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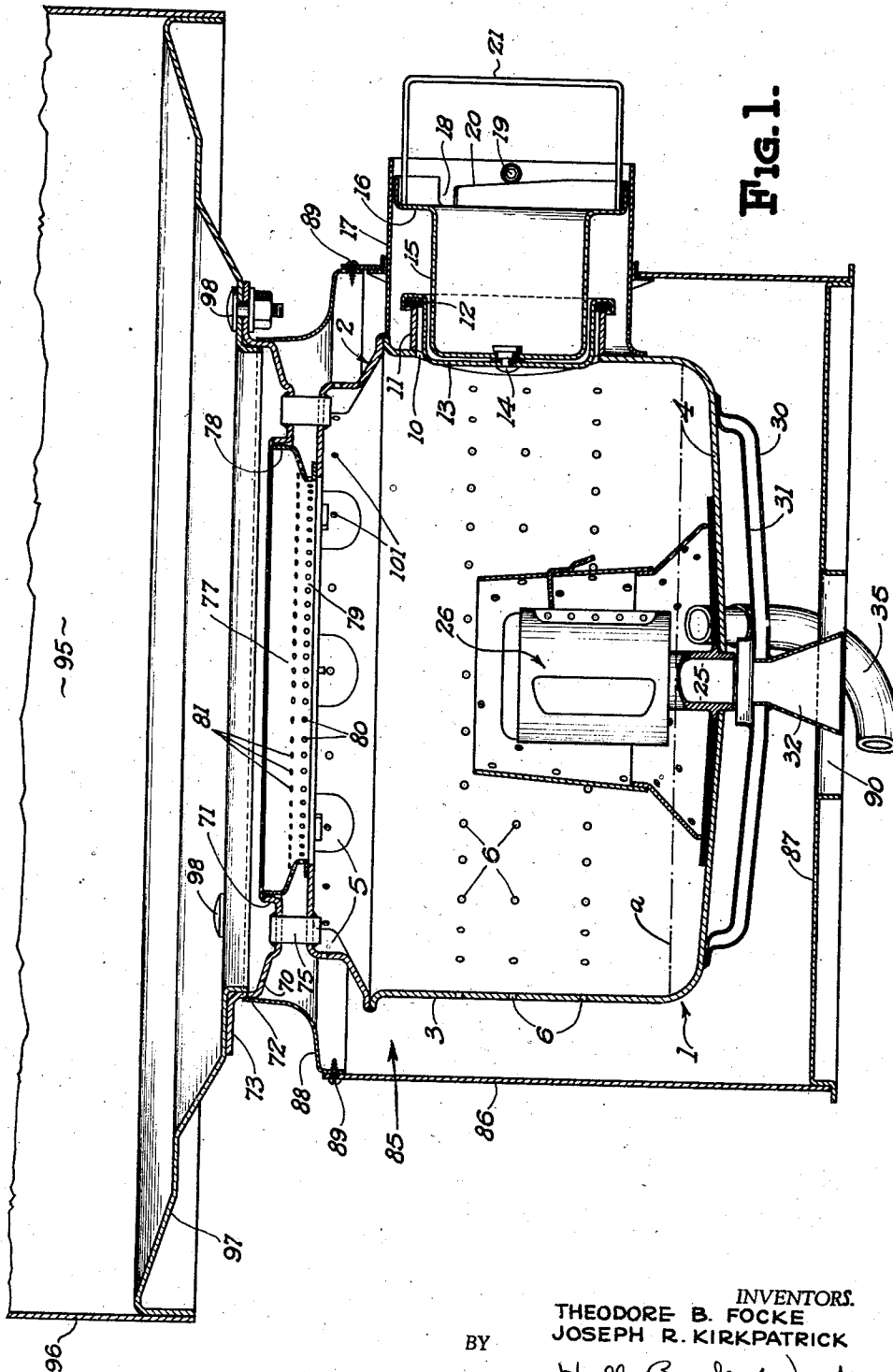
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LIQUID FUEL COMBUSTION APPARATUS

