

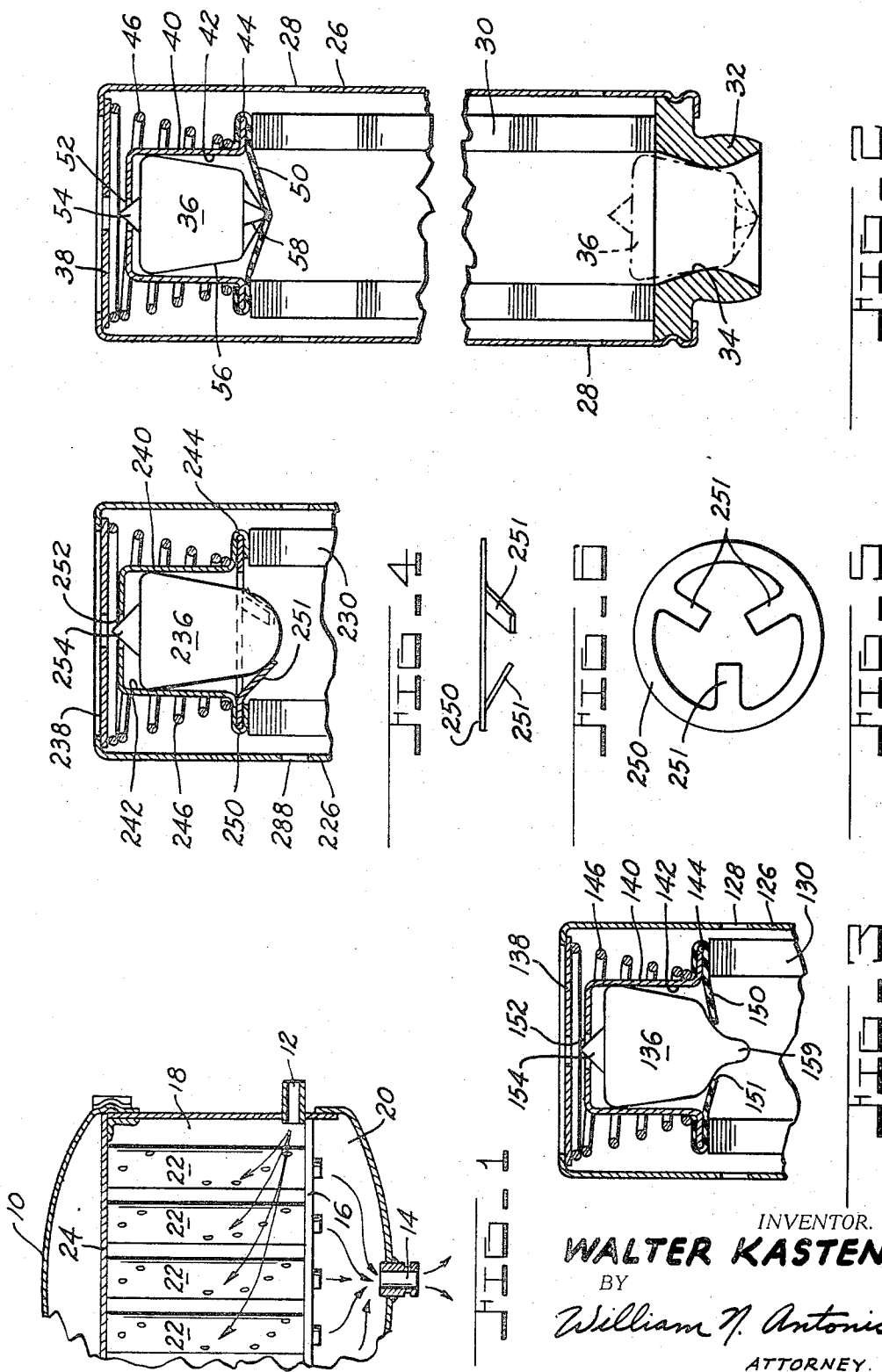
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SHUT-OFF VALVE FOR FUSE FILTER

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1

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SHUT-OFF VALVE FOR FUSE FILTER

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ABSTRACT OF THE DISCLOSURE

A positive shut-off valve for interrupting the flow of fuel through a fuse filter element of a fuel monitoring device in the event such fuel contains free water. The shut-off valve is responsive to the pressure differential across the fuse element, and is releasably confined at the end opposite the outlet port by a resilient member, such as a flexible diaphragm or a prong-type spring. The shut-off valve also incorporates a pilot or trigger valve control for actuating the shut-off valve.

