FIG. 4

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By
Attorney
My invention relates to fuel oil burning devices adapted for use in domestic service and more particularly to domestic fuel oil burning devices especially designed to atomize and burn residual oils commonly known as “heavy” fuel oils. Most oil burning devices, particularly those developed for domestic service, have heretofore been confined to the use of the distillate oils or “light” fuel oils, identified by the grade numbers 1, 2 and 3 by the American Society for Testing Materials. The distillate oils are those oils which are distilled from crude petroleum at certain stages of the distillation process, and each possesses to a greater or less degree the common characteristics of comparatively ready volatility and relatively low viscosity. For this reason they are readily adapted to use in domestic fuel oil burning devices since their relatively low viscosity at ordinary temperatures facilitates flow at these temperatures through restricted passages such as conduits of small section and also facilitates atomization thereof by the fuel burning nozzle. Moreover, their comparatively ready volatility assists in the attainment of complete combustion and in producing a steady flame.

The residual oils on the other hand, such oils for example as those known by grade numbers 4, 5 and 6 of the aforementioned American Society for Testing Materials have a relatively high viscosity at ordinary temperature and are substantially non-volatile. Owing to their thick, gummy nature at ordinary temperature, flow of these oils through the conduits normally employed in fuel burning devices of the nature described is not readily attained and satisfactory atomization of these oils employing the mechanical compressors and atomizing nozzles now in widespread use in domestic fuel oil burning devices is almost impossible of attainment. However, it is known that these residual oils possess highly combustible qualities and moreover the cost thereof on the open market is substantially lower than that of the distillate oils.

It is therefore an object of my invention to provide a readily manufactured and economically operated domestic fuel oil burning device which is capable of producing a hot steady flame by the atomization and combustion of residual or “heavy” oils.

It is further an object of my invention to provide a fuel oil burning device in which the need for a mechanical compressor in securing atomization of the oil and which consequently eliminates the employment of moving parts.

In accordance with my invention I employ a jet of steam for atomizing the fuel oil at an atomizing nozzle and in order to maintain a quantity of steam at suitable pressures, I provide an automatically controlled steam generator having an independent heating means other than the oil burner device, the steam output of the generator being maintained automatically within fixed limits by means controlling the generator heating means, and the water input to the generator being controlled in accordance with the water level therein. Further, in accordance with my invention, I employ a portion of the heat developed within the aforesaid steam generator for preheating the oil prior to its passage to the atomizing nozzle to a relatively high temperature and I control the rate of flow of the oil and steam to the atomizing nozzle manually in order to obtain a fixed definite ratio therebetweent and also I control the flow of oil and steam to the nozzle automatically in accordance with the temperature of a medium heated by the operation of the oil burning device.

My invention will be more fully understood from a consideration of the following particular description of embodiments thereof, and of the drawings attached thereto, and the features of my invention which I consider to be novel are pointed out with particularity in the claims appended thereto.

In the drawings:

Fig. 1 is a general view of an oil burning device of my invention, certain parts thereof being in section, and a control circuit being incorporated therewith;

Fig. 2 is a plan view of the heater plates shown in section in Fig. 1, the upper plate being partially removed to illustrate a portion of the lower plate;

Fig. 3 is a sectional view of a preferred form of atomizing nozzle, showing the oil and steam passages therethrough; and

Fig. 4 is an illustration of an oil burning device employing alternative forms of boiler, heating device, and water control.

In Fig. 1 the numeral 1 indicates an atomizing nozzle which is more clearly shown in Fig. 3. The numeral 2 indicates generally a steam generator to which is connected the steam conduit 3 and the inlet or water conduit 4. The numeral 5 indicates generally a tank for the storage of a residual or “heavy” fuel oil the surface of which is represented at 6.

The steam generator comprises a water boiler formed of a cylindrical casting 7 having the top and bottom members 8 and 9 secured thereto by...
means of the bolts 10 and 11 respectively. The top and bottom members 8 and 9 are provided with suitable gaskets represented at 12 in order to assure a satisfactory water-tight seal between these members and the cylindrical casting 7. The water boiler is mounted on an insulating block 14 preferably of porcelain having a recessed bottom providing a terminal box 14 and the porcelain block 13 is in turn supported on a mounting base 15 adapted to rest on the floor or other support on which the oil burning device is mounted.

