Feb. 1, 1949. J. E. FARRELL 2,460,451

GASIFYING FUEL BURNER

Filed June 13, 1946 2 Sheets-Sheet 1

Fig. 1.

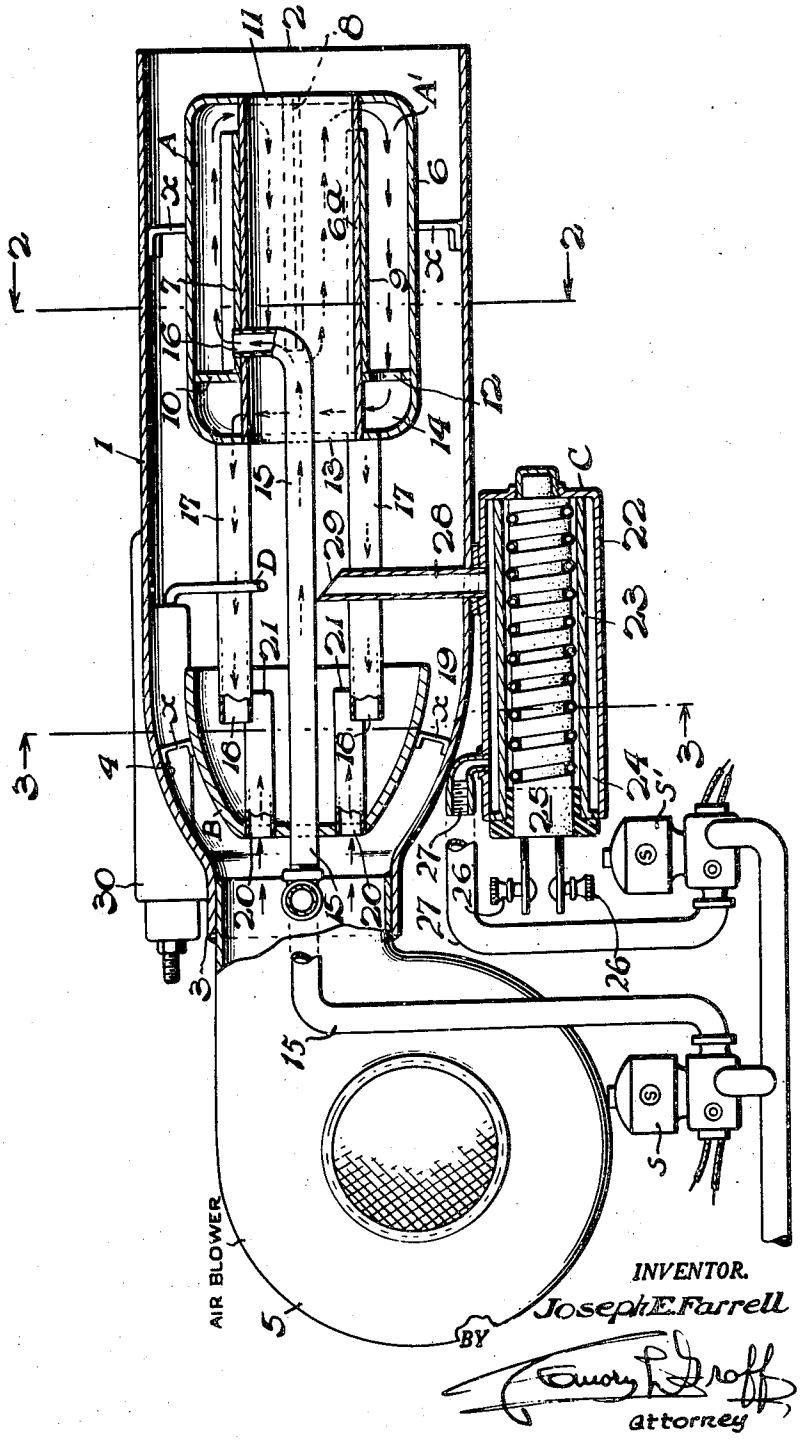

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Fig. 2.

