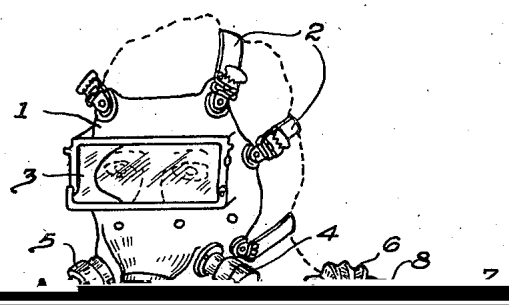
Sept. 27, 1949. O. D. YARBROUGH 2,483,116

UNDERWATER BREATHING APPARATUS

Filed Oct. 31, 1946 4 Sheets-Sheet 1



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UNDERWATER BREATHING APPARATUS

Filed Oct. 31, 1946 4 Sheets-Sheet 2

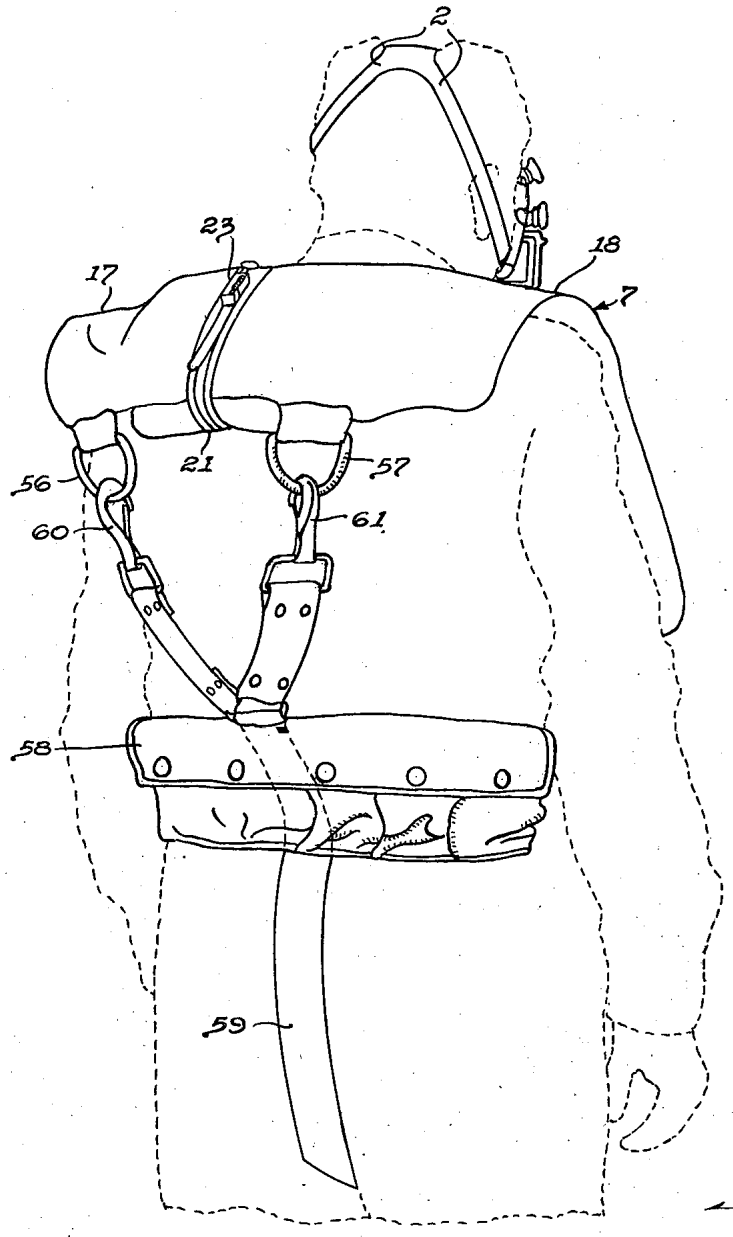

Fig. 2.

