May 13, 1969 S. J. LEE ETAL 3,443,365

RESTRICTION INDICATOR

Original Filed April 25, 1966 Sheet 1 of 2

FIG. 1

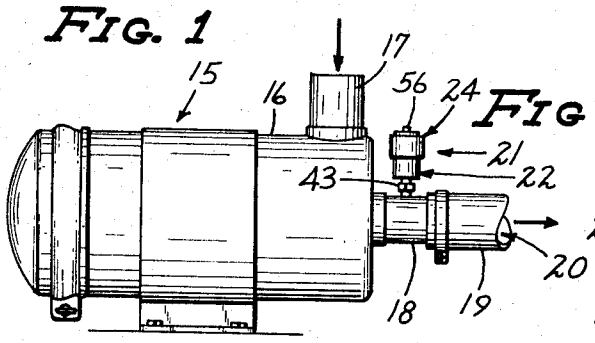


FIG. 2

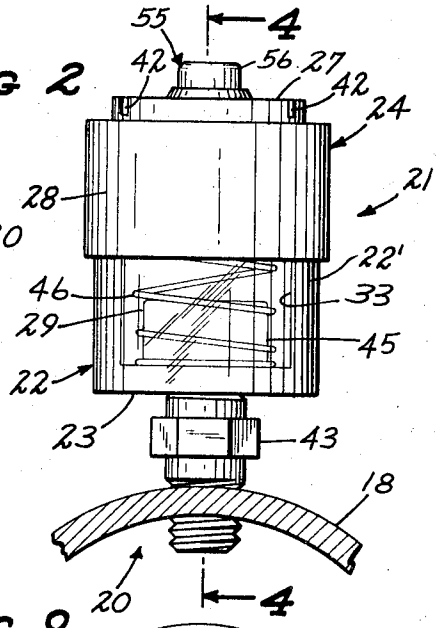


FIG. 3

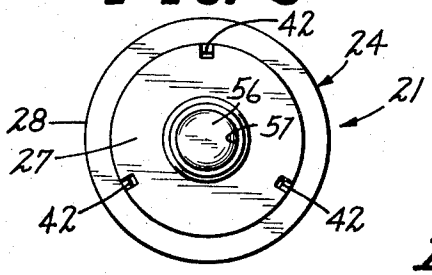


FIG. 9

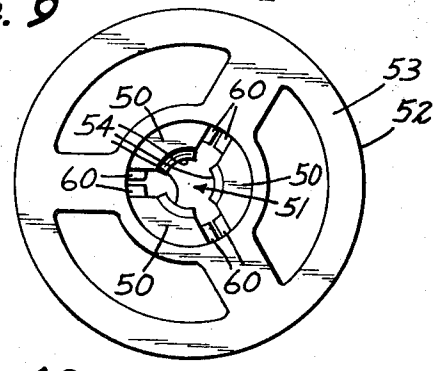


FIG. 8

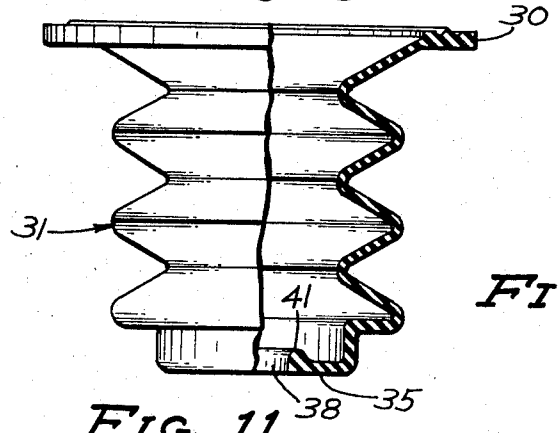


FIG. 10

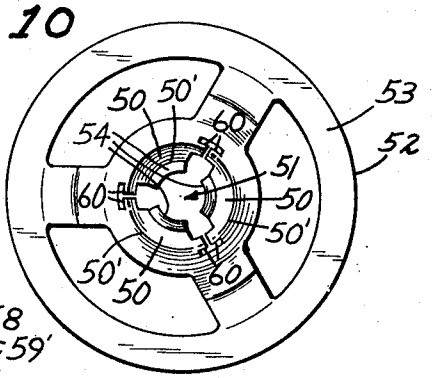


FIG. 11

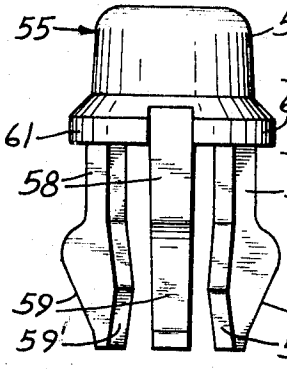
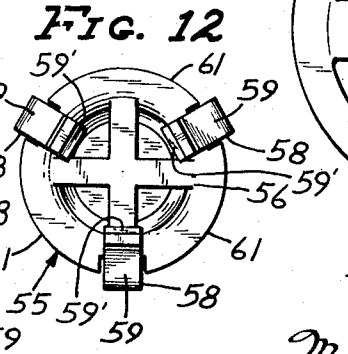


