

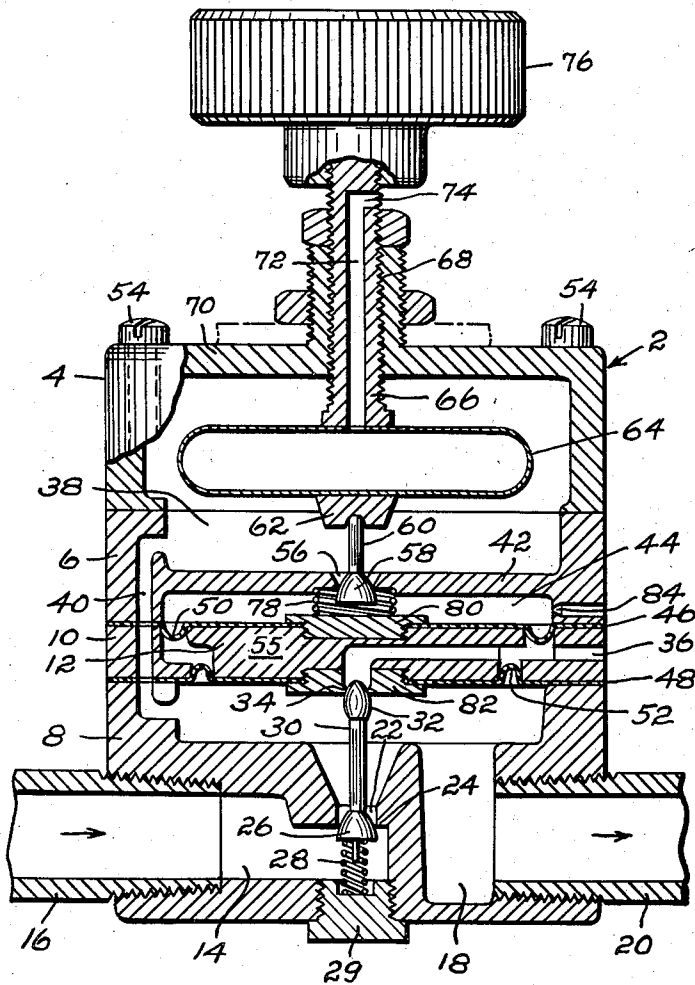
March 31, 1959

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2,879,783

MANOSTAT

Filed Nov. 7, 1956



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MANOSTAT

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Application November 7, 1956, Serial No. 620,920

16 Claims. (Cl. 137—116.3)

This invention is concerned with a new and novel construction of a manostat used in controlling the feed pressure to air gauges. Manostats are designed for use in controlling and maintaining at a substantially constant figure the downstream pressure of a fluid which is supplied by a higher upstream pressure.

The present manostat may be termed an indirect operated low-drift regulating valve and one of the objects of the invention is the provision of means for causing prompt and adequate opening of the supply valve immediately upon the downstream pressure falling below the required value to bring the pressure up to the required value. Conversely, when the downstream pressure is restored to the predetermined value, the supply is promptly cut off. If, at any time, there should be excess downstream pressure a relief valve will function to drain off such excess pressure thereby to maintain the pressure at the predetermined value within very narrow limits.

In maintaining the predetermined value the mechanism so functions that even when gaseous fluid on the downstream side is not being used or drawn off there will be a continuous opening and closing of the several valves so that a small quantity of the fluid is being constantly bled off to the atmosphere, all resulting in the downstream pressure fluctuating continuously between very narrow limits. Under other conditions when the downstream fluid is being used in quantity, the supply valve will be correspondingly opened fully either to maintain the downstream pressure or if it cannot be maintained because of excessive use, to re-build it in a minimum time.

A further object of the invention is the provision of a construction in which the supply valve and the relief valve may readily be removed for cleaning purposes and if need be, the entire unit may be completely disassembled for inspection or replacement of any parts, if necessary.

A further object of the invention is the inclusion of means in the manostat whereby the controlled downstream pressure may be selected, as desired, within a wide range, varying from slightly above atmospheric to a small amount below the available upstream pressure.

