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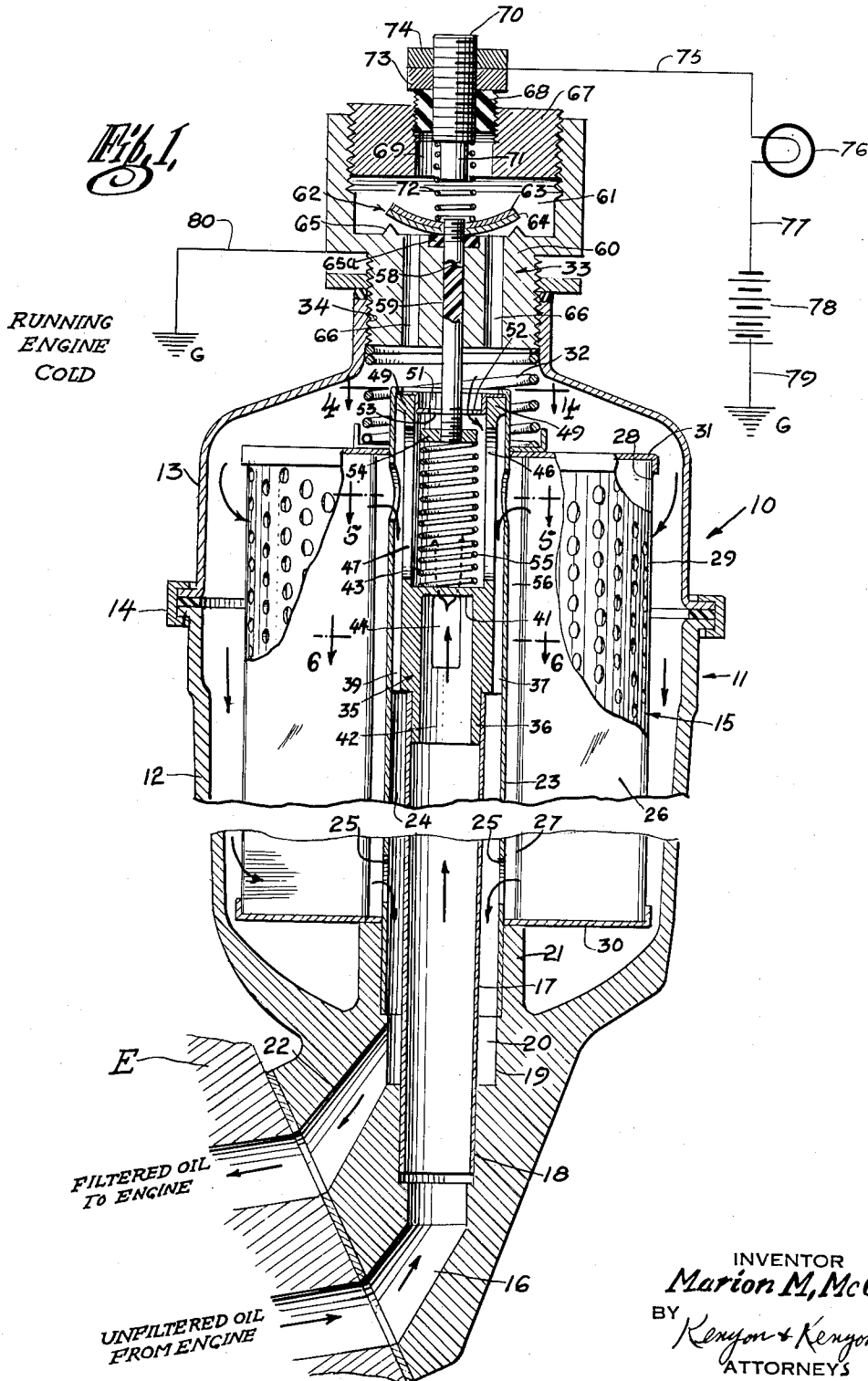
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AUTOMATIC DISCRIMINATORY CLOGGING DETECTOR FOR OIL FILTERS