The heating element for the steam generator 2 comprises as a pair of spaced plates 15 and 16, spaced apart in a vertical direction and mounted on the porcelain block 17 which is provided with a plurality of upstanding knobs 18 on its upper surface adjacent the periphery thereof. The lower plate 16 is provided with suitable apertures adapted to fit over the raised central portions 19 of knobs 18 and permit the lower plate 16 to be mounted on the knobs 18. The upper plate 15 rests on the top of the raised central portions 19 of knobs 18 and is thereby spaced from the lower plate 16 at the edges thereof. Lower plate 16 is secured to the bolts 20 brazed or otherwise secured to the lower surface thereof and extending downwardly through suitable apertures provided in the porcelain block 17, the lower plate member 9 of the water boiler, and in the porcelain block 13. The block 17 is secured to block 13 by means of the bolt 21 extending downwardly through suitable apertures provided therein and in the lower member 9 of the water boiler and the porcelain block 13. The bolt 21 is provided with an enlarged head having a central tapped aperture therein and a screw 22 extends through a suitable aperture provided in the upper plate 15 and through an enlarged aperture provided in the lower plate 16 and into the tapped aperture in the centre of the head of bolt 21. Washers are provided between plate 15 and the head of bolt 21 in order to properly space plate 15 from plate 16 at the centre thereof. Bolts 20 and 21 extending into the terminal box 14 provide a ready means for connecting the heating elements 15 and 16 in an electric circuit which is completed through the water maintained in the steam generator 2.

The solenoid valve 20 is connected to the steam outlet 25 to which is connected the conduit 3 extending to the atomizing nozzle 1 where the steam conduit 3 connects with steam passages provided within the nozzle (shown more clearly in Fig. 3). A pressure operated switch 21 of well known construction is connected to conduit 3 and is adapted to open and close its contacts 27a and 27b in response to variations in steam pressure within the generator 2 respectively above and below predetermined limits. A second pressure operated switch 28 is also connected in the steam conduit 3 and is adapted to open and close its contacts 28a and 28b in response to variations in steam pressure in generator 2 respectively below and above a second pair of predetermined limits. A solenoid operated valve 29, of well known construction, is connected in series in the steam conduit 3 and is arranged to be normally closed and to open only upon energization of its solenoid. A manually operated valve 30 is also connected in series in conduit 3 and permits a manual adjustment of the rate of flow of steam through the conduit when the solenoid valve 29 is open.

The water inlet conduit 4 enters the water boiler through the elbow member 31 at a point adjacent the bottom of the boiler and close to the heating elements 15 and 16. A baffle 32 is provided in the interior of the water boiler in order to prevent splashing of the water directly onto the heating elements 15 and 16, and the water conduit 4 is wound in a plurality of coils 33 about the steam generator 2 and in good heat transfer relation with the exterior surface of the cylindrical casting 7 in order that the water entering the boiler may be preheated to facilitate the more rapid generation of steam therein and to prevent severe fluctuations in steam pressure therein due to the entrance of cold water. Conduit connected in series with the water inlet pipe 4 are the manually operated valve 34 and the solenoid valve 35. The manually operated valve 34 permits a manual adjustment of the rate of water flow through conduit 4, and the solenoid operated valve is arranged to normally close the conduit 4 and to open only in response to the energization of its solenoid.

The oil supply tank 5 is arranged at a higher level than the nozzle 1 and oil is conductedtherefrom through an enlarged oil conduit 48, reducer 49 and the conduit 42 of reduced section thereto, and extends to the atomizing nozzle 1, where it connects with the oil passages therein. Connected in series with the oil conduit 42 and adjacent the nozzle end thereof are the solenoid valves 44 and 45 and the manually operated valve 46. Each of the solenoid valves 44 and 45 are arranged to normally completely close conduit 42 and to open only upon energization of their solenoids. The manually controlled valve 46 permits a manual adjustment of the rate of flow of oil in conduit 42 when the valves 44 and 45 are open.

