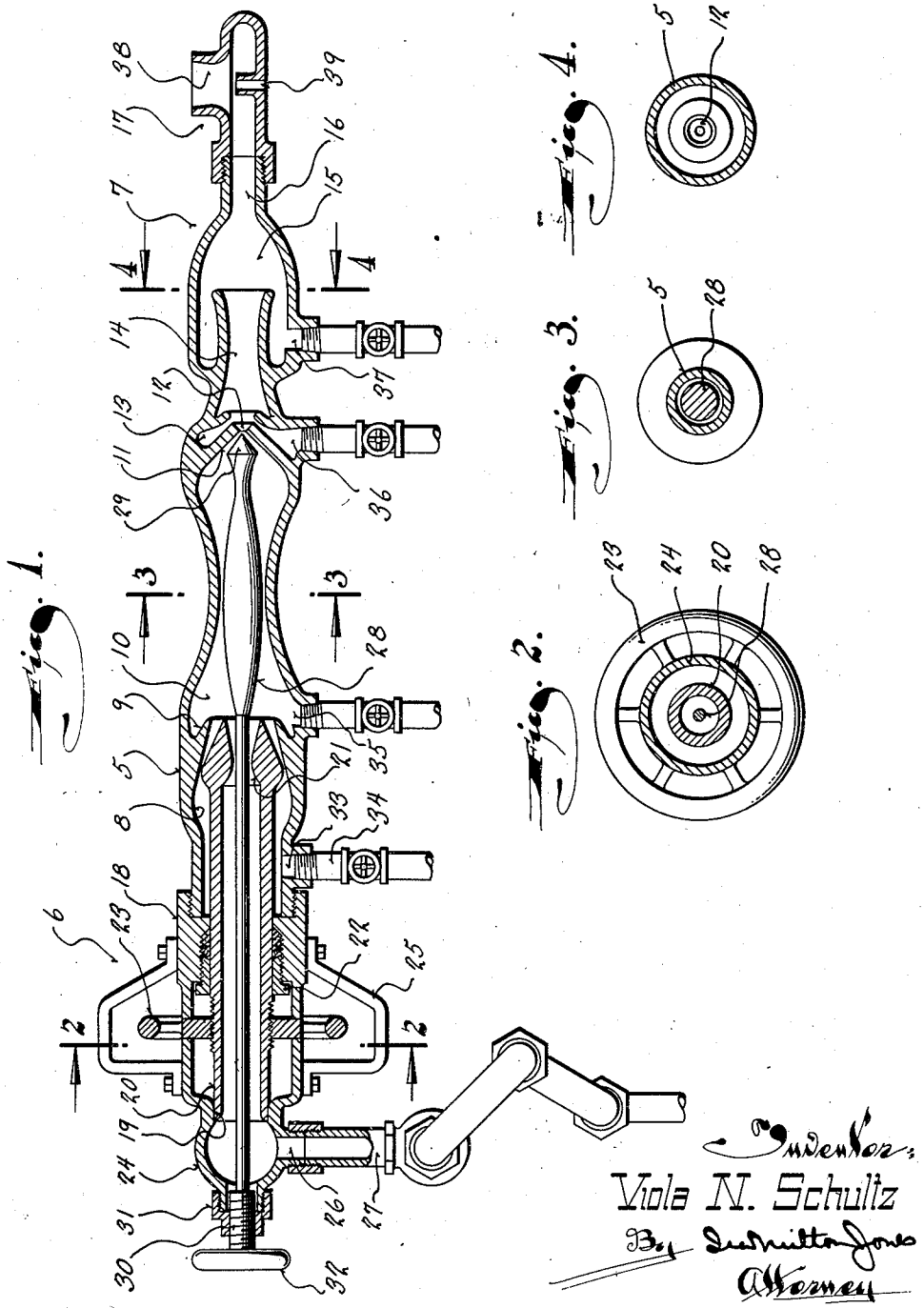
Aug. 20, 1940. V. N. SCHULTZ 2,212,052

OIL BURNER

Filed Sept. 17, 1937 2 Sheets-Sheet 1



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