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L. S. CHADWICK ET AL
AIR AND FUEL SUPPLY MEANS FOR LIQUID FUEL
BURNERS OF THE BOWL TYPE

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3 Sheets-Sheet 1

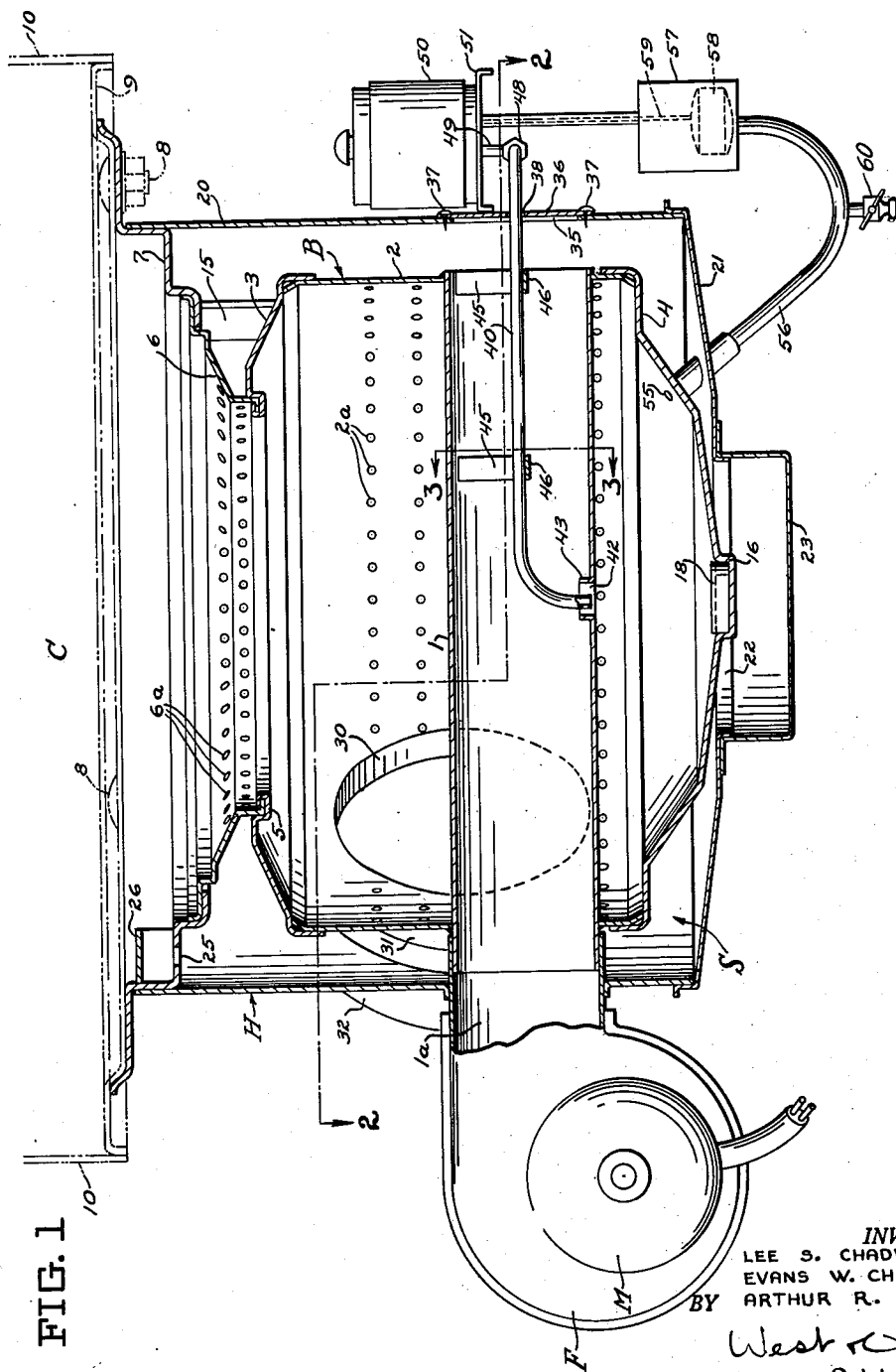


