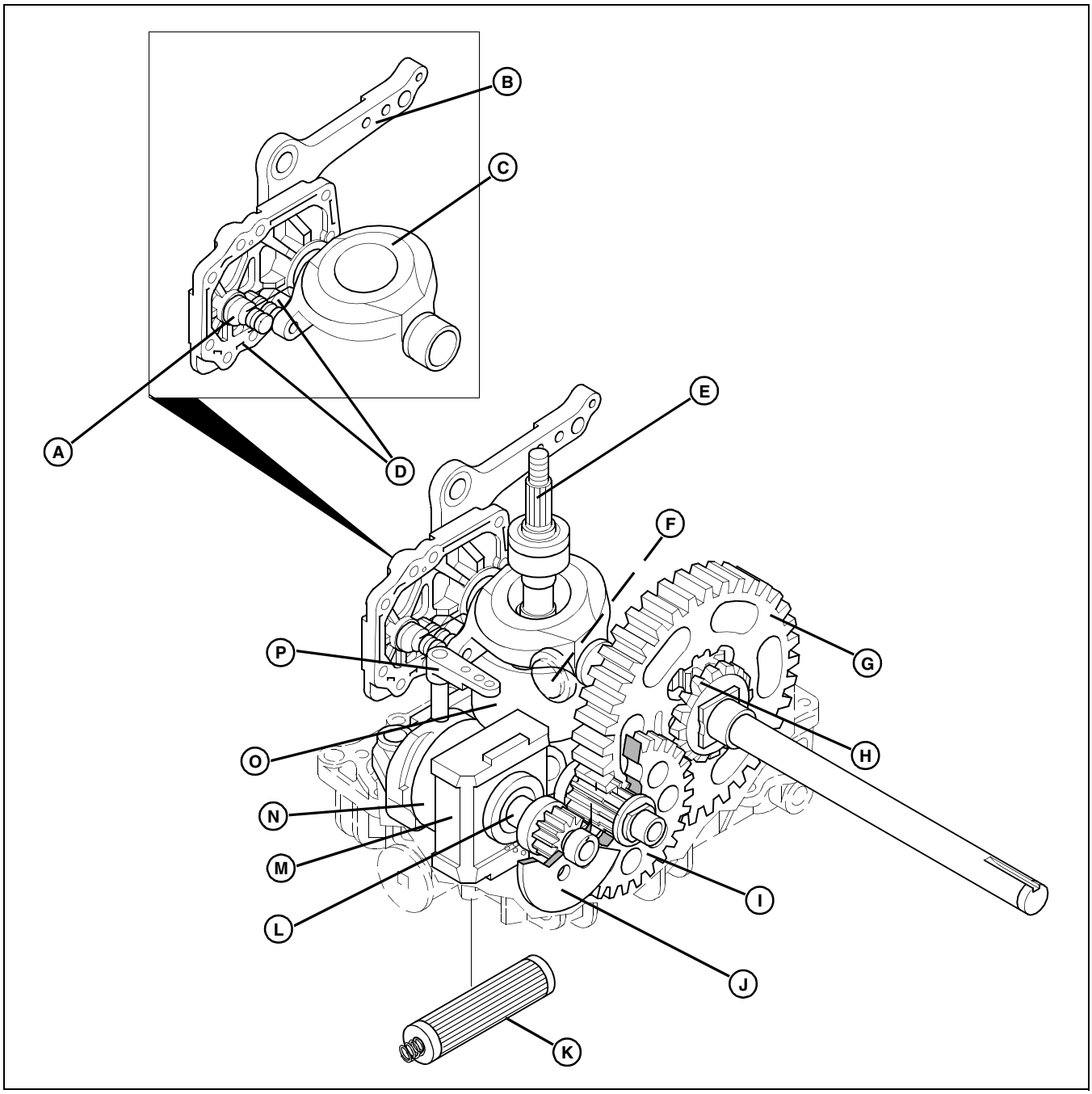
Hydrostatic System Operation



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A - Eccentric (Neutral Adjustment)
B - Directional Control Arm
C - Variable Displacement Swash Plate
D - Neutral Return Spring
E - Pump Input Shaft
F - Filter
G - Ring Gear
H - Differential Assembly
I - Reduction Gear
J - Brake Disk
K - Filter
L - Motor Output Shaft
M - Fixed Displacement Swash Plate
N - Motor Rotating Group
O - Pump Rotating Group
P - Freewheel Lever

Function:

The hydrostatic system provides a means of transferring power from the input sheave to the gear drive components of the transaxle. It also provides infinitely variable speed

control and the capability of forward or reverse directional travel of the vehicle.

