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[51] Int. Cl. H01h 35/00

[58] **Field of Search**.....200/61.03-61.09,
200/61.2, 84 R; 307/118; 340/235, 242;
73/40, 40.5, 86; 102/16

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[57] **ABSTRACT**

A cut-off and alarm system for detecting the presence of gasoline or similar hydrocarbon liquid in water. The system employs a sensing switch consisting of a mass of material soluble in the gasoline or similar hydrocarbon liquid. Switch contact elements embedded in the mass are biased to move to an alarm state when the material dissolves. When the material dissolves, the associated load device is thereby disconnected from its power source and an alarm device becomes energized.

9 Claims, 6 Drawing Figures

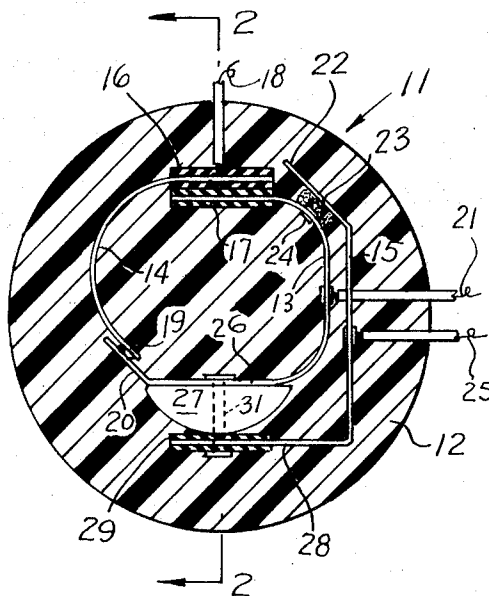


FIG. 1.

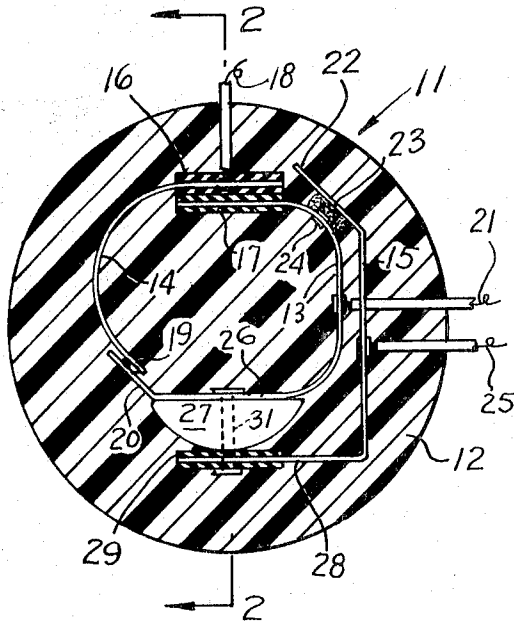


FIG. 2.

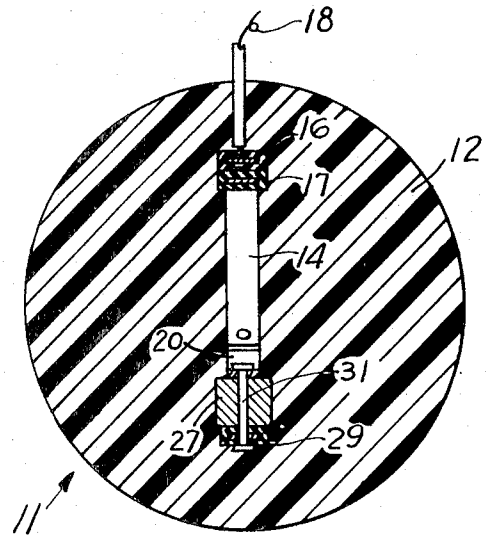


FIG. 3.

