Oct. 25, 1949. J. JEROME 2,486,164

VALVE

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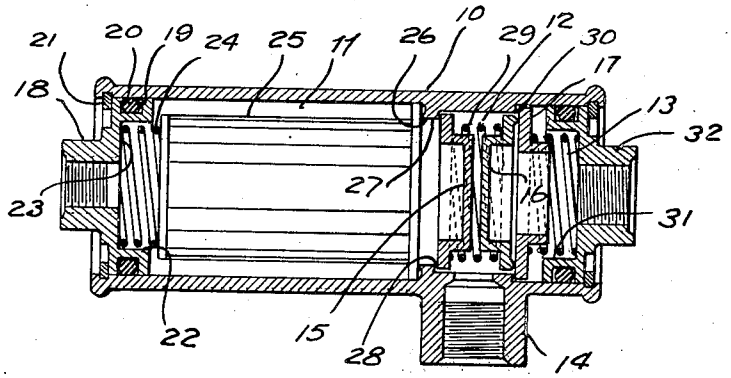
Fig. 1.



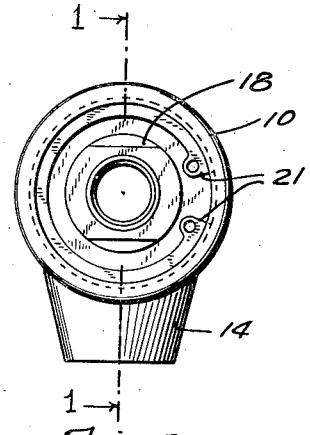


Fig. 2.

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VALVE

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7 Claims. (Cl. 277—60)

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This invention relates to a valve, and more particularly to what might be termed a pressurizing valve for use in conjunction with the oil reservoir of a hydraulic system.

In certain types of hydraulic systems, as, for example, one used for controlling or operating various parts of an aircraft, it has been found necessary to pressurize the fluid reservoir to a pressure above that of the prevailing atmospheric pressure at the ceiling altitude of the airplane. This must be done in order to maintain a supply of vaporless fluid for the hydraulic pumps at high altitude. Accordingly, means must be provided for introducing air under pressure to the fluid reservoir, and at the same time preventing air flow from the reservoir either to the pressure source or to the atmosphere when the atmospheric pressure is less than the pressure desired to be maintained in the reservoir. This latter condition is, of course, quite often the case, as it is desirable to maintain the reservoir pressure near the value of atmospheric pressure at sea level. Heretofore, such hydraulic systems, in order to maintain the above referred to conditions, have necessarily included three or more valves and filters, all installed and operating independently of one another, thus complicating the system and rendering adjustment as well as servicing thereof a difficult and time-consuming operation.

It is accordingly among the objects of this invention to provide a single valve unit which will permit flow of air under pressure from a pressure source into the oil reservoir, but not a return flow, or will permit flow of air from atmosphere to the reservoir when reservoir pressure is less than atmospheric pressure, and which will also provide relief for reservoir pressure in excess of a predetermined maximum. Another object is to provide a valve of the above nature characterized by structural simplicity and reliable operation, which is amenable to mass production methods as well as easy installation in the hydraulic system. Other objects will be in part apparent and in part pointed out hereinafter.

In accordance with one form of the invention, the valve unit comprises a chambered body having an inlet port connectable with a pressure source, another port open to atmosphere, and a third port connectable with the fluid reservoir of the hydraulic system. The valve chamber is provided with a plurality of seats against which a number of poppets are seatable, one adapted to permit air flow from the pressure inlet port to the reservoir, but not a return, another poppet open-

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able to communicate the atmosphere port with the reservoir port, and still another poppet which together with the second comprises a relief valve between the reservoir and atmosphere ports, the double function of the second-mentioned poppet being effected by reason of the fact that it is seated on the third poppet. The valve chamber also may include an air filter disposed between the pressure inlet and reservoir ports.

In the drawing, wherein I have shown one form of my invention,

Figure 1 is a sectional elevation taken along the line 1—1 of Figure 2; and,

Figure 2 is an elevation of the left-hand end of Figure 1.

Similar reference characters refer to similar parts throughout the views of the drawing.

