April 5, 1932. C. L. RAYFIELD 1,851,983

BURNER CONTROL

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Fig. 1.

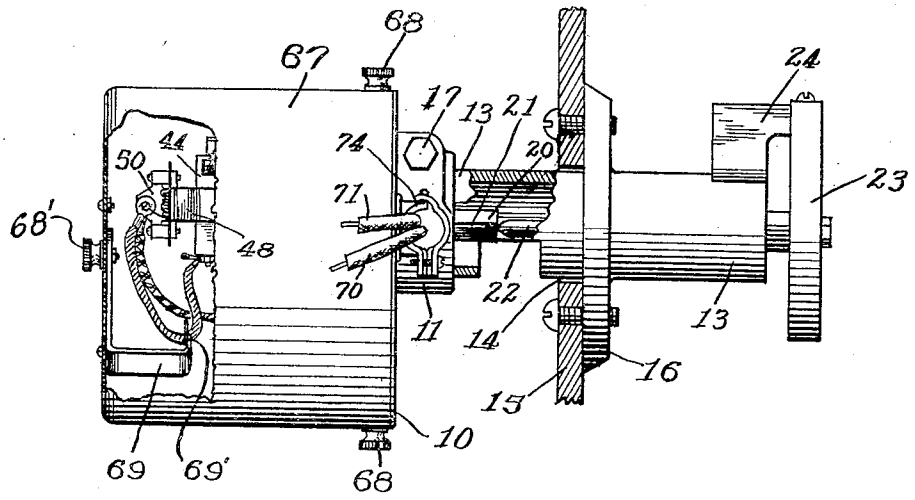

Fig. 6.

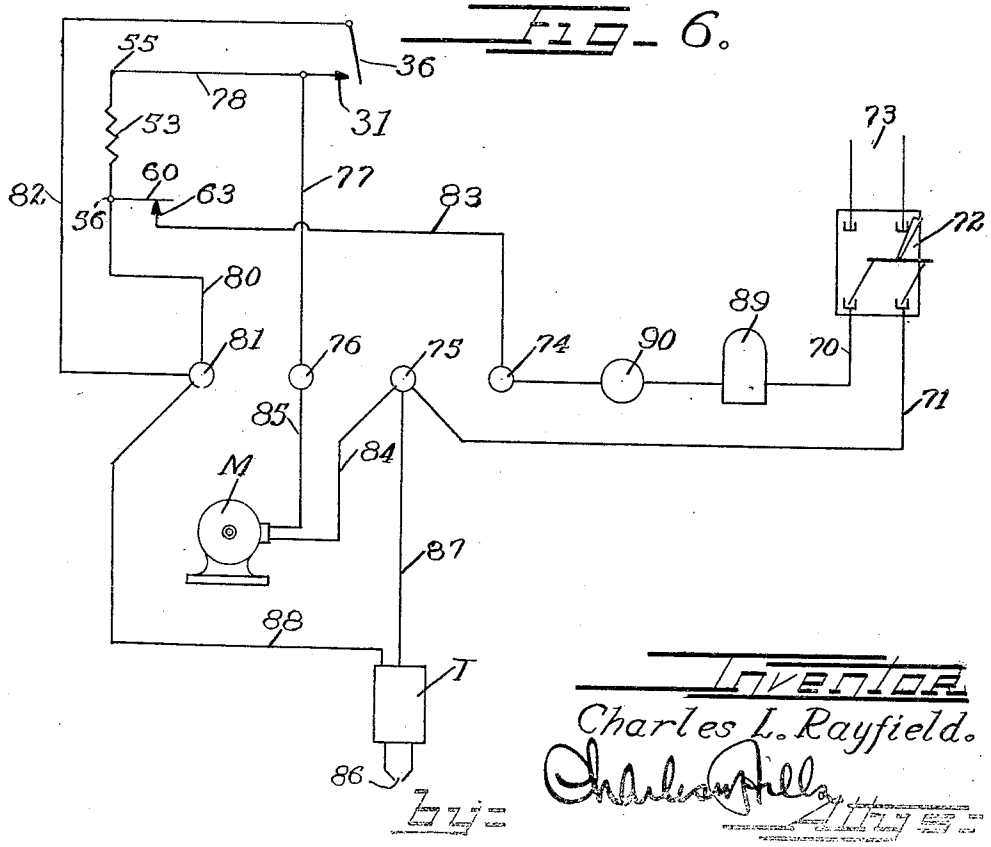

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Fig. 2.

