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The accompanying manual, "Hydraulic Pumps, Control Valves and Cylinders for International Crawler Tractor Equipment," form number ISS-1029Y, replaces "Hydraulic Pumps and Control Valves for International Tractor Equipment," form number ISS-1029, which should be destroyed.

Future revisions and additions to this new manual will be made in the form of loose-leaf pages.

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HYDRAULIC PUMPS, CONTROL VALVES AND CYLINDERS  
For  
INTERNATIONAL CRAWLER TRACTOR EQUIPMENT

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## HYDRAULIC PUMPS, CONTROL VALVES AND CYLINDERS

### INTRODUCTION

#### GENERAL

The instructions contained in this service manual are for the information and guidance of servicemen who are responsible for overhauling and repairing hydraulic pumps, control valves and cylinders for International crawler tractor equipment.

This manual provides the serviceman with a fast, convenient reference to information on maintenance and repairs, as well as descriptions of the major units and their functions in relation to other components.

#### ILLUSTRATIONS

Some of the illustrations in this manual are of GENERAL APPLICATION ONLY AND MAY NOT SHOW YOUR EQUIPMENT ACCURATELY IN ALL DETAILS.

#### LUBRICATION

Instructions on the lubrication of each assembly are given in the lubrication guide in the operator's manual. When assembling any parts, always coat all wearing surfaces with the lubricant specified in the guide. Except for such parts whose surfaces should be clean and dry, use sufficient quantities of lubricant to prevent any danger of seizing, scoring or excessive wear when the assembly is first operated. Failure to provide "starting lubrication" may result in serious damage.

#### GASKETS AND SEALS

Always use new gaskets, "O" rings and seals. When installing a seal, be sure to install it as specified in the instructions. Be extremely careful not to damage the seal in any way during installation.

#### SERVICE PARTS

International tractor equipment deserves genuine IH service parts. The best material obtainable and experience gathered through many years of manufacturing construction equipment, enable International Harvester to produce quality that will not be found in imitation or "just as good" repair parts. No serviceman can afford to guarantee a repair job that is not serviced with genuine IH parts. No owner should be satisfied with other than genuine IH parts.

For the correct service parts to be used on a machine, always refer to the parts catalog for the particular machine. The loose-leaf parts catalogs are accurate and are continually being brought up to date by the issuance of new pages covering any changes in part numbers.

It is the policy of International Harvester Company to improve its products whenever it is possible and practical to do so.

We reserve the right to make changes or add improvements in the design or construction of parts at any time, without incurring the obligation to install such changes on units previously delivered.



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## DESCRIPTION

## 1. TRACK FRAME MOUNTED HYDRAULIC SYSTEM

(For T and TD-6, T and TD-6 (61 Series), TD-6 (62 Series), T and TD-9, TD-9 (91 Series), TD-9 (92 Series), TD-14A, TD-14A (141 Series), TD-18A and TD-18A (181 Series) Crawler Tractors)

The hydraulic system used on the above listed tractors is a semi-closed system with a maximum operating pressure of 650 psi and a normal operating pressure of 250-400 psi. The main components of the system are the oil tank, hydraulic control valve, a gear type oil pump, two hydraulic cylinders, and the required piping and hoses to connect the components.

The hydraulic system operating principles, covering the various oil flows for raising, holding, lowering and floating the blade equipment, are explained and illustrated in Illust. 1, 2, 3 and 4.

## RAISE POSITION (Illust. 1)

Oil from the pressure side of the pump enters the valve housing at the lower inlet port, forcing the check valve off its seat. With the operating plunger in the "RAISE" position, the second port from the rear is uncovered, providing a path for high pressure oil to flow to the forward or piston rod end of the hydraulic cylinders. The rear port is also uncovered by the operating plunger, allowing return oil displaced by the rearward movement of the piston to flow back to the control valve. Return oil seats the flow-diverting plunger (upward), opening a path for oil to return to the suction side of the pump.

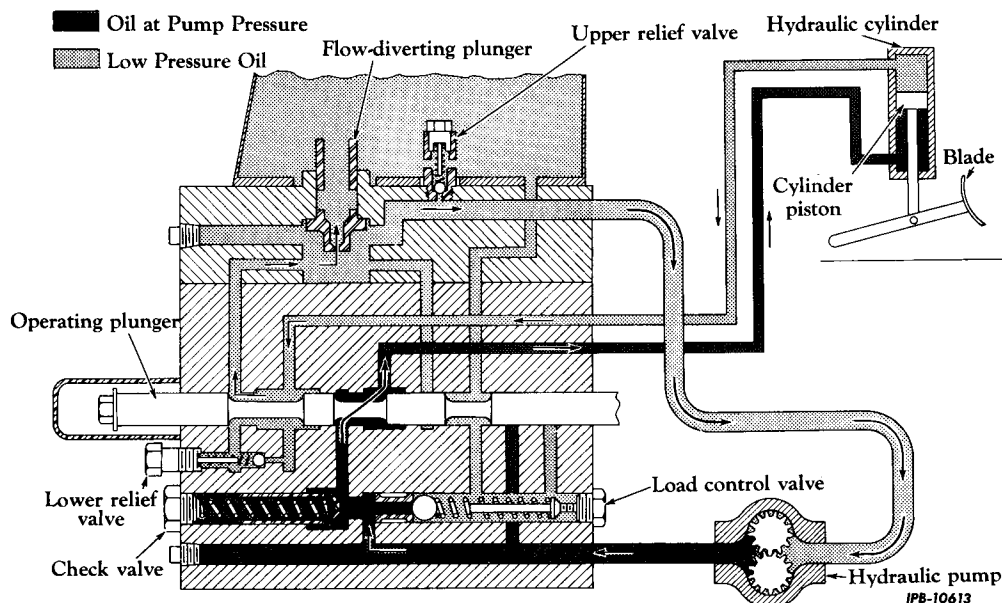
Excessive return oil enters the reservoir through a small hole in the bottom of the flow-diverting plunger. Excessive pressure on the suction side of the pump is further relieved by the upper relief valve which opens into the reservoir. In this manner, the oil on the suction side of the pump is under partial pressure, easing the load on the pump.

## HOLD POSITION (Illust. 2)

In the "HOLD" position, the operating plunger blocks off the two cylinder ports in the control valve, preventing the flow of oil to or from both ends of the lift cylinder, thus holding the blade position. The forward port is uncovered, allowing oil from the pressure side of the pump to return to the reservoir. The pump draws oil from the reservoir through the flow-diverting plunger, which is unseated by pump suction. In this position, the pump does no work, but merely circulates oil under low pressure.

## LOWER POSITION (Illust. 3)

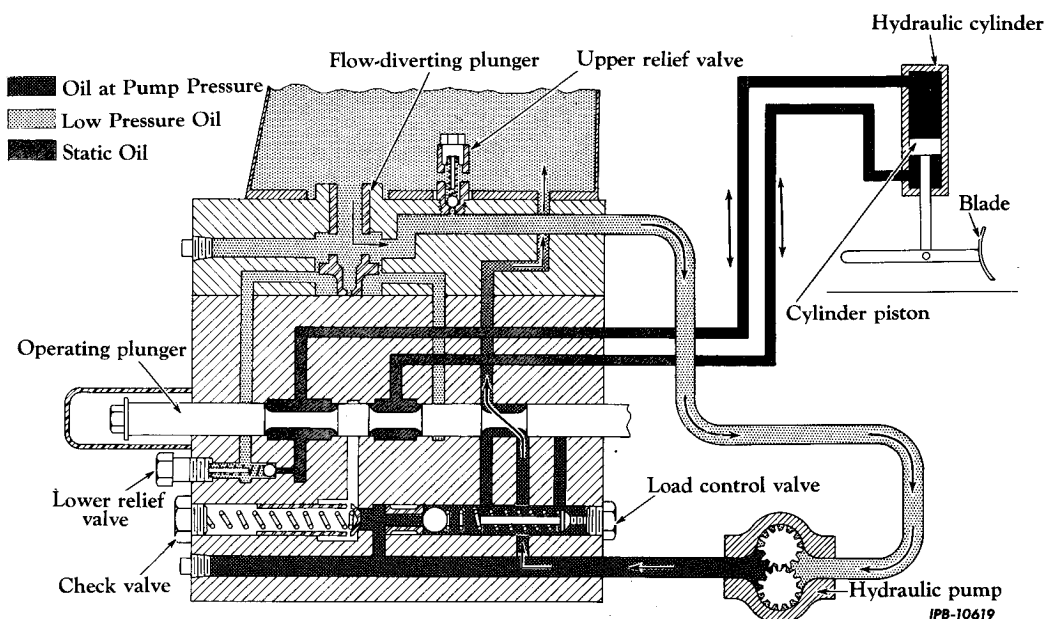
Oil from the pressure side of the pump enters the valve housing at the lower inlet port, forcing the check valve off its seat. The operating plunger, in the lowering position, uncovers the rear port directing the high pressure oil to the rear or head end of the hydraulic cylinders. The second port from the rear is also uncovered providing a path for the oil, displaced by the forward movement of the piston, to return to the suction side of the pump. This return oil



Illust. 1 - Raise Position.



## DESCRIPTION



Illust. 2 - Hold Position.

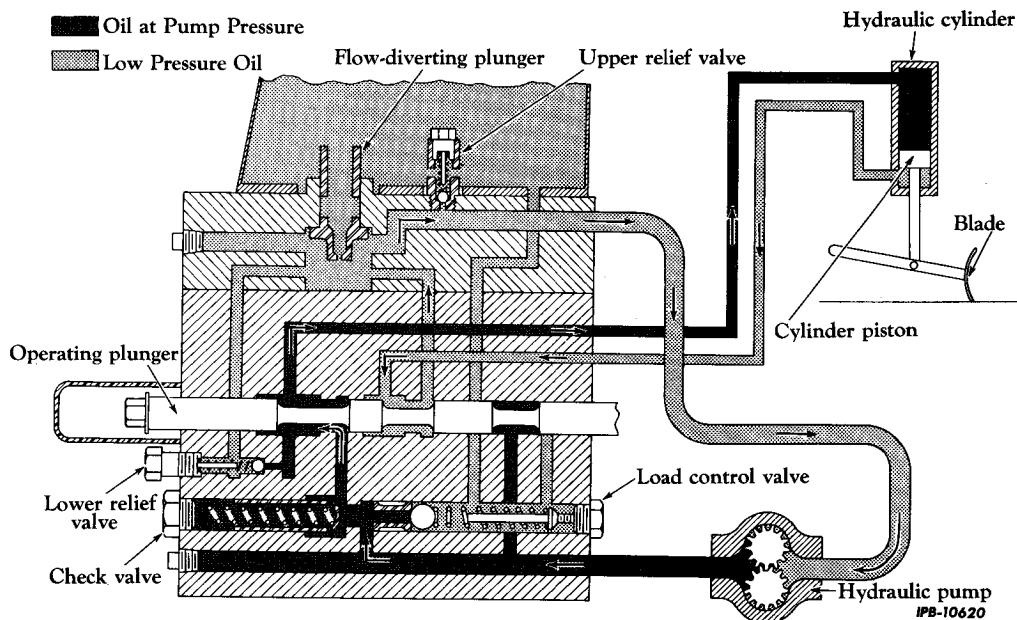
will not fully seat the flow-diverting valve, thus allowing any additional oil needed by the pump to be drawn from the reservoir.

## FLOAT POSITION (Illust. 4)

When the operating plunger is in "FLOAT" position, the two cylinder ports within the valve housing are connected to each other, but blocked off from the rest of the circuit. The pressure on both sides of the pistons is equal allowing the blade to float according to the ter-

rain. As the blade fluctuates, oil is displaced from one side of the piston to the other. When the blade is forced upward, all of the oil displaced from the head end of the cylinder will not fit in the opposite end due to the displacement of the piston rod. The excess pressure thus created is relieved by unseating the lower relief valve. When the blade drops, the situation is reversed as all the oil displaced from the piston rod end of the cylinder is not enough

Continued on next page.

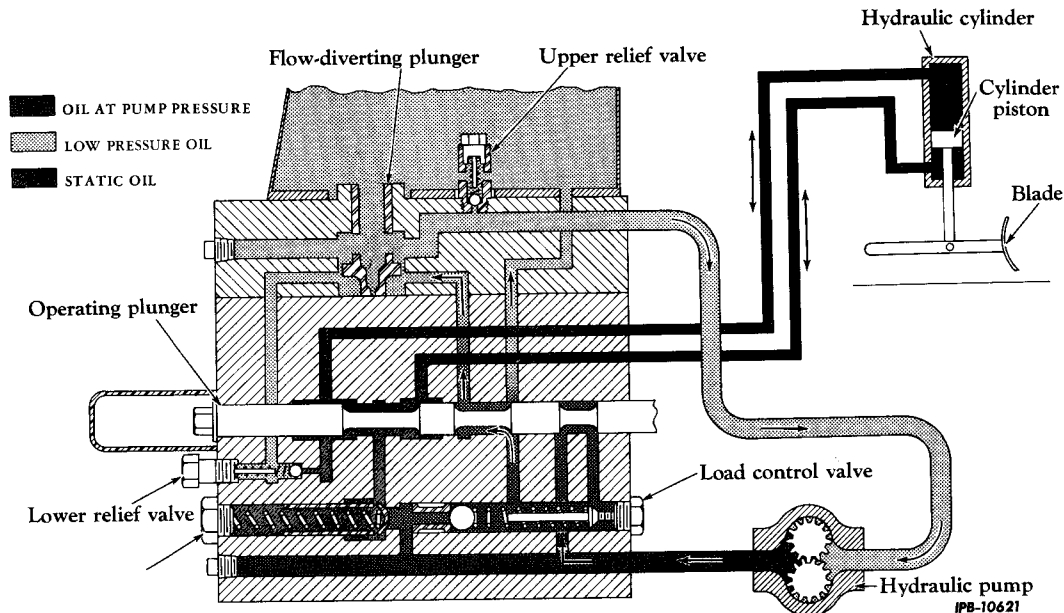


Illust. 3 - Lower Position.



## DESCRIPTION

### 1. TRACK FRAME MOUNTED HYDRAULIC SYSTEM - Continued



Illust. 4 - Float Position.

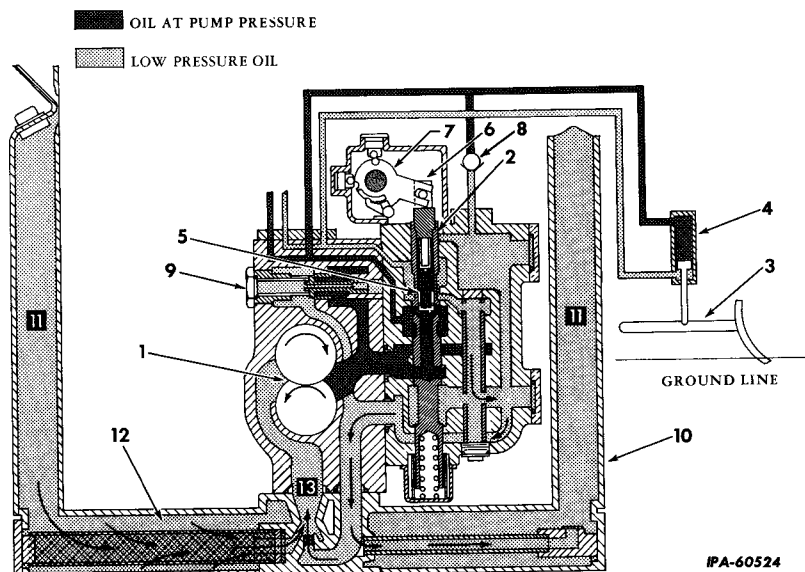
to fill the space at the head end of the cylinder. The pressure in the cylinder circuit drops, allowing pump pressure to force the check valve open and supply make-up oil. When the pump is not supplying make-up oil, it draws oil from the reservoir through the unseated flow-diverting valve and returns it through the two forward ports in the plunger bore.

### 2. DIRECT LIFT HYDRAULIC SYSTEM

Hydraulic System (TD-20 (200 Series) and TD-25 (250 Series))

(Ref. Nos. Refer to Illust. 5.)

The hydraulic system includes a gear type pump (1) designed for continuous operation. An oper-



Illust. 5 - Cut-away View of Direct Lift Hydraulic System (TD-20 (200 Series) and TD-25 (250 Series)).



## DESCRIPTION

Legend (Illust. 5)

- |                           |                           |
|---------------------------|---------------------------|
| 1. Pump.                  | 8. Anti-cavitation valve. |
| 2. Operating plunger.     | 9. Relief valve.          |
| 3. Blade.                 | 10. Radiator guard.       |
| 4. Cylinder.              | 11. Hydraulic oil.        |
| 5. Check valve.           | 12. Filter.               |
| 6. Lift eye.              | 13. Pump venturi.         |
| 7. Valve positioning cam. |                           |

ating plunger (2) controls the action of the blade (3) by directing the oil flow to and from the cylinders (4). A check valve (5) inside the operating plunger prevents the blade from lowering while in the "HOLD" position and when the engine pump lags. A plunger lift eye (6) connects the operating plunger to the arm of the valve positioning cam (7).

At low engine rpm, the pump may lag in supplying oil to the upper end of the cylinders while in the power "LOWER" position. Cavitation is prevented by an anti-cavitation valve (8) which opens and adds a portion of the oil returning from the lower end of the cylinders to that supplying the upper ends. The pump relief valve (9) is set to relieve pressure developed by the pump at a pre-determined specified psi setting.

The radiator guard (10) is a cored casting and forms a reservoir and cooler for the hydraulic oil (11). The hydraulic oil in the reservoir is drawn through the filter (12) in the lower left

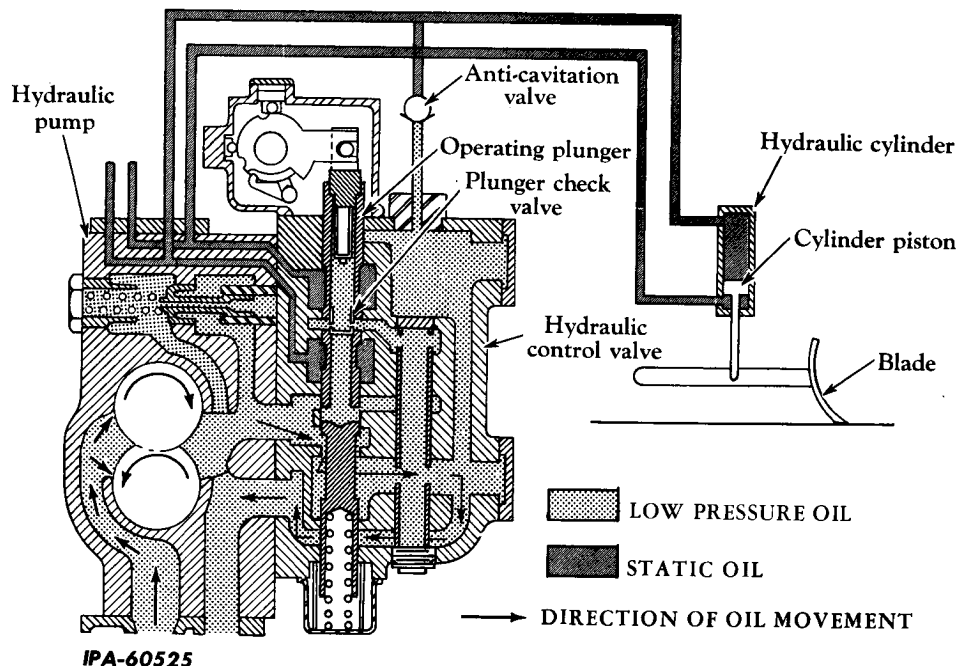
side of the radiator guard. From the filter, the oil passes through the venturi (13) and on to the pump gears.

The four operating positions ("HOLD," "RAISE," "LOWER" and "FLOAT") are illustrated and explained in Illust. 6, 7, 8, 9 and 10.

## HOLD POSITION (Illust. 6)

In the "HOLD" position the oil flows from the pressure side of the pump gears through the supply port in the valve body. The operating plunger is positioned so that the oil is free to flow back to the inlet side of the pump through the return port in the valve body. With the operating plunger in this position, both the "RAISE" and "LOWER" ports to the cylinders are sealed off, locking the oil and holding the blade rigidly.

Continued on next page.



Illust. 6 - Hold Position.



## DESCRIPTION

## 2. DIRECT LIFT HYDRAULIC SYSTEM - Continued

Hydraulic System (TD-20 (200 Series) and  
TD-25 (250 Series) - Continued  
(Ref. Nos. Refer to Illust. 5.)

The pump develops only a small amount of pressure at this time and the plunger check valve is held down on its seat by the spring.

## RAISE POSITION (Illust. 7)

In the "RAISE" position the oil enters through the supply port from the pump. The operating plunger is now positioned so the oil enters the inside of the plunger. As the pressure of the oil rises the plunger check valve is forced open, allowing the oil to flow out of the plunger through the "RAISE" port in the valve body. From here the oil goes to the rod end of cylinders, forcing the piston up and raising the blade.

Oil forced out of the upper end of the cylinders returns to the valve body through the "LOWER" port. The operating plunger is positioned to allow this returning oil to return to the reservoir.

## POWER LOWER POSITION (Illust. 8)

With the operating plunger in the "LOWER" position, the oil from the pump enters the

valve body as before and flows to the inside of the operating plunger.

The check valve is forced open and, with the plunger in this position, the oil now flows out of the plunger and through the "LOWER" port in the valve body to the upper end of the cylinders, forcing the blade down under power.

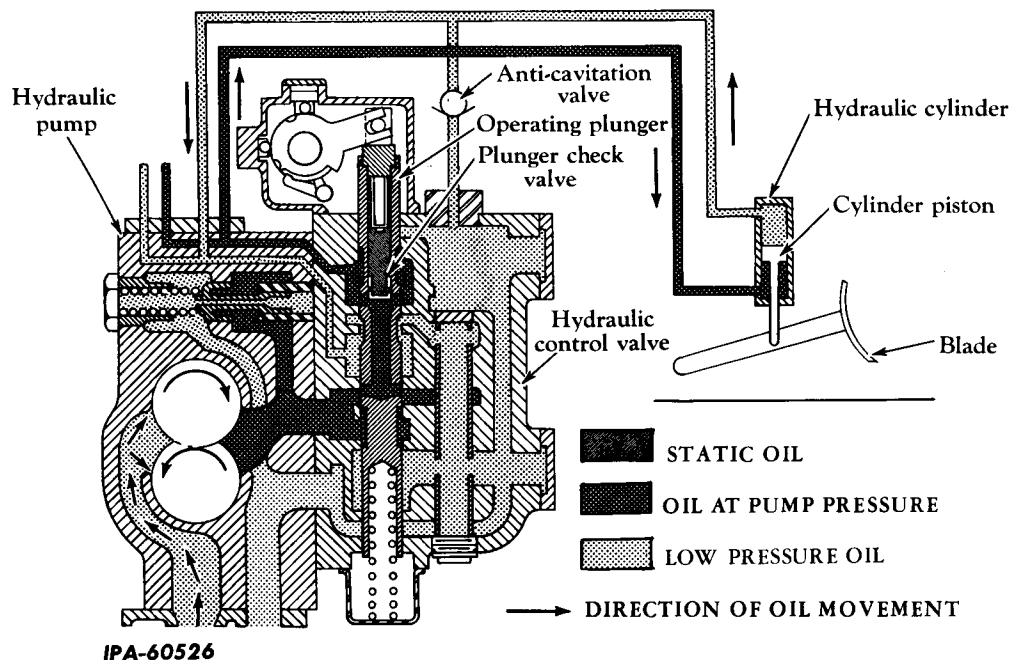
Oil returning from the rod end of the cylinders enters the valve body and is allowed to return to the reservoir.

If the pump should lag in supplying oil to the upper ends of the cylinders, the anti-cavitation valve, located in the manifold on top of the pump, will be brought into play.

As the pump lags, the pressure of the oil from the pump acting on the back side of the check valve plunger of the anti-cavitation valve is greatly reduced. The pressure on the other side, oil returning from the rod end of the cylinders, is increased. This causes the plunger to move in the direction shown in the Illust. 9. A part of the returning oil is thus added to that coming from the pump, preventing cavitation of the oil.

## FLOAT POSITION (Illust. 10)

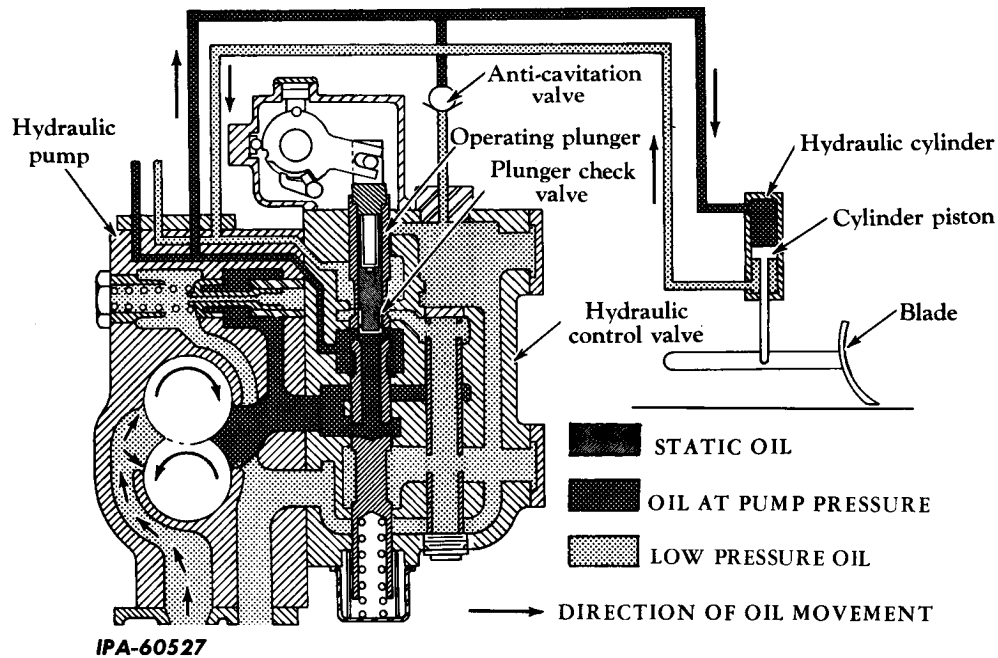
In the "FLOAT" position the oil from the pump enters the housing through the supply port. The



Illust. 7 - Raise Position.



## DESCRIPTION



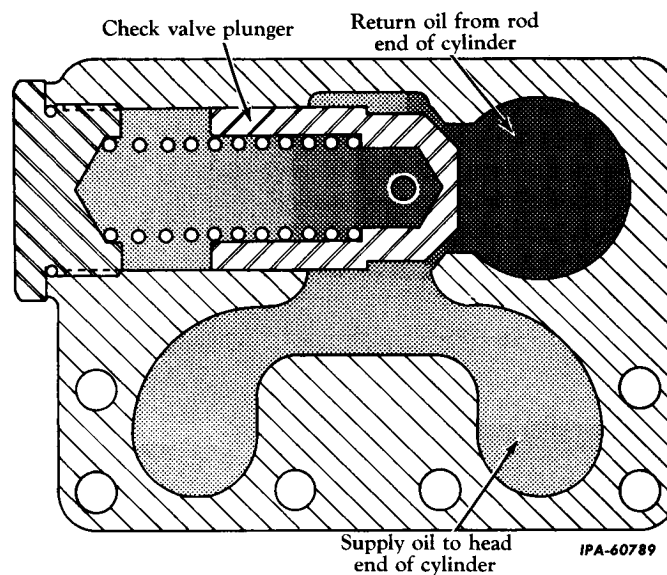
Illust. 8 - Power Lower Position.

operating plunger is positioned so the supply and return ports in the valve body are connected, allowing the supply oil to return to the tank. The "RAISE" and "LOWER" ports are also open to each other, allowing a free interchange of oil from one to the other, allowing the blade to float.

## Hydraulic System (TD-15 (150 Series))

(Ref. Nos. Refer to Illust. 11.)

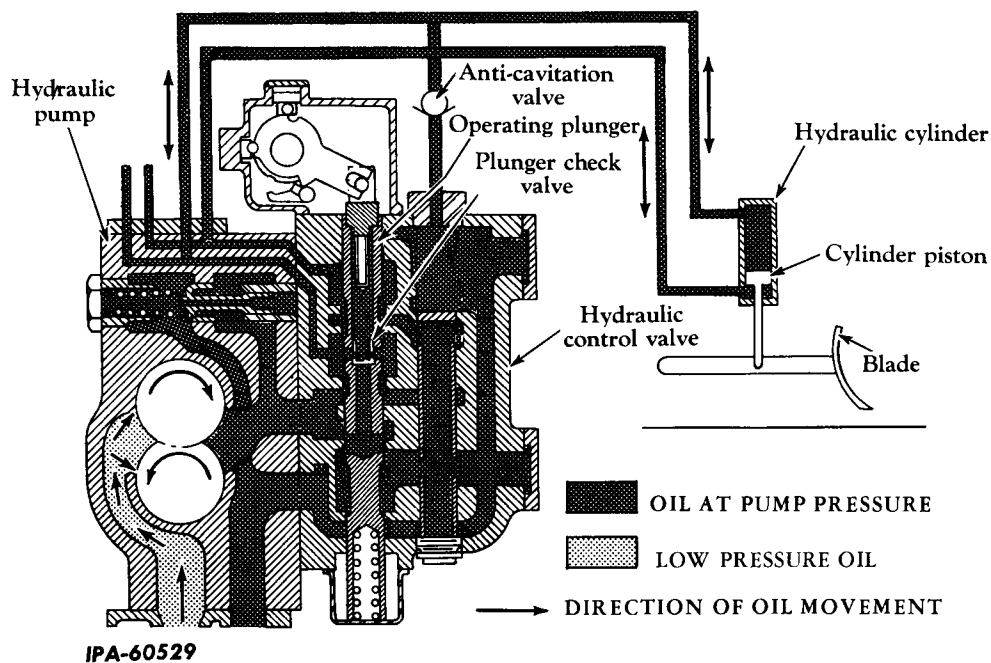
The hydraulic system for the TD-15 (150 Series) is similar to the system described in  
Continued on next page.



Illust. 9 - Anti-Cavitation Valve.



DESCRIPTION



Illust. 10 - Float Position.

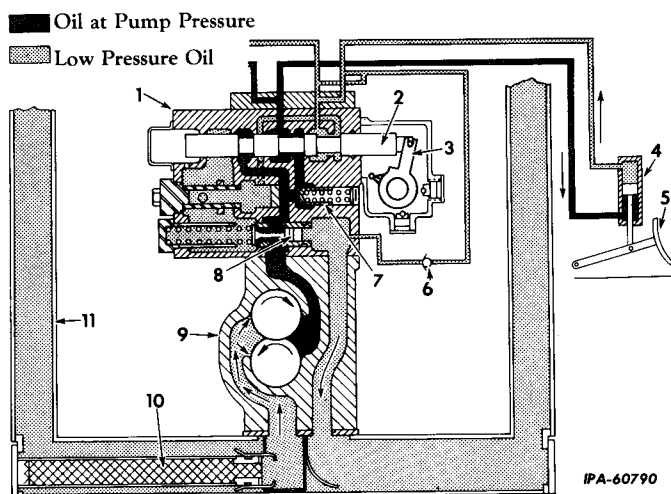
2. DIRECT LIFT HYDRAULIC SYSTEM - Continued

Hydraulic System (TD-15 (150 Series) - Continued

(Ref. Nos. Refer to Illust. 11.)

the beginning of this paragraph for the TD-20 (200 Series) and TD-25 (250 Series). The dif-

ferences are that the TD-15 pump and valve unit is smaller, the control valve is mounted horizontally and the check valve is not located in the operating plunger. In this unit the check valve is located in the valve housing.



Illust. 11 - Cut-away View of TD-15 (150 Series) Hydraulic System.

1. Control valve.
2. Operating plunger.
3. Cam plate.
4. Hydraulic cylinder.

5. Blade.
6. Manifold.
7. Check valve.
8. Relief valve plunger.

9. Hydraulic pump.
10. Strainer.
11. Hydraulic radiator guard.



## DESCRIPTION

## RAISE POSITION (Illustr. 11)

In the "RAISE" position oil flows from the pressure side of the pump gears and into the valve body. The oil forces the check valve off its seat and then flows to the operating plunger. The operating plunger is now positioned so the oil will flow around the small diameter of the

valve and out the valve body into the manifold. From there the oil flows through the raise ports to the rod end of the cylinders, raising the blade.

Oil forced out of the upper end of the cylinders enters the manifold and is returned to the reservoir.

## CHECKING MECHANICAL PROBLEMS

## 3. SERVICE DIAGNOSIS

This section has been prepared to serve as a guide in locating the source of problems that may be encountered with hydraulic pumps, control valves and cylinders. In diagnosing problems it should be remembered that it is possible for a given symptom to be caused by any one of a number of deficiencies. It is also

possible for a given deficiency to cause any one or more of various symptoms.

The following chart gives predominant symptoms and their primary causes, based on our experience. When a number of possible causes of a complaint are given, they are listed in a logical sequence for checking and corrective action.

## PROBABLE CAUSE

## REMEDY

## No Motion of Hydraulic System When First Started

- |   |   |
|---|---|
| 1. Low oil level due to leakage . . . . .                             | Examine hydraulic lines, etc., for leaks and correct.                                     |
| 2. Oil viscosity too heavy . . . . .                                  | Use oil recommended. (Refer to operator's manual.)  |
| 3. Air leak in pump inlet passage . . . . .                           | Inspect pump line mountings for leakage and correct.                                      |
| 4. Restricted pump inlet passage . . . . .                            | Examine oil strainer and clean.   |
| 5. Broken pump drive shaft, power take-off shaft or adapter . . . . . | Replace or repair.  |
| 6. Pressure relief valve plunger leaking and/or defective . . . . .   | Check for foreign matter on valve seat or broken plunger. Replace if necessary.           |
| 7. Pump not rotating . . . . .  | Check for broken pump drive shaft, power take-off shaft or adapter. Replace if necessary. |
| 8. Pump worn out . . . . .  | Replace.  |
| 9. Control lever linkage broken . . . . .                             | Remove and adjust or replace.   |
| 10. Broken hydraulic lines . . . . .                                  | Repair.   |
| 11. Broken relief valve spring . . . . .                              | Replace spring.   |

## Loss of Motion During Operation

- |   |  |
|---|--|
| 1. Insufficient oil supply . . . . .            | Check level of oil in oil tank and add oil if necessary. |
| A. Broken or loose pump inlet passage . . . . . | Replace or tighten.                                      |
| B. Broken outlet passage . . . . .              | Replace.   |
| C. Broken cylinder connecting lines . . . . .   | Replace.   |
| D. Broken tank return line . . . . .            | Replace.   |

NOTE: For additional "CAUSES" refer to the items listed under "No Motion of Hydraulic System When First Started" with the exception of Items 2, 7 and 9.

Continued on next page.



## CHECKING MECHANICAL PROBLEMS

## 3. SERVICE DIAGNOSIS - Continued.

## PROBABLE CAUSE

## REMEDY

## Slow Motion

- |  |   |
|--|---|
| 1. Pump wearing out . . . . .  | Repair.   |
| 2. Partially clogged pump inlet . . . . .                            | Clean hydraulic system. (Refer to operator's manual.)                   |
| 3. Air leak in pump inlet . . . . .                                  | Replace "O" ring seal.  |
| 4. Pressure relief valve plunger leaking . . . . .                   | Check for foreign matter on valve seat. Clean and replace if necessary. |
| 5. Badly scored relief valve plunger seat . . . . .                  | Replace.  |
| 6. Aerated oil supply (foam in tank) . . . . .                       | Check hydraulic system for air leaks.                                   |
| 7. Worn or scored piston packing or cups . . . . .                   | Replace.  |
| 8. Inside diameter of cylinder tube badly scored or nicked . . . . . | Replace.  |
| 9. Linkage to valve plunger bent . . . . .                           | Repair and adjust linkage.  |

## Jerky Motion in Upstroke

- |   |  |
|---|--|
| 1. Air in system . . . . .              | Vent hydraulic system. (Refer to operator's manual.) |
| 2. Cylinder packing too tight . . . . . | Refer to operator's manual.                          |

## Jerky Motion in Downstroke

- |   |          |
|---|----------|
| 1. Dashpot plunger spring or cap broken . . . . . | Replace. |
| 2. Float control plunger spring broken . . . . .  | Replace. |

## Noisy Operation

- |   |  |
|---|--|
| 1. Air in system . . . . .                        | Vent hydraulic system. (Refer to operator's manual.)                     |
| 2. Insufficient oil supply . . . . .              | Check level of oil in oil tank and add oil if necessary.                 |
| 3. Pump bearings worn out . . . . .               | Replace.   |
| 4. Pump and coupling worn out . . . . .           | Replace.   |
| 5. Partially blocked pump inlet . . . . .         | Drain hydraulic system and clean strainer. (Refer to operator's manual.) |
| 6. Pump squealing caused by:                      |  |
| A. Air in system . . . . .                        | Vent hydraulic system. (Refer to operator's manual.)                     |
| B. Insufficient oil supply. . . . .               | Check level of oil in oil tank and add oil if necessary.                 |
| C. Partially blocked pump inlet . . . . .         | Drain hydraulic system and clean strainer. (Refer to operator's manual.) |
| 7. Chattering relief valve spring . . . . .       | Replace.   |
| 8. Broken flow control plunger spring . . . . .   | Replace.   |
| 9. Broken dashpot plunger spring or cap . . . . . | Replace.   |
| 10. Dirty oil strainer . . . . .                  | Clean oil strainer.  |

## Load Slowly Drops (Valve Plunger in "HOLD" Position)

- |   |                         |
|---|-------------------------|
| 1. Oil leaking by valve plunger . . . . .                               | Repair.                 |
| 2. Oil bypassing from holding side to opposite side of piston . . . . . | Repair.                 |
| 3. Oil leaks at fittings or in cylinder connecting lines . . . . .      | Check hydraulic system. |



## CHECKING MECHANICAL PROBLEMS

## PROBABLE CAUSE

## REMEDY

## Momentary Drop of Load When Valve Plunger is Actuated From "HOLD" to "RAISE" or "RAISE" to "HOLD"

- |   |   |
|---|---|
| 1. Scored or worn check valve plunger or seat . . . . . | Replace.                                |
| 2. Check valve plunger held off its seat . . .          | Clean system. Check for foreign matter. |
| 3. Broken check valve spring . . . . .                  | Replace.                                |

## Sticking Valve Plunger

- |   |  |
|---|--|
| 1. Scored or burred lands in plunger bore . .                             | Repair or replace if necessary.        |
| 2. Mounting face not level, thereby distorting housing . . . . .          | Correct.                               |
| 3. Mounting bolts too tight or improperly tightened . . . . .             | Loosen and retighten to proper torque. |
| 4. Detent poppets worn or damaged (positive position type only) . . . . . | Replace.                               |
| 5. Dirt or foreign matter . . . . .                                       | Clean valve.                           |
| 6. Warped valve plunger . . . . .   | Replace.                               |
| 7. Linkage too tight or out of adjustment . .                             | Adjust linkage.                        |

## Pump Takes Too Long to Respond or Fails to Respond

- |   |   |
|---|---|
| 1. Low oil supply . . . . .                   | Fill to proper level.                                     |
| 2. Insufficient relief valve pressure . . . . | Reset to correct pressure setting. (Refer to Section 15.) |
| 3. Pump worn or damaged . . . . .             | Inspect, repair or replace.                               |

## Oil Heating Up

- |   |   |
|---|---|
| 1. Foreign matter lodged between the relief valve plunger and relief valve seat . | Inspect and remove foreign matter.                                    |
| 2. Using very light oil in a hot climate . . . .                                  | Drain and refill with proper oil. (Refer to operator's manual.)       |
| 3. Dirty oil . . . . .  | Drain, flush and refill with clean oil. (Refer to operator's manual.) |
| 4. Oil level too low . . . . .  | Fill to proper level.   |
| 5. Insufficient relief valve pressure . . . . .                                   | Reset to correct pressure setting. (Refer to Section 15.)             |
| 6. Relief pressure too high . . . . .   | Same as Item 5.   |
| 7. Pump worn (slippage) . . . . .   | Replace or repair.  |

## Oil Foaming

- |  |   |
|--|---|
| 1. Air leaking into suction line from tank to pump . . . . . | Tighten all connections.  |
| 2. Wrong kind of oil . . . . .                               | Drain and refill with proper oil. (Refer to operator's manual.) |
| 3. Oil too low . . . . .                                     | Fill to proper level.   |
| 4. Improper tank or reservoir baffling . . . .               | Baffle correctly.   |

## Oil Leakage at Front of Pump

- |   |                 |
|---|-----------------|
| 1. Gasket in pump cap defective . . . . . | Replace gasket. |
|---|-----------------|

## Oil Leakage at Rear of Pump

- |  |                                 |
|--|---------------------------------|
| 1. Rear oil seal worn or damaged . . . . . | Inspect and repair as required. |
|--|---------------------------------|

Continued on next page.



## CHECKING MECHANICAL PROBLEMS

### 3. SERVICE DIAGNOSIS - Continued

#### PROBABLE CAUSE

#### REMEDY

#### Short Life of Pump Bearings, Shafts, Wear Plates, Etc.

- |                                      |   |
|--------------------------------------|---|
| 1. Dirty oil . . . . .               | Drain, flush and refill with clean oil. (Refer to operator's manual.) |
| 2. Wrong kind of oil . . . . .       | Drain and refill with proper oil. (Refer to operator's manual.)       |
| 3. Incorrect pump assembly . . . . . | Disassemble and correct.  |

### 4. PUMP FLOW TEST

Testing the pump for proper output in gallons per minute is a short cut in determining the condition of a pump. The method described below is with the use of a Schroeder hydraulic portable circuit tester for the models indicated. This tester makes it possible to flow test the pump on the tractor by connecting the tester to a pressure line. The tester may be ordered under part number PT-100-B. An adapter kit which includes all adapters and hoses to make the necessary connections may be ordered under part number KTA. Send all orders to Schroeder Brothers, Nickol Avenue, Box 72, McKees Rocks (Pittsburgh, Pennsylvania.)

**Pumps Mounted Separate From Control Valves**  
(T-6, TD-6, T-6 (61 Series), TD-6 (61 Series), T-9, TD-9, TD-9 (91 Series), TD-14A, TD-14A (141 Series), TD-18A and TD-18A (181 Series) Crawler Tractors)

1. Connect the tester to the pump at the points shown in Illust. 12, 13, 14, 15 and 17, and connect the tester return line to reservoir fill port. Use the adapter indicated in the illustrations for the test being made. Remove the strainers from the filler opening in the reservoir before inserting the return line.

**CAUTION:** All the lines that are disconnected should be closed to prevent oil loss or dirt entering the system and to hold pressures.

2. Start the tractor and increase the throttle setting to obtain the desired rpm.

3. Use the tester load valve to build up pressure and to heat the oil for flow reading at operating temperatures.

A. Take flow readings on the tester gauge at:

- a. Zero psi (with tester adjusted for handling maximum flow, a pressure

slightly higher than zero may at times exist in lines at tester).

- b. Relief valve setting (shown on chart).

- B. Compare these readings with the gpm pump ratings as shown on chart.

PUMP CHART

Pump Model Number	Test at These RPM	Test at 0 PSI	Test At High Pressure	
		GPM	PSI	GPM
Hydreco 2020K8B2 & 2020K8B5	1450	19	650	18
Hydreco 2025K8B2	1400	32	650	30
Hydreco 3020C5A1	1400	46	650	44
Hydreco 3030J16B2	1650	79.5	800	78
Hydreco 3035C5A1	1450	83	650	79
Hydreco 3620A2A2	1000	81	⊗ 800	73
Hydreco 3625A2A2	1000	100	⊗ 800	90

⊗ TEST PSI LOWER THAN RELIEF PSI

4. Results from test:

- A. If flow readings taken in Step 3A are similar to the pump gpm ratings shown on the pump chart, the pump is functioning properly.

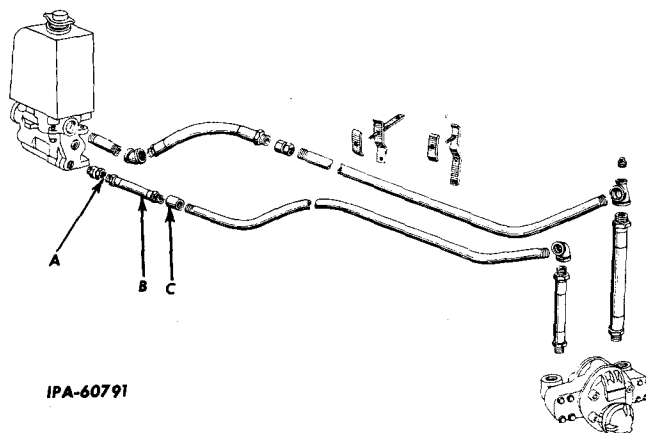


## CHECKING MECHANICAL PROBLEMS

- B. If the volume reading is similar at zero psi, but lower than the pump gpm ratings at the relief valve pressure, the pump is worn.
- C. If the volume is appreciably lower at zero psi and maintains close to the same reading at high pressures, it is an indication of suction line deficiency.

NOTE: Severely vibrating tester gauges are often an indication of entrained air. Check the color of the oil in the reservoir and check for suction line leaks.

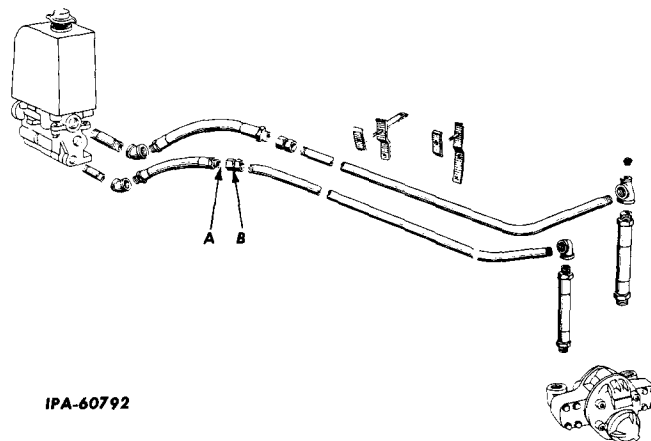
- 5. Disconnect the tester and reconnect tractor lines.



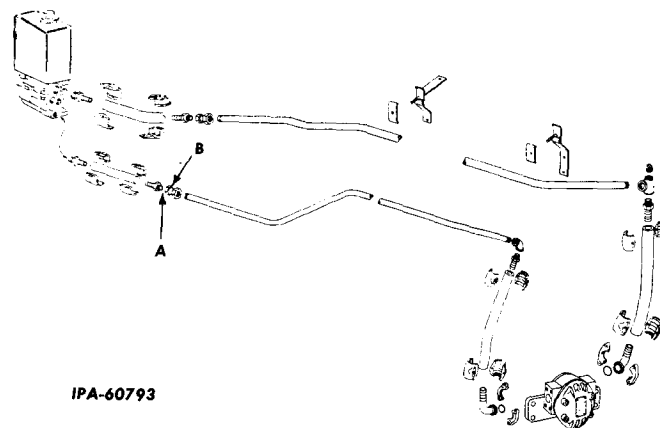
Illust. 12

MODELS T-6, TD-6 AND EARLY MODELS T-6 (61 SERIES) AND TD-6 (61 SERIES) CRAWLER TRACTORS (REF. NOS. REFER TO ILLUSTR. 12): Break the hydraulic line at the swivel fitting (A). Remove the rear pressure hose (B). Connect the tester pressure port to point "C" with hose assembly No. 3 (Illustr. 16). Connect the hydraulic tester return port to the reservoir with hose assembly No. 1 (Illustr. 16).

MODELS T-9, TD-9, AND EARLY MODELS TD-9 (91 SERIES) CRAWLER TRACTORS (REF. NOS. REFER TO ILLUSTR. 13): Break the hydraulic pressure line at point "A." Connect the tester pressure port to swivel fitting (B) with hose assembly No. 3 (Illustr. 16). Connect the hydraulic tester return port to the reservoir with hose assembly No. 1. (Illustr. 16.)



Illust. 13



Illust. 14

LATE MODELS T-6 (61 SERIES), TD-6 (61 SERIES) AND TD-9 (91 SERIES) CRAWLER TRACTORS (REF. NOS. REFER TO ILLUSTR. 14): Break the hydraulic pressure line at point "A" and connect the inlet test hose assembly No. 3 (Illustr. 16) to one inch female swivel fitting (B). Connect the hydraulic tester return port to reservoir with hose assembly No. 1 (Illustr. 16).

