

April 2, 1940.

R. W. HALLENBECK ET AL

2,195,649

OIL BURNER

Filed Aug. 6, 1937

3 Sheets-Sheet 1

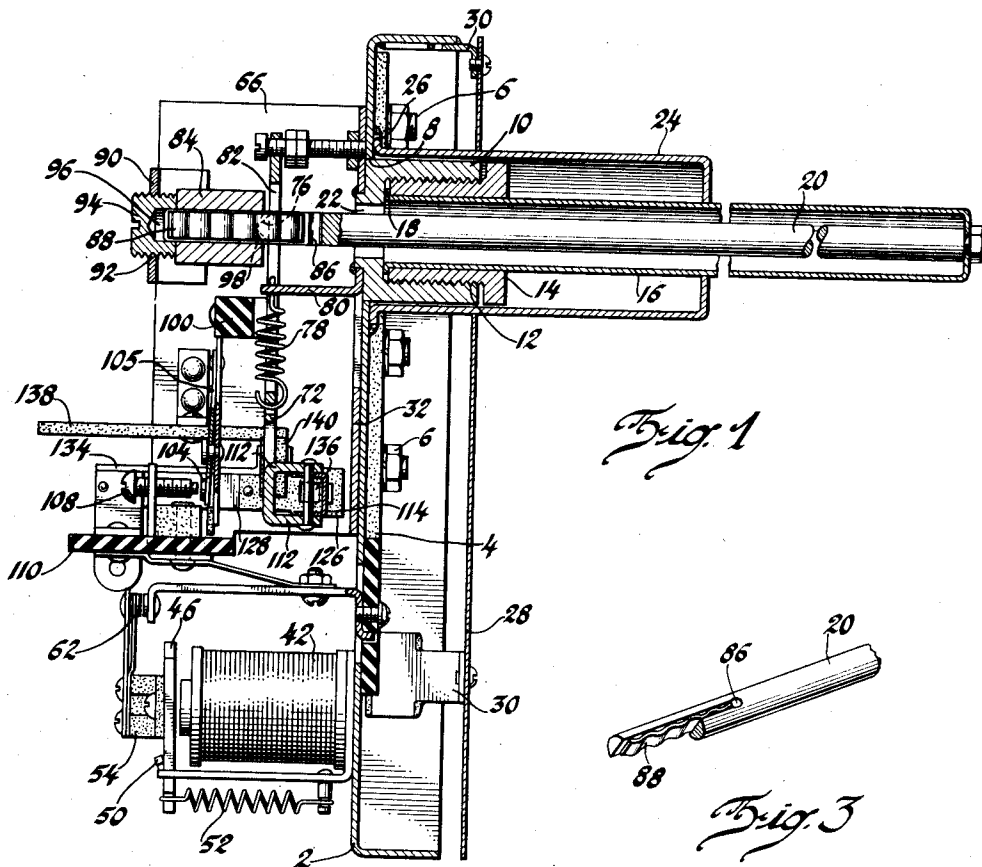


Fig. 1

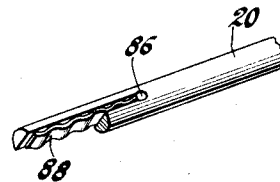


Fig. 3

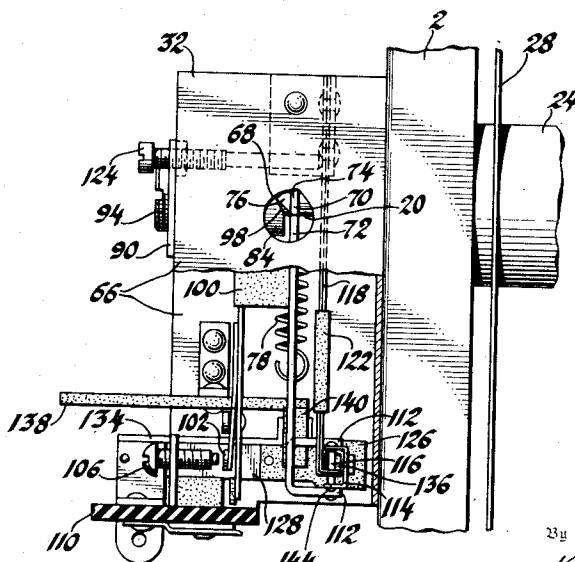


Fig. 2

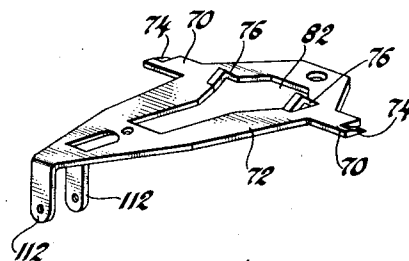


Fig. 4

Inventors
Richard W. Hallenbeck &
Franklin R. Stees

