Dec. 16, 1930. E. F. WHITE 1,785,707

LIQUID FUEL BURNER

Filed April 9, 1929

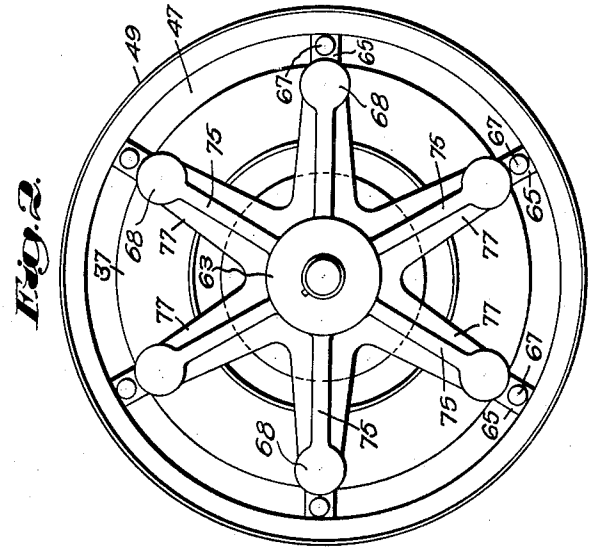


Fig. 2.

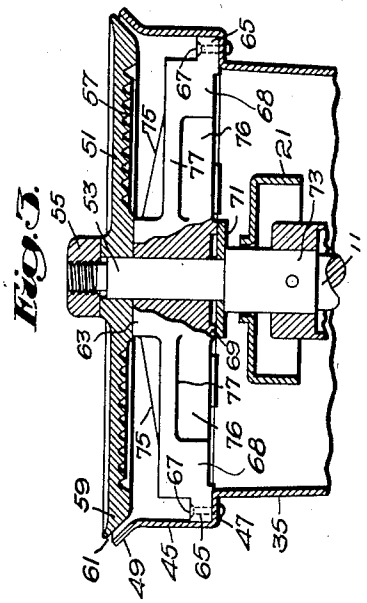


Fig. 3.

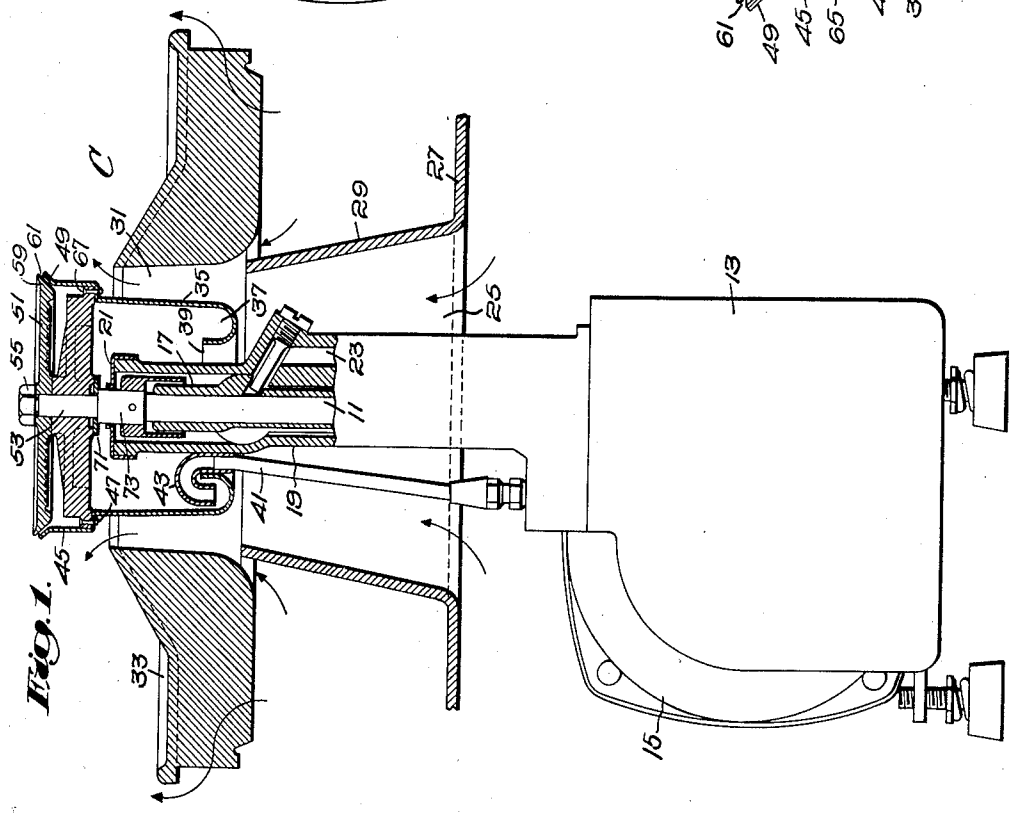


Fig. 1.

