Nov. 8, 1927. 1,648,389

I. E. McCABE

COMBINED SAFETY, SPARK, AND GAS CONTROL

Filed June 5, 1926 2 Sheets-Sheet 1

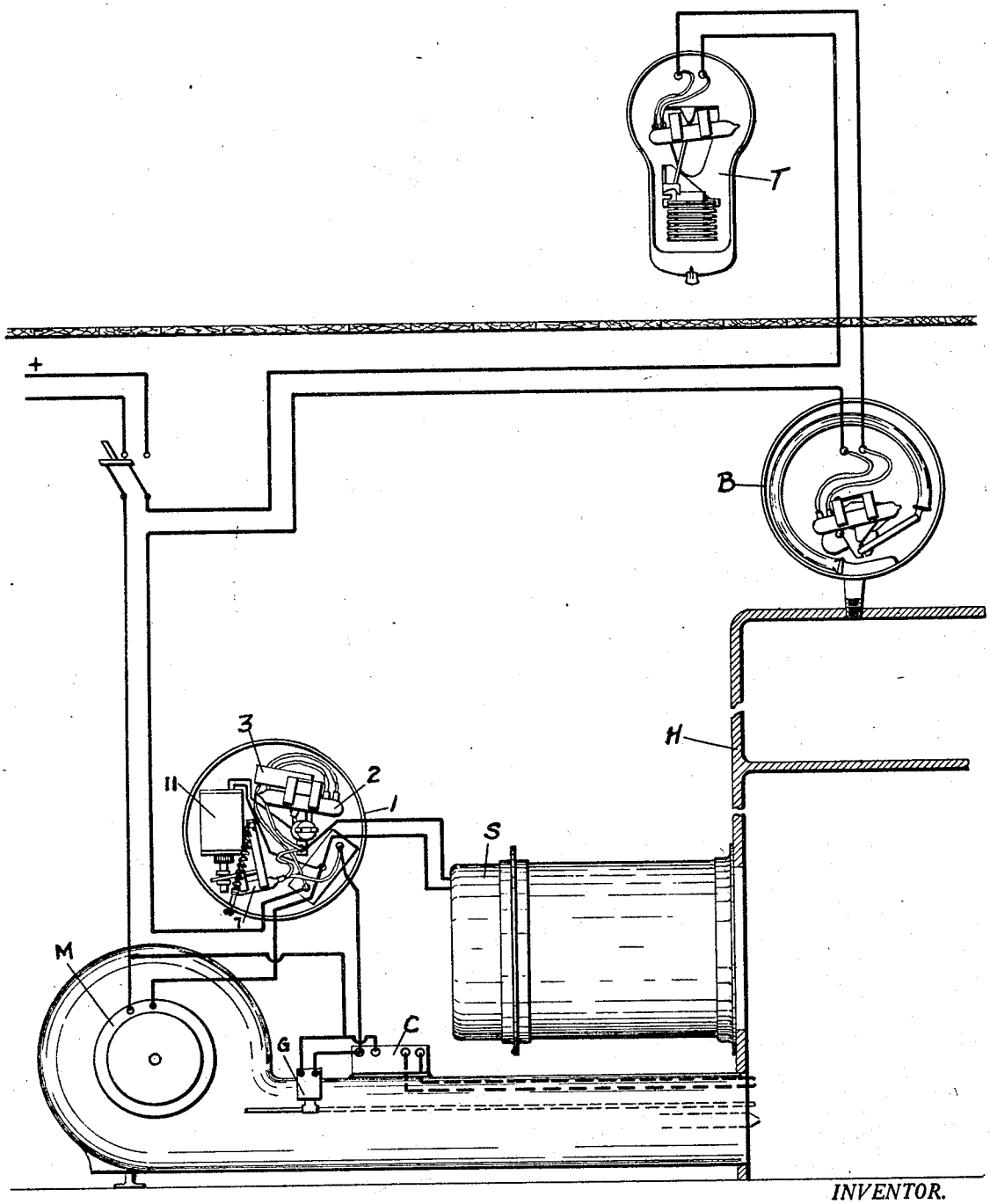


Fig. 1

