

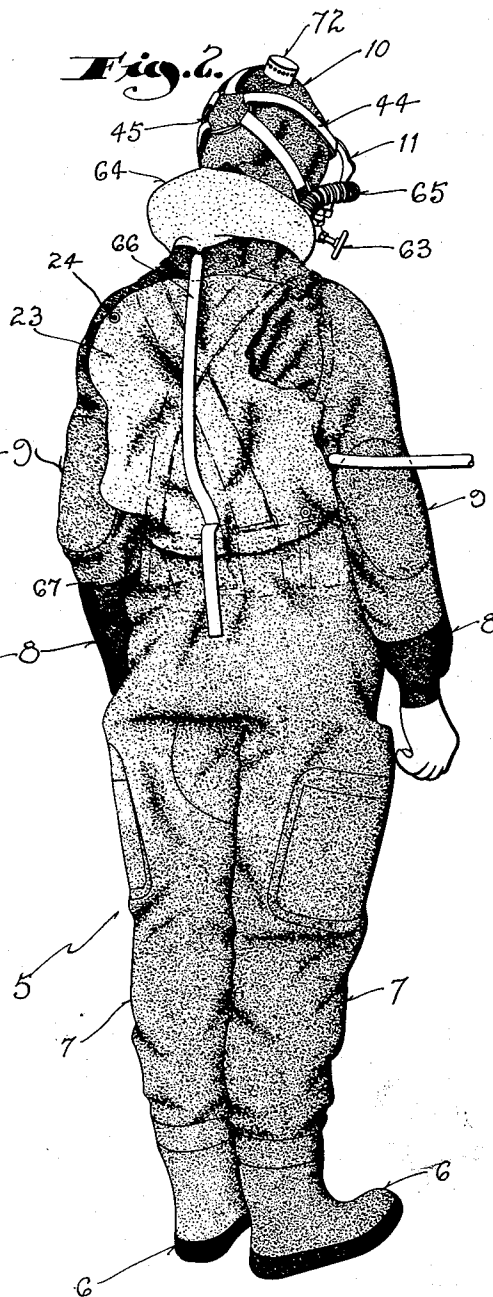
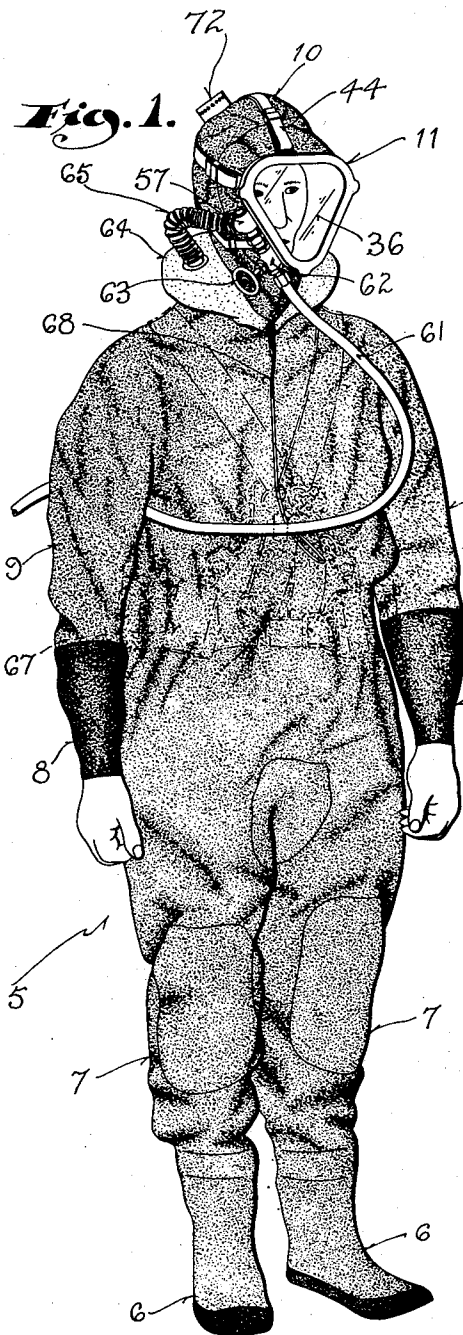
Oct. 2, 1951

