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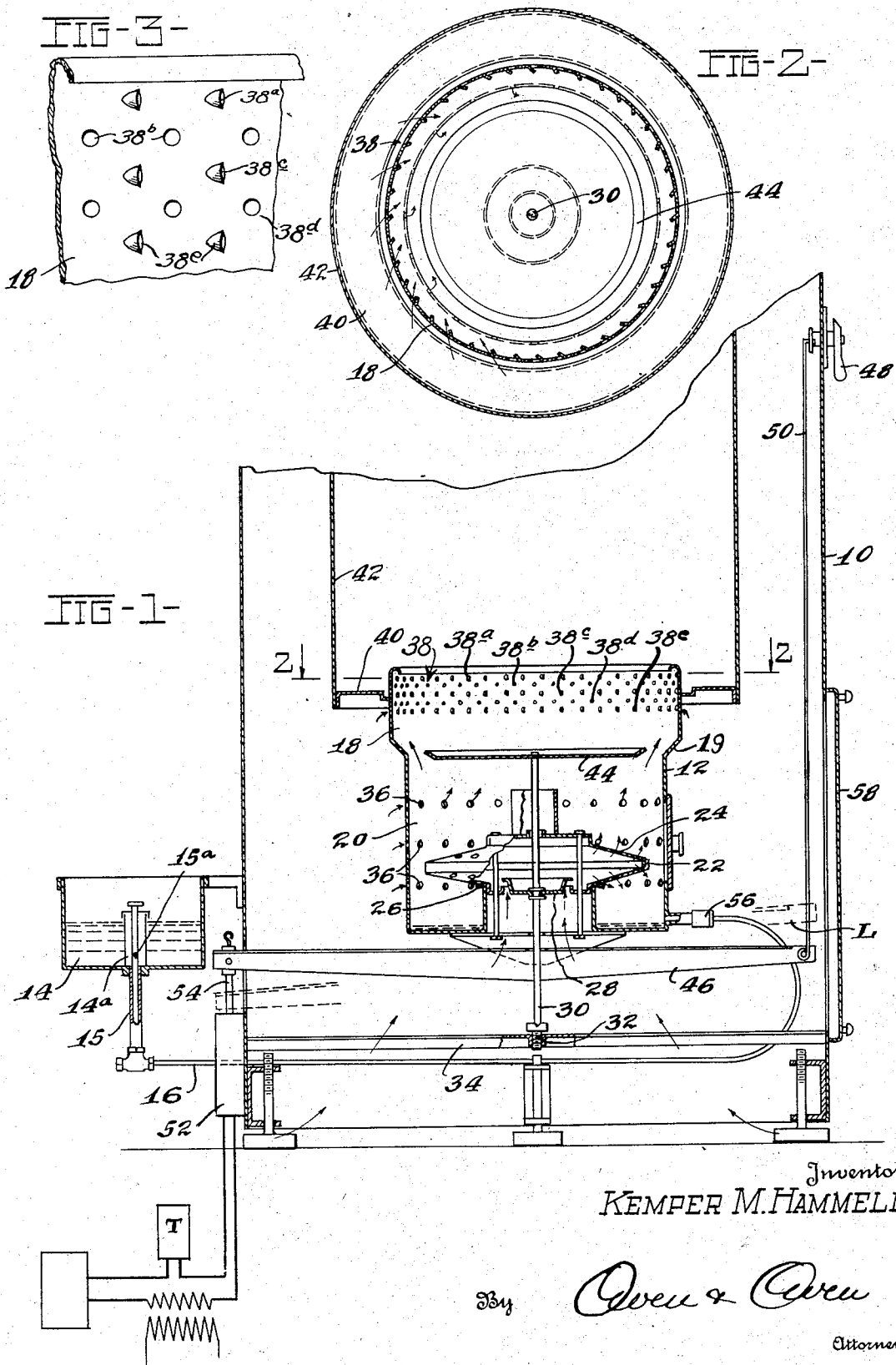
K. M. HAMMELL

