J. G. FLOOD & W. G. FITZGERALD.

DIVING BELL APPARATUS FOR SUBMARINE WORK.

APPLICATION FILED SEPT. 30, 1909.

962,019.

Patented June 21, 1910.

3 SHEETS—SHEET 1.

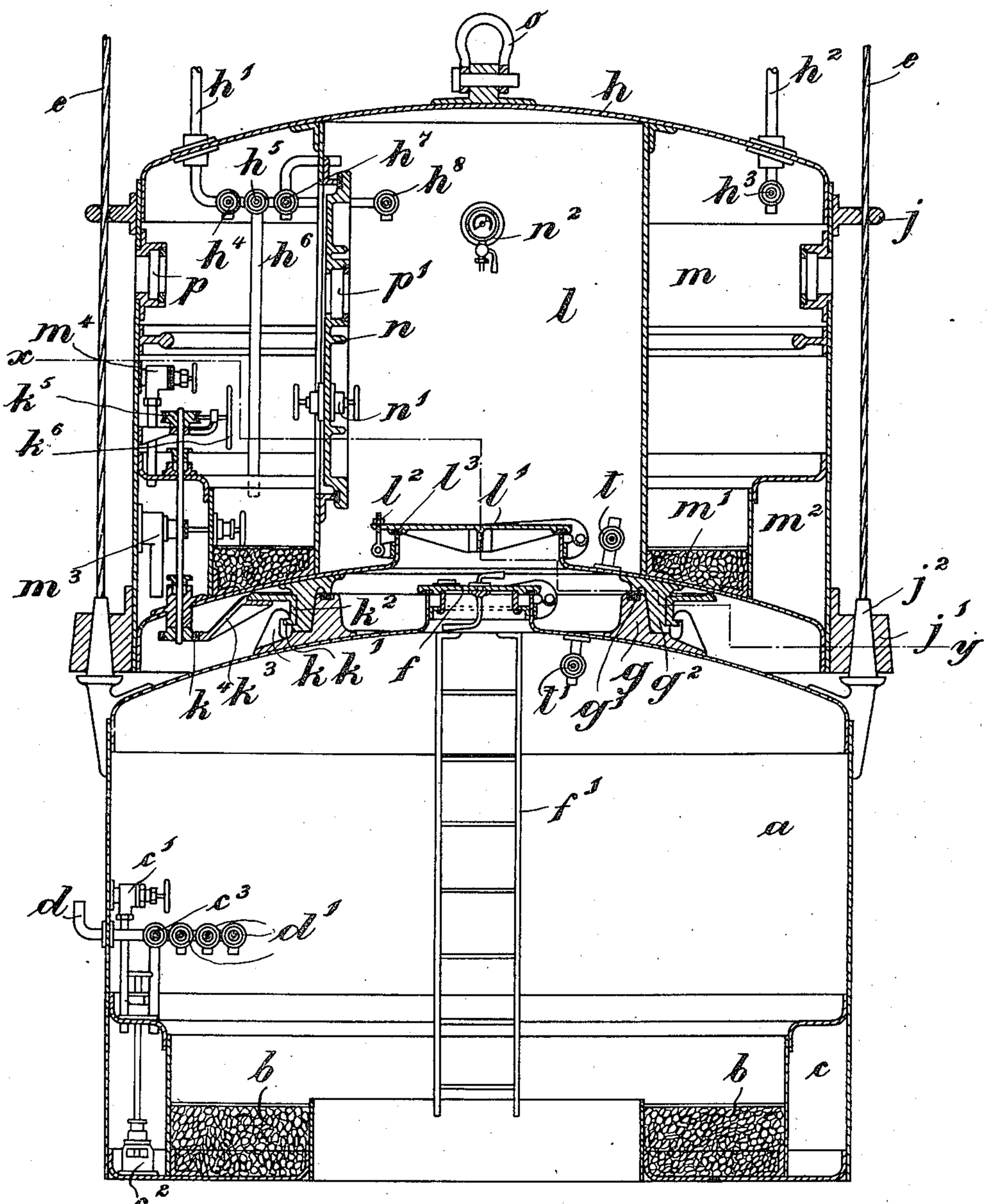

Fig: 1.

Witnesses:
Bent. N. Stahl.
Edwd L. Tolson.

