July 3, 1934. O. J. LEINS 1,964,954

BALL CONTACT SWITCH

Filed Jan. 11, 1932

Fig. 1.

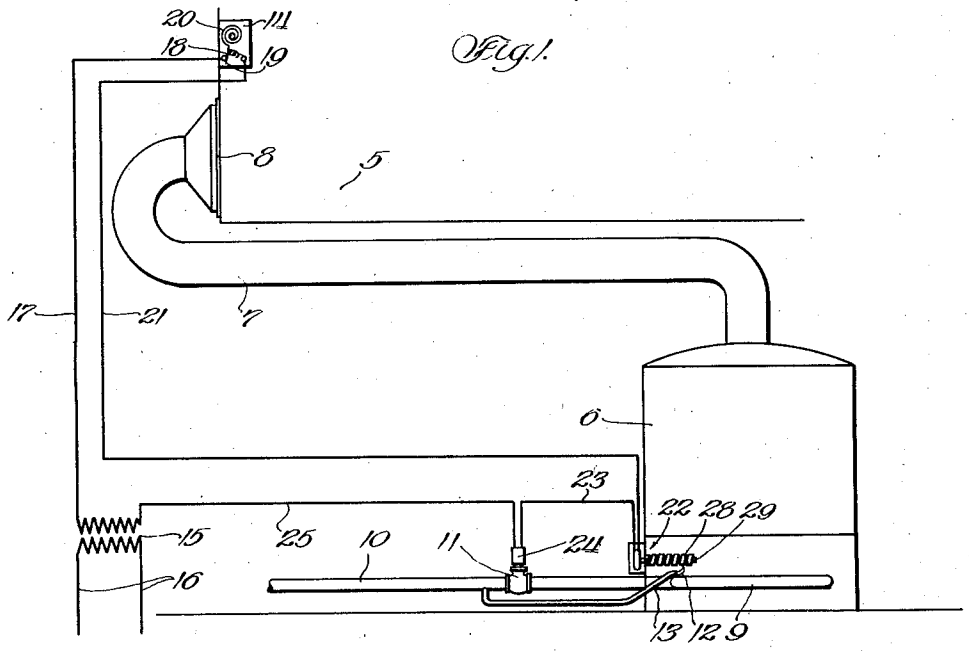


Fig. 2.

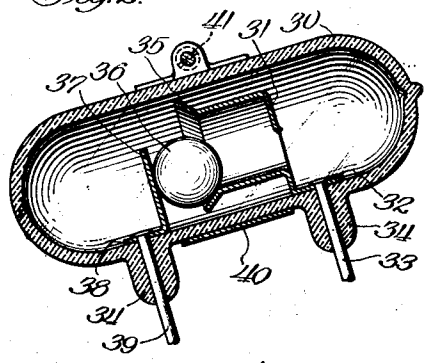


Fig. 3.

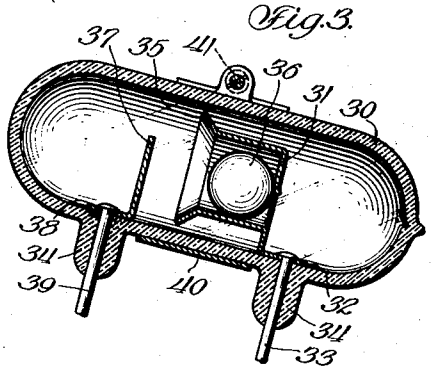
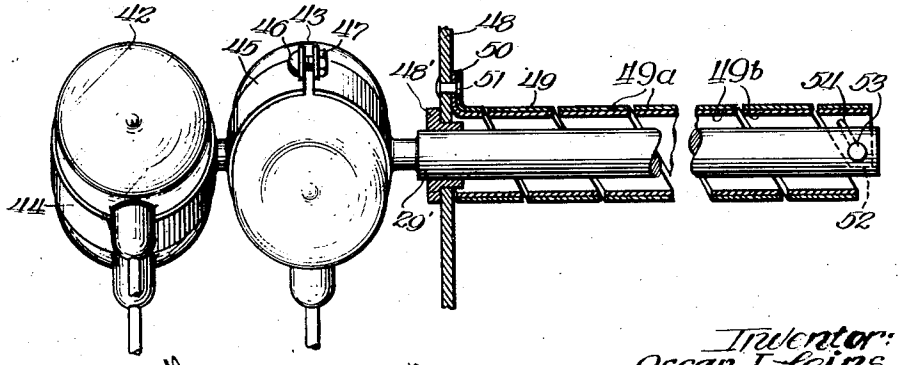


Fig. 4.



