Dec. 3, 1940. D. EISINGA 2,224,015

THERMOSTATIC SWITCH

Filed June 21, 1938

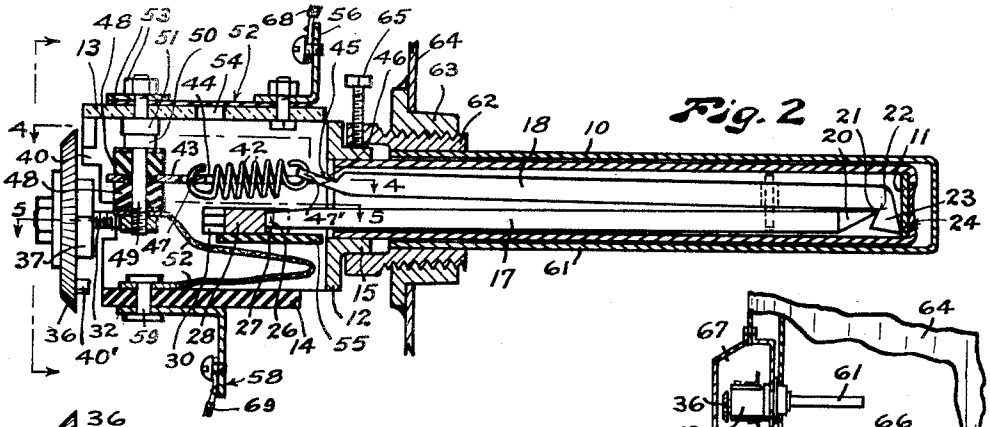

Fig. 2

Fig. 8

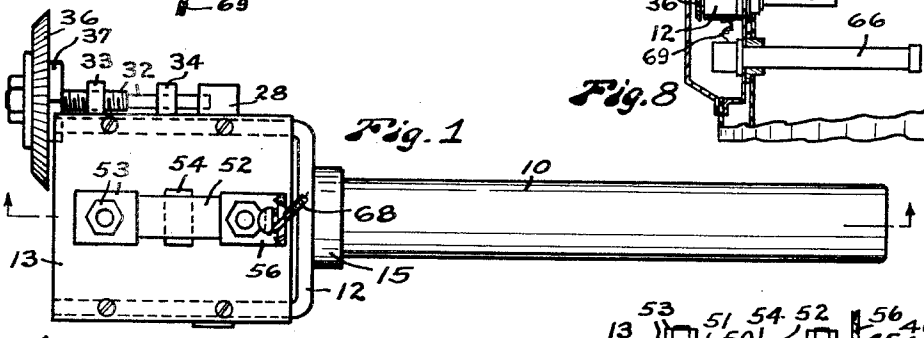

Fig. 1

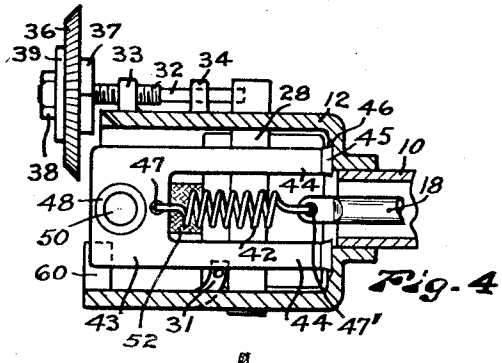

Fig. 4

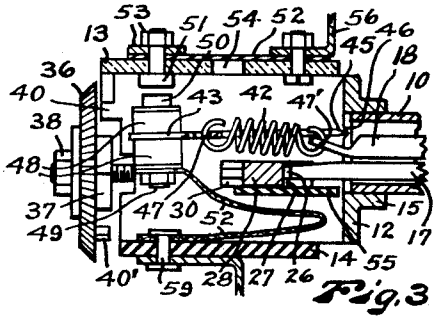

Fig. 3

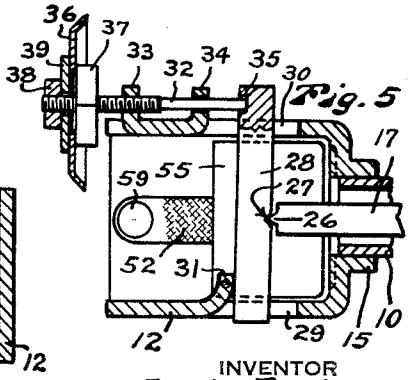

Fig. 5

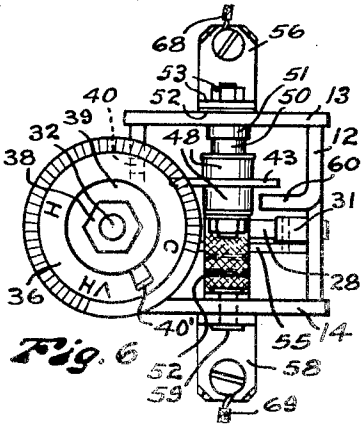

Fig. 6

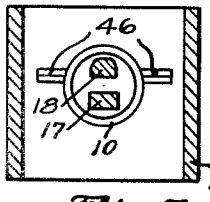

Fig. 7

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THERMOSTATIC SWITCH

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Application June 21, 1938, Serial No. 214,933

5 Claims. (Cl. 200—137)

My invention relates to thermostatic switches and my present invention is in the nature of an improvement on the thermostatic switch disclosed in my Patent No. 2,078,531, issued April 27, 1937.

A primary object of this invention is to simplify the construction of a thermostatic switch of this type, and render the same more efficient and reliable in operation.

Another object of the invention is to provide a thermostat having means by which it may be installed in a tank in such a manner as to be very quickly and easily removable from said tank for repair, adjustment, replacement and the like.

Another object is to provide an improved adjustable support for the end of a thrust rod embodied in the invention.

A further object is to provide a thermostatic switch of this nature having a fusible member combined therewith and interposed in the circuit controlled by said thermostatic switch, said fusible member being adapted to be melted by the heat of liquid in a tank connected with said thermostatic switch in case of an emergency in which the thermostatic switch fails to open the circuit when it should and the liquid in the tank is in danger of becoming overheated.

