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Ohtani

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[54] ELECTRICAL ALARM DEVICE FOR OIL FILTERS RESPONSIVE TO WATER SEDIMENT LEVEL

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[52] **U.S. Cl.** .....**340/244 C,** 73/304 R, 123/196 S, 184/1 C, 340/59, 340/270

[51] **Int. Cl.** **G08b 21/00,** F01m 11/10

[58] **Field of Search**.....340/244 C, 59, 270; 184/6.4, 184/1 C; 123/196 S; 73/304 R; 180/103, 82; 307/10 R, 118

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[57] **ABSTRACT**

An alarm device for oil filters responsive to the water sediment level in the filter includes a pair of electrodes which are short-circuited when the sediment reaches a predetermined level. Short-circuiting of the electrodes energizes an alarm circuit which includes an amplifier connected to the electrodes and a relay coil connected to the output of the amplifier. First and second pairs of switching contacts controlled by the relay coil complete a circuit between the amplifier and coil and a source in the normal, unactuated states thereof. These contacts, when actuated responsive to energization of the relay coil, complete a circuit to an indicating device and to a reset switch and break the circuit between the coil and amplifier. Opening of the reset switch de-actuates the switching contacts.

2 Claims, 2 Drawing Figures

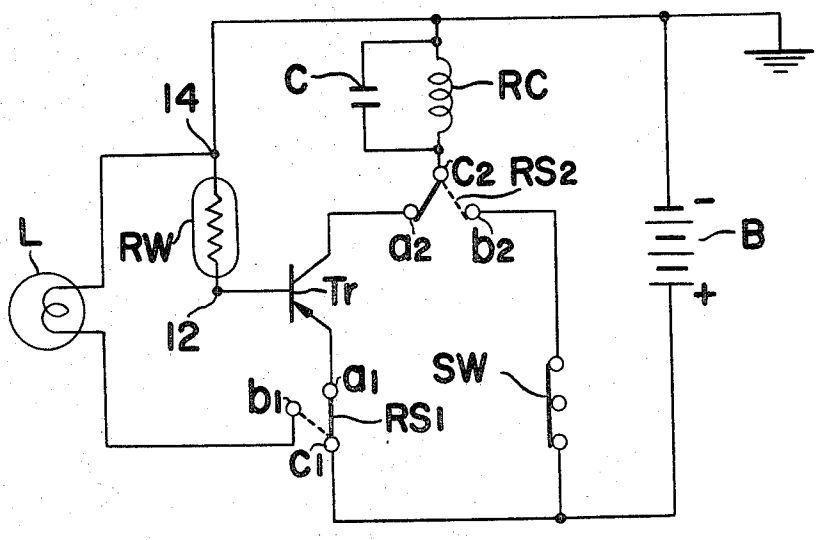

FIG. 1

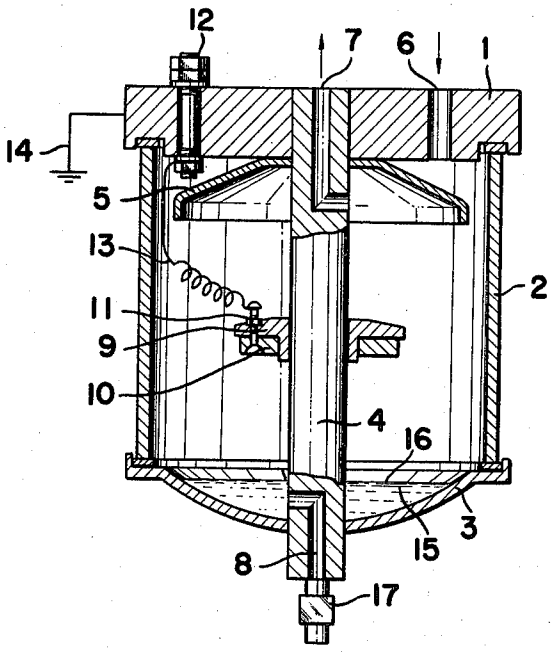
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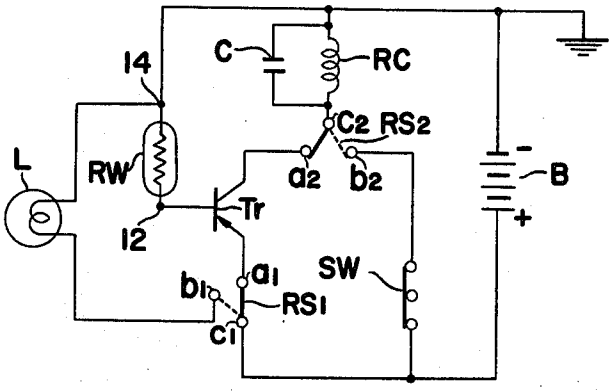
FIG. 2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ELECTRICAL ALARM DEVICE FOR OIL FILTERS RESPONSIVE TO WATER SEDIMENT LEVEL

FIELD OF THE INVENTION

This invention relates to an alarm device for oil filters, which produces an alarm signal when the water sediment in the oil filter has increased to a certain volume.

