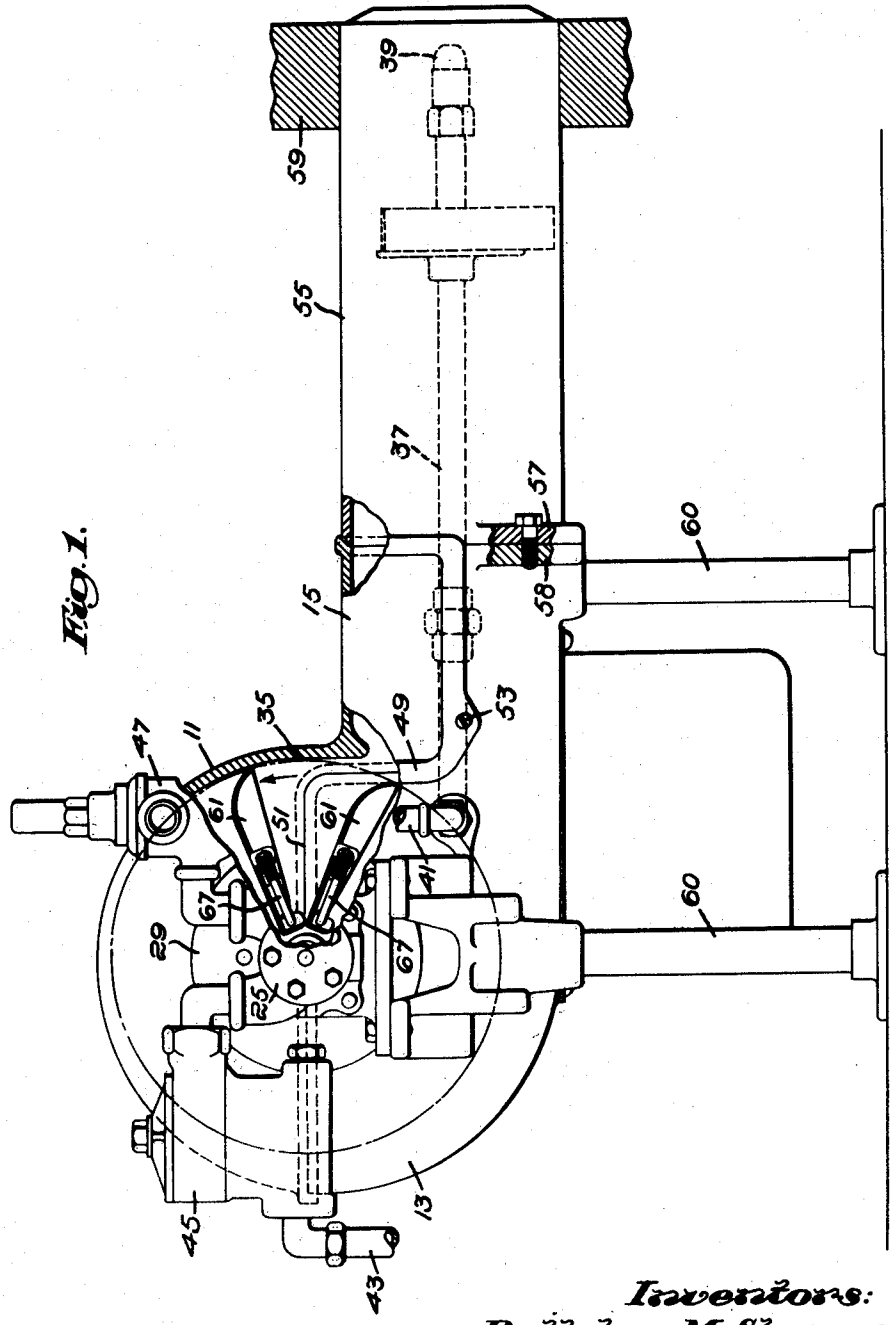
Oct. 18, 1938. R. M. SHERMAN ET AL 2,133,486

APPARATUS FOR BURNING LIQUID FUEL

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Fig. 1.



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Fig. 2.

