Aug. 21, 1962 R. G. VAUTIN 3,050,055

UNDERWATER BREATHING DEVICE

Filed June 29, 1960 3 Sheets-Sheet 1

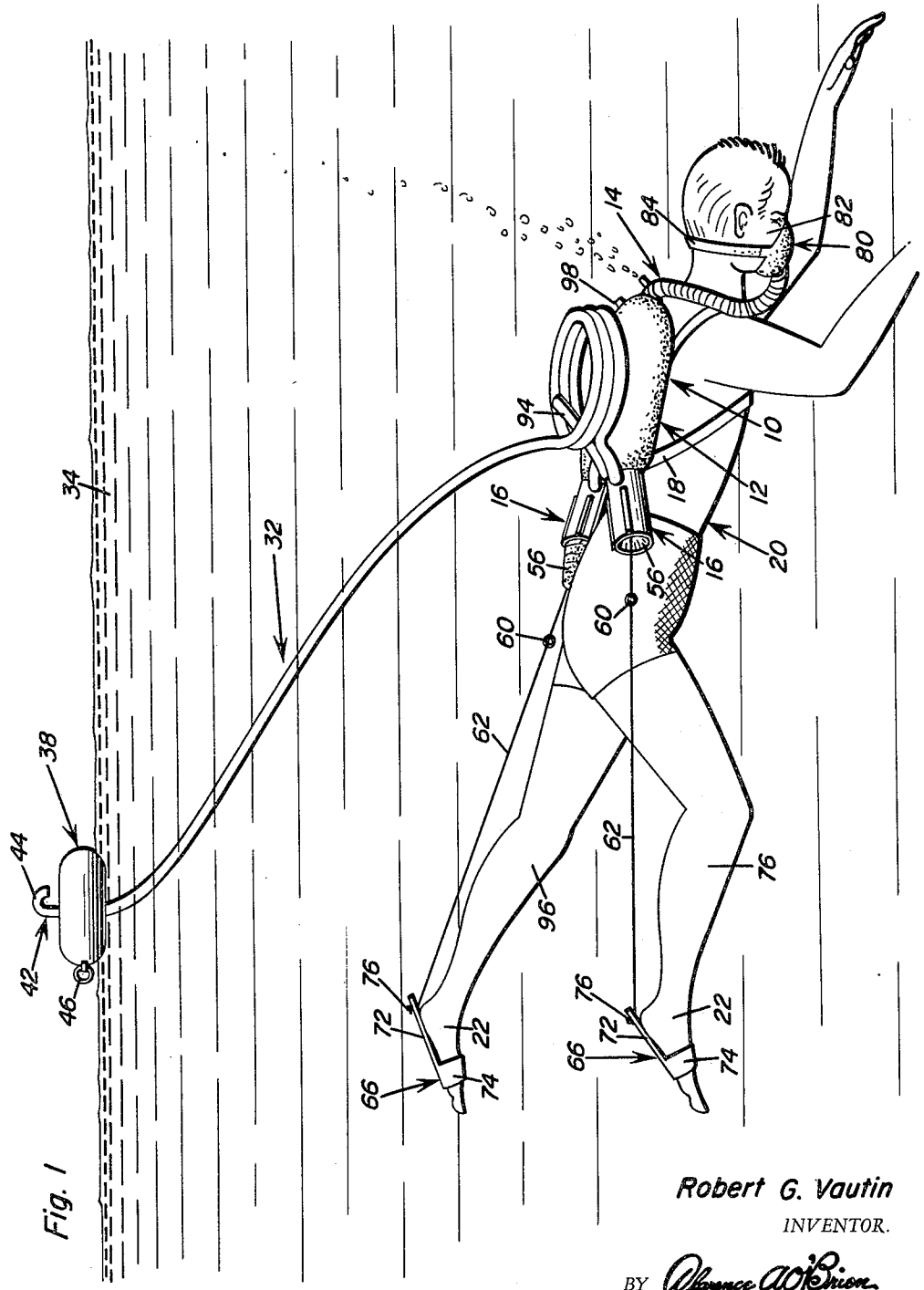


