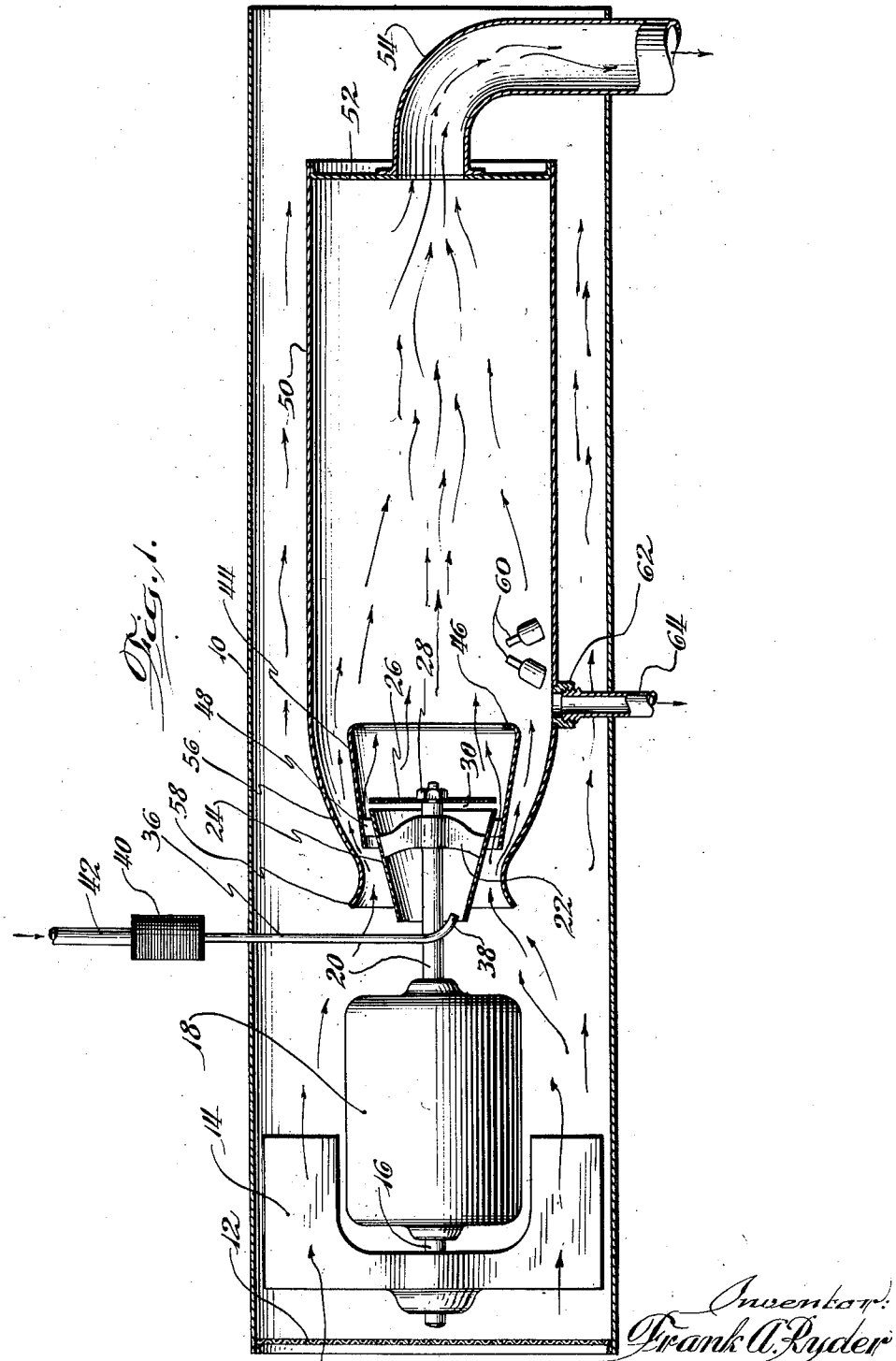
April 2, 1957 F. A. RYDER 2,787,319

SPINNER TYPE LIQUID FUEL BURNER

