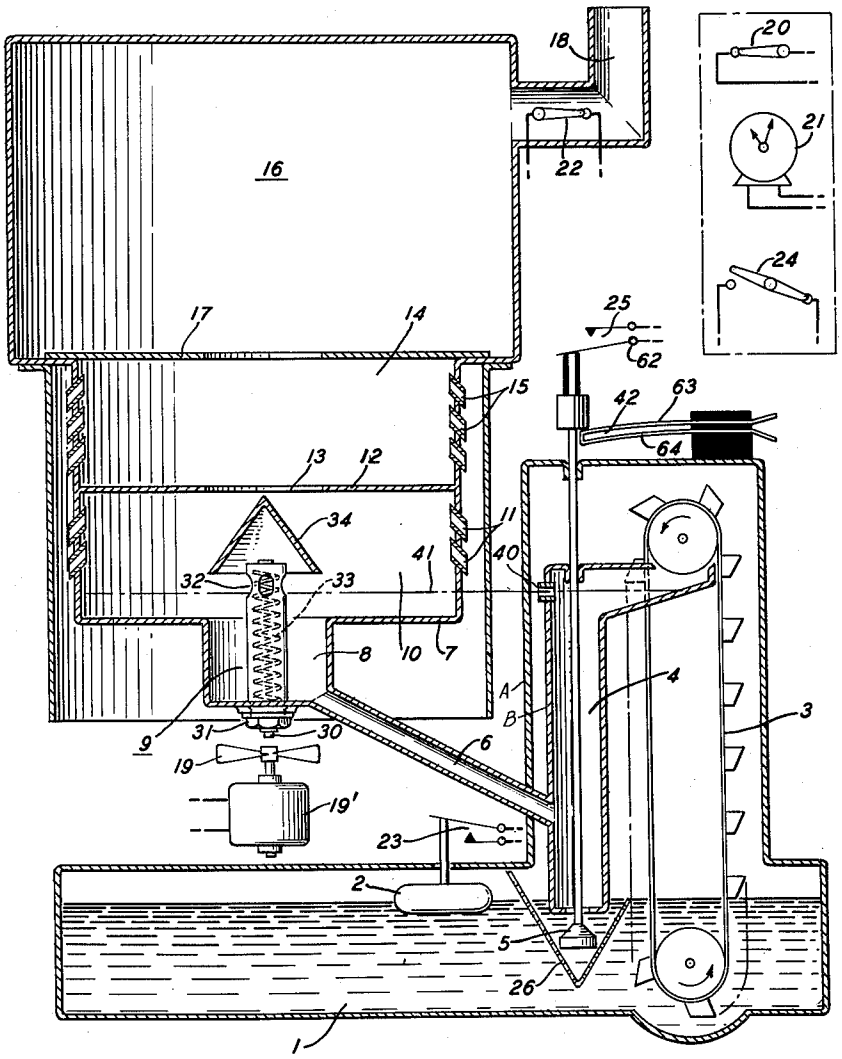
Jan. 23, 1962 H. STIERLIN 3,017,921

POT TYPE OIL BURNER

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FIG. 1



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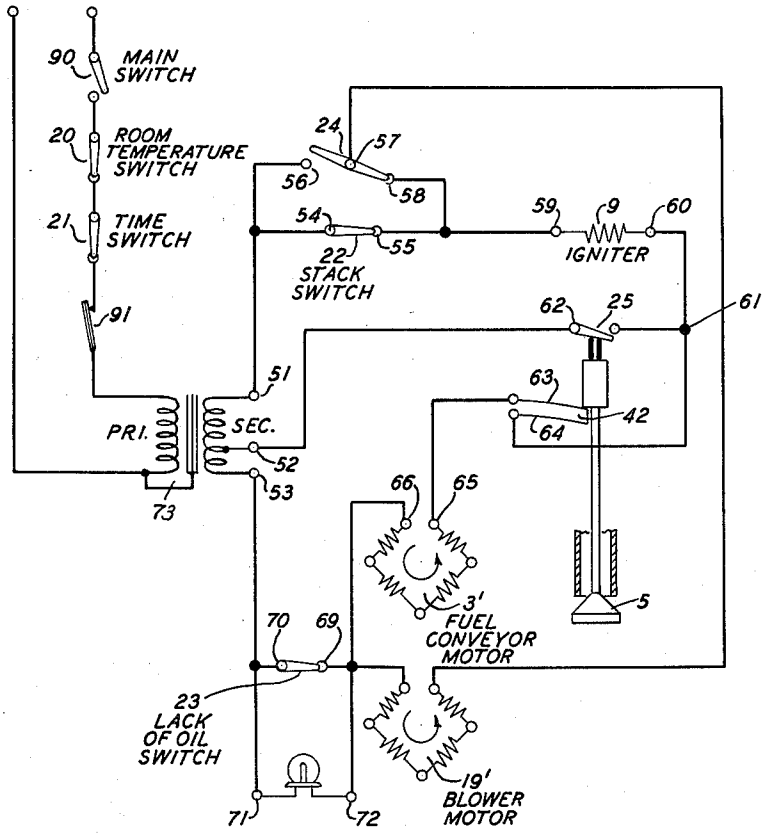
ATTORNEY