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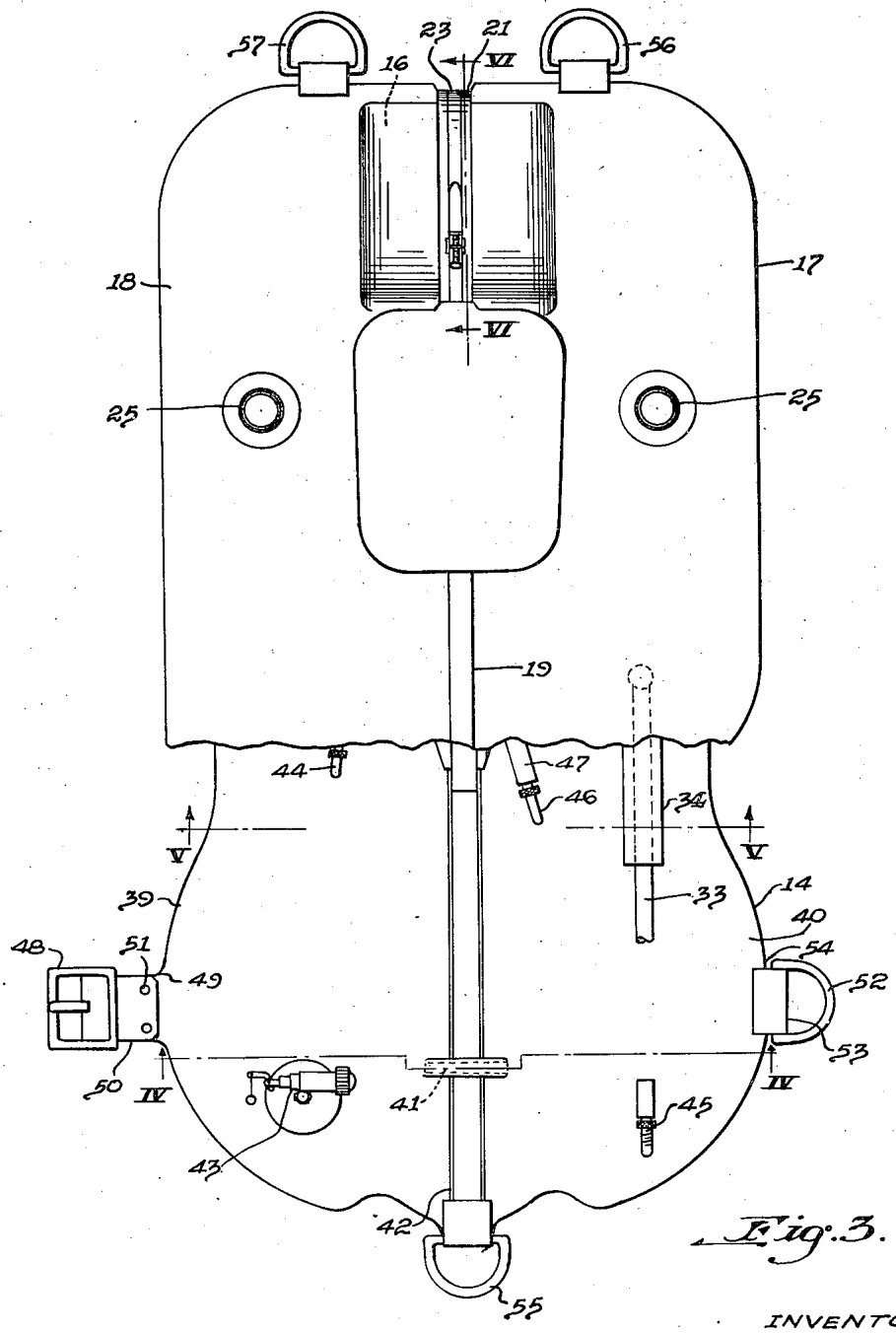

Fig. 3.