J. BROWNE
DIVING SUIT

2,569,451

Filed Feb. 28, 1946

5 Sheets-Sheet 1



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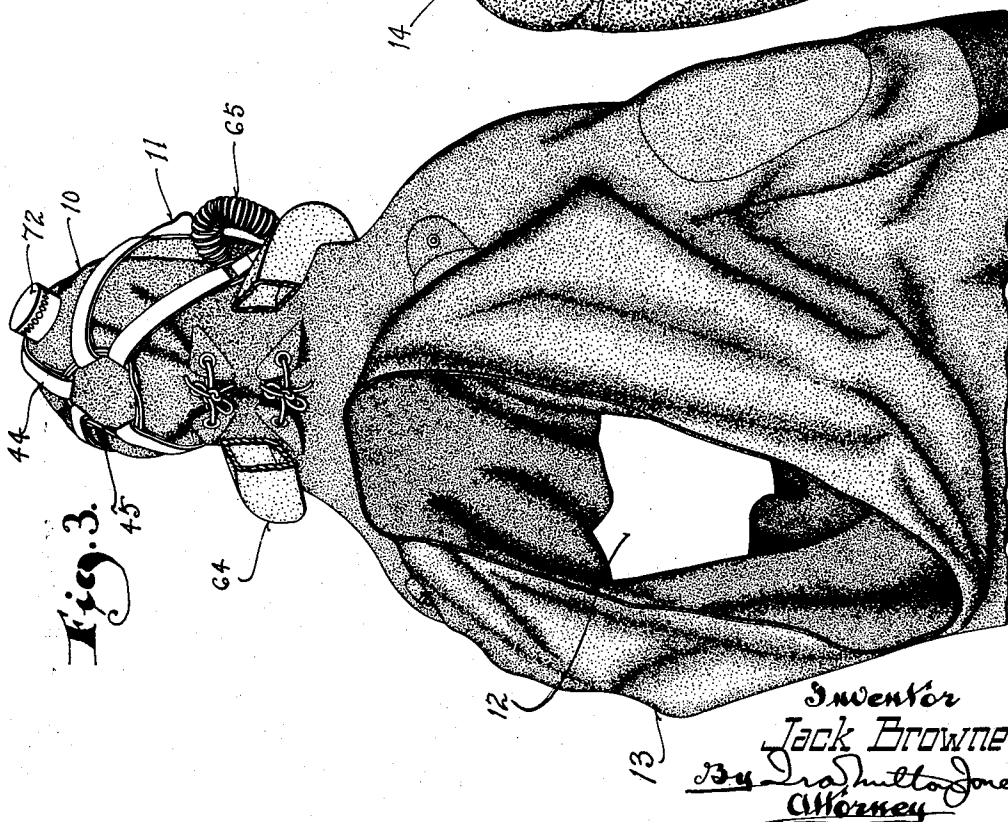
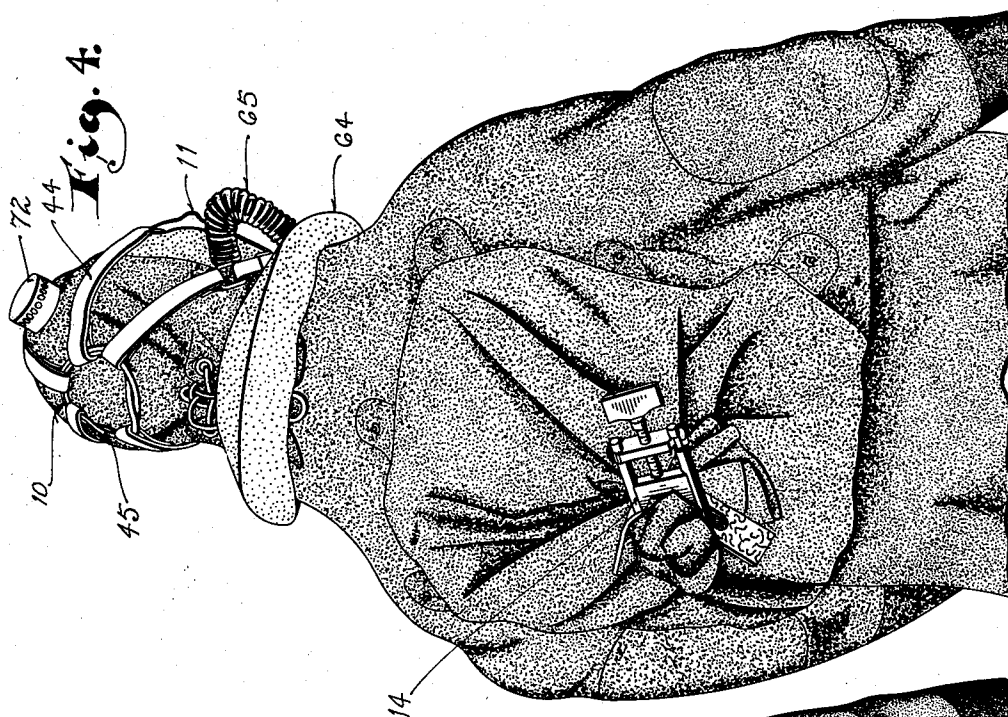
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J. BROWNE
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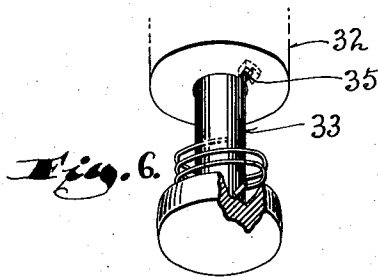
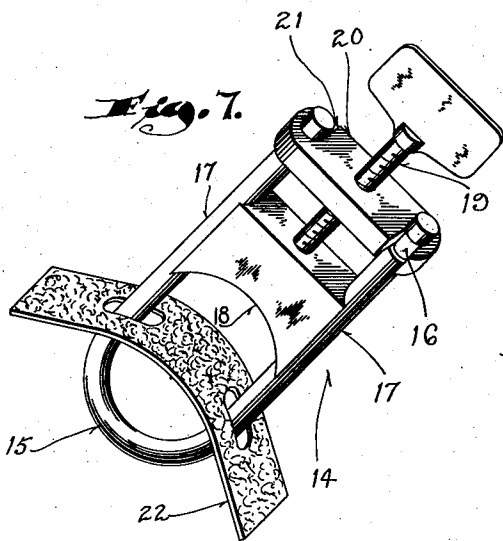
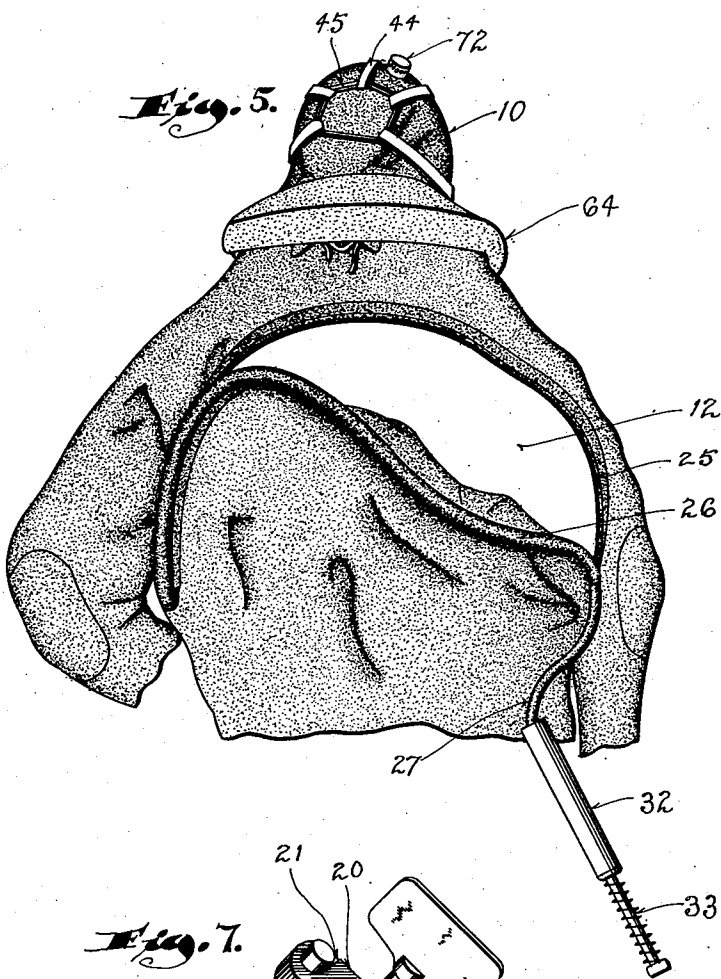
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5 Sheets-Sheet 3