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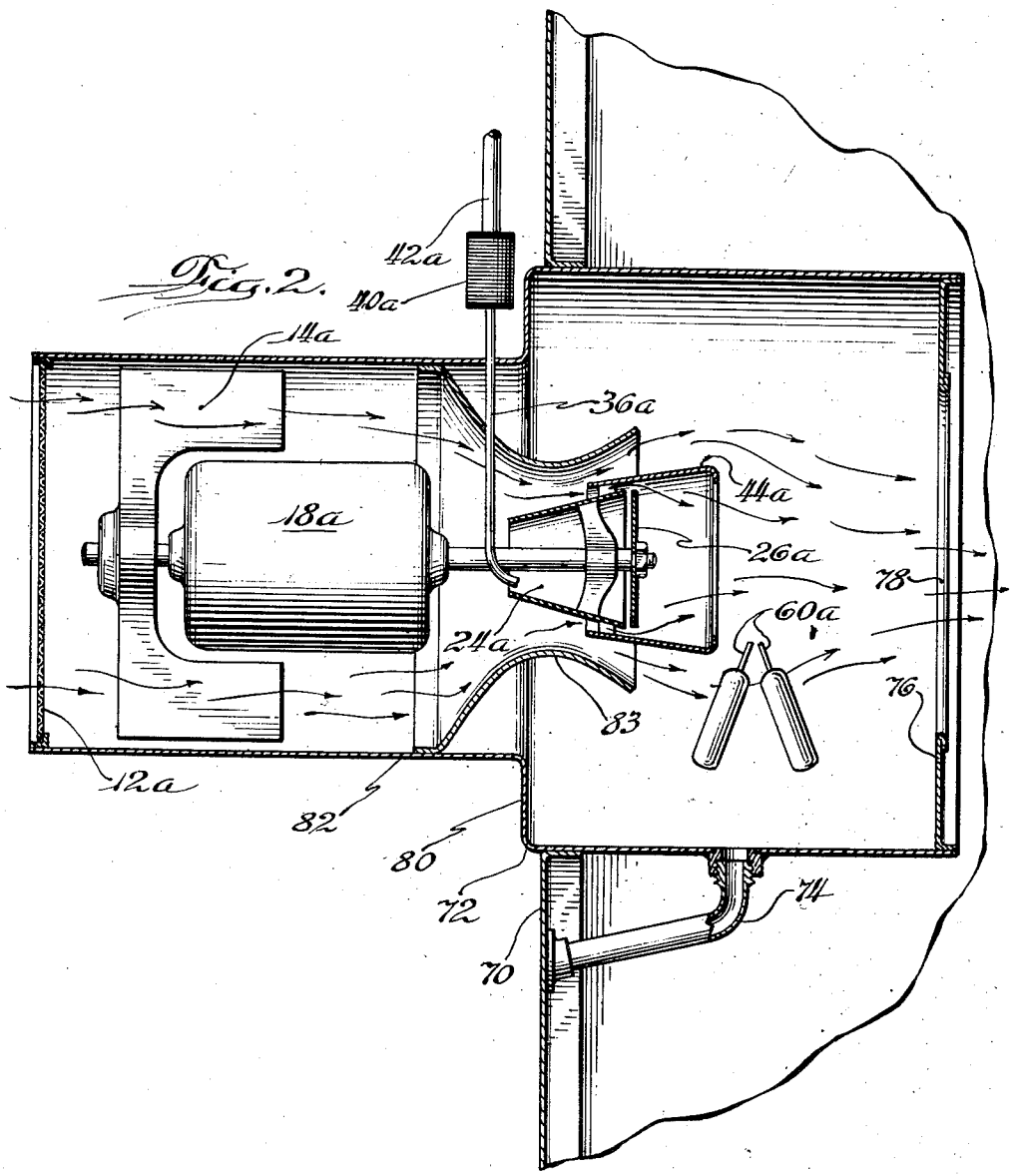
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Fig. 2.