FIG. 12



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FIG. 4

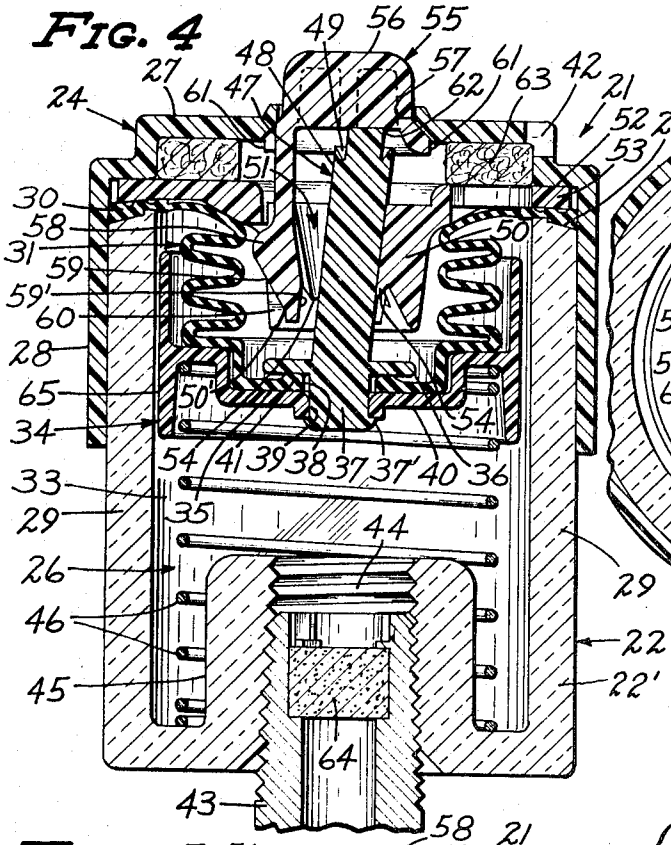


FIG. 6

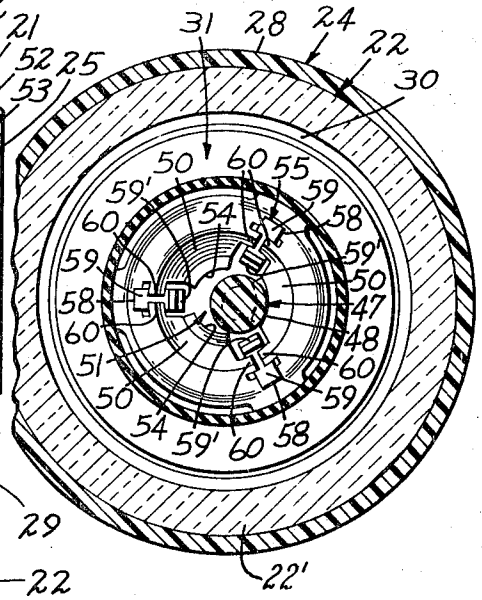


FIG. 7

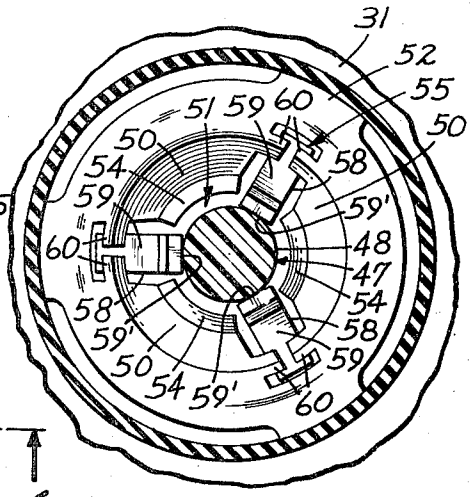
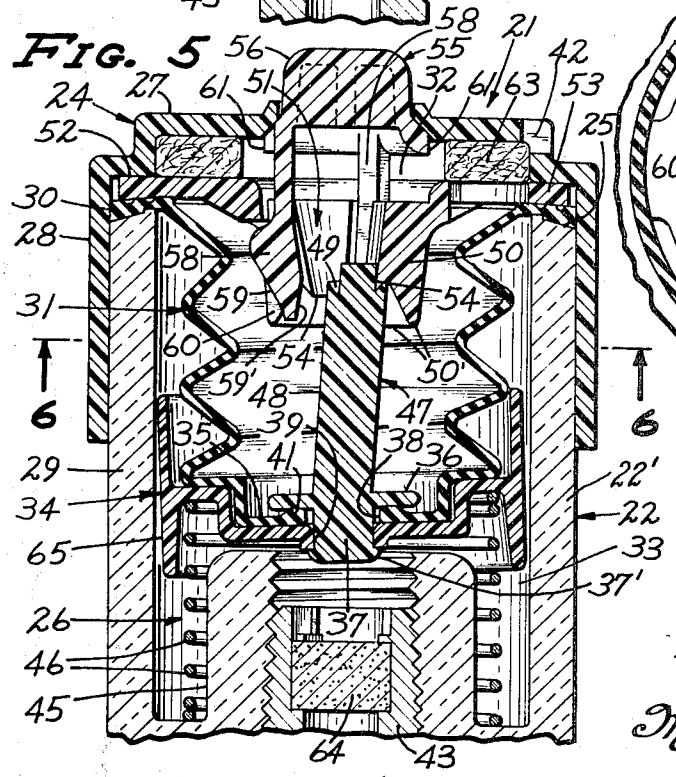


FIG. 5



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3,443,365

RESTRICTION INDICATOR

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Continuation of application Ser. No. 544,959, Apr. 25, 1966. This application Dec. 6, 1967, Ser. No. 688,406
Int. Cl. B01d 35/14; G01m 13/02
U.S. Cl. 55—274 7 Claims

ABSTRACT OF THE DISCLOSURE

A restriction indicator adapted to be inserted in a line between a filter and internal combustion engine. The indicator being provided with a bellows across an opening wherein the bellows includes a stem and a guide and signal element attached thereto. The guide and signal element being visible when the filter becomes clogged, the stem being retained by a spider element even though the indicator is removed from the line. A button and unlatching means extending through an opening in the cap whereby the stem may be released so that the guide and signal element may move upwardly to indicate an unclogged filter condition.

This application is a continuation of copending application Ser. No. 544,959, filed Apr. 25, 1966, now abandoned.

This invention relates generally to restriction indicators for fluid filters having an intake side and a negative pressure side, and more particularly to devices of this character which provide visible signalling means to indicate undesirable restriction within the fluid filters.

More particularly, this invention relates to restriction indicators for use in conjunction with conventional air cleaners associated with internal combustion engines.

Still more specifically, this invention relates to devices of the type above-described wherein latch means is provided for maintaining the signal in a warning position even though the internal combustion engine is in an inoperative condition.

The primary object of this invention is the provision of novel means for manually resetting the signalling device after the filter has been serviced to overcome the undue restriction, and in which the working parts of the latching and unlatching mechanism are totally received within a chamber-forming casing so as to render same unaffected by contaminants carried by the atmosphere, or by accidental impact.

A further object of this invention is the provision of a device of the class above-described which incorporates but a minimum of working parts, and is inexpensive to produce and assemble.

A further object of this invention is the provision of a device of the class described which is rugged and durable in construction, and which may be made in extremely compact size.

A further object of this invention is the provision of a device of the class described wherein the signalling device may be visible for 360° of circular arc.

These and other highly important objects will become apparent to those skilled in the art upon further consideration of the following specification, attached drawings, and appended claims.

