

May 23, 1939.

I. E. McCABE  
ELECTRIC SWITCH

2,159,392

Filed Aug. 5, 1936

2 Sheets-Sheet 1

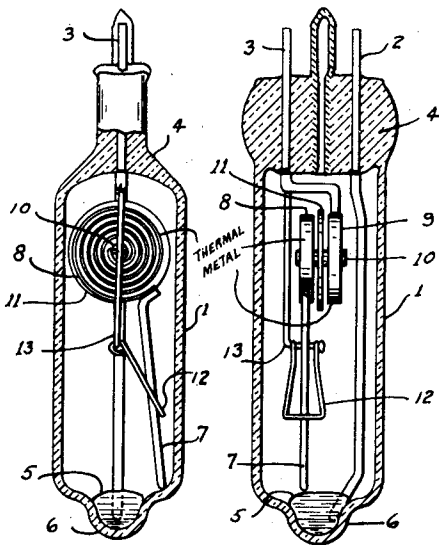


Fig. 1

Fig. 2

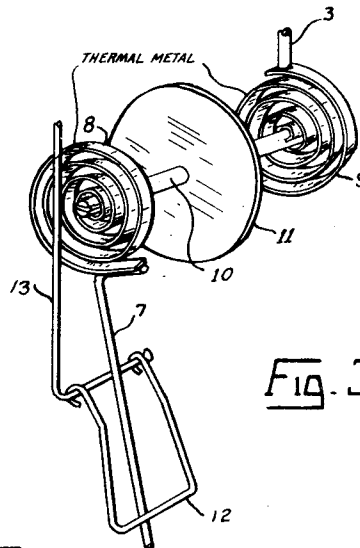


Fig. 3

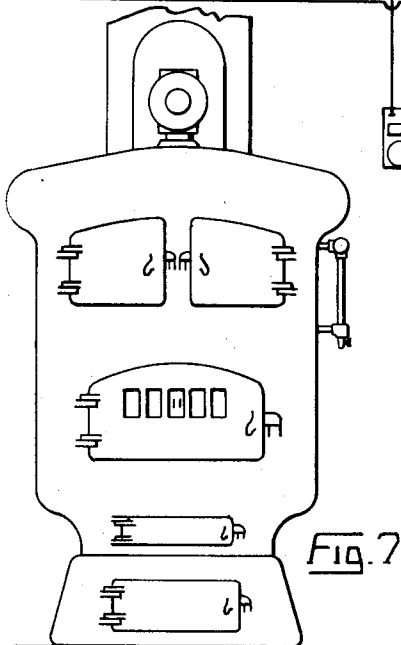
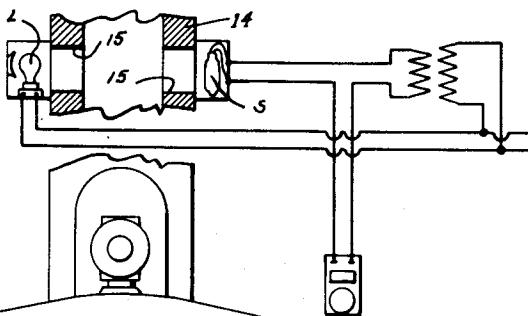


