GAS GENERATOR AND CARTRIDGE THEREFOR

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References Cited
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3,481,149 12/1969 Crane.......................... 62/45

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ABSTRACT

The gas generator includes a heat responsive means which communicates the reaction chamber with the liquified gas in the reservoir in order to pressurize and to flush out the liquified gas from the reservoir as well as a pressure responsive means which communicates the reaction chamber with the aspirating chamber in order to mix the reactive gases of the reaction chamber with the vaporized gas. The cartridge is insertable as a unit into the gas generator housing so as to be readily assembled and replaced.

21 Claims, 1 Drawing Figure
GAS GENERATOR AND CARTRIDGE THEREFOR

This invention relates to a gas generator and a cartridge therefor. More particularly, this invention relates to a gas generator for producing and delivering a gas from a stored liquefied gas and a self-contained reaction chamber cartridge for gas generators.

Hereinafter, various gas generators have been known in which a liquefied gas such as carbon dioxide or Freon have been maintained in a liquefied state in a reservoir for subsequent vaporization into a gas. In order to provide sufficient heat for vaporization of the liquefied gas, various combustible charges have been located within the gas generator in proximity to the reservoir of liquefied gas so as to generate a quantity of heat upon ignition which can be used to heat up the liquefied gas to a vaporized state. For example, as described in U.S. Pat. No. 3,481,149, a gas generator has been known in which a device containing a reactive charge of material and defining an axial passage extending concentrically of the charge has been mounted within a reservoir of liquefied gas so that upon ignition of the charge, sufficient heat is produced to cause a heat exchange between the liquefied gas flowing through the central passage and the reacted charge.

The various gas generators which have been previously used, particularly those which are portable, have found wide utility, for example, in the inflation of flotation equipment, such as life rafts or jackets, and safety convenience equipment such as inflatable slides, pads or mattresses. However, despite such wide usage, these previous gas generators have had certain inherent deficiencies. For example, one of the deficiencies has been that the working fluid has been overheated before being expelled from the gas generator. Another deficiency has been that the working fluid has been inadequately mixed with the hot gases which have been generated by the reactive mixtures used in the gas generators. Also, in the case of Freon, the Freon has frequent decomposed so as to form corrosive substances. These various deficiencies have resulted in the burning, weakening, porosity and other damage to the inflatable devices with which they have been used.

Accordingly, it is an object of this invention to provide a gas generator which prevents the overheating of a working fluid. It is another object of the invention to mix the working fluid of a gas generator with the generated hot gases of a combustible charge within the gas generator. It is another object of the invention to provide a gas generator which prevents the decomposition of a Freon working fluid within a gas generator. It is another object of the invention to reduce the possibility of damage to an inflatable device from a gas generator. It is another object of the invention to prevent the damage of an inflatable device from the inflating gases of a gas generator.

Briefly, the gas generator of the invention has a housing which defines a reservoir for containing a liquefied gas, means within the housing defining a reaction chamber for a heat generating means, a passage means which extends through the reaction chamber to conduct a liquefied gas from the reservoir in heat exchange relation with the heat generating means in the reaction chamber for vaporization of the liquefied gas, and a heat responsive means between the reaction chamber and the reservoir for venting the reaction chamber to the reservoir in response to the generation of a predetermined temperature in the reaction chamber. In addition, the gas generator includes a pressure responsive means for communicating the reaction chamber with the aspirating section of the reservoir in response to the existence of a predetermined pressure differential between the reaction chamber and the aspirating section of the reservoir.

The housing which defines the reservoir is of any suitable material such as metal in order to contain a liquefied gas under pressure and includes an aspirating or mixing chamber at an outlet end wherein the vaporized gas and hot gases of combustion can mix together prior to passing out of a discharge port in the housing. In addition, the housing is provided with a suitable fitting so as to be charged with a liquefied gas, such as carbon dioxide, Freon or other suitable liquefied gas.

