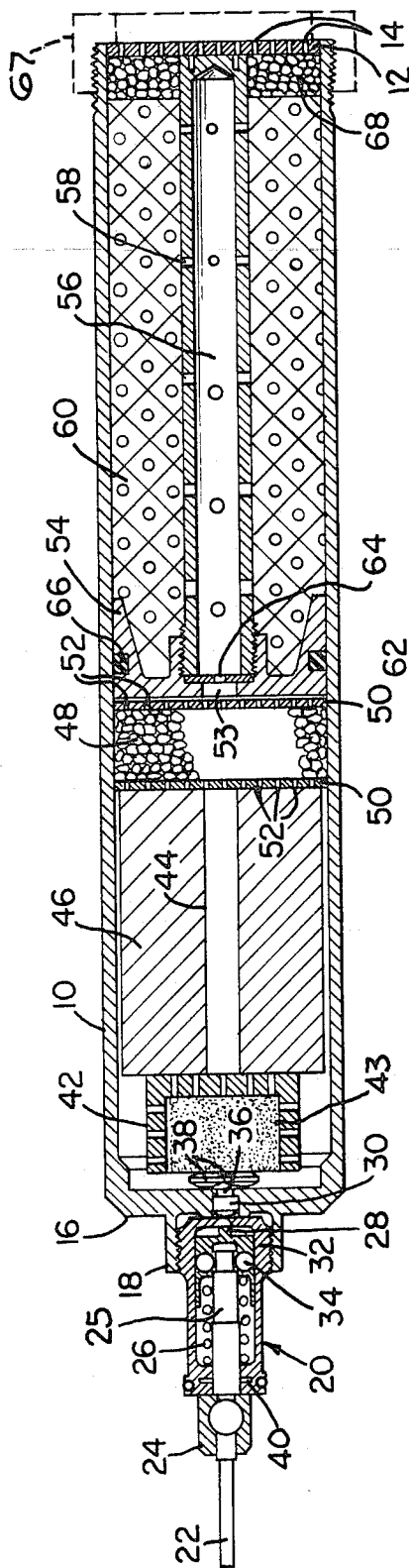


Jan. 26, 1971

T. Q. CICCONE ET AL
PROPELLANT GAS GENERATOR

3,558,285

Filed Oct. 1, 1969



INVENTOR.
THOMAS Q. CICCONE
WILMER WHITE
JAMES F. KOWALICK

By: Harry M. Baragovitz,
Edward J. Kelly, Herbert Paul &
S. Dubroff ATTORNEYS.

1

3,558,285

PROPELLANT GAS GENERATOR

Thomas Q. Ciccone, Langhorne, Pa., Wilmer White, Haddonfield, N.J., and James F. Kowalick, Southampton, Pa., assignors to the United States of America as represented by the Secretary of the Army
Filed Oct. 1, 1969, Ser. No. 862,733
Int. Cl. B01j 7/00

U.S. Cl. 23—281

8 Claims

ABSTRACT OF THE DISCLOSURE

A gas generator constructed to utilize a composition of matter including a body of carbonaceous material to chemically process a propellant gas and increase the total pressure of the gas in an inflatable item supplied by the generator, and decrease any subsequent pressure drop.

The invention described herein may be manufactured, used, and licensed by or for the Government for governmental purposes without the payment to us of any royalty thereon.

This invention relates to a propellant gas generator and more particularly to a propellant gas generator having means to reduce the water content of the gas entering inflation devices supplied thereby, thus minimizing pressure loss.

In the past, although generators of this type, as shown and described in U.S. Pat 3,305,319, produced sufficient amounts of gas to fully inflate the various inflatable items with which they were used, and although this gas was sufficiently low in temperature as not to damage these inflatable items, the gas pressure could not be maintained above a required minimum operating level over a desired period of time.

Water vapor has been identified as being a major cause of the undesirable phenomenon of pressure drop in the inflatable item. The gas entering an inflatable device is higher in temperature than the surroundings, and when this gas is cooled to the temperature of the surroundings, a considerable fraction of the water initially existant as vapor is condensed to liquid. This condensation process is responsible for appreciable pressure decrease.

It is therefore an object of this invention to provide a propellant gas generator which reduces the water content of the gas entering the inflation device to thereby minimize pressure loss.

A further object of this invention is the provision of a propellant gas generator having means therein to react with the water content in the gas generator in such a manner as to physically absorb or chemically decompose the water in an irreversible manner.

It is also a further object of this invention to provide a propellant gas generator utilizing a composition therein to increase the total pressure of gas in the inflatable item and decrease any subsequent pressure drop.

