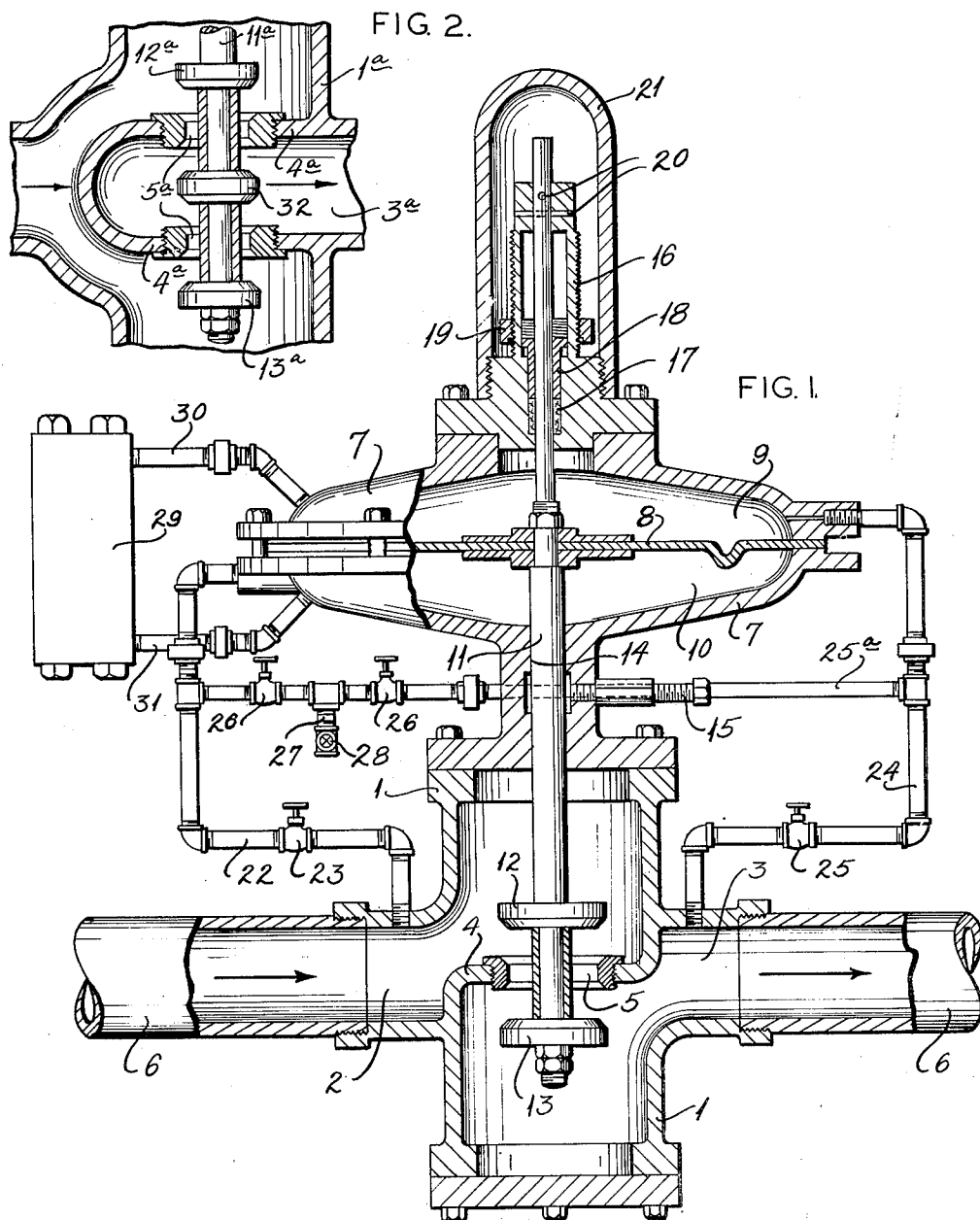


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AUTOMATIC CUTOFF VALVE

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AUTOMATIC CUTOFF VALVE

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The invention described herein may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to us of any royalty thereon in accordance with the provisions of the act of April 30, 1928 (Ch. 460, 45 Stat. L. 467).

