Nov. 13, 1945. J. W. BROWNE 2,388,674

DIVING SUIT

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Fig. 1.

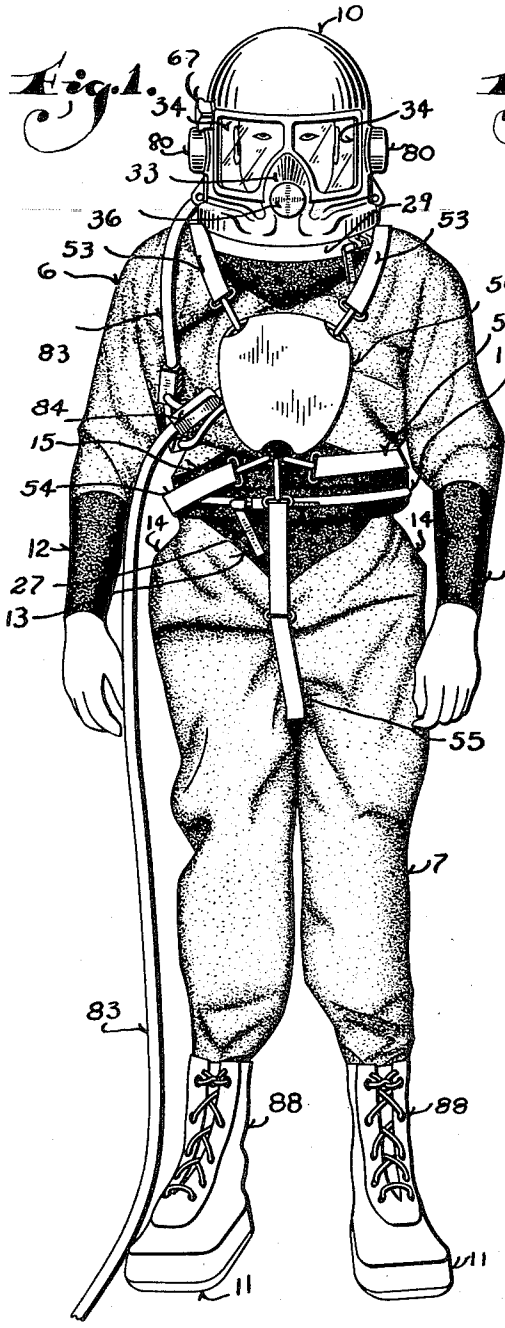

Fig. 2.

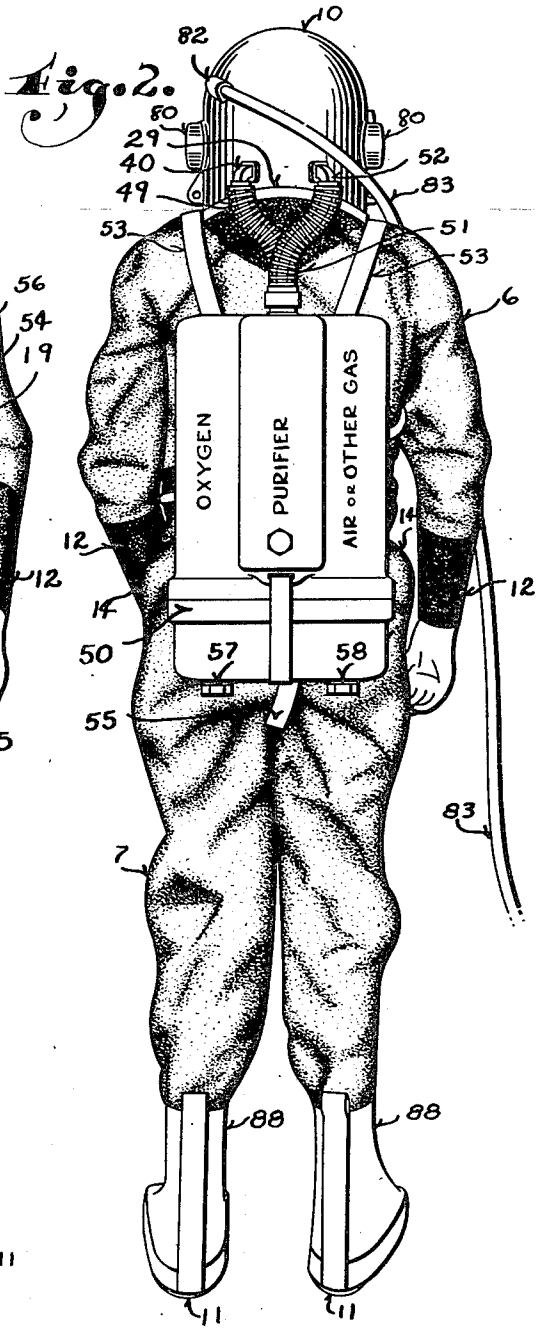

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Fig. 3.

