March 2, 1937. G. A. CROSBY 2,072,731

OIL BURNER

Filed Dec. 3, 1934

Fig. 1

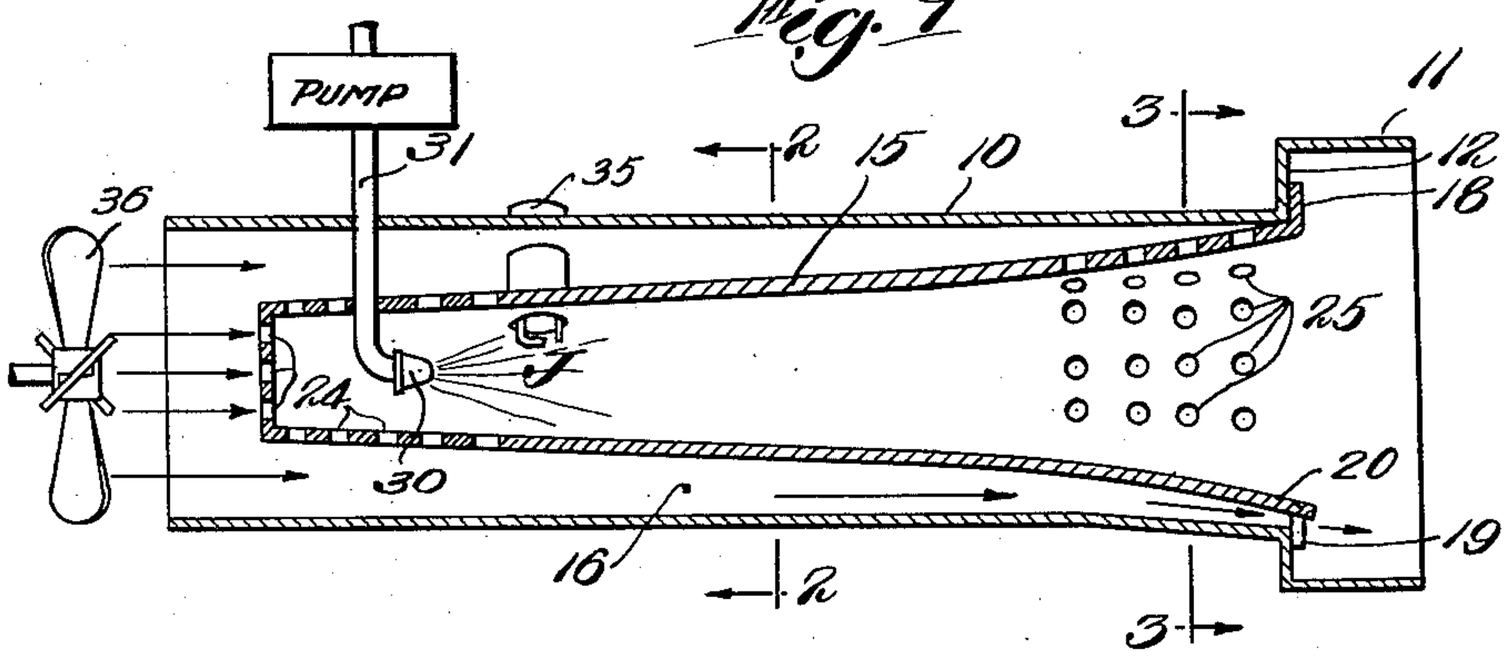


Fig. 2

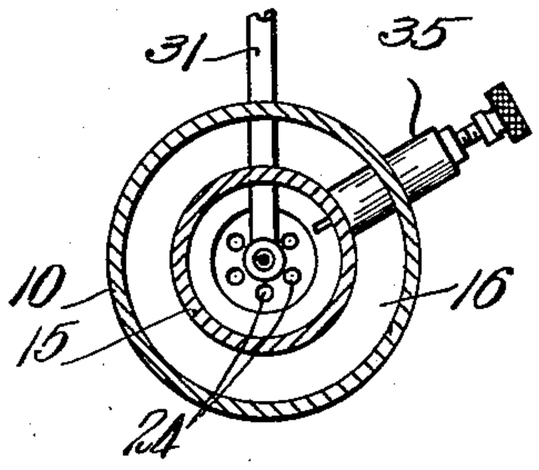


Fig. 3

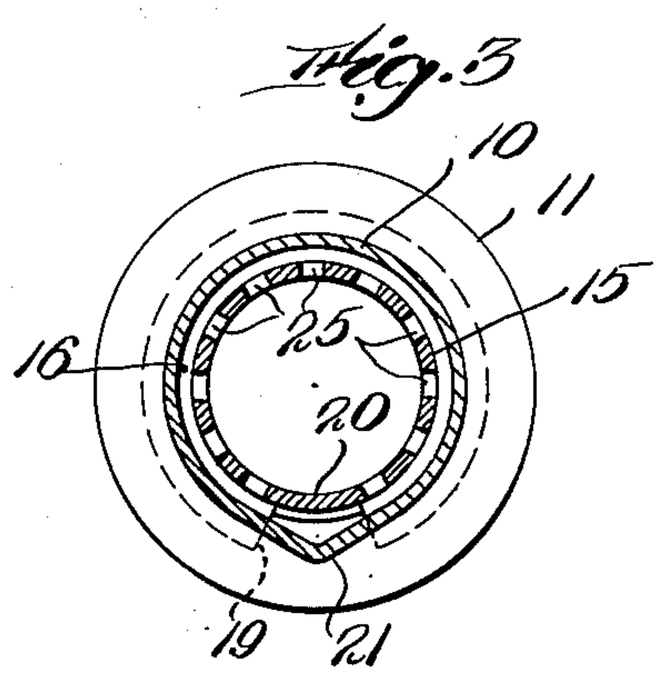
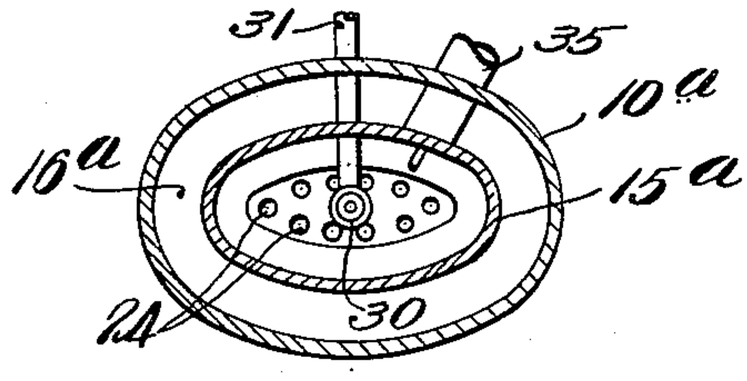


Fig. 4



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2,072,731

OIL BURNER

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4 Claims. (Cl. 158—28)

This invention relates to liquid fuel burners such, for example, as are used in steam propelled vehicles.

The principal objects of the invention are to provide a burner capable of use with a high gravity liquid fuel such, for example, as fuel oil, which is of simple design, having a minimum number of parts, which is inexpensive to manufacture and assemble, and which is of strong and durable construction; furthermore, to provide a burner in which a complete vaporization of the liquid fuel and its complete mixture with air may be effected in a comparatively small chamber and outside of the firebox, and the mixture of vaporized oil and air in a condition for complete combustion may be delivered to a combustion chamber occupying an unusually small space and burned therein with a very hot flame with the generation of an unusually large amount of heat, and which is efficient, reliable and quiet in operation.

Further objects relate to the construction and to the operation of my improved burner and will be apparent from a consideration of the following description and accompanying drawing, wherein:

Fig. 1 is a longitudinal sectional view of a burner constructed in accordance with the present invention;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a section on the line 3—3 of Fig. 1; and

Fig. 4 is a transverse section through a burner of modified construction.

