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TORO®

5xi Series Tractor Hydraulic Systems Service Manual



ABOUT THIS MANUAL

This service manual was written expressly for Toro Wheel Horse 5xi series garden tractors. The Toro Company has made every effort to make the information in this manual complete and correct.

This service and repair manual has been compiled to provide authorized Wheel Horse service personnel with the proper procedures and techniques for servicing the Wheel Horse automatic transaxle with Eaton Model 11 hydrostatic transmission. Basic mechanical/electrical skills are assumed. The Table of Contents lists the systems and the related topics covered in this manual.

It is advisable to read all the introductory sections first to gain a proper understanding of the Wheel Horse automatic transmission system.

For information on the electrical system, please refer to the Toro Electrical Demystification Guide (492-4404). For general service procedures, refer to the 5xi Series Tractor Service Manual (492-4715). For information specific to the engines used on these garden tractors, refer to the appropriate engine manufacturer's service and repair instructions.

We are hopeful that you will find this manual a valuable addition to your service shop. If you have any questions or comments regarding this manual, please contact us at the following address:

**The Toro Company
Consumer Service Training Department
8111 Lyndale Avenue South
Bloomington, MN 55420**

The Toro Company reserves the right to change product specifications or this manual without notice.

The automatic transmission and transaxle are sophisticated pieces of machinery. Maintain strict cleanliness control during all stages of service and repair. Cover or cap all hose ends and fittings whenever they are exposed. Even a small amount of dirt or other contamination can severely damage the system.

NOTE: This manual uses the terms "transmission, hydrostatic transmission, and hydrostatic unit" to refer to the Eaton Model 11 Hydrostatic Transmission. The term "transaxle" is used to refer to the assembly of intermediate gears, differential and case halves, less hydrostatic unit. "Transmission System" and "Automatic Transmission System" are used to refer to entire drive train as an assembly, including engine, transmission, transaxle, hydraulic lift system, and all related parts.

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This symbol means **WARNING** or **PERSONAL SAFETY INSTRUCTION** - read the instruction because it has to do with your safety. Failure to comply with the instruction may result in personal injury or even death.

This manual is intended as a service and repair manual only. The safety instructions provided herein

are for troubleshooting, service, and repair of the 5xi series garden tractor. The tractor and attachment operator's manuals contain safety information and operating tips for safe operating practices. Operator's manuals are available through your Toro parts source or:

The Toro Company
Publications Department
8111 Lyndale Avenue South
Bloomington, MN 55420

1a

THINK SAFETY FIRST

Avoid unexpected starting of engine...

Always turn off the engine and disconnect the spark plug wire(s) before cleaning, adjusting, or repair.

Avoid lacerations and amputations...

Stay clear of all moving parts whenever the engine is running. Treat all normally moving parts as if they were moving whenever the engine is running or has the potential to start.

Avoid burns...

Do not touch the engine, muffler, or other components which may increase in temperature during operation, while the unit is running or shortly after it has been running.

Avoid fires and explosions...

Avoid spilling fuel and never smoke while working with any type of fuel or lubricant. Wipe up any spilled fuel or oil immediately. Never remove the fuel cap or add fuel when the engine is running. Always use approved, labeled containers for storing or transporting fuel and lubricants.

Avoid asphyxiation...

Never operate an engine in a confined area without proper ventilation.

Avoid injury from batteries...

Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes, and clothing. Battery gases can explode. Keep cigarettes, sparks, and flames away from the battery.

Avoid injury due to inferior parts...

Use only original equipment parts to ensure that important safety criteria are met.

Avoid injury to bystanders...

Always clear the area of bystanders before starting or testing powered equipment.

Avoid injury due to projectiles...

Always clear the area of sticks, rocks, or any other debris that could be picked up and thrown by the powered equipment.

Avoid modifications...

Never alter or modify any part unless it is a factory approved procedure.

Avoid unsafe operation...

Always test the safety interlock system after making adjustments or repairs on the machine. Refer to the Electrical section in the 5xi Service Manual for more information.

SPECIFICATIONS

Transmission (Eaton Model 11)

Item	Description
Radial ball piston pump and motor with auxiliary charge pump	
Displacement, Pump	Variable 0 - 1.10 cu. in./rev. (18.03 cu. cm)
Displacement, Motor	Fixed 2.09 cu. in./rev. (34.2 cu. cm)
Speed, Input	3400 RPM
Speed, Output	0 - 1842 RPM
Torque Output	360 in·lb - Continuous (40.7 N·m)
Torque Output	540 in·lb - Intermittent (61 N·m)
Operating Temperature	Maximum continuous 180°
Cooling - Air	8" diameter fan (20.3 cm)
Cooling - Oil	Oil flow from charge pump
Oil Filter	Spin-on, Full flow 10 Micron
Charge Pump Flow @ 3400 RPM input	3.8 GPM (14.4 lpm) free flow 1.4 GPM (5.3 lpm) @ 700 PSI (48.21 bar)

Transaxle (Wheel Horse)

Item	Description
Two speed unidrive 8 pinion differential, double reduction gears	Gear Ratio 16:1 high; 27:1 low
Gears and Shafts	Heat-treated steel
Bearings	Ball (2) Needle (8)
Case Halves and Hubs	Cast iron
Seals	(3) double-lip, spring-loaded
Overall reduction ratio	30:1 high; 50:1 low
Axle shaft speed	115 RPM @ 1842 RPM trans output, high 68 RPM @ 1842 RPM trans output, low
Tractor Speed, Forward	0 - 7.4 MPH (11.8 km/h)
Tractor Speed, Reverse	0 - 4.35 MPH (6.96 km/h)

5xi Automatic Transmission System Speeds

	Engine Speed	Brake Shaft	Axle Shaft	MPH (Kmh)
High Range	3400 RPM	1319 RPM	115 RPM	7.40 (11.9 km/h)
Low Range	3400 RPM	775 RPM	68 RPM	4.35 (7.01 km/h)

Oil

Item	73470, 73540, 73541	73560, 73545, 73546, 73550, 73551
Capacity	6 Quarts (5.7l) Approx. (refill 4.5 Quarts (4.3l))	7 Quarts (6.6l) Approx. (refill 4.5 Quarts (4.3l))
Type	10W-30 or 10W-40 API service SH or higher	10W-30 or 10W-40 API service SH or higher

1b

Bolt Torque

Size - Thread Pitch	Torque
1/4 - 20	8 ft·lb (.9 N·m)
5/16 - 18	17 - 22 ft·lb (23 - 30.8 N·m)
3/8 - 16	30 - 35 ft·lb (42 - 49 N·m)
1/2 - 13	75 - 80 ft·lb (105 - 112 N·m)
Wheel Hub Set Screw	28 - 32 ft·lb (39.2 - 44.8 N·m)

Epoxy Patch Screws *

Part Number	Description/Where Used	Torque Value		
		In-Lbs	Ft-Lbs	N·m
94-7817	Shoulder bolt connects the Smart Turn linkage to the transaxle control assembly	90 - 120		10.2 - 13.6
94-7972	Torque strap bolt to transaxle		27 - 33	36.6 - 44.7
94-7955	Transmission cooling fan center bolt	90 - 120		10.2 - 13.6
94-7973	Electric PTO clutch bolt - for Kohler and Vanguard diesel engines		50 - 60	67.8 - 81.4
94-7974	Electric PTO clutch bolt - for Kawasaki engine		50 - 60	67.8 - 81.4
94-7975	Driveshaft coupling set screws	120 - 160		13.6 - 18.8
94-7976	Bolt connects the power steering cylinder to the steering arm		40 - 50	54.2 - 67.8
95-4183	Bolt to attach the iso-mount brackets to Vanguard diesel engine		17 - 21	23.0 - 28.5
95-4184	Bolt used in various places on Vanguard diesel engine and to retain the Kawasaki engine to the engine base plate		17 - 21	23.0 - 28.5
95-4232	Bolt to attach the rear PTO to the Kawasaki engine		17 - 21	23.0 - 28.5
98-3052	Bolt to attach steering arm to splined shaft		27 - 33	36.6 - 44.7
98-3498	Retaining bolt in bottom of steering pinion (manual steering)		15 - 19	19.8 - 25.4
99-4953	Bolt for 2-speed shifter assembly (starting with 1999 models)		15 - 19	19.8 - 25.4

***NOTE:** Designed for only one use. Fasteners are not reusable.

SPECIFICATIONS

Single-Use Fasteners

Part Number	Description/Where Used	Torque Value		
		In-Lbs	Ft-Lbs	N-m
911423 & 108881	Bolts and nuts / differential assembly; replace when rebuilding		39 - 47	52.9 - 63.7
95-4245	Bolt / nylon patch bolt - Used on front end of lift cylinder; replace, do not reuse		17 - 21	23.2 - 28.8
108881	Nut / Used to attach mid-attach-a-matic side plates to frame; replace, do not reuse		39 - 47	52.9 - 63.7
98-8088	Nut / attach front tie rod end to steering arms; replace, do not reuse		40 - 50	54.2 - 67.8
108881	Nut / rear end of power steering cylinder to frame; replace, do not reuse		31 - 37	41.8 - 50.9
108881	Nut / used with the power steering tilt assembly pivot bolt; replace, do not reuse		31 - 37	41.8 - 50.9
108881	Nut / slider lift pivot; replace, do not reuse		31 - 37	41.8 - 50.9
108881	Nut / link rod to slider lift pivot; replace, do not reuse		31 - 37	41.8 - 50.9
108881	Nut / parking brake pivot; replace, do not reuse		31 - 37	41.8 - 50.9
108881	Nut / Smart Turn™ pivot assembly; replace, do not reuse		31 - 37	41.8 - 50.9
108881	Nut / magnet plate pivot; replace, do not reuse		31 - 37	41.8 - 50.9

Critical Fasteners

Description/Where Used	Torque Value		
	In-Lbs	Ft-Lbs	N-m
Bolts / attach transaxle to frame		27 - 33	36.6 - 44.7
Nut / front axle pivot		55 - 75	74.6 - 101.7
Nut / attach rear tie rod end to steering plate		40 - 50	54.2 - 67.8
Bolt / attach brake pivot assembly to transaxle		27 - 33	36.6 - 44.7
Bolt / attach brake drum to brake shaft		27 - 33	36.6 - 44.7
Set screws / rear axle hubs		28 - 32	38 - 43.4
Bolts / L.H. and R.H. transaxle case halves - torque in crisscross sequence		27 - 33	36.6 - 44.7
Bolts / Transmission to transaxle - torque in crisscross sequence		27 - 33	36.6 - 44.7
Bolts / rubber driveshaft couplings		17 - 21	23.1 - 28.8
Nut / speed control arm to transmission control shaft		20 - 24	27.1 - 32.5
Bolts / rear wheel lug bolts		75 - 80	101.7 - 108.5
Bolts 1/2 - 13 / Vanguard diesel iso-mount - FRONT		78 - 94	105.8 - 127.5
Bolts 3/8 - 16 / Vanguard diesel iso-mount - REAR		32 - 38	43.4 - 51.5
Kohler exhaust manifold nuts	150 - 220		17 - 24.90
Kawasaki exhaust manifold nuts	52 - 70		5.9 - 7.9
Daihatsu exhaust manifold nuts	150 - 190		17 - 21.5

Service Schedule

Item	Interval
Oil Level Check	Every 25 hrs.
Oil Change	Every 200 hrs.
Oil Filter Change	@ 50 hrs. Every 200 hrs.
Clean Power Steering Screen	@ 50 hrs. Every 200 hrs.

@ = initial service

NOTE: Service more frequently under dry/dirty/dusty conditions.

NOTE: When cleaning the unit, use compressed air vs. water to avoid contamination of the transaxle fluid.

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TRANSAXLE FLUID General Information

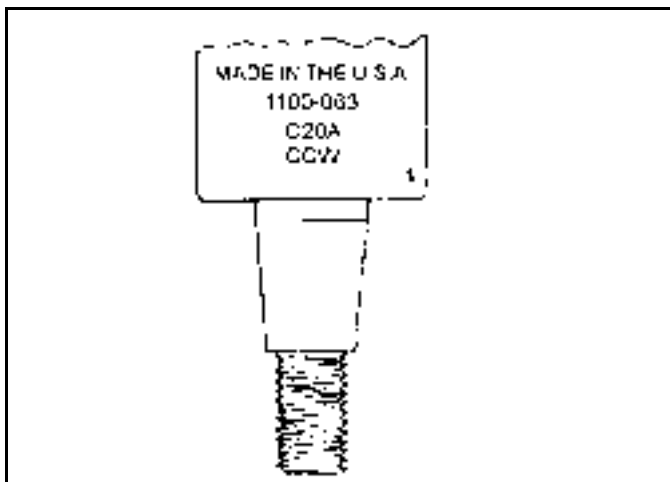


0144-029

All models of the 5xi series tractor use the Toro Wheel Horse transaxle with the Eaton model 11 hydrostatic transmission. The transmission is equipped with a charge pump which supplies hydraulic pressure to operate the attachment lift and power steering on units so equipped. The charge pump also provides pressurized fluid to the transmission pump to make up for normal internal leakage.

FLUID TYPE: SAE 10W-30 or 10W-40 detergent oil (API service SH or higher).

Eaton Model: 1100 - 063.



0202-001

The transmission is stamped with a model number, manufacturing date code, and direction of rotation. Rebuilt units are also marked with the number 1. This information is located on the case near the control shaft.

MAINTENANCE

Checking Fluid Level

1. The transaxle fluid level must be checked when the machine is cold and parked on a level surface.
2. Tilt the seat forward.
3. Clean around the dipstick to prevent dirt from falling into the system when the dipstick is removed.

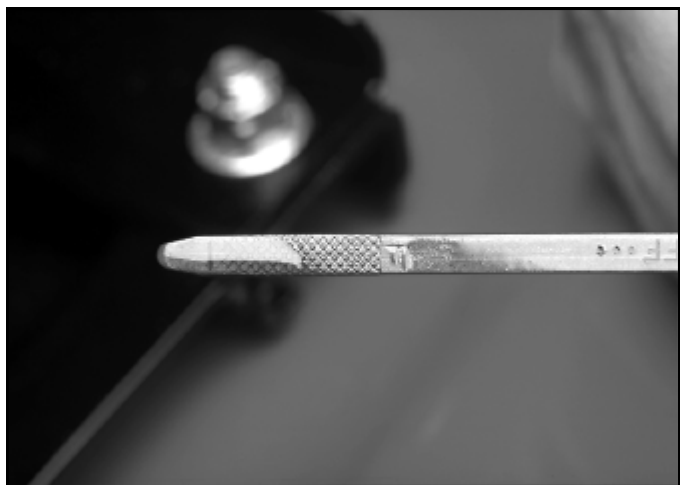
NOTE: Allowing dirt in the reservoir may result in severe damage to the transmission.



0757-015

4. Remove the dipstick. If necessary, add oil to the FULL line on the dipstick.

IMPORTANT: Do not fill the reservoir above the FULL line as the reservoir may overflow after the tractor is stopped and has set for awhile.



0109-007

Fluid Change

The transaxle fluid should be changed every 200 hours of operation.

Remove the drain plug and drain the transaxle fluid into a suitable container.

Replace the drain plug, and fill the transaxle to the FULL mark with 10W-30 or 10W-40 detergent oil with an API service rating of SH or higher.

System Capacity (refill capacity is 4.5 quarts (4.3l)):

With power steering: 7 qts. (6.6 l)

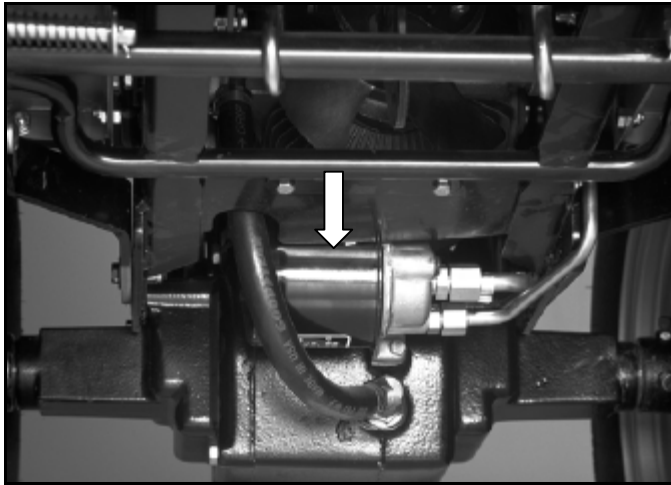
Without power steering: 6 qts. (5.6 l)



0415-004

Filter Change

The transaxle is equipped with a 10 micron spin-on oil filter. This filter should be changed after the first 50 hours of operation and then every 200 hours thereafter.



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0144-014

When replacing the filter, coat the gasket with oil. Tighten until the gasket contacts the base, then an additional 1/2 turn.

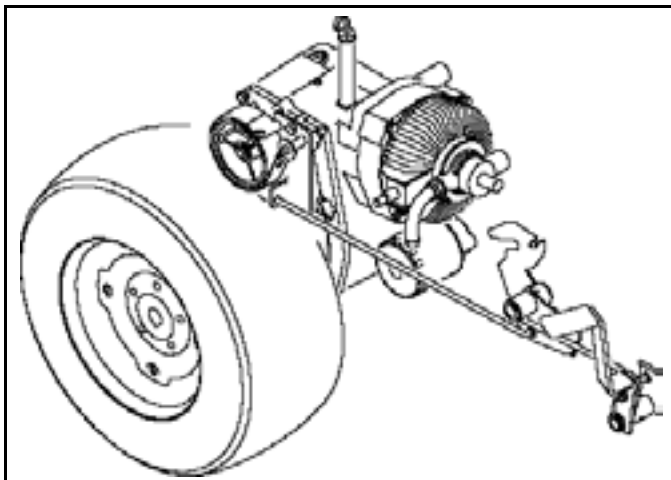
BRAKE

General Information

The 5xi series tractor is equipped with an external band parking brake which is located on the right side of the transaxle.

When the brake pedal is pressed, the linkage returns the transmission to neutral, then applies the brake.

The band brake supplements the transmission's dynamic braking to bring the tractor to a stop. It can also be locked in the applied position and serves as the parking brake.



7197-067

MAINTENANCE

Adjustment

1. Place the transmission in neutral.
2. Depress the brake pedal. There should be 2" (51mm) of free travel before resistance is felt.



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3. Turn the adjustment nut until the above condition is met.

CAUTION: Do not overtighten the adjustment nut.



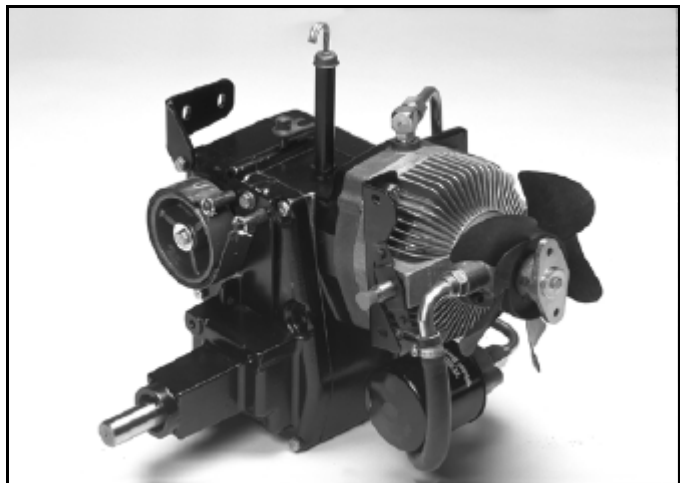
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NEUTRAL ADJUSTMENT

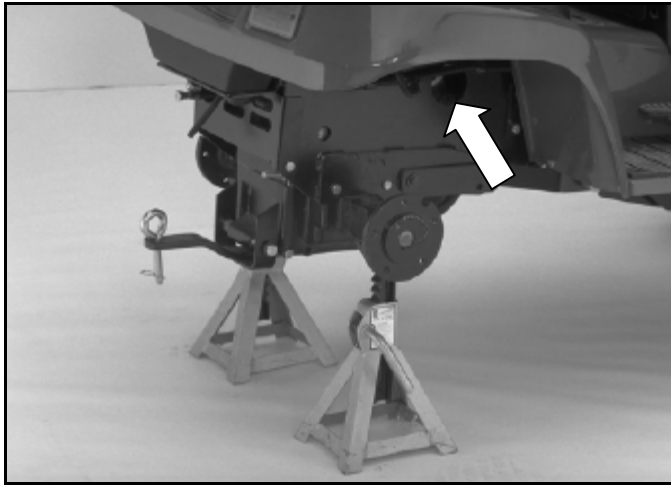
General Information

The hydrostatic transmission linkage is designed to be self-centering or "return to neutral". If the wheels continue to drive with no pressure on the control pedal (tractor creeps), neutral adjustment is required.

CAUTION: The drive shaft and hydrostatic cooling fan will be spinning. Use extreme caution to avoid making contact with moving parts while performing this adjustment.



0144-001



3653-006

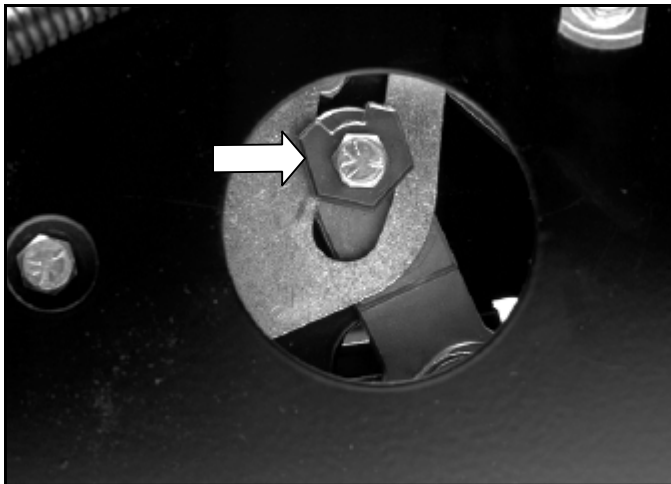
Adjustment Procedure

1. Place the rear axle on jack stands, and remove the rear wheels.

NOTE: Do not set the parking brake.

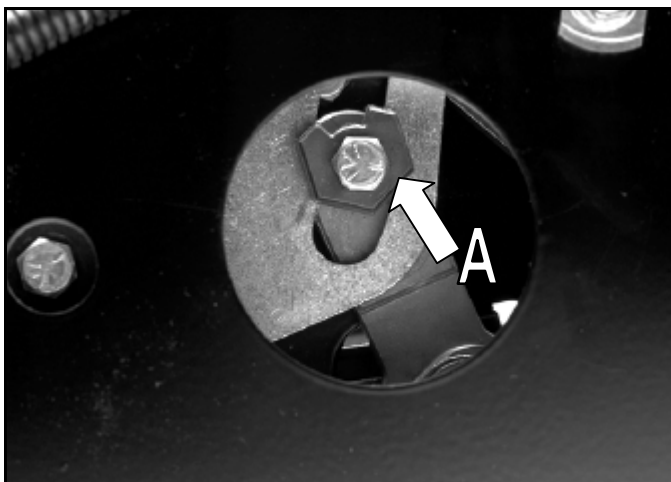
2. Bring the hydrostatic transmission up to operating temperature (at least 15 minutes' operation). The neutral eccentric is accessed through the hole indicated by the arrow.

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0144-072

3. To gain access to the adjustment eccentric, turn the front wheels in either direction to the steering stop. This causes the linkage rod to move up, out of the way.

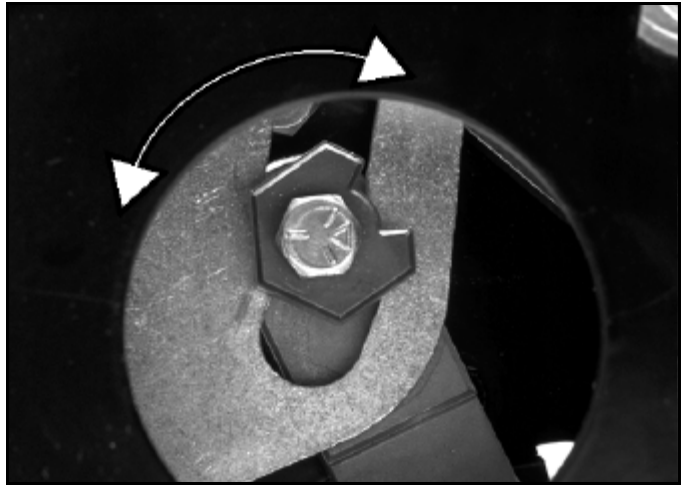


0144-072

4. Loosen the through bolt just enough to allow rotation of the eccentric (A).

MAINTENANCE

5. With the engine running, rotate the eccentric until the right rear wheel hub begins to turn. Note the position of the eccentric. Rotate the eccentric in the opposite direction until the wheel hub again begins to turn.

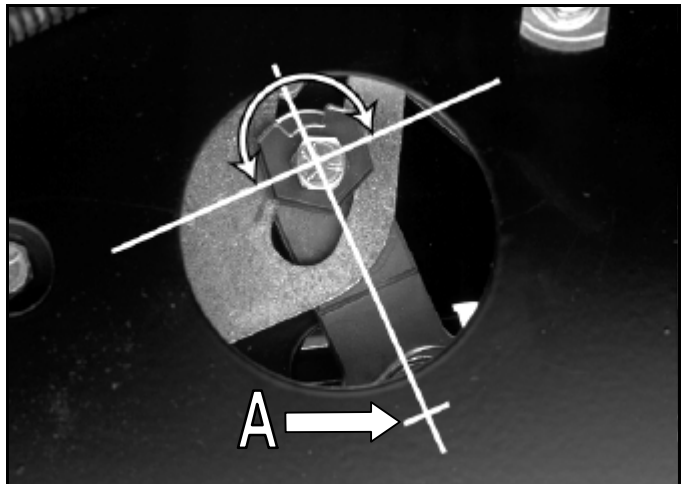


0144-071

6. Center the eccentric between these points, and tighten the through bolt while holding the eccentric.

(A) Pivot Point

NOTE: Do not turn the eccentric more than 90° in either direction. Notch in eccentric must be away from pivot point of control arm.



144-072

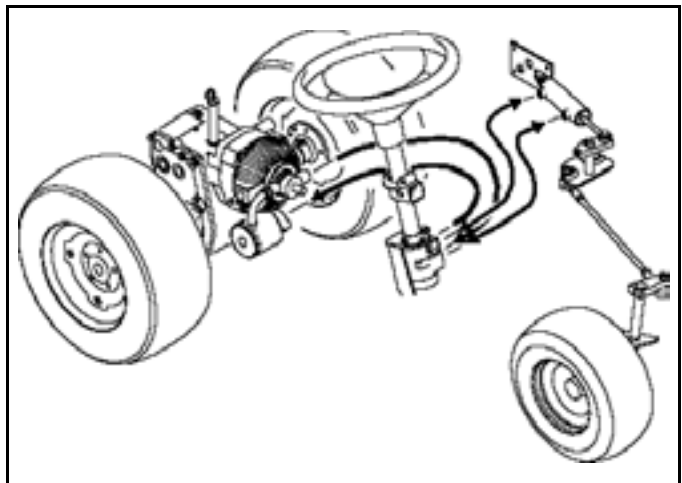
POWER STEERING

General Information

The 22 HP, 20 HP liquid-cooled and 23 HP diesel tractors are equipped with power steering.

This system routes pressurized transaxle fluid supplied by the hydrostatic transmission to a directional valve located at the base of the steering column. When the steering wheel is turned, this valve directs pressure to a double acting hydraulic cylinder, causing the steering plate to pivot as the cylinder extends or contracts. Tie rods attached to the steering plate turn the front spindles.

NOTE: A noisy or sluggish hydraulic system could be caused by a dirty power steering filter.



7195-029

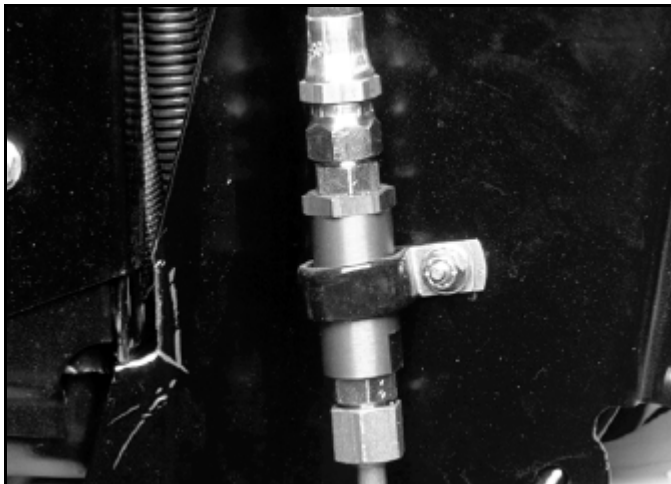


0109-044

When the tractor is not running, some oil will drain from the power steering system. On engine start-up, purge air from the system by turning the steering wheel fully left and right, at full engine rpm, until full steering performance is restored.

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Maintenance

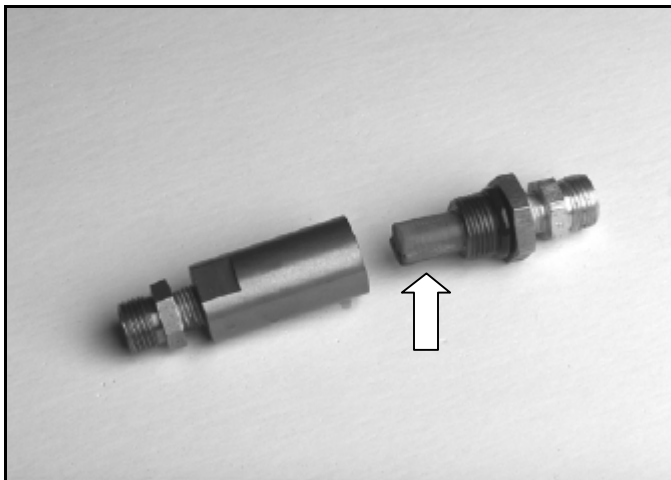


0144-16

The power steering system is equipped with an in-line filter screen. It should be cleaned after the initial 50 hours, then every 200 hours, or if the power steering gets noisy.

To clean the power steering screen:

1. Remove the left and center air intake screens.
2. Remove the screen housing from the clamp securing it to the left-hand side of the steering tower.
3. Remove the top hose first to prevent oil from back-flushing the screen.
4. Remove the hydraulic lines and seal the ends to keep out dirt.
5. Disassemble the housing and clean the screen and housing with solvent.

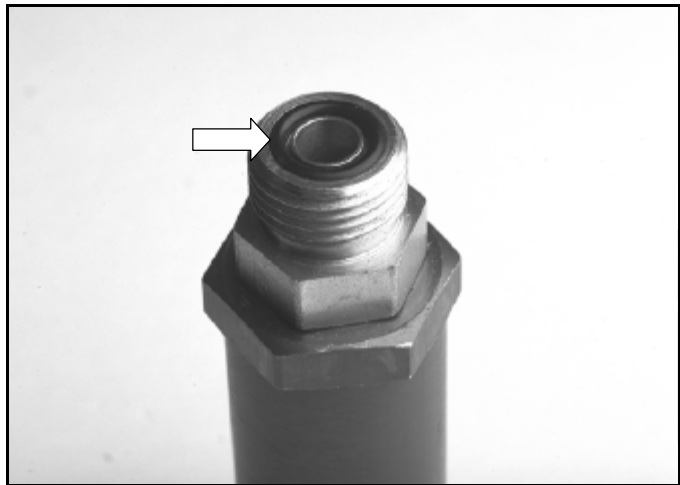


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MAINTENANCE

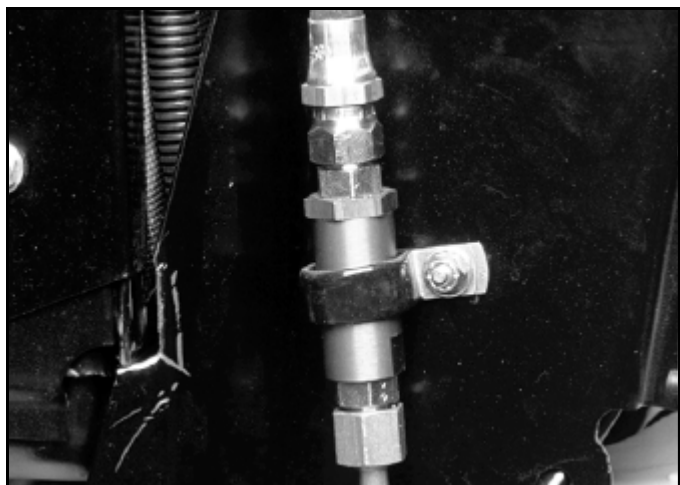
6. Inspect the O-rings which seal the lines and housings. Replace them if there are any signs of cuts and deterioration (i.e. hardening or swelling of the rubber).

Lubricate the O-rings before reassembly.



0144-086

7. Reassemble the housing, replace the lines, and secure to the steering tower.
8. Start the engine. Bleed air from the system by turning the steering wheel from stop to stop several times.
9. Check the transaxle fluid level.



0144-16

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Power Steering Cylinder Hydraulic Hose Routing 2 - 7

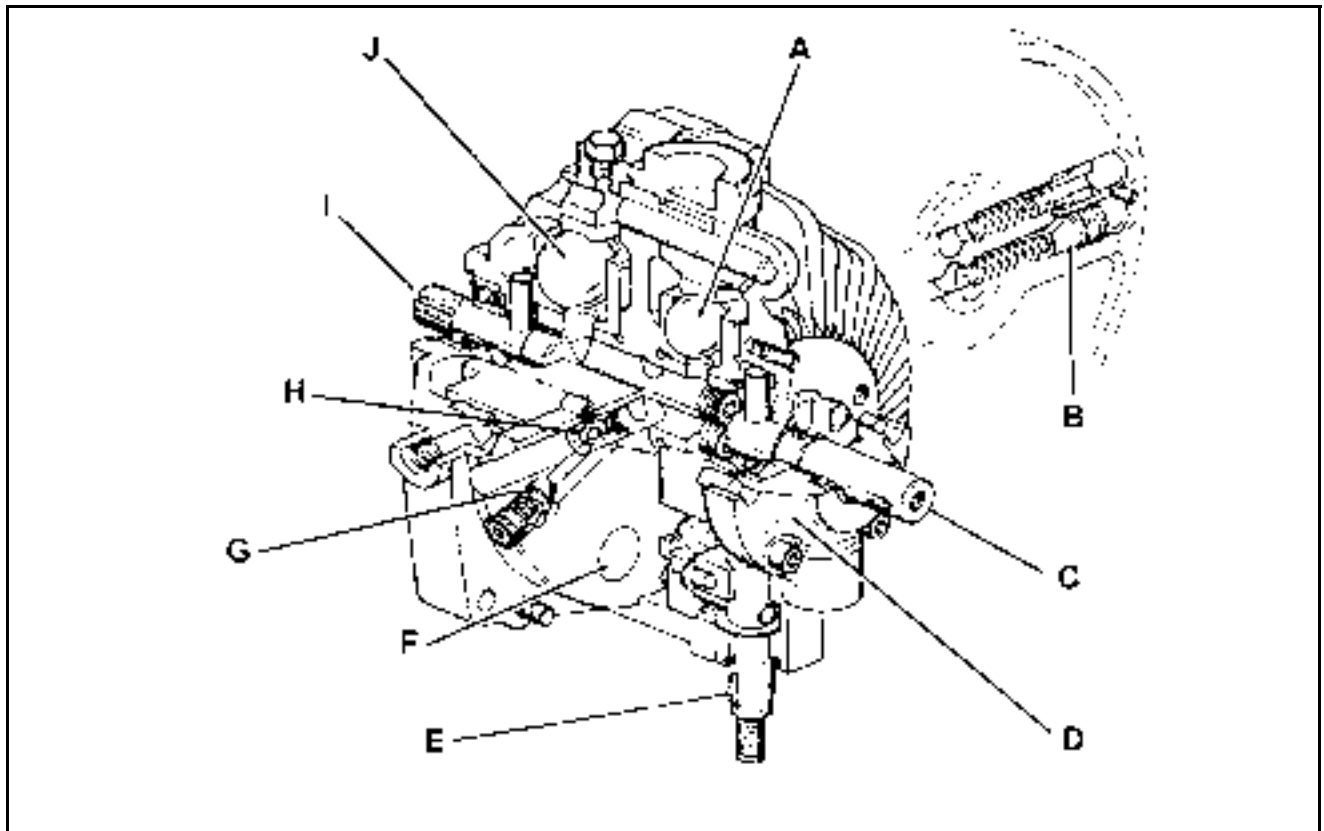
Lift Cylinder Hydraulic Hose Routing 2 - 7

Hydrostatic Transmission Flow Diagram, Units Without Power Steering 2 - 8

THEORY OF OPERATION

General Information

The Eaton Model 11 hydrostatic transmission, as used on the 5xi series, is equipped with an internal charge pressure valve, forward and reverse check and acceleration valves, and vibration dampening pistons. The transmission has a splined output shaft and keyed input shaft, both of which are supported by ball bearings.