Background of the invention

In most present day refueling installations fuel monitoring devices of the type described in my Patent No. 3,117,925 are located downstream of conventional filter water separators. In such installations, the fuel monitoring devices will normally operate for long periods of time without being exposed to large amounts of contamination. During such normal operations, the pressure drop through the fuel monitoring device will build up gradually, and the fuse elements will be replaced after a scheduled time interval, e.g., six months, or when the pressure differential across the fuse elements reaches a predetermined value, e.g., 15 to 20 p.s.i. Under such conditions, the fuse elements of the fuel monitoring device will retain all, or most all, of the solid and water contaminants in the fuel flowing therethrough.

More recently, in many installations fuel monitoring devices have been effectively utilized in place of filter water separators rather than in combination therewith. Even in such installations, if the fuel is of average quality, that is, contains only relatively small quantities of water and solid contamination, the fuse elements will have no difficulty in retaining or trapping the contamination. However, in such installations, certain operating conditions can occur which will cause small quantities of water to seep between the layers forming the edge-type fuse elements and flow to the outlet port of the fuel monitoring device. For example, if the fuel monitoring device is utilized in place of a filter water separator and the device is used at a fraction of its rated flow (25% or less), and if, in addition, the pumping system used to pump the fuel through the device has only a rather limited low operating pressure, then in those situations when the fuel flowing therethrough is contaminated with a high percentage of water, it will be possible for some of the water to seep through the fuse elements. The reason for this is that, under such conditions of limited flow and low pumping pressure, the piston in the fuse element cannot compress the edge-type filter element sufficiently to completely close off the pores between the layers and prevent further flow through the element. Thus, under such conditions water can in effect "seep" through the elements.

Summary of the invention

In view of the foregoing, it is an object of this invention to provide a fuel monitoring device which will function properly under all foreseeable operating conditions.

Another object of this invention is to provide a novel fuse element construction which will prevent water seepage therethrough.

2

In other words, it is an object of this invention to provide a "seepage proof" fuse element for use in a fuel monitoring device.

More specifically, it is an object of this invention to provide a tubular fuse element construction incorporating a releasable valve member which is releasably held at one end of the tubular fuse element by a resilient member, wherein the valve member incorporates a pilot valve control which upon a predetermined pressure drop across the fuse element will cause the valve member to be released by the resilient member and moved into the fuse outlet to prevent further flow therethrough. The resilient means can be formed of a rupturable imperforate diaphragm, a diaphragm having a stretchable central opening, or a prong-type spring.

A further object of this invention is to provide a shut-off valve for use in a fuse element which requires fewer critical manufacturing tolerances and is relatively inexpensive.

The above and other objects and features of this invention will become apparent from the following description taken in connection with the accompanying drawings.

Brief description of the drawings

FIGURE 1 is a fragmentary view partially in section of a fuel monitoring device containing a plurality of filter units, each of which incorporates the invention;

FIGURE 2 is an enlarged sectional view of a filter or fuse unit incorporating the invention and showing the shut-off valve in various positions;

FIGURE 3 is a fragmentary sectional view of a filter or fuse unit showing a second embodiment of the invention;

FIGURE 4 is a fragmentary sectional view of a filter or fuse unit showing a third embodiment of the invention; and

FIGURES 5 and 6 are plan and end views of the prong-type spring utilized in the FIGURE 4 embodiment.

Description of the preferred embodiments

Referring to FIGURE 1 of the drawings, it will be seen that the numeral 10 indicates a tank having a fuel inlet port 12 and fuel outlet port 14. Suitably attached to the housing is a partition 16 which separates the interior of the housing into an inlet chamber 18 and an outlet chamber 20. A plurality of filter or fuse units 22 (only four of which are shown) are suitably attached to partition 16 and are retained in position by a retainer plate 24 which is suitably attached to housing 10. The direction of flow through the tank is indicated by the arrows.

