Jan. 2, 1951 H. A. ALTORFER 2,536,832

ATOMIZING DEVICE

Filed Dec. 2, 1944

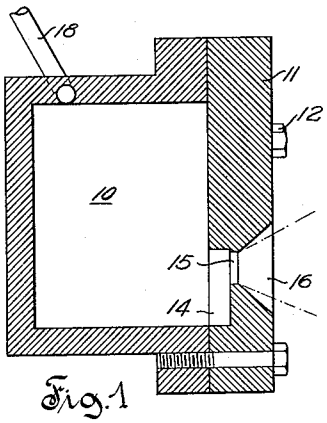

Fig. 1

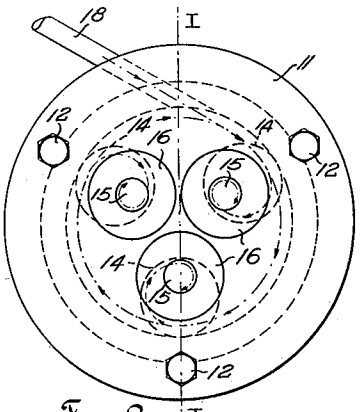

Fig. 2

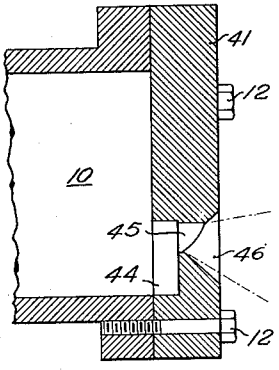

Fig. 7

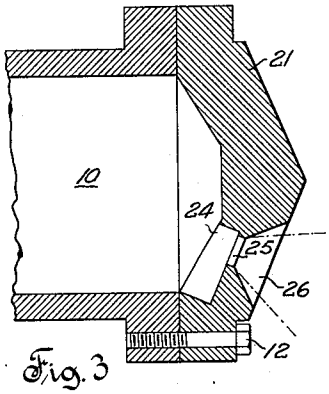

Fig. 3

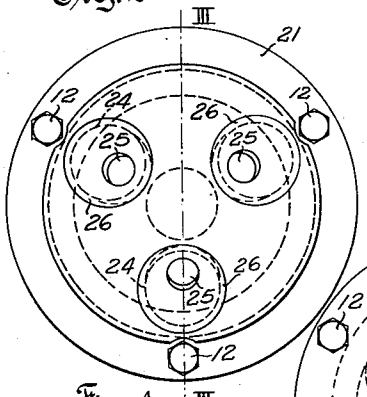

Fig. 4

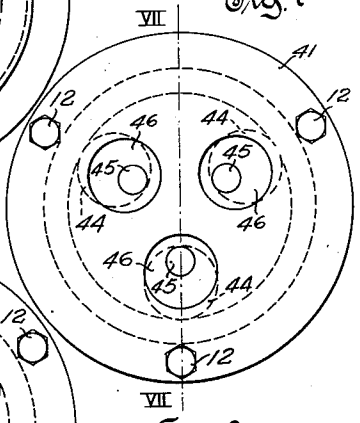

Fig. 8

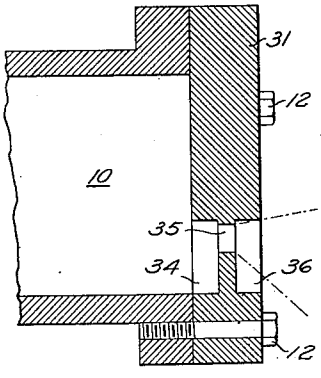

Fig. 5

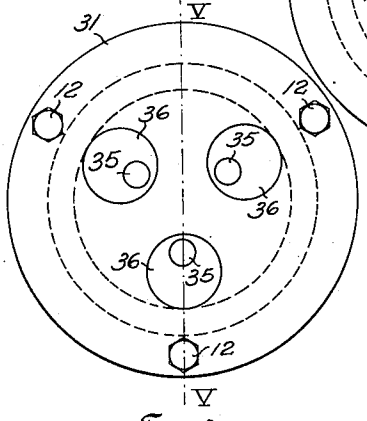

Fig. 6

Inventor
Hans A. Altorfer

by W. A. Lieber
Attorney

Patented Jan. 2, 1951 2,536,832

UNITED STATES PATENT OFFICE

2,536,832

ATOMIZING DEVICE

Hans A. Altorfer, Wauwatosa, Wis., assignor to Allis-Chalmers Manufacturing Company, Milwaukee, Wis., a corporation of Delaware