By Blackman, Spencer & Smith
Attorneys

April 2, 1940.

R. W. HALLENBECK ET AL

2,195,649

OIL BURNER

Filed Aug. 6, 1937

3 Sheets-Sheet 2

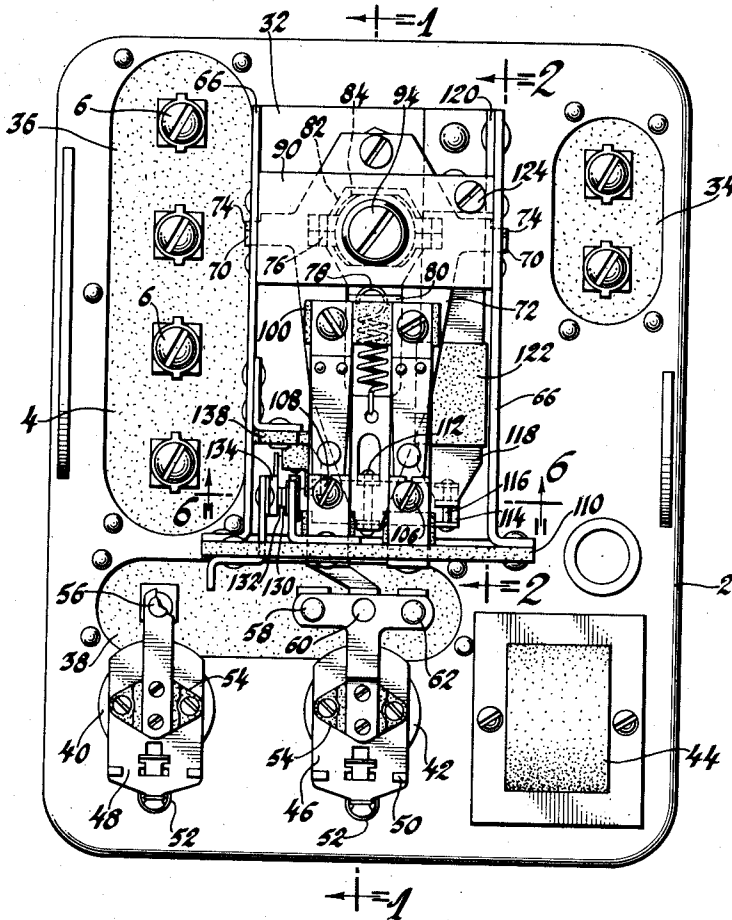


Fig. 5

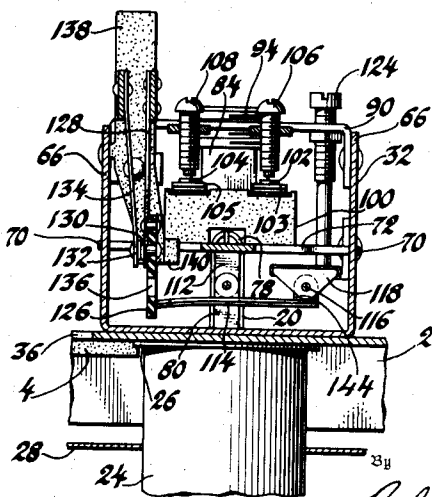


Fig. 6

Inventors
Richard W. Hallenbeck &
Franklin P. Stees

Blackman, Spencer & Clark
Attorneys

April 2, 1940.