The embodiment chosen for the purpose of illustration comprises a casing 10, here shown as cylindrical in form and having an enlarged end or mouth 11 which provides an interior shoulder 12. The end 11 opens into the fire box or combustion chamber of a boiler (not shown) and the opposite end of the casing may be juxtaposed or connected to a fan 36 or other suitable means for discharging a current of air into the interior of the casing 10. An elongate tubular member 15, preferably of a generally conical shape, is disposed within the casing so as to define a substantially annular chamber or passage 16 which surrounds the tubular member 15. The smaller end of the tubular member 15 is closed and its opposite end is flared outwardly and provided with a circumferential flange 18 which engages the shoulder 12 and holds the tubular member in fixed position within the casing.

The flange 18 preferably extends about substantially the entire circumference of the tubular member 15, thus closing the end of the air passage 16 and, as shown more clearly in Fig. 3, the flange 18 is provided with an opening or cut-out portion 19 which defines a discharge port or opening beneath the bottom of the tubular member 15 through which air may escape from the passage 16 into the combustion chamber or fire box, as indicated by the arrows in Fig. 1. That part of the bottom of the tubular member 15 which is disposed above the path leading to the opening 19 is imperforate and provides an inclined drainer or trough 20 (Fig. 3) for conducting oil, which may condense or otherwise accumulate at the bottom of the tubular member, into the path of travel of air escaping through the discharge opening 19. If desired the bottom of the casing directly beneath the trough 20 may be provided with an elongate depression or groove 21 so as to provide a discharge opening of greater cross-sectional area.