Filed July 14, 1939

4 Sheets-Sheet 1



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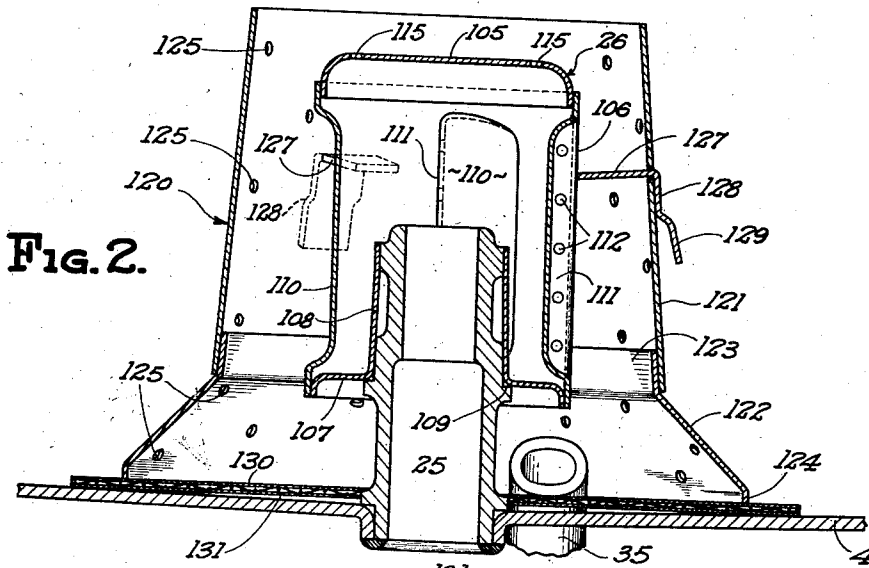
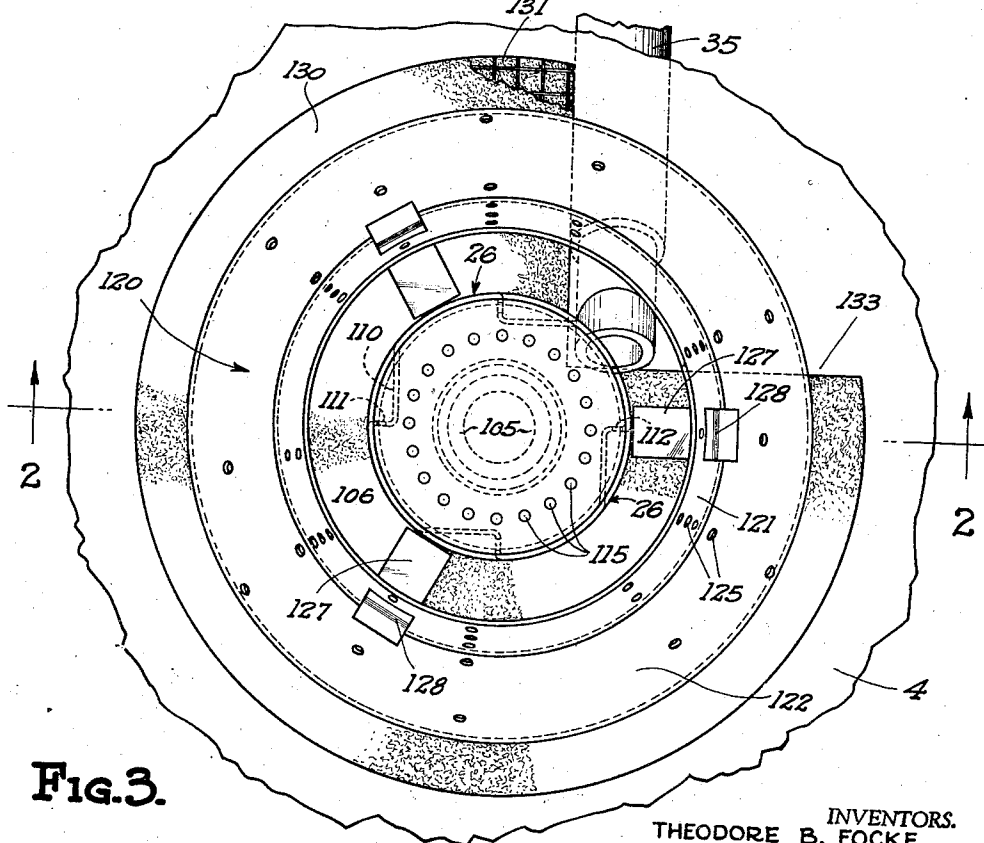
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4 Sheets-Sheet 2



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FIG. 4.

