

# **Section 33**

## **Chapter 1**

### **POWER BRAKES SYSTEM**

#### **How It Works and Troubleshooting**

## TABLE OF CONTENTS

BRAKE SYSTEM .....	33-1-3
General Information .....	33-1-3
General Description .....	33-1-4
Axle Pump .....	33-1-4
Axle Cooling Filter .....	33-1-5
Axle Lube Solenoid Valve .....	33-1-5
Pressure/Lube Control Valve .....	33-1-6
Brake Lubrication and Jet Pump .....	33-1-6
Pressure/Lube Control Valve .....	33-1-7
Regulated Pressure Spool .....	33-1-8
Park Brake/Tow Valve .....	33-1-10
Park Brake Applied .....	33-1-11
Park Brake Released .....	33-1-11
Tow Valve .....	33-1-11
BRAKE CIRCUIT COMPONENTS .....	33-1-12
Brake Pedal .....	33-1-12
Brake Control Valve .....	33-1-13
Brake Clutch Pack .....	33-1-13
Axle Brake Cylinders .....	33-1-13
HYDRAULIC BRAKE CONTROL .....	33-1-14
General Description .....	33-1-14
Brake Valve .....	33-1-14
Service Brake Circuit .....	33-1-15
Emergency Braking .....	33-1-18
BRAKE SYSTEM TROUBLESHOOTING .....	33-1-19

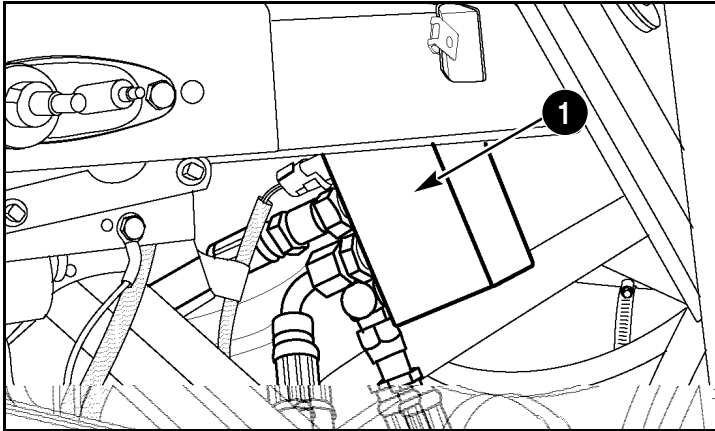
## BRAKE SYSTEM

### General Information

Inside the cab, below and to the right of the steering column, is a single brake pedal. When pushed by the operator, the brake pedal stops both axles simultaneously. If the operator releases the pedal, the service brakes will release and the axles will be free to rotate. The axle design incorporates the parking brake and service brake into each axle housing.

The pedal is used to actuate a brake valve (1) through a brake pedal actuator rod. The brake valve (1) is located below the steering column attached to the cab floor plate. As the operator pushes the brake pedal, the brake valve directs regulated supply pressure to/from the axle housings. A piston in the axle housing is pressed against the friction material and separator plates by the oil directed from the brake valve. As the friction material and separator plates are pressed together the axles stop.

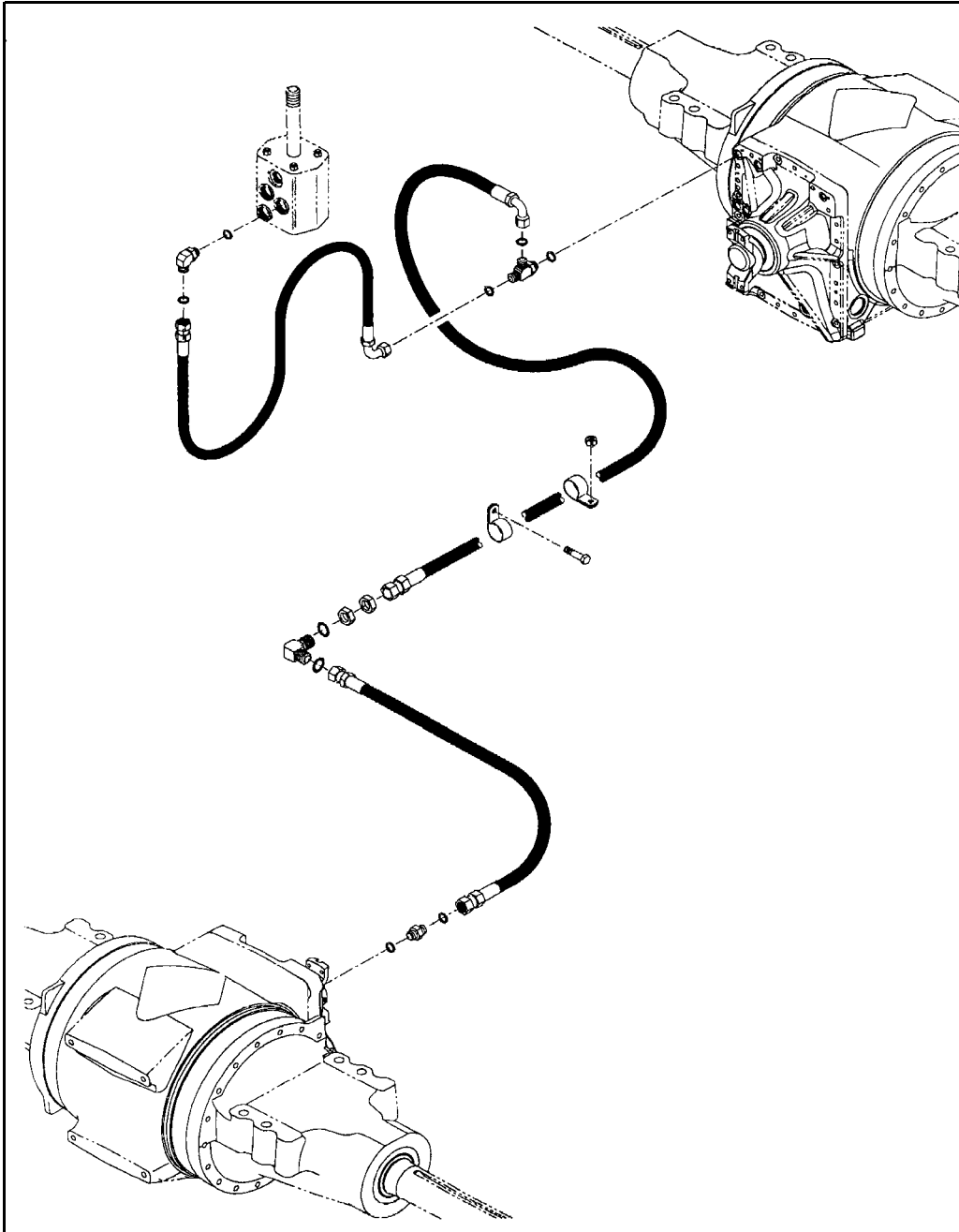
The brakes are multi-disc oil bath self adjusting clutch packs. The system incorporates a PFC pump mounted tandem hydraulic pump to supply the brake/differential lock systems regulated operating pressure and axle lubrication/cooling requirements.



MK00B237

## General Description

The brake system consists of a single foot operated pedal, a brake valve assembly, a bottom of brake switch, a park brake valve, an axle lube and regulated circuit hydraulic pump, a hydraulic filter, a regulator control valve, two differential carriers, two brake wheel cylinders, splined friction discs, steel separator plates and brake adjuster pins.