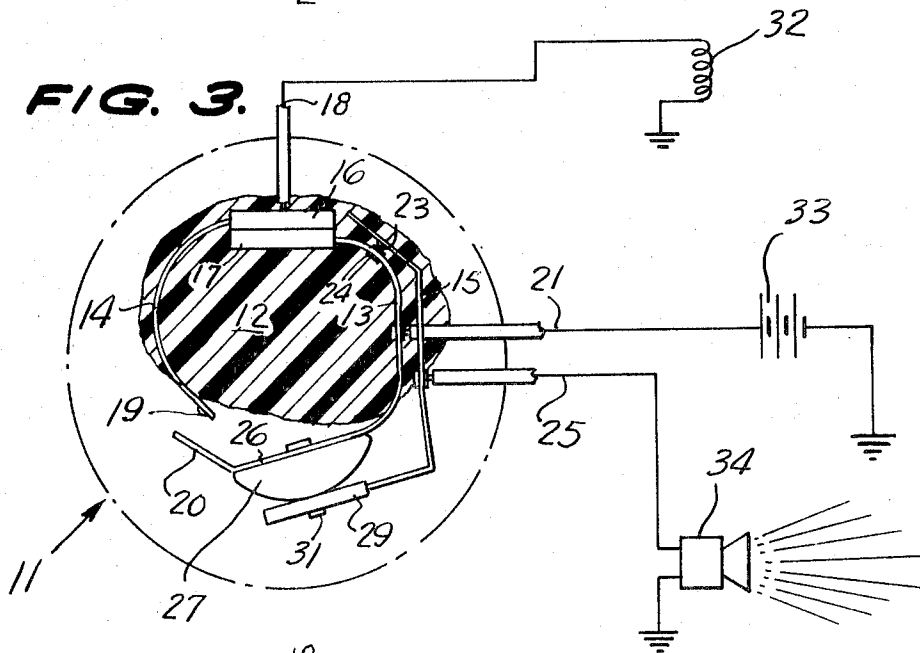
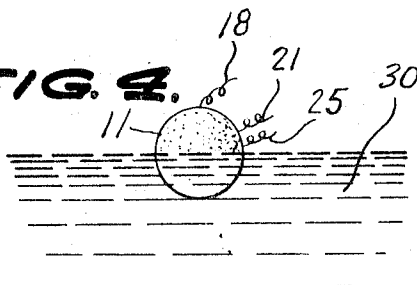


FIG. 4.



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FIG. 5.

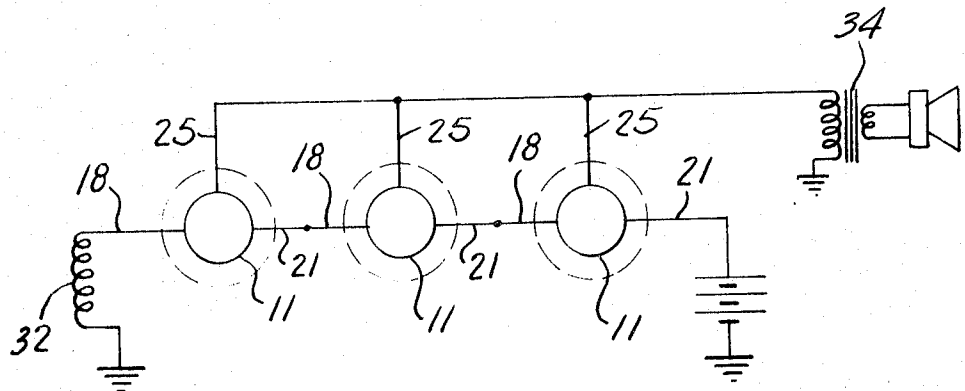
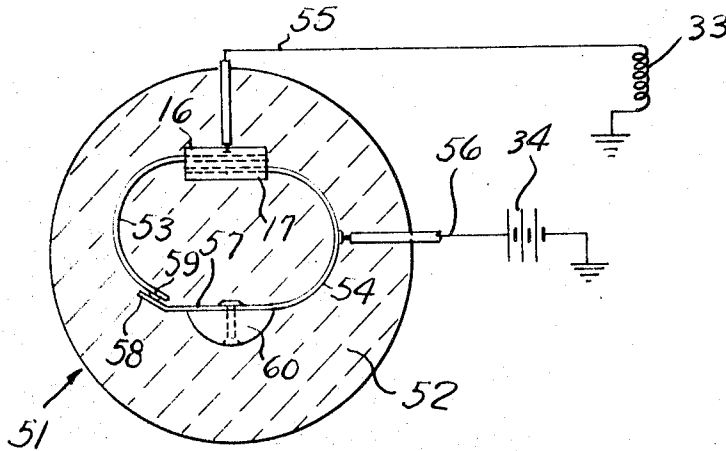


FIG. 6.