This invention relates to cut-off valves of the kind that are automatically closed by a predetermined difference in pressure between the inlet and outlet sides of the valve.

The invention has for its principal objects to devise a simple and economical valve of the above type that can be assembled and installed with facility; that will automatically close at a predetermined difference between the inlet and outlet pressures with a flow of fluid through the valve in either direction; that can be quickly and easily adjusted to vary the differential pressure required to close the valve; that will remain in fully opened position under differential inlet and outlet pressures less than the differential pressure for which the valve is set; that can be manually operated to close the valve; and that will have other advantages hereinafter appearing. The invention consists in the automatic cut-off valve and in the parts and combinations and arrangements of parts hereinafter described and claimed.

In the accompanying drawing, which forms part of the specification and wherein like symbols refer to like parts wherever they occur,

Fig. 1 is a central longitudinal sectional view of an automatic cut-off valve, embodying our invention; and

Fig. 2 is a fragmentary view, similar to Fig. 1, illustrating a modification of the invention.

The automatic cut-off valve shown in Fig. 1 of the accompanying drawing comprises a casing 1 having an inlet port 2 in one side thereof, an outlet port 3 in the opposite side thereof and a horizontal partition 4 with a vertical valve controlled port 5 for establishing communication between said inlet and outlet ports. These inlet and outlet ports 2 and 3 are internally threaded for connection with two adjacent sections of a pipe line 6; and the effective cross-sectional area of the intermediate valve controlled port 5 is preferably less than the cross-sectional area of each of said inlet and outlet openings so as to provide a restricted flow therebetween and a difference between the inlet and outlet pressures according to the rate of flow of the fluid.

Seated on and rigidly secured to the top of the valve casing 1 is a casing 7 that is divided by a horizontal diaphragm 8 into an upper pressure chamber 9 and a lower pressure chamber 10. A

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central vertically disposed valve stem 11 extends downwardly through the casing 7 and diaphragm 8 into the valve casing 1 and through the intermediate port 5 and is fixed to said diaphragm for reciprocation thereby. The valve stem 11 is provided at its lower end with a valve head 12 located above the intermediate port 5 and with a valve head 13 located below the said port. The two valve heads are rigidly secured to the valve stem 11 in axially spaced relation, whereby downward movement of the said valve stem causes the upper valve head 12 to close the intermediate port 5 and upward movement of said valve stem causes the lower valve head to close said intermediate port.

The valve stem 11 is supported for axial sliding movement in a central vertical bore 14 provided therefor in the diaphragm casing 7 below the lowermost pressure chamber 10 therein; and said valve stem is lubricated by a suitable lubricating device 15 secured to said casing. The valve stem 11 extends upwardly from diaphragm casing 7 through the supporting member 16 which is rigidly secured to the top of said casing centrally thereof. The valve stem receiving bore of the supporting member 16 is provided with a packing gland including a packing 17, a packing follower 18 and a packing nut 19. The upper end of the valve stem 11 is rigidly secured by means of one or more transverse shear pins 20 to the upper end of the support 16 with the disk heads 12 and 13 spaced equal distances above and below the intermediate port 5. The support 16 has a cap 21 threaded thereon which seals and protects the upper valve stem supporting portion thereof.

A pipe 22 having a normally open stop valve 23 therein leads from the inlet port 2 of the valve casing 1 to the lowermost pressure chamber 10; and a pipe 24 having a normally open stop valve 25 therein leads from the outlet port 3 of said valve casing to the uppermost diaphragm member 9. The two pressure pipes 22 and 24 are connected by a cross pipe 25^a provided with two normally closed stop valves 26 spaced apart longitudinally thereof and between said valves with a bleeder branch 27 provided with a stop valve 28. A double acting relief 29 of any suitable design is connected to the two pressure chambers 9 and 10 by pipes 30 and 31, respectively, and serves to protect the diaphragm 8 from excessive differential pressures.

