Feb. 11, 1936. H. A. TIFFANY 2,030,123

ROTARY PROJECTOR HEAD FOR OIL BURNERS

Filed April 17, 1929 2 Sheets-Sheet 1

FIG. 1.

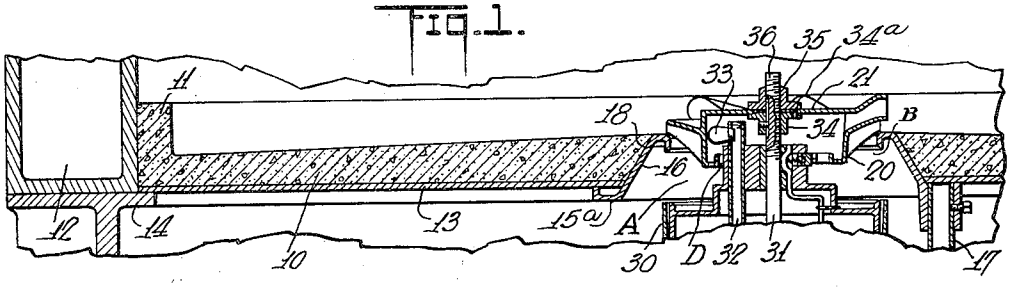


FIG. 2.

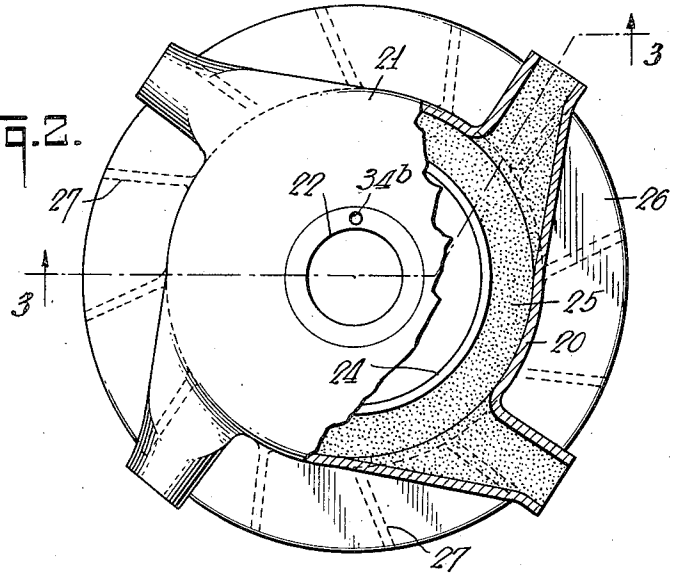


FIG. 3.

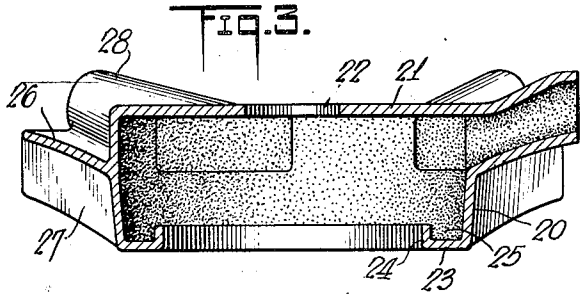


FIG. 4.

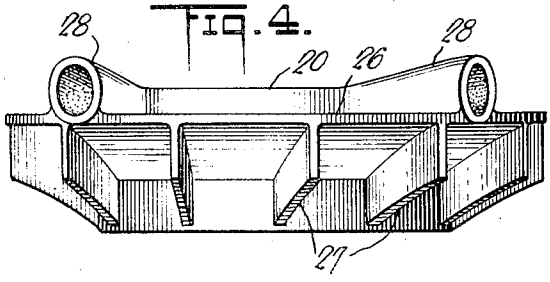
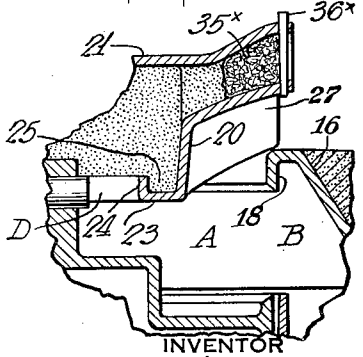


FIG. 5.



