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REGULATOR VALVE

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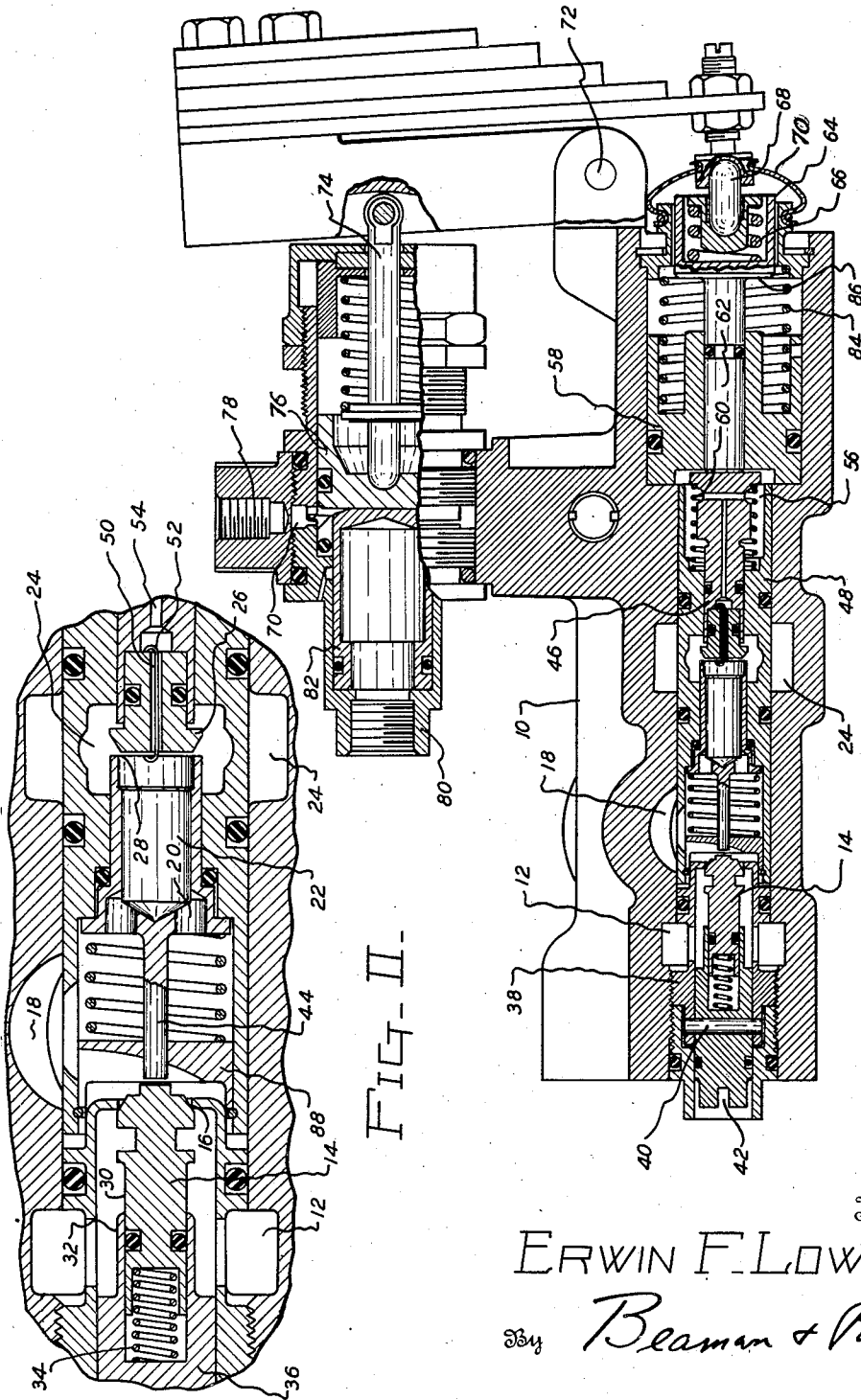


FIG. I-

FIG. II-

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REGULATOR VALVE

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2 Claims. (Cl. 303—54)

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The present invention relates to improvements in power brake valves for reducing the pressure to the brakes from the main pressure source, being a further development of the regulating valve structure disclosed in my copending application, Serial No. 545,638, filed July 19, 1944, now abandoned.