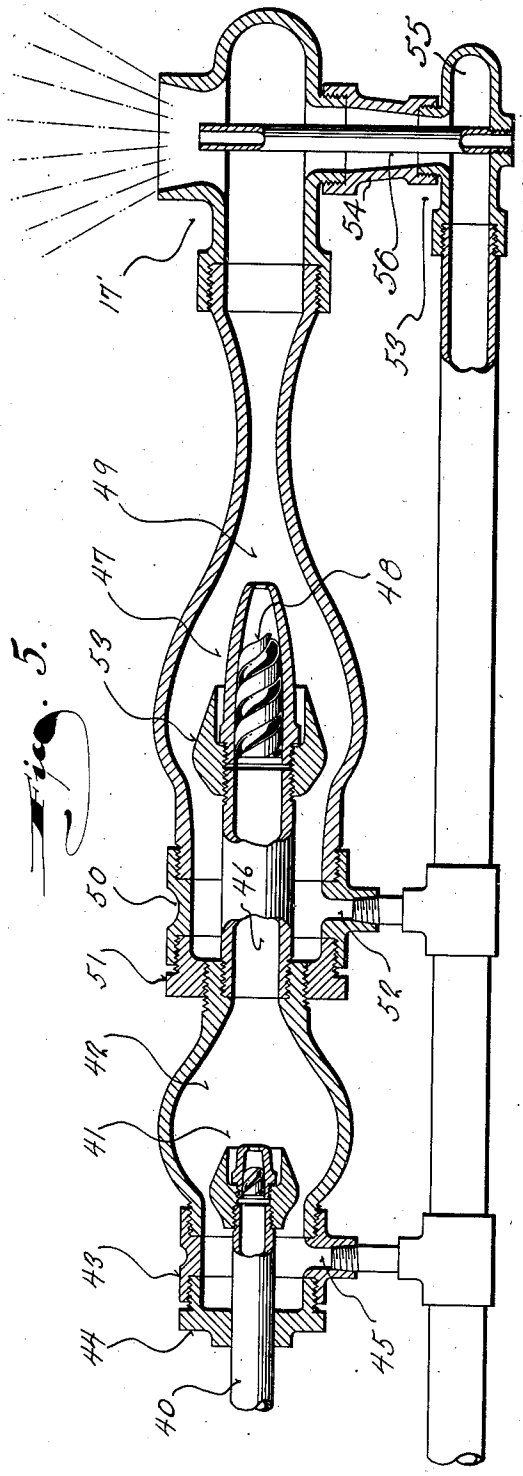

Fig. 5.

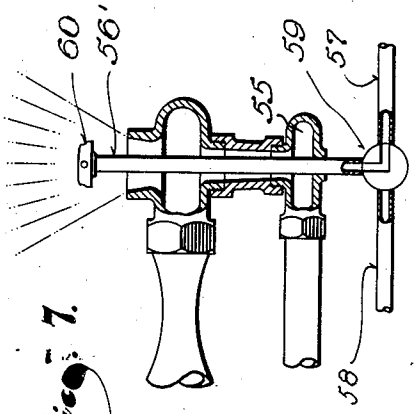

Fig. 7.

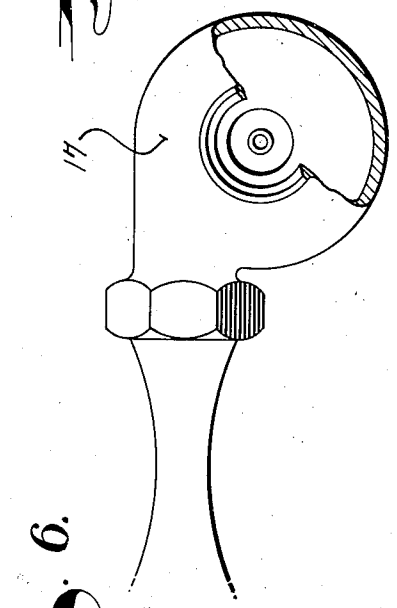

Fig. 6.

