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OVERHEAT CONTROL SWITCH

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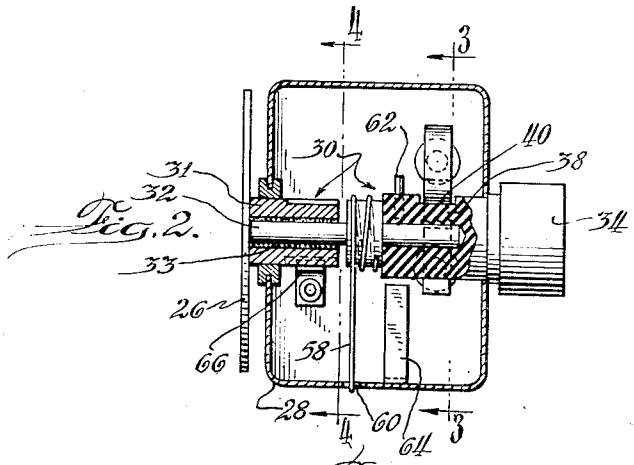


Fig. 2.

Fig. 1.

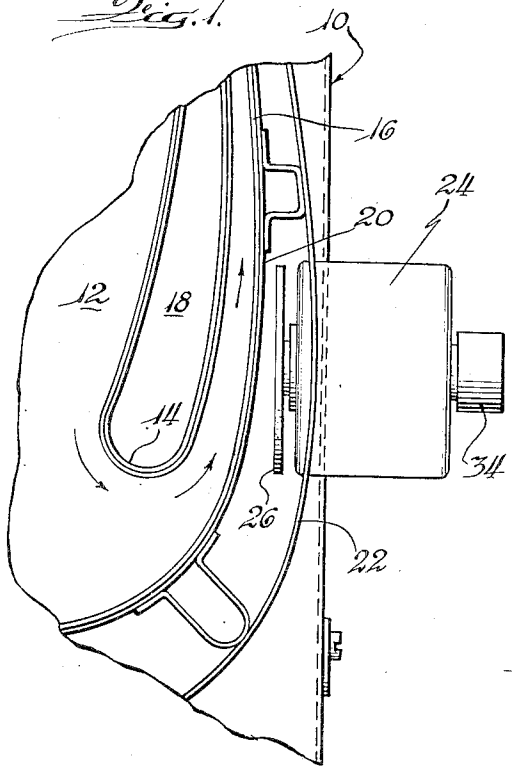


Fig. 3.

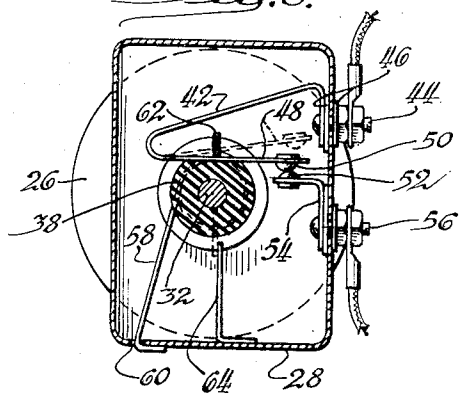
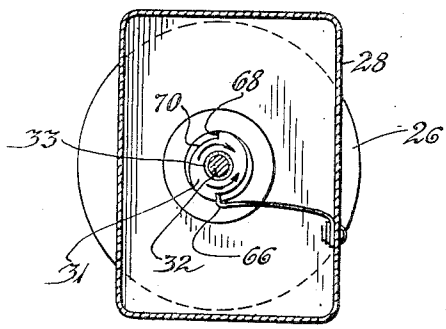


Fig. 4.



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OVERHEAT CONTROL SWITCH

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3 Claims. (Cl. 200—142)

The present invention relates to overheat control switches and is primarily concerned with switches of this type which, although they have a more general utility, are used primarily for turning off furnace or heater burners in the event that a condition arises which leads to overheating of the furnace or heater. This application is a division of our copending United States patent application Serial No. 684,350 filed July 17, 1946, for House Heaters.

It is a principal object of our invention to provide an overheat control switch or the like which can be manufactured at low cost, is safe and reliable in operation and which will respond extremely rapidly to overheat conditions.

Another object is to provide a novel overheat control switch or the like which will respond reliably and rapidly to conditions which cause overheating of the heat exchanger even when overheating is due to a cessation or a diminishing in the flow of ventilating air.

