

Aug. 3, 1926.

1,594,641

F. C. STARR

METHOD OF AND APPARATUS FOR ATOMIZING

Filed June 25, 1921

3 Sheets-Sheet 1

Fig. 2.

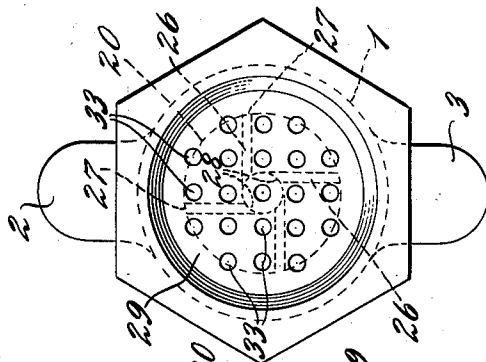


Fig. 1.

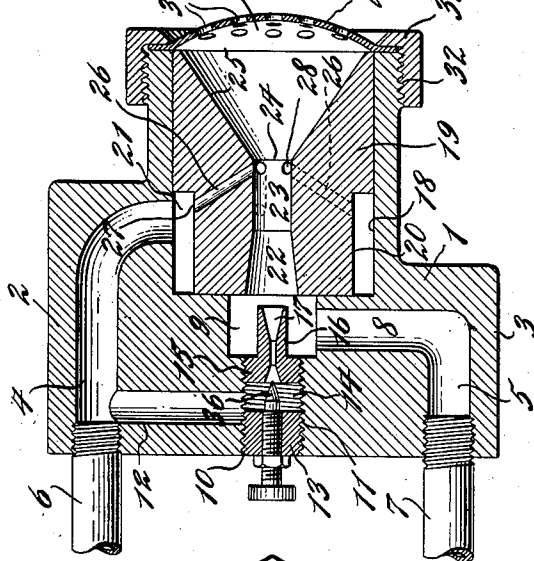
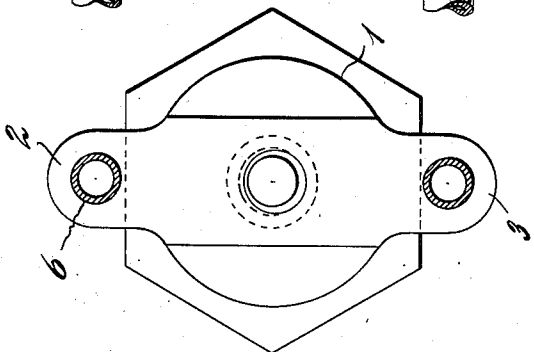


Fig. 3.



Fletcher Coleman Starr
INVENTOR.

