Aug. 4, 1942. W. LORENZ 2,292,278

PRESSURE SYSTEM

Filed Aug. 15, 1939

Fig. 3.

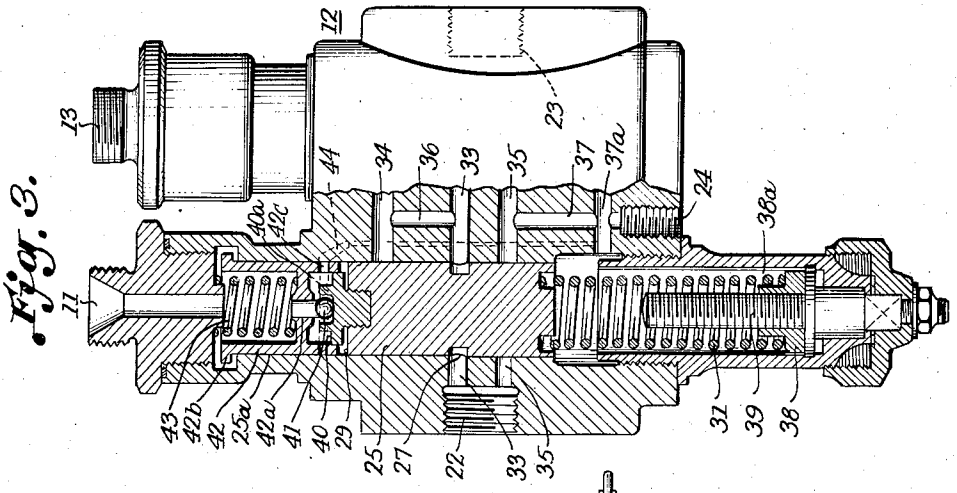


Fig. 1.

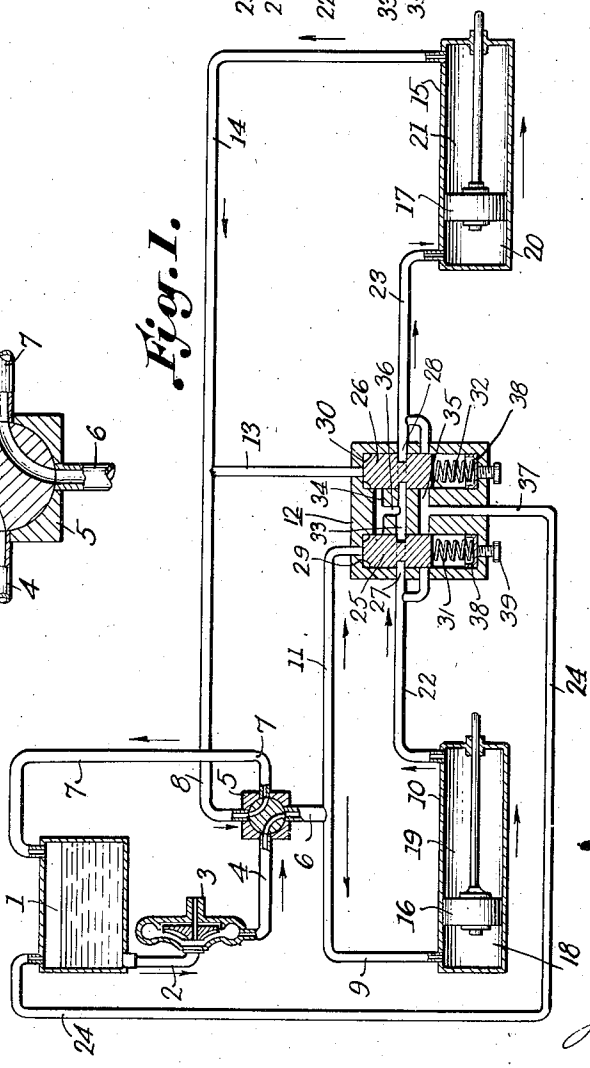
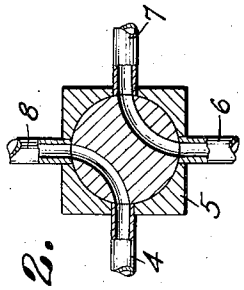


Fig. 2.



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PRESSURE SYSTEM

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3 Claims. (Cl. 60—97)

This invention relates to improvements in pressure systems, and refers particularly to systems wherein a plurality of separate devices are to be operated at the same time by hydraulic or pneumatic pressure.

