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INFORMATION AND TROUBLESHOOTING GUIDE

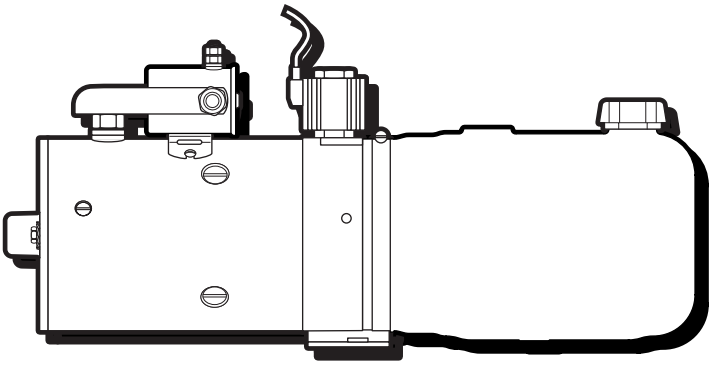
FOR

MONARCH

D.C. POWER UNITS

ON

SNO-WAY PLOWS



Snow Plows

Maintenance and Troubleshooting Guide for Monarch D.C. Hydraulic Power Units

SNO-WAY Snow Plows

WARNING

- Always wear eye protection and protective clothing when working around hydraulic systems.
- Remove jewelry and objects that might conduct electricity while working on power units.
- Fluid under pressure can pierce the skin and enter the bloodstream causing death or serious injury.
- Devices being operated by the hydraulic system should be securely propped or immobilized so they cannot move and cause injury while being inspected or repaired.
- Fluids should be contained and disposed of properly.

NOTE: Do not use Teflon tape on hydraulic fittings as it can easily jam valves and plug the filters in the system.

TEST EQUIPMENT

The following is a list of the test equipment required to troubleshoot D.C. powered hydraulic systems.

1. PRESSURE GAUGE

A small 0-5000 Pressure gauge, preferably glycerin filled, is a very valuable and relatively inexpensive tool for checking pressure in the various sections of the circuit.

2. D.C. TEST LIGHT

A test light is simply a light bulb which has one end connected by a wire to an alligator clip and the other end connected to a metal probe. It is used to check the electrical circuit when the battery is connected to the system. The alligator clip is grounded and the light glows when the probe comes in contact with a “HOT” electrical component. They are easily obtained from automotive jobbers or discount stores.

3. CONTINUITY LIGHT

A continuity light is like a test light but contains its own battery power source. It is used for testing electrical circuits when the components are not connected to a battery. They are easily obtained from discount stores or electrical jobbers at modest cost.

4. VOLT METER

A D.C. volt meter, as used in the automotive repair business, is a good investment for troubleshooting problems that are related to low voltage. They are used in two ways: first, one probe is grounded while the other is used to probe the “HOT” leads, the meter shows the voltage available at the point where the second probe is connected; second, they can be used to measure a voltage drop in a wire, one probe is connected to one end and the remaining to the other end, the reading is the voltage drop.

5. OHM METER

An ohm meter is used to measure resistance and is a very useful tool when working on wire circuits and solenoid coils. On some coils the wire resistance is up to a level where a D.C. test light might show an open circuit and it really is not so. An infinite meter reading on any test shows that the circuit is open. A coil test, however, will always show some value of resistance but it must not be infinite. All tests conducted with an ohm meter must be done with the battery disconnected from the system.

6. ASSORTED HOSES, HIGH PRESSURE FITTINGS

These can be used to connect and/or isolate certain parts of a hydraulic circuit to a pressure gauge or a shutoff valve for diagnosing hydraulic problems. Use gauge ports with diagnostic kit 96101978 or 96102736.

7. HIGH PRESSURE SHUTOFF VALVE

The shutoff valve can be used to choke off oil flow so that a “false” load can be put on the pump and other components. With the valve installed it can be slowly shut off while the equipment listed above records the data for making a proper diagnosis.

HYDRAULIC FLUID

1. THE PURPOSE OF OIL

The main purpose of hydraulic fluid is to transfer power from the pump to the actuators but it must also perform many other tasks which are critical to a well designed system. First, the oil must have good lubricity or be “slippery” so that the friction will be as low as possible to keep metal to metal wearing at a minimum. Second, the viscosity or “thickness” must be in the proper range at the operating temperature so that unwanted leakage will be at a minimum, but will still allow the oil to lubricate the close fitting parts in the system. Third, the oil must be compatible with the seals used in the system. Fourth, there should also be additives in the oil to slow down the effects of rust, oxidation (oxygen in the air combining with the oil to form sludge) foaming, and water settling to the bottom of the reservoir. Fifth, the oil must be able to pour or flow at the lowest expected temperature so that the oil can reach or get into the pump.

Sixth, the oil should contain EP (extreme pressure) additives to prevent breaking down the fluid.

For all the reasons just listed, Sno-Way oil 96005029 is the best fluid for use in snow plows.

RESERVOIRS

1. USE RECOMMENDED FLUID

Fill reservoir with the approved fluid and refer to the Hydraulic Fluid Section.

2. CORRECT FILLING AND OPERATING PROCEDURE

A. Operate unit several times starting with short cylinder strokes and increasing length with each successive stroke.

B. Recheck oil level often and add as necessary to keep pump from picking up air.

C. After system is completely "bled" check oil level in reservoir as described in owner's manual and install the filler/breather plug provided.

NOTE: Do not use a solid plug or a fill cap without a filler/breather element or damage will be caused to pump and/or reservoir.

3. PROBLEMS ASSOCIATED WITH THE RESERVOIR

A. Clear oil flowing out of the fill hole might indicate that the cylinder(s) rod was not in it's retracted position when the reservoir was filled.

B. Foamy oil flowing out of the fill hole points to the following:

1. Air is present in the system; that is, cylinders and fluid lines. The response usually is "spongy" and the cylinder moves with "jerking" motion.
2. There is no drop tube or "down spout" on the return line so that the oil is not returning to the bottom of the reservoir.
3. Check for a loose suction tube.