These and other objects of the invention will be more clearly understood as the description proceeds with the aid of the accompanying single figure of the drawing which shows the manostat in vertical section. Since the manostat in a preferred form is substantially symmetrical in all vertical sections, it is believed that a single sectional view will be sufficient for illustrative purposes.

Referring now more specifically to the drawing, there is a casing generally indicated at 2 having an upper section 4, an intermediate section 6 and a lower section 8. The sections 6 and 8 are separated by a spacer section 10 which is utilized in mounting an internally located annular element referred to as a spacer ring 12.

Lower section 8 has a suitable inlet or upstream port 14 which may be connected by a pipe 16 with a source of high pressure fluid. An outlet or downstream port 18

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may be connected by pipe 20 to a suitable container in which the fluid is stored at the required regulated pressure.

Between the inlet and outlet ports 14 and 18 is a passage 22 having a valve seat 24 adapted to be engaged by a supply valve 26, which valve is constantly urged towards closed position by spring 28, supported in turn by a screw threaded removable plug 29.

A valve stem 30 extends upwardly from valve 26 and has on its upper end relief valve 32 which is adapted to make engagement with valve seat 36 appropriately mounted on spacer ring 12. Leading from the relief valve 32 through spacer ring 12 and spacer section 10 to the atmosphere is a radially extending port 36 through which downstream fluid may escape if the pressure exceeds the predetermined value. Relief valve 32 is smaller in diameter than passage 22, so that upon removal of plug 29, supply valve 26 and relief valve 32 may be removed for repair or replacement.

Within the confines of the generally cylindrical upper section 4 and the upper part of the intermediate section 6 is a control chamber 38 which is in communication with the outlet port 18 and downstream pressure by means of one or more passages 40 extending through the spacer section 10. A horizontal wall 42 integral with the intermediate section 6 constitutes the lower wall of control chamber 38. On the lower side of wall 42 is a pilot pressure chamber 44 which chamber is closed on its lower side by the previously referred to spacer ring 12 and an interposed diaphragm 46. This ring is held in place by the said upper diaphragm 46 and a lower diaphragm 48. Upper diaphragm 46 has a downwardly turned circular movable convolution 50 and the lower diaphragm 48 has an upwardly turned circular movable convolution 52. The outer peripheries of diaphragms 46 and 48 are clamped between the sections 6, 10 and 8 in the manner shown, being firmly secured by a plurality of bolts 54 of which two are shown and which are threaded at their lower ends to make threaded engagement with lower section 8, thereby to draw all of the several sections tightly together. The spacer ring 12 and the upper and lower diaphragms 46 and 48 together constitute a movable wall 55 subject on its under side to the outlet pressure and on its upper side to the pressure in pilot pressure chamber 44. The pressure in chamber 44 is a variable pressure ranging from atmospheric as a minimum to the substantially outlet pressure as a maximum, all of which will be explained in detail hereinafter.

Centrally located of wall 42 is a port 56 leading from control chamber 38 to pilot pressure chamber 44. This port may be closed by upward movement of a pilot valve 58 having an upwardly extending stem 60 which is affixed to a suitable support 62 mounted on the underside of a measuring capsule or pressure sensitive device 64. This device of thin sheet metal is circular in horizontal section and on its upper side is affixed to a threaded tubular adjusting stem 66 which stem makes threaded engagement with an internally threaded boss 68 that extends upwardly from the center of the upper wall 70 of upper section 4. The passage 72, which is in direct connection with the interior of device 64, leads to the atmosphere through the laterally extending opening 74. A handle 76 is affixed to the upper end of stem 66 so that by rotation thereof the position of pilot valve 58 with respect to valve seat 56 may be varied as needed. By means of this adjustment the downstream pressure may be controlled in a manner that will hereinafter be more fully explained.

Centrally located in pilot pressure chamber 44 is a small helical compression spring 78, stronger than spring 28, which bears on threaded pad 80 and acts constantly to

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urge the spacer ring 12 downwardly. The exterior flange of pad 80 serves to hold the center interior periphery of diaphragm 46 tightly in place on the upper surface of spacer ring 12. The flange on the lower threaded pad 82, in which is also located valve seat 34, serves a similar purpose to hold the central portion of diaphragm 48 securely against the lower side of the spacer ring 12.