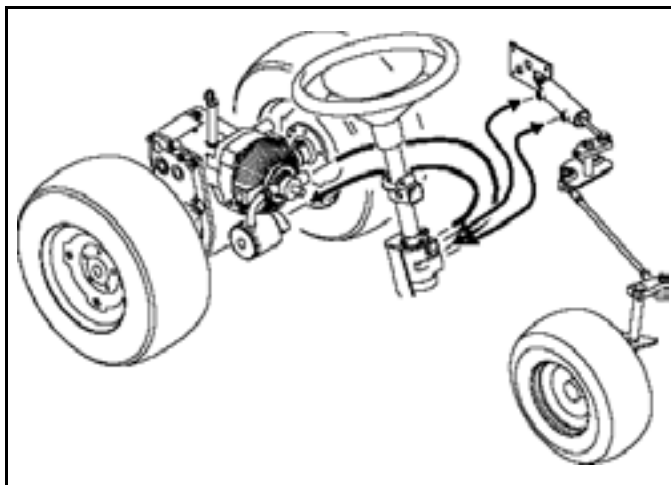
- (A) Radial Ball-Piston Pump.
- (B) Acceleration Valves.
- (C) Input Shaft.
- (D) Charge Pump - Charge pressure 30-90 PSI (2.1 - 6.2 bar). Implement lift pressure 700-800 PSI (48.2 - 55.2 bar) with manual steering, 725 PSI (50 bar) with power steering.
- (E) Control Shaft - Controls transmission output speed and direction of rotation - shaft points to the right when installed in the 5xi transaxle.
- (F) Dampening Pistons - Aids in quieter unit operation.
- (G) Charge Pressure Relief Valve.
- (H) Check Valve - Two used.
- (I) Output Shaft.
- (J) Radial Ball-Piston Motor.

THEORY OF OPERATION

Transmission Operation

Transmission input shaft is driven at engine speed by drive shaft. Both charge pump and transmission pump are driven by input shaft. Charge pump draws oil from transaxle to “supercharge” transmission pump, make up for normal internal leakage, and provide a cooling oil flow. Oil travels from the outlet of the charge pump through a hydraulic hose to the power steering valve (on units equipped with power steering). Then oil flows through the open-center hydraulic lift valve and out to the oil filter adapter through another hose. After filtering, oil passes through a metal line and into the transmission.

NOTE: Lift valve noise is normal on manual steering units.

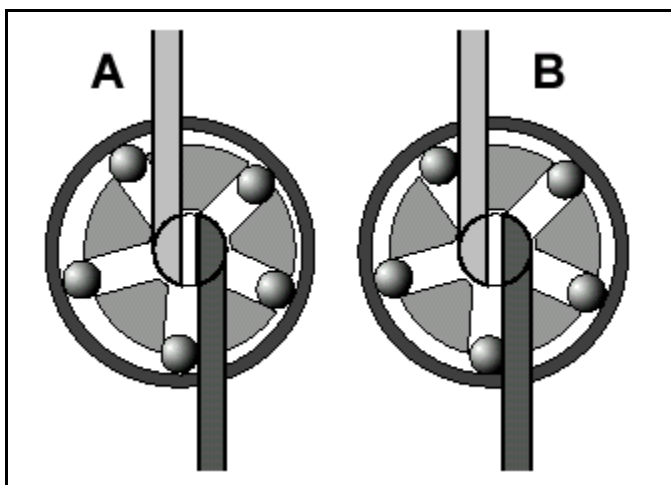


7195-029

2

Pump section of transmission controls volume and direction of oil flow to motor section depending on position of motion control linkage. As the motion control lever is moved away from neutral position, the cam ring increases the displacement of the pump and the flow of oil is increased to the motor making it go faster. The motor output shaft drives the tractor axles through two reduction gears and a differential assembly. Torque is generated in direct response to load; higher pump pressure (torque) is generated as resistance to movement increases.

(A) Maximum Flow (B) Minimum Flow



0202-100

For optimum performance engine should be operated at full throttle, and never less than 3/4 throttle. Under high load conditions tractor should be slowed using traction pedal, which will increase output torque. This is due to lower friction and pumping losses at slower transmission output speeds, and can be compared to the effect of shifting a manual transmission to a lower gear.



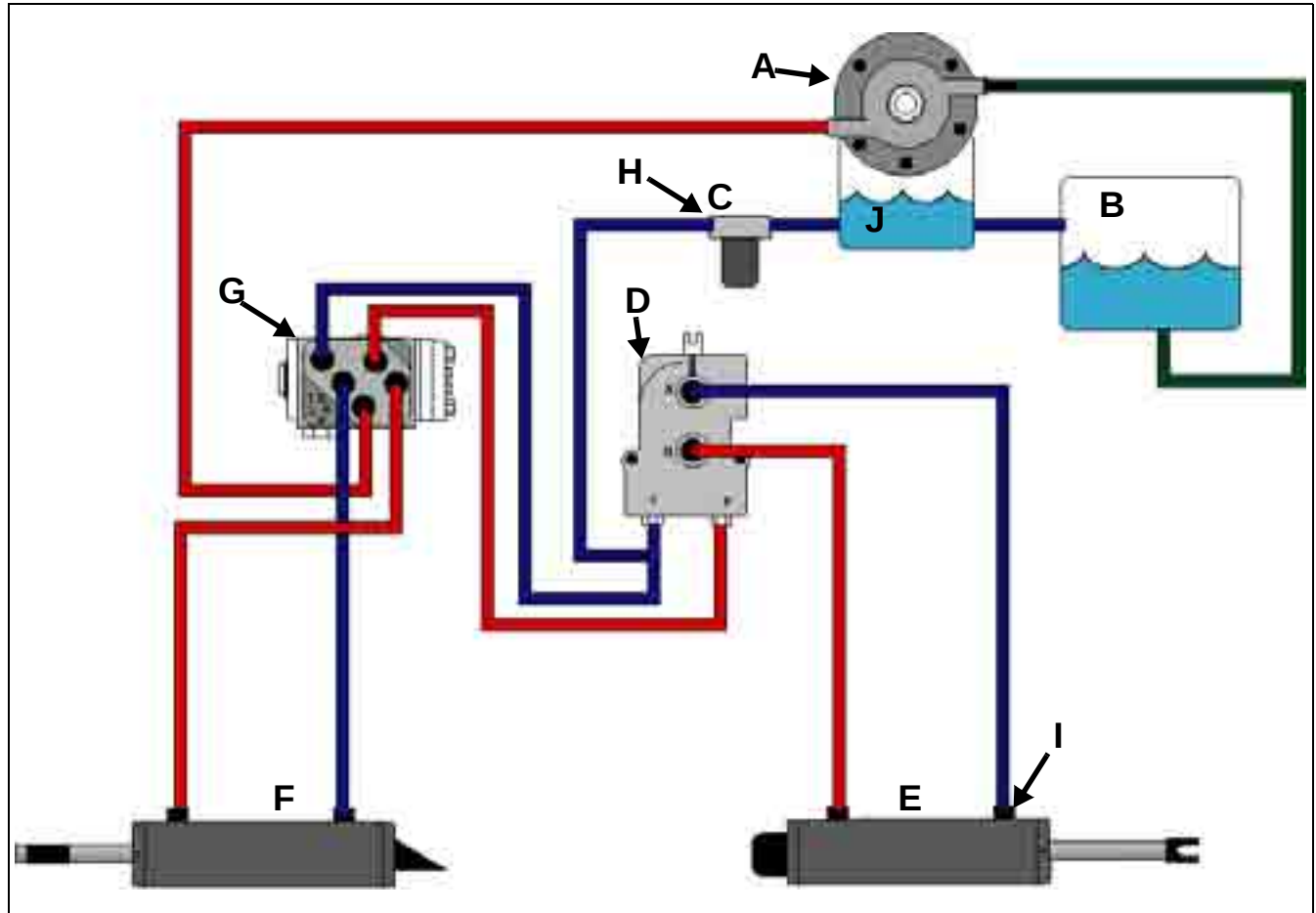
0202-002

THEORY OF OPERATION

The power steering and hydraulic lift circuit are also operated by the charge pump. When the lift control valve is moved to Raise or Lower position, the charge pump output is diverted to one of the hoses attached to the lift cylinder. The other hose is connected through the lift valve to charge pressure hose leading to the oil filter, permitting bleed-off of oil on that side of lift cylinder's piston. Implement relief valve located in control valve (manual steering) or power steering valve regulates lift system pressure at 700-800 PSI (48.2 - 55.2 bar). When this valve opens, excess oil is bled off into the charge pressure hose leading to the oil filter.

NOTE: Lift valve noise is normal on manual steering units.

HYDROSTATIC TRANSMISSION FLOW DIAGRAM WITH POWER STEERING



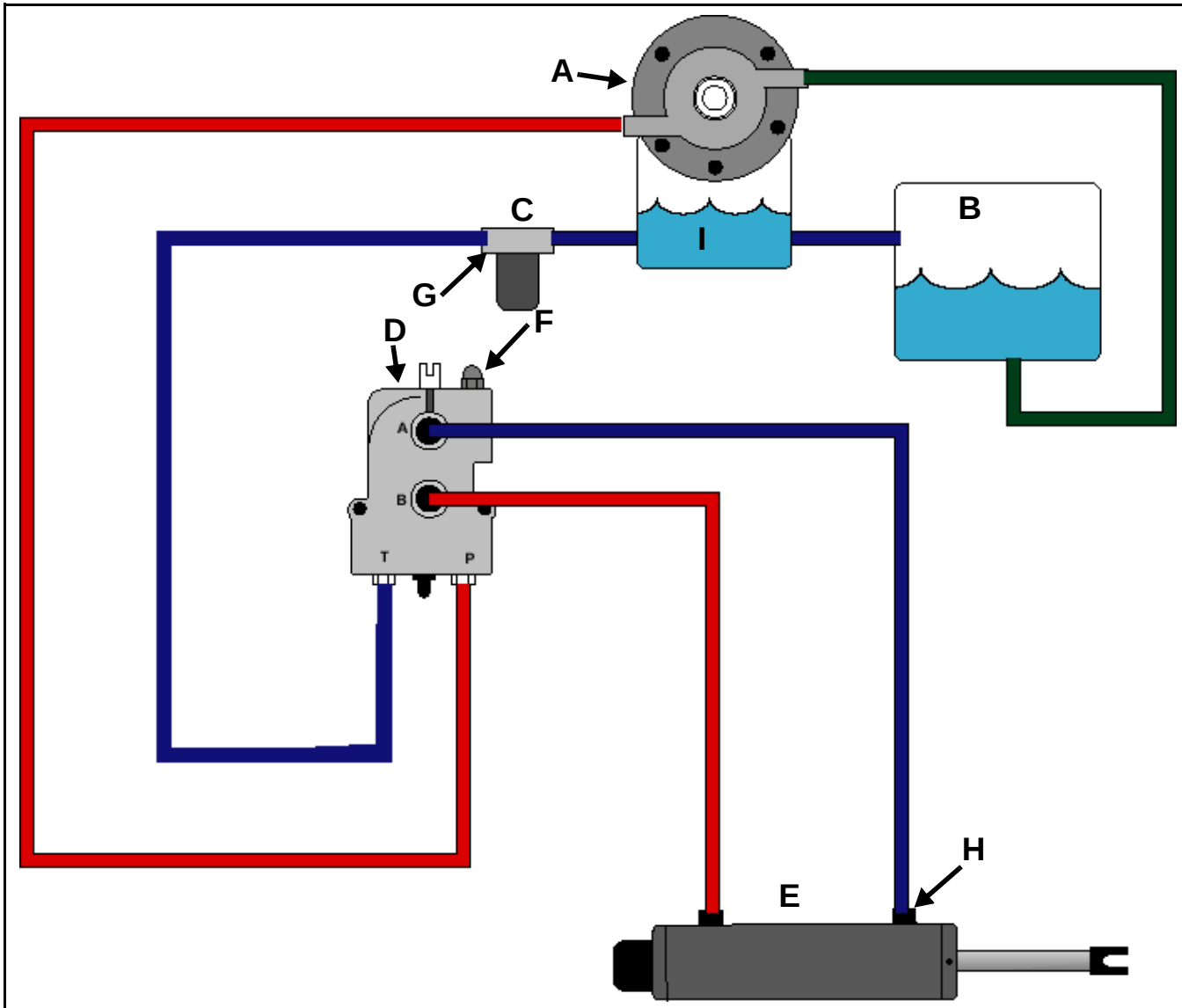
- (A) Charge Pump
- (B) Transaxle Sump
- (C) Filter
- (D) Lift Valve
- (E) Lift Cylinder
- (F) Steering Cylinder
- (G) Power Steering Valve - With 725 PSI (50 bar) relief valve
- (H) Charge Pressure Test Point: 30-90 PSI (2.1 - 6.2 bar)
- (I) Lift Pressure Test Point: 725 PSI (50 bar)

Red = Oil Under Pressure
Blue = Oil Not Under Pressure
Green = Suction Line

NOTE: Pressurization of lines at lift/steering cylinders reverses with change in valve actuation.

THEORY OF OPERATION

HYDROSTATIC TRANSMISSION FLOW DIAGRAM WITHOUT POWER STEERING



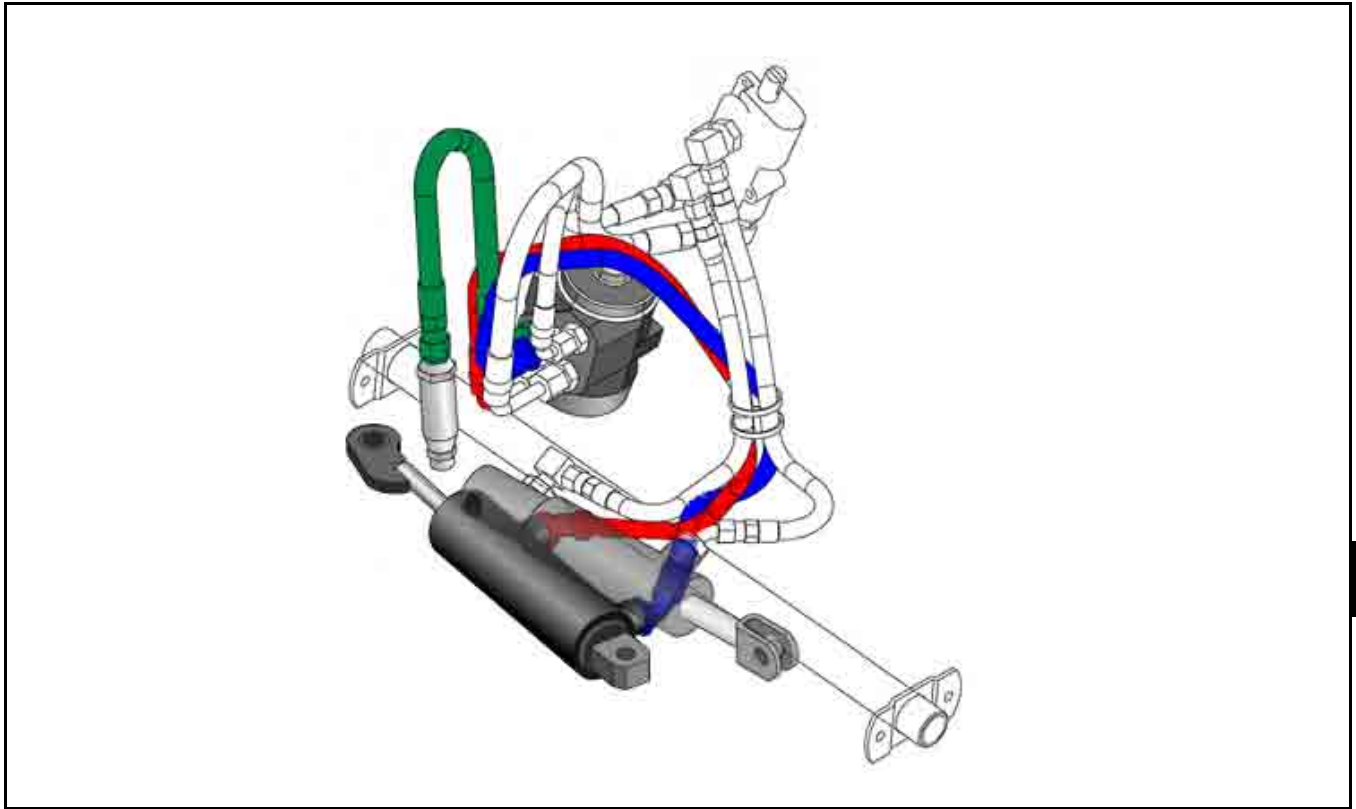
- (A) Charge Pump
- (B) Transaxle Sump
- (C) Filter
- (D) Lift Valve
- (E) Lift Cylinder
- (F) Relief Valve

Setting on manual steering units 700-800 PSI (48.2 - 55.2 bar)
 (G) Charge Pressure Test Point: 30-90 PSI (2.1 - 6.2 bar)
 (H) Lift Pressure Test Point: 700-800 PSI (48.2 - 55.2 bar)

Red = Oil Under Pressure
 Blue = Oil Not Under Pressure
 Green = Suction Line

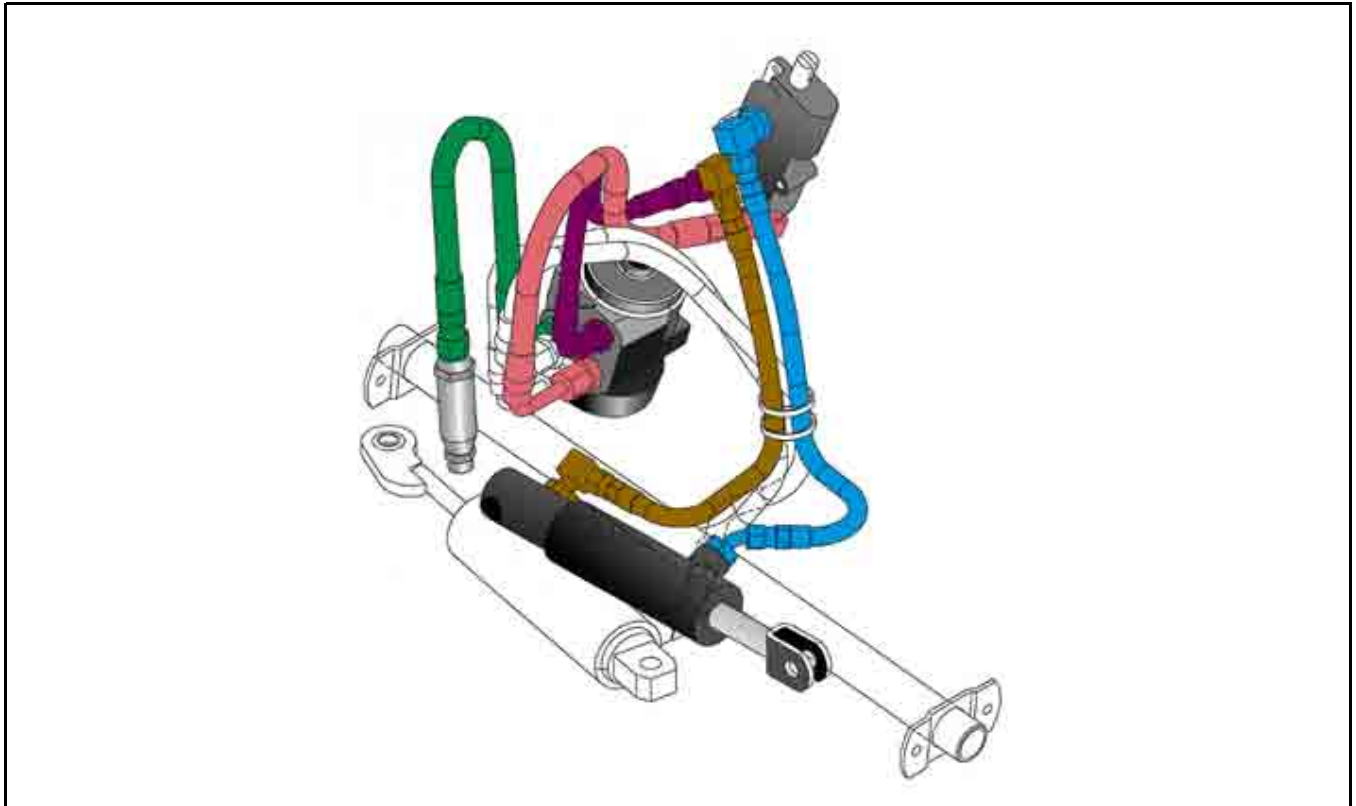
NOTE: Pressurization of lines at lift/steering cylinders reverses with change in valve actuation. Lift valve noise is normal.

POWER STEERING CYLINDER HYDRAULIC HOSE ROUTING



2

LIFT CYLINDER HYDRAULIC HOSE ROUTING



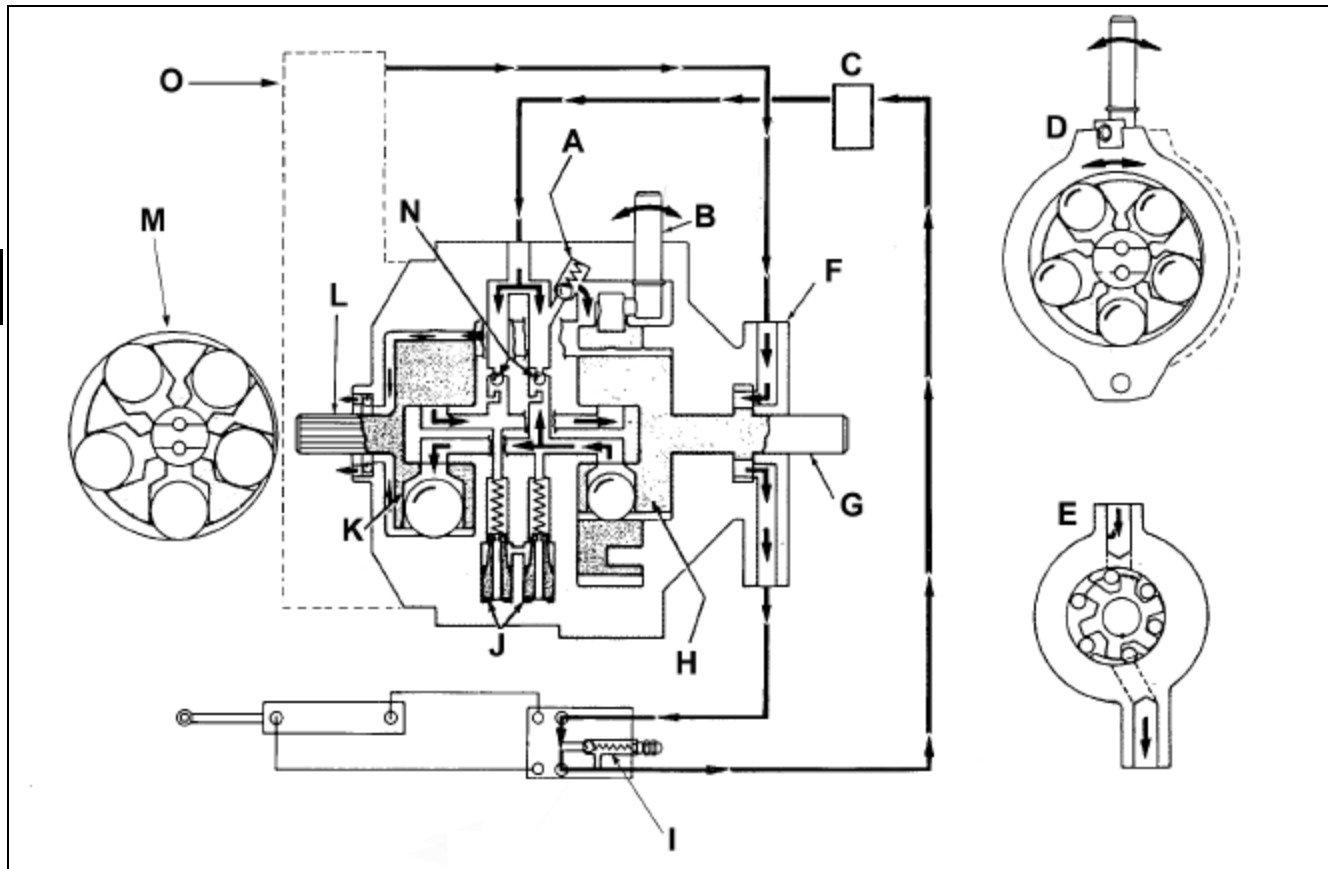
THEORY OF OPERATION

Flow diagrams show hydraulic circuits inside hydrostatic unit and illustrate high and low pressure areas during operation.

Pressurized oil from the charge pump is maintained between 30 and 90 PSI (2.1 - 6.2 bar) by the charge relief valve located inside the hydrostatic unit. When the valve opens, excess oil pressure is bled back to the transaxle sump through a hole in the housing.

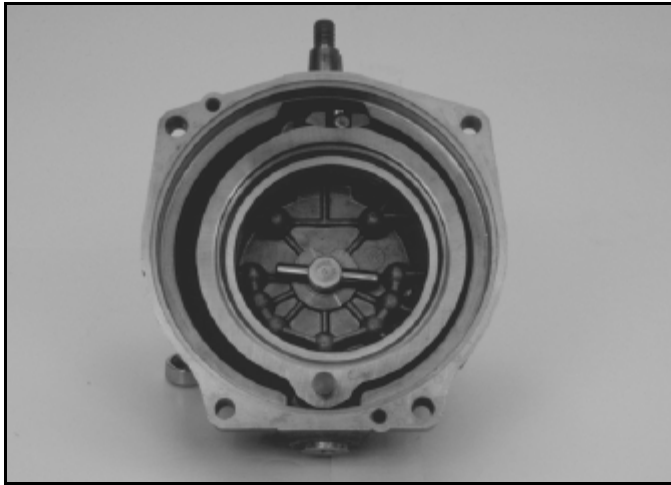
The charge pump oil enters the transmission pump section, which is turning at engine speed, and “supercharges” it.

HYDROSTATIC TRANSMISSION FLOW DIAGRAM, UNITS WITHOUT POWER STEERING



- (A) Charge Pressure Relief Valve.
- (B) Motion Control Shaft.
- (C) Filter.
- (D) Cam Ring - Radial ball-piston hydraulic pump. (variable displacement).
- (E) Charge Pump - Transmission charge pressure 30-90 PSI (2.1 - 6.2 bar). Implement lift system pressure 700 PSI (48.2 bar).
- (F) Charge Pump.
- (G) Input Shaft.
- (H) Hydraulic Pump.
- (I) Hydraulic Lift Control Valve - With 700 PSI (48.2 bar) relief valve.
- (J) Acceleration Valves.
- (K) Hydraulic Motor.
- (L) Output Shaft.
- (M) Radial Ball-Piston Hydraulic Motor - Fixed Displacement.
- (N) Forward/Reverse Check Valves.
- (O) Transaxle Sump.

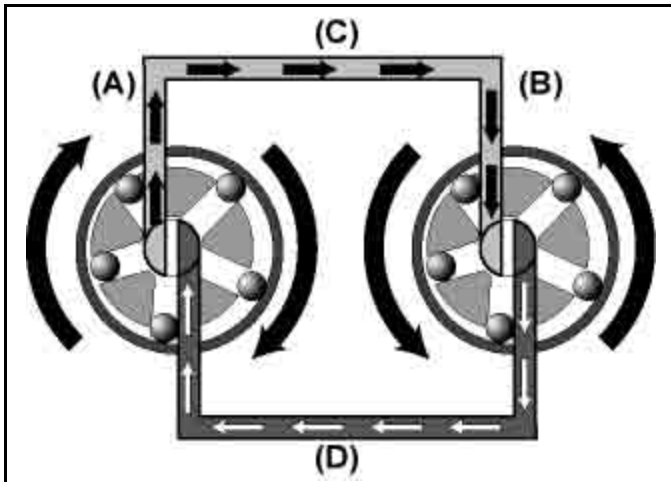
THEORY OF OPERATION



3094-042

The operator controls the transmission by moving the control shaft connected to the cam ring within the pump. With the control shaft in neutral, or its centered position, no flow is generated by the pump and, therefore, the motor portion is at rest.

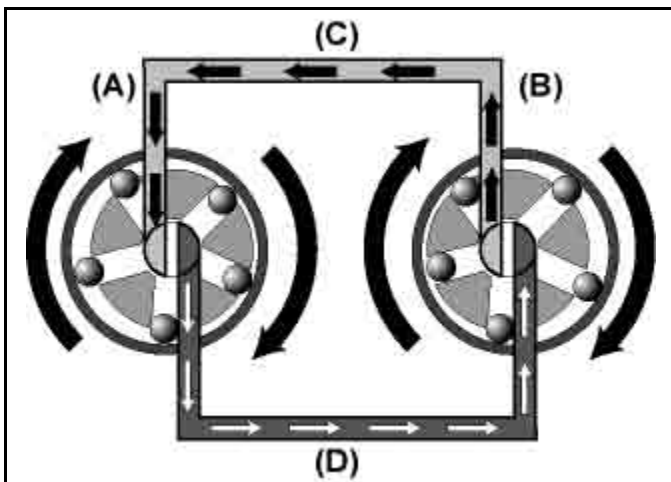
When the control shaft is moved from neutral in the "forward" direction, the cam ring in the pump is moved off center and the pump ball-pistons create a flow of fluid. The position of the control shaft/cam ring is infinitely variable and any flow rate is possible up to maximum cam ring movement/maximum pump displacement.



0202-003

Flow created by pump moves to fixed displacement motor through internal passageways. Because the motor is a fixed displacement unit, the motor requires a specific volume of fluid for it to make one complete revolution.

- | | |
|-----------|-------------------|
| (A) Pump | (C) High Pressure |
| (B) Motor | (D) Low Pressure |



0202-004

When the control shaft is moved from neutral to "reverse" direction, the cam ring is swung off center to the opposite side of the pump and the flow from the pump is "reversed". This flow is directed to the other side of the motor causing its output shaft to rotate in the opposite direction. The pump input shaft always rotates in one direction, dictated by the engine, while the motor output shaft rotates in either direction, depending on the direction of flow from the pump.

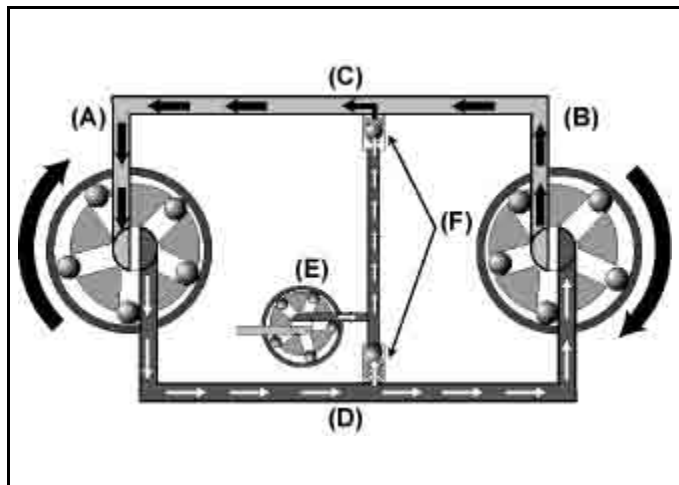
Pump discharge flow is high pressure (dictated by load) fluid. Flow returned from the motor to the pump is low (or charge) pressure fluid.

- | | |
|-----------|-------------------|
| (A) Pump | (C) Low Pressure |
| (B) Motor | (D) High Pressure |

THEORY OF OPERATION

Due to internal leakage, fluid being returned to the inlet side of the pump from the exhaust side of the motor is less than required by the pump. To replace this needed fluid, check valves are located in each side of closed loop. The check valve located on the low pressure side of the pump will open allowing fluid to enter loop, from the charge pump circuit, to make up leakage losses.

- | | |
|------------------|-------------------|
| (A) Pump | (D) High Pressure |
| (B) Motor | (E) Charge Pump |
| (C) Low Pressure | (F) Check Valves |

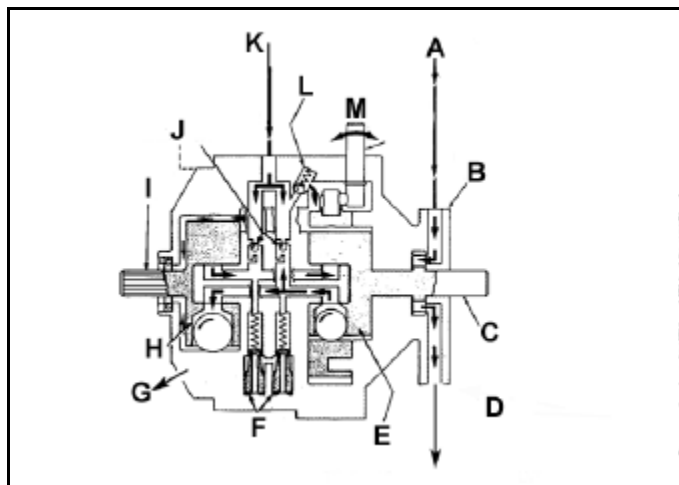


0202-005

2

Internal acceleration valves are used in both forward and reverse directions. These valves are spring loaded to close "slowly" as pressure (load) increases. These valves control the rate of acceleration of the motor output shaft, assist in providing a positive neutral, and permit hand pushing the tractor without operating the engine.