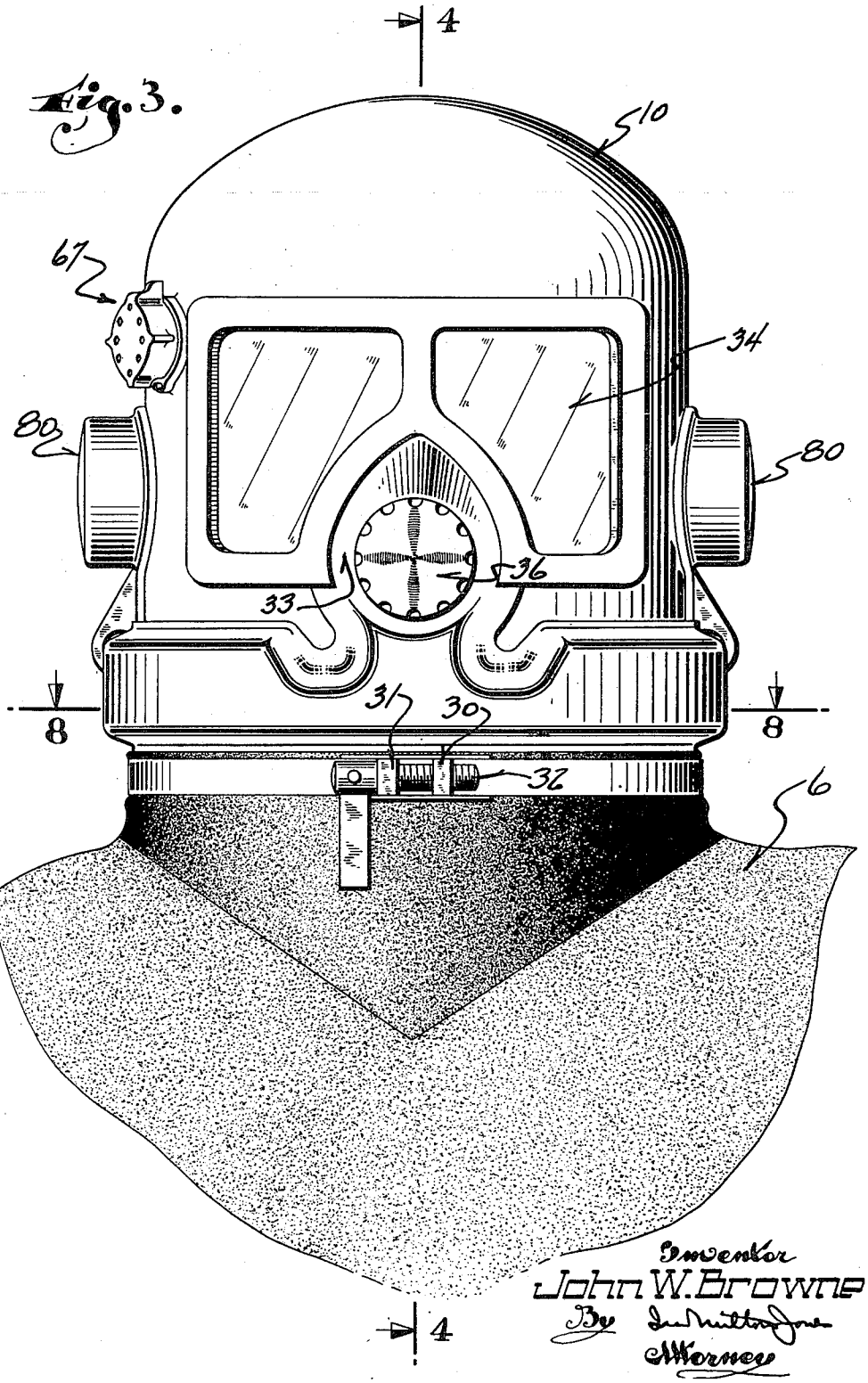

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Fig. 4.

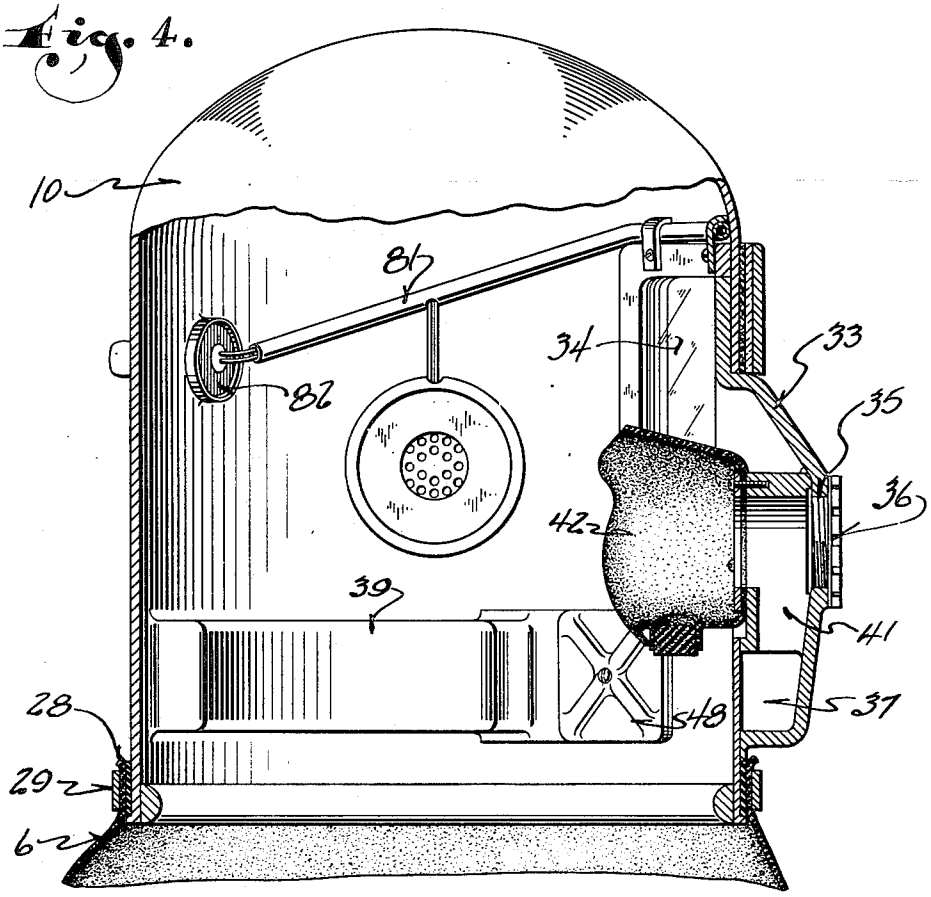

Fig. 5.