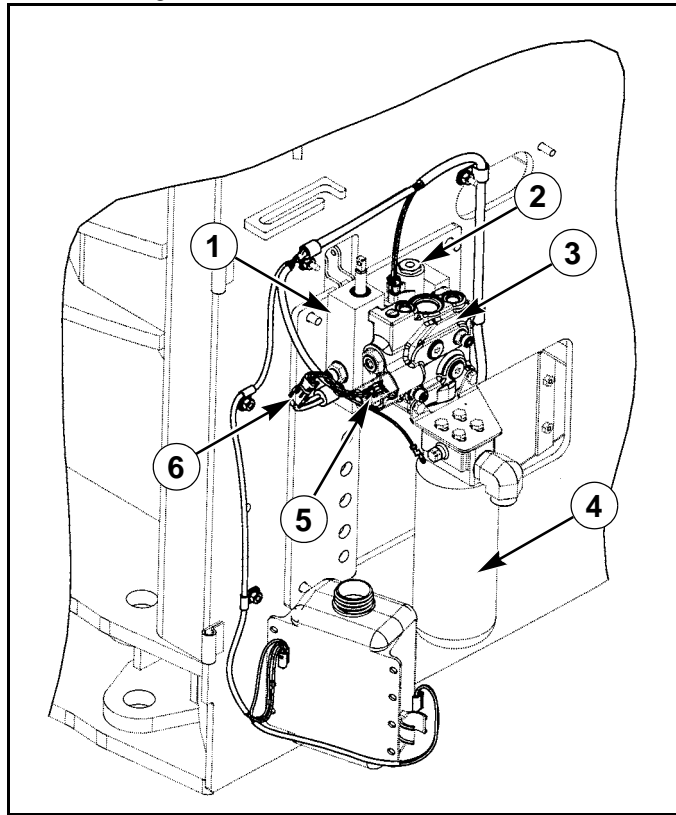
RH00H029

## Axle Pump

The axle hydraulic pump is driven by the PFC pump drive. The pump supplies the oil required for the service brake, parking brake release, differential lock, hitch pilot circuit, remote valve pilot circuit regulated circuits and axle lubrication/cooling requirements.

## Axle Cooling Filter

The system is protected from contamination with an in-line spin-on filter with a recommended service interval of 1500 hours. Oil from the axle pump flows through the oil cooler, to the filter, and then to the pressure/lube control valve located near the filter behind the right hand service door.



RI00FO

### Brake and Axle Components

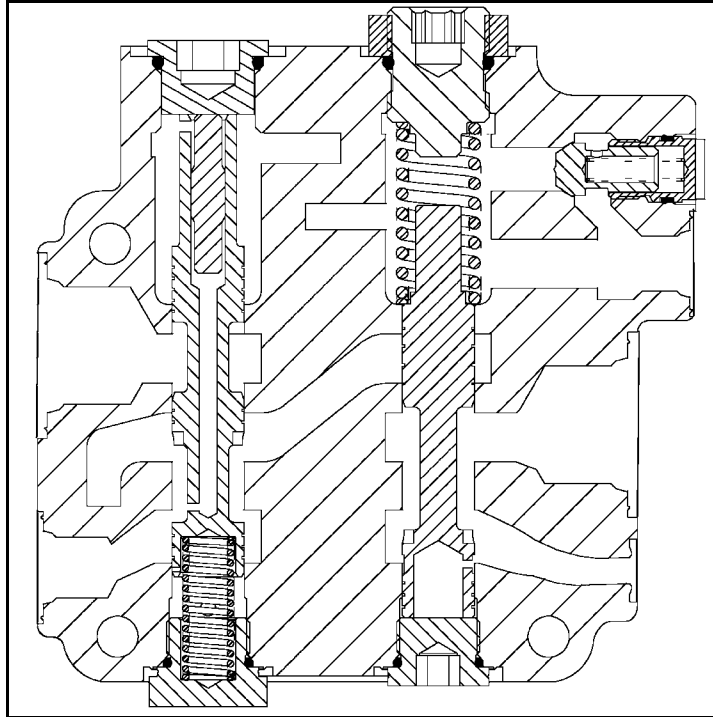
- |                                |                               |
|--------------------------------|-------------------------------|
| 1. PARK BRAKE/TOW VALVE        | 4. AXLE COOLING FILTER        |
| 2. PARK BRAKE SOLENOID         | 5. AXLE LUBE SOLENOID VALVE   |
| 3. PRESSURE/LUBE CONTROL VALVE | 6. PARK BRAKE PRESSURE SWITCH |

## Axle Lube Solenoid Valve

The axle lube solenoid valve is located in pressure/lube control valve housing and is used to protect the axle system from excessive lube pressures during cold weather. The purpose of this valve is to pressurize the non-spring end of the lube control spool during cold oil conditions, porting excess axle lube flow to the reservoir. This solenoid is activated by axle lube temperature switch at the axle filter.

## Pressure/Lube Control Valve

The pressure/lube control valve contains two spools; a regulated pressure spool and an axle lube flow spool. This valve is located behind the axle cooling filter. All of the oil flow from the axle cooling pump will be distributed from the pressure/lube control valve. First priority is the service brake, parking brake release, differential lock hitch pilot and remote pilot regulated circuits, second priority is the axle lube/cooling circuit. Excess flow will be returned to reservoir.



Ri99c012

## Brake Lubrication and Jet Pump

### Brake Lubrication

Oil to lubricate the brake and all other axle circuits is supplied from a gear pump driven by the PFC pump drive. Pump output is delivered to a Pressure/Lube Control Valve. The pressure/lube control valve supplies a regulated pressure is supplied as 1st priority to the service brake, parking brake, differential lock, hitch valve pilot and remote valve pilot regulated circuits. These regulated circuits are supplied at a pressure of approximately 270-290 PSI.

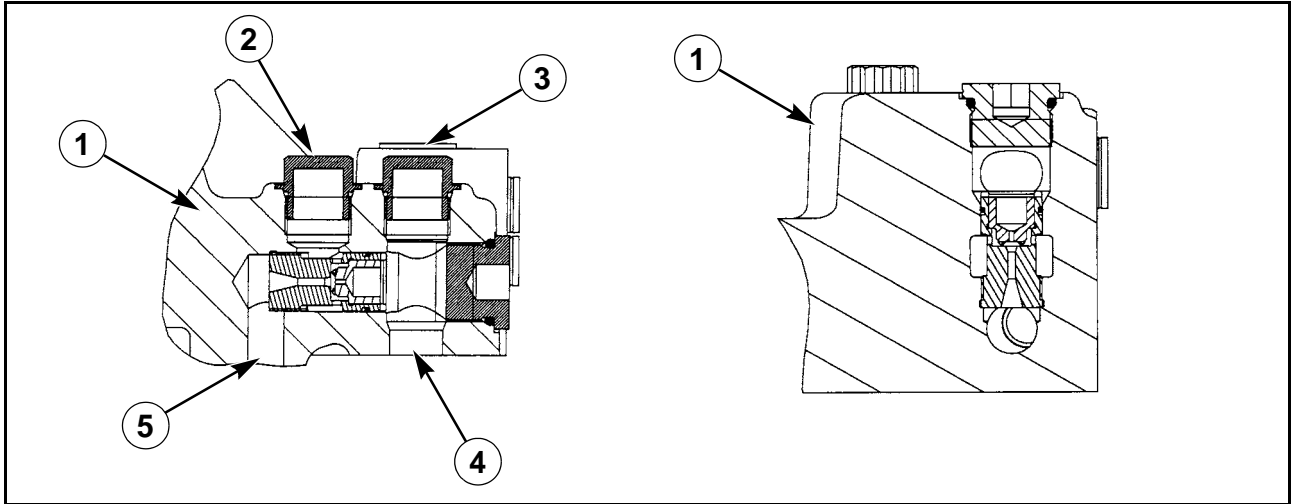
After the regulated circuits are satisfied, remaining pump supply is available to lubricate the axle components. Typical lube to the axle components is as follows:

- Brake Packs - 15.2 L/min. (4.0 GPM)
- Differential - 1.9 L/min. (0.5 GPM)
- Planetary/Bull Gears - 2.9 L/min. (0.75 GPM) Left, 2.9 L/min. (0.75 GPM) Right
- Pinion Bearings - 1.9 L/min. (0.5 GPM)

As the lubrication supply enters various axle circuits, a jet pump (venturi orificed fitting) draws off 1.5 GPM of oil and directs it to the bevel mesh and pinion bearings in the small axle. The remaining oil will be used for the differential and brake lube and cooling before returning to the bottom of the differential case.