Fig. 1

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Fig. 2

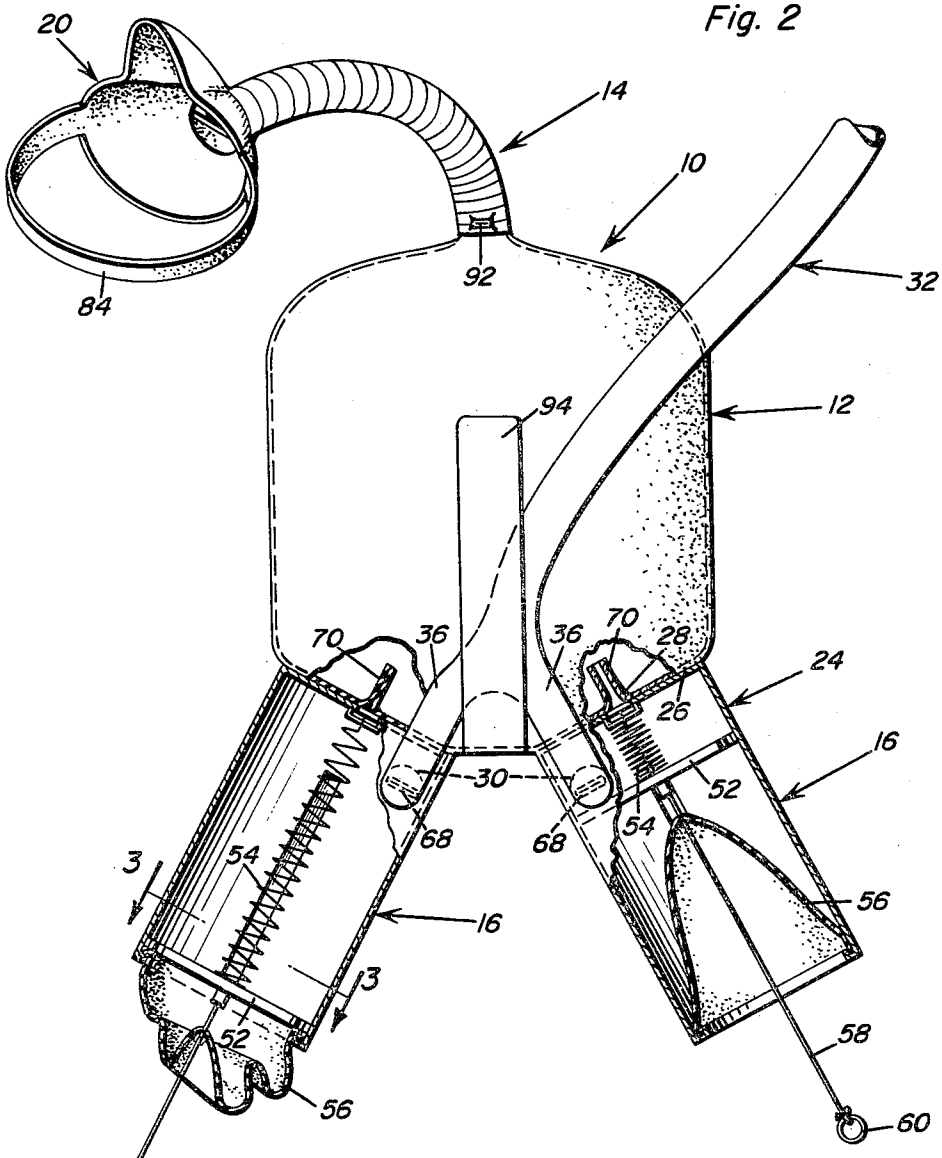
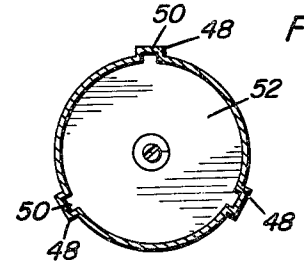


