Jan. 28, 1936. W. P. REIBOLDT 2,028,807

OIL BURNER

Filed Feb. 5, 1935 2 Sheets-Sheet 1

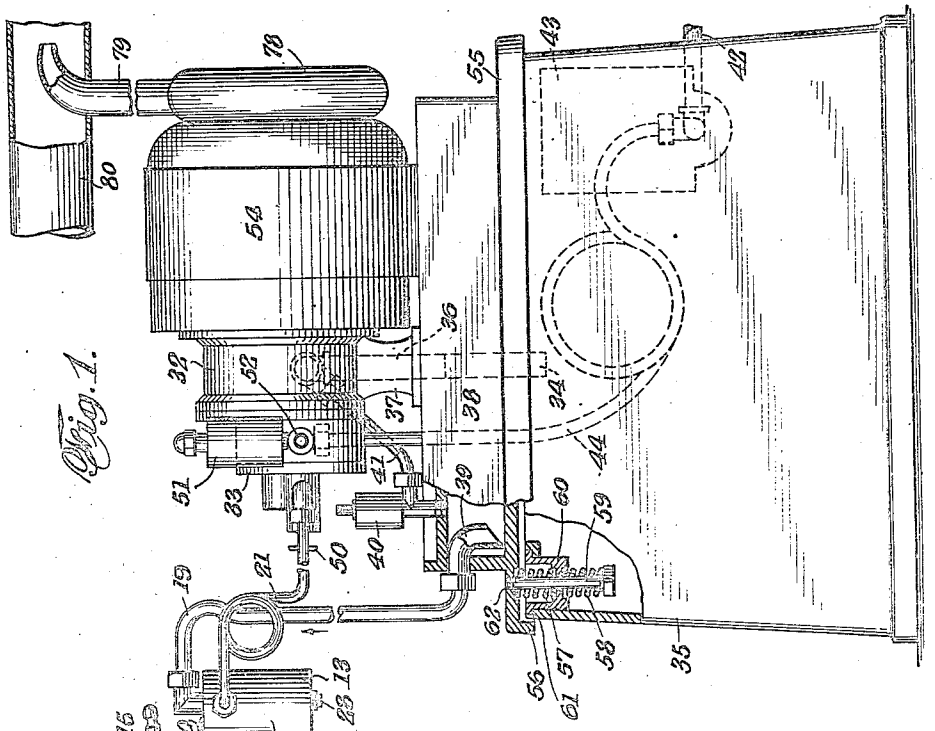


Fig. 1.

