

May 17, 1938.

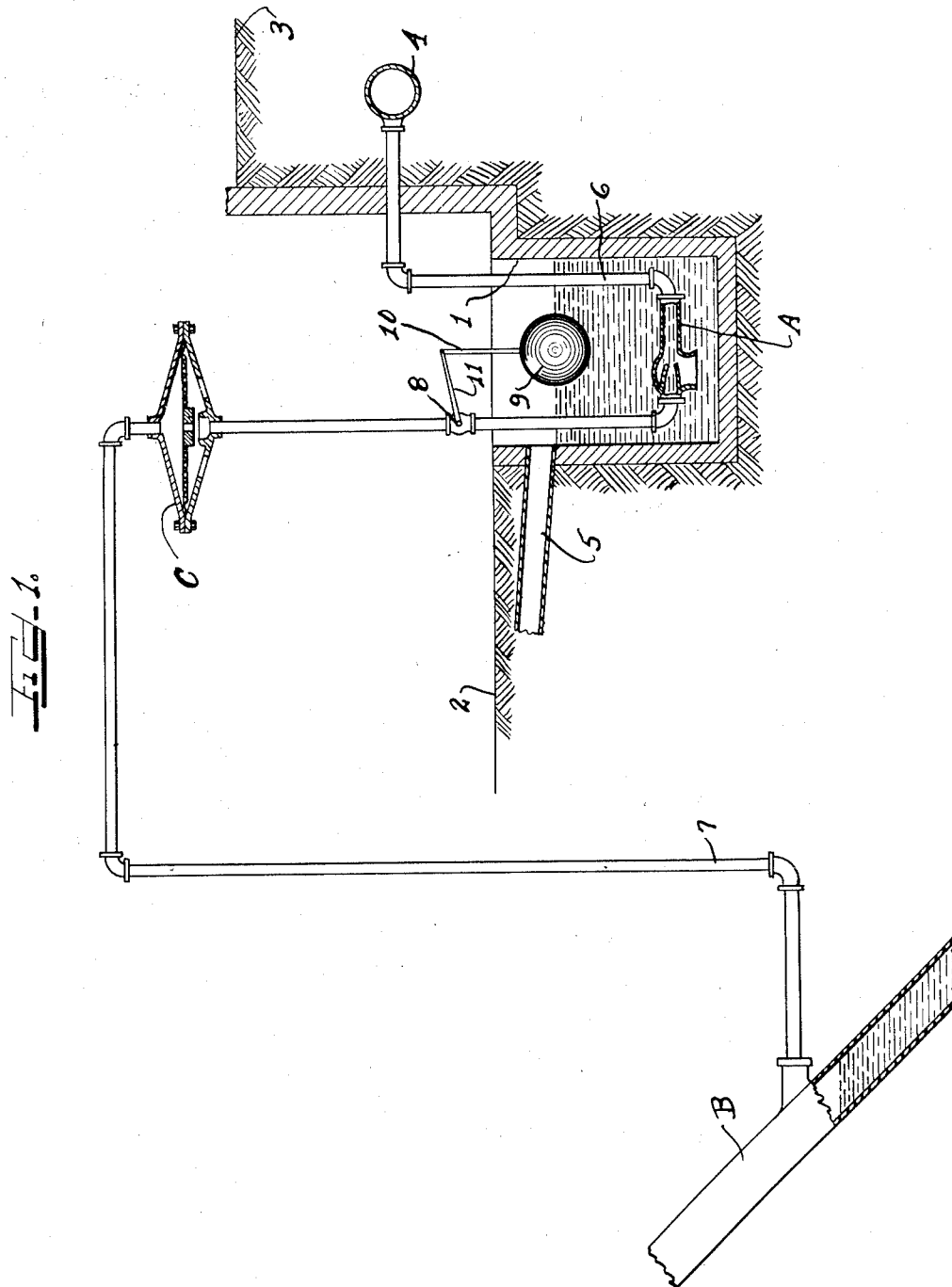
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2,117,389