A T-connection 50 is made in the steam conduit 3 adjacent the steam generator 2, to which is connected a conduit 51 of relatively small size which is led back through the reducer 41, the enlarged oil conduit 40 and up through the oil supply tank 5. The purpose of the conduit 51 is to preliminarily preheat in order to render more fluidly the heated oil conducted through oil conduit 40. The steam exhaust from the conduit 51 may be employed for humidifying the atmosphere in an enclosed space, such for example as in a room of the house or other structure to be heated.

In order to assure the most efficient operation of the generator 2 and to prevent the escape of heat from the oil conduit 42 and steam conduit 3, these members are provided with an exterior heat lagging as indicated at 52. Although this heat lagging is shown only around the generator and the coils of conduits 42 and 4 adjacent thereto, it will be apparent that it may be, and in some cases preferably is, extended around the conduits 42 and 3 up to the proximity of the nozzle 1.

Steam is generated within the steam generator 2 by passing a current between the plates 15 and 16 through the water contained within the generator. The plates 15 and 16 are connected to a suitable source of electrical supply represented in the drawings at line as a single phase three conductor circuit having a grounded neutral. The circuit for plates 15 and 16 includes in series therewith the normally open contacts 76.
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61 and 62 of the relay 63 and also the operating solenoid 64 of a relay 65 having the normally closed contacts 66. Relay 63 is arranged to close its contacts 61 and 62 upon the energization of its operating coil 67. The relay 64 is adapted to open its normally closed contacts 66 whenever current flows between the plates 18 and 16.

A control circuit for the solenoid valve 38 in the water pipe 4 is provided including in series therewith the normally closed contacts 66 of relay 65 and also the contacts 27a and 27b of the pressure switch 27. Thus the solenoid valve 45 is energized to open the water pipe 4 whenever the contacts 66 of relay 65 are closed and the contacts 27a and 27b of pressure switch 27 are also closed.

The contacts 27a and 27b of pressure switch 27 are also included in series in the energizing circuit for relay 63. Thus the relay 63 closes its contacts 61 and 62 to supply heat to the generator 2 in response to the closing of the contacts of pressure switch 27 and water is supplied to the generator 2 whenever the level water within the generator falls below the level of the upper plate 15 thus breaking the circuit between the plates.

Pressure switch 27 is arranged to close its contacts 27a and 27b whenever the steam pressure within the generator 2 falls below a predetermined low limit and to retain its contacts closed until the pressure reaches a predetermined upper limit. Thus the pressure switch 27 operates to control the maximum water level within the generator 2 within predetermined limits and also to control the operation of the solenoid valve 38 thereby to control the supply of water to the generator 2 in accordance with the water level therein.

In Fig. 3 I have illustrated one form of nozzle 10 which may be employed in the oil burner device of my invention. The nozzle as illustrated comprises a casing 100 having therein a steam passage 101 and an oil passage 102. The nozzle is provided with a having therein 100 a central oil passage 104 terminating in a restricted opening 105. Steam passages 106 communicating with the steam chamber 107 are also provided in nozzle head 100 and the restricted passages 101 are adjacent the oil opening 105 communicates with the nozzle chamber 107. When steam under pressure is supplied to the nozzle passages 102 oil dribs through the oil opening 101 in nozzle head 100 and is caught up in the high velocity steam blast and thereby atomized and thoroughly mixed with the escaping steam. A long narrow blast of atomized oil and steam is thus projected from the nozzle. If it is desired to provide a fan shaped flame steam may be permitted to escape from the chamber 107 through the drill holes 108 and peripheral passages 109 which direct the steam in a cone having a greater angle than that escaping from the annular passage 101. The particular form of nozzle employed is not essential to my invention, it being understood that any form of nozzle which gives a satisfactory atomization and mixing of the oil with the escaping steam may be used.

The blast of steam at high velocity through the annular passage 101, as will be understood by those familiar with the art, tends to reduce the pressure at the oil opening 101. Thus oil is forced from the tank 5 not only by gravity, as indicated above, but also by the Venturi action of the high velocity steam blast. In order to assure a combustible mixture of oil with the steam in the blast from nozzle 1, and to prevent severe variations in the ratio of oil to steam in the blast, it is necessary to maintain a pressure head of oil at the nozzle at all times during operation. Thus, in the modification illustrated in Fig. 1, the level of the oil supply tank 5 with regard to the oil conduit and nozzle is arranged so that a pressure head of oil is retained at the nozzle at all times during operation.

