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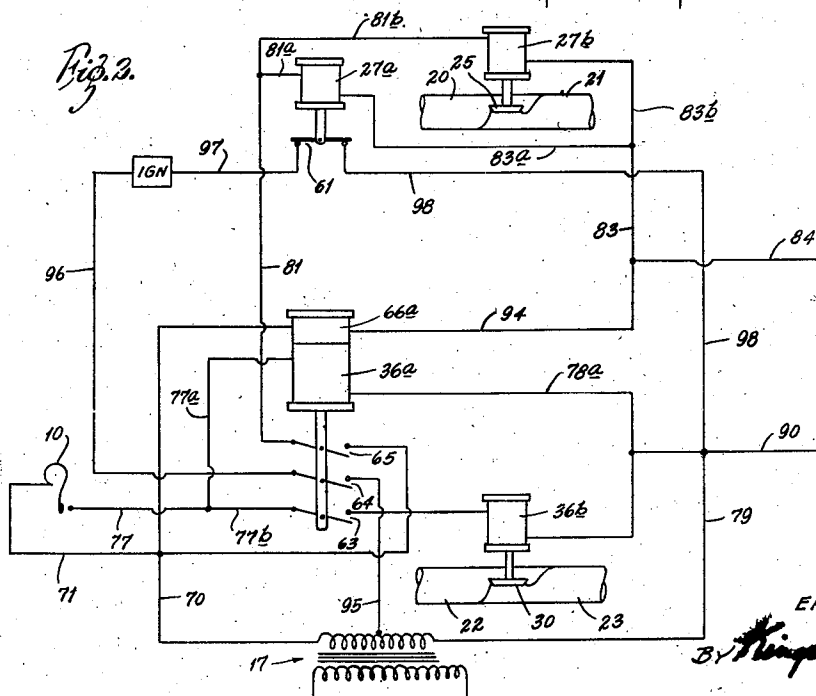
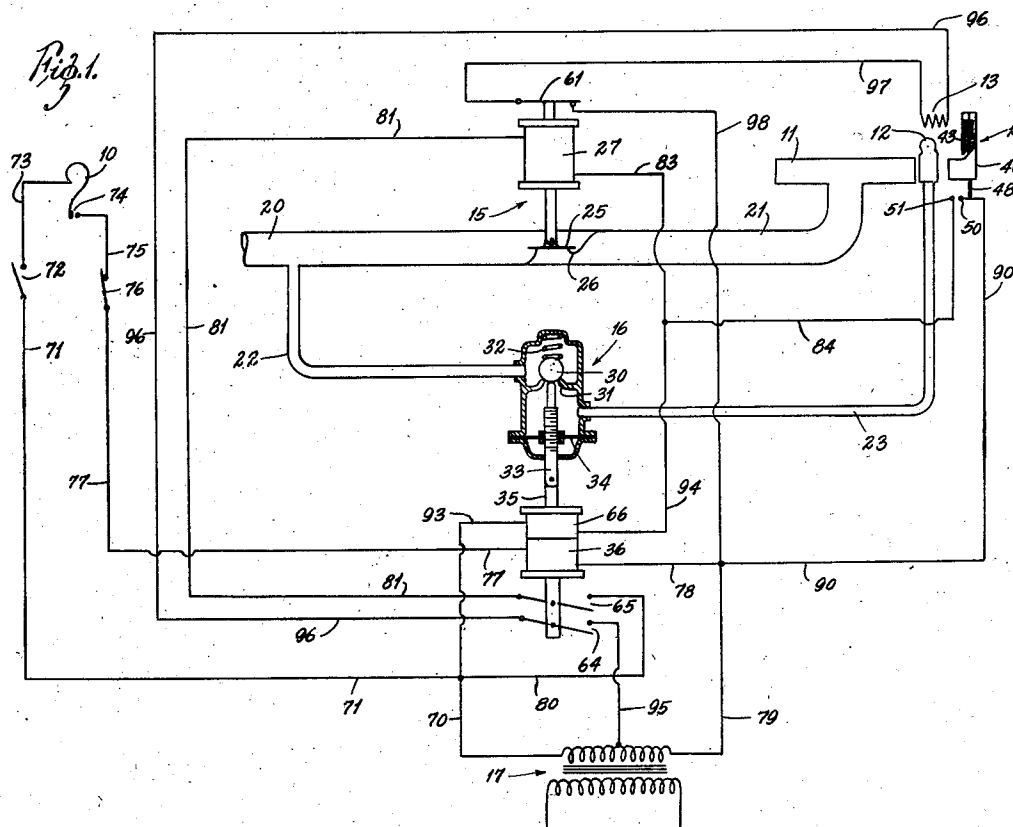
E. P. NEWMAN

