Sept. 6, 1949. A. J. RITCHIE 2,480,967

AERIAL DISCHARGE DEVICE

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Fig. 1.

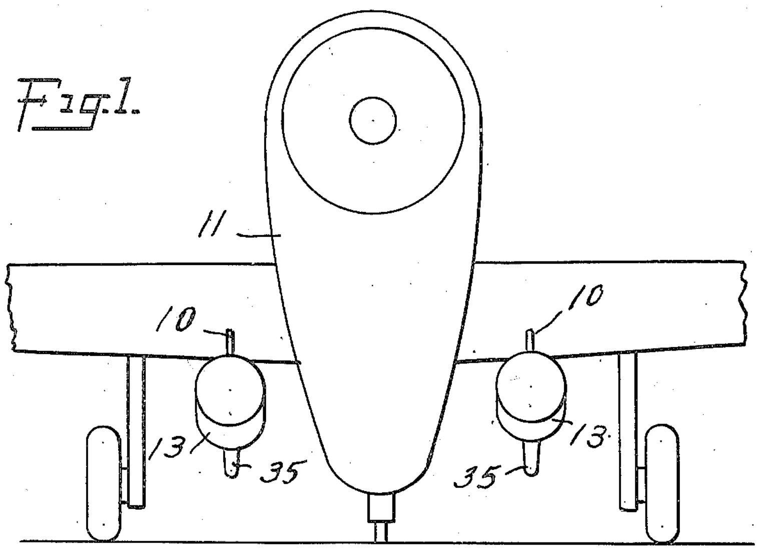


Fig. 2.

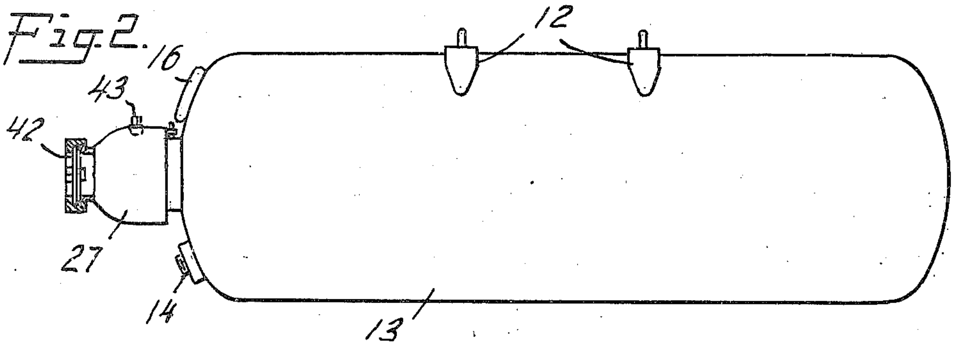
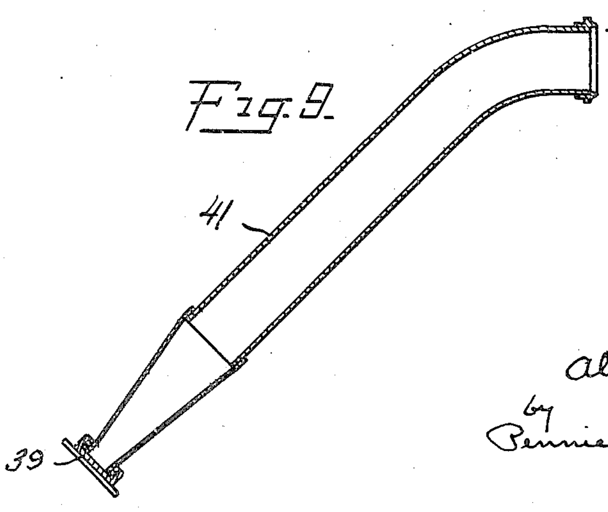


Fig. 9.



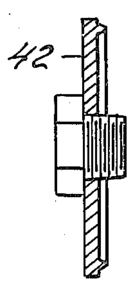


Fig. 8.

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Fig. 3.