Fig. 7

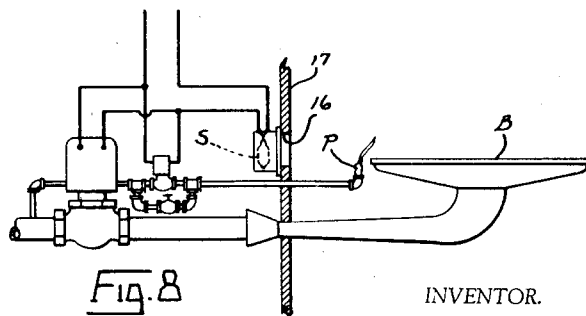


Fig. 8

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2 Sheets-Sheet 2

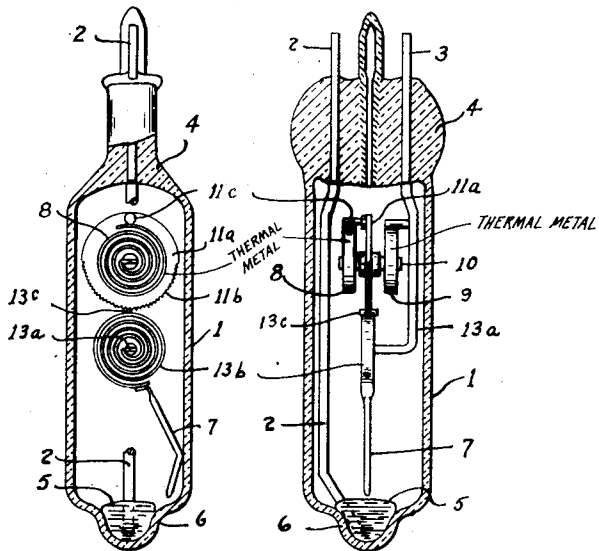


Fig. 4

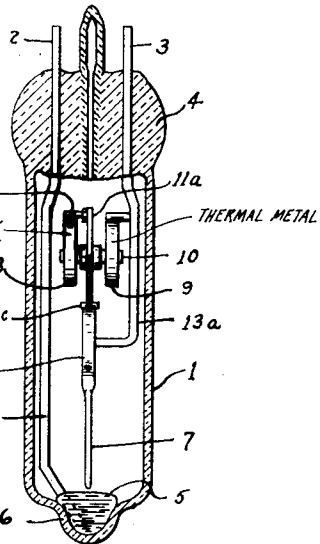


Fig. 5

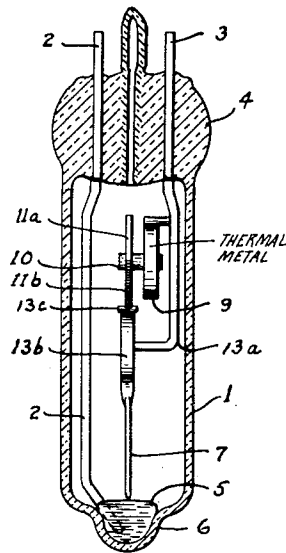


Fig. 6

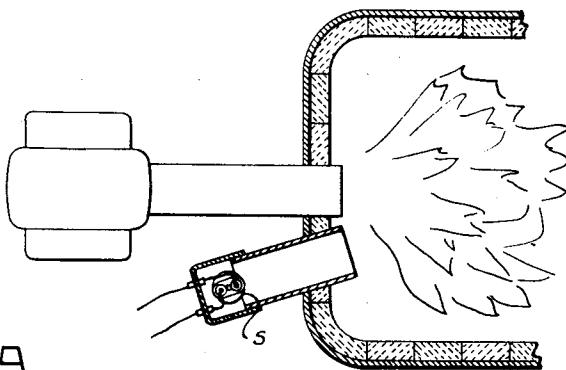


Fig. 9

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## UNITED STATES PATENT OFFICE

2,159,392

## ELECTRIC SWITCH

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Application August 5, 1936, Serial No. 94,352

6 Claims. (Cl. 200—138)

This invention relates to improvements in electric switches, and more particularly to a switch so constructed that, while unaffected by changes in ambient temperature, it is responsive to the action of radiant energy emanating from a side thereof to open or close, as the case may be.

It is an object of this invention to provide a switch of the character described of such a sensitive nature as to be operable by the presence or absence of light. A switch of this character may be substituted in many uses now employing a selenium cell or photoelectric cell, especially in those where speedy or frequent operation is neither necessary nor desirable. It may be employed to indicate smoke conditions arising from improper combustion within a furnace, as well as a part of the safety controls for fluid fuel burners.

With these and other objects in view, reference is made to the accompanying sheets of drawings which illustrate preferred forms of this invention, with the understanding that minor changes may be made without departing from the scope thereof.

In the drawings:

Figure 1 is a view in side elevation of an embodiment of this invention, with parts broken away, and partly in section.

Figure 2 is a view in transverse vertical section of Figure 1, with the operating parts shown in front elevation.

Figure 3 is an enlarged detail view in perspective of the operating parts, removed.

Figures 4 and 5 are views similar to Figures 1 and 2 of a modified form of this invention.

Figure 6 is a view similar to Figure 5 of another form of this invention.

Figure 7 illustrates an application of this invention to indicate smoke conditions, showing a furnace in front elevation, the chimney thereof in section and a schematic wiring diagram of an electric alarm actuated by a switch constructed in accordance with this invention.

Figure 8 illustrates an application of this invention to a gas burning furnace, showing the combustion chamber thereof in transverse vertical section, with the gas burner and parts thereof in elevation and a schematic wiring diagram of the electric controls including this improved switch.

Figure 9 illustrates an application of this invention to an oil burning furnace, showing the combustion chamber thereof in transverse horizontal section, the oil burner attached thereto

in top plan and the mounting of this improved switch in transverse horizontal section.

