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J. H. THORNBERRY

2,183,827

THERMOELECTRIC SAFETY SWITCH AND THE LIKE

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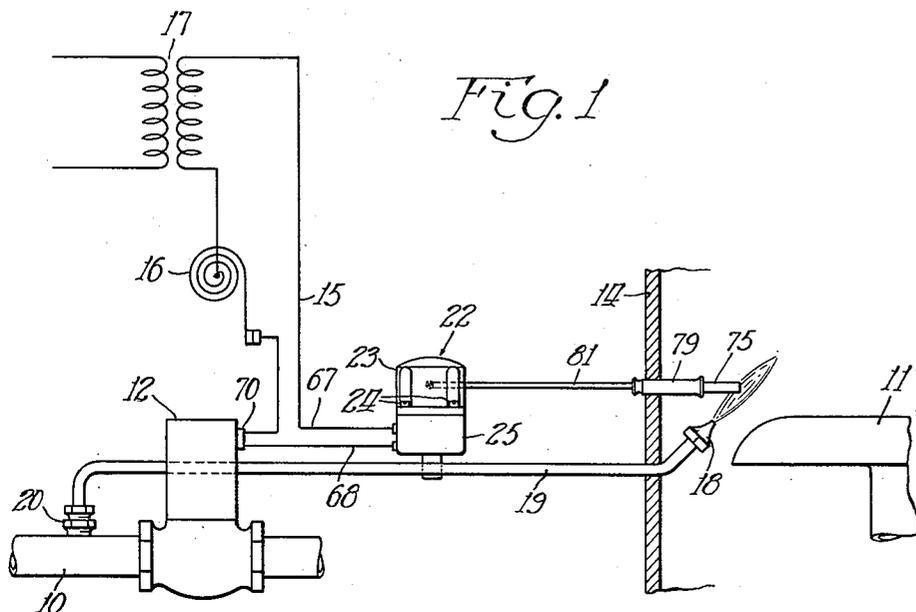