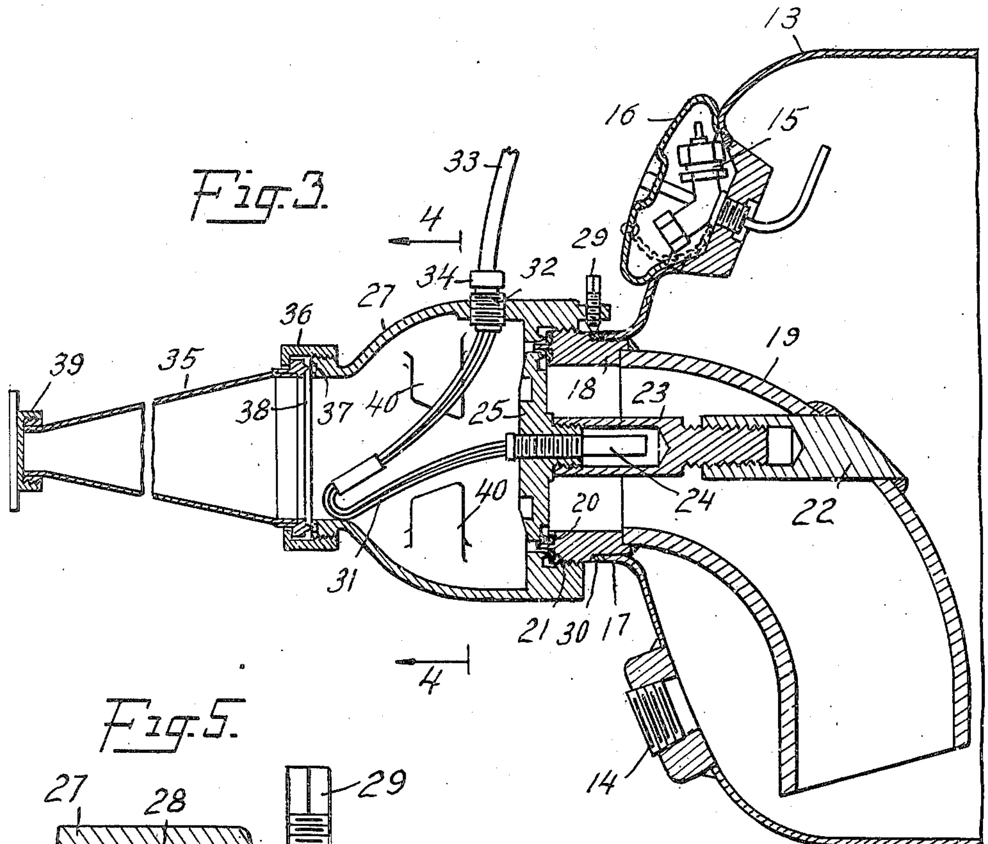


Fig. 5.

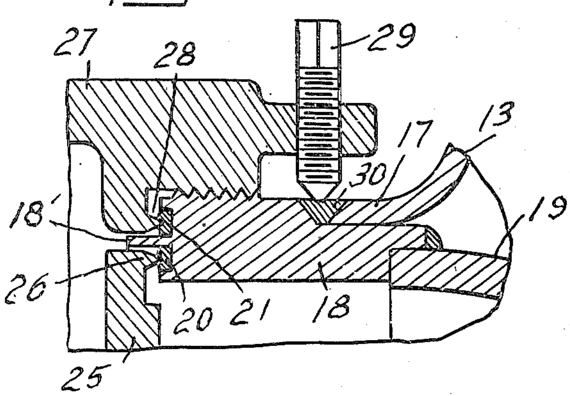


Fig. 4.

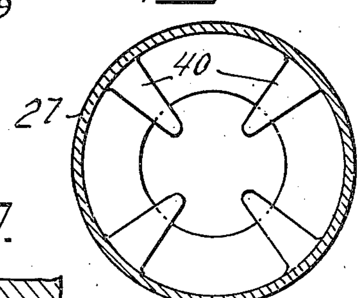


Fig. 6.

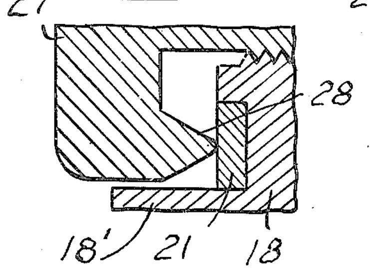
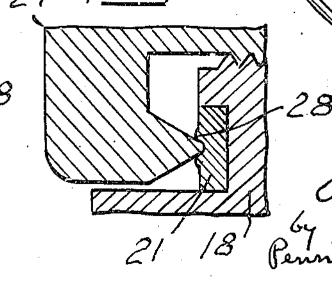


Fig. 7.