MODELS TD-14A, TD-14A (141 SERIES), TD-18A AND TD-18A (181 SERIES) CRAWLER TRACTORS (REF. NOS. REFER TO ILLUSTR. 15): Break the hydraulic pressure line at point "A." Connect the tester pressure port to the female swivel fitting (B) with adapter No. T-9 and hose assembly No. 3 (Illustr. 16). Connect the tester return port to the reservoir with hose assembly No. 2 (Illustr. 16).

Continued on next page.



## CHECKING MECHANICAL PROBLEMS

## 4. PUMP FLOW TEST - Continued

Pumps Mounted Separate From Control Valves - Continued  
(T-6, TD-6, T-6 (61 Series), TD-6 (61 Series), T-9, TD-9, TD-9  
(91 Series), TD-14A, TD-14A (141 Series), TD-18A and TD-18A  
(181 Series) Crawler Tractors)



Illust. 15

## Pumps Attached to Valves

(TD-14 (142 Series), Early Model TD-15 (150 Series), TD-18  
(182 Series), Early Model TD-20 (200 Series), TD-24 and TD-24  
(241 Series))

1. Connect the tester to the hydraulic circuit at the radiator junction block and disconnect the opposite cylinder line and plug (Illust. 17).

2. Start the tractor and increase the throttle to the test rpm setting shown in the "PUMP CHART." Maintain this rpm throughout the test.

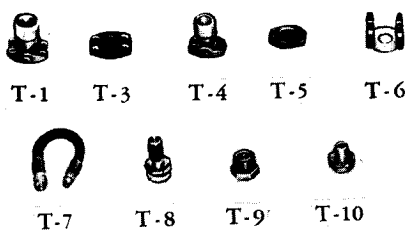
3. Position the control valve to the "LOWER" position. This directs the total pump output through the tester.

4. Use the tester load valve to build up the pressure and to heat the oil for the volume reading at operating temperatures.

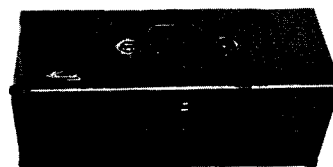
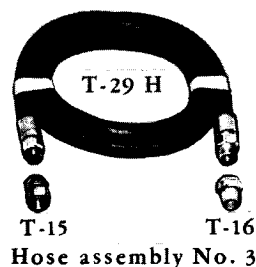
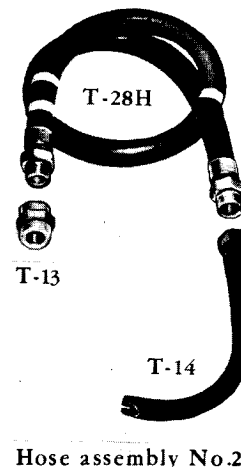
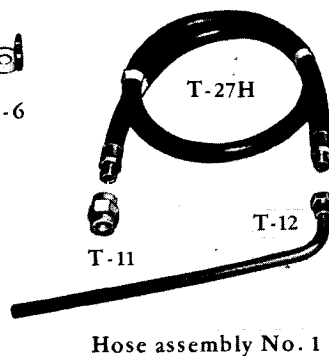
A. Take a volume reading on the tester gauge at zero psi.

B. Take a second volume reading at the following pressures:

- a. TD-14 (142 Series) 850 psi  
TD-15 (150 Series)



Special adapters



Kit for adapters

IPA-60564

Illust. 16 - Tool Kit.



## CHECKING MECHANICAL PROBLEMS

b. TD-18 (182 Series) 1300 psi  
TD-20 (200 Series)

c. TD-24 and TD-24 (241 Series) 1300 psi

C. In all installations where the system relief valve may bypass pump delivery during a flow check, the relief valve should be checked and adjusted prior to the test. During a flow check of such systems, the relief valve should not be bypassing oil. The relief valve may "crack" at a pressure lower than its rated setting. To determine whether the "cracking" pressure is lower than the test pressure, operate the engine at a constant rpm and gradually increase the pressure on the pump. The point where the flow drops suddenly will be "cracking" pressure.

D. Compare these readings with the gpm pump ratings shown in "PUMP CHART."

5. Results from test:

A. If the volume readings taken in Steps 4A and 4B are similar to the pump ratings shown on "PUMP CHART," the pump and relief valve are functioning properly. The control valve is satisfactory at the position tested.

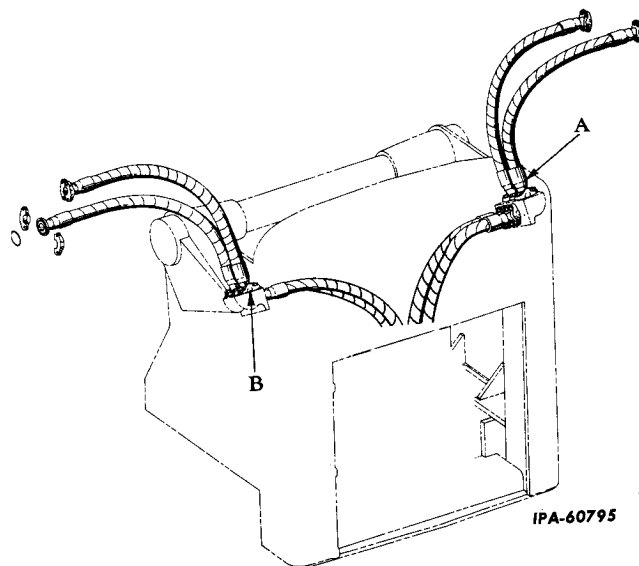
B. If the volume reading is similar at zero psi, but lower than the pump gpm ratings at the higher test pressure, the pump valve unit is faulty.

NOTE: If this situation occurs, there is a possibility that a restriction in the pressure line (pump to reservoir junction box) could cause the flow loss. Check this line for restrictions before removing the pump valve unit.

C. If the volume is appreciably lower at zero psi and maintains close to the same reading at higher pressures, it is an indication of suction line deficiency.

6. Disconnect the tester, remove the adapter caps and reconnect the tractor hoses.

MODELS TD-14 (142 SERIES) AND EARLY MODELS TD-15 (150 SERIES) CRAWLER TRACTORS (REF. NOS. REFER TO ILLUSTR.



Illustr. 17

17): Break the hydraulic pressure line at point "A." Connect the tester port to the radiator hydraulic pressure port with adapter No. T-4 and hose assembly No. 3 (Illustr. 16). Break the hydraulic pressure line at point "B" and the plug radiator hydraulic pressure port with adapter No. T-5 (Illustr. 16). Connect the tester return port to the reservoir with hose assembly No. 2 (Illustr. 16).

MODELS TD-18 (182 SERIES) AND EARLY MODELS TD-20 (200 SERIES) CRAWLER TRACTORS (REF. NOS. REFER TO ILLUSTR. 17): Break the hydraulic pressure line at point "A." Connect the tester port with the radiator hydraulic pressure port with adapter No. T-4 and hose assembly No. 3 (Illustr. 16). Break the hydraulic pressure line at point "B" and plug the radiator hydraulic pressure port with adapter No. T-5 (Illustr. 16). Connect the tester return port to the reservoir with hose assembly No. 2 (Illustr. 16).

MODELS TD-24 AND TD-24 (241 SERIES) CRAWLER TRACTORS (REF. NOS. REFER TO ILLUSTR. 17): Break the hydraulic pressure line at point "A." Connect the tester pressure port with adapter No. T-1 and hose assembly No. 3 (Illustr. 16). Break the hydraulic pressure line at point "B" and plug the radiator hydraulic pressure port with adapter No. T-3 (Illustr. 16). Connect the tester return port to the reservoir with hose assembly No. 2 (Illustr. 16).



**STANDARD TORQUE DATA FOR NUTS AND BOLTS**  
(For special torque data refer to specification paragraph of the pertinent section of this manual.)

Recommended torques, in foot-pounds, for standard application nuts and bolts shown below is applicable, provided:

- A. All threads are lubricated with engine oil or chassis grease. (Refer to NOTE.)
- B. Joints are rigid; for example, no gaskets or compressible materials are used.

**NOTE:**

1. Multiply the standard torque by .85 when metallic plated bolts or nuts are used.
2. Multiply the standard torque by .75 when parkerized bolts or nuts are used.
3. Multiply the standard torque by .70 when Molykote, white lead or similar mixtures are used as lubricants.
4. Multiply the standard torque by .90 when hardened surfaces are used under the nut or bolt head.

Bolt Size	Type 2		Type 4	
	Min.	Max.	Min.	Max.
1/4	9	10	12	14
5/16	19	21	27	30
3/8	33	37	45	50
7/16	53	60	75	85
1/2	80	90	115	130
9/16	110	125	160	180
5/8	160	180	220	250
3/4	290	320	400	450
7/8	420	470	650	730
1	630	710	970	1090
1-1/8	850	950	1380	1550
1-1/4	1200	1350	1940	2180

**BOLT TYPE IDENTIFICATION CHART**

IH Type	SAE Grade	DESCRIPTION	BOLT HEAD * MARKING
2	5	WILL HAVE AN IH AND 3 RADIAL LINES Quenched and tempered medium carbon steel	
4	8	WILL HAVE AN IH AND 6 RADIAL LINES Quenched and tempered special carbon or alloy steel	

\* The center marking identifies the bolt manufacturer. The IH monogram is currently used. Some bolts may still have a raised dot which previously identified IH bolts.



HYDRAULIC PUMP  
(Hydreco Models 2020K8B2, 2020K8B5 and 2025K8B2)

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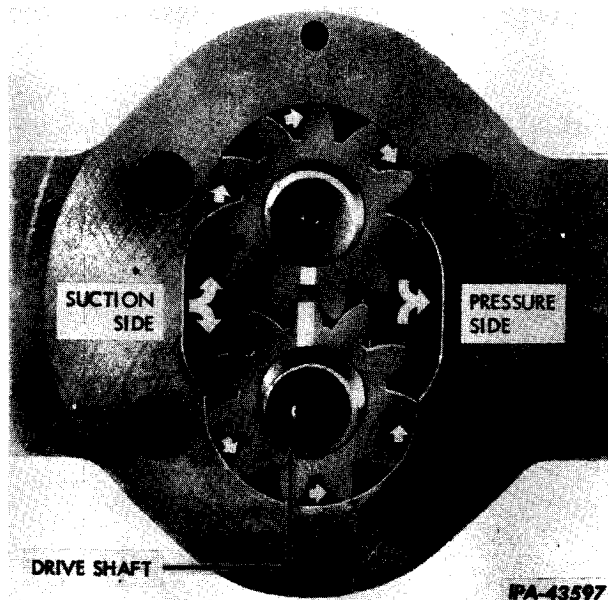
Paragraph	Page
1. Description . . . . .	2
2. Specifications . . . . .	2
3. Disassembly . . . . .	2 to 5
4. Inspection and Repair . . . . .	5, 6
5. Reassembly . . . . .	6 to 8
6. Break-in and Test of Repaired Pumps .	8



## 1. DESCRIPTION

The Hydreco pump Models 2020 K8 B2, 2025 K8 B2 and 2020 K8 B5 are positive displacement gear type pumps, power take-off driven and mounted on the front of the engine. The pumps force oil to the cylinders on each side of the unit for operating the cylinder pistons. The pump operates continuously when the engine is running, but is under a load only when the control valve demands pressure. The pump drive shaft rotates at engine speed in a clockwise direction, as viewed from the adapter end. The outlet or pressure side of the pump is the side on which the gear teeth mesh. The inlet or suction side of the pump is the side on which the gear teeth unmesh. (Illust. 1.)

As the pump drive shaft rotates, the drive gear turns the driven gear at the same speed, but in the opposite direction. As the gears revolve, oil is carried from the suction side to the pressure side of the pump in the pockets formed by the gear teeth, wear plate and housing. The remeshing of the gears on the pressure side forces the oil out of these pockets and through the outlet port. A small portion of the oil, which remains trapped in the pockets, is forced against the wear plates, creating a high pressure. To disperse this pressure, a 1/16 inch deep relief pocket is drilled in the wear plates, and is located on the pressure side of the pump.



Illust. 1 - Oil Flow Through Pump (Viewed from Cover End).

## 2. SPECIFICATIONS

Pump make	Hydreco
Pump shaft rotation (viewed from adapter end)	Clockwise
Housing gear bore diameter, inches	2.3335 - 2.3355
Maximum permissible, inches	2.3405
Gear tip diameter, inches	2.327 - 2.328
Minimum permissible, inches	2.326
Maximum permissible clearance (gear tip and housing bore), inch	.008
Bearing bore diameter, inches	1.000
Maximum permissible, inches	1.001
Shaft diameter, inch	.9990 - .9995
Minimum permissible diameter, inch	.9980
Maximum permissible clearance (shaft in bearing), inch	.003
Gear thickness, inches	2.5000 - 2.5005
Minimum permissible, inches	2.4995
Wear plate thickness, inch	.248 - .250
Minimum permissible thickness (at gear contact), inch	.245
Cover and adapter dowel hole diameter, inch	.312 - .313
Maximum permissible, inch	.314

### Torque Data (ft.-lbs.)

Cover cap screws	80
------------------	----

## 3. DISASSEMBLY

(Ref. Nos. Refer to Illust. 4.)

1. Clean the outside of the pump with an oil solvent and dry thoroughly. Remove sharp edges or burrs from the shaft keyway, with a fine file or oil stone, to prevent damage to the oil seal when removing it. Punch mark the cover, housing and adapter for proper reassembly (Illust. 2).

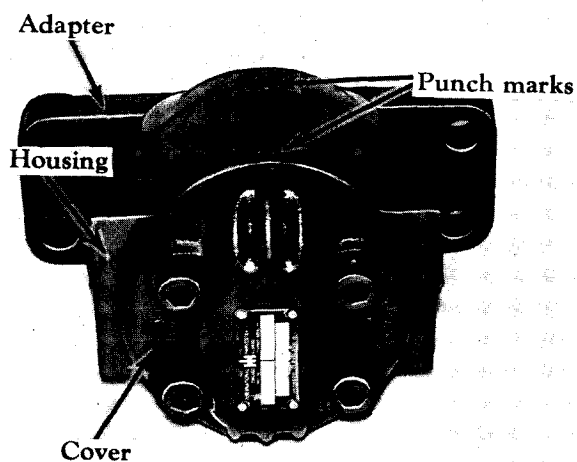
2. Remove the four socket head screws (14) which secure the cover and housing to the adapter. (Illust. 2.) Remove the cover (13), which may come off separately or with the housing (10). Avoid scoring or nicking machined surfaces of pump sections. **DO NOT USE A SCREWDRIVER** to pry the sections apart. Tap them with a fiber hammer to loosen them.

3. Note the position of the relief pocket and drilled hole in the wear plate (16) for proper reassembly. Remove the wear plate (16) and cover seal ring (15) from the cover. Note the locations and number of gaskets (11) when disassembling.



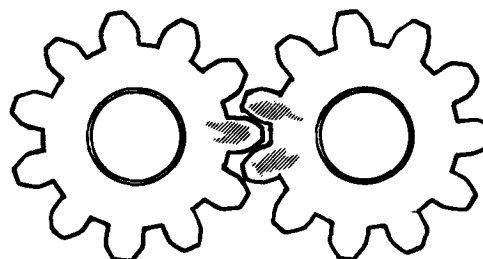
# HYDRAULIC PUMP (Hydrecos Models 2020K8B2, 2020K8B5 and 2025K8B2)

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Page 3



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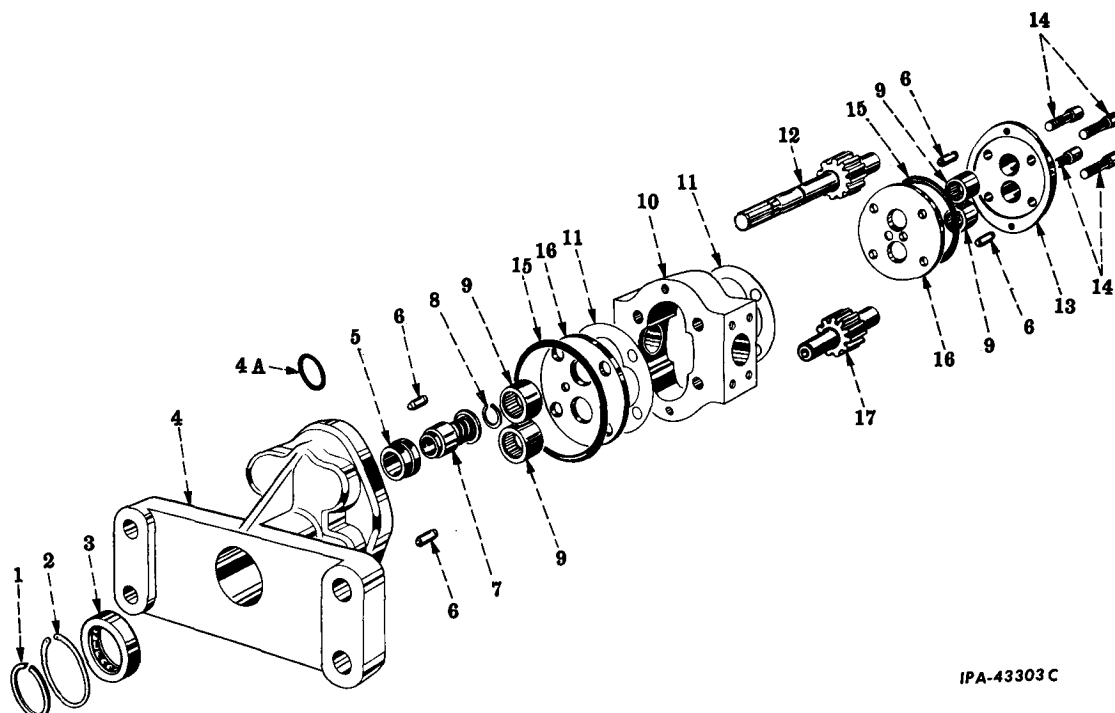
Illust. 2 - Punch Marks on Pump Cover, Housing and Adapter.



IPA-43598

Illust. 3 - Drive Gear and Driven Gear Marked for Proper Reassembly.

4. Mark the drive gear (12) and driven gear (17) with India stone or small pieces of tape for proper reassembly (Illust. 3). The reason  
Continued on next page.



IPA-43303C

Illust. 4 - Exploded View of Hydraulic Pump.

- |               |               |                  |
|---------------|---------------|------------------|
| 1. Snap ring. | 6. Dowel.     | 12. Drive gear.  |
| 2. Snap ring. | 7. Seal.      | 13. Cover.       |
| 3. Bearing.   | 8. Snap ring. | 14. Cap screw.   |
| 4. Adapter.   | 9. Bearing.   | 15. Seal ring.   |
| 4A. "O" ring. | 10. Housing.  | 16. Wear plate.  |
| 5. Seal seat. | 11. Gasket.   | 17. Driven gear. |



## 3. DISASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 4.)

for this is to re-establish the same gear tooth wear pattern when the original gears are to be reinstalled. The efficiency of the pump may otherwise be impaired.

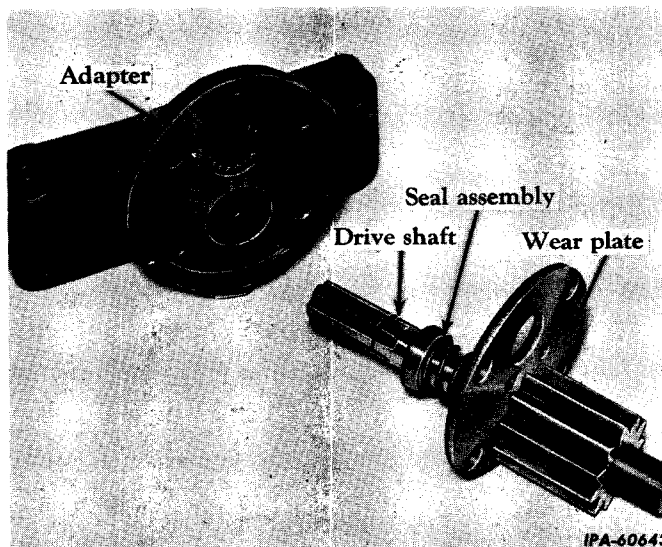
5. Remove the driven gear and shaft (17) from the adapter. The gear and shaft are one piece.

6. Remove the snap ring (1) from the drive shaft (12). Remove the housing (10) from the adapter (4). If the housing sticks, tap it loose from the dowels with a fiber hammer. Remove the gasket (11) and adapter seal ring (15). Again note the position of the relief pocket in the wear plate (16).

7. Position the adapter end of the pump in a press, supported under the edges so that the wear plate will clear. Press out the bearing by pressing on the splined end of the drive shaft. (Illust. 5.) The drive shaft, wear plate, bearing and seal will come out as a unit. (Illust. 6.)

8. Remove the seal (7), back-up washers and spring from the splined end of the shaft. Remove snap ring (8), which will free the bearing (9) and wear plate (16) from the shaft (12). (Illust. 7.)

9. Do not remove bearings unless it is necessary to replace them. Replace with the same make and type as originally installed. Check the bearings for freeness of rollers and pitted, broken or excessively worn rollers. Replace the bearing if it is possible to insert a .020

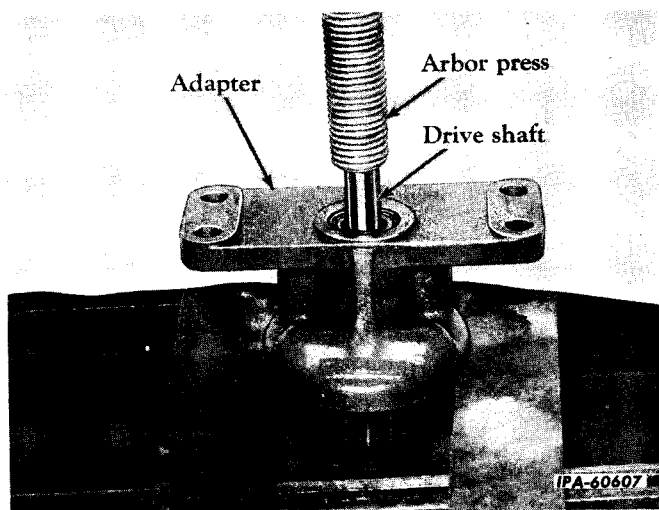


Illust. 6 - Drive Shaft Assembly Removed.

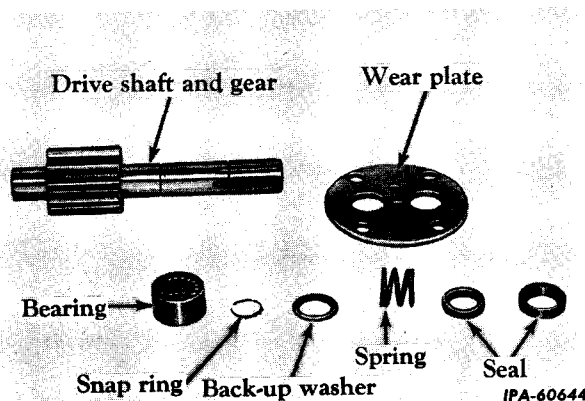
inch feeler gauge between the rollers. Remove the roller bearings by starting them out with the tool shown in Illust. 8. Complete removal of the bearing, using a puller (Illust. 9), and tap out with a heavy bar.

10. To remove the outboard bearing (3), remove the retaining snap ring (2) and pull the bearing out, using the tool shown in Illust. 9.

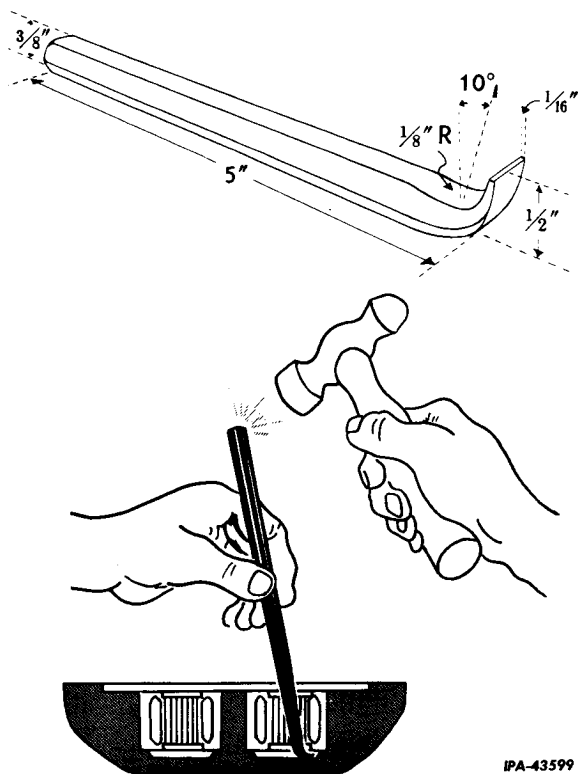
11. The seal seat (5) should not be removed unless the lapped sealing surface is excessively worn or damaged. To remove the seal seat (5), invert the adapter and press the seat out with a suitable driver.



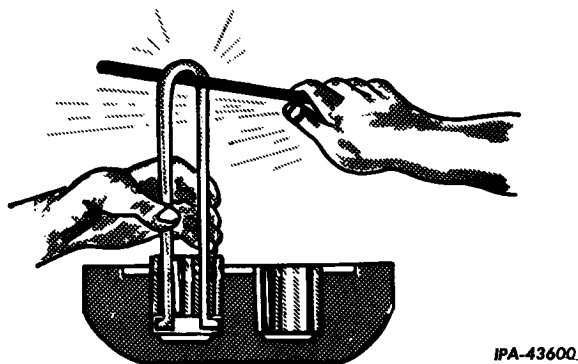
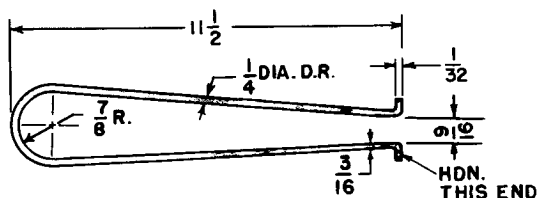
Illust. 5 - Removing Drive Shaft from Adapter.



Illust. 7 - Drive Shaft Assembly Disassembled.



Illust. 8 - Bearing Removal.



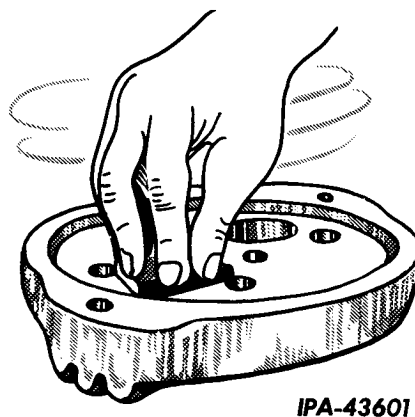
Illust. 9 - Outboard Bearing Removal.

#### 4. INSPECTION AND REPAIR

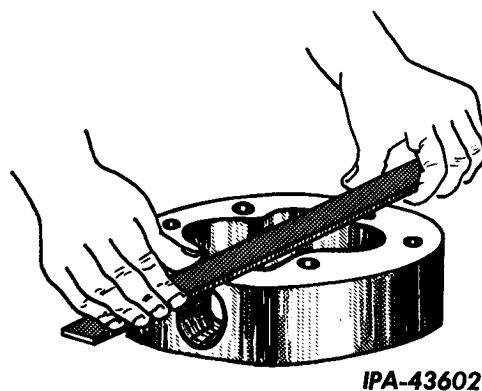
(Ref. Nos. Refer to Illust. 4.)

1. Wash all parts in oil solvent and dry thoroughly with compressed air. Do not spin the bearings when blowing dry with compressed air.
2. With a fine stone, remove all nicks and burrs from around the bearing bores and drilled holes of the adapter and cover (Illust. 10). Clean up burrs and nicks on the machined mating surfaces of the housing, adapter and cover (Illust. 11). Rewash before assembly.
3. Inspect the gear shafts at the bearing points and seal areas for rough surfaces and excessive wear.
4. Inspect the gear faces and edges of the teeth for scoring. Stone the face of the gears (Illust. 12) to minimize wear on the wear plates.

Continued on next page.



Illust. 10 - Removing Burrs from Adapter and Cover.

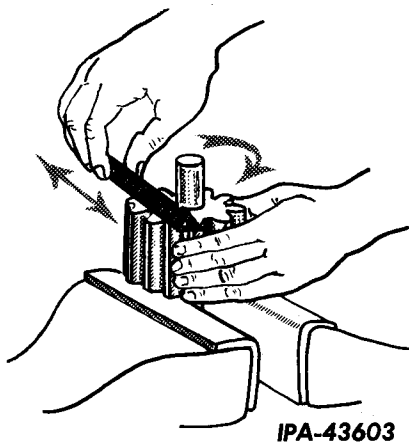


Illust. 11 - Removing Burrs from Housing.



## 4. INSPECTION AND REPAIR - Continued

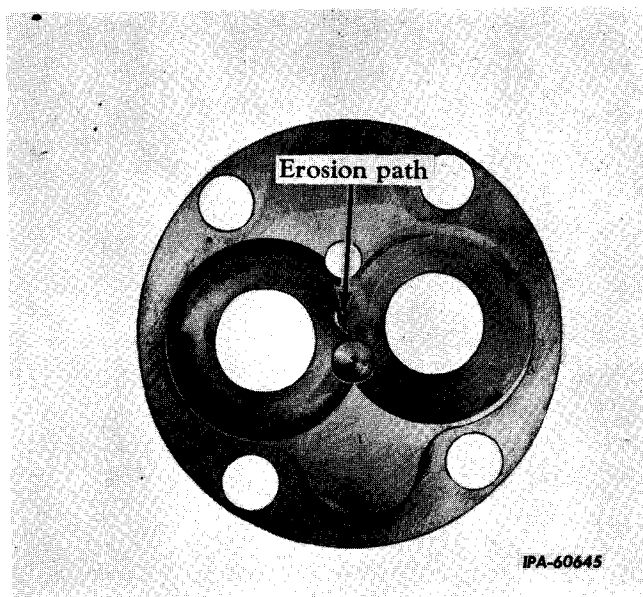
(Ref. Nos. Refer to Illust. 4.)



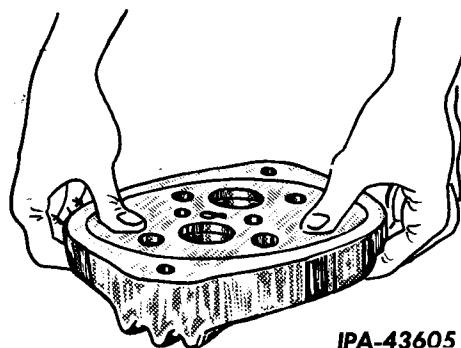
Illust. 12 - Stoning Gear Faces.

5. Check wear plates with a straight edge to see if they are warped. Replace the wear plates if they are found to be warped, scored or excessively worn or if there is an erosion path in the vicinity of the relief pocket (Illust. 13).

NOTE: Do not turn the wear plate around in assembling, as the relief pocket is on the gear side only. If original wear plates are reinstalled, do not interchange them from one side of the pump to the other.



Illust. 13 - Relief Pocket Erosion Path.



Illust. 14 - Checking Wear Plates for Proper Seating.

6. Check for proper seating of the wear plate in the adapter and cover (Illust. 14). If the wear plate is not warped, a rocking motion indicates a burr on the face of the adapter, cover or wear plate.

7. Use new seal rings and shims when the pump is reassembled.

## 5. REASSEMBLY

(Ref. Nos. Refer to Illust. 4.)

1. Press the seal seat (5) into the adapter (4), using a suitable sleeve driver.

2. Lubricate the rollers in the bearings (9) with light grease and coat the bearing bores with white lead. Press the two bearings (9) into the cover (13) and the drive gear bearings (9) into the adapter (4), so that they are flush with the machined surface.

NOTE: If new bearings are installed, they must be of the same make and type as removed. If bearings of a different type are used, they will not seat properly on the shaft.

3. Pack the outboard bearing (3) and its bore with high temperature melting point grease. Press the bearing (3) into the adapter (4) until it bottoms, and install the snap ring (2) in the bearing bore.

4. Place the adapter and wear plate (16) on the drive shaft (12) so that the counterbored relief pocket is facing the gear and will be toward the pressure side of the pump when installed. Install the bearing (9) and the small snap ring (8) on the shaft. Place a new seal assembly (7) on the shaft (12). Lubricate the rubber seal of the assembly and be sure it is fully seated.

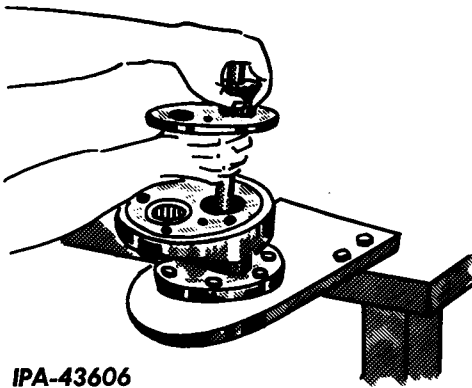


## HYDRAULIC PUMP

(Hydreco Models 2020K8B2, 2020K8B5 and 2025K8B2)

Section 2

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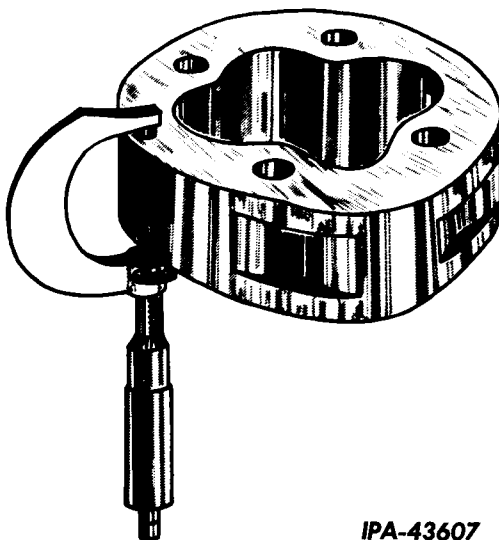
Illust. 15 - Installing Drive Shaft Unit.

5. Press the seal assembly down against the spring and compress it. When released, the spring should return the seal cup to the position held before compressing. If it sticks on the shaft, replace the oil seal assembly.

6. Wipe off and lubricate the lapped surfaces of the seal cup and seal seat. Install the entire drive shaft unit in the adapter, as shown in Illust. 15, and drive the bearing into position by tapping on the gear end of the shaft with a fiber hammer.

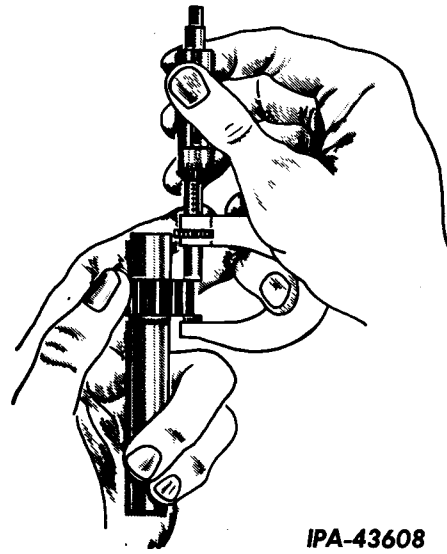
7. Place the seal ring (15) around the wear plate. Lubricate, with light oil, the section of the wear plate contacting the gear face.

8. Clearance between the gear face and wear plate is provided by the shim gaskets between the housing, adapter and cover. Measure the housing width and gear width with a micrometer (Illust. 16 and 17), and refer to the following



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Illust. 16 - Measuring Housing Width.



IPA-43608

Illust. 17 - Measuring Gear Width.

chart for the proper number and location of shims.

9. Place the proper shim, as indicated by the chart, on the face of the wear plate. If it is not practical to measure the housing and gears with a micrometer, use a .002 inch shim.

10. Line up the punch marks and install the housing on the dowels (6) in the adapter. Insert two of the screws (14) through the housing into the adapter to hold the shim in place. Tap the housing down on the dowels, being careful not to pinch the seal ring (15) around the wear plate. Remove the aligning screws when the housing and adapter are mated together.

11. Install the driven gear and shaft (17) into the adapter. Line up the punch marks previously made on the gear faces if original gears are used. Lubricate the gear faces with clean oil.

12. Select the proper shim for the cover side from the chart or, if no measurement is available, use a shim of .002 inch thickness and position it on the housing face.

13. Install the wear plate (16) over the shim (11). Be sure the relief pocket is facing the gears and is rotated 180 degrees from the pocket in the adapter wear plate. Place the seal ring (15) around the wear plate.

14. Place the cover (13) on the dowels in the housing so that the punch marks in the cover and housing are lined up. Be sure the cap screw holes in the wear plate, shim and hous-

Continued on next page.

# HYDRAULIC PUMP

(Hydreco Models 2020K8B2, 2020K8B5 and 2025K8B2)



Section 2

Page 8

## 5. REASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 4.)

ing are lined up, and tap the cover down. Be careful not to pinch the seal ring.

15. Install the four socket head cap screws (14). Be sure the spot faces, on the cover and the shoulder of the cap screws, are free of burrs to prevent leaks. Tighten opposite cap screws gradually to the torque specified in Par. 2, "SPECIFICATIONS."

16. If the shaft can be turned by hand with a slight drag and not too freely, the clearance between the gears and wear plates is correct. If the shaft is too tight or too free, add or remove as many shims as necessary to obtain the proper clearance.

NOTE: The installation of more shims than necessary will reduce the efficiency of the pump.

Shim Chart

Gear width greater (+) or less (-) than housing width (inch):	Install Shims As Indicated Below:	
	Adapter side (inch)	Cover side (inch)
+.002	.004	.002
+.001	.003	.002
.001	.002	.002
-.001	.002	.001
-.002	.001	.001

## 6. BREAK-IN AND TEST OF REPAIRED PUMPS

If a shop test stand is available on which the pump can be mounted and operated against full pressure and at a maximum speed, the following procedure is recommended for the break-in and test.

1. Run the pump for two minutes at zero pressure. Be sure the test stand reservoir is filled and that all the inlet and outlet ports are open.

2. By restricting the pump discharge line with a needle or globe valve, raise the discharge pressure to 500 psi for 10 seconds and lower to zero pressure for 10 seconds. Continue this procedure for five minutes.

3. Stop the pump and rotate the drive shaft by hand to see if it is free. If it cannot be turned easily, remove and rebuild the pump.

4. Start the pump and apply 1000 pounds of pressure for 10 seconds intermittently for five minutes.

CAUTION: Do not apply pressure for more than 10 second intervals.

5. Stop the pump and check for freeness, as in Step 3. During the preceeding break-in, check for leaks at the mating surfaces of the cover, housing and adapter, around the seal assembly, and at the four assembly cap screws.

6. Build up the pump pressure to the relief valve pressure.

CAUTION: This is done to see if the pump can maintain this pressure for a short time, and should not be applied for more than a few seconds at a time.

7. Run the pump at 1000 psi, and perform a flow test by whatever means are available on the test stand. If a test stand is not available, mount the pump on the unit and run it at zero pressure, with the engine at slow idle, for approximately 15 minutes. Gradually increase engine speed and operate the hydraulic equipment several times. Check the pump for leaks. Perform a relief valve pressure test to see if the pump can maintain the pressure for a short time.



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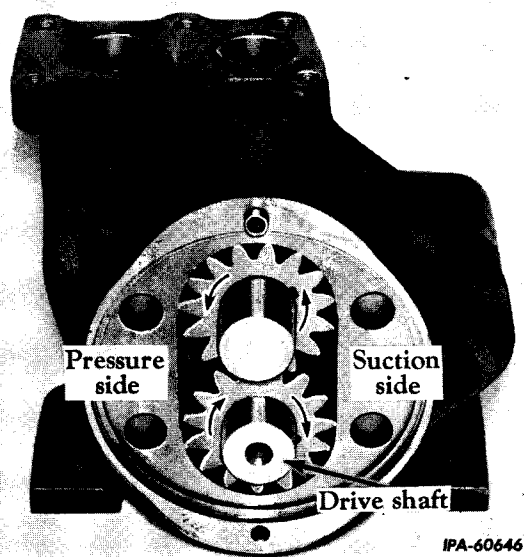


## 1. DESCRIPTION

The hydraulic pump is a positive displacement gear type pump consisting of a single set of close tolerance gears revolving between wear plates.

This pump is assembled for counterclockwise rotation as viewed from the splined end of the drive shaft (Illust. 2). The pump operates continually when the engine is running, but is under a load only when the control valve demands pressure.

As the pump drive rotates, the drive gear, which is keyed to the shaft, turns the driven gear at the same speed, but in the opposite direction. As the gears revolve, oil is carried from the suction side to the pressure side of the pump, in the pockets formed by the gear teeth, wear plates and housing. The remeshing of the gears on the pressure side forces the oil out of these pockets and through the outlet port. A small portion of the oil, which remains trapped in the pockets, is forced against the wear plates, creating a high pressure. To disperse this pressure, a 1/16 inch deep relief pocket is drilled in the wear plates, and is located on the pressure side of the pump.



Illust. 1 - Rotation of Drive and Driven Gears.

## 2. SPECIFICATIONS

Pump make . . . . . Hydrec  
Pump shaft rotation (viewed from splined end of drive shaft) . . . . . Counterclockwise

Housing gear bore diameter through center, inches . . . . .	3.402 - 3.404
Maximum permissible diameter through center gear bore at center, inches . . . . .	3.409
Gear diameter, inches . . . . .	3.388 - 3.389
Minimum permissible, inches . . . . .	3.387
Maximum permissible clearance (gear tip to housing bore on suction side), inch . . . . .	.008
Bearing inside diameter, inches . . . . .	1.6250 - 1.6255
Maximum permissible inside diameter, inches . . . . .	1.6260
Shaft diameter, inches . . . . .	1.6240 - 1.6245
Minimum permissible diameter, inches . . . . .	1.6230
Maximum permissible clearance between shaft and roller bearing, inch . . . . .	.0030
Gear width, inches . . . . .	3.0000 - 3.0005
Minimum permissible, inches . . . . .	2.9995
Wear plate thickness, inch . . . . .	.248 - .250
Minimum permissible thickness (at gear contact), inch . . . . .	.245
Thrust washer thickness, inch . . . . .	.126 - .128
Minimum permissible thickness (at shaft contact), inch . . . . .	.115
Spacer diameter, inches . . . . .	1.625 - 1.626
Minimum permissible diameter . . . . .	If groove can be felt

### Torque Data (ft-lbs.)

Cover cap screws:	
Four large cap screws . . . . .	110
Two small cap screws . . . . .	50

## 3. DISASSEMBLY

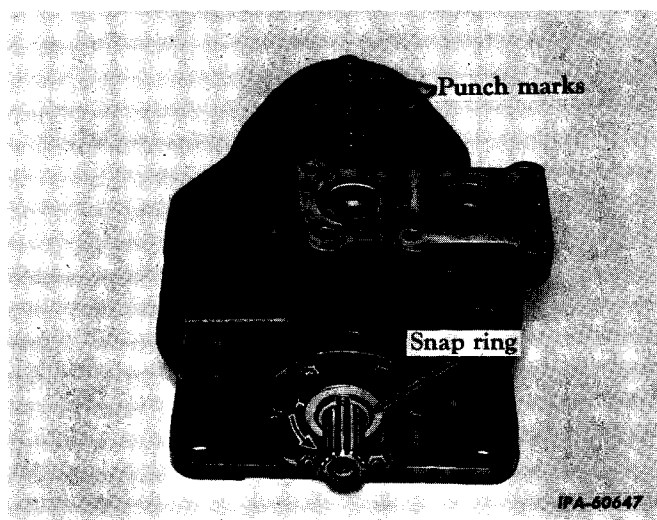
(Ref. Nos. Refer to Illust. 5.)

1. Clean the outside of the pump with solvent and dry thoroughly. Remove sharp edges or burrs from the shaft keyway, with a fine file or oil stone, to prevent damage to the oil seal when removing. Punch mark the pump cover, adapter, and housing (Illust. 2) for proper reassembly.
2. Remove the snap ring (30) from the exposed end of the drive shaft (41). Remove the lead seal (26) and cap screws (27) from the seal retainer plate (28). Remove the retainer plate.
3. Remove the "O" ring (29) from the seal retainer plate. Press the oil seal (25) out of the retainer plate.

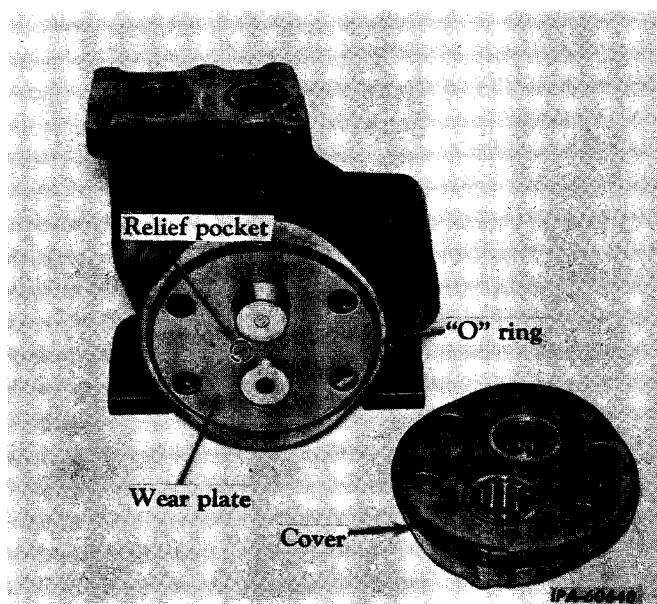


4. Remove the six socket head cap screws (19 and 21) from the cover (20). Remove the cover, which may come off separately or with the housing (12). Avoid scoring or nicking the machined surfaces of the pump sections. **DO NOT USE A SCREWDRIVER** to pry the sections apart. Tap with a fiber hammer to loosen.

5. Note the position of the relief pocket in the wear plate (17) for proper reassembly. Remove the wear plate and cover "O" ring (9) from the cover (20). (Illust. 3.) Note the location and number of shims (16) when disassembling.



Illust. 2 - Pump Rotation Viewed from Splined End of Drive Shaft.



Illust. 3 - Relief Pocket Location.

6. Mark the drive gear (13) and driven gear (13) with an India oil stone or small pieces of tape for proper reassembly. The reason for this is to re-establish the same gear tooth wear pattern if the original gears are to be reinstalled. The efficiency of the pump may otherwise be impaired.

7. Remove the drive shaft (41) with the drive gear and the driven shaft (14) with the driven gear. Slide the gears (13) off of the shafts and remove the keys (15).

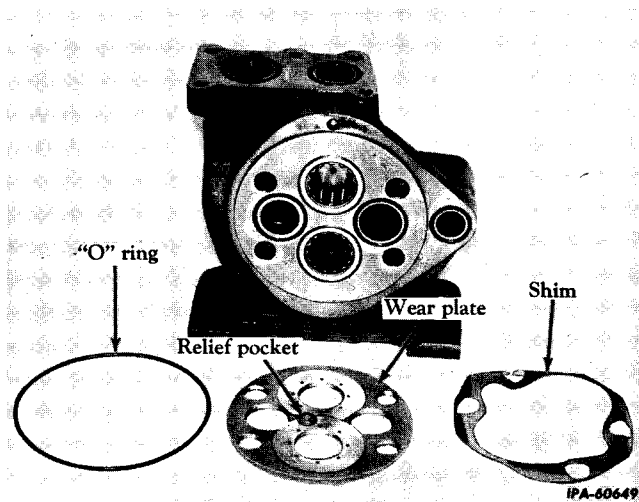
8. Remove the housing (12) from the adapter (3). If the housing sticks, tap it loose from the dowels with a fiber hammer. Remove the shims (11) and adapter "O" ring (9). Again note the position of the relief pocket in the wear plate (10). (Illust. 4.)

**NOTE:** Do not remove the bearings unless it is necessary to replace them. Replace them with the same make and type as originally installed.

9. Check the bearings (8) for freeness of rollers and pitted, broken or excessively worn rollers. If the drive and/or driven shafts are to be replaced, the bearings must also be replaced.

10. Remove the roller bearings (8) by starting them out with the tool shown in Illust. 6. Complete the removal of the bearing with a standard bearing puller. We suggest Owatonna bearing puller MD 956-B1 (IH part number 1 020 163 R1).

Continued on next page.



Illust. 4 - Inner Wear Plate Removed.

