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MEANS FOR OIL BURNERS

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2 Sheets-Sheet 1

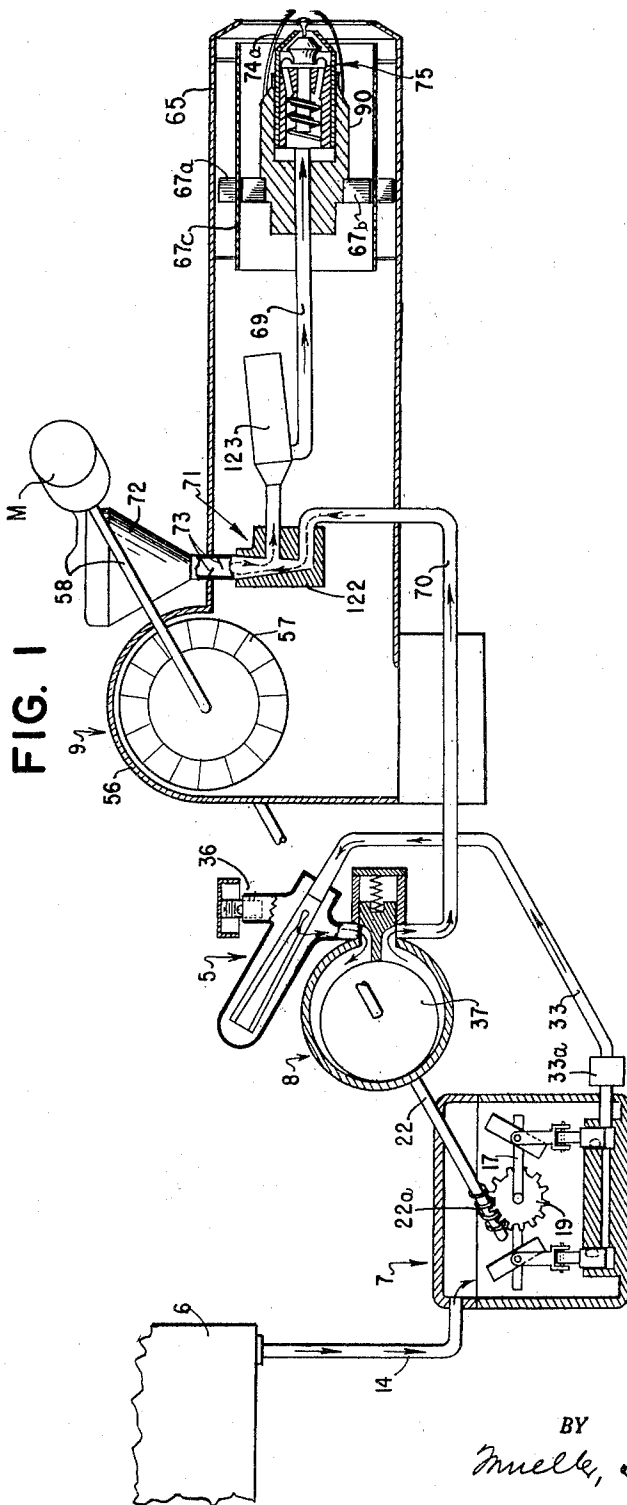


FIG. 1

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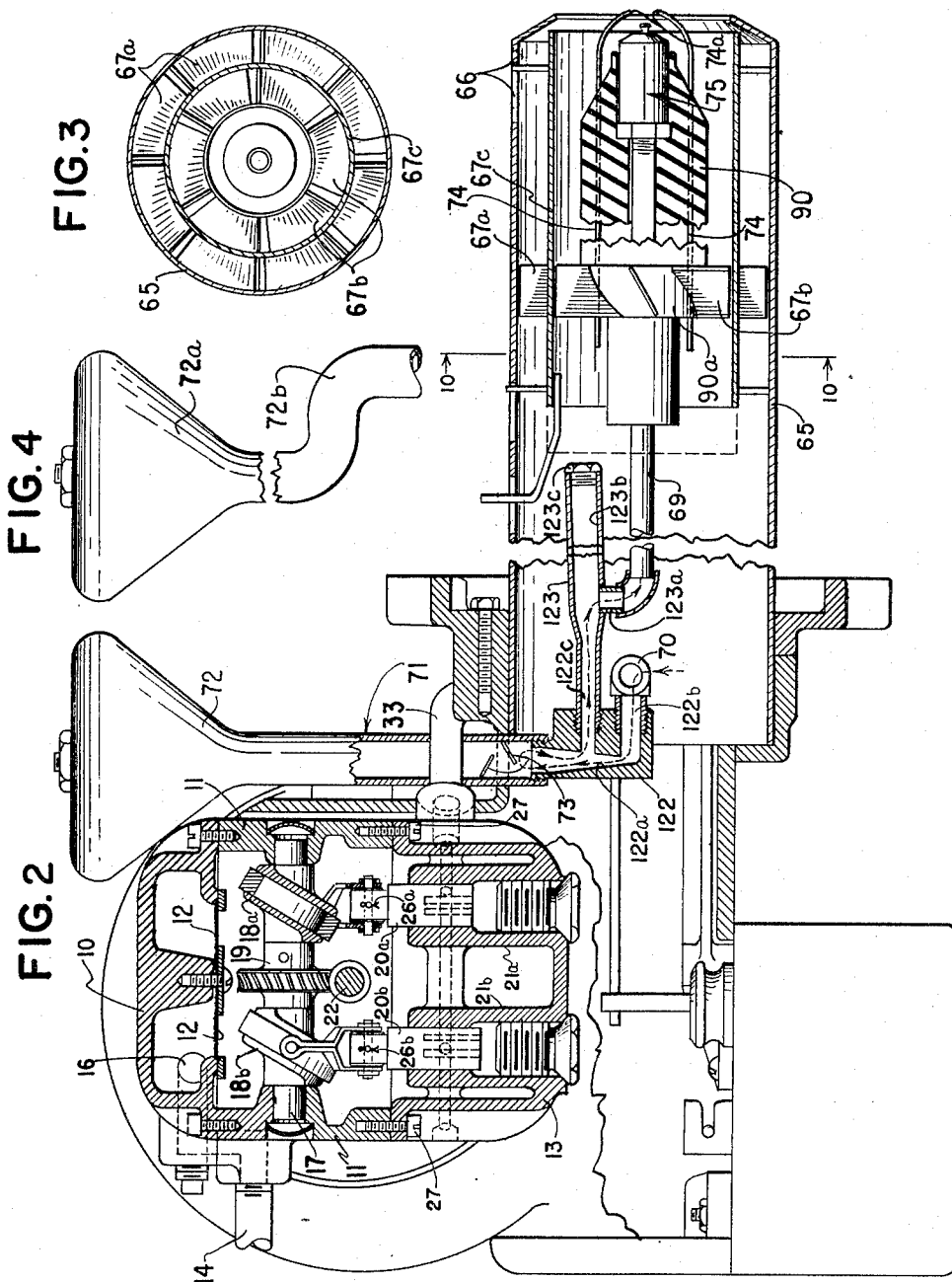
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LIQUID FUEL AND AIR MIXING AND SUPPLY
MEANS FOR OIL BURNERS

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2 Claims. (Cl. 158—36.3)

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This invention relates generally to liquid fuel burners and more particularly to a low pressure fuel mixing system for an oil burner.

Although liquid fuel burners have been used for many years and presumably developed to some degree of perfection, there are still numerous inherent disadvantages in structure, operation, and maintenance, which have evaded strenuous efforts to overcome the same. Present day liquid fuel burners for domestic and commercial use generally operate on a high pressure atomized fuel principle wherein fuel is delivered to a nozzle at pressures of 100 lbs. per square inch and greater, and the quantitative delivery of the liquid fuel itself, as well as the physical condition of the fuel delivered is regulated by the size of the orifice at the nozzle. This condition requires a rather delicate adjustment at the nozzle orifice, and with a change in fuel, or a change in the requirements of the quantity of fuel delivered, a change in nozzle has been necessary. This results in the requirement that the operator stay within a very limited range of fuels which can be burned in a particular construction, which is sometimes inconvenient if the particular fuels are not readily available, and also results in expensive operation if the particular liquid fuel which the burner is capable of handling is itself expensive.

In addition to these inherent disadvantages in systems now in use, it has been found that such systems require rather constant servicing to maintain the restricted nozzle orifice in proper operating condition. Furthermore, the sometimes complicated and rather fragile parts for these high pressure atomized fuel burners have a relatively short life and require replacement from time to time during the life of the complete burner system.