Application December 2, 1944, Serial No. 566,325

12 Claims. (Cl. 299—114)

1

The present invention relates generally to improvements in atomizing devices and relates more particularly to improvements in the construction and utilization of fuel atomizing nozzles for liquid fuel burners.

It is known to be very desirable, in liquid fuel burners and the like, to increase atomization of the fuel within the burner nozzle and prior to discharge thereof to the atmosphere. This increased atomization or breaking up of the fuel into a finely divided state results in a better intermixture of the fuel and air and consequently quicker and more effective combustion. In efforts to provide finer atomization and quicker combustion, various devices have heretofore been proposed, a number of which utilize means for causing tangential admission of the liquid fuel to a cylindrical chamber within the burner nozzle for effecting whirling of the fuel within the chamber. In some of these prior art devices wherein the fuel is atomized by imparting a whirling motion thereto, the delivery orifice or a plurality of delivery orifices are formed in the nozzle either concentrically or eccentrically of the whirl chamber. It has also been heretofore proposed to provide fuel atomizers wherein the liquid fuel is directed axially toward an orifice plate and caused to whirl within one or more whirl chambers formed within the plate, the whirling being caused by means of tangential slots leading to the whirl chambers. The fuel is delivered from the nozzle in these devices through an orifice formed concentric with its associated whirl chamber, thereby causing the fuel jet to issue at relatively low angular velocity. While these prior art devices produce some degree of atomization, the effectiveness of the whirling of the fuel to produce atomization is either destroyed by principally axial delivery of the fuel at relatively low angular velocity through the orifices or has not been fully utilized for various other reasons.

It is therefore an object of the present invention to provide an improved atomizing device which fully utilizes the effectiveness of whirling the liquid to increase atomization and wherein such effectiveness is not destroyed during delivery of the fuel.

Another object of the invention is to provide an improved nozzle wherein the liquid is whirled at an increasing angular velocity from the point of entrance to the nozzle to the point of discharge from the nozzle.

Another object of the present invention is to provide an improved atomizing device wherein liquid fuel is conducted directly and without the necessity of tangential slots or grooves from an initial whirl chamber to a final whirl chamber formed in a wall of the initial chamber.

Another object of the invention is to provide an improved atomizing device wherein the atomized liquid is delivered from the orifice to the atmosphere in a whirling manner and finely atomized state.

Another object of this invention is to provide

2

an improved liquid fuel atomizing nozzle which may be readily and economically manufactured and applied and which produces a uniform and quickly combustible spray.

Another object of the present invention is to provide an improved orifice plate having one or more whirl chambers formed therein and which may be reversed on the nozzle as wear occurs on one side or the other.

A further object of the invention is to provide in a liquid fuel atomizing nozzle, means defining an initial whirl chamber within the nozzle, a final whirl chamber formed in one end of the initial chamber and disposed eccentrically thereof, and an atomizing orifice leading outwardly from the final chamber and disposed eccentrically thereof.

An additional object of my invention is to provide an orifice plate for a liquid fuel atomizing nozzle wherein a cylindrical chamber is formed eccentrically within the plate and an atomizing orifice communicating with the chamber is formed in the plate and disposed eccentrically of the chamber.

Still another object of my invention is to provide an orifice plate for a liquid fuel atomizing nozzle wherein a pair of oppositely disposed coaxial cylindrical chambers are formed eccentrically within the plate and an atomizing orifice connecting the coaxial chambers is formed in the plate eccentrically of the common axis of the chambers.

