

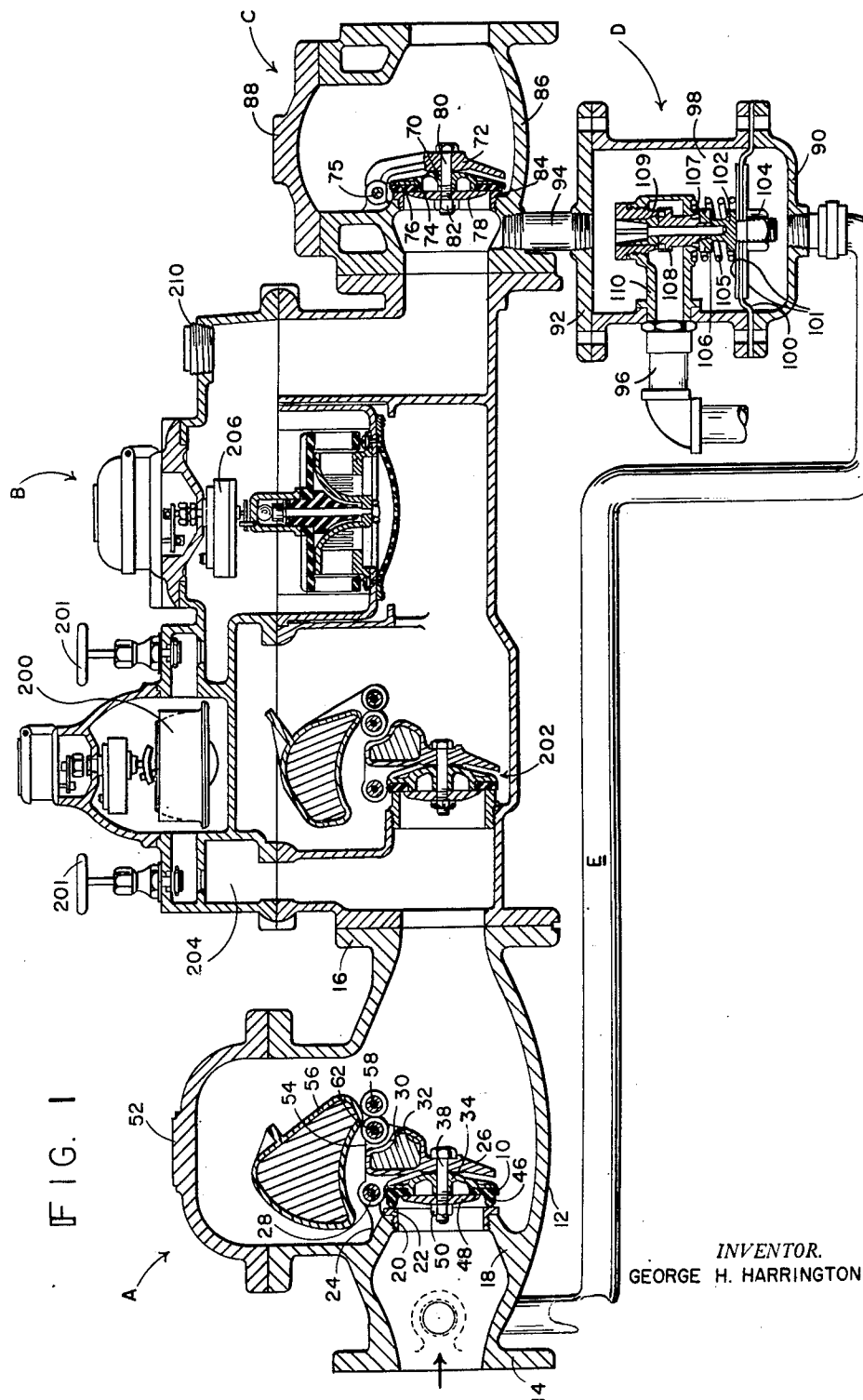
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ANTI-BACK-FLOW DEVICE