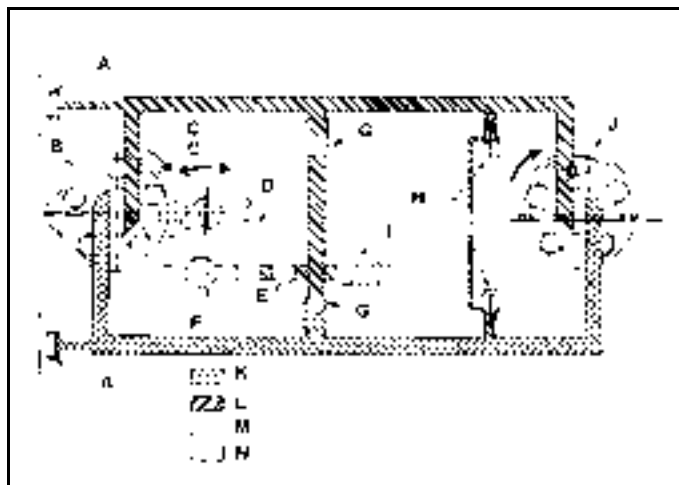
- | | |
|--------------------|--------------------------|
| (A) From Sump | (H) Hydraulic Motor |
| (B) Charge Pump | (I) Output Shaft |
| (C) Input Shaft | (J) Forward/Reverse |
| (D) To Lift | Check Valves |
| (E) Hydraulic Pump | (K) From Lift |
| (F) Acceleration | (L) Charge Pressure |
| Valves | Relief Valve |
| (G) To Sump | (M) Motion Control Shaft |



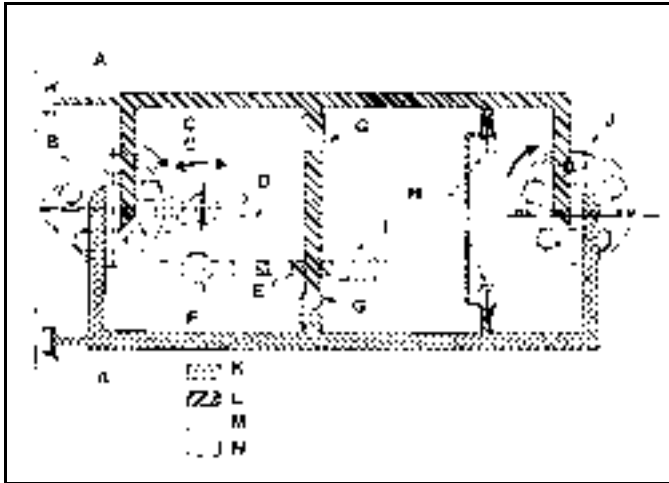
0202-006

In operation, as the tractor's motion control lever is moved out of neutral, the appropriate acceleration valve bleeds off some of the high pressure oil before it closes. This initial temporary pressure reduction results in smoother tractor acceleration from a standstill.

- | | |
|-------------------------|---|
| (A) Dampening Piston | (J) Motor |
| (B) Pump | (K) High Pressure |
| (C) Control Shaft | (L) Low Pressure (30-90 PSI) |
| (D) Aux. Hyd. Valve | (M) Transaxle Sump |
| (E) Filter | (N) Lift System Pressure |
| (F) Charge Pump | (700 PSI (48 bar) with manual steering; 725 PSI (50 bar) with power steering) |
| (G) Check Valve | |
| (H) Acceleration Valves | |
| (I) Charge Relief Valve | |



0202-007



0202-007

Model 11 has two dampening pistons (A), which rest against the cam ring and are controlled by system pressure. In operation, they reduce control shaft vibration and transmission noise.

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Tractor goes forward only at partial speed and is slow or
 does not operate in reverse. 3 - 3

Tractor will not operate in either direction. 3 - 3

Tractor operates erratically. 3 - 4

Tractor operates in both directions but with loss of power and
 condition becomes worse as transmission becomes hot. 3 - 4

Transmission overheating. 3 - 4

Abnormal vibration or noise. 3 - 4

Hydraulic lift system does not operate or does not operate properly,
 but tractor operates normally. 3 - 5

Oil is leaking out high-low shift fork hole during operation. 3 - 5

Whenever a problem occurs with the hydrostatic drive system, you should always check these items first:

1. Transmission oil is at proper level and air is bled from system.
2. Make sure the High-Low speed lever is not in neutral.
3. Speed control linkage functions properly.
4. Cruise control is turned off.

Tractor will not operate in either direction; engine bogs down or stalls.

Possible Cause	Corrective Action
Low transmission oil level	Fill to full "F" mark on dipstick (when trans. is cold)
Motion control linkage	Adjust, repair, or replace
The brake is sticking	Repair linkage; replace brake assembly
Brake adjustment is too tight	Adjust the brake

Tractor goes forward only at partial speed and is slow or does not operate in reverse.

3

Possible Cause	Corrective Action
The cruise control was engaged when the High-Low range lever was in "N".	Turn the cruise control off
The engine is running at partial speed	Move the throttle to "FAST"
The linkage is out of adjustment	Verify full motion is obtained on motion control shaft. Adjust if necessary.
Smart Turn™ steering out of adjustment	Adjust if necessary
There is internal hydro wear	Repair/replace transmission

Tractor will not operate in either direction.

Possible Cause	Corrective Action
The transmission oil is low	Fill to full "F" mark on transmission oil dipstick when transmission is cold
The power steering filter is dirty	Clean power steering filter
The control linkage needs adjustment or replacement	Adjust, repair, or replace
The parking brake was not released or the parking brake is not releasing	Release the parking brake or check the linkage
The drive shaft or wheel hub key has sheared	Replace
Faulty transmission/transaxle	Repair/replace transmission/transaxle

TROUBLESHOOTING

Tractor operates erratically.

Possible Cause	Corrective Action
The transmission control linkage needs adjustment or replacement	Adjust, repair, or replace
The transmission oil level is low	Fill to the full "F" mark on the transmission dipstick when transmission is cold
The transmission is faulty	Repair/replace

Tractor operates in both directions but with loss of power and condition becomes worse as transmission becomes hot.

Possible Cause	Corrective Action
The transmission oil level is low	Fill to the full "F" mark on the transmission dipstick when transmission is cold
The transmission shows signs of overheating or water contamination	Replace the transmission oil and filter
The cooling fan and/or transmission cooling fins are faulty or dirty	Clean the transmission and/or replace the fan
The engine is not operating at full throttle	Increase the engine speed to full throttle
The power steering filter is dirty	Clean the power steering filter

3

Transmission overheating.

Possible Cause	Corrective Action
Not operating engine at full throttle	Increase engine speed to full throttle
Low oil level	Fill to full "F" mark on dipstick (when trans. is cold)
Accumulation of dirt and debris on hydrostatic trans.	Clean
Loose fan or broken blades	Repair or replace

Abnormal vibration or noise.

Possible Cause	Corrective Action
The engine mounting bolts are loose	Tighten the engine mounting bolts
The idler pulley or cutter deck blade is loose	Tighten the appropriate pulley
The transaxle cooling fan is loose	Repair or replace as necessary
There is a problem with the electric clutch	Repair or replace as necessary
Drive shaft/couplings	Repair or replace as necessary

Hydraulic lift system does not operate or does not operate properly, but tractor operates normally.

Possible Cause	Corrective Action
Oil level is low	Fill to proper level
Faulty control valve*	Repair or replace
Restricted, plugged, or leaking hoses or fittings	Repair or replace
Low charge pump pressure	Check pressure
Faulty lift cylinder	Repair or replace cylinder

Oil is leaking out high-low shift fork hole during operation.

Possible Cause	Corrective Action
Dipstick vent hole plugged	Repair or replace dipstick

* Noise is normal on manual steering tractors.

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Tractor Operates In Both Directions, But Loses Power As Oil Becomes Hot and/or
Transmission Overheats 4 - 4

Tractor Does Not Return To Neutral 4 - 5

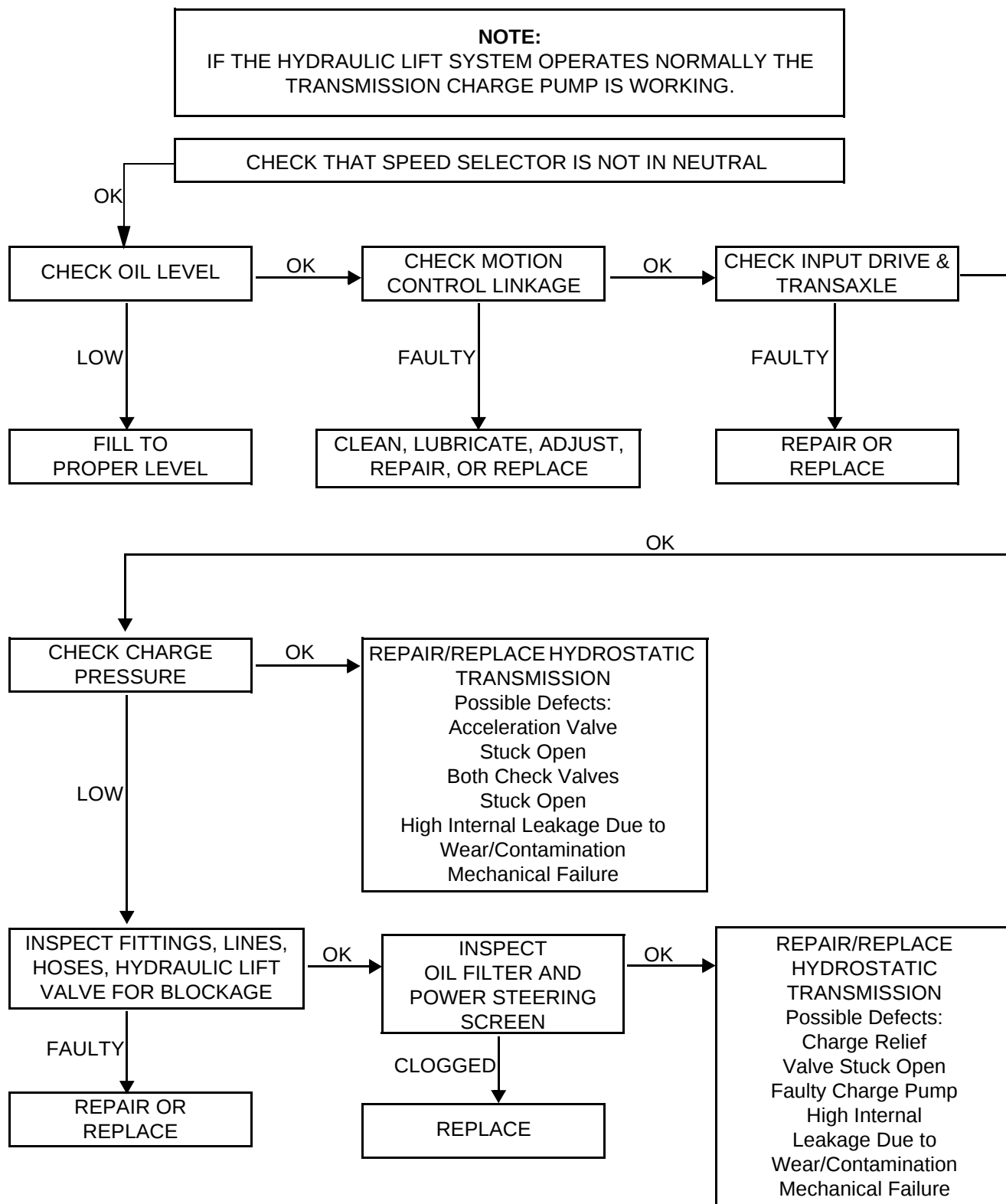
Tractor Operates Normally In One Direction,
But Is Very Slow in Opposite Direction 4 - 5

Tractor Operates In Only One Direction 4 - 5

Tractor Operates Erratically 4 - 5

Hydraulic Lift System Does Not Operate, Or Does Not
Operate Properly; Tractor Operates Normally 4 - 6

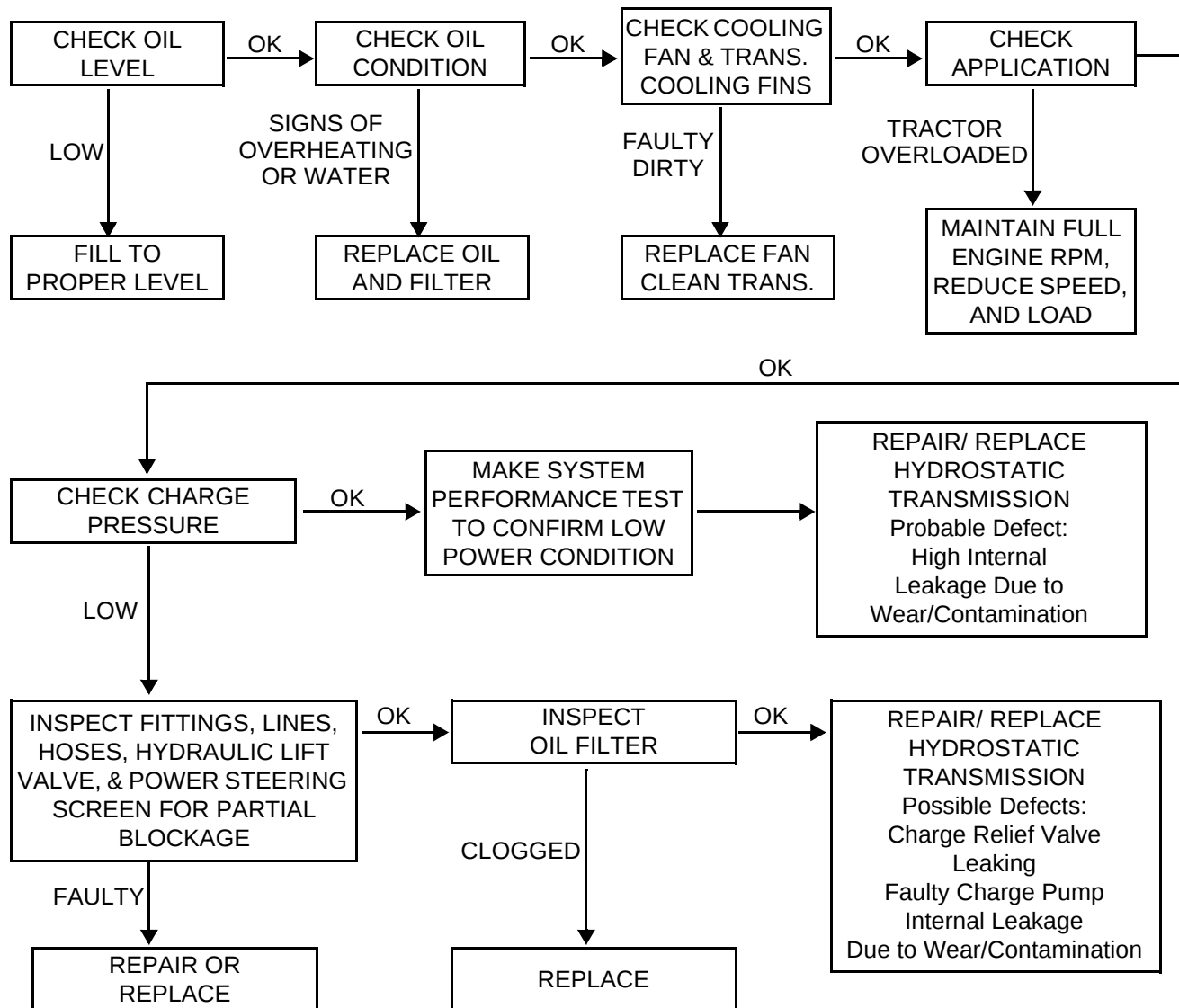
TRACTOR WILL NOT OPERATE IN EITHER DIRECTION



TROUBLESHOOTING

TRACTOR OPERATES IN BOTH DIRECTIONS, BUT LOSES POWER AS OIL BECOMES HOT

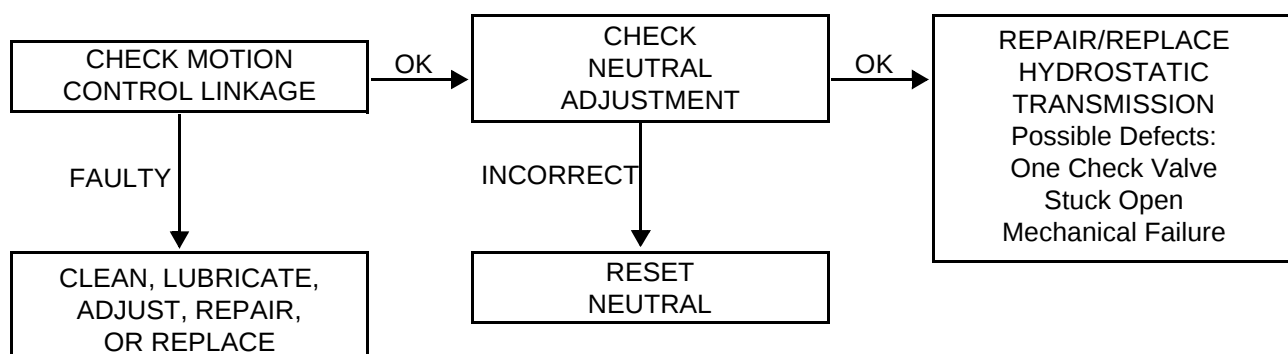
TRANSMISSION OVERHEATS



TRACTOR DOES NOT RETURN TO NEUTRAL.

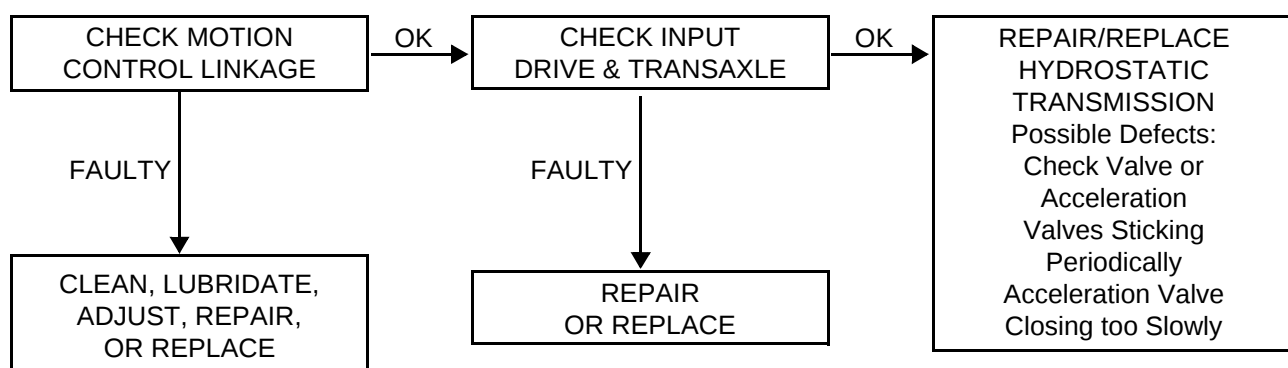
TRACTOR OPERATES NORMALLY IN ONE DIRECTION,
BUT IS VERY SLOW IN OPPOSITE DIRECTION.

TRACTOR OPERATES IN ONLY ONE DIRECTION.



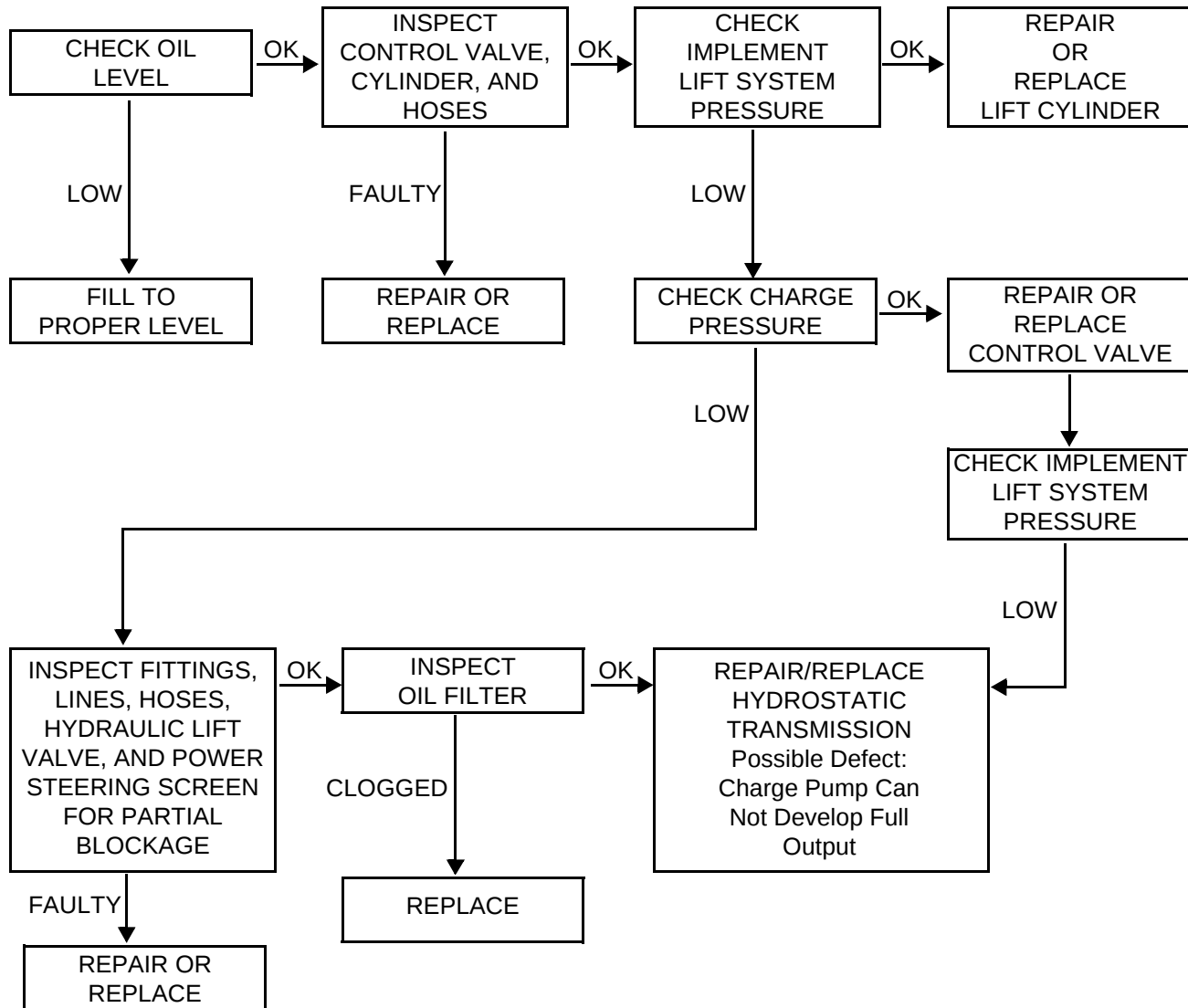
4

TRACTOR OPERATES ERRATICALLY



TROUBLESHOOTING

HYDRAULIC LIFT SYSTEM DOES NOT OPERATE, OR DOES NOT OPERATE PROPERLY; TRACTOR OPERATES NORMALLY.



HYDRAULIC SYSTEMS TESTING

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HYDRAULIC SYSTEMS TESTING

Testing System Performance



1116-01

A test for observing transmission system performance under load can be helpful when checking a “low power”, or “tractor loses power” condition.

1. Operate tractor to bring engine and drive train to normal operating temperature.
2. Anchor rear of tractor to an immovable object (tree, beam, etc.) with a chain secured to transaxle case. Rear wheels must be on a high friction surface, such as unfinished concrete or asphalt. Front wheels may be placed against a curb or wall as an alternative, **but provision must be made to keep front of tractor on ground.**



0202-002

3. With transaxle in high range, set engine at half throttle and move the motion control pedal fully forward. The tractor should have enough power to spin the rear wheels with an operator in seat.
4. If the wheels do not spin, carefully note transmission/transaxle performance to isolate the problem.

5



3653-005

5. If the test results are marginal, the tractor should be used under actual operating conditions to isolate the problem.

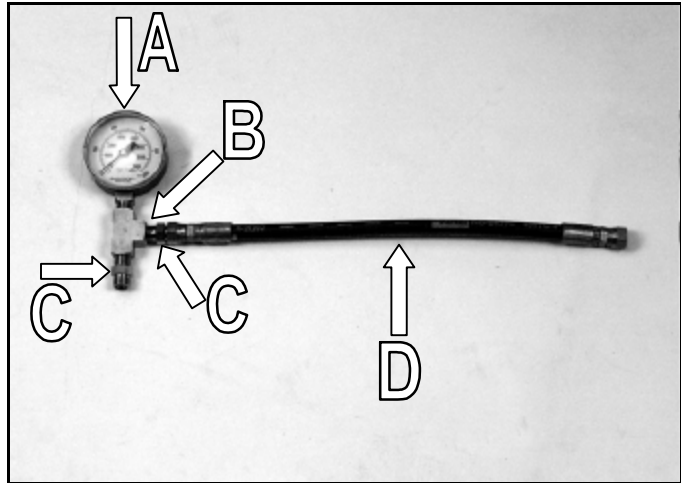
HYDRAULIC SYSTEMS TESTING

Pressure Checks

When performing hydraulic system pressure checks do not connect a pressure gauge in a way that cuts off flow to the hydraulic valve (manual steering) or power steering valve, which eliminates the pressure relief valve from the system. Charge pump pressure will build until internal failure occurs.

A suggested gauge system is illustrated.

- (A) Gauge 0 - 1000 PSI (0 - 700 bar)
- (B) T fitting 1/4 NPT (brass or steel)
- (C) Flat face to 1/4 NPT fitting
- (D) Replacement hydraulic hose

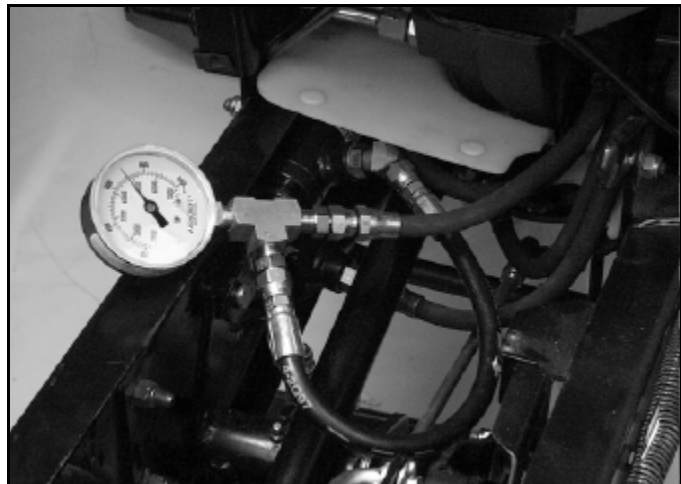


1118-04

Lift System Pressure

1. Connect the gauge system to the front lift cylinder hose. The gauge can be connected to place the hydraulic lift cylinder either in or out of the circuit, as desired.

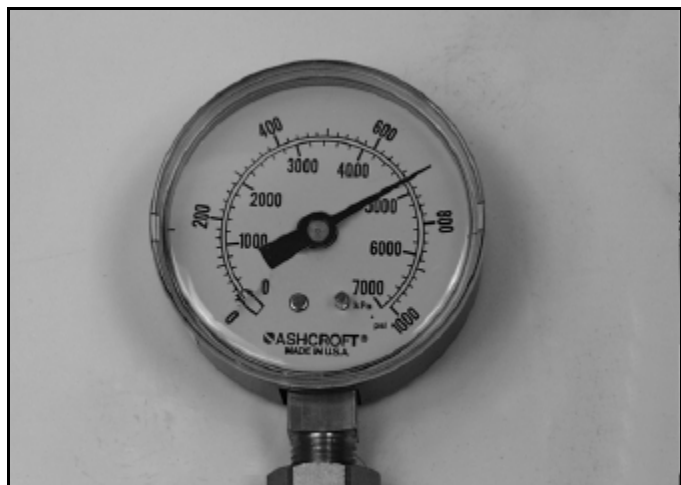
NOTE: Lift system pressure relief valve is part of lift control valve on manual steering models and power steering valve on power steering models. Noise from the control valve for manual steering tractors is normal.



1118-01

2. With the engine running, hold the lift control valve in "Down" direction. Normal pressure reading is 700-800 PSI (48.2 - 55.2 bar) for manual steering models, and 725 PSI (50 bar) for power steering models. If pressure is not to specification, replace the hydraulic lift control valve on manual steering units or the power steering valve on power steering units. **Do not attempt adjustment of the relief valve.**

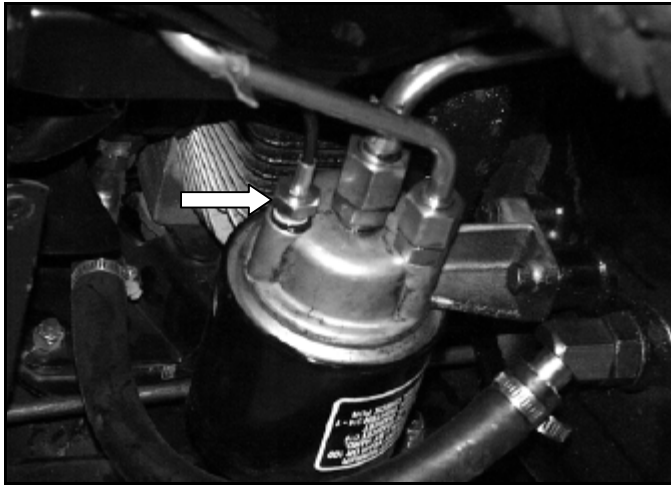
Refer to appropriate Troubleshooting Chart for troubleshooting procedure.



0202-008

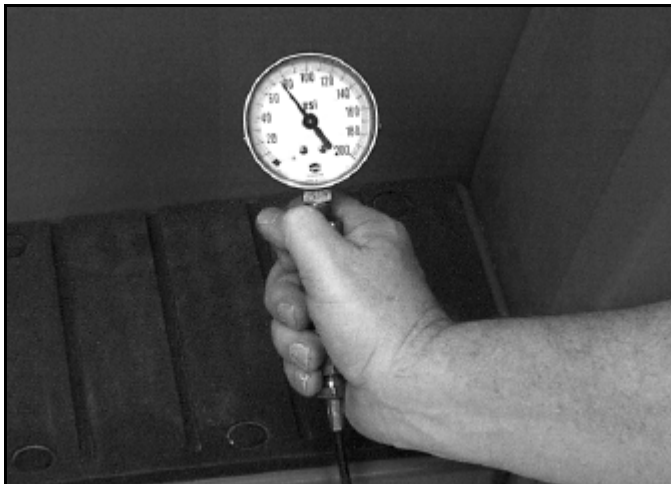
HYDRAULIC SYSTEMS TESTING

Charge Pressure



1118-03

1. Remove the pipe plug and connect gauge directly to filter base. Although thread is $\frac{1}{4}$ -18 NPT, it will accept $\frac{1}{2}$ -20 SAE fitting for test purposes.



1118-02

2. Operate engine. Normal charge pressure is 30 - 90 PSI (2.1 - 6.2 bar). Refer to appropriate Troubleshooting Chart for troubleshooting procedures.

NOTE: Always check implement lift pressure relief valve for signs of tampering if charge pressure is low. A relief valve set too high will cause permanent internal damage to charge pump and hydrostatic transmission. If damage has occurred, repair or replace transmission -- do not operate lift system until hydraulic lift control valve has been replaced or relief valve returned to original setting. The manual steering relief valve is not intended to be adjustable.

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REAR FENDERS, FOOTRESTS, & TUNNEL

General Information

The seat, rear fenders, footrests, and tunnel can be removed as a unit providing easy access to chassis components.



0109-039

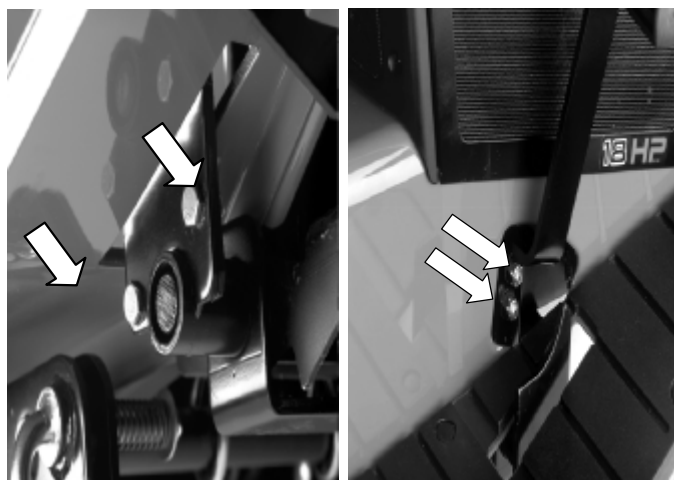
Removal

1. Disconnect the electrical connections for the seat switch, cruise control, and taillights (as applicable) from the wiring harness.

NOTE: The cruise control and taillights share the same connector, which is located under the right fender.



0109-021

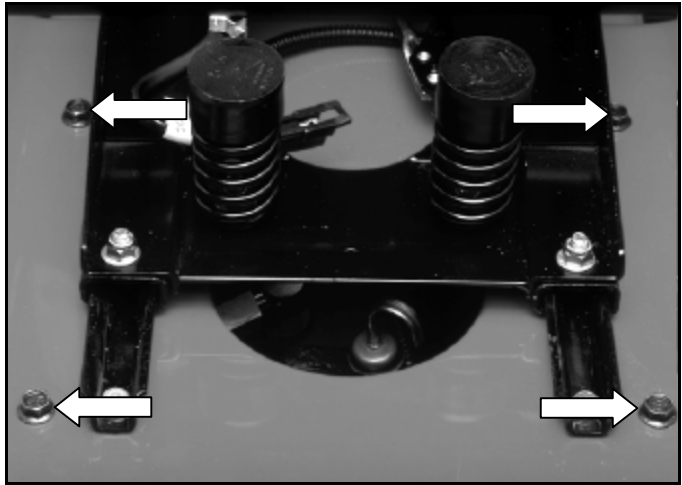


0109-003/0109-020

2. Remove the brake and motion control pedals.

CHASSIS

3. Remove the four bolts securing the fender to the frame (two on each side of the seat).



0109-004

4. Remove the nuts from the front footrest supports and the clamps from the rear supports.



0109-019

6

5. Remove the three air intake screens.

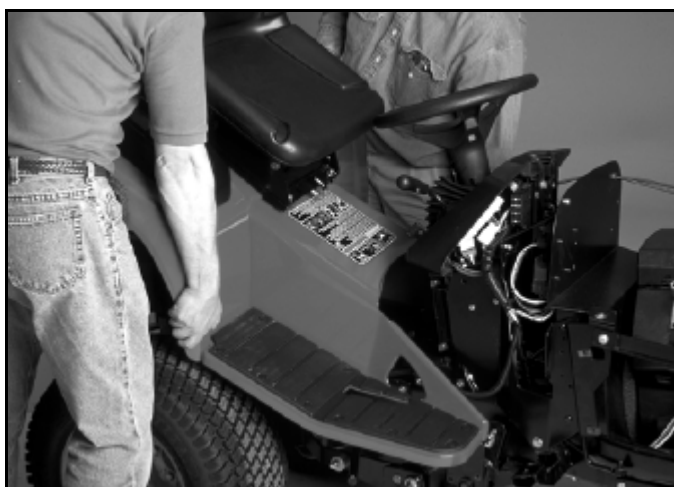


0109-015



0109-017

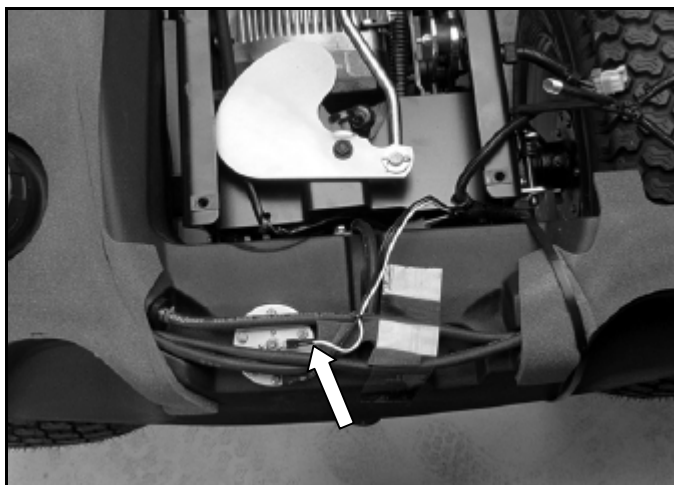
6. Remove the knob for the transaxle range selector.



