

March 17, 1936.

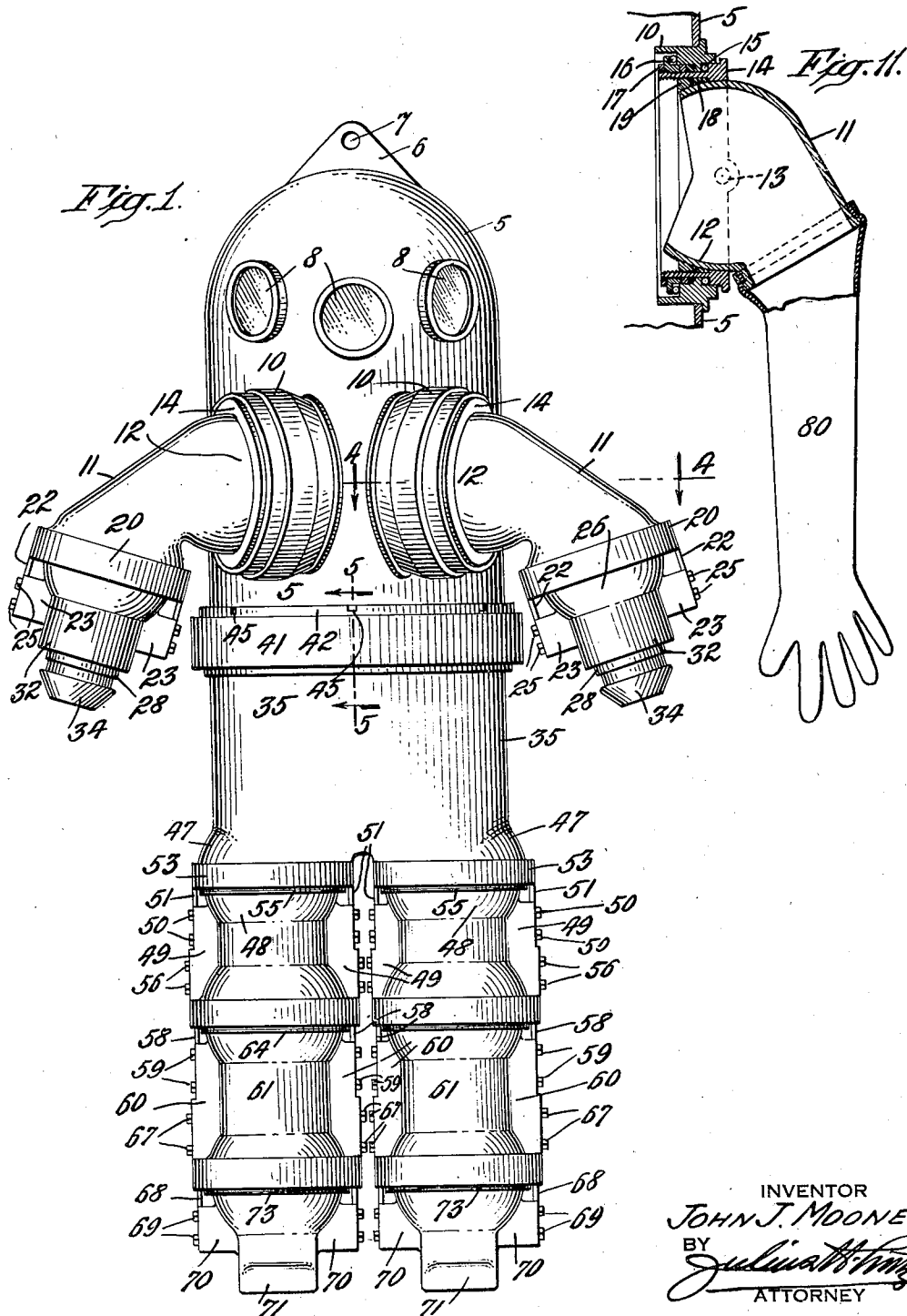
J. J. MOONEY

2,034,637

DIVING SUIT

Filed Aug. 22, 1935

3 Sheets-Sheet 1



