

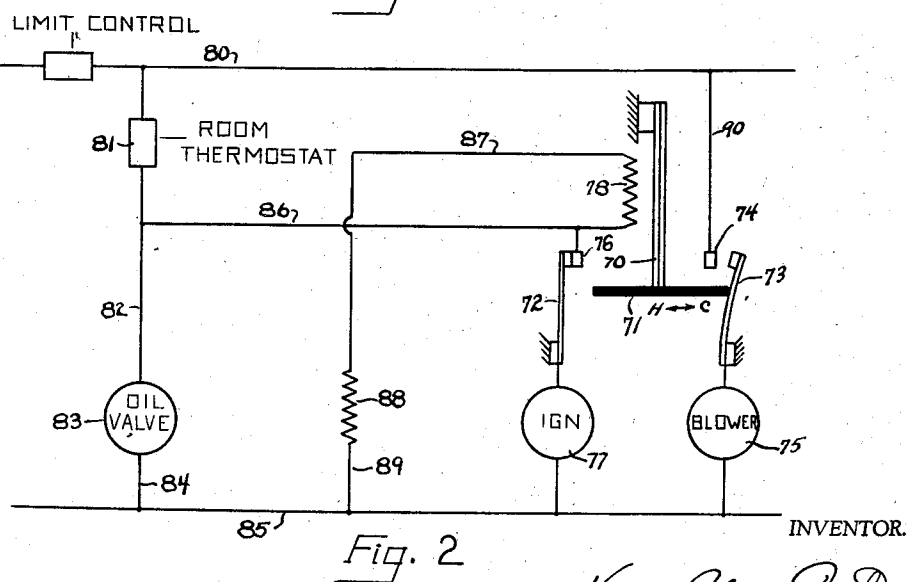
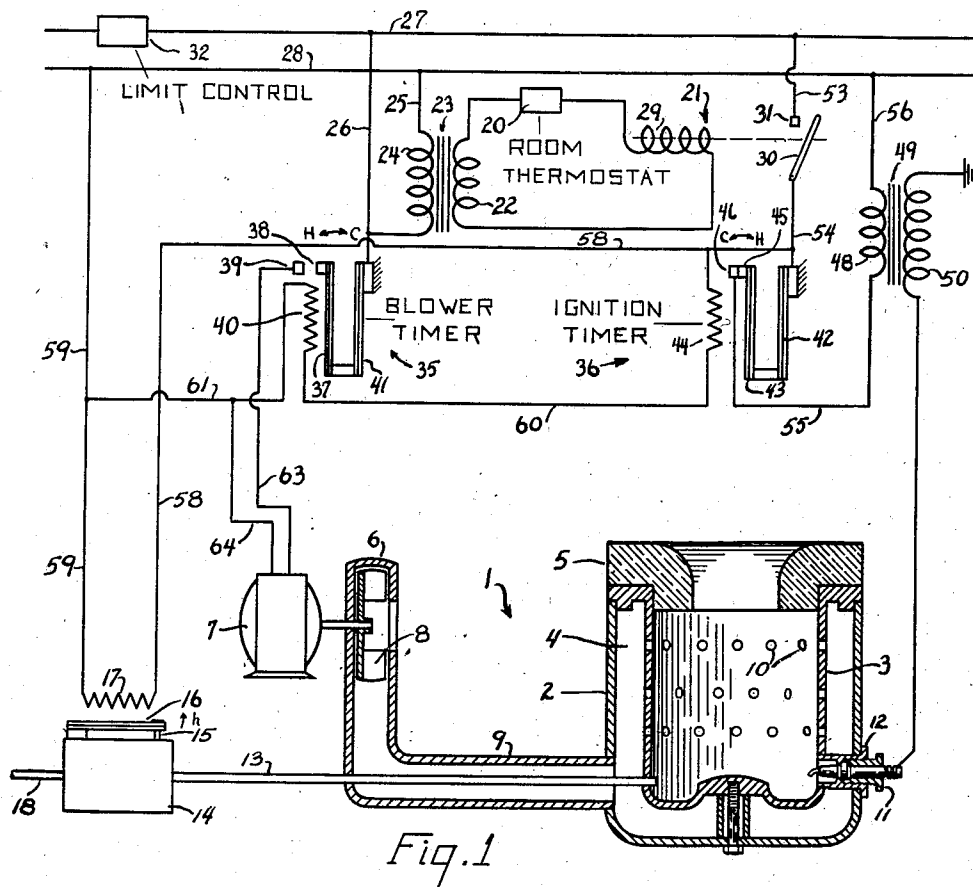
**Feb. 27, 1945.**