Theory of Operation:

As the input sheave is rotated by the traction drive belt. It rotates the pump input shaft. The pump input shaft is splined to the pump rotating group and the charge pump. The pump rotating group is composed of an axial piston pump and a swash plate which provides variable pump displacement. The charge pump is composed of a Gerotor pump that draws pressure-free oil from the reservoir through the filter and supplies oil to the pump rotating group. The pump rotating group provides oil under pressure to the motor rotating group. The motor rotating group is composed of an axial piston motor and an angled bearing housing which provides fixed motor displacement. The motor converts hydraulic energy into rotary motion, which is output through the motor output shaft. This rotary motion of the motor output shaft is the beginning of the gear power flow.

Neutral:

When the directional control arm is in the neutral position, the swash plate is held parallel to the pump pistons and cylinder block. Because of this, the pistons in the pump do not move in and out in their bores as the pump rotates, and no oil is displaced. Because there is no demand for oil in the pump, both directional check valves are closed, and the machine remains stationary.

Forward:

As the directional control arm is moved to the forward position, the swash plate tilts to the forward position.

Springs inside the pistons force them against the swash plate. When the swash plate is at an angle, the pistons are forced in and out of the pump body as the cylinder block turns, displacing oil. As the pistons follow the angled swash plate and move outward in their bores, oil is drawn into the cylinders. As the pump continues to rotate, the swash plate angle forces the pistons back into their bores, and oil is displaced through ports in the center case.

Pressurized oil from the pump forces the forward check valve closed and supplies high pressure oil to the motor rotating group.

The rotating group of the motor presses against a thrust bearing which is held at a fixed angle in a housing. This bearing acts as a fixed angle swash plate. Oil enters the motor cylinder block through the C-shaped pressure port in the center case. This port is located so that high pressure oil enters the cylinder bore at the bottom of the piston stroke.

As the oil fills the cylinder bore, the piston is forced out, causing the motor to rotate as the piston follows the angle of the fixed swash plate. The motor rotating group is splined to the output shaft. As system loads increase (climbing a hill for example) oil pressure between the pump and motor increases to meet system needs. This is known as the high pressure side.

As the motor rotates, the piston follows the fixed angle swash plate until it is no longer aligned with the pressure port of the center case. Since high pressure oil is no longer supplied to the piston, it no longer adds to the rotary motion of the motor. But, since the pistons next in line to it are now filling with oil, the rotary motion is continued.

As the motor continues to rotate, the pistons pass from the high pressure port to the low pressure port. As the pistons are forced back into their bores by the angle of the swash plate, oil is forced out of the piston bores, through the center case, and back to the inlet port of the pump. This is known as the low pressure side.

The oil path from the pump to the motor (high pressure side) and from the motor back to the pump (low pressure side) switch when the transmission is shifted from forward drive to reverse drive, causing the motor to rotate in the opposite direction.

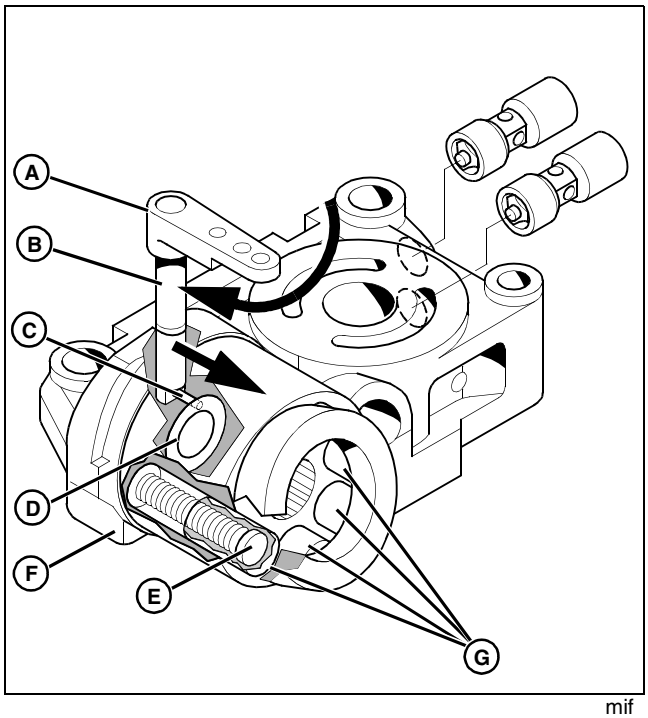
A certain amount of oil is lost from the pump and motor rotating groups. This is due to normal leakage (which provides lubrication), or may be caused by component wear. Since the pump/motor operate in a closed loop system, oil lost from the system must be replenished. Any additional oil required by the system is drawn from the sump, through the filter, by the charge pump. The charge pump keeps a constant pressure and volume of oil supplied to the piston pump. Charge pressure is controlled by the spring holding the charge pump housing on the center case.

