

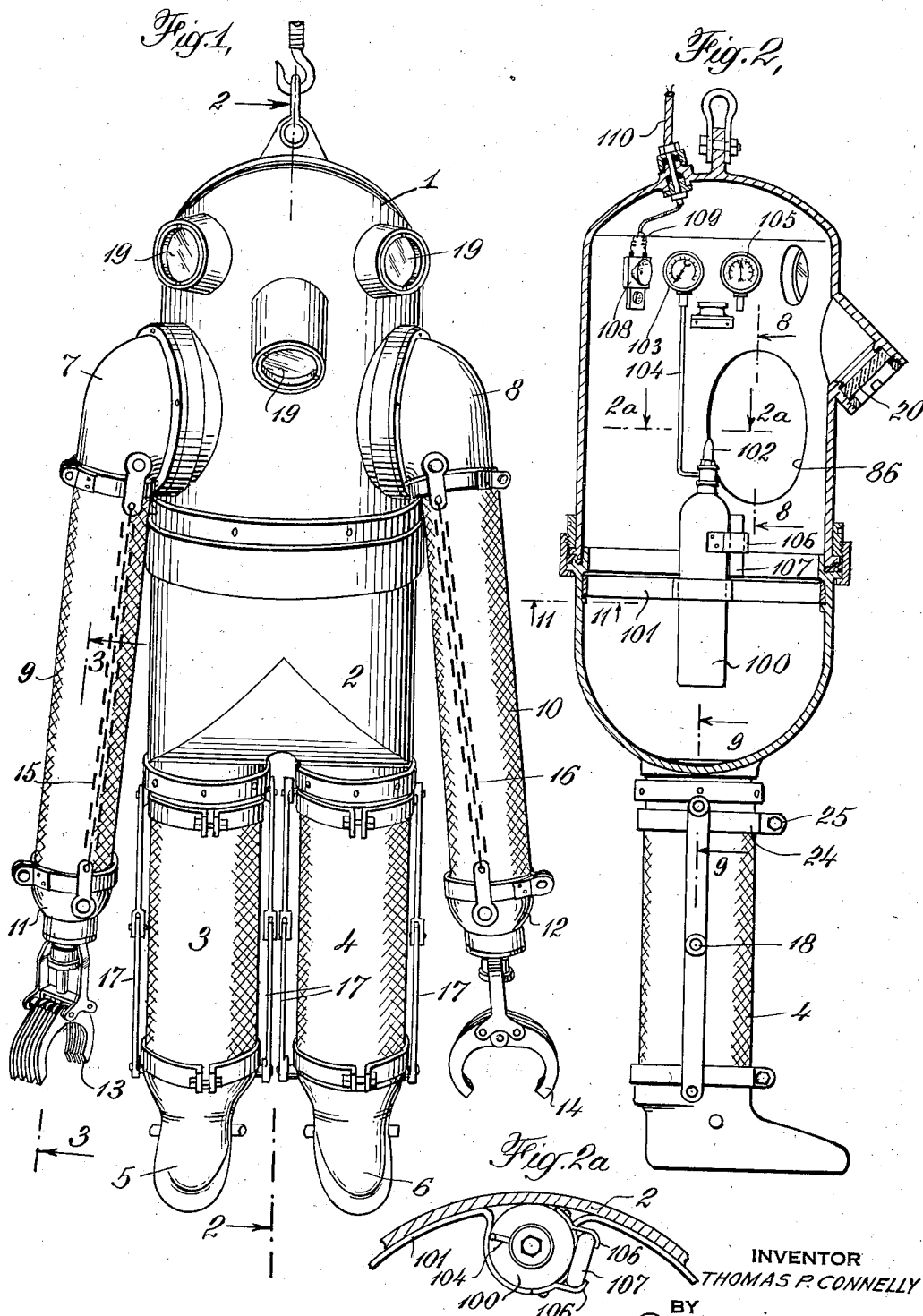
Oct. 22, 1935.

