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LIQUID MASS DISSEMINATOR

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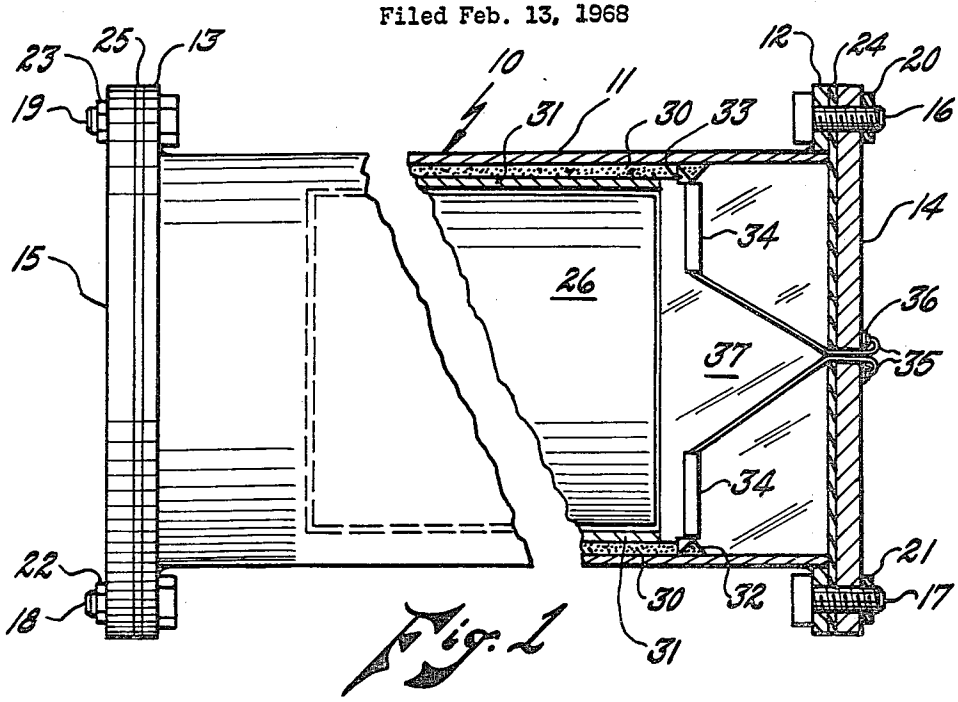


Fig. 1

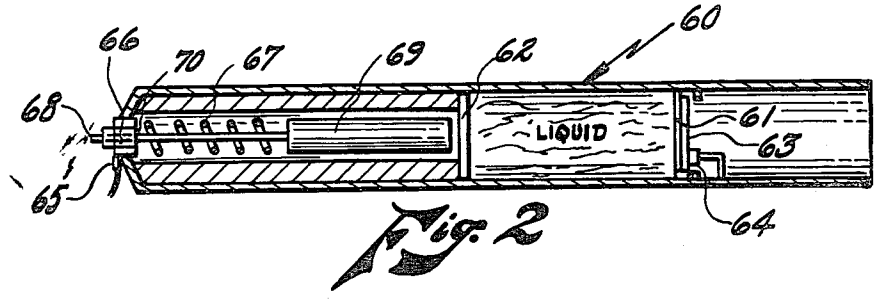


Fig. 2

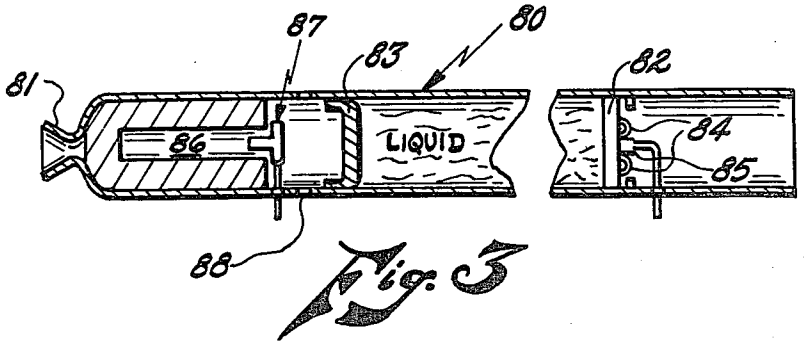


Fig. 3

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LIQUID MASS DISSEMINATOR

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ABSTRACT OF THE DISCLOSURE

An apparatus for dissemirating liquids, having a rupturable container in which the liquid mass to be disseminated intact is stored. The container is launched into a high velocity air stream ranging from sonic to supersonic speeds. The container is then ruptured by explosive means and the liquid mass is ejected, as an intact mass, into the high velocity air stream. Thereby, the liquid mass is disseminated rapidly over a wide area.