VACUUM OR SIPHON BREAKER

Filed March 4, 1935

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

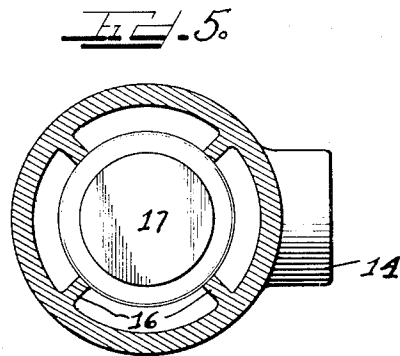
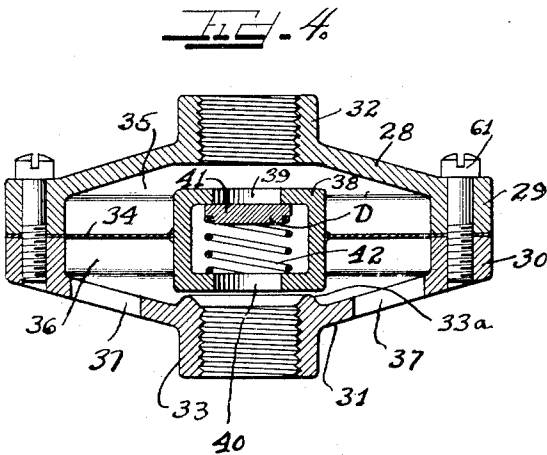
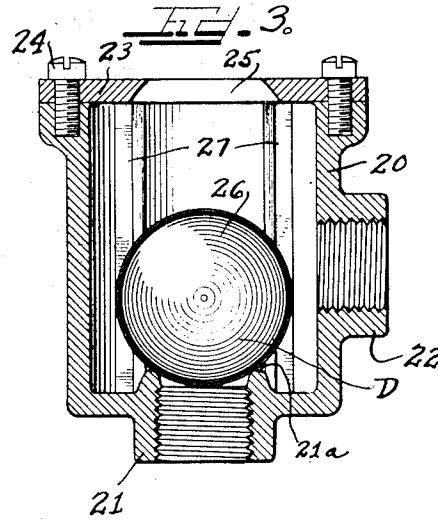
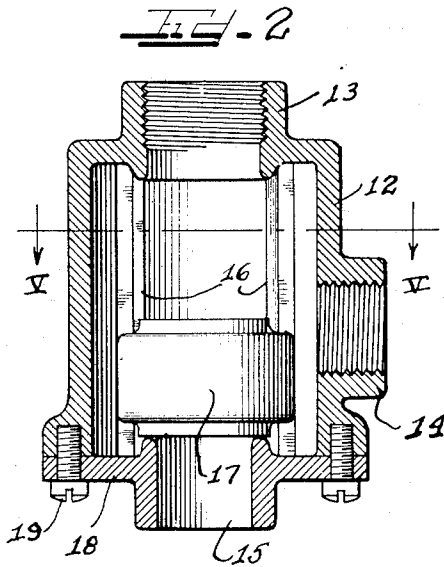
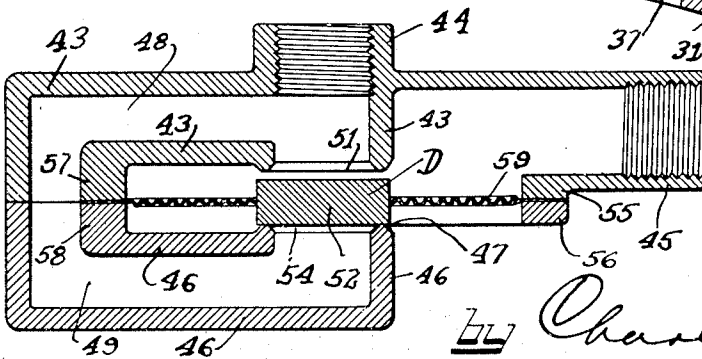
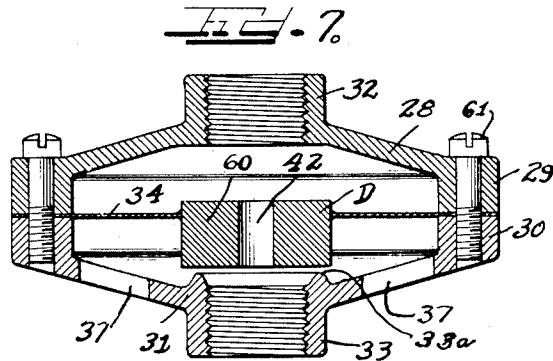