V. R. TATE

**2,370,205**

## BURNER CONTROL APPARATUS

Filed Aug. 22, 1941



INVENTOR.

Vigil Robins L.D.

## UNITED STATES PATENT OFFICE

2,370,205

## BURNER CONTROL APPARATUS

Virgil Robins Tate, Milwaukee, Wis., assignor to  
Perfex Corporation, Milwaukee, Wis., a corporation of Wisconsin

Application August 22, 1941, Serial No. 407,867

5 Claims. (Cl. 158—28)

This invention relates in general to automatic control of fuel burners and more particularly to control of oil burners of the pot or vaporization type.

In this type of burner oil is fed into a pot type of retort in which it vaporizes, the vapor rising and mixing with air passing through perforations in the side walls of the burner pot, this forming a combustible mixture which burns either within or at the top of the burner pot. In some types of burners, air passes into the burner pot by natural draft, while in others a blower is provided for forcing the draft and increasing the burner capacity. In some burners, automatic control is effected by varying the oil supply to cause the burner to operate with a high flame when heat is required and to cause the burner to operate with a low or pilot flame when heat is not required. In other burners, the oil supply is entirely cut off when heat is not required, an igniter being provided for igniting the fuel when heat is required.

The present invention provides a simple and dependable control system for vaporization burners of the type having both a blower and an igniter. The invention, however, is not limited to this type of burner, certain novel features or subcombinations being applicable to burners without blowers, other features being applicable to burners without igniters, and some features being applicable to fuel burners in general.

In controlling burners of the type having a blower for forcing the draft, it is desirable to operate the blower for a period of time after the oil supply is cut off or reduced to low flame operation. This provides for complete burning of the residual oil in the oil line or burner pot and reduces carbon formation therein. It is one object of this invention to provide an improved and simplified form of control system for providing this operating sequence.

It is a further object of this invention to provide a control system which acts upon call for heat to first provide a supply of oil to the burner and then after a period of time to place the blower into operation. In burners having "high-low" flame type of control, this sequence permits the low flame to increase considerably in size and to heat the burner pot nearer to vaporization temperature before the blower starts, thus insuring that the forced draft will not extinguish the flame and also providing improved initial operation of the burner. In burners provided with igniters, this sequence of operation has the

further function of making the operation of the igniter more positive.

It is a further object of the invention to provide a control system for a burner having an igniter and a fuel supply controller, which acts upon starting of the burner to operate the igniter for a period of time and then render the igniter inoperative, the control system upon shutting down of the burner acting to maintain a supply of fuel for sustaining the flame until the igniter is conditioned for operation. This sequence permits the use of a very simple form of control device for the igniter while at the same time insuring that combustion will always occur when the burner is started.

Other objects of the invention will become apparent from the following description and appended claims.

For a full disclosure of this invention, reference is made to the following description and to the accompanying drawing, in which

Fig. 1 shows schematically a preferred form of burner control system; and in which

Fig. 2 shows a modified form of system.