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SPINNER TYPE LIQUID FUEL BURNER

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2 Claims. (Cl. 158—4)

The present invention relates to liquid fuel burners and more particularly to burners of the type which have a spinning element therein for atomization of the fuel.

Liquid fuel burners are well known in which there is a motor driven spinning element into which the fuel is fed, such that the fuel is subjected to a centrifugal field and thrown away from the periphery of the spinner with sufficient velocity to bring about atomization of the fuel. Burners of this type have advantages among which are the following: The combustion air pressure drop through the burner system may be low since high air velocity is not required to break up the fuel particles. Fuel may be fed to the burner by gravity or by a low pressure pump, thereby avoiding the need for expensive and complicated high pressure pumping equipment. Such burners as contrasted with spray nozzle burners are less likely to clog inasmuch as the fuel does not need to be forced through a small orifice at high pressure. In other words, the fuel delivery pressures prevailing at a spinner burner are of such a low order that comparatively large fluid passages can be used. As contrasted with vaporizing pot type burners, spinner burners are generally more efficient and do not require a pool of fuel to be present in the burner and thus will extinguish more quickly after the fuel has been turned off. Burners of this type have a disadvantage in that the centrifuging element must travel at a high rim velocity in order to bring about proper fuel atomization. This requires either that a spinner of comparatively large diameter be used or else that the spinner be driven at an extremely high rotational speed. Inasmuch as extremely high rotational speeds are not ordinarily practical, it will be appreciated that burners of this character for practical considerations are quite large and therefore require considerable space for their installation. They are, therefore, impractical for installations requiring only a relatively low heat output.

One of the objects of the present invention is to retain the advantages of the spinner type burner while at the same time enabling such a burner to be installed in small space and without necessitating the use of high rotational speeds in order to bring about efficient combustion.

An additional object is to provide a low pressure liquid fuel burner which can be adapted to extremely small space and which does not have the disadvantages ordinarily associated with pot type vaporizing burners of similar size.

Yet another object is to provide a liquid fuel burner of the spinner type which operates efficiently and reliably at relatively low rotational speeds, which occupies little space, and which will so operate that combustion will cease almost immediately after the fuel supply thereto has been shut off.

Yet another object is to provide a novel heater of the above character which is admirably adapted for use as a furnace conversion burner or a vehicle heater burner.

Yet another object is to provide an improved liquid fuel burner which combines the advantages ordinarily associated with spinner type burners and vaporizing type burners without having the disadvantages ordinarily associated with burners of either type.

Other objects and advantages will become apparent from the following description of a preferred embodiment of my invention which is illustrated in the accompanying drawings.

In the drawings, in which similar characters of reference refer to similar parts throughout the several views:

Fig. 1 is a somewhat diagrammatic illustration of a heater incorporating a burner of the present invention shown in longitudinal medial section. This heater may be considered as being of the vehicle type in which the major heater components are located within a section of ventilating air duct; and

Fig. 2 is a view similar to Fig. 1 but showing the novel burner adapted for use as a furnace conversion burner.

Referring to Fig. 1 of the drawings, I have shown a ventilating air duct 10 which may be considered as a portion of the air supply duct in an automobile for instance, although of course it may be installed in other locations where heated air is required. Ordinarily the section of duct 10 will be connected at each end to additional duct work such that the left hand end as seen in Fig. 1 leads to a fresh air source whereas the right hand end leads to the space to be heated. If desired, the air can be heated and recirculated by connecting both ends of the duct work to the space to be heated. Near the left end of the portion of the duct indicated by the numeral 10, there may be a screen 12, or similar member, to prevent foreign objects such as large insects from coming into contact with the functioning portion of the heater mechanism.

