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CONTROL MECHANISM FOR BURNERS

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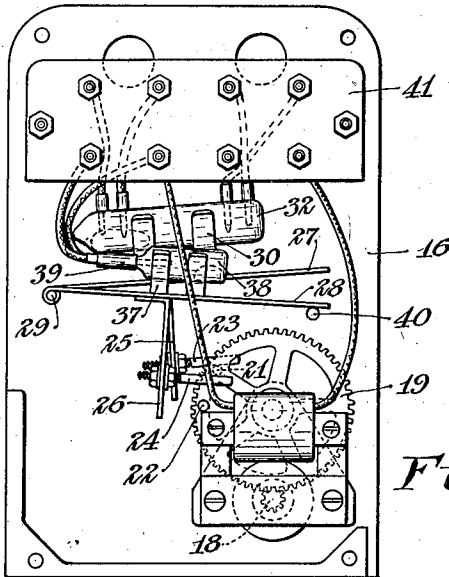


Fig. 2

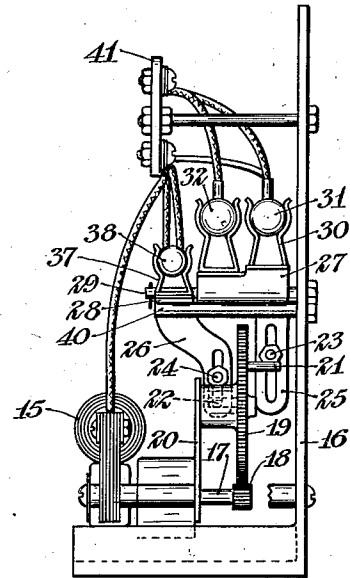


Fig. 3

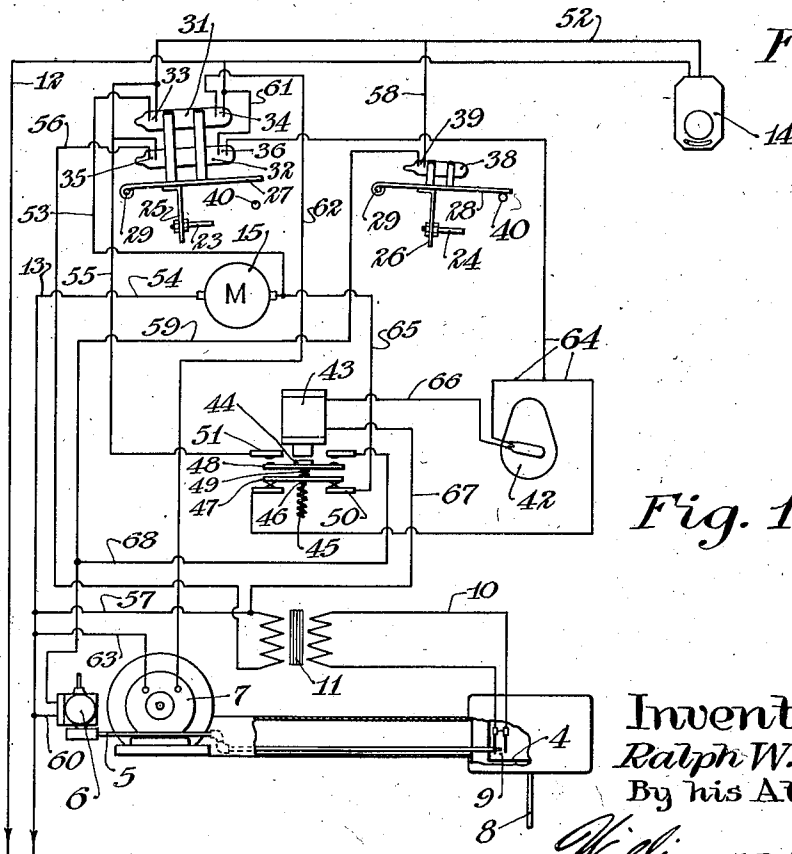


Fig. 1

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CONTROL MECHANISM FOR BURNERS

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4 Claims. (Cl. 158—28)

This invention relates to control mechanisms for burners and while these mechanisms may be used with different types of oil burners, gas burners, etc., they are particularly adapted for use in connection with vaporizing type oil burners.

