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2,641,668

THERMAL SWITCH

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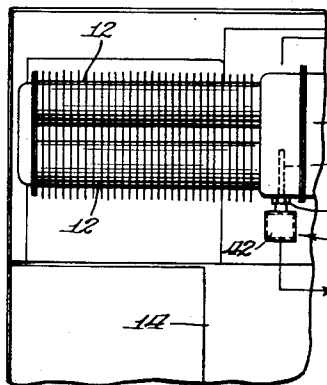


Fig. 1.

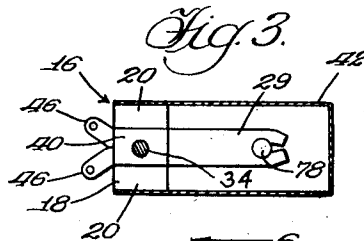


Fig. 3.

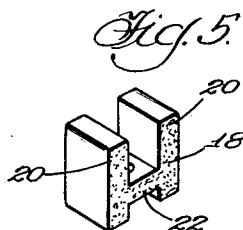


Fig. 5.

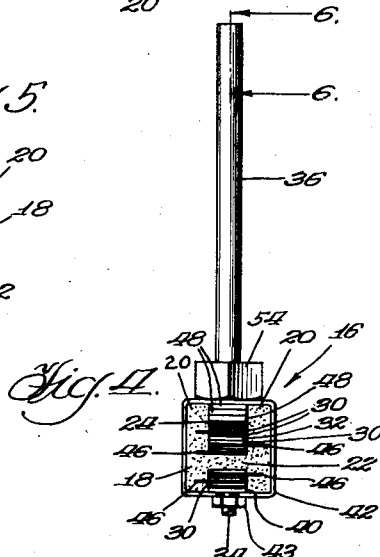


Fig. 4.

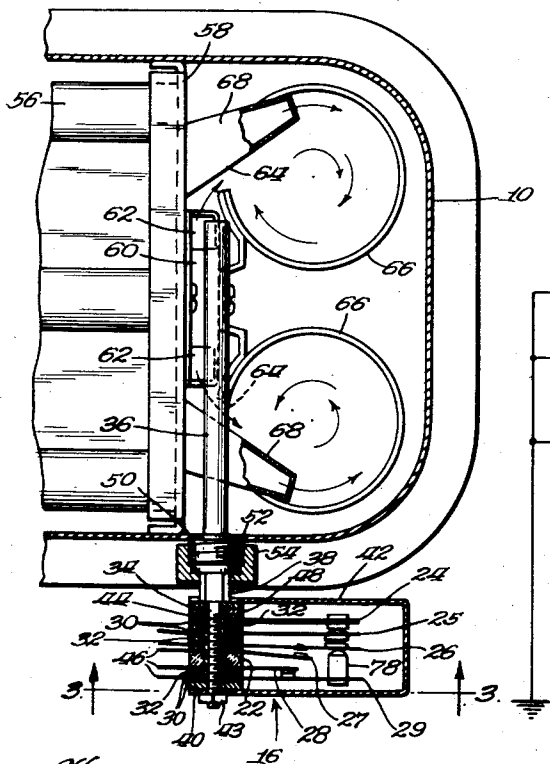


Fig. 2.

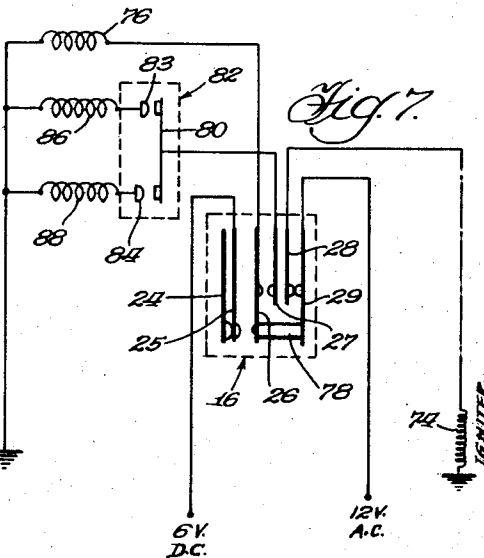


Fig. 7.