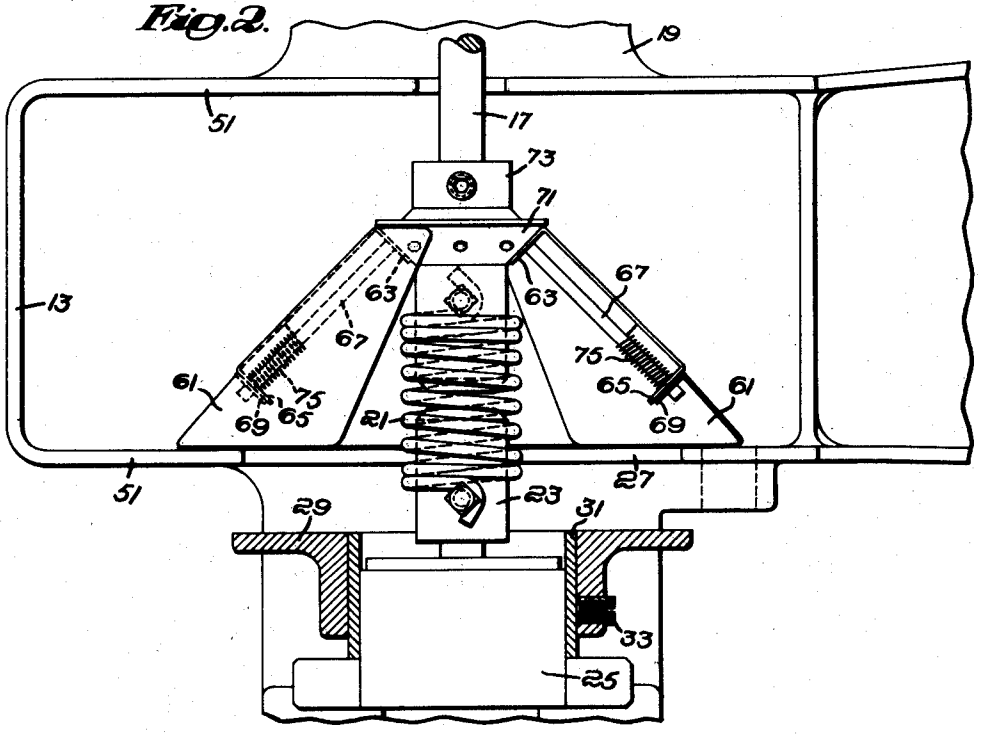
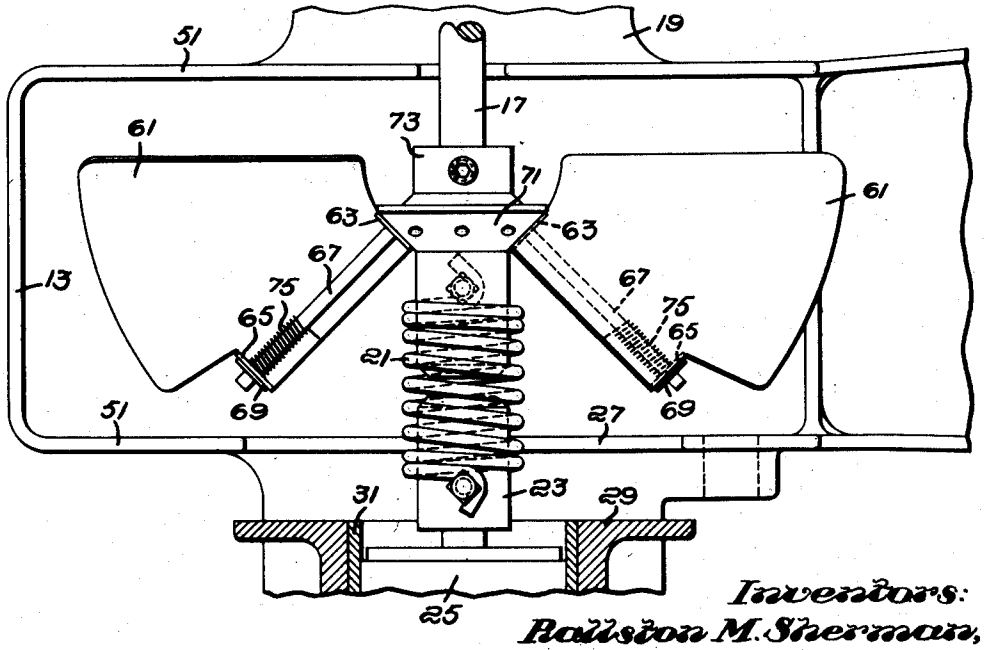


Fig. 3.



