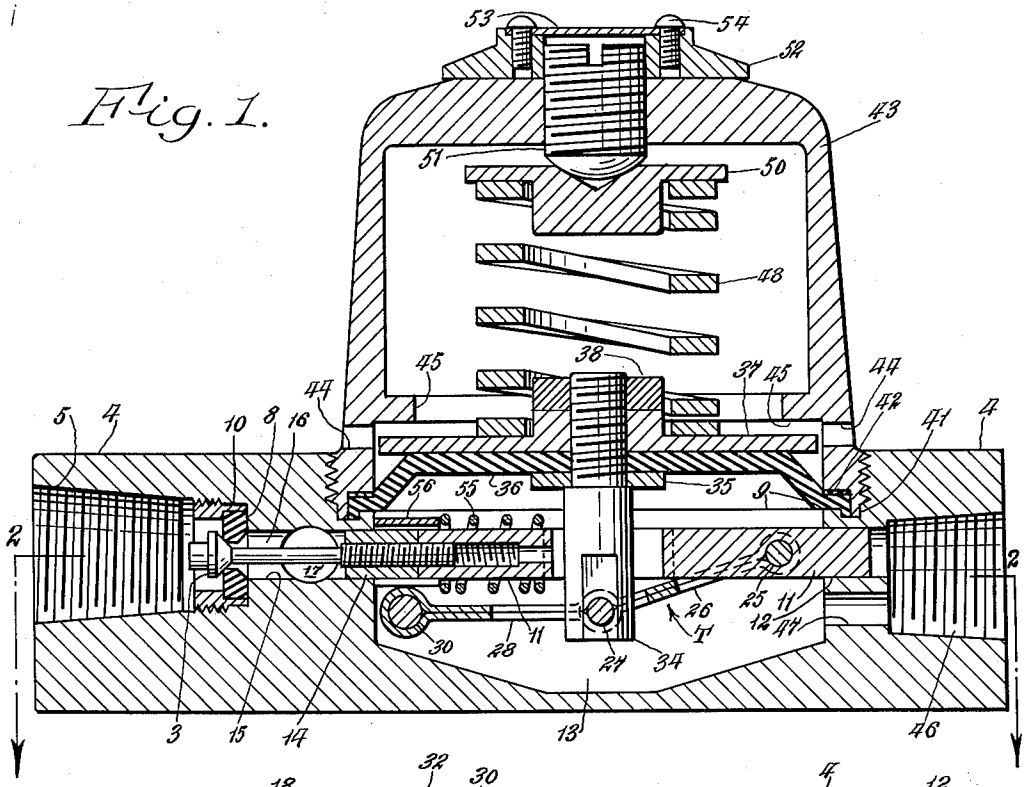
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PRESSURE REDUCING REGULATOR

Filed Sept. 3, 1957

Fig. 1.