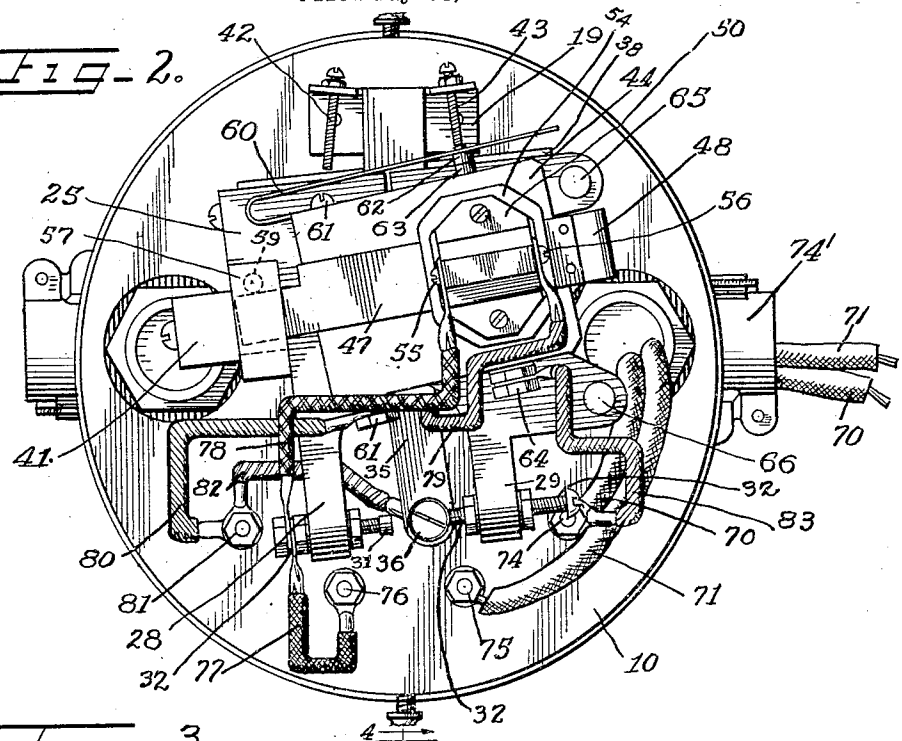

Fig. 3.

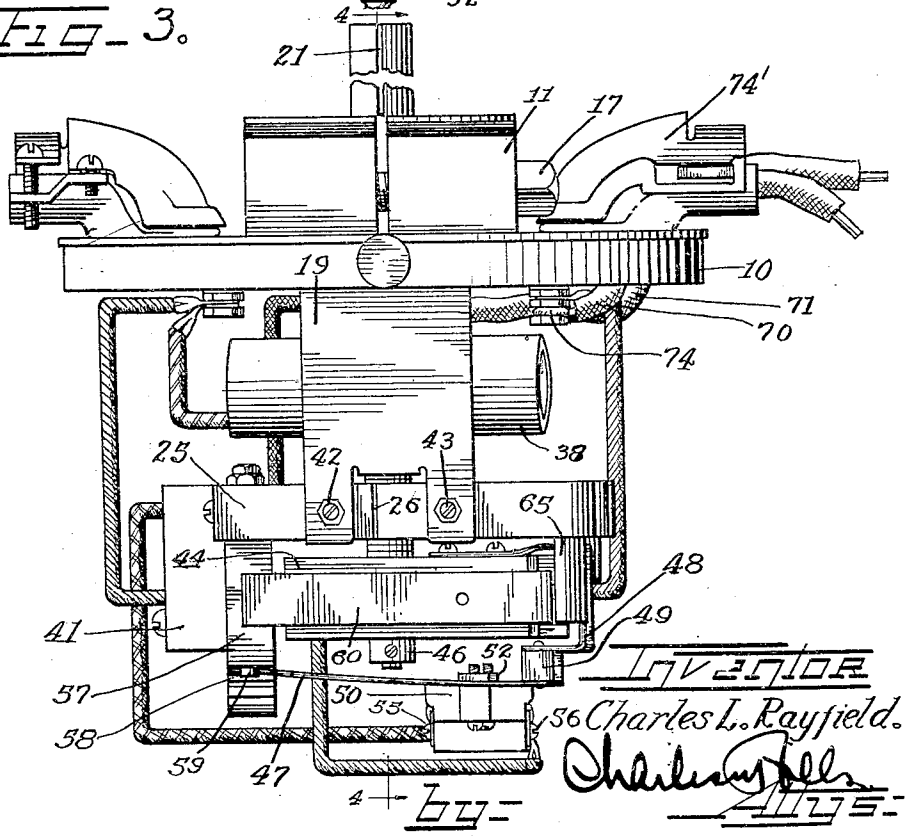

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Fig. 4.