Fig. 3



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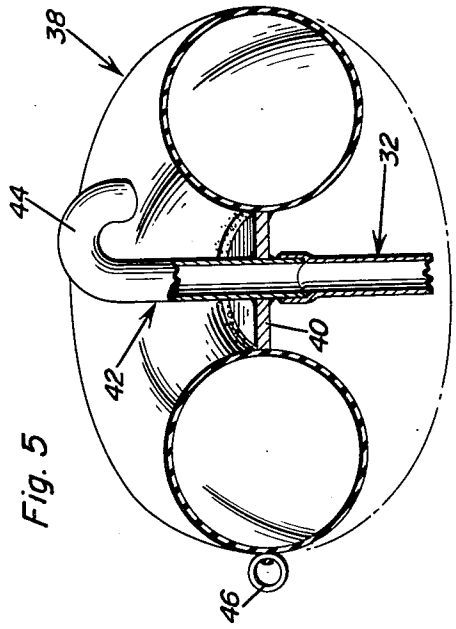


Fig. 5

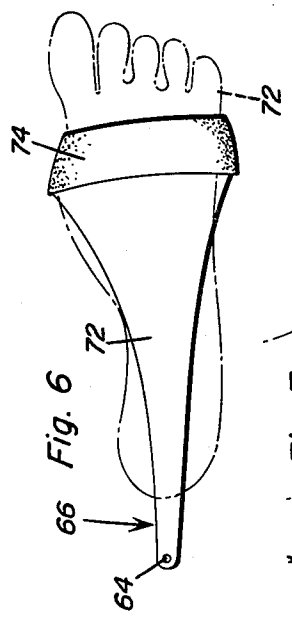


Fig. 6

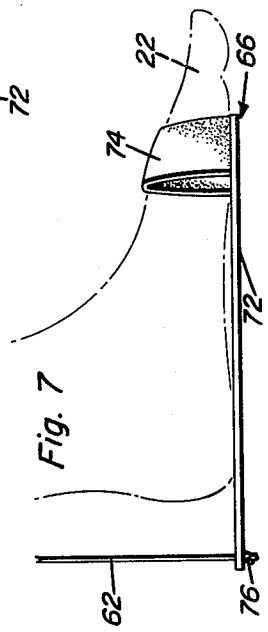


Fig. 7

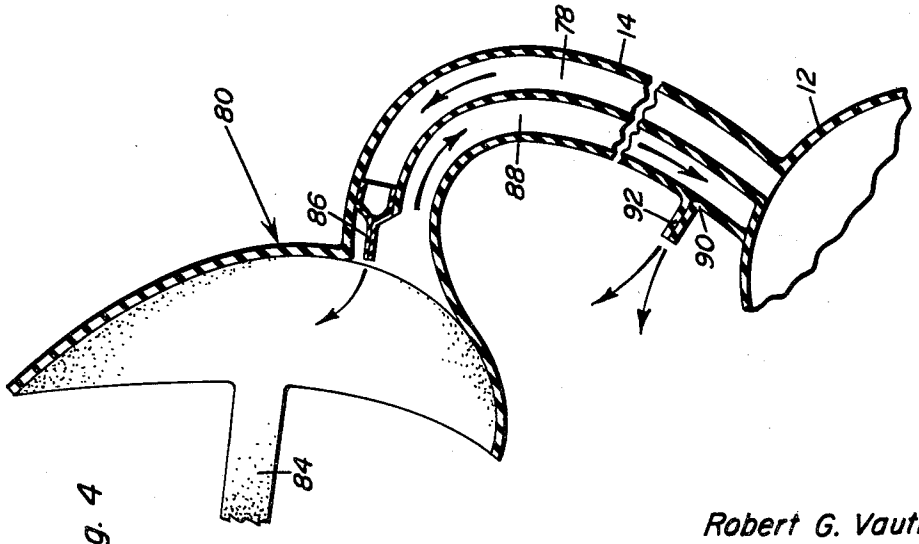


Fig. 4

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3,050,055

UNDERWATER BREATHING DEVICE

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8 Claims. (Cl. 128—145)

This invention relates to a novel and useful underwater breathing device, and more particularly to an underwater breathing device which is specifically adapted to communicate with the air above the surface of a body of water and provide the swimmer wearing the breathing device with air from the surface at the pressure of the water at the depth at which the diver is swimming.

