

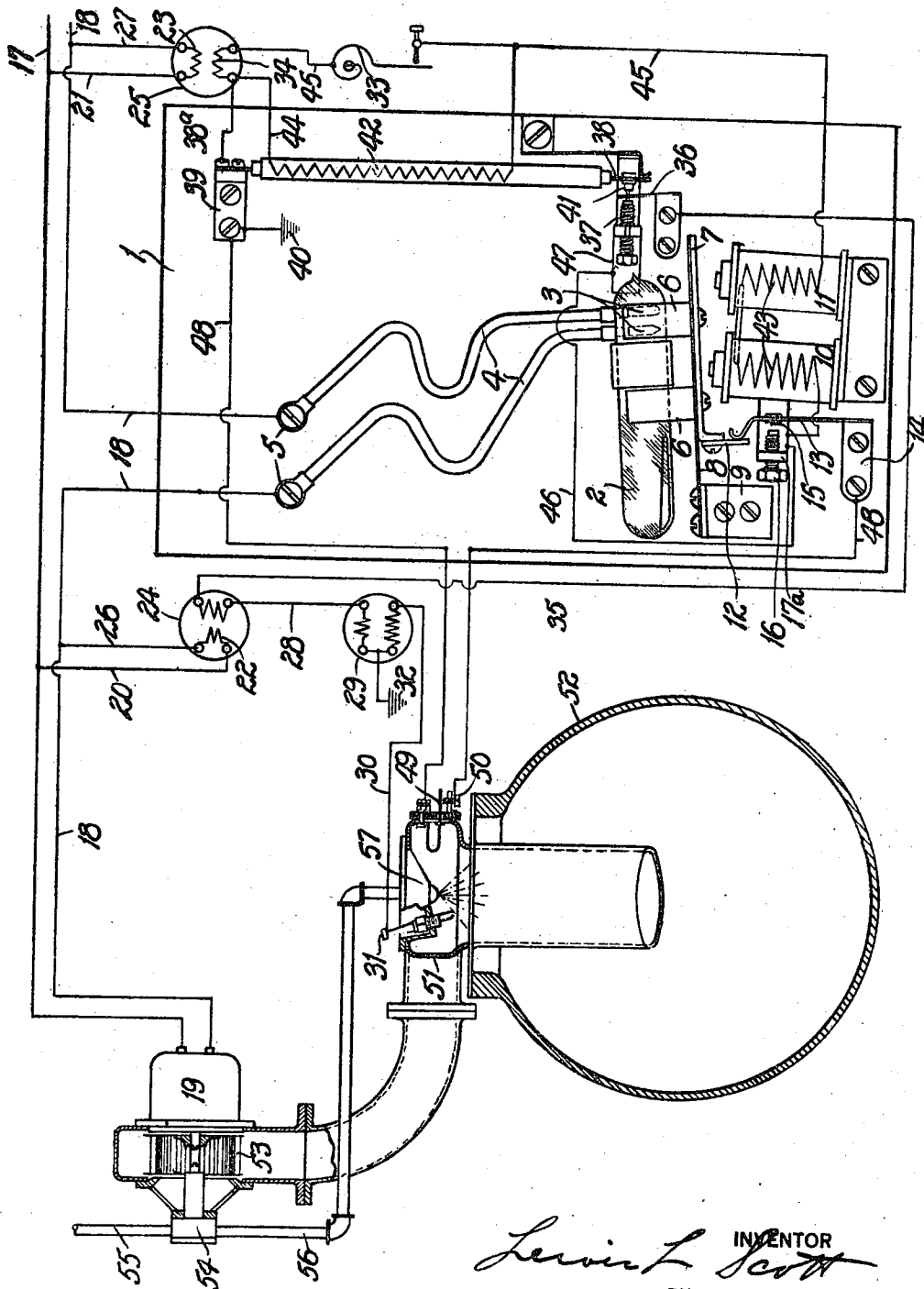
Oct. 5, 1926.

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1,602,175

ELECTRIC CONTROL SYSTEM FOR FUEL OIL BURNERS

Filed May 31, 1924



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Patented Oct. 5, 1926.

1,602,175

UNITED STATES PATENT OFFICE.

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ELECTRIC CONTROL SYSTEM FOR FUEL-OIL BURNERS.

Application filed May 31, 1924. Serial No. 717,189.

This invention relates to oil burning systems and particularly to a novel construction and arrangement of an automatic electric mercury switch for controlling combustion.