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FIG. 2



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3,017,921

Patented Jan. 23, 1962

3,017,921

POT TYPE OIL BURNER

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Filed Nov. 18, 1957, Ser. No. 697,219
Claims priority, application Switzerland Nov. 20, 1956
6 Claims. (Cl. 158—28)

The instant invention relates to oil burners or furnaces of the open pot type in which fuel oil is raised to the boiling point, the resulting oil vapor mixed with air, and the mixture ignited and combusted.

Oil furnaces of the open pot type have heretofore been used for heating plants of relatively small capacity. The advantages of this type furnace include its marked simplicity coupled with lack of noise of its flame, and it is relatively quite inexpensive to produce. Its drawbacks are its low capacity since, firstly, it permits of combustion at acceptable efficiency of but relatively small quantities of oil, for example of the order of two quarts per hour, and, secondly, control of the combustible mixture for efficient combustion, while possible within very narrow limits, is practically impossible over a wide range.

Evaporator burners presently on the market have a control range of about 1 to 5, and do not satisfy present day requirements. To circumvent this disadvantage, prior attempts have been made to provide an additional combustion stage in which but a very small pilot or ignition flame was maintained. While such arrangement, having a relatively wide range of control, does enable the restarting and restoration of the furnace to its full capacity without renewed ignition, such advantage is coupled with a quite marked sooting by the small flame and the attendant dangerous condition of the chimney because of the low temperature of the flue gases. As, in addition, control of fuel supply for such a small flame is exceedingly difficult, this solution has not resulted in any noteworthy acceptance in practice.

Another disadvantage of the prior art pot type oil furnace is that it must be lighted by hand, that is, by matches or other hand-operated igniters, which in these days of automation is rather crude and not acceptable. Furthermore, if such a furnace is provided with a chimney of poor draft characteristics, or if the drawing properties of the chimney are variable, there is danger that the burner cannot ignite, or the flame will be extinguished, or the burner will operate at low efficiency and hence generate soot which will lodge in both the burner and the chimney. Coupled to all this is the fact that most of the fuel oil control means provided with floats and outflow regulators now used with open shell or tray burners, are quite unsatisfactory in that constancy in the volume of fuel flowing to the burner is not obtainable due to marked variations in incidental matters, such as quality, grade and temperature of the oil, the installation made of the regulators and controls, the factory tolerances, etc.

Hence there were also attempts to supply the fuel oil to the burners by means of wicks, which mode of supply was likewise not adopted in practice because the wicks frequently became fouled and required replacement. To obtain optimum efficiency from fuel oil and for correct combustion thereof over the entire regulating range, regulation of the air supply in accordance with the regulation of the fuel supply is necessary. However, such regulator provision for this type of burner is much too expensive. Furthermore, with small oven loads the temperature of the flue gases may sink below the dew point, which not only would endanger the chimney but would also violate the operating code of the fire insurance companies and underwriters.

Chambered fuel oil burners in which the chimney draft is augmented by electrically driven air blowers or fans are prior known, the blower being turned on and off manually. If with a poor draft, the fan is not turned on a sooty flame results. So also regulation of the draft by chimney valves and flaps was tried but resulted in no satisfactory solution.

In addition most prior art oil furnaces had the very marked disadvantage that the oil tank had to be installed at an elevated position, for example at half the furnace height, so that the oil would flow to the burner plate or pot. This resulted in a high center of gravity of the furnace and a correspondingly decreased stability. Also, the oil tank had to be well insulated to avoid risk of fire. Where the oil tank was so disposed, regulatory codes provided that an oil catch basin be provided at the base of the furnace and be of a volume at least equal to that of the tank.

