July 20, 1926. 1,593,231

E. F. WHITE

LIQUID FUEL BURNER

Filed Feb. 23, 1924 3 Sheets-Sheet 1

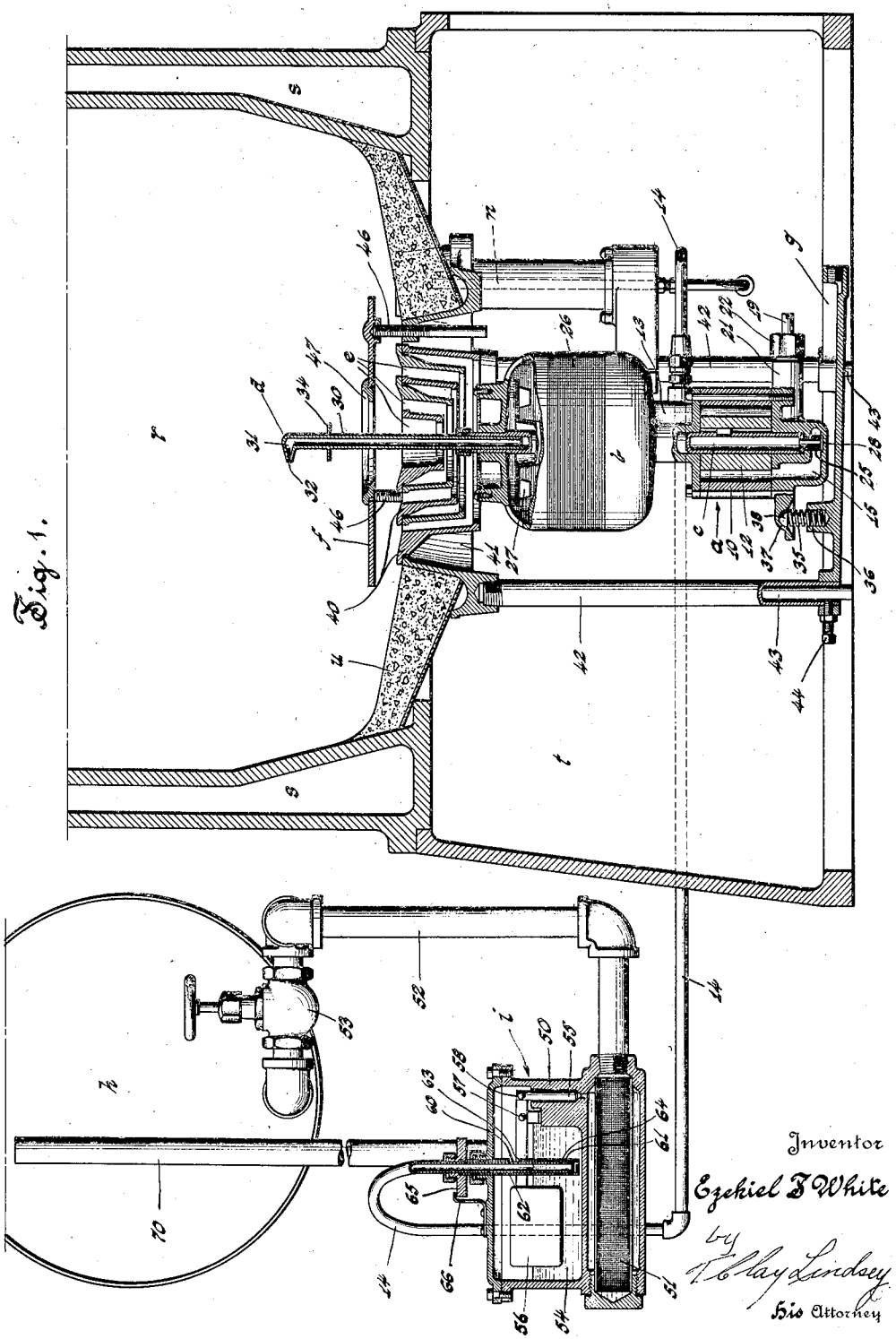


Fig. 1.

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Fig. 2.