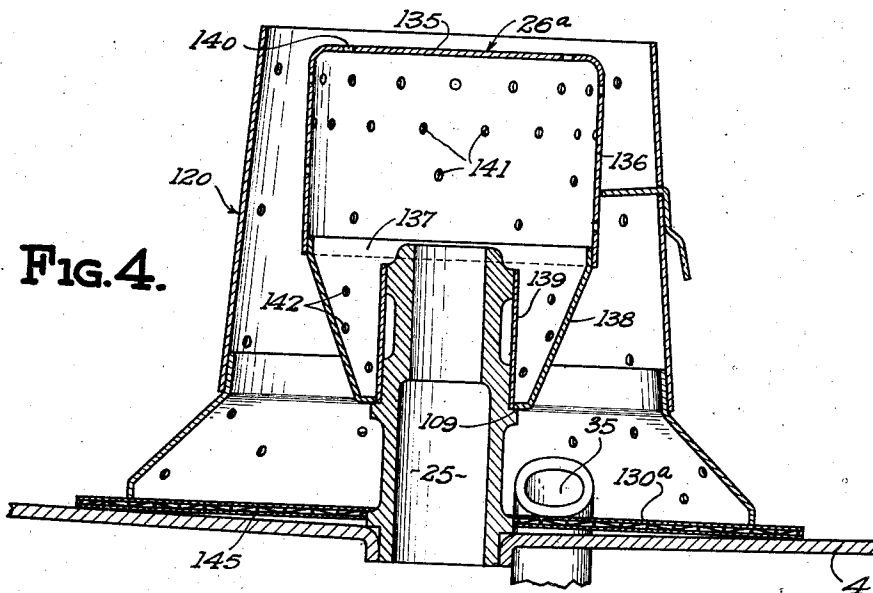
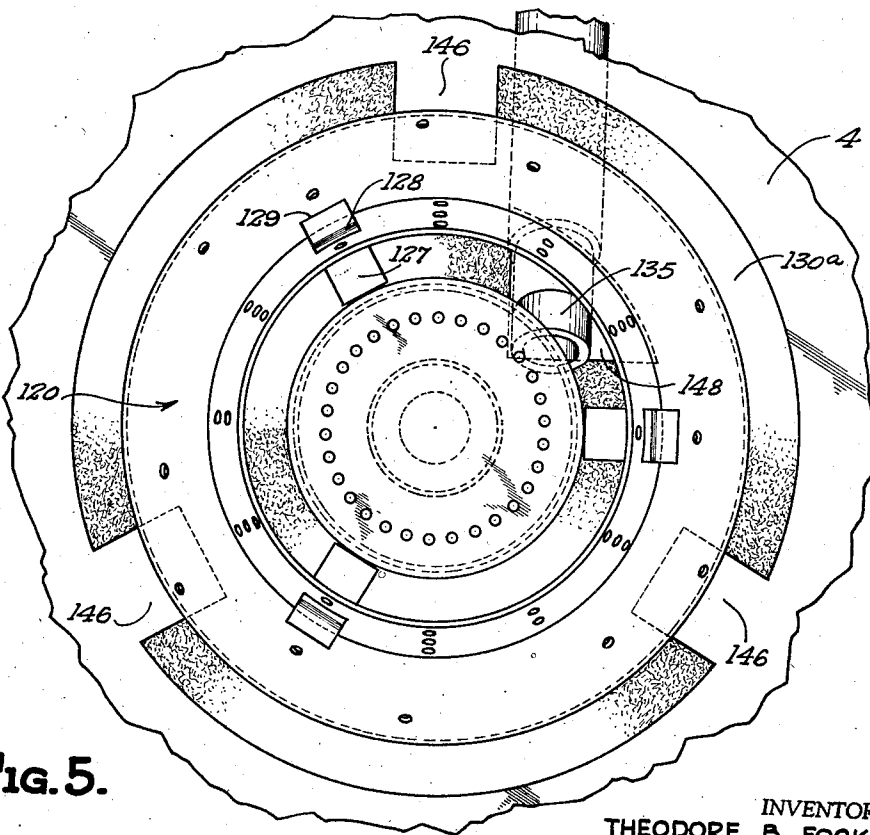


FIG. 5.