Fig. 1

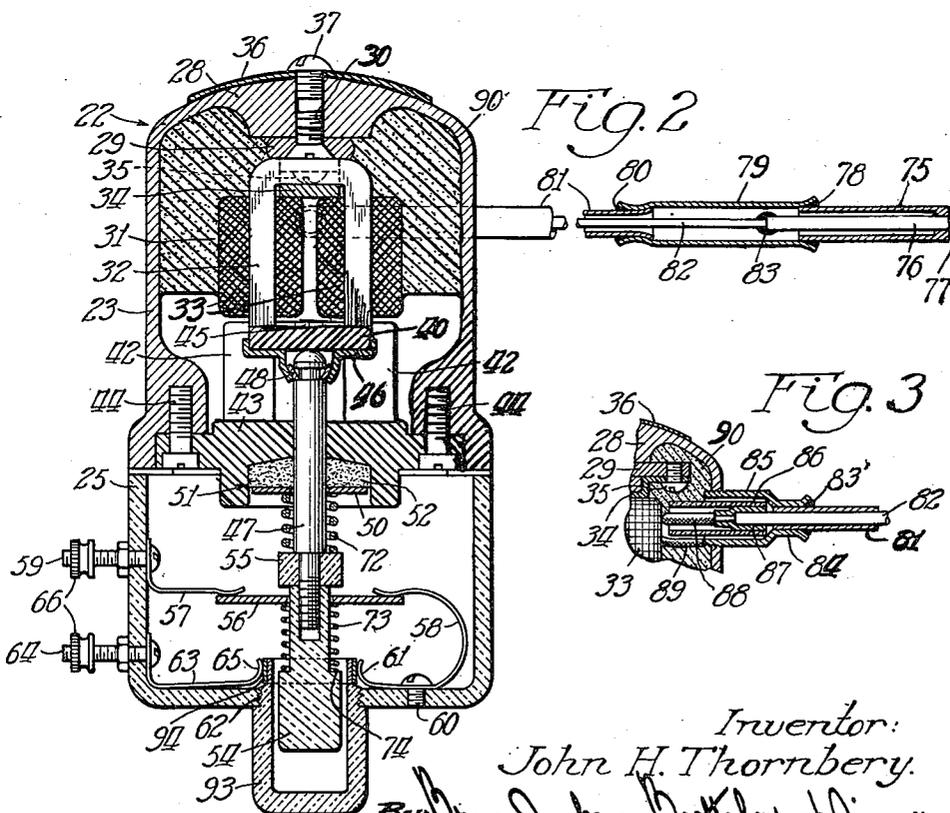


Fig. 2

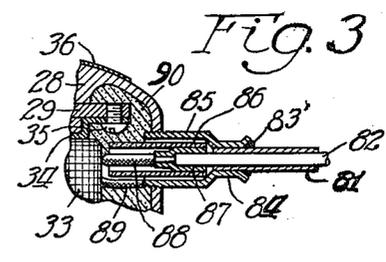


Fig. 3

Inventor:  
John H. Thornberry.  
By: Brown, Jackson, Dettchen & Niemer  
Attys

# UNITED STATES PATENT OFFICE

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## THERMOELECTRIC SAFETY SWITCH AND THE LIKE

John H. Thornbery, Milwaukee, Wis., assignor to  
Milwaukee Gas Specialty Company, Milwau-  
kee, Wis., a corporation of Wisconsin

Application August 22, 1935, Serial No. 37,276

16 Claims. (Cl. 158—117.1)

My invention relates to an improvement in thermoelectric safety switches and the like.

While the particular device with which I shall describe the present improvement, hereinafter in connection with the drawing, is the thermoelectric safety switch shown and described in the copending application of John H. Thornbery and Harold A. Mantz, Serial No. 14,551, filed April 4, 1935, it is to be understood that the present invention is not limited to use with this particular device but may be employed with all similar devices and elsewhere as suitable or desired. For example, the present improvement may be used with the thermoelectric safety valve and switch combination shown and described in the copending application of Thomas T. Arden, Serial No. 76,988, filed April 29, 1936, as well as with other thermoelectric safety switches and thermoelectric safety valves and devices of similar character.

Thermoelectric safety devices, which depend upon a weak voltage thermoelectric current for maintaining the flow of fuel to the main burner and which operate to shut off the flow of fuel to the burner upon extinction of the pilot flame, require resetting means for resetting the device after the pilot flame has been extinguished. These resetting devices usually move the armature into contact with the pole faces of the electromagnet and, simultaneously, the switch or other control device to position for setting up the supply of fuel to the main burner. If the switch or other control device is operated to set up the supply of fuel to the main burner when the resetting device is operated and, irrespective of whether the pilot burner is lighted, fuel may pass to the main burner and escape and collect unburned. This unburned gas presents the danger of asphyxiation and possible explosion when a flame is applied to light the pilot burner.

The object of the present invention is to provide means which will permit resetting and holding the armature in contact with the pole faces of the electromagnet without setting up the supply of fuel to the burner, and, particularly, means which will permit resetting and holding the armature in contact with the pole faces of the electromagnet without setting up the supply of fuel to the burner until the pilot flame has been relighted and a thermoelectric current set up to hold the armature in contact with the pole faces of the electromagnet.

In its more specific aspects, the resetting device has a resetting button provided with a closure cap, and the supply of fuel is not set up to the

burner until the pilot flame has been relighted to set up a thermoelectric current to hold the armature in contact with the pole faces of the electromagnet and the closure cap has been applied into position covering the resetting button.

Further objects and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawing, in which:

Figure 1 is a fragmentary and more or less diagrammatic view showing an embodiment of the present invention in a pilot burner and main burner gas supply system;

Figure 2 is a vertical section through the thermoelectric safety switch shown in Figure 1; and

Figure 3 is a fragmentary detail section.

Referring to the drawing, the pipe 10, which may be the gas supply pipe for the main burner 11, is provided with an electrically operated valve 12 of a type well known in the art.

The heater is diagrammatically indicated at 14, and the main burner 11, which may be associated therewith in any suitable or preferred manner, may be controlled by the valve 12. This valve 12 has electrically controlled mechanism connected into an electric circuit 15 which may be provided with a thermostat 16 to be opened or closed in accordance with the temperature of the room heated by the heater, where the heater is a room heater, or the thermostat 16 may be arranged to be opened and closed in accordance with the temperature of the water in the tank, where the heater is a water heater, or otherwise as desired. The circuit 15 may include the secondary winding of a transformer 17, which may be connected to a suitable source of current.

Associated with the main burner 11, in the usual or in any suitable or preferred manner, is a pilot burner indicated more or less diagrammatically at 18, which pilot burner is intended to remain lighted and which may be of any suitable construction. This pilot burner 18 is supplied with gaseous fuel by a tube 19 connected at 20 to the pipe 10 ahead of the valve 12.