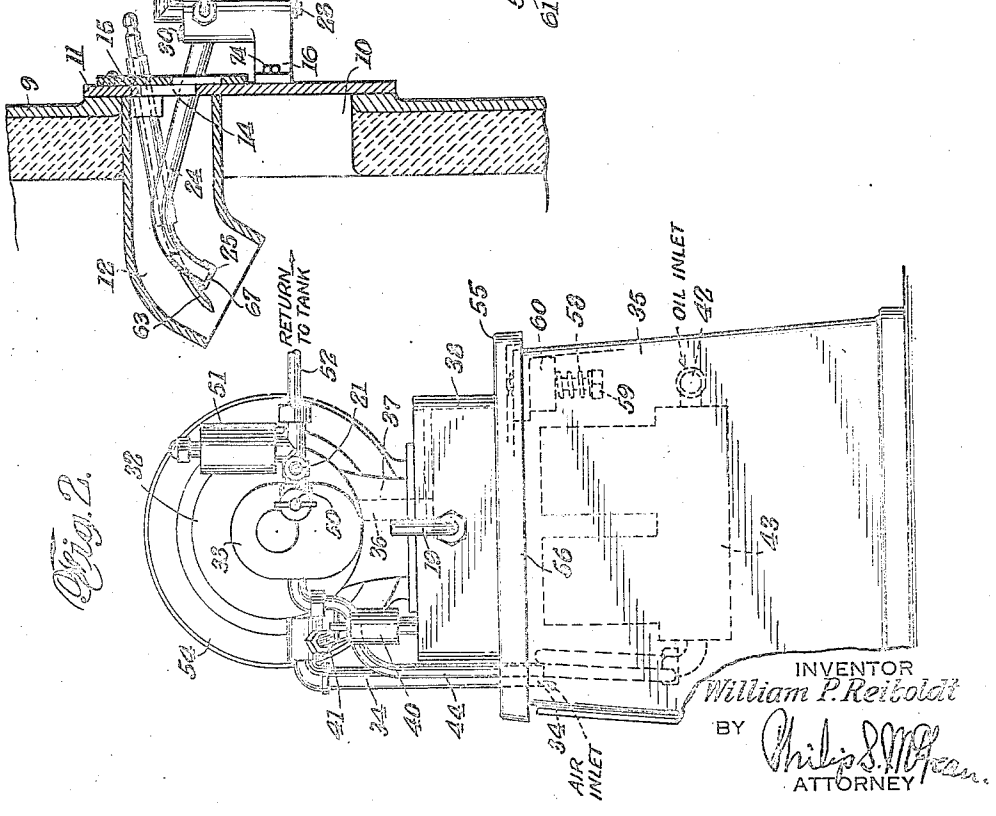


Fig. 2.

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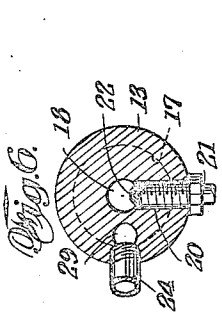


Fig. 6.

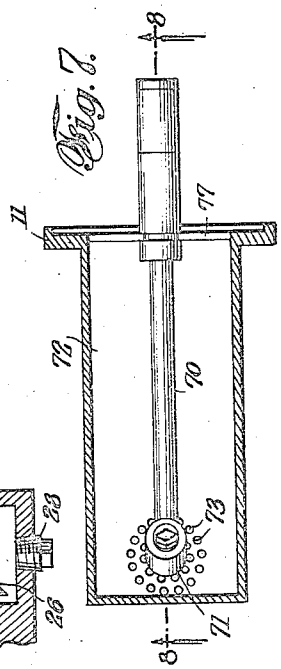


Fig. 7.

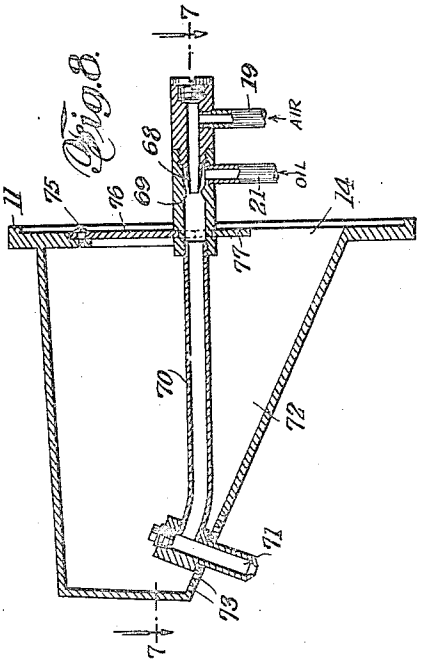


Fig. 8.

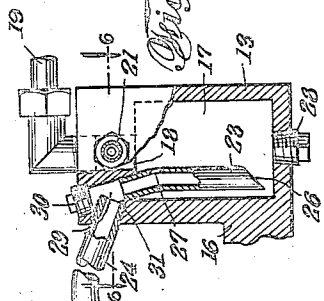


Fig. 5.

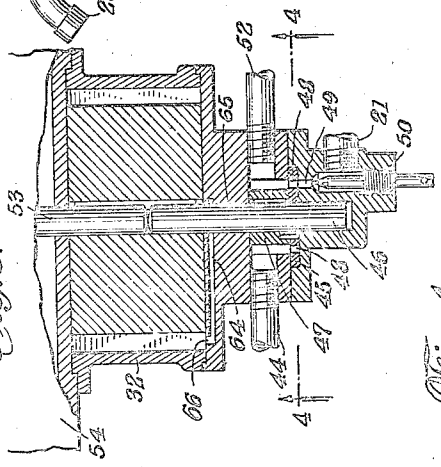


Fig. 3.

