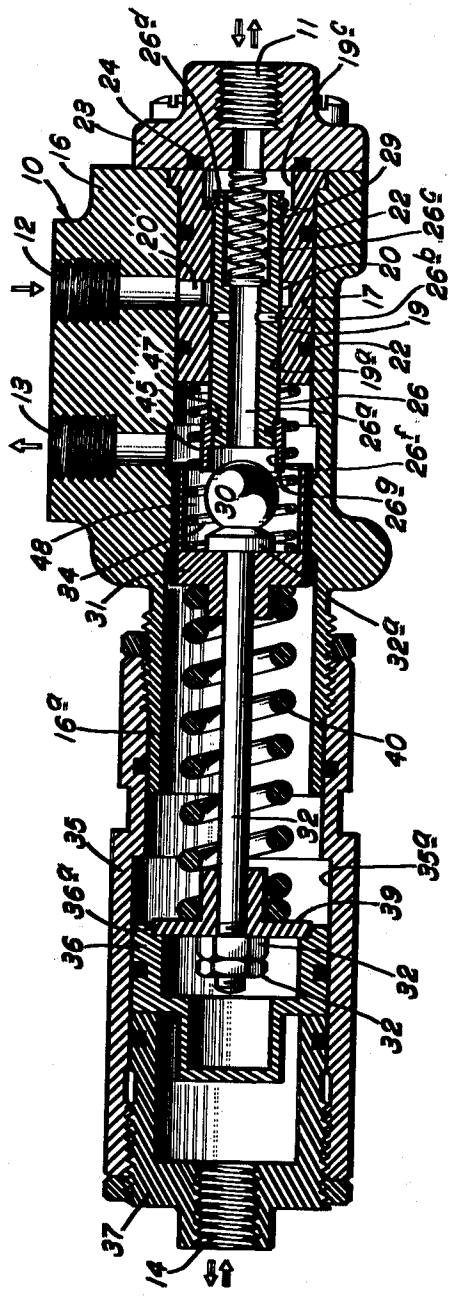
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POWER BRAKE VALVE

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POWER BRAKE VALVE

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This invention relates to pressure-reducing valves for controlling the application of pressure fluid to hydraulic brakes and like hydraulic devices.

An object of the invention is to provide a simple valve in which opening movement is unopposed by the pressure of the source and closing movement positively insures release of pressure in the brakes.

A feature of the invention is a pressure-reducing valve having a slide valve element controlling flow of fluid from the high pressure source to the load and a poppet valve element controlling release of fluid from the load.

Other more specific objects and features of the invention will become apparent from the description to follow.

Heretofore power brake valves have been either of the slide valve type or poppet valve type. The slide valve type has the advantage over the poppet type that there is less resistance to opening movement, but has the disadvantage that it may stick open because of dirt lodging between the closely fitted surfaces. Sticking in the prior slide valves could produce excessive pressure in the brake line and lock the brakes, a dangerous condition. Because of this danger it has been considered necessary by some users to provide a separate relief valve in the brake line to prevent excessive pressure being created.

The present invention provides a poppet return valve in combination with a slide type pressure inlet valve. The poppet return valve is always free to open in response to excess pressure, thereby giving the protection against excessive pressure afforded by a full poppet type valve, but retaining the easy operating characteristics of the slide type valve.

A full understanding of the invention may be had from the following detailed description of a preferred embodiment thereof as illustrated in the single figure of the drawing.

Referring to the drawing, there is shown a valve casing **10** having a working or delivery port **11**, a high pressure port **12**, a return port **13** and a control port **14**. Normally the delivery port **11** is connected to the return port **13** so that no pressure exists therein. However, in response to a control pressure applied to the port **14**, valve elements within the casing are actuated to disconnect the delivery port **11** from the return port **13** and connect it to the pressure port **12**. The valve functions to admit pressure fluid from the pressure port **12** to the delivery port **11** to the extent necessary to develop in the delivery port a pressure that is higher than but proportional to the control pressure in the port **14**. When the control pressure in port **14** is reduced, the valve functions to disconnect the delivery port **11** from the pressure port **12**, and connect it to the return port **13** to the extent necessary to reduce the delivery port pressure to a value proportionate to the control pressure in the control port **14**.