One of the objects of the invention is to provide an improved valve of the type described.

Another object is to provide an improved arrangement of the choke and displacement and regulating chamber over that disclosed in my copending application for producing a "delayed load feel" for noncompressible fluids.

These and other objects and advantages residing in the specific construction of parts, and combination and arrangement thereof will be more fully appreciated from a consideration of the following specification and the appended claims.

In the drawings,

Fig. I is a side elevational view of a power brake valve partly shown in broken vertical section, and

Fig. II is an enlarged fragmentary vertical section of the construction shown in Fig. I.

The power brake valve 10 has an inlet chamber 12 to conduct a noncompressible fluid from some suitable pressure source, such as an accumulator, to the inlet side of an unbalanced valve 14 controlling the flow of fluid pressure to the inlet 16 through which the flow of fluid pressure to the outlet or brake chamber 18 is controlled. The chamber 18 is hydraulically connected with the brakes, with the return fluid from the brakes passing through the opening 20 of the tubular valve part 22, with the flow of return fluid to the return or exhaust chamber 24 regulated by a valve part 26 engaging with the seat 28 of the valve part 22.

The valve 14 is of an unbalanced structure due to the fact that the diameter of the cylindrical portion 30 guided in the sleeve 32 is smaller than the diameter of the inlet 16, with the result that the pressure in the inlet chamber 12 functions to hold the valve 14 to its seat with the valve closed. The degree of unbalance is controlled through a compression spring 34, having one end reacting against the valve 14 and the opposite end against an adjustable abutment 36 supported in a threaded collar 38 with unitary movement between the parts 36 and 38 being provided through a pin connection 40. A screw driver slot 42 is provided as a convenient manner of adjusting the abutment 36 axially of the valve

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10 to regulate the reaction of the spring 34 against the valve 14. As more clearly shown in Fig. II, the valve 14 is moved from its seat by the pin portion 44 shown as an integral part of the tubular valve part 22.

The valve part 26 is supported in the member 46 and guided for axial movement in the sleeve 48. As more clearly shown in Fig. II, a choke passage 50 is provided in the valve part 26 with a wire 52 of correctly selected diameter located in the passage 50 to reduce the effective area diameter of the passage 50 and provide the desired choke action. At its inner end the passage 50 communicates with a passage 54 provided in the member 46 to provide fluid communication between the choke passage 50 and the displacement and regulating chamber 56, having an enlargement to receive the axially movable "load feel" piston 58.

The spring 60 acts against the member 46 holding the same in contact with the axially displaceable push rod 62, which is provided with a socket 64 at its outer end and having a low rate spring 66 housed therein and providing an operating link through the assembly 68 with the high rate laminated spring 70 pivoted at 72 and actuated by the rod 74 operatively connected with the piston 76.

The fluid connection with the master cylinder actuated by the foot pedal in a well-known manner is made at 78 with fluid pressure created by the pressure on the foot pedal being directed into the chamber 78 against the head of the piston 76. Movement of the piston 76 to the right as shown in Fig. I, results in the rod 62 being moved to the left. Such movement brings the valve part 26 into seating engagement with the tubular valve part 22 with continued movement moving the valve 14 from its seat upon engagement by the pin 44. As the valve 14 is unbalanced, as soon as the valve 14 is cracked from its seat, energy stored up in the low rate spring 66 because of the unbalanced condition of the valve, is released to rapidly increase the area of the valve opening.

An emergency operation of the brake valve 10 is provided through an air connection 80, with the air pressure being directed against the piston 82, which is shown in Fig. I abutted against the piston 76, and is capable of moving the piston 76 to open the valve 14 in a manner similar to movement of the piston 76 by fluid pressure from the master cylinder through the connection 78.