Other and more specific objects of the invention will be apparent from the following description taken in connection with the accompanying drawing.

Fig. 1 is a plan view of a thermostatic switch constructed in accordance with this invention.

Fig. 2 is a longitudinal section with parts in elevation substantially on broken line 2—2 of Fig. 1, showing the thermostatic switch installed in a tube within a tank, a fragment only of the tank being shown.

Fig. 3 is a fragmentary sectional view similar to Fig. 2, showing the switch mechanism in a different position from that shown in Fig. 2.

Fig. 4 is a sectional view with parts in plan, taken substantially on broken line 4—4 of Fig. 2.

Fig. 5 is a sectional view with parts in plan, taken substantially on broken line 5—5 of Fig. 2.

Fig. 6 is an end view taken substantially on broken line 6—6 of Fig. 2.

Fig. 7 is a sectional view taken substantially on broken line 7—7 of Fig. 2, parts being omitted.

Fig. 8 is a fragmentary small scale view illustrating an installation of this invention.

Like reference numerals designate like parts throughout the several views.

In the drawing 10 designates a tube formed of metal having a high coefficient of expansion. I prefer to make this tube of copper although obviously other metals or metal alloys may be used. The tube 10 is closed at one end by a hardened end member 11. The other end of said tube is open and is fixedly connected with a U shaped frame member 12 by securing it within a hub 15 on said U shaped frame member 12. Two plates 13 and 14 of insulating material are secured to opposite sides of the U shaped frame member and cooperate with said U shaped frame member to form an enclosure wherein certain operating devices are disposed. Preferably the upper insulating plate 13 is made of electrical insulating material having good heat conductive qualities, such as porcelain.