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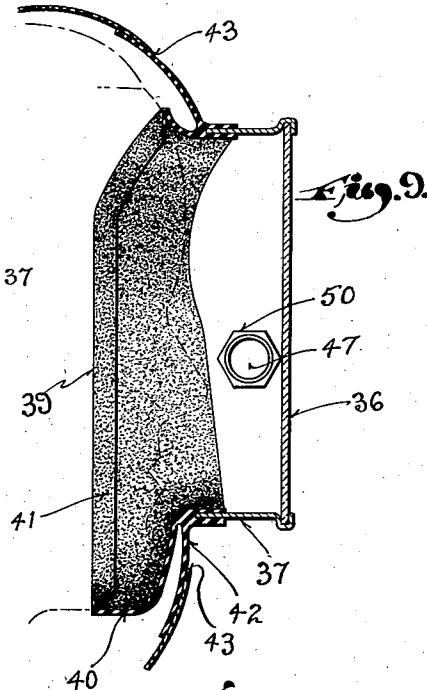
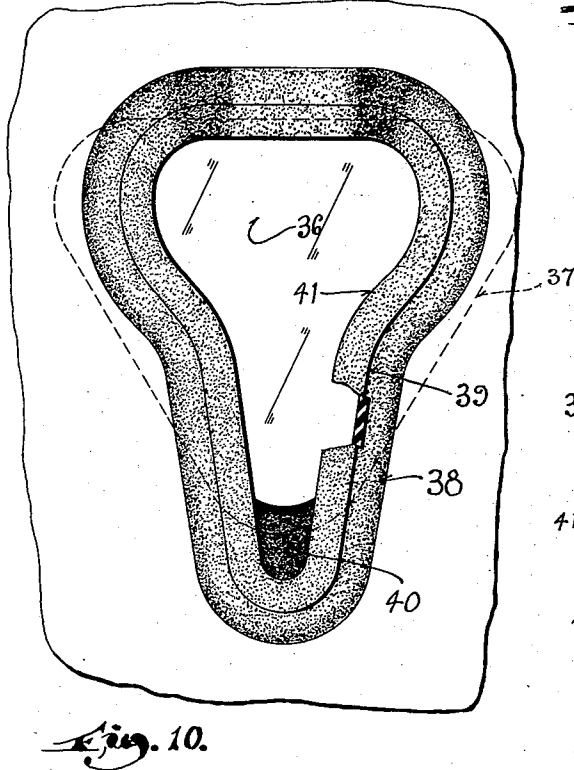
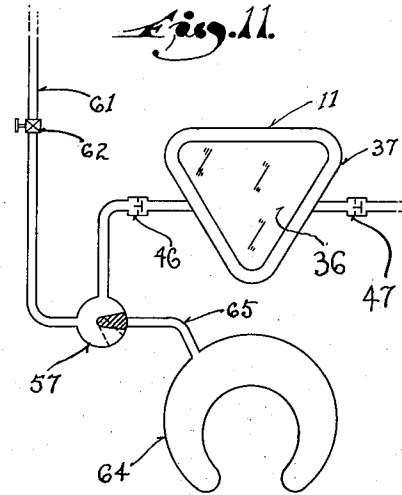
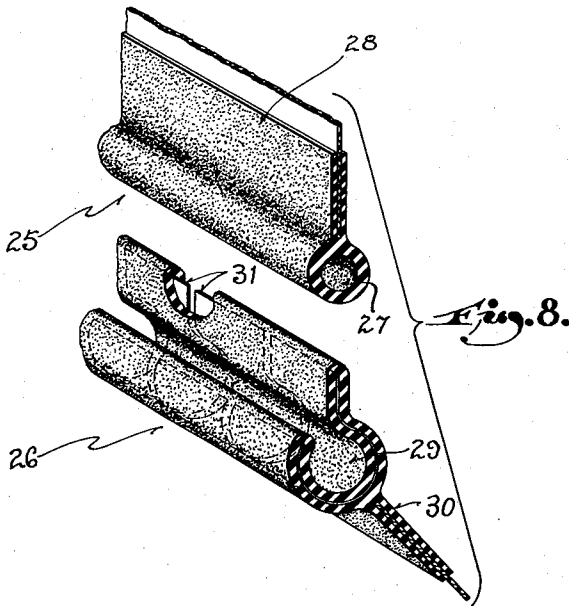
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5 Sheets-Sheet 4