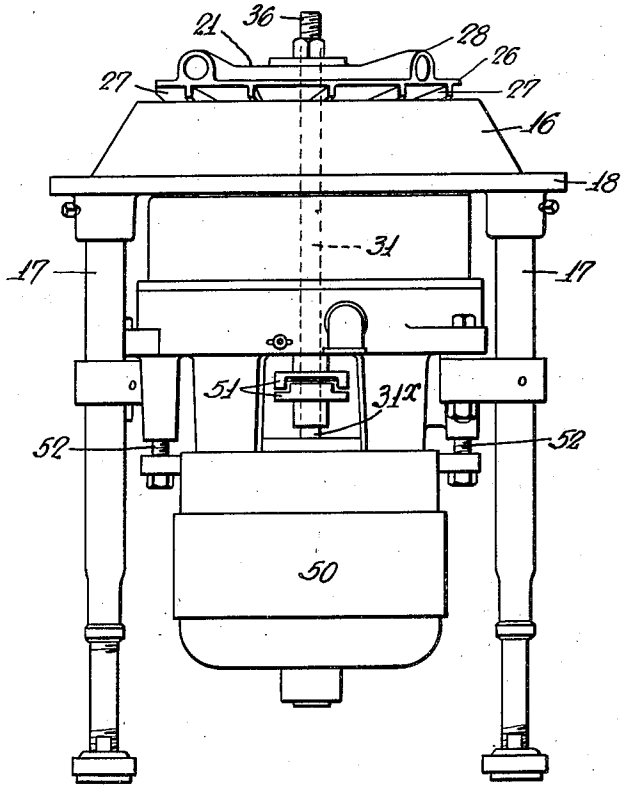
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Fig. 6.



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UNITED STATES PATENT OFFICE

2,030,123

ROTARY PROJECTOR HEAD FOR OIL BURNERS

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Application April 17, 1929, Serial No. 355,688

15 Claims. (Cl. 158—77)

My present invention relates to fuel burning apparatus of the type in which the fire box is closed at the bottom by a hearth above which projects a motor driven head for projecting fuel and air; and it relates more particularly to a recently developed type of such apparatus, in which the hearth and head are designed and operated so that a remote or peripheral flame wall functions as the real burner at which combustion is initiated; the head being specially designed and operated so as to prevent the fuel and air from igniting until impact with said flame wall, a characteristic of this type of head and hearth being that the flame thus initiated at the wall, may be as diffuse, and combustion as perfect, as may be desired.

The present invention concerns an improved method of furnace combustion and novel features of a centrifugal projector, specially adapted for any furnace that is operable in accordance with said improved method, but primarily designed for use in connection with hearths and ignition walls of the general type disclosed in the applications of Heath filed Feb. 10, 1928, Ser. Nos. 253,270 and 253,271, the latter being now Patent No. 1,886,675, granted November 8, 1932. Both show and describe my present fuel and air projector, while specifically acknowledging me as the inventor of the novel features thereof.

In burning oil in accordance with this new method, the rotary head is driven at relatively constant, low speed, say 1700 to 1750 R. P. M., regardless of the amount of fuel that is being burned; and preventing combustion until impact, and making certain that it will be initiated upon impact, depend upon the relations as well as the proportions of oil, air and burned out products of combustion in the projected draft; and the objects of my invention include producing a rotary projector which is of rugged construction, and is peculiarly adapted for projecting the oil, air and products of combustion in more perfect relation for insuring the desired results, under widely varying conditions of fire box sizes and amounts or rates of oil feed. Important features of my invention each of which are novel and all of which cooperate to produce the desired results, include the following:

The oil is projected through spouts or conduits which provide a plurality of discharge ports or orifices for flinging individual streams of oil outwardly. Preferably the spouts are few in number and afford wide spaces between spouts, thereby facilitating downward and radial movement of the hot burned out products of combustion so that the latter are mixed with and substantially envelop the streams of oil spray from the spouts. Preferably, the outlets at which the oil leaves the spouts are radially distant from the axis as far or farther than the periphery of the head and, preferably also, farther than the tips of the fan blades which are employed to establish the outward draft of a thin layer of air between the upper surface of the hearth and the oil spray. Preferably, the spouts project above the level of the top surface of the head so that there are spaces between them facilitating inflow of hot products of combustion, and preferably so that their projected surfaces function to a noticeable extent as fans tending to centrifugally project said products of combustion.

