

[54] **ACOUSTIC NOZZLE**

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[51] Int. Cl. **B05b 3/14**

[58] Field of Search. **239/101, 468, 102, 239/399, 521, 524 X, 424**

[56] **References Cited**

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[57]

ABSTRACT

A nozzle for finely dispersing a liquid in a gas stream, usually air or steam, has therein a stem and a cap for diverting the gas stream radially into a resonance chamber. The pressure waves resulting are effective for atomizing a liquid introduced either into the resonance chamber or into the gas stream downstream from the cap.

8 Claims, 4 Drawing Figures

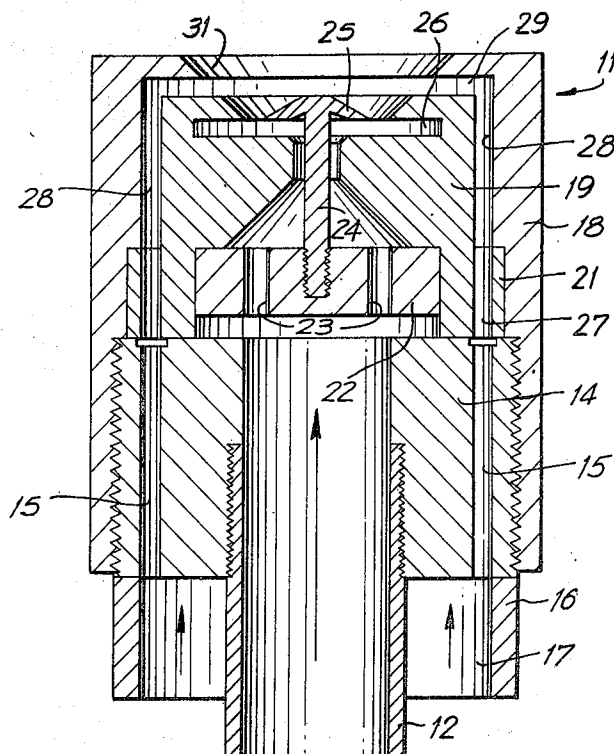


FIG. 1

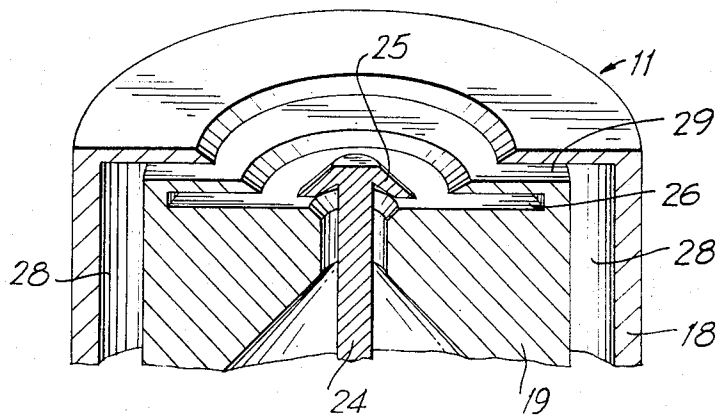


FIG. 2

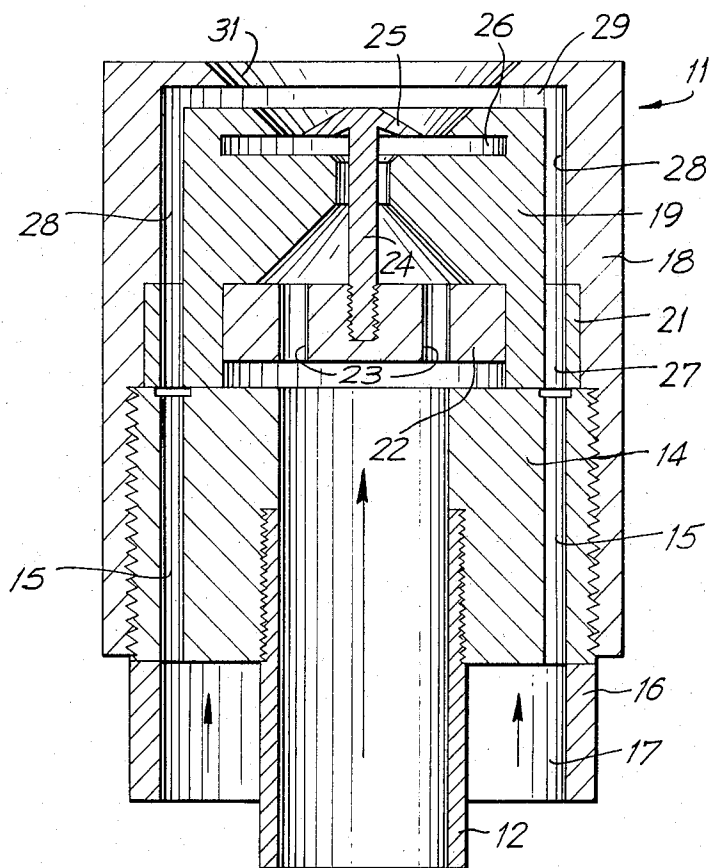


FIG. 3

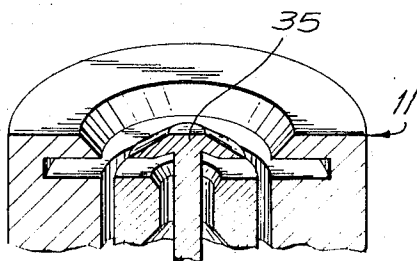
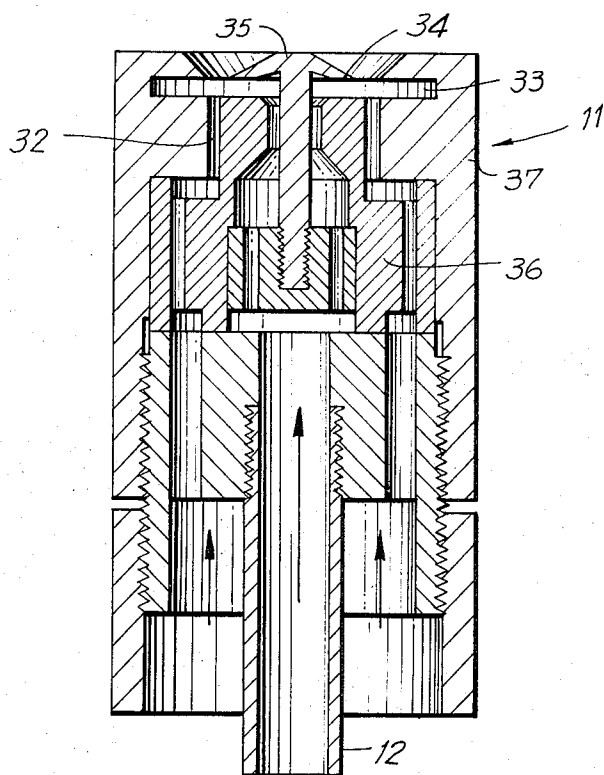


FIG. 4



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ACOUSTIC NOZZLE

BACKGROUND OF THE INVENTION

A variety of nozzles have been devised in which a rapidly moving gas stream is caused to generate pressure waves at sonic or supersonic frequencies for the purpose of atomizing a liquid. In the process, the energy in the pressure waves is transferred to the liquid causing the liquid stream to break up into droplets which is the form desired.

The energy transferred in the process is substantial, so that improvements in nozzle design which result in an increase in the efficiency of atomization can yield substantial savings. This is particularly the case where large quantities of fluid are to be dispersed.

Heretofore, attempts to increase the efficiency of atomization by nozzles have been directed at modifying the shape of the axial passage through which the gas stream flows. In general, modifications have consisted of contractions or expansions of the interior of the nozzle so that flow through the nozzle may be successively convergent, constant in cross section, and divergent. In such an arrangement, a resonant chamber may be mounted exterior to and downstream from the nozzle. Although such resonant chambers have increased the efficiency of atomization, the results have been less than optimum as measured by: efficiency of dispersion; the required pressure at which the gas must be supplied to the nozzle; and the quantity of gas which must be supplied to disperse a given amount of liquid.

SUMMARY OF THE INVENTION