The velocity of the steam blast issuing from the annular aperture 101 of the nozzle head is an important factor in obtaining satisfactory atomization of the oil and in obtaining the proper type of flame for efficient heating, a secondary advantage of nozzle this velocity is a function of steam pressure generated within the generator 2. I have found that, when employing a nozzle 20 as illustrated in Fig. 3 and in domestic installations wherein the flow of oil ordinarily is about 1 to 2 gallons per hour and does not exceed about 10 gallons per hour during operation, a quiet, steady, efficiently heating flame is obtained when the steam pressure ranges between 5 and 15 pounds per square inch. Preferably I adjust the setting of the pressure switch 27 to control the steam pressures within the generator 2 between the limits of 8 and 11 pounds.

Referring again to Fig. 1, a control circuit is also provided for the solenoid valves 25, 44 and 45 in parallel with one another and also in parallel with the primary winding of the ignition transformer 75 and in series with the contacts 16 and 77 of the thermal or other temperature responsive device 78 arranged to be responsive to temperature variations in a medium to be heated by means of the oil burner in accordance with practices well known in the art. The secondary winding of the transformer 75 is connected to the ignition terminals 76 located adjacent the nozzle 1 and in the path of a blast of atomized oil and steam from the nozzle. Thus when thermostat 76 closes its contacts 77 the solenoid valves 29, 44 and 45 are simultaneously operated to permit the flow of high velocity steam and of oil through the nozzle 1 thereby to secure a blast of atomized oil and steam therefrom. At the same time the terminals 78 are energized thereby igniting the blast of oil and steam from the nozzle 1. When the thermostat 76 operates to open its contacts the flow of oil and steam to nozzle 1 is shut off by the solenoid valves 29, 44 and 45 due to the de-energization of the solenoids thereof, and the terminals 78 are also deenergized. The function of solenoid valve 44 is duplicated in valve 45 for safety purposes in order to minimize the danger due to failure of either one of these valves.

The pressure switch 28 is arranged to be responsive to steam pressures within the generator 2, and its contacts 28a and 28b are connected in series in the common energizing circuit for the solenoid valves 25, 44 and 45 and ignition terminals 75, in order that, particularly in starting up the burner, generator 2 may be permitted to build up the proper steam pressure before the valve 29 in conduit 2 is opened. Thus, when pressure switch 27 is set to close its contacts at 8 pounds steam pressure and to open its contacts at 11 pounds, I have found it satisfactory to adjust pressure switch 28 to open its contacts at a low level such as 3 pounds and to close its
contacts at a level approximating the lower limit of pressure switch 27—as for example, 8 pounds. Thus during starting, and at any time during operation, when steam pressure within the generator is lower than, or falls to 3 pounds, pressure switch 28 operates to deenergize the valves 29, 44 and 45 and thus to prevent the supply of steam at undesired low pressures and oil to the nozzle 1. Furthermore during starting, the supply of steam to nozzle 1 is prevented until the steam pressure attains the lower limit of the desired range of pressures.

In describing the operation of the above described heavy fuel oil burner device it will be assumed that water has not as yet been admitted to the generator 2, that the thermostat 76 calls for heat, the contacts 75 and 77 thereof being closed, and that the switch 60 is closed. Under these circumstances due to the fact that no steam pressure is present within the steam generator 2 the contacts of pressure switch 28 are open and the contacts of pressure switch 21 are closed. The closure of contacts 27a and 27b of pressure switch 27 completes the circuit for the energizing coil 67 of relay 65 which may be traced as follows: from left hand line terminal through conductors 80 and 81, contacts 27a and 27b of pressure switch 27, conductor 82, operating coil 64 of relay 65 to the neutral line conductor 83.

