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GENERATION OF GASEOUS MIXTURES FOR INFLATABLE DEVICES

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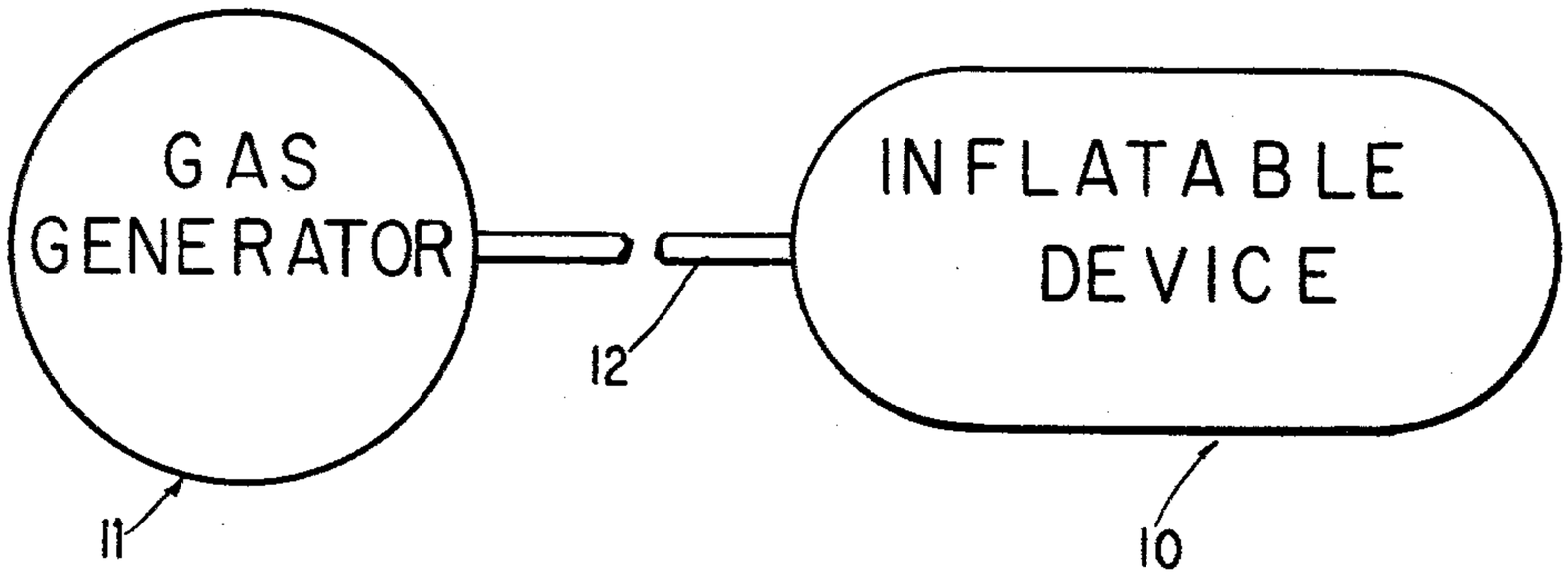
Fig. 1