The underwater breathing device includes at least one air pump which is carried by the swimmer and is adapted to be operated by the normal swimming movements of the swimmer and an inlet line for the air pump is provided and connected to the pump at one end while the other end is specifically adapted to be secured to a float which will maintain that end of the inlet line above the surface of the body of water in which the diver is swimming. The outlet of the air pump communicates with the interior of a sealed pressure chamber which in turn is provided with a delivery conduit extending therefrom and provided with any suitable means adapted for communication with the lungs of the diver on the free end thereof. It is to be noted that the free end of the delivery conduit is preferably provided with a mask adapted for sealing engagement with the nose and mouth area of the face of a diver, but that it may also be provided with a mouthpiece adapted for removable securement in the mouth of a diver. Suitable check valves are provided in the inlet line adjacent the air pump for restricting backward movement of air from the air pump to the surface of the water and check valves are also provided at the outlet of the air pump for restricting backward movement of air from the pressure chamber to the air pump.

The delivery conduit secured to the pressure chamber and adapted for engagement with the face area of a diver may also be provided with an outlet passage if the delivery conduit is provided with a mask adapted to cover both the mouth and nose area of the diver with an outlet opening being provided for the outlet passage and a check valve disposed in the outlet opening. If a delivery conduit provided with an outlet passage is used, then it will also be necessary to provide a check valve in the delivery conduit for restricting the reverse flow of air therethrough.

The air pump is specifically designed to be operated by the legs of a diver by means of his normal swimming movements and the air pump consists of at least one cylinder having a piston slidably disposed therein for movement toward and away from the feet of the diver so that a flexible member secured between the piston and the feet of the diver will reciprocate the piston in the cylinder of the air pump as the legs of the diver are extended and retracted. In this manner, the diver may provide himself with sufficient air for breathing purposes from the surface of the water up to depths of approximately twenty-five feet. Inasmuch as the air pump will become increasingly difficult to operate as the depth is increased, the depth at which a diver may obtain air from the underwater breathing device depends upon the strength and physical condition of the person using the underwater breathing device. Naturally even greater depths may be obtained if the diver is in excellent physical condition and is stronger than average.

The main object of this invention is to provide an underwater breathing device which will enable persons to enjoy underwater sports with maximum safety and at low cost to the swimmer for his underwater breathing device.

A further object of this invention, in accordance with the immediately preceding object, is to provide an underwater breathing device including an air pump operable by an underwater swimmer by means of his normal swimming movements and means for communicating the air pump with the air above the surface of the water in which the diver is swimming.

A further object of this invention is to provide a pressure chamber in communication with the outlet of the air pump whereby small quantities of air may be stored for breathing purposes if the diver wishes to relax for short periods.

Still another object of this invention is to provide a pressure chamber constructed of flexible material impervious to air so that the pressure within the pressure chamber will be equal to that of the water disposed outside thereof thereby automatically compensating for the air pressure needed by the diver.

A further object to be specifically enumerated herein is to provide an underwater breathing device which will conform to conventional forms of manufacture, be of simple construction and easy to use so as to provide a device that will be economically feasible, relatively trouble free in operation and operable by less experienced swimmers with a high degree of safety.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a view in perspective of the underwater breathing device shown strapped to the back of an underwater swimmer;

FIGURE 2 is a top plan view of the underwater breathing device with parts thereof being broken away and shown in section and the face mask and delivery conduit therefor being shown in perspective;

FIGURE 3 is a transverse vertical sectional view taken substantially upon the plane indicated by the section line 3—3 of FIGURE 2;

FIGURE 4 is an enlarged sectional view of the face mask illustrated in FIGURE 2 taken substantially upon a plane passing through the longitudinal center line of the delivery conduit, parts of the mask and pressure chamber being broken away;

FIGURE 5 is a transverse vertical sectional view on somewhat of an enlarged scale of the float utilized to maintain the free end of the inlet line above the surface of the water;

FIGURE 6 is a top plan view of the slipper attachment by which a diver or swimmer may operate the air pump by means of his feet, the outline of a foot being shown in phantom lines; and

FIGURE 7 is a side elevational view of the slipper attachment shown in FIGURE 6.