Fig. 6



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UNITED STATES PATENT OFFICE

2,117,389

VACUUM OR SIPHON BREAKER

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Application March 4, 1935, Serial No. 9,269

10 Claims. (Cl. 137-69)

The present invention relates to a so-called vacuum breaker and will be described in connection with a fluid pressure distributing system wherein fluid flows through service lines, and wherein, in event of temporary reversal or reduction of pressure in the lines, back flow of fluid through the service lines is prevented.

The invention contemplates the use of a choke or throttling device which prevents, or throttles, back flow, together with a large air intake, which is in communication with the service lines or pipes, so that on reduction or reversal of pressure through the service lines, a vacuum or lifting effect in the service lines is practically prevented.

An object of the present invention is to provide a vacuum breaker for fluid pressure distributing lines or systems.

Another object of the present invention is to provide a vacuum breaker for fluid pressure distributing systems wherein pressure variations in the system actuate the breaker for preventing back flow of fluid in the event of reduction or reversal of pressure.

A further object of the present invention is to provide a vacuum breaker wherein air communication with the service line is cut off during the presence of certain pressure of fluid, and established when the pressure is reduced or reversed to prevent back flow of fluid into the service line.

The above, other and further objects of the present invention will be apparent from the following description, accompanying drawings and appended claims.

The accompanying drawings illustrate various vacuum breakers constructed to embody the principles of the present invention, and the views thereof are as follows:

Figure 1 is a view, somewhat diagrammatic in nature, representing, in elevation, an automatic cellar drain system, utilizing water pressure for its operation, and showing included in such system a vacuum breaker of the present invention.

Figure 2 is a vertical sectional view through one form of vacuum breaker of the present invention.

Figure 3 is a vertical section through another form of vacuum breaker.

Figure 4 is a vertical section through a still other form of the present invention.

Figure 5 is a horizontal sectional view taken substantially in the plane indicated by line V—V of Figure 2.

Figure 6 and Figure 7 are vertical sections

through other forms of vacuum breakers, both embodying the principles of the present invention.

In the various forms of vacuum breakers shown in Figures 2 to 7 inclusive, the same principle of operation is involved, viz. the utilization of check or choke means responsive to pressure differentials in the breakers, for controlling communication between the air intakes and the fluid systems.

The drawings will now be explained.

Referring to Figure 1 a basement sump 1 is shown as applied to a basement and extending below the basement floor 2. The ground level is indicated at 3, while a sewer 4, between the ground level 3 and the basement floor 2 is laid in the earth outside of the building structure in which the sump is installed.

Included in the construction shown in Fig. 1 is a drain pipe 5 for supplying drain water to the sump 1 from other parts of the basement.

For the purpose of withdrawing the drain water from the sump 1 and delivering it to the sewer 4, an instrumentality, referred to generally as an ejector A, is submerged in the sump water and is operated by water pressure from a main B. There is a pipe 6 extending from the ejector A and opening into the sewer 4. A supply pipe 7 leads from the main B to the ejector A, for the purpose of supplying water under pressure thereto for actuating the ejector to drain the sump. Interposed in the supply line 7 is a vacuum breaker C. Also interposed in the supply line 7 between the vacuum breaker and the ejector A, is a float operated valve 8, opened and closed by means of a float 9 which is operably connected to the stem of the valve member of the valve 8, by means of links 10 and 11.

The vacuum breaker C of Figure 1 may be any of the various forms illustrated in Figures 2 to 7 inclusive. However, the vacuum breaker C shown in Fig. 1 is constructed similarly to that shown in Fig. 7 of the accompanying drawings.

Referring more particularly to Figures 2 to 7 inclusive, the various forms of vacuum breakers will now be explained.