Yet another object is to provide a novel overheat control switch having the above characteristics and which will respond to an overheat condition and will thereafter prevent any attempts of the heater or furnace to restart until the control is manually reset.

Other objects and advantages will become apparent from the following description of a preferred embodiment of our invention which is disclosed in the accompanying drawings.

In the drawings, in which similar characters of reference refer to similar parts throughout the several used:

Fig. 1 is a somewhat diagrammatic representation of a portion of a heater with the overheat control comprising the present invention attached thereto;

Fig. 2 is a somewhat diagrammatic sectional view through the overheat control switch taken in a vertical plane in a position inside the case of the switch so as to disclose the operating mechanism. Portions of the mechanism are further broken away to the axis of rotation of the switch so as to show additional details of the construction;

Fig. 3 is a vertical sectional view transverse of the axis of the switch which may be considered as taken in the direction of the arrows along the line 3—3 of Fig. 2; and

Fig. 4 is a sectional view similar to Fig. 3 but taken in the direction of the arrows along the line 4—4 of Fig. 2.

It is customary in heating devices such as furnace or house heaters or the like to provide some form of overheat control to turn off the fuel supply to the heater in the event that an overheat condition arises. Most of these overheat control systems with which we are familiar respond to the temperature of the ventilating air and therefore are not quickly responsive in the event that the ventilating air for some reason ceases to flow. As an example, in a typical hot air heating system in which the ventilating air is circulated by a blower, if the blower fails in its operation and ventilating air therefore ceases to move, the heater or furnace will quickly overheat, and particularly so in those instances where the heat exchanger operates at high output per unit of area. The temperature of the metal of the heat exchanger, therefore, will rise rapidly. However, before the conventional overheat protecting system can respond to such condition it is necessary that the high temperature of the heat exchanger cause an increased temperature in

the ventilating air and that this temperature in turn be transferred to the overheat control. Since under such conditions the ventilating air will not be circulating, the rate of heat transfer from the heat exchanger to the overheat control will be slow, it being determined largely by the rate of heat transfer through the dead air space in the furnace jacket supplemented somewhat by convection currents. It is possible, therefore, for the heat exchanger metal to be seriously damaged by overheating before the unsafe condition is communicated to the overheat control. As will be explained more fully presently, the overheat control switch of the present invention largely eliminates this possibility because the temperature of the switch sensitive element will rapidly follow the temperature of the heat exchanger itself and particularly so under conditions where little or no ventilating air is flowing.

In Fig. 1 we have indicated a fragmentary portion of a furnace or heater by the numeral **10**. For the purpose of explaining the present invention, it is sufficient simply to indicate that hot products of combustion from a combustion space **12** pass around a hollow tubular baffle **14** and thence upwardly along the inner surface of a heat exchanger side wall **16** and thence to an exhaust. Ventilating air flows horizontally through this heater from end to end, passing through the space **18** in the hollow baffle **14** and against the outside surface **20** of the heat exchanger side wall **16**, it being confined by an outside jacket sheet **22**. Of course the furnace or heater may be of other construction, it being necessary for an understanding of the present invention only to assume that there is a heat exchange surface such as the sheet **20** which is heated by hot products of combustion on one side and cooled by ventilating air on the other side.

The switch of the present invention is indicated generally at **24** and is positioned in an opening in the jacket sheet **22** by means of a bracket or by welding such that its inner end formed as a circular target **26** is positioned within the space where ventilating air flows and a short distance from the surface of the heat exchange metal such as that indicated at **20** in Fig. 1.