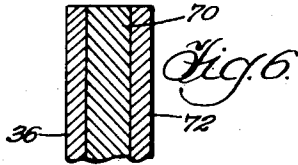


Fig. 6.

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THERMAL SWITCH

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9 Claims. (Cl. 200-138)

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This invention relates to heater control systems, and particularly to thermal switches for use in such systems.

In many heaters, particularly those of the combustion type, it is desirable that one or more thermal control switches be located close to a heat source so that they may respond very quickly to the presence or absence of heat at said source for automatically controlling the operation of the heater. Such switches must withstand intense heat over long periods of time without deteriorating, and in many instances they are required to be extremely compact because of the limited space available for mounting them. Where several heat-responsive switches serving different functions are required in the same control system, it is desirable that these switches have as many identical parts as possible for the most economical manufacture thereof.

An object of the present invention is to provide an improved thermal switch of economical design which satisfactorily meets all of the requirements mentioned above.

Another object is to provide a novel heat-responsive control switch having an insulating base of simple and rugged construction to which an arbitrarily arranged stack of spring contact members may be secured by simple fastening means.

Still another object is to provide an improved heater control switch that can be produced with simple manufacturing facilities.

A feature of the invention is the provision of a thermal switch having a ceramic base with flat parallel leg portions and a flat transverse portion extending between said leg portions, together with a stack of aligned leaf members having portions thereof disposed between the legs of the base and secured to the transverse portion thereof.

Another feature is the provision of novel fastening means for securing the stack to the switch base, such fastening means comprising a heat-conducting rod having a threaded portion which extends through the switch stack and the transverse part of the base. A bimetallic contact-actuating member in the stack is in heat-conducting relationship to the rod for actuating the contact members in the stack as the temperature of the rod varies.

Still another feature is the provision of a thermal switch that can be mounted in a very limited space closely adjacent to a heater, such switch comprising a heat-conducting rod which

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serves both to mount the switch on the heater casing and to conduct heat from a burner within the casing to the bimetallic actuating member of the switch, and an H-shaped ceramic base adapted to be secured to said rod and supporting a stack of aligned leaf members, one of which is a bimetallic actuating member and the others being contact members operated thereby. This assembly has the advantage that the leaf members can be arranged on the base to suit the convenience of the user.

The foregoing and other objects and features of the invention will be better understood from a study of the following description thereof taken in connection with the accompanying drawings, wherein:

Fig. 1 is a fragmentary, front elevational view of a heater assembly in which the present invention may be utilized;

Fig. 2 is a vertical sectional view on the line 2-2 in Fig. 1; showing a thermal switch embodying the invention mounted in association with the heater;

Fig. 3 is a sectional view of the switch taken on the line 3-3 in Fig. 2;

Fig. 4 is an end elevational view of the switch;

Fig. 5 is a perspective view of the switch base;

Fig. 6 is a fragmentary sectional view of the heat-conducting rod, taken on the line 6-6 in Fig. 4; and

Fig. 7 is a schematic diagram showing the manner in which the switch is associated with other parts of the heater control system.

In practicing the invention, the switch base is made of ceramic material and has an approximately H-shaped configuration. Leaf members consisting of resilient contact members and a bimetallic actuating member are stacked between the legs of the H on both sides of the transverse portion thereof. A heat-conducting rod having a threaded end portion extends through the stack and the transverse part of the base in heat-conducting relation to the bimetallic actuating member of the switch. This rod is provided with a mounting nut that cooperates with a nipple on the heater casing for securing the switch to this casing, with the rod extending into the flame zone of a burner within the casing. It also has a shoulder engageable with one side of the stack, and a nut is threaded on the rod on the other side of the stack for securing the stack to the transverse part of the switch base, with the legs of the base preventing the leaf members from turning with respect to the rod.

The heater chosen for illustration in Figs. 1 and 2 is a small household type of heater which may be similar to that disclosed and claimed in copending application Serial No. 52,169, filed October 1, 1948, in the name of Stanley J. Budlane, entitled "Heater" and assigned to the present assignee, and which is adapted to burn vaporized liquid fuel such as kerosene, although the principles of the invention may be applied to other heaters as well. The burner section of the heater is enclosed within a casing 10, and adjoining this casing 10 is a heat exchanger comprising finned ducts 12 through which combustion products pass to the exhaust duct (not shown) of the heater. Directly beneath the burner casing 10 is a compartment 14 in which a fan motor is housed.

