting: Model HPS52 - 33-37 foot pounds
Model HPS70 - 55-65 foot pounds

C. Install horn button parts, if used.

D. Center steering gear. Count number of turns of steering wheel from extreme left turn to extreme right turn, or vice versa. Turn the wheel back half this number of turns to the mid-position.

E. Set front wheels straight ahead, parallel with the frame rails. Measure from each rail to a corresponding point on each tire and make sure this dimension is the same on both sides.

F. Connect drag link to ball on steering arm.

G. Install steering arm on levershaft of gear. If arm does not line up with splines of shaft, turn steering wheel left or right, no more than approximately 1/4 turn, until it does. With lockwasher under nut, draw nut to specified torque.
Model HPS52 - 120 foot pounds
Model HPS70 - 250 foot pounds

H. Install hydraulic lines.

LUBRICATION

I. LUBRICATION

The steering gear housing should be kept full of lubricant. Lubricate through uppermost filler hole in top of steering gear housing. Caution: Avoid high pressure filling in order not to blow out seals.

The lubricants used are recommended to meet the following requirements:

A. Lubricant (Fluid Type) per Ross Specification No. 045070.

1. SAE90 Multi-Purpose Type gear lubricant (API Service GL4)
2. SAE90 gear lubricants meeting Mil-L-2105-B/ORD.
3. SAE90 gear lubricants (Mild EP) parafin base oil.

B. For sub-zero operation (0° - Minus 65° F.) use lubricant per Mil-L-10324/ORD. (Reference-Ross specification 045105).

C. Capacity - HPS52 Gear Housing - 1.0 pints.
HPS70 Gear Housing - 2.5 pints.

II. HYDRAULIC SYSTEM

Recommended Oils:

1. Automatic Transmission Fluid Type A-Suffix A (Armour Research Qualified)
2. SAE 10W Motor Oil (Sequence tested)

A. Fill reservoir to recommended level as indicated on reservoir. If level is higher, over flow will occur during operation. If level gets too low, air will be sucked into the system.

B. In most installations the system will bleed itself in 15 to 20 minutes of operation provided sufficient oil is in the system so that the air may be replaced by oil without further air entering the circuit. If not, more information is available on bleeding procedure.

III. ANALINE POINT

The above lubricants and oils should have analine point between 175° - 225° (Test Method: ASTM Test No. D611).

The analine point affects the stability (Swell or Shrinkage) of the oil resistance compound in oil seals. The acceptable analine point will range between 175° - 225° F., according to the composition of the compound.

PUMP MAINTENANCE

For pump maintenance, consult pump manufacturer.

1 Adjusting Screw
2 Lock Nut
3 Side Cover
4 Side Cover Gasket
5 Levershaft

6 Stud Roller Bearing Unit
7 Thrust Washer
8 Shims
9 Retaining Washer
10 Housing

11 Pipe Plug
12 Levershaft Bushing
13 Oil Seal
14 Steering Arm
15 Lock Washer

16 Levershaft Nut
17 End Cover
18 End Cover Gasket
19 Cam Bearing
20 Bearing Retaining Ring

21 Gasket, Actuating Housing - Upper Cover
22 Cam and Wheel Tube Assembly
22A Wheel Nut
23 Thrust Bearing
24 Thrust Washer
25 Actuator Retainer Screw

