Dec. 28, 1965 J. E. GOODMAN ETAL 3,226,029

PRODUCTION OF AEROSOLS AND THE LIKE AND APPARATUS THEREFOR

Filed Jan. 23, 1964

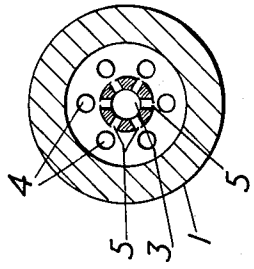

FIG. 2.

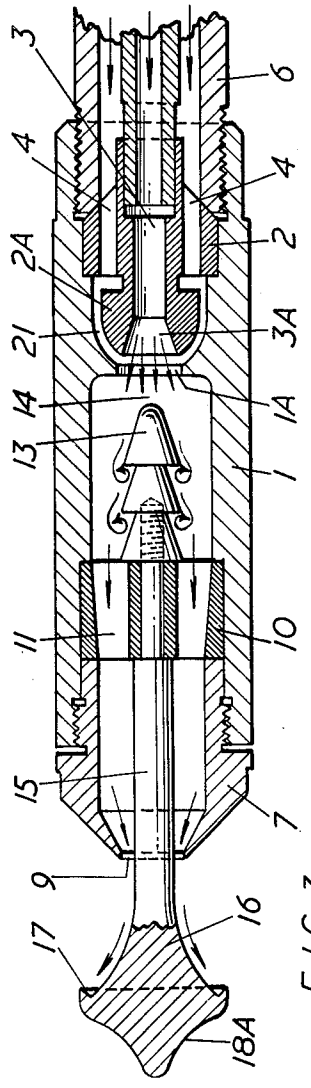

FIG. 3.

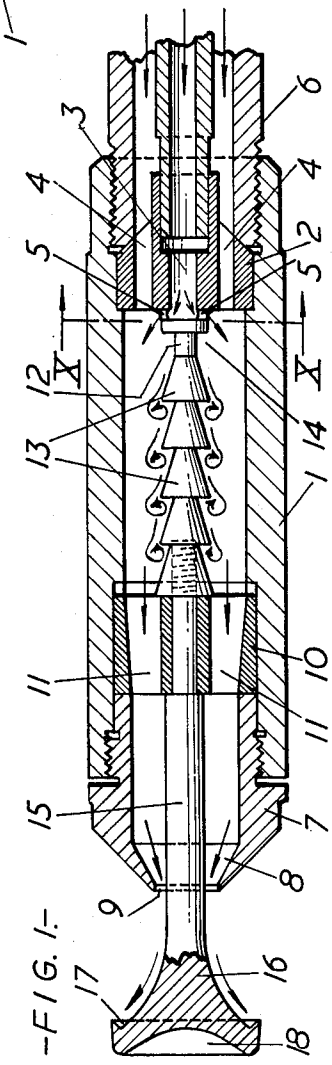

FIG. 1.

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3,226,029

Patented Dec. 28, 1965

3,226,029

PRODUCTION OF AEROSOLS AND THE LIKE AND APPARATUS THEREFOR

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Filed Jan. 23, 1964, Ser. No. 339,731
Claims priority, application Great Britain, Jan. 23, 1963, 2,851/63
5 Claims. (Cl. 239—4)

This invention relates to the production of aerosols and the like by means of a combined gas/liquid whistle.

Previous publications have dealt with devices producing sound for treating homogeneous media, e.g. liquids or, more frequently, gases. With regard to gases, the emphasis in these prior publications lay on generating pure sound waves rather than on the industrial uses of the phenomena involved, for example, the Hartmann gas whistle is well known. On the other hand, for example, British Patent No. 695,491 (of which one of the present inventors was one of the applicants) relates to a whistle for use with mixtures of liquids like oil and water, and was concerned with the processing of emulsions and relied on the effect of cavitation at the leading edge of a blade vibrating at its natural frequency.

In contra-distinction to these prior devices the present invention has for its object to provide a combined gas/liquid whistle for producing intimate mixtures of liquids and gases (e.g. aerosols). To this end the device according to the invention is arranged to operate by the steps of (a) subjecting the liquid to the effects of cavitation in a series of vortices to break up the liquid into small globules, (b) producing an indifferent or preliminary mixture of such liquid globules with a gas, and (c) subjecting this mixture to the action of sound waves in a sonic zone to further disintegrate and atomise the liquid.