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Fig. 4.

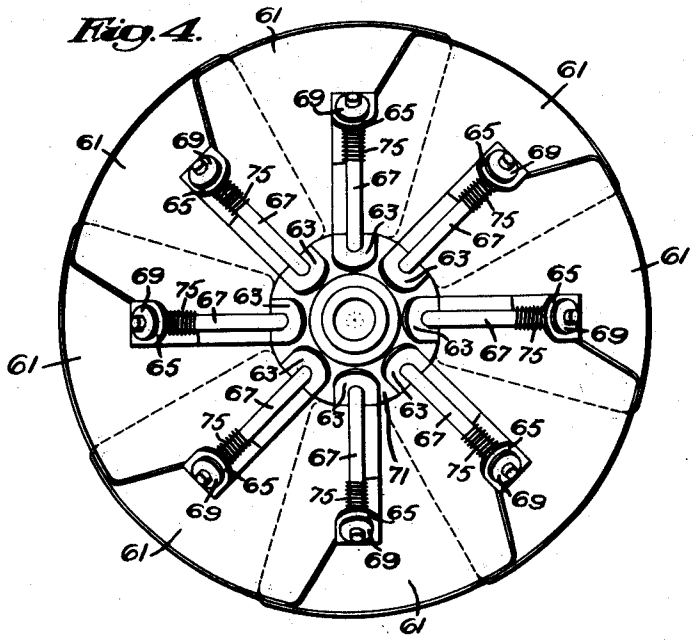
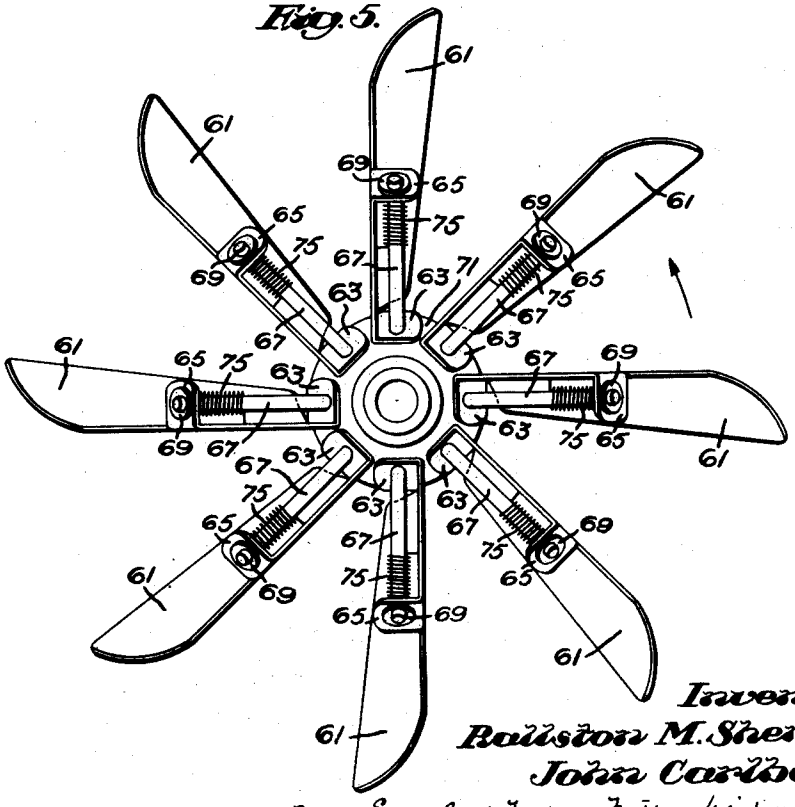


Fig. 5.



