United States Patent

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[54] **THERMAL SWITCH ASSEMBLY AND SYSTEM**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **337/104,** 417/36
[51] **Int. Cl.** **H01h 61/013**
[50] **Field of Search** 337/104, 107, 380, 381, 324, 327, 139, 393; 318/413; 103/25; 417/36

[56] **References Cited**
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ABSTRACT: A normally closed thermal switch adapted to open at temperatures above its closing temperature, is exposed to a temperature above closing temperature sufficient to maintain the switch open in an atmospheric environment, but insufficient to maintain said switch open in a liquid environment, wherein the switch is caused to close. Closing of the switch introduces additional heat which is sufficient to open the switch while in such liquid environment, but capable of affecting a fast opening of the switch upon subsequent removal of the liquid environment and exposing the switch to the initial atmospheric environment. The switch assembly, when employed in a sump pump system, will reduce the continued running of the pump following completion of a pumping operation, to protect the motor against heat up damage, and economize on power consumption.

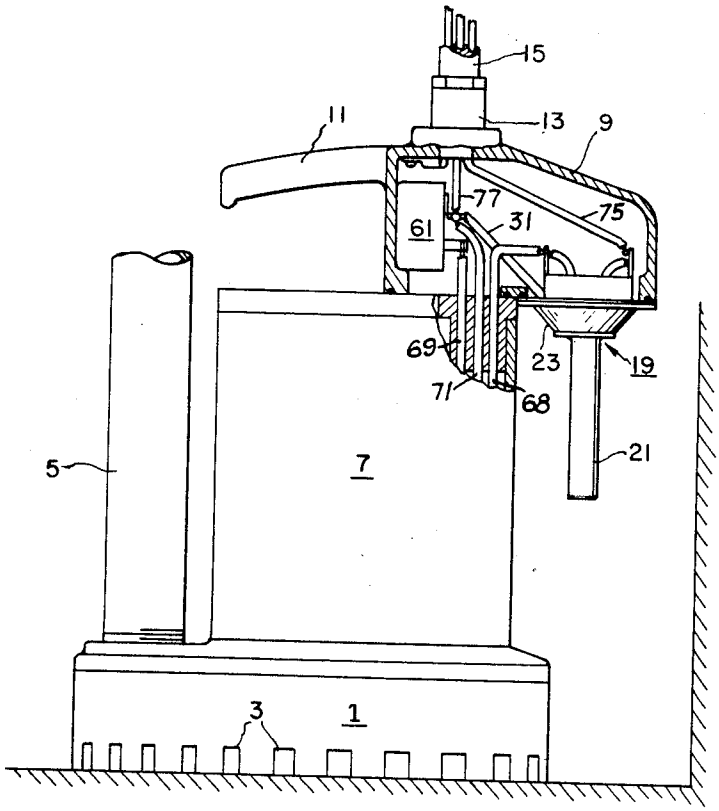


FIG. 1

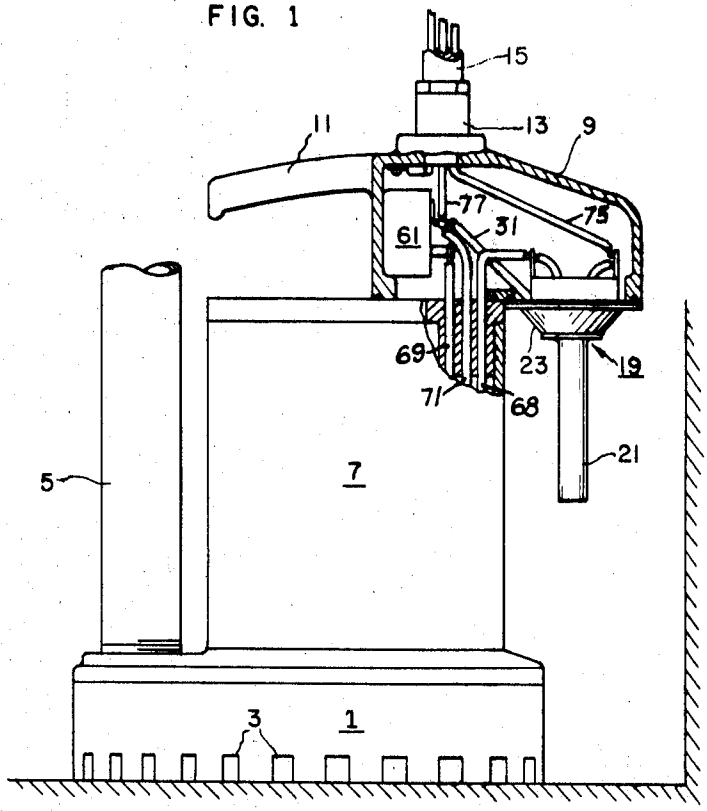


FIG. 2

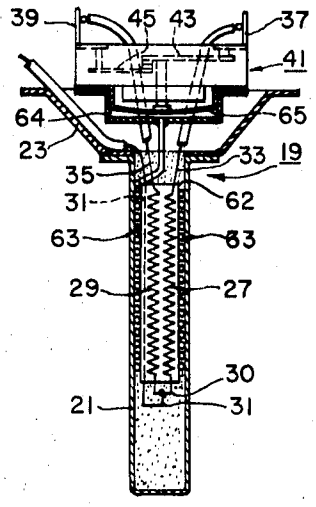
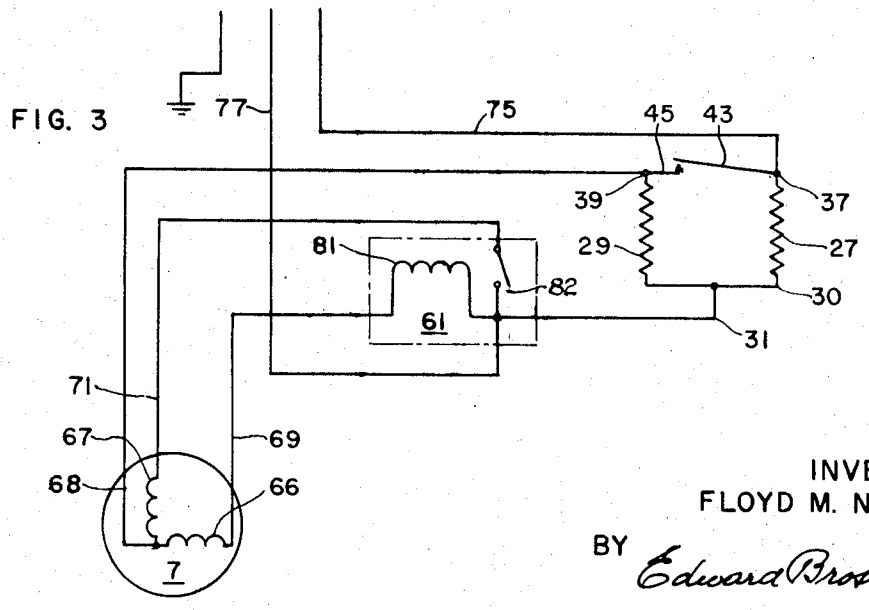


FIG. 3



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THERMAL SWITCH ASSEMBLY AND SYSTEM

My invention relates to liquid level control means and more particularly to a thermal switch assembly and system involving the same.

While the invention is of general utility, it has been developed primarily from the view point of its use in conjunction with a submersible sump pump, in controlling pumping cycles of such pump.

In the operation of a sump pump, it is desired that pumping halt while there remains sufficient water in the sump to maintain the motor seal submerged, to realize the benefit of the cooling effect of such water on the motor.