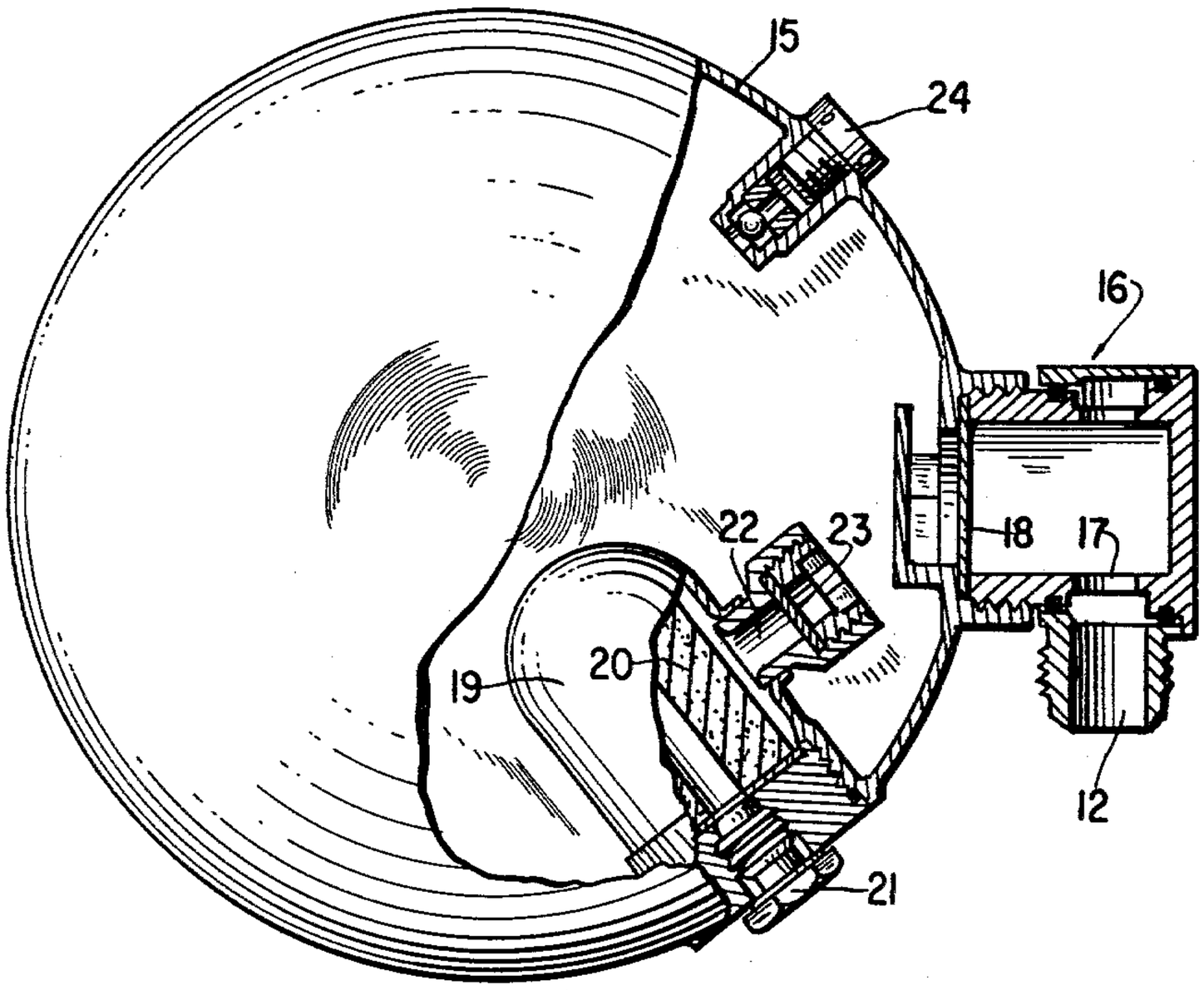


Fig. 2

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GENERATION OF GASEOUS MIXTURES FOR INFLATABLE DEVICES

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2 Claims. (Cl. 141—4)

The present invention relates to inflating inflatable devices, and, more particularly, to an improved method for generating gaseous mixtures of carbon dioxide or the like and combustion products of propellants suitable for inflating such devices.

Heretofore, it has been proposed to inflate landing pads for helicopters and flotation equipment such as rafts, boats, escape ladders and the like with a mixture of carbon dioxide and the gases produced by propellants whereby the gases effected expansion of the carbon dioxide and the expanding carbon dioxide reduced the temperature of the gases and the mixture. However, under certain conditions of operation, the temperature of the mixture was not sufficiently reduced to be safely withstood by the inflatable device or the pressure of the mixture was insufficient to fully inflate the device when cooled to ambient temperature.

Accordingly, an object of the present invention is to provide a method of effectively inflating equipment without subjecting the equipment to excessive temperatures.

