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FUEL BURNERS

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Fig. 1

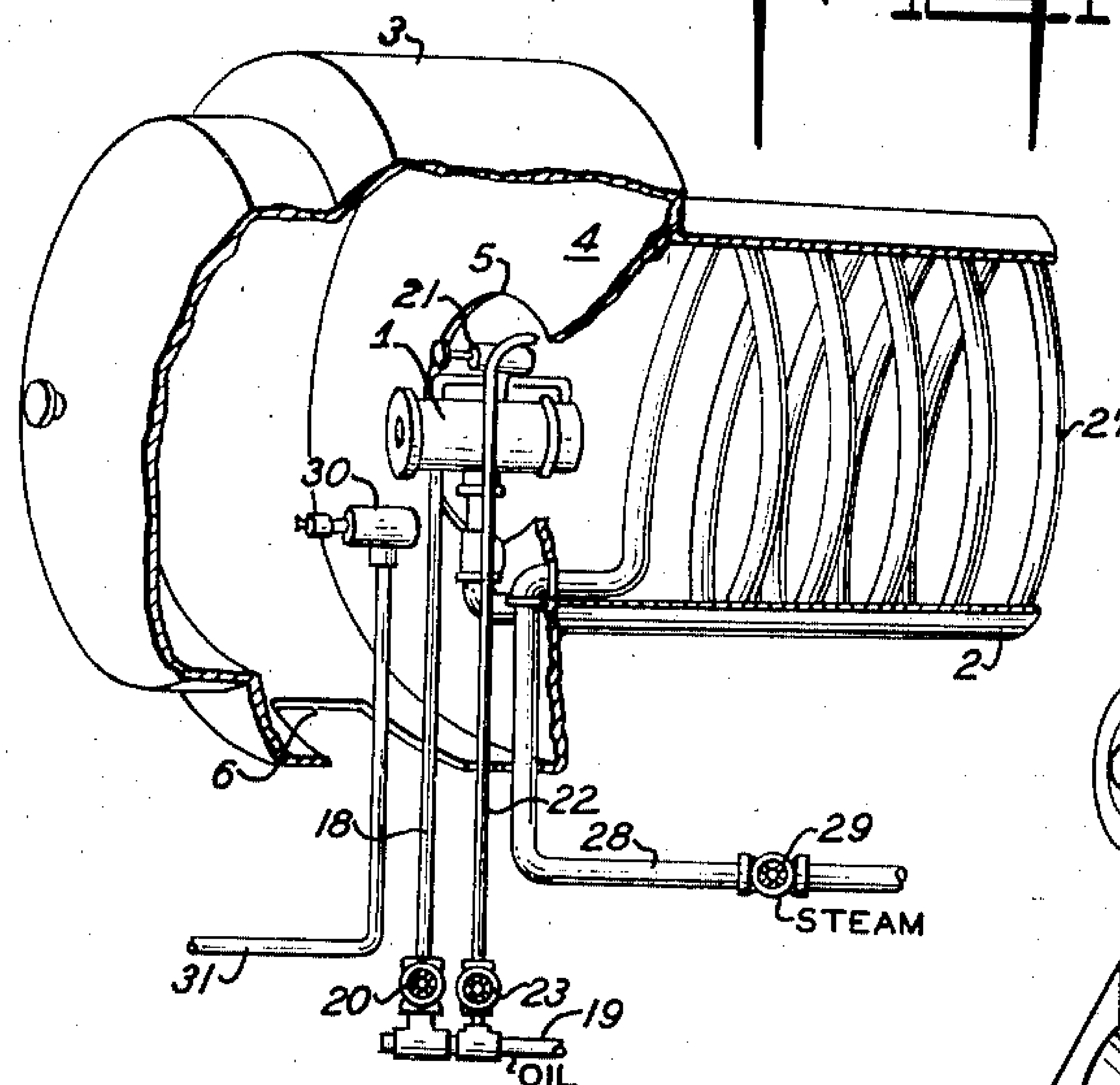


Fig. 2

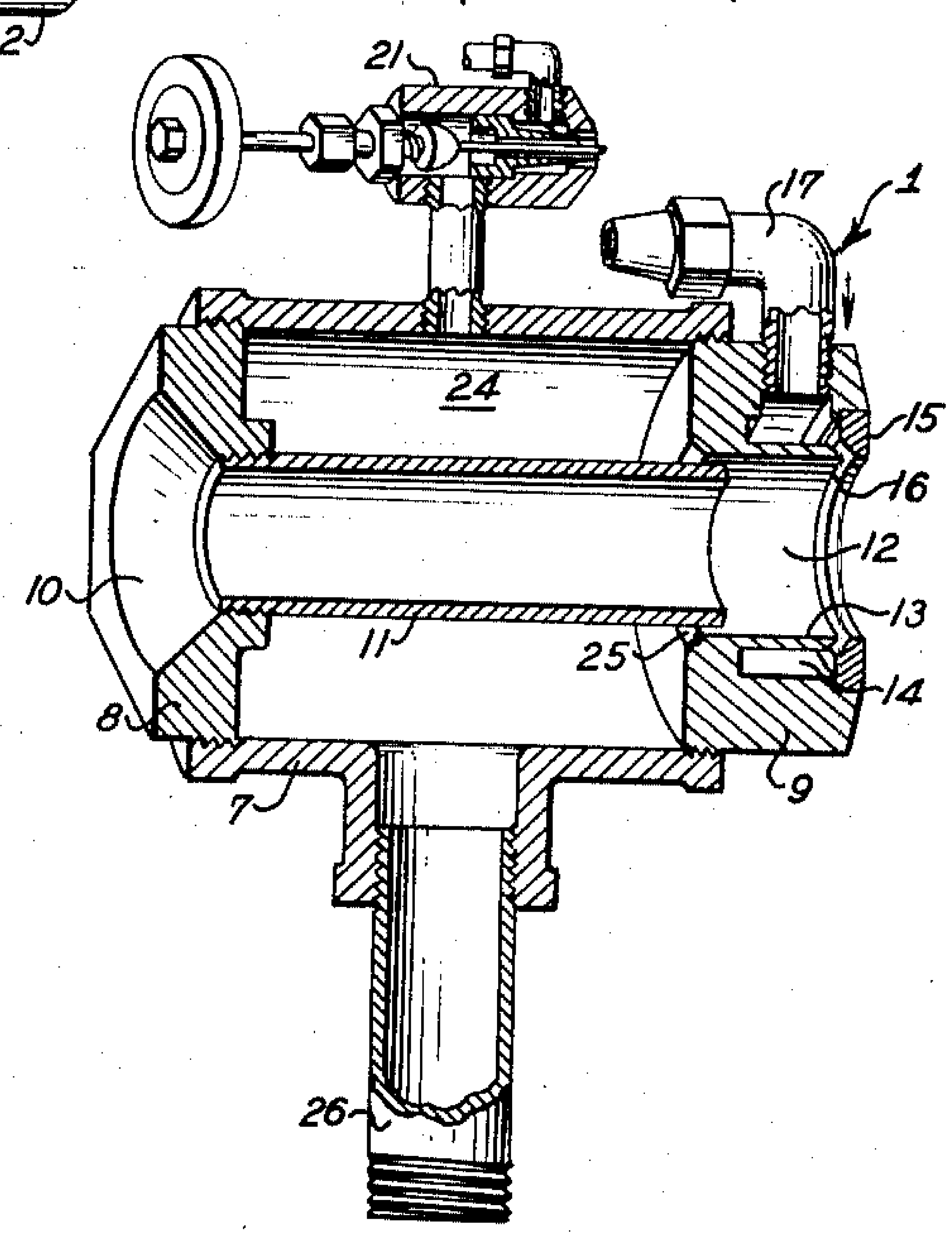
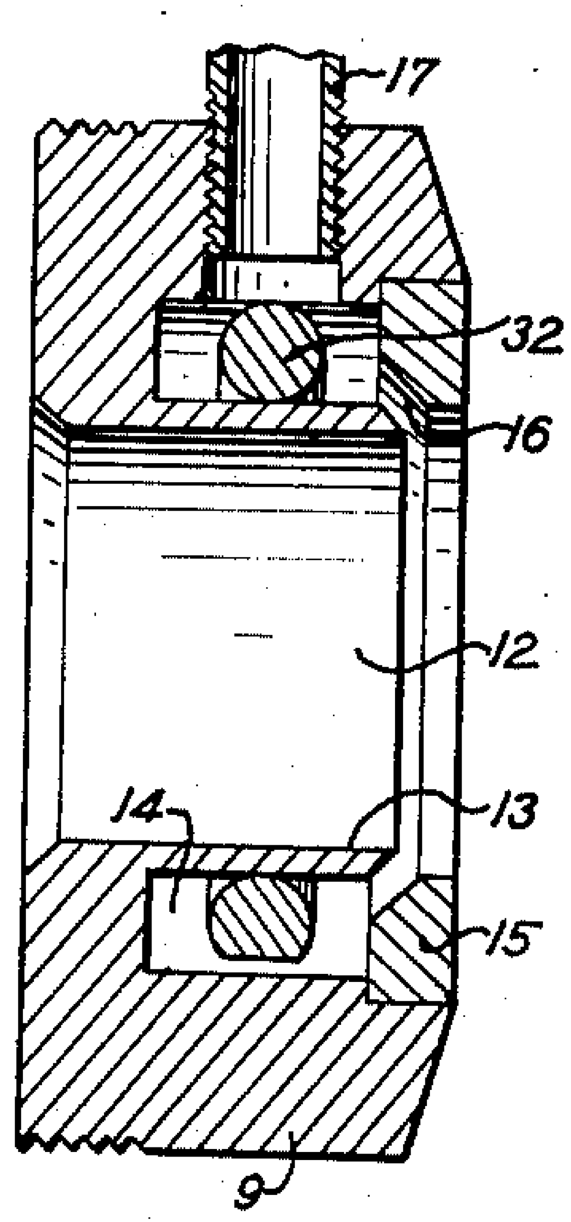


