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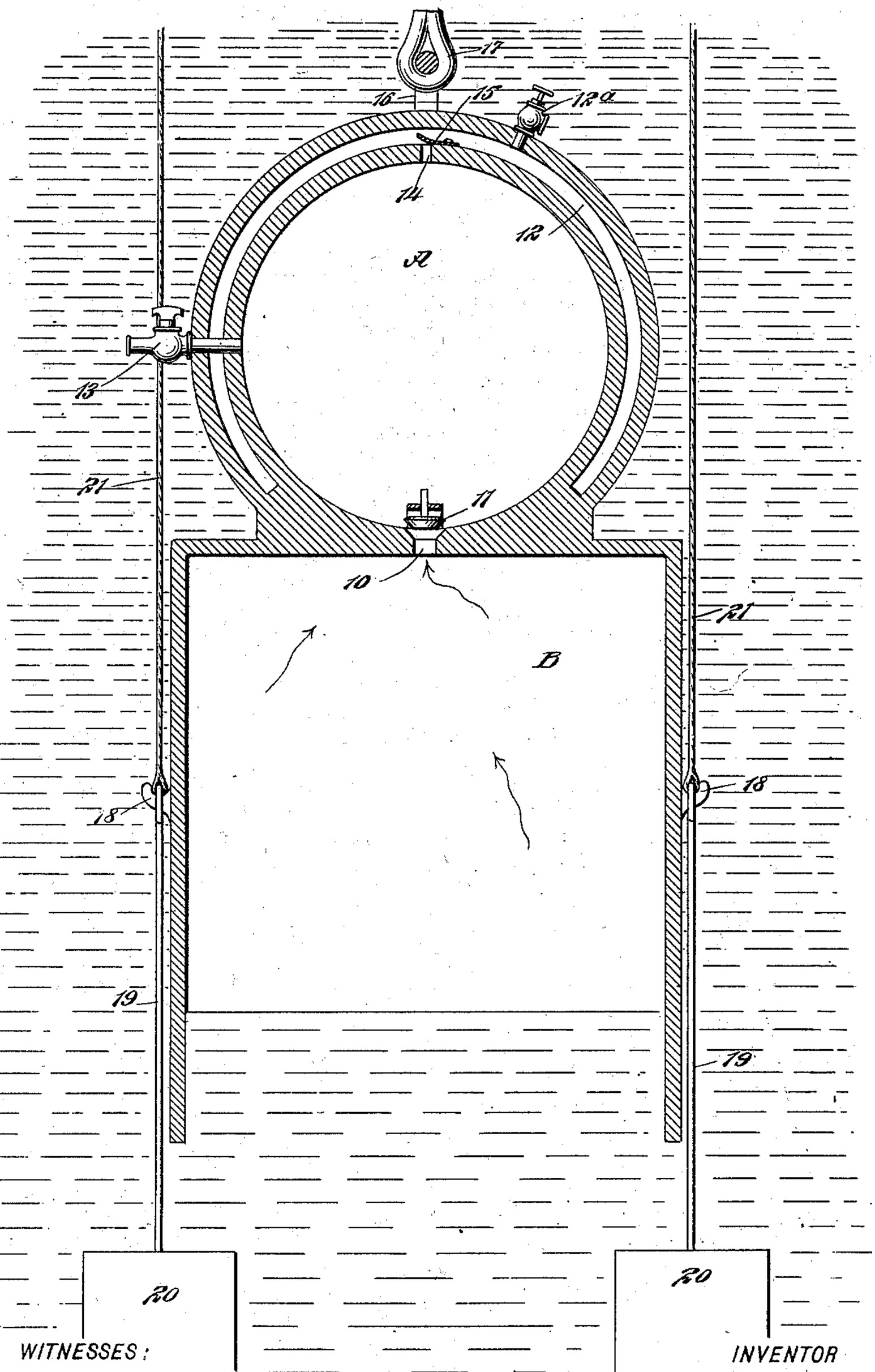
B. BORLAND.