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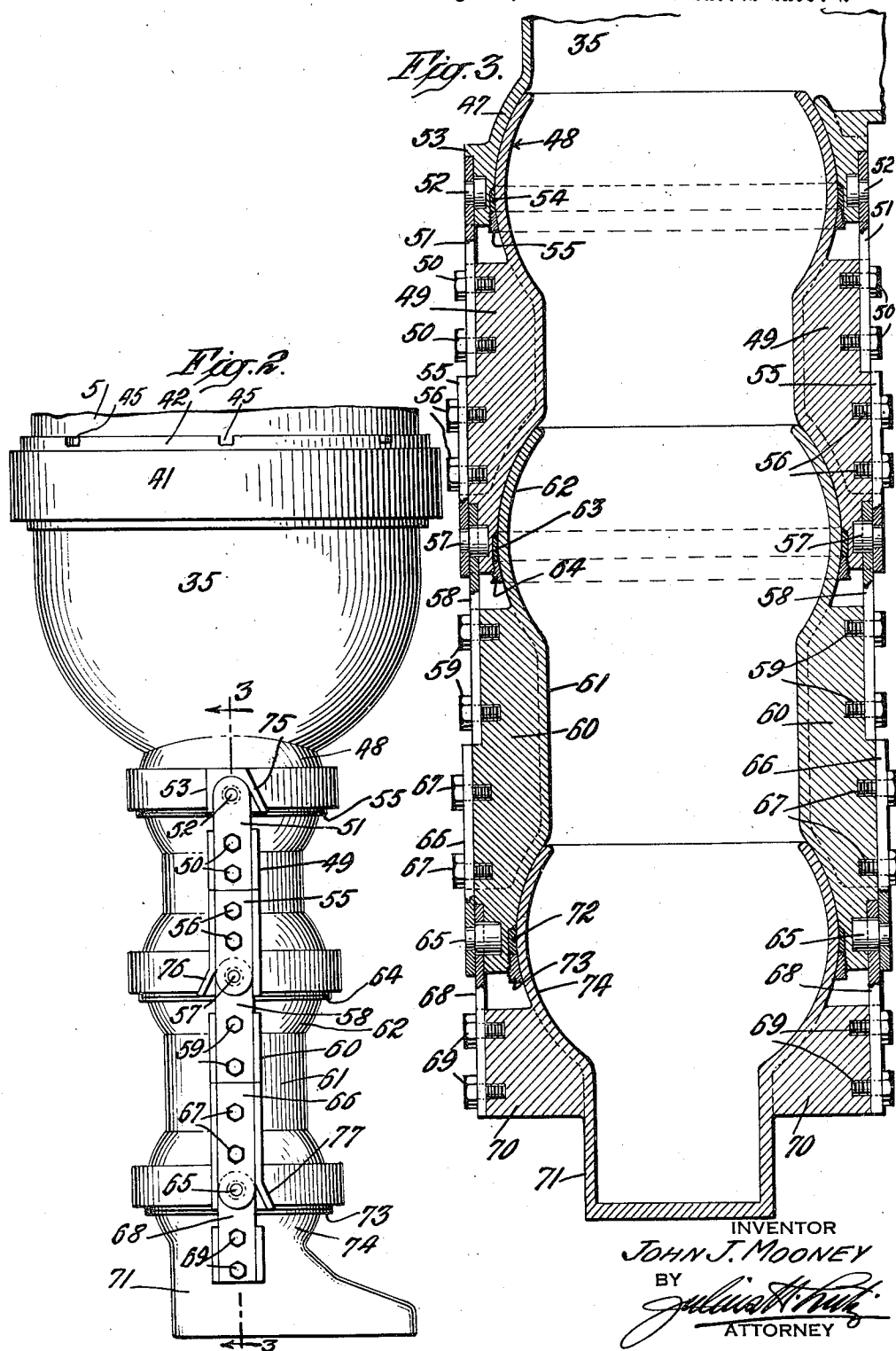
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