2,407,438

BURNER CONTROL

Filed June 15, 1944

2 Sheets-Sheet 1



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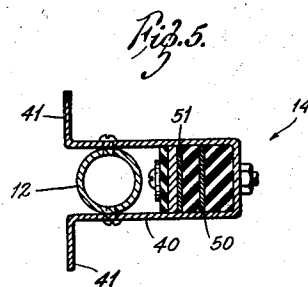
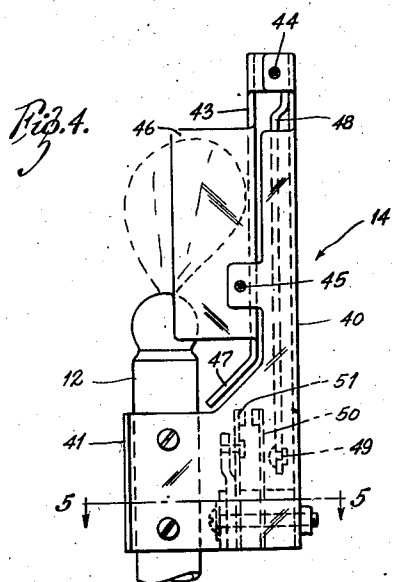
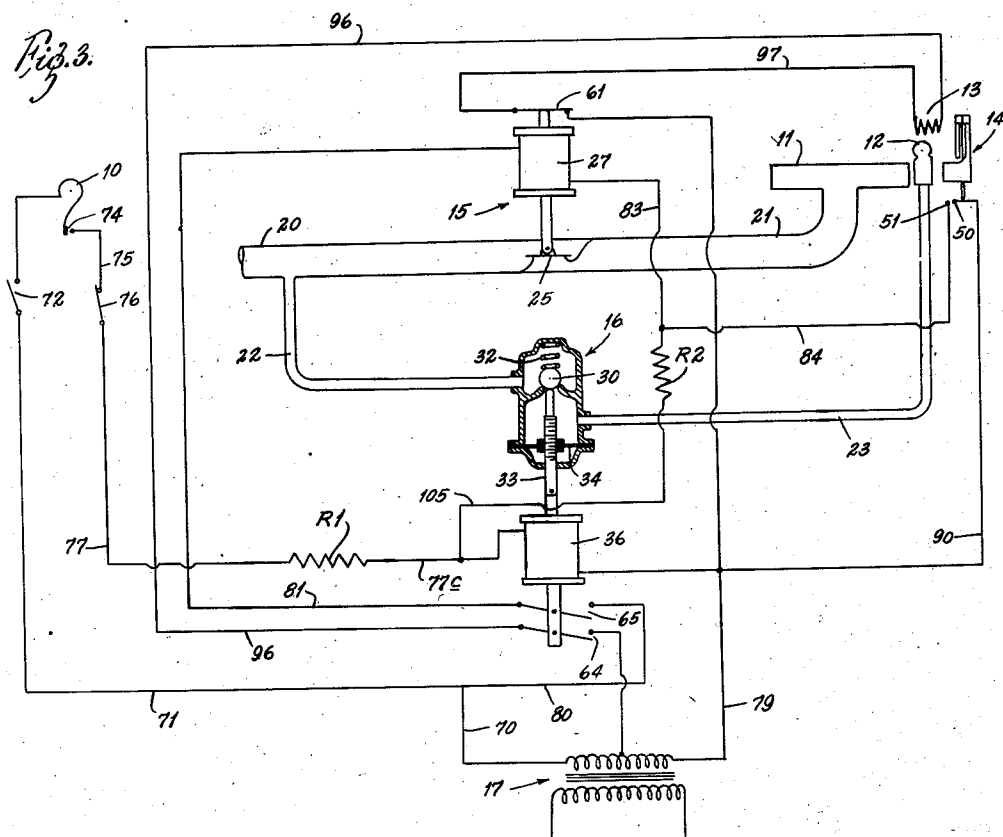
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BURNER CONTROL

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2 Sheets-Sheet 2



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2,407,438

BURNER CONTROL

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Application June 15, 1944, Serial No. 540,372

11 Claims. (Cl. 158—117.1)

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The present invention relates to a control, and particularly a control for burners and the like.

