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J. J. FILLIUNG

2,663,309

VACUUM BREAKER

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Fig. 1.

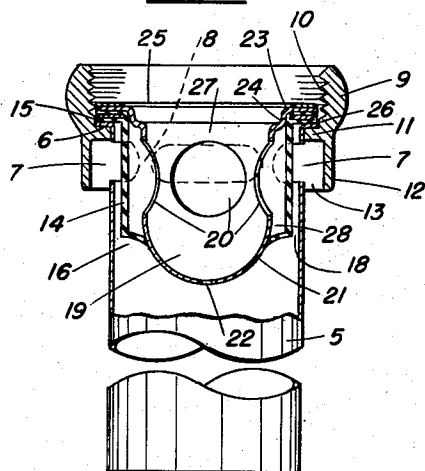


Fig. 2.

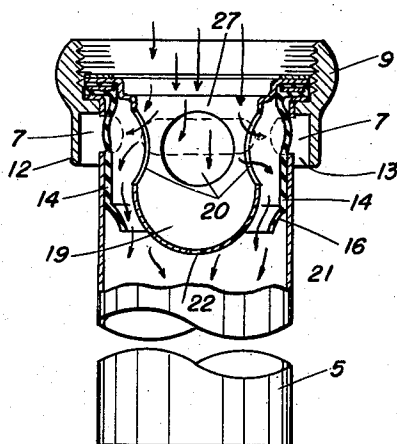


Fig. 3.

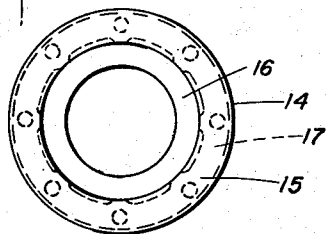
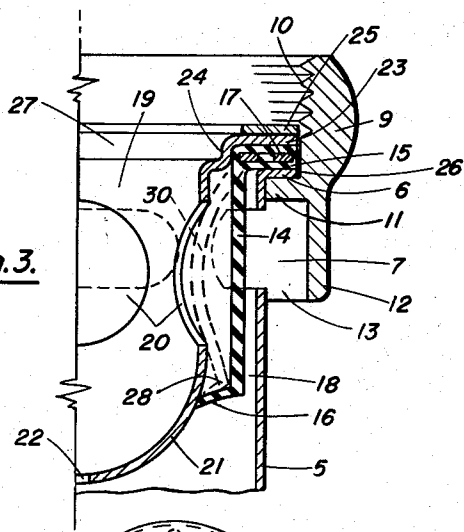
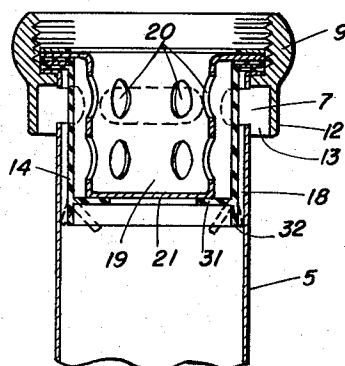


Fig. 4.

Fig. 5.



INVENTOR.
JACQUES J. FILLIUNG
BY *Parker Clarter*
ATTORNEYS.

UNITED STATES PATENT OFFICE

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VACUUM BREAKER

Jacques J. Filliung, Chicago, Ill., assignor to Sloan Valve Company, Chicago, Ill., a corporation of Illinois

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9 Claims. (Cl. 137-218)

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The present invention is concerned with vacuum breaking devices particularly adaptable for use with water supply systems where there is danger of back-syphonage occurring from contaminated plumbing fixtures such as water closets, for example.

The principal object of the invention is to provide a new and improved vacuum breaker and check valve which will not leak when water flows through it and which will safely and reliably prevent back syphonage from a plumbing fixture.

Another object is to provide a new and improved vacuum breaker which will pass a high rate of flow at low water pressures while preventing leakage, when relatively high back pressures are present at the outlet end thereof.