These and other specific objects and advantages of the present invention will be apparent from the following detailed description.

A clear conception of the features constituting the present improvement and of the mode of constructing and of utilizing devices built in accordance with my invention may be had by referring to the drawing accompanying and forming a part of this specification, wherein like reference characters designate the same or similar parts in the various views.

Fig. 1 is a section through a nozzle embodying the features of my present improvement taken along the line I—I of Fig. 2;

Fig. 2 is an end view of the nozzle;

Fig. 3 is a section through a nozzle provided with a modified type of orifice plate taken along the line III—III of Fig. 4;

Fig. 4 is an end view of the modified nozzle shown in Fig. 3;

Fig. 5 is a section through a nozzle provided with another modified type of orifice plate taken along the line V—V of Fig. 6;

Fig. 6 is an end view of the modified nozzle shown in Fig. 5;

Fig. 7 is a section through a nozzle provided with a further modified type of orifice plate taken along the line VII—VII of Fig. 8; and

Fig. 8 is an end view of the further modified nozzle shown in Fig. 7.

Referring to the drawing and more particularly to Figs. 1 and 2 thereof, my improved device comprises in general, a nozzle having formed in the

body thereof a cylindrical chamber 10 enclosed at one end by an orifice plate 11 secured to the nozzle body in any suitable manner as by means of bolts 12. The orifice plate 11, forming an end wall of the chamber 10, has one or more cylindrical chambers 14 formed eccentrically therein and a like number of orifices 15, each communicating with one of the chambers 14 and disposed eccentrically thereof. The orifices 15 may each be provided with a mouth 16 shown in Figs. 1 and 2 as being frusto-conical. In operation of the device, liquid fuel is supplied tangentially and, if desired but not necessarily, somewhat axially to the chamber 10 by way of one or more supply conduits 18 communicating therewith. By reason of the tangential admission of liquid to the chamber 10, the liquid is caused to whirl within the chamber and to move toward the low pressure area adjacent the orifice plate 11 where it is caught by the eccentrically disposed cylindrical chambers 14 and caused to continue its whirling and forward motion at what I believe to be an increased angular velocity by reason of the decreased circumference of the confined whirling space. From the whirl chamber 14, the finely atomized fuel is discharged to the combustion zone by way of the orifices 15, through which the whirling progress is continued and, I believe, the angular velocity further increased by reason of the eccentric disposition with respect to the chambers 14 and of the decrease in circumference. The course of the whirling liquid from its admission through conduit 18 to its discharge through orifices 15 is illustrated by dot and dash lines in Fig. 2. It is to be noted that the whirl chambers 14 are located adjacent the side wall of the cylindrical chamber 10 at which point the velocity of the liquid is the greatest, and the orifices 15 are likewise formed adjacent the side walls of the chambers 14 for the same reason. The progressive increase in the angular velocity of the whirling liquid as hereinbefore referred to results in a correspondingly finer atomization which is not disturbed upon discharge of the liquid through the orifices and their associated mouths which are flared outwardly to such an extent as not to interfere with the discharging jet, illustrated in the drawing by dot and dash lines.

The increased angular velocity in the chambers 14 can be readily calculated, and while it is not possible to prove by measurement that the liquid whirls at a greater angular velocity in the chambers 14 than in the chamber 10, actual test has conclusively proven that the liquid in chambers 14 does whirl if the liquid in chamber 10 is caused to whirl, and that the liquid particles are then discharged from the orifices 15 with a whirling component resulting in a divergent conical spray. On the other hand, if the liquid is introduced into chamber 10 so as not to whirl therein, a divergent conical spray will not be produced but instead the liquid is discharged from the nozzle in a cylindrical stream.

Figs. 3 and 4 show the invention applied to a nozzle provided with a conical orifice plate 21. In this embodiment the whirling liquid from the chamber 10 is caught by the eccentrically disposed whirl chambers 24 where the angular velocity of the whirling liquid is increased prior to delivery through the orifices 25 and mouths 26 in a diverging spray. While the action and atomization of the liquid in the device illustrated in Figs. 3 and 4 is similar to that already described with reference to Figs. 1 and 2, the conical orifice plate enables one to obtain a very wide and diverging spray which is desirable in certain instances.