0109-014

7. With the help of an assistant, lift the rear of the fender assembly until it clears the transaxle shift lever. Then remove the assembly to the rear of the tractor.

CAUTION: Do not dislodge the fuel tank from the mount. If there is fuel in the tank, it will be unbalanced and can tip.

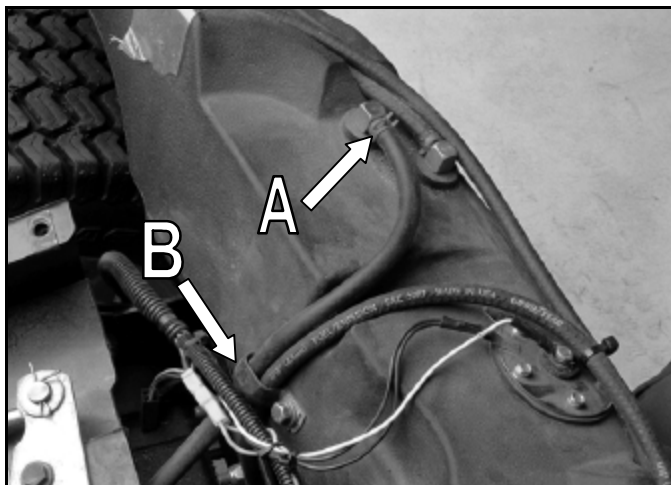


3031-03

Remove wiring for the fuel gauge sender (white rheostat, black ground).

CHASSIS

On diesel powered units, disconnect the fuel return line (A). Remove the vent line from the bracket (B), then remove the bracket.



3031-13

Close the fuel shut off valve, remove the supply line from the valve.



3606-003

6

Lift the fuel tank from the mounting bracket.

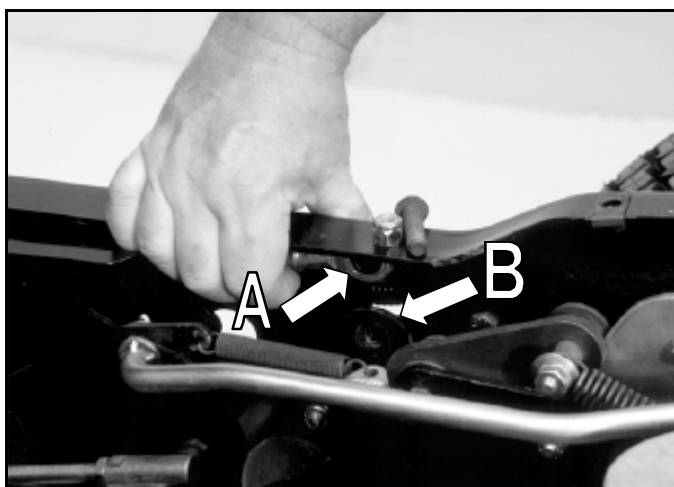


3606-005



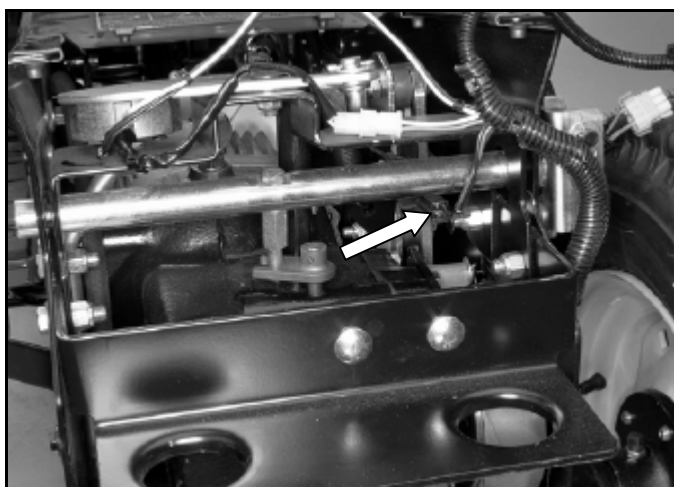
3606-008

Clean area around dipstick, then remove the dipstick tube from the axle and cover the hole with tape to prevent dirt from entering the transmission.



3606-012

Remove the link (A) connecting the lower steering plate to the bell crank (B).



3031-06

Unplug the safety switch.

CHASSIS

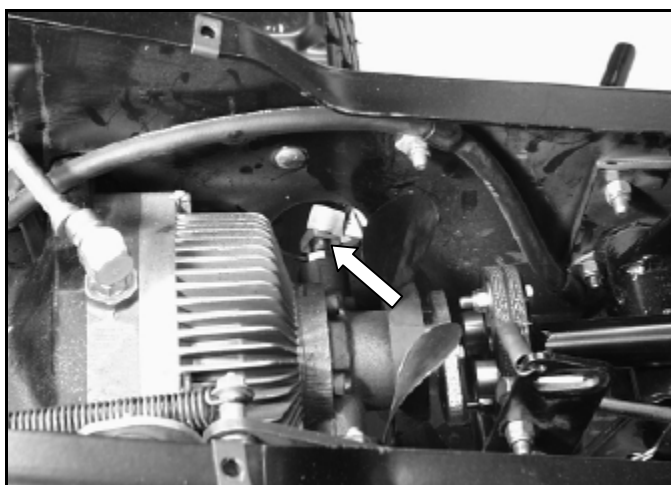
Remove the hydraulic line from the power steering valve.

Hold the 45° fitting in position while removing the hydraulic line.



3606-046

To remove the 45° fitting from the charge pump, loosen the jam nut and remove the fitting, washer, and O-ring.



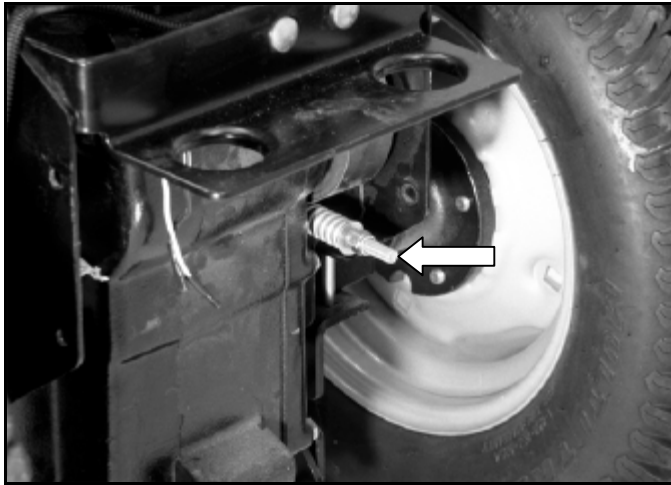
0202-009

6

Disconnect the drive shaft from the transmission input yoke.



0202-010



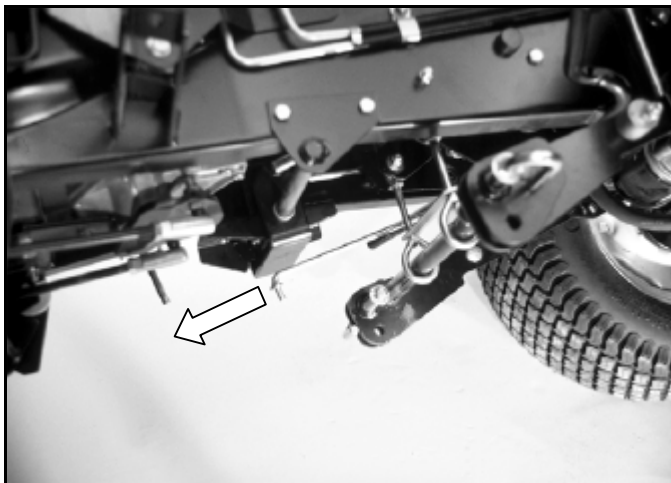
3606-020

Remove brake rod by first removing the adjusting nut and spring.



0202-011

Then remove the cotter pin and washer from the other end of the rod at the brake pivot plate.

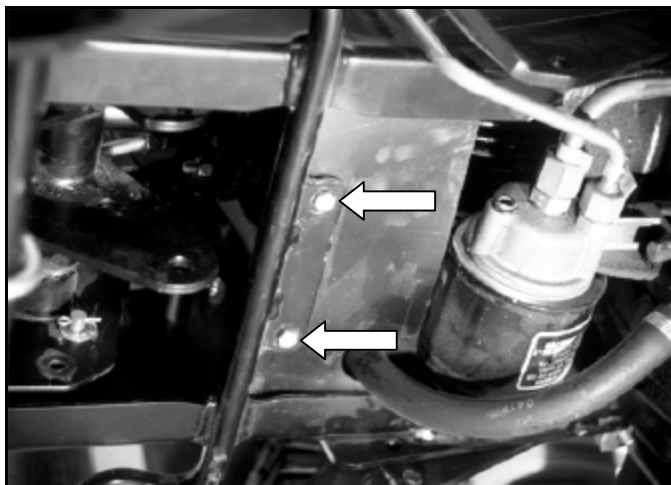


3606-031

Remove the rod by pulling it forward.

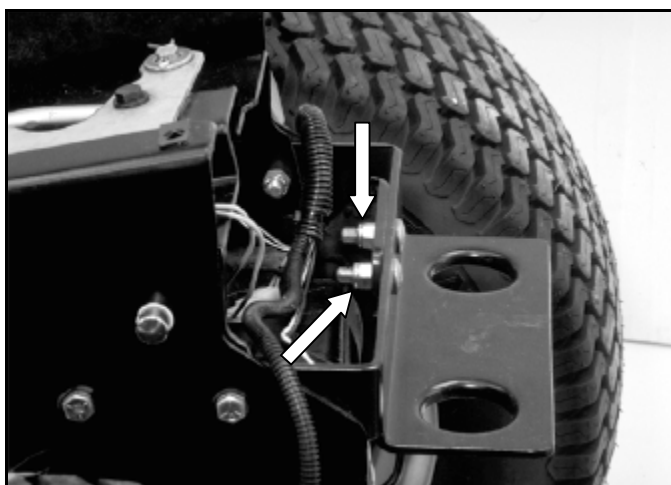
CHASSIS

Remove the two 1/4" bolts securing the guard below the transmission cooling fan and remove the guard.



3606-029

Remove the two carriage bolts securing the rear transaxle brace to the frame rails.



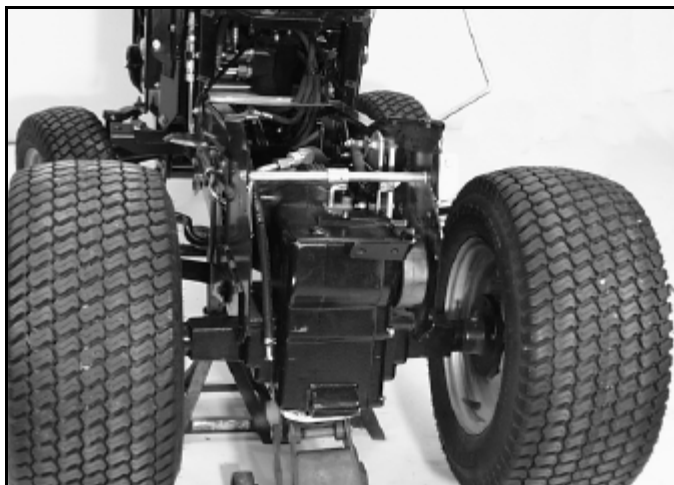
3606-038

6

Remove the frame crossmember/tank mount.

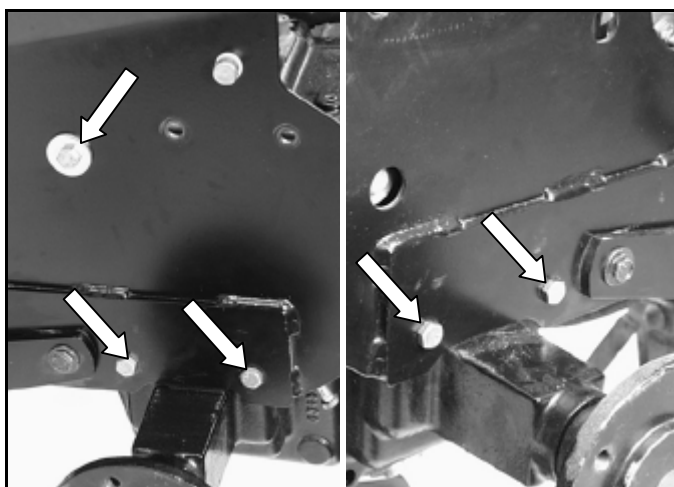


3606-043



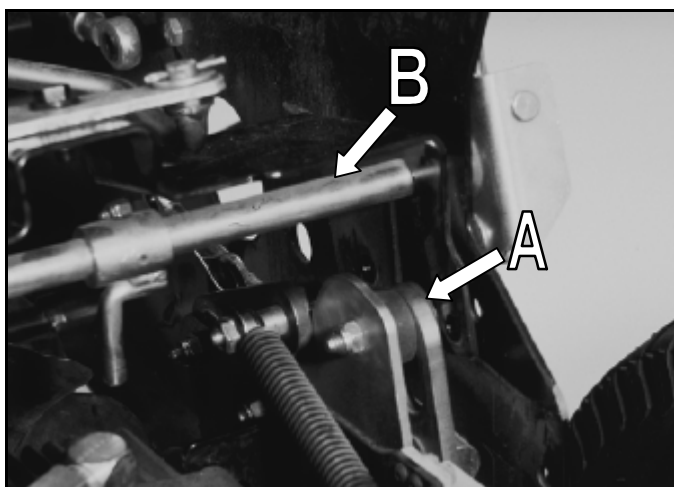
0202-12

Place a floor jack under the transaxle, raise the rear of the tractor and support the frame with safety stands.



0202-013/0202-014

Support the transaxle with a floor jack. Remove the five 3/8" bolts attaching the transaxle to the frame.

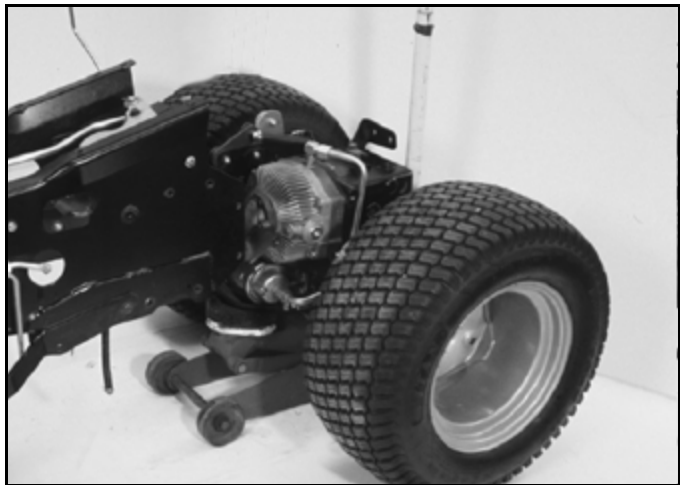


3606-072

Lower the transaxle until the Smart Turn™ Steering (A) clears the range selector pivot (B).

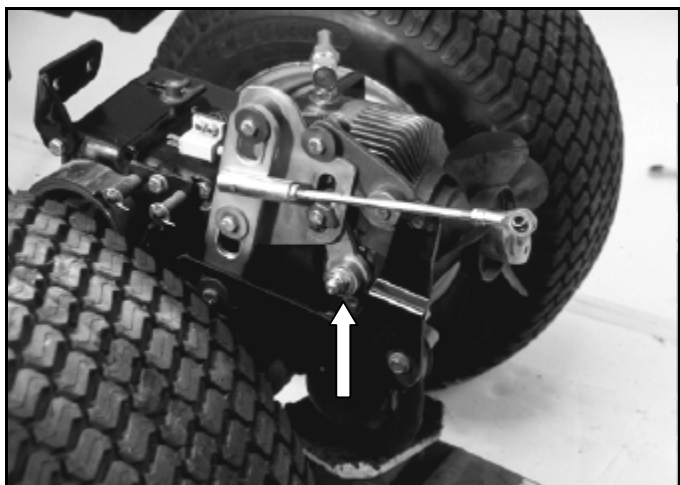
CHASSIS

Remove the transaxle assembly from the frame rails by carefully lowering it while rolling it out from the rear of the tractor.



3606-05-c

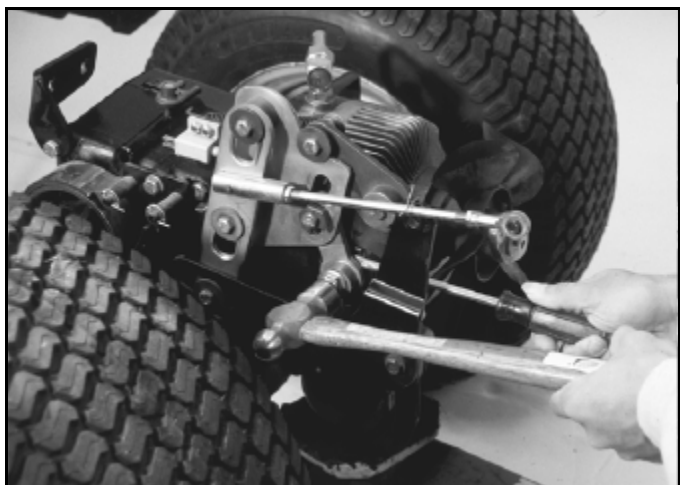
To remove the Smart Turn™ Steering mechanism, first loosen the nut securing the control lever to the tapered shaft one turn.



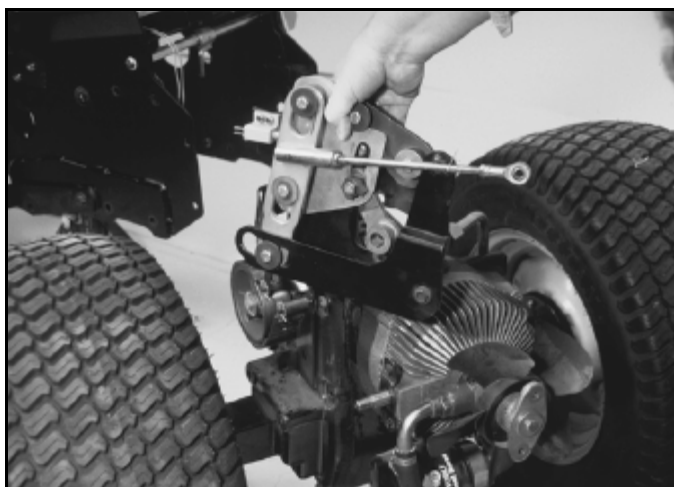
3606-060

6

Wedge a large straight blade screwdriver behind the control lever. Then tap the retaining nut sharply to separate the control lever from the shaft.



3606-062



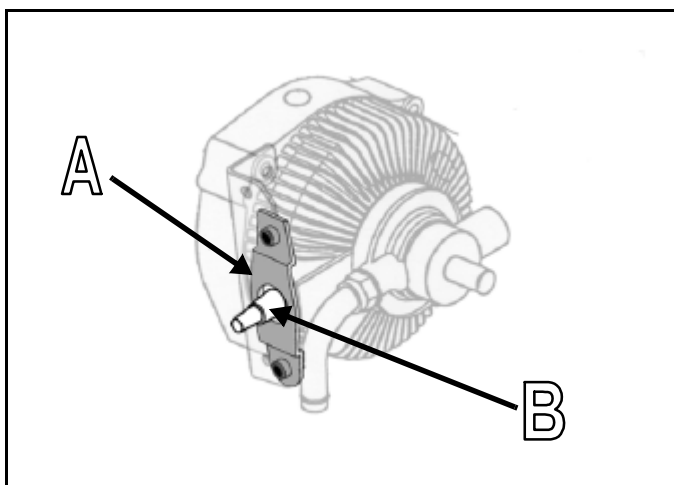
3606-068

Remove the nut from the control shaft along with the three bolts securing the Smart Turn™ Steering assembly to the transaxle.

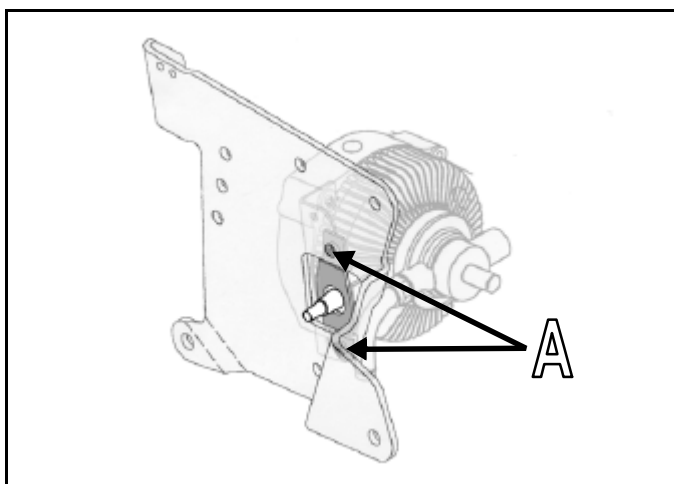
Reassembly

When installing the Smart Turn™ steering assembly, first slide the plastic locator plate over the speed control shaft on the hydrostatic transmission.

- (A) Plastic Locator Plate
- (B) Speed Control Shaft



0202-015

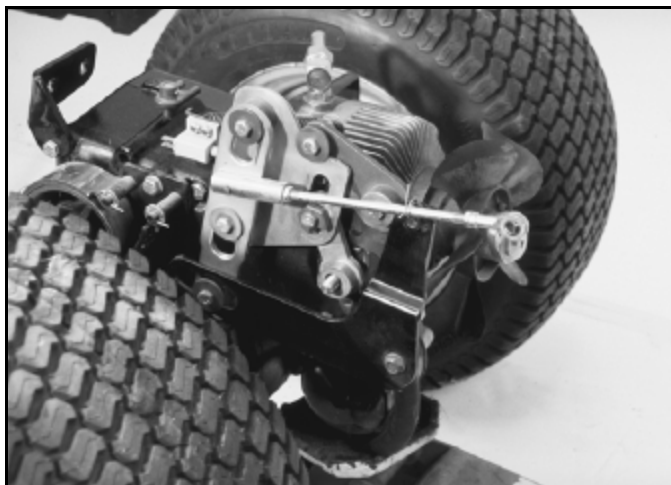


0202-016

Install the Smart Turn™ steering so that the buttons (A) on the plastic locator plate are fully seated in the holes in the Smart Turn™ steering control plate.

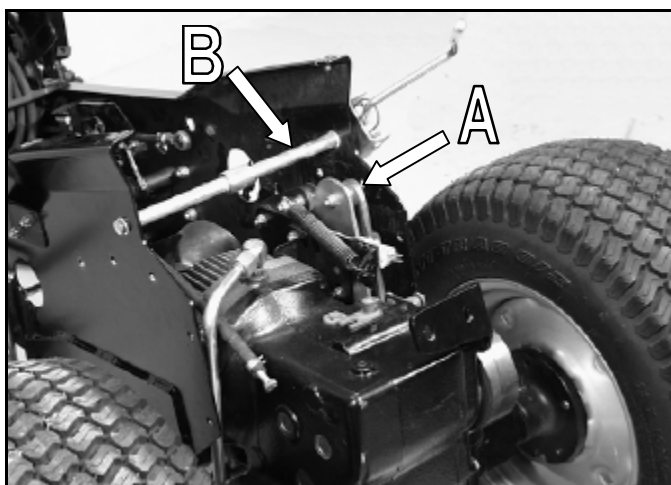
CHASSIS

Install Smart Turn™ Steering assembly on transaxle. Wire the actuating rod up to assist in properly locating it in the chassis.



3606-065

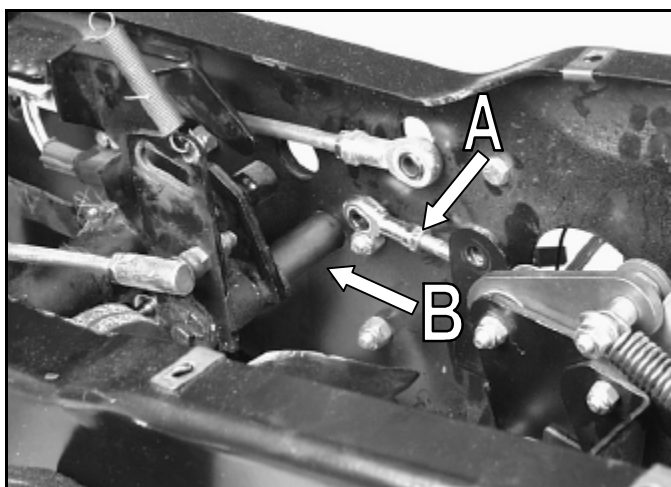
Place transaxle on floor jack and carefully slide it between the frame rails keeping it low enough so that the Smart Turn™ Steering assembly (A) clears the range selector crossbar (B).



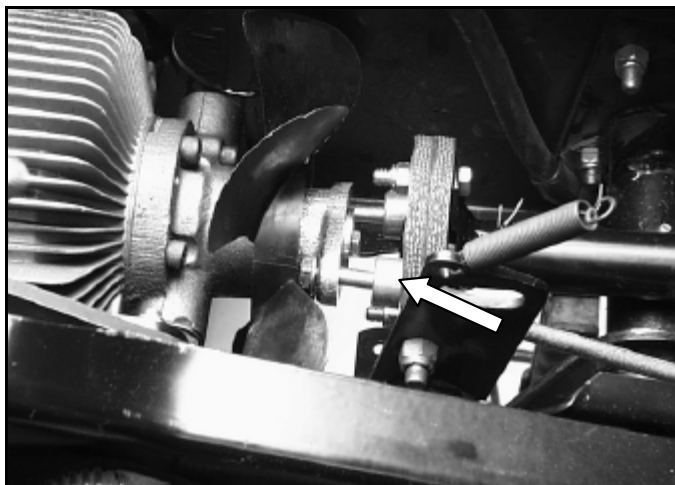
0202-017

6

When the Smart Turn™ Steering assembly is clear of the range selector raise the transaxle into position between the frame rails while guiding the Smart Turn™ Steering link (A) above the pivot (B).

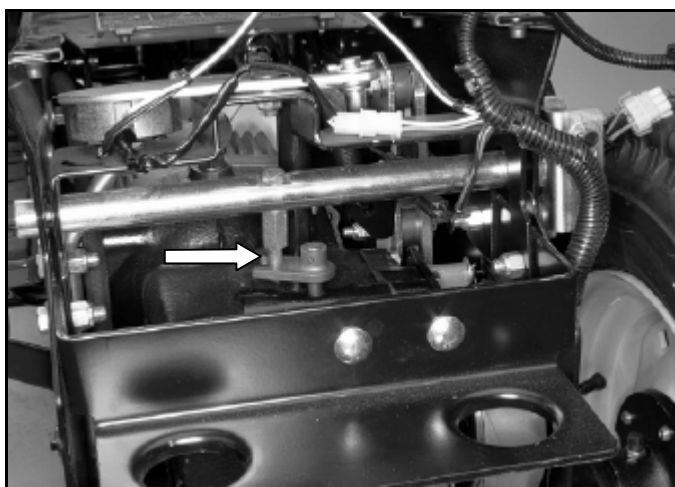


0202-018



0202-019

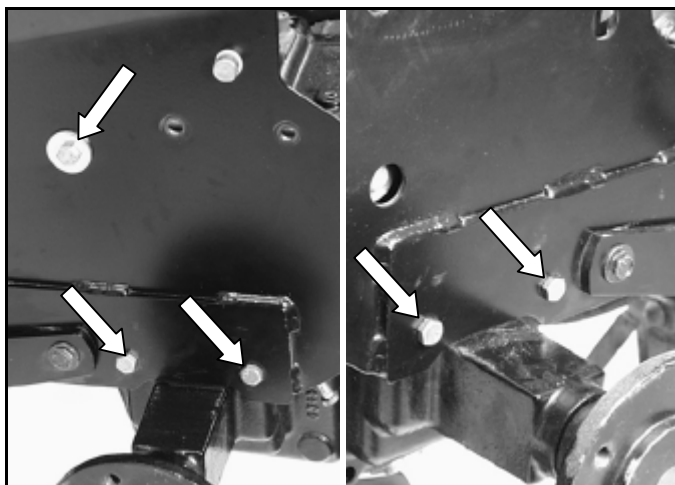
Guide the drive shaft bolts through the spacers in the rubber coupling.



3031-06

As the transaxle moves into place make sure the range selector pin is properly located in the shift fork.

NOTE: If oil is being forced out through High-Low shift fork hole during operation, the air vent in dipstick is plugged.

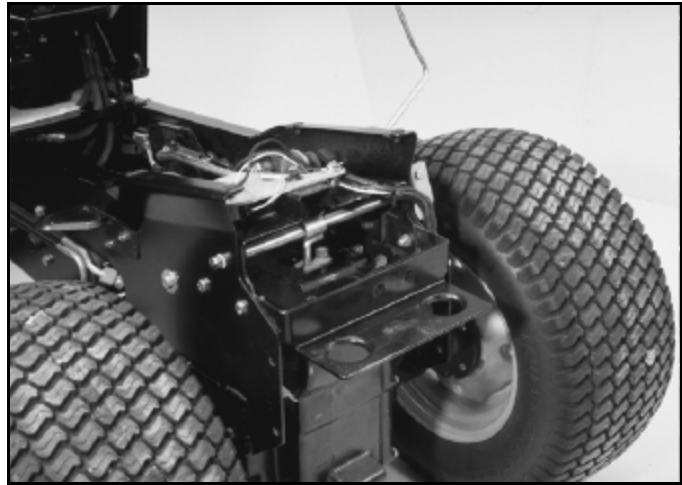


0202-013/0202-014

Install the five 3/8" mounting bolts and torque to 27-33 ft·lb. (37.8 - 46.2 N·m).

CHASSIS

Install the rear frame crossmember/fuel tank mount.



3606-041

Install the brake rod from the pivot to the brake band.



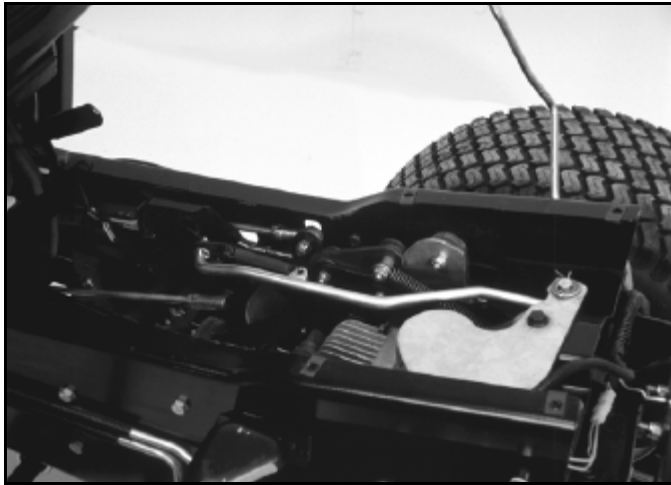
3606-020

6

Adjust the brake by turning the adjustment nut (A) in until there is 2" (51mm) of free travel in the brake pedal.



0109-010-2 / 0109-005-2



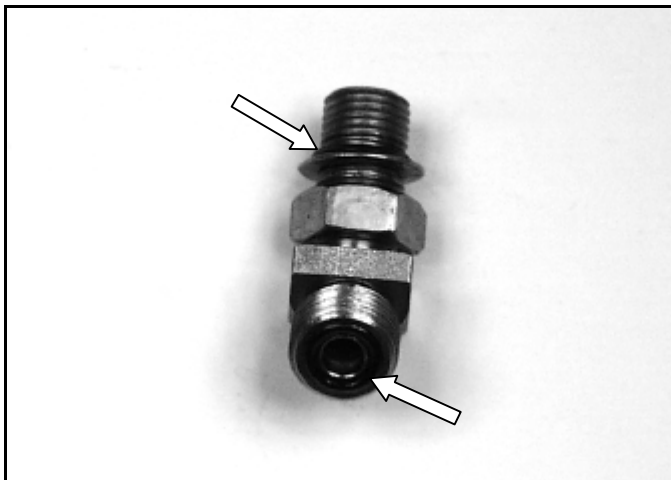
3606-009

Install the Smart Turn™ Steering linkage.



0202-010

Secure the drive shaft; torque bolts to 17-21ft·lb. (33-28 N·m).

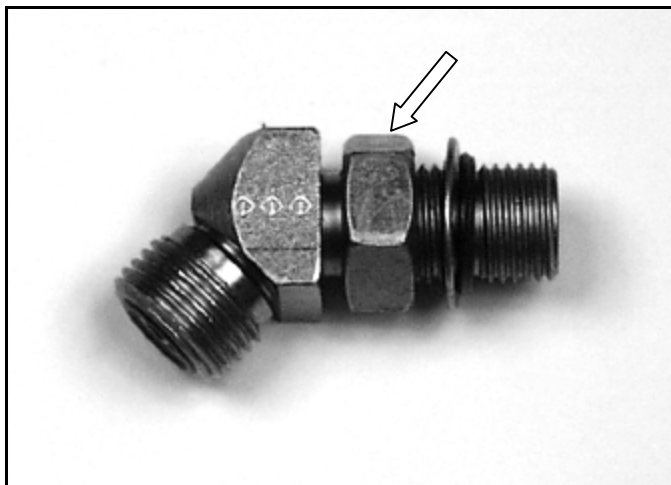


0202-020

Replace the O-rings on the 45° charge pump outlet fitting.

CHASSIS

Install the 45° fitting in the charge pump outlet by first backing off the locknut.



0202-021

Coat the O-rings with oil, then thread the fitting into the charge pump outlet.



0202-022

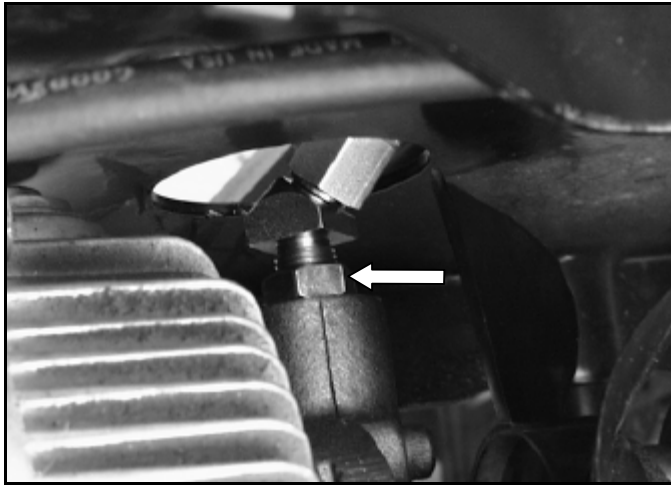
6

Install the hydraulic line from the power steering valve.