Certain vaporizing type oil burners include a combustion chamber, an oil supply line for feeding fuel to the combustion chamber, a control valve in the supply line, a blower for introducing air into the combustion chamber and an igniter for initially igniting the oil as it is discharged into the combustion chamber. Difficulty has been experienced in using such vaporizing type oil burners due to the rapid formation of carbon deposits in the combustion chamber of the burner. I have found that the rapid formation of carbon in the combustion chamber of such oil burners is largely due to the fact that the oil is not properly vaporized so that complete combustion takes place at the time the oil burner is first set in full operation, when the ordinary control mechanism is used with the oil burner. I have also found that when the ordinary control mechanism is used and the oil burner shuts down, complete combustion of whatever oil remains in the combustion chamber does not occur after the control valve closes for the reason that with the ordinary control mechanism the control valve is closed and the blower is set out of operation simultaneously. I have further found that the formation of carbon in the combustion chamber can be largely eliminated if at the time the burner is first set in operation, the igniter is first operated for a short period of time before oil is supplied to the combustion chamber and the blower is maintained out of operation until a short time after oil is first supplied to the combustion chamber. I have also found that, when the burner is shut down, if the blower is operated for some time after the control valve in the oil supply line is closed, the oil remaining in the combustion chamber may be properly vaporized and completely burnt without forming carbon deposits.

It is one of the main objects of this invention, therefore, to provide a novel and improved thermostatically operated control mechanism, which although capable of use with other types of burners than vaporizing type oil burners, is particularly adapted for use with such vaporizing type oil burners as above described and which as the burner is initially set in operation will first set the igniter in operation prior to the time that fuel is supplied to the combustion chamber and which will cause fuel to be supplied to the combustion chamber prior to the time that the blower

is set in operation to introduce air into the combustion chamber in large quantities.

It is a further object to provide such a control mechanism which will cause the fuel supply line to the combustion chamber to be closed prior to the time that the blower supplying air to the combustion chamber is placed out of operation, as the burner is shut down.

Another object is to prevent the danger of explosion by closing off the fuel supply line if ignition of the burner does not occur when the control is first set in operation and for preventing the igniter from being set in operation for a considerable period of time after the burner fails to ignite.

Other objects and advantages of the present invention will more fully appear from the following description made in connection with the accompanying drawing wherein like reference characters refer to the same or similar parts throughout the various views and, in which,

Fig. 1 is a wiring diagram and diagrammatic view illustrating an embodiment of the control mechanism of the invention operatively connected for use with a vaporizing type oil burner of standard construction;

Fig. 2 is a view in front elevation of a timing motor and certain switches that are operated therefrom, which form parts of my control mechanism; and

Fig. 3 is a view in side elevation of the parts shown in Fig. 2.

Referring to the drawing and first particularly to Fig. 1, portions of a vaporizing type oil burner of standard construction are illustrated. This oil burner includes a pot or combustion chamber 4, an oil supply line 5 leading to said chamber 4, a solenoid operated control valve 6 which controls the supply of oil through said supply line 5, a motor driven blower 7 for introducing air into the combustion chamber 4, an overflow pipe 8 running from said combustion chamber and a pair of electrical heating elements 9 forming an igniter located in the combustion chamber 4 adjacent the outlet end of the supply line 5. A conductor 10 leads from the secondary winding of an electrical transformer 11 to the heating elements 9.

A pair of line wires 12 and 13 of an electrical transmission line are shown and the line wire 12 runs to a thermostatic switch 14 located in the room or space to be heated by the oil burner and subject to the temperature of the air therein. This thermostatic switch is of standard construction and may be set to operate at various temperatures. The switch 14 is adapted to close