It is an object of the present invention to provide an improved, simplified, and long-life liquid fuel burner for household and commercial purposes.

Another object of the invention is to provide a system for burning liquid fuels varying over a wide range so far as specific gravity and viscosity are concerned. In fact, it is an object of the invention to provide a system for burning any type of combustible liquid fuel which flows.

Another object is to provide a liquid fuel burning system of this character which will satisfactorily burn fuel over the wide range of physical characteristics previously described, and yet for the same general heat output, will burn these

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various fuels without adjustment or change in the burner system.

A still further object of the invention is to provide a burner of liquid fuels which will not only have a long effective life, but requires substantially no servicing throughout the life thereof.

It is still another object of the invention to provide a liquid fuel burning system which operates at low nozzle pressures and delivers an aerated-finely-divided fuel to a combustion chamber by a fuel pumping and air mixing mechanism which will act on substantially any combustible liquid fuel which flows.

Another feature of the invention is the provision of a liquid fuel burning system operating at low pressures, and supplying liquid fuel by volumetric displacement at operating speeds of 50 R. P. M., and even lower, for the oscillating eccentric mechanism of the fuel-metering-and-supply pump.

Another feature of the invention is the provision of a liquid fuel burning system operated at relatively low pressures and provided with large bores and orifices throughout the system so that a dependable supply of fuel is provided for combustion, without servicing and adjustment of parts to adapt the system to various fuels and operating conditions.

Another feature of the invention is the provision of a system which, without adjustment of parts, is capable of burning liquid fuel as light as kerosene, or even lighter, and as heavy as asphalt cut by a distillate only enough to cause the asphalt to flow.

According to another and more specific object of the invention, improved facilities are provided for minimizing fluctuations in the pressure of the aerated liquid fuel delivered to the combustion chamber and for preventing puffing or irregular combustion during the starting periods of the apparatus.

In practicing the present invention, a complete burner system is provided having means for supplying liquid fuel to a burner nozzle at pressures as low as 3 lbs. per square inch, and supplying such fuel in a highly aerated atomized form resulting from mixing of air and fuel within the complete burner structure rather than from atomization by high pressure and small nozzle orifice at the outlet nozzle for the burner as is customary in prior devices. The orifice in the burner nozzle is relatively large, being generally $\frac{1}{8}$ inch in diameter or larger, and combustible liquid fuel is delivered thereto by mechanism in-

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cluding a metering pump which operates substantially at zero pressure and at speeds as low as 50 R. P. M., to supply a measured quantity of liquid fuel from a supply tank to an air and fuel mixing pump which sucks the fuel from the metering pump and simultaneously sucks in air for mixing with the fuel, which thereafter is delivered in mixed form into the fuel supply line to the burner nozzle. A combination flare preventing and air cushioning device is provided in the fuel line to maintain a constant flow of liquid fuel mixed with a corresponding substantially constant volume of air upon the initiation of operation of the burner, and to assist in maintaining a smooth flow of the mixed fuel and air after the beginning of burner operation. This low pressure liquid fuel burning system, operating on a volumetric displacement principle for the liquid fuel, will successfully burn liquid fuels varying over a wide range in specific gravity and viscosity. It has been found, for example, that the same burner with the same parts, and without any adjustment, will burn distillates as light as kerosene, and liquids as heavy as asphalt "cut" with a sufficient quantity of lighter distillate to permit the complete mixture to flow readily from a supply tank into the metering pump. The large orifices and bores throughout the system, low pressure operation, and simplicity of parts, permits the burning, not only of this wide range of clean fuels, but permits the use of a wide range of liquid fuels having dirt and other particles therein. Thus, ordinary oil drained from an engine or crank case can be utilized successfully with only a coarse strainer being provided in the burner to prevent correspondingly coarse particles or pieces that might be in such a supply of oil from entering the metering pump.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings, in which:

Fig. 1 schematically illustrates the working parts of an improved liquid fuel burning system characterized by the features of the present invention;

Fig. 2 is a side view partially in section illustrating the details of the fuel metering pump, the air cushioning and flare preventing means, and the flame shape adjusting means embodied in the burner;

Fig. 3 is an end sectional view of the blast tube and enclosed facilities provided to deliver supplementary air to a combustion chamber;

Fig. 4 is a fragmentary side view illustrating a modified embodiment of the air cushioning structure.