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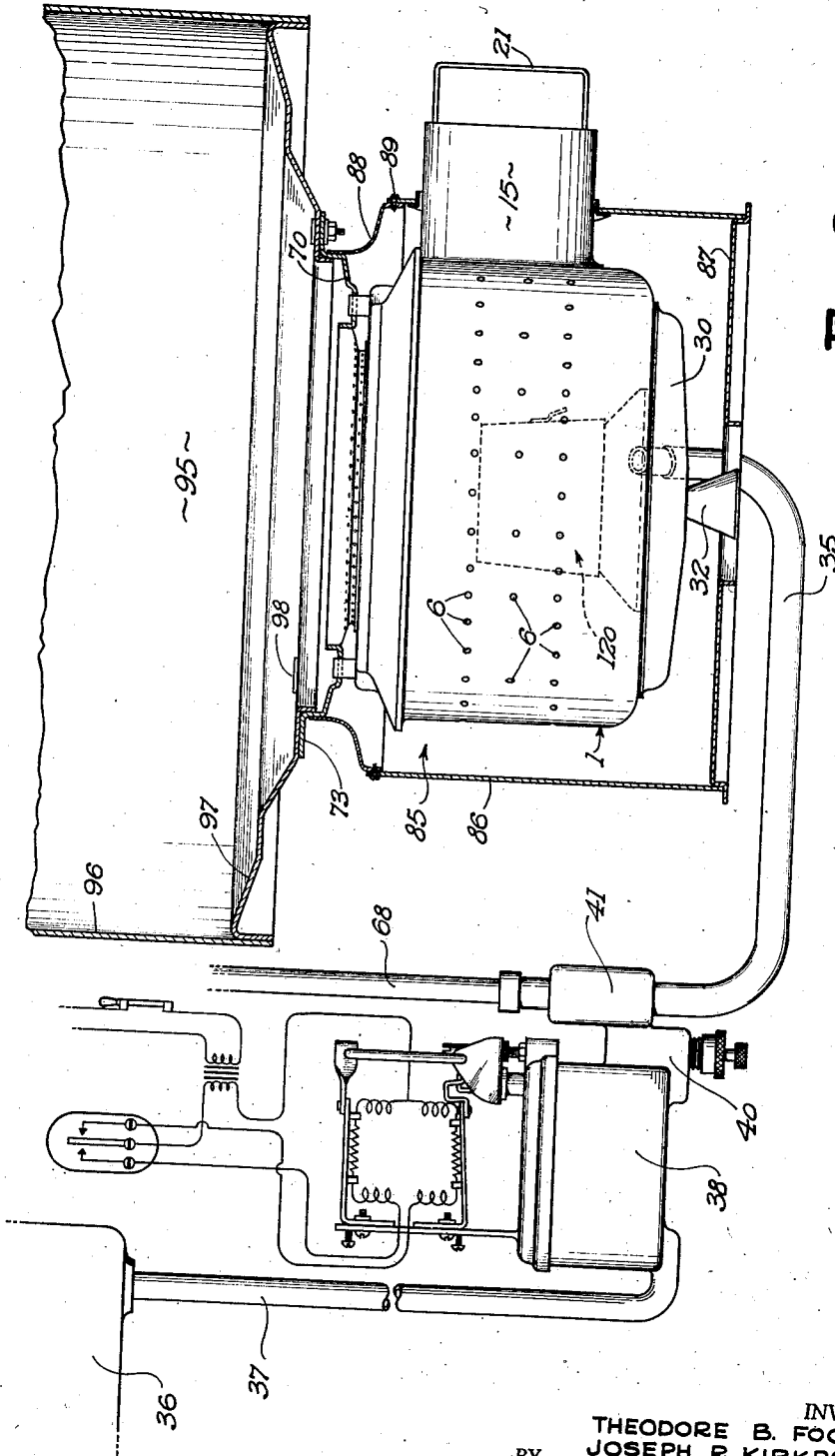
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FIG. 6.



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UNITED STATES PATENT OFFICE

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LIQUID FUEL COMBUSTION APPARATUS

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Application July 14, 1939, Serial No. 284,544

14 Claims. (Cl. 158—91)

This invention relates, generally, to liquid fuel combustion apparatus, and more particularly to liquid fuel burners of the bowl or pot type that are used extensively in the heating plants of dwelling houses and other buildings in conjunction with automatic control systems.

The basic object of the invention is the production of a burner of this type incorporating a feature that functions under minimum fire conditions as a pilot burner for which reason it is so termed herein. In a general way, the invention may be characterized as a burner within a burner.

More specifically stated, the primary purpose of the invention is the production of a bowl type burner enclosing a pilot burner that is similar in principle to a bowl type burner and which composite unit operates effectively, economically, with a clean fire, and otherwise satisfactorily, throughout a wide range of fires from minimum or pilot fire to high fire on a grade of fuel customarily employed in burners of the type in question and known as fuel oil and which is desirably supplied from the same source throughout the entire range of operation. The supply of combustion air automatically adjusts itself to the variable conditions encountered throughout said range, whereby the size of the fire is governed entirely by the amount of fuel fed.

Other objects and advantages will appear as this description proceeds, among which are the provision of a relatively simple and inexpensive construction, and one that facilitates lighting and cleaning and effects ready ignition of the fuel supply for higher fires from the flame of the pilot burner thus insuring smoothness of operation during the period of transition from pilot to higher fire.

In the accompanying drawings that form a part hereof, Fig. 1 is a central vertical section through a liquid fuel combustion apparatus embodying the invention; Fig. 2 is a similar section, as indicated by the line 2—2 of Fig. 3, through the pilot burner and adjacent parts of the burner bowl on a scale considerably enlarged over that of Fig. 1; Fig. 3 is a plan view of the parts disclosed in Fig. 2; Figs. 4 and 5 are views similar to Figs. 2 and 3, respectively, showing a modification of the invention; and Fig. 6 is a schematic representation of the invention including fuel feeding means and an automatic control system.

The burner bowl or pot of the combustion apparatus herein disclosed is designated generally by the reference numeral 1 and it comprises an annular top wall 2, a peripheral wall 3 and a bottom wall 4. The inner portion of the top wall is horizontal and at equally spaced parts thereabout the wall is formed with bays 5 for the purpose of increasing the radial dimension of the horizontal portion at these points. The periph-

eral wall 3 is provided with air inlet openings or perforations 6, three circumferential series of such perforations being shown.