The thermoelectric switch, indicated in its entirety at 22, is the same as that shown and described in the copending application of John H. Thornbery and Harold A. Mantz, Serial No. 14,551, filed April 4, 1935, except for the present improvement as will hereinafter appear. This switch comprises an upper hood or housing member 23 secured by cap screws 24 to the lower switch housing 25.

The hood 23 is provided with a central inwardly extending boss 28 which forms a flat supporting surface for receiving a magnet mounting plate 29 which is secured to the boss 28 by a screw 30. The electromagnet, indicated in its entirety at 31, is disposed within the hood 23 and comprises a U-shaped magnet frame 32 provided about each of its legs with a coil 33. The magnet frame 32 is held rigidly to the magnet mounting plate 29 by means of a bracket 34, which bracket is secured to the plate 29 by means of screws 35. A name-plate 36 is secured externally to the top of the hood 23 by a screw 37.

The ends of the legs of the U-shaped magnet 32 constitute pole faces, and the magnet armature 40 is adapted to have engagement with these pole faces of the electromagnet. The armature 40 is guided for reciprocatory movement within upright guide lugs 42 on an armature guide 43 which is secured to the hood 23 by screws 44. The armature 40 has attached thereto, by upwardly extending bent-over portions 45, a cradle 46 which, in turn, is connected to the upper end of a reciprocatory stem member 47 by means of a U-shaped washer or clip 48 engaging in a groove in the upper end of the stem 47 and cooperating with the inturned lower end of the cradle 46. A limited universal connection is thus provided between the armature 40 and the upper end of the reciprocatory stem member 47.

The stem member 47 has axial reciprocatory movement within the armature guide 43. The stem member passes through a packing washer 50, and the recess 51 in the member 43 is preferably provided with packing 52 above the washer 50. The provision of the packing 52 is optional, this packing being provided for use when the lower housing member is employed as a valve housing for a valve member carried at the lower end of the stem 47 for closing off the flow of fuel through a fuel line, as, for example, in the thermoelectric safety valve described in the copending application of Oscar J. Leins, Serial No. 4,741, filed February 4, 1935, or in the combination valve and switch structure shown and described in the copending application of Thomas T. Arden, Serial No. 76,988, filed April 29, 1936.

The reduced lower end of the stem 47 is threaded to thread into the upper stem portion of a resetting button 54, and a collar 55 is preferably interposed between the lower end of the enlarged portion of the stem 47 and the upper end of the stem of the button 54. Positioned loosely upon the stem portion of the button 54 is a contact disc 56 which is adapted to bridge and connect a pair of spring contacts 57 and 58. The contact 57 is connected to a terminal screw 59 which secures the contact to the lower housing member 25. The contact 58 is secured in place upon the bottom of the housing member 25 by a screw 60 and has an upturned end 61 adjacent a threaded opening 62 through the bottom of the housing 25 and coaxial with respect to the resetting button. A third spring contact 63 is connected to a terminal screw 64, which secures this contact to the housing member 25. The contact 63 has an upturned end 65 disposed in spaced relation to the upturned end of the contact 58 and adjacent the opening 62.

The terminal screws 59 and 64 have the usual nut members 66 for connecting the terminals to conductors 67 and 68. These conductors connect the terminals 59 and 64 through the circuit 15 to suitable terminals 70 for the electrically controlled actuating mechanism within the hous-

ing carried by the electrically operated valve 12. The lower housing member 25 is preferably formed of insulating material, such as a molded phenol condensation product, whereby the terminal screws and contacts are insulated from each other. It is to be understood that the terminal screws and contacts may be insulated from each other otherwise as suitable or desired.

A coiled compression spring 72 surrounds the stem 47 and is interposed between the packing washer 50 and the collar 55. When the electromagnet is deenergized, as will hereinafter appear, this spring moves the stem 47 and, with it, the collar 55, resetting button 54, and armature 40, downwardly. The collar 55, in its downward movement, strikes the contact disc 56 and moves the same downwardly out of contact with the contacts 57 and 58 to open the circuit between these contacts.

A second spring 73 surrounds the reduced stem portion of the button 54 and is interposed between the contact disc 56 and a shoulder 74 on the button 54. This spring, which is preferably a relatively weak spring, holds the contact disc 56 yieldingly against the contacts 57 and 58 when the device is in the position shown in Figure 2, and at the same time permits the armature 40 to be pressed and held firmly against the ends of the legs of the magnet frame 32 without depending solely upon the yieldability of the contact springs 57 and 58.