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GAS FUSING SENSING DEVICE

This invention relates to leakage protection devices, and more particularly to an improved system for detecting leakage of gasoline or similar hydrocarbon liquid and for automatically disconnecting associated load devices and simultaneously providing a warning alarm.

The main object of the invention is to provide a novel and improved cut-off and alarm system for detecting the presence of gasoline or similar hydrocarbon liquid or other abnormal conditions such as fire, excessive heat, or harmful liquid, fuel or vapor leakage, such as gasoline or other chemicals, solvents or similar hazards.

A further object of the invention is to provide an improved protective device responding to the presence of gasoline or similar hydrocarbon liquid material and acting in response thereto to disconnect an associated load device from its power source and to activate a signal device or protective device, such as a pump, fire extinguishing equipment, or the like, for the purpose of overcoming the detected emergency condition, the device including very simple parts, being easy to install, and being reliable in operation.

A still further object of the invention is to provide an improved protective device for the purpose above stated, the device having one or more sensitive elements affected by heat, water, gasoline, chemicals, solvents, dampness, gases or the like, acting in the nature of a fuse or circuit breaker and also acting to control signal devices or systems designed to correct the detected condition.

A still further object of the invention is to provide an improved protective device for the purpose above stated, said device comprising relatively inexpensive components, being of compact size so that it is easy to install in a desired location to be protected, and being specially applicable to detecting dangerous gasoline leakage, or the like, for example, on vessels or other craft, caused by abnormal conditions, such as leakage from conduits, tank overflow, deficiencies in associated valves, such as in the needle valve of the carburetor of an engine of the craft, the device providing deactivation of associated electrical circuits so as to avoid explosions, and the system operating to provide an alarm signal indicating the emergency condition.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

FIG. 1 is a cross-sectional view taken centrally through one form of liquid-detection switch assembly employed in a protective system according to the present invention.

FIG. 2 is a transverse vertical cross-sectional view taken substantially on the line 2—2 of FIG. 1.

FIG. 3 is a view similar to FIG. 1 but showing the detection switch assembly in a condition corresponding to the presence of gasoline, or similar hydrocarbon liquid to be detected, and showing the condition of the parts after a substantial portion of the matrix material has been dissolved away by the gasoline or other hydrocarbon liquid present.

FIG. 4 is a view illustrating how the detection switch assembly may be employed as a floating element on the surface of a body of water or other liquid in which the presence of gasoline or other hydrocarbon liquid is to be detected.

FIG. 5 is a cross-sectional view generally similar to FIG. 1, but showing a different form of detection switch assembly, employed merely as a fuse device to disconnect an associated load from its power supply responsive to the presence of gasoline or other harmful liquid.

FIG. 6 is a wiring diagram showing a typical protective system employing sensing switch assemblies such as the assembly illustrated in FIGS. 1, 2 and 3.

A prime purpose of the present invention is to provide a monitoring and sensing means in the form of a device having one or more sensitive elements affected by heat, water, gasoline, chemicals, solvents, dampness, gases or the like for energizing or deenergizing electrical circuits in which a signal device, pump, fire extinguishing device, or the like, is activated for the purpose of providing an alarm or providing property protection. Another purpose is to supply a protection device of simple and inexpensive construction provided with one or more open or closed switch combinations in a multiple wire circuit wherein the switch elements involved include an insulating partition or separator or a soluble or meltable material that is initially molded or formed to hold the switch elements in either a closed or open state, said material being dissolved or melted by heat, water, dampness, gasoline, gases, or the like, which may have injurious effects on persons or property intended to be protected by this means.