Inventor:
Ezekiel F. White
By Emery, Booth, Varney & Townsend
Attys

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UNITED STATES PATENT OFFICE

EZEKIEL F. WHITE, OF HARTFORD, CONNECTICUT, ASSIGNOR TO GROVER V. LASSEN, OF WEST HARTFORD, CONNECTICUT

LIQUID-FUEL BURNER

Application filed April 9, 1929. Serial No. 353,824.

This invention relates to liquid fuel burners and more particularly to those of the centrifugal, atomizing type, where liquid fuel is delivered in atomized form under centrifugal force to the combustion chamber of the furnace by a high speed rotating fuel atomizing member.

The invention has for its object more especially improvements designed to prevent intense heat, to which portions of the atomizer may be exposed, from coking or carbonizing the fuel within the atomizer, from distorting the structure of the atomizer, or from otherwise interfering with its continued, smooth and efficient operation.

The invention will be best understood by reference to the following description when taken in connection with the accompanying illustration of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a sectional elevation showing one form of liquid fuel burner, equipped with a centrifugal atomizing member, embodying one form of the invention;

Fig. 2 is a plan view, on an enlarged scale, showing the atomizer illustrated in Fig. 1, the protecting head or cap plate being removed; and

Fig. 3 is a sectional elevation, on the same scale as Fig. 2, showing the upper part of the atomizing member with the protecting head in position.

Referring to the drawings, I have there shown one form of the invention comprising a centrifugal burner of the upright type similar, except as to the atomizing member, to the burner shown in my co-pending application, Serial No. 247,543, filed January 18, 1928. As to many of the features herein disclosed, however, it may be employed in burners of the horizontal type as well.

The disclosed form of burner comprises a centrifugal, atomizing member located in the combustion chamber of a heater and secured to the upper end of an upright driving shaft or spindle 11. The latter is adapted to be rotated at a relatively high rate of speed, through suitable driving connections and interposed gearing contained within the casing 13, by a horizontal, relatively low speed motor, the casing of which is shown at 15. The spindle 11 rotates within the bearing sleeve 17, and, except for its upper protruding end, is enclosed within the upright casing 19, the open end of which is covered by the shield 21, leaving only a sufficient clearance for the rotation of the shaft within the same, the shield being provided to prevent the entrance of liquid fuel from the atomizer into the casing, or the escape from within the casing of lubricant supplied by the lubricant passage 23.

Air is directed into the combustion chamber space C centrally through an annular air admission passage 25 formed in the lower deflecting plate 27, which latter is provided with walls 29 in the form of a truncated cone. A portion of the air admitted through the passage 25 enters a second annular passage 31 surrounding the atomizer and formed by the upper deflecting plate 33 and passes into the combustion chamber around the exterior of the rotary atomizer. An additional and regulatable air supply may be admitted to the combustion chamber, as described in the aforesaid copending application, around the edges of the upper deflecting plate 33, and a portion of the last named air supply may be allowed to enter the passage 31 over the upper edges of the cone-shaped walls 29, as indicated by the arrows in Fig. 1. Additional air, as hereinafter described, is admitted from the passage 25 to and within the atomizer and is discharged from the latter with the atomized fuel.

Referring now to the construction of the atomizer, the latter is provided with a fuel delivery member or cup, the main body 35 of which is of circular cross section with inclined walls flared slightly outwardly and upwardly. The lower or fuel-receiving end of the cup is formed into a trough-like bottom 37 and is spaced from the shaft 11 and the casing 19 to provide an annular opening 39 through which air may enter and through which liquid fuel is adapted to be delivered by means of the stationary delivery pipe 41. An upright portion of the delivery pipe en-

ters through the annular opening in the bottom of the cup between the rim thereof and the casing 19 and out of contact with the rim, and is provided with the reverse bend 43 through which the fuel is delivered, the latter being fed as required to the fuel-receiving trough 37. The liquid fuel is delivered to the pipe 41 from any suitable source and by any suitable means, and any of the usual methods of regulation may be employed to regulate the feed thereof.

The opposite end of the cup is expanded into a short but more nearly cylindrical enlargement 45 providing a shoulder 47 by which the cup, as hereinafter described, is secured to the driving spindle. The open or fuel-delivery end of the cup terminates in an outwardly inclined delivery lip 49.