Reverse:

The operation in reverse is the same as in forward. The only difference being that the swash plate is tilted in the opposite direction, thus causing oil flow through the center case in the opposite direction. This causes the reverse check valve to close and supply high pressure oil to the opposite side of the motor rotating group. This causes the output shaft to rotate in the opposite direction, and results in reverse travel of the vehicle.

When in reverse, the reverse check valve is closed due to high pressure oil forcing it against the seat. The forward check valve will open to sump.

Freewheel:



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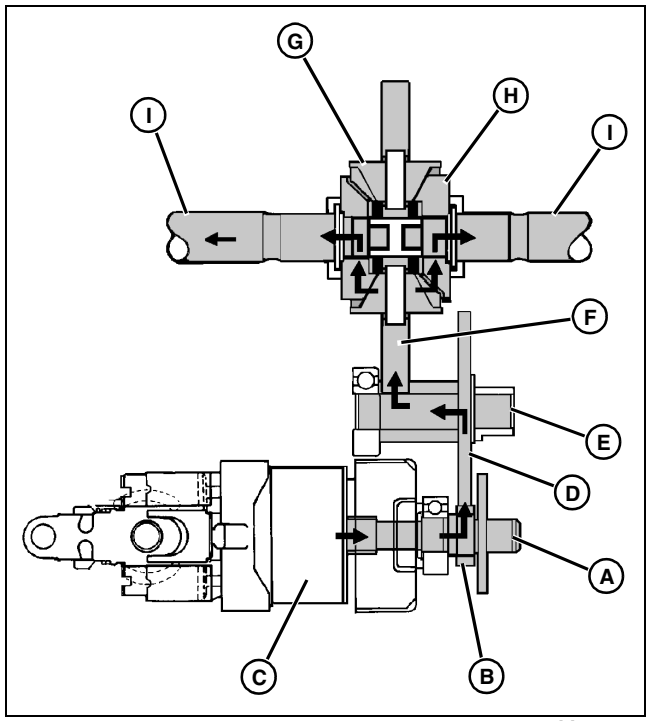
When the freewheel lever (A) is engaged, the freewheel shaft (B) turns, pushing a pin (C) against a thrust washer (D) on the motor cylinder block (E). This moves the cylinder block away from the center case (F), allowing high pressure oil to return directly to the reservoir without entering the motor cylinder bores and pistons (G).

Gear Power Flow

Function:

The gear components transfer power from the hydrostatic transaxle motor to the drive axles and wheels. They also provide a means of making turns with differential action for smooth operation.

Theory of Operation:



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The output shaft (A) and output shaft gear (B) are splined to the hydrostatic motor (C). Power from the motor is transferred to the output shaft. The output shaft gear meshes with the reduction gear (D) which drives the reduction shaft (E). The reduction shaft drives the differential ring gear (F). Power is transferred from the ring gear to the differential pinion shaft and differential pinion gears (G). The differential bevel gears (H), are splined to the axle shafts (I), and transfer power directly out to the drive wheels.

Diagnostics

Machine Will Not Move Forward Or Reverse

Test Conditions:

- Machine parked on level surface.
- Key switch in STOP position.
- Park brake DISENGAGED.
- Transaxle in NEUTRAL

Symptom: Machine Will Not Move Forward or Reverse

(1) Is the transaxle reservoir at full mark?

Yes - Go to next step.

No - Fill reservoir to correct level with specified oil.

(2) Is the freewheeling lever pushed in?

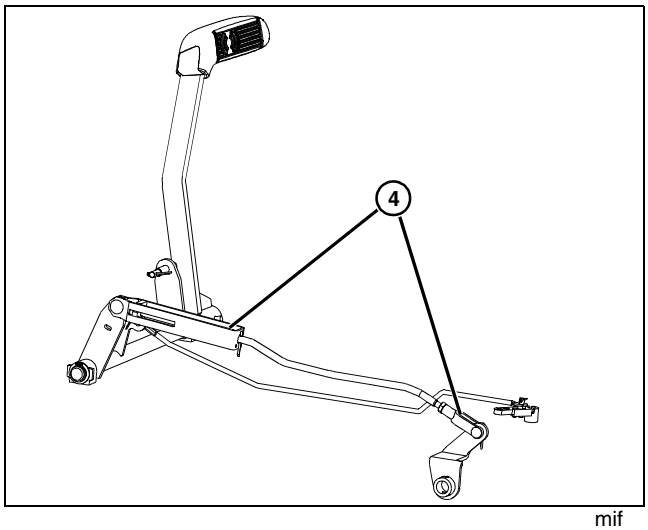
Yes - Go to next step.

No - Push lever in to disengage freewheeling.