BY

Gifford Bull
his ATTORNEYS

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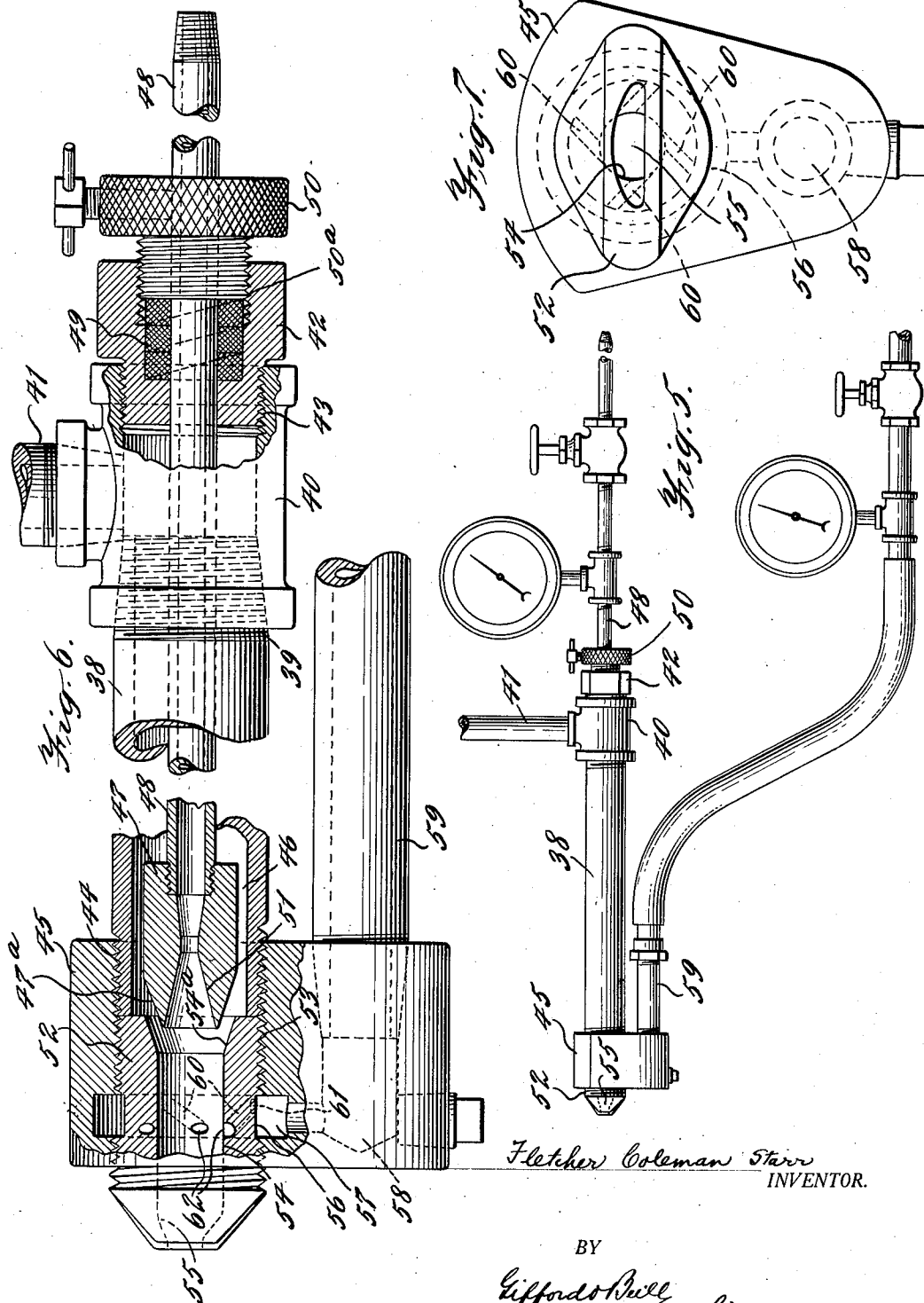
F. C. STARR

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METHOD OF AND APPARATUS FOR ATOMIZING

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3 Sheets-Sheet 2



Fletcher Coleman Starr
INVENTOR.

BY

Efford & Bull
his ATTORNEYS

Aug. 3, 1926.