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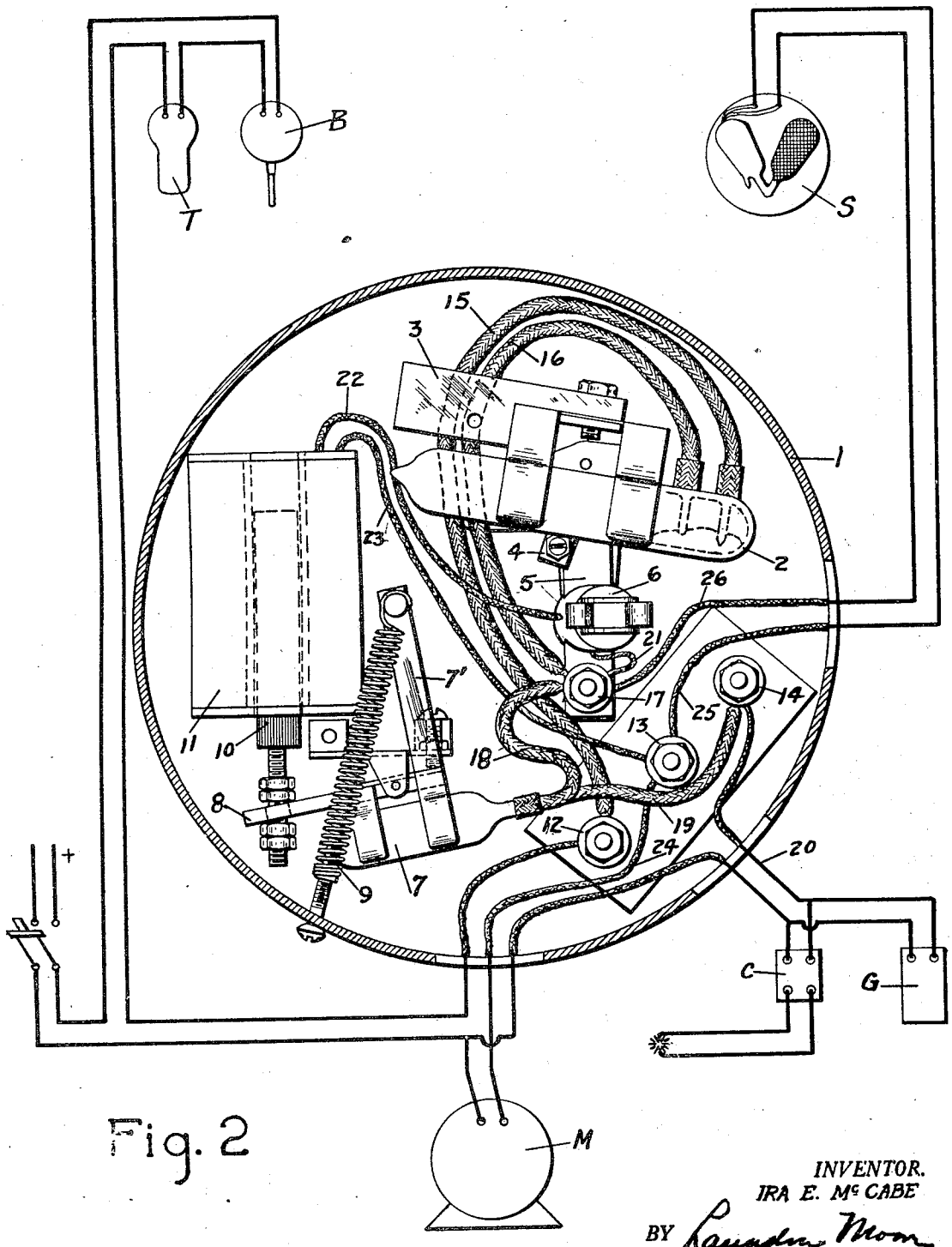


Fig. 2

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UNITED STATES PATENT OFFICE.