As illustrated, this invention is embodied within a mercury tube switch including the tubular container 1, preferably of glass, with two electrodes 2 and 3 sealed within and extending beyond one end seal 4 containing a body of mercury 5, through which the circuit between the two electrodes is opened and closed, all of which is the usual construction of this type of switch. In accordance with this invention, the axis of the tubular container is maintained vertical with the exterior ends of the electrodes (or lead-in wires, as they are called) projecting through the upper end for connection in the circuit and the lower end is preferably provided with a cup-like depression 6 to contain the mercury 5. The electrode 2 is extended parallel to the wall of the container 1 with its lower end terminating within the mercury 5 and the electrode 3 is provided with a member 7 movably carried thereon and adapted to bring its free end into and out of contact with the mercury to close and open the circuit through the electrodes 2 and 3.

In carrying out this invention, as shown in Figures 1, 2 and 3, two coils of thermal metal 8 and 9 are mounted with their interior ends secured to the opposite ends of a common shaft 10 which also mounts centrally thereon a disc 11, preferably of greater diameter than said coils.

To the outer end of the coil 8 and to one side of the vertical center is secured the upper end of the electrode member 7 so that member will normally depend therefrom. The outer end of the other coil 9 is secured upon its upper side upon the electrode 3 which is bent as it passes through the end seal 4 parallel thereto and then parallel to the electrode 2 in such a manner as to support the shaft 10 through the coil 9 with the disc 11 in the axis of the container 1 and the free end of the member 7 normally out of contact with the mercury 5.

The thermal metal is sufficiently sensitive to temperature changes to cause the coils 8 and 9 to expand or contract in response to the presence or absence of the heat of radiant energy. By employing two similar coils mounted as shown upon the common shaft with one coil secured to the electrode 3 and the other carrying the electrode member 7, the coils 8 and 9 will rotate in opposite directions upon changes in ambient temperature and the normal relation of the free end of the electrode member 7 and the mercury 5 will remain unchanged.

The disc 11 may be of any material desired,

although preferably of metal, to act as a shield for one of the coils, so that when the switch is interposed in the path of rays of light with the disc 11 shielding the far coil, the temperature of the near coil will respond to the heat thereof and operate the switch. If desired the disc 11, when of metal, may be polished on one side to reflect the rays upon the near coil.

Of course in practice the switch must be so mounted that the rays of light will fall upon but one coil, to establish the differential in temperatures between the coils to operate the switch. Likewise, the container may be of such substance as will absorb certain light rays, if it is desired to cause the switch to operate only in response to certain unabsorbed rays, or screens of such material may be employed, as disclosed in the applicant's prior Patent No. 1,733,615, of October 29, 1929.

As this construction is relatively delicate, external vibration may be so transmitted to the switch as to impart a vibration to the electrode member 7 carried thereby during such movement until its free end is entirely submerged within the mercury. To dampen such vibration, it is preferable to provide a U-shaped member 12 which is mounted preferably upon a bracket 13 depending vertically from the electrode 3 as it enters the container 1 by pivoting the free ends of the member 12 thereon with the bottom section of the U resting upon the opposite side of the member 7.

Figures 4 and 5 illustrate a modified form of this invention in which the parts 1 to 10 are constructed substantially the same as in Figures 1 and 2. In this form, however, the disc 11<sup>a</sup> is rotatably mounted upon the shaft 10 common to the coils 8 and 9 of thermal metal, the lower half of its circumference 11<sup>b</sup> is serrated and midway the non-serrated portion is provided with a stud 11<sup>c</sup> extending over and secured to the free end of the coil 8, whereby expansion or contraction of said coil imparts a rotation to the disc 11<sup>a</sup> about the shaft 10.

The movable member electrode 7 in this instance is mounted upon the outer convolution of a coil spring 13<sup>b</sup>, the inner end of which is secured to the end of the bracket 13<sup>a</sup> depending from the electrode 3 and forming a part thereof. The diameter of the coil spring is such that its outer convolution will normally have a sliding contact with the serrated portion of the rotatable disc 11<sup>a</sup>. A tooth 13<sup>c</sup> is mounted upon the outer convolution of spring 13<sup>b</sup> adapted to be engaged between the teeth of the serrated portion 11<sup>b</sup> of the rotatable disc 11<sup>a</sup> so that as the said disc is caused to oscillate by the presence or absence of radiant energy the tooth 13<sup>c</sup> will be carried over the center line between shaft 10 and the end of bracket 13<sup>a</sup> to move the movable electrode 7 into or out of contact with the mercury 5 and allow a continued movement of the disc 11<sup>a</sup> in the same direction without damage to the parts as the serrated portion 11<sup>b</sup> will wipe over the tooth 13<sup>c</sup> and yet reverse movement of the disc 11<sup>a</sup> will be imparted to the movable electrode.

This form possesses all of the advantages of the first form and the inclusion of the coil spring in the operating parts not only obviates vibration of the movable electrode 7, but prevents damage or strain on the parts by allowing the over-run after the switch has been operated.