The casing **10** comprises a main body **16** having a cylindrical bore **17** therein in which is fitted a liner **19**

having a bore **19***a* which constitutes a valve cylinder. The liner **19** contains a high pressure chamber **20** communicating with the valve cylinder **19***a* and with the pressure port **12**. The liner **19** is provided with sealing rings **22**, **22** on opposite sides of the pressure chamber **20** to prevent leakage of fluid between the liner and the body bore **17**. An end cap **23** closes the right end of the body bore **17** and is provided with a sealing ring **24** to prevent leakage of pressure fluid past the outer end of the liner **19**. Rearwardly (to the left) of the liner **19** to the bore **17** is in communication with the return port **13**.

Closely but slidably fitted in the valve cylinder **19***a* is a valve sleeve **26** having a central passage **26***a* extending therethrough and having lateral passages **26***b* which are normally disposed to the rear of and disconnected from the pressure chamber **20**. The sleeve **26** is normally retained in rear (normal) position by a helical compression spring **29** compressed between the end cap **23** and the inner end of a counterbore **26***c* in the forward end of the sleeve **26**, the rearward movement of the sleeve by the spring being limited by a snap ring **26***d*, positioned in an annular groove on the sleeve **26**, which engages the inner end of a counterbore **19***c* in the liner **19**.

The rear end of the valve sleeve **26** is enlarged and provided with a counterbore **26***f* of the same diameter as the cylinder **19***a*, the outer end of this counterbore constituting a poppet seat for a ball poppet **30**.

For convenience in manufacture, the poppet seat **26***g* may be defined by a separate sleeve **45** positioned on a reduced rear end section of the sleeve **26** and sealed with respect thereto by a sealing ring **47**.

The poppet **30** is normally supported in slightly spaced relation with respect to the poppet seat **26***g* by a pusher member **31** which is guided for sliding movement in the bore **17** of the body **16**. The ball poppet **30** is actually contacted by the head **32***a* of a bolt **32** which extends through the member **31** for a purpose to be described later, but this is merely incidental. The pusher member **31** is yieldably urged to the left by a light compression spring **34** which is compressed between the end of the liner **19** and the pusher member **31**.

The body **16** is provided with a rearward extension **16***a* on which there is threaded a tubular housing **35** which defines a control cylinder **35***a* containing a control piston **36**. The rear end of the housing **35** is closed by a plug **37** which contains the control pressure port **14**.

The piston **36** has an annular shoulder **36***a* against which there rests a disc **39** which is coupled to the poppet pusher member **31** by a helical compression spring **40** which is compressed between the disc **39** and the pusher member **31**. This spring **40** is preloaded by the bolt **32** which, as previously described, is connected at its right end to the pusher member **31**, and extends through an aperture provided therefor in the disc **39** and has a nut **32***b* and a lock nut **32***c* on its rear end, for limiting separating movement of the pusher member **31** and the disc member **39**. By adjusting the nuts **32***b* and **32***c* the spring **40** can be preloaded to any desirable extent, to balance the combined forces of the springs **34** and **29**.

The maximum desired loading of the spring **40** is adjusted by rotating the member **35** on its threaded connection with the body extension **16***a*. Thereafter, the spacing between the poppet **30** and the poppet seat **26***g* is adjusted by adjusting the position of the end cap **37** in the member **35**.

The valve operates as follows:

With the elements in normal position as shown in the drawing, the high pressure port **12** is disconnected from the delivery port **11** by displacement of the valve sleeve ports **26***b* rearwardly from the pressure port **20**, and the delivery port **11** is connected through the passage **26***a* in

the valve sleeve **26**, past the poppet **30**, to the chamber **48** which is always in communication with the return port **13**. Now let it be assumed that pressure fluid is admitted to the control port **14** to shift the piston **36** therein to the right. This movement is transmitted through the preloaded spring **40** to the poppet pusher member **31** which pushes the poppet **30** into engagement with the seat **26***g*. Thereafter, continuing movement of the piston **36** carries the valve sleeve **36** with it until the ports **26***b* register with the pressure chamber **20**, permitting flow of high pressure fluid through the ports **26***b* and the passage **26***a* to the delivery port **11**.