For instance, for various airplane parts, such as retractable landing gear, wherein two separate parts, or halves, are included in one system but are operated by separate actuating devices, it is very desirable that they move simultaneously and equally. In most systems it is very difficult, if not impossible, to accomplish this, due to the fact that different resistances must be overcome by each actuating means and the normal tendency is for the device against which least resistance is exerted to move first. This is naturally always the case when the system is so arranged that the actuating means operate in parallel; and moreover in systems so arranged it is generally deemed necessary to provide volume distributors to equalize the flows to the different actuating means. There are also objections to a system wherein the actuating means operate in series, not the least of which is that the displacement in all the actuating means must be the same; or again, in a hydraulic system, if air should be present in the line between two actuating means arranged in series, due to its compressibility, it will very probably prevent the second part to be moved reaching the end of its movement, so that any locking device provided to retain that second part in its end position cannot function, due to the fact that that position is not quite reached.

It is an object of this invention to provide a pressure system wherein the aforementioned drawbacks are overcome, and wherein means are provided for operating a plurality of actuating means simultaneously and substantially equally even if the resistances to be overcome by the separate actuating means differ materially.

Another object of the invention is to provide a pressure system wherein the separate actuating means are normally operated in series, and wherein means are provided for automatically switching the device to operate in parallel by excessive pressure built up in one of the feed lines; thereby providing a pressure system wherein less pressure is required than when operating only in series, and at the same time eliminating the necessity for volume distributors above referred to.

A further object of the invention is to provide an equalizing valve for such pressure systems wherein means are provided for normally permitting the passage of liquid, or fluid, displaced from one cylinder to flow to another so that the pistons therein may be operated in series; wherein automatic means are provided for connecting the feed line when in use directly to the second cylinder as soon as excessive pressure is built up in that feed line; and wherein means are provided for automatically resetting the equalizing valve so that series operation of the cylinders again results as soon as a sufficient drop occurs in the feed line.

Having thus briefly and broadly stated some of the objects and advantages of the invention I will now proceed to describe a preferred embodiment thereof, with the aid of the accompanying drawing, in which:

Figure 1 illustrates a lay-out of my pressure system.

Figure 2 is an enlarged detail in section showing the operating valve, and

Figure 3 is an enlarged view, partly in section, showing the equalizing valve.

Referring to the drawing, 1 designates a reservoir intended to contain suitable liquid, which is connected by a pipe 2 to a pump 3 the discharge from which is delivered through a line 4 which terminates in a valve 5 to which pipes 6, 7 and 8 are also connected. Extending from the pipe 6 are two branches 9 and 11, the former terminating in one extremity of a cylinder 10, and the latter in an equalizing valve 12. Similarly two branches 13 and 14 extend from the pipe 8, the former to the equalizing valve 12 and the latter to one extremity of a cylinder 15. The pipe 7 extends from the valve 5 back to the reservoir 1. Thus by turning the operating valve the pump discharge may be selectively connected to either pipe 6 or 8, and the other pipe 8 or 6 connected to the reservoir 1.

Provided in the cylinders 10 and 15 are pistons 16 and 17 which divide these cylinders into chambers 18 and 19, and 20 and 21 respectively. Extending from the ends of the cylinders 10 and 15 remote from the pipes 9 and 14 are lines 22 and 23 respectively which are normally connected to one another through the equalizing valve 12 so that liquid displaced from the chamber 19 of the cylinder 10 flows into the chamber 20 of the cylinder 15 upon admission of liquid under pressure through the pipe 9 into the chamber 18 whereby the piston 16 is moved to the opposite end of its stroke.

Referring now to the equalizing valve 12. Provided in the latter are two spaced parallel plungers 25 and 26 the extremities 29 and 30 of which

are normally retained towards the extremities of the valve through which the pipe inlets 11 and 13 extend by springs 31 and 32 respectively, and formed around these plungers 25 and 26 are annular groove 27 and 28 respectively which are usually in transverse alignment. I also provide means for adjusting the tension of the springs 31 and 32 so that the valve 12 may be set to operate at different working pressures. In this instance this arrangement consists of a screw 39 extending into each spring 31 and 32 which engages a nut 38 suitably held against rotation in a sleeve 38a depending from the valve body and forming a part thereof.