Another object of the invention is to provide a device having a flexible sleeve valve member which will automatically act as a back check to prevent back-syphonage in a water supply line upon the occurrence of a vacuum condition while admitting entry of air to the interior thereof, and which will seal off the air inlets to prevent leakage responsive to water flow through the device.

A further object of the invention is to provide a depending flexible sleeve valve member which positively cannot reverse itself upon the occurrence of a vacuum condition, and which is shielded from the full initial impact of the water flow to prevent its rupture.

Further objects consist in the provision of an improved vacuum breaker which is inconspicuous and attractive in its outward appearance, simple and compact in construction and operation, economical to manufacture and easy to install, and is highly efficient and durable in use.

With the foregoing and other objects in view, the invention consists in certain novel features of construction, operation and combination of elements as will be more fully pointed out hereinafter, reference being had to the accompanying drawings disclosing a preferred embodiment of the invention in which:

Fig. 1 is a full-sized cross-sectional view of the novel vacuum breaker with the parts in normal position;

Fig. 2 is a similar view showing the parts operated when water flow takes place;

Fig. 3 is an enlarged cross-sectional view of a portion of the device;

Fig. 4 is a top view of the flexible sleeve member; while

Fig. 5 shows a modified form of the device. Referring now to Fig. 1 and Fig. 3, the vac-

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uum breaker device includes a tubular outlet member or casing 5, the lower end of which is, in the usual plumbing installation, connected to a water closet bowl or other fixture and having the upper end connected to a flush valve for controlling the amount of water passing into the plumbing fixture. The vacuum breaker unit is interposed between the water closet bowl and flush valve for the purpose of preventing back-syphonage of contaminated water from a possible clogged water closet bowl into the potable water supply line connected to the flush valve. This could occur whenever a sub-atmospheric or vacuum condition existed in the supply line brought on by reasons well known. The vacuum breaker is usually located at a certain distance above the spill line of the water closet bowl and directly below the outlet end of the flush valve.

The upper end of the outlet tube 5 is provided with an annular supporting flange 6 formed therein together with a series of air ports or vents 7 arranged around the tube 5 immediately below the flange 6 and spaced apart by the connecting portions 8. A coupling nut 9 is provided for securely attaching the unit, as by internal screw threads 10, to the outlet of a flush valve. This nut has an inner annular flange 11 upon which the tube flange 6 rests to support the outlet tube 5 and the other elements of the unit. An annular depending skirt portion 12 is formed integral with the nut 9 and is spaced from the outer walls of outlet tube 5 as indicated at 13 in a manner to overhand the air ports 7 and protect the same from the insertion of foreign objects tending to obstruct the air ports 7 and interfere with their normal function. The annular space 13 is of sufficient size and area so that the air ports 7 are fully effective to break any vacuum condition, as will be pointed out.

Arranged within the outlet tube 5 and in nested relation therewith is a flexible annular sleeve valve member 14 constructed preferably of a synthetic product such as "neoprene" which has certain well known superior qualities over natural rubber when utilized for the present purposes. Flexible sleeve valve 14 has thin side walls vertically disposed and spaced apart slightly from the outlet tube 5 and at its upper end has an annular outward extending supporting flange 15 which rests directly on top of the outlet tube flange 6 as best seen in Fig. 3. At the lower end flexible sleeve 14 is provided with an inwardly projecting lip or flange 16 made somewhat thinner than the side walls of the sleeve to provide greater flexibility and present less restriction to

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the free flow of water at that point. In order to prevent distortion of the flexible sleeve side walls when the coupling nut 9 is drawn up tight, a reinforcing ring 17 is imbedded in the sleeve flange 15 as shown. As indicated at 18, the flexible sleeve 14 is spaced apart from the side walls of outlet tube 5 so that the interior of the outlet tube below the vacuum breaker is normally exposed to atmospheric pressure, except when water flow takes place through the device.