R. W. HALLENBECK ET AL

2,195,649

OIL BURNER

Filed Aug. 6, 1937

3 Sheets-Sheet 3

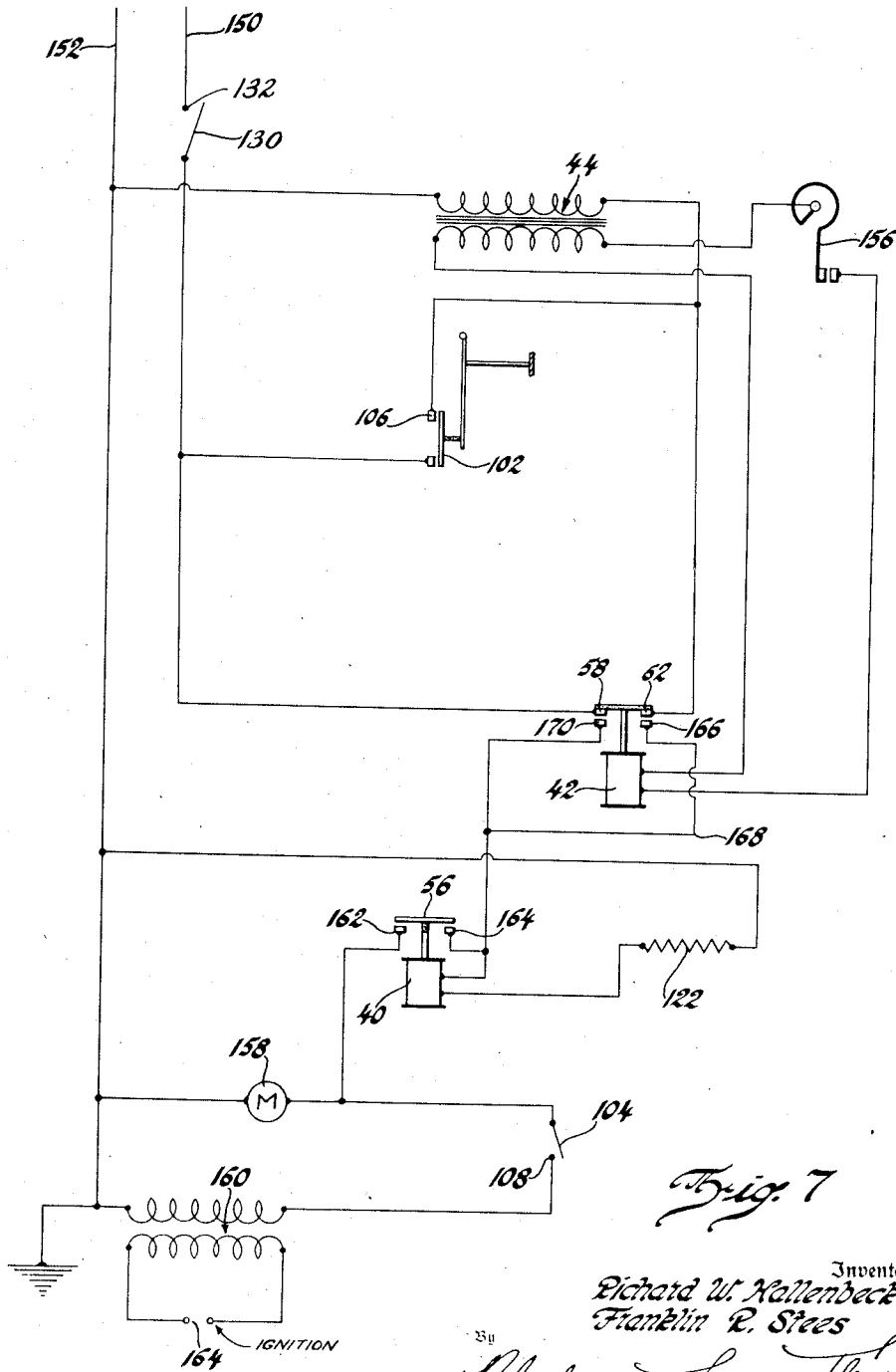


Fig. 7

Inventors
Richard W. Hallenbeck &
Franklin R. Stees

Blackwelder, Spencer & Thum
Attorneys

UNITED STATES PATENT OFFICE

2,195,649

OIL BURNER

Richard W. Hallenbeck and Franklin R. Stees,
Rochester, N. Y., assignors to General Motors
Corporation, Detroit, Mich., a corporation of
Delaware

Application August 6, 1937, Serial No. 157,676

11 Claims. (Cl. 200—137)

This invention relates to control apparatus and more specifically to apparatus for controlling automatically the operation of a fluid fuel burning system for domestic use.