30 Relay 63 thus operates to close its contacts 61 and 62 thus closing the heating circuit to the heating plates 15 and 16, which may be traced as follows: line conductor 68, contacts 61 of relay 63, conductor 54 to bolt 20 and lower plate 15, upper plate 15, bolt 21, conductor 85, contacts 62 of relay 63, conductor 68, operating coil 64 of relay 65, conductor 81 to the right hand line terminal. This circuit is broken between the plates 15 and 16 due to the absence of water within the generator 2 and thus the operating coil 64 of relay 65 is deenergized and the contacts 56 thereof are closed. The closure of contacts 27a and 27b of pressure switch 27 also completes a circuit for the solenoid valve 35 in water pipe 4 which includes in series therewith the normally closed contacts 85 of relay 55. This circuit extends from the left hand line terminal, conductors 80 and 81, contacts 27a and 27b of pressure switch 27, conductor 82, conductor 88, contacts 65, conductor 88, solenoid valve 28, conductor 98 to the neutral line conductor 83. Thus solenoid valve 35 is energized to open the water pipe 4 and to supply water to the generator 2. When the water reaches the level of upper plate 15 the energizing circuit for plates 15 and 16 above traced is completed and the operating coil 64 of relay 55 is energized, thus opening the contacts 85 and deenergizing the circuit for the solenoid valve 35. Solenoid valve 35 therefore closes the pipe line 4 to shut off the flow of water to the generator 2. Steam pressure now builds up within the steam generator 2 and when it has reached a predetermined pressure limit as above described, the contacts 28a and 28b of pressure switch 28 close. Closure of these contacts completes the energizing circuit for solenoid valves 29, 44 and 45 as follows: from right hand line terminal through conductors 87 and 81, contacts 75 and 77 of the thermostat 76, conductor 76, contacts 82a and 28b of pressure switch 28 which are now closed, conductor 94, conductor 95, the solenoid of valve 29, conductor 86 to the neutral line conductor 83. The solenoids of valves 44 and 45 are connected in shunt with the solenoid of valve 29 by means of the conductors 87 and 88. The primary winding of ignition transformer 75 is also connected in a series circuit with the contacts 76 and 77 of thermostat 76 and with the contacts 28a and 28b of pressure switch 28 by means of a circuit which is traced as follows: right hand line terminal through conductor 87, conductor 91, contacts 76 and 77 of thermostat 76, conductor 92, contacts of pressure switch 28, conductor 93, primary winding of transformer 75, conductor 91 to neutral line conductor 83.

Thus when the thermostat contacts 75 and 77 and the contacts of pressure switch 28 are closed a blast of atomized oil and steam is delivered from the nozzle 1 and ignited by the ignition terminals 79 connected to the secondary winding of transformer 75.

The pressure switch 27 maintains its contacts 27a and 27b closed until the steam pressure within generator 2 reaches a predetermined high limit as above described, when contacts 27a and 27b open. This deenergizes the coil 61 of relay 63 and opens the heating circuit for the plates 15 and 16 at the contacts 61 and 62 of relay 63. This also deenergizes the coil 64 of relay 65 permitting the contacts 62 to close, but the circuit for solenoid valve 35 is now open at the contacts 27a and 27b of pressure switch 27 so that this solenoid valve remains closed. When the steam pressure within generator 2 again falls to the lower limit determined by the lower setting of pressure switch 21 this switch again closes its contacts to reenergize relay 63 and close the heating circuit for plates 15 and 16. This cycle of operation continues until the water level within the generator again falls below the upper plate 15 at which time as above explained relay 65 remains deenergized when relay 55 closes and thus the energizing circuit for the solenoid valve 35 is again completed to supply more water to the generator 2.

If at any time during operation the pressure of steam within the generator 2 falls below the low limit determined by the pressure switch 25 this pressure switch again opens its contacts 28a and 28b to deenergize or prevent the energization of the solenoid valves 29, 44 and 45 and also to deenergize or to prevent the energization of the transformer 75, until the steam pressure within generator 2 again builds up.

When the desired temperature is obtained in the medium heated by the operation of the oil burner device the thermostat device 76 as is well understood opens its contacts to deenergize the transformer 75 and the solenoid valves 29, 44 and 45 which then operate to close the steam and oil conduits 3 and 47 respectively.