One of the objects of the invention is to provide novel means for mounting a mercury tube of an electric switch in a manner to obviate the formation of joints, which in time stick or corrode. This object is effected by mounting the tube on an armature which is, in turn, mounted on a flat spring, so that when the armature is attracted by electro-magnets, the spring will yield to permit the tilting of the tube to cause the mercury therein to flow from one end to the other.

Another object of the invention is to provide novel means for insuring that sufficient tilt shall be given to the mercury tube, in its actuation to close the switch, to insure that the mercury will flow to the end of the tube containing the contact wires.

Another object of the invention relates to means for actuating an armature by electro-magnets and at the same time automatically opening or closing a mechanical electric switch without subjecting the switch member to vibration, which follows from the usual arrangement in which a switch member is directly attracted by electro-magnets energized from an alternating current, whereby arcing occurs at the contacts, causing them to burn away, rendering the operation of the switch unreliable. In the specific embodiment of my invention, the armature carries the mercury tube of a main electric control switch.

Another object of the invention resides in the novel manner of mounting the mercury tube for movement under the influence of electro-magnets, whereby should the support for the tube break, the tube will fall into position to cause the mercury to flow to the end of the tube opposite to that containing the contact wires and thus shut off the electric motor which operates to cause fuel to be supplied to the furnace or other place of combustion.

A still further object of the invention resides in the provision of a safety device comprising an electric circuit for controlling the operation of electrical devices which in turn control the initiation and maintenance of combustion, a switch in said circuit normally open and automatic means for actu-

ating the switch controlled by combustion conditions and operating, upon combustion being established, to close said switch to permit the continuance of combustion and, upon failure of combustion to occur, to maintain said switch open and thereby render said electrical devices inoperative.

In the preferred embodiment of my invention shown in the drawings, this safety device is in the form of a thermostatic switch which is adapted to be moved to close the control circuit under heat of combustion and to hold the switch open when there is no heat. The invention, however, is not limited to this particular means for effecting the operation of this safety device.

Other objects of the invention relate to details of construction and to combinations and arrangements of parts hereinafter described and pointed out in the claims.

The invention is illustrated in the accompanying drawing in which the view is a diagrammatic view of a fuel burning system having my control apparatus applied thereto, the switch board being shown in front elevation and the furnace and connected parts being shown in sectional plan.

Referring now to the drawings, the numeral 1 indicates a board of insulating material, on which the control switches are mounted, and which switches will now be described. The numeral 2 indicates a glass tube which is partly filled with mercury and which has a pair of electric contacts 3—3 at one end, to which are connected the ends of flexible conductors 4, which at their other ends are connected to binding posts 5. The contacts 3 are adapted to be closed or opened by the mercury according to the angle at which the glass tube 2 rests. The tube 2 is mounted in clips 6 which, in turn, are mounted on an armature 7. Secured to the armature 7 is a flat or leaf spring 8, one end of which is secured to a bracket 9 mounted on the board 1. The armature 7 is adapted to be acted on by the electro-magnets 10—11, and when such action takes place, the tube 2 will tilt to the right and cause the mercury therein to flow to the right-hand end of the tube and close the electric contacts 3. In this movement, the spring 8 yields to permit the tilting of the tube as described. It will be observed that the magnets are inclined slightly to the right. The arrangement described is such as to secure a sufficient tilt of the tube to

effect closing by the mercury of the contacts 3. When the magnets 10—11 are energized, the armature 7 first engages the end of the magnet 10; thereafter, the magnet 11 draws
 5 down the outer end of the armature, causing the spring 8 to buckle slightly, giving additional tilt to the mercury tube. In some cases where the apparatus was not properly leveled, it would be found impos-
 10 sible for this mercury tube to properly operate because of the small angle through which it works.

When the magnets are de-energized, the spring 8 has sufficient power to tilt the tube
 15 2 to the left, or into the position shown in the drawing. The actuation of the armature 7 is used, according to my invention, to automatically and indirectly operate an electric switch in a circuit to be presently described.
 20 To this end, there is secured on the rear end of the armature 7 an arm 12, which normally engages the free end of a spring arm 13, which, at its other end, in the drawing the lower end, is secured to, or forms part of, a
 25 conducting plate 14, mounted on the board 1. The spring arm 13 constitutes a movable switch member and has mounted thereon, near its free end, a contact member or switch
 30 15, which is adapted to make and break contact with the end of an adjustable contact member 16, which is mounted in a conducting plate or bracket 17^a, secured on the board 1.

