Oct. 8, 1946. H. D. MACKAYE 2,408,865

OIL BURNER

Filed Feb. 23, 1945 2 Sheets-Sheet 1

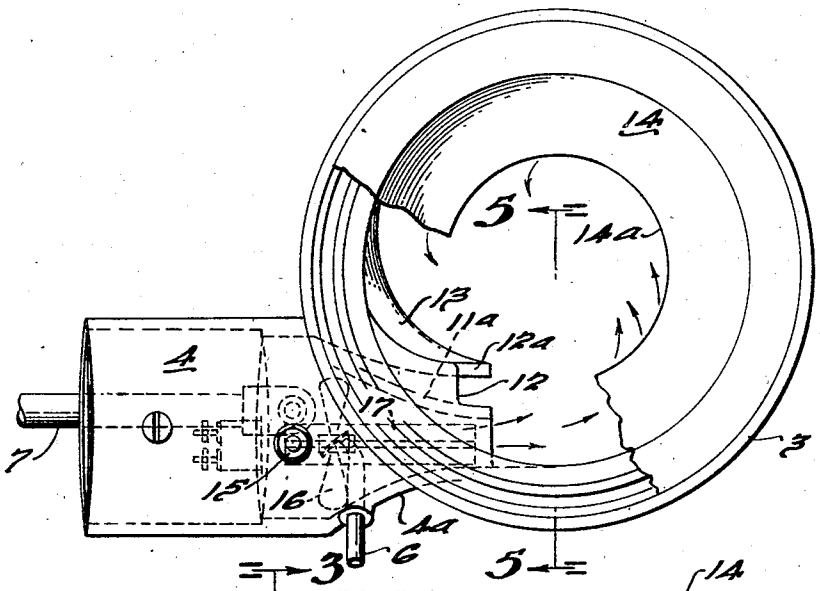


Fig. 1.

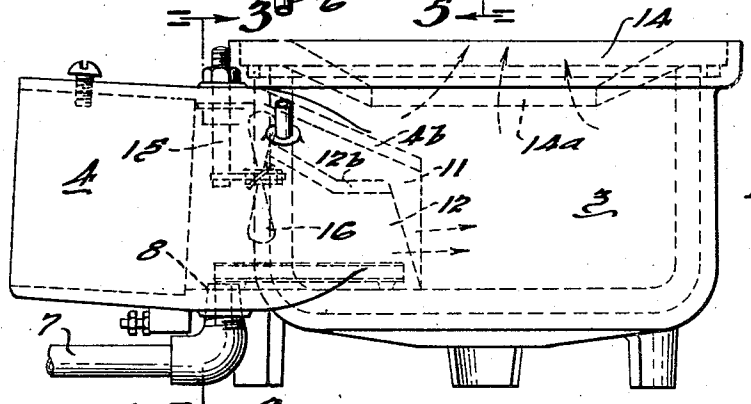


Fig. 2.

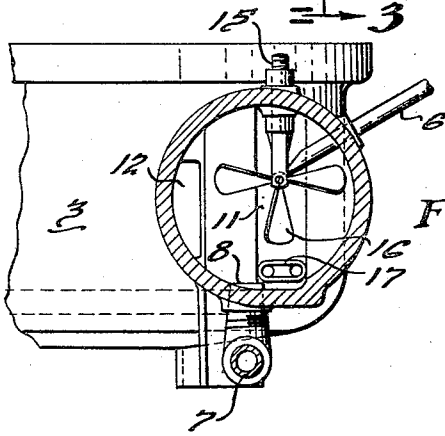


Fig. 3.

