

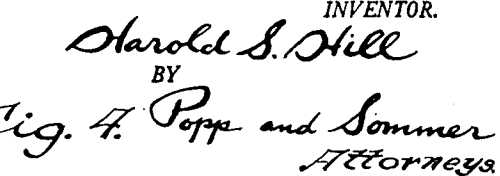
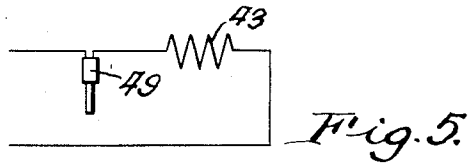
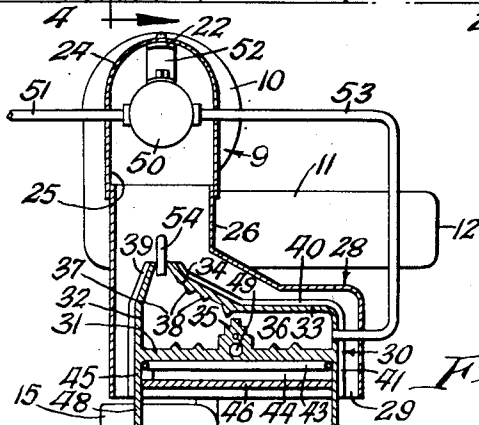
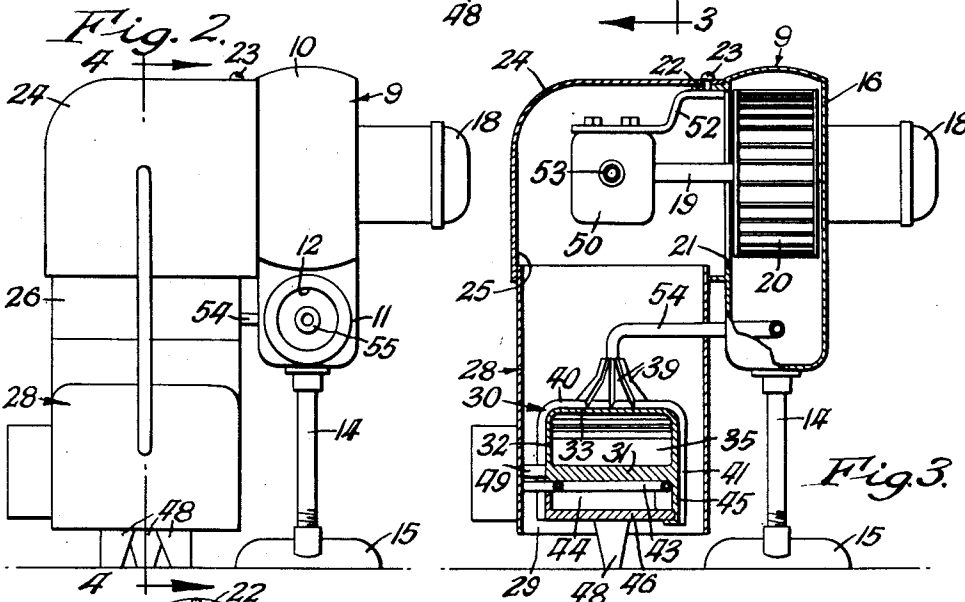
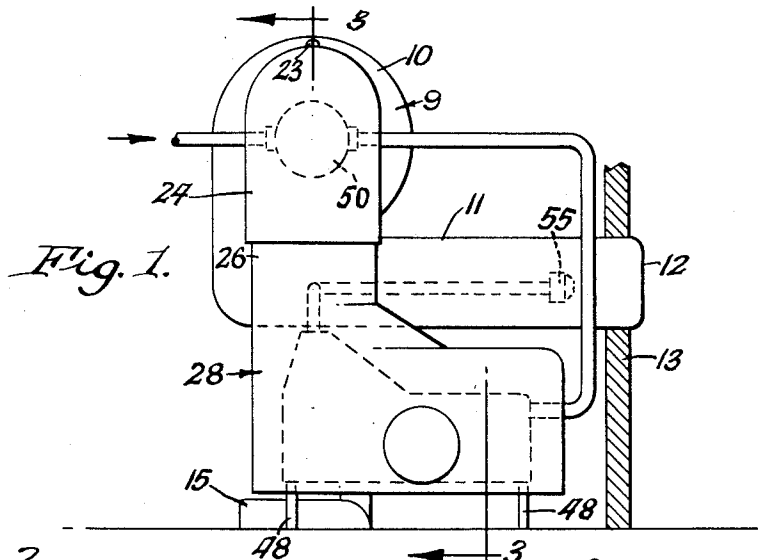
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2,625,211