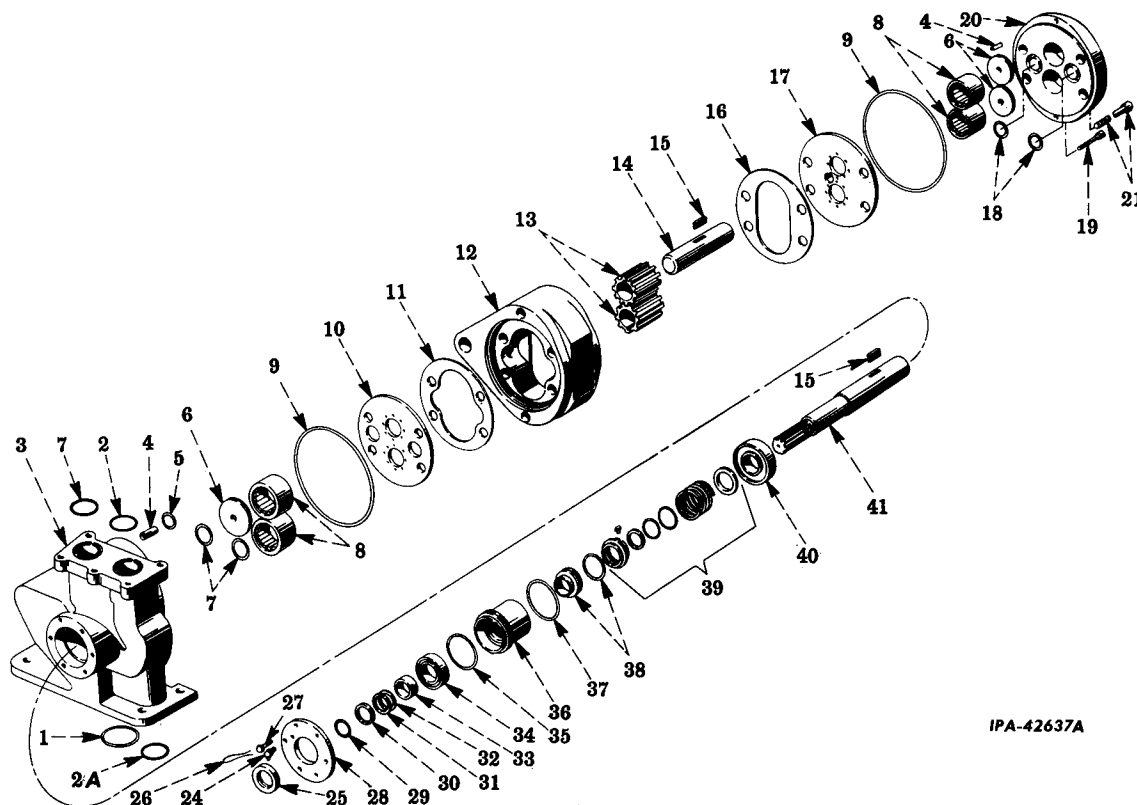


3. DISASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 5.)

11. Remove the thrust washer (6) from the bottom of the bearing bores. Remove the dowels (4) from the cover (20) and adapter (3).

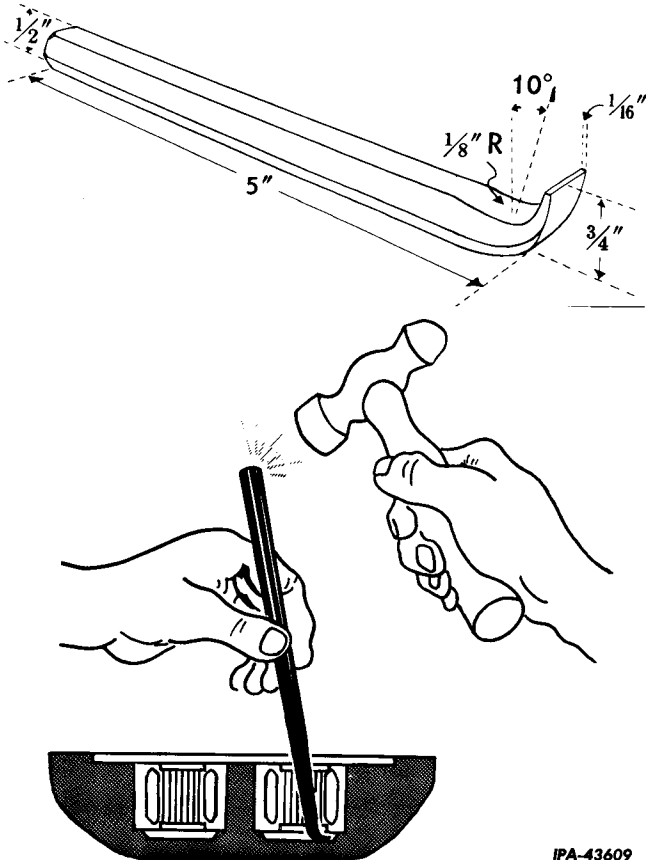
12. Remove the drive shaft bearings (34 and 40) by tapping lightly with a drift pin of soft material inserted through the drive shaft bearing bore. Tap the opposite sides alternately.



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Illust. 5 - Exploded View of Hydraulic Pump.

- |  |                                   |
|--|-----------------------------------|
| 1. Low pressure "O" ring, inlet to pump.   | 19. Hex head socket cap screw.    |
| 2. Valve to low pressure inlet "O" ring.   | 20. Cover.                        |
| 2A. Low pressure "O" ring, outlet to pump. | 21. Cap screw.                    |
| 3. Adapter.                                | 24. Lubrication fitting.          |
| 4. Dowel pin.                              | 25. Oil seal.                     |
| 5. "O" ring.                               | 26. Lead seal.                    |
| 6. Thrust washer.                          | 27. Cap screw.                    |
| 7. High pressure "O" ring, inlet to valve. | 28. Seal retainer plate.          |
| 7. Adapter end "O" ring.                   | 29. Drive shaft spacer "O" ring.  |
| 8. Roller bearing.                         | 30. Snap ring.                    |
| 9. Pump housing "O" ring.                  | 31. Shim.                         |
| 10. Wear plate.                            | 32. Shim.                         |
| 11. Gasket (.001 inch thick).              | 33. Spacer.                       |
| 11. Gasket (.002 inch thick).              | 34. Drive shaft bearing.          |
| 12. Pump housing.                          | 35. Seal retainer plate "O" ring. |
| 13. Gear.                                  | 36. Seal retainer.                |
| 14. Driven shaft.                          | 37. Seal retainer "O" ring.       |
| 15. Key.                                   | 38. Seal seat.                    |
| 16. Gasket (.001 inch thick).              | 39. Seal.                         |
| 16. Gasket (.002 inch thick).              | 40. Drive shaft bearing.          |
| 17. Wear plate.                            | 41. Drive shaft.                  |
| 18. Pump cover "O" ring.                   |                                   |



Illust. 6 - Removing Cover Bearings.

Seal Assembly

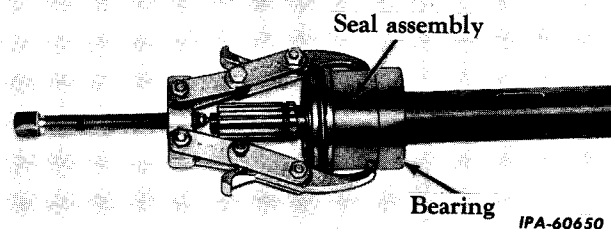
13. Remove the shims (31 and 32) and spacer (33) from the shaft (41).

14. Install a bearing puller into the notches in the seal retainer (Illust. 7) and pull the seal retainer off the shaft.

NOTE: The bearing (34) will also come off with the seal retainer.

15. Remove the seal seat and seal (Illust. 8).

16. Remove the "O" rings (35 and 37).



Illust. 7 - Removing Seal Assembly.

#### 4. INSPECTION AND REPAIR

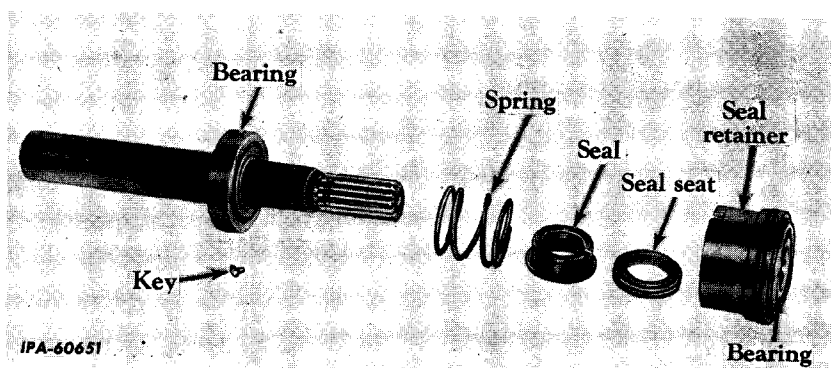
(Ref. Nos. Refer to Illust. 5.)

1. Wash all parts in oil solvent, and dry them thoroughly with compressed air. Do not spin the bearings when blowing them dry with compressed air.

2. With a fine stone, remove all nicks and burrs from around the bearing bores and drilled holes of the adapter (3) and cover (Illust. 9). Clean up burrs and nicks on the machining mating surfaces of the housing (Illust. 10). Rewash before assembly.

3. Inspect the gear shafts (14 and 41) at the bearing points and seal areas for rough surfaces and excessive wear. (Refer to Par. 2, "SPECIFICATIONS," for the maximum allowable wear limits.)

Continued on next page.



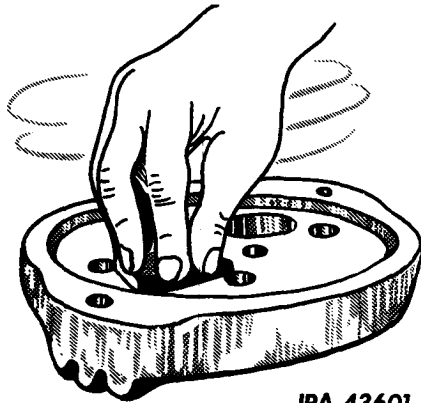
Illust. 8 - Seal Assembly Removed.



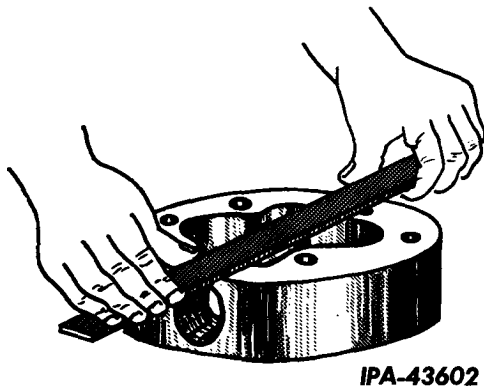
#### 4. INSPECTION AND REPAIR - Continued

(Ref. Nos. Refer to Illust. 5.)

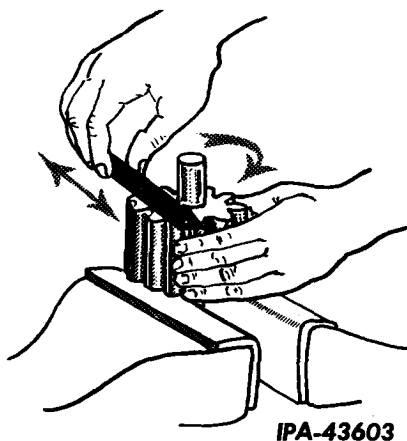
4. Inspect the gear faces and the edges of the teeth for scoring. The face of the gears should



Illust. 9 - Removing Nicks and Burrs from Cover.



Illust. 10 - Removing Nicks and Burrs from Housing Faces.

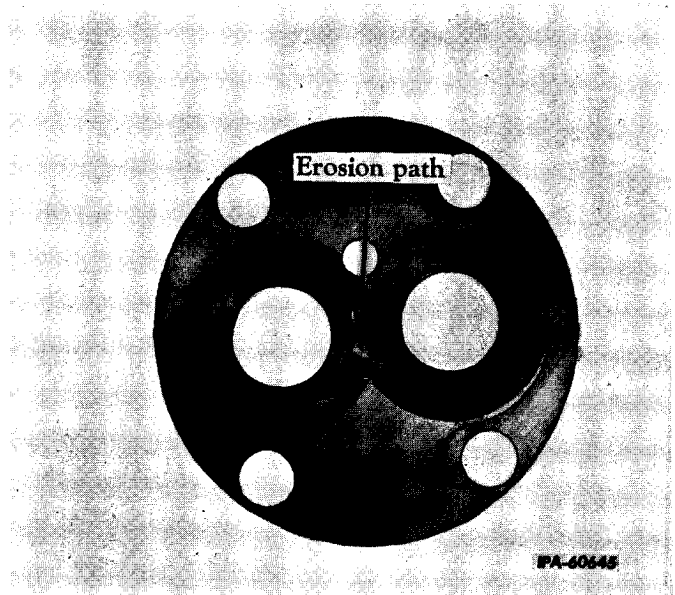


Illust. 11 - Stoning Gear Faces.

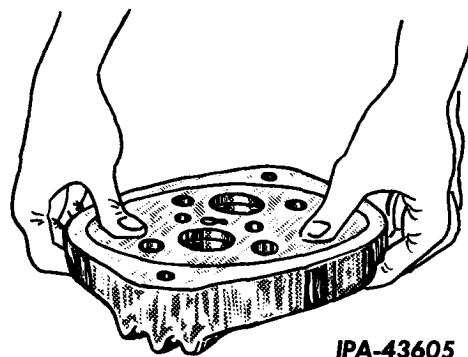
be stoned (Illust. 11) to minimize wear on the wear plates.

5. Check wear plates (10 and 17) with a straight-edge to see if they are warped. Replace the wear plates if they are found to be warped, scored or excessively worn or if there is an erosion path in the vicinity of the relief pocket (Illust. 12).

6. Check for the proper seating of the wear plates in the adapter and in the cover (Illust. 13). If the wear plates are not warped, a rocking motion indicates a burr on the face of the adapter, cover or wear plate.



Illust. 12 - Relief Pocket Erosion Path.



Illust. 13 - Checking Fit of Wear Plate.



7. Discard the housing (12) if either of the following conditions exist:

(a) If the housing gear bore diameter measures greater than the maximum permissible diameter through the dowel bushing hole center line. (Refer to Par. 2, "SPECIFICATIONS.")

(b) If the housing shows severe score marks that extend past the gear bore center line.

NOTE: If the wear has been smooth and even, it is not necessary to replace the housing.

8. Replace the gears (13) if the differential between the gear face width and the housing face width, with no shims, is in excess of that specified in Par. 2, "SPECIFICATIONS."

9. Replace the drive shaft (41) and driven shaft (14) if wear at the roller patterns is in excess of that specified in Par. 2, "SPECIFICATIONS."

10. The specified end clearance, at final assembly, between the gear faces and the housing width should be as shown in Par. 2, "SPECIFICATIONS."

11. If the bearings (8) are loose in the bores, replace the end cover (20) and adapter (3).

12. If the drive and/or driven shafts are to be replaced, the bearings (8, 34 and 40) must also be replaced.

13. Replace the seal seat (38), seal assembly (39), "O" rings and shims when the pump is rebuilt.

## 5. REASSEMBLY

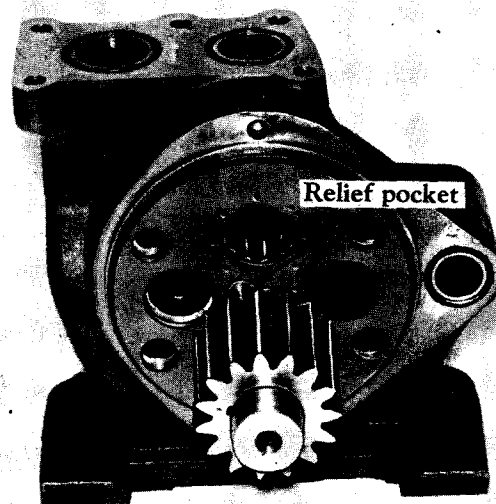
(Ref. Nos. Refer to Illust. 5.)

1. Lubricate the rollers in the bearings (8) with light grease and coat the bearing bores of the adapter (3) and cover (20) with white lead. Install the thrust washers (6) into the bearing bores. Be sure the bronze side of the thrust washer is facing the shaft ends.

2. Using a bearing driver, press the bearings (8) into the bearing bores of the adapter (3) and cover (20).

NOTE: If new bearings are installed, they must be of the same make and type as the ones removed. If bearings of a different type are used, they will not seat properly on the shaft.

3. Place the seal rings (7) in the seal ring grooves of the adapter (3).



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Illust. 14 - Relief Pocket Location.

4. Place the adapter end wear plate (10) on the adapter (3) so that the counterbored relief pocket is facing up and will be toward the pressure side of the pump (Illust. 14). Refer to Par. 1, "DESCRIPTION," to determine the pressure side. Lubricate the gear contact section of the wear plate with light oil. Install the "O" ring (9) around the wear plate.

5. Tap the dowel (4) into the adapter (3).

6. Clearance between the gear face and wear plate is provided by the brass shim (11) between the adapter (3) and housing (12). Measure the housing width and gear width with a micrometer and refer to the "Shim Chart" for the proper number and location of the shims. If the gears are so worn that the housing width becomes more than .004 inch greater than the gear width, replace both gears.

7. Install the keys (15) to the shafts (14 and 41); then install the shafts to the adapter bearing bores (Illust. 15).

8. Slide the gears (13) over the shafts, aligning the keyways with the keys. If the original gears are used, line up the marks previously made on the gear faces. If new gears are used, keep the keyways 180 degrees apart (Illust. 16). Lubricate the gear faces with light oil.

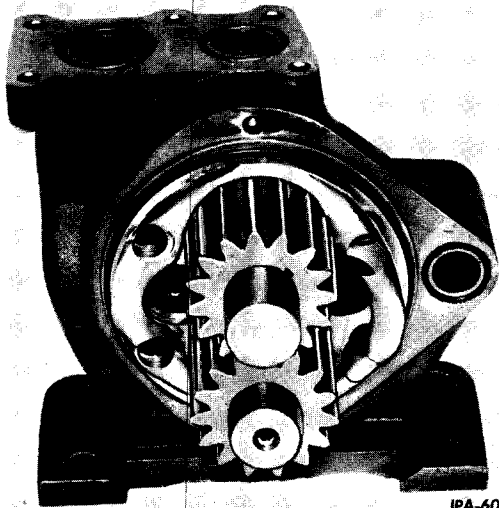
9. Place the proper shim, as selected in the chart, on the face of the wear plate.

Continued on next page.

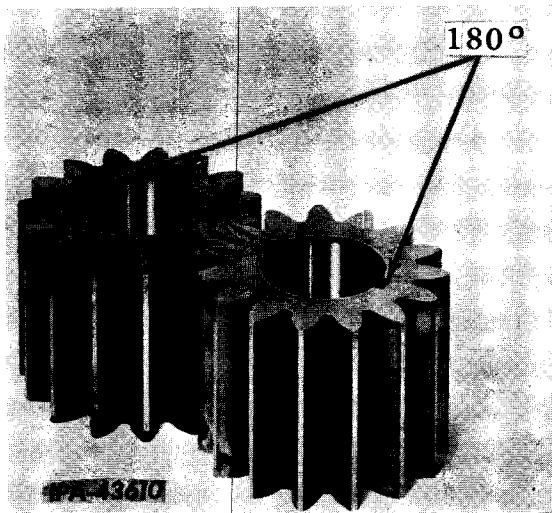


5. REASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 5.)



Illust. 15 - Drive and Driven Gears Installed.



Illust. 16 - Gear Keyway Positions.

10. Line up the punch marks and install the pump housing (12) on the dowels (4) in the adapter (3). Insert two of the cap screws through the housing (12) and into the adapter to hold the shims in place. Tap the housing down on the dowels, being careful not to pinch the "O" ring around the wear plate.

11. Select the proper shim for the cover side from the chart. Install the cover wear plate

(17) over the shim. Be sure the relief pocket is facing the gears and is toward the pressure side of the pump.

12. Place the seal ring (9) around the outside of the wear plate and center the wear plate with the shafts. Place the seal rings (18) in the grooves in the pump cover (20) and install the dowel (4).

13. Place the cover (20) over the shafts aligning the punch marks with the marks on the housing. Be sure the cap screw holes in the wear plate, shim and housing are lined up and tap the cover down with a fiber hammer. Be careful not to pinch the "O" ring around the wear plate.

14. Install the four large socket head cap screws (21). Be sure the spot faces on the cover and the shoulder of the cap screws are free of burrs to insure against leaks. Tighten opposite cap screws gradually to the torque specified in Par. 2, "SPECIFICATIONS."

15. If the shaft can be turned by hand with a slight drag and not too freely, clearances between the gears and wear plates are correct. If the shaft is too tight or too free, add or remove as many shims as necessary to obtain the proper clearance.

NOTE: Installation of more shims than necessary will reduce the efficiency of the pump.

16. Install the two small socket head cap screws (19) attaching the cover to the adapter, and tighten them gradually to the torque specified in Par. 2, "SPECIFICATIONS."

17. Lubricate the thrust bearing (40) with light grease. Install the thrust bearing over the drive shaft and bottom it against the shoulder. Be sure that the thickest side of the outer race is up or faces the splined end of the shaft. (Illust. 17.)

18. Place the steel washer over the shaft with the flat wear surface facing the splined end of the shaft (Illust. 17).

19. Place the seal assembly drive key in the hole in the shaft, with the long section parallel with the shaft, and place the coil spring on the steel washer (Illust. 17).

20. Using light grease, lubricate the "O" ring and back-up ring in the seal assembly. Install the seal over the drive shaft, inside the spring, being careful not to cut the "O" ring on the shaft splines. Be sure the key slot in the seal



assembly is aligned with the seal drive key in the shaft (Illust. 17).

21. Lubricate the ring on the seal seat with light grease and press the seal seat (38) into the seat bore of the seal retainer (36) until bottomed. If removed, press the outer drive shaft bearing into the seal seat (Illust. 17).

22. Assemble the "O" ring in the groove of the seal retainer and lubricate with light grease. Wipe off and lubricate the lapped surfaces of the seal seat and the seal. (Illust. 17.)

23. Place the seal retainer, with bearing, over the shaft and press down on the assembly enough to start the cap screws in the seal retainer plate (28). Be sure the seal drive key enters and engages the drive key slot in the seal assembly as it is compressed. Tighten the cap screws to 50 ft-lbs. torque, and secure them with lockwire (26).

24. Install the spacer "O" ring (29), spacer (33) and snap ring (30) on the drive shaft. Press the oil seal (25) into the seal retainer plate.

Shim Chart

Gear width greater (+) or less (-) than housing width (inch):	Install shims as indicated below:	
	Adapter side (inch)	Cover side (inch)
+.002	.003	.003
+.001	.003	.003
.000	.003	.002
-.001	.002	.001
-.002	.002	.001

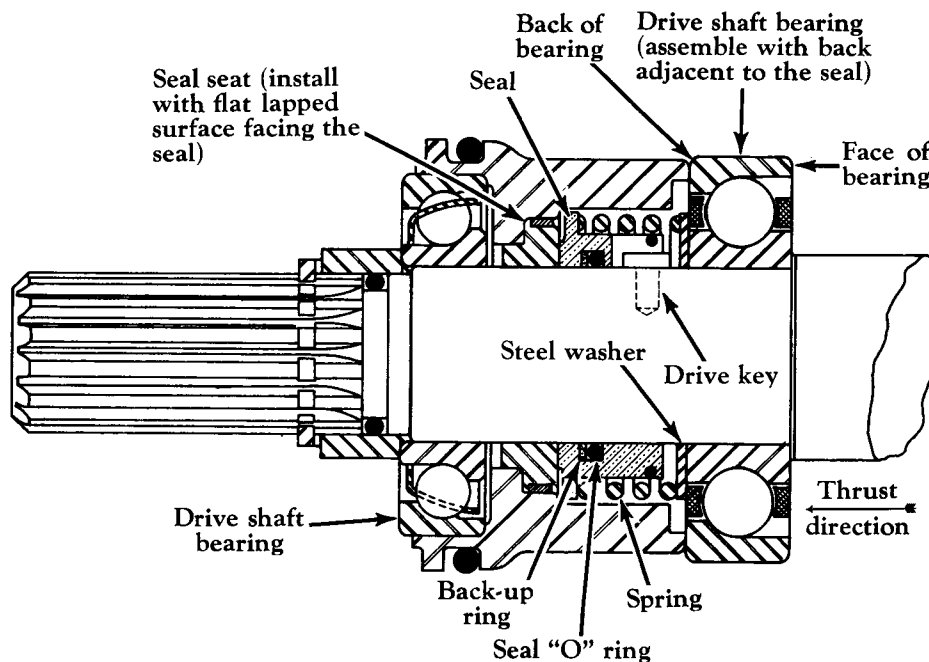
#### 6. BREAK-IN AND TEST OF REPAIRED PUMPS

If a shop test stand is available on which the pump can be mounted and operated against full pressure and at maximum speed, the following procedure is recommended for the break-in and test.

1. Run the pump for two minutes at zero pressure. Be sure that the test stand reservoir is filled and that all inlet and outlet lines are open.

2. By restricting the pump discharge line with a needle or globe valve, raise the discharge pressure to 500 psi for 10 seconds and lower to zero pressure for 10 seconds. Continue the procedure for five minutes.

Continued on next page.



IPA-60654

Illust. 17 - Drive Shaft Seal Assembly and Bearing Installation.



**6. BREAK-IN AND TEST OF REPAIRED PUMPS - Continued**

3. Stop the pump and rotate the drive shaft by hand to see if it is free. If it can not be turned easily, remove and rebuild the pump.

4. Start the pump and apply 1000 psi for 10 seconds intermittently for five minutes.

**CAUTION:** Do not apply pressure for more than 10 second intervals.

5. Stop the pump and check for freeness, as in Step 3. During the preceding break-in, check for leaks at the mating surfaces of the cover, housing and adapter, around the seal assembly, and at the four assembly cap screws.

6. Build up the pump pressure to 1500 psi which is the maximum operating pressure of

the hydraulic hoist system. A relief valve in the control valve prevents the pressure in the system from exceeding 1500 psi.

**CAUTION:** This is done to see if the pump can maintain this pressure for a short time, and should not be applied for more than a few seconds at a time.

7. Run the pump at 1000 psi and perform a flow test by whatever means is available on the test stand, or as described in Section 1 under "PUMP FLOW TEST."

If a shop test stand is not available, mount the pump on the unit and follow the procedure outlined in Section 15 under "DIRECT LIFT HYDRAULIC SYSTEM," "FUNCTIONAL TESTS," "Pump and Relief Valve."



HYDRAULIC PUMP  
(Hydreco Models 3020C5A1 and 3035C5A1)

Section 4  
Page 1

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## 1. DESCRIPTION

The hydraulic pump is mounted to the front of the tractor behind the radiator guard, and is driven by a front power take-off attached to the fan drive pulley on the crankshaft. The pump forces oil to the hoist cylinders, on each side of the tractor, for raising or lowering the blade.

## 2. SPECIFICATIONS

Pump make . . . . .	Hydrex
Pump filter element (in suction side manifold) . . . . .	Strainer screen
Pump shaft rotation (viewed from adapter end) . . . . .	Counterclockwise
Housing gear bore diameter through center, inches . . . . .	3.402 - 3.404
Maximum permissible, inches . . . . .	3.409
Gear diameter, inches . . . . .	3.390 - 3.391
Minimum permissible, inches . . . . .	3.389
Maximum permissible clearance between gear teeth tips and gear housing bore (on suction side of pump), inch. . . . .	.007
Gear width (face to face), inches . . . . .	3.500 - 3.5005
Minimum permissible, inches . . . . .	3.4995
Roller bearing inside diameter, inches . . . . .	1.6250 - 1.6255
Maximum permissible, inches . . . . .	1.6260
Maximum permissible clearance between shaft in roller bearing (bearing in end housings), inch . . . . .	.0035
Wear plate thickness, inch . . . . .	.248 - .250
Minimum permissible wear plate thickness (at gear wear patterns), inch . . . . .	.245
Dowel hole diameter (end housings), inch . . . . .	.4380 - .4390
Maximum permissible, inch . . . . .	.441
Check Spring:	
Free length, inch . . . . .	.750
Test length, inch . . . . .	.3475
Test load, pounds . . . . .	11.375 ± 5%
Coil, number . . . . .	5-1/2

## 3. DISASSEMBLY

(Ref. Nos. Refer to Illust. 1.)

**NOTE:** It is very important that the area in which the pump is to be disassembled is kept clean.

1. Clean the outside of the pump with an oil solvent and dry thoroughly.
2. Place the pump on a clean work bench.

3. Remove any sharp edges or burrs from the shaft splines with a fine file or oil stone.
4. Punch mark the cover (19), housing (31) and adapter end (6) to assure proper reassembly.
5. Using a fiber hammer, tap the cap (21) loose until it can be unscrewed by hand. Remove the gasket (22) from the cap (21).
6. Remove the four cap screws and lock washers that secure the left hand and right hand manifolds (13 and 33) to the housing (31).
7. Remove the gaskets (14) from both manifolds (13 and 33). Remove the oil strainer (32) from the left hand manifold (33).
8. Remove the lock screw (25) and set screw (26) from the end of the drive shaft (29).
9. Remove the crank pin (27) from the drive shaft.

**NOTE:** If necessary, use a brass drift and hammer to tap the crank pin through the shaft.

10. Remove the four hex socket head cap screws that secure the cover (19), housing (31) and adapter end (6) together.

**NOTE:** The cover (19) is doweled to the housing (31) and the housing is doweled to the adapter end (6). Avoid scoring or nicking the machined surfaces of the pump sections. **DO NOT USE A SCREWDRIVER** to pry the sections apart. Tap them with a fiber hammer to loosen them.

11. Using a fiber hammer, tap the cover (19) from the housing (31) and remove it.
12. Note the position of the relief pocket in the wear plate (Illust. 2) for proper reassembly. Remove the wear plate and cover "O" ring from the cover. Note the location and number of shims when disassembling. (Illust. 2.)

**NOTE:** Mark the wear plate (18) with paint or tape to identify which end of the pump it was removed from.

13. Mark the pump drive gear and driven gear with an India oil stone or small pieces of tape for proper reassembly (Illust. 3). The reason for this is to re-establish the same gear tooth wear pattern when the original gears are to be reinstalled. The efficiency of the pump may otherwise be impaired.

14. Remove the driven shaft (17), with the gear (28), from the housing (31).



HYDRAULIC PUMP  
(Hydrec Models 3020C5A1 and 3035C5A1)

Section 4  
Page 3

15. Using a fiber hammer, tap the drive shaft (29) out of the housing (31). (Illust. 4.)

16. Note the position of the relief pocket in the wear plate (10) for proper reassembly. (Illust. 5.)

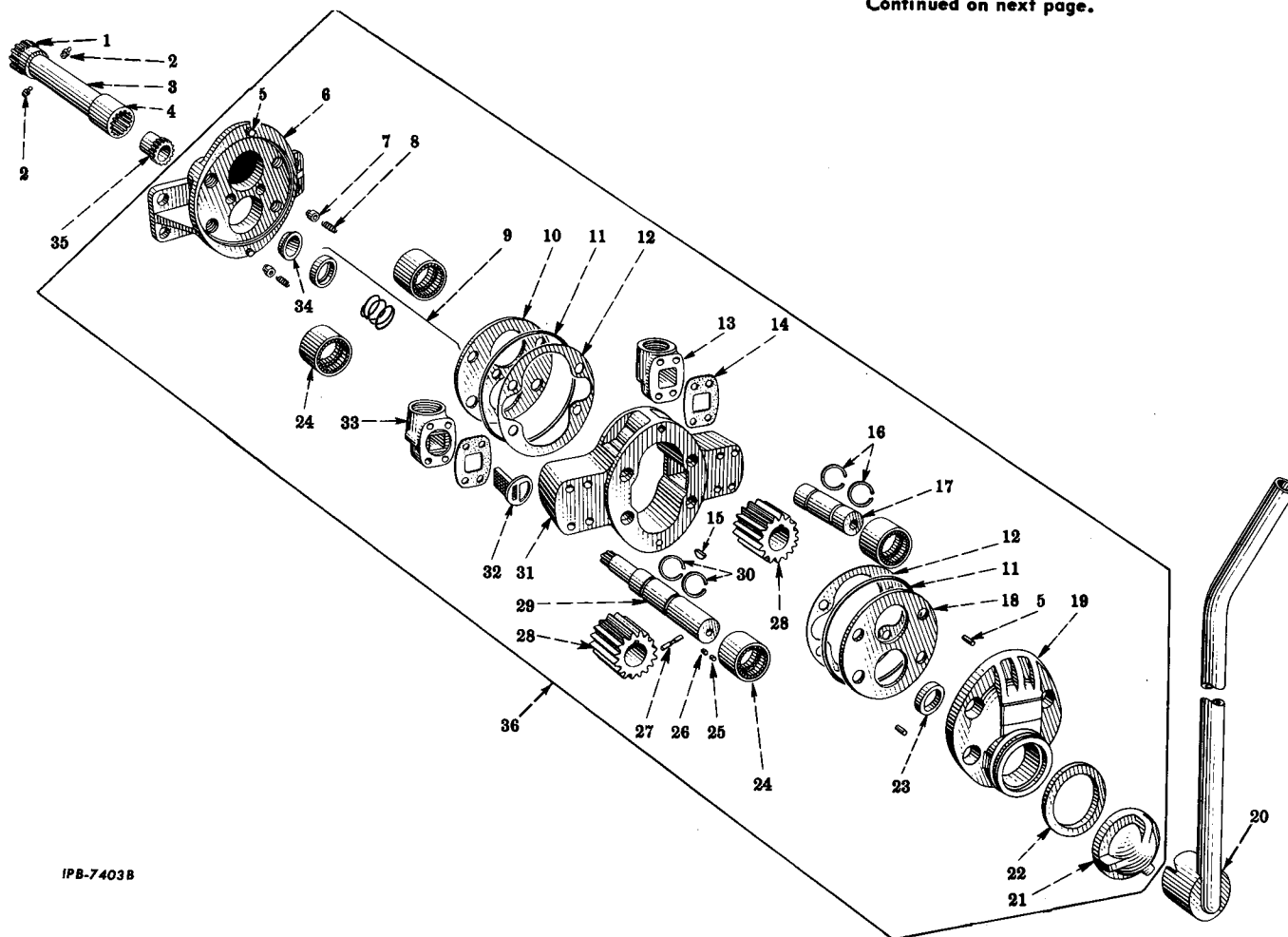
17. Using a fiber hammer, tap the housing (31) from the adapter end (6).

18. Remove the shim (12), wear plate (10) and "O" ring (11).

NOTE: Mark the wear plate (10) with paint or tape to identify which end of the pump it was removed from.

19. Remove the check valve plunger springs and plungers from the adapter end (Illust. 6).

Continued on next page.



IPB-7403B

Illust. 1 - Exploded View of Hydraulic Pump.

- |                                |                       |                    |
|--------------------------------|-----------------------|--------------------|
| 1. Power take-off shaft gear.  | 13. Manifold.         | 25. Lock screw.    |
| 2. Lubrication fitting.        | 14. Manifold gasket.  | 26. Set screw.     |
| 3. Power take-off shaft.       | 15. Woodruff key.     | 27. Crank pin.     |
| 4. Coupling.                   | 16. Snap ring.        | 28. Gear.          |
| 5. Pump housing dowel.         | 17. Driven shaft.     | 29. Drive shaft.   |
| 6. Pump adapter end.           | 18. Front wear plate. | 30. Snap ring.     |
| 7. Check valve plunger.        | 19. Cover.            | 31. Housing.       |
| 8. Check valve plunger spring. | 20. Timing crank.     | 32. Strainer.      |
| 9. Seal with spring.           | 21. Cover cap.        | 33. Manifold.      |
| 10. Rear wear plate.           | 22. Cover cap gasket. | 34. Seal seat.     |
| 11. "O" ring.                  | 23. Oil seal.         | 35. Coupling.      |
| 12. Shim gasket.               | 24. Bearing.          | 36. Pump assembly. |

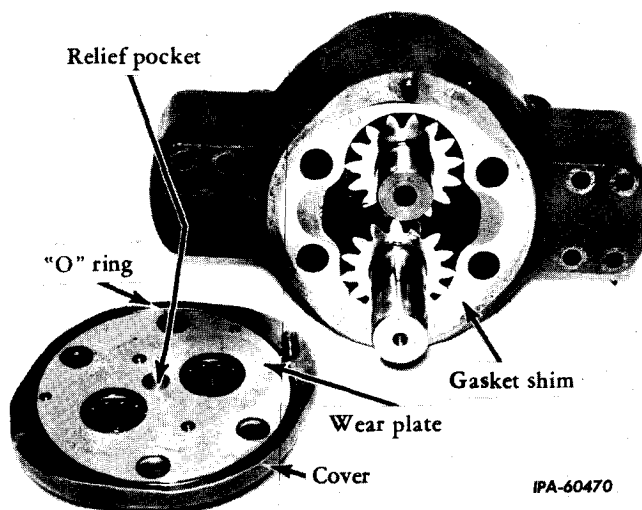


### 3. DISASSEMBLY - Continued

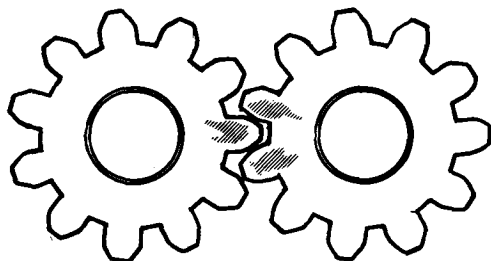
(Ref. Nos. Refer to Illust. 1.)

20. Remove the seal (23) from the cover (19) and discard the seal.

21. Using a standard bearing puller, remove the bearing (24), from the drive shaft bore of the adapter end (6), to facilitate removal of the seal and spring (9).

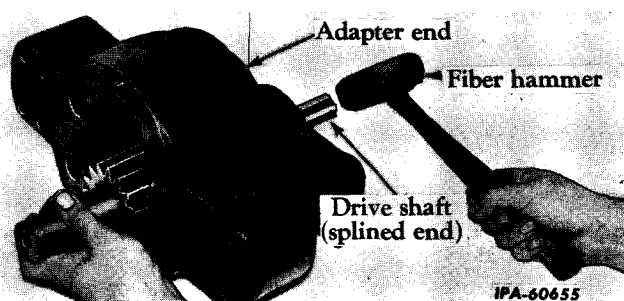


Illust. 2 - Relief Pocket Location.



IPA-43598

Illust. 3 - Pump Gears Marked Before Removal.



Illust. 4 - Removing Drive Shaft.

22. Remove the spring and seal from the drive shaft bore of the adapter end and discard them. (Illust. 7.)

### 4. INSPECTION AND REPAIR

(Ref. Nos. Refer to Illust. 1.)

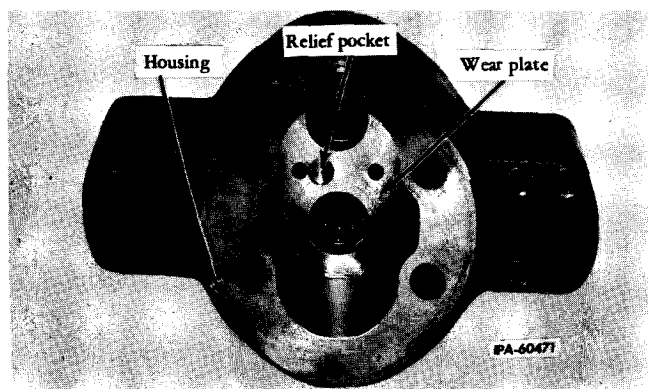
1. Wash all parts in an oil solvent and dry thoroughly with compressed air.

**CAUTION:** Do not spin the bearings dry with compressed air.

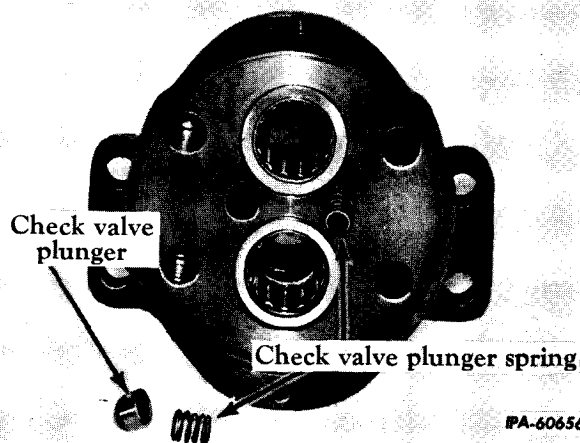
2. Inspect the bearings for freeness of rollers and pitted, broken or excessively worn rollers.

3. If the remaining bearings in the adapter end (6) and cover (19) are to be replaced, proceed as follows:

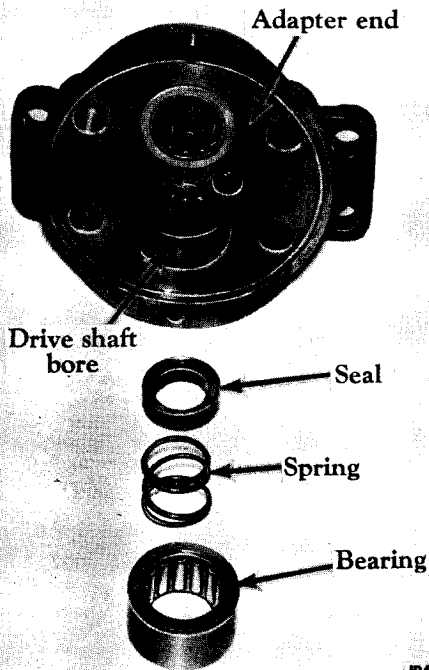
(a) Insert the tool (Illust. 8) under the bearing and tap the tool with a hammer until the bearing is raised.



Illust. 5 - Relief Pocket Location.



Illust. 6 - Removing Check Valve Plunger.



IPA-60657

Illust. 7 - Seal Assembly Removed.

(b) Complete the removal of the bearing using a standard bearing puller. We suggest Owatonna bearing puller MD 956-B1 (IH part number 1 020 163 R1).

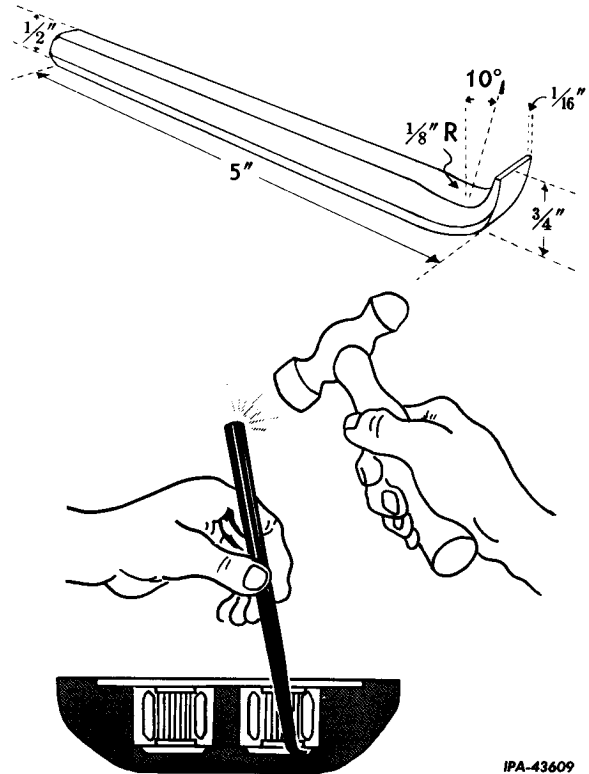
NOTE: Always replace the shafts (17 and 29) when the bearings are replaced.

4. Inspect the seal seat (34) in the drive shaft bore of the adapter end (6) for excessive wear, pits or grooving. If it is necessary to replace it, press or tap it out of the bore.

5. Using a fine oil stone, remove all nicks and burrs from around the bearing bores and drilled holes of the adapter end (6) and cover (19).

6. For practical purposes, it is suggested that the housing (31) be replaced when the pump is overhauled. If, however, the housing shows no signs of wear, it may be used after removing any small nicks or burrs on the mating surface of the housing.

7. Inspect the gear shafts (17 and 29) at the bearing points and seal areas for rough surfaces and excessive wear. Refer to Par. 2, "SPECIFICATIONS," for the specified maximum permissible shaft wear at the bearing points.



IPA-43609

Illust. 8 - Removing Bearings.

NOTE: If the shafts are not within specifications, replace the shafts and all bearings.

8. Inspect the gear faces and edges of the teeth for scoring. Stone the faces and edges of the gear teeth to remove any nicks or burrs.

9. Using a micrometer, check the gear width. Refer to Par. 2, "SPECIFICATIONS," for the specified minimum permissible gear wear.

10. If necessary to replace the gears (28), remove the snap rings (16 and 30) and press the gears off the shafts.

NOTE: The drive shaft gear is keyed to the shaft (29).

11. Check the check valve plunger springs (8) for free length, test length and test load. Refer to Par. 2, "SPECIFICATIONS."

12. Check the thickness of the wear plates (10 and 18) at the gear wear pattern area. Refer to Par. 2, "SPECIFICATIONS," for the minimum permissible thickness.

Continued on next page.



#### 4. INSPECTION AND REPAIR - Continued

(Ref. Nos. Refer to Illust. 1.)

NOTE: Replace the wear plates that have severe score marks, heavy wear or show erosion marks in the vicinity of the counterbored relief pocket. Do not turn the wear plates around in assembling, as the relief pocket is on the gear side only. If old wear plates are reinstalled, they should not be interchanged from one side of the pump to the other.

#### 5. REASSEMBLY

(Ref. Nos. Refer to Illust. 1.)

NOTE: Discard all "O" rings and seals and use new "O" rings and seals when reassembling the pump.

1. Using a suitable sleeve driver, press the seal seat (34) into the drive shaft bore of the adapter end (6).
2. Insert the new spring and seal (9) into the drive shaft bore of the adapter end (6).
3. Lubricate the rollers in the bearings (24) with light grease and coat the bearing bores in the adapter end (6) with white lead. Press the two bearings (24) into the bores of the adapter end (6) so that they are flush with the machined surface.
4. Insert the two check valve plungers (7) into the bores between the bearing bores in the adapter end (6). Insert the two springs (8) into the plungers (7). (Illust. 6.)
5. Place the wear plate (10) onto the adapter end (6), being sure that the counterbored relief pocket is up and on the pressure side of the pump.

NOTE: When the original wear plates are used over, they must be replaced in their original positions.

6. Place the new "O" ring (11) around the wear plate (10). Lubricate with light oil, the section of the wear plate contacting the gear face.
7. Clearance between the gear face and wear plate is provided by the shim gaskets between the housing, adapter and cover. Measure the housing width and gear width with a micrometer and refer to the shim chart for the proper number and location of shims.
8. Place the proper shim (12) on the face of the wear plate (10).

9. Line up the punch marks and install the housing (31) on the dowels (5) in the adapter end (6). Using a fiber hammer, tap the housing down on the dowels, being careful not to pinch the "O" ring (11) around the wear plate.

10. Place the key (15) into the slot on the shaft (29). Slide the gear over the shaft and key. Place a snap ring (30) in the groove in the shaft on each side of the gear.

11. Slide the gear over the shaft (17) and place a snap ring (16) in the groove in the shaft on each side of the gear.

12. Insert the shaft (29) with the splined end through the bottom bore of the adapter end (6), and the shaft (17) into the upper bore of the adapter end.

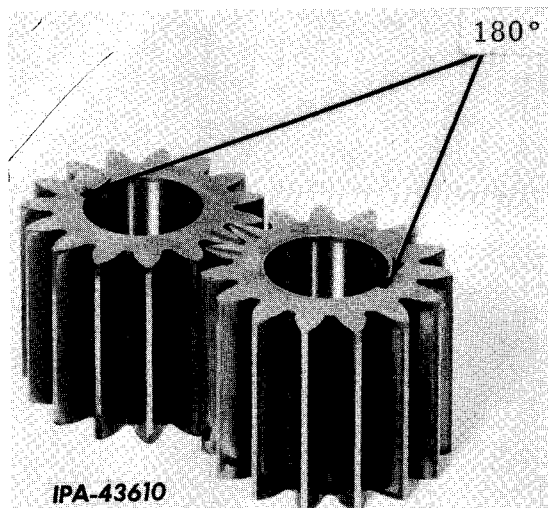
NOTE: Line up the marks previously made on the gear faces if the original gears are used. If new gears are used, keep the keyways 180 degrees apart. (Illust. 9.) Lubricate the face of the gears with light oil.

13. Select the proper shim (12) for the cover side from the shim chart, and position it on the housing face.

14. Install the wear plate (18) over the shim (12), being sure that the relief pocket is facing the gears and is on the pressure side of the pump.

