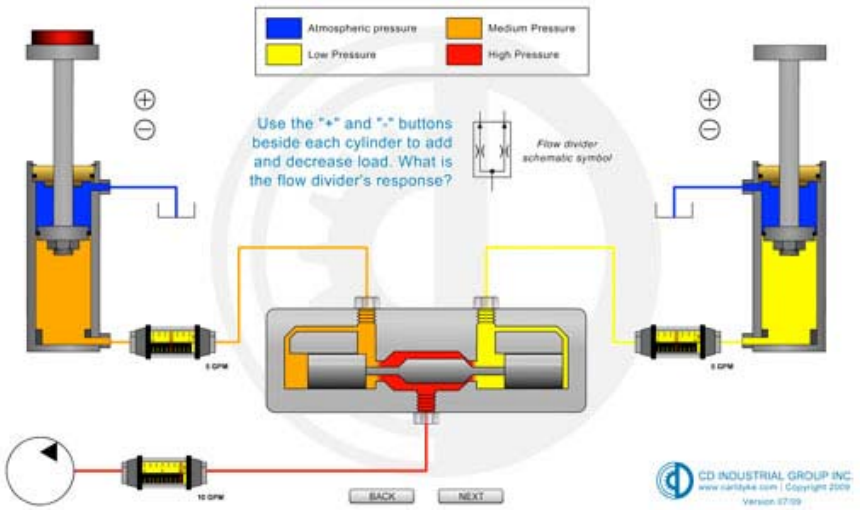
Newsletters That Teach.

Parallel Flow Paths, Part III

Oct 22, 2009
Posted in Hydraulic

Last time we looked at how a pressure compensated flow divider works to produce two simultaneous parallel flow paths. The flow divider automatically makes flow adjustments to keep the two paths at an even 50/50 balance, even when one cylinder is more heavily loaded than the other.



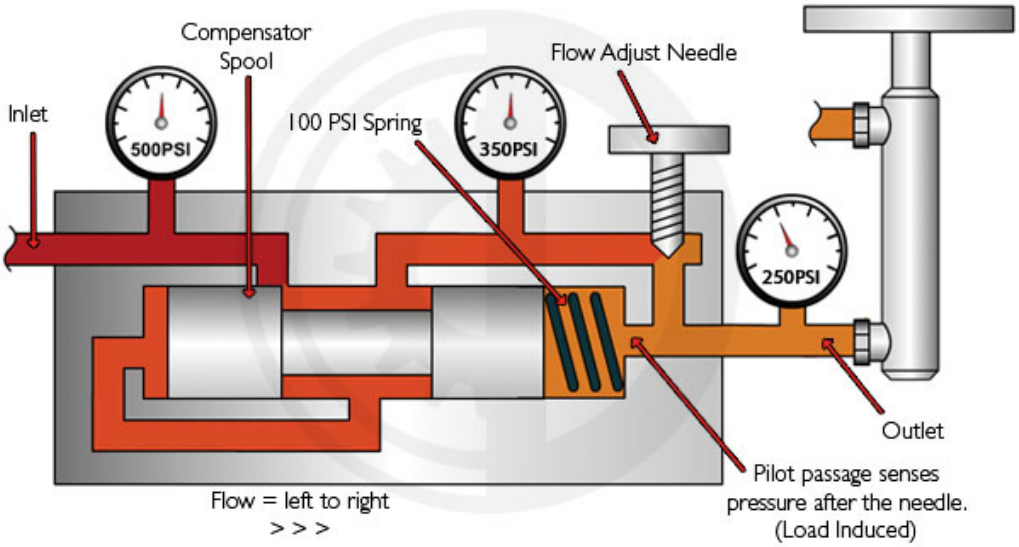
Don't forget that you can login and interact with the dynamic simulations at http://www.carldyke.com/sample/. Username and password are included in each emailed newsletter, so if you're not already a subscriber, click here to sign up for free!

In this edition of NEWSLETTERS THAT TEACH, we will finish up the series on parallel flow paths by looking at load sense circuits.

