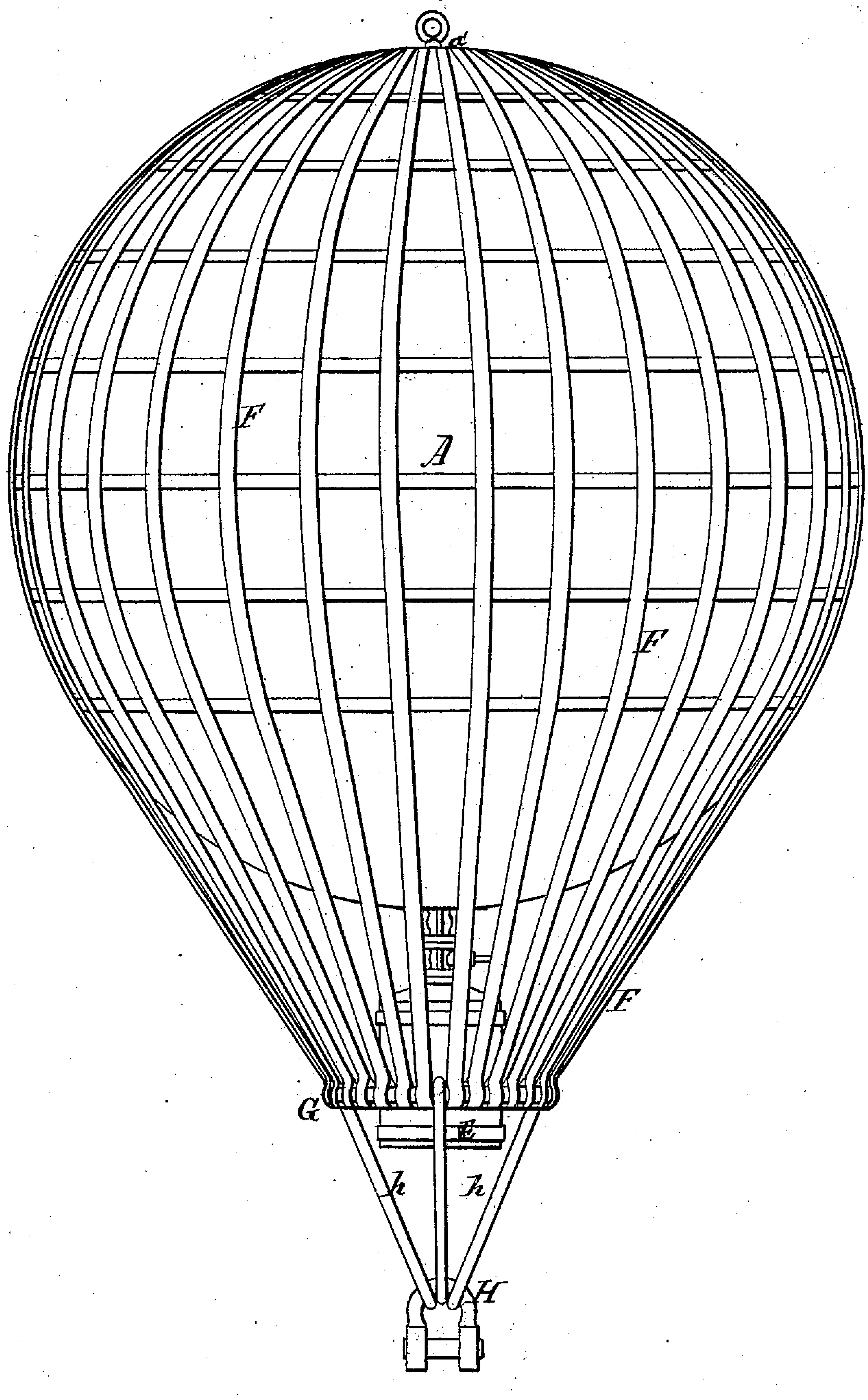
W. RAYDT.

Means for Raising Sunken Vessels, &c.

No. 211,587. **Patented Jan. 21, 1879.**

Fig. 1.



Witnesses

Henri Guillaume

Alf. L. Leonard

Inventor

Wilhelm Raydt

pr. Henry Orth

atty

2 Sheets—Sheet 2.

W. RAYDT.

Means for Raising Sunken Vessels, &c.

No. 211,587. **Patented Jan. 21, 1879.**

Fig. 2.