On closing the oil supply valve of oil furnaces of the prior art, the flame is not immediately extinguished. The oil in the pot is consumed whereupon the flame rapidly contracts but does not go out because the heated pot conducts heat to the oil supply feed tube. As the latter is no longer cooled by cool oil flowing therein, it heats up to such an extent that the oil in the tube begins to boil and oil vapor is generated for an appreciably long interval to maintain a small and very sooty flame. This type of afterburning can continue for up to a half hour depending on the furnace construction. In so doing there is danger that not only will the combustion chamber become sooted over, but also that the oil outflow line will become clogged by soot.

It is an object of the instant invention to provide an oil furnace of the pot type in which all the disadvantages above mentioned are eliminated, which is wholly automatic and instantaneous both in starting and stopping, while retaining the advantages of silent operation and simplicity of construction.

It is a further object of the invention to provide means preheating and vaporizing the fuel oil, and igniting the oil vapor, on starting the burner, of simple construction and under the control of temperature responsive devices which release such means only after a predetermined low furnace temperature is reached.

Still another object of the invention is to provide a dish type oil furnace in which thermally responsive means at a predetermined high furnace temperature cuts off the fuel supply to the burner and actuates means causing the withdrawal of all fuel oil from the hot regions of the furnace and oil feed line.

The foregoing, and other, objects and features of the invention will become more readily apparent from the following description of an illustrative embodiment thereof when taken in conjunction with the appended drawing, in which:

FIGURE 1 is a simplified, elevational section of the oil furnace showing the burner pot or dish, the mixing, combustion and flame chambers, the chimney, the igniter, the fuel oil reservoir and conveyor and the fuel oil head regulating means of an illustrative embodiment of the furnace of the invention, and

FIGURE 2 the electrical circuit of the elements of the furnace assembly.

Referring to the drawing and FIG. 1 thereof, the illustrative embodiment of the oil furnace according to this invention therein shown, has an oil reservoir **1** in the form of a base, a float gage **2** for indicating the level of oil within the tank or reservoir, an oil supplying means **3**, for example a bucket conveyor, an oil standpipe **4** with a thermally actuated drain valve **5** which is closed when the furnace is in operation generating heat. A burner pot, dish or plate **7** is connected by oil feed line **6** to standpipe **4**, the feed pipe **6** connecting the bottom region

of a central depression 8 of dish 7 to a point of the standpipe 4 below the plane of the bottom of such depression. An electric ignition plug 9 is supported within dish depression 8 so that its upper end is above the horizontal plane of the maximum level of oil in standpipe 4. Above plate 7 is a mixing chamber 10 having peripheral air intake slits 11 in its side walls, the mixing chamber having a top plate 12 with a central aperture 13 by which the mixing chamber opens into a combustion chamber 14 whose walls are likewise provided with air intake apertures or slits 15. Above the combustion chamber is disposed a flame chamber 16 separated from combustion chamber 14 by a cast ring 17, a chimney 18 extending from the upper region of the flame chamber. In addition, the oil furnace is provided with a main switch 90 (FIGURE 2), a fan or blower 19 driven by motor 19', a room thermostat 20, a time switch 21, a chimney thermostat 22, an oil supply indicating switch 23, a blower switch 24, as well as a single contact switch 25 for preventing reconnection of the furnace in its heated state. An oil filter 26 within oil tank 1 interconnects the lower end region of the tank and a vertical casing housing the standpipe 4 and the vertical bucket conveyor 3 which empties its buckets at the top of the conveyor, pouring the conveyed oil into the open upper end of the standpipe.

A drain valve 5, in the bottom region of standpipe 4, is normally open and is closed when the burner is generating heat, or "running," by means of a thermally responsive control element, as hereinafter described, the control element in the form of a bimetal strip 42 lifting valve 5 to close it against its seat in the bottom of the standpipe, thus closing the standpipe. As the oil conveyor 3 operates, the level of oil in standpipe 4 rises and, on sufficient rise in such level, oil flows from inclined oil feed line 6 into pot or dish depression 8 to surround the lower region of ignition plug 9. As shown clearly in FIGURE 1, the maximum level 41 of oil in standpipe 4 is controlled by overflow aperture 40 which is in a horizontal plane below the top region of ignition plug 9. Thus accumulation of oil in pot 7 in such amount that it would ultimately flow out through air slits 11 of the mixing chamber is impossible. Oil overflowing through aperture 40 of the standpipe is, obviously, returned to tank 1. Bucket conveyor 3 for the oil has the advantage that it is unaffected by impurities in the fuel oil, conveying a constant volume thereof wholly independent of the viscosity, temperature, specific gravity, etc., of the oil. Furthermore, by increasing or decreasing the number of buckets on the conveyor, it may be used for large as well as smaller furnaces.