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5 Sheets-Sheet 5

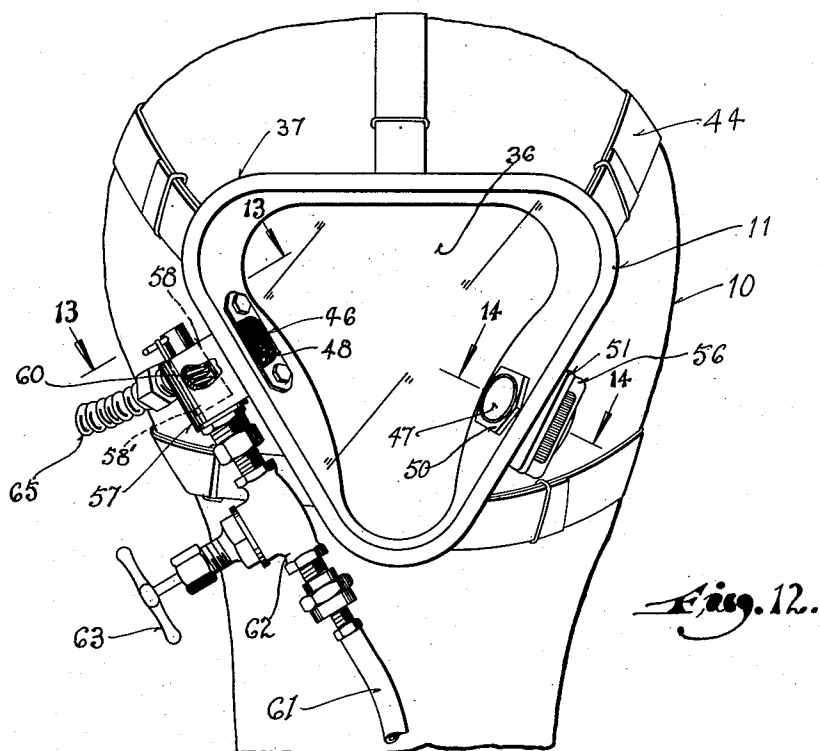


Fig. 12.

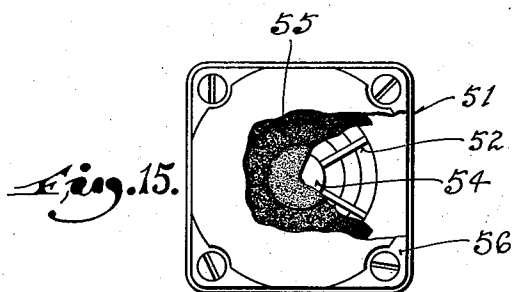


Fig. 15.