C. Water in the oil.

Water can enter the reservoir through the fill hole if the unit is left outdoors or washed with high pressure washers. Protect the unit, whenever possible, and change oil regularly to minimize problems. In cold weather the water will freeze and the pump will not work until the ice melts.

FILTERS

1. SUCTION FILTERS

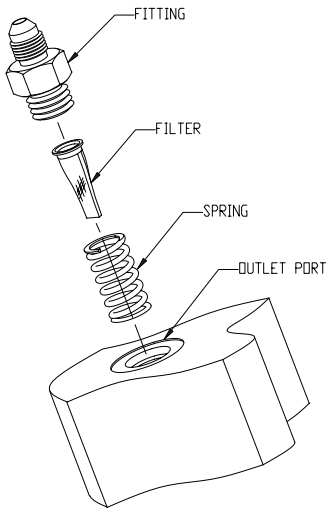
The hydraulic controls have suction filters which must be cleaned periodically or whenever flow is slow or sluggish. Some filters can be washed in cleaning solvent and blown dry with compressed air; those which cannot be cleaned properly should be replaced.

2. ADDITIONAL SYSTEM FILTERS

A. PORT FILTERS

All of the cylinder ports in the manifold have filters in them to help keep dirt from entering the valve package from the hoses and cylinders. They are located just below the "port" fitting. They can be reached as follows:

1. Remove the hose from the fitting on the valve manifold.
2. Remove the fitting from manifold.
3. A spring below the filter should push the filter up the port as the fitting is being removed.
4. Finish removing the screen by hooking the filter and pulling it out of the port.
5. Pull the spring out of the port.
6. Clean and/or replace the screen and blow off the spring.
7. Reinstall in reverse order. (See Fig. 1)



PORT FILTER

FIG. 1

B. Most cartridge solenoid valves and some check valves also have “body” filters located on the cartridge of the valve. Some can be replaced, others can only be cleaned.

NOTE: Do not use Teflon tape on hydraulic fittings as it can easily jam valves and plug the filters in the system.

ELECTRICAL PROBLEMS

1. LOW VOLTAGE

Operating direct current (D.C.) power units efficiently requires proper voltage. Any attempt to operate below the minimum required voltage could cause system failure.

A. Signals which point to low voltages are:
   1. The minimum voltage between the motor stud and ground is 9.0 volts at maximum load conditions.
   2. The minimum voltage between the valve solenoid power wire (“hot wire”) and ground is 9-1/2 volts at maximum load conditions.

B. Causes for low voltage are:
   1. Battery capacity too small.
   2. Cable ends not electrically secure to battery cable.
   3. Ground cable size not equivalent or larger than the battery “hotside” cable.
   4. Bad joints where cable ends are bolted to battery, motor solenoid, start switch, ground and etc.
   5. Burnt contacts on motor start solenoid switch.

! PLEASE REMOVE ALL RINGS, WATCHES AND JEWELRY PRIOR TO DOING ANY ELECTRICAL

C. Check for low voltage as follows: (A volt meter will be required).
   1. On vehicles equipped with an alternator the voltage should be approximately 13.5 volts with no electrical accessories operating and the engine running - Check it.
   2. Operate pump unit under maximum conditions; this would be either under full load or when pump is running over relief (cylinder dead headed). Use the volt meter to probe each connection, cable end, and cable from the battery all the way back to the motor stud and note the voltage losses. Make the necessary repairs to increase the voltage above the minimum required.

NOTE: Check the ground side as well. Paint, rust, and dirt are insulators - remove them.

2. D.C. MOTORS (Wound Field)

Motors should be serviced periodically to insure proper performance.
Service as follows:

A. Remove head assembly from motor.

B. Check sleeve bearing in head assembly for wear.

C. Place a few drops of oil on felt liner in head assembly.

D. Check brush set for wear and replace if necessary.

E. Blow dirt and dust out of motor housing and check for shorts, burnt wires, or open circuits in the field coil assembly.

F. Check armature and commutator for shorts or open circuits.

G. Check ball bearing on motor shaft, a growling motor can be caused by bad bearings.

NOTE: A motor that does not turn in freezing weather could be caused by water that has frozen inside the housing. (Check Motor Drain)

H. All D.C. motors turn counterclockwise when viewed from the drive end - check it when replacing a motor with a new one.

I. If motor fails to turn the pump, check the pump by turning the drive shaft by hand - it may be “setup” and the pump needs replacing. Shaft rotates clockwise.

NOTE: Always grease motor - pump tang when reassembling.

3. D.C. MOTORS (Permanent Magnet)

Permanent magnet motors are similiar to wound field motors except the field coils are replaced with permanent magnets. If the brush holder is mounted to the head assembly, it must be aligned with timing marks to the motor shell. If you cannot find the marks, make your own before you loosen the bolts. Repair similar to wound field motor above with exception of the field coils.

NOTE: Permanent magnet motors must be handled with care. Timing marks must be properly aligned for maximum performance and efficiency. PM motors have powerful magnets which will attract ferous materials. Magnets must be kept clean before inserting the armature . Keep fingers away from the area between the armature and the motor case when re-installing the armature in order to avoid injury.

NOTE: Regrease motor - pump tang when motor is reassembled to pump.

THE MAGNETS WILL PULL THE ARMATURE INTO THE MOTOR UPON REINSERTION.

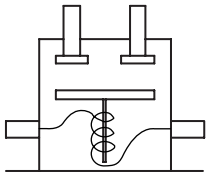
4. ELECTRICAL SWITCHES

(See Sno-Way Control Owners Manual)

A. Motor Start Solenoid Switches.

1. 4 Post Solenoid Switch (Fig 2.) (Isolated Ground)

FIG. 2



Isolated Ground

a. The four post solenoid switch is wired and constructed as follows:

(1.) One large switch post is connected to the battery cable (either one).

(2.) The remaining large post is connected to the motor cable.

(3.) The 2 small posts are connected to the coil, one post to each end.

