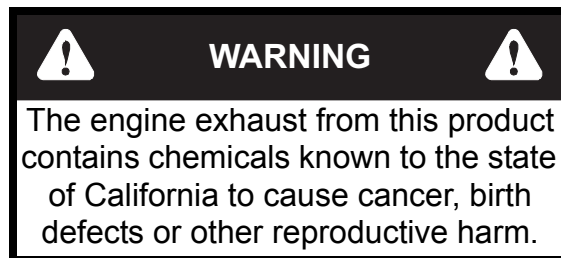


Hustler® 3500/3700 Service Manual



.....
200 South Ridge Road
...
Hesston, Kansas
.
67062-2097



NOTICE OF REQUIREMENT OF SPARK ARRESTER MUFFLER

This equipment may create sparks that can start fires around dry vegetation. California Public Resources Code Section 4442.6 provides that it is unlawful to use or operate an internal combustion engine on any forest-covered, brush-covered, or grass-covered land unless the engine is equipped with a spark arrester maintained in effective working order. A spark arrester is a device constructed of nonflammable materials specifically for the purpose of removing and retaining carbon and other flammable particles over 0.0232 of an inch in size from the exhaust flow of an internal combustion engine that uses hydrocarbon fuels or which is qualified and rated by the United States Forest Service. Other states or federal areas may have similar laws. The Operator Should Contact Local Fire Agencies For Laws or Regulations Relating to Fire Prevention Requirements. THIS EQUIPMENT DOES NOT HAVE A SPARK ARRESTER AND YOU SHOULD CONTACT YOUR AUTHORIZED DEALER FOR THE PURCHASE OF A SPARK ARRESTER.

Inspect spark arrester daily; replace every 500 hours or as needed.

The Engine Owner's Manual provides information regarding the U.S. Environmental Protection Agency (EPA) and the California Emission Control Regulation of emission systems, maintenance and warranty.

Keep Engine Owner's Manual with your unit. Should the Engine Owner's Manual become damaged or illegible, replace immediately. Replacements may be ordered per the information found in the Product Information section of the owner's manual.

Federal law and California State law prohibit the following acts or the causing thereof:

1. The removal or rendering inoperative by any person other than for purposes of maintenance, repair, replacement, of any device or element of design incorporated into any equipment for the purposes of emissions control prior to or after its sales or delivery to the ultimate purchaser or while it is in use, or
2. The use of the equipment after such device or element of design has been removed or rendered inoperative by any person.

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CHAPTER 1

GENERAL INFORMATION

Specifications and Performances

Model		3500	3700
		N843	N843L
Engine	Model	N843	N843L
	Type	Water-Cooled 4-Cycle Vertical Diesel Engine	
	Number of Cylinders	3	
	Total Stroke Volume	91.3 cu. in. (1496 cc)	101.42 cu. in. (1662 cc)
	Maximum Output	30 HP (22.4 kW)/2700 rpm	35 HP (26 kW)/2700 rpm
	Compression Ratio	22.5 : 1	
	Fuel	Ultra Low Sulphur #2 Diesel Fuel	
	Starting Method	12 Volt Gear Drive Solenoid Shift Starter	
	Overall Length	95.0 in. (2415 mm)	
	Overall Height	54.7 in. (1390 mm)	
	Overall Width	Narrow – 48.0 in. (1220 mm), Wide – 53.9 in. (1370 mm)	
	Weight	1609 lbs. (730 kg)	1653 lbs. (750 kg)
Maine Body	Tire	Front Wheel	23 × 10.5 – 12
		Rear Wheel	20 × 8.00 – 10
	No. of Running Speeds	2 Forward Speeds, 2 Reverse Speeds (Continuously variable speed)	
	Transmission System	L/H Switching, All Hydraulic Continuously Variable Speed (HST)	
	Brake	Wet Disc Brake	
	Lift Control Valve Relief Set Pressure	1421 psi (9.8 MPa)	
	Relief Set Pressure/ Steering	852.8 – 951.4 psi (5.88 – 6.56 MPa)/ Full Hydraulic Power Steering	
	Running Speed	Forward: L	0 – 6.0 mph (0 – 9.6 km/h)
		Forward: H	0 – 15.0 mph (0 – 24.0 km/h)
		Reverse: L	0 – 4.0 mph (0 – 6.4 km/h)
		Reverse: H	0 – 9.0 mph (0 – 14.4 km/h)
Capacity	Fuel Tank	13.3 gal. (50.5 ℓ)	
	Engine Oil	5.9 qts. (5.6 ℓ) (Including oil filter)	
	Transmission Gear Oil	Front 21.13 qts. (20 ℓ), Rear 2.4 qts. (2.3 ℓ)	
	Cooling Water	5.4 qts. (5.1 ℓ)	5.6 qts. (5.3 ℓ)
	Battery	BCI group 35, 12-volt battery (min. cold cranking ability of 490 amps)	
Electric Units	Starting Motor	12 V – 1.7 kW	12 V – 2.0 kW
	Alternator	12 V – 40 A	
	Head Light	23 W	
	Monitor Lamp	3 W	
	Dash Panel Lamp	2 W	
	Light Switch Lamp	1.4 W	

General Metric Bolt Torque Specification Table

Use the following torques when special torques are not given

NOTE: These values apply to fasteners as received from supplier, dry, or when lubricated with normal engine oil. They do not apply if special graphited or molly disulphide grasses or other extreme pressure lubricants are used.

Bolt Size	Grade No.	Coarse Thread		Fine Thread	
		Pitch (inches)	Ft.-Lbs. (N-m)	Pitch (inches) (mm)	Ft.-Lbs. (N-m)
M6	  4T	.039 (1.0)	3.61 – 5.09 (4.9 – 6.9)	–	–
	   7T		6.12 – 8.33 (8.3 – 11.3)		
	  10T		8.63 – 11.58 (11.7 – 15.7)		
M8	4T	.049 (1.25)	9.37 – 12.32 (12.7 – 16.7)	.039 (1.0)	11.21 – 14.82 (15.2 – 20.1)
	7T		16.67 – 20.95 (22.6 – 28.4)		19.55 – 25.30 (26.5 – 34.3)
	10T		21.02 – 26.77 (28.5 – 36.3)		22.42 – 29.65 (30.4 – 40.2)
M10	4T	.059 (1.5)	18.81 – 24.56 (25.5 – 33.3)	.049 (1.25)	20.95 – 26.70 (28.4 – 36.2)
	7T		32.53 – 41.23 (44.1 – 55.9)		36.14 – 46.32 (49.0 – 62.8)
	10T		39.83 – 51.33 (54.0 – 69.6)		42.70 – 54.21 (57.9 – 73.5)
M12	4T	.069 (1.75)	27.51 – 34.74 (37.3 – 47.1)	.049 (1.25)	31.79 – 40.49 (43.1 – 54.9)
	7T		48.46 – 61.51 (65.7 – 83.4)		54.95 – 69.40 (74.5 – 94.1)
	10T		68.00 – 85.56 (92.2 – 116)		73.02 – 93.67 (99.0 – 127)
M14	4T	.079 (2.0)	46.32 – 59.30 (62.8 – 80.4)	.059 (1.5)	51.33 – 64.39 (69.6 – 87.3)
	7T		76.71 – 96.62 (104 – 131)		86.29 – 109.2 (117 – 148)
	11T		102.5 – 129.1 (139 – 175)		108.4 – 137.2 (147 – 186)
M16	4T	.079 (2.0)	63.65 – 81.13 (86.3 – 110)	.059 (1.5)	67.27 – 84.82 (91.2 – 115)
	7T		109.9 – 135.7 (149 – 184)		115.8 – 141.6 (157 – 192)
	11T		151.9 – 188.1 (206 – 255)		163.0 – 199.1 (221 – 270)
M18	4T	.079 (2.0)	84.08 – 104 (114 – 141)	.059 (1.5)	96.62 – 120.2 (131 – 163)
	7T		144.6 – 173.3 (196 – 235)		169.6 – 205.89 (230 – 279)
	11T		202.8 – 245.6 (275 – 333)		220.5 – 271.4 (299 – 368)
M20	4T	.098 (2.5)	106.2 – 132. (144 – 179)	.059 (1.5)	126.9 – 155.6 (172 – 211)
	7T		177.0 – 213.2 (240 – 289)		202.8 – 245.6 (275 – 333)
	11T		267.7 – 325.3 (363 – 441)		292.8 – 357.7 (397 – 485)

Precautions Before Servicing

Have the power unit washed clean and have the oil, fuel, and cooling water drained out as would be required by the work to be performed.

Service shop should always be kept clean to prevent dust from rising and should be well lighted.

The disassembled parts shall have the oil and grease washed off and arranged on a stand separated by groups.

Clothing, service tools and equipment shall be checked to ensure safety in performing the operations.

Basic Understanding Of Servicing

Engine, transmission, and hydraulic apparatus have been specially manufactured to high accuracy so that care shall be exercised to maintain them in clean state and not to do any unnecessary disassembly.

Defective parts due to wear and other causes shall be discarded and new parts ordered with the power unit model, Serial No., Code No., and part name clearly defined. (Keep the defective parts on hand to enable showing it to the customer.)

When assembling, it is essential to have oil applied to all moving parts so that they will be provided with initial oil film until normal lubrication takes place.

Unless specially instructed, bolts and nuts shall be tightened by proper tools to the proper tightening torque.



This safety alert symbol is used to call attention to a message intended to provide a reasonable degree of PERSONAL SAFETY for operators and other persons during the normal operation and servicing of this equipment.

	DANGER	
– denotes immediate hazards which WILL result in severe personal injury or death.		

	WARNING	
– denotes a hazard or unsafe practice which COULD result in severe personal injury or death.		

Safe Servicing Practices

This product is capable of amputating hands and feet and throwing objects. Always follow all safety instructions to avoid serious injury or death.

Understand Correct Service

- ▲ Be sure you understand a service procedure before you work on the machine.
- ▲ Unauthorized modifications to the machine may impair the function and/or safety and affect machine life.
- ▲ If it is necessary to make checks with the engine running, always use two people - with the operator at the controls, able to see the person doing the checking.

Pre-Operation Precautions

Fuel Handling

- ▲ To avoid personal injury or property damage, use extreme care in handling fuel. Fuel is extremely flammable and the vapors are explosive.
- ▲ Observe usual fuel handling precautions:
 - Do not smoke while refueling. Extinguish all cigarettes, cigars, pipes and other sources of ignition.
 - **Do not remove fuel cap or fill tank with engine running or while engine is hot. Clean up any fuel spills.**
 - Allow engine to cool before storing machine inside a building.
 - Keep fuel away from open flame or spark and store machine away from open flame or spark or pilot light such as on a water heater or appliances.
 - Use extreme care when handling gasoline and other fuels. They are extremely flammable and vapors are explosive. A fire or explosion from fuel can burn you and others and can damage property.
 - Refuel outdoors. Never refuel or drain the fuel from the machine indoors.
 - Never attempt to start engine when there is a strong odor of gasoline or diesel fuel fumes present. Locate and correct cause.
 - Store fuel in an approved container and keep it out of the reach of children. Never buy more than a 30 day supply of fuel.
 - Do not fill fuel containers inside a vehicle or on a truck or trailer bed with interior carpets or plastic truck bed liners. Always place fuel containers on the ground away from your vehicle before filling.
 - When practical, remove gas or diesel fuel powered equipment from the truck or trailer and refuel the equipment with its wheels on the ground. If this is not possible, then refuel such equipment on the truck or trailer using a portable container and not a fuel dispenser nozzle. If a fuel dispenser nozzle must be used, keep the nozzle in contact with the rim of the fuel tank or container opening at all times until fueling is complete. Do not use a nozzle lock-open device.
 - Never use gasoline or diesel fuel for cleaning parts.
 - Read and observe safety precautions elsewhere in this manual.
- ▲ Gasoline and diesel fuel is harmful or fatal if swallowed.
 - Long-term exposure to vapors can cause serious injury and illness.
 - Avoid prolonged breathing of vapors.

- Keep face away from nozzle and gas tank or fuel container opening.
- Keep fuel away from eyes and skin.
- If fuel is spilled on clothing, change clothing immediately.

Understand Machine Operation

- ▲ Only qualified and trained personnel should operate the equipment.
- ▲ Carefully read the operator's manual and all manuals furnished with the attachments. Learn the location and purpose of all controls, instruments, indicators and labels.

Wear Protective Clothing

- ▲ Do not operate or service the equipment while wearing sandals, tennis shoes, sneakers, shorts or any type of loose fitting clothing. Long hair, loose clothing or jewelry may get tangled in moving parts. Always wear long pants, safety glasses, ear protection and safety shoes when operating or servicing this machine.
- ▲ Always wear adequate eye protection when servicing the hydraulic system and battery, or when grinding mower blades and removing accumulated debris.
- ▲ Prolonged exposure to loud noise can cause impairment or loss of hearing.
 - Always wear adequate ear protection, such as earplugs, when operating this equipment as prolonged exposure to uncomfortable or loud noises can cause impairment or loss of hearing.
 - Do not wear radios or music headphones while operating the machinery. Safe operation requires your full attention.

Operation Precautions

Avoid Fire Hazards

- ▲ **Clean flammable material from machine. Prevent fires by keeping engine compartment, top of deck, exhaust area, battery, hydraulic lines, fuel line, fuel tank and operator's station clean of accumulated trash, grass clippings, and other debris. Always clean up spilled fuel and oil.**

Start Engine Safely

- ▲ Avoid possible injury or death from machine runaway.
- ▲ Do not start engine by shorting across starter terminals.
- ▲ Before you start the engine:
 - Sit on the operator's seat.
 - Move control levers to the neutral/brake position.

Operate Machine Safely

- ▲ Refer to the unit's operator's manual for complete safety information on safe machine operation.
- ▲ Always maintain a safe distance from people and pets when mowing
- ▲ Always be aware of what is behind the machine before backing up.
- ▲ Never leave machine unattended with ignition key in switch, especially with children present.
- ▲ Follow daily and weekly checklists, making sure hoses are tightly secured and bolts are tightened.
- ▲ Always keep engine and machine clean, removing accumulated dirt, trash and other material from machine.
- ▲ Never put hands or feet under any part of the machine while it is running.
- ▲ Never attempt to start engine when there is a strong odor of gasoline fumes present. Locate and correct cause.
- ▲ Keep all safety shields and covers in place, except for servicing.
- ▲ Do not touch hot parts of machine.

General Maintenance Precautions

- ▲ **Repairs or maintenance requiring engine power should be performed by trained maintenance personnel only.**
- ▲ Never run the engine in an enclosed area unless exhaust is vented to the outside. Exhaust gases contain carbon monoxide which is an odorless and deadly poison.
- ▲ Unless specifically required, **DO NOT** have engine running when servicing or making adjustments to mower. Park the machine on level ground. Place steering control levers in the park brake position, disengage deck clutch, lower deck, remove ignition switch key and disconnect negative battery cable before doing any maintenance. Wait for all movement to stop before

adjusting, cleaning or repairing. To prevent carbon monoxide poisoning, be sure proper ventilation is available when engine must be operated in an enclosed area.

- ▲ Before working on or under the deck, make certain engine cannot be accidentally started. Shut engine off, remove ignition switch key and disconnect negative battery cable for maximum safety.
- ▲ Except when changing or checking belt, **always** keep belt covers on mower deck for safety as well as cleanliness.
- ▲ Use a stick or similar instrument to clean under the mower making sure that no part of the body, especially arms and hands are under mower.
- ▲ Keep your machine clean and remove any deposits of trash and clippings, which can cause engine fires and hydraulic overheating as well as excessive belt wear. Clean up oil or fuel spillage. Allow machine to cool before storing.
- ▲ Always wear adequate eye protection when servicing the hydraulic system and battery, or when grinding mower blades and removing accumulated debris.
- ▲ Never attempt to make any adjustments or repairs to the mower drive system, mower deck or any attachment while the engine is running or deck clutch is engaged.
- ▲ Never work under the machine or attachment unless it is safely supported with jack stands. Make certain machine is secure when it is raised and placed on the jack stands. The jack stands should not allow the machine to move when the engine is running and the drive wheels are rotating. **Use only certified jack stands.** Use only appropriate jack stands, with a minimum weight rating of 2000 pounds to block the unit up. Use in pairs only. Follow the instructions supplied with the vehicle stands.
- ▲ Keep nuts and bolts tight, especially the blade attachment bolts. Keep equipment in good working condition.
- ▲ Never tamper with safety devices. Check their proper operation regularly.
- ▲ Exercise caution when working under the deck as the mower blades are extremely sharp. Wrap the blade(s) or wear gloves and use extra caution when servicing them.
- ▲ Use only genuine Hustler® replacement parts to ensure that original standards are maintained.

Maintenance Precautions

Avoid Fire Hazards

- ▲ Be prepared if an accident or fire should occur. Know where the first aid kit and the fire extinguishers are located and how to use them.
- ▲ Provide adequate ventilation when charging batteries.
- ▲ Do not smoke near battery.
- ▲ Never check fuel level with an open flame.
- ▲ Never use an open flame to look for leaks anywhere on the equipment.
- ▲ Never use an open flame as light anywhere on or around the equipment.
- ▲ When preparing engine for storage, remember that fuel stabilizer is volatile and therefore dangerous. Seal and tape openings after adding the inhibitor. Keep container tightly closed when not in use.
- ▲ Inspect electrical wiring for worn or frayed insulation. Install new wiring if wires are damaged.

Prepare For Emergencies

- ▲ Be prepared if a fire starts.
- ▲ Keep a first aid kit and fire extinguishers available.
- ▲ Keep emergency numbers for doctor, ambulance service, hospital, and fire department near the telephone.

Prevent Battery Explosions

- ▲ Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.
- ▲ Charge batteries in an open well-ventilated area, away from sparks and flames. Unplug charger before connecting or disconnecting from battery. Wear protective clothing and use insulated tools.
- ▲ Avoid skin and clothing contact with battery acid.
 - Always wear eye protection when checking the battery, acid can cause serious injury to skin and eyes. If contact occurs, flush area with clean water and call physician immediately. Acid will also damage clothing.
 - Do not drink the battery electrolyte.
 - Do not allow open flame near the battery when charging.
 - Hydrogen gas forms inside the battery. This gas is both toxic and flammable and may cause an explosion if exposed to flame. Always **disconnect** the negative (black) battery cable(s) before disconnecting the positive (red) cable(s). Always **connect** the positive (red) battery cable(s) before connecting the negative (black) cable(s).
 - Do not overfill battery.
 - Electrolyte may overflow and damage paint, wiring or structure. When cleaning the battery, use soap and water. Be careful not to get soap and water into the battery. Clean the battery terminals with a solution of four parts water and one part baking soda when they become corroded.

- ▲ Shorts caused by battery terminals or metal tools touching metal mower components can cause sparks. Sparks can cause a battery gas explosion which will result in personal injury.
 - Prevent the battery terminals from touching any metal mower parts when removing or installing the battery.
 - Do not allow metal tools to short between the battery terminals and metal mower parts.
- ▲ Incorrect battery cable routing could cause damage to the mower and battery cables. This can cause sparks which can cause a battery gas explosion which will result in personal injury. Always **disconnect** the negative (black) battery cable(s) before disconnecting the positive (red) cable(s). Always **connect** the positive (red) battery cable(s) before connecting the negative (black) cable(s).

Avoid Acid Burns

- ▲ Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing and cause blindness if splashed in eyes.

Avoid the hazard by:

- Filling batteries in a well-ventilated area.
- Wearing eye protection and rubber gloves.
- Avoiding breathing fumes when electrolyte is added.
- Avoiding spilling or dripped electrolyte.

If you spill acid on yourself:

- Flush your skin with water.
- Apply baking soda or lime to help neutralize the acid.
- Flush your eyes with water for 10-15 minutes. Get medical attention immediately.

If acid is swallowed:

- Drink large amounts of water or milk.
- Then drink milk of magnesia, beaten eggs or vegetable oil.
- Get medical attention immediately.

Hydraulic Oil Pressure

- ▲ Hydraulic fluid escaping under pressure may have sufficient force to penetrate skin and cause serious injury. Foreign fluid injected into the skin must be surgically removed within a few hours by a doctor, familiar with this form of injury, or gangrene may result.
- ▲ Before applying pressure to hydraulic system, make sure all connections are tight and all hoses and lines are in good condition. To find a leak under pressure, use a piece of cardboard or wood — never use your hands. Relieve all pressure in the system before disconnecting or working on hydraulic lines. To relieve pressure, lower all attachments and shut off engine.

Chapter 2

TRANSMISSION & BRAKE

Description and Operation

A. Removal

The transaxle assembly consists of a two-speed gearbox, a differential assembly, PTO clutch assembly, PTO shaft and inboard brake.

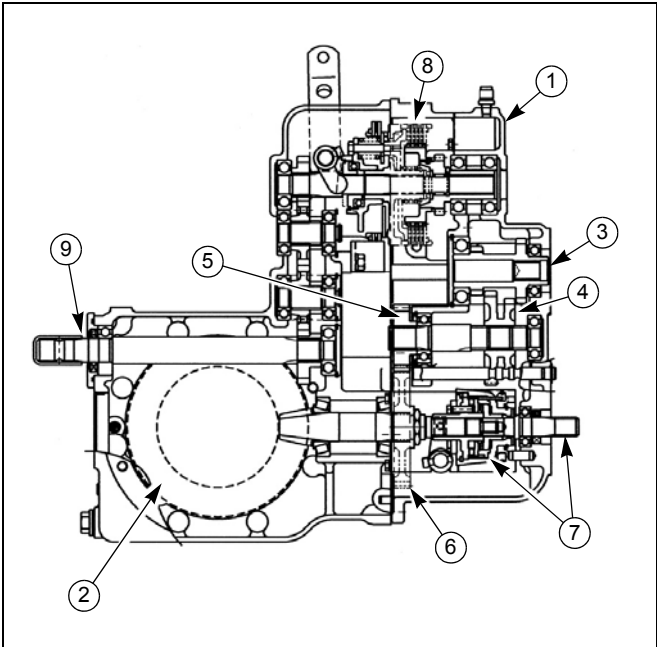


Figure 2-1

Transaxle Assembly	
1. Transmission Gearbox (2-speed)	6. Pinion Drive Gear
2. Differential assembly	7. Rear Wheel Drive Output Shaft and Two Way Clutch
3. Input Gear Cluster	8. PTO Clutch Assembly
4. Sliding Gears	9. PTO Shaft
5. Fixed Gears	

The front axle consists of differential lock, axles, and brakes.

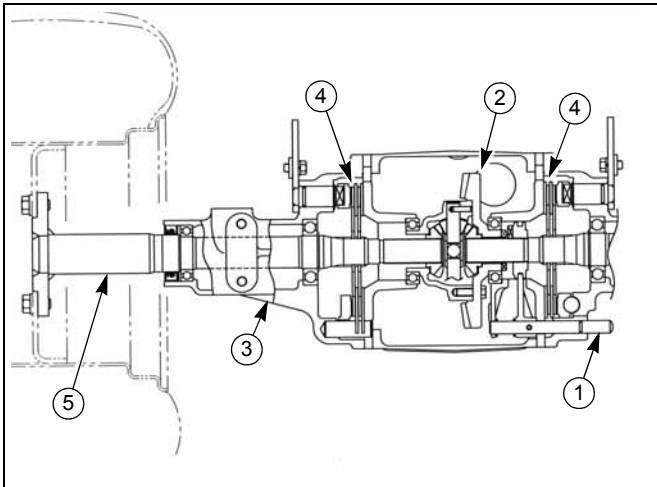


Figure 2-2

Transaxle Assembly	
1. Differential Lock	4. Inboard Brake
2. Differential assembly	5. Drive Axle
3. Axle Housing	

The range gearbox housing also supports the differential assembly, Figure 2-2. The two-speed transmission gearbox consists of constant mesh spur gears and sliding gears. The range gearbox also contains a four wheel drive output shaft and two way clutch.

The range selector lever is located on the left-hand panel adjacent to the operator’s seat. The range selector (Hi/Lo) cannot be shifted while the unit is in motion. The range selector lever and Four-Wheel-Drive (FWD) selector lever are activated by the same lever.

The range selector lever has three positions; back (high range) mid-position (neutral) and forward (Low range). In High Forward “H” forward speed ranges from 0 – 15.0 mph (0 – 24.0 km/h) and Low Forward from 0 – 6.0 mph (0 – 9.6 km/h). In Reverse High speed ranges from 0 – 9.0 mph (0 – 14.4 km/h) and in Reverse Low from 0 – 4.0 mph (0 – 6.4 km/h).

The differential assembly consists of a differential lock coupler, pinion differential and two bevel side gears splined directly to the axle shafts.

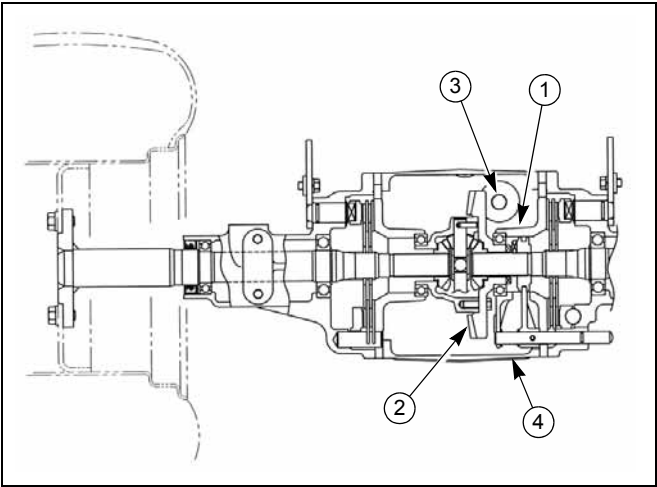


Figure 2-3

Range Gear & Differential Housing			
1.	Differential Lock Coupler	3.	PTO Shaft
2.	Differential	4.	Gearbox Housing

B. Brakes

The brakes are located in the front axle housing. The brakes are disc brakes and consist of a stator, disc, steel ball, spring, actuate plate and brake lever. The brakes are mechanically applied by individual pedals located on the left side of the steering column (optional).

A master brake pedal, located on the right side, applies both brakes evenly.

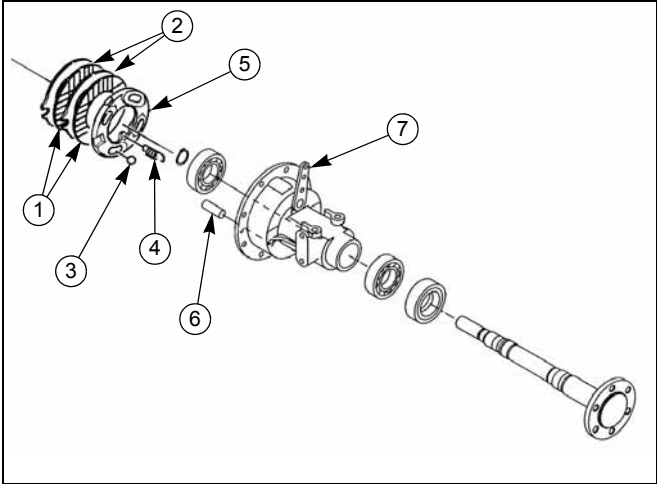


Figure 2-4

Brakes			
1.	Brake Disc	4.	Spring
2.	Stator	5.	Actuator Plate
3.	Steel Ball	6.	Pin
		7.	Brake Lever

C. Differential Lock

A differential lock is provided to lock the differential so that both front wheels rotate when power is provided by the transmission even though one wheel may lose traction. The differential lock control pedal is foot operated and is located on the left side of the steering column.

D. Power Flow (Range Gear)

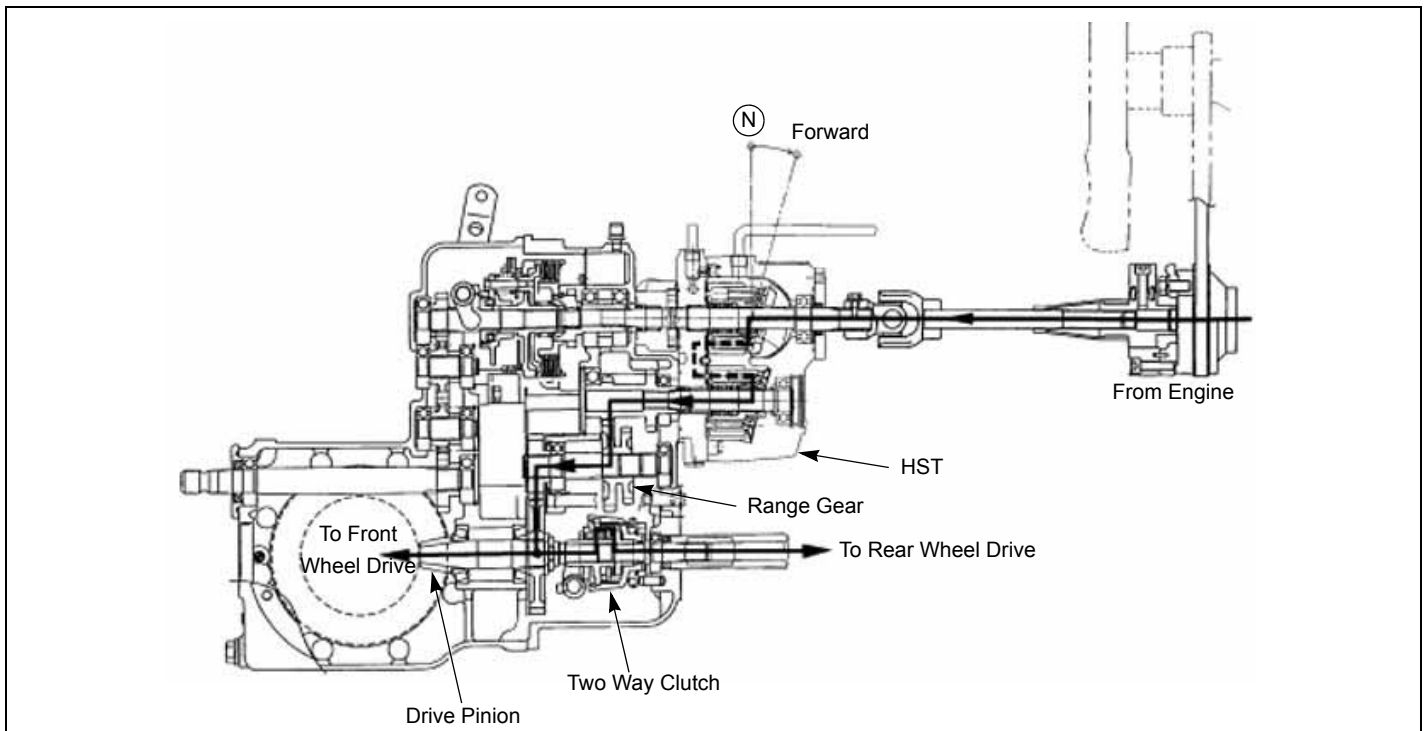


Figure 2-5

Range Change lever: L Position

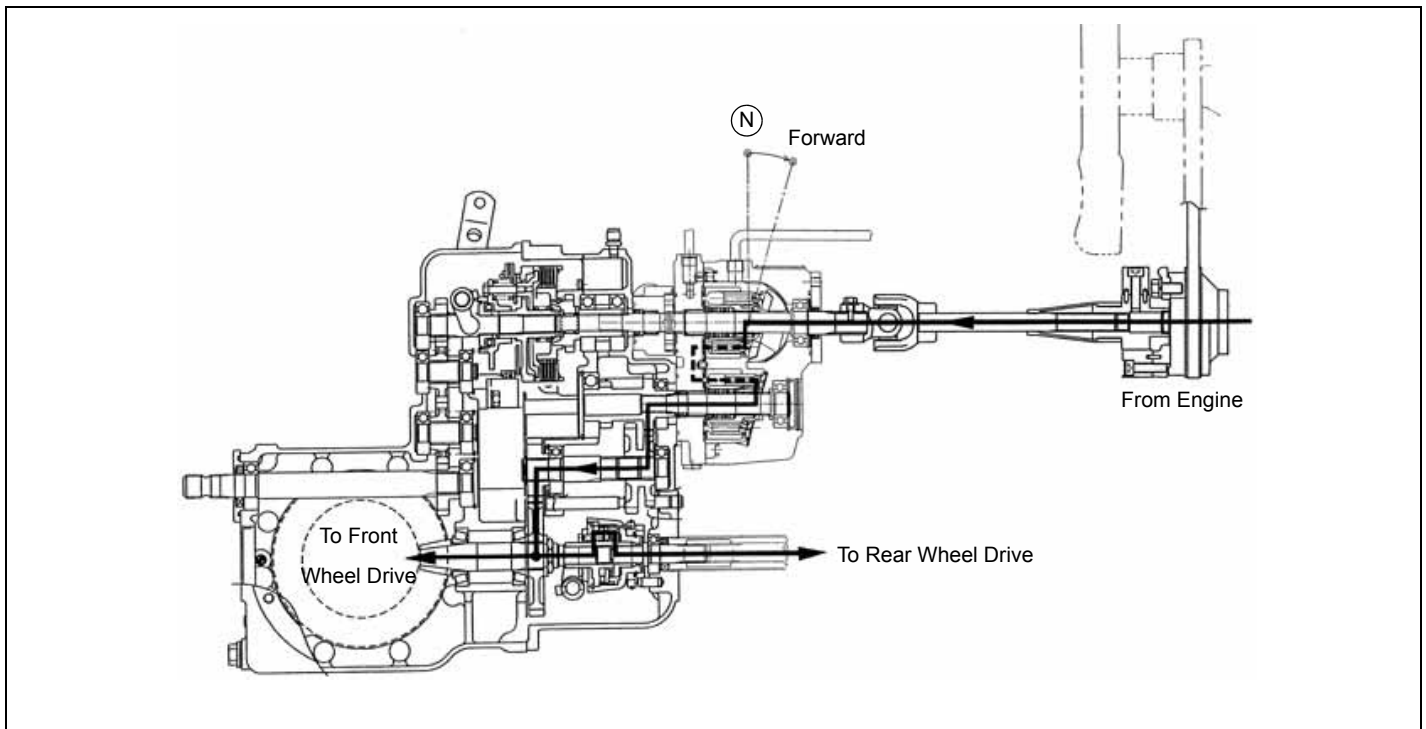


Figure 2-6

Range Change lever : H Position

E. Power Flow (PTO)

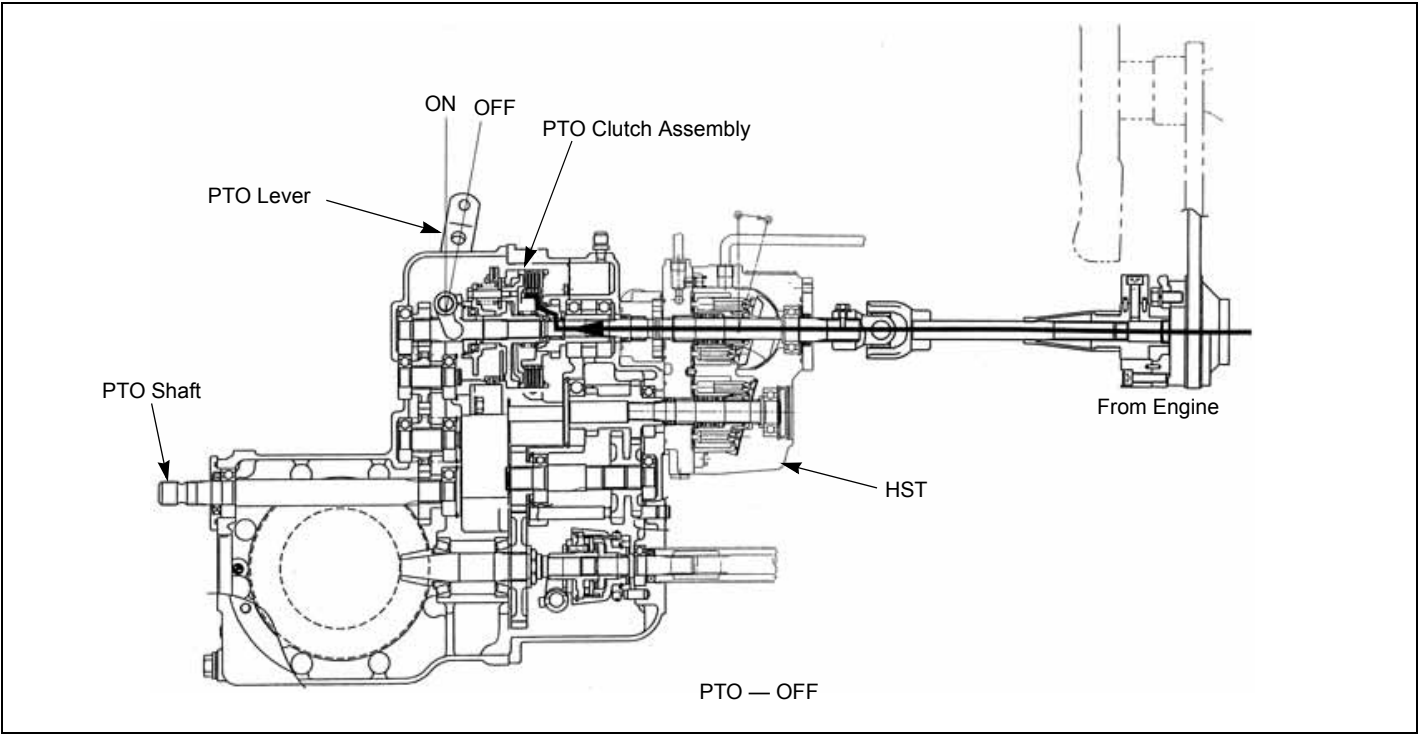


Figure 2-7

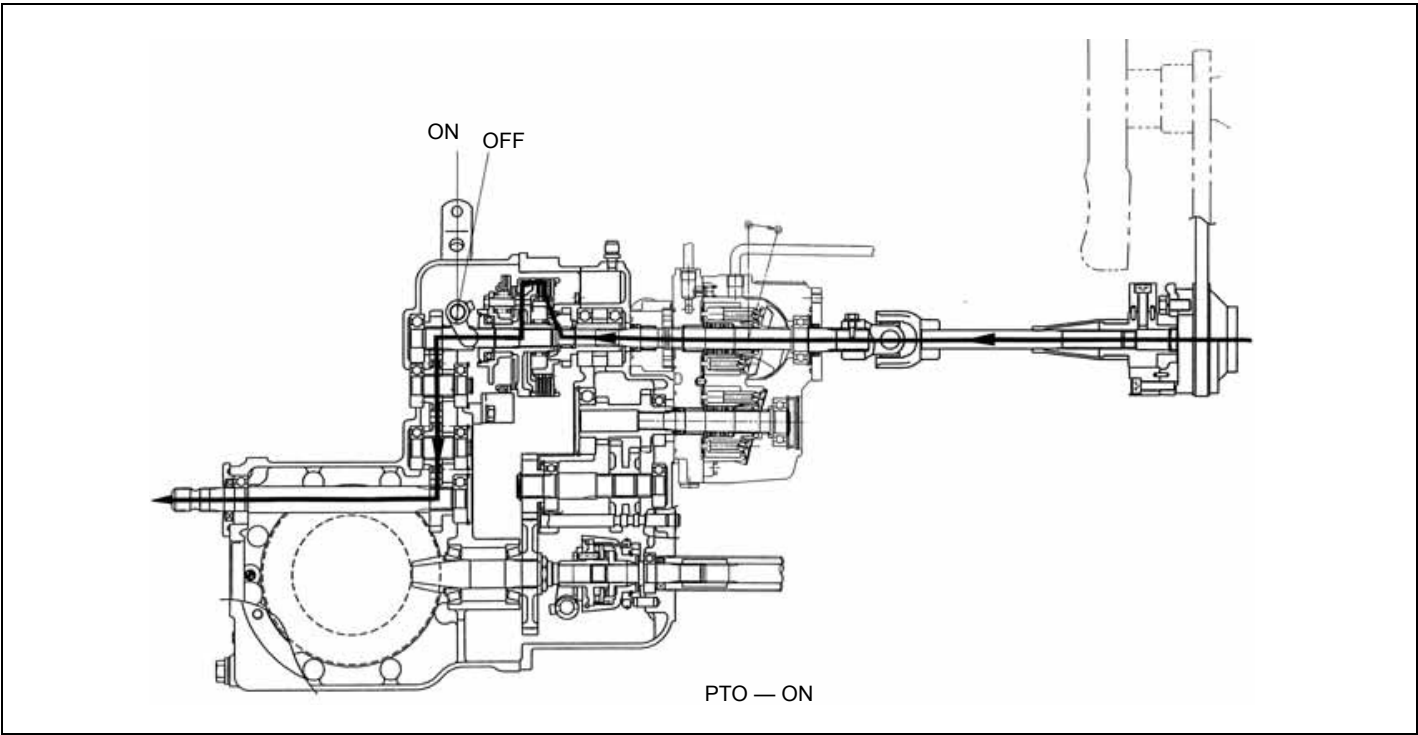


Figure 2-8

Transmission Unit

The transaxle assembly must be removed from the commercial mower to perform service work on the HST, transmission gearbox, four wheel drive output shaft differential.

A. Removal

1. Disconnect the negative battery cable.
2. Remove the various control handle grips ①, side cover ②, and fenders ③ and ④. Figure 2-9
3. Drain the hydraulic fluid from the axle assembly via the drain plug ⑤ located at the front center bottom of the front axle housing. Figure 2-9

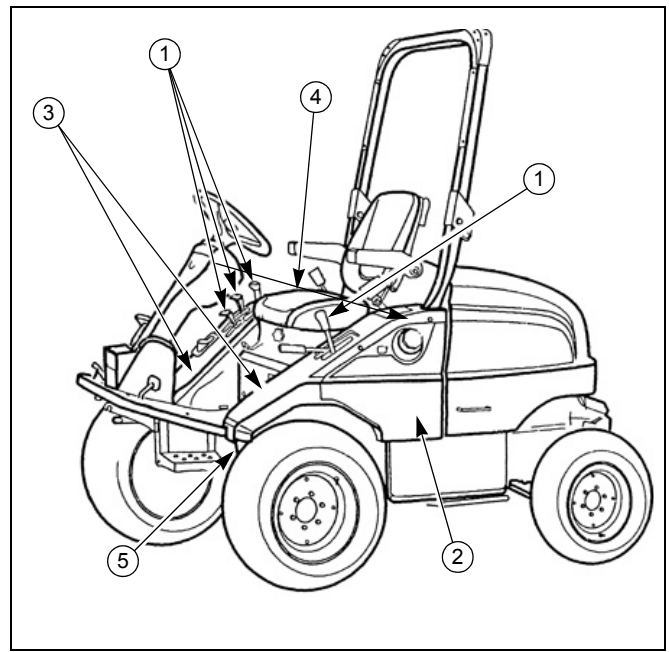


Figure 2-9

4. Release the seat pan latch, pivot the seat ② and seat pan up ① and over. Disconnect the mower harness from the seat switch ③. Unbolt the seat assembly from the seat pan and remove it. Figure 2-10

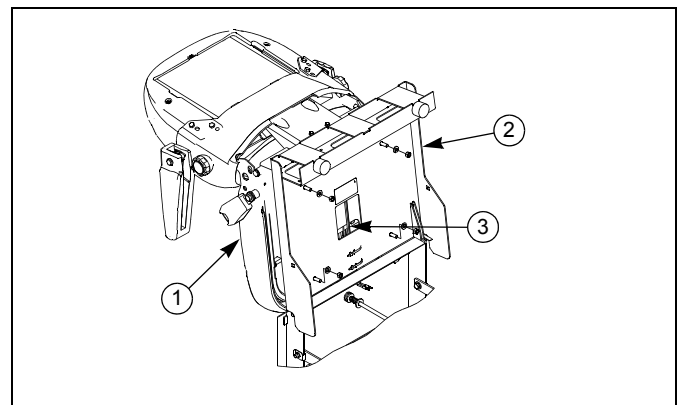


Figure 2-10

5. If the mower has the seat latch knob ① in the front cover ② you will need to disconnect the seat latch rod ③ from the latch plate ④. Figure 2-11

NOTE: If the mower has the seat latch lever located behind the seat proceed to Step 7.

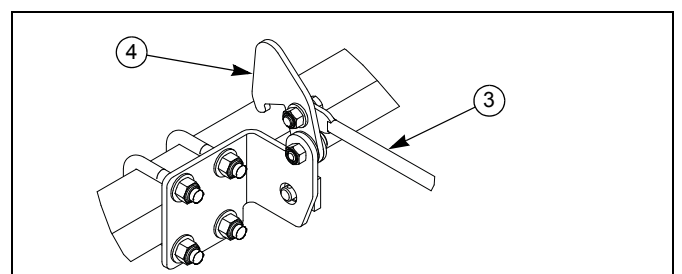
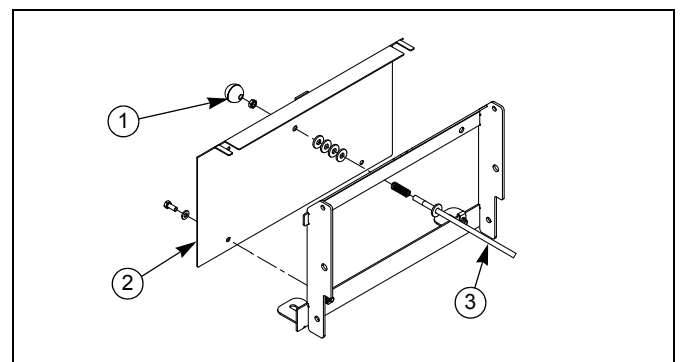


Figure 2-11

6. If the mower has a dampener ① connected to the seat pan ② it will need to be disconnected from the seat pan. Figure 2-12
7. Remove the seat pan ② from the front cover ③ by removing the pivot bolts ④. Figure 2-12
8. Remove the front cover ③. Figure 2-12

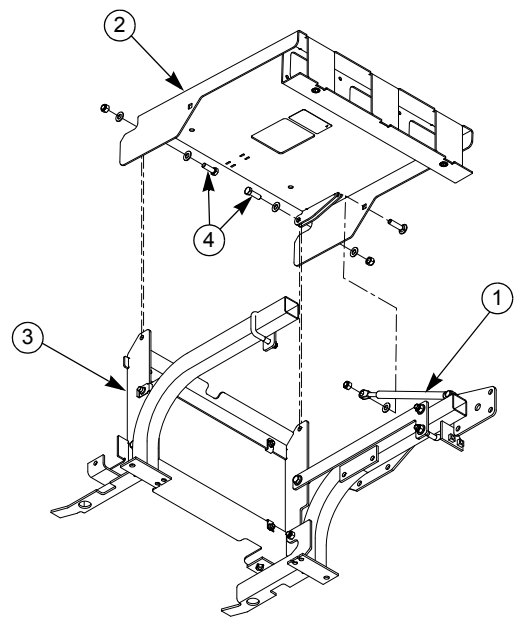


Figure 2-12

9. Disconnect the parking brake wire ④ from both brake levers. Figure 2-13
10. Remove the split pin, washer and pin, and disconnect the brake rod ① from both brake levers. Figure 2-13
11. Remove the split pin, pin, and disconnect the differential lock control rod ② from the differential lock lever. Figure 2-13.

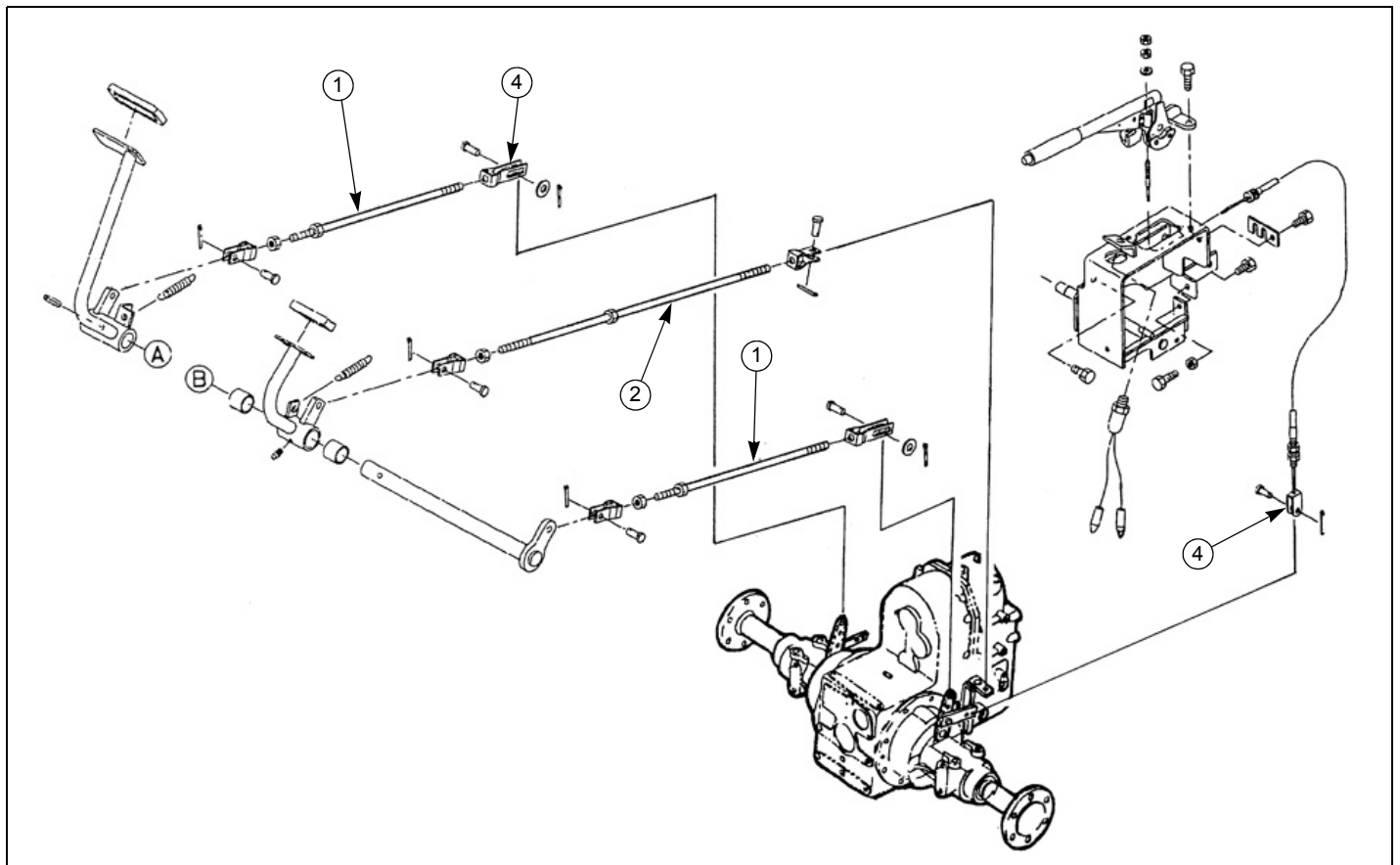


Figure 2-13

12. Disconnect the power steering lines ① from the power steering cylinder, located on the rear axle. Figure 2-14
13. Place four (4) safety stands under the main frame.
14. Remove the rear axle bearing holders ② from the frame and remove the rear axle assembly ③, pipe, drive shaft and coupling from the power unit. Figure 2-14

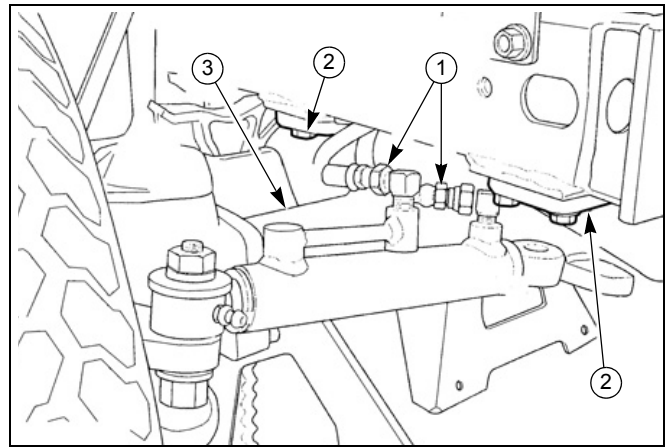


Figure 2-14

15. Remove the bolt ① from the universal joint ② and disconnect the joint from the HST input shaft by sliding the joint towards the engine. Figure 2-15

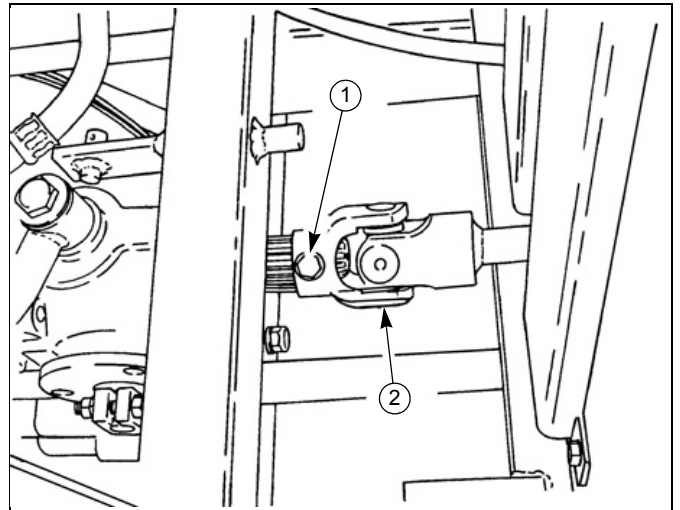


Figure 2-15

16. Disconnect the wire connector from the HST neutral switch ①. Figure 2-16

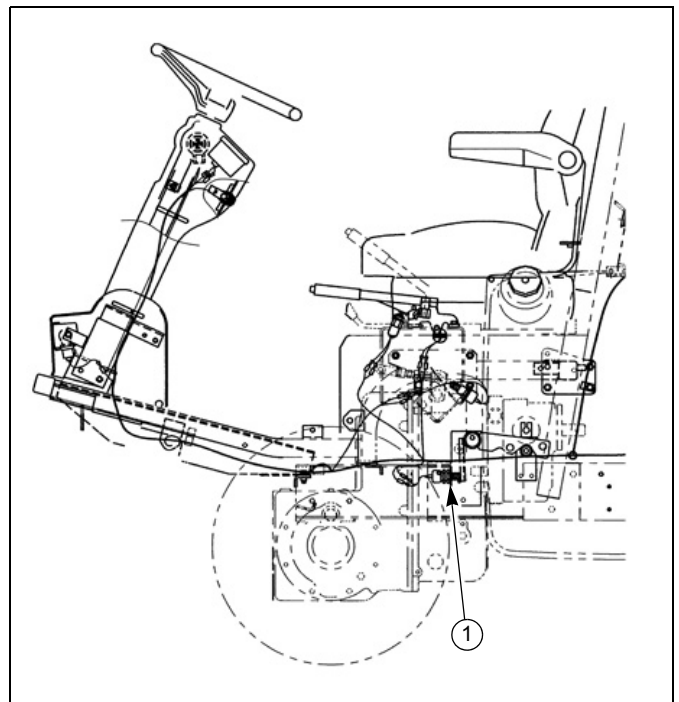


Figure 2-16

17. Remove the split pin ① and washer. Disconnect the PTO safety stop wire ② from the R.H. lift arm.
18. Remove the bolt ③ and pin ④ and separate the hydraulic cylinders ⑤ from the right and left lift arms.

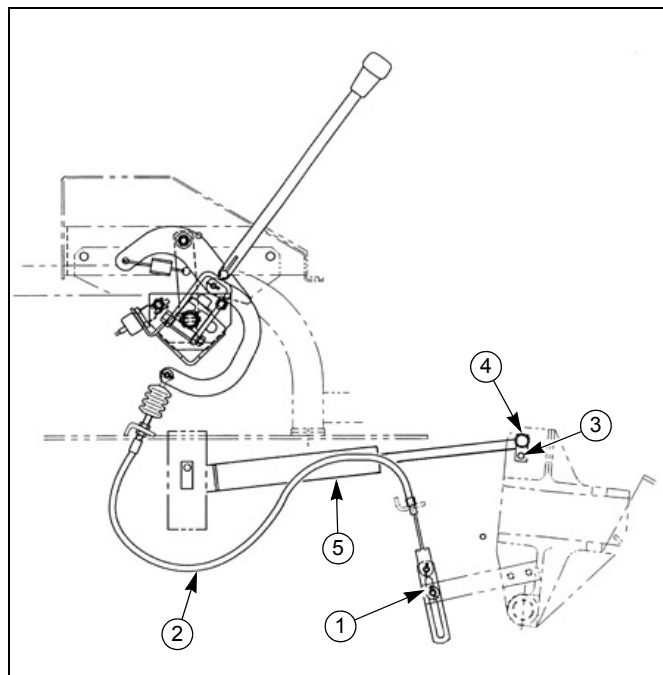


Figure 2-17

19. Loosen the hose clamps ① and disconnect the return hose ② from the vent hose on the transmission housing.
20. Disconnect the fork joint ③ by removing the pins from the PTO clutch control lever ④.
21. Remove the spring ⑤ from the PTO clutch control lever ④.