15. Place an "O" ring (11) around the wear plate (18).

16. Install the seal (23) into the cover (19).



Illust. 9 - Position of New Gears.



HYDRAULIC PUMP  
(Hydrex Models 3020C5A1 and 3035C5A1)

Section 4

Page 7

17. Lubricate the rollers in the bearings (24) with light grease and coat the bearing bores in the cover (19) with white lead. Press the two bearings (24) into the bores of the cover (19) so they are flush with the machined surface.

18. Place the cover (19) on the dowel in the housing (31) so the punch marks line up. Be sure the cap screw holes in wear plates, shims and the housing are lined up, and tap the cover down. Be careful not to pinch the "O" ring (11).

19. Install the four hex socket head cap screws in the cover and tighten.

20. Install the crank pin (27) through the drilled hole in the shaft (29) so the recess in the pin lines up with the tapped hole in the center of the shaft.

21. Install the set screw (26) and lock screw (25) into the tapped hole in the center of the shaft (29) and tighten.

22. Install the gasket (22) into the cap (21).

23. Screw the cap (21) onto the cover (19). Using a fiber hammer, tap the cap until tight.

24. Insert the oil strainer (32) into the manifold (33). Place a gasket (14) and the manifold (33) over the port on the pressure side of the housing (31) and secure with four cap screws and lock washers.

25. Place a gasket (14) and the manifold (13) over the remaining port in housing (31) and secure as outlined in Step 24.

26. If the shaft (29) can be turned by hand with a slight drag and not too freely, the clearance between the gears and wear plates is correct. If the shaft is too tight or too free, add or remove as many shims as necessary to obtain the proper clearance.

NOTE: Installation of more shims than necessary will reduce the efficiency of the pump.

27. Mount the pump on the unit and follow the procedure outlined in Section 1 under the "PUMP FLOW TEST" paragraph.

Shim Chart

Gear width greater (+) or less (-) than housing width (inch)	NOTE: Brass shim gaskets are .001 and .002 in thick- ness.	
	Adapter side (inch)	Cover side (inch)
+.002	.003	.003
+.001	.003	.003
.000	.003	.002
-.001	.002	.001
-.002	.002	.001



HYDRAULIC PUMPS  
(Hydreco Models 3620A2A2, 3625A2A2, 3615A1J1BL and 3625A1J1BL)

Section 5  
Page 1

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3. Disassembly . . . . .	2 to 5
4. Inspection and Repair . . . . .	6
5. Reassembly . . . . .	6 to 10



## 1. DESCRIPTION

These hydraulic pumps are the pressure-loaded gear type and are designed for continuous operation. The pump is located in front of the radiator and mounted on the oil strainer base. The pump is power take-off driven. The purpose of the pump is to force oil under pressure to the hydraulic cylinders for operation of the hydraulic equipment.

These pumps are assembled for counterclockwise rotation as viewed from the splined end of the drive shaft. They operate continually when the engine is running, but are under a load only when the control valve demands pressure.

As the pump drive rotates, the drive gear turns the driven gear at the same speed, but in the opposite direction. As the gears revolve, oil is carried from the suction side to the pressure side of the pump in the pockets formed by the gear teeth, wear plates and housing. The meshing of the gears on the pressure side forces the oil out of these pockets and through the outlet port. A small portion of the oil, which remains trapped in the pockets, is forced against the wear plates, creating a high pressure. To disperse this pressure, a 1/16 inch deep relief pocket, located on the pressure side of the pump, is drilled in the wear plates.

## 2. SPECIFICATIONS

Pump make . . . . .	Hydrecos
Pump shaft rotation (viewed from splined end of drive shaft) . . . . .	Counterclockwise
Housing gear bore diameter, inches . . . . .	4.405 - 4.407
Maximum permissible dimension across gear bore, inches . . . . .	4.413
Gear diameter, inches . . . . .	4.399 - 4.400
Minimum allowable, inches . . . . .	4.398
Maximum allowable clearance (gear tip to housing bore), inch . . . . .	.008
Bearing inside diameter, inches . . . . .	1.8775 - 1.8760
Maximum allowable, inches . . . . .	1.8765
Shaft diameter, inches . . . . .	1.8745 - 1.8750
Minimum allowable, inches . . . . .	1.8735
Maximum allowable clearance (shaft in bearing bore), inch . . . . .	.0030
Gear thickness (294296R91 and R92), inches . . . . .	2.5000 - 2.5005
Minimum allowable, inches . . . . .	2.4995
Gear thickness (290013 R92 and R94), inches . . . . .	2.0000 - 2.0005
Minimum allowable, inches . . . . .	1.9995

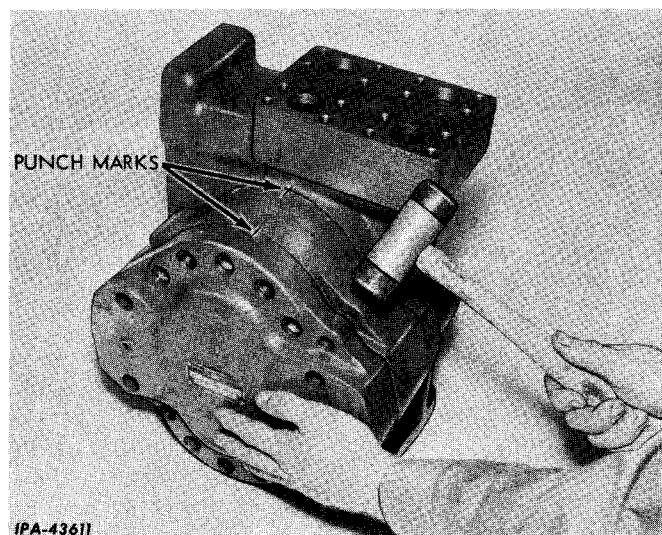
Wear plate thickness, inch . . . . .	.3730 - .3740
Minimum allowable at gear contact, inch . . . . .	.369
Relief seat bore, inches . . . . .	1.1250 - 1.1255
Maximum allowable, inches . . . . .	1.1265
Relief plunger barrel diameter, inches . . . . .	1.1240 - 1.1245
Maximum permissible, inches . . . . .	1.1235
Drive shaft diameter at outboard bearing location, inches . . . . .	1.5744 - 1.5748
Minimum allowable, inches . . . . .	1.5741
Drive shaft diameter at thrust bearing location, inches . . . . .	1.3781 - 1.3786
Minimum allowable, inches . . . . .	1.3778
Relief valve plunger spring:	
Free length, inches . . . . .	6
Test length, inches . . . . .	4-53/64
Test load, pounds . . . . .	450

## 3. DISASSEMBLY

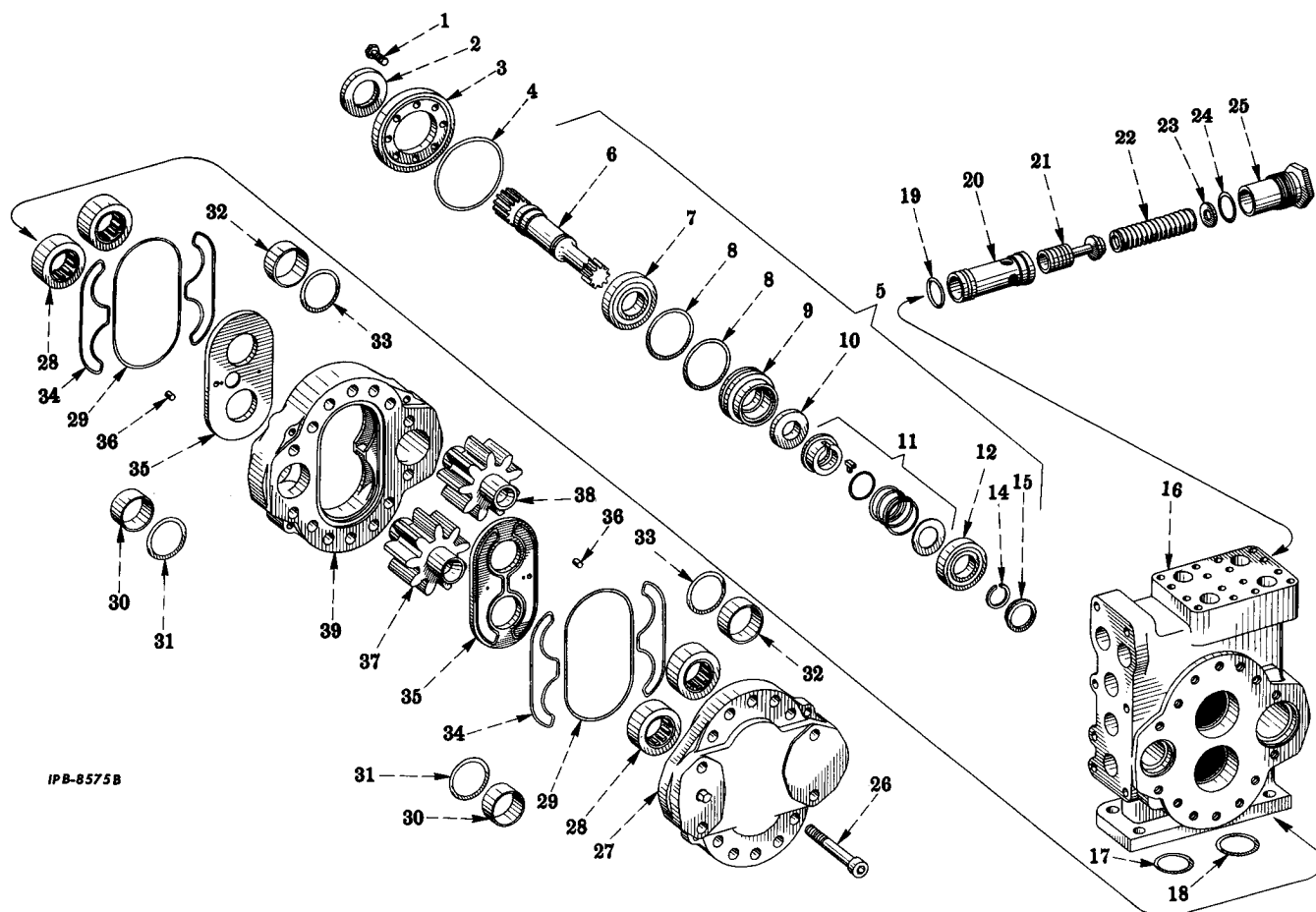
(Ref. Nos. Refer to Illust. 2.)

1. Position the pump and control valve on a clean bench and remove the seven cap screws from the control valve. Separate the valve from the pump.
2. Punch mark the cover, housing and adapter (Illust. 1) in order to reassemble them correctly. Remove the 14 cap screws (26) from the cover (27).
3. Tap the cover with a fiber hammer to loosen it (Illust. 1). Remove the cover with the dowels (30 and 32) from the housing (39). Remove the "O" rings (31 and 33) from the dowels.

Continued on page 4.



Illust. 1 - Removing Cover from Housing.



IPB-8575B

Illust. 2 - Exploded View of Hydraulic Pump. (Models 3615A1J1BL and 3625A1J1BL shown, others similar.)

- |                                       |   |
|---------------------------------------|---|
| 1. Pilot flange bolt.                 | 20. Relief valve seat.                    |
| 2. Drive shaft oil seal.              | 21. Relief valve plunger.                 |
| 3. Pilot flange.                      | 22. Relief valve plunger spring.          |
| 4. Pilot flange "O" ring.             | 23. Relief valve spring washer (special). |
| 5. Drive shaft and retainer.          | 24. Relief valve cap "O" ring.            |
| 6. Drive shaft.                       | 25. Relief valve cap.                     |
| 7. Drive shaft outer bearing.         | 26. Cover bolt.                           |
| 8. Retainer and drive shaft "O" ring. | 27. Cover.                                |
| 9. Retainer.                          | 28. Gear bearing.                         |
| 10. Seal seat.                        | 29. Cover "O" ring.                       |
| 11. Seal.                             | 30. Dowel.                                |
| 12. Drive shaft inner bearing.        | 31. Dowel "O" ring.                       |
| 13. Shim, .010 inch thick.            | 32. Dowel.                                |
| 14. Snap ring.                        | 33. Dowel "O" ring.                       |
| 15. Drive shaft retaining washer.     | 34. Cover and adapter "O" ring.           |
| 16. Adapter.                          | 35. Wear plate.                           |
| 17. Low pressure return "O" ring.     | 36. Dowel.                                |
| 18. Low pressure inlet "O" ring.      | 37. Drive gear.                           |
| 19. Relief valve seat "O" ring.       | 38. Driven gear.                          |
|                                       | 39. Housing.                              |



## 3. DISASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 2.)

4. Remove the "O" rings (29 and 34) from the wear plate (35). Remove the wear plate noting the position of the relief pocket and mark the plate for correct reassembly.

5. Paint mark the drive gear and driven gear for proper reassembly and remove (Illust. 2).

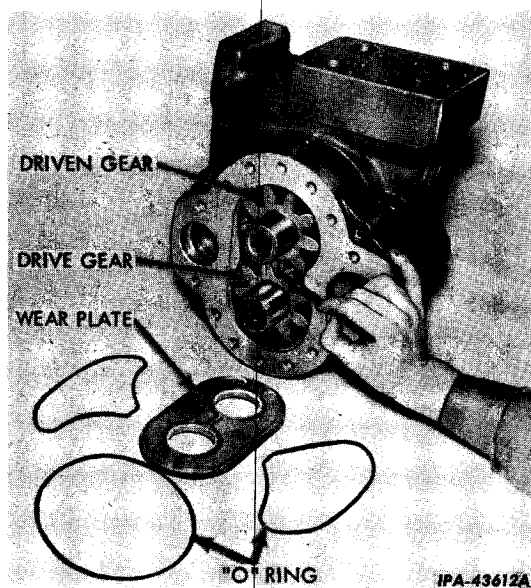
6. Remove the housing (Illust. 4). Remove the back "O" rings (29, 31, 33 and 34) and rear wear plate (35). Note the position of the relief pocket and mark the plate for proper reassembly (Illust. 5).

7. Cut the lockwire and remove the eight cap screws (1) from the pilot flange (3). Remove the pilot flange. Tap the drive shaft from the cover end with a fiber hammer to loosen and remove it (Illust. 6). Reference numbers 7 to 15 inclusive will come out on the drive shaft as a complete assembly.

NOTE: The drive shaft assembly can be removed without disassembling the pump.

8. Remove the relief valve cap (25), washers (23), relief spring (22) and plunger (21). (Illust. 7.)

9. The relief valve seat (20) can be removed by tapping it out the opposite end of the relief



Illust. 3 - Paint Marking Gears.

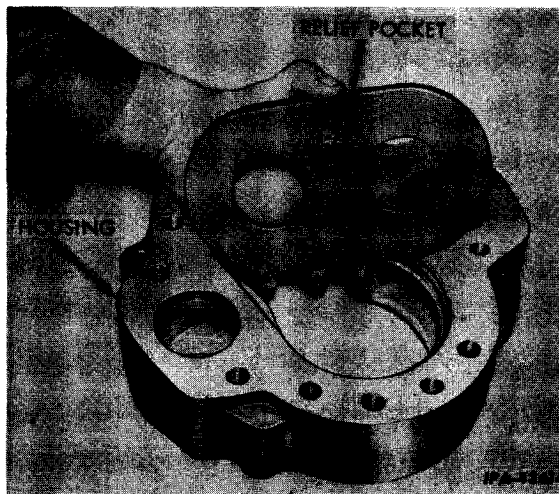


Illust. 4 - Removing Housing from Adapter.

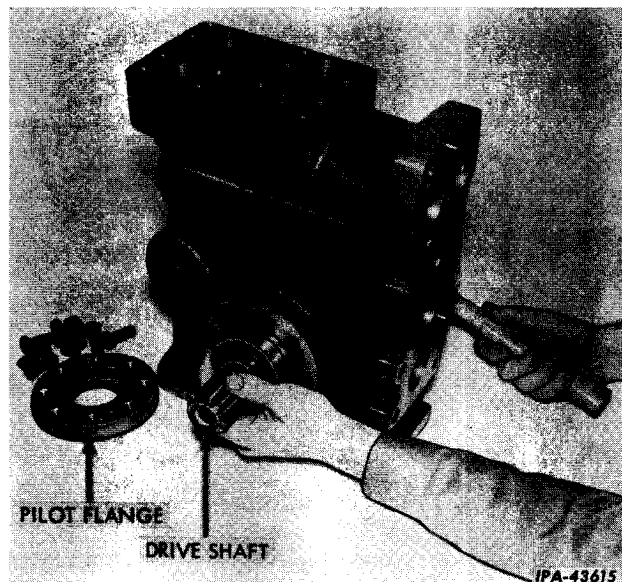
cap end (Illust. 7). Be sure the seat is a loose fit before reassembly.

## Gear Bearings

10. Remove bearings only if necessary. Check the bearings (28) in the cover (27) and adapter (16) for freeness of the rollers. Check for pitted, broken or excessively worn rollers and replace if necessary.



Illust. 5 - Removing Rear Wear Plate.



Illust. 6 - Removing Drive Shaft from Adapter.

#### Seal Assembly From Drive Shaft

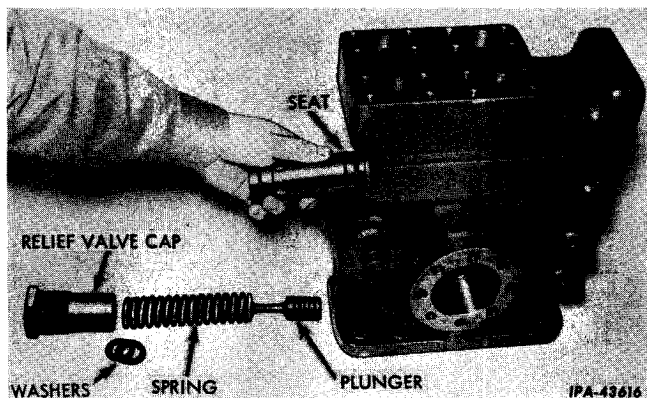
11. Wrap a rag around the large spline end of the drive shaft and place it in a vise (Illust. 8).

12. Remove the retainer (15) and snap ring (14).

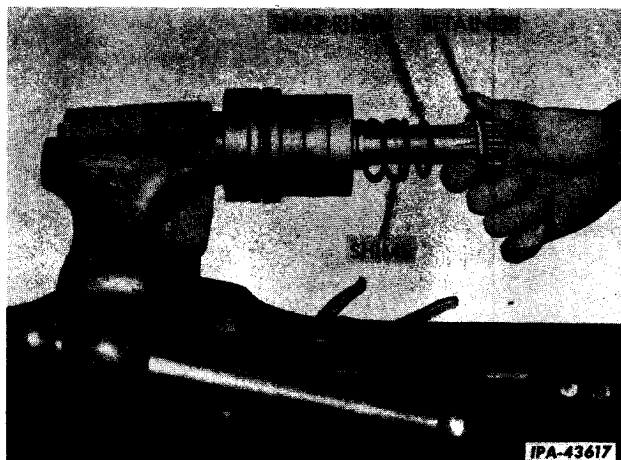
PUMP MODELS 3620A2A2 AND 3625A2A2 ONLY: Remove the shims (Illust. 8).

13. Remove the inner bearing with the aid of a puller (Illust. 9).

NOTE: Pump Models 3620A2A2 and 3625A2A2 are equipped with two inner bearings (12).



Illust. 7 - Removing Relief Valve Seat.



Illust. 8 - Removing Retainer from Drive Shaft.  
(Models 3620A2A2 and 3625A2A2 shown.)

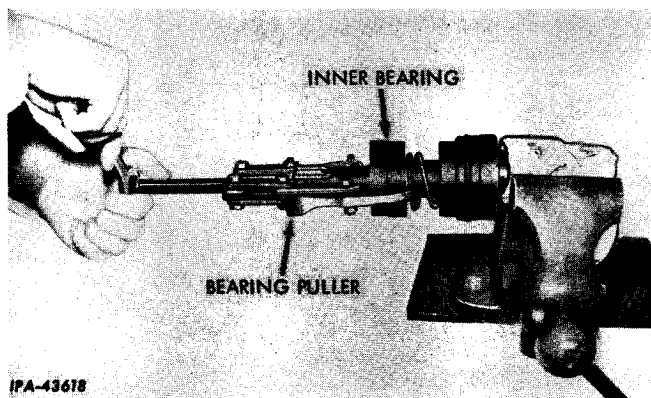
14. Remove the seal assembly snap ring and the key that holds the seal assembly (11) in place on the shaft.

15. Remove the seal assembly (11). Remove the seat retainer (9) with the seal seat (10). Push the seal seat out of the retainer.

CAUTION: BE CAREFUL NOT TO NICK OR SCRATCH THE LAPPED SURFACES OF THE SEAL ASSEMBLY OR SEAL SEAT.

16. Remove the shaft (6) from the vise and press the outer bearing (7) off of the shaft, using an arbor press. Note the position of the bearings for proper reassembly.

17. Discard all "O" rings and replace with new ones.



Illust. 9 - Removing Inner Bearings. (Models 3620A2A2 and 3625A2A2 shown.)



## 4. INSPECTION AND REPAIR

1. Wash all parts in oil solvent or fuel oil. Dry thoroughly with clean cloths or with compressed air. Do not spin the bearings with compressed air.

2. Inspect all parts for scoring or excessive wear.

3. With a small piece of flat, smooth, mill file or India oil stone, remove all nicks and burrs from the machined surface. Rewash before assembly.

## Wear Plates

4. Replace the wear plates if they are found to be scored or excessively worn.

5. Check for proper seating of wear plates in gear housing counterbore. A rocking motion indicates a burr on the counterbored surface or on the wear plate surface.

NOTE: Step 5 applies with the wear plates seated on the machined surface of the adapter and cover.

6. Check housing gear bores for excessive wear.

7. Refer to Par. 2, "SPECIFICATIONS," for the wear limits.

## 5. REASSEMBLY

(Ref. Nos. Refer to Illust. 2.)

## Seal Assembly to Drive Shaft

1. Using an arbor press, press the outer bearing (7) onto the shaft (6).

2. Wrap a rag around the large splined end of the shaft (6) and place it into a vise.

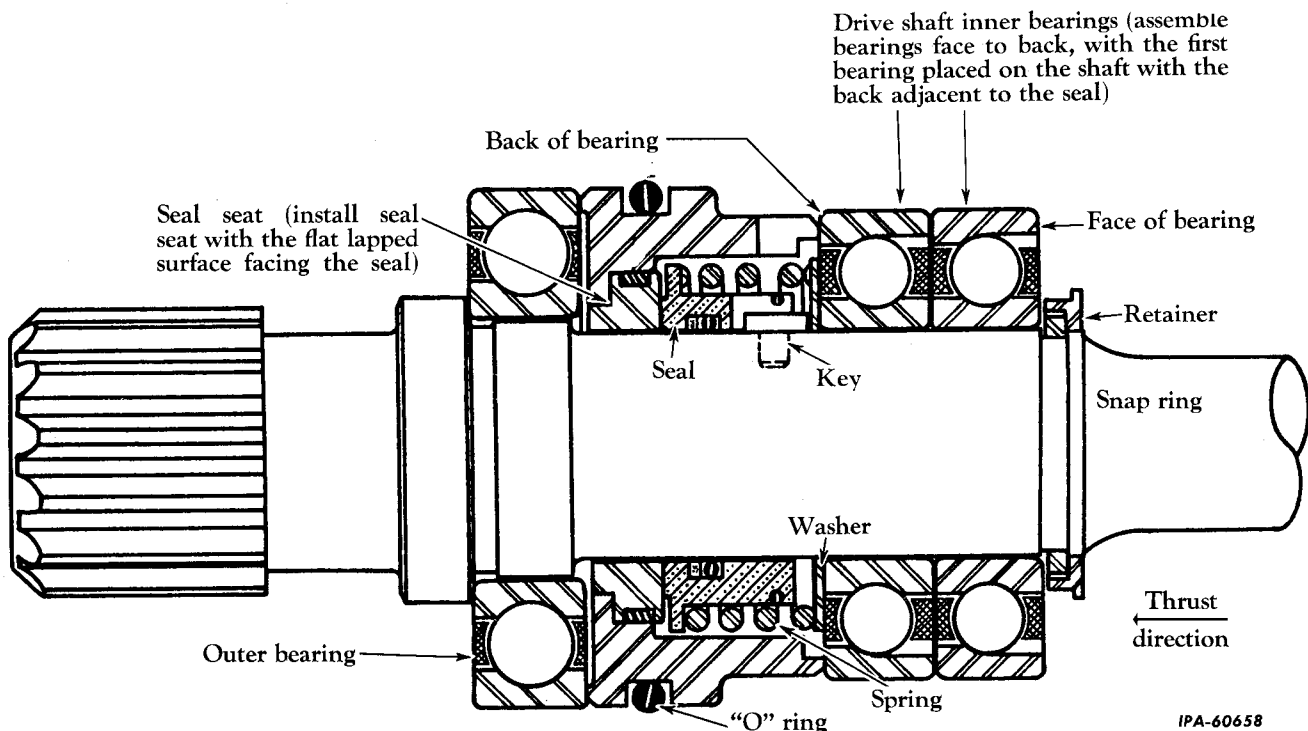
3. Install the two new "O" rings (8) onto the retainer (9).

PUMP MODELS 3620A2A2 AND 3625A2A2 ONLY: These models are equipped with one "O" ring (8).

4. Press the oil seal seat (10) into the retainer (9).

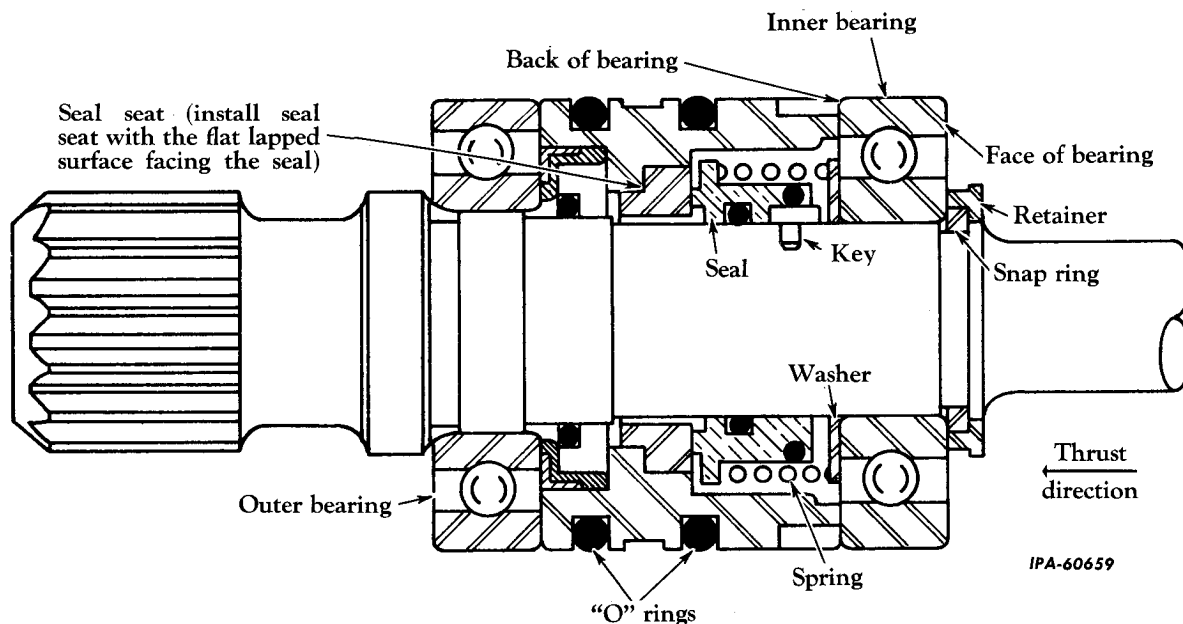
5. Press the seal seat (10) and retainer (9) onto the shaft (6).

NOTE: The slotted end of the retainer must face the small splined end of the shaft (Illust. 10 and 11).



IPA-60658

Illust. 10 - Assembly Drawing for Drive Shaft Inner Bearing, Seal and Seal Seat.  
(Models 3620A2A2 and 3625A2A2 only.)



Illust. 11 - Assembly Drawing for Drive Shaft Inner Bearing, Seal and Seal Seat. (Models 3615A1J1BL and 3625A1J1BL only.)

6. Install the seal assembly (11) onto the shaft (6). (Illust. 10 and 11.) Be sure the slot in the seal engages the drive key in the shaft.

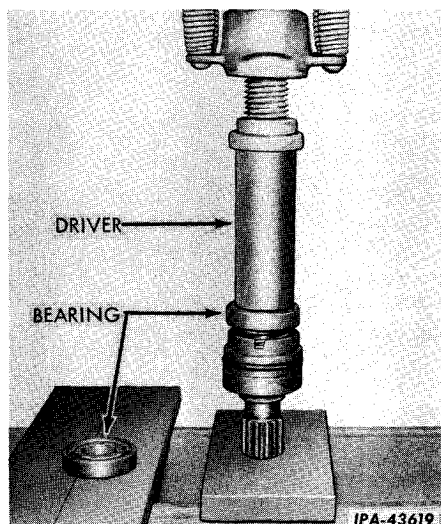
7. Coat the inner bearing (12) with light oil and press it onto the drive shaft (6) until it bottoms. (Illust. 12.)

**PUMP MODELS 3620A2A2 AND 3625A2A2 ONLY:** These models are equipped with two inner bearings.

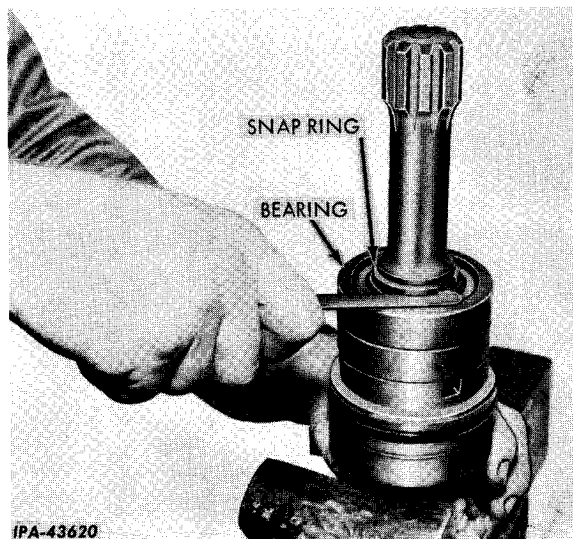
8. Install the snap ring (14) on the drive shaft (6).

**PUMP MODELS 3620A2A2 AND 3625A2A2 ONLY:** Measure the clearance between the snap ring and the race of the top inner bearing with a feeler gauge (Illust. 13). When the clearance has been determined, remove the snap ring and install the required amount of .010 inch thick shims.

Continued on next page.



Illust. 12 - Pressing Bearing on Drive Shaft.



Illust. 13 - Checking Clearance Between Snap Ring and Inner Bearing. (Pump Models 3620A2A2 and 3625A2A2 only.)



# 5. REASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 2.)

## Seal Assembly to Drive Shaft - Continued

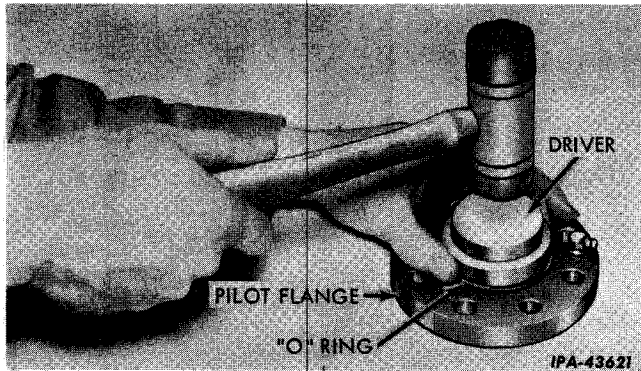
### Shim Requirements:

(a) If the clearance is .030 inch, install three shims.

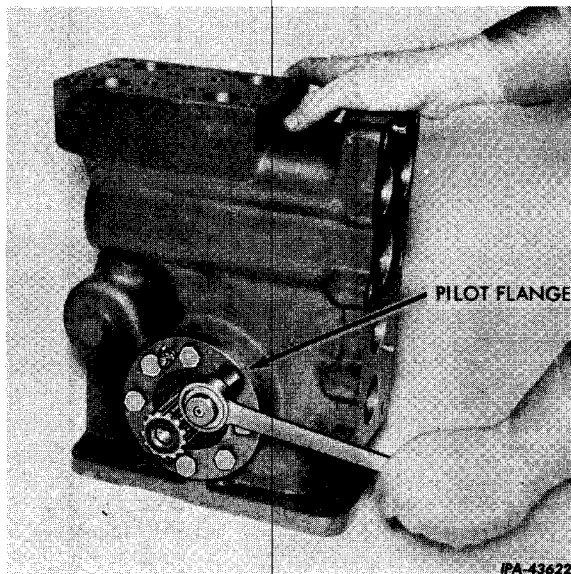
(b) If the clearance is between .020 inch and .029 inch, install two shims.

9. Install the snap ring (14) and snap ring retainer (15) on the drive shaft (6).

10. Remove the drive shaft assembly from the vise.



Illust. 14 - Installing Oil Seal in Pilot Flange.



Illust. 15 - Installing Pilot Flange.

11. PUMP MODELS 3620A2A2 AND 3625A2A2 ONLY: Tap the small spline end of the drive shaft (6) with a fiber hammer to set the clearance and allow the outer bearing to rotate without dragging.

12. Install the "O" ring in the pilot flange and insert the oil seal into the pilot flange (Illust. 14).

13. Place the pilot flange (3) over the large spline of the drive shaft (6), and install the drive shaft into the back of the adapter (16). Tap the drive shaft with a fiber hammer until it is properly seated in the pump. Secure the pilot flange to the adapter with eight cap screws and the lockwire (Illust. 15).

### Relief Valve

14. Place the "O" ring (19) on the relief valve seat (20) and insert the seat into the adapter (16).

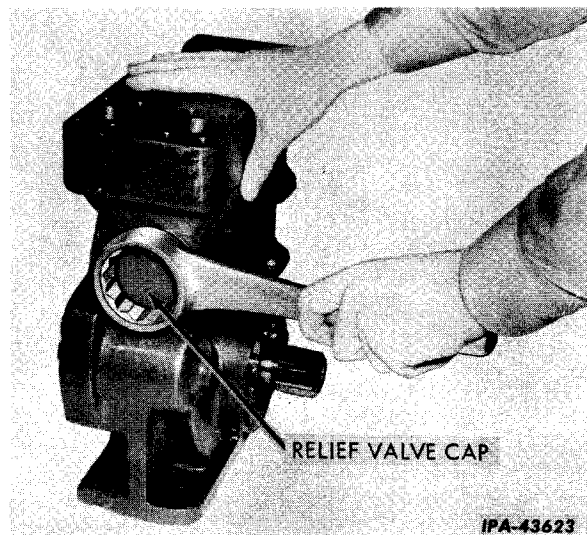
15. Insert the relief valve plunger (21) (barreled end first) into the seat (20).

16. Insert the spring (22) and washer (23) into the adapter (16).

17. Place the "O" ring (24) on the relief valve cap (25) and secure the cap into the adapter (Illust. 16).

### Pump Adapter, Housing and Cover

18. Lubricate the bearings (28) with a light grease and press them into the adapter (16) and cover (27).



Illust. 16 - Installing Relief Valve Cap.

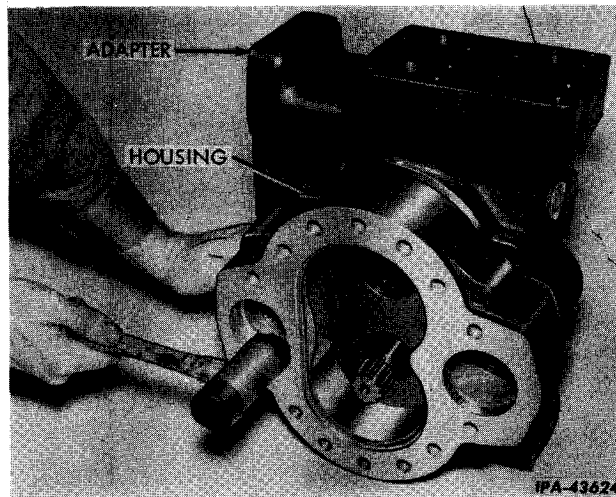


## HYDRAULIC PUMPS

(Hydrec Models 3620A2A2, 3625A2A2, 3615A1J1BL and 3625A1J1BL)

Section 5

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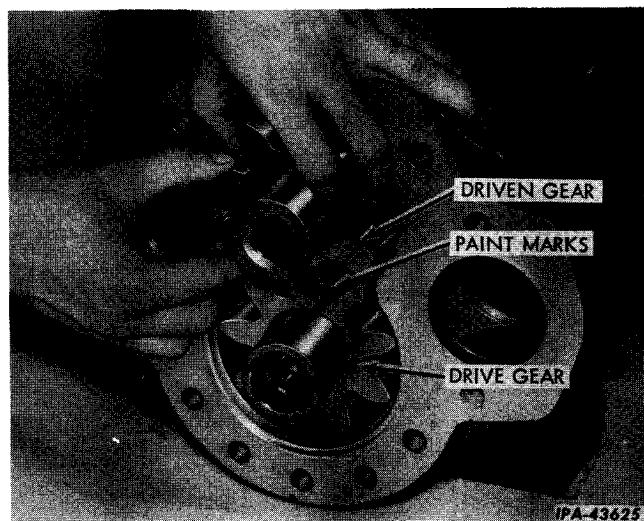
Illust. 17 - Installing Housing on Adapter.

19. Insert the dowels (30 and 32) into the bores of the adapter (16) and cover (27). Tap the dowels with a fiber hammer until they are properly seated.

20. Place the "O" rings (31 and 33) over the dowels (30 and 32) and position the rings into the recesses of the adapter (16) and cover (27).

21. Insert the rear dowel (36) into the adapter (16).

22. Lay the housing (39) down and place the wear plate (35) into the recess of the housing with the counterbored relief pocket, facing the gears, down. (Illust. 5.)



Illust. 18 - Installing Gears.

23. Place the "O" rings (29 and 34) into the recesses of the rear wear plate.

24. Place the housing on the dowels of the adapter and tap the housing, being careful not to pinch the "O" ring, until it is flush to the adapter. (Illust. 17.)

25. Lubricate the face of the gears (37 and 38) with light oil. Insert the drive gear (37) in the bottom section and the driven gear (38) in the top section of the housing. At the same time, line up the marks previously made on the gear faces if the original gears are used (Illust. 18).

26. Check the drive gear and driven gear for backlash (Illust. 19). Backlash is to be .012 to .016 inches.

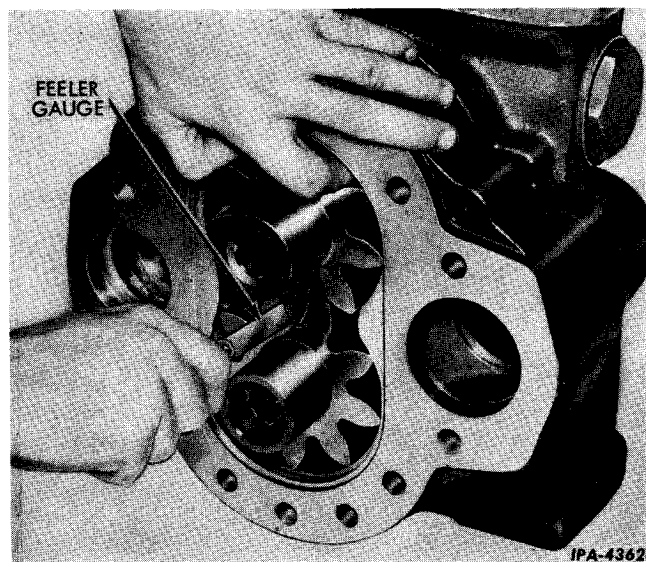
27. Place the front wear plate (35) over the gears and into the recess of the housing. The counterbored relief pocket of the wear plate must face the gears. (Illust. 20.)

28. Place new "O" rings (29 and 34) into the recesses of the front wear plate.

29. Align the dowel pin in the cover (27) with the hole in the front wear plate (35) and place the cover onto the housing (39). Be careful not to pinch the "O" ring around the front wear plate. Tap the cover until it is flush with the housing. (Illust. 21.)

30. Insert the 14 cap screws (26) into the cover and torque to 50 ft-lbs.

Continued on next page.



Illust. 19 - Checking Gear Backlash.

## HYDRAULIC PUMPS

(Hydrex Models 3620A2A2, 3625A2A2, 3615A1J1BL and 3625A1J1BL)



Section 5

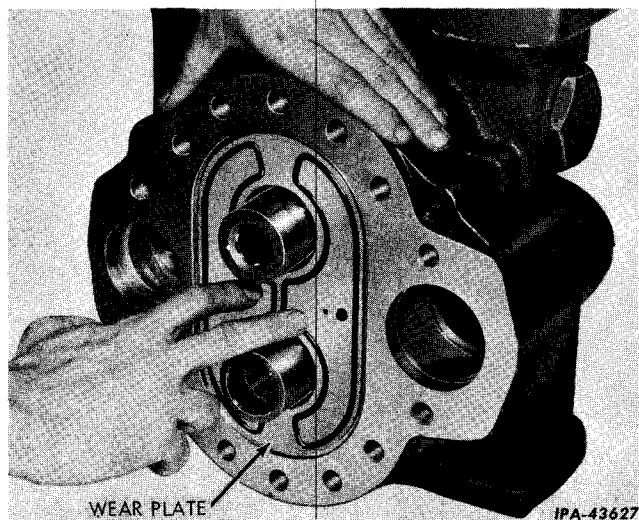
Page 10

### 5. REASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 2.)

#### Pump Adapter, Housing and Cover - Continued

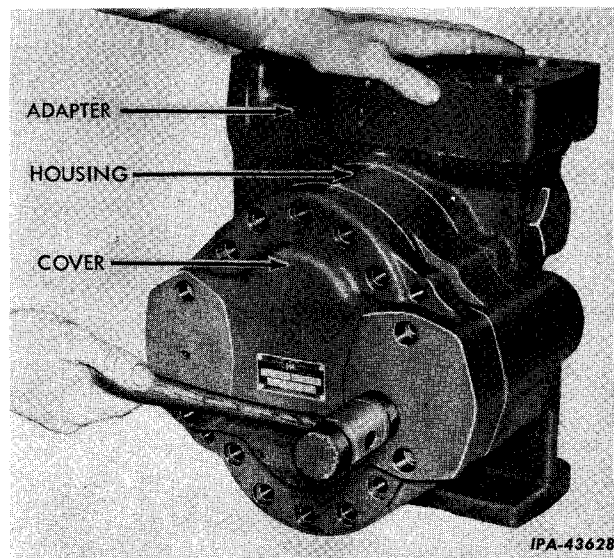
31. Check to see if the pump is free by turning the drive shaft.



Illust. 20 - Installing Front Wear Plate.

32. Assemble the pump to the control valve.

33. Test the hydraulic system. Refer to Section 15, "TESTS AND ADJUSTMENTS," under "DIRECT LIFT HYDRAULIC SYSTEM."



Illust. 21 - Installing Cover.



HYDRAULIC CONTROL VALVE  
(IH 285 147 R93, 285 707 R93 and 285 755 R93)

Section 6

Page 1

CONTENTS

Paragraph	Page
1. Description . . . . .	2
2. Specifications . . . . .	2
3. Disassembly. . . . .	2 to 4
4. Inspection and Repair . . . . .	4, 5
5. Reassembly . . . . .	5, 6



## 1. DESCRIPTION

The hydraulic valve is used to establish a pressure control for the hydraulic system. The main components of the valve are the operating plunger, load control valve, check valve, unloading valve and a flow diverting plunger. Through these components, the unit regulates pressure and controls the operation of hydraulic equipment used with it. The operating plunger directs the flow of hydraulic oil to accomplish the desired action of the hydraulic cylinders. For a detailed description of the control valve operation, refer to Section 1.

Pressure control is established at the control valve through a pressure relief valve. This relief valve or load control valve is pre-set at a pressure of 1000 pounds per square inch and automatically by-passes oil when that pressure is reached.

## 2. SPECIFICATIONS

Low pressure housing and  
high pressure housing relief  
valve springs:

Free length, inches . . . . .	1.89
Test length, inches . . . . .	1.345
Test load, pounds . . . . .	36.1 ± 5%
Coil, number . . . . .	14

Load control valve spring:

Free length, inches . . . . .	3.25
Test length, inches . . . . .	2.875
Test load, pounds . . . . .	170.5
Coil, number . . . . .	14

Check valve spring:

Free length, inches . . . . .	4.688
Test length, inches . . . . .	4.281
Test load, pounds . . . . .	4.1 ± 10%
Coil, number . . . . .	18.5

Operating plunger:

Standard plunger outside diameter, inches . . . . .	1.3733 - 1.3737
.005 inch oversize plunger outside diameter, inches . . . . .	1.3790 - 1.3794
.010 inch oversize plunger outside diameter, inches . . . . .	1.3840 - 1.3844

Housing plunger bore:

Inside diameter for standard plunger, inches . . . . .	1.3743 - 1.3745
---	-----------------

## 3. DISASSEMBLY

(Ref. Nos. Refer to Illust. 1.)

### Tank from Valve

1. Remove the nuts from the six studs holding the tank and valve together.

2. Remove the gasket.

### Valve Plunger

3. Place the valve on a clean work bench. Keep parts clean and protect them from becoming scratched or marred.

NOTE: The operating plunger (18) and housing (47) have been individually fitted to each other for close fit on contact surfaces. It is seldom necessary to replace an operating plunger, but, if one is bent, scored or worn, it should be replaced. Remove the plunger from the housing only if a new set of chevrons (21), with packing (20) and wave spring (19), are available. Care must be taken not to damage the plunger surfaces.

4. Remove the cover (43).

5. Remove the end cover washer (44) from the cover (43).

6. Apply a wrench to the cap screw (45) at the rear end of the plunger (18) and another wrench to the lock nut on the eye (23) at the front. Turn the wrenches in opposite directions and loosen the cap screw. Remove the cap screw (45), lock washer (46) and stop washer (24).

7. Remove the plunger (18) from the housing (47) by tapping the plunger from the cover end of the housing. Place the plunger in a padded vise so that the remaining eye (23) can be removed from the plunger. Be careful not to damage the machined surfaces of the plunger.

8. Remove the chevron packing set (21), wave spring (19) and adapter (20) from the cover end of the housing.

9. Remove the retainer plate (22), chevron packing set (21), adapter (20) and wave spring (19) from the eye end of the housing.

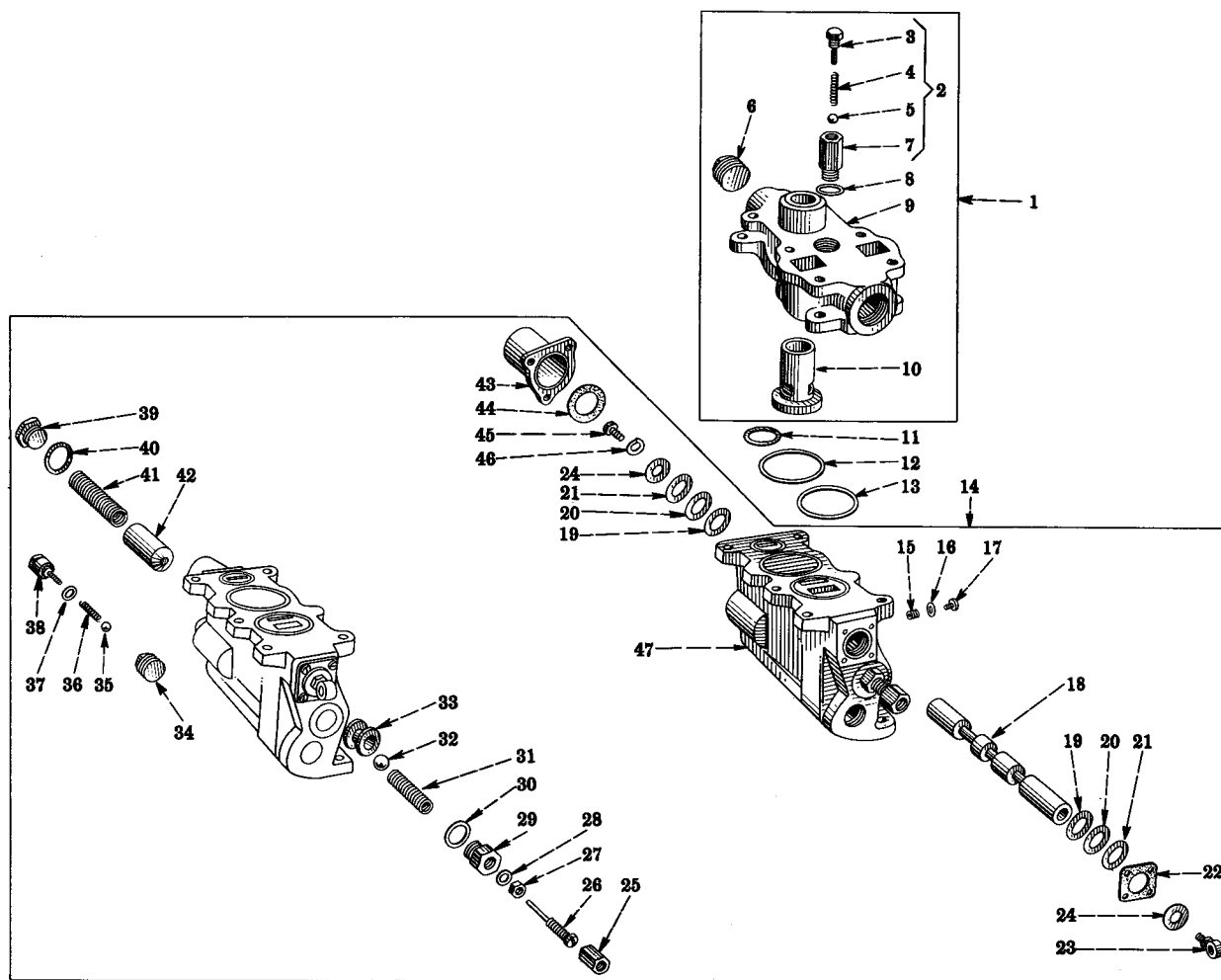
NOTE: Once the valve is disassembled, as in Steps 1 through 7, the chevron packing sets (21), adapter (20) and wave springs (19) cannot be used again.