It comprises broadly a main fuel valve in a main fuel line, a pilot fuel valve in a pilot fuel line, and an igniter, all under control of some external control such as a space or room thermostat, with suitable switches and connections to operate the burners safely.

An object of the invention is to provide a control wherein, in response to external demand for heat, the pilot flame is ignited, and, in response to a substantial and rapid change in heat at the pilot, the main fuel line is opened. More particularly, an object is to provide a control wherein the pilot acts in a dual capacity of being a means to ignite a main burner and also as the actuating means for a flame switch which controls the main valve actuating circuit.

A further object of the invention is to provide a control wherein a failure of the flame switch to open or a short-circuiting of the flame switch at the time of a call for heat will result in a lock-out of both main and pilot fuel valves.

A further object is to provide a control system for a fuel burning system which is entirely automatic from one winter season to the next, which wastes no pilot gas when heat is not needed, and which is small and can be installed at a very reasonable cost.

Another object is a control which will operate regardless of changes in ambient temperature in the furnace before, during, or after fuel combustion.

A further object is to provide a control system operable with either alternating or direct current.

Further objects of the invention include the provision of a control wherein a momentary break of the pilot valve relay circuit, such as by the walking of or manual vibration of the room thermostat or a momentary power failure, will cause a complete recycling to prevent escape of unburned fuel through the main valve.

Fig. 1 is a diagrammatic view of one type of the control employing a bucking coil principle therein;

Fig. 2 is a diagrammatic view of a modification of Fig. 1;

Fig. 3 is a modification thereof wherein a resistance combination is used;

Fig. 4 is a view of the flame switch preferably used herein; and

Fig. 5 is a section on the line 5—5 of Fig. 4.

Referring to Fig. 1, the mechanism includes broadly an external control, here shown as a room thermostat 10. It includes also a main burner

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11, a pilot burner 12, an igniter 13, and a flame switch 14. In addition, it comprises a relay actuated main valve mechanism 15, and a relay actuated pilot valve mechanism 16, and a transformer 17.

The main burner is fed from a fuel line 20, which leads to the main valve mechanism 15, and thence by a line 21 to the burner 11. A pilot line 22 is connected into the main line 20 ahead of the main valve mechanism 15, the line 22 leading to the pilot valve mechanism 16, and thence by a line 23 to the pilot burner 12.

The main valve mechanism 15 includes a valve member 25 operating against a valve seat 26 interposed between the fuel lines 20 and 21. The valve is actuated by a magnetic coil 27, which, when energized, opens the valve.

The pilot valve mechanism 16 comprises a ball type valve element 30 adapted to seat upon a seat 31, toward which it is urged by a spring 32. The seat 31 is disposed between the lines 22 and 23. The valve is actuated by a pin 33 extending up beneath the valve seat. A flexible diaphragm 34, supported on the valve housing and secured in sealing relation to the pin 33, seals the pin to prevent leakage of gas around it. The pin 33 is, in turn, attached to an armature 35, operated by a magnetic coil 36, the latter elements, together with a coil 66, forming a relay generally designated 37.

The flame actuated switch 14 is preferably of the rate of change type. An illustrative form of it comprises a channel-shaped supporting member 40, having flanges 41 thereon, by means of which it may be secured properly to the burner. This channel-shaped member 40 embraces and supports the pilot burner 12. The member 40 likewise has secured thereto an inner member 43 formed of metal of substantially the same coefficient of expansion as the outer member 40, the two members being secured together at 44 by overlapping ears spot-welded together and secured at 45 by similar ears on the member 40 that overlap wings 46 extending towards the sides of the pilot burner in the lateral limits of the member 43. A tongue 47 projects from the lower part of the member 43 toward the pilot burner to form a shield.

The member 40, at its upper end, holds an actuating blade 48 that extends downwardly to the bottom part of the member 40, where it has an insulated actuating button 49 that may be moved over to close the switch blade 50 against the switch blade 51.

This flame actuated switch is adapted to receive

the pilot flame against the member 43, confined between the wings 46. When flame is applied thereto, the member 43 expands rapidly, increasing in length between the spot-welds 44 and 45. The outer member 40, within the corresponding length between the welds 44 and 45, receives heat only indirectly from the pilot flame, primarily by conduction through the small welded ears. As a result, the length between the welds of the outer member 40 expands less rapidly than the corresponding part of the inner member and does not attain the temperature of the inner member so long as heat is applied to the inner member in the relatively unlimited quantity represented by the pilot flame. Consequently, both will expand, but the inner will always be longer when the pilot flame is applied to it. Conversely, when the pilot flame is extinguished, the two members rapidly equalize in temperature and assume their relative starting positions.