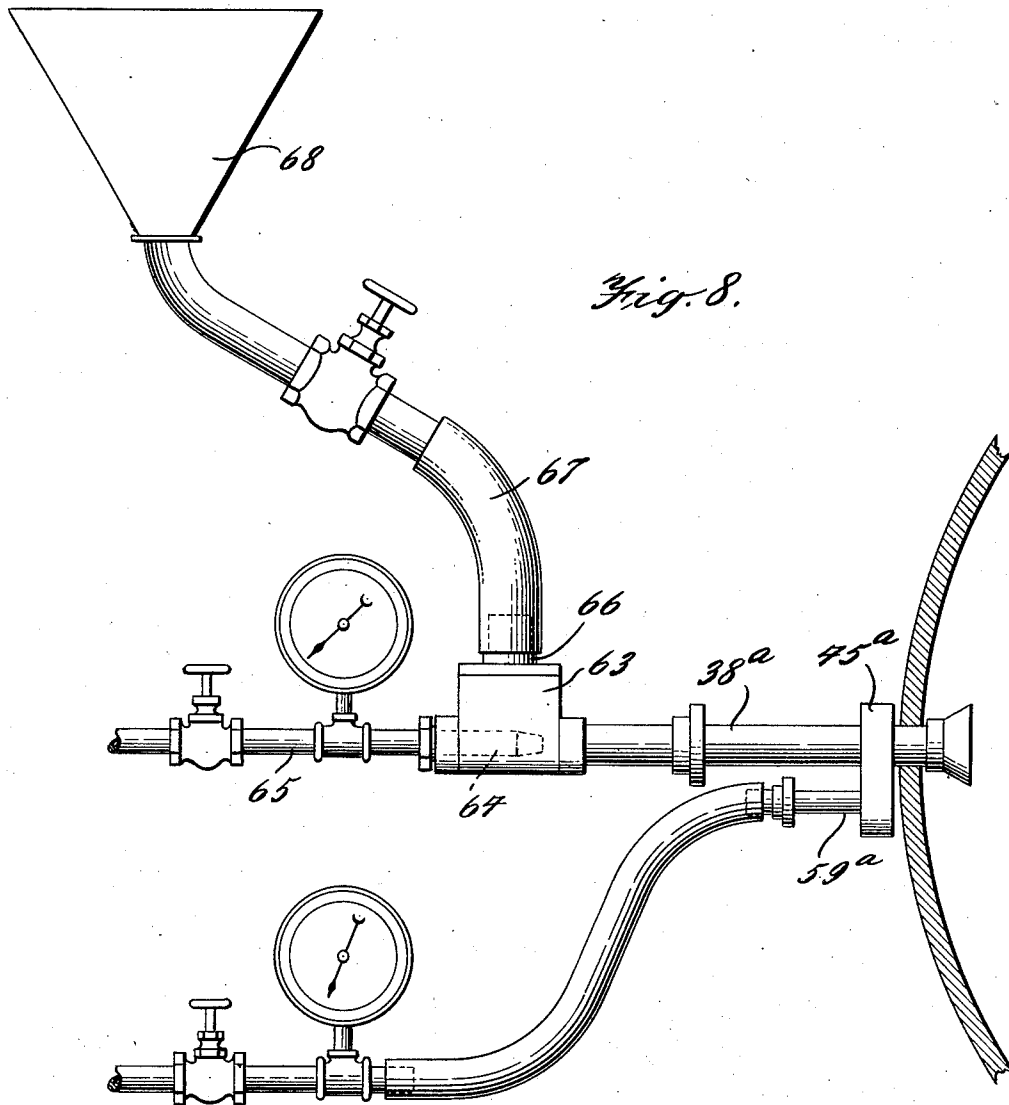
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F. C. STARR

METHOD OF AND APPARATUS FOR ATOMIZING

Filed June 25, 1921

3 Sheets-Sheet 3



Fletcher Coleman Starr
INVENTOR.

BY

Gifford Bull
ATTORNEYS

UNITED STATES PATENT OFFICE.

FLETCHER COLEMAN STARR, OF PHILADELPHIA, PENNSYLVANIA.

METHOD OF AND APPARATUS FOR ATOMIZING.

Application filed June 25, 1921. Serial No. 480,326.

My invention relates to new and useful improvements in methods of and apparatus for atomizing a liquid or other material by a suitable atomizing medium under pressure, such, for example, as air or steam.

The invention is applicable in its broad aspect to the atomization of a number of materials, and I therefore desire it understood that the invention is not to be limited in its use to the atomization of any particular material, but for the purposes of this application I will describe the invention as applied to a burner or nozzle for the atomization of fuel, such as oil, or fine powdered fuel, for use in heating apparatus.

