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APPARATUS FOR SUBMARINE EXPLORATIONS AT GREAT DEPTHS

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2 Sheets-Sheet 1

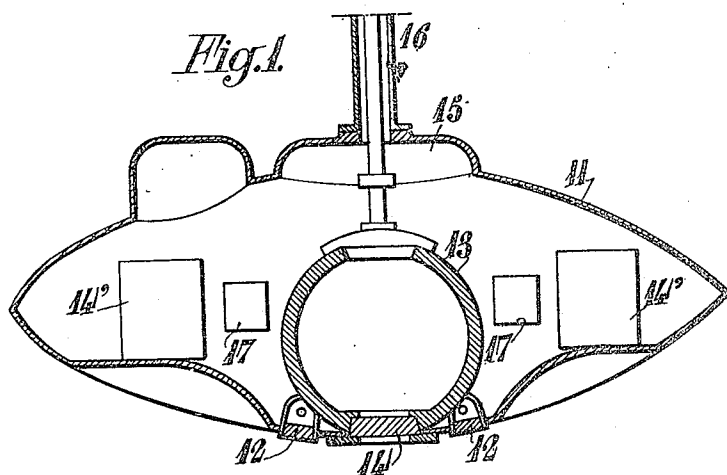


Fig. 2.

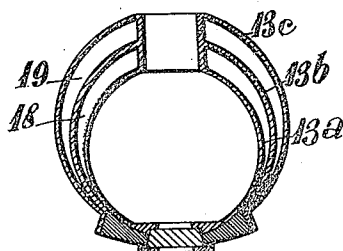
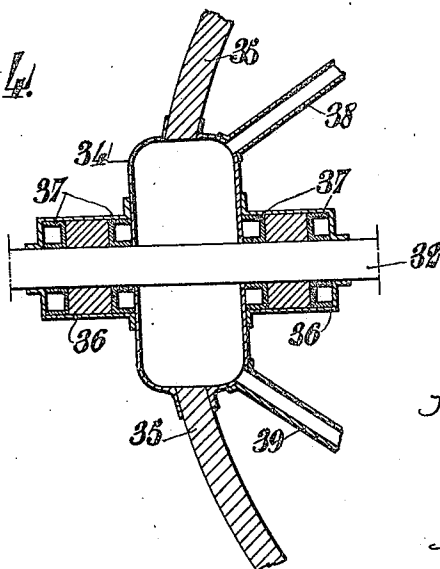


Fig. 4.