Inventors.
John Garner Flood.
William George Fitzgerald
by John Wallace Flint
Atty

J. G. FLOOD & W. G. FITZGERALD.

DIVING BELL APPARATUS FOR SUBMARINE WORK.

APPLICATION FILED SEPT. 30, 1909.

962,019. Patented June 21, 1910.

3 SHEETS—SHEET 2.

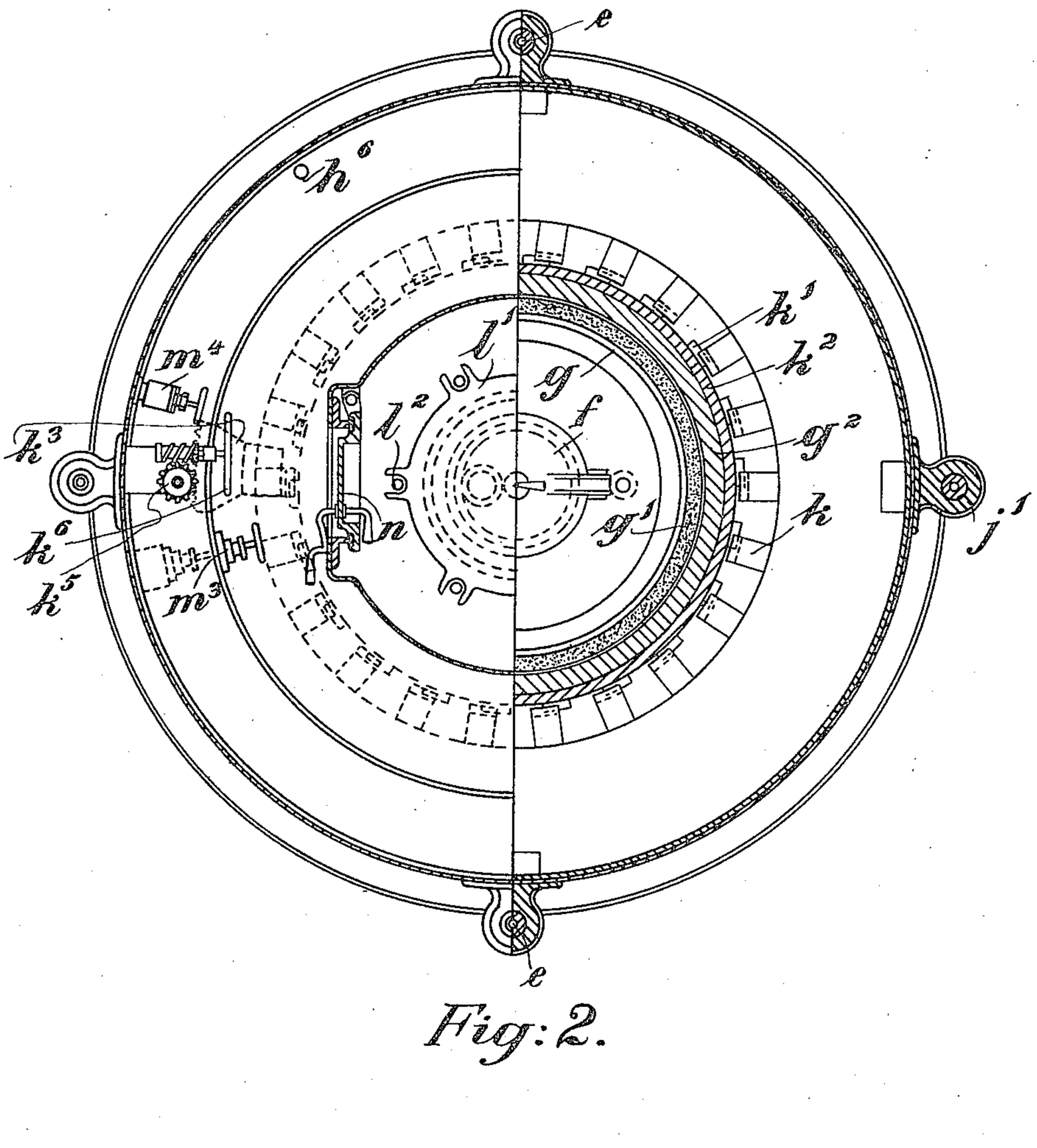

Fig: 2.