One of the problems, in connection with the operation of sump pumps, is the tendency of the motor and pump to continue running after the sump has been pumped down to the desired level, thus drawing the liquid level down below the desired level and leaving the motor running without liquid to maintain a cooling effect thereon. This continued running of the pump motor beyond its useful pumping cycle, can therefore not only injuriously affect the motor, but represents a waste of useful power.

Also, conventional type sump pumps normally involve the use of floats, linkages, diaphrams, or bellows, all of which can cause malfunctioning, attributable to accumulation of floating debris, or can otherwise get out of adjustment.

Among the objects of my invention are;

1. To provide a novel and improved thermal switch assembly;
2. To provide a novel and improved thermal switch assembly adaptable for use in a sump pump system, to more effectively control the useful pumping cycles of such pump;
3. To provide a novel and improved sump pump system adapted to provide early disconnection of a sump pump motor, following completion of a useful pumping cycle; and
4. To provide a novel and improved sump pump which is immune to accumulation of floating debris, and is otherwise stable.

Additional objects of my invention will be brought out in the following description of a preferred embodiment of the same, taken in conjunction with the accompanying drawings wherein:

FIG. 1 is an elevation view, partly in section, depicting a thermal switch assembly of the present invention as applied to a sump pump system;

FIG. 2 is a view in section through the thermal switch assembly depicted in the sump pump system of FIG. 1;

FIG. 3 is a circuit diagram related to the sump pump system of FIG. 1.

Referring to the drawings for details of my invention in its preferred form, I have disclosed in FIG. 1, a representative sump pump 1 having intake ports 3 at its lower end, and a discharge pipe 5 extending upwardly from the pump, the pump being driven by a motor 7 mounted on the upper end thereof and forming therewith, a unitary assembly.