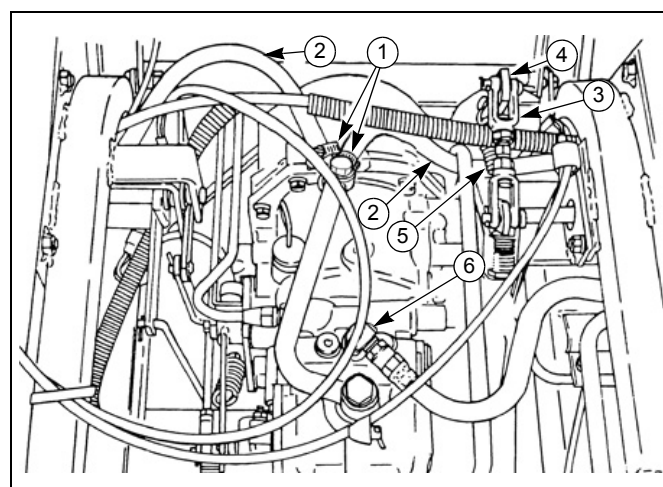


Figure 2-18

22. Disconnect the oil line ① from the HST charge pump.

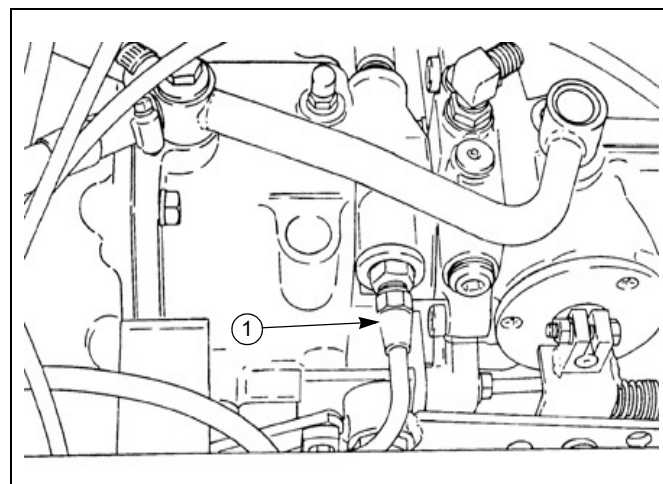


Figure 2-19

23. Loosen the hose clamp ① and disconnect the suction hose ② from the hydraulic oil pump.

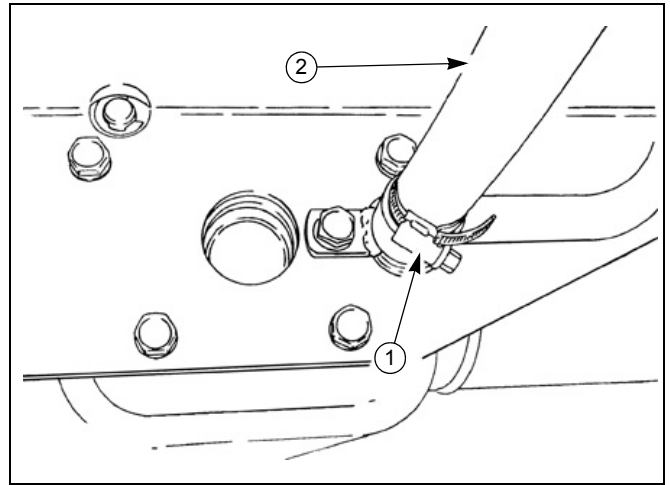


Figure 2-20

24. Remove the split pin, washer and disconnect the HST speed control rod ① from the HST control lever.
25. Remove the u-nut and the damper ② from the HST control lever.
26. Unhook the spring ③ from under the HST speed control lever.

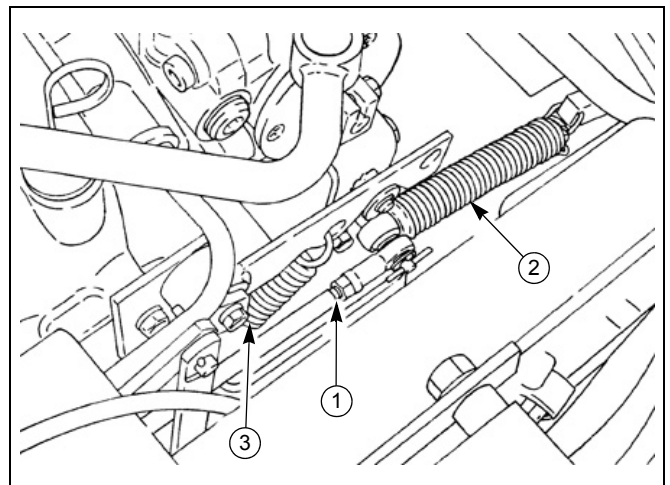


Figure 2-21

27. Remove the split pin, washer and disconnect the four-wheel drive control rod ① and range gear control rod ② from the change lever.

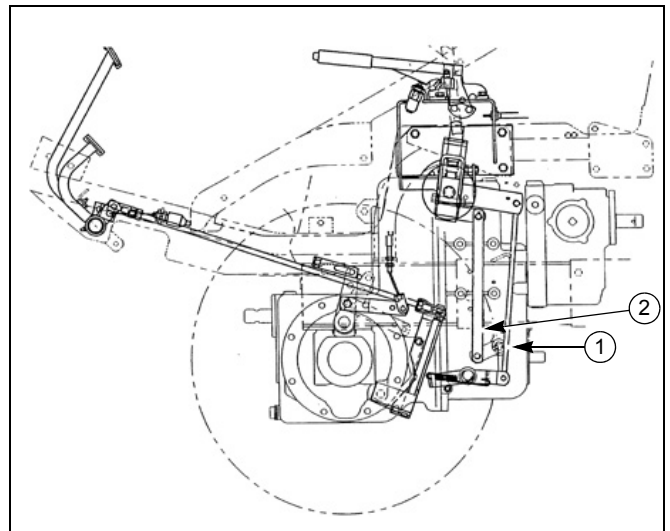


Figure 2-22

28. Remove the banjo bolt and clamp ① from the oil cooler return line. Disconnect the return line ②, from the oil cooler.
29. Use two wrenches (to prevent twisting, a backup wrench must be used) and disconnect the feed line ⑥, for the HST on the top of the HST unit, Figure 2-18.

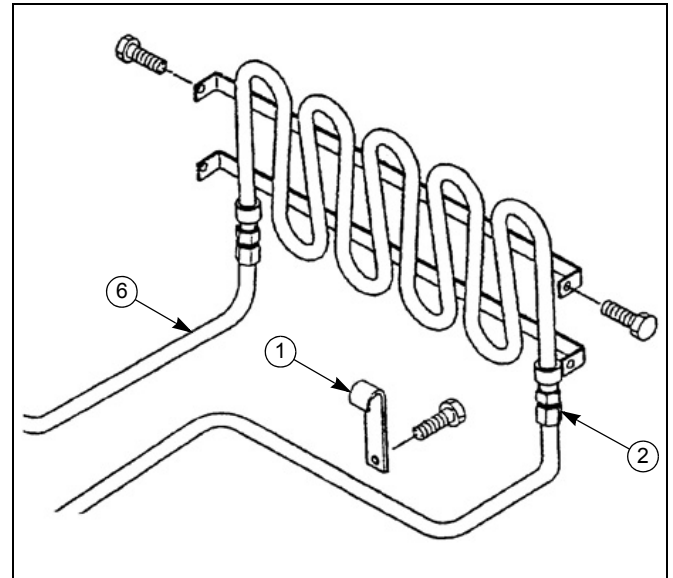


Figure 2-23

30. Hold the front frame up with the chain block.
31. Remove the rear frame ①, attaching bolts ②, and nuts ③.

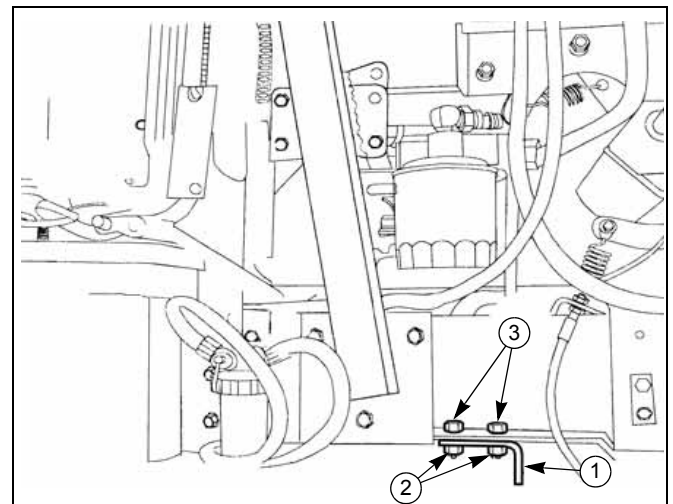


Figure 2-24

32. Remove the bolts ① from the front axle housing.
33. Lower the front axle and transmission housing assembly ②, from the main frame.

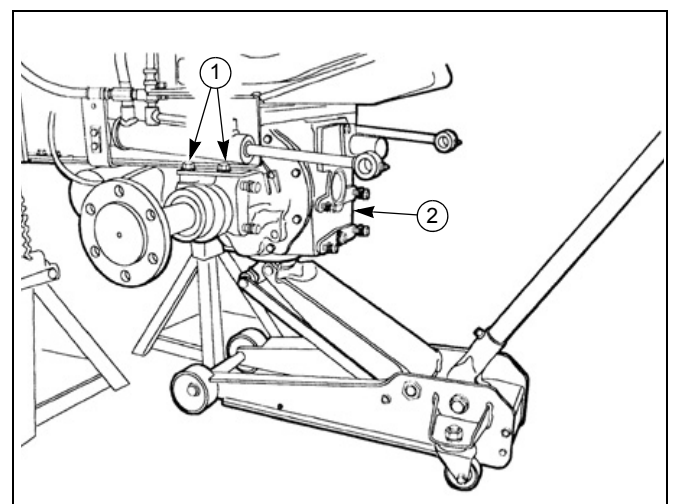


Figure 2-25

34. Remove the rear frame ① from the rear transmission housing.

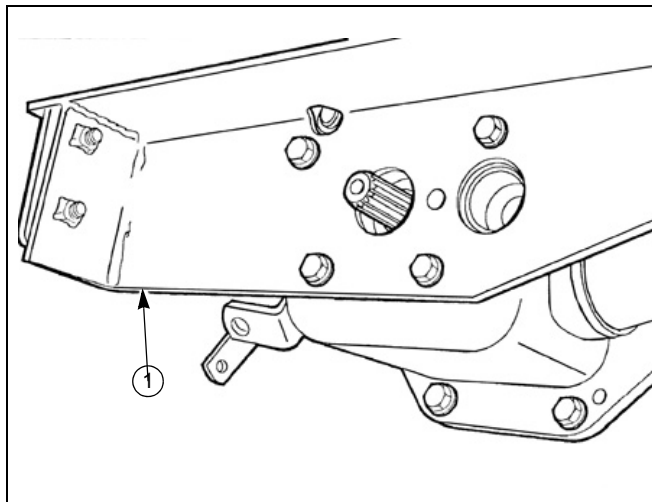


Figure 2-26

35. Unhook the spring ④, remove the shift arm ① and shift guide ② as a set from the transmission.
If necessary, remove the control lever ③ from the HST unit.

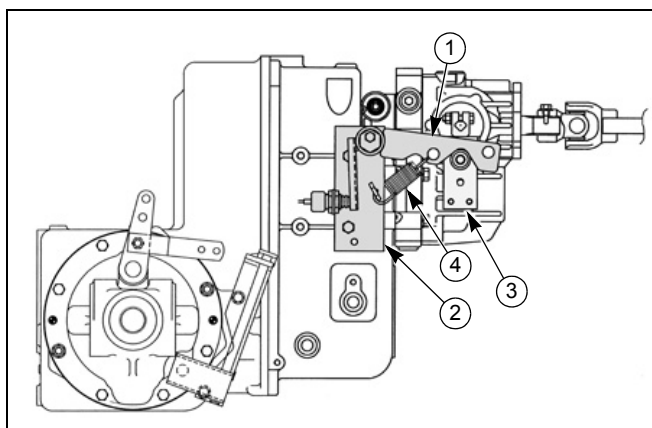


Figure 2-27

Front Transmission Unit

A. Disassembly

1. Remove the side PTO unit from the transmission housing and HST unit.

NOTE: The Side PTO is not used on Hustler® models.

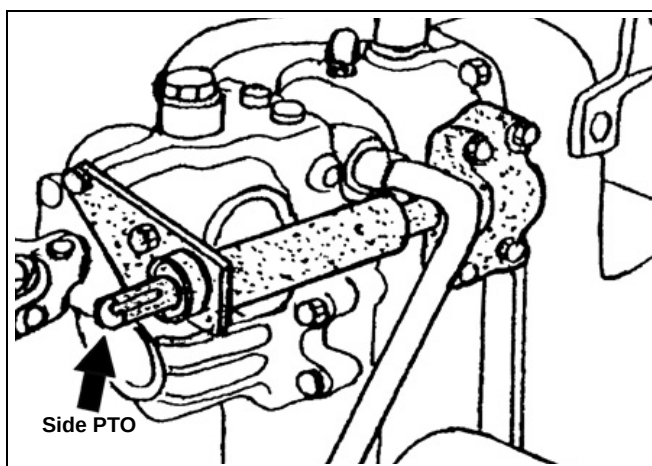


Figure 2-28

2. Remove the HST unit ① from the transmission assembly.

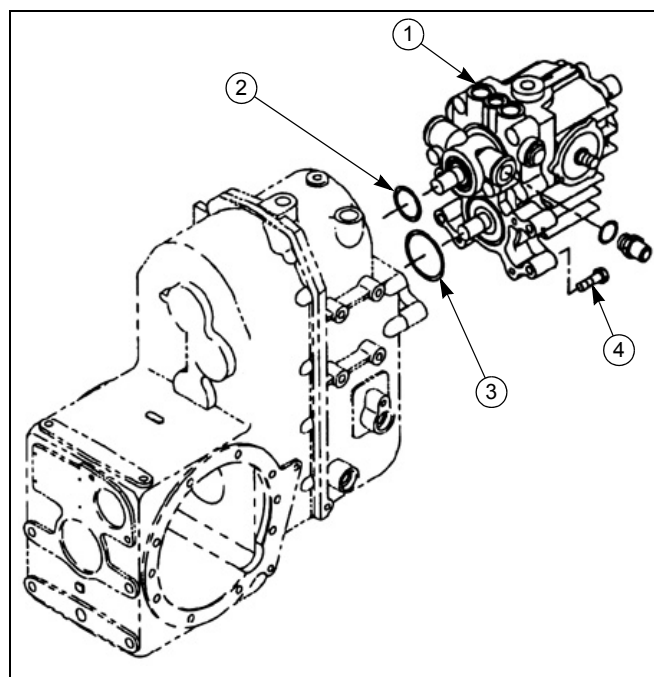


Figure 2-29

1. HST Unit	3. O-Ring
2. O-Ring	4. Bolt

3. Remove the L.H. wheel shaft housing ① and bearing holder ②.

NOTE: Note the total amount of shims and thickness used between differential bearing and bearing holder.

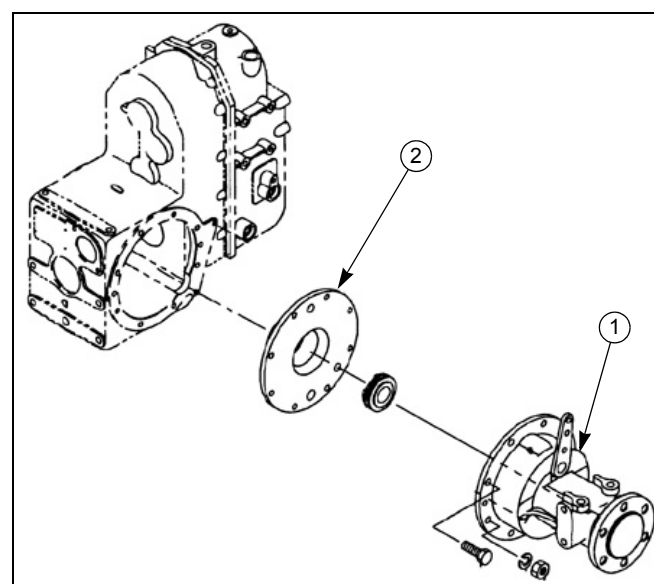


Figure 2-30

4. Remove the L.H. wheel shaft housing ②, the bearing holder ③, and differential assembly ①.

NOTE: Note the total amount of shims and thickness used between differential bearing and bearing holder.

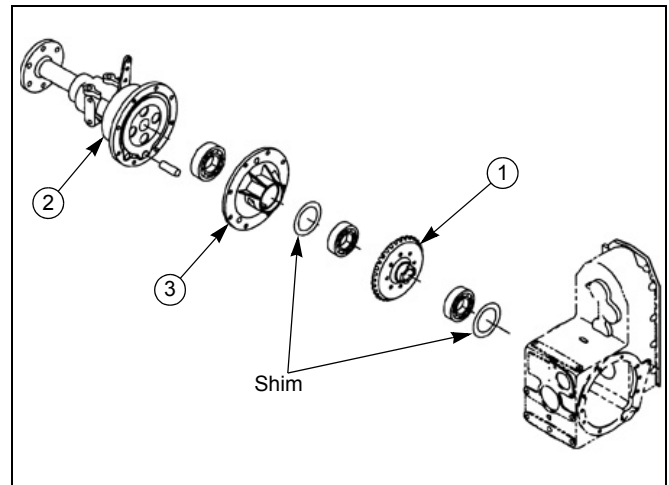


Figure 2-31

5. Separate the rear transmission housing ① from the front transmission housing ②.

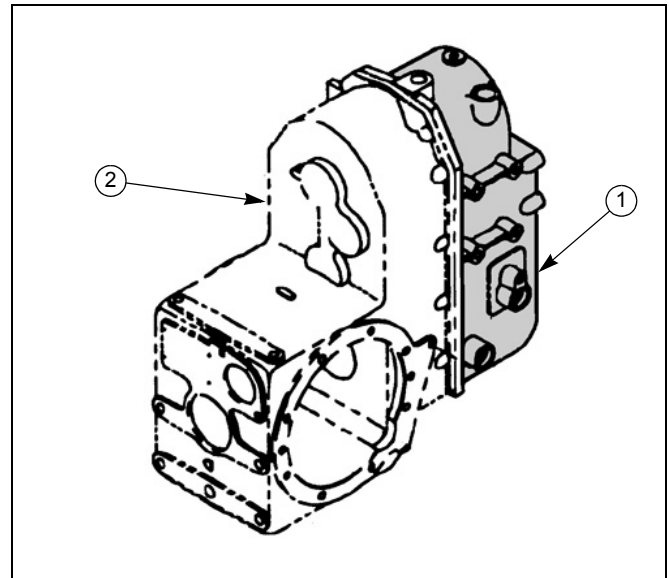


Figure 2-32

6. Remove the seal cover ①, with oil seal ②, and O-Ring ⑧ from the transmission housing.
7. Drive out the PTO shaft ③ and remove the fixed gear ④, snap ring ⑤, bearings ⑥ and ⑦ from the transmission housing.

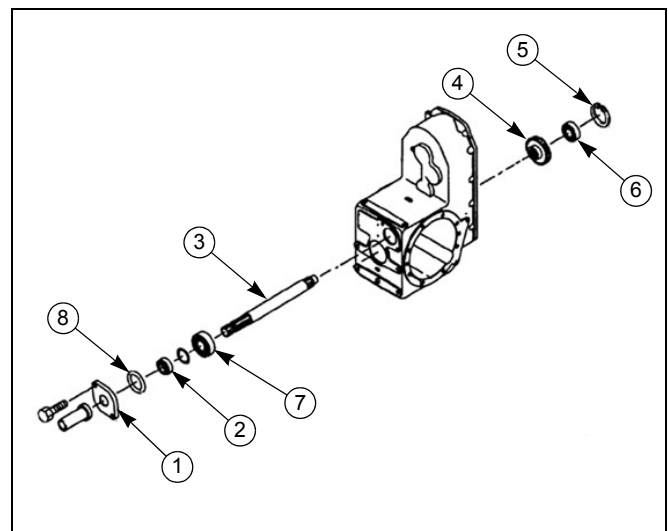


Figure 2-33

8. Remove the PTO clutch assembly ① and thrust bearing ②.
9. If necessary, remove the plate ③ from the transmission housing.

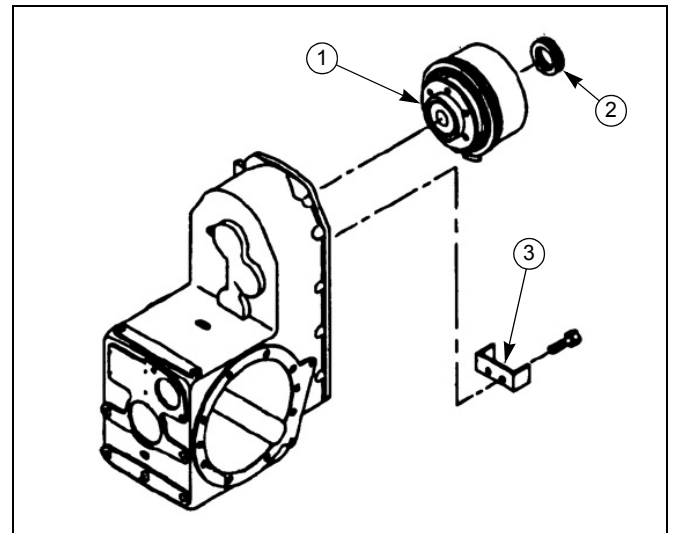


Figure 2-34

10. Loosen the lock nut ① on the drive pinion shaft ②.
11. Remove the washer ⑤ and fixed gear ④ from the drive pinion shaft ②.

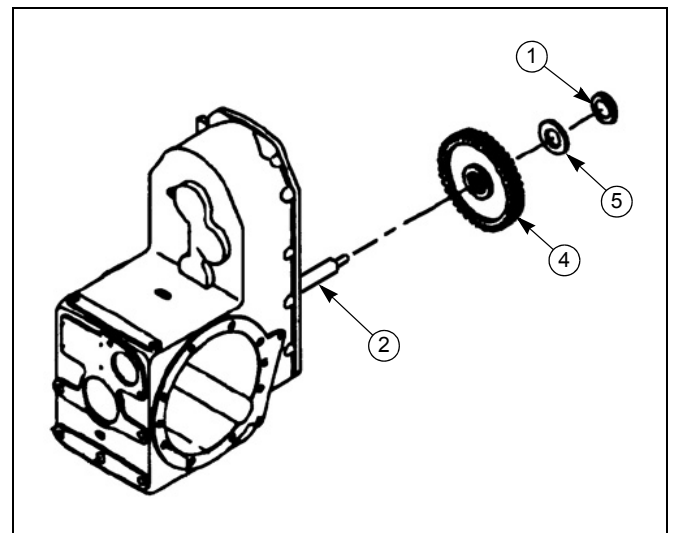


Figure 2-35

12. Pull out the drive pinion shaft ①, thrust washer ②, and shims ⑤ from the front of the transmission housing.
13. Remove bearings ② and ③ from the housing.
14. If necessary, drive out the seal cover ⑥ to inspect the ring gear backlash.

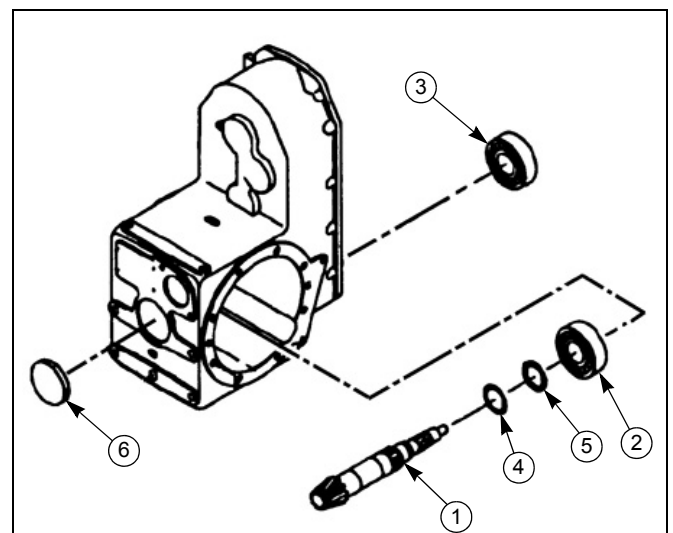


Figure 2-36

15. Remove the snap ring ① and pull out the counter shaft ② with bearing ③, and collar ④.
16. Take out the fixed gear ⑤ and bearing ⑥ from the housing.

NOTE: Put an identifying mark on the fixed gear ⑤ using paint.

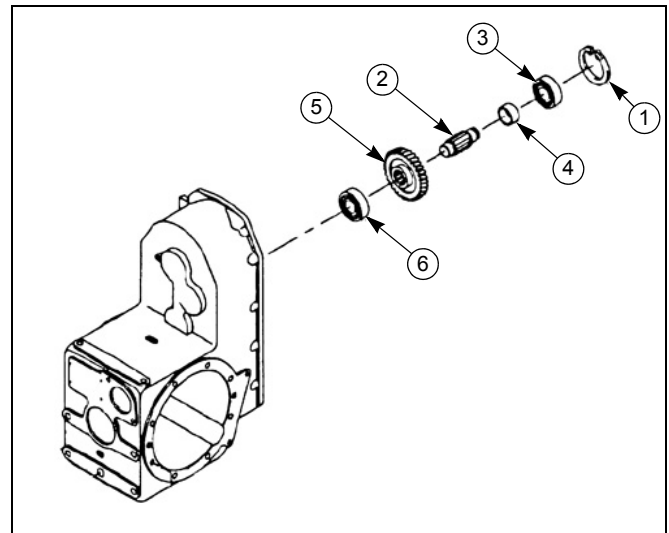


Figure 2-37

17. Remove the snap ring ① and pull the counter shaft ② with bearing ③ out.
18. Remove the collar ④, fixed gear ⑤, and bearing ⑥ from the housing.

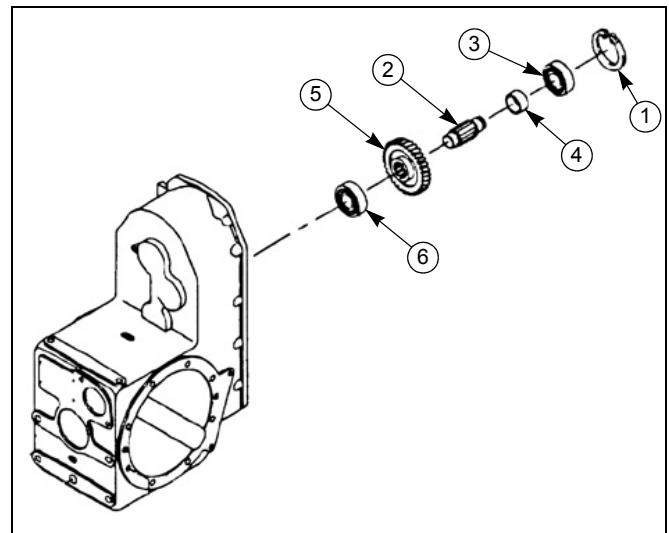


Figure 2-38

19. Heat the two bolts ①, with a torch, and remove them. Then, pull the PTO clutch shaft ② out. Heat must be applied to break the Loctite bond on the bolts.
20. Remove the clutch fork ③ from the housing.
21. Remove the drive shaft ④ with snap ring ⑤.
22. Remove the fixed gear ⑥ and bearing ⑦.

B. Inspection

1. Wash all components with a suitable cleaning solvent and air dry.
2. Inspect all bearings for excess wear, score marks, discoloration from overheating, or other damage. Rotate the bearings by hand and check for roughness while slowly rotating the inner and outer races.
3. Lubricate all bearings with a clean lubricant before installation.
4. Inspect the transmission case for cracks, worn bearing bores or other damage.
5. Inspect all parts for excess wear, chipped teeth, or other damage.
6. Inspect the shift forks for excess wear, bends or other damage.

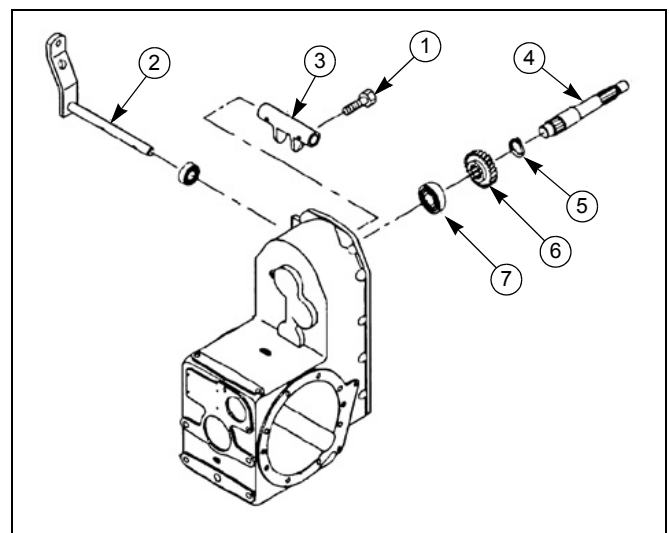


Figure 2-39

C. Assembly

Reassembly generally follows the disassembly procedure in reverse.

Be sure all components are free of dirt and foreign matter and lubricate all components with clean hydraulic oil on assembly.

During assembly observe the followings:

1. Use solvent to remove debris and oil from bolt threads ① and thread holes in the clutch shaft. Apply Loc-tite 242 to bolt threads when installing the clutch fork ③.

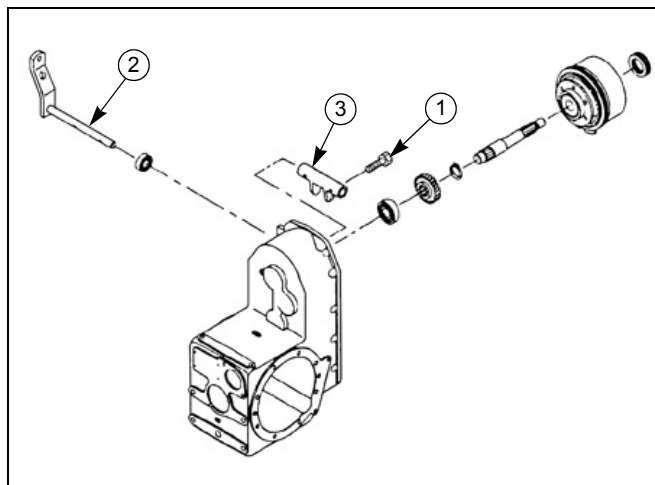


Figure 2-40

2. **IMPORTANT:** Position the clutch shaft lever ① as shown before installing the PTO clutch assembly.

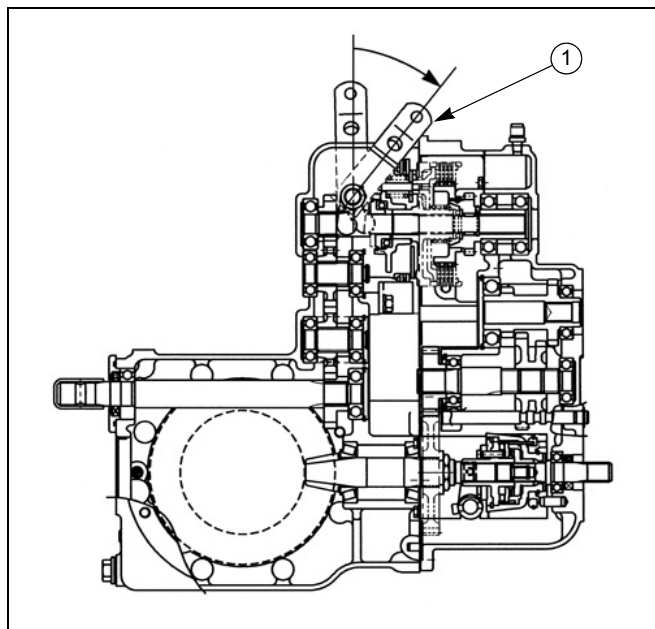


Figure 2-41

3. The fixed gear ① (with identity mark) when it is removed is installed in position A.

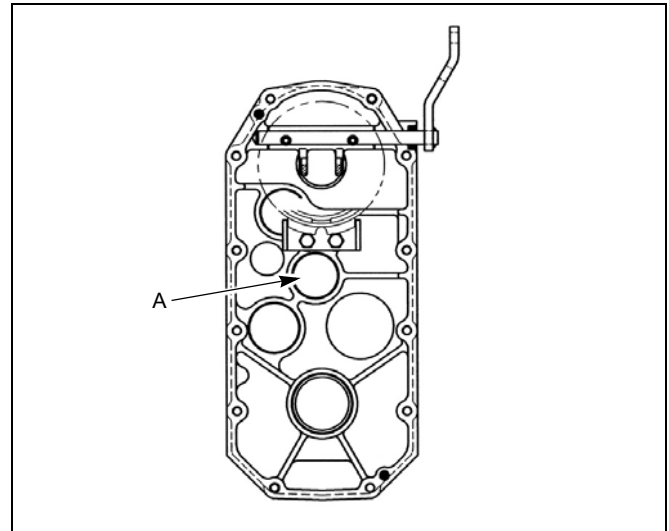


Figure 2-42

4. The shims ① are installed between thrust washer ② and bearing ③ on the drive pinion ④.
5. Adjust the pinion bearing pre-load using a strong cord wrapped around the pinion shaft spline and a pull scale. Tighten the pinion nut to obtain the specified pounds of constant pull to rotate the pinion assembly.

Pinion Bearing Pre-Load Constant Pull 44 lbf (196 N)

NOTE: Turn drive pinion several times by hand before performing pull scale test.

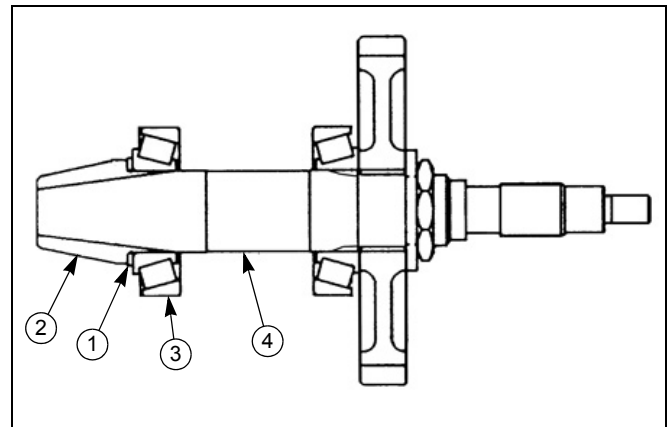


Figure 2-43

6. Bend the lock nut flange with a chisel at the notch in the pinion shaft after adjusting the pre-load.

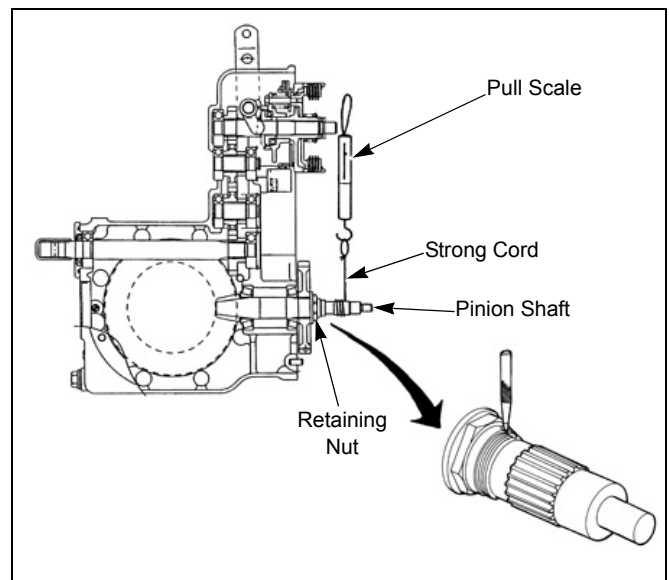


Figure 2-44

7. If removed, use care to install the plate ①, properly engaging the brake disc of PTO clutch assembly.
8. Align the brake disc projection ②, of PTO clutch in the plate ①.

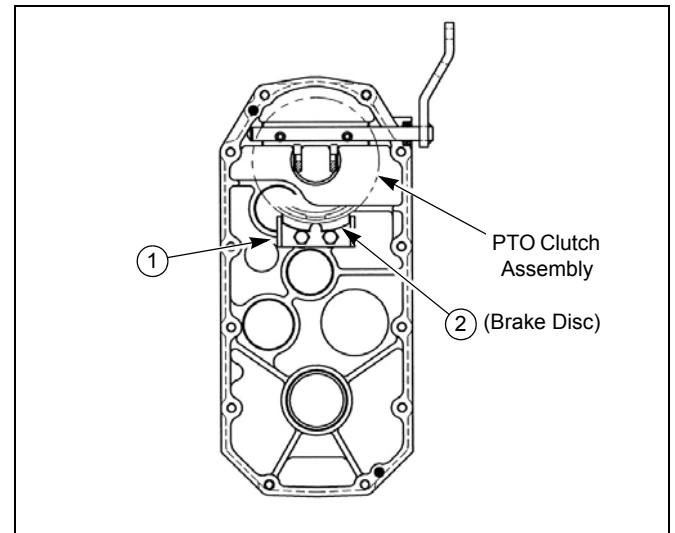


Figure 2-45

9. Apply grease to the .708 in. (18 mm) (inside diameter) bearing race ① and ball bearings ②. Install them on the PTO clutch drive shaft.
- Apply grease to the .669 in. (17 mm) (inside diameter) bearing race ③ and install the coupling in the rear transmission housing.

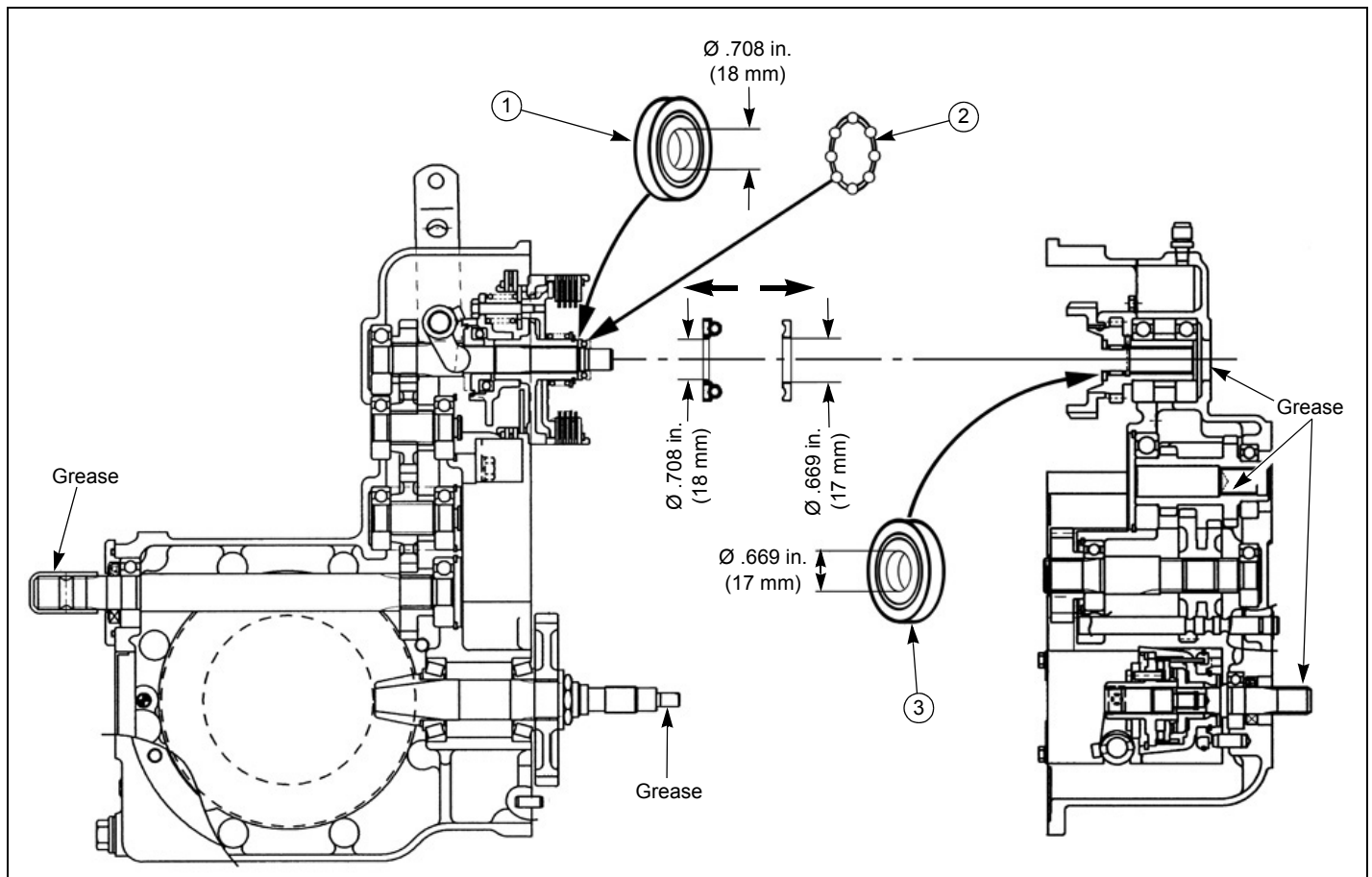


Figure 2-46

10. Apply a light coat of silicone (red RTV sealer) to the matching surfaces of both transmission housings.
11. Align the PTO clutch separator plate teeth before installing in the rear transmission housing.

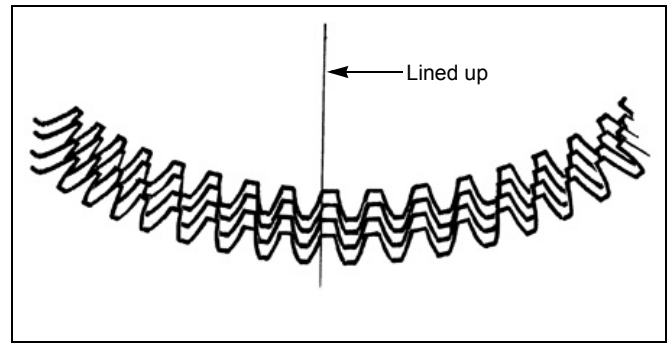


Figure 2-47

12. Install guide sticks (special tool) to the transmission housing, and align the each part as follows while sliding the rear transmission housing.
 - a. Align the drive pinion shaft and center to 4WD one way clutch center.
 - b. Align the PTO clutch separator plates with coupling of rear transmission housing.
 - c. Align the fixed gear on the drive pinion shaft with fixed gear on the range counter shaft while rotating the mainshaft.

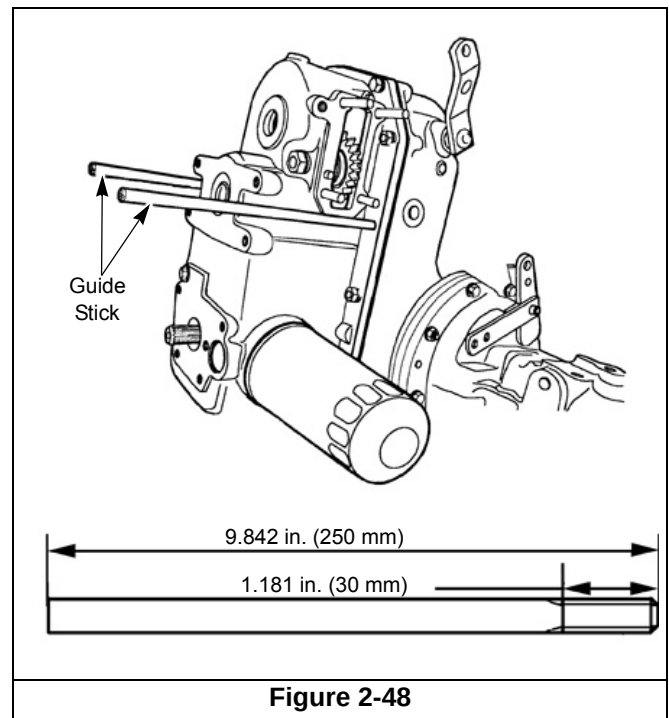


Figure 2-48

Rear Transmission Unit

A. Disassembly

1. Heat the two clutch shaft bolts ① before attempting removal. Heating is required to loosen the permanent Loctite used in assembly. Remove the bolts and pull the shaft ② from the rear transmission housing on the 4WD model.
2. Take out the shifter fork ③, with tips ⑨, from the housing on 4WD model.
3. Remove the thrust washer (thick) ④, two way clutch assembly ⑤, thrust washer (thin) ⑥, drive shaft ⑦, with bearing ⑧, from the rear transmission housing on 4WD model.

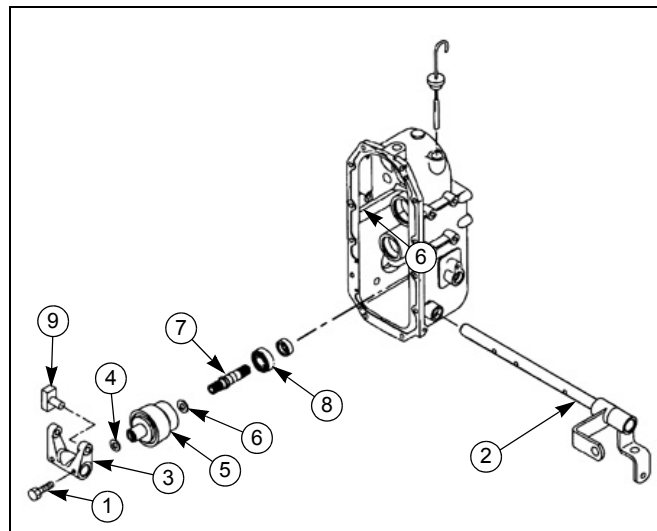


Figure 2-49

4. Remove the snap ring ①, shifter rod ②, steel ball ③, spring ④, and range shifter fork ⑤.



WARNING



Hold a shop towel over the top of the shift fork to restrain the detent ball when the rail is removed from the fork. The detent ball will be expelled with considerable force when it is released.

5. Drive out the roll pin ⑥ and remove the change lever ⑦.
6. Remove the bolt ⑧ and plate ⑨ and pull out the shift arm ⑩ from the transmission.

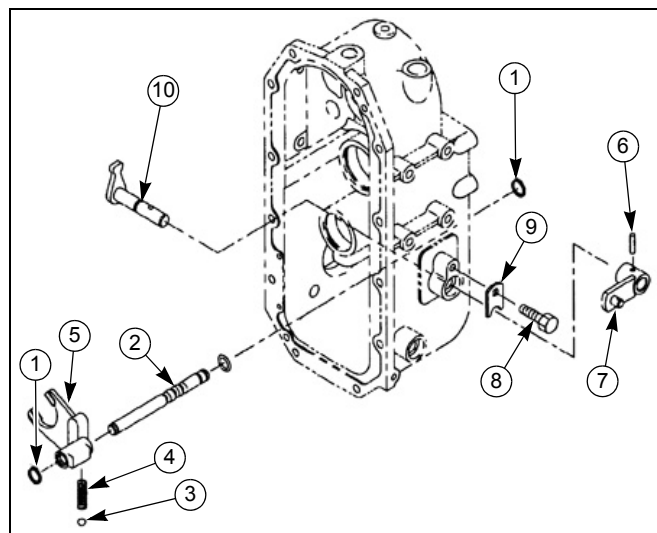


Figure 2-50

7. Remove the snap ring ① and fixed gear ② from range gear counter shaft ③.
8. Remove the snap ring ④ and pull out the range gear counter shaft ③ with bearing ⑤.
Take out the range slide gear ⑥ and bearing ⑦.
9. Remove the plate ⑧ with magnets ⑨.
10. Remove the snap ring ⑩ and drive out the main shaft (gears) ⑫ with bearings ⑪ and ⑬.

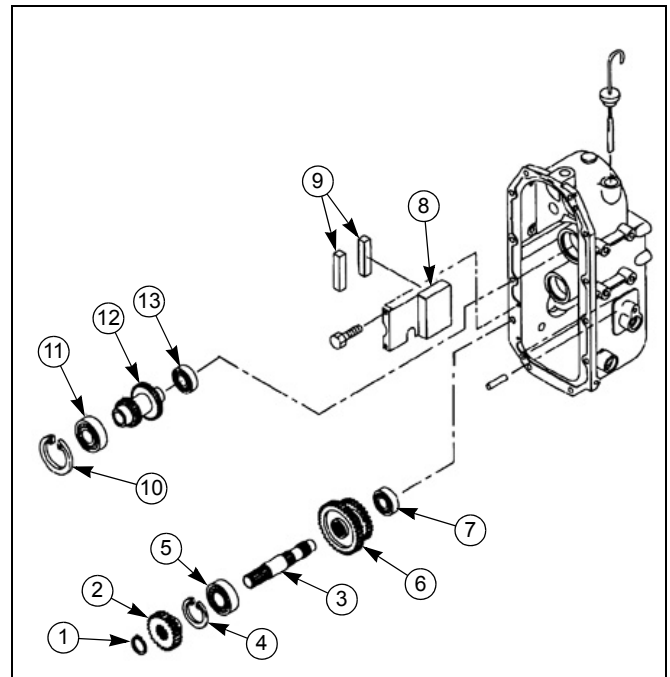


Figure 2-51

11. Remove the nut ① and washer ⑧. Drive out the countershaft ② with o-ring ③ from the housing.
12. Remove the collar ⑦ and the counter gear ④ with bearing ⑤ and snap ring ⑥.

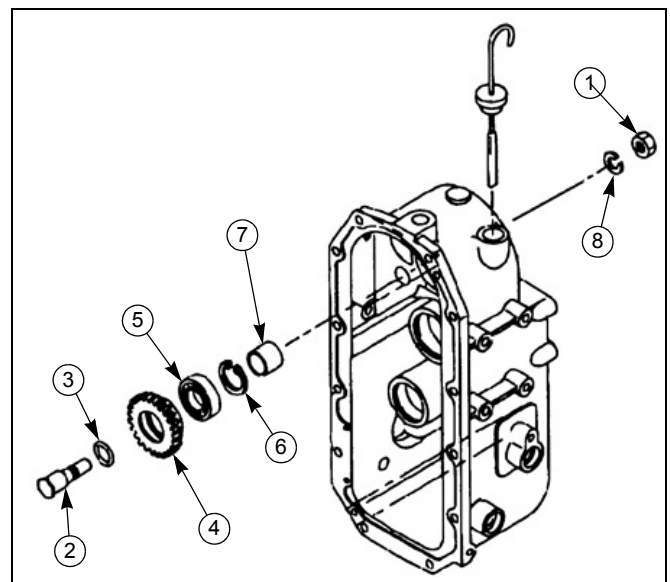


Figure 2-52

13. Remove the thrust bearing ⑤ and drive out the coupling ① and needle bearing ⑥.
14. Take out the collar ④, bearings ② and ③, from the transmission housing.
15. If necessary, remove the plate ⑦ from the housing.

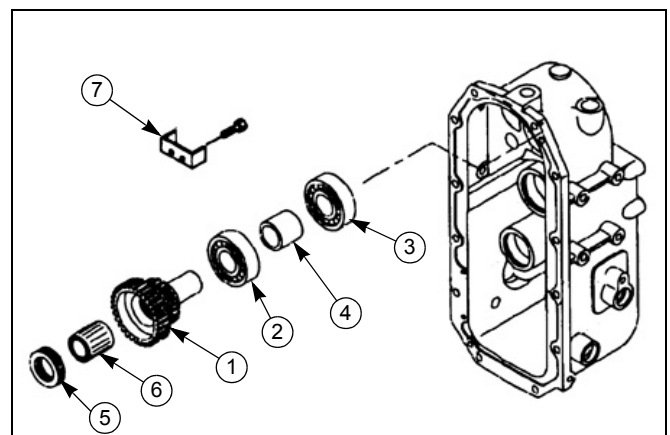


Figure 2-53

B. Inspection

1. Wash all components with a suitable cleaning solvent and air dry.
2. Inspect all bearings for excess wear, score marks, discoloration from overheating, or other damage. Rotate the bearings by hand and check for roughness while slowly rotating the inner and outer races.
3. Lubricate all bearings with a clean lubricant before installation.
4. Inspect the transmission case for cracks, worn bearing bores or other damage.
5. Check the detent springs for wear, chipped or weak spring extension.
6. Inspect the detent balls for excess wear or damage.
7. Inspect the shift rail detent grooves for excess wear.
8. Inspect all gears for excess wear, chipped teeth, or other damage.
9. Inspect the shift forks for excess wear, bends or other damage. See “Wear Specifications,” in this Chapter.

C. Assembly

Reassembly generally follows the disassembly procedure in reverse.

Be sure all components are free of dirt and foreign matter and lubricate all components with clean hydraulic oil on assembly.

During assembly observe the followings:

1. Install the range shift arm ① in the rear transmission housing.
2. Install the range slide gear shifter fork ②, as follows:
 - a. Install the spring ④ and steel ball ③ into the shifter fork ② by pressing them into the shaft.
 - b. Assemble the stick [outside diameter is $\varnothing .551 - .571$ in. (14 – 14.5 mm), length is 1.772 – 1.968 in. (45 – 50 mm)] ⑤ in the hole of the shifter fork.
 - c. Place the assembled shifter fork ② on the range sliding gear in the rear transmission housing.
 - d. Install the shifter rod ⑥ through the housing and shifter fork ② and secure with snap ring ⑦.
 - e. Take out the stick ⑤.

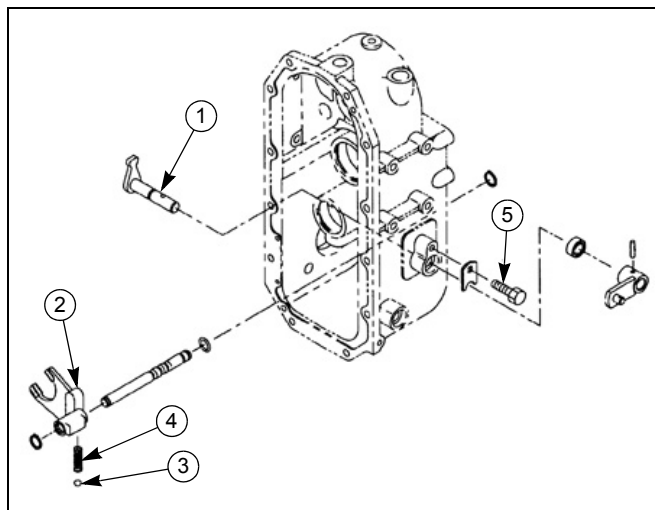


Figure 2-54

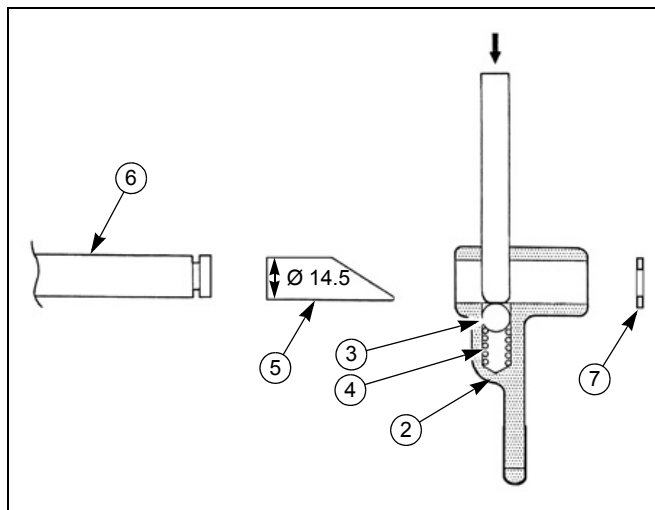


Figure 2-55

3. Install the two way clutch assembly (4WD only) as follows:
 - a. Install the oil seal ① and bearing ② in the housing.
 - b. Install the 4WD drive shaft ③ in the housing.
 - c. Install the small thrust washer ④ on the 4WD drive shaft with the oil ditch toward the two way clutch assembly ⑤.
- d. Install the two way clutch assembly ⑤ on the drive shaft.

NOTE: Align the notch of the two way clutch assembly to pin in the housing.

- e. Install the large thrust washer ⑥, on the two way clutch assembly with the oil ditch toward the two way clutch assembly.
- f. Use solvent to remove debris and oil from bolt threads ⑦ and thread holes in shaft ⑧. Apply Loc-Tite 232 to bolt threads when installing the shifter fork ⑨.

NOTE: Take care the direction of the tips on the shifter fork as shown Figure 2-58.

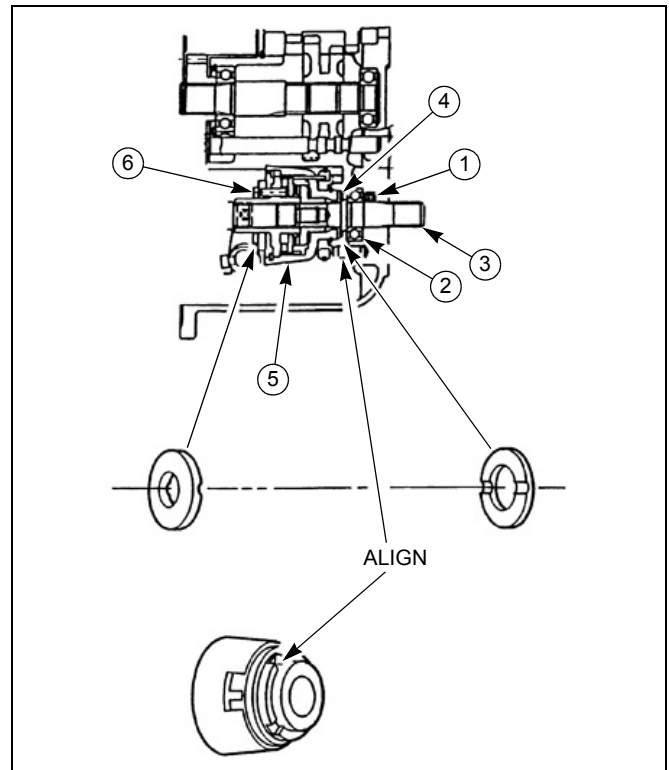


Figure 2-56

4. For installation of the rear transmission housing to the front transmission housing refer to the “*Front Transmission Assembly*” section.

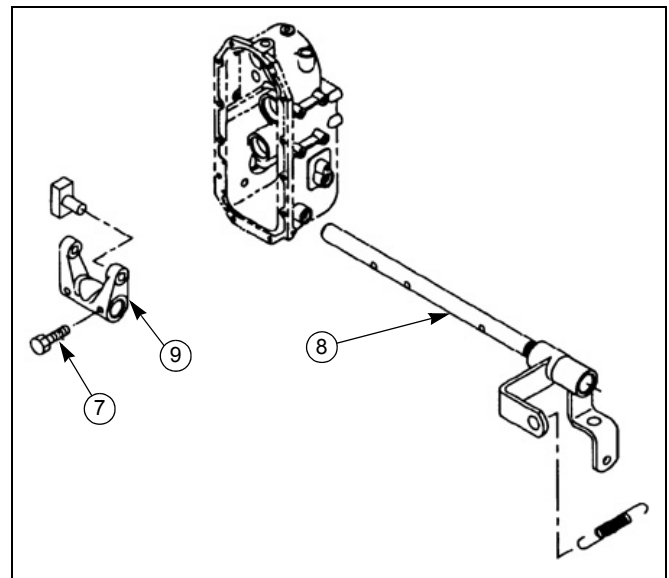


Figure 2-57

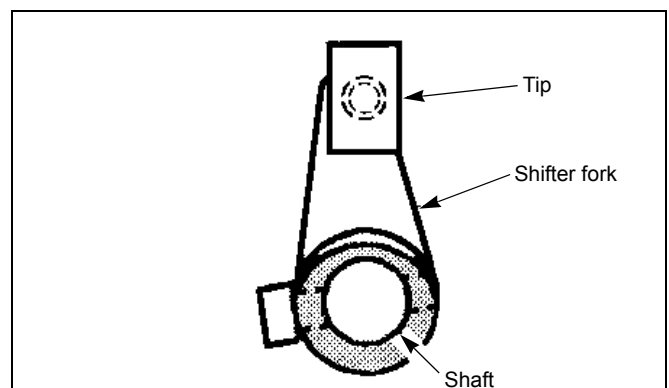


Figure 2-58

PTO Clutch Unit

A. Disassembly

Remove the PTO clutch assembly. Refer to Chapter 2.