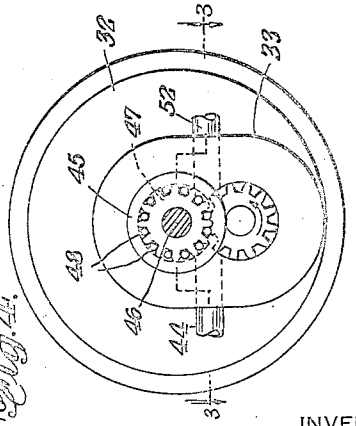


Fig. 4.

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2,028,807

UNITED STATES PATENT OFFICE

2,028,807

OIL BURNER

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Application February 5, 1935, Serial No. 5,020

9 Claims. (Cl. 158—73)

This invention relates to apparatus for burning oil.

Special objects of the invention are to provide a burner which will operate satisfactorily on low cost fuel, such as No. 4 or No. 5 fuel oil; to obtain smooth, even, uniform, quiet, efficient combustion and at relatively low pressure; to provide apparatus accomplishing these results, of relatively simple and inexpensive design; to provide fuel burning apparatus having a relatively wide range or output and capable of ready adjustment to suit different heat requirements; to provide fuel burning equipment of the above characteristics, which will be free of sensitive adjustments or servicing requirements and which will be safe, practical and desirable for the purposes intended.

The objects mentioned and others desirable in character are attained by the novel features of construction, combinations and relations of parts as hereinafter described, illustrated in the accompanying drawings and broadly covered in the claims annexed.

The drawings are illustrative in character, showing certain of the present preferred embodiments of the invention, it being apparent from the scope of the claims that various changes and modifications in structure may be resorted to, if desired, all within the true intent and broad scope of the invention.

Fig. 1 in the drawings is a broken part sectional and part side elevation view of a representative burner equipment.

Fig. 2 is a broken part sectional end elevation of the same.

Fig. 3 is a broken and part sectional view on a larger scale of the air pump and oil pump with parts appearing substantially on the line 3—3 of Fig. 4.

Fig. 4 is a vertical sectional view showing particularly details of the oil pump and the so-called "chopper" substantially on the plane of line 4—4 of Fig. 3.

Fig. 5 is a broken part sectional view of the combined atomizer and preheater.

Fig. 6 is a broken horizontal sectional detail taken on line 6—6 of Fig. 5.

Figs. 7 and 8 are horizontal and sectional views respectively of an alternative form of atomizer and preheater, Fig. 7 appearing as on line 7—7 of Fig. 8 and Fig. 8 appearing substantially on the line 8—8 of Fig. 7.

In Figure 1, there is indicated a furnace wall 9, having an opening 10, which may be considered as a fire door opening, since the latter constitutes a convenient and practical mounting for the burner head, particularly in cases where the oil burning equipment is a replacement for coal or other fuel.

The burner head is shown as consisting of a base or plate 11, secured as a cover over the furnace opening and serving as a support or carrier for an inwardly and downwardly directed air induction nozzle 12, at the inner or furnace side of the plate and a combined mixing and preheating chamber 13, at the outer side of the plate. The mounting plate has a free air induction opening or openings 14, therethrough in line with nozzle 12, which opening or openings if desired, may be regulatable by an adjustable slide or damper indicated at 15.

The mixer and preheater, 13, is shown supported in outwardly spaced relation from the mounting plate 11, by a bracket structure 16, to prevent overheating of the same.

By reference to Fig. 5, it will be seen that the preheater and mixer involves in its structure a mixing chamber 17, into the top of which discharges a vertical passage 18, connected with an air line 19. A lateral passage 20, opens into the side of vertical passage 18, and to this lateral passage 20 there is connected the oil line 21, which, as indicated in Fig. 6, may terminate in a nozzle structure 22, in the path of air flow down through passage 18. A discharge tube 23, extends from the lower portion, up through the top of the mixing chamber and communicates at its upper end with an upwardly and thence downwardly inclined mixture tube 24, entered through the air induction nozzle and having at its inner downwardly directed end, a cap 25, with an atomizing opening therein. The lower end of the discharge tube 23, is shown as close to the bottom of the mixing chamber and as beveled at 26, toward the downward jet from the vertical passage 18. At a point near the top of the chamber and also faced toward the downward jet, a passage 27, is provided in the tube 23.