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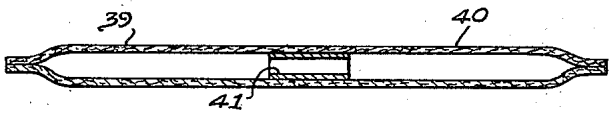

Fig. 4.

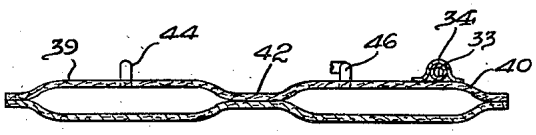

Fig. 5.

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UNITED STATES PATENT OFFICE

2,483,116

UNDERWATER BREATHING APPARATUS

Oscar D. Yarbrough, Washington, D. C.

Application October 31, 1946, Serial No. 707,016

8 Claims. (Cl. 128—142)

1

This invention relates to improvements in self-contained breathing apparatus, and more particularly in breathing apparatus adapted for use in

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afloat on the surface of the water should he come to the surface at a point where there is no boat or other means of flotation and should his sup-

By making the vest of such a shape that it substantially covers the wearer's abdominal regions, protection from blast injuries in the water is afforded. The vest can be kept filled with compressible gas to form a cushion to absorb the pressure waves transmitted in the water from the detonation of explosive charges.

Since under some conditions, the wearer of apparatus might come to the surface at a point remote from his tender, means are provided to enable him to remove his facepiece in the water so that water does not enter the breathing bag and air purifying canister. Should his supply of compressed gas be exhausted, a small carbon dioxide cartridge is provided to inflate the buoyancy vest, thus enabling the wearer to remain afloat.

In one embodiment of my invention, a carbon dioxide cartridge is also used to provide sufficient buoyancy to bring the wearer to the surface of the water.

The construction and operation of my invention can be seen more clearly by referring to the drawings, in which:

Fig. 1 is a front view of the apparatus showing it being worn by a diver;

Fig. 2 is a rear view of the apparatus as worn;

Fig. 3 is a top view of the apparatus less the facepiece as it would appear if laid out on a flat surface. Part of the breathing bag is broken away to show more clearly the construction of the buoyancy vest;

Fig. 4 is a section view taken along line IV—IV of Fig. 3;

Fig. 5 is a section view taken along line V—V of Fig. 3;

Fig. 6 is a section view taken along line VI—VI of Fig. 3; and

Fig. 7 is a broken view showing another embodiment of the control valve in relation to the apparatus.

Referring to the drawings, the apparatus consists of a tight fitting, flexible molded facepiece 1, which is held securely in place on the wearer's face by flexible rubber headstraps 2. The facepiece is provided with a single, flat, glass lens 3 extending laterally in the facepiece so as to cover both eyes of the wearer. At the sides of the facepiece are mounted the inhalation check valve 4 and the exhalation check valve 5. A flexible rubber breathing tube 6 is attached to breathing bag 7 by coupling nut 8. A manually operated plunger valve 9, normally open, is attached to the exhalation check valve 5 so that the gas passage in the exhalation circuit may be closed. A flexible rubber breathing tube 11, attached to the manually operated plunger valve, is connected to the breathing bag 7 by a coupling nut at 10. A manually operated plunger valve 12 is located in the lower portion of the facepiece. This valve is normally closed unless the wearer depresses the plunger 13.

The main portion of the apparatus consists of the breathing bag 7, the buoyancy vest 14, the oxygen cylinder 15, and the carbon dioxide absorbent canister 16. The breathing bag 7 is constructed of a lightweight, durable, rubberized fabric. It is divided into two sections, the inhalation side 17 and the exhalation side 18. This division is made in the front by cementing the two sides of the bag together to form seam 19 which is shown as a shaded area in Fig. 1. The back of the breathing bag 7 is split into an open section on either side to receive the canister 16. The bag at this split is provided with soft, pliable,