1. Remove the snap ring ①, back plate ②, disc plates ③ and separator plates ④.

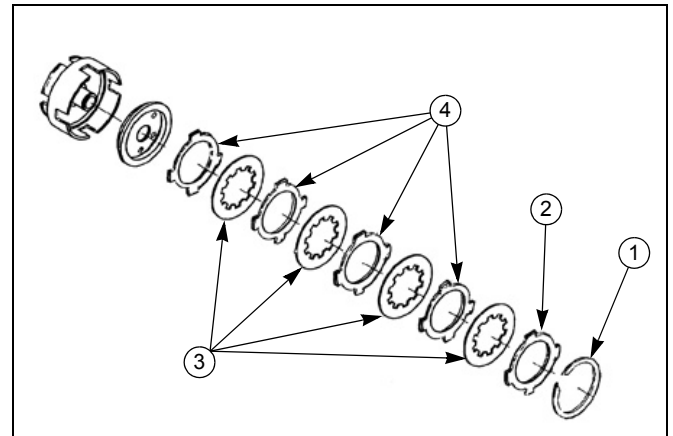


Figure 2-59

2. Press the washer ⑤ with a jig and remove the snap ring ⑥.
3. Release the washer ⑤ and remove the jig, washer and spring ⑦.

NOTE: The spring is installed under the washer. Use care when removing the snap ring as the spring will be expelled with considerable force when released. Cover the PTO clutch with a shop towel to contain the spring while removing the snap ring.

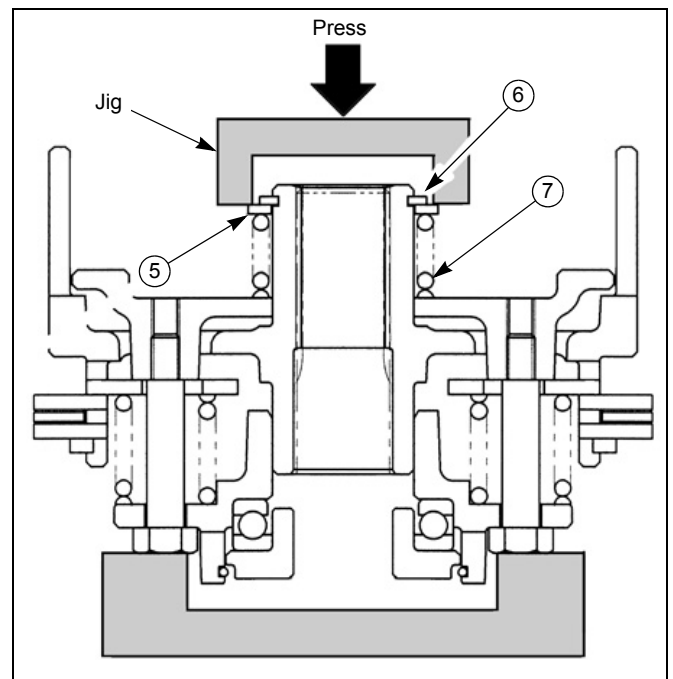


Figure 2-60

4. Press the clutch lifter ⑧, and remove the snap ring ⑪.

NOTE: Never remove the six bolts ⑯ Figure 2-62, because they will be broken by fixed them thread sealant.

NOTE: The six bolts ⑯ holding the assembly together cannot be removed. Loc-Tite was applied to them during assembly. Attempting to remove them will result in the bolts twisting off.

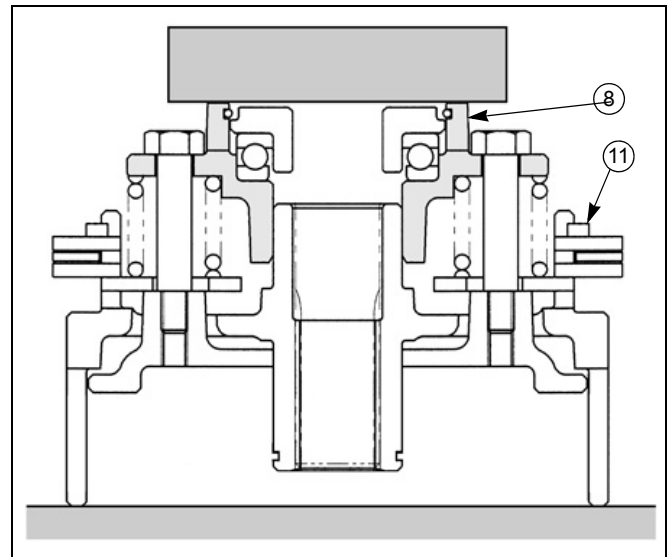


Figure 2-61

5. Remove the pressure plates ⑫ and ⑬, and brake disc ⑭, from the housing.

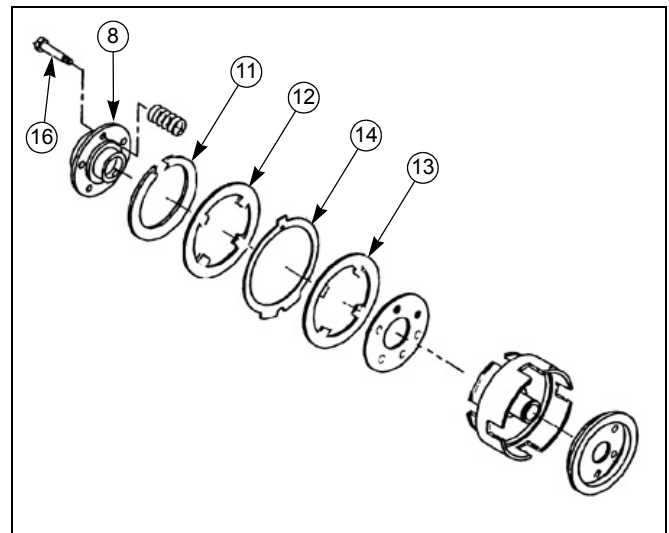


Figure 2-62

6. Remove the stop ring ⑯, release hub ⑰, and release bearing ⑱, from the clutch lifter ⑧.

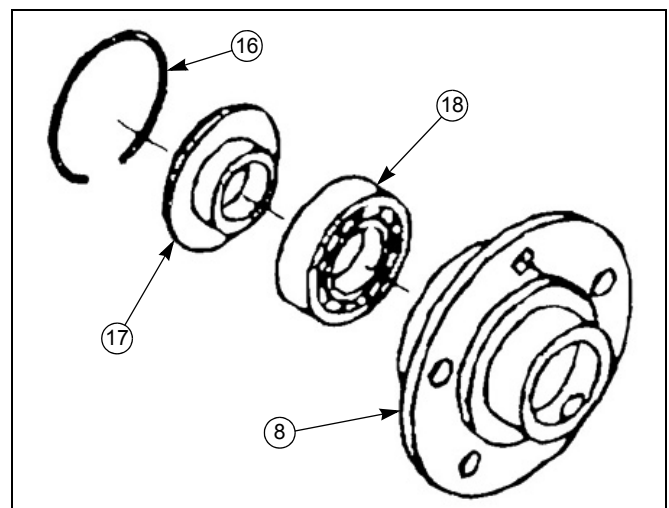


Figure 2-63

B. Inspection

1. Wash all parts in a suitable solvent and air dry.
2. Inspect the separator plates, disc plates and brake disc thickness for any damage. If either is defective, replace the PTO clutch assembly.

	Standard	Wear Limit
Disc Plate Thickness	.079 in. (2.0 mm)	.055 in. (1.4 mm)
Brake Disc Thickness	.118 in. (3.0 mm)	.087 in. (2.2 mm)

C. Assembly

Prior to assembly coat the parts with clean hydraulic oil.

Assembly of the PTO clutch generally follows disassembly procedures in reverse, however, the following must be observed:

1. When installing the snap ring, make sure it's gap is not in the housing's groove.

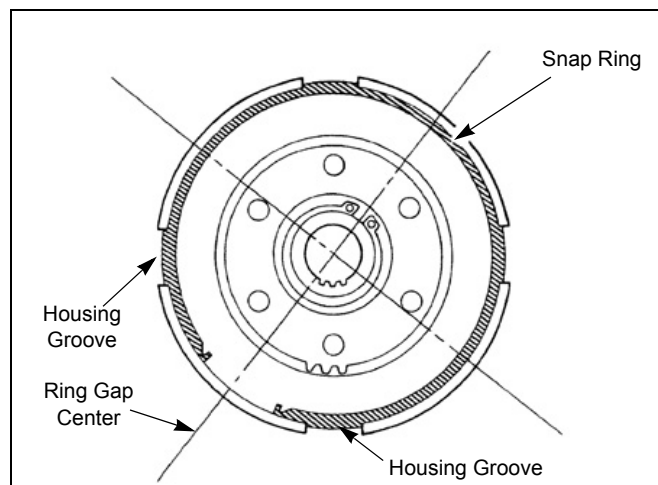


Figure 2-64

2. When installing the snap ring ⑪, for brake disc, make sure it's gap position is as shown in Figure 2-65.

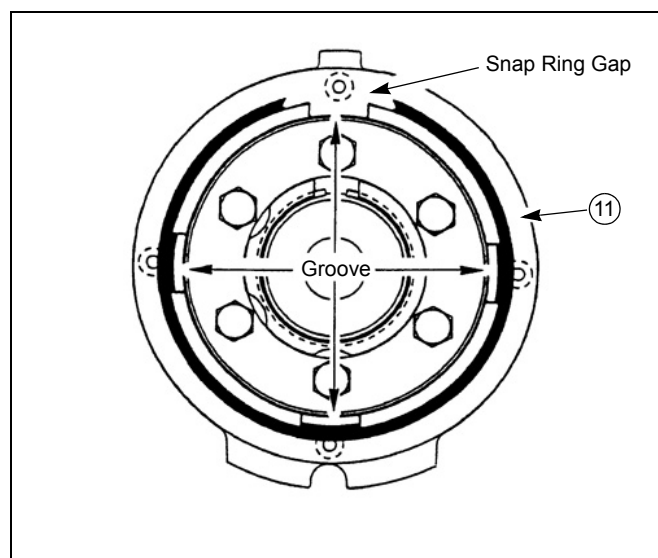


Figure 2-65

3. The thrust bearing must be installed in the following order:
The small inside diameter race is installed on the release hub ⑰, and the large inside diameter race is installed in the clutch lifter ⑧.

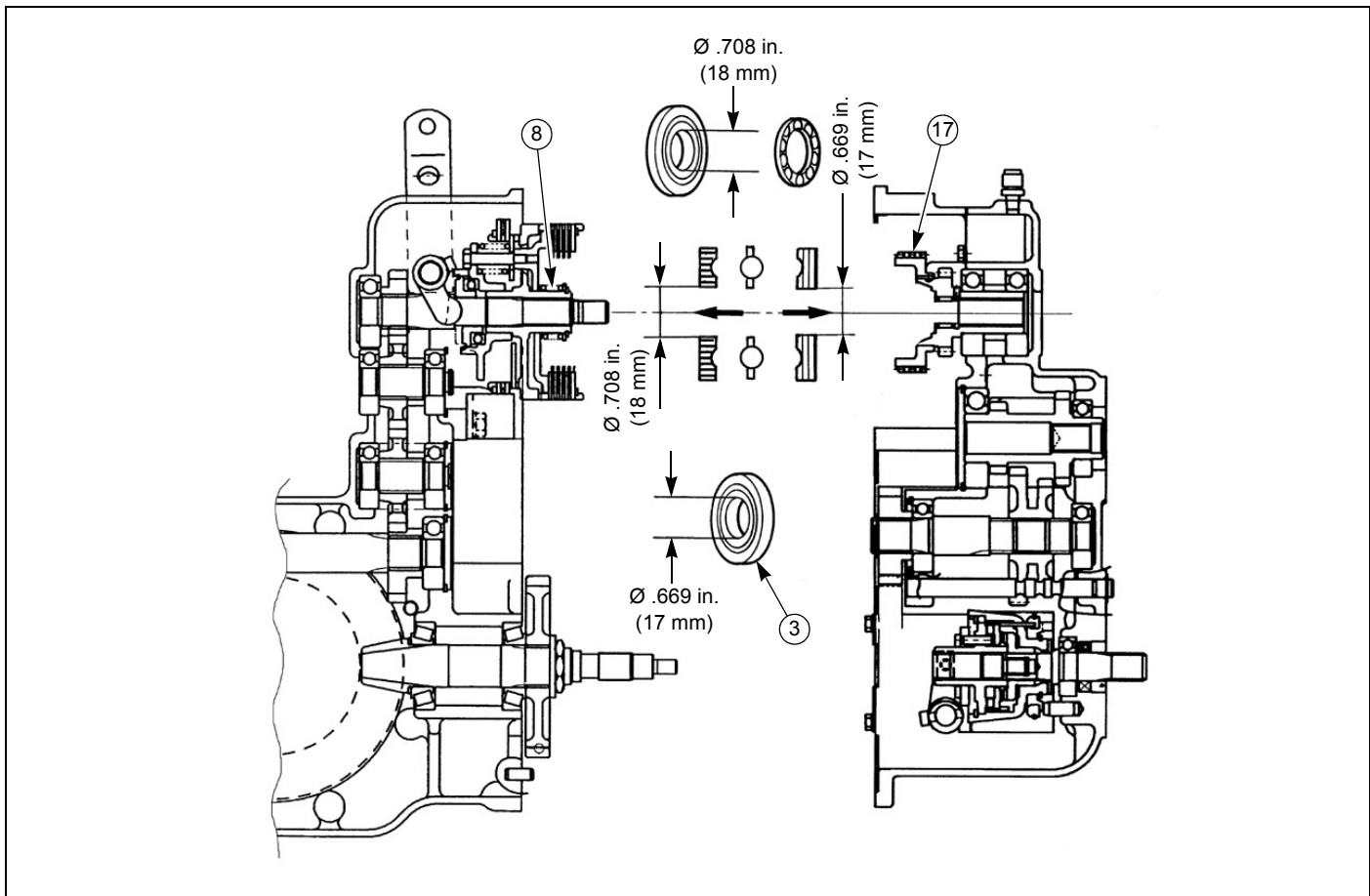


Figure 2-66

Front Wheel Shaft and Brake Unit

A. Disassembly

1. Remove the brake discs ①, stators ②, and the anchor pin ⑥ from in the housing.
2. Remove the springs ③ and brake disc ④ in order to take out the steel balls ⑤.
3. Remove the snap ring ⑦ and pull the brake cam ⑧ out of the housing.

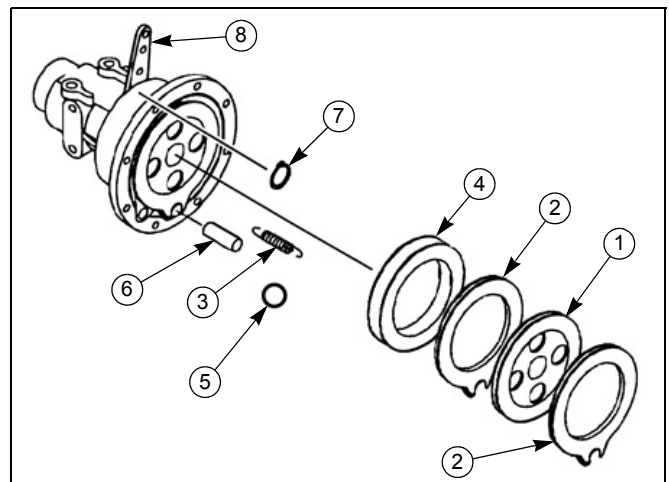


Figure 2-67

4. Remove the snap ring ① and drive the wheel shaft ② out of the wheel shaft housing.
5. Remove bearings ③ and ④ and oil seal ⑤ from wheel shaft housing.

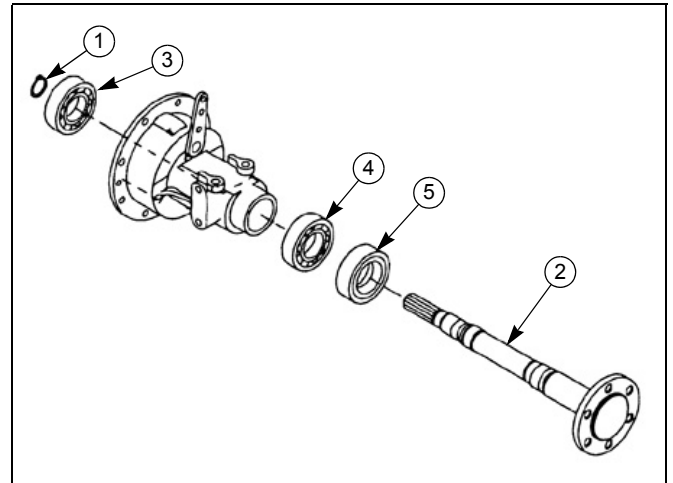


Figure 2-68

6. Drive out the roll pin ① and pull the diff-lock shaft ② out of the bearing holder (L.H.) ③.
7. Remove the spring ④, diff-lock fork ⑤, and diff-lock clutch ⑥ from the bearing holder.

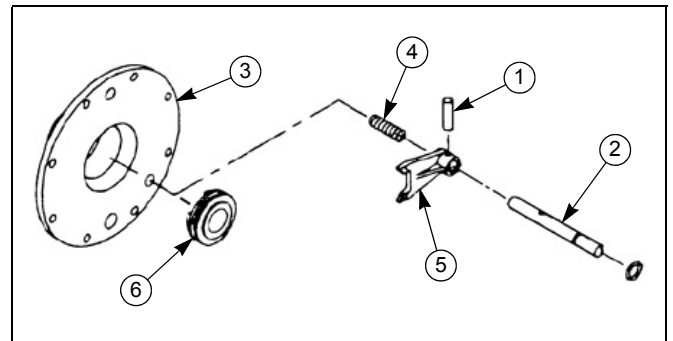


Figure 2-69

B. Inspection

1. Inspect the brake discs for excess wear or damage.
 - a. Using a micrometer, measure the brake disc lining groove depth. Replace the brake disc if the lining groove depth is less than .004 in. (0.1 mm).

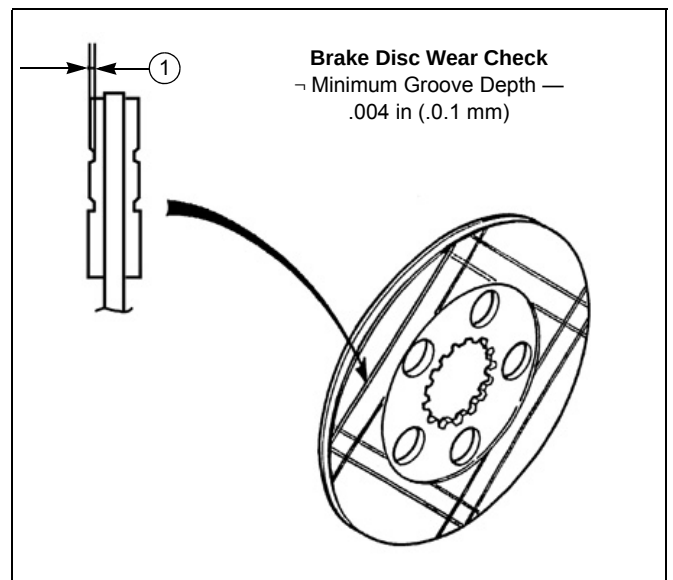


Figure 2-70

2. Inspect the stators for excess wear or damage.
 - a. Replace the stator if contact surfaces are scored or worn by the brake disc.
 - b. Using a micrometer, measure the level difference of the stator, and replace it if the level difference is more than .004 in. (0.1 mm).
3. Component Wear:
 - a. Check the brake cover, steel balls, actuating cam and springs, and replace any found abnormal.

C. Assembly

Reassembly generally follows the disassembly procedure in reverse.

During assembly observe the following:

1. Be sure all components are free of dirt and foreign matter and lubricate all components with clean hydraulic oil on assembly.
2. Install the oil seal at the steel face toward the outside.

D. Brake Adjustment

1. Check the brake pedal free travel and if necessary adjust the brake control rod to obtain 1.378 – 1.772 in. (35 – 45 mm) free travel at the pedal.

NOTE: Be sure to test drive the power unit to make sure the braking action on both wheels is equal. If necessary, adjust the outer brake rod to equalize the free-play travel.

2. Tighten the clevis locknuts securely.

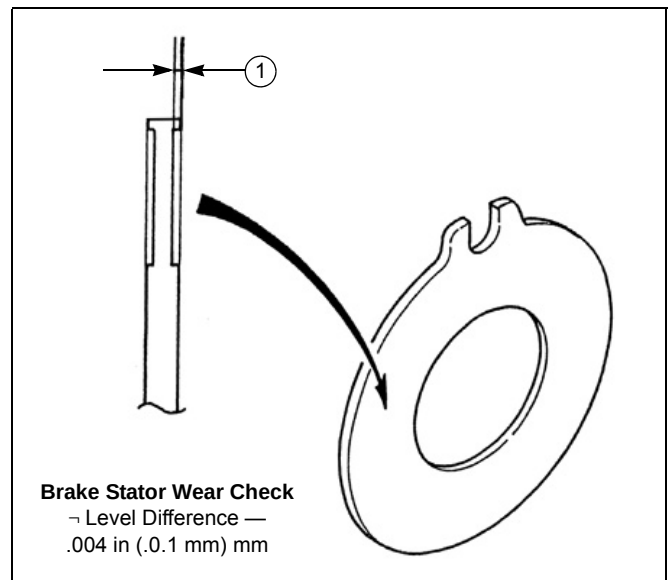


Figure 2-71

Two Way Clutch Unit (SENSITRACK DISASSEMBLY)

A. Disassembly

Reference – Figure 2-72

1. If installed, remove the thrust washers ① and ②.
2. Remove the sleeve ③.
3. Remove the snap ring ④, drive cam ⑤, keeper pins ⑥, center cam ⑦, compression spring ⑧, driven cam ⑨, and thrust washer ⑩ from the two-way clutch ⑪.

B. Inspection and Repair

1. Inspect the shifter fork blocks. The blocks should be smooth and free of any nicks or scratches. Minor nicks or scratches can be removed using fine emory cloth on a flat surface.
2. Inspect the drive cam, center cam, and driven cam mating areas for excessive wear. Replace if found defective.
3. Inspect all thrust washers for excessive wear and replace if necessary.
4. Inspect the compression spring for distortion. Replace as required.

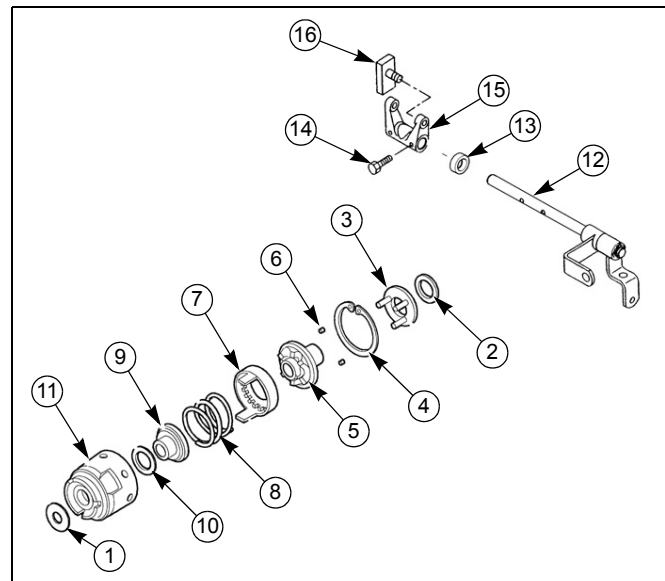


Figure 2-72

C. Assembly

Reference – Figure 2-72

1. Install thrust washer ⑩, driven cam ⑨, compression spring ⑧, and center cam ⑦ in the one-way clutch assembly housing ⑪.
2. Install the keeper pins ⑥ in their recess on both sides of the housing and insert the drive cam ⑤ into position.
3. Install the snap ring ④ so that the snap ring end gap is 90° from the keeper pins ⑥ as shown in Figure 2-73.
4. Install the sleeve ③ and thrust washers ① and ②.

Differential Gear Unit

A. Disassembly

Reference – Figure 2-74

1. Remove the bearing ① and shims ②.
2. Remove the ring gear tightening bolts ⑭ and ring gear ⑫.
3. Take out the thrust washer ④ and differential gear ⑤.
4. Remove the dowel pins ⑩ and pinion shafts ⑦ and ⑧.
5. Take out the pinion gears ⑥, thrust washers ③, joint ⑪, differential gear ⑤, and thrust washer ④.

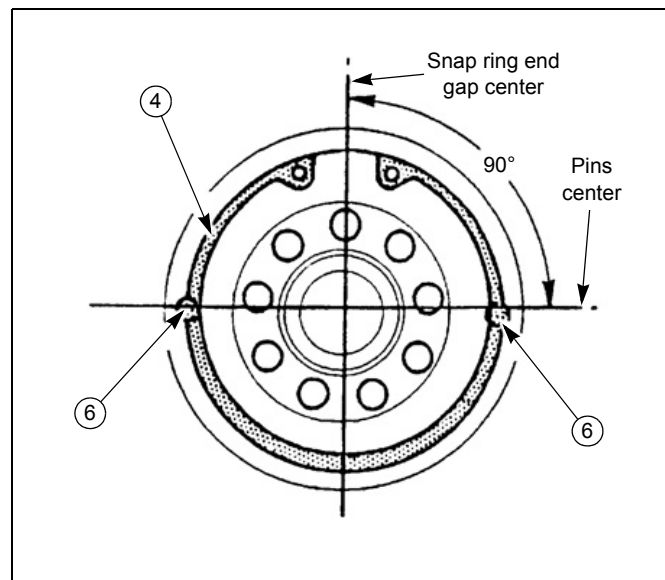


Figure 2-73

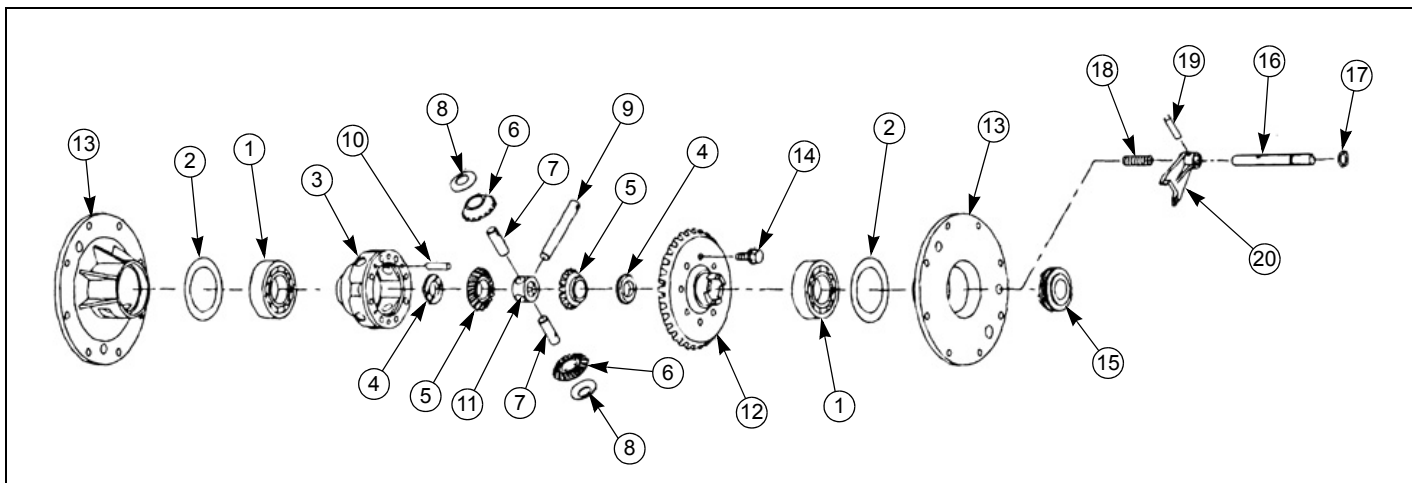


Figure 2-74

Differential Gear Case Disassembly			
1. Ball Bearing	6. Gear	11. Joint	16. Diff-Lock Shaft
2. Shim	7. Pinion Shaft	12. Ring Gear	17. O-ring
3. Differential Housing	8. Thrust Washer	13. Bearing Holder	18. Spring
4. Thrust Washer	9. Pinion Shaft	14. Bolt	19. Roll Pin
5. Differential Gear (Side Gear)	10. Dowel Pin	15. Differential Lock Clutch	20. Shifter Fork

B. Inspection

1. Inspect gear teeth for excessive wear or damage.
2. Measure the thickness of the differential gear thrust washers. Replace washers that exceed the minimum thickness. See "Specifications".
3. Inspect the differential pinion shaft and gears for excessive wear. See "Specifications".
4. Inspect the drive pinion to ring gear tooth wear pattern. See Figure 2-81, for wear indications and shimming adjustments.
5. Inspect the bearings for excessive wear or binding when rotated by hand.

C. Assembly

NOTE: When the drive pinion and ring gear are reused, assemble using the same shims as removed. When the drive pinion and ring gear are replaced, adjust the shims as described below. The ring gear and pinion are serviced only as a matched set and must be replaced together.

If the drive pinion and ring gear are replaced:

The drive pinion and ring gear are identified by an assembly number which is stamped into the end of the drive pinion gear and on the circumference of the ring gear. In addition, a "Value of Error" number is also stamped into the end of the pinion gear.

The tolerance value is not stamped when the tolerance is zero. This number is prefixed with a (+) or (-) to indicate the amount of error from zero adjustment. If the value of error is greater on the new pinion than on the old pinion, additional shims will be required. If the value of error is less on the new pinion than on the old pinion, the number of shims must be decreased.

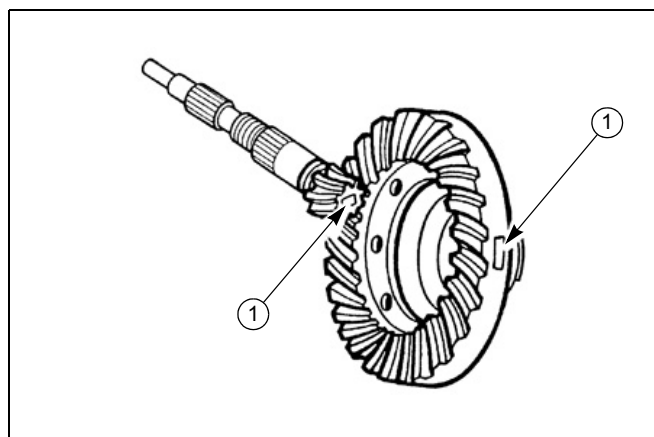


Figure 2-75

1. Assembly number and tolerance "Value of Error" number

Example:

Replaced pinion -0.008 in. (-0.2 mm)
New pinion ±0.0 in. (±0.0 mm)
-0.008 in. (-0.2 mm) + 0.0 in. (mm) = -0.008 in. (-0.2 mm)
Decrease the shims by .008 in. (0.2 mm)

D. Differential Ring Gear and Pinion Assembly

1. Assemble the differential pinion shaft, pinion gears, thrust washers dowel pins and side gears as shown. Figure 2-74
2. Install the ring gear on the case and tighten new bolts and additional lock washers to the specified torque.
3. Bend the tabs to secure the bolts.
4. If removed, install the two drive pinion bearings in the housing.
5. Assemble the thrust washer, shims and pinion shaft front bearing on the shaft. Insert the pinion shaft into the housing from the front while installing the rear bearing, fixed gear, washer and lock nut as shown.

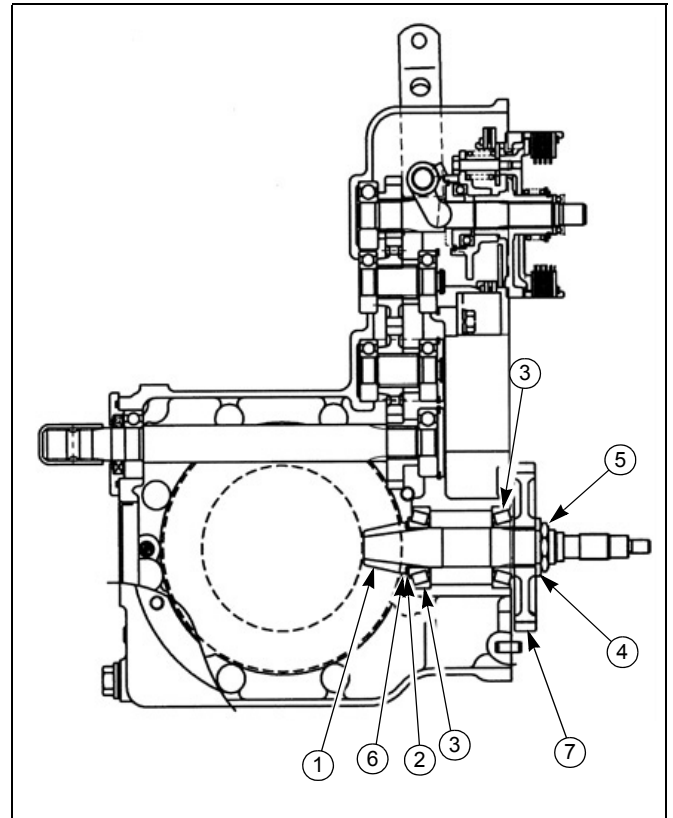


Figure 2-76

Differential Pinion Assembly (Four Wheel Drive Shown)	
1. Pinion Gear	5. Locknut
2. Shims	6. Thrust Washer
3. Bearings	7. Fixed Gear
4. Washer	

6. Adjust the pinion bearing pre-load using a strong cord wrapped around the pinion shaft and a pull scale. Tighten the pinion nut to obtain the specified pounds of constant pull to rotate the pinion assembly.
Tighten the locknut and crimp it at the ditch of the pinion shaft.

Pinion Bearing Pre-Load Constant Pull
44 lbf (196 N)

- NOTE:** Turn drive pinion several times by hand before performing pull scale test.

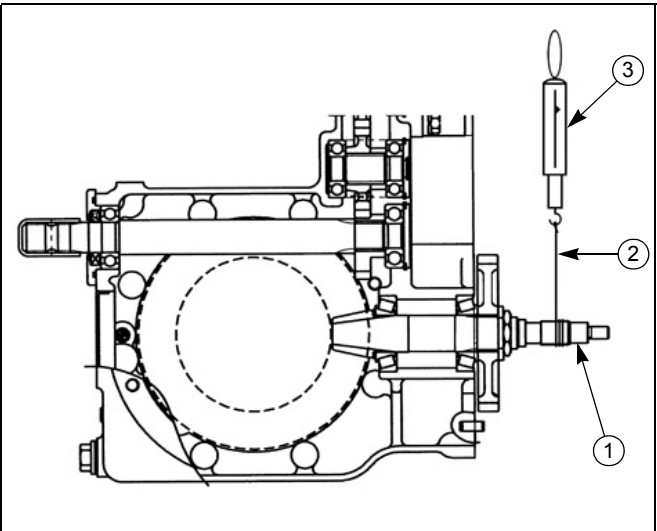


Figure 2-77

Pinion Pre-Load Adjustment	
1. Pinion Shaft	3. Pull Scale
2. String	

7. Attach the right hand bearing carrier ① and wheel shaft assembly ② to the front transmission housing.
8. Position the differential assembly ③ in the housing.

- NOTE:** When installing the original components, use the same quantity and thickness shims on each side as removed during disassembly.

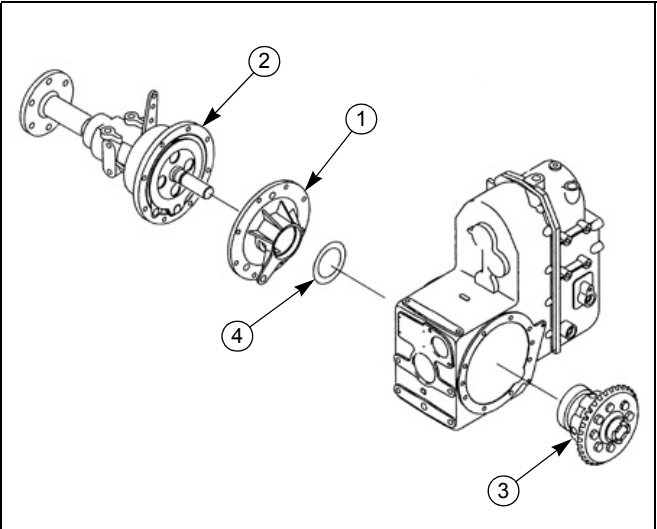


Figure 2-78

1. Pinion Shaft	3. Differential Assembly
2. String	4. Shims

9. Install the bearing ①, fixed gear ②, PTO shaft ③, and bearing ④ into the housing.
10. Install the seal cover ⑤, oil seal ⑥, and O-Ring ⑦, into the housing.

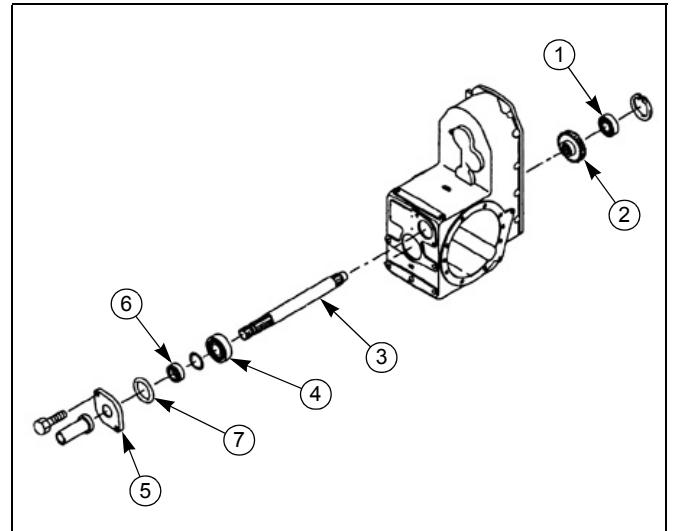


Figure 2-79

1. Bearing	4. Bearing
2. Fixed Gear	5. Seal Cover
3. PTO Shaft	6. Oil Seal
	7. O-Ring

11. Install the left hand bearing carrier ①, differential clutch ②, and fork ③, as a set.
12. Install the wheel shaft assembly.

NOTE: Make sure the brake stator falls easily into place.

If new differential components are used, adjust the backlash and ring gear contact pattern as follows:

Place a dial indicator gauge at a right angle to the top of the ring gear teeth, Figure 376X from the hole of the seal cover. Rock the ring gear back and forth and observe the dial indicator reading.

Adjust the shims to obtain the correct backlash.
See “Specifications.”

Using Prussian blue on the pinion gear teeth, rotate the pinion gear and check the gear tooth pattern. Adjust the differential and pinion shims to obtain the correct tooth contact.

13. Install the seal cover into the housing after inspecting the ring gear backlash.
14. Complete the assembly and installation following the disassembly and removal procedure in reverse.

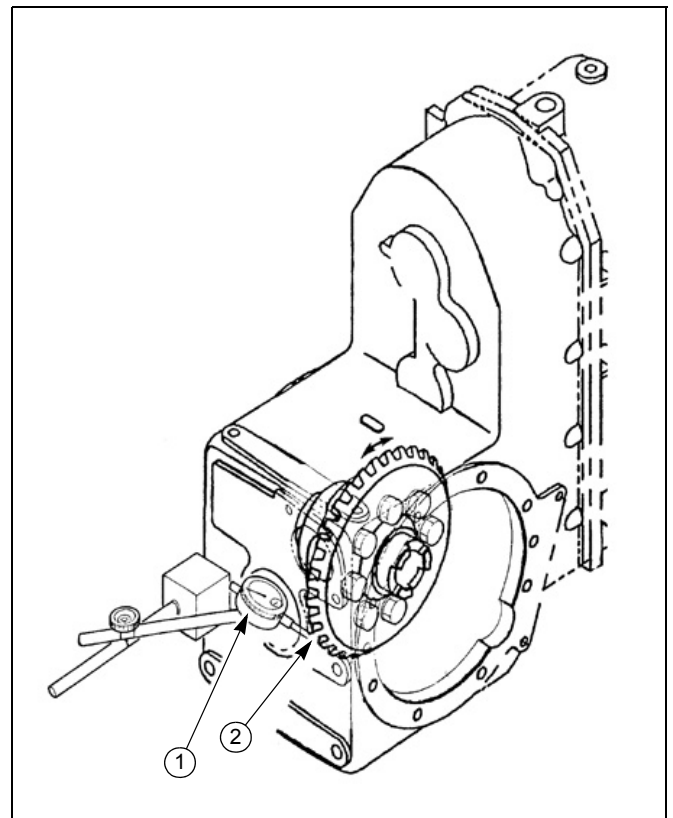


Figure 2-80

1. Dial Indicator	2. Ring Gear
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Ring Gear and Pinon Gear Pattern Specification and Adjustment

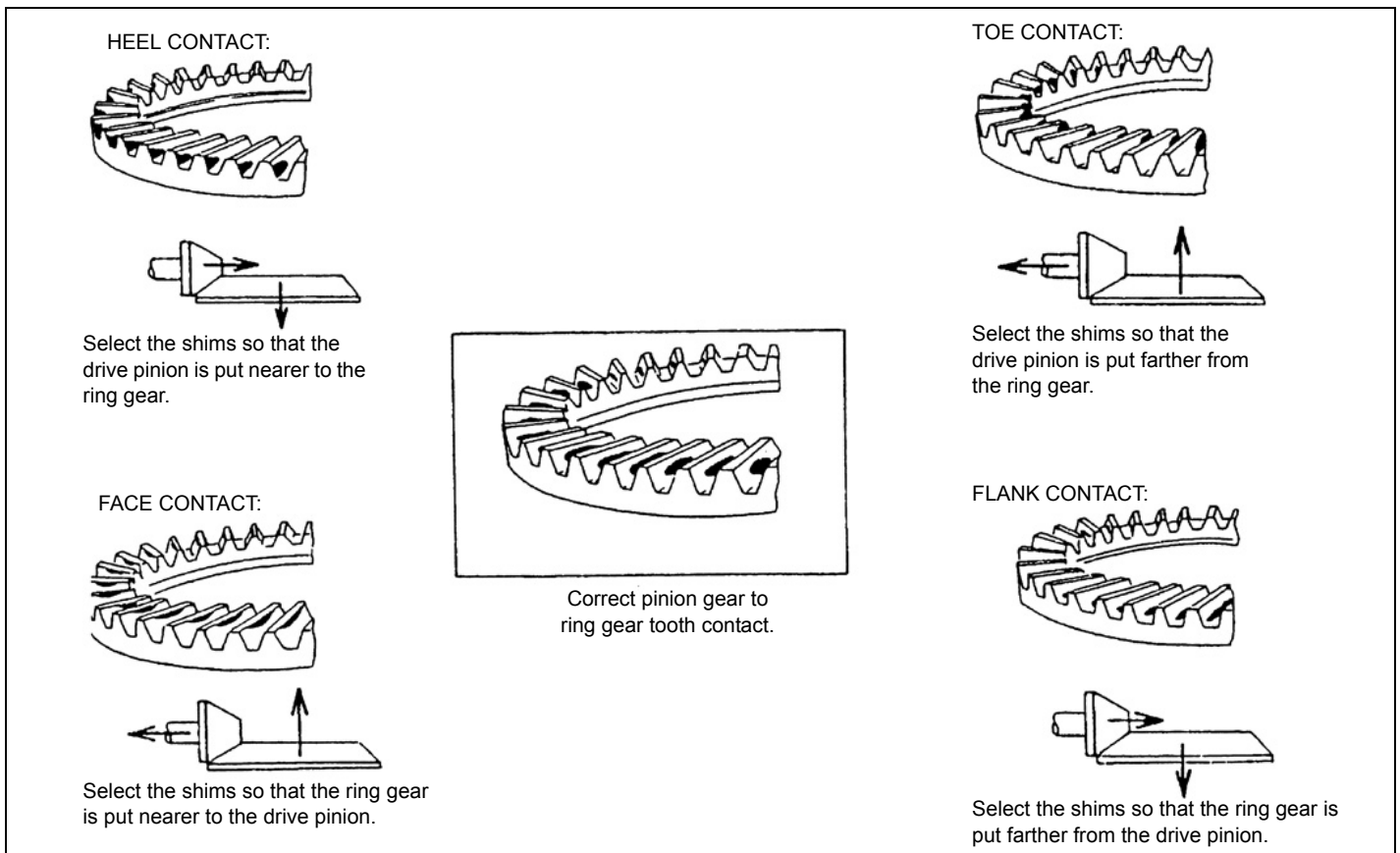


Figure 2-81

E. 4WD Control Spring

If the spring from the 4WD change lever is removed, make sure the spring is hooked in the correct directions and position as shown in Figure 378x. Incorrect assembly will prevent the two way clutch from operating properly. Use care to hook the spring at the correct direction and position as shown Figure 2-82.

If not attached properly, the spring, will not work properly with the two way clutch assembly.

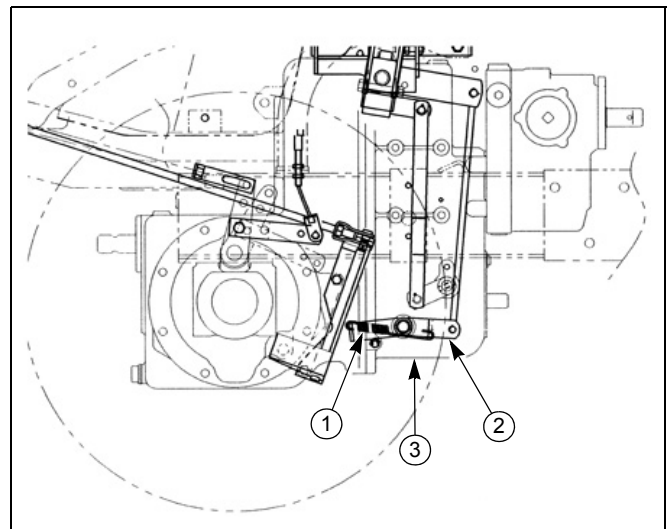


Figure 2-82

- | | |
|---------------------|--------------------------|
| 1. Spring | 3. Transmission Assembly |
| 2. 4WD Change Lever | |

Chapter 3

HST SYSTEM

Oil Flow

A. Neutral Position

Fluid drawn from the transmission reservoir ⑪ is pressurized by the rotor type charge pump ①. The fluid flows from the charge pump through the power steering control valve ④, the filter ③, the feed (check) valve ⑨ and ⑤, returns to the sump through the charge pump relief valve ⑦. The charge pump relief valve maintains 71.07 psi (0.49 MPa) pressure to the feed (check) valves 5 and 9, at all times. Fluid flowing past the feed (check) valves pressurizes passages “A” and “B” the pump ⑩, and motor ⑥ cylinder blocks. Equal pressures in passages “A” and “B” keep the motor from rotating.

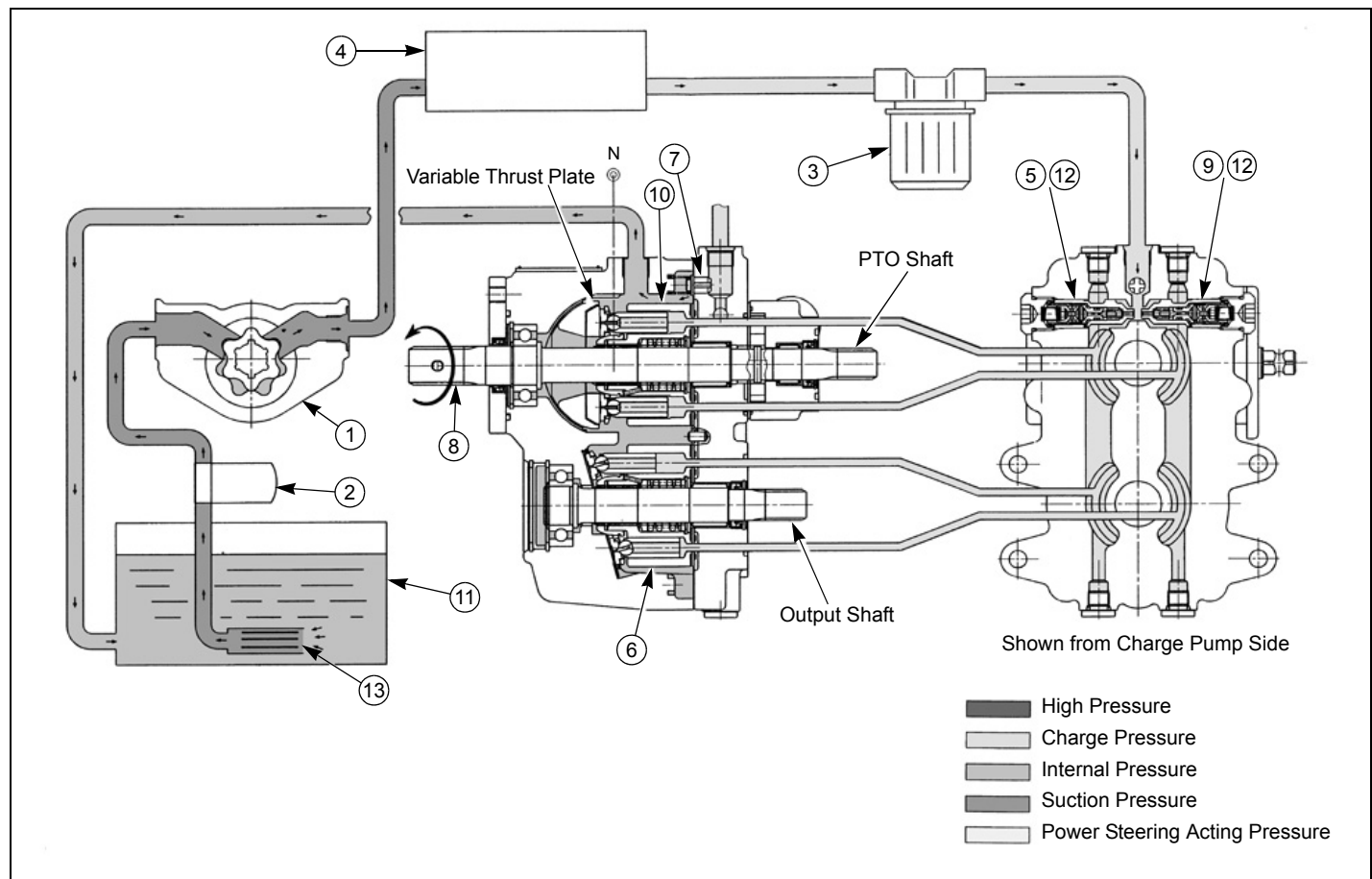


Figure 3-1

1. Charge Pump	8. Input Shaft
2. Filter	9. Feed (Check) Valve “A”
3. Filter	10. Hydrostatic Pump
4. Power Steering Control Valve	11. Reservoir
5. Feed (Check) Valve “B”	12. High Pressure Relief Valve
6. Hydrostatic Motor	13. Magnet
7. Charge Pump Relief Valve	

B. Forward Position

When the foot pedal is shifted forward, the pump swash plate is tilted and a quantity of fluid is discharged from the piston pump ⑩ into passage “A”. Pump pressure on the back of the feed (check) valve ⑨ closes the feed (check) valve and all fluid flow from passage “A” flows to the hydrostatic motor ⑥ causing the motor to rotate. Fluid is discharged from the hydrostatic motor ⑥ at “A2” into passage “B2” then flows back to the hydrostatic pump ⑩ to complete the cycle. When fluid leakage in the sytem causes a drop in pressure on the suction passage “B” the feed (check) valve ⑤ opens and provides make-up fluid from the charge pump ①. Excess fluid from the charge pump ① is returned to the sump via the charge relief valve ⑦ when above 71.07 psi (0.49 MPa).

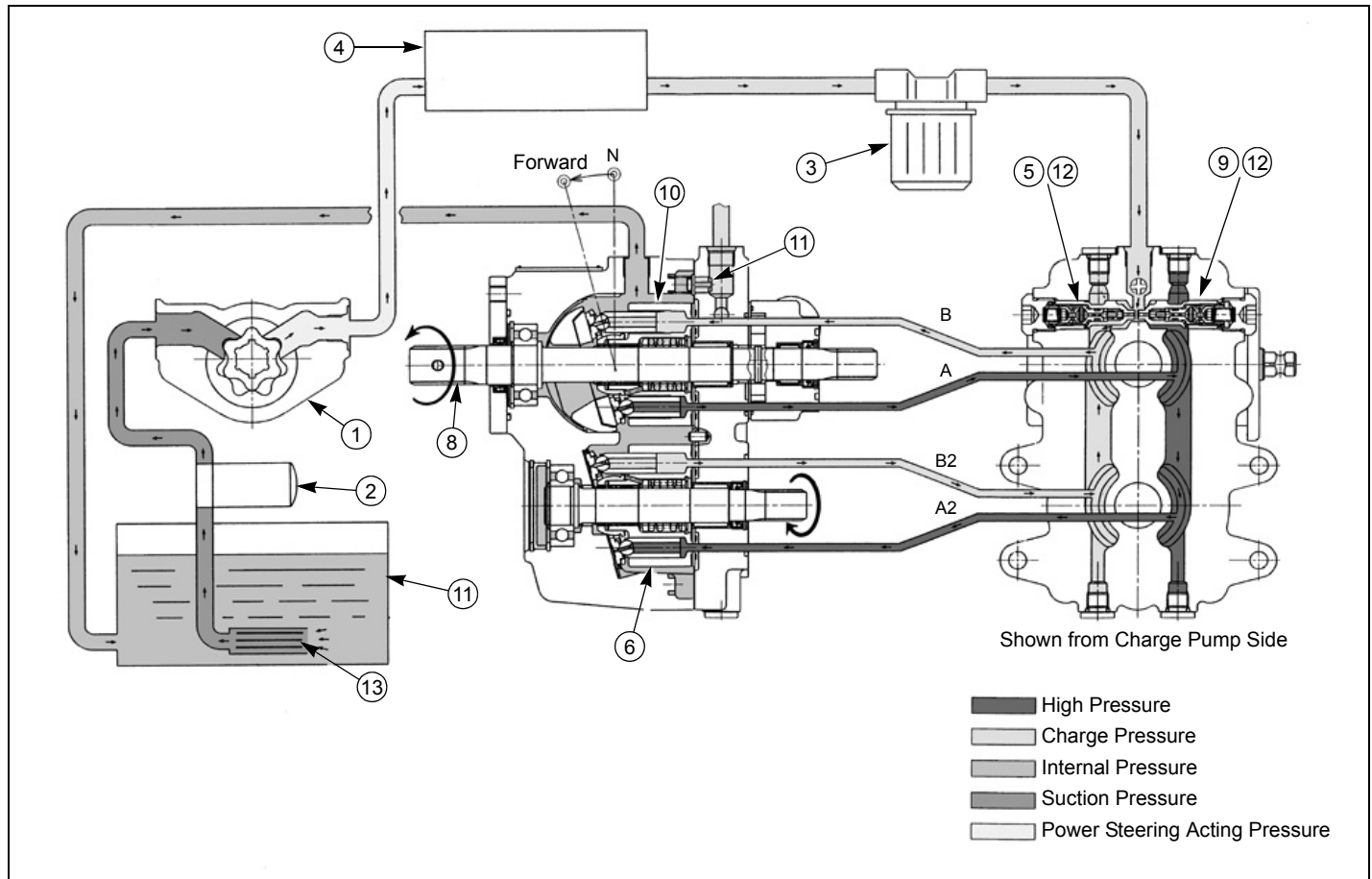


Figure 3-2

1. Charge Pump	8. Input Shaft
2. Filter	9. Feed (Check) Valve “A”
3. Filter	10. Hydrostatic Pump
4. Power Steering Control Valve	11. Reservoir
5. Feed (Check) Valve “B”	12. High Pressure Relief Valve
6. Hydrostatic Motor	13. Magnet
7. Charge Pump Relief Valve	

C. Reverse Position

When the foot pedal is shifted rearward, the pump swash plate is tilted in the opposite direction and a quantity of fluid is discharged from the piston pump ⑩ into passage “B”. When the foot pedal is shifted further rearward, more fluid flows from the piston pump through passage “B”. Pump pressure on the back of feed (check) valve ⑤, closes the feed (check) valve and all fluid flows from passage “B” to the hydrostatic motor ⑥ causing the motor to rotate in the reverse direction. Fluid is discharged from the hydrostatic motor ⑥ at “A2” into passage “A”. Fluid then flows back to the hydrostatic pump ⑩ to complete the cycle.

When fluid leakage in the system causes a drop in pressure on the suction passage “A” the feed (check) valve ⑨ opens and provides make-up fluid from the charge pump ①.

Excess fluid from the charge pump ① is returned to the sump ⑪ via the charge relief valve when above 71.07 psi (0.49 MPa).