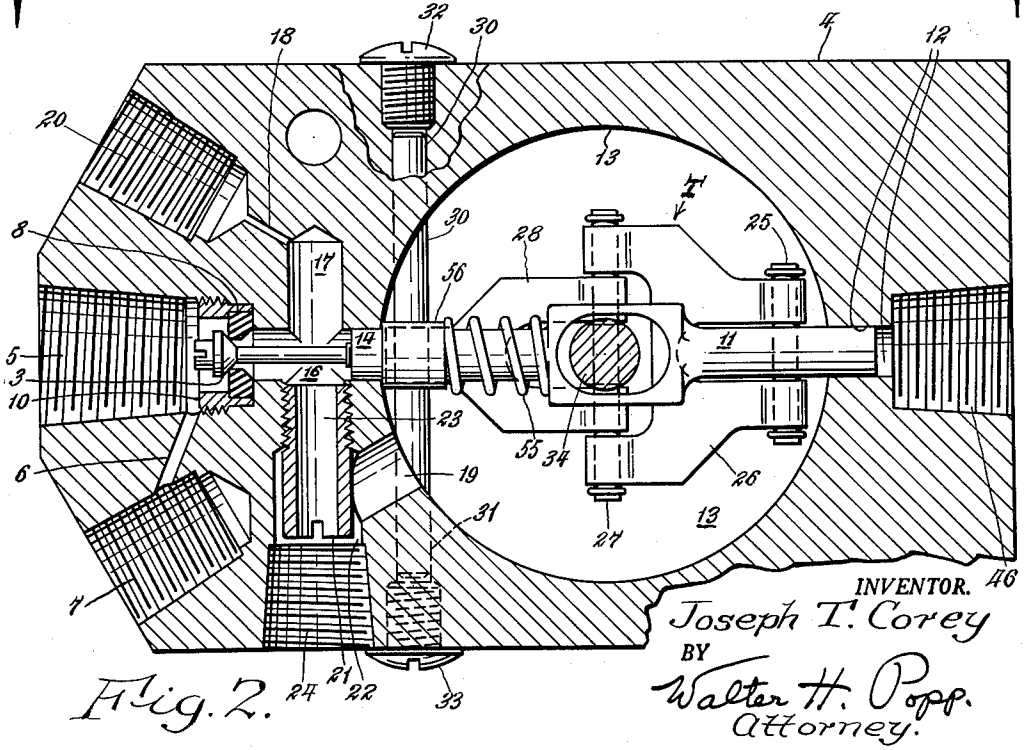


Fig. 2.

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PRESSURE REDUCING REGULATOR

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This invention relates to a regulator for receiving fluid at variable high pressures and reducing the pressure and supplying the fluid to a fluid consuming apparatus at a pressure which is substantially constant.

The principal object of the invention is to provide a pressure reducing regulator which supplies a low pressure which remains constant within very narrow pressure variations, irrespective of whether its control valve 3 is just being "cracked open" or whether said valve is wide open. More particularly, the object of the invention is to provide very high rates of low pressure fluid flow at substantially the same pressure which is supplied at very low rates of fluid flow. Other collateral objects of the invention are explained in the following description and illustrated in the accompanying enlarged scale drawing wherein:

FIG. 1 will be considered, for convenience, a medial, vertical, longitudinal section thru my regulator showing the same with its control valve 3 in closed position. It is to be understood, however, that the regulator functions properly if arranged in other positions than that shown.

FIG. 2 is a horizontal, longitudinal section thereof taken on line 2—2 FIG. 1.

This invention will be described precisely as it is illustrated, but it is to be understood that the scope of the invention is to be determined solely by its inherent novelty and by the scope of the appended claims.

The main, block-shaped casing 4 is pipe-thread-tapped medially at its left end to form a high pressure inlet 5 which is adapted to be tubularly connected to a source of fluid under high pressure such as compressed air or oxygen at 1800 p.s.i. Extending obliquely and laterally from said high pressure inlet 5 is drilled a high-pressure gage duct 6 which communicates with a pipe-thread-tapped hole 7 that is adapted to be tubularly connected with the customary high pressure gage (not shown).

At the inner end of the high pressure inlet 5 is a coaxially disposed, washer-shaped, nylon valve seat 8 which is firmly clamped fluid-tight, relatively to the casing 4, by an externally threaded, hollow, clamping sleeve 10.

Adapted to engage with said valve seat 8 is the aforementioned, conical valve 3 whose stem is threaded coaxially into the one end of a horizontal, longitudinal yoke 11. The opposite end of said yoke is cylindrical and is slidably received within a suitable, cylindrical bore 12 which is formed horizontally and longitudinally in the casing 4 adjacent the right side of a low-pressure well or chamber 13. The latter is formed centrally of the casing 4 and is annular in shape, with its axis positioned vertically, and opens downwardly from the coaxial, annular shoulder 9 and said casing 4 to almost the bottom face of said casing. After the valve 3 has been threadedly adjusted to its proper position relatively to the yoke 11 it is locked in place by a tubular lock nut 14 having a pair of flat faces (not shown) for enabling it to be conveniently tightened relatively to the yoke 11. This lock nut 14, when tightly locked in position, becomes, in effect, an integral part of the yoke 11 and slidably supports the left end of said yoke 11 by being slidably received within an annular bore 15 which is formed in the casing 4 coaxially in alignment with the bore 12 but at the opposite (left) side of the low-pressure well or chamber 13.