The thermostatic mechanism which cooperates with the tube 10 in providing the movement for operating the electric switch is in the nature of a metal rod 17 having a low coefficient of expansion and a lever arm 18 cooperating with said rod 17 and with the tube 10, which tube has a high coefficient of expansion. The rod 17 has a hardened bearing member 20 on one end thereof. The bearing member 20 has a knife edge 21 which bears against a recessed and hardened seat 22 in an angular portion 23 of the end of the lever arm 18 and forms a fulcrum on which the lever arm pivots. The tip 24 of the angular portion 23 rests against the hardened end 11 of the tube 10. This provides a relatively short lever arm 23 between the tip 24 and bearing seat 22 or fulcrum and a relatively long lever arm from the bearing seat 22 to the other end of the lever arm 18. The rod 17 and lever 18 both extend throughout substantially the entire length of the tube 10 and have their outer end portions positioned in the U shaped frame member 12. The forward end portions of the rod 17 and lever 18 are loosely connected together to prevent sidewise displacement thereof by a dowel pin 19 which is rigid with the bar 17 and fits loosely into a hole 29 in the lever 18. The pin 19 has a length only slightly less than the diameter of the tube 10 and serves as a means for preventing movement of the end portion of rod 17 transversely of the tube.

The end portion of the rod 17 which is positioned within the U shaped frame member 12 has a knife edge bearing 26 provided thereon which fits into a shallow V shaped recess 27 in a bar 28 which is positioned crosswise of the U shaped frame member 12 and extends through slots 29 and 30 in the side portions of said U shaped frame member 12. A support 31 for one end portion of the bar 28 is provided by leaving the

metal which is displaced in forming the slot 30 connected with the frame member 12 at one end and bending said metal inwardly, as shown in Figs. 4, 5 and 6. The other end portion of the bar 28 is supported by an adjusting screw 32 which is positioned externally of the frame member 12 in close proximity to one side of said frame member 12. The adjusting screw 32 has a threaded portion which is threaded through a lug 33 on the frame 12. The end portion of the adjusting screw 32 which supports the cross bar 28 is slidably guided in a fixed frame lug 34 and projects into a recess 35 in the cross bar 28. The adjusting screw 32 thus serves to prevent endwise movement of the cross bar 28.

The lug 31 provides a fixed fulcrum for the bar 28 inwardly from one side of the U shaped frame bracket 12 and the screw 32 is positioned outwardly from the other side of the U shaped frame bracket 12. The distance from the inner end of the screw 32 to the notch 27 which engages the knife edge 26 of rod member 17 is approximately twice as great as the distance between the notch 27 and the fixed fulcrum provided by the lug 31 and consequently a leverage is provided which relieves the adjusting screw of strain, makes it operate easily and provides a finer and more accurate adjustment for the rod member 17.

A dial member 36 is secured to the outer end portion of the adjusting screw 32. This dial member 36 is preferably tightly clamped between a fixed nut or flange 37 on the adjusting screw 32 and a nut 38 on the outer end portion of this screw. A washer 39 is preferably provided between the dial member 36 and the nut 38. Graduations are provided on the peripheral portion of the dial member 36 and a fixed reference line 40 is provided on the frame member 12 to which the graduations may be adjusted. For convenience I preferably bevel a portion 40' of the rear edge of the frame leaving a knife edge to serve as a reference line 40. Preferably a lug 41 is provided on the dial member 36 in a position so that it will engage with a portion of the fixed frame 12 and limit the angular movement of the dial member 36 and screw 32 to approximately one revolution. I find that this is all of the turning movement necessary to adjust the thermostat sufficiently to maintain water in a hot water tank at any desired heat. In assembling the thermostat the screw 32 will be adjusted to substantially the correct position for operation of the thermostat before the dial member 36 is placed thereon. When the dial 36 is then placed on the screw 32 the lug 41 will be positioned for engagement with the frame 12 and said dial may be adjusted into the correct angular position and the nut 38 applied and tightened to securely bind the dial 36 to the screw 32. The dial 36 may also be marked with letters such as "C," "H" and "VH" to indicate a setting for cold, hot and very hot water respectively. In dis-assembling the device the dial 36 is first removed and the adjusting screw 32 is then retracted to relieve the cross bar 28 of strain, after which the other parts of the device may be dis-assembled. The end portion of the lever arm 18 which is positioned in the frame member 12 is preferably cut away as shown and is connected with one end of a tension spring 42. The other end of the tension spring 42 is connected with a plate portion 43 of a switch lever. This switch lever has two spaced apart arms 44 between which the spring 42 is operatively disposed. The ends of the arms 44 remote from the plate 43 are provided with knife edge bearings 45 which seat within V shaped notches 46, see Figs. 4 and 7 in the frame member 12 on substantially diametrically opposite sides of the end portion of the tube 10.