As has been pointed out above, the oil conduit 42, of reduced cross-section, is arranged in a plurality of coils 43, supported on, and in good heat transfer relation with, the exterior surface of the cylindrical casting 7 of steam generator 2. During the course of its flow through the coils 43, the oil in the conduit 42 acquires a relatively high temperature approaching that of the steam within the generator 2. It has been found that the characteristics and behaviour of the flame at the nozzle 1 are dependent, particularly in starting, on the temperature of the oil in conduit 42; too low a temperature causes a gusty, intermittent or inefficient flame, and, if the temperature is much too low may prevent ignition altogether. It is my present belief, although I do not wish to be limited thereby, that the temperature of the oil in the conduit 42 should exceed, for others.
most satisfactory operation of the oil burner, a temperature of about 175° F.

In Fig. 4, I have illustrated an alternative form of steam generator employing a well known form of immersion unit as a heating element and further employing a pair of float valves for controlling the flow of water into the steam generator. The steam generator shown in Fig. 4 comprises a chamber 140 provided with an upper closure member or plate 111 secured thereto by means of the screws 112 and having the gasket 113 therebetween. The member 140 is provided with a steam outlet 26 to which is connected the steam conduit 3 which is connected at its end to the nozzle 1.

A water inlet pipe 4 is also connected to a suitable opening provided in the member 140 to deliver water interiorly of the generator 2. The water inlet pipe is connected within the generator to the inlet of the float controlled valve 114.

The outlet 115 of which is connected to the inlet of the second control valve 116. Each of the valves 114 and 116 is provided with a float illustrated respectively at 117 and 118 and as will be obvious, each is adapted to control the flow of water into the generator in accordance with the level of the water contained therein.

The heating element 119 for the generator 2 comprises a well known form of immersion heating unit mounted within the generator and adapted to be connected to an electrical circuit through the terminal chamber 120.

The oil conduit 42 is wound in a plurality of coils 43 which are mounted on and secured to the exterior of the member 140 in good heat transfer relation therewith and one end of the conduit 42 is connected with the nozzle 1 in communication with the oil passages therein. Connected in series with the oil conduit are the solenoid valves 44 and 45 and the manually controlled valve 46.

Connected in series with the steam conduit 3 are the pressure switches 27 and 28 having contacts 27a and 27b and 28a and 28b respectively, the solenoid operated valve 29, and the manually operable valve 30.

Because of the use of an immersion heater and also because of the employment of the float controlled valves for controlling the flow of water into the generator the control circuit for the generator of Fig. 4 is considerably simplified. The immersion heater is connected in series across the power supply source through the contacts 27a and 27b of the pressure switch 27. Thus the heat supplied to the generator 2 is controlled directly by the operation of the pressure switch 27 in response to steam pressure within the generator. The solenoid valves 29, 44 and 45 and the ignition transformer 75 are controlled directly by the joint operation of the thermostat device 78 and the pressure switch 28 in the manner fully explained above in connection with Fig. 1.

In describing the operation of the apparatus illustrated in Fig. 4 it will be initially assumed that no water has been admitted to the generator and that the float 78 has closed its contacts 76 and 77, and that the main switch 60 has been closed. Under these circumstances the contacts 28a and 28b of pressure switch 28 are open and the contacts 27a and 27b of pressure switch 27 are closed. Moreover each of the floats 117 and 118 are depressed to the level of the valve 114 and 116 permitting water to flow into the steam generator 2. When the water has reached a desired level valves 114 and 116 operate to shut off the flow of water. Since pressure switch 27 is closed current is supplied to the immersion heating element 119 to thereby evaporate the water in the generator 2 and to generate steam pressure therein. Pressure switch 28 remains closed until a desired maximum pressure within the generator 2 is obtained at which time these contacts open to shut off the heating circuit. The contacts of pressure switch 28 remain open until the steam pressure within the generator 2 reaches a desired level determined by the upper setting of the pressure switch 28 as described above, and when this point has been reached contacts 28a and 28b close to energize a circuit for the solenoids 29, 44 and 45 and for the ignition transformer 75. A blast of atomized oil and steam is thus projected from the nozzle 1 and ignited by means of the ignition terminals 79 and continues so long as the thermostat contacts 76 and 77 remain closed. When a desired temperature of the medium to be heated by the oil burning device of my invention has been attained contacts 78 and 77 of thermostat 78 open to thereby deenergize the valves 29, 44 and 45 and to close the conduits 3 and 42.