2,357,587

OIL BURNER

Filed Feb. 25, 1942

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FIG-5-

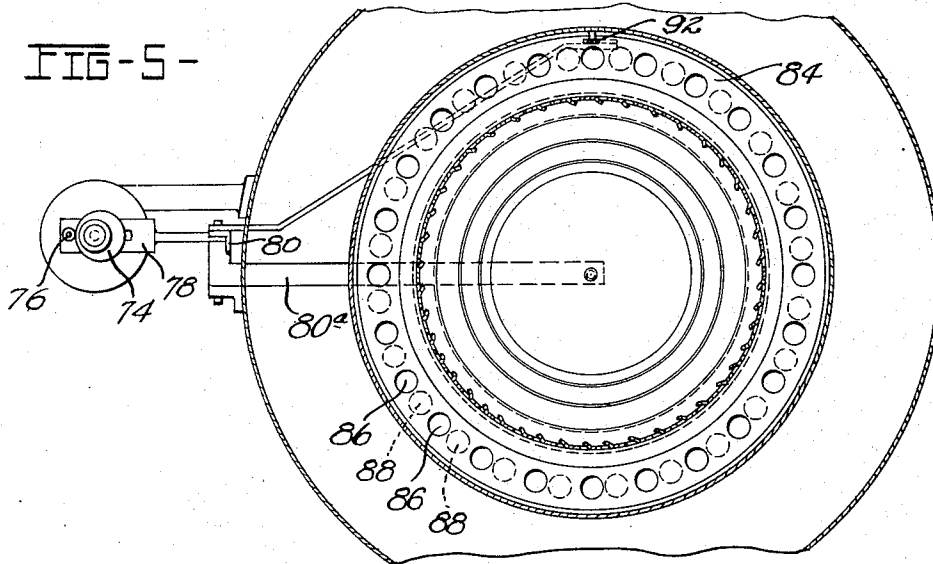
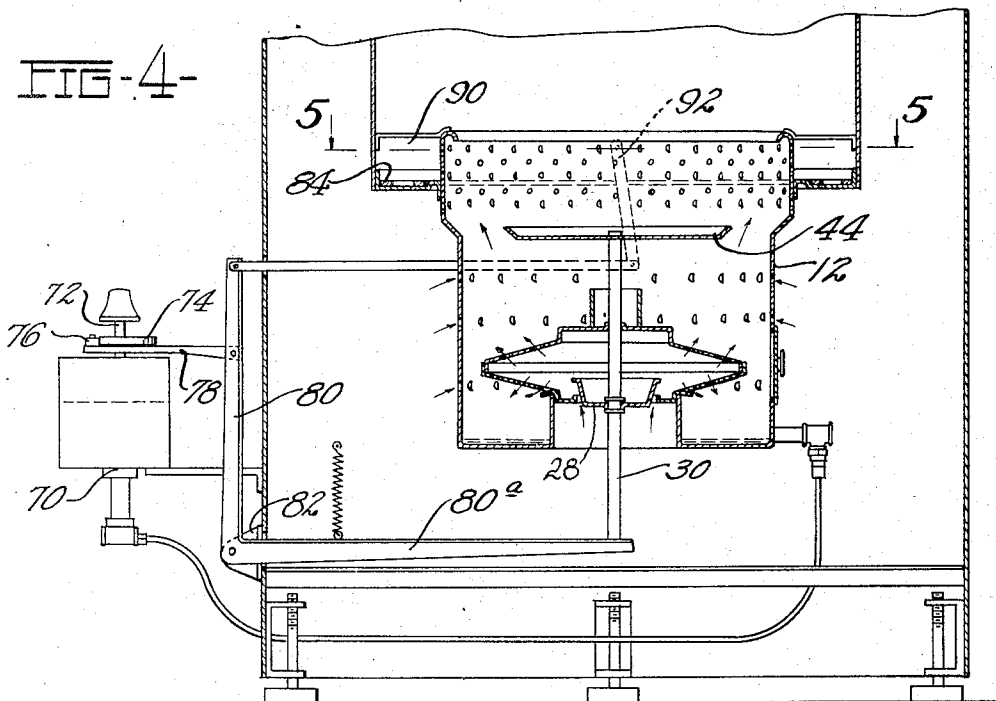


FIG-4-



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UNITED STATES PATENT OFFICE

2,357,587

OIL BURNER

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16 Claims. (Cl. 158—91)

This invention relates to oil burners, and is more particularly directed to a pot type burner and the air and fuel feeds therefor.