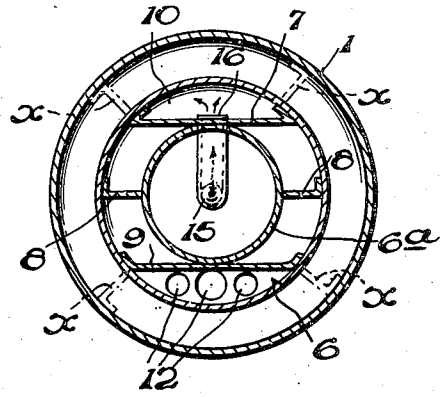
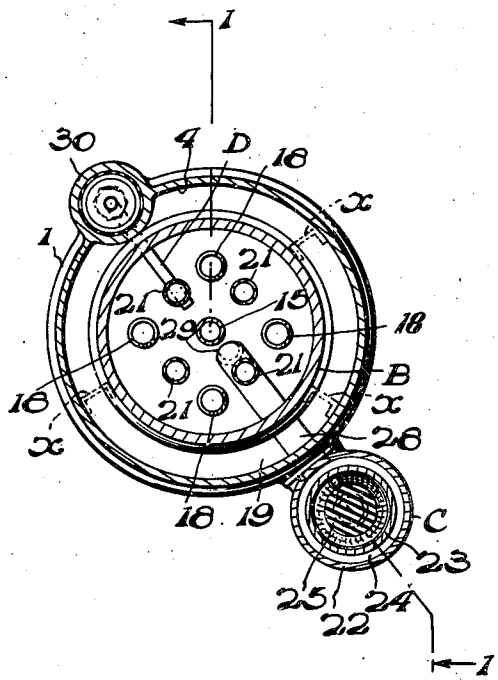


Fig. 3.



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2,460,451

GASIFYING FUEL BURNER

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9 Claims. (Cl. 158—53)

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This invention relates to liquid fuel burners, and more particularly to a novel construction wherein liquid fuel is converted into its gaseous form before combustion.

While it has heretofore been proposed to convert liquid fuel into gas before combustion, nevertheless, certain practical difficulties have been encountered, chiefly from the standpoint of providing apparatus for adequately and efficiently automatically starting the burner in operation under the demand of electrical controls when it is desired to initiate the combustion cycle.

Generally, in the operation of conventional gun type fuel oil burners, two basic engineering principles must be considered. (A) Oil will not burn until it is changed from a liquid into a gas. (B) There is, at present, no mechanical method for changing oil into gas. The function known as atomization, which consists of breaking down the fuel oil into small globules, is used only to speed up the gasification, which is subsequently accomplished by heat directed on the small oil drops. The entire process consists of forcing the liquid fuel under pressure through a spray nozzle into the combustion chamber. As the thus atomized oil enters the combustion chamber, a small quantity of oil is gasified by the heat produced by a high tension electrical arc and thus ignited. In reality proper combustion does not take place until the entire surrounding refractory chamber is heated to about 900 degrees F., and sufficient heat is reflected on the flame to gasify the oil globules. The time necessary to generate this heat is approximately five minutes in properly designed combustion chambers. During this period, which may even be of longer duration if the flame should happen to be too small for the combustion chamber, unburned carbon (soot) is deposited in the combustion chamber, the heat exchanger and the flue passages. The same is true in too small a combustion chamber where the flame impinges on the refractory walls before it is gasified. This condition well known to those skilled in the art has been well proven by low carbon dioxide percentage of 8 to 10% for example, whereas the potential reading of #2 distillate is 15.3%.

Aside from the formation of carbon which causes frequent service calls and renders the heating plant economically wasteful, high pressure gun type burners are limited to the use of fuels of low viscosity (#2 and #3 distillates) and because of practical difficulties cannot operate at a firing rate of less than 1¼ gallons per hour

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which is definitely excessive in numerous small installations.

Accordingly, the primary object of this invention is to provide complete oil gasification before combustion in a gasifying chamber or medium so as to obtain the complete release of combustible hydro-carbons before entering the combustion chamber or heat exchanger thereby insuring absolute and complete combustion of the liquid fuel.

Another object of the invention is to provide means for gasifying liquid fuel oil in a medium free from oxygen thereby preventing any oxidization of the gasifying chamber or of the connecting means leading to and from said chamber.

Another object is to provide a liquid fuel burner capable of burning efficiently liquid fuel to high viscosity (#4 and #5 distillates) which are lower in costs and contain more calories per unit quantity than lower viscosity fuel oils (#2 and #3 distillates).

Another object is to provide a liquid fuel oil burner capable of burning efficiently at relatively low firing rates, say one pint per hour, for example, thus making said burner adaptable to small installations.