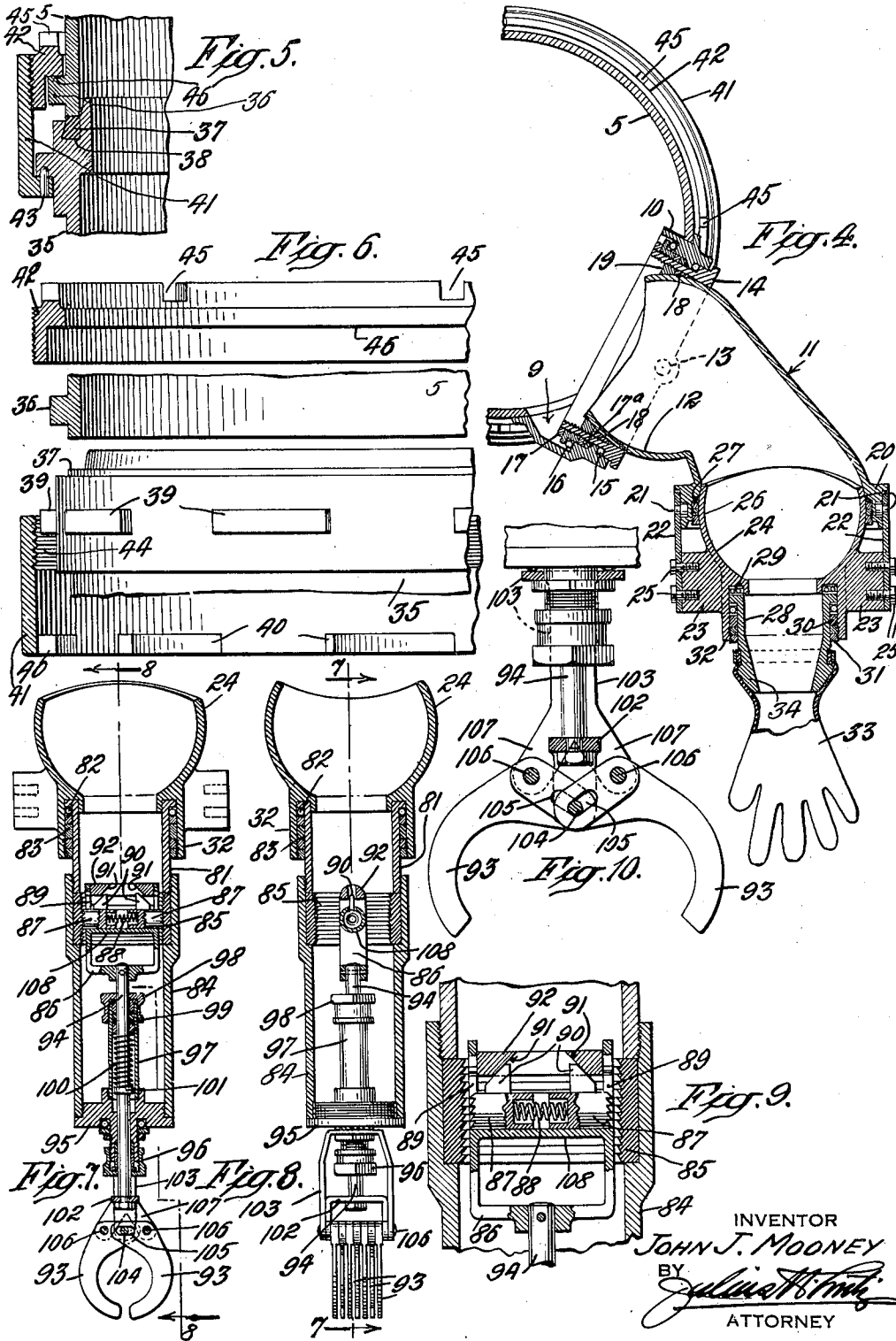
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UNITED STATES PATENT OFFICE