Referring now more specifically to the drawings, and to FIGURE 2 in particular, it will be noted that the underwater breathing device is generally designated by the reference numeral **10**. A hollow pressure chamber generally referred to by the reference numeral **12** is provided and has secured to one end thereof one end of a delivery conduit generally referred to by the reference numeral **14** which communicates with the interior of the pressure chamber **12**. The pressure chamber **12** also has a pair of air pumps each generally referred to by the reference numeral **16** secured thereto which also communicate with the interior of the pressure chamber **12**.

With particular reference to FIGURE 1 of the drawings it will be noted that the pressure chamber **12** is provided with a harness **18** for strapping the underwater

breathing device 10 to the back of a diver generally referred to by the reference numeral 20.

The air pumps 16 project rearwardly from the pressure chamber 12 toward the feet 22 of the diver 20. Each of the air pumps includes an elongated cylinder generally designated by the reference numeral 24 which is secured to the pressure chamber 12 at its forward end. The forward end of the cylinder 24 is provided with a closure wall 26 having an outlet opening 28 formed therein which communicates with the interior of the pressure chamber 12.

Each of the air pumps 16 is also provided with an inlet opening 30 and an inlet line generally referred to by the reference numeral 32 is provided for communicating the inlet openings 30 with the air above the surface of the water 34. The inlet line 32 is forked at its lower end adjacent the air pumps 16 and each leg 36 is secured to one of the inlet openings 30.

With particular reference to FIGURE 5 of the drawings it will be noted that the free end of the inlet line 32 is secured to a hollow annular float generally referred to by the reference numeral 38 which may either be constructed of a rigid material or of a flexible material and inflated to provide a buoyant support for the free end of the inlet line 32. A circular bracing wall 40 is secured between the inner peripheral surfaces of the annular float 38 and a standpipe generally designated by the reference numeral 42 is secured through the bracing wall 40 in any convenient manner. The upper end of the standpipe 42 terminates in a back turned portion 44 and the lower end thereof projects slightly below the circular bracing 40 and has the upper end of the inlet line 32 secured thereto. If it is desired, a mooring ring 46 may be provided on the float 38 for securing the float to a stationary object or tongue 94.

Thus, it may be seen that the annular float 38 will support the upper end of the inlet line 32 above the surface of the water 34 and that the back turned portion 44 will tend to restrict the entrance of water into the upper end of the standpipe 42. If it is desired, suitable valving means may be provided in the back turned portion 44 of the standpipe 42 for positively precluding the entrance of water thereinto and subsequently into the intake line 32.

With particular attention directed now to FIGURES 2 and 3 of the drawings it will be noted that each of the cylinders 24 is provided with a plurality of longitudinally extending channels 48 which slidingly guide the radially extending lugs 50 formed on the corresponding piston 52.

An expansion spring 54 is secured between each closure wall 26 and the confronting surface of the corresponding piston 52 to normally urge the associated piston 52 forwardly in its cylinder 24. The rear end of each of the cylinders 24 is sealed against the entrance of water into the rear end thereof by means of a flexible diaphragm 56 secured over the rear end thereof. Each of the diaphragms 56 is generally conical in shape and has its center sealingly secured about a portion of the corresponding flexible member 58 intermediate the opposite ends thereof. The forward ends of the flexible members 58 are each secured to one of the pistons 52. The flexible members 58 project rearwardly from the pistons 52 and extend out of the rear ends of the cylinders 24. The rear ends of the flexible members 58 each have a circular ring 60 secured thereto which is in turn secured to the forward end of one of the flexible members 62. The rear ends of the flexible members 62 are adapted to be secured through the apertures 64 formed in the slipper attachments generally designated by the reference numeral 66 which are adapted to be worn on the feet 22 of the diver 20.

With attention again directed more particularly to FIGURE 2 of the drawings it will be noted that the inlet openings 30 are each provided with a check valve 68 of any convenient type utilized to prevent reverse flow of air through the corresponding inlet line 32. The outlet openings 28 are each also provided with a check valve designated by the reference numeral 70 and which may be of any convenient construction to restrict the flow of air from the pressure chamber 12 into the associated cylinder 24.

Each of the slipper attachments 66 comprises a sole member 72 and a strap 74 which is adapted to receive the forward portion of each of the diver's foot 22. The rear end of the flexible members 62 may be conveniently secured to the rear portion of each of the corresponding sole 72 by passing the end of the flexible member 62 through the corresponding aperture 64 and knotting that portion of the flexible member 62 projecting through that aperture 64 as at 76.