As shown in Figure 1, the valve includes a body 10, comprising an air filter chamber 11, a poppet chamber 12, an atmosphere chamber 31, and a reservoir port 14 adapted to be connected to the fluid reservoir. In the poppet chamber 12 are three poppets 15, 16 and 17. Poppet 15 permits air flow through air filter chamber 11 to reservoir port 14, but not a return. Poppet 16 permits air flow from atmosphere chamber 31 to reservoir port 14, but not a return, and poppet 17 permits pressure relief from reservoir port 14 to atmosphere chamber 31 if the reservoir pressure exceeds a predetermined maximum, all as will be described in detail hereinbelow.

In the left-hand end of valve body 10 is a pressure inlet port 18 which may be secured in the valve body in any suitable manner, and is provided with an annular groove 19 in which is disposed packing 20. This port is held in the valve body in any suitable manner as, for example, by a snap ring 21, and includes a chamber 22, the bottom 23 of which affords a seat for a spring 24 which bears against one end of an air filter 25 to force the air filter against a seat 26 formed at one edge of an annular rib 27 projecting inwardly from valve body 10 between filter chamber 11 and poppet chamber 12. Pressure inlet port 18 may be connected to any suitable source of pressure on an aircraft, for example, to the carburetor intake manifold, cabin pressure pump or supercharger, as may be desired or convenient.

The valve body rib 27 also provides a seat 28 for poppet 15, against which the poppet is held by a spring 29 disposed between poppets 15 and 16 and biasing them in opposite directions. Poppet 16 being forced to the right, as viewed in Figure 1, seats against poppet 17 which, in turn, is held against a seat at the right-hand end of the poppet chamber 12 by a spring 13 disposed

in the atmosphere chamber 31. The right-hand end of spring 13 rests against an atmosphere port 32 which may be identical to pressure inlet port 18, being held at the right-hand end of valve body 10 in the same manner.

It will now appear that poppets 15 and 16 are check valves, i. e. these poppets permit flow of air to reservoir port 14 from the pressure or atmosphere inlets, but prevent flow of air from the reservoir port to the pressure or atmosphere ports. It will further appear that poppet 17 is a relief valve past which air can flow from reservoir port 14 to the atmosphere port 32 when reservoir pressure exceeds the pressure of spring 13 which holds poppet 17 against its seat 30. The pressure of spring 13 is sufficient to maintain relief poppet 17 on its seat against a back pressure derived from reservoir port 14 equal to the maximum pressure permitted in the reservoir.

Spring 29, on the other hand, maintains poppets 15 and 16 against their respective seats, i. e. seat 28 and poppet 17, under all conditions other than when a very light pressure is applied from either inlet port 18 or atmosphere port 32 to open either of them. These poppets, of course, remain closed as long as the pressure in the reservoir and acting in poppet chamber 12 is greater than either the pressure at the inlet port 18 or the pressure in atmosphere chamber 31.

In normal operation, and assuming that the reservoir pressure equals atmospheric pressure, air under pressure from the pressure source enters the valve through port 18, is filtered as it passes through filter 25, and exerts sufficient force on poppet 15 to move the poppet from its seat 28 and flow into reservoir port 14 and thus to the reservoir. This air flow continues until the reservoir pressure reaches a value almost equal to that of the pressure source, the difference between reservoir pressure and that of the pressure source being represented by the force of spring 29. As fluid is drained from the fluid reservoir, additional air is, of course, drawn into the reservoir from the pressure source. When, however, fluid is returned to the reservoir, the air space therein is reduced and consequently reservoir pressure rises to a value above that of the pressure source. If the reservoir pressure exceeds a predetermined maximum value, it exerts sufficient force against relief poppet 17 to overcome the force of spring 13, thus forcing the relief poppet away from its seat 30 to exhaust air from the reservoir to atmosphere. Air continues thus to exhaust until the reservoir air pressure is reduced to a value less than the force of spring 13, whereupon relief poppet 17 closes.

In the event that the pressure at the pressure source falls below that of reservoir pressure, poppet 15 acts as a check valve to prevent escape of air from the reservoir back to the pressure source. Of course, if the pressure at the pressure source is low, and reservoir pressure is less than atmospheric, poppet 16 open and air flows from the atmosphere into the reservoir, thus to maintain the pressure in the reservoir at a value only slightly less than atmospheric, i. e. the minimum pressure of the reservoir under such conditions would equal the atmospheric pressure less the pressure differential across check valve poppet 16, which results from the force of the spring 29.