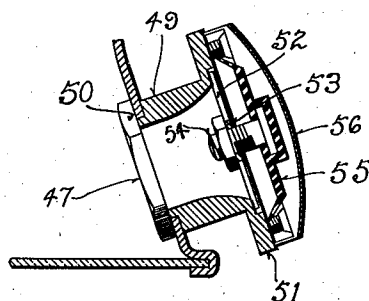


Fig. 14.

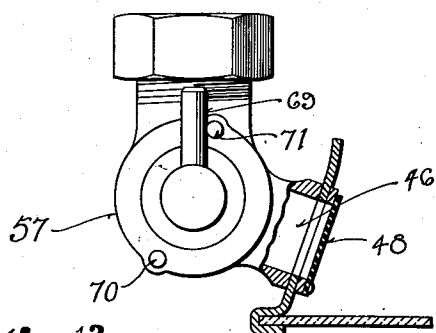


Fig. 13.

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UNITED STATES PATENT OFFICE

2,569,451

DIVING SUIT

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mesne assignments, to Diving Equipment and
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Wisconsin

Application February 28, 1946, Serial No. 650,916

12 Claims. (Cl. 128—145)

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This invention relates to diving apparatus and refers particularly to a diving suit.

In the conventional diving suit which employs a rigid metal helmet in open communication with the interior of the dress, the suit as well as the helmet contains air and the upper portion thereof is kept inflated. As a consequence, the conventional diving suit has considerable buoyancy so that the diver must be heavily weighted down in order to make his descent possible. The result is a heavy, cumbersome outfit which makes it difficult for the diver to do useful work.

Another very serious disadvantage of the conventional type of diving suit lies in the fact that, if through accident, the diver should fall or tip over, the entire suit fills with air and due to the stiffness of the material from which the suit is made, the inflated arms stand straight out making it impossible for the diver to reach the control valve and shut off the air.

With these and other objections to existing and past diving suits in mind, the present invention has as an object to provide an improved diving suit lighter than that heretofore in use and one in which the diver can safely take any position while submerged.

More specifically it is an object of this invention to provide a diving suit which is so designed and constructed that no rigid helmet is employed but instead, the dress has a hood formed integrally therewith, the hood as well as the dress being formed of flexible water-proof material, preferably fabric, so as to permit the same to conform closely to the body of the diver, and thus reduce buoyancy to a minimum.

Another object of this invention is to provide a diving suit of the character described in which air is supplied only to the interior of a mask built into the suit. As a consequence, much less air is needed and this permits the supply hose to be smaller which reduces the drag and enables lower cost surface equipment to be employed.

Another object of this invention is to provide a diving suit which can be more quickly and easily donned.

Another object of this invention is to provide a suit in which the diver can swim and which by virtue of its light weight enables the diver to move about quicker without tiring.

In the conventional diving suit, entry is effected through the neck opening of the dress. To enable subsequent attachment of the heavy metal helmet, the conventional neck entry dress has a heavy breast plate to which the helmet is bolted, an operation which requires considerable time.

In contrast, the present invention provides a novel entry through which the diver can quickly and easily get into the suit; and in this connection, it is another object of this invention to provide an improved manner of closing the entry opening of the suit.

Still another object of this invention is to provide an improved mask and breathing apparatus

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for use in suits of this type, and one which may be built into a diving suit of the character described or used independently thereof.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described, and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate two complete examples of the physical embodiment of the invention constructed in accordance with the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a front perspective view of a diving suit embodying this invention;

Figure 2 is a back perspective view thereof;

Figure 3 is a back perspective view showing the entry opening through which the diver enters the suit;

Figure 4 is a back perspective view similar to Figure 3, but showing one manner in which the entry opening in sealed shut;

Figure 5 is a back view of the upper portion of the suit illustrating another manner of closing the entry opening;

Figure 6 is a detail perspective view showing part of the means used to effect the closure shown in Figure 5;

Figure 7 is a perspective view of the clamp employed in the closure illustrated in Figure 4;

Figure 8 is a detail perspective view illustrating the elements of the closure means shown in Figure 5;

Figure 9 is a longitudinal sectional view through the mask;

Figure 10 is a plan view of the inside of the mask;

Figure 11 is a diagrammatic view illustrating the circuit of the air supply to the mask;

Figure 12 is a front view of the mask;

Figure 13 is a detail sectional view through Figure 12 on the plane of line 13—13;

Figure 14 is a detail sectional view through Figure 12 on the plane of line 14—14; and

Figure 15 is a plan view of the exhaust valve unit with parts broken away to illustrate the details of the construction.

Referring now more particularly to the accompanying drawings, the numeral 5 designates generally the dress of a diving suit embodying this invention. The dress is made of relatively light weight water-proof fabric and has integral boot portions 6 on the legs 7 thereof and close fitting cuffs 8 on the sleeves 9. A hood 10 of the same flexible water-proof fabric is permanently attached to the neck of the dress, and secured in the hood is a mask 11.

Entry into the dress is effected through an

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opening 12 in the back (see Figure 3). This opening is large enough to permit the diver to first insert his legs into the opening, and thereafter extend the arms into the sleeves and duck head and shoulders through the shirt portion of the dress in much the same fashion as getting into a pullover sweater.