Directly downstream, that is to the right of screen 12, I have shown a fan of axial flow type indicated by the numeral 14 as connected to a shaft 16 extending from one end of an electric motor 18 supported at the center of the duct 10 in any suitable fashion. The motor shaft also extends to the right of the motor where it is indicated by the numeral 20 and is secured to the center of a small spider 22 which is attached at the ends of its arms to the internal surface of a sheet metal atomizing cone 24. This spinner cone is open at both ends and is coaxial with the shaft 20. It has its larger end faced toward the right away from the motor 18. Just beyond the right hand open end of the cone 24 a shielding disc 26 is secured to the threaded end of the motor shaft 20 by a nut 28. This disc has a diameter slightly larger than the opening of the adjacent large end of the cone 24 and is spaced longitudinally therefrom a short distance so as to provide an annular slot 30 between the two.

Fuel is introduced into the spinner 24 by a tube 36 which extends through the upper portion of the wall of the duct 10 in a position between the rearward end of the spinner 24 and the motor 20 and which has a forwardly curved lower end indicated at 38 extending into the rearward end of the cone 24 such that fuel dripping from the open end 38 will fall against the interior surface of the cone 24. The flow of fuel to the tube 36 is controlled by any suitable means such as an electrically operated solenoid valve 40 which is fed by a fuel line 42. This fuel line 42 may be connected to a source of fuel under low pressure or the fuel may be supplied under a slight gravity head, it being necessary merely that when the burner is in operation, fuel will drip or run slowly from the open end 38 of the tube 36.

A vaporizing conical member or retainer 44, which will be referred to hereafter as the retainer is formed of sheet metal in such fashion that it is somewhat more nearly cylindrical than the cone 24 and such that its rearward open end is slightly larger than the large end of the cone 24. The opposite or forward end of the cone 44 is still

larger but has the extreme end 46 thereof rolled inwardly, as shown, to extend radially toward the axis of the cone 44 in substantially perpendicular relation thereto to form an annular fuel retaining flange or lip the purpose of which will appear presently. The rearward end of the retainer 44 is connected to the forward portion of the cone 24 by a plurality of small spacers 48 which retain the two cones in coaxial alignment. There is enough room between the spacing elements 48, however, to permit air to flow freely between the external surface of the cone 24 and the interior of the retainer 44.

The atomizing spinner 24 and vaporizing retainer 44 together with the supporting and drive structure connected thereto form an atomizing and vaporizing rotor assembly extending into the open end of a generally cylindrical combustion chamber 50 which is formed of sheet metal with a closed downstream end 52, this end closure in turn being connected to an exhaust pipe 54 which leads out through the side wall of the duct 10 to some remote point. The open or upstream end portion of the combustion chamber 50 is rolled inwardly as at 56 so as to confine the burner cones 24 and 44 comparatively closely, excepting that the extreme upstream end is flared outwardly as at 58 to form a bell mouth opening to reduce the entrance pressure loss of the air introduced into the annular space between the open end of the combustion chamber 50 and the spinner 24.

Ignition is obtained by a pair of sparking electrodes 60 which extend through the side wall of the combustion chamber 50 at a suitable location so as to place the electrodes in a region enveloped by a combustible mixture at the time of starting. These electrodes are connected as is customary to a source of high voltage. Also in the interest of safety, a drain fitting 62 can be arranged at the bottom of the combustion chamber 50 and connected to a tube 64 leading to some remote point.

The burner cone 24 is quite small, such that if it were depended upon to vaporize the fuel, as is customary in spinner burners, it would be necessary to spin this cone at a speed of the order of ten thousand to twenty thousand revolutions per minute. According to the present invention, however, it is intended that this cone be rotated only at a speed of say three thousand to four thousand revolutions per minute, which is well within the capabilities of ordinary low cost fractional horse power electric motors either of the direct current or alternating current type.