FIG. 1

INVENTORS
LEE S. CHADWICK
EVANS W. CHEESEMAN
BY ARTHUR R. MOORE

West Oldham
Attorneys

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FIG. 3

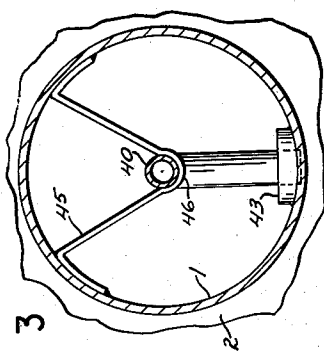
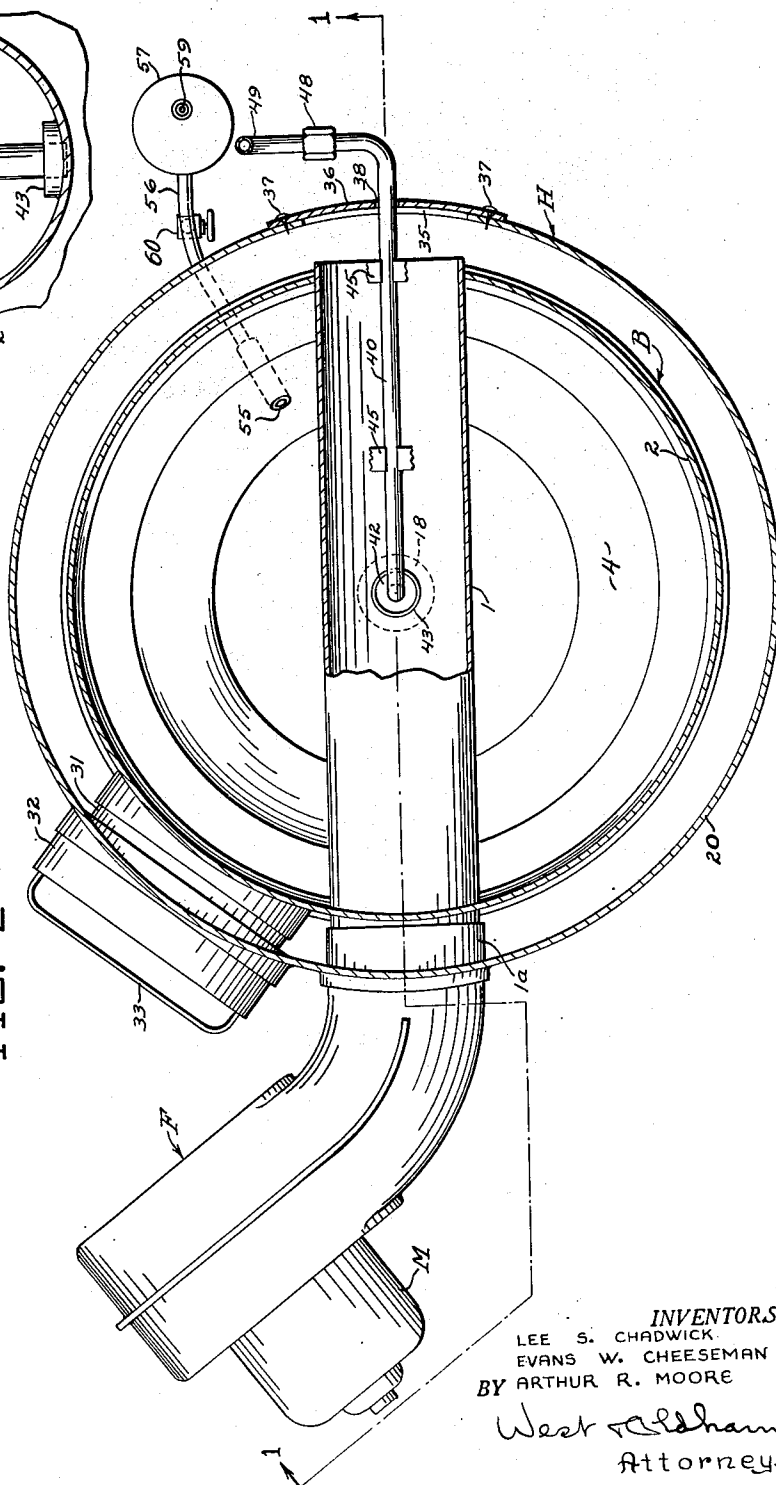