The above objects as well as others, together with the benefits and advantages of the invention, will further be understood from the following description, when considered with reference to the accompanying drawing.

Referring to the drawing and the single figure thereof, a propellant gas generator embodying the invention is shown. This includes a cylindrical steel housing 10 having a forward end discharge disc or plate 12 defining a plurality of gas outlet or discharge ports 14 therethru and a closed rearward end 16 having threaded socket means 18 for securing thereon, in coaxial operational relation, a

2

rearwardly extending firing mechanism 20. The firing mechanism 20 is provided with a firing lanyard or pull cord 22 which is attached by means of a coupler 24 with the rear end of a firing pin 25. This is provided with a forward striker end 28 and a firing pin spring 26 which biases the firing pin and the striker 28 toward a primer 30. The firing pin 25 and striker 28 are contained in a tubular housing 32 forming part of the said firing mechanism 20 and are guided and centered by an annular ball ring 34 in rear of the striker 28.

Adjacent to the primer 30 is a firing hole 36 through which passes the combustion products of said primer 30 when detonated by the firing pin striker in response to operation of the lanyard. This fires a pair of igniter capsules 38 contained in an igniter assembly comprising an outer metal perforated cage 42 and an igniter body 43 contained therein and which may be of boron and potassium nitrate. A seal 40 is provided to prevent any of the combustion products from passing out from the rear end of the firing mechanism 20.

Upon firing of the igniter capsules 38 by the primer 30, the igniter body 43 is fired and the combustion products thereof pass through the cage 42 and around the propellant charge 46 which is in the propellant chamber or section therewith. This ignites the propellant charge 46 which may be of a double base composition comprising nitrocellulose and nitroglycerin, or a composite propellant comprising an oxidizer such as ammonium nitrate or ammonium perchlorate plus a binder, is thereby ignited. It will be seen that the combustion products from the igniter not only pass through the open center 44 of the propellant body but also around the outside of the propellant body.

As the propellant burns at relatively high temperature and pressure, the resultant high-pressure gases pass through a relatively-thick body or field of charcoal 48 compressed or contained between two spaced baffle plates 50 on either side thereof at the forward end of the propellant section. The baffles 50 have a plurality of holes 52 therein which allow the gases to pass evenly through the charcoal body wherein an irreversible chemical reaction takes place. In this reaction, which occurs at the elevated temperatures within the charcoal field, water vapor decomposes and passes off with the gases as carbon monoxide and free hydrogen, thereby increasing the gas evolution rate. A fixed piston element 54 is provided adjacent the forward one of the baffles 52 and is provided with a central opening 53 communicating with an axially and forwardly extending gas-conducting or distribution tube 56 attached to the piston element. This is perforated or provided with a plurality of radial holes 58 along its length for allowing the gases to pass into an elongated body 60 of chemical coolant surrounding the tube. This coolant can be of ammonium carbamate, or preferably ammonium carbonate, and cools the gases which pass through down to a proper utilization temperature for an inflation device or the like. In addition, the gas evolution rate is increased by the decomposition of the coolant 60 to CO₂ and NH₃. An orifice or pressure disc 62 is provided at the forward end of the gas conducting tube 56. Said disc 62 has a pressure-control orifice 64 therein to allow the gases to pass therethru with a desired lower outlet pressure from the burning propellant 46. The piston 54 has a seal 66 which prevents any gas leakage around it from the charcoal area of the generator.

After the gases pass through the elongated coolant body or area 60 they enter a second field or body 68 containing a plurality of calcium chloride or magnesium carbonate crystals which cause any residual water vapor or water from the gases to be absorbed into the crystals. This is a dryer and provides a physical reaction as com-

3

pared with the chemical reaction which takes place when the hotter gases pass through the charcoal field or body 48. After passing through the calcium chloride or magnesium carbonate body 68 the gases then leave the exit or discharge means 12 through the outlet ports 14 and enter into the means to be inflated, the connection for which is indicated at 67 and attached to the end of the housing 10.

The gas generator thus described is of unitary construction and adapted to be contained in a single elongated cylindrical housing having firing and ignition means at one end and gas outlet means at the opposite end to which utilization means, such as an inflation device, may be connected or attached. Between the ignition means and the outlet means are provided a propellant or gas generating section in contact with the ignition means and a chemically reactant water-vapor-removing or eliminating section directly forwardly thereof comprising a body of charcoal material between perforated baffles through which the gases flow from the propellant flow forwardly.