The spring arm 13 tends normally to move
 35 the contact 15 into engagement with the end of contact 16, but is held from such movement by the arm 12 on the armature 7. When the magnets 10—11 are energized and the armature 7 pulled downward, the arm
 40 12 will be moved away from the free end of the spring arm 13, and the latter will move to the left, as shown in the drawings, to bring the contact 15 into engagement with the contact 16. When the armature 7 is
 45 raised by spring 8, the arm 12 again moves the switch member 13 to the right to break connection between the contacts 15 and 16.

From the above described arrangement, it will be seen that the switch member 13, while
 50 controlled in its movement by the armature 7, is not subject to vibration as, when the contacts 15 and 16 are closed, the arm 12 will be out of engagement with the end of the switch member 13, and while the arma-
 55 ture 7 will, or may, vibrate, and will certainly do so if the magnets are energized by alternating current, such vibration has no effect upon said switch member 13.

The numerals 17 and 18 indicate the main electric wires of which the wire 17 runs to a motor 19 and is connected by branch wires
 60 20 and 21 to one end of primary coils 22 and 23, respectively, of transformers 24 and 25. The wire 18 leads to the binding post 5 and
 65 through the contacts 3—3 and the second

binding post 5 to the motor 19. Branch wires 26—27 connect wire 18 to the respective coils 22 and 23 of the transformers 24 and 25. From the low-voltage side of the transformer 24, a wire 28 leads to an or-
 70 dinary spark coil 29, and from this spark coil a wire 30 leads to a spark plug 31. The ground connection is indicated at 32. The numeral 33 indicates a room thermostat which controls the current to the magnets
 75 10—11 according to the temperature of the room in which said thermostat is located. Current for the room thermostat circuit is supplied by the low-voltage side 34 of the transformer 25.

A wire 35 from the low-voltage side of transformer 24 runs to a spring contact member 36, which co-operates with an ad-
 80 justable contact member 37. The numeral 38 indicates a strip of thermostatic metal, which at its upper end is secured to a conducting plate 39 mounted on the board 1 and grounded at 40, and its lower end is provided with a contact 41 which is adapted,
 85 when the strip of thermostatic metal 38 is cold, to engage the spring contact member 36 and force it ultimately into engagement with the contact member 37. A wire 38^a connects the thermostatic metal 38 with the low-voltage side of transformer 25. When
 90 the contact 41 engages the contact 36, the current to the spark coil 29 will be completed through the strip of thermostatic metal 38 which is grounded at 40, one side
 95 of the spark coil 29 being also grounded at 32, as previously stated.

It is necessary that the mercury tube 2 be tilted to the right before current will flow to motor 14 and transformer 24.

Wound about the thermostatic strip of
 100 metal 38 is a coil 42 which is for the purpose of heating said thermostatic metal and causing it to move to the right to open certain circuits which will be described in detail later. The coil 42 is connected in parallel
 110 with the coils 43 of the magnets 10—11. The wire 44 of transformer 25 runs to coil 42, and the other wire 45 from said transformer runs through room thermostat 33 to one end of the coils 43 of magnets 10—11.
 115 The other end of the coils 43 is connected to the conducting plate 17^a, previously referred to, and from this plate a wire 46 leads to a conducting plate 47 on which the adjustable contact 37 is mounted. A wire
 120 48 runs from the switch member 13 to the ground connection 40, but has interposed in its length a thermostatic switch comprising a thermostatic bar 49 and a contact screw
 125 50. The thermostatic bar is located in suitable proximity to the burner 51 which supplies ignited fuel to the furnace 52 to be effected by the heat thereof, and when heated, it acts to close a contact between itself and the screw 50 to establish the circuit over
 130

the line wire 48. The electric motor 19 operates the air blower 53 and a fuel pump 54. A suction pipe 55 runs to a fuel tank (not shown) and the discharge pipe 56 is connected to a fuel spray nozzle 57.

When the motor 19 starts, fuel is pumped to spray nozzle 57 and air is furnished to the fuel spray by the blower wheel 53, and said fuel is ignited by the spark plug 31.