As the oil level rises in the axle housing, it will cover the drain port fitting. Pressure will build up to approximately 5-7 PSI. This pressure will force oil to return to the hydraulic reservoir.

Although lubrication and flow patterns are different in the large axle, the jet pump (venturi orificed fitting) circuit is similar to the small axle in function and operation.



R100F049, R100F050

### Brake Lubrication and Jet Pump

- |                                 |                                   |
|---------------------------------|-----------------------------------|
| 1. AXLE LUBE, JET PUMP MANIFOLD | 4. LUBE TO DIFFERENTIAL AND BRAKE |
| 2. AIR INLET                    | 5. LUBE TO RING AND PINION        |
| 3. LUBE INLET                   |                                   |

### Pressure/Lube Control Valve

The pressure/lube control valve contains an axle lube solenoid valve (not shown) and two spools; a regulated pressure spool and an axle lube flow spool. This valve is located behind the axle cooling filter. All of the oil from the axle cooling pump will be controlled/distributed from the pressure/lube control valve.

The regulated pressure to the service brake, parking brake, differential lock, hitch pilot and remote pilot regulated circuits is supplied as first priority. The axle lube/cooling circuit is supplied as second priority. Excess flow will be returned to the charge circuit of the PFC pump during normal operation or to the reservoir in a cold oil condition.

The regulated pressure spool will regulate circuit pressure and prioritize the pump flow to the regulated circuits. The regulated pressure spool has an adjustable spring to maintain the regulated circuit pressure at 270-290 PSI. The axle regulated circuits are as follows:

- brakes
- differential lock
- direct the excess flow to the axle lube and cooling circuit

In addition to the axle regulated circuits mentioned above the following regulated circuits are also supplied from the pressure/lube control valve:

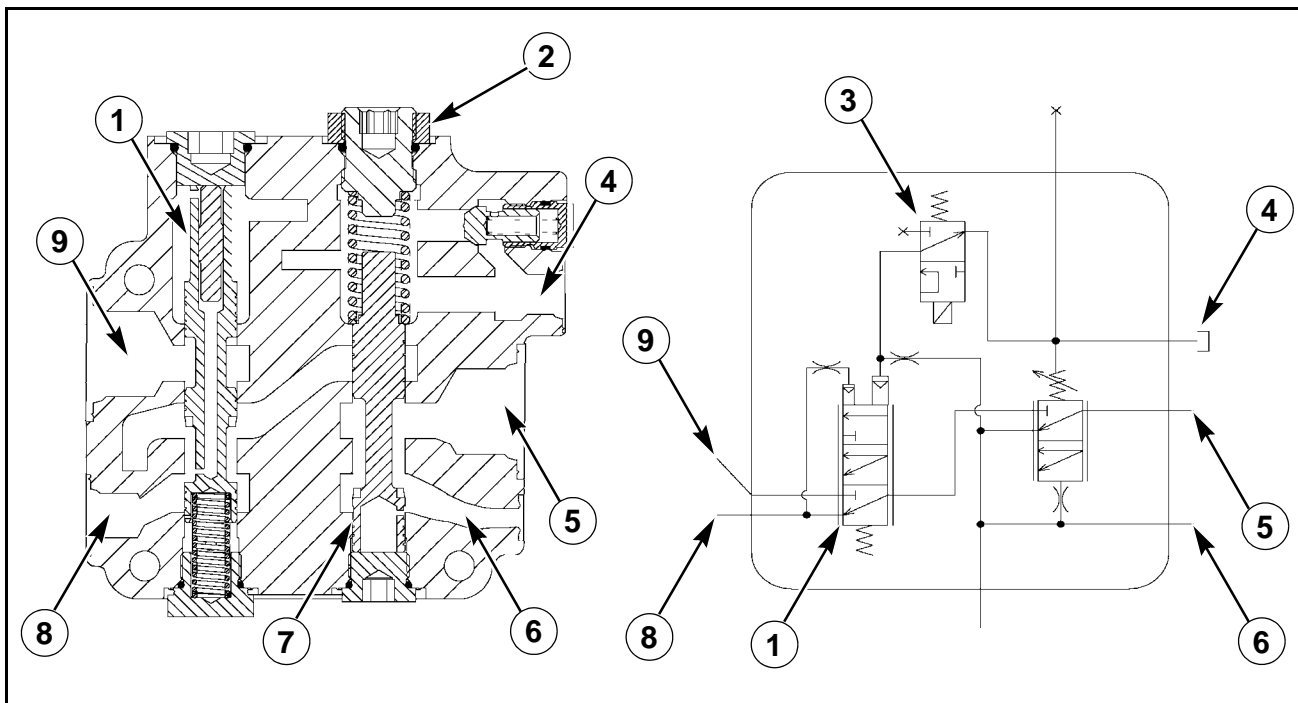
- hitch pilot circuit
- remote pilot circuit

Since the brake and differential lock valves are closed center in design there should only be a minimal amount of oil flow (volume) used for these circuits.

## Regulated Pressure Spool

The regulated pressure spool provides the hydraulic supply to the service brake, parking brake release and differential lock regulated circuits of the axle. Once all of the regulated circuits are satisfied the excess oil is directed to the lube control spool. Regulated pressure is adjustable through a threaded plug and locknut on the spring end of the regulator spool. On the non-spring end of the spool there is an orifice that allows the spool to monitor the regulated pressure. As regulated circuit outlet pressure approaches 270-290 PSI, the oil on the non-spring end shifts the regulated pressure spool against the spring. This spool movement restricts the oil flow into the regulated circuits. This has the effect of controlling pressure to the regulated circuits, maintaining 270-290 PSI. Circuits supplied include the parking brake (release), service brakes and differential lock. The spool then routes the excess flow to the lube control spool.

