

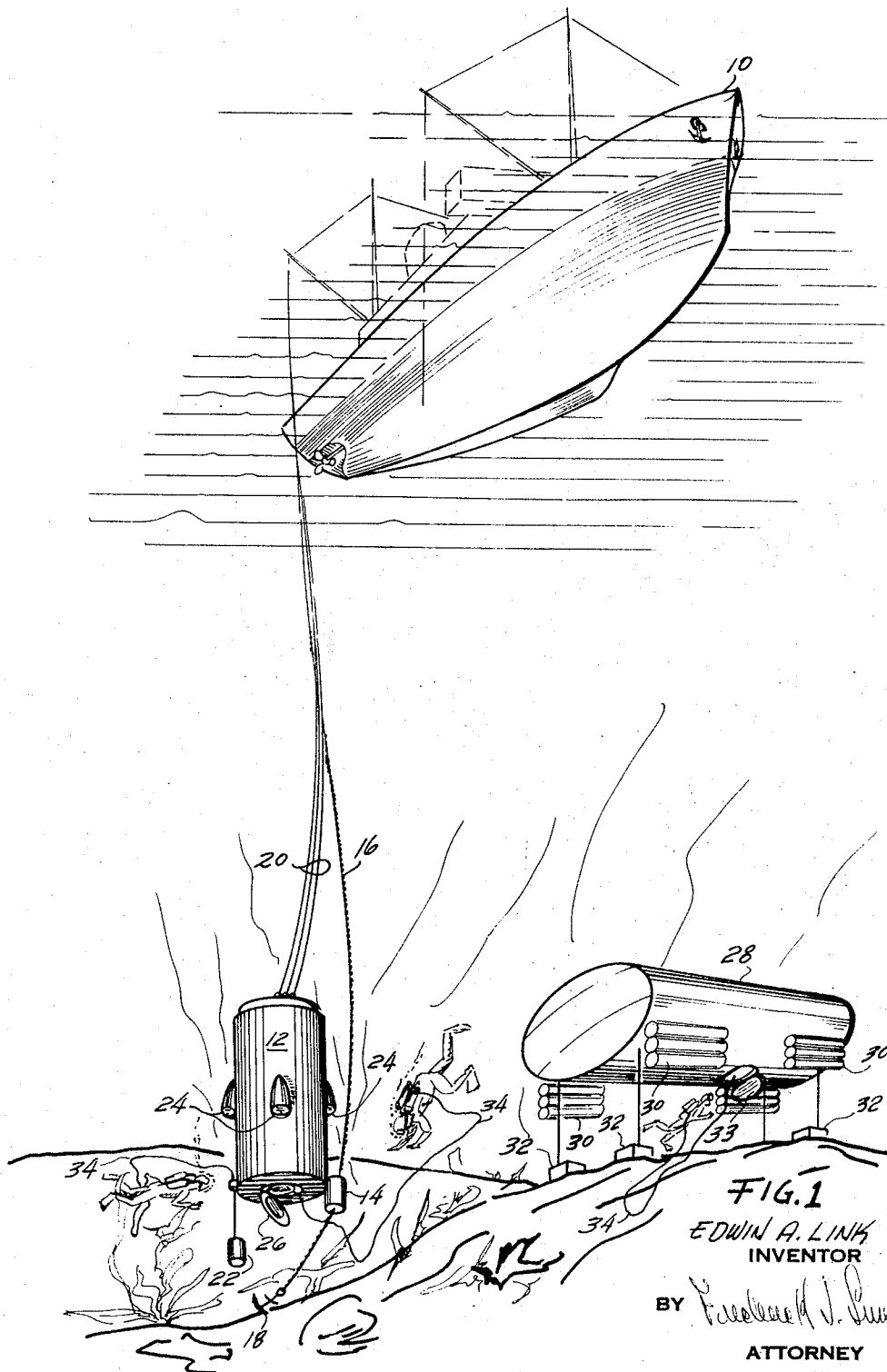
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E. A. LINK
UNDERWATER CAPSULE