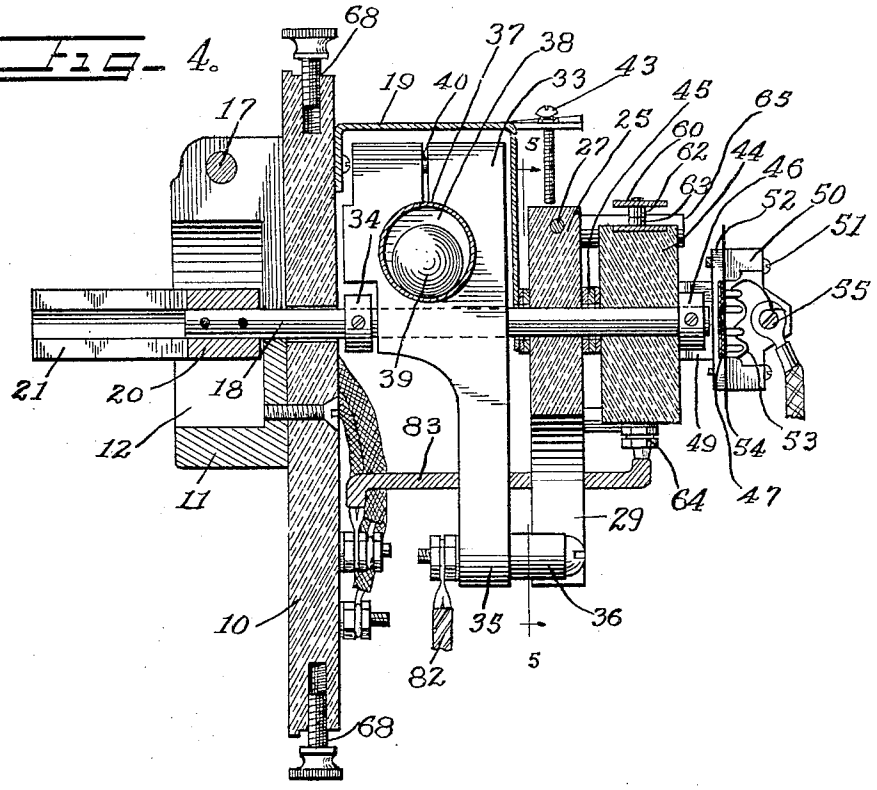
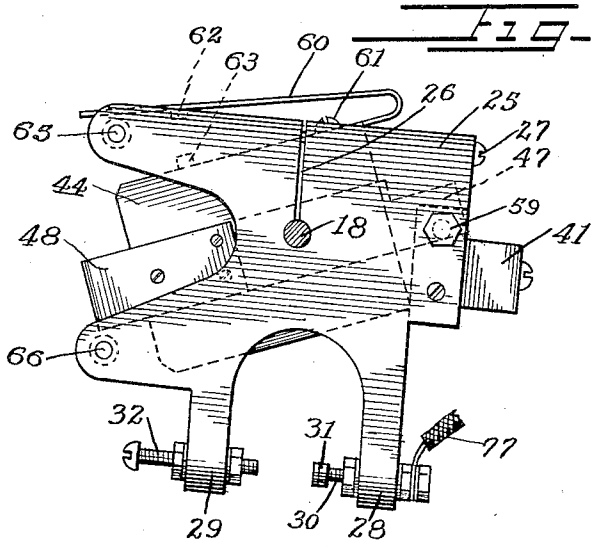


Fig. 5.



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Patented Apr. 5, 1932 1,851,983

UNITED STATES PATENT OFFICE

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BURNER CONTROL

Application filed May 31, 1930. Serial No. 453,241.