OIL AND AIR PREHEATER FOR OIL BURNERS

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Fig. 4. Pope and Sommer
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UNITED STATES PATENT OFFICE

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OIL AND AIR PREHEATER FOR OIL BURNERS

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2 Claims. (Cl. 158—36)

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This invention relates to an air and liquid fuel preheater for liquid fuels derived from petroleum, shale, oil and coal and used in oil burning furnaces, gasoline engines and the like.

This application is a continuation-in-part of my copending applications, Serial No. 35,362 filed June 26, 1948, now Patent No. 2,511,848 for Electric Heater and Serial No. 120,908 filed October 11, 1949, now Patent No. 2,592,568 for Method and Apparatus for Pretreating Liquid Fuel.

One of the principal objects of the present invention is to reduce the viscosity of the fuel oil used so as to bring heavy fuels within the range of utility as a liquid fuel by preheating both the liquid fuel and also the air supplied to support combustion of the fuel.

Another object is to preheat both the fuel and air supplied at the start of operation of the burner to a higher degree than obtains during continued operation thereof so that the viscosity of the fuel oil is reduced to a greater degree at the start of each on period of operation of the burner.

Another object is to improve the atomization of the fuel oil during operation of the burner by decreasing the viscosity of the fuel oil, better atomization in turn insuring more intimate mixing with the air so as to require less air and provide improved combustion.

Another object is to provide a greater degree of atomization at the start of each on period of operation of the burner, to secure rapid ignition, such improved atomization being obtained by preheating both the fuel and also the air to a higher degree during off periods of operation than that which obtains during a continued on period of operation. Such improved atomization at the start of each on period of operation insures more intimate mixing with air and more rapid ignition thereof.

Another object of the invention is to improve the combustion by preheating both the liquid fuel and also the air, combustion being a chemical process accelerated by increase in temperature of the reacting substances.

Another object is to provide an improved combustion or reaction of the liquid fuel and air at the start of each on period of operation as compared with a continued on period of operation for preheating both the liquid fuel and also the air to a higher degree during off periods of operation than that which obtains during continued periods of on periods of operation.

Another object of the present invention is to provide such apparatus which during off periods of demand will segregate the lighter fractions of the stagnant body of liquid fuel retained in a preheater and render these lighter fractions available for immediate withdrawal when the oil furnace, gasoline engine or the like again goes into operation. By this means the lighter and more volatile fractions of the fuel are supplied

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to the apparatus served each time it is started and optimum conditions are established both for instantaneous starting and also for establishing proper operating conditions for the continued burning of the liquid fuel.

Another object is to provide such apparatus which during continued on periods of the apparatus being served will operate to preheat the liquid fuel to a lower temperature than that which obtains during the off periods of demand thereby to preheat the liquid fuel for improved operation of the apparatus being served without, however, separating the lighter fractions. Such lower preheat temperature during continuation of an on period of operation is desirable as the combustion of the fuel in the equipment served supplies a large part of the heat necessary for efficient operation so that less preheating is required.

Another object is to provide a liquid fuel preheater which is so chambered and baffled as to insure rapid heating of the liquid fuel both during on and off periods of demand and to insure the rapid segregation of the lighter fractions during the off periods and which is also so constructed as to rapidly dissipate heat to an air stream which is drawn into the burner to support combustion.

Another object is to provide such a preheater the wall thicknesses of certain parts of which are selected to avoid scorching of the liquid fuel with resultant flaking off of solid products of the liquid fuel and which are apt to disrupt the operation of the apparatus being served and in which certain parts of the preheater are selected to insure adequate heat transfer to the stream of air supplied to the apparatus to support combustion.

Another object of the invention is to provide such a preheater the wall thicknesses of certain parts of which are selected to slow down the application of heat when called for and to retain heat in the walls thereby to level off the on and off periods of the preheater and to maintain more uniform liquid fuel and air preheating conditions.

Another object is to provide such a preheater which can be used to vaporize liquid fuel if desired.