The primary object of the present invention is to provide a pot type oil burner in which the primary air inlet, secondary air inlet and fuel inlet are all controlled simultaneously to the end that fuel introduced into the burner is consumed properly, and at relatively high efficiencies.

Another object of the invention is to provide air distributing means within the burner defining zones of combustion and serving the additional function of causing intimate admixture of the partially hydroxylated fuel with the subsequently introduced air.

Still another object of the invention is to provide a burner which requires no forced draft, but which will burn ordinary furnace oil with an efficient, smokeless flame using a draft as low as .04 inch and which will have an extended range of fuel consumption rates on such draft.

Still another object of the invention is to provide a burner in which the primary and secondary air are introduced at a rate which varies with the rate of fuel input and in which the fuel feed means is so constructed as to maintain a constant rate of supply at low fires.

Another object is to provide a burner which may readily be removed from the furnace, disassembled, cleaned and replaced without disturbing furnace, flue connections, etc.

Other objects and advantages of the invention will become apparent as the description proceeds, reference being had to the accompanying drawings, in which—

Fig. 1 is a fragmentary vertical sectional view of a furnace and burner pot embodying the present invention; Fig. 2 is a section on line 2—2 of Fig. 1; Fig. 3 is an enlarged fragmentary view of the upper section of the burner pot; Fig. 4 is a central vertical section of a modification of the invention and Fig. 5 is a section on line 5—5 of Fig. 4.

Referring to the drawings, in Figs. 1 and 2 the invention is shown in one embodiment incorporated in a heater having a jacket 10 heated by a burner pot 12 and supplied with fuel from a constant level sump 14 through a flexible pipe 16. Fuel is maintained at a constant level in the sump 14 by any of several well-known devices, and the combustion rate is varied by varying the rate of introduction of the fuel through pipe 16 into the bottom of the burner pot 12. It will be seen that the effective head of fuel depends on the vertical position of the burner pot relative

to the constant fuel level in the sump 14 and if the burner pot is lowered the fuel head is increased and more fuel will enter the pot in a given time than if the burner pot is raised to decrease the effective head of fuel. Thus, for a "high" fire the burner pot is moved down and for a "low" fire the burner pot is moved upwardly to decrease the rate of fuel supply. The sump 14 is provided with a strainer 14^a which surrounds the upper end of a fuel conduit 15, which fuel conduit is provided with a metering orifice of relatively large dimensions, designated 15^a. It will be appreciated that by using a large orifice 15^a and varying the effective head of the fuel, much more accurate control on "low" fires is obtainable than if the head of the fuel remained the same and the size of the orifice varied. Modern fuel oils have a tendency to clog a small orifice over a period of time, and for this reason a furnace which adjusts its rate of combustion by adjusting the size of the port through which fuel flows to the furnace is unreliable on "low" fire because of the tendency of the fuel to clog the port and cut the fire off entirely.

The burner pot 12 has a generally circular cross-section, and is provided adjacent its upper end with an enlarged secondary air supply zone 18, the lower part of the pot forming a hydroxylating zone 20. Between the hydroxylating zone 20 and the secondary air supply zone 18 the pot tapers as at 19.

The base of the pot 12 is provided with a circular opening which is closed at its upper end by a primary air distributing member or supercharger 22 which is a flattened hollow body and which is provided with openings 24 in its upper and lower surfaces through which air passes both upwardly and downwardly to combine with the fuel vapor. In addition to the holes 24, the supercharger is further provided with "lanced" openings 26 in its lower surface adjacent the inner edge, so that air passing from such openings passes rapidly outward across the lower surface of the supercharger body 22. As used herein, a "lanced" opening may be defined as one which is substantially normal to the pierced surface and results from rupture of the surface along a single line and displacement of a portion of the surface material in the form of a bulge. The supercharger serves to define two precombustion zones, one above and one below itself in each of which the oxygen of the air combines with the hydrocarbon vapor in a hydroxylating process.

A primary air control valve 28 is carried on a

stem 30, which stem rests loosely upon an adjustable regulating member 32 in a cross-frame member 34 carried by the furnace. The supercharger body 22 is fixed to the pot 12, so that if the pot is raised or lowered the valve 28 will be opened or closed against its seat, the degree of opening being dependent upon the extent of movement of the pot. The number and location of the holes in the supercharger body are such that no substantial secondary combustion occurs at this point, that is, no flame is visible.