Referring to the drawings wherein like reference characters indicate like parts throughout the several views:

FIG. 1 is a view in side elevation of an air filter device showing our novel restriction indicator mounted thereon;

FIG. 2 is an enlarged view in side elevation of the restriction indicator of FIG. 1;

FIG. 3 is a view in top plan thereof;

FIG. 4 is an enlarged view in vertical section as seen from the line 4—4 of FIG. 2 in a position indicating a normal filter condition;

FIG. 5 is a view showing a different position of some of the parts thereof and indicating a restricted filter condition.

FIG. 6 is a view in horizontal section as seen from the line 6—6 of FIG. 5;

FIG. 7 is an enlarged view similar to FIG. 6 showing a different position of some of the parts and with portions thereof broken away;

FIG. 8 is an enlarged view partly in side elevation and partly in axial section of the bellows-like diaphragm of the structure of FIG. 4;

FIG. 9 is an enlarged view in top plan of the guide element and supporting spider of the structure of FIG. 4;

FIG. 10 is a view in bottom plan of the structure of FIG. 9;

FIG. 11 is an enlarged view in side elevation of the reelase button of the structure of FIG. 4; and

FIG. 12 is a view in bottom plan of the structure of FIG. 11.

With more particular reference to the drawings there is shown a conventional air filter **15**, the housing **16** of which is provided with a fresh air intake **17** and a filtered air outlet **18**. Outlet **18** is adapted to be connected to the air intake of a suction device such as a conventional internal combustion engine, not shown, by means of a tubular member **19**. Outlet **18** and tubular member **19** cooperate to define a negative pressure chamber or side **20** between the filter **15** and internal combustion engine, not shown.

In filter systems of the character above described, and particularly in those which are required to operate in areas where there is a high degree of contaminants in the air passing through such filters **15**, it is necessary to clean or replace the filter element, not shown, but contained within the housing **16**, at frequent intervals to assure economical, trouble-free operation of the engine on which the filter **15** may be mounted.

For the purpose of providing adequate warning to an operator of the need for such a cleaning or replacement of filter parts, there is provided a restriction indicator indicated in its entirety by the numeral **21**. Restriction indicator **21** includes a tubular casing **22**, having a peripheral wall **22'** and closed at one end by a wall portion **23**, and a cap **24** which closes the other or open end **25** and cooperates therewith to define a chamber **26**. Cap **24** is formed of a top wall **27** and an annular skirt **28** which encloses the upper portion of the casing wall **22'**. It will here be noted that the casing **22** is formed from a transparent plastic material and the cap **24** of an opaque plastic material, for reasons which will become apparent hereinafter. As such, the housing **22** defines a window means **29** between the lower edge of skirt **28** and wall portion **23** of housing **22**.

Interposed between the cap **24** and the open end **25** of the casing **22** is an annular sealing flange **30** of a bellows-like diaphragm **31**. Diaphragm **31** traverses chamber **26**, in a manner to extend and retract axially therein toward and away from the wall portion **23**, and divides the chamber **26** into first and second chamber sections **32**, **33**, respectively, with the first chamber section **32** being disposed adjacent the cap **24** and the second chamber section adjacent the wall portion **23**. A cup-shaped guide and signal element **34** is disposed within the chamber section **33** and is secured to the intermediate portion **35** of bellows **31** by means of a disc-like plate **36** having an axially projecting boss portion **37**. Boss portion **37** includes a diametrically enlarged flange **37'** which projects

through cooperating apertures 38, 39 formed in the intermediate portion 35 of diaphragm 31 and the intermediate portion 40 of the guide and signal element 34 and has a snap engagement with intermediate portion 40 of guide and signal element 34. The disc 36 is positioned to engage an annular bead 41 formed peripherally of the aperture 38 to effectively seal the chamber section 32 from chamber section 33. With the above connection, diaphragm 31 and guide and signal element 34 are mounted for common movements, axially within the chamber 26, from the position of FIG. 4, wherein the signal element 34 is enclosed or hidden from sight by the opaque skirt 28 of cap 24, to the position of FIG. 5 wherein the guide and signal element 34 may be viewed from substantially 360° of arc through the window portion 29 of casing 22. It should be here noted that signal element 34 may be colored, with a color such as red, to make same more readily visible through the window 29.