T. P. CONNELLY
DEEP SEA DIVING SUIT

2,018,511

Filed July 6, 1934

3 Sheets-Sheet 1



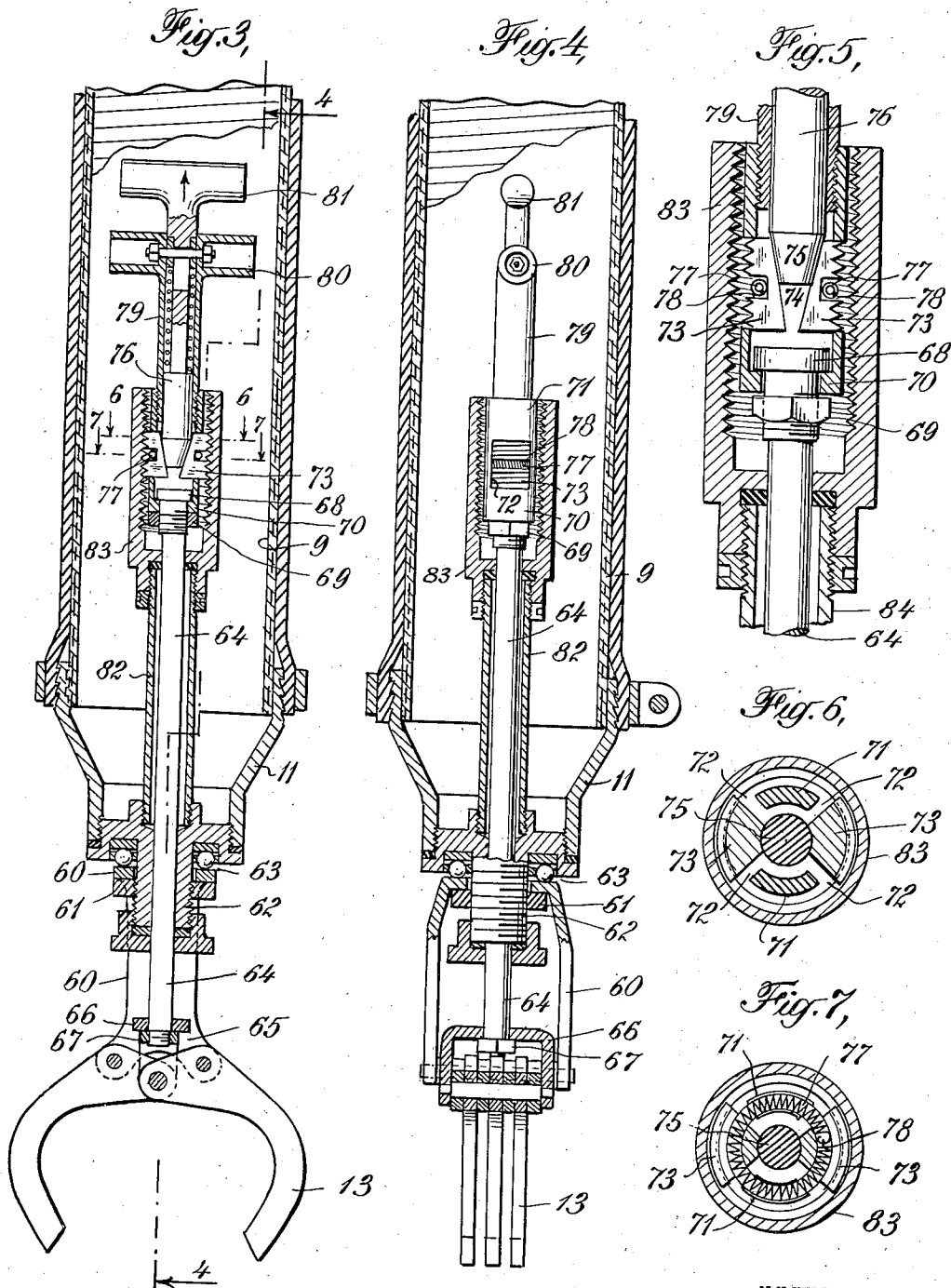