Continued on page 4.



HYDRAULIC CONTROL VALVE  
(IH 285 147 R93, 285 707 R93 and 285 755 R93)

Section 6  
Page 3



IPA-32210

Illust. 1 - Exploded View of Hydraulic Control Valve.

- |   |   |
|---|---|
| 1. Low pressure housing assembly.         | 25. Special nut.                        |
| 2. Relief valve assembly.                 | 26. Load control valve adjusting screw. |
| 3. Cap.                                   | 27. Hex nut.                            |
| 4. Spring.                                | 28. Fiber gasket.                       |
| 5. Steel ball.                            | 29. Load control valve adjusting cap.   |
| 6. Plug.                                  | 30. Gasket.                             |
| 7. Housing.                               | 31. Load control valve spring.          |
| 8. Gasket.                                | 32. Ball.                               |
| 9. Low pressure housing.                  | 33. Load control valve ball seat.       |
| 10. Flow diverting plunger.               | 34. Drain plug.                         |
| 11. "O" ring.                             | 35. Relief valve ball.                  |
| 12. "O" ring.                             | 36. Relief valve spring.                |
| 13. "O" ring.                             | 37. Relief valve cap gasket.            |
| 14. High pressure control valve assembly. | 38. Relief valve cap.                   |
| 15. Set screw.                            | 39. Check valve cap.                    |
| 16. Fiber gasket.                         | 40. Check valve cap gasket.             |
| 17. Machine screw.                        | 41. Check valve spring.                 |
| 18. Operating plunger.                    | 42. Check valve plunger.                |
| 19. Wave spring.                          | 43. Plunger end cover.                  |
| 20. Male packing adapter.                 | 44. Washer.                             |
| 21. Chevron packing set.                  | 45. Cap screw.                          |
| 22. Packing retainer plate.               | 46. Lock washer.                        |
| 23. Plunger eye.                          | 47. High pressure housing.              |
| 24. Washer.                               |   |



### 3. DISASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 1.)

#### Low Pressure Housing

10. Remove the cap (3), spring (4) and ball (5) from the relief valve housing (7).
11. Remove the housing (7) and gasket (8) from the low pressure housing (9).
12. Remove the plug (6).
13. Remove the low pressure housing (9) from the housing (47) by removing the five attaching cap screws.
14. Remove the "O" rings (11, 12 and 13) from the housing (47).
15. Remove the plunger (10) from the housing (9).

#### Check Valve Unit

16. Remove the cap (39), gasket (40), spring (41) and plunger (42) from the housing (47).

#### Load Control Valve

17. A control valve seat tool can be made to remove and install the control valve seat (33). Make this tool from a 12 inch length of 1-1/32 inch mild steel rod. Make a 7/8 inch pilot on one end and flame harden the other end. (Refer to Illust. 2 for instructions.)

18. Remove the special nut (25), adjusting screw (26), nut (27), gasket (28), cap (29) and gasket (30).

19. By tipping the housing (47) downward, the spring (31) and ball (32) will slide out.

20. Remove the screw (17), gasket (16) and set screw (15) from the housing (47).

21. Remove the ball seat (33) by inserting the special tool (Illust. 2) in the check valve opening and driving out the seat.

#### Relief Valve

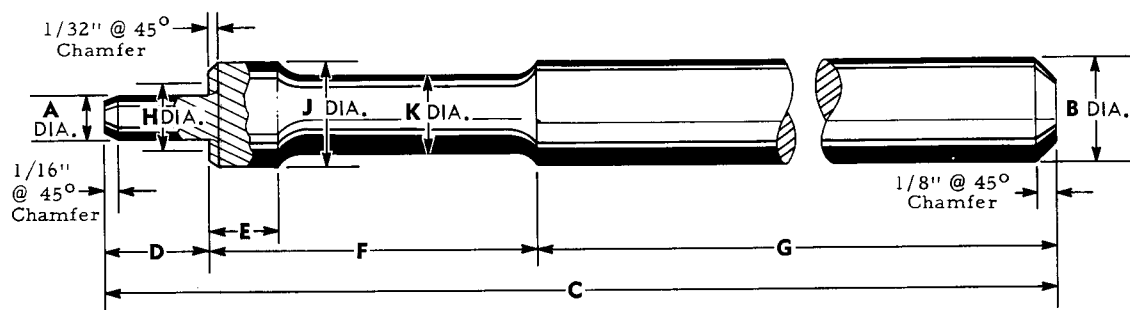
22. Remove the cap (38) and gasket (37) from the housing.

23. By tipping the housing downward, the spring (36) and ball (35) will slide out.

### 4. INSPECTION AND REPAIR

(Ref. Nos. Refer to Illust. 1.)

1. Discard all "O" rings, gaskets and chevron packings as they must be replaced with new when assembling the valve.
2. Wash all parts in oil solvent and dry them thoroughly with compressed air.
3. Inspect all machined surfaces of the valve and its components for scoring, damage or excessive wear.



VALVE	A	B	C	D	E	F	G	H	J	K	Material
	31/64"	31/32"	12"	7/8"	1/2"	2-1/2"	8-5/8"	5/8"	63/64"	7/8"	C-1045

IPA-43629

**Illust. 2 - Special Load Control Valve Seat Tool.**



4. If the operating plunger is bent and the plunger valve housing bore is still in good condition, check the diameter of the plunger with a micrometer and replace the old plunger with a new one of the same diameter.

5. If the operating plunger and plunger housing are both damaged or worn excessively, a new oversize plunger will be required and the bore will have to be reamed. There are .005 and .010 inch oversize operating plungers available (refer to Par. 2, "SPECIFICATIONS"). The amount that the bore will have to be reamed is determined by the diameter of the new plunger. A maximum clearance of .001 inch is allowable in reaming the bore to the plunger diameter.

6. Clean all cuttings and chips from the control valve after reaming.

7. Insert the new operating plunger in the control housing and check to be sure that it moves back and forth freely. When the plunger has been properly fitted, lay it aside in a clean place for later installation.

8. Check the low pressure housing relief valve spring (4), load control valve spring (31), relief valve spring (36) and valve spring (41) for free length, test length and test load. (Refer to Par. 2, "SPECIFICATIONS.")

#### 5. REASSEMBLY

(Ref. Nos. Refer to Illust. 1.)

##### Load Control Valve

1. Insert the ball seat (33) into the housing (47). Using the seat tool (Illust. 2), tap the tool until the seat lines up exactly with the set screw hole in the housing.

2. Insert the set screw (15) in the opening of the housing (47) and tighten the screw securely against the seat. Close the set screw opening by placing the machine screw (17) in the gasket (16) and turning the screw (17) into the opening.

3. Assemble the adjusting cap (29), gasket (28), lock nut (27), adjusting screw (26) and special nut (25).

4. Install the gasket (30) on the adjusting cap (29).

5. Place the spring (31) over the adjusting screw (26) and, after placing the ball (32) into the seat (33), screw the cap (29) into the housing (47).

##### Check Valve

6. Insert the plunger (42) into the housing (47) and place the spring (41) into the plunger (42).

7. Place the gasket (40) over the cap (39) and screw the cap (39) into the housing (47) until tight.

##### Relief Valve

8. Insert the ball (35) into the housing opening.

9. Place the gasket (37) and spring (36) on the cap (38). Screw the cap assembly into the housing opening.

10. Screw the plug (34) in the opening of the housing, which is below the relief valve cap section.

##### Operating Plunger

11. Slide the plunger (18) into the housing (47) with the eye end protruding from the same end of the housing as the load control valve.

12. Install the new wave spring (19), adapter (20) and chevron packing set (21) into each end of the housing plunger opening.

13. Install the retainer plate (22) over the chevron packing set and secure it to the housing with four cap screws and lock washers.

14. Install the cap screw (45), with lock washer (46), in the rear of the plunger. Install the eye and lock nut (23) and stop washer (24) at the front end of the plunger.

15. Tighten the cap screw (45) and plunger eye (23) by applying a wrench to each and turning them until they are tight.

16. Install the cover (43) with the end cover washer (44) to the housing, using three cap screws and lock washers.

NOTE: Move the plunger back and forth to be sure it does not bind at this time.

##### Low Pressure Housing to High Pressure Housing

17. Insert new "O" rings (11, 12 and 13) in the grooves on the top face of the lower housing (47).

18. Install the plunger (10) in the opening in the upper housing (9) and check for free movement.

Continued on next page.



**5. REASSEMBLY - Continued**

(Ref. Nos. Refer to Illust. 1.)

**Low Pressure Housing to High Pressure Housing - Continued**

19. Place the housings (9 and 47) together, being sure the openings match. Fasten the housings together with the cap screws and lock washers.

NOTE: Do not draw up the two halves of the valve too tight. To do so, may distort the valve housing and cause the operating plunger to bind. Use a box wrench on the cap screws, pulling up evenly until snug. Be sure the operating plunger can still be pulled back and forth by hand.

**Relief Valve**

20. Insert the ball (5) and spring (4) in the housing (7). Screw the cap (3) into the housing (7) and tighten it securely.

21. Be sure the ball (5) will move. Check the ball by pushing a rod against it through the small hole at the bottom.

22. Place the gasket (8) on the housing (7), screw the relief valve assembly (2) into the upper housing, and tighten securely.

**Tank**

23. Check the tank to be sure it is thoroughly clean.

24. Place the new gasket on the studs that are part of the tank.

25. Set the tank carefully in place and secure it to the valve with six nuts and lock washers. Be sure to get a tight seal.

26. Clean the filler cap in solvent. Cement the rubber gasket in the filler cap if it is loose, and screw the cap on the tank.

27. Refer to Section 15 under "TRACK FRAME MOUNTED HYDRAULIC SYSTEM," for adjustment.



HYDRAULIC CONTROL VALVE  
(Hydreco Models VZ26X1 and VZ26X4)

Section 7

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3. Disassembly . . . . .	3 to 6
4. Inspection and Repair . . . . .	6,7
5. Reassembly. . . . .	7,8

# HYDRAULIC CONTROL VALVE (Hydreco Models VZ26X1 and VZ26X4)



Section 7

Page 2

## 1. DESCRIPTION

The hydraulic valve is used to establish a pressure control for the hydraulic system. The main components of the valve are the operating plunger, load control valve, check valve, unloading valve and flow diverting plunger. Through these components the unit regulates pressure and controls the operation of the hydraulic equipment used with it. The operating plunger directs the flow of hydraulic oil to accomplish the desired action of the hydraulic cylinders. The load control valve controls the maximum pressure that can be built up within the hydraulic system. For a detailed description of control valve operation, refer to Section 1.

## 2. SPECIFICATIONS

Hydraulic valve make . . . . .	Hydreco
Relief valve setting, at 1500 rpm. . . . .	1650 psi
Housing operating plunger bore diameter (standard), inches . . . . .	1.6098 - 1.6102
Housing operating plunger bore diameter (.010 inch oversize), inches . . . . .	1.6199
Operating plunger diameter (standard), inches . . . . .	1.6092 - 1.6094
Operating plunger diameter (.010 inch oversize), inches . . . . .	1.6182 - 1.6194
Housing flow control plunger bore diameter, inches . . . . .	1.3740 - 1.3755
Maximum permissible diameter, inches . . . . .	1.3775
Flow control plunger outside diameter, inches . . . . .	1.372 - 1.373
Minimum permissible diameter, inches . . . . .	1.370
Maximum permissible clearance (housing and flow control plunger), inch . . . . .	.0075
Dashpot cap diameter, inches . . . . .	1.249 - 1.251
Maximum permissible diameter, inches . . . . .	1.253
Dashpot outside diameter, inches . . . . .	1.245 - 1.246
Minimum permissible diameter, inches . . . . .	1.243
Maximum permissible clearance (dashpot and housing), inch . . . . .	.008
Poppet check outside diameter, inches . . . . .	1.364 - 1.369
Minimum permissible diameter, inches . . . . .	1.285
Maximum permissible clearance (poppet check and housing), inch . . . . .	.057
Relief seat plunger barrel inside diameter, inches . . . . .	1.1250 - 1.1255
Maximum permissible diameter, inches . . . . .	1.1258

Relief plunger barrel outside diameter, inches . . . . .	1.1240 - 1.1245
Minimum permissible diameter, inches . . . . .	1.1236
Maximum permissible clearance (plunger and seat), inch . . . . .	.0022

### Plunger Lever Control Housing Assembly

Detent plunger bearing inside diameter, inch . . . . .	.250
Maximum permissible diameter, inch . . . . .	.260
Detent plunger pin diameter, inches . . . . .	.2500 - .2505
Minimum permissible diameter, inch . . . . .	.247
Maximum permissible clearance (bearing and pin), inch . . . . .	.013
Latch shaft bearing inside diameter, inch . . . . .	.500
Maximum permissible diameter, inch . . . . .	.501
Latch shaft diameter, inches . . . . .	.5000 - .5005
Minimum permissible diameter, inch . . . . .	.498
Maximum permissible clearance (bearing and shaft), inch . . . . .	.003
Control shaft bearing inside diameter, inch . . . . .	.875
Maximum permissible diameter, inch . . . . .	.876
Control shaft diameter, inch . . . . .	.8750 - .8755
Minimum permissible diameter, inch . . . . .	.8720
Maximum permissible clearance (bearing and shaft), inch . . . . .	.004
Spring plate inside diameter, inches . . . . .	1.505 - 1.507
Maximum permissible diameter, inches . . . . .	1.510
Cam plate outside diameter, inches . . . . .	1.500 - 1.502
Minimum permissible diameter, inches . . . . .	1.498
Maximum permissible clearance (spring plate and cam plate), inch . . . . .	.012

### Springs

Check valve spring:	
Free length, inches . . . . .	4
Test length, inches . . . . .	2-1/2
Test load, pounds . . . . .	1
Dashpot plunger spring:	
Free length, inches . . . . .	4-13/16
Test length, inches . . . . .	1-3/4
Test load, pounds . . . . .	33



# HYDRAULIC CONTROL VALVE (Hydreco Models VZ26X1 and VZ26X4)

Section 7

Page 3

## Detent spring:

Free length, inches . . . . .	1-3/16
Test length, inch . . . . .	3/4
Test load, pounds . . . . .	70

## Flow control plunger spring:

Free length, inches . . . . .	3-29/64
Test length, inches . . . . .	1-7/16
Test load, pounds . . . . .	104

## Poppet spring:

Free length, inches . . . . .	1-3/8
Test length, inch . . . . .	7/8
Test load, pounds . . . . .	11-1/2

## Relief valve plunger spring:

Free length, inches . . . . .	6
Test length, inches . . . . .	4-53/64
Test load, pounds . . . . .	450

## Torque Data (ft-lbs.)

Plunger lever housing cover cap screws . 11

## 3. DISASSEMBLY

(Ref. Nos. Refer to Illust. 2.)

1. Clean the outside of the valve with solvent and dry thoroughly. Place the valve on a clean work bench.

2. Remove the four cap screws and lock washers from the plunger cover (54). Remove the cover and gasket (55).

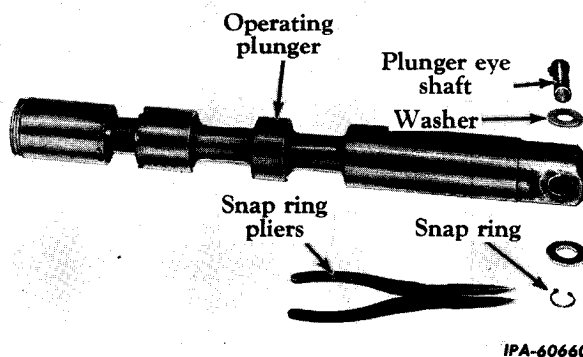
3. Remove the snap ring (56) from the exposed end of the plunger (58). Remove the washer (57) from the plunger. Inspect the snap ring groove for nicks or burrs, and remove them with an India stone or fine file.

4. Remove the four hex socket cap screws that secure the plunger lever housing (10) to the valve housing (35) and separate the housings with a twisting motion.

NOTE: When removing the plunger lever housing assembly, the operating plunger will come with it. The reason for this, is the plunger eye engages and is held in place by the spring and cam plate assembly (88), located in the plunger lever assembly.

5. Install the plunger lever assembly (10) in a padded vise.

CAUTION: DO NOT apply excessive pressure when tightening the plunger lever assembly in the vise, as the casting is made of aluminum and may crack or distort.



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Illust. 1 - Disassembly of Operating Plunger.

6. Using a handle or wrench, rotate the shaft (18) into the "FLOAT" position. Disengage the plunger (58) from the spring and cam plate (88).

7. Remove one of the snap rings from the plunger eye shaft and remove the plunger eye shaft and the two washers (Illust. 1).

## Flow Control Plunger

8. Remove the flow control plunger cap (51), located next to the relief valve cap (42). There is a slight spring pressure which will push the cap out when it is unscrewed. Note the sequence of the parts that follow.

9. Remove the guide (49), spring (48), dash-pot plunger (47) and spring (46).

10. Remove the plugs (80 and 79). Remove the spring (78) and check poppet (77).

11. Insert a suitable drift in the pipe plug opening and push the flow control plunger (43) out through the bore. Remove the special washer (45) and snap ring (44) from the plunger (43).

12. If the seat (76) needs to be replaced due to excessive wear or scoring, remove the machine screw (32), gasket (33) and set screw (34). Insert a suitable soft drift in the bore end and tap the seat out through the pipe plug hole. Be sure the drift is the correct size so as not to damage the bore.

## Relief Valve

13. Remove the relief valve cap (42) and "O" ring (41). Remove the spring (40) and plunger (39).

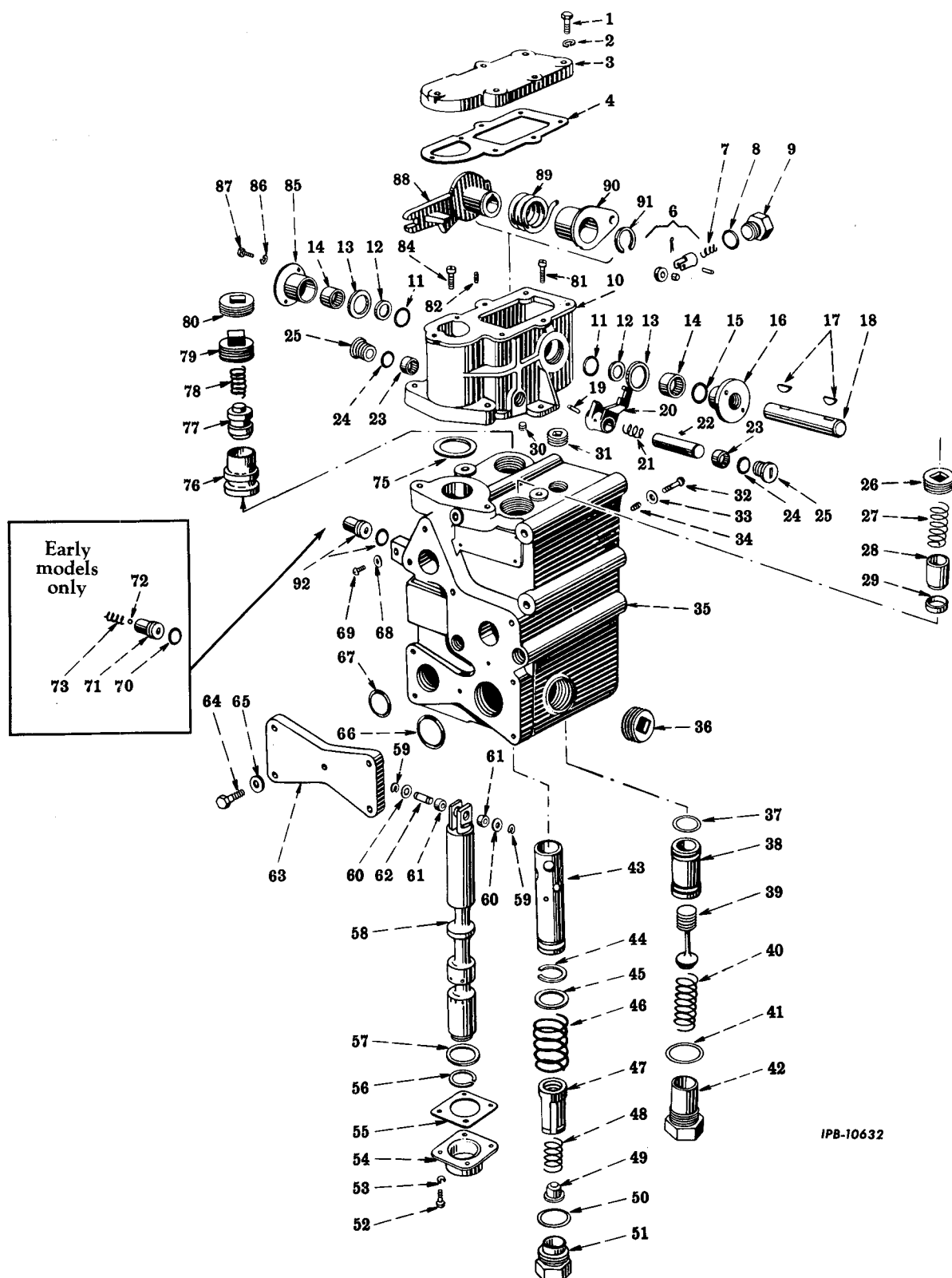
Continued on page 5.

# HYDRAULIC CONTROL VALVE (Hydrex Models VZ26X1 and VZ26X4)



Section 7

Page 4



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Illust. 2 - Exploded View of Valve Assembly.



HYDRAULIC CONTROL VALVE  
(Hydreco Models VZ26X1 and VZ26X4)

Section 7  
Page 5

Legend for Illust. 2.

- |                              |   |
|------------------------------|---|
| 1. Cap screw.                | 48. Spring.   |
| 2. Lock washer.              | 49. Spring guide.                                     |
| 3. Cover.                    | 50. "O" ring.   |
| 4. Gasket.                   | 51. Cap.  |
| 6. Detent.                   | 52. Cap screw.  |
| 7. Spring.                   | 53. Lock washer.                                      |
| 8. "O" ring.                 | 54. Plunger cover.                                    |
| 9. Detent cap.               | 55. Gasket.   |
| 10. Plunger lever housing.   | 56. Snap ring.  |
| 11. Washer.                  | 57. Washer.   |
| 12. Washer.                  | 58. Operating plunger.                                |
| 13. "O" ring.                | 59. Snap ring.  |
| 14. Control shaft bearing.   | 60. Washer.   |
| 15. "O" ring.                | 61. Plunger eye shaft bearing.                        |
| 16. Bearing retainer.        | 62. Plunger eye shaft.                                |
| 17. Woodruff key.            | 63. Cover.  |
| 18. Control shaft.           | 64. Cap screw.  |
| 19. Roll pin.                | 65. Lock washer.                                      |
| 20. Cam and latch.           | 66. "O" ring.   |
| 21. Spring.                  | 67. "O" ring.   |
| 22. Latch shaft.             | 68. Gasket.   |
| 23. Cam latch shaft bearing. | 69. Machine screw.                                    |
| 24. "O" ring.                | 70. "O" ring.   |
| 25. Cap.                     | 71. Relief valve seat.                                |
| 26. Pipe plug.               | 72. Steel ball.                                       |
| 27. Spring.                  | 73. Spring.   |
| 28. Check valve.             | 74. Pipe plug.  |
| 29. Check valve seat.        | 75. "O" ring.   |
| 30. Pipe plug.               | 76. Flow control plunger seat or<br>check valve seat. |
| 31. Pipe plug.               | 77. Check poppet.                                     |
| 32. Machine screw.           | 78. Poppet spring.                                    |
| 33. Gasket.                  | 79. Check valve plug.                                 |
| 34. Set screw.               | 80. Pipe plug.  |
| 35. Valve housing.           | 81. Cap screw.  |
| 36. Pipe plug.               | 82. Screw.  |
| 37. "O" ring.                | 83. Oil filter screen.                                |
| 38. Relief valve seat.       | 84. Cap screw.  |
| 39. Relief valve plunger.    | 85. Bearing retainer.                                 |
| 40. Spring.                  | 86. Lock washer.                                      |
| 41. "O" ring.                | 87. Cap screw.  |
| 42. Cap.                     | 88. Cam plate.  |
| 43. Flow control plunger.    | 89. Torsion spring.                                   |
| 44. Snap ring.               | 90. Spring plate.                                     |
| 45. Washer.                  | 91. Snap ring.  |
| 46. Spring.                  | 92. Thermal relief valve plug and "O" ring.           |
| 47. Dashpot plunger.         |   |

3. DISASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 2.)

Relief Valve - Continued

14. Remove the plug (31) and, using a brass drift, drive the relief valve seat (38) out through the cap hole. Remove the "O" ring (37) from the seat (38).

Thermal Relief Valve (If So Equipped)

15. Remove the pipe plug (74), spring (73) and ball (72).
16. Remove the machine screw (69) and gasket (68).
17. Remove the seat (71) and "O" ring (70).

Continued on next page.



### 3. DISASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 2.)

#### Check Valve

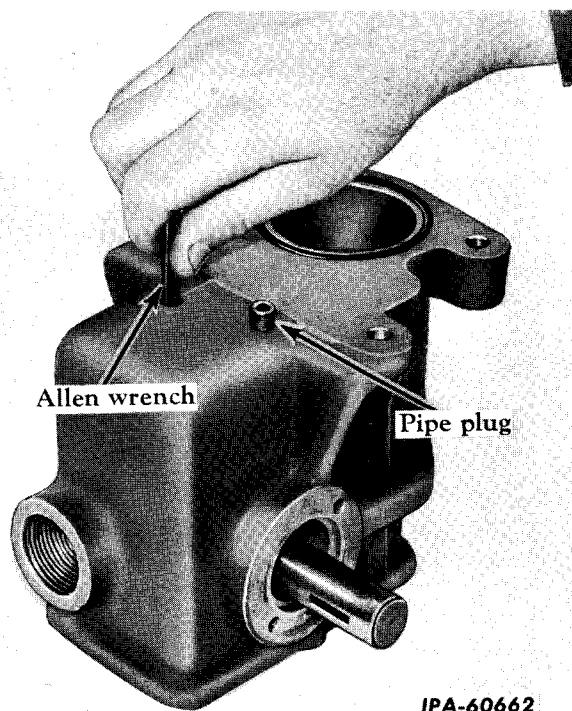
18. Remove the plug (26), spring (27), plunger (28) and seat (29).

#### Plunger Lever Housing

19. Remove the exposed key (17) from the control shaft (18).
20. Remove the cover and gasket from the plunger lever housing (Illust. 3).
21. Remove the detent cap (9), with "O" ring (8), from the housing (10). Remove the detent (6) and spring (7).
22. Remove the cap screws (87) and lock washers (86) from the retainers (16 and 85). Remove the retainers, "O" rings (13), washers (11) and washers (12) from the housing (10). Bearings (14) will remain in the retainers.

NOTE: Count the number and note the location of the metal shim washers (11) which are used to take up end play in the spring and cam plate assembly.

23. Remove the pipe plug (30). Depress the spring and cam plate (88) and rotate until the set screw in the cam plate is in view when looking through the pipe plug opening. Remove the set screw as shown in Illust. 4.



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Illust. 4 - Removing Cam Plate Set Screw.

24. Using a suitable drift, tap the shaft (18) out of the housing.

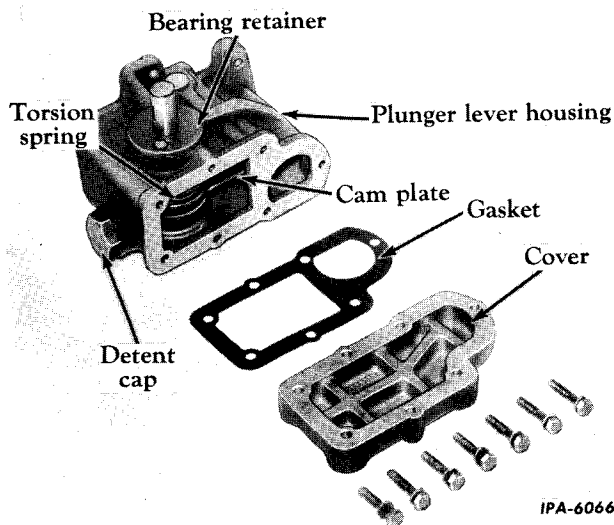
NOTE: The cam plate is keyed to the shaft.

25. Remove the spring and cam plate assembly (88, 89, 90 and 91).
26. Remove the caps (25) with "O" rings (24). Drive the roll pin (19) from the cam and latch (20). Remove the shaft (22), cam and latch (20) and spring (21).

NOTE: When removing the above parts, note their position and sequence.

### 4. INSPECTION AND REPAIR

1. Discard all "O" rings and gaskets, as they must be replaced with new when assembling the valve.
2. Wash all parts in solvent and dry thoroughly.
3. Inspect all machined surfaces of the valve and its components for scoring, damage or excessive wear. Refer to Par. 2, "SPECIFICATIONS," for sizes, fits and wear limits.
4. If the operating plunger and plunger housing are both damaged or worn excessively, a new oversize plunger will be required and the bore



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Illust. 3 - Plunger Lever Housing Cover Removed.



## HYDRAULIC CONTROL VALVE (Hydrec Models VZ26X1 and VZ26X4)

Section 7  
Page 7

will have to be reamed. There is a .010 inch oversize plunger available. Refer to Section 11, "INSTALLATION OF OVERSIZE PLUNGER."

5. On earlier models, if the thermal relief valve seat (71) needs to be replaced, discard the seat (71), "O" ring (70), ball (72) and spring (73). Replace them with a thermal relief valve plug and "O" ring (92). (Illust. 2.)

6. If it is necessary to replace them, drive out the plunger eye shaft bearings (61) and install new ones.

### 5. REASSEMBLY

(Ref. Nos. Refer to Illust. 2.)

#### Plunger Lever Housing

1. Press the bearings (61) into the plunger eye (58) if they were removed or replaced. Install the shaft (62), two washers (60) and snap rings (59). (Illust. 1.)

2. Assemble the detent (6).

3. Press the bearings (14) into the two retainers (85 and 16) if they were removed or replaced, and install the two "O" rings (13).

4. Press the bearings (23), if they were removed or replaced, into the plunger lever housing (10). Hold the cam and latch (20) and spring (21) in position in the housing and insert the shaft (22) through the bearing (23), cam and latch, and spring.

5. Line up the drilled hole in the cam and latch (20) with the hole in the shaft (22). Drive in the roll pin (19).

6. Install the caps (25) with new "O" rings (24). Tighten the caps in the housing securely.

7. Assemble the cam plate (88), torsion spring (89) and spring plate (90). Secure the spring plate to the cam plate with the snap ring (91). Install the assembly into the housing (10).

NOTE: Be sure that the detent in the cam plate (88) is in line with the tapped hole in the end of the housing.

8. Insert the shaft (18) through the housing (10) and cam plate assembly, lining up the key (17) in the shaft with the key slot in the cam plate.

9. Rotate the cam plate (88) until the set screw hole in the cam plate is in view when looking through the hole for the pipe plug (30). Install and tighten the set screw (82) into the cam plate assembly. Install the pipe plug (30).

10. Install the bearing retainers (16 and 85). Check the cam plate assembly for end play. If there is excessive end play, remove the retainers and install as many metal shim washers (11) to the shaft (18) as required.

NOTE: Always add an equal number of shim washers to both ends of the shaft when taking up end play. This will help to center the cam plate assembly.

11. Install the retainers (16 and 85) to the shaft (18) and secure them to the housing (10) with the cap screws (87) and lock washers (86).

12. Rotate the cam plate assembly until the detent in the cam plate is lined up with the tapped hole in the end of the housing (10).

13. Install the detent assembly (6), spring (7) and cap (9) with the new "O" ring (8), being sure that the detent roller engages the detent in the cam plate.

14. Coat both sides of the gasket (4) with non-hardening Never-Seez compound or its equivalent. Place the gasket in position on the housing (10). Install the cover (3) and secure it with the cap screws and lock washers. Tighten the cap screws to the torque specified in Par. 2, "SPECIFICATIONS."

15. Install the key (17) in the exposed end of the shaft (18).

#### Thermal Relief Valve (If Used)

16. Install the "O" ring (70) on the seat (71) and coat the "O" ring with light grease. Drive the seat into place until it bottoms in the housing. Insert and seat the steel ball (72). Install the spring (73) over the steel ball. Install the pipe plug (74) and tighten it securely. Install the machine screw (69) with the new gasket (68) and tighten it securely.

#### Flow Control Plunger

17. If it was removed, install the seat (76) into the valve housing (35) so that the groove in the seat is aligned with the tapped hole in the housing.

18. Install the set screw (34) and tighten it securely. Install the fiber washer (33) and screw (32) and tighten securely.

19. Coat the threads of the plugs (79 and 80) with white lead and install and tighten them into the housing (35).

Continued on next page.



5. REASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 2.)

Flow Control Plunger - Continued

20. Install the snap ring (44) on the plunger (43). Coat the plunger with light oil and install it into the plunger bore.

21. Install the washer (45) on the plunger (43) with the concave side facing away from the snap ring (44).

22. Install the spring (46) into the plunger bore. Assemble the dashpot plunger (47), spring (48) and guide (49). Coat the inside of the cap (51) with light oil and install the assembly into the bore. Tighten the cap (51), with new "O" ring (50), into the housing securely.

Relief Valve

23. Install the "O" ring (37) around the groove in the seat (38). Lubricate the "O" ring with light grease and drive the seat into its bore until the shoulder bottoms in the bore of the housing.

24. Coat the plunger (39) with light oil and insert it into the relief valve seat (38).

NOTE: DO NOT grind or lap the mating surfaces.

25. Install the spring (40). Install a new "O" ring (41) on the cap (42). Install the cap in the bore, tighten it securely and install the pipe plug (31).

Check Valve

26. Install the check valve seat (29) in the housing (35).

NOTE: If a new check valve plunger (28) is to be installed, re-seat the plunger by lapping it in the seat with valve grinding compound until a good seat surface shows on the plunger and seat. Clean off the compound before proceeding with the reassembly.

27. Install the plunger (28) and spring (27). Install the pipe plug (26) and tighten it securely.

Plunger Lever Housing to Valve Housing

28. Place the plunger lever assembly (10) in a padded vise.

CAUTION: DO NOT apply excessive pressure when tightening the plunger lever assembly in the vise, as the casting is made of aluminum and may crack or distort.

29. Rotate the shaft (18) to the "FLOAT" position (so the slot in the end of the cam plate is down in the housing (10). Install the eye end of the plunger (58) into the cam plate (88). Be sure the plunger eye shaft (62) engages the slotted end of the cam plate.

30. Rotate the shaft (18) until it is in the neutral or "HOLD" position. Remove the plunger housing (10) from the vise. Install a new "O" ring (75) in the groove in the face of the housing (10).

31. Lubricate the plunger (58) with a light coat of clean oil and insert the plunger into the bore of the valve housing (35) with a twisting motion to avoid binding. Install the cap screws (81 and 84) and tighten them securely.

32. Install the washer (57) on the plunger (58) and secure it with the snap ring (56).

33. Install a new gasket (55) and the cover (54) to the housing.

34. Rotate the shaft (18) through the operating cycle and check the plunger (58) for freeness. If the plunger hangs up, remove the cover (3) and check the eye of the plunger (58) for interference with the cam plate (88). If there is interference, remove the bearing retainers (16 and 85) and remove the shim washers (11) as needed to centralize the cam plate. When the proper clearance is obtained, install the retainers and cover.

35. Refer to Section 15 under "DIRECT LIFT HYDRAULIC SYSTEM" for adjustments.



HYDRAULIC CONTROL VALVE  
(Hydreco Models VZ14X2, VZ14X4, VZ14X5, VZ14X6 and VZ14X10)

Section 8

Page 1

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3. Disassembly . . . . .	4 to 7
4. Inspection and Repair . . . . .	7
5. Reassembly. . . . .	7 to 9

# HYDRAULIC CONTROL VALVE

(Hydreco Models VZ14X2, VZ14X4, VZ14X5, VZ14X6 and VZ14X10)



Section 8

Page 2

## 1. DESCRIPTION

These control valves are used to establish a pressure control for the hydraulic system. The main components of the valves are the operating plunger, load control valve, check valve, unloading valve and a flow diverting plunger. Through these components the valve regulates pressure and controls the operation of the hydraulic equipment used with it. The operating plunger directs the flow of oil to accomplish the desired action of the hydraulic cylinders. The load control valve controls the maximum pressure that can be built up within the hydraulic system. For a detailed description of control valve operation, refer to Section 1.

## 2. SPECIFICATIONS

Hydraulic valve make . . . . .	Hydreco
Relief valve setting, at 1500 rpm . . . . .	1650 psi
Housing operating plunger bore diameter (standard), inches . . . . .	1.9718 - 1.9722
Housing operating plunger bore diameter (.010 inch oversize), inches . . . . .	1.9819
Operating plunger outside diameter (standard), inches . . . . .	1.9711 - 1.9713
Operating plunger outside diameter (.010 inch oversize), inches . . . . .	1.9811 - 1.9813
Housing flow control plunger bore diameter, inches . . . . .	1.3740 - 1.3755
Maximum permissible diameter, inches . . . . .	1.3775
Flow control plunger outside diameter, inches . . . . .	1.372 - 1.373
Minimum permissible diameter, inches . . . . .	1.370
Maximum permissible clearance (housing and flow control plunger), inch . . . . .	.0075
Dashpot cap inside diameter, inches . . . . .	1.249 - 1.251
Maximum permissible diameter, inches . . . . .	1.253
Dashpot plunger outside diameter, inches . . . . .	1.245 - 1.246
Minimum permissible diameter, inches . . . . .	1.243
Maximum permissible clearance (dashpot plunger and cap), inch . . . . .	.008
Operating plunger poppet check bore diameter, inches . . . . .	1.3125
Maximum permissible diameter, inches . . . . .	1.342

Poppet check outside diameter, inches . . . . .	1.292 - 1.297
Minimum permissible diameter, inches . . . . .	1.285
Maximum permissible clearance (poppet check and operating plunger poppet check bore), inch . . . . .	.057

### Plunger Lever Control

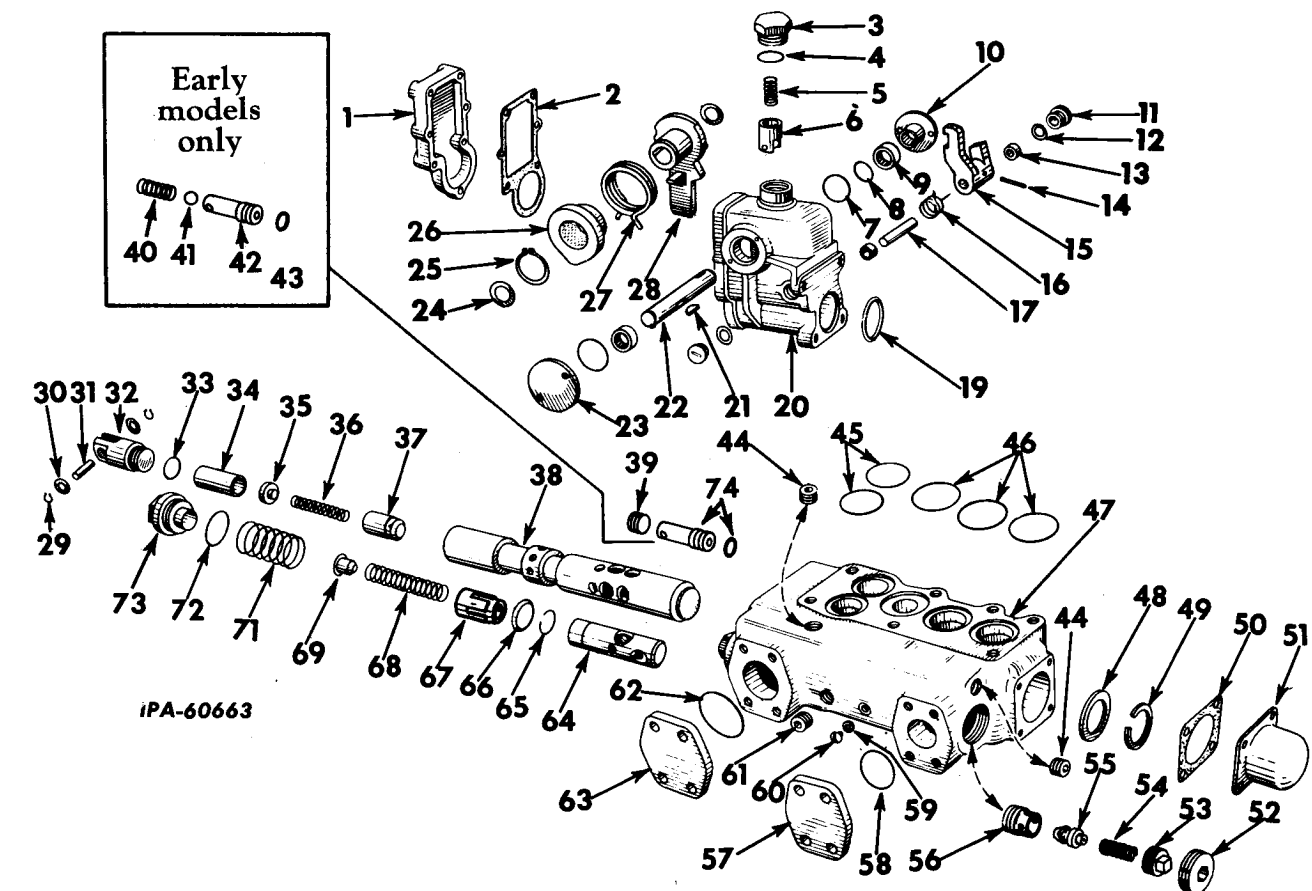
Detent plunger bearing inside diameter, inch . . . . .	.250
Maximum permissible diameter, inch . . . . .	.260
Detent plunger bearing pin diameter, inch . . . . .	.2500 - .2505
Minimum permissible diameter, inch . . . . .	.247
Maximum permissible clearance (bearing and pin), inch . . . . .	.013
Detent plunger cap inside diameter, inches . . . . .	.9990 - 1.005
Maximum permissible diameter, inches . . . . .	1.0025
Detent plunger outside diameter, inch . . . . .	.995 - .997
Minimum permissible diameter, inch . . . . .	.992
Maximum permissible clearance (cap and plunger), inch . . . . .	.010
Latch shaft bearing inside diameter, inch . . . . .	.500
Maximum permissible diameter, inch . . . . .	.501
Latch shaft diameter, inch. . . . .	.5000 - .5005
Minimum permissible diameter, inch . . . . .	.498
Maximum permissible clearance (bearing and shaft), inch. . . . .	.003
Control shaft bearing inside diameter, inch . . . . .	.875
Maximum permissible diameter, inch . . . . .	.876
Control shaft diameter, inch. . . . .	.8750 - .8755
Minimum permissible diameter, inch . . . . .	.8720
Maximum permissible clearance (bearing and shaft), inch . . . . .	.004
Spring plate inside diameter, inches . . . . .	1.5025
Maximum permissible diameter, inches . . . . .	1.5045
Cam plate outside diameter, inches . . . . .	1.499 - 1.502
Minimum permissible diameter, inches . . . . .	1.492
Maximum permissible clearance (plate assembly and cam plate), inch . . . . .	.012

Continued on page 4.



HYDRAULIC CONTROL VALVE  
(Hydrex Models VZ14X2, VZ14X4, VZ14X5, VZ14X6 and VZ14X10)

Section 8  
Page 3



Illust. 1 - Exploded View of VZ14X10 Hydraulic Valve.

- |                            |                          |  |
|----------------------------|--------------------------|--|
| 1. Housing cover.          | 26. Spring plate.        | 50. Gasket.                              |
| 2. Cover gasket.           | 27. Torsion spring.      | 51. Cover.                               |
| 3. Cap.                    | 28. Cam plate.           | 52. Pipe plug.                           |
| 4. "O" ring.               | 29. Snap ring.           | 53. Check valve plug.                    |
| 5. Detent spring.          | 30. Washer.              | 54. Poppet spring.                       |
| 6. Detent.                 | 31. Plunger eye shaft.   | 55. Check valve poppet.                  |
| 7. "O" ring.               | 32. Plunger eye.         | 56. Check valve seat.                    |
| 8. "O" ring.               | 33. "O" ring.            | 57. Cover.                               |
| 9. Control shaft bearing.  | 34. Spacer.              | 58. "O" ring.                            |
| 10. Bearing retainer.      | 35. Spring guide.        | 59. Fiber washer.                        |
| 11. Cap.                   | 36. Spring.              | 60. Machine screw.                       |
| 12. "O" ring.              | 37. Check valve.         | 61. Pipe plug.                           |
| 13. Bearing.               | 38. Plunger.             | 62. "O" ring.                            |
| 14. Roll pin.              | 39. Pipe plug.           | 63. Cover.                               |
| 15. Cam latch.             | 40. Relief valve spring. | 64. Flow control plunger.                |
| 16. Torsion spring.        | 41. Steel ball.          | 65. Snap ring.                           |
| 17. Latch shaft.           | 42. Relief valve seat.   | 66. Washer.                              |
| 19. "O" ring.              | 43. "O" ring.            | 67. Dashpot plunger.                     |
| 20. Plunger lever housing. | 44. Pipe plug.           | 68. Dashpot spring.                      |
| 21. Key.                   | 45. "O" ring.            | 69. Dashpot guide.                       |
| 22. Control shaft.         | 46. "O" ring.            | 71. Plunger spring.                      |
| 23. Bearing retainer.      | 47. Housing.             | 72. "O" ring.                            |
| 24. Shim washer.           | 48. Washer.              | 73. Cap.                                 |
| 25. Snap ring.             | 49. Snap ring.           | 74. Relief valve seat plug and "O" ring. |



## 2. SPECIFICATIONS - Continued

### Springs

Detent spring:	
Free length, inches . . . . .	1-3/16
Test length, inch . . . . .	3/4
Test load, pounds . . . . .	70
Flow control plunger spring:	
Free length, inches . . . . .	3-29/64
Test length, inches . . . . .	1-7/16
Test load, pounds . . . . .	104
Dashpot plunger spring:	
Free length, inches . . . . .	4-13/16
Test length, inches . . . . .	1-3/4
Test load, pounds . . . . .	33
Check valve spring:	
Free length, inches . . . . .	3-3/4
Test length, inches . . . . .	1-3/8
Test load, pounds . . . . .	5
Poppet spring:	
Free length, inches . . . . .	1-3/8
Test length, inch . . . . .	7/8
Test load, pounds . . . . .	11-1/2

### Torque Data (ft.-lbs.)

Plunger lever housing cover cap screws . . . . .	11
--	----

## 3. DISASSEMBLY

(Ref. Nos. Refer to Illust. 1.)