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AERIAL DISCHARGE DEVICE

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3 Claims. (Cl. 222—394)

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This invention relates to the aerial discharge of liquids confined in a container under a gaseous pressure, and has for its object the provision of certain improvements in devices therefor.

The invention is particularly applicable to the aerial discharge of synthetic fog or smoke compositions from aircraft, but is equally applicable wherever it is desired to aerially discharge a liquid, such for example as an insecticide. The container, confining the composition under a gaseous pressure, may advantageously be carried in the conventional bomb rack of a military bombing airplane, or may be otherwise suitably suspended from the aircraft. In accordance with the invention, a disc or equivalent closure is operatively associated with the delivery end of the outlet or discharge tube of the container, and expansible, and preferably explosive, means is provided for rupturing the operative association of the disc and tube to permit the gaseous pressure within the container to move the disc away from its closing position with the tube. The action of the expansible or explosive means is initiated exteriorly of the container, by the pilot or other aircraft personnel. In the preferred and more complete form of the invention, a throat ring having two concentric annular seats of relatively soft metal on its outer face is operatively connected to the delivery end of the outlet tube, which is adapted to dip beneath the liquid level in the container. The closing disc forms a seal with the inner of the annular seats, and is screw-threaded to a blow tube, which in turn is screw-threaded to a stud position within and secured to the outlet tube. The expansible or explosive means is positioned within the blow tube, and when actuated ruptures the connection between the blow tube and disc and thereby permits the gaseous pressure within the container to move the disc away from its closing position with respect to the outlet tube. A coupling threaded on the ring encloses the disc and the delivery end of the outlet tube and has an interior circular ridge forming a seal with the outer of the annular seats. Lugs on the interior of the coupling arrest the movement of the disc, and the discharging liquid holds the disc against these lugs during the interval of discharge.

The foregoing and other novel features of the invention will be better understood from the following description taken in conjunction with the accompanying drawings, in which

Fig. 1 is a front elevation of an aircraft with two devices of the invention suspended therefrom,

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Fig. 2 is a side elevation of the device, partly in section, prepared for transportation or storage,

Fig. 3 is a sectional elevation of the discharge end of the device, assembled for operation,

Fig. 4 is a sectional elevation on the section line 4—4 of Fig. 3,

Fig. 5 is an enlarged detail of a portion of Fig. 3,

Figs. 6 and 7 are enlarged explanatory details of a portion of Fig. 5,

Fig. 8 is a sectional elevation of the temporary or protective closing cap shown in Fig. 2, and

Fig. 9 is a sectional elevation of a modified form of discharge nozzle.

Fig. 1 of the drawings shows two aerial discharge devices of the invention suspended from the conventional bomb racks 10 of an airplane 11 by means of suspension straps 12 operatively secured to the upper surface of a cylindrical container 13 for the liquid composition to be aerially discharged. In general, the container is similar to the bomb which the rack 10 is adapted to accommodate for military purposes, and when the liquid composition has been discharged, in accordance with the invention, the container may, if desired, be jettisoned in the manner that a bomb would be dropped from the rack.

The container 13 is completely closed, except at its filling and discharge end, and may advantageously be made of stainless steel or the like. When the device has been assembled as hereinafter described, the container is filled to the desired extent with the liquid composition through the port 14, and gas, e. g. carbon dioxide, is forced into the container through a conventional check valve 15 until the desired gaseous pressure is established within the container. A removable cap 16 is provided for covering the valve 15.

The container 13 has an axially positioned discharge opening terminating in a circular flange 17. A throat ring 18 is welded or otherwise appropriately secured to the inside of the flange 17, and the delivery end of an outlet or induction tube 19 is welded or otherwise appropriately secured to the inner end of the ring 18. The tube 19 is positioned entirely within the container and is suitably shaped so that its inlet end is approximate the bottom of the container and hence beneath the liquid level in the container during the entire period of liquid discharge. Two concentric annular seats 20 and 21 of relatively soft metal (e. g. Babbitt or other anti-friction bearing metal) are inlaid in the outer end face of the ring 18.