2,034,637

DIVING SUIT

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Application August 22, 1935, Serial No. 37,280

10 Claims. (Cl. 61—71)

This invention relates to diving suits and has for its object the provision of an all-metal enclosing structure affording a maximum of protection during submersion, together with lightness of weight permitting easy mobility. The improved structure also has novel leg and arm joints whereby resistance to limb movements is minimized and great freedom of undersea operation is afforded.

A further object of the invention is to provide means for articulating the various leg and arm joints to facilitate easy movement of the wearer's limbs when the device is worn, at the same time preventing the possibility of leakage at the articulated joints.

Another object of the invention is to provide improved grappling means for use in conjunction with the suit, which enables grappling operations to be conducted easily and expeditiously under water.

These and other objects are attained by the improved structure hereinafter described and more particularly pointed out in the claims appended hereto.

Reference is to be had to the accompanying drawings forming a part hereof, in which Fig. 1 is a front elevation of a diving suit made in accordance with the invention; Fig. 2 is a side elevation of the lower portion of the suit; Fig. 3 is a sectional view on the line 3—3 of Fig. 2, looking in the direction of the arrows; Fig. 4 is a sectional view on the line 4—4 of Fig. 1, looking in the direction of the arrows, with the arm enclosure or sleeve swung slightly upward; Fig. 5 is a sectional view on the line 5—5 of Fig. 1, looking in the direction of the arrows; Fig. 6 is a sectional view through the elements shown in Fig. 5 with the parts in separated relationship; Fig. 7 is a vertical sectional view through the grappling device, the view being taken on the line 7—7 of Fig. 8, looking in the direction of the arrows; Fig. 8 is a sectional view on the line 8—8 of Fig. 7, looking in the direction of the arrows; Fig. 9 is a sectional view through the grip or handle portion of the grappling mechanism; Fig. 10 is a view of the grappling hooks, with parts in section, showing the hooks in open position; and Fig. 11 is a sectional view through a modified arm enclosure or sleeve showing a flexible rubber enclosure member for the hand and greater portion of the arm.

With reference to Fig. 1 of the drawings, 5 indicates the upper member or body portion of the suit, said member being made of sheet or cast metal and having a dome shaped top pro-

vided with a projecting lug 6 formed with an opening 7 for engagement by a line. The top member 5 is provided with a plurality of observation windows 8 which may be formed therein in any suitable way common to this art. Said top member 5 is provided with arm openings 9 from which the arm enclosures or sleeve members 11 extend. Mounted in the arm hole 9 is an annulus or ring 10 in which the sleeve member 11 is mounted to move universally. Said sleeve member is provided with a rounded or ball-shaped inner end 12 pivoted on pins 13 in a ring 14 mounted for rotative movement within the outer ring or annulus 10. To permit of easy rotary movement of the sleeve portion 11 and the ring 14 in which it is pivoted within ring 10, ball bearings are provided at 15 and 16, these bearings being maintained in position by means of the nut 17 threaded on the outside of the ring 14. A packing shown at 17^a prevents leakage between ring 14 and the outer ring 10. Packing is also provided at 18 between the ball-shaped inner end 12 of the sleeve and the inner surface of the ring 14, said packing being held in place by the nut 19.

From the arrangement described, it will be clear that a universally movable shoulder joint between the sleeve portion 11 and the upper body portion 5 of the suit is provided. The sleeve portion 11 may be composed of sheet or cast metal or other rigid material. At its outer end the sleeve portion 11 is formed with a thickened annular terminal 20 and projecting laterally therefrom at diametrically opposite points are studs 21 (Fig. 4) on which links or plates 22 are pivoted, said links or plates being attached near their opposite ends to laterally extending lugs 23 provided on the forearm portion 24 of the sleeve, by the screws 25. Through this arrangement, the forearm portion 24 of the sleeve has a pivotal movement transversely of the longitudinal axis to conform to the elbow movement of the arm. To permit of a smooth pivotal movement of this kind, the inner portion of the forearm part 24 is made partly spherical as at 26, as clearly shown in Figs. 1 and 4. Packings 27 are disposed between the outer face of the rounded part 26 and the inner surface of the part 20 to prevent leakage therebetween.

Rotatably mounted in the end of the forearm portion 24 is a cuff portion 28 which rotates with a minimum of friction in the ball bearings 29. Packings 30 prevent leakage between said cuff portion and the forearm portion 24, the packings being held in place by the threaded nut or ring

31 received in the projecting boss 32. A rubber glove 33 is secured on the end of the cuff part 28, said part being formed with a nipple-shaped extremity 34 to receive and securely hold the glove.

Through the arrangement described, each arm enclosure or sleeve is so jointed that the natural easy movements of the wearer's arms are permitted. That is to say, the shoulder joint is provided with a universal movement; the elbow joint has a swinging movement; and the wrist joint has a freely rotative movement.