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UNITED STATES PATENT OFFICE

2,133,486

APPARATUS FOR BURNING LIQUID FUEL

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Application January 27, 1937, Serial No. 122,650

8 Claims. (Cl. 158—76)

This invention relates to rotary bladed structures usable for impelling a body of air with the accompaniment of either pressure or suction, and more particularly, though not exclusively, to the utilization of such structures for the purpose of supplying air in the burning of liquid fuel, herein referred to for descriptive purposes as oil.

In the drawings:—

Fig. 1 is a side elevation of a burner of the so-called gun type, partly broken away to show the relation of the rotary bladed air impeller therein;

Fig. 2 is a partial plan in section, showing the casing of the burner of Fig. 1 with the air impeller therein, the blades of the latter being shown in closed position to cut off the air;

Fig. 3 is a similar view, showing the impeller with the blades open in the positions to which they move under centrifugal force to force an air supply to the burner when the impeller is rotated;

Fig. 4 is a front view of the impeller with the blades closed; and

Fig. 5 is a similar view showing the blades open.

Referring to the drawings and to one embodiment of the invention herewith submitted, this is shown for illustrative purposes (Figs. 1, 2 and 3) as embodied in an oil burner of the gun type. This is provided with a casing, the upper part 11 of which is generally cylindrical in form and the lower part 13 of which merges into a prolonged straight cylindrical tubular air discharge conduit member 15 having itself or in an extension thereof an open mouth at its discharge end, the conduit being arranged in a generally tangential relation to the lower or discharge part of the casing.

Within the casing is a rotary air impeller (hereinafter more fully described) mounted on and driven by the shaft 17 (Figs. 2 and 3) of an electric motor 19, which latter is arranged on a supporting plate at one side of the casing. The impeller, at the opposite side of the casing, is connected by the resilient driving connection 21 to the prolonged end of the driving shaft 23 of the oil pump 25 mounted on a shelf or extension at the outside of the casing and at the opposite side thereof from the motor.

The side wall of the casing adjacent the motor is closed except for the opening through which the driving shaft 17 extends, while the opposite side wall facing the pump 25 is provided with a circular admission opening 27 of substantial size and coaxial with the impeller shaft. The volume of air admitted through the air admission opening may be controlled by a disk-shaped shutter 29 (Figs. 2 and 3) slightly larger in diameter than that of the opening 27, the shutter being adjustable toward and away from the opening and mounted on a sleeve 31 surrounding the pump 25 on which it may be held fixed by any suitable means, such as the set screw 33.

The impeller, which rotates in the direction of the arrow shown in Figs. 1 and 5, is mounted in eccentric relation to the inner peripheral walls of the casing so that the clearance between such walls and the blades of the impeller, when the blades are fully opened to the position shown in Figs. 1, 3 and 5, is at a minimum at the point designated 35 in Fig. 1 (which may be termed the point of air registry or cut-off), but gradually increases from that point to the air discharge portion at the bottom thereof.

Positioned axially within the casing 15 is an oil delivery pipe 37 terminating just short of the conduit mouth in a nozzle 39 and connected to an oil supply pipe 41. Oil is drawn by the pump 25 from a suitable source of supply (not shown), such as a main storage tank, through the pipe 43 and strainer 45 and delivered to the supply pipe 41 and nozzle 39 through the pressure reducing valve 47 at a relatively high pressure to produce a mechanical atomization of the oil leaving the nozzle and to discharge from the latter a cone-shaped oil spray without premixture with air. The oil spray, commingled with air discharged through the conduit 15, is ignited in front of the nozzle by sparking electrodes (not shown).

For convenience in assemblage or inspection of the interior working parts of the burner, the impeller housing is formed of two separable and interfitting parts, one of which comprises the lower half 13 of the casing and the lower half of the immediately adjacent portion of the tubular air conduit 15. The other part comprises the upper half 11 of the casing and the upper half of the tubular conduit portion. The upper part has a bead or flange 49 which laps over the edges 51 of the lower part so that the two sections are in interfitting relation, being fastened together by means, such as the screws 53 (Fig. 1), permitting the removal of the upper part and the exposure of the impeller and other interior parts for purposes of repair or inspection.