The back of the dress has considerable fullness 13 surrounding the opening 12. This fullness is bunched together or folded upon itself and so held by a clamping unit 14 (Figure 7) to effect a fluid tight closure. The clamping unit 14 comprises a U-shaped metal staple 15 having an annular groove 16 near the end of each of its legs 17. Slidably engaged between the legs 17 is a slide or block 18 adapted to be forced toward the closed end of the staple by a screw 19.

The screw 19 is threaded in a cross-bar 20, the ends of which are provided with notches 21 opening to opposite side edges of the bar. The bar is substantially as thick as the width of the annular grooves 16 so that when the notches 21 are engaged therein as shown in Figure 7, the cross bar is held against endwise movement with respect to the legs of the staple.

Attention is directed to the fact that by virtue of the specific disposition of the notches, torque applied on the screw 19 during tightening thereof tends to keep the notches and grooves interengaged.

To protect the fabric of the dress, a leather gasket 22 is preferably provided. This gasket consists of a strap of leather with holes to receive the legs of the staple, and as will be readily apparent, protects the fabric of the dress against being wedged and pinched between the slide 18 and the legs of the staple.

After the back entry opening has been clamped shut in the manner described, the bunched up and clamped portion as well as the clamp are covered by a cover 23 removably secured to the back of the dress by snap fasteners 24 or the like.

As an alternative, the back entry opening may be closed in the manner illustrated in Figures 5, 6 and 8. In this case interengageable male and female parts 25 and 26 are secured along the edge of the opening each extending for one-half the perimeter of the opening. Both parts 25 and 26 are formed of rubber; the former consists of a tube 27 with an integral flange 28 by which it is secured to the fabric of the dress, and the latter a re-entrant groove 29 likewise provided with an attaching flange 30. Slightly spaced individual spring metal inserts 31 are embedded in the member 26 to hold the same against deformation without seriously interfering with required flexure thereof.

One end of the tube 27 is connected to a pump 32. The pump contains a suitable liquid such as glycerine, and has a capacity such that when its plunger 33 is withdrawn, the tube 27 will be collapsed, allowing the same to be inserted laterally into the groove 29. With the tube properly inserted into the groove, expulsion of the liquid from the pump by depressing its plunger 33 expands the tube and locks the same firmly in the groove 29. The plunger may be releasably secured in its depressed position by the engagement of a pin in a slot 35 (see Figure 6).

The mask 11 which is built into the hood of the dress has a window or transparent front wall 36 joined to a metal side wall 37. The window may be of triangular shape as shown, and being flat, assures against distortion of the vision. The

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metal side wall extends rearwardly from the front window and has a rubber gasket portion indicated generally by the numeral 38 vulcanized thereto. The gasket portion 38 is made of relatively soft molded rubber with its rear edge 39 shaped to snugly fit around the face of the wearer. Thus, viewed from the back, the gasket portion is substantially pear-shaped. Attention is directed to the fact that at its bottom the gasket has a chin receiving part 40 which projects below the metal side wall portion.

Although the gasket portion snugly fits the face, assurance against leakage is provided by an intumed flange 41 extending around the marginal edge of the entire gasket portion. This flange seals flat against the face of the wearer because of the air pressure within the mask.

The assembly of the mask to the hood of the dress is by means of an attaching flange 42 integral with the gasket portion and extending therefrom substantially along the line of the rear edge of the metal side wall 37. This attaching flange is vulcanized or otherwise secured to the fabric surrounding an opening 43 cut into the fabric of the hood. Thus, the flange 42 in effect constitutes a continuation of the adjacent portions of the fabric hood.

The mask is held in place on the face of the diver by a plurality of head straps 44 adjustably connected to the exterior of the side wall 37 of the mask and reaching around the back of the head where they connect with an elastic ring 45.

The side wall 37 has an inlet port 46 at one side of the mask and an outlet port 47 on the other side. Mounted over the inlet port on the inside of the side wall is a flap valve 48 which opens freely upon inhalation but is closed during exhalation.

The exhaust port 47 has a tubular body 49 fixed therein by a clamping nut 50. The outer end of the body 49 has a square flange 51, the outer face of which is perfectly flat. Supported within the hollow body 49 by means of spider arms 52 is a hub 53. The hub 53 has a stud 54 secured therein and projecting beyond the flat face of the flange 51. A rubber disc 55 secured to the outer end of this stud normally has its periphery seating on the flat face of the flange 51 in a manner enabling the unseating thereof during exhalation. A guard 56 is preferably secured over the rubber disc in such a manner as to protect the disc and at the same time allow the air to pass from the exhaust port.

Mounted on the side wall 37 over the inlet port is a fitting 57. This fitting has a tapered bore 58 in which a rotatable plug is mounted. The fitting 57 with its plug thus is somewhat in the nature of a conventional gas cock, with the plug being held down in the tapered bore by a spring 60. The interior of the fitting opens to the inlet port and has two air admission openings leading thereto. One of these air admission openings is coaxial with the rotatable plug 58' and is supplied by an air line 61. A shut-off valve 62 is interposed between the line 61 and the fitting 57 being directly supported from the fitting so that its hand wheel 53 is conveniently located for adjustment by the diver.