(3) Is the traction drive belt properly tensioned and not broken, frayed, glazed or stretched?

Yes - Go to next step.

No - Eliminate binding, replace faulty or damaged components or belt.



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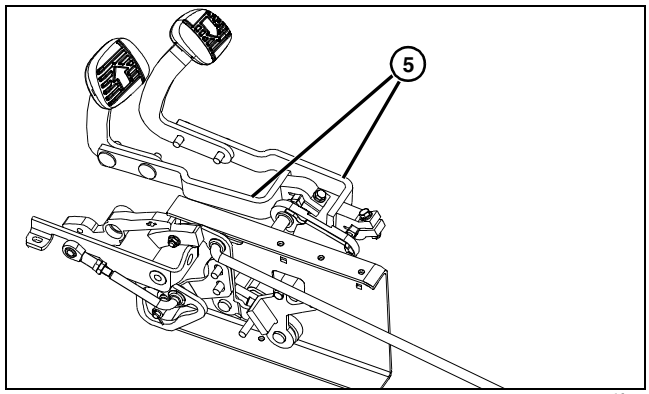
(4) Is the brake linkage properly adjusted and the brake rod and lever not damaged or binding?

Yes - Go to next step.

No - Adjust brake linkage. See “Brake Linkage Adjustment” on page 217. Eliminate binding, replace damaged components.

Symptom: Machine Will Not Move Forward or Reverse



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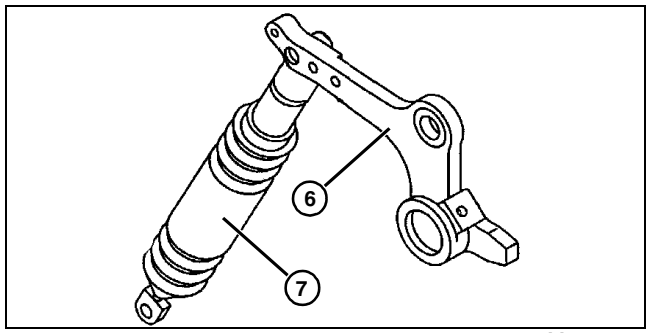
(5) Are the forward/reverse pedal linkages not damaged and move freely?

Yes - Go to next step.

No - Eliminate binding, replace faulty or damaged components. See “Control Pedals and Linkage” on page 221.



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(6) Is the control arm damaged, or the spring pin broken or missing?

Yes - Replace control arm and/or spring pin.

No - Go to next step.

(7) Is the shock absorber binding or damaged?

Yes - Replace shock absorber.

No - Go to next step.

(8) Are the engine or transaxle sheaves , keyways and keys damaged or have evidence of wear?

Yes - Replace sheaves or keys.

No - Go to next step.

(9) Does the idler arm assembly pivot freely and has no wear in bearing?

Yes - Go to next step.

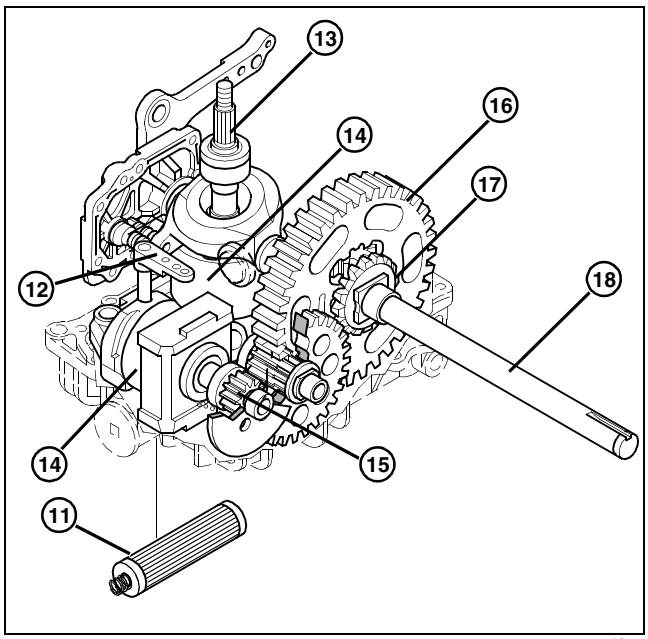
Symptom: Machine Will Not Move Forward or Reverse

No - Lubricate and/or replace assembly.

(10) Does the belt idler assembly tension spring maintain tension on drive belt and is not stretched or damaged?

Yes - Go to next step.

No - Replace tensioning spring.



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(11) Is the hydrostatic oil filter clean, free of debris and is not plugged[1]?

Yes - Go to next step.

No - Replace filter.

(12) Do the freewheel linkage components move freely and are not damaged[1]?

Yes - Go to next step.