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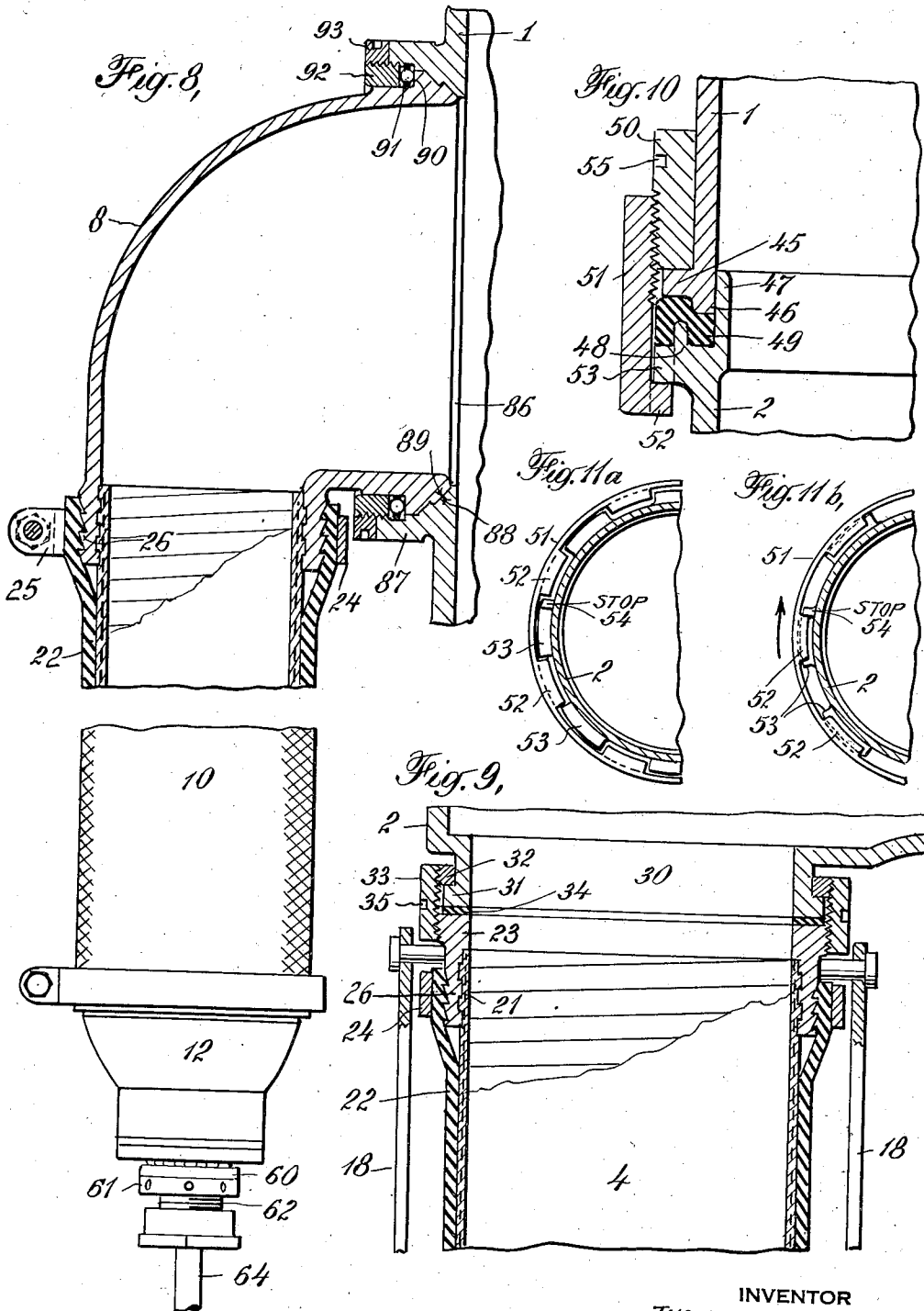
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UNITED STATES PATENT OFFICE