The other air admission port leading to the interior of the fitting 57 is connected with a breathing bag 64 by means of a flexible duct 65. This breathing bag fits around the neck of the diver like a collar. It is held down in place by a strap 66 fastened at the back of the diver to a weighted

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belt 67 (indicated in dotted lines in Figures 1 and 2) and by cord 68 tied to the two ends of the collar-like breathing bag and the harness of the weighted belt 67.

The rotatable plug 58' in the valve fitting 57 has passages so arranged that regardless of its position of adjustment, open communication is always maintained between the air supply and the interior of the mask, but in one position of adjustment, identified by the engagement of a handle 69 on the plug with a pin 70, the breathing bag is connected with the air supply and the interior of the mask, while in its other position of adjustment, identified by the engagement of the handle 69 with a pin 71, the breathing bag is disconnected from the air supply line and the interior of the mask.

When the breathing bag is connected in the air supply circuit, it serves as an air reservoir to facilitate breathing. During exhalation, the breathing bag fills with air and during inhalation the diver draws the air readily and easily from the bag. This permits a smaller diameter air supply hose to be used as more time is available to supply the air for the diver's consumption.

Although the exhaust valve in the mask is normally adequate to preclude blowing up the suit, additional assurance against this possibility due to failure of the exhaust valve is provided by a safety air relief valve indicated generally by the numeral 72 and located in the upper portion of the hood. This air relief valve, which may be of conventional design, opens automatically in event of pressure building up within the suit beyond a predetermined value.

From the foregoing description taken in connection with the accompanying drawings, it will be readily apparent to those skilled in this art that this invention provides a diving suit having many advantages over the conventional equipment heretofore in use. It will also be apparent that while the mask here shown and described constitutes a vital part of the complete suit, it can be used apart from the dress and hood in circumstances where so called "skin diving" is desirable. In that event, the attaching flange 42 is omitted but in other respects the mask remains the same, being held in place by the head straps 44 and utilizing the air supply and control means described, in conjunction with the breathing bag 64. Of course, when so used, a weighted belt must be employed and the breathing bag tied down to the weighted belt in the same way shown in Figures 1 and 2.

What I claim as my invention is:

1. A flexible light-weight suit for divers comprising: a dress of flexible water-proof material; a hood of flexible water-proof material joined permanently to the dress; a mask built into the hood and including flexible side wall portions shaped to fit snugly around the face of the wearer to isolate the interior of the mask from the interior of the hood and dress; the back of the dress having an opening large enough to provide an entry for the diver into the dress; and means including a screw tightened metal clamp for closing said back entry opening in a water-tight manner, said clamp comprising a U-shaped staple, a block slidably engaged between the legs of the staple to be forced toward the closed end of the staple and means for slidably moving and retaining said block in a fixed clamped position.

2. A flexible light weight suit for divers comprising: a dress of flexible water-proof material;

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a hood of flexible water-proof material joined permanently to the dress; a mask built into the hood and including flexible side wall portions shaped to fit snugly around the face of the wearer to isolate the interior of the mask from the interior of the hood and dress, the dress having an opening large enough to provide an entry for the diver; means on half the perimeter of said entry opening having a stiffened form retaining re-entrant groove extending therealong; a collapsible tube fixed to and extending along the other half of the perimeter of the entry opening, said collapsible tube, when collapsed, being laterally insertable into the re-entrant groove and when expanded, filling said groove; and means for collapsing and expanding said tube.

3. In a suit for divers: a dress of flexible water-proof fabric, said dress having an opening large enough to provide an entry into the dress for the diver; and means for closing the entry opening in a fluid tight manner, comprising, a stiff form retaining re-entrant groove secured to and extending along half the perimeter of the opening; a flexible collapsible tube secured to and extending along the remainder of the perimeter of said opening and being adapted, when deflated, for lateral insertion into the re-entrant groove; and means for inflating said tube into intimate contact with the walls of the re-entrant groove to securely lock the same therein and thereby close the entry opening.

4. In a suit for divers: a dress of flexible water-proof fabric; said dress having an opening large enough to provide an entry into the dress for the diver; a fullness in the dress surrounding said entry opening, said fullness permitting the portions thereof contiguous to the perimeter of the opening to be folded upon themselves and bunched up to effectively close the opening; and a clamp for securely holding said folded end bunched up portion tightly together, said clamp comprising a U-shaped metal staple, a block slidably engaged between the legs of the staple to be forced toward the closed end of the staple, and means for slidably moving and retaining said block in a fixed clamping position.