No - Eliminate binding and/or replace damaged components. See “Transaxle Disassembly and Assembly” on page 228.

(13) Are the input (pump) shaft splines worn or damaged and/or do not positively engage in pump[1]?

Yes - Replace shaft and/or correct engagement. See “Transaxle Disassembly and Assembly” on page 228.

No - Go to next step.

(14) Do the pump and motor rotating groups have scoring on center case/cylinder block mating surfaces or pistons[1]?

Symptom: Machine Will Not Move Forward or Reverse

Yes - Replace rotating groups and center case. See “Transaxle Disassembly and Assembly” on page 228.

No - Go to next step. See “Transaxle Disassembly and Assembly” on page 228.

(15) Is the motor output shaft and gear worn or damaged[1]?

Yes - Replace shaft. See “Transaxle Disassembly and Assembly” on page 228.

No - Go to next step.

(16) Are the final pinion and ring gear worn or damaged[1]?

Yes - Replace worn or damaged components. See “Transaxle Disassembly and Assembly” on page 228.

No - Go to next step.

(17) Are the differential gears damaged[1]?

Yes - Replace gears. See “Transaxle Disassembly and Assembly” on page 228.

No - Go to next step.

(18) Are the axle shafts damaged[1]?

Yes - Replace axle shafts. See “Transaxle Disassembly and Assembly” on page 228.

No - End of diagnosis.

1. Requires removal of transaxle from machine and disassembly.

Noisy Operation

Test Conditions:

- Machine parked on level surface.
- Key switch in STOP position.
- Park brake DISENGAGED.
- Transaxle in NEUTRAL.

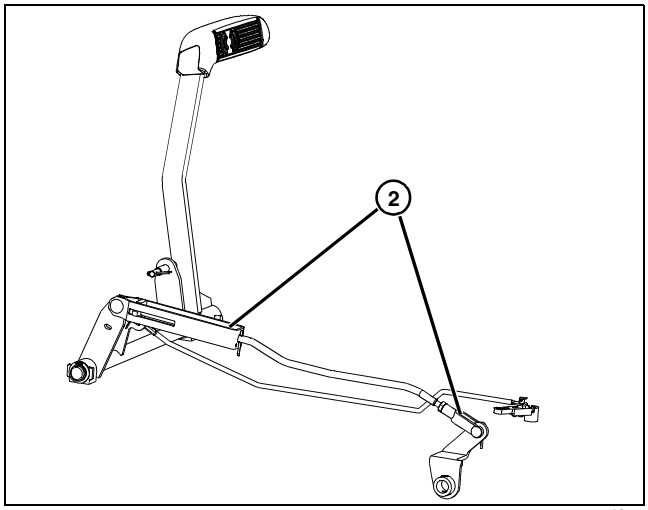
Symptom: Noisy Operation

(1) Is the hydraulic oil full, not contaminated and not foamy?

Yes - Go to next step.

No - Drain and or fill reservoir. Bleed air from system if foamy. See “Hydrostatic Transaxle Bleeding Procedure” on page 216.

Symptom: Noisy Operation



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(2) Is the brake linkage properly adjusted and the brake rod and lever not damaged or binding?

Yes - Go to next step.

No - Adjust brake linkage. See “Brake Linkage Adjustment” on page 217. Eliminate binding, replace damaged components.

(3) Is the freewheeling linkage and lever damaged or binding?

Yes - Eliminate binding and/or replace damaged components.

No - Go to next step.

(4) Is the hydrostatic oil filter clean, free of debris and not plugged, and installed with rubber seal into transmission and spring end facing out to cap/plug[1]?

Yes - Go to next step.

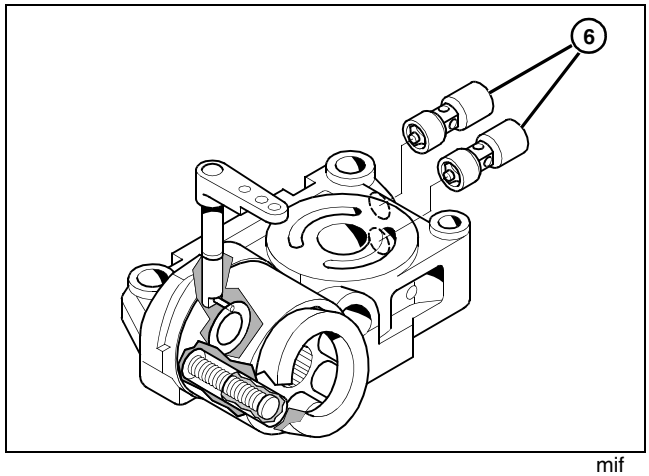
No - Replace filter. Install filter correctly.

(5) Do the pump and motor rotating groups have scoring on center case/cylinder block mating surfaces or pistons[1]?