Assuming the mercury tube 2 is in the position shown and that the contacts 37, 36 and 41 are all in proper engagement with each other, upon closing of the thermostatic switch 33, current will flow from transformer 25 through the magnet coils 43 through contacts 37, 36 and 41, and through the coil 42 back to the transformer 25. The instant that current flows through the magnet coils 43, the armature 7 will be attracted by the magnets 10 and 11 and the tube 2 will tilt to the right, causing the mercury therein to flow to the end of the tube containing the contacts 3 and through said contacts to close the circuit to motor 19 and transformer 24. This transformer will furnish current to the spark coil 29, as before described. In the movement of the armature under the attraction of the magnets 10 and 11, the said armature will first engage the end of magnet 10 and then its outer end will be drawn downward by magnet 11, causing the spring 8 to slightly buckle, and insuring a sufficient tilt of the tube 2 to cause the mercury therein to flow to the end containing the contacts 3. When the armature 7 is attracted by the magnets, the arm 12 thereon will release the spring switch member 13 and permit it to engage the contact 16 whereby a parallel electric current from the magnet coils 43 to the coil 42 will be established over the wire 48 as soon as the heat of the burner actuates the thermostatic bar 49 to make engagement with contact 50. As soon as the thermostatic strip 38 has been heated by coil 42 to the proper temperature, said strip will move to the right and open the contacts 37, 36 and 41. That is to say, when the thermostatic strip moves to the right, the spring contact member 36 will also move to the right a small amount so as to be out of engagement with the end of the screw contact 37. The opening of these contacts 37 and 36 breaks the circuit of one of the parallel circuits to magnet coils 43 and coil 42, the circuit thus broken being that carried over the wire 46. The opening of contacts 41 and 36 breaks the circuit to the spark coil 29 over the wire 35. It will be seen, however, that current continues to flow through coils 42 and 43 because of the circuit established by contact of the switch member 13 with the contact 16 as before described. If the circuit to the room thermostat is broken, or if the main line current is shut off, no current will flow through the

magnet coils 43 or coil 42 and the mercury tube 2 will instantly tilt to the left under the influence of spring 8, and the circuit to motor 19 and transformer 24 will be instantly broken. The immediate closing of the room thermostat circuit, or of the main line circuit, will not start the motor until the thermostatic strip 38 has been cooled down sufficiently so that it will move to the left and establish the contacts at 41 and 36 and then at 36 and 37. With this arrangement, it is impossible at any time to turn on the motor 19 until the circuit to spark coil 29 has been closed by contacts 41 and 36. I usually set the thermostatic strip 38 so that it will close contacts 36 and 37 in from one to two minutes after current is shut off from coil 42. This feature of the invention, however, is claimed in my pending application Serial Number 602,291, filed November 20, 1922, and is only briefly referred to herein to make the general construction and operation of the device clear.

The electric safety feature afforded by the thermostatic switch 49, 50 is an important feature of the invention and is distinguished by the fact that this switch is closed by heat from the fire and is open when there is no heat; therefore, with this arrangement, the turning on of the burner depends on having the switch closed, and the turning off of the burner depends upon having the switch open. This yields the maximum of safety as compared to an electric safety device where the turning off of the burner depends on the making of the circuit rather than on the breaking thereof.

In order that the operation and the advantages of this safety device may be understood, let it be assumed that when the room thermostat circuit was closed and the circuit to the motor established, the spark plug failed to operate or, operating, failed to ignite the fuel. Under these circumstances, the thermostatic bar 49 would remain out of contact with the screw 50 and no circuit will have been established over the wire 48 by the release of the switch member 13 effected by the attraction of the armature 7. As soon, therefore, as the coil 42 had heated the thermostatic bar 38 to cause it to break the contacts at 37, 36 and 41, no current would pass through the coils 43, the circuit over the wire 48 being open, and hence the magnets would be de-energized and the spring 18 would cause the mercury tube 2 to tilt, and break the circuit to the motor 19. Thus, it will be seen that when the room thermostat circuit is closed, if the fuel fails to ignite, for any cause, the electrical control system described will automatically cause the operation of the motor to cease after a brief interval of time.

I claim:

1. In an electric control system for oil

burners, in combination with electrically-operated means for initiating and maintaining combustion, a control circuit therefor, a switch in said circuit normally closed when the burner is started and operating thereafter to open the circuit to said electrically-operated means, a safety device for controlling the operation of said electrically-operated means after the circuit thereto has been broken comprising an electric circuit including said electrically-operated means, and an automatic switch in said circuit normally open and operating, upon establishment of combustion, to close before said first named switch opens.