As shown, chamber section 32 is vented to atmosphere by means of apertures 42 formed in the top wall 27 circumferentially of the cap 24 and chamber section 33 has communication with negative pressure chamber 20 between the filter 15 and internal combustion engine, not shown, by means of a brass fitting 43. Brass fitting 43 has screw-threaded engagement within an aperture 44 formed in a boss 45, which is carried by the wall portion 23 and projects axially inwardly of the chamber section 33 of casing 22. A coiled compression spring 46 is interposed between the guide and signal element 34 and the wall portion 23 of casing 22 with one end encompassing the boss 45 and simultaneously maintains the diaphragm 31 in the retracted position of FIG. 4 against atmospheric pressure in chamber section 32 and the cup-shaped guide and signal element 34 in the position where it is not visible through the window portion 29 of casing 22 during normal unrestricted flow of air through filter 15. Such unrestricted flow, of course, provides but a minimum of negative pressure within the negative pressure chamber 20 and, consequently, atmospheric pressure in chamber section 32 is not sufficient to overcome the bias of spring 46. When passage of air through the filter element within the housing 16 of filter 15 becomes sufficiently restricted, negative pressure within the chamber 20 and chamber section 33 will be increased to a point where atmospheric pressure within chamber section 32 will overcome the bias of coil compression spring 46 and the diaphragm 31 will be forced to the extended position of FIG. 5. With diaphragm 31 in such an extended position, it will be seen that the cup-shaped guide and signal element 34 is moved to a position wherein it is exposed to view through the window portion 29 of casing 22 thus providing visual indication that needed repairs to the filter 15 should be effected.

To assure visual warning of filter restriction, even though the internal combustion engine, not shown, may be inoperative or shut down, there is provided means 47 within the chamber section 32. Means 47 is adapted to maintain the cup-shaped guide and warning element in the warning position of FIG. 5, even though the negative pressure in chamber 20 and chamber section 33 returns to the normal pressure of atmosphere during such engine shutdown and includes an elongated stem 48 carried by the plate 36. Stem 48 projects axially from plate 36, in the direction of the cap 24, on an axis which is slightly angularly disposed with respect to the axis of the diaphragm 31. Stem 48 has an outer end portion which defines latch means in the nature of a latch detent 49 and which is radially offset with respect to the axis of the diaphragm 31. Means 47 further includes guide means in the nature of axially extended segments 50, which define a central opening 51 extending axially therethrough, having their axially outer end portions, adjacent the cap 24, supported by means of a spider element 52. The outer peripheral edge 53 of spider 52 is interposed between the flange 30 of diaphragm 31 and cap 24 and supports the segments 50 within the chamber section 32 in axially spaced relationship to the cap 24. The axially projecting inner ends 50′ of the segment 50 each define a latch means in the nature of a latch dog 54. It will be seen that, as the diaphragm 31 and cup-shaped warning device 34 move from the position of FIG. 4, wherein the stem 48 is received through the opening 51 to the warning position of FIG. 5, stem 48 engages one of the segments 50 and is guided thereby to a point where it moves radially outwardly with respect to the axis of opening 51. This movement causes engagement between one of the latch dogs 54 of segments 50 and the detent 49 of stem 48.