It will be noted, see FIGURE 4, that the delivery conduit 14 is divided into two passageways. The delivery passage 78 is in communication with the interior of the pressure chamber 12 and the interior of the face mask which is generally designated by the reference numeral 80. The face mask 80 is of a size and shape to conform to the nose and mouth area of the face 82 of the swimmer and is held in sealing engagement therewith by means of the head strap 84.

The delivery passage 78 has a check valve 86 disposed therein for preventing reverse flow of air therethrough and the outlet passage 88 in the delivery conduit 14 communicates with the interior of the mask 80 and is provided with an outlet opening 90 which is also provided with a check valve 92. The check valve 92 of course is to prevent entrance of water into the outlet passage 88.

It is to be understood that the inlet line 32 may be constructed of any convenient length and that a tongue 94, see FIGURES 1 and 2, is provided for maintaining the unneeded portion of the inlet line 32 in a neat and coiled state on the pressure chamber 12.

The pressure chamber 12 is preferably formed of a flexible and expandible material which is impervious to the passage of air. The pressure chamber 12 is thus constructed to enable it to collapse or yield under the pressure of the water at the level of the diver which will automatically maintain the pressure of the air within the pressure chamber 12 at the same level as the water disposed outside the pressure chamber 12 and around the diver 20. Of course, the pressure chamber 12 could be constructed of rigid material and provided with suitable automatic pressure regulating valves in the delivery conduit 14 for supplying the diver 20 with air at the correct pressure or a rigid pressure chamber 12 could be provided with an expandible compartment disposed in the interior thereof. This expandible compartment would be communicated with the water pressure disposed on the exterior of the pressure chamber 12 which would then enable the expandible compartment to expand until the air within the pressure chamber 12 was at the same pressure as the surrounding water.

Additionally, as previously set forth, the mask 80 could be substituted for by a mouthpiece adapted to be inserted in the mouth of the swimmer 20 in accordance with the individual preference of the person using the underwater breathing device 10. In operation, the pressure chamber 12 is strapped to the back of a swimmer 20 in the manner shown and the slipper attachments 66 are secured to the feet 22 of the swimmer 20. The free ends of the flexible members 62 are then secured to the circular rings 60 whereupon the pistons 52 are operatively connected with the slipper attachments 66 for reciprocating movement within the cylinders 24 upon movement of the slipper attachments 66 toward and away from the air pumps 16. Thus, as the swimmer 20 proceeds beneath the surface of the water 34 his normal swimming movements will cause rearward movement of the pistons 52 in the cylinders 24 which will enable air to enter the forward portions of the cylinders 24 through the inlet openings 30 and the check valves 68. As the legs 96 of the swimmer 20 are relaxed, the expansion springs 54 will draw the pistons 52 forwardly in the cylinders 24 to compress the air

disposed therein and force the pressurized air into the pressure chamber **12**. In this manner, air from above the surface of the water **34** may be supplied to the pressure chamber **12** under pressure from where it may be taken by the swimmer **20** through the delivery conduit **14**.

It is of course to be understood that the depth at which the underwater swimming device **10** may be used will be limited by the strength of the swimmer **20** who, in operation of the air pumps **16**, will have to exert a pull on each of the flexible members **62** greater than one-half pound per square inch of area of the pistons **52** for each foot in depth at which the underwater breathing device **10** is being operated inasmuch as water pressure increases at the rate of approximately one-half pound per square inch for each additional foot of depth obtained.

However, the underwater breathing device is extremely simple in construction and may be manufactured at considerably less cost than the conventional type of scuba equipment. It will be noted that the check valves **68**, **70**, **86** and **92** can be constructed very simply and it will be noted that the length of the inlet line **32** limits the depth at which the underwater breathing device **10** can be operated as well as the strength of the swimmer **20** so that the swimmer **20** will always be fairly near to the surface of the water **34** with the float **38** providing a visual means of determining at least the approximate position of the swimmer **20**.