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

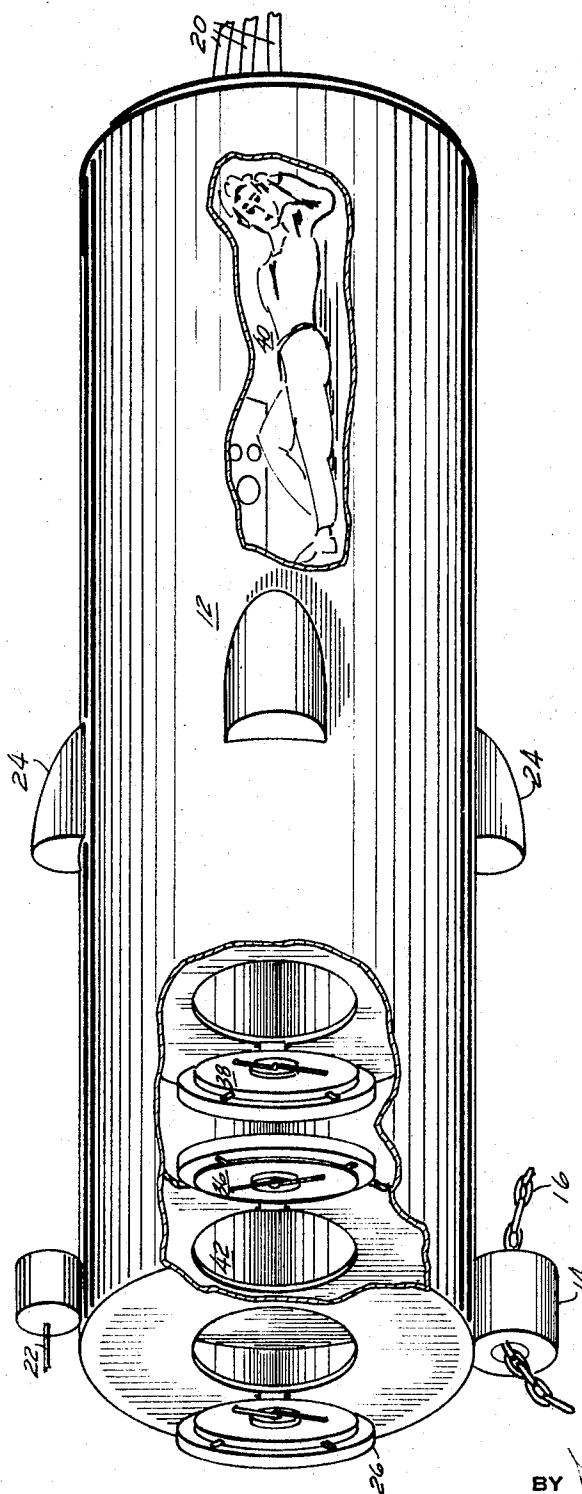


FIG. 2

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3,299,645

UNDERWATER CAPSULE

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5 Claims. (Cl. 61-69)

This invention relates to an underwater capsule and more particularly to an improved underwater capsule which allows a human diver to operate at greater depths for an extended period of time than heretofore possible.

It has long been known that, for a great many separate reasons, it is highly desirable to enable an operator to work beneath the sea for salvage, mining, and/or exploration operations. At the present time two individual undersea diving methods are employed. The first consists of the conventional heavy canvas diving suit together with a massive protective metal helmet. The user of this equipment, which includes a number of lead weights, may operate in depths of several hundred feet for a period of several hours, the total operational time being limited by the fact that the return trip to the surface must be interrupted by a number of time periods, at particular depths, in order to prevent "bends" which normally result from too rapid an ascension from the working depth to the surface. The second system, known as scuba diving, employs a thin, waterproof suit and a self-contained supply of breathing atmosphere, which is effective only for limited underwater exploration.

As is well-known, each of the above briefly described systems are characterized by the fact that the diver can remain submerged for only a relatively brief period of time at the desired working depth. By way of example, a helmeted diver can remain submerged to a depth of 200 feet for a total period of less than 3 or 4 hours, and, additionally, requires a period of about 7 hours in order to ascend to the surface from this depth. It clearly is obvious that each of the above disclosed systems preclude extensive underwater operations.