Hold the 45° fitting in position while securing the hydraulic line.



3606-046



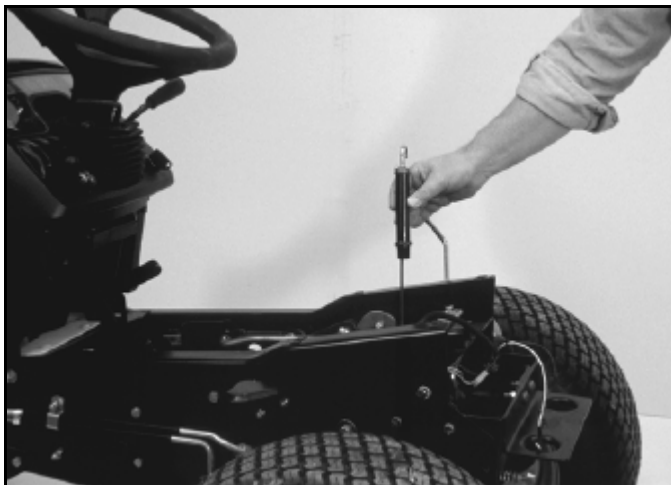
0202-023

Then tighten the jam nut.



0202-024

Coat the O-ring with oil and install the hydraulic fitting into the filter adapter.

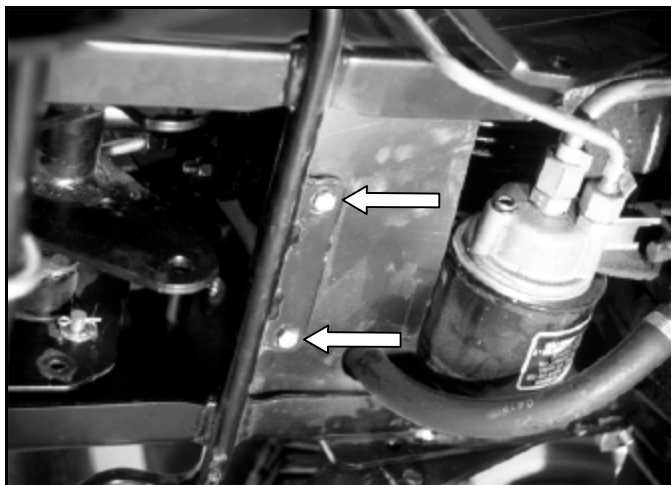


3606-007

Replace the dipstick tube.

CHASSIS

Fasten the lower fan shield to the fender support.



3606-029

Place the fuel tank on the mounting plate.

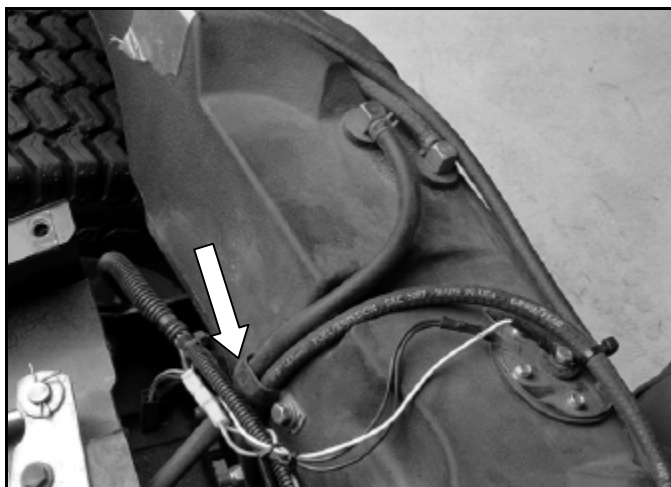
CAUTION: Do not pinch the fuel lines or wiring.



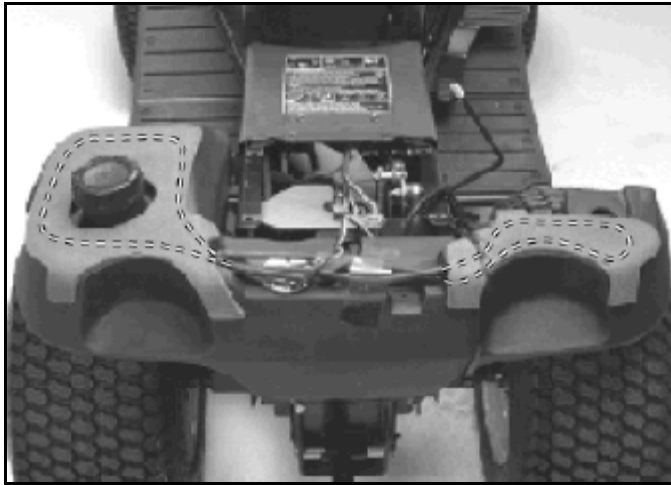
3606-005

6

Route the 1/4" fuel return line (diesel tractor) through the bracket on the fuel tank. Install on fitting and install hose clamp.



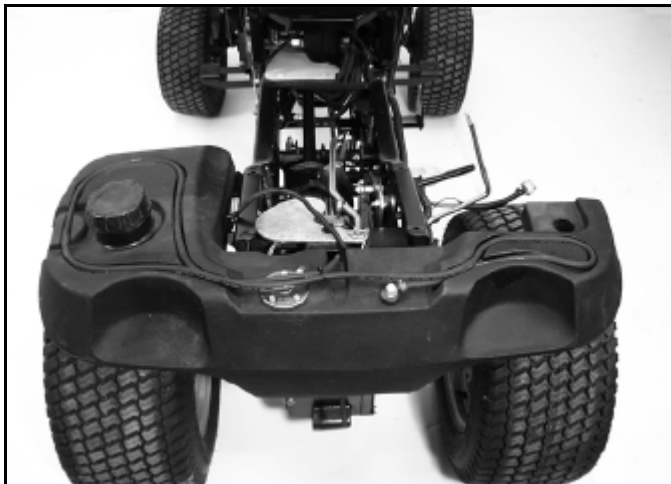
3031-13



0099-03

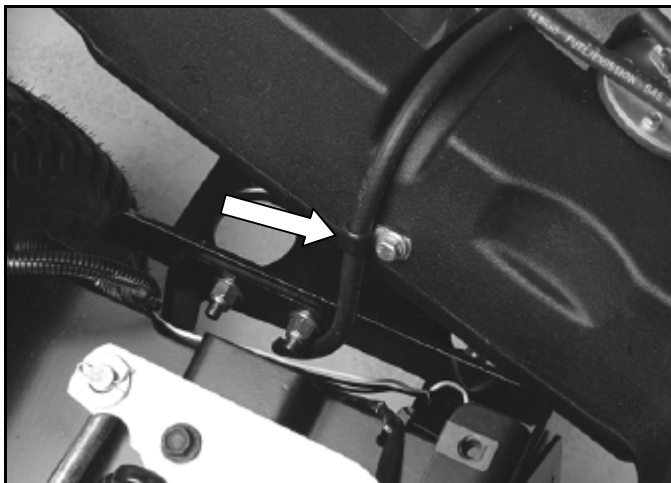
For gasoline units, route the fuel vent lines as shown.

1999 and later.



0202-025

1998 models. Use tape to hold lines in place, as needed.



3031-07

Route the 3/8" vent line through the bracket and under the tank.

CAUTION: Do not pinch off vent line.

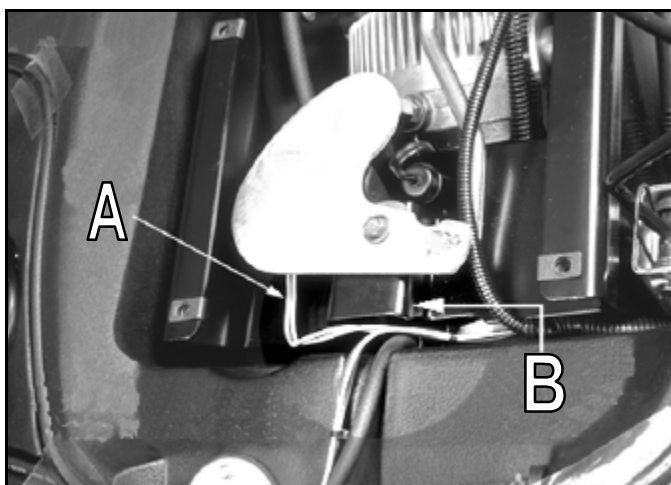
CHASSIS

Install the 5/16" fuel supply line to the shut-off valve and install hose clamp.



3606-004

Route cruise control wires (A) behind and behind/below the bracket as shown (B).



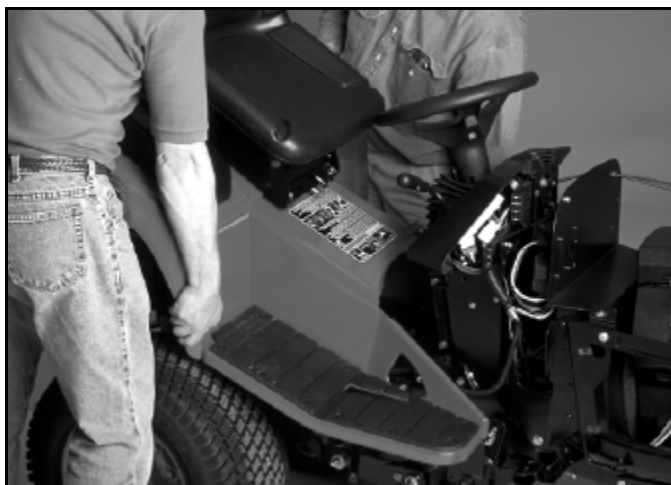
0202-026

6

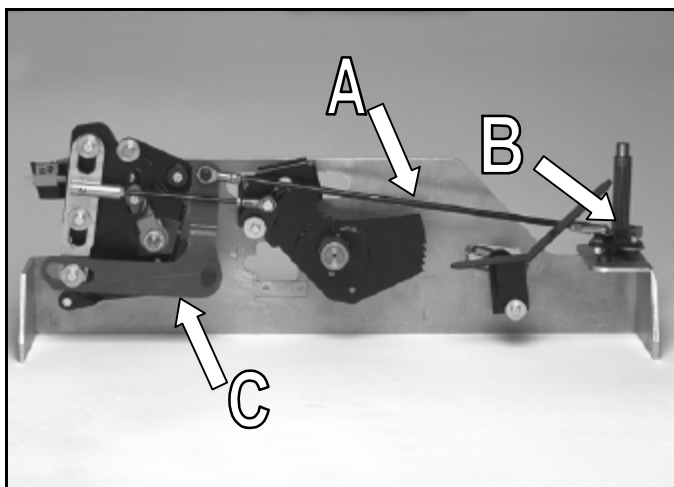
Smart Turn™ Linkage Adjustments

IMPORTANT: The adjustment procedure must be performed in the sequence given.

1. Remove the fender assembly.

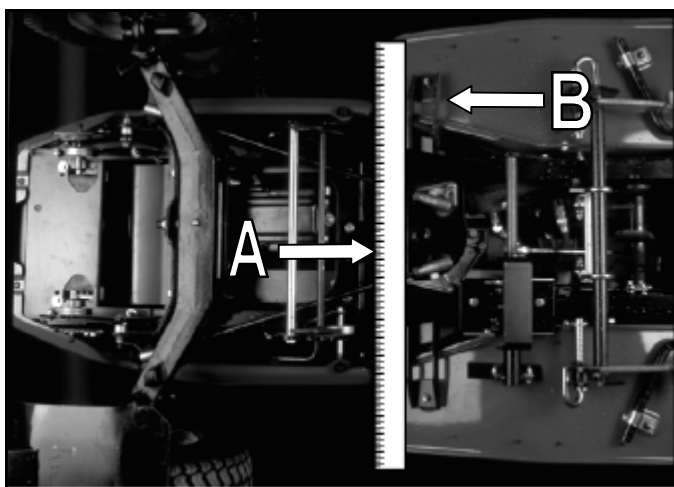


0109-014



0144-059

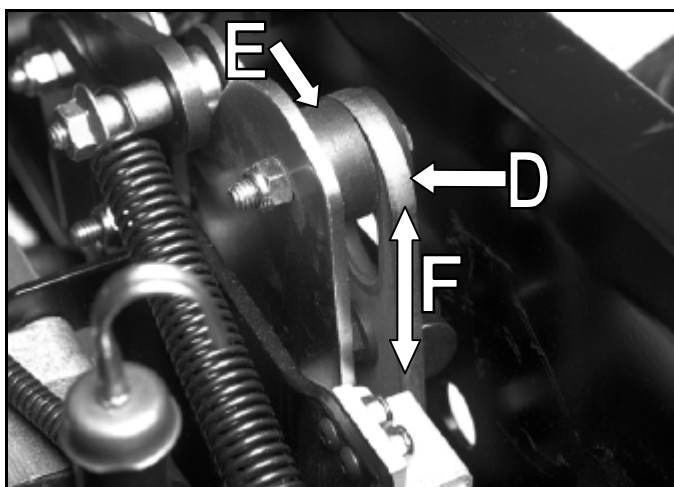
2. Check the adjustment of link (A) which connects the lower steering plate (B) to the bell crank (C). To do this:



1489-002

- A. Align the front wheels straight ahead so that the front of the lower steering plate is square to the frame rails of the tractor. Verify the alignment by placing a straight edge across the front edge of the lower steering plate (A), aligning it with the rest support (B).

NOTE: Keep wheels aligned straight ahead except where noted.



0144-087

- B. Check the slider (D) making sure it is all the way down, flush with top of spacer (E).

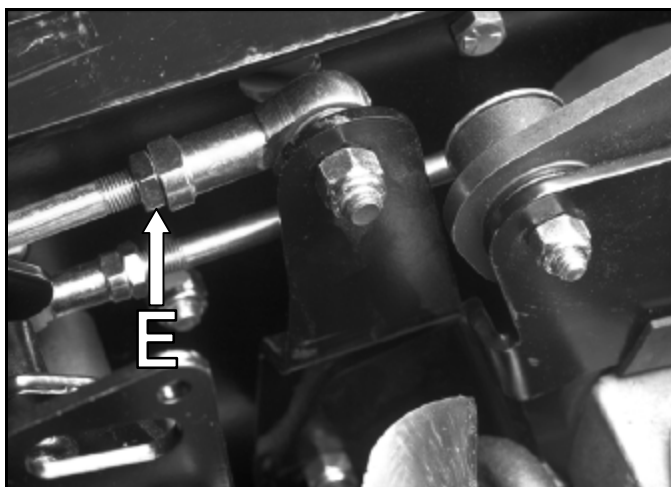
IMPORTANT: There must be a slight vertical looseness (F) in the slider or there may be binding in the pedal linkages. Lift up on the slider to check.

CHASSIS

If the slider is not adjusted correctly, loosen jam nuts (E), and turn the link to adjust the length. Then tighten the jam nuts securely.

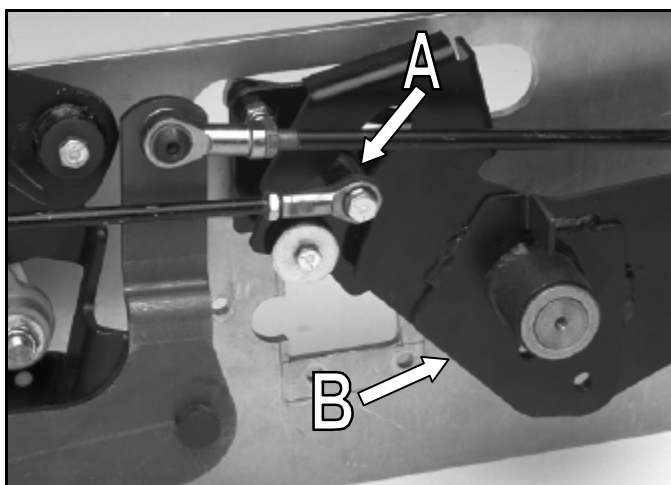
NOTE: The front jam nut is left hand thread, and the rear jam nut is right hand thread.

NOTE: Jam nuts "E" are marked with paint at the factory to discourage unnecessary tampering.



0144-088

Test the adjustment of link F, below, by looking at the position of the bushing (A) in the slot of the brake pivot plate (B). The bushing should not contact either side of the slot.



0144-066

6

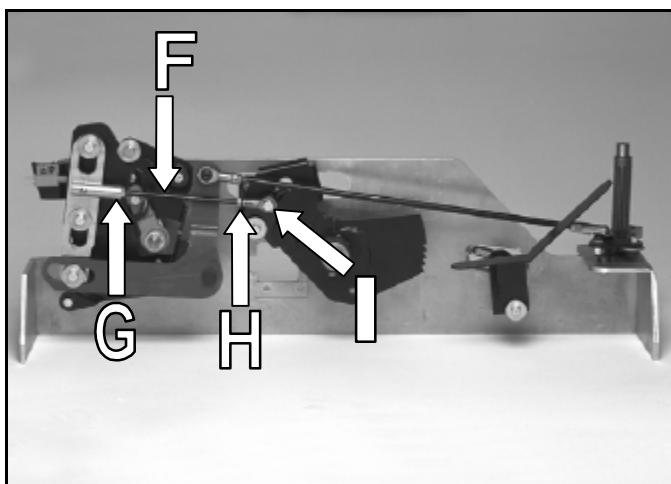
3. If adjustment is necessary:

- A. Depress the brake. Push forward lightly on link (F) to remove the slack from the system.

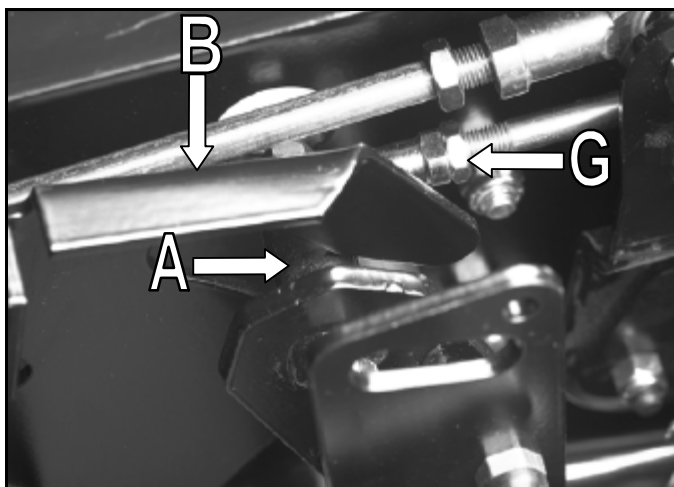
G - Rear Jam Nut (Right Hand Thread)

H - Front Jam Nut (Left Hand Thread)

I - Front Rod End Fitting

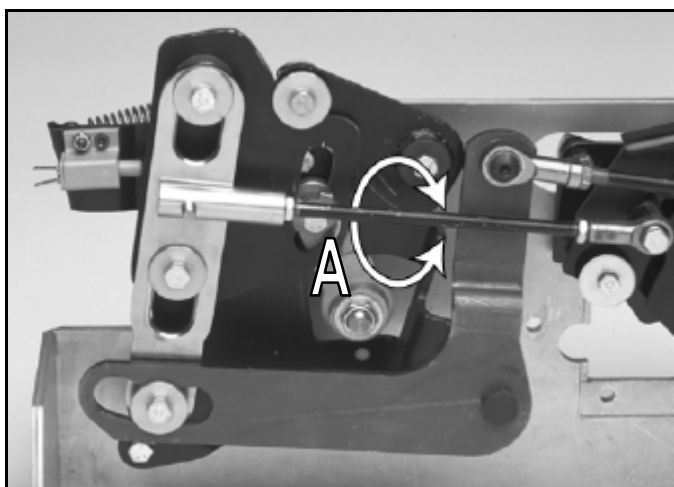


0144-059



0144-089

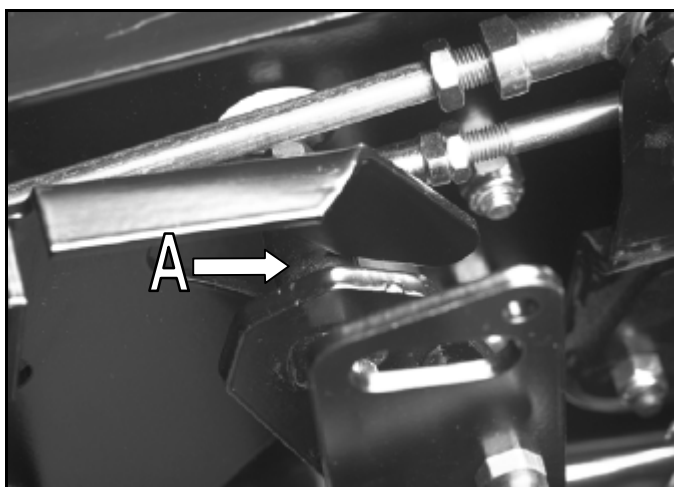
Check the bushing (A) making sure it is centered in the slot in the brake pivot plate (B). If the bushing contacts the sides of the slot, loosen jam nuts (G), and turn the link until the bushing is centered in the slot.



7233-073

Tighten the rear jam nut first. Hold the front rod end fitting while tightening the front jam nut.

IMPORTANT: There must be axial looseness in the rod (A) or there may be binding in the pedal linkages.



0144-089

Test the adjustment by cycling the brake. The slot should travel over bushing (A) without touching.

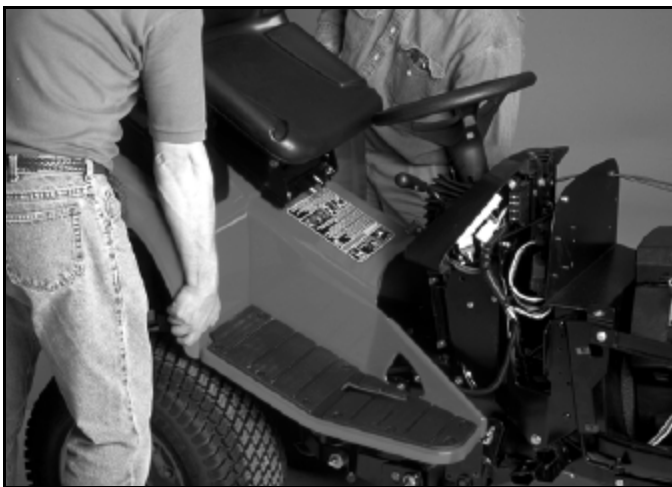
CHASSIS

Replace the fender and tunnel assembly.

NOTE: It is suggested that the fuel tank vent orifice be checked for restriction before reinstalling the fender - see the photo/ instructions on page 6 - 29.

NOTE: Failure to keep all hoses in place on the top of the fuel tank could result in improper operation of the fuel vent or supply system.

NOTE: Do not pinch any wiring between the fender assembly and the top edges of the frame.



0109-014

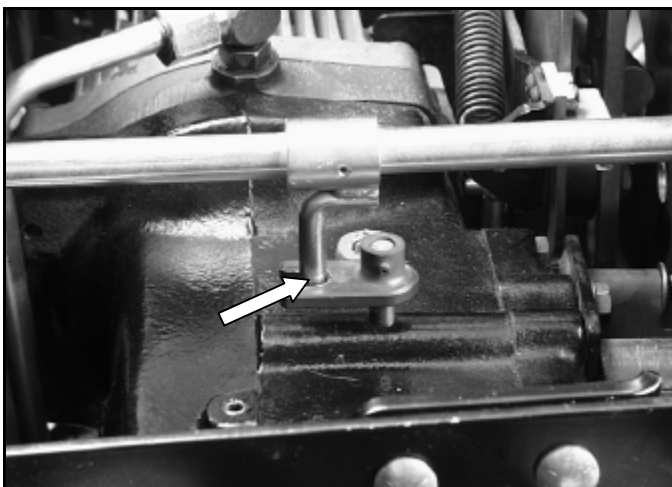
Adjust the range selector linkage by loosening the adjustment bolt at the bottom of the lever.



0202-027

6

Place the range selector yoke in the neutral detent. The tractor should roll freely.



0202-028



0202-027

Adjust bolt. "Feel" for the neutral detent and tighten the bolt.



0109-017

Install the knob for the transaxle range selector.

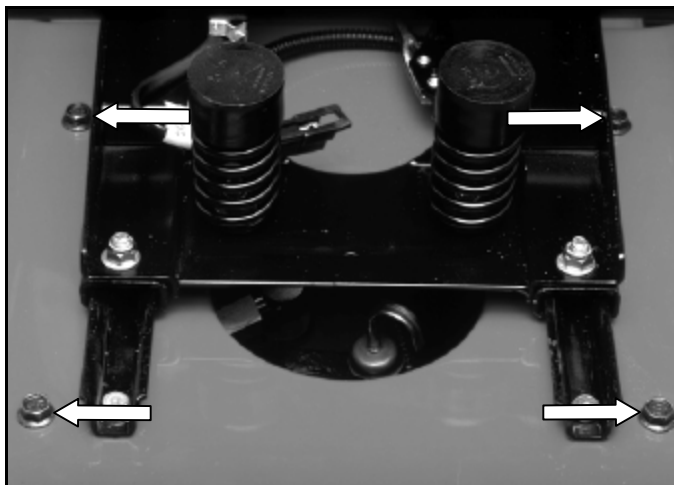


0109-019

Replace the nuts from the front footrest supports and the clamps from the rear supports.

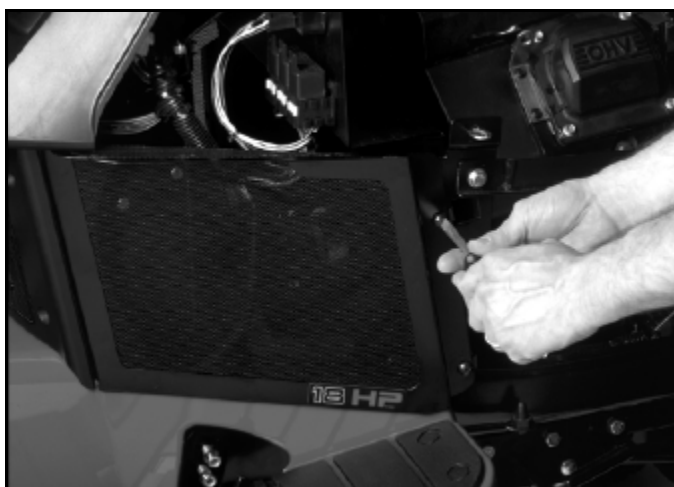
CHASSIS

Replace the four bolts securing the fenders to the frame (two on each side of the seat).



0109-004

Replace the three air intake screens.



0109-015

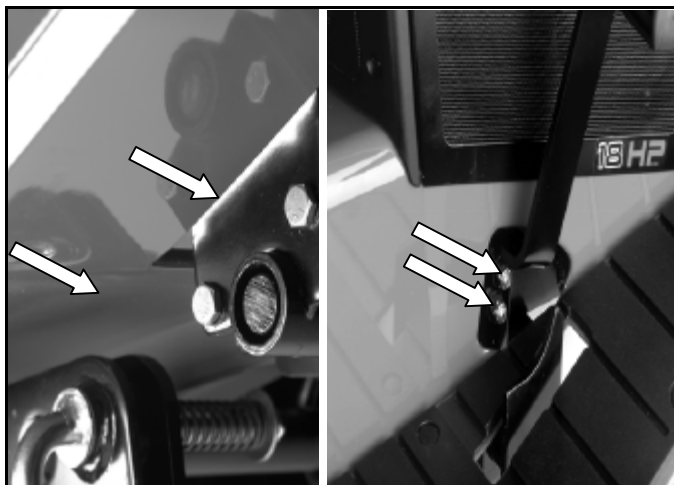
6

Connect the plug for the seat switch, cruise control, and seat switch.

NOTE: The cruise control and taillights share the same connector, which is located under the right fender.

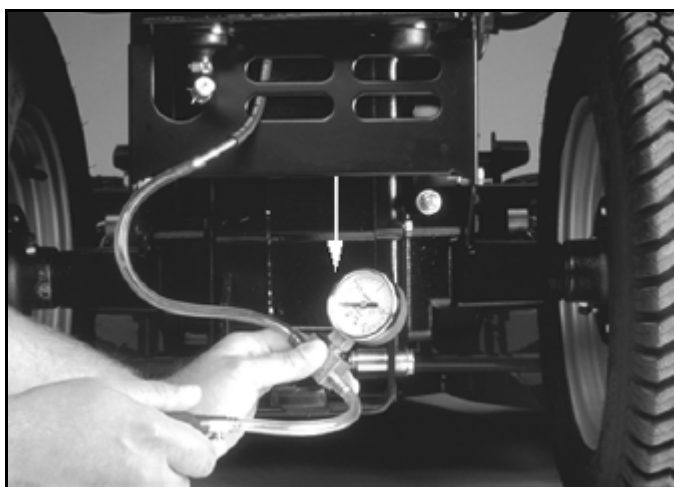


0109-021



0109-003 / 0109-020

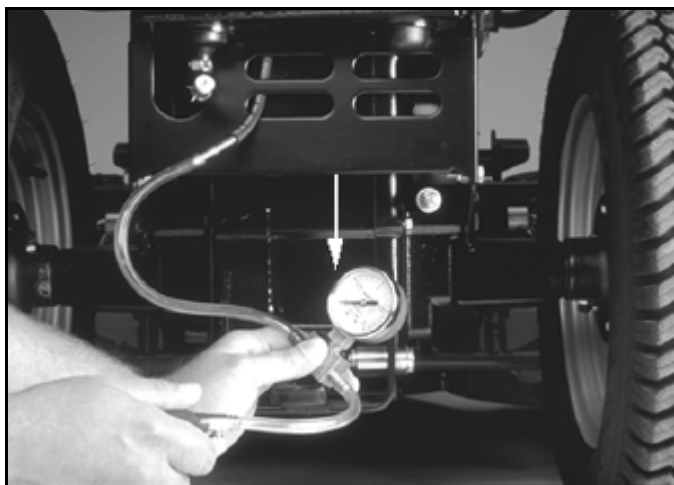
Install the brake and motion control pedals.



0202-029

Test to make sure the fuel vent system is functioning properly before and after repairs involving removal of the rear fender.

1. Modify a carburetor needle and seat tester by installing a 3/8" (3.17mm) copper tube at the discharge side of the tester.

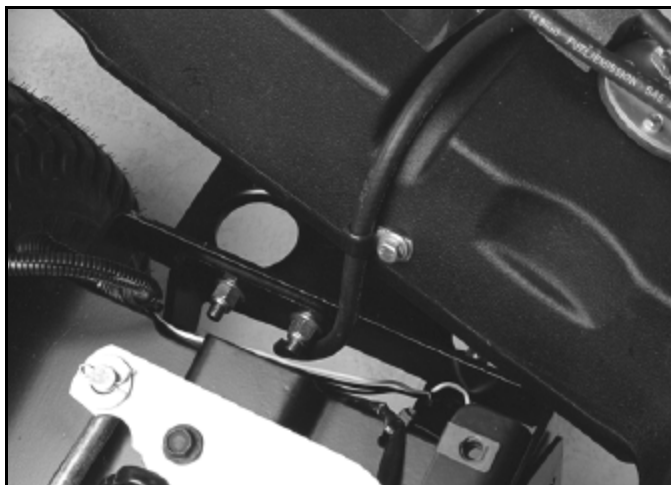


0202-029

2. Connect the test gauge to the vent hose and pressurize to 7 - 14 psi (.5 - 1 bar). The pressure should drop to "0" in one second or less.

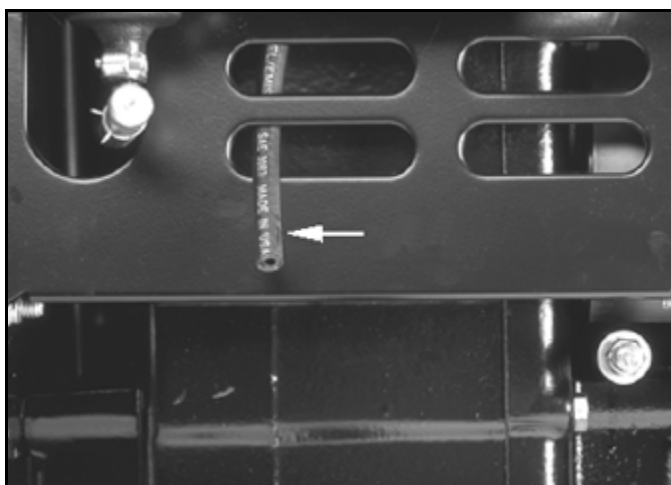
CHASSIS

If the pressure does not drop, the vent is restricted. Check for a pinched or kinked vent line,



3031-07

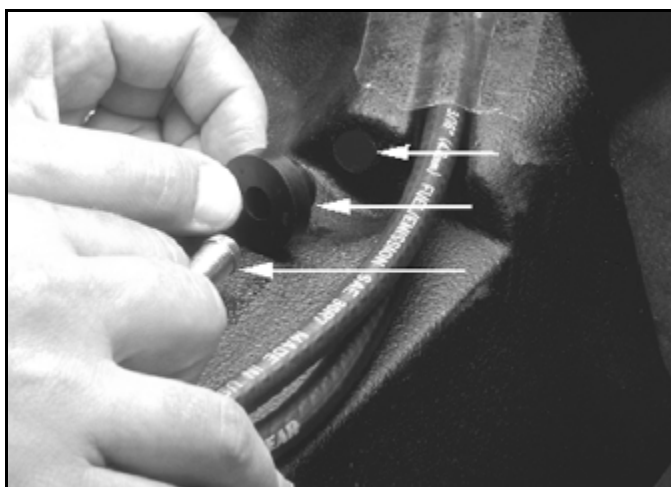
If the vent line is plugged, loosen the fill cap. Connect the vent hose to 50 - 100 psi (3.4 - 7 bar) compressed air hose for 1-2 seconds and retest.



0202-030

6

If the vent is still restricted, remove the vent hose at the fitting. Clear the orifice with a .024" (.61mm) or smaller wire.