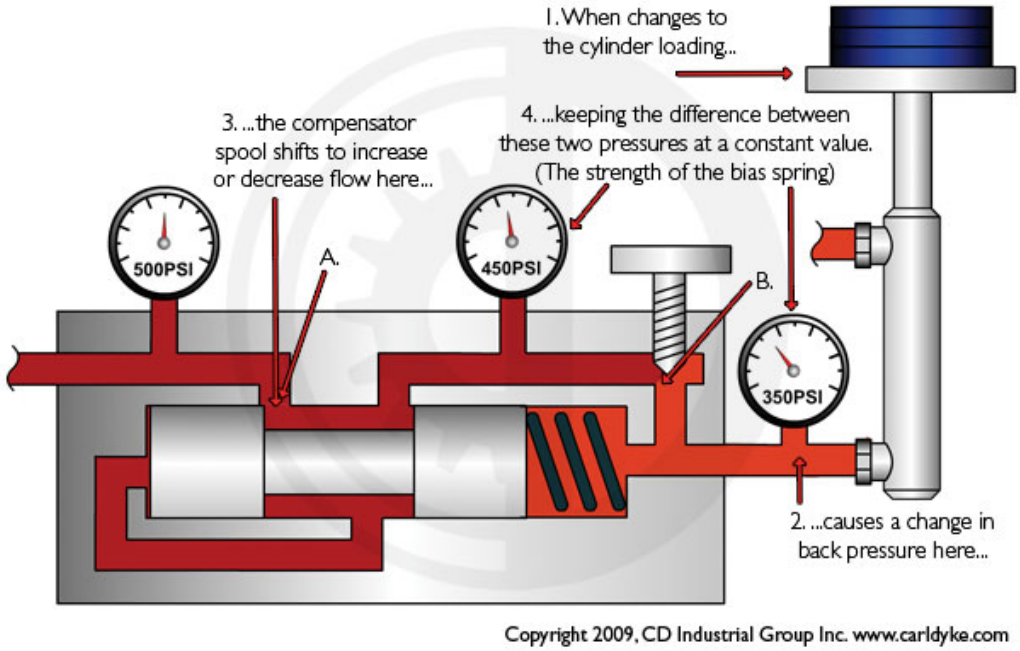
The basic assumption of a load sense design is that the system pressure, (measured at the pump outlet before any restriction or actuator load,) should never be more than a few hundred PSI higher than the heaviest parallel load. This saves input energy while still providing enough hydraulic potential energy (system pressure) to meet system needs.

Pressure Compensated Flow Control

But first let's back up a little. A pressure compensated flow control is a basic device that features a needle valve for restriction. However, the rate of flow through any fixed amount of orifice opening will change if the pressure changes on one side of that orifice or the other. What changes the pressure?



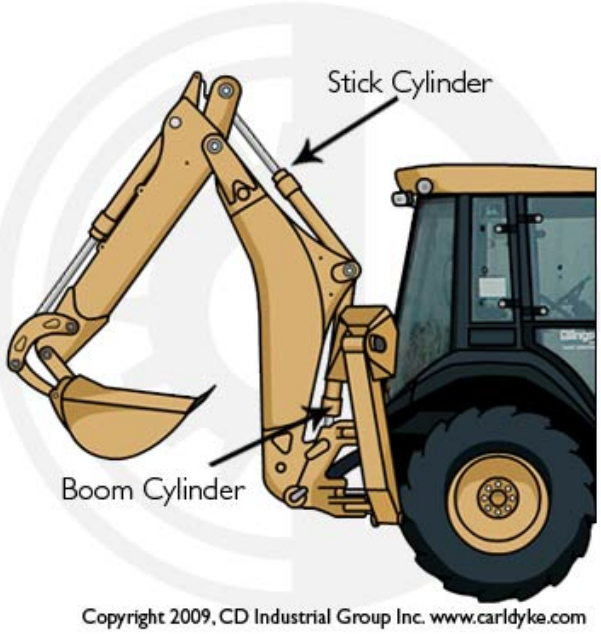
If you increase the load on the cylinder, then the load pressure will rise on the downstream side of the needle valve (orifice). On the other hand if the pump is shared with other applications where pressure is rising and falling, then the pressure is changing on the upstream side of the needle valve. In either case, as the difference (ΔP) in pressure changes from the upstream to downstream side across the needle valve, the flow rate will change.



If you add a pressure compensator to the flow control with the bias spring chamber plumbed to the cylinder load, you now have a flow control that adjusts automatically for pressure fluctuations. The compensator spool will open up when either supply pressure drops or when cylinder load pressure increases. Conversely it will close down when either supply pressure increases or when cylinder load pressure decreases. In this way the pressure differential across the needle valve remains steady (determined by the strength of the spring) which ensures a consistent flow rate (steady cylinder stroke speed). The pressure compensator spool becomes an automatic variable restriction in series with the main needle valve.