Certain thermal control switches are associated with the heater to govern the operation thereof. Some of these switches are responsive to the presence or absence of combustion within the burner casing 10. A switch of this character, indicated generally by the reference numeral 16, is shown mounted on the underside of the burner casing 10, Figs. 1 and 2. The space in which this switch may be accommodated is extremely limited, necessitating a very compact switch construction. The switch is required to be very durable, particularly as regards its ability to withstand extreme heat and intermittent cooling. If more than one control switch of this character is employed in the heater control system, it is desirable that as many of the switch parts as possible be standardized so that they may be used interchangeably.

The switch 16 illustrated in Figs. 2, 3 and 4 satisfies the foregoing requirements and is of simple, economical construction. An important feature of this switch is the one-piece ceramic base 18 (shown in Fig. 5), which in the illustrated embodiment is H-shaped, although in some instances it may be preferred to make it U-shaped. The flat, parallel leg portions 20 and the transverse portion or crosspiece 22 of the base 18 define rectangular spaces for receiving a stack of aligned leaf members, including a bimetallic leaf member 24 and resilient contact members 25 to 29.

Referring to Fig. 2, the bimetallic member 24 and the contact members 25, 26 and 27 are disposed on the upper side of the transverse part 22 of the base 18, while the contact members 28 and 29 are disposed on the underside of the transverse part 22. All of the various leaf members just mentioned are located between the legs 20 of the base 18, as stated above. Small insulating sheets 30 and metallic spacers 32 of rectangular configuration are interspersed between the various leaf members in the stack. The entire stack is secured to the transverse part 22 by the threaded end portion 34 of a heat-conducting rod 36, Figs. 2 and 4. This threaded part 34 extends downwardly through the stack and through an aperture in the transverse part 22 and emerges from the bottom side of the stack. An integral shoulder portion 38 of the rod 36 engages the upper side of the stack. Near the lower end of the threaded portion 34 there is a rectangular nut 40, Figs. 2 and 3, which fits between the legs 20 of the base 18 and is threaded onto the part 34 to hold the switch stack in place.

Preferably, a shield can 42 of rectangular configuration encloses the extending parts of the various leaf members 24 to 29 and fits over the ceramic base 18, the can 42 being appropriately

slotted to clear the threaded part 34 and shoulder 38 of the rod 36. A hexagonal nut 43 is threaded onto the part 34 projecting beyond the can 42. When the nuts 40 and 43 are tightened, they secure the shield can 42 to the switch stack and secure the switch stack to the crosspiece 22 between the legs 20 of the ceramic base 18, with the various members of the stack being compressed between the shoulder 38 and the nut 40. Thus, the switch 16 is assembled in a very convenient manner.

The contact members 25 to 29 are insulated from each other by the insulating spacers 30, and they are insulated from the threaded part 34 by an insulating sleeve 44 on this part. The contact members may be stacked in any desired fashion on the base 18. Where a large number of contacts is employed, an H-shaped base as 18 is found most convenient to use. For a smaller number of contacts, a U-shaped base may serve satisfactorily. The parts of the contact members 25 to 29 which protrude rearwardly from the stack beyond the mouth of the shield can 42 are provided with soldering lugs 46, as shown. If desired, however, the soldering lugs 46 may be disposed on separate pieces mounted adjacent to the respective contact members. The lugs are staggered for convenience in soldering.

One or more spacers 48 may be interposed between the shoulder 38 of the rod 36 and the bimetallic leaf member 24. These spacers 48 afford a heat-conducting path from the shoulder 38 to the bimetallic member 24, so that the member 24 is approximately at the same temperature as the heat-conducting rod 36 of the switch. The rod 36 is adapted to extend through a mounting nipple 50, Fig. 2, on the burner casing 10. The rod 36 has an integral collar 52, adjoining the shoulder portion 38 thereon, and a mounting nut 54 is disposed on the shoulder portion 38. The nut 54 has an internally threaded sleeve which extends beyond the collar 52 and screws onto the nipple 50 for mounting the switch 16 on the burner casing 10. The major portion of the rod 36 extends into the interior of the casing 10.