when the temperature of the room or space within which it is located falls below the temperature for which the switch is set and it is adapted to open when the temperature of the room or space within which it is located rises above the temperature for which the switch is set. A self starting timing motor 15 of slow speed is provided and this motor as best shown in Figs. 2 and 3 may be mounted on a suitable base attached to a panel 16 and the shaft 17 of the motor may carry a pinion 18 which meshes with and is adapted to drive a gear 19 mounted on a shaft journaled in a suitable supporting arm 20 secured to the base of the panel 16. The gear 19 carries a pair of pins 21 and 22 which project respectively from opposite sides of the gear for cooperation respectively with pins 23 and 24 adjustably mounted within slots in arms 25 and 26 depending from respective levers 27 and 28, both of which are pivoted on a pivot pin 29 secured to the panel 16 and located above the gear 19. The lever 27 carries two pair of spring clips 30 within which mercury tubes 31 and 32 are respectively mounted. The tube 31 has a pair of contacts at one end forming a switch 33 and a pair of contacts at its other end forming a switch 34. The tube 32 has a pair of contacts at one end forming a switch 35 and a pair of contacts at its other end forming a switch 36. A pair of spring clips 37 are mounted on the lever 28 and a mercury tube 38 is carried by these clips 37 and this mercury tube 38 has a pair of contacts at one end forming a switch 39. A stop pin 40 secured to panel 16 prevents the free ends of the levers 27 and 28 from being carried below a certain level. Carried by the panel 16 adjacent its upper end is a plate 41 having a number of binding posts thereon to which certain electrical conductors are conveniently connected. The pin 21 is set about 30° in advance of the pin 22 relative to the direction of rotation of the gear 19, and the two pins 21 and 22 are so disposed relative to the pins 23 and 24 that when the motor 15 is set in operation, the pins 21 and 22 will respectively successively engage the pins 23 and 24 to raise these pins and tip the levers 27 and 28 respectively upwardly from the gravity held position against the stop pin 40 and later successively allow the levers 27 and 28 to drop down against the pin 40. When the lever 27 is in upwardly tipped position, the mercury in the two tubes 31 and 32 will close the two switches 33 and 35, while when the lever 27 is in downwardly disposed position against the stop pins 40, the mercury in the tubes 31 and 32 will close the two switches 34 and 36, it being understood that when the switches 33 and 35 are closed the switches 34 and 36 will be open and when the switches 34 and 36 are closed, the switches 33 and 35 will be open. When the lever 28 bears against the stop pin 40, the switch 39 will be open and when the lever 28 is tipped upwardly, the mercury in the tube 28 will close the switch 39.

A thermostatic switch 42 located to be affected by the temperature of the air passing from the combustion chamber 4 of the oil burner and preferably located in the smoke flue of the furnace in which the oil burner is installed, is provided and this switch may be designated as a stack thermostatic switch as distinguished from the thermostatic switch 14 which may be designated a room thermostatic switch. The stack thermostatic switch 42 may be of standard construction and this switch is adapted to close as

the temperature of the air passing through the smoke flue of the furnace raises in temperature and it is adapted to open as the temperature of this air falls. For cooperation with the stack thermostatic switch 42, there is provided a relay 43 having an armature 44 normally held out of engagement with the relay by means of a spring 45. The armature 44 carries a pin 46 upon which a pair of short bars 47 and 48 are loosely mounted, there being a spring 49 surrounding the pin 46 between these two bars. The bar 47 carries a pair of contacts at its two ends adapted to be engaged respectively with fixed contacts 50 to bridge the same when the relay 43 is not energized. The bar 48 carries a pair of contacts at its two ends adapted to engage with fixed contacts 51 to bridge the same when the relay 43 is energized.

A conductor 52 runs from the room thermostatic switch 14 to one contact of the switch 33. Another conductor 53 runs from the other contact of the switch 33 to the timing motor 15, while a conductor 54 runs from the timing motor to the line wire 13. A conductor 55 connected to conductor 52 runs to one contact of the switch 35 and to one of the two fixed contacts 51. A conductor 56 runs from the other contact of the switch 35 to the primary winding of the transformer 11, while a conductor 57 runs from the opposite end of the primary winding of the transformer 11 then the end to which the conductor 56 is connected, to the line wire 13. A conductor 58 runs from the conductor 52 to one contact of the switch 39, while another conductor 59 runs from the other contact of the switch 39 to the solenoid control valve 6 and a conductor 60 runs from the solenoid operated control valve to the line wire 13. A short conductor 61 connected to the line wire 12 ahead of the room thermostatic switch 14 runs to one contact of each of the two switches 34 and 36. A conductor 62 runs from the remaining contact of the switch 34 to the motor controlled blower 7 while a conductor 63 runs from the motor controlled blower to the line wire 13. A conductor 64 runs from the remaining contact of the switch 36 and has branches, one of which leads to one of the fixed contacts 50 and the other of which leads to the stack thermostatic switch 42. A conductor 65 leads from the other fixed contact 50 to the motor 15. A conductor 66 leads from the stack thermostatic switch 42 to the relay 43, while a conductor 67 leads from the relay and connects with the conductor 57. A conductor 68 leads from the fixed contact 51 not connected with the conductor 55, to the conductor 59.

