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2,707,481

VALVES

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2 Sheets-Sheet 1

Fig-1

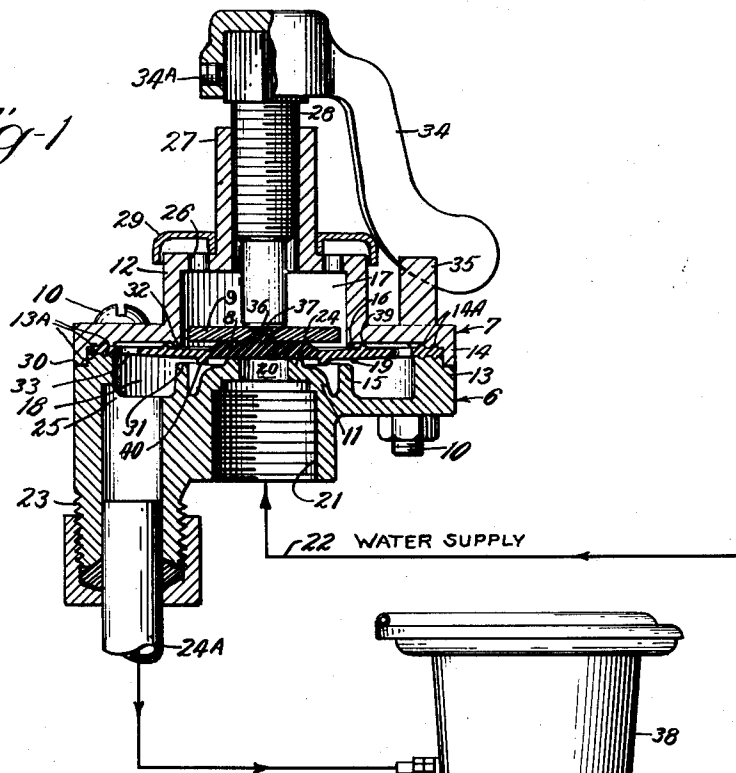
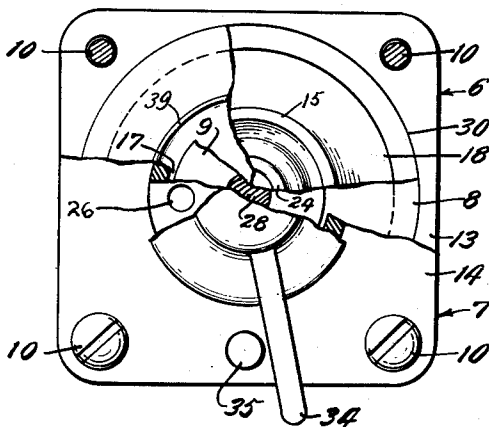