As shown in FIGURE 1, ignition plug 9 has a central external terminal 30, a screw cap 31 peripheral terminal, a coil 33 having a lower heating portion and an upper incandescent igniting portion 32. Coil 33 may have its incandescent portion of a finer gage wire than its oil preheating portion. On applying electric power to the ignition plug, portion 32 of its coil heats up to such a temperature that the fuel oil surrounding this portion of the plug is vaporized. The generated oil vapors are mixed with the air available in the mixing chamber to form an ignitable mixture, which mixture circulates about the incandescent portion 32 of the coil due to the positioning above the plug of a spreader cap or formed plate 34 and is ignited by the glowing coil. It will be noted the incandescent coil portion is directly exposed to the combustible mixture through the usual aperture provided at the top region of the ignition plug. The heat resulting from such ignition favors the generation of more oil vapor, the flame becomes larger, air enters through slits 11 and 15 assisted by blower 19, and the flame displaces itself into the combustion chamber 14 and extends, at least partially, into flame chamber 16, with the flue gases grazing and sweeping over the walls of the flame chamber. A portion of the air propelled by blower 19 circulates externally about the flame chamber walls thus increasing the air borne transmission of heat, resulting in an improved heat transfer relation and smaller furnaces for given capacities or ratings. Thereupon the flue gases discharge through chimney 18 and in so doing flow about chimney thermostat 22.

Operation of the furnace, as well as the regulation and control thereof, will now be described with the aid of the circuit diagram of FIGURE 1. The main switch 90 is connected to the line supply, the main switch with room thermostat 20 and time switch 21 being series connected to the primary of a transformer 73, are thus at line potential. The remaining electrical elements of the furnace are connected to the secondary of this line transformer and are at low potential, varying between 1 and 9 volts for example, and thus no special electric protective or safety devices are required. Such circuit includes the chimney thermostat 22 in series with the ignition plug 9 and the bimetal strip 42 for actuating the drain valve 5, the motor 3' driving oil conveyor apparatus 3, as also the lack-of-oil indicating switch 23. Connected in parallel between a terminal 51 of the transformer secondary winding and the lack-of-oil indicator switch 23 is switch 24 for blower 19 with blower motor 19'. The first identified circuit connected to the secondary transformer winding is tapped at a point 61 beyond the terminals of ignition plug 9, the tap being connected by way of single contact switch 25 to a tap 52 of the secondary winding of the transformer, the latter tap dividing the potential of such secondary winding in a ratio of 1 to 8. This circuit portion, comprising terminals 54 and 55 of chimney switch 22, terminals 59 and 60 of ignition plug 9, common point 61, terminals 65 and 66 of the motor driving oil conveyor apparatus 3, terminals 69 and 70 of the lack-of-oil indicator switch 23, and transformer terminals 51 and 53 is designated the "starting" portion thereof since a portion of its elements are de-energized after the burner has started. When the burner is started, and simultaneously therewith, the "operating" portion of the circuit, comprising transformer tap 52, terminal 62 of contact switch 25, common point 61, terminals 65 and 66, terminals 69 and 70, and terminal 53, is closed by closure of single contact switch 25 so that current now flows in the "operating" circuit portion. It will be noted that the starting and operating circuit portions have elements 61, 65, 66, 69, 70 and 53 in common.

When the furnace is started, room thermostat 20, time switch 21, chimney thermostat 22, as also lack-of-oil indicating switch 23 if there is oil in the tank, are closed as is blower switch 24 by way of terminals 56 and 58 thereof as shown in FIGURE 2. Then the main switch 90 is closed and, the primary circuit of the transformer being now closed, current flows in the secondary circuit by way of chimney thermostat 22 to ignition plug 9, thus heating its ignition-preheater coil 32 and the body of igniter 9, through the bimetal strip 42 and motor 3' driving oil conveyor apparatus 3 which thus commences to lift oil and pour it into standpipe 4. While the bimetal strips 42 are shown mutually spaced for ease of illustration they are actually contiguous, the elements 63 and 64 thereof having such coefficients of thermal expansion, absolute and relative to each other, and being so positioned that the combined strip under the influence of the flowing current and the resulting heat is bent to curve increasingly, raising its free end and carrying with it the operating stem of drain valve 5, the stem having a projection resting on such bimetal strip free end. The drain valve 5 is raised an amount sufficient to close the valve on its seat, closing the bottom of standpipe 4 so that the level of oil therein rises. As soon as oil reaches dish depression 8 through feed line 6, it is heated by the heated body of ignition plug 9 and vaporizes, the vapor mixing with air in the mixing chamber, and the combustible mixture being ignited by incandescent coil 33 of plug 9. In curving upwardly to lift the stem of drain valve 5, the bimetal strip also closes contact 25 since the valve stem extends upwardly beyond the pro-