Operation

The various switches and movable parts of the 60 control mechanism are shown in the drawing in the position that they will assume after the oil burner is shut down and before the oil burner is set in operation. When the parts are in this position, the room thermostatic switch 14 is open, the stack thermostatic switch 42 is open, the bar 47 of the relay bridges the two fixed contacts 50 while the bar 48 does not bridge the two fixed contacts 51, switches 33 and 35 are closed and switches 34 and 36 and 39 are open. The pin 21 carried by the gear 19 engages the pin 23 on arm 25 to hold the lever 27 in raised position from the stop pin 40. The lever 28 is in its gravity held position against the stop pin 40.

As the temperature of the room or space to be heated falls below the temperature for which the room thermostatic switch 14 is set, the contacts of this switch will close and two electrical circuits will be initially established. A first timing motor circuit will be established from the line wire 12 through room thermostatic switch 14, conductor 52, switch 33 and conductor 53 to the timing motor 15 and from the timing motor 15 through the conductor 54 to line wire 13. An igniter circuit will also be established from the line wire 12 through room thermostatic switch 14, conductor 52, conductor 55, switch 35 and conductor 56 to the primary winding of the transformer 11 and from the primary winding of the transformer through the conductor 57 to the line wire 13. The timing motor 15 will, accordingly, be immediately set in operation as soon as the room thermostatic switch 14 is closed. The transformer 11 will also be energized and an induced current will flow from the secondary winding of the transformer through the conductor 10 to heat the heating elements 9 and thereby set the igniter immediately in operation upon the closing of the room thermostatic switch 14. As the timing motor 15 rotates, the pin 22 due to the rotation of the gear 19, will be carried into engagement with the pin 24 to raise the lever 28 from the stop pin 40 and thereby tilt the mercury tube 38 to such a position that the mercury in the tube will bridge the contacts of the switch 39 to close this switch. The gearing between the shaft 17 of the timing motor 15 and the gear 19 is such that the switch 39 will be closed approximately 35 seconds after the room thermostatic switch 14 is closed to set the igniter 9 in operation. As the switch 39 is closed, a first control valve electric circuit will be established from the line wire 12 through room thermostatic switch 14, conductor 52, conductor 58, switch 39 and conductor 59 to the solenoid operated control valve 6 and from the solenoid operated valve through the conductor 60 to line wire 13. The solenoid of the valve 6 will thus be energized to open the valve to permit the supply of oil through the supply line 5 to the combustion chamber 4 of the burner. During the interval between the time that the igniter 9 is set in operation and the time that the control valve 6 is opened, the heating elements of the igniter will be intensely heated, so that as oil is supplied from the supply line 5, this oil should be immediately ignited due to the vaporization of the oil as it comes in contact with the heating elements of the igniter 9. The timing motor 15 will continue to rotate whereupon approximately thirty seconds after the control valve circuit has been established, the pin 21 will fall off the pin 23 thereby allowing the lever 27 to drop downwardly and engage the stop pin 40. As this occurs, the two tubes 31 and 32 will tip to such a position that the mercury in these tubes bridges the contacts of the two switches 34 and 36 to close these switches, while the two switches 33 and 35 will be simultaneously opened. As the switches 33 and 35 are opened, the first timing motor circuit will be broken and the igniter circuit will also be broken. The igniter 9 will be immediately placed out of operation. As the switch 34 is closed, a blower circuit will be established from the line wire 12 through conductor 61, switch 36, and conductor 62 to the motor operated blower 7 and thence through the conductor 63 to the line wire 13. If the temperature of the smoke flue has not raised, the stack thermostatic switch 42 will re-