Fig-2



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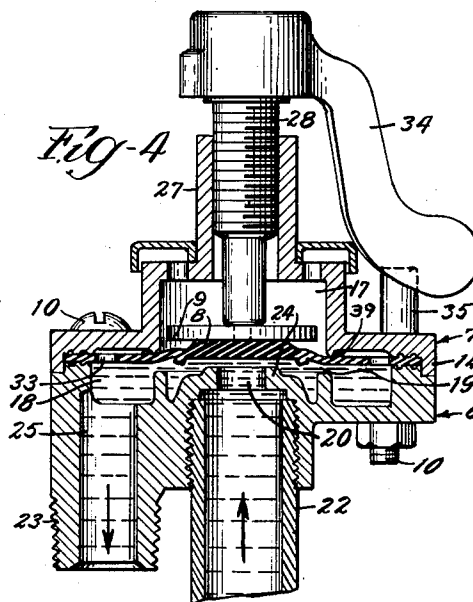
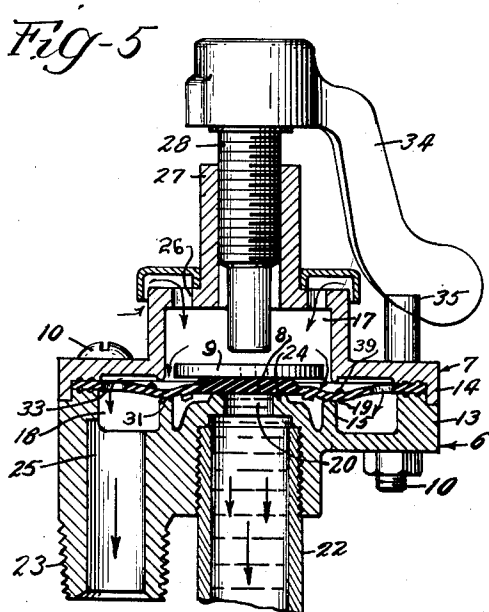
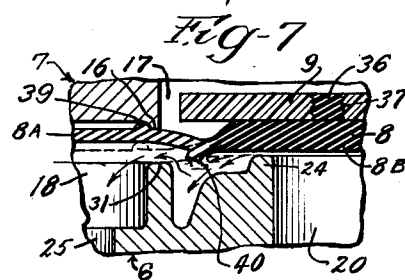
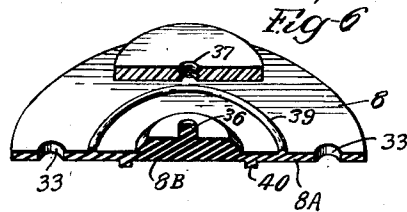
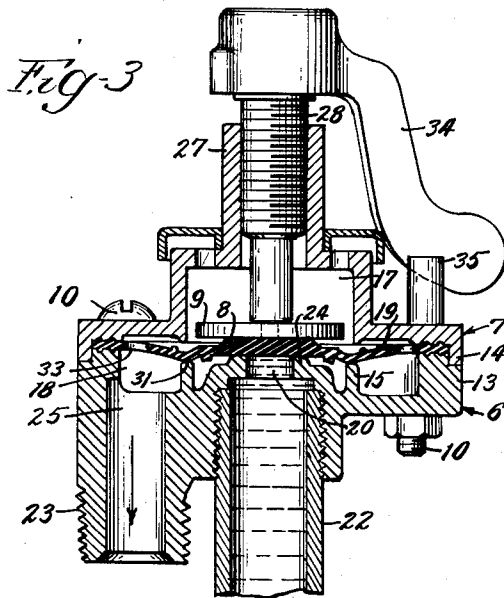
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VALVES

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2 Sheets-Sheet 2



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VALVES

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7 Claims. (Cl. 137—218)

This invention relates to valves for use with various types of flushing mechanisms controlling communication between water inlets and outlets. More particularly, the valve is for use with flushing mechanisms employed in sewage disposal systems and especially those in which water pressure and the sewage disposal are isolated from community-operated systems wherefore such service must be provided for each individual housing or a limited group of housing units.

For the protection of health, any connected water supply and sewage disposal system requires that there must be no possibility of the contents of the discharge being sucked back up into the supply, regardless of whether the manual control of the valve is in full open position, partially opened in a regulating position, or in a closed position. Inasmuch as the water pressure may recede at times, sufficient to create a vacuum in the inlet line near the point of the valve-controlled communication with the outlet, there is a constant danger of suction in the inlet line causing polluted water to flow back through the valve into the water inlet, creating a health hazard. For that reason it is necessary for the valve to function so as to positively prevent such action from taking place.

The main objects of this invention, therefore, are to provide an improved valve construction suitable for use with any flushing mechanism where communication is intermittently opened and closed between a water pressure source and a discharge outlet; to provide a valve construction of this kind which effectively serves the plural functions of a check valve to cut off fluid flow from the inlet to the outlet, of a regulating valve to control the flow of fluid from the inlet to the outlet, and as a vacuum breaker to prevent the creation of a suction on the outlet by a recession of the water in the inlet source; to provide improved means in a valve construction of this kind for automatically and positively sealing off communication between the outlet and the inlet, if and when a vacuum is created in the inlet capable of creating a suction on the outlet; to provide an improved sealing means of this kind which may be manually operated to effectively seal off communication between the inlet and outlet, but which is free to seat itself in the event of an inlet supply vacuum when the manually shiftable means is retracted; to provide an improved sealing means of this kind which is adapted to seal off communication between the outlet and the atmosphere when the manually shiftable means is retracted to open communication between said inlet and outlet; to provide a valve in which the diaphragm is of composite construction with the central area made of relatively hard material and the surrounding area of relatively soft material; to provide means for quickly sealing the outlet from the atmosphere as soon as the valve is actuated to release the diaphragm from the seat closing the inlet, whereby the valve may serve to regulate the flow of fluid therethrough in addition to starting and stopping such flow; and to provide a valve construction of this kind which is simple and economical to manufacture, highly efficient in

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use, and easy and inexpensive to repair or to replace parts. In the accompanying drawings:

Figure 1 is a vertical, sectional elevation of an improved valve, constructed in accordance with this invention, its connection with a water supply line and a sewage disposal unit being indicated diagrammatically;