Fig. 3



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FUEL BURNERS

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3 Claims. (Cl. 158—74)

This application is a continuation in part of our prior application for Fuel Burners, Serial No. 291,691, filed June 4, 1952.

This invention relates to improvements in fuel burners which may be applied to any suitable or desired heating appliance, either for space heating, power purposes or other applications. It may be used in small units of home heating size or of much larger sizes adapted for industrial installation.

Oil burners have come into extensive commercial use both for home heating and for industrial installations. Nevertheless, the type of oil burners usually employed are very inefficient and while many attempts have been made to improve the efficiency thereof, these have not been very satisfactory. Attempts have been made to supply water to the oil burner for producing ordinary steam therein to atomize the fuel oil. Most available water supplies contain some minerals which, in the ordinary system using water or steam supplied to the oil burner, will cause the coil or burner to clog up in a short time with a mineral deposit out of the water.

One object of this invention is to improve the construction of fuel burners, especially oil burners, to provide greater efficiency and more complete combustion of the fuel, thereby requiring much smaller quantities of fuel for a given output of heat or power.

Another object of the invention is to provide in a fuel burner for a substantially constant high temperature and high B. t. u. content.

A further object of the invention is to provide a fuel burner which is relatively small and inexpensive to construct and to operate and which is compact and practical for manufacture and for use either as home heating size or for industrial installation.

Still another object of the invention is to provide more complete combustion of all combustible particles of the fuel, thereby reducing to a minimum if not to an absolute zero the discharge flue gases and visible smoke.

These objects may be accomplished according to one embodiment of the invention by the construction of a burner having provision for atomizing liquid fuel into a stream of superheated steam and air which are combined before the introduction of the fuel thereto. A coil or other steam heating unit is associated with the burner in position to be subjected to the heat of the burner. Steam is supplied to this coil or other unit under a pressure of approximately 90 pounds preferably and is superheated therein to a temperature of the order of 1,000° F. to 1500° F. although higher temperatures can be used if materials are available to withstand such higher temperatures without appreciable deterioration.