The device operates in the following manner: By means of any suitable electric circuit, the motor 18 is energized as is the fuel valve 40 and the sparking electrodes 60. It will be assumed, therefore, that the motor 18 is turning the axial flow fan 14 and the spinner 24 at 3000 or so R. P. M., that fuel is flowing slowly or dripping from the end 38 of the fuel delivery tube 36, and that sparking is taking place at the electrodes 60. Under these conditions, fuel falling from the end of the delivery tube 38 against the inner surface of the cone 24 will immediately spread out in a thin film and migrate forwardly toward the large open end of the cone 24 due to centrifugal action. As the fuel reaches the forward edge of the cone 48 it will be thrown outwardly in small droplets accompanied by some vapor.

Air flowing toward the right from the axial flow fan 14 will have a portion thereof diverted into the bell mouth 58 of the combustion chamber 50 so that it flows around the cone 24. This portion is then divided and one portion thereof passes through the annular space between the spinner 24 and retainer 44, whereas a second portion of the air will pass around the exterior of the retainer. The air portion which passes into the rearward end of the retainer 44 flows past the forward end of the spinner 24 and mixes with the fuel vapor produced by the spinner. This mixture of air and vaporized fuel travels forwardly out of the open end of the retainer 44 and is ignited by the spark plug 60.

Meanwhile an additional portion of the fuel which was not picked up by the air stream at the large open end of the spinner 24 forms a thin film upon the interior surface of the retainer 44 and flows forwardly therein, but is prevented from leaving the forward end of the retainer by the inwardly turned flange 46 which in effect forms an annular trough which will retain a considerable quantity of fuel before overflowing. This portion of the fuel within the retainer 44 is subject to radiation heating by the flame within the combustion chamber as is also the retainer cone 44. The temperature of the liquid fuel within the retainer cone 44 therefore rises rapidly until it vaporizes and passes out of the opening at the forward end of the retainer. As soon as it leaves the retainer 44 it mixes with additional air passing around the outside thereof and thus forms a combustible mixture which burns within the combustion space. Additional heat is therefore absorbed by the retainer and raises its temperature still further until an equilibrium is reached, such that the fuel passing through the annular slot between the forward end of the spinner 24 and the shield 26 vaporizes quite soon after it is caught in the retainer. The result is that no appreciable quantity of fuel accumulates within the retainer, but the small reservoir of fuel thus provided smooths out the operation of the burner. The shield 26 prevents the fuel within the spinner 24 from being heated to such an extent that carbonization of gum formation takes place in this portion of the mechanism.

The hot products of combustion flow from the combustion chamber by way of the exhaust fitting 54 and heat is transferred through the wall 50 of the combustion chamber to ventilating air which is propelled through the duct 10 by the axial flow fan 14.

From the above it will be seen that the burner as described has several important advantages over either spinner burners, pot type burners or spray burners as conventionally constructed. For instance, since a portion of the fuel is vaporized by the spinning action and an additional portion by the thermal effect of the flame upon the retainer 44, it is not necessary to rotate the spinner 24 at high speed. This has an ancillary advantage in that the burner can be made quite small without necessitating impractically high rotational speeds. On the other hand no appreciable quantity of fuel can collect as is ordinarily the case with vaporizing pot type burners and thus whenever the flow of fuel to the spinner 24 is cut off, the fuel within the cone 24 and within the retainer 44 will be quickly exhausted. It is not necessary, therefore, to make special provision for a purging cycle to remove unburned fuel and products of combustion from the combustion space after the heater has been turned off, since ordinarily the fan and motor 18 will coast long enough to accomplish this.

An additional advantage of the arrangement shown as compared with the ordinary pot top vaporizing burners is that inasmuch as the fuel is spread in a thin film over the entire inner surface of the retainer, there is a large surface area for absorbing heat so as to produce vaporization even though the heater may be quite small. There is no tendency therefore for the operation of the burner to stabilize under a condition requiring a considerable size pool of fuel within the combustion space which continues to burn after the fuel has been turned off. Also, because of the initial direct vaporization of a portion of the fuel, due to the spinning effect alone, ignition is quite rapid without the need for preheating.