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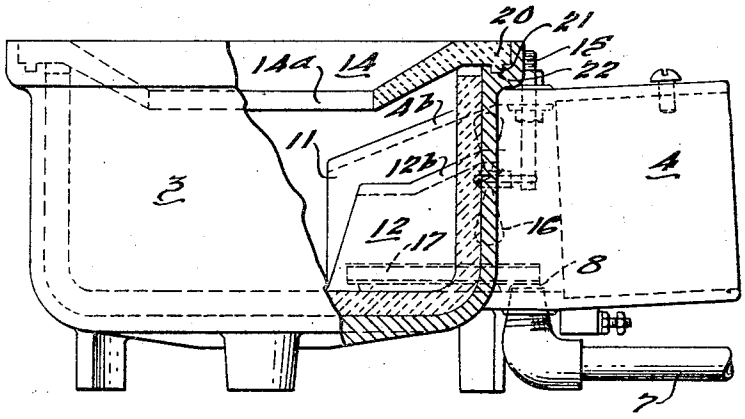


Fig. 4.

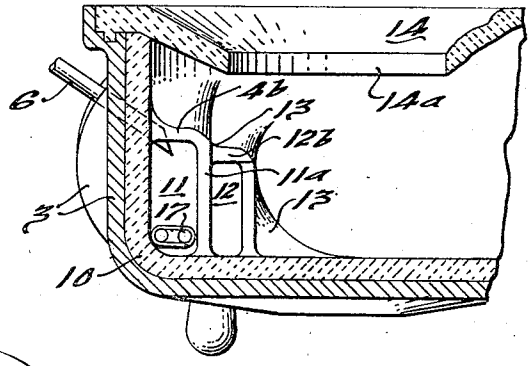


Fig. 5.

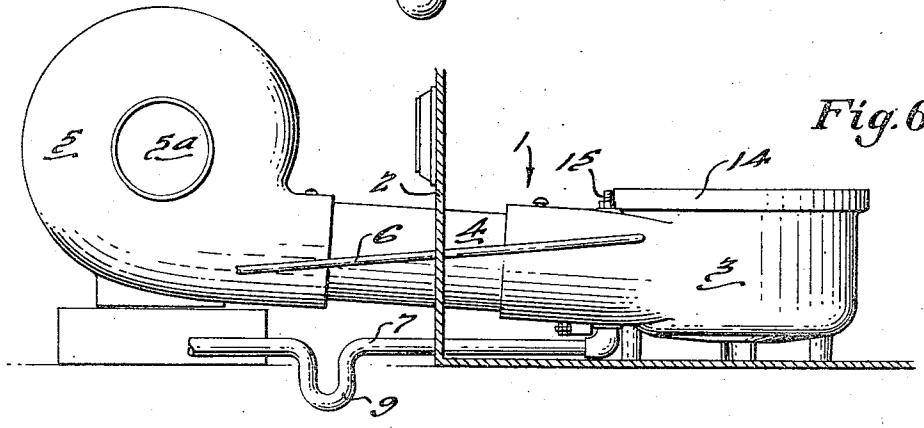


Fig. 6.

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OIL BURNER

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7 Claims. (Cl. 158—28)

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The present invention relates to improvements in oil burners, relating particularly but not exclusively to so-called "pot type" burners which may be either automatically or manually controlled. Burners embodying the present invention comprise the heat generating element of the heating system and may be used either for original installations or as conversion burners in various types of heat absorbing and distributing devices, such for example as hot air furnaces, steam boilers and the like.

The present application is filed in place of my abandoned application Serial No. 350,398, filed August 3, 1940, and abandoned June 3, 1944.

Among the important objects of the invention is the provision of an oil burner in which a continuous flame may be propagated in part of the burner, which flame may be directed and controlled to provide for a low flame or a high flame or intermediate flames. Also combustion at a high flame may be effected in all parts of the burner when additional heat is required. Furthermore, combustion of the fuel is substantially complete at all flame adjustments, thereby eliminating deposits of carbon resultant from incomplete combustion and, at the same time, providing a very effective and readily controlled heating means.

Another object of the invention is to provide a simple, reliable and effective oil burner which will give an efficient and uniform combustion of the fuel supplied thereto with the production of a full flame and a steady and uniform heat. More expressly, I propose to provide an oil burner of the "pot type" in which the flame and radiant heat produced by the fuel in the burner are distributed radially of the combustion chamber of the furnace without the use of any moving parts in the combustion chamber.