MEANS FOR COMPRESSING OR LIQUEFYING GASES.

(Application filed June 7, 1900.)

(No Model.)



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MEANS FOR COMPRESSING OR LIQUEFYING GASES.

SPECIFICATION forming part of Letters Patent No. 698,362, dated April 22, 1902.

Application filed June 7, 1900. Serial No. 19,392. (No model.)

To all whom it may concern:

Be it known that I, BRUCE BORLAND, a citizen of the United States, and a resident of Cambridge, in the county of Middlesex and State of Massachusetts, have invented a new and Improved Means for Compressing or Liquefying Gases, of which the following is a full, clear, and exact description.

The purpose of the invention is to provide means for compressing or liquefying gases—such, for instance, as ammonia and carbon dioxid—for the purpose of obtaining such gases in their liquid form for any desired use, and to so construct the apparatus for the purpose that it will be simple, easily controlled, and successfully used in large bodies of water—as, for example, the ocean.

The invention consists in the novel construction and combination of the several parts, as will be hereinafter fully set forth, and pointed out in the claims.

Reference is to be had to the accompanying drawing, forming a part of this specification, in which is represented a vertical section through the apparatus, the apparatus being immersed in a body of water.

The apparatus consists of an upper gas-receiver A and a lower compressing-cylinder B. The compressing-cylinder B is open at its bottom, and the gas-receiver A, which constitutes, preferably, an integral portion of the compressing-chamber at the top, is of circular formation, so as to better resist pressure from the outside and the inside. A channel 10 establishes communication between the upper central portion of the compressing-cylinder B and the central lower portion of the gas-receiver A, and this channel or source of communication is normally closed by an inwardly-opening valve 11—a check-valve, for example, or a valve of any description.

A chamber 12 is formed between the inner and the outer walls of the gas-receiver, and this chamber extends nearly the entire circumference of the receiver, terminating near the bottom thereof at opposite sides. A faucet 13, located at the outside of the gas-receiver A, is placed in communication with the interior of the main chamber of the gas-receiver, and the compressed gas is permitted to escape, when desired, through the faucet 13, which is constructed to that end. A second channel 14 is located at the upper portion of the gas-receiver and establishes communication between the inner or main chamber and the circumferential chamber 12, and this channel 14 is provided at its upper end with a valve 15, made of spring metal, fitting gas-tight and normally closed, which valve opens outward, so that a portion of the gas that has been compressed in the receiver A will pass into the circumferential chamber 12. An eye 16 or the equivalent thereof is formed at the top portion of the gas-receiver A, and a link 17 is connected with this eye, which link in its turn is connected with a rope or a chain of any desired length.

At opposite sides of the compressing-cylinder B upwardly-turned hooks 18 are formed, and these hooks receive eyes which are formed upon downwardly-extending rods 19. These rods extend beyond the lower end of the compressing-cylinder and carry weights 20 at their lower extremities, the weights being sufficient to carry the apparatus down through the water to the desired depth. Ropes 21 are attached to the eyes forming portions of the rods 19, and these ropes extend upward and are adapted to be manipulated at a point above the surface of the body of water. As the apparatus is lowered the gas in the cylinder B is gradually compressed by the water rising in the said cylinder, and the compressed gas is thereupon forced into the receiver A, where it is retained until it is withdrawn after the apparatus has been raised from the water. The weights 20 may be disconnected from the hooks 18 when all of the gas in the cylinder B has been forced into the receiver A by merely pulling upward upon the ropes 21, to which the hooks 19 are secured. These ropes 21 can be manipulated independently from above for this purpose.

In order to obtain the requisite pressure and cold for liquefying such gases as may be liquefied by this device, it is necessary to lower the apparatus to a suitable depth in the body of water, and to this end my apparatus is constructed and the bulk of the weights calculated. The chamber 12 between the two walls of the gas-receiver A permits the gas to expand into the said chamber through the channel 14, and the gas in said chamber tends considerably to cool the bulk of gas in the re-

ceiver A, thereby materially aiding to liquefy it. A relief-valve 12ª is provided for the chamber 12.