1. Clean the outside of the valve with solvent and dry thoroughly. Place the valve on a clean work bench.

2. Remove the cover (51) and gasket (50) from the end of the valve housing.

3. Remove the snap ring (49) and retaining washer (48) from the end of the plunger (38).

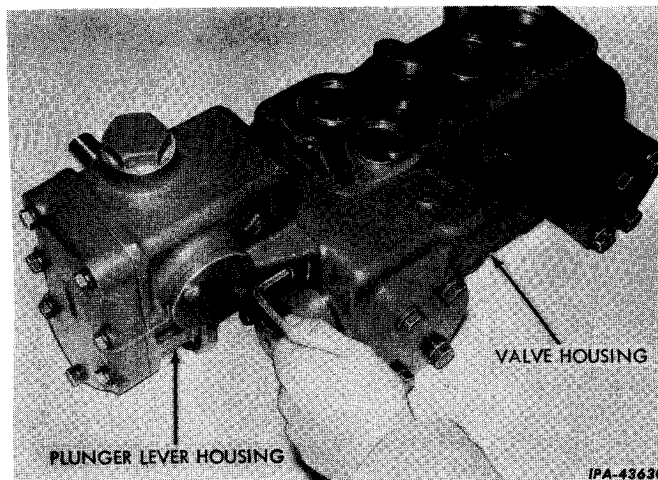
4. Remove the four hex socket head cap screws securing the plunger lever housing to the valve housing (Illust. 2). Remove the plunger lever housing, with plunger (38), from the valve housing. Remove the "O" ring (19) between the housings.

5. ON ALL UNITS SO EQUIPPED: Remove the pipe plug (39), spring (40), ball (41) and seat (42) from the housing (47). (Illust. 3.)

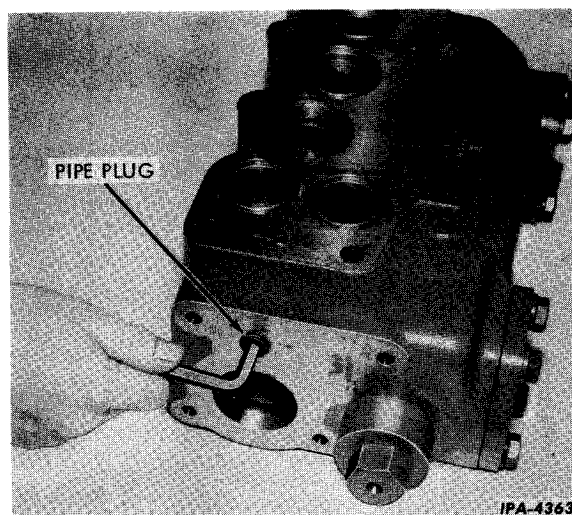
6. Install the plunger lever housing (20) in a padded vise. Insert a brass rod into one of the oil holes in the plunger and unscrew the plunger from the plunger eye (32). (Illust. 4.)

7. Remove the spacer (34), guide (35), spring (36) and check valve (37) from the inside of the

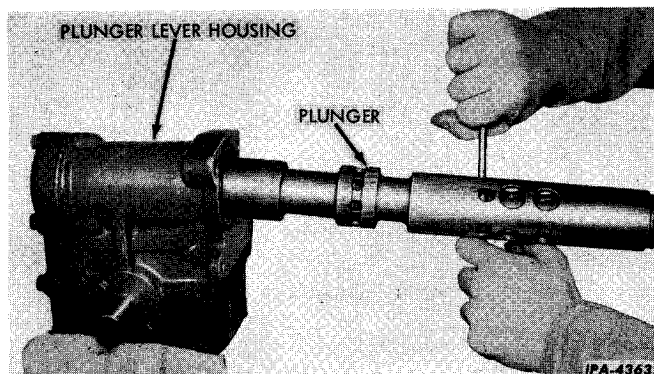
plunger (38). Remove the plunger lever housing (20) from the vise.



Illust. 2 - Separating Valve Housing from Plunger Lever Housing.



Illust. 3 - Removing Relief Valve Pipe Plug.



Illust. 4 - Removing Plunger from Housing.

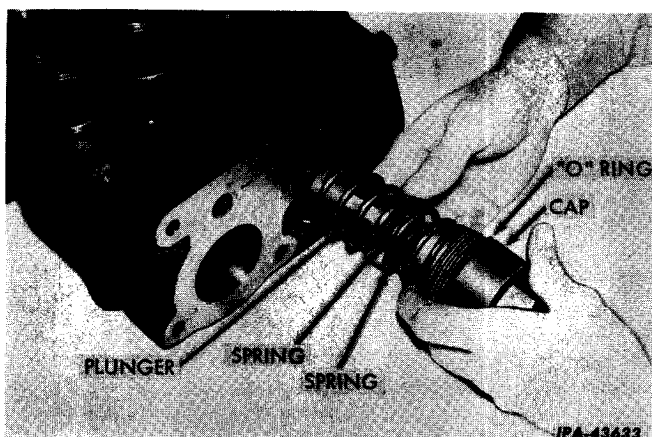


#### Flow Control Plunger

8. Remove the cap (73) with "O" ring (72), spring (71), guide (69), spring (68), dashpot plunger (67) and flow control plunger (64) from the housing (47). (Illust. 5.) Remove the retainer washer (66) and snap ring (65) from the plunger (64). Note the position of the concave side of the retainer washer for proper reassembly.

9. Remove the pipe plugs (52 and 53). Remove the poppet spring (54) and check valve poppet (55) on units so equipped.

10. If necessary to remove the check valve seat (56), remove the machine screw (60) and the set screw (not shown) under the machine screw. Insert a brass drift through the flow control plunger bore and tap the seat out through the pipe plug opening.



Illust. 5 - Removing Flow Control Plunger Assembly.

#### Plunger Lever Housing

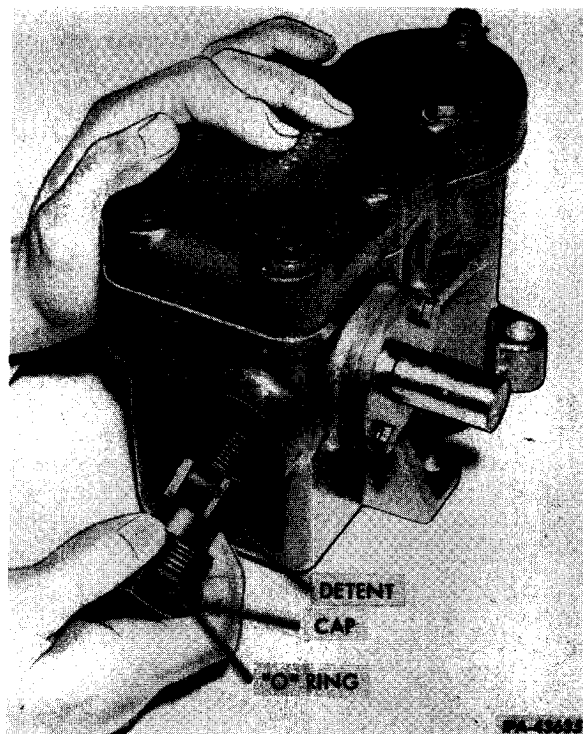
11. VZ14X2 VALVES ONLY: Remove the detent cap, spring and detent from the housing cover (1).

12. Remove the cap (3), spring (5) and detent (6) from the housing (20). (Illust. 6.)

13. Remove the plunger lever housing cover (1) and gasket (2).

14. Press the cam latch (15) down with a screwdriver, so that it is free of the spring and cam plate (28).

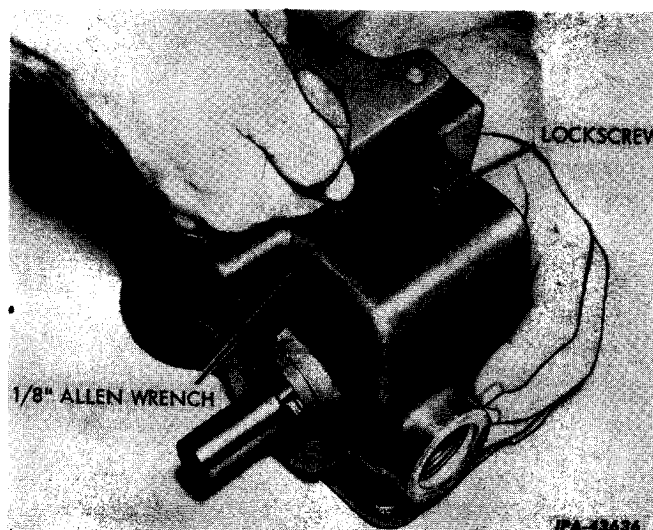
15. A set screw and lock screw in the cam plate must be removed if it is necessary to remove the control shaft (22). To get at these screws, remove the pipe plug (not shown) that is in the opposite end of the housing from the



Illust. 6 - Removing Cap and Detent.

detent bore. Rotate the control shaft (22) so that the lock screw in the cam plate is in view when looking in the pipe plug hole. Remove the lock screw with a long 1/8 inch Allen wrench (Illust. 7).

Continued on next page.



Illust. 7 - Removing Control Shaft Set Screw.



### 3. DISASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 1.)

#### Plunger Lever Housing - Continued

16. Turn the set screw from the cam plate at least five full turns so it clears the shaft (22). (Illust. 7.)

NOTE: If the set screw is not loosened enough to clear the shaft, the shaft will be damaged when it is tapped out of the housing.

17. Remove the cap screws and lock washers from the retainers (10 and 23). Remove the retainers and "O" rings (7 and 8) from the housing (20). (Illust. 8.)

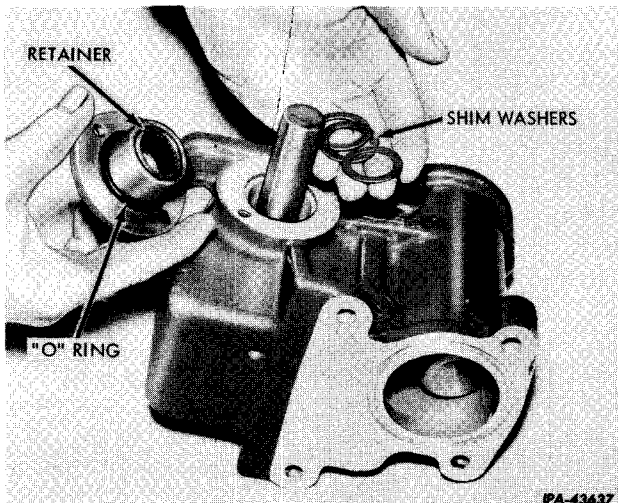
18. Remove the metal shim washers from both ends of the control shaft (22), noting their location and number for proper reassembly (Illust. 8).

NOTE: The shim washers are used to take up end play between the spring plate (26), cam plate (28) and the housing (20).

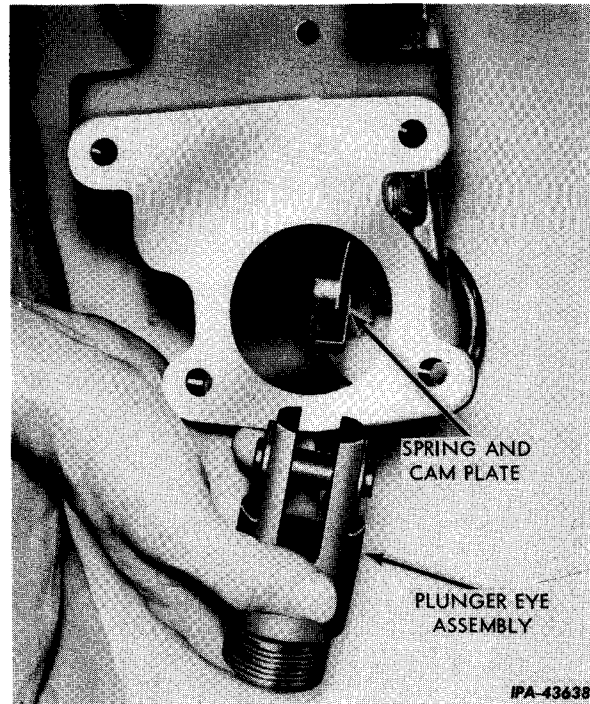
19. Tap the shaft (22) out of the housing (20) using a suitable drift and fiber hammer. The shaft is keyed to the cam plate.

20. Lift up the cam plate and the plunger eye assembly will drop out of the plunger bore opening (Illust. 9). Remove the spring and cam plate assembly from the housing.

21. Remove the snap rings (29) and plain washers (30) from the plunger eye shaft (31). Remove the shaft from the plunger eye (32).



Illust. 8 - Removing Bearing Retainer.

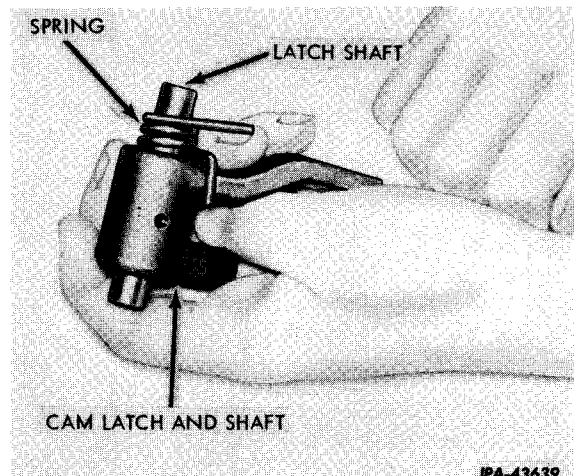


Illust. 9 - Removing Plunger Eye Assembly.

22. Remove the two caps (11) from the housing (20). Tap out the roll pin (14) that holds the cam latch to the shaft (15).

NOTE: Earlier model control valves are equipped with a three piece cam and latch shaft. The two cams are held to the latch shaft by roll pins. Both pins must be removed before the latch shaft can be removed.

Tap the latch shaft (17) out of the housing (20). Remove the cam latch (15) and spring (16) from



Illust. 10 - Position of Spring on Latch Shaft.



the housing. If necessary, press the bearings (13) out of the housing and replace.

#### 4. INSPECTION AND REPAIR

1. Discard all "O" rings and gaskets, as they must be replaced with new when assembling the valve.
2. Wash all parts in solvent and dry thoroughly.
3. Inspect all machined surfaces of the valve and its components for scoring, damage or excessive wear. Refer to Par. 2, "SPECIFICATIONS," for wear limits.
4. ON UNITS SO EQUIPPED: If the seat (42) needs to be replaced, discard the seat (42), "O" ring (43), ball (41) and spring (40), and replace them with a relief valve seat plug and "O" ring (74). (Illust. 1.)

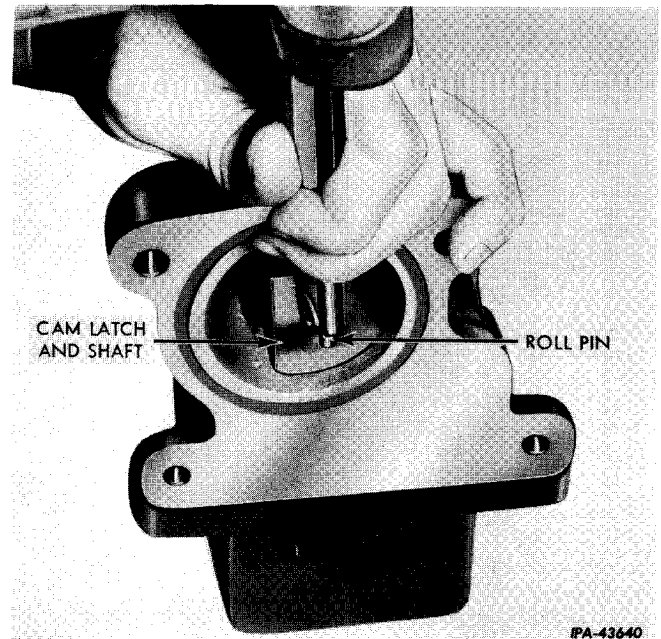
5. If the operating plunger and plunger housing are both damaged or worn excessively, a new oversize plunger will be required and the bore will have to be reamed. There is a .010 inch oversize plunger available. Refer to Section 11, "INSTALLATION OF OVERSIZE PLUNGER."

#### 5. REASSEMBLY

(Ref. Nos. Refer to Illust. 1.)

##### Plunger Lever Housing

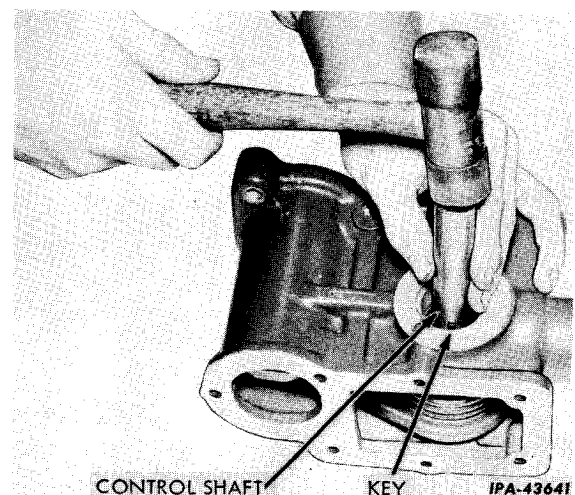
1. Press the two bearings (13) into the housing (20) if they were removed.
2. Position the cam latch (15) and spring (16) in the housing (20). Position the spring on the latch, as shown in Illust. 10. Insert the shaft (17) in the bore and through the cam latch and spring. The drilled hole in the cam latch (15) and the latch shaft (17) must be lined up.
3. Install the roll pin (14) in the drilled hole and tap it in securely (Illust. 11).
4. Install the two caps (11), with the new "O" rings (12), in the housing and tighten them securely.
5. Insert the shaft (31) in the plunger eye (32) and install the washers (30) and snap rings (29) to each end of the shaft.
6. Position the spring (27), cam plate (28) and spring plate (26) in the housing (20). Install the plunger eye (32) in the housing and engage the plunger eye shaft (31) into the cam plate (Illust. 9).



Illust. 11 - Installing Latch Shaft Roll Pin.

7. Tap the shaft (22) into the housing (20) so the key in the shaft engages the cam plate (28). (Illust. 12.)
8. Install an equal amount of shim washers (24) on each end of the shaft (22). Install the retainers (10 and 23), with new "O" rings (7 and 8), on the shaft and secure them to the housing with the cap screws and lock washers.
9. Check the cam plate assembly for end play. If there is excessive end play, remove the retainers and install an equal amount of shim

Continued on next page.



Illust. 12 - Installing Control Shaft.



## 5. REASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 1.)

### Plunger Lever Housing - Continued

washers to each end of the shaft. Install and secure the retainers.

**NOTE:** Always add shim washers at both ends of the shaft when removing end play.

10. Press the cam latch (15) down to free the cam plate (28). Rotate the cam plate assembly until the lock screw hole is in view when looking in the pipe plug opening. (Illust. 7.) Using a long Allen wrench, install the set screw in the cam plate, being sure that the screw engages the notch in the shaft (22). Install the lock screw and the pipe plug.

11. Install the detent (6), spring (5) and cap (3), with a new "O" ring (4), in the detent bore and tighten the cap securely.

12. Install the cover (1) and a new gasket to the housing and tighten the cap screws to the torque specified in Par 2, "SPECIFICATIONS."

13. VZ14X2 VALVES ONLY: Install the other detent assembly in the cover (1).

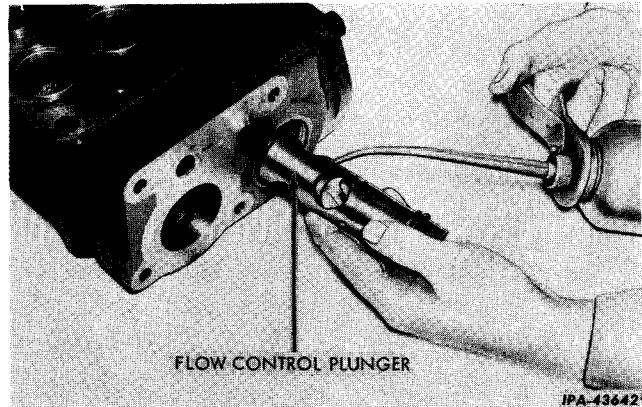
### Flow Control Plunger

14. If it was removed, install the seat (56) through the pipe plug bore which is opposite the flow control plunger bore in the housing (47). Drive the seat into place so the groove in the seat is lined up with the lock screw hole in the front of the housing. Install the set screw (not shown) into this lock screw hole and tighten securely. Install the machine screw (60) with new fiber washer (59).

15. Install the check valve poppet (55) and spring (54). Coat the threads of both pipe plugs (52 and 53) with white lead and install and tighten them securely into the housing.

16. Install the snap ring (65) on the flow control plunger (64). Coat the plunger with light oil (Illust. 13) and install the plunger into the bore of the housing. Install the retainer washer (66) over the plunger with the concave side facing up.

17. Install the dashpot plunger (67), spring (68), guide (69) and flow control spring (71) into its bore in the housing (47). (Illust. 5.) Install the cap (73) with new "O" ring (72) and tighten it securely.



Illust. 13 - Installing Flow Control Plunger.

### Control Valve

18. Place the plunger lever housing (20) in a padded vise. Rotate the shaft (22) until it is in the "FLOAT" position. This will bring the cam plate arm into a downward position so the plunger (38) can be screwed onto the plunger eye.

19. Install the check valve (37), spring (36), guide (35) and spacer (34) into the control plunger (38).

20. Screw the plunger (38) onto the plunger eye (32). Tighten it securely by inserting a brass rod into one of the oil holes of the plunger. (Illust. 4.)

21. On valves so equipped, install the relief valve seat (42), with new "O" ring (43), into the housing (47). Install the steel ball (41), spring (40) and plug (39). Tighten the plug securely. (Illust. 3.)

### Plunger Lever Housing to Valve Housing

22. Position the valve housing (47) on a bench, with the oil ports facing up. Coat the mating surfaces of the valve housing (47) and plunger lever housing (20) with light oil. Install a new "O" ring (19) into the groove of the plunger lever housing (20). Coat the plunger (38) with light oil and insert it with a twisting motion into the bore of the valve housing (47). Secure the two housings with the four socket head cap screws.

23. Install the washer (48) on the plunger (38) with the grooved side facing the housing. Install the snap ring (49) on the plunger.

24. Install the cover (51), with a new gasket (50), over the plunger.



**HYDRAULIC CONTROL VALVE**  
(Hydrex Models VZ14X2, VZ14X4, VZ14X5, VZ14X6 and VZ14X10)

Section 8

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25. Rotate the shaft (22) through the operating cycle to see that the control plunger (38) does not bind. If the plunger binds, remove the cover (1) and check the plunger eye (32) for interference with the cam plate assembly (28). If there is interference, remove the bearing retainers (10 and 23) and move the shim washers

(24) from one side to the other as needed to centralize the cam plate. When proper clearance is obtained, install the retainers and cover.

26. For adjustments, refer to Section 15 under "DIRECT LIFT HYDRAULIC SYSTEM."



HYDRAULIC CONTROL VALVE  
(Hydreco Model VZ14X12)

Section 9

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# HYDRAULIC CONTROL VALVE (Hydreco Model VZ14X12)



Section 9

Page 2

## 1. DESCRIPTION

The hydraulic control valve is used to establish a pressure control for the hydraulic system. The main components of the valve are the operating plunger and plunger check valve. Through these components the valve regulates pressure and controls the operation of the hydraulic equipment used with it. For a detailed description of control valve operation, refer to Section 1.

The anti-cavitation valve, mounted on the hydraulic pump, is used to supply oil to the pressure side of the cylinders when the pump is operating at low engine rpm, while in the power lower position. This prevents the pressure in the oil tank from increasing. It also prevents air pockets forming on the pressure side of the pump under these conditions.

## 2. SPECIFICATIONS

### Hydraulic Control Valve

Hydraulic valve make . . . . .	Hydreco
Relief valve setting at 1500 rpm . . . . .	1650 psi
Housing operating plunger bore diameter (standard) inches . . . . .	1.9718 - 1.9722
Housing operating plunger bore diameter (.010 inch oversize), inches . . . . .	1.9819
Operating plunger diameter (standard), inches . . . . .	1.9711 - 1.9713
Operating plunger diameter (.010 inch oversize), inches . . . . .	1.9811 - 1.9813
Check valve spring:	
Free length, inches . . . . .	3-3/4
Test length, inches . . . . .	1-3/8
Test load, pounds . . . . .	5

### Plunger Lever Control

Latch shaft bearing inside diameter, inch . . . . .	.500
Maximum permissible diameter, inch . . . . .	.501
Latch shaft diameter, inch . . . . .	.5000 - .5005
Minimum permissible diameter, inch . . . . .	.498
Maximum permissible clearance (bearing and shaft), inch . . . . .	.003
Control shaft bearing inside diameter, inch . . . . .	.875
Maximum permissible diameter, inch . . . . .	.876

Control shaft diameter, inch . . . . .	.8750 - .8755
Minimum permissible diameter, inch . . . . .	.8720
Maximum permissible clearance (bearing and shaft), inch . . . . .	.004
Plate assembly bushing inside diameter, inches . . . . .	1.5025
Maximum permissible diameter, inches . . . . .	1.5045
Cam plate outside diameter, inches . . . . .	1.499 - 1.502
Minimum permissible diameter, inches . . . . .	1.492
Maximum permissible clearance (plate assembly and cam plate), inch . . . . .	.012

### Anti-cavitation Valve

Check valve plunger, inches . . . . .	1.901 - 1.906
Check valve plunger spring:	
Free length, inches . . . . .	4-5/16
Test length, inches . . . . .	2-3/16
Test load, pounds . . . . .	16.9

### Torque Data (ft.-lbs.)

Plunger lever housing cover cap screws . . . . .	11
--	----

## 3. DISASSEMBLY

### Control Valve

(Ref. Nos. Refer to Illust. 1.)

1. Clean the outside of the valve with solvent and dry thoroughly. Place the valve on a clean work bench.
2. Remove the cover (48) and gasket (46).
3. Remove the spring (47) and sleeve (45).
4. Remove the snap ring (44) and spacer (43) from the end of the plunger (38).
5. Remove the four hex socket head cap screws used to attach the plunger lever housing to the valve housing (Illust. 2). Remove the plunger lever housing with plunger (38) from the valve housing. Remove the "O" ring (16).
6. Install the plunger lever housing in a padded vise. Insert a brass rod into one of the oil holes in the plunger and unscrew the plunger from the plunger eye (32). (Illust. 3.)



# HYDRAULIC CONTROL VALVE (Hydrec Model VZ14X12)

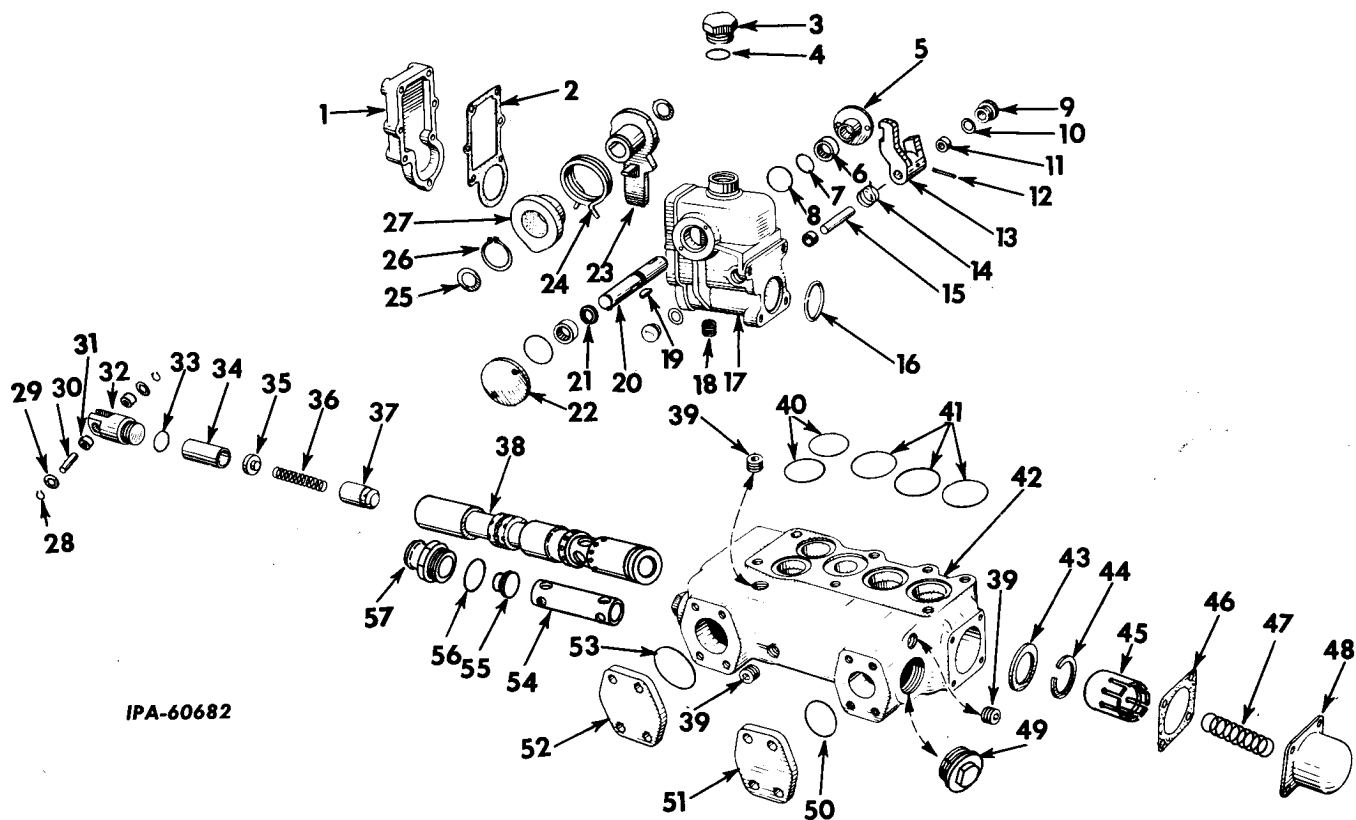
Section 9

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7. Remove the spacer (34), guide (35), spring (36) and check valve (37) from the inside of the plunger (38). Remove the plunger lever housing (17) from the vise.

8. Remove the cap (57) with "O" ring (56), plug (55), sleeve (54) and cap (49).

Continued on next page.



Illust. 1 - Exploded View of VZ14X12 Hydraulic Valve.

- |                            |                        |                |
|----------------------------|------------------------|----------------|
| 1. Housing cover.          | 20. Control shaft.     | 39. Pipe plug. |
| 2. Cover gasket.           | 21. Snap ring.         | 40. "O" ring.  |
| 3. Cap.                    | 22. Bearing retainer.  | 41. "O" ring.  |
| 4. "O" ring.               | 23. Cam plate.         | 42. Housing.   |
| 5. Bearing retainer.       | 24. Torsion spring.    | 43. Spacer.    |
| 6. Control shaft bearing.  | 25. Shim washer.       | 44. Snap ring. |
| 7. "O" ring.               | 26. Snap ring.         | 45. Sleeve.    |
| 8. "O" ring.               | 27. Spring plate.      | 46. Gasket.    |
| 9. Cap.                    | 28. Snap ring.         | 47. Spring.    |
| 10. "O" ring.              | 29. Washer.            | 48. Cover.     |
| 11. Bearing.               | 30. Plunger eye shaft. | 49. Cap.       |
| 12. Roll pin.              | 31. Bearing.           | 50. "O" ring.  |
| 13. Cam latch.             | 32. Plunger eye.       | 51. Cover.     |
| 14. Torsion spring.        | 33. "O" ring.          | 52. Cover.     |
| 15. Latch shaft.           | 34. Spacer.            | 53. "O" ring.  |
| 16. "O" ring.              | 35. Spring guide.      | 54. Sleeve.    |
| 17. Plunger lever housing. | 36. Spring.            | 55. Plug.      |
| 18. Pipe plug.             | 37. Check valve.       | 56. "O" ring.  |
| 19. Key.                   | 38. Plunger.           | 57. Cap.       |

HYDRAULIC CONTROL VALVE  
(Hydrec Model VZ14X12)



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3. DISASSEMBLY - Continued

Plunger Lever Housing

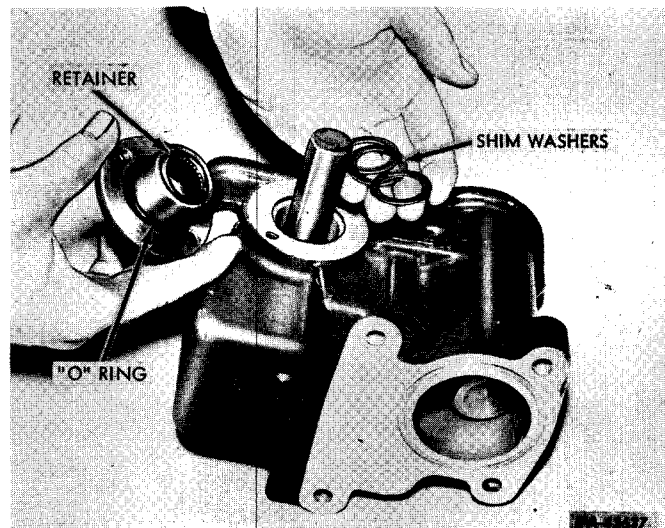
(Ref. Nos. Refer to Illust. 1.)

9. Remove the cap (3) with "O" ring (4). Remove the plunger lever housing cover (1) and gasket (2).

10. Press the cam latch (13) down with a screwdriver, so that it is free of the spring and cam plate (23).

11. Remove the cap screws and lock washers from the retainers (5 and 22). Remove the retainers and "O" rings (7 and 8) from the housing (17). (Illust. 4.)

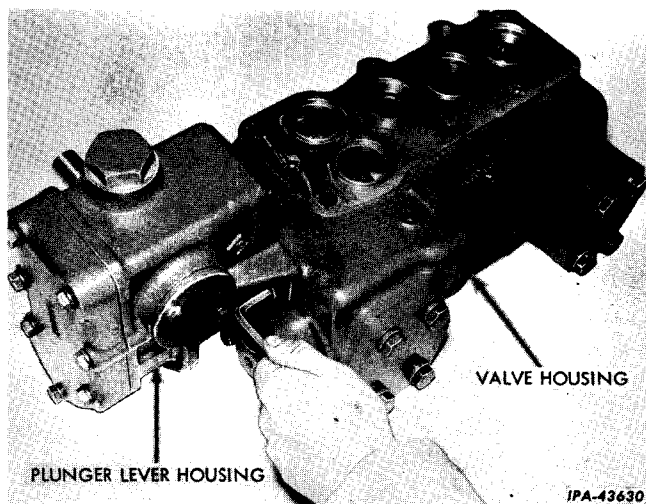
12. Remove the shim washers from both ends of the control shaft (20) noting their location and number for proper reassembly (Illust. 4.).



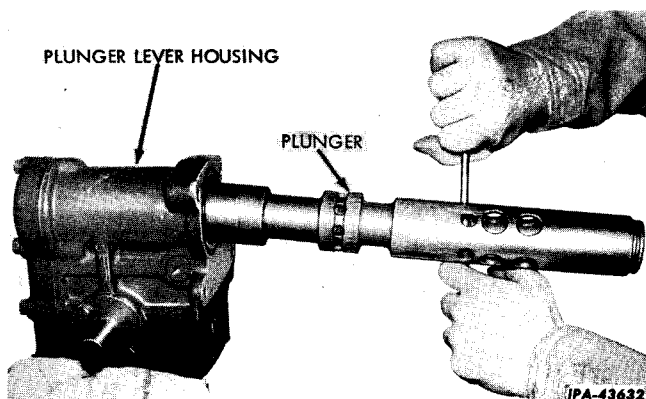
Illust. 4 - Removing Bearing Retainer.

NOTE: The shim washers are used to take up end play between the spring plate (27), cam plate (23) and the housing (17).

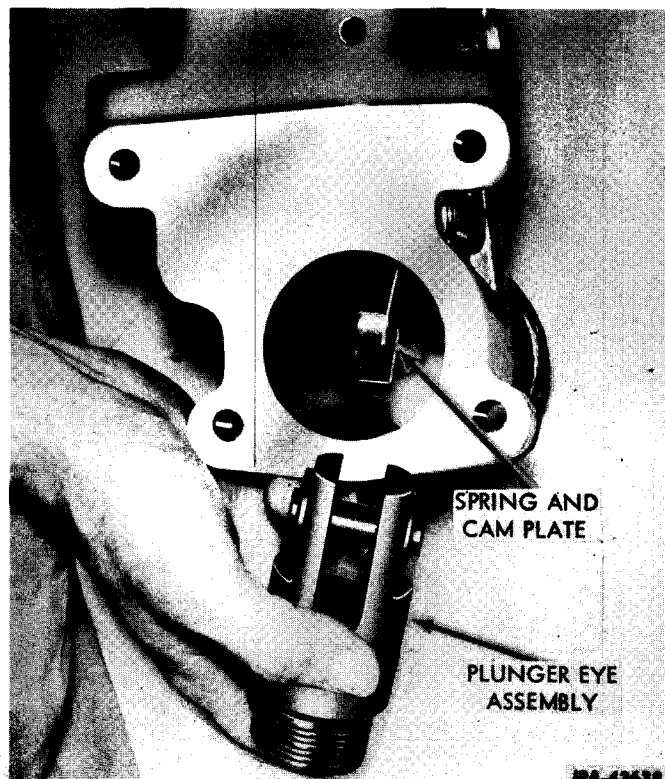
13. Remove the snap ring (21) from the control shaft (20) and tap the shaft out of the housing. The shaft is keyed to the cam plate (23).



Illust. 2 - Separating Valve Housing from Plunger Lever Housing.



Illust. 3 - Removing Plunger from Housing.



Illust. 5 - Removing Plunger Eye Assembly.



# HYDRAULIC CONTROL VALVE (Hydrex Model VZ14X12)

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14. Lift up the cam plate and the plunger eye assembly will drop out of the plunger bore opening (Illust. 5). Remove the spring and cam plate assembly from the housing.

15. Remove the snap rings (28) and plain washers (29) from the plunger eye shaft (30). Remove the shaft (30) and if necessary the bearings (31) from the plunger eye (32).

16. Remove the two caps (9) from the housing (17). Tap out the roll pin (12) that holds the cam latch (13) to the shaft.

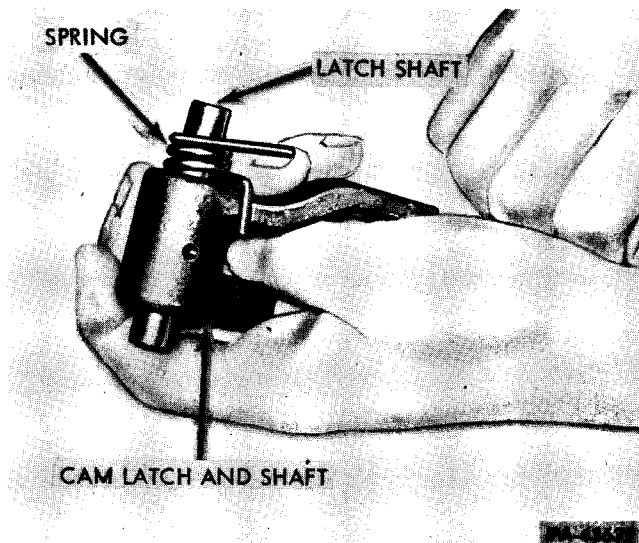
17. Tap the latch shaft (15) out of the housing (17). Remove the latch shaft (13) and spring (14) from the housing. If necessary, press the bearings (11) out of the housing and replace.

## Anti-cavitation Valve (Hydrex Model VC5X1)

(Ref. Nos. Refer to Illust. 7.)

18. Remove the anti-cavitation valve from the hydraulic pump.

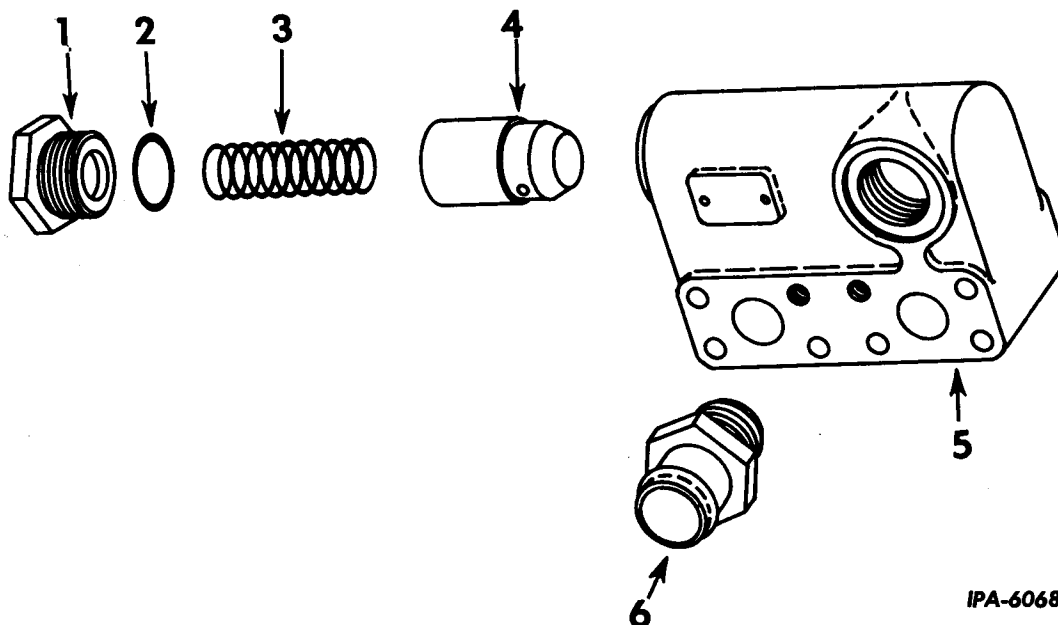
19. Clean the outside of the valve with solvent and dry thoroughly. Place the valve on a clean work bench.



Illust. 6 - Position of Spring on Latch Shaft.

20. Remove the cap (1) with "O" ring (2) from the housing.

21. Remove the spring (3) and check valve plunger (4) from the housing.



IPA-60683

Illust. 7 - Exploded View of Anti-cavitation Valve.

1. Cap.
2. "O" ring.
3. Spring.

4. Check valve plunger.
5. Housing.
6. Cap.



#### 4. INSPECTION AND REPAIR

1. Discard all "O" rings and gaskets, as they must be replaced with new when assembling the valve.
2. Wash all parts in solvent and dry thoroughly.
3. Inspect all machined surfaces of the valve and its components for scoring, damage or excessive wear. Refer to Par. 2, "SPECIFICATIONS," for the wear limits.
4. If the operating plunger and plunger housing are both damaged or worn excessively, a new oversize plunger will be required and the bore will have to be reamed. There is a .010 inch oversize plunger available. Refer to Section 11, "INSTALLATION OF OVERSIZE PLUNGER."

#### 5. REASSEMBLY

Anti-cavitation Valve (Hydrec Model VC5Xi)

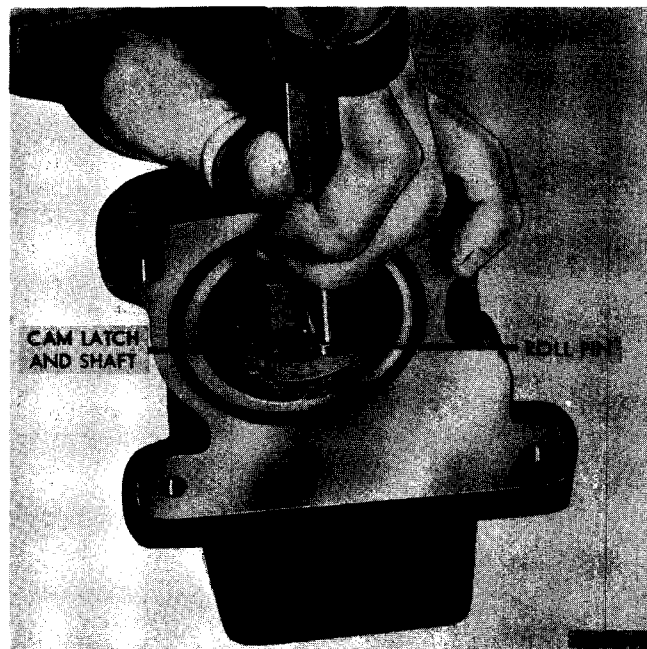
(Ref. Nos. Refer to Illust. 7.)

1. Install the check valve plunger (4) and spring (3) into the housing.
2. Install the cap (1) with new "O" ring (2) into the housing and tighten securely.
3. Install the anti-cavitation valve on the hydraulic pump.

Plunger Lever Housing

(Ref. Nos. Refer to Illust. 1.)

4. Press the two bearings (11) into the housing (17) if they were removed.
5. Position the cam latch (13) and spring (14) in the housing (17). Position the spring on the latch as shown in Illust. 6. Insert the shaft (15) in the bore and through the cam latch and spring so that the drilled hole in the cam latch and shaft are lined up. Tap the roll pin (12) through the cam latch and shaft (Illust. 8).
6. Install the two caps (9) with new "O" rings (10) in the housing and tighten them securely.
7. Press the bearings (31) into the plunger eye (32). Insert the shaft (30) in the plunger eye and install the washers (29) and snap rings (28) to each end of the shaft.
8. Position the spring (24), cam plate (23) and spring plate (27) in the housing (17). Install the plunger eye (32) in the housing and

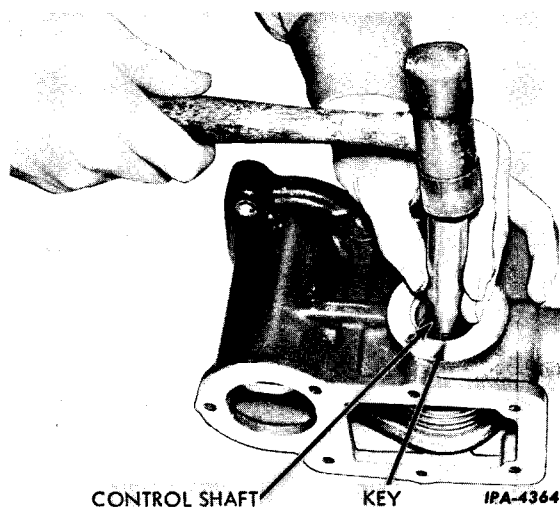


Illust. 8 - Installing Latch Shaft Roll Pin.

engage the plunger eye shaft (30) into the cam plate (Illust. 5).

9. Tap the shaft (20) into the housing (17) so the key in the shaft engages the cam plate (23). (Illust. 9.) Install the snap ring (21) on the end of the shaft (20).

10. Install the bearings (6) into the bore of the retainers (5 and 22) if they were removed.



Illust. 9 - Installing Control Shaft.



## HYDRAULIC CONTROL VALVE (Hydrex Model VZ14X12)

Section 9

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11. Install an equal amount of shim washers (25) on each end of the shaft (20). Install the retainers (5 and 22) with new "O" rings (7 and 8) on the shaft and secure them to the housing with the cap screws and lock washers.

12. Check the cam plate assembly for end play. If there is excessive end play, remove the retainers and install an equal amount of shim washers to each end of the shaft. Install and secure the retainers.

NOTE: Always add shim washers at both ends of the shaft when removing end play.

13. Install the cap (3) with new "O" ring (4) in the housing and secure.

14. Install the cover (1) and a new gasket to the housing and tighten the cap screws to the torque specified in Par. 2, "SPECIFICATIONS."

### Control Valve

(Ref. Nos. Refer to Illust. 1.)

15. Install the cap (49) into the housing (42) and secure.

16. Install the sleeve (54) and plug (55) into the housing bore. Install the cap (57) with new "O" ring (56) into the housing and tighten securely.

17. Place the plunger lever housing (17) in a padded vise. Rotate the shaft (20) until it is in the "FLOAT" position. This will bring the cam plate arm into a downward position so the plunger (38) can be screwed onto the plunger eye.

18. Install the check valve (37), spring (36), guide (35) and spacer (34) into the control plunger (38).

19. Screw the plunger (38) onto the plunger eye (32). Tighten it securely by inserting a brass drift into one of the oil holes of the plunger. (Illust. 3.)

### Plunger Lever Housing to Valve Housing

20. Position the valve housing (42) on a bench, with the oil ports facing up. Coat the mating surfaces of the valve housing (42) and plunger lever housing (17) with light oils. Install a new "O" ring (16) into the groove of the plunger lever housing (17).

21. Coat the plunger (38) with light oil and insert it with a twisting motion into the bore of the valve housing (42). Secure the two housings with the four socket head cap screws.

