

# **310-1500/310-1700 Integrated Hydrostatic Transaxle Service and Repair Manual**

BLN-52178  
December 2008

## TABLE OF CONTENTS

---

Section	Page
<b>Foreword</b> .....	<b>1</b>
<b>Description and Operation</b> .....	<b>2</b>
<b>Introduction</b> .....	<b>2</b>
General Description .....	2
Introduction .....	2
Hydraulic Schematic .....	3-5
Product Identification .....	6
Technical Specifications.....	7
<b>Safety</b> .....	<b>8</b>
Personal Safety.....	8
Tool Safety .....	8
Work Area Safety .....	8
Servicing Safety.....	8
<b>Troubleshooting</b> .....	<b>9</b>
<b>Service and Maintenance</b> .....	<b>10</b>
External Maintenance .....	10
Service and Maintenance Procedures .....	10
Fluids .....	11
Brake Maintenance .....	12
Return to Neutral Setting Foot Control.....	13
Purging Procedures .....	14
<b>Repair</b> .....	<b>15</b>
General Instructions.....	15
Required Tools .....	15
Torque Specifications.....	15
Transaxle Removal .....	15
Limited Disassembly .....	15
How To Use This Manual .....	16
Brake Assembly .....	17,18
Bypass Assembly .....	19
Control Assembly .....	20,21
Seal Kit Replacement .....	22
Torque Bracket Assembly .....	23
Fan and Pulley Assembly.....	24
Input Shaft Assembly .....	25
Auxiliary Pump.....	26
Charge Pump Assembly .....	27
Lower Housing/Filter/Manifold Assembly.....	27,29
Planetary Differential Assembly .....	30-33
Motor/Center Section/Pump Assembly .....	34-36
Directional Control Assembly .....	37
Transaxle Installation .....	38
Assembly After a Complete Teardown .....	38
Sealant Application .....	39
<b>Parts List</b> .....	<b>40-43</b>
<b>Glossary of Terms</b> .....	<b>44,45</b>

## FOREWORD

---

Headquartered in Sullivan, Illinois, Hydro-Gear® is a world leader in the design, manufacture, and service of quality hydrostatic transaxles for the lawn and garden industry. The mission of our company is to be recognized by our customers and the industry as a world-class supplier and the quality leader in everything we do.

This Service and Repair Manual is designed to provide information useful in servicing and troubleshooting the Hydro-Gear -1500 or -1700 Integrated Hydrostatic Transaxle (IHT).

Also included is a glossary of terms that are frequently used throughout the industry and in Hydro-Gear service publications. Understanding terminology is very important!

It is necessary, and a good shop practice, that your service area be equipped with the proper tools and the mechanics be supplied the latest information available. All repair procedures illustrated in this guide are suggested, but preferred methods of repair.

Repair procedures require that the transaxle unit be removed from the vehicle.

This is not a certification, test or study guide for a certification test. If a technician is interested in certification, they should contact an agent representing the OPEESA (Outdoor Power Equipment and Engine Service Association) at (860) 767-1770 or their Hydro-Gear Central Service Distributor. Many distributors will be hosting certification testing. These study guides will cover most of the products and manufacturers in our industry.

For more information about Hydro-Gear or our products, please contact your Central Service Distributor, or call our Customer Service Department at (217) 728-2581.

## SECTION 1. DESCRIPTION AND OPERATION

### INTRODUCTION

The purpose of this manual is to provide useful information for servicing the Hydro-Gear® -1500/ -1700 Integrated Hydrostatic Transaxles (IHT). This manual includes transaxle general description, hydraulic schematic, technical specifications, product identification, safety, troubleshooting, maintenance, and repair procedures.

The transaxle normally will not require servicing during the life of the vehicle in which it is installed. Should other servicing be required, the transaxle will need to be thoroughly cleaned before beginning most procedures.

Please refer to the instructions titled "How to Use This Manual" in the Repair Section for an explanation of the layout of the disassembly, inspection, and reassembly portions of this manual.

### GENERAL DESCRIPTION

The -1500/-1700 series transaxles are self contained units designed for the transfer and control of power. They provide an infinitely variable speed range between zero and maximum in both forward and reverse modes of operation.

The transaxle uses a variable displacement pump with a maximum displacement of 10 cc per revolution, and motor with a fixed displacement of 21cc per revolution. The variable displacement pump features a cradle swash-plate with a direct-proportional displacement control. Reversing the direction of the swash-

plate reverses the flow of oil from the pump and thus reverses the direction of the motor output rotation. The pump and motor are of the axial piston design and utilize spherical nosed pistons which are held against a thrust race by internal compression springs.

The -1500/-1700 series transaxles have a self contained fluid supply and an internal filter. The fluid is drawn through the internal reservoir and feeds the fixed displacement gerotor charge pump. Excess fluid in the charge circuit is discharged over the charge relief valve and dumps back to case. Charge check valves in the center section are used to control the makeup flow of the fluid to the low pressure side of the loop.

The transaxle is filled and tested at the factory and should not require fluid or filter changes unless the fluid becomes contaminated.

A cam style, block lifting bypass is utilized in the -1500/-1700 series to permit moving the vehicle for a short distance at a maximum speed of 2 m.p.h. (3.2 km/hr) without starting the engine.



#### WARNING

**Actuating the bypass will result in the loss of hydrostatic braking capacity. The machine must be stationary on a level surface and in neutral when actuating the bypass.**

The -1500/-1700 series transaxles utilize an in-line floating disc brake controlled by a "cam" style actuating arm.

# HYDRAULIC SCHEMATIC

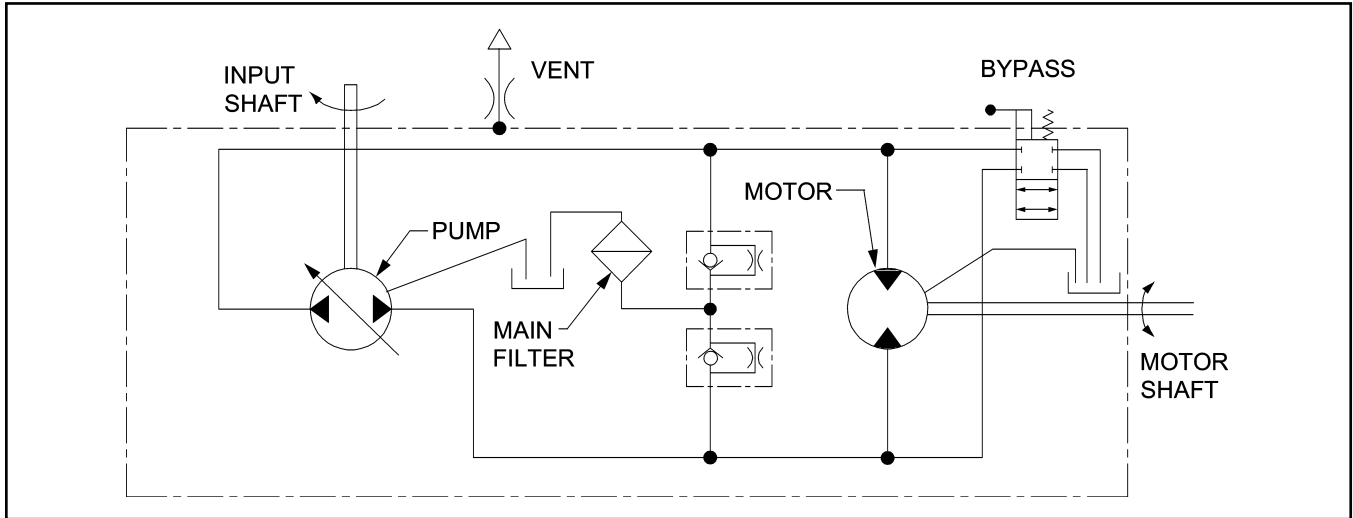


Figure 1. -1500 Hydraulic Schematic

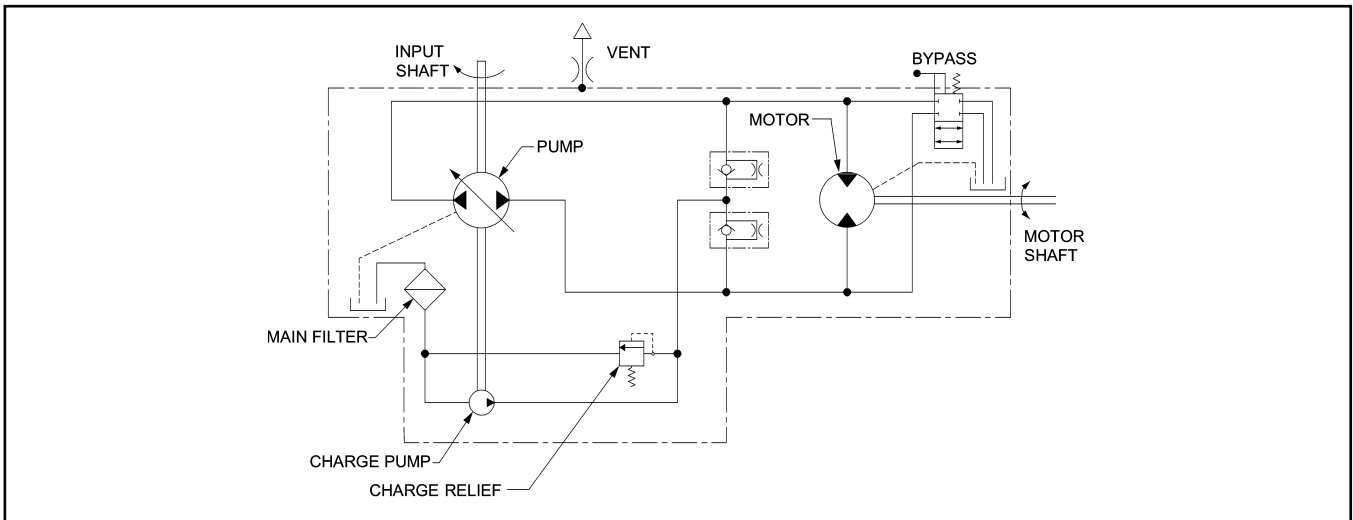


Figure 2. -1700 Hydraulic Schematic

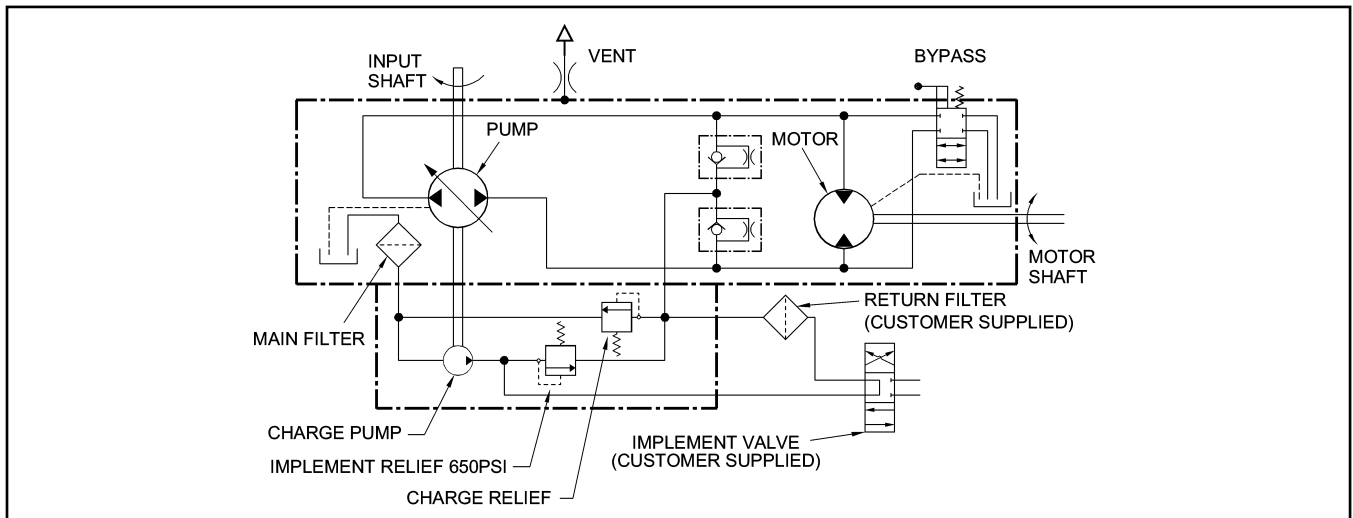


Figure 3. -1700 Hydraulic Schematic with Auxiliary Pump

## HYDRAULIC SCHEMATIC

Figures 4 and 5 provide illustrations of the hydraulic oil circuit. The oil supply for the hydraulic system of the IHT is also utilized for the lubrication of the planetary differential drive gears.

The input shaft and pump cylinder block are turned in one direction only by the engine/drive belt/pulley combination. Output of the oil flow is controlled by the direction and amount that the swashplate is angled. As the pump pistons compress they force the oil to flow through one of two passageways (forward or reverse) in the center section (or valve body) to the motor cylinder block and motor shaft. Since the motor has a fixed displacement angle it is forced to turn with the flow of oil. As the angle of the swashplate is increased the amount of oil being pumped will increase and cause a higher RPM output of the motor. Reversing the angle of the pump swashplate will reverse the direction of oil flow.

During the operation of the transaxle, fluid is "lost" from the hydraulic loop through leak paths designed into the product for lubrication purposes (around pistons, under the rotating cylinder blocks, etc.). This "lost" fluid returns

to the transmission housing and must be made up in the loop. A charge pump is included on the IHT to supply this makeup flow. The make up flow is controlled (or directed) by the check valves. Each check valve will either be held open or closed (depending upon the direction of vehicle operation) by the system operating pressure (closed) or by charge pressure (open) from the charge pump.

The charge pump maintains a continuous flow of oil as long as the input shaft is turning. All of the oil being pulled into the charge pump first must pass through an internal filter. Any oil not needed by the transmission for make up flow is discharged through the charge relief valve. The charge relief valve maintains the charge pressure.

The motor cylinder block mounts onto the splined motor shaft which drives the planetary differential gear/differential assembly.

The bypass feature in the IHT has a mechanical lever which lifts the motor block off of the center section running surface, allowing any oil flowing from the pump block to be discharged into the housing without turning the motor.