The reset button 54 is provided with a closure cap 93 which has threaded engagement in the threaded opening 62 in the lower housing member 25. A metal contact band carried by the upper end of the cap 93 closes the circuit across the contacts 58, 63 when the cap 93 is in place, and opens the circuit across these contacts when the cap is removed.

A suitable thermo-couple, comprising an outer tubular member 75, which, at one end, is welded to the inner element 76 as shown at 77 for the purpose of providing a hot welded junction between the two members, is disposed with this junction in proximity to the pilot flame, as shown more or less diagrammatically in Figure 1, so as to be responsive to the heat of the pilot flame. The external element 75 is joined at its opposite end, as by welding or the like, at 78 to a tubular couple connector 79. The opposite end of the tubular connector, which may be formed of copper or other suitable material, is joined, as by welding or the like, at 80 to the adjacent end of the lead tube 81. Extending through the tube 81 is the lead wire 82 which may be an insulated wire and which, within the connector 79, is joined at 83 to the internal element 76 of the thermo-couple. The thermo-couple elements 75 and 76 are formed of dissimilar metals, such as "Constantan" and "Chromel", "Chromel" and "Cope", or any other dissimilar metals which, when heated at the junction therebetween, are adapted to produce a thermoelectric current.

The lead tube 81, which may be formed of copper, extends to the thermoelectric switch 22, and is secured as by means of a welded joint at 83' within a reduced portion 84 of a connector 85 which is threaded into and electrically contacts the hood 23. Within the connector 85 is provided an insulating sleeve 86 disposed about the adjacent end of the conductor 82 and enclosing the connector 87 between the conductor 82 and the terminal conductor 88 of one of the coils 33. The other coil terminal is connected to the connector 85 as shown at 89. Thus a circuit is

completed through the coils 33 and the conductors 81 and 82 leading to the hot thermo-couple junction.

After the connections are made between the electromagnet and the tube 81 and conductor 82, and between the electromagnet and the connector 85, the space between the electromagnet and the upper portion of the hood is filled with sealing compound, indicated at 90, for holding the parts in position and sealing the same in place.

The operation of the device is as follows:

When the pilot flame is burning the heat of this flame upon the junction 77 of the thermo-couple produces a thermoelectric current in the coils 33 of the electromagnet. The magnet frame 32 and armature 40 are preferably formed of "Permaloy", "Hypernic", or a similar alloy of relatively low magnetic reluctance, and, as a result, the relatively weak thermoelectric current produces a magnetic field of sufficient strength so that when the armature is placed in contact with the ends of the magnet frame by pushing the reset button 54 the magnetic attraction holds the armature in raised position against the frame with a force greater than the force exerted by the spring means, thereby holding the contact disc 56 in contact with the contacts 57 and 58 yielding through the spring 73.

If the pilot light goes out, the thermoelectric current through the electromagnet 31 ceases, and the spring means moves the stem 47 downwardly, the collar 55 striking the contact disc 56 and moving the same to open position.

The operation of the spring 72 in opening the switch is aided by gravity if the device is installed vertically, as shown, but this disc spring is preferably of sufficient tension to open the switch without the aid of gravity whereby the device may be installed in any desired position. The spring also assures detachment of the armature from the electromagnet upon deenergization of the same and notwithstanding any residual magnetization therein. The opening of the circuit across the contacts 57 and 58 opens the circuit 15 for the safety control valve 12, whereupon this valve moves to closed position to close off the supply of gas to the main burner.

In resetting the device, the circuit 15 is closed by two independent operations. The first operation after removal of the cap 93 is to engage the armature with the magnet poles where it will be held by magnetic force providing the pilot flame has heated the thermo-couple to its operating temperature. The operation of the reset button to engage the armature with the magnet poles brings the contact disc 56 against the contacts 57 and 58 where it is held by the thermoelectric current when the pilot flame has heated the thermo-couple to its operating temperature. The second operation is to replace the reset cap 93. This replacement of the cap positions the contact band 94 in bridging engagement with the contacts 58, 63 to close the circuit therebetween. When the cap 93 is removed, the band 94 moves out of bridging engagement with the contacts 58, 63, opening the circuit between these contacts so that the circuit will not be closed to set up a flow of fuel to the burner 11 merely by the resetting operation and until the pilot burner has been lighted and sets up a thermoelectric current to hold the armature against the pole faces of the electromagnet and the reset cap 93 has been replaced.