The pressure in the delivery port **11** is always applied to the poppet **30** when the latter is closed against the seat **26***g*, producing a reactive force on the poppet which is transmitted through the poppet pusher **31** and the spring **40** to the piston **36**, thereby apprising the operator, by the reaction pressure created within the control port **14**, of the pressure that has been applied to the brakes. Whenever the reaction pressure exceeds the force of the spring **40**, the poppet **30** and the pusher **31** are moved to the left by it. The sleeve **26** follows the poppet because of the constant force exerted thereon by the spring **29**. A relatively slight movement of the sleeve **26** to the left disconnects the ports **26***b* from the pressure chamber **20**, thereby isolating the delivery port **11** from the pressure source. After leftward movement of the sleeve **26** is limited by engagment of the snap ring **26***d* with the counterbore in the liner **19**, the poppet **30** then leaves the seat **26***g*, to permit the pressure fluid in the delivery port **11** to be exhausted into the chamber **48** and thence out through the return port **13**.

It will be noted that even if, as a result of dirt in the fluid, the sleeve **26** should stick in forward position in which the ports **26***b* are connected to the pressure chamber **20**, the pressure within the delivery port **11** will be relieved at any time the poppet pusher **31** is retracted, because the pressure will always force the poppet **30** away from the seat **26***g* and permit relief of the pressure within the passage **26***a* to the return port **13**.

As has been previously described, the diameter of the seat **26***g* is substantially the same as the outside diameter of the portion of the sleeve **26** seating in the cylinder **19***a*. Hence when the poppet **30** is engaged with the seat **26***g* the opposite end areas of the sleeve **26** exposed to the high pressure fluid in the delivery port **11** are equal and opposite so that there is no resultant pressure thrust on the sleeve in either direction. This is desirable for the reason that it leaves the sleeve balanced by the pressure forces and permits the opening of the poppet **30** by the pressure thereagainst promptly in response to retraction of the control piston **36**. If the seat **26***g* were smaller than the cylinder **19***a*, additional leftward movement of the piston **36** would be required to open the poppet **30** after completion of leftward movement of the sleeve **26**.

It is to be understood that the invention is not limited to a pressure-reducing valve in which the controlling force is derived from a master cylinder, but is equally applicable to systems in which the controlling force is applied directly to the disc **39** or the pusher **31**.

Although for the purpose of explaining the invention, a particular embodiment thereof has been shown and described, obvious modifications will occur to a person skilled in the art, and I do not desire to be limited to the exact details shown and described.

I claim:

1. A valve comprising: a casing having a pressure port, a delivery port and a return port; a valve cylinder in said casing having a lateral pressure chamber connected to said pressure port, a forward end spaced from said pressure chamber and connected to said delivery port, and a rear end spaced from said pressure chamber and connected to said return port; a valve sleeve reciprocable in said cylinder in sealing relation therewith and having an axial passage extending therethrough, said sleeve having a poppet seat at its rear end and a lateral port extending through said sleeve from said axial passage and registering with said pressure chamber in an advanced position of said sleeve and displaced from said pressure chamber in a normal retracted position of said sleeve; a poppet at the rear end of said sleeve movable against said poppet seat to break communication between said return port and the said axial passage in said sleeve and advance said sleeve; and actuating means for moving said poppet; said cylinder and valve sleeve having cooperating, closely-fitted sliding surfaces sealing with each other on each side of said pressure chamber in all positions of said sleeve whereby said lateral port and axial passage in said sleeve constitute the sole flow path for fluid between said pressure chamber and said delivery port.

2. A valve according to claim 1 in which said sleeve projects rearwardly beyond said valve cylinder and has a rear end portion the external diameter of which is larger than said cylinder, said rear end portion having a counterbore of substantially the same diameter as said cylinder and defining said poppet seat.

3. A valve according to claim 1 in which said actuating means comprises: a poppet pusher member engaging the rear end of said poppet and means guiding it for sliding longitudinal movement in said casing; an actuating member rearwardly spaced from said pusher member and means guiding it for longitudinal movement; a helical compression spring interposed between said pusher and actuating members for yieldably coupling them; and spring preloading means comprising an axial rod extending through apertures provided therefor in said members and having heads on its outer ends engaging said members for limiting separating movement of said members, one of said heads including a nut means threaded on said rod for varying the effective length of the rod to adjust the preloading of the spring.

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