Thus it may be seen that I have combined into a compact, inexpensive and simple unit, the several functions of a plurality of valves necessary to maintain air pressure in the oil reservoir of the hydraulic system.

As many possible embodiments may be made of the above invention, and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a valve construction, in combination, a valve body having a pressure inlet port connectable with a pressure source, an atmosphere port in communication with the atmosphere and a reserve port connectable with a reservoir or the like in which pressure is to be maintained, a check valve in said body between said inlet and reservoir ports for passage of air from said inlet to said reservoir port when the pressure at said reservoir port falls below the pressure at said inlet port, the combination of a second check valve and a relief valve mounted between said atmosphere and reservoir ports, said second check valve retained closed by resilient means and seated against said relief valve, said relief valve retained closed by a resilient means and opening in an opposite direction to the second check valve to relieve the pressure from said reservoir port when it exceeds a predetermined maximum.

2. In a valve construction, in combination, a valve body having a pressure inlet port connectable with a pressure source, an atmosphere port in communication with the atmosphere and a reserve port connectable with a reservoir or the like in which pressure is to be maintained, a check valve in said body between said inlet and reservoir ports for passage of air from said inlet to said reservoir port when the pressure at said reservoir port falls below the pressure at said inlet port, the combination of a second check valve and a relief valve mounted between said atmosphere and reservoir ports, said second check valve retained closed by resilient means and seated against said relief valve, said relief valve seated against said valve body and said relief valve providing a seat for said second check valve, said relief valve retained closed by a resilient means and opening in an opposite direction to the second check valve to relieve the pressure from said reservoir port when it exceeds a predetermined maximum.

3. In a valve construction, in combination, a valve body having a pressure inlet port connectable with a pressure source, an atmosphere port in communication with the atmosphere and a reserve port connectable with a reservoir or the like in which pressure is to be maintained, a check valve in said body between said inlet and reservoir ports for passage of air from said inlet to said reservoir port when the pressure at said reservoir port falls below the pressure at said inlet port, the combination of a second check valve and a relief valve mounted between said atmosphere and reservoir ports, said second check valve retained closed by resilient means and seated against said relief valve, said first and second check valves and said relief valve being axially aligned in said valve body, said relief valve retained closed by a resilient means and opening in an opposite direction to the second check valve to relieve the pressure from said reservoir port when it exceeds a predetermined maximum.

4. A valve in accordance with claim 1 wherein said relief valve includes a portion constituting a seat for said second check valve.

5. A valve in accordance with claim 1 wherein said relief valve includes a portion constituting a seat for said second check valve, and spring means

for forcing said second check valve against said relief valve.

6. In a valve construction, in combination, a valve body having a pressure inlet port connectable with a pressure source, an atmosphere port in communication with the atmosphere and a reserve port connectable with a reservoir or the like in which pressure is to be maintained, a check valve in said body between said inlet and reservoir ports for passage of air from said inlet to said reservoir port when the pressure at said reservoir port falls below the pressure at said inlet port, the combination of a second check valve and a relief valve axially aligned with said first check valve, said second check valve and relief valve checking the passage of air from said reservoir port to said atmosphere port when the reservoir pressure is more than atmospheric pressure, and said relief valve allowing the atmospheric pressure to pass therethrough when said reservoir pressure is less than atmospheric pressure.

7. In a valve construction, in combination, a valve body having a pressure inlet port connectable with a pressure source, an atmosphere port in communication with the atmosphere and a reservoir port connectible with a reservoir or the like in which pressure is to be maintained, a first check valve in said body between said inlet and reservoir ports for passage of air from said inlet to said reservoir port when the pressure at said reservoir port falls below the pressure at said

inlet port, a second check valve in said body between said atmosphere and reservoir ports for passage of air from said atmosphere to said reservoir port when the pressure at said reservoir port falls below the pressure at said atmosphere port, a relief valve in said body between said reservoir and atmosphere ports for passage of air from said reservoir port to said atmosphere port when the pressure in said reservoir port is more than atmospheric pressure, and independent pressure means for both said second check valve and said relief valve to retain them in a normal closed position, the said pressure means for retaining said relief valve closed being less than the said pressure means for retaining said check valve closed.

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