Provided in the body of the valve 12 at right angles to the axes of the plungers 25 and 26 are three passages 34, 33 and 35. The passage 34 terminates at opposite ends in the bores wherein the said plungers are mounted and somewhat above the latter when they are in their lowered positions. The passage 33 extends through the valve 12 in alignment with the normal positions of the plunger grooves 27 and 28, and is connected to the passage 34 by an aperture 36 formed in the body of the valve. The passage 35 also extends transversely through the body of the valve and is connected at its extremities, either exteriorly of the valve as shown in Figure 1, or within the latter as shown in Figure 3, to the lines 22 and 23. Extending through the valve body from the passage 35 is an outlet 37 from which a line 24 extends back to the reservoir 1, and connecting the said outlet with the lower portions of the bores wherein the plungers 25 and 26 are mounted are suitable apertures 37a.

As the detailed arrangement of the plungers 25 and 26 and their coacting parts is identical I will now describe the arrangement relative to the plunger 25 with the aid of Figure 3. Projecting upwardly from the plunger 25 and having a shank in threaded engagement therewith is an insert 40 of smaller diameter than the said plunger, and having an annular retaining wall 40a upon its upper face to encircle a ball 41. Mounted for axial movement in the bore 25a coaxial with the plunger 25 is a hollow auxiliary plunger 42 the lower portion of which is a good sliding fit around the insert 40. Formed integral with the said auxiliary plunger intermediately of its length is an annular flange 42a the underside of which is normally seated upon the ball 41 by a spring 43 extending between the top of the said flange 42a and the adjacent end of the bore 25a. The upper extremity of the said bore 25a is of increased diameter to receive an external flange 42b formed around the upper extremity of the auxiliary plunger 42 and limit the axial movement of the latter. Formed radially through the said plunger 42 beneath the annular flange 42a is an aperture 42c which is adapted to register with an opening 44 formed in the valve body and connected to the outlet 37.

The operation of the system is as follows:

When the operating valve is in the position shown in Figure 1 liquid under pressure is delivered from the pump 3 through the pipe 6 to the branches 9 and 11. The liquid delivered into the chamber 18 causes movement of the plunger 16 thereby displacing the liquid in the chamber 19 and discharging it through the line 22, the passage 33 and grooves 27 and 28 and the line 23 to the chamber 20, thereby moving the piston 17 and discharging the liquid from the chamber 21 through the branch 14, pipe 8, valve 5 and pipe 7 to the reservoir 1. However, if excessive pressure is built up in the branch 11 this pressure overcomes the tension of the spring 31 by exerting pressure upon the top of the flange 42a and forcing the auxiliary plunger 42 downward until its flange 42b contacts the shoulder formed around the lower end of the enlarged portion of the bore 25a, by which time the said auxiliary plunger has moved downward sufficiently to close the aperture 44, which normally prevents an accumulation of pressure beneath the said flange 42a. Then the pressure unseats the ball 41 and the liquid flows beneath the annular flange 42a and exerts pressure upon the insert 40 and forces the latter downwardly in the bore of the auxiliary plunger 42 until the said insert is free from the latter, whereupon the liquid exerts pressure directly upon the top of the plunger 25 and forces it down sufficiently to open the passage 34. As the plunger 26 has meanwhile remained stationary the liquid then flows from the passage 34 through the aperture 36 to the passage 33, around the annular groove 28, and through the line 23 to the chamber 20.

Due to the fact that the effective area of the insert 40 against which pressure is exerted while within the auxiliary plunger 42 is less than the effective area of the plunger 25 against which pressure is subsequently exerted, greater pressure is required to move the plunger in its former stage than in the latter. In this way provision is made for obtaining rapid and sensitive movement of the plunger 25 during the final part of its movement; and again, due to this arrangement the system will continue to work in parallel even after a slight drop in pressure due to the increased effective area of the plunger 25 upon which pressure is then being exerted. However when a sufficient drop in pressure exerted through the pipe 11 occurs the spring 31 again raises the plunger 25 to its normal position so that the equalizing valve 12 is automatically returned to such position that the system again operates in series. It will also be noted that when the plunger 25 is at its lowered position the line 22 is connected to the outlet 37 by the passage 35 and the annular groove 27 so that continued movement of the piston 16 is permitted and liquid from the chamber 19 is discharged to the reservoir 1.