Thus, upon rapid temperature change applied to the inner member, as when the pilot flame comes on, the inner member 43 will expand rapidly relative to the outer, and warp the upper end of the device outwardly. As the blade 48 is rigidly secured to the upper part of the outer member 40, the lower end of this blade, through the button 49, will act to close the contacts 50 and 51. And when the pilot flame goes off, the two members will rapidly equalize in temperature, and when the temperature differential is below the operating differential, the switch will reopen.

It will be seen that changes in ambient temperature will not change the position assumed by this switch in response to the condition of the pilot flame, because ambient conditions expand or contract the distance between the welds on both inner and outer members in a similar amount. Although the changes in ambient temperature affect the amount of the differential in temperature to a small degree, they do not affect the existence of a substantial differential of a quantity to operate the switch. Hence the device operates in response strictly to pilot flame conditions, regardless of the starting temperatures of the two members 40 and 43 resulting from any changes in ambient temperature, and regardless of changes in ambient temperature during main burner operation.

The foregoing switch is in principle the same as that disclosed in the patent of James A. Rodgers, 2,392,065, issued January 1, 1946.

A relay switch 61 is provided for joint operation with the main valve 25 by the coil 27.

The coil 36 operates through the armature 35, switches 64 and 65, these switches being for purposes to be described. The coil 36 also has associated therewith a bucking coil 66 wound to oppose the magnetic pull of the main coil 36, but of lower power.

The connections are as follows: From the transformer 17, a lead 70 is joined with a line 71, that leads through a manual switch 72, to a line 73, connected into the room thermostat 10. When this thermostat cools to a predetermined temperature, it closes a switch 74 connecting the line 75 to the line 73. The line 75 leads to a limit switch 76, which comprises one of the familiar thermal devices for opening the circuit when the heat transfer medium does not remove heat sufficiently rapidly to keep the furnace at a safe temperature. From the limit switch 76, the line 77 leads to the relay coil 36. The line 78

extends from the other end of the coil 36 to the other transformer lead 79.

From the line 70, there also leads a line 80 into the switch 65. From this switch, a line 81 leads into the coil 27, operating the valve 25 and the switch 61. From the coil 27, the line 83 leads to a line 84. The line 84 leads to the contact 51 of the flame switch. The contact 50 thereof is connected by a line 90 to the transformer lead 79. Thus the foregoing main valve operating circuit is directly across the secondary of the transformer in parallel with the room thermostat previously mentioned, but subject to control by the room thermostat through the switch 65.

An additional circuit is provided in parallel with the coil 27 in the last described circuit. It comprises a line 93 connected to the lead 70, leading to a bucking coil 66, from which a line 94 leads into the line 84.

A lower voltage line 95 leads from an inner point of the secondary of the transformer to the switch 64. From this switch, a line 96 leads to the igniter 13. From the igniter, a line 97 leads to the switch 61, from which a line 98 connects into the return lead 79 of the transformer.

Operation

The manual switch 72 is closed during any period in which the system is to be used. The limit switch 76 will normally be closed. At the start, the room thermostat switch 74 is open, the burner 11 and pilot 12 are off, the flame switch 14 is open, the switch 61 is closed, and the switches 64 and 65 are open.

When the room thermostat 10 closes its switch 74 a circuit from the lead 79 of the transformer is closed through the line 71, the room thermostat 10 and its switch 74, the line 77, the main coil 36 of the pilot valve 16, the line 78, the lead 79, back into the transformer. Thereupon the coil 36, being energized, lifts its armature, causing the rod 33 to lift the ball valve 30 from its seat and admit gas from the supply line 20 through the pilot line 22, past the valve, and by the line 23 to the pilot burner 12.

Energizing the coil 36 also closes the switches 64 and 65. The closing of the switch 64 closes a circuit from the inner tapped line 95 of the transformer through the aforesaid switch 64, the line 96, to the igniter 13, and thence by the line 97 through the now closed switch 61, by the line 98 to the return lead 79 to the transformer. The igniter 13 will then glow and ignite the pilot flame of the pilot burner 12. This flame will then act upon the flame switch 14, expanding the inner member 43 relative to the outer member 40, and warping the blade 48 to close the contacts 50 and 51. This latter will occur only if the pilot flame ignites and remains ignited. The closure of these two contacts after such ignition of the pilot burner completes a circuit through the other switch 65 of the coil 36 as follows: From the transformer lead 70, a line 80 leads through the switch 65, and by a line 81 into the coil 27 of the main valve 15, and thence by a line 83 to the line 84 through the flame switch 14, and by the line 90 back to the return lead 79 of the transformer.