**NOTE:** The check valve has no function in this application.



Ri99c012, Ri99j088

### Pressure Control/Lube Flow Control Valve

- |                                  |                                     |
|----------------------------------|-------------------------------------|
| 1. LUBE CONTROL SPOOL            | 6. REGULATED PRESSURE PORT          |
| 2. REGULATED PRESSURE ADJUSTMENT | 7. REGULATED PRESSURE CONTROL SPOOL |
| 3. AXLE LUBE SOLENOID VALVE      | 8. AXLE LUBE PORT                   |
| 4. RESERVOIR PORT                | 9. CHARGE PFC PUMP PORT             |
| 5. VALVE INLET                   |                                     |

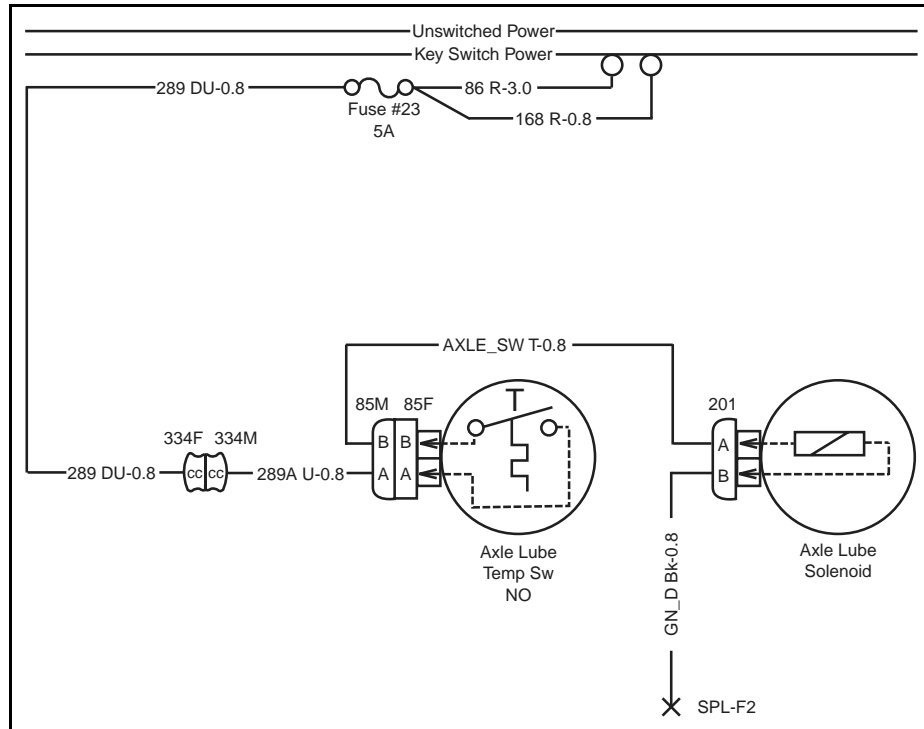


**Lube Spool**

The lube control spool will prioritize the oil not used by the service brake, parking brake release, differential lock, hitch pilot, and remote pilot regulated circuits. Oil is supplied to axle lube/cooling and any excess will be sent to the PFC Pump charge circuit or the hydraulic reservoir (cold oil condition). The lube/cooling supply oil from the regulating valve will go through the lube flow divider to provide lubrication to both axles.

At start up, a spring positions the lube control spool to direct oil to the axle lube circuit. The lube control spool contains an orifice, leading to the non-spring end of the spool. As the axle lube circuit pressurizes, the pressure is monitored at the non-spring end of the spool through the orifice. As pressure increases at the non-spring end, the spool shifts against the spring directing excess lube to the charge circuit of the PFC pump. This action stabilizes the axle lube supply circuit pressure.

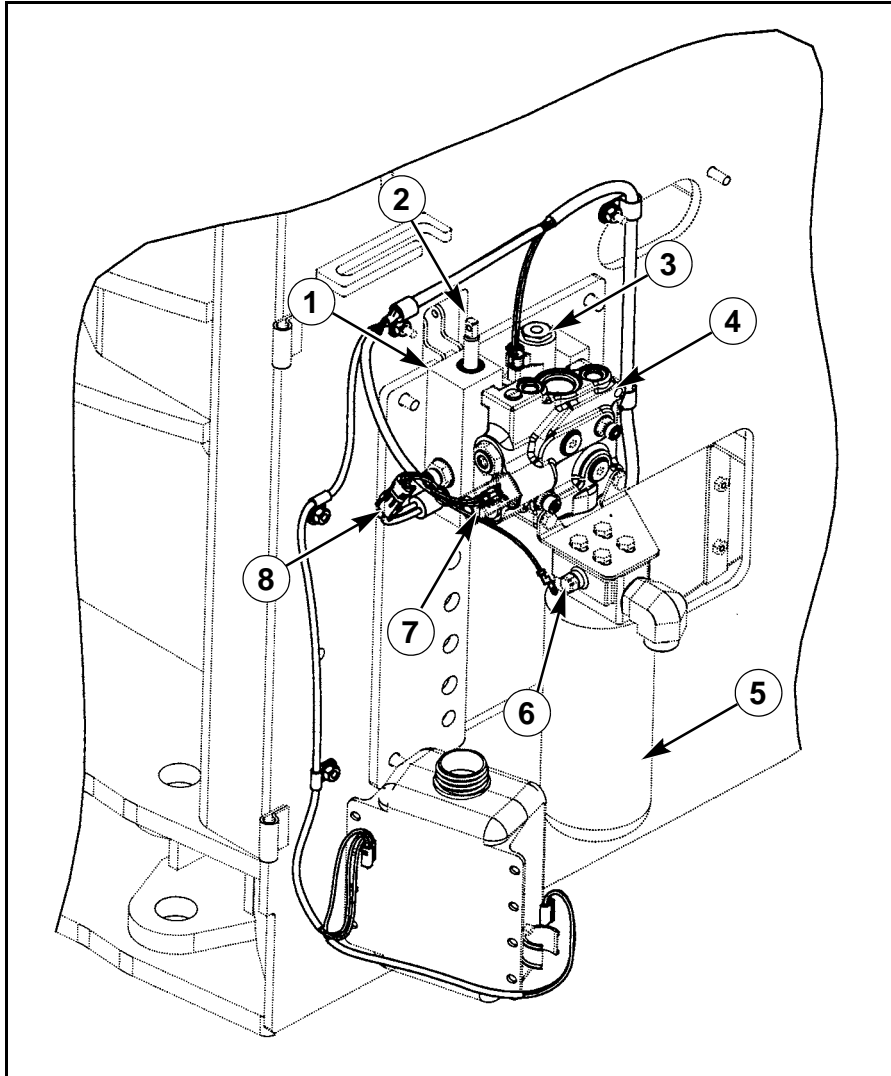
During extreme temperature conditions (cold start) lube pressure might exceed desired values. To prevent this condition, the lube control circuit is equipped with an axle lube solenoid valve. This solenoid is located on the pressure/lube control valve housing and operated by an axle lube temperature switch located at the axle lube filter housing. During cold temperature operation the axle lube temperature switch activates the axle lube solenoid valve. When the solenoid valve is activated it directs regulated pressure to the non-spring end of the lube control spool. As the regulated pressure moves the lube control spool axle lube is diverted to the PFC pump charge circuit for the duration of the cold oil condition.



RH00H030

## Park Brake/Tow Valve

The Park Brake/Tow Valve is located on the right hand side of the tractor below the cab and will control the engagement and release of the parking brake. The Park Brake/Tow Valve also provides a means to release the parking brake if towing is required. The parking brake function is operated by an electric switch (located at the transmission control lever) and solenoid. The tow valve is operated with a manual pumping lever. When the solenoid is de-energized, the brake will be applied with a single Belleville spring. The valve incorporates a 65 PSI by-pass valve and a 1.5 mm orifice to help modulate (control) the brake engagement.