26 Washer, Seal
27 Actuator Housing
28 Gasket, Actuator Housing
29 Actuating Lever
30 Centering Washer

31 Actuator
32 Springs, Centering
33 Tongued Washer
34 Lock Washer
35 Adjusting Nut

36 Contact Ring
36A Mounting Screw
37 Upper Cover
38 Jacket Tube
39 Contact Brush
40 Insulator

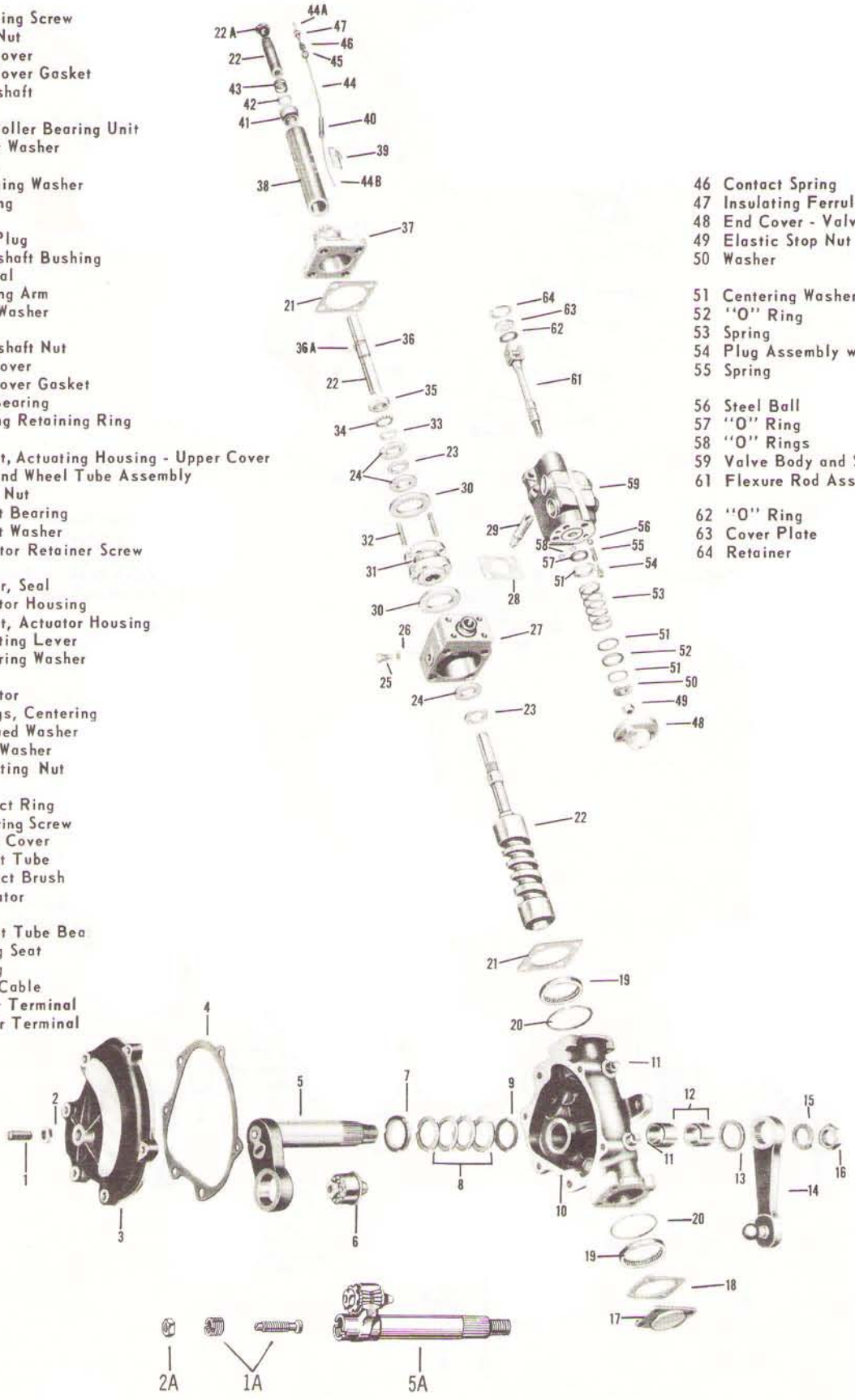
41 Jacket Tube Bea
42 Spring Seat
43 Spring
44 Horn Cable
44A Upper Terminal
44B Lower Terminal