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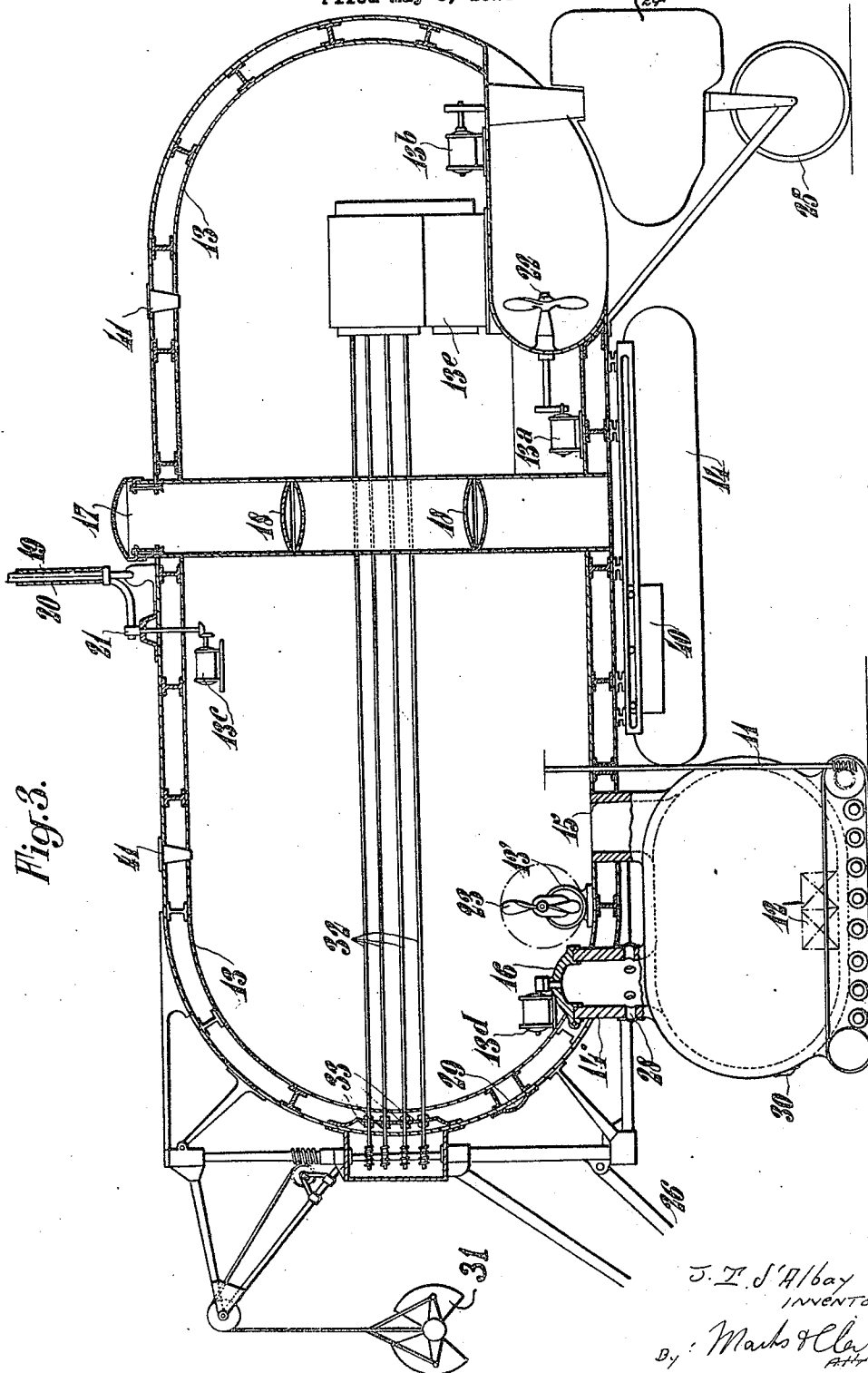
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UNITED STATES PATENT OFFICE

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APPARATUS FOR SUBMARINE EXPLORATIONS AT GREAT DEPTHS

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The present invention relates to an apparatus for submarine explorations at great depths. This apparatus comprises a shell which can be immersed at great depths, and contains the tools for releasing and gripping wrecks, one or more doors for the attendants controlling the operation of these tools, and devices for operating the shell and for the security of the attendants.

10 This apparatus is mainly characterized by the use of a fluid-tight shell in which is maintained a fluid under a pressure variable according to the depth of immersion, of at least one shell of reduced dimensions, devised for resisting external pressures, and within which is maintained air at atmospheric pressure. The shell constituting the quarters for the attendants controlling the operation of tools is arranged in the first shell.

20 A form of construction of an apparatus for submarine explorations at great depths is mainly characterized in that:

The two main shells of the apparatus: low pressure shell and high pressure shell, are internal or external one to the other, the high pressure shell constituting the floating part of the apparatus and has propulsion and balancing means, as well as means for bearing and moving on a resistant bottom, combined with propelling means, such as caterpillars carried by the low pressure shell which contains the attendants;

30 The fluid introduced in the floating shell has a pressure approximately equal to the external pressure. The fluid used is preferably compressed air obtained from a source at the surface through one or more conduits forming a suspension cable for the apparatus, and from a reserve supply stored in fluid-tight compartments. The reserve fluid can also be used for ensuring the action of water-ballasts adapted to facilitate the evolutions of the apparatus in combination with movable balancing bodies.