(4.) With access to both ends of the coil, the specific wiring arrangements can be varied, but to energize the coil one lead has to be positive and the other end negative.

b. Testing for a faulty solenoid switch: When testing use an OHM meter, conti nuity light, or test light, and check all functions as described above. (See Test Equipment Section).

5. SHORTS, "GROUNDING FAULTS" AND "OPEN" CIRCUITS

In control wiring, shorts can only occur when "hot" lines (lines connected directly to the battery) come in contact with ground. A short will either cause a fuse to blow, if there is one, or burn the wire off at its weakest point. Likely spots for shorts are switches, electrical strain relief, electrical junction boxes, and control cord(s) that have been pinched or cut.

6. SOLENOID COILS

Coils are used in solenoid operated valves and solenoid start switches. Failures can be caused by vibration, water, improper voltage, or corrosion. The best way to test a coil is with an OHM meter. The meter should read some value of OHMS and an infinite reading means that the coil has an open circuit. The reading between any lead on the coil and the "can" should be infinite.

RELIEF VALVES

1. THE PURPOSE OF A RELIEF VALVE IS TO:

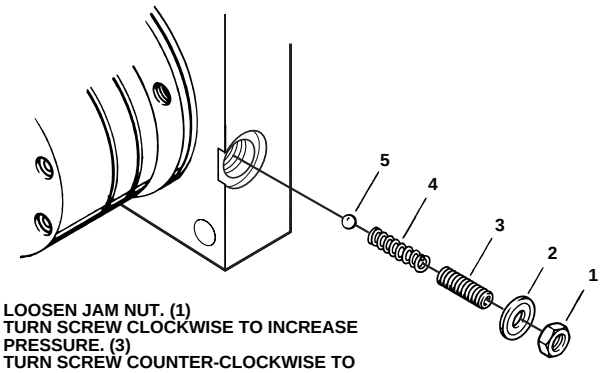
A. Keep the maximum system pressure at a safe level.

B. Keep the amp draw and battery drain at a minimum when the cylinder "dead heads" (reaches full stroke).

2. THE TWO STYLES OF RELIEF VALVES USED ARE:

A. Loose Component Style

1. Internal Cavity with Loose Components.(See Fig. 3).

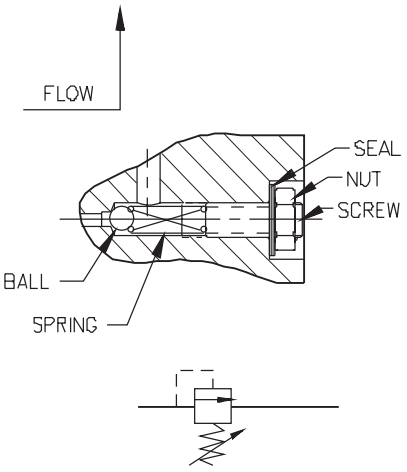


1. LOOSEN JAM NUT. (1)
2. TURN SCREW CLOCKWISE TO INCREASE PRESSURE. (3)
3. TURN SCREW COUNTER-CLOCKWISE TO DECREASE PRESSURE. (3)

NOTE:

OUTLET PORT FLOW MUST BE BLOCKED TO MAKE RELIEF VALVE OPERATE WHILE ADJUSTING.

4. TIGHTEN JAM NUT. (1)



RELIEF (STD.)

FIG. 3

An “internal” cavity is drilled into the pump base into which the following parts are inserted to make up the relief valve assembly.

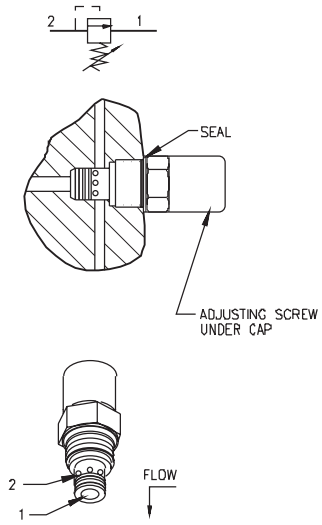
a. Ball or cone, heavy spring, and in some cases a jam nut and seal washer.

B. Cartridge Style. (See Fig. 4)

A complete cartridge is assembled into an intregal cavity.

3. DIAGNOSING AND REPAIRING RELIEF VALVES

NOTE: When testing or making adjustments on the relief valve the system must be “dead headed” (cylinder at full stroke or in a position where cylinder movement is zero).



CARTRIDGE RELIEF VALVE

FIG. 4

A. Relief Valve Pressure Too High
   1. Symptoms:
      a. Amp draw and battery drain excessive when system is “dead headed”.
      b. Motor RPM is slow in comparison to full load system operation.
   2. Repair Procedure:
      a. Turn relief valve adjusting screw counterclockwise using a gauge, in port GP, to record the proper pressure setting. (See Fig. 3). In style shown in Fig. 3 loosen jam nut.

B. Relief Valve Pressure Too Low

1. Symptoms:
   a. Motor RPM is faster than normal.
   b. Cylinder will not extend.
   c. Excessive turbulence in the reservoir.

Note: On applications where the cylinder is being replaced or the mechanical mechanism is being modified, make sure the pressure capability of the pump is not being exceeded.

2. Repair Procedure.
   a. There are 2 possible causes for lack of pressure.
      (1) The adjusting screw has backed up.
      (2) Foreign matter or "dirt" is trapped between the seat and the ball or cone.

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- Fluids should be contained and disposed of properly.

   b. Repair as follows:
      (1) Using a gauge, in port GP, loosen the jam nut and turn the adjusting screw clockwise a turn or two and watch the gauge; if it goes up, continue to turn the screw until the required setting is reached. Retighten the jam nut.
      (2) If the pressure does not increase when the adjusting screw is tightened, turn the adjusting screw counterclockwise; to remove all pressure from relief spring (See Fig 3); energize the pump to "flush" the dirt past the seat. ***Caution: Make sure adjusting screw remains seated in pump body when pump is energized.*** Inspect the cone or ball for nicks and replace it if necessary; reseat the ball or cone using a small drift punch and hammer with a light tap; reinstall the spring and adjusting screw and reset the pressure.
      (3) If you are replacing a cartridge relief valve it cannot be readily disassembled. Push a blunt object into the nose area to push the poppet after you have the screw backed off as far out as possible. Blow compressed air thru ports to try and get dirt to "exit" the way it "entered". Pick it out if possible. If you cannot dislodge the contamination you will need to replace the cartridge.