Each filter or fuse assembly 22 includes a metal tube 26 having a plurality of perforated inlet ports 28 surrounding a compressible porous tubular edge-type filter element 30 formed from a plurality of washers in registered face-to-face contact. The washers which are used in the filter may be formed from paper, cellulose, or other suitable fibrous or non-fibrous materials and are arranged so that flow through the filter element will be via the radially extending pores formed between the washers. The filter element may also be formed by utilizing a ribbon-like material wound edgewise. The method for winding and making the ribbon-type element is disclosed and claimed in my Patent No. 2,421,704. In the arrangement shown in FIGURE 1, flow will be from outside the filter element to inside the filter element. For additional details regarding this type of fuse assembly, reference may be made to my Patent No. 3,117,925 and Patent No. 3,151,071.

A nipple-like ferrule 32 which is suitably connected to one end of the tube and is in abutment with one end of

the filter element, is formed with a tapered valve seat 34 for receiving a valve member, indicated generally by the numeral 36. A perforated retainer washer 38 is located at the other end of the tube, and a cup-shaped or thimble-shaped metal stamped endplate 40 having a recess 42 therein and an outwardly extending flange 44 at the open end, is located at the other end of the filter element 30. A preloaded spring 46 is located between the retainer washer 38 and the flange 44 of the endplate 40 for preloading the edge-type filter element under the desired calibrated precompression. The valve member 36 is located within the endplate recess 42 and is confined therein by a relatively thin imperforate diaphragm 50 which is stretched tautly over and around the flanged end 44 of the endplate. This diaphragm can be formed of molded rubber or other suitable material. The valve member 36 is formed so that it is longer than the recess 42 so that the rubber diaphragm will be stretched sufficiently to urge the valve member in an upward direction. The closed end of the endplate 40 is formed with an orifice 52 therein which is blocked by the conical end portion 54 of the valve member, which in effect constitutes the pilot valve portion of the valve member. The main valve portion of the valve member is the larger conical portion 56 which is seatable on the valve seat 34 of the outlet port. The end of the valve member 36 which is in contact with the diaphragm 50 is also pointed and includes, if desired, shear blade edges 58 for assisting in rupturing the diaphragm, as described in more detail hereafter.

When the shut-off valve is assembled within the end of the fuse element, the resilient diaphragm 50, which performs the function of a spring, forces the conical end portion 54 against the orifice 52 so that flow is prevented through the orifice. This portion 54 in effect is the pilot valve mechanism which is utilized to trigger or actuate the valve member 36. If the area of the orifice is .05 square inch, and if it is desired to have the valve plug 36 shut off flow through the outlet port upon the occurrence of a pressure drop across the fuse element amounting to 25 p.s.i., then the diaphragm should be stretched so as to exert a force against the valve member 36 which amounts to 1.25 lbs. Thus, when the differential pressure across the fuse elements exceeds 25 p.s.i., the pilot valve 54 will open and allow the differential pressure of 25 p.s.i. to act on the full projected end area of the valve member 36. If the valve member has a projected or effective area of approximately 0.75 square inch the force acting on the valve member will amount to approximately 19 lbs., which is approximately fifteen times the normal force acting against the rubber diaphragm. At this greater pressure, the diaphragm will be stretched to such a degree that the cutting-knife edges of the valve member will rupture the diaphragm and permit the valve member to be propelled toward the outlet port of the fuse, where it will wedge into the outlet nipple, thereby interrupting flow therethrough. It will be understood that the taper of the valve plug is such that once it is wedged or seated in the outlet nipple, it becomes locked in place.

In FIGURE 3, which shows another embodiment of the invention, like parts are designated by like numerals plus 100. In this embodiment an elastic diaphragm 150 having a centrally located stretchable opening 151 receiving a nipple-like end 159 of the valve member 136 is utilized. Such an arrangement permits the shut-off valve to function without the necessity for actually rupturing the diaphragm, since the diaphragm need only stretch sufficiently to permit the valve member to pass through the stretched opening 151.