Referring now to the drawings and more particularly to Fig. 1 thereof, the present improved liquid fuel burning system is there illustrated in its use to deliver an aerated mixture of liquid fuel and air to a combustion chamber defined within suitable chamber walls. Liquid fuel is delivered to the system from a conventional supply tank 6 through a conduit 14 which leads to the inlet side of a slow speed fuel metering pump 7 having the primary function of measuring and delivering into the succeeding portions of the system liquid fuel. From the metering pump 7, the measured fuel is delivered through a check valve 33a, a conduit 33 and a flow control device 5 to a relatively high speed fuel and air mixing pump 8 of the eccentric type. The inlet side

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of the mixing pump also communicates with the atmosphere through an adjustable air breather assembly 36, so that during each revolution of the pump rotor 37 a quantity of fuel and a predetermined quantity of air is sucked into the pump chamber of the pump. In effect, therefore, the pump 8, which under ordinary conditions of atmospheric temperature can only "bite off" a given quantity of air during each revolution, functions to determine the fuel-to-air ratio of the mixture delivered to the combustion chamber. Since the pump 7 is essentially a constant volume device and the pump 8 is only capable of "biting off" a given quantity of air during each revolution of its rotor, it will be understood that the fuel-to-air ratio, by volume, remains substantially constant regardless of the characteristics of the fuel delivered to the measuring pump 7.

From the fuel and air mixing pump 8, the mixture of fuel and air is delivered under pressure through the conduits 70 and 69 to the discharge nozzle 75 for transmission through the orifice of this nozzle into the combustion chamber. In order to minimize fluctuation in the pressure of the air and fuel mixture being delivered to the nozzle 75 and thus insure more even burning of the mixture within the combustion chamber, and for the additional purpose of preventing puffing or interrupted combustion during the starting periods of the burner, the connected and communicating conduits 69 and 70 are arranged to communicate with a combination pulsation cushioning and fuel flow control device 71. This device comprises a dome shaped cushioning structure 72 which is arranged in elevated relationship relative to the conduit 69, thereby to prevent oil from accumulating in its chamber which might flow back into the conduit system at the end of a burning period to provide an excess of fuel at the start of the next succeeding burning period. Further to this end, additional facilities comprising the angularly disposed baffle plates 73 are provided in the conduit connecting the chamber of the structure 72 with the conduits 69 and 70. These baffles function in the manner more fully described below to form an oil block which separates the oil from the air and prevents the oil from passing upwardly into the cushioning chamber.

Supplementary air which assists in producing efficient combustion of the mixture delivered to the combustion chamber is furnished by a blower 9, Fig. 1, having a fan or blower wheel 57 housed within a shell 56 which communicates with a blast tube 65 projecting into the combustion chamber. At the end of this tube an improved and adjustable structure, comprising an adjustable inner shell 67c and swirl baffles 67a and 67b formed integral with the shell 67c, is provided for dividing the supplementary air into two streams and for imparting opposed whirling action to the two air streams as the air enters the combustion chamber, thereby to provide for intimate mixture of the supplementary air with the fuel and air mixture entering the combustion zone through the nozzle 75. Ignition of the combustible mixture delivered to the combustion chamber during each starting period of the burner is produced by means of an electric discharge between the discharge points 74a of a pair of insulated electrodes 74 which are connected to opposite terminals of a suitable high voltage source, not shown, and are embedded within a formed ceramic piece 90 disposed concentrically within the shell 67c. This ceramic

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piece is recessed longitudinally thereof to receive the nozzle 75 and connecting conduit 69. Control of the ignition circuit may be effected in any conventional manner forming no part of the present invention.

All moving parts of the burner are arranged to be driven by a common motor M preferably having a rated speed of 1750 R. P. M. More specifically, the structural arrangement of the burner is such that the blower wheel 57, the pump rotor 37 and the driving element of the metering pump 7 are in alignment axially of the motor rotor shaft 58, so that they may be easily interconnected to be concurrently operated by a single motor M. This structural arrangement lends itself to the production of a burner of simple mechanical construction in which unnecessary duplication of parts is minimized.