22. Install the spacer (43) and snap ring (44) on the end of the plunger (38).

23. Install sleeve (45), spring (47), new gasket (46) and cover (48) over the plunger and secure the cover to the housing.

24. Rotate the shaft (20) through the operating cycle to see that the control plunger (38) does not bind. If the plunger binds, remove the cover (1) and check the plunger eye (32) for interference with the cam plate assembly (23). If there is interference, remove the bearing retainers (5 and 22) and move the shim washers (25) from one side to the other as needed to center the cam plate. When proper clearance is obtained, install the retainers and cover.

25. Refer to Section 15 under "DIRECT LIFT HYDRAULIC SYSTEM," for adjustments.



HYDRAULIC CONTROL VALVE  
(Hydrec Model VZ26X12)

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# HYDRAULIC CONTROL VALVE (Hydrec Model VZ26X12)



Section 10

Page 2

## 1. DESCRIPTION

The hydraulic valve is used to establish a pressure control for the hydraulic system. The main components of the valve are the operating plunger, check valve and relief valve. Through these components the unit regulates pressure and controls the operation of the hydraulic equipment used with it. For a detailed description of control valve operation, refer to Section 1.

## 2. SPECIFICATIONS

Hydraulic valve make . . . . . Hydrec  
Relief valve setting at 1500 rpm . . . 1650 psi  
Housing operating plunger bore  
diameter (standard),  
inches . . . . . 1.6098 - 1.6102  
Housing operating plunger  
bore diameter (.010 inch oversize),  
inches . . . . . 1.6199  
Operating plunger outside diameter  
(standard), inches . . . . . 1.6092 - 1.6094  
Operating plunger outside diameter  
(.010 inch oversize), inches . 1.6182 - 1.6194

### Plunger Lever Control

Latch shaft bearing inside  
diameter, inch . . . . . .500  
Maximum permissible  
diameter, inch . . . . . .501  
Latch shaft diameter, inch . . . .5000 - .5005  
Minimum permissible  
diameter, inch . . . . . .498  
Maximum permissible clearance  
(bearing and shaft), inch . . . . .003  
Control shaft bearing inside  
diameter, inch . . . . . .875  
Maximum permissible  
diameter, inch . . . . . .876  
Control shaft diameter, inch . . .8750 - .8755  
Minimum permissible  
diameter, inch . . . . . .8720  
Maximum permissible clearance  
(bearing and shaft), inch . . . . .004  
Spring plate inside diameter,  
inches . . . . . .1.505 - 1.507  
Maximum permissible  
diameter, inches . . . . . .1.510  
Cam plate outside diameter,  
inches . . . . . .1.500 - 1.502  
Minimum permissible  
diameter, inches . . . . . .1.498  
Maximum permissible clearance  
(spring plate and cam plate),  
inch . . . . . .012

## Springs

Control valve check valve spring:  
Free length, inches . . . . . 4  
Test length, inches . . . . . 2-1/2  
Test load, pound . . . . . 1  
Relief valve plunger spring:  
Free length, inches . . . . . 6  
Test length, inches . . . . . 4-53/64  
Test load, pounds . . . . . 450  
Manifold check valve plunger spring:  
Free length, inches . . . . . 2-7/16  
Test length, inches . . . . . 1-1/2  
Test load, pounds . . . . . 3

## Torque Data (ft.-lbs.)

Plunger lever housing cover  
cap screws . . . . . 11  
Manifold to valve housing  
cap screws . . . . . 50

## 3. DISASSEMBLY

(Ref. Nos. Refer to Illust. 1.)

### Control Valve

1. Clean the outside of the valve with solvent and dry thoroughly. Place the valve on a clean work bench.
2. Remove the eight cap screws that secure the manifold (59) to the valve housing (33). Remove the manifold from the valve housing.
3. Remove the "O" rings (67 and 68) from the ports in the valve housing (33).
4. Remove the plunger cover (49), gasket (51) and spacer (50).
5. Remove the sleeve (52). Remove the snap ring (53) from the exposed end of the plunger (54). Inspect the snap ring groove for nicks or burrs, and remove them with an India stone or fine file.
6. Remove the four socket head cap screws (77 and 78) that secure the plunger lever housing (10) to the valve housing (33) and, using a twisting motion, remove the housing (10) and plunger (54) from the housing (33).

NOTE: When removing the plunger lever housing from the valve housing, the operating plunger will come with it. The reason for this is the plunger eye engages and is held in place by the spring and cam plate assembly (76) located in the plunger lever housing.



7. Install the plunger lever housing (10) in a padded vise.

CAUTION: DO NOT apply excessive pressure when tightening the housing in the vise as the casting is made of aluminum and may crack or distort.

8. Rotate the shaft (18) into the "FLOAT" position. Disengage the plunger (54) from the cam plate (76).

9. Remove the two snap rings (55), two washers (56) and plunger eye shaft (58) from the plunger. Remove the bearings (57) only if necessary.

10. Remove the pipe plug (35), cap (34) and cap (46) with "O" ring (45).

11. Remove the pipe plugs (72 and 71) and plug (70). Insert a suitable drift in the pipe plug opening and push the sleeve (42) and plug (43) out through the bore. Remove the "O" ring from the plug (43).

12. Remove the relief valve cap (41) with "O" ring (40). Remove the spring (39) and plunger (38).

13. Remove the plug (31) and, through this hole, drive the relief valve seat (37) out through the cap hole. Remove the "O" ring (36) from the seat (37).

14. Remove the plug (26), spring (27), check valve (28) and seat (29).

#### Plunger Lever Housing

15. Remove the exposed key (17) from the shaft (18).
16. Remove the cover (3) and gasket (4) from the plunger lever housing.
17. Remove the cover cap (9) with "O" ring (8) from the housing (10).
18. Remove the retainers (15 and 75), with bearings (14), "O" rings (13) and washers (11 and 12), from the housing. Remove the bearings from the retainers only if necessary.
19. Tap the shaft (18) out of the housing.

NOTE: The cam plate (76) is keyed to the shaft.

20. Remove the spring and cam plate assembly (76, 5, 6, and 7) from the housing. To disassemble, remove the snap ring (7).

21. Remove the caps (25) with "O" rings (24) from both sides of the housing (10). Drive out the roll pin (20) from the cam and latch (21). Remove the shaft (22), cam and latch (21) and spring (32). Remove the bearings (23) from the housing only if necessary.

NOTE: When removing the above parts, note their position and sequence.

#### Manifold

22. Remove the covers (61) and "O" rings (60) from the manifold (59).
23. Remove the cap (65) with "O" ring (64), spring (63) and plunger (62) from the manifold.
24. Remove the four "O" rings (66) from the ports in the manifold.

#### 4. INSPECTION AND REPAIR

1. Discard all "O" rings and gaskets as they must be replaced with new when assembling the valve.
2. Wash all parts in solvent and dry thoroughly.
3. Inspect all machined surfaces of the valve and its components for scoring, damage or excessive wear. Refer to Par. 2, "SPECIFICATIONS," for wear limits.
4. If the operating plunger and plunger housing are both damaged or worn excessively, a new oversize plunger will be required and the bore will have to be reamed. There is a .010 inch oversize plunger available. Refer to Section 11, "INSTALLATION OF OVERSIZE PLUNGER."

#### 5. REASSEMBLY

(Ref. Nos. Refer to Illust. 1.)

#### Plunger Lever Housing

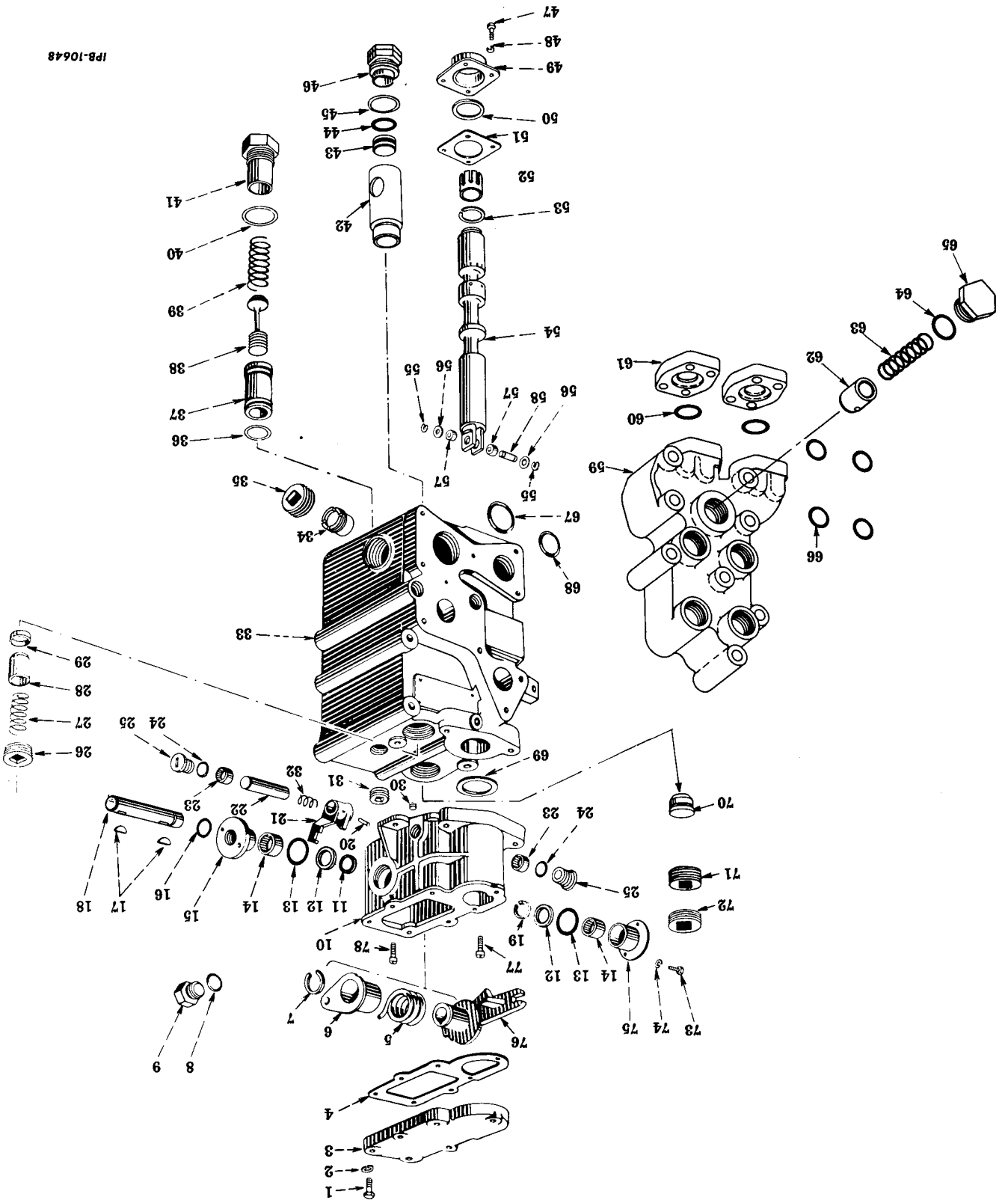
1. Press the bearings (57) into the eye of the plunger (54) if they were removed. Install the shaft (58), two washers (56) and snap rings (55).
2. Press the bearings (14) into the two retainers (75 and 15), if they were removed, and install the "O" rings (13) on the retainers.
3. Press the bearings (23), if they were removed, into the plunger lever housing (10). Install the latch shaft (22) through one bearing in the housing.

Continued on page 5.



# HYDRAULIC CONTROL VALVE (Hydrex Model VZ26X12)

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Illustr. 1 - Exploded View of Valve Assembly.

IPB-10648



HYDRAULIC CONTROL VALVE  
(Hydreco Model VZ26X12)

Section 10

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Legend for Illust. 1.

- |                                  |                            |
|----------------------------------|----------------------------|
| 1. Cap screw.                    | 40. "O" ring.              |
| 2. Lock washer.                  | 41. Cap.                   |
| 3. Cover.                        | 42. Sleeve.                |
| 4. Gasket.                       | 43. Plug.                  |
| 5. Torsion spring.               | 44. "O" ring.              |
| 6. Spring plate.                 | 45. "O" ring.              |
| 7. Snap ring.                    | 46. Cap.                   |
| 8. "O" ring.                     | 47. Cap screw.             |
| 9. Cover cap.                    | 48. Lock washer.           |
| 10. Plunger lever housing.       | 49. Plunger cover.         |
| 11. Shim washer.                 | 50. Spacer.                |
| 12. Washer.                      | 51. Gasket.                |
| 13. "O" ring.                    | 52. Sleeve.                |
| 14. Control shaft bearing.       | 53. Snap ring.             |
| 15. Bearing retainer.            | 54. Control valve plunger. |
| 16. "O" ring.                    | 55. Snap ring.             |
| 17. Woodruff key.                | 56. Washer.                |
| 18. Control shaft.               | 57. Plunger eye bearing.   |
| 19. Snap ring.                   | 58. Plunger eye shaft.     |
| 20. Roll pin.                    | 59. Manifold.              |
| 21. Cam and latch.               | 60. "O" ring.              |
| 22. Latch shaft.                 | 61. Cover.                 |
| 23. Cam and latch shaft bearing. | 62. Check valve plunger.   |
| 24. "O" ring.                    | 63. Spring.                |
| 25. Cap.                         | 64. "O" ring.              |
| 26. Pipe plug.                   | 65. Cap.                   |
| 27. Spring.                      | 66. "O" ring.              |
| 28. Check valve.                 | 67. "O" ring.              |
| 29. Check valve seat.            | 68. "O" ring.              |
| 30. Pipe plug.                   | 69. "O" ring.              |
| 31. Pipe plug.                   | 70. Plug.                  |
| 32. Spring.                      | 71. Pipe plug.             |
| 33. Valve housing.               | 72. Pipe plug.             |
| 34. Cap.                         | 73. Cap screw.             |
| 35. Pipe plug.                   | 74. Lock washer.           |
| 36. "O" ring.                    | 75. Bearing retainer.      |
| 37. Relief valve seat.           | 76. Cam plate.             |
| 38. Relief valve plunger.        | 77. Cap screw.             |
| 39. Spring.                      | 78. Cap screw.             |

5. REASSEMBLY - Continued.

(Ref. Nos. Refer to Illust. 1.)

Plunger Lever Housing - Continued

4. Position the cam and latch (21) and spring (32) in the housing (10). Tap the shaft (22) through the spring (32) and cam and latch (21) into the bearing (23) in the opposite end of the housing.
5. Align the drilled hole in the cam and latch (21) with the hole in the shaft (22) and secure with the roll pin (20). Install the caps (25) with new "O" rings (24) in the housing (10).
6. Assemble the cam plate (76), torsion spring (5) and spring plate (6) and secure with the snap ring (7). Position the assembly in the housing (10) so the notch in the cam plate is in line with the tapped hole in the end of the housing.
7. Insert the shaft (18) through the housing (10) and cam plate assembly (76), aligning the key (17) in the shaft with the key slot in the cam plate.
8. Install an equal amount of shim washers (11) on each end of the shaft (18). Install bearing retainers (75 and 15) with new "O" rings on the shaft and secure to the housing. If the cam plate end play is excessive, remove the retainers and install additional shim washers equally on both ends of the shaft. After securing the retainers, install the other key (17) on the exposed end of the shaft.

Continued on next page.



## 5. REASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 1.)

### Plunger Lever Housing - Continued

9. Install the cap (9) with new "O" ring (8) into the housing (10) and tighten securely.

10. Coat both sides of the gasket (4) with non-hardening Never-Seez compounds or its equivalent. Install the gasket and the cover (3) on the housing and tighten the cap screws to the torque specified in Par. 2, "SPECIFICATIONS."

### Control Valve

11. Install the sleeve (42) into the housing (33). Install a new "O" ring (44) on the plug (43) and install the plug in the housing. Install the cap (46) with a new "O" ring (45).

12. Install the plug (70) into the housing (33). Coat the threads of the pipe plugs (71 and 72) with white lead and install and tighten them into the housing securely.

13. Install the cap (34) and plug (35) into the housing bore and tighten it securely.

14. Install a new "O" ring (36) in the groove of the seat (37). Lubricate the "O" ring with light grease. Drive the seat into its bore until it bottoms in the housing.

15. Coat the plunger (38) with light oil and insert it into the bore of seat (37).

NOTE: DO NOT grind or lap the mating surfaces.

16. Install the spring (39). Install a new "O" ring (40) on the cap (41) and install the cap in the bore.

17. Install the pipe plug (31) and tighten it securely.

18. Install the check valve seat (29), valve (28), spring (27) and plug (26) in the housing (33).

NOTE: If a new check valve (28) is to be installed, re-seat the valve by lapping it in the seat with valve grinding compound until a good seat surface shows on both valve and seat. Clean off the compound before proceeding with reassembly.

### Plunger Lever Housing to Valve Housing

19. Place the plunger lever housing (10) in a padded vise.

ISS-1029Y. (2-61.)

CAUTION: DO NOT apply excessive pressure when tightening the plunger lever housing in the vise as the casting is made of aluminum and may crack or distort.

20. Rotate the shaft (18) to the "FLOAT" position. Install the eye end of the plunger (54) into the slot in the cam plate (76).

21. Rotate the shaft (18) to the neutral position.

22. Remove the plunger lever housing (10) from the vise. Install a new "O" ring (69) in the groove in the face of the housing (10).

23. Lubricate the plunger (54) with a light coat of clean oil and insert the plunger into the bore of the housing (33) with a twisting motion.

24. Secure the housings (10 and 33) with the four socket head cap screws.

25. Install the snap ring (53) on the plunger (54). Install the sleeve (52) over the end of the plunger (54). Place the spacer (50) into the cover (49). Using a new gasket (51), install the cover on the housing and secure with the four lock washers and cap screws.

26. Rotate the shaft (18) through the operating cycle to be sure the plunger (54) does not bind. If the plunger binds, remove the cover (3) and check the eye of the plunger for interference with the spring and cam plate assembly (76). If there is interference, remove the bearing retainers (15 and 75) and remove the shim washers (11) or transfer from one side to the other as needed to center the cam plate. When proper clearance is obtained, install the retainers and cover.

### Manifold to Valve Housing

27. Install the new "O" rings (60) into the recesses of the covers (61). Install the covers to the manifold (59) and secure with lock washers and cap screws.

28. Install the plunger (62) and spring (63) in the bore of the manifold (59). Install a new "O" ring (64) on the cap (65) and install the cap in the bore and tighten it securely.

29. Install new "O" rings (67 and 68) in the ports of the housing (33).

30. Assemble the manifold (59) to the housing (33) and tighten the cap screws to the torque specified in Par. 2, "SPECIFICATIONS."



**HYDRAULIC CONTROL VALVE**  
(Hydreco Model VZ26X12)

Section 10

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31. Install four new "O" rings (66) in the ports of the manifold (39).

32. Refer to Section 15 under "DIRECT LIFT HYDRAULIC SYSTEM," for adjustments.



Following is a suggested method for reaming the valve housing to accommodate the .010 inch oversize operating plunger.

This work can be done on a single spindle drill press or a radial drill, with at least a 24 inch clearance between the drill spindle and the housing and at least a 14 inch stroke (Illust. 1).

NOTE: Horizontal reaming is not recommended as the tool will flex and cut an elliptical bore.

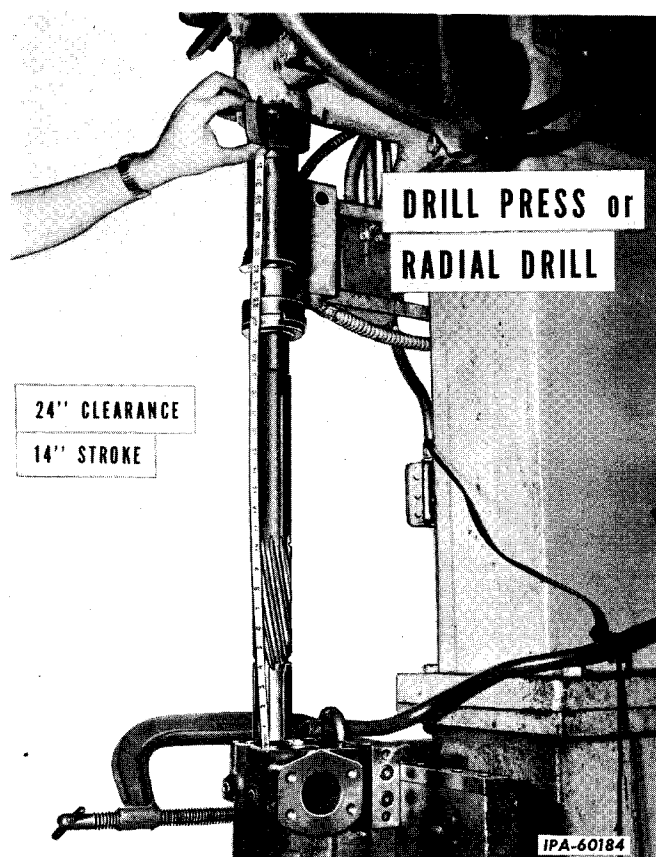
The tools shown in Illust. 2 are the ones needed to perform the reaming process. (Refer to I Illust. 3 for the dimensional drawing of the reamer and Illust. 4 for the dimensional drawing of the aligning bar.) The compensating tool holder may be purchased from the J.C. Glenzer Co., 6463 Epworth Blvd., Detroit 10, Michigan, by part number type "H."

1. Insert two 9/16 inch dowels into the housing as shown in Illust. 5. Place the assembly on a vertical plate and secure with a "C" clamp.

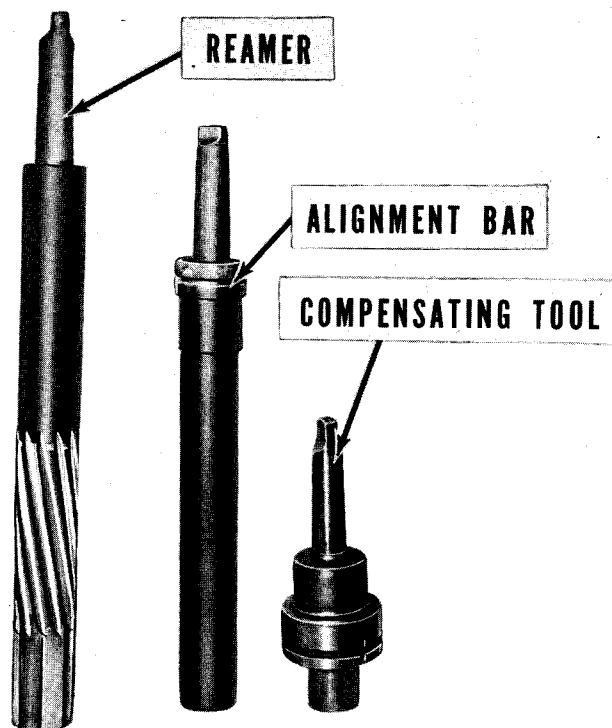
2. Install the compensating tool holder and alignment bar into the spindle and align the housing (Illust. 6).

3. Replace the alignment bar with the reamer. Set the machine for a .010 feed at 200 rpm. During the reaming operation, the chips must be washed out with a steady flow of petroleum base lubricant. (DO NOT use water base.) This operation should be done in one pass and the carbide tip of the reamer must pass through the entire bore of the housing.

4. Inspect the bore for clearance, taper and out-of-round. The clearance between the plunger and new bore should be between .0008 inch and .001 inch and the bore taper and out-of-round should not exceed .0002 inch.



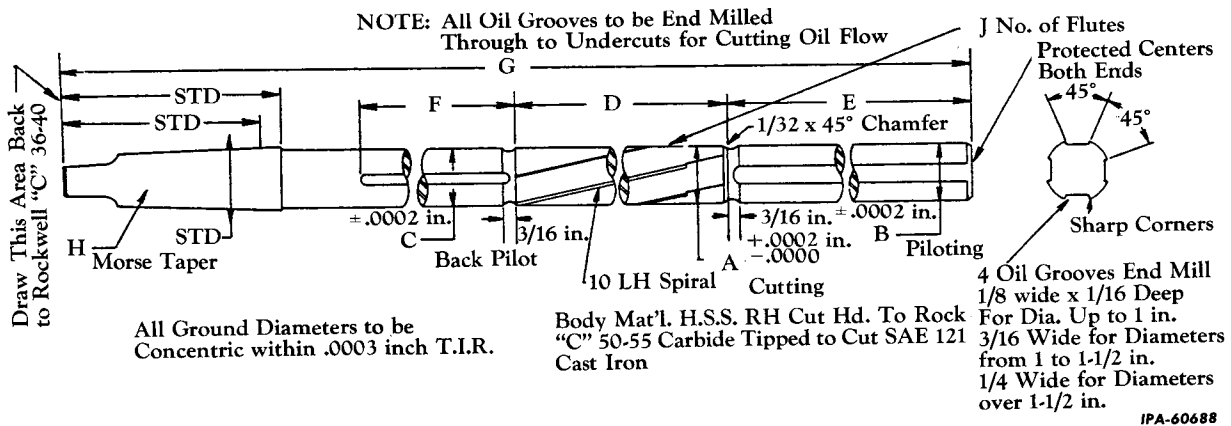
Illust. 1 - Drill Press or Radial Drill.



Illust. 2 - Tools.

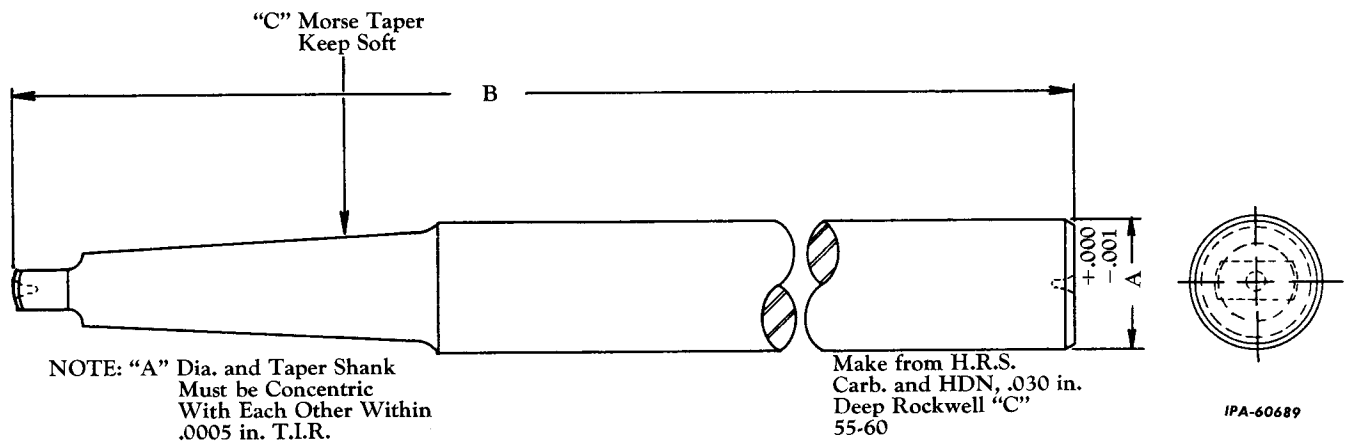
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## INSTALLATION OF OVERSIZE PLUNGER



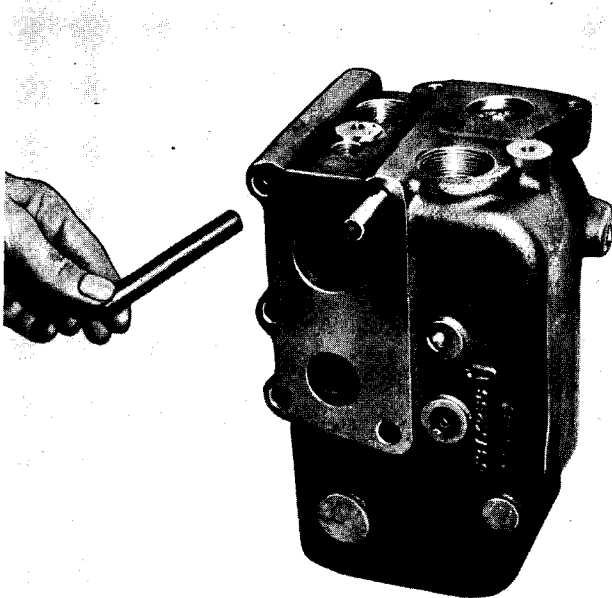
Illust. 3 - Reamer Dimensional Drawing.

Hydrex Model	A	B	C	D	E	F	G	H	J
VZ26X1, VZ26X4 and VZ26X12	1.6199 in.	1.6090 in.	1.6190 in.	4-3/4 in.	3-1/4 in.	12-3/8 in.	24-3/8 in.	Morse Taper No. 3	8 Flutes
VZ14X2, VZ14X4, VZ14X5, VZ14X6, VZ14X10 and VZ14X12	1.9819 in.	1.9710 in.	1.9810 in.	5 in.	3-1/4 in.	12-1/8 in.	24-1/4 in.	Morse Taper No. 3	8 Flutes



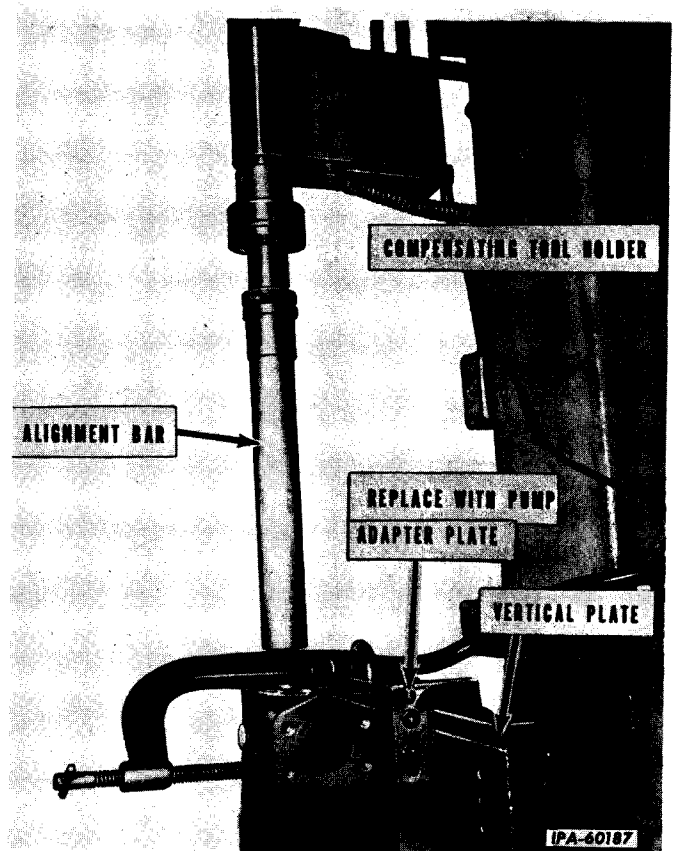
Illust. 4 - Aligning Bar Dimensional Drawing.

Hydrex Model	"A" Dia.	"B" Lg.	"C"
VZ26X1, VZ26X4 and VZ26X12	1.6085 in. +.000 -.001	17 inches	No. 3 Morse Taper
VZ14X2, VZ14X4, VZ14X5, VZ14X6, VZ14X10 and VZ14X12	1.9705 in. +.000 -.001	21 inches	No. 3 Morse Taper



IPA-60186

Illust. 5 - TD-14 Housing Shown (Others Similar).



Illust. 6 - Aligning Housing with Alignment Bar.





HYDRAULIC CYLINDER  
(For T and TD-6 (61 Series), T and TD-6 (62 Series), TD-9 (91 Series) and  
TD-9 (92 Series) Crawler Tractors)

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# HYDRAULIC CYLINDER

(For T and TD-6 (61 Series), T and TD-6 (62 Series), TD-9 (91 Series) and TD-9 (92 Series) Crawler Tractors)



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Page 2

## 1. DESCRIPTION

The hydraulic cylinders used on these units are of the double acting type. They are used to raise and lower the blade equipment to which they are attached. Refer to your operator's manual for removal and installation of the cylinder.

## 2. SPECIFICATIONS

Number of cylinders . . . . . 2  
Make and model . . . . . IHC  
Type . . . . . Single stage, double acting

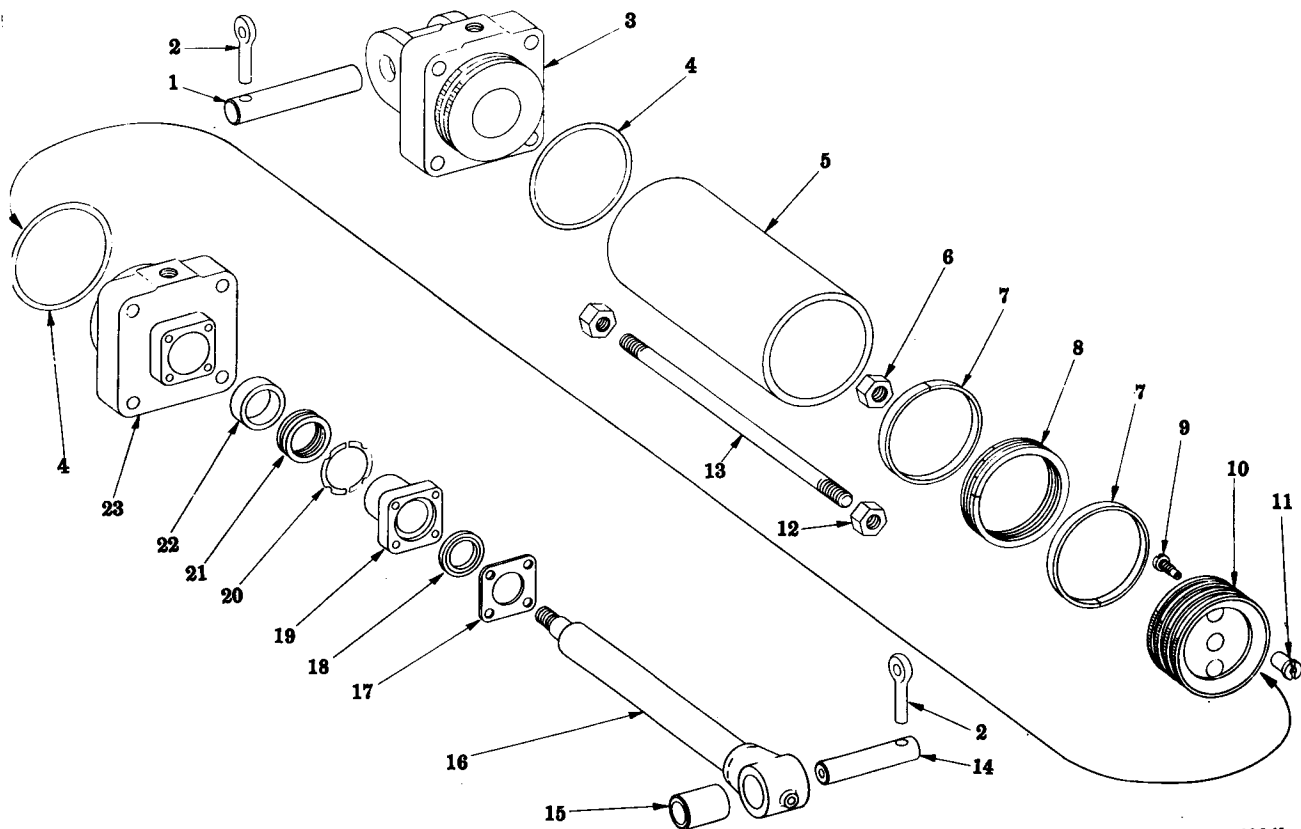
## Torque Data (ft.-lbs.)

Retainer plate cap screws . . . . . 45-50  
Valve ends . . . . . 85-95  
Self-locking nut . . . . . 400-475

## 3. DISASSEMBLY

(Ref. Nos. Refer to Illust. 1.)

1. Clean the cylinder thoroughly in solvent.
2. Remove the four nuts (12) from the tie rods (13) at the cylinder head (3).
3. Remove the cylinder head and "O" ring (4) from the cylinder (5).



IPA-43041

Illust. 1 Exploded View of Hydraulic Cylinder.

- |                      |                 |                      |
|----------------------|-----------------|----------------------|
| 1. Clevis pin.       | 9. Valve end.   | 17. Plate.           |
| 2. Lock pin.         | 10. Piston.     | 18. Dust seal.       |
| 3. Cylinder head.    | 11. Valve stem. | 19. Packing gland.   |
| 4. "O" ring.         | 12. Nut.        | 20. Shims.           |
| 5. Cylinder.         | 13. Tie rod.    | 21. Chevron packing. |
| 6. Self-locking nut. | 14. Clevis pin. | 22. Bushing.         |
| 7. Rings.            | 15. Bushing.    | 23. Cylinder cap.    |
| 8. Piston packing.   | 16. Piston rod. |                      |



# HYDRAULIC CYLINDER

(For T and TD-6 (61 Series), T and TD-6 (62 Series), TD-9 (91 Series) and TD-9 (92 Series) Crawler Tractors)

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4. Remove the four tie rods (13) with nuts (12) from the cylinder cap (23). Slide the piston rod and assembled parts out of the cylinder (Illust. 2).

5. Remove the self-locking nut (6) from the piston rod (16) and slide the piston (10) off of the piston rod.

6. If necessary to remove them, unstake the relief valve ends (9) and unscrew them from the valve stems (11). The stems will then drop out of the piston (10).

7. Loosen the four cap screws in the retainer plate (17) to relieve the pressure on the packing. Slide the piston rod (16) out of the cylinder cap and packing gland assembly.

8. Remove the four cap screws and lock washers from the retainer plate (17) and remove the

packing gland (19), shims (20) and chevron packing (21) from the cylinder cap (23).

9. If necessary, remove the self-aligning bushing (15) by torch cutting the ball width on the inside at three points approximately 120 degrees apart as shown in Illust. 3. Make a single cut (on the inside) through one of the two bushing halves, to permit race and snap ring removal.

## 4. INSPECTION AND REPAIR

(Ref. Nos. Refer to Illust. 1.)

1. Clean all parts in an oil solvent and dry thoroughly with compressed air.

2. Inspect the piston wear rings (7) and piston packing (8) and replace if necessary.

3. Replace all "O" rings.

4. Inspect the dust seal (18) in the packing gland (19) and replace if necessary. The seal is pressed into the gland.

5. Inspect the bushing (22) in the cylinder cap (23) for wear and replace if necessary. The bushing is pressed into the cap.

6. Inspect the inside bore of the cylinder (5) for scoring or excessive wear. Replace if necessary.

## 5. REASSEMBLY

(Ref. Nos. Refer to Illust. 1.)

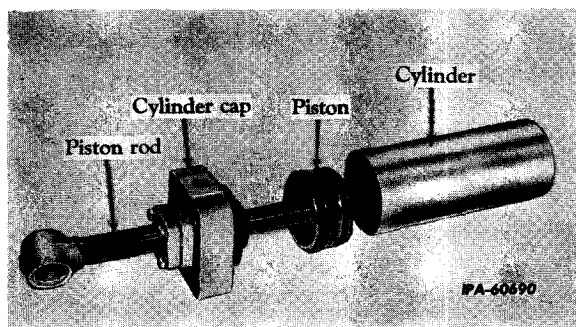
1. If a new self-aligning bushing (15) is to be installed in the piston rod, remove the shipping wire or tape that binds the two halves of the bushing together and discard it.

NOTE: This wire is used for shipping purposes only and is not to be confused with the snap ring retainer which is a strong square section steel snap ring.

2. Remove all rust, scale or paint from the bore in the piston rod end so it will not be forced into the snap ring groove.

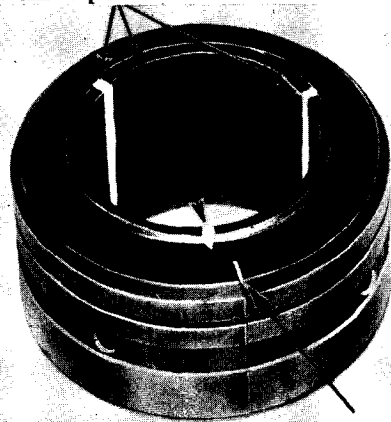
3. Compress the snap ring and bushing halves together with a hose clamp or a compressor tool. Smear a light coat of grease in the piston rod bushing bore.

4. Press the bushing and snap ring into the bore of the piston rod with an arbor press until



Illust. 2 - Piston Rod and Assembled Parts Removed.

Torch cut ball width (on the inside) at these three points



Make single cut through bushing halves at this point (on the inside)

PA-52661

Illust. 3 - Removal of Self-aligning Bushing.

Continued on next page.

**HYDRAULIC CYLINDER**  
(For T and TD-6 (61 Series), T and TD-6 (62 Series), TD-9 (91 Series) and  
TD-9 (92 Series) Crawler Tractors)



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**5. REASSEMBLY - Continued**

(Ref. Nos. Refer to Illust. 1.)

the snap ring is part way in the bore. Remove the hose clamp or compressor tool and then press the bushing all the way in until the snap ring has seated in the groove.

5. Install the chevron packing (21) into the cylinder cap (23). The point of the V-sections of the packing must be facing the piston rod eye when the cap and rod are assembled.

6. Install the packing gland (19) into the cylinder cap (23). Tap the gland lightly to seat the packing properly. Hold the gland against the packing with approximately 25 pounds hand pressure. Determine the number of shims (20) which will fill the gap between the packing gland (19) and the cylinder cap (23) and add one additional set of shims.

7. Install the retainer plate (17) on the packing gland (19), but do not tighten the cap screws.

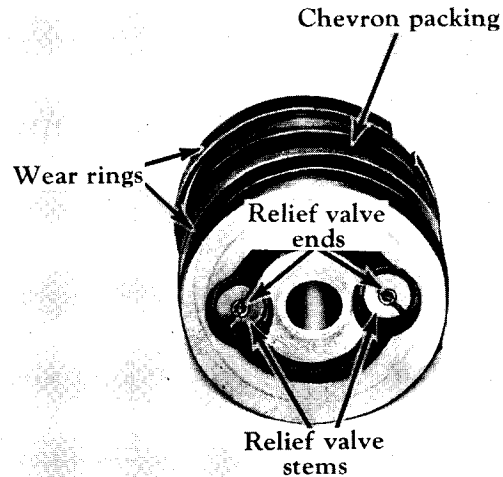
8. Slide the piston rod (16) through the packing gland and cylinder cap. Tighten the four retainer plate cap screws to the torque specified in Par. 2, "SPECIFICATIONS."

9. Install a new "O" ring (4) on the cylinder cap (23).

10. Install the wear rings (7) and chevron packing (8) on the piston (10) (Illust. 4). Stagger the slots of the packing at least 1/2 inch apart. The packing must be installed so that the point of the V-section will be facing away from the piston rod eye when the piston and rod are assembled.

11. Install both relief valve stems (11) into the piston (10). Tighten the valve ends (9) into the stems to the torque specified in Par. 2, "SPECIFICATIONS." Stake the valve ends into the slots on the valve stems as shown in Illust. 4.

12. Install the piston (10) on the piston rod (16) and secure with the self-locking nut (6).



IPA-60691

**Illust. 4 - Piston Assembly.**

Tighten the nut to the torque specified in Par. 2, "SPECIFICATIONS."

13. Soak the piston (8) with oil and coat the inside of the cylinder with oil.

14. Slide the piston and rod assembly into the cylinder, being careful not to damage the wear rings or packing. (Illust. 3.)

15. Install the cylinder head (3) with new "O" ring (4) on the cylinder (5).

16. Install the four tie rods (13) and eight nuts (12).

**NOTE:** The hydraulic port in the cylinder head (3) and cylinder cap (23) must both be on the same side.

17. The proper tightening of the piston rod packing (21) is determined by the amount of oil on the piston rod (16) during operation. The piston rod should be covered with a light film of oil. If too heavy an oil coating appears on the rod, take out a shim or two. If no oil appears on the rod, add shims as needed.



HYDRAULIC CYLINDER  
(For TD-14A (141 Series) and TD-18A (181 Series) Crawler Tractors)

Section 13

Page 1

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4. Inspection and Repair . . . . .	2
5. Reassembly . . . . .	2 to 4



## 1. DESCRIPTION

The hydraulic cylinders used on these units are of the double acting type. They are used to raise and lower the blade equipment to which they are attached. Refer to your operator's manual for instructions on the removal and installation of the cylinders.

## 2. SPECIFICATIONS

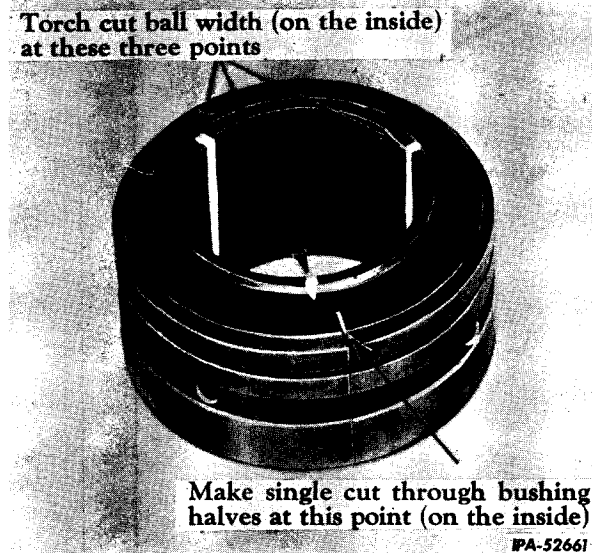
Number of cylinders . . . . . 2  
Make and model . . . . . IHC  
Type . . . . . Single stage, double acting  
Torques, ft-lbs. . . . . Standard

## 3. DISASSEMBLY

(Ref. Nos. Refer to Illust. 2.)

1. Clean the outside of the cylinder with an oil solvent and dry thoroughly.
2. Punch mark the cylinder head (2) and cylinder (18) to assure proper reassembly.
3. Remove the eight nuts securing the cylinder head (2) to the cylinder (18).
4. Remove the cylinder head (2) and "O" ring (3) from the cylinder (18).
5. Remove the cotter pin (4) from the nut (5) and remove the nut.
6. Slide the piston rod (14) out of the cylinder, being careful not to damage the oil seal (17).
7. Cut and remove the lockwire (16) and remove both cap screws (13) from the retainer (12). Remove the retainer.
8. If the oil seal (17) needs to be replaced, remove it from the retainer (12).
9. Pull the piston (7) out of the cylinder head end of the cylinder (18) by hooking it through the piston rod hole or pushing with a small rod from the piston rod end of the cylinder (18).
10. If the piston rings (6) need to be replaced, remove them from the piston. Be careful not to scratch the piston surface.
11. Remove the packing (11) from the bushing (8).

12. If necessary, remove the piston rod bushing (8) by pressing it free from the piston rod end of the cylinder (18).



Illust. 1 - Removal of Self-aligning Bushing.

13. If necessary, remove the plug (9) and ball check retainer (21).
14. If necessary, remove the self-aligning bushing (15) by torch cutting the ball width on the inside at three points approximately 120 degrees apart as shown in Illust. 1. Make a single cut (on the inside) through one of the two bushing halves, to permit race and snap ring removal.

## 4. INSPECTION AND REPAIR

(Ref. Nos. Refer to Illust. 2.)

1. Wash all parts in an oil solvent and dry thoroughly with compressed air.
2. Inspect all parts and replace any parts showing damage or excessive wear.
3. Check the inside bore of the cylinder (18) for scoring or excessive wear and replace if necessary.
4. Replace all "O" rings.

## 5. REASSEMBLY

(Ref. Nos. Refer to Illust. 2.)

1. If a new self-aligning bushing (15) is to be installed in the piston rod, remove the shipping wire or tape that binds the two halves of the bearing together and discard it.



# HYDRAULIC CYLINDER (For TD-14A (141 Series) and TD-18A (181 Series) Crawler Tractors)

Section 13

Page 3

NOTE: This wire is used for shipping purposes only and is not to be confused with the bushing retainer ring which is a strong square section steel snap ring.

2. Remove all rust, scale or paint from the bore in the piston rod ends to prevent rust, scale or paint from being forced into the snap ring groove.

3. Compress the snap ring and bushing halves together with a hose clamp or compressor tool.

4. Smear a light coat of grease in the bushing bore of the piston rod. Press in the bushing and snap ring until the snap ring seats in its groove.