Adjacent the front of the apparatus, the peripheral wall 3 has a relatively large lighting and clean-out opening 10 that is surrounded by a forwardly projecting flange 11 against the outer end of which is adapted to seat a gasket 12 of suitable non-inflammable packing material carried within the channeled edge portion of a member 13 that is swiveled, through a pivotal element 14, to the inner end of a plug 15. The enlarged outer end 16 of this plug fits within a sleeve 17 that surrounds the flange 41 and is secured at its inner end to the burner bowl or pot. The enlarged end 16 of the plug is notched at diametrically opposite points for the passage of projections or rollers that extend inwardly from the sleeve 17, one of said notches being shown at 18 in Fig. 1, and the corresponding projection or roller at 19. The front edge of the enlargement of the plug is cut away on a taper to one side of each of the notches thereby to provide a cam portion 20 for cooperation with the corresponding projection or roller, these parts cooperating to press the plug inwardly so as to seal the joint between the gasket 12 and the flange 11 when the plug is turned clockwise by means of its handle 21.

The bottom wall 4 of the burner bowl 1 is slightly dished, and at its center is provided with an opening in which is secured the lower end of an air tube 25 that is surmounted by an air distributor designated, generally, by the numeral 26 and later to be described in detail. Welded or otherwise secured to the exterior of the bottom wall 4 are insulating shields 30 and 31, having central openings that align with the air tube 25, a funnel 32 being shown as having its smaller end welded within the central opening of the outer shield 30.

Liquid fuel is adapted to be delivered to the burner bowl or pot through a supply pipe 35 that passes through openings in the shields 30 and 31 and in the wall 4, the pipe being welded or otherwise secured to said wall with a leak-proof joint. As disclosed in Fig. 6, the supply pipe 35 is a part of the communicative connections between the burner and a source 36 of liquid fuel supply, such source being represented as a tank. Liquid fuel gravitates from the tank through a pipe 37 to a chamber 38 wherein a float controlled valve (not shown) establishes a maximum liquid level within the portion of the system including the burner bowl, such level being designated by the dot-and-dash line *a* in Fig. 1. The fuel feeding and control means shown in Fig. 6 constitutes the subject matter of an application bearing Serial No. 273,969, filed May 16, 1939, by one of the present applicants, Theodore B. Focke.

Reference may be made to said application for details, although said means may be described briefly as including a by-pass valve 40, a metering valve 41, and a suitable automatic control system for governing the flow of fuel within the range of operation between pilot and high fires. The maximum flow is controlled by the metering valve 41, which may be manually adjusted through its stem 68. Also by means of this metering valve the flow may be entirely shut off during seasons in which it is desired the combustion apparatus shall be inactive.

Disposed above and in spaced relation to the inner horizontal portion of the top wall 2 of the burner bowl is a ring-like member 70 whose inner edge is flanged upwardly at 71. From its inner horizontal portion adjacent the flange 71, the member 70 flares upwardly at a slight angle and joins, through a vertical portion 72, a relatively wide horizontal peripheral flange 73. The member 70 is rigidly secured to the top wall 2 by posts 75 which have their upper and lower ends engaged through openings in the member 70 and top wall 2 and desirably connected to said parts by welding. The posts 75 are located at the radially enlarged parts of the inner horizontal portion of the top wall 2 provided by the previously mentioned bays 5.

An annular element 77, preferably of relatively thin sheet steel having the quality to effectively withstand the heat to which it is subjected, has its upper cylindrical end 78 fitted within the flanged edge 71 of the ring-like member 70 and secured thereto, as by welding. From its cylindrical end 78 the element converges downwardly in frusto-conical form and therebelow assumes cylindrical shape to provide a shallow vertical wall that constitutes a neck 79, the element beyond such neck being flanged outwardly over the inner edge portion of the wall 2 to which it is secured, as by welding. The neck 79 is provided with a circumferential series of relatively closely spaced perforations or openings 80, while the frusto-conical portion thereabove is provided with an annular series of perforations or openings 81.

Surrounding the burner bowl 1 is an air compartment 85 enclosed by a peripheral wall 86, a circular bottom wall 87 and an annular top wall 88. This latter wall has its contracted upper end fitted over and secured, as by welding, to the vertical portion 72 of the ring-like member 70, and its flared lower end is surrounded by a vertical flange that fits within the upper edge of the peripheral wall 86 to which it is fastened by screws 89. The bottom wall 87, apertured to accommodate the supply pipe 35, is provided with an opening 90 surrounded by a depending flange to which may be connected an air supply duct (not shown) that may lead from a suitable air impelling means, such as a fan or blower. A combustion chamber 95 is enclosed by a drum 96 within the lower end of which is fitted an annular bottom wall 97 whose inner portion is inter-engaged with the ring-like member 70 and is fastened to the peripheral flange 73 thereof by bolts 98.