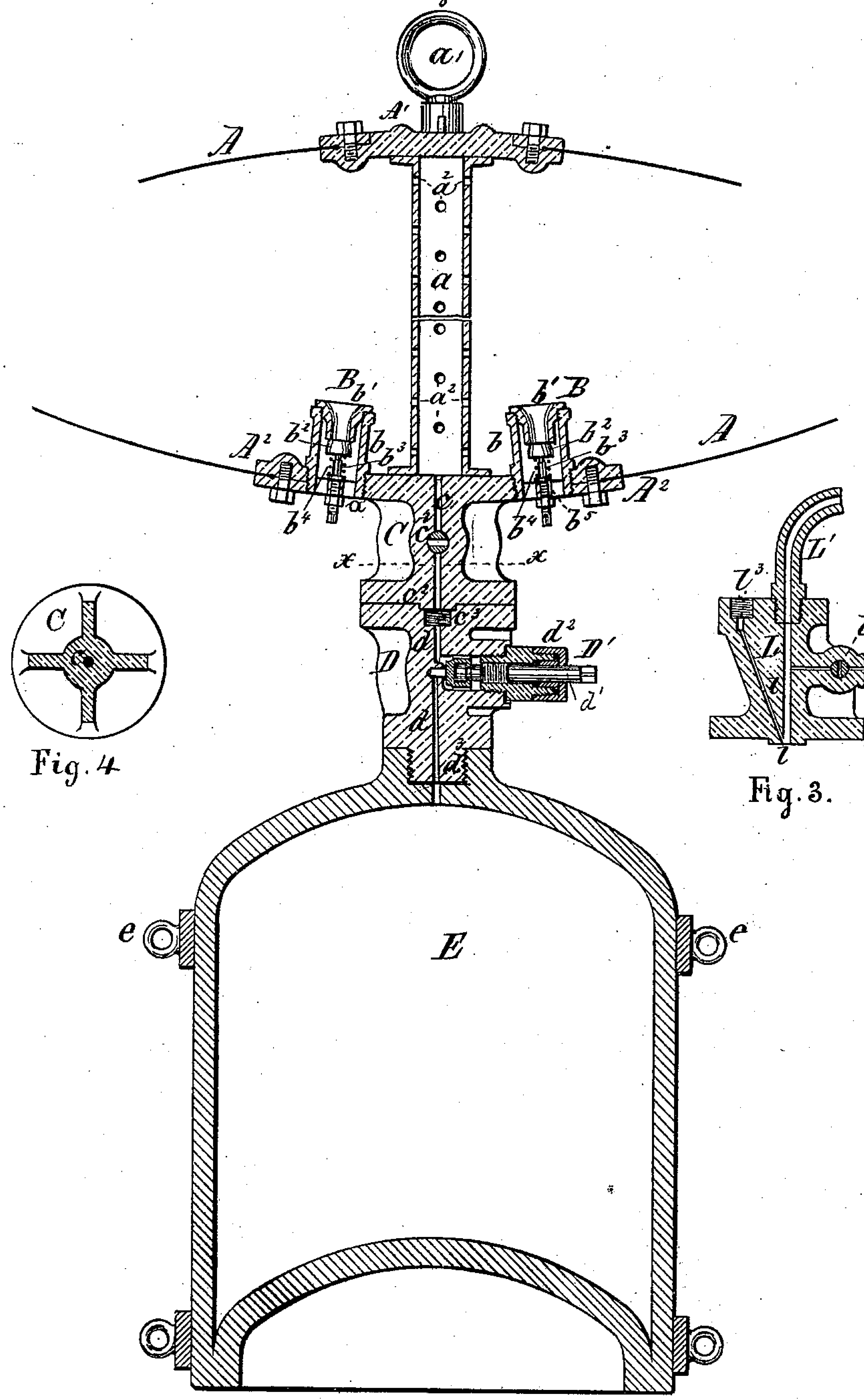


Fig. 4.

Fig. 3.

Witnesses.
Henri Guillaume
Alf. L. Leonard

Inventor
Wilhelm Raydt
pr Henry Orth att.y

UNITED STATES PATENT OFFICE.

WILHELM RAYDT, OF HANOVER, PRUSSIA, GERMAN EMPIRE.

IMPROVEMENT IN MEANS FOR RAISING SUNKEN VESSELS, &c.

Specification forming part of Letters Patent No. **211,587**, dated January 21, 1879; application filed November 25, 1878.