Attest.

Bert. M. Stahl.

Edwd L. Tolson.

Inventors.

John Garner Flood.

William George Fitzgerald.

By Wm. Wallace White

Atty.

J. G. FLOOD & W. G. FITZGERALD.

DIVING BELL APPARATUS FOR SUBMARINE WORK.

APPLICATION FILED SEPT. 30, 1909.

962,019.

Patented June 21, 1910.

3 SHEETS—SHEET 3.

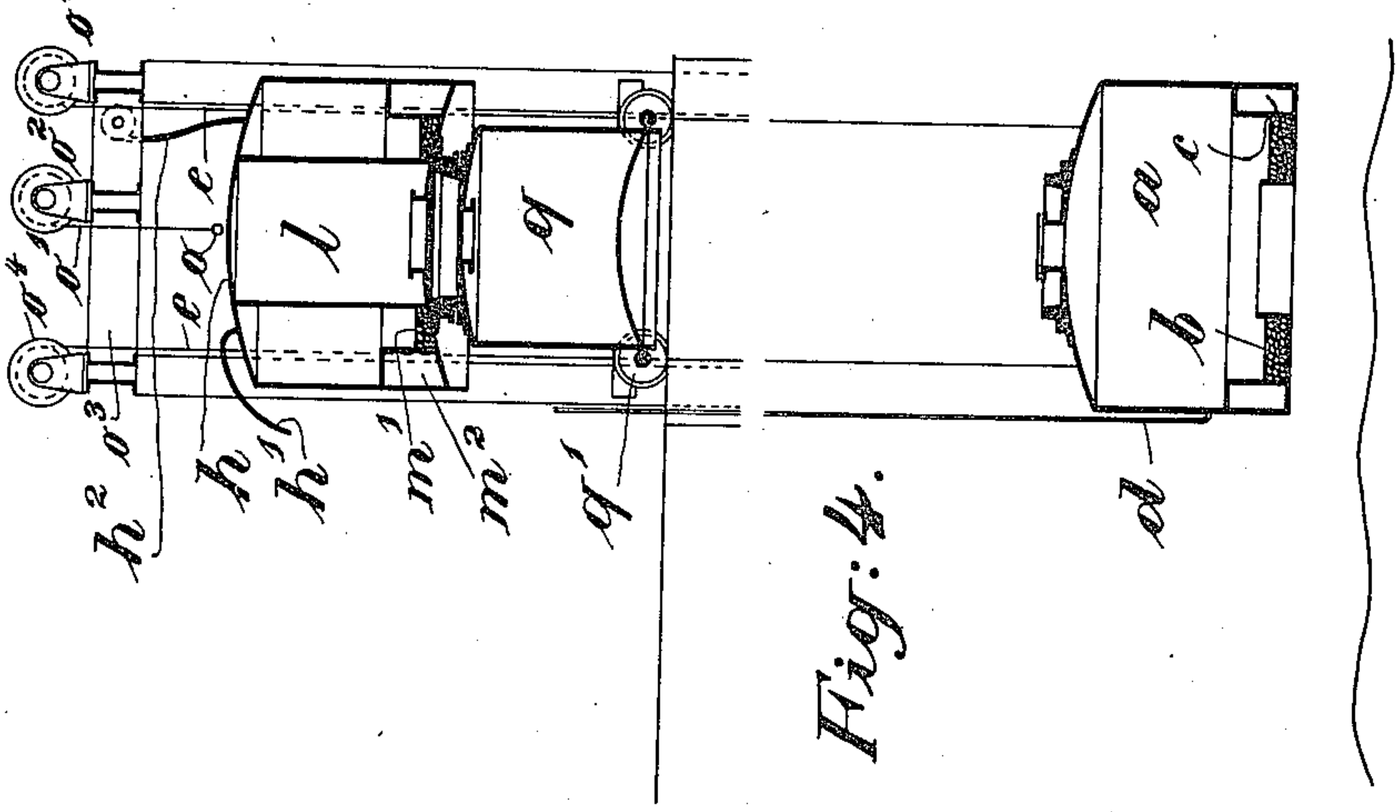

Fig: 4.