The operation of the apparatus, as thus far described, may be set out, briefly, as follows: Assuming that the burner is functioning at any stage above pilot fire, a rich mixture of primary air (entering through the perforations 6) and fuel vapors (generated by heat from the flame above), rises through the throat 79 into the chamber 95 where, by the secondary air admitted through the openings 81, it is converted into a

highly combustible mixture and is practically completely consumed. To the furtherance of this end, additional secondary air is supplied to the central portion of the column of rich mixture, as it ascends through the throat of the burner, by the previously mentioned air distributor 26, the same having openings in its top and side walls, as will presently appear.

The air distributor 26, shown in detail in Figs. 2 and 3, is desirably constructed of sheet metal and comprises a circular top wall 105, a peripheral wall 106 and a bottom wall 107. The latter wall is formed with an upwardly extending sleeve 108 that fits over the air tube 25, the bottom wall resting upon a shoulder 109 of said tube. The peripheral wall 106 is cylindrical and receives, at its upper and lower ends, the flanged peripheral portions of the top wall 105 and bottom wall 107, respectively, the parts being welded or otherwise secured together. The peripheral wall 106 includes several—desirably four—inward depressions 110 of such character as to provide radial walls 111 having openings 112 through which air escapes from the interior of the distributor in a direction tangent to the cylindrical wall 106. The top wall 105 has a circular series of apertures 115.

Surrounding the air distributor is a unit designated generally by the reference numeral 120, and shown as made up of two frusto-conical wall sections 121 and 122. The upper section 121 is of relatively slight taper, and its lower end is fitted over a flange 123 that forms the upper terminal of the lower section 122, the latter section being relatively shallow and flaring downwardly at a considerably greater angle than the former section to where it terminates in a substantially vertical flange 124. Constructed as described and provided with openings 125, the unit 120 constitutes, in effect, an upstanding perforated wall that encloses what may be termed the pilot burner space. The unit 120 is held in proper or concentric relation to the air distributor 26 by fingers 127 that extend radially inwardly from the section 121 and engage the cylindrical wall 106 of the air distributor, such fingers being shown as parts of members 128 that are welded or otherwise secured to the outer side of the section 121 and have their lower ends flared outwardly, as indicated at 129, the fingers 127 being extended inwardly through slots in the wall section 121.

Shown as resting upon the bottom wall 4 of the burner bowl, and surrounding and positioned by the air tube 25, is a capillary fuel diffuser 130 constructed, desirably, of top and bottom layers of absorbent, non-inflammable material, such as woven asbestos fiber or the like, and an intermediate layer 131 of some such material as coarse wire mesh. The fuel diffuser 130 is shown as circular and is preferably of a diameter somewhat greater than that of the bottom of the unit 120. A relatively large notch 133, whose sides are shown as at right angles to each other, is formed in the diffuser for the obvious purpose of accommodating the supply pipe 35, as well as for a further and important purpose which will presently be explained.

During low or pilot fire, when a very small quantity of fuel is being fed, the fuel saturates the diffuser 130 within the bottom of the pilot burner space enclosed by the unit 120 and is vaporized by the heat given off by the surrounding parts of the burner and the flame that occupies said space. Under the conditions now prevailing, the pilot burner (comprised of the air

distributor and the surrounding upstanding perforated wall or unit 120 functions in much the same way as the complete burner at higher fire. That portion of the interior of the burner bowl surrounding the pilot burner serves the latter at low fire substantially as the air chamber 85 serves the burner bowl 1 at higher fire. Primary air is admitted to the pilot burner space through the lower openings 125 producing, with the fuel vapors, a mixture to which secondary air is added through the more elevated openings 125 and through the openings 112 of the air distributor 26. Practically complete combustion of the fuel at low fire is thus effected, wherefore the formation of carbon to any appreciable degree upon the pilot burner parts is avoided.

When the automatic control system operates to increase the fuel supply, the fuel in excess of the amount fed for pilot fire purposes flows to the surrounding portion of the burner bowl; and as the fuel supply is thus increased and diffused, the flame of the pilot burner is communicated to the fuel in the surrounding portion of the burner bowl through the notch 133 beneath the adjacent edge portion of the unit 120. This insures immediate ignition of the oil escaping to the surrounding portion of the burner bowl so that there is no perceptible break in the continuity of operation during the transition from minimum or pilot fire to higher fire. Under these conditions the diffuser 130 serves as a wick and aids in vaporizing the fuel flowing into the surrounding burner bowl.