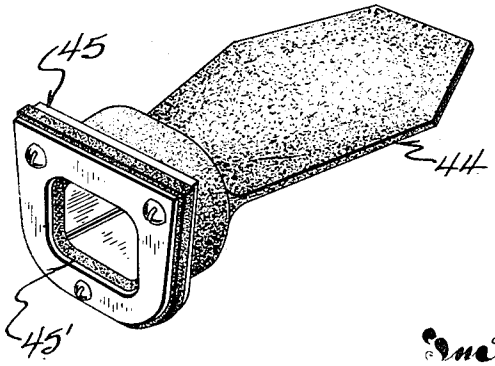

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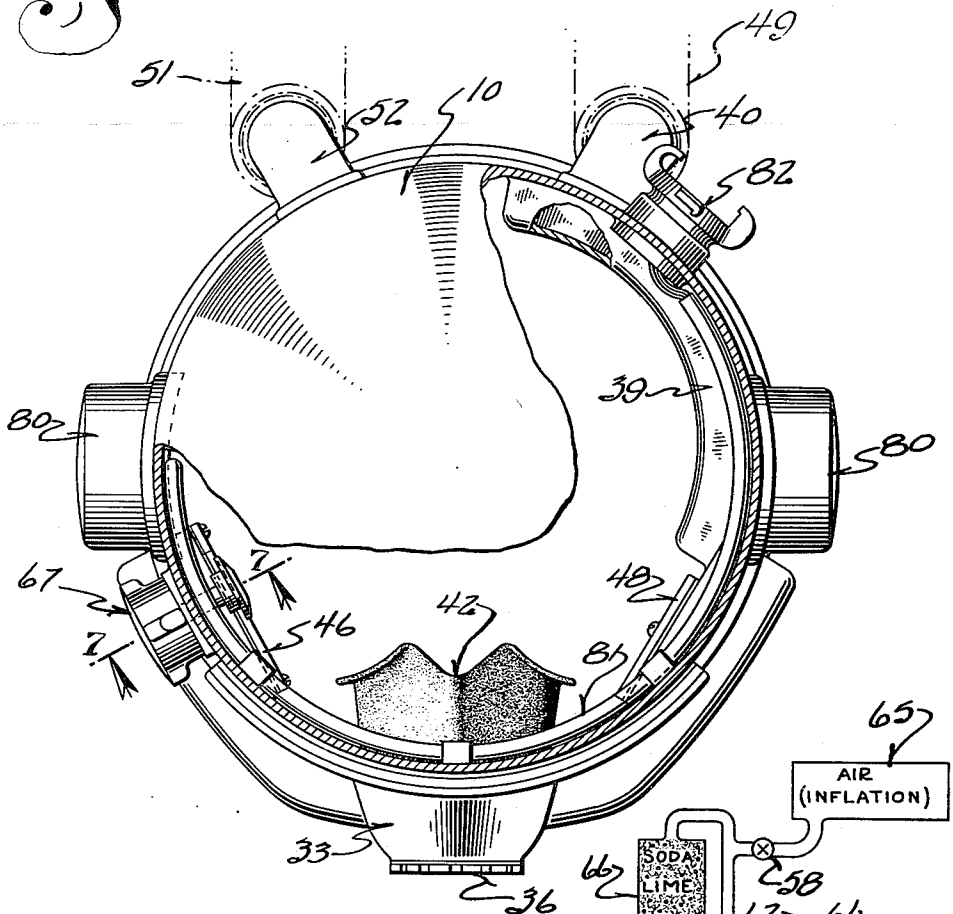
Fig. 6.



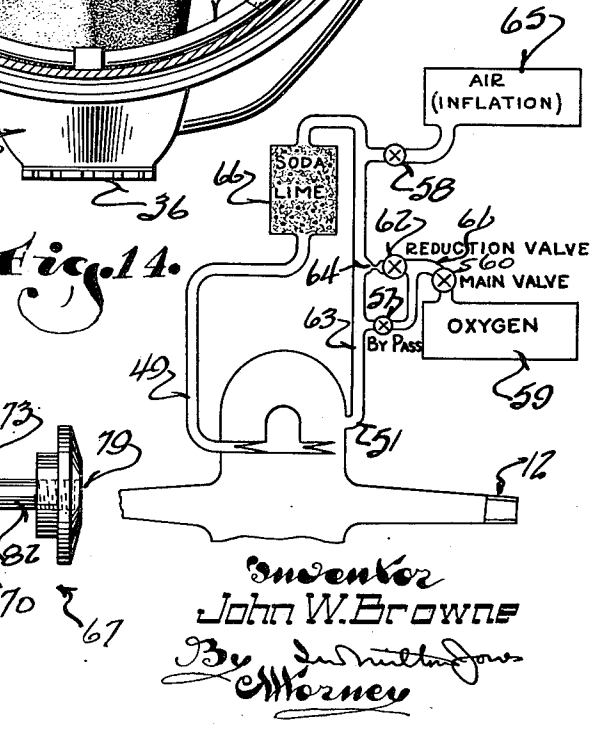


Fig. 14.

Fig. 7.

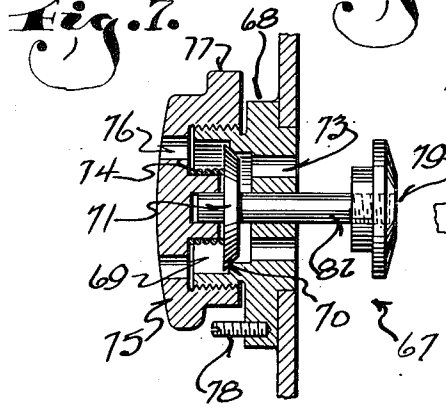


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Fig. 8.

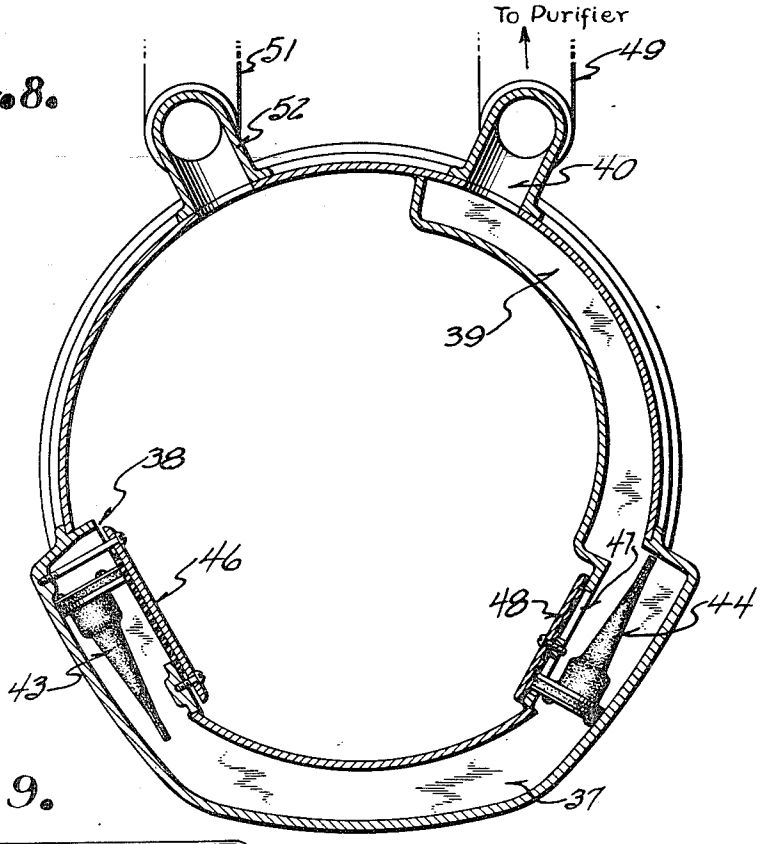

Fig. 9.