The embodiment of the invention illustrated in Fig. 2 is intended primarily as an adaptation of the device illustrated in Fig. 1 for use as a conversion burner in an ordinary household coal fired furnace. In this embodiment the wall of the furnace is represented by the numeral 70 and this wall has an opening therein which may be considered for instance as the ordinary furnace firing door opening. A combustion chamber 72 is fitted to this opening. It is formed of sheet metal and is provided at

its lower extremity with a drain **74** leading to the outside. The combustion chamber **72** may be generally cylindrical or drum shaped with an inwardly extending annular flange **76** forming a partial closure at the open end thereof. The opening **78** at the center of this flange permits hot products of combustion to flow to the interior of the furnace fire box and hence through the customary furnace heat exchanger. The motor **18***a*, fan **14***a*, spinner **24***a*, shield **26***a* and retainer **44***a* are counterparts of the elements just described in connection with the previous embodiment of the invention and therefore need no additional discussion here. This is also true of the fuel line **42***a*, valve **40***a* and fuel delivery tube **36***a*.

The rearward end of the combustion chamber **72** is connected by an adapter flange **80** to a short cylindrical section **82** which may be considered as the counterpart of the left hand portion of the duct **10** of the previous embodiment. Within the duct section **82** the motor **18***a* and fan **14***a* are located as is an inlet screen **12***a* and a partial restrictor **83** equivalent to the bell mouth opening **58** of the previous embodiment.

As in the previous embodiment, air is drawn in through the screen **12***a* by the fan **14***a* driven by the motor **18***a*. This air passes toward the right, with the major portion thereof flowing through the bell mouth restrictor **83** directly to the large combustion chamber **72**, a minor portion being diverted so as to pass between the exterior surface of the spinner **24***a* and the interior of the retainer **44***a*. As in the previous example, fuel is delivered by the tube **36***a* and flows forwardlly as a thin film against the interior surface of the spinner **24***a* and is thrown outwardly at the extremity thereof against the interior surface of the retainer **44***a*. This centrifugal action forms some vapor which is picked up by the air stream flowing through the interior of the retainer, and this mixture is ignited by sparking electrodes **60***a*. As in the previous example, therefore, fuel for combustion is partly vaporized by the spinning action of the spinner **24***a* and partly by the vaporizing action of the retainer **44***a*, with the result that a rich mixture of fuel vapor and primary air combines with secondary air slightly beyond the forward end of the retainer **44***a*, so as to burn with high efficiency, and a portion of the heat thus generated serves to elevate the temperature of the retainer **44***a* and the fuel therein so as to insure continuous vaporization.

Inasmuch as the burner shown in Fig. 2 is intended primarily for adaptation to an ordinary furnace, the motor **18***a* does not supply ventilating air inasmuch as the furnace is already equipped with the necessary elements for providing heat exchange and ventilating air circulation. In addition to the advantages previously mentioned for a burner of the type described, the arrangement illustrated in Fig. 2 has the added advantage in an ordinary furnace installation of being quiet since the motor speed need not be high and there is no requirement for relatively high pressure combustion air blowers or fuel pumps.

From the above description of a preferred embodiment of my invention it will be apparent that changes and variations in the structure may be made without departing from the scope or spirit of the invention and that therefore the scope of the invention is to be measured by the scope of the following claims.

1. Compact combustion means adapted for efficiently burning liquid fuel which may be supplied at a low pressure, comprising, in combination, means defining a combustion chamber, a centrifugal fuel atomizing and vaporizing rotor assembly projecting into said combustion chamber and including an atomizing cone truncated at opposite ends, the smaller end of said atomizing cone defining an air intake opening therein, the larger end of said atomizing cone projecting into said combustion chamber, means axially shielding said larger cone end and defining therewith an annular passage opening radially outward with respect to the axis of the cone, rotary driving means connected to said atomizing cone for