0202-031

QUICK REFERENCE SECTION

Safety Information	1 a
Specifications	1 b
Maintenance	1 c

TROUBLESHOOTING

Theory of Operation	2
Troubleshooting Tables	3
Troubleshooting Flow Charts	4
Hydraulic Systems Testing	5

REPAIR PROCEDURES

Chassis	6
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Differential Disassembly 7 - 8

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HYDROSTATIC TRANSMISSION

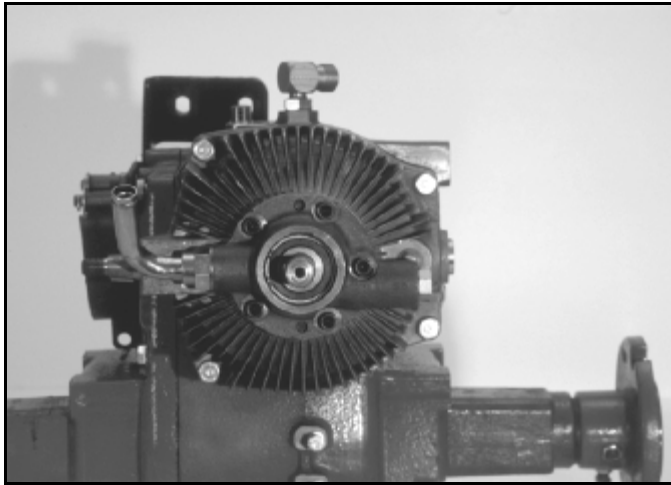
Transmission Disassembly 7 - 11

Reassembly 7 - 19

HYDROSTATIC DRIVE

TRANSMISSION/TRANSAXLE

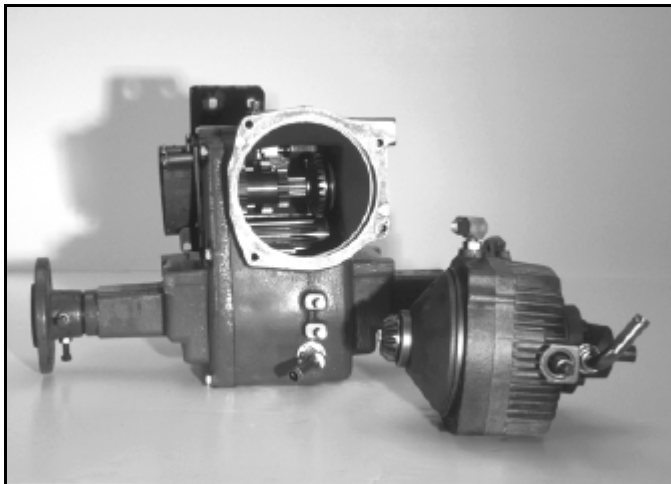
Disassembly



3095-004

Drain oil from transaxle, if not already done. Transmission will still have oil in it, up to the level of the outlet hole in the transmission body.

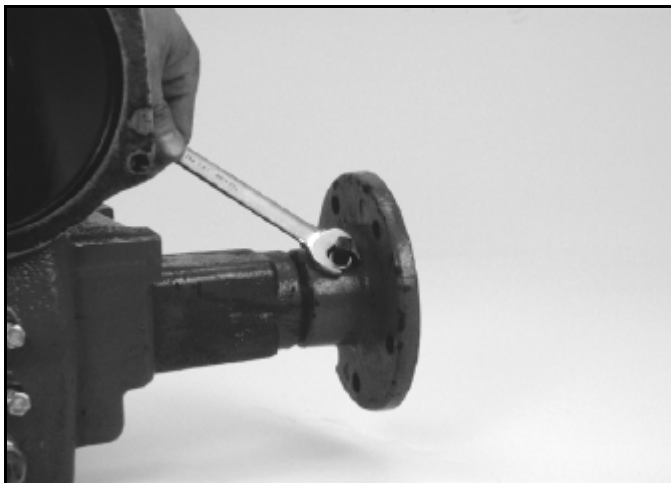
Remove the 4 bolts attaching the transmission to the axle assembly.



3095-007

Then separate the transmission and transaxle.

NOTE: During reassembly replace the gasket and torque the bolts to 30-35 ft·lbs (42-49 N·m).



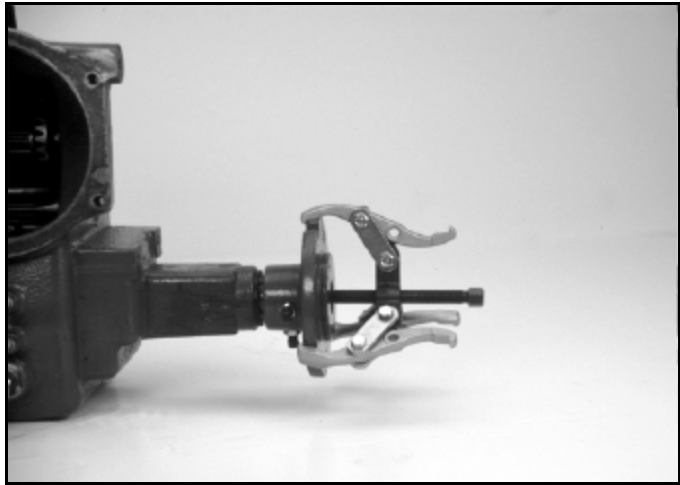
3095-011

To remove the hubs, loosen the lock nuts and set screws.

NOTE: Reassemble using new set screws and torque to 28-32 ft·lbs (38-43.4 N·m).

HYDROSTATIC DRIVE

Attach a puller and tighten the forcing screw to remove the hubs.



3095-014

Remove the woodruff key and washer. File smooth any burrs caused by the set screws and axle keys. These may cause damage to the needle bearings if not removed before disassembly.

Replace the axle seals after reassembly.

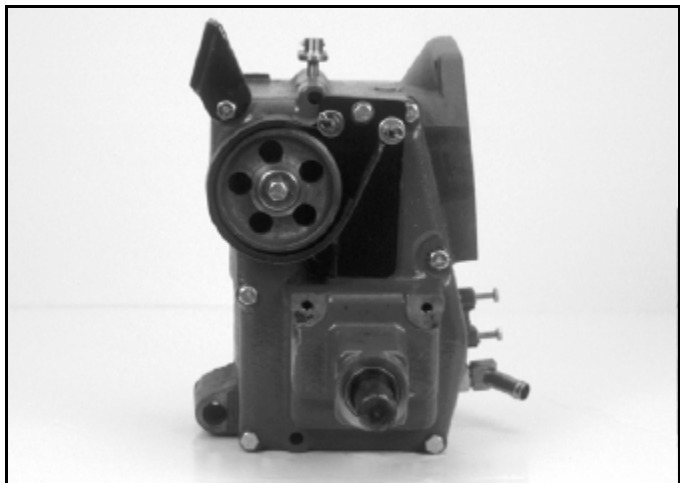
NOTE: Use seal bullet or other cover over keyway when installing new seal.



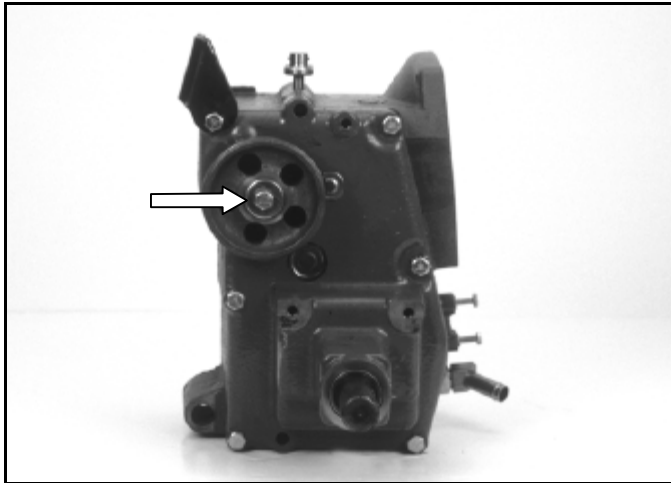
3095-015

7

Remove the bolts securing the brake band. Replace the brake band if lining is excessively worn, glazed, or cracked.

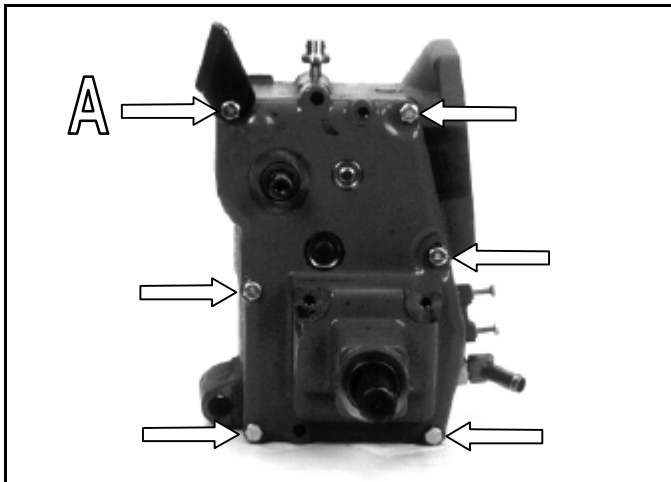


3095-018



3095-019

Remove bolt securing the brake drum, and remove the brake drum.



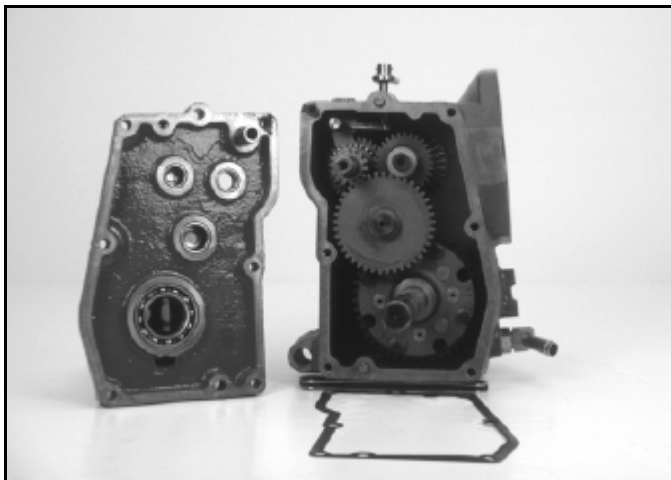
3095-021

Remove the 6 bolts securing the right-hand case half.

NOTE: Bolt "A" is an epoxy patch bolt. Use a new bolt on reassembly.

Replace brake shaft oil seal after reassembly.

NOTE: Use seal bullet or other cover over keyway when installing new seal.

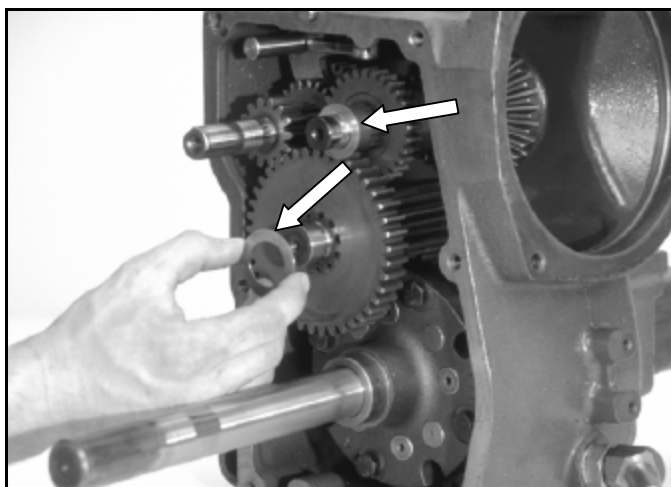


3095-026

Use a soft faced mallet to break the gasket seal and remove the right-hand case half.

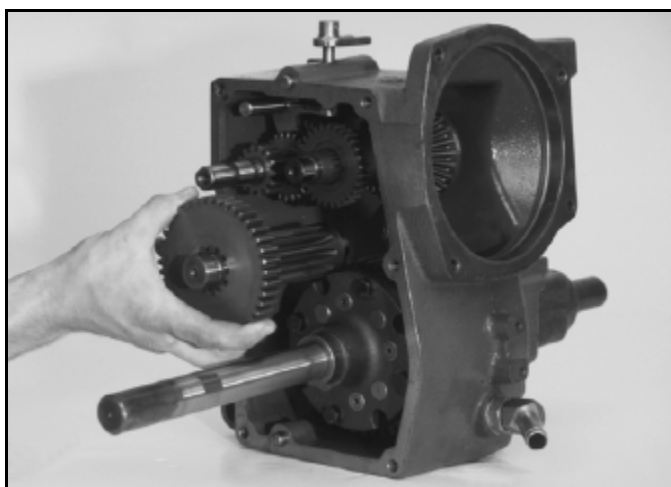
HYDROSTATIC DRIVE

Remove washer from intermediate gear and drive gear shaft. These are the only washers used in the transaxle.



3095-028

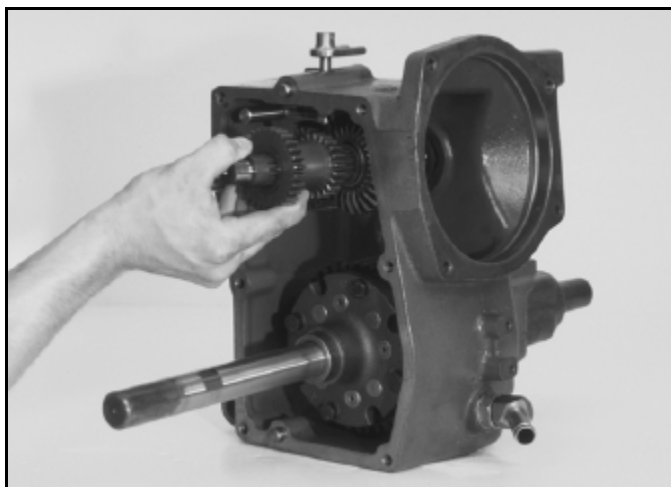
Pull intermediate gear from case.



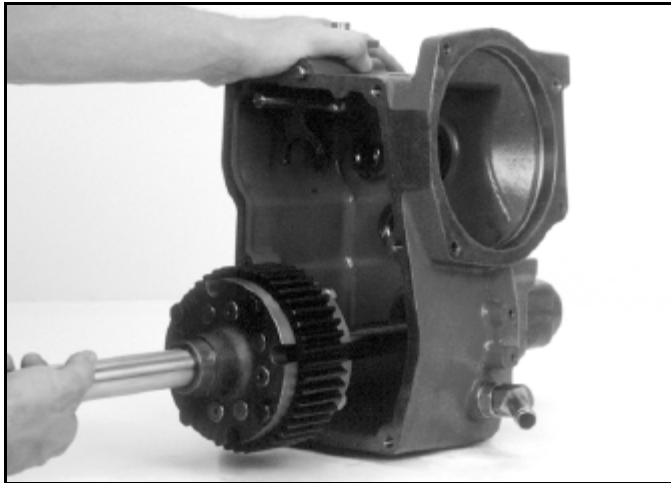
3095-032

7

Remove the hi-low range reduction gear.

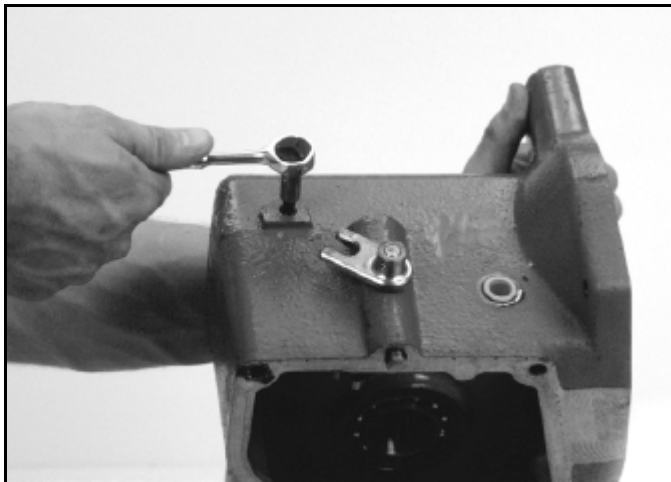


3095-033



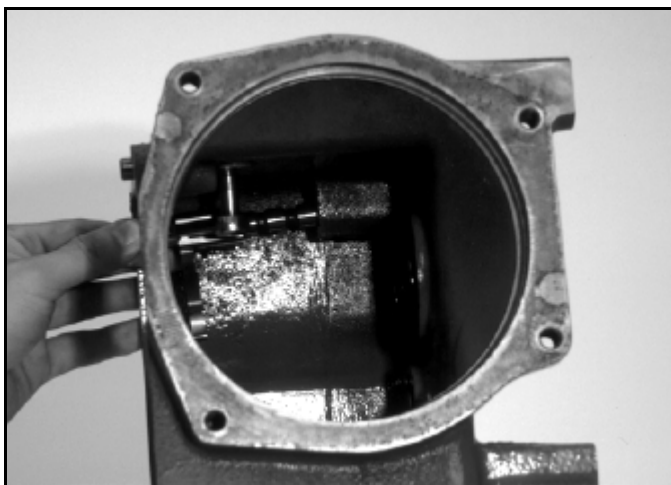
3095-038

Remove differential assembly.



3095-042

Remove allen head screw. Use a magnet to remove detent ball and spring from case.

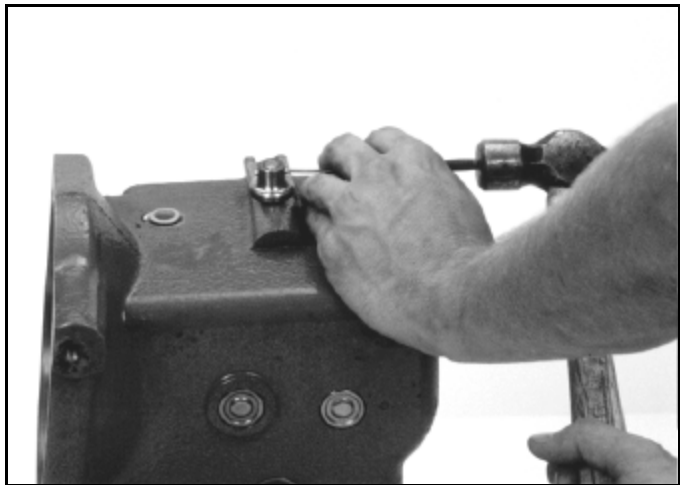


3095-044

Pull shifter shaft/yoke from case.

HYDROSTATIC DRIVE

Use a straight punch to drive out the roll pin securing the shift selector.

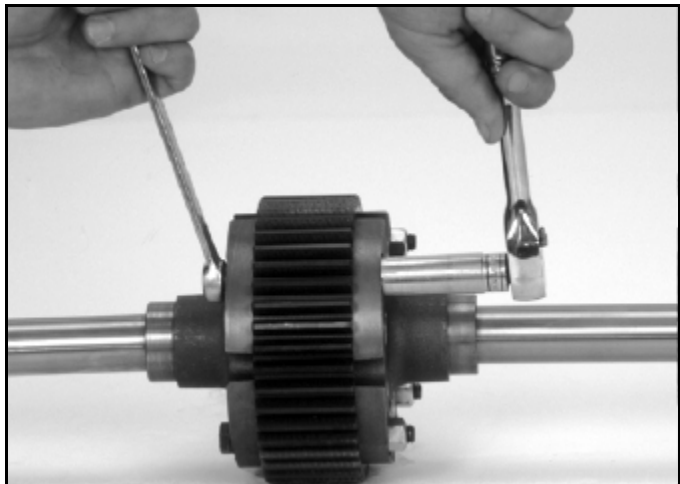


3095-047

Differential Disassembly

Remove the 4 bolts holding the differential assembly together. During reassembly replace the nuts and bolts and torque to 39 - 47 ft·lbs (52.9 - 63.7 N·m).

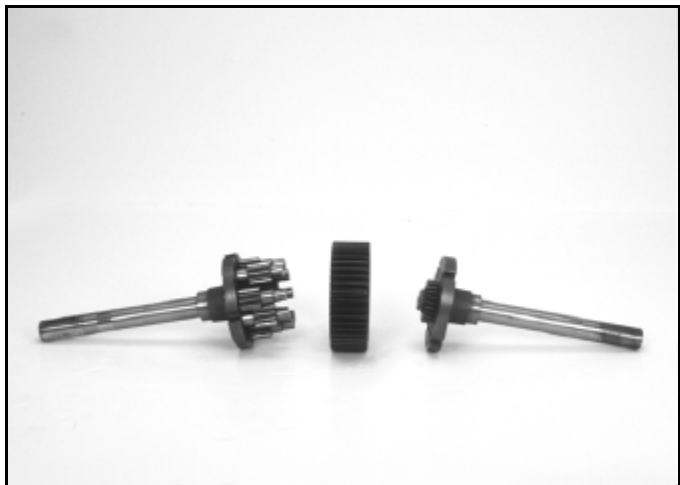
NOTE: A washer is used under the bolt heads.



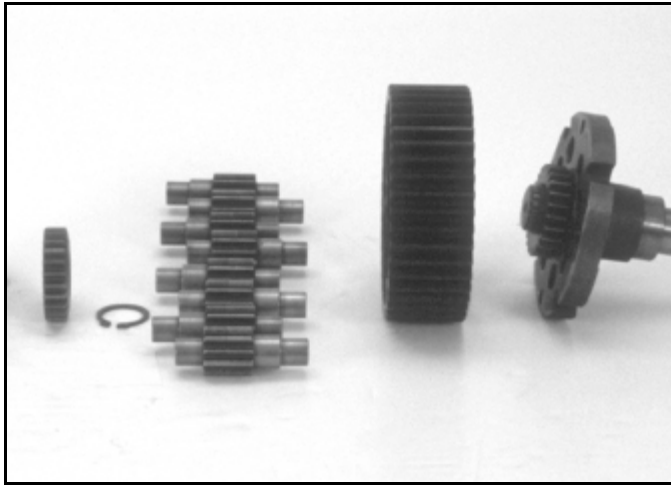
3095-049

7

Separate the axles and pinions from the ring gear.



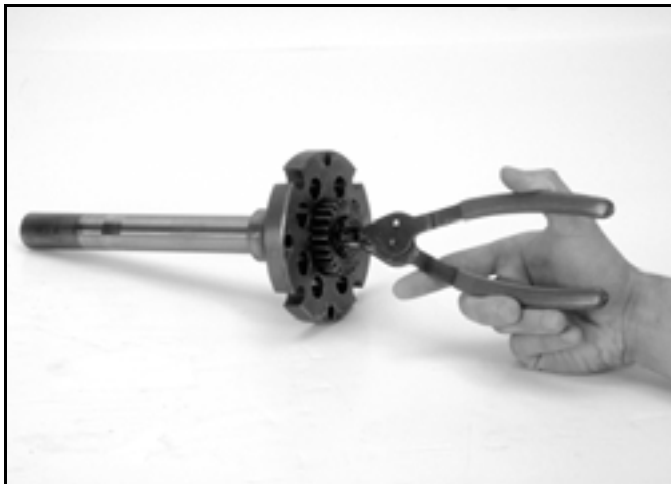
3095-050



3095-070

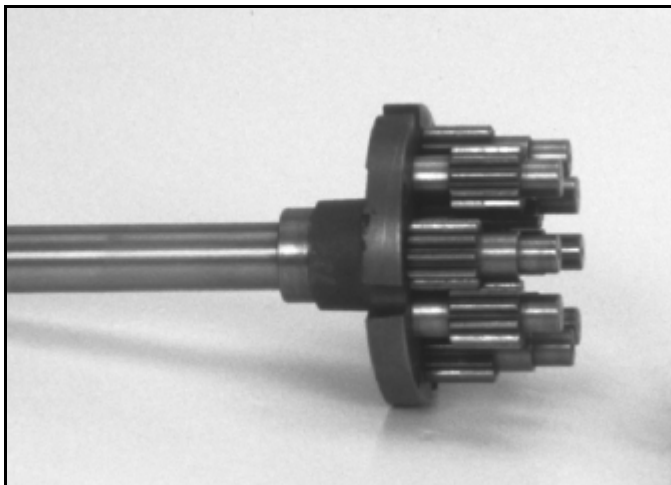
Inspect gears, bearings, and shafts for wear or damage. Replace as necessary.

Reassembly



3095-067

The snap ring should be installed with the sharp edge facing away from the gear. The rounded side of the gear teeth should be towards the end cap.

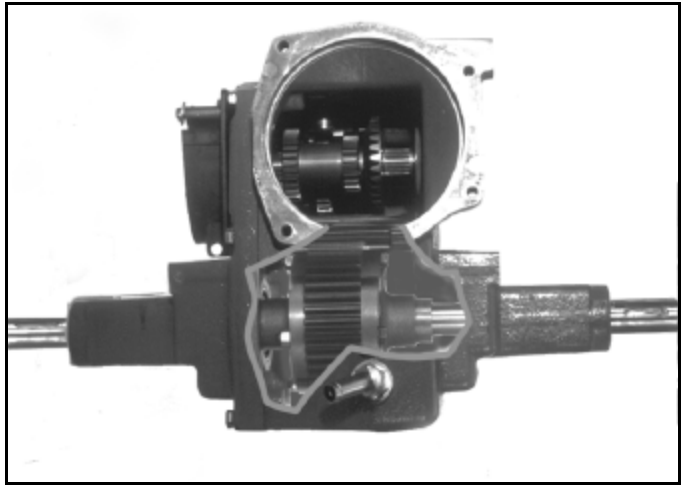


3095-50

Lubricate the pinion bearing surfaces and install in the differential end cap.

HYDROSTATIC DRIVE

Follow the disassembly instructions in reverse order using new gaskets and seals to complete the transaxle reassembly.



0202-032

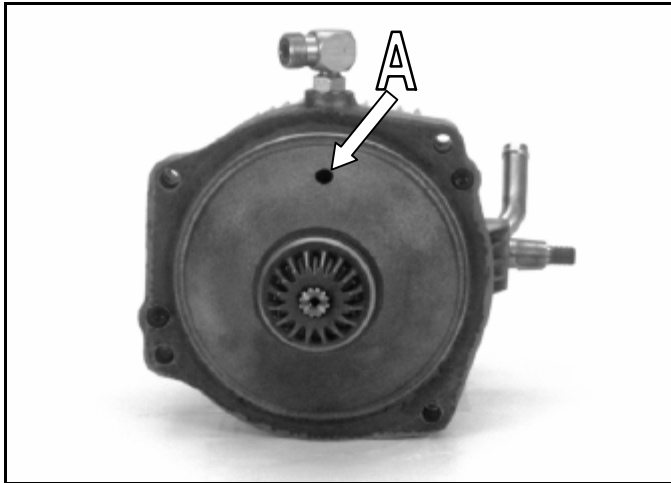
HYDROSTATIC DRIVE

HYDROSTATIC TRANSMISSION

Transmission Disassembly

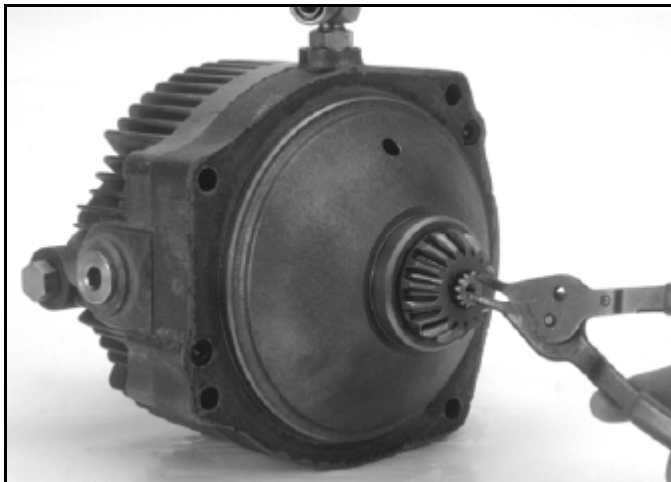
Drain the transaxle fluid from transmission case.

(A) Transmission Drain



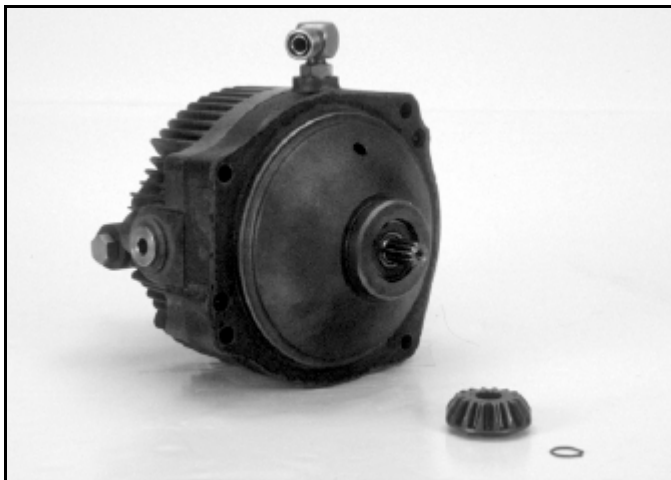
3095-095

Remove snap ring securing the drive gear to the output shaft.



3095-096

Remove gear.



3095-098

HYDROSTATIC DRIVE

Separate body from cover assembly.

NOTE: Ball pistons are a select fit in each position. If a ball is removed, make sure it goes back into the same rotor bore it came from.



3095-103

Place large rubber band around motor rotor to hold ball pistons in place.



3095-104

7

Lift off motor rotor assembly.



3095-107



3095-111

Remove O-ring and pintle assembly.



3095-113

Remove pump rotor.



3095-117

Place rubber band around pump rotor to hold ball pistons in place.

NOTE: Ball pistons are a select fit in each position. If a ball is removed, make sure it goes back into the same rotor bore it came from.

HYDROSTATIC DRIVE

Mark the pivot pin so it can be installed in the same direction. Then remove the cam ring by sliding it off the pivot pin along with the cam ring insert.



3094-045

Finally, remove the two buttons from the case.



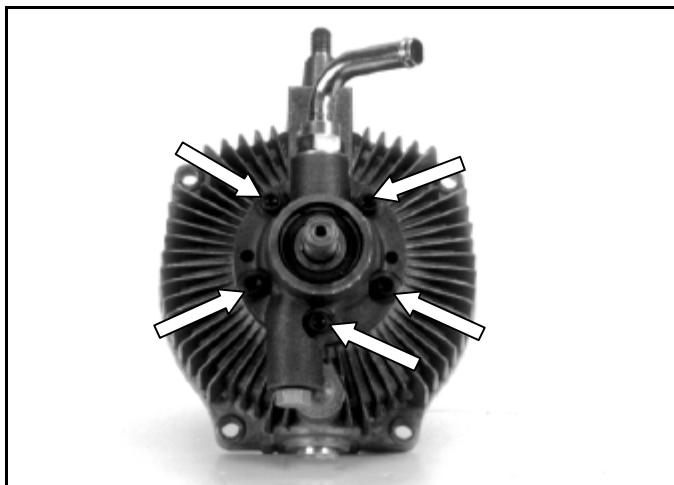
3094-047

7

Remove the snap ring from the input shaft.



0202-033



3095-124

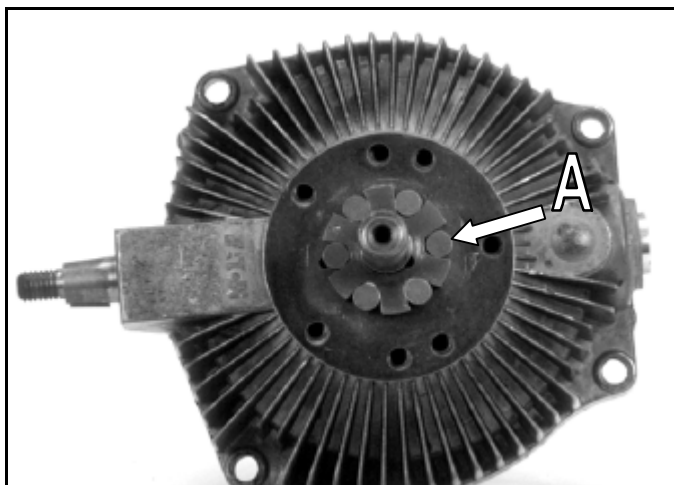
Remove the allen bolts holding the charge pump to the cover.



3095-127

Install a two jaw puller on charge pump housing.

NOTE: Charge pump housing must be removed in this manner; do NOT attempt to press input shaft through the transmission housing, or damage will occur.



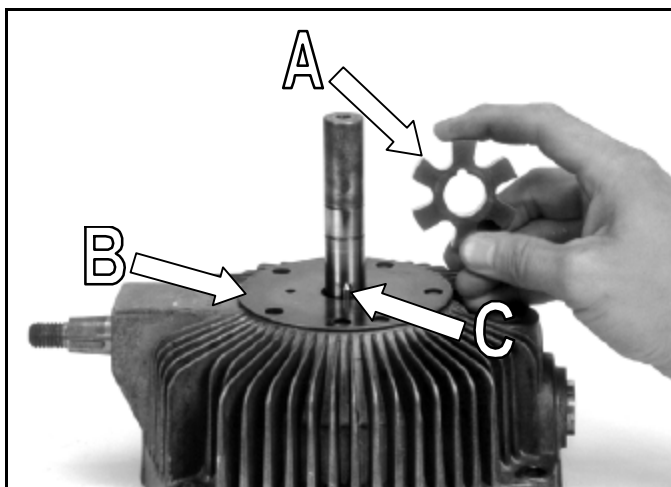
3095-134

Remove charge pump housing along with the six carrier rollers (A).

HYDROSTATIC DRIVE

Remove the snap ring, charge pump rotor, and the carrier drive pin.

- (A) On reassembly, it is important that the charge pump rotor is installed with the correct side up. Note the direction of the arms and mark the top of the rotor.
- (B) Remove the wear plate and inspect for wear and flatness.
- (C) Remove the rotor key pin from the shaft.



3094-005

Press output shaft from bearing. Remove snap ring and press bearing out of transmission body.



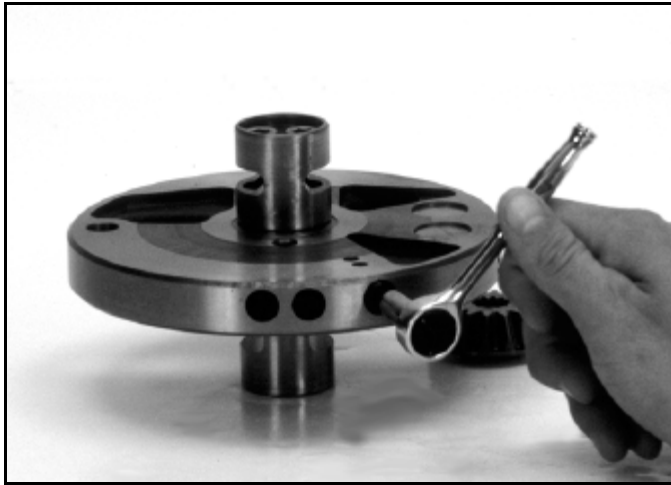
3094-012

7

Do not turn or remove these plugs from the pintle assembly.



3094-015



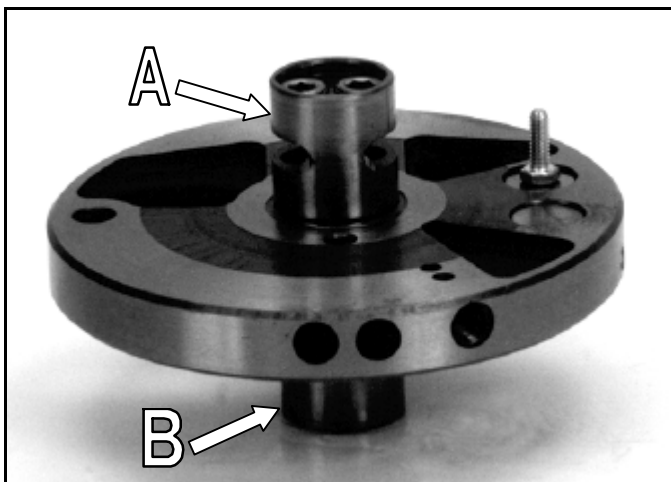
3094-017

Use an allen wrench to remove the charge pressure relief valve plug.



3094-018

The relief valve assembly consists of relief ball, spring, and plug. Use a 1/4" allen wrench to remove the plug.