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BALL CONTACT SWITCH

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Application January 11, 1932, Serial No. 585,813

3 Claims. (Cl. 200—153)

This invention relates to switches, and more particularly to switches of the ball contact type which are adapted to be thermally operated.

The preferred form of the present invention is directed to a ball contact type of switch mounted in such a manner as to be rotated upon expansion or contraction of a thermally sensitive member, this rotation causing either opening or closing of the circuit controlled by the switch.

I prefer to employ my switch in connection with the control of heating devices for rooms, chambers, ovens and the like, but it is obvious that the switch may be used in any situation wherein a thermally responsive switching device is desired. For instance, the switch may be used for controlling a circuit in accordance with predetermined minimum or maximum temperature requirements. Also, I may employ my switch as a thermostat for automatically regulating the temperature within a given chamber or compartment.

The switch of the present invention preferably comprises a glass housing or shell, filled with an inert gas and sealed to prevent escape of the gas to the exterior of the shell. The switch may, of course, be of the vacuum type, but I preferably employ an inert gas or dielectric to prevent arcing at the switch contacts or terminals as the circuit is broken.

The contacting means of the present invention comprises, in a preferred embodiment, a metallic ball that is normally carried by and contacts with a metallic cup-shaped terminal member. Upon rotation of the switch, the ball contacting means is adapted to roll along the inner surface of the supporting cup-shaped terminal and engages a second terminal member spaced away from the first terminal for effecting closing of the circuit. The terminal members are connected, by suitable extending lugs, with an external circuit.

The switch housing is mounted upon one end of a shaft which is suitably supported for rotation, the other end of the shaft having secured thereto a helically extending thermally sensitive member adapted to rotate the shaft in accordance with temperature changes.

My invention further contemplates the provision of a plurality of ball contact switches mounted upon a single shaft, the switches being disposed in different angular positions. The common shaft is subjected to rotation in accordance with temperature changes. This provides a series of switches opening and closing a plurality of circuits at different intervals in response to variations in temperature.

The switch is of simple and compact design, and is readily mounted in position and connected into a circuit. In connection with this feature, I preferably provide means for adjusting the position of the shaft upon which the switch is mounted with respect to the thermally sensitive element, in accordance with the different ranges of temperature that may be desired for the operation of the switch.

Further features and advantages will appear from the following detailed description, which, taken in connection with the accompanying drawing, will disclose to those skilled in the art the construction and operation of a preferred form of my novel switch.

In the drawing:

Figure 1 is a diagrammatic view illustrating the invention as embodied in a control circuit for maintaining a desired temperature within a room;

Figure 2 is a sectional elevational view of my switch in closed position;

Figure 3 is a sectional elevational view, similar to Figure 2, showing the switch in open position; and

Figure 4 is an elevational view, partly in section, illustrating a modified construction wherein a plurality of switches are mounted upon a common operating shaft.

Referring now in more detail to the drawing, and more particularly to Figure 1, the reference numeral 5 indicates a room or chamber adapted to be heated by a hot air furnace 6, or any other suitable type of a heating device. A duct 7 is adapted to conduct the hot air to the room 5, and terminates in a suitable grille or register 8 positioned in the wall of the room near the floor, as is well known in the heating art.

The furnace or heating device 6 preferably receives its heat from a burner 9, this burner 9 preferably using gaseous fuel and receiving its supply through the supply pipe 10, control of the flow of fuel being obtained by a valve 11. This valve 11 is preferably of the solenoid type, and its purpose will be more fully explained later. It is contemplated, however, that any suitable type of valve or control device may be used.

The burner 9 is provided with a pilot flame 12, this pilot flame issuing from a pilot tube 13 which is tapped into the supply pipe 10, as shown. A suitable metering screw (not shown) is provided for the purpose of regulating the quantity of fuel flowing through the pilot tube 13.

A room thermostat, indicated at 14, is provided for the purpose of regulating the temperature

within the room 5. This room thermostat may be of the type disclosed in the copending application of Harold A. Mantz, Serial No. 548,088, filed July 1, 1931. However, any suitable type of room thermostat may be used for controlling the temperature within the room 5. This thermostat is connected into an electrical circuit leading from a transformer, indicated at 15, which is connected to a power supply line 16, or any other suitable electrical power supply. A conductor 17 leads from the transformer 15 to the room thermostat, and is connected by means of a suitable spring or the like, indicated at 18, to the thermally controlled contact arm 19 of the thermostat.