main open and a second timing motor circuit will be established from the line wire 12 through conductor 61, switch 36, conductor 64, one of the contacts 50, bar 47, the other contact 50, conductor 65 to the motor 15, and thence through the conductor 54 to the line wire 13. The blower 7 will thus be set in operation to introduce a strong draft of air into the combustion chamber 4 some time after oil is first introduced into the combustion chamber from the supply line 5. During the interval of time that elapses between the time when the control valve 6 is first opened, and the time when the blower 7 is first set in operation, large quantities of air are not supplied to the combustion chamber 4 and as a result the oil in the combustion chamber may be heated to vaporize a large portion of this oil before the blower is set in operation. When the blower then operates, there will be no tendency for the blower to blow out the film produced by the oil as would otherwise be the case if the control valve 6 and the blower 7 were set in operation simultaneously. The second timing motor circuit that is established as the switch 36 is closed will cause the timing motor 15 to operate thereby rotating the gear 19 until the pin 24 falls off the pin 22 thereby allowing the lever 28 to fall against the stop pin 40 to open the switch 39 and thereby break the first control valve circuit. The switch 39 will be opened approximately one minute after the blower circuit has been established.

Assuming that ignition of the oil burner has taken place, the blower 7 will force a draft of warm air out through the smoke flue of the furnace thereby causing the contacts of the stack switch 42 to engage to close this switch. As this occurs, a relay circuit will be established from the line wire 12 through conductor 61, switch 36, conductor 64, thermostatic stack switch 42, conductor 66 to the relay 43 and from the relay through the conductor 67 and conductor 57 to line wire 13. As the relay circuit is established, relay 43 will be energized to raise the armature 44 and thereby cause the bar 48 to bridge the two fixed contacts 51 and to cause the bar 47 to be carried out of engagement with the two fixed contacts 50. The second timing motor circuit will thus be broken to place the timing motor out of operation. At the same time a second control valve circuit will be established from the line wire 12 through the room thermostatic switch 14, conductor 52, conductor 55, one of the contacts 51, bar 48, the other contact 51, conductor 68 and conductor 59 to the solenoid operated control valve 6 and thence through the conductor 60 to the line wire 13. The control valve 6, previously open but having been closed when the first control valve circuit was broken by the opening of the switch 39, will now again be opened by the establishment of the second control valve circuit. The oil burner will now be in full operation and will continue in full operation until the temperature of the room or space to be heated has been raised to the temperature for which the thermostatic control switch 14 is set, whereupon this switch will open.

As the room thermostatic switch 14 opens, the second control valve circuit will be broken thereby causing the control valve 6 to close cutting off the supply of oil to the combustion chamber through the supply line 5. It will be noted however, that the blower circuit will remain established so that the blower will be maintained in op-

eration to supply the proper draft of air to the combustion chamber 4 to maintain the oil burner in operation until all the oil in the combustion chamber 4 has been used up. Incomplete combustion of the oil remaining in the combustion chamber 4 and the consequent formation of carbon in the combustion chamber will not take place when the control valve 6 is closed as would otherwise be the case if the blower 7 was placed out of operation simultaneously with the closing of the control valve 6. When the oil in the combustion chamber 4 is nearly or completely used up, the temperature of the air passing through the smoke flue will drop, thereby opening the stack thermostatic switch 42 to break the relay circuit. As the relay circuit is broken, the relay 43 will of course be de-energized, thereby allowing the armature 44 to drop to cause the bar 47 to bridge the two contacts 50 to establish the second timing motor circuit. The timing motor 15 may then again be set in operation to carry the gear 19 through the balance of a full revolution from its original starting position or until the pin 21 strikes the pin 23 to tip the lever 27 to the upwardly raised position shown in the drawing. The two switches 34 and 36 will then open to break the blower circuit and the second timing motor circuit, while the two switches 33 and 35 will again be closed. The blower 7 will thus be placed out of operation, the oil burner will be completely shut down and the timing motor 15 will, of course, be placed out of operation. The control mechanism will have now finished a complete cycle of operation. Preferably the gear 19 will be made of such a size that after the stack thermostatic switch has opened, the switches 34 and 36 will not be opened for four or five minutes. The complete cycle of the control mechanism will thus take from six to seven minutes excluding the time that the oil burner is in full operation.