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2 Sheets-Sheet 1



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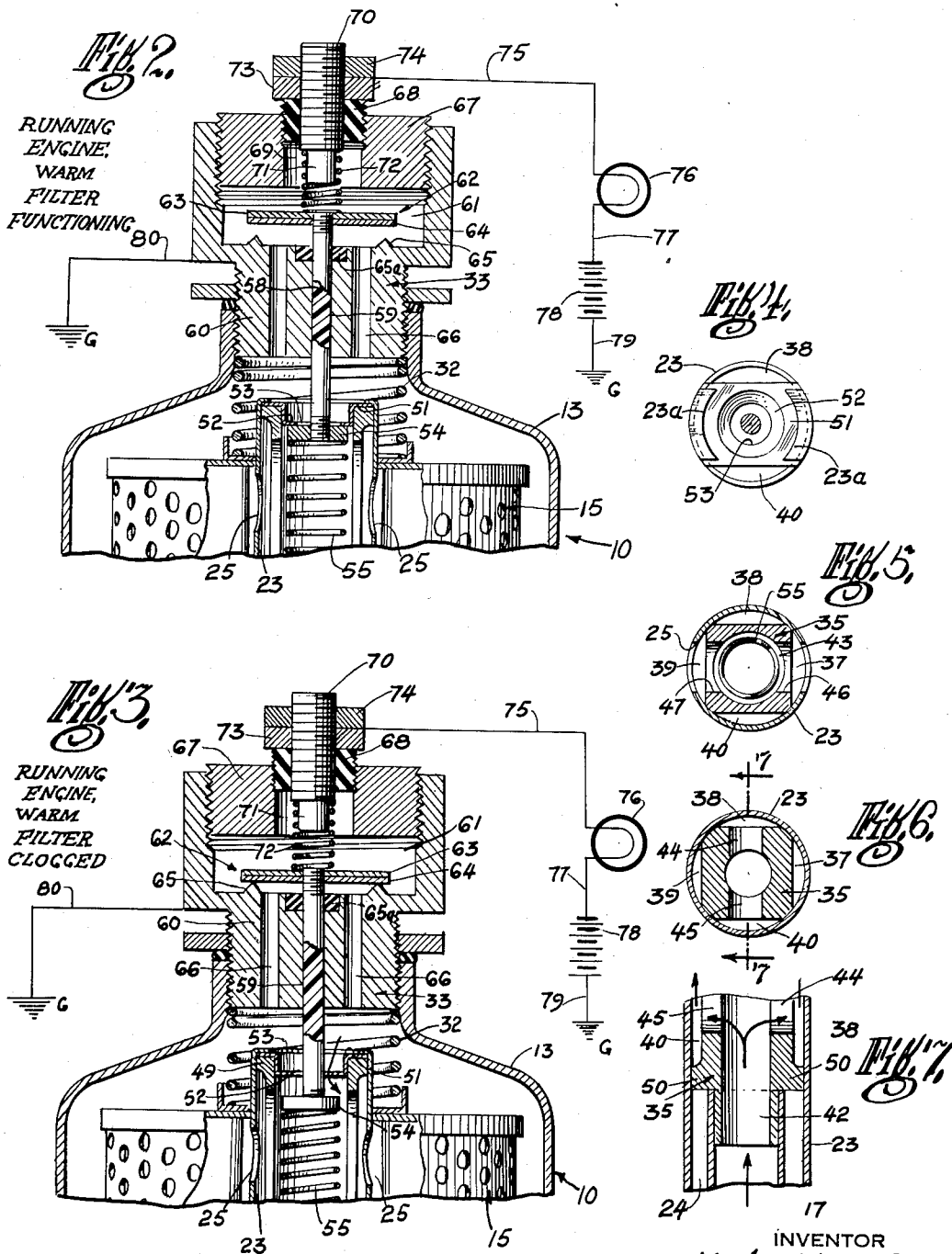
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AUTOMATIC DISCRIMINATORY CLOGGING DETECTOR FOR OIL FILTERS

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5 Claims. (Cl. 210—183)

This invention relates to an improved device for automatically detecting the clogging of an oil filter element in an automotive vehicle filter.