While in accordance with the patent statutes I have described in detail an embodiment of my invention I do not wish to be limited thereby and aim in the appended claims to cover all such modifications of my invention as may occur to those skilled in the art and which fall within the true scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a burner for non-volatile residual fuel oils of high viscosity at ordinary temperatures, the combination of a nozzle, a steam generator, a steam conduit connecting said generator to said nozzle, and an independent heating device associated with said generator, said generator means responsive to steam pressures within said generator for controlling the operation of said generator whereby to maintain within said generator steam pressures within predetermined upper and lower limits and to provide a substantially constant blast of steam at said nozzle during the operation of the burner, an oil conduit connected to said nozzle, and means supplying oil to said conduit and maintaining a pressure head of said oil at said nozzle, said oil conduit having a portion adjacent said fuel oil supply adapted for the free flow of such oil therethrough at ordinary temperatures and another portion arranged in intimate heat transfer relation with the steam within the generator, whereby the steam therein acquires a relatively high temperature approaching that of the steam.

2. In a burner for non-volatile residual fuel oils of high viscosity at ordinary temperatures, the combination of a nozzle, a steam generator, a steam conduit connecting said generator to said nozzle, and an independent heating device associated with said generator, with an independent means responsive to steam pressures within said generator for controlling the operation of said generator whereby to maintain within said generator steam pressures within predetermined upper and lower limits and to provide a substantially constant blast of steam at said nozzle during the operation of the burner, an oil conduit connected to said nozzle, and means supplying oil to said conduit and maintaining a pressure head of said oil at said nozzle, a portion of said oil conduit adjacent said fuel oil supply being provided with means for maintaining a free flow of said oil.
therethrough and another portion arranged in intimate heat transfer relation with the steam within the generator, whereby the oil therein acquires a relatively high temperature approaching that of the steam.

3. In a burner for non-volatile residual fuel oils of high viscosity at ordinary temperatures, the combination of a nozzle, a steam generator, and a steam conduit connecting said generator to said nozzle, with an oil conduit connected to said nozzle, and means supplying oil to said conduit and maintaining a pressure head of oil at said nozzle, said oil conduit having a portion adjacent said fuel oil supply adapted for the free flow of such oil therethrough and another portion arranged in intimate heat transfer relation with the generator whereby the oil therein acquires a relatively high temperature approaching that of the steam.

4. In a burner for non-volatile residual fuel oils of high viscosity at ordinary temperatures, the combination of a nozzle, a steam generator, and a steam conduit connecting said generator to said nozzle, with an oil conduit connected to said nozzle, and means supplying oil to said conduit and maintaining a pressure head of oil at said nozzle, a portion of said oil conduit adjacent said fuel oil supply being provided with means for maintaining the free flow of such oil therethrough and another portion arranged in intimate heat transfer relation with the generator whereby the oil therein acquires a substantially constant blast of steam at said nozzle during the operation of the burner, whereby a substantially constant ratio of steam to oil is maintained in the blast from the nozzle.

5. In a burner for non-volatile residual fuel oils of high viscosity at ordinary temperatures, the combination of a nozzle, a steam generator, and a steam conduit connecting said generator to said nozzle, with an oil conduit connected to said nozzle, and means supplying oil to said conduit and maintaining a pressure head of oil at said nozzle, said oil conduit having a portion adjacent said fuel oil supply adapted for the free flow of such oil therethrough and another portion arranged in intimate heat transfer relation with the generator whereby the oil therein acquires a relatively high temperature approaching that of the steam.

6. In a burner for non-volatile residual fuel oils of high viscosity at ordinary temperatures, the combination of a nozzle, a steam generator and a steam conduit connecting said generator to said nozzle, with an oil conduit connected to said nozzle, and means supplying oil to said conduit and maintaining a pressure head of oil at said nozzle, said oil conduit having a portion of relatively large cross-section adjacent said fuel oil supply adapted for the free flow of such oil therethrough and another portion of relatively small cross-section and arranged in intimate heat transfer relation with the generator whereby the oil therein acquires a relatively high temperature approaching that of the steam.