Another object of the present invention is to use a common heating element for preheating both the liquid fuel and also for preheating the air supplied to support combustion of this fuel.

Another object is to provide a thermostat control which is not subject to hunting or unnecessarily rapid action, the sensitive parts of the thermostat control being located in the thicker walls of the preheater for this purpose.

Another object is to provide such a preheater for both the liquid fuel and also the air used to support combustion of the fuel which is economical in consumption of electrical energy when electrically heated.

Another object is to provide such a preheater

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which can be heated from the jacket water being served and which can also be used to preheat water for admixture with the fuel and air prior to or after combustion.

Other objects and advantages of the invention will appear from the following description and drawings in which:

Fig. 1 is a side elevational view of an oil burner having a fuel and air preheater embodying the present invention.

Fig. 2 is an end elevational view thereof viewed from the right hand end of Fig. 1.

Fig. 3 is a vertical section taken generally on line 3—3, Fig. 1.

Fig. 4 is a vertical section taken generally on line 4—4, Fig. 2.

Fig. 5 is a wiring diagram of the electrical components of the present invention.

The invention is shown in conjunction with a conventional oil burner having a fan housing 9 which comprises a scroll 10, this scroll 10 discharging into a horizontal tubular tangential outlet 11. This tangential tubular outlet 11 is provided with a discharge nozzle 12 for the burning fuel and air and is shown as extending horizontally through the wall 13 of a combustion chamber, such as the wall of a furnace. The fan housing 9 is shown as supported by a leg 14 carried by a base 15. The scroll 10 of the fan housing is shown as having one vertical side wall 16 on which a fan motor 18 is suitably mounted, this motor having a drive shaft 19 extending through the fan scroll. Within the fan scroll 10 a fan wheel 20 is fast to the fan shaft 19, this fan wheel 20 being of the usual construction to draw air in through the inlet opening or eye 21 of the fan scroll and to discharge it through the tangential tubular outlet 11 and nozzle 12.

Around the inlet or eye 21 of the fan scroll, the fan scroll is formed to provide an outwardly projecting rim 22 to which is removably secured, as by screws 23 a hood 24 which forms a continuation of the rim 22 and which is generally rectangular in horizontal section. The bottom of this hood 24 is open, as indicated at 25, and in the opening 25 is fitted the outlet neck 26 of an air inlet shell indicated generally at 28. This air inlet shell is made of sheet metal and is of generally rectangular form in horizontal section, the open bottom 29 of this shell being spaced from the floor, and the bottom portion of this air inlet shell being enlarged to receive a preheater indicated generally at 30. All of the walls of the air inlet shell 28 are spaced from the corresponding walls of the preheater 30 so that air is free to pass between the preheater 30 and the air inlet shell up into the hood 24 and thence into the inlet opening or eye 21 of the fan scroll 10 to be thence discharged by the fan wheel 20 through the tubular tangential outlet 11 into the combustion chamber formed by the wall 13 of the furnace.

The preheater 30 is preferably constructed in the manner shown in my said copending patent application, Serial No. 120,908 and to this end is shown as comprising a cast metal casing through which the liquid fuel for the burner flows and which is shown as comprising a relatively thick bottom wall 31, relatively thick side walls 32 rising from the margin of this bottom wall, and a relatively thin top wall 33, one end of which rises to provide a thin walled dome 34. The casing is formed to provide a relatively thick integral dam 35 which extends transversely across the interior of the casing and divides the same into an inlet

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chamber 36 and an outlet chamber 37, the latter being disposed under the thin walled dome 34. As described in greater detail in my said copending application, Serial No. 120,908, the relatively thick bottom wall is preferably provided with upwardly projecting transverse ribs which accelerate the transfer of heat from this bottom wall 31 to the oil flowing through the chambers 36 and 37 of the casing, and the dome 34 is also provided with a plurality of integral, depending transverse ribs 38 which accelerate the transfer of heat from the oil within the dome 34 to the thin wall of this dome, thereby to condense the lighter and more volatile fractions of the oil which segregate in this dome. To further accelerate this condensation, the dome 34 is provided with external fins 39. These fins 39 also serve to transfer heat to the surrounding air and to further accelerate such transfer, the top wall 33 and side walls 32 are also provided with external fins 40 and 41, respectively.