A further object is to accomplish the foregoing in a simple, practical, reliable and economical manner.

Other and further objects of the invention will be obvious upon and 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.

In accordance with the present invention, it has been discovered that the foregoing objects can be generally accomplished by mixing the hot gaseous combustion products of propellants such as burning powders with liquefied carbon dioxide and a material having a high heat of vaporization, such as ethyl alcohol for example. The got gases heat and gasify the carbon dioxide to attain a desired pressure and the subsequent expansion of the carbon dioxide produces a cooling effect which reduces the temperature of the hot gases so that the mixture is at a temperature which the inflatable equipment can withstand. The temperature of the hot gases is further reduced and the pressure of the mixture is further increased by the alcohol or the like.

It is contemplated that a predetermined amount of heat is produced by the propellant for each pound of carbon dioxide used and a predetermined amount of alcohol is used for each 1000 B.t.u of heat produced. These amounts may be varied by summertime or high ambient temperature operations (e.g., 20° F. to 125° F.) and for wintertime or low temperature operation (e.g., —20° F. to 80° F.) by using more carbon dioxide, more propellant and less alcohol in the wintertime than in the summertime, as will be explained hereinafter with reference to the specific examples of the present invention. Also, these amounts may be adjusted to compromise for summertime and wintertime operation to provide a charge operable within the temperature range of —20° F. to 125° F.

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 schematic view of a system utilizing apparatus in accordance with the present invention for producing a gaseous mixture for inflating an inflatable device.

FIG. 2 is an enlarged longitudinal sectional view, partly in elevation, of apparatus for producing the gaseous mixture.

Referring now to the drawing in detail, a system is shown in FIG. 1 which comprises an inflatable device **10**, a gas generator **11**, and a conduit **12** for conducting a mixture of gases from the gas generator to the inflatable device.

The inflatable device **10** may be a bag of any desired shape and size used in connection with boats, rafts, rescue devices or helicopter landing pads.

The interior of the gas generator **11** for producing the mixture of gases is shown in FIG. 2. The gas generator comprises a container **15** for confining carbon dioxide; an outlet assembly **16** having the conduit **12** connected to its outlet **17**; a pressure rupturable disc **18** for normally sealing the container to prevent discharge through the outlet; a hot gas generating chamber **19** including a charge **20** of propellant adjacent the outlet, an electrically actuated squib **21** for igniting the charge, and a passageway means **22** for conducting the hot gases from the chamber to the interior of the container **15** for admixture with the carbon dioxide; and a safety disc assembly **24** adapted to burst in the event an unsafe pressure is created within the container.

In operation, the squib **21** is actuated to ignite the charge **20**, and the propellant generates hot gases which are admixed with the alcohol and the carbon dioxide to increase the pressure within the container **15** and burst the disc **18**. This mixture is discharged through the outlet **17** and is conducted by the conduit **12** to the inflatable device **10** or other points of use. As this occurs, the hot gases increase the pressure of the carbon dioxide and vaporize the alcohol and the carbon dioxide upon expansion cools the hot gases by the Joule-Thomson effect which takes place when it is suddenly expanded from a high pressure to a much lower pressure, whereby the temperature of the mixture which enters the inflatable device is not too high to harm the device and the pressure of the gaseous mixture is adequate to fully inflate the device.

Numerous tests have indicated that, at ambient temperatures between —20° and 125° F., the temperature of the gaseous mixture entering the bag can be maintained at between about —30° F. and about 160° F. by varying the ratio of the number of B.t.u. produced for each pound of carbon dioxide. This ratio is higher at the lower ambient temperature than at the higher ambient temperatures. For example, at —20° F. about 159 B.t.u. may be generated by the propellant for each pound of carbon dioxide, and at 125° F. about 145 B.t.u. may be generated by the propellant for each pound of carbon dioxide which is in excess of the heat theoretically required and to thereby take into account heat losses to atmosphere and work done in inflating the bag.