The form of vacuum breaker illustrated in Figure 2 includes a casing 12 having an inlet connection 13, an outlet connection 14, for fluid, and an air inlet or intake 15. The interior of the casing is shown as provided with a plurality of vertically extending ribs 16 for the purpose of guiding a float or choke 17. The float or choke 17 is made as a cylindrical article, constructed to travel vertically within the casing 12, and guid-

ed by the ribs 16. The casing 12 is shown as closed at its lower end by a flange 18 secured in place by bolts 19, which flange or lid 18 carries the air inlet or intake 15. The inner portion of the air inlet 15 constitutes a seat for the check or choke member 17 when acting to exclude air from the system. The inner portion of the fluid pressure inlet 13 constitutes a seat for the check or choke member 17 when the valve is exposed to an abnormal or reversed fluid pressure.

When a vacuum breaker of the form illustrated in Figure 2 is installed in a service line, the fluid under pressure enters the casing 12 through the inlet 13 and passes out therefrom through the outlet 14 and the various pipes thereto connected. The presence of pressure within the casing 12 urges the check or choke 17 downwardly against the seat of the air inlet, thus closing air admission to the casing, as long as the entering fluid is maintained under certain pressure. Should the operation of the system result in a reduction of pressure, or a reversal of pressure, then the water pressure against the top side of the float or choke member 17 would be reduced, thereupon enabling the buoyance of the float or choke to dislodge the float or choke member 17 and move it upwardly, away from the air inlet and to seat on the inlet seat. Such movement of the member 17 causes admission of air into the vacuum breaker 12 and chokes a reversal of flow through 13, thus breaking any vacuum that may exist in the service line and practically preventing flow from the pipe connected to the outlet 14 into the supply pipe connected to the inlet 13.

The form of vacuum breaker illustrated in Figure 3 is somewhat similar to that shown in Fig. 2 and includes a casing 20 having an inlet connection 21 entering from the bottom of the casing and an outlet 22. Its upper end is closed by a lid 23, secured in position by bolts 24. The lid 23 is provided with an opening 25 shaped to receive and conform to the check or choke member 26, which, in this instance, is a weighted ball. The ball 26 is guided in vertical movement within the casing by means of ribs 27 fashioned on the inside of the casing. The inner extremity of the inlet 21 provides a seat for the ball under certain circumstances.

In using this form of vacuum breaker, the fluid water pressure entering the casing 20 through the inlet 21 urges the ball 26 upwardly closing the opening 25, and maintains the opening closed by the ball as long as pressure of a certain amount is sustained in the fluid system. As soon as such pressure falls, or is reversed, the ball 26 drops away from the opening 25, by gravity to a seat 21a on inlet 21, thereupon admitting air to the interior of the casing 20 through opening 25 and throttling the vacuum appearing at inlet 21, which acts to break any vacuum that there may be in the system, due to such reduction or reversal of pressure.

The form of vacuum breaker illustrated in Figure 4 contemplates a two part casing, the upper part 28 having a marginal flange 29 which is attached to a similar flange 30 of the lower part 31 of the casing. Bolts 61 secure the two parts of the casing together in operative relation. The upper portion 28 of the casing is provided with an inlet connection 32 while the lower portion 31 is provided with an outlet connection 33. Secured between the flanges 29 and 30 of the casing members is a diaphragm 34 dividing the interior of the casing into chambers 35 and 36. The lower portion 31 of the casing is provided

with openings 37 constituting air ports. Carried by the diaphragm 34 is a hollow barrel-like member 38 having openings 39 and 40 through its top and bottom portions. Within the barrel-like member 38 is a disc 41 which is actuated toward a seat about opening 39 by a spring 42.

When a vacuum breaker of the form illustrated in Figure 4 is inserted in a fluid pressure system, the fluid enters the chamber 35 through the inlet 32 and the integrated force exerted by the pressure on the diaphragm 34 urges the barrel-like member 38 against the seat 33a formed at the upper extremity of the outlet 33, thus effecting a sealing engagement between the interior of the chamber 36 and the pipe line connected to the outlet 33. The fluid under pressure and flowing conditions thereupon displaces the disc 41 and passes through the barrel-like member 38 into the outlet 33 and through any pipe or pipes thereto connected. The movement of the barrel-like member 38 against its seat as described, seals air communication between the air inlets 37 and the pipe lines connected to the outlet 33. As soon as the fluid pressure diminishes or is reversed, the disc 41 seats against the under side of the opening 39, closing it, and the diaphragm 34, together with the atmospheric pressure against the under side thereof, displaces the barrel-like member from sealing engagement with its seat, thereby admitting air to the pipe lines connected to the outlet 33, and practically eliminating any back-flow or vacuum effect appearing in the supply lines connected to the inlet 32.