Another object is to provide a novel construction and arrangement embodied in a form conventionally known as the gun type burner and which includes not only means for converting liquid fuel into gas before combustion for the sustained operation of the burner, but also provides a starting unit which converts the liquid fuel into gas for starting purposes. That is to say, the present invention contemplates the utilization of a preliminary or secondary gasifying unit which is quickly responsive to electrical heat thereby to generate or transform liquid fuel into gas which is ignited by an electrical spark to provide a flame for initially heating the main generator until the latter reaches sufficiently high temperature to convert raw fuel into gas in sufficient quantity in proportion to the air supply to provide a properly blended mixture of air and gas to insure sustained operation.

A further object of the invention is to provide a novel form of main generator providing a maximum area for heat absorption and fuel distribution thereby to insure complete and continuous gasification of the liquid fuel.

A still further object of the invention is to provide a novel air distributing cone or shell having special relation to the main generator in the flame end of the housing thereby not only to assure proper distribution of air but to also pro-

vide a sufficient vacuum for aspirating gas from the main generator into the airstream while at the same time properly blending and oxygenating it for combustion. The latter is important since the liquid fuel is gasified in a chamber devoid of oxygen thereby obviating the formation of carbon.

With the above and other objects in view which will more readily appear as the nature of the invention is understood, the same consists in the novel construction, combination, and arrangement of parts, hereinafter more fully described, illustrated and claimed.

A preferred and practical embodiment of the invention is shown in the accompanying drawings, in which:

Figure 1 is a vertical sectional view of the improved burner;

Figure 2 is a vertical sectional view taken on the line 2—2 of Figure 1; and

Figure 3 is a vertical sectional view taken on the line 3—3 of Figure 1 looking in the direction of the arrows.

Similar reference characters designate corresponding parts throughout the several figures of the drawings.

According to the embodiment of the invention shown in the drawings, the same includes tubular barrel or casing 1 having a flame discharge outlet 2 at one end and a relatively constricted air intake end 3 which is joined with the main section of the casing by a tapering or curved throat portion 4. Air is supplied to the intake end 3 at appropriate velocity by an electrically driven blower 5 of relatively low fractional horsepower. A primary or main generator A and a substantially conical aspirating shell B are supported on spider arms x within the casing respectively near the flame outlet end 2 and the throat portion 4. The secondary or starting generator C may be supported on the outside of the shell and provided with a gas delivery tube, later to be described, whose outlet end is located upstream of the main generator, and in flame propagating proximity to an igniting terminal D.

Referring now more particularly to the several instrumentalities above noted in the order named, it will be observed that the main generator A preferably comprises a hollow housing 6 internally provided with a cylinder 6*a* open from end to end and providing a gasifying chamber A' which is entirely closed to the atmosphere except for gas outlet tubes as will presently appear. Said chamber A' is provided with a series of horizontally disposed baffle plates 7, 8, and 9, the plates 7 and 9 projecting forwardly from an internal vertical baffle wall 10 and the plate 8 projecting rearwardly from the front wall 11 of the housing, said plates in each instance being of less length than the space between the walls 10 and 11 to permit of the liquid fuel cascading from the uppermost plate to the one next below thereby to insure maximum travel of liquid fuel over heating surfaces. The exterior of the housing and the hollow core insure the chamber A' being bathed in flame so as to insure complete and rapid gasification of raw liquid fuel. The vertical baffle wall 10 is provided in its lower portions with a plurality of gas outlet openings 12, and, in cooperation with the inner end wall 13 of the housing, provides a gasified fuel collecting chamber 14.

The rear end of the hollow core 6*a* receives a fuel entry tube 15 whose forward extremity is curved upwardly so that its outlet end 16 is in feeding relation to the uppermost partition plate 7. Liquid fuel is supplied to and retained in the inlet end of tube 15 by conventional type solenoid valve S and which is standard equipment in all approved installations. The rear wall 13 of the housing is also provided with a plurality of rearwardly extending dry gas conveying tubes 17, the outlet ends 18 of which extend into the aspirating shell B. That is to say, the discharge ends of the tubes 17 are in overlapping relation to the flared forward end of the conical shell B which, as previously set forth, is located in the throat portion 4 of the casing and has its outer surface spaced relatively to said throat so as to define a relatively constricted air passage 19. The aspirating shell B has its rear end closed except for a series of horizontally disposed air jet tubes 20 whose outlet ends 21 extend forwardly of the outlet ends 18 of the gas tubes 17.

When the blower is in operation, an air blast of appropriate velocity enters the inlet end 3 of the casing where it meets the aspirating shell B and is guided through the passages 19, thereby to create, with the assistance of air passing through the tubes 20, a partial vacuum within the shell, said vacuum being of sufficient degree to suck or aspirate gas from the main generator through the tubes 17. Thus, the air moving through the annular passage 19 not only aspirates gas from the main generator but also oxygenates it for combustion.