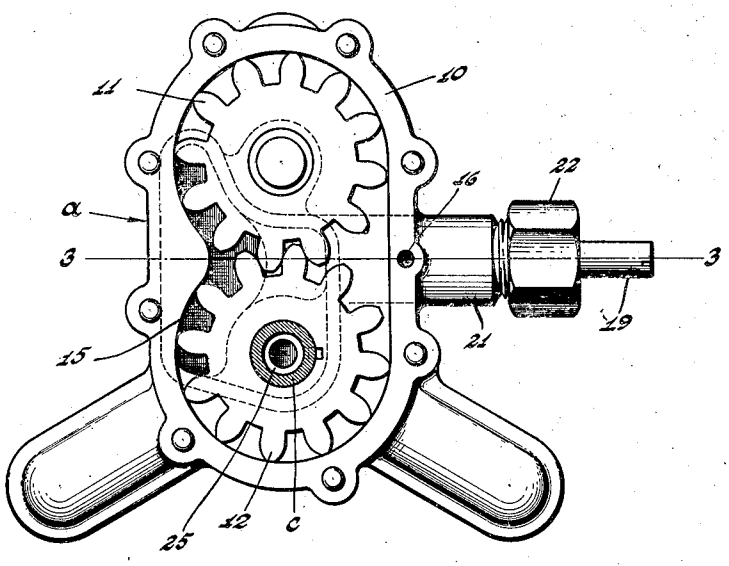
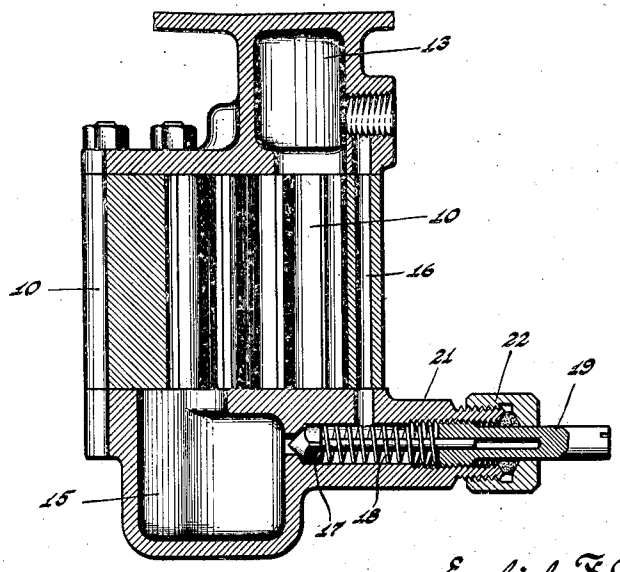


Fig. 3.



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Fig. 6.

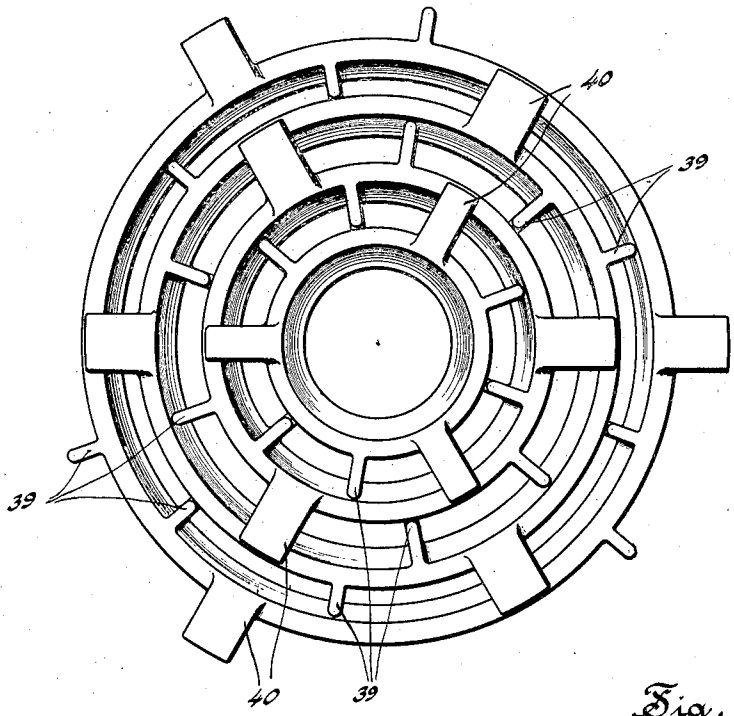


Fig. 4.

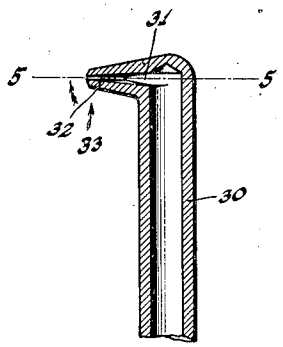


Fig. 5.