This superheated steam is then directed into the burner jet around a tube and is discharged at high velocity into a mixing chamber where it is mixed with air at one end of this tube and is carried along into the combustion zone by the high vacuum or suction created in the burner. The liquid fuel is dropped or atomized into this mixture of air and superheated steam and is carried thereby be-

yond the end of the jet before combustion takes place. The combustion of the burner continues to maintain a supply of superheated steam to the burner producing complete combustion of the fuel and high efficiency of operation as will be explained hereinafter.

This embodiment of the invention is illustrated in the accompanying drawings in which:

Fig. 1 is a perspective view partly broken away and in section showing the burner construction;

Fig. 2 is a longitudinal section through the burner partly in perspective; and

Fig. 3 is a cross section through the discharge nozzle showing a distributing ring in place therein.

The fuel burner illustrated as an embodiment of this invention includes a main jet assembly generally indicated by the numeral **1**. This jet assembly **1** is shown as axially disposed within the burner construction although if several such jet assemblies be required, these may be disposed around the axis in spaced relation to each other.

The jet assembly **1** is directed toward a combustion chamber which may be formed in any suitable manner according to the use of the burner. The combustion chamber may be provided by a surrounding wall of refractory material or other suitable material and in the illustrated embodiment is shown as enclosed by a surrounding housing generally indicated at **2**, being of cylindrical form merely as an example. The housing **2** projects outwardly from a front cover construction indicated generally at **3** and which is provided with a face plate **4** on the side thereof toward the housing **2**. The face plate **4** has an enlarged opening **5** therein in which the burner assembly **1** is located and directed and which opening **5** also serves to supply secondary air to the interior of the combustion chamber **2**. The front cover **3** is provided with an enlarged opening **6** in the bottom thereof for admitting air into the cover both for supplying primary air and also for supplying secondary air to the burner.

The burner assembly is illustrated more in detail in Fig. 2. This burner assembly includes an enlarged housing **7** closed at one end by a head **8** and at the opposite end by a nozzle **9**. These parts may be screw threaded together as shown or otherwise secured in rigid relation to each other.

The head **8** has a tapered center opening **10** therein within which is mounted a tube **11**, one end of which is secured rigidly to the head **8** and the tube is supported thereby. The tube **11** extends into telescoped relation with a mixing chamber **12** formed in the center of the nozzle **9**, and surrounded by a sleeve **13** formed in the nozzle. The nozzle in turn has a liquid fuel atomizing chamber **14** surrounding the sleeve **13**.

The chamber **14** is partially closed at the discharge side of the nozzle **9** by a closure ring **15** that is secured to the nozzle by welding or in other suitable manner. The inner face of the closure ring **15** is tapered complementary to the tapered end of the sleeve **13**, providing a discharge slot **16** therebetween surrounding the mixing chamber **12** through which the fuel is discharged into the stream of mixed steam and air as hereinafter described.

Fuel is supplied to the chamber **14** through a coupling **17** and a branch pipe **18** leading from a main oil or other supply pipe **19** as shown in Fig. 1. A manual control valve is shown at **20** for controlling the supply of liquid fuel supplied through the pipes **18** and **17** to the interior of the liquid fuel chamber **14**.

A pilot jet assembly is illustrated generally at **21** mounted on the body **7** and in open communication therewith to receive superheated steam from the interior of the body **7** for mixing with oil or other liquid fuels supplied through a pipe **22** from the main oil supply **19**. A control valve is shown at 23 for regulating the supply of liquid fuel through the pipe 22. The auxiliary jet 21 may be of conventional construction, if desired, and is not described in detail. This auxiliary jet is directed into the combustion chamber adjacent the jet assembly 1 to prevent back-draft from causing the flame to be deflected, or causing the jet assembly to go out. This will not be required in any instance where such back-draft is not encountered and may be omitted, if desired.

The interior of the body 7 is enclosed as a steam chamber which has communication through a passage 25 between the inner end of the nozzle 9 and the discharge end of the tube 11 into the mixing chamber 12. Superheated steam is thus supplied from the chamber 24 into the mixing chamber and is mixed with air that is directed through the tube 11 into said mixing chamber. This occurs before the liquid fuel is discharged into the mixed stream at the slot 16.

