

March 6, 1962

J. C. WOODFORD

3,023,767

VACUUM BREAKER

Filed Dec. 16, 1958

2 Sheets-Sheet 1

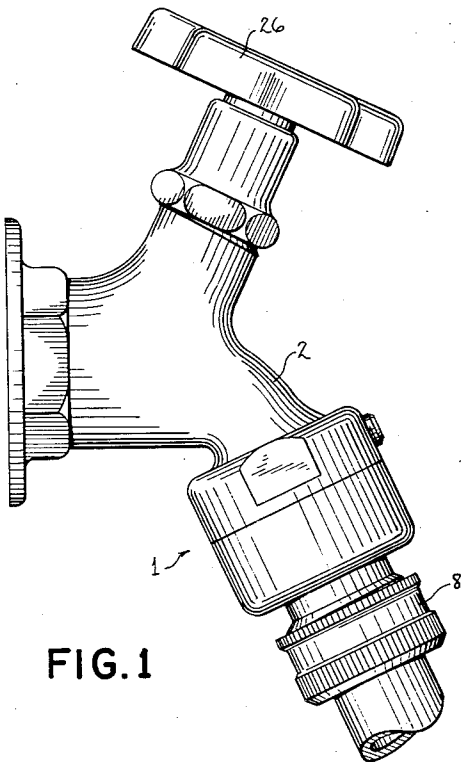


FIG. 1

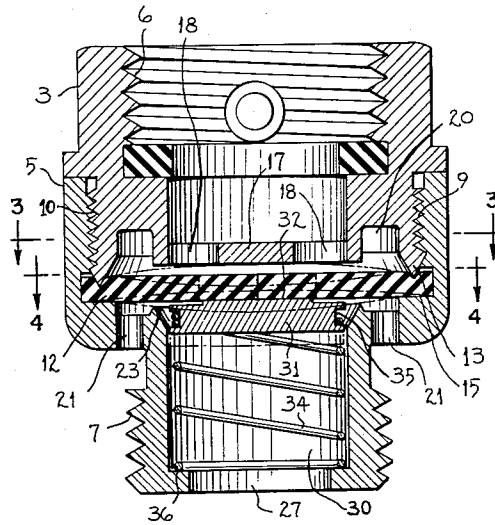


FIG. 2

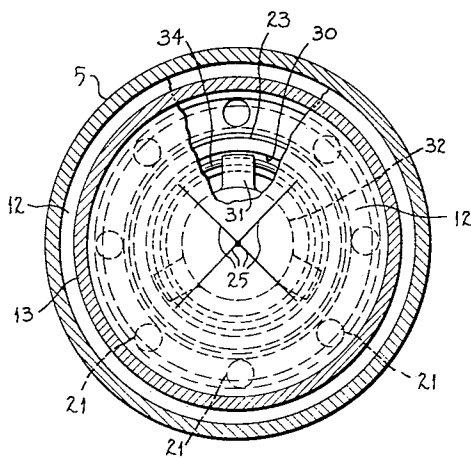


FIG. 4

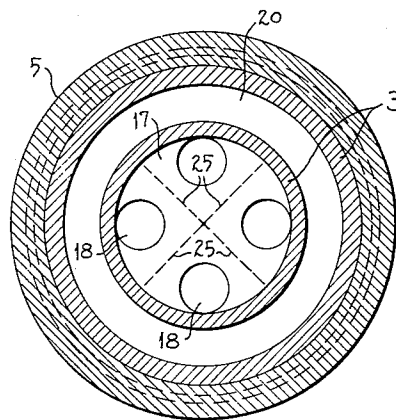


FIG. 3

INVENTOR.
JOSEPH C. WOODFORD
BY *Paul E. Baig*
ATTORNEY

March 6, 1962

J. C. WOODFORD

3,023,767

VACUUM BREAKER

Filed Dec. 16, 1958

2 Sheets-Sheet 2

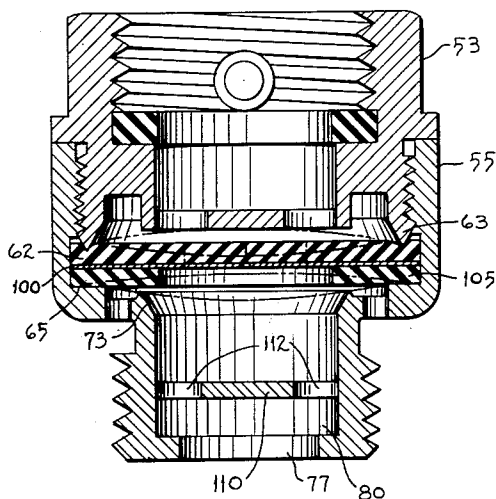


FIG. 5

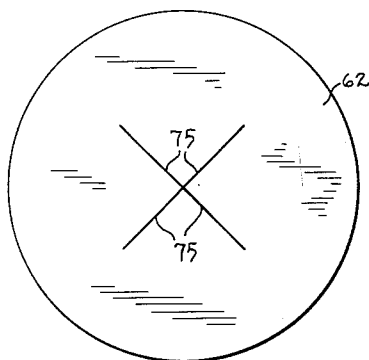


FIG. 6

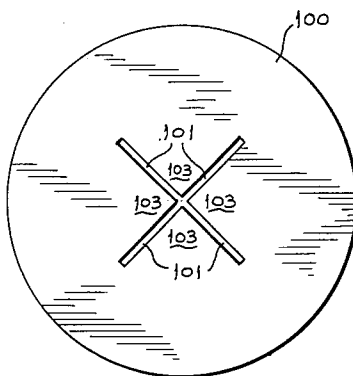


FIG. 7

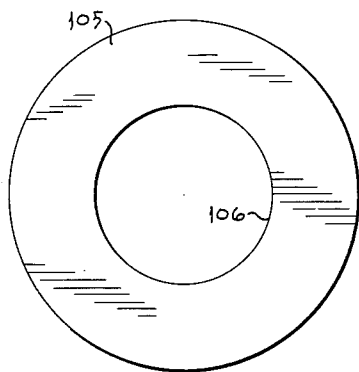


FIG. 8

INVENTOR.
JOSEPH C. WOODFORD
BY *Samuel E. Dargatzis*
ATTORNEY

1

3,023,767

VACUUM BREAKER

Joseph C. Woodford, 205 N. Buchanan St.,
Spring Lake, Mich.

Filed Dec. 16, 1958, Ser. No. 780,807

4 Claims. (Cl. 137-218)

My invention relates to an improvement in valve means for breaking vacuum, which may be created in fluid lines, such as water pipes, under certain abnormal conditions, to prevent back flow in the fluid line. My improved vacuum breaker and back flow preventing means is particularly adaptable for use on ordinary water service threaded outlets located both inside and outside of homes, and in hotels, hospitals, office buildings, laboratories, etc.

One object of my invention is to provide a vacuum breaker which will prevent any back flow of contaminated water into the water supply systems of homes, hotels, hospitals, etc., under all normal conditions of use.

Another object of my invention is to provide a vacuum breaker which will allow a sufficient volume of water to flow therethrough without causing excessive flow resistance or back-pressure.

Another object of my invention is to provide a vacuum breaker which will not leak or spray through the vacuum relief ports of the device under any conditions of supply pressure, or the rate of flow.

Another object of my invention is to provide a vacuum breaker which will not jet or splash excessively through its outlet when the outlet end of the vacuum breaker is not connected to some means such as an attached hose, or pipe.

Another object of my invention is to provide a vacuum breaker which will register no vacuum within its outlet chamber under any degree of vacuum in the inlet chamber or in the fluid supply pipe connected with such inlet chamber.

Another object of my invention is to provide a vacuum breaker which will function under normal conditions of service, which includes it being connected to a water source of supply wherein dirt, grit, sand, pipe scale, etc., may be carried occasionally by the water stream.

Another object of my invention is to provide a vacuum breaker which will function through any range of use, including very short and intermittent periods of fluid flow therethrough, and to the other extreme of very long periods of fluid flow, varying from a very slow rate to the maximum rate of flow.

Another object of my invention is to provide a vacuum breaker which will adapt itself to a wide range of performance conditions and which will function properly for long periods of time without the requirement of frequent servicing attention.