This arm 19 is adapted to contact with a suitable contact in the thermostat, upon movement of the thermally sensitive element 20, to provide an electrical connection to the conductor 21 leading to the ball contact switch or limit switch, indicated generally by the reference numeral 22, which is disposed within the furnace 6 above the pilot flame 12. From the ball contact switch, a conductor 23 leads to a suitable solenoid mechanism, indicated at 24, disposed above the valve 11 for controlling the opening and closing of this valve. A conductor 25 leads from the solenoid mechanism 24 back to the transformer 15, thus completing the circuit.

In the normal operation of this system, as long as the pilot flame 12 is burning, the limit switch 22 will be in closed position and the circuit will be controlled by movement of the arm 19 carried by the thermostat 14. When the arm 19 contacts a suitable contact within the thermostat for energizing the conductor 21, current will flow through the limit switch 22 and will actuate the solenoid mechanism 24 for opening the valve 11. This opening of the valve 11 will permit fuel to flow from the supply line 10 to the burner 9, and will cause heating of the furnace 6 when the burner 9 is ignited by the pilot flame. Upon heating of this furnace, the hot air will rise through the conduit or duct 7 and will enter the room through the grille 8. When the room temperature reaches the desired temperature, the thermostat 14 will function to force the arm 19 out of contact, and will thus break the circuit. When the circuit is broken, the solenoid mechanism 24 becomes inoperative, and the valve 11 closes, thus shutting off the fuel supply to the burner 9. This condition is maintained until the temperature within the room 5 drops to a point below that desired, at which time the thermostat 14 will again actuate the contact arm 19 to close the circuit and reopen the valve 11. This is a typical control system, and needs no further explanation.

The limit switch 22 will remain in closed position as long as the pilot light 12 is burning. However, if the pilot light 12 should become accidentally extinguished, the lack of heat supplied by this pilot light will cause the thermometallic coil 28 to contract, this contraction causing the rod or shaft 29 to rotate. This rotation causes the switch 22 to open the circuit, thus positively closing the valve 11, and permitting no flow of fuel to the burner 9 until the pilot light has again been reignited. Thus the limit switch 22 will serve as a safeguard for preventing flow of unignited fuel from the burner 9 into the surrounding atmosphere.

This limit switch, or control switch, is shown more in detail in Figures 2 and 3, and comprises a glass housing or shell 30, which is substantially an elongated tube filled with an inert gas or other suitable dielectric, and which is sealed to the outside atmosphere by any well known process.

Disposed within the housing 30 is a suitable cup-shaped terminal member 31, which has a depending flanged portion 32 engaging the inner surface of the housing 30. This flanged portion 32 is provided with a suitable aperture for receiving a lug or terminal member 33 to secure the cup-shaped element 31 in position. The lug 33 passes through the housing or shell 30 and is suitably secured and sealed therein by means of the molded portion 34 of the shell. The lug 33 is provided with any suitable means for connecting it to one side of an electrical circuit. The cup-shaped element 31 is provided with an outwardly flared portion 35, and contains a metallic contact ball 36 which is adapted to be carried within the cup-shaped element when the switch is in its off position, as illustrated in Figure 3.

Referring now to Figure 2, which shows the switch in closed position, the ball 36 rolls outwardly along the interior surface of the cup-shaped terminal 31, and engages a second terminal member 37, which is provided with a flanged portion 38, engaged by a suitable terminal or lug member 39 for securing an electrical contact between the terminal member 37 and an exterior electrical circuit. The terminal member 39 is secured and sealed in the housing 30 by means of a molded portion of the housing, indicated by the numeral 34, and corresponding to the molded part of the housing securing the lug member 33 in position. The ball 36 is adapted to drop into a depressed position, since the center of the ball passes beyond the cylindrical portion of the member 31 before the ball contacts with the terminal member 37. This provides a wedging action which assures that the ball will form a good electrical contact between the terminal 31 and the terminal 37.

A suitable split supporting ring, or band 40, is placed about the center portion of the housing 30 and serves to secure the housing upon the rotatable shaft 29. The two adjacent ends of this band, or mounting, are provided with upwardly turned tongue portions, and are adapted to receive a screw member 41 for securing the band in tight engagement with the housing 30 to prevent rotation of the housing within the band. The shaft 29 extends in a plane normal to the longitudinal axis of the switch 22, and is suitably mounted so that it may be rotated freely by means of the expansion and contraction of the thermally sensitive element 28.