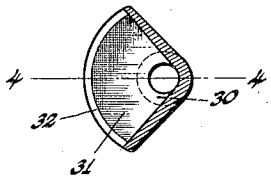
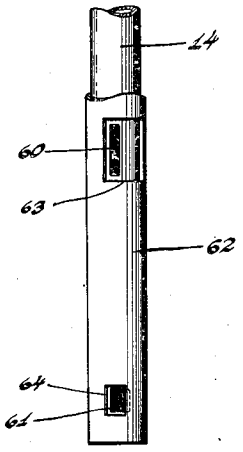


Fig. 7



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Patented July 20, 1926. 1,593,231

UNITED STATES PATENT OFFICE.

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LIQUID-FUEL BURNER.

Application filed February 23, 1924. Serial No. 694,516.

This invention relates to liquid fuel burners, and has as its object to provide a burner of this sort having various features of novelty and advantage. My improved burner is particularly suitable for application in furnaces usually employed in connection with the heating of homes or the like, but it is not limited to this use, as it is susceptible of general application.

The general aim of the invention is to provide an improved liquid fuel burner which is characterized by its extreme simplicity, ruggedness, and economy in construction, and by its effectiveness, efficiency and quietness in operation.

More particularly, the purpose of the invention is to provide an improved burner of this sort wherein the fuel, which may be a relatively poor grade of fuel oil, is completely burned, giving off a maximum amount of heat, which means the burner is extremely economical in operation; wherein the fuel is burned without making smoke or soot; wherein the nozzle is of such construction as to obtain an even and well dispensed flame, and to prevent the collection and incrustation of carbon or other foreign material thereon; wherein the fuel is fed to the nozzle in a steady flow; wherein the quality and the quantity of the mixture of oil and air supplied to the nozzle is efficiently controlled; wherein the danger of fire and damage to the motor or other parts of the apparatus are effectively guarded against; wherein the leakage of oil, with its attendant muss and danger of fire, is prevented; and wherein the parts are so supported, assembled and related that noise and vibrations are reduced to a minimum.

The construction and arrangement are such that the hot gases will be distributed substantially uniformly in a horizontal plane over the bottom of the combustion chamber, while said gases are in a state of combustion, without any particular part of the heat absorbing surface of the furnace having an unduly heavy concentration of hot gases impinging thereagainst; a substantially uniform temperature may be maintained in the house or other building being heated; and the burner, while in operation, may be regulated as to the size of the fire maintained in order to obtain any desried degree of heat.

Other objects of the invention, together with those aforementioned, will be pointed out more in detail in the following description.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts and also in various elements of the device and sub-combinations of parts, which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

In the accompanying drawings, I have shown, for illustrative purposes, one embodiment which the features of the present invention may take, but it is to be understood that this showing is by way of exemplification only, and it is not to be taken as restrictive of my conception, it being evident that the invention is susceptible of various modifications, changes and variations which would be within the spirit of the invention without departing from the scope of the appended claims.

In said drawings:

Figure 1 is a view of my improved burner and its appurtenances, the burner being illustrated as positioned within a boiler shown more or less diagrammatically in vertical central section;

Fig. 2 is a plan view of the pump with the cover or top plate removed;

Fig. 3 is a sectional view through the pump, taken substantially on line 3—3 of Fig. 2;

Fig. 4 is a sectional view through the nozzle, being taken substantially on line 4—4 of Fig. 5.

Fig. 5 is a horizontal section through the nozzle, being taken substantially on line 5—5 of Fig. 4;

Fig. 6 is a top plan view of some of the rings *e*; and

Fig. 7 is a detail view showing, on an enlarged scale, the air and oil ports of the carburetor.

Referring to the drawings in detail, and particularly to Fig. 1, *a* designates a pump driven by a motor *b* having a hollow shaft *c* through which the pump forces a mixture of air and oil to a nozzle *d* carried by the shaft *c* and rotatable therewith. *e* designates a series of rings between the motor and the nozzle and which rings provide air supply passages to the combustion chamber and at the same time constitute means for preventing the flame from passing down into the compartment or working chamber

of the furnace or boiler in which the motor and other parts of the apparatus are positioned. *f* is a plate, vertically adjustable to control the draft of air to the fire chamber, and *g* is a platform or base on which the burner is resiliently mounted. *h* designates the fuel supply from which the oil passes through an air and oil mixing device such as the carburetor *i* to the pump *a*. *n* is the pilot light.

The invention may, of course, be employed in heating plants of various sorts and kinds, but by way of illustration I have shown a burner in the drawings as being applied to a water or steam boiler having a fire or combustion chamber *r* surrounded by a water space *s*, and a bottom or working chamber *t*. The chambers *r* and *t* are separated by a partition *u* of firebrick or the like.