The illustrated burner has a metallic vaporizer block 56 disposed within the casing 10. On the front plate 58 of this vaporizer block 56 there is mounted a baffle 60 which serves as a combustion chamber for the pilot burner of the heater. The pilot flame emerges through openings such as 62, Fig. 2, in the baffle 60 and is directed toward openings 64 in a pair of burner tubes 66 which serve as combustion chambers for the main burners of the heater. The main burner nozzles 68 extend from the front plate 58 through the openings 64 tangentially into the interior of the burner tube 66. Liquid fuel vaporized within the vaporizer block 56 is mixed with air therein to form combustible fuel and air mixtures which are fed to the pilot burner and the main burners. As the main burner fuel mixtures issue from the nozzles 68 into the tubes 66, they are ignited by the parts of the pilot flame that project through the openings 64. The combustion products then pass into the heat exchanger ducts as 12, Fig. 1, that are respectively aligned with the burner tubes 66.

The heat-conducting rod 36 of the switch 16 extends upwardly adjacent the baffle 60 so that portions of the pilot flame issuing from the openings 62 can play upon the rod 36. As shown in Fig. 6, the rod 36 has a core 70 of highly heat-conductive material, such as copper, and this core is surrounded by a sheath or jacket 72 of corrosion-resistant material which will withstand

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the heat of the pilot flame without deteriorating. As the rod 36 heats (or cools), the temperature of the bimetallic member 24 in the switch 16 likewise changes. This causes the contact members 25 to 29 to be actuated for automatically controlling certain functions of the heater operating system.

Fig. 7 illustrates the portion of the heater operating system which is controlled by the switch 16. When the heater is in a cold condition initially, and the main switch is turned on, a circuit is closed from a 12-volt alternating-current source through the switch contacts 28 and 29 to an igniter, represented by the coil 74. In the illustrated heater this igniter is of the fuel-burning type, and it provides an igniter flame that is projected through the openings 62 in the pilot burner baffle 60. As the igniter flame plays upon the rod 36, heat is transferred through the rod 36 to the bimetallic member 24, causing the latter to flex. Bimetallic member 24, as it flexes, causes the contact member 25 to engage the contact member 26, thereby closing a circuit from a 6-volt direct-current source to a solenoid 76 which operates a valve for admitting fuel to the pilot burner of the heater. A pilot flame is established as this fuel is ignited by the flame from the igniter. The bimetallic member 24 continues to flex and bends the contact member 26 to the right, as viewed in Fig. 7. The contact member 29 carries an insulating stud 78 which bears against the contact member 26. Therefore, as the bimetallic member bends the member 26, the contact member 29 also bends and becomes separated from the contact member 28. This interrupts the circuit to the igniter, which no longer is required to operate once the pilot flame is established.

The continued heating of the rod 36 and the consequent flexing of the bimetallic member 24 causes the contact member 26 to engage the contact member 27, thus preparing a circuit from the 6-volt direct-current source to the movable contactor 80 of a temperature-control switch 82, schematically represented in Fig. 7. The contactor 80 is actuated by a suitable temperature responsive device, such as a bellows (not shown) filled with a fluid having a high temperature coefficient of expansion. This device is located at any suitable point where it is exposed to the air that is being heated by the heater. If only a minimum heat is demanded, the contactor 80 remains disengaged from both of the stationary contacts 83 and 84. If the heat demand is moderate, the contact 80 engages the contact 83, closing a circuit to a solenoid 86 which operates a valve for admitting fuel to one of the main burners. If the heat demand is heavy, the contactor 80 advances until it engages both of the contacts 83 and 84, thus closing circuits to the solenoid 86 and another solenoid 88 that controls a valve for admitting fuel to the other main burner.