Energizing of the coil 27 causes it to lift its armature, opening the valve 25 to admit fuel to the main burner 11, which is ignited by the pilot burner 12. The coil 27 also opens the switch 61 to break the circuit to the igniter 13 and to deenergize the same.

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Also when the flame switch closes, the bucking coil 66 is energized as follows: The lead 70, the line 93, the bucking coil 66, the line 94, to the line 84, and thence through the flame switch and back to the transformer. The bucking coil is of insufficient strength to overcome the holding force of the main coil 36, but is of sufficient force to prevent the main coil from moving its armature.

When thus started, the burner 11 will operate for a running period. The pilot burner will likewise burn during this period. Thereafter, when the room thermostat 10 is heated by the heat from the burner, it will break the contacts of the switch 74, which will open the circuit through the relay coil 36. The pilot valve will close instantly under the influence of the spring 32, and the switches 64 and 65 will open. Opening of the switch 64 gives an additional break to the circuit to the igniter, which, during the running period, is already open at the switch 61. Opening of the switch 65 breaks the circuit to the main valve coil 27, so that the main valve 25 immediately closes, and the switch 61 also recloses. However, as noted, the closure of the switch 61 does not close the circuit to the igniter at this time, since it is now open at the switch 64. With both the main and the pilot valve closed, the main and pilot burners 11 and 12 stop operating, and the flame switch 14 cools. With the type of flame switch shown, and which is preferred, this opening of the contacts 50 and 51 will occur within a few seconds after the pilot burner goes out, as this control responds immediately to an abrupt change of temperature on the inner member 43, regardless of the ambient temperature applying equally to both members.

As noted, the bucking coil 66 opposes the main coil 36, but is of insufficient power to cause a release of the armature. Since it is of sufficient power to prevent the armature from being pulled in when both coils are energized, any instantaneous break of the principal circuits, such as by vibration of the room thermostat contacts or an instantaneous power failure either of which are of insufficient duration to permit the flame switch contacts to open, will, nevertheless, result in a complete recycling of the control. This occurs because any such action deenergizes the main coil 36 and its armature falls out. If this break of the circuit of the main coil 36 occurs by jiggling of the thermostat, the coil 66 will remain in circuit and will act to open the switches 64 and 65 and close the pilot valve 30. If, however, the main coil 36 is deenergized because of a momentary power failure, the armature will fall, and upon restoration of power the coils 36 and 66 will become simultaneously energized providing the contacts 50 and 51 remain closed. In such case, the coil 66 is energized at the same time the coil 36 becomes reenergized, and, although the algebraic sum of the forces produced by the opposed coils will hold the armature 35 up once it is raised, this force is not great enough to pull the armature up from its lower position.

Thus, with the armature of the coil 36 down, the pilot valve is closed and the circuit to the main valve coil 27 is broken through the switch 65. Therefore, the main valve closes upon such instantaneous circuit failure, and it is prevented from reopening until the switch 14 cools and the "bucking" effect of the coil 66 is destroyed by the opening of the contacts 50 and 51, whereupon the coil 36 is effective again to close the switches 64 and 65, to open the pilot valve 30, to start the

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igniter 13, and, in short, to produce a complete recycling from the starting condition.

Were it not for the coil 66 or its equivalent, an instantaneous failure of the principal circuits, resulting in at least momentary closing of the valves, might be accompanied by a failure of flame at both burners followed by an immediate reopening of both valves with the igniter 13 in an open circuit. Thus, when the power fails, the armature 35 drops out and the switches 64 and 65 open. Resumption of power before the switch 14 cools, and without the coil 66 in operation, would close the switch 65, open the valve 25 and break the igniter circuit at 61. Thereafter, when the contacts 50 and 51 open upon the cooling of the switch 14, the coil 27 is deenergized, the valve 25 is closed and the igniter 13 is made operative by the closing of the switch 61. The igniter circuit is thus completed after a substantial amount of unburned gas had been delivered by the main burner to the furnace, which action could easily cause an explosion even though the main burner had been shut off before the ignition came on.

If the pilot is extinguished during operation, and is not relit by the main burner flame, this will normally result in opening of the contacts 50 and 51 of the flame switch, followed immediately by closing of the main valve 25 and closing of the switch 61, so that the igniter 13 may again be put in the circuit for re-ignition. If fuel pressure falls substantially, the pilot flame will not generate sufficient heat to maintain the switch 14 closed, and the main valve 25 will close due to the opening of the circuit to the coil 27.