For example, a typical protective device, according to the present invention, could employ a body of suitable material, such as expanded polystyrene, and could be placed in the bilge areas of gasoline-powered boats for the purpose of detecting gasoline spillage, or leakage, tending to collect in the boats bilge water. The protective sensing device is preferably designed to float on the surface of the bilge water, in the presence of gasoline therein, the outer shell of expanded polystyrene, normally holding the switch in an initial configuration disintegrates, rapidly releasing the spring tension switch elements, opening the associated load circuit and energizing the associated alarm circuit, and simultaneously turning on fire extinguishing equipment or other electrically powered protective devices.

Other applications of the protective system of the present invention could be for the detection of fuel leakage in aircraft engines, detection of fuels, chemicals or solvents in sewer systems or manufacturing operations, or for the detection of fire or excessive heat.

There will be described herein a typical embodiment of the present invention which is designed for use in a boat and wherein the detection element thereof is intended to float on the surface of bilge water in the boat to detect the presence of gasoline caused by spillage or leakage.

Referring to the drawings, 11 generally designates a typical sensing switch assembly in accordance with the present invention. The assembly comprises a body of matrix material, shown at 12, buoyant in water and adapted to disintegrate upon exposure to the material to be detected, which in this case is gasoline. Thus, the matrix material 12 may comprise expanded polystyrene. Other materials which may be useful for this purpose are wax, various plastics, fibers, or other well known material which can be dissolved by gasoline. In the typical application of the invention described specifically herein, expanded polystyrene has been found to be a preferred material.

Embedded in the matrix material 12 and held therein in a normal relative configuration are respective conductors 13, 14 and 15 comprising strips of spring tempered conducting metal, such as beryllium copper, or other suitable material having similar characteristics. The strips 13 and 14 are of generally C-shape configuration and are arranged in opposition to each other with their top ends disposed substantially parallel and insulated from each other by the provision of lengths of shrink sleeving 16 and 17 on the parallel top portions, as shown in FIG. 1, the sleeving being of insulating material. A terminal wire 18 is connected to the top end portion of the metal strip 14. The lower end portion of strip 14 is provided with a contact element 19 which normally engages the inclined lower end portion 20 of the mating metal strip 13. A terminal wire 21 is connected to the intermediate portion of strip 13.

The metal strip 15 has an inclined top end portion 22 provided with a contact element 23 which is located adjacent to an opposing contact element 24 provided on the arcuately curved upper right hand corner portion of the metal strip 13, as shown in FIG. 1. Strip 13 is spring biased so that when in a free condition the contact element 24 tends to move toward and engage the contact element 23, but in the normal state of the assembly, the contact elements 23 and 24 are held separated by the matrix material 12. The metal strip 15 is of generally L-shape and a terminal wire 25 is connected to the intermediate portion of its upstanding leg, as viewed in FIG. 1.

Secured to the horizontal lower portion 26 of the metal strip 13 is a weight element 27 of lead or other suitable heavy material, the weight 27 being secured between the leg 26 and the horizontal lower leg 28 of metal strip 15 but being insulated therefrom by the provision of insulating shrink sleeving 29 on the leg 28. The spring strip 13 is spring biased so that the inclined contact portion 20 thereof, which normally engages contact element 19 of strip 14 tends to separate from the contact element 19 when the member 13 is released, for example, in the condition thereof shown in FIG. 3. This tendency for separation is also aided by the weight 27 which urges leg 26 downwardly when the strip 13 is released, by the action of gravity. The weight 27 also serves as a ballast means to cause a sufficient degree of immersion of the device 11 in the bilge water, shown at 30, so that the device will respond efficiently to the presence of gasoline on the top surface of the water. Thus, the weight member 27 preferably has a sufficient magnitude to cause the body of material 12 to float substantially half submerged in the bilge water 30.

As above mentioned, the weight 27 may be made of lead, solder, or any other suitable relatively heavy material. The weight 27 may be fastened between the legs 26 and 28 by a suitable rivet 31 which mechanically connects the legs and clampingly holds the weight 27 therebetween. However, leg 26 is insulated from leg 28 by any suitable means, such as by the provision of the insulating shrink sleeving 29, shown in FIGS. 1, 2 and 3.