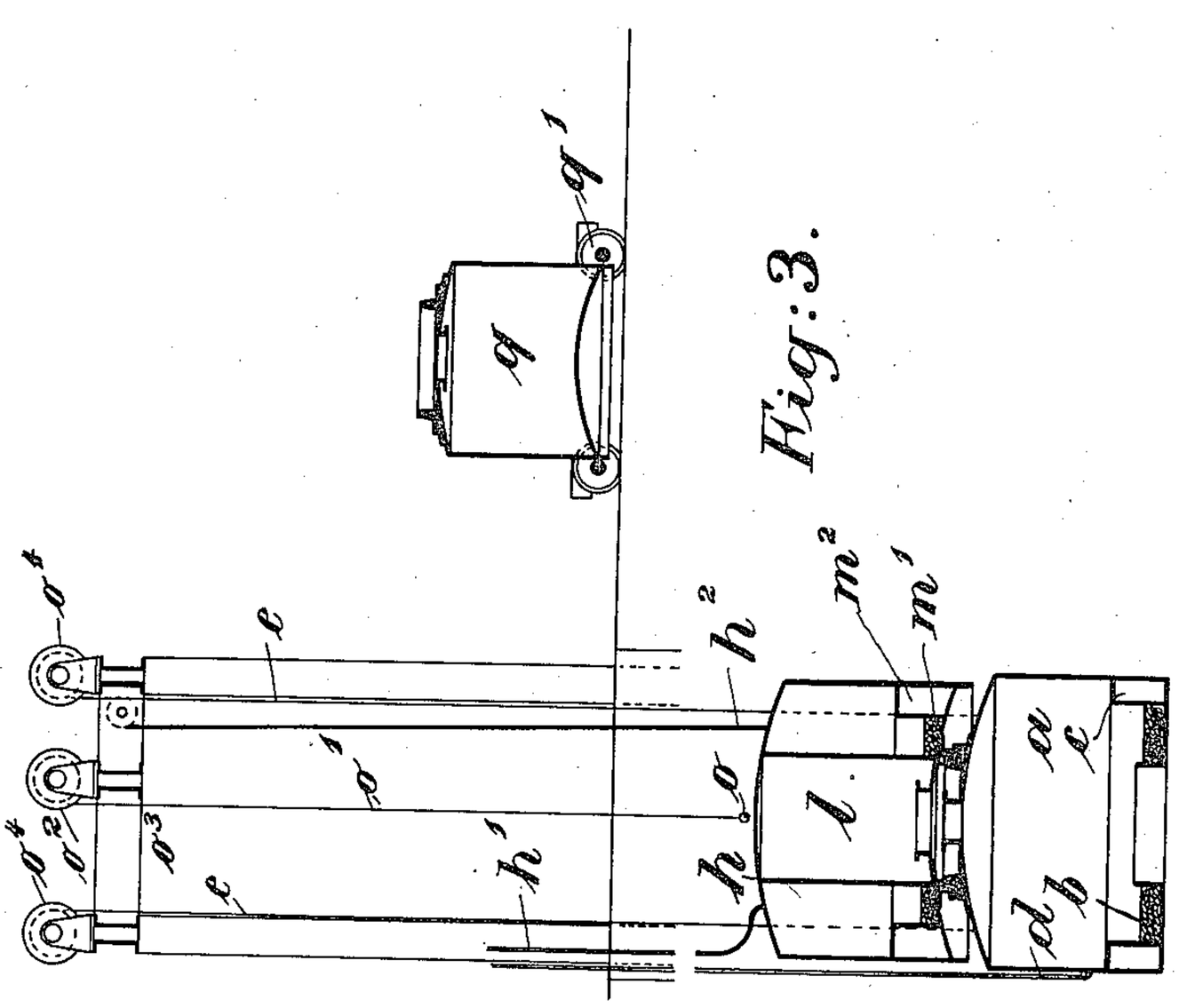

Fig: 3.

Attest

Bent. M. Stahl.

Edwd L. Tolson.

Inventors.

John Garner Flood.

William George Fitzgerald.

by Wm. Wallace White

Atty.

UNITED STATES PATENT OFFICE.

JOHN GARNAR FLOOD, OF WESTCLIFFE-ON-SEA, AND WILLIAM GEORGE FITZGERALD, OF WEST EALING, ENGLAND.

DIVING-BELL APPARATUS FOR SUBMARINE WORK.

962,019. Specification of Letters Patent. Patented June 21, 1910.