If for any reason ignition of the oil burner does not occur, when the control valve 6 is opened or if when the blower 7 is set in operation, the flame in the combustion chamber is blown out so that the temperature of the air passing through the smoke flue is not raised to close the thermostatic stack switch 42, the relay circuit will not be established and as a result the second control valve circuit will not be established and the control valve will remain closed after the first control valve circuit has been broken by the opening of the switch 39. After the blower 7 has been set in operation therefore, the second timing motor circuit will remain closed until the control mechanism has run through a complete cycle of operation, i. e. until the switches 34 and 36 are again opened and the switches 33 and 35 are closed four or five minutes after the control valve 6 has closed by the breaking of the first control valve circuit. It will be impossible for the oil burner to be set in operation during this four or five minute period of time, for the reason that the igniter circuit cannot be established during this period of time. The blower 7 will remain in operation during this period of time and will carry off whatever vaporized gases there may be in the combustion chamber through the smoke flue of the furnace. The danger of igniting a large quantity of vaporized gases in the combustion chamber and the consequent danger of an explosion is prevented when the present control mechanism is used, even though proper ignition of the oil burner does not take place when the control mechanism first acts.

If the oil burner is not properly ignited during the first cycle of operation of the control mechanism, the control mechanism will be carried through subsequent cycles of operation until either the oil burner is set in full operation or until the current passing through the transmission lines 12 and 13 is turned off.

If when the oil burner is in full operation, the electric current should be turned off for a time and should then be turned on when the room thermostatic switch 14 is closed, the stack thermostatic switch 32 will have opened due to the lowering of the temperature of the air in the smoke flue while the oil burner was out of operation and as a result when the current is turned on, the burner cannot be ignited until the mechanism first runs through the latter part of its cycle and through the first part of its cycle. In this situation during the latter part of its cycle, the control mechanism will cause the blower circuit to be established and the operation of the blower will carry off whatever unburnt vaporized gases there may be in the combustion chamber prior to the time that the igniter circuit is again established. As a result it will be impossible for an explosion to occur even though the electric current be turned off during operation of the burner. During a momentary power failure of insufficient duration to permit opening of the contacts of the stack switch 42, the blower motor 7 and the respective coils of the solenoid controlled oil valve 6 and the relay 43 will, of course, be de-energized. The oil valve will be closed and the blower will stop. The bar 48 of the relay 43 will leave the contacts 51, opening the second oil valve control circuit, and the bar 47 will engage the contacts 50, closing the second timing motor circuit. The oil remaining in the combustion chamber, will continue to burn sluggishly for a moderate period of time in the absence of the air blast from the blower. When power is available, current flowing through the stack switch and the coil 43 will immediately operate the relay 43 to open the second timing motor circuit and to close the second oil valve control circuit to open the oil valve. At the same time the blower will be started. If the oil in the burner is still burning, the burner will resume normal operation. If the oil in the burner has been consumed, the stack thermostat will have been cooling and operation of the blower with no combustion taking place will very rapidly cool the stack thermostat which will operate its contacts to de-energize the relay coil 43 and close the second timing motor circuit. The timing motor will then return the control mechanism to its idle position and, if the room thermostat is still calling for heat, a new starting cycle will begin. If in attempting to obtain the proper setting for the room thermostatic switch 14, the setting arm of the thermostatic switch 14 should be worked backwards and forwards, thereby starting and stopping the timing motor 15, so that the various switches 33, 35, 34, 36 and 39 are not in their regular position for the start of the cycle of the control mechanism and as a result when the thermostatic switch 14 is finally closed, proper ignition of the oil burner does not occur, the stack thermostatic switch 42 will not close and the control mechanism will simply run through the balance of a complete cycle until the parts are in their original starting position, whereupon the control mechanism will begin a complete new cycle.