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OIL BURNER

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8 Claims. (Cl. 158—74)

This invention relates to oil burners and has as a general object to provide a burner which will improve the preparation of the fuel-air mixture to insure more complete combustion, and to accomplish this result without the use of moving parts or other complicated mechanical expedients.

More particularly it is an object of this invention to provide an oil burner so constructed that the fuel and air or other suitable gas such as superheated steam are successively injected into a plurality of mixing chambers or zones to first atomize and then nebulize the oil.

Another object of this invention is to provide a burner designed that the oil can be drawn into the mixing duct by vacuum created by an injector action resulting from the shape of the duct and the manner of introducing the air or other gas under pressure.

Another object of this invention is to provide an oil burner of the character described wherein a primary atomization of the fuel is effected at low velocity by steam or compressed air, and thereafter, the velocity of the mixture is increased for introduction into a secondary mixing or impact chamber.

Another object of this invention is to completely nebulize the fuel-air mixture by spraying it into a secondary mixing or impact chamber and directing a flow of gas under pressure into this secondary mixing chamber in such a manner as to strike the spray crosswise and thus forcibly commingle with the fuel-air mixture to nebulize it.

Another object of this invention is to provide an oil burner in which the final discharge nozzle has a large unrestricted orifice to overcome objections inherent in oil burners of certain types heretofore in use wherein the fuel-air mixture was sprayed into the combustion chamber through a very fine orifice.

Another object of this invention is to provide an oil burner wherein the fuel-air mixture is given a whirling motion as it leaves the discharge nozzle to insure complete combustion.

Still another object of this invention is to provide an oil burner of the character described which is quiet in operation and which is so constructed that none of its parts are likely to become worn, or if worn, will not seriously affect the efficiency of the burner.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate two complete examples of the physical embodiment of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, as illustrated in the drawings:

Figure 1 is a longitudinal sectional view through an oil burner constructed in accordance with this invention;

Figure 2 is a cross sectional view taken through Figure 1 on the plane of the line 2—2;

Figure 3 is a cross sectional view taken through Figure 1 on the plane of the line 3—3;

Figure 4 is a cross sectional view taken through Figure 1 on the plane of the line 4—4;

Figure 5 is a longitudinal sectional view through a modified embodiment of this invention;

Figure 6 is a top view of the discharge nozzle employed in both of the modifications, parts thereof being broken away and in section; and

Figure 7 is a vertical sectional view through a modified form of discharge nozzle.

Referring now particularly to the accompanying drawings in which like numerals indicate like parts throughout the several views, the numeral 5 designates a duct having an inlet end 6 and an outlet end 7. This duct constitutes practically the whole of the burner. Near its inlet end it is slightly enlarged to provide an oil receiving chamber 8. The walls of this chamber, which is cylindrical in cross section, are taperingly reduced to provide a nozzle 9 which discharges into a primary mixing or impact chamber 10.

This primary mixing or impact chamber 10 is shaped like a venturi and has its discharge end abruptly reduced to provide a valve seat 11 and a restricted orifice 12 which opens into an annular space 13 leading to a second Venturi tube 14. This second Venturi tube 14 constitutes a secondary mixing or impact chamber and discharges into a final mixing chamber 15 whose discharge end 16 is connected to a spray nozzle 17.

Threaded onto the inlet end of the tube is a cylindrical fitting 18 having a reduced bore 19 to slidably receive a tube 20, the inner end of which has its internal diameter reduced to form a venturi 21 and its outside diameter increased to cooperate with the taperingly reduced walls of

the nozzle 9 to provide a needle valve construction. A packing gland 22 is preferably mounted in the cylindrical fitting 18 to seal the chamber 8.