3094-021

NOTE: Servicing the pintle is usually not needed, unless oil was severely contaminated.

To remove the dampening pistons from the pintle. Glue a bolt head to the piston, then use the bolt to pull the piston from its bore.

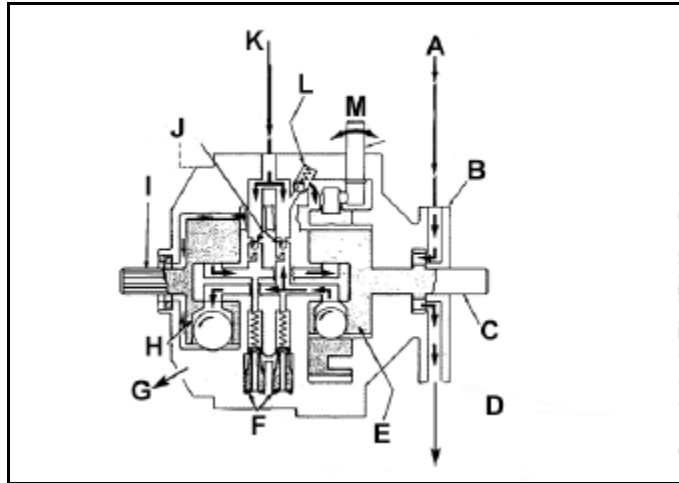
Inspect for wear or scratches at (A) and (B). If wear is present, inspect mating surfaces on pump and motor rotors.

HYDROSTATIC DRIVE

NOTE: Servicing check balls and acceleration valves is normally not needed.

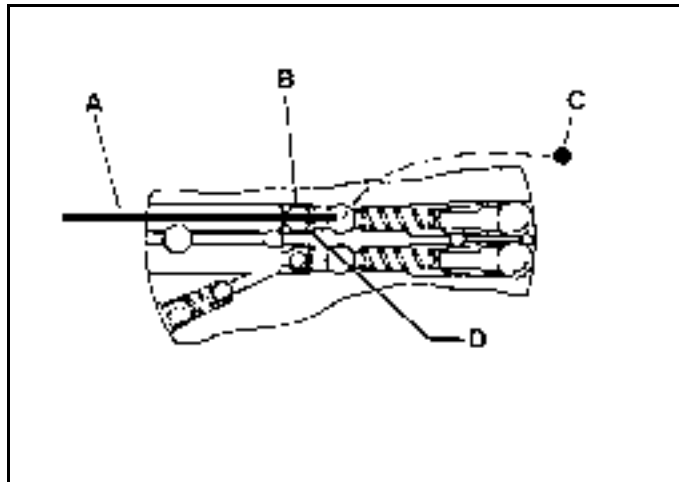
To remove the check balls and acceleration valves from the pintle, first drive the roll pin and solid pin retaining the assemblies.

- | | |
|--------------------|---------------------|
| (A) From Sump | (H) Hydraulic Motor |
| (B) Charge Pump | (I) Output Shaft |
| (C) Input Shaft | (J) Forward/Reverse |
| (D) Lift | Check Valves |
| (E) Hydraulic Pump | (K) From Lift |
| (F) Acceleration | (L) Charge Pressure |
| Valves | Relief Valve |
| (G) To Sump | (M) Motion Control |
| | Shaft |



0202-006

Then insert a 3/16" diameter rod (A) through the check valve body (B). Then tap the rod to push the ball (C) through the retaining ring (D) and into the center port. Then remove the ball from the port by shaking the pintle; repeat the procedure for the second ball.

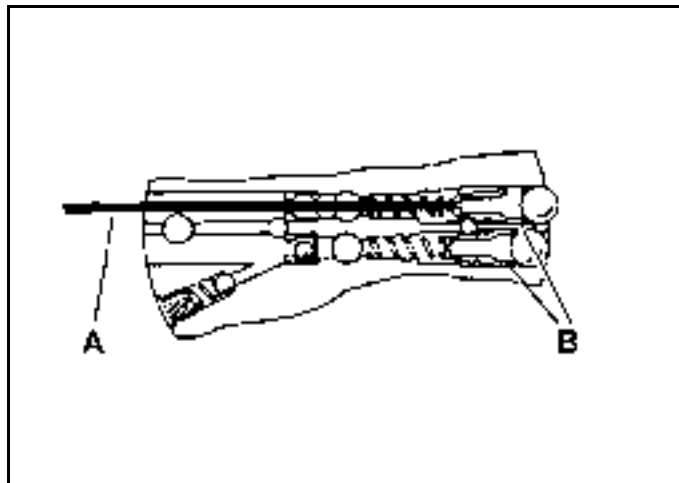


0202-034

7

Reinsert the rod (A) and drive out the acceleration valves (B) and valve bodies. Remove the spring.

NOTE: Identify the springs and valves so they can be installed in the same bore when reassembled.



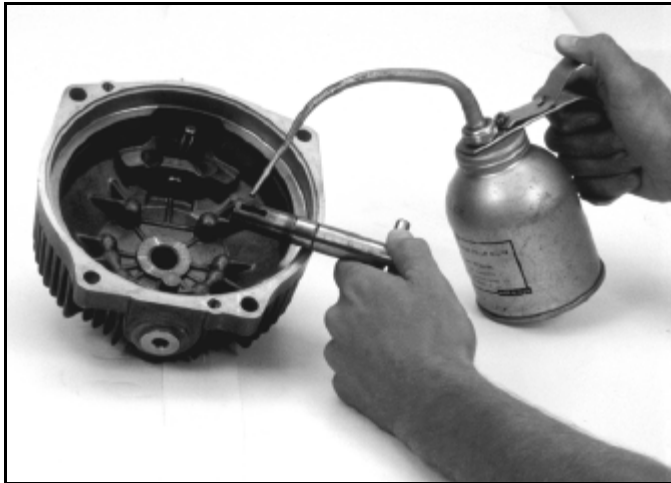
0202-035

HYDROSTATIC DRIVE

Reassembly

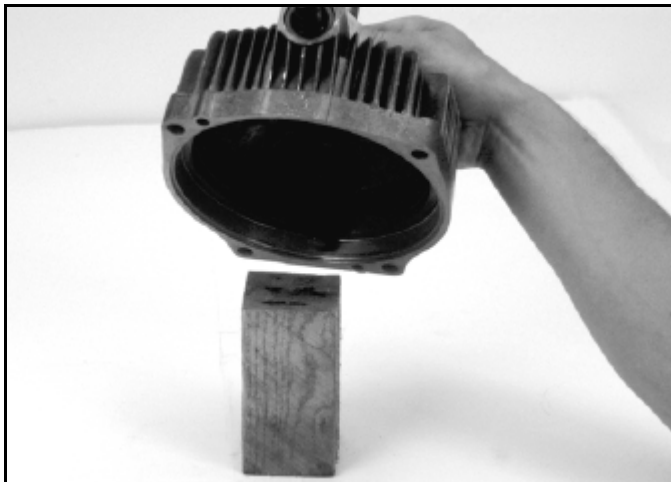
Seal Kit Part Number: 56-3310.

Apply a coating of oil to the input shaft and install through bushing.



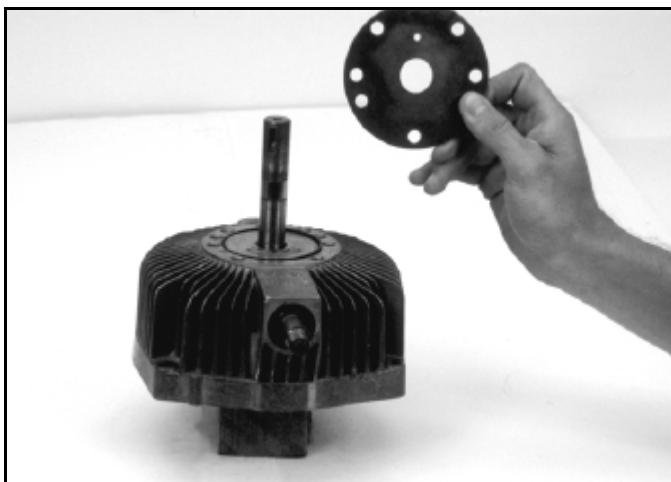
3094-052

Place cover assembly over wooden block to support input shaft.



3094-056

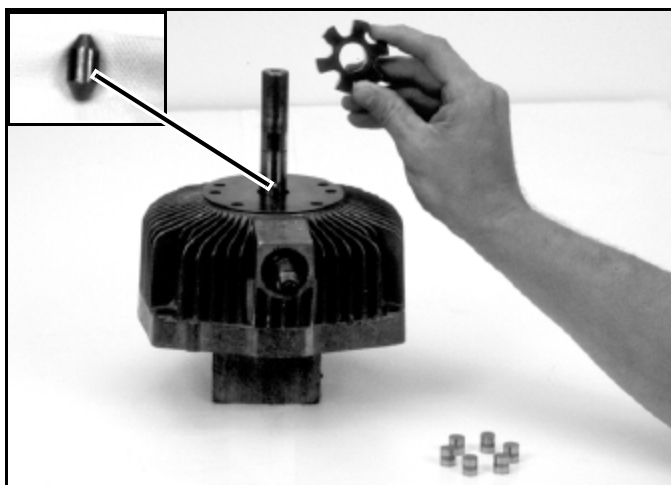
Lubricate and install a new O-ring seal and install pump plate. Align holes in pump plate with holes in cover.



3094-058

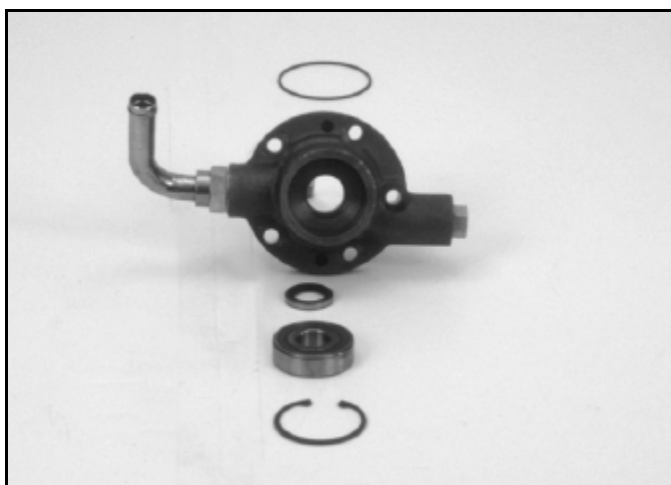
HYDROSTATIC DRIVE

1. Install the carrier drive pin in input shaft.
2. Install rotor on shaft with witness mark up.



3094-059 / 3094-061

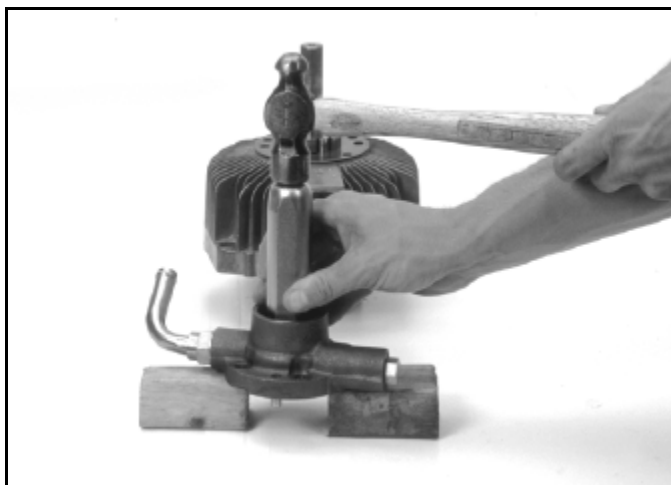
Remove the snap ring, seal, and bearing from the charge pump housing.



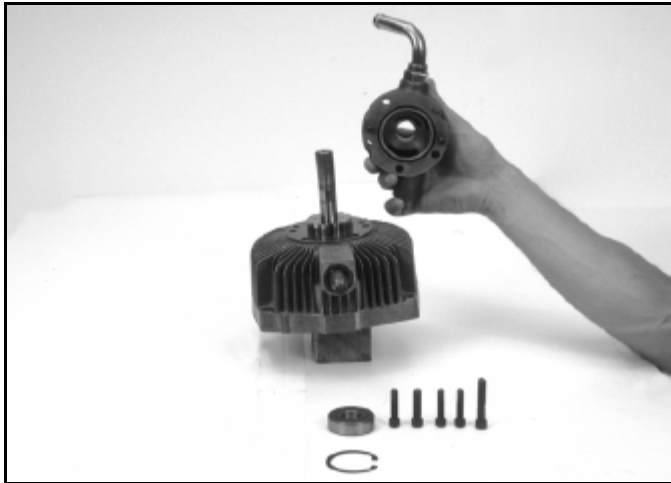
3094-068

7

Use seal driver to install a new input shaft seal.



3094-074



3094-072

NOTE: Use caution when installing the charge pump housing to avoid damaging the seal on the snap ring grooves. Use a Post-It[®] note, plastic wrap, or similar material to cover the grooves while installing housing. Secure housing in place.

Lubricate and place rollers into the charge pump carrier. Install a new O-ring in charge pump housing and install the housing.



3094-079

There are two snap rings - one below and one above the input shaft bearing. Install the lower snap ring.



3094-081

Press bearing in place while supporting the input shaft with a block of wood.

HYDROSTATIC DRIVE

Install snap rings to input shaft and charge pump housing.

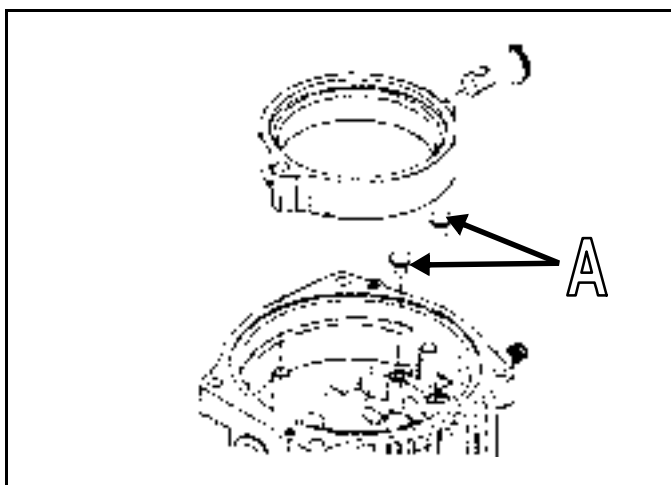


3094-084

Install two buttons (A) in cover.

Install cam ring insert, with hole away from cam ring.

Align cam ring with control shaft pin and cam ring pivot pin.



0202-036

7

Install the small rotor into the pump housing. Leave the rubber band in place until the rotor is in place.

Rotate the rotor until the slot in the rotor is aligned with the input shaft and the rotor drops in place.

Apply oil liberally to all components.

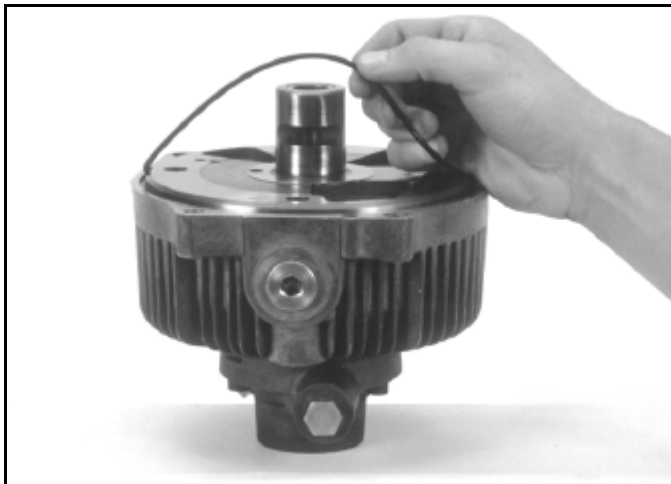


3095-112



3095-111

Install the pintle assembly with the roller bearing up (damping pistons down).



3095-108

Install a new square ring seal over pintle assembly.



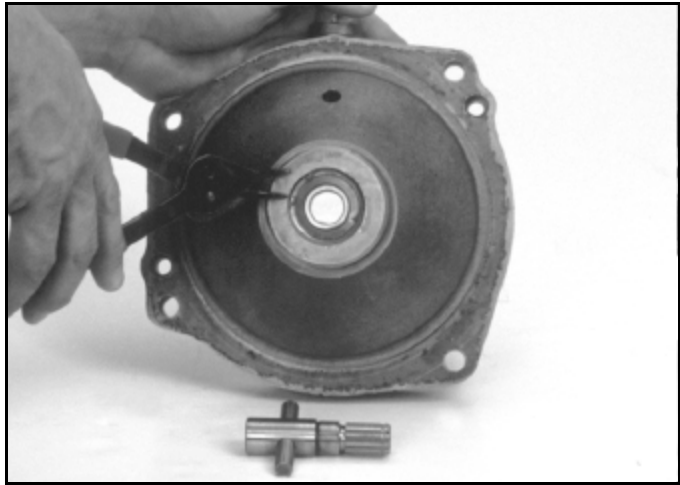
3095-107

Install motor rotor on pintle with rubber band in place.

Apply oil liberally to motor section.

HYDROSTATIC DRIVE

1. Press the seal into the housing.
2. Press the bearing into the housing. Apply force to the outer race of the bearing only.
3. Install the snap ring.



3094-010

Install the output shaft by supporting the bearing inner race while pressing the shaft in place.



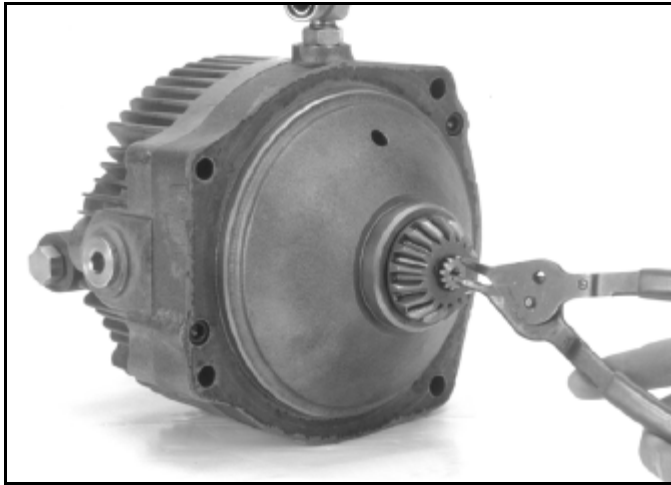
0202-037

7

Install the motor housing so that the slots in the rotor align with the cross pin in the output shaft. Secure with two bolts.



3095-103



3095-097

Install the output gear and snap ring.

NOTE: If output shaft appears to be “too short”, it has been pushed back into the housing. Either draw press it back out, or remove the housing and press it back out from the inside.

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Maintenance	1 c

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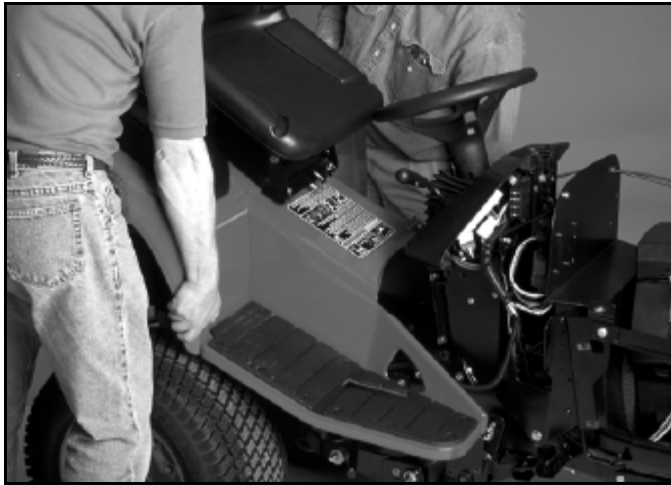
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HYDRAULIC SYSTEMS

LIFT CYLINDER R & R



0109-014

Remove the fender assembly as outlined on pages 6 - 3 through 6 - 5.



0202-010

Remove the drive shaft. Refer to the 5xi Service Manual (492-4715) for the complete procedure.



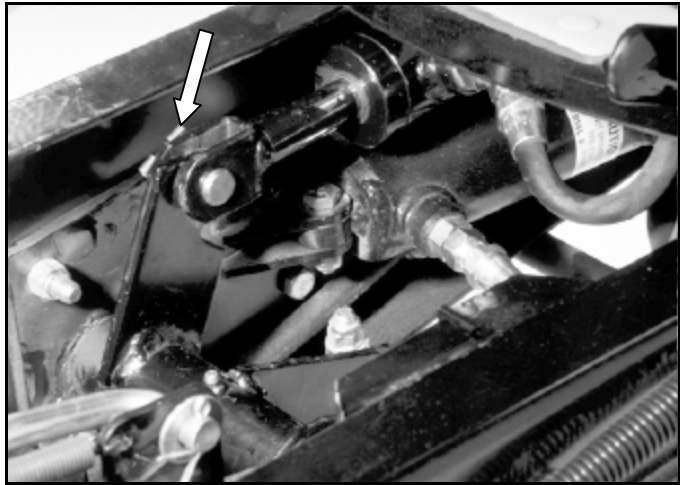
0202-038

Remove the bolt anchoring the lift cylinder case to the frame using a long extension and a 1/2" universal socket.

NOTE: On reassembly, use a new bolt.

HYDRAULIC SYSTEMS

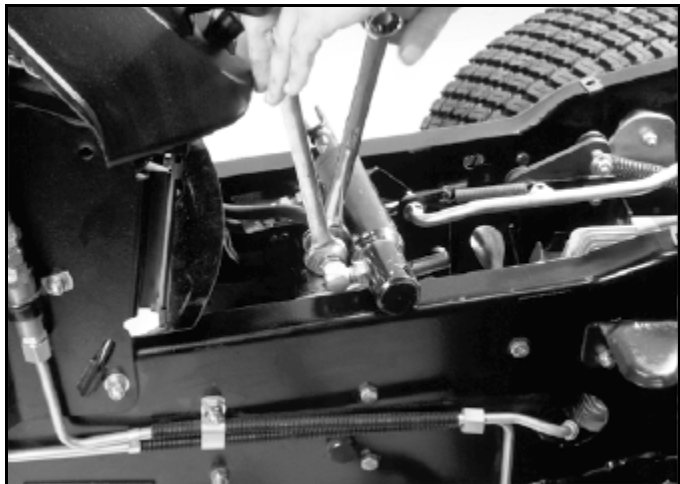
Remove the clip and pin securing the cylinder ram from the attachment lift bell crank.



3606-086

Lift the cylinder out from between the frame rails and remove the hydraulic hoses.

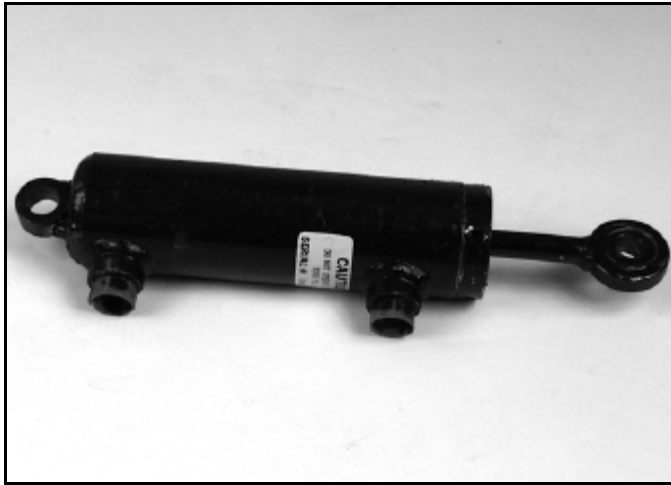
NOTE: Use a back-up wrench on the fittings. Cover all open fittings to prevent contamination.



3606-082

HYDRAULIC SYSTEMS

LIFT CYLINDER DISASSEMBLY / REASSEMBLY



0722-01

Thoroughly clean the outside of the cylinder to prevent contamination. Always work in a clean environment.



0722-02

Using a spanner wrench, remove the cylinder rod guide from the cylinder body.



0722-03

Pull the rod and piston from the cylinder body.

HYDRAULIC SYSTEMS

Remove the piston nut while holding the rod.

CAUTION: Do not damage the cylinder rod by clamping in a vise, vise grip, pliers, etc.



0722-04

Note the position and orientation of the piston seals. Carefully remove the seals.

Seal Kit Part Number: 95-4007

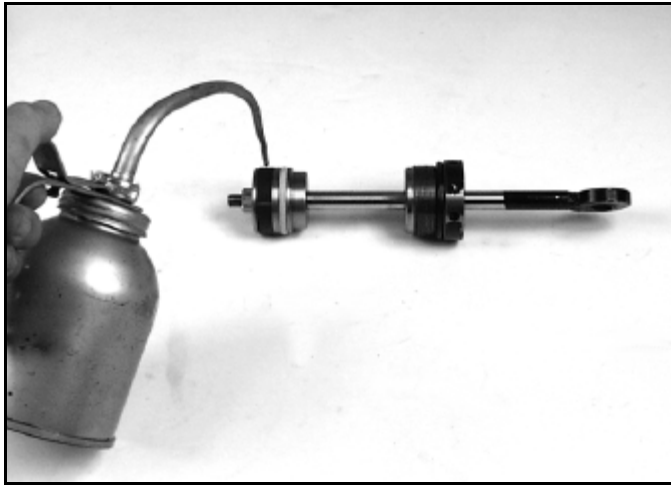


0722-05

Install new piston seals and rod guide O-ring.

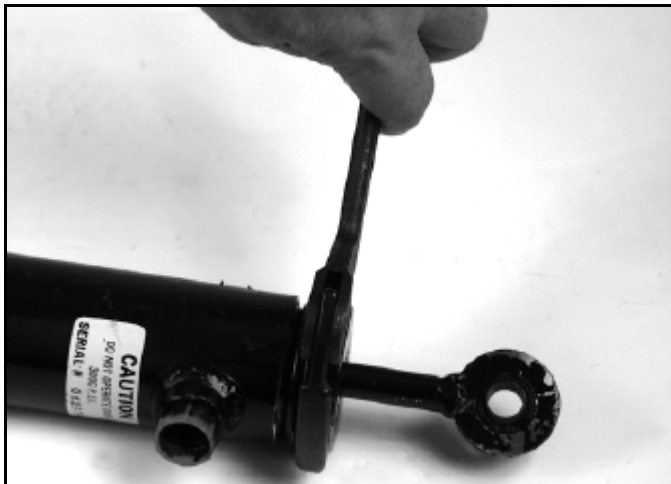


0722-06



0722-07

Apply a light coating of transaxle fluid to the seals and O-rings.



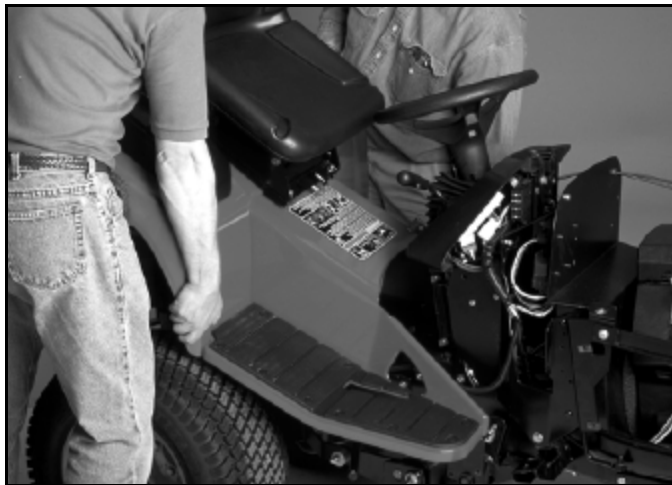
0722-08

Carefully insert the piston in the cylinder and tighten the rod guide.

HYDRAULIC SYSTEMS

STEERING CYLINDER R & R

Remove the fender assembly as outlined on pages 6 - 3 through 6 - 5.



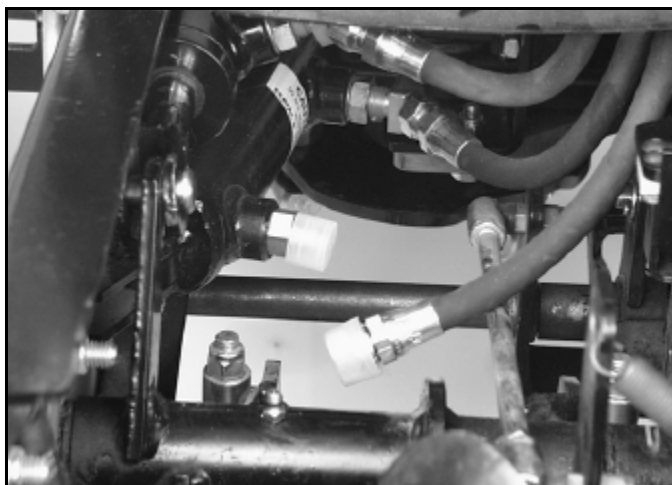
0109-014

Remove the drive shaft. Refer to the 5xi Service Manual (492-4715) for the complete procedure.

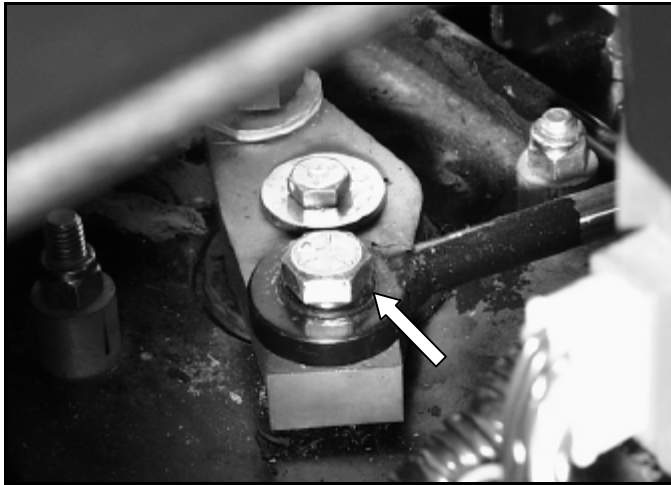


0202-010

Remove the hydraulic lines from the steering cylinder and cap them to keep out dirt.



0202-039



0202-040

Remove the bolt at the steering bell crank.

NOTE: Use a new bolt on reassembly.



0202-041

Remove the bolt and nut and spacer securing the cylinder to the frame.

HYDRAULIC SYSTEMS

POWER STEERING CYLINDER DISASSEMBLY / REASSEMBLY

Thoroughly clean the outside of the cylinder to prevent contamination. Always work in a clean environment.



0105-01

Using a spanner wrench, remove the cylinder rod guide from the cylinder body.



0105-02

Pull the rod and piston from the cylinder body.



0105-03



0722-04

Remove the piston nut while holding the rod.

CAUTION: Do not damage the cylinder rod by clamping in a vise, vise grip, pliers, etc.



0105-05

Note the position and orientation of the piston seals. Carefully remove the seals.

Seal Kit Part Number: 95-4008.

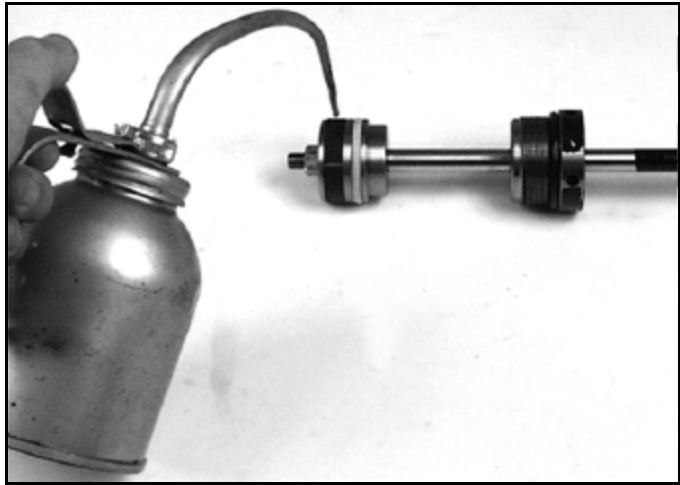


0722-06

Install new piston seals and rod guide O-ring.

HYDRAULIC SYSTEMS

Apply a light coating of transaxle fluid to the seals and O-rings.



0722-09

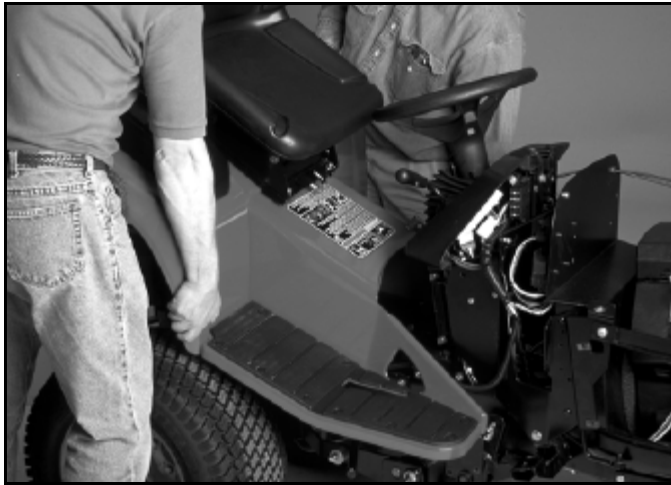
Carefully insert the piston in the cylinder and tighten the rod guide.



0106-01

HYDRAULIC SYSTEMS

POWER STEERING VALVE R & R



0109-014

Remove the fender assembly as outlined on pages 6 - 3 through 6 - 5.



3606-094

Raise the base of the boot which seals the steering column to the instrument panel and place the column in the lowest position.



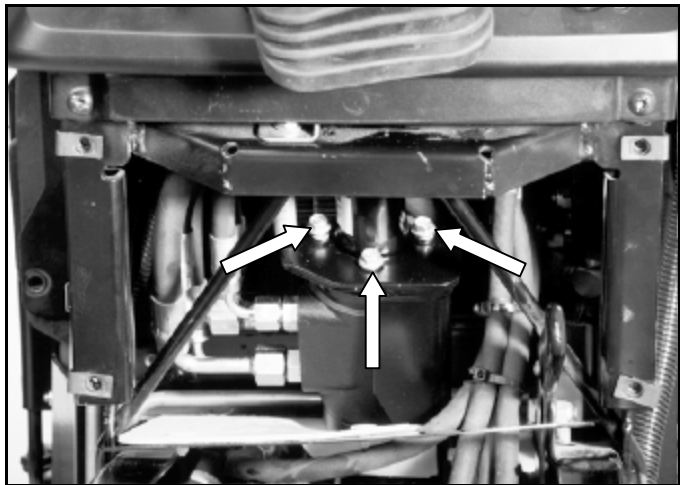
3606-097

Remove the top bolt securing the steering column and valve to the steering valve bracket.

Note where all the hydraulic hoses are located and that they must clear all rotating and moving parts at all positions of the tilt steering. Hoses must also clear the radiator screen.