The prevailing practice in the automotive field is to change filter elements at arbitrary intervals, which is not satisfactory because it is so inaccurate. Changing too soon wastes some of the effective life of the element, while changing too late means that the by-pass valve of the filter has already functioned and that the filter element is no longer functioning. Various devices for actuating a dashboard signal when the filter element is clogged, have been known. The principal fault with such devices, however, has been false signaling because of their failure to discriminate between a truly clogged filter element and a cold engine. Since the oil pressure will be unusually high when the engine is first started under cold conditions because of sluggish cold oil whose passage through the filter element is retarded, cold engine conditions in many respects simulate clogged filter conditions. Since most such detecting devices are actuated by oil pressure in the filter, it can readily be seen that a false indication of clogging may be frequently given when the engine is cold.

It is a primary object of this invention to provide a discriminatory clogging detector device that will indicate true clogging of the filter element but will not give a false signal when the engine is cold.

It is a further object to provide a device of this kind that may easily be installed in a conventional filter.

Other objects and features of the invention will become apparent from the following specification and the accompanying drawings, in which:

Fig. 1 is a sectional elevation of a filter equipped with detecting mechanism embodying the invention, showing the operating position of this mechanism when the engine is cold and has just been started;

Fig. 2 is a fragmentary view similar to that of Fig. 1, showing the operating position of the detector mechanism during normal filter operating conditions in the filter when the engine is warm and is running and the unclogged filter element is functioning;

Fig. 3 is a view similar to that of Fig. 2 showing the operating position of the detector mechanism when the filter element is actually clogged and the engine is warm and running;

Fig. 4 is a transverse sectional view taken along line 4—4 of Fig. 1 illustrating structural details and viewed in the direction of the arrows;

Fig. 5 is a transverse sectional view taken along line 5—5 of Fig. 1 illustrating further structural details and viewed in the direction of the arrows;

Fig. 6 is a transverse sectional view taken along line 6—6 of Fig. 1 illustrating still further structural details and viewed in the direction of the arrows; and

Fig. 7 is a longitudinal sectional view taken along line 7—7 of Fig. 6 and viewed in the direction of the arrows.

Referring now to the drawings, and particularly Fig. 1, 10 represents a filter and element assembly of conven-

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tional full-flow construction. The assembly 10 includes a housing 11 in two parts. This housing comprises the lower portion 12 and the upper portion 13 joined together as by a clamp ring 14. A replaceable filter element 15 of any conventional kind is contained in the housing 11. The housing portion 12 has an inlet passage 16 leading to the bore of a center tube 17. Unfiltered oil pumped from the engine E enters said inlet passage 16.

The center tube 17 extends axially upward in the housing portion 12 being supported therefrom by having its lower end fit into a bore 18 in said housing portion 12. The bore 18 which is in communication with inlet passage 16 has an enlarged diametered portion 19 which extends through a tubular part 21 integral with the housing portion 12. This tubular part 21 is concentrically located about the center tube 17 and is in spaced relationship therewith. An annular chamber or space 20 is defined by the walls of the bore portion 19 and the outer surface of center tube 17. An outlet passageway 22 in housing portion 12 communicates with annular chamber 20. This outlet passageway 22 permits filtered oil leaving filter assembly 10 to reenter the engine.

A pipe 23 is carried by the tubular part 21 and is concentric with the center tube 17, being spaced therefrom to provide the annular space 24 which communicates directly with annular chamber 20 and thus with outlet passageway 22. A plurality of lateral openings or ports 25 are provided in the wall of pipe 23 for purposes presently to be described.