If combustion should fail within the heater, the flame rod 36 cools. The bimetallic member 24 thereupon cools also and resumes its normal position as shown in Fig. 7, successively opening the circuits to the main burner solenoids 86 and 88 and the pilot burner solenoid 76, and reestablishing the energizing circuit for the igniter 74. The above described cycle of operations then is repeated to bring the heater back into operation.

Hence, it will be seen that the thermal control switch 16 plays a vital part in the automatic operation of the heater. It is required to be dependable over long periods of service, and yet

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its cost must be kept sufficiently low (particularly in a small heater) so that it is not a substantial part of the total cost. The disclosed switch 16 is simple, cheap and rugged, has only a few parts and is of very small size. The form of the base 18 permits the contact pile to be arranged in a number of different ways. Thus, the same form of base may be used for different switches than are associated with the burner structure. Other advantages of the invention not specifically mentioned above may readily occur to those skilled in the art.

While there has been disclosed what is at present considered to be a preferred embodiment of the invention, it will be understood that various modifications thereof may be made within the true spirit and scope of the invention as defined in the appended claims.

I claim:

1. An electric switch of the thermal type comprising a one-piece ceramic base having two parallel leg portions and a transverse portion extending between said leg portions, a stack of aligned leaf members having portions thereof disposed between the leg portions of said base, at least one of said leaf members being a bimetallic heat-responsive member, and the other leaf members being resilient contact members arranged for actuation by said heat-responsive member as the temperature thereof varies, insulating members interspersed with the contact members in said stack, a heat-conducting rod extending through said stack and said transverse portion of said base, said bimetallic member being in heat-conductive relationship to said rod and moving in response to the heat derived therefrom, said rod having a shoulder portion disposed on one side of said stack and a threaded end portion protruding from the other side of said stack, and a nut threaded on said end portion for securing said stack to said transverse portion, with the leg portions of said base preventing said leaf members from turning relative to said rod.

2. An electric switch of the thermal type comprising a one-piece ceramic base having two flat parallel leg portions and a flat transverse portion extending between said leg portions, a stack of aligned leaf members having portions thereof disposed between the leg portions of said base, at least one of said leaf members being a bimetallic heat-responsive member and the other leaf members being resilient contact members arranged for actuation by said heat-responsive member as the temperature thereof varies, an elongated connecting member extending through said stack and through said transverse portion for securing said stack to said base, said connecting member being of heat-conducting material and being in heat-conductive relation to said bimetallic member to supply heat thereto for causing movement of said bimetallic member, and means in said stack electrically insulating said contact members from said connecting member and from each other.

3. An electric switch of the thermal type comprising a one-piece ceramic base having two flat parallel leg portions and a flat transverse portion extending between said leg portions, a stack of aligned leaf members having portions thereof disposed between the leg portions of said base, at least one of said leaf members being a bimetallic heat-responsive member, and the other leaf members being individual contact members arbitrarily arranged for actuation by said bimetallic member as the temperature thereof varies, spacers

interspersed with said contact members in said stack, a heat-conducting rod extending through said stack and through the transverse portion of said base, said bimetallic member being in heat-conductive relationship to said rod and moving in response to the heat derived therefrom, said rod having a shoulder portion disposed on one side of said stack and a threaded end portion protruding from the other side of said stack, and a nut threaded on said end portion for securing said stack to said transverse portion, with the leg portions of said base preventing said leaf members from turning relative to said rod.

4. An electric switch of the thermal type comprising an H-shaped ceramic base having two parallel leg portions and a transverse portion extending between said leg portions, a stack of aligned leaf members having portions thereof disposed between the leg portions of said base on both sides of said transverse portion thereof, at least one of said leaf members being a bimetallic heat-responsive member and the other leaf members being resilient contact members arranged for actuation by said heat-responsive member as the temperature thereof varies, an elongated connecting member extending through said stack in said transverse portion for securing said stack to said base, said connecting member being of heat-conductive material and being in heat-conductive relation to said bimetallic member to supply heat thereto for causing movement of said bimetallic member, and means in said stack electrically insulating said contact members from said connecting member and from each other.