The pump *a* is of the positive displacement type and includes a casing 10 and a pair of elements 11 and 12, the latter of which is fixed to the hollow motor shaft or spindle *c*. In the upper portion of the pump casing 10 is an inlet chamber 13 to which leads a pipe 14 from the carburetor *i*. In the lower portion of the pump casing 10 is an outlet chamber 15 which communicates with the passage or bore through the shaft *c*. Leading from the discharge chamber 15 to the inlet chamber 13 of the pump is a by-pass 16, and 17 is a valve for controlling the flow of mixture through this by-pass in order to regulate the amount of fuel supplied to the nozzle *d*. The valve is normally urged towards its seat by a spring 18, the compression of which may be regulated by turning a screw 19 threaded into the bore of a boss 21 in which the spring and valve are located. 22 designates a stuffing box or gland through which the screw 19 extends. The shaft *c* has bearings in the top and bottom portions or plates of the casing 10. It will be understood that a mixture of air and liquid fuel, the latter in a suspended or pulverized state, passes from the carburetor into the inlet chamber 13 and is forced by the pump elements along the internal walls of the casing 10 to the discharge chamber 15. If a large, hot fire is desired, the regulating device, of which the valve 17 forms a part, is adjusted to hold this valve against its seat so that none of the mixture will be by-passed back to the inlet chamber. If a smaller flame is wanted, the screw 19 is suitably adjusted so that some of the air will be by-passed, which means that a lesser amount of mixture will be forced up to the nozzle. Since the oil is heavier than the air, practically no oil will be by-passed. By means of the regulating device, which may be adjusted while the burner is in operation, any desired size of flame may be had, substantially without disturbing or varying the quality of the mixture supplied to the nozzle. Thus, it will be understood that the regulating device controls the amount of fuel forced up to the nozzle but will not appreciably affect the quality of that fuel.

Some of the oil as it passes through the pump tends to separate out and collect in the bottom of the chamber 15. If the depth of the oil in the bottom of this chamber is appreciable, waves will be created on its surface by the air and vaporized portion of the fuel passing thereover, and, owing to the suction effect on the oil beneath the lower end of the shaft *c*, the oil will be forced up in globules, resulting in fluctuations in the quality of the mixture admitted to the lower end of the shaft *c*, which means that the flame at the nozzle will be uneven and flickering. In order to prevent this, I provide an arrangement by means of which the collection of an appreciable amount of oil in the bottom of the chamber 15 is prevented. This arrangement consists in providing a bushing or sleeve 25 which, in effect, forms an extension of the lower end of the shaft *c*, and the lower end of this sleeve just clears the bottom of the chamber 15. Preferably, the bottom of the chamber 15, immediately beneath the bushing 25, is provided with a shallow well 28. If desired, the sleeve 25 may be dispensed with, and the shaft itself carried down to within a slight distance of the bottom of the chamber 15. The arrangement shown, however, is preferred, as the lower end of the shaft *c* has a bearing on the bushing 25. It will be seen that, since the lower end of the sleeve 25 is but a slight distance away from the edge of the well 28, the passage leading up through the hollow shaft has a restricted throat at its lower end through which the air passes at a higher velocity drawing with it any oil which may tend to collect in the bottom of the chamber 15. Since the oil is thus drawn out of this chamber at such a rate that it cannot collect therein, such oil as does separate out from the air flows down the side walls of the chamber 15 and along the bottom thereof in such a thin film that no waves of a sufficient size to interfere with the free and even flow of the mixture from the chamber 15 to the shaft *c* are formed.

The electric motor *b* may be of any suitable type and, therefore, the internal construction thereof is not shown. It will be understood that on the casing 26 of the motor may be carried the field coils, and the rotor may be fixed to the shaft *c*. The top plate of the pump, the bottom portion of the casing 26 of the motor, and the bearing therebetween may be formed in a single casting, as shown. Within the casing 26 and suitably secured to the shaft *c*, so as to rotate therewith, is a fan 27 for keeping the motor cool.

