Oct. 20, 1959 R. P. CRIST 2,909,119

HYDROGEN GAS GENERATOR

Filed July 15, 1955

FIG. 1.

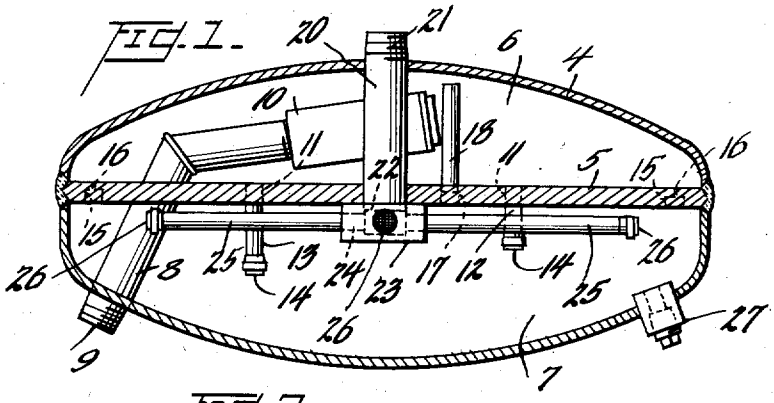


FIG. 2.

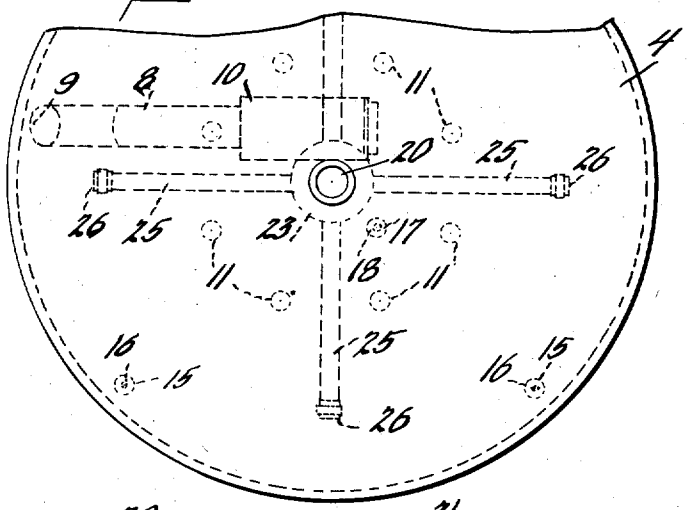
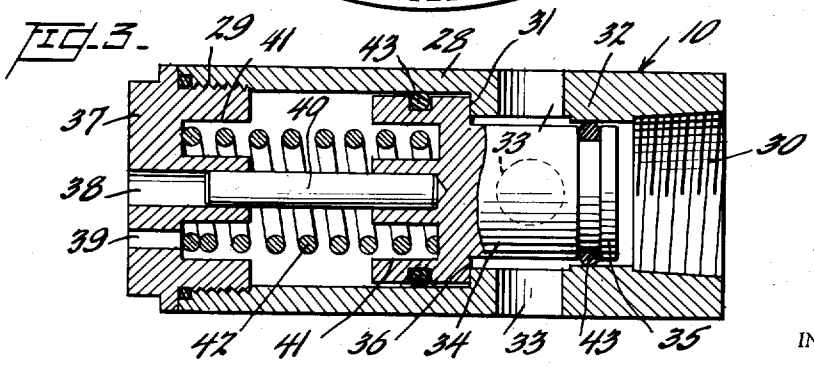


FIG. 3.



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HYDROGEN GAS GENERATOR

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9 Claims. (Cl. 102—14)

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to a gas generator and more particularly to a compact hydrogen gas generator for use in combination with a submarine launched moored mine for making the mine buoyant in water.

Heretofore submarine launched moored mines were made buoyant by sealing off a section of the mine housing. As the mines were necessarily weighty, the sealed section had to be large to make them buoyant and as a consequence, the mine housings were large. Further such mines had to carry their own water supply whereby the chemicals therein were actuated to make the mines buoyant. This feature was disadvantageous because a large space was required to contain water and chemicals in addition to the sealed section.

The present invention is a hydrogen gas generator which is compact and which will permit the use of a shorter mine housing. It is designed as a component of buoyancy mechanism of a submarine launched mine and comprises a container divided into two compartments by means of a partition. The upper compartment communicates with the exterior of the container through a check valve designed and arranged to admit a predetermined amount of water into the interior of the container and to prevent the escape of generated gases. The lower compartment contains lithium hydride which upon contact with water liberates hydrogen gas. The partition between the upper and lower compartments is provided with openings for the passage of water from the upper to the lower compartments as well as for the equalization of pressure between said compartments. A conduit communicates with the lower compartment to transport the liberated gas to the mine casing to give the mine a predetermined buoyancy.