7. In a fuel oil burner, the combination of a nozzle, means comprising a source of oil and an oil conduit for maintaining a pressure head of oil at said nozzle, a steam generator, a steam conduit connecting said generator to said nozzle and an independent heating device associated with said generator, with an independent means responsive to steam pressures within said generator for controlling the operation of said independent heating device to maintain steam pressures within said generator in accordance with predetermined pressure conditions in the steam generator.

8. In a fuel oil burner, the combination of a nozzle, means comprising a source of oil and an oil conduit for maintaining a pressure head of oil at said nozzle, a steam generator, a steam conduit connecting said generator to said nozzle, an independent heating device associated with said generator, and an independent means responsive to steam pressures within said generator for controlling the operation of said independent heating device to provide a substantially constant blast of steam at said nozzle during the operation of the burner, whereby a substantially constant ratio of steam to oil is maintained in the blast from the nozzle.

9. In an automatic oil burner comprising a nozzle, means comprising a source of fuel oil supply and an oil conduit for maintaining a pressure head of oil at said nozzle, a steam generator, a steam conduit connecting said generator to said nozzle, an independent heating device associated with said generator, means responsive to steam pressures within said generator for controlling the operation of said generator, and a water conduit connecting said water supply with said steam generator, said nozzles collared about the generator in intimate heat transfer relation therewith for preheating the water therein to prevent undesirable pressure fluctuations within the generator, whereby substantially constant predetermined steam pressures are maintained within said generator and a substantially constant ratio of steam to oil is maintained in the blast from the nozzle during operation of the burner.

10. In an oil burner, the combination of a nozzle, an oil conduit connecting said nozzle to a source of fuel oil, a steam generator, a steam conduit connecting said nozzle to said steam generator, an independent heating device for said generator, means responsive to steam pressures within said generator for controlling the operation of said heating device, and means responsive to the operation of said thermal responsive device for actuating said valves to produce a blast of atomized oil and steam from said nozzle.

11. In an oil burner, the combination of a nozzle, an oil conduit connecting said nozzle to a source of fuel oil, a steam generator, a conduit connecting said nozzle to said steam generator, an independent heating device for said generator, means responsive to steam pressures within said generator for controlling the operation of said heating device to maintain steam pressures within said generator in accordance with predetermined upper and lower limits, valves located in said oil conduit and said steam conduit, means responsive to the operation of said thermal responsive device for actuating said valves to control a blast of atomized oil and steam from said nozzle, and means for controlling said latter means in accordance with predetermined pressure conditions in the steam generator.

12. In an oil burner, the combination of a nozzle, an oil conduit connecting said nozzle to a source of fuel oil, a steam generator, an independent heating device for said generator, means responsive to steam pressures within said generator for controlling the operation of said heating device to maintain steam pressures within said generator in accordance with predetermined pressure conditions in the steam generator.
pendent heating device for said generator, means responsive to steam pressures within said generator for controlling the operation of said heating device to maintain steam pressures within said generator within predetermined upper and lower limits, a thermal responsive device, normally closed valves located in said oil and steam conduits, means responsive to the operation of said thermal responsive device for opening said valves to permit the discharge of a blast of atomized steam and oil from said nozzle, and means for rendering inoperative said last mentioned means whenever the steam pressure within said generator falls below a predetermined value.

13. In an oil burner, the combination of a nozzle, an oil conduit connecting said nozzle to a source of fuel oil, a steam generator, a conduit connecting said nozzle to said steam generator, an independent heating device for said generator, means responsive to steam pressures within said generator for controlling the operation of said heating device to maintain said pressures within a predetermined limited range, a thermal responsive device, valves located in said oil conduit and said steam conduit, means responsive to the operation of said thermal responsive device for actuating said valves to control a blast of atomized oil and steam from said nozzle, and another means responsive to steam pressures within said generator for rendering inoperative said last mentioned means when said steam pressure falls below a limit lower than said predetermined limited range and subsequently rendering operative said last mentioned means only when steam pressure has risen to said predetermined limited range.

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