According to the present invention there is provided a novel apparatus which is effective to allow one or more operators to be gainfully engaged in undersea explorations for a period of time measured in days, weeks or even months, thereby combining the effectiveness of a submarine vehicle with that of a self-contained diver. It is well-known that a diver equipped with a conventional diving suit is unable, while so equipped, to either eat or drink, and, obviously, cannot possibly enjoy either a relaxation period or sleep. As hereinafter more particularly described, it will be shown that the apparatus of the invention not only allows one or more persons to operate efficiently at a selected depth, but also provides necessary feeding and relaxation conditions. Essentially, the apparatus of the invention provides a house under the sea.

Briefly, the invention provides at least one pressurized vehicle in which an operator can be housed during a period of submersion and, further, the operator can enter and leave the housing at will. Apparatus is included, controlled by the operator, to maintain the pressure within the vehicle equal to or greater than the surrounding water pressure. Thus, when the undersea house is opened to allow the operator to freely explore the depths in his immediate neighborhood, water is effectively prevented from entering the housing. Additionally, since nitrogen has an adverse effect at depths in excess of 60 feet, the operator is provided with a mixture of oxygen and helium, the mixture being adapted for the particular depth at which the housing is located. Further, due to the difficulty and expense of obtaining helium, the helium is re-

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circulated through the breathing system with only oxygen being added and carbon dioxide being removed as necessary.

As a particular example, at a depth of 200 feet, the breathing mixture comprises 97% helium and 3% oxygen, while at a depth of only 40 feet the oxygen content is raised to total 21% of the overall mixture. Further, and this is an important feature of the invention, the operator, during the times he is located external to the housing system of the invention, is supplied with the necessary breathing mixture not directly from a surface vessel but directly from the housing system itself. In this manner, the lung resistance problem is completely overcome, since the operator is supplied not from an extensive, narrow, pressurized feeder cable but merely through a short-length of tubing connected with the housing apparatus at a pressure which is merely 2 or 3 p.s.i. above the pressure existing in the housing apparatus.

It is an object, therefore, to provide an improved underwater capsule.

Another object of the invention is to provide an underwater capsule effective to permit one or more operators to operate efficiently for an extended period of time at a preselected depth.

Still another object of the invention is to provide a novel underwater capsule operative to allow underwater farming.

Still another object of the invention is to provide an improved underwater breathing system.

A further object of the invention is to provide a simplified decompression apparatus.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a diagrammatical illustration of the system of the invention.

FIG. 2 is a cross-sectional view of one embodiment of the apparatus of the invention.

Before describing the apparatus of the invention in detail, it is believed pertinent to emphasize yet another important feature of the invention, which is the recognition of the fact that, essentially independent of the total time an operator is submerged or remains submerged at selected depths, the overall decompression time remains a constant. By way of example, with the helium-oxygen breathing mixture employed in the apparatus of the invention, the human body becomes completely saturated with helium after a duration of approximately 12 hours. Further exposure to the helium-oxygen mixture thereafter will not increase the quantity of helium absorbed into the body's circulatory system. Therefore, if the operator remains submerged for a day, a week, or month, the total decompression time is constant. Prolonged submersion to a depth of 200 feet requires a decompression time of 16 to 18 hours, and prolonged submersion at 400 feet necessitates a decompression time of 18 to 24 hours; each of these times being independent of the time duration expended by the operator at the recited depths. Further, as will become apparent as the description proceeds, the basic housing provided by the invention allows the decompression to be attained either submerged or even on board the surface vehicle.

Referring now to the drawings, FIG. 1 diagrammatically illustrated a first preferred embodiment of the apparatus of the invention. As there shown, a mother ship 10 provides support for the underwater exploration.