Application filed September 30, 1909. Serial No. 520,408.

To all whom it may concern:

Be it known that we, JOHN GARNAR FLOOD, resident of Westcliffe-on-Sea, in the county of Essex, England, and WILLIAM GEORGE FITZGERALD, resident of West Ealing, in the county of Middlesex, England, both subjects of Great Britain, have invented new and useful Improvements in Diving-Bell Apparatus for Submarine Work, of which the following is a specification.

This invention relates to diving bell apparatus for use in submarine work and has for its object the provision of means whereby submarine work can be carried on continuously, such means enabling ready access to and from the chamber from which the work is being conducted without any necessity for interfering with or necessitating the movement of such chamber.

To carry the invention into effect, we form the apparatus in two parts, the lower part consists of a diving chamber provided with suitable permanent ballast and also independent water ballast, the quantity of which can be regulated as circumstances require. This chamber is connected by two or more wire ropes or the like from a supporting device, situated above the surface of the water. The upper part of this lower diving chamber is provided with a door adapted to make a water tight joint with the casing against which it abuts.

Superposed on the lower diving chamber is a detachable upper diving chamber or elevator, and means are provided where these two chambers abut against one another to form a water tight joint and locking attachment between the two chambers. The upper diving chamber or elevator is provided with a separate compartment which can be under ordinary atmospheric pressure, an air-tight door being arranged between this chamber and the main chamber of the device, from which latter access can be had through the door before mentioned in the top of the lower diving chamber to the interior thereof.

The upper diving chamber is provided with permanent ballast and also water ballast, the necessary connections with the water ballast tank and high pressure air supply being arranged so that the occupants of the upper diving chamber can discharge water ballast to give the said chamber buoyancy, and as the chamber is provided with lugs through which the suspension wire ropes pass, on the increase of buoyancy the upper chamber will rise to the surface in a guided manner. In this way ready communication can be made between the lower diving chamber and the surface without difficulty and entirely under the control of those in the upper diving chamber. In order to insure the co-axial alinement of the upper and lower chambers, rigid guides are attached to the lower chamber which may be formed as part of the suspension gear.

It will be observed that as far as the occupants of the upper chamber are concerned there is no necessity whatever for any pressure therein higher than atmospheric pressure, but when access is to be obtained from the upper to the lower diving chamber the air lock must be closed in the upper diving chamber and sufficient air pressure be admitted within the air lock in the upper chamber to balance the pressure in the lower chamber in order to open the door in the upper part of the lower chamber through which admission can be effected.

In order that the invention may be the better understood, we will now proceed to describe the same with reference to the accompanying drawings, reference being had to the letters and figures marked thereon.

Like letters refer to like parts in the various figures.

Figure 1 is a sectional elevation of one form of our invention. Fig. 2 is a sectional plan on the line *x*—*y* of Fig. 1. Fig. 3 is a diagrammatic view showing the apparatus in use under water. Fig. 4 is a similar view showing the lower part of the apparatus under water, and the upper part raised above the water connected to the pressure varying chamber.

Referring to Figs. 1 and 2 the lower part *a* consists of a diving chamber provided with permanent ballast *b* and independent water ballast tank *c* which ballast can be varied in amount by means of a vent pipe and valve c^1 and flooding valve c^2, the discharge of the ballast being effected by air pressure admitted through the valve c^3 from the air pressure pipe *d*. This chamber is supported by two or more wire ropes *e* suspended from a suitable device such as a barge on the surface of the water. On the upper part of the

chamber a man-hole with a hermetically closing door f is provided through which ingress and egress can be effected when desired, a ladder f^1 being arranged for easy passage from the door to the floor of the chamber.

Fresh air from the high pressure air supply d is led to the cocks d^1 to which can be attached air pipes to the diver's helmet, and also for feeding of air to the interior of the chamber a, and if necessary the air from the same source can be obtained for rock drilling and like operations.

On the upper part of the chamber a surrounding the door f is arranged a circular ring g having a conical periphery, and provided at its upper part with a jointing ring g^1 of india-rubber or other suitable material, and on which engages the circular ring g^2 with a conical internal periphery, carried on the under side of the upper chamber h.