Axially disposed in nested relation to the flexible sleeve 14 and outlet tube 5 is a metal cup-shaped member 19 having a series of transverse openings in its side walls constituting water ports 20. These water ports 20 are of somewhat larger size than the air ports 7 and are arranged substantially in alignment therewith. The flexible sleeve 14 is interposed between the cup member 19 and outlet tube 5 and its side walls are spaced approximately equal distance from both as shown. The cup member 19 is closed across its rounded bottom end 21 except for a small hole 22 in the bottom thereof, and the flexible lip 16 lightly engages the curved portion of the bottom 21 above the location of the opening 22.

In order to support the cup member 19 accurately within the outlet tube 5, there is provided a transverse annular flange portion 23 resting immediately on top of the flexible sleeve flange 15 and within the coupling nut 9 as shown in Fig. 3. A shoulder 24 formed around the top end of the cup member 19 serves to accurately and rigidly hold the depending flexible sleeve 14 centralized and in proper spaced relationship with the cup member 19 and the outlet tube 5. A packing ring 25 is preferably placed on top of the cup member flange 23 and the complete unit is attached to the outlet end of a flush valve, not shown, by the coupling nut 9 being threaded thereon. The flanges 6, 15, 23 and packing 25 are thereby clamped together in water tight engagement between the coupling nut flange 11 and the outlet end of the flush valve. The coupling nut 9 may be drawn up as tightly as desired without distorting the flexible sleeve 14 due to the reinforcing ring 17, and since the outer peripheral edges of all the flanges are of a size to closely fit into the inner circumference 26 of the coupling nut 9, there can be no lateral shifting of the cup member 19 and flexible sleeve 14 with respect to the outlet tube 5. The complete device is therefore accurately maintained centralized at all times in the desired manner for uniform operation.

In the operation of the vacuum breaker when installed in association with a flush valve and water closet, the manual tripping of the flush valve handle results in a flow of water through the device as indicated in Fig. 2 by the arrows. The water passes into the inlet end 27 of the cup member 19 and out transversely through the four water ports 20, forcing the flexible sleeve 14 to expand its side walls into engagement with the walls of the outlet tube 5 and close off the annular space 18. This action likewise causes the flexible sleeve to seat on the air ports 7 and prevent leakage of water through these ports during the water flow. In case the water supply pressure is fairly high, the portion of the flexible sleeve walls closing off the air ports will effect a slight bulge through the air ports 7 to seal them tighter as shown. Splashing of water through the air ports is quickly prevented because the flexible sleeve is forced into engagement with the air ports immediately, due to the fact that

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the path of the water flow is transversely through the water ports 20 and at a point substantially in alignment with the air ports 7.

Water flow next passes into the space 28 between the cup 19 and flexible sleeve 14 and parallel therewith, bending and forcing the thin flexible lip 16 outward until it is substantially parallel to the side walls of the flexible sleeve 14 and the water flow. The end of thin lip 16 being normally lightly in contact with the cup member 19 only offers slight restriction to the free passage of the water. The bending or hinging action of lip 16 also enables a tighter seal to be applied between the bottom of the flexible sleeve 14 and the outlet tube 5 to further assist in preventing leakage from the air ports 7. The flexible sleeve 14 is made sufficiently elastic so that fairly low water pressures will be effective to expand the side walls and seal off the air ports and still not be bulged out of the air ports by high pressures to cause a bursting of the sleeve.

From the foregoing action of the device upon water flow therethrough, it will be evident that the flexible sleeve is shielded by the brass cup 19 from the full initial impact of the stream of water and therefore cannot be stretched or torn beyond its maximum elasticity, the cup acting to divert the stream transversely to the side walls of the sleeve 14 and outlet tube 5.

In the event that back pressures are built up in the outlet tube 5 either due to restrictions imposed by the type of water closet bowl connected thereto, or to partial stoppage of the same, the flexible sleeve 14 is caused to bulge outward by pressure applied below the lip 16 and by the expansion caused by the inlet flow, causing the air ports to be sealed off and preventing spurting and leakage therethrough.

