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THROTTLING BUTTON FOR DIAPHRAGM VALVE

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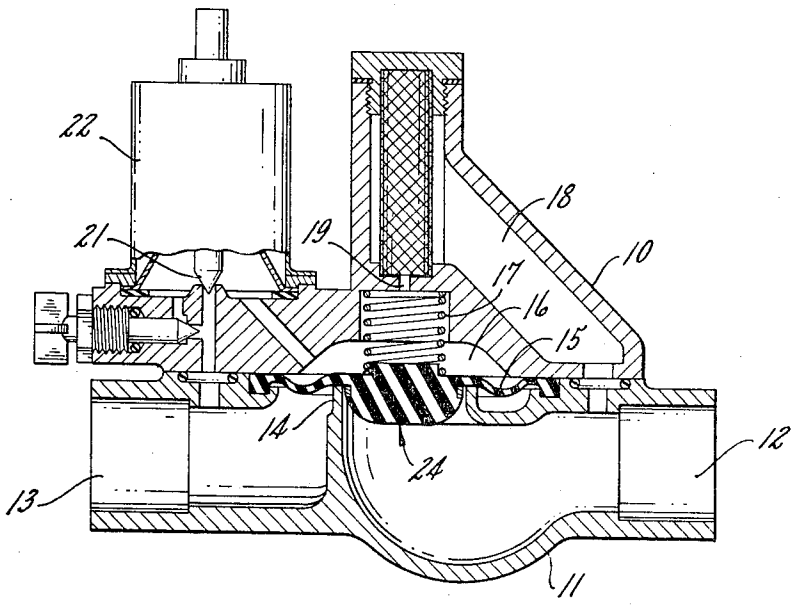


Fig. 1.

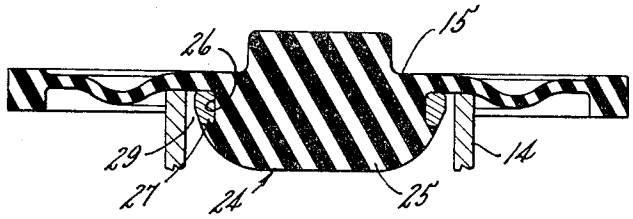


Fig. 2.

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THROTTLING BUTTON FOR DIAPHRAGM VALVE

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This invention relates to pilot-controlled diaphragm valves of the type in which the valve closes against pressure and is maintained closed by equalization of unit pressures on opposite sides of the diaphragm. In one form of such a valve, that face of the diaphragm remote from the valve is exposed to fluid pressure in a chamber which communicates with the upstream side of the valve through a restricted orifice and with the downstream side of the valve through the pilot valve. With the pilot valve closed, unit pressures on opposite sides of the diaphragm will be equal, and the diaphragm will be held in engagement with the valve seat. When the pilot valve is opened to permit flow through the restricted orifice and chamber, the unit pressure in the chamber is reduced to the extent of the pressure drop across the orifice, and the diaphragm is forced away from the valve seat by the pressure within the valve seat.

In a valve of the type just described, closing of the pilot valve initiates a progressively increasing pressure in the chamber and a progressively increasing valve-closing effort, with the result that ultimate seating of the diaphragm may occur so abruptly as to create an objectionable water hammer. To prevent that effect, it has been proposed to form the diaphragm with an integral throttling button or boss which, as the valve moves toward closed position, gradually reduces the effective area of the flow-path through the valve seat. Such valves operate satisfactorily so long as the material of which the diaphragm and button are formed does not react unfavorably to the character of the liquid whose flow the valve controls. While some of the synthetic elastomers, such as neoprene, are adequately resistant to the action of many liquids, other liquids cause them to swell, thus causing the throttling button to expand. Such expansion may cause the button to bind in the valve seat and interfere with the action of the valve.