FIG. 2



INVENTORS
LEE S. CHADWICK
EVANS W. CHEESEMAN
BY ARTHUR R. MOORE

West & Aldham
Attorneys

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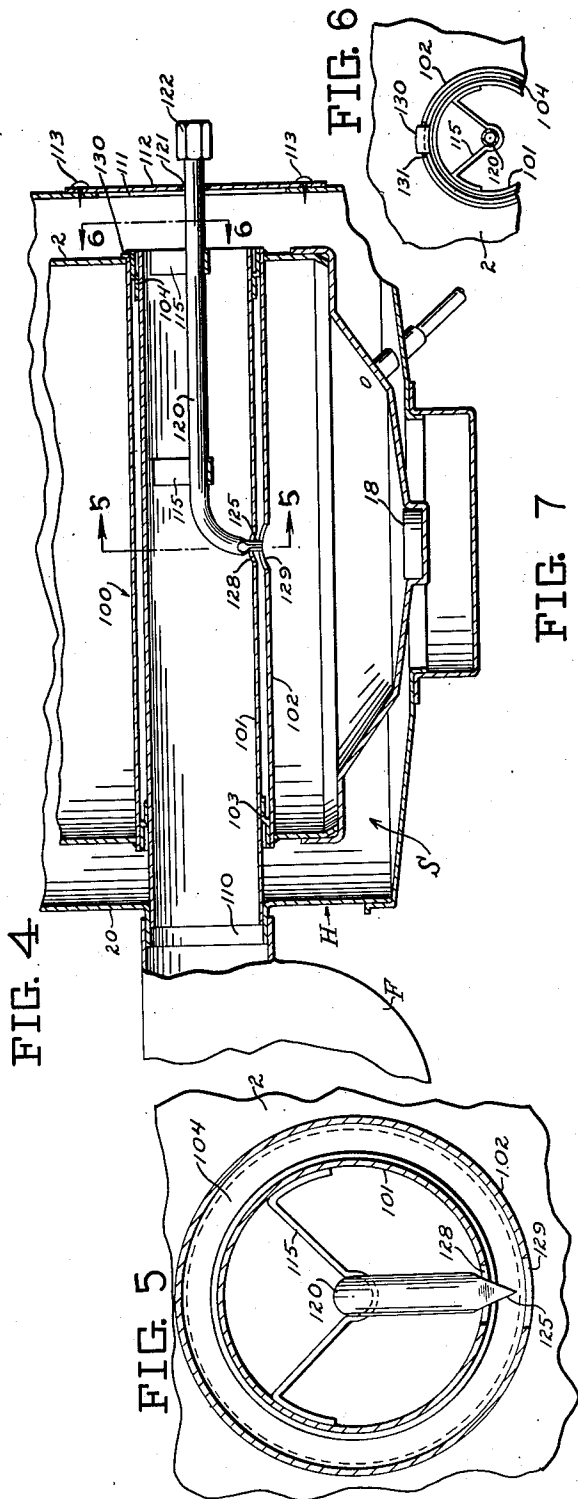
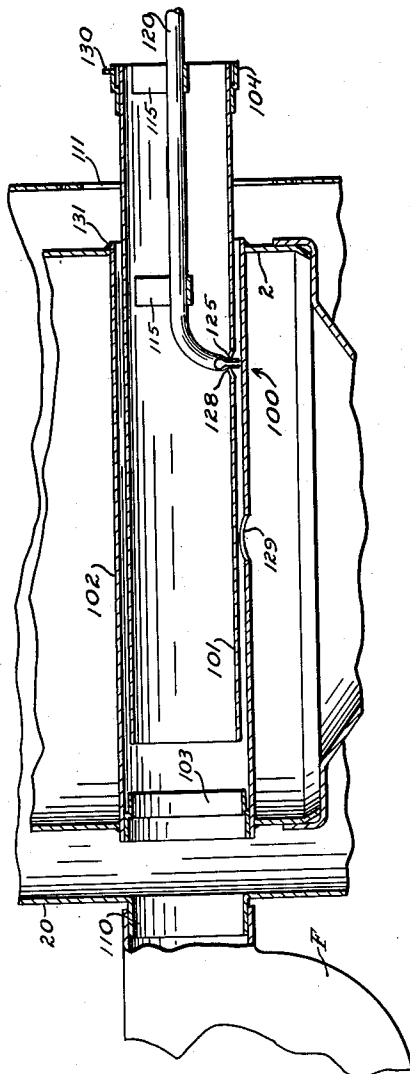


FIG. 7



INVENTORS
LEE S. CHADWICK
EVANS W. CHEESEMAN
BY ARTHUR R. MOORE

West & O'Leary
Attorneys

UNITED STATES PATENT OFFICE

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AIR AND FUEL SUPPLY MEANS FOR LIQUID FUEL BURNERS OF THE BOWL TYPE

Lee S. Chadwick, Shaker Heights, Evans W. Cheeseman, Lakewood, and Arthur R. Moore, Cleveland, Ohio, assignors to Perfection Stove Company, Cleveland, Ohio, a corporation of Ohio

Application September 21, 1948, Serial No. 50,312

12 Claims. (Cl. 158—91)

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This invention relates to liquid fuel burners of the bowl or pot type, and more particularly to improved means for admitting fuel and air thereto.

Heretofore, with respect to burners of the above mentioned type, carbon deposit, and the accumulation of other fuel residues, in and about the fuel inlet of the bowl, have attended the operation of the burners; and this, obviously, has necessitated frequent cleaning, and occasional repair and replacement of the fuel inlet means. This unfavorable condition, which is especially pronounced in the burning of the so-called "catalytically cracked fuels," develops at a rate inversely proportionate to the size of the fire. In other words, it grows more rapidly during low or "pilot" fire operation.

We have discovered that, in order to successfully burn the beforementioned catalytically cracked or similar fuel in a bowl type burner, it is necessary that the fuel be maintained at a relatively low temperature during its passage from the fuel supply and metering means, common in the type of burner above referred to, to the point of its liberation within the bowl. However, after its being liberated, the fuel must be rapidly transformed into a state suitable for combustion, which generally means that it must be converted from liquid to gas and immediately mixed with a predetermined amount of air. It is essential, on the other hand, that actual combustion take place relatively remote from the point where the fuel is liberated so that the fuel discharge means or tip of the fuel supply pipe will be maintained at a comparatively low temperature in order to prevent undesirable cracking of the fuel and the ensuing deposit of carbon and residue in or upon said means or tip.

It is, therefore, the primary object of our invention to provide, in a bowl type burner, means for supplying liquid fuel and air to the bowl in proper proportions and in a manner to bring about the results above set forth, and which is equally effective at all stages of burner operation, from low or "pilot" fire to high or maximum fire, both inclusive.