The cooling effect referred to is brought about as follows: The valve 15, being somewhat difficult to lift, will not allow the gas to flow from the receiver A into the receiver 12 until a considerable pressure is obtained in the receiver A. By the time the apparatus has descended a sufficient depth into the ocean to compress the gas in the receiver A to a degree sufficient to move the valve 15 the apparatus will be considerably cooled by the surrounding water, the temperature of which is low at great depths. The apparatus having descended a sufficient depth to move the valve the gas passes from the receiver A through the channel 14 into the receiver 12, and in doing so expands slightly. The effect of this is to lower the temperature in the inner receiver A and to raise the temperature in the outer receiver 12. This receiver being almost in immediate contact with the water, however, is rapidly cooled thereby, so that the heat produced by the compression of the gas in the receiver 12 is rapidly conveyed away by the water. The effect upon the gas in the inner receiver is clearly a cooling effect for the reason that the gas having been compressed, and thereby heated, and this heat having been abstracted by the surrounding water, (aided by the conductivity of the metal,) when allowed to expand slightly is rendered cooler than it was before. The gas in the receiver A is cooled to the same extent that the gas in the receiver 12 is heated; but as the heat is almost immediately absorbed by the water from the gas in the receiver 12 the ultimate effect upon the inner receiver A is a cooling effect. A little heat might be imparted from the outer receiver to the inner receiver as the inner receiver is cooled and the outer receiver is heated; but if any part of the heat imparted to the outer receiver is absorbed by the water in immediate contact with said receiver it is clear that all of the heat cannot return to the gas in the receiver A.

I contemplate so building the apparatus that it will float when the lower or compressing chamber is full of liquid and the weights employed to sink the apparatus are entirely or partially removed from engagement therewith, whereupon the apparatus will float to the surface or may be readily assisted in rising, the automatic action occurring only when all of the weights are released, which may be accomplished automatically, as stated, through the action of the apparatus when all the gas has been forced from the compressing-cylinder or by manipulating the ropes or chains 21, connected with said weights.

It will be observed that when the means described are employed the lower portion of the apparatus need not be built extra strong, as at all times the pressure on the inside and outside is practically the same; but the upper portion of the apparatus, where the compressed gas is stored, should be very strong in order to withstand the pressure when the apparatus is brought to the surface of the liquid in which it has been immersed.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. Means for compressing and liquefying gas, which consists in a compressing-cylinder open at its bottom, a gas-receiver carried by the upper portion of the cylinder, a communication between the gas-receiver and cylinder, which communication is normally closed by a valve opening inwardly in the receiver, the said receiver being provided with a circumferential chamber between its inner and outer walls in communication with the main chamber, and means for drawing off the compressed gas from the receiver, as set forth.

2. Means for compressing and liquefying gas, which consists in a compressing-cylinder open at its bottom, a gas-receiver carried by the upper portion of the cylinder, a communication between the gas-receiver and cylinder, which communication is normally closed by a valve opening inwardly in the receiver, the said receiver being provided with a circumferential chamber between its inner and outer walls in communication with the main chamber, means for drawing off the compressed air from the receiver, projections from the cylinder, weights suspended from the said projections, and means for manually disconnecting the weights from the cylinder, the said weights being adapted also to automatically disconnect themselves from the cylinder when the air in the cylinder has been compressed in the receiver, as set forth.

3. A deep-sea apparatus for the liquefaction of gases, comprising an open receptacle and two closed receptacles, said open receptacle communicating with one of said closed receptacles by means of a valve, and said closed receptacles communicating with each other by means of another valve, and means for sinking said receptacles into the deep sea and raising the same therefrom.

4. A deep-sea apparatus for the liquefaction of gases, comprising an open receptacle and a receptacle closed by a valve, said receptacles communicating with each other, detachable weights for sinking said receptacles into the sea, and means for disengaging said detachable weights at will.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

BRUCE BORLAND.

Witnesses:
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