My invention relates to a burner control of the same general character as that described and disclosed in my co-pending patent application Serial No. 219,652, filed September 15, 1927, and is particularly applicable to heating devices in which the combustion element is gas or the vapor of fuel oils.

An important object of the invention is to provide simple, compactly arranged switch mechanisms thermostatically controlled to automatically adjust the current supply circuit for the fuel delivery motor so that efficient and safe operation of the heating device will result.

A further object is to reduce the number of switch actions to a minimum and to eliminate delicate switch elements, such as mercury switches.

A still further object is to provide simple means for efficiently and quickly making and breaking the controlling circuits.

The above enumerated and other features of the invention are incorporated in the structure shown on the accompanying drawings.

Referring to the drawings,

Figure 1 is a side elevation, partly in section, of the electrical and thermal controlling apparatus mounted on a furnace wall;

Figure 2 is a front elevation of the apparatus mounted on a base from which the enclosing cover has been removed;

Figure 3 is a plan view of the apparatus;

Figure 4 is a section on plane IV—IV of Figure 3;

Figure 5 is a section on plane V—V of Figure 4; and

Figure 6 is a diagram of the circuit connecting the various electrical and thermal elements.

The electrical, thermal, and other elements forming part of my improved control are compactly mounted on a base 10 which is preferably of insulating material and to the back of which is secured a supporting block or frame 11 having the cylindrical opening 12 for receiving the cylindrical outer end of a tubular frame 13. As shown in Figure 1, this tubular frame extends through an opening 14 in the wall 15 of the furnace to be supplied, and the frame has a flange 16 by means of which it is rigidly secured to the wall. The frame 11 is split, as clearly shown in Figures 3 and 4 and receives a screw 17 by means of which the frame may be securely contracted around the tubular frame 13 to rigidly secure the frames together.

The frame 11 is mounted a distance above the center of the base 10 which is cylindrical, and extending through the frame 11 and the base 10 is the shaft 18, the frame 11 forming a bearing for the shaft. An inverted U-shaped bracket 19 is secured to the front side of the base 10 and extends downwardly to receive the shaft 18 at an intermediate point to form a bearing support therefor.

Extending from the outer end of the shaft 18 is a coupling sleeve 20 having channels or slots 21 for receiving the outer splined end of a rod 22 which extends inwardly through the frame 13 and is secured to the inner end of a thermostat element 23 which is of clock-spring shape and which has its outer end secured to a bracket 24 on the frame 13. Response of the thermostat element 23 to temperature changes will result in rotation of the rod 22 and of the shaft 18.

Mounted on the shaft 18 just outside of the bracket 19 is a setting member or frame 25, preferably of insulating material, which frame, above the shaft, has the slit 26 and receives a screw 27 so that the frame may clamp the shaft with more or less friction, in order that, when the frame is unobstructed, rotation of the shaft will rotate the frame, but when the frame is stopped, the shaft may continue to rotate. This is for the purpose of relieving the thermostat element 23 from strain and to permit further contraction or expansion thereof after it has served the purpose of rotating the shaft to position the setting member.

At its lower end, the setting frame 25 is cut away to leave the opposed legs 28 and 29. The leg 28 supports an adjustable contact screw 30 having a contact point 31, while the leg 29 supports an adjustable stop screw 32.

Mounted on the shaft 18 between the outer wall of the bracket 19 and the base 10 is a switch member or frame 33 which may freely

rotate on the shaft and whose longitudinal movement is restrained by the bracket 19 and the collar 34 on the shaft. The frame has the depending arm 35 from which the contact post 36 extends into position between the contact point 31 and the stop screw 32 on the setting member 25. Above the shaft 18, the switch frame 33 has the transverse bore 37 for receiving the closed tube 38 containing a ball weight 39. The frame above the tube is split and is drawn together by a screw 40 to securely clamp and hold the tube. The tube extends beyond each side of the frame and, when the frame is swung, the ball will move to the lower end of the tube and will tend to hold the frame in its swung position.