It is another object of the invention to provide means of the above-described character that insures efficient burning of the fuel at all stages of burner operation.

Another object of the invention is to provide fuel and combustion air inlet means for bowl type burners that is so related to the region of combustion that the combustion air is preheated a limited amount before being discharged into the bowl.

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It is another object of the invention to provide a liquid fuel burner of the type aforesaid including an air housing about the burner bowl and wherein there are air admitting means disposed peripherally of the bowl through which its interior communicates with that of the housing, and which is characterized by additional means for conveying air to the central region of the bowl, said additional means being so constructed and arranged as to effect a proper control and distribution of the air, thereby to assure stable conditions of combustion at all stages of fire.

A further object of the invention is to provide a bowl type burner incorporating means for delivering fuel and a proportional amount of combustion air to an area within the bowl a suitable distance above the bottom thereof and in such manner that the fuel, as it is liberated and drops to the bottom of the bowl, will be enveloped in the combustion air, whereby, upon vaporization and ignition of the fuel, combustion will be localized to a given region of the bottom of the bowl in spaced relation to the point of admission of the fuel. With the fuel and air thus delivered to the burner bowl and combustion localized as described, it is protected from abnormal conditions or disturbances, such as air currents or eddies caused within the bowl by down drafts in the chimney to which the burner is connected, or such as would be caused by momentary interruptions in the supply of fuel to the burner.

A still further and fundamental object of the invention is to provide a construction wherein the fuel supply pipe is so related to the combustion air supply means that said pipe is maintained at a relatively low temperature during burner operation, thereby to avoid the conditions conducive to carbon formation.

The invention is susceptible to different embodiments, two being disclosed herein, characterized, respectively, by a single wall air supply tube, and by a double wall air supply tube. The latter has the advantage of providing an insulating space between the inner and outer walls of the air supply tube which, obviously, maintains the incoming combustion air at a lower temperature than would otherwise be the case; and as a consequence of this the outside diameter of the double wall air supply tube may be less than that of the single wall modification, under which circumstances it would interfere less than the larger single wall tube with the radiation of heat, during higher fire conditions, from the flame to the fuel spread over the bottom of the burner bowl.

Another object of the invention is to provide a discharge tip of novel character for the fuel sup-

ply pipe that will liberate the fuel in smaller droplets and with greater frequency than occurs when the conventional shaped tip is employed, and which latter is formed by cutting or trimming the discharge end of the fuel supply pipe in a plane normal to the axis of the tube in the immediate region of said end. Our improved tip is especially advantageous when the fuel is fed at an extremely low rate, such as for "pilot" or low fire. In this connection it may be explained that when the fuel is fed in larger drops at relatively long intervals, a fluctuating fire results that is hard to control because of the difficulty of supplying the requisite amount of combustion air under such circumstances.

Other objects will appear as we proceed to describe the herein disclosed embodiments of the invention and among which are convenience of assembly and disassembly, ready accessibility of the parts, and ease of fabrication.

In the accompanying drawings that form a part hereof and wherein like reference characters designate like parts in the different views, Fig. 1 represents a central vertical section through liquid fuel burning apparatus incorporating one form of our invention; Fig. 2 is a horizontal section, in offset planes, through the apparatus, as indicated by the line 2—2 of Fig. 1; Fig. 3 is a sectional detail, taken on the line 3—3 of Fig. 1, and drawn to a scale somewhat enlarged over that of the preceding views; Fig. 4 is a view similar to, but less comprehensive than Fig. 1, showing another form of the invention; Figs. 5 and 6 are sectional details on the respective lines 5—5 and 6—6 of Fig. 4, Fig. 5 being on a somewhat enlarged scale, and Fig. 7 is a view, similar to Fig. 4, showing the inner air tube and the fuel supply pipe partially withdrawn from the assembly.

We shall first describe the simpler form of our invention, illustrated in Figs. 1, 2 and 3, wherein a single wall air supply tube 1 is shown as passing diametrically through the burner bowl, the latter being designated generally by the reference letter B. The burner bowl is shown as fabricated from sheet metal parts including a cylindrical peripheral wall 2, to the respective upper and lower ends of which are suitably connected, as by welding, an annular top wall 3 and a circular bottom wall 4. Shown as connected by a seam 5 to the top wall 3 about the large central opening thereof is an upwardly divergent perforated throat member 6 which has its outer edge portion overlying and connected to an annular, stepped member 7. This member is detachably connected by fastening means 8 to the bottom wall 9 of a structure shown in broken lines and which includes vertical wall portions 10. Said structure encloses a combustion chamber or space C that communicates with the interior of the burner bowl through a large opening in the bottom wall 9 and the passage where-with it registers that is surrounded and thus defined by the stepped member 7, throat member 6, and top wall 3. Said top wall 3 and member 7 are rigidly connected together at circumferentially spaced points by ties 15 in accordance with prior practice.