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COMBINED SAFETY, SPARK, AND GAS CONTROL.

Application filed June 5, 1926. Serial No. 113,906.

This invention relates to improvements in electrical controls and particularly to a combined safety, spark and gas control for electrically-operated heating systems.

While the application of this invention is illustrated and hereinafter described in relation to an electrically operated liquid fuel burning system employed in connection with a domestic heater or furnace, yet it is to be understood that the same may be employed with different types and different forms of electrically-operated fuel burning devices for domestic or industrial purposes.

It is an object of this invention to provide a single instrument which will control not only the circuit of the operating mechanism for providing fuel to the furnace but will also control the activity of a pilot from an independent gas supply and the operation of an electric spark for igniting the pilot at the commencement of the operation. It is also an object of this invention that when the circuit is closed to initiate the operation of the fuel feeding means, the valve in the independent gas supply is open, the spark ignition for the pilot is operated and after a predetermined time, sufficient for the ignition of the fuel supply from the pilot flame, to discontinue the spark ignition and close the valve in the independent gas supply pipe. It is a further object of this invention after the initial ignition of the fuel supply, should for any reason the same fail or the ignition thereof be extinguished, the safety device will be operated to break the circuit to the fuel supply operating means.

In the drawings:

Figure 1 is a view in side elevation, partly in section, and partly diagrammatic of a preferred form of this device, as applied to a commercial liquid fuel burner employed in a domestic heater or furnace.

Figure 2 is an enlarged detailed view of the instrument casing containing this improved combined safety, spark and gas control, illustrating in diagram the wiring employed therein and the connections to the various operating parts of such a system.

In the embodiment illustrated, a conventional type of oil burner having an electric motor for supplying the liquid fuel and air to the burner nozzle is shown attached to the conventional type of domestic heater or boiler. The liquid fuel is supplied to the burner from any source, such as a tank, not shown, and the independent gas supply may be taken from any source, such as the commercial gas line. As these two features are old and well known in this art, the connections from the burner casing to these respective sources are not shown. The electrical circuit employed is taken from a commercial source and, as illustrated in this particular type, preferably passes through a room thermostat T of commercial type, through a boiler control B, of commercial type, to the improved safety, spark and gas control mechanism, and thence to the motor M for operating the supply of fuel to the combustion chamber of the heater H. The ignition device for the pilot flame preferably comprises a commercial spark plug connected to a spark coil C of commercial form and an electrically-operated valve G, thereby controlling the independent gas supply to the pilot which is also of commercial form and, therefore, it is not thought necessary to describe the preferred construction of these parts. This device also employs in combination with the circuit a device S actuated by the internal condition of the combustion chamber. While it is preferable to employ a device of this character as illustrated in my pending application, Serial No. 101,588, filed April 12, 1926, yet any other commercial device, such as a stack control, may be employed and operated as well.

Referring to the enlarged, detailed view in Figure 2, this improved combined safety, spark and gas control is mounted in a circular casing 1 and comprises a mercury switch tube 2, having two terminals adjacent each other and adjacent one end thereof, pivotally mounted on the back of the casing and provided with a counterweight 3 which will normally rotate the switch about its pivot to break the circuit and provided with a depending pawl member 4 adapted to contact with a bi-metal plate 5, controlled by a heating element 6, which at normal temperature will remain stationary and when the heating element has been energized to a predetermined degree will cause the free end of plate 5 to move and release the pawl.

A second mercury tube switch 7 is rotatively mounted upon the back of the casing preferably having two terminals entering one end thereof, the mounting of which is preferably provided with right angular extensions 7′ and 8, one of which, is attached