The connection between the top body portion 5 and the lower body portion 35 at about waist-line level, is shown in detail in Figs. 5 and 6. It will be there seen that near its lower edge the top body portion 5 is provided with a laterally projecting annular flange 36 on its outer face and that the lower edge of the part 5 rests upon a rubber gasket or washer 37, located in an annular seat 38 formed on the upper edge of the lower body portion 35. Said lower portion 35 is provided on its outer surface with a number of spaced, laterally extending lugs 39 which are adapted to be taken under by inwardly extending lugs 40 located on the inner face of a clamping ring 41 which acts when in its operative position shown in Figs. 1 and 5, to clamp together the two body portions 5 and 35. A locking ring 42 threads into the clamping ring 41 and impinges against the upper surface of the flange 36 on the body portion 5. To prevent rotative movement of the clamping ring 41 while the locking ring 42 is being threaded into it, a pin 43 is extended through one of the lugs 40 into one of the lugs 39. To don the suit and then establish a water-tight connection between the lower body portion 35 and upper body portion 5, the wearer first steps into the lower body portion and the upper body portion 5 is then brought down to rest upon the packing or gasket 37. The clamping ring 41 is lowered to permit its lugs 40 to pass between the spaced lugs 39 and it is then turned slightly so that the lugs 40 are located directly below and take under the lugs 39. With the pin 43 then placed in position so that ring 41 is prevented from rotating, and the locking ring 42 engaging the internal threads 44 on the clamping ring 41, the locking ring 42 is then tightened down by a suitable tool engaging in the notches 45 on ring 42. The locking ring 42 is provided with a shoulder portion 46 which exerts downward pressure on the flange 36 and forces the lower edge of the upper or body portion 5 down hard upon the gasket or packing 37. With this arrangement, the two parts 5 and 35 of the body of the suit are tightly clamped together, yet are capable of quick separation by unthreading movement of ring 42 when it is desired to remove the suit.

In Figs. 1, 2 and 3, the construction of the leg portions of the suit are shown, and since both legs are similar in structure, a description of one will suffice for both. The lower body portion 35 is provided with leg openings or sockets 47 and capable of pivotal movement therein is a nearly spherical portion 48. Said portion is provided with lateral projections 49 and attached to said projections by screws 50 are links 51, each of which is pivotally mounted near its upper end on the studs 52 fixed in and projecting from the annular laterally-projecting part 53 on the leg sockets 47. A packing 54 is interposed between the outer surface of the spherical part 48 and is held in position by a nut 55. Below the links

51 are a pair of links 55 which are attached by screws 56 to the part 49 on the upper leg member 48. The studs 57 pivotally receive the upper ends of links 58 which are secured by screws 59 to projections 60 formed on intermediate leg member 61, the upper end of this member 61 being connected by ball and socket joint to the lower end of the upper leg member 48. The wall portion of the joint is formed by the rounded member 62 on intermediate leg section 61 co-operating with a complementary shaped socket in the lower portion of the upper leg member 48. Packing 63 held in place by nut 64 prevents leakage between the ball-shaped member 62 and the socket in which it is mounted. Near its lower end, intermediate leg member 61 is provided with laterally projecting studs 65 over which links 66 extend, said links being rigidly attached to the part 61 by means of the screws 67. Studs 65 also pivotally receive the upper ends of links 68 which are secured by screws 69 to projections 70 formed on the foot portion 71 of the suit. A packing 72 held in place by a nut 73 is interposed between the ball-shaped upper end 74 of the foot portion 71 and the socket in which said end is mounted.

Through the arrangement of links and ball and socket joints just described, it will be seen that leg joints are provided permitting the wearer of the suit full leg freedom, and complete leg movement co-extensive with normal leg movements. In Fig. 2 it will be seen that the movements of the various connecting links between the leg parts are limited in certain directions, as, for example, the upper links 51 have a movement forward limited by means of the angular shoulders 75. The knee joint has a limited movement reversely by means of the angular shoulder 76, and the ankle joint has a limited forward movement by means of shoulder 77. The entire method of articulation of the various leg enclosure parts are such that complete freedom of movement is afforded for the legs without the possibility of jamming or locking any of the leg joints.

In Fig. 4 the arm enclosure or sleeve is shown as being provided with a short glove to cover the hand only. To afford greater arm action it may, in some cases, be found desirable to have the greater portion of the arm of the wearer encased in a glove. In such cases, the entire forearm and elbow can be enclosed in a lengthy glove, such as shown at 80 in Fig. 11. The remainder of the arm enclosure, consisting of the shoulder part and upper arm is similar in all respects to that previously described and shown in Figs. 1 and 4.

