

[54] PYROTECHNIC COOL GAS GENERATION
METHOD FOR INFLATABLE STRUCTURE

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[22] Filed: Nov. 19, 1973
[21] Appl. No.: 417,453

Related U.S. Application Data

[63] Continuation of Ser. No. 224,525, Feb. 8, 1972,
abandoned.
[52] U.S. Cl. 60/219; 102/39; 280/150 AB;
149/109.4
[51] Int. Cl.² C06D 5/00
[58] Field of Search 102/39 X; 149/109.4;
60/219; 280/150 AB

[56] References Cited

UNITED STATES PATENTS

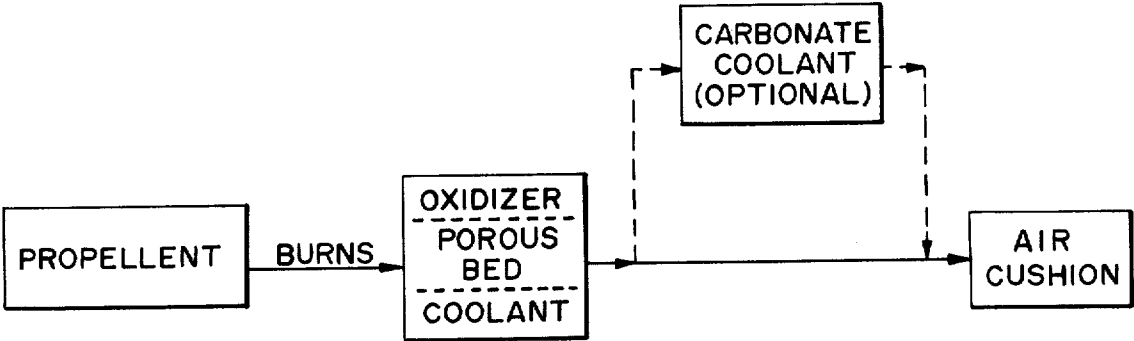
3,532,359 10/1970 Teague et al. 280/150 AB
3,647,393 3/1972 Leising et al. 102/39 X

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[57] ABSTRACT

The introduction of a generated gas through an ox-
idizer bed, which, optionally, may also include a cool-
ant.

3 Claims, 1 Drawing Figure



PYROTECHNIC COOL GAS GENERATION METHOD FOR INFLATABLE STRUCTURE

This is a continuation of application Ser. No. 224,525, filed Feb. 8, 1972, now abandoned.

BACKGROUND OF THE INVENTION

Automobile safety has indicated use of air cushion systems for passenger restraint. Much research and development has recently been carried out in the development of such air cushion systems both for the protection of passengers, as disclosed for example in U.S. patent application Ser. No. 81,947, filed Oct. 19, 1970, U.S. Pat. No. 3,874,059 and for the protection of the driver, as for example in U.S. patent application Ser. No. 147,913, filed May 28, 1970 now U.S. Pat. No. 3,787,074. In both the case of the protection of the passenger and the driver, the gas used to fill the protective structure (cushion or bag) may be in part or all generated gas from a combustible material.

It is necessary that the generated gas withstand storage from about -40°F. to $+220^{\circ}\text{F.}$, ignite rapidly, for example within just a few milliseconds be totally ignited and producing non-toxic gas, and produce gas at a relatively low temperature (less than about $2,000^{\circ}\text{F.}$) when burned at pressures from 100 to 20,000 lbs/in². It has been proposed to use a pure pyrotechnic gas generator producing a non-toxic gas where the propellant and the oxidizer are mixed, either as a rough grain or as a contracted product. It has further been proposed to add to that mixture or to cool the gas produced from that mixture with a carbonate or other coolant. However, such mixtures present problems, as it is extremely difficult to control the rate of burn because of the mix of ingredients, and with the mixture of ingredients the burning occurs at a relatively high pressure. Furthermore, the mixture of propellant and oxidizer results in stabilizing problems connected to ambient temperature changes and storage conditions.