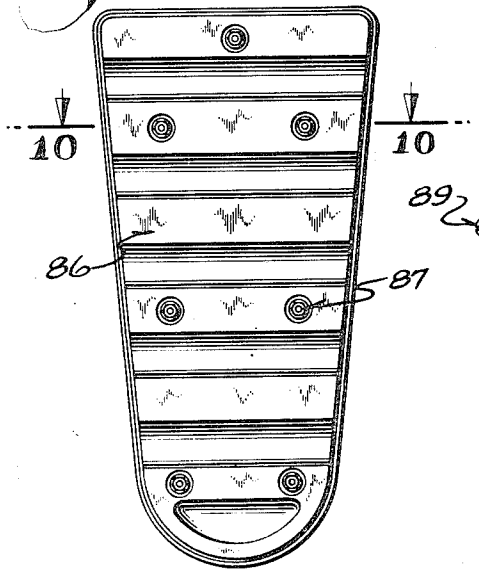

Fig. 10.

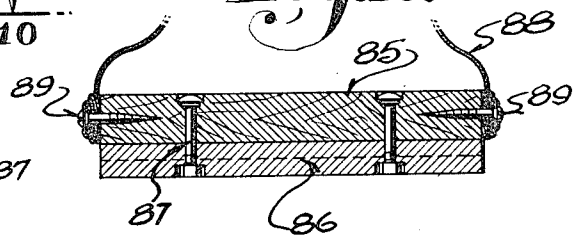

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Fig. 11.

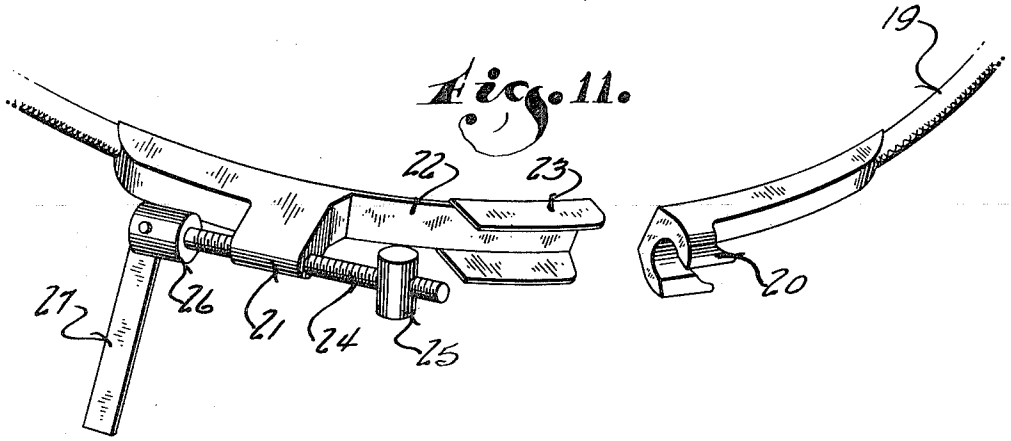


Fig. 12.

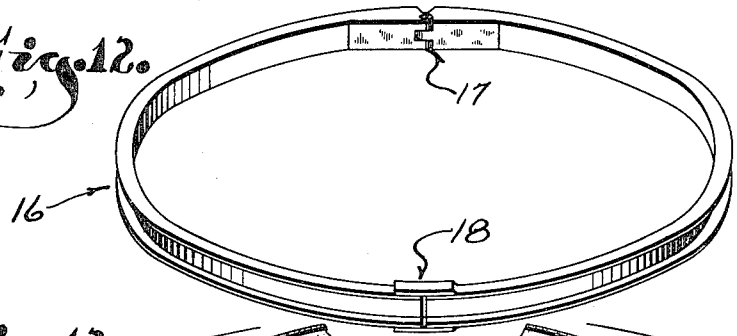
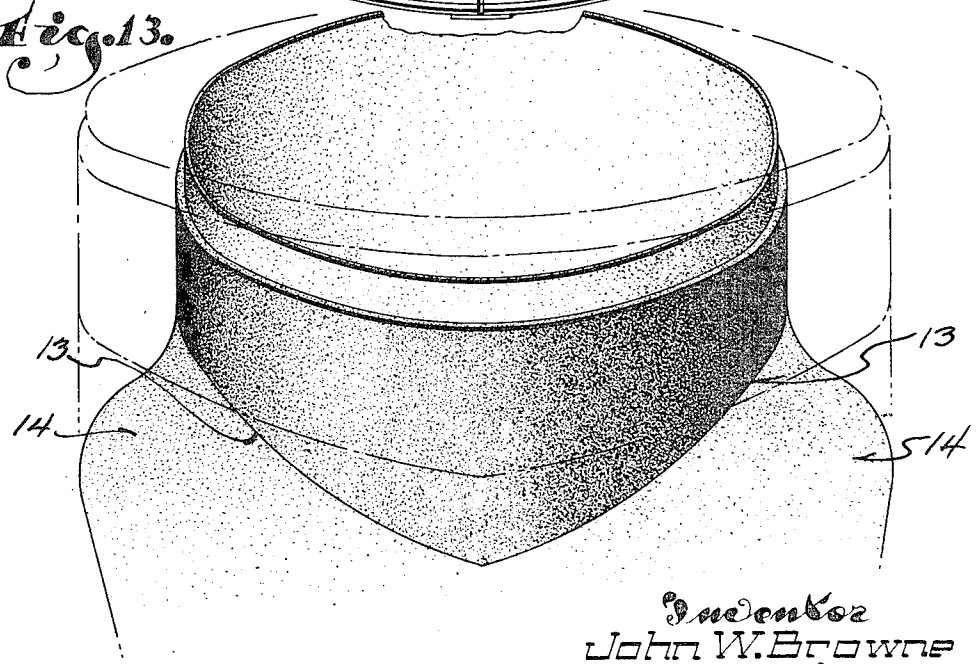


Fig. 13.