In Figs. 7 to 10 inclusive, is shown a grappling device which is often found desirable in certain cases. Such device consists of the part 24 heretofore described, provided with the boss 32 in which a sleeve 81 is rotatively mounted on the ball bearings, 82, with suitable packing 83 interposed between the boss 32 and sleeve 81 to prevent leakage therebetween. Sleeve 81 is threaded in the upper end of a tube 84 and held in position within said tube is a cylindrical ratchet member 85. Mounted for vertical movement within the ratchet member is a yoke 86 in which is mounted a pair of dogs 87 which are normally spread apart by means of a spring 88 interposed between them. The spring 88 normally tends to cause the toothed ends of the dogs 87 to be held in engagement with the toothed face of the ratchet 85. The dogs are enclosed in a sleeve 108 and are movable through slots 89, in the arms of yoke 86, and each of said

dogs carries a cam 90 having an inclined upper face adapted to be engaged by a correspondingly inclined cam surface 91 provided on a movable cross-bar 92 extending across the upper end of the yoke 86 and movable in the slots 89. This arrangement is such that when the wearer presses downwardly on the cross-bar 92, cam surfaces 91 operating against the cams 90 will draw the two dogs 87 toward one another against the tension of the spring 88 to cause the dogs to be disengaged from the ratchet 85 so that the entire yoke including the dogs 87 is movable downwardly under pressure of a spring 100, as viewed in Figs. 7 and 8, the effect of this movement being to cause the jaws or hooks shown at 93 to spread apart or open as will be hereafter explained. The yoke 86 is connected to a rod 94 slidable through a closure plug 95 secured in the end of the tubular member 84 and through a stuffing box 96 provided on plug 95. Within the tubular member 84 the rod 94 is surrounded by a sleeve 97, said sleeve having its upper end closed by a cap 98 holding packings 99 in position. Coil spring 100 surrounding the rod 94 within the sleeve 97 exerts pressure against a collar 101 fixed on the rod. At its lower end, the rod 94 is secured to the cross-bar of a U-shaped bracket 102, movable within a yoke 103. Bracket 102 has a cross rod 104 (Fig. 10) passing through slots 105 in the ends of the jaws or hooks 93 and these jaws or hooks are pivoted at 106 in the diverging ends 107 of yoke 103. This provides a toggle joint by which the jaws 93 are held in either the closed position shown in Fig. 7 or in the open position shown in Fig. 10. The operation of the grappling device is substantially as follows:

The handle portion, comprising the tubular enclosure 108, within which the dogs 87 slide, and the member 92 is gripped in the hand. When pressure is imposed on member 92 it is forced downwardly, or in a direction toward the jaws 93, which action causes the dogs 87 to be drawn toward one another and released from their engagement with the ratchet 89, so that the yoke 86 and rod 94 attached thereto can be moved longitudinally of the tubular casing 84 by pressure of spring 100. As rod 94 is moved toward the jaws 93, it forces the jaws to move to open position, as shown in Fig. 10, by movement of the cross rod 104 in the slots 105 of the jaws. When the gripping pressure of the hand against member 92 is relaxed, dogs 87 engage ratchet 89 and as the yoke 86 is drawn upward the jaws will close as shown in Fig. 7 and will so remain until pressure on cross bar 92 again disengages dogs 87 from the ratchet to enable spring 100 to function and open the jaws.

The structure of the suit is such that extreme lightness, consistent with requisite strength is provided and easy movement of the limbs during undersea operations is had.

What I claim is:

1. An apparatus of the character described comprising, a body portion composed of upper and lower members, the lower member having articulated leg sections and the upper member having articulated arm portions, a connection between the upper and lower members at substantially waist-line level comprising a seat on the lower member provided with a gasket on which the lower edge of the upper member rests, projections on the outer surfaces of the upper and lower members adjacent to the points of meeting between said members, and clamping means for engaging said projections and drawing the upper and lower

members toward one another to hold the upper member firmly against the gasket.