In the illustrated form of the burner, the air conduit is completed by a cylindrical open mouth or extension 55 which fits within the end of the conduit section formed by the two separable parts of the casing and is removably secured to the

lower half of that section by the provision of flanged walls 57 bolted to the corresponding flanged walls 58 at the end of such lower section. The housing is supported by any suitable means, such as the posts 60 resting on the floor. The conduit extension discharges air about the nozzle into a combustion chamber through the wall 59 thereof, being preferably the only source of any substantial amount of air entering the chamber.

Referring now to the air impeller, shown in detail in Figs. 2, 3, 4 and 5, this comprises a series of similar light, sheet-metal, concavo-convex segmental blades 61, herein eight in number, each slightly convex on its air delivery face and with an arc-shaped outer edge, the blades being so assembled that when they are closed, as in Figs. 2 and 4, the convex faces of the blades present an outer conical surface, with the outer edges of the blades at the base of the cone forming a substantially unbroken peripheral edge.

Each blade, at the inner end of one of its radial edges, has a small inturned flange 63, and, on the same radial edge nearer its outer end, a similar flange 65, both bent at right angles inwardly from the convex side of the blade, by means of which the blade is pivotally mounted for turning movement on a pin or small rod 67 and on which it is held by the small disk-shaped washer 69 secured on the end of the pin. The several rods 67 are fixedly secured in equally spaced relation to and about the conical walls of the fan hub 71 and extend outwardly therefrom but are inclined to the axis of rotation of the hub. The inner edges of the blades have a concaved, arcuate shape so that, when the blades are closed (Figs. 2 and 4), they fit about the periphery of the hub 71 and provide a closure for the small end of the structure which assumes the form of a truncated cone.

The fan hub has a sleeve extension 73 by which it is mounted on and secured to the motor shaft 17 by a set screw or other means, as indicated in Figs. 2 and 3. A torsion spring 75 encircles each pin, having one end fastened to the pin and the other extending over and lying against the adjacent edge of the blade, so that, when the fan is normally at rest, the blades are urged by the light pressure of the spring in a direction moving them to the closed position shown in Figs. 2 and 4. In this position the free end of the concave face of each blade comes to rest in overlapping relation to the convex face of the next adjacent blade near the pivoted edge thereof.

The impeller blades are of such dimensions that in closed position the continuous peripheral edge of the cone formed by the outer arc-shaped edges overlaps the periphery of the air admission opening 27 and the closed blades form a truncated cone, providing a substantially complete closure for such opening and preventing the entrance of any substantial amount of air therethrough. The sleeve extension 73 is preferably positioned on the motor shaft so as to bring the edges of the closed blades almost, but not quite, in contact with the walls of the casing surrounding the opening 27, sufficient clearance only being left to permit the blades to move without friction against the casing when rotation of the impeller is started.

When the impeller is started into rotation, however, the angle of inclination of the pivotal axes of the blades causes the latter to move under centrifugal force about the pivot points and open up against the opposing pressure of the spring 75. This opening movement continues until either positively arrested or until the center of gravity of each blade reaches its maximum radial distance from the axis of rotation.

It will be observed that the rods 67 terminate short of the outer arc-shaped edges of the blades by an appreciable distance so that they lie entirely within the conical formation of the structure when closed, as indicated in Fig. 2. The corner of each blade beyond the outer flange 65 is cut away, as best indicated in Fig. 3, both as a convenience in manufacture and to bring the center of gravity of the blade nearer the free edge thereof, effecting a more forcible blade-opening movement, the overlapping of the free edge of the next adjacent blade being sufficient to cover the cut-away corner of the blade when the blades are closed. This overlap also provides a blade of greater width when the blade has opened under rotation of the impeller and provides a greater volume of air delivered to the burner.

It will be observed that the impeller is positioned in the housing on the delivery side of the air admission opening and the axis of rotation of each blade is inclined to the direction of the resulting movement of the air, so that, when opened by centrifugal force, the blades move away from the air admission opening 27 into the enlarged space of the housing and in the same direction as that of the resulting movement of the air, swinging about their inclined pivotal axes in the same direction as that in which the impeller is rotated.