2. In an electric control system for oil burners, in combination with electrically-operated means for initiating and maintaining combustion, a safety-device for controlling the operation of said electrically-operated means comprising an electric circuit including said electrically-operated means, an automatic device controlling the operation of said electrically-operated means which is normally in position to permit the starting thereof, an automatic safety switch responsive to combustion conditions for controlling the operation of said electrically-operated means and maintaining the circuit thereto during the running period of said electrically-operated means, said automatic safety switch being adapted to co-operate, when closed, with said automatic device to permit the burner to continue to operate if combustion takes place, and, when open, to shut off the burner when there is no combustion, said automatic safety switch being normally open and operating upon the establishment of combustion to close, whereby upon the failure of combustion, the failure of said switch to close will permit the automatic device to render said electrically-operated means inoperative.

3. In an electric control system for oil burners, in combination with electrically-operated means for initiating and maintaining combustion, a circuit therefor controlled by a room thermostat, automatic means operating, after closing said circuit, to break the circuit to said electrically-operated means, and a safety device for controlling the operation of said electrically-operated means after the circuit thereto has been broken, comprising a second electric circuit including said electrically-operated means, and established in part by the initial actuation of the latter, and an automatic switch in said second circuit normally open and operating, upon establishment of combustion, to close, whereby, upon failure of combustion, the failure of said circuit to close will render said electrically-operated means inoperative.

4. In an electric control system for oil burners, in combination with a burner, electrically-operated devices for effecting the

operation of the same, an electric circuit including said devices, electrically-operated means controlling the making and breaking of said circuit, a room thermostat controlling the circuit to said electrically-operated means, automatic means operating to break the circuit to said electrically-operated means after it has been established by the operation of the room thermostat, a third circuit for controlling said electrically-operated means and established in part by the actuation of the latter to close the first named circuit, and automatic means responsive to combustion conditions normally holding said third circuit open and operating, upon establishment of combustion, to close the same, whereby upon the failure of combustion, the failure of said automatic means to close said last named circuit will render the system inoperative.

5. In an electric control system for oil burners, in combination with a burner, electrically-operated devices for effecting the operation of the same, a circuit therefor, a main control switch governing the circuit to said devices, an automatic switch which controls the operation of said main control switch, a parallel circuit which connects to said automatic switch and which is established in part by the closing of said main control switch, and when established, controlling the operation thereof, and a thermostatic switch located in proximity to the burner and actuated to be closed by the heat thereof and to open when there is no heat whereby, upon failure of ignition upon operation of the main control switch, the automatic switch will cause the main control switch to break the circuit to said devices.

6. In an electric control system for oil burners, in combination with electrically-operated means for initiating and maintaining combustion, a safety device for controlling the operation of said electrically-operated means, comprising an electric circuit including said electrically-operated means, an electrically-heated thermostatic device which is normally in position to permit the starting of the electrically-operated means, an automatic switch in the electric circuit and which is adapted to co-operate with said electrically-heated thermostatic device either to permit the burner to continue to operate if combustion takes place, or to shut off the burner if there is no combustion, said automatic switch being normally open and operating upon the establishment of combustion to close, whereby upon the failure of combustion, the failure of said switch to close will permit the electrically-heated thermostatic device to render said electrically-operated means inoperative.

7. In an electric control system for oil burners, in combination with a burner, electrically-operated devices for effecting the

operation of the same, a main control switch governing the circuit to said devices, an electro-magnet for actuating said switch, an electric circuit including said magnet, automatic means operating to establish said circuit to actuate said switch and thereafter to break the circuit, and safety means for controlling said switch comprising a parallel circuit including said magnet and having a thermostatic switch located therein in proximity to the burner and adapted to be closed by the heat thereof and to open when there is no heat, whereby, after the main switch has been closed to establish the circuit to said devices, should the fuel fail to ignite, when the first named circuit to said magnet is broken, the magnet will be de-energized by failure of the thermostatic switch to close the parallel circuit and said control switch will open to break the circuit to said devices.

8. In an electric control system for oil burners, in combination with a burner, electrically-operated devices for effecting the operation of the same, a main control switch

governing the circuit to said devices, an electro-magnet for actuating said switch, an automatic switch in said electro-magnet circuit which is normally closed and which is adapted to automatically open in a short time after said main control switch is closed, and safety means for controlling said main switch comprising a parallel circuit including said magnet and having a thermostatic switch located therein in proximity to the burner and adapted to be closed by the heat thereof and to open when there is no heat, whereby, after the main switch has been closed to establish the circuit to said devices, should the fuel fail to ignite, when the circuit to said magnet is broken, the magnet will be de-energized by the failure of the thermostatic switch to close the parallel circuit, and said main control switch will open to break the circuit to said devices.

In testimony whereof, I have hereunto set my hand.

LEWIS L. SCOTT.