5. An electric switch of the thermal type comprising an H-shaped ceramic base having two flat parallel leg portions and a flat transverse portion extending between said leg portions, a stack of aligned leaf members having portions thereof disposed between the leg portions of said base on both sides of said transverse portion thereof, at least one of said leaf members being a bimetallic heat-responsive member and the other leaf members being resilient contact members arranged for actuation by said bimetallic member as the temperature thereof varies, an elongated connecting member having a portion extending through said stack and said transverse portion for securing said stack to said base, said connecting member being of heat-conductive material and having an extending portion adapted to be positioned in heat-conductive relation to a heat source to transfer heat therefrom to said bimetallic member, and means in said stack electrically insulating said contact members from said connecting member and from each other.

6. An electric switch of the thermal type comprising a one-piece ceramic base having two flat parallel leg portions and a flat transverse portion extending between said leg portions, a stack of aligned leaf members having portions thereof disposed between the leg portions of said base, at least one of said leaf members being a bimetallic heat-responsive member and the other leaf members being resilient contact members arranged for actuation by said heat-responsive member, a heat-conducting rod having a shoulder portion disposed on one side of said stack and a threaded portion extending from said shoulder portion through said stack to the other side thereof, heat transfer means connecting said rod to said heat responsive member for transferring heat thereto for moving said heat responsive member to change the position of said contact members, a shield can enclosing said leaf members and fitted

on the exterior of said base, and screw-threaded means on the threaded portion of said rod for securing said stack and said can to said base.

7. A thermally operated electric switch responsive to the temperature within a casing having an operating portion positioned remote from the casing and a heat conducting portion extending into the casing, said switch including in combination a heat-conducting rod extending into said casing, a ceramic switch base having two parallel leg portions and a transverse portion extending between said leg portions, said transverse portion being aligned with said rod, a stack of aligned leaf members having portions thereof disposed between the leg portions of said base, at least one of said leaf members being a bimetallic heat-responsive member and the other leaf members being switch contact members arranged for actuation by said heat-responsive member, said rod having a reduced portion thereof extending through said stack and through said transverse portion, screw-threaded means on said rod for securing said stack to said base, and heat transfer means connecting said rod to said heat-responsive member so that said heat-responsive member moves to change the position of said contact members as the temperature in said casing varies.

8. A thermally operated electric switch responsive to the temperature within a casing having an operating portion positioned outside the casing and a heat conducting portion extending in the casing, said switch including in combination a heat conducting rod extending into said casing from the exterior thereof, means securing said rod to said casing, and switch means mounted on said rod including a one-piece ceramic base having a pair of flat parallel leg portions and a flat transverse portion extending between said leg portions, said transverse portion being aligned with said rod, a stack of aligned leaf members having portions thereof disposed between the leg portions of said base, said rod having a shoulder disposed on one side of said stack and a threaded portion extending through said stack and through the transverse portion of said base to the other side of said stack, and a nut on said threaded portion of said rod securing said stack and said base thereto, said stack including a bimetallic heat-responsive member in heat-conductive relation to said rod, and a plurality of switch contact members arranged for actuation by said bimetallic member as the temperature of said rod varies in accordance with the temperature within said casing.

9. A demountable thermal electric switch assembly adapted to be removably mounted as a unit on a liquid fuel burner adjacent the combustion portion of the latter in heat conducting relation therewith and adapted to operate in response to temperature changes in such combustion portion, said thermal electric switch assembly including in combination, a plurality of electric contact members having a mounting portion at one end of each and having contact means at the other end through which to make and break an electrical circuit, a heat responsive thermal member for actuating said contact members and having a mounting portion, a stud having a transverse shoulder portion and having said contact members and said thermal member mounted thereon at the mounting portions of said members with said members extending transversely of the direction of said stud, electrical insulating means separating each of said contact members and said thermal member from one another at

the mounting portions thereof, a head on said stud for maintaining said contact members and said thermal member and said insulating means in place on said stud with said thermal member in heat conducting relation with said transverse shoulder portion, and a threaded demountable mounting means on said stud for removably mounting the thermal electric switch assembly as a unit upon the combustion portion of the burner with said stud extending directly outwardly from the combustion portion and with said thermal member and contact members lying generally

parallel with the wall of the combustion portion so as to be compactly associated with said wall.

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