A fixed piston element is provided in the housing at the forward end of the vapor removing section with a central opening therein. This is aligned and communicates with an axially and forwardly-extending gas distribution tube which is perforated along its length and surrounded by a body of coolant material through which gases flow from the tube. A pressure disc with a control orifice is interposed between the rearward end of the tube and the opening in the piston element to control the outlet pressure from the propellant section. Between the coolant and the outlet means is a second water reducing or removing means comprising a body of dryer material through which the outflowing gases must pass to absorb and remove any residual water vapor, so that the final gas output for inflation devices contains the maximum amount of non-condensable gas products.

We claim:

1. A gas generator including in combination, an elongated cylindrical housing having a closed rear end and an open forward end, means containing a body of dryer material within said forward end through which generated gas may flow outwardly, firing and ignition means for said generator connected with and contained in said rear end of the housing,
- a propellant body in said housing in contact with and adjacent to said firing and ignition means for gas generation in response to ignition,
- a body of water reducing material located axially along the interior of said housing for receiving the generated gas flow therethrough,
- a fixed piston element providing a barrier axially along and following said body of water reducing material and having a central opening for gas flow forwardly therethrough,
- a radially perforated gas distribution tube extending axially forward from and communicating with said piston opening,
- a pressure control disc interposed between said opening and said tube and having a pressure reducing orifice, and
- a body of chemical coolant surrounding said tube within the housing for receiving and cooling the gas flow from said tube and in contact with said body of dryer material for delivering the gas output therethrough.
2. A gas generator as defined in claim 1, wherein the firing and ignition means includes an igniter body of boron and potassium nitrate and contained in a perforated cage in contact with the propellant body.
3. A gas generator as defined in claim 1, wherein the body of water reducing material includes a field of charcoal supported by perforated baffles on both front and rear ends thereof.
4. A gas generator as defined in claim 1, wherein the

4

body of water reducing material is of charcoal pellets and the body of dryer material is of crystals containing calcium chloride and magnesium carbonate.

5. A propellant gas generator comprising in combination,

an elongated tubular casing, a firing mechanism including a primer and a movable firing pin therefor located at one end of said casing in connection therewith,

means providing a body of igniter material positioned within said housing to be fired by said primer,

a body of propellant gas generating material in contact with said igniter means to be fired thereby,

a fixed piston with a central opening therethrough providing a barrier across the interior of said housing forwardly of the body of propellant material,

a chemically-reactant body of material filling the interior of said housing between the body of propellant and said piston for removing water vapor and increasing the gas evolution rate, and through which the propellant gas flows to said piston opening,

perforated baffle means at opposite ends of said body of water-vapor-removing material for retaining said material in position,

a perforated axially-extending tube connected with said piston in alignment with said opening therein,

means providing a pressure control orifice between said opening and the interior of said tube,

an elongated body of chemical coolant surrounding said tube within said housing for receiving the gas outflow through said tube and effecting a cooling action thereon,

means providing a gas outlet at the opposite end of said housing from said firing mechanism and adapted for connecting a utilization device, and

a physically-reactant water-vapor-removing body of material positioned between said outlet means and said body of coolant material for receiving and treating the gas flow from said coolant body to said outlet means,

6. A propellant gas generator as defined in claim 5, wherein the chemically reactant water-vapor-removing body comprises charcoal pellets compacted between said baffles, and wherein the physically reactant water-vapor-removing body comprises a class of materials including calcium chloride and magnesium carbonate in crystal form.

7. A propellant gas generator comprising in combination,

an elongated tubular casing having firing and ignition means at a rearward end thereof and having gas outlet and connection means for a utilization device at the opposite and forward end thereof,

means providing a propellant section for the generation of gas within said housing in association with said firing and ignition means,

means providing an elongated gas coolant section adjacent the forward end of said housing,

a fixed piston element having central gas conducting opening therethrough positioned between said sections within said housing,

a perforated gas conducting tube connected with said piston element and communicating with said opening, said tube extending axially through said coolant section,

means providing a first water-vapor-removing section between said propellant section and said piston element and which additionally effects an increase with gas evolution rate, and

means providing a second water-vapor-removing section between said coolant section and the outlet means,

8. A propellant gas generator as defined in claim 7 wherein the first water-vapor-removing section includes a body of charcoal pellets, and wherein the second water-

vapor-removing section includes a dryer material comprising calcium chloride and magnesium carbonate in crystal form.

References Cited

UNITED STATES PATENTS

2,779,281 1/1957 Maurice et al. ----- 102—39
2,816,419 12/1957 Mueller ----- 23—281X

3,305,319 2/1967 Kowalick et al. ----- 23—281
3,458,288 7/1969 Lafyatis et al. ----- 23—282

JAMES H. TAYMAN, Jr., Primary Examiner

U.S. Cl. X.R.

5

60—39.82, 39.47; 102—39, 103