If there is a failure of the igniter or of pilot ignition at the start of a cycle, the main burner valve 25 will not open and the escaped gas will be only in the limited volume running through the pilot line.

If the room thermostat remains closed, either by failure or otherwise, so that the burner attains an excessive temperature, the limit switch 76 will be opened in conventional fashion. This will break the circuit to the coil 36, resulting in closure of the main and pilot valves, which will remain in circuit until the contacts 50 and 51 are opened. Thereafter the control will be required to recycle completely upon any reclosure of the limit switch.

If the flame switch 14 fails in hot position, the control will operate to complete the cycle started, but after the cycle ends a new one cannot be instituted because the bucking coil 66 is energized whenever the contacts 50 and 51 are closed. Obviously, too, if the flame switch fails in open position, the main burner valve can never open. These two failures are controlled in the foregoing manner, regardless of an additional failure of the room thermostat.

Modification of Fig. 2

In Fig. 2 is shown a modification wherein the valves are operated by separate coils from their associated switches. Each switch coil is connected in parallel with its related valve coil.

The main switch relay (37a) coils are shown at 36a and 66a, the coil 66a being wound oppositely from the coil 36a. These coils operate the switches 64 and 65, as before, and an additional switch 63. The pilot valve coil is at 36b, connected in parallel with the coil 36a, but dependent upon the newly added switch 63 controlled by the coil 36a.

The main valve switch coil is at 27a, and the main valve operating coil is at 27b. These two

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coils are directly in parallel for simultaneous energization, whereby the valve 26 and the switch 61 will be opened simultaneously.

It will be seen that the transformer leads 70, 73, and 95 remain as before, as do the leads 84 and 90 to the flame switch. The line 77 from the thermostat 10 branches into a line 77a leading to the coil 36a, and into a line 77b leading to the coil 36b by way of a switch 63.

When the room thermostat 10 closes, current flows from the transformer lead 70 through the line 71, the thermostat 10 and the line 77. In this modification, the line 77 branches into a line 77a and a line 77b. The current flows through the line 77a, and thence through the coil 36a, whence it flows by a line 78a to the other transformer lead 79. Thus the coil 36a is put in circuit as soon as the room thermostat closes, in the same manner as before. It then closes the three switches 63, 64, and 65. When the switch 63 is closed, it closes a circuit from the line 77 through a line 77b to the coil 36b, and thence back to the transformer lead 79. This puts the coil 36b for operating the pilot valve 30 in parallel with the coil 36a but under control of the switch 63 of the latter coil.

When the switch 64 closes, it establishes the ignition circuit through the line 96 as before, and the line 97 and the closed switch 61, and the line 98 back to the transformer lead 79. As the coil 27a is then out of circuit, as was the coil 27 at a corresponding time in the other illustration, the igniter will become operative. Thus the pilot burner may become ignited.

When the switch 65 closes, the line 81 is connected with the transformer lead 70, and this line through its connections 81a and 81b leads to the two coils 27a and 27b, and thence by the two leads 83a and 83b. These two parallel leads merge in the line 83, which is connected with the lines 94 and 84 as before. Thus the two coils 27a and 27b are directly in parallel and operate in unison whenever the switch 65 is closed and the flame switch also is closed, the two operating in the same manner as the single coil 27 in the earlier illustration.

The bucking coil 66a is connected directly across the transformer leads and through the flame switch as before. Its operation is the same as before, but the third switch 63 is employed so that when the bucking coil is effective it not only breaks the circuits through the switches 64 and 65, controlling the main valve and igniter, but also is effective through the switch 63 to open the circuit to the pilot valve coil 36b and insure closing of that valve.

It will further be evident that the choice of one or two coils, either for the pilot valve control or for the main valve control, does not affect the overall operation of the mechanism where the connections are made as shown in Figs. 1 and 2. Sometimes, for mechanical reasons such as efficiency of manufacture or the desire for separating the switch operation or control from the valve operation or controls, it may be desirable to use separate coils to actuate one or more of the valves and switches.

Modification of Fig. 3

In Fig. 3, there is shown a control that accomplishes the same objective but uses a resistor instead of the bucking coil 66. In this arrangement, the parts are the same except for this substitution. It comprises the introduction of a first resistor R1 in the line 77 leading from the ther-

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mostat. The line from the resistor R1 into the coil 36 is designated 77c. From the line 77c, a line 105 leads through a resistor R2 to the line 84.