To improve the efficiency of finely dispersing a liquid in a gas stream flowing essentially axially through a nozzle, a stem is positioned coaxially within the nozzle, a cap is mounted on the downstream end of the stem and has an upstream face and an outer lip, and the nozzle is provided with a disc-shaped resonant cavity which is coaxial with the gas stream and with the stem, the cap causing the direction of flow of the gas stream to become radial at the upstream face thereof, and the resonant cavity being essentially coplanar with the upstream face of the cap whereby the gas stream on entering the cavity radially gives rise to pressure waves suitable for atomizing a liquid.

In general, the liquid to be dispersed is introduced into the gas stream either in the resonant chamber or downstream from the cap. At any rate, the gas stream encounters the cap before liquid is introduced therein.

Accordingly, an object of the present invention is to provide a nozzle for atomizing a liquid in a gas stream at higher efficiency, based on energy requirements, than hitherto achieved.

Another object of the present invention is to provide a nozzle for atomizing a liquid in a gas stream while lowering the requirement with respect to gas pressure and quantity of gas.

A further object of the invention is to provide a nozzle for dispersing a liquid in a gas stream wherein a resonant chamber operating at sonic or supersonic frequencies is used for the transfer of energy from a gas stream to a liquid.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises an article of manufacture possessing the features, properties, and

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the relation of elements which will be exemplified in the article hereinafter described, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWING

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawing, in which:

FIG. 1 is a partial, cross sectional, perspective view of a nozzle constructed in accordance with the present invention;

FIG. 2 is a cross-sectional, elevational view of the nozzle of FIG. 1;

FIG. 3 is a partial, cross-sectional, perspective view of another embodiment of the present invention; and

FIG. 4 is a cross-sectional, elevational view of the nozzle of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A nozzle, generally indicated by the reference numeral 11 has therein a pipe 12 through which flows a gas stream. The pipe 12 is seated in a block 14 which has ducts 15 therethrough. Fluid to be dispersed by the nozzle is brought to ducts 15 through the space 17 between pipe 12 and housing 16.