The hereinbefore described automatic cut-off valve operates as follows:

The valve stem 11 is normally held by means

of the shear pins 20 of the desired shear strength with its two axially spaced valve heads 12 and 13 fully open and spaced equal distances above and below the intermediate port 5. Fluid enters the valve casing 1 at the inlet port 2, passes through the intermediate port 5 and leaves through the outlet port 3. The restricted intermediate port 5 produces a differential pressure between the inlet and outlet ports 2 and 3, such differential pressure being a function of rate of flow of the fluid. The relative high fluid pressure existing at the inlet port 2 is transmitted through the pipe 22 to the lower pressure chamber 10 and the relatively low fluid pressure existing at the outlet port 3 is transmitted through the pipe 24 to the upper pressure chamber 9. Thus, opposite sides of the diaphragm are exposed to the different fluid pressures in the two pressure chambers 9 and 10. The differential pressure created by a normal flow through the valve is not sufficient to shear the valve stem supporting shear pins 20 to permit the diaphragm 8 to actuate the valve stem 11 and close the intermediate port. When, however, a break or leak occurs in that portion of the pipe line leading from the outlet port of the valve, the differential pressure between the inlet and outlet ports of the valve will increase considerably; and the action of this increased differential pressure on the diaphragm 8 will create an upwardly thrust on the valve stem 11 sufficient to shear the shear pins 20 and force said valve stem upwardly and cause the lower valve head 13 to close the intermediate port 5 and thus cut off flow of the fluid through the valve. This increased differential pressure serves to hold the lower head 13 in closed position until the break or leak in the pipe line is repaired and the pressure at the inlet and outlet ports of the valve are again nearly equal.

The excess rate of flow upon which the valve becomes operative may be determined by the differential pressure produced by the flow through the restricted intermediate port 5, the area of the diaphragm 8 to which said differential pressure is applied, and the force necessary to shear the pins 20 which hold the valve heads 12 and 13 in open position. In normal operation, the stop valves in the pipes 22 and 24 are open and the stop valves in the cross connecting pipe 25^a are closed. By closing either of the stop valves in the pipes 22 and 24 and by opening the valves in the cross pipe 25^a, the pressure transmitted to opposite sides of the diaphragm 8 may be equalized, or the pressure on either side of the diaphragm may be reduced to atmospheric pressure while retaining full operating pressure on the other side thereof. Thus, by manual operation of the valves in the pipes 22, 24 and 25, the pressure applied to opposite sides of the diaphragm 8 may be controlled so that the lowermost valve head 13 may be opened or closed or the valve stem 11 adjusted to a position that will permit replacement of the shear pins 20. Sudden surges in fluid flow in the pipes 22 and 24 may be dampened by restricting the diameter of these pipes.

In the event of a break in the pipe line on the inlet side of the valve, there is a reverse fluid flow from the outlet port 3 towards the inlet port 2, thereby reversing the differential pressure in the pressure chambers 9 and 10 and creating a downward thrust on the valve stem 11 sufficient to shear the shear pins 20 and force said stem downward until the upper valve head 12 closes the intermediate port 5.

The hereinbefore described valve construction has numerous important advantages. It permits the cut-off valve to remain fully open under differential pressures below the differential pressure required to close the valve. The valve may be readily adjusted for the desired predetermined valve closing pressure; and it may also be manually adjusted to open and close the valve and to permit replacement of the shear pins. The valve is adapted to operate at a predetermined differential pressure during fluid flow therethrough in either direction. The valve is of simple and economical construction and can be readily incorporated in pipe lines for various fluids as a safety device for preventing loss of fluid in the event of a breakage or leak in the line on either side of the valve.