jection thereon to an amount sufficient on the upward movement of the stem to closure of drain valve 5 simultaneously to close a movable contact, connected to point 61, upon contact 25 thereby closing operating circuit portion 62, 52. In normal operation of the burner this portion of the circuit is closed while, as shown, during the starting period it is open at contact 25. It is well to note that in the place and stead of the drain valve as shown a magnetically operable displacement element, releasing an additional container for outflow of oil, may be used.

The blower circuit may be connected before or after chimney thermostat 22 depending on the position of switch 24, and hence may be controlled by the chimney thermostat or remain constantly connected independently of the temperature of the flue gases in chimney 18. The use of blower 19 is indispensable since normal draft or drawing relations prevail within the chimney only after a period of operation, that is, after the chimney has been warmed. Until such normal draft conditions prevail, the furnace flame, in the absence of the blower, will burn with an inadequate supply of air and will be sooty. After operation of the burner for a predeterminable time, the hot flue gases will operate the chimney thermostat 22 to disconnect ignition plug 9 as well as blower motor 19'. The starting circuit portion is thus disconnected, and now the current, in the same magnitude, will flow through the operating circuit portion 52, 61, so that the other circuit elements remain energized and the controls continue to function normally.

When the level of oil in tank 1 is below a predetermined minimum, the lack-of-oil switch 23 opens while the circuit remains closed by way of optical or acoustic warning signal 71, 72 of which the resistance is of such magnitude that the current amplitude no longer suffices to operate the drive of conveyor apparatus 3, the latter stops, and after an interval of time the flame extinguishes. If thereupon no oil is added to the tank, bimetal strip 42 ultimately restores to its cold position, opening drain valve 5 so that the oil in standpipe 4 flows instantly back into tank 1 and the flame is quenched. At the same time the circuit is opened at switch contact 25.

When the required room temperature is reached, room thermostat 20 opens, disconnecting the primary circuit from the line, thereby stopping operation of the furnace. As the temperature sinks to a settable value below the required or desired temperature, thermostat 20 recloses the primary circuit and the furnace is automatically restarted, as hereinabove described. The above described control is designated an "On-Off" control. The desired or required temperature may be adjusted or displaced by time switch 21, for example, to take into account the outside or street temperature, or the time of day or night, in well known manner.

In order to avoid explosion hazards, it is absolutely imperative that no further oil be supplied to an oil burner after it is extinguished. Hence to avoid any reconnection of the circuits to the operating condition before the same should be reconnected, chimney stack switch 22 and bimetal strip 42 are provided, the latter opening single contact switch 25 as has been described which contact must be closed in the operating condition. The starting portion of the circuit, and therewith the drive of the oil conveyor apparatus, can only be reconnected, when the furnace has cooled off, by way of the chimney thermostat, whereupon with the automatic closing of the starting circuit, ignition plug 9 is again energized.

The transformer connecting with the electric line may be protected by a fuse, for example a thermal packet 91 of bimetal strips, so that the supply of line current to its primary winding will be interrupted when the transformer reaches a predetermined temperature. By appropriate dosage of the thermally sensitive mass, the furnace may automatically be stopped in the event of non-ignition of the flame, the standpipe 4 and feed tube 6 again emptied, and after the transformer has cooled, the furnace will automatically again attempt to ignite the burner. As a result of the series connection of ignition plug 9, bimetal strip 42, and the motor driving oil conveyor apparatus 3, the latter can not be started should the ignition plug be defective. Such arrangement further serves to prevent overfilling the furnace with fuel oil.

The oil furnace of the above described construction in accordance with the invention is economical in operation, fully automatic, safe in operation, secure against all hazard and danger of explosion, and noiseless. It meets all the requirement of a modern heating installation which users demand thereof.