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Patented Nov. 13, 1945

2,388,674

UNITED STATES PATENT OFFICE

2,388,674

DIVING SUIT

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Application January 22, 1942, Serial No. 427,736

7 Claims. (Cl. 61—70)

This invention relates to improvements in diving suits.

The conventional present-day commercial diving equipment consists of a suit or diving dress of flexible waterproof material open at the neck sufficiently to enable the diver to step into the suit. The large neck opening is thereafter closed by a metal plate on which the helmet is mounted. The most common method employed for effecting the connection between this helmet supporting plate and the neck of the suit is by a series of bolts which clamp the neck rim of the dress to the plate and which have to be individually tightened up. Thus it requires considerable time to "dress" the diver.

The diving suit above described is known as the "ventilated type" as air must be pumped into it from the surface to supply oxygen to the diver and also to offset the water pressure as the diver descends.

The difficulties and objections to this ventilated type suit are deemed obvious. Failure of the pump, tangling of the air hose, and the excessive power necessary to provide the pressure required as the depth increases are but a few of its undesirable features.

The present invention overcomes all of these objections by providing a diving suit which is entirely self-contained in that the diver's oxygen supply and the air pressure source for expanding the suit to offset water pressure are carried with him and are at all times under his direct control.

It is recognized that the broad concept of a self-contained diver's suit or apparatus which would enable the diver to be wholly independent of surface assistance is not new. Many schemes have been proposed in an effort to attain this desideratum, but as far as known no one heretofore has succeeded in producing a practical and reliable solution to the problem. This invention, on the other hand, has been proven successful in every respect by actual tests including dives in excess of four hundred feet.

It is, therefore, the primary object of this invention to provide a diving suit which incorporates a novel and entirely practical manner of having the diver carry his own supply of oxygen and inflation air.

In a self-contained suit of the type to which this invention appertains, the air is not exhausted from the suit except when the diver intends to reduce buoyancy or during ascent when pressure inside the suit must be relieved. The air exhaled by the diver thus stays in the circulatory system. It is, therefore, another object of this invention to provide a diving suit equipped with means for purifying the air exhaled by the diver, that is, removing the carbon dioxide from the exhaled air and returning the same to the suit interior.

Another object of this invention is to provide a more comfortable diving suit and one which the diver can be more readily dressed in. With this thought in mind, it is a further object of this invention to provide a diving suit in which the dress or suit proper is made in two pieces, pants and shirt, joined at the waist.

Inasmuch as the establishment of a fluid-tight juncture between the shirt and pants requires their waistband portions to overlap snugly, and as it is desirable to restrict the waist dimension of the dress to a comfortable dimension, it is a further object of this invention to provide a novel waistband construction for the shirt and pants which enables the same to be stretched to provide a large opening to facilitate dressing the diver and which in its normal condition more nearly fits the waist of the diver.

It is also an object of this invention to provide a diving suit so designed that the helmet may be left joined to the shirt portion of the dress so as to preclude the possibility of leakage as a result of improper or hurried attachment of the helmet to the dress.

It is also an object of this invention to provide an improved and greatly simplified manner of attaching the helmet to the shirt portion of the dress.

Another object of this invention is to provide a helmet for a diving suit of the character described which affords greater visibility and obviates the necessity for turning the head in the helmet.

Another object of this invention is to provide a helmet for diving suits of the character described which has a breathing mask and air passages built therein and through which the air exhaled by the diver is conducted exteriorly of the helmet for passage through an air purifier and through which the purified air fortified with additional oxygen returns to the interior of the suit.

Another object of this invention is to provide a helmet of the character described having an earphone and microphone built into it for connection with a telephone line which forms part of a combination lifeline and telephone cable, by plugging the end of the cable into a socket conveniently mounted on the exterior of the helmet.

It is also an object of this invention to provide a novel valve in the wall of the helmet with an

actuator button so located that the valve may be opened by the diver by pressing his head against the button.

Still another object of this invention is to provide an improved shoe for divers by which the tendency for the feet to rock as the diver walks on a submerged surface is materially lessened.

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 herein disclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate several complete examples of the physical embodiments 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 view of a diving suit embodying this invention in position on a diver;

Figure 2 is a back view thereof;

Figure 3 is an enlarged front view of the helmet and adjacent portion of the suit;

Figure 4 is a longitudinal sectional view through the helmet taken on the plane of the line 4—4 in Figure 3;

Figure 5 is a detail perspective view of one of the valves used in the helmet to control the air passages;

Figure 6 is a view of the helmet partly in top elevation and partly in horizontal section;

Figure 7 is a detail sectional view taken through Figure 6 on the plane of the line 7—7 and illustrating the air relief valve which may be operated by the diver's head;

Figure 8 is a cross-sectional view through the helmet, said view being taken on the plane of the line 8—8 in Figure 3;

Figure 9 is a bottom view of the sole of one of the shoes;

Figure 10 is a cross-sectional view through the sole illustrating the construction of the shoes, said view being taken on the plane of the line 10—10 in Figure 9;

Figure 11 is a perspective view showing the front portion of the clamping band of the fluid-tight juncture between the waistbands of the shirt and pants;

Figure 12 is a perspective view of the hinged rigid inner waistband which forms part of this juncture;

Figure 13 is a perspective view of the waist portion of the pants and illustrating the manner in which it may be stretched to facilitate dressing and undressing the diver; and

Figure 14 is a diagrammatic view illustrating the air and oxygen supply circuits of the apparatus.

Referring now particularly to the accompanying drawings in which like numerals indicate like parts, the numeral 5 designates that portion of the diving suit known as the dress and which comprises in this instance a shirt 6 and pants 7 separably joined at the waist with a fluid-tight juncture indicated generally by the numeral 8.