With the advents of gas and oil fire furnaces for domestic use, it has become necessary to provide therefor suitable controls automatically regulating the operation so that the householder would have practically nothing to do but to turn on the main control switch in the fall of the year and open the same switch in the spring. Of course, the broad control of operating either a fuel valve or motor propelling fuel into the combustion chamber by a master thermostat is old. This thermostat merely causes the source of heat to operate when the temperature falls below a predetermined level and to open the circuit to the source of heat when the temperature has risen above that same level.

When this type of apparatus is, however, installed in a domestic residence, it is necessary to provide against any abnormal operation which may arise, especially since the people present in the home are probably not conversant with the construction or operation of the device. It is, therefore, necessary to provide safety features which will automatically cause the burner to go to a safety position in case that at first the burner does not start initially after a predetermined interval; second, when there is a flame failure after the burner is operating normally, and third, where there is a current failure during normal operation. It is, therefore, an object of our invention to provide a control system fulfilling the above requirements.

It is a further object of our invention to provide simple, serviceable apparatus for control.

It is a still further object of our invention to provide a master control unit which will be very sensitive and yet not of delicate parts.

With these and other objects in view, which will become apparent as the specification proceeds, our invention is set forth in the following specification and claims and illustrated in the accompanying drawings, in which:

Figure 1 is a vertical section through a master control of our invention, taken on line 1—1 of Figure 5.

Figure 2 is a sectional view taken on the line 2—2 of Figure 5.

Figure 3 is a detail perspective view with parts broken away showing the friction rod.

Figure 4 is a perspective view showing the knife edge switch member.

Figure 5 shows an end view of the elevation of a master control of our invention.

Figure 6 is a sectional view taken on line 6—6 of Figure 5.

Figure 7 is a schematic wiring diagram of our control system.

Referring now more specifically to Figure 1, a flange supporting plate 2 is provided as a main member of our master control. Supported along one face of the member plate 2 is an insulating plate 4 secured thereto as by rivets and provided with suitable terminal bolts 6. Adjacent one end of the plate 2 is provided a circular opening 8 in which is suitably rigidly secured a hollow sleeve member 10, the inner surface of which is threaded toward one extremity as shown at 12, and into which is threaded a thimble 14 within which is carried one end of a tubular member 16. One end of the member is flanged as shown at 18 and is, therefore, tightly pinched between the member 14 and the member 10 to secure it in place. The member 10 is secured within the opening 8 due to the fact that it is rigidly secured to a large flat plate 32 which lies parallel with and is secured to the plate 2.

Within the tube 16 is supported an Invar rod 20, the opposite end of which is supported by a guide so as to maintain the rod at substantially the center of the opening 22 in the member 10 with its end attached to the end of the tube 16. Suitably secured over the rear portion and concentric with the tube 16 is a larger protective tube 24 which has its base flanged as shown at 26 and secured to the backing plate 2. This protects the inner end of the members supporting the tube 16.

Also supported in spaced relation and parallel to the plate 2 is a protective plate 28 supported by suitable spaced brackets 30 at various intervals around the perimeter. There are provided at various intervals in the plate 2 as shown best in Figure 5 a plurality of openings 34, 36, and 38 so that the insulating plate 4 will be available therethrough and any desired contact members may be supported within these areas.

A plurality of relay magnet coils such as 40 and 42 are mounted on the panel 2 adjacent the lower edge thereof in alignment therewith. There is also provided a small transformer 44. The relays are provided with armatures 46 and 48 which are pivoted adjacent their lower portion as shown at 50 and spring biased by such springs as 52 to maintain them in a position to move from the coil. Each of these armatures carries suitable insulating blocks 54 and contact members

56, 58, 60 and 62 which cooperate with stationary contacts mounted on the insulating backing plate 4.

