Dec. 12, 1967 R. J. RAUPP 3,357,560

FUSE FILTER WITH PRESSURE RESPONSIVE CLOSURE MEANS

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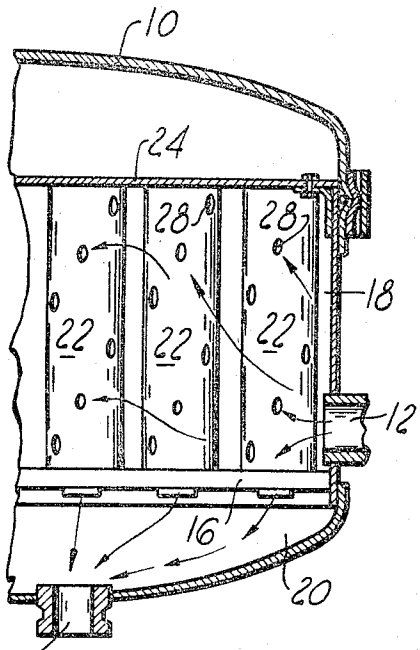

Fig. 1

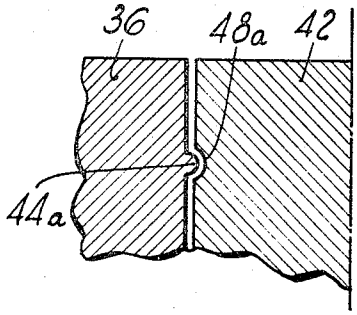

Fig. 4

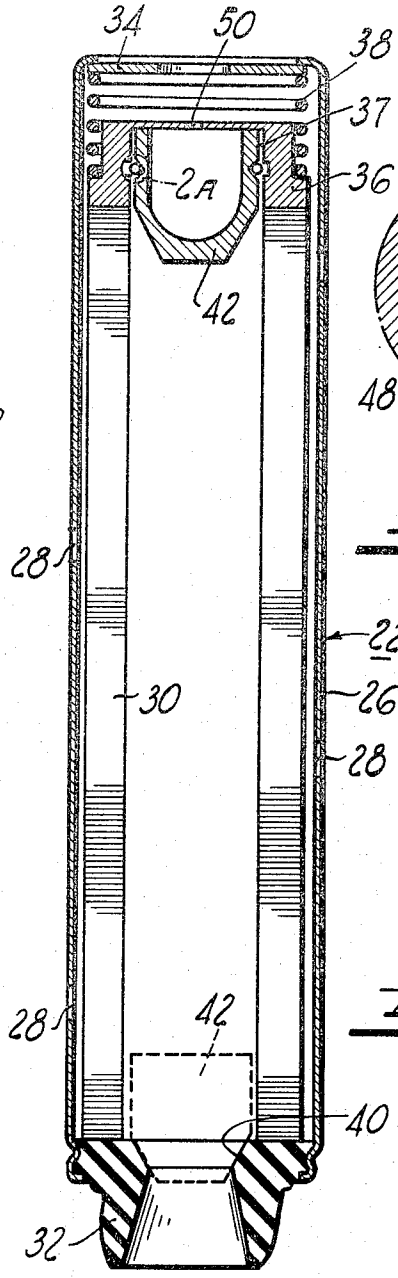

Fig. 2

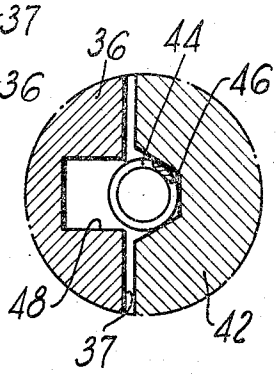

Fig. 2A

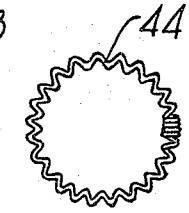

Fig. 3

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FUSE FILTER WITH PRESSURE RESPONSIVE CLOSURE MEANS

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1 Claim. (Cl. 210—96)

ABSTRACT OF THE DISCLOSURE

A fuel-monitoring filter or fuse unit having a positive piston-type shut-off valve therein for interrupting the flow of fuel therethrough in the event such fuel contains free water. The shut-off valve, which is responsive to the pressure differential across the filter unit, is confined by a tongue-and-groove arrangement within a recess in an endplate member located at the end opposite the outlet port of the filter unit. A garter spring constitutes the tongue of the tongue-and-groove arrangement.

In most installations fuel monitoring devices of the type described in Kasten 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 will trap and 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 element.

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.

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 which incorporates a detachable valve member wherein one side thereof communicates with the fluid outside the fuse element and the other side thereof communicates with the fluid inside the fuse element so that when the differential pressure thereacross increases above a predetermined value the valve member will be detached from the fuse element and moved into the fuse outlet to prevent further flow therethrough.