Another feature of my invention is to provide a vacuum breaker of a construction which is of a relatively small cross-section and length, so as to permit the installation of the vacuum breaker in the limited space available on standard sill-cocks, etc.; and which length will result in only a short extension of the existing faucet nozzle, to avoid extending below the rims of sinks.

Many devices of the nature of my improved vacuum breaker, for use on the threaded spout end of an ordinary water outlet to prevent back flow and contamination, have been made and sold previously. However, none of these prior art devices has adequately satisfied all of the

2

necessary requirements, and none has proven satisfactory in actual service in accordance with the uniform opinions of the authorities of the various states. Accordingly, a great need and demand has existed for a long time for an effective means of protection against the dangerous contamination of water supply systems which include ordinary water outlets such as faucets, sillcocks, etc.

My improved vacuum breaker has been subjected to exhaustive laboratory tests and actual service tests by various state authorities. Such exhaustive laboratory tests have established definitely that my device meets all of the necessary requirements, including the very stringent requirements of the state of Michigan.

My invention includes the various novel features of construction and arrangement hereinafter more definitely specified with reference to the accompanying drawings. In said drawings:

FIG. 1 is a side elevation view of my improved vacuum breaker installed on the screw-threaded spout of a common and well-known form of faucet.

FIG. 2 is an axial vertical sectional view of the vacuum breaker shown in FIG. 1, but on a larger scale.

FIG. 3 is a horizontal sectional view, taken on the line 3-3 in FIG. 2.

FIG. 4 is a horizontal sectional view, taken on the line 4-4 in FIG. 2.

FIG. 5 is an axial vertical sectional view, similar to FIG. 2, showing a modified form of the structure shown in FIG. 2.

FIG. 6 is a plan view of the diaphragm valve element of the structure shown in FIG. 5.

FIG. 7 is a plan view of the disc spring element for the diaphragm, as shown in FIG. 5.

FIG. 8 is a plan view of the resilient sealing ring element of the diaphragm structure shown in FIG. 5.

Referring to FIGS. 1 to 4, inclusive, of the drawings; my vacuum breaker and back flow preventor, indicated generally at 1, is shown mounted on the ordinary screw threaded end of a faucet 2 of a common and well-known construction.

The vacuum breaker, indicated at 1 in FIG. 1, is formed of an inlet member 3 and an outlet cap member 5. The inlet member 3 is provided with the axial internal screw thread 6 adapted for engagement with the screw threaded end of an ordinary faucet, or other similar device. The outlet cap 5 is provided with an external screw thread 7 adapted to be engaged by the internally threaded coupling member 8 of an ordinary hose, or the like.

The inlet member 3 is provided at its lower portion with an external screw thread 9 adapted to engage the internal screw thread 10 of the outlet cap 5.

The inlet member 3 is provided with a substantially flat diaphragm valve member 12 made of any suitable flexible and resilient material. The circular valve member 12 is clamped near its outer periphery between a relatively sharp annular projection 13, formed at the bottom end of the inlet member 3, and an annular seat surface 15 formed in the outlet cap member 5.

The inlet member 3 and the outlet cap 5 are tightly screwed together so as to form a water-tight joint around the outer edge of the diaphragm member 12.

The inlet member 3 is provided with a substantially flat and smooth valve seat surface 17 which has a series of openings 18 therethrough to permit the flow of water

to pass through the inlet member 3. The bottom end of the inlet member 3 is provided with an annular groove 20 to allow a space in which any dirt or foreign matter in the water may accumulate without interference with the operation of the diaphragm member 12, as herein-after described.

The outlet cap member 5 is provided with a circumferential series of air inlets, or vacuum breaking ports, 21 between the diaphragm 12 and the annular seating surface 15 and the relatively sharp annular seating edge 23 extending toward the diaphragm member 12.

As best shown in FIGS. 4 and 3, the diaphragm member 12 is provided with cross slits 25 therethrough which are of less length than the diameter of the annular seating edge 23. The space between the valve seat surface 17 and the annular seating edge 23 is sufficient to allow limited movement of the central portion of the diaphragm 12. Accordingly, the diaphragm 12 can alternately seal against the valve seat surface 17 or the annular seating edge 23, under vacuum condition or flow condition, respectively.