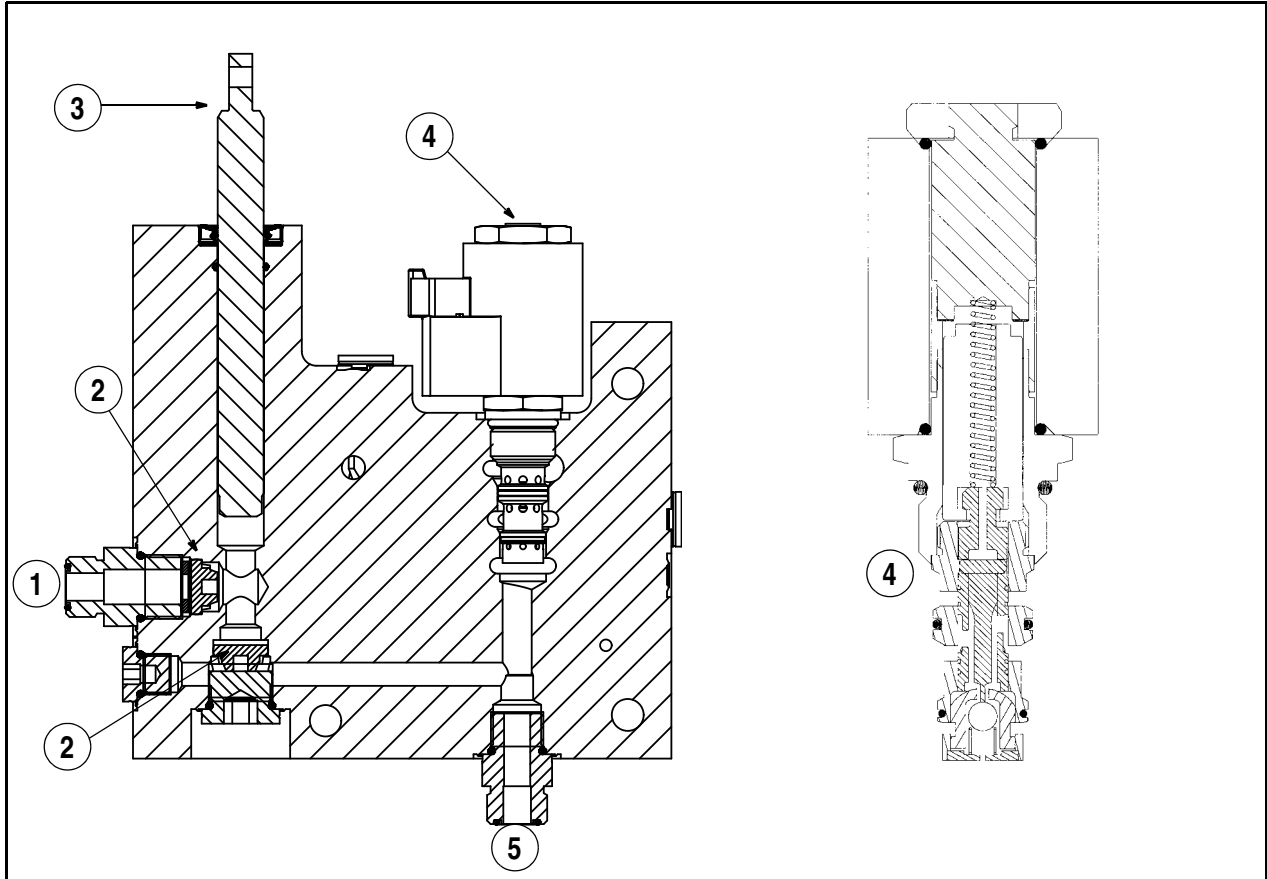
RI00F077

### Park Brake and Tow Valve - Right Service Door

- |   |                                 |
|---|---------------------------------|
| 1. PARK BRAKE/TOW VALVE MANIFOLD              | 5. AXLE COOLING FILTER          |
| 2. TOW VALVE PUMP (Operated from inside cab.) | 6. AXLE LUBE TEMPERATURE SWITCH |
| 3. PARK BRAKE SOLENOID VALVE                  | 7. AXLE LUBE SOLENOID VALVE     |
| 4. PRESSURE/LUBE CONTROL VALVE                | 8. PARK BRAKE PRESSURE SWITCH   |

## Park Brake Applied

The park brake valve is a closed center, solenoid operated valve. The park brake valve receives regulated supply pressure at the valve inlet port. When the park brake switch is in the "On" position (transmission control lever in Park) the valve is closed, The brake piston port is bled to the reservoir through the valve and the park brake is applied by a Belleville spring in the brake housing. The brake engagement is modulated by a 65 PSI orifice check valve in the return line of the parking brake valve. When the park brake is applied, the regulated pressure will open the orifice check valve until the pressure has dropped below 65 PSI. The orifice/check will close and the remaining oil bleeds through the orifice, providing a smooth engagement of the park brake.



RI00F04

### Park Brake Valve

- |                 |                        |
|-----------------|------------------------|
| 1. TO RESERVOIR | 3. TOW VALVE PUMP      |
| 2. CHECK VALVE  | 4. PARK BRAKE SOLENOID |
|                 | 5. PARK BRAKE SUPPLY   |

### Park Brake Released

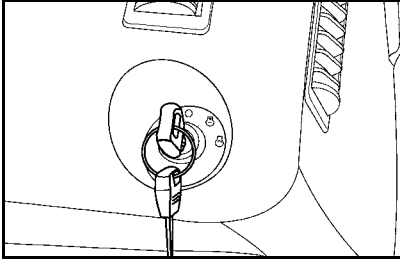
When the park brake switch is in the "Off" position (transmission control lever in the Forward, Neutral, or Reverse), the solenoid is energized and the valve cartridge is opened. The solenoid pulls the spool up, permitting regulated pressure oil, to flow through the valve and to the park brake piston in each axle, releasing the brake. At the same time the spool will close off the reservoir, from the park brake piston.

## Tow Valve

The tow valve is mounted on the right hand side of the tractor below the cab. The tow valve provides a manual means of releasing the park brake when there is no hydraulic power available. The tow valve is part of the parking brake valve body.

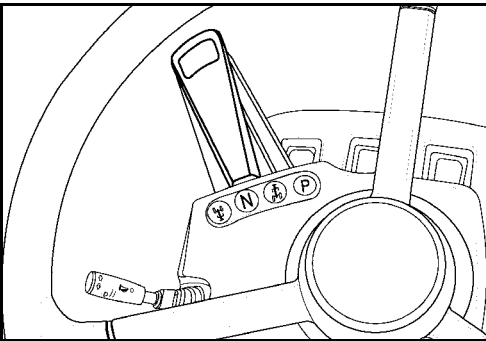
### Tow Valve Use

1. Place the key switch in the Run position.



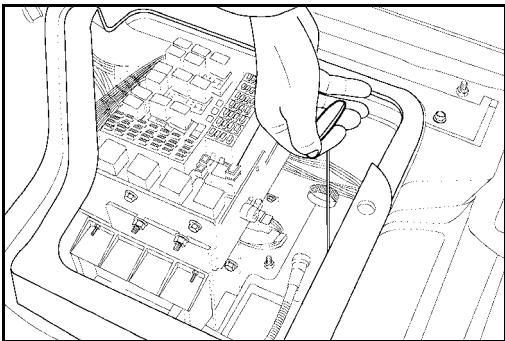
MK99M023

2. Both differential locks must be placed in the "OFF" position (if equipped).
3. Place the transmission control lever in the Neutral position.



RR01H017

4. Using the hand operated pump handle located in the right rear corner of the cab, pressurize the brake system with hydraulic oil by pumping the hand operated pump handle up and down 25 times.