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DEEP SEA DIVING SUIT

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4 Claims. (Cl. 61—71)

This invention relates to diving suits, and more particularly to improvements in fluid-tight, non-collapsible deep sea diving suits adapted to withstand severe hydrostatic pressure from without, while maintaining atmospheric conditions within the suit.

The diving suit in accordance with the present invention comprises an upper metallic body or helmet portion having arm portions of non-collapsible flexible tubing articulated thereto, and a lower metallic body portion or torso joined to leg portions of non-collapsible flexible tubing terminating in metallic feet. Articulated braces are provided for the leg portions. The arm portions terminate in grappling jaws manipulatable from within the arm portions.

A feature of the invention resides in a novel arrangement for so uniting the helmet and lower body portions in a fluid-tight joint, that the helmet may be removed in a few seconds to permit of access to the diver in the event of an accident. This joint is characterized in the provision of a flanged termination for the helmet on which an externally threaded ring member is rotatably supported. A second ring member threaded to the first is provided with peripherally spaced inwardly projecting lugs adapted, in assembling the helmet and body portions, to pass between spaced outwardly projecting peripherally spaced lugs formed on the body portion, to provide a lap joint between the helmet and body portions. Thereafter the second ring is rotatable to align the lugs of the ring member with those of the body portion thereby to provide locking engagement between the helmet and body portions. The body portion is rabbeted at its upper edge to house a gasket of rubber or the like interposed between the body portion and the helmet. Once the locking engagement is secured, the joint may be tightened to fluid-tight proportions by application of a wrench to screw the first ring member into the second.

A second feature of the invention resides in the novel means for manipulating the grappling jaws from within the arm portions. The manipulation is such that the diver may quickly grapple an object and then lock the jaws in a desired closure to maintain his grasp. This locking engagement is effected by means of a screw-threaded leverage which may be employed additionally further to tighten the grip of the jaws on the object.

To this end each pair of jaws has linked thereto a rod displaceable within a metallic sleeve of the associated arm portion to close the jaws on

the object by means of a grip available within the sleeve to the operator. Rotatably affixed to the displaceable rod, is a resiliently contractible segmented member the segments of which, exteriorly threaded, are expandible by a second grip into threaded engagement with a threaded portion of the metallic sleeve thereby to lock the jaws in a desired closure. The grips may be rotated by the operator to further tighten the jaws upon the object by virtue of the threaded leverage provided between the threadedly engaged segments and sleeve.

Still another feature of the invention consists in the improved means employed for articulating the arm portions to the helmet. The helmet is provided with arm holes comprising a pair of circular, tapered, stepped recesses, each of which cooperates with a bevelled, stepped edge of an arm portion to form bearing surfaces. These surfaces are maintained in fluid-tight articular contact by means of a bushing threaded to and surrounding the recess, the bushing exerting pressure against the arm portion through the medium of a ball bearing interposed between the helmet and the arm portion.

The buoyancy of the suit is such that it will normally remain in an upright position. The diver may lean over by throwing his body weight in a desired direction, but as soon as the force thus exerted is removed, the suit will automatically resume an upright attitude. This highly advantageous feature is believed to constitute a radically new departure from the known constructions of metallic diving suits. It results from the fact that the helmet and body portions of the suit comprise an air chamber of considerable buoyancy maintained in a vertical position by the anchoring effect of the relatively heavy leg and feet portions, which, owing to their relatively small cubical content, have, of themselves, little inherent buoyancy.

The suit of the present invention requires no air hose extending to the surface there to be supplied from a pumping system such as is present in the orthodox construction. To eliminate this undesirable element with its accompanying danger of failure in air supply, the suit is equipped with an oxygen tank permitting the diver to remain submerged for approximately four hours. A bottle of caustic soda or other suitable chemical absorbs the carbon dioxide as well as the deleterious gases of exhalation. Gauges are provided as part of the suit equipment for indicating to the diver the pressure in the suit as well as that in the tank. Communica-

tion is effected by means of phones or the like connected by a cable to the supply ship.

These and other features of the invention will be more clearly understood from the following detailed explanation given with reference to the accompanying drawings in which:

Fig. 1 is a perspective view in front elevation of the assembled suit. Fig. 2 is a longitudinal section at 2-2 of Fig. 1. Fig. 2a is a sectional detail at 2a-2a of Fig. 2. Fig. 3 is a section at 3-3 of Fig. 1; Fig. 4 a section at 4-4 of Fig. 3; Fig. 5 an enlarged sectional detail of Fig. 2; and Figs. 6 and 7 are sections at 6-6 and 7-7 of Fig. 2. Fig. 8 is a partial section at 8-8 of Fig. 2; Fig. 9 a section at 9-9 of Fig. 2; Fig. 10 an enlarged sectional detail of Fig. 2. Figs. 11a and 11b are sections at 11-11 of Fig. 2 for the unlocked and locked positions respectively of the helmet and lower body portions.