When water flow is permitted by the opening of the valve of the faucet 2, by rotational movement of the valve operating handle 26, the diaphragm 12 first seals effectively against the sharp annular seating edge 23, thereby preventing any escape through the circumferential series of ports 21. The pressure of the water, passing through the openings 18 in the valve seat surface 17 of the inlet member 3, against the slitted portions 25 of the diaphragm 12 deflect the slitted portions 25 of the diaphragm 12 in a downward opening direction toward the outlet 27 of the cap member 7 to permit water to flow through the opened up slitted area of the diaphragm 12.

It is to be noted that the slitted portions 25 are flexed, but not expanded, and, therefore, readily return to their substantially flat, or plane, closed positions after the flow of water has been shut off through the faucet 2.

When the inlet portion of the inlet member 3 is subjected to vacuum, the central portion of the diaphragm 12 moves slightly upwardly, as indicated in dotted lines in FIG. 2, to sealingly seat against the underside of the valve surface 17, to thereby close the series of ports 18 and, of course, the diaphragm 12 moves away from sealing engagement with the annular seating edge 23 of the cap member 5.

With the diaphragm 12 moved away from sealing engagement with the seating ring edge 23, communication between the cylindrical outlet chamber 30 of the cap member 5 and the circumferential series of ports 21 is effected. Thus, return of any contaminated liquid which might otherwise pass upwardly through the outlet 27 to the inlet member 3 is prevented by two valve sealing functions: first, by the sealing closure of the slits 25 of the diaphragm 12 and, second, by the closure of the series of openings 18 in the valve seat surface 17 by the movement of the upper surface of the diaphragm valve member 12 into sealing engagement with said series of openings 18. Accordingly, the occurrence of any degree of vacuum is prevented in the outlet chamber 30 because said chamber 30 is open to atmosphere through the ports 21.

My improved vacuum breaker, as above described thus far, would provide fully adequate protection against back flow and contamination of water supply lines under conditions of light and intermittent use of the water supply lines, providing that some spraying or jetting from the outlet 27 of the cap member 5 would not be objectionable. However, I deem it preferable to provide my improved vacuum breaker with additional means which will assure that the vacuum breaker will function properly even under most severe conditions of maximum flow of water through the outlet for long periods of time.

Referring to FIG. 2, a spider-shaped element 31 is provided at its upper surface with a reduced diameter portion 32. The element 31 is continually stressed up-

wardly, as in FIG. 2, by means of a coil spring 34, one end of which is engaged in the recess 35 formed in the periphery of the spider arms of the element 31, and the other end of the spring 34 is positioned in an offset 36 formed at the bottom of the cap member 7. The element 31 and spring 34 are of such diameter as to be freely movable axially within the chamber 30.

Under conditions of flow of water through the faucet 2, the element 31 is pushed downwardly, as in FIG. 2, by the flexing of the slitted portions of the diaphragm 12. The forces of the spring 34 are such that they may be readily overcome by slitted portions of the diaphragm 12 when opened by the water pressure. With the element 31 moved downwardly by the flexed slitted segments of the diaphragm 12 under water pressure to cause an opening through the diaphragm 12, the water pressure itself moves the element 31 further downwardly, as in FIG. 2, to a position wherein the spring 34 and element 31 are moved to their lowest possible position within the chamber 30. The element 31 being of a spider construction, as indicated in FIG. 4, with a reduced diameter central portion 32, water may flow freely through the spaces between the legs of the spider to the outlet 27 of the cap member 7.

When the flow of water is shut off by closure of the valve in the faucet 2, the slitted portions of the resilient diaphragm member 12 tend to return to their substantially plane position, and the spring pressed member 31 follows the diaphragm 12 and assists in repositioning the slitted portions of the diaphragm 12 into valve closed position. It is to be noted that during long periods of non-use of water through the vacuum breaker 1, the element 31 with its spring 34 acts as a supporting member for the diaphragm 12 and prevents any tendency of the segments, produced by the slits 25, to sag or fatigue out of their normal plane positions.

Under conditions of vacuum within the inlet member 3, when the ports 18 are closed by the diaphragm 12 and with the diaphragm slits in closed positions, the element 31 provides a third valve seal against the slitted outer surface of the diaphragm 12.