By referring to Figs. 2, 3 and 4 it will be seen that a generally rectangular sheet metal case **28** of suitable construction is provided with openings at opposite sides so as to journal a rotating mechanism indicated generally by the numeral **30**. The rotating mechanism is made up of the previously referred to circular target **26** at one end which is secured directly to the end of a sleeve **31** mounted for rotation in a wall of the case **28**. This sleeve forms a loose fit with the end of a shaft **32** and is sweated thereto by soft solder **33**. At its opposite end this shaft is secured to a resetting knob **34** disposed on the opposite side of the case and having a cam providing neck **38** which extends into the interior of the case so as to provide a cylindrical portion therein. The cylindrical portion is shaped to provide a flat spot **40** which in one rotational position of the shaft **32** is uppermost and is in alignment with a leaf spring **42**. This leaf spring has one end secured to an electric terminal **44** passing through the side wall of the case and insulated therefrom by nonconducting washers **46**. The leaf spring as shown passes inwardly from the terminal to a position beyond the cylindrical neck **38** and thence is bent around so as to project backwardly in a generally horizontal position across the top of the neck **38**. It is bent so as to have a downward springing tendency bringing the horizontal portion **48** of the leaf spring against the cylindrical neck **38**. This portion is in alignment with the flat spot **40** so that throughout the major rotational position of the neck portion **38** the free end of the leaf spring which carries an electrical contact **50** is raised somewhat. However, when the knob **34** and neck **38** along with the stem **32** are rotated so as to bring the flat spot uppermost, the leaf spring rests against the flat spot and is thereby lowered so as to bring its contact **50** against a second contact **52**. This latter contact is secured to a bracket **54** connected in turn to a second binding post **56** which is similarly attached to the side wall of the case and insulated therefrom by appropriate insulating washers or other means.

A spring wire 58 is coiled around an enlargement of the shaft 32 formed adjacent the inner end portion of the neck 38 and has its opposite end secured through a small hole 60 in the case wall. This spring is so biased that it tends to rotate the knob in a counterclockwise direction as seen in Figs. 3 and 4. Rotation in this direction is limited by a pin 62 which projects radially from the inner end of the neck 38 being brought against a stop member 64 welded or otherwise suitably secured to the case. The relative orientation of the pin and stop member is such that when the spring 58 has brought the pin 62 against the stop member 64, the flat spot 40 is lowermost and therefore the horizontal portion 48 of the leaf spring 42 is lifted so as to separate contacts 50 and 52. Normally, rotation of the knob and attached mechanism under the influence of the spring 58 is prevented by a spring latch 66 one end of which is secured to the case wall. The free end of the latch engages against one or the other of two radial flat spots 68 at the ends of inwardly extending spiral camming surfaces 70 formed in the otherwise cylindrical outer surface of the sleeve 31. The two flat spot detents 68 are located 180 degrees apart so that the knob 34 and attached mechanism can be latched in either of two positions 180 degrees apart. The device operates in the following manner. The switch should be installed with the resetting knob accessible and so that the target is near the heated surface of the heat exchanger to be protected but out of contact therewith and the target should be in a space through which the ventilating air normally flows, such arrangement being shown in Fig. 1. Under these conditions the switch normally is not subjected to high temperatures and therefore has a long and trouble-free life.

Now if it is assumed that the knob 34 is rotated in a clockwise direction so as to bring one of the detent surfaces 68 against the end of the latch 66 with the pin 62 in the uppermost position, the device will stay with the parts in this relative location when the knob is released. There will be a tendency, however, in the spring 58 to rotate the knob 34 and attached mechanism in a counterclockwise direction as seen from the knob end. In this set position the flat spot 40 formed as a portion of the neck extension of the knob 34 is uppermost thereby permitting the contacts 50 and 52 to be brought together under the influence of the spring 42. A circuit is therefore established between the terminals 44 and 56 by way of the spring 42 and contacts 50 and 52, and these terminals may be inserted therefore in any suitable manner in a heater burner control circuit, such that current flow through the switch is essential to the operation of the burner system. As an example, the switch may be used in a simple series electrical circuit with a normally closed solenoid valve connected in the fuel supply line to the heater burner.

If it now is assumed that the circulating means for the ventilating air fails in its operation so that ventilating air ceases to flow through the heat exchanger, the temperature of the heat exchanger wall 20 rises rapidly thereby greatly increasing the rate of heat radiation from the heat exchanger surface to the target 26. In addition the stagnant ventilating air will not transfer heat from the target 26 at as high a rate as under normal operating conditions. The temperature of the target 26 therefore rises rapidly and heat is caused to be conducted to the sleeve 31 secured to the target and thence to the solder film 33. The result is that at some predetermined temperature, depending upon the melting point of the solder alloy selected, the solder will become fluid. The shaft 32 is thus released from restraint by the sleeve 31. The shaft 32 and knob 34 therefore rotate under the influence of the spring 58 until the stop pin 62 strikes against the stop member 64.