2,706,488

Filed Nov. 30, 1950

2 Sheets-Sheet 1



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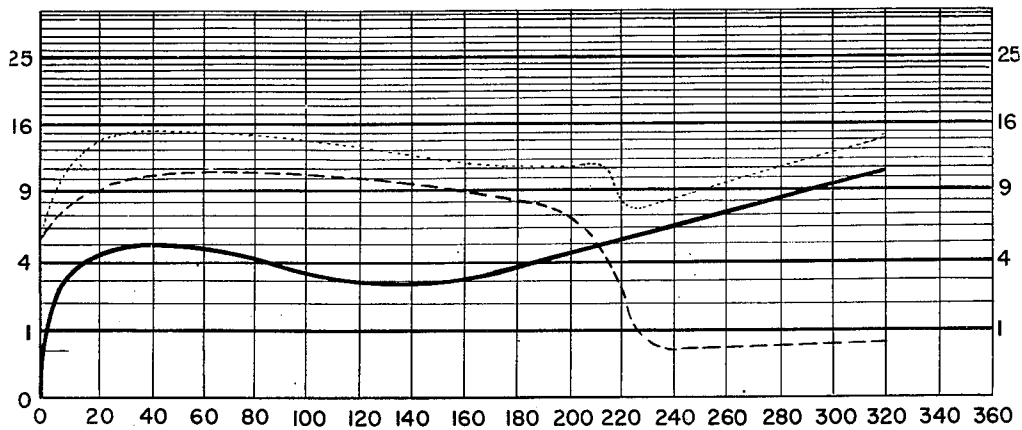
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FIG. 2



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ANTI-BACK-FLOW DEVICE

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2 Claims. (Cl. 137—116)

This invention relates to an anti-back-flow device, and particularly to such a device in which one element is a water meter, for use in liquid flow systems which are subject to pressure differential resulting in reverse flow tendencies. The general purposes of the device, therefore, are to prevent any reverse flow and thereby avoid pollution and contamination in potable water distribution systems.

In the past, various devices have been employed in an effort to prevent backflow between potable and non-potable supply lines, but for various reasons their operation has not proved entirely successful, particularly due to excessive pressure drop therethrough. The present invention has as its principal object to provide a satisfactory leak-proof anti-back-flow device and which attains such object with a relatively low pressure drop therethrough during maximum flow conditions, approximating substantially full pressure for which the system would otherwise be capable. Another important object is prevention of damaging intercommunication between high and low pressure services. These and other objects and advantages will be apparent from the following description read in connection with the drawings illustrating a preferred embodiment of the device in which—

Fig. 1 is a longitudinal cross-section of an application of the device of this invention including a water meter, and

Fig. 2 shows a series of characteristic pressure drop curves as hereinafter more fully explained.

Referring to the drawings in which like letters and numerals designate like parts—

The major components of the combination shown include a multiple-lever check-valve generally designated A; a compound water meter generally designated B; a swing type check-valve generally designated C; a differential pressure-relief valve generally designated D; and a pipe E providing a pressure-responsive free passage between the valve D, just referred to, and the high pressure or inlet side of the check-valve A.

The valve A of the preferred type, as shown, includes a movable member or flap 10 pivotally mounted to control the passage of a liquid through the valve casing 12 having external flanges 14 and 16 by which it may be suitably fastened in place. The casing 12 has an internal flange 18 in which there is threaded a sleeve 20 having a seat surface 22. The casing 12 is provided with lugs 24 between which is pivoted a carrier 26 on the flap 10. In order that the flap 10 may automatically close the passage through the casing 12 when it is not opened or held open by the flow of water, the carrier 26 is pivoted about a horizontal rod 28 in the lugs 24 at the upper part of the casing so that it will be closed by its own weight, adjustably predetermined by the addition or removal of heavy material such as lead 30 in the pocket 32 of said carrier. Actual closure of the passage is effected by a disk-shaped valve member 34 supported in the carrier 26 by a bolt 38. This valve member 34 has an annular groove upon its face in which a soft rubber washer 46 is held by means of a smaller disk 48 pressed against the washer and held there by a nut 50 on the bolt 38. The upper part of the casing 12 is closed by means of a dome 52 providing a space for a lever arm 54 on the valve carrier 26 and having an auxiliary weighted lever 56 pivotally supported on the rod 58 so that the auxiliary lever overhangs the arm 54. The weighted auxiliary lever 56 swinging in the opposite sense of the flap 10 is arranged to overhang said valve member and to bear against a