In addition to the primary air supplied through the supercharger, the sides of the pot 12 are further provided with primary air openings, preferably in three series, being designated 36 in Fig. 1. It has been found in practice that drilled holes will ordinarily suffice for the openings 36, but in some installations it is desirable to lance alternate openings in the second series, thereby providing a tangential direction for the air passing through such openings and giving a slight swirl to the mixture at that point.

Secondary air enters the pot through a plurality of series of openings 38, individually designated as 38^a, 38^b, 38^c, 38^d and 38^e. The upper end of the burner pot slides vertically in the lower wall 40 of a combustion chamber or furnace 42, the upper end of which communicates with a suitable flue outlet, which is not shown. It will be appreciated that the form and disposition of the combustion chamber is conventional and no claim for improvement is made in connection with this part. By raising or lowering the pot 12, one or more of the series of secondary air openings 38 is exposed and utilized for the introduction of secondary air to the previously partially hydroxylated fuel vapor. The supply of air to the entire burner is, of course, taken from the floor under the furnace and up through the interior thereof in the space around the burner pot 12.

A fire baffle 44 is provided within the burner pot and is carried preferably by the stem 30 and is spaced vertically from the supercharger and laterally from the interior wall of the burner pot, so as to force the fuel vapors passing upwardly into the combustion chamber into close and intimate contact with air entering through the secondary air openings 38. The fire baffle 44 thus assures a complete intermingling of the fuel vapor and secondary air and prevents any "starved" zone in the center of the ascending body of vapor which might result in a smoky, incompletely burned mass of fuel. Further, the fire baffle cooperates with the tapered portion 19 of the burner pot to define an annular orifice for the passage of fuel into the secondary zone 18, which orifice is automatically increased in size as the burner pot is moved down for higher fire.

It has been found that in most installations more satisfactory burning of the fuel vapor can be had if the flame in the combustion chamber is kept relatively short in its vertical dimensions and is given a directional movement such that the path of movement of the burning mass within the combustion chamber is lengthened by following a helical path. For this purpose certain series of secondary air openings 38, for example 38^a and 38^c, may be lanced to give the flame a rotary movement of any desired velocity, the velocity being dependent upon the number of lanced holes as compared to the number of drilled openings through which air enters radially into the secondary combustion zone 18. It has been found in use that by lancing alternate

rows of the holes, for example 38^a and 38^c, a burner is provided which burns very satisfactorily through a range in which the fuel consumption varies as much as six or eight to one, and which will not "growl" or pulsate when the burner is rapidly turned from one extreme position to the other. The flame is stable under all conditions and the combustion is essentially complete, as practically no carbon is deposited in the flue of the furnace, even though the draft used is kept to a minimum.

In the form shown in Figs. 1 and 2 adjustment of the burner is, as previously indicated, made by moving the fire pot bodily in a vertical direction with reference to the combustion chamber 42 and the remaining parts of the furnace 10. For this purpose, the burner is carried on a cross member 46 and the cross member is vertically adjusted at one end by a control lever 48 which operates on a connecting rod 50 attached at one end to the control lever and at its other end to one end of the cross member 46. For automatic operation, the connecting rod 50 may be left stationary and used as a fulcrum about which the cross member 46 is pivoted and operated by a thermostat motor 52 connected to the rear end of the lever through a connecting rod 54 and operated in response to a suitable thermostat T. For manual operation, the pivot between the connecting rod 54 and the cross member 46 remains stationary and the pot is moved by the connecting rod 50 and control lever 48.

It will be seen that by pivoting each end of the cross member 46, a seasonal control can be had from this combination of elements. For example, if the control lever 48 is moved to lower the burner pot, which would result in a normal "high" fire, the thermostat motor 52 can be used to cause a fluctuation of the burner from, for example "high" to "medium" fires. However, if the control lever 48 is turned to raise the burner pot to the "medium" position, the thermostat motor, operating through the same range, will cause a fluctuation in the fire from, for example, "low" to "medium." This feature is of considerable advantage since it may be employed during mild weather to maintain a relatively constant "low" fire and during severe weather to maintain a relatively constant "high" fire, but, of course, the device may be set to operate in any range between these extremes, depending on the severity of the climatic conditions.