In this position a cylindrical portion of the neck 38 is brought against the lower surface of the contact carrying leaf spring member 42—48 thereby lifting the leaf and separating the contacts 50 and 52. This opens the circuit through the switch and puts the heater or furnace burner out of operation and prevents any possibility of it restarting. When the wall surface 20 of the heat exchanger cools, the target 26 will also cool until the film of solder 33 resolidifies thereby fixing the shaft 32 to the collar 31. During the period while the solder 33 is fluid it will remain in place because of capillary action.

After the malfunctioning cause has been corrected and it is desired to reset the switch, the knob is simply rotated in a clockwise direction so as to cause the end of the spring latch 66 to ride up the spiral camming surface 70 and drop into the next flat spot detent 68 whereupon the knob may be released. This again brings the flat spot 40 in the neck 38 uppermost and permits contacts 50 and 52 to reclose.

From the above it will be appreciated that the target 26 and sleeve 31 should preferably be formed of a material having a comparatively high rate of thermal conductivity since they form a heat path to the solder 33. It will also be appreciated that in the drawing for purposes of illustration the solder film 33 has been shown as being thicker than actually would be preferred in practice. The thickness of this film is not at all critical, it being necessary that the sleeve 31 merely be loose on the shaft 32 without there being so much space as to permit the solder to run out when melted.

From the above it will be appreciated that a switch of the type described has among other things the virtue of normally standing by a quite cool temperature and that further it is not required to be submerged in products of combustion which, with some fuels at least, are likely to be quite corrosive. It will be appreciated further that since the switch receives heat from the heat exchanger surface almost entirely by radiation, the rate of heat transfer will be greatly accelerated upon a rise in the heat exchanger temperature. Also under the most severe overheat condition, that is, one arising due to a total failure in the ventilating air supply, there will be very little cooling effect upon the target 26 by the ventilating air and therefore the speed of response of the switch will be even faster, whereas conventional overheat controls which depend upon the temperature of the ventilating air may be dangerously slow to respond under conditions where the air stops flowing completely.

Having described our invention, what we claim as new and useful and desire to secure by United States Letters Patent is:

1. An overheat control switch comprising circuit making and breaking means, a rotatable shaft, cam means fixed to and carried by said shaft and engageable with said circuit making and breaking means so that said cam means when rotated operates said circuit making and breaking means, stop means for limiting the rotational movement of said shaft and said cam means, resilient means connected to bias said shaft and said cam means toward said stop means, a rotatable heat conducting sleeve mounted on said shaft and annularly slightly spaced therefrom, means on said sleeve forming a detent, a thin layer of solder in the annular space between said shaft and said sleeve and connecting said sleeve to said shaft, a latch engageable with said detent, and a manually operable means carried by said shaft for rotating said shaft, said cam means, and said sleeve in a direction opposite to said bias from a position against said stop means to a second position where said detent is engaged and held by said latch.

2. An overheat control mechanism comprising a casing, a switch having a flexible member which in one position closes the switch and in a second position opens the switch, a heat conducting sleeve rotatably mounted in a wall of said casing, a rotatable shaft having one end projecting into said sleeve and annularly slightly spaced therefrom, a thin layer of solder in the annular space between said shaft and said sleeve and connecting said sleeve to said shaft, said sleeve having means thereon adapted to be exposed to the temperature conditions to be sensed so that a rise in such temperature to a predetermined point will melt said solder, a cam means and reset knob fixed to and carried by said shaft at its end opposite said sleeve, said cam means being in engagement with said flexible member of said switch so that said cam means upon rotation by said shaft will move said flexible member from said one position to said second position to open said switch, stop means for limiting the rotational movement of said shaft and said cam means, resilient means connected to said shaft to bias said shaft and said cam means toward said stop means, means on said rotatable sleeve forming at least a pair of detents, and a latch normally in engagement with one of said detents to hold said shaft and said cam means against rotation by said resilient means, whereby melting of said solder will permit said resilient means to rotate said shaft and said cam means relative to said sleeve to open said switch and subsequent solidification of said solder will condition the mechanism for resetting by rotation of said reset knob, said cam means, said shaft

and said sleeve against the force of said biasing means to engage a second of said detents with said latch.

3. An overheat control mechanism as claimed in claim 2 wherein one end of said rotatable sleeve projects from the casing, and said means on said sleeve adapted to be exposed to the temperature conditions to be sensed comprises a heat conducting target secured to said projecting end of said sleeve in heat conducting relationship therewith.

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