The means defining the reaction chamber is constructed in the form of a cartridge which can be placed within the housing as a self-contained unit and which can be replaced at suitable intervals. The cartridge includes a casement means, for example, of cylindrical shape which defines at least one reaction chamber, for example, of annular or compartmentalized structure, in which a suitable heat generating means is contained. The heat generating means may be in any suitable form, such as, a solid chemical cartridge of pellet form, a liquid phase combustible product, a fuel grain powder or any other suitable material. The cartridge further has an axially extending central passage which is separated from the reaction chamber, for example, by a heat exchange tube secured to the casing so as to define the heat exchange passage.

The heat responsive means is secured in a wall of the casement means of the cartridge for venting the reaction chamber to the exterior of the casement means in response to the generation of a predetermined temperature in the reaction chamber due to the combustion of the heat generating means. For example, the heat responsive means is in the form of a nozzle which has a fusible plug disposed across the opening of the nozzle. The fusible plug is made of a material which melts upon being subjected to a predetermined temperature from the hot gases produced within the reaction chamber so that the opening of the nozzle is exposed to the passage of the hot gases. The temperature responsive means can also be formed of fusible plugs which are softened by the heat generated within the reaction chamber and which are ejected due to a predetermined pressure differential between the reaction chamber and the reservoir.

The pressure responsive means is also secured in the casement means of the cartridge and includes a passage between the reaction chamber and the aspirating chambers at the exterior of the cartridge and a pressure responsive disc which is disposed across the passage in sealed relation. The disc is constructed so as to be ruptured upon the existence of a predetermined pressure differential between the reaction chamber and the aspirating chamber. In this way, the hot reactive gas can be mixed with the vaporized gas so as to be diluted prior to passage out of the generator.
The cartridge is further provided with a trap between the reaction chamber and the pressure responsive means so as to trap solid particulate particles from passing from the reaction chamber to the pressure responsive means with the hot gases generated within the reaction chamber. In addition, the cartridge can include a filler valve which communicates with the reaction chamber for introducing pressurized gas such as a gas mixture of oxygen, an inert gas and hydrocarbon gas into the reaction chamber.

The housing and cartridge of the generator are constructed so that the cartridge can be inserted into the housing and fixed therein in any suitable manner. For example, the housing is formed of two parts, one of which defines the reservoir proper for the liquified gas and includes an outwardly extending neck and another of which fits into the neck and defines the aspirating chamber. The cartridge, in turn, is provided with a shoulder at one end which projects from the contour of the cartridge so as to seat against a corresponding shoulder or ledge within the neck of the housing while the base of the cartridge seats on a floor of the housing. The part of the housing which defines the aspirating chamber is secured over the shoulder of the cartridge within the neck of the housing so as to secure the cartridge in place.

In order to ignite the heat generating means within the cartridge, a suitable ignition means is mounted in the housing of the gas generator to communicate with the reaction chamber. In one embodiment, the ignition means is in the form of a flame jet ignitor which includes a retaining pin which secures a firing pin in set position, a spring which is compressed when the firing pin is in the set position and which expels the firing pin against a percussion cap of an explosive cartridge when the retaining pin is released. The explosive cartridge is used to produce a flame jet which can be directed into the reaction chamber for igniting the heat generating means. In order to preserve the sealed integrity of the cartridge when used with such an ignition means, a suitable fitting is mounted in the cartridge with a disc sealed across a passageway therethrough. When the flame jet of the ignitor assembly is created, the heat of the jet is used to rupture the disc so as to permit passage of the flame jet into the reaction chamber. In another embodiment, a friction ignitor can be utilized for the ignition means.

The heat generating means within the reaction chamber can be formed of any suitable reactive materials which are activated, for example, by friction heating, sparking, or percussion. For example, the heat generating means can be in the form of chemically reactive materials which produce an exothermic reaction. Such a reaction can be achieved by igniting a fuel grain powder containing sulfur, carbon, potassium nitrate and derivatives of cyclo ammonium naphthalene in various proportions.