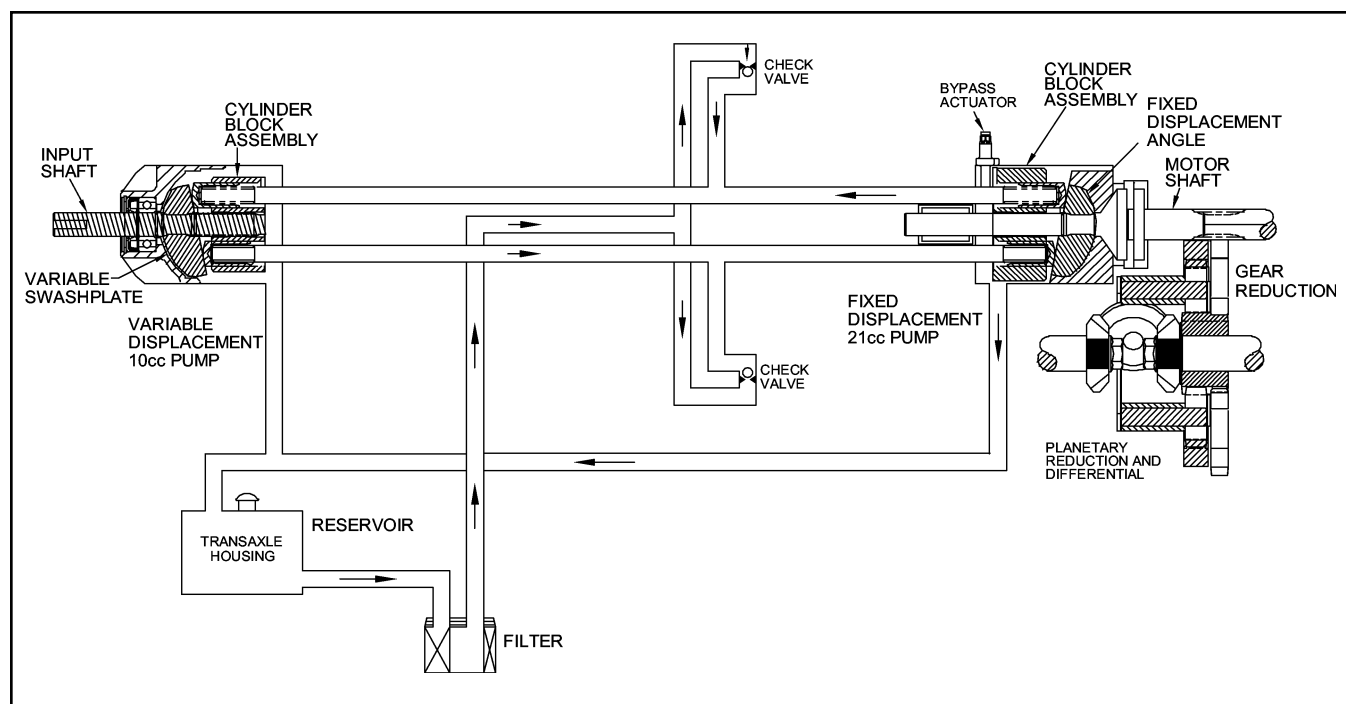


Figure 4. -1500 Hydraulic Flow Illustration

# HYDRAULIC SCHEMATIC

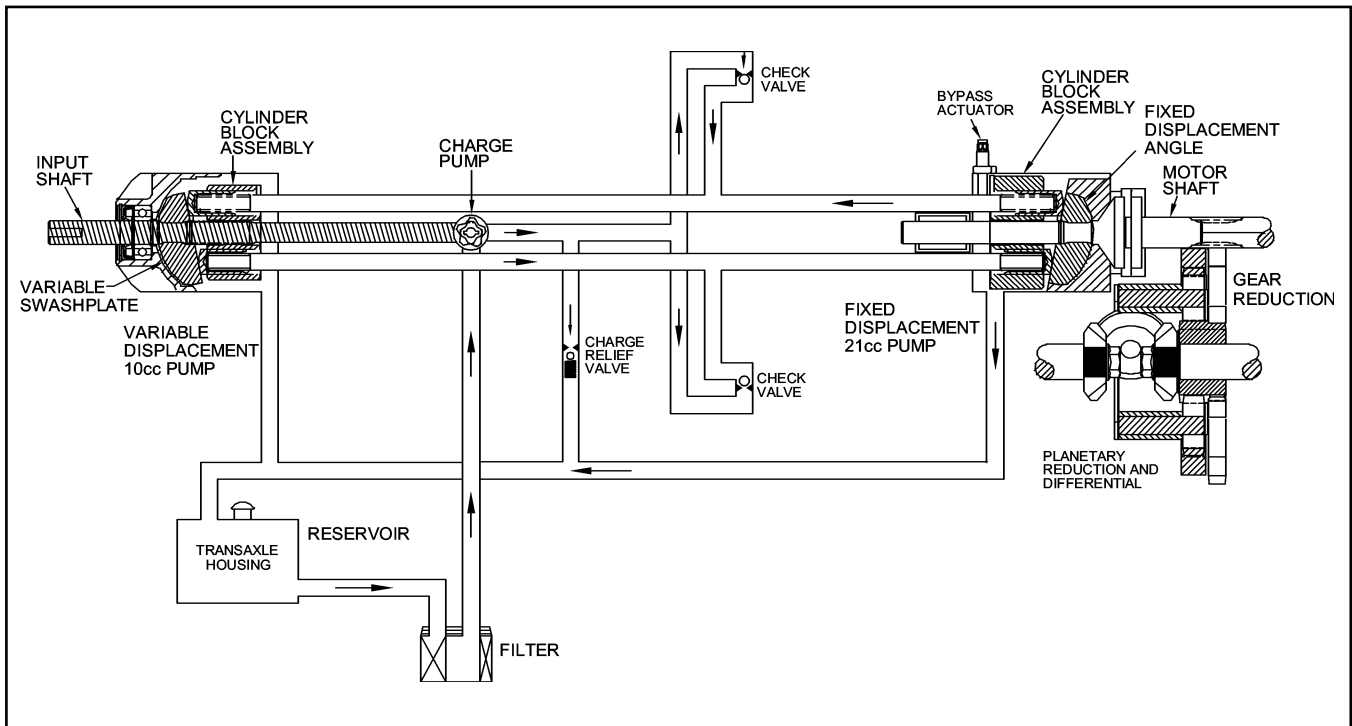
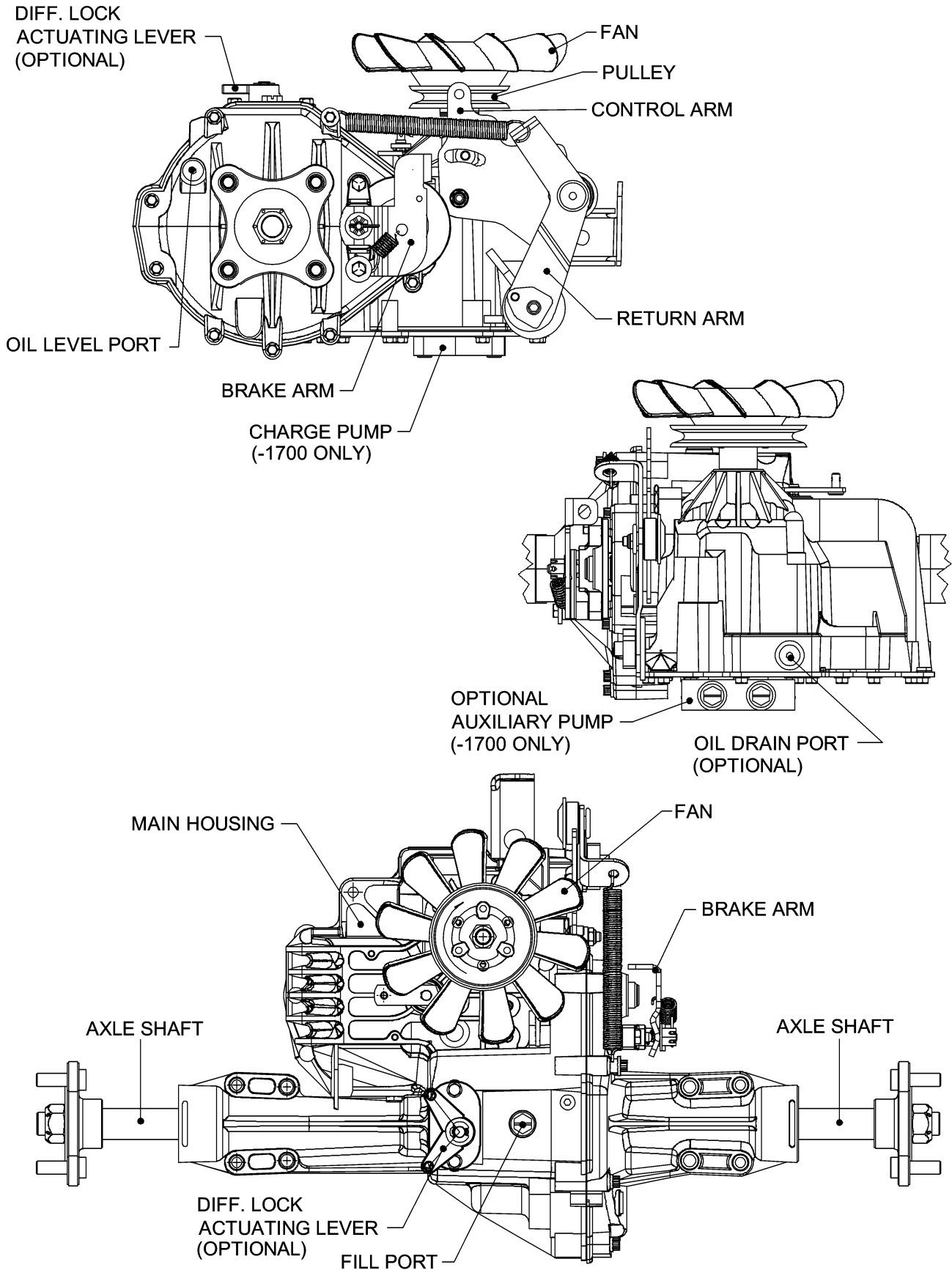


Figure 5. -1700 Hydraulic Flow Illustration

# EXTERNAL FEATURES -1500 AND -1700





# TECHNICAL SPECIFICATIONS

Technical specifications for the -1500 and -1700 IHT's are given in Table 1.

	-1500	-1700
<b>Overall Transaxle Reduction</b>	24.6:1	24.6:1
<b>Input Speed (rpm)</b>	3000 max. 1800 min.	3600 max. 1800 min.
<b>Maximum Tire Diameter</b>	20 in. (508 mm)	23 in. (584 mm)
<b>Axle Shaft Diameter</b>	1.00 in. (25.4 mm)	1.00 in. (25.4 mm)
<b>Axle Shaft End Options</b>	4-Bolt Flange  Splined	4-Bolt Flange  Splined
<b>Brake Type</b>	Disc	Disc
<b>Weight of Unit</b>	53 lb. (24 kg)	53 lb. (24 kg)

Table 1. Technical Specifications

# PRODUCT IDENTIFICATION

The model and configuration of the -1500 or -1700 IHT can be determined from the label shown in Figure 6.

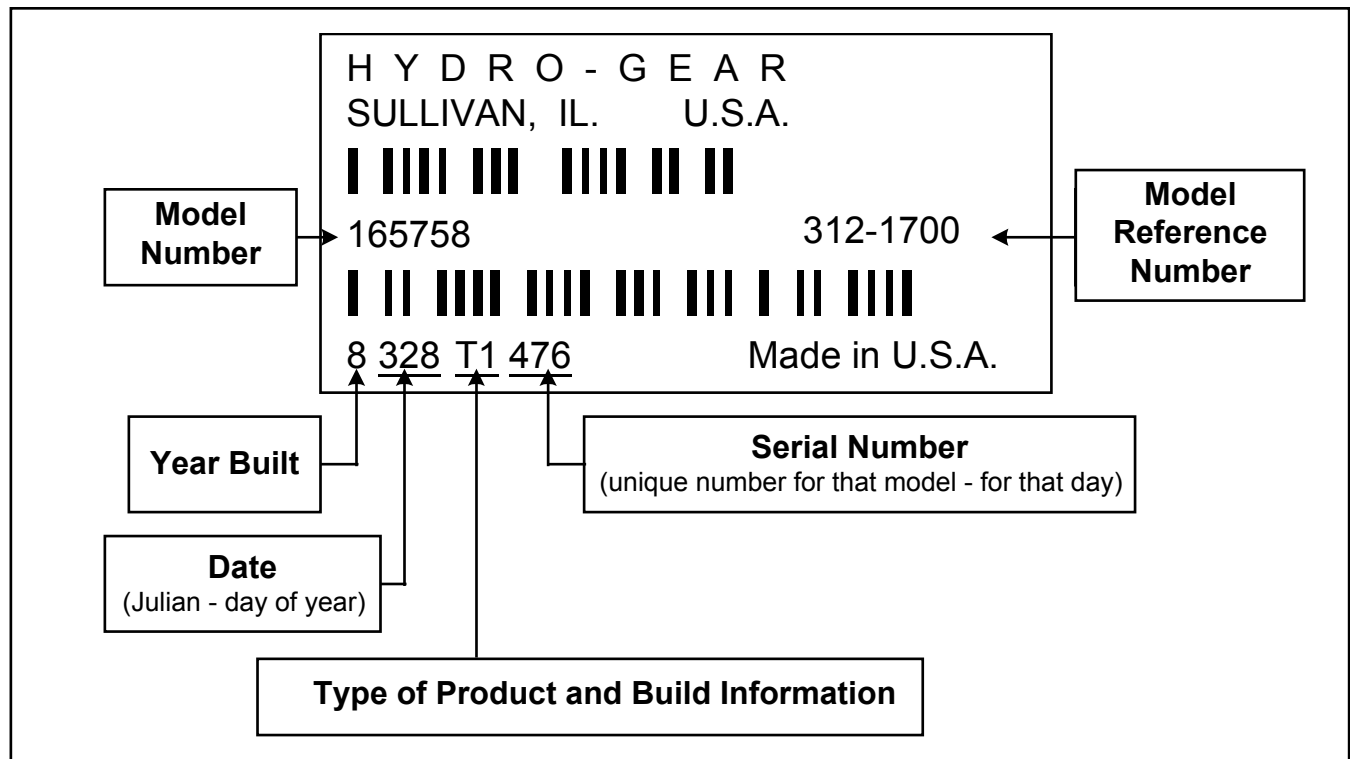


Figure 6. -1700 Configuration Label

## SECTION 2. SAFETY



This symbol points out important safety instructions which, if not followed, could endanger the personal safety and/or property of yourself and others. Read and follow all instructions in this manual before attempting maintenance on your transaxle. When you see this symbol - **HEED ITS WARNING.**



### WARNING

#### POTENTIAL FOR SERIOUS INJURY

**Inattention to proper safety, operation, or maintenance procedures could result in personal injury, or damage to the equipment. Before servicing or repairing the IHT, fully read and understand the safety precautions described in this section.**

## PERSONAL SAFETY

Certain safety precautions must be observed while servicing or repairing the IHT. This section addresses some of these precautions but must not be considered an all-inclusive source on safety information. This section is to be used in conjunction with all other safety material which may apply, such as:

- 1) Other manuals pertaining to this machine
- 2) Local and shop safety rules and codes
- 3) Governmental safety laws and regulations

Be sure that you know and understand the equipment and the hazards associated with it. Do not place speed above safety.

Notify your supervisor whenever you feel there is any hazard involving the equipment or the performance of your job.

Never allow untrained or unauthorized personnel to service or repair the equipment.

Wear appropriate clothing. Loose or hanging clothing or jewelry can be hazardous. Use the appropriate safety equipment, such as eye and hearing protection, and safety-toe and slip-proof shoes.

Never use compressed air to clean debris from yourself or your clothing.

## TOOL SAFETY

Use the proper tools and equipment for the task.

Inspect each tool before use and replace any tool that may be damaged or defective.

## WORK AREA SAFETY

Keep the work area neat and orderly. Be sure it is well lit, that extra tools are put away, trash and refuse are in the proper containers, and dirt or debris have been removed from the working areas of the machine.

The floor should be clean and dry, and all extension cords or similar trip hazards should be removed.

## SERVICING SAFETY

Certain procedures may require the vehicle to be disabled in order to prevent possible injury to the servicing technician and/or bystanders.

The loss of hydrostatic drive line power may result in the loss of hydrostatic braking capability. Proper brake maintenance is very important should this condition develop.

Some cleaning solvents are flammable. Use only approved cleaning materials: do not use explosive or flammable liquids to clean the equipment.

To avoid possible fire do not use cleaning solvents in an area where a source of ignition may be present

Discard used cleaning material in the appropriate containers.

## SECTION 3. TROUBLESHOOTING



### WARNING

**Do not attempt any servicing or adjustments with the engine running. Use extreme caution while inspecting the drive belt assembly, and all vehicle linkage!**

**Follow all safety procedures outlined in the vehicle owner's manual!**

In many cases problems with the IHT are not related to a defective transmission or axle, but are caused by slipping drive belts, partially engaged bypass valves, and loose or damaged control linkages. Be sure to perform all operational checks and adjustments outlined in Section 4 before assuming the unit is malfunctioning. Table 2 below provides a troubleshooting check list to help determine the cause of operational problems.

**Table 2. Troubleshooting Checklist**

Possible Cause	Corrective Action	Refer To:
<b>UNIT OPERATES IN ONE DIRECTION ONLY</b>		
Control linkage bent or out of adjustment Drive belt slipping or pulley damaged	Repair or replace linkage Repair or replace drive belt or pulley	Control Linkage Repair, Page 23 Pulley Repair, Page 27
<b>UNIT IS NOISY</b>		
Oil level low or contaminated oil Excessive loading Brake setting incorrect Loose parts Bypass assembly sticking Air trapped in hydraulic system	Fill to proper level or change oil Reduce vehicle loading Adjust brake to proper setting Repair or replace loose parts Repair or replace valve or linkage Purge hydraulic system	Fluid Maintenance, Page 11 Vehicle Specifications Brake Adjustment, Page 12 Appropriate Repair Procedure Bypass Repair, Page 22 Purging Procedure, Page 15
<b>UNIT HAS NO/ LOW POWER</b>		
Engine RPM low Control linkage bent or out of adjustment Brake setting incorrect Drive belt slipping or pulley damaged Oil level low or contaminated oil Excessive loading Bypass assembly sticking Air trapped in hydraulic system	Adjust to correct setting Repair or replace linkage Adjust brake to proper setting Repair or replace drive belt or pulley Fill to proper level or change oil Reduce vehicle loading Repair or replace valve or linkage Purge hydraulic system	Vehicle Specifications Control Linkage Repair, Page 23 Brake Adjustment, Page 12 Pulley Repair, Page 27 Fluid Maintenance, Page 11 Vehicle Specifications Bypass Repair, Page 22 Purging Procedure, Page 15
<b>UNIT OPERATING HOT</b>		
Debris buildup around transaxle Brake setting incorrect Cooling fan damaged Oil level low or contaminated oil Excessive loading Air trapped in hydraulic system	Clean off debris Adjust brake to proper setting Repair or replace cooling fan Fill to proper level or change oil Reduce vehicle loading Purge hydraulic system	Brake Adjustment, Page 12 Cooling Fan Repair, Page 27 Fluid Maintenance, Page 11 Vehicle Specifications Purging Procedure, Page 15
<b>TRANSAXLE LEAKS OIL</b>		
Damaged seals, housing, or gaskets Air trapped in hydraulic system	Replace damaged component Purge hydraulic system	Appropriate Repair Procedure Purging Procedure, Page 15

## SECTION 4. SERVICE AND MAINTENANCE

---

**NOTE: Any servicing dealer attempting a warranty repair must have prior approval before conducting maintenance of a Hydro-Gear® product unless the servicing dealer is a current Authorized Hydro-Gear Service Center.**

### EXTERNAL MAINTENANCE

Reference Table 4., Page 16 for tools required in the maintenance of the IHT.

Regular external maintenance of the IHT should include the following:

1. Check the vehicle operator's manual for the recommended load ratings. Insure the current application does not exceed load rating.
2. Check oil level See Figure 7, Page 11.
3. Inspect the vehicle drive belt, idler pulley(s), and idler spring(s). Insure that no belt slippage can occur. Slippage can cause low input speed to the transaxle.
4. Inspect the transaxle cooling fan for broken or distorted blades and remove any obstructions (grass clippings, leaves dirt, etc.).

5. Inspect the axle parking brake and vehicle linkage to insure proper actuation of the parking brake.
6. Inspect the vehicle control linkage to the directional control arm on transaxle. Also, insure the control arm is securely fastened to the trunnion arm of the transaxle.
7. Inspect the bypass mechanism on the transaxle and vehicle linkage to insure it actuates and releases fully.

### SERVICE AND MAINTENANCE PROCEDURES

All the service and maintenance procedures presented on the following pages can be performed while the transaxle is mounted on the vehicle. Any servicing beyond those given must be performed after the unit has been removed from the vehicle. Additional procedures are provided in Section 5. Repair Procedures.

## FLUIDS

The fluids used in Hydro-Gear® products have been carefully selected, and only equivalent, or better products should be substituted.

Typically, an engine oil with a minimum rating of 9 cSt (55 SUS) at 230° F (110° C) and an API classification of SJ/CD is recommended. A 20W-50 engine oil has been selected for use by the factory and is recommended for normal operating temperatures.

## FLUID VOLUME

Fluid volume information is provided in Table 3.