by an adjustable coil spring 9 to the side wall casing and normally maintains the switch tube in position with the circuit broken. The other angular extension 8 is pivotally and adjustably connected to the lower exterior end of the core 10 of a solenoid 11, also mounted on the casing. Three binding posts, 12, 13, and 14, are mounted within the casing for connecting the switches and solenoid to the source of current, to the spark coil, and to the thermal safety device, spark coil and gas valve. As illustrated, the current from the commercial source passes through the room thermostat T the boiler control B and thence to the lowermost 12 of the three binding posts within the instrument casing. A lead 15 from this binding post is connected to one terminal of the heat-controlled safety switch 2. A lead 16 from the other terminal of this switch is attached to a binding post 17 below the heating element 6. This binding post 17 is connected by a lead 18 to one terminal of the lower mercury tube switch 7 operated by the solenoid 11. The other terminal of this switch 7 is connected by a lead 19 to the upper 14 of the three binding posts within the casing. This latter binding post 14 is connected by a lead 20 through the spark coil C and electrically controlled gas valve G to the source of electricity. The binding post 17 forming the connection between the two mercury tube switches is also connected by a lead 21 to one side of the heating element 6 of the upper switch, the other side of which element is connected by a lead 22 to one end of the winding solenoid 11, the other end of which windings is connected by a lead 23 to the intermediate 13 of the three binding posts upon the back of the casing. This intermediate binding post 13 is connected by a lead 24 to one pole of the motor M and also by a lead 25 to the thermal safety controls actuated by the internal conditions of the combustion chamber, the other pole of which is connected by a lead 26 to the binding post 17 forming the connection between the two switches. The other pole of the motor is connected to the source of electricity.

The position of the various elements as illustrated in Figure 2 is that assumed when the burner is in inoperative position. The heat controlled safety switch 2 has been rotated about its pivot to the closed position and is held in this position by its pawl 4 sliding over the heat controlled plate 5. When the circuit is closed, as through the room thermostat T, the current passes therethrough and through the boiler control 3, through the lowermost 12 of the three binding posts within the casing to the binding post 17 below the heat element 6. The safety switch S actuated by the internal condition of the heater is normally open so that when the burner is not operating and the thermostat closes the circuit, no current will pass through the leads connecting this safety switch with the instrument. The current, therefore, passes from the binding post 17 below the heating element through the lead 21 to the heating element 6, and thence through the lead 22 to the solenoid 11, and from the solenoid to the intermediate 13 of the three binding posts and thence to one pole of the motor, the other pole of the motor being connected to the commercial source of electricity. Therefore, the closing of the circuit through the room thermostat not only energizes the motor but the current also passes through the heating unit and energizes the solenoid which draws its core 10 upward to overcome the tension of the spring 9 and rotates the lower mercury tube switch 7 in closed position.

This closing of the mercury tube switch 7 closes the circuit between the binding post 17 below the heating element to the uppermost 14 of the three binding posts, the circuit then passing from that binding post to the other lead to the commercial circuit will actuate the electrically operated valve G to open the independent gas supply to the pilot light and will also energize the spark coil C. The heating element is so adjusted that it will not release the plate 5 holding the mercury tube switch 2 in closed position until after the elapse of a predetermined time which time is sufficient for the ignition of the fuel from the burner by the pilot to raise the temperature within the combustion chamber sufficiently to close the thermally actuated safety switch S. The closing of the circuit through this safety switch closes the circuit from the binding post 17 below the heating unit to the intermediate binding post 13 and this shunt circuit will reduce the amount of current passing through the heating element and solenoid to prevent the release of the plate 5 holding the upper switch in closed position and allow the spring 9 together with the weight of the core 10 of the solenoid 11 to rotate the lower mercury tube switch 7 into its open position, thereby breaking the circuit through the gas valve and spark coil. With the device in this position, the motor will continue to operate as long as the temperature within the combustion chamber maintains the thermally actuated safety switch in closed position.

As it is a well recognized fact that a motor consumes more current for the initial operation than it does during its normal running, the coil spring 9 acting upon the solenoid controlled mercury tube switch 7 is so adjusted that should the flame of the burner become extinguished after the initial operation above described the thermally actuated safety switch will operate to break the circuit therethrough, whereby the full strength of

the current thereby passes through the heating element and windings of the solenoid, but will not be sufficient to withdraw the core of the solenoid against the tension of this spring to close the circuit through the gas valve and spark coil, so that the full strength of the current passing through the heating element will produce sufficient heat to deflect the bimetal plate 5 and thereby allow the counterweight 3 of the upper mercury tube switch 2 to rotate this swich about its pivot to break the circuit to the motor.