With reference to Figs. 5 and 6, the operation of the device is likewise as hereinabove described. However, in this modification, the flat orifice plate 31 has one or more pairs of oppositely disposed coaxial cylindrical chambers 34, 36 formed eccentrically therein and connected by an orifice 35 eccentrically of the common axis of the chambers 34, 36. The orifice plate thus formed is reversible. In other words, either side of the plate may be faced toward the chamber 10 with equal effectiveness in operation. As shown in the drawing, the cylindrical chambers 34 may form the whirl chambers receiving the liquid from the initial whirl chamber 10; and as wear occurs at the edges of the chamber 34 or at the inner edge of the orifice, the plate may be reversed so that the cylindrical chambers 36 form the whirl chambers.

In any of the modified forms of my invention the directional spread of the spray issuing from a plurality of orifices may be varied by displacing the mouth from a concentric to an eccentric position with respect to its orifice, thereby varying the shape of the orifice outlet to cause a portion of the jet to issue in a desired direction. In Figs. 7 and 8, I have shown a nozzle provided with an orifice plate 41 wherein the whirl chambers 44 discharge through orifices 45, each formed with a discharge mouth 46 eccentrically disposed with respect thereto. As shown, the axis of each mouth is displaced outwardly toward the periphery of the plate 41 with respect to the axis of its associated orifice 45. Such construction results in a spray wherein the jets are directed, to some extent, away from the nozzle axis, as illustrated in Fig. 7, whereas the opposite action may be obtained by displacing the axis of each mouth inwardly toward the axis of the orifice plate.

From the foregoing detailed description, it will be apparent that the present invention provides an improved atomizing device for liquid fuel burners which is simple in construction, and may be readily manufactured, which may be readily applied and replaced, which requires no separate or loose parts to effect efficient operation, which is strong and durable, and which is highly flexible in application. The construction eliminates any need for tangential slots or grooves to effect whirling of the liquid fuel from the initial whirl chamber to the orifice, and the fuel is delivered in a whirling and finely divided state. The orifice plate may be made reversible, if desired, and any number of orifices and auxiliary whirl chambers may be provided to produce the desired spray.

It should be understood that it is not desired to limit the present invention to the exact details of construction or the precise mode of operation herein shown and described, since various modifications within the scope of the claims may occur to one skilled in the art.

I claim:

1. Liquid fuel atomizing nozzle means having a discharge orifice, said nozzle means having whirl chamber means communicating with said discharge orifice, said chamber means including in series a first chamber and a second chamber, said second chamber being interposed between said first chamber and said orifice and being eccentric to both said first chamber and said orifice, and means for introducing a stream of liquid fuel substantially tangentially into said first chamber to cause said fuel to whirl in said first cham-

ber and proceed through said second chamber and out of said orifice.

2. Liquid fuel atomizing nozzle means having a discharge orifice, said nozzle means having whirl chamber means communicating with said discharge orifice, said chamber means including in series a first chamber and a second chamber, said second chamber being interposed between said first chamber and said orifice and being eccentric to both said first chamber and said orifice, said chambers having circular cross-sections, and means for introducing a stream of liquid fuel substantially tangentially into said first chamber to cause said fuel to whirl in said first chamber and proceed through said second chamber and out of said orifice.

3. Liquid fuel atomizing nozzle means having a discharge orifice, said nozzle means having whirl chamber means communicating with said discharge orifice, said chamber means including in series a first chamber and a second chamber, said second chamber being interposed between said first chamber and said orifice and being eccentric to both said first chamber and said orifice, said first and second chambers having at a place of junction between them cross-sectional outlines approximately tangent to each other, and means for introducing a stream of liquid fuel substantially tangentially into said first chamber to cause said fuel to whirl in said first chamber and proceed through said second chamber and out of said orifice.