## FLUID LEVEL

Certain situations may require additional fluid to be added or even replaced. Refer to Figure 3 for the proper fill port and fluid level port locations. Fill the unit until fluid flows out of the fluid level port. Recheck the fluid level once the unit has been operated for approximately 1 minute. Purging may be required. Refer to the purging procedures, Page 14.

## FLUID CHANGE

This transaxle is factory filled and does not require a regular oil change. In the event of oil contamination or degradation an oil change may improve performance.

Using the transaxle removal procedure from Section 5, Page 15, remove the transaxle and drain the oil from the top fluid fill port. Fill unit per Table 3, reinstall the transaxle and perform the purging procedures, Page 14.

In the event a fluid change and filter inspection is required, refer to Page 27, Disassembly/Assembly instructions.

### Caution

#### Do not overfill.

**If you overfill the transaxle while the unit is "cold", it may overflow as it reaches normal operating temperatures. The oil level should not be above the manufacturer's suggestions outlined in this manual. This will allow the space needed for the oil to expand as it warms up.**

Fluid Description	Model	Volume
20W-50 engine oil	-1500	124.4 fl.oz. (3680 ml) to 129.5 fl.oz. (3830 ml)
	-1700	106.2 fl.oz. (3140 ml) to 110.8 fl.oz. (3280 ml)

Table 3. Fluid Volumes for the -1500 and -1700 IHT

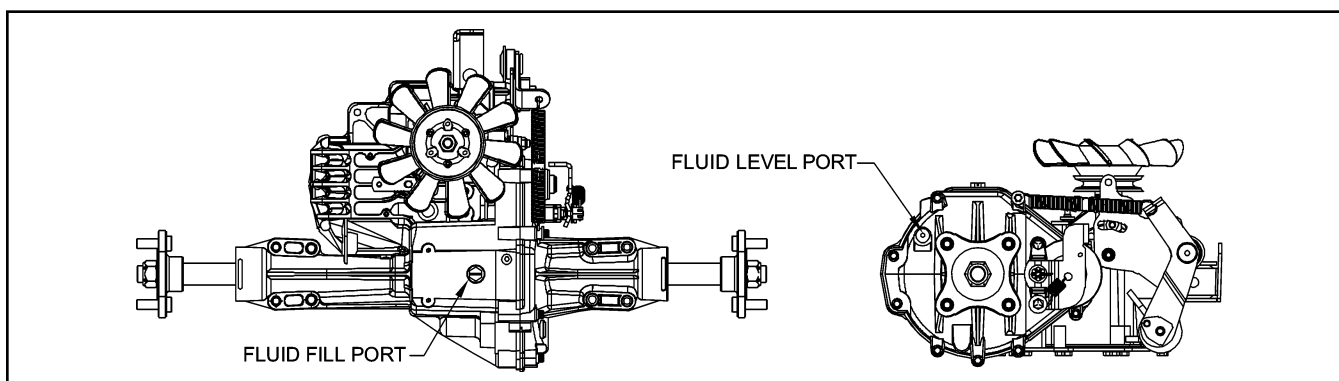


Figure 7. -1500 and -1700 Fluid Fill and Level Ports

## **BRAKE MAINTENANCE**

### **BRAKE SETTING**

1. Remove the brake arm bias spring, and then the cotter pin securing the brake castle nut.
2. Insert a 0.015" (.381 mm) feeler gage between the brake disc and top brake puck, and then set the brake by tightening or loosening the castle nut.
3. Adjust brake gap to 0.015" (.381 mm) clearance.
4. Install the cotter pin to secure the castle nut, and then install the brake arm bias spring.

## RETURN TO NEUTRAL SETTING FOOT CONTROL



### WARNING

#### POTENTIAL FOR SERIOUS INJURY

Certain procedures require the vehicle engine to be operated and the vehicle to be raised off of the ground. To prevent possible injury to the servicing technician and/or bystanders, insure the vehicle is properly secured.

The return to neutral mechanism on the transmission is designed to set the directional control into a neutral position when the operator removes their foot from the foot control. Follow the procedures below to properly adjust the return to neutral mechanism on the transaxle:

1. Confirm the transaxle is in the operating mode (bypass disengaged). Raise the vehicle's drive tires off the ground to allow free rotation.

**NOTE:** It may be necessary to remove the drive tire from the axle hub to access the linkage control and the transaxle control arm.

2. Remove the Original Equipment Manufacturer's (OEM's) control linkage at the control arm. Refer to Figure 9.



### WARNING

Do not attempt any adjustments with the engine running. Use extreme caution while inspecting all vehicle linkage!

Follow all safety procedures outlined in the vehicle owner's manual!

3. Start the engine and increase the throttle to full engine rpm.
4. Check for axle rotation. If the axles do not rotate, go to Step 5. If the axles rotate, go to Step 6.
5. Stop the vehicle's engine. Adjust the OEM linkage according to the OEM manual. Recheck according to Step 3 and 4. Stop the vehicle engine. Refer to Figure 9.
6. Note the axle directional movement. Stop the vehicle engine. Loosen the adjusting puck screw until the puck can be rotated. Rotate the adjusting puck the opposite direction of the wheel rotation on the control linkage side in 5 degree increments. Tighten the adjusting puck screw. Refer to Table 5. Required Torque Values, Page 17. Recheck according to Step 3 and 4. Stop the vehicle engine. Adjust the OEM linkage according to the OEM manual. Recheck according to Step 3 and 4. Refer to Figure 9.

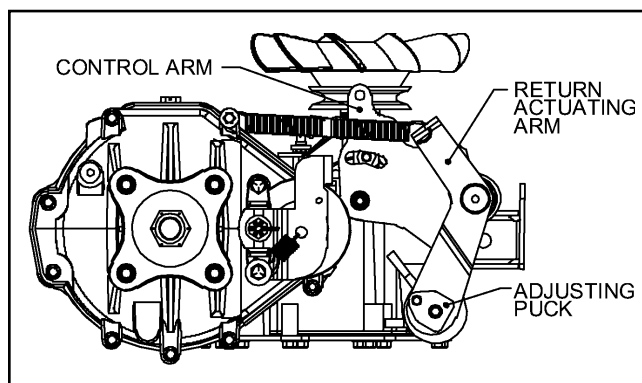


Figure 9. Return to Neutral, Foot Control

## PURGING PROCEDURES

Due to the effects air has on efficiency in hydrostatic drive applications, it is critical that it be purged from the system.

These purge procedures should be implemented any time a hydrostatic system has been opened to facilitate maintenance or any additional oil has been added to the system.

Air creates inefficiency because its compression and expansion rate is higher than that of the oil normally approved for use in hydrostatic drive systems.

The resulting symptoms in hydrostatic systems may be:

1. Noisy operation
2. Lack of power or drive after short term operation
3. High operation temperature and excessive expansion of "oil", in the latter case, oil may overflow.

Before starting, make sure the transaxle/ transmission is at the proper oil level. If it is not, fill to the manufacturers suggestions outlined in the vehicle owners manual.

**The following procedures should be performed with the vehicle drive wheels off the ground, then repeated under normal operating conditions.**

1. With the bypass valve open and the engine running, slowly move the directional control in both forward and reverse directions 6 to 10 times, as air is purged from the unit, the oil level will drop and bubbles may appear in the oil. After stopping the engine, add oil, as necessary. Fill to the level outlined in Figure 7, Page 11.
2. With the bypass valve closed and the engine running, slowly move the directional control in both forward and reverse directions (6 to 10 times). Check the oil level, and add oil as required after stopping engine.
3. It may be necessary to repeat Steps 1 and 2 until all the air is completely purged from the system. When the transaxle moves forward and reverse, purging is complete.

### CAUTION

#### DO NOT OVERFILL.

**If you overfill the transaxle while the unit is "cold", it may overflow as it reaches normal operating temperatures. The oil level should not be above the level shown in figure 7, Page 11. This will allow the space needed for the oil to expand as it warms up.**



## SECTION 5. REPAIR

**NOTE: Any servicing dealer attempting a warranty repair must have prior approval before conducting maintenance of a Hydro-Gear® product unless the servicing dealer is a current Authorized Hydro-Gear Service Center.**

### GENERAL INSTRUCTIONS

Cleanliness is a primary means of assuring satisfactory life on repaired units. Thoroughly clean all exposed surfaces prior to any type of maintenance. Cleaning of all parts by using a solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign material and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material. The external surfaces should be cleaned before beginning any repairs.

Upon removal, it is recommended that all seals, O-rings, and gaskets be replaced. During installation lightly lubricate all seals, O-rings, gaskets with a clean petroleum jelly prior to assembly. Also protect the inner diameter of seals by covering the shaft with a cellophane (plastic wrap, etc.).

Parts requiring replacement must be replaced from the appropriate kits identified in the Items Listing, found at the end of this manual.

### REQUIRED TOOLS

A list of tools required for the repair of the -1500 or -1700 IHT is provided in Table 4, Page 17.

### TORQUE SPECIFICATIONS

Torque specifications for fasteners used on the -1500 and -1700 IHT are provided in Table 5.

### TRANSAXLE REMOVAL

It is necessary to remove the -1500 or -1700 from the vehicle before performing the repair procedures presented in this section. Use the following procedure to prepare the unit for removal from the vehicle.

1. With the vehicle wheels on the ground, loosen the nut (119, Figure 29) Page 40, retaining the hub (118, Figure 29) on the control side of the transaxle only. Use an air impact wrench and a 1-1/8" socket to loosen the hub.
2. Lift the vehicle wheels from the ground and remove the nut completely.
3. Remove the wheel from the hub.
4. Using a wheel or gear puller, remove the hub from the shaft.

#### CAUTION

**USE CARE IN REMOVING THE HUB TO PREVENT CRACKING.**

### LIMITED DISASSEMBLY

The following procedures are presented in the order in which they must be performed to completely disassemble the unit. Do not disassemble the unit any farther than is necessary to accomplish the required repairs. Each disassembly procedure is followed by a corresponding assembly procedure, and the disassembly process can be halted after any given procedure.

Assembly is accomplished by performing the assembly portions of the procedures. If the unit has been completely disassembled, a summary of the assembly procedures, in the order in which they should occur, is given on Page 38.

## HOW TO USE THIS MANUAL

Many of the parts and subassemblies of this transaxle can be removed and serviced independently of other components. The disassembly, inspection, and assembly portions of this manual are therefore laid out in subsections. Each assembly is treated as a unit, and the disassembly, inspection, and assembly procedures follow one another.

Where some components and assemblies must be removed before a given assembly can be serviced, that information is given at the beginning of the disassembly instructions.

Subassemblies removed to reach another component or feature need not be fully disassembled. They may be reassembled intact following the necessary repairs.

Each assembly is provided with an exploded view showing the parts involved. At the end of the manual, after the reassembly summary, a complete exploded views and items lists are provided.

<p><b>Miscellaneous</b>                      -1500/-1700 Service &amp; Repair Manual                      Loctite                      Flat Blade Screw Driver                      Torque Wrench                      Air Impact Wrench</p> <p><b>Pliers</b>                      Needle Nose                      External Snap Ring                      Internal Snap Ring</p> <p><b>Allen Wrenches</b>                      5 mm, 6 mm, 1/4 inch</p>	<p><b>Sockets</b>                      3/8" Drive: 7/16", 1/2", 13/16"                      1/2" Drive: 9/16", 15/16", 1-1/8"                      #8 Internal Torx Drive                      #10 Internal Torx Drive</p> <p><b>Socket Drivers</b>                      3/8", 1/2"</p> <p><b>Combination Wrenches</b>                      7/16", 1/2", 9/16", 13/16", 15/16", 1-1/8"</p>
---	--

Table 4. Required Tools

Operation	Torque	Item	Description
Center Section Screws (Item #44)	525-700 lb-in (59-79 Nm)	44	Screw
Lower Housing Screws (Item # 50)	135-185 lb-in (15-21 Nm)	50	Screw
Charge Pump Cover Screws (Item # 29)	87-108 lb-in (9-12 Nm)	29	M6 x 1-22
Axle Shaft Jam Nut (Item # 73)	660-800 lb-in (75-90 Nm)	73	5/16-18
Right Hand Housing Screws (Item # 80)	230-290 lb-in (26-33 Nm)	80	5/16-18
Axle Hub Nut (Item # 119)	200-295 lb-ft (271-400 Nm)	119	3/4-16
Pulley Nut (Item # 115)	360-520 lb-in (41-59 Nm)	115	Jam Nut
Torque Bracket Nut (Item # 142)	160-210 lb-in (18-24 Nm)	142	5/16-18
Control Arm Stud (Item # 36)	50-120 lb-in (6-14 Nm)	36	5/16-24
Control Bearing Screw (Item # 92)	190-240 lb-in (22-27 Nm)	92	Screw
Control Arm Nut (Item # 95)	85-120 lb-in (10-14 Nm)	95	5/16-24
Adjusting Puck Screw (Item # 88)	250-320 lb-in (28-36 Nm)	88	5/16-24 x 1-3/4
Brake Nuts (Item # 127)	80-120 lb-in (9-14 Nm)	127	1/4-20
Differential Lock Sleeve Screws (Item #50)	135-185 lb-in (15-21 Nm)	50	Screw 1/4-20 x .75

Table 5. Required Torque Values

## BRAKE ASSEMBLY

Refer to Figures 12 and 13.

### DISASSEMBLY

1. Remove the cotter pin (129), castle nut (128), and washer (77).
2. Remove brake arm (124), and brake arm bias spring (141).
3. Remove brake anti-drag compression spring (151), and two brake pins (125).
4. Remove upper bolt (121) which secures brake yoke assembly (122).
5. Remove lower bolt (132), washer (139) and spacer (130) which secure the brake yoke assembly (122).
6. Remove brake yoke assembly (122), puck plate (131), and outer brake puck (120).
7. Remove brake disc (85), and inner brake puck (120).

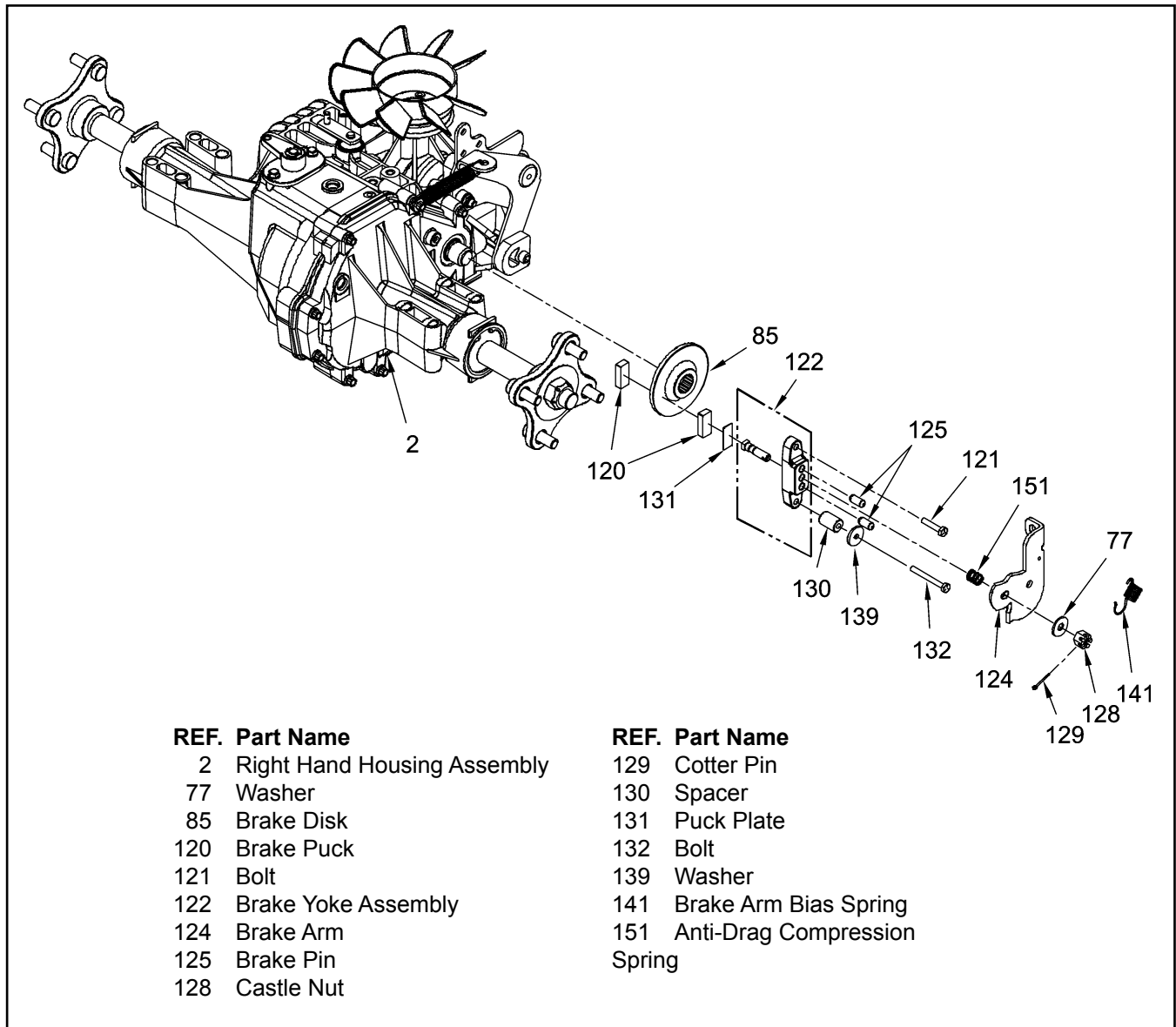


Figure 12. Brake Assembly

## INSPECTION

1. Inspect the brake pucks (120) for excessive wear.
2. Replace with new if necessary.

## ASSEMBLY

1. Install inner brake puck (120), and brake disc (85).
2. Assemble the brake yoke assembly, by installing puck plate (131), outer brake puck (120) into brake yoke (122).
3. Position the brake yoke assembly against the brake disc.
4. Install the upper bolt (121).
5. Install the lower bolt spacer (130), washer (139) and bolt (132) to secure the brake yoke assembly (122).
6. Install brake anti-drag compression spring (151), and two brake pins (125).
7. Install brake arm (124) onto brake yoke assembly.
8. Install washer (77), and castle nut (128).
9. Insert a (0.015") (.381 mm) feeler gage between brake disc (85) and outer brake puck (120). Adjust the brake by turning castle nut (128) until it is snug but not tight against the feeler gage. (The brake gap must be adjusted to a (0.015") (.381 mm) clearance.
10. Install cotter pin (129) to secure castle nut (128).
11. Install brake arm bias spring (141) to brake arm (124) and lower brake yoke assembly bolt (132).