The central portion of the bottom wall 4 is depressed to provide an oil sump of considerable area and, at its center, said wall is shown as formed to provide a shallow cup 16 that is preferably occupied by a body or disc of pervious refractory material. A material found especially suitable for our purpose is a relatively coarse grained sintered metal. For descriptive purposes the aforesaid body or disc of pervious material,

or, in its absence, the interior of the cup 16, will be referred to as the target 18.

Enclosing the burner bowl B is a housing that is designated generally by the reference letter H and that consists of a cylindrical peripheral wall 20 and a slightly dished circular bottom wall 21. The bottom wall has a relatively large central opening surrounded by a depending flange 22, and fitted over the latter is the outwardly flanged upper end of a relatively shallow sheet metal cup 23, said cup being fastened, as by welding, to the bottom wall 21. The upper end of the peripheral wall 20 of the housing H fits over a cylindrical portion of the previously mentioned annular stepped member 7, the overlying portions of said wall and member being welded or otherwise secured together. The peripheral wall 20 of the housing H is radially spaced from the peripheral wall 2 of the burner bowl B to provide an air space S that surrounds the burner bowl and communicates with its interior through perforations 2^a in the wall 2. The air space S also communicates with the combustion chamber or space C through the perforations 6^a of the throat member 6 and through an aperture 25 in the member 7, over which aperture is an air director or hood 26. This latter feature constitutes no part of my invention, but is disclosed and claimed in the application of Marc Resek, et al., Serial No. 789,052, filed December 1, 1947.

In the wall 2 of the burner bowl is the usual lighting and cleanout opening 30. This opening is in axial alignment with an opening in the peripheral wall 20 of the housing H, and projected inwardly through the latter opening, and having its inner end joined to the wall 2 about said opening 30, is a tube 31. Within the enlarged outer end portion 32 of the tube 31 is fitted the customary plug (not shown) for closing the tube, the handle 33 of the plug appearing in Fig. 2. The wall 20 of the housing H has a hole that is aligned with the air supply tube 1, and projecting inwardly through said hole is a tubular extension 1^a through which the outlet of the scroll casing of a centrifugal fan or blower F has communicative connection with the air supply tube 1. For present purposes, said extension and tube may be regarded as a unit, and the same may be described as extending inwardly through the opening in the wall 20 and diametrically through the burner bowl 1 and as having its end portions sealed in holes in opposed parts of the wall 2. The end of the air supply tube remote from the fan or blower F opens into the air space S. Said fan or blower is operated by an electric motor M that is shown as attached to the side of the before-mentioned scroll casing.

Opposite the inner or discharge end of the air supply tube 1, the wall 20 of the housing H is provided with an opening 35 that is normally closed by a plate 36. The plate is shown as attached to said wall by screws 37, and as having a central aperture 38 through which a fuel supply pipe 40 is extended inwardly, the pipe continuing within the air supply tube 1 to about the longitudinal center thereof where it is curved downwardly and has its discharge end disposed within an aperture 42 in the bottom of the air supply tube 1, said aperture being shown as surrounded by an upstanding flange 43. It is to be observed that said discharge end of the oil supply pipe is cut off square, or in a plane normal to the axis of said end and that it is located substantially in vertical alignment with the central portion of the target 18. The horizontal portion of the fuel

supply pipe is shown as supported approximately centrally of the tube 1 by V-shaped hangers 45 that are tack welded or otherwise fastened to the wall of the air supply tube. Each hanger has a substantially semi-cylindrical socket portion 46 wherein the pipe rests, said socket portion desirably embracing something more than half the pipe so that the pipe will snap into the socket when fully depressed. At its outer end, the fuel supply pipe has connection, through a coupling 48, with a tubular outlet 49 of a liquid fuel supply and control means 50. This means desirably consists of a so-called "constant level valve," an article well known to those familiar with the subject to which the invention relates. The liquid fuel supply and control means 50 is shown as supported by a member 51 that may be attached to a convenient part of the apparatus.

In order to avoid flooding of the burner bowl, and to provide for a definite maximum liquid level therein, the depressed portion of the bottom wall 4 of the bowl is provided with an overflow opening 55, from which a pipe 56 leads to a vessel 57. This vessel encloses a float 58 that has operative connection, through a rod 59, with trip mechanism of the liquid fuel supply and control means 50. Such trip mechanism is a part of the previously mentioned well known "constant level valve" that is employed in the present instance as the liquid fuel supply and control means. When liquid fuel rises within the burner bowl to an abnormal height, and the excess escapes through the overflow opening 55, said excess fuel drains to the vessel 57 through the pipe 56 and lifts the float 58 thereby to operate the aforesaid trip mechanism and stop the flow of oil through the pipe 40. Communicating with the lowest part of the pipe 56 is a drain valve 60 through which the vessel 57 and pipe 56 may be emptied of liquid fuel at the time of resetting the trip mechanism. This restores the apparatus to condition for normal operation.