The annular space surrounding the stem of the valve 3, intermediate said valve and the tubular lock nut 14,

may for convenience be denominated an intermediate chamber 16. Drilled laterally from this intermediate chamber 16 is an annular pocket 17 which communicates with a low pressure gage duct 18 that opens into the bottom of a pipe-thread-tapped hole 20. The latter is adapted to receive the exteriorly-threaded shank of the customary, low pressure gage (not shown).

Opening laterally from the intermediate chamber 16 is a tubular nozzle 21 whose inner end is threaded into the casing 4 and whose outer end projects outwardly into a suction chamber 22. For convenience we will term the bore of the nozzle a transfer passage 23 which is adapted to convey low pressure fluid from the intermediate chamber 16 to the outer end of the suction chamber 22. This is a function separate from that involved in its being the bore of the suction nozzle 21. The outer end of the chamber 22 opens up into the bottom of a pipe-thread-tapped, low-pressure outlet 24 which is adapted to be tubularly connected with whatever apparatus to be supplied with the low-pressure fluid. In addition to this, said suction chamber 22 communicates with the low pressure chamber 13 thru a balancing passage 19 which is drilled diagonally in the casing 4 so as to aid in the suction action.

Pivoted on a horizontal, transverse pivot pin 25 to the right end of the yoke 11 is a dually-bifurcated, toggle link 26 whose inner end is pivoted on a pivot pin 27 to the inner or right end of a Y-shaped toggle link 28 whose inner or right end is bifurcated. The left or outer end of said toggle link 28 is pivoted on a pivot pin 30 which is mounted at its opposite ends in the casing 4 in a pair of horizontally drilled holes 30 and 31. This pivot pin 30 is prevented from escaping from said drilled holes 30 and 31 by the provision of a pair of oval-headed machine screws 32 and 33. It will be obvious that the toggle links 26 and 28, together with their pivotal connections 25, 27 and 30, constitute a toggle T.

In the drawing, this push rod 34 is pivotally connected at its lower end to the central part of the pivot pin 27. The upper end of said push rod is shouldered to receive a thrust washer 35 that bears against the lower face of an annular, flexible diaphragm 36. Upon the top face of said diaphragm is arranged a pressure-distributing disk 37 which is threaded onto the upper end of the push rod 34 and is locked in place by a lock nut 38.

The periphery of the diaphragm 36 is hermetically sealed and secured to the upper end of the low pressure chamber 13 by having its flanged, annular periphery clamped down upon the annular shoulder 9 and an annular channel 41 by a metal thrust washer 42. The latter is adapted to be pressed downwardly against the upper face of the diaphragm's peripheral flange by a cup-shaped, threaded cap or dome 43 whose interior is maintained at ambient pressure by the provision of a plurality of pressure-equalizing holes 44 that are drilled radially thru its peripheral walls. Excessive lateral movement of the diaphragm 36 is prevented by the peripheral edge of the pressure-distributing disk 37 coming into contact with the bore of the dome 43, while excessive upward movement of said diaphragm 36 is prevented by the provision of an annular, inwardly-projecting flange 45 which is adapted to contact the upper peripheral face of the disk 37 if the pressure in the low pressure chamber 13 should become excessive.

Normally, however, any such excessive pressure within the low pressure chamber 13 is prevented by providing, at the right side of the casing 4, a pipe-thread-tapped hole 46 which is adapted to be tubularly connected to a suitable safety valve or other safety pressure device (not shown). The pressure at the inner end of this tapped hole 46 is maintained at the same pressure as that in the low pressure chamber 13 by the provision of a pressure-

balancing hole 47 which is drilled thru the casing 4 parallel with the yoke 11. This hole 47 ensures that the pressure exerted within the bore 12 against the right end of the yoke 11 will be no greater than nor less than the pressure in the low pressure chamber 13.