The filter element 15 is of conventional kind comprising, for example, pleated phenol formaldehyde resin impregnated paper 26 arranged in the form of a tubular annulus with the inner fold edges 27 of the pleats defining the internal bore of the annulus. The outer fold edges 28 of the pleats are covered by a perforated wrapping 29 and the opposite ends of the pleated body are closed off by end caps 30 and 31. This filter element 15 is mounted concentrically about the pipe 23 with inner fold edges 27 somewhat spaced from the outer surface of said pipe and with end cap 30 resting on the tubular part 21. The filter element 15 is spring pressed into its mounted position by a spring 32 interposed between the upper end cap 31 and a threaded cap member 33 which is removably screwed into the threaded opening 34 in the upper housing part 13. Any other conventional tubular filter element may be substituted for the filter element 15 just described.

A by-pass valve assembly is provided in conjunction with the center tube 17 and the surrounding pipe or tube 23. This by-pass assembly includes a tubular fitting 35 mounted at 36 in the upper end of center tube 17. This fitting 35 as seen in Figs. 5 and 6 has substantially rectangular cross section and is externally dimensioned so that its corners fit tightly within the pipe 23, and so that its outer side faces define separated longitudinal passageways 37, 38, 39 and 40 with the inner surface of pipe 23. A transverse partition 41 divides the longitudinal bore of the tubular fitting 35 into two superposed chambers 42 and 43. Lower chamber 42 communicates directly with the bore of center tube 17. Lateral openings 44 and 45 in the walls of chamber 42 (Figs. 1 and 6) provide direct communication between it and the respective longitudinal passageways 38 and 40 for purposes presently to be described. Lateral openings 46 and 47 (Figs. 1 and 5) in the walls of upper chamber 43 of the tubular fitting 33 provide direct communication between said chamber 43 and the respective longitudinal passageways 37 and 39. The lower ends of these two passageways 37 and 39 communicate directly with the annular space 24. The upper ends of longitudinal passageways 37 and 39 are closed off by the sealing lips 49 (Fig. 1) provided on the walls of fitting 35.

The lower ends of longitudinal passageways 38 and

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40 are closed off from communication with annular space 24 by the sealing lips 50 provided on the walls of fitting 35 (see Fig. 7). The upper ends of passageways 38 and 40 are open at the upper end of pipe 23 (see Fig. 4).

A plate member 51 provided with a valve seat 52 arranged around an opening 53 spans the upper end of chamber 43. This plate member 51 is supported on the lips 49 and is held in place by the bent over flanges 23a of pipe 23. A by-pass valve 54 within the chamber 43 is normally biased against the valve seat 52 by a spring 55 located within chamber 43 to normally close off said opening 53. The width of plate member 51 is insufficient to close off the upper ends of longitudinal passageways 38 and 40 (see Fig. 4) so that contaminated fluid to be filtered reaching longitudinal passageways 38 and 40 from the inlet passageway 16 via center tube 17, chamber 42 of fitting 35 and the lateral openings 44 and 45 is free to flow outwardly from the upper ends of longitudinal passageways 38 and 40 and fill the housing 11 externally of the filter element 15. The contaminated fluid filling the housing 11 can only leave it normally by passage through the component parts of the filter element 15 including the pleated paper element 26. In its passage through the filter element 15 the contaminated fluid is rid of its contaminants. On leaving the filter element 15, the purified fluid enters the space 56 between the inner fold edges 27 of the pleated element 26 and the outer surface of pipe 23 and from thence flows through the openings or ports 25 of pipe 23 into annular space 24 between pipe 23 and center tube 17. From space 24 the filtered fluid flows into annular chamber 20 and thence outwardly through the outlet passageway 22 to engine E.