The sequence of events, namely steps (a) and (b) preceding step (c), as described in the preceding paragraph is important. If the liquid were to be presented in the form of a continuous stream to the sonic zone, the degree of atomisation produced would not be sufficient for practical applications were comparatively large quantities of liquid have to be dealt with rapidly (e.g. 50 gallons per hour).

In one arrangement for carrying the invention into effect, oil is introduced into an annular zone of low pressure within the atomiser housing in which zone it is first broken up into globules by the action of cavitation produced in a series of vortices. The gas is introduced into this zone at a higher pressure than that of the oil so as to mix with the globules and to carry them through a restricted jet outlet from the housing and to project this preliminary mixture into a sonic zone produced by the impact of the mixture upon a sound-producing device, which may be supported upon a stabilising rod projecting centrally through the jet outlet.

In order that the invention may be fully and clearly comprehended the same will now be described with reference to the accompanying drawings, which illustrate diagrammatically two constructions of device according to the invention and wherein:

FIGURE 1 represents a longitudinal section through one construction;

FIGURE 2 represents a partial section on the line X—X in FIGURE 1; and

FIGURE 3 represents a longitudinal section through another construction.

In the preferred embodiment of the invention illustrated in FIGURES 1 and 2, an elongated cylindrical housing **1** has secured in its inlet end a closure member

2 having an axial liquid passage **3** and a ring of paraxial gas passages **4**, the passage **3** terminating in a ring of radially directed restricted ports **5** aligned with the passages **4** as indicated in FIGURE 2. The closure member **2** is shown in FIGURE 1 as being mounted and held in the housing by one end of the externally threaded securing member **6** in the form of an open-ended tubular sleeve providing passages for introduction of liquid and gas.

The outlet end of the housing **1** has a cap **7** with an internally frusto-conical part **8** leading to a circular jet outlet **9** of reduced diameter, and held in the housing near this outlet end is a spider **10** having a plurality of passages **11** which gradually diminish in cross-sectional area as they approach said outlet end.

Supported axially between the members **2** and **11** is a spigoted or stepped vortex member **12** consisting of a series of successive frusto-conical surfaces **13** extending longitudinally along the central axis of the elongated housing each of which has its diameter increasing towards the outlet end of the housing so as to form annular shoulders and recesses as illustrated in FIGURE 1. The space around this spigot constitutes an annular low pressure zone **14**.

A central spindle or stabilising rod **15** supported in the spider **10** projects axially through the jet outlet **9** and carries at its end at a predetermined distance from said outlet a sound-producing device **16** of exponential form having an annular knife-edge **17** around the rear of its rim and a front face **18** of any shape suited to the intended purpose of the device. It may be mentioned here that the use of a stabilising rod to support a sound-producing device is known in this art, but in this invention the spindle **15** is of such a strength and diameter as to ensure that it is accurately maintained centrally in the jet outlet **9**, because any deflection would seriously disturb the efficient functioning of the whole device.

In using the above described device, liquid under a small pressure is introduced to the low pressure zone **14** through passage **3** and ports **5**, being sucked out of such ports and entrained into the gas which is introduced at a higher velocity through passages **4**. For example in a device for atomising fuel oil in furnace or like burners these initial gas and liquid pressures may be of the order of 30 p.s.i. and 20 p.s.i. respectively. The spigot member **12** acts on the liquid and gas passing through the zone **14** to set up a series of vortices producing a cavitation effect which breaks up the liquid into small globules and forms an indifferent or preliminary mixture of these with the gas. Arrows in the drawing indicate the direction of flow and the vortices. This preliminary mixture is then projected through the jet outlet **9** and against the edge **17** to become thoroughly atomised in the surrounding sonic zone by the action of sound waves of high intensity which convert the mixture into an aerosol or intimate mixture.

It will be seen that the use of the annular knife edge **17** conjunction with the outwardly flared form of the adjacent part of the spindle **15** reduces the cavity in the rear of the device **16** to a very small proportion which we find to be a considerable advantage. Of course, the device **16** could be mounted adjustably upon the spindle **15** or the latter could be adjustable in the spider **10** in order to enable the axial spacing of the device **16** from the jet outlet **9** to be varied as may be required.