Background of the invention

This invention relates to an apparatus for disseminating liquids and, more particularly, for disseminating liquids into, and throughout, an air stream which is at sonic or supersonic velocity.

In the prior art, liquids are disseminated into air streams whose velocity relative to the liquid is sonic or supersonic by the use of small diameter injection-type apparatuses. However, it is often desirable, and many times necessary, to attain, or attempt to attain, dissemination of the liquid at rates much higher than are obtainable with the use of conventional apparatuses.

This invention increases the rate of dissemination of the liquid by introducing the liquid, as a mass or "slug," into the sonic or supersonic air stream.

Although this invention is primarily concerned with the rate of aerosolization of the liquid, rather than with the rate at which the liquid, as a mass, is introduced into the sonic or supersonic air stream, the invention does permit high rates of introduction or "ejection" of large masses of liquids into high velocity air streams.

Summary of the invention

This invention provides an apparatus for disseminating liquids into, and throughout, an air stream which is at sonic or supersonic velocity.

One object of this invention, therefore, is to cause rapid and wide dispersion of a liquid in a high velocity air stream.

Another object of this invention is to permit aerosolization of liquids without the use of external means to cause aerosolization.

Still another object of this invention is to control the rate of introduction or "ejection" of the liquid mass into the air stream, thereby permitting some control over the droplet size distribution of the aerosolized liquid.

These and still further objects will become readily apparent after a consideration of the description and all of the drawings.

Description of the drawing

FIGURE 1 is an elevation view, partially in cross-section, of one embodiment of the invention;

FIGURE 2 is a simplified schematic view, in elevation and cross-section, of another embodiment of the invention; and

FIGURE 3 is still another embodiment shown in simplified cross-section and in elevation.

Description of the embodiments

With reference to FIGURE 1, casing **10** comprises an open-ended right circular cylinder member **11** to which flange rings **12** and **13** are welded at each end. Capping plate **14** is at one end of cylinder **11** and capping plate **15** is at the other end. These capping plates are affixed to flange rings **12** and **13** of cylinder **11** by bolts, such as **16**, **17**, **18** and **19**, and by nuts, such as **20**, **21**, **22** and **23**. Gaskets **24** and **25**, preferably of rubber, are interposed between flange rings **12** and **13** and capping plates **14** and **15**.

Within casing **10** is a container **26**, impervious to liquids and which may be of rigid or of flexible material, such as polyethylene, in which the liquid to be disseminated is stored. Interposed between the inner surface of cylinder **11** and container **26** are linear cutting charges, such as **30**, preferably aluminum clad, each in a section of angle iron, such as **31**, as support for the individual linear cutting charge. At each end of the space in which container **26** is positioned, are circular cutting charges, such as **32**, preferably lead clad. Disposed between, and abutting upon, linear cutting charges **30** and circular cutting charges **32** are boosters, such as 33. Detonators, such as **34**, are suitably placed with leads, such as **35**, going therefrom to terminal **36**, external of capping plate **14**. Suitably configurated spacers, such as **37**, are at each end of cylinder **11**, in the space, between gaskets **24** and **25** and each end of container **26**, forming a compartment housing container **26**. The rigid spacers **37**, are preferably of rigid thermoplastic resin, or the like, such as "Flexiglas," the trademark designation for a cast acrylic thermoplastic resin (polymethyl methacrylate).

With reference to FIGURE 2, the liquid to be disseminated is stored in a portion of a cylinder member **60**, which is closed at one end except for a small diameter hole **70**. More specifically the liquid is stored in the compartment formed by the inner surface of cylinder **60** and end plates **61** and **62**. A linear cutting charge **63**, together with an initiator **64**, is placed on the external face of end plate **61**. End plate **62**, on the surface external to the liquid storage area, faces a piston **69** with rod **68**. The rod **68** is of appropriate diameter to fit through hole **70**, and is of sufficient length to extend beyond the closed end of cylinder **60**. Interposed between piston **69** and closed end of cylinder **60**, and disposed axially along rod **68**, is compressed spring **67**. An explosive rod cutter **66** and initiator **65** are external to cylinder **60** at the closed end and on rod **68**.

With reference to FIGURE 3, the liquid to be disseminated is stored in a portion of a cylinder member **80**, which is open at one end and closed at the other end, except for a nozzle **81**. More specifically the liquid is stored in the compartment formed by the inner surface of cylinder **80** and end plate **82** and piston head **83**. Linear cutting charges **84**, with an initiator 85, are placed on the external face of end plate **82**. Disposed in the annular space between piston head **83** and nozzle **81** is a propellant **86** with squib and igniter **87**. A pressure relief blowout disc **88**, in the form of an annular ring which is an integral part of cylinder **80**, is located between piston head **83** and squib and igniter **86**.