A propellant charge which has been found suitable is a potassium perchlorate type powder capable of producing about 1740 B.t.u. a pound. Thus, by varying the weight of the charge the desired number of B.t.u. to be produced can be predetermined within accurate limits.

Any suitable materials which remain in liquid state within the working temperature range and which have a high latent heat of vaporization may be utilized. Ethyl alcohol (synthetic) may be preferred because it is readily available and inexpensive, is readily mixed with the carbon dioxide in the container, and can be confined in the container together with the carbon dioxide. Also, the presence of ethyl alcohol has no harmful effect on the components of the system.

The use of alcohol at high ambient temperature operation is particularly beneficial. At low ambient temperature operation, alcohol does not reduce the temperature of the carbon dioxide to induce the formation of snow, but a smaller amount of alcohol can be used to control the temperature of the gaseous mixture than at high temperature operation. For example, at —20° F. about 0.40 pound of alcohol is used for each 1000 B.t.u. produced by the charge, and at 125° F. about 0.77 pound of alcohol is used for each 1000 B.t.u. produced by the charge.

As specific examples of the present invention, a 56 cubic foot bag for a helicopter pad was inflated to a pressure of about three p.s.i.g. in less than four seconds by a hot gas generator container 11 having a volume of about 350 cubic inches and containing the following amounts of material:

Example I

Working temperature range, ° F.	—20 to 80
Carbon dioxide pounds	7.28
Charge 20 do	0.66
Ethyl alcohol do	0.46
Bag temperature range, ° F.	4 to 136

Example II

Working temperature range, ° F.	20 to 125
Carbon dioxide pounds	6.89
Charge 20 do	0.57
Ethyl alcohol do	0.66
Bag temperature range, ° F.	36 to 155

Example III

Working temperature range, ° F.	—20 to 125
Carbon dioxide pounds	7.33
Charge 20 do	0.67
Ethyl alcohol do	0.90
Bag temperature range, ° F.	30 to 160

Other tests indicated that the mixture in accordance with the foregoing examples are also suitable for inflating flotation equipment, particularly such equipment having a relatively large bag volume.

While the present invention has been described with reference to carbon dioxide by way of example, it will be understood that other compounds can be substituted

in place of carbon dioxide. Such compounds should have a comparable expanded volume to weight ratio, and should be gaseous and have a vapor pressure within the operating temperature range desired to sufficiently inflate the bag. For example, such compounds are ammonia, ethane, propylene and nitrous oxide. Ammonia can be employed in systems where its dangerously toxic and corrosive nature and high water solubility can be tolerated.

From the foregoing description, it will be seen that the present invention provides a simple, practical and economical manner of inflating inflatable devices.

It will be understood that the details and examples hereinbefore set forth are illustrative only and that the invention as broadly described and claimed is in no way limited thereby.

This application is a division of application Serial No. 149,896, filed November 3, 1961, now U.S. Patent No. 3,143,445.

I claim:

1. The method of inflating an inflatable device, which method comprises generating a predetermined charge of hot gases under pressure in a confined zone, mixing the gases with a predetermined charge of carbon dioxide under pressure and a liquid material having a high latent heat of vaporization in the zone to increase the pressure of the carbon dioxide and vaporize the material, releasing the mixture of gases and carbon dioxide from the zone, expanding the released pressurized carbon dioxide in admixture with the gases to cool the gases, and introducing the expanded mixture into the inflatable device, the quantitative relationship of the charge of carbon dioxide and material and the charge of hot gases being such so as to produce the expanded mixture at temperatures and pressures suitable for introduction into the inflatable device.

2. The method according to claim 1, wherein a sufficient amount of hot gases are generated to produce between about 145 and about 159 B.t.u. for each pound of carbon dioxide and between about 0.40 and about 0.77 pound of ethyl alcohol are admixed with the gas and the carbon dioxide in the zone for each 1000 B.t.u. produced by the hot gas.

No references cited.

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