Assume, now, for example, that a vacuum condition occurs within the inlet water supply line, due possibly to a sudden withdrawal of the water from the plumbing system caused by any number of conditions well known in the plumbing trade. Operation of a flush valve under such circumstances will usually result in the contaminated contents of a clogged water closet being sucked back as by syphonic action, into the pure water supply line. The present vacuum breaker prevents this undesirable action and in response to such a vacuum condition the side walls of the flexible sleeve 14 are immediately forced or bulged inward by atmospheric pressure passing through air ports 7, and in case the degree of vacuum present is great enough, the walls will seat upon the water ports 20 and bulge slightly into them, as shown at 30 in Fig. 3. This action effectively seals off the flow of water in the manner of a back-check and prevents reverse flow. At the same time that the flexible sleeve walls 14 are forced inward, the space 18 between the flexible sleeve and outlet tube is greatly enlarged, affording a wide opening for entry of atmospheric pressure through the air ports 7 to the space below the vacuum breaker to break the vacuum therein and thereby prevent any rise in the water level in the outlet tube. In addition to the flexible sleeve "hugging" the cup member 19 on a vacuum condition, the thin lip 16 likewise closely embraces the bottom of the cup to act as a back-check, and in most instances where a low degree of vacuum is encountered, this check is sufficient to prevent back-syphonage.

From the foregoing action of the flexible sleeve,

it will be apparent that the sleeve cannot reverse itself upwardly upon the occurrence of a vacuum condition due to the presence of the brass cup member 19. Should it occur that foreign objects lodge in the water ports 20 and hang downward, the thin lip 16 will wrap itself around the object on a vacuum condition to prevent back-syphonage. The small opening 22 in the bottom of cup member 19 serves to provide a means for gradually dissipating the vacuum condition in the supply line and yet is small enough so as not to cause a rise of water in the outlet tube 5 and cause back-syphonage. The opening 22 also serves as a drain for the bottom of the cup member 19.

In the event of any defect in the flexible sleeve, attention will be quickly brought to the same by the leakage which will occur from the air ports. The device is therefore self-policing and replacement or repair can be quickly accomplished.

Referring now to the modification of the invention disclosed in Fig. 5, the elements thereof are substantially the same construction as those shown in Fig. 1, with the exception that the brass cup member 19 has a flat bottom portion 21 and two rows of water ports 20 to more evenly distribute the water pressure around the inside of the flexible sleeve walls. The flexible sleeve 14 is also provided with a thin lip 31 lightly engaging the flat bottom 21 of the brass cup, while the side walls of the sleeve are further extended below the lip 31 as indicated by the skirt portion 32. Upon water flow through the device, the thin lip 31 is bent forward as shown by the dotted lines and this assists in bending the skirt 32 outward against the tube walls to further assist in preventing leakage out of the air ports 7. This modification otherwise operates the same as that shown in Fig. 1.

Other applications and modifications of the invention are contemplated within the scope of the present invention, as will be apparent to those skilled in the art. It is therefore to be understood that the embodiments herein disclosed are to be regarded as only illustrative of the invention and not restrictive, and the appended claims are therefore to be construed broadly, except for such limitations as may be necessary in view of the prior art.

What is claimed is:

1. In a vacuum breaker for a water supply system, a vertical tubular casing having air ports around the sides thereof, a cup-shaped member inside said tubular casing having water ports around the sides thereof and being closed at its bottom end, a flexible sleeve member arranged between said tubular casing and said cup-shaped member adapted to close said air ports responsive to water flow and to close said water ports responsive to a vacuum condition, said water ports and said air ports being disposed in substantial horizontal alignment whereby water flow is directed through said water ports transversely against the inside vertical wall of said flexible sleeve member to force the same outward directly against said aligned air ports to seal them against leakage, and whereby under vacuum conditions atmospheric pressure is directed through said air ports transversely against the outside wall of said flexible sleeve member to force the same inward directly against said aligned water ports to seal them against back syphonage, and an inwardly extending annular flange around the lower open end of said flexible sleeve member, the closed bottom end of said cup-shaped mem-

ber projecting through said annular flange and contacting the same at a point between the bottom end of said cup-shaped member and said water ports, and means for clamping said tubular casing, said cup-shaped member and said sleeve member together at one end.