MK99H163

5. To engage the parking brakes, turn the key switch "OFF" or place the transmission control lever in Park.

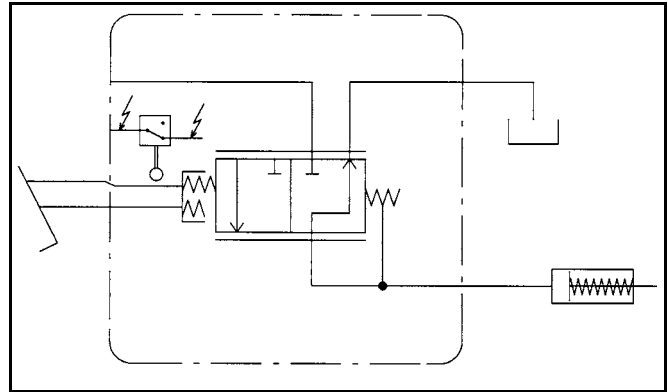
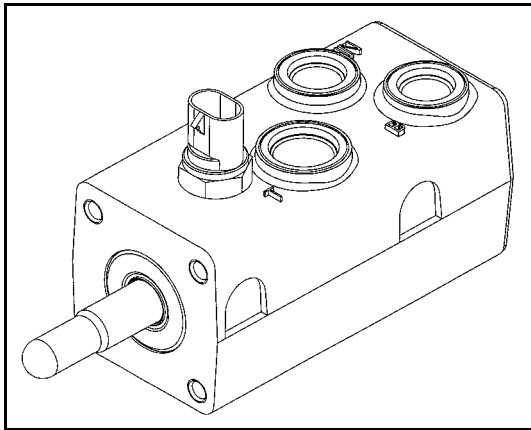
## BRAKE CIRCUIT COMPONENTS

### Brake Pedal

The brake pedal operates the brake valve control spool. The spool compresses a modulation spring actuating the brake valve modulation spool. The spool also operates a bottom of brake switch. The bottom of brake switch actuates the parking brake in the event the power braking system fails to operate.

## Brake Control Valve

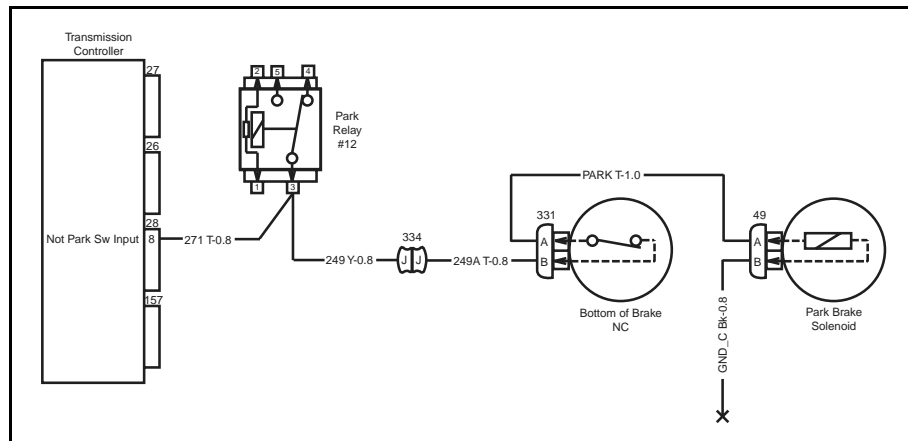
The brake valve is mounted below the right front cab floor plate. It directs regulated supply circuit oil (270-290 PSI) to/from the axle brake cylinders for braking purposes. This valve also operates the bottom of brake switch.



RI00F046

## Bottom of Brake Switch

The normally closed (NC) bottom of brake switch is mounted in the brake valve assembly below the cab. As the brake pedal is pushed, the brake valve spool operates a NC bottom of brake switch. During emergency braking, the bottom of brake switch opens due to spool travel, interrupting the electrical supply to the park brake solenoid. When the electrical supply to the parking brake solenoid is interrupted, the parking brake is spring applied to stop the vehicle.



RH00H031

## Brake Clutch Pack

The brake clutch assembly is mounted on the differential carrier, providing the braking action for both sides of the axle assembly. There is only one brake clutch pack per axle, and the brake may be hydraulically applied by the brake valve or spring applied by the parking brake valve circuit.

## Axle Brake Cylinders

The axle brake cylinders are located in each axle housing. The axle brake cylinders force the brake friction discs and separator plates together. The brake friction discs are splined to the differential carrier, providing the braking action for both sides of the axle assembly. The separator plates are pinned to the axle housing. The friction discs and the separator plates work together to slow or stop the differential assembly and also the axle.

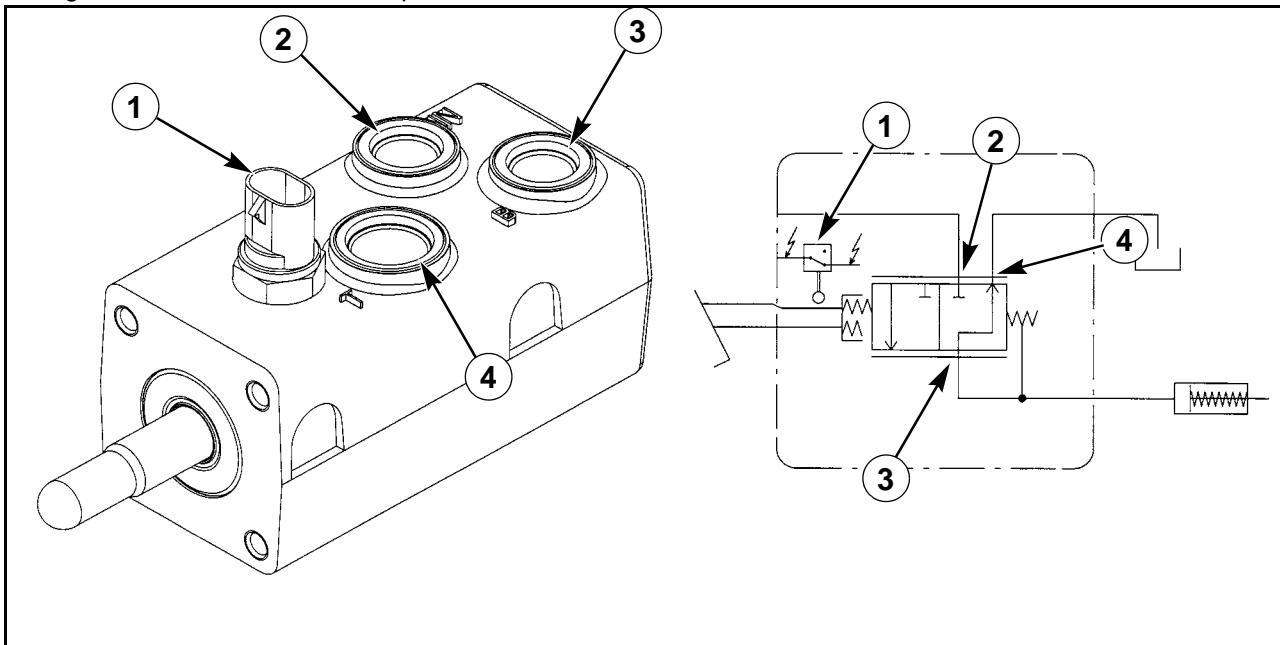
# HYDRAULIC BRAKE CONTROL

## General Description

The brake system consists of a single foot operated pedal, a brake valve assembly, a bottom of brake switch, a park brake valve, a 24 GPM axle hydraulic pump, a hydraulic filter, a regulator control valve, two differential carriers, two brake wheel cylinders, splined friction discs, steel separator plates, and brake adjuster pins.