The mixer 13 is shown as having a removable inspection plug 28, in the bottom of the same, which plug also is of aid in the assembly of the device when constructed as shown, that is, with a screw-threaded opening 29, down through the top of the chamber to receive the combined discharge and mixing tube 23. In assembling such a structure, the tube 23 may be entered up through the hole in the bottom of the chamber and screwed into its seat by a suitable tool passed up through said opening. Where the plug is located at the center of the chamber as shown, the top opening 29 may be drilled and tapped at

an angle coinciding with such opening and then after tube 23 is screwed to its seat, it may be bent back as shown to lie substantially parallel with the side of the chamber nearest the furnace. The upper end of opening 29 may then be closed by a suitable plug 30. The final discharge tube 24, extending from the mixing chamber in through the air induction nozzle may be screwed at its base into a downwardly inclined seat 31, opening into the side of the passage 29, the outer end being given the desired downward bend either before or after mounting it thus.

As shown in Figs. 1 and 2, air under pressure is supplied through the line 19 in the present disclosure by a rotary air pump 32, which may be of the sliding vane type as indicated, or of other suitable design and oil is forced through line 21 by an oil pump 33, which may be an intermeshing gear pump, substantially as indicated.

The air pump is shown as having an intake line 34, extended downwardly through the top of the hollow supporting stand 35, and a discharge line 36, extending down through the hollow pedestal 37, of the compressor into the top of an equalizing and pulsation elimination chamber 38. The air line 19 is shown as connected with this chamber by a coupling or connection 39, having a beveled lower end extended down close to the bottom of the chamber to serve as a collector for any oil that might drain down into this chamber.

A pressure regulator, which may be of the adjustable spring loaded valve type is shown at 40, connected with the top of the air chamber and having a relief pass 41, extended back to the intake of the compressor. Regulation of air pressure in the line 19, may be readily effected by simply adjusting this pressure relief valve.

The oil pump is shown as taking oil from a service line 42, through a solenoid valve 43 and a flexible pipe 44, extending from this valve to the intake side of the pump.

The heavier fuel oils, such as the so-called No. 4 and No. 5, which the burner will handle, vary widely in viscosity and contain varying amounts of heavier semi-solids more or less in the nature of vaseline. To enable the burner to work smoothly and efficiently with such materials, it has been found desirable to break or chop the fuel passed on by the pump. The gear teeth of the pump have a certain chopping action, but in addition, there is provided in the present disclosure a "chopper" in the form of a disc 45, Fig. 3, on the main shaft 46, of the pump at one side of the gear 47, thereon and having one or a number of perforations 48, therein, in line with the cuts between the gear teeth and adapted to register with a discharge passage 49, controlled by valve 50, and from which the oil line 21 extends to the burner head. The number of perforations and the pump speed determines the frequency of the chopper action and the valve 50, meters the fuel which can be passed by the chopper.

A pressure relief valve which may be of the adjustable spring loaded type, is indicated at 51, Figs. 1 and 2 in an oil return line 52, extending from the pressure side of the oil pump. A special feature of this oil return line, as indicated in Fig. 3, is that it extends from the pressure side of the pump at one side of and clear of the chopper, so that excess oil may be returned to storage without having to pass through the chopper, leaving the latter the duty of merely breaking up that oil which is actually being used.

The air and oil pumps 32, 33, are shown mounted in line with and driven by the shaft 53, of the motor 54, and the unit thus formed is shown as mounted upon and supported by the air chamber 38. This air chamber is in turn shown as having an extended base flange 55, projecting as a closure over the upper end of the hollow base or standard 35, and having a dependent skirt 56, concealing the connection between the motor-pump unit and the supporting base or stand.