As best shown in Figs. 1 and 2 pump 7 is in the form of an oscillating eccentric pump which provides valve closing and pumping operations, is substantially the same as those heretofore in common use for similar pumping operations and effectively functions as a volumetric metering device. It operates at a slow speed to measure a positive volume of liquid fuel from a supply tank. Not only does this particular pump provide accurate and dependable fuel metering, but it additionally serves to close the supply line between the fuel tank and the burner when the burner is not in operation, thereby preventing flooding of the burner upon stoppage of the burner operation. In order to prevent oil seepage from the storage tank through the pump 7 to the line 33 when the burner is stopped for any long period of time, such as during the summer months, a spring loaded ball check valve 33a as shown in Fig. 1 is provided in the conduit 33. This valve opens only during each pumping stroke of the pump 7.

Referring to Fig. 2, the pump comprises a housing in the form of a top casting 10 which is secured to a middle section casting 11, with the latter casting supporting a third or bottom casting 13. A filter 12 is provided intermediate the top and middle castings for straining out any coarse particles or foreign material which might get into the fuel tank from salvage oil and the like. The lower casting 13 is in the form of a cylinder body and is detachably secured to the middle section at the bottom of the pump. Carried within cylinders 21a and 21b, formed in the lower casting 13, are pistons 20a and 20b which are operated by oscillating eccentrics 18a and 18b, respectively, carried on a shaft 17 which is driven from the motor shaft 58 through shaft 22, worm 22a, and a worm gear 19 mounted on the shaft 17. Fuel oil is delivered by gravity from the supply tank 6 through the supply line 14 and the port 16 into the cavity within the top casting 10. The oil flows through the filter screen 12 down into the piston and shaft cavity in the section 11 as well as down into the cylinders in the cylinder body portion 13. Although the oil flows through the supply line 14 from the supply tank primarily by gravity, there is also some amount of suction pressure on the oil coming into the metering device because there is a tight connection between each piston and its cylinder within the pump.

In view of the slow speed at which the metering pump 7 operates a very slight and almost imperceptible variation in flame intensity within the combustion chamber occurs if no means are provided for smoothing out the flow of fuel

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to the air and fuel mixing pump 8 and subsequently to the fuel mixture delivery nozzle 75. In accordance with the present invention, the flow control device 5 is provided to smooth out the liquid fuel pulsations causing such variations in flame intensity.

The air and fuel mixing pump 8 (Fig. 1) receives the mixture of liquid fuel and air from the flow control device 5 and delivers this mixture to the conduit 70.

In the present system, the liquid fuel trapped between the mixing pump 8 and the nozzle during a period when the burner is not operating tends to accumulate in the general vicinity of the outlet end of the conduit 70 and the low end of the conduit 69. Such accumulation of fuel during an idle period of the burner is caused by separation of the fuel from the air stream, and would normally be discharged in a body or slug at the start of the next burner operating period. If this accumulation of oil were permitted to flow with the first charge of oil and air directly into the conduit 69 and out the nozzle 75, there would be an initial sudden flare and black smoke and hence carbon or soot which would, of course, be very undesirable. There would also be a short interval when there was no flow of fuel or rather the fuel flow was less than normal and consequently it could happen that after the initial flare, combustion would stop and then restart after a slight interruption. Thus, with unimpeded shooting of the oil into the conduit 69 there would either be insufficient oil at the nozzle to start combustion, or very ragged and interrupted combustion would occur at the start of burner operation which would cause puffing and spitting until a normal fuel flow was established.

In order to obviate the flare which would otherwise occur during each burner starting period and to provide for a steady flow of fuel mixture into the combustion chamber after operation of the burner is initiated, the combination air cushion and flare preventing device indicated generally at 71 in Figs. 1 and 3 of the drawings, is provided. In brief, this device comprises an entrance fitting 122 having an inlet opening 122b communicating with the outlet end of the conduit 70, a fuel discharge fitting 123 communicating with the discharge opening 122c in the fitting 122, and a dome-shaped air cushioning structure 72 arranged in elevated relationship relative to the fitting 122. More specifically, the outlet and inlet openings 122c and 122b of the fitting 122 are disposed one above the other in the order named, and communicate with a cone-shaped cavity 122a which opens at the top into the elongated tube leading to the air cushioning chamber of the structure 72. Directly above the open end of this cavity, and within the tubular part of the structure 72, opposite extending baffles 73 are provided to prevent oil from passing into the cushioning chamber at the top of this structure. The fitting 123 is in the form of a tube having two diameters and is provided along the length thereof with a discharge opening 123a communicating with the conduit 69 leading to the nozzle 75. At its projected end, this fitting is closed by a screw plug 123c. The large diameter portion 123b of the fitting is, in the installed position of the burner, disposed at an angle of approximately five degrees relative to the horizontal, with the extended end thereof being located above the end closest to the fitting 122.