Among further features of specific contributory importance which are preferably employed, is that of having the peripheral orifices for the projected oil arranged so that when the head is rotated, the leading edge of each orifice projects farther from the axis than does its trailing edge.

Preferably, the head is hollow and has an inner oil groove into which the oil is metered and from which it is centrifugally driven over the upwardly and outwardly diverging inner surfaces of the head in a thin film, to and through the discharge pipes. Preferably, these spouts are wide at the base or inlet end and converge to relatively small outlet ports or orifices for the spray; and preferably the leading wall trails rearwardly from the base or entrance end while the trailing wall is nearly radial.

Beneath the oil outlets, preferably on the lower surface of the head, are fan blades operating to discharge a radial draft of air across the upper surface of the hearth. In practice, the slope of the hearth, the speed of rotation of the head and the distance between the head and flame wall are so proportioned that the hearth surface parallels the oil trajectory nearly enough to prevent substantial amounts of oil from impact, air-mixing and burning except on and adjacent the flame wall. It may be desirable to have the upper surface of the hearth slope downwardly from the central head to the peripheral flame wall so as to more closely parallel the falling trajectory of the oil for a greater distance.

The head receives air from below the hearth, the supply being preferably regulated by a valve controlling the air intake opening. The low pressure condition produced in the head is the resultant of the stack draft, and the centrifugal effects of the fan and of the spouts upon the air in each. The centrifugal effects of the head are

operative to cause a considerable amount of hot burned out gases, mainly nitrogen and carbon dioxide, to be admixed with the air and fuel layers projected from the head and thus assist in preventing combustion before the layers reach the flame wall. The hot burned out gas is further effective to maintain the head at the proper temperature and to lessen the skin tension and prevent oversized oil globules or particles projected from the spouts. The decreased skin tension obviously will further cause the globules to follow the desired definite path of projection. The burned out gas, being rich in carbon dioxide has the further well known effect of diluting the air draft, prolonging and diffusing the combustion and, consequently, it promotes complete combustion at the flame wall.

The projector head is noteworthy in that it is almost self-accommodating to fire chambers of various sizes and boilers of various capacities. I have found that in all standard boilers from the small atmospheric heating unit to the large boiler plant the heads need only be made in two sizes, the smaller size being a four-spout head, approximately nine inches in diameter and the larger size being a six-spout head, approximately eleven and one-half inches in diameter. These heads may be respectively converted into three-spout or two-spout heads by properly plugging up certain of the spouts.

On the other hand, each of said heads will operate satisfactorily, without plugs for the spouts, when the oil is fed to them in widely varied amounts, to suit different conditions. For instance, assuming a four-spout head rotating at approximately 1750 R. P. M. is associated with a hearth of relatively small diameter, and is supplied with oil and air at suitably proportioned rates whereby combustion is initiated and localized, at and by impact upon a peripheral ignition wall, the same head may be used to burn a substantially greater supply of oil without change of speed of the motor, merely by adjusting the air supply; or the same head rotated at the same speed may be associated with a much larger hearth, requiring a much larger amount of oil, and yet the same results of initiating combustion at the ignition wall may be attained in the same way, namely, by adjusting the air supply.

The invention may be more fully understood from the following description in connection with the accompanying drawings, wherein:

Fig. 1 is a fragmentary vertical sectional view through the hearth of the boiler showing my improved projector head in operative position.

Fig. 2 is an enlarged top plan view of the head with parts broken away and in section for clearness.