## Figure 1

In Fig. 1 reference character 1 indicates generally a pot or vaporization type of oil burner. The burner illustrated is of known form and comprises a cup-shaped outer jacket 2 which surrounds a perforated bowl or pot 3, an annular air space 4 being provided between these members. The bowl 3 is suitably secured within the outer jacket and supports a refractory ring 5 at its upper end. The burner also includes a fan or blower 6 which may be of the centrifugal type including a motor 7 driving a rotor 8. This fan is connected by a blast tube 9 to the outer jacket 2, this tube delivering air from the fan into the annular chamber 4 from which it flows through the perforations 10 into the interior of the bowl 3. The burner 1 is also provided with a suitable igniter which may consist of a spark plug 11 screwed into a sleeve 12 extending through the walls of the outer jacket and burner pot. Oil is supplied to the burner through an oil line 13 which leads from an automatic constant level valve 14, this oil line being shown as extending through the blast tube 9 into the side wall of the burner bowl. The constant level valve 14 may be of a form well known in the art and includes a metering valve stem 15 which is positioned by a bimetal element 16, this element being subjected to the influence of an electric heater 17. This arrangement constitutes a fuel

supply control means for controlling the flow of oil from a suitable source 18 to the burner. In the embodiment illustrated the bimetal element 16 warps upwardly when the heater 17 is energized, this raising the metering valve 15 and permitting flow of oil to the burner. When the heater 17 is deenergized the bimetal element 16 will cool down, lowering the valve stem 15 and cutting off the flow of oil to the burner.

The control system for the burner is shown as including a room thermostat 20 controlling a relay 21 which receives current from the secondary 22 of a step-down transformer 23, the primary 24 of which is connected by wires 25 and 26 across line wires 27 and 28. The relay may be of any suitable form and is shown diagrammatically as consisting of a coil 29 which operates through a suitable armature (not shown), a switch arm 30 cooperating with a contact 31. When the room thermostat calls for heat it closes the circuit for the relay coil 29 which causes the switch arm 30 to engage the contact 31, which as hereinafter described causes operation of the burner. When the room thermostat becomes satisfied it breaks the circuit for coil 29, causing switch arm 30 to disengage contact 31 and discontinue burner operation. Preferably the control system also includes a limit control 32 which is shown connected in line wire 27. This limit control may be responsive to the temperature or pressure of the furnace heated by the burner and places the burner out of operation in the event that such temperature or pressure rises to a predetermined value.

The control system for the burner also includes air flow control means including a blower timer 35 and additionally includes an igniter control means comprising an ignition timer 36. The blower timer may include an active bimetal element 37 having a movable contact 38 which is adapted to engage a fixed contact 39. The active bimetal element 37 is also provided with an electric heater 40. This bimetal element 37 is preferably secured to a compensating bimetal element 41 which in turn is fixedly secured at its upper end. This compensating element 41 is arranged to act oppositely to the active element 37 and serves to compensate the element 37 for changes in ambient temperature. When the heater 40 is deenergized the active element 37 becomes cool and assumes the position shown in which the contact 38 is disengaged from the contact 39. This prevents operation of the fan. When the heater 40 is energized, however, after a period of time elapses the element 37 will become heated sufficiently to cause contact 38 to engage contact 39, which causes the fan to operate.

The ignition timer 36 may be of the same general construction as the blower timer 35 and includes a compensating bimetal element 42, an active element 43 and an electric heater 44 for heating the active element. The active element carries a movable contact 45 cooperating with a fixed contact 46. When the active element 43 is cold, due to heater 44 being deenergized, it assumes the position shown in which the movable contact 45 engages the fixed contact 46 which permits energization of the primary 48 of an ignition transformer 49, the secondary 50 of which is connected to the spark plug 11. When the active element 43 becomes heated it warps to the right, causing the movable contact 45 to disengage the fixed contact 46 and thus prevent energization of the ignition transformer.

The timers 35 and 36 are preferably designed

or adjusted so that when the heaters 40 and 44 are energized simultaneously, the blower timer will close its switch a period of time before the ignition timer opens its switch. These timers are also preferably designed or adjusted in a manner so that when the heaters 40 and 44 are simultaneously deenergized, the ignition timer will close its switch before the blower timer opens its switch. This relation between the timers may be obtained by proper sizing of the heaters, by proper adjusting of the distances between the fixed and movable contacts and/or by providing the proper relationship between the thermal masses of the two active elements. This designing or adjusting of the thermal timers so as to provide the above specified sequence may readily be done by those familiar with the characteristics of timers of this type, and accordingly no further explanation is necessary.