The invention consists in the novel method and the means for carrying the same into effect, as will be fully described hereinafter, and the novelty of which will be particularly pointed out and distinctly claimed.

I have fully and clearly illustrated several forms of atomizers embodying the apparatus features of my invention in the accompanying drawings to be taken as a part of this specification, and wherein—

Figure 1 is a central longitudinal section through an atomizer, in the form of a fuel burner, for practicing my method and embodying in a preferred form the apparatus features of my invention;

Fig. 2 is a view in front elevation of the device shown in Fig. 1;

Fig. 3 is a view in rear end elevation of the device shown in Figs. 1 and 2;

Fig. 4 is a detail sectional view;

Fig. 5 is a view in side elevation of another embodiment of the same invention with the pertinent parts associated therewith;

Fig. 6 is an enlarged view partly in side elevation and partly in central longitudinal section of the embodiment shown in Fig. 5;

Fig. 7 is a view in front elevation of the embodiment of the invention shown in Figs. 5 and 6, and

Fig. 8 is a further embodiment of the invention adapted for atomizing powdered or finely divided material, such, for example, as coal.

Referring to the drawings by characters of reference, and particularly Figs. 1 to 3, 1 designates a body member preferably provided on opposite sides thereof with integral bosses 2, 3, containing, respectively, ducts 4, 5, for the flow of atomizing medium

such as steam or air, and the liquid or fluid to be atomized, in the present instance fuel oil, although it will be understood that other fluids to be atomized may flow through the duct 5. 6 designates a supply pipe threaded into one end of the duct 4, and by means of which the atomizing medium is supplied to said duct, while a pipe 7 threaded into the duct 5 supplies the latter with the material to be atomized. The duct 5 extends for a distance lengthwise of the boss 3 and is then directed laterally, as at 8, towards the center of the body 1, and at its inner end communicates with a chamber 9, preferably cylindrical in form and located at the center portion of the said body. The chamber 9 is adapted to receive a body of liquid or other material supplied thereto by the duct 5. The body 1 is provided at its rear portion with a central bore 10 which is screw-threaded, as at 11, which bore 10 constitutes a chamber into which the atomizing medium under pressure is fed from the duct 4 by means of a branch duct 12. At its rear portion the bore 10 is closed by means of a plug 13 threaded into said bore, and the inner face of which plug constitutes the rear wall of the chamber 14 constituted by the bore 10. At its forward end the chamber 14 opens through the rear wall of the chamber 9 into the latter. Threaded into said bore 10 is a plug 15 carrying an injector nozzle 16 having a Venturi bore 17 extending centrally thereof and communicating with the chamber 14, said nozzle 16 extending through the chamber 9 for the proper distance to produce an injector effect on the liquid fed to the chamber 9 through the duct 5, so as to atomize and impel said liquid through a passage leading from the chamber 9 in the direction of the longitudinal axis of the body 1. At its forward end and concentric with the chamber 9 and the injector nozzle 16, is a bore 18, preferably cylindrical in form, and of greater diameter than the said chamber 9, said bore 18 constituting a seat for a plug 19 conforming to said bore and provided with a cylindrical reduced portion 20 forming with the adjacent wall of the bore 18 an annular passage 21 with which the inner end of the duct 4, heretofore described, communicates, so that a body of atomizing medium flows into and circulates in said passage 21 around the rear end of the plug 19. The plug 19 is

formed in its rear portion with a mixing passage, consisting of a tapered bore 22 in longitudinal alinement with the bore of said nozzle 16, the forward end of said tapered portion merging into the rear end of a substantially cylindrical portion, or throat, 23, the forward end of which merges, as at 24, into a widely flaring outlet mouth, or enlarged chamber, 25 in said plug 19. This chamber 25 may be of any desired shape in cross-section, but I have shown the same as being circular (see Fig. 2).

The arrangement so far described is such that the liquid or material fed into the chamber 9 by the duct 5 is atomized and propelled by the atomizing medium emitted from the bore 17, into and through the passages 22, 23, wherein the atomizing medium is mixed with the atomized liquid.