MODE OF OPERATION OF THE EMBODIMENTS

As to the embodiment shown in FIGURE 1

Casing **10**, in which is container **26** which houses the liquid to be disseminated, is launched, released or the like, into a high velocity air stream by suitable means, such as dropping from a high speed aircraft. Simultaneously, the explosive train is activated. That train includes, but is not necessarily limited to, detonator wires **35**, detonators

36, boosters 33, circular cutting charges 32, and linear cutting charges 30.

After activation of the explosive train, and as a direct result thereof, casing 10 and container 26 are ruptured. Thereby, the liquid to be disseminated is presented or "dumped" as a mass into the high velocity air stream. As is well known, at the time of "dumping" the liquid mass is actually a grouping of rather large drops, i.e., ¾" to 3" in diameter, that are referred to as "slugs." These "slugs" are quickly torn apart by the aerodynamic forces exerted by the high velocity air stream, form smaller droplets, and are aerosolized.

Although droplet size and rate of aerosolization are determined by the relative air stream velocity and the physical properties of the liquid disseminated, the net result is very rapid and wide dispersion of the liquid.

As to the embodiment shown in FIGURE 2

Cylinder 60, which contains the liquid to be disseminated, is launched, released or the like, into a high velocity air stream by suitable means, such as dropping from a high speed aircraft. Simultaneously, the explosive trains are activated. Initiator 64 sets off linear cutting charge 63 and, at the same time, initiator 65 sets off explosive rod cutter 66. Spring 67 urges piston 69 forward which, in turn, pushes end plate 62 forward. The liquid is, thereby, ejected into the air stream and rapid, wide dispersion of the liquid is obtained.

As to the embodiment shown in FIGURE 3

Cylinder 80, which contains the liquid to be disseminated, is launched, released or the like, into a high velocity air stream by suitable means, such as dropping from a high speed aircraft. Simultaneously, the explosive trains are activated. Initiator 85 sets off linear charge 84. At the same time, squib and igniter 87 set off propellant 86. The backward explosive force exits through nozzle 81 and pressure relief disc is blown. The forward explosive force pushes piston head 83 forward, thereby pushing and ejecting the liquid into the air stream with resultant rapid and wide dispersion of the liquid.

While there has been shown and described the fundamental novel features of the invention, as applied to the preferred embodiments, it is understood that various substitutions and omissions may be made by those skilled in the art without departing from the spirit of the invention. For example: The liquid, in "slug" form, may be ejected into the high velocity stream by ram-air from the aft section of a ram-air ejector.

What is claimed is:

1. An apparatus for disseminating a liquid into an air stream which is at sonic or supersonic velocity comprising:

(a) a casing, including a hollow open-ended cylindrical member, a flange ring affixed, and made integral to, the exterior surface of said cylindrical member at each end of said cylindrical member, capping metal plates fastened to said flange rings, and gaskets interposed between said flange rings and said capping plates;

(b) a container, impervious to liquids, mounted within said casing for storing the liquid to be disseminated;

(c) spacers, at each end of said cylindrical member of said casing, in the space between each gasket and the nearest end of said container;

(d) means for launching said casing and its contents into said air stream;

(e) and means for rupturing said casing and said container in said air stream, wherein said means comprises an explosive train, including:

(1) linear cutting charges disposed within and horizontally along the inner surface of said casing in the annular space between the inner surface of said casing and the outer surface of said container;

(2) circular cutting charges, disposed longitudinally along the inner surface of said cylinder and at either end of the space in which said container is mounted;

(3) boosters, disposed between and abutting upon, said liner cutting charges and said circular cutting charges;

(4) and detonators, disposed in the space between said casing and said container, adjacent to, and abutting upon, said boosters and said circular cutting charges, with leads from said detonators to an activating source external to said casing.

2. The apparatus, as set forth in claim 1, wherein said linear cutting charges are aluminum clad.

3. The apparatus, as set forth in claim 1, wherein said circular cutting charges are lead clad.

4. The apparatus, as set forth in claim 1, wherein said linear cutting charges are each supported in place by a section of angle iron affixed to the inner surface of said casing.

5. The apparatus, as set forth in claim 4, wherein said container is of polyethylene.

6. The apparatus, as set forth in claim 5, wherein said means for launching said container and its contents includes the release of said container and its contents from a aircraft into said air stream.

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