The secondary generator or starting unit C preferably consists of an outer shell 22 and an inner shell 23 of smaller diameter, said shells being assembled to provide an initial gas generator chamber 24. The inner shell 23 contains an appropriate electrical heating device 25 which may be connected by terminals 26 with a source of electrical current under the control of a thermostat or its equivalent. Starting fuel is supplied to the secondary generator C through inlet pipe 27 controlled by solenoid type valve S'. Gas generated in the chamber 24 is delivered therefrom by the gas delivery tube 28 which projects radially into the casing and has its outlet end 29 disposed between the main generator A and shell B at a point substantially along the axis of both of these units. It will also be noted that the outlet end 29 is cut obliquely or chamfered so that the long side is upstream of the air currents. Thus, as air passes through the casing 1 the obliquely cut outlet 29 will also tend to aspirate gas for starting purposes out of the secondary generator C.

The terminal D of the spark plug or igniter device 30 is located in flame propagating proximity to the outlet end 29 of the tube 28. Thus, when dry gas has been formed in the secondary generator C by electrical heat, the initiating flame will be propagated centrally of the casing and its heat will be conducted downstream to the main generator A. After a short period of secondary generator operation, the main generator A becomes sufficiently heated so that fuel supplied by the tube 15 will be continually gasified and supplied to the airstream through the tubes 17. The burner is then ready for sustained operation through gas supplied by the main generator. An appropriate control for the secondary generator will discontinue the supply of electrical current and liquid fuel thereto.

It will, of course, be understood that appropriate electrical controls are utilized for both the secondary generator and the sparking element 30, and likewise, suitable valves are provided for controlling the supply of liquid fuel to the main generator A as well as the secondary generator C.

When the burner is not in operation, the main generator becomes in effect a "Diving bell." The residual liquid fuel held in the fuel supply tube 15 by the conventional solenoid valve previously referred to provides a hydrostatic seal at the fuel entry end 16 and prevents air from entering the generator through the gas delivery tubes 17. That is to say, atmospheric air tending to enter the main generator during periods of non-operation will be locked off somewhere in the tubes 17 and before filling the chamber of the generator because of the liquid seal at 16. The moment the operating cycle starts and the blower operates, the vacuum producing means immediately deprives the tubes 17 of any small amount of air that may be present, nor can the aspirating means pull any air through the hydrostatic seal formed by the fuel supply means. This assures the breaking down of whatever controlled amount of fuel is supplied to the generator into gas, by temperature, and in an airless, and thus oxygen-lacking atmosphere.

Although a single embodiment of this invention is shown in the accompanying drawings, several other connecting means may be used between the main and secondary generator as well as other dispositions of combinations of these two basic units without departing from the spirit and scope of the invention.

I claim:

1. A gaseous fuel burner comprising, a casing having a flame discharge end and a tapering throat portion leading to a relatively constricted air intake end, a blower for supplying air to said intake end, a main generator for converting liquid fuel into a dry gas located within the flame discharge end of the casing, means for supplying liquid fuel to the main generator, a plurality of gas conveying tubes extending rearwardly from said main generator, a substantially conical aspirating shell supported in spaced relation to the throat portion of the casing and having its fired end in overlapping and receiving relation to the outlet ends of the gas conveying tubes leading from the main generator, means for generating and delivering a preliminary supply of dry gas to the casing upstream of the main generator, and means for igniting the dry gas to provide heat for initiating the generation of gas in the main generator.

2. A gaseous fuel oil burner according to claim 1 wherein the main generator includes, a housing having a centrally disposed tubular member open from end to end of the housing thereby to form a gaseous fuel chamber with the inner face of the housing, a substantially vertical wall within the gaseous fuel chamber of the housing having openings at its lower portion, said wall forming a dry gas chamber at the inner end of the housing adapted to communicate with the gas generating space of the chamber, and a plurality of horizontal partition elements disposed within the gasifying chamber of the housing, said partition elements terminating short respectively of the front end wall of the housing and said vertical wall forming the gas chamber, and being arranged in staggered relation so as to provide a circuitous passage for liquid fuel, and means for supplying liquid fuel for discharge on the uppermost of said partition plates.