5. A breathing apparatus for under water divers comprising: a mask having a transparent window and side walls provided with a yieldable marginal edge portion shaped to snugly fit around the face of the wearer; means for holding the mask in place; inlet and outlet ports in the side walls of the mask; valves for said ports, the former adapted to open on inhalation and the latter upon exhalation; a hollow fitting secured to the side wall of the mask over the inlet port and in open communication therewith, said fitting having two air admission ports; an air supply line connected with one of said two air admission ports; an air reservoir bag; a flexible duct connecting the other one of said two air admission ports of the fitting with said air reservoir bag; and said outlet port communicating directly with the exterior of said mask when open.

6. A breathing apparatus for under water divers comprising: a mask having a transparent window and side walls provided with a yieldable marginal edge portion shaped to snugly fit around the face of the wearer; means for holding the mask in place; inlet and outlet ports in the side walls of the mask; valves for said ports, the former adapted to open on inhalation and the latter upon exhalation; a valve body having two

inlets and one outlet secured to the side wall of the mask with the outlet of the valve body over the inlet port therein; a supply line connected to one of said two inlets of the valve body; an air reservoir bag; a flexible duct connecting the other one of said two inlets of the valve body with said air reservoir bag; and a valve in said valve body for disconnecting the air reservoir bag from the circuit without disrupting communication between the mask interior and the supply line.

7. A diving mask comprising: a transparent front wall; a metal side wall secured to said transparent front wall; inlet and outlet ports in said side wall, both opening to the interior of the mask; a control valve supported on the side wall of the mask for regulating the admission of air into the mask through the inlet port; a molded rubber gasket portion vulcanized to the metal side wall and projecting rearwardly therefrom, said molded rubber gasket portion having a chin receiving part in open communication with the interior of the mask but projecting downwardly beneath the transparent window and side wall, and said entire gasket portion having its marginal edge shaped to snugly fit around the face of the wearer with his chin positioned in said chin receiving portion; and head straps secured to the side wall and adapted to pass around the head of the wearer.

8. A breathing apparatus for under-water divers comprising: a mask having a transparent window and side walls provided with a yieldable marginal edge portion shaped to snugly fit around the face of the wearer; means for holding the mask in place; inlet and outlet ports in the side walls of the mask; inlet and outlet valves for said ports, the former being adapted to open on inhalation and the latter upon exhalation; a valve body secured to the side wall of the mask over the inlet port of the mask and communicating with said inlet; an air supply line communicating with the interior of the mask through said valve body; an air reservoir bag of substantially U-shape permitting the same to be worn as a collar by the diver; means for securing the reservoir bag around the neck of the wearer; a single flexible duct leading from the bag and connected to the fitting, said duct providing the sole access to the bag interior and communicating the interior of the mask with the air reservoir bag through said valve body; and a valve carried by said valve body for disconnecting the air reservoir bag from the circuit without disrupting communication between the mask interior and the supply line.

9. In a suit for divers: an opening in the suit large enough to provide an entry into the suit for the diver; and means for closing the entry opening in a fluid tight manner, comprising, interengageable male and female parts closing and sealing the opening when engaged, the female part comprising a stiff form retaining re-entrant groove, the male part comprising a flexible collapsible tube and adapted, when deflated, for insertion into the re-entrant groove of the female part; and means for inflating said tube into intimate contact with the walls of the re-entrant groove to securely lock the same therein and thereby close the entry opening.

10. In a suit for divers, means providing a water-tight closure for the suit to prevent fluid from penetrating within the suit comprising: interengageable male and female marginal portions of the suit closing and sealing off the inside

of the suit from the outside of the suit when engaged; the female marginal portion comprising a relatively stiff form retaining re-entrant groove; the male marginal portion comprising a flexible collapsible tube adapted, when deflated, for insertion into said re-entrant groove; and means for inflating said tube into intimate contact with the wall of the re-entrant groove to securely lock the same therein and thereby seal the inside of the suit from the outside thereof.

11. The suit described in claim 10 wherein the means for inflating said tube comprises a fluid within the tube; and a pump integral with said male portion and communicating with the fluid for creating a fluid pressure within the tube to expand the same so as to effect a water-tight seal between the marginal portions and whereby release of the fluid pressure by the pump causes the collapse of the tube to permit disengagement thereof.

12. In combination: a diver's mask having a transparent front wall and side walls projecting rearwardly therefrom; an elastic rear edge portion on the side walls shaped to snugly fit around the face of the diver; inlet and outlet ports in the side walls of the mask, the outlet port communicating directly with the exterior when open; an inlet valve controlling the inlet port and adapted to open upon inhalation and close upon exhalation; an outlet valve controlling the outlet port and adapted to open upon exhalation and close upon inhalation; a U-shaped flexible air reservoir bag of a size to be worn around the neck of the diver; means for securing the bag around the neck of the diver; a fresh air supply line; means including a valve connecting the mask and air reservoir bag to the supply line, said valve including a movable element ported to provide fixed communication between the air supply line and the interior of the mask through its inlet port and controllable communication between the interior of the air reservoir bag and the interior of the mask through its inlet port; and manually operable means for actuating the movable element of the valve to enable the diver to disconnect the air reservoir bag from the air supply line and the interior of the mask without disrupting communication between the air supply line and the interior of the mask.

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