Note: In an emergency if, a pressure gauge is not available, turn the relief valve screw in until the cylinder moves under worst conditions and then tighten 1/2 to 3/4 additional turns.

      (4) If the above mentioned procedure fails to increase the relief valve setting, check for a worn pump.

Note: Do not use teflon tape on hydraulic fittings as it can easily jam valves and plug the filters in the system.

CHECK VALVES

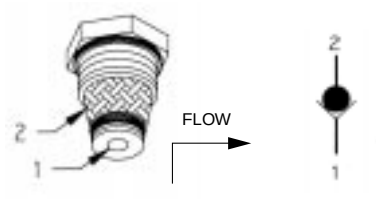
1. PURPOSE OF A CHECK VALVE

To allow free flow in one direction but block reverse flow.

2. TYPE OF CHECK VALVE USED

A. Cartridge Type

A Cartridge Type Check Valve is made up of a ball or poppet in a completely contained cartridge. (See Fig 5).



CARTRIDGE CHECK VALVE

FIG. 5

3. TROUBLESHOOTING AND REPAIRING CHECK VALVE FAILURES

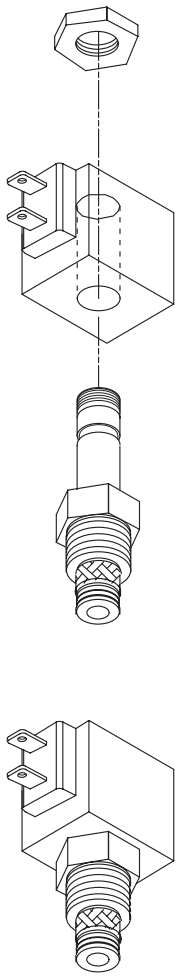
A. Load Drift Failure
   1. Symptom
      In most cases a check valve will fail such that the load will drift down when the unit is in the "hold" position.
   2. Repair Procedure (Cartridge)
      a. Remove cartridge and clean or replace (See Specialty Valve Section A)

DIRECTIONAL CONTROL AND SPECIALTY VALVES

1. 2-WAY/2-POSITION NORMALLY CLOSED VALVES

These valves allow for free flow in one direction (from the bottom port to the side ports) at all times and checked flow in the opposite direction until the solenoid coil is energized. (See Fig. 6)Troubleshoot and repair as follows:

A. If the valve does not shift, check for and repair the following:
   1. The valve "hot" wire. Check continuity. (See section on open circuits).
   2. The valve ground wire. Check continuity. (See section on open circuits).
   3. The switch controlling the valve. (See plow control owners manual).
   4. Low Voltage. (See section on low voltage).
   5. The solenoid coil. (See section on solenoid coil).
   6. Dirt in the valve cartridge. This can be done by energizing the valve without starting the motor and listening for the valve to shift (a definite "Click" is heard when the valve in energized. If the valve does not shift, remove the cartridge from the valve body. Blow compressed air through the cartridge in both directions while holding the plunger off its seat (use a blunt object inserted through bottom of cartridge). It will help to have the "body" filter removed.
   7. A bent valve stem. Replace valve.



2 WAY/2 POSITION VALVE & COIL

FIG. 6

NOTE: The cartridge itself cannot be disassembled in the field as the proper tolerances cannot be duplicated. If the dirt cannot be removed the cartridge will have to be replaced.

B. If the valve does not return to the neutral or

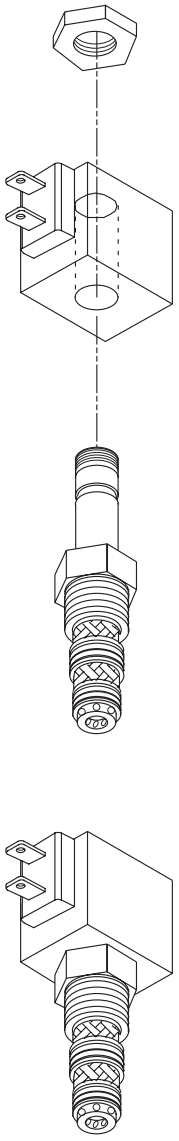
unshifted position, check for dirt in the valve cartridge or a bent stem.

2. 3-WAY/2-POSITION VALVES

Troubleshoot and Repair As Follows: (See Fig. 7)

A. If the valve does not shift, check for and repair the following:
   1. The valve "hot" wire. (See section on Open Circuits).
   2. The valve ground wire. (See section on Open Circuits.
   3. The switch controlling the valves. (See section on Electrical Switches).
   4. Low Voltage. (See section on Low Voltage).
   5. The Solenoid Coil. (See section on Solenoid Coils).
   6. Dirt in the valve cartridge. This can be done by energizing the valve without starting the motor and listening for the "valve shift". If it cannot be heard, remove the cartridge from the valve body and blow compressed air through all parts to dislodge dirt. Clean all parts in solvent, blow dry, and lubricate.

B. If the valve does not return to the neutral or unshifted position, check for dirt in the valve cartridge and repair in the same manner as above.



3 WAY/2 POSITION VALVE & COIL

FIG. 7

3. SPECIALTY VALVES

A. Fixed Orifice.

Orifices are "normally" installed in the return portion of a hydraulic circuit. They are made by drilling a hole in a 1/16" NPTF Plug.

Troubleshoot and Repair as Follows: (See Fig. 8)

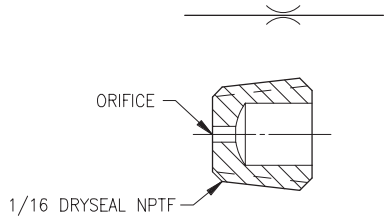
If flow is blocked it could be because a particle of dirt has covered the orifice hole. The orifice plug can be removed by removing the SAE plug and reaching down the hole with a hex wrench to remove the plug. Inspect orifice hole for dirt and blow compressed air through the hole to dislodge contamination.