An additional feature of construction is of considerable importance in connection with the present invention, in that the burner pot 12 is readily removable in its entirety from the furnace for cleaning or needed repairs. In order to remove the burner, it is only necessary to disconnect the coupling 56 where the fuel pipe 16 enters the burner pot and to uncouple the connection between the cross member 46 and the thermostat motor connecting rod 54 at the rear end and the manual control rod 50 at the front end. The burner pot 12 will then move downwardly in the furnace to such an extent that its upper end becomes completely free of the lower wall 40 of the combustion chamber 42, and by unseating the rod 30 from its adjustable stop 32 in the lower furnace member 34 the entire burner and its supports 46 and rod 30 may be moved outwardly through an access door 58 in the front wall of the furnace 10. After cleaning, the burner may be reinserted in the same simple manner and the three connections re-

established. It has been found in practice that less than a minute is required to completely disconnect and remove the burner from the furnace.

A modified form of the invention is shown in Figs. 4 and 5. In this form the burner pot is left stationary and adjustment of the primary air, secondary air, and fuel supplies made by an interrelated mechanism. Thus the various factors which influence the rate and character of burning within the pot are simultaneously controlled, as in the modification previously described.

The combustion control mechanism in this modification includes a fuel valve 70 which may be any satisfactory, non-clogging construction, operated by rotating a stem 72. The stem 72 carries a cam 74 which drives a cam follower 76 and operator plate 78. The operator plate 78 is connected to a bell crank lever 80 pivoted to the furnace on a bracket 82. One arm of the bell crank lever, 80, operates the primary air valve by lifting its stem 30. The other arm of the bell crank lever controls the secondary air supply by rotating a perforated, circular plate 84 which has openings 86 movable into and out of register with openings 88 in the lower wall of a plenum chamber 90. The plate 84 is driven by a connecting rod 92.

The operation of the invention is similar for the two modifications. Oil enters the burner pot 12 from the constant level reservoir 14 and is controlled in its quantity by the differential head in one modification and by the fuel control valve 70 in the other. The fuel vaporizes within the pot and passes up around the supercharger where it receives primary air both from the perforations in the side of the pot and from the interior of the supercharger. This latter air is regulated in quantity by the primary air control valve 28.

Combining with the primary air in a hydroxylated mixture the fuel passes upwardly in the pot and is forced outwardly by the fire baffle 44 into intimate contact with the secondary air entering through the periphery of the top. The secondary air is controlled in quantity either by raising or lowering the pot to expose one or more series of openings as in Fig. 1 or by increasing or decreasing the registry of openings 86 and 88 to admit more or less air into the plenum chamber 90 in Fig. 4. The thoroughly hydroxylated mixture is then burned in the combustion chamber 42, the contour and length of the flame being largely controlled by the directional characteristics imparted to it by the secondary air stream. As previously noted it is frequently desirable to impart a whirling motion to the flaming gases to keep the flames short for complete combustion in a furnace whose vertical dimension is small.

To adjust the degree of heat output the user may turn the manual control lever 48 in Fig. 1 or the stem 72 in Fig. 4. This operation causes a simultaneous change in fuel input, primary air input and secondary air input. In other words, the user does not make an adjustment of any single element which enters into the combustion, but adjusts all elements at once.

Should a thermostatic control be used, as suggested in Fig. 1, operation of the thermostat motor causes a movement of the parts to give an increase or decrease in the amount of heat by raising or lowering the pot 12, a lowering of the

pot 12 causing an increase in the heat, and a raising of the pot causing the fuel consumption to be reduced.

As previously described, the thermostatic and manual controls may be combined to give a "seasonal" control. For example if the manual control is moved to the "low fire" position, in which the pot is raised about to the dotted line position indicated at L in Fig. 1 the thermostatic control will then operate between the lower fire position and a medium fire position, since, when fully lowered by the thermostat the pot can travel only far enough to expose about half of the secondary air holes. In more severe weather the manual control is moved to the medium fire position which is shown in full lines in Fig. 1 and the thermostat then operates between the medium and high fire positions because its motion is sufficient to lower the pot enough to expose all of the secondary air holes and give the maximum effective fuel head thus giving the highest possible fire.