It is therefore an object of this invention to produce a diaphragm valve of the type described in which the throttling button is not subject to swelling which would cause the button to bind within the valve seat. Another object of the invention is to produce, for use in valves of the type described, an integral diaphragm and throttling button so constructed that undesirable swelling of the button is prevented.

In carrying out the invention, I employ an integral valve-diaphragm and throttling button of conventional type, but around the base of the button I provide it with an annular groove which receives a metal ring. The outer face of such ring is desirably flush with the outer face of the button-portion projecting beyond it and has a diameter and taper such as will provide essentially the same throttling action as would be provided by the unmodified button if it retained its initial contour. The ring extends along the side of the button from the base thereof to a point where the progressively increasing clearance between the side of the button and the valve-seat walls has attained an extent such that the button material beyond the ring can swell without causing it to bind in the valve seat.

Further objects and features of the invention will become apparent from the following more detailed description and from the accompanying drawing in which:

FIG. 1 is an axial section through a pilot-controlled valve embodying a diaphragm to which my invention is applicable; and

FIG. 2 is a fragmental section similar to FIG. 1, but on a substantially enlarged scale, showing the diaphragm as modified in accordance with my invention.

The valve shown in FIG. 1 comprises upper and lower housing portions **10** and **11** which are secured together in any appropriate manner. The lower housing portion embodies an inlet opening **12** and an outlet opening **13** flow between which occurs through a valve seat **14** under the control of a valve diaphragm **15**. Such diaphragm is circular and is clamped at its periphery between the two housing portions **10** and **11**. Above the diaphragm, the upper housing portion **10** is provided with a circular recess or chamber **16** pressure within which controls opening and closing of the valve. Such recess has a diameter larger than that of the valve seat, so that when unit pressures on opposite sides of the diaphragm are equal the diaphragm will be forced downwardly into engagement with the valve seat. To assist valve-closing, a compression spring **17** acting downwardly on the diaphragm may be provided.

The existence and control of pressure within the chamber **16** is effected through the medium of passages which connect it with the inlet and outlet openings **12** and **13**. The passage connecting the chamber **16** with the inlet opening includes, in addition to a main passage-portion **18**, a restricted orifice **19**. The passage connecting the chamber **16** with the outlet opening **13** contains a pilot valve **21** shown as operated by an electrical solenoid **22**.

As so far described, the valve shown in FIG. 1 operates in the following manner:

When the pilot valve **21** is closed, upstream pressure in the inlet opening **12** is transmitted to the chamber **16** through the main passage-portion **18** and the restricted orifice **19**, with the result that fluid pressures above and below the diaphragm are equal. Since the upper face of the diaphragm is exposed to that pressure over an area greater than that within the valve seat, the net effect of fluid pressure on the diaphragm is to maintain the valve closed. When the valve is to be opened, the pilot valve **21** is opened to permit flow through the chamber, thereby reducing chamber-pressure by the extent of the pressure-drop across the orifice **19**. With the pressure on the upper face of the diaphragm thus reduced, the upstream pressure acting on the lower face of the diaphragm within the valve seat opens the valve. Subsequent closing of the pilot valve **21**, interrupts flow through the chamber **16** and permits fluid pressure therein to build up to a point where the diaphragm again engages the valve seat **14** to close the valve. Since the building up of pressure in the chamber **16** is progressive, the valve-closing effort gradually increases, with the result that the final closing of the valve may occur abruptly and create an undesirable water hammer. To prevent such abrupt closing, diaphragms **15** have been formed on their lower faces with a throttling button **24** adapted to lie within the valve seat as the valve approaches and attains closed position. Such a button is roughly hemispherical in shape and has a base diameter somewhat less than the internal diameter of the valve seat **14**. As a result, as the valve diaphragm approaches closed position the effective area of the valve seat is gradually reduced by the presence of the button within it until, at the instant of valve closing, flow has been throttled to such a low rate that final closing of the valve produces no hammer.