A small restricted passageway 84 leads from pilot pressure chamber 44 to the atmosphere. This is a very small opening in the order of .010" in diameter and its purpose will shortly be explained.

Diaphragms 46 and 48 are apertured at those areas in alignment with port 40 so that fluid may flow freely between outlet chamber 18 and control chamber 38. Thus the downstream pressure is at all times present in the control chamber 38.

With the foregoing construction in mind, the operation of the manostat will now be explained. If we start the operation with the pressure on the downstream side below the desired value and with the pressure in the control chamber 38 at the same reduced pressure, pilot valve 58 will be open and due to the low pressure in outlet port 18 the movable wall 55 comprised of spacer ring 12 and diaphragms 46 and 48 will be forced downwardly by spring 78 sufficiently to have engaged relief valve 32, and acting through stem 30, to have moved supply valve 26 downwardly to maximum open position. Under these conditions relief valve 32 being engaged by valve seat 34 will be closed.

With supply valve 26 open, the high pressure upstream supply of fluid will flow through port 22 and thence through the outlet port 18 to the downstream container. Gradually the downstream pressure will build up to approach the desired value. As this pressure increases downstream, the pressure in control chamber 38 will correspondingly increase and likewise fluid flowing through open port 56 will cause a build-up of pressure in pilot pressure chamber 44. Since at this stage fluid will enter chamber 44 through port 56 faster than it can escape through small restricted passageway 84, the pressure in control chamber 38 and pilot pressure chamber 44 will be substantially the same so long as pilot valve 58 remains open.

As the downstream pressure is increased and the desired value is approached (and this pressure is determined by the setting of valve stem 66 and its related pilot valve 58), the pressure in control chamber 38 will increase correspondingly to cause gradual collapse of device 64 to raise valve 58 to closed position. As soon as valve 58 closes, the pressure in pilot pressure chamber 44 drops rapidly as the fluid exhausts to the atmosphere through passageway 84. Thus a large pressure differential acting upwardly on diaphragm 48 with respect to downward pressure on diaphragm 46 develops causing the movable wall 55 to move upwardly at an accelerated rate permitting corresponding upward movement of relief valve 32 and supply valve 26 under the influence of the spring 28. Upon sufficient upward movement of movable wall 55 valve 26 will be closed and the desired downstream pressure will have been attained.

The following explanation of the functioning of the valve will show how the downstream pressure is continuously thereafter maintained at this value. Let us assume that some of the downstream fluid is used, thereby to cause a drop in the downstream pressure. Immediately the pressure falls below the required value, the pressure in control chamber 38 correspondingly falls, causing slight but immediate opening of pilot valve 58. This small opening of valve 58 is nevertheless much larger than the restricted passageway 84 and hence, due to the small volume of pilot pressure chamber 44, the pressure in chamber 44 instantly builds up to a pressure substantially in excess of atmospheric and may, if pilot valve 58 is open sufficiently, reach a figure substantially equal

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to control chamber 38. With the effective forces on the upper and lower sides of movable wall 55, now substantially equal, spring 78 acts to move movable wall 55 downwardly immediately, thereby opening supply valve 26 an appreciable amount, thus enabling high pressure upstream fluid to flow in large quantity into the outlet chamber, thereby to restore the downstream pressure quickly to its required figure.

In the form of movable wall shown the effective area of diaphragm 46 on which the pressure in chamber 44 acts may be somewhat larger than the effective area of diaphragm 48 on which the downstream pressure acts, thus giving a quicker response than would be the case if the diaphragms were equal in effective area. However, it is to be understood that the diaphragms may be of equal or unequal areas depending on the particular type of response desired.

From the foregoing explanation, it is believed clear that a slight opening of pilot valve 58 will produce an immediate and substantial opening of supply valve 26. Thus, a small deviation of downstream pressure below the desired value will result in substantial opening of the supply valve 26 to provide immediate restoration of the required pressure.

Conversely, over-running on the high side is limited because, upon closure of pilot valve 58 which occurs as soon as the required pressure is restored in control chamber 38, there follows a substantial and immediate drop in the pressure in pilot pressure chamber 44, thus causing quick upward movement of movable wall 55 accompanied by corresponding quick closure of supply valve 26.