The setting frame 25 has a weight 41 secured thereto on the side from which the leg 28 extends which supports the contact 31, so that the frame will tend to rotate to carry the contact point 31 against the terminal post 36 and to swing the switch frame 33 beyond its center line so that the ball will roll in the tube and will tend to hold the switch frame with the terminal post against the stop screw 32. The swing of the setting frame 25 is limited by stop screws 42 and 43 threading through the top of the bracket 19. The adjustment of the screw 43 is such that the setting frame 25 may be swung by its weight 41 a distance sufficient to swing the switch frame 33 beyond its neutral line so that the ball weight 39 may continue the movement of the switch frame to carry the contact post 36 against the stop screw 32 and away from the contact point 31. The stop screw 42 permits rotation of the setting frame in the opposite direction a sufficient distance to swing the switch frame through its neutral line so that the ball weight may then continue the movement of the switch frame to carry the terminal post 36 away from the stop screw 32 and against the contact point 31.

The arrangement of the thermostat element 23 is such that, when it becomes cool, it will cause rotation of the rod 22 in counterclockwise direction (Figure 2). Rotation of the rod 22 will rotate the shaft 18, and the frictional engagement of the shaft 18 with the setting member, assisted by the weight 41 on the setting member, will swing this member in counterclockwise direction, this resulting, as has just been explained, in swinging the switch frame 33 to carry the terminal post 36 away from the contact point 31 and against the stop screw 32. When the thermostat element 23 is heated, the rotation of the shaft 18 will be in the opposite direction and against the weight 41, and the terminal post on the switch frame will be moved away from the stop screw 32 and against the terminal point 31. After swing of the setting member to either of the setting positions, the shaft 18 may continue to be rotated by the thermostat element on account of the friction engagement between the shaft 18 and the setting member.

It will be noted that, although the setting member 25 may be comparatively slowly swung, the switch frame 33, after being carried through its neutral line by the setting member will then be rapidly swung by the ball weight into either of its positions to thus cause quick make and break of circuits to be controlled and to reduce to a minimum any sparking between the terminal post 36 and the contact point 31.

Mounted to freely rotate on the shaft 18 in front of the setting member 25 is a block 44 of insulating material which forms part of safety switch mechanism. The block is restrained against extended longitudinal movement on the shaft by a washer 45 and a collar 46. The shaft 18 receives the block at one side thereof, so that the right end of the block (Fig. 2) is heavier and tends to swing the block in clockwise direction.

Extending across the front of the block 44 is a bi-metallic, thermal-responsive strip 47 which extends from the front leg of a U-shaped supporting bracket 48 secured by its rear leg to the rear side of the block. This bracket 48 is also formed of a bi-metallic, thermal-responsive strip, but the arrangement is such that the thermal response of the strip 47 and bracket 48 will be in opposed directions in order that any tendency of the strip 47 to respond to ordinary atmospheric changes of temperature will be counteracted by the response of the bracket 48 to such temperature variations. The supporting connection between the bracket 48 and the strip 47 may be by means of a small block 49 (Fig. 3).

A heater structure is secured to the bi-metallic element 47 and comprises a block of insulating material 50 clamped against the front face of the element by screws 51 and a bar 52 engaged across the back of the strip. The block has grooves supporting a heating coil 53, and a plate of mica or other insulating material 54 is interposed between the block and the strip to prevent electrical contact of the coil with the strip. The block has terminal screws 55 and 56 receiving the ends of the heating coil so that it may be readily connected in circuit. The bi-metallic strip 47 is so arranged that, when heated by the heating coil, it will flex forwardly.

Extending forwardly from the left side of the setting member 25 is an arm 57 having a vertical slot 58 at its outer end for receiving the end of the bi-metallic element 47 to limit the deflection thereof. Threading through the arm 57 is a rod 59 whose outer end projects a distance into the slot 58 to be above the free end of the bi-metallic element 47 when such element is deflected inwardly, so that this rod will thus form a stop to prevent swing of the block 44 by gravity and inde-

pendently of the swing of the setting member 25. When the bi-metallic element is deflected forwardly upon being heated by the heating coil, it will release itself from the rod, so that the unbalanced block 44 will rotate clockwise (Fig. 2).