The presence of gasoline in the bilge water 30 causes the expanded polystyrene material 12 to be dissolved, until eventually a sufficient amount of material 12 is dissolved to release the strips 13 and 15 and to allow them to unflex to the configurations thereof shown in

FIG. 3. In the state shown in FIG. 3, strip 13 is disconnected from strip 14 and is connected to strip 15.

In the typical arrangement illustrated in FIGS. 1, 2 and 3, the device 11 is employed as a gasoline-responsive single pole, double throw safety switch device whose pole comprises the strip 13, normally in conductive engagement with the strip 14 and disengaging therefrom in response to the presence of gasoline in the bilge water 30, moving to a position wherein it conductively engages the strip 15 under these emergency conditions. Thus, in the typical circuit shown in FIG. 3, the terminal wire 18 is connected to one terminal of an operating load circuit, schematically illustrated at 32, for example, the ignition circuit of the associated engine of the boat. The other terminal of the circuit 32 is grounded. The terminal wire 21 associated with the strip 13 is connected to one terminal of a power supply device, such as a battery 33, the other terminal of the power supply device being grounded. The terminal wire 25 is connected to one terminal of a suitable alarm device 34, or other device intended to respond to the presence of gasoline in the bilge water 30, such as a pump, or the like. The remaining terminal of the device 34 is grounded. It will be seen that under normal conditions, with the sensing switch device 11 in the state shown in FIGS. 1 and 2, the load circuit 32 will be energized and the device 34 will be deenergized. However, when gasoline is detected in the bilge water 30, as above described, the matrix material 12 disintegrates, producing the condition illustrated in FIG. 3, releasing the spring strips 13 and 15 and allowing arm 20 to disengage from contact 19, as well as allowing contact element 23 to come into engagement with contact element 24 due to the softening and disintegration of the matrix material adjacent thereto. This opens the energizing circuit of the load device 32, causing said load device to become deenergized and substantially at the same time energizes the device 34 by the closure of the contacts 23, 24.

As above mentioned, the weight 27 has a double function in that it provides the desired degree of immersion of the matrix material 12 in the bilge water 30, as well as acting in cooperation with the spring tension in the strip 13 to provide the desired biasing action tending to cause the strip to assume the configuration thereof shown in FIG. 3 following the disintegration of a substantial amount of the matrix material 12.

If the protective sensing switch device 11 is not intended to float, the weight member 27 may be omitted.

FIG. 5 illustrates a simplified form of gasoline-sensing switch device which acts merely to disconnect the load circuit 33 from the power supply source 34 under emergency conditions, namely, when gasoline is detected in the bilge water 30. Thus, the device, shown at 51, comprises a main body of matrix material 52, for example, expanded polystyrene similar to that employed in the previously described embodiment of the invention. Embedded in the body 52 are the spring tempered conducting metal strips 53 and 54 of generally C-shaped configuration arranged in opposing relationship with their top end portions parallel and insulated from each other by sleeving 16 and 17, as in the previously described embodiment of the invention. A terminal wire 55 is connected to the top end of the metal strip 53 and a terminal wire 56 is connected to

the intermediate portion of the other metal strip 54. The horizontal bottom leg 57 of strip 54 is provided with an inclined contact arm 58 at its end and the strip 53 is provided with a contact element 59 normally engaging the arm 58. The arm 57 may be provided with a suitable weight member 60 of lead, or the like, similar to the weight 27, and resilient strip 54 is spring-biased to unflex so as to separate arm 58 from contact 59 responsive to the disintegration of a substantial amount of the matrix material 52. Thus, the load circuit 33, which is normally energized from the power supply battery 34, becomes deenergized responsive to the opening of the switch contacts 58, 59, automatically stopping the associated internal combustion engine when a quantity of gasoline is detected in the bilge water, as in the previously described form of the invention.