Longitudinal adjustment of the tube 20 to open and close the needle valve is effected by means of a hand wheel 23 threaded onto the tube and held against longitudinal motion by being confined between the cylindrical fitting 18 and a cap 24 assembled therewith by arms 25. The cap 24 closes the outer open end of the tube 20 and has an inlet opening 26 to which a supply pipe 27 is connected to provide for the introduction of compressed air or superheated steam.

Slidable through the tube 20 is a needle valve stem 28, the point 29 of which coacts with the valve seat 11 to provide a second needle valve adjustment. Longitudinal motion is imparted to the valve stem 28 by a screw 30 threaded in a bonnet 31 attached to the outer end of the cap, the screw being provided with an adjusting knob 32.

Opening into the chamber 8 is an inlet 33 to which a valved fuel line 34 leads, and opening into the venturi-like mixing chamber 10 directly adjacent the nozzle 9 is an inlet 35 for additional compressed air or superheated steam. The compressed air or steam introduced through the inlets 26 and 35 produces a vacuum by an injector action which draws the liquid fuel through the inlet 33 and into the chamber 8 to be discharged therefrom through the nozzle 9 together with the air introduced through the tube 20.

The air or steam and the liquid fuel are thus sprayed into the primary mixing or impact chamber 10 and while so sprayed into this chamber are subjected to the force of the stream of air or steam entering the inlet 35.

Atomization and partial mixture of the fuel with the air or steam thus takes place within the primary mixing chamber 10. The atomized fuel-air mixture is then projected forwardly at increasing velocity through the venturi 10 and the particles of fuel are thereby further broken up. To increase this action, the needle valve stem 28 is increased in diameter opposite the throat of the venturi to restrict the passage to a small annular space.

The solid gradually increasing and then decreasing cross section of the stem or spindle 28 not only provides a double reduction to the contraction of the area of chamber 10, but also imparts a true annular section to the stream of mixture flowing therethrough.

At high speed but low pressure, the fuel-air mixture is then projected through the orifice 12 where it is subjected to forcible commingling with additional compressed air of superheated steam introduced through an inlet 36 which opens into the annular space 13. This forcible commingling of the compressed air or superheated steam with the atomized fuel-air mixture nebulizes the fuel and effects further mixture with the additional air or steam to increase its combustibility and projects the same in a fine mist through the venturi 14 into the final mixing chamber 15 where additional compressed air or superheated steam is injected into it through an inlet 37 in quantities sufficient to insure complete combustion of the mixture.

Thus, the fuel spray is subjected to successive impacts by the air or steam entering the duct to completely nebulize the same and gradually form a mixture capable of efficient combustion.

It is to be noted, however, that any one of the valved air or steam inlets alone is capable of supplying sufficient air to the fuel spray for efficient combustion; but it is more desirable to forcefully introduce only portions of the required amount of air at a number of points along the length of the duct for the purposes of nebulizing the fuel spray and so that the total air supply from the various air inlets is the proper amount necessary for complete combustion of the mixture.

The discharge nozzle 17 which receives the fuel-air mixture in its final nebulized state imparts a whirling motion to the mixture and discharges the same in a hollow upright combustible spray through its discharge orifice 38. The desired whirling motion is imparted to the fuel-air mixture by the involute shape of the discharge nozzle which is illustrated in Figure 6. The hollow formation of the spray of combustible mixture as it leaves the discharge nozzle promotes more complete combustion, and to further insure complete combustion, an auxiliary air opening 39 is provided in the bottom of the discharge nozzle in line with its discharge orifice 38 for the admission of free air.

Being unrestrictedly open, the mouth of the discharge orifice is not subject to wear or erosion and consequent change of area. This is an important advantage over many existing types of burners which use a very fine discharge orifice and spray the fuel mixture at very high pressure therefrom. In such constructions the edge of the orifice soon becomes ragged and in view of the very small size of the orifice any such change in its side or shape has a deleterious effect upon the combustion. The carbon deposits and other objectionable effects of such improper combustion are entirely eliminated with the nozzle 17, and proper combustion is at all times assured.