FIGURES 4, 5 and 6, wherein like parts are designated by like numerals plus 200, show another embodiment which utilizes a flat washer prong-type metal spring 250 in place of the diaphragms of the previous embodiments. The spring is assembled and retained in the flanged over portion 244 of the metal endplate 240. With this construction, the prongs 251 of the spring 250 urge the conical

portion 254 of the valve member 236 against the orifice 252 to close the trigger valve port. As in the previous diaphragm embodiments only a relatively small force is needed to close the trigger valve port. Once this force is exceeded, by the increased pressure drop through the fuse element, the pilot or trigger valve will open and permit flow through the orifice 252, at which time the force exerted against the valve member 242 will be increased by a factor of fifteen and will cause deflection of the prongs 251 sufficiently to permit the valve member 242 to escape from the cup-shaped endplate 240. With this construction it is necessary to have a rather close fit to seal the space between the outer periphery of the valve member 236 and the recess 242 of the endplate. However, since this needs to be only a relatively thin line-type seal, it can readily be obtained by actually shearing the valve member during assembly with the endplate, which normally can be held to rather close tolerances.

Those acquainted with this art will readily understand that the invention set forth herein is not necessarily limited and that various changes and modifications may be resorted to without departing from the spirit of my invention. Accordingly, I do not desire to be limited to the specific details described herein primarily for the purposes of illustration, but instead desire protection falling within the scope of the appended claims.

Having thus described the various features of the invention, what I claim as new and desire to secure by Letters Patent is:

1. A filter unit comprising a housing having a plurality of inlet ports and a single outlet port therein, a tubular filtering element located within said housing for permitting flow of fluid therethrough from the outside of the element to the inside of the element, said tubular element having one end thereof in abutment with said housing and in alignment with said outlet port, a cup-shaped endplate member in abutment with the other end of said tubular element, said endplate member having a recess therein and orifice means extending therethrough, a movable pressure responsive valve member slidable in said recess and having a pilot valve portion constructed and arranged to be seated in said orifice means to prevent flow therethrough and a main valve portion constructed and arranged to be seated in said outlet port to prevent flow therethrough after said valve member has moved to permit flow through said orifice means, said valve member having one side thereof subjected to the fluid pressure outside the tubular element and the other side thereof subjected to the fluid pressure inside the tubular element, resilient means located at said other end of said tubular element and operatively connected to said endplate member and valve member to normally releasably confine said valve member within said recess and urge the pilot valve portion thereof into seating engagement with said orifice means, said valve member coacting with said tubular element and said outlet port so that when the differential pressure acting thereon increases above a predetermined value the valve member will be released by said resilient means and moved into said outlet port to prevent further flow therethrough.

2. A filter unit, as defined in claim 1, wherein said resilient means is an elastic diaphragm which abuts said valve member.

3. A filter unit, as defined in claim 2, wherein said elastic diaphragm is imperforate and rupturable.

4. A filter unit, as defined in claim 3, wherein said valve member is formed with means thereon for rupturing said diaphragm after moving a predetermined distance towards said outlet port to thereby cause said diaphragm to release said valve member and permit movement thereof into said outlet port.

5. A filter unit, as defined in claim 4, wherein said means formed on said valve member for rupturing said

5

diaphragm comprises shear blade edges formed thereon.

6. A filter unit, as defined in claim 2, wherein said elastic diaphragm includes a centrally located stretchable opening for receiving one end of said valve member and permitting said valve member to pass therethrough when the differential pressure acting on said valve member increases above said predetermined value.

7. A filter unit, as defined in claim 1, wherein said resilient means is a spring having flexible prong-type means extending therefrom for abutting said valve member, said prong-type means being deflectable to permit said valve member to pass therethrough when the differential pressure acting on said valve member increases above said predetermined value.

8. A filter unit, as defined in claim 7, wherein said spring comprises a washer having a plurality of inwardly extending flexible prongs.

6

References Cited

UNITED STATES PATENTS

542,024	7/1895	McIlhenny	137—461
932,149	8/1909	Lockwood	137—461
2,048,388	7/1936	Johnsen	137—68
2,806,484	9/1957	Schultz	137—460
3,339,734	9/1967	Kasten	210—96
3,339,735	9/1967	Kasten	210—100
3,357,560	12/1967	Raupp	210—96
3,367,503	2/1968	Topol	210—96

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