40 Internally to the high pressure shell, are arranged all the driving sources and the kinematic devices connecting them to the propelling or stabilizing parts, and to the mechanical tools secured on the high pressure shell externally to the latter.

The lighting sources can be distributed on the high pressure and low pressure shells, the means for direct and indirect visions being arranged only on the low pressure shell.

The accompanying drawings illustrate, by way of example only, forms of construction of improved submarine devices.

Fig. 1 is a vertical longitudinal axis section of a first form of construction.

Fig. 2 is a cross section of a modification of the quarters for the attendants.

Fig. 3 is a vertical longitudinal axial section of a second form of construction.

Fig. 4 is a sectional view of a detail.

In the form of construction illustrated in Fig. 1, the outer shell 11 can advantageously be constituted from the hull of an old submarine boat, and the shell serves to support exteriorly thereon tools such as pincers or grippers of any suitable arrangement, adapted to be driven by electric motors placed under the control of the attendants of the apparatus. These grippers or pincers adapted to grip the wrecks, operate in zones lighted by search-lights 12 placed on board the apparatus and provided with any suitable means allowing to orientate the light beams at the desired places.

The outer shell 11 contains at least a second shell 13 containing air at atmospheric pressure and which constitutes the quarters of the operators. The shell 13 is preferably spherical and its resistance is computed according to the pressures corresponding to the maximum depths for the exploration of which the apparatus is devised.

The shell 13 is suitably secured within the shell 11 and is provided with one or more port-lights or apertures 14 provided with a resistant glass plate for allowing the operators to see and control the operation of the pincers or other tools. The search-lights 12 with orientable beams, allow of lighting the bottom below the apparatus.

The shell 11 can enclose the electric motors actuating the mechanisms operating the tools for gripping the wrecks, and is provided with one or more openings having fluid-tight closures. One of these openings receives a conduit 16 which can constitute one

of the suspension means of the entire apparatus. Within this conduit 16 pass the conductors feeding current to the various motors of the apparatus, as well as the telephone lines allowing the occupants of the shell 13 to remain in relation with the ship or ships at the surface which ensure the descent or the raising of the apparatus.

The conduit 16 is preferably made of a material the density of which is as near as possible to that of sea water.

As indicated in the foregoing, a fluid is maintained under pressure within the shell 11, so as to constantly balance the external pressure of water. In this way, the hull which constitutes the shell 11 being simply compressed between two opposite thrusts is not necessarily very resistant and may be formed by the hull of an old submarine boat.

The fluid under pressure may be air, or a liquid such as oil. The electric motors 14' can be iron-clad with their parts immersed in a liquid such as the oil of transformers.

The control of the motors and of the various mechanisms driving the tools of the apparatus, is effected by the occupants of the shell 13, through the medium of relays 17 resiliently driven from the interior of the shell 13 by suitable electric circuits.

It is obvious that electric motors can be arranged externally to the shell 11. These motors being iron-clad with their parts immersed in an oil bath, and can be arranged at various points of the mechanisms of the tools for releasing and gripping wrecks, for facilitating the operations, these operations being controlled from the interior of the shell 13 by electric devices, with interposition of relays, if need be.

The means of access within the shell 11, on the one hand, and the shell 13, on the other hand, may be those already used on submarine boats, but reinforced for resisting to the pressures to which they are subjected.

As illustrated in Fig. 2, the shell 13 can be constituted by multiple walls 13a, 13b and 13c between which are maintained fluids under pressure. With such an arrangement, it will be seen that the walls 13a, 13b, 13c can be subjected to stresses which are for the greater part compression stresses. The walls can be, from this fact, of reduced thicknesses. The pressures increase in the spaces 18, 19 from the interior of the shell 11 which is at atmospheric pressure.

The apparatus can be self-propelled, its depth of immersion being preferably obtained by adjustment of the length of the suspension means (conduit 16—frame and cables) which connect it to the ships at the surface.

A second form of construction is more particularly illustrated in Figs. 3 and 4. This second form comprises also three main parts:

A low inner pressure shell having thick

walls, which constitutes the quarters for the operators of the apparatus.