Fig. 3 is a transverse sectional view on the staggered line 3—3 of Fig. 2.

Fig. 4 is a side elevational or edge view of the head, and

Fig. 5 is a sectional detail showing the manner in which the steel wool packing may be arranged in the spouts.

Fig. 6 is an elevation of the projector with conventional supports and driving motor therefor.

The hearth 10 is generally similar to the hearth disclosed in the prior Heath applications above identified, including a peripheral upstanding flame wall 11 in the region of the water leg 12 of the boiler. This hearth slopes downwardly from the central opening which accommodates the projector head to the flame wall.

The hearth may be supported on plate 13, the edges of which rest on ledge ring 14 and the intermediate portion of which is sustained by the outwardly turned flange 15*a* of hollow, generally frusto-conical air collar 16, the latter being supported on suitable legs 17 resting on the bottom of the ash pit see Fig. 6. Member 16 preferably forms a liner for the central opening in the hearth, being provided at its upper edge with an inwardly and downwardly turned flange 18.

The oil projector head preferably comprises a sand casting including a generally cylindrical body portion 20, the top 21 of which is closed over save for central opening 22. The lower edge of the body is formed with an inwardly projecting annular flange 23 terminating in upturned lip 24, the lip, flange and body wall forming a relatively shallow annular trough 25 into which the oil to be projected is delivered. Externally the body 20 is formed with an upwardly inclined external flange 26 which divides the body into an upper oil projector portion and a lower fan portion.

The fan includes a plurality of blades 27 below and integral with the flange 26 and the oil projector portion includes a plurality of discharge spouts or conduits 28 integral with and above the flange.

These projectors are of generally tapering formation, their inner ends being of general rectangular shape, as best seen in Fig. 3, and their outer ports or orifices being substantially circular. The projectors preferably incline slightly upwardly, this inclination being generally in the plane of the flange 26. It will be noted that they also project above the flange so that their exterior surfaces function somewhat as fan blades to accelerate recirculation of the hot burned out gases and to project them outward with the oil and air. The trailing edges or sides of the projectors are disposed approximately radially of the head and the leading edges of the projectors are disposed approximately tangentially of the body 20 and project somewhat further beyond the periphery of the flange than do the trailing edges, tending in this manner to create a slight suction at the outlet ports or orifices of the projectors. The important result of having the trailing walls of the projectors disposed in a general radial plane is that the oil should be positively centrifugally flung or impelled from the orifices of the projector spouts and not be permitted to simply leak out of them, as might be the case were the trailing edges disposed at the same radial distance from the axis of the head as the leading edges.

In the drawings I have shown a four-spout projector, but as suggested above a six-spout one may be used if necessary, and the four or six spout devices readily converted into two or three spout devices by the simple expedient of plugging certain of the spouts.

The head is mounted within the central opening of the hearth defined by the air collar 16 with the lower outer edges of the fan blades just clearing the inner upper edge of the collar. The air draft upwardly through the collar 16 is controlled by a vertical adjustable damper collar 30 which may be raised from the position of Fig. 1 to restrict the size of the annular air inlet opening as desired.

The head is mounted upon the upper end of a vertical shaft 31 driven from any suitable power source such as an electric motor 50 as by coupling 51, connecting it to the armature shaft, 31*x*,

of the motor, as is now common in this art. Oil supply pipe 32 extending upwardly into the head carries a laterally extending oil spout 33 which overhangs the trough 25 and delivers oil into the trough. For purposes of the present invention it is immaterial whether the oil is pumped through 32 or supplied by gravity from an overhead tank.

The overhang of the spout 33 presents a slight problem in assembling the head which is taken care of by the provision of opening 22 of considerably larger diameter than the motor shaft 31 and of slightly smaller diameter than the fixed driving collar 34 of the motor shaft having a pin 34a to fit the opening 34b in the head and the nut 35 which coacts with the collar to clamp the head in position. The upper end of the motor shaft is threaded at 36 for the reception of the collar and nut. This oversize opening 22 permits the head to be dropped down over the threaded end of the motor shaft, moved laterally until the trough is clear of the spout 33 and then brought back to center and clamped by screwing home the nut 35.