On top of the block 44 a U-shaped switch spring 60 is secured by its shorter leg by means of a screw 61 extending through the block. The upper longer leg of the spring extends laterally across the block and near its free end has a contact point 62 for contacting with a terminal contact 63 at the end of a bolt 64 extending through the block (Fig. 2). The switch spring is tensioned so that, when unrestrained, it will hold its contact 62 against the terminal contact 63. However, when the block 44 is rotated independently of the setting member 25, the free end of the switch spring will encounter a post 65 projecting forwardly from the adjacent end of the member 25, and the switch spring will then be restrained while the block 44 continues its rotation, and the spring contact will be separated from the terminal point 63, as shown in Figure 5. The post 65 may serve also as a stop to be engaged by the bi-metallic member 48 on the block 44 to limit the swing of the block in counterclockwise direction, while a post 66 extending forwardly from the setting member 25 will be engaged by the member 48 to limit the clockwise rotation of the block 44. It will be noted that, when the bi-metallic element 47 is deflected forwardly to unlatch itself from the rod 59, and the block 48 rotates, the element will remain in front of the rod so that, when it is deflected rearwardly upon cooling, it will engage its inner face against the end of the rod, so that, when the block 48 is restored, the element will pass along the end of the rod and will then swing back into latching position under the rod.

Referring to Figure 1, a protecting housing 67, which may be in the form of a metal shell, is provided for the apparatus and seats on the base 10 and is detachably secured by means of thumb screws 68. Pivoted to the outer wall of the housing is a resetting lever 69 which may be turned by means of a button 68′ to engage its end 69′ against the right end of the bi-metallic structure to thereby swing the block 44 in counterclockwise direction to reset the bi-metallic element 47 in latching engagement with the rod 59.

On Figure 6, I diagrammatically represent the various operating elements of the control and the electrical circuit connection therefor. The supply conductors 70 and 71 are connected by a line switch 72 with a current supply circuit 73. The conductors 70 and 71 extend through a pipe fitting 74′ and connect respectively with the terminal posts 74 and 75 mounted on the base 10. The terminal post 76 on the base is connected by conductor 77 with the screw 30 which terminates in the contact point 31. This contact point is connected by a conductor 78 with the terminal 55 of the heating coil 53, whose other terminal 56 is connected by a conductor 79 with the terminal screw 61 connecting with the switch lever 60. This terminal screw 61 is connected by a conductor 80 with the binding post 81 on the base 10. A conductor 82 connects this binding post with the terminal post 36 on the switch frame 33. The terminal screw 64, terminating in the contact point 63 for the switch lever 60 is connected by conductor 83 with the terminal post 74 on the base 10.

The motor M for driving the means for projecting the oil or gas into the furnace is connected by conductors 84 and 85 with the terminal posts 75 and 76 on the base 10, and a transformer T for producing ignition sparks at the points 86 is connected by conductors 87 and 88 with the binding posts 75 and 81 on the base 10.

The spark points 86 are located to ignite the gas or vapor issuing from the burner or nozzle in the furnace, and the thermostat element 23 is located in close proximity to the burner or nozzle so as to be subjected to the heat therefrom after ignition takes place. A house thermostat 89 of any of the well-known types may be included in one of the supply conductors, and, where the heating device is a boiler, a suitable device 90 may be included in the circuit for automatically opening the supply circuit as, for example, when the boiler water falls below a certain predetermined level, or when the steam temperature or pressure reaches a certain predetermined maximum.

Describing now the operation, suppose that the heating device to be served is cold. When the thermostat element 23 cooled after its last heating, it rotated the shaft 18 in counterclockwise direction (Fig. 2) to swing the setting member 25 in the same direction and to thereby cause swing of the switch frame 25 by the ball weight 27 to disengage the contact post 36 from the contact point 31 and to hold it against the stop 32, as shown in Figure 2. When the line switch 72 is now closed, current will flow through the conductor 70, the control devices 89 and 90, conductor 83 to the contact point 63 of the safety switch, and, as this switch is at this time latched in normal position by the rod 59, the current will continue through the switch contact 62 and the switch spring 60, then through the heating coil 53, conductors 78, 77 and 85 to the motor M, and from the motor through conductor 84 to the supply conductor 71. The motor will now set the oil or gas delivery apparatus in operation. At the same time, a branch circuit delivers current through the transformer T, this circuit extending from the binding post 74 through

conductor 83, switch 60, conductors 80 and 88, the transformer, and the conductor 87 to the supply conductor 71, and this circuit bridges or shunts the motor and the heater coil. The ignition sparking is thus produced as soon as the motor is connected in circuit, and the projected gas or oil is ignited.