Yes - Replace rotating groups and center case. See “Transaxle Disassembly and Assembly” on page 228.

No - Go to next step.

Symptom: Noisy Operation



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(6) Do the check valve spools move freely and are not damaged[1]?

Yes - Go to next step.

No - Clean, free up valves or replace valves. See “Transaxle Disassembly and Assembly” on page 228.

(7) Are the final pinion and ring gear worn or damaged[1]?

Yes - Replace worn or damaged components. See “Transaxle Disassembly and Assembly” on page 228.

No - End of diagnosis.

1. Requires removal of transaxle from machine and disassembly.

Machine Creeps

Test Conditions:

- Machine parked on level surface.
- Key switch in STOP position.
- Park brake DISENGAGED.
- Transaxle in NEUTRAL.

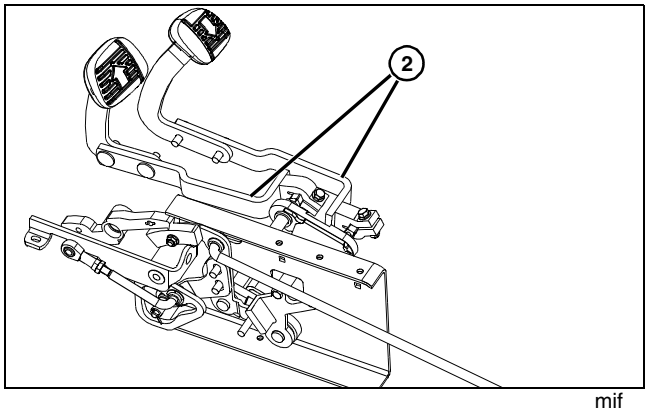
Symptom: Machine Creeps

(1) Is the transaxle reservoir at full mark and the oil at room temperature?

Yes - Go to next step.

No - Fill reservoir to correct level with specified oil.

Symptom: Machine Creeps



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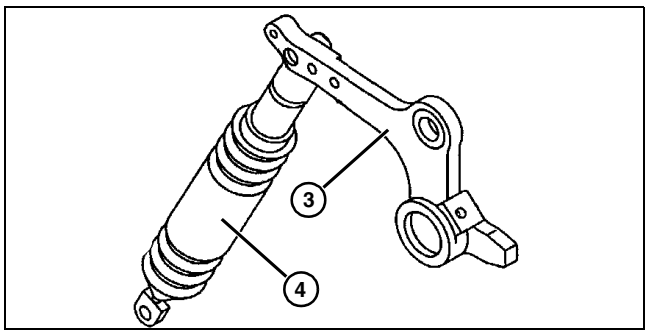
(2) Are the forward/reverse pedal linkages properly adjusted, not damaged and move freely?

Yes - Go to next step.

No - Adjust linkage. See “Forward and Reverse Pedal Height Adjustment” on page 217. Eliminate binding, replace faulty or damaged components. See “Control Pedals and Linkage” on page 221.



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(3) Is the control arm damaged, or the spring pin broken or missing?

Yes - Replace control arm and/or spring pin.

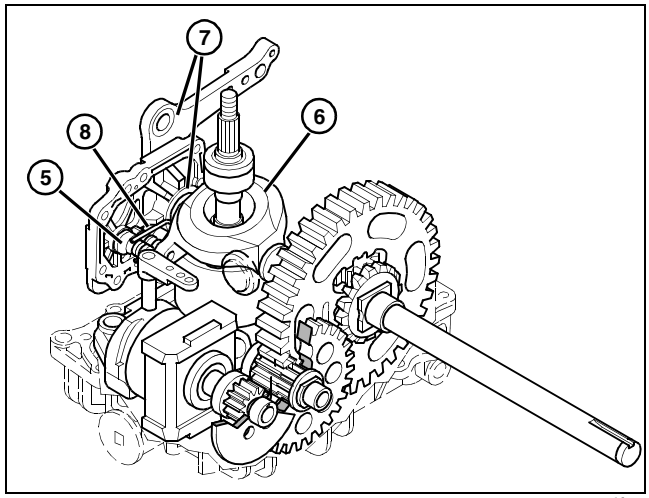
No - Go to next step.

(4) Is the shock absorber binding or damaged?

Yes - Replace shock absorber.

No - Go to next step.

Symptom: Machine Creeps



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(5) Is the neutral eccentric properly adjusted for no wheel movement at fast idle, one wheel off the ground?

Yes - Go to next step.

No - Adjust neutral eccentric. See “Neutral Creep Adjustment” on page 216.

(6) Are the variable swash plate shaft ends and transaxle case bearing surfaces worn or damaged, and/or the thrust washers binding[1]?