Obviously if the operating valve 5 is set as shown in Figure 2, the direction of movement of the pistons 17 and 16 is reversed, and the flow then occurs through the pipe 8, branches 13 and 14, and normally from the chamber 20 through the line 23, the valve 12, and line 22 to the chamber 19; and from the chamber 18 back to the reservoir 1 through the pipes 9, 6 and 7 and the operating valve 5. If excess pressure is built up in the branch 13 the operation of the plunger 26 is similar exactly to the operation of the plunger above described.

While the preferred embodiment of the invention has been described and shown, it is understood that this system may be adapted to include any desired number of working cylinders, and that the construction shown is susceptible to such alterations and modifications as fall within the scope of the appended claims; and while throughout the description mention has been made of the use of liquid, it is understood that the system can be equally successfully operated by other fluid under pressure.

What I claim is:

1. A pressure mechanism for simultaneously operating a plurality of control devices comprising a pair of cylinders each having a piston and having ports at its opposite ends, an equalizing valve device having ports connected to a port of each cylinder and a main passage normally placing said latter cylinder ports in communication and having additional ports, a source of fluid under pressure, a main operating valve connected thereto, pipes connecting said main operating valve with the other port of each cylinder and with the source of fluid, a branch extending from each of said port-connecting pipes to one of said additional ports of the equalizing valve device, said device including passages connecting each branch-connected port with the main passage therein, a pair of valves in the equalizing valve device each cooperating with one of the cylinder-connected ports of the equalizing valve device and with one of the branch-connected ports thereof, and means biasing each of said last-named valves normally to keep the cooperating cylinder-connected port of the equalizing valve device open and the cooperating branch-connected port closed for series operation of the pistons and yieldable at predetermined pressure in the corresponding branch whereby one valve of said last named valves will move to close the cooperating cylinder-connected port and open the cooperating branch-connected port and its connection to the main passage for parallel operation of the pistons.

2. A pressure mechanism for simultaneously operating a plurality of control devices comprising a pair of cylinders each having a piston and having ports at its opposite ends, an equalizing valve device having ports connected to a port of each cylinder and a main passage normally placing said latter cylinder ports in communication and having additional ports, a source of fluid under pressure, a main operating valve connected thereto, pipes connecting said main operating valve with the other port of each cylinder and with the source of fluid, a branch extending from each of said port-connecting pipes to one of said additional ports of the equalizing valve device, said device including passages connecting each branch-connected port with the main passage therein, a pair of valves in the equalizing valve device each cooperating with one of the cylinder-connected ports of the equalizing valve device and with one of the branch-connected ports thereof, spring means biasing each of said last-named valves normally to keep the cooperating cylinder-connected port of the equalizing valve device open and the cooperating branch-connected port closed for series operation of the pistons and yieldable at predetermined pressure in the corresponding branch whereby one valve of said last named valves will move to close the cooperating cylinder-connected port and open the cooperating branch-connected port and its connection to the main passage for parallel operation of the pistons, and means for adjusting the spring means to vary the pressure in said branch at which said one valve operates.

3. A pressure mechanism for simultaneously operating a plurality of control devices comprising a pair of cylinders each having a piston and having ports at its opposite ends, an equalizing valve device having ports connected to a port of each cylinder and a main passage normally placing said latter cylinder ports in communication and having additional ports, a pump for fluid, a main operating valve connected to the discharge of said pump, pipes connecting said main operating valve with the other port of each cylinder and with the source of fluid, a branch extending from each of said port-connecting pipes to one of said additional ports of the equalizing valve device, said device including passages connecting each branch-connected port with the main passage therein, a pair of valves in the equalizing valve device each cooperating with one of the cylinder-connected ports of the equalizing valve device and with one of the branch-connected ports thereof, means biasing each of said last-named valves normally to keep the cooperating cylinder-connected port of the equalizing valve device open and the cooperating branch-connected port closed for series operation of the pistons and yieldable at predetermined pressure in the corresponding branch whereby one valve of said last named valves will move to close the cooperating cylinder-connected port and open the cooperating branch-connected port and its connection to the main passage for parallel operation of the pistons, and a return line extending from the equalizing valve device to the intake of said pump normally closed by the valves in said device and adapted to be opened by further movement of either of said last-named valves resulting from a predetermined higher pressure in either of the branches.

WALTER LORENZ.