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roller 62 mounted at the end of the arm 54 of the valve carrier in all positions of the parts. The underside of the weighted lever 56 is curvingly shaped for the reception of the roller 62. This curved shape is such that for a portion of its length when the valve is in open position (not shown) the center of the curve coincides with the center of the pivot rod 28. At the end of the lever 56 near the pivot 58, however, the lever is shaped more nearly as a flat surface for contacting the roller 62. The shape is such that as the valve starts to open, the movement is opposed, not only by the weight of the flap 10 itself with its weight 30 but is also opposed by the lever 56 with its flat surface contacting the roller 62, as shown in Fig. 1, thus resisting the opening movement to the desired extent as hereinafter referred to.

Further, as the roll 62 is forced upwardly along the curved surface of the lever 56, the latter is moved practically to an upright position within the housing 52 thereby practically eliminating its leverage upon the valve with consequent minimizing of the resistance of the valve to liquid flow therethrough. Thus, this valve, as shown, provides a certain initial resistance to opening rapidly reaching the maximum, thereafter gradually diminishing, and finally, at still higher flow rates, sharply falling off to a point where it offers substantially no resistance to flow—all as shown in the dashed line curve of Fig. 2, hereinafter referred to. Though I have shown and described my preferred type of upstream check-valve, other types having built-in initial resistance-to-opening characteristics will answer the purpose though less advantageously, particularly at higher rates of flow.

Referring now to the check-valve C which, though it may be of any type, is preferably of swing type as shown so as to minimize resistance to normal flow therethrough. The valve element itself is similar to that just described in connection with the check-valve A and has a movable flap member 70 mounted in a carrier 72 pivoted at 75, the flap member in turn having an annular groove portion 74 carrying a soft rubber washer 76 with the latter held in place by a disk 78, bolt 80, and nut 82, as shown, the entire valve unit swinging to and seating against the seat member 84 mounted in the casing 86, the latter enclosed by the cap 88.

In addition to the check-valve C just described, the device includes a differential relief-valve D with a pressure connection to the inlet side of the check-valve A, as by the pipe generally designated E leading from the latter to the bottom portion of the casing 90 of the relief-valve D, the top or cap portion 92 thereof being connected to the left-hand side of the check-valve C as by a nipple 94, or other suitable passage. The third connection to the relief-valve D is simply an over-flow passage 96 connected to the body portion 98 of the valve D for the purpose of eliminating to the atmosphere any liquid discharge from the valve D. This valve D, as shown, though it may be of other suitable types, consists of a diaphragm member 100 the peripheral portions of which are held between the flanged portions of the casings 90, 98 of the valve D, also serving as a gasket therebetween, the diaphragm having attached at its central portion, as shown, a vertically arranged valve member 102 held in position between disks 101 by a nut 104 screw-threadedly attached to the downwardly extending portion of the valve 102. On the two flange portions 106 and 108, respectively, are mounted rubber washers which seat against the valve seats 107 and 109, respectively, when the valve member 102 is urged upwardly by fluid pressure below the diaphragm 100, as shown. When the fluid pressure above the diaphragm is such as to push it downwardly from the position shown in Fig. 1, free flow is established between the chamber of the casing 98 and the passage of the connection 96 through the inner housing 110 surrounding the upper portion of the valve 102.

Referring again to Fig. 1, and particularly to the water meter generally designated B, the meter shown is of the compound type which includes registering elements of the positive displacement type and inferential type, the meter shown being the well-known compound Torrent meter of Hersey Manufacturing Company of Boston, Mass. However, other types of meters may be employed, for example, disc type positive displacement meters, the plain inferential type meters, proportional

type meters, or other meters, or devices other than meters having the required flow characteristics involving suitable pressure drop for operation of the differential valve D, such devices including even a common throttling type of valve between the check-valves A and C.