The periphery of the tubular member 15 at and adjacent to its closed end is provided with a plurality of spaced openings 24 which constitute primary air inlets, and its periphery adjacent to the opposite end of the tubular member is also provided with a plurality of spaced openings 25 which constitute secondary air inlets from the annular air passage 16 to the interior of the tubular member 15. The size and arrangement of the primary air inlets 24 is such as to produce a rich combustible mixture which may be readily ignited and which burns with a hot flame.

A spray nozzle 30 is disposed within the tubular member 15 adjacent to its closed end and is arranged to discharge an atomized jet J of oil or other liquid fuel longitudinally through the tubular member toward its mouth or open end, the nozzle being so positioned that the major portion of the primary air inlets are disposed rearwardly of the jet J and the secondary inlets are spaced an appreciable distance in front of the jet. The nozzle 30 is connected by a pipe line 31 through which oil is supplied under sufficient pressure (as by a pump as indicated in Fig. 1) to force the oil or other liquid fuel through the line 31 and out of the nozzle 30 in the form of a spray or atomized jet of predetermined size. A part of the jet may impinge upon the imperforate wall of the tubular member between the primary and secondary inlets and the escape or loss of any oil, in either a gaseous or liquid condition, is entirely prevented. Suitable ignition means are provided for igniting the jet and to this end a spark plug 35 is secured in any suitable manner to the tubular member 15 and/or casing 10 between the nozzle 30 and secondary inlets

25, so that its points project into or lie adjacent to the path of the jet J.

In installations where there is a limited space in which to accommodate the burner it may be necessary to vary its size and shape to meet the requirements of the particular conditions. For example, in the burner shown in Fig. 4, the casing 10a and tubular member 15a are elliptical in cross section, but the relative positions of the nozzle, primary and secondary air inlets, and the ignition means remain the same as those of the previously described embodiment. This type of burner may be advantageously employed in installations wherein it is necessary to save as much space as possible in one direction or another.

It will be observed that the burner tube 15 is elongated and comprises three sections, a rear section containing the primary air admission inlets 24, a forward section at the flared mouth of the tube and containing the secondary air inlets 25 which are concentrated relatively close to the discharge mouth of the tube, and a third or intermediate section with imperforate walls. It will also be observed that the nozzle 30 is positioned to direct its spray of liquid fuel to impinge upon the walls of the intermediate section near the rear thereof and that the imperforate section extends for a prolonged distance from the part of the tube on which the said spray first impinges to the part where the secondary air is first admitted and this distance is greater than the length of the forward or secondary air admission section.

The operation of my improved burned used with a heavy grade of fuel oil is as follows:

With the ignition turned on the fuel oil, without premixture with air, is forced through the pipe 31 and a liquid oil jet J of the desired size is produced. The air flow or draft through the end of the casing 10, indicated by the arrows in Fig. 1, is so adjusted as to supply the necessary amount of air to support complete combustion. The air taken in through the primary inlets 24 mixes with the jet J and provides a rich combustible mixture which is readily ignited by the spark plug 35.

The ignited jet burns progressively throughout the length of the tube, and, when the burner is under full operation, this flame heats the imperforate walls of the intermediate section to a temperature sufficient to completely vaporize all liquid fuel coming in contact therewith. Due to the limited admission of primary air, however, the richness of the mixture and the consequent incompleteness of combustion, the temperature of the tube is kept within such limits as to prevent damaging effect on the material of the tube.

The liquid fuel sprayed from the nozzle impinges in large part against the imperforate walls of the rear end of the prolonged intermediate tube section and is completely vaporized within such tube section and before intermixture with the secondary air in and about the flared mouth of the tube can take place.

The secondary air admitted at and about the mouth of the tube encounters, therefore, only fully vaporized oil. Such air forms with the oil vapor and the primary air a complete mixture which emerges from the mouth of the tube in a condition for complete combustion in the combustion chamber, which latter, therefore, may occupy a relatively small space. This introduction of secondary air, however, is confined to the relatively short forward section of the tube, so that such complete mixture takes place only at or about the mouth of the tube, the combustion occurring within the tube itself being insufficient to raise the temperature of the tube to a degree damaging to the material of the tube.

Due to the annular air passage maintained between the burner tube 15 and the casing 10, the air flowing through such passage absorbs the excess heat from the intermediate portion of the tubular member, not only keeping the casing relatively cool but further assisting in and preventing the burner tube from becoming excessively heated and contributing its heat usefully to the secondary air.