3. A gaseous fuel burner comprising, a casing having a flame discharge end and a tapering throat portion leading to a relatively constricted air intake end, a blower for supplying air to said intake end, a main generator for converting liquid fuel into a dry gas located within the flame discharge end of the casing, means for supplying liquid fuel to the main generator, a plurality of gas conveying tubes extending rearwardly from said main generator, a substantially conical aspirating shell supported in spaced relation to the throat portion of the casing and having its flared end in overlapping and receiving relation to the outlet ends of the gas conveying tubes leading from the main generator, a plurality of air jet tubes extending forwardly from the apical wall of the shell toward the flared end thereof and having their discharge ends in overlapping relation to the outlet ends of the gas conveying tubes of the main generator thereby to assist the conical shell in aspirating gas from the main generator, means for generating and delivering a preliminary supply of dry gas to the casing upstream of the main generator, and means for igniting the dry gas to provide heat for initiating the generation of the gas in the main generator.

4. A gaseous fuel burner comprising, a casing having a flame discharge end and a tapering throat portion leading to a relatively constricted air intake end, a blower for supplying air to said intake end, a main generator for converting liquid fuel into a dry gas located within the flame discharge end of the casing, means for supplying liquid fuel to the main generator, a plurality of gas conveying tubes extending rearwardly from said main generator, a substantially conical aspirating shell supported in spaced relation to the throat portion of the casing and having its flared end in overlapping and receiving relation to the outlet ends of the gas conveying tubes leading from the main generator, and an electrically heated starter generator having a delivery tube whose discharge end is disposed between the flared end of the aspirating shell and the main generator, and an electrical igniter having its sparking terminal in flame propagating relation to the discharge end of the delivery tube.

5. A gaseous fuel burner comprising, in combination, a casing having a flame discharge end and a tapering throat portion leading to a relatively constricted air intake end, a blower for supplying air to said intake end, a main generator for converting liquid fuel into a dry gas located within the flame discharge end of the casing, means for supplying liquid fuel to the main generator, a plurality of gas conveying tubes extending rearwardly from said main generator, a substantially conical aspirating shell supported in spaced relation to the throat portion of the casing and having its flared end in overlapping and receiving relation to the outlet ends of the gas conveying tubes leading from the main generator, and an electrically heated starter generator having a delivery tube whose discharge end is disposed between the flared end of the aspirating shell and the main generator, said discharge end being obliquely cut and arranged with its long side upstream of the air currents flowing in the casing thereby to aspirate gas from the starting generator.

6. A gaseous fuel burner, comprising, a casing having a flame discharge end and an air intake end, means for supplying air to said intake end, a main fuel generator for converting liquid fuel into a dry gas, means for supplying liquid fuel to said main generator, means for aspirating the dry gas from the generator and discharging the same upstream thereof, means for generating and delivering a preliminary supply of dry gas to the casing between the main generator and the

aspirating means, and means for igniting the preliminary supply of dry gas to provide heat for initiating the generation of gas in the main generator.

7. In a gaseous fuel burner of the gun type, the combination, including, a casing having a flame discharge end and an air intake end, primary means for converting liquid fuel into a dry gas disposed in the flame discharge end of the casing, means upstream of said primary means for aspirating dry gas therefrom, a starting unit comprising an electrically heated fuel receiving chamber and a delivery tube, said tube disposed between said primary means and the aspirating means and having its outlet end formed to provide means for aspirating dry gas out of the starting unit, and ignition means operatively related to the outlet end of the delivery tube to ignite the starting fuel and provide heat for initiating the generation of gas in said primary means.

8. In a fuel burner of the class described having controls including a solenoid controlled fuel supply line and adapted to be placed in the normal draft stream of the installation, the combination including, a casing having a flame discharge end and an air intake end, a main generator having a chamber for converting liquid fuel into gas and located within the casing adjacent the flame discharge end, gas delivery tubes extending from the main generator toward the air intake end of the casing, means for aspirating dry gas from the generator through said gas delivery tubes to sustain combustion in the casing in advance of and about the said generator to gasify liquid fuel therein, a tube having its inlet end connected to said fuel supply line and also having an outlet end opening upwardly into the generator for supplying liquid fuel thereto when the burner is in operation, said tube containing residual fuel when the solenoid controlled valve in the supply line is closed and the burner ceases operation to provide a hydrostatic seal within the main generator, said valve and seal together with the substantially non-condensable gas remaining in the chamber of the generator preventing atmospheric air from entering said generator, and means for supplying initial heat to the main generator.

9. A fuel burner of the class described according to claim 8, wherein the chamber of the main generator is provided with a substantially horizontal baffle plate and the outlet end of the liquid delivery tube discharges liquid fuel on the face of the plate most remote from the gas delivery tubes.

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