To all whom it may concern:

Be it known that I, WILHELM RAYDT, physician, of Hanover, in the Kingdom of Prussia, German Empire, have invented a new and useful Means for Raising Sunken Bodies, of which the following is a specification:

My invention has for its object the raising of sunken bodies, such as vessels or other bodies; and consists, essentially, in raising such bodies by means of a gas adapted to inflate a collapsible body, such as a balloon, or a series of such, sunk in a collapsed state, made fast to the body to be raised, and then inflated by means of gas contained in a reservoir in a compressed or liquefied state, said reservoir being attached to and connected with the balloon.

The invention further consists in providing each balloon with one or more safety-valves, adapted to permit the gas contained in the balloon, when inflated, to gradually escape as said balloon rises to the surface and the external pressure of the surrounding water diminishes.

The invention further consists in the peculiar manner of connecting the reservoir with the balloon, and the means employed for filling said reservoir with the compressed or liquefied gas; and, lastly, the invention consists in certain details of construction, as hereinafter described, and shown in the accompanying drawings, in which—

Figure 1 is a vertical elevation, and Fig. 2 a vertical section, part of the balloon being broken away, of an apparatus for raising sunken bodies, constructed according to my invention. Fig. 3 is a vertical section of the piece employed for charging the reservoir; and Fig. 4 is a transverse section of the coupling C, taken on line *x x* of Fig. 2.

The lifting power developed by a hollow body sunk and then charged with air or a gas is very great, and when properly applied is capable of lifting very large masses. Atmospheric air, for instance, which at 0° weighs about one one-hundred-and-seventieth of an equal volume of water, is capable of lifting seven hundred and seventy times its own volume or weight, and when employed in a submerged receiver at a depth of about twenty meters, at which depth the density of the air is increased threefold, is yet capable of lifting about two hundred and forty times its own weight.

Many attempts have been made to practically apply these well-known properties of atmospheric air to the raising of sunken bodies. Air-tight casks, chests, and other like means filled with water and then sunk, have been employed for this purpose; but the difficulties encountered in the pumping out of these receivers and replacing the water by atmospheric air pumped into them, both of which operations has to be effected from above the surface of the water, have been such as to lead to no practical results in cases where the vessel or other body to be raised was at a certain depth under water. Nor could the operation of raising be carried on except in very fair weather with a very calm sea, as the least ruffled surface of the water would prevent the pumping out of the receivers. Other attempts in this direction have resulted in utter failure for want of proper application of the lifting power.

By my improved method and means sunken bodies may be raised with comparative facility, and in such weather as would have prevented any attempt at raising by the old methods.

The great advantages derived from my improved method and means consist in facilitating the submersion of the lifting apparatus; in removing all difficulties of introducing the lifting power, which may be effected from the surface of the water or by the diver below; and, finally, in making the operation entirely independent of the state of the weather, as it may be suspended and again resumed whenever required.

In my improved method I employ, preferably, carbonic-acid gas, as being the most advantageous, not only on account of its low price, but also on account of its specific properties. Any other gas, however, may be employed, if desired; but only such gases should be used which may be liquefied by a moderate pressure to facilitate the charging of the receiver.

In the application of this method to practical use I have found that a collapsible flexible body, such as a balloon of spherical, or nearly spherical, form, having a diameter of three meters, is capable of lifting, when submerged in sea-water of a temperature of 10° centigrade, one hundred and sixteen thousand four hundred and sixty-four kilograms. Forty-three of such balloons would, therefore, be required to lift a vessel of about five thousand tons, viz., $\frac{5000000}{116464}$ = forty-three.

In the accompanying drawings, A represents a closed and perfectly air-tight balloon of any desired shape, preferably spherical in form, and made of strong sail-cloth saturated with a water-proof solution—such as a solution of rubber—and provided on its interior surface with a thick coating of the same material. The balloon is provided with and held between two metallic plates, A^1 A^2, above and below, the plate A^1 having a ring, a^1, or other suitable device, to which a cord, chain, or other like means for sinking the balloon may be attached.

The plates A^1 A^2 are connected together by means of a hollow vertical axis, a, provided with a series of perforations, a^2; and the lower plate, A^2, carries one or more valves, B, consisting of a short tube, b, an inverted cup-shaped seat, b^1, and a valve, b^2, connected to a valve-stem, b^3, which holds the valve closed by means of a spring, b^4, the valve-stem being guided by a sleeve, b^5. The tension of the spring b^4 is such as to keep the valve in its seat until the pressure of the gas within the balloon has attained a certain limit, and when this limit is exceeded the valve or valves will be opened by the excess of pressure to permit the gas to escape from the balloon. A provision of this kind is necessary in order to prevent an explosion when the balloon rises to the surface of the water and the pressure of the water gradually diminishes or exerts less power upon the external surface of the balloon.