Another advantage of this construction and particularly of the fact that the nebulous fuel mixture is emitted from the nozzle as a hollow whirling conical spray, is that the actual flame is spaced a substantial distance above the mouth of the nozzle. Hence the nozzle is not subjected to any but the radiant heat of the flame.

A modified embodiment of the invention is illustrated in Figure 5. In this construction the oil is introduced by a supply pipe 40 through a discharge nozzle 41 into a primary mixing chamber 42, the nozzle 41 being constructed to impart a whirling motion to the oil as it leaves the nozzle.

The primary mixing chamber is cylindrical in cross section and is taperingly reduced in diameter at its forward discharge end. Its rear end is threaded into a sleeve 43, the end of which is closed by a cap 44 through which the tube 40 extends. An inlet opening 45 in the sleeve provides for the introduction of compressed air or superheated steam into the mixing chamber rearwardly of the fuel nozzle 41.

As in the embodiment heretofore described, the fuel and the air or steam are commingled in this primary mixing chamber to atomize the oil, and in this condition the mixture is projected forwardly through a tube 46 which terminates in a discharge nozzle 47 having a spirally grooved insert 48 to impart a whirling motion to the mixture so that it is sprayed from the nozzle as a whirling spray into a secondary mixing chamber 49.

The secondary mixing chamber, like the first, has its discharge end reduced in diameter and has its rear end of large diameter and threaded in a ring 50. A cap 51 threaded into the ring and onto the discharge end of the mixing chamber 42 connects these parts and closes the adjacent end

of the secondary mixing chamber. The ring 50 has an inlet 52 for the admission of compressed air or superheated steam into the secondary mixing chamber, which by virtue of the shape of the mixing chamber and the bulbous enlargement 53 formed by a fitting which secures the discharge nozzle 47 to the pipe 46, enters the secondary mixing chamber in a hollow stream to strike the spray issuing from the nozzle 47 with sufficient force to completely nebulize the fuel.

Broken up into a fine mist in this manner, the fuel advances forwardly with increasing velocity through the discharge end of the secondary mixing chamber which is in the shape of a Venturi tube to enter the final discharge nozzle 17'. The discharge nozzle 17' is like that employed in the other embodiment illustrated except that compressed air or superheated steam is positively projected upwardly therethrough by means of a pipe 54 opening into the bottom of the nozzle to insure complete combustion of the mixture.

While not necessary, it is preferable that the compressed air or superheated steam being introduced into the discharge nozzle 17' be given a whirling motion by means of a discharge nozzle 55 similar in construction to the nozzle 17 of the embodiment hereinbefore described. The provision of a free air inlet at the bottom of the nozzle 55 with a pipe 56 leading upwardly therefrom through the nozzle 17', counteracts the puffing or surging due to vacuum in the core of the vortex formed by the fuel-air mixture as it discharges from the nozzle 17'.

The center vent which is shown in Figure 1 as merely an opening in the bottom of the nozzle and in Figure 5 as an upstanding pipe, can be used to supply gas for ignition if desired and in Figure 7 one manner of using the center vent for this purpose is illustrated. As there shown, the pipe 56' is preferably extended above the mouth of the orifice and at its bottom is suitably attached to either a gas supply line 57 or an air line 58, through a valve 59. At its upper end the pipe has a spreader 60 to throw the gas flame outwardly.

Any other form of ignition may be used, and as the burner is used preferably on high-low operation as distinguished from on-off operation, ignition is no problem. To effect high-low operation it is only necessary to control the needle valve 28 (Figure 1) from a suitable thermostat.

From the foregoing description taken in connection with the accompanying drawings, it will be readily apparent to those skilled in the art that this invention provides an oil burner of simplified construction in that it eliminates all moving parts, and that through the successive impact of the fuel with compressed air or superheated steam in the manner defined, complete nebulization of the fuel is effected to insure complete combustion.