Supported on the upper end of the motor, is a housing 9 provided with a laterally extending handle 11, and bushing 13 in the roof of the housing for a cable 15.

The housing 9 overhangs the motor, and in the overhand portion, it is provided with a circular opening in the floor thereof for installation of a thermal switch assembly 19.

Such thermal switch assembly comprises a tube 21 of brass or other noncorrosive material of good heat conductivity, connected at its upper end to a flared mounting receptacle 23, which is flanged at its open end for the purpose of installation.

Installed in the tube are heater means in the form of a pair of electrical resistors 27, 29 which are connected together at one end 30 and provided with leads extending upwardly through the open end of the tube, one lead 31 from the junction of the two resistors, one lead 33 from the free end of one

of the resistors 27, and one 35, from the free end of the resistor 29. The free end leads 33 and 35 are connected, each to a different one of a pair of terminals 37, 39 respectively, which are bridged by a normally closed thermally actuated microswitch 41 involving an armature 43 electrically connected to one of the terminals 37, and a contact 45 connected to the other terminal 39. The junction lead 31 emerges from the switch assembly and together with the aforementioned terminals 37 and 39, provide for connection of the thermal switch assembly into an appropriate system. Such system, as it applies to the sump pump assembly of FIG. 1, includes a relay 61 mounted on an interior wall of the housing.

The resistors may be installed in a ceramic tube 62 about which is wound a helical tube 63, filled with thermal expansive liquid. This helical tube is sealed at its lower end and anchored in any appropriate manner as by a hard wax or like material while at its upper end it terminates in a bellows type arrangement formed by a shallow receptacle 64 in which is sealed a normally concave snap disc 65.

Between this snap disc and the armature of the microswitch, is an armature actuator, adapted, upon snapping of the disc to a convex form, to urge the armature to open position of the switch.

For a disclosure of the system, reference will be made to FIG. 3 of the drawings, wherein the motor 7 is disclosed as being of the split phase type involving a pair of standard windings 66, 67, 90 electrical degrees out of phase with one another, with a lead 68 emerging from a connection between the two windings, and a pair of leads 69, 71 from the free ends of the windings 66, 67 respectively. This motor is energized from a single phase power source, through a pair of leads 75, 77, the lead 75 going to the terminal 37 of the thermal switch, while the other side of the single phase supply source is connected by lead 77 to one end of the winding 81 of the relay 61, and to the lead 31 of the thermal switch assembly. The relay winding controls contacts 82 in the lead 71 to the motor.

Energization of the relay, however, can only occur when the thermal switch 41 is in its closed condition, and this, in turn, is normally prevented, when the switch assembly is exposed to atmosphere, by the one heater resistor 27 which is initially connected across the single phase supply source to hold the switch open, and remains so connected during operation of the system. The remaining heater resistor 29 can function only upon closing of the thermal switch, which places it in circuit across the supply source in parallel with heater resistor 27, and at the same time that the motor is energized.

For effecting operation of the system, the actual as well as relative values of these heater resistors become important, and will depend somewhat on the temperature conditions under which the system is to function.

As applied to a sump pump installation such as depicted in FIG. 1, the value of the one heater resistor 27, which is always energized, will be such that in air, it will generate sufficient heat to expand the liquid in the helical tube and actuate the normally closed switch 41 to an open condition, and hold it open so long as the tube 21 of the thermal switch assembly is exposed to atmosphere.

In the event, however, the sump fills up with water to the point of submerging the tube 21, the resulting cooling effect on the heaters therein will overcome the effects of heat generated by the permanently connected resistor 27, which would then be insufficient to maintain the switch open. Consequently, the switch will close and energize the relay to place the motor in operation and a cause the pump to pump water from the sump, at the same time adding the heater resistor 29 to the circuit.

Assuming the added resistor were not involved in the circuit, then upon withdrawal of water from around the thermal switch assembly attributable to operation of the pump, the first heater resistor will again develop heat at a rate sufficient to cause the thermal switch to open and disconnect the motor, but this can take an appreciable time, during which time the pump could draw down the water level in the sump to the

point where the motor would have no water surrounding it to exert the desirable cooling effect, and consequently, the motor under such conditions could develop sufficient internal heat to dry out the motor seal, with ultimate ruin of the motor.

To materially shorten the period within which the motor switch will open, and to effect a quick opening thereof, when the water level drops below the thermal switch assembly and exposes it to atmosphere, is the function of the second heater resistor **29** in the thermal switch assembly.