In Figs. 4 and 5 are shown modifications of the air distributor and fuel diffuser, the former being designated, generally, by the reference numeral 26^a, and the latter by the reference numeral 130^a. The body portion of the present air distributor is in the nature of an inverted cup comprising a circular top wall 135 and a cylindrical side wall 136; and the lower end of the peripheral wall fits over a substantially vertical flange 137 that surrounds the top of an inverted frusto-conical wall 138 whose lower end is turned inwardly and welded or otherwise secured to the corresponding end of a sleeve 139 that fits over the upper end of the air tube 25 and bears against the shoulder 109 thereof. The top wall 135 is provided with a circular series of openings 140, and the walls 136 and 138 with openings 141 and 142, respectively. In this case, the air is directed radially of the pilot burner space by the openings 141 and 142, while air escapes from the openings 140 in a vertical direction.

The diffuser 130^a is made up of layers of fibrous material separated by an intermediate layer 145 of wire mesh, as in the former case, but in the present modification notches 146 open through the edge of the diffuser and extend inwardly a substantial distance beyond the base flange of the unit 120. An opening 148, shown as triangular, accommodates the feed pipe 135.

The burner involving the air distributor 26^a and diffuser 130^a operates substantially like the one above described, with the exception that the air issuing from the distributor into the pilot burner space is not given a swirling action.

With respect to the diffuser 130^a, when the burner goes from minimum or pilot fire to higher fire, the flame of the pilot burner is communicated to the fuel in the surrounding portion of the burner bowl through the notches 146.

For the purpose of cleaning, inspection or replacement, the unit 120, the air distributor, and the fuel diffuser may be lifted from the bowl. It

is to facilitate this operation that the outer ends 129 of the members 128 are flared outwardly so that beneath any of them a suitable lifter may be readily engaged.

Having thus described our invention, what we claim is:

1. A liquid fuel burner comprising a bowl having means for admitting air thereto in the region of its peripheral wall, an air distributor situated substantially centrally of the bowl for supplying additional air thereto, an upstanding perforated wall surrounding the air distributor and spaced intermediate the same and the peripheral wall of the bowl, said upstanding wall enclosing a pilot fire space, and means for supplying liquid fuel to said space in limited quantity for pilot fire, and, in greater quantity, to the portion of the bowl outside said space for higher fire.

2. A liquid fuel burner comprising a bowl having means for admitting air thereto in the region of its peripheral wall, an air distributor situated substantially centrally of the bowl for supplying additional air thereto, an upstanding perforated wall surrounding said distributor and spaced intermediate the same and the peripheral wall of the bowl, said upstanding wall enclosing a pilot fire space and the distributor having provisions for expelling air into said space in such manner as to impart to the air a swirling action, and means for feeding liquid fuel to said space in limited quantity for pilot fire, and thence, in greater quantity, to the portion of the bowl outside said space for higher fire.

3. A liquid fuel burner comprising a bowl provided with means for admitting air thereto in the region of its peripheral wall, an upstanding perforated wall enclosing a pilot fire space substantially centrally within the bowl, means for feeding liquid fuel to said space in limited quantity for pilot fire and in greater quantity to the portion of the bowl outside said space for higher fire, and a fuel diffuser adjacent the bottom of said space and extending outwardly beneath said upstanding wall to the surrounding portion of the bowl, said diffuser being shaped to provide a void beneath said upstanding wall thereby to facilitate ignition of the fuel outside said space from the pilot fire therein.

4. A liquid fuel burner comprising a bowl having means for admitting air thereto in the region of its peripheral wall, an air tube rising centrally of the bowl, an air distributor surmounting said tube, an upstanding perforated wall surrounding the distributor and being removable from the bowl, means spacing said upstanding wall from the distributor, the upstanding wall enclosing a pilot fire space, a fuel diffuser adjacent the bottom of said space and extending at intervals outwardly beneath the upstanding wall, and means for feeding liquid fuel to said space in limited quantity for pilot fire, and thence, in greater quantity, to the portion of the bowl outside said space for higher fire.

5. A liquid fuel burner comprising a bowl having means for admitting air thereto in the region of its peripheral wall, an air tube rising centrally of the bowl, an air distributor surmounting said tube, an upstanding perforated wall surrounding the distributor and being removable from the bowl, means spacing said upstanding wall from the distributor, the upstanding wall enclosing a pilot fire space, a fuel diffuser adjacent the bottom of the bowl surrounding the air tube and extending outwardly beneath the upstanding

wall, the same having voids in the region of said wall through which the pilot fire space communicates with the surrounding portion of the bowl, and means for feeding liquid fuel to said space in limited quantity for pilot fire, and thence, in greater quantity, to the portion of the bowl outside said space for higher fire.