When rotation ceases, the blades swing in a direction opposite to the preceding rotation of the impeller and move back in a direction opposite to that in which the air is drawn into the casing and into a position where the air admission opening is closed and further entrance of air prevented.

This relation of the impeller to the air admission opening and to the direction of air movement avoids the creation of a back pressure, and the resulting diminution of the efficiency of the impeller, which has been found to result from positioning the impeller on the inlet side of the air admission opening where, to render it at all effective, it should be enclosed circumferentially by walls diverging away from the air admission opening to be sealed and providing a reasonable clearance only for the opening of the blades, which walls accentuate the back pressure referred to.

When the impeller is rotated, the blades swing outwardly, spreading transversely across the chamber within the casing and with their smooth convex faces presented in impelling relation to the air. The rotation of the impeller blades drives the air around the casing and expels it forcibly in a generally tangential direction through the lower discharge portion of the casing into and through the tubular air conduit. Air is drawn into the casing through the air admission opening 27, and in a generally axial direction with relation to the impeller, by the suction created through the movement of the blades across the point of air registry 35, as well as by the slight inclination or curvature of the convex faces of the blades, which accelerates the normal movement of the air into and through the air opening.

A positive stop may be employed to adjustably limit this opening movement of the blades, but as such adjustment tends to alter the velocity-

volume ratio of the air impelled it is preferable to allow the blades to open to a fixed working position and regulate the volume of air by adjusting the air shutter or damper 29. As employed in the present case, where the rotary impeller is required to take the air in axially and deliver it in a generally tangential direction, the blades are preferably allowed to open to their maximum position, which is substantially as indicated in Figs. 3 and 5.

As soon as the rotation of the impeller ceases, caused, for example, by the action of a room thermostat or other switch designed to stop the rotation of the motor and the functioning of the burner, the blades move back to the closed position indicated in Fig. 2, stopping further entrance of the air into the casing and air conduit. This provides the function of automatically stopping further passage of cold air into the furnace as soon as the burner stops and as soon as the impeller ceases to function in creating its forced draft. This automatically seals off the furnace from the entrance of cold air, whether induced by the natural draft of the chimney or otherwise, thereby protecting the walls of the combustion chamber and the furnace from the chilling effect of such cold entering air and conserving the heat previously imparted to such walls.

Features of the air impeller, independent of their cooperative relation to the features of the liquid fuel burner, are separately claimed in our co-pending application, Serial No. 138,604, filed April 23, 1937.

While there is herein shown and described for purposes of illustration one specific embodiment of the invention, it is to be understood that extensive deviations and changes may be made in the form, relative arrangement and details of the parts herein shown and in the application of the subject matter of the claims, all without departing from the spirit of the invention.

We claim:

1. A liquid fuel burning apparatus having the following elements: a nozzle for delivering liquid fuel to a combustion chamber, an air delivery conduit for delivering air to said chamber, and a housing of generally cylindrical form with an air admission opening in an end wall thereof, said conduit being tangentially related to the discharge portion of the housing, said elements being in combination with a rotary bladed air impeller eccentrically mounted within the housing, the blades of said impeller normally effecting a substantial closure of the air admission opening at the air delivery side thereof but movable, when said impeller is rotated, in the direction of resulting air movement to a position within the space enclosed by said housing and effective for drawing air laterally through said orifice into the housing and discharging it through said conduit in a direction tangentially to the impeller blades, and a motor for rotating said impeller.

2. A liquid fuel burning apparatus having the following elements: a nozzle for delivering liquid fuel to a combustion chamber, a housing having an air admission opening and an air discharge conduit for delivering air to said chamber, and a tubular air discharge conduit connected to said housing for delivering air to said chamber, said elements being in combination with a rotary air impeller mounted within the housing and effective for drawing air through said opening in a generally axial direction and discharging it from said housing through said conduit in a generally tangential direction with relation to the blades of the impeller, said blades being movable to substantially close said air admission opening on the stoppage of said impeller but movable on rotation of the impeller to a position within said housing in the direction of resultant air movement, and a motor for rotating said impeller.