The nozzle *d* is of novel and advantageous

construction. It is formed on, and extends laterally from, the upper end of a pipe 30, the lower end of which is fixed within the upper end of the shaft *c*. The nozzle in top plan is, as shown most clearly in Fig. 5, in the form of a sector of a circle, and may be described as fan-like. This nozzle is provided with a chamber 31 communicating with the bore of the pipe 30 and terminating at the circular edge of the nozzle in an elongated narrow slot or outlet 32. The chamber 31 has its upper and lower walls converging toward the slot. The top surface of the nozzle is inclined downwardly towards its forward edge. It will be seen that the slot or outlet of the nozzle is positioned to one side of the axis of rotation of the hollow shaft carrying the nozzle. The slot is relatively narrow as compared to its length, and may be described as being in the form of a section of a ring. The slot does not extend entirely around the nozzle. I have found that by the use of a nozzle constructed as described, the fuel will issue therefrom in a thin, uniform sheet, and the collection and incrustation of carbon on the top of the nozzle and at the slot 32 does not take place; and, further, the nozzle remains cool even though the burner be in operation for a long period of time. Because the oil is heavier than the air, they tend to stratify when they reach the nozzle, with the result that there is more oil in the upper portion of the sheet issuing from the slot than in the lower portion of the sheet. The air which sweeps up in front of the slot (as indicated by the arrow 33) tends to roll, upwardly and backwardly on the top surface of the nozzle, globules or drops of oil which, if allowed to remain on top of the nozzle, would, unless otherwise prevented, become heated and carbonized, resulting in an incrustation which, in time, would grow to such extent that particles thereof would project into the sheet of mixture issuing from the nozzle, with the result that this sheet would be broken up, giving an uneven flame and causing incomplete combustion. With the arrangement described, however, the oil, instead of staying on the top of the nozzle, rolls backwardly to the rear edge thereof and then down the pipe 30 onto a circumferential flange or baffle 34 from which it is thrown by centrifugal force into the draft of air coming through the rings *e*. Unspent air is free to flow upwardly of the pipe 30 over the back and the top of the nozzle, thus maintaining, in a cool condition, the nozzle and the oil which may be rolling or flowing backwardly over the top thereof. Also, this air which sweeps over the top of the nozzle merges into the mixture issuing from the slot of the nozzle, thus supplying sufficient air to the mixture, and particularly to the upper portion thereof in which there is more oil than air, to insure complete combustion and, therefore, maximum efficiency.

For the purpose of reducing noise and vibration to a minimum, I resiliently support the assembly so far described, and including the pump, the motor and the nozzle. In the present illustrated disclosure, I have shown the pump as being supported by three coil springs 35, positioned 120° apart and resting in suitable sockets 36 on the platform or base *g*. The bottom of the pump is provided with semi-spherical recesses 37 in which engage semi-circular heads of pins or plungers 38 mounted on the top of the springs 35, as shown most clearly in Fig. 1. I have found that by so supporting the pump and motor, noise is very greatly reduced and vibrations are substantially eliminated.

For preventing the flame from any cause (as, for instance, when a back draft is set up in the chamber *r*) from getting down into the chamber *t* and injuring the motor or other parts, I provide, between the motor and the nozzle, the series of concentric rings *e*. Each ring has, on its inner and outer peripheries, a plurality of radially extending ribs or fins 39. The spaces between these concentric rings and fins permit of a draft of air passing from the bottom chamber *t* up to the fire chamber. These rings, however, will present a large area of cooling surface to any flame which may reach the same and, therefore, will extinguish the same. They are supported in any suitable manner. For instance, each ring may have radially extending flanges 40 resting on the next outer ring, and the flanges of the outermost ring may overhang a supporting ring 41, mounted on the top of pipes 42, into which telescope rods 43 resting on the bottom of the chamber *t*. The pipes 42 may be fixed at their lower ends to the platform or base *g*, and the base and pipes may be secured in any desired vertical position on the rods 43, by set screws 44.

For the purpose of regulating the draft of air from the working chamber *t* to the fire chamber *r*, I provide, above the concentric rings, a vertically adjustable plate having a central opening the size of which may be varied. This plate is supported on screws or rods 46 which may be adjusted as to height in any suitable manner; in the present instance, these rods are screwed into openings in the supporting ring 41. For the purpose of changing the size of the opening in the plate *f*, I provide a plurality of interchangeable rings having different size openings, one of such rings being designated, in Fig. 1, by the numeral 47. It will be seen that by selecting the proper size ring 47, any desired degree of draft up to the nozzle may be obtained. By adjusting

the height of the plate, the lateral draft of air, that is to say the air which is deflected out over the bottom of the fire chamber and along the side walls thereof, may be controlled. If a draft of air of maximum strength is wanted, the full size of the opening in the plate *f* will be employed, and this plate will be adjusted to its highest position. If a slight draft is desired, a ring 47, having a small opening, will be placed on the plate *f*. Varying degrees of draft, both immediately about the nozzle and along the side walls of the furnace, may be had by properly correlating the height of the plate and the size of the opening therein.