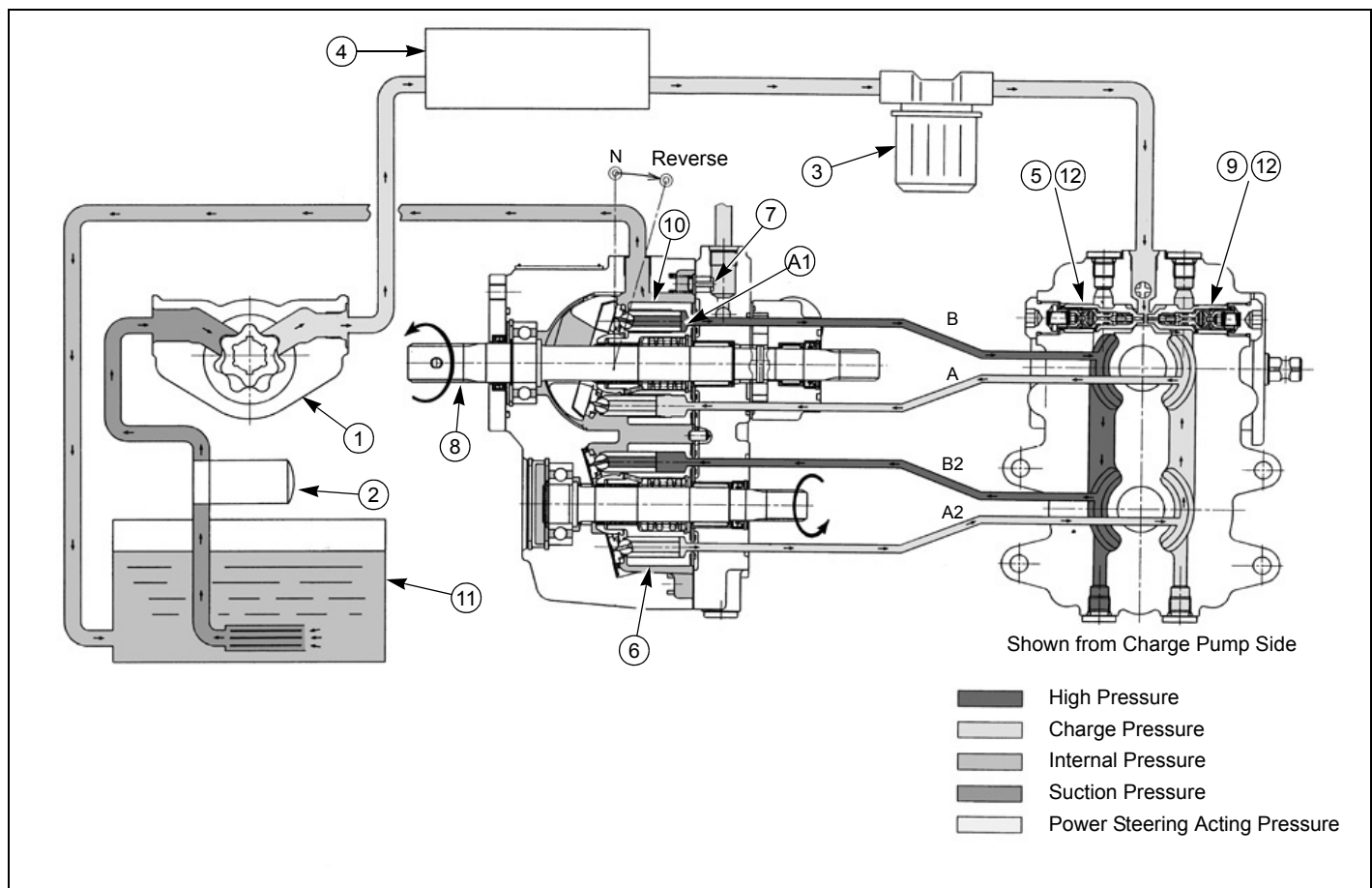


Figure 3-3

1. Charge Pump	7. Charge Pump Relief Valve
2. Filter	8. Input Shaft
3. Filter	9. Feed (Check) Valve “B”
4. Power Steering Control Valve	10. Hydrostatic Pump
5. Feed (Check) Valve “A”	11. Reservoir
6. Hydrostatic Motor	12. High Pressure Relief Valve

HST Unit Removal

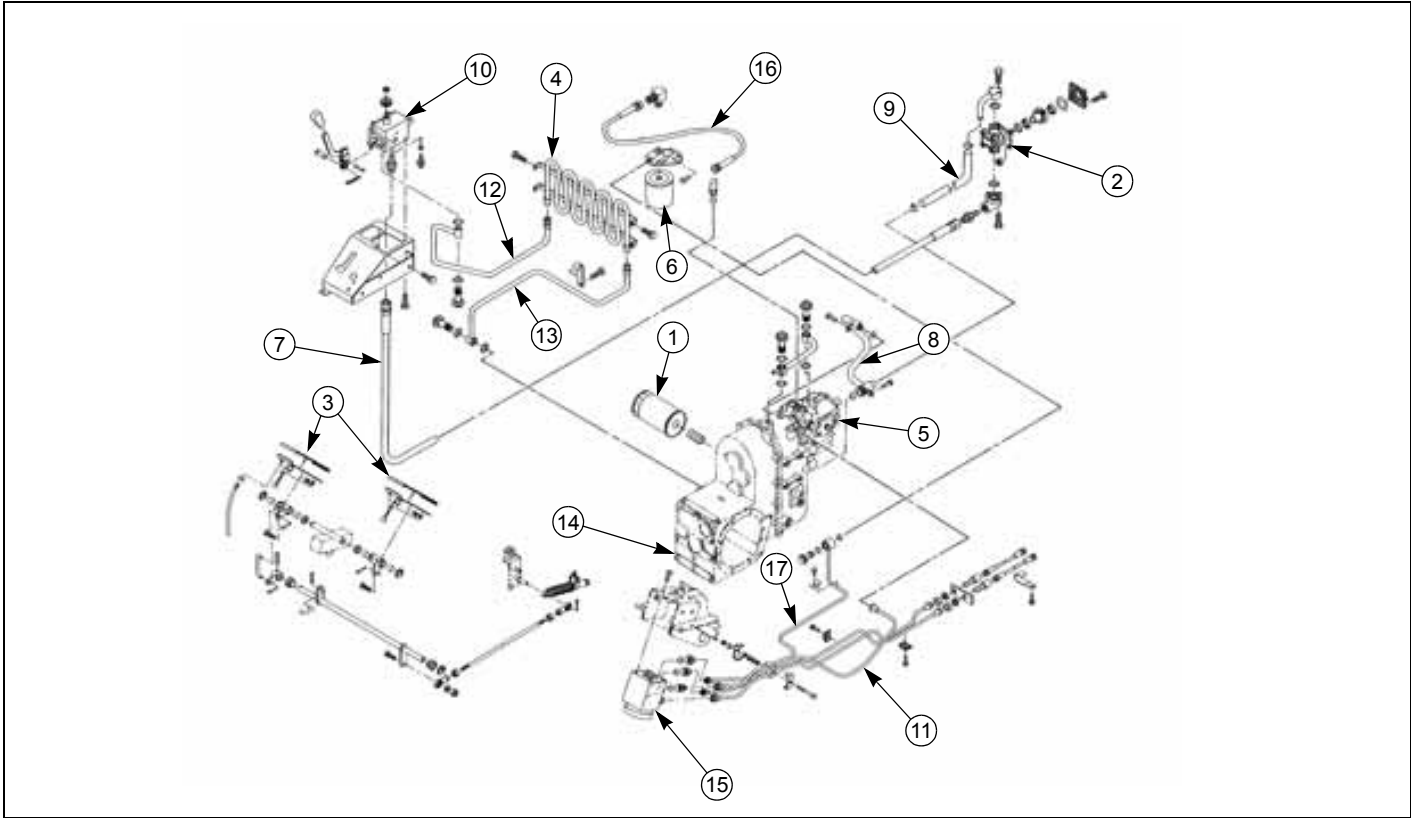


Figure 3-4

1. Suction Filter	7. HPL Supply Line	13. Cooler Return Line
2. Hydraulic Pump	8. Charge Pump Suction Line	14. HST Return to Sump
3. Foot Control Pedal	9. Hyd. Pump Supply Line	15. Power Steering Control Valve
4. Oil Cooler	10. Hyd. Control Valve	16. HST Supply Line (Hose)
5. HST Unit	11. Power Steering Supply Line	17. Power Steering Return Line
6. HST Filter	12. Cooler Supply Line	

Separate the HST unit from the transmission housing after removing the transmission assembly. Refer to “Chapter 3”, TRANSMISSION UNIT, A. Removal located in this manual.

NOTE: When separating the HST unit ① from the transmission housing, be careful not to lose the o-rings ② and ③.

NOTE: Drain the front axle (reservoir) via the front drain plug before attempting to remove the suction filter, suction pipe and hose, or the HST.

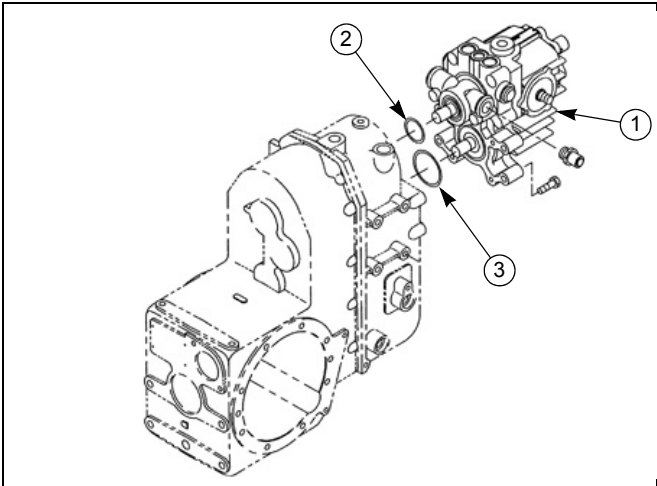


Figure 3-5

If removing the HST unit only from the power unit, refer to the following:

1. Remove the eye bolt and return oil pipe ① from the top of the HST unit.
2. Loosen the flare nut and disconnect the oil pipe ② from the charge pump to power steering control valve.
3. Use two wrenches, and disconnect the feed hose ③ from top of the HST unit.

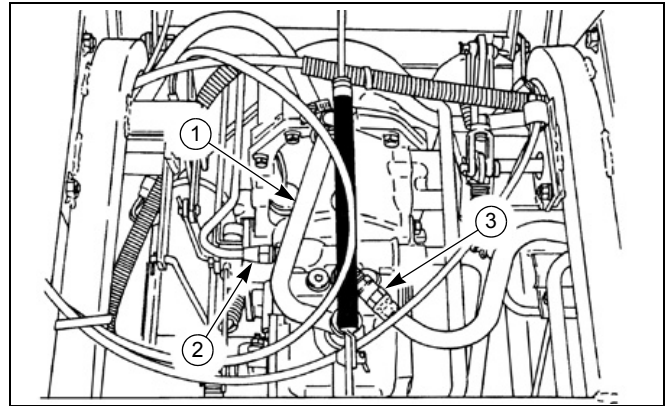


Figure 3-6

4. Remove the split pin, washer and disconnect the HST speed control rod ① from the HST control lever.
5. Remove the U-nut, and remove the damper ② from the HST control lever.
6. Unhook the spring ③ from under the HST speed control lever.

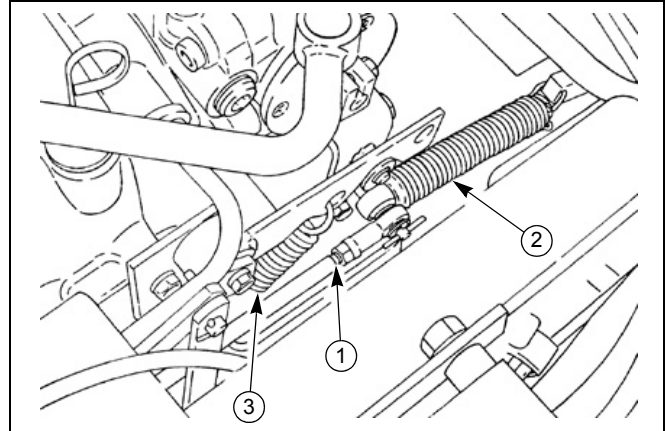


Figure 3-7

7. Disconnect the wire connector from the HST neutral switch ①.
8. Remove the two bolts ② and remove the HST shift guide ③ and shift arm ④ as a set.

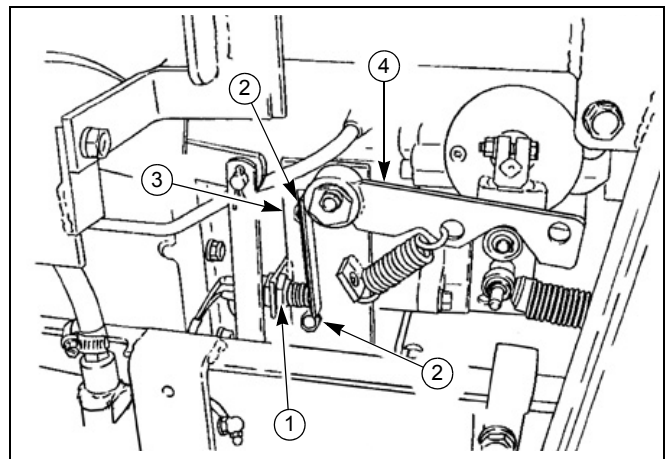


Figure 3-8

9. Remove the bolt ① from the universal joint ② and disconnect the joint from the HST input shaft by sliding the joint rearward.

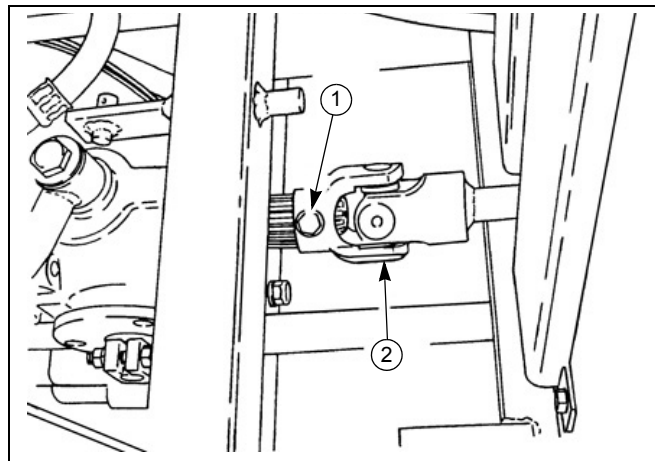


Figure 3-9

10. Remove the eye bolt and clamp ① for the oil cooler return pipe ② from the oil cooler.

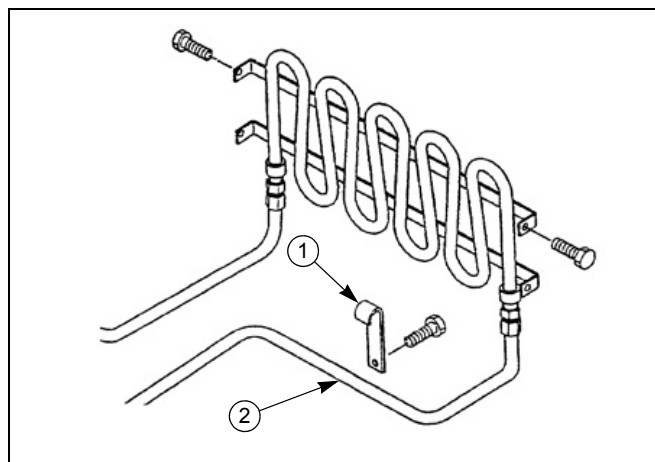


Figure 3-10

11. Loosen the hose clamp ③ and disconnect the suction hose ④ for the hydraulic oil pump.

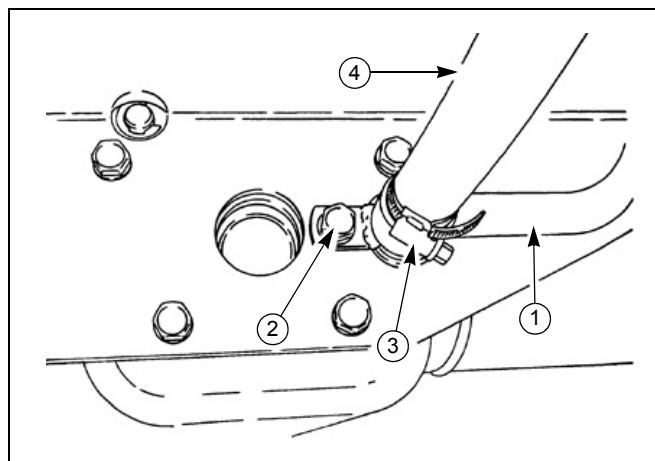


Figure 3-11

12. Remove the bolts ② and suction pipe ① from the HST unit and rear transmission housing.
13. Remove rear axle assembly, pipe and rear drive shaft, see “*REAR AXLE ASSEMBLY*” of Chapter 6.
14. Remove the rear frame from main frame and rear of transmission, see “*TRANSMISSION AND BRAKE*” of Chapter 3.
15. Install the special tool to HST return pipe attaching hole. Raise with hoist.

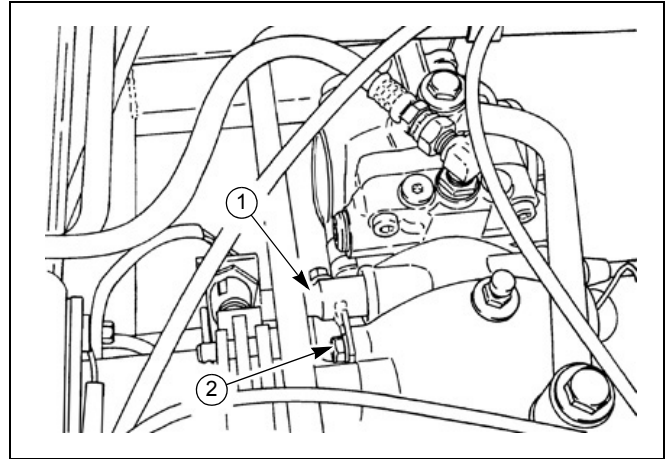


Figure 3-12

16. Remove the four bolts ① to remove the HST unit ② by sliding rearward and downward from the transmission housing.

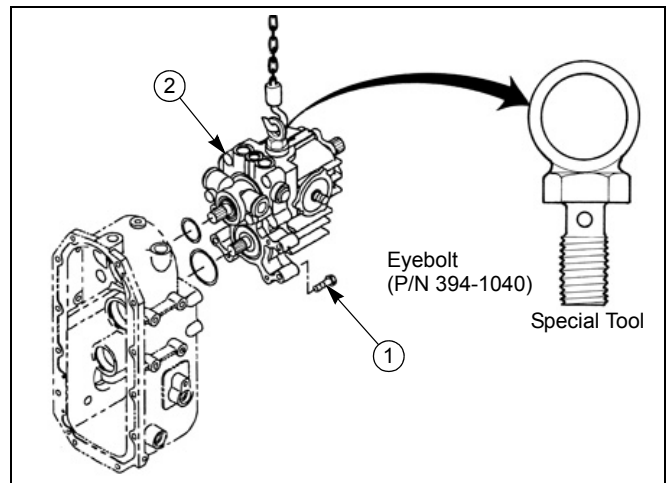


Figure 3-13

Precautions Before Disassembly

1. Thoroughly clean the HST unit and plug all openings to prevent contamination from foreign particles.
2. Maintain a clean work area so as not to contaminate or damage any of the HST components.
3. Handle the HST components with care so as to not scratch or otherwise cause damage to the parts.
4. Drain the oil from the HST unit before disassembly.

Disassembly
Reference – Figure 3-14

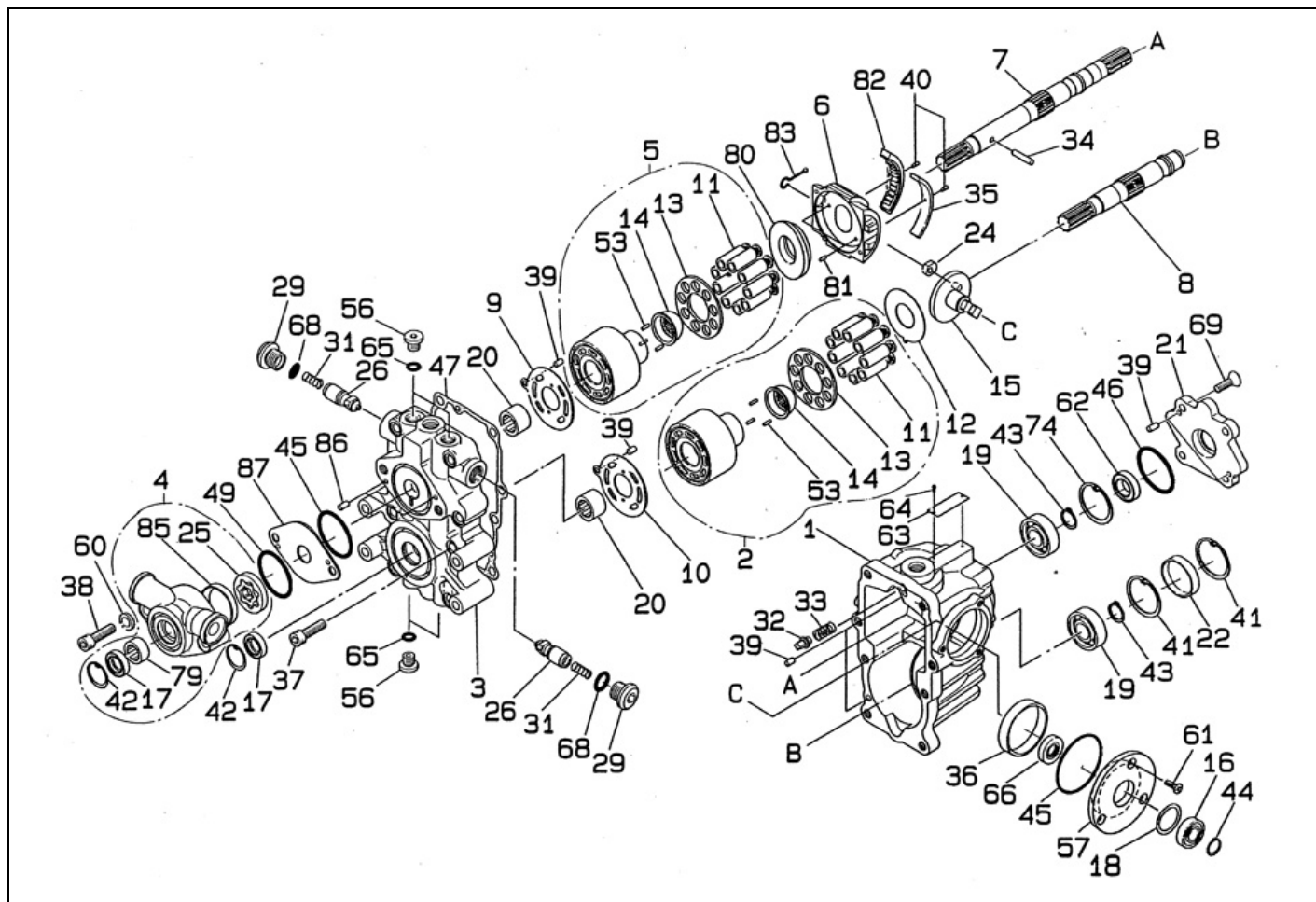


Figure 3-14

1. Remove the socket head bolts ③, charge pump case ④ and o-ring ④.
2. Remove the trochoid rotor assembly ⑤.
3. Remove the pin ④ from the drive shaft ⑦.
4. Remove the plate ⑦, o-ring ④, and pin ⑥, from the port block ③.
5. Remove the socket head bolts ⑦, port block ③, and gasket ④.

NOTE: Take care not to drop the valve plates ⑨ and ⑩.

6. Remove the valve plates ⑨ and ⑩ from the port block.
7. Remove the cylinder block assembly ⑤ from the pump.
8. Remove the cylinder block assembly ② from the motor.
9. Remove the swash plate ⑥ and take out the roller bearing ⑧, bushing ⑤ and slide metal ④.
10. Remove the thrust plate ⑩ from the pump swash plate ⑥.
11. Remove the thrust plate ⑫ for the motor in the housing.
12. Remove the screws ⑪ and trunnion cover ⑦ from the housing.
13. Remove the snap ring ④ and trunnion shaft ⑤ from the trunnion cover ⑦.
14. Remove the screws ⑨, cover ②, o-ring ④, and pins ③ from the housing.
15. Drive out the drive shaft (input shaft) ⑦, using soft jawed hammer.
16. Remove the snap ring ④, from the housing.
17. Drive a screw driver under the seal cover ②, and remove the cover using leverage. Discard the seal cover ②.
18. Remove the snap ring ④, from in the housing.
19. Drive out the transmission drive shaft (input shaft) ⑧, using a soft jawed hammer.
20. Remove the plugs ②, springs ③, check and relief valve assemblies ⑥, from the port block.

Inspection

A. Piston assembly

1. Replace the piston assembly if the play at the marked area as of the piston and shoe exceeds the service limit.

Standard assembling value	Service limit
.001 in (0.03 mm)	.004 in (0.1 mm)

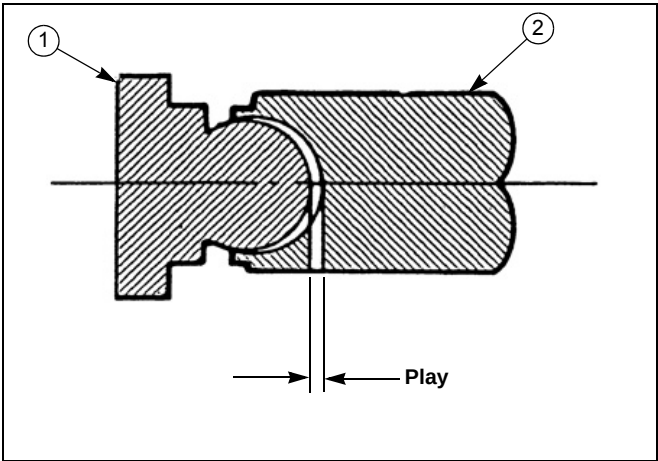


Figure 3-15

2. Replace the piston assembly if the clearance between the piston and cylinder block exceeds the service limit.

Standard assembling value	Service limit
.0007 in (0.02 mm)	.001 in (0.03 mm)

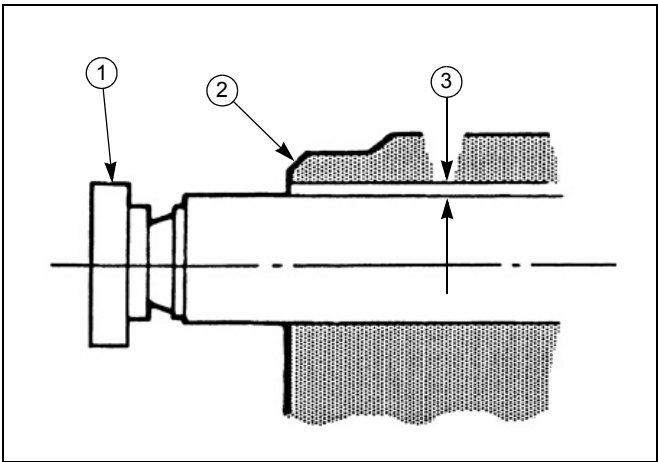


Figure 3-16

3. Replace the piston assembly if the shoe thickness is below the service limit.

Standard assembling value	Service limit
.118 in (3.00 mm)	.114 in (2.9 mm)

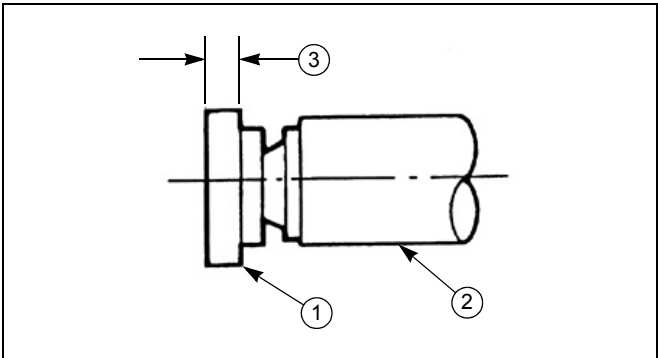


Figure 3-17

B. Charge pump assembly

1. Measure the side clearance of the trochoid rotor and replace if the service limit is exceeded.

Standard assembling value	Service limit
.001 in (0.025 mm)	.002 in (0.055 mm)

C. Lapping distance

1. Lapping distance should be less than 0.005 mm, if each sliding surface is damaged, correct by lapping. If the fault cannot correct by lapping, replace the parts.

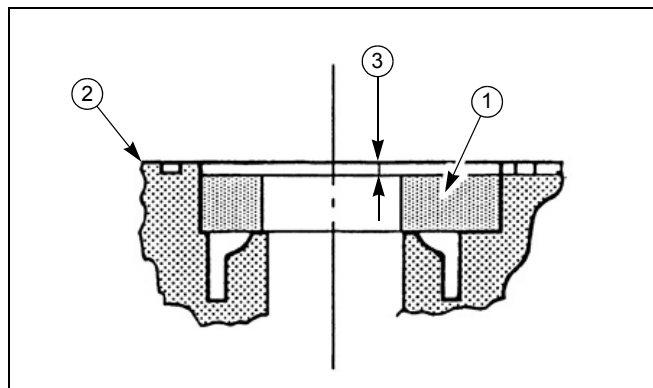


Figure 3-18

Reassembly

Before assembly refer to the following:

1. Be sure all components are thoroughly cleaned and well coated with clean transmission fluid.
2. Replace the oil seal, o-ring, gasket and seal cover with new seals and gaskets.
3. Apply the lithium grease to o-ring and seal lip of oil seal.
4. Tighten the screw and bolt to specified torque.

Assembly

Reference – Figure 3-14

1. If removed, install the bushing ③⑥ into the housing ①, to a depth of .421 in (10.7 mm) from the trunnion cover matching surface.
2. Install the input shaft as follows:
 - a. Install the bearing ①⑨, on the shaft ⑧, and secure with snap ring ④③.
 - b. Install the shaft ⑦, in the housing and secure with snap ring ⑦④.
3. Install the output shaft as follows:
 - a. Install the bearing ①⑨ on the output shaft ⑧ and secure with snap ring ④③.
 - b. Install the shaft ⑧ in the housing and secure with snap ring ④①.
 - c. Install the new case cover ②② in the housing ① and secure with snap ring ④①.
4. Install the cover as follows:
 - a. Install the o-ring ④⑥ and pins ③⑨ on the housing.
 - b. Install the oil seal ⑥② in the cover ②① and install them on the housing and tighten the bolts ⑥⑨ to 12.7 ft.-lbs. (17.2 Nm).
5. Install the thrust plate as follows:
 - a. Align the thrust plate's projection ①② for motor to housing's ditch.
6. Install the swash plate as follows:
 - a. Install the pins ④⑩ and bush ③⑤ and roller bearing ⑧② in the housing.
 - b. Install the swash plate sub-assembly (consist of swash plate ⑥, guide assembly ③③, pin ⑧① and thrust plate ⑧⑩) in the housing.

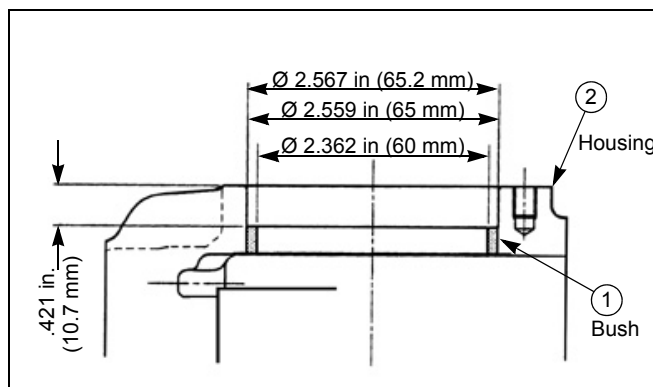


Figure 3-19

- c. Inspect the swash plate sub-assembly to assure it moves smoothly. If it does not, check the roller bearing position.
7. Install the cylinder block sub-assemblies ② and ⑤ in the housing as follows:
 - a. Apply transmission oil to the thrust plate contact surface.
 - b. The cylinder block for pump ②, is brass color of the cylinder block end and the cylinder block for motor ⑤ is the gray color of the cylinder block end.
8. Install the port block sub-assembly as follows:
 - a. Install the check and relief valve assemblies ②⑥ and springs ③① in the port block ③ and tighten the plugs ②⑨ to 47 ft.-lbs (63.7 Nm).
 - b. Install the high pressure relief valve check port's plug ⑤⑥ tighten to 22 ft.-lbs. (29.4 Nm).
 - c. Press in the oil seal ①⑦ to .118 in. (3mm) depth from the surface in the port block ③ and secure with snap ring ④②.
 - d. Install the needle bearings ②⑩ in the port block with the marked surface to outside, protruding .098 in. (2.5 mm) from the matching surface.
 - e. If removed, install the dowel pins on the housing.
 - f. Apply grease to the spring and install it in the housing.
 - g. Install the gasket ④⑦ on the housing.
 - h. Apply grease to the valve plates ⑨ and ⑩ and low pressure relief valve ③② to prevent slippage and install them to the port block.
 - i. The notch side (V shape ditch) of the pump valve plate ⑩, fits against the cylinder block assembly.
 - j. Place brass color surface of the motor valve plate ⑨ to against the cylinder block assembly.
 - k. Apply mission oil to the cylinder block contact surfaces and install the port block assembly ③ to the housing and tighten the bolts to 36 ± 3.69 ft.-lbs. (49.0 ± 5 Nm).

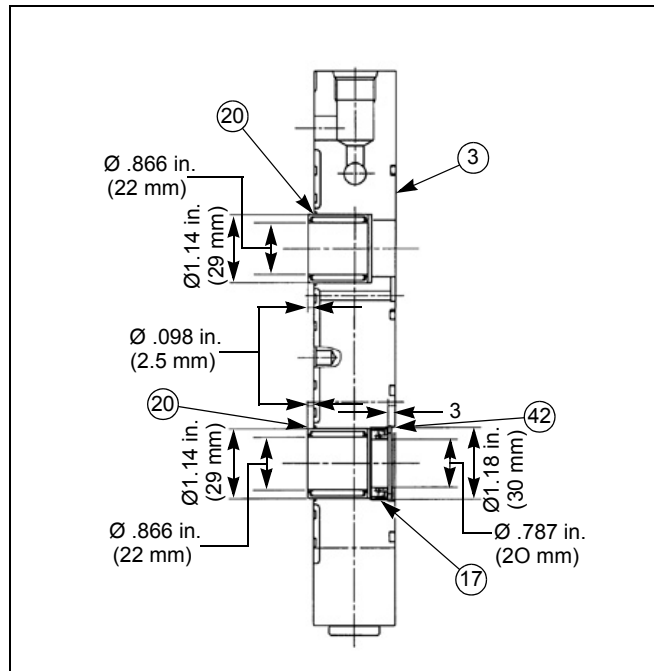


Figure 3-20

1. Port Block	20. Needle Bearing
17. Oil Seal	42. Snap Ring

9. Install the trunnion cover to the housing as follows:
 - a. Install the metal slide ②④ and position the pin hole against the port block in the direction of the swash plate sub assembly ⑥.
 - b. Install the bearing ①⑥ in the trunnion cover ⑤⑦.
 - c. Install the washer ①⑧ in the trunnion cover.
 - d. Install the oil seal ⑥⑥ in the housing to 1 mm depth from the cover surface.
 - e. Install the trunnion shaft ①⑤ in the cover and secure with snap ring ④④.
 - f. Install the trunnion cover sub-assembly and align the slide metal's hole to trunnion shaft's pin, and tighten the screw to $5 \pm .5$ ft.-lbs. (6.9 ± 0.7 Nm).

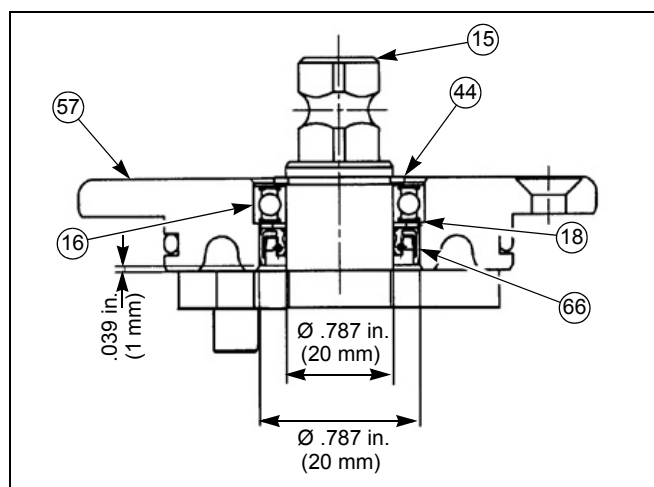


Figure 3-21

10. Install the charge pump as follows:
 - a. Install the o-ring and pins to the port block.
 - b. Install the plate ⑧ with the brass color surface against the charge pump.
 - c. Position the pin ③④ into the input shaft ⑦, and install the trochoid rotor sub-assembly ②⑤, on the input shaft by aligning the punch marks ① and pin center ②.
 - d. Install the new oil seal in the charge pump case and secure with snap ring.
 - e. Install the charge pump case sub assembly ④ by aligning the pins, and tighten the bolts to 36 ± 4 ft.-lbs. (49.0 ± 5 Nm).
11. Inspect both shafts ⑦ and ⑧ by rotating with an adjustable wrench. The shafts should rotate smoothly after assembly.

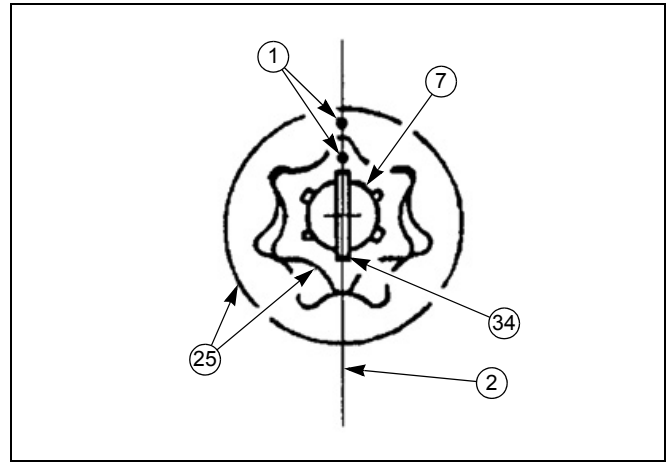


Figure 3-22

Adjustment

A. Link Adjustments

1. Neutral Position Adjustment
 - a. Jack the front and rear wheels off of the ground and place jack stands under the axles. Make sure all four wheels are clear of the ground and the commercial mower is properly supported.
 - b. Disconnect the wires from the seat neutral start switch and connect a jumper wire between the two harness leads. Apply the park brake and start the engine, release the park brake.
 - c. Set the throttle at low speed and place the range shift lever in the low range position.
 - d. If the wheels rotate at this time, loosen bolt ① and rotate the eccentric sleeve ② until the wheels stop. Tighten the bolt ①, when it is properly adjusted. Figure 3-23

NOTE: Turning the control lever ③ clockwise will cause wheels to rotate in forward and turning counterclockwise the wheels will rotate in the reverse direction.

 - e. Stop the engine and remove the jack stands. Lower the wheels to the ground.
 - f. Re-connect the seat neutral start switch wires.
 - g. While seated in the operators seat, start the engine with the range lever in low range, and increase the engine speed to full throttle. The commercial mower should not move in either direction.

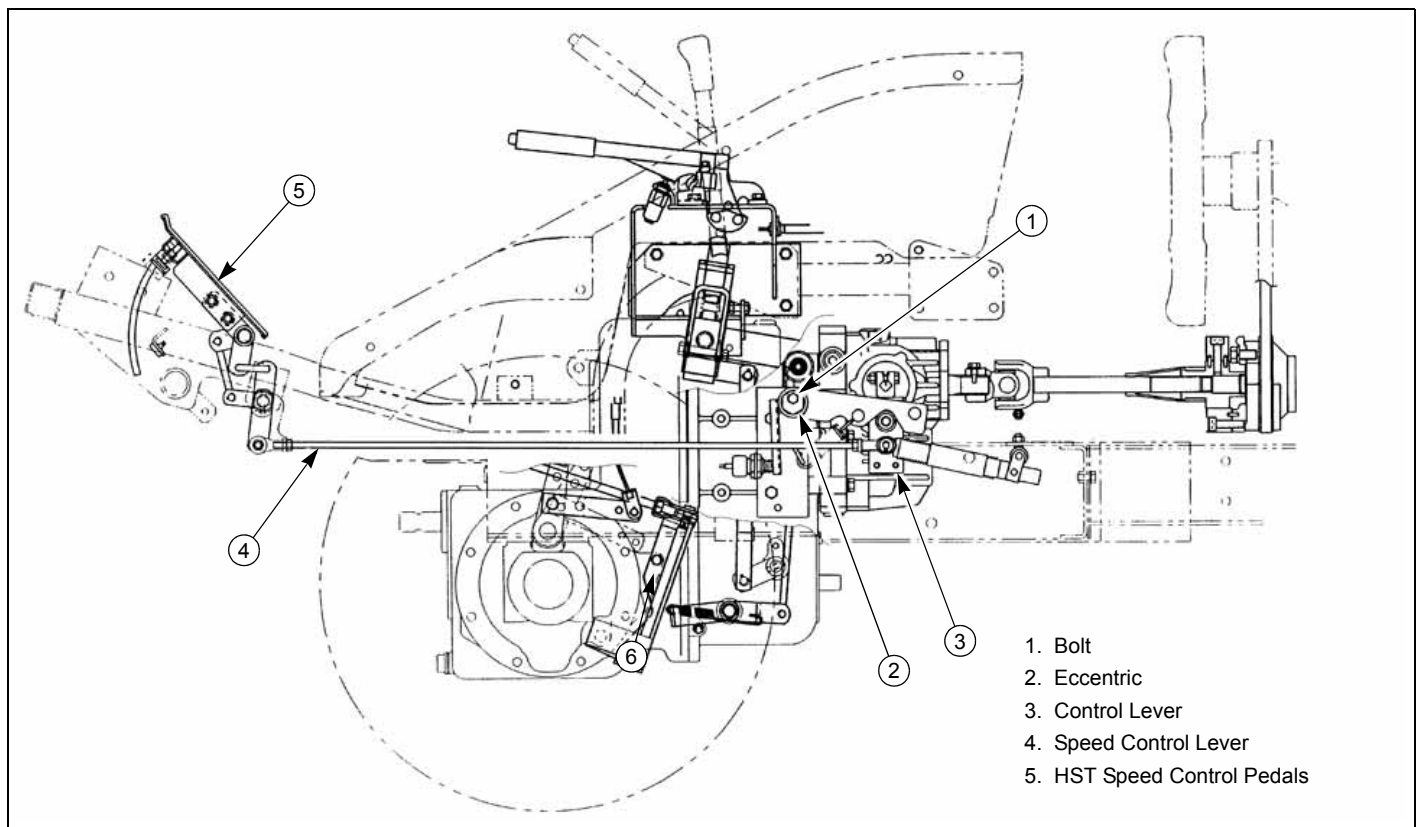


Figure 3-23

2. HST Neutral Switch Adjustment

- a. Adjust the HST neutral switch ① after adjusting the neutral position. Loosen the lock nuts ②. Disconnect the switch wires at the connector and connect the ③ leads across switch, and turn the switch ① until the switch is in the "ON" (continuity) position. Tighten the two lock nuts ② and recheck with continuity tester after the adjustment to the speed control rod ④. Manually check by moving from forward and reverse several times.

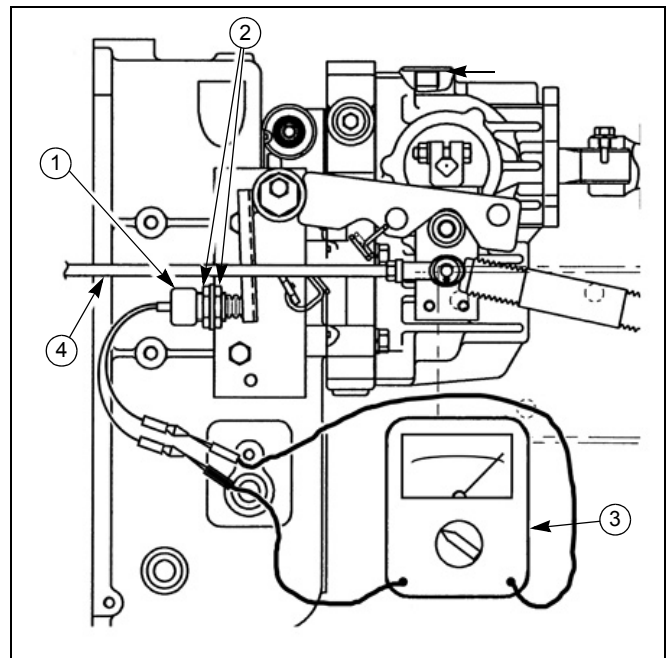


Figure 3-24

3. HST Speed Control Pedal Position Adjustment

- a. Adjust the pedal height by lengthening or shortening the speed control rod ①. Untighten the two lock nuts ②, and turn the rod ① with a wrench until the forward speed control and reverse speed control pedal ③ are at the same flat level (same angle from the floor). Tighten two lock nuts ②.

1. HST Neutral Switch	3. Ohmmeter
2. Lock Nuts	4. Speed Control Rod

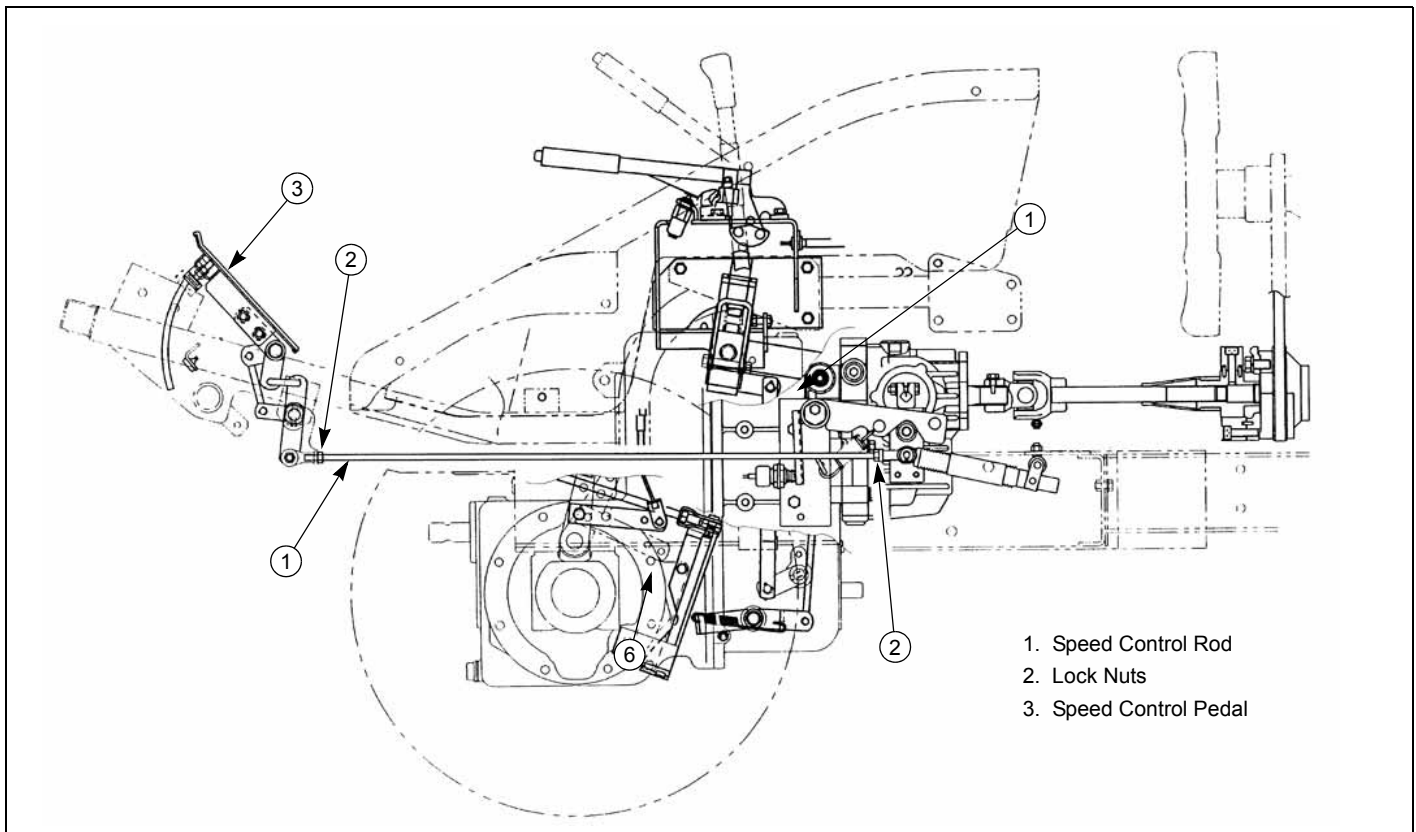


Figure 3-25

- b. Adjust the reverse speed control pedal stroke to 60% – 70% of the forward speed control pedal stroke. Loosen the lock nuts and adjust the stopper length by turning them as shown illustration. Forward speed control pedal stopper length is about .787 in. (20 mm). Reverse speed control pedal stopper length is about 1.181 in. (30 mm).

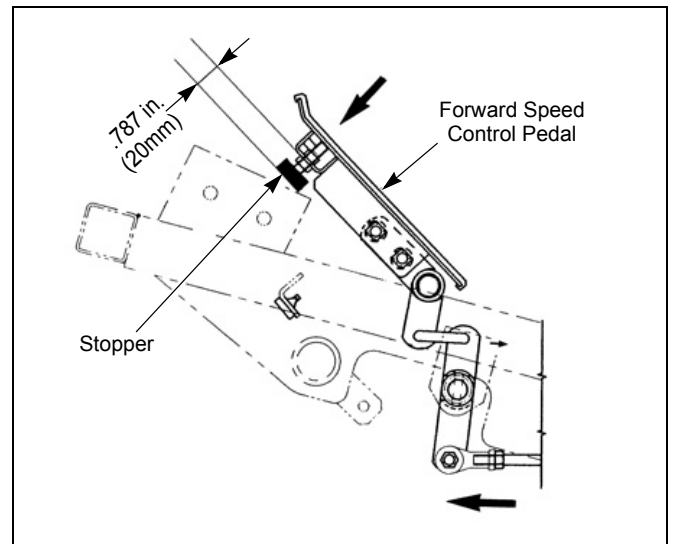


Figure 3-26

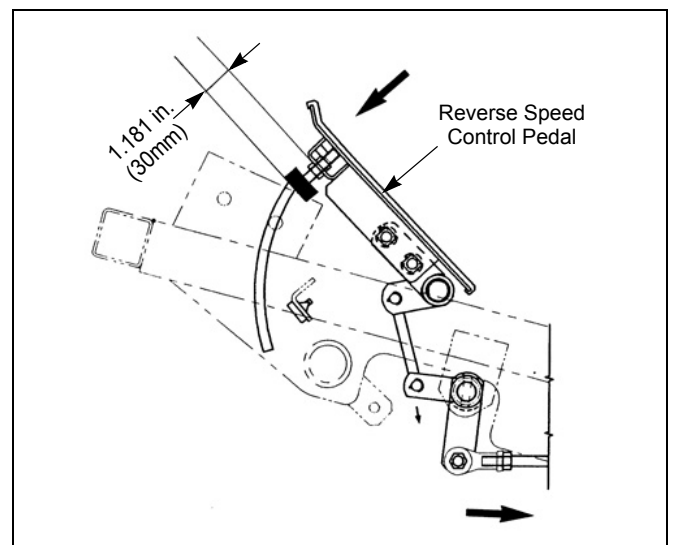


Figure 3-27

B. Pressure Checks

The following pressure checks should be done using Hustler® Hydraulic Test Kit (601661).

1. High Pressure Relief Valve
 - a. Raise the front and rear wheels of the unit off of the ground and support the axles with jack stands making sure the wheels are clear of the ground.
 - b. Remove the plug from port “A”, Figure 3-28 and install Hydraulic Test Kit (601661) and 6000 psi gauge.

NOTE: Port “A” will check the high pressure relief valve for forward travel and port “B” for reverse.
 - c. Start the engine and place the range shift lever in high range.
 - d. Depress the forward pedal a third of the way down.
 - e. Increase the engine speed to full throttle.
 - f. Apply the master brake pedal and read the pressure on the gauge.

NOTE: Measure the pressure reading in 2 – 3 seconds. The pressure reading must be 4974.8 psi (34.3 MPa). If the pressure is not within specifications replace the high pressure relief valve.
 - g. Stop the engine and install the pressure gauge and hose into “B” port, Figure 3-28.
 - h. Install the plug to port “A”.
 - i. Depress the reverse pedal and master brake pedal and read the pressure. The pressure reading must be 4974.8 psi (34.3 MPa). If pressure is not within specifications replace the valve assembly.

NOTE: Do not cause the HST to go over relief for more than a few seconds as instructed above. Longer periods of over relief operation will overheat the system.

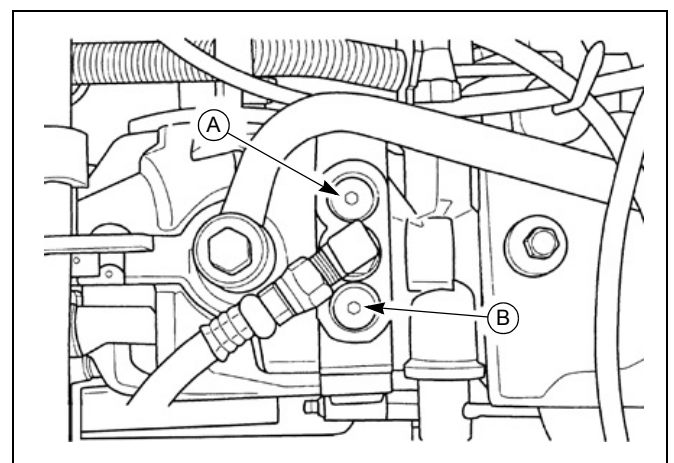


Figure 3-28

2. Low Pressure Relief Valve

Refer to Figure 3-29, Figure 3-30, Figure 3-31, Figure 3-32, Figure 3-33, Figure 3-34, & Figure 3-35

- a. Disconnect the hose ①.
- b. Connect the Tee adapter ② to install the pressure gauge.
- c. Install the pressure gauge (0-200 psi gauge from kit).
- d. Start the engine and set the transmission range lever to neutral.
- e. Increase the engine speed to Maximum rpm.
- f. The pressure should be approximately 0.5Mpa (4.9 bar, 71 psi).

If the pressure is not as specified, replace the valve and spring.

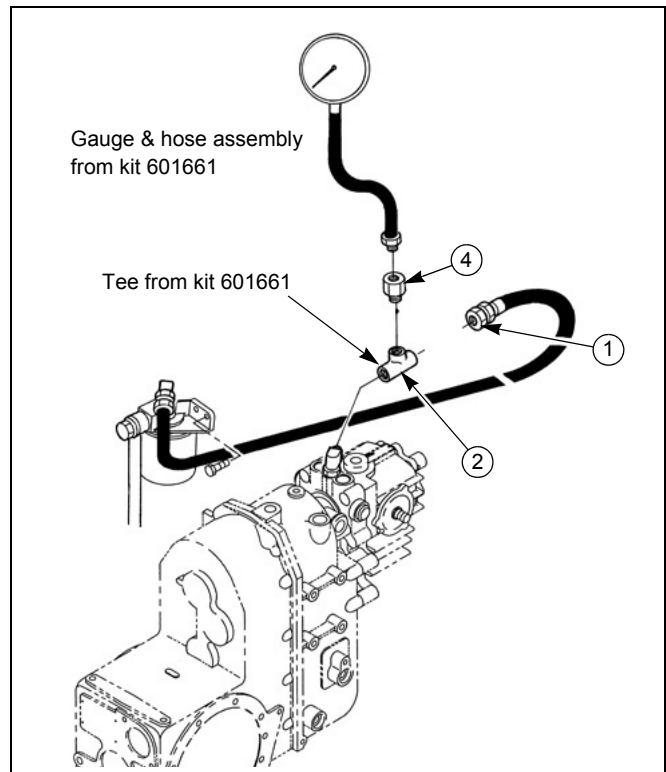


Figure 3-29

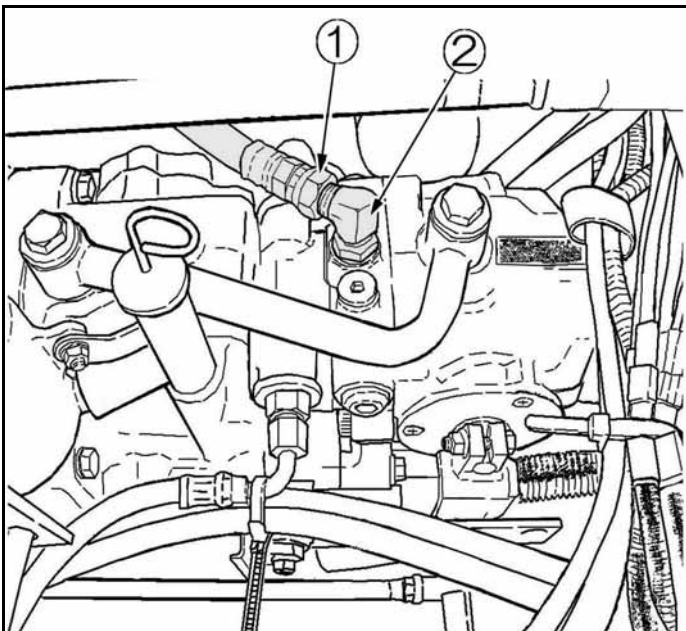


Figure 3-30

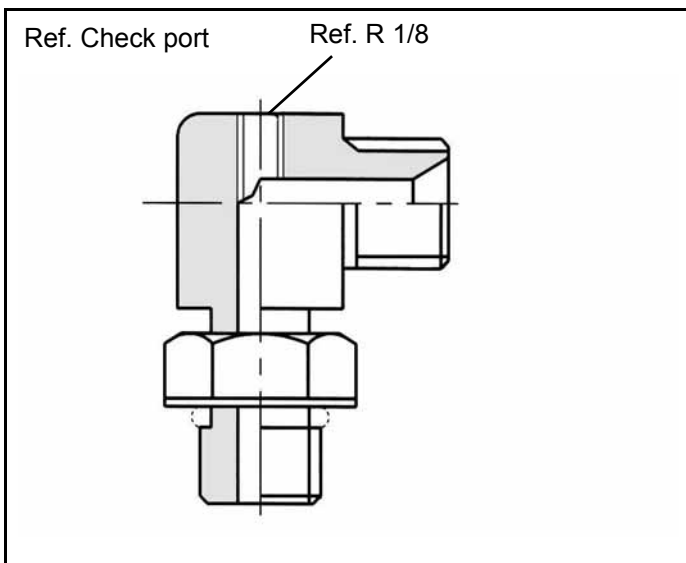


Figure 3-31

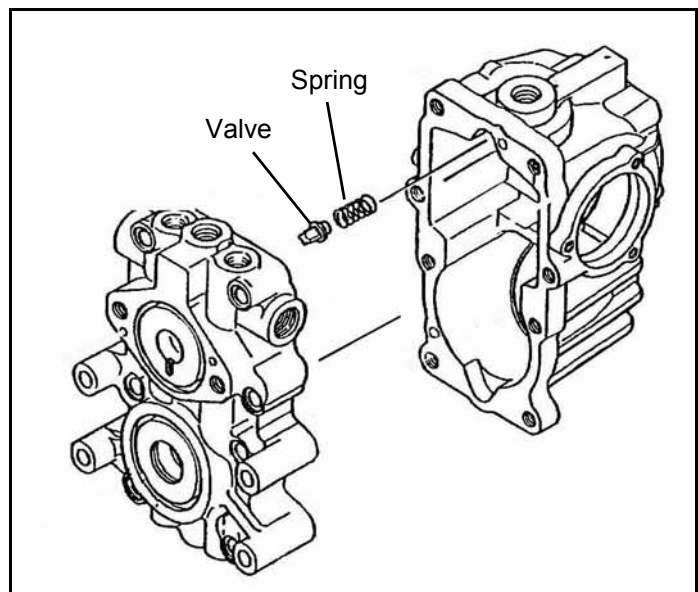


Figure 3-32



Figure 3-33



Figure 3-34



Figure 3-35

Troubleshooting and Specifications

A. Troubleshooting

CONDITION	POSSIBLE CAUSE	REMEDY
1. Output shaft fails to rotate when the HST pedal is set position.	1. Improper operation of HST pump or motor. 2. Damaged charge pump 3. Charge pump pressure low. 4. High pressure relief valve set too low. 5. Defective HST check valve. 6. Low pressure relief valve set too low. 7. Air is mixture in the HST oil.	Check the trunnion shaft movement and replace the assembly. Measure the charge pressure and replace the assembly. Check the low pressure circuit relief valve and replace defective parts. Check the high pressure circuit relief pressure. Replace valve if necessary. Replace check valve and spring. Check the low pressure circuit relief valve. Check the suction piping connection and transmission oil level.
2. Output shaft fails to stop rotating with the HST pedal in the neutral position.	1. Defective check and high pressure relief valve. 2. Linkage out of adjustment. 3. Defective the seat of check and high pressure relief valve.	Disassembly and clean. If condition still exists, replace valve. Adjust linkage. Replace the defective parts.
3. Low power and rpm of output shaft	1. Lack of oil in the HST circuit by clogged oil filter. 2. Air is mixture in the HST oil circuit. 3. Lack of charge pump capacity by abnormal oil temperature. 4. High pressure oil leakage due to wear of the pump and motor assembly.	Replace the oil filter. Check the suction piping connection and transmission oil level. Warm up the power unit when too low oil temperature. Stop the engine until the oil temperature become low when too high oil temperature. Wash oil circuit and replace the HST pump and motor assembly.
4. Abnormal sound from the HST	1. Air in the HST circuit. 2. Lack of oil in the HST circuit by clogged oil filter. 3. Lack of charge pump capacity by abnormal oil temperature. 4. High pressure oil leakage due to wear of the pump and motor assembly. 5. Linkage out of adjustment.	Check the suction piping connection and transmission oil level. Replace the oil filter. Warm up the power unit when too low oil temperature. Stop the engine until the oil temperature become low when too high oil temperature. Wash oil circuit and replace the HST pump and motor assembly. Adjust linkage.
5. Oil leaks at shaft and seal.	1. Oil leakage due to damaged oil seal or o-ring. 2. HST case internal pressure too high. 3. HST case oil return tube to front case plugged.	Replace damaged seal or o-ring. Check for worn piston pump or motor and replace if necessary. Case pressure should not exceed 145 psi (1 MPa). Remove and check tube for restrictions.