The current flow through the heating coil generates heat which is transmitted to the bi-metallic thermostat element 47 which thereupon starts to flex forwardly, but, if everything is in proper condition, the main thermostat element 23 will respond more quickly to the heat of the furnace and will cause rotation of the shaft 18 in clockwise direction (Fig. 2), so that before the thermostat element 47 becomes effective to unlatch the switch block 44, the setting member 25 will be rotated in clockwise direction by the shaft 18 to cause swing of the switch member 25 to carry its terminal post 36 into engagement with the contact point 31, and then the short circuit comprising the conductors 80, 82 and 77, is closed around the heating coil, which, being then deprived of its current flow, will cool off so that the thermostat element 47 will be held latched. The switch 60 which is included serially in the supply circuit will then remain closed and current will continue to flow through the motor. When this short circuit is closed, the transformer will be directly bridged around the motor and will continue to receive current flow for supplying ignition sparking.

The heating coil 53 is accurately dimensioned, so that, under the current flow from the supply circuit with which the control is connected, a predetermined time will expire before the thermostat element is sufficiently heated to unlatch itself. It will also be noted that the latch rod 59 is adjustable to cause delay or advance of the unlatching of the thermostat element 47.

If, for any reason, the main thermostat element 23 fails, after closing of the supply circuit, to cause closure of the short circuit around the heating coil before the generated heat becomes effective to unlatch the thermostat element 47, the released or unlatched switch block 44 will swing by gravity, and, upon such swing, the end of the safety switch 60 will encounter the stop post 65 and the terminal 63 will be withdrawn from the switch contact 62 and the supply circuit to the motor will be opened, so that further supply of gas or oil to the heating device will be stopped. For example, the motor might start after closure of the supply circuit by the line switch 72, but the transformer would fail to function. The gas or oil delivered to the furnace would then not be ignited and the main thermostat element 23 would not be heated, and flooding or gas accumulation would result, and there might be a violent explosion should the spark suddenly become operative. However, as explained, failure of the thermostat 23 to function will keep the heater coil effective and the safety switch structure will become unlatched and will cause opening of the supply circuit for the motor, which then stops.

It might also happen that, after a period of efficient operation of the heating device and control apparatus, the flame would become extinguished, as, for example, by the failure of proper oil or gas supply to the burner or nozzle. The main thermostat element 23 would then cool and set the control apparatus to effect opening of the short circuit around the heating coil, which would then become effective to cause unlatching of the safety switch and opening of the switch and the motor supply circuit.

It may also happen that the main thermostat element 23 becomes defective. It might break or become detached from the rod 22 and, consequently, from the shaft 18. Under these conditions, the weight 41 on the setting member 25 will swing the setting member and cause disconnection of the switch member 25 from the contact point 31, so that the short circuit around the heating coil will be opened and the coil will function to supply heat to cause unlatching of the safety switch, with consequent opening of the motor supply circuit.

It is understood, of course, that the house thermostat 89 will open the motor supply circuit when the temperature in the room reaches the predetermined maximum, and likewise, the control device 90 will open the motor supply circuit, as for example, when the water in the boiler becomes too low for the steam temperature or pressure reaches a predetermined maximum.

My improved burner control is of simple and compact arrangement, and the various parts therefor can be economically manufactured and assembled. It will be noted that delicate switch elements, such as mercury switches, have been eliminated, and simple, rugged and durable circuit-controlling or switch elements have been provided. The easily rotatable switch member 25, which controls the short circuit for the heating coil causes quick make and break of the controlling circuits by means of the ball weight 27. Likewise, the overbalanced safety switch structure 44, when unlatched, quickly breaks the motor supply circuit. In my improved control apparatus, the parts therefor accurately retain their adjusted conditions and cannot readily become out of order.

It is evident, of course, that changes and modifications, both in construction, arrangement and operation, may be made without departing from the scope and principles of the invention, and I, therefore, do not desire to be limited except as is specified in the appended claims.

I claim as follows:

1. In a switch mechanism, the combination of a shaft, a setting member mounted on said shaft to rotate therewith, abutment arms on said setting member, a switch member mounted on said shaft to swing freely thereon and having a circuit contact extending therefrom between said abutment arms, rotation of said setting member causing engagement of its abutment arms with said contact to cause swing of said switch member to either side of a neutral line, means associated with said switch member for continuing the swing thereof after setting thereof by the setting member, and a contact on one of said abutment arms for cooperating with said switch member contact.