What I claim is:

1. A fuel burner and control arrangement comprising a furnace having a chimney and means in the furnace forming a mixing chamber for air and fuel vapor, means to supply fuel oil to the mixing chamber, means included in the supply means to drain fuel oil from the mixing chamber, means to supply air to the mixing chamber and an igniter within the mixing chamber, comprising a first thermally responsive means positioned in the room to be heated for controlling on shut down of the burner the oil supply means and the oil drain means so that above a first predetermined temperature in the heated room the drain means is actuated to its position at which oil drains from the mixing chamber while the supply means remains stopped, and a second thermally responsive means positioned in the furnace chimney serially connected to the first thermally responsive means in such manner that when the second thermally responsive means after a shutdown is still at a temperature above a second predetermined temperature in the furnace higher than the first predetermined temperature in the heated room the supply means remains unactuated irrespective of the state of operation of the first thermally responsive means while when at a temperature below the second predetermined temperature, the first thermally responsive device being at a temperature below the first predetermined temperature, the supply means is actuated to supply oil to the mixing chamber and the drain means remains actuated to closure preventing the drainage of oil from the mixing chamber.

2. An oil furnace and control arrangement comprising a chamber for mixing air and oil vapor, a fuel oil reservoir, a standpipe connected to the chamber, a conveyor for supplying fuel oil from the reservoir to the standpipe, a motor driving the conveyor, the standpipe including a normally open drain valve for draining all oil from the mixing chamber and the standpipe back into the reservoir, a first circuit for connection to a source of electric power supply comprising in series a first normally closed switch responsive to the temperature of the flue gases from the furnace and constructed to open at a predetermined high temperature of such gases, an electrical igniter for the mixed air and oil vapor of the mixing chamber, and an electrically heated bimetal actuator having a free end, which free end is so connected to the drain valve that when current flows through the actuator it closes the drain valve, and a second circuit in shunt across the first circuit from a point thereof between the igniter and the bimetal actuator to the source of electric power supply, a normally open second switch being in the second circuit of which second switch the movable arm is actuated by the free end of the bimetal actuator to close the second switch on increasing temperature of the bimetal actuator to short the first switch and the igniter.

3. The oil furnace and control arrangement according to claim 2 in which the furnace includes a second motor for driving a blower for supplying air to the furnace for combustion, and the second motor is connected in shunt of the first switch and the motor driving the conveyor.

4. The oil furnace and control arrangement according to claim 2 in which a normally closed third switch re-

sponsive to the level of the oil in the reservoir is opened when substantially no oil is in the reservoir, and the third switch is connected in series between the motor driving the conveyor and the source of electric power supply.

5. A fuel burner and control arrangement comprising means forming a mixing chamber for air and fuel vapor, a combustion chamber open to the mixing chamber, a flame chamber open to the combustion chamber, a chimney from the upper region of the flame chamber, the mixing chamber having a centrally depressed portion, a source of electric power supply, a room thermostat, a first normally closed stack switch within the chimney, an electrical igniter within the mixing chamber and in series electrically with the first stack switch, a fuel oil standpipe of which the bottom is below the bottom of the mixing chamber, a fuel oil passage interconnecting a portion of the depressed bottom of the mixing chamber and the bottom of the standpipe, a fuel oil reservoir below the mixing chamber and the standpipe, a bucket conveyor for transporting measured quantities of oil from the reservoir to the standpipe, an electric motor for driving the conveyor, a normally open drain valve in the bottom of the standpipe, an electrically heated thermally responsive device which on passage of electrical current therethrough actuates the drain valve to its closing position to permit oil in the standpipe to flow by gravity through the oil passage into the mixing chamber, a first electrical circuit serially connecting in succession the room thermostat, the first stack switch, the igniter, the thermally responsive device and the motor to the source of electric power on closure of the room thermostat to energize the igniter and to energize the thermally responsive device to close the drain valve and to drive the conveyor motor, a second normally open switch actuatable to closure by the drain valve movement to closure, and a second circuit in shunt of the first circuit across the igniter and the first stack switch, the second switch being in the second circuit, for maintaining the thermally responsive device and the motor energized when the first stack switch opens on increase in temperature within the chimney and disconnects the igniter from the electric power source.

6. The burner and control arrangement according to claim 5 in which a normally closed second stack switch within the chimney is in shunt of the first stack switch, a blower is cooperatively associated with the mixing and combustion chambers to supply air thereto, a blower motor, and a third circuit including the second stack switch and the blower motor connected in parallel to the first circuit and to the electric power source to disconnect the blower motor when the second stack switch opens with increased temperature in the chimney.

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