Means is provided whereby the body of atomized fluid propelled through the mixing passages 22, 23, is further atomized and has a whirling motion applied thereto as it is delivered from the end of the throat 23. This means preferably consists of one or more ducts 26, one end of each of which communicates, as at 27, with the passage 21, to receive atomizing medium therefrom, and the other end of which is located, as at 28, preferably adjacent the delivery end of the throat 23. These ducts 26 are so arranged as to deliver the atomizing medium tangentially relative to the stream of atomizing medium and atomized material flowing through the throat 23, so that the atomizing medium issuing from the ducts 26 acts to impart a whirling motion to said mixture, and the latter is maintained in a whirling condition and under pressure in the chamber 25 with the atomized or finely divided material in suspension in the atomizing medium. If desired, the atomized, whirling mass may be discharged directly into a furnace chamber to be burned therein, in the event that the atomized fluid is a combustible fuel.

It will be noted that the fluid under pressure emitted from the bore 17 acts to induce a flow of the liquid from the chamber 9 into the mixing passage constituted by the bores 22 and 23 and to partially atomize and propel the same through the passage, whereupon, said atomized or partially atomized liquid is further atomized and has a whirling motion imparted thereto by means of the atomizing medium under pressure emitted from the ducts 26.

Especially in a burner, the outlet end of the device constituted by the flaring chamber 25 is most desirably covered by a curved cover plate 29, having its concave face 30 adjacent the chamber 25, said plate being held in place by a flanged ring nut 31 threaded, as at 32, onto the outlet end of the body 1. The plate 29 is provided with

one or a plurality of perforations 33, providing a restricted discharge orifice, of any desired size, shape or location, in order to give the stream flowing from the chamber 25 any desired shape, or form, and direction. For example, if the stream is to be substantially conical in form, the perforations may be in the arrangement shown in Figs. 1 and 2, but other arrangements may be substituted without departing from the spirit and scope of my invention.

In the form shown in Fig. 1, the nozzle 16 is shown, and described above, as being provided with a Venturi bore, which is desirable, in that the oil or other fluid flowing through the bore 8, and intended to be atomized, need not be under pressure, as the Venturi effect produced at the injector will feed the liquid at the desired rate into the mixing passage 22. The Venturi form of injector is preferred, but I may, if desired, use the form of nozzle shown at 34 in Fig. 4, in which said nozzle is provided with a cylindrical or straight bore 35, which may be used, provided the oil or other liquid is under sufficient pressure so that, aided by the inducing action of the jet from the nozzle, the liquid will flow into the mixing passage at the desired rate. If desired, I may employ any suitable form of needle valve 36 threaded, as at 37, through the plug 13, and adapted to cooperate with the bore 17 (or the bore 35, as the case may be) to regulate the amount or rate of atomizing medium fed from the duct 12 to said bore.

I will now describe the embodiment of the invention illustrated in Figs. 5, 6 and 7 of the drawings. In these Figures, 38 designates a chamber member consisting of a pipe threaded at its rear end, as at 39, into one member of a T-coupling 40, to which coupling and chamber oil or other fluid to be atomized is fed through a supply pipe 41. At its rear end the coupling 40 is closed by a plug 42 threaded into said coupling, as at 43. At its forward end the chamber member 38 is threaded, as at 44, into a head or body 45, said member 38 forming a chamber 46 corresponding to the chamber 9 heretofore described. Located in the chamber 46 is a nozzle member 47 threaded at its rear end upon a supply pipe 48 for atomizing medium, such as air or steam. The pipe 48 extends rearwardly through the pipe 38, centrally of the latter, and through the plug 42, suitable packing 49 being provided, and held in place by compression nut 50 threaded into said plug 42, as at 50^a. The rear end of the pipe 48 is adapted to be connected to any suitable source of atomizing medium under pressure, such, for example, as steam or air. The nozzle 47 is provided with a bore 51 through which the steam or air under pressure is projected lengthwise of the burner, said bore being

preferably in the form of a venturi as shown.