In the water meter B, as shown, a positive displacement type registering element 200 is located generally above the multilever valve 202, and serves especially to meter at the lower flow rates. Globe valves 201 on each side of the element 200 may be closed to permit service work on the positive displacement registering element 200 without stopping flow of water through the meter. The multilever valve 202, which is similar to valve A in construction and operation, does not normally open until a certain flow rate, for example about 11 G. P. M. for a meter of 3" size, is reached, all the water at lower flow rates thus by-passing said valve through the channel 204. Water flowing through the valve 202 is metered by the inferential type registering element 206 shown in Fig. 1. Total flow is shown as the sum of the flow metered by the two registering elements, both of which simultaneously meter except of course at very low flow rates. The solid line curve of Fig. 2 shows the flow characteristics of the meter as a whole. The plug 210 is provided for removal to permit introduction of a pipe connecting the meter B in series with a calibrated water meter, for test or service purposes, if desired.

In operation, for example, with the device assumed to be in a pipe line designed to convey water at 100 lbs./sq. in. pressure, the water first entering the inlet end of the valve A will be temporarily prevented by this valve from continuing along through the valve, thus causing some of it to flow down into the pipe E and contact the diaphragm 100 of the differential relief-valve D, exerting the upward force on the diaphragm, which will, when the water pressure at this point reaches approximately 2 lbs./sq. in., cause the spring 105 in the relief-valve to be overcome and allow valve 102 to seat against 107 and 109.

As the inlet pressure continues to build up to, say, approximately 6 lbs. it will force the valve 102 and the rubber washers harder against their seats 107 and 109 assuring drip-tight valve closures. When the inlet pressure reaches approximately 6 lbs., the valve A will gradually open to a degree dependent upon a small flow demand, for example, a domestic demand. The pressure of the water passing the valve A will thus be reduced by an amount varying from 6 lbs. at the cracking point of the said valve to an amount depending upon the rate of flow. The water then proceeds through the water meter B, to be registered, then on through the check-valve C to the point of usage.

At cessation of flow the pressure at the inlet side of the valve A will be 100 lbs./sq. in. and the pressure between the outlet side of the valve A all the way through to the inlet side of the downstream check-valve C including the zone down to the top side of the diaphragm of the relief-valve D will be 94 lbs./sq. in. It is this 6 lb. (or other suitable predetermined) minimum differential across the relief-valve diaphragm that keeps the balanced valve 102 closed preventing spillage of water under normal flow conditions, or at cessation of flow.

If a back-flow condition tends to start because of a decrease in supply pressure or an increase in service line pressure, or both, no harm will result if the downstream check-valve C remains tight, but if this check should leak, the device would perform as follows, to prevent domestic water which might be polluted, from getting back into the supply pipe. In the first case, if the supply pressure should drop from 100 lbs. to approximately 98 lbs., which is still 4 lbs. higher than the pressure existing between the valve seat of valve A and the seat of the downstream check-valve C, the diaphragm 100 will be forced down by the 98 lb. pressure causing the balanced valve 102 to dissipate excessive pressure coming back through the check-valve C because the 6 lb. differential required to seat the balanced valve tightly no longer exists; there now being only 4 lbs. differential. As the inlet pressure to the lever valve A continues to drop, the relief-valve D will open wide to safely dissipate to the atmosphere any quantity of water trying to get back through the check-valve C.

Considering, then, another possible cause of back-flow; i. e., a greater pressure existing on the discharge side of the downstream check-valve C than exists at the

inlet side of the same check-valve. Again no harm will result if the check-valve C holds tight, but let us assume that the domestic, or service line, pressure builds up to 125 lbs. and the check-valve leaks. The pressure at the inlet side of the check-valve at the start of the back-flow condition would be 94 lbs. as before, but as soon as this pressure builds up to 96 lbs. because of domestic back-flow leakage, still 4 lbs. below the pressure on the inlet side of the upstream valve A, the 6 lb. differential pressure required across the relief-valve diaphragm to keep the balanced valve 102 shut will have been reduced to 4 lbs., so the damaging increase in back-flow pressure will be dissipated to the atmosphere through the pipe 96 in the same manner that it was in the other case.

A balanced valve is preferred as a relief-valve because this arrangement allows the device to be used in pipe lines of varying intensities of pressure, and also the varying pressures that exist within a single pipe line because of varying domestic flow demands.