I claim:

1. In combination, a burner, a fuel supply conduit therefor, a valve in said conduit, an electric

control circuit for said valve, a switch in said circuit, a thermoelectric device controlling said switch and comprising an electromagnet having coil means and a core, an armature, a thermo-couple connected to said coil means for producing a thermoelectric current therein to hold the armature against the core, means for resetting the armature against the core, and a second switch for opening said circuit during the resetting operation.

2. A thermoelectric safety device comprising an electromagnet having coil means and a core, an armature, a stem carried by said armature, a housing for said device, a thermo-couple connected to said coil means for producing a thermoelectric current therein to hold said armature against said core, a reset button for resetting said armature against the core, a cap having removable attachment to said housing for enclosing said reset button, contacts within said housing and insulated from each other, and a contact member carried by said cap for bridging said first contacts when said cap is applied to the housing and opening the circuit between said first contacts when said cap is removed from the housing.

3. In combination, an upper hood, a lower housing member formed of insulating material, said lower housing member having a threaded opening, contacts within said lower housing member and having turned ends adjacent said opening, a closure cap having threaded engagement in said opening, and a contact band carried by said cap for bridging the turned ends of said first contacts when said cap is applied to the lower housing member and opening the circuit between said first contacts when the cap is removed.

4. A thermoelectric device comprising an upper hood, a lower housing member formed of insulating material, an electro-magnet disposed in said hood and having coil means and a core, an armature, a thermo-couple connected to said coil means for producing a thermoelectric current therein to hold said armature against said core, a stem having a universal connection with said armature, a pair of contacts within said lower housing member, a bridging contact held yieldingly in engagement with said first contacts when said armature is engaged with said core, spring means for separating the armature from said core and the bridging contact from said first contacts when said electromagnet is deenergized, means for resetting the armature in engagement with the core, a closure cap for said resetting means, a contact disposed within the lower housing member in proximity to one of said first contacts, and a contact carried by said cap for bridging said last contacts when said cap is in place.

5. In combination, a safety valve, an electric circuit having a switch for controlling said valve, a thermoelectric device comprising an electromagnet having coil means and a core, a thermo-couple connected to said coil means for producing a thermoelectric current therein, an armature adapted to be held to the core of said electromagnet upon energization of said electromagnet and connected to the switch to hold the switch closed when said electromagnet is energized, means for resetting the armature into co-operation with the core and the switch to closed position, and means for opening said circuit during said resetting operation.

6. In combination, a burner, a fuel supply conduit therefor, a valve in said conduit, an electric control circuit for said valve, a switch

in said circuit, a thermoelectric device controlling said switch and comprising an electromagnet having coil means and a core, an armature, a pilot burner, a thermo-couple responsive to the heat of the pilot burner and connected to said coil means for producing a thermoelectric current therein to hold said armature against said core and said switch closed when the pilot burner is lighted, means for resetting the armature into cooperation with the core, and a second switch for opening said circuit during the resetting operation and until the pilot burner is lighted and heats the thermo-couple to a temperature to maintain said thermoelectric device reset.

7. In combination, an electric circuit, a switch in said circuit, a thermoelectric device controlling said switch and comprising an electromagnet having coil means and a core, an armature, a thermo-couple connected to said coil means, means for resetting said armature against said core, and means for opening said circuit during the resetting operation.

8. In combination, an electric circuit, a switch in said circuit, a thermoelectric device controlling said switch, said thermoelectric device comprising an electromagnet having coil means and a core, an armature, a housing for said thermoelectric device, a thermo-couple connected to said coil means for producing a thermoelectric current therein to hold said armature against said core, means for resetting the armature into cooperation with the core, a closure cap for said resetting means and having removable attachment to said housing, contact means in said circuit, and cooperating contact means carried by said cap and engageable with and disengageable from said first contact means upon application of the cap to said housing and removal of said cap from said housing.

9. A thermoelectric device comprising an electromagnet having coil means and a core, an armature, a stem carried by said armature, an electric circuit, a switch member carried by said stem for controlling said circuit, a thermo-couple connected to said coil means for producing a thermoelectric current therein to hold said armature against said core, means for resetting said armature into cooperation with the core, an upper hood member, a lower housing member, contacts in said circuit, said contacts being carried by said lower housing member and insulated from each other, a closure cap for said resetting means and having removable attachment to said housing member, and a contact carried by said cap for bridging said first contacts when said cap is applied to said lower housing member and opening the circuit between said first contacts when said cap is removed.