B. Specifications

MODEL 3500 and 3700

HST Transmission

Type	HVFD-18A18-M
Input Speed	0 – 3200 rpm
Output Speed	0 – 3000 rpm
Swash Plate Tilt Angle	0 – 16°
High Pressure Relief Valve	4975 psi (34.3 MPa)
Charge Pump Pressure.	71 psi (0.49 MPa)
Case Pressure.	13.9 psi (0.096 MPa) Max.
Pump Capacity – Variable Type	0 – 1.11 cu. in/rev (0 – 18.2 cc/rev.)
Motor Capacity	0 – 1.11 cu. in/rev (0 – 18.2 cc/rev.)
Charge Pump Capacity	299 cu. in./rev (4.9 cc/rev.)

Bolt Torques

Swash Plate Covers	4.57 – 5.61 ft.-lbs. (6.2 – 7.6 Nm)
Charge Pump Case Screws	32.45 – 39.82 ft.-lbs. (44 – 54 Nm)
Relief Valve (High Pressure) Check Plug	21.68 ft.-lbs. (29.4 Nm)
Check and High Pressure Relief Valve’s Plug.	46.98 ft.-lbs. (63.7 Nm)
Port Block Screws	32.45 – 39.82 ft.-lbs. (44 – 54 Nm)

Chapter 4

POWER STEERING

OIL FLOW

Pressurized oil from the HST charge pump flows to the power steering motor and HST transmission. During a turning cycle, pressurized oil is directed to the steering cylinder for right or left turns.

Return oil from the power steering cylinder is directed by the steering control valve to the HST transmission. The relief valve in the steering motor protects the system from over loading.

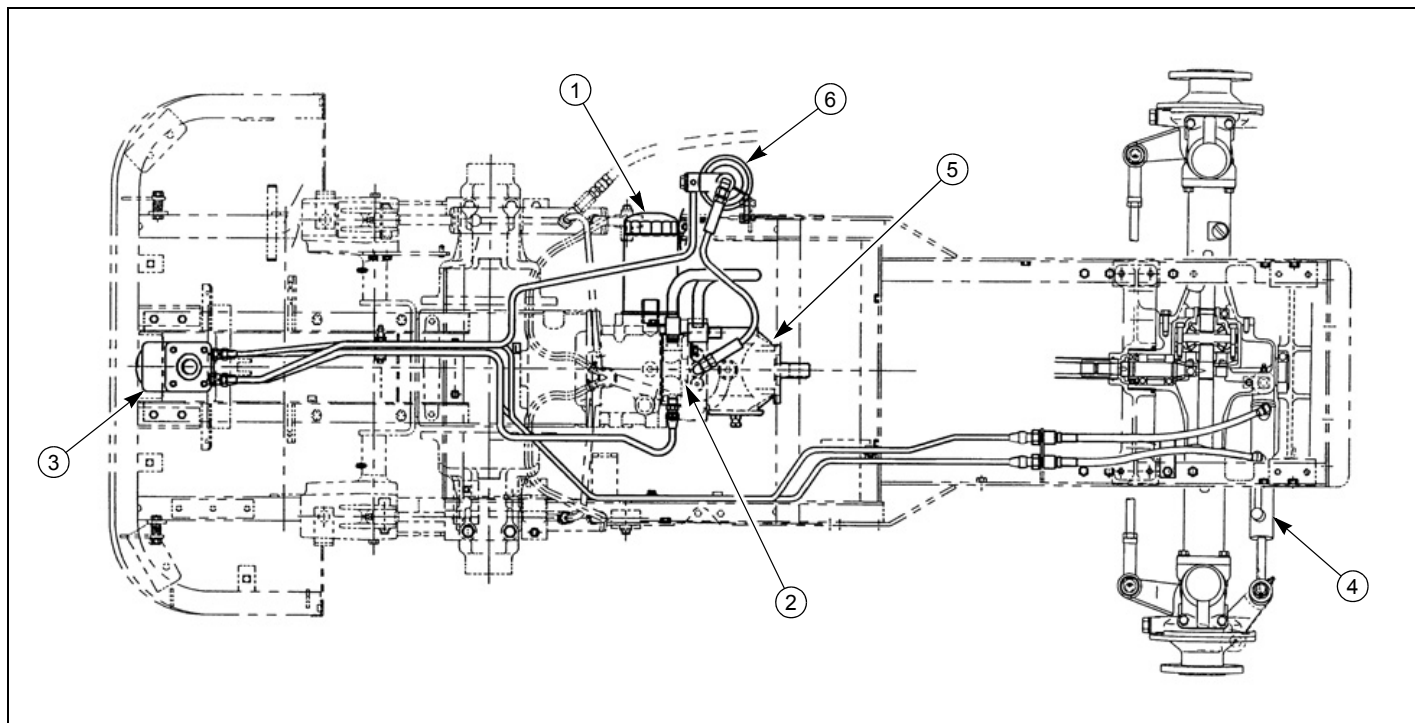


Figure 4-1

1. Filter	4. Cylinder
2. Charge Pump	5. HST Unit
3. Steering Motor	6. Oil Filter

A. Neutral Operation

Pressurized oil from the HST charge pump enters the valve body at port “P”. The oil flows through the check valve ⑦ past the relief valve ③ and through the radial holes in the valve spool ①. In the neutral position, the oil flows through the hollow spool and returns to the HST unit via port “T”.

Passage to ports “L” and “R” leading to the cylinder are blocked by the spool and sleeve. Oil contained in the tubes and cylinder is trapped and the cylinder remains in a fixed position. In this position the front wheels hold in the same position. The system is fully hydraulic and as such there is no road feel or front wheel reaction transmitted to the steering wheel.

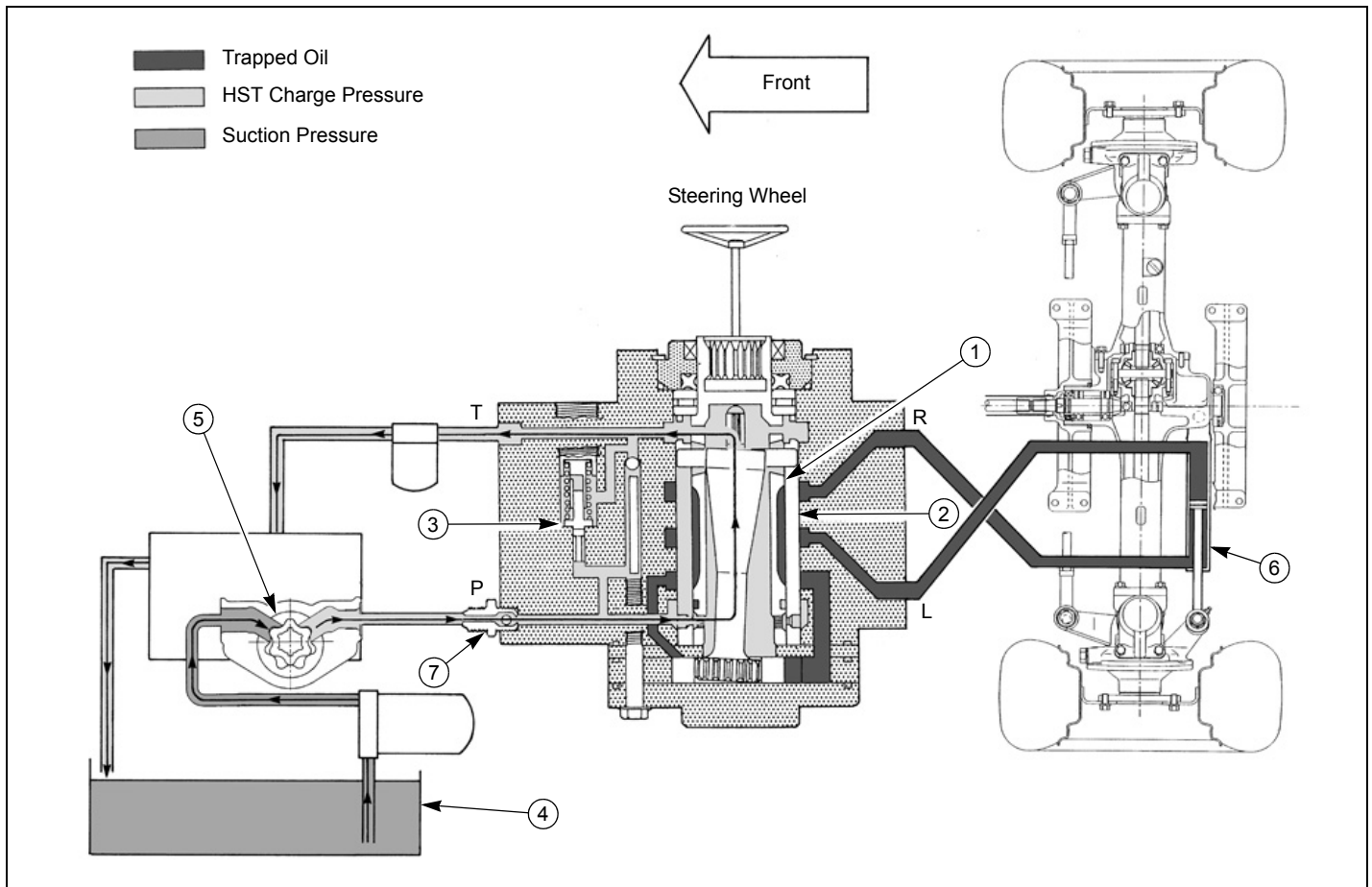
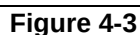


Figure 4-2

1. Spool	5. Oil Pump
2. Sleeve	6. Steering Cylinder
3. Relief Valve	7. Check Valve - Kick Back
4. Oil Tank	

B. Left Turning

Turning the steering wheel to the left rotates the valve spool and indexes the grooves in the spool with holes in the sleeve. This allows oil from the pump to flow through the spool and sleeve and enter the gerotor gear pump. Since the gerotor pump is being turned counterclockwise, the oil flows through the valve body to the port "L". From port "L" the pressurized oil flows to the piston side of the power steering cylinder and causes the front wheels to turn left.



C. Right Turning

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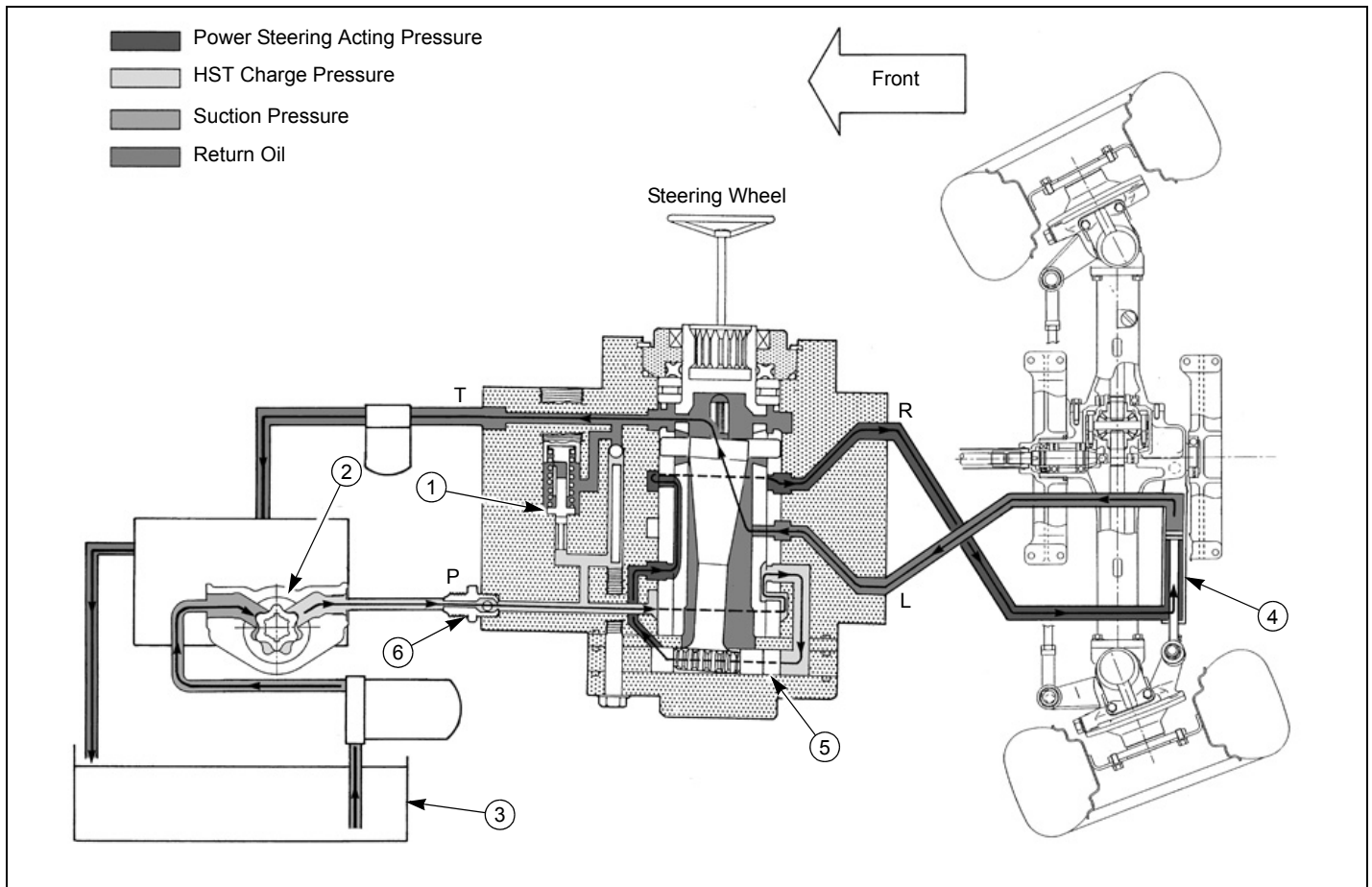


Figure 4-4

1. Relief Valve	4. Steering Cylinder
2. Oil Pump	5. Gear Pump, (Gerotor Pump)
3. Oil Tank	6. Check Valve - Kick Back

D. Manual Operation

In the event of a power steering pump failure or loss of oil pressure, the power steering system can be operated manually. Turning the steering wheel manually drives the gerotor gear pump to force oil into the power steering cylinder to whichever side of the cylinder required as directed by the rotation of the steering wheel. On the suction side of the gerotor pump, return oil flows from the cylinder and is drawn through the check valve ⑦ to feed the gerotor. When additional oil supply is required, as in making a left turn, make-up oil from the check valve ⑦ feeds the gerotor pump.

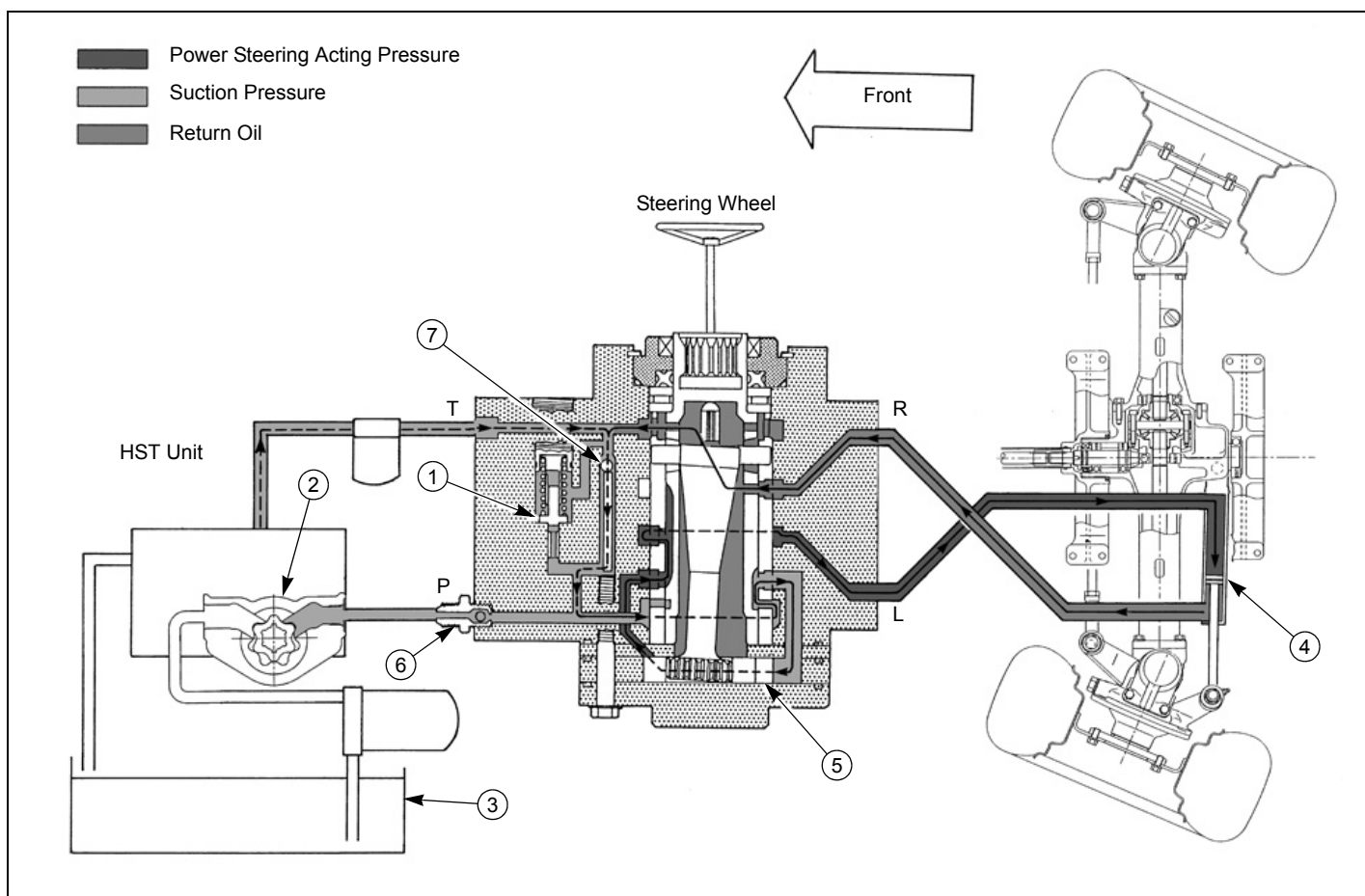


Figure 4-5

1. Relief Valve	5. Gear Pump, (Gerotor Pump)
2. Oil Pump	6. Check Valve - Kick Back
3. Oil Tank	7. Check Valve
4. Steering Cylinder	

CONTROL VALVE ASSEMBLY

A. Removal

1. Disconnect the negative battery cable from the battery post.
2. Pull the light mask ① to front ward and remove the bolts ⑥ and lower cover ② from the floor.
3. Disconnect the four oil pipes ③ from the control valve.
4. Remove the four bolts ④ and control valve ⑤ from the frame.

B. Disassembly

Reference – Figure 4-8.

1. Place the control valve upside down in a vise, and remove the retaining bolts ② and valve retainer bolt ③.

NOTE: Use soft metal jaws on the vise and apply only enough pressure to support the valve assembly. Do not over tighten or the valve body may become distorted and permanently damaged.

2. Remove the end cap ⑪, seals ⑫ and o-ring ⑬.
3. Remove the gerotor gear pump ⑭ and o-ring ⑬.

NOTE: The inner rotor separates easily from the outer pump body rotor. Use care in to prevent damage to these components.

4. Remove the second large o-ring ⑬.
5. Remove the drive shaft ⑮, spacer plate ⑯ and third large o-ring ⑬.
6. Remove the check ball ⑰.
7. Remove the retaining ring ②.

NOTE: Remove the valve from the vise and place on a clean lint-free shop towel. Use care in handling the valve parts so as not to mar or the precision finishes.

8. Rotate the spool and sleeve to position the pin horizontally. Gently push on the bottom end of the spool and sleeve forcing the gland ③ out of the valve body.
9. Separate the seals ① and ⑤ from the gland ③.
10. Remove the thrust bearing ⑦ and two bearing races ⑥.
11. Remove the spool and sleeve as an assembly ⑬, ⑭ and ⑮.
12. Remove the pin ⑭.
13. Push the spool upward out of the sleeve slightly and remove the centering springs ⑪ and ⑫.
14. Remove the spool from the bottom side of the sleeve.

NOTE: Rotate the spool while pushing it out of the sleeve to prevent binding.

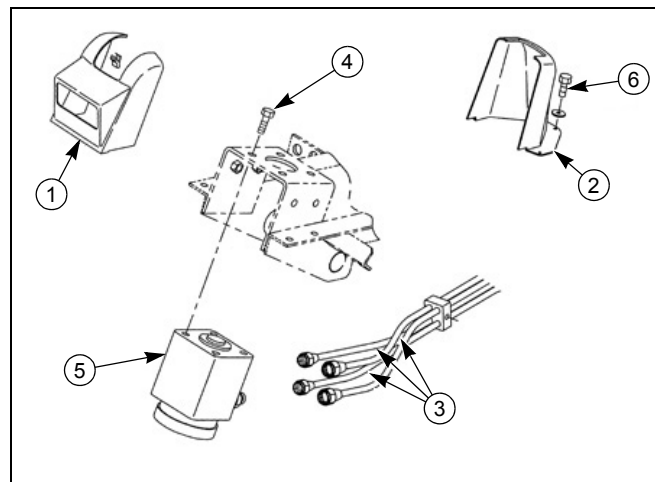


Figure 4-6

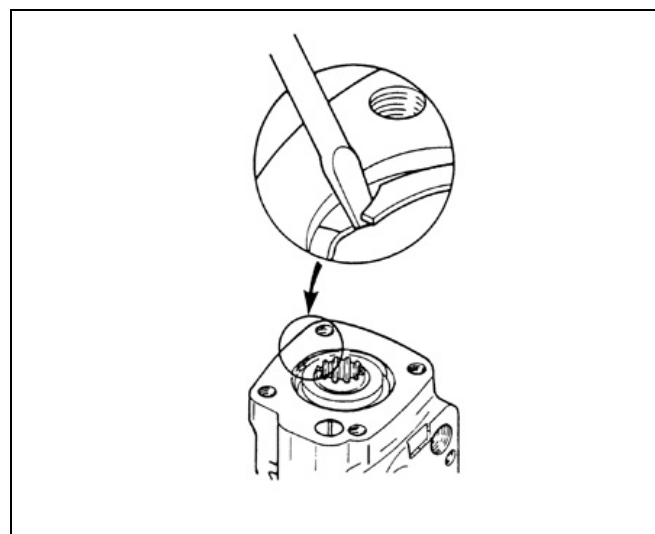


Figure 4-7

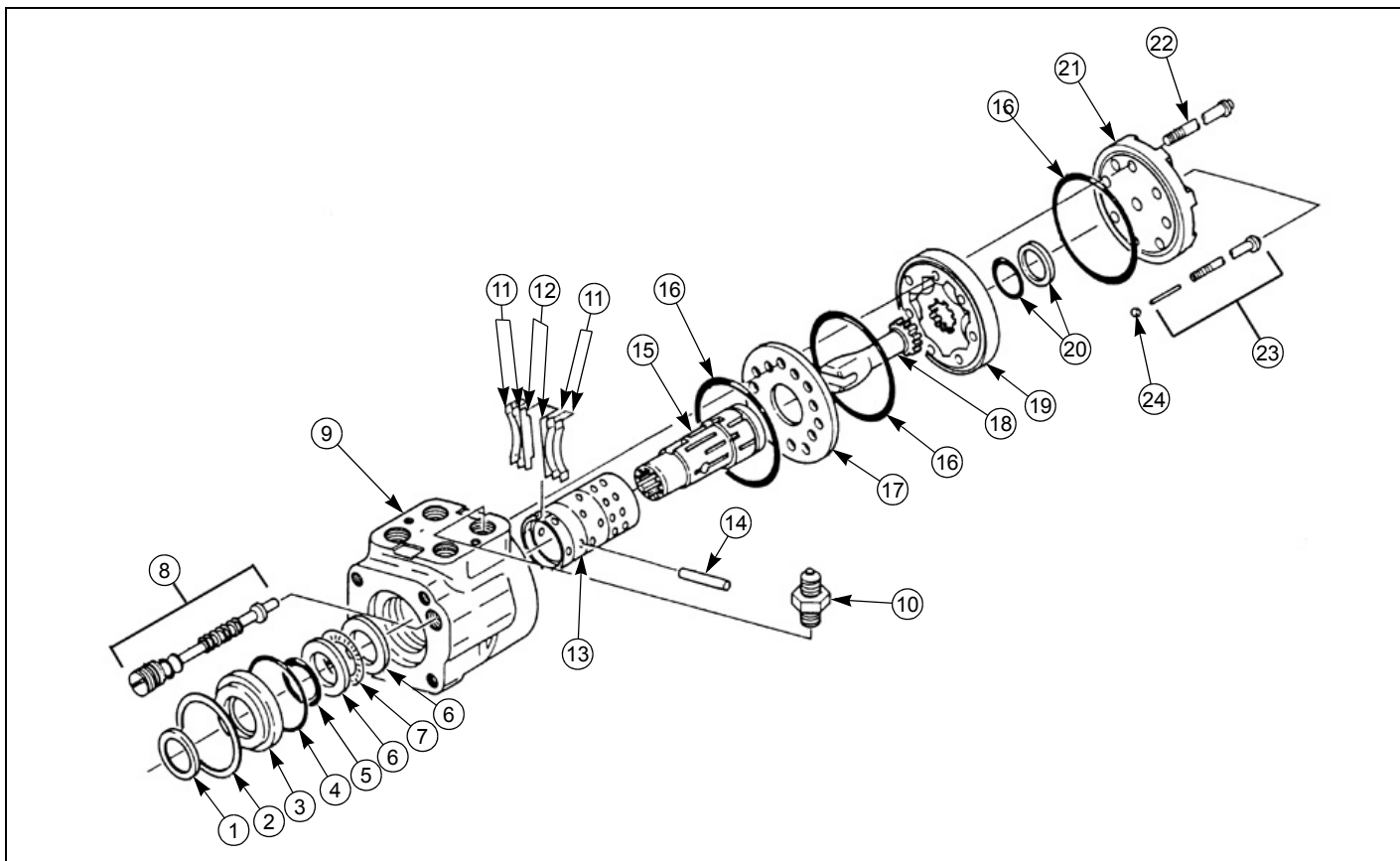


Figure 4-8

1. Seal - Dust	8. Relief Valve Assembly	13. Sleeve	20. Seal Assembly
2. Retaining Ring	9. Body	14. Pin	21. End Cap
3. Seal Gland	10. Connector	15. Spool	22. Bolts
4. O-Ring	11. Centering Spring (Curved)	16. O-Rings	23. Check Ball and Retaining Bolt
5. Oil Seal	12. Spring (Flat)	17. Spacer Plate	24. Ball (Check)
6. Bearing Race		18. Shaft	
7. Bearing		19. Geromotor Pump	

C. Inspection

1. Inspect the spool and sleeve for evidence of sticking, scuff marks and any damage. If defective, replace the spool and sleeve as a matched set.
2. Upon disassembly, replace all seals and o-rings with new.

D. Assembly

1. Insert the spool in to the sleeve while slowly rotate the spool.

NOTE: Bring the matching marks into register to align the centering spring slots. Check to be sure the spool rotates freely within the sleeve.

2. With the spring slots lined up insert the special tool in the slots.
3. Position the combination of centering springs into the groove of the installer.

NOTE: The springs are arranged with two flat springs in the center and two curved spring on each side with the convended side facing the flat spring. Be sure the notched edges of the spring face downward.

4. While gripping the outer end of the spring combination and maintaining pressure against the tool, slide the tool out of the assembly leaving the springs positioned in slots.

NOTE: Positioning the spool in a slightly higher than normal position in the sleeve will ease this assembly operation.

5. Position the spool and sleeve so that their ends are flush.
6. Install the pin ⑭ marking its end flush with the sleeve surface.
7. Insert the spool and sleeve assembly into the valve body for the bottom. Position the assembly so that the end is flush with the valve body.
Check the sleeve rotation to be sure it rotates freely in the housing bore.
8. Install the o-ring ④ into the valve body.
9. Position the thrust bearing assembly in the bore making sure it seats firmly on the sleeve and spool.
10. Install the dust seal ① to the gland ③ bushing.
11. Install the oil seal ⑤ to the gland. Be sure the seal is not cocked in any way.
12. Position the gland assembly in the bore being sure its outer end face is parallel with the valve body end face.
13. Install the retaining ring in the valve body groove.
14. Position the valve body in a soft jawed vise to support the assembly. Do not over grip the valve body as it will distort the valve body and cause permanent damage to the unit.
15. Position the check ball ② in to the retainer bolt bore.
16. Position the spool and sleeve assembly so that it is slightly below the bottom face of the valve body.

NOTE: Be sure the matching surface of the components are clean and free of dart lint.

17. Install the o-ring ⑩ and position the spacer plate ⑪ on the valve body being sure match the bolt holes and ports to that of the valve body.
18. Rotate the spool and sleeve to position the pin slots parallel with the valve body port face.
19. Scribe a reference mark on the splined end of the drive shaft parallel to the pin slot as shown.
20. Position the drive shaft in the valve body engaging the slot with the pin.

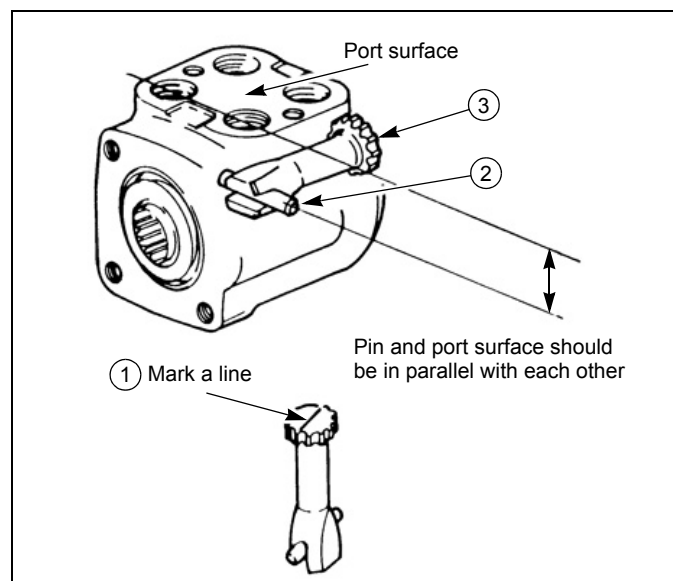


Figure 4-9

- | | |
|----|-----------------------|
| 1. | Reference Scribe Mark |
| 2. | Pin |
| 3. | Drive Shaft |

21. Install the o-ring and seal ⑳ on the rotor ⑲.

NOTE: Apply a grease type lubricant to the face of the rotor to make the o-ring and seal to the rotor surface.

22. Position the rotor in the pump ring and install the o-ring ⑯ in the pump groove.
23. Position the gerotor pump assembly onto the valve body with the seal side up. Align the drive shaft reference line with a diametrical line running through the center of the pump gear valleys as shown.

NOTE: It is important that the pump drive shaft, gear lobes and valve ports are in the correct relationship for proper valve timing as described above and reference in the parallel lines A, B, C and D.

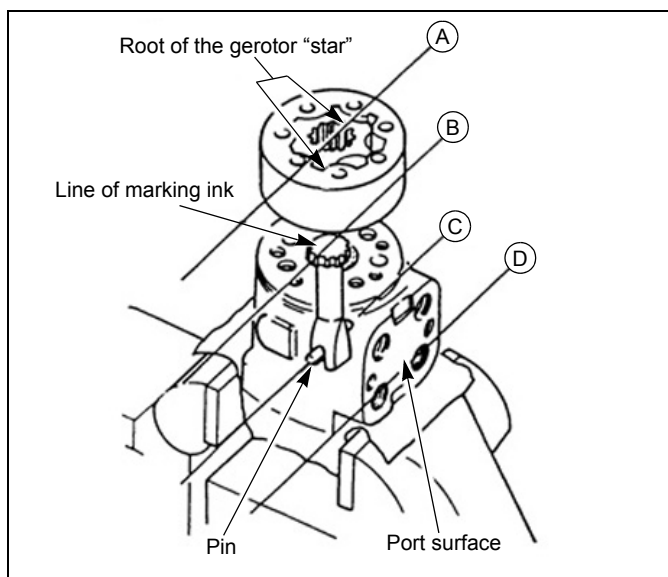


Figure 4-10

- | | |
|----|----------------------------|
| A. | Gear Lobe Reference |
| B. | Drive Shaft Reference Mark |
| C. | Drive Shaft Pin Location |
| D. | Port Face Reference |

24. Install the o-ring ⑯ onto the end cap ㉑ and position the assembly on the valve body.
Align the bolt holes and install the retaining bolts ㉒.

NOTE: Lubricate the bolt threads and tighten to specified torque in two steps to maintain equal pressure on the valve body. Tighten the bolts in the sequence as shown.

Tightening torque — 15 ft.-lbs. (20 Nm)

Recheck the valve spool to be sure it smoothly without binding.

25. Install the connector fitting ⑩ in the valve pressure port and tighten to the specified torque.

Tightening torque — 51 ± 6 ft.-lbs (69 ± 9 Nm)

26. Install the control valve assembly on the power unit and complete the assembly following the removal procedures in reverse.

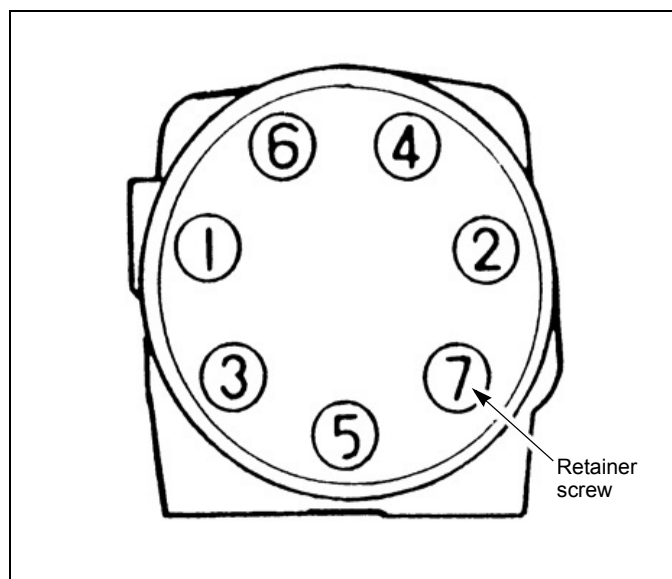


Figure 4-11

E. Pressure Testing

1. With the power unit engine stopped, disconnect one of the hydraulic lines which run to the steering cylinder.
2. Connect the pressure gauge to the end of the line from the steering control unit and cap the line leading to the steering cylinder.
3. Start the power unit engine, and allow it to idle. Observe the gauge, it should read at 0 or near 0 psi (0 or near 0 MPa).
4. Turn the steering wheel so that the line which the gauge is connected to receives pump oil intended for the steering cylinder. For instance, if the gauge is connected to the left side of the cylinder (as viewed from the operator's seat), turn the steering wheel to the clockwise. Observe the gauge reading. (Engine speed at approx. 2900 rpm)

NOTE: Use Hustler® Hydraulic Test Kit (601661) to perform the above.

a. Test results

1. If the pressure gauge reading rises before the steering wheel is turned, it indicates that steering control valve timing is off and the steering unit will have to be disassembled and inspected.
2. If the pressure gauge reading rises to the relief valve setting 855.7 – 957.2 psi (5.9 – 6.6 MPa) when the steering wheel is turned, it indicates the pump and relief valve are working properly.

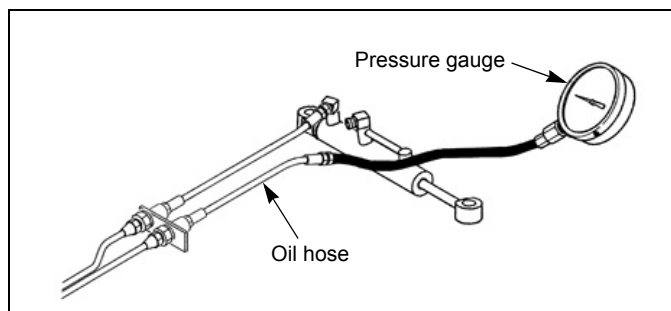


Figure 4-12

F. POWER STEERING CYLINDER

1. Removal

- a. Disconnect the steering hoses to the power steering cylinder and cap all openings.
- b. Remove the cylinder from the power unit.

NOTE: Do not disassemble the power steering cylinder assembly. If oil is leaking and/or trouble is evident from cylinder assembly, replace the cylinder assembly.

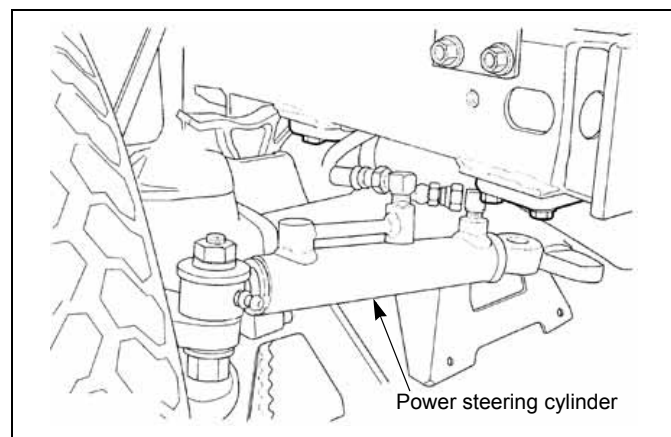


Figure 4-13

2. Inspection

- a. Inspect the anchor pins and bushings for excess wear and excessive clearance. Replace cylinder assembly and/or pins if the clearance is over .02 in. (0.5 mm).

3. Installation

- a. Install the cylinder on the power unit.
- b. Connect the power steering hoses to the adapter and tighten to 14.5 – 22 ft.-lbs. (19.6 – 29.4 Nm).

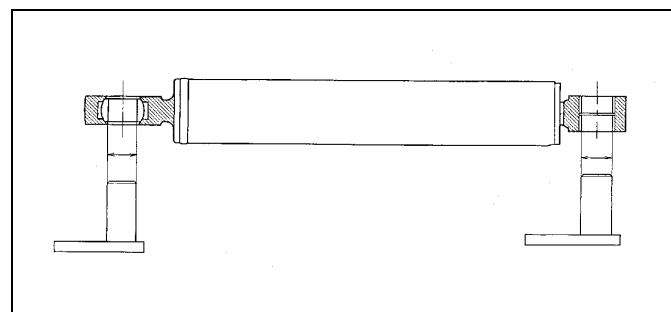


Figure 4-14

- c. Start the power unit, operate the steering system, and check for any leaks.

4. Piping

Replace the oil hoses and pipes if cracks, oil leakage, or other damage is noticed.

Any time a seal is broken, always use sealing tape on the tube fittings to ensure a tight non-leak fit. Torque the fitting to the specified torque. Do not tap on the flare nut fitting.

NOTE: When applying seal tape to the thread, be careful not to allow the tape to flow into the hydraulic piping.
Be careful to keep oil hoses and oil pipes off other parts. Fix clamps securely.

a. Tightening Torque of Piping

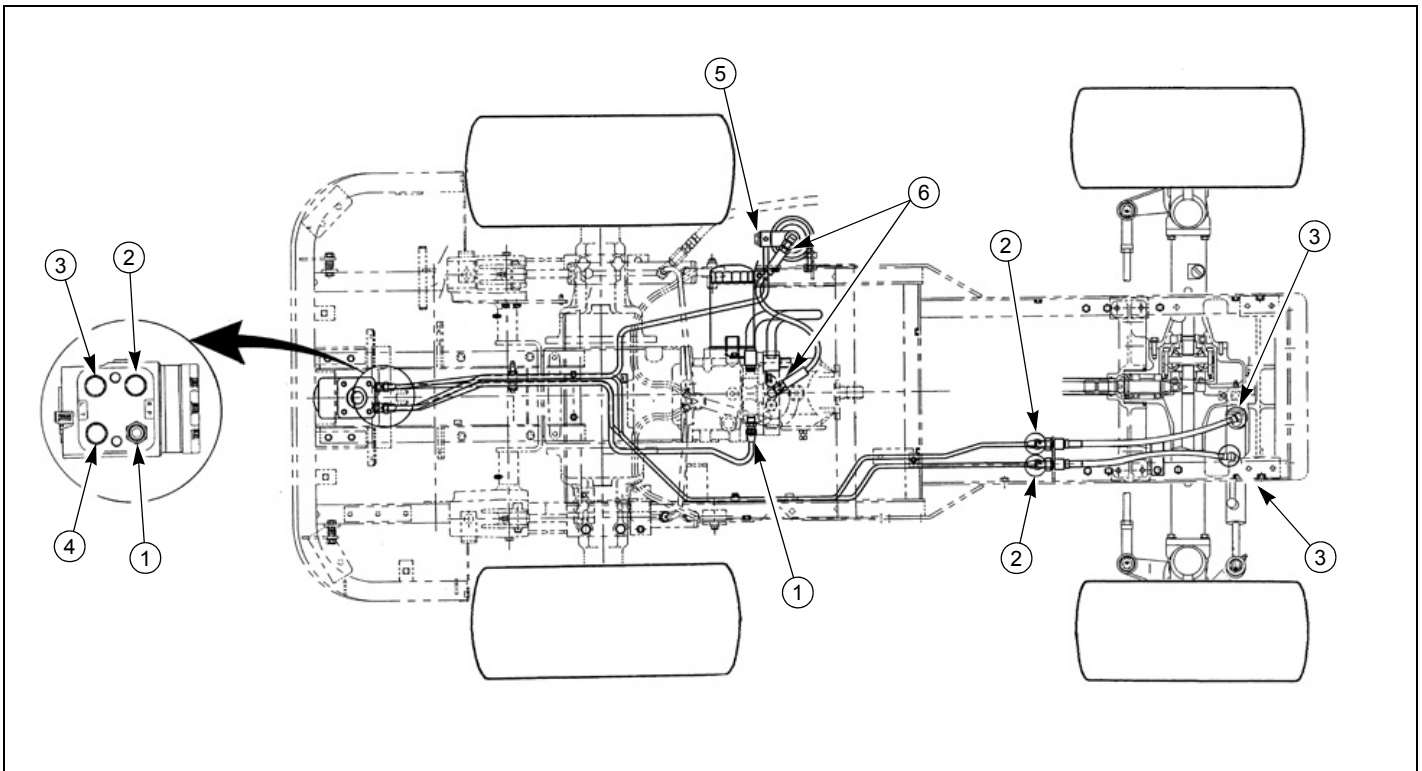


Figure 4-15

1. Flare nuts of oil pipe for charge pump to steering motor : 22 – 29 ft.-lbs. (29.4 – 39.2 Nm)
2. Flare nuts of oil pipes for steering motor to power steering cylinder "L" and "R" port : 22 – 29 ft.-lbs. (29.4 – 39.2 Nm)
3. Nuts for oil hose to power steering cylinder "L" and "R" port : 15 – 22 ft.-lbs. (19.6 – 29.4 Nm)
4. Flare nuts of oil pipes for steering motor to HST oil filter : 29 – 36 ft.-lbs. (39.2 – 49.0 Nm)
5. Banjo bolt of oil pipe for steering motor to HST oil filter : 33 – 40 ft.-lbs. (44.1 – 53.9 Nm)
6. Nuts of oil hose for HST oil filter to HST unit : 22 – 29 ft.-lbs. (29.4 – 39.6 Nm)

5. Troubleshooting

Most malfunctions in the steering system can usually be traced to dirt or foreign matter in the system. Dirt can cause such things as stickiness, erratic operation, or hard steering.

Before considering the procedures below, follow these suggested steps:

- Check the pump for proper relief valve action. See “Pressure Testing”, discussed in this section.
- Jack the rear end of the power unit off the ground and cycle the steering from stop to stop to check for rear axle binding.
- Be sure the hydraulic hoses from the pump-to-control valve and from the control valve-to-cylinder are hooked up correctly.

NOTE: If the steering system oil continues to overheat above 200°F (93°C), seals in the system can shrink, harden or crack thus losing steering ability.

CONDITION	POSSIBLE CAUSE	REMEDY
Clicking noise	1. Steering components loose and shifting under load.	Check and correct.
Steering wander	1. Tire pressure incorrect. 2. Worn tie rod ends. 3. Steering column shaft binding.	Check tire pressure. Replace. Remove and correct.
High steering effort	1. Low pressure. 2. Steering motor binding.	Check pressure. Check and repair.
Excessive heat	1. Kinked hose. 2. Bent tubes. 3. Restricted re-centering of steering motor.	Check hose routing. Check tubes. Repair as necessary.
Hard Steering	1. Lack of transmission oil. 2. ORBITROL (control valve unit) A. ORTITROL not aligned to steering column. B. Spool-and-sleeve combination is seized because of foreign matter. C. Over tightening of the end cap bolts. 3. Oil pump (HST Charge Pump) A. The pump is stuck and will not work. B. The pump is worn down. C. Pumping performance inadequate. 4. Relief valve A. The valve is damaged because of internal deterioration. B. Pressure setting is too low.	Fill the transmission oil. Reposition ORBITROL. (If loosening its mounting bolts lightens the handwheel, it means that ORBITROL was in misalignment). Replace. Re-tighten to the specified torque limit. Replace oil pump. (HST Charge Pump) Replace oil pump. (HST Charge Pump) Test pump performance and, if necessary, remove the pump. Disassemble the pump and replace the internal seals. Replace control valve assembly. Replace control valve assembly.

CONDITION	POSSIBLE CAUSE	REMEDY
Steering wheel will not return to neutral or will turn by itself.	1. ORBITROL A. Spool and sleeve combination is stuck and will not rotate. B. ORBITROL not aligned to steering column.	Replace control valve assembly. Re-align
Cylinder will not follow steering wheel rotation or will respond sluggishly.	1. ORBITROL A. ORBITROL has been improperly rebuilt, resulting in valve mistiming. 2. Steering cylinder A. Air is trapped in the cylinder. B. Internal oil leakage because of damaged piston seal.	Repair. Bleed air out. Replace the seal.
Steering wheel will “kick back”	1. ORBITROL A. ORBITROL has been improperly rebuilt, resulting in valve mistiming. 2. Piping A. Pipes are improperly connected to the four ports of ORBITROL.	Repair. Correct the pipe connections.
Oil leakage 1.From the splined connection of column to spool. 2.From mated face joints (valve body, spacer plate, ORBITROL, end cap).	1. Leaky oil seal A. Dirty hydraulic oil. 2. Damaged O-Ring.	Replace the seal. Change the oil. Replace.
Stiff or Jerky Steering Action	1. Worn or damaged bearings	Inspect and repair.

Chapter 5

REAR AXLE ASSEMBLY

Description and Operation

The four-wheel drive rear axle is supported by an axle pivot pin at the rear of the frame.

Range Selector Lever and Four-Wheel Drive (AWD) Selector Lever are activated by the same lever.

The range selector lever is on the left side of the seat. The range can only be selected when the HST foot pedal is in the NEUTRAL position and the power unit is not moving.

1. When the lever is located in the position of Range Selector Lever, the power unit will run in AWD mode.
2. When the lever is brought to the outer slot, the power unit will run in Locked AWD mode.

NOTE: When power unit is in Locked AWD mode, only low range is engaged.

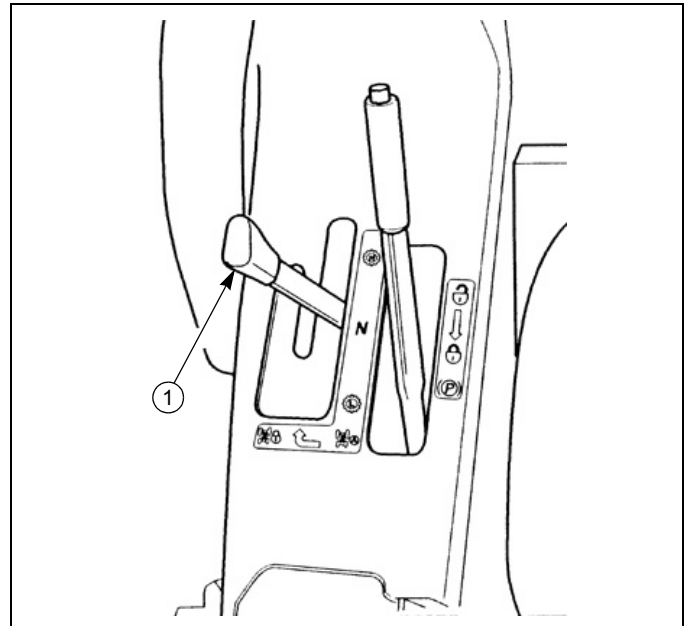


Figure 5-1

- | |
|-------------------------|
| 1. Range Selector Lever |
|-------------------------|

The four-wheel drive output shaft ④ in the range gear box is contained in a two way clutch assembly ④.

The two way clutch assembly ④ is installed on the front wheel drive pinion ②. During operation, placing the lever into the Automatic four wheel drive position will automatically give the operator full four-wheel drive when the front wheels lose traction.

Since the rear wheel drive axle gears rotate slightly faster than the range gears in the transmission, the four-wheel drive output shaft ④ is free to rotate within the two way clutch ④.

When one of the front drive wheels starts to spin, the two-way clutch engages and sends power to the rear wheels thus giving the operator automatic four-wheel drive.

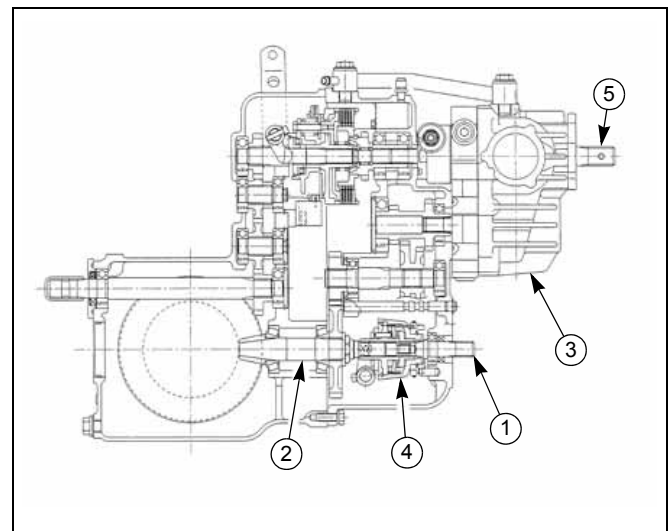


Figure 5-2

- | | |
|----------------------------------|----------------------------|
| 1. Four Wheel Drive Output Shaft | 3. HST Unit |
| 2. Drive Pinion Shaft | 4. Two Way Clutch Assembly |
| | 5. Input Shaft |

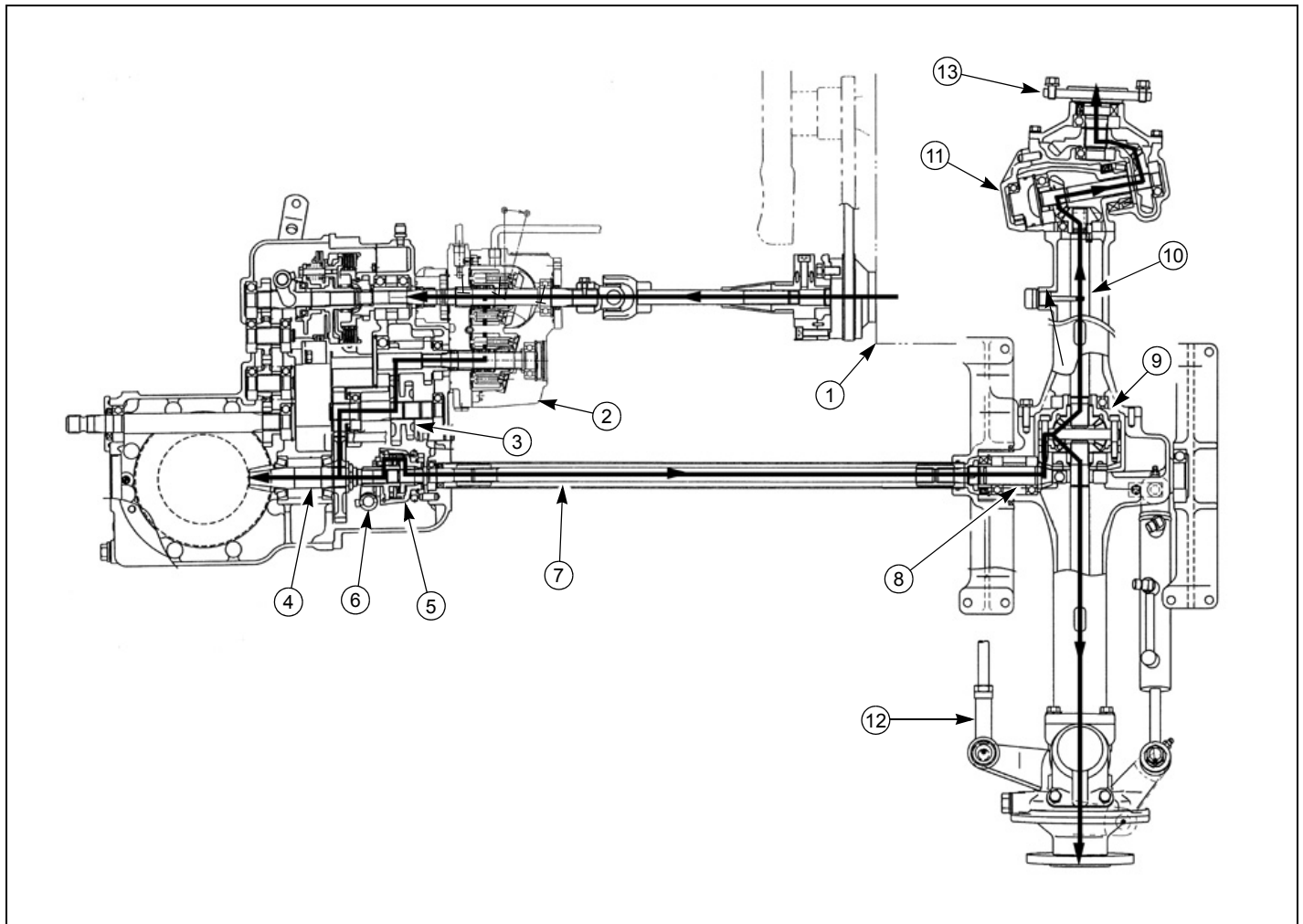


Figure 5-3

1. Engine	5. Two Way Clutch	8. Drive Pinion	11. Reduction Case
2. HST Unit	6. Locked AWD	9. Differential Gear	12. Tie Rod
3. Range Slide Gear	Shifter Fork	Assembly	13. Wheel Shaft
4. Drive Pinion	7. Rear Wheel Drive Shaft	10. Axle Shaft	

Rear Axle Removal

1. Disconnect the power steering lines from the power steering cylinder.
2. Place safety stands under the main frame.
3. Remove the rear axle bearing holders from the frame ,and remove the rear axle assembly.
4. If necessary, remove the pipe, drive shaft and coupling from the transmission.