The motor-pump unit is illustrated as having a cushioned mounting on the stand in the form of supporting and cushioning springs 57, 58, respectively, surrounding bolts 59, screwed into the bottom of the pump base and engaging above and below the mounting cups or washers 60, removably set in the seats 61, provided in the top of the hollow base stand. These spring mounts resiliently cushion and support the entire motor pump unit and the removability of the mounting washers or cups 60, enables detachment of this entire unit by simply lifting it off the pedestal, the oil line 44 to the pump being sufficiently flexible for this purpose or being readily disconnectible. In case of complete removal of the motor pump unit, the oil line 44, would be disconnected at some suitable coupling which might be at the solenoid valve or at the intake to the pump. When removed from the pedestal, the base of the motor pump unit enables this unit to be readily handled and to be placed in this unitary form on a bench or other support. If desired, the unit may be permanently mounted in this way, for example, be set flat on a floor or other support after removal of the bolts 59, or even without removing these bolts, the latter then constituting feet or elevating the pump base off the floor or other support. This unitary base flange (55) also enables the unit to be hung from above, where such a construction may be necessary as by putting suspension bolts or other supports down through the screw seats 62, in which the spring bolts 59, are entered.

A suitable electrode or electrodes, such as indicated at 63, Fig. 1, may be provided for igniting the mixture at the atomizing nozzle, the same being conveniently mounted on the base plate 11, of the burner head and extending inwardly through the air induction nozzle 12, to a point adjacent the atomizer cap 25. The transformer usually required for electric ignition may be mounted in the hollow base or pedestal 35, where it may to some extent be cooled by the flow of air drawn from within the pedestal through the suction pipe 34, of the compressor. This arrangement also has the effect of muffling the intake of the compressor.

The fuel handled by the oil pump serves to lubricate the same and in order that the air pump also may be automatically lubricated, there is provided in the present disclosure, a small passage 64, Fig. 3, in the outer wall of the compressor casing, extending from the oil pump bearing 65, in that wall and opening out into the suction side of the air pump at 66. These parts are proportioned and arranged so that this oil passage will draw off enough oil from the inner oil pump bearing to properly lubricate the compressor. Careful regulation of the quantity of this lubricating oil is not required as any more than that actually needed simply passes down into the air chamber 38, and from there is blown up the collector 39 and out through the air line 19, to the burner head. This arrangement also is effective to keep the parts clean, the suction exerted by the air pump having the effect of removing traces of oil which

otherwise might appear about the oil pump bearings.

Operation

Air drawn from within the hollow base 35 through pipe 34 is compressed by the air pump 32, and passed downward through conduit 36, into the equalizing pressure chamber 38, and any oil that may have been passed into this chamber by the compressor or may have drained back through air line 19, when the burner was previously shut off, is blown up past the inclined lip of the collector 39, and out through the air line 19 into the top of the atomizing chamber 13. Fuel oil from the line 44, is picked up by the gear pump and chopped by flow between the gear teeth and through chopper disc 45 to the pressure outlet 49. Fig. 3, the amount of this oil permitted to pass by the metering valve 50, flowing through the line 21, to the side atomizing nozzle 22 (Fig. 6) in the head of the mixing chamber. The downward blast of air through passage 18 (Fig. 5) atomizes oil issuing from nozzle 22, and this atomizing effect is enhanced by the turbulence created in the lower portion of the chamber 17, where the mixture passes upward over the inclined lip 26, into the lower end of outlet tube 23. Part of this mixture enters this tube through the upper opening 27, at the bend in the tube 23. In the course of such flow, the mixture is preheated by reason of the proximity of chamber 13 to the base plate 11 (Fig. 1), which is applied over the fire door or other suitable opening 10 in the furnace wall.

The preheated atomized mixture is projected from the mixing unit 13, upwardly and thence downwardly by burner tube 24, with a final atomizing effect exerted by the atomizing cap 25, at the end of this tube.