B. Cartridge Type Port Relief (Also see section above and Fig. 4 on Cartridge Relief Valves).

Troubleshoot and Repair as Follows:

"Dead Head" the port in question. Place gauge in corresponding gauge port, start pump and note pressure. If it is too high the adjusting screw will need to be turned counterclockwise. If it is too low, turn the adjusting screw clockwise a turn and note the pressure gauge reading.If it does not move turn screw counterclockwise, start pump, and flush dirt past the poppet. Then, turn the screw to the proper pressure setting.

NOTE: The valve itself cannot be disassembled in the field; replace it if cleaning does not correct the problem.



ORIFICE PLUG

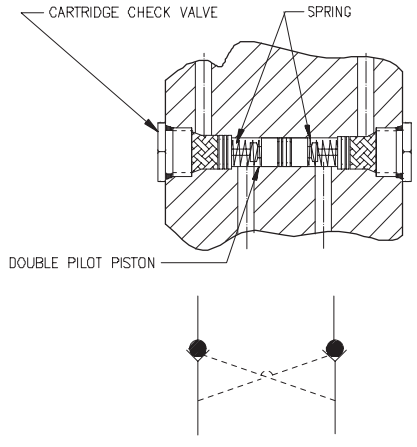
FIG. 8

C. Double Pilot Operated Checks.

Double Pilot Operated checks are used for Load Holding. One design is made up of two check valves and a pilot piston complete with springs (See Fig. 9). The other style is made up of two check valves and a pilot piston w/o springs (See Fig. 10).

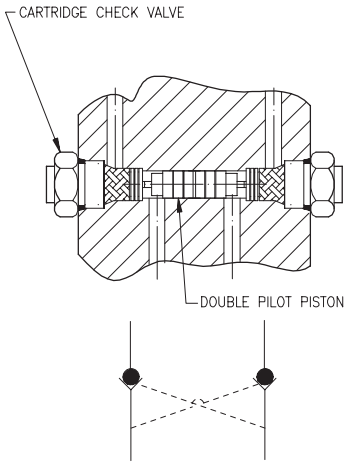
The Checks can be cleaned by blowing compressed air through them. But the cartridges cannot be disassembled. See note below.

NOTE: The parts must not be interchaged between designs or the pilot operated check will not work properly.



DOUBLE PILOT OPERATED CHECK w/ SPRINGS

FIG. 9

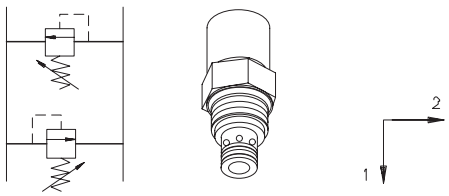


DOUBLE PILOT OPERATED CHECK w/o SPRINGS

FIG. 10

D. Cross Over Relief Valves

The Cross Over Relief Valve is used to relieve pressure from one side of a cylinder to the other side or to an equal size cylinder that is tied mechanically to the first.They are designed to help absorb high forces if the plow strikes a heavy object.They should only pass oil if the plow is hit by an outside force and the Directional and Check Valves are in the holding position.



CROSS OVER RELIEF

FIG. 11

Troubleshoot and Repair as Follows:

Remove Valve from Manifold and try to blow air through it. If air passes, it is stuck open and it should be replaced. If it is not stuck open, but the plow moves too easily, the spring is set too

low and it should be adjusted up. To adjust remove cap and turn screw clockwise to proper pressure. (See Fig. 11)

NOTE: Both sides of the Cross Over Relief are adjusted with (1) Spring. Both ports adjust up and down together.

PUMP REPLACE

After all possible failure modes with the Hydraulic Circuit and Cylinders have been eliminated and Plow speed and/or pressure is below specifications, the Pump should be looked at.

Replace Pump as Follows:

1. Remove pump from reservoir by loosening the the band clamp. Note the orientation of the suction screen and tube assembly on the old pump.
2. Loosen (4) pump screws in old pump.
3. Pull old pump off.
4. Wipe surface of the base clean, removing old oil, dirt, etc.
5. Replace 00120 O-ring provided in pump kit. (See Figure 12)

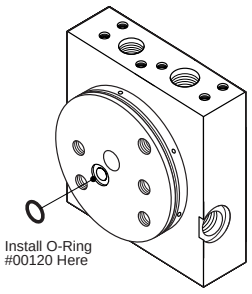


FIG. 12

6. **IMPORTANT:** Place a small amount of grease on the tang of the drive shaft. This will help the tang slide past the shaft seal in the pump base without damaging it. Carefully slide the pump into place.
7. Align (4) through holes with (4) empty screw holes in the pump. (See Figure 13)

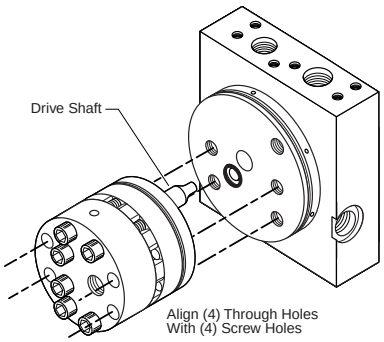


FIG. 13

8. Drop the (4) screws provided in the pump kit into the holes. The screws should be started by hand -- no air tools.
9. Torque (4) provided screws to between 130 and 150 inch pounds. (See Figure 14)

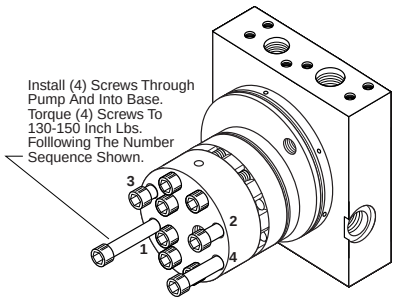


FIG. 14

IMPORTANT: Do not over tighten! Do not tighten any other screws in the pump other than the (4) provided loose in the kit.