A cylindrical stud (or blow-tube socket) 22 is positioned within and welded or otherwise appropriately secured to the outlet tube 19 in the axis of the tube's delivery end. The stud 22 has a threaded axial bore in which the shank of a blow-tube 23 is screw-threaded. The blow-tube has a hollow body for the accommodation of an expansible, and preferably explosive, means 24, such as a squib. A blow-disc 25 is threaded into the end of the hollow body of the blow-tube 23, and has on its inner face a circular ridge 26 adapted to form a gas-tight seal with the inner annular seat 20 on the ring 18. The outer end face of the throat-ring 18 has an integral guide ring 18′ extending outwardly between the seats 20 and 21 to assist in centrally positioning the blow-disc 25 as it is screwed (by a spanner or the like) into the blow-tube 23, the inside diameter of the guide ring being slightly greater than the peripheral diameter of the disc.

A bell-shaped coupling or transformation piece 27 is screw-threaded on the ring 18 and has a circular ridge 28 adapted to form a gas-tight seal with the outer annular seat 21. The coupling is firmly held in its sealing position by a lock bolt 29 adapted to bite into a circumferential seat of relatively soft metal 30 inlaid in the ring 18, approximate its juncture with the flange 17 (Fig. 5). The circular ridges 26 and 28 have slightly rounded apexes which bite into the soft metal seats with a flow of the soft metal around the apex to form a perfect seal, as illustrated in Figs. 6 and 7.

In the operation of the device, the parts hereinbefore mentioned are assembled as described. With the delivery end of the outlet tube 19 sealed by the blow-disc 25, the container is filled with the liquid composition under a gaseous pressure. The squib 24 is axially threaded into a central hole in the disc 25. The squib may advantageously be a copper tube filled with an explosive compound, preferably slow burning, such for example as coarse grain single base nitrocellulose powder. An electric match, or other suitable primer, is appropriately associated with the explosive compound, and its control cable 31 is arranged within the coupling 27, and has a terminal socket 32 screw-threaded in the wall of the coupling. The cable 31 is electrically connected to the cock-pit of the aircraft by a cable 33 having a terminal plug 34 adapted to be inserted in the socket 32. A suitable nozzle 35 is attached to the outer end of the coupling 27 by a nut 36. The outer end face of the coupling has an inlaid annular seat 37 of soft metal with which a circular ridge 38 on the inner end of the nozzle cooperates to form a gas-tight seal. The protective cap 39 on the discharge end of the nozzle is removed prior to the actual operation of the device.

With the aircraft in motion and over the locality where it is desired to discharge the liquid composition, the pilot or other aircraft personnel initiates the action of the explosive in the squib 24 by means of the electric match or other primer controlled from the cockpit. The resulting explosion ruptures the screw-threaded connection between the blow-tube 23 and the disc 25, and the gaseous pressure within the container forces the disc away from its closing position of the delivery end of the outlet tube 19 and against the interior lugs 40 of the coupling 27. The lugs serve to arrest the movement of the disc and provide a rest against which the disc is firmly held by the pressure of the discharging liquid. The free cross-sectional area of the larger part of the coupling 27 is about 1⅔ the area of the disc 25, to provide adequate space for the flow of the discharging liquid around the disc while resting against the lugs 40.

The device of the invention is especially adapted for laying a smoke screen, over water, for the protection of surface war ships, or over land for obscuring the position or movement of military equipment such as tanks etc. To this end, the liquid composition may consist principally of titanium tetrachloride, to which may be added a relatively small amount (preferably about 10% by weight) of hexachloroethane (C_2Cl_6) to slow down the smoke-forming reaction of the titanium tetrachloride as well as to supplement the smoke effect. For laying down an effective smoke screen, the aircraft must fly close to the water or land, say at a height of 125 to 200 feet. The rate of discharge depends upon the size of the nozzle, and is correlated to the speed of the aircraft. A high rate of discharge is necessary because of the usual high speeds of the aircraft. The discharge of about 800 pounds of the liquid smoke composition in about 12 seconds is in general suitable for present prevailing aircraft speeds, although if desired the present normal charge of 800 pounds of liquid smoke composition may be discharged in 4 seconds.

In addition to laying smoke screens, the device of the invention may be used wherever it is desired to effect the aerial discharge of a liquid, as for example of poison gas, a disinfectant, germicide, insecticide, fungicide etc. Various types and sizes of nozzles may be used, and in Fig. 9 an elongated and depending nozzle 41 is illustrated for attachment to the coupling 27 in place of the nozzle 35 of Fig. 3. When transporting or storing a charged container, the nozzle is preferably replaced by a cap 42 (Fig. 8) which forms a sealing closure of the open end of the coupling 27 in the manner hereinbefore described. Additionally, the electric cable and squib are preferably omitted for transportation and storage, and the socket hole in the coupling is then closed by a suitable plug 43 (Fig. 2).