Two opposite edges of the plate 32 are bent forwardly to lie at right angles to the remainder of the plate and provide members 66 which form side plates for the switch apparatus operated by the Invar rod 20. In each of these side plates there is provided openings 68 which are in alignment with each other and which are non-circular, being drawn somewhat to a point at their upper extremity and within which fit the opposite ends of the two arms 70 which project from the main portion of a switching member 72 which is best shown in Figure 4.

The arms 70 are drawn to a knife edge 74 and are provided adjacent their center with two other raised pointed portions 76 at right angles to the first knife edges, all four of which act as fulcrums in the operation of the device. The arms 70, as before mentioned, extend into the openings 68 and are spring biased against the upper pointed portion of the openings by a suitable spring 78, the opposite end of which is connected to a projecting arm 80 on plate 32. Thus the member may rotate about the two knife edges 74 which act as a pivot in a horizontal plane.

The Invar rod 20 extends through the central opening 82 in the plate 72 and then enters a graphite bronze sleeve 84 which is a snug fit but which is adapted to slide longitudinally on the rod under varying conditions. The portion of the rod extending through the sleeve 84 is split as shown at 86 and there is inserted in the slot an expansion spring 88 adapted to bias the two sides of the rod away from each other and toward the inner surface of the graphite bronze sleeve.

Extending between the two side plates 66 near the upper portion thereof is a suitable cross member 90 secured thereto by rivets and adjacent the center of this member 90 is a circular threaded opening 92 in which is inserted a plug 94, the portion facing the inner casing being hollow as shown at 96 and acting as a bearing for the end of the Invar rod 20. The plug 94 is threaded and adjustable in order to engage one end of the sleeve 84 and limit the movement of sleeve 84 in one direction to a desired amount. The graphite bronze sleeve 84 is provided with a plurality of notches 98 at the other end which are adapted to bear against the two raised tips 76 on the member 72 so that as the Invar rod moves back and forth due to temperature changes the graphite bronze sleeve and spring 78 will force the member 72 back and forth in a horizontal plane. As will be apparent, the frictional connection between the sleeve 84 and rod 20 provides for an immediate movement of the sleeve with the rod upon initial movement of the rod in either direction while permitting a continued movement of the rod beyond the limited movement of the sleeve.

Carried on the lower end of the member 72 is an insulating block 100 to which is attached two separate spaced contacts 102 and 104 which cooperate with two adjustable contacts 106 and 108 which are supported from an insulating panel 110 secured to and carried by the lower edges of the side plates 66. The contacts 102 and 104 are mounted upon spring arms 103 and 105 carried by arms having armatures cooperating with small magnets on panel 110 in order to provide snap action as the movable contact approaches the cooperating adjustable one. Also carried by the lower edge of the member 72 are

two extending arms 112 which extend in the opposite direction from the block 100 and which carry between them a pivot for the approximate center of a switch actuating arm 114 formed of bimetal material. One end of the arm 114 is also pivoted as shown at 116, which pivot point is suspended on the lower end of the bimetal arm 118, the opposite end of the latter being rigidly secured to a bracket 120 which is in turn pivotally mounted on one of the slide plates 66. This bimetal arm has intermediate its ends a heating coil 122 and as the heat is applied the lower end will assume different positions, depending on the warping of the bimetal member. The position of this pivot may also be adjusted by suitable adjusting screw 124.

The opposite end of the arm 114 supports the safety switch in closed position by holding the insulating tip 126 thereof in the position shown in Figure 6. This insulating tip is riveted to one end of a spring arm 128 which also supports one of the contacts 130 of a safety switch, the other contact 132 of which is supported on its second spaced spring arm 134. If the arm 114 is allowed to enter the opening 136 in the member 126, the contact 130 may move away from contact 132 and break the circuit. In order to reset these contacts in their closed position with the arm 114 in the position shown, it is necessary to manually move the lever 138, the projecting tip 140 of which closes the switch and moves it to such a position that the arm 114 may assume its usual position.

The pivot of the arm 114 on 116 is best shown in Figure 2 which clearly shows how the end of the bimetal element 118 projects downwardly and supports a pin 116 which in turn supports the member 144 through which the element 114 is connected.