When the atomizer is rotated at a high speed, fuel delivered to the trough 37 passes in the form of a thin film up the side of the cup to the delivery lip 49, whence it is thrown under centrifugal force into the combustion chamber.

While the cup may be otherwise formed for the reasons hereinafter set forth, it is preferably of relatively thin metal, such, for example, as sheet steel.

To protect the open fuel-receiving end of the cup from the flame and direct heat of the combustion chamber, a protecting head or cap in the form of a disc-like plate 51 is provided which is fastened to the reduced end 53 of the spindle 11 by the clamping nut 55. The protecting plate 51 is relatively thin and light and preferably of non-ferrous metal, such as brass or aluminum, thereby providing a high coefficient of heat diffusion. On its under side it is provided with an expanded radiating surface in the form of circular fins or ribs 57. The protecting cap, which provides a cover or closure for substantially all of the open end of the atomizing cup, has its outer beveled edges 59 in close but non-contacting relation to the walls of the lip 49, leaving a narrow, peripheral fuel delivery slot 61 and preventing the direct conduction of heat from the walls of the plate to the edges of the cup.

When clamped in position, the plate 51 seats against the hub 63 of a spider-like member, the latter having a series (herein six) radial arms out of contact with the plate but extending to the peripheral walls of the cup, and carrying each at its end a small lug 65 resting on the shoulder 47 of the cup, by which lugs the spider is fastened to the cup through any suitable means, as by the rivets 67. Each spider arm is provided near its outer end adjacent the walls of the cup with an enlargement of substantial mass, herein in the form of a cylindrical boss 68. This adds a certain amount of mass to the periphery of the cup and affords a means for bringing the cup to a condition of balance, where its center of gravity will coincide with its geometrical center, by drilling or otherwise removing the necessary amount of metal from one or more of the bosses as may be required.

To hold the spider, plate and cup in fixed, non-rotative relationship to the shaft 11, the spider is preferably keyed or otherwise secured to the spindle end 53 and the plate clamped tightly in position by the nut 55 against the hub of the spider.

The under side of the spider hub is recessed to form an annular flange 69 through which it seats against the outer edge of a resilient member 71 in the form of a steel washer. The latter in turn is seated against a shoulder formed by the sleeve 73 pinned or otherwise secured to the driving spindle 11, but has its peripheral edges projecting laterally beyond the sleeve.

Under the intense heat acquired from the combustion chamber, the plate 51 and the spider hub 63 tend to expand in the direction of the axis of the shaft. Under such conditions, the edges of the resilient washer tend to yield and the latter will be forced out of its true disc-like formation, returning to its normal shape and position when the head subsequently cools. The plate 71 therefore presents a resilient abutment which adapts itself to such axial expansion without danger of breaking or rupture of any of the parts, and permitting their restoration to their normal conditions and positions when the parts are subsequently cooled on cessation of the burner operation.

In the operation of the burner, the centrifugal atomizing member is driven at a high rate of speed, which may, for example, be from seven to eight thousand revolutions per minute. The fuel delivered to the cup passes up the flared sides into the cylindrical section 45 about the spider lugs 65 and is thereby discharged from the edge of the annular lip 49, entering the combustion chamber tangentially in atomized form and in an approximately horizontal disc-like sheet.

The cool air which is directed about the exterior of the cup through the annular passage 31 of the plate 33 provides a layer of air underlying the sheet of atomized fuel, and also provides a cooling medium to which the outer walls of the cup are exposed, tending to withdraw and dissipate the heat acquired by the cup and maintain its temperature at a relatively low point.

The air entering the annular opening 39 within the cup passes through the same, also helping to cool the inner walls of the cup, and, on meeting the radial arms of the rapidly rotating spider, is agitated and churned thereby, causing the transference of heat from the spider arms to the air and maintaining the former relatively cool. After passing over the under corrugated side of the plate and extracting further heat from

the plate, due to the expanded radiating surface thereof, the air passes through the slot 61 and is deflected above the sheet of atomized fuel, providing an overlying layer of air and producing the effect of an atomized sheet of fuel between an upper and a lower sheet or layer of air.

In the operation of an atomizer of this type, it is important that the heat transmitted to the parts of the atomizer which are exposed to the combustion chamber be rapidly and effectively diffused and that those parts with which liquid fuel comes into contact be maintained at a temperature less than the carbonizing temperature of the fuel. If the cup, for example, becomes overheated and its temperature raised above the coking point of the fuel the volatile elements will be driven off and the fuel gradually solidified or carbonized, leaving carbonized accumulations on the inside of the cup which will gradually increase and impair the action of the atomizer and the efficiency of the combustion.