2. In a switch mechanism, the combination of a rotatable shaft, a setting member mounted on said shaft to rotate therewith, a safety switch structure, latch means normally connecting said switch structure to rotate with said setting member, thermally controlled means for effecting unlatching of said switch structure from said setting member, means for swinging said unlatched switch structure independently of said setting member, an abutment in the path of the swinging switch structure, and circuit contacts separated upon engagement of said switch structure with said abutment.

3. In a switch mechanism, the combination of a shaft, a setting member mounted to rotate with said shaft, a switch block, latch mechanism normally connecting said block to rotate with said setting member, thermally actuated means for releasing said latch, means tending to swing the unlatched switch block, a switch mounted on said block, and an abutment on said setting member engaged by said switch when said block rotates to thereby cause actuation of said switch.

4. In a switch mechanism, the combination of a shaft, a setting member mounted to rotate with said shaft, a switch frame pivoted adjacent to said setting element, said frame being overbalanced and tending to swing in one direction relative to said setting member, a latch projection on said setting member, a thermostatic latch member normally engaging said latch extension to hold said frame from swinging, an electrical heating element for said thermostatic latching member, heating of said latch member causing disengagement thereof from said latch projection thereby permitting rotation of said frame, a switch on said switch frame, and an abutment on said setting member engaged by said switch when said frame rotates to thereby cause actuation of said switch.

5. In a switch mechanism, the combination of a pivoted frame, said frame being overbalanced and tending to swing downwardly, a thermostatically controlled latch normally holding said frame up, thermal means responsive to current flow for heating said thermostat latch mechanism to cause unlatching of said frame whereby said frame will swing downwardly, a circuit terminal on said frame, a switch spring mounted on said frame and normally engaging said circuit terminal, and an abutment in the path of said spring engaged thereby when said frame swings to be thereby separated from said terminal contact.

6. In a switch mechanism, the combination of a rotary shaft, a thermostat member responsive to changes in temperature to rotate said shaft, switch mechanism actuated by the rotation of said shaft, an auxiliary switch and a pivoted supporting frame therefor, said frame being overbalanced and tending to swing downwardly when released, a thermostat controlled latch normally holding said frame up, a heating coil responsive to current flow for heating said thermostat latch controlling mechanism to cause unlatching of said frame, a short circuit closed around said heating coil when said shaft controlled switch mechanism is actuated by the rotation of the shaft in one direction, said short circuit being opened when said shaft is rotated in the opposite direction, said auxiliary switch being closed when said frame is held in latched position, and an abutment cooperating with said auxiliary switch to cause opening thereof when the unlatched frame swings down.

7. In a switch mechanism, a rotary element, a member movable by said element including a contact on one side of the element and tilting means on the other side of the element for forcing said contact into either one of two positions, contact means for engaging said contact when it is in one of said positions, switch means associated with said element and electro-thermal means for opening said switch means upon a failure of said element to move said contact to the position in which it is in engagement with said contact means.

8. In a switch mechanism, a rotary element, a member movable by said element including a contact on one side of the element and tilting means on the other side of the element for forcing said contact into either one of two positions, contact means for engaging said contact when it is in one of said positions, switch means associated with said element and electro-thermal means for opening said switch means upon a failure of said element to move said contact to the position in which it is in engagement with said contact means, said tilting means including a tube having therein a ball rollable in said tube over the axis of said element to effect movement of said contact.

9. In a switch mechanism, a rotary element, a member movable by said element including a contact on one side of the element and tilting means on the other side of the

element for forcing said contact into either one of two positions, contact means for engaging said contact when it is in one of said positions, switch means associated with said element and electro-thermal means for opening said switch means upon a failure of said element to move said contact to the position in which it is in engagement with said contact means, said electro-thermal means including a bi-metallic latch for normally maintaining said switch means in a closed position and a heater coil for releasing said latch to permit of the opening of said switch means.

10. In a switch mechanism, a rotary element, a member movable by said element including a contact on one side of the element and tilting means on the other side of the element for forcing said contact into either one of two positions, contact means for engaging said contact when it is in one of said positions, switch means associated with said element, electro-thermal means for opening said switch means upon a failure of said element to move said contact to the position in which it is in engagement with said contact means, and manual means for closing said switch means upon an opening of the same by said electro-thermal means.

In testimony whereof I have hereunto subscribed my name at Chicago, Cook County, Illinois.

CHARLES L. RAYFIELD.