It is to be noted that it is highly improbable that particles of foreign matter entrained in the water would render all three sealing means, as described above, inoperative and non-functioning. Moreover, due to the assistance of the element 31, the slitted portions of the diaphragm 12 are retained in proper position, even under the most severe conditions of use. It is noted that severe conditions of use have caused distortion of resilient elements in, and the failure of, previous constructions of vacuum breakers.

Referring to the modified form of my invention shown in FIGS. 5 to 8, inclusive; the vacuum breaker shown in FIG. 5 is formed of an inlet member 53 and an outlet cap member 55, provided with respective screw threads in the same manner as heretofore described with reference to the form of my invention shown in FIG. 2. The inlet member 53 is provided with a flexible and resilient flat valve diaphragm member 62 having slits 75 in the same manner as heretofore described with reference to the diaphragm 12. A flat spring 100 of substantially the same diameter as the valve diaphragm 62 is positioned in contact with the under surface of the diaphragm 62. The flat spring member 100 is provided with a series of openings 101 therethrough to form a multiplicity of "finger type" spring members 103 which may be readily deflected by any deflection of the segments formed by the slits 75 of the diaphragm member 62.

A lower sealing ring 105, of substantially the same diameter as that of the diaphragm member 62 and the flat spring member 100, is positioned in contact with the spring member 100. The sealing ring member 105 has a large axial center opening 106 therethrough.

The diaphragm member 62, spring member 100 and

sealing ring member 105 are shown as separate elements in the drawing for purposes of clarity. However, it probably would be preferable to vulcanize together the diaphragm member 62, spring 100, and sealing ring 105 as a unit.

The circular valve member 62 is clamped near its outer periphery between a relatively sharp annular projection 63 formed at the bottom of the inlet member 53 and an annular seal surface 65 formed in the outlet cap member 55, in the same manner as heretofore described with reference to the structure shown in FIG. 2. The inlet member 53 and outlet cap 55 are tightly screwed together so as to form a water-tight joint around the outer edge of the composite diaphragm member 62, flat spring 100, and sealing ring member 105.

It is to be noted that in the modified form of my invention shown in FIG. 5, the element 31, with its spring 34 in the form shown in FIG. 2 are omitted, as the functions of the element 31 with its spring 34 are performed by the "finger type" thin spring member 100. Although only four "fingers" are shown in FIG. 7, a greater number may be used. The resilient sealing ring member 105 is provided merely to enable the securing of sealing contact on the relatively sharp annular seating ring edge 73.

If desired, the modified form of my invention, shown in FIG. 5, may be provided with a water flow diffuser element 110 provided with a multiplicity of openings 112 therethrough. The diffuser element 110 is located within at the lower portion of the outlet chamber 80 and spaced remotely away from the diaphragm member 62 and spring 100 so as not to present any interference of the movement of the slitted portions of the diaphragm at any position of deflection. The flow diffuser element 110 is sufficiently above the outlet 77 of the cap member 55 to allow the diffused water to consolidate into a slow velocity stream of water before emerging from the outlet end 77 of the cap element 55.

It is noted that if the element 31 with its spring 34 be not used in the form of my invention shown in FIG. 2, the flow diffuser element similar to the flow diffuser element 110 could be correspondingly located in the lower portion of the chamber 30 of the construction shown in FIG. 2.

I do not desire to limit myself to the precise details of construction and arrangement as hereinafter set forth, as it is obvious that various modifications may be made therein without departing from the essential features of my invention as defined in the appended claims.

I claim:

1. A vacuum breaker and back flow prevention means comprising an inlet body member; a hollow chamber formed in said body member; a transverse substantially plane web-like partition formed in said hollow chamber, said web-like partition having a valve surface at its underside, and having a plurality of flow ports therethrough; an outlet body member provided with an outlet opening; a hollow chamber formed in said outlet member; an annular seating edge formed at the top portion of said hollow chamber of said outlet member, said annular seating edge projecting toward the valve surface of said transverse web-like partition of said inlet body member; a multiplicity of vent ports surrounding said annular seating edge, said vent ports affording communication between said hollow chamber of said outlet member and atmosphere; a flexible resilient substantially plane diaphragm member clamped at its periphery between said inlet body member and said outlet body member, the central portion of said diaphragm member having limited freedom of motion between the valve surface of said transverse web-like portion of said inlet body member and the annular seating edge of said outlet body member; port means through said diaphragm member at its central portion to permit liquid to flow through said diaphragm member under inlet pressure; and an axially movable spring pressed combination dia-