## BYPASS ASSEMBLY

Refer to Figure 14.

### DISASSEMBLY

1. Remove retaining ring (42).
2. Remove bypass arm (41).
3. Remove bypass lip seal (40).

### INSPECTION

1. Inspect bypass arm (41) for wear.

### ASSEMBLY

1. Install bypass lip seal (40). See Page 25 for instructions.
2. Install bypass arm (41).
3. Install retaining ring (42).

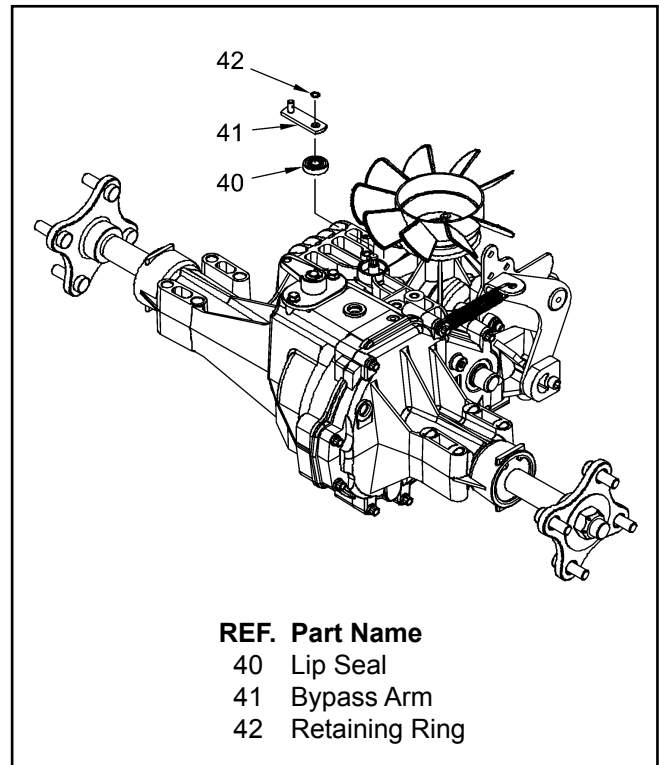


Figure 14. Bypass Assembly

## CONTROL ARM ASSEMBLY

Refer to Figure 15, Page 21

### DISASSEMBLY

#### RETURN TO NEUTRAL ASSEMBLY

1. Remove screw (88) and adjusting puck (48).
2. Remove neutral spring (46), return arm (34), and washer (87).

#### CONTROL ARM ASSEMBLY

1. Remove lower lock nut (95), and trunnion spacer (106), from the trunnion arm (31).
2. Remove control arm (26).
3. Remove stud (36), if necessary.

### INSPECTION

1. Inspect bearing (89), and replace if necessary. Remove bearing by removing countersink screw (92), and spacer (90).
2. Inspect trunnion arm lip seal (33) and replace if necessary. See page 22 for replacement instructions.

### ASSEMBLY

#### CONTROL ARM ASSEMBLY

1. Install new trunnion arm lip seal (33), into main housing (1). See page 22 for instructions.
2. Install stud (36), per Table 5, Page 16.
3. Install control arm (26), onto trunnion arm (31) and stud (36).
4. Install trunnion spacer (106) and lock nut (95), per table 5, Page 16, onto the trunnion arm (31).

#### NEUTRAL ASSEMBLY

**NOTE: If bearing (89) must be replaced, install bearing (89), spacer (90), and countersink screw (92).**

1. Install washer (87), return arm (34) and neutral spring (46).
2. Install adjusting puck (48), and bolt (88).
3. Reference page 13 for proper neutral adjustment procedures.

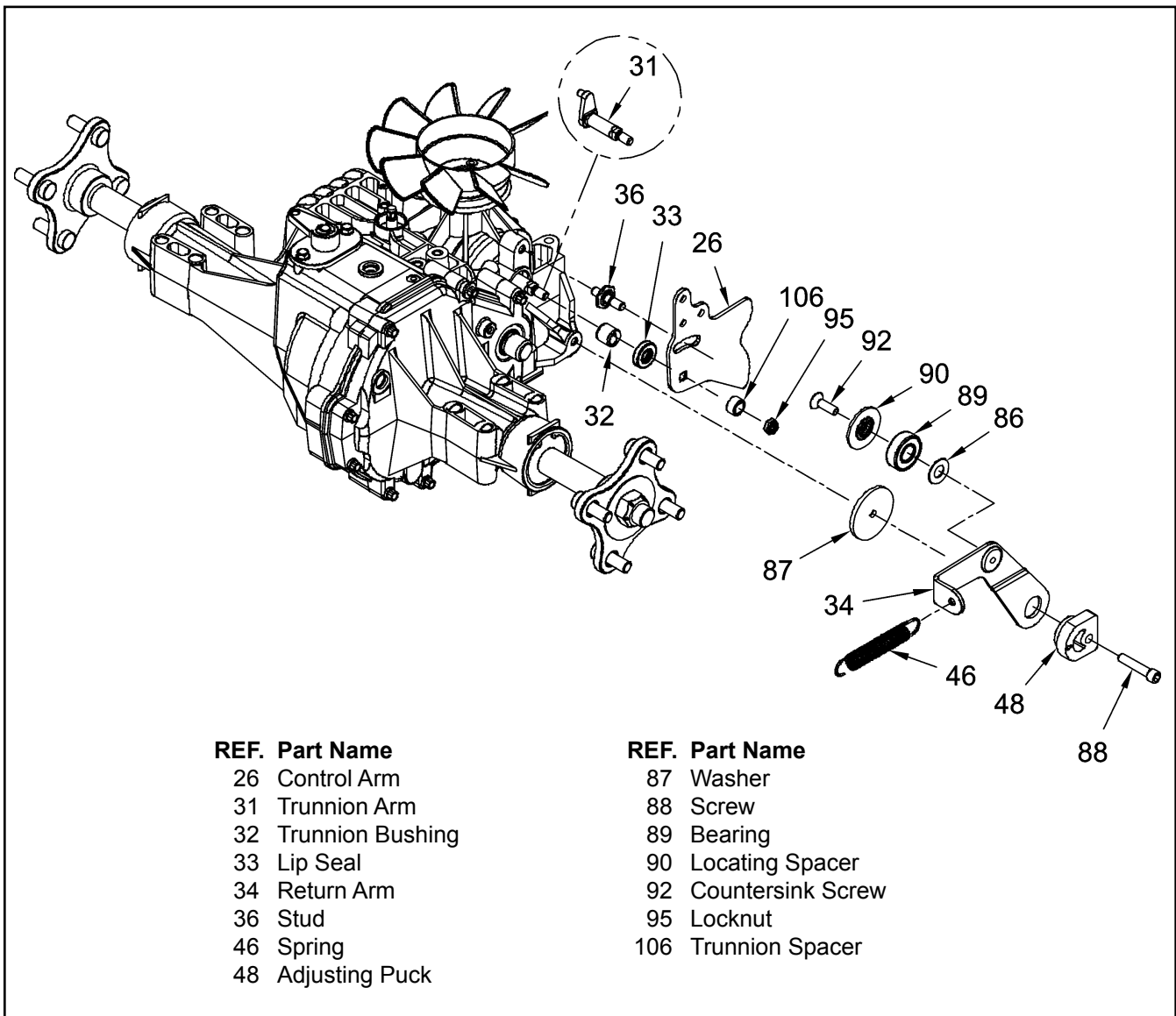


Figure 15. Control Arm Assembly

## SEAL KIT REPLACEMENT

Before disassembly, wipe the unit free of any debris to avoid contamination.

Refer to Figure 16.

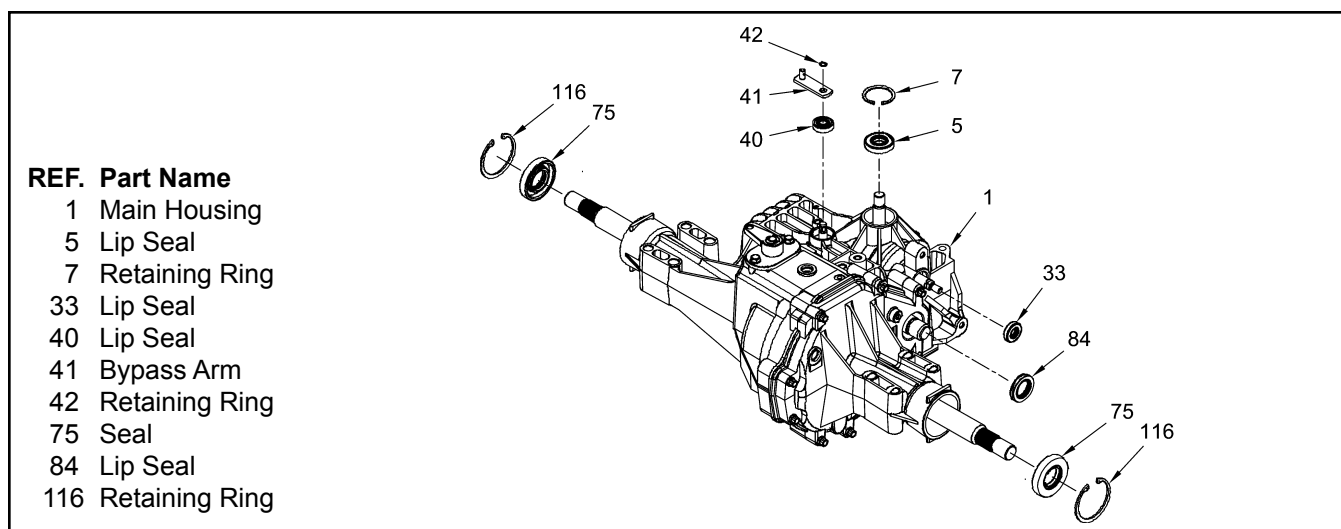


Figure 16. Seal Replacement Kit

### INPUT SEAL

1. Remove the input pulley from the input shaft.
2. Remove the seal retaining ring (7).
3. Carefully pull the input seal (5) out of the housing bore with a "hook" type tool. Care must be taken to avoid damage to the housing bore or shaft sealing area.
4. Lubricate the new seal with petroleum jelly prior to installation.
5. Wrap the shaft keyway (splines) with cellophane to prevent damage to the seal lip during installation.
6. Slide the seal over the shaft and press it into the housing bore.
7. The seal should seat against the spacer.
8. Install the seal retaining ring (7) and make sure it is fully seated in its groove.

### AXLE SEAL

1. The seal (75) can be replaced by following steps 2-6 of the procedure used to replace the input seal.

2. Install the retaining ring (116) and make sure it is fully seated in its groove.

### MOTOR SHAFT SEAL

1. Remove the brake assembly. See Pages 17-18.
2. The seal (84) can be replaced by following steps 3-6 of the procedure used to replace the input shaft.

### TRUNNION SEAL

1. Remove the control arm and any attachments to the control arm. See Page 20.
2. The seal (33) can be replaced by following steps 3-6 of the procedure used to replace the input shaft.

### BYPASS SEAL

1. Remove the bypass arm and any attachments to the bypass arm. See Page 19.
2. Remove the bypass rod seal (40). Deburr the bypass rod.
3. Install the seal (40). Install the bypass arm (41) and retaining ring (42).



## TORQUE BRACKET ASSEMBLY (IF EQUIPPED)

Refer to Figure 17.

### DISASSEMBLY

1. Remove lock nut (142), and bolt (143), from torque bracket (102).
2. Remove torque bracket (102), from main housing (1).

### ASSEMBLY

1. Install torque bracket (102), onto main housing (1).
2. Install lock nut (142), and bolt (143), to secure torque bracket (102) to main housing (1). Reference Table 5, Page 16 for torque values.

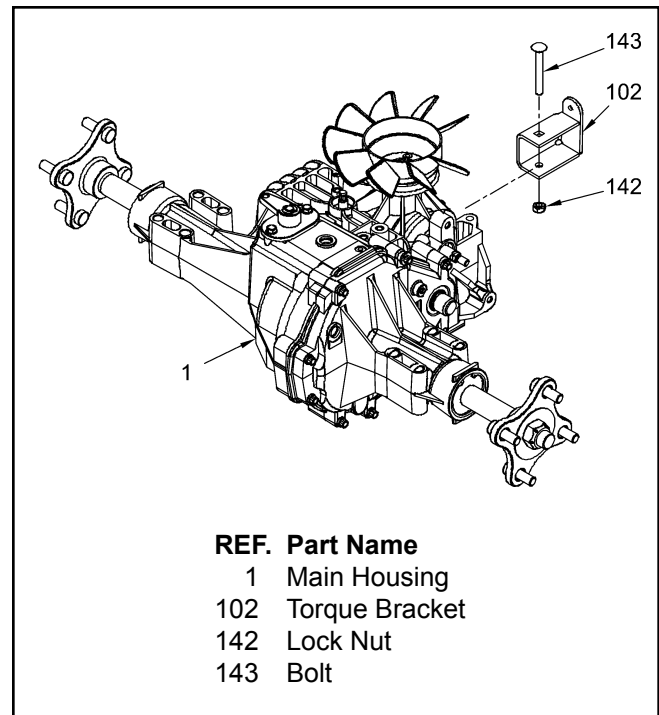


Figure 17. Torque Bracket Assembly

## FAN AND PULLEY ASSEMBLY

Refer to Figure 18.

### DISASSEMBLY

1. Remove jam nut (115) and slotted washer (107) from input shaft (12).
2. Remove fan/pulley assembly (104) and (103).

### INSPECTION

1. Inspect fan (104) for broken and/or damaged blades. If necessary to replace fan (104), remove fan (104), from pulley (103).

### ASSEMBLY

1. Install fan/pulley assembly (104) and (103) onto input shaft (12).
2. Secure fan/pulley assembly (104) and (103) onto shaft (12) by installing slotted washer (107) and jam nut (115), per table 5, Page 16.

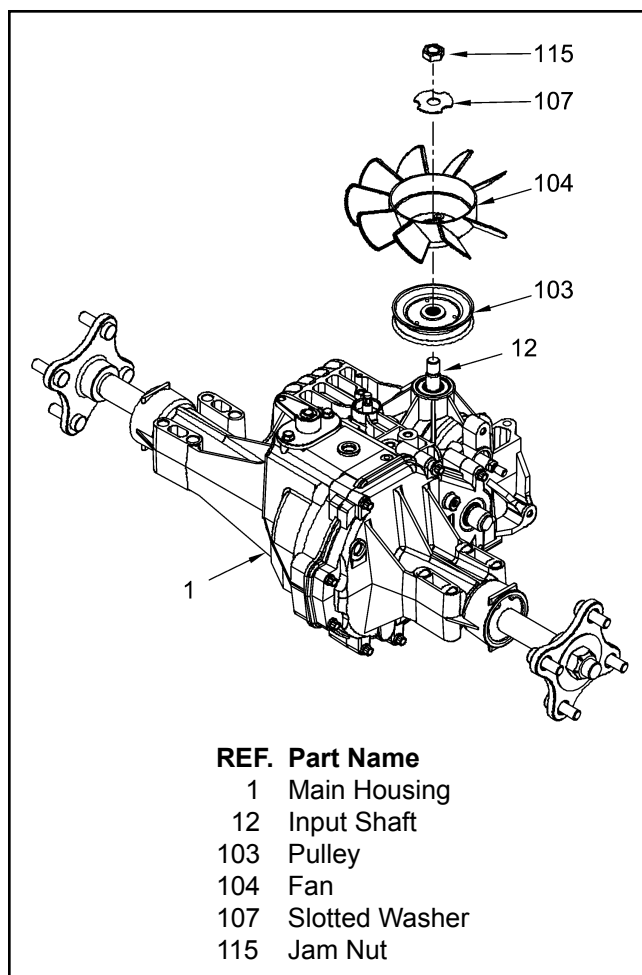


Figure 18. Fan and Pulley Assembly

## INPUT SHAFT ASSEMBLY

Refer to Figure 19.

### DISASSEMBLY

1. Drain the oil from the transaxle by opening the fill port or level port and positioning the unit so the oil drains. If equipped, open the oil drain port. See page 6 for location.
2. If replacing the input shaft only, continue with step 3. **If further disassembly of the unit is required, leave the input shaft in the transaxle at this time and proceed to the next page.**
3. Remove the snap ring (7), input shaft lip seal (5), and spacer (4).
4. Remove the input shaft assembly which consists of the input shaft (12), ball bearing (8) and retaining ring (6).
5. Remove washer (13) from the input shaft bore.

### INSPECTION

1. Inspect bearing (8) for damage and, if necessary replace bearing, remove wire retaining ring (6) and bearing (8) from input shaft (12).

### ASSEMBLY

1. Carefully install washer (13) onto top of spring in the input shaft bore.
2. Press bearing (8) onto input shaft (12) and secure by installing wire retaining ring (6).
3. Install input shaft assembly (items 12, 8 and 6) into input bearing bore of main housing (1).
4. Install spacer (4) into the input bearing bore.
5. Install the input shaft lip seal (5). See page 25.
6. Secure input shaft assembly (12) by installing retaining ring (7).
7. Fill the unit with new motor oil. See page 11.