It is another object of the invention to provide an oil burner of the above type in which installation, upkeep, maintenance and replacement costs are reduced to a minimum; and one which is so constructed that it may be readily adapted for relatively low cost production on a commercial basis.

A further object of the invention is to provide an oil burner in which a combustible mixture rich in oil is admixed with air in such a manner as to suspend the rich mixture in the air stream and project the same as a substantially homogeneous combustible mixture into the burner chamber as a vapor or an oil bearing gas, whereby a substantially complete combustion of the fuel is accomplished in the combustion chamber.

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Still another object of the invention is to provide an oil burner in which a stream of combustible mixture is forced to travel in a substantially circular path in the burner pot and is so directed by baffles in the burner that there is, prior to the ignition of said combustible mixture, a substantially complete gasification and a substantially complete homogenization of the fuel and the air, the direction of travel of the combustible mixture being such that when ignited, a swirling flame of the so-called "sunburst" type is developed at all points adjacent the periphery of the burner pot.

Other objects and advantages of this invention will appear in the following description, reference being had to the accompanying drawings forming a part of this specification, wherein like reference characters designate corresponding parts in the several views, and in which:

Fig. 1 is a fragmentary top plan view, with parts broken away, of an oil burner embodying the present invention;

Fig. 2 is a side elevation of the burner shown in Fig. 1;

Fig. 3 is a fragmentary section taken substantially on the line 3—3 of Fig. 2 in the direction of the arrows;

Fig. 4 is a side elevation of the form of the invention shown in Fig. 1, with parts of the side wall and lining of the fire pot broken away to show the interior construction of the fire pot. This view also particularly illustrates the longitudinal sectional contour of the air and fuel nozzles;

Fig. 5 is a fragmentary vertical section taken substantially on the line 5—5 of Fig. 1 in the direction of the arrows; and

Fig. 6 is a view in side elevation of a burner embodying the present invention installed in the ash pit of a furnace shown in fragmentary section.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring to Fig. 6, the oil burning system of the present invention comprises a burner indicated generally by the numeral 1 which is mounted in the ash pit 2 beneath the combustion cham-

ber of a furnace (not shown). The firebox and combustion chamber of the furnace may be of any desired conventional type so long as a substantially gas-tight chamber is provided within the furnace which is connected with a flue for the exhaust gases and which is provided with a space surrounding its exterior surfaces in which a heat-absorbing medium, such for example as air or a liquid, is circulated in heat-exchanging relation. The function of the furnace combustion chamber is to permit the complete combustion of the heat-generating fuel therein and to provide a vent to the atmosphere for the noxious and other gases of combustion while permitting the transfer of heat from said gases to said heat-exchanging medium.

Fuels most commonly employed in burners of the type to which this invention pertains are mixtures of liquid hydrocarbons which require the admixture of air therewith before they may be completely burned. In the burner assembly shown in Fig. 6, the air for supporting combustion of the fuel is supplied through the duct 4 which communicates with a power-driven blower 5. The blower 5 may be provided with a suitable control damper to restrict the air intake opening 5a. In the embodiment here shown, however, such damper is not required as the capacity of the blower 5 is so selected with reference to the air requirements of the burner that the blower may be operated with an unrestricted air intake at all times to supply the proper amount of air to the burner. As will be hereafter explained in more detail, the blower 5 is driven by a motor, the speed of which may be controlled with relation to the amount of fuel fed to the burner to assure a proper proportion of air and fuel in the combustible mixture whether the burner is adjusted to produce either a full or a partial flame.