## Brake Valve

The brake valve will provide the operator the ability to apply the service brakes on both axes. The valve provides modulation and lock-up pressure for the brakes. This pressure is supplied from the pressure/lube control valve regulated circuit at 270-290 PSI. The brakes are applied with hydraulic pressure and released with the brake adjuster pins. The valve incorporates a bottom of brake switch that will apply the parking brake if the service brake pedal goes to the end of the valve spool travel.

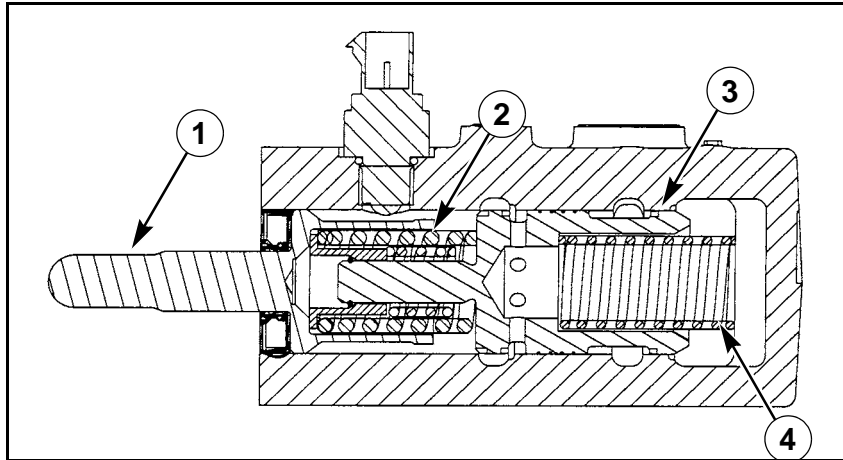


RI00F046

### Brake Valve

- |                           |                         |
|---------------------------|-------------------------|
| 1. BOTTOM OF BRAKE SWITCH | 3. BRAKE ACTUATION PORT |
| 2. INLET PORT             | 4. TANK PORT            |

When the brake pedal is pressed, a valve spool is pushed into the valve housing. The valve spool has a flange, which in turn compresses a modulator spring located below the valve spool. As the modulator spring is compressed, force to the brake valve modulator piston is increased. The brake valve modulator piston moves into the valve bore against a return spring.



R100F047

### Brake Valve

### Service Brake Circuit

- |                     |                     |
|---------------------|---------------------|
| 1. VALVE SPOOL      | 3. MODULATOR PISTON |
| 2. MODULATOR SPRING | 4. RETURN SPRING    |

From the Pressure/Lube Control Valve, hydraulic fluid at regulated pressure (approximately 270-290 PSI) is supplied to the brake valve mounted below the right front cab floor plate. The hydraulic brakes are controlled by this closed center spool valve. The brake valve spool supplies pressurized fluid to both axle brake cylinders.

When the brake pedal is released, the pressurized supply is stopped at the inlet port and fluid from the brake pistons is directed back to the brake valve by the brake adjuster pins. This action purges air into the return passage of the valve. As the brakes are operated, the air is purged to the hydraulic reservoir.

Brake apply volume is controlled by modulator piston travel within the brake valve. There is no mechanical connection between the brake pedal and the modulator piston. As the operator pushes the pedal a spring is compressed forcing the modulator piston into the valve body.

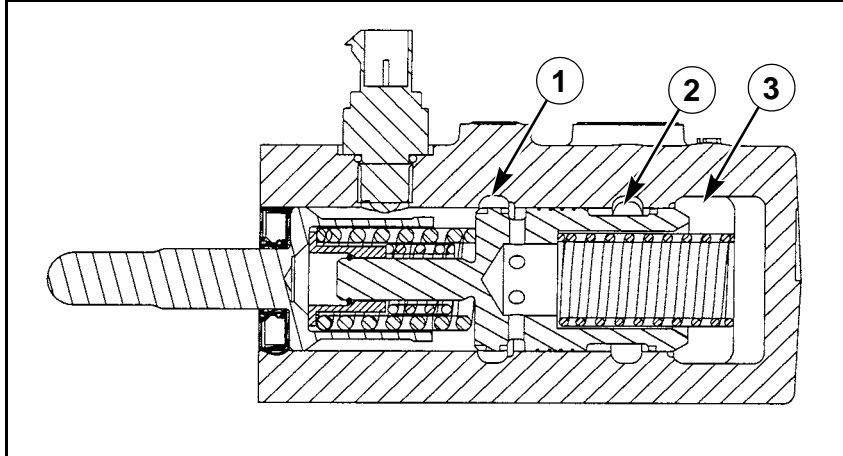
If the brakes are not applied, brake adjuster pins at each wheel deactivate the brakes and the valve drains the return oil back to the hydraulic reservoir.

### Brake Valve Operation - Brake Apply

Braking and brake actuation pressure is controlled by the modulator piston. When the brake pedal is actuated, the brake valve spool begins to move into the valve body. The only connection between the valve spool and the modulator piston is the modulator spring. As the spool to moves inward, the modulator spring forces the modulator piston inward. As the modulator piston begins to move, it blocks the brake actuation port to tank port connection. It also begins to open the inlet supply port to the brake actuation port. As the modulator piston moves inward, the metered oil supply to the brake axle cylinder is increased slowing the tractor movement. This brake actuation pressure also acts on the inboard end of the modulator piston, attempting to turn the supply oil off. This is used to help provide a smooth braking action.

Increased force from the operator on the brake valve spool causes the modulator piston to move inward further, increasing the brake actuation pressure. Due to the spring connection between the brake valve spool and the modulator piston, the brake apply pressure and there for the braking action increases gradually.

**NOTE:** During power braking, it is only necessary to push the pedal enough to port the pressurized oil supply to the axle cylinder. Pedal force is not required to pressurize the oil within the valve. The regulated supply pressure is sufficient to stop the wheels from turning



R100F047

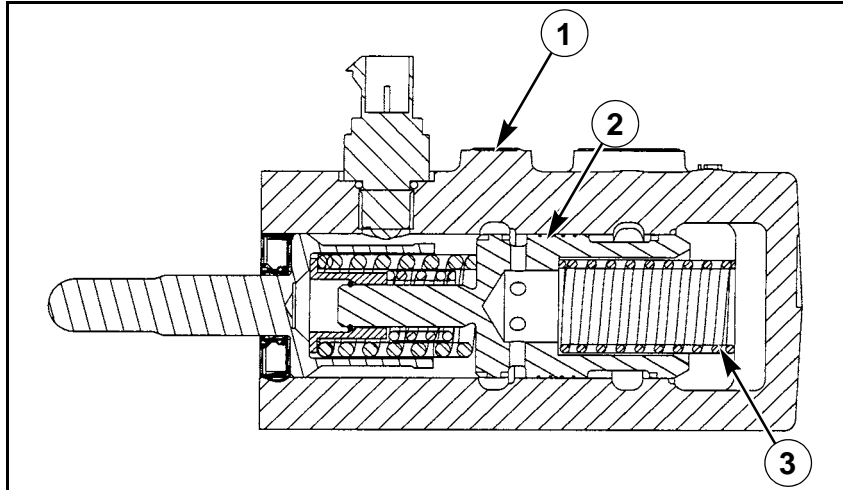
### Brake Valve

- 1. TANK PORT
- 2. VALVE INLET
- 3. BRAKE ACTUATION PORT



**Brake Valve Operation - Brakes Released**

As the brake pedal is released, the modulator piston return spring pushes the modulator spool outward to the released position. This in turn, pushes the brake control spool outward. Regulated circuit pressure at 270-290 PSI is supplied to the inlet. The modulator spool blocks this oil supply to the brake port. With the modulator piston in the release position, brake port oil is connected to the tank port through the inside of the modulator spool and cross-drilled holes. This connection ports the brake piston to tank and allows the brakes to release.



