The present invention relates to improved apparatus for generating gaseous mixtures from liquefied carbon dioxide or other refrigerants and combustion products of propellants, and the vapors of alcohol or other materials having a high latent heat of vaporization, if desired.

One of the difficulties which has been encountered in the use of such apparatus is that the hot combustion gases and the refrigerant and alcohol (if used) are not thoroughly and uniformly admixed, particularly when the propellant is first ignited, with the result that hot spots are caused in the mixing chamber of the apparatus which burn out or weaken the structural elements of the apparatus. This difficulty is overcome by utilizing apparatus such as disclosed in copending application for United States Letters Patent, Serial No. 167,519, filed January 22, 1962, now Patent No. 3,117,424, dated January 14, 1964.

Accordingly, the primary object of the present invention is to provide improved apparatus for more thoroughly and uniformly mixing hot combustion gases, refrigerant and alcohol, if used, which apparatus is constructed of a minimum of parts and requires a minimum number of assembling operations, whereby the apparatus is more economical in construction.

Another object is to provide such apparatus which is safe and reliable in operation.

Another object is to provide such apparatus which is rugged in construction but yet is light in weight and compact in arrangement.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawing, forming a part of the specification, wherein:

FIG. 1 is a vertical longitudinal sectional view of apparatus in accordance with the present invention.

FIG. 2 is an enlarged plan view of a mixing baffle as seen when viewed along the line 2—2 on FIG. 1.

Referring to the drawing in detail, a gas generator 10 for producing a mixture of gases is shown which generally comprises a container 11 for confining carbon dioxide or other refrigerants; an outlet assembly 12 having an outlet 14 for connection of a conduit 15 thereto by a coupling 16; a valve or closure such as a pressure rupturable disc 17 for normally sealing the container and allowing discharge of the gaseous mixture through the outlet upon rupture thereof; a hot gas generating chamber 18 opposite the outlet including a charge 19 of propellant and an electrically actuated squib 20 for igniting the charge; and a gas mixing arrangement including a nozzle 21 formed with a bore 22 and a baffle assembly 23 disposed between the chamber 18 and the sealing disc 17.

The container 10, as shown, preferably is generally spherical and has hemispherical upper and lower sections 24 and 25, although the container may be generally cylindrical and may have hemispherical end domes similar to the sections 24 and 25. The upper section 24 has a central tubular portion 26 located within the container for securing the chamber 18, and the lower section 25 has a central external tubular portion 27 for mounting the outlet assembly 12. The chamber 18 has a tubular depending portion 23 formed with a stepped bore providing an outlet 28 facing the outlet assembly 12; and the nozzle 21 is connected to the portion 23 with a pressure rupturable disc 29 in the stepped bore normally sealing the outlet 28 and allowing discharge of hot gases through this outlet upon rupture of the disc 29.

The baffle assembly 23 comprises a ring or annular band 30 which is formed with circumferentially spaced apertures 31, for example six in number, and is secured over the outlet sealing disc 17; and a baffle member 32 which is secured to the upper edge of the band 30.

As shown herein, the baffle member 32 is a generally cylindrical truncated element obliquely which is disposed to the vertical at an angle of about 15°. The baffle member has a lower face 34 which is horizontally disposed and has an upper face 35 which is disposed to the horizontal at an angle of about 30°. The upper face 35 is formed with a con cave generally spherical recess 36 having its upper portion at the left side as viewed from the nozzle 21 and in approximate alignment with the corresponding side of the nozzle bore 22 and having its lower portion at the right side as viewed spaced from and extending outwardly of the corresponding side of the nozzle bore 22 (FIG. 1), whereby the hot gases discharged through the nozzle bore are directed towards the right and upwardly by the baffle recess 36 for admixture with refrigerant within the container.

The baffle member 32 is further formed with an orifice or bore 37 which is eccentrically disposed therein to the right as viewed and extends from the recess 36 to the lower face 34 at an angle of about 15° to the horizontal, whereby a portion of the hot gases discharged from nozzle 21 passes through the bore 37 and is directed onto the sealing disc 17.