phragm port closing and diaphragm support member positioned in said hollow chamber formed in said outlet member, said support member comprising a disc having a substantially plane upper surface supporting the major portion of the underside of the cross slitted part of said diaphragm member when said cross slits are in closed position, said substantially plane upper surface being of a dimension which prevents the tips of said cross slits from catching on the peripheral edge of said support member when said cross slits are in a fully open position.

2. A vacuum breaker and back flow prevention means comprising an inlet body member; a hollow chamber formed in said body member; a transverse substantially plane web-like partition formed in said hollow chamber, said web-like partition having a valve surface at its underside, and having a plurality of flow ports therethrough; an outlet body member provided with an outlet opening; a hollow chamber formed in said outlet member; an annular seating edge formed at the top portion of said hollow chamber of said outlet member, said annular seating edge projecting toward the valve surface of said transverse web-like partition of said inlet body member; a multiplicity of vent ports surrounding said annular seating edge, said vent ports affording communication between said hollow chamber of said outlet member and atmosphere; a flexible resilient substantially plane diaphragm member clamped at its periphery between said inlet body member and said outlet body member, the central portion of said diaphragm member having limited freedom of motion between the valve surface of said transverse web-like portion of said inlet body member and the annular seating edge of said outlet body member; cross slits through said diaphragm member at its central portion to enable the segments formed by the slits to be moved to open position to form a flow port when subjected to the pressure of fluid flowing through said inlet body member; and an axially movable spring pressed combination diaphragm flow port closing and diaphragm support member positioned in said hollow chamber formed in said outlet member, said support member comprising a disc having a substantially plane upper surface supporting the major portion of the underside of the cross slitted part of said diaphragm member when said cross slits are in closed position, said substantially plane upper surface being of a dimension which prevents the tips of said cross slits from catching on the peripheral edge of said support member when said cross slits are in a fully open position.

3. A vacuum breaker and back flow prevention means comprising an inlet body member; a hollow chamber formed in said body member; a transverse substantially plane web-like partition formed in said hollow chamber, said web-like partition having a valve surface at its underside, and having a plurality of flow ports therethrough; an outlet body member provided with an outlet opening; a hollow chamber formed in said outlet member; an annular seating edge formed at the top portion of said hollow chamber of said outlet member, said annular seating edge projecting toward the valve surface of said transverse web-like partition of said inlet body member; a multiplicity of vent ports surrounding said annular seating edge, said vent ports affording communication between said hollow chamber of said outlet member and atmosphere; a flexible resilient substantially plane diaphragm member, the central portion thereof having limited freedom of motion between the valve surface of said transverse web-like portion of said inlet body member and the annular seating edge of said outlet body member; cross slits through said diaphragm member at its central portion to enable the segments formed by the slits to be moved to open position to form a flow port when subjected to the pressure of fluid flowing through said inlet body member; a flat readily flexible spring member, having a series of openings therethrough which form a multiplicity of finger type flow port closing and diaphragm

7

support members, in engagement with the underside of said diaphragm member; and a sealing ring member, coacting with the said seating edge in said outlet body member to effect closure of said vent ports when fluid is flowing through said outlet body member, and having an opening therethrough of larger diameter than the length of said slits in said diaphragm member, in engagement with the underside of said flat flexible spring member; said diaphragm member, flexible spring member and sealing ring member being clamped as a unit at their peripheries between said inlet body member and said outlet body member.

5

10

8

4. A structure as in claim 3; wherein said diaphragm member, said flexible spring member, and said sealing ring member are formed as a unitary element.

References Cited in the file of this patent

UNITED STATES PATENTS

597,842	Edmands	Jan. 25, 1898
2,292,373	Groeniger	Aug. 11, 1942
2,629,393	Langdon	Feb. 24, 1953
2,646,063	Hayes	July 21, 1953
2,875,776	Skipwith	Mar. 3, 1959
2,897,835	Philippe	Aug. 4, 1959