The liquid fuel is supplied to the burner from a suitable source or supply tank (not shown) through the fuel supply pipe 6. The fuel is preferably under sufficient pressure to flow readily through the pipe 6; for instance, this flow may be accomplished by placing the fuel source in a higher plane than the plane of the discharge end of the pipe 6 and thus assure the flow of fuel by the force of gravity. If, however, it is desired to so place the fuel supply source that the fuel will not flow satisfactorily by gravity, a suitable fuel pump (not shown) may be provided. A conventional type of control valve (not shown) which may be either mechanically or manually controlled, is provided in the pipe 6 to meter a desired amount of fuel during a selected time interval to the discharge end of the pipe 6.

An overflow pipe 7 is connected at the lower end of the inside of the burner pot 3 and communicates with a suitable sewer outlet (not shown) to prevent flooding of the combustion chamber in the event that more fuel is supplied to the burner than can be burned therein. As most clearly shown in Fig. 4, this arrangement is such that the outlet 8 leading from the combustion chamber to the overflow pipe 7 is placed adjacent the floor of the burner and at a point slightly above the plane of the floor. In this manner, fuel may accumulate in the burner to a desired extent before it is carried out of the burner through the pipe 7. A suitable trap or liquid seal 9 is provided in the pipe 7 and prevents the escape of sewer gases through the pipe 7.

As best shown in Fig. 5, the pot 3 of the burner

is lined with a molded refractory lining 10. Referring particularly to Figs. 4 and 5, the top of the pot is covered by an annular refractory cover 14 which is molded of a suitable refractory material and is provided with a downwardly and inwardly flared portion surrounding a central circular opening 14a. The cover 14 is provided with a suitable rim 20 which is provided with a depending circumferential tongue 21 which mates in the female groove 22 provided in the circumferential top portion of the burner pot casting. This construction provides a tight seal between the refractory cover 14 and the pot 3 of the burner.

While the refractory parts of the present invention may be of any desired type of refractory material, it is my preference that they be formed of sillimanite or similar refractory material, and thereafter kiln fired and glazed. This provides a serviceable structure and one which is impervious to the fluids injected into the burner as a part of the combustible mixture. Preferably, the refractory material is placed inside the pot 3 in its unfired condition so that the firing causes the refractory material to fuse inside the pot 3. The cover 14 is preferably separately fired and thereafter is cemented or otherwise secured in place on top of said pot.

The air duct 4 connecting the blower 5 and the fire pot 3 is divided or branched at its terminus which leads to the fire pot, forming, as a result, a pair of nozzles 11 and 12. As shown in Figs. 4 and 5, these nozzles are situated side by side in adjacent relation. The nozzle 11 is formed by the inwardly tapering right side wall of the air duct 4, as shown at 4a of Fig. 1, and by the downward taper of the top wall of the right branch of the duct 4, as shown at 4b of Figs. 2 and 4. The nozzle 12 is formed by the inwardly tapering left side wall of the air duct 4, as shown at 12a of Fig. 1, and by the top wall of the left branch of the duct 4, as shown at 12b of Figs. 2 and 4. The reference numeral 11a represents a common portion or wall forming the inner sides of both nozzles 11 and 12 and separating them so that they are in adjacent relation. In view of the foregoing it will be readily understood that the nozzle 11 is of a "Venturi" form in plan view and tapers inwardly and downwardly in section. It will also be understood that the aforementioned particular arrangement of the nozzles 11 and 12 provides but one suitable structure and that other satisfactory arrangements can be used. For instance, these nozzles may be concentrically arranged in nested spaced relation. For example, the nozzle 12 could be constructed to surround the nozzle 11 to provide such a construction. In the preferred embodiment of the invention here shown, the nozzles 11 and 12 are formed partly in the cast member forming the outer shell of the pot 3 and partly in the refractory material 10. In order to assure a smooth flow of the combustible within the pot as generally tangential streams, refractory fillets 13 are provided adjacent the sides and tops of the nozzles 11 and 12.