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A housing 12 is controllably operated by a diver to attain a selected depth by means of a winch 14 cooperating with a chain 16 to raise and lower housing 12, the lower end of chain 16 being secured to the sea bottom by an anchor 18. Also connected to the upper portion of the housing 12 are a plurality of cables 20, one of which supplies the pressurized breathing mixture from ship 10 to housing 12, another one of which returns the exhausted mixture from housing 12 to ship 10 and the remaining cables coupling the necessary power and communication systems between the ship and the housing. Additionally, a weight 22 is secured to a lower portion of housing 12 in order to maintain the housing in approximately vertical condition.

Housing 12, hereinafter more particularly described, which effectively functions as an "elevator," includes a number of viewing ports 24 effective to permit an operator contained therein to view the external surroundings. Additionally, in the lower portion of housing 12 are a pair of hatches 26 and 36, which allow an operator to selectively explore the area external to the housing. Further, it should be noted that the use of a pair of hatches positioned in the lower portion of housing 12, is of extreme importance when housing 12 is employed as an "elevator"; that is when conveying one or more divers from the surface to a selected depth. This results from the fact that during the ascent and descent of the "elevator," the pressure within the diver's compartment 40 is maintained relatively constant, although the external water pressure is varying at approximately one-half pound per foot. If initially the pressure internal of housing 12 was set to correspond to the water pressure encountered at a depth of 200 feet, it will be seen that that internal pressure is substantially greater than the surface water pressure, tending to allow the internal pressure to exhaust externally. However, at a desired depth of about 400 feet, the internal pressure is much less than the external water pressure, resulting in the water tending to enter the internal volume of housing 12. It is obvious that these opposing forces, which are analogous to tension and compression, result in severe design requirements should a single hatch be employed, such as in a submarine wherein the internal pressure is always less than the external water pressure. Although it is possible to maintain the pressure within the housing equal to the external pressure during vertical movement of the "elevator," such a complex apparatus necessarily is relatively expensive and increases the hazards encountered by the divers. By means of compound hatches 26 and 36, however, the first of which opens outwardly and the second of which opens inwardly, the problem is solved in an economical and efficient manner. Thus the purpose of hatch 26 is to restrain the external water pressure, and that of hatch 36 is to confine the breathing mixture internal of housing 12. It should be apparent, that, from the substantially vertical position of the housing together with the fact that the pressure within the housing is maintained equal to or greater than the surrounding water pressure when the housing has reached the desired depth, hatches 26 and 36 may readily be opened without any water entering the interior section of the housing. Thus an operator within the housing can selectively leave and return to the housing at will, all without the necessity of removing water from the internal area of the housing.

Housing 12 is essentially a self-contained underwater capsule which, not only operates in a manner similar to an "elevator," but can also be employed as a base for one of more operators. Additionally, housing 12 operates as a decompression chamber within which the operator is relaxably contained during the necessary decompression time interval, either while submerged or even on board ship 10.

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Also shown in FIG. 1, is a further housing 28 which includes a number of breathing mixture tanks 30. Alternatively, of course, housing 28 could be directly supplied from ship 10 as is housing 12. As should now be apparent, housing 28 can have any desired dimensions sufficient to provide support and housing conditions for a predetermined number of operators. As shown, housing 28 is secured to the sea bottom by a number of anchors 32 although other and various devices may be so employed if desired.

In operation, it being remembered that the capsule of the invention is effective to permit one or more operators to remain at a great depth for an extended period of time, housing 12 is immersed into the sea from ship 10, the pressure within the housing being maintained at a level sufficient to prevent the entry of water therein. At this time an operator enters the housing through hatch 26 and operates winch 14 to cause the housing to attain the desired depth. At this depth the operator, through the use of hosing 34 may then emerge from the housing and engage in an exploration or other desired operations returning to the housing for rest and relaxation as desired. Alternatively, of course, the operator may leave housing 12 and enter housing 28 through a hatch 33. It is important to note, and this is an important aspect of the invention, that the self-contained diver while operating remotely from either of housings 12 or 28 is supplied with a breathing mixture directly from the associated housing. By this method the pressure in hosing 34 is merely 2 to 3 p.s.i. greater than the pressure within the housing. This important feature permits improved efficiency of the diver, since his breathing mixture is not supplied through several hundred feet of small tubing. Thus, the breathing mixture is fed to housing 12, or contained upon housing 28, and the mixture is provided directly from these housings to the diver rather than being directly supplied from ship 10. Additionally, which is another important feature of the invention, a mixture of helium and oxygen is supplied from ship 10 to eliminate any possibility of nitrogen narcosis affecting the operations of the diver. As a result of the expense and the difficulty of obtaining helium, the helium is continually recirculated through the system. The associated breathing mixture from housing 12 is returned to ship 10 whereat the carbon dioxide is removed from the mixture by a conventional lithium hydroxide filter, and oxygen is added at a percentage sufficient to insure that the absolute quantity delivered to the diver is independent of the operating depth.