The eyes j and j^1 are provided on the exterior of the upper chamber h through which the suspending ropes e pass, the eyes j^1 being provided with a conical hole to engage on to the conical studs j^2 fastened to the upper part of the chamber a in such a manner as to insure the upper chamber h being properly guided into position upon the lower chamber a, so as to insure a water tight joint being made between the two chambers on the ring g^1. When so placed the chambers are locked together by means of a series of claws k arranged around the ring g with which engage a series of projections k^1 carried by a ring k^2, adapted to rotate upon the ring g^2. The engaging surfaces of the claws k and the projections k^1 are inclined to the plane of revolution of the ring k^2 so as to produce on relative rotation a drawing together in an axial direction of the rings g and g^2 against the jointing ring g^1. The ring k^2 is operated by means of a toothed quadrant k^3 attached to the said ring, into which meshes a pinion k^4 operated by worm and worm wheel gearing k^5 and hand wheel k^6.

It will be observed that the upper chamber h is divided into two compartments, a central compartment l which can be put under internal pressure and an annular compartment m which is under atmospheric pressure. The chamber h is provided with a high pressure air supply pipe h^1 and a vent pipe h^2 the latter having a control valve h^3 situated within the compartment m, fresh air being supplied to the compartment through the valve h^4. At the lower part of the chamber, permanent ballast m^1 is arranged, and around this ballast the water ballast tank m^2 is formed.

The water ballast is admitted through the flooding valve m^3 a vent pipe and valve m^4 leading to the top of the ballast tank allowing the air to be displaced by the water. The water is displaced when necessary, by means of high pressure air led into the ballast tank through the valve h^5 and pipe h^6.

The compartment l is formed as an air-lock and is provided with a door n fitted with a pressure equalizing valve n^1. Air from the high pressure supply is admitted to the compartment l through the valve h^7 operated by any person in the compartment m or by the valve h^8 operated by any person in the compartment l, the pressure in the chamber being indicated by a pressure gage n^2. At the lower part of the compartment l the man-hole door l^1 is fitted, having fastening devices l^2 and jointing ring l^3.

At the upper part of the chamber h an eye bolt o is fixed to the suspending rope o^1 which passes around the winding drum o^2 on the gauntree o^3 carried by the barge on the surface of the water. The ropes e which are attached to the chamber a are led around the winding drums o^4 mounted on the same gauntree.

As in deep sea diving it is necessary to take considerable time for the diver to undergo the processes of compression and decompression which time under known conditions has been lost and the energy of the diver materially sapped by the process of sending the diver down, and bringing him up, during a period of considerable duration; in order to avoid these conditions, in our apparatus we provide compression and decompression chambers q on the surface, which are generally similar in construction to the chamber a as far as the means for connecting thereto the chamber h. These chambers q are preferably mounted on wheels q^1 so that they may be moved under and drawn away from the chamber h, when raised into the position shown in Fig. 4. In this way the processes of compression and decompression can be carried out on the surface with no fatigue to the diver, who can be resting comfortably in the chamber q under the best conditions.

A series of windows p are arranged around the sides of the chamber h so that the operations in the water can be observed by the occupants of the compartment m. The window p^1 is also provided in the door n, through which observation can be made from the compartment m into the compartment l, or vice versa.

The method of using the apparatus is as follows:—The lower chamber a is lowered to any given depth, the operators then enter the compartment m through the door n which is then closed, the compartment m being under atmospheric pressure. The compressing chamber q containing the diver in a compressed atmosphere is now placed into position under the chamber h, and the two chambers are locked together by manipulating the hand wheel k^6. The pres-

sure in the compartment l is now raised until it reaches that of the compartment q, when the diver can open the door in the upper part of the chamber q and pass into the compartment l when he closes the door l^1 and tightens up the fastening device l^2. The hand wheel k^6 is now operated to unlock the chambers q and h from one another, and the chamber q is moved from under the chamber h. The chamber h is now lowered into the water, the necessary amount of water ballast being admitted to the tank m^2 in order to cause it to sink. In its descent it is guided by the ropes e into position on the chamber a, and when so placed, the hand wheel k^6 is operated so as to lock the two chambers to one another. The diver now unfastens the doors l^1 and f when he can descend through the man-hole into the interior of the chamber a; to enable him to open the door l^1 the valve t is provided. The diver can then attach his air pipe to one of the valves d^1 and can enter the water through the passage in the lower part of the chamber a. Should it be desirable to drain the chamber surrounding the door f the valve t^1 can be opened. In returning from the chamber a to the compartment l the operations above described are reversed in order. It will be observed that the occupants of the atmospheric compartment m can observe the work of the divers through the windows p. When the doors l^1 and f have been closed and fastened, the chamber h can return to the surface, which it does in a guided manner, either by being lifted by the rope o^1 or by discharging the water ballast from the ballast tank m^2 or if desired by both means.