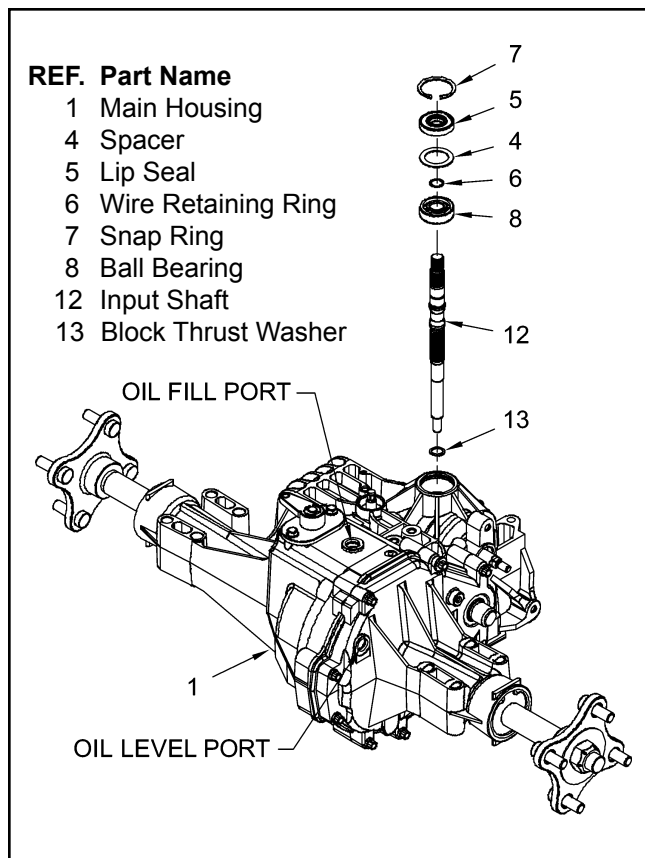


Figure 19. Input Shaft Assembly

## AUXILIARY PUMP ASSEMBLY (IF EQUIPPED)

Refer to Figure 20.

### DISASSEMBLY

1. Remove two screws (29) from the auxiliary pump cover (54), and remove the cover (54).
2. Remove o-ring (53), gerotor assembly (52), shim (162) and pins (163).

### INSPECTION

1. Inspect gerotor assembly (52), pump cover (54), for damage or excessive wear.

### ASSEMBLY

1. Install gerotor (52) with new o-ring (53) onto input shaft (12) (not shown).
2. Install new O-ring (53) into pump cover (54).
3. Install pins (163) and shim (162) onto the pump cover (54).
4. Install cover (54) and secure by installing two screws (29), per Table 5, Page 16.

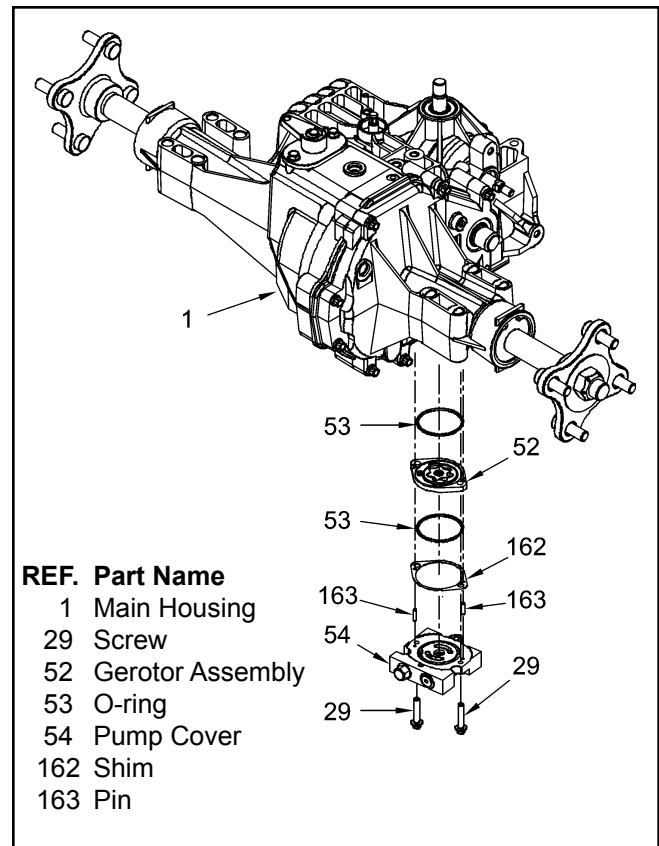


Figure 20. Auxiliary Pump Assembly

## CHARGE PUMP ASSEMBLY (IF EQUIPPED)

Refer to Figure 21.

### DISASSEMBLY

**NOTE: Before disassembling, note the orientation of the charge pump cover (54). Scribe or mark the charge pump cover (54) for correct orientation during assembly.**

1. Remove two screws (29) from the charge pump cover (54), and remove the charge pump cover (54).
2. Remove the o-ring (53) and gerotor assembly (52) from the charge pump cover (54).

### INSPECTION

1. Inspect gerotor assembly (52) and the charge pump cover (54) for damage or excessive wear.

### ASSEMBLY

1. Install gerotor (52) onto input shaft (12) (not shown).
2. Install new O-ring (53) into charge pump cover (54).
3. Install charge pump cover (54), making sure it is properly oriented.
4. Secure charge pump cover (54) by installing two screws (29), per Table 5, Page 16.

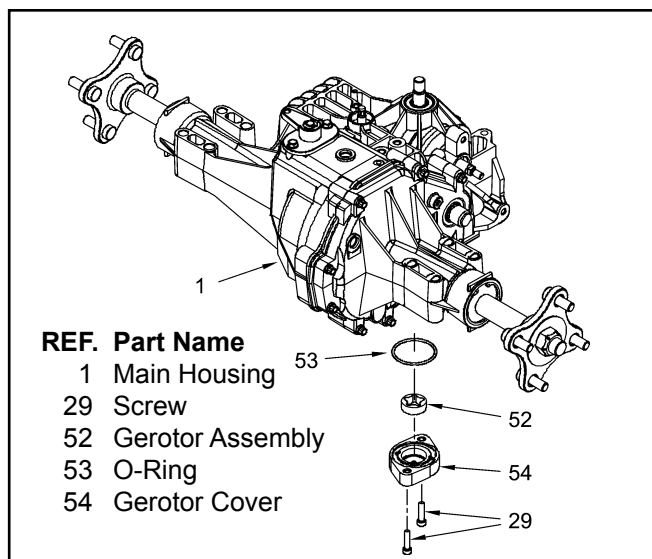


Figure 21. Charge Pump Assembly

## LOWER HOUSING/FILTER ASSEMBLY (-1500)

Refer to Figure 22.

### DISASSEMBLY

1. Remove the eleven housing screws (50) and lower cover (51), and remove sealant from the housing and lower cover (51).
2. Remove filter (55) from the center section assembly (3) (not shown).

### INSPECTION

1. Inspect filter (55), replace if necessary.

**NOTE: Filter replacement is suggested.**

### ASSEMBLY

1. Install filter (55) onto the center section (3) (not shown).
2. Apply sealant (79) to lip of main housing (1). See Figure 30, Page 39 for sealant path.
3. Secure lower cover (51) to main housing (1) by installing the eleven housing screws (50), reference Table 5, Page 16.

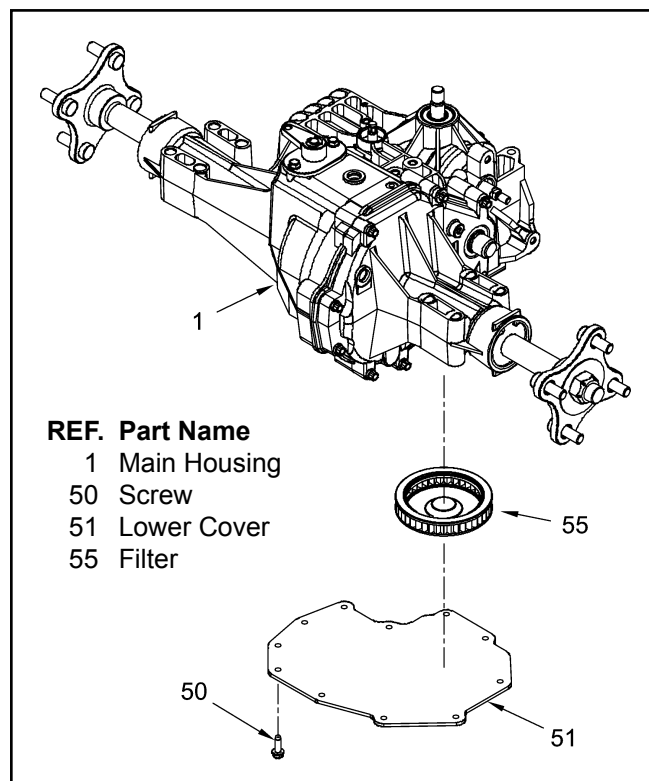


Figure 22. Lower Housing/Filter Assembly/ -1500

## LOWER HOUSING/FILTER/ MANIFOLD ASSEMBLY -1700 (STANDARD CHARGE PUMP)

Refer to Figure 23.

**NOTE: Charge Pump assembly must be removed before the following steps can be performed. See page 30.**

### DISASSEMBLY

1. Remove the eleven housing screws (50) and lower cover (51), and remove sealant.
2. Remove screw O-rings (157).
3. Remove spring (145) and ball (146).
4. Remove filter (55) and charge manifold (56).
5. Remove o-ring (144).

### INSPECTION

1. Inspect filter (55) and manifold (56), replace if necessary.

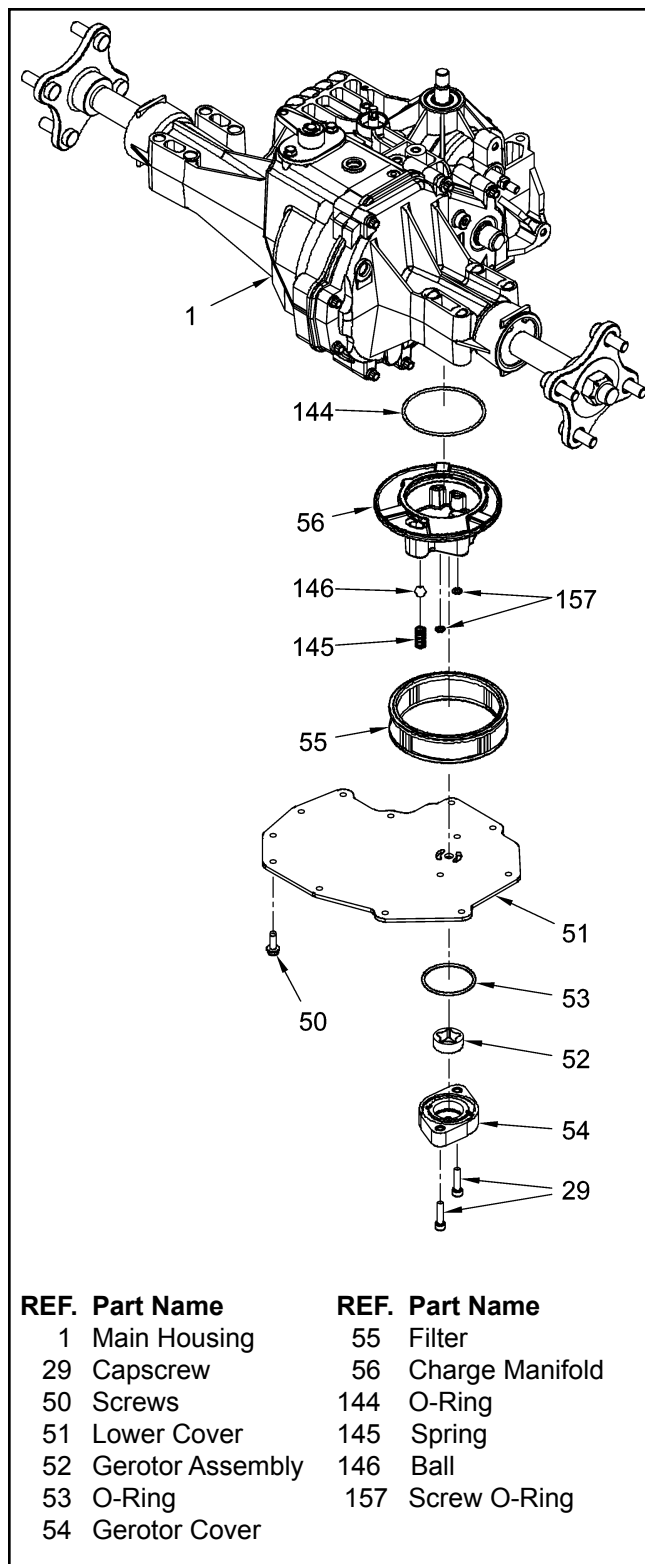
**NOTE: Filter replacement is suggested.**

2. Inspect o-ring (144) and screw O-rings (157).

### ASSEMBLY

1. Install o-ring (144) onto center section assembly (3), refer to Figure 27.
2. Install filter (55) and charge manifold (56).
3. Install spring (145) and ball (146).
4. Install screw O-rings (157).
5. Dry fit lower cover (51) on housing, using screws (29) to align cover and manifold (56).
6. Remove screws (29) and cover (51). Apply sealant (79) to lip of main housing (1). See Figure 30, Page 39 for sealant path.
7. Reinstall cover (51) and screws (29), reference Table 5, Page 16.

8. Secure lower cover (51) to main housing (1) by installing the eleven housing screws (50), reference Table 5, Page 17.



REF.	Part Name	REF.	Part Name
1	Main Housing	55	Filter
29	Capscrew	56	Charge Manifold
50	Screws	144	O-Ring
51	Lower Cover	145	Spring
52	Gerotor Assembly	146	Ball
53	O-Ring	157	Screw O-Ring
54	Gerotor Cover		

Figure 23. Lower Housing/Filter/Manifold Assembly

## LOWER HOUSING/FILTER/ MANIFOLD ASSEMBLY/ -1700 (AUXILIARY CHARGE PUMP)

Refer to Figure 23A.

**NOTE: Charge Pump assembly must be removed before the following steps can be performed. See page 26.**

### DISASSEMBLY

1. Remove the eleven housing screws (50) and lower cover (51), and remove sealant.
2. Remove filter (55) and charge manifold (56).
3. Remove o-ring (144).

### INSPECTION

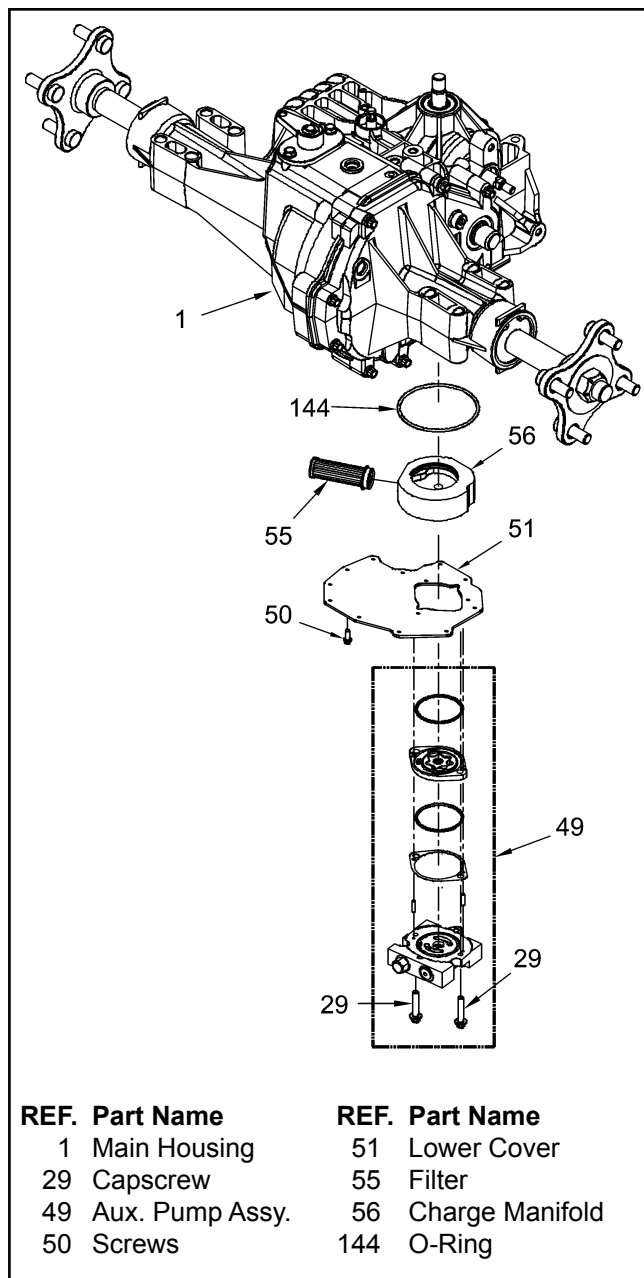
1. Inspect filter (55) and manifold (56), replace if necessary.

**NOTE: Filter replacement is suggested.**

2. Inspect o-ring (144).

### ASSEMBLY

1. Install o-ring (144) onto center section assembly (3), refer to Figure 27.
2. Apply sealant to filter (55) before assembling with charge manifold (56).
3. Install filter (55) and charge manifold (56).
4. Dry fit lower cover (51) on housing, using screws (29) to align cover and manifold (56).
5. Remove screws (29) and cover (51). Apply sealant (79) to lip of main housing (1). See Figure 30, Page 39 for sealant path.
6. Reinstall cover (51) and screws (29).
7. Secure lower cover (51) to main housing (1) by tightening the eleven housing screws (50), reference Table 5, Page 16.



**Figure 23A. Lower Housing/Filter/Manifold Assembly**

REF.	Part Name	REF.	Part Name
1	Main Housing	51	Lower Cover
29	Capscrew	55	Filter
49	Aux. Pump Assy.	56	Charge Manifold
50	Screws	144	O-Ring

## PLANETARY DIFFERENTIAL ASSEMBLY W/O DIFF. LOCK

Refer to Figure 24, next page.