2. In a vacuum breaker for a water supply system, a vertical tubular casing having air ports around the sides thereof, a cup-shaped member nested inside said tubular casing but spaced therefrom, said cup-shaped member having water ports around the sides thereof and being closed on the bottom end, a flexible sleeve member nested between said tubular casing and said cup-shaped member and spaced from both, and means for supporting said tubular casing, said cup-shaped member and said sleeve member together at one end, and an inwardly extending annular flange around the lower open end of said flexible sleeve member, the closed bottom end of said cup-shaped member projecting through said annular flange and contacting the same at a point between the bottom end of said cup-shaped member and said water ports, said flexible sleeve member being movable towards said tubular casing to close said air ports responsive to water flow and being movable towards said cup-shaped member to close said water ports responsive to a vacuum condition, said water ports and said air ports being disposed in substantial horizontal alignment whereby water flow is directed through said water ports transversely against the inside vertical wall of said flexible sleeve member to force the same outward directly against said aligned air ports to seal them against leakage, and whereby under vacuum conditions atmospheric pressure is directed through said air ports transversely against the outside wall of said flexible sleeve member to force the same inward directly against said aligned water ports to seal them against back syphonage.

3. In a vacuum breaker device for installation in a water supply system, a vertically disposed tubular casing having air ports arranged in the sides thereof, a cup-shaped member arranged inside said tubular casing having water ports arranged in the sides thereof and a closed bottom end, said cup-shaped member being spaced from said tubular casing, said air ports and water ports being disposed in substantial horizontal alignment, a flexible tubular sleeve member arranged between and in spaced relationship to said tubular casing and said cup-shaped member, means for clamping both of said members together at one end of said tubular casing, said flexible member arranged to close said air ports responsive to water flow through said device, said water flow being directed transversely against the inside vertical wall of said flexible sleeve member to force the same outward directly against said aligned air ports to seal them against leakage, and to close said water ports responsive to a vacuum condition in said device, whereby atmospheric pressure is directed transversely against the outside wall of said flexible sleeve member to force the same inward directly against said aligned water ports to seal them against back syphonage, and an inwardly extending annular flange around the lower open end of said flexible sleeve member, the closed bottom end of said cup-shaped member projecting through said annular flange and contacting the same at a point between the bottom end of said cup-shaped member and said water ports.

4. In a vacuum breaker device for installation

in a water supply system, a vertical tubular casing having air ports in the sides thereof, a rigid cup-shaped member having water ports in the sides thereof arranged in substantial horizontal alignment and directly opposite the air ports and being closed at the bottom end thereof, a flexible sleeve member interposed between said tubular casing and said cup-shaped member and spaced therefrom, means for clamping all of said members together at one of their ends, the opposite end of said flexible sleeve member having a lip portion thereon extending inward into engagement with said cup-shaped member at a point below said water ports and above the bottom end thereof, said flexible sleeve member being operated as a valve responsive to water flow through said device to close said air ports, said water flow being directed transversely against the inside vertical wall of said flexible sleeve member to force the same outward directly against said aligned air ports to seal them against leakage, and responsive to a relatively high vacuum condition to close said water ports whereby atmospheric pressure is directed transversely against the outside wall of said flexible sleeve member to force the same inward directly against said aligned water ports to seal them against back syphonage, the lip portion of said flexible sleeve being effective to prevent back syphonage when a relatively low vacuum condition is present and said water ports are not closed by said flexible sleeve.