As so far described, the valve shown in FIG. 1 is not new with me. As previously indicated, a difficulty sometimes encountered in valves of this type arises as a result of the fact that materials available for the diaphragm are subject to swelling under the action of certain liquids with which the diaphragm may come into contact in use.

In order that the button may provide the desired degree of throttling, the clearance between its base and the inner surface of the valve seat is necessarily rather small. Excessively hot water, certain pipe-cleaning compounds, and other substances can, and not infrequently do, cause the button to swell to eliminate clearance between its base and the inner face of the valve seat **14** with the result that the button may bind within the valve seat and interfere with the valving operation.

To prevent the swelling just referred to, I construct the diaphragm and button as shown in FIG. 2. As there illustrated, the button has a central core **25** integral with the body of diaphragm **15** and provided at its base with a peripheral groove **26** adapted to receive a metal ring **27**. Such ring, which is circumferentially continuous, is desirably formed of brass or other metal relatively resistant to water and other liquids which the valve may be called upon to control. The ring **27** extends downwardly from the lower face of the diaphragm **15** for a substantial fraction of the total vertical dimension of the button **24**, has a width equal to that of the groove **26**, and is desirably so shaped that its outer face is substantially flush with the outer face of that portion of the button which projects below the ring. The inner diameter of the ring and the depth of the groove **26** are such that the ring can be forced into position by distortion of the flexible button-material. After the ring has been seated against the lower face of the diaphragm **15**, the lower end of the case will expand and the lower wall of the groove **26** will constitute a shoulder engaging the ring and retaining it in position. With the ring in position, swelling of the button at its base is prevented, and the clearance indicated at **29** between the inner face of the valve seat and the outer face of the ring will never be destroyed by swelling of the button. While the diameter of the core below the ring can increase as a result of swelling, the width of the clearance **27** at that point is such that swelling will have no significant effect on the throttling action and will not be sufficient to cause binding of the button in the valve seat.

In a neoprene diaphragm embodying my invention and suitable for use in a valve having a seat one inch in internal diameter, the ring **27** had an internal diameter of 0.800″, an external diameter of 0.937″, and a width of one-eighth inch. For about the upper one-half of its width, the outer surface of the ring was of uniform diameter, but for the lower half it tapered at an included angle of about 50°. Button material below the ring formed a mushroom-like head which, because its diameter was about 0.850″, could readily be forced through the ring to expand therebelow and retain the ring in position.

I claim:

1. In a diaphragm valve having a valve seat and a diaphragm comprising a disk-like body adapted to seat against the valve seat and, projecting centrally from one face of said body, a throttling button which enters the valve seat as the diaphragm body moves toward seated position, said button having a central core and a ring of rigid material surrounding said core at its junction with said body, said body and core being formed as an integral unit of flexible elastomeric material, said core projecting beyond said ring, said button being of progressively smaller diameter away from the diaphragm body and the outer surface of said ring being substantially flush with the surface of that portion of the core which projects beyond the ring.

2. In a diaphragm valve having a valve seat and a diaphragm comprising a disk-like body adapted to seat against the valve seat and, projecting centrally from one face of said body, a throttling button which enters the valve seat as the diaphragm body moves toward seated position, said button having a central core and a ring of rigid material surrounding said core at its junction with said body, said body and core being formed as an integral unit of flexible elastomeric material, said core projecting beyond said ring, and having an outer annular ring-engaging shoulder for retaining the ring in position, the material of which the diaphragm and button-core are formed being elastically distortable to permit the projecting portion of the core to be forced through the ring, at least that portion of the ring remote from the diaphragm being of progressively decreasing diameter away from the diaphragm.

3. A valve according to claim **2** in which the outer surface of the ring is substantially flush with the surface of said projecting core-portion.

References Cited by the Examiner

UNITED STATES PATENTS

2,462,189	2/1949	Hess	251—358 X
2,638,127	5/1953	Griswold	251—331
2,993,676	7/1961	Dahl	251—45 X
3,022,039	2/1962	Cone et al.	251—210 X

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