In order to maintain the gas generator in a sealed condition prior to use, a closure disc is mounted over the discharge port of the housing in sealed relation. This closure disc can be sealed in place, for example, by a hose connector which adapts the gas generator to a suitable valve on an inflatable device. In order to open the gas generator, the closure disc is made of a material such as a heat-rupturable, a pressure-rupturable or a mechanically-rupturable material. In one embodiment, the closure disc can be ruptured at the same time as the heat generating means is activated in the reaction chamber while in another embodiment the closure disc can be ruptured after activation of the heat generating means. For example, the closure disc can be ruptured by the heat or pressure of the hot gases which are produced in the reaction chamber after the gases have passed through the pressure responsive means between the reaction chamber and the aspirating chamber. In still another embodiment, the closure discs can be ruptured by a suitable mechanical device such as a cable membrane tearing mechanism which embodies a scored closure disc, a hardened tear ring, a pull ring connected to the tear ring and a cable secured to the pull ring. The closure disc can also be weakened by hot gases alone or in conjunction with an exothermic reaction of chemicals situated on the surface of the disc to permit the liquified gas contained in the reservoir to escape through the discharge port.

Where an explosive shock is used to fracture the rupture disc within a fitting leading to the reaction chamber, the shock can also be used to impinge upon the closure disc across the discharge port to rupture the closure disc. In use, once the heat generating means has been ignited by the particular ignition means used with the gas generator, heat is given off from the reaction chamber through the heat exchange tube to the liquified gas in the heat exchange passage. The liquified gas thus becomes heated to a vaporized state and passes out of the discharge port of the generator once the closure disc has been fractured. As this process continues, the fusible plugs of the heat responsive means melts and allow venting of the hot gases in the reaction chamber to the reservoir upstream of the heat exchange passage. This pressurizes the liquified gas in the reservoir to expel and flush the liquified gas from the reservoir. As a result, the gas which leaves the gas generator is a cool gas.

As the operation of the gas generator continues, the pressure generated within the reaction chamber by the hot gases therein causes the occurrence of a pressure differential across the discs of the pressure responsive means sufficient to rupture the discs. Upon rupture of these discs, the reaction chamber gases are vented to the aspirating chamber where they are mixed with the vaporized gas so that the hot gases are diluted to an extent sufficient to prevent a concentration of the hot gases in the device being supplied with the gas of the generator.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawing in which:

The drawing illustrates a cross-sectional view of a gas generator constructed in accordance with the invention.

Referring to the drawing, the gas generator 10 includes a housing 11 formed of two parts 12, 13. The lower part 12, as viewed, is of bulbous construction with an upstanding neck 14 and defines a reservoir therein for containing a liquified gas 15 such as carbon dioxide or Freon therein while the upper part 13 is of generally cylindrical shape with a conical upper portion.
so as to define an aspirating and mixing chamber 16 and a discharge port 17. In order to secure the two parts 12, 13 together, each is provided with mating threads 18, 19 along suitable surfaces. In addition, a seal ring 20 is sealingly seated between the two parts 12, 13 so as to prevent leakage past the thread surfaces. Also, in order to seal the discharge port 17, a closure disc 21 is disposed across the mouth of the port 17 and is held in place, for example, by a hose connector 22 suitable for attachment to a gas utilization device (not shown). The hose connector 22 is secured, as by threading, to the exterior surface of the upper housing part 13. The closure disc 21 is made of any suitable material which can be ruptured or fractured, for example, by heat, pressure, chemical or mechanical means. For example, the closure disc 21 can be provided with a heat responsive coating on the inside surface so as to rupture in response to a predetermined temperature in the aspirating chamber 16. Also, the closure disc 21 can be pressure sensitive so as to fracture when the pressure within the chamber 16 reaches a predetermined level or the disc may be fractured physically by a suitable tool. In order to withstand the pressure and temperature to which the housing 11 will be subjected and also to provide a safety factor which will prevent any undesired release of liquefied gas, the housing parts 12, 13 are formed of a suitable metallic material. Also, either of the housing parts 12, 13 is provided with a suitable valve, as is known, to charge the liquefied gas into the housing 11.