It may be mentioned here that the bimetal arm 118 and the cross bimetal member 114 are assembled in opposed relation so that upon changes in temperature they tend to move in opposite directions and the resultant movement of the tip of arm 114 about the central pivot pin carried by arms 112 is zero which thereby compensates for ambient temperature changes.

Since the tube 16 has a much higher coefficient of expansion than the Invar rod 20 it will be apparent that the relative expansion and contraction of the tube and rod on changes in stack temperature will cause a movement of the free end of the rod carrying the sleeve 84 and the movement of the sleeve 84 in one direction will actuate the switching device against the tension of spring 78 which will return the switching device to its former position upon movement of the sleeve 84 in the opposite direction.

This particular device may be used in the circuit shown diagrammatically in Figure 7 in the following manner:

A source of current is provided across incoming lines 150, 152 and the safety switch 130, 132 is provided in line 150 to entirely deenergize the whole system under certain conditions. The transformer 44 is connected across the lines and has in series therewith switches 102, 106 which are closed when cold and opened by movement of the switching member when the thermal elements are heated by the stack temperature. In parallel with this stack switch there is provided suitable relay switching apparatus operated by relay 42. In the secondary or low voltage circuit of the transformer 44 there is provided a room thermostat 156 which operates in series

with the relay coil of the relay 42. The other relay 40 is connected in series with the heating element 122 of the bimetal safety switch and operates the motor switch.

5 The motor 158 operates to provide fuel for combustion in the furnace and a transformer 160 provides ignition sparks for igniting the same.

10 The ignition switch 104, 108 operates to maintain the sparks only for a predetermined time interval and is operated by the actuation of the stack element. The operation of the device is as follows:

15 If the temperature of the room falls below a predetermined set figure, the room thermostat 156 will close its contacts to energize relay 42, the primary circuit of the transformer being closed due to the fact that the stack contacts 102, 106 are closed when the stack is cold. This completes the circuit from contact 62 through relay 40, heating coil 122 and back to the line 152 which causes the heating coil to heat the bimetal element and at the same time closes the con- 20 tacts 56, 162, 164 which places the motor 158 across the line and oil or other fluid fuel is fed to the combustion chamber.

25 At the same time, since the switch 104, 108 is closed, the ignition transformer 160 will be energized to provide sparks for ignition spark gap 164. The device therefore proceeds in normal operation and as the temperature in the stack rises, contacts 102, 106 will be broken but the primary circuit for the transformer is maintained through the holding circuit through the contacts 30 62, 166, line 158, contacts 170 and contact 58. Also with an increase in temperature, the stack will open the contacts 104, 108 to deenergize the ignition transformer.

35 As the heating coil 122 causes the pivot 116 to move, the end of the arm 114 will commence to approach the opening 136 which would allow the safety switch to open. However, if the temperature within the stack increases, the pivot formed at 112 will counteract this effect by its 40 movement in the same direction and prevent the safety switch from opening. If, for any reason, the temperature within the burner does not rise, this latter action will not take place and after a set interval the safety switch will open its con- 45 tacts 130, 132 to deenergize the whole system which will require a manual resetting.

50 If, during the normal operation, the flame is extinguished for any reason, this same pivot will be moved to its cold position by the cooling of the rod which will cause the safety switch to be 55 operated to deenergize the whole system. If there is a current failure after the burner has once been warm, then relay 42 will allow its contacts to drop out, and it will not be possible to energize this relay until the stack switch points 60 102, 106 are again closed which will provide a suitable time delay for the purging of the furnace so that no explosion will result.

We claim:

65 1. In a burner control, a base, a bimetal arm carried thereon, heating means carried by the arm, a lever pivoted to the lower end of the bimetal arm, means responsive to temperatures in the burner projecting from the base, a second 70 pivot for the lever connected to the temperature responsive member, a switch held in closed position by the lever mounted on the base whereby the two pivots may be moved without opening the switch.

75 2. In a burner control, a support, a first bi-

metal arm secured at one end to the support, a second bimetal arm pivotally secured at the other end of said first bimetal arm, a spring biased switch arm pivoted on the support and abutting the free end of the second bimetal arm to main- 5 tain said switch arm in a desired position.