R100F047

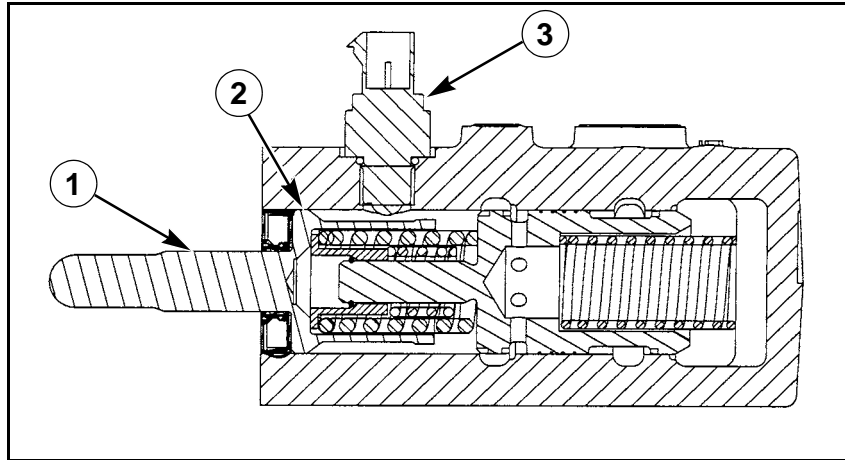
**Brake Valve**

- 1. TANK PORT
- 2. MODULATION SPOOL
- 3. PISTON RETURN SPRING

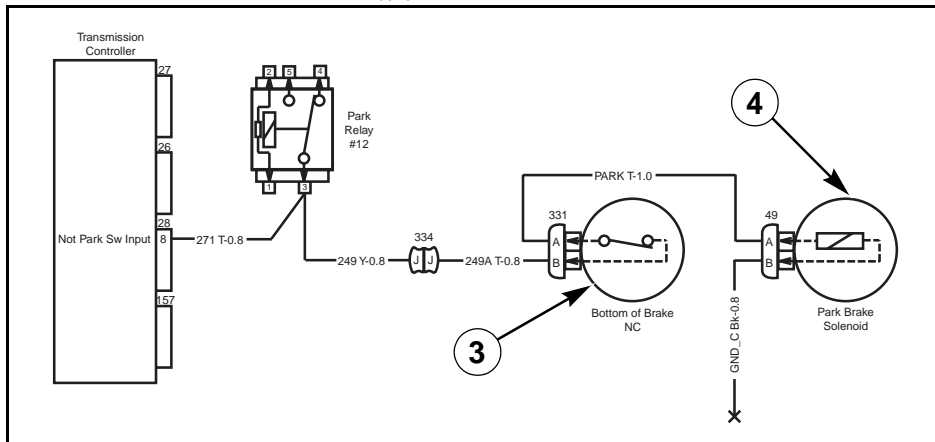
## Emergency Braking

When the engine is not running, regulated supply pressure is not available for power braking. As the brake pedal is pushed by the operator (to the end of travel), the brake valve spool operates a bottom of brake switch. During emergency braking, the normally closed (NC) bottom of brake switch opens, stopping the electrical supply to the park brake solenoid valve. As the parking brake solenoid loses power, the parking brake circuit is spring applied and the tractor stops.

**NOTE:** The pedal must be pushed to the full travel position to activate the emergency braking action of the parking brakes.



R100F047



RH00H031

### Brake Emergency Braking

- |                                     |                           |
|-------------------------------------|---------------------------|
| 1. BRAKE VALVE SPOOL                | 3. BOTTOM OF BRAKE SWITCH |
| 2. ACTUATOR, BOTTOM OF BRAKE SWITCH | 4. PARK BRAKE SOLENOID    |

## BRAKE SYSTEM TROUBLESHOOTING

### Service Brake Will Not Engage

- I. Check the function of other regulated circuits supplied from the axle pump (Parking Brake Release, Differential Lock, Remote Pilot Circuit, Hitch Pilot Circuit).
  - A. If other circuits supplied from axle hydraulic pump do not operate, check regulated pressure per Hydraulic How it Works section in this manual.
- II. Brake pedal linkage is binding.
  - A. Check linkage connection points for interference.
- III. Brake circuit leaking internally.
  - A. Cap brake valve outlet port. Start engine, step on brake pedal.
    - i. If pedal is solid, leak is in axle circuit. Pressure test axle circuits.
    - ii. If pedal is soft.
      - a. Leak is in brake valve. Repair brake valve.
      - b. Leak is in brake valve and axle circuit. Repair brake valve and axle circuit.

### Service Brake Will Not Disengage

- I. Check the function of other regulated circuits supplied from the axle pump (Parking Brake Release, Differential Lock, Remote Pilot Circuit, Hitch Pilot Circuit).
  - A. If other circuits supplied from axle hydraulic pump do not operate, refer to Hydraulic Systems - How It Works and Troubleshooting in this manual and check regulated pressure.
- II. Brake pedal linkage is binding.
  - A. Check linkage connection points for interference.
- III. Brake valve modulation piston is sticking.
  - A. Disassemble brake valve. Clean modulation piston and reassemble.
- IV. Brake adjusting pins not releasing brake piston.
  - A. Disassemble brake assembly. Repair brake mechanism.

### Parking Brake Will Not Engage

- I. Check the function of other regulated circuits supplied from the axle pump (Service Brake, Differential Lock, Remote Pilot Circuit, Hitch Pilot Circuit).
  - A. If other circuits supplied from axle hydraulic pump do not operate, refer to Hydraulic Systems - How It Works and Troubleshooting in this manual and check regulated pressure.

II. Parking brake solenoid valve is stuck in disengaged position.

A. Check parking brake solenoid cartridge for proper operation. Replace cartridge if necessary.

III. Parking brake piston stuck internally.

A. Repair parking brake piston.

**Parking Brake Will Not Disengage**

I. Check the function of other regulated circuits supplied from the axle pump (Parking Brake Release, Differential Lock, Remote Pilot Circuit, Hitch Pilot Circuit).

A. If other circuits supplied from axle hydraulic pump do not operate, refer to Hydraulic Systems - How It Works and Troubleshooting in this manual and check regulated pressure.

II. Parking brake solenoid valve is stuck in engaged position.

A. Check parking brake solenoid cartridge for proper operation. Replace cartridge if necessary.

III. Parking brake solenoid valve is leaking.

A. Check parking brake solenoid cartridge for failed o-rings. Replace/repair as necessary.

IV. Parking brake solenoid failed open.

A. Check parking brake solenoid resistance. Replace if necessary.

V. Bottom of brake switch failed open.

A. Check function of bottom of brake switch (NC). Replace if necessary.

VI. Parking brake piston stuck internally.

A. Repair parking brake piston.

**Thanks very much for your reading,  
Want to get more information,  
Please click here, Then get the complete  
manual**

**JustClickHere** 

**NOTE:**

**If there is no response to click on the link above,  
please download the PDF document first, and then  
click on it.**

**Have any questions please write to me:  
[admin@servicemanualperfect.com](mailto:admin@servicemanualperfect.com)**