In the operation of the apparatus I have found that the sand casting of the head affords a very material advantage. The minute protuberances on the rough internal surfaces of the casting are wetted by the oil, thereby increasing the area of contact of the oil with the heated metal surface. Another effect is to retard and distribute the oil film more uniformly, this being of advantage for rendering the resulting spray more uniform, particularly when relatively large amounts of oil are being discharged. With a polished or smooth surface, it would be much easier for a wavelet or thick film to develop irregularities due to the film tension of its exposed surface, the area of which is constant and is a smaller factor where the metal-wetting area is increased by the papillary nature of the surface which results from sand-casting the head.

In operation, when the head is set in motion and the oil feed turned on, the oil collecting in the bottom of the trough 25 will act by centrifugal force to form a film which gradually creeps up the interior of the wall 20 and as it reaches the spouts flows outwardly through them, and is centrifugally thrown with considerable force and in a fairly straight trajectory toward the flame wall 11, this oil, when the motor is running at its normal speed, tending to impinge upon the flame wall without depositing on the hearth at points between the projector and the wall.

The air draft on the other hand is projected radially from the fan blades 27, the air trajectory being below the oil trajectory so that there is only partial admixture of the oil and air except in the immediate neighborhood of the flame wall.

For most efficient operation the air supply is adjusted by raising the collar 30 until a substantially blue ring of flame is initiated at and in the region where the oil and air are mixed by impingement on the peripheral ignition wall. In order to simplify illustration I have not shown the usual ignition torches arranged near the periphery of the hearth.

The head being rotated clockwise, the blades 27 constitute a large volume fan drawing air through the variable passage B, between stationary collar 16 and upwardly adjustable collar 30 (Fig. 5). In normal operation, this passage is sufficiently restricted to tend to create a vacuum in the interior space A. The four nozzles 28 constitute another fan tending to create suction within the head, and, through annular passage D, this suction tends to take effect in the same space that the fan blades 27 draw from. Thus, the many blades 27 and the four nozzles 28 constitute two fans connected in parallel to the same source. When the main air supply is unrestricted there may be a small amount of air delivered through nozzles 28, but this amount is much smaller than that delivered through blades 27, because the flow section through D and the four little nozzles is very much less than that of the annulus through which blades 27 discharge.

It will be seen that by adjusting collar 30 to appreciably restrict the air inlet to the chamber A, the fan blades 27 may actually recirculate some of the hot combustion gases by drawing them through the nozzles 28 in opposite direction to the flow of outgoing oil. This recirculation, however, can do no harm and under certain conditions it is of advantage to have combustion gases mixed with the primary air to produce a low blue flame of very high efficiency.

In operation, oil is supplied to the trough 25 through the interior nozzle 33. Centrifugal force causes a film of this oil from trough 25 to creep up the walls and ultimately to be thrown off as a fine spray projected from the rear lips of the four nozzles 28. Centrifugal force may cause a relatively small volume of air to be projected through these nozzles 28 while a much larger volume of air is being projected by the fan blades 27. The nozzles 28 project substantially above the plane of the top plate 21 of the rotor. Consequently, said plate, together with the upwardly projecting surfaces of the nozzle, constitute in effect a third fan whereby hot products of combustion are projected in the same horizontal plane with the spray. Thus the composite draft produced by the nozzles consists of a non-combustible mixture of hot products of combustion, oil spray and possibly a small percentage of air. When this composite mixture strikes the periphery of the hearth, the oil spray is further atomized; and mixed with the air from the fan blades. This final mixture easily ignites, at starting, and when the apparatus is in full operation so that the refractory impact surfaces are at high heat, substantially perfect combustion begins and is maintained entirely at the periphery.