When the room thermostat 10 closes, the same circuit from the line 70 through the line 71, the room thermostat 10, the line 77, the resistor R1, the line 77c, the coil 36, the line 78 and the line 79 is effected. This closes the switches 64 and 65 as heretofore. When the switch 64 closes, the igniter 13 is energized because the switch 61, operated by the main valve coil 27, is closed. The pilot valve 30 is open and the pilot flame ignites, whereupon the flame switch 14 closes the contacts 50 and 51. This closes the circuit from the line 70 through the line 80, the switch 65, the line 81, the coil 27, the line 83, the line 84, the switch 14, the line 90, and the lead 79, whereupon the main valve 27 is opened and the switch 61 is also opened to cut the igniter 13 out. Thus the cut out of the igniter and the opening of the main valve are, as before, dependent upon the existence of a pilot flame.

At the same time this last circuit is closed, the parallel circuit from the line 77c, through the line 105 and the resistor R2, is closed by way of the line 84, the switch 14 and the line 90. The resistor R2 introduces a circuit drawing current in parallel with the coil 36. This current increases the voltage drop across the resistor R1 (which resistor may comprise in whole or in part the inherent resistance in the circuit). The increased voltage drop across the resistor R1 reduces the voltage available to the coil 36, so that its current drop and its magnetic pull is lowered. The reduction in magnetic pull is insufficient to cause the coil to drop its switches open, but is sufficient to prevent the coil from pulling the switches from an open position.

In this circuit, it will be seen that the same results as in Fig. 1 attain, except that the parallel voltage reducing circuit is open whenever the room thermostat opens. It acts to prevent the main valve from returning to open position upon break in current through the coil 36 until the flame safety switch 14 has cooled.

It will be understood that the control may be employed with other controlling elements, such as diaphragm valves, in which case the particular valves illustrated become relay or pilot valves controlling the bleed lines of the familiar diaphragm type valves.

For use with D. C., the system may be modified, as by employing voltage dividers of conventional types, in which case, the bucking coil has the advantage of opposing the lifting of the armature, as well as diminishing the force of the main coil.

In some installations, it may be desirable to use a separate transformer for the igniter instead of a center tap on the main transformer. In such case the primary of the second transformer could be energized in parallel with the circuit including the coil 27 and flame switch 14, and the primary circuit would include the switch 61. Obviously this would eliminate one switch 64 of the relay 37, as the voltage into the switch 61 and the primary would be the same as that through the switch 65, permitting interconnection of the circuits.

What is claimed is:

1. In a control for use with a main burner, a pilot burner, and a main control device including a power element, electrical means operated through the main control to supply fuel to the main burner, a flame-responsive switch op-

erated by combustion at the pilot burner, and means controlled by said flame-responsive switch for reducing the power of said element to render the same effective to hold said control device in a closed position once this position is attained, but ineffective to move said device from an open to a closed position.

2. In a control for use with a main burner, a pilot burner, and a main control device, a flame-responsive switch operated upon existence of combustion at the pilot burner, an electrical fuel supply means energizable to operate the main burner, means responsive to operation of the main control device to cause operation of the pilot burner, means operated in response to operation of the pilot flame switch to energize the main burner fuel supply means, and means operated in response to operation of the pilot flame switch to prevent reoperation of the main burner fuel supply means when the flame-responsive switch is in operative position.

3. In a control for use with a main burner, a pilot burner, and a main control device, a flame-responsive switch operated upon existence of combustion at the pilot burner, first means responsive to operation of the main control device to effect operation of the pilot burner, said means including mechanism concurrently operated to control actuation of the main burner, said mechanism being also dependent upon operation of the flame-responsive switch, and safety means operated upon closing of the pilot flame switch to render the first means incapable of shifting from inoperative to operative position when the flame switch is in operative position.

4. In a control for use with a main burner, a pilot burner, and a main control device having a power element, a flame-responsive switch operated upon existence of combustion at the pilot burner, pilot fuel supply means operated by said main control device, first means responsive to operation of the main control device to effect ignition of the pilot burner, said means including mechanism concurrently operated to control actuation of the main burner, said mechanism being also dependent upon operation of the pilot flame switch, and safety means operated upon closing of the pilot flame switch to render the first means incapable of shifting from inoperative to operative position when the flame switch is in closed position, said safety means comprising a power reducing means adapted to reduce the power of said element below that required to operate the first means from an open to a closed position, but not less than that required to hold the first means in a closed position once this position is attained.

