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DIRECTIONAL CONTROL VALVE – CIRCUITS

BASIC TYPES OF VALVES

1. Flow Control valves
2. Pressure control valves
3. Directional Control valves

FLOW CONTROL VALVES

Flow control valves vary or control the flow through the system. Examples:

1. RD100 (priority flow divider) can vary the flow
2. RD200 (proportional flow divider) splits the flow
3. Check Valve stops the flow

PRESSURE CONTROL VALVES

1. Pressure reducing valve (like what we use on the Series 20 Utility Section)
2. Relief valve (a specialized case of a pressure control valve – intermittent use)

DIRECTIONAL CONTROL VALVES

1. Selector valves etc.
2. RD500, SV, Series 20, Loader valves etc.

Directional control valves act like a switch, reconnecting flow paths

They do not create pressure
They do not change the flow rate
They simply redirect the flow paths

DIRECTIONAL VALVE CIRCUIT CONCEPTS:

4 WAY & 3 WAY valves.

The terminology “way” generally refers to the number of ports for a single spool valve.
A 4 way valve has an inlet, an outlet and two work ports (typically used with a double acting cylinder, reversible motor etc.).
A 3 way valve has an inlet, an outlet and one work port (typically used with single acting cylinders or a non-reversible motor).

POSITIONS i.e. 4 way-3position, 3 way-3 position, 4 way-2 position 4 way-4 position etc.

The number of positions refers to the number of distinct locations or spool positions.
The most common valve is a 3 position spool (spool in, neutral, spool out).
A 4 position spool might be spool out, neutral, spool in and float.
A 2 position spool might be limited to spool in and neutral only.
When using the valve handle one can usually feel the position the spool is in by some type of mechanical mechanism. It might be spring center to neutral. It might be end of travel for spring center. It might be a detented position, it might be a soft stop on a regen spool.

OPEN CENTER vs. CLOSED CENTER

OPEN CENTER as we use the terminology refers to valves that allow the oil to circulate

(at low pressure) through the valve and back to tank when all the spools are in neutral. Some people use the terminology “open center” to refer the work port condition with the spool in neutral. To them, open center means the work ports are connected to the tank in neutral (i.e. a motor spool).

CLOSED CENTER, as we use the terminology refers to valves that do not allow oil to flow through the valve when the spools are in neutral. The flow path is “dead headed”. Some people use the terminology “closed center” to refer the work port condition with the spool in neutral. To them, closed center means the work ports are blocked in neutral (we call that a tandem center spool for lack of better terminology).

Open center systems are typically used with gear pumps. A gear pump “pumps” a constant volume of fluid into the system with each revolution. Oil HAS to flow through the system if the pump is turning.

Closed center systems are typically used with piston pumps. Piston pumps usually have special controls that control what volume of fluid is “pumped” into the system with each revolution. These controls can change the gallons per minute coming out of the pump from effectively zero to “full flow”. One type of control uses the pump outlet pressure to control how much flow comes out of the pump. This type of control is called pressure compensated. At low pressure the pump “strokes up” to full flow. If the pressure at the outlet increases to a preset pressure – let’s say 3000 psi (compensator setting), the pump de-strokes to ~zero flow, but pumps just enough match any leakage and maintains the high pressure at the pump outlet. When used with our closed center valves, the inlet line and the pressure cores in the valves will always be at high pressure with the spools in neutral. (Note, our closed center valves should typically NOT be equipped with reliefs.)

RELIEF VALVES (a special type of pressure control)

Reliefs are intermittent devices, they should not be used to regulate, they should be used to limit the pressure/provide protection.

When flow is going over a relief, there is usually a squealing or a rushing sound.

Flow going over a relief generates heat. All of the energy in the pressure and flow of an oil stream will turn into heat. (If 20 horsepower is required to pump the oil ~20 horsepower will go into heat).

A relief can only accurately be set with a gage. An inlet relief can be set by shifting the spool to send the flow to a blocked port (or a cylinder at end of stroke) which in turn causes the flow to go over a relief. If the relief setting is unknown, the setting should be “backed off” before sending the flow to a blocked port.

Relief curves are not perfectly flat, the apparent relief pressure changes with flow. The apparent relief setting on our entry level relief valves varies quite a bit with flow. For higher accuracy, they should be set at the approximate flow they will be used at.

Most of our reliefs can be adjusted “solid” which means there is no relief protection if

"screwed tight" (the exceptions are the Series 20 reliefs which still have relief protections when the adjuster is screwed all the way in).

TROUBLE SHOOTING CONCETPS

The load is what causes pressure in a system, not the pump not the valve.

Common items to check when someone says, "my valve doesn't have any pressure" or "nothing happens when I move the lever on the valve.

Always confirm how the lines are connected and if there are any additional valves or Tees in the circuit. Always follow all the potential flow paths, remember, the valve just switches paths. Is there another path the oil can take before it gets to our valve? Is there a Tee in the line before our valve? Is there a flow control valve before our valve?

Is the relief set too low? If it is, oil will flow over the relief (before the cylinder moves) when the spool is shifted or is the motor stalled without enough pressure to start it.

Is there air in the system? Is the reservoir too small? The "mobile" rule of thumb is 1 gal of reservoir size for 1 gpm of flow rate. Is the oil "frothy"?

Is the oil "bypassing"? Is it going around the piston seal? Is it bypassing in the motor?

Is the pump producing any flow at the required pressure? The flow in worn pumps often decreases (sometimes to zero) as the pressure increases.

If our RD5000, SV, and Series 20 valves are leaking out the end cap, there is a 90%+ probability that the tank core has been pressurized to a high pressure. It only takes once to bend parts and leak.

Is there a path for the return oil to go back to tank? For instance on a power beyond configuration, is there a line from the outlet to tank **and** a line from the power beyond to the downstream valve?

Are there quick disconnects in the system? Are they fully connected or is one half on? Are the quick disconnects from a remote valve on a tractor where moving the tractor handle can direct flow to the wrong disconnect i.e. backwards through the system.

Again, a directional control valve is like a switch, which redirects the flow path. If oil is getting to the inlet, not going over relief and has a path to tank, there's not much that can go wrong with the valve.