rotating the latter about the axis thereof, means supplying liquid fuel to the interior of the smaller end of said atomizing cone to flow by centrifugal force along the inner surface thereof to the larger end thereof, said atomizing cone upon rotation during operation serving centrifugally to sling liquid fuel reaching said larger end thereof radially outward in small droplets, a vaporizing cone truncated at opposite ends, means mounting said vaporizing cone in coaxial relation with said atomizing cone for rotation therewith, the smaller end of said vaporizing cone axially overlapping said larger end of said atomizing cone in close radially spaced relation thereto to define therewith an unobstructed annular air intake into said vaporizing cone, the larger end of said vaporizing cone extending deep into said combustion chamber beyond the larger end of said atomizing cone, said vaporizing cone serving to catch fuel droplets slung radially outward from said larger end of said atomizing cone, the outer surface of said vaporizing cone being substantially surrounded along substantially the entire length thereof by internal space of said combustion chamber for full exposure during operation to radiant heat of combustion in said chamber, an annular liquid fuel retainer lip integrally formed on the peripheral edge of said larger end of said vaporizing cone and extending radially inward in substantially perpendicular relation to the axis thereof for efficient collection of radiant heat from combustion within said chamber immediately beyond the larger end of the vaporizing cone, the heat collected by said lip and the adjacent portion of said vaporizing cone subjected to most intensive heating in said combustion chamber being readily transferred to liquid fuel caused by centrifugal force generated by rotation of said vaporizing cone to flow toward said retaining lip thereon, and means defining an annular air intake for said vaporizing cone closely encircling said smaller end of said atomizing cone and merging with said combustion chamber around the smaller end of said vaporizing cone.

2. Fuel burning apparatus comprising, in combination, means defining a combustion chamber, a centrifugal atomizing and vaporizing rotor assembly projecting into said combustion chamber and including an atomizing cone having a larger end projecting into said combustion chamber, rotary driving means connected to rotate said atomizing cone about the axis thereof, means supplying liquid fuel to the interior of the smaller end of said atomizing cone to flow to said large end thereof by centrifugal force generated by rotation of the cone, liquid fuel reaching said large end of said atomizing cone during rotation thereof being centrifugally slung radially outward in small droplets, a vaporizing cone truncated at opposite ends, means mounting said vaporizing cone in coaxial relation to said atomizing cone for rotation therewith, the small end of said vaporizing cone axially overlapping the large end of said atomizing cone in close radially spaced relation thereto to define therewith an unobstructed annular air intake into said vaporizing cone, the large end of said vaporizing cone projecting deep into said combustion chamber beyond the large end of said atomizing cone, the outer conical surface of said vaporizing cone being substantially surrounded along substantially the entire length thereof by internal space of said combustion chamber for full exposure during operation to radiant heat of combustion in said chamber, the axial portion of said vaporizing cone generally aligned axially with the large end of said atomizing cone serving to catch fuel droplets slung radially outward from said atomizing cone, an annular liquid retainer lip formed on the peripheral edge of said large end of said vaporizing cone and extending inwardly toward the axis thereof to retain liquid fuel caused to flow along the inner surface of the vaporizing cone to the large end thereof by centrifugal force generated by rotation of the vaporizing cone, said lip and said vaporizing cone being subjected for efficient fuel vaporization to intensive heating by radiant heat from com-

bustion within said chamber, and means defining an annular air intake for said vaporizing cone closely encircling said smaller end of said atomizing cone and extending into said combustion chamber around the smaller end of said vaporizing cone.

References Cited in the file of this patent

UNITED STATES PATENTS

1,693,053	Rodler	Nov. 27, 1928
1,699,488	Klemm	Jan. 15, 1929
2,200,826	Johnson	May 14, 1940
2,204,170	Zwilling	June 11, 1940
2,374,569	Tramontini	Apr. 24, 1945
2,620,864	Ray	Dec. 9, 1952

FOREIGN PATENTS

758,734	France	Nov. 7, 1933
187,974	Switzerland	Mar. 1, 1937