If desired the ports **5** instead of being radial could be inclined to impart to the issuing liquid a tangential component for giving it a swirling motion.

In the modified construction of FIGURE 3 in which like parts to those in FIGURE 1 are indicated by like reference numerals, the housing **1** has a central inlet aperture **1A** axially opposite to the flared discharge end **3A**

of the passage 3 formed in an extension 2A of the closure member 2 between which extension and the housing is furnished an annular space 21 connecting the passages 4 to the aperture 1A. The vortex-producing surfaces 13 are supported clear of the aperture 1A and the front face 18A of the device 16 is shown with a different shape which may, however be altered as already explained, for example to assist in preventing the build-up thereon of carbon when the device is used as a furnace burner.

With this form of the atomiser device, the liquid is introduced through the passages 4 and the gas (which may be steam) is introduced through passage 3 to draw the liquid into the low-pressure zone 14 where the vortices are produced as before to break the liquid up into small globules.

By the above described method and means aerosols or very intimate mixtures may be produced efficiently and rapidly for various commercial and other purposes, and especially mixtures of oil or other liquid fuel and air for use in liquid fuel burning furnaces or other apparatus. In the latter application of the invention the housing, stabilising rod and sound-producing device may constitute the burner nozzle. This application of the invention is of particular advantage because a burner nozzle constructed according thereto is well adapted to withstand the rough usage to which it may be put without deflecting the accurate setting of the jet outlet and sound-producing device, upon which accuracy the efficiency of the device so greatly depends.

Also we have found that, in contra-distinction to conventional oil burners which produces a spray, an atomiser device according to the present invention is capable of producing a cloud or mist which gives an improved combustion effect with suitably supplied combustion air or oxygen.

Air consumption compares very favourably with that of conventional fuel atomisers. In one test, consumption of 0.14 unit of air per unit of fuel oil consumed was recorded. An air consumption of 0.25 unit of air per unit of fuel oil is generally accepted as necessary for a conventional atomiser.

We claim:

1. A method of producing intimate mixtures of liquids and gases in aerosol form comprising the steps of:

(a) introducing a liquid under pressure at the end of an elongated atomizer housing which is provided with interior axially located frusto-conical surfaces which divert the liquid and produce along the longitudinal extent the effects of cavitation in the liquid to form a series of liquid vortices in the free space bounded by said surfaces and thereby break up the liquid into small globules;

(b) introducing a gas into the same end of the housing as said liquid and mixing along the axial length of said housing said gas with said globules of liquid to form a preliminary mixture of air and liquid globules, applying a higher pressure to said gas than to said liquid to provide a first atomizing step in forming the liquid-gas mixture; and,

(c) subjecting said mixture to the jet action of sound waves in a sonic zone at the outlet of said housing to further disintegrate and atomize the liquid-gas mixture.

2. An atomizer device comprising an elongated housing, inlet means at one end of said housing for introducing liquid, inlet means at said one end for introducing gas, outlet means including a whistle at the other end of said housing, cavitation means between said inlet means and said outlet means for producing a series of vortices with the liquid so as to subject it to the effect of cavitation, preliminary mixing means surrounding said cavitation means for producing a preliminary mixture of said liquid globules from the entering liquid with the introduced gas, said outlet means provided with jet atomizing means which projects said mixture of liquid and air through the outlet of the whistle into a sonic zone, and said inlet means including entraining surfaces which places the introduced gas under greater velocity than the liquid to create a zone of lower pressure for the liquid between the inlet means and the cavitation means producing the vortices.

3. A device according to claim 2, wherein said cavitation means for producing the vortices comprises a series of successive frusto-conical surfaces located centrally and longitudinally in the low-pressure zone of the housing.

4. A device according to claim 2, including a closure member for the inlet end of the housing having a central passage for one of the media and a plurality of passages for the other one of the media to be mixed, said plurality of passages being arranged around said central passage.

5. A device according to claim 4, including a sound-producing device supported at a predetermined distance beyond the jet outlet, said device including a spindle-shaped stabilizing rod which is axially mounted within the housing and which projects centrally through the jet outlet of said housing, said sound producing device being of outwardly flared form extending outside of said outlet means and having a knife-edge around the rear of its rim for impingement thereon of the jet of mixture.

No references cited.

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