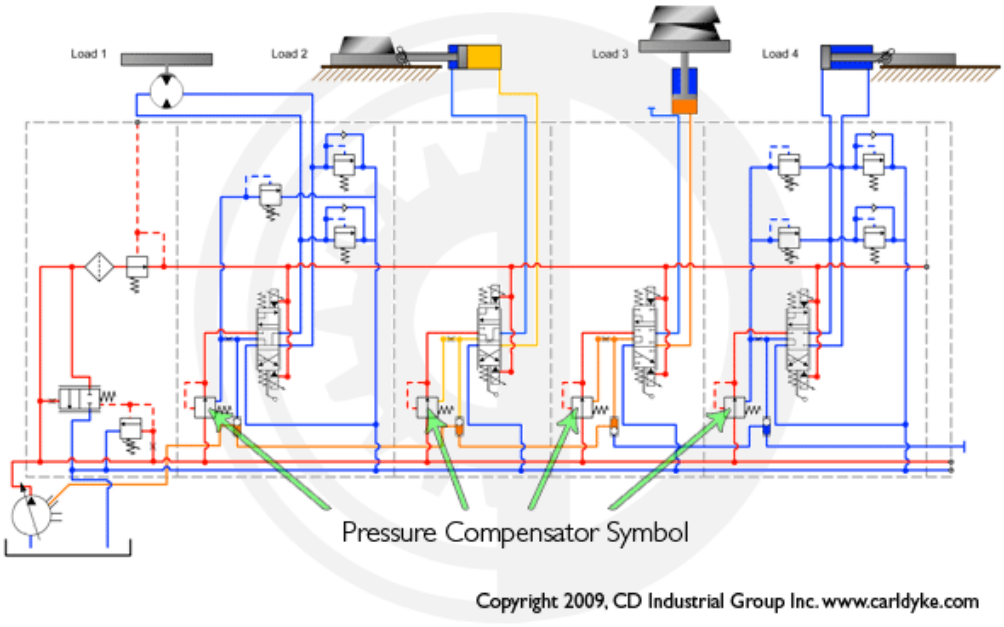
If you can grasp the basic functioning of this flow control, (login and try out the interactive simulation model!) then you're ready to think about a load sense valve bank with parallel functions.

Load Sensing Hydraulic Circuits



The operator of an excavator may wish to move both the boom and the stick cylinders simultaneously. If the two functions represent different load pressures, the maximum system pressure will be set slightly higher than the greater of the two loads. This adjustment is done automatically with a sensing line from the valve bank that instructs the pump to increase its displacement slightly.

With this adjustment made we would expect that the lighter load would speed up. This would be undesirable. If the operator has opened the proportional, directional valve to move a load at a certain speed, it is then hard to operate the machine well if that load speeds up when another parallel function causes an increase in system pressure. We are now ready to answer for the mystery components from the previous two lessons. If you guessed that the symbols represent a pressure compensator, then you are correct.

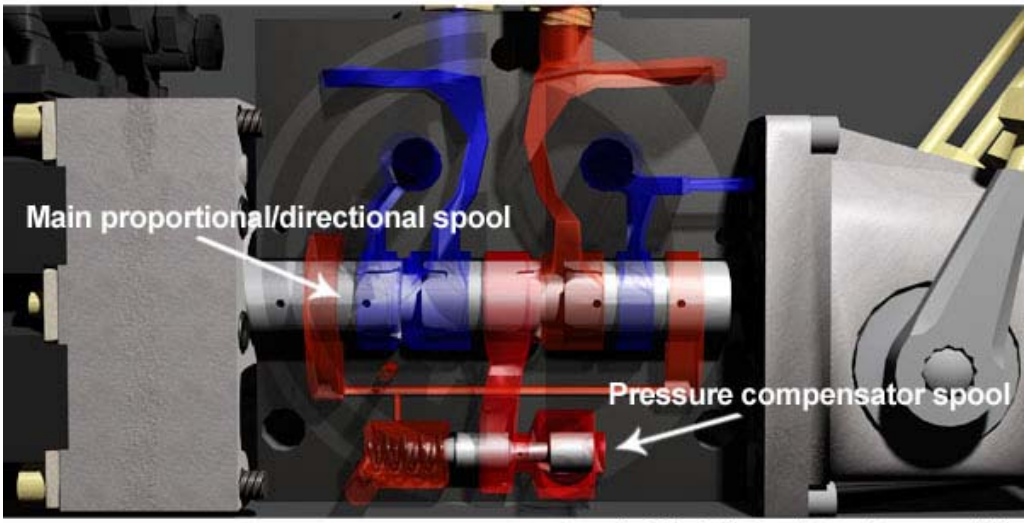


A load sense (flow compensating) hydraulic system that allows parallel multi-functioning.

Just like the pressure compensated flow control we spoke of earlier, each section of the valve bank has its own pressure compensator. As the overall system pressure automatically increases in a load sense system to support the heaviest load, the pressure compensator on each section of the valve bank with a lighter load pinches down a little to keep that section from speeding up.

Troubleshooting Note

The pressure compensator in most valve bank designs is a small spool that is located below the main proportional/directional spool. If the pressure compensator jams due to contaminants in the system, then the lighter loads will speed up when another parallel application takes on a heavier load during multi-functioning (more than one parallel valve is open for flow at one time).



Feel free to login and try out the interactive models that accompany this lesson. In the next edition of NEWSLETTERS THAT TEACH we'll head back into the plant environment.