While the invention has been described in connection with two modifications it will be appreciated that numerous other modifications will suggest themselves to those skilled in the art and that such modifications are included within the scope of the appended claims.

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

1. In a device for burning liquid hydrocarbon fuel, a pot having apertures in its side wall and having an open top, means to introduce fuel into said pot, primary air distributing means disposed within said pot and comprising a flattened hollow body, controllable means to supply air to the interior of said body, said body having perforations in its upper and lower surfaces to distribute air downwardly and outwardly into a first pre-combustion zone immediately over the body of fuel in the bottom of said pot and upwardly and outwardly into a second precombustion zone; means to introduce secondary air adjacent the top of said pot and means to vary the quantity of secondary air simultaneously with the quantity of primary air introduced into said hollow body.

2. In a device for burning liquid hydrocarbon fuel, a pot having apertures in its side wall and having an open top, said pot having a top portion of enlarged diameter with relation to the lower portion thereof, a tapered side portion joining said upper and lower portions of the pot, means to introduce fuel into the bottom of said pot, means to introduce primary air into the lower portion of said pot, means to introduce secondary air into the enlarged upper portion of said pot, a fire baffle disposed within said pot and forming with said tapered portion an annular orifice between said upper and lower portions of the pot, and means to change the relative vertical disposition of said fire baffle and said tapered wall portion whereby the effective area of the orifice between them may be increased or decreased.

3. In a device for burning liquid hydrocarbon fuel, a pot having openings in its lower portion for the admission of primary air to its lower interior portion and having openings in its side wall for admitting secondary air to its upper interior portion, means for supplying fuel to the lower interior portion of the pot, separate valve means for respectively controlling the admission of primary air to the pot through said first openings and secondary air to the pot, and means oper-

able to actuate said valve means to vary simultaneously and in predetermined proportions the admission of primary and secondary air to the pot.

4. An arrangement as called for in claim 3 wherein the means which actuates the separate air admission valve means also connects to and is operable to control the fuel supply means to vary the supply of fuel to the pot simultaneously with and in predetermined proportion to the admission of primary and second air.

5. In a device for burning liquid hydrocarbon fuel, a pot having apertures in its top portion for the admission of secondary air and being mounted for vertical movements, means cooperating with said apertures to vary the amount of air admitted to the pot when the latter is vertically moved, and means operable to move said pot to effect such movements.

6. In a device for burning liquid hydrocarbon fuel, a fuel pot mounted for vertical movement and having apertures in its top portion for the admission of secondary air and having apertures in its lower portion for the admission of primary air to the interior of the pot, separate means for varying the quantity of air permitted to enter the pot through said upper and lower sets of apertures when the pot is vertically moved, and means for admitting fuel to the pot below said apertures.

7. In a device for burning liquid hydrocarbon fuel, a pot having an imperforate bottom portion for holding fuel, means for supplying fuel to said bottom portion, means interiorly of the pot above its bottom and forming an air chamber with perforated walls for discharging air upwardly and downwardly into the interior of the pot and having an air admission port in its bottom, a valve controlling said port, and means operable to create relative movement between said valve and said chamber forming means to vary the admission of air to the chamber through said port.

8. In a device for burning liquid hydrocarbon fuel, a pot, means for supplying fuel to the interior bottom portion of the pot, said pot having openings for admitting primary air to its lower interior portion and for admitting secondary air to its upper interior portion, separate means for controlling the supply of fuel to said pot and the supply of primary and secondary air thereto, and means connecting said several control means and operable to impart simultaneous movements thereto to vary in predetermined proportions the admission of fuel and of primary and secondary air to the pot.

9. In a device for burning liquid hydrocarbon fuel, a pot for containing liquid fuel in its bottom portion, means operable to control the supply of fuel to the pot, means forming an air chamber interiorly of the pot and having openings for discharging primary air into the pot and an air inlet opening, said pot and the chamber forming means being mounted for vertical movements together, means for effecting said movements, and means for closing said inlet opening when the pot is in one position of its movement and to progressively open it when the pot is moved from such position.