3. A liquid fuel burning apparatus having the following elements: a nozzle for delivering liquid fuel to a combustion chamber, a housing of generally cylindrical form with an air admission opening for the passage of air, and a tubular air conduit tangentially related to the housing for delivering air to said chamber, and a motor, said elements being in combination with a rotatable structure within the housing driven by the motor and having movable blades serving to cut off air from said air opening when said structure is at rest but movable under centrifugal force into the space enclosed by said housing and in the direction of resultant air movement to effect the delivery of air through said orifice, said housing and said conduit when the structure is rotated.

4. A liquid fuel burning apparatus having the following elements: a nozzle for delivering liquid fuel to a combustion chamber, a housing of generally cylindrical form having an opening for the passage of air, a tubular air conduit tangentially related to the housing for delivering air to said chamber, and a motor, said elements being in combination with a rotatable air impeller within the housing, said impeller having blades movable each on its individual axis to an impelling position and in the direction of resultant air movement to draw air through the admission opening in a direction axially of the rotatable impeller and deliver it tangentially through the tubular conduit when the structure is rotated but movable out of an air impelling position to form a closure for the air opening when the impeller is at rest.

5. A liquid fuel burning apparatus having the following elements: a nozzle for delivering liquid fuel to a combustion chamber, a structure having an air conduit for the delivery of air to said chamber, an orifice for admitting air to said air conduit, and a motor, said elements being in combination with a rotary air impeller driven by said motor for impelling air through said orifice to said conduit, said impeller having movable blades mounted each to turn on an axis extending outwardly from the axis of impeller rotation but inclined to the latter axis in a direction opposite to the direction of resultant air movement, said blades being automatically movable on the stoppage of the impeller to effect a substantial closure of said orifice and cut off further passage of air to the conduit when the impeller is at rest, said blades being mounted to move in their opening movement in the same direction as that of the resulting air movement.

6. A liquid fuel burning apparatus having the following elements: a nozzle for delivering liquid fuel to a combustion chamber, a structure having an air conduit for the delivery of air to the combustion chamber and an orifice for admitting air to said conduit, and a motor, said elements being in combination with a rotary air impeller within said structure at the delivery side of the air admission opening and driven by said motor for forcing air through said orifice to said conduit, said impeller having blades movably mounted each on a separate axis and movable under centrifugal force to open position for impelling the air when the impeller is rotated and movable in an opposite direction to effect a

substantial closure of the air orifice and cut off further passage of air to the conduit when the impeller is at rest, said blades being mounted to move in their opening movement in the same direction as that of the resulting air movement.

7. A liquid fuel burning apparatus having the following elements: a nozzle for delivering liquid fuel to a combustion chamber, a structure having an air conduit for the delivery of air to said chamber, an orifice for admitting air to said air conduit, and a motor, said elements being in combination with a rotary air impeller driven by said motor for impelling air through said orifice to said conduit, said impeller having a series of concavo-convex blades mounted each on an axis at the concave side of the blade near one edge thereof, said axis extending outwardly from but inclined to the axis of rotation, said blades being normally moved to an overlapping position to form a conical structure closing said air admission orifice, said blades being each movable about its axis under centrifugal force when the impeller is rotated to move to an air impelling position in the same direction as that of the resulting air movement.

8. In a liquid fuel burning apparatus, the combination with a rotary air impeller, of an impeller housing of generally cylindrical form within which said impeller is mounted, said housing having an air admission orifice in one side facing said impeller and having further an adjacent tubular discharge conduit tangentially related to the discharge portion of the housing, a fuel delivery nozzle in said conduit, said impeller having blades movably mounted each on an individual axis extending outwardly from and inclining to the axis of rotation of the impeller, means for moving said blades when the impeller is at rest to form a conical closure for said air admission orifice within said housing on the air delivery side of the orifice, said blades, when said impeller is rotated, being movable under centrifugal force each on its axis in the direction of resultant air movement to an air impelling position away from said orifice and into the space enclosed by said housing for drawing air through said orifice in a direction axially of said impeller and discharging it tangentially through said air conduit, and a motor for driving said impeller.

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