**NOTE: Brake Assembly, and optional Return to Neutral have to be removed before the following steps can be performed.**

### DISASSEMBLY

1. Remove the axle hub assembly (118) on control side by removing nuts (119), and hub assemblies (118).
2. Remove the eight torx head screws (80) and one shouldered torx head screw (168) that secure the R.H. housing assembly (2).
3. Remove R.H. housing axle seal. See page 22.
4. Remove R.H. housing assembly (2), while holding axle shaft (76) in place.
5. Remove the two housing pins (117).
6. Remove washer (71) from axle shaft (76).
7. Remove spur gear (60), and thrust plate (62).
8. Remove 21T sun gear (61), and sleeve bearing (96).
9. Remove the planetary gears (59).
10. Remove the axle shaft (76).
11. Remove the four carrier pins (58) from planetary carrier (64).
12. Remove 51T ring gear (63) from main housing (1).
13. Remove the two bevel gears (66), and differential shaft (67).
14. Remove planetary carrier (64) and differential thrust plate (68).
15. If necessary, remove the axle seal and second axle shaft assembly (76) from main housing (1).

16. See page 22 for axle shaft seal removal.

### INSPECTION

1. Inspect all gears for excessive wear or damage and replace if necessary.
2. Remove all sealant from both housings and inspect seal lands for damage when cleaning.
3. If bevel gear (65) needs replacing, remove jam nut (73) from axle shaft (76).

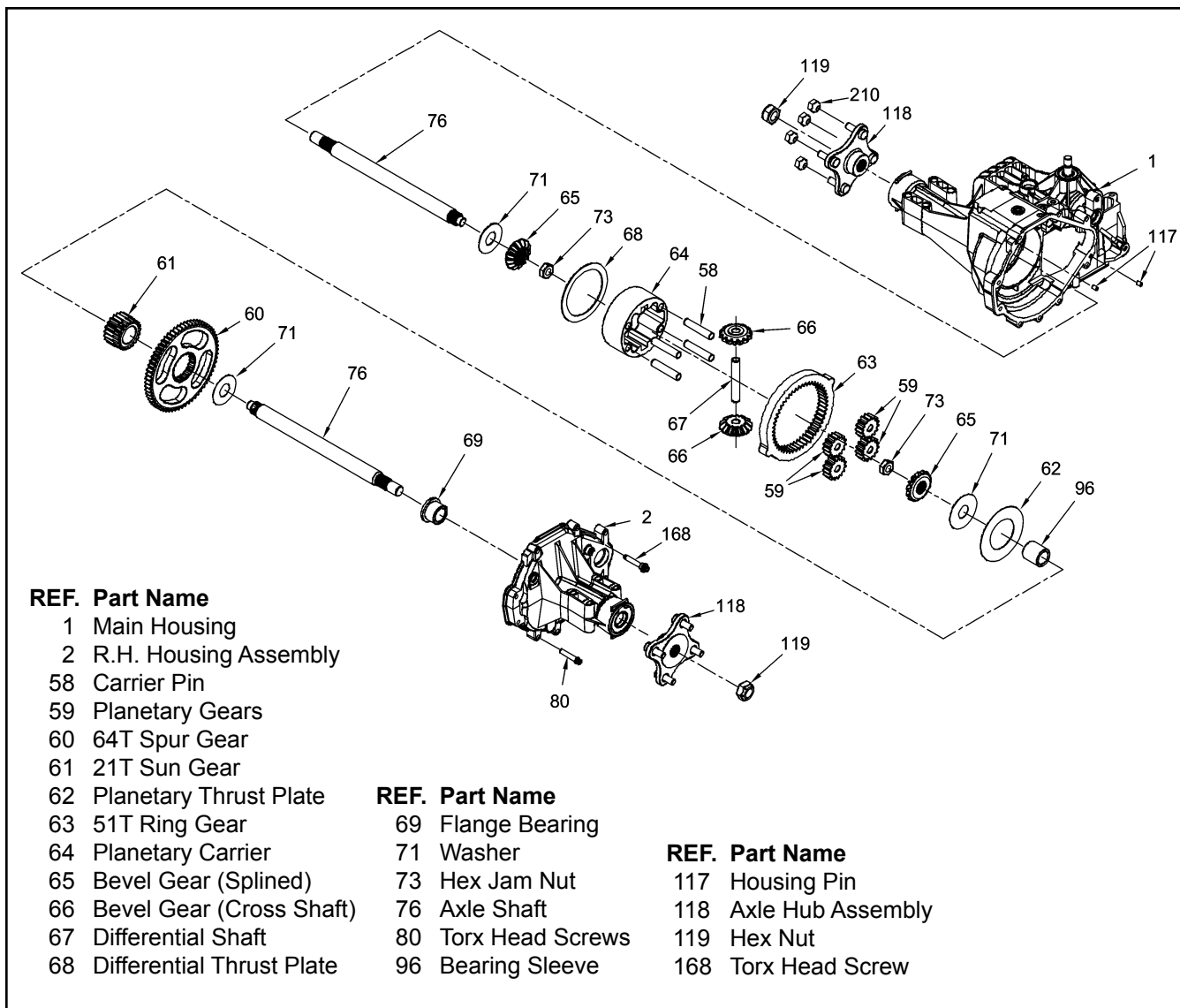
### ASSEMBLY

1. If necessary, install L.H. Axle shaft assembly (76) into main housing (1). If necessary, reassemble axle shaft assembly (76) by installing washer (71), bevel gear (65), and jam nut (73) onto axle shaft (76).
2. Install differential thrust plate (68) into main housing (1).
3. Install planetary carrier (64) into main housing (1).
4. Reassemble the two bevel gears (66) onto differential shaft (67), and install assembly into planetary carrier (64).
5. Install 51T ring gear (63) into main housing (1).
6. Install the four carrier pins (58) into planetary carrier (64).
7. If necessary, reassemble axle shaft assembly (76) by installing washer (71), bevel gear (65), and jam nut (73) onto axle shaft (76).
8. Install R.H. Axle shaft assembly (76) partway into assembled differential components.

**NOTE: It will be necessary to support the RH axle shaft in the partially installed position while steps 9 through 16 are completed.**

9. Assemble sleeve bearing (96) and sun gear (61), sliding them onto R.H. axle shaft. The smaller diameter on the sun gear OD should be "IN".





**Figure 24. Planetary Gear Reduction and Differential Assembly**

10. Install the four 15T planetary gears (59) on pins (80) . Make sure the planetary gears are properly aligned with the sun gear (61). Mate the bevel gear (65) on the end of the RH axle shaft with the bevel gears (66) in the differential assembly. Continue to support the RH axle shaft.
11. Install the planetary thrust plate (62).
12. Install the 64T spur gear (60) onto the 21T sun gear (61).
13. Slide washer (71) onto axle shaft (76).
14. Install the two housing pins (117) into the main housing (1).
15. Apply a bead of sealant to the main housing.
16. Install R.H. housing (2) by sliding it down the axle shaft (76), over motor shaft assembly (24, Figure 27) and onto main housing (1).
17. Secure housings by installing the eight housing screws (80) and one shouldered torx screw (168), per Table 5, Page 16.
18. Install the axle shaft seals. See page 22.
19. After the transaxle has been installed in the vehicle, install the axle hub assemblies (118), according to the instructions in "Transaxle installation", Page 37.

## PLANETARY DIFFERENTIAL ASSEMBLY W/ DIFF. LOCK

Refer to Figure 25, next page.

**NOTE: Brake Assembly, and optional Return to Neutral have to be removed before the following steps can be performed.**

### DISASSEMBLY

1. Remove retaining ring (182), and actuating handle (181).
2. Remove screws (50), sleeve (180), o-ring (184), cam (178) and shaft (179) from the main housing.
3. Remove the axle hub assembly (118) on control side by removing nuts (119), and hub assembly (118).
4. Remove the axle seal. See page 25.
5. Remove the eight torx head screws (80) and one shouldered torx head screw (168) that secure the R.H. housing assembly (2).
6. Remove R.H. housing assembly (2), while holding axle shaft (76) in place.
7. Remove the two housing pins (117).
8. Remove washer (71) from axle shaft (76).
9. Remove spur gear (60), and thrust plate (62).
10. Remove 21T sun gear (61), and sleeve bearing (96).
11. Remove the planetary gears (59).
12. Remove the axle shaft (76).
13. Remove the four carrier pins (58) from planetary carrier (64).
14. Remove 51T ring gear (63) from main housing (1).
15. Remove the two bevel gears (66), and differential shaft (67).
16. Remove planetary carrier (64) and differential thrust plate (68).
17. If necessary, remove the second axle shaft assembly (76) from main housing (1). See page 22 for axle seal removal.

18. Remove differential components washer guide (177), relief springs (145), dogs (175), load plate (173), washer (172), rotating cam (171) and stationary cam (170).

### INSPECTION

1. Inspect all gears for excessive wear or damage and replace if necessary.
2. Remove all sealant from both housings and inspect seal lands for damage when cleaning.
3. If bevel gear (65) needs replacing, remove jam nut (73) from axle shaft (76).

### ASSEMBLY

1. If necessary, install L.H. Axle shaft assembly (76) into main housing (1). If necessary, reassemble axle shaft assembly (76) by installing washer (71), bevel gear (65), and jam nut (73) onto axle shaft (76).
2. Install stationary cam (170), rotating cam (171), washer (172), load plate (173), dogs (175), washer guide (177) and relief springs (145) into the main housing (1).
3. Install differential thrust plate (68) into main housing (1).
4. Install planetary carrier (64) into main housing (1).
5. Reassemble the two bevel gears (66) onto differential shaft (67), and install assembly into planetary carrier (64).
6. Install 51T ring gear (63) into main housing (1).
7. Install the four carrier pins (58) into planetary carrier (64).
8. If necessary, reassemble axle shaft assembly (76) by installing washer (70), bevel gear (65), and jam nut (73) onto axle shaft (76).
9. Install R.H. Axle shaft assembly (76) partway into assembled differential components.

**NOTE: It will be necessary to support the RH axle shaft in the partially installed position while steps 10 through 17 are completed.**

10. Assemble sleeve bearing (96) and sun gear (61), sliding them onto R.H. axle shaft. The smaller diameter on the sun gear OD should be "IN".

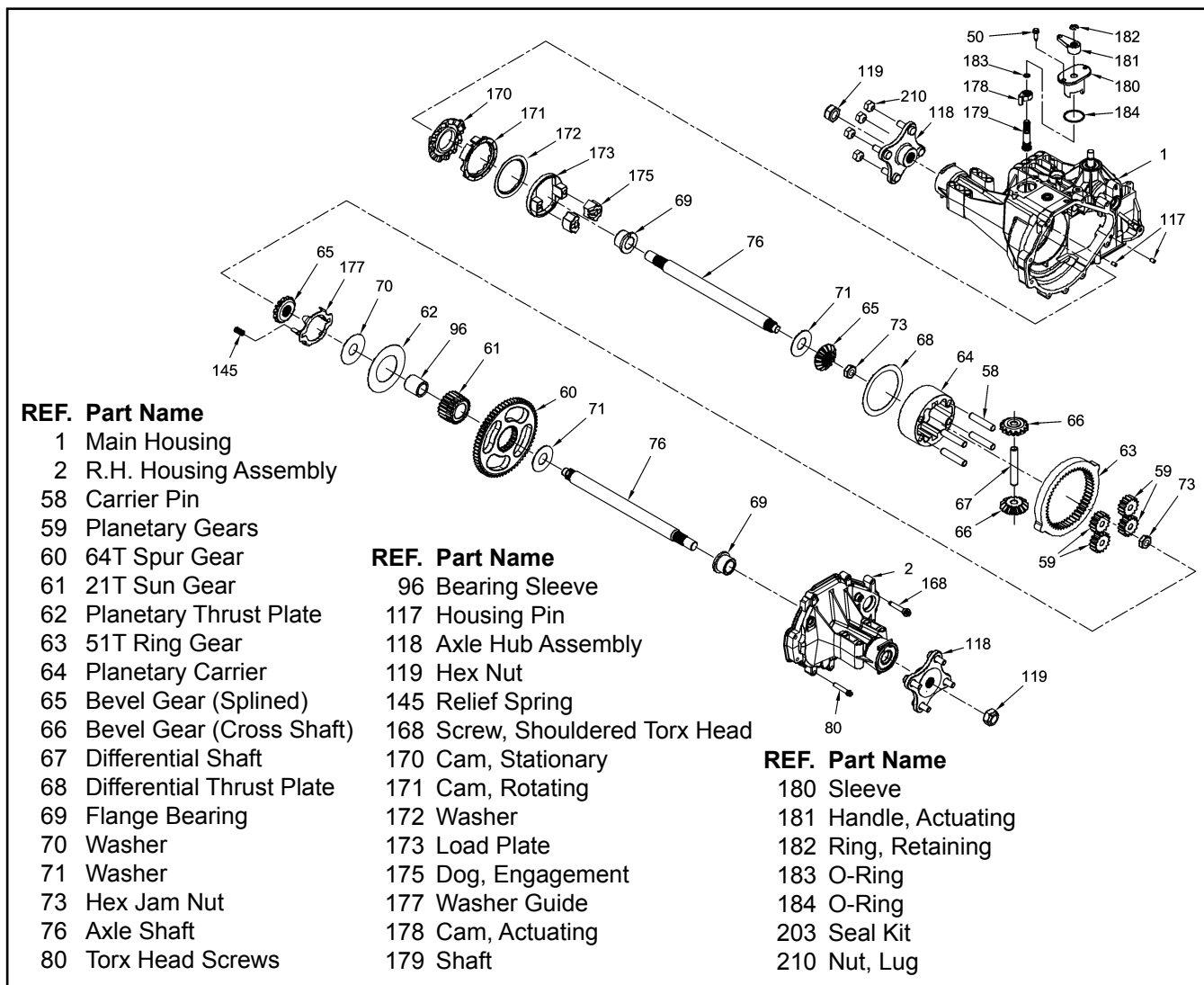


Figure 25. Planetary Gear Reduction and Differential Assembly

11. Install the four 15T planetary gears (59) on pins (80) . Make sure the planetary gears (59) are properly aligned with the sun gear (61). Mate the bevel gear on the end of the RH axle shaft with the bevel gears (66) in the differential assembly. Continue to support the RH axle shaft.
12. Install the planetary thrust plate (62).
13. Install the 64T spur gear (60) onto the 21T sun gear (61).
14. Slide washer (71) onto axle shaft (76).
15. Install the two housing pins (117) into the main housing (1).
16. Apply a bead of sealant to the main housing (1). See page 39 for sealant path
17. Install R.H. housing (2) by sliding it down the axle shaft (76), over motor shaft assembly (24, Figure 27) and onto main housing (1).

18. Secure housings by installing the eight housing screws (80) and one shouldered torx screw (168), per Table 5, Page 17.
19. Assemble shaft (179), cam (178), o-ring (183) and o-ring (184) into sleeve (180) then install sleeve assembly into main housing (1).

**NOTE: Make sure tab from cam (178) fits into slot in rotating cam (171).**

20. Secure sleeve assembly (180) with screws (50).
21. Install actuating lever (181) and retaining ring (182).
22. Install new axle seals. See page 22.
23. After the transaxle has been installed in the vehicle, install the axle hub assemblies (118), according to the instructions in "Transaxle installation", Page 37.

## MOTOR/CENTER SECTION/ PUMP ASSEMBLY

Refer to Figures 26 and 27, (next pages).

**NOTE: Brake Assembly, Charge Pump Assembly, Differential Assembly, and Lower Housing/Filter/Manifold Assembly have to be removed before the following steps can be performed.**

### DISASSEMBLY

1. Remove the motor shaft assembly which consists of the washer (82), snap ring (83), washer (82), 16T pinion gear (28), spacer (27), and shaft (24).
2. Remove motor thrust bearing retainer (57).
3. Remove the three screws (44) from center section assembly (3).
4. Lift center section assembly (3) and motor block assembly (21) out of main housing (1).
5. Remove each piston (23), spring (18), and piston seat (22) from the 21cc motor cylinder block assembly.
6. Remove motor thrust bearing (25).
7. Remove bypass plate (38) from center section assembly (3).
8. Remove the two center section assembly pins (43).
9. Remove bypass actuator (39) from the center section (3).
10. Remove 10cc pump cylinder block assembly (15).
11. Remove each piston (17), spring (18), piston seat (16) from the 10cc pump cylinder block assembly (21).
12. Remove block spring (14), and block thrust washer (13) from shaft (12, Figure 19).
13. Remove the input shaft if not already removed. See page 25.

### INSPECTION

1. Inspect running surface of thrust bearing (25) for excessive wear.
2. Inspect each piston (23), spring (18), and piston seat (22) in the motor cylinder block assembly.
3. Inspect seal lands of the 21cc motor cylinder block assembly (21) for excessive wear (grooving or smearing).
4. Inspect the two running surfaces of center section assembly (3) for excessive wear (grooving or smearing). Abnormal wear patterns will usually be visible. Any wear detectable when a fingernail is dragged across the surface is cause for rejection.
5. Inspect each piston (17), spring (18), piston seat (16) in the pump cylinder block assembly.
6. Inspect seal lands of 10cc pump cylinder block assembly (15) for excessive wear (grooving or smearing).

### ASSEMBLY

1. Install input shaft assembly (12, Figure 19).
2. Install pump cylinder block thrust washer (13) and spring (14) onto input shaft assembly (12, Figure 19).
3. Install piston washers (18), springs (17), and pistons (18) in to the pump cylinder block (15).
4. Install pump cylinder block assembly (15) onto the input shaft (12). Be sure spring tension is even around the entire block. To assist in cylinder block installation, a rubber band can be placed around all of the pistons to hold them in position. After the cylinder block is installed, cut the rubber band and remove it from the the housing.
5. Install the two center section assembly pins (43).
6. Install the bypass actuator (39) into the center section (3).