An object of the present invention is to provide a gas generator which is a component of a buoyancy mechanism for a submarine launched mine.

Another object is to provide a hydrogen gas generator which does not require its own water supply.

A further object of this invention is to provide a gas generator which is compact and is capable of generating 10 cubic feet of gas at 600 pounds per square inch.

Another object of this invention is to provide a generator capable of operating satisfactorily when held in many different positions.

Still another object of the invention is to provide a valve for use with the gas generator which will quickly flood the water compartment at pressures ranging from 40 to 600 pounds per square inch and then act as a seal for hydrogen gas at pressures as high as 600 pounds per square inch.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following

detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a vertical cross-sectional view of the gas generator;

Fig. 2 is a fragmentary plan view of the hydrogen gas generator; and

Fig. 3 is a cross-sectional view of the check valve used in the gas generator.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in Figs. 1 and 2, which illustrate a preferred embodiment, a casing 4 of welded construction adapted to form a streamlined assembly with a mine casing (not shown). The casing 4 is divided by a partition 5 into an upper compartment 6 and lower compartment 7. Secured to the casing 4 and the partition 5 is a conduit 8 having an inlet 9 adapted to admit sea water into the upper compartment 6 through a check valve 10 after the mine has been launched. The inlet 9 of the conduit 8 may be provided with any well known trigger mechanism actuated upon the mine being launched from a submarine or may be stoppered by any well-known compound quickly dissolvable in sea water to thereby admit water into the upper compartment.

The partition contains openings 11, eight in number in the preferred embodiment, into which are threaded water inlet pipes 12 and 13 of different lengths alternately disposed around the circle of openings 11. The difference in lengths of these pipes is to insure that the water will be evenly distributed throughout a chemical substantially filling the lower compartment 7. The openings of these pipes 12 and 13 are covered by screens 14 to prevent any foreign matter from getting into the chemical compartment 7.

The partition 5 also has screened pressure equalizing openings 15, four in number in the preferred embodiment, having a restricted portion 16 whereby a portion of the gas generated may flow up into the water compartment to thereby equalize the pressures and allow water to continue to flow from the upper compartment 6 into the lower compartment 7. A further opening 17 similar to openings 15 has an equalizing pipe 18 affixed thereto. This equalizing pipe 18 is adapted along with openings 15 to equalize pressures rapidly when the gas generator is in the vertical position shown by allowing gas to enter compartment 6 above the initial water level. Should the device be displaced from the vertical position shown, the pressure equalizing openings 15 will function as rapid equalizing orifices depending on which quadrant with respect to the vertical position the generator is listing, an opening 15 being provided in each quadrant.

Centrally disposed of the partition 5 is an exhaust conduit 20 adapted to be secured as by threads 21 to a mine housing so that gases generated in chemical compartment 7 will flow through the conduit 20 into the mine to thereby make the mine buoyant. An inlet 22, in the conduit 20, is secured to a circular block 23 having four openings 24. Through these openings in block 23 are threaded pipes 25 at right angles having screened ends 26 for carrying the generated gas into the exhaust conduit 20 and to the mine casing. It is obvious that any number of pipes 25 may be used to carry the gas to the conduit 20. A plug 27 in the casing 4 permits the insertion of chemicals into compartment 7.

Threadedly affixed to the outlet of conduit 8 in the upper compartment 6 is the check valve 10 which is designed to admit a predetermined amount of water into the upper compartment 6 and to prevent generated gases from escaping backwardly through conduit 8.

Referring now to Fig. 3, the check valve comprises

a hollow cylindrical housing **28** having internally threaded end sections **29** and **30**, the latter being adapted to threadedly engage conduit **8**. The internal bore of the housing has a shoulder **31** intermediate the end sections that forms a thickened portion **32** extending toward end section **30**. A plurality of radial ports **33** at right angles to each other are provided in portion **32**. A piston **34**, with its head **35** facing end section **30**, is mounted within portion **32** of the housing for controlling the opening of ports **33** and has a step **36** formed thereon which cooperates with the shoulder **31** to limit longitudinal motion of the piston.

Threaded into end section **29** is a cap **37** having a central bore **38** coincident with the longitudinal axis of the housing **28** and having a vent opening **39** displaced from the longitudinal axis of the housing. A piston rod **40** secured to the rear of the piston **34** is adapted to slide within the bore **38** of the cap **37** upon actuation of the piston. The end portion of the cap **37** within the housing and the back end of the piston **40** have formed therein annuli **41** which receive a spring **42** biasing the piston toward the end section **30**. A plurality of O-rings **43** are provided on the piston to render the piston fluid-tight whereby both gas and water are prevented from leaking past the piston.