#### Operation

With the parts in the positions shown, the room thermostat is satisfied, as indicated by the relay switch arm 30 being disengaged from contact 31. The heaters 40 and 44 are now deenergized and the timers are in their "cold" positions. Thus the ignition switch 45-46 is closed and the blower switch 38-39 is open.

The room thermostat constitutes a heat demand responsive device. When this device calls for heat, it energizes the relay 21. This instantly energizes the ignition transformer, the heater 17 of the fuel controller and the heaters 40 and 44 of the thermal timers. The ignition circuit extends from line wire 27 through wire 53, contact 31, switch arm 30, wire 54, bimetal elements 42 and 43, contacts 45 and 46, wire 55, ignition transformer primary 48 and wire 56 to line wire 28. The energizing circuit for the heater 17 extends from switch arm 30, through wires 54 and 55, heater 17 and wire 56 to line wire 28. The timer heaters 40 and 44 are connected in series and are energized by a circuit extending from switch arm 30 through wires 54 and 55, heater 44, wire 56, heater 40 and wires 61 and 59 to line wire 28. From the description thus far it will be apparent that when the room thermostat first calls for heat, the igniter is placed into operation immediately and the oil valve heater is energized for causing opening of the oil valve, the blower motor 7 remaining at rest. When the oil valve opens, oil flows from the constant level valve 14 through oil line 13 into the burner pot, this oil being ignited by the spark produced by the spark plug 11. Due to the blower 7 remaining at rest, the small amount of oil in the burner pot is readily ignited and the heat therefrom is retained in the burner pot, the pot thereby becoming quickly heated. Thus the flame is permitted to build up considerably by natural draft before the blower is started, which insures that the flame will not be blown out upon starting of the blower.

Due to the timer heater 40 being energized, the timer switch 38-39 will be closed a period of time after the igniter and oil valve are energized. This closure of the blower switch completes a circuit from line wire 27 through wire 28, bimetal elements 41 and 37, contacts 38 and 39, wire 63, blower motor 7 and wires 64, 61 and 59 to line wire 28. The blower is thus placed into operation, this providing a forced draft and increasing the rate of burning of fuel. Due to the ignition timer contacts still being closed, the igniter 12 will continue to operate after the

blower starts. This is desirable as it provides further insurance that the burner will operate properly. After a period of time the igniter contacts 45—46 will open, thus deenergizing the ignition transformer 49 and placing the igniter out of operation. The burner will now operate until either the room thermostat becomes satisfied or the furnace becomes heated to the setting of the limit control 32.

When the room thermostat becomes satisfied it will deenergize the relay 21, causing the switch arm 30 to disengage contact 31. This breaks the circuit for the fuel valve heater 17 and also deenergizes the timer heaters 40 and 44. Thus the blower and ignition timers begin cooling, and also the valve operating bimetal 16 begins to cool. As the blower circuit through the blower timer is independent of the relay 21, the blower 7 continues to operate. The ignition timer 36 after a short period of time closes its contacts 45—46 and then the bimetal element 16 shuts off the supply of oil to the burner. The blower timer is designed so as to maintain its contacts closed for a substantial period of time after the oil valve 15 becomes completely closed. This causes the fan to operate until the residual oil in the line 13 is consumed. The blower switch 38—39 then opens for stopping the blower. The burner then remains at rest until the room thermostat again calls for heat and the cycle above described is then repeated.

As pointed out above, the ignition timer is preferably designed so as to close its contacts before the valve positioning bimetal element 16 completely closes the metering valve 15. This insures that oil will be supplied to the burner until the ignition timer switch recloses. As a result a flame is always present in the burner pot at least until the ignition timer is ready to begin a new cycle. This insures that combustion will always take place, irrespective of when the room thermostat calls for heat. Thus if the thermostat calls for heat before the timer switch recloses, the igniter will not operate. However, operation of the igniter is not necessary at such time as the flame is still present in the burner pot. If the thermostat calls for heat after the igniter switch is reclosed there may be no flame in the burner pot, but now the ignited is operative for igniting the fuel supplied. While it is preferable to utilize a slow acting oil control valve as illustrated, this is not entirely essential and a quick acting valve such as a solenoid valve may be employed with like results if the oil line 13 has sufficient capacity to maintain flame in the burner bowl until the ignition timer recloses its switch.