Figure 2 is a plan view of the valve with parts being broken away on successive levels to more clearly indicate the underlying constructions;

Figure 3 is a view of the valve similar to Figure 1 but showing the handle pressed to the full limit of its rotative movement so as to force the diaphragm into contact with the ridge surrounding the inlet port;

Figure 4 is a similar view but showing the valve handle shifted to open communication between the inlet and outlet ports;

Figure 5 is also a view similar to the other figures, but showing the action of the diaphragm when the diaphragm-shifting member is retracted as in Fig. 4 and the water supply in the inlet line has so receded as to create a vacuum drawing the diaphragm down to close the inlet port;

Figure 6 is a fragmentary, top perspective view of the diaphragm and the valve head, both being sectioned, which illustrates their configuration; and

Figure 7 is a partial sectional view of the base member, cap member, diaphragm and valve head, illustrating how, when the valve is in an open position, positive forces to close communication between the outlet and the atmosphere are exerted on the diaphragm by the fluid flowing from the inlet port.

A valve constructed in accordance with this invention, comprises base and cap members 6 and 7, between which is interposed diaphragm 8 adapted to be shifted by force applied to a valve head 9, said members being secured in assembled relation by fastening means 10.

The members 6 and 7 are formed with hub parts 11 and 12, rim parts 13 and 14, and intermediate partitions 15 and 16, respectively. When secured in their assembled relationship these members 6 and 7 form concentric chambers 17 and 18 on opposite sides of the partitions 15 and 16, which communicate with each other through an annular passage 19 formed by the opposed spaced peripheries of the partitions 15 and 16.

The hub part 11 of the member 6 is formed with an inlet port 20 and is threaded at 21 for connection with an inlet line 22. The member 6 also has a nipple 23 integrally formed thereon for connection to an outlet line 24A leading from an outlet port 25 communicating with the chamber 18. Ridge 24 is formed on the inner end of the hub part around the inlet port 20 and constitutes the primary seat for the diaphragm 8 to seal off communication between the inlet port 20 and the outlet port 25 through the chambers 17 and 18 and the passage 19 on the under side of the diaphragm 8.

The hub part 12 of the member 7 is offset from the plane of the rim part 14 and is provided with apertures 26 to vent to the atmosphere the chamber 17 above the diaphragm 8. A reduced portion 27 of the hub part 12 is threaded to receive a stem 28, which is adapted to bear against valve head 9. A flanged disk 29 is secured on the hub part 12 over the vents 26 to protect against the entrance of foreign matter into the chamber 17.

The rim parts 13 and 14 of the respective members 6 and 7 are recessed and flanged as shown at 30 to provide interfitting alignment of the members 6 and 7 when assembled.

The partitions 15 and 16 of these respective members 6 and 7 extend inwardly and, when the members are assembled, are axially aligned with their opposed inner peripheries 31 and 32 spaced apart to form the annular passage 19 connecting the chambers 17 and 18. Also

these respective inner peripheries constitute seats for the diaphragm 8 to seal off communication between the chambers 17 and 18 on one side or the other of the diaphragm 8, depending upon whether the valve head 9 is held down or in its upper position.

The construction of the diaphragm constitutes one of the novel features of my new valve construction. Referring particularly to Figure 6, it will be seen that the diaphragm 8 is composed of an outer portion 8A bonded to an inner thicker portion 8B. The outer, or flanking portion 8A, is of a flexible material, while the inner portion, which is utilized to close the inlet port 20, is of a much harder material. By way of example, I have found it very satisfactory to use 30 Durometer rubber for the flanking portion and 90 Durometer rubber for the central or valve seating portion and to bond the two by vulcanizing. It should be appreciated that suitable substitutes could be used for rubber which, together with rubber, may conjointly be called rubber-like materials and the example hardness ratings are not to be considered as limiting, since a wide range of materials of different hardness ratings may be used. One of the greatest disadvantages of diaphragm valves used heretofore, wherein a homogeneous diaphragm was used, is that the soft material necessary to provide flexibility over portions of the diaphragm was unable to withstand the forces applied thereto at the seating portions, and, hence, breakdown of the diaphragm created leakage. By providing the harder valve seating portion in the diaphragm, I have overcome this disadvantage.