Referring to Figs. 1 and 2 the diving suit includes a metallic helmet 1, metallic body 2, legs 3 and 4 of non-collapsible flexible tubing, terminating in metallic feet 5 and 6. Articulated to the helmet are metallic shoulders 7 and 8 from which depend arms 9 and 10 of the same kind of flexible tubing as the legs. The arms terminate in metallic members 11 and 12 supporting grappling jaws 13 and 14. Chains 15 and 16 transfer the load of the grappling jaws directly to the shoulders. The legs are supported by braces 17 articulated at the knee 18. The helmet is provided with ports 19 conveniently located for vision in various directions and rendered fluid-tight to this end by heavy glass plates 20.

As shown in Figs. 8 and 9, the non-collapsible flexible tubing composing the arms and legs is formed of resilient metal strip 21 wound in a flat helix and encased within tubing 22 of rubber or a like material impervious to moisture.

A generally similar means is employed throughout for securing the end sections of the tubing to the associated metallic terminal members. Thus in the leg construction of Fig. 9, strip 21 is soldered, brazed or welded to the inner surface of ring 23, while the rubber casing 22 fits snugly over the ring. A metal strap 24 surrounding the casing is provided with spaced, apertured lugs 25 for reception of a bolt having a nut threaded thereto for clenching the casing between the outer metal strap and inner ring to form a rugged fluid-tight connection. The rubber casing 22 and the associated metallic members 8, 23, etc., are peripherally serrated at the juncture 26 so that the two grip one another to provide increased security.

The body 2 terminates in a pair of piped apertures 30 each terminating in an outwardly projecting radial flange 31 supporting a bushing 32 threaded to a ring 33 which in turn is threaded to the upper metallic leg member 23. A gasket 34 of rubber or the like is interposed between members 23 and 30. Bushing 32 is keyed to ring 33 to permit of tightening the joint as required by means of a wrench or lever inserted in bores 35 of the ring.

The novel rapid assembly construction by which the helmet 1 is united with the body 2 in a fluid-tight joint is illustrated in Figs. 2, 10, 11a and 11b. The helmet terminates at its lower edge in a radial flange 45 and a longitudinal flange 46. With the units assembled flange 46 of the helmet overlaps an upwardly projecting flange 47 of the body 2. Flange 47 forms part of a rabbet 48 which houses a gasket 49, of rubber or the like,

interposed between members 1 and 2 to provide a fluid-tight joint.

A ring 50 is rotatably supported on flange 45. Ring 50 is externally threaded to a second ring 51 which terminates at its lower edge in inwardly projecting peripherally spaced lugs 52. The body 2 is provided with similar outwardly projecting peripherally spaced lugs 53.

Lugs 52 and 53 are so spaced that in the process of assembly the helmet 1 on the body 2, lugs 52, will, upon properly allocating the position of ring 51, slip through the spaces between lugs 53 as shown in Fig. 11a, until lugs 52 are below lugs 53. Thereafter ring 51 is rotated slightly until lugs 52 are aligned with lugs 53, as illustrated in Figs. 10 and 11b, to provide locking engagement between members 1 and 2. To assure proper alignment, one or more of the lugs 53 may be provided with a downwardly projecting stop 54. When the lugs are thus aligned in locking engagement, ring 50 is tightened up by insertion of a wrench in bores 55 thereby to force members 1 and 2 against gasket 49 sufficiently to provide a fluid tight joint. It will be understood that as ring 50 is screwed up in the manner described, ring 51 will remain stationary to secure the tightening operation.

When the diver emerges, it requires but a slight turn of ring 50 by means of a wrench inserted in 55, to loosen ring 51 sufficiently to permit its rotation to the extent of permitting lugs 52 to pass between lugs 53 thereby to remove helmet 1 from the body 2.