The chamber 24 is connected through a steam supply pipe 26 with a steam superheating unit generally indicated at 27 in Fig. 1. In this embodiment of the invention, steam may be supplied from a steam generator at about 90 lbs. pressure.

A pilot burner is shown at 30 which may be supplied with natural gas, butane, propane or the like through a conduit 31. This burner 30 is shown as mounted on the face plate for directing a frame into the combustion chamber for initial ignition of the burner assembly.

In the event that the liquid fuel should not be distributed uniformly around the periphery of the mixing chamber 12 at the slot 16, a distributing ring 32 may be mounted in the atomizing chamber 14. A metal ring is used for this purpose and is telescoped over the sleeve 13 substantially as shown in Fig. 3. The ring 32 preferably is somewhat flattened in the lower segment thereof and throughout about the lower one-half thereof tapering from a full circular cross section to substantially a semi-circular cross section. This ring has been found to aid the distribution of the liquid fuel around the entire chamber 14, thus obtaining better supply thereof to the mixture of air and superheated steam.

Operation

When it is desired to start the operation of the burner, the steam pipe 28 may be initially closed by the valve 29 and liquid fuel supplied through the pipes 18 and 22 to the jet assemblies 1 and 21. A small supply of steam may be admitted through the pipe 28 to the chamber 24 and mixing chamber 12 to aid in atomization of the liquid fuel in the initial burning process. The pilot burner 30 is started to produce a flame in the combustion chamber and to cause burning of the atomized fuel discharged from the jet assembly 1.

When the jet assembly is operating sufficiently to heat the coils 27 to a substantial extent, the supply of steam may be turned on or increased and the operation of the burner will then proceed.

We prefer to use 90 pounds of steam pressure on the line 28 to give the velocity needed. During normal operation of the burner, the steam that is supplied to the coil 27 should be heated to a temperature of 1000° F. to 1500° F. and may be increased still more if materials are available which will withstand such higher temperatures. We prefer to use stainless steel or Monel metal in forming the coil or other superheating element.

This superheated steam is supplied from the steam chamber 24 through the opening 25 into the mixing chamber 12. A high velocity of steam is used preferably about 200 feet per second in movement through the mixing chamber 12 which will create a suction through the tube 11 to draw primary air in from the front cover assembly and the opening 6 therein. This high velocity steam and air mixture will be forced through the mixing chamber into the combustion zone at such velocity that combustion cannot take place in the region of the nozzle 9 of the jet

assembly, but combustion will occur appreciably spaced from the jet assembly in the region of the coil 27. The latter may be placed at or adjacent the point of highest combustion as desired and according to the materials available for the construction of the coil. A very high temperature will be generated in the normal operation of the burner and the coil must not be too close to that area so as to cause disintegration thereof.

The liquid fuel is dropped into the stream of moving steam and air at the very vortex of the jet assembly and substantially at the discharge end of the latter. Thus, the liquid fuel does not come into contact with the superheated steam to any appreciable extent within the jet assembly itself. The high velocity movement of the steam and air will carry the fuel outward from the jet assembly before any combustion could take place. This high velocity movement will create a low pressure area at the discharge side of the jet assembly and the liquid fuel is discharged into this area.

We do not understand fully the physics of the action that takes place within the burner, but it is our belief that the high velocity of movement through the burner and the high temperature of the superheated steam causes the water molecules in the steam to break down into their hydrogen and oxygen atoms which aids hydrogenation of the fuel by combining the hydrogen atoms with the carbon atoms of the fuel and utilizing the oxygen to aid combustion.

We have conducted extensive individual and comparison tests with this burner and with other available oil burners, and these have revealed the very superior qualities of this burner and have demonstrated its ability to operate under the more efficient operation as herein set forth.

This improved fuel burner achieves complete combustion of oil regardless of weight. There is no wasted or unburned fuel to smoke or pollute the air. This is especially important where smoke ordinances are in effect. At the same time only a small amount of air is required for complete combustion and no blowers are needed even on the largest models, thus resulting in additional savings of cost of installation and of operation. It has been demonstrated that the burner uses only approximately fifty percent of the amount of fuel of other comparable burners, and moreover that much less costly fuels are required, of lower grades and yet full efficiency is obtained.