BRIEF SUMMARY OF INVENTION

Therefore, according to this invention a gas generating, solid propellant grain which may be of a conventional type, such as a PVC propellant, is utilized to product a gas. That gas is then passed through an oxidizer, such as a metal chlorate or perchlorate, in the form of a porous bed. Optionally, a coolant, such as a carbonate, may be added to the oxidizer to further cool the generated gas. The products produced by such treatment of the produced gas from a PVC propellant include approximately 10 percent carbon dioxide (CO_2), 10 percent water vapor and 80 percent oxygen, with substantially no toxic carbon monoxide (CO) produced. The temperature of the gas supplied as a result of oxidation, without the use of the carbonate coolant, is below 2000°F. and as low as 1400°F. or lower.

DESCRIPTION OF INVENTION

In the preferred embodiment of this invention, the combustible propellant is made up of a PVC propellant grain, though the propellant may be any standard propellant which will produce non-toxic gas for use in filling an air cushion assembly. In the drawing, which shows a schematic flow of the invention, propellant is shown as burning and then passing through a porous bed of oxidizer.

The porous bed of oxidizer may be formed of any metal chlorate or perchlorate, preferably potassium chlorate (KClO_3) and/or potassium perchlorate (KClO_4). The gas from the burning propellant passing through the oxidizer undergoes extreme oxidation, and the resultant products as a result of this oxidation are carbon dioxide (CO_2), water and oxygen, with substantially no carbon monoxide (CO) produced. The porous bed may include a coolant such as metal carbonate and/or bicarbonate to further lower the temperature of the generated gas before it passes, as shown in the schematic, into the air cushion. Furthermore, optionally, the gas leaving the porous bed can also be further cooled by mechanical heat exchange, such as passing it over metal wire, chain, sintered or loose metal particles, etc., if desired, before passing it into the air cushion.

The solid propellant can be used as an extruded, cast, or mechanically compacted (pressed) grain.

The coolant is preferably a carbonate, such as magnesium carbonate and/or sodium carbonate which will absorb heat as a result of decomposition from the generated gas.

In one specific example, a PVC propellant grain commercially known as Arcite 497C of the Atlantic Research Corporation was burned and the produced gas introduced into a porous bed of recrystallized potassium chlorate crystals of an average of about 500 microns diameter. No separate carbonate coolant was used. A temperature of about 1400°F. of the resultant gas directed to the air cushion was achieved. About 10 percent carbon dioxide (CO_2), 10 percent water vapor, and 80 percent oxygen was produced as the gas filling the air cushion. Substantially no toxic carbon monoxide was produced. Of course, the addition of a chemical coolant, such as a carbonate which will absorb heat as a result of its contact with the generated gas in the porous bed, or thereafter, if desired, would further lower the temperature of the generated gas.

By the process indicated, the burn of the propellant can be controlled, as previously discussed, because there is no intermixture of the oxidizer or the oxidizer and the coolant with the burning propellant grain. Furthermore, without the mixture of oxidizer and propellant, lower pressures at which the propellant burns are attainable for an equal amount of gas produced per given amount of time. Furthermore, as a result of the lack of such intermixture, the storability of the product is made more favorable.

It is understood that the above-described example and general descriptive matter is merely illustrative of the invention and not meant to limit said invention, except as such invention is within the scope of the following claims.

I claim:

1. A method of filling an air cushion assembly with a generated gas without the production of carbon monoxide and at a temperature less than about 2000°F. , comprising burning a propellant grain to generate gas, passing said generated gas through a porous bed of oxidizer and coolant, further cooling said gas by mechanical heat exchange with a heat exchange surface after passing the gas through the bed, further treating the oxidized gas emerged from the porous bed with a separate coolant, and directing the generated gas to an air cushion assembly.

2. A method as set forth in claim 1, said coolant in each occurrence selected from a class consisting of

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magnesium carbonate, sodium carbonate, or a combination of the two.

3. A method as set forth in claim 1, said porous bed of oxidizer selected from the class consisting of a metal

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chlorate, metal perchlorate and a combination of the two.

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