The burner is operated at relatively low pressure, at present a pressure of between one and two pounds at the atomizing tip, producing a quiet, smooth, uniform efficient flame. At this low pressure, a fairly large atomizing opening 67, in the burner tip, of approximately 3/32" may be employed. This is ample to pass any ordinary impurities in the oil, does not clog and produces a desired dispersion, resulting in the drawing in of free air through the surrounding induction nozzle 12, sufficient to effect complete combustion of the fuel.

With the relatively low pressure at which the burner operates, there is no forcing of the flame and no blowing of combustion products up the chimney. Consequently, a low stack temperature can be maintained with little or no heat loss up the stack.

The spacing of the mixing chamber back from the mounting plate 11 prevents overheating of the mixture such as might cause carbonization. While with proper regulation there should be no oil, as such, in the burner tube 24, the slope of said tube back to the mixing chamber assures that any oil possibly left in this tube may drain back into the atomizing and mixing chamber when the burner is cut off. The construction of the atomizing and mixing chamber assures that any such oil drained back thereinto will be passed on with the mixture, to the point of combustion. When the burner is shut down, any oil that may be in the air line 19, may be drained back into the chamber 38, ready to be picked up by the air at the next start of the burner.

On stopping the air pump, the air in the expansion chamber 38, picking up heat from the adjoining parts, may expand and this with expansion of air remaining in the preheater 13, may force the burning of the last bit of mixture at the burner tip, preventing drip and other objectionable features.

The quantity of fuel delivered by the oil pump may be regulated as required by adjusting the oil return valve 51, and in generally similar fashion, the pressure of air may be regulated by adjusting the pressure relief valve 40, connected between the air reservoir 38 and suction side of the air pump. These two are the only adjustments needed to regulate the output of the burner and the special construction and arrangement disclosed provides a wide range of adjustment enabling one size burner to answer a considerable range of heating requirements.

As the mixing and complete atomization is effected at the burner head and only air and oil are conducted to the head, the pumping unit may be located where most convenient, either near to or far removed from the burner head. This unit may thus be placed in some out of the way location, where it will not be seen or heard. The burner head is a relatively small unit, readily applicable to existing furnaces without disfiguring or marring the appearance of the same.

The cushioning of the motor pump unit deadens any sound and prevents transmission of vibration through piping to the burner head. When desired, this unit may be readily lifted off its pedestal and be supported on its own base on a floor, bench or other object.

The burner as a whole contains no complicated or expensive parts, all the parts in fact being simple and of sturdy design, inexpensive to manufacture and assemble. There being no intricate parts or such requiring sensitive adjustments, it is possible to install and operate the equipment without any special skill or training and servicing needs are reduced to a minimum.

In a modified form of burner head, the injector effect of the air stream is utilized to induce and effect atomization of the oil, such a construction is shown in Figs. 7 and 8, where in place of the atomizing and preheating chamber 13, there is provided an air nozzle 68, projecting through a venturi 69, connected with the oil line. The burner tube 70, carries a downwardly directed atomizing nozzle 71, corresponding generally to the downwardly faced nozzle tip or cap 25 in Fig. 1.

Also in the modified construction, the inwardly extending and downwardly directed air inducing preheating nozzle 12, is replaced by an air inducing and preheating chamber 72, surrounding the burner tube and having air discharge passages 73, surrounding or about the atomizing tip.

The invention avoids the need for maintaining pools or reservoirs of liquid fuel and hence is clean and free of odor. The system, except for the air intake in the base, is entirely closed and the air compressor tends to keep the unit clean by drawing any free oil from the oil pump bearings, any such oil if not entirely used in the compressor passing on to the air chamber 38, and thence out through the air line to the burner head. No mechanical mixers or mechanically operating valves are required, the only operating parts being simply the air pump and the oil pump, the chopper being actually a part of the oil pump itself. In both forms of the burner head disclosed, that is, in Figs. 1, 7 and 8, the burner tube 24 or 70, projects from a preheating and atomizing chamber spaced at the outside of the mounting plate through the air inducing and air pre-