A further feature of my diaphragm, best seen in Figure 6, is that the central portion 8B is provided with an integral, upwardly extending threaded stud 36. The valve head 9 having a threaded central aperture 37 is threaded onto stud 36, thereby providing a positive connection between the diaphragm 8 and head 9. By having a central portion 8B of a reasonably hard material in direct physical contact and connecting with the valve head 9, it is unnecessary to construct the head 9 of brass or metal, but various less expensive materials such as Micarta (laminated phenol-formaldehyde resin) of the Westinghouse Electric Mfg. Co., may be used. Since the central portion 8B is thicker than flanking portion 8A, the valve head 9 is displaced sufficiently from portion 8A to permit portion 8A to be bowed upwardly, in a manner herein-after described, to close communication through passage 19 above the diaphragm 8.

The diaphragm 8 is clamped between the rim parts 13 and 14, which parts have depressions 13A and 14A formed therein to assure a tight seal between the rim parts and the diaphragm, and spans the chambers 17 and 18 through the annular passage 19. A circumferential series of apertures 33 are formed in the diaphragm 8 substantially concentric with the chamber 18 and provide communication between the outlet port 25 and the vented chamber 17 above the diaphragm 8. (See Figs. 1 and 3.)

The valve head 9, mounted on the diaphragm 8, is disposed below the stem 28 so that axial movement of the stem will either press the diaphragm down onto the ridge 24 and the partition periphery 31 (see Fig. 3), or free the diaphragm to be retracted by the pressure of the water at the inlet port 20 (see Fig. 4). The pitch of the threads on the stem 28 is such that only one revolution of the stem is necessary to make this shift in the diaphragm 8 and suitably seat it. A handle 34 is secured to the end of the stem 28 whereby it is revolved. The end of the stem 28 and the handle 34 are formed with inter-fitting polygonal stud and socket which permit an adjustment of the handle 34 on the stem 28 when necessary to insure a proper seating of the diaphragm. A suitable set screw 34A in the hub of the handle 34 secures the handle against accidental removal from the stem 28. A stop 35 on the cap member 7 limits the swing of the handle 34 to substantially one complete revolution of

said stem 28, so that the diaphragm may never be overstressed or ground down onto the ridge 24.

This improved valve is designed primarily for controlling the water supply to equipment used in connection with installations where the sewage is drained off to septic tanks or trenches. However, it can be used in any equipment where it is desired or required to have a valve that can serve the plural purpose of closing communication between a water inlet and a water outlet, of regulating the flow of water between an inlet and outlet, and of breaking a vacuum adjacent the water inlet, if and when it occurs in the water supply system by reason of a recession in the water pressure. In the accompanying drawings (see Fig. 1) this improved valve is shown connected in the water supply line for a toilet 38 of the type commonly used for trailers or small cabins. This improved valve is particularly adapted for use in a water supply line for a toilet of the type shown in co-pending application, Serial No. 13,971 now abandoned.

When the stem 28 shifts valve head 9 to close communication between the inlet port 20 and the outlet port 25, the diaphragm 8 seats on ridge 24 and on the peripheral edge 31 of the partition 15. There is thus formed a multiple seal against communication between these two ports. The handle 34 is so adjusted on the stem 28 that a single rotation of the stem 28 from one side of the stop 35 to the other will apply sufficient force through the head 9 to the diaphragm to close the inlet port 20.

If it should happen that the diaphragm was defective at ridge 24, communication from the chamber 17 to the chamber 18 through the annular passage 19 would be closed on the underside of the diaphragm 8 by contact of the diaphragm 8 with the peripheral edge 31 of the partition 15 (see Fig. 3).

When the diaphragm 8 is pressed against ridge 24 and the partition 15, the outlet port 25 and outlet line 24A are vented to the atmosphere through the diaphragm apertures 33 and the hub apertures 26.

If, at any time, when the stem 28 is retracted, thereby opening communication between the inlet and outlet ports 20 and 25, the pressure in the inlet line 22 should fall so as to create a vacuum, even so small as to draw six inches of water, at the inlet port, the resulting suction would pull the diaphragm 8 down against ridge 24 and periphery 31 (see Fig. 5). Generally, this will effectively seal off the outlet 25 from the inlet and prevent any possible draught of products from the outlet line into the inlet line 22. The greater the recession of water in the inlet line 22 the more forcibly the diaphragm will be drawn down against ridge 24 and periphery 31 to seal the inlet port 20. Moreover, at such a time, fresh outside air is admitted to the outlet line 24A through the vents 26 into the chamber 17 above the diaphragm and through the diaphragm apertures 33 into the outlet port 25.