The factors which control the blueness or efficiency of the flame ring which impinges almost directly on the cold water leg of the boiler are of course the correct admixture of air and oil which is determined to a large extent by the extent of volatilization and atomization of the oil when the latter reaches the combustion wall. By proper metering of the air and the oil this mixture will be substantially the same at the periphery of a 17" hearth or of a 56" hearth, since while the additional oil flow necessary for the larger hearth results in the oil being projected from the head in larger particles, the added distance through which the oil must travel and in which it is subject to the heat of the fire box increases volatilization to such an extent that there is no appreciable difference in the efficiency of the mixture.

It is not only possible but desirable in certain instances to promote a finer atomization of oil in the head or at the head, and this may be readily accomplished by the introduction of small wads of steel wool such as 35x shown in Fig. 5 in the oil nozzles. These wool wads are rather loosely packed and the wool is of fairly coarse grade,

the wad being held against flying out centrifugally by the pins 36x.

What I claim is:

1. Apparatus of the class described, including a firebox, a hearth closing in the bottom thereof, an upstanding impact wall adjacent the periphery of the hearth, and a power driven centrifugal head discharging air and spraying oil in such relation that combustion is initiated by impact upon and disturbance thereof, by said peripheral upstanding wall; said head including means for projecting substantially radial layers of oil and air radially against said wall, the oil projecting means including horizontally disposed discharge spouts projecting above the level of the top of the head and communicating with a supply trough within the hollow head, the air projecting means including a fan for creating an air draft under the oil.

2. Apparatus of the class described, including a firebox, a hearth closing in the bottom thereof, an upstanding impact wall adjacent the periphery of the hearth, and a power driven centrifugal head discharging air and spraying oil in such relation that combustion is initiated by impact upon and disturbance thereof, by said peripheral upstanding wall; said head including a fan projecting an air draft below the oil, and the oil projecting means including spouts extending towards the periphery, having relatively wide intake ends and terminating in relatively small discharge outlets which are spaced apart to afford relatively wide peripheral intervals between said outlets, means for supplying oil to said spouts through said head and means controlling the flow of air to both the fan and to the spouts from beneath the hearth.

3. Apparatus of the class described, including a firebox, a hearth closing in the bottom thereof, an upstanding impact wall adjacent the periphery of the hearth, and a power driven centrifugal head discharging air and spraying oil in such relation that combustion is initiated by impact upon and disturbance thereof, by said peripheral upstanding wall; said head including a fan projecting an air draft below the oil, and the oil projecting means including spouts extending at least as far as the periphery of the head and having discharge outlets spaced apart to afford relatively wide peripheral intervals between said outlets; the leading walls of the outlets extending radially beyond the trailing walls.

4. A rotary oil burner comprising a supporting member, an electric motor thereon, an armature shaft for said motor, a centrifugal distributor head fixed to said armature shaft and provided with a series of discharge tubes, means for feeding liquid fuel to said head, and a fan surrounding said head and rotatable therewith and adapted to discharge air for combustion at a lower level than the level of the discharge tubes in said distributor head.

5. A motor driven rotary head of the class described including a generally cylindrical body having an oil receptacle at its interior and having oil discharge openings through which oil rising along the outer wall of said receptacle is adapted to be projected, the body having a papillary internal surface for the purposes described.

6. A motor driven rotary head of the class described including a generally cylindrical body having an oil receptacle at its interior and having oil discharge openings through which oil rising along the outer wall of said receptacle is adapted to be projected, the body having a papillary internal surface for breaking up the oil, and metal wool arranged in the openings to atomize the oil flowing therefrom.

7. Apparatus of the class described, including a firebox, a hearth closing in the bottom thereof, an upstanding impact wall adjacent the periphery of the hearth, and a power driven centrifugal head discharging air and spraying oil in such relation that combustion is initiated by impact upon and disturbance thereof, by said peripheral upstanding wall; said head being arranged to discharge horizontally above the hearth, and including a series of discharge conduits and means for feeding liquid fuel through the head into said conduits and a fan concentric with said head and rotatable therewith; the discharge outlets of said oil conduits being located at greater radial distances from the axis of the armature shaft than are the fan outlets, whereby the peripheral speed of the oil outlets is greater than that of the fan outlets, and said fan being adapted to maintain outwardly flowing air for combustion, between said projected oil spray, and the underlying hearth.