heating hood or nozzle and terminates at its inner end in a downwardly directed atomizing nozzle surrounded by a stream or streams of preheated air. The invention has the advantage that no critical adjustments are required and that practically uniform operation is secured. With the use of a gear pump instead of a more complicated and expensive metering pump, such as have heretofore been considered necessary. The burner is particularly safe because of the low pressure employed and because in fact the system is self protective in that if the diaphragm or valve mechanism of the pressure determining valve break or get out of order, the oil flow created by the pump will simply be returned to storage. The action of the burner is substantially instantaneous, the final atomizing tube delivering a very fine mist which accompanied by the induced air will ignite and burn immediately and without any preliminary explosive action. The atomizer cap 24 is preferably made with a relatively large atomizer opening both because of the low pressure operation and to allow for a wide range of heat delivery. If desired, different size atomizer caps may readily be substituted, but for simplicity a wide range atomizer cap is ordinarily preferred.

In both forms of the invention, it is to be noted that the atomizing chamber located at the outer end of the air inducing and air preheating hood or nozzle is spaced back from the base structure in such a way as to be more or less in the path of the induced air. This both prevents overheating in the atomizing stage and to some extent preheats the air induced in the nozzle or hood. In the first form of atomizer, Fig. 5, the opening 27 in the upper portion, at the bend in the tube 23, aids in the mixing and atomizing and also in effecting discharge of the mixture up into the inclined burner tube 24.

In both the forms shown, the combination mixer and atomizer, carrying the burner tube is quickly removable from the base plate, in Fig. 1, upon simply removing the mounting bolts 74 and in Figs. 7 and 8, upon removing screw 75, which fastens the plate 76, holding the burner tube 70, down on the bridge piece 77.

The special combinations disclosed accomplish repeated or successive atomization. Thus any compressor lubricating fuel oil in the air chamber 38 will be forced out of that chamber with the air in a mixed or atomized condition. This air in line 19, if it carries a certain amount of atomized lubricating fuel oil, has a greater affinity for more oil and consequently is the more effective in atomizing the oil from the fuel line 21, which is delivered by atomizing nozzle 22, into the air passage 18 in the top of atomizer 13, Fig. 5 or in Fig. 8, is delivered into the venturi 69. Additional and final atomization is effected at the burner tip 25, Fig. 5, and 71, Fig. 8, and, in the first form further mixture or atomization is effected intermediate these points by turbulence in chamber 17, by the inclined atomizing lip 26 and by the atomizing port 27 in the side of tube 23. By such repeated atomizing effects, the burner is enabled to handle the heavier and cheaper fuel oils and its ability so to do is enhanced by the preliminary chopping or grinding effect accomplished by passage of the oil between the teeth of the gear at the pressure side of the oil pump. Operating as disclosed, the air necessary for combustion is supplied without forcing in an excess of air which would tend to cool the fire and force part of the combustion products up the stack. If the stack draft is so low as to require some acceleration for best burner operation, this may be accomplished without forcing in air which would cool the flame, by providing a blower as at 78, in Fig. 1, on the end of the motor shaft opposite the pump end and connected by a pressure line 79, with the furnace pipe or stack 80, creating an up draft which may draw in more air through the more or less customary bottom damper (not shown) of the furnace and through the air induction tube of the burner head.

While preferred forms of the invention have been illustrated and described, it will be appreciated that the invention is not confined to such particular disclosure. Words and phrases employed herein have been used in a descriptive rather than in a limiting sense.

What is claimed is:

1. In an oil burner, a heat conducting base plate for application to a furnace opening, an inwardly projecting air induction and air preheating hood at the furnace side of said base plate, a preheating and mixing chamber supported by and spaced from the outer face of said base plate and heated thereby, said base plate having a free air inlet opening extending therethrough into said hood and a burner tube projecting from said preheating and mixing chamber through said air inlet and preheating hood and terminating in a downwardly directed atomizing nozzle.

2. In an oil burner, a heat conducting base plate for application to a furnace opening and having a free air opening therethrough, an inwardly projecting air inlet and air preheating hood on the inner face of said base plate in line with said free air opening, a mixing and mixture preheating chamber mounted in outwardly spaced relation on the outer face of said base plate and heated thereby, a burner tube extending from said chamber inwardly through said air preheating hood and terminating in a downwardly directed atomizing nozzle and means for furnishing a stream of fuel oil and a flow of air to said chamber.