As shown in Fig. 3, a bracket 15 is provided adjacent the inlet end of the nozzle 11 and supports a gyrator 16 thereon. In the present instance the gyrator is a light-weight metal fan, but it may be any other desired form of rotary atomizing device which will break up globules of the liquid fuel and admix the same with air. The hub of the gyrator 16 terminates on a line with the discharge end of the fuel supply pipe 6. This structure is such that when the burner is in

operation, air driven by the blower 5 through the duct 4 causes the gyrator 16 to rotate and as fuel is discharged on the hub thereof from the end of the pipe 6, the gyrator 16 causes the oil to be thrown outwardly of the blades and this creates an area of diminished pressure adjacent the hub of the gyrator and causes the drops of fuel from the fuel supply pipe 6 to be broken up and admixed with the air stream which flows through the nozzle 11.

Due to the "Venturi" form and restriction of the nozzle 11 and the maintaining of a constant volume of air and fuel in the nozzle, it will be seen that the velocity of the air and fuel mixture is increased in the nozzle 11. This is accentuated still further after the burner has been in operation and the refractory portion of the nozzle 11 has become heated. Thus it will be seen that the fuel and air mixture is initially admixed by the mechanical action of the gyrator but that this initial admixture is further homogenized by the velocity and confinement of the air and fuel mixture and its heating in the nozzle 11. It has been found that this arrangement provides a substantially completely homogenized fuel and air mixture which approaches a state of complete atomization or gasification before it is ignited.

As the homogenized air and fuel mixture passes through the nozzle 11, it is ignited by any suitable ignition means, such for example as the refractory covered electric resistance element 17. It is to be understood, however, that any other desired type of ignitor may be employed, such for example as an ignitor of the electric spark type or an ignitor of the gas flame type. The ignited gases passing from the end of the nozzle 11 are then admixed with additional air driven by the blower 5 through the duct 4 and thence through the nozzle 12, and the resulting combustion further increases the carbon dioxide content of the gases. In this connection it will be noted that fuel is fed into and driven through the nozzle 11 only since the fuel discharge pipe 6 and gyrator 16 are located in the nozzle 11. Air only is driven through the nozzle 12 for mixing with the burning air and fuel mixture emitted from the nozzle 11. Furthermore, this air is discharged into the fire pot in substantially parallel relation to the burning air and fuel.

The flow of the combustible mixture and air in the pot 3 is indicated schematically by the arrows shown in Figs. 1 and 2. As shown, the cover 14 defines the top portion of what in effect is a three-sided duct within the pot 3, the fourth side of the duct being open and communicating with the circular opening 14a provided in the cover. The velocity of the combustible mixture and air in the pot 3 and the direction imparted thereto by the nozzles 11 and 12 cause the ignited mixture to flow initially through said three-sided duct until the gases are forced in ignited condition upwardly through the opening 14a. Thus the pot is in effect the combustion chamber of the burner as the initial combustion occurs entirely within the pot and the subsequent combustion occurs as the flame continues to be propagated outside of the pot 3. The arrows shown in Fig. 2 provide a schematic view of the flow of the burning gases from the burner. As is known, movement of such gases as indicated by said arrows will provide a flame placement in the form of a radially extending sunburst flame, the base of which will be adjacent the outer circumference of the cover 14. Thus it will be seen that

the shape of the cover, with its downwardly and inwardly flaring top which surrounds the opening 14a, provides the means for controlling the flame placement within the combustion chamber of the furnace and at the same time controls and directs the flow of the combustible mixtures within the pot 3. When the pressure of the incoming gases within the pot 3 exceeds the forces which tend to confine the gases within said three-sided duct, the burning gases flow outwardly and upwardly through the opening 14a toward the areas of diminished pressures produced in the furnace combustion chamber by the stack.

While I have not discussed in detail the features or arrangement of the control means which may be used with this burner, it is to be understood that any desired type of either manual or automatic control means may be employed. For example, the valve controlling the oil supply may be controlled automatically and in synchronism with means for controlling the action of the ignitor and the speed of the motor driving the fan or blower. The entire control means may be electrically connected with a thermostat in a selected room or other remotely located point which will actuate said means when heat is required. In using the electric resistance ignitor here described, the ignitor is first heated, the air and fuel are then admixed in the nozzle 11 and then brought in contact with the ignitor. After a suitable heat is generated in the burner, the ignitor circuit may be broken as the heat produced by the combustion will continue to propagate a flame within the combustion chamber. It is to be understood, however, that the control means may be of the manually actuated type if desired.