A second high inner pressure shell having thin walls.

The power sources, the various mechanisms of the apparatus and their connections.

The low pressure shell 11, which constitutes the quarters for the operators of the apparatus, has a volume as reduced as possible. Its wall is made for resisting pressures distinctly higher than those to which it may be subjected. In this shell are grouped all the members for the control from a distance of the power sources and of the devices provided in the apparatus. In the shell 11 are also arranged the apparatus 12 adapted to maintain a breathable atmosphere and to eventually evacuate the water which may have entered the said shell.

The shell 11 may be placed within the high pressure shell, as in the first form of construction, or it may be external to the same, as in the second form of construction.

A high pressure shell 13 may be of any suitable shape and, for instance, it may be constituted by a cylindrical body with hemispherical ends. The walls, which may be simple or multiple walls, are relatively thin, since the pressures on both their faces are approximately equal.

The inner pressure is preferably obtained by means of compressed air and can be slightly higher than the external pressure for avoiding any entrance of water through the various joints for the passage of the connection members between the various mechanisms and devices of the apparatus.

The shell 13 encloses partially or in totality the machinery; and it comprises one or more tanks 14 having resistant walls and containing reserves of compressed air. The various electric motors 13', 13a etc., are also arranged in the shell 13.

The shells 11 and 13 are connected together by one or more conduits 14' and 15 provided with fluid-tight obturators 16, of any suitable arrangement, operated preferably mechanically by a motor 13^a. The operators have access to the shell 11 through at least one of these conduits, when the pressures are equal in both shells and equal to a value which is not dangerous for the operators. One or more conduits, such as 14' and 15, are used for the passage of the electric conductors or of the gas pipe lines, or optical tubes, or mechanical connections between the inner plant of the shell 13 and the various control means arranged in the shell 11. Access to the shell 13 is obtained through one or more openings 17 provided with suitable obturators, locks 18 being advantageously provided for entering or going out of the apparatus as long as the internal or external pressure allows it.

The connection between the apparatus and

the ships at the surface can be permanent or temporary, according to requirements, and constituted for instance in the following manner:

One or more comprised air feeding conduits 19 are so manufactured that their resistance to bursting varies with the depth of immersion. A suspension cable is also provided and preferably constituted by steel wires. The cables feeding the current to the various motors, as well as the telephone lines ensuring the connection between the operators of the shell and the crews of the ships at the surface are preferably arranged within the conduit 19.

The whole of the various conductors and of the conduit 19 can be enclosed in an insulating lining 20. It is possible, by a judicious choice of the various sections of the elements of the cable, to obtain, for the whole, a medium specific weight, approximately equal to the unit and to suppress, from this fact, the tensions arising from the immersed length of cable. It is also possible, for the same purpose, to provide, at suitable intervals, on the length of the cable, balancing floats. The junction of the cable with the shell 13 can be established so as to be dispensed with at will for allowing the apparatus to freely move about. For that purpose, a locking bolt 21 can be actuated by an electric motor 3° for breaking the connection.

The accessory devices of the apparatus can be classified in five groups:

- a The movement devices,
- b The sighting devices,
- c The lighting devices,
- d The working devices,
- e The safety devices.

The group *a* comprises, first of all, all the propelling, steering and stabilizing means appropriate to submarine navigation. These means comprise propellers 22 for propelling purposes and propellers 23 for evolution purposes (these propellers being actuated by motors 13' and 13"), and rudders 24. These various parts, combined with the water-balloasts above mentioned, satisfy the requirements of the technics of submarine navigation and do not present any remarkable particularities. These latter means can comprise carrying wheels; such as 25, mounted, if necessary, on orientable frames or chassis, and supporting skids 26, preferably telescopic skids or skids movable in any suitable manner. The propelling means on the bottom are advantageously constituted by caterpillars 27 carried by the shell 11.