rubber sections. One side is slightly larger than the other so that one rubber section 21 overlaps the other 22, which is in contact with the canister 16. A metal clamp 23 is placed over the outer rubber section 21 and tightened so as to apply a uniform circumferential compression to seal rubber portion 21 against rubber portion 22, and rubber portion 22 against the canister 16. On both sides of the breathing bag 7, a rubber reinforcing strip 24 covering the entire inside of each half of the breathing bag extends the length of the canister 16 to protect the rubberized fabric of the bag from abrasion due to repeated insertions and removals of the canister 16. Threaded metal inserts 25 are locted on both sides of the breathing bag 7 for attachment of the threaded coupling nuts 8 on the facepiece breathing tubes. These inserts extend as elbows into the interior of the breathing bag to prevent the bag from collapsing and closing off the breathing circuit.

On the wearer, the breathing bag is so positioned that the portion containing the carbon dioxide absorbent canister 16 falls high on the back of the wearer. The carbon dioxide canister 16 is an oval shaped canister constructed of sheet metal. The interior is filled with a chemical 70 which is a combination of lime, sodium hydroxide, Portland cement, kieselguhr, and water, and which is a highly efficient carbon dioxide absorbent. The canister is so constructed that it has a large cross sectional area in proportion to its length, thus reducing resistance to gas flow. The outlets in breathing bag 7 containing threaded inserts 25 are so positioned that they are located over the wearer's shoulders so that they are approximately at the highest point of breathing bag 7 when the apparatus is worn.

In the front, breathing bag 7 terminates at seam 26 at which point the two sides of the bag are joined together in a gas tight and leak-proof seam. The rubberized fabric material, however, is extended to form a pocket 27 which holds oxygen cylinder 15. Constructed of forged alloy steel so that it will safely hold gas at 2000 p. s. i., oxygen cylinder 15 is provided with a high pressure opening and closing valve 29 of conventional design. Attached to cylinder valve 29 and extending downwardly is control valve 30. Valve 30 is a high pressure needle valve consisting of a brass body and a handwheel 32 attached to a stainless steel stem (not shown) that passes through a packing and terminates in a V-shaped point. A flexible rubber tube 33 is connected to control valve 30 and extends upwardly into the inhalation side 17 of breathing bag 7. Tube 33 is enclosed by a sheath 34 of the rubberized bag material over a portion of its length to hold it close to the wearer's body so that it cannot become fouled by underwater obstructions. A strap 71 constructed of strong webbing fits around the neck portion of cylinder valve 29 to prevent oxygen cylinder 15 from slipping out of pocket 27. Pocket 27 terminates in a seam 72 at its lower side. D ring 73 is attached to seam 72 at its center portion by a rubberized fabric tab 35 that is doubled over the D ring and cemented to the seam.

Extending downwardly in front of the wearer, so as to enclose his abdominal region, is buoyancy vest 14. Vest 14 is constructed of the same lightweight, durable rubberized fabric as breathing bag 7. It is attached to breathing bag 7 at points 37 and 38 so that the apparatus consists of a single lightweight garment. The pocket 27 containing cylinder 15 fits over the upper portion of

vest 14 when the apparatus is worn. The buoyancy vest 14 is divided into two sections 39 and 40 with tubular member 41 which may be constructed of rubber or metal interconnecting the two sections to permit gas flow between them. Otherwise, sections 39 and 40 are separated by seam 42 formed by joining the two sides of the vest together. The division of the vest 14 into two sections tends to flare the vest out toward the sides when inflated so that the point of greatest expansion when inflated is not at the center of the vest.

Section 39 has a carbon dioxide inflator valve 43 of conventional design attached in its lower portion. At the top of section 39 is a screw type outlet valve 44. Valve 45, a screw type valve, is located in the lower portion of section 40. Valve 45 may be used either as an inlet or outlet valve. In the upper portion of section 40 is located valve 46, a screw type valve, to which rubber tube 47 is attached. Valve 46 and tube 47 are used to orally inflate buoyancy vest 14. At the side of section 39 of buoyancy vest 36 is buckle 48. Buckle 48 is attached to tab 49 by a leather strip 50 and rivets 51. At approximately the same location on the side of section 40, D ring 52 is held in place by tab 53 which passes through the ring and is connected to the vest at point 54 in the same manner as D ring 73 is attached. D rings 55 are similarly attached at the bottom of seam 42 on buoyancy vest 14.