When the apparatus is in operation, oil will be delivered to the burner bowl through the pipe 40 at a rate depending upon the adjustment of the liquid fuel supply and control means 50. By this means the fuel may be fed at different rates to produce low or "pilot" fire, intermediate fire, and high or maximum fire. In any event, the fuel drops from the discharge end or tip of the tube 40 onto the target 18. It will be understood, of course, that during operation of the apparatus, the motor M is energized and drives the fan or blower F which impels air through the tube 1 into the space S and, through the aperture 42 of said tube, into the lower portion of the burner bowl. The air entering the bowl through the aperture 42 is more or less in the form of a column that is projected toward the target 18 about the fuel that drops from the pipe 40. The burner may be lighted by any suitable means, as by a burning taper or the like introduced through the lighting and cleanout opening 30. Very shortly after the burner is lighted, the target 18 and the surrounding portion of the bottom wall of the burner bowl become sufficiently heated to vaporize the oil. The vapors immediately commingle with the air that is projected downwardly through the aperture 42 and the mixture burns within the bowl. During the time the oil is fed at a rate to produce only low or "pilot" fire, combustion is confined to the lower central region of the bowl, the air entering through the aperture 42 supplying practically all of the primary air, while secondary air, in sufficient amount to render combustion sub-

stantially complete, enters through the perforations 2^a in the peripheral wall of the bowl. Under these conditions the products escape through the open top of the bowl into the combustion space or chamber C. When the fuel supply is increased by an appropriate adjustment of the means 50 (whether it be accomplished manually or by thermostatic means, in which latter event the apparatus would be equipped with an automatic control system of usual character) the dropping of the oil quickens and the volume of the fire increases. Under these circumstances the air entering through the aperture 42 supplies only a part of the primary air, the balance being supplied through the perforations 2^a of the wall 2. During high or maximum fire, substantially the entire capacity of the perforations 2^a is needed to supply the requisite amount of primary air, wherefore a rich mixture fills the bowl and, as it rises through the throat member 6, it receives secondary air through the perforations 6^a and is thus conditioned for combustion within the combustion space or chamber C.

During all stages of operation, the discharge end or tip and adjacent portion of the fuel supply pipe 40 is maintained relatively cool by the surrounding column of air, while the air supply tube itself is kept at a relatively low temperature by the air stream that is constantly flowing through it. Also, the region of said tube above the target 18 is protected from the intense heat of combustion by the presence of the air issuing through the aperture 42. As a consequence of the favorable temperature conditions just described, carbon deposit and the accumulation of other fuel residues within or upon the tip of the fuel pipe is prevented, and deterioration of the air supply tube is avoided. While we have referred to relatively low temperatures of the air supply tube and fuel supply pipe, it will be understood that operating temperatures within the bowl will be high enough to cause the air flowing through the air supply tube to be preheated to a desirable degree.

What we at present consider the preferred form of our invention is illustrated in Figs. 4 to 7, where the air supply tube is of double wall construction, and the oil supply pipe is formed with a unique tip. This modification we shall now describe.

The air supply tube, designated generally by the numeral 100, consists of an inner cylindrical wall 101 and an outer cylindrical wall 102 that are maintained in radially spaced, and desirably concentric, relation to each other by collars 103 and 104 that are substantially Z-shaped in cross section. The larger ends of these collars fit within the ends of the outer cylindrical wall 102, while their smaller ends fit about the adjacent portions of the inner wall 101. The larger end of collar 103 is welded or otherwise secured to the adjacent end of said outer wall 102, while the smaller end of collar 104 is similarly fastened to the inner wall 101. The reverse ends of said collars are unfixed with respect to the walls wherewith they cooperate. The ends of the outer wall 102 are projected through holes of appropriate size in diametrically opposed portions of the peripheral wall 2 of the burner bowl, and are welded or otherwise fastened to said wall. The portion of the peripheral wall 20 of the housing H that is nearest the collar 103 is provided with an opening shown as surrounded by a flange 110 that is axially aligned with said collar and is substantially equal in inside diameter to the outside diameter of the

wall 101. Also, the portion of said housing wall 20 that is adjacent the collar 104 is provided with an opening 111 aligned with said collar and that is somewhat greater in diameter than the larger end thereof. This latter opening is adapted to be closed by a plate 112 that is shown as fastened to the wall 20 by screws 113. When the parts of the assembly are in normal relation, as shown in Fig. 4, the inner wall 101 projects a substantial distance through the collar 103, across the air space S and into the flange 110. Shown engaged over the flange 110 is the outlet connection of the scroll casing of the fan or blower F. Supported within and permanently connected to the cylindrical wall 101, through hangers 115, is a fuel supply pipe 120 that enters the housing through a hole 121 in the previously mentioned plate 112. It will be understood that the outer end of the fuel supply pipe is adapted to be connected, through a coupling 122, with a fuel supply and control means, such as that shown at 50 in Fig. 1. The inner end of the fuel supply pipe 120 is curved downwardly and terminates in a unique oil feeding tip 125 that is formed by cutting away the sides of the tube at an angle, as best shown in Fig. 5, to form two pointed, laterally curved beaks that are then flattened and pressed toward each other to dispose them in slightly spaced parallel relation. The tip 125 projects through an aperture 128 in the inner wall 101 that registers with a larger aperture 129 in the outer wall 102. A lug 130 extends radially from the larger end of the collar 104 and, when the parts are in normal relation, said lug occupies a notch 131 in the adjacent end of the wall 102. Thus, means are provided for positioning the inner wall 101 in such relation to the fixed outer wall 102 that the aforesaid apertures 128 and 129 are in register, and the tip 125 is directly above the target 18.