10. If you removed the motor, turn the drive shaft with a pair of pliers to ensure it turns freely after you have tightened the screws.
11. Remove the suction tube and screen assembly from the old pump's suction plate and install it in the new suction plate.
12. Slide the pump assembly back into the reservoir collar, making sure that the tank O-ring is properly installed. A pinched or deformed seal may result in leaking. Make sure that the suction tube assembly is pointing to the bottom of the reservoir. Align the reservoir while sliding them together.
13. Replace and tighten the band clamp.

TIPS ON REPAIRS

1. Do not screw cartridge valves into cavity too fast; use a back and forth motion and have O-rings well lubricated.
2. Clean all parts thoroughly before assembly and lubricate with clean oil.
3. Do not use Teflon tape on hydraulic connections as it can easily jam the valves and plug the filters in the system.
4. Use care when working on electrical components to prevent shorts, “ground faults”, and “open” circuits.
5. Remove all rings, watches and jewelry that might come into contact with electrical connections prior to working on the electrical system.

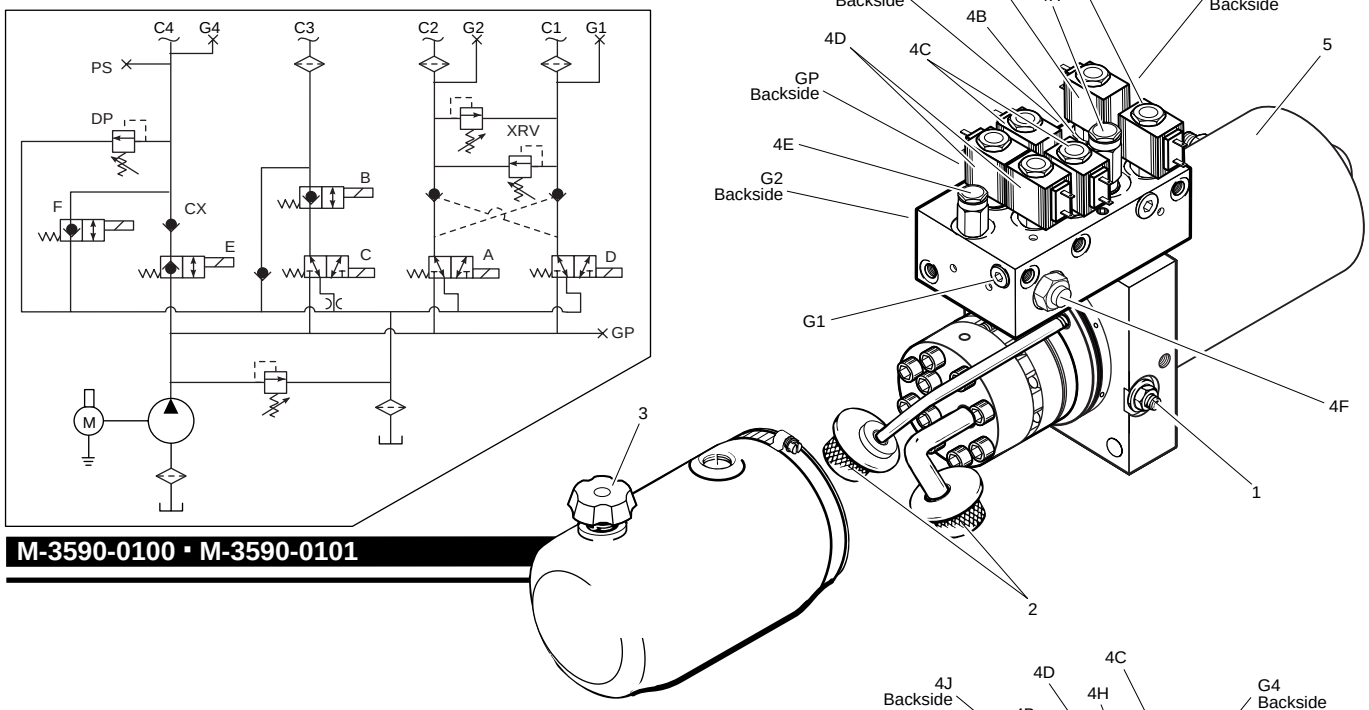
! WARNING

- Always wear eye protection and protective clothing when working around hydraulic systems.
- Remove jewelry and objects that might conduct electricity while working on power units.
- Fluid under pressure can pierce the skin and enter the bloodstream causing death or serious injury.
- Devices being operated by the hydraulic system should be securely propped or immobilized so they cannot move and cause injury while being inspected or repaired.
- Fluids should be contained and disposed of properly.

D.C. Hydraulic Models

Typical Location of Basic Parts:

1. Relief Valve/Main
2. Suction Filter
3. Fill - Vent Plug
4. Valves
   - 4-A Port Relief
   - 4-B Cartridge Check
   - 4-C 2-Way/2-Position Valve
   - 4-D 3-Way/2-Position Valve
   - 4-E Cross Over Relief
   - 4-F Double PO Check
   - 4-H Down Pressure Relief
   - 4-J Orifice Access Port
5. DC Motor
6. Gage Ports
   - GP Pump Pressure Gage Port
   - G1 Port C1 Gage Port
   - G2 Port C2 Gage Port
   - G3 Port C3 Gage Port
   - G4 Port C4 Gage Port
   - G5 Port C5 Gage Port