The shirt 6 has a neckband 9 to which a helmet 10 is secured. The helmet is preferably cast of suitable metal such as an aluminum alloy. The shirt and pants of the dress are made of flexible waterproof material and the legs of the pants, as is customary, are complete with closed foot portions over which the shoes 11 are drawn.

The arms of the shirt have sleeve cuffs 12 of rubber which closely hug the wrists of the diver and preclude ingress of water at this point while leaving the hands free to manipulate the various appliances of the diving equipment and tools with which the diver may be called upon to work.

The waist portion of the pants consists of a band of rubber secured to the fabric of the pants along substantially V-shaped lines 13 in front and back. The sides of the fabric pants adjacent to the narrow parts of the rubber waistband are abruptly enlarged as at 14. This, and the double V-shaped line of the juncture of the rubber band to the inelastic upper portion of the pants allows the band to be stretched a substantial amount to facilitate dressing and undressing the diver. It likewise enables the waist portion of the pants to fit the body of the diver without excessive bulging.

The waist portion of the shirt 6 is provided with a rubber waistband 15 similar to the band 13 and attached to the shirt in the same manner.

It is to be observed with relation to the attachment of these rubber waistbands that the V-shaped contour of their junction to the pants and shirt gives the juncture a perimeter considerably greater than that of the outer edge of the band. It is this fact together with the abrupt bulges 14 in the sides of the shirt and pants which allows the rubber waistbands to be stretched.

After the diver pulls on the pants, a rigid metal waistband 16 is placed about the waist of the diver and the rubber waistband of the pants stretched over the metal band. The metal band as best shown in Figure 12 has a channel-shaped cross section with the channel facing outwardly, and consists of two sections hingedly connected as at 17 with their free ends provided with an overlapping joint 18 so that the channel-shaped cross section is substantially continuous about the entire band. The hinged construction of the band allows the same to be applied about the waist of the diver as will be readily apparent.

The shirt 6 is preferably kept attached to the base of the helmet so that these two units are applied as one.

In applying the connected shirt and helmet to the diver, the assistant, standing in front of the diver, holds the helmet while the diver slips his hands into the sleeves. The diver then holds the helmet himself and ducks his head into the waistband whereupon the shirt portion of the suit may be drawn over his head like a sweater.

The rubber waistband 15 which forms the bottom of the shirt is lapped over the band on the pants which already has been stretched over the rigid waistband or ring 16 and thereafter an outer tension member or band 19 (see Figure 11) is applied.

The outer band or tension member 19 consists of a length of cable having a hook 20 on one end and a bearing bracket 21 on the opposite end thereof. An extension 22 projecting from the forward end of the bearing bracket and provided with flanges 23 serves as a guide to receive the hook portion 20.

A tension screw 24 freely rotatable and slidable in the bearing bracket 21 and threaded into a nut member 25 which is detachably engageable behind the hook 20 serves to draw the ends of the cable together. During such tensioning a head 26 on the outer end of the screw and to which a handle 27 is pivoted, bears against the

outer face of the bearing bracket as will be readily apparent.

The attachment of the helmet to the neckband of the shirt is similar to the manner in which the juncture is effected between the waist portions of the shirt and pants. To this end the neckband 9 of the shirt, like the waistbands of the shirt and pants, is formed of elastic rubber and its junction with the neck portion of the shirt is in the form of a V, front and back, to enable the neckband to be stretched about the lower edge of the helmet.

Before applying the neckband to the base of the helmet a sealing compound 28 is applied to the outer surface of the helmet base; and after the rubber neckband has been stretched over the base of the helmet, a tension member 29 is applied. The tension member is similar to the tension band 19 but preferably consists of a flexible flat metal strip one end of which has a nut member 30 mounted thereon and the opposite end of which has a bearing bracket 31 projecting therefrom.

A tension screw 32 similar to the screw 24 passes freely through the bearing bracket 31 and threads into the nut member 30.

The helmet 10 is formed with a protuberance 33 in its front portion and at opposite sides thereof are window openings 34. These window openings are closed with a suitable transparent material which may be bent so as to conform to the curvature of the helmet. "Pyrolin" has been found exceptionally suitable for this purpose as this material is unbreakable and may be bent as required.

The protuberance 33 has a surface breathing port 35 therein adapted to be closed by a removable screw plug 36. When the diver is on the surface this plug is removed so that he may breathe fresh, outside air in the normal manner.

The protuberance 33 may be an integral part of the helmet wall or a separate piece welded to the front wall of the helmet, but in any event its lower portion continues around the base of the helmet below the window openings to form an air chamber 37.

One end this air chamber opens to the interior of the helmet through an opening 38 and its opposite end connects with another air chamber 39 which extends around the base of the helmet along its inner surface to a point adjacent to the rear thereof where it connects with an exhaust port 40 leading to the exterior of the helmet.

Inside the protuberance 33 is an upright extension 41 of the air chamber 37 which not only connects with the surface breathing port 35 but also opens to a soft rubber mask 42 fastened on the inside of the helmet. This mask 42 is similar to the soft rubber nose and mouth pieces of gas masks and the like and is so shaped as to comfortably and snugly fit the face of the diver. The diver thus breathes through this mask.

It is to be observed that the position of the mask with relation to the windows is such that the diver has substantially 180° of vision merely by shifting his eyes laterally. This follows from the protuberant formation of the helmet, and obviously is a great convenience to the diver.

During inhalation the diver draws air from inside the suit through the opening 38 which leads to the air passage 37 and during exhalation, the air exhaled by the diver enters the passage 37 and passes out through the exhaust port 40. To assure these results, inlet and outlet flutter valves 43 and 44, respectively, are mounted in the passage 37.

These valves as best shown in Figure 5 have base portions 45 of a size to fit the air passage 37 and completely close the same except for an opening 45' through the base portion which leads to the interior of the flutter valves. The flutter valves thus have the common function of check valves.

The inlet valve 43 is mounted in the air passage 37 at its open end 38. A cover plate 46 secured over all of that portion of the opening 38 at the downstream side of the flutter valve, removably holds the valve in position and permits air to be drawn from inside the helmet and suit past the valve and into the air passage 37.