If the underwater breathing device **10** is operated at shallow depths, it is quite possible that the amount of air supplied by the air pumps **16** will be greater than that required by the driver **20**. In this instance the pressure chamber **12** will continue to expand until the tensioning of the chamber **12** is sufficient to raise the pressure of the air therein above that of the surrounding water. When the air pressure within the chamber exceeds a predetermined level above that of the surrounding water the pressure relief valve **98**, see FIGURE 1, will vent the excess pressure. This relief valve **98** could be provided with audible signaling means to signal an excess of air if it is desired whereby the diver **20** could then relax his legs for a short period of time until the air supply within the chamber **12** is nearly exhausted.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. An underwater breathing device comprising a sealed pressure chamber, a delivery conduit having one end in communication with the interior of said chamber, means on the other end of said conduit adapted for sealing engagement with a portion of the face of a swimmer and communication with his lungs, at least one air pump having a discharge opening communicating with the interior of said chamber, an inlet opening in said air pump, an inlet line having one end sealingly secured to said inlet opening and the other end adapted for positioning above the surface of a body of water, and operating means operatively connected to said air pump and adapted for securement to a limb of a swimmer for movement therewith to operate said pump, means on said chamber adapting the latter to be strapped to the back of a swimmer, said pump comprising a hollow cylinder secured to said chamber and projecting toward the feet of a swimmer on whose back said chamber is strapped, a piston slidably disposed in said cylinder for reciprocating movement therein, said inlet and discharge openings of said pump being formed in the forward end of said cylinder adjacent said chamber, a check valve in said inlet opening and a check valve in said discharge opening, said check valves permitting air to flow from the inlet line into said cylinder and preventing the flow of air from the cylinder back into the inlet line and permitting the air to flow from the cylinder into said chamber and preventing the flow of air from the chamber back into the cylinder respectively, means disposed in said cylinder resiliently urging said piston forwardly therein, means sealing the rear end of said cylinder, said operating means comprising a flexible member having one end secured to said piston and the other end adapted for securement to the foot of a swimmer.

2. The combination of claim 1, wherein said sealing means comprises a flexible diaphragm secured over the rear end of said cylinder, said flexible member passing through the center of said diaphragm in sealing engagement therewith.

3. The combination of claim 1, including guide means in said cylinder slidably guiding said piston.

4. The combination of claim 1, including a float secured to the other end of said inlet line for resiliently maintaining the latter above the surface of a body of water.

5. The combination of claim 4, wherein said float comprises an annular hollow member, a circular bracing wall secured between the inner peripheral surfaces of said float, a standpipe secured through said bracing wall and projecting upwardly therefrom and terminating in a down turned portion, the lower end of said standpipe sealingly engaged with said other end of said inlet line.

6. The combination of claim 1, wherein said pressure chamber is constructed of flexible air impervious material.

7. The combination of claim 1, including a slipper attachment adapted for engagement with the foot of a swimmer, said other end of said flexible member being secured to said slipper attachment.

8. An underwater breathing device comprising a sealed pressure chamber, a delivery conduit having one end in communication with the interior of said chamber, means on the other end of said conduit adapted for sealing engagement with a portion of the face of the swimmer and in communication with his lungs, at least one air pump having a discharge opening communicating with the interior of said chamber, an inlet opening in said air pump, an inlet line having one end sealingly secured to said inlet opening and the other end adapted for positioning above the surface of a body of water, and operating means operatively connected to said air pump and adapted for engagement by a limb of a swimmer for movement therewith to operate said pump, means on said chamber adapting the latter to be secured to a swimmer, said pump comprising a hollow cylinder, a piston slidably disposed in said cylinder for reciprocating movement therein, said inlet and discharge openings of said pump being formed in one end of said cylinder, a check valve in said inlet opening and a check valve in said discharge opening, said check valves permitting air to flow from the inlet line into said cylinder and preventing the flow of air from the cylinder back into the inlet line and permitting the air to flow from the cylinder into said chamber and preventing the flow of air from the chamber back into the cylinder respectively, means disposed in said cylinder resiliently urging said piston toward the other end of said cylinder, means sealing said one end of said cylinder, said operating means comprising an elongated actuator having one end portion secured to said piston and the other end portion adapted for engagement by a limb of a swimmer.

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