BACKGROUND OF THE INVENTION

In the engine of an automobile, for example, a lubricating oil containing water will not lubricate satisfactorily. There must be no water in the lubricating oil or trouble may occur in varied form in the engine, and therefore a means of removing water from the oil must be provided. Such a means of water removal generally utilizes the difference in specific gravity between water and oil. For instance, separation of water from the lubricating oil in recirculation can be effected in the oil filter, wherein water is allowed to settle down by sedimentation to the bottom of the filter from the passing oil. The filter must be drained to remove the water sediment before or when it has increased to a certain volume within the filter. For the device issuing an alarm to indicate the increase of water sediment to the predetermined volume, a conventional method uses two electrodes within the oil filter and has these electrodes so arranged that a closed electric circuit will be formed through these electrodes and water sediment when the sediment has increased to said volume, and that a current flows in the circuit to energize a relay, thereby closing the switch to light up an indicating lamp. In such a conventional device, however, the electric current continues to flow in the circuit, which includes the water sediment, until the oil filter is drained by the user of the engine who has been alarmed by the indicating lamp. Since the source of the relay-energizing current is a storage battery in an automobile, the current, which is a direct current, gives rise to electrolytic decomposition in the oil filter to generate harmful gases and to erode the electrodes, producing harmful particles of erosion which will be carried away by the lubricating oil passing through the filter.

SUMMARY OF THE INVENTION

This invention purports to eliminate the drawbacks of the conventional alarm device. The object of this invention is to provide an improved water sediment alarm device whose operation is substantially free from electrolytic decomposition. How the object is accomplished by this invention will be made clear by way of describing an embodiment thereof illustrated in the attached drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a diagrammatical cross section of the oil filter and

FIG. 2 shows a circuit of an embodiment of this invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 shows a cross section of an oil filter, wherein 1 is a filter lid, 2 is a cylinder serving as a side wall, 3 is a dished bottom or bowl and 4 is a metallic shaft. The lid 1 is made of a metal and has an oil inlet opening 6. An electrical terminal 12 is insulatedly carried by the lid 1 and extends through the lid. The cylinder 2 is made of such a material as glass, whereas a material of the bowl 3 is generally a metal. The shaft 4 is centrally positioned and extends through the lid 1 and the bowl 3 at their respective centers. The top and bottom portions of the shaft 4 are so shaped as to provide an oil outlet hole 7 and a water sediment drain hole 8, respectively. The shaft 4 carries an insulator support 9 at its intermediate portion; an annular electrode 10 is mounted on this support 9. By a terminal 11 extending from the electrode 10 and by a lead wire 13 connected between a terminal 12 and the terminal 11, the annular electrode 10 is electrically connected to the terminal 12 and the lid 1 is grounded at 14. 5 is an oil baffle shaped like an inverted dish and mounted on the shaft 4 to bear against the underside of the lid 1.

In the oil filter so constructed, lubricating oil enters the filter through the inlet opening 6 and impinges on the oil baffle 5 to be splashed away against the wall of the cylinder 2. The oil within the filter flows out through the outlet hole 7 formed in the top portion of the shaft 4. Out of the oil in motion from the inlet to the outlet, water, if any, separates and falls to the bottom because the specific gravity of water is higher than that of the oil. The falling water accumulates in the bowl 3 as water sediment 15. The surface of the sediment accumulating in the bowl is indicated at 16. As the sediment increases, the surface 16 will touch the electrode 10. When this occurs, a closed circuit comes into being through the ground 14, the lid 1, the shaft 4 which constitutes an electrode, the water sediment 15 and the electrode 10, to light up the indicating lamp.

The circuit for lighting the indicating lamp is diagrammatically shown in FIG. 2, wherein L is an indicating lamp, which is connected across a battery B between its positive and negative terminals through a stationary contact point b_1 and a movable contact point c_1 of a switch RS_1. R_c is a relay coil, whose one end is connected to the negative terminal of the battery B and the other end to the movable contact point c_2 of the switch RS_2. When energized, the relay coil R_c actuates the switches RS_1 and RS_2. The stationary contact point b_2 of the switch RS_2 is connected to the positive terminal of the battery B through the resetting switch SW, and the other stationary contact point a_2 is connected to the positive terminal of the battery B through the emitter-collector circuit of a transistor T_r and two contact points a_1 and c_1 of the switch RS_1. The base of the transistor T_r is connected to the terminal 12 shown in FIG. 1. This terminal 12 becomes connected to the ground 14 when the water sediment 15 increases to raise its surface 16 to the level mentioned above. The water sediment 15 is represented in FIG. 2 by R_w. The battery B has its negative terminal grounded, so that the circuit as a whole is a negative-ground system. C is a capacitor paralleled to the relay coil R_c.