2. An apparatus of the character described comprising, a body portion composed of an upper member and a lower member, means for detachably connecting said members together, said means including a seat on one of the members bearing a packing against which the edge of the other member rests, projections formed on both members and projecting laterally from the outer surfaces of the same, a clamping ring engaging the projections on one of the members, a locking ring adjustably received into the clamping ring and engaging the projections on the other member, and a threaded connection between the two rings for drawing one within the other to a required extent to cause them to exert pressure on the two sets of projections and clamp the upper and lower members together.

3. An apparatus of the character described comprising, a body portion having a dome-shaped top, articulated arm sleeves extending therefrom, a lower body portion removably attached to the upper body portion, means for clamping the top and lower body portion together with a liquid tight joint, the lower body portion having dependent leg enclosures, each of said enclosures being composed of several connected sections, each of said sections being connected to the next section by a ball and socket joint, packings for rendering said joints watertight, and stop means for limiting the degree of articulation of the joints.

4. An apparatus of the character described comprising, a body portion composed of an upper member and a lower member, means for detachably connecting said members together, said means including a seat on the lower member bearing a packing against which the edge of the upper member rests, projections formed on both members and projecting laterally from the outer surfaces of the same, a clamping ring engaging the projections on the lower member, a locking ring threaded into the top of the clamping ring and engaging the projections on the upper member, and a threaded connection between the two rings for drawing the locking ring within the clamping ring to cause the two rings to co-operate in exerting pressure on the two sets of projections and clamp the upper and lower member together.

5. An apparatus of the character described comprising, a body portion composed of an upper and a lower member, the lower member having a seat bearing a gasket, the upper member having its lower edge resting upon said gasket, a ring adapted to extend over the joint between the two members, said ring having spaced lugs on its inner surface near one of its ends, similar spaced lugs on the outer face of the lower member beneath which the lugs on the ring are adapted to engage, lugs on the outer surface of the upper member, a threaded annulus adjustably received into the ring and provided with an inwardly extending annular flange engaging the lugs on the upper member to draw said upper member down on the gasket.

6. In an apparatus of the character described, a limb enclosure consisting of several tubular members connected together with a ball and socket joint, means for maintaining a packing between the surfaces of the ball and socket portion of the joint, a projection on one of the tubular members carrying studs positioned at diametrically opposite points, and links attached near

one of their ends to the other tubular member and having their opposite end portions extending over and pivotally mounted on the studs.

7. In an apparatus of the character described, 5 a limb enclosure consisting of several tubular members connected together with a ball and socket joint, a packing located between the surfaces of the ball and socket portion of the joint, means for maintaining said packing in operative position, a projection on one of the tubular members 10 carrying studs positioned at diametrically opposite points, the other tubular member having a similar projection and links attached to the last mentioned projection and having their end portions extending over and pivotally mounted 15 on the studs.

8. In an apparatus of the character described, a body portion, an upper sleeve portion having an upper end mounted with a universal joint in 20 the body portion, a packing for rendering said joint liquid-tight, a fore-arm sleeve portion mounted for pivotal movement only at the lower end of the upper sleeve portion, a cuff portion mounted for rotative movement at the end of 25 the fore-arm sleeve portion, said cuff portion terminating in a nipple, and a flexible glove received on said nipple.

9. In an apparatus of the character described, 30 a body portion, a tubular sleeve portion pivoted in the body portion and projecting therefrom, a

grappling device located within said sleeve portion and having parts projecting out of the end of the same, a support at the end of the sleeve portion, grappling hooks pivoted on said support, an operating rod slidable in the sleeve 5 for opening and closing the hooks, a toggle joint between said rod and the hooks, means within the sleeve and connected to the rod for forcing it in one direction to open the hooks, ratchet means for restraining movement of the rod toward 10 opening position of the jaws, and manually operated release means for said ratchet means.

10. In an apparatus of the character described, a body portion, a tubular sleeve portion pivoted in the body portion and projecting therefrom, a 15 grappling device located within said sleeve portion and having parts projecting out of the end of the same, a swiveling bracket at the end of the sleeve portion, grappling hooks pivoted on said bracket, an operating rod slidable in the sleeve 20 for opening and closing the hooks, a toggle joint between said rod and the hooks, a spring within the sleeve forcing the rod in one direction to open the hooks, ratchet means for restraining movement of the rod toward opening position of 25 the jaws, dogs for engaging the ratchet, and cam means for causing disengagement of the dogs from the ratchet.

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