In a specific example of apparatus in accordance with the present invention, the container 11 has a net volume of about 460 cubic inches and is adapted to contain about 10 pounds of carbon dioxide and about 1.5 pounds of 200 proof denatured ethyl alcohol. A charge 19 of propellant weighing about 0.9 pound and capable of generating about 1750 B.t.u. per pound is used to produce hot gases for vaporizing the carbon dioxide and alcohol, while this hot gas is cooled by the carbon dioxide and the alcohol to supply a mixture at a temperature suitable for inflating an inflatable device having a bag volume of about 80 cubic feet.

In this apparatus, the nozzle bore 22 has a cross-sectional flow area of about 0.197 square inch, the baffle member 32 has a recess 36 of a depth of about 0.31 inch and a diameter at its upper end of about 1.25 inches, and the orifice 37 through the baffle member has a cross-sectional area of about 0.003 inch. The baffle member is constructed of 4130 steel and has a mass of about 0.2 pound. The surface of the recess preferably is coated with molybdenum to resist the action of the hot gas. The ring 30 has an internal cross-sectional area of about 1.02 square inches and has six 0.25 inch diameter apertures 31 providing a combined cross-sectional flow areas of about 0.00294 square inch.

In operation, when the charge 19 is ignited, pressure is built up in the chamber 18 which causes the disc 29 to burst when a pressure of about 2800 p.s.i. is attained. The hot combustion gases immediately heat the carbon dioxide to increase its pressure in container 11 which causes the disc 17 to burst when pressure of 4000 p.s.i. is attained. Upon discharge of combustion gases through the nozzle 21 the hot combustion gases strike the baffle
recess 36 obliquely and are directed upwardly and radially outwardly to swirl through the container in a generally counter-clockwise circular path (as viewed) and drive the carbon dioxide and alcohol in a similar path to effect admixture of the hot combustion gases therewith. By reason of the dimensioning of the nozzle flow area and the baffle ring aperture flow area, discharge through the outlet 14 is delayed to provide ample time for admixture of combustion gases, carbon dioxide and alcohol to take place in the container whereby uniform cooling of the mixture is effected prior to discharge thereof. As the gaseous mixture passes through the apertures 31 into the ring 30, rapid expansion of the mixture occurs to cool the same by the Joule-Thomson effect.

During discharge a maximum pressure of about 5200 p.s.i. is attained in the propellant chamber 18, and a maximum pressure of about 4500 p.s.i. is attained in the container 11. The maximum temperature developed in the container 11 does not exceed about 200° F., and the maximum temperature of the gaseous mixture discharged through the outlet 14 does not exceed 175° F.

The orifice 37 through the baffle member 32 serves to displace any liquid within and about the ring 30 so that it can mix with the main stream.

The apparatus by reason of its construction and arrangement is operable in any attitude of position.

From the foregoing description, it will be seen that the present invention provides improved apparatus for producing a large volume of gas at a temperature suitable for inflating inflatable devices and for other purposes.

As various changes may be made in the form, construction and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:

1. Apparatus for producing a mixture of gases under pressure comprising a container for confining a fluid under pressure having an outlet at one end; a closure for said container outlet; a source of hot combustion gases including a nozzle having an outlet facing said container outlet; and a baffle disposed between said outlets including an apertured ring portion concentric with said container outlet and overlying said closure, and including a top portion overlying said ring portion and having an oblique surface facing said nozzle outlet for directing combustion gases radially outwardly and towards the end of said container opposite said container outlet.

2. Apparatus according to claim 1, wherein said baffle top portion has an orifice extending from said oblique surface to within said ring portion.

3. Apparatus according to claim 1, wherein said surface is in the form of a generally spherical concave recess.

4. Apparatus according to claim 3, wherein said recess is disposed at an angle of about 75° to the longitudinal axis of said container in which said container outlet is disposed and said baffle top portion has an orifice extending from said recess to within said ring portion at an angle of about 15° to said longitudinal container axis.

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