The form illustrated in Figure 6 is designed to take advantage of the latter advantageous

construction without the feature of compensating for changes in ambient temperature. In this modification, the disc 11<sup>a</sup> is secured upon the shaft 10 and the coil 8 is omitted.

Three different applications or uses of this improved switch are illustrated in Figures 7, 8 and 9.

In Figure 7, the chimney 14 of the furnace is provided with oppositely aligned openings 15. An electric lamp bulb L is mounted in a housing opposite one opening and one of these improved switches S, so constructed as to maintain an open circuit in the presence of light, is similarly mounted opposite the other opening so that the rays of light from the lamp will fall upon the thermal coil of the switch. The wiring diagram shows how the switch may be connected in circuit with an electric alarm. In the event that an excessive amount of smoke passes up the chimney, it will obscure the light from the lamp L and the switch S will respond by operating the alarm.

In Figure 8, the improved switch S is mounted in a housing secured about an aperture 16 in the wall of the combustion chamber of a gas burner B in alignment with the flame of a constantly burning pilot P so that the rays of light therefrom fall upon the thermal coil of the switch. The wiring diagram indicates the manner in which the extinguishment of the pilot flame actuates the switch S to operate the valves in the gas lines to the pilot and to the burner.

Figure 9 illustrates the application of the improved switch S in an electric safety control for an oil burner. Inasmuch as this illustration merely substitutes this improved switch for another form of light responsive switch in a similar safety control which is fully disclosed in this applicant's prior Patent Nos. 1,745,178, of January 28, 1930, and 1,834,287, of December 1, 1931, further description is not here necessary.

It is obvious that the arranging of the operating parts of the switch within a sealed container prevents corrosion resulting from atmospheric conditions or the collection of dust or dirt affecting the sensitiveness of the operation of the thermostatic coils and at the same time prolongs the life of the switch as the container protects the operating parts from damage.

What I claim is:

1. An electric switch including a sealed container, two electrodes sealed therein, a shaft, a disc mounted centrally upon said shaft, two coils of thermostatic metal responsive to radiant energy having their inner ends secured to said shaft with said disc interposed between the coils, the outer convolution of one of said coils secured to one of said electrodes, a continuation of said electrode connected with the outer convolution of the other coil to be movable therewith, and means for making and breaking an electrical connection between said electrodes when one of said thermostatic coils is exposed to the presence or absence of radiant energy, said two coils compensating for changes in ambient temperature and said disc shielding one coil and concentrating the rays of radiant energy upon the other coil.

2. The structure of claim 1 wherein means is provided to dampen vibration of the movable electrode as the switch responds to the presence or absence of radiant energy by extending the electrode supporting the thermal coil to form a bracket below said coils and disc, and rotatably mounting upon said bracket a member adapted

to rest upon and have sliding engagement with the opposite side of said movable electrode.

3. An electric switch including a sealed container, two electrodes sealed therein, one of said electrodes having a free end adapted to be moved to make and break the circuit through the switch, means for establishing a circuit through said electrodes, thermally operated means for actuating said movable electrode consisting of two thermal operating members, one of said members, upon changes in ambient temperature adapted to move said movable electrode, the other of said members, upon changes in ambient temperature adapted to bodily move the first member to counteract movement imparted to said electrode, whereby the relative position of the first means and movable electrode remain unchanged and a shield interposed between said members whereby a temperature differential in said members may be made by the application of radiant energy upon one member while shielding the other to effect a change in the relationship between said first means and movable electrode.

4. An electrical switch, including a sealed container, two electrodes sealed therein, an electrical conductor therefor, one electrode mounting one end of a strip of thermal metal, a continuation of said electrode having an operative connection with the free end of said thermal strip to be movable therewith and means to render the thermal means immediately responsive to the presence

or absence of radiant energy to actuate the movable extension to make or break the electrical connection through the conductor irrespective of ambient temperatures.

5. An electric switch, including a sealed container, two electrodes for opening and closing the circuit through the switch sealed therein, one of said electrodes having a movable extension, operating means for actuating the movable extension consisting of a shaft, two coils of thermal metal responsive to temperature changes having their inner ends secured to said shaft, a rotatable disc mounted upon the shaft between the coils having a fixed connection to the outer convolution of one of the coils to be moved thereby, a support for said operating means having a fixed connection to the outer convolution of the other coil, means providing an operative connection between the movable extension and the disc, said coils compensating for changes in ambient temperature, and said disc shielding one coil while concentrating rays of radiant energy upon the other coil to operate the switch.

6. The structure of claim 5, wherein the last named means is arranged to immediately transmit movement of the disc, in either direction, to the movable extension and to allow unrestricted movement of the disc after a limited movement of the extension.

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