The mechanism for manipulating jaws 13 and 14 from within the suit is illustrated by the sectional diagrams, Figs. 3-7 inclusive. Jaws 13 are hinged to bracket 60 supported by a nut 61 threaded to a sleeve 62 which in turn is threaded to the metallic arm member 11. The ball bearing 63 permits rotation of jaws 13 with a minimum of frictional resistance when thrust against an object. Jaws 13 are mechanically coupled to a rod 64 axially displaceable within sleeve 62 through a standard linkage 65 for varying the jaw closure in accordance with the rod displacement. This linkage includes an apertured bracket 66 through which rod 64 extends in a permanent connection formed by a nut 67 threaded to the end of the rod. The upper end of rod 64, within the sleeve 9, terminates in a flanged head 68 below which is a threaded portion carrying a nut 69, the head and nut cooperating to provide a peripheral slot rotatably housing a flanged portion 70 of a sleeve 71. Sleeve 71 is provided with a pair of diametrically opposed rectangular, radially tapered apertures 72. These apertures house externally threaded segments 73 cooperating to form a tapered bore 74 coaxial with sleeve 71, within which a bevelled termination 75 of a rod 76 is axially displaceable to vary the lateral separation of segments 73 against the restraining action of a coiled spring 77 housed in a peripheral slot 78 of members 73. Threaded to the upper portion of sleeve 71 is a sleeve 79 terminating in a hand grip 80. Rod 76 passing up through sleeve 79 terminates in a second grip 81 slightly above grip 80. Grips 80 and 81 are so located as to be within easy reach of the operator.

Grip 80 serves to vary the closure of jaws 13, by virtue of the direct mechanical connection from grip 80 through sleeves 79 and 71 to rod 64. The operator by raising or lowering grip 80 thus raises or lowers rod 64 to like extent thereby adjusting the closure of jaws 13 as desired to grip an object.

Rod 64 is housed within a sleeve 82 threaded at 75

its lower end into member 62 and at its upper end into a sleeve 83 surrounding sleeve 71. Sleeve 83 is internally threaded the greater portion of its length so that irrespective of the elevation of sleeve 71 due to the mentioned manipulation of grip 80, the externally threaded expandable segments 73 are adapted upon expansion threadedly to engage sleeve 83.

This threaded engagement is effected by pressure exerted on grip 81, as by grasping grips 80 and 81 in the hand and squeezing them together. This causes rod 76 to be thrust downwardly in sleeve 79 wedging the bevelled termination 75 increasingly between members 73 thereby expanding these members against the contracting force of spring 76 into threaded engagement with sleeve 83. The bevel 75 of rod 76 is such that the rod will be held in its depressed position by the friction between rod 76 and segments 73.

It will be observed that the threaded engagement of segments 73 with sleeve 83 clamps or locks jaws 13 at the closure corresponding to the elevation of grip 80 at the instant segments 73 engage sleeve 83. Thus the manipulations described provide means whereby the operator may quickly grasp an object in a locking grip. If, however, the operator desires further to tighten his grip on the object, this may be done by rotation of grips 80 and 81. Rotation of the grips turns sleeves 79 and 71, causing thereby the threads of segments 73 to traverse the threads of sleeve 83 and gradually to lower rod 64 by the threaded leverage thus afforded. By this means the operator is enabled to transmit a powerful closing grip on jaws 13. An equally powerful release of the jaws is of course secured by reversing rotation of the grips. Due to the fact that sleeve 71 is rotatable at 70 with respect to rod 64, rotation of grips 80 and 81 causes the rod to be elevated or depressed without rotation.

To release the locking grip it is only necessary for the operator to raise grip 81 with respect to grip 80, whereupon withdrawal of the bevelled end 75 of rod 76 permits spring 77 to contract segments 73 out of threaded engagement with sleeve 83.

Fig. 8 shows in sectional detail the manner of joining the metallic shoulders 7 and 8 to the helmet 1. The helmet is provided with arm holes 86 each surrounded by an outwardly projecting flange 87 integral with the helmet. The inner surface of flange 87 terminates adjacent the arm hole 86 in a circular, tapered stepped recess 88.