A cartridge 23 which provides a self-contained reaction assembly is removably disposed within the interior of the housing 11 and is of generally cylindrical contour to slide through the neck 14 of the lower part 12 of the housing 11. This cartridge 23 is formed of a cylindrical casement means 24 such as a shell of hollow construction, a pair of shouldered discharge plugs 25, 26 which are threadably secured in the opposite ends of the shell 24 and a heat exchange tube 27 which extends concentrically within the cylindrical shell 24. The shell 24 and heat exchange tube 27 are mounted in spaced relation to each other so as to define a reaction chamber 28 of annular shape. The reaction chamber 28 can also be compartmentalized by suitable partition walls (not shown) so as to define a plurality of individual compartments.

The cartridge 23 also contains a plurality of heat generating means 29, such as cartridge or pellets of chemically reactive exothermic materials such as a fuel grain powder 29', within the reaction chamber 28. In addition, the shell 24 has an integral annular wall 30 thereon which extends radially inwardly into sealed relation with the heat exchange tube 27 so as to segregate the reactive materials 29' in the reaction chamber 28 from the upper discharge plug 25. This wall 30 includes a tortuous passage 31 therethrough which serves as a baffle to trap solid particulate particles from passing from the reactor chamber 28 to the upper plug 25. In this instance, the baffle utilizes the greater momentum of the solid particles to prevent them from following the path of the gases generated by the reactive materials 29' and to cause them to deposit on the baffle surfaces.

The wall 30 also includes one or more sockets 32 into which a reactive material cartridge 29 is fitted as well as a passage 33 which communicates the socket 32 with the opposite side of the wall 30.

The shell 24 also has one or more heat responsive means 34 corresponding, for example, to the number of reactive material cartridges 29 disposed in the outer wall. Each heat responsive means 34 is formed of a fusible plug nozzle, as is known, which includes a nozzle having a passage therethrough to communicate the reaction chamber 28 with the reservoir of liquefied gas 15 and a fusible plug which is disposed in sealing relation across the nozzle passage. The fusible plug is of a heat responsive material which melts at a predetermined temperature for example, in the range of 200° to 1,200° F so as to open the nozzle passageway and vent the reaction chamber 28 to the reservoir of gas 15.

The discharge plugs 25, 26 which are secured in the shell 24 also receive the ends of the heat exchange tube 27 within recessed portions 35 in a snug fit relation while sealing rings 36 are positioned within suitable grooves 37 to seal the tube 27 to the plugs 25, 26 against leakage.

In addition, the upper discharge plug 25 is provided with at least one pressure responsive means 38 for each reactive material cartridge 29 in order to communicate the reaction chamber 28 with the aspirating chamber 16 in response to a predetermined pressure differential therebetween. Each pressure responsive means 38 is constructed of a centrally apertured fitting 39 which is threadably secured into a counterbored aperture 40 in the plug 25 and a rupture disc 41 which is located within the aperture 40 between a shoulder of the aperture 40 and the fitting 39. The rupture disc 41 thus serves to seal the passage between the aperture 40 of the plug 25 and the aperture 42 of the fitting 39. In addition, the rupture disc 41 is formed of a material of a suitable strength so as to be ruptured under the existence of a predetermined pressure differential across the disc 41, for example, a pressure in the range of 25 psig to 1,800 psig.

The upper discharge plug 25 is also provided with a fitting 43 similar to the other fittings 39 which includes a rupture disc 44 disposed within a counterbore 45 of the plug 25 and which is threaded into the bore 45 to secure the disc 44 in place. However, this fitting 43 is elongated to extend upwardly from the plug 25 to communicate with an ignition assembly 46. The bore 45 is further positioned directly in alignment with the passage 33 in the baffle wall 30 of the shell 24.