Installation

Installation generally follows removal procedure in reverse, however the following must be observed:

1. Replace cracked or damaged hoses.

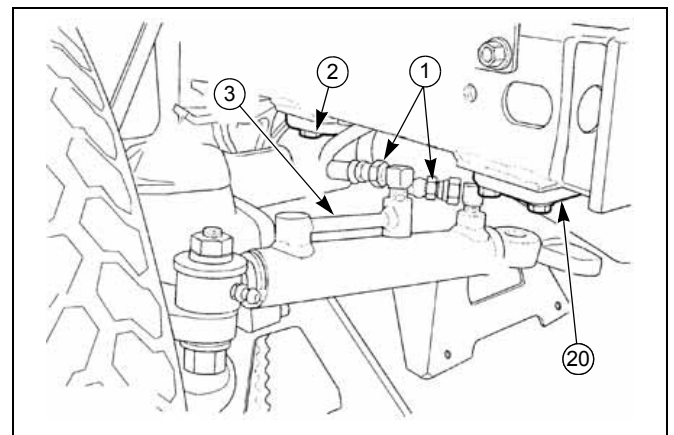


Figure 5-4

1. Oil Pipe	3. Rear Axle Assembly
2. Bearing Holder	

Disassembly

Reference Figure 5-5.

1. Remove the rear axle as outlined above and then remove the power steering cylinder ①, wheels ② and tie rod ③ from the rear axle assembly.
2. Remove the outer case cover ④ and bevel gear ⑤ as an assembly.
3. Remove the bolts ⑥, arm ⑦ and king pin ⑧.
4. Remove the final case ⑨, final pinion ⑩ and drive shaft ⑪ to downward.

NOTE: If necessary, remove the seal ⑫ and bearing ⑬ from the case.

5. Remove the bolts ⑭ and remove the idler gear case ⑮ assembly.
6. Remove the snap ring ⑯, bearings ⑰ and idler bevel gears ⑱ from the idler gear case ⑮.

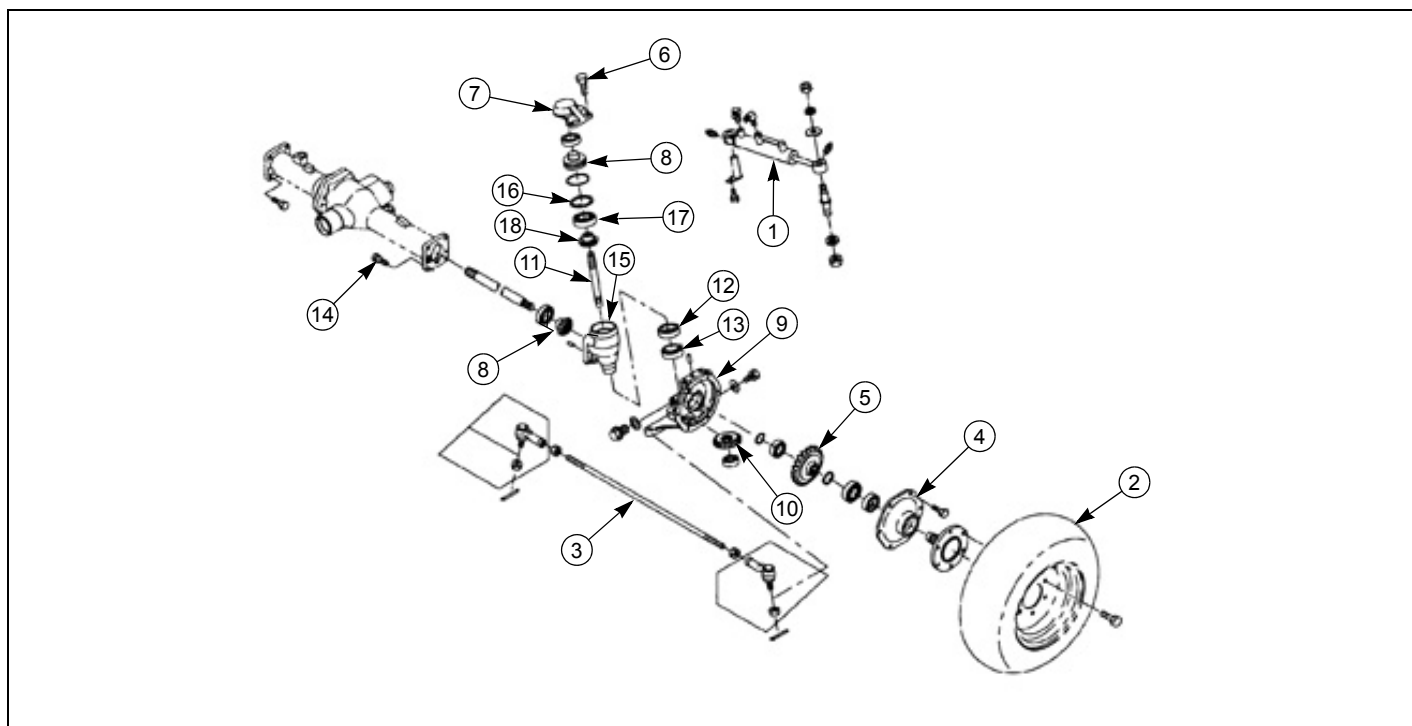


Figure 5-5

1. Power Steering Cylinder	6. Bolt	11. Drive Shaft	16. Snap Ring
2. Rear Wheel	7. Arm	12. Seal	17. Bevel Gear
3. Tie Rod	8. King Pin	13. Bearing	18.
4. Outer Case Cover	9. Final Case	14. Bolt	
5. Bevel Gear	10. Final Pinion	15. Idler Gear Case	

Reference – Figure 5-6

7. Remove the bolts ① on the right side housing and remove the housing ② and drive shaft ③ as an assembly.
- IMPORTANT:** Note the total amount of the shims ③ and thickness used between differential bearing ④ and right axle housing ②.
8. Remove the differential assembly ⑤ from the left axle housing ⑥.
9. Remove the bearing holder ⑦. Remove the lock nut ⑧, pry the oil seal ⑨ out and discard.
10. Remove the snap ring ⑩ and remove the drive pinion ⑪, collars (⑫ and ⑬) and bearings (⑭ and ⑮) as a set.

NOTE: If necessary, remove the bearings (⑭ and ⑮), collars (⑫ and ⑬), o-ring ⑰ and spacer ⑱ from the pinion shaft ⑪.

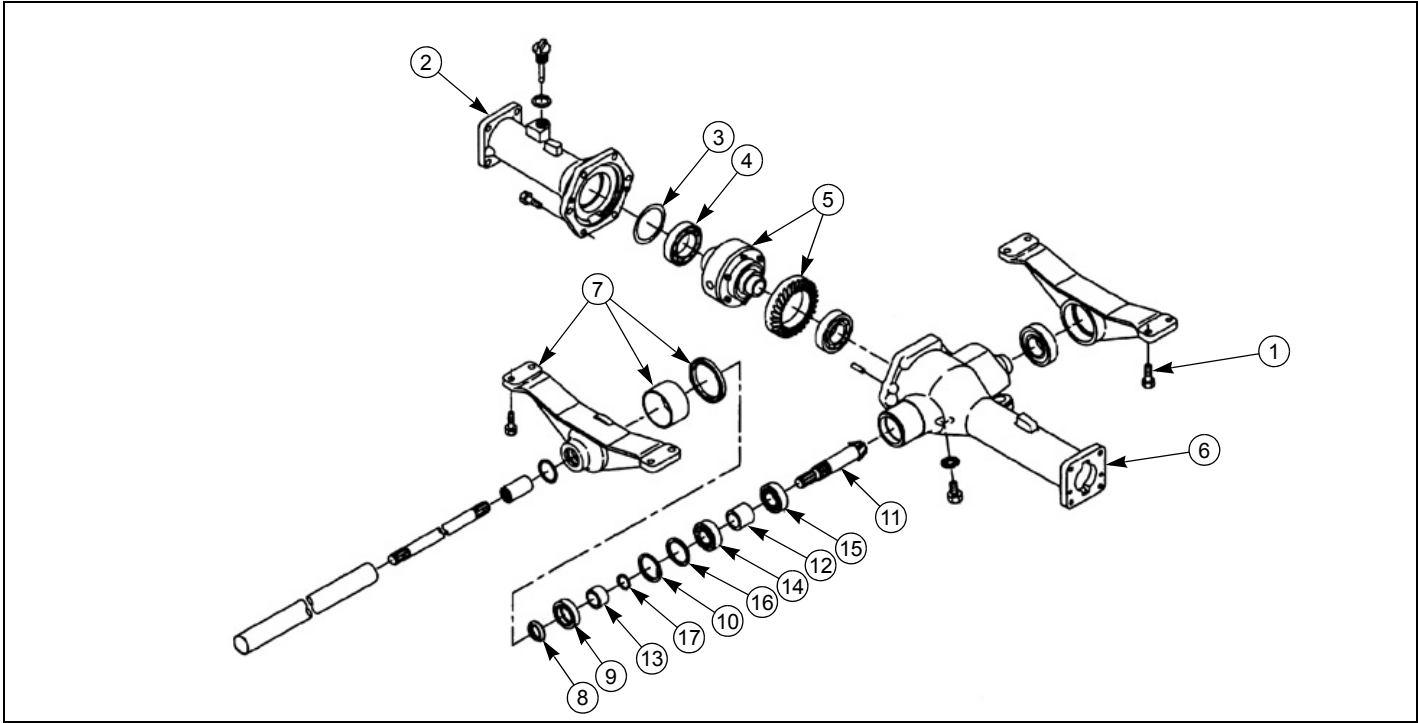


Figure 5-6

1. Bolt	6. Left Axle Housing	11. Pinion Shaft	16. Spacer
2. Right Axle Housing	7. Bearing Holder	12. Collar	17. O-Ring
3. Shims	8. Lock Nut	13. Collar	
4. Bearing	9. Oil Seal	14. Bearing	
5. Differential Assembly	10. Snap Ring	15. Bearing	

Reference – Figure 5-7.

11. Remove the bearing ① and final gear ② .
12. Remove the snap ring ③ and drive out the wheel shaft ④ from the case cover ⑤.
13. If necessary, remove the oil seal ⑥ and bearing ⑦ from the case cover ⑤.

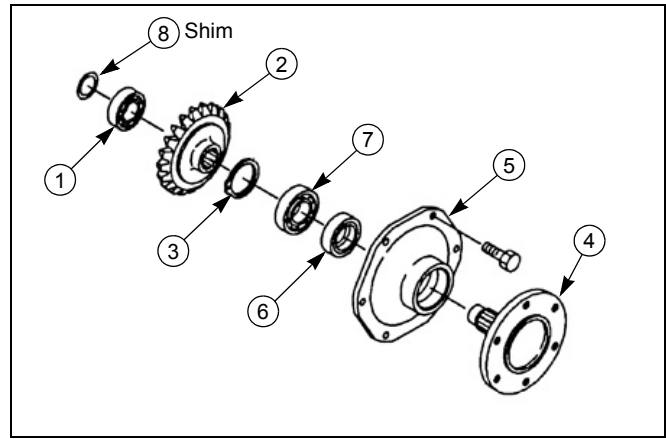


Figure 5-7

14. Remove the bolts ⑪ from the ring gear ②, and remove the gear, side cover ③, thrust washer ⑦ and side gear ⑤.
15. Remove the pinion shaft ⑧, pinions ⑥, thrust washer ⑦ and the opposite side gear and thrust washer.

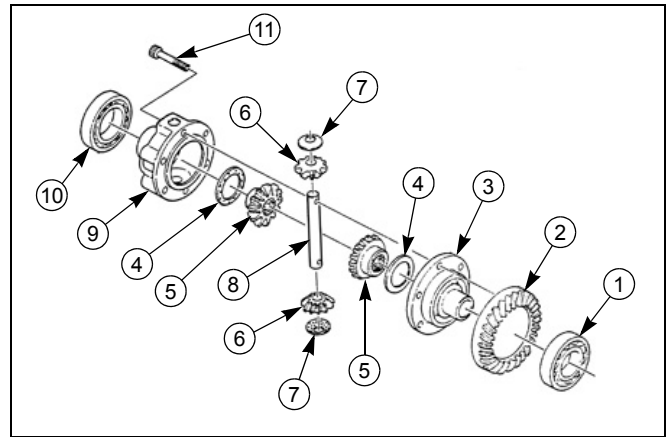


Figure 5-8

Inspection

1. Wash all parts in a suitable solvent and air dry.
2. Check the bearings for discoloration and wear.
3. Discard all seals and o-rings.
4. Check all gears for wear, chips or broken teeth.
5. Measure the thickness of the thrust washers ④. Replace the thrust washers if thickness is less than .035 in. (0.9 mm).
6. Measure the thickness of the thrust washers ⑦. Replace the thrust washers if thickness is less than .035 in. (0.9 mm).
7. Measure the outside diameter of the pinion shaft ⑧ and inside diameter of the pinion gears ⑥. Replace the pinion or gear if clearance is more than .020 in. (0.5 mm).
8. Measure the outside diameter of the pivot shaft ① and inside diameter of the bushings ②. Replace the pivot shaft or bushing if clearance is more than .012 in. (0.3 mm).

Assembly

Assembly generally follows disassembly procedures in reverse however the following must be observed:

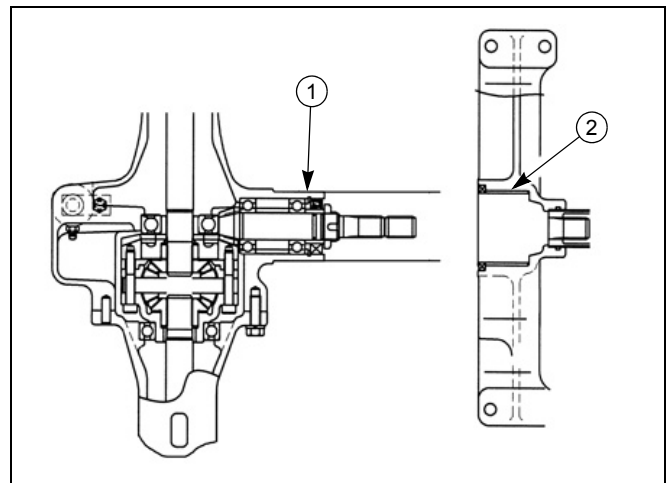


Figure 5-9

1. Pivot Shaft	2. Bush
----------------	---------

1. Completely remove the oil from the ring gear thread and ring gear bolts before reassemble.
2. Coat all ring gears to differential housing bolts with Locktite sealant and torque to 17.7 – 22.1 ft.-lbs. (24 – 30 Nm).
3. Install the bearings (② and ③) and collar ④ on the pinion shaft ①, and install a new o-ring ⑤.

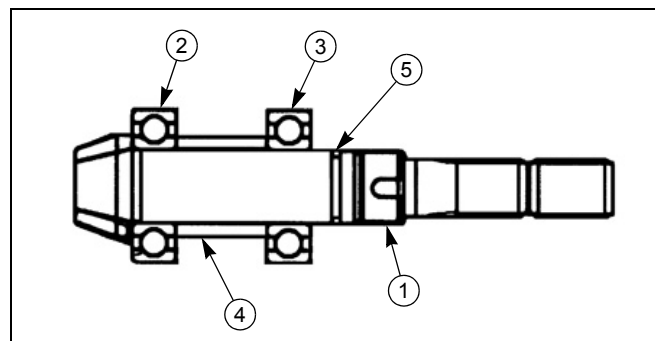


Figure 5-10

- | | |
|-----------------------|-----------|
| 1. Drive Pinion Shaft | 4. Collar |
| 2. Bearing | 5. O-ring |
| 3. Bearing | |

4. Install the drive pinion ① as a set and spacer ② secure with snap ring ③ in the left axle housing ④.
5. Install the new oil seal ⑤ in the left axle housing.
6. Install the collar ⑥ on the drive pinion shaft.
7. Install the lock nut ⑦ and tighten to 48.5 – 61.4 ft.-lbs. (65.7 – 83.3Nm). Stake the nut to the pinion shaft groove.

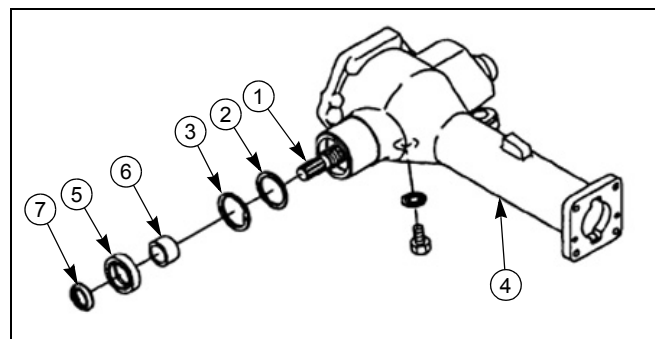


Figure 5-11

- | | |
|-----------------------|-------------|
| 1. Drive Pinion Shaft | 5. Oil Seal |
| 2. Spacer | 6. Collar |
| 3. Snap Ring | 7. Lock Nut |
| 4. Left Axle Housing | |

8. Adjust the ring gear to pinion backlash as follows:
 - a. With the drive pinion and left axle installed, place the differential assembly into the housing. Measure the distance “A” from bearing to the housing.
 - b. Measure the depth of the right hand axle housing “B” from the housing to the bottom of the bearing bore.
 - c. Select shims so that measurement “A” equals measurement “B”.

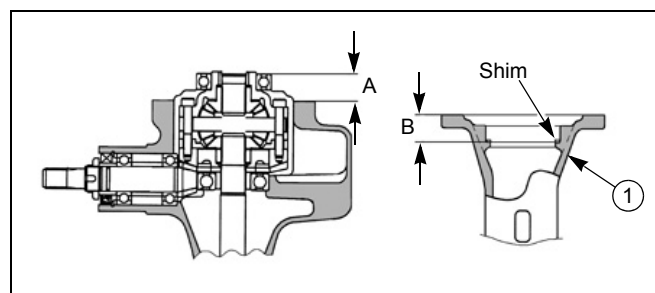


Figure 5-12

For example: If measurement “B” is .807 in. (20.5 mm) and measurement “A” is .787 in. (20.0 mm), the difference is .020 in. (0.5 mm).

Place the selected shim(s) into the right axle housing ① prior to assembly. This procedure will give you the correct ring gear to pinion backlash.

Installation

Installation generally follows removal procedure in reverse however, the following must be observed:

Adjust the toe-in ($A - B$) with the tie rod to .197 in. (5 mm).

Fill the rear axle to the level plug with gear oil.

Fill the steering head housings at both ends of the axle with gear oil up to the level of the fill plug if they have been drained. Oil from the center section of the axle makes its way slowly from the center to these housings.

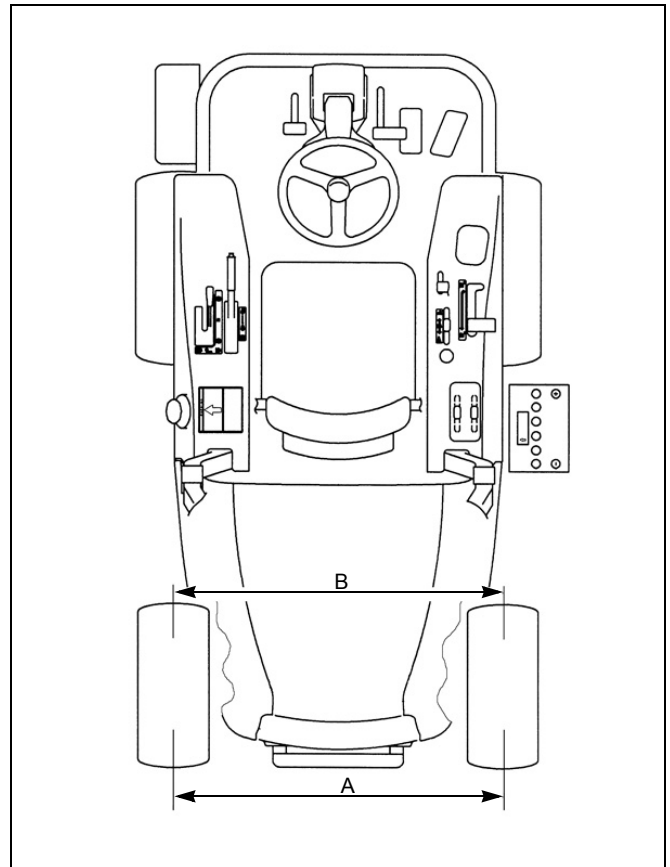


Figure 5-13

Chapter 6

HYDRAULIC LIFT SYSTEM

Description and Operation

The hydraulic system consists of a filter, hydraulic pump, oil cooler, control valve, weight transfer valve, lift cylinders, tubing, restriction valve and lift arms.

The oil pump is a gear type which is installed on the engine timing gear case.

The control valve consists of a body, valve spool, weight transfer valve, relief valve and float detent assembly.

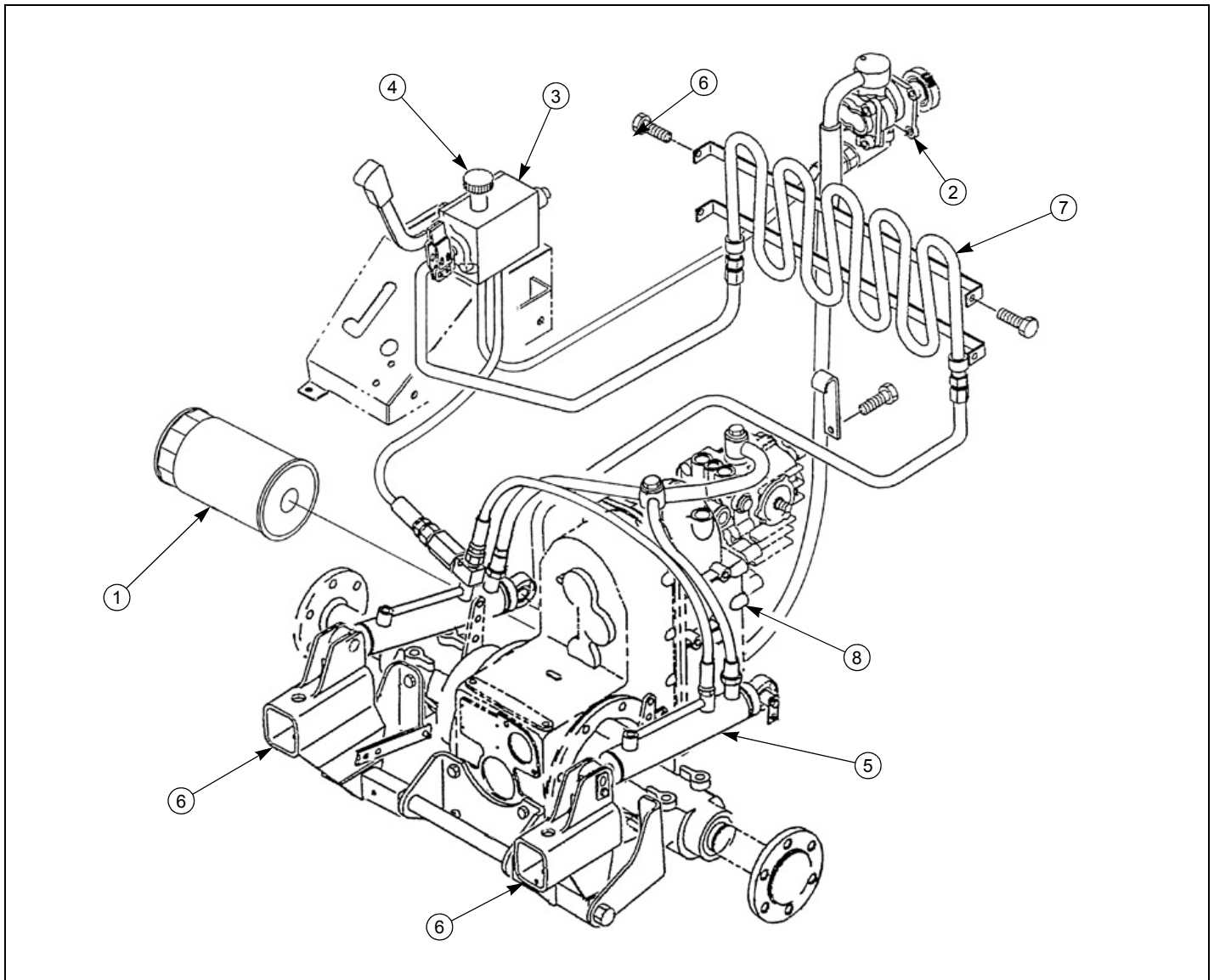


Figure 6-1

1. Oil Filter	5. Lift Cylinders
2. Oil Pump	6. Lift Arms
3. Control Valve	7. Cooler
4. Weight Transfer Valve Grip	8. Transmission Reservoir

Oil Flow

A. Neutral Position

Pressurized oil flows to the “P” port of the control valve. The oil flows through a passage in the spool and is directed to the “T” port, then to the cooler and transmission. The oil in the lift cylinders port “A” is trapped by the spool and holds the lift arms in a constant position.

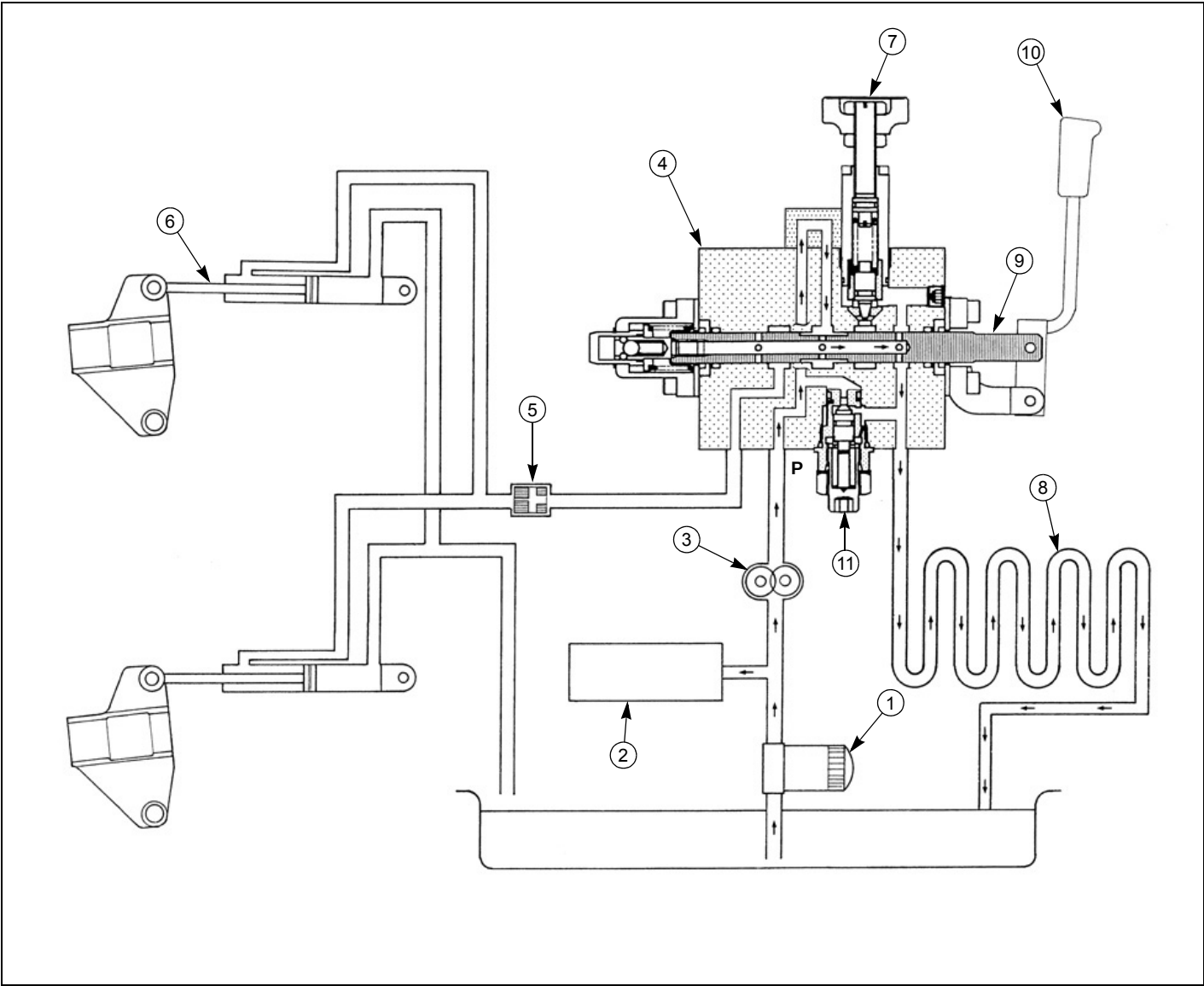


Figure 6-2

1. Oil Filter	5. Restriction Valve	9. Spool
2. HST Unit	6. Lift Cylinder	10. Control Lever
3. Oil Pump	7. Weight Transfer Valve	11. Relief Valve
4. Control Valve	8. Oil Cooler	

B. Raising Position

When the control valve lever is moved to the raised position (in), the pressurized oil from “P” port flows to A1 and is directed to the lift cylinder rods side “A” and raises the lift arms. Oil on the piston side “B” is directed to the transmission. Holding the lift lever in the raised position, with the lift arms fully raised, will cause the relief valve in the control valve to open and direct the oil to the cooler circuit.

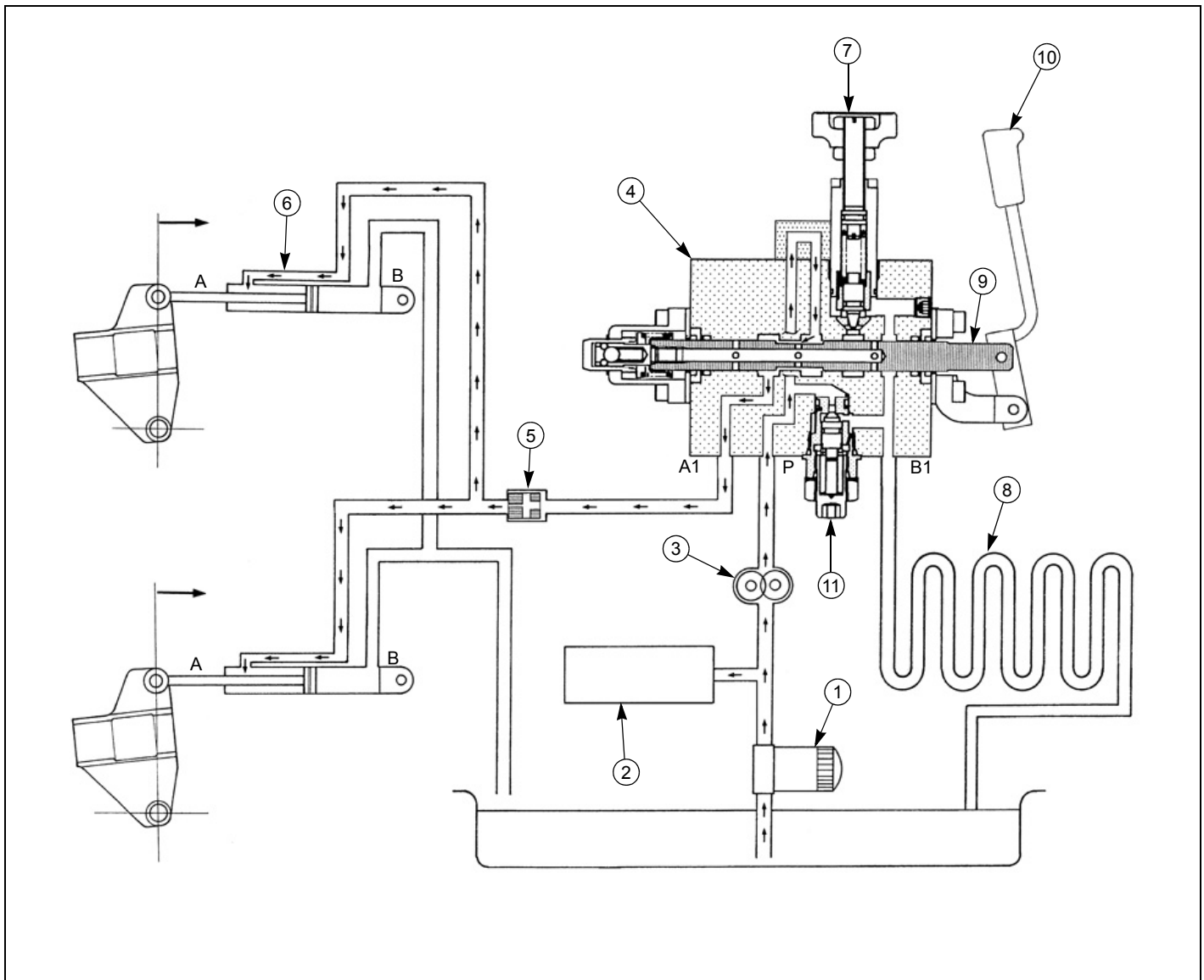


Figure 6-3

- | | | |
|------------------|--------------------------|-------------------|
| 1. Oil Filter | 5. Restriction Valve | 9. Spool |
| 2. HST Unit | 6. Lift Cylinder | 10. Control Lever |
| 3. Oil Pump | 7. Weight Transfer Valve | 11. Relief Valve |
| 4. Control Valve | 8. Oil Cooler | |

C. Lowering (Float) Position

When the control lever is moved to the lowering position pressurized oil enters port “P” and is directed to “B1” port. Oil from “B1” port flows to the weight transfer valve and is returned to the transmission via the oil cooler.

At the same time oil in port “P” is fed oil from the rod side of the lift cylinders port “A” by the weight of the implement. The oil then flows through a passage to “B1” port and through the weight transfer valve to the transmission and the implement lowers.

Turning the adjuster in on the weight transfer valve will reduce the flow rate, and the pressure in the lift cylinder “A” side can be changed to reduce the weight of the implement on the gauge wheels. The weight transfer valve contains a drilled passage to allow oil to flow if the knob is fully closed.

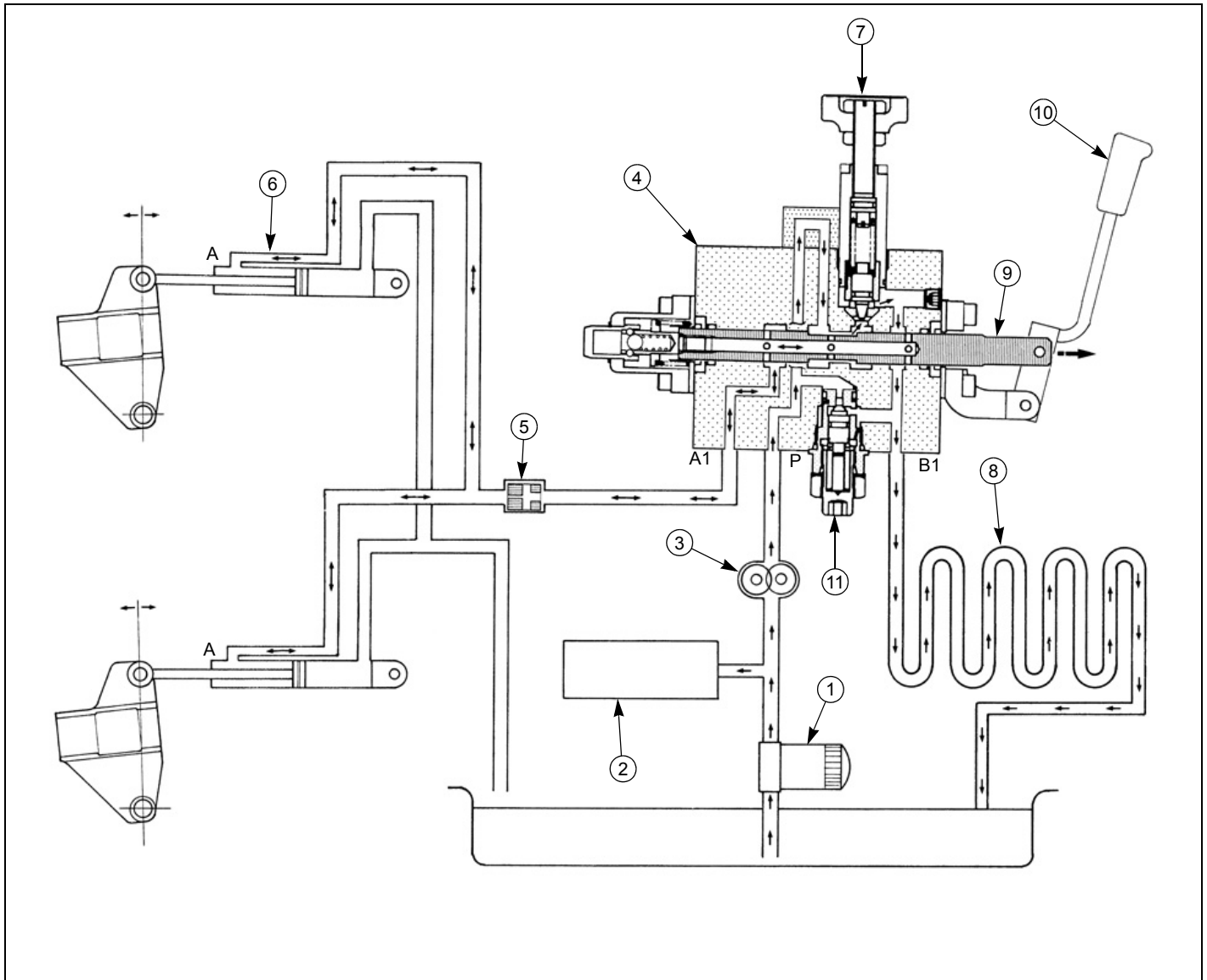


Figure 6-4

1. Oil Filter	5. Restriction Valve	9. Spool
2. HST Unit	6. Lift Cylinder	10. Control Lever
3. Oil Pump	7. Weight Transfer Valve	11. Relief Valve
4. Control Valve	8. Oil Cooler	

Overhaul

A. Control Valve

1. Removal

- Remove the R.H. side cover.
- Remove the weight transfer valve grip.
- Remove the eye bolt ① from bottom of the control valve ④.
- Disconnect the oil hoses (② and ③) from under the control valve.
- Drive out the roll pin ⑤ from the spool.
- Remove the snap pin and pin ⑥ and separate the control lever ⑦ from the control valve.

2. Disassembly

Reference – Figure 6-6

Repair of hydraulic control valve is limited to seal replacement only.

- Remove the bolts ① and pull the cap ③ and spool ② with plate ⑪ as an assembly.
- Place the control end of the spool in a vice and remove the snap ring ④.

NOTE: Do not expand the snap ring to far. The snap ring will become deformed and will not hold during assembly.

- Using care not to lose balls (⑦ and ⑧), remove the holders ⑥ and spring ⑨ from the spool.

NOTE: Do not remove the stopper ⑮, spring and seat from the spool.

- Remove the sealing plate ⑪, wiper ⑫, spacer ⑬ and o-ring ⑭ from the valve body.

3. Inspection

- Wash all parts in a suitable solvent and air dry.
- Discard all o-rings and seals.
- Inspect the control valve spool and valve body bore for any damage. If either is defective, replace the control valve assembly.

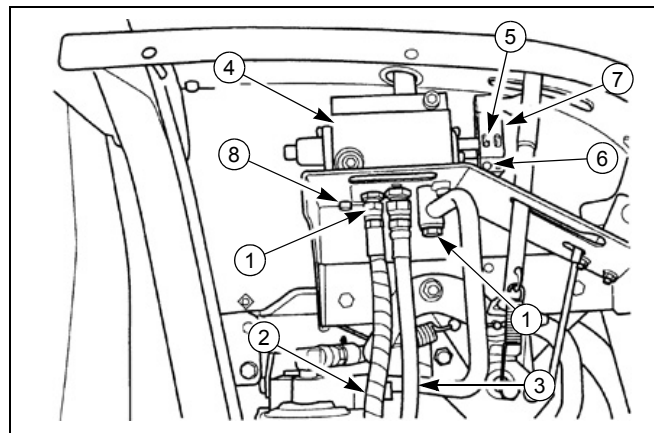


Figure 6-5

- | | |
|------------------|------------------|
| 1. Eye Bolt | 5. Roll Pin |
| 2. Oil Hose | 6. Pin |
| 3. Oil Hose | 7. Control Lever |
| 4. Control Valve | 8. Bolt |

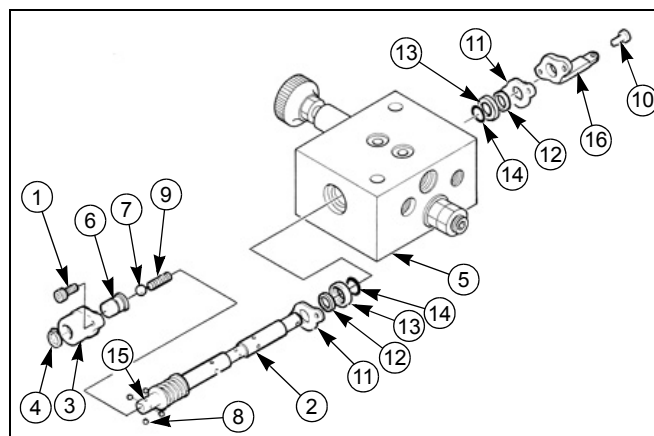


Figure 6-6

- | | |
|---------------|-------------------|
| 1. Bolt | 9. Spring |
| 2. Spool | 10. Bolt |
| 3. Cap | 11. Plate |
| 4. Snap Ring | 12. Wiper |
| 5. Valve Body | 13. Spacer |
| 6. Holder | 14. O-Ring |
| 7. Ball | 15. Stopper |
| 8. Ball | 16. Lever Support |

- d. If necessary, remove the relief valve assembly ① as a set.

NOTE: Do not disassemble the relief assembly.

- e. If necessary, remove the weight transfer assembly ② as a set.

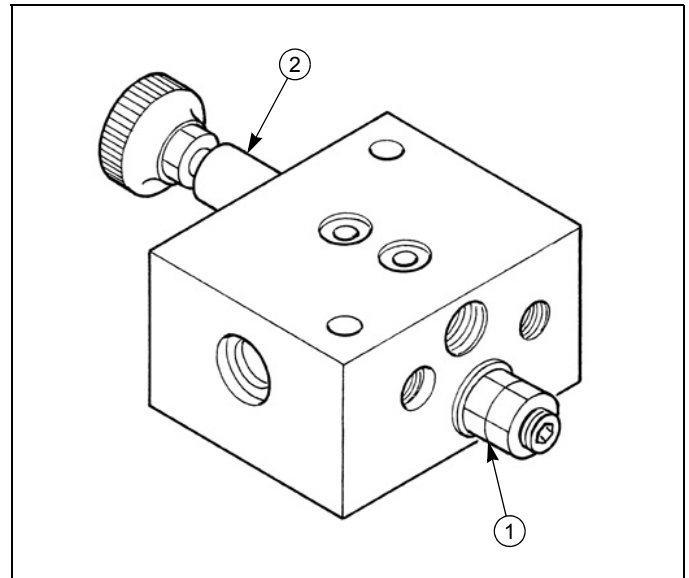


Figure 6-7

- | | |
|----|-----------------------|
| 1. | Relief Valve |
| 2. | Weight Transfer Valve |

4. Assembly

Prior to assembly coat the valve body bore and spool with clean hydraulic oil. Assembly of the control valve generally follows disassembly procedures in reverse, however the following must be observed:

- a. Coat all steel balls using grease.
- b. Install the snap ring ① with the rounded edge facing the cap.
- c. Tighten the sealing plate bolts ⑩ to 4 ft-lbs. (5.5 Nm) and check the spool for smooth operation, Figure 6-6.

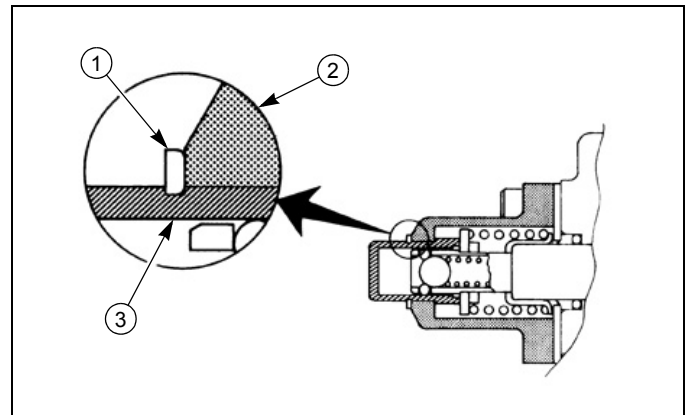


Figure 6-8

- | | |
|----|-----------|
| 1. | Snap Ring |
| 2. | Cap |
| 3. | Holder |

B. Remote Valve

On units equipped with a remote valve the repair procedure is the same as the control valve.

The remote valve does not utilize a detent (float) position and it is not equipped with a relief valve assembly and weight transfer valve assembly. The single action changeover control valve is found on the remote valve.

C. Lift Cylinder

1. Removal

- Remove the both side panels.
- Place the stands under the power unit and remove the front wheels.
- Disconnect the high pressure oil hose ① from the adapter.
- If necessary, remove the adapter ③ from the cylinder ④. Loosen the hose band, and disconnect the vent hose ⑤ from the adapter.
- Remove the bolts ⑥ and pins ⑦, and remove the cylinder ④ from the frame while supporting the lift arms.

NOTE: Do not disassemble the lift cylinder assembly. If oil leaking and/or trouble is evident from cylinder assembly, replace the assembly.

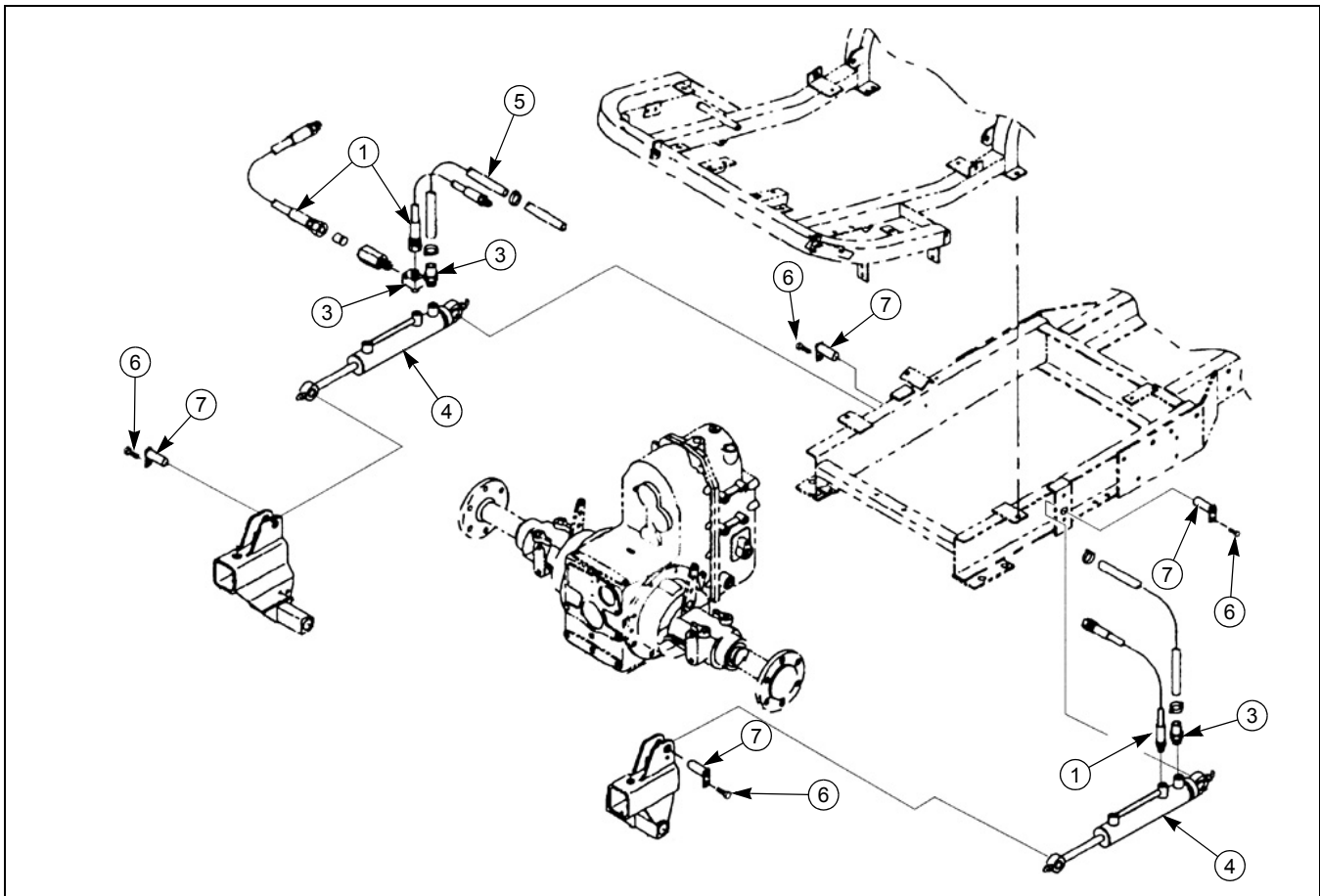


Figure 6-9

2. Inspection

- Inspect the anchor pins and bushings for excess wear and excessive clearance. Replace cylinder assembly and/or pins if the clearance is over .02 in. (0.5 mm).

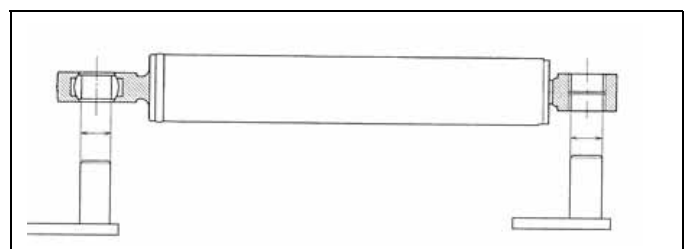


Figure 6-10

3. Pressure Test

- Remove the side cover and front R.H. wheel.
- Disconnect the high pressure hose from the adapter.
- Install the fitting (Part No. 340630260) and a 0 – 3000 psi (0 – 19.6 MPa) pressure gauge to the high pressure oil hose to the cylinder.
- Start the engine, and allow it to idle.
- Observe the pressure gauge, it should indicate 0 psi (0 MPa).
- Push the hand throttle lever forward and keep the engine high idle speed.
- Pull the lift control lever rearward and read the pressure gauge immediately.
- Stop the engine.

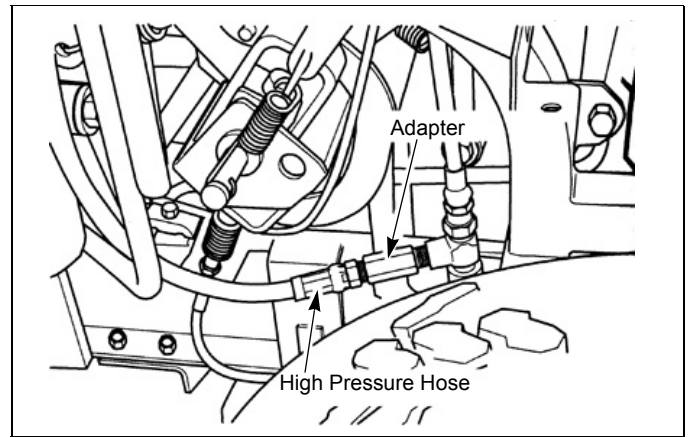


Figure 6-11

Test Result

If pressure rises to the relief valve setting of 1421 psi (9.8 MPa), it indicates that the system is operating properly.

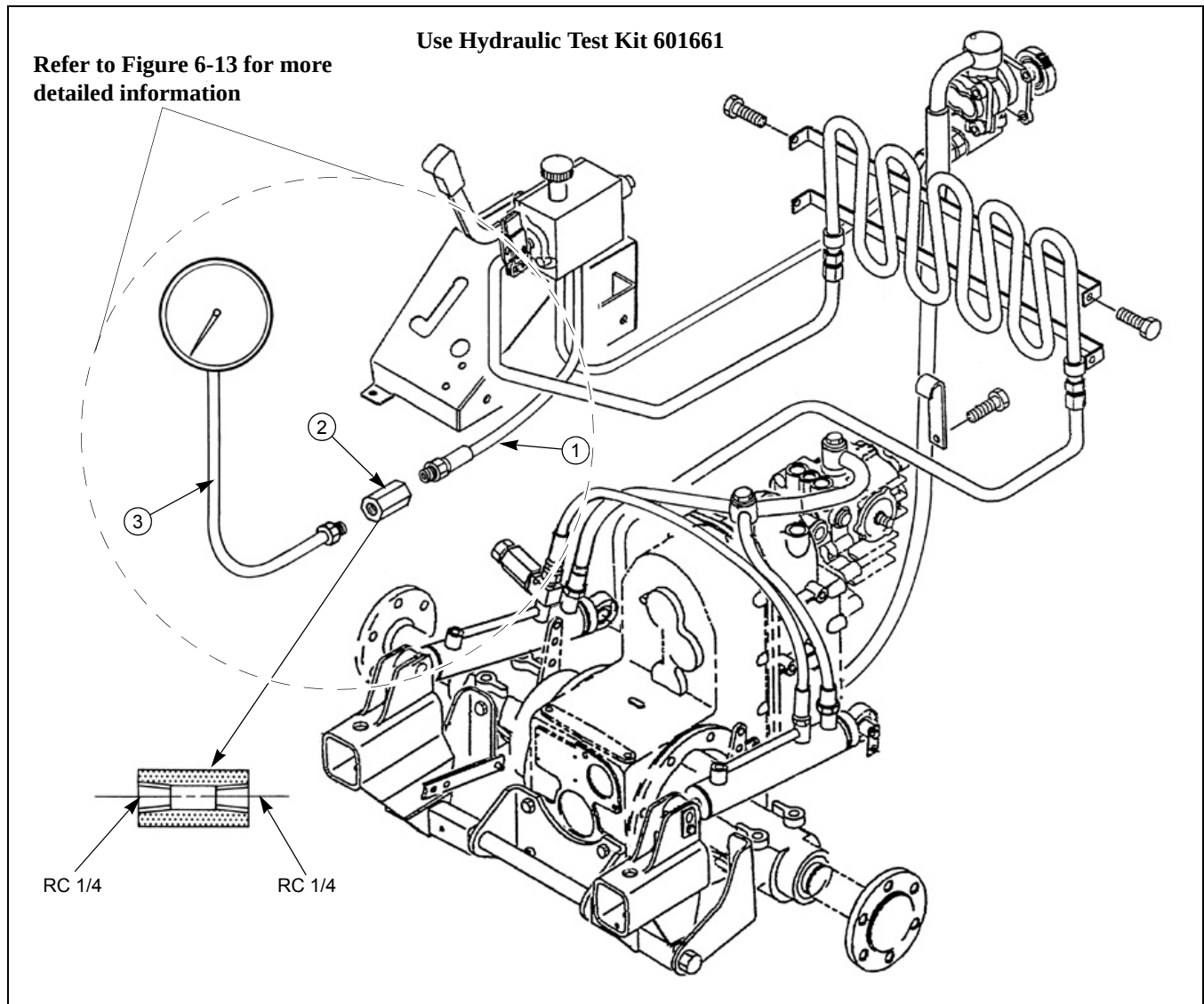


Figure 6-12

1. High Pressure Oil Hose
2. Fitting
3. Oil Pressure Gauge

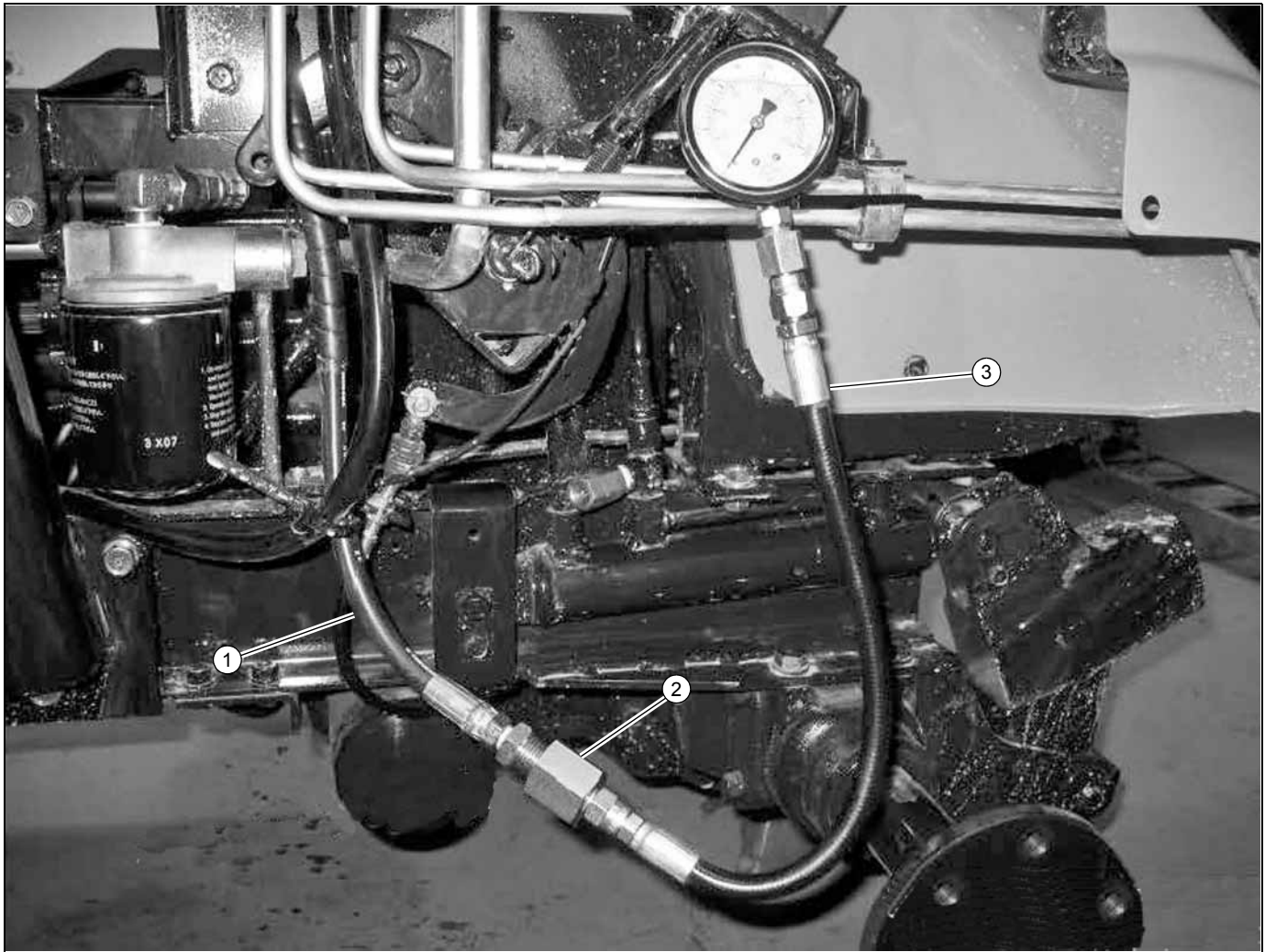


Figure 6-13

1. High Pressure Oil Hose
2. Fitting
3. Oil Pressure Gauge

NOTE: If the restriction valve is removed, note the direction of the orifice (toward cylinder).