In general, the operation of the present form of the invention is the same as that of the form previously described. However, in the present case, at a corresponding rate of flow, the fuel is delivered in smaller drops and with greater frequency than in the former case. This result is due to the difference in the discharge end or tip of the fuel supply pipe, and it contributes to a more even fire, a more uniform vaporization of the fuel, and a better mixture of primary air with the vapors. Also, experience has shown that there is less tendency for carbon and other fuel residues to form or accumulate in or upon a tip of the style shown in Figs. 4 and 5.

Furthermore, because of the double wall construction of the air supply tube 100, with its insulating air space, the temperature of the combustion air is better controlled; and a further advantage is that this construction admits of a smaller external diameter than the single wall tube, thereby affording a larger vaporizing area during higher fire, as already pointed out.

It is also evident from the construction at present under consideration that the inner and outer walls of the air supply tube are capable of independent elongation and contraction. Therefore, the outer wall 102, which has its ends fastened to the peripheral wall 2 of the burner bowl, is free to expand and contract with the latter wall under temperature changes and independently of the inner wall 101, which is kept relatively cool by the air flowing through it. Accordingly, undesirable stresses are not so likely to occur in the double wall air tube construction as in the single tube embodiment where such stresses in the structure might result from the difference in tem-

perature between the tube 1 and the burner bowl wall 2 to which said tube is rigidly connected.

In Fig. 7 we have shown how the inner cylindrical wall 101 may be withdrawn from the assembly or replaced, when the plate 112 is removed from the opening 111 of the wall 20.

Having thus described our invention, what we claim is:

1. In liquid fuel burning apparatus, the combination of a burner bowl including a peripheral wall, a housing enclosing said bowl and having a peripheral wall spaced from the corresponding wall of the bowl, an air supply tube extending inwardly through the peripheral wall of the housing and entirely through the bowl and opening at its inner end into the space between said walls, the tube having an aperture in its lower side through which the interior of the tube communicates with that of the bowl, and a fuel supply pipe projecting into the air supply tube and arranged with its discharge end above said aperture.

2. In liquid fuel burning apparatus, the combination of a burner bowl including a peripheral wall, a housing enclosing said bowl and having a peripheral wall spaced from the corresponding wall of the bowl, an air supply tube extending inwardly through the peripheral wall of the housing and diametrically through the bowl and opening at its inner end into the space between said walls, the tube having an aperture in its lower side through which it communicates with the bowl, and a fuel supply pipe projecting inwardly through the peripheral wall of the housing substantially diametrically opposite the entrance of the air supply tube through said wall and continuing into the air supply tube and having its inner end turned downwardly and arranged substantially within the area of said aperture.

3. In liquid fuel burning apparatus, the combination of a burner bowl including a peripheral wall and a bottom wall, a housing enclosing said bowl and having walls spaced from the peripheral and bottom walls of the bowl, an air supply tube extending inwardly through the peripheral wall of the housing and diametrically and horizontally through the bowl and opening at its inner end into the space between the peripheral walls of the bowl and housing, said tube being spaced a substantial distance above the bottom wall of the bowl and having an aperture in its lower side substantially coincident with the vertical axis of the bowl, and a fuel supply pipe projecting through the peripheral wall of the housing and into the air supply tube through the inner end thereof and having its discharge end turned downwardly in alignment with said aperture, the bottom wall of the bowl having a central depression.

4. The combination of elements defined by claim 3, plus: a target consisting of a body of pervious refractory material occupying said depression.

5. In liquid fuel burning apparatus, the combination of a burner bowl including a peripheral wall and a bottom wall, a housing enclosing said bowl and having a peripheral wall spaced from the corresponding wall of the bowl, substantially diametrically opposite portions of the peripheral walls of the bowl and housing having substantially axially aligned openings, an air supply tube extending inwardly through one of the openings of the housing wall and through the burner bowl and having its inner end fixed within the opening of the burner bowl wall at the side thereof

remote from that through which the air supply tube enters the housing, the air supply tube having an aperture in its lower side at about the vertical center of the burner bowl, a plate removably attached to the peripheral wall of the housing over the opening therein adjacent the inner end of the air supply tube, said plate having a hole, an oil supply pipe extending inwardly through said hole and into the air supply tube and having its inner end turned downwardly and aligned with the aperture of the air supply tube, the bottom wall of the bowl having a depression in vertical alignment with said aperture, and a target consisting of a body of pervious refractory material occupying said depression.

6. In liquid fuel burning apparatus, the combination of elements defined by claim 5, plus: a tube surrounding and radially spaced from the air supply tube within the burner bowl and having an aperture registering with that of said air supply tube.