It should also be noted that mobility, improved depth control, and portability are especially significant advantages to a diver who is not dependent on an umbilical connection to the mother ship. Operating from a submerged housing, such as housing 28, he is not subjected to the forces incurred from surface storms. Important work reaching a critical point will not have to be interrupted to make the then dangerous return to the mother ship buffeted by high seas. Further, long drawn out repeated decompression cycles will not have to be continuously made during large scale diving operations, since the divers involved can return into and relax within inflated housing 28. Although the decompression cycle for deep dives is necessarily lengthened, as a result of the total amount of helium absorbed in the blood stream, the advantages gained by the lengthier work and rest periods on the bottom more than compensate for this inconvenience. The combined savings in "commuting time" alone for deep dives will at least double the effectiveness of diving teams, and the additional 400 feet of depth enlarges the possible diving areas of the world by a factor of 20. It should be noted that this feature is of extreme importance when it is understood that the diver or divers can relax and live in submerged housing 28 for essentially an unlimited time interval.

As the diver descends to the selected depth by means of the "elevator," the inflatable house 28 is also transported to the sea bottom. Thereafter, the diver, or divers leave the "elevator" and inflate housing 28 and prepare it for habitation. During the extended period during which the diver or divers remain at the selected depth, housing 28 is employed as the living quarters, and, as will be understood, the inflatable underwater house contains the necessary life support and communication systems including individual breathing support systems, the exposure suits, living comfort equipment such as sleeping bags, electric blankets, water, food, and waste containers, closed-loop TV systems, and the necessary biomedical instrumentation. Again it should be noted that the uninflated housing 28, when released from the mother ship rapidly descends to the sea bottom through the action of anchor weights 32, yet when inflated by one or more divers thereafter provides comfortable quarters for the divers living therein. Again, since housing 28 is generally inflated to a pressure greater than that of the surrounding sea water, hatch 33 can remain open to provide an exit and entranceway for the divers, without any danger of water entering into and flooding the internal volume of the housing. Finally, only a single hatch is necessary on housing 28, since during its descent the pressure within the housing is always less than the water pressure and after inflation, when the hatch is open, the internal pressure is normally maintained greater than the water pressure at the selected depth.

Referring now to FIG. 2, there is illustrated a more detailed view of "elevator" 12. As there shown, three hatches 26, 36 and 38 are employed to not only allow a diver to enter from and return to the housing while submerged at the selected depth, but also to provide entry to nourishments during the decompression time interval during which the diver remains in a pressurized environment. By way of example, during decompression, which may occur either on board ship 10 or underwater, the various hatches are employed in order to provide food and drink to the diver while he remain in a pressurized environment. Assume now that housing 12 has been returned to ship 10 after the diver has remained at a depth of several hundred feet for an extended period of time. As hereinbefore pointed out, if being exposed to a depth of 400 feet for a period in excess of 12 hours, the diver must remain in a pressurized environment, the pressure being reduced in steps during a period of between 18 and 24 hours. In order to supply the diver with nourishment, hatch 38 is first closed to isolate compartment 40 from the remainder of the housing. Next, hatches 26 and 36 are opened and the food or other supplies are placed within compartment 42. Hatches 26 and 36 are then reclosed and the operator within housing 12 then increases the pressure of chamber 42 to equal that of compartment 40. At this time hatch 38 is opened allowing the operator access to the supplies positioned in chamber 42. This operation can be repeated a number of times until the termination of the decompression time interval.