If fluid is not being withdrawn from the downstream supply, then any leakage that may occur, either through relief valve 32, pilot valve 58 or other valves or connections associated with the downstream tank or container, will be compensated for in the same manner just described but all of the valve movements will be of a limited nature just sufficient to constantly restore the downstream pressure to the required value.

If it is desired to raise the controlled downstream pressure to a new higher value, then valve stem 66 should be screwed downwardly to increase the normal opening between pilot valve 58 and valve seat 56. In this way greater pressure will be required in control chamber 38 before valve 58 is closed and hence, supply valve 26 will stay open for a longer time so that this required higher pressure can be built up. Conversely, if the controlled downstream pressure is to be reduced, then valve stem 66 will be screwed upwardly to decrease the normal opening between valve 58 and valve seat 56.

Since atmospheric pressure in any given location is substantially constant, it is apparent that if desired the handle 76 can be calibrated to permit the manostat to be set to give any required pressure. If the handle is not calibrated, then reference may be made to a pressure gage on the downstream container and the handle adjusted until the desired downstream pressure has been arrived at after which the desired pressure will be maintained until changed by further adjustment of the handle.

It is my intention to cover all changes and modifications of the example of the invention herein chosen for purposes of the disclosures which do not constitute departures from the spirit and scope of the invention.

I claim:

1. A manostat comprising a casing including an inlet port and an outlet port and a movable supply valve and fixed seat therebetween, a movable wall, one side being subjected at all times to the outlet pressure and the other side being subjected to a pilot pressure variable from atmospheric to substantially outlet pressure, a second valve responsive to said outlet pressure, said pilot pressure being determined by the degree of opening of said second valve and means for opening and closing said supply valve in accord with movement of said wall.

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2. A manostat as set forth in claim 1, said wall being carried in said casing by two spaced diaphragms.

3. A manostat as set forth in claim 1, said movable wall having different effective areas on opposite sides.

4. A manostat as set forth in claim 2, said wall having a relief port extending therethrough connecting the outlet port with the atmosphere and a relief valve for closing said relief port movable in unison with said supply valve.

5. A manostat as set forth in claim 1, said means for opening and closing said supply valve comprising an element extending from said supply valve to said wall.

6. A manostat as set forth in claim 5, said wall being carried in said casing by two spaced diaphragms, a relief port extending from said outlet port between said diaphragms to the atmosphere, said element including a relief valve on the end thereof for closing said relief port when said wall moves toward said supply valve.

7. A manostat as set forth in claim 6, and spring means for urging said supply and relief valves in the direction of said wall and other spring means for urging said wall toward said relief valve to augment the force exerted on said one side.

8. A manostat as set forth in claim 1, spring means for urging said wall in the direction of said supply valve to assist in opening said supply valve and other spring means urging said supply valve toward closed position.

9. A manostat as set forth in claim 1, said means for opening said supply valve including a spring constantly urging said wall toward said supply valve and said means for closing said supply valve comprising a second spring effective to move said supply valve toward closed position as said wall is moved away from said supply valve seat.

10. A manostat comprising a casing having therein an inlet port, an outlet port, a first passage therebetween, a supply valve for controlling the flow of fluid through said first passage from said inlet port to said outlet port, a control chamber, a second passage from said outlet port to said control chamber, a pilot pressure chamber having a wall fixed with respect to said casing, a pilot valve port through said wall leading from said control chamber to said pilot pressure chamber, a movable element mounted on said casing by spaced flexible diaphragms, one diaphragm forming a wall of said pilot pressure chamber and the other diaphragm forming a wall of said outlet port, a relief passage in said element extending from said outlet port to the atmosphere, a relief valve fixed with respect to said supply valve for closing said relief passage, spring means constantly urging said supply valve and relief valve toward closed position, other stronger spring means constantly urging said element toward said relief valve, a restricted passage from said pilot pressure chamber to the atmosphere, a pressure measuring device in said control chamber movable as the pressure in said control chamber fluctuates, a pilot valve actuated by said pressure measuring device for closing said pilot valve port when said control chamber pressure increases above a predetermined degree and for opening said pilot valve port when said control chamber pressure decreases below said predetermined degree, whereby pressure in said outlet port below said predetermined degree will cause said pressure measuring device to open said pilot valve and said element will be moved downwardly to close said relief valve and to open said supply valve and whereby pressure in said outlet port above said predetermined degree will cause said device to close said pilot valve thereby to reduce the pressure in said pilot pressure chamber and said element will be moved upwardly to permit closing of said supply valve.