The burner does not require any forced draft. The test has shown only 8.71% excess air average over four hour periods with 15% CO_2. This means that the stack temperature will be kept low and that only a vent pipe will suffice for disposing of spent products, thus reducing a major item of expense in construction.

The operation of the burner is very simple. There are no moving parts to wear out. A long life is assured with constant operation and few service calls. Where the burner is employed in industrial installations, this is especially important, not only because it minimizes the man hours required for maintenance but also because it eliminates to a substantial extent shut-down of the plant. There is no problem of carbon or soot deposits that must be cleaned out as required in many other burners.

It will be understood that the manually controlled valves can be replaced, if desired, by automatically controlled valves and other automatic controls used as found desirable.

While the invention has been illustrated and described in one embodiment, it is also recognized that variations and changes may be made therein without departing from the invention as set forth in the claims.

We claim:

1. A fuel burner comprising an elongated hollow body, a head closing one end of the body, a nozzle having an open-ended mixing chamber therein closing the other end of the body, an open-ended relatively small

air tube within said body and extending from said head to the inner end of the mixing chamber, the space in said body around the air tube forming a relatively large steam chamber having a superheated steam inlet thereto, said steam chamber at its inner end having restricted opening means surrounding said air tube for the discharge of steam into the inner end of the mixing chamber, said enlarged steam chamber providing for a large residue of superheated steam substantially to preheat the column of air in said relatively small air tube, said nozzle having a fuel chamber with a fuel inlet therein surrounding said mixing chamber, said fuel chamber having restricted opening means surrounding the mixing chamber at the outer end thereof for the discharge of fuel thereto, whereby steam passing from said steam chamber through said steam discharge means will cause a vacuum in said air tube drawing air therein and will mix with the air in the mixing chamber and air and steam passing out of said mixing chamber will draw fuel out to the discharge end of the mixing chamber.

2. A fuel burner comprising an elongated hollow body, a head closing one end of the body, a nozzle having an open-ended mixing chamber therein closing the other end of the body, an open-ended relatively small air tube within said body and extending from said head to the inner end of the mixing chamber, the space in said body around the air tube forming a relatively large steam chamber having a superheated steam inlet thereto, said steam chamber at its inner end having restricted opening means surrounding said air tube for the discharge of steam into the inner end of the mixing chamber, said enlarged steam chamber providing for a large residue of superheated steam substantially to preheat the column of air in said relatively small air tube, said nozzle having a fuel chamber with a fuel inlet therein surrounding said mixing chamber, said fuel chamber having restricted opening means surrounding the mixing chamber at the outer end thereof for the discharge of fuel thereto, a distributing ring in said fuel chamber substantially coplanar with the axis of said fuel inlet whereby steam passing from said steam chamber through said steam discharge means will cause a vacuum in said air tube drawing air therein and will mix with the air in the mixing chamber and air and steam passing out of said mixing chamber will draw fuel out to the discharge end of the mixing chamber.

3. A fuel burner comprising a combustion chamber, a coil in the combustion chamber, means for supplying steam to said coil for superheating therein, an elongated hollow body in said combustion chamber, a head closing one end of the body, a nozzle having an open-ended mixing chamber therein closing the other end of the body, an open-ended relatively small air tube within said body and extending from said head to the inner end of the mixing chamber, the space in said body around the air tube forming a relatively large steam chamber having a superheated steam inlet thereto communicating with said coil, said steam chamber in its inner end having a restricted opening means surrounding said air tube for the discharge of steam into the inner end of the mixing chamber, said enlarged steam chamber providing for a large residue of superheated steam substantially to preheat the column of air in said relatively small air tube, said nozzle having a fuel chamber with a fuel inlet therein surrounding said mixing chamber, said fuel chamber having a restricted opening means surrounding the mixing chamber at the outer end thereof for the discharge of fuel thereto, whereby steam passing from said steam chamber through said steam discharge means will cause a vacuum in said air tube drawing air therein and will mix with the air in the mixing chamber and air and steam passing out of said mixing chamber will draw fuel out to the discharge end of the mixing chamber.

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