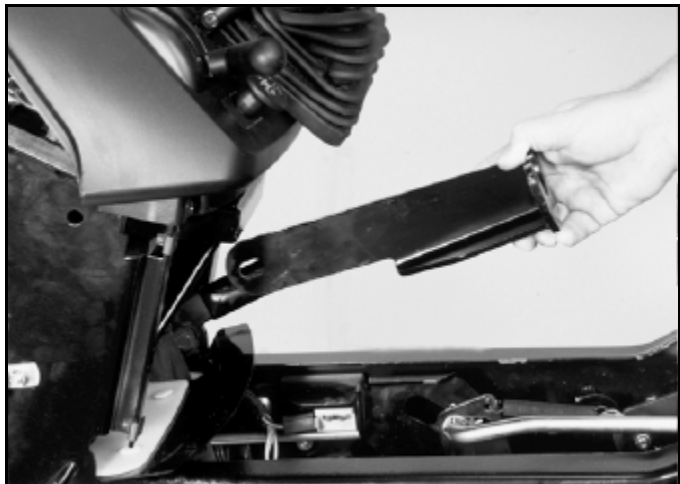
HYDRAULIC SYSTEMS

Remove the remaining three bolts securing the steering valve to the bracket.



3606-099

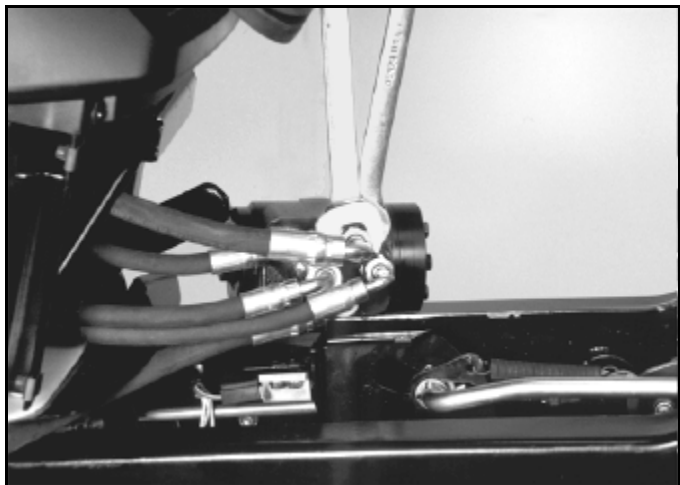
Remove the bolt at the bottom of the bracket.
Remove the steering valve bracket.



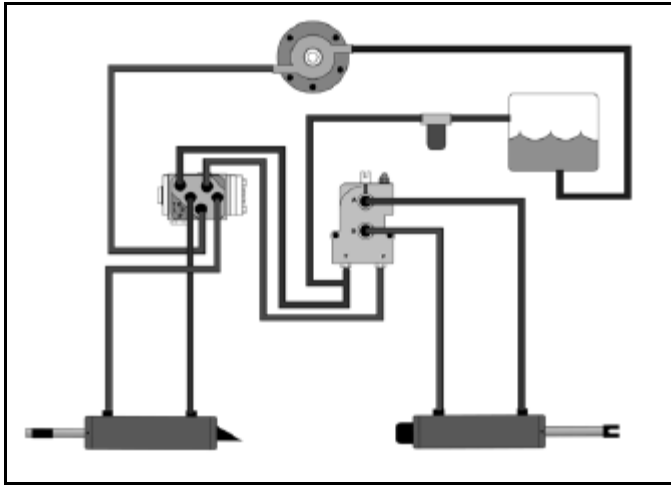
3606-111

Separate the steering valve from the steering column and remove the fittings from the steering valve.

NOTE: Cover all open lines and fittings to protect them from contamination.

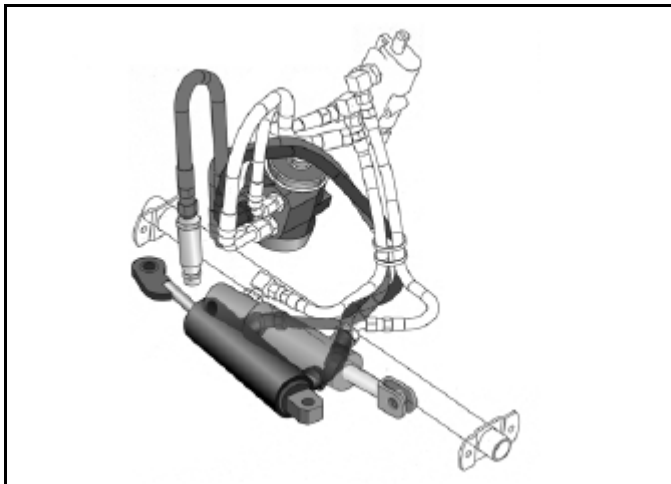


3606-112



0099-02

Power steering valve hose connections. Refer to page 2 - 5 for a larger drawing.



0202-042

Power steering hose routing. Refer to page 2 - 7 for larger drawings.

HYDRAULIC SYSTEMS

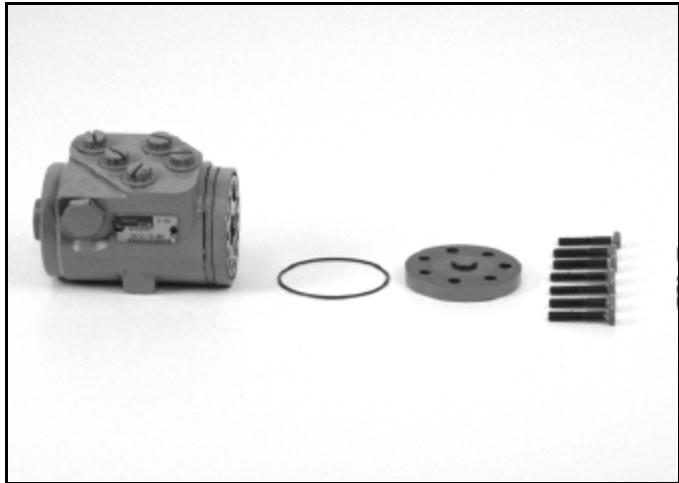
POWER STEERING VALVE DISASSEMBLY / REASSEMBLY

Steering Valve Disassembly

NOTE: Cleanliness is extremely important when repairing hydraulic Steering Control Units (SCU). Work in a clean area. Before disconnecting the hydraulic lines, clean the port area of the SCU. Before disassembly, drain the oil, then plug the ports and thoroughly clean the exterior of the SCU. During repairs, always protect machined surfaces.

Eaton Char-Lynn Power Steering 2 Series
Control Unit
Model 291-5119-001

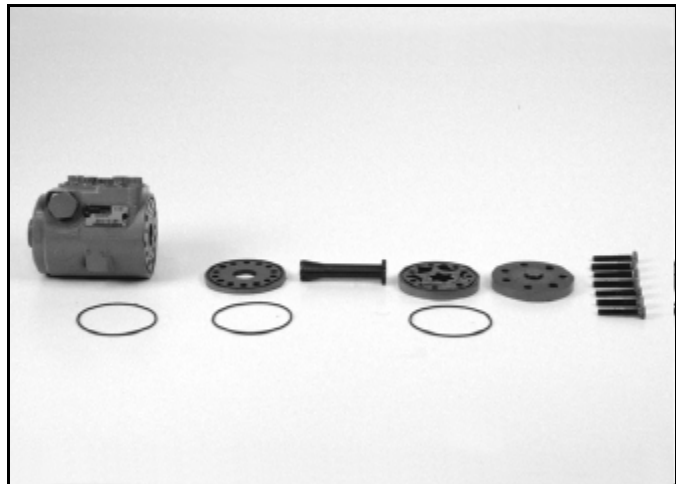
Remove the seven cap screws securing the end cap. Remove the end cap, two O-rings, and seal ring.



3605-009

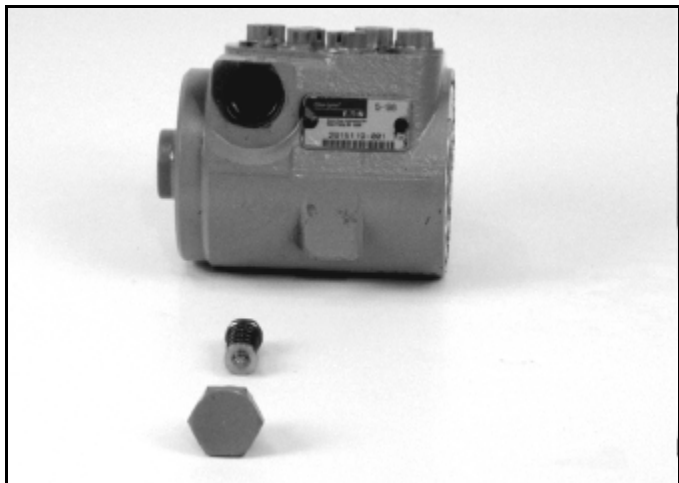
Remove the gerotor, spacer, and drive shaft from the housing.

Remove the wear plate along with the two O-rings.

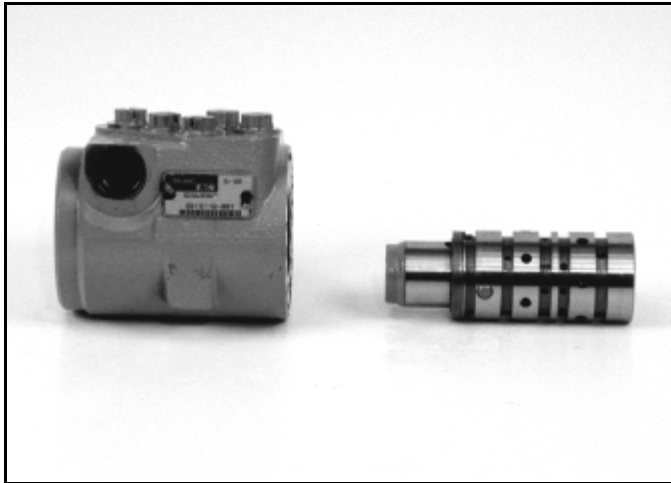


3605-010

Remove the relief valve plug and the relief valve.

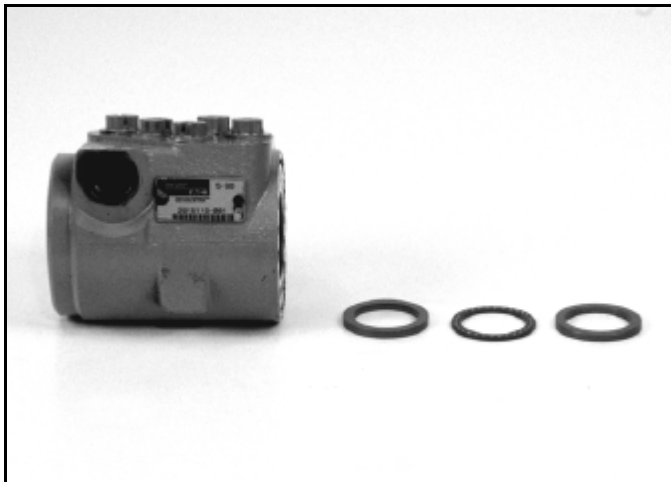


3605-012



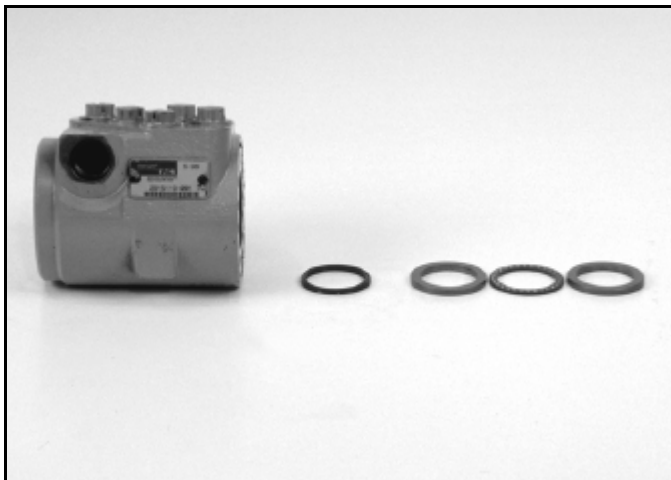
3605-014

Slide the spool and sleeve assembly from the housing.



3605-016

Remove the thrust bearing and races.



3605-019

Remove the quad seal.

HYDRAULIC SYSTEMS

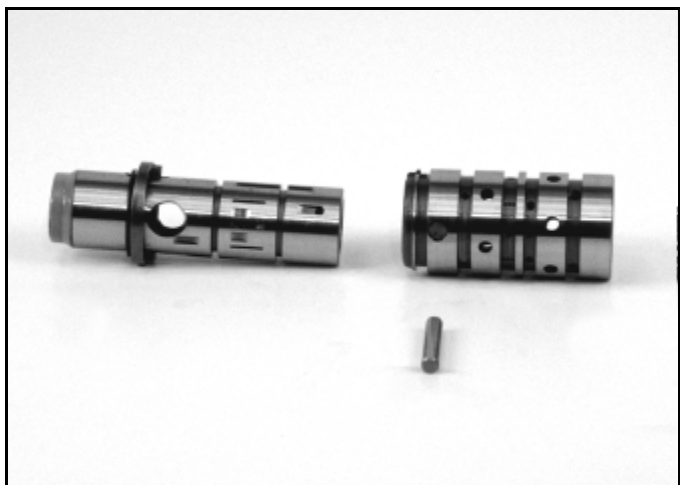
Using a small screwdriver, carefully pry the dust seal from the housing.

CAUTION: Do not damage the dust seal seat.



3605-020

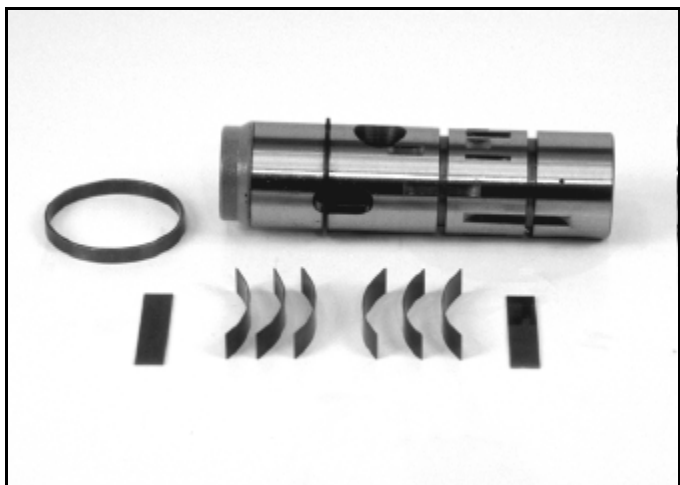
Remove the pin that holds the spool and sleeve together. Carefully slide the spool out of the sleeve. The springs and retaining ring will stay with the spool as it's removed.



3605-022

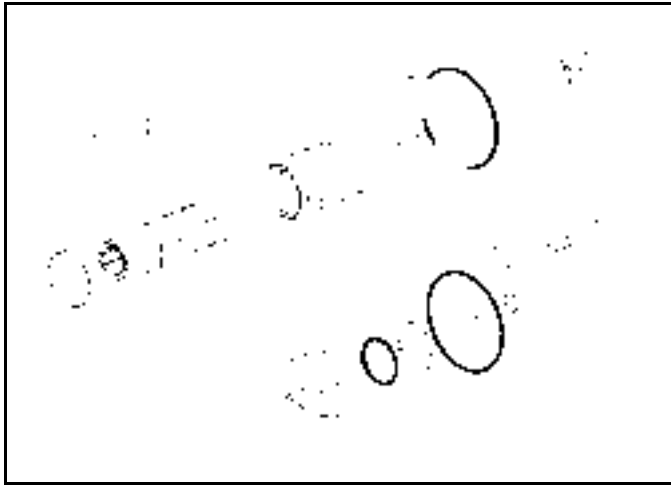
Remove the retaining ring and springs.

CAUTION: The centering springs are under tension; remove the retaining ring carefully.



3605-024

Reassembly

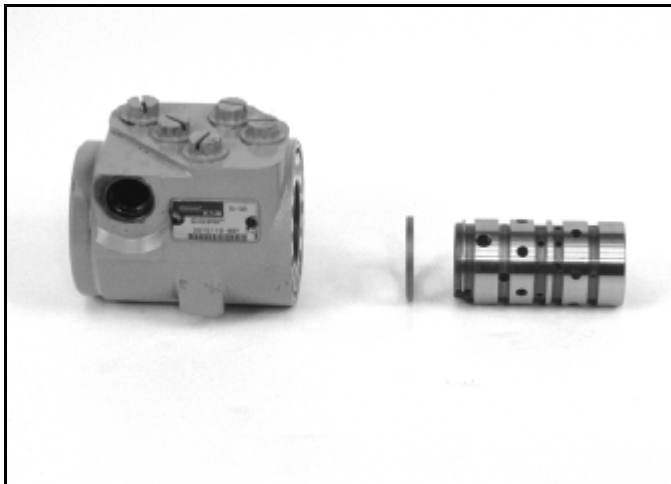


0202-043

Check all mating surfaces. Replace the steering valve if parts are worn, scratched, or have damage that could cause leakage. Wash all metal parts in clean solvent. Blow them dry with pressurized air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.

NOTE: Always use new seals when reassembling hydraulic steering control units. Seal Kit Part Number: 94-4099.

IMPORTANT: During reassembly lubricate the new seals with a petroleum jelly like Vaseline. Also lubricate machined surfaces and bearings with clean 10W-30 oil.



3605-037

To install the quad seal, place one of the bearing races and the sleeve into the housing. Together the housing and bearing race create a groove into which the quad seal will be installed.



3605-039

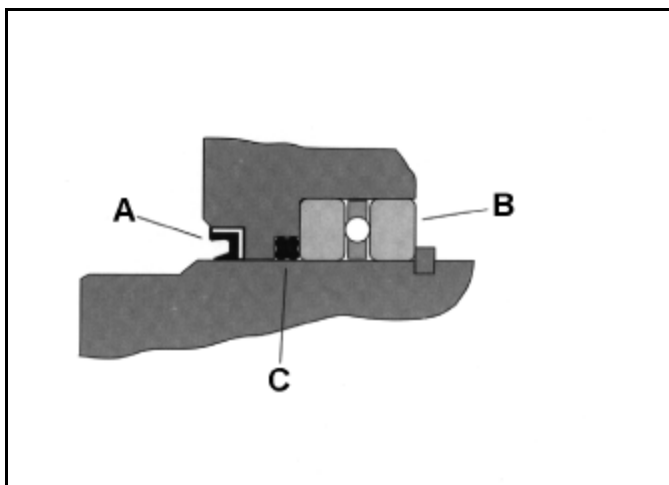
Fit the quad seal into its seat through the input end of the housing. Be sure the seal is not twisted.

Remove the sleeve and bearing race.

HYDRAULIC SYSTEMS

Lubricate and install the dust seal, see drawing for correct seal orientation.

- (A) Dust Seal
(B) Thrust Bearing and Race (2)
(C) Quad Seal



0202-044

Install the centering springs in the spool. It is best to install the two flat pieces first. Next, install the curved pieces, three at a time.

Fit the retaining ring over the centering springs.

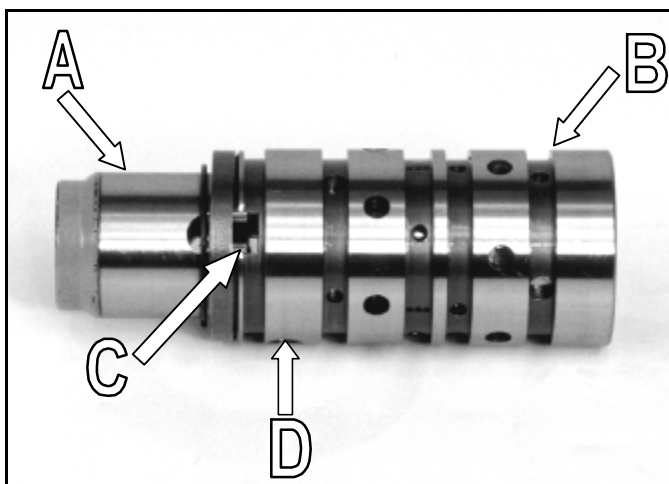
Centering Spring Kit Part Number: 94-4095.



3605-025

Apply a light coating of 10W-30 oil to the spool (A) and slide it into the sleeve (B). Be sure the centering springs fit into the notches (C) in the sleeve.

Install the pin (D).



3605-030



3605-047

Apply a light coating of petroleum jelly to the inner edge of the dust and quad seals.

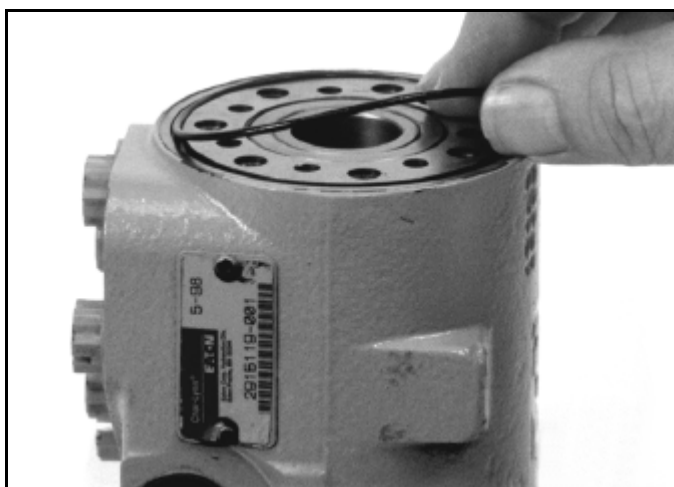
Put the thrust bearing and races into the housing. The thrust bearing goes between the two races.



3605-049

Apply a light coating of clean 10W-30 oil to the spool and sleeve assembly and slide it into the housing.

IMPORTANT: Do not damage the dust or quad seals.



3605-051

Clamp the housing in a vise. Use just enough clamping force to hold the housing securely.

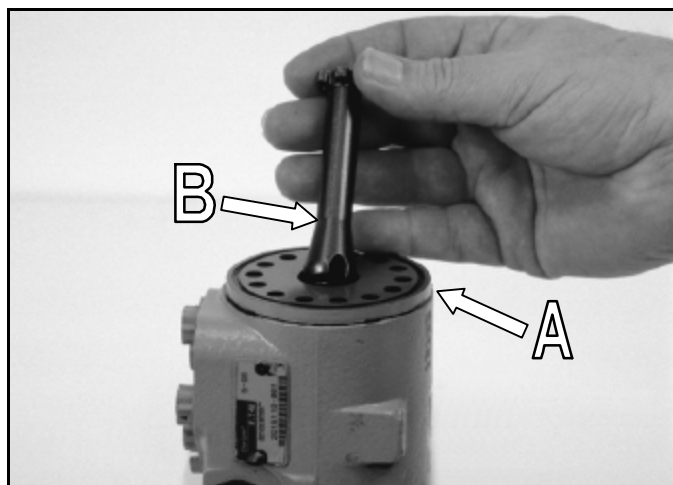
Lubricate and install a new O-ring in the groove in the housing.

HYDRAULIC SYSTEMS

Install the wear plate (A) and align the holes in the wear plate with threaded holes in the housing.

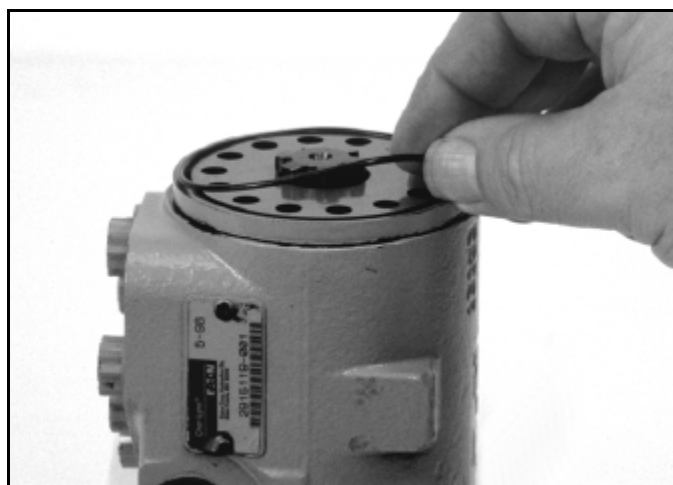
NOTE: The holes in the wear plate are symmetrical.

Install the drive (B); be sure the slot in the drive engages the pin.



3605-053

Lubricate and install a new O-ring seal in the groove in the wear plate.

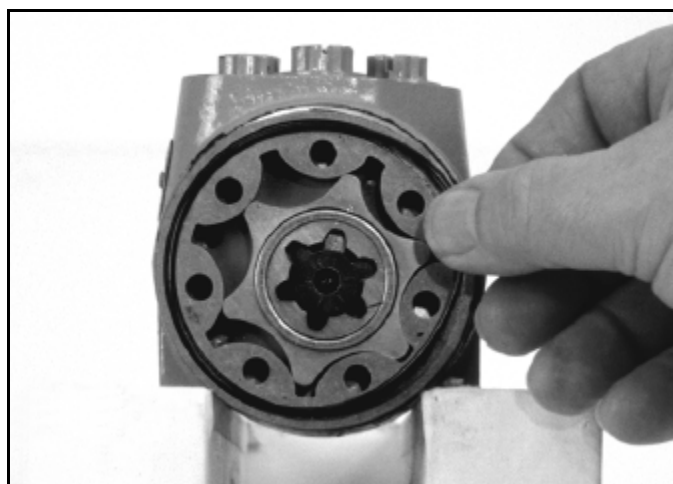


3605-055

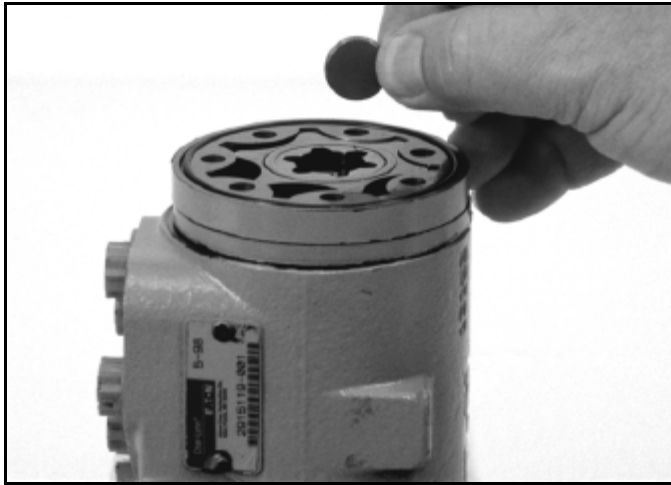
Install the gerotor and align the screw holes.

Lubricate and install a new O-ring seal in the groove in the gerotor ring.

Lubricate and install a new O-ring and seal ring in the gerotor star.



3605-059



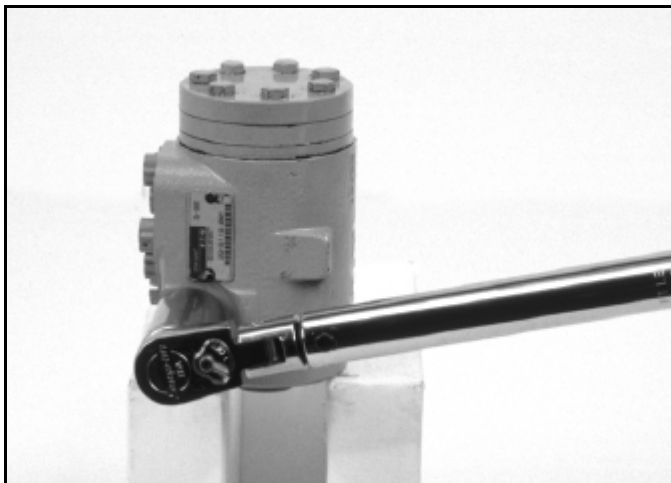
3605-061

Install the spacer.



3605-064

Install the end cap and seven cap screws. Tighten the cap screws, in a crisscross pattern to 140 - 160 lb·in (16 - 18 N·m).



3605-066

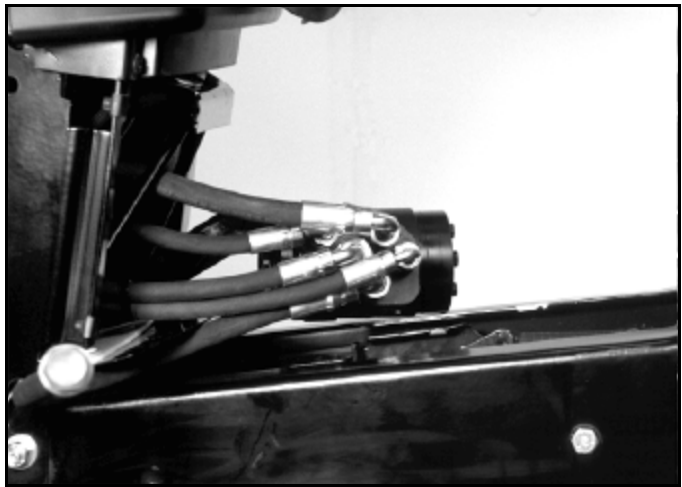
Remove the SCU from the vise.

Install the relief valve/check or check ball and plug. Use a new O-ring and tighten the plug to 150 lb·in (17 N·m).

HYDRAULIC SYSTEMS

LIFT VALVE R & R

Remove steering valve as outlined on pages 8 - 16 through 8 - 18 (power steering models only). Leave hoses connected.



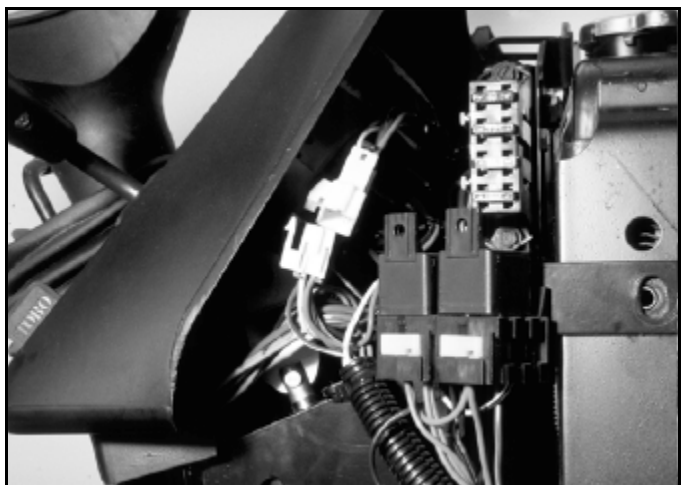
3606-114

Remove the four screws securing the instrument panel.



3606-116

Disconnect the white wiring harness plug.

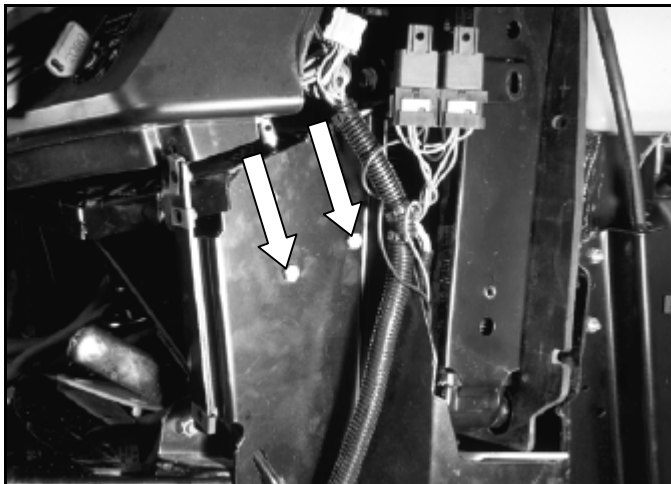


3606-119



3606-122

Disconnect the fitting on the return oil line (steel) from the "T" fitting at the bottom of the lift valve.



3606-128

Remove the two lift valve mounting bolts and nuts.



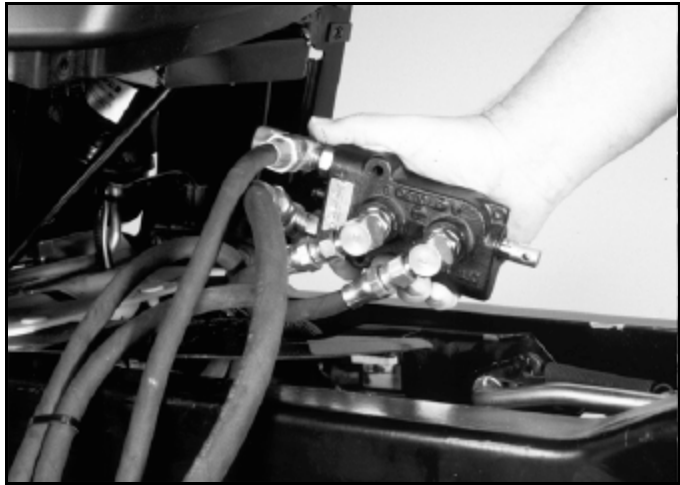
3605-003

Using a back-up wrench, remove the hydraulic lines and fittings from the valve.

NOTE: Cover the lines and fittings to prevent contamination.

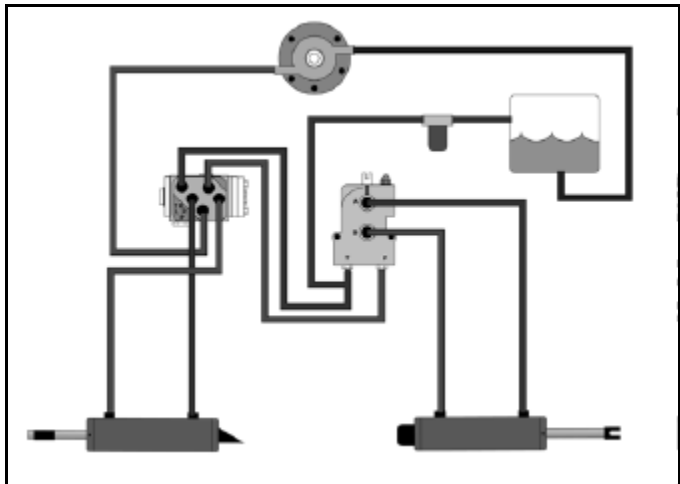
HYDRAULIC SYSTEMS

On installation, orient the fittings as shown (power steering shown).



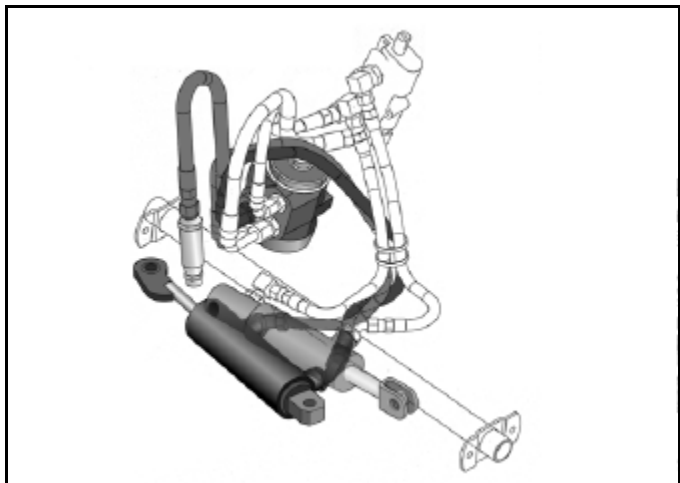
3605-001

Power steering lift valve hose connections. Refer to page 2 - 5 for a larger diagram. Refer to page 2 - 6 for manual steering lift valve hose connections.



0099-02

Power steering hose routing. Refer to page 2 - 7 for larger diagrams.



0202-042