The group *b* comprises sighting devices. These devices comprise port lights 28 which allow, either directly, or indirectly, by any suitable optical devices, of observing the explored regions, through the walls of the shell 11. The field of visibility of these parts is so determined as to allow the observation

of the various working apparatus secured on the shell 13. Sighting means can also be provided for allowing to observe the interior of the shell 13.

The lighting devices of the group *c* can use light sources operating as excess pressure fluids, and such as 29 (Fig. 3), or electric light sources enclosed in fluid-tight chambers in which exist a fixed internal pressure, and such as 30 in Fig. 3. These latter types of light sources can be combined with optical systems of any suitable arrangement, the glasses of which can advantageously be coloured for limiting the loss of lighting intensity and for giving a light which is as similar as possible to solar light.

The working devices which constitute the group *d*, are variable with the object of the explorations undertaken. They are preferably all supported by the shell 13, the shell 11 being still reserved as quarters for the crew and for containing the apparatus for control from a distance.

In the example illustrated, the working devices comprise gripping devices such as grapple 31, actuated from the interior of the shell 13 by various shafts 32.

These various shafts pass through the wall of the shell 13 in stuffing-boxes 33 which, considering the small difference between the internal and external pressures, can be devised in a relatively simple manner. An example of advantageous realization of these stuffing-boxes is diagrammatically illustrated in Fig. 4.

A fluid-tight box 34 is secured on the wall 25 through which passes the shaft 32 and comprises two end housings or chambers 36 for fluid-tight packings such as cup leathers 37, for instance. The box 34, is located between the two chambers 36, and is in communication, through a chamber 38, with a source of lubricant under pressure. It can also be in communication through a conduit 39, with a header collecting the leakage of the various joints and evacuating it to the exterior.

When the working devices and the various tools are in service, balancing bodies 40 (Fig. 3) can be displaced for allowing the gripping devices to exert important stresses without rocking of the whole of the apparatus.

The group *e* comprises the various security devices.

These devices comprise, first of all, the means allowing to vary the pressure within the shell 13. For that purpose, compressed air can be forced through the conduit 19 fed by compressors or compressed air reserves, at the surface. The reserve of air under high pressure, contained in the chamber or chambers 14, may also be caused to intervene.

The buoyancy of the shell is adjusted by

the water-ballasts, according to the technics adopted in submarine navigation.

Valves 41, ensuring a large outflow, are provided on the shell 13 for allowing the sudden escape of the compressed air in case of sudden variation of the external pressure from any cause whatever.

The depths which can be reached with the improved apparatus as just explained, are variable and particularly depend on the wall of the shell 11. They depend also on the slack which can be given to the suspension cables when the apparatus operates as a captive apparatus.

In case the connection with the ships at the surface is suppressed, the radius of action of the apparatus depends on its reserves of energy, that is to say on the capacity of the accumulators, and on the importance of the reserves of compressed air. These latter reserves obviously intervene in potential for determining the maximum depth which can be reached. Finally, another factor, the physical resistance of the crew, intervenes in the duration of the explorations. However, concerning this point, it is to be noted that the crew work in an atmosphere the pressure of which is as near as desired to atmospheric pressure. This atmosphere can be easily renewed, considering the reserve of air available in the shell 13.

What I claim as my invention and desire to secure by Letters Patent is:

A submarine device having in combination a shell of sufficient strength to serve as a supporting base, mechanical operating or engaging means arranged exteriorly upon said shell, electric motors in said shell, drive means between said motors and said operating or engaging means, a substantially non-corrosive dielectric compressed or incompressible fluid filling said shell, means to maintain a substantially equal pressure in said fluid and the exterior water, a second shell, connected to said first shell, a fluid under approximately atmospheric pressure filling said second shell, remote control means in said second shell for controlling said motors and said operating or engaging means, said second shell being of relatively small dimensions and having strong walls to permit said second shell to operate with approximately atmospheric pressure therein to relatively enormous depths of immersion.

In testimony whereof I have signed my name to this specification.

JACQUES TOURNADOUR d'ALBAY.