The outlet valve 44 is removably mounted in the air passage 37 at its junction with the passage 39. An opening 47 in the inner wall of the air passage 37 and a cover plate 48 provide for removably mounting this valve 44. So positioned, the valve 44 permits only passage of air from the chamber 37 into the chamber 39.

The outlet port 49 is adapted to have a flexible hose line 49 quickly detachably secured thereto. This line leads to a purifier carried on the back of the diver as part of a cannister pack 50.

Another similar flexible hose line 51 connects the outlet of the purifier as well as the outlets of oxygen and inflation gas cartridges with an inlet port 52 which opens directly to the interior of the helmet and consequently the interior of the entire suit.

The cannister pack 50 is conveniently strapped to the back of the diver by means of a harness comprising shoulder straps 53, a belt 54 and a jock strap 55. The ends of all of these straps are connected to a weighted plate 56 worn on the chest of the diver.

At the bottom of the cannister pack are two valves 57 and 58 both readily accessible to the diver's hands. The former constitutes a by-pass valve, the opening of which enables the diver to admit oxygen into the suit in an emergency resulting from exhaustion of the supply of inflation gas. The other valve 58 controls the admission of inflation gas to the interior of the suit.

The complete air supply circuit is diagrammatically illustrated in Figure 14. As here shown, the outlet from the oxygen cartridge 59 has a main valve 60 in a main supply line 61. This supply line leads to a reduction valve 62 by which the pressure of the oxygen is reduced and to the by-pass valve 57.

The outlet of the by-pass valve connects directly with a line 63 which leads to the air supply hose 51 and thence into the interior of the suit. The outlet of the reduction valve leads to a restricted orifice 64 which discharges into the line 63.

The outlet of the inflation gas cartridge 65 leads to the control valve 58 and from the outlet of this valve as noted hereinbefore the inflation air passes through the duct 63 into the supply pipe 51.

The outlet of the air purifier 66 also leads to the duct 63, while the inlet to the purifier is connected to the exhaust line 49. The air purifier may be of any suitable design but preferably consists merely of a quantity of soda lime in a suitable baffled container through which all the air exhaled by the diver flows. As it passes through the soda lime, the carbon dioxide is removed from the exhaled air so that the air may be returned to the suit.

The oxygen used up by the diver is replaced by the constant admission of oxygen through the restricted orifice 64.

Ordinary air may be used for the inflation gas but if desired, helium or some other gas may be used for admixture with oxygen or even another cartridge of oxygen may be used for the inflation gas.

In any event the diver controls the amount of inflation gas entering the suit by means of the valve 58 so that his buoyancy is at all times under his own control. He is, therefore, enabled to locate the level of collapse at the point taught best by experience. During descent the air inside the suit is compressed by the water pressure so that the suit collapses. The level of collapse rises from the feet toward the helmet. By adjusting the valve 58 and admitting inflation gas, this level of collapse is maintained at the desired point, and when a diver reaches the bottom or the extent of his descent and he has adjusted the valve 58 to suit his comfort no further adjustments thereof are required.

Thereafter the functions of the apparatus are automatically performed to maintain the air in proper condition. Oxygenation and purification continue without attention from the diver who is thus enabled to direct his entire attention to whatever work he has been sent to do.

At the upper portion of the helmet is a pressure relief valve indicated generally by the numeral 67. This valve as shown in detail in Figure 7 comprises a flange 68 secured in a hole in the upper side wall of the helmet. The outer portion of this flange is bored to provide a valve pocket or chamber 69, the side wall of which is stepped to form a valve seat 70.

A valve plug 71 is slidably guided by a stem 72 passing through the flange 68 for movement to and from a closed position engaging the valve seat 70, and ports 73 through the flange 68 communicate the valve pocket or chamber 69 with the interior of the helmet so that when the valve plug is lifted from its seat a pressure relief opening is provided.

The valve plug is yieldingly urged to its closed position by a spring 74 confined between the plug and a cap 75 threaded onto the flange 68, the cap being provided with ports 76. This cap 75 also has a central boss bored to receive the adjacent end of the valve stem and so positioned that when the cap is screwed all the way onto the flange the valve plug is positively held down on its seat.

Hence, by controlling the extent the cap 75 can be unscrewed, it is possible to regulate the degree of opening of the pressure relief valve, and to this end a lug 77 projects radially from the cap to collide with a stop 78.

On the inner end of the valve stem 72 is a button 79 so positioned that the diver may press against it with the side of his head when he desires to open the valve, providing, of course, that the cap 75 has been unscrewed to allow such opening.

Another novel innovation in diving equipment resides in the provision of a microphone and earphone built into the helmet. For this purpose, the helmet has two cup-shaped caps 80 secured thereto over openings in its opposite side walls. One of these cup-shaped caps houses a microphone and the other has an earphone positioned therein. These phones are electrically connected through suitable conductors 81 with the terminals of a socket 82 in the upper portion of the helmet. This socket is adapted to have the terminal plug of a combination telephone cable and lifeline 83 readily detachably but securely connected thereto.

Attention is directed to the manner in which this combination lifeline and telephone cable is applied. As shown in Figures 1 and 2, it is looped about the chest of the diver and secured by cleats 84 so that a pull on the line will not detach the terminal plug 83.

The end of the cable extends from the cleats 84 over the right shoulder and around the rear of the helmet for connection with the socket 82.

In case the combination telephone cable and lifeline becomes hopelessly tangled with a submerged object, the diver can disconnect the cable from the socket 82 and undo the cleats 84 to completely free himself of the line. He is, of course, then cut off from surface communication but can effect ascent under his own control by merely increasing his buoyancy through the admission of added inflation air.

The shoes 11 also embody novel features of construction as is clearly shown in Figures 9 and 10. The soles of these shoes consist of an inner sole 85 of wood or like material and an outer tread 86 of lead or other heavy metal. Bolts 87 or other suitable securing means hold the treads to the soles 85.

The uppers 88 of the shoes are preferably made of canvas and are secured to the soles by screws 89 or other fastening means passing through the marginal edges of the uppers and threaded into the wooden soles 85.

Attention is particularly directed to the formation of the toes of the shoes. As best shown in Figure 9, the toes are square and have substantial width. This materially reduces the tendency of the feet to rock as the diver walks over a submerged surface and thus minimizes the danger of tipping over.