If the diaphragm should be punctured so as not to be drawn down against ridge 24, air drawn in through the apertures 26 and through the puncture would serve to break the vacuum in the pipe 22.

In the drawings, and particularly in Figure 6, it will be noted that an integral, circular, upstanding seating ridge 39 is formed on the outer portion 8A of diaphragm 8. Seating ridge 39 is concentric with partition 16 and lies in a position contiguous thereto. As shown in Figure 4, and in solid lines in Figure 7, the inner face of seating ridge 39 is forced upwardly into contact with a mating outer face of partition 16, and the portion 8A is forced into contact with periphery 32 of partition 16, thereby providing a double seal to prevent flow of fluid into the chamber 17 above diaphragm 8, when the stem 28 is turned to release the diaphragm from ridge 24.

Diaphragm valves heretofore developed have not been satisfactory as regulating valves, but by providing an annular deflector flange 40 on the lower side of the diaphragm 8 in chamber 18, I have found that my valve gives very satisfactory regulation of flow from the full

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open to closed positions of the diaphragm 8. The function of deflector flange 40 is illustrated in Figure 7 which shows in dotted lines the position of diaphragm 8 when the valve is closed, and which shows in solid lines the position of the diaphragm when the valve is just cracked, i. e., a very small amount of fluid is permitted to flow into the outlet. The significant thing to note is that seating ridge 39 and portion 8A have closed communication through passage 19 on the upper side of the diaphragm, and thereby prevents any leakage of fluid to the atmosphere, even with the diaphragm barely removed from contact with ridge 24. This quick sealing action between seating ridge 39 and partition 16 is produced by forces exerted on deflector flange 40.

It will be noted in Figure 7 that the path of fluid flow (indicated by arrows) is tortuous through the chamber 17 on the lower side of the diaphragm. Hence the pressure on the right side of the deflector flange 40 will be greater than on the left side and a force will be exerted on the flange. Since the central portion is relatively rigid, this force constitutes a bending moment on portion 8A which bows it upwardly into the position shown in solid lines. Kinetic flow energy of the fluid expended against the right side of flange 40 will also contribute to the bending moment. As the fluid flows into passage 19, it will be directed against the underside of the diaphragm 8 to further assist in holding the diaphragm into sealing relation with partition 16. Hence communication between the outlet and atmosphere is cut off as soon as the valve is opened the least bit. This permits the valve to function very effectively as a regulating valve with no danger of fluid escaping to the atmosphere.

As will be obvious from these disclosures, the parts are simple of form and assembly thus making manufacture very economical. Moreover, there is nothing to get out of order except the diaphragm. When that does require repair or replacement it is very simple to remove the fastening means 10, separate the members 6 and 7, and then reassemble them with a new or repaired diaphragm in place.

It combines in one valve functions usually heretofore assigned to at least two separate valves. The valve may be used in either horizontal or vertical position and serve equally well.

This application is a continuation-in-part of my earlier application, Serial No. 158,110, filed April 26, 1950, now abandoned, and the entire disclosure of that application is incorporated herein by reference to the extent that it is not inconsistent with the present disclosure.

Variations and modifications in the details of structure and arrangement of the parts may be resorted to within the spirit and coverage of the appended claims.

I claim:

1. A valve comprising associated members partitioned to form concentric chambers communicating with each other through an annular passage between the peripheries of opposed partitions, said members having an inlet port communicating with one of said chambers and an outlet port communicating with another of said chambers, a diaphragm seat formed around said inlet port, a diaphragm interposed between said members and spanning said chambers through said passage, and a seating ridge on said diaphragm arranged to contact the side of one of said partitions, said diaphragm being adapted to seat on said diaphragm seat to close communication between said inlet and outlet ports, said diaphragm seating against the periphery of said one partition and said seating ridge contacting the side of said one partition to form a seal between said chambers on one side of said diaphragm when said inlet and outlet ports are in communication.

2. A valve comprising associated members partitioned to form concentric chambers communicating with each other through an annular passage between the peripheries of opposed partitions, said members having an inlet port communicating with the central chamber and an outlet

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port communicating with the outer chamber, a diaphragm seat formed around said inlet port, a diaphragm interposed between said members and spanning said chambers through said passage, a valve head arranged to contact said diaphragm in the vicinity of said diaphragm seat, a deflector flange on said diaphragm concentric with said inlet port, and means to apply force to said valve head to hold said diaphragm on said seat, said diaphragm being bowed into sealing relation with one of said partitions by forces, derived from the fluid flowing between said inlet and outlet ports, applied to said deflector flange and diaphragm when said force-applying means is operated to release the diaphragm from said seat.