3. In an oil burner, a chamber with a downwardly directed air passage in the upper portion of the same, means supplying air under pressure to said passage an oil nozzle entered through the side of said air passage, a discharge tube extending upwardly from the lower portion of said chamber and having an inclined lip at its lower end and an opening in the upper portion of the same, a burner tube in communication with said discharge tube extending laterally from said chamber, said burner tube sloping upwardly and thence downwardly, a downwardly discharging atomizing tip carried by said burner tube and a downwardly directed air inlet and air preheating nozzle about said burner tube.

4. An oil burner of the character disclosed, comprising an air preheating hood provided with means for mounting same in a furnace opening, said hood having an air induction opening at the outer end of same and an air discharge opening at the inner end of same, a mixture supplying tube extending from the outer end of said preheating hood through said hood to the inner end of same and terminating in an atomizing orifice, an air and oil mixing chamber connected to the outer end of said mixture tube and disposed in the path of air induced into the outer end of the air preheating hood, means for delivering oil and air under pressure into said chamber and means in said chamber for effecting mixture of the oil and air delivered thereto.

5. An oil burner of the character disclosed, comprising an air preheating hood provided with means for mounting same in a furnace opening, said hood having an air induction opening at the outer end of same and an air discharge opening at the inner end of same, a mixture supplying tube extending from the outer end of said preheating hood through said hood to the inner end of same and terminating in an atomizing orifice, an air and oil mixing chamber connected to the outer end of said mixture tube and disposed in the path of air induced into the outer end of the air preheating hood, means for delivering oil and air under pressure into said chamber, and means in said chamber for effecting mixture of the oil and air delivered thereto, said last named means including intersecting air and oil passages in the upper portion of the chamber and a discharge tube connected with the mixture tube, said discharge tube having an opening in the side of the same and extending down into the lower portion of the chamber.

6. An oil burner of the character disclosed, comprising an air preheating hood provided with means for mounting same in a furnace opening, said hood having an air induction opening at the outer end of same and an air discharge opening at the inner end of same, a mixture supplying tube extending from the outer end of said preheating hood through said hood to the inner end of same and terminating in an atomizer orifice, an air and oil mixing chamber at the outer end of said mixture tube and disposed in the path of air induced into the outer end of the air preheating hood, means for delivering oil and air under pressure into said chamber and means in said chamber for effecting mixture of the oil and air delivered thereto, including an injector made up of cooperating air and oil nozzles.

7. An oil burner comprising a base plate, an air induction and air preheating hood projecting from one face of said plate and having a downwardly directed discharge opening, a mixing and mixture preheating chamber removably mounted in spaced relation on the opposite side of said base plate, a mixture carrying tube projecting from said chamber upwardly and thence downwardly through said air induction and preheating hood and terminating in an atomizing nozzle and air and oil conduits terminating in oil and air mixing relation in said chamber.

8. An oil burner, comprising a mixing and mixture preheating chamber having a downwardly directed inlet passage in the upper portion of the same, oil and air supply means delivering to said passage, a discharge tube extending upwardly from the lower portion of said chamber and having an inclined lip at its lower end and an opening above the same, a burner tube in communication with the upper portion of said discharge tube extending laterally from said chamber, said burner tube sloping upwardly and thence downwardly, a downwardly discharging atomizing nozzle carried by said burner tube, a downwardly directed air induction and preheating nozzle about said burner tube and having an air inlet adjacent said chamber and a common support for said chamber and said air induction nozzle.

9. An oil burner, comprising a heat conducting base plate having an air inlet and an air induction and air preheating hood projecting from said air inlet and terminating in a downwardly directed discharge nozzle, a mixing and mixture preheating chamber mounted in spaced relation on the opposite side of said base plate, means supplying air and oil to said chamber, a mixture carrying tube projecting from said chamber through said air inlet opening and terminating in a downwardly directed atomizing nozzle in the nozzle end of said air induction and preheating hood, and oil and air mixing means within said chamber and in communication with the mixture carrying tube projecting therefrom.

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