From the foregoing it will be evident that any condition that prevails to prevent the proper minimum differential pressure to exist across the diaphragm of the relief-valve, will by the discharge of water from the relief-valve to the atmosphere indicate that a condition of back-flow to the supply system is being prevented, or that some part of the back-flow prevention mechanism is not working properly, such as a ruptured diaphragm or a faulty multilever valve.

Referring again to Fig. 2, from which certain advantages of the device will be more apparent—the dashed line curve, as already referred to, represents the pressure drop performance curve of the valve A taken alone and at various rates of flow, the latter being expressed in gallons per minute at the top and bottom of the graphs, and the loss of pressure in pounds per square inch being expressed at the vertical side edges of the graph.

The dashed line shows that the flow through the valve A when tested alone is "0" until a pressure of 6 lbs. is reached, whereupon it opens, at first gradually, and then with increasing rapidity at increasing rates of flow. At the same time, as shown, the pressure drop across the valve increases fairly rapidly at first, then levels off, and then gradually decreases to a point representing 180 G. P. M., thereafter falling rapidly to approximately ½ lb./sq. in., and then levelling off so that as the valve, taken alone, is subjected to increasing rates of flow there is substantially no resistance to liquid flow there-through.

The lower or solid line curve of the graph of Fig. 2 represents the pressure drop characteristics of the specific 3 inch meter B shown in Fig. 1, evidencing that through this meter alone, taken as a whole, the pressure drop starts at "0" at the start of a small flow there-through, gradually increasing to a peak of 5 lbs. pressure drop at 40 G. P. M., falling off somewhat as shown, and then gradually increasing with an increase in the rate of flow to approximately 11 lbs. at 320 G. P. M.—the rated capacity for the particular type of meter shown in a 3" pipe diameter size.

The pressure drop curve of the complete combination of Fig. 1 at varying rates of flow is shown by the fine dotted line which begins at "0" rate of flow at 6 lbs. as determined by the valve A, and shows the overall pressure drop through the combination at successive points of the curve, first, rapidly rising to a total aggregate pressure drop of 15 lbs., and then levelling off at approximately 11 lbs., thereafter by the curve showing that the valve A has opened fully and to a point of minimum flow resistance; thereafter, rising gradually with the curve of (and at a pressure of the order of 3 lbs. above) the pressure drop of the meter B, taken alone.

The valve A regulates pressure drop in such a way that it provides the differential pressure required to operate the relief-valve, and then ceases to be a source of a material pressure drop when the inherent pressure drop in the water meter, or other element, develops and becomes operative to a point whereby the pressure drop of the meter or other element produces the minimum differential pressure across the relief-valve required for operation thereof.

I claim:

1. Apparatus for backflow prevention which comprises a flow line having an upstream portion and a downstream portion, a check valve in the upstream portion, a check valve in the downstream portion, said check valves arranged to prevent backflow from said downstream por-

tion to said upstream portion, a conduit connecting said check valves for the passage of fluid therebetween, a relief valve communicating with said conduit for venting the same, means biasing said relief valve closed with a predetermined force, a flow-indicating meter positioned in said conduit having a movable portion responsive to the fluid flow between said check valves and arranged to establish a pressure drop and to register the flow between said check valves, differential pressure responsive means having substantially equal opposed areas for operating said relief valve in opposite directions, said differential pressure responsive means being subjected, in a valve opening direction, to the pressure downstream of said movable portion and in a valve closing direction to the pressure upstream of said upstream check valve whereby said relief valve will vent said conduit

when the pressure in said conduit approaches the pressure upstream of said upstream check valve.

2. The combination of claim 1 in which said upstream check valve is of the multilever type.

References Cited in the file of this patent

UNITED STATES PATENTS

1,720,444	Rowley	July 9, 1929
1,725,428	Tilden	Aug. 20, 1929
2,310,586	Lohman	Feb. 9, 1943
2,491,604	Carlton	Dec. 20, 1949
2,503,424	Snyder	Apr. 11, 1950

FOREIGN PATENTS

586,166	Great Britain	Mar. 10, 1947
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