From the foregoing it will be seen that I have provided an oil burner of the pot type in which there are no moving parts within the combustion chamber and which is of such a design and construction that it may be readily manufactured on a commercial production basis. The burner is so constructed that a substantially complete atomization of the fuel is provided. Also, means are provided to assure a substantially complete combustion of the fuel and air supplied to the burner. The burner may be operated at a low flame or a high flame by a suitable adjustment of the control mechanism to operate the blower at a selected speed and by regulation of the desired amount of fuel to be fed through the pipe 6. The construction is such that in operation, the incoming gases cause a complete washing and scrubbing of all parts of the burner exposed to the flame which prevents the formation of carbon thereon and keeps these parts clean and in operating condition. Thus service and maintenance costs are reduced to a minimum.

I claim:

1. A pot-type oil burner comprising a substantially cylindrical open top pot lined with fire glazed sillimanite, an annular refractory cover for said pot formed of glazed fired sillimanite and having a flange extending upwardly and outwardly from the central opening to the circumference thereof, a fuel feeding duct, a nozzle for discharging a stream of a liquid hydrocarbon fuel into said duct, said duct having a passage of reduced size near its mouth to provide for an accelerated rate of discharge of a fuel and air stream from the mouth thereof, a separate air feeding duct, said ducts each having a discharge port communicating with the interior of said pot and arranged to discharge separate streams of products of combustion and air on lines sub-

stantially tangent to the inner circumference of said pot, a power driven fan connected with said ducts and adapted to supply air under pressure thereto, a fuel and air mixing device located within said first named duct and comprising a rotatable air driven blade type impeller located in said duct adjacent the point of fuel discharge and adapted to break up a fuel stream discharged thereon through said nozzle and admix the broken up fuel stream with sufficient air to provide a primary combustible mixture, an ignitor located in said duct adjacent said impeller and adapted to ignite the primary mixture within said duct to effect initial combustion of said primary mixture within said duct, the gaseous products of said initial combustion upon entry into said pot admixing with air from said air duct.

2. A pot-type oil burner comprising a generally cylindrical refractory lined open top pot, a separate annular refractory cover for said pot, an atomizing and primary combustion duct, a fuel feeding nozzle for discharging a stream of liquid hydrocarbon fuel into said duct, an air feeding duct having its axis substantially parallel to the axis of said atomizing and primary combustion duct, both of said ducts terminating in discharge ports opening into said pot and located on lines substantially tangent to the circumference of said pot, a power driven fan connected with said ducts for supplying air under pressure thereto, means located in said atomizing and primary combustion duct for breaking up a stream of liquid hydrocarbon fuel discharged from said fuel feeding nozzle and admixing it with air to provide a primary combustible mixture, and an ignitor located in said atomizing and primary combustion duct adjacent said means and adapted to ignite the primary combustible mixture and effect an initial combustion thereof within said atomizing and primary combustion duct.

3. A pot-type oil burner comprising a generally cylindrical refractory lined open top pot, a separate annular refractory cover for said pot, a downwardly and inwardly extending flange extending from the outer circumference of said cover to the centrally located opening therein, a fuel feeding nozzle having a passage of reduced size near its mouth arranged to discharge a stream of a liquid hydrocarbon fuel into a duct and a discharge port communicating with the said pot, an air feeding duct extending on an axis substantially parallel to the axis of said nozzle and terminating in a separate discharge port communicating with the interior of said refractory pot, both of said discharge ports opening in planes substantially tangential to the inner circumference of said pot, a power driven fan connected with said ducts for supplying air under pressure thereto, means located in said duct adjacent said fuel feeding nozzle for breaking up the stream of liquid hydrocarbon fuel discharged therefrom and admixing the fuel with sufficient air to provide a primary combustible mixture, and an ignitor located in said first named duct adjacent said means and adapted to ignite the primary combustible mixture within said fuel feeding nozzle.