10. In a device for burning liquid hydrocarbon fuel, a fuel pot mounted for vertical movements and having apertures in its top portion for the admission of secondary air thereto and having apertures in its lower portion for the admission of primary air thereto, means operable to vary the quantity of air permitted to enter the pot

through said upper and lower sets of apertures when the pot is vertically moved and including a valve element in association with said upper set of apertures and a valve element in association with said lower set of apertures, and means operable to supply fuel to the pot, the quantity of fuel supplied being dependent on the elevation of the pot.

11. In a device for burning liquid hydrocarbon fuel, a fuel pot, means forming a chamber within the lower portion of the pot and having an air inlet opening and openings for discharging air from the chamber into the pot, said pot and means being in fixed relation, a valve for said inlet opening, one of said valve and pot being vertically movable relative to the other to open and close said inlet opening, means for supplying fuel to the pot, means for controlling the supply of fuel to said pot, and means connecting said last means and the movable one of said valve and pot to cause the supply of fuel to the pot and the supply of air to the chamber through said inlet opening to be varied in unison and in predetermined relation when the fuel control means is operated.

12. In a device for burning liquid hydrocarbon fuel, a fuel pot having openings in its upper portion for admitting secondary air into the pot, a chamber disposed within the lower portion of the pot in fixed relation thereto and having an inlet opening for admitting air thereto and outlet openings for discharging primary air into the pot, separate valve means for said first-mentioned openings and the inlet opening to said chamber, means for supplying fuel to the lower portion of said pot, means for controlling the supply of fuel to the pot, and means operable by said fuel control means to actuate said separate valve means to control the admission of air to the upper portion of the pot and to the interior of said chamber in predetermined proportion to the fuel supplied to the pot.

13. In a device for burning liquid hydrocarbon fuel, a fuel pot having air admission openings in its upper side wall portion and air admission openings in its lower portion and also having an internal enlargement in its side wall, a baffle in the upper portion of the pot between said upper and lower air admission openings and spaced from the enlarged portion of the pot wall, one of said pot and baffle being vertically movable relative to the other and when moved cooperating with the other to vary the size of the space between the baffle and pot, means for supplying fuel in variable quantity to the bottom portion of the pot, and means operable to effect relative movements of said pot and baffle to vary the size of the space between the baffle and pot enlargement in accordance with the quantity of fuel supply to the pot.

14. In a device for burning liquid hydrocarbon fuel, a fuel pot having an upper set of openings for admitting secondary air to the pot and a lower set of openings for admitting primary air to the pot and having a tapered side wall between said sets of openings, means forming a chamber in the lower portion of the pot and having a portion at least of said lower set of openings, said means having an air inlet opening, a stem projecting up into the pot through said means and inlet opening, a valve on said stem for closing said inlet opening, a baffle on said stem within the pot adjacent to and in spaced relation to said tapered side wall portion, and means for effecting relative movement of the stem and pot

lengthwise of the stem whereby said inlet opening is varied by the valve and the space between the baffle and pot wall is varied in predetermined relation with said variation in the inlet opening.

15. In a device for burning liquid hydrocarbon fuel, a fuel pot having an upper set of openings for admitting secondary air to the pot and a lower set of openings for admitting primary air to the pot and having a tapered side wall portion between said sets of openings, means forming a chamber in the lower portion of the pot and having a portion at least of said lower set of openings, said means having an air inlet opening, a stem projecting up into the pot through said means and inlet opening, a valve on said stem for closing said inlet opening, a baffle on said stem within the pot adjacent and in spaced relation to said tapered side wall portion, and means operable to raise and lower the pot relative to the stem to effect opening or closing respectively of the valve and a respective simultaneous enlarging or restricting of the space between the baffle and pot wall.

16. In a device for burning liquid hydrocarbon fuel, a fuel pot having an upper set of openings for admitting secondary air to the pot and a lower set of openings for admitting primary air to the pot and having a tapered side wall portion between said sets of openings, means forming a chamber in the lower portion of the pot and having a portion at least of said lower set of openings, said means having an air inlet opening, a stem projecting up into the pot through said means and inlet opening, a valve on said stem for closing said inlet opening, a baffle on said stem within the pot adjacent and in spaced relation to said tapered side wall portion, and means to raise and lower said stem relative to the pot to simultaneously move the valve and baffle to increase or diminish the quantity of air permitted to pass through said inlet opening and to accordingly increase or diminish the size of the space between the baffle and pot wall.

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