The upper discharge plug 25 is also formed with an annular shoulder 47 which projects from the remainder of the plug 25 and rests upon a ledge 48 on the internal surface of the lower housing part 12. In addition, the upper housing part 13 is abutted against the shoulder 47 of the plug 25 so as to clamp the plug 25 between the two parts 12, 13 of the housing 11. A suitable sealing ring 49 is also disposed in a groove 50 between the ledge 48 and the annular shoulder 47 of the plug 25.

The lower discharge plug 26 is formed with a depending collar-like extension 51 which is suitably apertured to permit passage of the liquefied gas therethrough into the heat exchange tube 27. In addition, the floor 52 of the lower housing part 12 is provided with a plurality of thrust stops 52', for example, three, so as to center the plug extension 51 and, in turn, the cartridge 23 therein. Also, a filler valve 53 of
known construction is secured within the discharge plug 26 to communicate with the reaction chamber 28 so as to introduce a pressurized gas therein. The ignition assembly 46 is provided with a hollow stem 54 which is threadably mounted through a threaded bore 55 within the upper housing part 13 and which is slidably disposed within the fitting 43 with a seal ring 56 therebetween. The stem 54 includes a passage 57 therein which communicates with the bore in the fitting 43. In addition, the ignition assembly 46 includes a retaining pin 58 which is removably mounted within a firing pin guide 63 and a hole in a firing pin 59 which is held in its retracted position by the retaining pin 58 and a spring 60 which biases the firing pin 59 in a direction towards a percussion cap 61 of a shell type explosive cartridge 62 located within the stem 54.

In order to assemble the gas generator 10, the solid chemical cartridges 29 are first placed in the reaction chamber 28 with the bottom plug 26 removed. After loading, the bottom plug 26 is threadably engaged in the cylindrical shell 24 and the reaction chamber 28 is pressurized with gas such as a mixture of oxygen, inert gas and hydrocarbon gas, through the filler valve 53. The cartridge 23 is then inserted into the lower housing part 12 through the neck 14 so that the shoulder 47 of the cartridge plug 25 rests on the ledge 48 adjacent the neck 14 of the housing 11 while the bottom plug extension slides within the thrust stops 52' onto the floor 52 of the housing 11. The upper housing part is then threadably engaged in the internally threaded neck of the lower housing part 12 through the neck 14 so that the shoulder 47 of the cartridge plug 25 rests on the ledge 48 adjacent the neck 14 of the housing 11 while the bottom plug extension slides within the thrust stops 52' onto the floor 52 of the housing 11. The upper housing part to which the ignition assembly has been previously attached is then threadably engaged in the internally threaded neck of the lower housing part 12 so as to clamp the cartridge 23 in position. Thereafter, the closure disc 22 is secured in place so as to seal off the interior of the gas generator 10. Alternatively, the upper housing part 13 can be provided with the closure disc 21 prior to threaded engagement with the lower housing part 12. Finally, the reservoir is suitably charged with a liquefied gas.

In use, in order to initiate the vaporization of the reservoir of liquefied gas, the retainer pin 58 of the ignition assembly 46 is manually removed so that the firing pin 59 is released to impinge against the percussion cap 61. The explosive cartridge 62 then produces a shock wave which ruptures the disc 44 located within the fitting 43 so that the hot gases which are generated by the explosive cartridge 62 and pass through the stem 54, bore 45 and passage 33 cause the burning of a gaseous mixture and the ignition of the solid chemical cartridges 29 in the reaction chamber 28. In addition, the shock generated by the explosive cartridge 62 can also be used to fracture the rupture discs 41 in the pressure responsive means 38 so as to permit the hot gases to impinge upon the closure disc 21. The weakening of the closure disc 21 by the hot gases alone or in conjunction with the exothermic reaction of a chemical coating on the surface of the disc 21 allows the liquefied gas contained in the reservoir to escape to the discharge port 17.