46 Contact Spring
47 Insulating Ferrule
48 End Cover - Valve Housing
49 Elastic Stop Nut
50 Washer

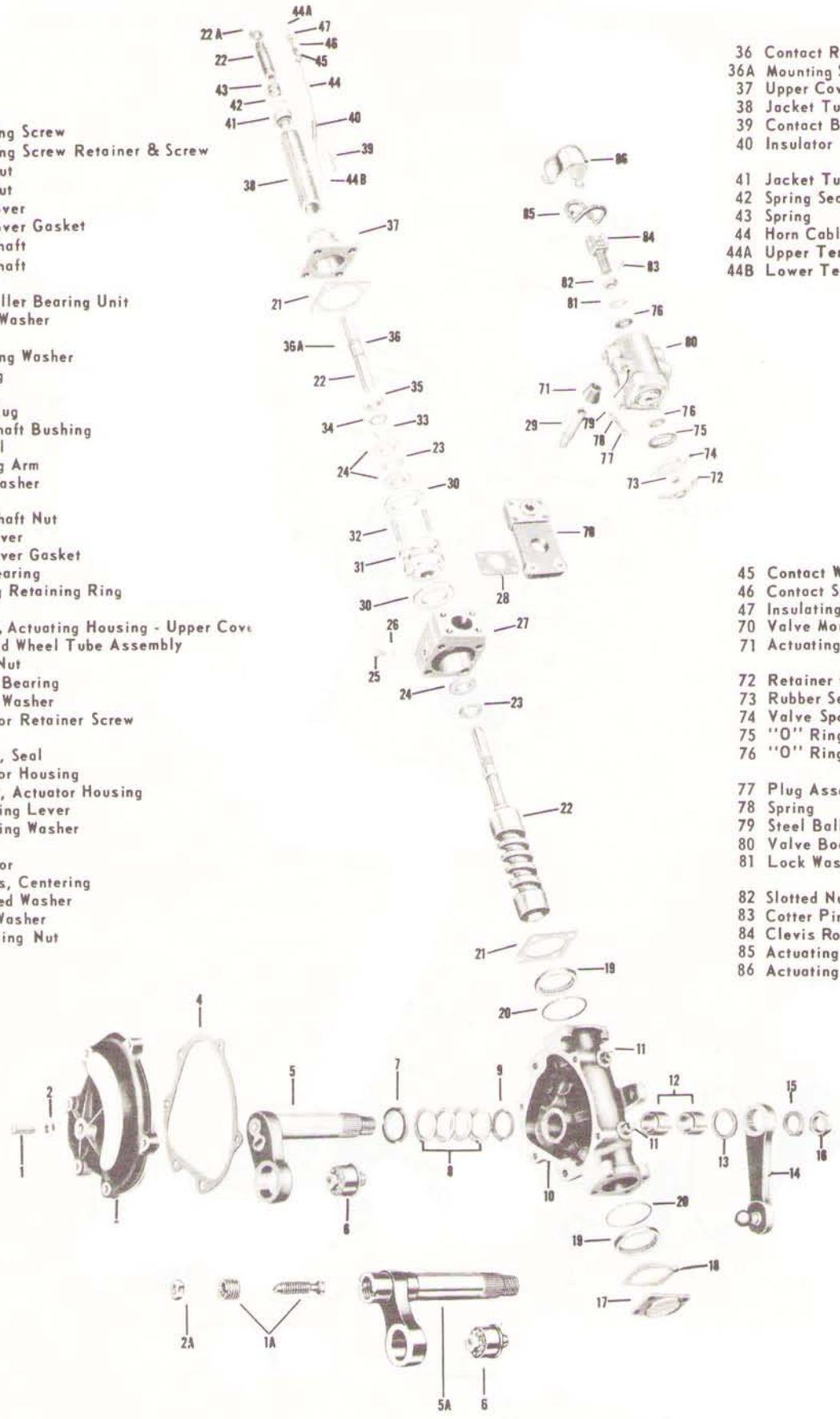
51 Centering Washer
52 "O" Ring
53 Spring
54 Plug Assembly w/"O" Ring
55 Spring

56 Steel Ball
57 "O" Ring
58 "O" Rings
59 Valve Body and Spo
61 Flexure Rod Assemb.

62 "O" Ring
63 Cover Plate
64 Retainer



EXPLODED VIEW - HPS70 GEAR WITH V14 VALVE AND UNIT ACTUATOR



1 Adjusting Screw
1A Adjusting Screw Retainer & Screw
2 Lock Nut
2A Lock Nut
3 Side Cover
4 Side Cover Gasket
5 Levershaft
5A Levershaft

6 Stud Roller Bearing Unit
7 Thrust Washer
8 Shims
9 Retaining Washer
10 Housing

11 Pipe Plug
12 Levershaft Bushing
13 Oil Seal
14 Steering Arm
15 Lock Washer

16 Levershaft Nut
17 End Cover
18 End Cover Gasket
19 Cam Bearing
20 Bearing Retaining Ring

21 Gasket, Actuating Housing - Upper Cove
22 Cam and Wheel Tube Assembly
22A Wheel Nut
23 Thrust Bearing
24 Thrust Washer
25 Actuator Retainer Screw