The tension spring 42 exerts a pull on the plate 43. This places the arm members 44 under compression and presses the knife edges 45 against the frame 12. If the line of pull of the spring 42 coincides with the plane of the switch lever, that is, with the plane which passes through the fulcrum point 45—46 and through a point 47 from which the pull of the spring is exerted on the plate 43, then there will not be any tendency for the switch lever to pivot or swing in either direction. If the line of pull of the spring is shifted to either side of the above mentioned plane, then a component of the force exerted by the spring 42 will tend to angularly move the switch lever 43—44 in a direction toward the side of the plane of the switch lever to which the pull is exerted. It is thus apparent that by moving the end of the lever arm 18 to which the spring 42 is connected at point 47' it is possible to shift the line of pull of the spring 42 to either side of the plane passing through points 47 and 45—46 and thus move the switch lever with a quick snappy movement in either direction. Movement of the end of the lever arm 18 to which the spring 42 is connected is controlled by expansion and contraction of the tube 10.

As the pull of the spring 42 is exerted substantially longitudinally of the switch lever 44—45 and the lever arm 18, at all times, and is not exerted directly on other levers or parts, the tendency of said spring to deflect parts is substantially negligible.

Two tubular blocks 48 of insulating material are mounted on the switch plate 43 and have an electrical conductor member 49 extending therethrough. The upper end portion of conductor member 49 has a contact member 50 adapted to make electrical contact with another contact member 51 which is carried by the upper plate 13 of insulating material. The contact member 51 extends through the insulation plate 13 and is electrically connected with a conductor member 52 of heat fusible metal which preferably rests on the heat conductive insulating plate 13. Washer and nut means 53 are provided on the end of the conductor 52 in engagement with the fusible conductor member 52. The fusible conductor member 52 is preferably thin and flat and said member 52 extends across an opening 54 in the insulating plate 13 and has one end portion thereof positioned under an angular bracket 56 to which a suitable circuit wire 58 may be connected. The fusible conductor 52 is constructed of a metal alloy that will be softened and break apart when it is subjected to a predetermined temperature. Preferably this fuse will become sufficiently softened to part at from 190 degrees to 200 degrees Fahrenheit. When this fuse parts the parted portions thereof will hang down in the opening 54 and the circuit which is controlled by the thermostat will be broken. This fuse is an additional or emergency safety device which will melt out at the predetermined temperature and interrupt the circuit through the thermostat in the event the thermostat fails to operate normally and break the circuit as it should do.

A flexible electrical conductor member 57, which is preferably flat and formed of small flexible braided wires, connects the lower end portion of the conductor member 49 with an L

shaped terminal clip 58 on the lower insulation plate 14. This completes means for closing an electrical circuit between terminal clips 56 and 58 when contact members 50 and 51 are in electrical contact with each other. As conductor member 57 is very flexible and relatively long and arranged in substantially V shape it will flex very easily and will not retard or hamper the free movement of the switch lever 43—44. A rivet 59 may be used to connect conductor member 57 with L shaped clip 58. Circuit wires 68 and 69 respectively are connected with the terminal clips 56 and 58 and the circuit wire 69 is connected with an electric water heater 66, see Fig. 8.

The amount of angular movement of the switch lever in the direction required to close the switch is limited by engagement of the two contact members 50 and 51, while angular movement of said switch lever in the direction required to open the switch is limited by engagement of the plate member 43 with a shelf like portion 60 of the frame 12. A plate 55 of insulating material is positioned between the bar 28 and conductor member 57 as shown in Figs. 2 and 3.