Alternatively, the exothermic reaction can be initiated by means of a friction ignitor which consists of flint, abrasive and fuse materials which are activated by physical means. Alternate means of opening the closure disc are suitable for some applications and consist of a cable membrane tearing mechanism which embodies a scored closure disc, a hardened tear ring and an attached pull ring connected to a cable.

Once the chemical reaction takes place, the heat generated within the reaction chamber 28 heats the wall of the heat exchanger tube 27 and results in the vaporization of the liquefied gas passing through the tube 27 and escaping through the discharge port 17 past the fractured closure disc 21. Heat is thus applied in the region where the gas exits from the reservoir. As the reaction proceeds, the heat generated in the reaction chamber 28 by the exothermic reaction softens the fusible plugs in the nozzles of the heat responsive means 34 causing the plugs to be melted and ejected therefrom. This allows the hot gases from the reaction chamber 28 to enter the reservoir 15 and force the liquefied gas to discharge through the heat exchange tube 27.

Since gaseous reaction products are also generated within the reaction chamber 28, a positive pressure also develops during use. Thus, when the pressure differential across the rupture disc 41 in each pressure responsive means 38 becomes great enough, the disc 41 is fractured and the gaseous reaction products enter the aspirating chamber 16 and mix with the exiting working fluid. As the gaseous reaction products of the reaction chamber 28 pass through the baffle passage 31, the solid particles are trapped. The baffle also serves as a heat shield to prevent excessive heat from reaching the disc material prior to being fractured by pressurization. That is, overheating is avoided by preventing direct impingement of radiant heat from luminous reacting material on the disc material and by decreasing the rate of convective heat transfer to the disc material by restricting the passage through which the hot gases must be transported.

The invention further provides a gas generator in which the liquid gas can be ejected and flushed under a positive pressure from the reservoir so as to provide a more efficient use of the gas generator.

In addition, the invention provides a gas generator which efficiently mixes the hot gases produced in the exothermic reaction of a heat generating means with the working fluid within the gas generator. This prevents the inflated device from being detrimentally influenced by a concentration of the hot gases from the reaction chamber.

What is claimed is:

1. In a gas generator having a reservoir for a liquefied gas, a reaction chamber within said reservoir for housing a heat generating means in sealed relation to said reservoir, and a passage means extending through said reaction chamber and communicating at each of the ends thereof with said reservoir to conduct a liquefied gas therethrough in heat exchange relation with a heat generating means in said reaction chamber for vaporization of the liquefied gas upon activation of the heat generating means in said reaction chamber, heat responsive means for venting said reaction chamber to said reservoir upstream of said passage means in response to a predetermined temperature
condition in said reaction chamber subsequent to activation of the heat generating means in said reaction chamber to deliver a heated gaseous mixture from said reaction chamber to said reservoir.

2. In a gas generator as set forth in claim 1 wherein said heat responsive means includes at least one nozzle having a fusible plug therein wherein said plug is melted in response to said predetermined temperature condition to cause said nozzle to communicate said reaction chamber with said reservoir.

3. In a gas generator as set forth in claim 1 wherein further includes a pressure responsive means for communicating said reaction chamber with said reservoir downstream of said passage means in response to a predetermined pressure differential between said reservoir and said reaction chamber.

4. In a gas generator as set forth in claim 3 wherein said pressure responsive means includes a passageway between said reservoir and said reaction chamber and a rupture disc sealingly disposed within said passageway, said disc being rupturable in response to said pressure differential.