The "delayed load" characteristic of the power brake valve 10, in the illustrated form of the invention, is accomplished through the restricted

flow of pressure through the choke 50 into the displacement and regulating chamber 56. This restricted flow of fluid pressure acts against the "load feel" piston 58 to displace the same to the right against the tension of the spring 84. The rate at which the piston 58 is moved to the right and the time interval between its initial movement and its engagement with the shoulder 86 of the push rod 62 determines the delay in the "load feel" through the springs 66 and 70 back against the operator's foot on the brake pedal. By selecting the proper size wire 50, this delay may be increased or decreased without any other structural change in the production of the valve 10.

To briefly describe the operation of the power brake valve, in the terminology of the appended claims, the relatively noncompressible brake fluid flows from the source of fluid pressure, such as an accumulator, into a pressure inlet chamber comprising chamber 12. With the valve 14 cracked from its seat, the fluid from the pressure inlet chamber flows past the valve 14 and with high initial acceleration assisted by the baffle or jet 88, flows into a pressure chamber, comprising the chamber 18, from which it is conducted to the brake cylinders on the wheels. Following brake application, fluid pressure from the wheel brakes is returned through the port 20, flows axially through the valve part 22, between the valve part 26 and its seat 28, into a pressure return or exhaust chamber comprising the chamber 24, from which it flows into the fluid supply. Fluid pressure flowing through the choke 50 into the passage 54 flows into a dual purpose chamber, comprising the chamber 56, which is enlarged to receive piston 58. This dual purpose chamber functions first as a displacement chamber in that the piston 58 has initial movement relative to the rod 62 and after this initial movement it functions as a regulating chamber with the piston 58 engaging with the wall 86 and influencing the movement and position of the rod 62.

Having thus described my invention, what I claim as new and desire to cover by Letters Patent is:

1. A power brake valve comprising a main valve body, a plurality of coaxial chambers, including a pressure inlet chamber, a pressure outlet chamber, a pressure exhaust chamber, and a pressure regulating and displacement chamber, a first movable valve part located between said pressure inlet and pressure outlet chambers, a second movable valve part between said pressure outlet chamber and said pressure exhaust chamber, said movable valve parts being in co-axial alignment, a choke extending coaxially through said second movable valve part and placing said regulating and displacement chamber in restricted isolation

from said pressure outlet chamber, movable means having an operative connection with said movable valve parts, displacement means in said regulating and displacement chamber actuated by the restricted flow of fluid pressure through said choke to delay the pressure build up in said regulating and displacement chamber, said displacement means being constructed and arranged to have an initial movement to increase the volume of said regulating and displacement chamber independently of said movable means, and an operative connection between said movable means and said displacement means effective following said initial movement.

2. A power brake pressure regulating valve for aircraft and the like for use in a brake system using a non-compressible operating liquid under pressure for brake actuation, said valve comprising a main hollow body part, a plurality of chambers defined in said body part and including a pressure inlet chamber, a pressure outlet chamber and a pressure regulating and displacement chamber, a movable valve part located between said inlet and pressure outlet chambers and adapted to control the flow of the pressure liquid therebetween, another movable valve part located between said pressure outlet chamber and said pressure regulating and displacement chamber, a choke extending through said last mentioned movable valve part placing said last mentioned chamber in restricted isolation from said pressure outlet chamber, common actuator means for said movable valve parts, the latter being moved one by the other in the operation of said actuator means to apply the brake, displacement means in said regulating and displacement chamber actuated by the restricted flow of liquid pressure through said choke to delay the pressure build-up in said regulating and displacement chamber, said displacement means being constructed and arranged to have an initial movement to increase the volume of said regulating and displacement chamber independently of said actuator means, and an operative connection between said actuator means and said displacement means effective following said initial movement to produce a delayed load feel against said actuator means.

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