When the amount of the water sediment 15 is small, with its surface 16 being substantially below the electrode 10, resistance R_w representing the sediment has an infinite ohmic value and, consequently, the base current for transistor T_r is practically nil, so that this transistor remains in non-conductive state to hold the relay coil R_c in de-energized condition. With the relay coil R_c de-energized, the switches RS_1 and RS_2 stay in the positions shown in FIG. 2. As water sediment 15 increases and raises its surface 16 high enough to contact the electrode 10, the ohmic value of the resistance R_w decreases drastically (to the order of 1 kilohm, for example) to cause a current to flow through the contact points c_1 and a_1, the emitter and base of the transistor T_r, and the resistance R_w. By this current, the transistor T_r becomes conductive: the resultant current flows through the contact points c_1 and a_1, the emitter and the collector of the transistor T_r, the contact points a_2 and c_2, and the relay coil R_c. Thus, the relay coil R_c, now energized, actuates the switches RS_1 and RS_2 to make the point c_1 and contact point b_1 in the switch RS_1 and the point c_2, and contact b_2 in the switch RS_2. These switching actions are sequential: the point c_1 separates from the point a_1 and then the point c_2 separates from the point a_2. The moment the point c_2 separates from the point a_2, the relay coil R_c would become de-energized to cause the points c_1 and c_2 to move back again into contact with the points a_1 and a_2, respectively, were it not for the presence of the capacitor C paralleling the coil R_c. Stated specifically, when the relay coil R_c becomes energized by the current established through the emitter-collector circuit of the transistor T_r as mentioned above, time capacitor C becomes charged at the same above, and, just as the energized relay coil actuates the switches RS_1 and RS_2 to interrupt the energizing current, the capacitor C discharges to keep the relay coil R_c energized just long enough to allow the points c_1 and c_2 to move over to the points b_1 and b_2, respectively. With the point c_2 brought into contact with the point b_2 in the switch RS_2, the relay coil R_c draws an energizing current through the switch S_w. With the point c_1 brought into contact with the point b_1, a current flows in the circuit of the lamp L to make the lamp burn, thereby issuing a visual alarm. This condition

of the lamp L burning and the relay coil R_c energized persists until resetting the switch S_w is opened. It must be noted that, except for the brief initial duration in which the base current flows, the water sediment or the resistance R_w remains free from current at all times, and that, even when the lamp L is burning as above, no current flows in the water sediment **15** because the point C_1 is then off the point a_1.

It will be noted in the foregoing description that the device according to this invention performs the alarm issuing acting accurately and positively whenever the water sediment increases to the predetermined volume, and that the electrolytic action inherent in the conventional method is practically avoided in the present instance because it is during the short period of initiating the relay action that a current flows in the water sediment.

It will be understood that this invention is not limited to the embodiment thereof described above and illustrated in the attached drawing, but is susceptible to varied modification. For instance, the transistor T_r may be replaced by any other proper amplifying element, the relay coil R_c with its switches may be replaced by any other proper switching means, and the indicating lamp L may be supplanted by an other proper indicating means of known type. Resetting the switch S_w may be linked with the drain valve **17** in such a way that operating this switch to reset the system will open the valve **17** to drain out the water sediment.

What is claimed is:

1. An alarm device for water sediment in an oil filter comprising, a pair of electrodes extending within the oil filter so as to be short-circuited when the water sediment accumulated in the oil filter reaches a predetermined level, and an electrical indicating circuit comprising an amplifier having an input connected to one of said electrodes, a relay coil normally connected to the output of said amplifier and energized when the water sediment reaches said predetermined level, an electrical indicating means, a first pair of switching contacts actuated responsive to the energization of said relay coil for, in the first, unactuated state thereof, connecting the output of said amplifier to said relay coil, and for, in the second, actuated state thereof, opening the connection between the output of said amplifier and said relay coil, a second pair of switching contacts actuated responsive to the energization of said relay coil for, in the first, unactuated state thereof, completing a circuit between said amplifier and an electrical energy source, and for, in the second, actuated state thereof, completing a circuit between said indicating means and the source, and a reset switch for, when opened, de-energizing said coil, said first pair of switching contacts in the second, actuated state thereof completing a circuit between said reset switch and the source.

2. In combination an oil filter and an alarm device for water sediment in the oil filter, said oil filter comprising an electrically conductive lid, a bowl, a cylinder between said lid and said bowl, and a metallic shaft mounted on the center-line of said lid, cylinder and bowl, and said alarm device comprising electrode means insulatingly mounted on said shaft spaced from the bottom of said bowl and an electrical indicating circuit comprising an amplifier having an input connected to said electrode means, a relay coil normally connected to the output of said amplifier, an electrical indicating means, first and second pairs of switching contacts actuated responsive to the energization of said relay coil for, in the first, unactuated state thereof, connecting the output of said amplifier to said relay coil and completing a circuit between said amplifier and an electrical energy source and for, in the second, actuated state thereof, opening the connection between the output of said amplifier and said relay coil, and completing a circuit between said indicating means and the source, and a reset switch for, when opened, de-energizing said coil, one of said pairs of switching contacts in the second, actuated state thereof completing a circuit between said reset switch and the source.

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