If the engine is cold or the filter element 15 becomes clogged, the contaminated fluid cannot flow freely through filter element 15 as just described, and as a result fluid pressure of contaminated fluid in housing 11 builds up sufficiently to overcome the seating action of spring 55 on by-pass valve 54 moving it downwardly away from its valve seat 52 as seen in Figs. 1 and 3. This uncovers opening 53 and allows relief flow of contaminated fluid in housing 11 through opening 53 into upper chamber 43 of tubular fitting 35. From chamber 43, this fluid passes via the lateral openings 46 and 47 into respective longitudinal passageways 37 and 39 and emerges from the lower ends of the latter into annular chamber 24. It then flows into annular space 20 and outwardly through outlet port passageway 22. This relief flow continues as long as either clogged filter or cold engine operating conditions exist which build up fluid pressure in the housing sufficient to unseat said valve 54.

A detecting device which discriminates between clogged filter element conditions and cold engine operating conditions and gives indication only of truly clogged filter element conditions is associated with the by-pass valve assembly.

In the embodiment shown, the detecting device includes a rod 58 of insulating material which is appropriately secured at one end to the by-pass valve 54. This rod 58 extends upwardly from valve 54 through a guide opening 59 in the wall 60 of the threaded cap member 33, and terminates above the upper surface of wall 60 in a space 61 of said threaded cap member.

A thermostatic member or bimetallic assembly 62 is secured to the rod 58 in chamber 61. This assembly 62 consists of an upper plate 63 and a lower plate 64 of different metals brazed or otherwise permanently united to form a bimetallic or thermostatic or heat responsive member. The thermostatic assembly 62 as seen in Fig. 1 has a normally bowed configuration when cold. Upon being heated sufficiently, the assembly 62 assumes a flat configuration in accord with well known thermostatic principles. The temperature at which flattening occurs can be controlled by the nature and dimensions of the dissimilar metals of the plates 63 and 64. In the in-

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stant case, the bowed condition of the thermostatic assembly 62 exists when the engine is cold and is the normal condition of said thermostatic assembly.

A raised lip or stationary contact 65 is provided on the wall 60 of threaded metallic cap member 33. This lip 65 lies in the space 61 and underlies the thermostatic assembly 62. An insulating disc 65a is positioned in the upper face of wall 60 being concentric with rod 58 which passes therethrough. This disc 65a prevents electrical contact between assembly 62 and the upper face of wall 60. A plurality of drillings or holes 66 in the wall 60 of cap member 33 serves to permit entry of fluid from housing 11 into the space 61 for purposes to be presently described.

A closure plug 67 is threadably engaged in the cap member 33 above its space 61. An insulative bushing 68 is threadably mounted in an opening 69 in plug member 67. A stud 70 of electrically conductive material is mounted in the bushing 68. A portion 71 of the stud projects into the space 61 through opening 69. The upper end of an electrically conductive contact spring 72 is carried on the projecting portion 71 of stud 70 and the lower end of said spring 72 is in electrical contact with the upper face of the uppermost plate 63 of the bimetallic or thermostatic assembly 62. Nuts 73 and 74 on the stud 70 serve to lock it in place and serve as an electrical contact terminal for said stud.

A wire 75 connects the stud 70 to a signalling device such as an electric light bulb 76. A wire 77 connects the bulb 76 to one terminal of a battery 78 or other electrical power source. The other terminal of battery 78 is connected to ground G as by wire 79. Another wire 80 connects the electrically conductive cap member 33 to the ground G. Battery 78 may be for example the battery of an automotive vehicle in which the filter 10 is used and bulb or light 76 may be mounted at some conveniently visible place for example on the dashboard of the vehicle.

The discriminating and detecting device just described operates in conjunction with the filter as follows:

When the engine is cold and not running, the by-pass valve 54 is seated on its seat 52 and the thermostatic member or assembly 62 is in an elevated position in space 61 and out of contact with the stationary contact or lip 65. The thermostatic element or assembly 62 at this time has the bowed configuration shown in Fig. 1. In this bowed condition, even though valve 54 should become unseated, when the engine is first started from cold condition, and move downwardly, the thermostatic assembly 62 will not be able to make circuit closing contact with the lip or stationary contact member 65. Thus, no current from battery B can flow to light the bulb 76 as the electric circuit to it is open between contact lip 65 and the bowed away ends of the thermostatic assembly member 62.