3. A valve comprising associated members partitioned to form concentric chambers communicating with each other through an annular passage between the peripheries of opposed partitions, said members having an inlet port communicating with one of said chambers and an outlet port communicating with another of said chambers, a diaphragm seat formed around said inlet port, a composite diaphragm formed with a flexible outer portion and a relatively rigid inner portion, and spanning said chambers through said passage, said inner portion having a hardness rating greater than that of said outer portion and being adapted to contact said diaphragm seat to close communication between said inlet and outlet ports, a deflector flange on said outer portion of said diaphragm concentric with said inlet port, and means to apply force to said inner portion to close said inlet port, said outer portion being bowed into sealing relation with one of said partitions by forces, derived from the fluid flowing between said inlet and outlet ports, applied to said deflector flange and outer portion, when said force-applying means is operated to release the diaphragm from the seat.

4. A valve comprising associated members partitioned to form concentric chambers communicating with each other through an annular passage between the peripheries of opposed partitions, said members having an inlet port communicating with one of said chambers and an outlet port communicating with another of said chambers, a diaphragm seat formed around said inlet port, a composite diaphragm formed with a flexible outer portion and a relatively rigid inner portion, and spanning said chambers through said passage, said inner portion having a hardness rating greater than that of said outer portion, a valve head secured to said inner portion of said diaphragm, a seating ridge on said outer portion of said diaphragm arranged to contact the side of one of said partitions, a deflector flange on said outer portion of said diaphragm concentric with said inlet port, and means to apply force to said valve head to hold said inner portion of said diaphragm on said diaphragm seat and to hold said outer portion of said diaphragm in sealing contact with another of said partitions, said outer portion of said diaphragm being bowed to bring said seating ridge into contact with the side of said one partition and to bring said outer portion into contact against the periphery of said one partition by forces, derived from the fluid flowing between said inlet and outlet ports, applied to said deflector flange and outer portion of said diaphragm, when said force-applying means is operated to release the diaphragm from said seat.

5. In a control valve and vacuum breaker, inlet and outlet ports, a first diaphragm seat adjacent said inlet port, a second diaphragm seat, a diaphragm extending across said seats, a deflector flange formed on said diaphragm adjacent said inlet port and between said diaphragm seats, and means to force said diaphragm into sealing contact with said first seat to close communication between said inlet and outlet ports, said diaphragm being bent into sealing contact with said second seat to close communication between the atmosphere and said

outlet port by forces applied to said flange and diaphragm from fluid flowing between said inlet and outlet ports, when said forcing means is released.

6. A shutoff valve and vacuum breaker comprising a base having a centrally located inlet opening terminating in an upwardly facing seat and a laterally located outlet opening, a cap for the base having a downwardly facing annular sealing rib located intermediate the inlet seat and the outlet, a flexible diaphragm clamped between the base and cap, a valve stem operable to seat or release said diaphragm with respect to said inlet seat to close or open communication between said inlet and outlet openings, and a downwardly extending deflector flange formed on said diaphragm between said inlet seat and said sealing rib, whereby the flow of fluid between said inlet and outlet openings will cause forces to be applied to said flange and diaphragm to force the latter into contact with said sealing rib and a reduction in pressure in said inlet opening will draw said diaphragm into sealing contact with said inlet seat.

7. A valve comprising, a base member formed with a center inlet port hub constituting a primary valve seat, a rim outlet port and an intermediate partition forming a secondary valve seat, inlet and outlet lines connected to said ports, respectively, a cap member having a vented hub, a rim and an intermediate partition, means securing said members in assembled relation with the respective hubs and partitions in opposed axial alignment with the inner peripheries of said hubs spaced apart to form concentric chambers and an annular passage affording communication between said chambers, a diaphragm of flexible and compressible material anchored between said

rim parts and spanning said chambers through said annular passage, said diaphragm being adapted to react to the pressure conditions in said inlet line to unseat said diaphragm from said primary seat and said intermediate partition on said base to thereby open communication between said inlet port and outlet port through said annular passage or unseat said diaphragm from said intermediate portion on said cap to open communication between said outlet port and said vented hub through said annular passage, said diaphragm having an aperture therein registering with said outlet port, and a head mounted on a stem axially supported in said cap member concentrically of said inlet port and adapted to be shifted to positively compress said diaphragm on said primary valve seat to close communication between said inlet and outlet ports.

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