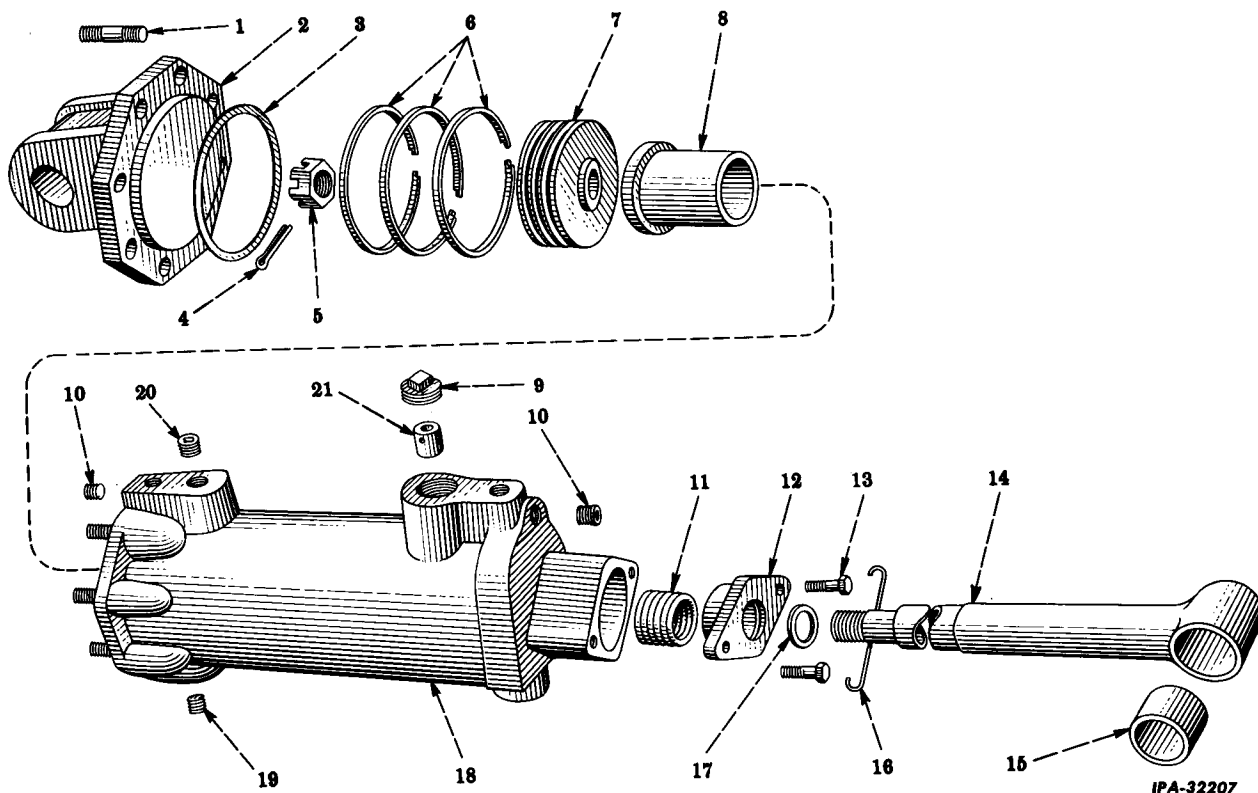
5. If the piston rod bushing (8) was removed, insert it from the cylinder head end of the cylinder (18). Slide it into the opening in the pis-

ton rod end of the cylinder, seating it solidly against the inside of the cylinder casting with an arbor press.

6. Insert new piston rings (6), facing the side of the ring marked "TOP" toward the front of the piston (away from nut). Be careful when sliding these rings over the piston surface to avoid scratching the piston and also to avoid springing rings unnecessarily. The rings are hard and can be broken if forced out of shape. Stagger the ring seal joints 120 degrees for best sealing.

NOTE: These rings are of special construction to provide a permanently sealed joint for the life of the ring. The curved lap surface assures maximum compression seal and minimizes cylinder and ring wear. Be sure, however, that

Continued on next page.



Illust. 2 - Exploded View of Hoist Cylinder.

1. Cylinder head stud.
2. Cylinder head.
3. "O" ring.
4. Cotter pin.
5. Nut.
6. Piston ring set.
7. Piston.

8. Hoist cylinder bushing.
9. Plug.
10. Plug.
11. Piston rod packing.
12. Piston rod packing retainer.
13. Cap screw.
14. Piston rod.

15. Piston rod bushing.
16. Lockwire.
17. Oil seal.
18. Cylinder.
19. Drain plug.
20. Plug.
21. Ball check retainer.



## 5. REASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 2.)

in installing these rings, the side of the ring marked "TOP" is turned toward the front end of the piston. It is from this direction that tight sealing is most important.

7. Slide the piston (7) into the cylinder (18), using a ring compressor to facilitate the installation of the piston and rings into the cylinder.

8. Being careful not to damage the oil seal (17), slide the retainer (12) on the piston rod (14). Install the packing (11) in position on the piston rod (14). (Illust. 3.)

NOTE: Packing consists of one male ring, which goes into the bushing (8) first, four center rings, which follow, and one female ring, which goes in last.

9. Slide the piston rod through the piston rod bushing and into the cylinder, carefully inserting the packing into the bushing. (Illust. 3.) Push the retainer into place behind the packing

and partially tighten it with the two cap screws (13).

10. Slide the piston (7) over the end of the piston rod (14) and secure in place with the nut (5). Secure with cotter pin (4).

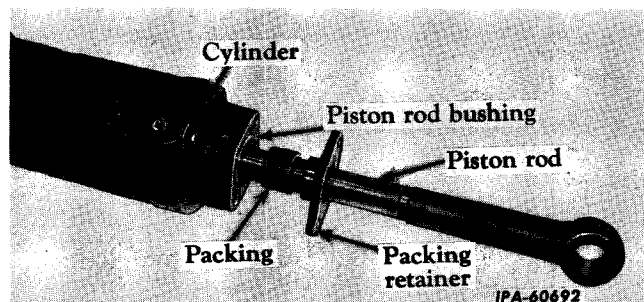
11. Tighten the retainer cap screws (13) enough to compress the packing slightly and lock them with lockwire (16). (Illust. 4.)

12. Place the "O" ring (3) over the flange of the cylinder head (2).

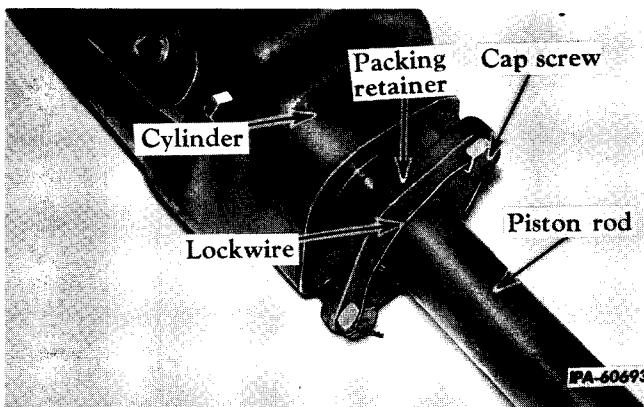
13. Place the cylinder head (2) on the studs (1) and secure in place with eight nuts.

14. Install the retainer (21) and plug (9).

15. The retainer (12) is properly tightened if there is a light film of oil on the piston rod during operation of the cylinder. If there is too heavy an oil coating, remove the lockwire and tighten the retainer cap screws. If the rod is wiped almost dry, loosen the cap screws.



Illust. 3 - Installing Piston Rod.



Illust. 4 - Retainer Installed.



HYDRAULIC CYLINDER  
(For TD-14 (142 Series), TD-15 (150 Series), TD-18 (182 Series), TD-20 (200 Series),  
TD-24 (241 Series) and TD-25 (250 Series) Crawler Tractors)

Section 14

Page 1

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# HYDRAULIC CYLINDER

(For TD-14 (142 Series), TD-15 (150 Series), TD-18 (182 Series), TD-20 (200 Series),  
TD-24 (241 Series) and TD-25 (250 Series) Crawler Tractors)



Section 14

Page 2

## 1. DESCRIPTION

These hydraulic cylinders are the single-stage, double acting type. They are used to power raise and lower the blade equipment to which they are attached. Refer to your operator's manual for instructions on the removal and installation of the cylinders.

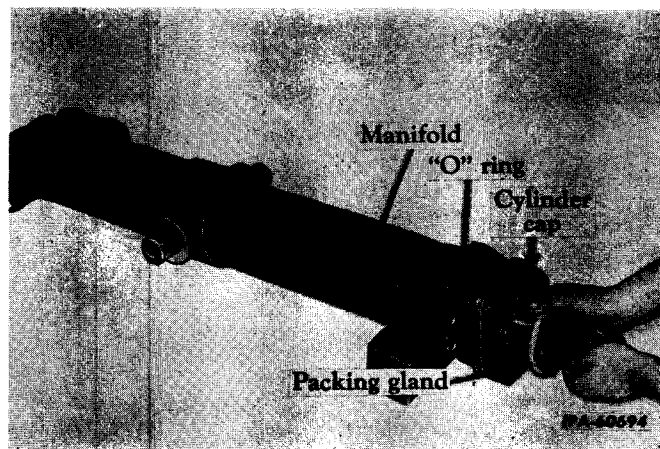
## 2. SPECIFICATIONS

Number of cylinders . . . . . 2  
Make and model . . . . . IHC  
Type . . . . . Single-stage, double acting

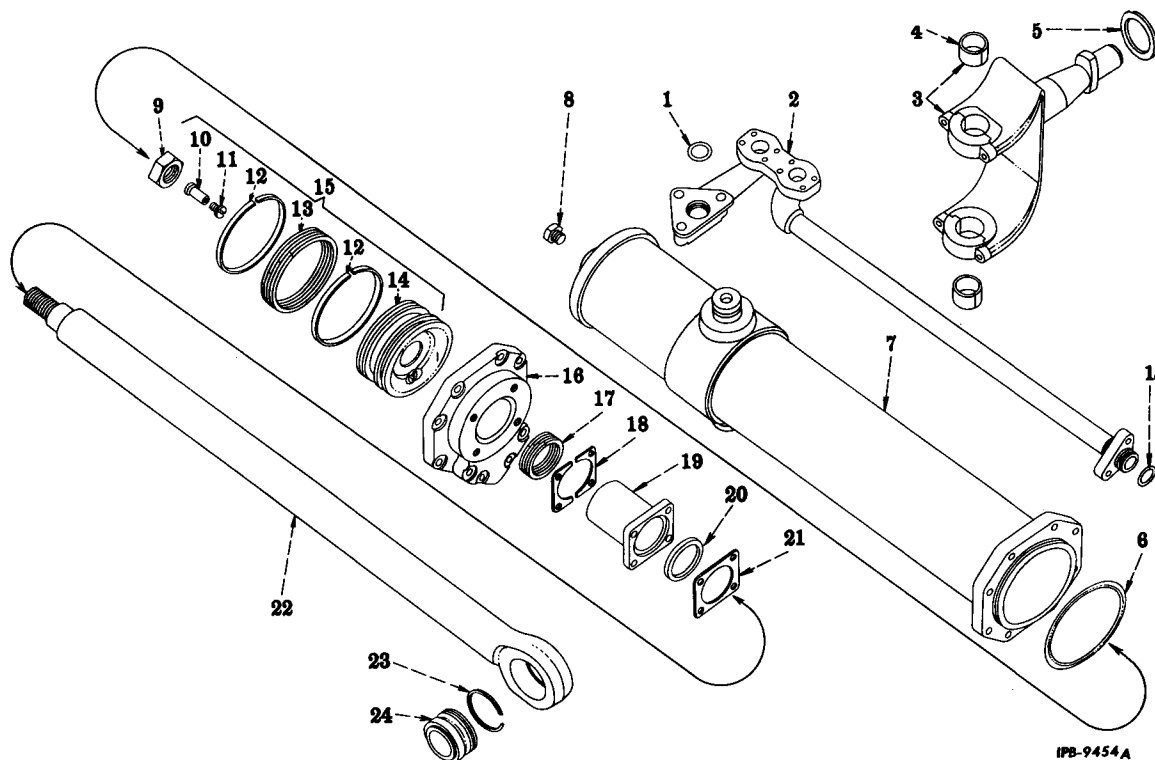
Torque Data (ft.-lbs.)

Piston rod stop nut:

TD-14 (142), TD-18 (182), TD-15  
(150) and TD-20 (200) Series . . 400-500  
TD-24 (241) and TD-25  
(250) Series . . . . . 500-575



Illust. 1 - Removing Piston Rod and Piston.



Illust. 2 - Exploded View of the Hydraulic Cylinder.

- |                                 |                                |                               |
|---------------------------------|--------------------------------|-------------------------------|
| 1. Manifold "O" ring.           | 9. Stop nut.                   | 17. Piston rod packing.       |
| 1A. Manifold "O" ring.          | 10. Relief valve stem.         | 18. Packing gland shim.       |
| 2. Hydraulic cylinder manifold. | 11. Relief valve end.          | 19. Packing gland.            |
| 3. Hoist yoke and cap.          | 12. Piston rod wear ring.      | 20. Dust seal.                |
| 4. Hoist yoke and cap bushing.  | 13. Piston packing.            | 21. Dust seal retainer plate. |
| 5. Thrust washer.               | 14. Hydraulic piston.          | 22. Piston rod.               |
| 6. Cylinder cap "O" ring.       | 15. Hydraulic piston assembly. | 23. Snap ring.                |
| 7. Hydraulic cylinder housing.  | 16. Hydraulic cylinder cap.    | 24. Self-aligning bushing.    |
| 8. Pipe plug.                   |                                |                               |

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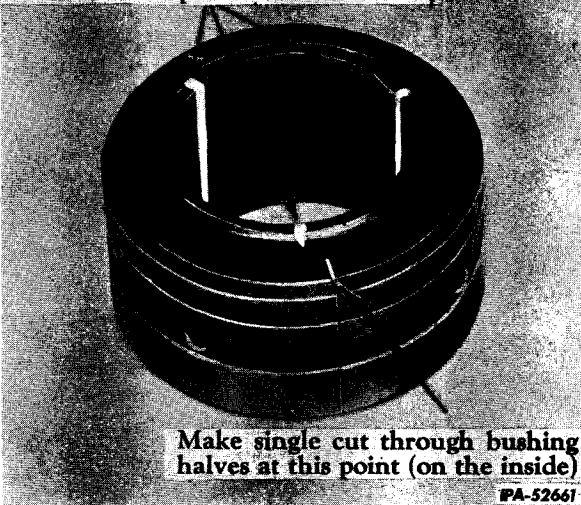
Relief valve end . . . . .	85-95
Manifold:	
Three hole flange end . . . . .	85-95
Two hole flange end . . . . .	35-40
Cylinder cap screws . . . . .	45-50

### 3. DISASSEMBLY

(Ref. Nos. Refer to Illust. 2.)

1. Loosen the vent plug (8) to relieve any pressure remaining in the cylinder.
2. Loosen the four cap screws in the dust seal retainer plate (21) until pressure on the packing (17) is completely relieved.
3. Remove the ten cap screws securing the cylinder cap (16) to the cylinder and the manifold (2).
4. Slide the piston and piston rod out of the cylinder together with the cylinder cap and packing gland (Illust. 1).
5. Remove the stop nut (9) from the piston rod (22) and remove the piston (14). If the relief valve stems (10) are to be replaced, remove them by unscrewing the valve ends (11) from them.
6. Remove the four cap screws and lock washers from the retainer plate (21). Note the location and number of shims (18) for proper re-assembly.

Torch cut ball width (on the inside)  
at these three points



Make single cut through bushing  
halves at this point (on the inside)

PA-52661

Illust. 3 - Removal of Self-aligning Bushing.

7. Slide the cylinder cap (16), piston rod packing (17), packing gland (19) and retainer plate (21) off the piston end of the piston rod (22).

8. Remove the piston rod packing (17) from the cylinder cap (16) if it did not come out when the cap was removed from the rod.

9. If necessary, remove the self-aligning bushing (24) by torch cutting the ball width on the inside at three points approximately 120 degrees apart as shown in Illust. 3. Make a single cut (on the inside) through one of the two bushing halves to permit race and snap ring removal.

10. Remove the manifold (2) from the cylinder. Remove the "O" rings (1 and 1A) from the manifold.

### 4. INSPECTION AND REPAIR

(Ref. Nos. Refer to Illust. 2.)

1. Wash all parts in an oil solvent and dry thoroughly with compressed air.
2. Inspect the piston wear rings (12) and piston packing (13). Replace them if they are worn.
3. Inspect the dust seal (20) and, if it is necessary to replace, press the seal out of the packing gland (19).
4. Inspect the inside bore of the cylinder housing (7) for scoring or wear and replace if necessary.
5. Inspect the piston rod (22) for scoring and replace if necessary.
6. Replace all "O" rings.

### 5. REASSEMBLY

(Ref. Nos. Refer to Illust. 2.)

1. Install new "O" rings (1 and 1A) on the manifold (2) and fasten the manifolds to the head end of the cylinder.
2. If a new self-aligning bushing (24) is to be installed in the piston rod, remove the shipping wire or tape that binds the two halves of the bearing together and discard it. This wire is used for shipping purposes only and is not to be confused with the snap ring retainer which is a strong square section steel snap ring.

Continued on next page.



5. REASSEMBLY - Continued

(Ref. Nos. Refer to Illust. 2.)

3. Remove all rust, scale or paint from the bore in the piston rod ends to prevent rust, scale or paint from being forced into the snap ring groove.

4. Compress the snap ring and bushing halves together with a hose clamp or compressor tool.

5. Grease the bushing bore of the piston rod slightly. Press the bushing and snap ring into the bore of the piston rod with an arbor press until the snap ring seats in its groove in the bore.

6. If the dust seal (20) was removed, press it into the cylinder cap packing gland (19) so that the metal backing is against the gland.

7. Soak the packing (17) in oil and install it into the cylinder cap (16) with the points of the V-sections facing toward the piston rod eye when assembled.

8. Slide the cylinder cap packing gland (19) into the cylinder cap (16). Place the retainer plate (21) on the gland (19) and install the four lock washers and cap screws. Tighten the cap screws finger-tight.

NOTE: Do not install the shims (18) at this time.

9. Slide the cylinder cap (16), and assembled parts, onto the piston rod (22).

10. Install a new "O" ring (6) on the cylinder cap (16).

11. If the relief valve ends (11) and stems (10) were removed from the piston, reinstall them and tighten them to the torque specified in Par. 2, "SPECIFICATIONS."

12. Install the wear rings (12) and piston packing (13) on the piston (14). Stagger the separations of the packing 1/2 inch apart. The packing must be installed so that the points of the V-sections will be facing away from the piston rod eye when the piston and rod are assembled.

13. Install the piston (14) on the piston rod (22) and secure with the self-locking nut (9). Tighten the nut to the torque specified in Par. 2, "SPECIFICATIONS."

14. Soak the piston (14) with oil and slide the piston and piston rod into the cylinder housing (7). (Illust. 1.)

15. Secure the cylinder cap (16) to the cylinder housing (7) with eight lock washers and cap screws.

TD-14 (142), TD-18 (182), TD-15 (150) AND TD-20 (200) SERIES: The two 3-1/4 inch long cap screws go in the holes which are in the thickest part of the cap.

Tighten the cap screws to the torque specified in Par. 2, "SPECIFICATIONS." Install the two cap screws which secure the manifold (2) to the cylinder cap.

16. Tighten the four cap screws in the retainer plate (21) to four ft-lbs. torque. Measure the gap between the cylinder cap (16) and packing gland (19). Remove the cap screws and lock washers and install enough shims (18) to fill the gap. Install the lock washers and cap screws and tighten the cap screws to the torque specified in Par. 2, "SPECIFICATIONS."

NOTE: The proper tightening of the piston rod packing (17) is determined by the amount of oil on the piston rod (22) during operation. The rod should be covered with a light film of oil. If too heavy an oil coating appears on the rod, remove one or two shims. If no oil appears on the rod, add shims as needed.

17. Install and tighten the vent plug (8).



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1. General . . . . .	4
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3. Functional Tests . . . . .	6 to 8



## TRACK FRAME MOUNTED HYDRAULIC SYSTEM

## 1. GENERAL

Before attempting the following checks, be sure:

- The entire system is filled with the proper type and viscosity oil recommended.
- The oil strainer is free from obstruction.
- The oil is at normal operating temperatures or above 120° F.

## 2. VALVE CONTROL LEVER ADJUSTMENT

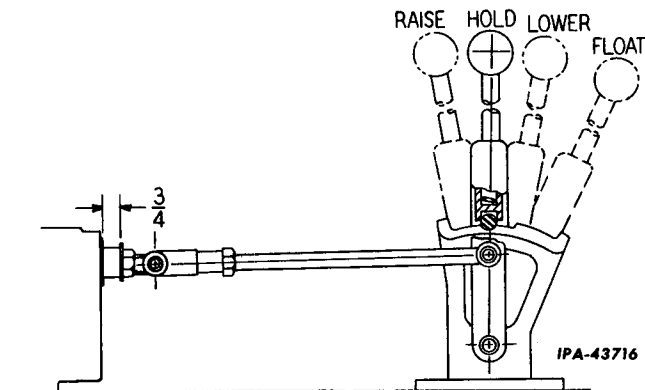
(Ref. Nos. Refer to Illust. 2.)

To insure maximum speed and satisfactory operation, be sure that the valve control hand lever is properly adjusted in conjunction with the operating plunger of the control valve.

The operating plunger should extend forward  $\frac{3}{4}$  of an inch out of the valve housing with the lever in "HOLD" position (Illust. 1).

Place the control lever in the "HOLD" position (second notch from the rear of the control quadrant) and adjust as follows:

- Remove the clevis pin (9) from the clevis (10) and disconnect the clevis from the eye of the operating plunger.
- Using a ruler, slide the operating plunger in or out to obtain a  $\frac{3}{4}$  inch adjustment (Illust. 1).
- Adjust the clevis (10) on the end of the control lever reach rod (11) so that the clevis pin (9) can be pushed through the hole in the clevis (10) and the eye of the operating plunger freely without moving the set position of the operating plunger. Place the cotter pin in the clevis pin (9).

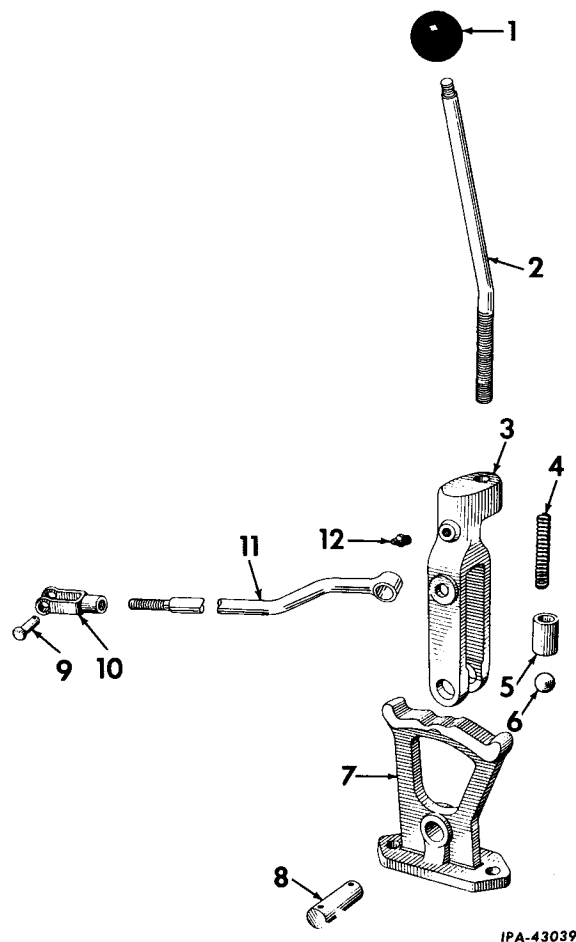


Illust. 1 - Valve Plunger Adjustment.

## 3. LOAD CONTROL VALVE ADJUSTMENT

1. TD-14A, TD-14A (141 SERIES), TD-18A AND TD-18A (181 SERIES) ONLY: Remove the rear top pipe plug of the right hand hydraulic cylinder and place a 1500 pound pressure gauge into the open pipe plug hole.

T AND TD-6, T AND TD-6 (61 SERIES), T AND TD-6 (62 SERIES), TD-9, TD-9 (91 SERIES) AND TD-9 (92 SERIES) ONLY: Disconnect the rear hose on the right hand hydraulic cylinder and fasten a "TEE" connection to the cylinder. Connect the rear hose to the "TEE" connection. Place a 1500 pound pressure gauge in the open end of the "TEE" connection.



Illust. 2 - Valve Control Lever.

- |              |              |
|--------------|--------------|
| 1. Ball.     | 7. Bracket.  |
| 2. Handle.   | 8. Pin.      |
| 3. Yoke      | 9. Pin.      |
| 4. Spring.   | 10. Clevis.  |
| 5. Retainer. | 11. Rod.     |
| 6. Ball.     | 12. Fitting. |



## TRACK FRAME MOUNTED HYDRAULIC SYSTEM

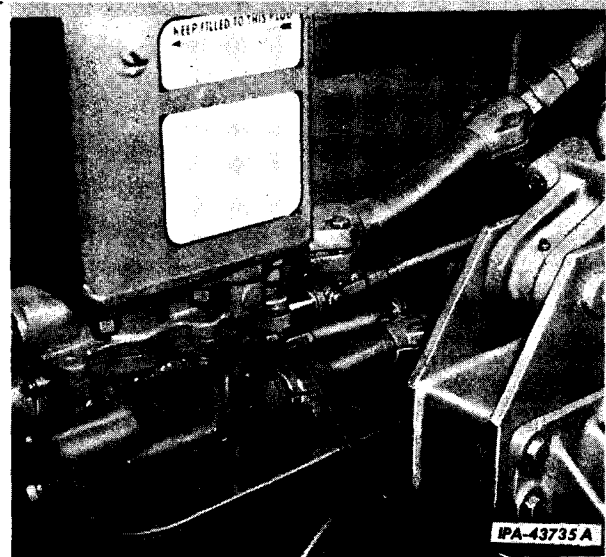
2. Place blocking between both rocker arms and tracks at a point in line with the front idler blocks. The blocking must be of sufficient length or height to allow the piston rods to extend only half way out of the hydraulic cylinders.

NOTE: If the piston rod is allowed to extend completely forward in the cylinders, the pistons will unseat the relief valves. A pressure test cannot be taken when the relief valves are unseated.

3. The hydraulic system operating pressures should be checked as outlined in the following steps:

- a. Start the tractor and run it at low idle speed.
- b. Push the hydraulic control lever forward slowly into the "LOWER" position. Hold the lever in the "LOWER" position for a few seconds and then return it to the "HOLD" position.
- c. Gradually increase the engine speed, each time slowly pushing the control lever into the "LOWER" position and returning it to the "HOLD" position.
- d. Upon reaching the high idle engine speed, slowly place the hydraulic control lever into the "LOWER" position and read the pressure gauge. The proper operating pressure is 1000 psi, and must be set only when the engine is operating at high idle. Pressures greater than this will damage the unit.

**CAUTION:** Do not hold the unit at the relief valve pressure for an extended length of time. This will cause the oil to become excessively hot, resulting in a false indication of oil pressure.



Illust. 3 - Load Control Valve.

4. If the pressure is too high or too low, adjust the relief valve as outlined in the following steps:

- a. Remove the special nut on the forward end of the control valve (Illust. 3).
- b. Loosen the lock nut and turn the load control valve adjustment screw in (clockwise) to increase the pressure or out (counterclockwise) to decrease the pressure. One full turn of the adjustment screw will raise or lower the pressure approximately 100 psi.
- c. After the correct pressure setting has been made, securely tighten the lock nut on the adjusting screw and replace the special nut.

NOTE: If the correct pressure setting cannot be obtained with the adjustment screw, remove the load control valve and inspect the spring, ball and seat. Replace if damaged. (Refer to Section 6, "HYDRAULIC CONTROL VALVE.") If the correct pressure still cannot be obtained, the hydraulic pump should be disassembled for inspection. (Refer to Sections 2 or 4, "HYDRAULIC PUMP.")



## DIRECT LIFT HYDRAULIC SYSTEM

### 1. GENERAL

Before attempting any of the following checks, be sure:

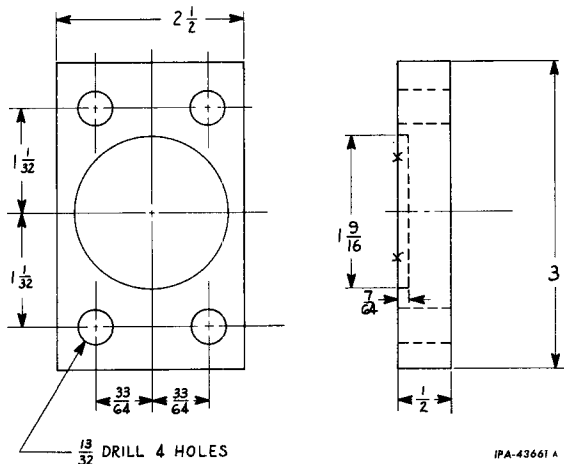
- The entire system is filled with the proper type and viscosity oil recommended.
- The suction strainer is free from obstruction.
- The oil is at normal operating temperatures or above 120° F.

### 2. RELIEF VALVE CHECK

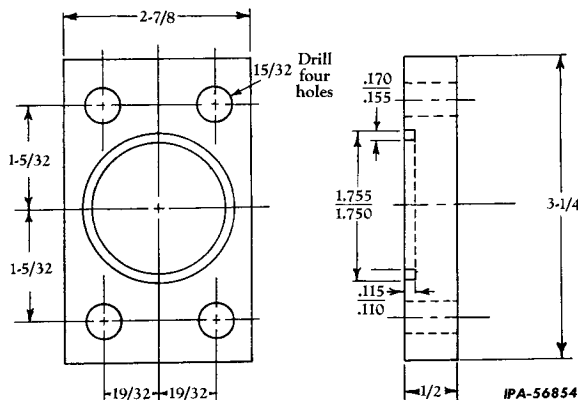
The following suggested method of making this check requires a flange adapter (Illust. 4 and 5), fabricated out of steel bar as an inexpensive service tool.

NOTE: When testing early Model TD-14 (142), TD-18 (182) and TD-24 crawler tractors with hydraulic pumps not equipped with a pipe plug in the front cover or on the side of the pump housing, drill and tap a 1/4 inch NPT hole in the center of the flange adapters for installing the pressure gauge.

1. EARLY MODEL TD-14 (142), TD-18 (182) AND TD-24 CRAWLER TRACTORS: Remove the lift pressure hoses from the left and right manifold on the radiator guard (Illust. 6). Coat two "O" rings with cup grease and place them in the recesses in the flange adapters. Fasten the flange adapters (Illust. 4 and 5) over the opened holes in the left and right manifold on the radiator guard, using four cap screws and lock washers in each adapter. Install an accurate gauge calibrated to 3000 psi



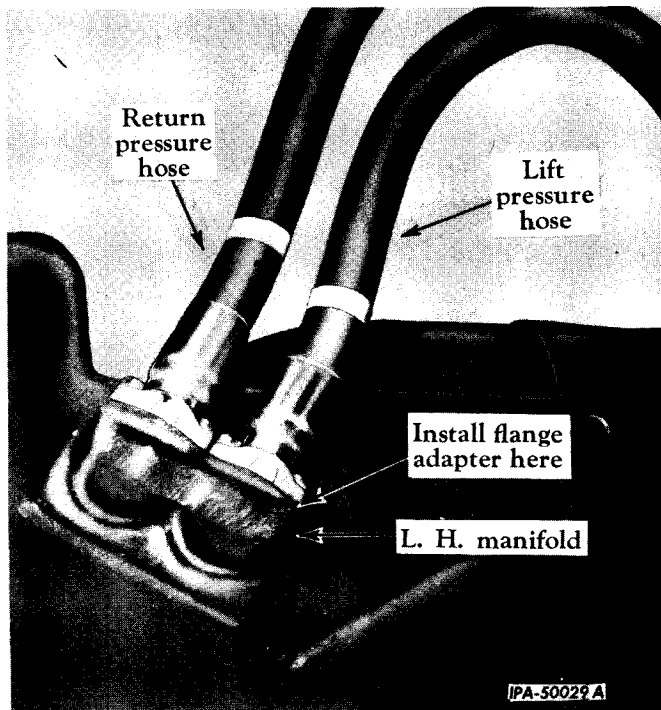
Illust. 4 - Flange Adapter (for TD-14 (142 Series), TD-15 (150 Series), (TD-18 (182 Series) and TD-20 (200 Series) Crawler Tractors).  
ISS-1029Y. (2-61.)



Illust. 5 - Flange Adapter (for TD-24, TD-24 (241 Series) and TD-25 Crawler Tractors).

into the center hole of one of the adapters, and close the other with a pipe plug.

LATER MODEL TD-14 (142), TD-18 (182), TD-24, TD-24 (241) AND EARLY MODEL TD-15 (150) AND TD-20 (200) CRAWLER TRACTORS: Remove the lift pressure hoses from the left and right manifold on the radiator guard (Illust. 6). Coat two "O" rings with cup grease and place them in the recesses in the flange adapters. Fasten the flange adapters over the opened holes in the left and right mani-



Illust. 6 - Hydraulic System Pressure Hoses (Model TD-14 (142 Series), TD-18 (182 Series), TD-24, TD-24 (241 Series) and Early Model TD-15 (150 Series) and TD-20 (200 Series) Crawler Tractors).  
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## DIRECT LIFT HYDRAULIC SYSTEM

fold on the radiator guard using four cap screws and lock washers in each adapter.

Remove the pipe plug from the front cover or side of the pump housing (Illust. 7 and 8). Insert a hose with an accurate gauge calibrated to 3000 psi into the pipe plug opening. The hose must be long enough to reach from the pump to a position where the operator can read the gauge.

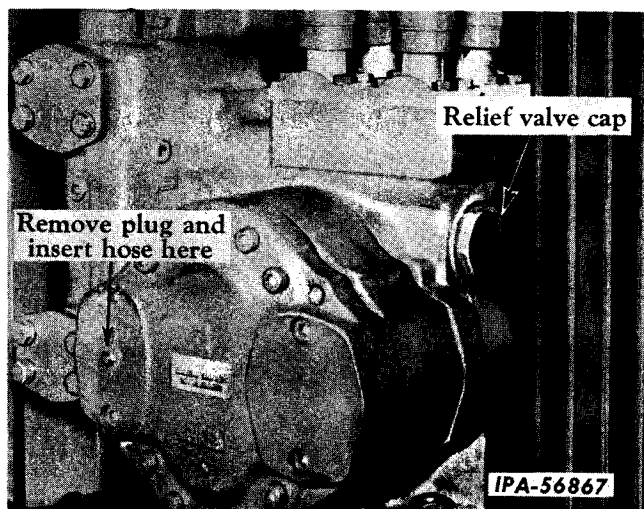
**LATER MODEL TD-15 (150), TD-20 (200) AND ALL TD-25 CRAWLER TRACTORS:** Install the flange adapters between the lift pressure hose flange and the hydraulic cylinder manifold on both sides of the tractor (Illust. 9). Remove the pipe plug from the front cover or side of the pump housing (Illust. 7 and 8). Insert a hose with an accurate gauge calibrated to 3000 psi into the pipe plug opening. The hose must be long enough to reach from the pump to a position where the operator can read the gauge.

**NOTE:** When the flange adapters are installed as outlined, the flow of oil from the control valve to the hydraulic cylinders is prevented when in the "RAISE" position, causing all oil to be unloaded through the relief valve.

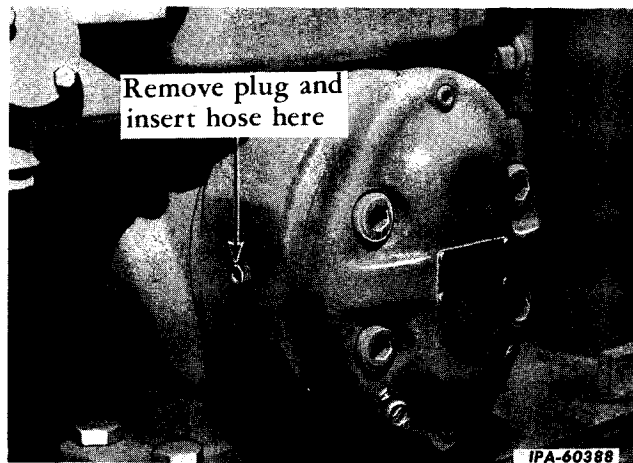
2. The hydraulic system operating pressure should be checked as outlined in the following steps:

- a. Start the tractor engine and run it at low idle speed.

**CAUTION:** Avoid unloading through the relief valve for more than a few seconds at a time to prevent possible overheating of the pump and valve.



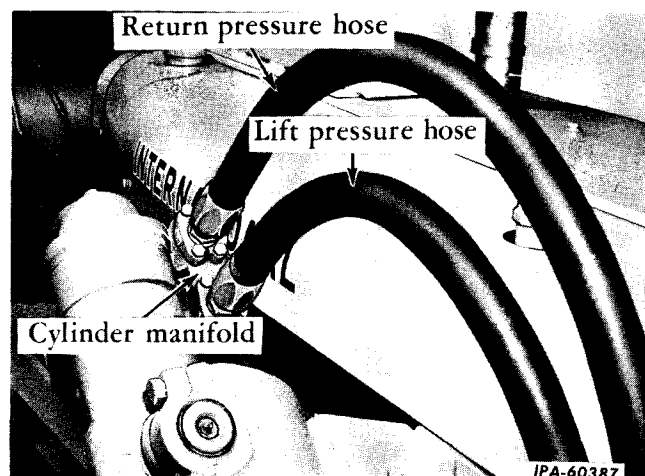
Illust. 7 - Pump Pressure Check Point (For Model TD-18 (182 Series), TD-20 (200 Series), TD-24, TD-24 (241 Series) and TD-25 Crawler Tractors).



Illust. 8 - Pump Pressure Check Point (For Model TD-14 (142 Series) and TD-15 (150 Series) Crawler Tractors).

- b. Pull the hydraulic control handle back slowly into the "RAISE" position. Hold the handle in the "RAISE" position for a few seconds and return to the "HOLD" position.
- c. Gradually increase the engine speed, each time slowly pulling back the control handle into the "RAISE" position and returning it to the "HOLD" position. Observe the pressure gauge for the proper function of the relief valve.
- d. Upon reaching the high idle engine speed, slowly place the hydraulic control handle again into the "RAISE" position and read the pressure gauge. The

Continued on next page.



Illust. 9 - Hydraulic System Pressure Hoses (Later Model TD-15 (150 Series), TD-20 (200 Series) and all TD-25 Crawler Tractors).



## DIRECT LIFT HYDRAULIC SYSTEM

## 2. RELIEF VALVE CHECK - Continued

proper operating pressure is 1650 psi when the engine is operating at high idle.

NOTE: Holding the control handle in the "RAISE" position for a short length of time will not damage the hydraulic system; but extended holding in this position will produce excessive heat and will not give an accurate reading on the pressure gauge.

3. If the pressure is too high or too low, adjust the relief valve as outlined below:

a. Stop the engine and remove one of the drain plugs from the bottom of the radiator guard and drain, into clean containers, sufficient oil to clear the relief valve cap. Replace the drain plug.

b. Remove the relief valve cap (Illust. 7 and 10) and add spacers, between relief valve spring and relief valve cap, to increase pressure or remove spacers to decrease pressure. One spacer will change the pressure approximately 50 psi.

c. After adding or removing spacers, replace the relief valve cap. If the oil that was drained out was kept clean, it can be put back in the system. If not, fill the system with new oil to the oil level plug on the left side of the radiator guard. Start the tractor engine and repeat the relief valve check.

d. If the pressure is still too high or low, add or remove spacers until the correct pressure is obtained.

e. Remove the adapters after completion of this relief valve check. Leave the hose and gauge connected to the front pump cover.

f. Check the "cracking" pressure of the relief valve by throttling down. The gauge should reach a point where the pressure remains steady (from 100 to 200 psi less than maximum pressure). If the pressure continues to drop, the valve seat is defective or has dirt in it.

## 3. FUNCTIONAL TESTS

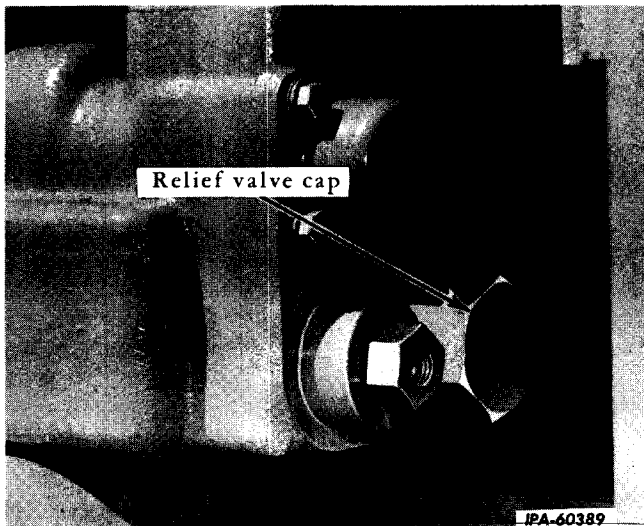
**CYLINDER POPPET TEST:** With the engine running and the oil at normal operating temperature, start with the blade level and power raise the blade at wide open throttle. The gauge should read approximately 450 psi at extreme lift with full oil flow through the poppet. Repeat the operation at the opposite end of the stroke, on maximum dig position. Again the reading should be 450 psi. If this reading is not obtained, check the cylinder poppets for obstruction.

**CONTROL VALVE NEUTRAL TEST:** Again at wide open throttle, place the valve control in the "NEUTRAL" (HOLD) position to check the circulatory pressure, which must be less than 75 psi.

**FLOW CONTROL VALVE TEST:** Check the flow control opening pressure by putting the control lever in the "FLOAT" position. Gauge reading will be approximately 125 psi. Raise the blade to maximum lift and power lower it to the ground at both wide open throttle and low idle speeds. In making this check, the blade should go into immediate dig with no visible lag or hesitation. If there is a substantial drop in pressure, it will indicate a lag. On the low idle speed check, the blade must not chatter on the way down from maximum lift. If these conditions cannot be met, remove the flow control valve and check it.

**PLUNGER CHECK VALVE TEST:** With the engine running and the blade off the ground, slowly move the control lever into the "RAISE" position. There should be no perceptible lag or drift.

There are three main types of malfunctioning of the hydraulic system; namely, blade drift, slow blade speed or response, and low blade capacity or power. All of these items can be traced to two main causes; internal and external leakage. External leakage is not detailed



Illust. 10 - Relief Valve Cap Location (For TD-14 (142 Series) and TD-15 (150 Series) Crawler Tractors).



## DIRECT LIFT HYDRAULIC SYSTEM

here since it can be visually located. Internal leakage, however, may be difficult to locate since it can originate in any one of four main places in the system; the cylinders, control valve, relief valve and the pump.

Following is a series of simple checks for the purpose of isolating the internal leakage. These checks are broken down into two basic divisions; "Cylinders and Control Valves" and "Pump and Relief Valve." For an over-all check of the system, all of the steps should be carried out in the sequence given. If the problem encountered is that of blade drift only, follow the steps under "Cylinders and Control Valves" only. If the problem is that of slow blade speed, low capacity or response and there is no objectional blade drift, only the steps under "Pump and Relief Valve" need to be followed.

## Cylinder and Control Valve

There are three distinct places in the cylinders and control valve which can be a source of internal leakage. The cylinders can have leakage by the piston bypass poppets or the piston packings, while the control valve can have excessive leakage by the spool. To determine if leakage is present in these three places, proceed as follows:

1. Raise and lower the blade several times to its extreme position to wash out any foreign

material which might be keeping the bypass poppets off their seats.

2. Raise the blade three or four feet off the ground and put the control valve in "HOLD" position. Check for drift. If excessive drift is still present, a check of the piston packings and poppets will be necessary.

NOTE: In making this test, do not raise blade to its extreme limit, since this will hold the bypass poppets off their seats and cause a momentary drift when the control valve is placed in "HOLD" position.

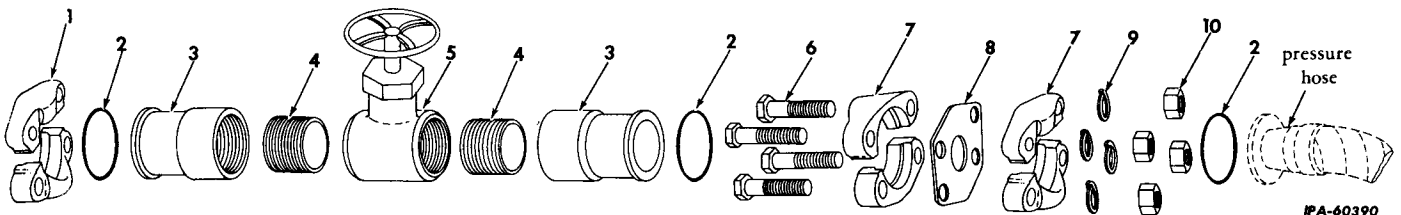
3. To check piston packings and poppets, lower the blade and shut down the tractor. Install the equipment shown in Illust. 11 between the pressure power raise circuit and the junction blocks of both cylinders.

4. Open the needle valves, start the engine and raise the blade several feet off the ground.

5. With the blade off the ground, close the needle valve on one cylinder and put the control valve in "FLOAT" position.

6. If drift is present, the cylinder is defective and should be repaired.

Continued on next page.



Illust. 11 - Hydraulic Cylinder Testing Equipment.

- A. TD-14 (142 Series), TD-15 (150 Series), TD-18 (182 Series) and TD-20 (200 Series).

- B. TD-24 (241 Series) and TD-25 (250 Series).

1. Split flange halve (part of lift pressure hose).

2. "O" ring (1-5/16 x 1-9/16 x 1/8 inch).

3. Flange "O" ring fitting.

A. Anchor No. 16F-16F0.

B. Anchor No. 20F-20F0.

4. Close nipple (high pressure).

5. Needle valve (high pressure).

6. Bolt.

A. Anchor No. 628B.

B. Anchor No. 728B.

7. Split flange halve.

A. Anchor No. 16SF2.

B. Anchor No. 20SF2.

8. Connector plate.

A. Anchor No. 16CP.

B. Anchor No. 20CP.

9. Lock washer.

A. Anchor No. 6LW.

B. Anchor No. 7LW.

10. Nut.

A. Anchor No. 624N.

B. Anchor No. 720N.



DIRECT LIFT HYDRAULIC SYSTEM

7. Repeat the above procedure with the other cylinder. It is imperative that this be done. If one cylinder checks good or bad, it is no indication that the other cylinder will be in the same condition.

8. If in the above tests both cylinders check out satisfactorily, the following checks should be performed in the valve.

a. With the engine off and the blade up, put the control lever in "NEUTRAL" (HOLD) position. If there is any drift, the valve is leaking and must be repaired.

b. With the engine stopped and the blade up, put the control lever in the "RAISE" position. If there is any noticeable drift, either the valve is leaking or the pump is worn. The pump may be checked with a Schroeder hydraulic portable circuit tester. (Refer to "Pump Flow Test," Section 1.)

If the pump proves to be satisfactory, the valve is at fault and should be repaired.

c. The preceding test must also be done with the control lever in the "LOWER" position.

Pump and Relief Valve

If there is no excessive drift in the blade when the control valve is in "HOLD" position, but slow blade speed, slow response or low power is present, the problem lies in either the pump or relief valve. The loss of flow can be caused by the relief valve making a poor seat, thus by-passing some oil, premature opening at the relief valve or excessive clearances in the pump.

1. Check the relief valve as described in Par. 2, "Relief Valve Check." If it is not satisfactory, perform the following steps:

a. Dismantle the relief valve.

b. Be sure the relief valve poppet has a free sliding fit in its bore.

c. Check the poppet seat for pitting and warpage.

d. If parts are defective, replace.

e. If the above items are satisfactory, reassemble and set the pressure at 1650 psi.

2. Perform the following steps when checking the pump:

NOTE: The Schroeder hydraulic test is preferred. (Refer to "Pump Flow Test," Section 1.) If not available, perform the following steps:

a. Position the tractor so the blade will not touch the ground in its fully lowered position.

b. Run the engine at 1400 rpm.

c. Starting with the blade in its fully lowered position, put the control valve in "RAISE" position and check the time required to raise the blade to its extreme position.

NOTE: This check should be made only in raising the blade.

d. The time required to raise the blade should not be more than:

5.6 seconds - TD-24 (241 Series) and TD-25 (250 Series).

5.2 seconds - TD-18 (182 Series) and TD-20 (200 Series).

4.9 seconds - TD-14 (142 Series) and TD-15 (150 Series).

If the time cycles obtained are greater than the ones stated above, the pump is at fault and it should be repaired.