It should be noted that if the furnace becomes heated beyond the setting of the safety or limit control 32, the burner will shut down in the same manner as described when the room thermostat becomes satisfied, except that the blower instead of operating to blow out or purge the fire pot, will stop immediately. At such time it is more important to reduce the supply of heat to the furnace as quickly as possible than to provide for burning residual fuel under forced draft. If this sequence of operation provided by the limit control location illustrated is not desired, the limit control may be connected in series with the room thermostat or in series with the relay.

Figure 2

In Fig. 2 a modified form of control system is illustrated for obtaining the same sequence of

operation as the system of Fig. 1. In this system a high voltage type of room thermostat is shown, and also a single timing element is utilized for controlling the blower and igniter instead of two separate timers as illustrated in Fig. 1.

In this figure, a combined ignition and blower controller is diagrammatically illustrated as comprising a bimetal element 70 which is fixed at its upper end and which carries an insulating member 71 at its lower end which is adapted to actuate flexible switch blades 72 and 73. The switch blade 73 is adapted to cooperate with a fixed contact 74 and controls the blower motor 75. The switch blade 72 cooperates with a fixed contact 76 forming a switch for controlling the igniter 77. The bimetal element 70 is provided with a heater 78. When this heater is deenergized and the bimetal element 70 cold, this element assumes the position shown in which the switch blade 72 is permitted to engage its fixed contact 76 and in which the switch blade 73 is pressed to the right out of engagement with the fixed contact 74. When the bimetal element 70 heats under the action of heater 78 it warps to the left which first permits the switch blade 73 to engage contact 74 and then after a period of time presses switch blade 72 away from contact 76. When the bimetal element 70 cools it warps to the right, which permits reclosing of the igniter switch 72—76 and later reopens the blower switch 73—74.

The sequence of operation of the system shown in Fig. 2 is the same as the system of Fig. 1. Thus when the room thermostat calls for heat, the oil valve is energized immediately through a circuit extending from line wire 80 through the room thermostat 81, wire 82, oil valve 83 and wire 84 to line wire 85. Simultaneously the igniter 77 is energized by a circuit extending from the room thermostat through wires 82 and 86, contact 76, switch blade 72 and igniter 77 to line wire 85. At the same time the timer heater 78 is energized by a circuit extending from wire 86 through heater 78, wire 87, ballast heater 88 and wire 89 to line wire 85. Thus when the room thermostat calls for heat the oil valve and igniter are immediately energized and the heater 78 is also energized for causing the timer to begin functioning. As the bimetal element 70 becomes heated it warps to the left, first closing the blower switch 73—74 for placing the blower into operation, and later opening the ignition switch 72—76 for placing the igniter out of operation. The blower at this time is energized through an independent circuit extending from line wire 80 through wire 90, contact 74, switch blade 73 and blower 75 to line wire 85. When the room thermostat becomes satisfied it deenergizes the oil valve and the timer heater 78, which permits the timer to begin cooling. Shortly thereafter the bimetal element 70 moves to the right for reclosing the igniter switch 72—77. At this time the operating member 71 is out of engagement with the switch blade 73 and consequently the blower switch remains closed and the blower continues to operate. After a substantial period of time which permits the residual oil to be burned, the member 71 engages switch blade 73 for opening the blower switch and placing the blower out of operation.

From the foregoing description it will be apparent that the present invention provides an extremely simple control system for a fuel burner having an igniter and/or a blower, the system

preventing operation of the blower for a period of time after oil is supplied to the burner and also maintaining the blower in operation for a period of time after the oil supply is discontinued, for properly burning the residual oil. It will also be apparent that the present invention provides an igniter control arrangement which insures that combustion of the fuel will always take place. While the invention is particularly applicable to a pot or vaporization type burner, certain features of the invention are of broader application. Inasmuch as many changes may be made without departing from the scope of the present invention, it is desired to be limited only by the appended claims.