4. A pot-type oil burner comprising a generally cylindrical open top pot having fired refractory lining, a separate annular cover for said pot formed of a fired refractory material and having an upwardly and outwardly extending flange extending from the central opening thereof to the

circumference of said cover, a fuel feeding nozzle and an air feeding duct having substantially parallel axes, a separate discharge port on said nozzle and on said duct both opening into the interior of said pot and arranged respectively to discharge a burning combustible mixture and air into said pot on lines substantially tangent to the circumference thereof, a power driven fan connected with said fuel feeding nozzle and said air feeding duct and adapted to supply air under pressure thereto, means adjacent said fuel feeding nozzle for breaking up a stream of a liquid hydrocarbon fuel and admixing it with air to provide a primary combustible mixture, and an ignitor located adjacent said means and adapted to ignite the primary combustible mixture prior to the discharge thereof into said pot.

5. A pot-type oil burner comprising a refractory lined open top pot, a separate annular refractory cover for said pot, an atomizing and primary combustion duct, a fuel feeding nozzle for discharging a stream of liquid hydrocarbon fuel into said duct, an air feeding duct having its axis substantially parallel to the axis of said atomizing and primary combustion duct, both of said ducts terminating in discharge ports opening into said pot and located on lines substantially tangent to the circumference of said pot, a power driven fan connected with said ducts for supplying air under pressure thereto, a rotatable air driven fan located in said atomizing and primary combustion duct and having a plurality of blades for breaking up a stream of liquid hydrocarbon fuel discharged from said fuel feeding nozzle adjacent said fan and admixing it with air to provide a primary combustible mixture, and an ignitor located in said atomizing and primary combustion duct adjacent the blades of said rotatable air driven fan and adapted to ignite the primary combustible mixture and effect an initial combustion thereof within said atomizing and primary combustion duct.

6. A pot-type oil burner comprising a generally cylindrical refractory lined open top pot, a separate annular refractory cover for said pot, an atomizing and primary combustion duct, a fuel feeding nozzle for discharging a stream of liquid hydrocarbon fuel into said duct, an air feeding duct having its axis substantially parallel to the axis of said atomizing and primary combustion duct, both of said ducts terminating in discharge ports opening into said pot and located on lines substantially tangent to the circumference of said pot, a power driven fan connected with said ducts for supplying air under pressure thereto, means located in said atomizing and primary combustion duct for breaking up a stream of liquid hydrocarbon fuel discharged from said fuel feeding nozzle and admixing it with air to provide a primary combustible mixture, and an electrically actuated ignitor located in said atomizing and primary combustion duct adjacent said means and adapted to ignite the primary combustible mixture and effect an initial combustion thereof within said atomizing and primary combustion duct.

7. A pot-type oil burner comprising a refractory lined open top pot, a separate annular refractory cover for said pot, an atomizing and primary combustion duct, a fuel feeding nozzle for discharging a stream of liquid hydrocarbon fuel into said duct, an air feeding duct having its axis substantially parallel to the axis of said atomizing and primary combustion duct, both of said ducts terminating in discharge ports

opening into said pot and located on lines substantially tangent to the circumference of said pot, a power driven fan connected with said ducts for supplying air under pressure thereto, a rotatable air driven fan located in said atomizing and primary combustion duct and having a plurality of blades for breaking up a stream of liquid hydrocarbon fuel discharged from said fuel feeding nozzle adjacent said fan and admixing it

with air to provide a primary combustible mixture, and an electrically actuated ignitor located in said atomizing and primary combustion duct adjacent the blades of said rotatable air driven fan and adapted to ignite the primary combustible mixture and effect an initial combustion thereof within said atomizing and primary combustion duct.

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