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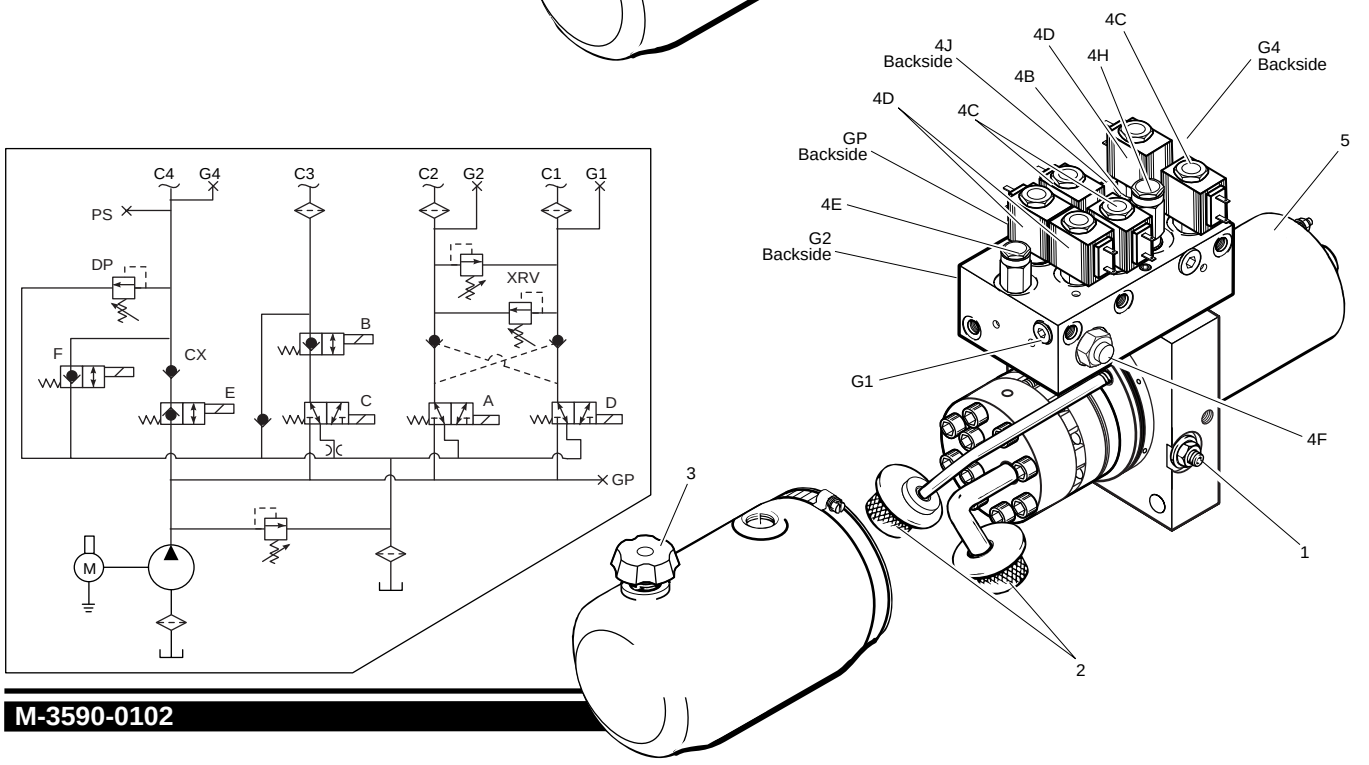

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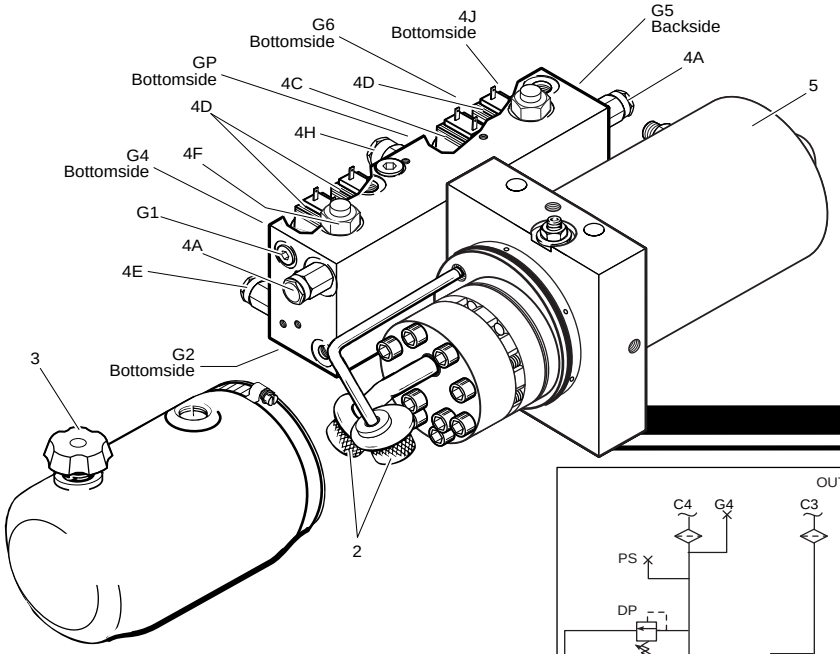

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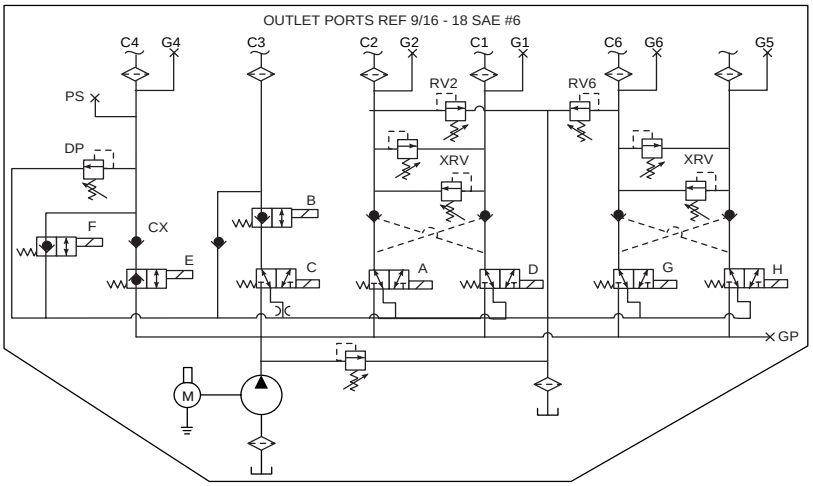