6. A liquid fuel burner comprising a bowl having means for admitting air thereto including a substantially central air tube, a distributor detachably engaged over said tube, and a perforated wall surrounding said distributor and having means spacing it therefrom, said wall being removable from the bowl, and means for delivering liquid fuel exclusively to the space enclosed by said wall in varying quantities to sustain operation throughout the entire range of the burner from pilot to high fire.

7. A liquid fuel burner comprising a bowl having means for admitting air thereto including a substantially central air tube, an air distributor detachably engaged over said tube, a perforated wall surrounding said distributor and having means spacing it therefrom, a fuel diffuser surrounding the air tube between the aforesaid wall and the bottom of the bowl and being so shaped as to dispose its edge partly inside and partly outside of said wall, said diffuser and the aforesaid perforated wall being removable from the bowl, and means for delivering liquid fuel to the space enclosed by said wall in varying amounts to sustain operation throughout the entire range of the burner from pilot to high fire.

8. In combination, liquid fuel combustion apparatus including a combustion chamber, an air compartment therebelow, and a burner bowl situated in said compartment and communicating at its top with the combustion chamber, the bowl having means for admitting air from said compartment, an air distributor situated substantially centrally of the bowl for supplying air to the central region thereof, an upstanding perforated wall surrounding the distributor intermediate the same and the peripheral wall of the bowl and enclosing a pilot fire space that is open at the top, liquid fuel supply means for delivering fuel to the pilot fire space and to the space outwardly of said upstanding wall, and a control system for varying the quantity of fuel delivered by said means throughout the entire operating range of the apparatus from pilot to high fire.

9. A liquid fuel burner comprising a bowl having means for admitting air thereto in the region of its peripheral wall, an air distributor situated centrally of the bowl, an upstanding perforated wall surrounding the distributor and being removable from the bowl, members attached to the outer side of said upstanding wall and having fingers projecting through openings therein for spacing said wall from the distributor, the upstanding wall enclosing a pilot fire space, and means for feeding liquid fuel to said space in limited quantity for pilot fire, and thence, in greater quantity, to the portion of the bowl outside said space for higher fire.

10. A liquid fuel burner comprising a bowl having means for admitting air thereto in the region of its peripheral wall, an air distributor situated centrally within the bowl, an upstanding perforated wall surrounding said distributor and spaced intermediate the same and the peripheral wall of the bowl, said upstanding wall comprising an upper frusto-conical section and a more shallow and flaring lower frusto-conical

section and enclosing a pilot fire space, and means for feeding liquid fuel to said space in limited quantity for pilot fire, and, in greater quantity, to the portion of the bowl outside said space for higher fire.

11. A liquid fuel burner comprising a combustion chamber, a burner bowl situated below said combustion chamber and having a top wall provided with an opening through which the bowl communicates with said chamber, the peripheral wall of said bowl being provided with air openings, a perforated annular partition of less height than the peripheral wall dividing said bowl into inner and outer combustion compartments, means for admitting air to the inner compartment, and further means for feeding fuel to both of said compartments for high fire and, in smaller quantity, to the inner compartment only for lower fire.

12. A liquid fuel burner comprising a combustion chamber, a burner bowl situated below said combustion chamber and having a top wall provided with an opening through which the bowl communicates with said chamber, the peripheral wall of said bowl being provided with air openings, an annular partition dividing said bowl into inner and outer compartments, the inner compartment being open at the top so that products therefrom may rise directly through the aforesaid opening into the combustion chamber, means for feeding fuel to both of said compartments for high fire and in smaller quantity to the inner compartment only for pilot fire, and a wick arranged so as to aid in vaporizing fuel flowing into the outer compartment when changing from pilot fire to higher fire.

13. A liquid fuel burner comprising a combustion chamber, a burner bowl situated below said combustion chamber and having a top wall provided with an opening through which the bowl communicates with said chamber, the peripheral wall of said bowl being provided with air openings, an annular partition dividing said bowl into inner and outer compartments, the inner compartment being open at the top so that products therefrom may rise directly through the aforesaid opening into the combustion chamber, means for feeding fuel to both of said compartments for high fire and, in smaller quantity, to the inner compartment only for pilot fire, and a wick lying on the bottom of the bowl below the annular partition and extending into both compartments.

14. A liquid fuel burner comprising a combustion chamber, a burner bowl situated below said combustion chamber and having a top wall provided with an opening through which the bowl communicates with said chamber, the peripheral wall of said bowl being provided with air openings, an annular partition dividing said bowl into inner and outer compartments, the inner compartment being open at the top so that products therefrom may rise directly through the aforesaid opening into the combustion chamber, means for feeding fuel to both of said compartments for high fire and, in smaller quantity, to the inner compartment only for pilot fire, and a wick lying on the bottom of the bowl below the annular partition and extending into both compartments, there being a passageway leading from the inner to the outer compartment adjacent said wick.