To distill the more volatile fraction of the oil to so rise and segregate in the dome 34 of the casing, the lower part of the body of fuel within the chambers 36, 37 of the casing is heated to a temperature above the initial flash point of the liquid fuel passing through the casing. To this end an electrical heating element 43 is shown as arranged immediately below the relatively thick bottom 31 of the casing 30 and is disposed in a chamber 44 formed by the relatively thick bottom 31, a skirt 45, and a removable bottom plate 46 which is removably supported within the skirt 45. In addition, the casing 30 is preferably provided with three legs 48 which form downward continuations of the skirt 45. It will be understood that the bottom wall 31 could be heated in whole or part from another source of heat as from the jacket water of the apparatus served.

As illustrated in Fig. 5, the electrical heating element 43 is in series with a thermostat 49 the sensitive parts of which are disposed within an aperture in the relatively thick dam 35 and hence influenced by the temperature of the oil within the chambers 36, 37 as transmitted through the thick walls of this dam. This thermostat 49 is set to cut into and out of operation so as to maintain the temperature of the oil contained within the casing 30 at a point slightly above the initial flash point of the oil so as to distill the more volatile fraction thereof, this distilled fraction migrating upwardly into the dome 34 where it encounters the relatively cool wall of this dome so as to be condensed and provide a more volatile body of fuel oil in this dome. As described in greater detail in my said copending application, Serial No. 120,908, this more volatile fraction is available for use in starting the oil burner, the oil originally supplied to the burner not only being warmed but also being of a higher degree of volatility than the overall composition of oil supplied to the burner.

Oil is supplied to the casing 30 by a pump 50 having an inlet line 51 which extends through one wall of the hood 24 and connects with the usual supply tank (not shown). The pump 50 is arranged within the hood 24 and is driven by the drive shaft 19 of the motor 18 which also carries the fan 20. To support the pump 50, a bracket 52 is suitably secured to the annular rim 22 of the fan scroll 10, the pump being suspended from this bracket. The outlet of the pump 50 connects with a line 53 leading to the inlet chamber 36 of the casing 30.

The oil from the casing 30 is discharged from the dome 34 through an outlet line 54, this outlet line extending through the adjacent walls of the air inlet shell 28 and horizontal tubular discharge 11 of the fan scroll 10 and thence co-axially along this tubular outlet 11 to the discharge end thereof. Adjacent the discharge end of this horizontal tubular discharge 11 the usual nozzle 55 is mounted on the oil pipe 54, this nozzle discharging toward the nozzle 12 of the tubular air discharge 11.

In the operation of the air and fuel oil preheater, the motor 18 is automatically cut in and out of operation in response to the demand for heat. During off periods no fuel is supplied by the pump 50 and hence the body of liquid fuel in the casing 30 becomes a stagnant or quiescent body. The thermostat 49 is set a few degrees above the initial flash point of the fuel being used, and preferably, though not necessarily, below the fire point or lowest temperature at which heated oil gives off vapor that supports continuous combustion, this fire point being usually from 10 to 15° F. higher than the initial flash point. Thus, if the initial flash point of the liquid fuel being used is, say, 148° F., and the fire point is, say, 160° F., the thermostat 49 would be set to cut into operation at 150° F., and to cut out of operation at 153° F. This setting of the thermostat is readily accomplished by the operator who places the apparatus in operation, the operator knowing the flash point and fire point from data supplied to him or determining the flash point of the liquid fuel for himself and then taking the temperature of the dam 35. With such temperature the operator can readily set the thermostat 49 to cut into and out of operation at the temperatures indicated.

With the thermostat 49 so set, it calls for heat during on periods of the burner operation, and accordingly at the start of the off period of operation, the heating element 43 is energized and heat is being supplied by this element to the relatively thick bottom wall 31 of the casing 30. This energization of the electric heating element continues until the temperature of the control dam 35 builds up to the assumed temperature of 153° F., the quiescent body of liquid fuel in the bottom of the chambers 36 and 37 also being heated to approximately this temperature. It will be noted that this heat is supplied at the bottom of the quiescent body of liquid fuel by the thick bottom wall 31, and, through conduction through the metal, at the sides of the body of liquid fuel and from the thick control dam 35 and relatively thick side walls 32 of the casing 30.