In initially starting the burner and before the burner tube has become sufficiently heated to completely vaporize therein all the oil delivered thereto, a certain amount of liquid oil may accumulate without vaporization in the bottom of the tube 15. Such oil, however, is conducted along the trough 20 to the mouth of the burner tube where it is picked up by the current of air discharged through the opening 19 and carried into the combustion chamber or fire box of the boiler without interference with the operation of the burner. The latter, however, quickly assumes the condition of operation as described above, in which all oil delivered to the tube becomes vaporized within the tube itself.

It will be noted that in a burner constructed in accordance with the present invention, the air introduced through the primary inlets provides a rich combustible mixture which is more readily ignited and burns more quietly than a leaner and more efficient mixture which would support complete combustion. The preheated air taken in through the secondary inlets insures complete combustion of the fuel and does not in any way impair the quiet and efficient operation of the burner.

It should be understood that the present invention is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. A liquid fuel burner comprising an elongate tubular member closed at one end and open at its opposite end, said tubular member having openings defining primary air inlets adjacent to its closed end and secondary air inlets adjacent to its open end, a casing surrounding said tubular member and defining therewith an air passage which communicates with the interior of said tubular member through said air inlets, the end of said air passage adjacent to the open end of said tubular member being substantially closed but having a discharge opening beneath the bottom of said tubular member through which air may escape from said air passage, the bottom of said tubular member providing a trough for conducting accumulations of fuel into the path of air passing through said discharge opening, and a spray nozzle disposed within said tubular member adjacent to its closed end, said nozzle being arranged to discharge a jet of liquid fuel longitudinally toward the open end of said tubular member.

2. A liquid fuel burner comprising an elongate tubular member of generally conical shape having its smaller end closed and its opposite end open and provided with a circumferentially extending flange, the periphery of said smaller end having a plurality of spaced openings providing primary air inlets and the periphery adjacent to the open end having spaced openings providing secondary air inlets, a casing surrounding said

tubular member and defining therewith an air passage which communicates with the interior of said tubular member through the air inlets, said flange engaging said casing and providing a closure for the end of said air passage, said flange having an opening defining a discharge passage beneath said tubular member through which air may escape, the bottom of said tubular member above said air passage being imperforate so as to provide a trough along the bottom of said tubular member leading to said discharge passage, and a spray nozzle disposed within said tubular member adjacent to its closed end, said nozzle being arranged to discharge a jet of liquid fuel longitudinally toward the open end of said tubular member.

3. A high capacity liquid fuel burner for burning high gravity liquid fuel, comprising an elongated burner tube having a discharge mouth, said tube being of progressively increasing cross-sectional area toward said mouth, a surrounding enclosing casing spaced from said tube up to and about the mouth thereof to provide an intermediate annular air space or passage entirely surrounding said tube, means for supplying air under pressure at the opposite end of said casing to and about said burner tube, the latter having a rear section the walls of which are provided with a plurality of air admission openings for admitting from said air supply into said tube a plurality of inwardly directed jets of primary air from a plurality of directions, said tube having a forward section provided with a plurality of air inlet openings distributed around and concentrated near the mouth of said tube to admit a plurality of inwardly directed jets of secondary air, said tube having further an intermediate section of prolonged length having imperforate walls, a spray nozzle within the tube, means for delivering under pressure liquid fuel unmixed with air to the nozzle, the latter being so disposed as to direct its spray of liquid fuel to impinge against the walls of said intermediate imperforate section, the portion of said last named section extending from the part where said spray first impinges thereagainst to the part where the secondary air is first admitted being of greater length than the length of said forward section, and means immediately in advance of the nozzle for igniting the mixture and heating the walls of said imperforate section, thereby to thoroughly vaporize the liquid fuel impinging thereagainst prior to the introduction of the secondary air and to provide a mixture emerging from the mouth of said tube in a condition ready for complete combustion in the combustion chamber.

4. A high capacity liquid fuel burner for burning high gravity liquid fuel, comprising an elongated burner tube having a forward discharge mouth for discharging into a combustion chamber, said tube having means for admitting primary air to the rear thereof, said tube comprising a forward section with air admission openings concentrated near the mouth thereof through which secondary air is admitted and a second section at the rear of said forward section having imperforate walls, a spray nozzle within the tube and means for delivering under pressure liquid fuel unmixed with air to the nozzle, the latter being so disposed as to direct its spray of liquid fuel to impinge against the walls of said second section, the said second section from the part against which said liquid spray first impinges to the part where the secondary air is first admitted being longer than the forward section, and an ignition device within the tube immediately in advance of the nozzle for igniting the rich mixture thereat, thereby heating the said imperforate walls to thoroughly vaporize said liquid fuel by contact with said heated walls before admission of said secondary air.

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