Upon closing of the thermal switch **41**, this second heater resistor is connected into the circuit, in parallel with the first heater resistor, and thus, increases the heat output within the thermal switch assembly. The value of this second heater resistor is so selected that the total heat output, while the thermal switch assembly tube is submerged in water, is still insufficient to bring about an opening of the thermal switch.

However, upon subsequent reduction of water level in the sump, to a point below the thermal switch assembly, the increased heat output within the thermal switch assembly tube, will quicken the opening of the thermal switch, and thereby disconnect the motor much sooner than would otherwise be the case, were the operation of the system to depend solely upon the permanently connected heat resistor alone.

Once the switch is opened, the second heater resistor **29** is disconnected from the circuit, and the conditions prevailing at the start of the cycle are thereby restored. From this it will be apparent, that the purpose of the second heater is to raise the temperature of the thermal expansive liquid quite rapidly, following withdrawal of the cooling liquid from contact with the tube **21**.

Thus, aside from the protection to the pump motor, offered by the present invention, a savings in power is realized.

In one embodiment of the invention where it was desired that the permanently connected heater **27** prevent the thermal switch from closing at air temperatures down to as low as 30° F., a permanently connected heater of approximately 5 watts rating, functioned effectively. In such installation, it was not desired that the thermal switch open when the thermal switch assembly was submerged in water up to 120° F., and to satisfy this requirement, a supplemental or booster heater **29** having a rating of approximately 30 watts was employed. A thermal switch assembly, of course, would have to be selected, which would function as desired, in the temperature range between 30° F. in air and 120° F. with the heater elements submerged in water.

It will be apparent, however, that for other different temperature limitations, the values of the heaters will have to be altered accordingly. The values previously given as constituting one embodiment of the invention, have been offered by way of illustration only, and not as limitations on the present invention.

While I have illustrated one form of the invention in considerable detail, it will be apparent that the same is subject to alteration and modification without departing from the underlying principles involved, and I accordingly, do not desire to be limited in my protection to the specific details so illustrated and described, except as may be necessitated by the appended claims.

I claim:

1. A thermal switch assembly comprising thermally actuated switch means including heat responsive means and a switch of the normally closed type which is adapted to be opened in response to a rise in temperature of said heat responsive means, heating means within heat affecting range of said heat responsive means and adapted, in an atmospheric environment, of increasing the temperature of said heat responsive means sufficiently to open said switch and maintain it in its open condition during prevalence of such atmospheric environment, and adapted to close said switch from an open condition thereof when said heating means is exposed to a change in environment having heat conductively exceeding that of said atmospheric environment, sufficient to cool said heat responsive means below the switch opening temperature of said heat responsive means, and means, in response to such closing of said switch, for increasing the capacity of said heating means to a point still below the switch opening temperature of said heat responsive means while said heating means of increased capacity is exposed to such changed environment, whereby upon subsequently removing such changed environment and exposing said heating means of increased capacity to said initial atmospheric environment, said heating means of increased capacity will more rapidly restore said switch to its open condition.

2. A thermal switch assembly in accordance with claim **1**, characterized by said switch means including a normally closed microswitch and said heating means including an electrical resistance element and a housing therefor of heat conductive material.

3. A thermal switch assembly in accordance with claim **2** characterized by said means for increasing the capacity of said heating means including a paralleling electrical resistance element connectable in circuit by said microswitch when said microswitch is in its closed condition.

4. A thermal liquid level control system comprising a pump having an electrical motor drive coupled thereto; a thermal switch assembly including thermally actuated switch means involving heat responsive means and a normally closed switch adapted to be opened in response to a rise in temperature of said heat responsive means, heating means within heat affecting range of said heat responsive means, and adapted, in an atmospheric environment, to increase the temperature of said heat responsive means sufficiently to open said switch and maintain it in its open condition during prevalence of such atmospheric environment, and adapted to close said switch from an open condition thereof, when said heating means is exposed to a change in environment having a heat conductivity exceeding that of said atmospheric environment, sufficient to cool said heat responsive means below the switch opening temperature of said heat responsive means, and means in response to such closing of said switch, for increasing the capacity of said heating means to a point still below the switch opening temperature of said heat responsive means while said heating means of increased capacity is exposed to such changed environment whereby, upon subsequently removing such changed environment and exposing said heating means of increased capacity to said initial atmospheric environment, said heating means of increased capacity will more rapidly restore said switch to its open condition; means mounting said thermal switch assembly alongside said motor where it will be subject to immersion in liquid rising about said motor; and means electrically connecting said switch in the power supply circuit to said motor.

5. A thermal liquid level control system in accordance with claim **4**, characterized by said motor being mounted on said pump, a housing carried by said motor in overhanging relationship thereto with said thermal switch assembly depending from the overhanging portion of said housing.