Yes - Replace damaged or worn components. See “Transaxle Disassembly and Assembly” on page 228.

No - Go to next step.

(7) Are the swash plate and control lever bent[1]?

Yes - Replace swash plate control arm. See “Transaxle Disassembly and Assembly” on page 228.

No - Go to next step.

(8) Does the swash plate return to neutral when forward/reverse pedals are released? Is the neutral return spring fatigued or damaged[1]?

Yes - Replace spring. See “Transaxle Disassembly and Assembly” on page 228.

No - End of diagnosis.

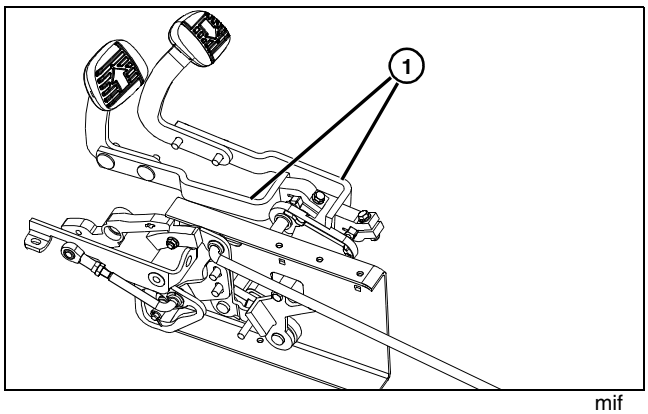
1. Requires removal of transaxle from machine and disassembly.

Machine Moves In One Direction Only

Test Conditions:

- Machine parked on level surface.
- Key switch in STOP position.
- Park brake DISENGAGED.
- Transaxle in NEUTRAL

Symptom: Machine Moves In One Direction Only



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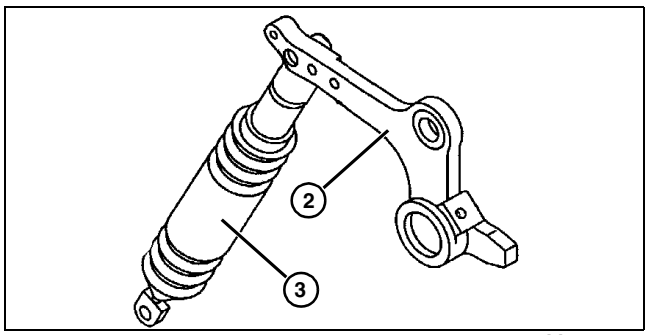
(1) Are the forward/reverse pedal linkages properly adjusted, not damaged and move freely?

Yes - Go to next step.

No - Adjust linkage. See “Forward and Reverse Pedal Height Adjustment” on page 217. Eliminate binding, replace faulty or damaged components. See “Control Pedals and Linkage” on page 221.



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(2) Is the control arm damaged, or the spring pin broken or missing?

Yes - Replace control arm and/or spring pin.

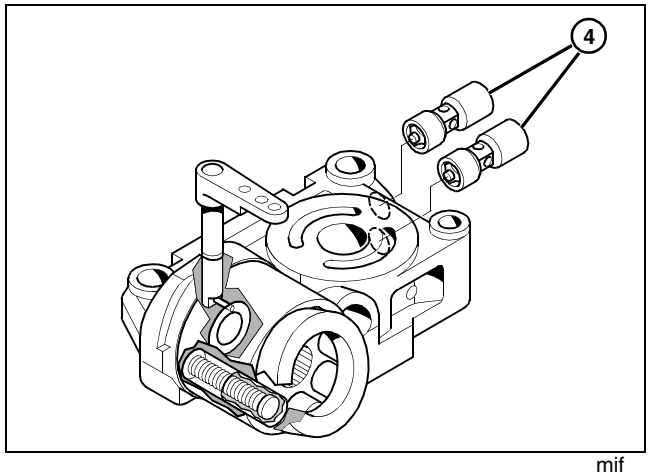
No - Go to next step.

(3) Is the shock absorber binding or damaged?

Yes - Replace shock absorber.

No - Go to next step.

Symptom: Machine Moves In One Direction Only



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(4) Do the check valve spools move freely and are not damaged[1]?

Yes - End of diagnosis.

No - Clean, free up valves or replace valves. See “Transaxle Disassembly and Assembly” on page 228.

1. Requires removal of transaxle from machine and disassembly.

Erratic Speed

Test Conditions:

- Machine parked on level surface.
- Key switch in STOP position.
- Park brake DISENGAGED.
- Transaxle in NEUTRAL.

Symptom: Erratic Speed

(1) Is the hydraulic oil full, not contaminated and not foamy?

Yes - Go to next step.

