ABSTRACT: A buoy adapted to aid in the location of a submerged craft comprising an open-bottomed normally flooded buoyancy chamber, a case enclosed in said chamber containing a gas-producing substance used to displace the water in said chamber upon release, and another casing also enclosed in said chamber containing a signal transmitter. Both of said casings are partially expansible to permit a balance of fluid pressures to prevent crushing the buoy at extreme ocean depths.
MY INVENTION has for its object to allow shipwrecks, buoys and the like bodies which have sunk to the bottom of the sea or the like mass of water to be raised in a floating condition.

To this end, I substitute within the immersed body for a given volume of water an equal volume of a gas produced under the pressure prevailing at the depth of immersion upon release of a chemical reaction obtained with a solid or liquid product or else upon starting of the combustion of a pyrotechnical fuse composition.

My invention allows in particular a stranded vessel to be set afloat and similarly a submarine sinking down to a dangerous depth to be speedily lightened. It leads also to the execution of signalling buoys retaining a positive buoyancy whatever may be the depth, say even 10,000 meters down to which they have sunk.

As a matter of fact, it is of interest to ascertain accurately and within a time as short as possible the location of a submarine or craft or else of an aircraft which may have sunk into the water down to a considerable depth, chiefly in the case of a machine propelled by nuclear energy or carrying loads which may be dangerous for the surrounding area.

The principle of my invention is applicable to the lightening of immersed crafts such as distressed submarines and also to the setting afloat of shipwrecks.

It has already been attempted to produce an autonomous fluidtight apparatus adapted to float at midwater, said apparatus enclosing automatic locating means. However, if it is desired to produce a chamber adapted to resist the pressure of deep waters, say when lying under 10,000 meters of water, it is impossible to obtain a positive buoyancy capable of raising, in addition to the weight of the chamber, an arrangement ensuring an automatic signalling, even if a considerable straining of the compressed walls is granted, of say 150 kg/sq. mm.

Another arrangement which has been proposed hitherto for submarine exploring apparatus provides for the buoyancy of a system associated with a float enclosing a liquid which is lighter than water such as a hydrocarbon, the rough buoyancy per liter being then equal to the difference between the specific weights of the light liquid and of sea water. However such arrangements have led to the production of very bulky and brittle apparatus.

Similarly the buoyancy of a submarine sinking fortuitously down to a dangerous depth could be restored by driving the water out of the water ballasts by means of compressed air passing out of storing containers which latter show however the drawback of being heavy and of having a limited output.

In contradistinction, my invention solves perfectly the problem of the buoyancy of a vessel, buoy, shipwreck or the like body immersed at any depth whatever, the solution consisting in replacing when required the water carried in a compartment of such a body or in a chamber opening downwardly while its upper part remains watertight, by an equal volume of gas subjected to the water head at the depth of immersion. Said gas is produced by the fortuitous or automatic release of a chemical reaction between solid or liquid products or else by the combustion of a pyrotechnical composition as disclosed hereinafter. The replacement of the water driven out by an equal volume of compressed gas generates thus the rising force required in the case considered.

My invention is applicable to the setting afloat of shipwrecks wherein compartments have remained fluid tight in their upper sections so that they may be filled with gas in accordance with the above-disclosed method.

My invention allows an almost instantaneous lightening of a submarine which has sunk to a dangerous extent, the lightening being obtained by introducing into the water ballasts a plurality of gas generating emergency elements as disclosed hereinafter.