In the modified construction shown in Fig. 2, the valve casing 1^a is provided with upper and lower partition walls 4^a that are connected to form an outlet chamber 3^a and have axially aligned intermediate ports 5^a therein. The valve stem 11^a has an upper valve head 12^a located above the upper intermediate port, a lower valve head 13^a located below the lower intermediate port, and a valve head 32 located intermediate between said ports. By this arrangement, the two intermediate ports 5^a are closed by the lower and intermediate valve heads when the valve stem moves upwardly and are closed by the upper and intermediate valve heads when said valve stem moves downwardly. An important advantage of this valve construction is that the flow of the fluid through the two intermediate ports 5^a equalizes the endwise pressure on the intermediate valve head 32 and thus serves to balance the triple valve head construction.

Obviously, the hereinbefore described automatic cut-off valve admits of considerable modification without departing from the invention. Therefore, we do not wish to be limited to the precise valve construction shown and described.

What we claim is:

1. An automatic cut-off valve comprising a casing having an inlet and an outlet, a valve for cutting off fluid flow between said inlet and outlet in either direction of fluid flow therethrough, a reversely operable diaphragm operatively connected to the valve and responsive to differential pressure between said inlet and outlet for closing said valve, a double acting relief valve communicating with opposite sides of the diaphragm, and a shear pin connection between said casing and said valve for rendering the latter inoperative by said diaphragm except at a differential pressure sufficient to shear said shear pin.

2. An automatic cut-off valve comprising a casing having an inlet and an outlet, a flow restricting port between said inlet and outlet for generating a differential fluid pressure therebetween in proportion to the rate of flow of fluid therethrough, a valve for cutting off fluid flow through said port in either direction of fluid flow therethrough, a reversely operable diaphragm operatively connected to the valve and responsive to said differential pressure for closing said valve, a double acting relief valve communicating with opposite sides of the diaphragm, and a shear pin connection between said casing and said valve for rendering the latter inoperative by said diaphragm at all differential pressures thereon up to a differential pressure sufficient to shear said shear pin.

3. An automatic cut-off valve comprising a casing having an inlet and an outlet, a flow restrict-

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ing port between said inlet and outlet for generating a differential fluid pressure therebetween in proportion to the rate of flow of fluid there-through, a valve for cutting off fluid flow through said port in either direction of fluid flow there-through, a reversely operable diaphragm operatively connected to the valve and responsive to said differential pressure on opposite sides thereof for closing said valve upon a flow through said port in either direction, a double acting relief valve communicating with opposite sides of the diaphragm, and a shear pin connection between said casing and said valve for rendering the latter inoperative by said diaphragm at all differential pressures thereon up to a differential pressure sufficient to shear said shear pin.

4. An automatic cut-off valve comprising a casing having an inlet and an outlet, a flow restricting port between said inlet and outlet for generating a differential fluid pressure therebetween in proportion to the rate of flow of fluid there-through in either direction, a valve stem reciprocable axially of said port and having two valve heads, one for closing said port upon movement of said stem in one direction and the other for closing said port upon movement of said stem in the other direction, a diaphragm operatively connected to the valve and responsive to said differential pressure for reciprocating said valve stem to close said port, a double acting relief valve communicating with opposite sides of the diaphragm, a shear pin connection between said casing and stem for holding the latter inoperative by said diaphragm at all differential pressures thereon up to a differential pressure sufficient to shear said shear pin.

5. An automatic cut-off valve comprising a casing having an inlet, an outlet, two pressure chambers and a flow restricting port between said inlet and outlet for generating a differential fluid pressure therebetween in proportion to the rate of flow of fluid therethrough in either direction, two conduits leading one from said inlet to one of

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said pressure chambers and the other from said outlet to the other pressure chamber, normally open stop valves in said conduits, a cross conduit connecting said two conduits and having a valved bleed opening, normally closed stop valves in said cross conduit on opposite sides of said bleed opening, a valve for cutting off fluid flow through said port in either direction, a diaphragm operatively connected to the valve and forming a common wall of said pressure chambers and responsive to said differential pressure to close said valve, a double acting relief valve communicating with opposite sides of the diaphragm, and means for positively locking said valve in fully open position and for rendering said diaphragm inoperative to close said valve except at a predetermined maximum differential pressure between said inlet and outlet.

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