A further object of this invention is to provide a fuse element construction wherein a differential pressure operated piston-like valve member is detachably connected to the endplate of the fuse element through tongue and groove means, said valve member being caused to move into the fuse element outlet to prevent further flow therethrough upon the occurrence of a predetermined differential pressure thereacross.

A still further object of this invention is to provide a novel fuse element construction which incorporates a relatively inexpensive and simple positive shut-off valve therein.

The above and other objects and features of this invention will become apparent from the following description taken in connection with the accompanying drawings which form a part of this specification and in which:

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 a sectional view of a filter or fuse unit with a shutoff valve therein shown in various positions;

FIGURE 2A is an enlarged sectional view of the circumscribed portion of FIGURE 2;

FIGURE 3 is a view of the garter spring used in FIGURE 1; and

FIGURE 4 is a fragmentary sectional view of a filter or fuse unit showing a modification of the invention.

Referring to FIGURE 1 of the drawings, it will be seen that 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 three of which are shown) are suitably attached to partition **16** and are retained in position by a retainer plate **24** which is suitably connected 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. A nipple-like ferrule **32** is suitably connected to one end of the tube and is in abutment with one end of the filter element. A retainer washer **34** is located at the other end of the tube and a cup-shaped endplate **36** having a recess **37** therein is located within the tube and at the other end of the filter element. A preloaded spring **38** is located between the retainer washer **34** and the endplate **36** for placing the edge-type filter element under the desired calibrated precompression. The washers which are used in the filter element 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 Kasten 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 Kasten Patent No. 3,117,925 and Kasten Patent No. 3,151,071.

It will be seen from FIGURE 2 that the nipple-like ferrule **32** of each fuse element is formed with a tapered valve seat **40**. A piston-like valve member, indicated generally by the numeral **42**, is detachably connected to the endplate member **36** through tongue and groove means. In FIGURES 2 and 2A, the tongue and groove means comprises a garter spring **44** located in a tapered annular notch **46** formed in the valve member **42** and an annular groove **48** formed in the recess of the endplate member **36**. In effect, the garter spring constitutes the tongue which extends into groove **48**. The valve member can be made of plastic or any other suitable material. It will be noted that one side of the valve member **42** communicates with the fluid outside the filter element **30** via restricted orifice **50** in endplate **36** and the other side thereof communicates with the fluid inside the filter element **30**. The purpose of the restricted orifice is to suppress fluid surges against the valve member which would detach the valve member from the endplate member before the desired differential pressure across the valve member has been attained.

From the foregoing it will be understood that whenever the differential pressure or pressure drop between the outside and inside of the fuse element **30** increases above a predetermined value, e.g. 25 p.s.i., the force exerted against the valve member **42** will tend to cause it to move in a downward direction. Such downward movement will force the garter spring **44** to move radially outwardly into annular groove **48** until the valve member is released or detached from the endplate. After such detachment the higher pressure at the back of the valve member will propel it towards the nipple-like ferrule **32** and cause it to be locked in the tapered seat **40**, as shown in phantom in FIGURE 2. Obviously, after movement of the valve member to a seated position, further flow through the outlet port will be prevented by the valve member. The differential pressure at which the valve member is released can be changed by varying the amount of tension exerted by the garter spring.

Referring to the alternate embodiment shown in FIGURE 4, it will be seen that the tongue **44*a*** is formed on the endplate **36** and that the groove **48*a*** is formed in the valve member **42**. If desired, the tongue and groove relationship of these members can also be reversed. It should be understood, however, that the tongue should have a certain degree of flexibility so that it will permit detachment of the valve member from the endplate at differential pressures above the predetermined value. In this embodiment upon attainment of differential pressures above the predetermined value, the valve member will in effect "pop" loose from the endplate member and will then be propelled into the fuse outlet port to prevent further flow therethrough.

Those acquainted with this art will readily understand that the invention set forth herein is not necessarily limited and restricted to the precise and exact details presented 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 purposes of illustration, but instead desire protection falling within the scope of the appended claim.

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

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 passage means extending therethrough, a piston-like valve member detachably connected to said endplate member through annular tongue and groove means and located in the recess thereof, said valve member having one side thereof communicating with fluid outside the tubular element via the passage means in said endplate member and the other side thereof communicating with the fluid inside the tubular element, said valve member coacting with said tubular element and said outlet port so that when the differential pressure thereacross increases above a predetermined value the valve member will be detached from said endplate member and moved into said outlet port to prevent further flow therethrough, said tongue and groove means including a garter spring which is located in a tapered notch formed in said valve member and extends into an annular groove formed in the recess of said endplate member, said garter spring being constructed to be urged radially outwardly into said annular groove to release said valve member when the differential pressure thereacross increases above said predetermined value.

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