To facilitate quick and easy installation of this thermostatic switch in a hot water tank and quick and easy removal of the same from the hot water tank I preferably provide a tube 61 which is closed at one end and has an externally threaded fitting 62 at the other end. The fitting 62 is adapted to be screwed into an internally threaded fitting 63 in the side of a hot water tank 64, a fragment of which is shown in Figs. 2 and 8. This tube 61 is water tight so that no leakage can occur therethrough. The tube 61 is just large enough in diameter to snugly receive therein the tube 10 of the thermostatic switch. The outer end portion of the fitting 62 is large enough to receive therein the hub 15 on the frame member 12 and a set screw 65 is threaded through the outer end portion of the fitting 62 to jam against the hub 15 and hold the thermostatic switch in place. The tube 61 will prevent the water in the tank 64 from coming into direct contact with the tube 10 of the thermostatic switch thus preventing danger of leakage of water into the thermostatic switch. The temperature of the water surrounding the tube 61 will be communicated quickly to the tube 10 and the responsiveness of the thermostat to changes in the temperature of the water will not be interfered with. Installing this thermostatic switch within the tube 61 makes it possible to quickly and easily withdraw the thermostatic switch for inspection, repair and the like without shutting off the water or draining the hot water tank, as obviously no opening will be left in the tank when the thermostatic switch is removed from the tube 61.

This thermostatic switch will usually be installed in a hot water tank in close proximity to and preferably just above an electric water heater 66 as shown in Fig. 8, and will control the flow of electric current to the water heater 66. When the water around the tubes 61 and 10 is cold the tube 10 will contract in length and will move the end of the lever arm 18 which is connected with the tension spring 42 upwardly. This will elevate the line of pull of the spring 42 on the switch plate 43—44 and hold the contact member 50 in electrical contact with the contact member 51 thus closing the switch and holding the same closed. As the water surrounding tubes 61 and 10 heats up the tube 10 will expand and elongate, and when a predetermined temperature is reached, depending on the adjustment of the screw 32, the line of pull of the spring 42 will pass below the plane of the knife edges 45 of the switch plate and the switch will be snapped open. The switch will always open and close with a quick snappy movement and arcing between the terminals will be reduced to a minimum.

It will be noted that the notches 46 which receive the knife edge bearings 45 of the switch plate are positioned a sufficient distance above the center of the tube 10, as shown in Figs. 2, 3 and 7, so that when the switch is in the closed position shown in Fig. 2, a straight line passing through the fulcrum point 22 and the point 47 of connection of the spring 42 with the switch plate will be below the point 47′ of connection of the end of the spring 42 with the lever arm 18. The pull of the spring 42 will always tend to pull point 47′ into alignment with point 47 and fulcrum 22 and when the switch is closed the tension of the spring 42 will always provide a component tending to move the end portion of the lever arm 18 at the location of point 47′ toward the rod 17 and toward the position in which it is shown in Fig. 3. This force is overcome by pressure against tip 24 when the tube 10 is contracted in length sufficiently to move the end portion of the arm 18 adjacent point 47′ upwardly far enough to move point 47′ across the line which passes through point 47 and knife edges 45 and by so doing snap the switch into closed position. The switch will ordinarily be positioned with the lever arm 18 above the rod 17 as shown in the drawing and when it is in this position gravity will help to move the end of the lever arm 18 adjacent point 47′ downwardly when the pressure against the tip 24 of said lever arm is released due to the heating up and elongating of tube 10. It will thus be seen that the pull of the spring 42 and the force of gravity both help to bring about the opening of the switch when pressure against the tip 24 is released. The bracket member 12 and parts carried thereby are positioned within a housing 67 which is provided on the side of the hot water tank. When the water surrounding the tubes 61 and 10 becomes hot the heat will be transmitted through the metal parts and porcelain plate 13 to the fusible conductor 57 and this conductor will become heated to a temperature within a few degrees of the temperature of the water in contact with the tube 61 and will not have much chance to cool off as there will not be much circulation of air in the housing 67. Consequently if this fusible conductor is adapted to melt at from one hundred ninety to two hundred degrees Fahrenheit and if for any reason the thermostat fails to open the switch at a lower temperature this fusible conductor will melt and break the circuit to electric heater 66 before the water in the tank gets hot enough to boil.