The head or protecting cap, particularly, is exposed to excessive heat, and, in the case of small furnaces, where the burner flame strikes the sides and tends to roll back over the top of the burner, the plate tends to become excessively hot. Where the construction is such that this heat is transmitted directly to the side walls of the cup, either through the plate or otherwise, the cup tends to become overheated and carbonize the fuel. Where the plate is utilized to fasten the cup to the shaft by contacting with the cup at detached points, the cup is also subject to distortion in shape, particularly where the latter is constructed of sheet metal, due to the fact that the coefficient of the expansion of the head is relatively greater than that of the cup. The effect of such expansion is to produce bulges in the cup at the points of connection with the plate, thereby concentrating the fuel delivery at certain points instead of providing for a smooth, uniform delivery coming from a truly circular lip or edge.

By preserving a non-contacting relation between the periphery of the protecting plate and the side walls of the cup and utilizing an independent heat diffusing member, such as the spider, to connect the cup to the shaft, it is possible to support the cup near its fuel delivery end, leaving a retreating cup portion spaced from the shaft and providing the annular fuel and air inlet opening 39, while at the same time direct transmission of heat to the cup is prevented and a heat conducting path is provided which, consisting as it does of the ribbed or corrugated under surface of the plate and the radial arms of the spider, both rapidly rotated in a current of relatively cool air, causes the rapid and effective diffusion of the heat from the heated head to the air, so that the outer and cup contacting ends of the arms are maintained relatively cool. This, particularly in conjunction with the maintained currents of air on the outside and the inside of the cup, keeps the cup relatively cool, preventing the carbonization of the fuel and preventing any distortions of the cup or alterations from its true circular, cross sectional shape.

To increase the heat diffusion of the radial arms which form a part of the heat contacting path between the plate and the cup, the latter are preferably provided with upper and lower vertical radiating ribs or vanes 75 and 76 and horizontal radiating ribs 77.

Through the described construction of atomizer, the atomizing cup may be made of relatively light sheet metal, which not only reduces the mass of the rotating parts but is susceptible of effective cooling through the contact with the inner and outer air currents, and the protecting plate may also be made relatively thin and light, also further reducing the mass of the rotating parts, while providing an efficient heat diffusing member.

The capacity of the head and spider to dissipate the heat quickly to the air circulating through the cup, and the dissipation of heat from the outside of the cup enables the latter to be run below the carbonizing temperature of the fuel and at the same time raises the temperature of the air entering the combustion chamber to the benefit of effective combustion.

While I have herein shown and described for the purposes of illustration one specific embodiment of the invention, it is to be understood that extensive changes may be made in the structure of the illustrative embodiment and various changes in the form and relative arrangement may be had, all without departing from the spirit of the invention.

Claims:

1. A centrifugal, rotary atomizer for a liquid fuel burner having a driving shaft, a thin-walled atomizing cup of circular cross section having upwardly and outwardly flared walls terminating at its upper, open fuel delivery end in an outwardly inclined lip, said cup having a lower oil receiving end formed into an oil receiving trough and spaced from the shaft to provide an opening for the introduction of fuel therethrough, a protecting, disc-like plate covering the open end of the cup having its periphery in close but non-contacting relation to the walls of said lip, the inner side of said plate having a ribbed formation, means connecting the delivery end of the cup to the shaft comprising a spider having a hub with radial arms, the ends of which are secured to the peripheral walls of the cup and out of contact with the plate, said plate being clamped against the hub of said spider, and a resilient plate carried by the shaft, against the peripheral edges only of which the hub of said spider is seated

to permit of longitudinal expansion under the effect of heat.

2. A centrifugal, rotary atomizer for a liquid fuel burner having a rotary shaft, an atomizing cup secured to said shaft, a protecting head for said cup exposed to the heat of the combustion chamber and also mounted on said shaft, and a resilient abutment carried by the shaft and opposing axial expansion of said head when the latter is heated.

3. A centrifugal, rotary atomizer for a liquid fuel burner having a rotary shaft, an atomizing cup, a spider having a hub mounted on said shaft and connecting the cup thereto, and a resilient plate carried by the shaft against the peripheral edges only of which the hub of said spider is seated to permit the axial expansion thereof under the effect of heat.

4. A centrifugal, rotary atomizer for a liquid fuel burner having a rotary shaft, an atomizing cup secured to said shaft, a heat protecting head for the delivery end of the atomizing cup also mounted on said shaft, and yieldable means carried by the shaft adapted to permit the axial expansion of said heat protecting head.

In testimony whereof, I have signed my name to this specification.

EZEKIEL F. WHITE.