What I claim as my invention is:

1. In an oil burner: an external tubular member having a valve seat intermediate its ends and guide means rearwardly of the valve seat; an inner tube slidably fitting said guide means and spaced from the external tubular member so as to form an annular passage therewith, said inner tube having a valve formed on its exterior to fit said valve seat; means for admitting oil to said passage between the guide means and valve seat; means for adjusting the inner tube longitudinally to carry the valve toward and from its seat; means for introducing air under pressure into the external tube at its portion in advance of the valve seat, said portion of the tubular member being shaped to form a venturi and providing a mixing chamber wherein the oil and air are mixed to form a combustible mixture, said external tube having an outlet at its forward end; a valve seat formed at said outlet; a valve movable to and from said last mentioned valve seat; means to adjust the last mentioned valve; and a discharge nozzle formed to discharge a hollow whirling spray of combustible mixture therefrom and from which the mixture issues to burn in a flame.

2. In an oil burner: an external tubular member having a valve seat intermediate its ends and guide means rearwardly of the valve seat; an inner tube slidably fitting said guide means and spaced from the external tubular member so as to form an annular passage therewith, said inner tube having a valve formed on its exterior to fit said valve seat; means for admitting oil to said passage between the guide means and valve seat; means for adjusting the inner tube longitudinally to carry the valve toward and from its seat; means for introducing air under pressure into the external tube at its portion in advance of the valve seat, said portion of the tubular member being shaped to form a venturi and providing a mixing chamber for the oil and air to mix the same so as to produce a combustible mixture, said external tube having an outlet at its forward end; a valve seat formed at said outlet; a valve movable to and from said last mentioned valve seat; means to adjust the last mentioned valve, said external tubular member being shaped to form a nozzle-like chamber forwardly of the second mentioned valve and having an outlet at its forward end; means to admit air under pressure to the rear end of said nozzle-like chamber for increasing the combustibility of the mixture flowing therethrough; and a discharge nozzle formed to discharge a hollow whirling spray of combustible mixture therefrom and from which the mixture issues to burn in a flame.

3. In an oil burner: an external tubular member having a valve seat intermediate its ends and guide means rearwardly of the valve seat; an inner tube slidably fitting said guide means and spaced from the external tubular member so as to form an annular passage therewith, said inner tube having a valve formed on its exterior to fit said valve seat; means for admitting oil to said passage between the guide means and valve seat; means for adjusting the inner tube longitudinally to carry the valve toward and from its seat; means for introducing air under pressure into the external tube at its portion in advance of the valve seat, said portion of the tubular member being shaped to form a venturi and providing a mixing chamber for the oil and air to mix the same and produce a combustible mixture, said external tube having an outlet at its forward end; a valve seat formed at said outlet; a valve movable to and from said last mentioned valve seat; means to adjust the last mentioned valve, said external tubular member being shaped to form a nozzle-like chamber forwardly of the second mentioned valve and having an outlet at its forward end; means to admit air under pressure to the rear end of said nozzle-like chamber for increasing the combustibility of the mixture flowing therethrough; said external tubular member being also shaped to form an accelerating chamber into which the nozzle opens, said accelerating chamber having a cylindrical

tubular outlet at its forward end; means to admit additional air under pressure at the rear end of said accelerating chamber for further increasing the combustibility of the mixture flowing through the external tube; and a discharge nozzle formed to discharge a hollow whirling spray of highly combustible mixture therefrom and from which the mixture issues to burn in a flame.