As each particle of the liquid fuel is heated above its flash point, the lighter or volatile fraction vaporizes and rises in the quiescent body of liquid fuel. On encountering the cooler fuel, this vaporized portion, of course, recondenses, but since heat is applied from the sides and bottom of the quiescent body of fuel, the net effect of the vaporization and recondensing of the more volatile fraction or light ends of the liquid fuel is a migration of the light ends to the top of the body of liquid fuel. Since the top of the oil chamber 37 is provided by the dome 34, these lighter ends migrate up into the top of this dome. Since this dome 34 is relatively thin walled, and also is provided with the fins 39 so as to rapidly dissipate heat to the surrounding air, after entering the dome 34 and contacting its walls, the

light ends of the fluid oil are cooled below their flash point and thus condense as a segregated body of light ends within the dome 34. These light ends also ascend the tubes 54 to replace the heavier fuel oil therein and hence these light ends are immediately available on starting.

The migration of the lighter ends from the inlet chamber 36 is impeded by the transverse rib 41 arranged directly over the dam 35 and under which any particle of fuel oil must pass in close proximity to the heated dam 35 before it can escape to the dome 34. This provides independent distillation action in the two chambers 36 and 37, only the substantially completely distilled lighter ends being permitted to escape from the chamber 36 into the chamber 37.

Accordingly during off periods of demand, mild distillation action takes place which effects a segregation of the light ends or more volatile fraction in the dome 34 and line 54. Therefore, when the furnace goes into operation the fuel initially supplied is not only heated to a relatively high temperature but also is more highly volatile than the fuel supplied to the preheater by the pump 50. Accordingly, when this fuel is discharged through the outlet line 54 from the casing 30 through the nozzle 55, ignition of this initially supplied fuel at the start of each on period is materially expedited and proper combustion of the fuel for a substantial time on each start is assured. After the starting period the combustion of less volatile fuel supplied at a low temperature presents no problem, proper economy in fact demanding that the burner be set to operate with the fuel of average volatility and at lower preheated temperature. Accordingly, the capacity of the heating element 43 is deliberately selected so as to heat the liquid fuel flowing through the preheater on continued operation of the fuel burner to only a fraction of the setting of the thermostat 49. This is for the reason that during a continued on period the combustion of the fuel in the apparatus supplies part of the heat for efficient operation so that preheating to a lower temperature is required. It will also be noted, that the transition from the high initial temperature of the fuel oil of each on period to the relatively low temperature is gradual, this being due to the heat in the body of liquid fuel contained in the chambers 36 and 37, and in the relatively thick bottom wall 31, relatively thick side walls 32 and also the relatively thick control dam 35 of the preheater casing 30.

As long as the on period lasts preheated liquid fuel is supplied by the preheater and when the demand is satisfied, the motor 18 is deenergized thereby to deenergize the fuel pump 50 and stop the flow of liquid fuel through the preheater casing 30. Accordingly, the now quiescent body of liquid fuel in this preheater casing 30 is again heated to a few degrees above its flash point to again segregate the lighter ends in the dome 34 for the start of another on period.

During off periods of operation, as indicated, a part of the heat generated by the heating coil 43 is dissipated by the dome 34 and casing 30 to the surrounding atmosphere in effecting a partial distillation and segregation of the lighter ends of the fuel oil. Since the shell 30 of the preheater is surrounded by the air inlet shell 28, this heated air is trapped and rises in the upper outlet neck 25 of this shell into the hood 24 and scroll 10 of the fan housing 9. Accordingly, at the start of operation heated air is supplied to

support the combustion of the preheated lighter ends being discharged from the fuel nozzle 55, this preheated air being drawn through the air inlet shell 28, hood 24 and scroll 10 by the operative fan wheel 20 and being discharged through the tangential tubular outlet 11 to mix with the preheated lighter ends being discharged by the fuel nozzle 55 into the furnace 13.

During continued on period of operation, the oil supply to the nozzle 55 is being heated to a lesser degree by the electrical element 43, and also the air supplied by the fan 20 to support combustion of this fuel is being preheated inasmuch as on being drawn into and through the air inlet shell this air passes around the exterior of the preheater shell 30 and hence is preheated. This preheating of both the fuel oil and also of the air during continued periods of operation is an important feature of the present invention. So far as preheating of the fuel is concerned during continuation of operation of the burner, the principal need for preheating is to bring the viscosity of the relatively heavy fuels used within the range of utility as a liquid fuel in the burner. This reduction in the viscosity of the fuel oil is principally accomplished by the preheating of the fuel oil, the viscosity of the fuel oil being an inverse function of its temperature, the viscosity falling as the temperature rises. Better combustion is obtained through preheating both the fuel and also the air, because combustion is a chemical reaction which is accelerated by an increase of the temperature of the reacting substances.