Upon plate A^2 is formed a coupling, C, provided with a central passage, c, communicating with the hollow axis a, for the delivery of the gas from the reservoir to the balloon. The gas is intercepted by means of a stop-cock, c^1, requiring a quarter-turn to open or close it. The under face of the coupling forms a shoulder, c^2, provided with a screw-threaded central projection, c^3, through which the passage c is continued, by means of which threaded portion c^3 the coupling is connected to an intermediate safety-coupling, D, provided with a central gas-passage, d, and a screw-valve, D′, of any usual or preferred construction, the valve-stem d^1 of which passes through a stuffing-box, d^2, to prevent all escape of gas or ingress of air, whereby the liquefied carbonic acid may be converted into gas. This coupling is also necessary for charging the reservoir, as will be described hereinafter. The upper end of the passage d is enlarged and threaded to receive the threaded projection c^3 of the coupling C, while the lower part of the safety-coupling D is provided with a threaded shank, d^3, by means of which it is screwed to the reservoir.

E is the reservoir, of any desired shape, and preferably cast in one piece, as all soldering should be avoided, and if constructed of more than one piece the sections should be so formed as to be capable of being united by welding. The walls of the reservoir are of the proper thickness to resist the pressure of the gas contained therein, and if liquefied carbonic acid is employed the walls should be of such a thickness as to resist any expansion of gas which may be accidentally generated. The weight of this reservoir and its couplings, as well as the hollow metallic axis and the plates, facilitates the sinking of the apparatus. The reservoir is provided with suitable eyes e, by means of which it may be moved from place to place, or stayed to the balloon by means of stay-ropes.

The balloon A is provided with a series of lifting-belts, F, secured at one end to plate A^1, and at the other to a metallic ring, G. These belts not only serve as a means for connecting the balloon with the burden to be raised, but also as a strengthening for the balloon itself, and for this purpose I preferably employ strong belts made of sail-cloth or woven for the purpose.

H is a clevis or other suitable device, connected to the metallic ring G by means of draft-rods h, as shown.

In practice I test the resisting power of the balloon and its valves, as well as that of the reservoir and parts connected therewith, and the tensile strength of the belts and its attachments, before the apparatus is employed for actual service, and according to the weight it is intended to sustain.

The filling or charging of the reservoir is effected by means of a filling-piece or charging-piece, L, Fig. 3, adapted to be screwed upon the safety-coupling D, when the latter with the reservoir have been unscrewed from the coupling C. This filling-piece is provided with a passage, l, adapted to communicate at one end with passage d in the safety-coupling D, and terminating at the opposite end in a pipe, L′, connected with a compressing-pump of any usual construction. (Not shown in the drawings.) A second passage, l^1, at right angles to passage l, communicates with the outer space, and is closed by a stop-cock, l^2, a third passage, l^3, communicating at its lower end with passage l, and at its upper end with a manometer. (Also not shown in the drawings.) As the carbonic-acid or other gas is forced into the reservoir through pipe L, the air contained therein will be gradually compressed until the pressure is such as to liquefy the gas, and when the pressure of the air within the cylinder is greater than is necessary to liquefy said gas, as indicated by the manometer, the stop-cock l^2 is opened and the air is allowed to escape until the pressure within the cylinder or reservoir, as indicated by the manometer, is again reduced, and so on until the necessary quantity of carbonic-acid gas has been liquefied within the reservoir to furnish the gas required for the inflation of the balloon.

When so charged the reservoirs may be stored away until required, and should then be kept in a cool or cold place, and when required for use they may then be placed in a tank of water and shipped to the place where required, together with the balloon or balloons.

The operation of the apparatus is as follows: The divers having attached the chains or other tackle to the vessel or other body to be raised, and the reservoirs having previously been connected with the balloon by screwing them to the coupling C, the balloon and its attachments are then sunk as near as possible to the spot where they are to be attached to the wreck, the valves D′ of the coupling D having been opened before sinking the apparatus. The diver now opens the stop-cock c^1, and allows the generated gas within the reservoir to flow into the balloon until the latter is sufficiently inflated to float and sustain its own weight, when it may be readily guided to the place where it is to be connected with the wreck, the stop-cock c^1 having again been closed. When all the balloons are attached the diver or divers open the stop-cocks c^1 again to fully inflate the balloons, which, by their lifting power, raise the wreck to the surface, in which position other balloons may be attached, or chains may be passed under the keel of the wreck, which is then towed into port. As the balloons ascend from the depth of the sea and the pressure of the water upon the outer surface of the balloon diminishes, the valve or valves B are opened by the pressure—that is to say, the excess of pressure of the gas which gradually escapes—so that a rupture of the apparatus is almost impossible.