If the engine now is started from a cold condition the contaminated oil from the engine admitted to the housing 11 via inlet 15 also is cold and sluggish. This sluggish condition of the oil retards its flow as hereinbefore described through the filter element 15 to the outlet passageway 22 and causes a build up of fluid pressure in the housing 11 that serves to unseat the by-pass valve 54 against opposition of spring 55 for relief flow of oil as hereinabove described to outlet passageway 22 of the filter. The unseating movement of valve 54 moves rod 58 with it. This moves the thermostatic or bimetallic member 62 toward contact member lip 65. Some of the cold oil circulates in chamber 61 about thermostatic assembly 62 and being cold, keeps the latter bowed. Because said assembly 62 is cold and thus bowed upwardly, as shown in Fig. 1, it still will not engage the stationary contact member or lip 65. Insulating ring 65a prevents any electrical contact between the bowed member 62 and electrically conductive surfaces of wall 60. As long as no electrical contact or engagement exists between bowed member 62 and sta-

tionary contact member or lip 65, the electrical circuit through bulb 76 remains broken at said lip 65 and no current can flow from the battery to light the bulb.

As the engine warms up, the oil pumped from it to filter housing 11 for filtration also warms up. If the filter element 15 is not clogged, normal filtering flow of the warm oil is established through the filter element 15 as described and the by-pass valve 54 closes under action of its biasing spring 55 because of resulting reduction of fluid pressure in the housing 11. The upward closing movement of valve 54 moves the rod 58 upwardly and moves the bimetallic member 62 upwardly away from lip 65. Some of the warm oil in housing 11 enters the chamber 61 through the holes 66, and circulates around the bimetallic member 62 also warming it. The two plates of the bimetallic member or thermostatic assembly 62 then interact and tend to flatten out the assembly 62 as seen in Fig. 2. However, the flattened bimetallic element 62 is then in an elevated position in chamber 61 because by-pass valve 54 is closed and no circuit closing can occur between movable bimetallic contact member 62 and stationary contact member or lip 61.

If now, however, the filter element 15 becomes clogged in any way fluid pressure again builds up in housing 11 unseating by-pass valve 54 for relief flow of oil from the filter as hereinabove described. This unseating of valve 54 moves rod 58 and with it the now flattened bimetallic contact member 62 downwardly toward stationary contact member or lip 65. When the movable bimetallic contact member 62 engages the stationary contact member or lip 65 as seen in Fig. 3, the electric circuit required to energize or light bulb 76 is completed. This electric circuit is as follows: From battery B through wire 77 to bulb 76, through bulb 76, through wire 75, through plug 70, through contact spring 72, through bimetallic contact member 62, through stationary member or contact lip 65, through electrically conductive cap member 33, through wire 80 to ground G, and from ground G through wire 79 back to the battery 78.

The illumination of bulb 76 when the said circuit is closed by the circuit closing engagement of bimetallic member 62 and lip 65 gives a visual indication that the filter element 15 is truly clogged and requires replacement.

Since the circuit cannot close when the bimetallic contact member 62 is cold because of its bowed condition and can only be closed when the bimetallic contact member 62 has been flattened out by being heated to the temperature of warm engine oil being filtered, the detecting arrangement, including the bimetallic member 62 can readily be termed a discriminating device which discerns actual filter clogging in contrast with sluggish oil flow conditions incidental to cold engine operation. Being discriminatory in its action, the detecting arrangement precludes giving of a false clogged filter element signal to the operator of the vehicle.

It is to be understood that a different type of electrically operated indicator may be substituted for the bulb 76 operation of which will depend upon completion of the electrical circuit through closure of the normally open gap between the movable bimetallic contact element 62 and the stationary contact member or lip 65. This substitute indicator might in fact be a solenoid operated relay of conventional design energized upon completion of the electric circuit between said bimetallic assembly 62 and said contact lip 65 to actuate an engine cut-off device and thus stop the engine when actual clogging occurs. It is conventional in the art to actuate solenoids in this manner.