The form of vacuum breaker illustrated in Figure 7 includes a casing like that described with reference to Fig. 4 with the modification, however, that in place of the barrel-like member 38, the diaphragm 34 carries a cylinder 60, having an opening 42 of reduced diameter, relatively to the inlet 32, through it.

In a vacuum breaker of the type illustrated in Fig. 7, when fluid pressure is introduced through the inlet 32 it causes the diaphragm 34 to deflect away from the inlet 32, said deflection being made possible by virtue of the choking action of opening 42 through cylindrical member 60 under flow conditions, and thereby causes cylindrical member 60 to seat on the seat 33a provided at the upper extremity of the outlet 33, thus sealing the air communication between the inlet 37 and the pipe connected to the outlet 33. This condition prevails as long as the pressure is maintained, above a certain amount. As soon as the pressure is reduced, or reversed, the cylinder 60 is displaced from against its seat by atmospheric pressure against its under side, and against the under side of the diaphragm, so that air communication is established between the air inlet 37 and the pipes connected to the outlet 33 of the breaker, while at the same time the suction or reduced pressure appearing at inlet 32 is so throttled by restriction 42 as to be so within the capacity of the air inlets 37 that the net vacuum or suction effect appearing in the outlet connection 33 and pipes thereunto connected will be held to a desired minimum.

The form of vacuum breaker illustrated in Fig. 6 is shown as fashioned as a two part casing, one part of the casing 43 having a fluid inlet 45, a fluid outlet 44, and an air conduction passage 48. Body part 43 also has flanges 55 and 57 integral with it, for engaging a diaphragm 59, and choke or check seat 51 which communicates with air passage 48 and outlet 44. The other portion of the casing is made up of part 46 having flanges

56 and 58, an air passage 49, an air seat 47 integral with 46. Air valve seat 47 communicates with air passages 49 and 48 and thus communicates with outlet 44. The diaphragm or flexible membrane 59 is engaged and held in a suitable position between parts 43 and 46 by flanges 55, 57 and 56, 58 respectively. The diaphragm or flexible membrane 59 carries at a suitable point a disc 52 fastened to it, said disc 52 being so positioned, so fashioned, and so designed as to engage the check or choke seat 51 under certain conditions, and also to engage air seat 47 under certain other conditions.

A vacuum breaker of the form illustrated in Fig. 6 when inserted in a pressure line, receives the fluid under pressure through the inlet 45 which acts on diaphragm or flexible membrane 59, causing disc 52 to seat on the air inlet seat 47, thereby sealing off air communication with passages 49, 48, inlet 44 and pipes thereunto connected. Under normal pressure conditions, the pressure fluid therefore flows through inlet 45 through choke passage or past choke seat 51 to outlet 44 and pipes thereunto connected. As long as a certain pressure is maintained on the entering fluid, the breaker is sealed against air admission. As soon as the pressure is reduced, or reversed, the diaphragm or flexible membrane moves toward the choke seat 51, by virtue of the pressure differential between the internal pressure of the system relative to the atmospheric pressure carrying disc 52 away from air seat 47 and toward choke seat 51. Under the proper reduced pressure conditions, therefore, disc 52 seats on choke seat 51 and opens air seat or valve entrance 47. Any vacuum or suction action caused by reduced or reversed pressures and appearing at inlet 45 is therefore first choked, throttled or checked, by virtue of disc 52 seating on seat 51, and then the residual suction which may pass seat 51, by reason of leakage or other means, is dealt with by air being vented through seat 47, which in this condition is open, and through passages 49 and 48 which are in communication with the outlet 44 and pipes thereunto connected. Therefore vacuum appearing at inlet 45 can be stopped, reduced or regulated to a required minimum in outlet 44 and pipes connected thereto by the proper choice of openings, clearances, flexibility and dimensions of parts herein described and aforementioned, as applying to schematic diagram or sketch of principle as represented in Fig. 6.