The foregoing description and accompanying drawing clearly disclose a preferred embodiment of my invention but it will be understood that this disclosure is merely illustrative and that changes may be made which are within the scope and spirit of the following claims.

I claim:

1. In apparatus of the class described, a thermostatic switch housing mounted on a hot water tank and subject to changes of temperature of the water in said tank; a plate of electrical insulating heat conductive material on said switch housing positioned to receive heat from the water in said tank where it will be maintained at substantially the same temperature as said water, said plate

having an opening therein; a conductor member positioned on said plate and extending across said opening and unsupported at the location of said opening and formed of heat fusible material having a melting temperature below the boiling temperature of water, whereby the heat transmitted by said plate to said fusible conductor member will fuse said conductor member and cause it to separate at the location of the unsupported portion thereof before the water in said tank reaches a boiling temperature; and a circuit controlling the temperature of the water in said hot water tank, said fusible conductor member forming a part of said circuit.

2. In apparatus of the class described, a thermostatic switch housing mounted on a hot water tank and subject to changes of temperature of the water in said tank; a plate of electrical insulating heat conductive material on said switch housing positioned to receive heat from the water in said tank whereby it will be maintained at substantially the same temperature as said water; a conductor member positioned on said plate and formed of heat fusible material having a melting temperature below the boiling temperature of water whereby the heat of said plate will fuse said conductor member and render it incapable of conducting current before the water in said tank reaches a coiling temperature; and a circuit controlling the temperature of the water in said tank and including said fusible conductor member.

3. A thermostatic switch of the class described comprising a tube having a closed end; a rod member disposed longitudinally within said tube, said tube having a higher coefficient of expansion than said rod member; a movable lever disposed longitudinally within said tube; said lever having a relatively short inclined arm rigid with one end thereof operatively fulcrumed on an end of said rod member and provided with a tip portion positioned in engagement with the end of said tube; frame means fixedly connected with the outer end portion of said tube; a bar extending crosswise of said frame means and forming a support for one end of said rod member; means rigid with the frame supporting one end portion of said bar; an adjusting screw adjustably supporting the other end portion of said bar; and switch devices in said frame means operatively connected with the end portion of said lever.

4. A thermostatic switch of the class described comprising a tube having a closed end; a rod member disposed longitudinally within said tube, said tube having a higher coefficient of expansion than said rod member; a movable lever disposed longitudinally within said tube, said lever having a relatively short inclined arm rigid with one end thereof operatively fulcrumed on an end of said rod member and provided with a tip portion positioned in engagement with the end of said tube; a U shaped frame bracket connected with the outer end portion of said tube and having slots in the walls thereof; a cross bar extending crosswise of said frame bracket through said slots and providing a rigid support for an end of said rod member; adjusting means positioned outside of said U shaped frame supporting one end of said cross bar; and switch means operatively connected with the end portion of said lever.

5. A thermostatic switch of the class described comprising a tube having a closed end; a rod member disposed longitudinally within said tube, said tube having a higher coefficient of expansion than said rod member; a movable lever disposed longitudinally within said tube, said lever having a relatively short inclined arm rigid with one end thereof operatively fulcrumed on an end of said rod member and provided with a tip portion positioned in engagement with the end of said tube; a U shaped frame bracket connected with the open end portion of said tube, said frame bracket having two slots in opposite sides thereof; an inwardly extending lug rigid with one side of said frame bracket; two spaced apart outwardly extending lugs rigid with the other side of said frame bracket; a cross bar extending crosswise of said frame bracket through said slots and fulcrumed on said inwardly extending lug; knife edge means on the end of said rod member bearing against said cross bar; an adjusting screw threaded through one of said spaced apart outwardly extending lugs and guided in the other one of spaced apart outwardly extending lugs; a recess in an end portion of said cross bar receiving the end portion of said adjusting screw, whereby longitudinal movement of said cross bar is prevented; a dial on the outer end of said adjusting screw; and electric switch means within said U shaped frame operatively connected with the end portion of said lever.

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