52 designates a plug threaded, as at 53, into the body 45, said plug having a central longitudinal bore or passage 54 in longitudinal alinement with the chamber 46 and the passage 51 in the nozzle 47. The bore 54 at its rear portion is tapered forwardly, as shown at 54^a, the tapered face thereof being substantially parallel to a forwardly tapering outer face 47^a on the plug 47, thereby forming an annular forwardly tapering passage between the nozzle and the wall 54^a. The passage 54, in that portion forward of the tapered portion 54^a, is substantially cylindrical, except at the outlet orifice, the latter being contracted, as at 55, or given any shape necessary to give the desired form to the stream emitted from the plug. The plug 52 is provided with an annular channel 56 which cooperates with an annular channel 57 in the body 45 to form an annular chamber for atomizing medium. The chamber 57 communicates with a passage 58 in the body 45, said passage being supplied with atomizing medium through a supply pipe 59. In this form, as in the forms previously described, the body of atomized liquid fluid propelled by the injector nozzle 47 into the mixing chamber formed by the passage 54 is further atomized and has a whirling motion given thereto. For effecting this result, ducts 60 are provided extending from the annular chamber or passage formed by the channels 56 and 57 to the mixing chamber for discharging forwardly and tangentially directed jets into the mixing chamber, preferably at a point about midway between the tapered face 54^a and the contracted outlet 55.

In the form shown in Figure 8, the invention is adapted to feed and atomize finely divided material, for example, powdered coal, as distinguished from liquid material. In this form the head 45^a is constructed in a manner similar to that shown in Figs. 5 to 7, inclusive, the same being mounted on a pipe 38^a corresponding to the pipe 38, and having an atomizing medium fed to said head by a supply pipe 59^a corresponding to the pipe 59. The rear end of the pipe 38^a is connected to a casing 63 into which, in longitudinal alinement with the interior of the bore and the pipe 38^a, extends an injector nozzle 64 fed with steam or air under pressure from a supply pipe 65. The casing 63 is provided at one side with an inlet 66 connected to a supply pipe or chute 67, which in turn is connected to a hopper 68 for holding the supply of fine material. The material gravitates, or is otherwise caused to be deposited into the casing 63 and is projected therefrom by means of the injector 64 through the pipe 38^a into the head 45^a where the stream of atomizing medium and fine fuel is whirled by jets from one or more

ports (not shown) similar to the ports 60 shown in Fig. 5.

What I claim and desire to secure by Letters Patent of the United States is:—

1. The method of atomizing, which comprises directing a high velocity jet of atomizing medium axially into a passage and thereby inducing a flow into the passage of liquid to be atomized, and discharging the mixture of atomizing medium and partially atomized liquid into an enlarged chamber, maintaining a body of the mixture under pressure in such chamber and further atomizing the partially atomized liquid and imparting movement to the body of mixture to maintain the atomized liquid in suspension in the atomizing medium by means of a jet of atomizing medium directed into the chamber, and discharging the mixture through a restricted orifice.

2. The method of atomizing, which comprises directing a high velocity jet of atomizing medium axially into a passage and thereby inducing a flow into the passage of liquid to be atomized, maintaining a body of the mixture under pressure and further atomizing the partially atomized liquid and imparting a whirling movement to the body of mixture to maintain the atomized liquid in suspension in the atomizing medium by means of a jet of atomizing medium, and discharging the mixture through a restricted orifice.

3. In a device of the character described, a body having a chamber, means for feeding liquid to the chamber, a nozzle in said chamber and having a Venturi bore to deliver an atomizing medium, a mixing passage in line with said nozzle and through which the stream of atomizing medium and atomized liquid is propelled, and a duct arranged to discharge a jet of atomizing medium into the stream of mixture to impart a whirling motion thereto.