What has been described is a novel underwater capsule which permits extended underwater operation of one or more divers in a manner heretofore not obtainable.

It will thus be seen that the object set forth above, among those made apparent from the preceding description, are efficiently attained, and since certain changes may be made in the above construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An underwater capsule for providing support for an operator beneath the sea comprising,

(a) a submerged inflated housing member of sufficient

size for inhabitation by at least one human operator;

(b) anchoring means on the sea water floor secured to said housing member for positioning such member in the submerged state;

(c) adjustable pressurizing means for inflating the submerged housing member and maintaining same at pressure greater than the pressure of the surrounding sea water;

(d) a normally opened hatch device located in the lower wall of said housing member to provide human ingress and egress to said housing member; and

(e) a source of breathing mixture attached to said housing member.

2. The capsule of claim 1 further including means to supply said at least one human operator from said source of breathing mixture at a pressure only 2 to 3 p.s.i. greater than the pressure within said inflated housing member.

3. The method of providing support for an operator beneath the sea comprising the steps of,

(a) submerging an inflatable but uninflated housing member including a source of breathing mixture for said operator;

(b) positioning said submerged housing member at a predetermined location;

(c) inflating said housing member with a breathable gaseous mixture to a pressure slightly greater than the surrounding water pressure, said inflated housing member including an opening in the lower surface thereof to provide said operator with a passageway to and from the interior of said housing member; and supplying said operator while external of said housing member for an extended time interval with breathing mixture from said source, said breathing mixture being maintained at a pressure 2 to 3 p.s.i. greater than the pressure within said housing member.

4. The method of providing support for a diver for essentially an unlimited time interval comprising the steps of,

(a) submerging a housing member containing life support and communication systems to a predetermined location beneath the sea;

(b) anchoring said housing member at said predetermined location;

(c) thereafter pressurizing the submerged housing member to a pressure equal to or greater than the surrounding water pressure, said pressurized housing member having an opening in the extreme lower portion thereof;

(d) transporting said diver in a self-contained underwater capsule to the depth of said submerged housing member; and

(e) transferring said diver from said self-contained underwater capsule to said life support and communication systems within said housing member.

5. The method of providing support for a diver for essentially an unlimited time interval beneath the sea at depths in excess of 200 feet and returning said diver to the surface, comprising the steps of,

(a) submerging a housing member containing life support and communication systems to a predetermined location beneath the sea;

(b) anchoring said housing member at said predetermined location;

(c) pressurizing said housing member to a pressure equal to or greater than the surrounding water pressure, said pressurized housing member including an opening in the extreme lower portion thereof;

(d) transporting said diver in a pressurized dual compartment underwater capsule containing alternate life support and communication systems, each of said compartments being interconnected and individually pressurizable and each normally main-

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tained at a pressure equal to the pressure within said housing member;

- (e) decoupling said diver from said alternate life support and communications systems within said capsule and coupling said diver to said life support and communications systems within said housing member for the time interval said diver remains submerged and thereafter recoupling said diver to said alternate life support and communication systems; 5
- (f) positioning said diver in a first of said dual compartments of said underwater capsule and selectively reducing the pressure to atmospheric in timed steps within said first compartment during and after the time period required to return said capsule to the surface; and 10
- (g) periodically reducing the pressure within the second of said compartments to equal the surrounding pressure, placing a supply of materials therein, and repressurizing said second compartment to equal 15
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the pressure within said first compartment, whereby the diver has access to said materials.

References Cited by the Examiner

UNITED STATES PATENTS

962,019	6/1910	Flood et al.	61—69.1
1,008,301	11/1911	Baker	61—69.1
1,223,515	4/1917	Papanastasiou	61—69 X
1,795,408	3/1931	O'Rourke	61—69
2,479,217	8/1949	Diamond	61—69
2,798,639	7/1957	Urban	52—2 X

FOREIGN PATENTS

2,268	1858	Great Britain.
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OTHER REFERENCES

The Washington Post, April 7, 1940, page 12.

CHARLES E. O'CONNELL, *Primary Examiner*.
JACOB SHAPIRO, *Examiner*.