The quality of the mixture of air and oil supplied to the pump *a* is controlled by a carburetor which may take the form shown in Fig. 1. This carburetor includes the casing 50 having an oil chamber 51 connected to the oil supply or tank *h* by a pipe 52 which may have interposed in it a shut-off valve 53. The carburetor also has a float or mixing chamber 54, the flow of oil to which from the chamber 51 is controlled by a needle valve 55 which, in turn, is controlled by a float 56 pivoted as at 57 and hingedly connected to the needle valve as at 58. Extending downwardly into the float chamber and to within a short distance of the bottom thereof is the pipe 14 which leads to the inlet chamber of the pump *a*. This pipe has an air orifice 60 located above the level of the oil within the float chamber, and an oil orifice 61 located near its lower end and below the oil level, the end of the pipe being closed. Surrounding that portion of the pipe 14 which extends into the chamber 54, is a rotatable sleeve 62 having an enlarged opening 63 adapted to register with the orifice 60 but of such size and so arranged that, when the sleeve is rotated, the air passing through the orifice 50 is not throttled. Adjacent the lower end of the sleeve 62 is a port 64 registerable with the oil orifice 61 and adapted to vary the effective size of this latter orifice when the sleeve is turned in order to control the supply of oil to the inside of the pipe 14 to suit conditions. The sleeve may be turned by means of a head or dial 65 secured to its outer end, and this head may have a suitable scale on its upper surface with which cooperates an indicating marker 66 for the purpose of designating the position of adjustment of the sleeve 62 and, consequently, the effective size of the oil orifice 61. Since, when the sleeve is turned, the amount of oil admitted to the pipe 14 is controlled but the size of the air orifice is not changed, the ratio of the air and oil passing through the pipe 14 to the burner is suitably regulated.

The air is admitted to the float chamber of the carburetor through an air pipe 70, the upper end of which is preferably above the level of the oil within the tank *h*. The advantage of having the pipe of such height is that, in the event oil should leak past the needle valve 55, when the burner is not in operation, the oil cannot flow out of the air intake of the carburetor. Should the needle valve leak, oil would flow out of the tank *h* until the oil in the tank and the oil in the pipe 70 reach the same level. The oil cannot pass through the pump *a* when this pump is not working. If the needle valve should leak as just described and flood the intake of the pump with oil, say during the night when the burner is not working, and one not acquainted with this fact should attempt to start the motor, the load on the motor would be so great that the electric fuse associated therewith would "blow"; thus, there is no danger in rotating the pump and forcing liquid fuel out of the nozzle.

The pilot light *n* is preferably supplied with fuel from a source of supply other than the tank *h;* for instance, this pilot light may be supplied with gas from the usual city source of supply.

It will be seen from the foregoing description, taken in connection with the drawings, that, when the burner is in operation, the nozzle is rotated while a sheet of flame issues therefrom in a horizontal plane over the bottom of the combustion chamber. The air, which issues with the oil from the nozzle, and the air, supplied from the working chamber, support complete combustion of the oil. The heat is uniformly distributed to the heat absorbing surface of the boiler, and the hot gases are presented first to the lowest part of the heat absorbing surface and give off considerable heat thereto. No particular part of the heat absorbing surface is subjected to an unduly heavy concentration of hot gases. The burner may be in operation for an indefinite length of time without any danger or likelihood of its efficiency or effectiveness becoming impaired in any way, as, for example, by the nozzle slot becoming partly clogged by incrustations forming on the nozzle. As previously stated, the intensity and size of the flame may be readily controlled, they being capable of being varied during the operation of the burner. Little or no attention need be given to the burner, as leakage of oil and danger of fire are effectively guarded against.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the lan-

guage used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim as my invention:

1. A liquid fuel burning apparatus having a combustion chamber and an underlying working chamber, and comprising an upright nozzle member located in the combustion chamber and having a lateral discharge orifice, a source of liquid fuel supply located outside the combustion chamber and the working chamber, an air and fuel mixing device also located outside of said chambers comprising a constant fuel level carburetor supplied from said fuel source and presenting a fuel containing space and a mixing chamber space, with means for admitting air to said chamber, means for feeding comingled fuel and air to the nozzle and comprising a rotary positive displacement pump with pumping elements, the said pump being located in the said working chamber beneath the nozzle, a conduit connecting the intake side of the pump with both the mixing chamber and fuel space of the carburetor to cause the pump to draw comingled air and fuel, means for rotating the nozzle and actuating the pump comprising a motor located in the working chamber co-axial with the nozzle member and between the latter and the pump, said motor having a hollow armature shaft connecting the discharge side of the pump with the nozzle.