The metallic shoulder 8 terminates adjacent the arm hole 1 in a circular, stepped, bevelled edge 89 of identical configuration with surface 88, so that the two surfaces 88 and 89 engage in a snug fit.

Member 8 is provided with a vertical shoulder 90, adjacent the outer edge of bevelled surface 89, which forms one bearing surface for a ball bearing 91, the opposite bearing surface for which is provided by a bushing 92 threaded to flange 87 of the helmet. The bushing 92 thus secured to flange 87 exerts pressure against member 8 through the interposed ball bearing 91 to maintain surfaces 88 and 89 in fluid-tight articular contact. A lock ring 93 is threaded to bushing 92.

Figs. 2 and 2a show the self sufficient equipment whereby the diver may remain submerged over relatively long periods. An oxygen tank 100 is held against the inner side of the lower body portion 2 by a flexible band 101 extending about the inner side of the body and looped around tank 100. The oxygen escape is through a needle valve 102 of known construction and such as to maintain

atmospheric pressures within the suit. The oxygen pressure is indicated by a gauge 103 having access to the tank through a pipe line 104. A second gauge 105 shows the pressure within the suit. Mounted on tank 100 by means of resilient brackets 106 is a bottle 107 of caustic soda or other suitable chemical for clarifying the atmosphere within the suit of noxious gases. A two-way telephone or speaker 108 is connected by conductors 109 extending through a cable 110 permits the diver to maintain communication with the supply ship.

It will be observed from Figs. 1 and 2, that the helmet 1 and body 2 constitute an air chamber of considerable buoyancy which is further increased by constructing members 1 and 2 of a strong metal of low specific gravity such as duralumin or the like. The legs and feet on the other hand are quite heavy in relation to their cubical content and thus have an anchoring effect on the body which, as stated, will automatically maintain the suit in a vertical attitude unless the diver throws his weight against the suit to lean in a desired direction.

The employment of flexible tubing for the arms and legs together with the articulation of the shoulder members 7 and 8 renders the entire suit extremely mobile and flexible to suit the needs of the diver.

I claim:

1. In a diving apparatus in combination, a water-tight chamber, grappling jaws externally affixed thereto, and means for manipulating said jaws from within said chamber comprising, a rod linked to said jaws and axially displaceable within a sleeve to adjust said jaws, a resiliently restrained threaded member carried by said rod and adapted to engage a threaded portion of said sleeve to lock said jaws in a desired closure, means for causing said threaded member to engage said sleeve and means for rotating said member while so engaged to adjust said jaws by threaded leverage.

2. In a diving apparatus in combination: a water-tight chamber, grappling jaws externally affixed thereto, and means for manipulating said jaws from within the chamber comprising, a rod linked to said jaws and displaceable within a sleeve to close said jaws on an object, means including a grip for displacing said rod, resiliently contractible, spaced threaded segments rotatably supported by said rod and expandable by a bevelled rod to threaded engagement with a threaded portion of said sleeve for locking said jaws in a desired closure, means including a second grip for displacing said bevelled rod, said grips being rotatable for said threaded locking engagement further to tighten said jaws upon said object.

3. In a diving apparatus in combination: a water-tight chamber, grappling jaws externally affixed thereto, and means for manipulating said jaws from within said chamber comprising, a rod linked to said jaws and displaceable within a sleeve to vary the closure of said jaws, means including a grip for displacing said rod, externally threaded spaced segments resiliently affixed to said rod, means including a second grip and a bevelled member for expanding said segments to engagement with a threaded portion of said sleeve to lock said jaws at a desired closure, said grips being rotatable for said threaded engagement to tighten said jaws upon an object.

4. In a diving apparatus in combination: a water-tight chamber, grappling jaws externally

affixed thereto, and means for manipulating said jaws from within said chamber comprising, a rod linked to said jaws and displaceable within a first sleeve to vary their closure, a second sleeve within the first rotatably affixed to said rod and transversely apertured to house resiliently restrained externally threaded spaced segments, a bevelled

rod within said second sleeve displaceable to expand said segments to engagement with a threaded portion of said first sleeve thereby to lock said jaws in a desired closure, and means for rotating said second sleeve to adjust said jaws by threaded leverage. 5

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