4. Liquid fuel atomizing nozzle means having a discharge orifice having an enlarged discharge mouth, said nozzle means having whirl chamber means communicating with said discharge orifice, said chamber means including in series a first chamber and a second chamber, said second chamber being interposed between said first chamber and said orifice and being eccentric to both said first chamber and said orifice, and means for introducing a stream of liquid fuel substantially tangentially into said first chamber to cause said fuel to whirl in said first chamber and proceed through said second chamber and out of said orifice.

5. Liquid fuel atomizing nozzle means having a discharge orifice having an enlarged frustoconical discharge mouth, said nozzle means having whirl chamber means communicating with said discharge orifice, said chamber means including in series a first chamber and a second chamber, said second chamber being interposed between said first chamber and said orifice and being eccentric to both said first chamber and said orifice, and means for introducing a stream of liquid fuel substantially tangentially into said first chamber to cause said fuel to whirl in said first chamber and proceed through said second chamber and out of said orifice.

6. Liquid fuel atomizing nozzle means having a discharge orifice, said nozzle means having whirl chamber means communicating with said discharge orifice, said chamber means including in series a first cylindrical chamber and a second cylindrical chamber, said second chamber being interposed between said first chamber and said orifice and being eccentric to both said first chamber and said orifice, and means for introducing a stream of liquid fuel substantially tangentially into said first chamber to cause said fuel to whirl in said first chamber and proceed through said second chamber and out of said orifice.

7. Liquid fuel atomizing nozzle means having a discharge orifice comprising a cylindrical portion, said nozzle means having whirl chamber means communicating with said discharge orifice, said chamber means including in series a first cylindrical chamber and a second cylindrical chamber, said second chamber being interposed between said first chamber and said orifice and being eccentric to both said first chamber and said orifice, and means for introducing a stream of liquid fuel substantially tangentially into said first chamber to cause said fuel to whirl in said first chamber and proceed through said second chamber and out of said orifice.

8. Liquid fuel atomizing nozzle means having a discharge orifice having an enlarged frusto-conical discharge mouth eccentric to said orifice, said nozzle means having whirl chamber means communicating with said discharge orifice, said chamber means including in series a first chamber and a second chamber, said second chamber being interposed between said first chamber and said orifice and being eccentric to both said first chamber and said orifice, and means for introducing liquid fuel substantially tangentially into said first chamber to cause said fuel to whirl in said first chamber and proceed through said second chamber and out of said orifice.

9. In a liquid fuel atomizing nozzle, a cylindrical first chamber within said nozzle, an orifice plate forming an end wall of said chamber, said plate having a pair of cylindrical chambers formed in opposite faces thereof with their axes eccentric to the axis of said first chamber, and an atomizing orifice connecting the chambers formed in said plate.

10. In a liquid fuel atomizing nozzle, a cylindrical first chamber within said nozzle, an orifice plate forming a wall of said chamber, said plate having a pair of coaxial cylindrical chambers formed in opposite faces thereof with their common axis eccentric to the axis of said first chamber, and an atomizing orifice connecting said coaxial chambers eccentrically of the common axis thereof.

11. An orifice plate for a liquid fuel atomizing nozzle, said plate having a first cylindrical chamber formed in one face thereof with the axis of said chamber eccentric to the central axis of said plate, said plate having a second cylindrical chamber formed in the other face thereof with the axis of said second cylindrical chamber coaxial with said first cylindrical chamber, said plate having a discharge orifice connecting said chambers and having its axis eccentric to the axis of said chambers.

12. An orifice plate for a liquid fuel atomizing nozzle, said plate having a cylindrical chamber formed in one face thereof with the axis of said chamber eccentric to the central axis of said plate, said plate having a discharge orifice communicating with said chamber and having its axis eccentric to the axis of said chamber.

HANS A. ALTORFER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
905,032	Washburn	Nov. 24, 1908
1,716,175	Klein	June 4, 1929
2,284,264	Crisp	May 26, 1942

FOREIGN PATENTS

Number	Country	Date
268,742	Italy	Oct. 28, 1929