One use of the present invention is to prevent cross connection contamination of domestic fresh water supply in the event a supply pipe or conduit ever loses its pressure and suction is developed. The need for a vacuum breaker in such application arises only when and if the pressure in the distributing system falls and abnormal suction develops in any portion of the system or connected devices. Should any such suction develop, there is a possibility that, without a vacuum breaker in the system, the supply of fluid might readily be contaminated from cross connections.

The various forms of vacuum breakers herein described and illustrated, are illustrated as adapted for admission of atmospheric pressure so that the pressure necessary in the supply line to close the vacuum breakers to atmospheric air, must be above-atmospheric and any sub-atmospheric pressure would result in the opening of the breakers to the atmosphere. It is to be understood, however, that by means of suitable adjustments, the breakers of the present invention

could be very readily adapted for operation at other than atmospheric pressure. It is believed that anyone skilled in the art would very readily comprehend such alterations as might be needed to adapt the vacuum breakers of the present invention to operate on other than atmospheric pressure.

In a fluid pressure system, if an air intake only, were relied on to break the suction pull exerted through the unrestricted service lines, the size of such air opening might be prohibitive. The utilization of a choke or check valve member makes possible the reduction of the air inlet so that such inlet may be only large enough to take care of any assumed leakage through the service line check.

Preferably a diaphragm is used in connection with such check to avoid the time lag in opening and closing communication between the service lines and the air intake, and also to assure positive action of the check at low pressures.

It will be noted that the vacuum breaker of the present invention depends on the pressure in the service lines to close communication between the air inlet and the service lines. A reduction or reversal of pressure thereupon acts to open the air inlet to the system and at the same time to bring into play a choking, checking or throttling device, so that the suction action so appearing is reduced and the residual suction getting past said check or choke is dealt with by introducing air into the system. Thus, the breaker acts to prevent back flow from cross connections or other parts of the system, which are connected to the outlet of the breaker, from entering the pressure supply connected to the inlet of said valve or breaker.

The invention has been described herein more or less precisely as to details, yet it is to be understood that the invention is not to be limited thereby, as changes may be made in the arrangement and proportion of parts, and equivalents may be substituted, without departing from the spirit and scope of the invention.

The invention is claimed as follows:

1. In a device of the class described, means providing a chamber having fluid inlet and outlet and an air inlet, a diaphragm within said chamber movable responsively to pressure differentials therein, said diaphragm carrying means providing a choke orifice, the parts being so arranged that pressure flow through said chamber closes communication between said air inlet and said fluid inlet and outlet and abnormal drop in pressure opens communication with said air inlet and chokes back flow through said orifice.

2. In a device of the class described, means providing a chamber having fluid inlet and outlet and an air inlet, a diaphragm within said chamber movable responsively to pressure differentials therein, said diaphragm carrying a barrel-like member having openings through its ends adjacent the fluid inlet and outlet respectively, a closure disc within said member, means within said member tending to maintain said disc in position to close the member opening adjacent said fluid inlet, the parts being so arranged that normal fluid pressure moves said diaphragm and member to close communication between said air inlet and said fluid inlet and outlet and displaces said disc permitting fluid flow through said member and abnormal pressure drop causes movement of diaphragm and member to open air communication with said air inlet and closes said

disc against said member to stop back flow into fluid inlet.