Pressing downwardly against the top face of the pressure-distributing disk 37 is a helical compression spring 48, whose upper end is engaged by an annular pressure head 50, and whose tension is rendered adjustable by the provision of an adjusting screw 51 that is threaded coaxially into the "roof" of the dome 43. After being adjusted, this adjusting screw 51 is locked in its adjusted position by a locking sleeve 52 which is threaded onto the upper end of said adjusting screw 51. Tampering by unauthorized persons with this screw 51 is somewhat frustrated by covering the upper end of said screw with an annular, sheet metal disk or cover 53 which is detachably held in place by a pair of machine screws 54.

Because of lost motion in the various connections between the control valve 3 and the diaphragm 36 it is desirable to resiliently close said control valve 3 by the used of a light compression spring 55, independently of the heavy compression spring 48. This light spring 55 bears at its inner end against the enlarged, rectangular central part of the yoke 11, and bears at its outer end against the inner end of a split, resilient collar 56 which is snapped over the left end of the yoke 11 and over its tubular lock nut 14. This split collar 56 merely prevents interference between the light spring 55 and the left, bifurcated toggle link 28.

Operation

The control valve 3, for the purpose of taking up lost motion, is always resiliently urged toward its closed position by a light compression spring 55. If, however, the pressure in the low pressure outlet 24 is less than that for which the pressure regulator has been adjusted, the heavy compression spring 48, together with the ambient pressure in dome 43 will push down the central pivot pin 27 of the toggle T and will open the control valve 3. It should be noted that, as this pivot pin 27 moves downwardly, the control valve 3 is opened at a quickly accelerated rate due to the toggle connection T between the diaphragm 36 and the control valve 3. This means that, when the flow of fluid out of the low pressure outlet 24 is very large in volume, there will be a minimum of throttling effect at the control valve 3, and hence the pressure in said outlet 24 will not be materially lessened as the fluid flow increases in volume (as far as the throttling effect at the control valve 3 is concerned).

The tubular connections which convey the fluid from the low pressure outlet 24 to the apparatus which is using the fluid will, of course, cause an increase of resistance to fluid flow as the volume of said flow increases. To counteract this, my invention provides for a lowering of pressure in the low pressure chamber 13 as the volume of flow increases. This is effected by providing a nozzle 21, the flow thru whose bore corresponds to the volume of flow thru the pressure regulator, and the pressure in whose chamber 22 (surrounding the outer end of said suction nozzle) decreases as the volume of flow thru said nozzle increases. This chamber 22 communicates with

the low pressure chamber 13 thru the balancing passage 19 so that, as the volume of flow thru the instrument increases, the pressure in the low pressure chamber 13 decreases, and the control valve 3 caused to open to a greater extent than it otherwise would. This, in combination with the variable opening of said control valve 3 (due to its toggle connection with the diaphragm 36) ensures that the pressure which is delivered to the apparatus which is using the fluid will remain substantially constant irrespective of the volume of flow which is being supplied to said apparatus.

Another feature of the toggle arrangement T employed in the present invention is that when the control valve 3 is in its closed position, said toggle is effecting its maximum leverage. This ensures that there will be no leakage of fluid past said control valve 3 when the latter is closed and when the flow thru the pressure regulator is zero.

I claim:

1. A pressure regulator comprising: a casing having an inlet and an outlet; a low-pressure chamber communicating with said outlet; a spring-loaded diaphragm arranged in said casing with its one face exposed to the pressure in said low-pressure chamber and its other face exposed to the pressure of the ambient atmosphere; a control valve arranged between said inlet and said outlet and adjustably secured to a yoke which spans said low-pressure compartment and is guided at its opposite ends in said casing; a split resilient collar encircling said yoke and bearing against said casing at its outer end; a compression spring interposed between the iner end of said collar and an adjacent portion of said yoke; a push rod operatively connected with said diaphragm and passing through the open portion of said yoke; and a pair of toggle links centrally pivoted to each other and to said push rod, the outer end of one of said toggle links being movably connected with said casing, and the outer end of the other of said toggle links being movably connected with said yoke.

2. A pressure regulator as in claim 1 with a light resilient means arranged to urge the control valve toward its closed position and interposed between the casing and the yoke.

3. A pressure regulator as in claim 1 with one of the toggle links being bifurcated.

4. A pressure regulator as in claim 1 with both of the toggle links being bifurcated.

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