What is claimed is:

1. In a control system for a pot type oil burner having an igniter, the combination of, an oil valve for controlling the flow of oil to the burner pot, control means responsive to the demand for heat from the burner for opening and closing said valve and controlling said igniter, said control means acting upon a demand for heat to open the oil valve and place the igniter in operation, an igniter controller having a first position in which the igniter is rendered operative under the control of said control means and a second position in which the igniter is rendered inoperative, slow acting means controlled by said control means for moving the igniter controller from its first position to its second position a period of time after opening of the oil valve upon demand for heat by the control means and for returning said igniter controller to its first position a period of time after the control means becomes satisfied, said slow acting means being timed to return the igniter controller to its first position before the oil supplied to the burner pot by the valve becomes exhausted.

2. In a control system for a fuel burner having an igniter, the combination of, control means responsive to the demand for heat, a fuel valve for controlling the flow of fuel to the burner, valve operating means including a first slow acting device for controlling said fuel valve, said valve operating means being controlled by the control means and acting to open the fuel valve in response to a call for heat by the control means and to close the fuel valve a period of time after the control means becomes satisfied, a second slow acting means having a first position rendering the igniter operative under the control of said control means and a second position for rendering the igniter inoperative, said second slow acting means being controlled by said control means and moving from its first position to its second position when the control means calls for heat to render the igniter inoperative after a timed period and returning from its second position to its first position a period of time after the control means becomes satisfied, said second slow acting means being constructed and arranged to return to its first position before the first slow acting means effects closing of the fuel valve.

3. In a control system for a pot type fuel burner having an igniter, the combination of, control means responsive to the demand for heat

from the burner, an oil line, a fuel valve disposed in said oil line a substantial distance from the burner pot, whereby a substantial amount of oil is permitted to flow to the burner pot after the oil valve is closed, valve operating means including a device for controlling the oil valve, said valve operating means being controlled by the control means and acting to open the oil valve in response to a call for heat by the control means and to close the oil valve in response to the control means becoming satisfied, a slow acting means having a first position rendering the igniter operative under the control of said control means and a second position for rendering the igniter inoperative, said slow acting means being controlled by said control means and moving from its first position to its second position when the control means calls for heat to render the igniter inoperative after a timed period and returning from its second position to its first position a period of time after the control means becomes satisfied, said slow acting means being constructed and arranged to return to its first position before the oil in the oil line between the oil valve and burner pot becomes exhausted.

4. In a control system for a burner having fuel feeding means, an igniter and a blower, the combination of, control means responsive to the demand for heat from the burner, said control means acting upon call for heat to place the fuel feeding means and igniter into operation and acting when the demand for heat is satisfied to place the fuel feeding means out of operation, and timing means controlled by said control means for controlling the blower and igniter, said timing means being constructed and arranged to place the blower into operation a period of time following the demand for heat, and then placing the igniter out of operation, said timing means also being arranged to first render the igniter operative under the control of said control means and then place the blower out of operation when the demand for heat is satisfied.

5. In a control system for a burner having an electrically operated blower and an electrically operated igniter, the combination of, an electrically operated fuel valve, a circuit for the fuel valve, a circuit for the igniter, condition responsive switching mechanism interposed in said circuits and operative to close said circuits upon demand for heat, a normally closed ignition switch interposed in said igniter circuit, a blower circuit independent of said switching mechanism, a normally open blower switch in said blower circuit, and timing means placed into operation upon closure of said valve and igniter circuits, said timing means being constructed and arranged to act a predetermined period of time thereafter to first close the blower switch and then open the ignition switch, said timing means also being arranged to act upon opening of the valve and igniter circuits to reclose the ignition switch before the oil supplied by the oil valve becomes exhausted and to open the blower circuit after a further period of time.

VIRGIL ROBINS TATE.