7. Install center section assembly (3) into main housing (1). Make sure center section seats fully on its mating surface.
8. Secure center section assembly (3) by installing three screws (44) reference Table 5, Page 13. Apply a few drops of loctite on screws when installing.
9. Install bypass plate (38) into center section assembly (3).

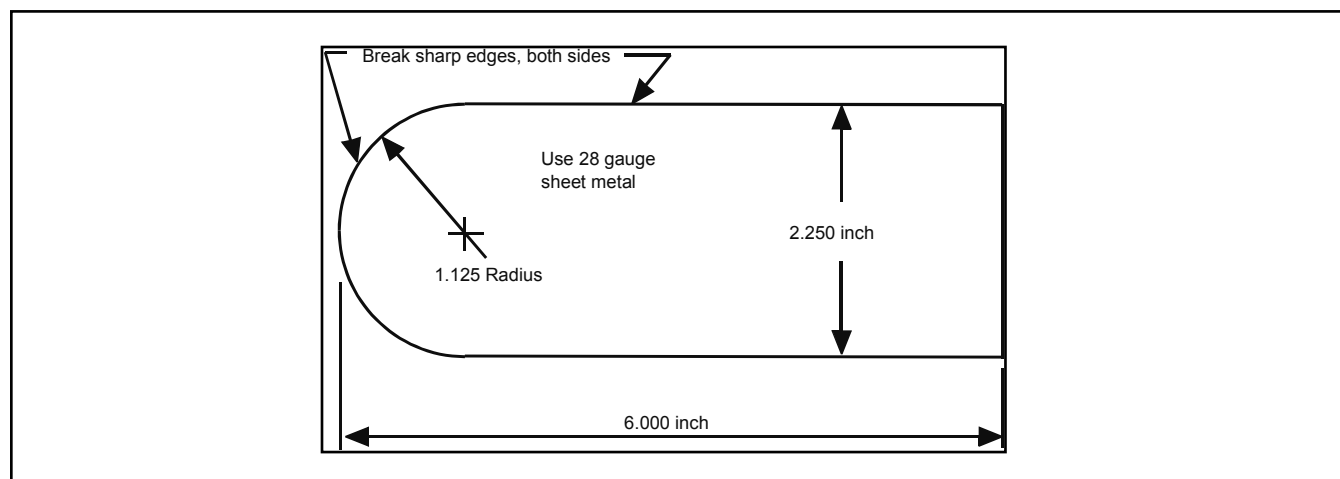
**NOTE: To hold bypass plate (38) in position, apply a small drop of grease to its slot before installing.**

10. Install spacer (27), 19T pinion gear (28), washer (82), snap ring (83), and washer (82) onto motor shaft (24).
11. Install piston washers (18), springs (17), and pistons (16) into the motor cylinder block (21).
12. If not already available, make an assembly tool from 28 ga. sheet metal as shown in Figure 26. The assembly tool must be free of burrs and rough edges.

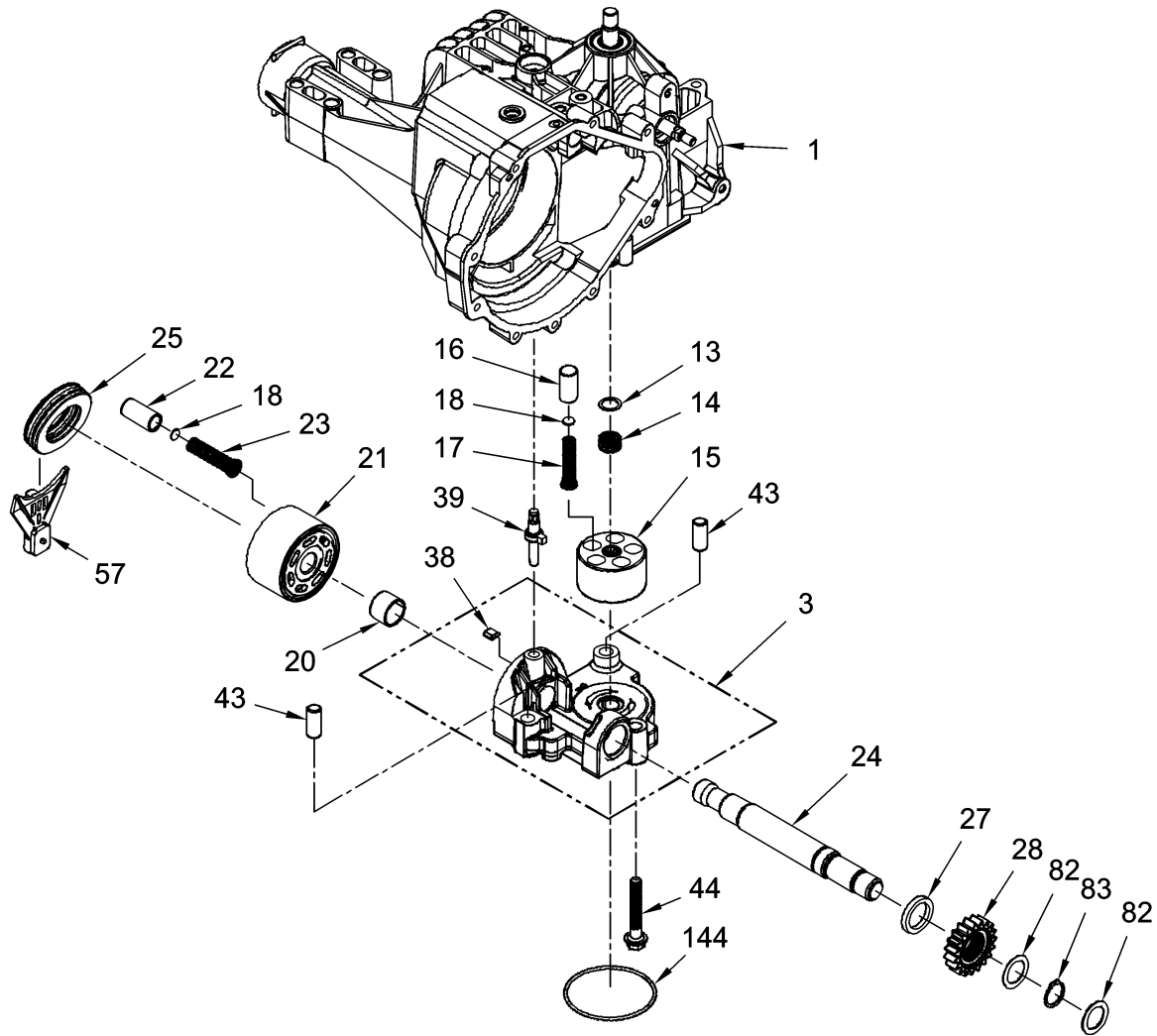
13. Using the assembly tool to compress pistons (22), install motor cylinder block assembly (21). Be careful not to dislodge bypass plate (38) when installing the motor cylinder block assembly.
14. Again using the assembly tool to compress pistons (22), slide thrust bearing (25), behind the tool, into its cavity in front of the motor cylinder block assembly (21).

**NOTE: The thick race of thrust bearing (25) must face the pistons.**

15. While holding the cylinder block assembly (21) and the thrust bearing (25) in place, withdraw the assembly tool from between the thrust bearing and the pistons.
16. Install motor thrust bearing retainer (57).
17. Insert the motor shaft assembly (24) far enough into the center section (3) to seat and engage the motor cylinder block (21).
18. Reassemble the planetary differential assembly and install removed components as directed in their respective assembly procedures.



**Figure 26. Motor Cylinder Block Assembly Tool**



REF. Part Name	REF. Part Name	REF. Part Name
1 Main Housing	20 Bushing	39 Bypass Actuator
3 Center Section Assembly	21 21cc Cylinder Block	43 Pin
13 Block Washer	22 Pistons	44 Screws
14 Block Spring	23 Springs	53 O-Ring
15 10cc Cylinder Block	24 Motor Shaft	57 Bearing Retainer
16 Pistons	25 Thrust Bearing	82 Washer
17 Springs	27 Spacer	83 Retaining Ring
18 Piston Washers	28 19T Pinnion Gear	144 O-ring
19 Block Spring	38 Bypass Plate	

Figure 27. Motor/Center Section/Pump Assembly

## DIRECTIONAL CONTROL ASSEMBLY

Refer to Figure 28.

**NOTE: The Motor/Center Section/Pump Assembly must be disassembled before this procedure can be completed.**

### DISASSEMBLY

1. Remove swashplate assembly (10). Disassemble swashplate assembly by removing thrust bearing (11) from swashplate (10). The thick race of thrust bearing must face pistons.
2. Remove slot guide (30) from the trunnion arm (31).
3. Remove the trunnion arm (31) from the main housing (1).

### INSPECTION

1. Visually inspect (in place) the two cradle bearings (9), which are staked in main housing. Do not remove the Cradle Bearings (9) from housing (1).

### ASSEMBLY

1. Install the trunnion arm in the main housing (1).
2. Install slot guide (30) onto the trunnion arm (31).
3. Assemble swashplate assembly (10) by installing thrust bearing (11) into swashplate (10).

**Note: Assemble thrust bearing with thick race facing pistons.**

4. Install swashplate assembly (10) into main housing (1). The swashplate (10) will couple with slot guide (30).

**NOTE: When installing swashplate assembly (10), use flat head screwdriver to hold slot guide (30) in place.**

5. Rotate the trunnion arm to confirm proper swashplate movement.

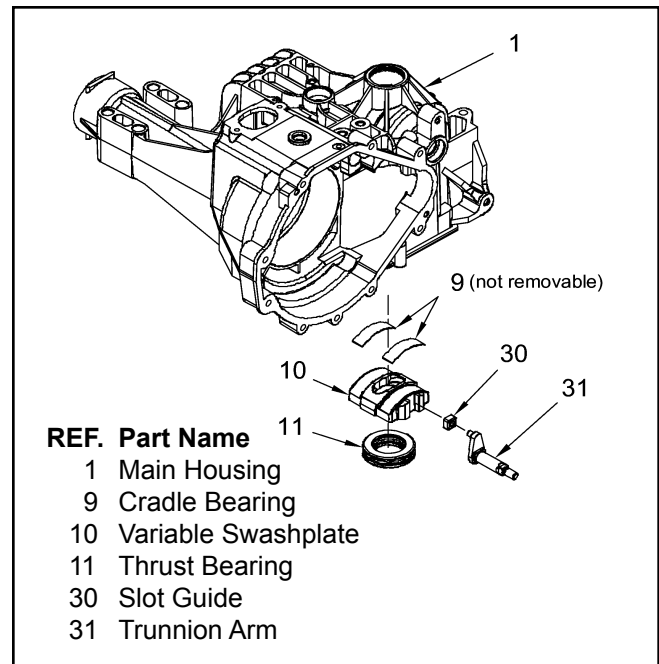


Figure 28. Directional Control Assembly

## TRANSAXLE INSTALLATION

Use the following procedure to complete installation of the transaxle on the vehicle.

1. Install and secure the transaxle on the vehicle according to instructions in the vehicle owner's manual.
2. Install the hub assembly (118, Figure 29) on the shaft. Install hex nut (119, Figure 29).
3. With the vehicle raised, install the wheel on the hub, and retain with the wheel lug nuts.
4. Lower the vehicle wheels to the ground, and torque the nut retaining the hub to 290 to 295 lb.-ft., using an air impact wrench.
5. Tighten the wheel lug nuts. Consult the vehicle owner's manual for proper torque.

## ASSEMBLY AFTER A COMPLETE TEAR-DOWN

If the unit has been torn down completely, the following summary identifies the assembly procedures necessary to completely assemble the unit, in the order they must be completed. Each assembly procedure is located by a page reference.

The part reference numbers provided in each assembly procedure are keyed to the individual exploded views, and are also keyed to the complete unit exploded view, Figure 29.

1. Assemble the Directional Control Assembly (Page 37).
2. Assemble the Motor/Center Section/Pump Assembly (Page 34,35,36).
3. Assemble the Planetary Gear Reduction and Differential Assembly (Page 30,31,32,33).
4. Assemble the Lower Housing/Filter/Manifold Assembly (Page 27,28,29).
5. Assemble the Charge Pump Assembly (Page 27).
6. Assemble the Auxiliary Pump Assembly (Page 26)
7. Assemble the Input Shaft Assembly (Page 25).
8. Assemble the Fan and Pulley Assembly (Page 24).
9. Assemble the Torque Bracket Assembly (Page 23).
10. Assemble the Control Arm Assembly (Page 20,21).
11. Assemble the Bypass Assembly (Page 19).
12. Assemble the Brake Assembly (Page 17,18).



## SEALANT APPLICATION

**NOTE:** Prior to applying the new sealant, the old sealant must be removed from all surfaces.

A small consistent bead of the sealant around the housing face will be sufficient. Use sparingly.

The illustration below illustrates the correct areas.

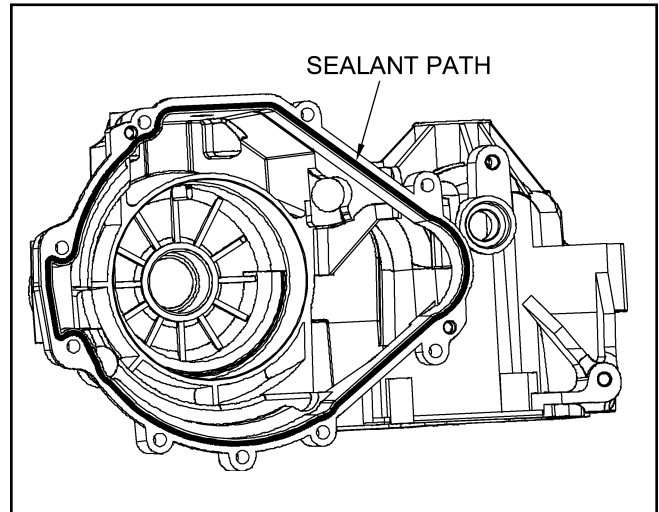


Figure 29.

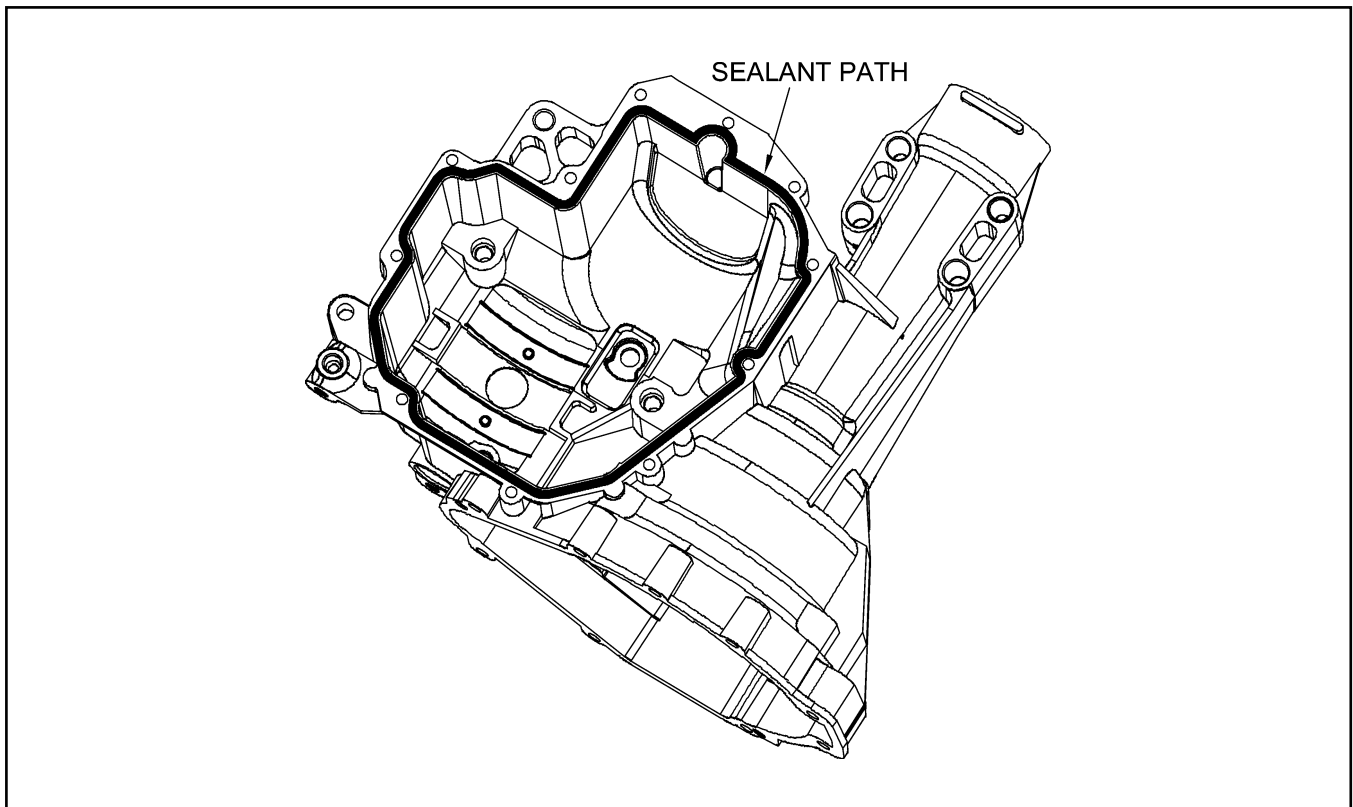


Figure 30.