Hood 18 in which is seated dispersion member 19 is threaded so that it may be screwed onto block 14. Dispersion member 19 has a flange 21 by which it is held between hood 18 and block 14.

Mounted within dispersion member 19 is cylinder 22 through which pass channels 23. Cylinder 22 serves to support stem 24 which is coaxial with nozzle 11; on the downstream end of stem 24, is mounted cap 25; essentially coplanar with the upstream face of cap 25 is resonant chamber 26. Resonant chamber 26 is disc shaped and is coaxial with stem 24.

Ducts 15 in block 14 are in registry with ducts 27 in dispersion member 19. Ducts 27 terminate at the downstream face of flange 21 where they communicate with annular passages 28 between hood 18 and dispersion member 19. Liquid traversing the annular passage 28 joins the gas stream through the disc-shaped passage 29. In this embodiment exit end 31 and nozzle 11 is divergent and the liquid to be dispersed joins the gas stream in an essentially radial direction.

An embodiment in which the liquid to be dispersed is introduced directly into the resonant chamber is shown in FIGS. 2 and 4. In this embodiment, annular passage 32 between dispersion member 36 and hood 37 corresponds to annular passage 28 of FIGS. 1 and 2 but is of smaller diameter. Consequently, it intercepts resonant chamber 33 proximate outer lip 34 of cap 35. As is indicated in the Figures, caps 25 and 35 are beveled at the downstream surface thereof so that the outer lip in each case is relatively sharp.

Although the Figures show a passage for the gas stream which is first convergent and then constant area immediately prior to the resonant chamber and is divergent subsequent to the resonant chamber, the invention is not restricted to this combination. The essential features are a stem coaxial with the nozzle, a cap mounted on the stem to convert axial flow to radial flow, a resonant chamber essentially coplanar with the cap and passages for introduction of liquid to be dispersed either into the resonance chamber or downstream therefrom.

The principal application of the nozzle described herein is for combustion, in which case the liquid to be dispersed is a fuel and the gas stream consists either of air or of steam.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiency attained and, since certain changes may be made in the above articles without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. In an acoustic nozzle for finely dispersing a liquid in a gas stream flowing essentially axially through said nozzle, the improvement comprising a stem positioned coaxially within said nozzle, a cap mounted on the downstream end of said stem and having an upstream face and an outer lip, and a disc-shaped resonant cavity, said cavity being coaxial with said gas stream and said stem, said cap causing the direction of flow of said gas stream to become radial at the upstream face thereof and said resonant cavity being essentially coplanar with said upstream face of said cap, whereby said gas stream on entering said cavity radially gives rise to pressure waves suitable for atomizing a liquid.

2. In an acoustic nozzle for finely dispersing a liquid in a gas stream flowing essentially axially through said nozzle, the improvement defined in claim 1, further comprising said dispersion member around said stem and a hood surrounding said dispersion member, said hood and said dispersion member defining therebetween a duct connecting with said resonant chamber, said duct serving to introduce a liquid to be dispersed

proximate said outer lip.

3. In an acoustic nozzle for finely dispersing a liquid in a gas stream flowing essentially axially through said nozzle, the improvement defined in claim 1, further comprising a disc-shaped chamber downstream of said cap and said cavity and coaxial with and in communication with said gas stream, said chamber serving to introduce said liquid to be dispersed into said gas stream.

4. In an acoustic nozzle for finely dispersing a liquid in a gas stream flowing essentially axially through said nozzle, the improvement defined in claim 1, wherein said outer lip is beveled to a sharp edge.

5. In an acoustic nozzle for finely dispersing a liquid in a gas stream flowing essentially axially through said nozzle, the improvement defined in claim 1, wherein the interior of said nozzle downstream from said cap is divergent.

6. In an acoustic nozzle for finely dispersing a liquid in a gas stream flowing essentially axially through said nozzle, the improvement defined in claim 1, further comprising a cylinder firmly engaging said dispersing member proximate the upstream end thereof, said cylinder having ducts therethrough for the passage of said gas stream and said stem being held in said cylinder.

7. In an acoustic nozzle for finely dispersing a liquid in a gas stream flowing essentially axially through said nozzle, the improvement defined in claim 6, further comprising a block having passages therethrough for the passage of fluid therethrough said block being threaded externally and said hood being threaded internally, said block engaging said hood by said internal and external threads.

8. In an acoustic nozzle for finely dispersing a liquid in a gas stream flowing essentially axially through said nozzle, the improvement defined in claim 6, wherein said dispersion member has ducts therethrough for passage of fluid, each of said ducts in said dispersion member communicating with a duct in said block.

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