During normal operation of the burner, the air and fuel mixture flows directly from the conduit 70 through the passages 122b, 122c, and 123a to the conduit 69 for delivery to the nozzle 75. Since this mixture is under pressure, a pressure is built up in the closed air cushioning chamber within the structure 72, which pressure opposes the pressure of the combined air and fuel mixture traversing the conduits 69 and 70. This elastic opposing pressure serves to damp out pressure pulsations or fluctuations produced in the mixture through the action of the air and fuel mixing pump 8. When operation of the burner is stopped, oil will accumulate in the lower portion of the cavity 122a within the fitting 122 as a result of separation of the oil from the air. When operation of the burner is restarted this accumulation of oil is thrown upward in the cavity 122a against the baffles 73 where it is broken up to flow downwardly and out the passage 122c into the fitting 123. The excess of oil is forced past the discharge opening 123a in this fitting and flows up the inclined bottom wall of the fitting portion 123b. This oil gradually flows back along the inclined bottom wall of the fitting to enter the outlet passage 123a for delivery to the nozzle 75. Thus the device 71 functions to prevent the excess of oil accumulated in the conduit system from being discharged as a slug into the combustion chamber during a burner starting period.

As will be evident from the above explanation, the baffles 73 function to prevent the oil from entering the air cushioning chamber of the structure 72. A modified structure for this purpose which may be used with or without the baffles 73 is illustrated in Fig. 11 of the drawings. As there shown, the tube leading from the fitting 122 to the dome-shaped air cushioning chamber is provided with a double elbow or offset portion 72b having the function of blocking the passage of oil into the air cushioning chamber. With this arrangement, oil forced upwardly in the tube strikes the shoulder at the top of the first bend in the double elbow 72b and thus is prevented from entering the air cushioning chamber 72a. The oil then drains slowly back to the fitting 122 along the side walls of the vertical portion of the tube.

From the above description it is seen that the invention provides an air and fuel mixing system for an oil burner in which the mixture is retained in an aerated form for discharge from the burner nozzle. The air cushion and flare preventing device 71 constitutes what might be termed a percolator valve in that it eliminates the discharge of any oil slugs through the nozzle 75, on the commencement of burner operation, and during burner operation functions continuously to percolate or move air into the fuel mixture passing through the device 71.

Although the invention has been described with respect to a preferred embodiment thereof it is to be understood that it is not to be so limited since changes and modifications can be

made therein which are within the full intended scope of the invention as defined by the appended claims.

I claim:

1. In an oil burning apparatus having a nozzle, the means for preparing and supplying an air and oil mixture to said nozzle for burning comprising an air and oil mixing unit, a cushioning chamber including at its lower end an upright inverted cone shaped portion terminating in an apex, an inlet at said apex and an outlet spaced above said inlet, a fluid conduit connected to said inlet and to the outlet of said mixing unit, and a second fluid conduit connected to the outlet of said cushioning chamber and to said nozzle, with said inlet and last mentioned outlet being laterally projected in the same direction from said cone portion and said inlet being of a substantially greater diameter than said outlet.

2. In an oil burning apparatus having a nozzle, an air and oil mixing unit, a cushioning chamber having an upright lower portion formed with an upwardly and outwardly inclined side wall section, a laterally positioned inlet open to the bottom of said lower portion, a laterally positioned outlet spaced above said inlet, with said inlet and outlet being arranged in the side wall section of said lower portion opposite said inclined wall section and laterally projected in the same direction from said lower portion, a first fluid conduit connected to said inlet and to the outlet of said mixing unit, and a second fluid conduit connected to the outlet of said lower portion and to said nozzle, with said inlet being of a substantially greater diameter than said last mentioned outlet.

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