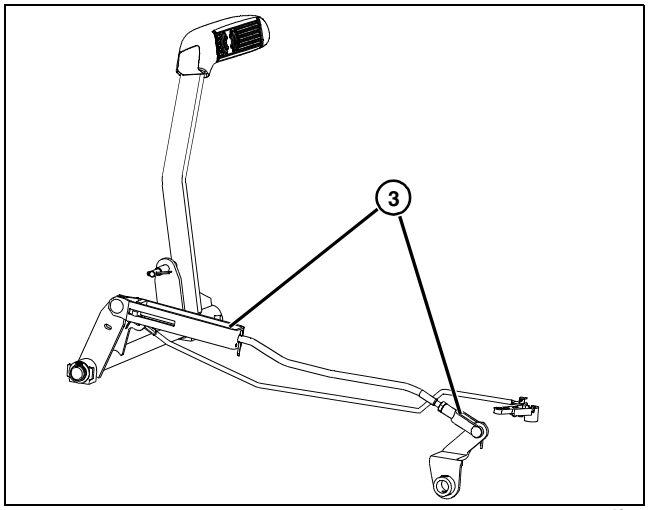
No - Drain and or fill reservoir. Bleed air from system if foamy. See “Hydrostatic Transaxle Bleeding Procedure” on page 216.

(2) Is the traction drive belt properly tensioned and not broken, frayed, glazed or stretched?

Yes - Go to next step.

No - Eliminate binding, replace faulty or damaged components or belt. See “Traction Drive Belt Removal and Installation” on page 219.

Symptom: Erratic Speed



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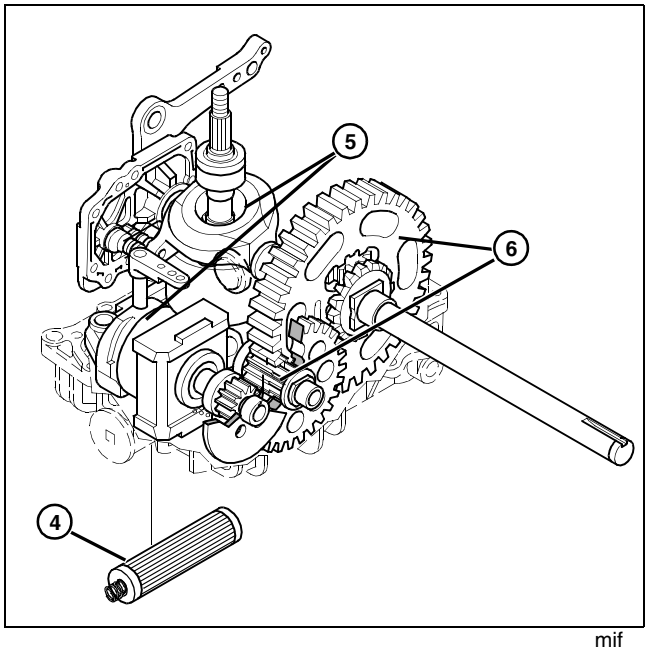
(3) Is the brake linkage properly adjusted and the brake rod and lever not damaged or binding?

Yes - Go to next step.

No - Adjust brake linkage. See “Brake Linkage Adjustment” on page 217. Eliminate binding, replace damaged components.



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(4) Is the hydrostatic oil filter clean, free of debris and not plugged, and installed with rubber seal into transmission and spring end facing out to cap/plug[1]?

Yes - Go to next step.

No - Replace filter. Install filter correctly.

Symptom: Erratic Speed

(5) Do the pump and motor rotating groups have scoring on center case/cylinder block mating surfaces or pistons[1]?

Yes - Replace rotating groups and center case. See “Transaxle Disassembly and Assembly” on page 228.

No - Go to next step.

(6) Are the final pinion and ring gear worn or damaged[1]?

Yes - Replace worn or damaged components. See “Transaxle Disassembly and Assembly” on page 228.

No - End of diagnosis.

1. Requires removal of transaxle from machine and disassembly.

Machine Does Not Achieve Full Ground Speed

Test Conditions:

- Machine parked on level surface.
- Key switch in STOP position.
- Park brake DISENGAGED.
- Transaxle in NEUTRAL.

Symptom: Machine Does Not Achieve Full Ground Speed

(1) Is the transaxle free of debris?

Yes - Go to next step.

No - Remove debris from transaxle.

(2) Is the park brake depressed and locked?

Yes - Release brake.

No - Go to next step.

(3) Is the cooling fan damaged?

Yes - Replace cooling fan.

No - Go to next step.

(4) Is the traction drive belt properly tensioned and not broken, frayed, glazed or stretched?

Yes - Go to next step.

No - Eliminate binding, replace faulty or damaged components or belt.

Yes - Release park brake.

No - Go to next step.

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