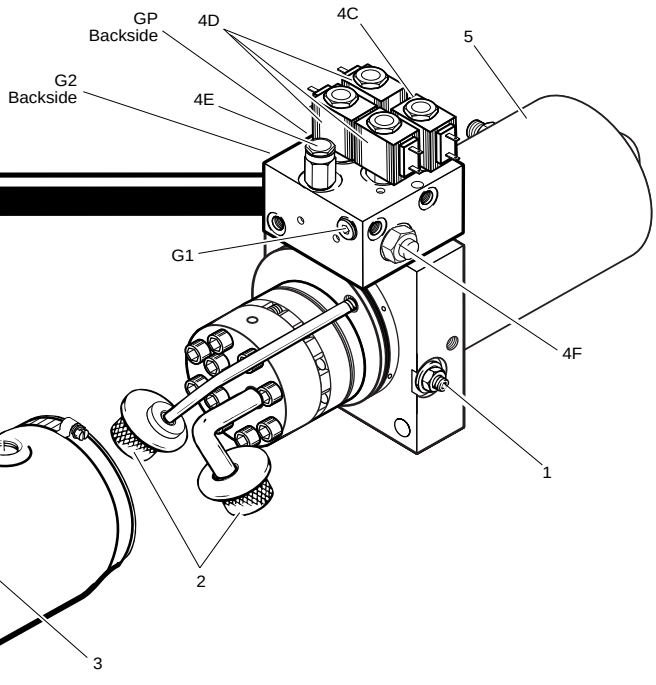

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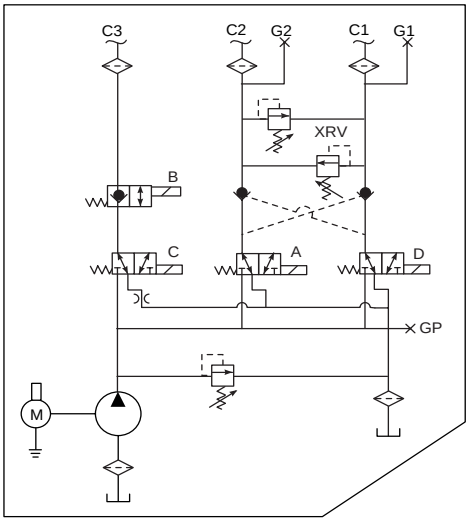

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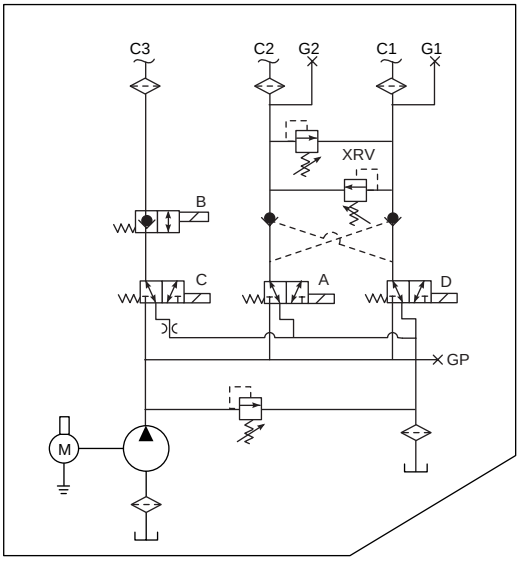

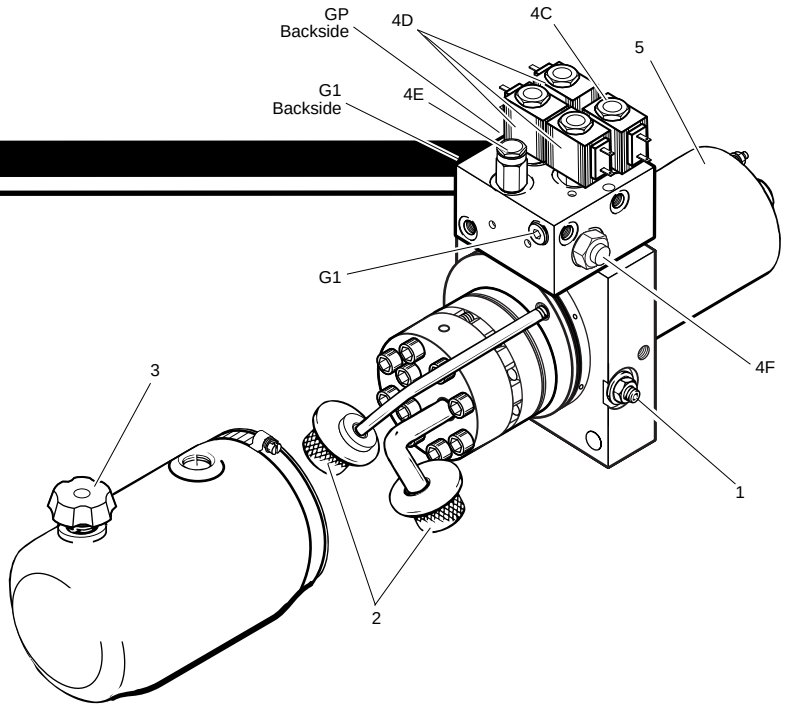

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NOTES

NOTES

General Information

THIS GUIDE IS MADE AVAILABLE TO YOU BY

SNO-WAY, INTERNATIONAL
1353 Wacker Drive
Hartford, Wi. 53027
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Telefax: (262) 673-7409
http://www.snoway.com

PLEASE: Before Calling SNO-WAY be certain that:

1. You have read the guide carefully and are certain that all of the possible causes pertaining to your problem have been reviewed.
2. You have the following information available:
   a. Model Number _____
   b. Serial Number _____

IMPORTANT

DO NOT VOID YOUR WARRANTY

This guide carries many useful tips for troubleshooting your hydraulic power unit. It should be noted, however, that any disassembly of a power unit that is still under warranty will void that warranty. If you need any assistance, contact the factory.

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