In the rear of the breathing bag 7 at the section where canister 16 is located, D-rings 56 and 57 are similarly attached. Belt 58 containing lead weights passes around the wearer's waist and is attached to the apparatus at buckle 48 and D ring 52. Crotch strap 59 constructed of high tensile strength webbing is attached to the apparatus at D rings 56 and 57 by snaps 60 and 61. In the front of the apparatus, crotch strap 59 passes through D rings 55, up through D ring 73 and is then looped through D rings 55.

In one embodiment of my apparatus, as shown in Fig. 7, control valve 30 is replaced by valve 63. Valve 63 consists of a fitting 64 that connects to the outlet of oxygen cylinder valve 29, and a brass manifold section 65 into one side of which fitting 64 is threaded. In the other side of manifold 65 are threaded two control valves 66 and 67 similar in construction to control valve 30. Rubber tube 68 corresponding to rubber tube 33 is connected to valve 67 and extends upwardly into the inhalation side 17 of breathing bag 7. A flexible rubber tube 69 is attached to valve 66.

closes on exhalation so that none of the exhaled air will pass back through the inhalation breathing tube 6 and into the inhalation side of breathing bag 7. Upon inhalation again, the exhaled air is pulled through canister 16, containing a carbon dioxide absorbent chemical, where the carbon dioxide is removed. The purified air then passes into the inhalation side 17 of breathing bag 7 and thence into the facepiece 1 and the wearer's lungs. Control valve 30 is opened only to supply additional oxygen as the supply in the breathing bag becomes depleted due to consumption by the wearer. Exhalation check valve 5 closes on inhalation so that air is inhaled only from the inhalation side 17 of the breathing bag. In this manner, a one-way circuit is provided in the apparatus so that all exhaled air must pass through canister 16 for removal of carbon dioxide.

Plunger valve 12 on facepiece 1 is used to initially purge the apparatus of nitrogen and to relieve any excess pressure that might be built up by permitting too great a flow of oxygen through control valve 30.

To control buoyancy underwater, a double control valve 63 may be attached to cylinder valve 29 as shown in Fig. 7. Valve 67 of the double valve controls the oxygen supply to the breathing bag 7 while the valve 66 is used to supply gas to the buoyancy vest 14. Should it be desired to release gas from the vest underwater, valves 44 and 40 at the top of the vest may be opened. The water pressure will then force out the gas.

Should the wearer desire to ascend without any attempt to control buoyancy, the carbon dioxide inflator valve 43 is opened to permit gaseous carbon dioxide to fill buoyancy vest 14 and provide sufficient buoyancy to bring the wearer to the surface and enable him to remain afloat there.

Should the wearer come to the surface at a point where he must remain afloat for some time before he is reached by a boat, he may close valve 9 and remove facepiece 1. Valve 9 will close breathing tube 11 so that water will not enter the exhalation side 18 of breathing bag 7 and damage the carbon dioxide absorbent material 70 in canister 16. Should his facepiece drag in the water, inhalation check valve 4 will automatically close in the water so that water cannot enter breathing tube 6 and the inhalation side 17 of breathing bag 7.

Where protection from blast injuries is desired, buoyancy vest 14 can be initially filled with a compressible gas either through valve 66, the carbon

of the appended claims, the invention may be practiced otherwise than as specifically described.

I claim:

1. In a self-contained breathing apparatus of the character described, a breathing bag divided by a central seam extending lengthwise thereof into inhalation and exhalation portions, the bag being provided at one end of the seam with a passage connecting said portions, and an air purifying canister mounted in said passage so that all exhaled air passes through said canister before inhalation.