5. A gas generator comprising a housing defining a reservoir therein for a liquefied gas; first means within said housing including a hollow cylindrical shell and a heat exchange tube defining a reaction chamber for a heat generating means, said reaction chamber being sealed from said reservoir; a passage means extending through said reaction chamber and communicating at the ends thereof with said reservoir for conducting a liquefied gas therethrough in heat exchange relation with a heat generating means in said reaction chamber for vaporization of the liquefied gas; and a heat responsive means mounted in said shell between said reaction chamber and said reservoir for venting said reaction chamber to said reservoir in response to the generation of a predetermined temperature in said reaction chamber.

6. A gas generator as set forth in claim 5 which further comprises pressure responsive means between said reaction chamber and said reservoir for communicating said reaction chamber with said reservoir in response to the existence of a predetermined pressure differential between said reaction chamber and said reservoir.

7. A gas generator as set forth in claim 6 wherein said heat responsive means communicates said reaction chamber with said reservoir upstream of said passage means and said pressure responsive means communicates said reaction chamber with said reservoir downstream of said passage means.

8. A gas generator as set forth in claim 6 which further comprises a trap located between said pressure responsive means and said reaction chamber for trapping solid particulate particles from passing from said reaction chamber to said pressure responsive means.

9. A gas generator as set forth in claim 5 which further comprises ignition means for activating the heat generating means within said reaction chamber to produce heat.

10. A gas generator as set forth in claim 5 which further comprises the heat generating means in the form of a fuel grain powder within said reaction chamber.

11. A gas generator as set forth in claim 5 wherein said housing further defines an aspirating chamber at one end in communication with said reservoir for conducting vaporized gas therethrough out of said housing.

12. A gas generator as set forth in claim 5 which further comprises a discharge port at one end of said housing, a connector secured to said housing at said discharge port and a closure disc mounted between said housing and connector in sealed relation across said discharge port.

13. A gas generator comprising a housing defining a reservoir therein for a liquefied gas and a chamber at one end for aspirating a vaporized gas therefrom; a hollow cylindrical shell and a heat exchange tube defining a reaction chamber for a heat generating means within said housing in sealed relation thereto; a passage means extending concentrically through said heat exchange tube and communicating at one end with said reservoir and at an opposite end with said chamber for conducting a liquefied gas therethrough in heat exchange relation with a heat generating means in said reaction chamber for vaporization of the liquefied gas; and a pressure responsive means mounted in said shell and said heat exchange tube between said reaction chamber and said aspirating chamber for communicating said reaction chamber with said aspirating chamber in response to the existence of a predetermined pressure differential between said chambers.

14. A cartridge for a gas generator comprising a casement means defining at least one reaction chamber and a heat generating means received therein; a heat responsive means secured in said casement means for venting said reaction chamber to the exterior of said casement means in response to the generation of a predetermined temperature in said reaction chamber; and a pressure responsive means secured in said casement means for communicating said reaction chamber with the exterior of said casement means in response to the existence of a predetermined pressure differential thereacross.

15. A cartridge as set forth in claim 14 which further comprises a baffle between said pressure responsive means and said reaction chamber for trapping solid particulate particles from passing from said reaction chamber to said pressure responsive means.

16. A cartridge as set forth in claim 14 which further comprises a valve fitting in said casement for injecting pressurized gas into said reaction chamber.

17. A cartridge as set forth in claim 14 wherein said heat responsive means includes at least one nozzle having a fusible plug therein communicating with said reaction chamber.

18. A cartridge as set forth in claim 14 wherein said pressure responsive means includes a passageway between said reaction chamber and said exterior of said
11. A casement and a rupture disc sealingly disposed across said passageway, said disc being rupturable in response to said predetermined pressure differential.

19. A cartridge as set forth in claim 14 wherein said casement is cylindrical in shape and defines a central axial passage and said reaction chamber is of annular cross-section and surrounds said axial passage.

20. A cartridge as set forth in claim 14 which further comprises a plug removably secured to said casement at one end thereof for closing said reaction chamber to the exterior of said casement.

21. A cartridge as set forth in claim 20 which further comprises a valve fitting in said plug for injecting pressurized gas into said reaction chamber.

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