In the case of a buoy provided with a positive buoyancy, said buoy may remain preferably attached to the derelict ves-
The compressed gas taking the place of sea water and of the material which has produced it bestows the buoy with a buoyancy which allows it to carry, when floating, its own weight together with that of all the parts carried by it, the rough buoyancy per liter being equal to the difference between the specific weight of the compressed gas and that of the sea water which said gas replaces. By way of exemplification under a pressure of 1,000 bars, that is about 10,000 meters of water, the specific weight of the gases obtained through combustion may be of a magnitude of 300 grams per liter at 4°C, which means that the rough buoyancy of a magnitude of 700 grams per liter of useful capacity in the buoy and a buoyancy of a useful capacity of 40 liters may cause the floating of a total weight of 28 kilograms when immersed at a depth of 10,000 meters. If it is preferred to resort as disclosed hereinafter to a chemical reaction producing hydrogen, in such a case the buoyancy of the buoy reaches 38 kilograms. The gases produced by a pyrotechnical combustion or a chemical reaction may be hot and cooled only partly during their compression in order that the cooled gas may occupy the useful volume which has been reckoned for cool conditions, the case 4 extends downwardly to form a skirt 12 which provides an additional volume 4B to be occupied by the expanded hot gases which upon cooling occupy entirely the sole useful space 4A. The production of hot gases would risk damaging the fittings of the box 3. The latter is thus protected, the recess housing it leaving a free space or jacket 5 round said box while channels 2 afford a passageway for the sea water which flows freely through the said jacket 5 so as to prevent the box from becoming too hot. The sea water entering the case escapes freely through the ports 11 and 13 and therefore the case 4 of the buoy is subjected merely to very reduced differences in pressure. Said case may therefore be very thin walled and light, the buoyancy being associated chiefly with the supersonic or wireless transmitter in the box 3 and with the electric implementing together with the means driving the cable 14. The buoy is secured to the submarine for instance through pins or bolts adapted to be broken by explosive charges 17 of a known type which may be released voluntarily or else automatically by an electric system carried in the box 3 as described for instance in my copending U.S. patent application Ser. No. 809,912. The buoyancy of the buoy is preferably reckoned so that when released the buoy carries along with it the cable 14 to stretch it, said cable being coiled within a recess 15 at the lower end of the case. The cable 14 is short and holds the buoy attached to the sunken submarine or ship while restraining the parts of the buoy to remain in a position suitable for the transmission of signals 8 and may be the location of the stranded vessel at the bottom of the sea (FIG. 3). The cable may possibly incorporate an electric lead through which the buoy may be released purposely by control means located inside the stranded vessel. When the cable is cut off, the buoy may rise up to sea level and operate a beacon providing an indication as to the area wherein the submarine has sunk, the superfluous transmission being superceded then by a wireless signalling. The box 3 carries manometric means of a known type controlling the automatic release of the buoy as soon as the submarine sinks down to a dangerous depth through the closing of the electric circuit controlling said release through a firing of the explosive charge 8, preferably with a delay for said firing so as to give the vessel time for it to sink onto the bottom of the sea. The buoy may be given any desired shape beyond that described say that illustrated in FIG. 2 which raises the thrust center above the center of gravity so as to ensure a better stability of the buoy as to position. In the case of buoys intended for use with submarines and in order to reduce the weight of the battery carried inside the box 3, it is of interest to produce extremely short supersonic signals of a considerable instantaneous energy. For instance, the signals may last one thousandth of a second and be spaced by intervals of nine hundred ninety-nine-thousandths during which the transmitters is reloaded which produces a signal 1,000 times more powerful than in the case of a continuous output of the transmitter baud. The selection of the gas-generating means under the pressure produced by immersion is a difficult matter since the reaction should be only slightly modified by pressure and performed at ambient temperature. I resort preferably to calcium hydride which has the property of decomposing water through more contact at ambient temperature, the reaction forming lime which exfoliates in water and releases four molecules of hydrogen in accordance with the formula Ca(OH)2 = CaO + H2, which leads to the production of 950 liters of hydrogen per kilogram of hydride, the specific weight of which is 1.2. It is also possible to use lithium or strontium hydrides but their price is very high. In fact 1 kilogram of lithium hydride produces 700 liters of hydrogen. If a pyrotechnical composition is used it is of advantage to resort to fuse compositions producing a maximum amount of gases which are not soluble in water nor condensable when compressed under ambient temperature conditions such as H, N2, CO and O. It is thus possible to resort to the combustion of nitroglycerine in the presence of a nitrocellulose gel, mitigated possibly by centralite as well known in the art, said explosive releasing 862 liters of useful gases per kilogram in accordance with the formula CH4N4O2 H2O + CO+H2+2 N2. Another example of the application of the invention to submarines is illustrated in FIG. 4 showing emergency charges of calcium hydride adapted to be distributed in the water ballasts. If the submarines sinks down to a dangerous depth, the scattering of said charges within the water of the water ballasts is obtained through any suitable means such as a small explosive charge; the hydrogen in statu nascendi which is in a compressed condition drives thus out in an exceedingly short time a corresponding volume of water which allows the stranded vessel to rise up to sea level. By way of example at a depth of 400 meters, an emergency charge of 600 kilograms of lithium hydride entering the water ballasts leads to an almost instantaneous lift of 15 tons, this being independent of the gaseous injections produced by the conventional equipment of the vessel. If the water ballasts are subdivided as illustrated at 21, the partial release of the hydride charges allows the vessel's trim which has been momentarily jeopardized to be restored, even if its conventional equipment is no longer operative. The principle of my invention may be applied also to the refloating of a ship, this being obtained by generating gases in a number of compartments including upper fluidight sections. This restores enough buoyancy for the stranded vessel to rise up to sea level, which is obtained much more speedily and more economically than if compressed air were to be injected into such compartments according to conventional practice. The wreck-locating buoy described hereinafter for vessels stranded at great depths has been disclosed merely by way of exemplification of my invention and the distribution of the parts inside the buoy, the shape of the latter as well as the arrangement of the gas-generating charges with reference to the water ballasts of a submarine have also been disclosed without this limiting by any means the scope of my invention as defined by the accompanying claims. What I claim is: 1. An equipment for buoys, submarines, and the like objects liable to sink down to a dangerous depth comprising at least one chamber, the lower end of which is fully and permanently open, a first partly expansible enclosure carried entirely within said chamber, said first enclosure carrying a gas-generating charge and having normally covered openings adapted to be opened by the pressure of the gas evolved within said first enclosure, a second partly expansible enclosure within said chamber an insulating liquid body filling entirely said second enclosure, and a signalling transmitter immersed in said liquid and adapted to operate at a predetermined moment.