10. In combination, a fluid supply conduit, an electromagnet comprising a magnetic frame and a coil, an armature, a thermo-couple connected to said coil for producing a thermoelectric current in said coil to develop magnetism in said magnetic frame for holding said armature against said frame, said armature separating from said magnetic frame when said coil is deenergized, electrically operated valve means having an electric circuit controlled by the movement of said armature for controlling the supply of fluid through said conduit, a reset stem member for resetting said armature against said magnetic frame, a closure cap member for said reset stem member, and means controlled by said closure cap member for controlling the elec-

tric circuit for said electrically operated valve means.

11. In combination, a main burner, a fuel supply line for said burner, a pilot burner for said main burner, an electromagnet comprising a magnetic frame and a coil, an armature, a thermo-couple in proximity to the pilot burner and connected to said coil for energizing said electromagnet by the heat of the pilot burner to hold said armature against the magnetic frame of said electromagnet, said armature separating from said magnetic frame when said electromagnet is deenergized, electrically operated valve means having an electric circuit controlled by said armature said electrically operated valve means being disposed in said fuel supply line for controlling the supply of fuel through said line, a reset stem member for resetting said armature against said magnetic frame, a closure cap member for said reset stem member, and means controlled by said closure cap member for controlling the electric circuit for said electrically operated valve means.

12. In combination, a fluid supply conduit, a valve for controlling the supply of fluid through said conduit, a movable armature operable to control said valve, an electromagnet for said armature, a thermo-couple connected to said electromagnet for energizing said electromagnet, means for resetting said armature with respect to said electromagnet, and means operable to shut off the supply of fluid through said conduit during the resetting operation.

13. In combination, a main burner, a fuel supply line for said burner, a pilot burner for said main burner, valve means in said fuel supply line for controlling the supply of fuel through said line, a movable armature operable to control said valve, an electromagnet for said armature, a thermo-couple in proximity to the pilot burner and connected to said electromagnet for energizing said electromagnet by the heat of the pilot burner, means for resetting said armature with respect to said electromagnet, and means operable to shut off the supply of fuel through said fuel-supply line during the resetting operation.

14. In combination, a fluid supply conduit, an electrically operated valve in said conduit, an electric circuit for said valve, a switch in said circuit, an electromagnet, a thermo-couple connected to said electromagnet for energizing said electromagnet, an armature adapted to be held to said electromagnet upon energization thereof and connected to the switch to hold said switch closed when said electromagnet is energized, said armature separating from said electromagnet and opening said switch when said electromagnet is deenergized, means for resetting the armature against said electromagnet, and means for opening said electric circuit during the resetting operation.

15. In combination, a fluid supply conduit, an electrically operated valve in said conduit, an electric circuit for said valve, a switch in said circuit, an electromagnet, a thermo-couple connected to said electromagnet for energizing said electromagnet, an armature adapted to be held to said electromagnet upon energization thereof and connected to the switch to hold said switch closed when said electromagnet is energized, said armature separating from said electromagnet and opening said switch when said electromagnet is deenergized, means for resetting the armature against said electromagnet, a closure cap for said resetting means, and cooperating

contact means in said electric circuit and on said closure cap for opening said circuit when said cap is removed for access to said resetting means and closing said circuit when said cap is in position enclosing said resetting means.

16. In combination, a burner, a fuel supply line, a thermo-couple in proximity to said burner, a thermoelectric device comprising a magnetic frame, a coil connected to said thermo-couple for setting up a magnetic field in said magnetic frame by the action of said burner on said thermo-couple, an electrically operated valve in said fuel supply line, an electric circuit for said valve, a switch in said circuit, an armature adapted to be held to said magnetic frame by

the magnetic field set up therein and connected to said switch to hold said switch closed when said coil is energized, said armature separating from said magnetic frame and opening said switch when said coil is deenergized, means for resetting the armature against said magnetic frame and for opening said electric circuit during the resetting operation, a closure cap for said resetting means, and cooperating contact means in said electric circuit and on said closure cap for opening said circuit when said cap is removed for access to said resetting means and closing said circuit when said cap is in position enclosing said resetting means.

JOHN H. THORNBERRY. 15

### Disclaimer

2,183,827.—*John H. Thornbery*, Milwaukee, Wis. THERMOELECTRIC SAFETY SWITCH AND THE LIKE. Patent dated Dec. 19, 1939. Disclaimer filed May 26, 1949, by the assignee, *Milwaukee Gas Specialty Company*, the inventor assenting.

Hereby enters this disclaimer to claims 12 and 13 of said patent.

[*Official Gazette June 21, 1949.*]

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