FIG. 6 illustrates a typical arrangement wherein a plurality of sensing switch assemblies 11 are employed in a distributed system adapted to detect the presence of gasoline or other volatile liquids or gases in bilge water, or, in general, other emergency conditions, in separated different areas of a boat or other location to be protected. FIG. 6 illustrates the system which would be employed on a boat having various locations where bilge water might accumulate and wherein gasoline from spillage or leakage might collect. A sensing switch device 11 is located at each one of these locations, adapted to float in the bilge water or otherwise to be exposed to the presence of gasoline. The arrangement of FIG. 6 provides a series connection of the various normally closed sets of switch contacts 19, 20 of the respective switch assemblies 11, so that opening of any one of these sets of contacts deenergizes the load device 32, which may be in the typical case under consideration, the ignition circuit of the associated boat internal combustion engine. The respective alarm terminal wires 25 of the gasoline-sensitive switch device 11 are connected in parallel to one terminal of the alarm or corrective device 34. Thus, the disintegration of a substantial amount of the matrix material 12 of any one of the sensing switch devices 11 deenergizes the load device 32 and substantially at the same time energizes the alarm or corrective device 34, since the device 34 will become energized when any one of the respective sets of switch contact elements 23, 24 of the device 11 closes. Thus, the circuit arrangement of FIG. 6 may be employed in a situation where gasoline might tend to collect in any one or all of a number of different bilge water locations on a boat.

As above mentioned, systems corresponding to those above described and illustrated in the drawings may be provided as "fuse" protection devices for protection against accumulation or leakage of gasoline, other liquid materials, including water, chemicals, solvents, dampness, gases, heat, or the like, such as would cause the outer body or shell of matrix material to dissolve, melt, disintegrate or weaken, whereby to permit the spring loaded metal strip elements to unflex and assume a configuration different from that in their initial embedded condition. The release of the spring loaded strip elements opens contacts which causes all power to the associated load circuits to be removed and substantially simultaneously therewith closes contacts to energize an alarm or corrective device, such as fire extinguishing equipment, pumps, or the like.

As will be apparent from FIGS. 1 to 5 of the drawings, the body of matrix material 12 is preferably of spherical shape, and the respective metal strips forming the switch assembly are preferably arranged in a diametral plane of said body of matrix material. Thus, the weight member employed with the assembly is preferably of a sufficient magnitude to cause the body of matrix material to float substantially half submerged in water, namely, with the water line being substantially at the equator of the spherical body, as is illustrated in FIG. 4.

While certain specific embodiments of improved protective sensing switch devices and accompanying circuits have been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A protective sensing switch device responsive to the presence of gasoline or similar hydrocarbon material comprising a body of matrix material which disintegrates upon exposure to gasoline or similar hydrocarbon material, said matrix material comprising expanded polystyrene buoyant in water, a spring-loaded switch assembly embedded in and completely surrounded by said body of matrix material, said switch assembly comprising a first conductor and a second conductor in contact with said first conductor, at least one of said conductors being resilient and being spring-biased toward a position disengaged from the other conductor, said one conductor disengaging from said other conductor responsive to the disintegration of the surrounding matrix material, and respective terminal wires connected to said conductors.

2. The protective sensing switch device of claim 1, and an external circuit branch connected to said terminal wires and including a source of current and a load device.

3. The protective sensing switch device of claim 2, and wherein said one conductor is connected to said source of current, an auxiliary device, a third conductor embedded in said body of matrix material in a position to be engaged by said one conductor responsive to said disintegration of the surrounding matrix material, and circuit means connecting said auxiliary device to said source of current through said one conductor and said third conductor.

4. The protective sensing switch device of claim 1, and a weight of heavy material secured to one of the conductors in said body of matrix material.

5. The protective sensing switch device of claim 4, and wherein said body of matrix material is substantially spherical in shape.

6. The protective sensing switch device of claim 4, and wherein said weight is secured to said resilient conductor.

7. The protective sensing switch device of claim 6, wherein said weight is secured to said resilient conductor adjacent its region of contact with said first conductor.

8. The protective sensing switch device of claim 7, and wherein said body of matrix material is substantially spherical in shape and said weight is of a magnitude to cause the body of material to float substantially half submerged in water.

9. The protective sensing switch device of claim 8, and wherein said conductors comprise strips of metal arranged substantially in a diametral plane of said body of matrix material.

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