It will thus be seen that direct and easy means of communication is provided, between the operating chamber and the surface of the water, without disturbing the conditions set up in the operating chamber in any way, so that a succession of divers or operators can be kept going, and the work be proceeded with continuously.

The difficulties and inconveniences which result under known methods of diving relative to the currents acting on the air hose and life lines attached to the diver, which involve the risk of his being pulled off his feet at any moment, and of fouling the hose and lines around wreckage or other obstructions is entirely avoided as the present invention only requires a short length of pipe for connection to one of the air valves d^1; this pipe being disposed more or less in a horizontal position.

The method of using the apparatus already described is very advantageous when depths of 150 to 200 feet have to be dealt with, as in such cases more time is spent in compression and decompression than in actual work.

In cases of depths less than those mentioned above, in which compression or decompression is not a serious item, the use of the chamber q may be dispensed with, and access be effected to the compartment l from the compartment m through the door n while under water, in which case the equalization of pressures necessary for relieving pressure on the door n must be effected.

What we claim as our invention, and desire to secure by Letters Patent is:—

1. Diving apparatus consisting of two parts adapted to be superposed on one another, the lower part being formed as a diving bell with a closable orifice in its upper portion, means for suspending said lower part from a supporting device at the water surface, the upper part being formed as a closable chamber and provided with means for being guided on to and making a water tight joint with the lower part, and operative means attached to said upper part, adapted to support, raise and lower the said upper part, substantially as described.

2. In a diving apparatus consisting of two parts adapted to be superposed on one another, the lower part being formed as a diving bell with a closable orifice in its upper portion, means for suspending said lower part from a supporting device at the water surface, the upper part being formed as a closable chamber and provided with means for being guided on to and making a water tight joint with the lower part, operative means attached to said upper part, adapted to support, raise and lower the said upper part, a water ballast tank in the upper part of the apparatus and means by which air is made to displace the water ballast or vice versa in order to vary the buoyancy of said upper part, substantially as described.

3. In a diving apparatus consisting of two parts adapted to be superposed on one another, the lower part being formed as a diving bell with a closable orifice in its upper portion, means for suspending said lower part from a supporting device at the water surface, the upper part being formed as a closable chamber and provided with means for being guided on to and making a water tight joint with the lower part, operative means attached to said upper part, adapted to support, raise and lower the said upper part, a water ballast tank in the lower part of the apparatus, and means by which air is made to displace the water ballast or vice versa in order to vary the buoyancy of said lower part, substantially as described.

4. In a diving apparatus consisting of two parts adapted to be superposed on one another, the lower part being formed as a diving bell with a closable orifice in its upper portion, means for suspending said lower part from a supporting device at the

water surface, the upper part being formed as a closable chamber and provided with means for being guided on to and making a water tight joint with the lower part, operative means attached to said upper part, adapted to support, raise and lower the said upper part, means by which the upper chamber is guided by the suspending ropes of the lower chamber on to the same jointing devices on the two chambers co-acting with each other to form a water tight joint and fastening means operable from the upper chamber adapted to firmly clamp the jointing devices together at will, substantially as described.

5. In a diving apparatus consisting of two parts adapted to be superposed on one another, the lower part being formed as a diving bell with a closable orifice in its upper portion, means for suspending said lower part from a supporting device at the water surface, the upper part being formed as a closable chamber and provided with means for being guided on to and making a water tight joint with the lower part, operative means attached to said upper part, adapted to support, raise and lower the said upper part, an atmospheric chamber and a pressure chamber in said upper part, closable means of communication between the two chambers and means for supplying and controlling high pressure air to the pressure chamber, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

JOHN GARNAR FLOOD.
WILLIAM GEORGE FITZGERALD.

Witnesses:
RICHARD A. HOFFMANN,
RICHARD WESTACOTT.