4. In a device of the character described, a body having a chamber, means for feeding liquid to the chamber, an injector nozzle in said chamber and having a Venturi bore to deliver atomizing medium, a valve controlling said bore, a mixing passage in line with said nozzle and through which the stream of atomizing medium and atomized liquid is propelled, and a duct arranged to discharge a jet of atomizing medium into the stream of mixture to impart a whirling motion thereto.

5. In a device of the character described, a body having a chamber, means for feeding liquid to the chamber, a mixing passage leading from the chamber, a nozzle set to discharge a jet of atomizing medium into said passage to induce a flow of the liquid from said chamber into and through said passage, an enlarged chamber into which the mixture of atomizing medium and partially atomized

liquid is delivered from said passage, and a duct arranged to discharge a jet of atomizing medium to impart a whirling motion to the mixture in said enlarged chamber, and a restricted orifice through which the mixture is discharged.

6. In a device of the character described, a body having a chamber, means for feeding liquid to the chamber, a mixing passage leading from the chamber, a nozzle set to discharge a jet of atomizing medium into said passage to induce a flow of the liquid from said chamber into and through said passage, an enlarged chamber into which the mixture of atomizing medium and partially atomized liquid is delivered from said passage, a perforated plate forming the end wall of said enlarged chamber, and a duct arranged to discharge a jet of atomizing medium to impart a whirling motion to the mixture in said enlarged chamber.

7. In a device of the character described, a body having a chamber, means for feeding liquid to the chamber, a mixing passage leading from the chamber, a nozzle set to discharge a jet of atomizing medium into said passage to induce a flow of the liquid from said chamber into and through said passage, an enlarged chamber into which the mixture of atomizing medium and partially atomized liquid is delivered from said passage, a plate forming the end wall of said enlarged chamber having perforations suitably grouped to shape the stream of mixture delivered from said enlarged chamber, and a duct arranged to discharge a jet of atomizing medium to impart a whirling motion to the mixture in said enlarged chamber.

8. In a device of the character described, a body having a chamber, means for feeding liquid to said chamber, an injector nozzle in said chamber to deliver atomizing medium, a recess in said body, a plug seated in said recess having a mixing passage in line with said nozzle through which a stream of atomizing medium and atomized liquid is propelled, and a duct arranged to discharge

a jet of atomizing medium into the stream of mixture to impart a whirling motion thereto.

9. In a device of the character described, a body having a chamber, means for feeding liquid to said chamber, an injector nozzle in said chamber to deliver atomizing medium, a recess in said body, a plug seated in said recess having a mixing passage in line with said nozzle and through which a stream of atomizing medium and atomized liquid is propelled, an annular passage about said plug, means for supplying atomizing medium thereto, and a duct leading from said annular passage to said mixing passage and arranged to deliver a jet of atomizing medium in such relation to said stream as to impart a whirling motion thereto.

10. An atomizer comprising a body having a chamber, means for feeding a liquid to said chamber, a nozzle projecting into said chamber and surrounded by the liquid therein, a mixing passage into which the said liquid is atomized and propelled by an atomizing medium delivered by said nozzle, and a duct to discharge a jet of atomizing medium and so positioned relative to the moving body of atomized liquid as to cause said jet to impart a whirling motion to the mixture of atomizing medium and atomized liquid.

11. An atomizer comprising a body having a chamber, means for feeding a liquid to said chamber, a nozzle projecting into said chamber and surrounded by the liquid therein, a mixing passage into which the said liquid is atomized and propelled by an atomizing medium delivered by said nozzle, and a plurality of ducts for delivering jets of atomizing medium positioned to surround the moving body of atomizing medium and atomized liquid and to cause said jets to impart a whirling motion to said mixture.

In testimony whereof I have hereunto signed my name.

FLETCHER COLEMAN STARR.