In operation, upon release of the mine and gas generator assembly, water will flow into conduit **8** and hydrostatic pressure will force piston **34** toward end section **29**. The air in the housing escapes out of vent **39**. This movement of the piston toward end **29** of the housing opens ports **33** so that water flows into and floods compartment **6** until the force due to the spring constant exceeds the differential pressures on the piston and closes ports **33**. In the preferred embodiment, the spring constant was such that the valve closed when the pressure within the generator was approximately **35** pounds per square inch less than the external pressure. The water admitted into compartments **6** drops through openings **11** into compartment **7** which in the preferred embodiment is partially filled with nine pounds of granular lithium hydride (18–30 U.S. standard mesh).

The water reacts with the lithium hydride and causes hydrogen gas to be liberated. A portion of the gas generated flows up through equalizing pipe **18** and/or openings **15** to equalize pressures on both sides of the partition **5** so that water will continue to drop into compartment **7**. The major portion of the gas generated flows through pipes **25** into exhaust conduit **20** and into the mine housing to provide the buoyancy necessary to float the mine into position. The pressure built up in the generator housing also acts upon the rear of piston **34** through vent **39** and upon rod **40** to force the piston step **36** tightly against shoulder **31** to thereby prevent the escape of gas past the piston **34**. The generator described is capable of operating in any position except the position with the exhaust conduit **20** down. In the preferred embodiment, the generator delivered 10 cubic feet of gas at 600 pounds per square inch.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In combination with a mine housing, a gas generator comprising a closed casing partitioned into an upper and lower compartment, pressure-controlled means for admitting water into said upper compartment, a chemical disposed in said lower compartment, a plurality of openings in said partition for permitting water to flow from the upper compartment into said lower compartment whereby the water will react with the chemical to produce a gas, a plurality of pressure equalizing ports in said partition, and means for directly conveying the liberated gas from the lower compartment out of said casing and into said mine housing.

2. In combination with a submarine launched moored mine housing, a gas generator forming with said mine housing a streamlined assembly, said generator comprising a closed casing having a water compartment and a gas-generating compartment, a water-flow connection between said compartments, water inlet means to said water compartment, a chemical in said gas-generating compartment, a pressure-controlled check valve in said water inlet means for admitting sea water into said water compartment, said water flowing from said water compartment into said gas-generating compartment and reacting with said chemical to produce a gas, and gas outlet means from said casing for conveying the gas out of said casing and to said mine housing.

3. A device as described in claim 2 wherein said check valve comprises a housing having a water inlet and a plurality of water outlets, a piston within said housing, a spring normally biasing said piston to prevent communication between said inlet and outlets, said piston being actuated by water pressure to permit passage of water between said inlet and outlets, and means responsive to the pressure of the generated gas within said container for sealing the escape of gas from said housing.

4. A buoyancy component of a submarine launched moored mine comprising a closed container, a partition separating said container into an upper compartment and a lower compartment, a water reacting chemical in said lower compartment, pressure-controlled means for admitting water into said upper compartment, said partition having a plurality of dispersed openings for permitting water to flow from the upper compartment into the lower compartment, said partition having a plurality of orifices for equalizing the pressures in said compartments, a plurality of gas outlet means in said lower compartment, and means connected to said gas outlet means for conveying the generated gas out of said container.

5. A device as described in claim 4 wherein said chemical is lithium hydride and said gas is hydrogen.

6. A device as described in claim 4 wherein said plurality of orifices and gas outlet means are spaced about said partition whereby said buoyancy component can operate in positions other than the vertical position.

7. A device as described in claim 4 wherein said means for admitting water is a spring biased check valve having means adapted to seal the valve and prevent generated gases from escaping out the water inlet.

8. A device as defined in claim 4 wherein said plurality of openings has a plurality of depending pipes of different lengths associated therewith.

9. A buoyancy device of a type described comprising a closed container, a partition separating said container into an upper compartment and a lower compartment, a water-reacting chemical in said lower compartment, an inlet conduit for admitting sea water into said upper compartment, said inlet conduit including a check valve having a piston therein and means exposing one side of the piston to the pressure in said container and the other side to pressure of the sea water, said partition having opening means for water to flow from said upper compartment into said lower compartment, means in said container for equalizing the pressures in said compartments, and means for conveying gas generated in said container to a point outside thereof.

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