It will, of course, be understood that by set-

ting the pins 21 and 22 differently on the gear 19, the time intervals between the opening and closing of different switches may be varied as desired. Also by varying the position of the pins 23 and 24, by adjusting these pins in slots of the arms 25 and 26, the various switches may be held closed for different periods of time. It will also be understood that different types of switches than those illustrated and different mechanisms than those illustrated for operating these switches may be used without departing from the scope of the invention. It is also possible to operate other types of burners or heating devices than vaporizing type oil burners with the control mechanisms of the invention. It is, for example, possible to use the control mechanisms of the invention with gun type oil burners, pilot light type oil and gas burners etc.

The control mechanism is quite simple in construction and in operation and may be readily installed for use. It has been amply and successfully demonstrated in practice.

It will, of course, be understood that various changes may be made in the form, details, arrangement, and proportions of the various parts and in the electrical circuits without departure from the scope of the present invention, which, generally stated, consists in the matter shown and described and set forth in the appended claims.

What is claimed is:—

1. In combination, a burner having an electrical igniter, a blower and fuel line for said burner, said igniter being in the path of discharge of fuel from said fuel line, a motor for operating said blower, and an electrically operated valve in said fuel line operative to open when energized, control mechanism for said motor, igniter, and valve comprising a timing motor, a main switch operative on closure to energize said timing motor and said igniter, a first switch operated by said timing motor some time after energization thereof to energize said oil valve, a second switch operated by said timing motor some time after energization of said oil valve to energize said motor, and third and fourth switches operated by said timing motor to respectively de-energize said igniter some time after energization of said oil valve and de-energize said timing motor as said motor is energized, said main switch when open de-energizing said oil valve, and combustion responsive switching means operable to energize said timing motor when combustion has ceased in said burner, subsequent operation of said timing motor opening said second switch to de-energize said motor.

2. In combination, a burner having an igniter, a blower and fuel supply line for said burner, a motor for operating said blower and an electrically operated valve in said fuel line operative when energized to open, control mechanism for said motor and valve comprising, a relay having two switches operated thereby and a timing motor, a main switch operative to close the starting circuit for said timing motor, means operated by

said timing motor to energize said valve and blower motor, establish a running circuit for said timing motor through one of said relay switches independent of said main switch and subsequently de-energize said valve, a switch responsive to combustion operative if combustion occurs to energize said relay to open said relay switch in the timing motor running circuit to de-energize the same, said second relay switch operative to close on relay energization to place the valve under control of said main switch, whereby opening of said main switch de-energizes said valve, said blower motor continues energized until said combustion responsive switch de-energizes said relay to re-energize said timing motor and said means operated by said timing motor operates to open the blower motor circuit and its own running circuit.

3. The structure defined in claim 2 and if combustion fails to occur, said combustion responsive switch remains open and said relay remains de-energized to leave timing motor energized and oil valve de-energized, further operation of timing motor causing switches operated thereby to open the blower motor circuit and its own running circuit.

4. In combination, a burner having an electrical igniter, a blower and fuel line for said burner, a motor for operating said blower, and an electrically operated valve in said fuel line operative to open when energized, control mechanism for said motor, igniter, and valve comprising a relay having two switches operated thereby, one switch being normally closed and one being normally open, a timing motor, a main switch operative on closure to energize said timing motor and said igniter, a first switch operated by said timing motor some time after energization thereof to energize said oil valve, and a second switch operated by said timing motor some time after energization of said oil valve to energize said motor, third and fourth switches operated by said timing motor to respectively de-energize said igniter some time after energization of said oil valve and de-energize said timing motor as said motor is energized, a fifth switch operated by said timing motor as said motor is energized to energize said timing motor through said normally closed switch of said relay, said normally open switch of said relay being connected to energize said oil valve through said main switch when closed, and a combustion responsive switch operative to energize said relay after combustion occurs to energize said oil valve through said main switch and to de-energize said timing motor, said oil valve remaining de-energized if combustion does not occur and said timing motor remaining energized, further operation of said timing motor subsequently operating said second switch to de-energize said motor, returning said third and fourth switches to their normal positions to permit a new starting cycle if said main switch is still closed, and opening said fifth switch to de-energize said timing motor if said main switch is open.

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