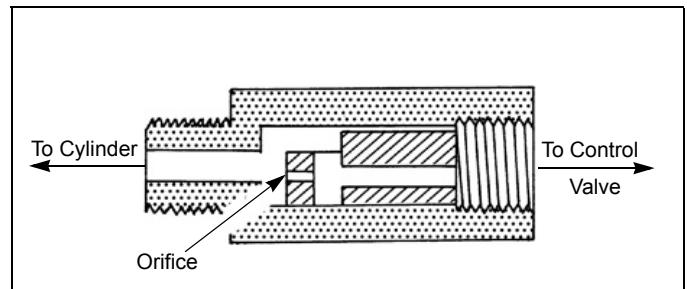


Figure 6-14

Chapter 7

IMPLEMENT DRIVE

Description and Operation

The implement drive is helical gear driven. The wet disc clutch is engaged by a PTO lever on the right side adjacent to the operator's seat.

When the PTO lever ① is moved to the engaged position, it contacts a shaft ②, the fork joint assembly ③ and rotates the lever ④ of PTO clutch shaft.

When the clutch fork ⑤ on the PTO clutch shaft is rotated the release bearing ⑥ is pushed rearward placing pressure on the pressure plate and engaging the clutch discs and plates ⑦.

During normal operation attempts to raise the attachment (deck, blade, etc) higher than a 20 degree angle will result in the lift arm ⑧ to automatically disengage the PTO

As the attachment is raised, the cable ⑨ on the lift arm pulls the bell crank ⑩ downward. The downward action causes the shift plate cam ⑪ to unhook from the PTO lever ①. Springs in the PTO clutch assembly move the PTO lever rearward, disengaging the PTO. To resume operation the PTO lever must be returned to the "OFF" position to reset the disconnect mechanism with the attachment lowered within the operating range.

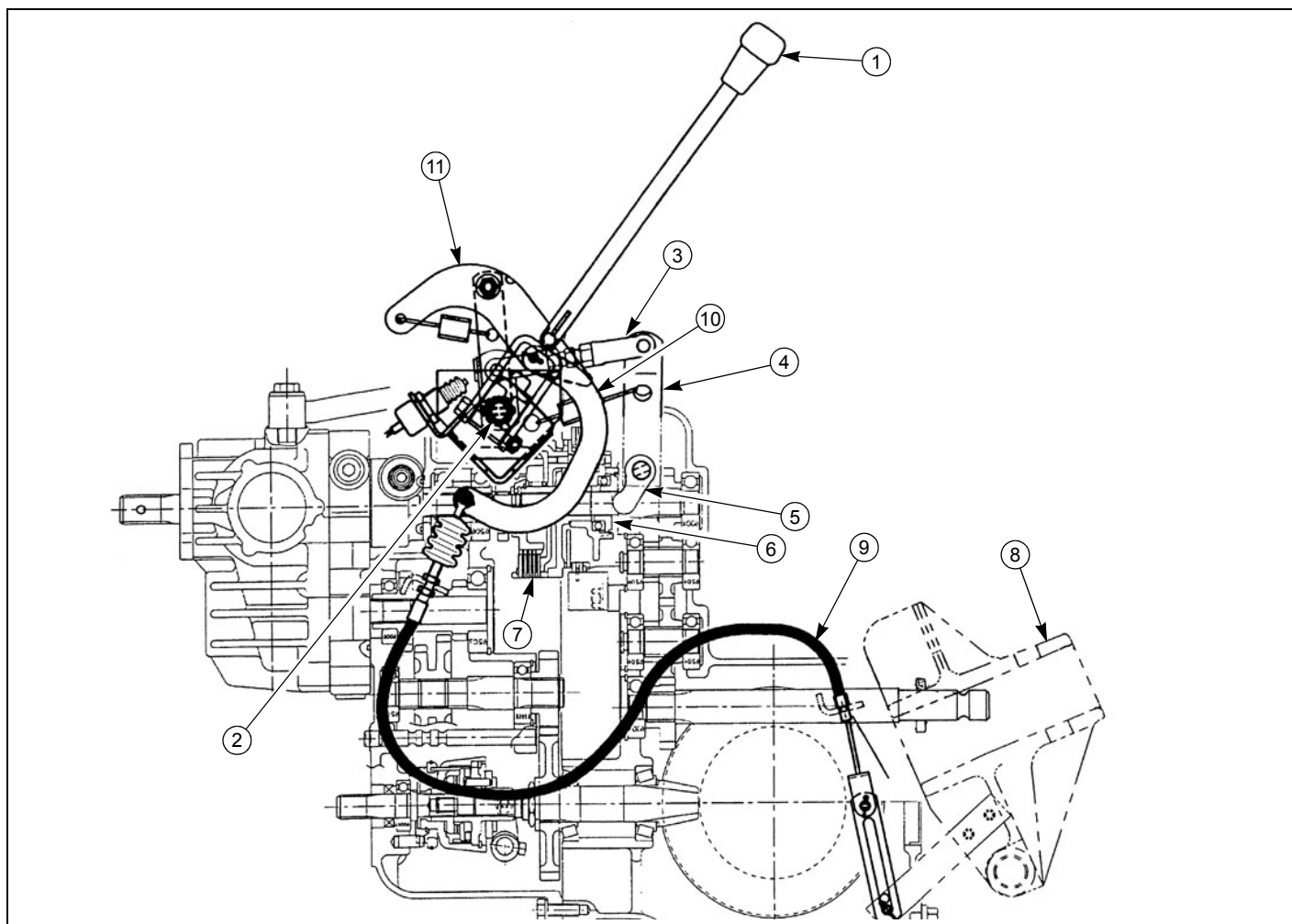


Figure 7-1

1. PTO Lever	5. Clutch Fork	8. Lift Arm
2. Shaft	6. Release Bearing	9. Cable
3. Fork Joint Assembly	7. Clutch Disc and Plate Assembly	10. Bell Crank
4. Lever		11. Shift Plate Cam

Power Flow

A. Front PTO

Power flows from the engine through the HST transmission input shaft ① and is coupled to the PTO clutch coupling ②.

When the PTO lever ③ is in the “OFF” position the clutch discs and plates slip, disengaging the PTO and shaft.

When the PTO lever ③ is in the “ON” position, the clutch fork ⑥ rotates and pushes the release bearing ⑦. The clutch spring ⑧ then applies pressure to the pressure plate which engages the clutch discs and plates ④. Power then flows to PTO shaft ⑤ through the helical gears ⑨.

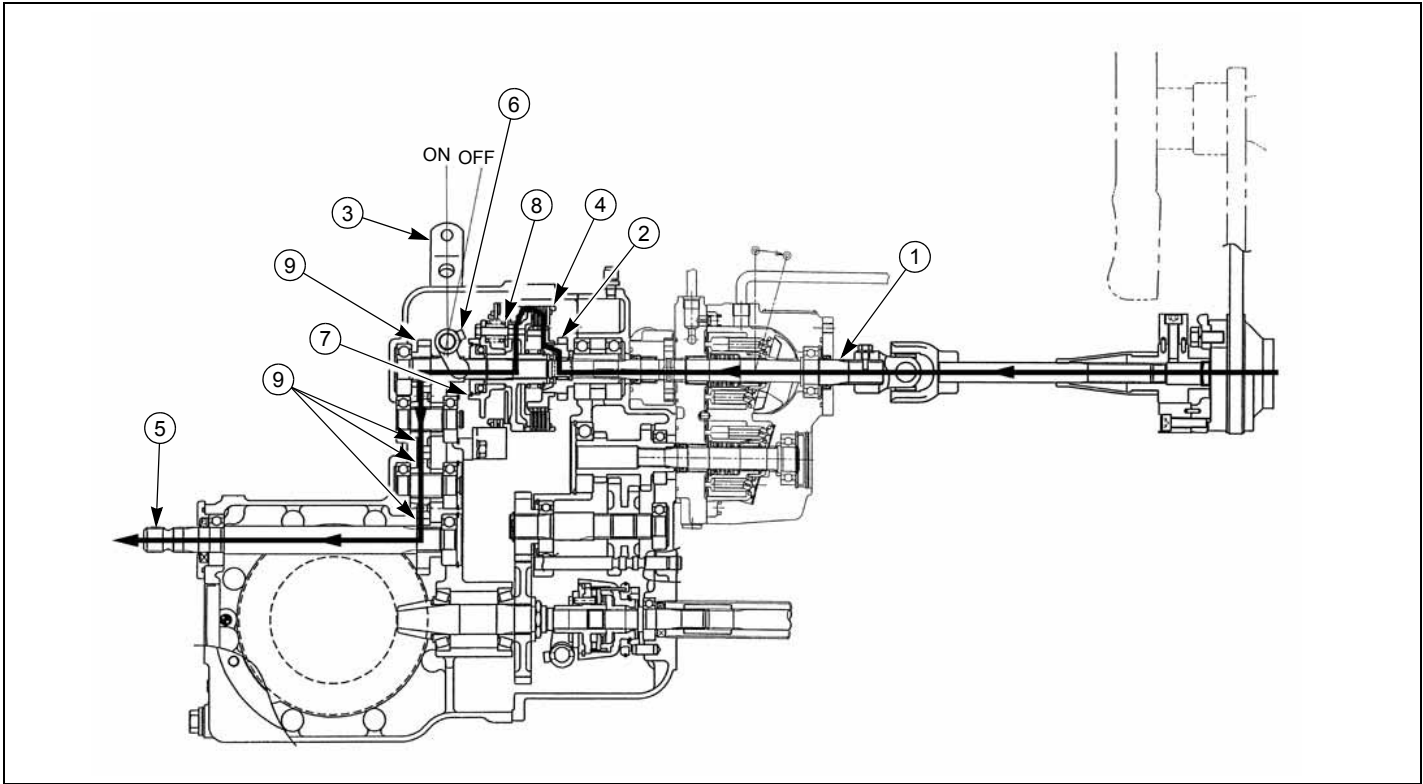


Figure 7-2

1. Input Shaft	6. Clutch Fork
2. PTO Clutch Coupling	7. Release Bearing
3. PTO Lever	8. Clutch Spring
4. Clutch Disc and Plate	9. Helical Gear
5. PTO Shaft	

B. Automatic PTO Disengage System

1. When the lift arm is lower position the PTO lever is in the "ON" position.
2. In the "ON" position the shift plate cam ① and PTO lever ② are coupled at position "A" causing the PTO shaft to rotate.

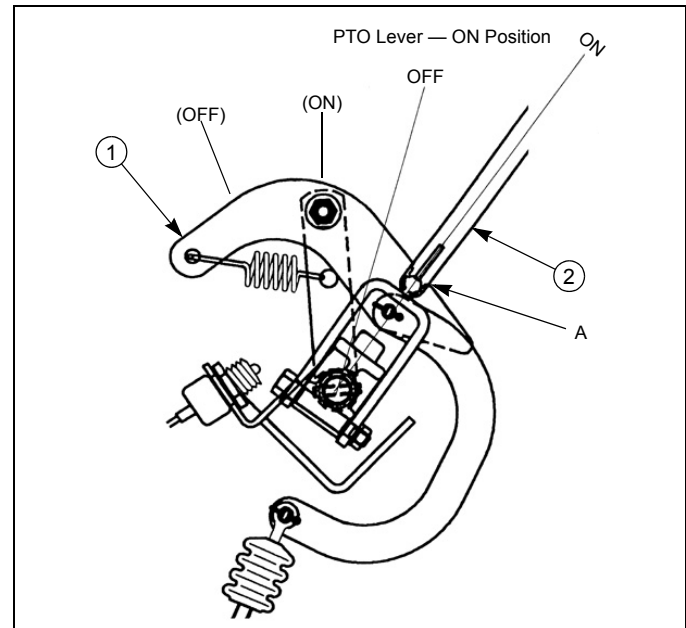


Figure 7-3

- | | |
|----|-----------------|
| 1. | Shift Plate Cam |
| 2. | PTO Lever |

3. As the lift arm is raised (near it's highest position) the pin ③ in the bell crank is pulled downward by the cable ④. The bell crank rotates on the center pin ⑤ and the fulcrum pin ⑥ until the pin ⑦ in the PTO lever slips out of the shift plates cam groove ⑧.

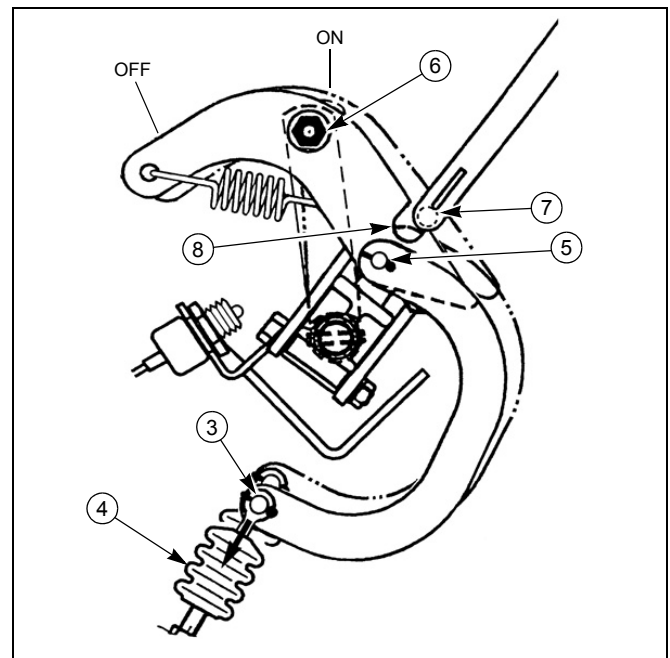


Figure 7-4

- | | |
|----------|-----------|
| 3. Pin | 6. Pin |
| 4. Cable | 7. Pin |
| 5. Pin | 8. Groove |

4. When the lift arm is raised to its highest position, the pin ③ in the bell crank is pulled further downward by the cable ④. The downward force causes the shift plates cam groove ⑧ to unhook from the pin ⑦. Springs in the PTO clutch assembly move the shift plate cam ① and lever ⑨ to the “OFF” position.
5. The power flow to PTO shaft and the clutch assembly are disengaged at the same time.

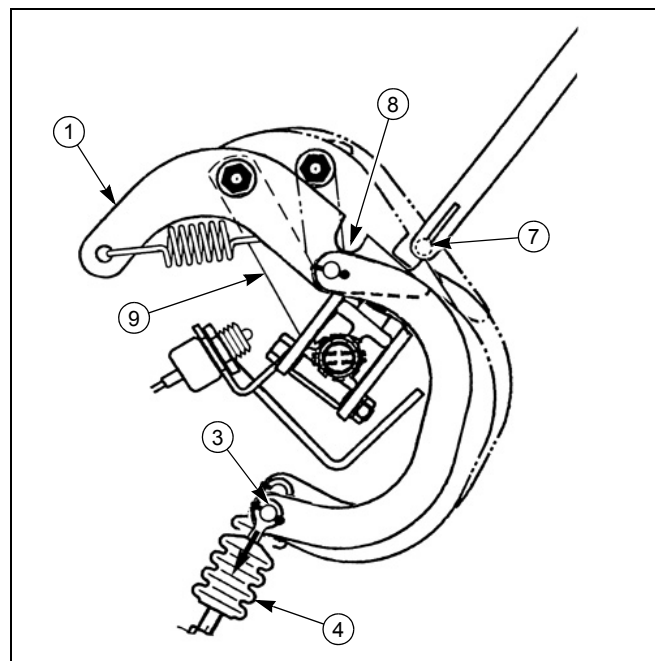


Figure 7-5

- | | |
|--------------------|-----------|
| 1. Shift Plate Cam | 7. Pin |
| 3. Pin | 8. Groove |
| 4. Cable | 9. Lever |

C. Adjustment and Specification

1. PTO Lever Link System

Check the PTO lever force by moving the lever from the “OFF” position to the “ON” position.

When the PTO lever reaches the halfway point (50%) of allowable travel the force should be hard. If the force is not hard at the halfway point, adjust as follows:

- If necessary, disconnect the seat safety switch wire and remove the seat and floor pan from the power unit.
- Loosen lock nuts ① and ② on the adjustment rod ③.
- Adjust the rod ③ until the moving force has reached halfway (50%) of the PTO lever stroke.

NOTE: Adjust pressure until approximately 10 - 12 pounds of pressure is required to move the rod half way and 20 - 24 pounds of pressure to engage and lock the lever.

- Tighten the lock nuts (① and ②) and recheck the PTO lever's position.

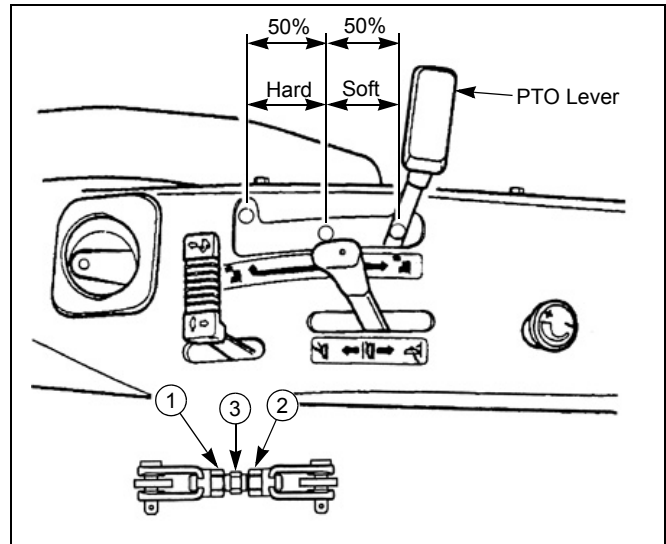


Figure 7-6

- | | |
|-------------|--------|
| 1. Lock nut | 3. Rod |
| 2. Lock nut | |

2. PTO Release Cable Adjustment

- Park the unit of level ground, turn the engine off, chock the wheels, and set the parking brake before making this adjustment.
- Place the hydraulic lift control lever in the down (lower) position and manually push down the lift arms.
- If necessary, remove the side cover.
- Loosen the lock nuts (① and ②) located at the end of the cable ③.
- Start the engine and raise the lift arms to the highest position. Then, shut the engine off.
- Move the PTO lever ⑤ to the “ON” position.
- Turn the lower lock nut ① until the shift plate cam ⑥ disengages.
- Turn the lower lock nut ① two additional turns, then tighten the upper lock nut ②.
- Replace the side cover, if removed.

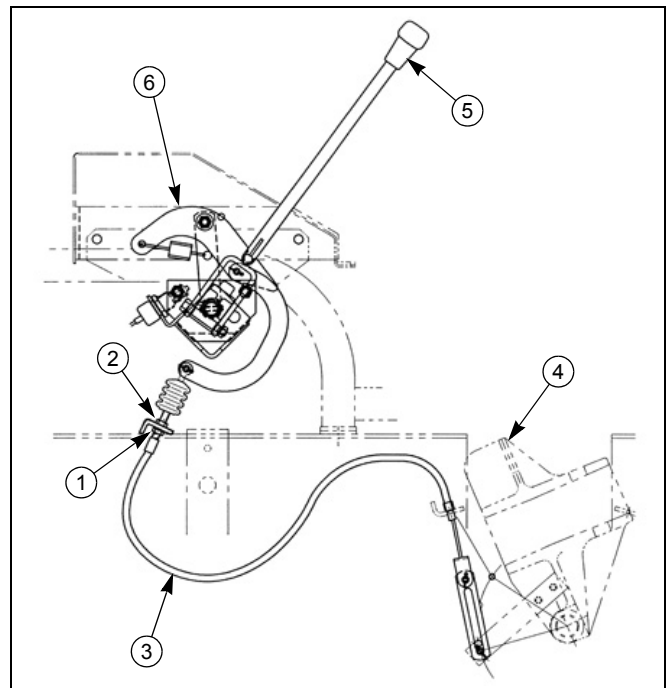


Figure 7-7

- | | |
|-------------|--------------------|
| 1. Lock nut | 4. Lift Arm |
| 2. Lock nut | 5. PTO Lever |
| 3. Cable | 6. Shift Plate Cam |

Chapter 8

MAINTENANCE STANDARDS TABLE

Maintenance Standards Table

* Unless noted all values are in inches (mm)

Unit	Part	Inspection Item	Standard Dimensions	Standard Assembling Value	Repair Value	Service Limit	Remarks
Power unit main body	Transmission	Gear backlash		.001 - .006 (0.04 - 0.16)		.023 (0.6)	
		Slide gear shifter fork clearance		.0008 - .0016 (.02 - 0.4)		.039 (1.0)	
	Differential/PTO	Differential pinion - pinion shaft clearance		.004 (0.1)		.019 (0.5)	
		Differential pinion - thrust washer thickness	.047 (1.2)	.047 (1.2)		.035 (0.9)	
		Differential gear - thrust washer thickness		.079 (2.0)		.067 (1.7)	
		Differential gear/differential pinion backlash		.004 - .008 (0.1 - 0.2)		.016 (0.4)	
		Ring gear tightening torque ft.-lbs. (Nm)		34.0 - 42.7 (46.1 - 57.9)			
		Drive pinion preload lbf (N)		44.06 (196)			Load when pulled with string wound on spline
		Drive pinion/ring gear backlash		.004 - .008 (0.1 - 0.2)	.016 (0.4)		
		PTO shaft end run-out		Less than .004 (0.1)		.012 (0.3)	
		Gear oil quantity qt (ℓ)	21.13 (20)				
	Front wheel	Rim run-out		.118 (3)		.197 (5)	
		Tire size	23 x 10.50 - 12 4PR				
	Brake	Brake lining groove depth		.004 (0.1)		0	
		Level difference to stator (on lining contact surface)	0			.004 (0.1)	
		Pedal shaft - bush clearance		.002 - .014 (0.05 - 0.35)		.039 (1.0)	
		Pedal play		1.378 - 1.772 (35 - 45)	More than 1.968 (50)		
		Pedal shaft bush bore		Ø .984 (25)		Ø 1.016 (25.8)	
	Hydraulic lift	Relief valve working pressure psi (MPa)		1421.4 (9.8)			
		Arm shaft - bush clearance		.001 - .004 (0.025 - 0.1)		.019 (0.5)	
		Hydraulic lift natural settlement (lower link end) in/min (mm/min)		1.18/5 (30/5)	3.94/5 (100/5)		Engine stop. Load 771.6 (350kg) Hydraulic oil 140 - 158°F (60 - 70°C)
		Hydraulic cylinder - piston clearance				.028 (0.7)	
		Piston rod - cylinder head clearance				.012 (0.3)	

Unit	Part	Inspection Item	Standard Dimensions	Standard Assembling Value	Repair Value	Service Limit	Remarks
Power unit	4WD rear axle	Differential pinion – pinion shaft clearance		.001 - .004 (0.03 - 0.1)			
		Differential pinion thrust washer thickness	.047 (1.20)	.043 - .047 (1.1 - 1.2)		.035 (0.9)	
		Differential gear thrust washer thickness				.035 (0.9)	
		Differential gear/differential pinion backlash		.009 - .012 (0.2 - 0.3)		.016 (0.4)	
		Ring gear tightening torque ft.-lbs. (Nm)		17.7 - 22.1 (24 - 30)			
		Drive pinion/ring gear backlash		.040 - .012 (1.010 - 0.2)	.012 (0.3)		
		Pivot shaft bush clearance	Front	.001 - .006 (0.02 - 0.15)		.012 (0.3)	
		Toe in		± .197 (± 5)	± 10		
		Rim run-out		.118 (3.0)		.197 (5.0)	
		Tire size	20 x 8.00 - 10 4PR				
		Gear oil ℓ	Differential chamber	.051 (1.3)			Dipstick check
			Gear chamber	.019 (0.5) on one side			Level plug check
	Power Steering	Relief valve working pressure psi (MPa)		852.8 - 951.5 (5.88 - 6.56)			At 16.9 qt/min (16 ℓ/min)
		Oil quantity qt (ℓ)	21.13 (20)				Common use HST oil
		Oil type	ISO VG46				Hydraulic oil
		Hydraulic cylinder - piston clearance				.028 (0.7)	
		Cylinder head bush - piston rod clearance				.012 (0.3)	
		Pin- bush (piston rod cylinder tube) clearance				.019 (0.5)	
		Steering wheel peripheral play	.787 - 1.575 (20 - 40)			50	
	HST	Model	HVFD-18A18-M				
		High pressure relief valve psi (MPa)	4935.6 (34.03)				
		Low pressure relief valve psi (MPa)	71.07 (0.49)				
		Charge pump capacity cu. in/rev (cc/rev.)	.299 (4.9)				

Chapter 9

ELECTRICAL SYSTEM

Description

The electrical system is a 12-volt negative (-) ground system consisting of wiring harness.

Component Location and Function

Reference - Figure 9-1

A. Battery

The battery is located on right side of the frame.

B. Fusible Link

The fusible link is located on left side of engine, near the starting motor. It controls current flow for the entire power unit.

C. Parking Brake Switch

The parking brake switch is located under the parking brake lever, and actuates when the parking brake is engaged.

D. Alternator

The alternator provides current flow to the battery.

E. Safety Start Switches

1. The HST neutral switch is located on the left side of the HST unit. It is in the "ON" position when the HST foot pedals are released.
2. The PTO neutral switch is located on the PTO control linkage. It is in the "ON" position when the PTO lever is in the "OFF" position.
3. The brake switch is located on the right side under the floor. It is in the "ON" position when the master brake pedal is depressed.
4. The seat switch is located under the seat. It is in the "ON" position when operator is seated. The power unit can be started when all the above switches are in the "ON" position.

NOTE: The power unit can be started without being seated and/or the master brake pedal is not depressed when the parking brake lever is locked.

F. Fuel Level Sending Unit

The fuel level sending unit is located inside the fuel tank, it sends a signal indicating fuel level to the instrument panel.

G. Engine Coolant Temperature Sensor

The engine coolant temperature sensor is located in the thermostat housing of front left side of the engine cylinder head.

This sender regulates a variable resistance to ground which translates into the movement of the temperature gauge.

H. Engine Coolant Temperature Switch

The engine coolant temperature switch is located in the

thermostat housing of front left side of the engine cylinder head.

This switch is open under normal operating temperatures and closes when operating temperatures reach higher than normal limits 224.6 – 235.4°F (107 – 113°C).

I. Starter

The starter is located to the left side of the engine. It rotates the engine for starting.

J. Head Light Switch

The head light switch is located under the instrument panel. It controls current to head lamp.

K. Key Switch

The key switch is located on the right side of the instrument panel.

L. Engine Oil Pressure Sending Unit

The engine oil pressure sending unit is located in front of the cylinder head. It provides a warning of low engine oil pressure with an oil pressure lamp and a buzzer for audible alarm.

M. Head Light

The head light is located at the base of the steering column. It is controlled by the head light switch.

N. Instrument Panel

The instrument panel is located in the center of the dash. It monitors power unit functions.

O. Fuel Shutoff Solenoid

The fuel shutoff solenoid is located on the right side of the engine. It shuts off fuel flow to the injection pump to stop the engine. It must be energized with 12v DC to allow engine operation.

P. Glow Plugs

The glow plugs are located on the right side of the cylinder head adjacent to the fuel injectors. They aid in engine startup by warming the air in the combustion chamber.

Q. Fuse Blocks

The fuse blocks are located on the left side of the compartment fire wall. They control current flow for individual circuit.

R. Relays

Five standard relays and one optional relay are installed on the left side of the compartment fire wall. Four relays (starter, engine stop solenoid, over heat warning buzzer, and engine oil pressure warning buzzer) and one optional relay (cruise control) are interchangeable. The relays color

connector's are different for identification reasons.

S. Alarm Buzzer

The buzzer is located on the left side of the compartment fire wall. The buzzer activates when the engine oil pressure is low and/or engine is over heated.

T. Air Cleaner Restriction Sending Unit

The air cleaner restriction sending unit is located on the top of the engine. It warns when the air cleaner element is clogged.

U. Electric Fuel Pump

The electric fuel pump is located on right side of the battery stand. It supplies fuel under pressure to the fuel injection pump.

V. Cruise Control Switch

The cruise control switch is located on the right side of the dash board. It controls current to the speed control magnet.

W. Cruise Control Magnet

The cruise control magnet is located on the control lever of the left side of the HST unit.

It locks the HST linkage in place to set constant speed.

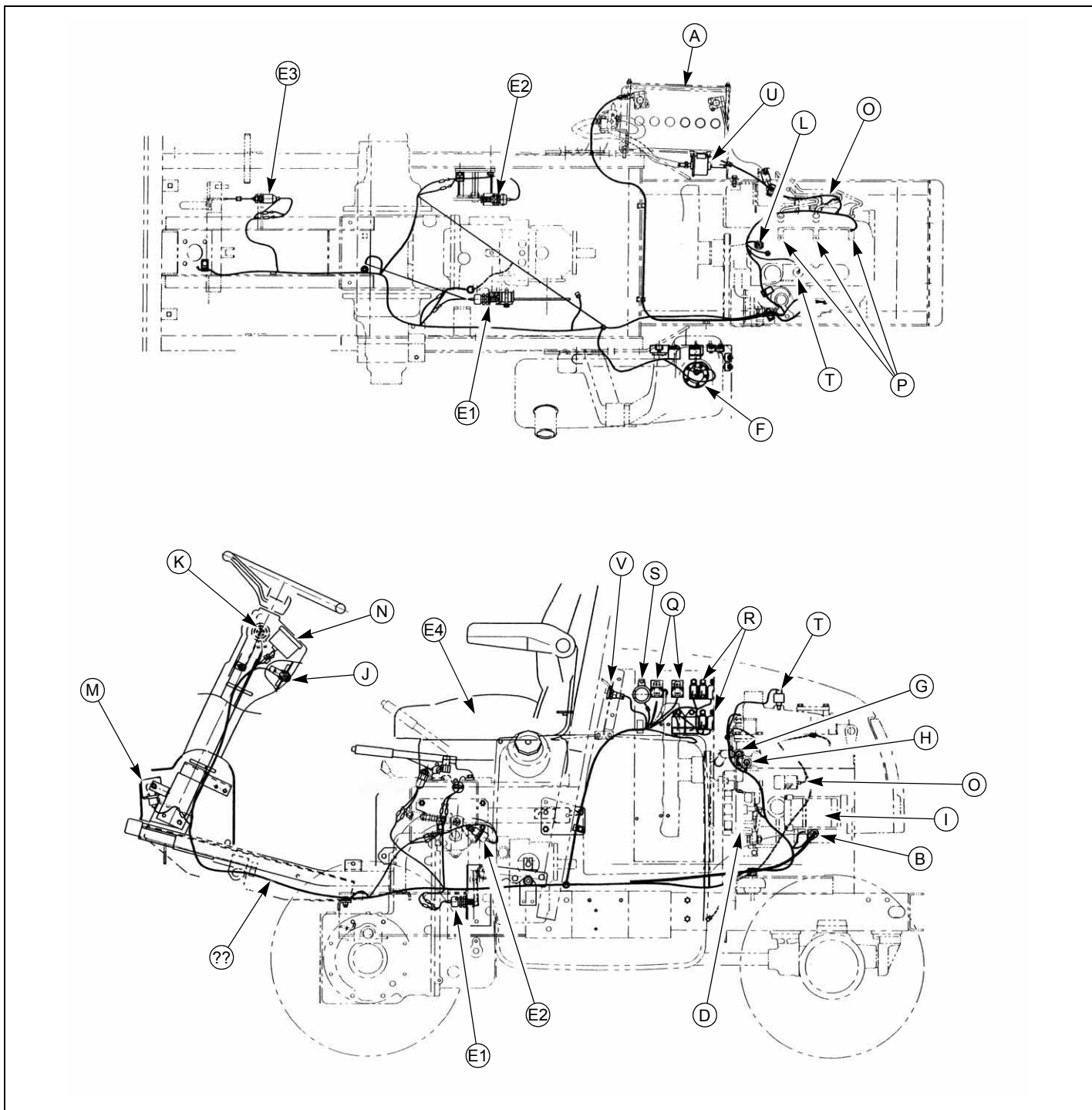


Figure 9-1

Function Inspection and Adjustment

A. Battery

Disconnect the negative (-) battery cable first then disconnect the positive (+) battery cable.



WARNING



Always check the electrolyte level with the power unit engine off, as an explosive gas is produced inside the battery when the alternator is charging. Do not use an exposed flame and do not smoke when checking the battery electrolyte level.

B. Fusible Link

A fusible link wire is used to protect the power unit's entire electrical system. If too much amperage passes through this wire it will melt down so that it will no longer allow current to pass (similar to the way a fuse works). The fusible link wire is a red wire that goes to a connector that links into the main wiring harness. It connects the battery positive post on the starter solenoid to the wiring harness.

C. Parking Brake Switch

The switch is normally closed. The switch is closed when the parking brake lever is in the locked position and is open when the lever is in the released position.

1. Inspection

Use an ohmmeter to test the parking brake switch.

- With the button at the "OUT" position, there will be continuity across the terminal leads.
- With the button at the "IN" position, there will be no continuity across the terminal leads.
- If test result are not as outlined above, replace the parking brake switch.

2. Adjustment

Using an ohmmeter check to make sure the contacts open when the parking brake is in the released position. The contacts close when the parking brake lever is the raised position.

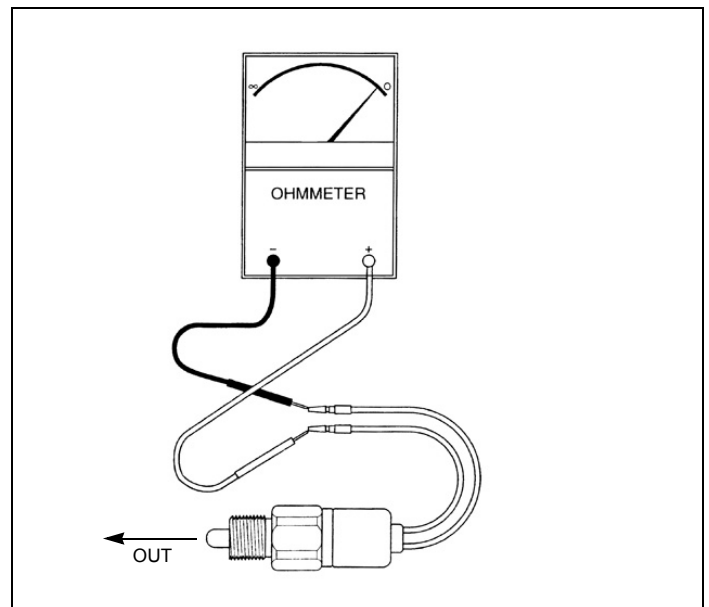


Figure 9-2

D. Alternator

Alternator provides current flow to the battery. See "CHAPTER 2 ELECTRICAL UNIT".

E. Safety Start Switches

1. HST Neutral Switch

HST Neutral Switch is "ON" position when the HST foot pedals are released. HST Neutral Switch and PTO Neutral Switch are interchangeable.

a. Inspection

Use an ohmmeter to test the HST neutral switch.

1. With the button at the "IN" position, there will be continuity across the terminal leads.
 2. With the button at the "OUT" position, there will be no continuity across the terminal leads.
- If test result are not outlined above, replace the HST neutral switch.

2. Adjustment

Using an ohmmeter check to make sure the contacts open when the HST pedal is pushed down. When the HST pedal is in the released position, the contacts are closed. Adjust the contacts by turning the switch.

3. PTO Neutral Switch

PTO Neutral Switch is in the "ON" position when the PTO lever is in the "OFF" position.

a. Inspection

Use an ohmmeter to test the PTO neutral switch.

1. With the button at the "IN" position, there will be continuity across the terminal leads.
 2. With the button at the "OUT" position, there will be no continuity across the terminal leads.
- If test result are not as outlined above, replace the PTO neutral switch.

b. Adjustment

Using an ohmmeter check to be sure the contacts open when the PTO control lever is in the "ON" position, and closed when the PTO lever is in the "OFF" position. Adjust by turning the switch.

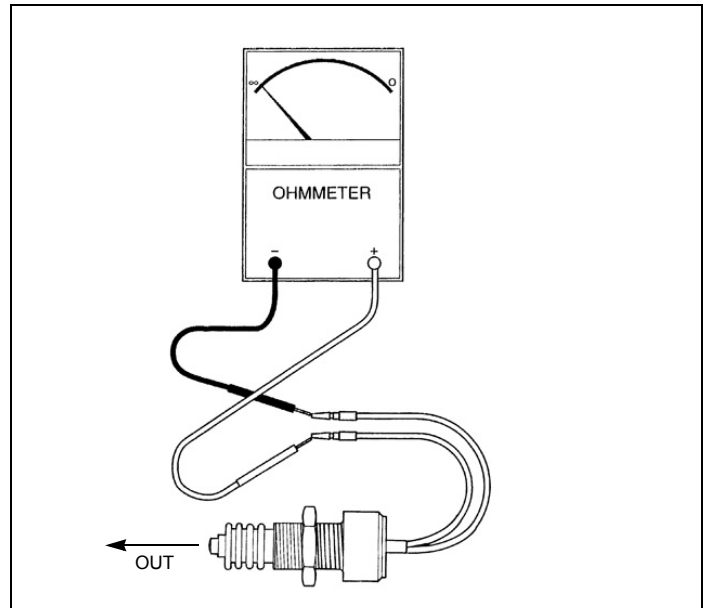


Figure 9-3

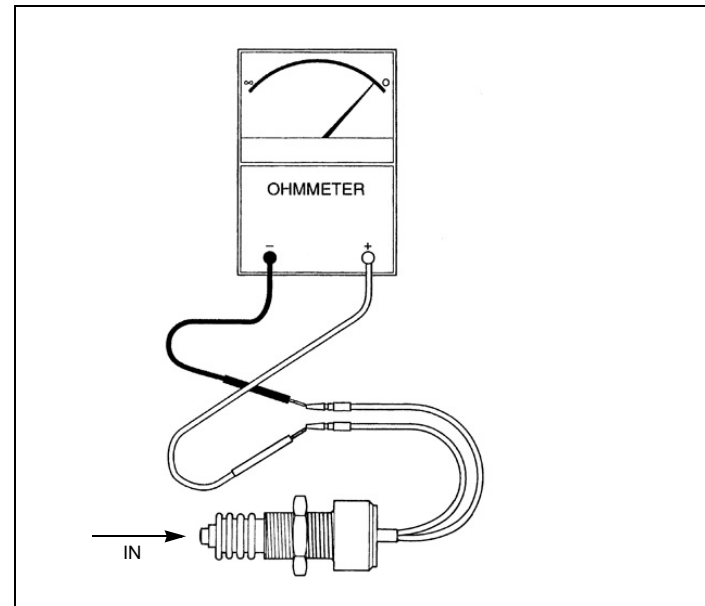


Figure 9-4

4. Brake Switch

Brake Switch is in the "ON" position when the master (foot) brake pedal is depressed.

a. Inspection

Use an ohmmeter to test the brake switch.

1. With the button at the "OUT" position, there will be continuity across the terminal leads.
2. With the button at the "IN" position, there will be no continuity across the terminal leads.
3. If test result are not as outlined above, replace the brake switch.

b. Adjustment

Using an ohmmeter check to be sure the contacts open when the brake pedal is in the "Released position", and closed when the brake pedal is in the "Depressed position". Adjust by turning the switch.

5. Seat Switch

Seat Switch is closed when operator is seated.

The power unit can be started when the above all switches are "closed".

NOTE: The power unit can be started without beng seated and/or the master brake pedal is not depressed when the parking brake lever is locked.

a. Inspection

Use an ohmmeter to test the seat switch.

1. With the operator seated, there will be continuity across the terminal leads.
2. With the operator unseated, there will be no continuity across the terminal leads.
3. If test result are not as outlined above, replace the seat switch.

b. Adjustment

The seat switch is non-adjustable.

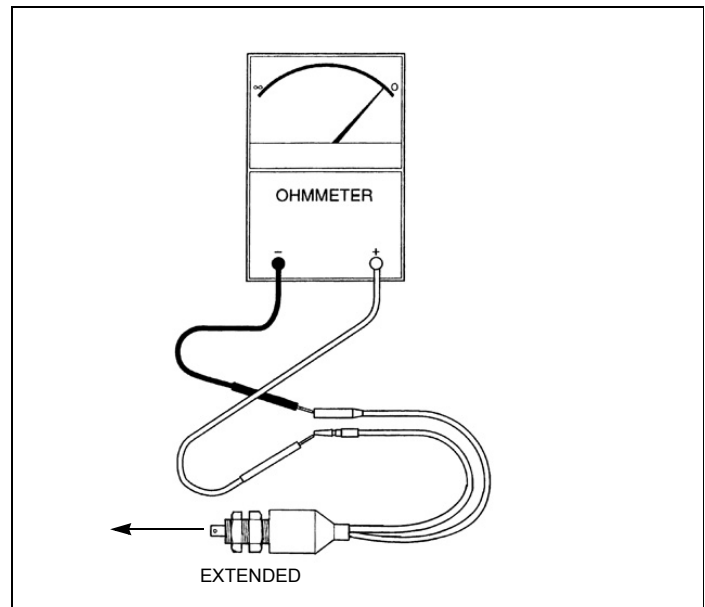


Figure 9-5

F. Fuel Level Sending Unit (sensor) and Fuel Gauge

Fuel level sending unit sends a signal indicating fuel level to the fuel gauge in the instrument panel.

1. Inspection

Use an ohmmeter to test the resistance of the fuel level sending unit at the fuel tank empty and full.

- a. Attach one of the meter leads to the center terminal A of the sensor.
- b. Attach the other meter lead to post B.
- c. Test result
 1. 103 - 117 ohms at the empty mark.
 2. 1 - 5 ohms at the full mark.
 3. If test results do not meet the above replace the fuel level sensor.

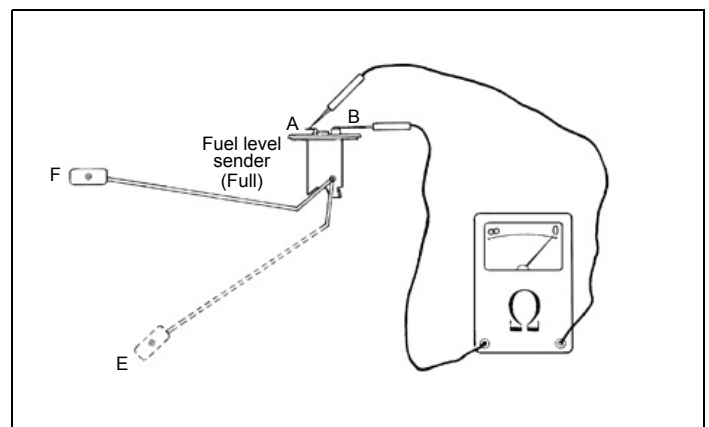


Figure 9-6

G. Engine Coolant Temperature Sensor

Engine coolant temperature sensor is regulates a variable resistance to ground with translates into the movement of the temperature gauge.

H. Engine Coolant Temperature Switch

Engine coolant temperature sending switch is open under normal operating temperatures and is closed when temperatures reach higher than normal limits 224.6 – 235.4°F (107 – 113°C).

If test results are not the same as above, replace the sensor.

I. Starter

Starter rotates the engine for starting. See "*Chapter 2 Electrical Unit*".

J. Head Light Switch

Head light switch controls current to head lamp.

1. Inspection

Use an ohmmeter to test the continuity of the head light switch connector terminals.

- With the switch in the "OFF" (released) position, there will be continuity between the terminals B and C, and D and E.
- With the switch in the "ON" (pushed) position, there will be continuity between the terminals A and C, and D and E.
- If test results are not as outlined above, replace the light switch.

K. Key Switch

The starter switch has four key operating positions are: OFF, ON, GLOW PLUG, and START.

Turning the key from OFF to one of the three positions will align the circuit and battery current will flow through the circuit.

Use an ohmmeter to test the continuity of the key switch connector terminals.

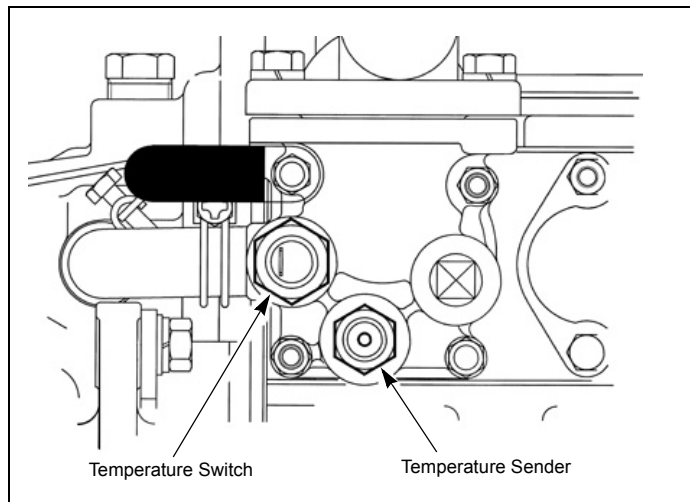


Figure 9-7

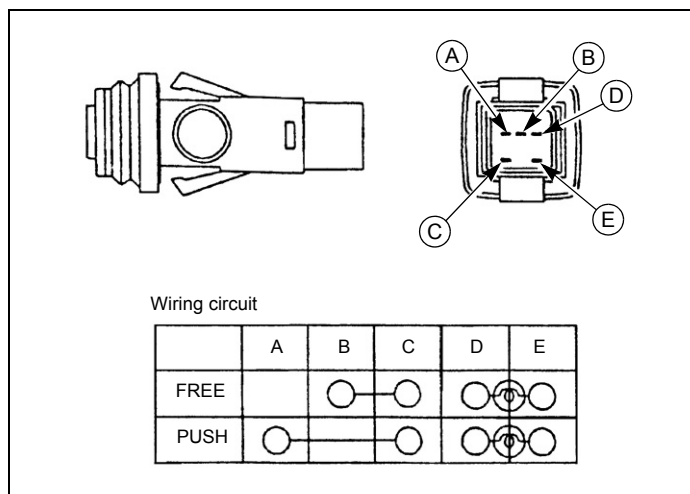


Figure 9-8

Key Position	Terminal			
	19	30	50	AC
OFF				
ON		●	●	●
HEAT	●	●	●	●
START	●	●	●	●

Figure 9-9

Conduct continuity test between terminal and the other terminals at each position of the key switch.

1. Test results

- a. A low resistance reading means, the switch is operating properly.
- b. A high resistance reading indicates an open circuit, the start switch needs to be replaced.

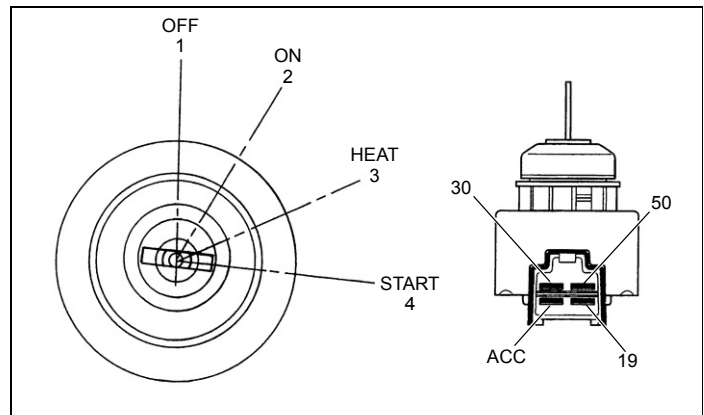


Figure 9-10

L. Engine Oil Pressure Sending Unit

Engine oil pressure sending unit provides a warning of low engine oil pressure. When pressure is low the oil pressure lamp will go on and the alarm will sound.

M. Head Light

The head light is controlled by the head light switch.

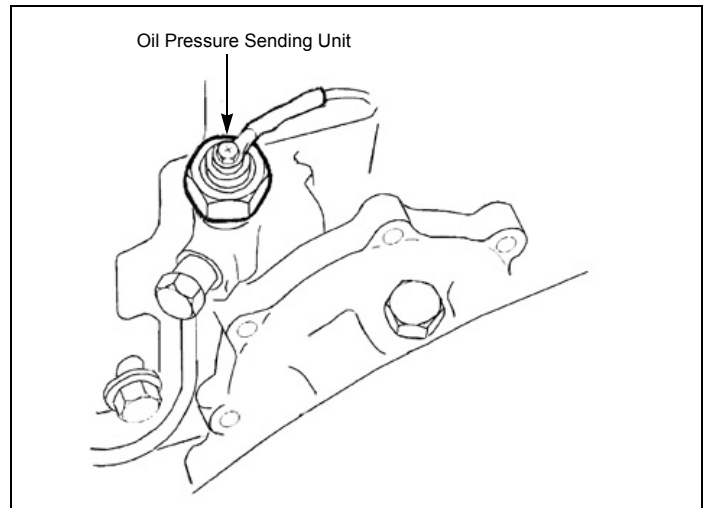


Figure 9-11

N. Instrument Panel

The instrument panel monitors power unit functions.

The instrument panel consists of hour meter ①, engine coolant temperature gauge ②, fuel gauge ③, glow plug indicator lamp ④, engine oil pressure warning lamp ⑤, charge lamp ⑥, air cleaner restriction warning lamp ⑦, and parking brake warning lamp ⑧, Figure 9-13.

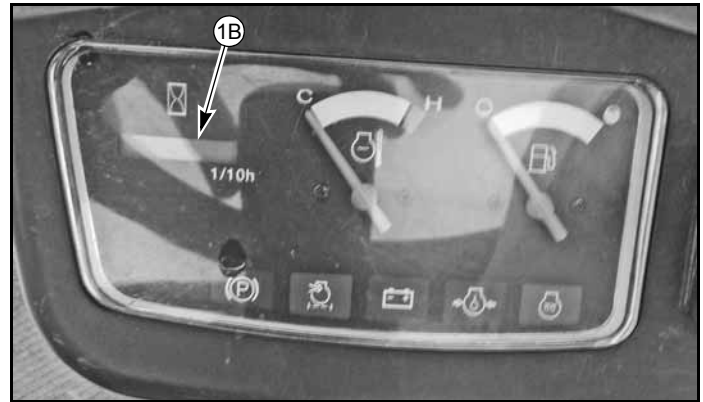
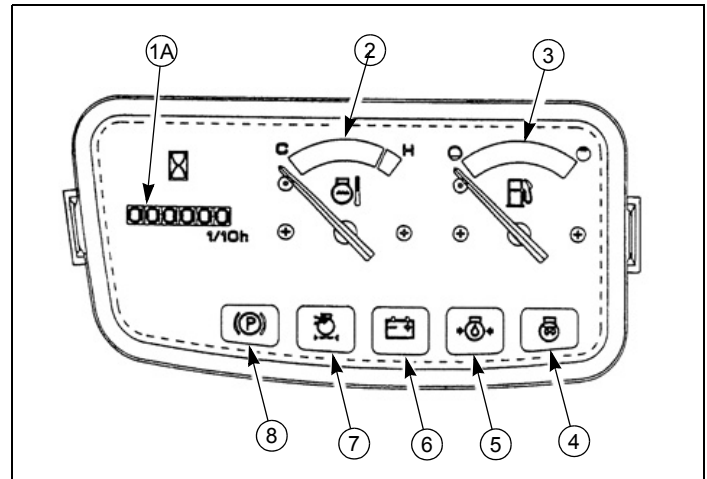
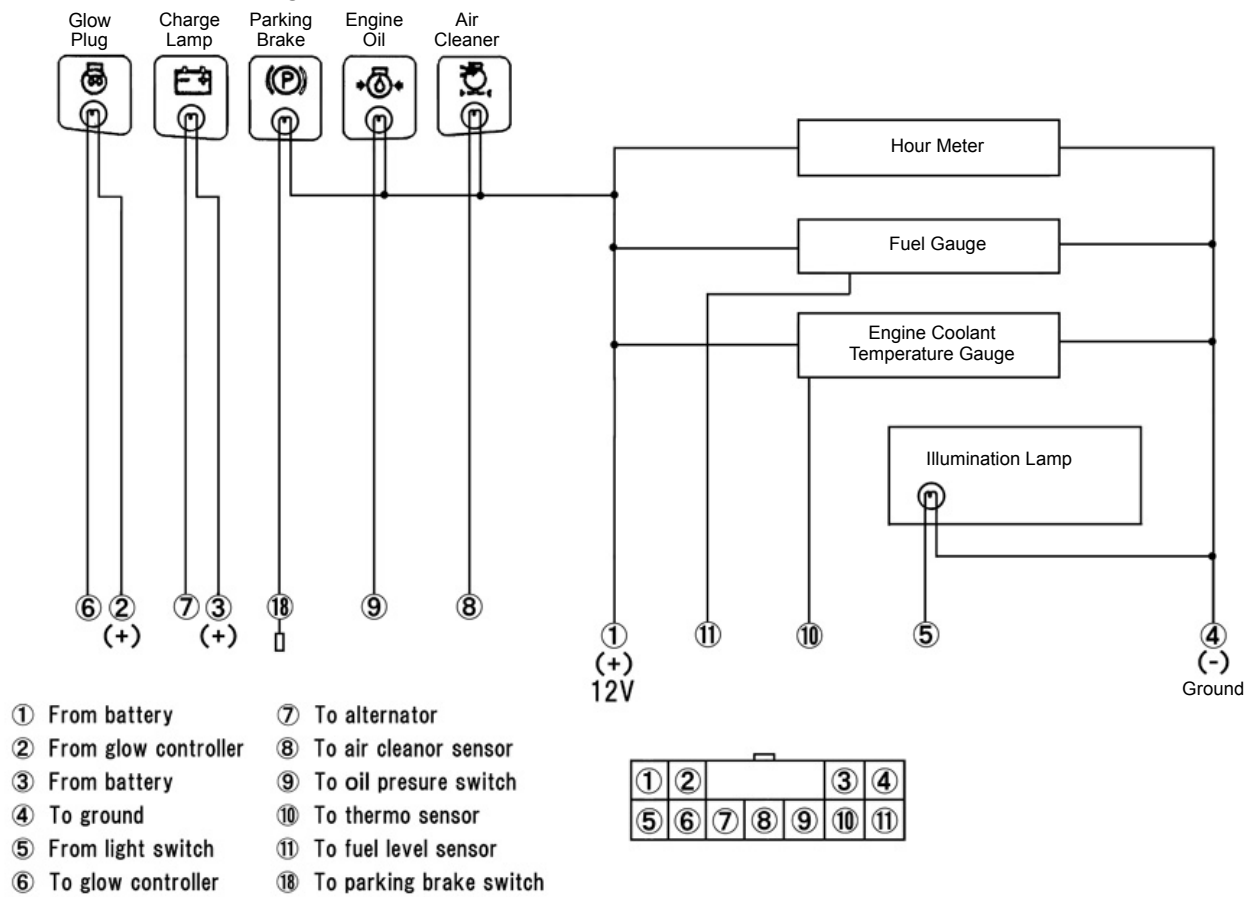


Figure 9-12

1A. Hour meter (mechanical)	5. Engine oil pressure warning lamp
1B. Hour meter (digital)	6. Charge lamp
2. Engine coolant temperature gauge	7. Air cleaner restriction warning lamp
3. Fuel gauge	8. Parking brake warning lamp
4. Glow plug indicator lamp	

Instrument Panel Wiring



NOTE: Do not keep the instrument panel turned upside down when removed, the silicone oil in the gauge will leak out and the gauges will not move smoothly.

Figure 9-13

1. Inspection

a. Engine coolant temperature gauge

1. Use an ohmmeter to test the resistance of the engine coolant temperature gauge. Attach one of the meter leads to the terminal No. ① or ④ of the connector. Attach the other meter lead to the terminal No. ⑩ of the connector.
2. The measure resistance should be 110 ± 2 ohms.
3. If the resistance measured is outside the specification, or an open circuit is measured, the instrument panel should be replaced.

b. Fuel gauge

1. Use an ohmmeter to test the resistance of the fuel gauge. Attach one of the meter leads to the terminal No. ① or ④ of the connector.
2. Attach the other meter lead to the terminal No. ⑪ of the connector.
3. The measure resistance should be 110 ± 2 ohms.
4. If the resistance measured is outside the specification, or an open circuit is measured, the instrument panel should be replaced.

O. Fuel Shut Off Solenoid

The fuel shut off solenoid shuts off fuel flow to the injection pump to stop the engine.

The solenoid is energized when the key switch is turned to the "ON" and "START" positions. The solenoid plunger is retracted and the governor linkage moves the pump control rack rearward into operating position.

1. Testing

- With the solenoid de-energized, measure the protrusion distance "A" of the plunger. In the shut-off position, the plunger protrusion distance should measure, 1.00 in. - 1.04 in. (25.5 - 26.4 mm).
- Connect a jumper wire from the solenoid terminal to the battery positive terminal. Connect a second jumper wire from the battery negative terminal to the solenoid body. The solenoid plunger will retract. Measure the protrusion distance "B" of the plunger. In the retracted position, the plunger protrusion distance should measure .45 - .57 in. (11.5 - 14.5 mm).

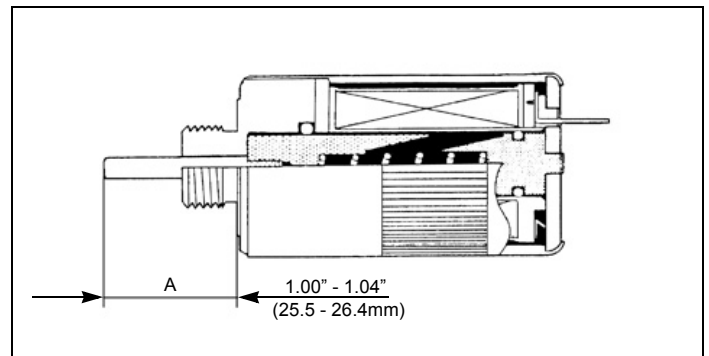


Figure 9-14

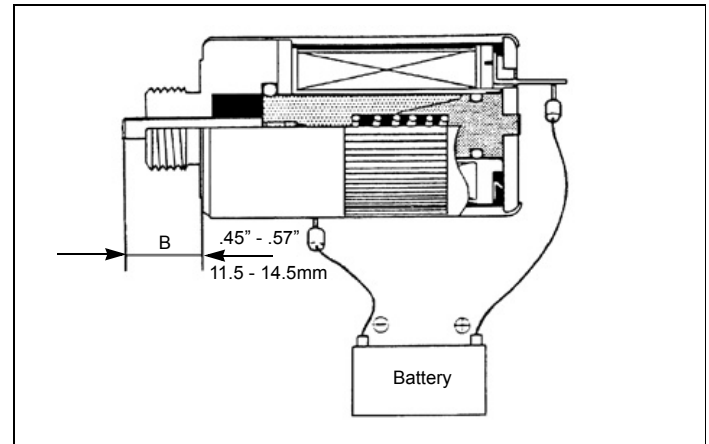


Figure 9-15

P. Glow Plug

The glow plugs aid in engine startup by warming the air in the combustion chamber.