The by-pass valve means herein specifically described is merely an example of one of many types that may be used in conjunction with the bimetallic or thermostatic assembly described.

While a specific embodiment of the invention has been

described and shown, variations in structural details are possible and are contemplated within scope of the appended claims without departing from the spirit of the invention. There is no intention therefore of limitation to the exact details shown and described.

What is claimed is:

1. In a filter for engine liquids including a housing, a center tube, a replaceable filter element in said housing and by-pass valve means carried by said center tube and operable in the axial direction of said tube to relieve liquid pressure in said housing whenever flow of liquid through the filter is hampered by reason of low temperature of the liquid being filtered or actual clogging of the filter element, clogged filter detector means operable in response to operation of said by-pass valve means, said detector means including an electric circuit, and a thermostatic circuit closing member in said circuit disposed transversely of the axis of said center tube and which is movable axially with and by operation of said by-pass means to close said electric circuit only when the liquid flowing through said filter has been warmed to usual engine operating temperatures, said thermostatic member being so constructed as to preclude circuit closing action notwithstanding operation of the by-pass valve means when the liquid being filtered is below usual warm engine operating temperatures.

2. In a filter for engine liquids including a replaceable filter element in said housing, a center tube and by-pass valve means carried by said center tube and operable in the axial direction of said tube to relieve excessive liquid pressures built up in said housing when flow of liquid through said filter is hampered by a clogged filter element or by cold sluggish condition of the liquid being filtered, clogged filter detector means operated by said by-pass valve means comprising an electric circuit, and a thermostatic circuit closing member in said circuit responsive to temperature of liquid in said housing and movable axially with and by operation of said by-pass valve means to close said circuit only when said filter element is actually clogged and the liquid in said housing is warm, said thermostatic member being in a deformed condition when cold liquid is in said housing to preclude any circuit closing action by said member at such time even though said by-pass valve means operates.

3. In a filter for engine liquids including a replaceable filter element in said housing, a center tube, and by-pass valve means carried by said center tube and operable in the axial direction of said tube to relieve excessive liquid pressures in said housing, means for closing an electric circuit for detecting true clogged condition of said filter element comprising a fixed contact and a movable normally bowed bimetallic contact member whose shape depends upon its temperature, means for coupling said bimetallic contact member to said by-pass valve means to effect movement of said bimetallic contact member axially with said valve means toward circuit closing condition with said fixed contact whenever said by-pass valve means is operated, said bimetallic element however, being bowed when it is cold so that it cannot then make circuit closing engagement with said fixed contact, and means for circulating some of the liquids in said housing about said bimetallic contact member to impart its temperature to said bimetallic contact member whereby when said liquid is warm said bimetallic contact member flattens out and may then engage said fixed contact to close said circuit when said by-pass valve means is operated.

4. In a filter for liquids comprising a filtering element within a housing, a center tube and a by-pass valve carried by the center tube and operable to by-pass condition on the occurrence of determined excessive fluid pressures in the housing, the combination comprising a cap removably secured to the housing, a stationary contact on said cap, a rod member of insulation material movably mounted in said cap and secured to said valve for movement therein in the axial direction of said center tube, a normally

bowed bimetallic element assembly secured to said rod member and extending transversely of its axis, said element being movable by the rod member in said axial direction and towards circuit closing contact with said stationary contact but being unable to effect said contact while in its bowed condition, and means in said cap for permitting circulation of heated liquid from the housing around the bimetallic element to warm the latter and flatten it out and thereby permit it to establish circuit closing contact with the stationary contact when said valve is operated to by-pass condition and thus complete an electric circuit.

5. The combination of claim 4 wherein said cap has a chamber in which the bimetallic element is located and wherein said cap has openings providing communication 15 between said chamber and said housing to admit liquid

from the housing to the chamber for circulation therein about the bimetallic element.

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