5. In a control for use with a main burner, a pilot burner, and a main control device including a relay, a flame-responsive switch operated upon existence of combustion at the pilot burner, pilot fuel supply means operated by said main control device, first means responsive to operation of said relay to effect ignition of the pilot burner, said means including mechanism concurrently operated to control actuation of the main burner, said mechanism being also dependent upon operation of the pilot flame switch, and safety means operated upon closing of the pilot flame switch to render said relay incapable of shifting said first means from an inoperative to an operative position when the flame switch is closed, said first means comprising a switch device, and said safety means comprising an electrical device to reduce the magnetic pull of said relay.

6. In a control for use with a main burner, a pilot burner, and a main control device including a relay and coil, a flame-responsive switch operated upon existence of combustion at the pilot burner, pilot fuel supply means operated by said main control device, first means responsive to operation of said relay to effect ignition of the pilot burner, said means including mechanism concurrently operated to control actuation of the main burner, said mechanism being also dependent upon operation of the pilot flame switch, and safety means operated upon closing of the pilot flame switch to render said relay incapable of shifting said first means from an inoperative to an operative position when the flame switch is in a closed position, said first means comprising a switch device and said safety means comprising a bucking coil producing a magnetic force in opposition to that of the relay coil.

7. In a control for use with a main burner, a pilot burner, and a main control device including a relay, a flame-responsive switch operated upon existence of combustion at the pilot burner, pilot fuel supply means operated by said main control device, first means responsive to operation of said relay to effect ignition of the pilot burner, said means including mechanism concurrently operated to control actuation of the main burner, said mechanism being also dependent upon operation of the pilot flame switch, and safety means operated upon closing of the pilot flame switch to render said relay incapable of shifting said first means from an inoperative to an operative position when the flame switch is in a closed position, said first means comprising a relay switching device and said safety means including a current reducing device to lower the current through a coil of said relay.

8. In a control for use with a main burner, a pilot burner, and a main control device including a relay, a flame-responsive switch operated upon existence of combustion at the pilot burner, pilot fuel supply means operated by said main control device first means responsive to operation of said relay to effect ignition of the pilot burner, said means including mechanism concurrently operated to control actuation of the main burner, said mechanism being also dependent upon operation of the pilot flame switch, and safety means operated upon closing of the pilot flame switch to render said relay incapable of shifting said first means from an inoperative to an operative position when the flame switch is in a closed position, said first means comprising a switching device and said safety means including a resistance to reduce the current through the relay.

9. In a control for use with a main burner, a pilot burner, a pilot igniter and a main control device, a first means to admit fuel to the pilot burner upon operation of the main control device, said means being also adapted to operate the pilot igniter, second means including a device operated to actuating position upon existence of combustion at the pilot burner and the first means to admit fuel to the main burner, said second means being also adapted to render the igniter inoperative, said combustion device being operable in response to combustion or combustion failure at the pilot regardless of ambient temperature variations, and said device, upon failure of pilot combustion, being adapted to render the second means inoperative.

10. In a control for use with a main burner, a pilot burner, a pilot igniter and a main control

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device, first means to admit fuel to the pilot burner upon operation of the main control device, said means being also adapted to operate the pilot igniter, second means including a device operated to actuating position upon existence of combustion at the pilot burner and the first means to admit fuel to the main burner, said second means being also adapted to render the igniter inoperative, said combustion device being operable in response to combustion or combustion failure at the pilot regardless of ambient temperature variations, and said device, upon failure of pilot combustion, being adapted to render the second means inoperative, means to effect shut-off of the main burner fuel supply means upon current break in its circuit, and means to prevent reoperation of the main burner fuel supply means until the pilot flame device has returned to inoperative position.

11. In a control device for use with a burner or the like, under control of a room thermostat, the combination of a relay having an actuated device for controlling operation of the burner, a main

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coil capable of actuating said device to burner operating position, and a bucking coil operatively associated with the main coil and adapted, when both coils are energized, to reduce the power of the relay to a value sufficient to hold the device in operating position, but incapable of pulling it to said position, the main coil being adapted to be energized and to operate the actuated device to provide burner operation when the space thermostat demands heat, a combustion-responsive switch movable to a combustion-indicating position when combustion exists at the burner, the bucking coil being connected with the combustion-responsive switch to be energized when the same moves into combustion-indicating position in response to existence of combustion at the burner, whereby when said thermostat demands heat and the combustion-responsive switch is in combustion-indicating position the relay can hold the actuated device, but cannot pull the same to operating position.

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