From the foregoing description taken in connection with the accompanying drawings, it will be readily apparent to those skilled in the art that this invention provides a diving suit or apparatus having many valuable advantages over diving equipment heretofore in use.

What I claim as my invention is:

1. In a diving helmet, an air passage built into the wall of the helmet and disposed substantially horizontally with a medial portion thereof extending across the front of the helmet and end portions at the sides of the helmet, a breathing port opening into the helmet through an inner wall of the medial portion of the passage, a mask connected to the breathing port and through which the diver breathes; the inner wall of the air passage at opposite sides of the breathing port having openings of substantial size leading to the interior of the helmet, and an outer wall of one end portion of the air passage having an outlet port leading to the exterior of the helmet; an outlet valve inserted into the air passage through the opening in that end of the air passage which leads to the outlet port and disposed across the air passage to open only upon exhalation; a closure for said opening; an inlet valve inserted into the air passage through the other one of said openings and disposed across the air passage to open only on inhalation; a partial closure for said opening leaving an inlet port from the air passage into the interior of the helmet between which and said breathing port the inlet valve is located, and means for feeding life sustaining air into the helmet.

2. In a diving apparatus, a helmet made of

metal and having an air passage built into a wall thereof so as to be unitary with the helmet, said air passage being disposed horizontally in the lower portion of the helmet with a part thereof extending across the front of the helmet, a breathing port in said front part of the air passage opening to the interior of the helmet; an inlet port in an inner wall of the air passage also opening to the interior of the helmet, an exhaust port in an outer wall of the air passage opening to the exterior of the helmet, a mask connected with the breathing port through which the diver inhales and exhales from and into said air passage, an inlet valve interposed between the breathing port and the inlet port opening only on inhalation, and an outlet valve in the air passage between the breathing port and the exhaust port opening only on exhalation.

3. In a diving apparatus, a helmet made of metal and having an air passage built into a wall thereof so as to be unitary with the helmet, said air passage being disposed horizontally in the lower portion of the helmet with a part thereof extending across the front of the helmet, a breathing port in said front part of the air passage opening to the interior of the helmet, an inlet port in an inner wall of the air passage also opening to the interior of the helmet, an exhaust port in an outer wall of the air passage opening to the exterior of the helmet, a mask connected with the breathing port through which the diver inhales and exhales from and into said air passage; an inlet valve interposed between the breathing port and the inlet port opening only on inhalation, an outlet valve in the air passage between the breathing port and the exhaust port opening only on exhalation, the exterior wall of the air passage adjacent to the breathing port having a surface breathing port, and a removable plug closing said surface breathing port.

4. In a diving apparatus, a metal helmet formed with a protuberance in its front portion and windows adjacent thereto, said windows extending a substantial distance to the sides of the helmet, the forward protuberance on the helmet enabling the diver's face to be positioned well forward in the helmet so as to increase the angle of side vision without necessitating turning the head, an air passage built into the helmet as an integral part thereof and extending from the protuberance substantially horizontally in opposite directions, said air passage having open connection with the interior of the protuberance, a breathing port in said protuberance; a mask connected to said breathing port through which the diver exhales and inhales into and from the air passage, a valved inlet port connecting one end portion of the air passage with the interior of the helmet and opening only on inhalation so that the diver breathes air from inside the helmet, and a valved outlet port leading from the other end of the air passage to the exterior of the helmet and opening only on exhalation.

5. A diving suit of the character described comprising: a flexible diving dress having a neck band; a helmet; a fluid tight connection between the helmet and the neck band of the diving dress; a mask inside the helmet through which the diver breathes; a valved inlet for the mask through which the diver breathes air from inside the suit, said inlet opening only upon inhalation; a valved outlet for the mask opening only upon exhalation; an air purifier connected with the valved outlet and the interior of the suit for purifying the air exhaled by the diver and returning it to the suit; a pressure tank containing life sustaining gas; a pressure tank containing inflation gas also suitable for life sustenance; duct means connecting both said tanks with the interior of the suit so that gas from either one or both tanks may be admitted into the suit; a pressure reducing valve through which the tank containing the life sustaining gas is connected with said duct means to continuously replenish the oxygen used up by the diver; a bypass around said pressure reducing valve; individual valves readily accessible to the diver for controlling said bypass and the flow of gas from the tank containing the inflation gas so that the diver has at his command two sources of life sustaining gas as well as a source of buoyancy producing gas; and a normally closed exhaust valve in the helmet adapted to be opened by pressure applied to the actuator of the valve by means of the diver's head so that the diver also has at his command means for adjusting his buoyancy and maintaining the level of collapse of the suit at the most comfortable point.

6. A diving apparatus comprising: a flexible diving dress having a neck band; a helmet; a fluid tight connection between the helmet and the neckband of the diving dress; a mask inside the helmet through which the diver breathes; a valved inlet for the mask through which the diver inhales air from inside the suit, said inlet opening only on inhalation; an inlet port on the helmet opening directly to the interior thereof; an outlet port on the helmet; an air passage in the helmet connecting the mask with said outlet port; an outlet valve in said passage opening only on exhalation; a tank containing life sustaining gas; a tank containing inflation gas under pressure; an air purifier cannister; means for supporting said tanks and the cannister on the back of the diver outside the diving dress; a flexible hose connection leading from the outlet port on the helmet to the inlet of the air purifier cannister; a single flexible hose connection leading from the outlet of the air purifier cannister and from both tanks to the inlet port on the helmet; and valves for controlling flow from said tanks into the helmet whereby oxygen supply and buoyancy may be controlled by the diver.

7. In a diving apparatus: a metal helmet formed with a protuberance in its front portion and windows adjacent thereto, said windows extending a substantial distance to the sides of the helmet; the forward protuberance on the helmet enabling the diver's face to be positioned well forward in the helmet so as to increase the angle of side vision without necessitating turning the diver's head, an air passage built into the helmet as an integral part thereof, said air passage connecting with the protuberance and having a breathing port in said protuberance leading to the interior of the helmet, a mask connected to the breathing port through which the diver exhales and inhales to and from said air passage; means for exhausting exhaled air from said passage; and means for admitting fresh air to said passage.

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