2. In a self-contained breathing apparatus of the character described, a breathing bag adapted to fit around the neck of a wearer and to fit over his shoulders with sections falling over his chest and back, said bag being divided into two separate sections, one for inhalation and one for exhalation, and a removable air purifying canister in said bag between the inhalation and exhalation sections thereof.

3. In a self-contained breathing apparatus of the character described, an oblong breathing bag having an opening in its central portion for the wearer's head, the rear portion of said bag being split so as to form two overlapping sections adapted to hold an air purifying canister within the bag, and said bag being divided in the front by a seam and in the rear by said canister into two separate sections, one for inhalation and one for exhalation.

4. A self-contained breathing apparatus comprising a facepiece, inhalation and exhalation check valves connected to said facepiece, flexible breathing tubes, a breathing bag divided into inhalation and exhalation sections, a carbon dioxide absorbent canister interposed between said sections, a cylinder containing compressed oxygen, and a control valve to regulate the flow of oxygen into said breathing bag.

5. A self-contained breathing apparatus comprising a facepiece, inhalation and exhalation check valves connected to said facepiece, a manually operated valve located in the lower front portion of said facepiece, a breathing bag, breathing tubes connecting said facepiece to said bag, said bag being divided into two separate sections, one for inhalation and one for exhalation, a removable canister containing a carbon dioxide absorbing chemical interposed between said bag sections so that all exhaled air passes through said canister, a clamp passing around the breathing bag enclosing said canister so as to seal the bag against the canister, a cylinder containing compressed oxygen, a control valve to regulate the flow of oxygen into said breathing bag, and a buoyancy vest attached to said breathing bag.

6. A self-contained breathing apparatus comprising a facepiece, inhalation and exhalation check valves connected to said facepiece, a breathing bag adapted to fit around the neck of the wearer and to fit over his shoulders with sections falling over his chest and back, said bag being divided into two separate sections, one for inhalation and one for exhalation, breathing

around a portion of the section of the breathing bag enclosing said canister, a cylinder containing compressed oxygen, a control valve to regulate the flow of oxygen, and an inflatable buoyancy vest attached to said breathing bag.

7. Apparatus adapted for use underwater consisting of a self-contained breathing apparatus comprising a facepiece, directional flow check valves connected to said facepiece, breathing tubes, a breathing bag substantially oblong in shape provided with an opening in its central portion adapted to permit said bag to pass over the wearer's head, an air purifying canister, the rear portion of said bag being split so as to form two overlapping sections adapted to hold said canister within the bag, said bag being divided in the front by a seam and in the rear by said canister into two separate sections, one for inhalation and one for exhalation, a clamp passing around said overlapping bag sections to hold said canister, a cylinder containing compressed oxygen carried on its side in a pocket in the front of the apparatus, a control valve to regulate the flow of oxygen from said cylinder, and an inflatable buoyancy vest attached to said breathing bag but containing an entirely separate volume reservoir, said vest being provided with means for controlling and varying its bouyancy.

8. Apparatus adapted for use underwater consisting of a breathing apparatus comprising a facepiece, inhalation and exhalation check valves connected to said facepiece, a breathing bag substantially oblong in shape provided with an opening in its central portion adapted to permit said bag to pass over a wearer's head, an air purifying canister, the rear portion of said bag being split so as to form two overlapping sections adapted to hold said canister within said bag, said bag being divided in front by a seam and in the rear by said canister into two separate sections, one for inhalation and one for exhalation, a clamp passing around said overlapping bag sections to hold said canister, a cylinder containing compressed oxygen, an inflatable buoyancy vest attached to the breathing bag but containing an entirely separate volume reservoir, a double control valve to regulate the flow of oxygen from the cylinder, one side of the double valve regulating oxygen flow into the breathing bag and other side of said valve regulating oxygen flow into said vest, and valves disposed in the upper portion of the vest to permit the escape of gas therefrom when they are open.

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