For the purpose of resetting restriction indicator 21, upon completion of needed repairs to filter 15, there is provided unlatching means 55. Unlatching means 55 terminates at its axially outer end in a button 56 which projects slidably through an opening 57 formed centrally of the top wall portion 27 of cap 24. A plurality of resilient, circumferentially spaced fingers 58, project axially from the button 56 into the chamber section 32 and terminate adjacent the inner ends 50′ of the segments 50 in encompassing relationship to the stem 48. Fingers 58 each define adjacent their inner ends a radially outwardly facing cam surface 59. It will be noted, with particular reference to FIGS. 4–7, that segments 50 project axially of the chamber section 32 and are disposed one each between adjacent ones of the fingers 58 with the axially inner end portions 50′ of segments 50 having cam surface forming portions 60 adjacent ones of which are adapted to engage the cam surface 59 of an adjacent finger upon axially inward movement of the button 56. It will be seen that as the button is moved axially toward the stem 48, the fingers 58 carried thereby are equally cammed radially inwardly by engagement of the cam surfaces 59 thereof with the cam forming portions 60 of segments 50. As the fingers move radially inwardly an inwardly facing cam surface 59′ on fingers 58 engages the stem 48 adjacent the latch detent 49 and disengages detent 49 from the particular latch dog or dogs 54 with which it is engaged. Stem 48 is thus moved to a position wherein it is centered with respect to the central opening 51, see particularly FIGS. 6 and 7, and is engaged equally by all of the fingers 58. At this time the segments 50 are moved radially outwardly by the cam action of the cam surfaces 59 of fingers 58 bearing against the cam forming portions 60 of segments 50 with the result that the central opening 51 is enlarged slightly to provide easy passage of the stem 48 therethrough. Passage of the stem through the opening 51 permits retracting movement of the diaphragm 31 and movement of the cup-shaped guide and signal element 34 to the position of FIG. 4, under the bias of coil spring 46, where it is again ready to indicate a future restriction in the repaired filter 15. Circumferentially spaced flange elements 61 formed on the axially inner end of the button 57 prevent axially outward displacement of the button 57 and fingers 58 from their operative position of FIG. 4. Also, it will be noted that the extended end of stem 48 normally engages the button 55 under the bias of coil spring 46, as at 62, when diaphragm 31 is in its retracted position, see FIG. 4. This permits the tightest possible seal between the flange elements 61 of button 56 and cap 24 to help exclude moisture or other contaminants from the first chamber section 32 during the retracted or generally normal position of FIG. 4.

An annular filter element 63, formed from Dacron fibre filter or the like, is interposed between the cap 24 and spider 52 and serves to exclude moisture and/or dust which may enter the first chamber section 32 through the apertures 42. It will be appreciated that such moisture, in the event of cold weather, would freeze. Otherwise the moisture would serve to collect dust or dirt. In either event normal operation of restriction indicator 21 would be impaired, thus rendering same inoperable. In order to prevent entry of contaminants into the second chamber sec-

tion 33, for the above-mentioned reasons, a second filter means is provided in the nature of a sintered bronze plug 64. Plug 64 is securely mounted in the opening of brass fitting 43 and filters air passing between the second chamber 33 and the negative pressure chamber 20 of fluid filter 15. Filters 63, 64 provide means for effectively maintaining an operative condition of restriction indicator 21 during all extremities of operating conditions.

It is further noted that the cup-shaped guide and signal element 34 is provided with an annular skirt portion 65 which forms an axial extension thereof. Consequently, cocking of the signal element 34, such as illustrated in FIG. 5, does not cause same to become wedged in the chamber 26 thus rendering the indicator 21 inoperative. With the above combination of parts a visual restriction indicator 21 has been provided in which working parts of the latching and unlatching means 47, 55 respectively are protected from damage due to heavily contaminated air and/or accidental impact.

This invention has been thoroughly tested and found to be completely satisfactory for the accomplishment of the above objects, and while we have shown and described a preferred embodiment, it is to be specifically understood that the same is capable of modification without departure from the spirit and scope of the appended claims.

What is claimed is:

1. In a restriction indicator for fluid filters having an intake side and a negative pressure side:

(a) a tubular casing which is closed at one end and the wall of which defines a window means adjacent said one end;

(b) a cap having a central opening closing the other end of said casing and cooperating with said casing to define a chamber;

(c) a bellows-like diaphragm extending transversely of said chamber for extending and retracting movements therein toward and away from said one end and dividing said chamber into first and second chamber sections, the former of which is adjacent said cap, and the latter of which is adjacent said one end;

(d) aperture means in said cap providing communication between said first chamber section and atmosphere;

(e) a cup-shaped guide and signal element within said second chamber section;

(f) means securing said guide and signal element to the intermediate portion of said diaphragm for common movements therewith toward and away from said one end and visible through said window means when in the extended position of said diaphragm;

(g) means for detachably connecting said one end of said casing to the negative pressure side of a fluid filter to provide communication therebetween and said second chamber section;

(h) a coil compression spring interposed between said cup-shaped guide and signal element and said one end of said casing, said spring maintaining said diaphragm in a retracted position against atmospheric pressure in said first chamber section, and simultaneously retaining said guide and signal element in a position where it is not visible through said window means, but permitting extending movements of said bellows against the bias thereof when a predetermined increase of negative pressure occurs within said chamber section; and

(i) means within said first chamber section for releasably retaining said diaphragm in said extended position, said means comprising:

(1) an elongated stem secured to and carried by the intermediate portion of said diaphragm and extending in the direction of said cap on the axis slightly angularly disposed with respect to the axis of said diaphragm;

(2) said stem having an axially outer portion which defines latch means;

(3) axially extended guide means within said first chamber section defining an axially extended opening therethrough inwardly of said cap for said stem and having an axially inner end portion which defines latch means adapted to cooperate with the latch means defined by said stem to maintain said bellows in said extended position, the axailly outer portion of said stem slidably engaging one side of said axially extended opening; and

(4) unlatching means for said stem carried by and cooperating with said guide means, said unlatching means terminating in a button at its axially extended outer end which projects slidably through the central opening in said cap, said button having a portion normally engaging said cap adjacent said central opening to close said central opening;

(5) said unlatching means further including a plurality of circumferentially spaced resilient fingers defined by the axially inner end thereof, said fingers defining cam surfaces which engage and center said stem with respect to said guide means and which cooperate with cam surfaces defined by said guide means to cause simultaneous radially inward stem centering movements of said fingers upon axial inward movement of said button.

2. The structure defined in claim 1 in which said guide means is secured to said casing by means of a spider which is disposed between said casing and said gap.

3. The structure defined in claim 2 in which said guide means is formed to define axially elongated resilient segments which extend circumferentially between said fingers, and which are formed at their axially inner ends with cooperating portions which define said cam surfaces.

4. The structure defined in claim 3 in which said axially inward movements of said button cause radially outward movements of said segments whereby said axially extended opening in said guide means is slightly diametrically enlarged.

5. The structure defined in claim 1, in which said cap and button portion cooperate to provide stop means positively limiting the axially outer movement of said button with respect to said cap.

6. In a restriction indicator for fluid filters having an intake side and a negative pressure side:

(a) a casing having a peripheral side wall, an end wall, and an open end opposite said end wall, said peripheral wall providing window means;

(b) a cap mounted on said housing over said open end, said cap having an axial opening therethrough and cooperating with said casing to define a chamber;

(c) a flexible bellows-like diaphragm mounted in said housing for axial extending and retracting movements and dividing said chamber into first and second chamber sections adjacent said cap and end wall respectively, said first chamber section being open to atmosphere;

(d) said end wall having means for establishing communication between said second chamber section with the negative pressure side of a fluid filter;

(e) a guide and signal element disposed within one of said chamber sections;

(f) means securing said guide and signal element to said diaphragm for common extending and retracting movements therewith and toward and away from register with said window means;

(g) a compression spring interposed between said guide and signal element and said casing end wall for yieldingly maintaining said diaphragm in one of its extended and retracted positions against atmospheric pressure in said first chamber section and simultaneously yieldingly holding said guide and

signal element axially out of register with said window means, said diaphragm moving to the other of its extended and retracted positions and said guide and signal element compressing said spring and moving into register with said window means responsive to a predetermined increase of negative pressure in said second chamber against bias of said spring; and

(h) means within said first chamber section for releasably retaining said diaphragm in the spring compressed position thereof, said means comprising:

(1) an elongated generally axial stem secured to said diaphragm and extending in the direction of said cap on an axis slightly angularly disposed with respect to the axis of said diaphragm;

(2) said stem having an axially outer portion which defines latch means;

(3) axially extended guide means within said first chamber section defining an axially extended opening therethrough inwardly of said cap for said stem and having an axially inner end portion which defines latch means adapted to cooperate with the latch means defined by said stem to maintain said diaphragm in the position thereof when said spring is compressed and said guide and signal element is in register with said window means, the axially outer portion of said stem slidably engaging said opening in the guide means; and

(4) unlatching means for said stem carried by and cooperating with said guide means said unlatching means terminating in a button at its axially extended outer end which projects slidably through the central opening in said cap;

(5) said unlatching means further including a plurality of circumferentially spaced fingers defined by the axially inner end thereof, said fingers defining cam surfaces which engage and center said stem with respect to said guide means and which cooperate with cam surfaces defined by said guide means to cause simultaneous radially inward stem centering movements of said fingers upon axial inward movement of said button.

7. The structure defined in claim 6 in which said guide means is formed to define axially elongated resilient segments which extend circumferentially between said fingers and which are formed at their axially inner ends with cooperating portions which define said cam surfces.

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U.S. Cl. X.R.

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