3. In a burner control, a pair of bimetal arms pivoted to each other at adjacent ends, a sup- port, one end of one arm being secured to the support, a spring biased switch arm pivoted on 10 the support and abutting the free end of the second bimetal arm to maintain said switch arm in a desired position and a member pivoted to the second bimetal arm intermediate its ends and means responsive to the temperature within the 15 burner for moving the member and thus changing the pivot point.

4. In a burner control, a support, a hollow tube secured to said support, a rod within said tube, said rod being of a material having a different 20 coefficient of expansion than said tube and rigidly secured at one end thereto, a sleeve on said rod adjacent the opposite free end thereof in frictional engagement therewith, and switch operat- ing means on said support engaging said sleeve 25 and adapted to be moved thereby, said rod being slotted in the end within said sleeve and spring means in the slot thereof tending to force the two sides apart to increase the frictional engagement between the rod and sleeve.

5. In a burner control, a support, a hollow tube secured to said support, a rod within said tube, said rod being of a material having a different coefficient of expansion than said tube 30 and rigidly secured at one end thereto, a sleeve on said rod adjacent the opposite free end thereof in frictional engagement therewith, a plate pivoted on said support at right angles to said rod, projecting means therein engageable with said sleeve whereby movement of the latter will 35 cause the plate to pivot, switching means on said support actuated by the plate movement, and a spring biased safety switch on the base with a bimetal latch to hold said switch in closed position, said bimetal latch being pivoted on said 40 plate and adapted to be moved thereby.

6. In a burner control, a support, a hollow tube secured to said support, a rod within said tube, said rod being of a material having a different co- 45 efficient of expansion than said tube and rigidly secured at one end thereto, a sleeve on said rod adjacent the opposite free end thereof in frictional engagement therewith, a plate pivoted on said support at right angles to said rod, pro- 50 jecting means thereon engageable with said sleeve whereby movement of the latter will cause the plate to pivot, switching means on said support actuated by the plate movement, and spring bias- 55 ing means between said plate and support tending to maintain said plate in one position.

7. In a burner control, a support, a hollow tube secured to said support, a rod within said tube, said rod being of a material having a different coefficient of expansion than said tube and rigidly 60 secured at one end thereto, a sleeve on said rod adjacent the opposite free end thereof in frictional engagement therewith, switch operating means pivoted on said support and adapted to engage one end of said sleeve and be operated by 65 movement of said sleeve in one direction, and a bearing for the free end of said rod, said bearing being mounted on said support and adapted to en- 70 gage the other end of said sleeve and limit the movement thereof with respect to the rod in the opposite direction.

8. In a burner control, a safety switch in the burner circuit biased to open position, releasable means for normally holding said switch in closed position, a bimetal warp element for moving said
- 5 holding means when said element is heated to release said switch to open position, a heater for said bimetal warp element, and combustion responsive means for so moving said holding means when heated by combustion as to counteract the
- 10 movement thereof by said warp element and prevent the release of said switch thereby.
9. In a burner control, a safety switch in the burner circuit biased to open position, a pivoted latch for normally holding said switch in closed
- 15 position, a bimetal warp element for moving said latch to release the same when said element is heated, a heater for said warp element, and means for preventing the release of said latch by said element including a movable fulcrum for
- 20 said latch and means for moving said fulcrum in response to combustion to counteract the movement imparted to said latch by said warp element.
10. The elements set forth in claim 9, in which

said latch is made of bimetallic material and functions to compensate for the effect of changes of ambient temperature on said bimetal warp element.

11. In a burner control, a safety switch in the burner circuit biased to open position, a pivoted
- 5 latch having one end normally engaging said switch to hold the same in closed position, a bimetal warp element connected to the other end of
- 10 said latch to release the latch when said element is heated, a heater for said element, and means responsive to combustion temperature for preventing the release of said latch by said warp element, said means including a movable fulcrum
- 15 for said latch intermediate the ends thereof and means for moving said fulcrum in response to combustion to prevent such pivotal movement of
- 20 said latch about said fulcrum by the warp element as would release said latch in the absence of combustion.

RICHARD W. HALLENBECK.
FRANKLIN R. STEES.