If desired, lines may be attached to the stop-cocks c^1, and the balloons may then be simultaneously inflated by opening all the stop-cocks at the same time from the boat. The partial freezing of the acid by the intense cold produced by the expansion of the gas could only slightly retard the inflation of the balloon, as the water surrounding the reservoir could not freeze, owing to its constant movement. This apparatus may also be employed as a means for raising the divers themselves to the surface, as the method employed at present for raising the diver by means of air he breathes out is a very dangerous one, since death would inevitably follow a rupture of his diver's suit.

I propose to provide for each man two small balloons, of a radius of 0.25 meters each, for raising about one hundred and twenty kilometers, and a reservoir containing about two liters of a liquified gas, which would suffice to lift the above weight and raise it to the surface from a depth of about sixty meters.

The two balloons are to be folded up and held upon the shoulders of the diver by a cross-strap, both balloons being connected by means of flexible tubes, with the reservoir attached to said balloons in any convenient manner and made fast to the chest of the diver. In case of danger the diver would then be able to rise to the surface by opening a screw-valve and inflating the balloons. For this purpose I prefer to use anhydrous ammonia, which, although of a higher price than carbonic acid, is preferable, as it is liquefied by a less pressure (four atmospheres at 0°) than carbonic acid, which adapts it for use with reservoirs of less weight, and also removes all danger of explosion, which would have to be feared at all times with a reservoir containing liquefied carbonic acid in contact with the human body, from which it may be warmed, or in case of heat coming in contact with such reservoir in any other manner.

Such apparatus may also be employed on land and sea in case of war for making observations, and employed as captive balloons; and in this case the charged reservoirs may be carried in specially-constructed wagons, in which the reservoirs are kept cool by surrounding them with water or other cooling agent, and the balloon may be carried upon a second wagon, provided with a windlass and the necessary quantity of rope.

In this manner the balloon may be inflated when desired, a basket attached thereto to accommodate the officers or engineers and their instruments, and allowed to ascend, and upon a signal from the balloon by the occupants of the basket it may be drawn down again.

Upon vessels the reservoirs may be kept in suitable tanks ready for use when required, surrounded by some cooling agent.

For these purposes I would also recommend the use of ammonia, for reasons stated above.

Instead of carrying the charged reservoirs upon the wagons, they may be carried empty, and charged when required by means of a compressing-pump arranged upon the wagon, also.

The inflation of the balloon is effected by means of a pipe, which may be disconnected from, and connected to, both the balloon and reservoir, and the gas may be withdrawn from the balloon and forced back into the reservoir after the observations have been completed and the balloon drawn down again.

Owing to the heat developed in pumping the gas from the balloon into the reservoir and the consequent danger of explosion, the latter should be provided with a manometer and surrounded by a cooling agent.

Having now described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination, with the balloon and the plates A^1 and A^2, of the rigid central axis a, the former to protect the fabric against damage during the sinking or the rising of the balloon, and the latter to permit of the balloon being collapsed or folded around it to facilitate the sinking thereof, substantially as described.

2. In an apparatus for raising sunken bodies,

a flexible balloon adapted to be collapsed upon and around a central axis, serving as gas-duct, in combination with a gas-reservoir rigidly connected with the balloon and central axis, and serving as a weight to assist in sinking the balloon when in a collapsed state, substantially as described.

3. The combination, with the balloon A, and its bearing-plates A^1 A^2, and valves B, of the hollow perforated axis *a*, the coupling-piece C, and the generator D, substantially as described, for the purpose specified.

4. The combination, with the balloon A, and hollow axis *a*, and plate A^2, and coupling-piece C, provided with a central passage and a stop-cock, of the safety-piece D, having a central passage and a screw-valve, and the reservoir E, substantially as described, for the purpose specified.

5. The combination, with the reservoir and safety-piece D, of the charging-piece L and a force-pump, substantially as shown and described, and for the purpose specified.

In witness that I claim the foregoing I have hereunto set my hand this 19th day of September, 1878.

WILHELM RAYDT.

Witnesses:
GEORGE LOUBIER,
BERTHOLD ROI.