7. In liquid fuel burning apparatus, the combination of a burner bowl, an air supply tube extending substantially horizontally into the bowl and having an aperture through which it communicates with the interior of the bowl, said aperture being located on the underside of the tube, and a fuel supply pipe projecting into the air supply tube and arranged with its discharge tip substantially within the area of said aperture, said tip being characterized by opposed substantially flat downwardly pointed beaks that are spaced apart in approximately parallel relation a distance less than the diameter of the pipe.

8. In liquid fuel burning apparatus, the combination of a burner bowl, a housing including a wall so related to the bowl as to provide an air space between the bowl and said wall, an air supply tube extending substantially horizontally into the bowl and having an opening through which it communicates with the aforesaid space and an aperture through which it communicates with the interior of the bowl, said aperture being located on the under side of the tube, a fuel supply pipe projecting into the air supply tube and arranged with its discharge end substantially within the area of said aperture, said air supply tube being spaced a substantial distance above the bottom of the bowl, and a heat insulator in shielding relation to the air supply tube.

9. In liquid fuel burning apparatus, the combination of a burner bowl including a peripheral wall having substantially diametrically opposed openings spaced a substantial distance above the bottom of the bowl, a tube extending through the bowl and having its ends fixed in said openings, a housing enclosing the burner bowl and having a peripheral wall spaced from the corresponding wall of the bowl and provided with openings aligned with those in the peripheral wall of the bowl, an air supply tube of smaller diameter than the former tube extending inwardly through one of said openings in the peripheral wall of the housing and axially through the aforesaid tube and terminating adjacent the end of the first mentioned tube remote from that through which the air tube enters said first mentioned tube, means supporting and spacing the air supply tube from the first mentioned tube, the air supply tube and the first mentioned tube having registering apertures on their lower sides that are substantially central of the burner bowl, and a liquid fuel supply tube entering through the other opening of the peripheral wall of the hous-

ing and projecting into the air supply tube and having its inner, discharge end turned downwardly in alignment with the aforesaid apertures.

10. In liquid fuel burning apparatus, the combination of a burner bowl including a peripheral wall and a bottom wall, substantially diametrically opposed portions of said peripheral wall having openings that are spaced a substantial distance above the bottom wall of the bowl, a tube disposed across the burner bowl and having its ends fixed within said openings, a housing enclosing the burner bowl and having a peripheral wall spaced from the corresponding wall of the bowl, said peripheral wall of the housing having openings that are substantially in axial alignment with the aforesaid tube, an air supply tube extending axially through the aforesaid tube and having one of its ends within one of the openings of the peripheral wall of the housing and its other end substantially in the plane of the corresponding end of the first mentioned tube, said tubes having registering apertures in their lower sides, collars embracing the air supply tube and fitting within the ends of the first mentioned tube, and a fuel supply pipe extending through the other opening in the peripheral wall of the housing and into the air supply tube and having its inner end turned downwardly and aligned with the apertures of said tubes.

11. In liquid fuel burning apparatus, the combination of a burner bowl including a peripheral wall and a bottom wall, substantially diametrically opposed portions of said peripheral wall having openings that are spaced a substantial distance above the bottom wall of the bowl, a tube disposed across the burner bowl and having its ends fixed within said openings, a housing enclosing the burner bowl and having a peripheral wall spaced from the corresponding wall of the bowl, said peripheral wall of the housing having openings that are substantially in axial alignment with the aforesaid tube, one of said openings being of a diameter at least as great as that of the aforesaid tube and the other opening being of somewhat lesser diameter, an outwardly extending flange surrounding the smaller opening, an air supply tube extending axially through the aforesaid tube and having one of its ends supported within the before-mentioned flange and its other end adjacent the corresponding end of the first mentioned tube, said tubes having registering apertures in their lower sides that are substantially central of the burner bowl, collars embracing the air supply tube and fitting within the ends of the first mentioned tube, the collar nearest the end of the air supply tube that occupies said flange being fastened to the first mentioned tube, and the other collar being fastened to the air supply tube, whereby the air supply tube, with the last mentioned collar attached, may be slid free of the other collar and withdrawn from the first mentioned tube through the larger opening in the peripheral wall of the housing, a plate detachably connected to said housing wall over said larger opening, the plate having a hole, and a fuel supply pipe extending through said hole and into the air supply tube and having its inner end turned downwardly and aligned with the apertures of said tubes.

12. In liquid fuel burning apparatus, the combination of a burner bowl, an air supply tube leading substantially horizontally into the bowl a distance above the bottom thereof and having an aperture in its under side through which it

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communicates with the interior of the bowl, a fuel supply pipe extending into the air supply tube and arranged with its discharge end in spaced relation to the perimeter of said aperture so that fuel discharged from the pipe will drop freely into the bowl enveloped by air entering the bowl through said aperture, and an insulating structure including a tube entirely encasing and radially spaced from the portion of the air supply tube within the bowl, and end means separating the space between said tubes from the interior of the bowl, the second mentioned tube having an aperture in register with that of the air supply tube.

LEE S. CHADWICK.
EVANS W. CHEESEMAN.
ARTHUR R. MOORE.

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