The rupturing of the operative connection between the blow-tube and the blow-disc by the action of the expansible or explosive means is such that these parts can be used only once, and they must be replaced by new parts where the device is reassembled and refilled for another aerial discharge operation. These parts, as well as the stud and throat-ring, may advantageously be made of brass, and the cost of replacing the expendable parts is insignificant. Frequently, and especially in military uses, it is uneconomical to reuse or recharge the device, and in such cases, the device, after use, is jettisoned by appropriate manipulation of the bomb-rack mechanism from the cockpit, in much the same manner that a bomb is dropped from the aircraft.

The blow-disc 25 additionally serves as a safety valve. When the disc is screwed into the blow-tube 23, its circular ridge 26 bites into the seat 20. The resistance to this biting action progressively increases as the disc is screwed in and the metal of the seat flows around the ridge 26, and ultimately becomes so great that further turning of the disc causes its outer surface to deflect inwardly and assume a slightly concave contour. The disc is screwed in until a predetermined deflection or concavity has been thus attained. Any increase in the pressure within the container 13 will decrease this deflection or concavity of the disc's outer surface, and should the pressure increase sufficiently to entirely overcome the deflection, the seal between the ridge **26** and the seat **20** is broken or opened to permit a release of the pressure within the container until the deflection of the disc is sufficiently restored to renew the seal. This safety valve action of the disc is automatic, and only comes into action whenever an excessive or critical pressure exists within the container. When the pressure is relieved below the critical point, the disc automatically resumes its sealing position. The amount of deflection or concavity of the disc, with the normal pressure within the container, is a measure of the excessive pressure required to open or break the seal between the ridge **26** and the seat **20**. The curvature of the rounded apex of the ridge **26** (as well as the similar ridges of the device) is correlated to the hardness of the metal of the seat **20**. I now prefer to make these seats of an alloy containing about 11% antimony, 2% arsenic and the balance lead. With seats of such an alloy, the radius of curvature of the apex of the ridge may advantageously be $\frac{1}{32}$ inch. With seats of harder metal, the radius of curvature will be smaller, and with seats of softer metal, the radius of curvature will be greater.

I claim:

1. A device for the aerial discharge of a liquid comprising a container adapted to contain a liquid under a gaseous pressure, an outlet tube adapted to dip beneath the liquid level in the container, a throat ring associated with the delivery end of said tube and having two concentric annular seats of relatively soft metal associated with its outer face, a coupling operatively associated with said ring and having an interior circular ridge adapted to form a seal with the outer of said annular seats, a disc positioned within said coupling and adapted to close the delivery end of said outlet tube by forming a seal with the inner of said annular seats, explosive means within said outlet tube for rupturing the closure thereof by said disc, and means exterior of the container for initiating the action of said explosive means.

2. A device for the aerial discharge of a liquid comprising a container adapted to contain a liquid under a gaseous pressure, an outlet tube adapted to dip beneath the liquid level in the container, a stud positioned within and secured to said tube in the axis of its delivery end, a blow-tube having a screw-threaded connection with said stud, a disc having a screw-threaded connection with said blow-tube and adapted to close the delivery end of said outlet pipe, explosive means within said blow-tube adapted to rupture the screw-threaded connection between the blow-tube and disc to permit the gaseous pressure within the container to move the disc away from its closing position with said outlet tube, a coupling enclosing said disc and the delivery end of said outlet tube, and means exterior of the container for initiating the rupturing action of said explosive means.

3. A device for the aerial discharge of a liquid comprising a container adapted to contain a liquid under a gaseous pressure, an outlet tube adapted to dip beneath the liquid level in the container, a stud positioned within and secured to said tube, a blow tube connected to said stud and having a hollow body, a throat ring associated with the delivery end of said outlet tube and having an annular seat of relatively soft metal on its outer face, a disc connected to said blow tube and having an interior circular ridge, the connections between the stud and blow tube and between the blow tube and disc being such that turning of the disc draws it toward said stud until said ridge bites into said annular seat and the disc closes the delivery end of the outlet tube, explosive means within said hollow body adapted to rupture the connection between said disc and blow tube to permit the gaseous pressure within the container to move the disc away from its closing position with respect to the tube, and means exterior of the container for initiating the action of said explosive means.

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