2. A liquid fuel burning apparatus having a combustion chamber and an underlying working chamber, and comprising an upright nozzle member located in the combustion chamber and having a lateral orifice, a source of liquid fuel supply located outside the combustion chamber and the working chamber, an air and fuel mixing device located outside both said chambers, means for feeding comingled fuel and air to the nozzle comprising a positive displacement pump located in the working chamber beneath said nozzle, a conduit connecting the intake side of the pump with the air and fuel mixing device to cause the pump to draw comingled air and fuel, and a motor for rotating the nozzle and actuating the pump, said motor being located in the working chamber above the pump and co-axial with the nozzle member and having a hollow armature shaft connecting the discharge side of the pump with the nozzle.

3. A liquid fuel burning apparatus having a combustion chamber and an underlying working chamber, and comprising an upright nozzle member located in the combustion chamber, a source of liquid fuel supply located outside the combustion chamber and the working chamber, an air and fuel mixing device located outside both said chambers, a motor in said working chamber for rotating the nozzle, and means also in said working chamber for feeding comingled air and fuel to the nozzle, the same comprising a positive displacement pump actuated by said motor and having a conduit connecting the intake side of the pump with the air and fuel mixing device.

4. A liquid fuel burning apparatus having a combustion chamber and an underlying working chamber, and comprising an upright nozzle member located in the combustion chamber, a source of liquid fuel supply and an air and fuel mixing device both located outside said chambers, a motor in said working chamber having an upright hollow shaft, to the upper end of which said nozzle member is connected, and a positive displacement pump also located in the working chamber and actuated by said motor for withdrawing comingled air and fuel from said mixing device and delivering it through said shaft to said nozzle.

5. An apparatus for burning liquid fuel comprising, in combination, a motor having an extended hollow shaft, a nozzle on one end of said shaft, a positive displacement pump on said shaft driven by said motor and connected to deliver fuel to said nozzle, and a liquid fuel and air mixing device connected to the intake of said pump.

6. A liquid fuel burning apparatus comprising, in combination, an upright hollow shaft, a nozzle on the upper end of said shaft and adapted to rotate therewith, fuel and air mixing means, and a positive displacement pump having its intake connected thereto for supplying fuel to said nozzle and a casing into which the lower end of said shaft has a bearing, said pump having a plurality of pumping elements one of which is fixed to and rotated by said shaft.

7. An apparatus for burning liquid fuel comprising a furnace having a combustion chamber and a working chamber therebeneath, a source of liquid fuel supply, an air and fuel mixing device, a rotary nozzle located in the combustion chamber, a motor in the working chamber having a hollow upright shaft on the end of which said nozzle is located, and a positive displacement pump also in the working chamber beneath the motor and driven thereby for feeding comingled air and fuel from the air and fuel mixing device to the nozzle through said hollow shaft.

8. An apparatus for burning liquid fuel comprising, in combination, a furnace having a combustion chamber and a working chamber therebeneath, a motor in the working chamber having an extended hollow shaft, a nozzle on said shaft and within said combustion chamber, a source of liquid fuel

supply and an air and fuel mixing device outside of said working chamber, and a pump below said motor having a pumping element fixed to said motor shaft for feeding comingled air and fuel from said mixing device to said nozzle through said hollow motor shaft.

9. An apparatus for burning liquid fuel comprising, in combination, a rotary nozzle, a motor having a hollow shaft to the end of which said nozzle is connected, a positive displacement pump having a rotary member to which the lower end of said shaft is connected and by which it is rotated, said shaft providing a discharge passage for said pump, and a fuel and air mixer connected to supply comingled air and fuel to the pump.

10. A liquid fuel burning apparatus having a combustion chamber and comprising a nozzle member located therein and having one or more lateral orifices, a source of liquid fuel supply, an air and fuel mixing device, means for feeding comingled air and fuel to the nozzle comprising a positive displacement pump between said air and fuel mixing device and said nozzle, the intake side of the pump being connected to said mixing device, and means for rotating said nozzle.

11. A liquid fuel burning apparatus having a combustion chamber, a nozzle located therein, a source of liquid fuel supply, an air and fuel mixing device having an enclosed mixing chamber in which a body of liquid fuel of substantially constant amount is maintained, said device having means to admit air to said mixing chamber, means for feeding comingled air and fuel to the nozzle comprising a positive displacement pump located between the nozzle and the fuel mixing device, the intake side of said pump being connected to withdraw fuel and contacting air from said chamber, and means to actuate the pump.