11. A manostat comprising a casing having an inlet port and an outlet port, a movable supply valve and a fixed supply valve seat intermediate the said ports, means urging said supply valve toward closed position, a movable relief valve fixed with respect to said supply valve and a movable cooperating relief valve seat, a control

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chamber subject to outlet port pressure, a pilot pressure chamber with a movable wall subject to opposing variable forces and supporting said relief valve seat, a restricted orifice leading from said pilot pressure chamber to the atmosphere, a pilot valve port leading from said control chamber to said pilot pressure chamber with a fixed valve seat therein, a pressure sensitive device in said control chamber subject to the pressure in said outlet port, a pilot valve cooperating with said fixed valve seat for opening and closing said port under the influence of changing control chamber pressure acting on said pressure sensitive device, whereby the pressure in said pilot pressure chamber can be quickly varied from atmospheric to substantially outlet port pressure and said movable wall will be shifted according to the opposing forces to which it is subjected, said supply valve being opened by downward movement of said movable wall when said relief valve seat is in engagement with said relief valve, and said supply valve being closed when said relief valve seat is out of engagement with said relief valve.

12. A manostat for maintaining the downstream pressure at a required value, comprising a casing having an inlet port and an outlet port and a supply valve therebetween, a movable wall for actuating said supply valve, said wall subject to the pressure in said outlet port on one side and means for varying the pressure on the other side from a minimum not less than atmospheric to a maximum not more than said outlet pressure, said pressure varying means comprising a pilot pressure chamber having a fixed exhaust port and being in communication with said outlet port, the pressure in said pilot pressure chamber being controlled by a movable pilot valve actuated by the outlet pressure, the parts so constructed and arranged that when the outlet pressure is below the required value, said pilot valve and supply valve will be open and when said outlet pressure is above said required value, said pilot valve and supply valve will be closed.

13. A manostat comprising a casing including an inlet port and an outlet port and a supply valve therebetween, a movable wall supported by spaced diaphragms for opening said supply valve, spring means urging said supply valve toward closed position, a control chamber connected with said outlet port, a pilot pressure chamber having a restricted outlet to the atmosphere, a pilot port opening from said control chamber into said pilot pressure chamber, a pilot valve for said pilot port controlled by the pressure in said control chamber, said movable wall subject to the pressure in said outlet port and said pilot pressure chamber, other spring means urging said movable wall toward said supply valve for assisting the pressure in said pilot pressure chamber in moving said wall toward said supply valve to open said valve.

14. A manostat as set forth in claim 13, a relief passage to the atmosphere through said wall and casing, and a relief valve for closing said passage and moving in unison with said supply valve.

15. A manostat comprising a casing including an inlet port and an outlet port and a supply valve therebetween, a movable wall supported by spaced diaphragms, means for transmitting movement of said wall to said supply valve, spring means urging said supply valve toward closed position, a control chamber connected with said outlet port, a pilot pressure chamber having a restricted outlet to the atmosphere, a pilot port opening from said control chamber into said pilot pressure chamber, a pilot valve for said pilot port controlled by the pressure in said control chamber, said movable wall subject to the pressure in said outlet port and said pilot pressure chamber, other spring means urging said movable wall toward said supply valve, the effective operating areas of the opposed sides of said movable wall being unequal.

16. A manostat comprising a casing including an inlet port and an outlet port and a movable supply valve and fixed seat therebetween, a movable wall, a pilot pressure chamber, one side of said wall being subjected to the out-

let pressure and the other side of said wall being subjected to the pressure in said pilot pressure chamber, said pilot pressure chamber having an intake port and an exhaust port, the intake port providing for the transmission of outlet pressure to said pilot pressure chamber and the exhaust port providing for transmission of pressure in said pilot pressure chamber to the atmosphere, a pilot valve for controlling flow of fluid through one of the ports of said pilot pressure chamber and means subject to the outlet

pressure for actuating said pilot valve whereby the pressure in said pilot pressure chamber may be varied when said outlet pressure varies.

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