- Use an ohmmeter to test the glow plugs.
 - Touch one lead to the center electrode.
 - Place the other lead against the glow plug body.
 - A meter reading of 0.8 ohms maximum is normal. If test results are as outlined above, replace the faulty glow plug.

Q. Fuse Blocks

Fuse blocks control current flow for individual circuits.

R. Relays

Five relays (starter, engine stop solenoid, over heat warning buzzer, engine oil pressure warning buzzer and cruise control) are interchangeable.

The relay connectors are color coded for easier identification and as follows:

- Connector color "BLUE" is for safety start relay.
- Connector color "RED" is for engine stop solenoid relay.
- Connector color "GREEN" is for engine over heat warning buzzer relay.
- Connector color "BLACK" is for engine oil pressure warning buzzer relay.
- Connector color "WHITE" is for cruise control relay.

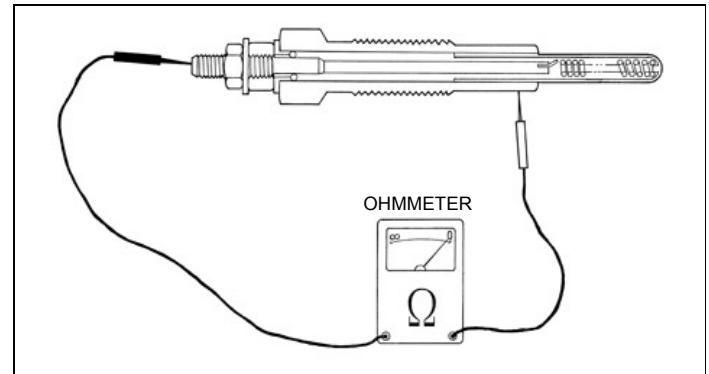


Figure 9-16

1. Four terminals relay

A relay consists of two parts which work together, a coil and an SPST switch. Terminals "A" and "B" are connected to a coil. Applying 12 volts to "A" terminal energized the coil, turning it into an electromagnet. Terminals "C" and "D" are actually part of a single pole, single throw switch.

When the coil is energized, the switch is thrown, and terminals C and D are connected.

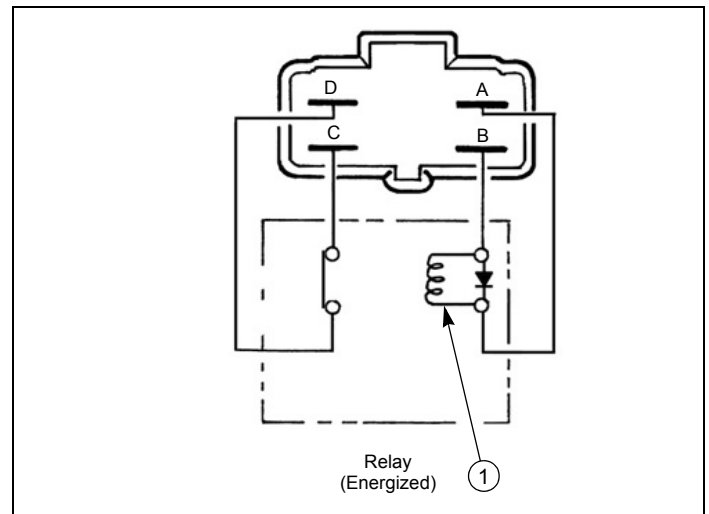


Figure 9-17

The SPST switch is spring loaded so terminals C and D are opened when the coil is not energized.

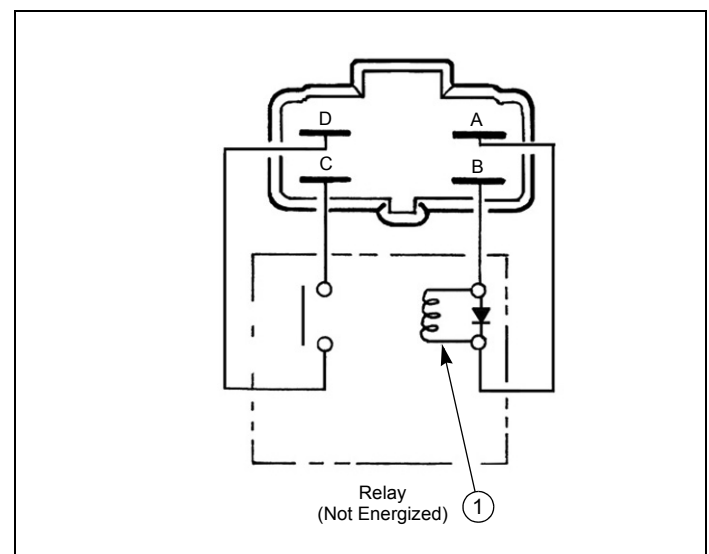


Figure 9-18

2. Five terminal relay

The brake relay is different with four terminal relays. It has five terminals and connector color is "BLACK".

A relay consists of two parts which work together a coil and an SPDT switch.

Terminals "A" and "B" are connected to a coil. Applying 12 volts to "A" terminal energized the coil, turning it into an electromagnet.

Terminals "C", "D" and "E" are actually part of a single pole, double throw switch.

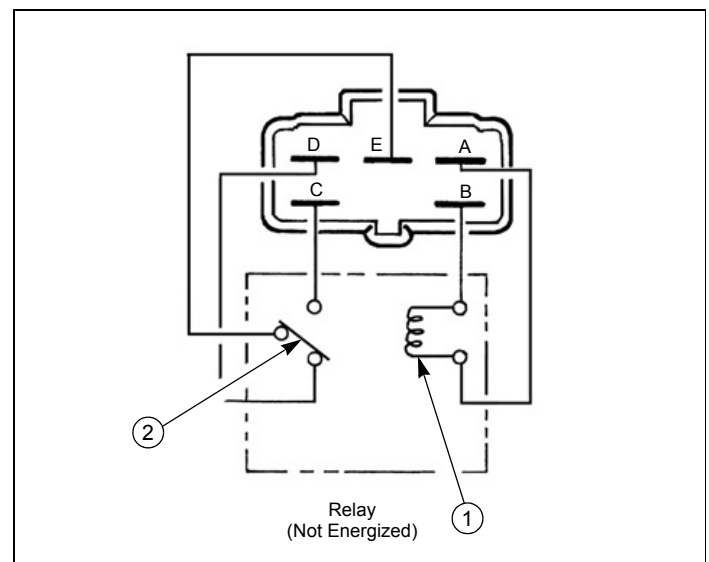


Figure 9-19

The SPDT switch is spring loaded so terminals D and E are opened when the coil is not energized.

When the coil is energized, the switch is thrown, and terminals C and E are connected.

1. Coil
2. Switch

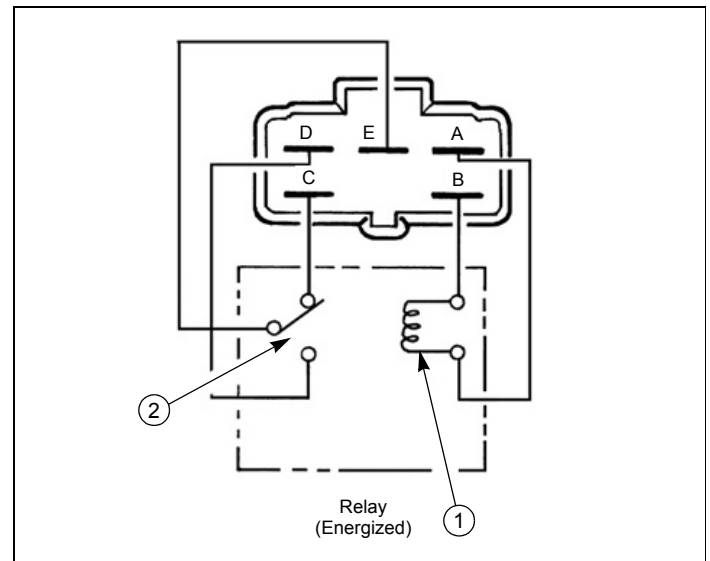


Figure 9-20

3. Inspection

- a. Four terminals relay
 1. To test a relay, disconnect it from the circuit.
 - a. Connect the ohmmeter leads to terminals C and D.
 - b. There is no continuity between terminals C and D if the relay is working properly.

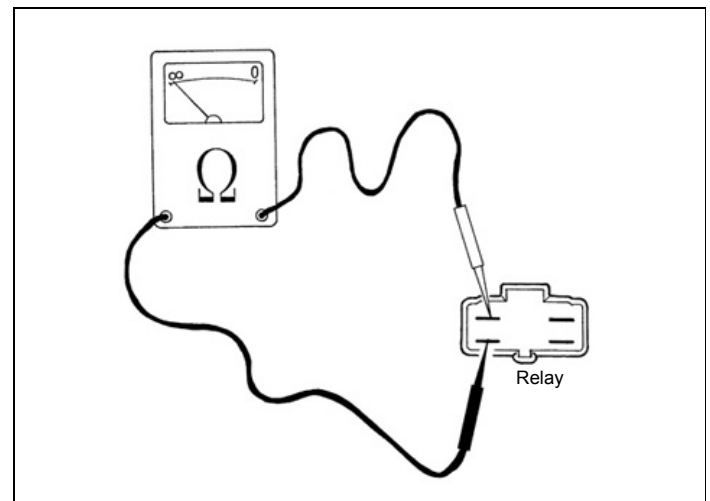


Figure 9-21

2. Next use the ohmmeter to verify energized conditions.
 - a. Energized the coil by applying 12 volts of current across terminals A and B.
 - b. Connect the ohmmeter leads to terminals C and D.
 - c. There is continuity between terminals C and D if the relay is working properly.

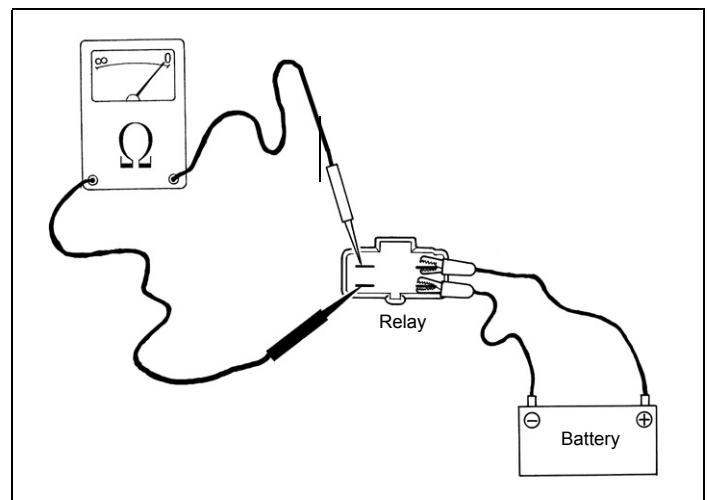


Figure 9-22

b. Brake relay (Five terminals relay)

1. To test a relay, disconnect it from the circuit. Use the ohmmeter to verify non-energized conditions.
 - a. Connect the ohmmeter leads to terminals D and E.
 - b. There is no continuity between terminals E and D if the relay is working properly.
 - c. Connect the ohmmeter leads to terminals C and E.
 - d. There is continuity between terminals C and E if the relay is working properly

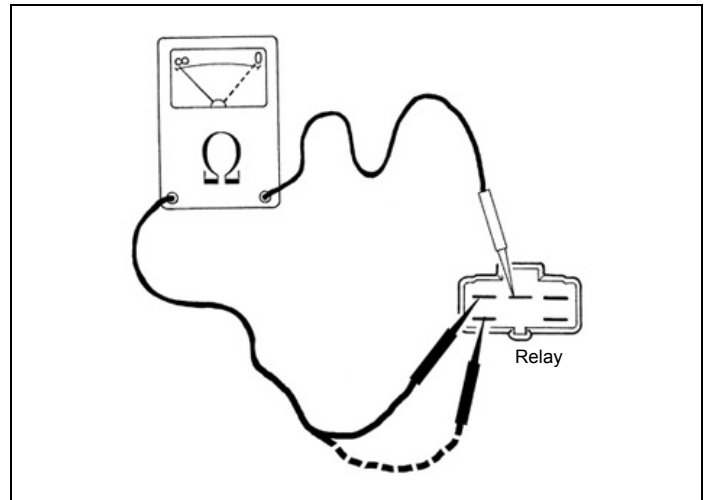


Figure 9-23

2. Next use the ohmmeter to verify energized conditions.
 - a. Energized the coil by applying 12 volts of current across terminals A and B.
 - b. Connect the ohmmeter leads to terminals D and E.
 - c. There is continuity between terminals D and E if the relay is working properly.
 - d. Connect the ohmmeter leads to terminals C and E.
 - e. There is no continuity between terminals C and E if the relay is working properly.
 - f. If continuity readings do not match those stated in the above test procedures, replace the relay.

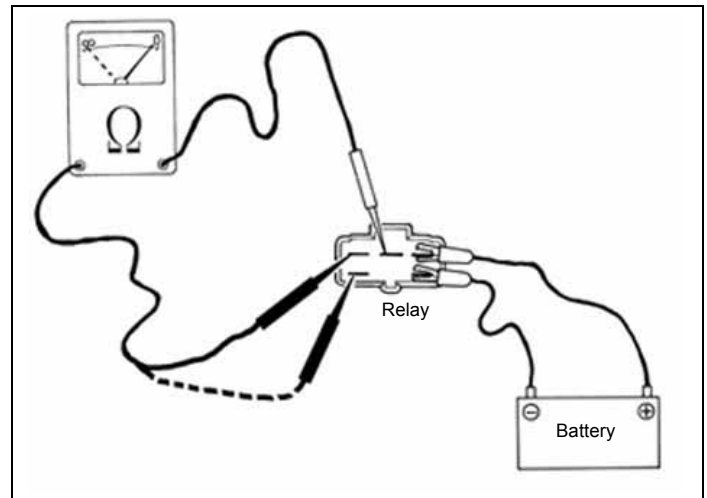


Figure 9-24

S. Alarm Buzzer

The buzzer is activated when the engine oil pressure is lower and/or engine is over heated.

1. Inspection

- a. To test a buzzer
 1. disconnect it from the circuit.
 2. Energize the buzzer by applying 12 volts of current across terminals A and B.
 3. If buzzer sounds, it is working properly.

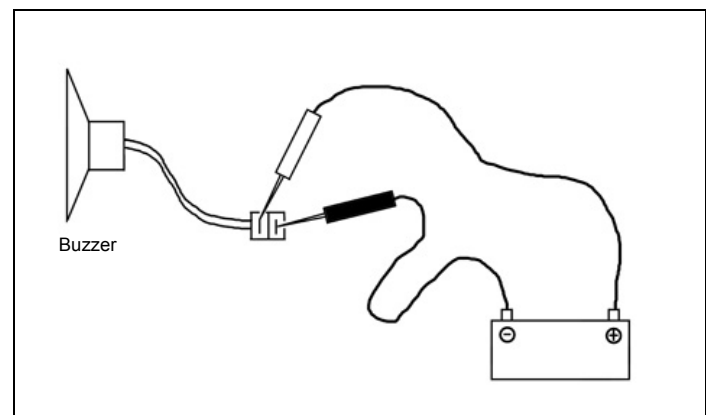


Figure 9-25

T. Air Cleaner Restriction Switch

Air cleaner restriction sending unit warns when the air cleaner element is clogged.

1. Inspection

- a. To test an air cleaner restriction switch
 1. disconnect it from the circuit and remove it.
 2. Use an ohmmeter to test the switch. Touch leads to the both terminals.
 3. Normally, there will be no continuity.
 4. Draw a vacuum on the switch, there will be continuity.
 5. If test result are not as outlined above, replace the switch.

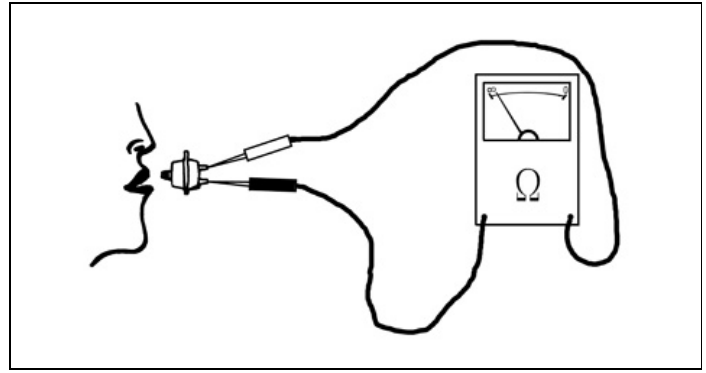


Figure 9-26

U. Electric Fuel Pump

The electric fuel pump supplies fuel under pressure to the fuel injection pump.

1. Inspection

If a fuel system malfunction indicates a faulty fuel pump, a simple shop test of the fuel pump can be performed using water as the liquid for testing.

- a. To test a fuel pump, remove it from the power unit.
 1. Set up the fuel pump, rubber hoses, switch, jumper cables, clean containers and battery per illustration.
 2. Place 3.7 qts. (3.5 liters) of water in a container.
 3. Operate the fuel pump using the switch and run the fuel pump for 15 seconds to charge the system. Empty the water back into the inlet filled container.
 4. Operate the pump for five minutes. Measure the water in the outlet side container.
 5. If the pump delivered 2.11 qts. (2 liters) or more the pump is normal.

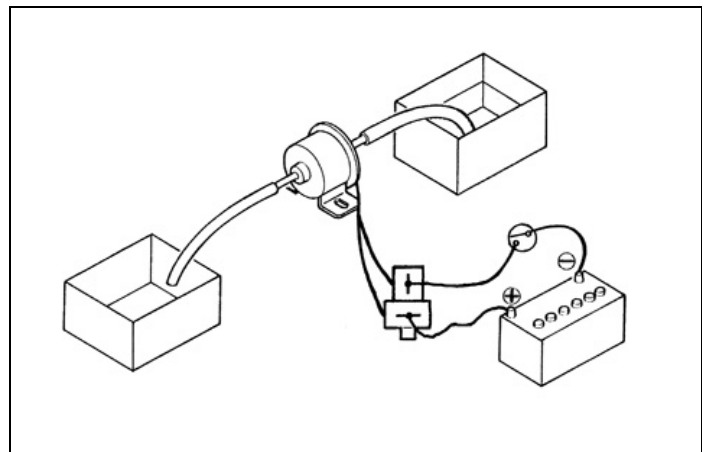


Figure 9-27

IMPORTANT: Before installing water tested fuel pump back on the power unit, place the inlet hose in a small container filled with clean diesel fuel. Operate the pump until the test water is purged from the pump.

V. Cruise Control Switch

The cruise control switch controls current to the speed control magnet.

1. Inspection

- a. Remove the switch from the wiring harness.

NOTE: The switch terminals are identified on the back of the switch. Number 1 and 4 are blank.

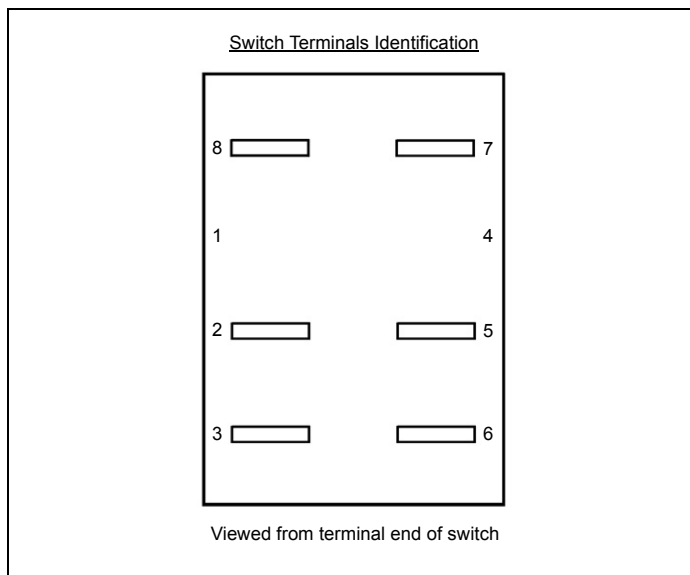


Figure 9-28

- b. Using an ohmmeter, depress the switch to the "ON" position and connect the ohmmeter leads across terminals 5 and 6. Then across terminals 2 and 3. If continuity exists across these terminals, the switch is operating properly.

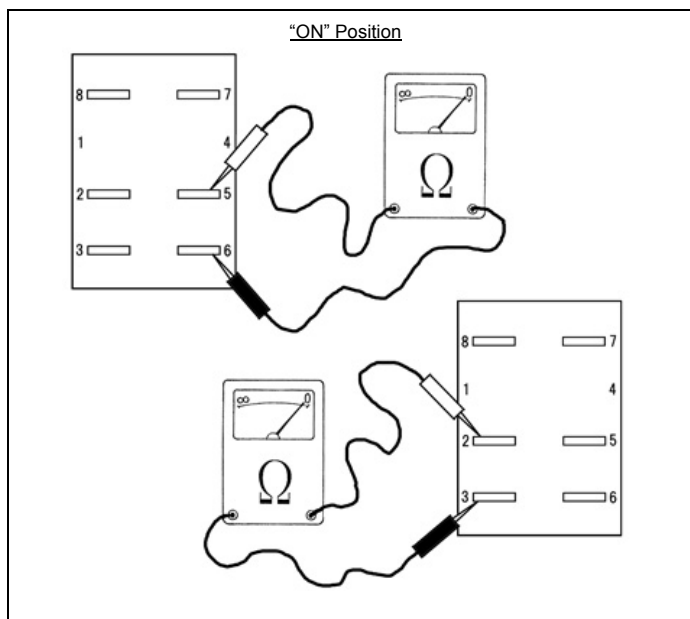


Figure 9-29

- c. Next place the switch in the "STAND BY" (middle) position and connect the ohmmeter leads across terminals 2 and 3. If there is continuity, the switch is good.

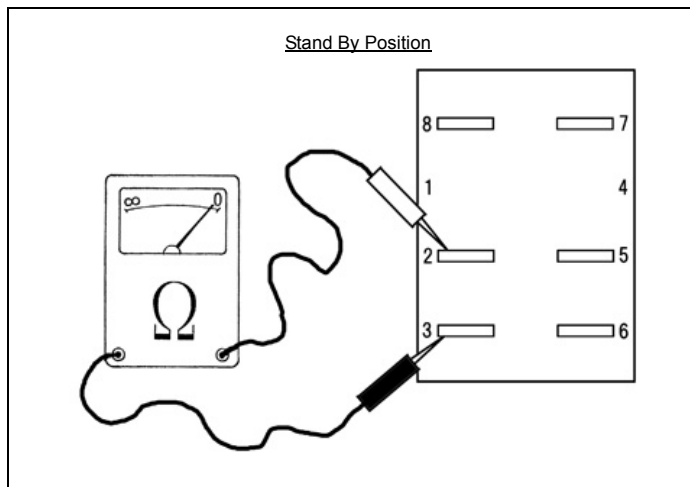


Figure 9-30

- d. To test the internal light bulb, connect the ohmmeter leads across terminals 7 and 8 (the switch may be placed in any of its three positions). The reading should be between 55 and 60 ohms.

NOTE: The light is not serviced separately. If it does not illuminate, replace the switch. Replace the switch if the correct readings are not obtained during testing.

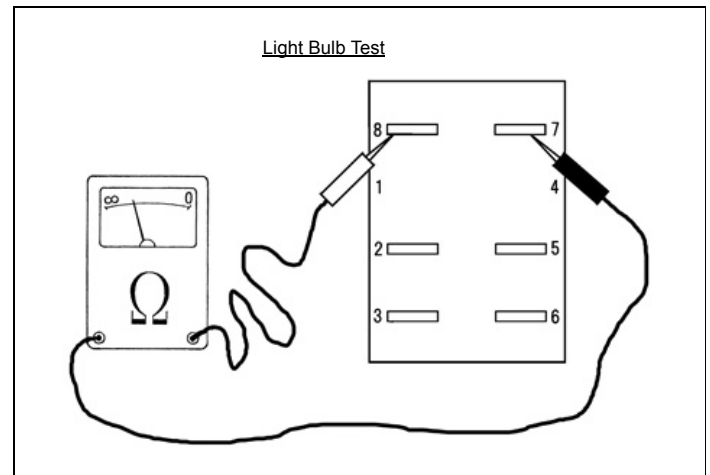


Figure 9-31

W. Cruise Control Magnet

The cruise control magnet locks the HST linkage in place by switch to set constant speed.

1. Inspection

Use the ohmmeter to test the cruise control magnet.

- a. Disconnect the magnet from the power unit wiring harness and connect the ohmmeter leads to the two leads coming from the magnet.
- b. A meter reading of 11 - 12 ohms is normal.

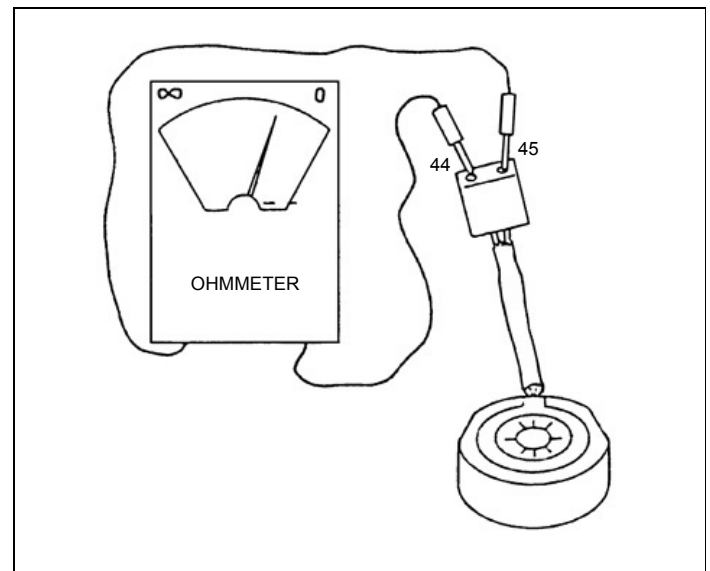


Figure 9-32

- c. Disconnect the ohmmeter from the magnet and apply 12 volts across the magnet leads.
- d. The surface will become magnetized and attract any ferrous object if the cruise control magnet is working properly.
- e. If the test results are not as outlined above, replace the cruise control magnet.

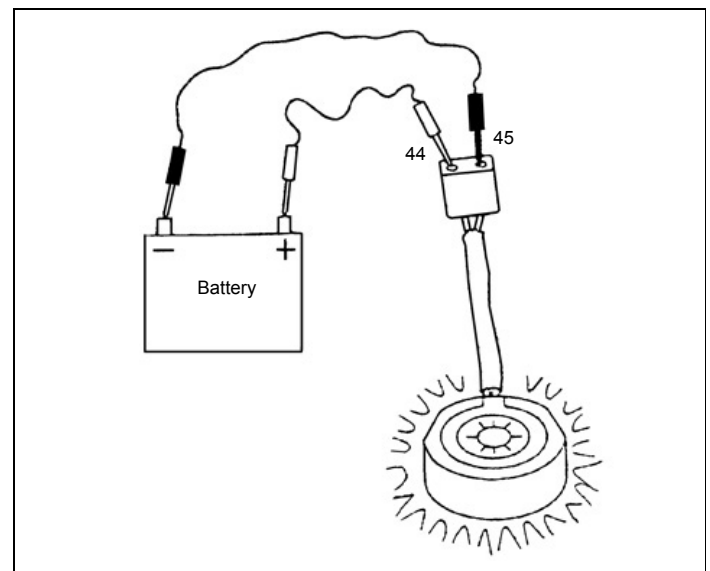
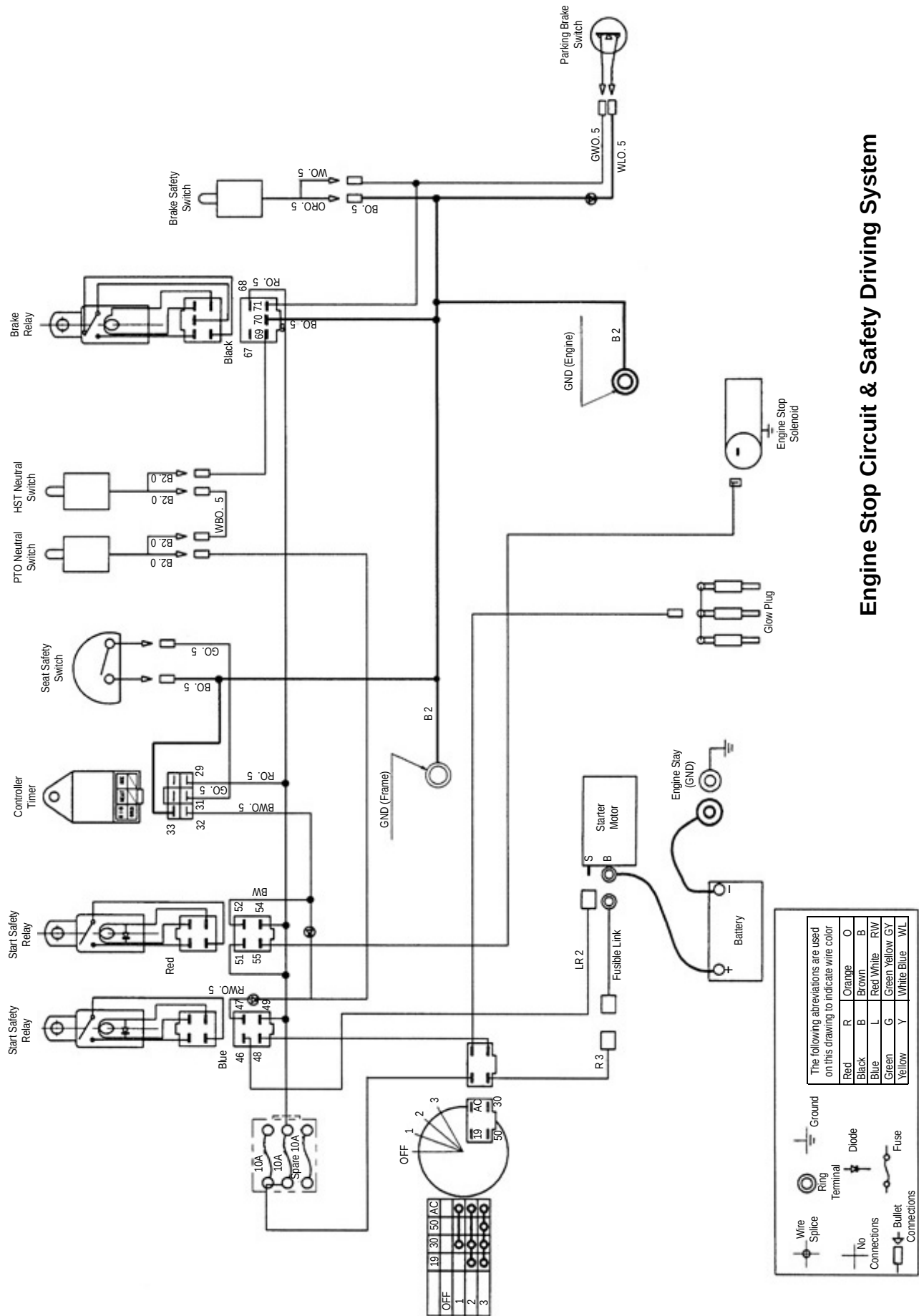
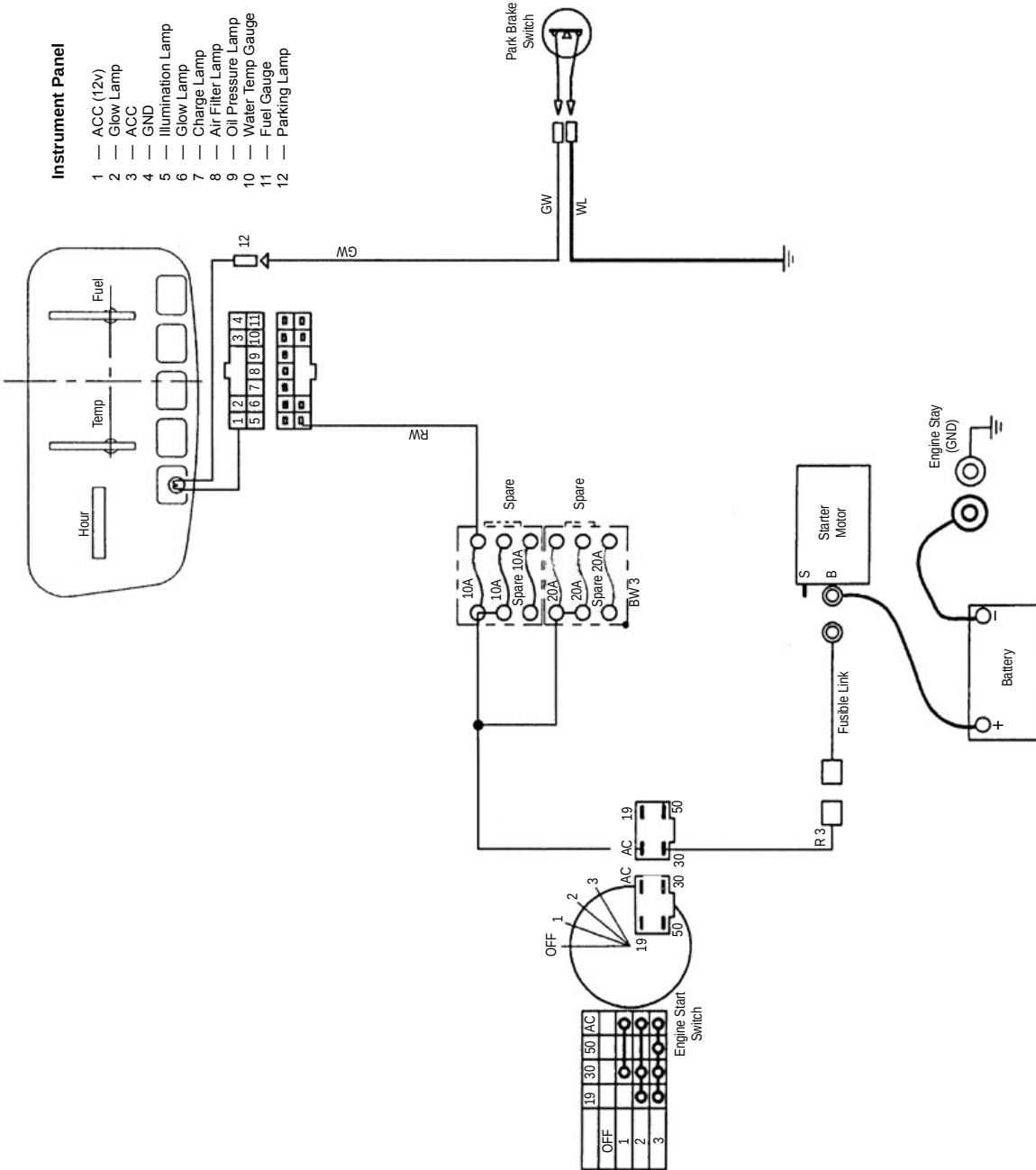


Figure 9-33

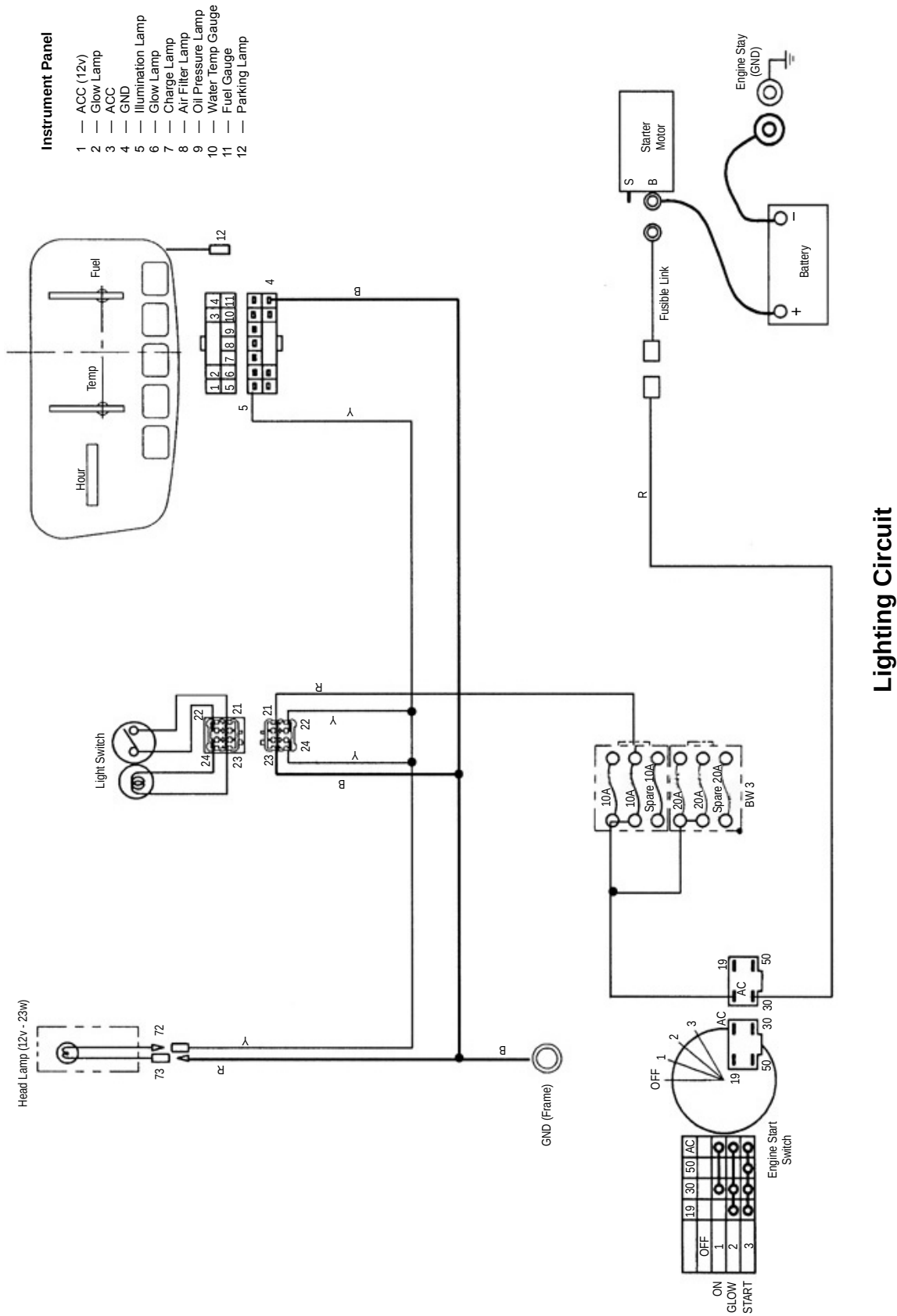


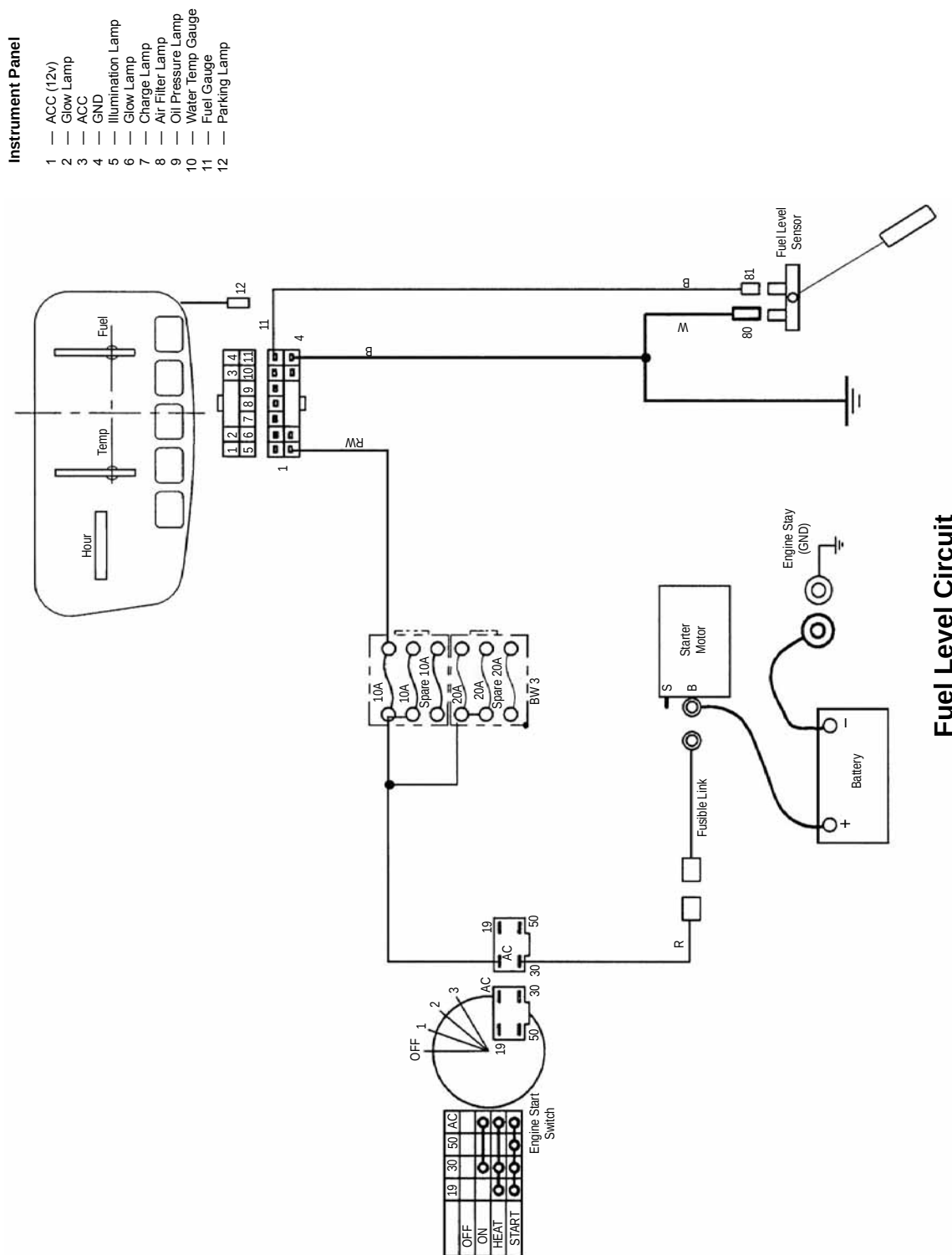


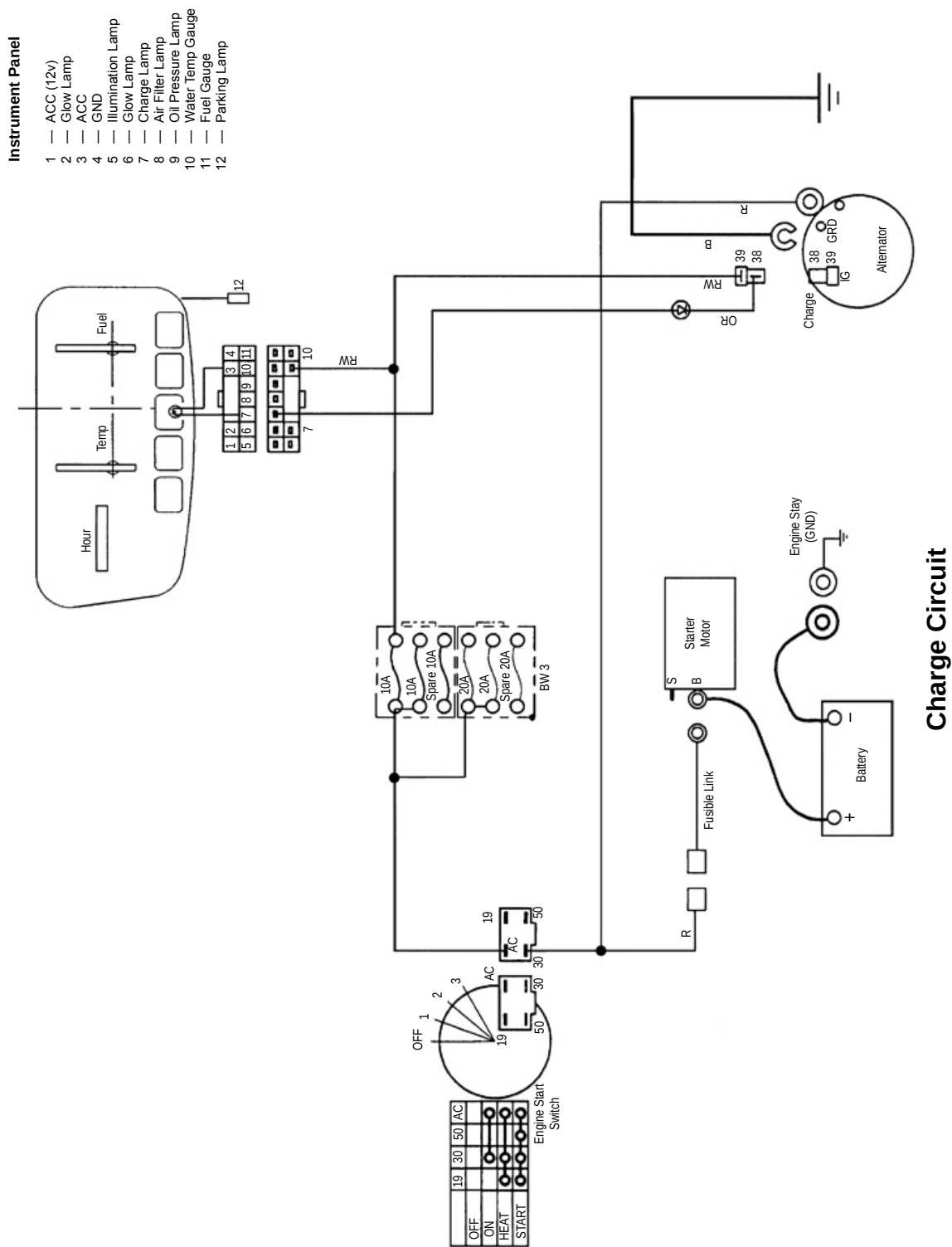
Engine Stop Circuit & Safety Driving System

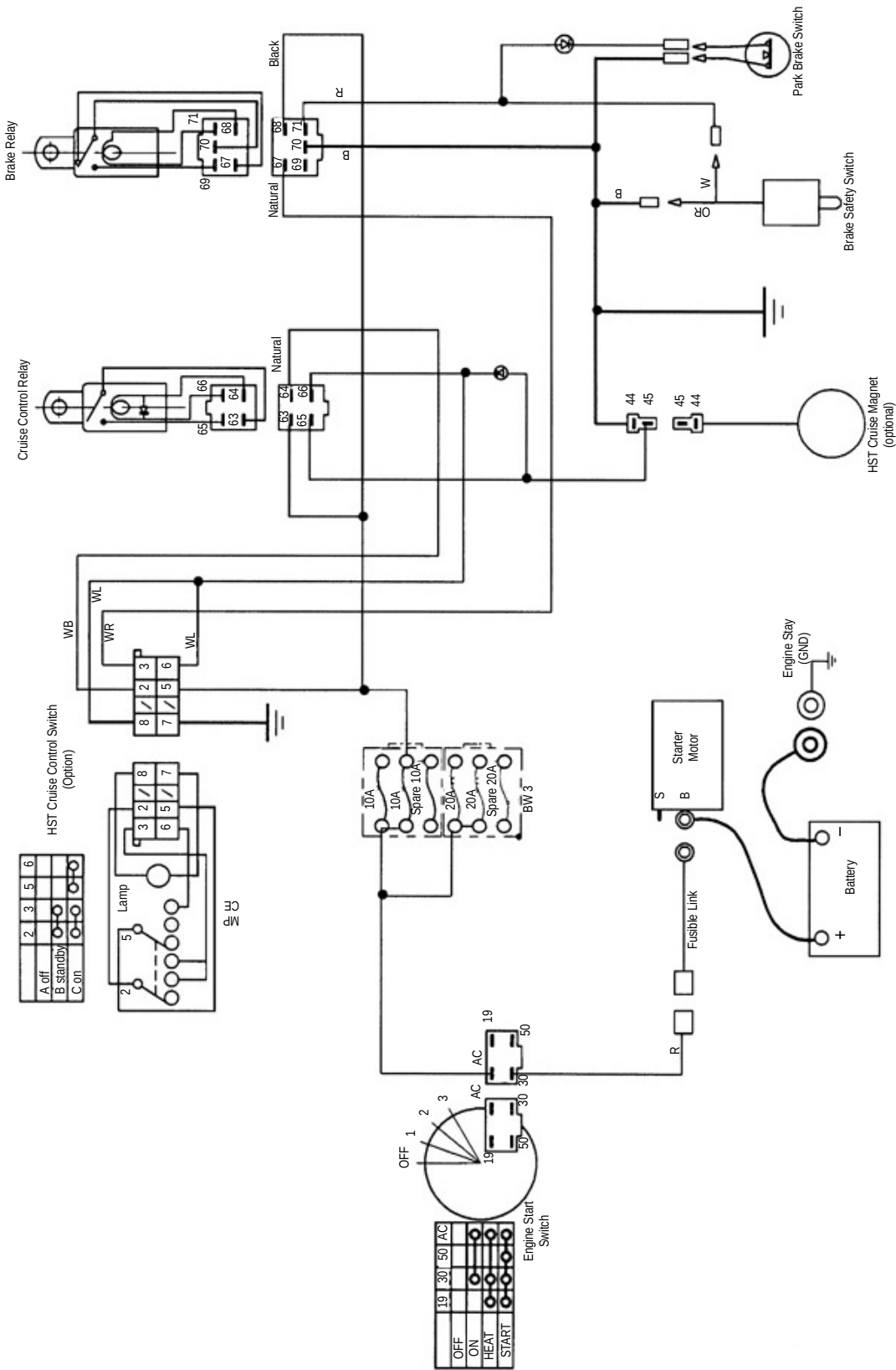


Parking Brake Circuit

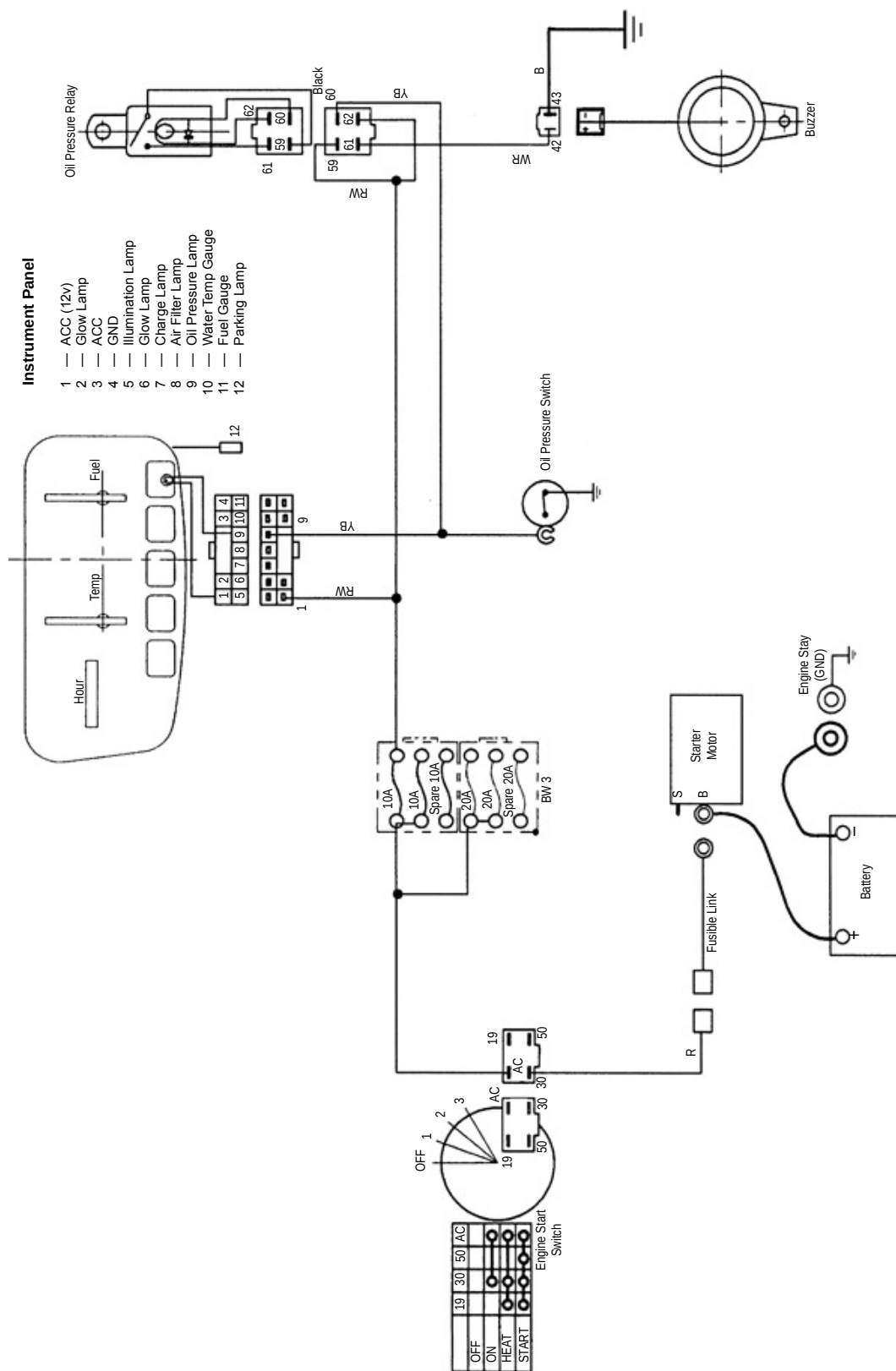




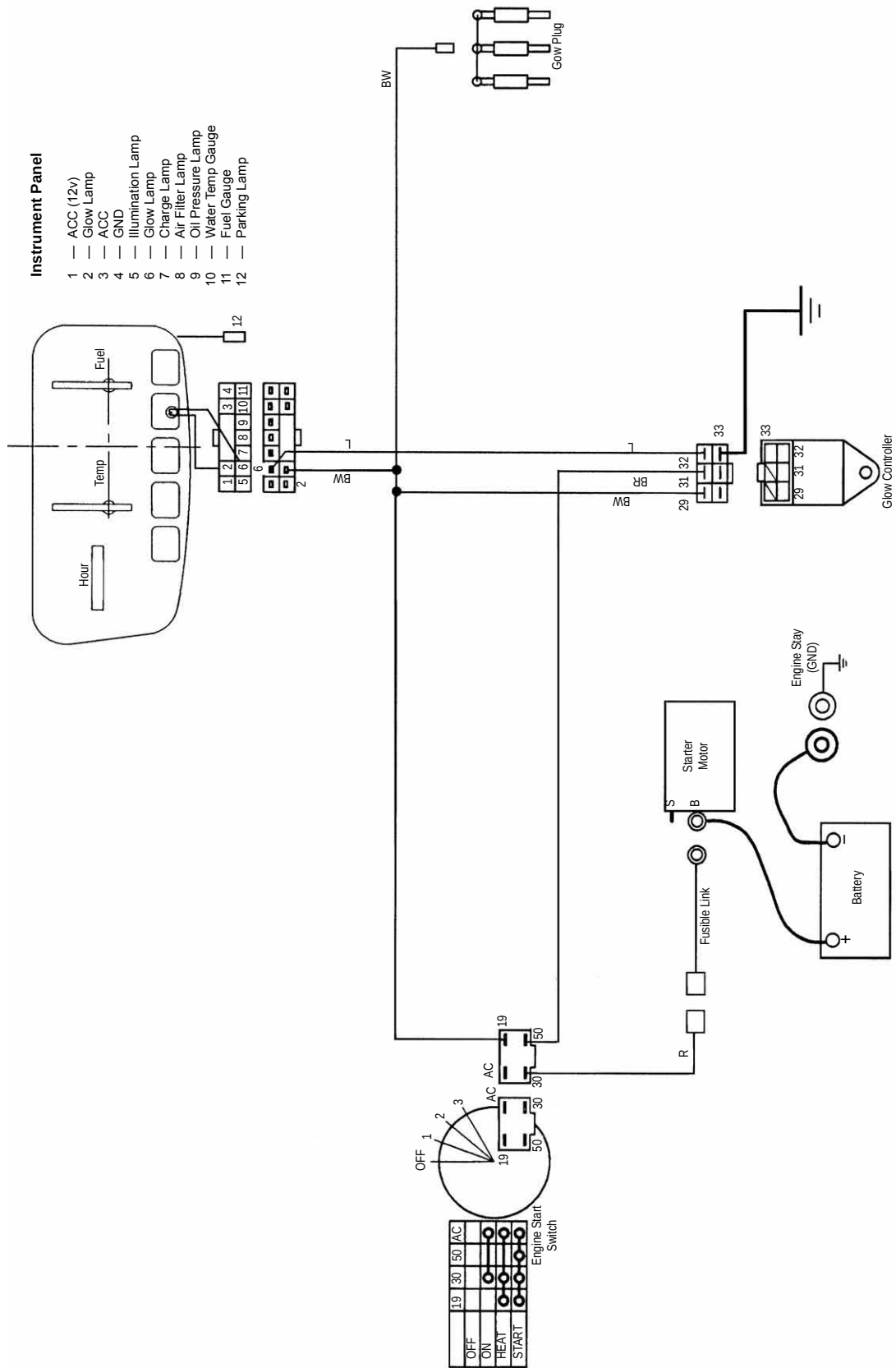




Cruise Control Circuit



Engine Oil Pressure Warning Lamp & Alarm Circuit



Glow Indicator Lamp Circuit



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