12. An apparatus for burning liquid fuel having, in combination, a source of liquid fuel supply, an air and fuel mixing device, an enclosed chamber in which a body of liquid fuel is maintained, said device having means to admit air to said chamber, a rotary nozzle, means for feeding comingled air and fuel to the nozzle comprising a positive displacement pump, the intake side of which is connected to withdraw the fuel contacting air from the said mixing chamber, and a motor for actuating the pump and rotating the nozzle.

13. An apparatus for burning liquid fuel having a combustion chamber, a nozzle therein, a working chamber communicating with the combustion chamber to supply air about the nozzle, means in the working chamber for rotating the nozzle, and means between the combustion chamber and the working chamber for preventing backfire from the former to the latter including a multiplicity of cooling walls in the communicating space between the chambers.

14. An apparatus for burning liquid fuel having a combustion chamber, a nozzle therein, a working chamber communicating with the combustion chamber to supply air about the nozzle, means in the working chamber for rotating the nozzle, and means for preventing backfire from the combustion chamber to the working chamber, comprising a series of metallic walls forming air passages disposed to cool the flame and gases coming in contact therewith.

15. An apparatus for burning liquid fuel having a combustion chamber, a nozzle therein, said chamber having an air admission opening for admitting air about the nozzle, means outside the combustion chamber for rotating the nozzle, and means for preventing backfire from the chamber to the rotating means, comprising a series of concentric members with intermediate air admission passages located in said opening and presenting surfaces disposed to cool the flame and gases coming in contact therewith.

16. An apparatus for burning liquid fuel having a combustion chamber, a nozzle therein, said chamber having an air admission opening for admitting air about the nozzle, means outside the combustion chamber for rotating the nozzle, means for preventing backfire from the chamber to the rotating means comprising a series of concentric members with intermediate air admission passages located in said opening and presenting surfaces disposed to cool the flame and gases coming in contact therewith, and a spreader plate located above said passages and below the nozzle.

17. A liquid fuel burning apparatus having a combustion chamber, an upright nozzle member therein, means for rotating the nozzle, means for feeding comingled air and fuel to the nozzle, an air passage leading to the combustion chamber about the nozzle, a spreader plate below the nozzle for providing a draft of air along the bottom and side walls of said combustion chamber about the nozzle, and means for adjusting the said plate to control the air.

18. A liquid fuel burning apparatus having a combustion chamber and comprising a rotary nozzle located therein, a source of liquid fuel supply, a pump, means for feeding air and fuel to the intake side of the pump, the latter having a discharge passage connected to supply comingled air and fuel to the nozzle, said pump being provided with a settling chamber for free liquid fuel exposed to the passage of the air discharged at the nozzle, and means for rotating the nozzle.

19. A liquid fuel burning apparatus having a combustion chamber and comprising a rotary nozzle located therein, a source of liquid fuel supply, a rotary positive displacement pump with means for feeding air and fuel to the intake side thereof, the discharge passage thereof being connected to supply comingled air and fuel to the nozzle and having a restricted portion, said pump being provided with a settling chamber for free liquid adjacent said restricted portion of said discharge passage, and means for rotating the nozzle.

20. A liquid fuel burning apparatus having a combustion chamber, a nozzle located therein, a source of liquid fuel supply, an air and fuel mixing device having an enclosed chamber in which a body of liquid fuel of substantially constant amount is maintained, said device having means to admit air to said chamber, means for feeding comingled air and fuel to the nozzle comprising a pump located between the nozzle and the fuel mixing device, the intake side of the pump being connected to withdraw fuel and contacting air from said chamber, and a settling chamber for free liquid fuel exposed to the passage of the air discharged to the nozzle.

21. In a liquid fuel burning apparatus, the combination with an upright hollow shaft, of a nozzle at the upper end thereof, a rotary positive displacement pump at the lower end thereof, and means for feeding liquid fuel and air to the intake side of said pump, the discharge side of the pump being connected to the open lower end of the shaft, said pump being provided with a discharge chamber having a shallow well immediately beneath the lower end of the shaft.

22. A liquid fuel burning apparatus having a combustion chamber, a nozzle located therein, a source of liquid fuel supply, means for feeding comingled air and oil to the nozzle comprising a pump, means for feeding commingled air and fuel to the pump, a settling chamber connected to the delivery side of said pump and an adjustable by-pass connected to said settling chamber.

23. A liquid fuel burning apparatus having a combustion chamber and comprising a nozzle located therein, a source of liquid fuel supply, means for feeding commingled air and oil to the nozzle comprising a pump, means for feeding air and oil to the pump, the latter having a settling chamber for free liquid and a by-pass for by-passing a part of the air from the discharge side of the pump at a point above the settling chamber to the intake side thereof, and means for adjusting said by-pass.

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