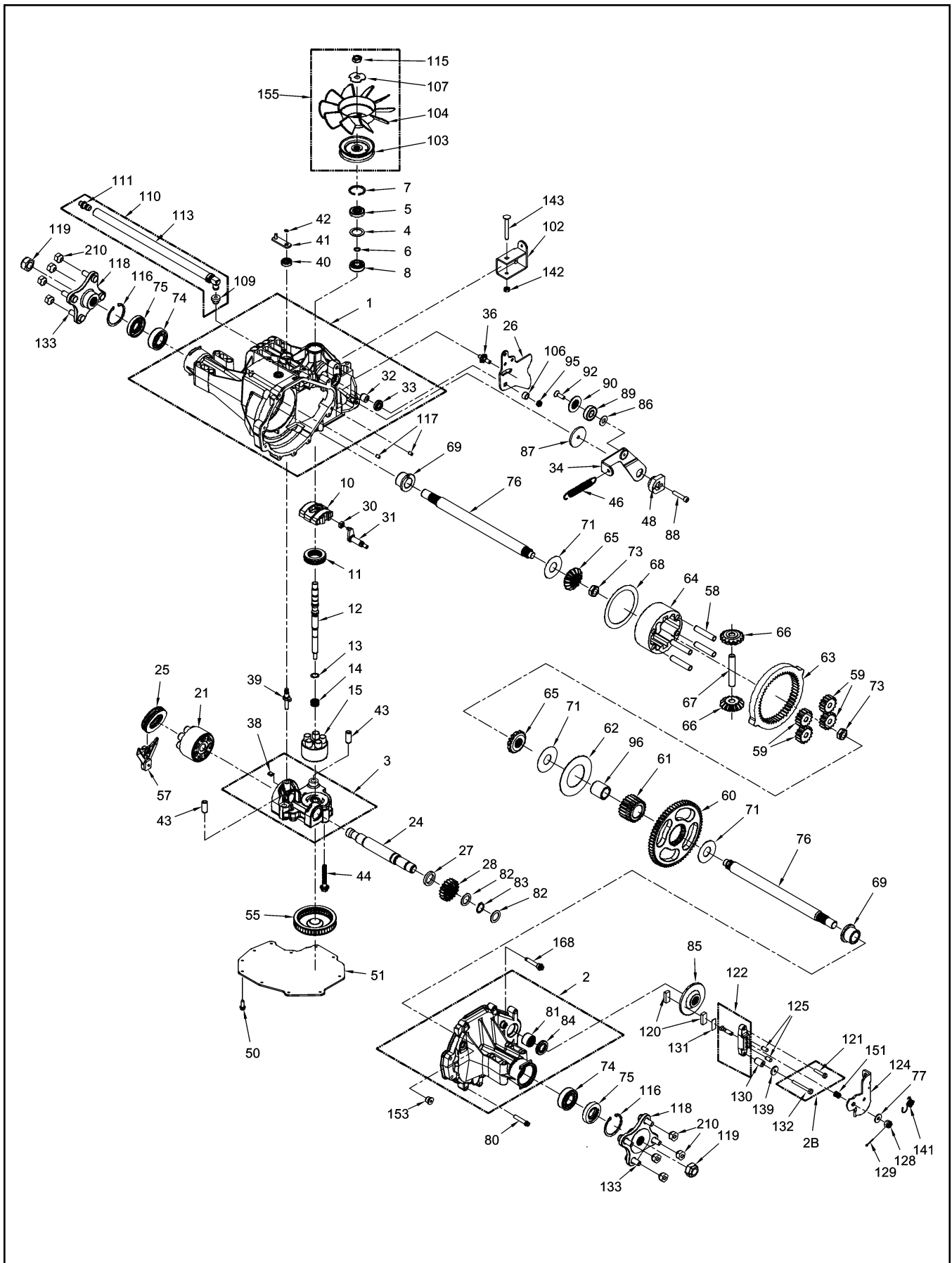


Figure 31. IHT -1500 Exploded View

## ITEMS LIST -1500

Part numbers are not provided in this manual. See CD (BLN-51427) for part numbers.

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Main Housing Assembly	76	Shaft, Axle
2A	R.H. Housing Assembly	77	Washer
2B	Brake Bolt Kit	79	Gasket Material/Sealant
3	Center Section Assembly	80	Torx Head Screw 5/16 - 18
4	Spacer	81	Needle Bearing
5	Lip Seal	82	Washer
6	Wire Retaining Ring	83	Retaining Ring
7	Retaining Ring	84	Lip Seal
8	Ball Bearing	85	Brake Disc
10	Variable Swashplate	86	Washer
11	Thrust Bearing	87	Washer
12	Input Shaft	88	Screw 5/16 - 24 X 1-3/4
13	Block Thrust Washer	89	Bearing
14	Block Spring	90	Spacer, Locating
15	10cc Cylinder Block Assembly	92	Countersunk Screw
21	21cc Cylinder Block Assembly	93	Spring Spacer
24	Output (Motor) Shaft	94	Spacer
25	Thrust Bearing	95	Nut, Hex Lock 5/16 - 24
26	Control Arm	96	Sleeve Bearing
27	Spacer	97	20W50 Oil
28	19T Pinion Gear	102	Torque Bracket
30	Slot Guide	103	Pulley
31	Trunnion Arm	104	Fan
32	Trunnion Bushing	106	Spacer, Trunnion
33	Lip Seal	107	Screw
34	Return Arm	109	Vent Bushing
35	Actuating Arm	110	Fitting Kit
36	Stud 5/16 - 24	111	Cap-Vent Assembly
38	Bypass Plate	113	Hose/ Fitting Assembly
39	Bypass Actuator	115	Jam Nut
40	Lip Seal	116	Retaining Ring
41	Bypass Arm	117	Std Hlds Pins
42	Retaining Ring	118	Hub Assembly 7/16 - 14
43	Pin	119	Nut, Hex 3/4 - 16
44	Screw	120	Puck, Brake
46	Neutral Spring	121	Bolt, 1/4 - 20 X 1.25
48	Adjusting Puck	122	Brake Yoke
50	Screw , Self-Tapping	124	Arm, Brake
51	Lower Cover	125	Pins, Brake
55	Filter Kit	128	Nut, Castle
57	Retainer, Motor Bearing	129	Cotter Pin
58	Pin, Carrier	130	Spacer
59	15T Planet Gear	131	Puck Plate
60	67T Spur Gear	132	Bolt, 1/4 - 20 X 2.25
61	21T Sun Gear	133	Wheel Stud 7/16-14
62	Planet Thrust Plate	141	Spring, Brake Arm Bias
63	51T Ring Gear	142	Hex Lock Nut 5/16 - 18
64	Planetary Carrier	143	Bolt 5/16 -15 X 2.5
65	Miter Gear, Differential (SPLINED)	151	Compression Spring Brake Anti-Drage
66	Miter Gear, Differential	153	Plug, Straight Thread
67	Shaft , Differential	155	Fan/ Pulley Assembly
68	Differential Thrust Plate	157	Screw O-Ring
69	Flange Bearing	168	Screw, Shoulder Torx Head
71	Washer	180	Manifold Kit
73	Hex Jam Nut, 5/8 - 18	203	Seal Kit (310-3000)
74	Ball Bearing 6205-1	210	Nut, Lug
75	Seal, 1" ID X 2.0472" X 0.375"		

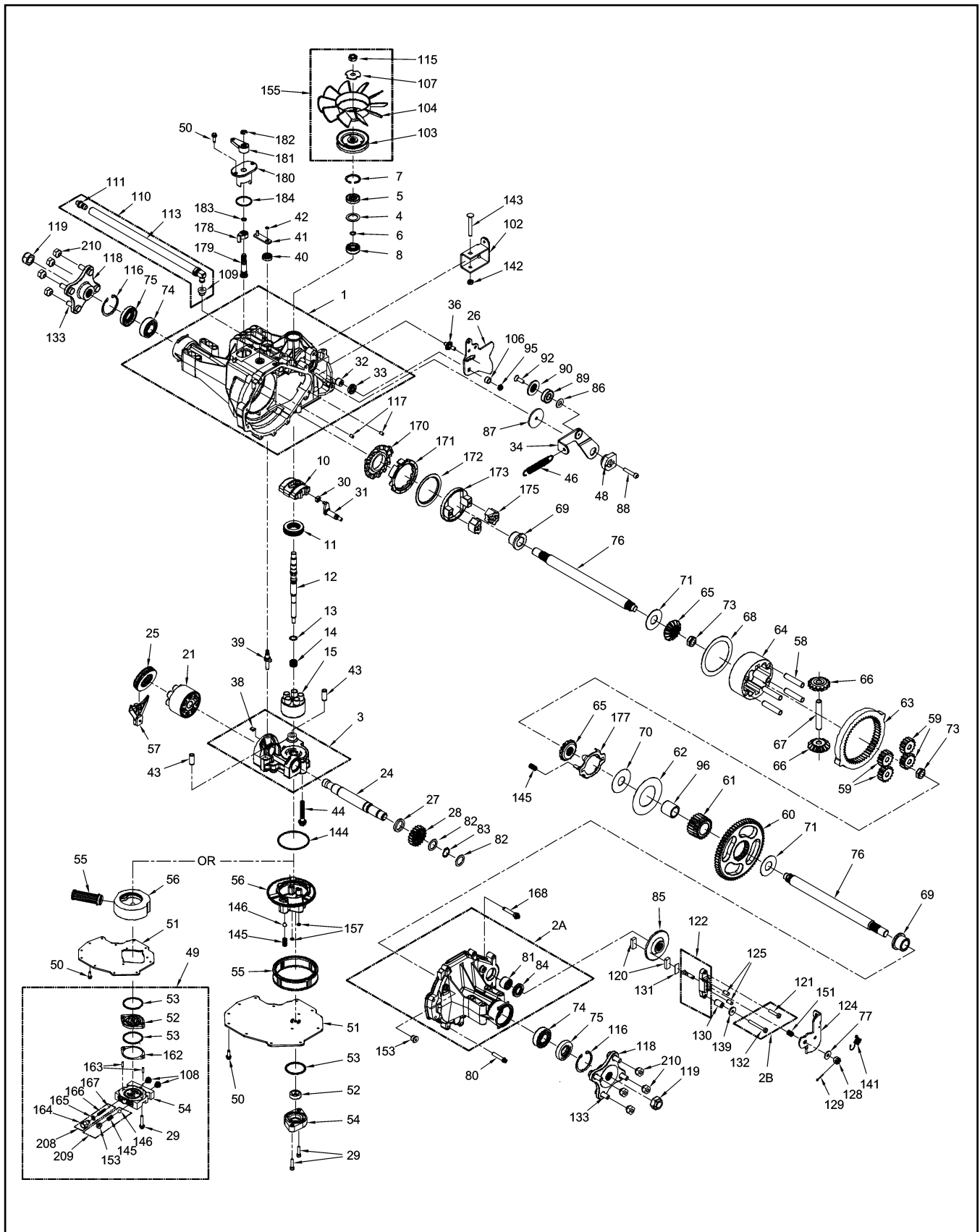


Figure 32. IHT -1700 Exploded View

**ITEMS LIST -1700**

Part numbers are not provided in this manual. See CD (BLN-51427) for part numbers.

<b>NO.</b>	<b>DESCRIPTION</b>	<b>NO.</b>	<b>DESCRIPTION</b>
1	Main Housing Assembly	86	Washer
2A	R.H. Housing Assembly	87	Washer
2B	Brake Bolt Kit	88	Screw 5/16 - 24 X 1-3/4
3	Center Section Assembly	89	Bearing
4	Spacer	90	Spacer, Locating
5	Lip Seal	92	Countersunk Screw
6	Wire Retaining Ring	95	Nut, Hex Lock 5/16 - 24
7	Retaining Ring	96	Sleeve Bearing
8	Ball Bearing	97	20W50 Oil
10	Variable Swashplate	102	Torque Bracket
11	Thrust Bearing	103	Pulley
12	Input Shaft	104	Fan
13	Block Thrust Washer	106	Spacer, Trunnion
14	Block Spring	107	Screw
15	10cc Cylinder Block Assembly	108	Plug
21	21cc Cylinder Block Assembly	109	Vent Bushing
24	Output (Motor) Shaft	110	Fitting Kit
25	Thrust Bearing	111	Cap-Vent Assembly
26	Control Arm	113	Hose/ Fitting Assembly
27	Spacer	115	Jam Nut
28	19T Pinion Gear	116	Retaining Ring
30	Slot Guide	117	Std Hlds Pins
31	Trunnion Arm	118	Hub Assembly 7/16 - 14
32	Trunnion Bushing	119	Nut, Hex 3/4 - 16
33	Lip Seal	120	Puck, Brake
34	Return Arm	121	Bolt, 1/4 - 20 X 1.25
35	Actuating Arm	122	Brake Yoke
36	Stud 5/16 - 24	124	Arm, Brake
38	Bypass Plate	125	Pins, Brake
39	Bypass Actuator	128	Nut, Castle
40	Lip Seal	129	Cotter Pin
41	Bypass Arm	130	Spacer
42	Retaining Ring	131	Puck Plate
43	Pin	132	Bolt, 1/4 - 20 X 2.25
44	Screw	133	Wheel Stud 7/16-14
46	Neutral Spring	139	Washer
48	Adjusting Puck	141	Spring, Brake Arm Bias
49	Auxiliary Charge Pump Kit	142	Hex Lock Nut 5/16 - 18
50	Screw , Self-Tapping	143	Bolt 5/16 -15 X 2.5
51	Lower Cover	145	Relief Spring
52	Gerotor Assembly	146	Ball
53	O-Ring	151	Compression Spring Brake Anti-Drag
54	Auxiliary Manifold Kit	153	Plug, Straight Thread
55	Filter Kit	155	Fan/ Pulley Assembly
57	Retainer, Motor Bearing	157	Screw O-Ring
58	Pin, Carrier	162	Shim
59	15T Planet Gear	163	Pin
60	67T Spur Gear	164	Valve Body
61	21T Sun Gear	165	O-Ring
62	Planet Thrust Plate	166	Spring
63	51T Ring Gear	167	Ball
64	Planetary Carrier	168	Screw, Shoulder Torx Head
65	Miter Gear, Differential (SPLINED)	170	Cam, Stationary
66	Miter Gear, Differential	171	Cam, Rotating
67	Shaft , Differential	172	Washer
68	Differential Thrust Plate	173	Load Plate
69	Flange Bearing	175	Dog, Engagement
71	Washer	177	Washer Guide
73	Hex Jam Nut, 5/8 - 18	178	Cam, Actuating
74	Ball Bearing 6205-1	179	Shaft
75	Seal, 1" ID X 2.0472" X 0.375"	180	Sleeve
76	Shaft, Axle	181	Handle, Actuating
77	Washer	182	Ring, Retaining
79	Gasket Material/Sealant	183	O-Ring
80	Torx Head Screw 5/16 - 18	184	O-Ring
81	Needle Bearing	203	Seal Kit
82	Washer	208	Auxiliary Relief Valve Kit
83	Retaining Ring	209	Charge Relief Kit
84	Lip Seal	210	Nut, Lug
85	Brake Disc		

## SECTION 6. GLOSSARY OF TERMS

---

**Axial Piston:** Type of design for hydraulic motors and pumps in which the pistons are arranged parallel with the spindle (input or output shaft).

**Bypass Valve:** A valve whose primary function is to open a path for the fluid to bypass the motor or pump. Also referred to occasionally as the freewheel valve or dump valve.

**Case Drain Line (Return Line):** A line returning fluid from the component housing to the reservoir.

**Cavitation:** A concentrated gaseous condition within the fluid causing the rapid implosion of a gaseous bubble.

**Center Section:** A device which acts as the valve body and manifold of the transmission.

**Charge Pump:** A device which supplies replenishing fluid to the fluid power system (closed loop).

**Charge Pressure:** The pressure at which replenishing fluid is forced into a fluid power system.

**Charge Relief Valve:** A pressure control valve whose primary function is to limit pressure in the charge circuit.

**Check Valve:** A valve whose primary function is to restrict flow in one direction.

**Closed Loop:** A sealed and uninterrupted circulating path for fluid flow from the pump to the motor and back.

**Decay Rate:** The ratio of pressure decay over time.

**End Cap:** See "Center Section"

**Entrained Air:** A mechanical mixture of air bubbles having a tendency to separate from the liquid phase.

**Gerotor:** A positive displacement pump frequently used as a charge pump.

**Hydraulic Motor:** A device which converts hydraulic fluid power into mechanical force and motion by transfer of flow under pressure.

**Hydraulic Pump:** A device which converts mechanical force and motion into hydraulic fluid power by producing flow.

**Hydrostatic Pump:** See "Hydraulic Pump"

**Hydrostatic Transaxle:** A multicomponent assembly including a gear case and a hydrostatic transmission.

**Hydrostatic Transmission:** The combination of a hydraulic pump and motor in one housing to form a device for the control and transference of power.

**Inlet Line:** A supply line to the pump.

**Integrated Hydrostatic Transaxle (IHT):** The combination of a hydrostatic transmission and gear case in one housing to form a complete transaxle.

**Manifold:** A conductor which provides multiple connection ports.

**Neutral:** Typically described as a condition in which fluid flow and system pressure is below that which is required to turn the output shaft of the motor.

**Pressure Decay:** A falling pressure.

**Priming:** The filling of the charge circuit and closed loop of the fluid power system during start up, frequently achieved by pressurizing the fluid in the inlet line.

**Purging:** The act of replacing air with fluid in a fluid power system by forcing fluid into all of the components and allowing the air a path of escape.

**Rated Flow:** The maximum flow that the power supply system is capable of maintaining at a specific operating pressure.

**Scoring:** Scratches in the direction of motion of mechanical parts caused by abrasive contaminants.

**Swash Plate:** A mechanical device used to control the displacement of the pump pistons in a fluid power system.

**System Charge Check Valve:** A valve controlling the replenishing flow of fluid from a charge circuit to the closed loop in a fluid power system.

**System Pressure:** The pressure which overcomes the total resistance in a system, including all losses.

**Valve:** A device which controls fluid flow direction, pressure, or flow rate.

**Variable Displacement Pump:** A pump in which the displacement per cycle can be varied.

**Volumetric Displacement:** The volume for one revolution.

Hydro Gear Parts or New Units Call 606-678-9623 or 606-561-4983



© 2008 HYDRO-GEAR  
Printed in U.S.A.  
Rev. P1



[www.mymowerparts.com](http://www.mymowerparts.com)