26 Washer, Seal
27 Actuator Housing
28 Gasket, Actuator Housing
29 Actuating Lever
30 Centering Washer

31 Actuator
32 Springs, Centering
33 Tongued Washer
34 Lock Washer
35 Adjusting Nut

36 Contact Ring
36A Mounting Screw
37 Upper Cover
38 Jacket Tube
39 Contact Brush
40 Insulator

41 Jacket Tube Bearing
42 Spring Seat
43 Spring
44 Horn Cable
44A Upper Terminal
44B Lower Terminal

45 Contact Washer
46 Contact Spring
47 Insulating Ferrule
70 Valve Mounting Bracket Ass'y.
71 Actuating Lever Seal

72 Retainer for Rubber Seal
73 Rubber Seal, Water
74 Valve Spool Cover
75 "O" Ring
76 "O" Ring, Each End of Spool

77 Plug Assembly
78 Spring
79 Steel Ball
80 Valve Body & Spool
81 Lock Washer

82 Slotted Nut
83 Cotter Pin
84 Clevis Rod
85 Actuating Lever Cover Seal
86 Actuating Lever Cover

EXPLODED VIEW – HPS70 GEAR WITH HP70 VALVE AND UNIT ACTUATOR

TROUBLE SHOOTING

Trouble	Cause	Remedy
Hard Steering	1. Pump belt slipping.	Tighten belt. Replace belt if worn.
	2. Insufficient pump pressure.	Check pump pressure with gauge. If insufficient, check for cause -- belt slipping, sticky relief valve in pump or flow control, defective pump.
	3. Sticky relief valve in pump or flow control. (Prevents pressure build up.)	Replace relief valve - May require total replacement.
	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 Bearings No. 1, then check Adjustment of Valve Spool, page 9. (Note: There is no adjustment on type V14 valve.)
	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 No. 1. If valve is type HP70, make Adjustment of Valve Spool, page 9. Check for equal amount of an end movement of spool each way from center.
	7. Wear of actuator lever in bushing of actuator housing or valve mounting bracket.	Replace actuator lever and possibly bracket with bushing or actuator with bushing.
	8. Bind of cam in needle bearings.	Eliminate cause of bind.
	9. Wheel tube bent or sprung.	Replace bent parts and correct column alignment.
	10. Bind in wheel tube bearing.	Eliminate cause of bind such as a bracket clamped tight over jacket tube where bearing is located.
	11. Improper front end alignment.	Align to specifications.
	12. Taper stud adjusted too tight in cam groove.	Adjust per Adjustment No. 2, page 8.
	13. Broken piston or piston rings in power cylinder.	Replace. Check condition of cylinder wall.
	14. Lack of steering gear lubricant.	Add lube to proper level.
	15. Valve loose on mounting.	Tighten, then check adjustment.
	16. Low tire pressure.	Inflate to proper pressure.

TROUBLE SHOOTING

Trouble	Cause	Remedy
Hard Steering (Cont.)	17. 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.	Tighten ball sockets until parts are compressed solid, then back off to nearest lock point. Lubricate.
	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. Bind of cam in needle bearings. (Prevents centering of valve)	Eliminate cause of bind.
	7. 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 No. 1. If valve is type HP70, make Adjustment of Valve Spool, page 9. Check for equal amount of end movement of spool each way from center.
	8. Taper stud adjusted too tight in cam groove.	Adjust per Adjustment No. 2, page 8.
Shimmy	1. Loose ball socket connections or other linkage connections.	Tighten ball sockets until parts are compressed solid, then back off to nearest lockpoint.
	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 hydraulic system. (May cause chatter which may incite front wheel shimmy.)	Bleed system.

TROUBLE SHOOTING

Trouble	Cause	Remedy
Lost Motion at Steering Wheel	1. Loose ball socket connections or other linkage connections.	Tighten ball sockets until parts are compressed solid then back off to nearest lockpoint.
	2. Loose thrust bearing adjustment.	Adjust per Thrust Bearing Adjustment No. 1, page 7.
	3. Excessive back lash of taper stud in cam groove.	Adjust per Adjustment No. 2, page 8.
	4. Steering wheel loose on wheel tube.	Tighten wheel nut.
	5. Pitman arm loose on levershaft.	Tighten levershaft 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. (Air bleeding procedure is available.)
	4. Dirt and sludge in pump.	Drain system and clean.
	5. Pump worn.	Replace or repair.

CAUTION

DON'T - - - hold valve open against stop except momentarily to get pressure readings. Holding valve open more than this will shorten belt and pump life, in fact, pump can be "burned out" quickly.

"TIPS" FOR MAINTENANCE OF STEERING GEAR SYSTEMS

1. Always check for wear in steering linkage and other system components first, before making adjustments to steering gear assembly.

2. Prevent internal bottoming of steering gear. . . Carefully check axle stops.

3. Make periodic checks of lube level for steering gear and components to prevent malfunction due to inadequate lubrication.

4. Make routine and/or periodic checks for proper front end alignment.

5. Maintain correctly inflated tires.

6. Always use a "puller," never use a torch or hammer to remove steering arms.

7. Always carefully examine all steering parts which have been subject to "impact" and replace any that are questionable.

8. Investigate immediately, and correct cause of any play, rattle, or shimmy in any part of the linkage or steering mechanism.

9. Remove cause of steering column misalignment, and if necessary elongate support bracket holes at dash.

10. Encourage all drivers to report any malfunction or accident that could have damaged the steering mechanism.

11. Do not attempt to weld any broken steering component. (Replace only with original equipment.)

12. It is not recommended to severely cold straighten any steering system part.

13. It is not recommended to hot straighten or bend any steering system part.

14. Always use new seals and "O"rings during repairs and overhauls.

15. Replacement of single bearing assemblies, or balls, if one or more make a "set" is not recommended.

16. Excessive heat will develop if any power steering gear is held in an extreme right or left turn longer than a few seconds. (Heat developed can damage seals and/or pump.)

17. Prevent dirt or foreign particles from entering hydraulic steering systems. (Always clean off around filler caps, before removing, to check oil supply.)

18. Use care to prevent even minor hydraulic leaks to continue.

HPS Series Service Manual

Distributed By

Cat.
Part No. HPS-H

Heavy Duty Parts Division
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