4. In an oil burner: a primary mixing chamber having a taperingly reduced discharge opening at its forward end; means for introducing liquid fuel into the rear portion of the mixing chamber; means for admitting air under pressure into the mixing chamber rearwardly of the point of admission of the fuel to mix with the fuel and form a combustible mixture; a duct leading from the discharge end of the primary mixing chamber to conduct the fuel mixture forwardly; a nozzle at the forward end of said duct through which the fuel mixture is sprayed; a secondary mixing chamber enclosing the nozzle to receive the spray of fuel mixture issuing from the nozzle; means for admitting additional air under pressure into the secondary mixing chamber at a point rearwardly of said nozzle so that further mixture between the fuel and air is effected by the forward rush of air striking the fuel spray to thereby increase the combustibility of the fuel mixture; and a discharge nozzle connected to the discharge end of the secondary mixing chamber for discharging the combustible fuel mixture, said discharge nozzle being shaped to impart a whirling motion to the combustible fuel mixture.

5. In an oil burner: a primary mixing chamber having a taperingly reduced discharge opening at its forward end; means for introducing liquid fuel into the rear portion of the mixing chamber; means for admitting air under pressure into the mixing chamber rearwardly of the point of admission of the fuel for mixture therewith; a duct leading from the discharge end of the primary mixing chamber to conduct the fuel mixture forwardly; a nozzle at the forward end of said duct through which the fuel mixture is sprayed; a secondary mixing chamber enclosing the nozzle to receive the spray of fuel mixture issuing from the nozzle; means for admitting additional air under pressure into the secondary mixing chamber at a point rearwardly of said nozzle so that further mixture between the fuel and air is effected by the forward rush of air striking the fuel spray to thereby form a highly combustible mixture; a discharge nozzle connected to the discharge end of the secondary mixing chamber for discharging the fuel mixture, said discharge nozzle being shaped to impart a whirling motion to the fuel mixture; and means for injecting air under pressure into the discharge nozzle in line with its discharge orifice to insure complete combustion of the mixture.

6. In an oil burner, the combination of: a mixing chamber; means for introducing liquid fuel into said mixing chamber; means for introducing air under pressure into said mixing chamber in a manner to commingle with the fuel and form an atomized fuel and air mixture; another mixing chamber connected with said first named mixing chamber to receive said atomized mixture; means for injecting additional air under pressure into said other mixing chamber in sufficient quantities and in a manner to forcibly commingle with the atomized mixture therein to form a nebulized combustible mixture therewith, said other mixing chamber being in the form of a venturi; and a discharge nozzle receiving the nebulized combustible mixture from the venturi, said discharge nozzle having a large open discharge orifice and being shaped to discharge a hollow whirling spray of nebulized combustible mixture therefrom.

7. In an oil burner, the combination of: a duct having portions of successively large and small internal cross sectional areas to provide a plurality of successively connected mixing chambers: means for introducing liquid fuel into one of said mixing chambers; means for introducing air under pressure into said mixing chamber in a manner to commingle with the fuel and form an atomized fuel-air mixture which passes into the next successive mixing chamber; means for injecting additional air under pressure into said next mixing chamber in sufficient quantities and in a manner to forcibly commingle with the atomized mixture therein and form a nebulized combustible mixture therewith; and a discharge nozzle having a large discharge orifice for discharging the nebulized combustible mixture received from said last named mixing chamber, said nozzle being shaped to discharge a hollow whirling spray of combustible nebulized mixture therefrom.

8. In an oil burner, the combination of: a mixing chamber; means for introducing liquid fuel into said mixing chamber; means for introducing air under pressure into said mixing chamber in a manner to commingle with the fuel and form an atomized fuel air mixture; another mixing chamber connected with said first named mixing chamber to receive said atomized mixture; means for injecting air under pressure into said other mixing chamber so that it strikes the spray of atomized mixture to nebulize the same and form a combustible mixture therewith; a discharge nozzle connected with the last named mixing chamber to receive the nebulized combustible mixture for discharge into a combustion chamber, said discharge nozzle being formed to discharge a hollow whirling spray of mixture therefrom; and means for introducing air into the discharge nozzle to further commingle with the nebulized combustible mixture as it discharges therefrom to form a more completely combustible mixture.

VIOLA N. SCHULTZ.