5. In a vacuum breaker device for installation in a water supply system, a vertical tubular casing having air ports in the sides thereof, a rigid cup-shaped member having water ports in the sides thereof arranged opposite the air ports and being closed at the bottom end thereof, a flexible sleeve member interposed between said tubular casing and said cup-shaped member and spaced therefrom, means for clamping all of said members together at one of their ends, the opposite end of said flexible sleeve member having a flange thereon extending inward toward said cup-shaped member at a point below said water ports and above the bottom end thereof, said flexible sleeve member being operated as a valve responsive to water flow through said device to close said air ports and responsive to a vacuum condition to close said water ports, said water ports and said air ports being disposed in substantial horizontal alignment whereby water flow is directed through said water ports transversely against the inside vertical wall of said flexible sleeve member to force the same outward directly against said aligned air ports to seal them against leakage, and whereby under vacuum conditions atmospheric pressure is directed through said air ports transversely against the outside wall of said flexible sleeve member to force the same inward directly against said aligned water ports to seal them against back syphonage.

6. In a vacuum breaker device for installation in a water supply system, a vertical tubular casing having air ports in the sides thereof, a cup-shaped member having water ports in the sides thereof and being closed on the bottom end thereof, said water and air ports being arranged horizontally and in substantial alignment, a flexible sleeve member interposed in spaced relationship between said tubular casing and said cup-shaped member, coupling means for clamping all three of said members together at one end, and a flange formed on the opposite end of said flexible sleeve member extending into contact with said cup-

shaped member at a point between the bottom end of said cup-shaped member and said water ports, said flange being thinner than the wall thickness of said flexible sleeve member, said flexible sleeve member being operative as a valve responsive to water flow into said device through said water ports said water flow being directed transversely against the inside vertical wall of said flexible sleeve member to force the same outward directly against said aligned air ports to seal them against leakage, and responsive to a vacuum condition in said device whereby atmospheric pressure is directed transversely against the outside wall of said flexible sleeve member to force the same inward directly against said aligned water ports to seal them against back syphonage, said flange being moved out of contact with said cup-shaped member by the water flow.

7. In a vacuum breaker device for installation in a water supply system, a tubular casing having air ports in the sides thereof, a cup-shaped member having water ports in the sides thereof and being closed on the bottom end thereof, said water and air ports being in substantial alignment, a flexible sleeve member arranged between said tubular casing and said cup-shaped member and normally out of contact with said air and water ports, means for clamping said members together at one end, a flange on the other end of said flexible sleeve member in contact with said cup-shaped member at a point between the bottom end of said cup-shaped member and said water ports, said flexible sleeve member operative as a valve to close said air ports responsive to water flow through said water ports and responsive to a vacuum condition to close said water ports and prevent back flow through said device, said cup-shaped member having an orifice in the bottom thereof to dissipate said vacuum condition.

8. In a vacuum breaker for a water supply system, a vertically disposed tubular casing having air ports in the sides thereof, a rigid cup-shaped member arranged inside said tubular casing having water ports in the sides thereof and having a closed bottom extending substantially across said tubular casing, said air ports and said water ports being in substantial horizontal alignment, a flexible sleeve member arranged between and in spaced relationship to said tubular casing and said cup-shaped member, means for clamping said tubular casing, said cup-shaped member and said flexible sleeve member together at their upper ends, the lower end of said flexible sleeve being open and having an inwardly extending annular flange around said opening, the closed bottom end of said cup-shaped member protruding through said flexible sleeve member opening and in contact with the edge of said annular flange whereby the passage through said tubular casing is normally closed, said flexible member operative to close said air ports responsive to water flow through said tubular casing and to close said water ports responsive to a vacuum condition therein, said water flow being directed transversely against the inside vertical wall of said flexible sleeve member to force the same outward directly against said aligned air ports to seal them against leakage, and whereby atmospheric pressure is directed transversely against the outside wall of said flexible sleeve member to force the same inward directly against said aligned water ports to seal them against back syphonage, said annular flange being moved

away from said cup-shaped member by the flow of water and more tightly embracing said member upon occurrence of a vacuum condition.

9. The structure of claim 8 characterized by the annular flange alone being effective to prevent back syphonage on low vacuum conditions in case the water ports are not closed by said flexible sleeve.

JACQUES J. FILLIUNG. 10

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