3. In an improved automatic self-policing air valve and back pressure control device, the combination of a valve body, a chamber therein, a diaphragm valve located in said chamber, a normally closed self-closing opening in said diaphragm valve and arranged to permit passage of fluid from the inlet through the chamber, and said normally closed self-closing opening automatically closing on the reduction of pressure in the passage to prevent return of fluid to the inlet passage.
4. In an improved automatic self-policing air valve and back pressure control device, the combination of a valve body defining a hollow chamber, an entrance passage at one end of the chamber, a resilient diaphragm in said chamber provided with a normally closed self-closing valve to prevent flow of fluids toward the entrance passage, an exit passage at the end of the body opposite the entrance passage, said exit passage being centrally located with respect to the contour of the body, a valve seat formed at the inner end of the exit passage, air ports between the diaphragm and the valve seat, said valve seat cooperating with the resilient diaphragm to prevent escape of fluid to the atmosphere when such fluid flows through said valve from the entrance passage into the exit passage.
5. In an improved automatic self-policing air valve and back pressure control device, the combination of a valve body, a hollow chamber formed therein, an entrance passage at one end thereof communicating with the chamber, a resilient valve member provided with a normally closed self-closing opening in said chamber, whereby passage of fluid from the chamber to the entrance passage is prevented, an exit passage communicating at the inner end with the chamber and with the atmosphere having a valve seat formed at its inner end and cooperating with the resilient valve member, said resilient valve member seating on the valve seat of the exit passage to close communication to the atmosphere and opening to permit passage of fluid from the chamber to the exit passage when positive pressure exists in the fluid passing from the entrance passage through the chamber.
6. In an improved automatic self-policing air valve and back pressure control device, the combination of a valve body, a passage extending longitudinally therethrough, a chamber formed in the body and connecting at each end with said passage, a diaphragm member arranged in the chamber and dividing the same into two parts and with the lower part open to the atmosphere, whereby that portion of the passage connecting with the lower part of the chamber, is normally open to the atmosphere, a valve seat formed at the upper end of that portion of the passage connecting with the lower part of the chamber, said diaphragm member having a normally closed self-closing valve, said diaphragm member being normally out of engagement with the valve seat and seating thereon when fluid under pressure flows through the chamber, to thereby seal the air opening in the portion of the passage connecting with the lower part of the chamber, said normally closed self-closing valve moving to open position to permit fluid to flow therepast into the lower portion of the passage.

7. In a device of the class described, means providing a chamber having a fluid inlet and fluid outlet and an air inlet and having an annular seat between said fluid outlet and air inlet, a diaphragm within said chamber movable responsively to pressure differentials therein, said diaphragm carrying a hollow member having openings through its ends adjacent the fluid inlet and outlet respectively, a closure disc within said member and working against the opening in the end thereof adjacent the fluid inlet, spring means acting against said disc to normally maintain it in position to close the member opening adjacent the fluid inlet, the parts being so arranged that normal fluid pressure moves said diaphragm to urge said member against said annular seat to close communication between said air inlet and said fluid inlet and outlet and displaces said disc permitting fluid flow through said member and that abnormal pressure drop causes movement of the diaphragm and member to open air communication with said air inlet and closes said disc against said member to stop back flow into said fluid inlet.

8. In an improved automatic self-policing vacuum breaker or air valve, the combination of a valve body, a chamber formed therein open at one end, an entrance passage for said chamber at the other end, a cylindrical valve seat of less diameter than the internal diameter of the chamber located in the chamber, and a resilient annular valve secured at its peripheral edge to the valve body normally out of engagement with the valve seat and seating thereon on an excess of negative pressure of fluid within the chamber, whereby reverse flow of fluid through the valve body is prevented.

9. A device of the class described comprising a casing defining a chamber having a fluid inlet on one side thereof and a fluid outlet and an air inlet on the other side thereof, a resilient diaphragm within said chamber provided with a choke orifice, said diaphragm being so arranged with respect to said fluid outlet and air inlet that: with balanced pressure on each side of said diaphragm, said fluid outlet and air inlet are in communication; with pressure flow occurring normally through said choke orifice, said fluid inlet and outlet are closed off from said air inlet; and with lower than atmospheric pressure on the inlet side of said diaphragm, said fluid outlet and air inlet are in communication.

10. A device for use in a liquid pressure system for passing a flow of liquid under pressure in the normal direction and for preventing back siphonage of liquid whenever pressure on the pressure side drops below atmospheric, comprising a casing having a liquid inlet, a liquid outlet and air ports therein, a resilient diaphragm member within said casing and providing a reduced opening between said inlet and outlet, said diaphragm member being arranged to close off said air ports during normal pressure flow but responsive to a reduction of pressure at said inlet side of the casing to open communication from said air ports, the size of said opening and of said air ports being such as to admit sufficient air to prevent back siphonage of liquid through said casing when the pressure at the inlet thereof is reduced below atmospheric.

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