8. Apparatus of the class described, including a firebox, a hearth closing in the bottom thereof, an upstanding impact wall adjacent the periphery of the hearth, and a power driven centrifugal head discharging air and spraying oil in such relation that combustion is initiated by impact upon and disturbance thereof, by said peripheral upstanding wall; said head including means for projecting oil against said wall, and a fan projecting air adjacent the oil, the oil projecting means including conduits having outlets which are located beyond the periphery of the fan and which are spaced apart to afford relatively wide peripheral intervals between said outlets; means for supplying oil to said conduits through said head; and an opening for inlet of air to the fan and to the oil conduits, from below the hearth.

9. Apparatus of the class described, including a firebox, a hearth closing in the bottom thereof, an upstanding impact wall adjacent the periphery of the hearth, and a power driven centrifugal head discharging air and spraying oil in such relation that combustion is initiated by impact upon and disturbance thereof, by said peripheral upstanding wall; said head having an inner supply trough communicating with discharge outlets spaced apart to afford relatively wide peripheral intervals between said outlets; a fan below said outlets projecting an air draft below the oil; and means for supplying oil to said trough and air to said outlets, through said head; including an adjustable opening controlling inlet of air to the head and to the fan, from below the hearth.

10. In a liquid fuel burner of the type wherein a hearth closes the bottom of a combustion chamber, a distributing head located above the hearth and having means providing a plurality of individual spaced fuel distributing ports for discharging substantially radially from the head, a plurality of air impelling members carried by said head adjacent said fuel distributing ports to discharge a blast of air outwardly over the hearth surface in a layer separate from and below the discharged fuel, and means provided on said head to assist in maintaining separate the air discharged by the impelling member and the fuel discharged at said distributing ports.

11. In a liquid fuel burner of the wall flame type, a distributing head having adjacent its periphery a plurality of relatively small fuel dis-

tributing orifices designed to discharge individual fuel streams substantially radially from the head, means for rotating said head, and means associated with said head to create a radial blast of air in vertically offset relation to said ports.

12. In a liquid fuel burner, in combination, a combustion chamber having an upright wall adjacent its periphery, a liquid fuel and air discharging head arranged in the center of said combustion chamber, said head having at least one radially extending fuel flinging conduit, a hearth closing in the bottom of said combustion chamber and surrounding said head below said conduit, means on the head between the hearth and said conduit to discharge a blast of air outwardly over the hearth surface, the axis of the discharge end portion of said conduit and the surface of the hearth adjacent the head being relatively divergent outwardly whereby when said head is rotated at normal operating speed, liquid fuel thrown from said conduit will reach said upright wall without falling on the intermediate area of said hearth under the action of gravity.

13. In a burner of the character described, a rotatable distributing head provided with a peripheral rim portion having relatively small apertures spaced substantial distances apart for the centrifugal discharge of oil spray therethrough when the head is rotated, the side walls of said apertures converging toward the periphery of the head and one side wall of each aperture extending approximately radially of the head, and means for rotating the head.

14. In a liquid fuel burner, a rotary distributing head having a centrifugally operable fuel projector and means for supplying fuel to said projector, said fuel projector comprising several approximately radially arranged tubes spaced apart and adapted to receive liquid fuel at their inner ends from said supply means, and a plate-like structure closing the spaces between the tubes, said structure being substantially offset from one side of the set of tubes so that some of the external surface area of the latter cooperates with said structure to form a centrifugal fan.

15. In a liquid fuel burner of the type wherein a hearth closes the bottom of a combustion chamber, a rotary distributing head located above the hearth and comprising a plate having fan blades carried thereon adjacent its periphery, means for supplying air to the inner ends of the fan blades, means for supplying liquid fuel internally of the head, and a set of fuel flinging conduits arranged approximately radially of the head and adapted to receive liquid fuel from said supply means, said conduits having their outer ends disposed above said plate but in close proximity thereto and thereby being adapted to propel gases of combustion outwardly in the same general direction as the fuel is discharged.

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