Should the burner fail to ignite when the circuit is first closed and the pilot light ignited, the thermally actuated safety switch S will remain in open position so that the continued passage of current through the heating element will release the pawl 4 and allow the circuit to be broken by the counterweight through the upper mercury tube switch to the motor.

When it is desired and circumstances permit, the gas valve may be omitted from the system and the ignition will take place from the spark.

What I claim is:—

1. In a safety control for a fuel burning system including electrically operated means for supplying fuel to be burned and electrical operating means for igniting said fuel, the combination of a heat controlled switch in the electric circuit controlling the supply means, an electrically operated switch in said circuit and in circuit with the ignition means, adjustable means normally tending to operate said switch to open position, an electrically operated heat generating unit controlling said first switch and a solenoid controlling said second switch connected in series in a shunt circuit between the first switch and the operating means, and a thermally operated switch actuated by combustion of the fuel in a shunt circuit between said first switch and the operating means, whereby upon the independent closing of the circuit the full current passes through the first switch, the heat generating element and the solenoid, energizes the operating means, the energizing of the solenoid closes the circuit through the second switch, and operates the ignition means, and upon ignition of the fuel the thermally operated switch operated thereby closes the shunt between the first switch and the operating means, reducing the current through the solenoid and heating element and allowing the mechanical means to open the solenoid controlled switch to break the circuit between the first switch and the igniting means.

2. In a safety control for fuel burning systems including electrically operated means for supplying fuel to be burned and electrical operating means for igniting said fuel, the combination of a heat controlled switch in the electric circuit controlling the supply means, an electrically operated switch in said circuit and in circuit with the ignition means, mechanical means tending to operate said switch to open position, an electrically operated heat generating unit controlling said first switch and a solenoid controlling said second switch connected in series in a shunt circuit between the first switch and the operating means, and a thermally operated switch actuated by combustion of the fuel in a shunt circuit between said first switch and the operating means, whereby upon the independent closing of the circuit the full current passes through the first switch, the heat generating element and the solenoid, energizes the operating means, the energizing of the solenoid closes the circuit through the second switch, and operates the ignition means, and upon ignition of the fuel the thermally operated switch operated thereby closes the shunt between the first switch and the operating means, reducing the current through the solenoid and heating element and allowing the mechanical means to open the solenoid control switch to break the circuit between the first switch and the igniting means, and upon failure of ignition of the fuel the thermally-operated switch opens breaking its shunt circuit and causing the full strength of the current to pass through the heat generating element whereby the first switch is operated to break the circuit to the operating means.

3. In a safety control for fuel burning systems including electrically operated means for supplying fuel to be burned and electrical operating means for igniting said fuel, the combination of a heat controlled switch in the electric circuit, controlling the supply means, an electrically operated switch in said circuit and in circuit with the ignition means, adjustable mechanical means normally tending to operate said switch to open position, an electrically operated heat generating unit controlling said first switch, and a solenoid controlling said second switch connected in series in a shunt circuit between the first switch and the operating means and a thermally operated switch actuated by combustion of the fuel in a shunt circuit between said first switch and the operating means whereby upon the independent closing of the circuit the full current passes through the first switch, the heat generating element and the solenoid, energizes the operating means, the solenoid closes the circuit through the second switch, and operates the ignition means, and upon ignition of the fuel and thermally operated switch operated thereby closes the shunt between the first switch and the operating means, reducing the current through the solenoid and heating element, and allowing the mechanical means to open the solenoid controlled switch to break the circuit between the first switch and the ig-

niting means, and upon failure of ignition of the fuel the thermally-operated switch opens breaking its shunt circuit and causing the full strength of the current to pass through the heat generating element whereby the first switch is operated to break the circuit to the operating means, said mechanical means normally holding the solenoid control switch in open position being adjustable and arranged to hold said switch in the open position upon the opening of the thermally operating switch after initial ignition of the fuel.

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