This thermally sensitive element 28 preferably comprises a helical bi-metallic strip, composed of two metals having different coefficients of expansion, the two strips being securely joined together to provide a warping action with changes in temperature. One end of the bi-metallic strip is suitably secured to the projecting end of the shaft 29. The other end of the bi-metallic strip or thermally sensitive member 28 is locked in position upon the structural portion of the furnace 6 so that the action of this member 28 will serve to rotate the shaft 29, and thus will either close or open the circuit controlled by the terminal members 31 and 37, depending upon whether the temperature is increasing or decreasing.

The embodiment disclosed in Figure 4 illustrates a modified type of switching means, wherein the shaft 29' controls a plurality of switches,

such as switches 42 and 43. These switches 42 and 43 are mounted upon the shaft by means of the bands 44 and 45, and, as shown, are positioned in different angular positions with respect to the axis of the shaft. Each switch is securely held within its band by means of the bolt 46 and nut 47, which urge the bands into tight frictional engagement with the surface of the switches.

These switches are of the same type as the switch shown in Figures 2 and 3, and are provided with the projecting terminal members for connection to an exterior circuit.

The operating shaft 29' passes through a suitable opening formed in a supporting wall or other suitable frame 48, and projects inwardly therefrom. A suitable bushing 48' serves to support the shaft for rotation.

A suitable thermally sensitive member, indicated by the numeral 49, similar to the member 28, and composed of an inner metallic strip 49^b and an outer metallic strip 49^a, the two strips being securely held together and having different coefficients of thermal expansion, is provided with a radially projecting flanged portion 50 adapted to be secured to the inner surface of the wall or frame member 48, as by means of a rivet 51. The member 49 is helically coiled about the shaft 29', and has its end 52 secured to the shaft by means of a screw 53 threading into the projecting end portion of the shaft 29'. The end 52 of the member 49 is provided with a slot 54, this slot providing said adjustment of the shaft 29' with respect to the member 49.

By means of this arrangement, the shaft 29' can be positioned in a plurality of angular positions with respect to the thermally sensitive member 49, these different positions causing the switches 42 and 43 to operate under different thermometric conditions.

It is thus apparent that, by providing a plurality of switches upon a single operating shaft, various circuits may be opened and closed at different points in the thermometric scale, and thus various appliances for heating, or for controlling various processes that may be governed by temperature variations, may be successively controlled in this manner.

The switch of the present invention is of simple form, and has only the one moving part, which is the ball 36. There is no possibility of sparking, or arcing at the terminals, due to the switch terminals being enclosed in a housing filled with inert gas.

I do not intend to be limited to the exact details shown and described in the preferred embodiment of the switch as illustrated, but only insofar as defined by the scope and spirit of the appended claims.

I claim:

1. A switch of the class described comprising a sealed rotatable housing, a pair of terminals secured in said housing, one of said terminals comprising a cup-shaped member having a defining outwardly flared lip portion, the other of said terminals comprising a member spaced from said lip portion and extending normal to the axis of said first terminal, and ball contact means of less diameter than said cup-shaped terminal disposed therein and having its center disposed below said flared lip portion when said switch is in open position, said contact means rolling outwardly along the inner surface of said cup-shaped terminal upon rotation of said housing toward switch-closing position and having accelerated movement after passing onto the surface of said flared lip portion to drop into wedging engagement with said other terminal.

2. A switch of the class described comprising a sealed rotatable housing, a pair of terminals secured in said housing, one of said terminals comprising a cup-shaped member having a defining outwardly flared lip portion, the other of said terminals comprising a member spaced from said flared lip portion and extending normal to the axis of said first terminal, and ball contact means of less diameter than said cup-shaped terminal disposed therein and having its center disposed below said flared lip portion when said switch is in open position, said contact means being wedged between said other terminal and said flared lip portion in switch-closed position of said housing, said flared lip portion providing for movement of said contact means away from said other terminal only after substantial rotation of said housing toward switch open position.

3. In combination, a tiltable housing, a first terminal mounted in said housing and comprising a cup-shaped member having a generally cylindrical wall with a stop at one end and an outwardly flared lip at the opposite end, a second terminal spaced from the flared lip of said first terminal, and a ball contact member disposed in said cup-shaped housing and movable into and out of engagement with said second terminal, said ball contact member rolling upon the cylindrical wall and upon the flared lip of said cup-shaped member in different portions of its movement between said second terminal and the stop at one end of said cup-shaped member upon tilting of said housing.

OSCAR J. LEINS.