Preheating of both the air and also the fuel oil has also been found to provide improved atomization of the fuel oil in the preheated air. Atomization is a function of viscosity and improved atomization has been found to result from preheating both the fuel oil and the air so as to reduce the viscosity of the oil. Improved atomization in turn provides more intimate admixture of the fuel oil with the air, and hence less air is required and also less fuel oil is required because of the improved combustion.

If desired, it is also possible to use the preheater 30 to supply hot water for addition to the fuel and air either before or after combustion thereof by passing a small stream of water through a suitable duct in the preheater 30.

From the foregoing it will be seen that the apparatus forming the subject of the present invention reduces the viscosity of the fuel oil, both on starting and during operation, by preheating both the fuel oil and the air supplied to support combustion of the fuel oil. The apparatus also improves atomization by such reduction in the viscosity of the fuel oil thereby to insure more intimate mixing of the fuel oil with the air and therefore to require less air and to provide improved combustion. It will also be seen that the present invention provides better combustion by preheating both the air and the fuel oil since combustion is a chemical process accelerated by increase of the temperature of the reacting substances. It will further be seen that the above factors favorable to improve combustion are increased at the start of each on period of operation when instantaneous ignition and combustion of the fuel are particularly important. This is due to the fact that the stagnant body of oil in the chambers 36 and 37 of the preheater casing 30 are built up to a much higher temperature during off periods of operation so as to be available at a higher tempera-

ture at the start of each on period of operation and also this is due to the fact that similarly a quiescent body of air is built up in the air inlet shell 28, hood 24 and fan scroll 10 to a much higher temperature than obtained during on periods of operation of the apparatus. The initial ignition of the fuel oil is further accelerated by the fact that during off periods of operation a mild distillation of the fuel oil within the preheater shell 30 takes place so as to effect a migration of the lighter ends thereof into the dome 34 and line 54 where they are rendered available as the initial fuel supply to the burner.

I claim:

1. A preheater for the air and liquid fuel supplied for combustion to combustion apparatus, comprising a liquid fuel casing having an inlet for said liquid fuel, a heater arranged to apply heat to the fuel within said liquid fuel casing, a thermostat responsive to the temperature of said liquid fuel in said liquid fuel casing and controlling said heater to prevent the temperature of said liquid fuel in said liquid fuel casing from rising above a predetermined maximum, a liquid fuel outlet line from said liquid fuel casing leading to said combustion apparatus, an air casing enveloping said liquid fuel casing in spaced relation thereto and open to the atmosphere at its bottom, a fan arranged to withdraw air from said air casing, and an outlet duct from said fan leading to said combustion apparatus and arranged below the level of the upper part of said air casing to cause warm air to be trapped in the upper part of said casing during off periods of operation of said fan.

2. A preheater for the air and liquid fuel supplied for combustion to combustion apparatus, comprising a fan housing having an air inlet of relatively small cross sectional area and having an air outlet communicating with said combustion apparatus, a motor, a fan shaft driven by said motor, a fan wheel fast to said fan shaft and arranged within said fan housing and arranged to draw air in said inlet and to discharge it toward said air outlet, an air hood of relatively larger cross sectional area than said inlet, connected to said fan housing with its interior in communication with said air inlet and having an opening communicating with the atmosphere, a liquid fuel casing arranged in said air hood with its walls in closely spaced relation thereto and having an inlet for said liquid fuel, a heater arranged to apply heat to the liquid fuel within said liquid fuel casing, a thermostat responsive to the temperature of said liquid fuel in said liquid fuel casing and preventing the temperature thereof from rising above a predetermined maximum, and a liquid fuel outlet line rising from said liquid fuel casing and discharging into the stream of air delivered by said fan to said combustion apparatus.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,555,631	Brown	Sept. 29, 1925
2,275,689	Shepperd et al.	Mar. 10, 1942
2,411,040	Holthouse	Nov. 12, 1946
2,511,848	Hill	June 20, 1950