Nov. 2, 1954 R. GALEAZZI 2,693,180

EXHALATION VALVE FOR DIVING SUITS

Filed May 3, 1951

FIG. 1

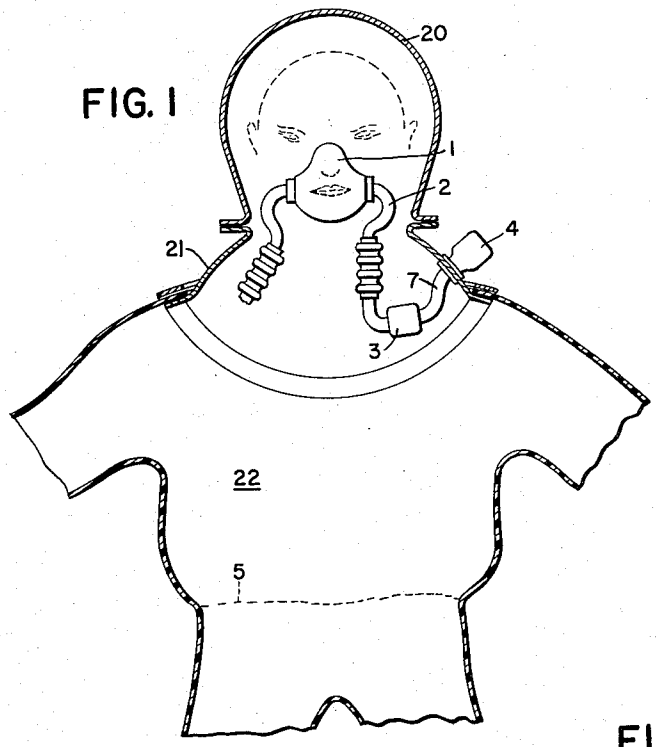


FIG. 2A

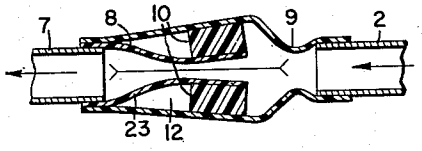


FIG. 2

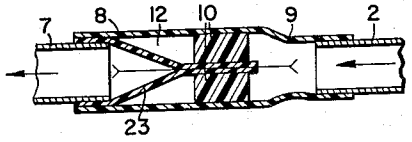


FIG. 3

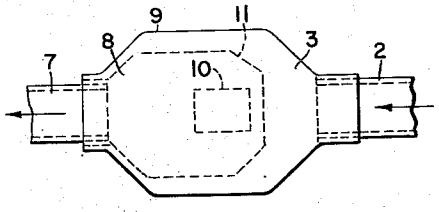


FIG. 4A

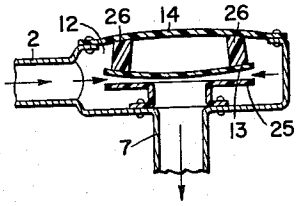
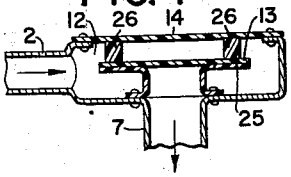


FIG. 4



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EXHALATION VALVE FOR DIVING SUITS

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5 Claims. (Cl. 128—144)

This invention relates to improvements in diving suits a portion of the upper parts of which are designed for inflation to balance the forces between the weight of the diver and the upward thrust when submerged, the air for inflation being separated from the breathing air, but more particularly the invention relates to an exhalation valve which permits the discharge of exhaled air in accordance with the pressure of the air for inflation.

It is an object of the instant invention to provide a device for more perfectly equalizing the pressure in the lungs of the diver with that of the air breathed as compared with known similar devices.

Other objects of the instant invention will become apparent in the course of the following specification.

In the attainment of the aforesaid objective, an exhalation valve is interconnected in the discharge tube for the exhaled air. The valve is made in two forms. In the first form, the valve is constituted of flexible lips inserted in a flexible envelope within the suit in such a manner that when the pressure of the exhaled air is sufficient to expand the envelope against the pressure of the inflated air, the lips will open to permit the discharge of the exhaled air. In the second form, the exhalation valve is constituted of a casing one side of which is open and covered with a flexible membrane the outer surface of which is subject to the pressure of the inflated air. Connected to the inner surface of the membrane is a disc with flexible lips designed in coaction with a fixed annular member to block the discharge tube when the pressure in the tube is less than the pressure on the outside of the membrane, that is between successive moments of exhaling, but to open the discharge tube when exhaling, that is when the pressure in the tube is greater than the pressure on the outer surface of the membrane.

The invention will appear more clearly from the following detailed description when taken in coniunction with the accompanying drawings showing by way of example the preferred embodiments of the inventive concept.

In the drawings:

Figure 1 is a schematic view of the diving suit showing the relative position of the exhalation valve.

Figures 2, 2A, and 3 show the first form of the valve constructed in accordance with the principles of this invention and in which:

Figure 2 is a vertical sectional view of the valve in the closed position;

Figure 2A is similar to Figure 2 but with the valve in the open position; and

Figure 3 is a plan view of the valve shown in Figures 2 and 2A.

Figures 4 and 4A show the second form of the valve, and in which:

Figure 4 is a vertical sectional view of the valve in the closed position; and

Figure 4A is a view similar to Figure 4 but with the valve in the open position.

Referring now in greater detail to Figure 1, the diving suit is constituted of a mask **1**, the helmet **20**, the shoulder portion **21**, and the dress portion **22**.

The mask **1** is of known type with the usual inlet for fresh air and an outlet for exhaled air, and is fastened over the nose and mouth of the diver in a known manner.

The helmet **20** is also of known type with the bottom edge thereof designed for air tight attachment to the top of the shoulder portion **21** in a known manner.

The shoulder portion **21** is a rigid member extending over the shoulders and front and back of the diver.

The dress **22** is a flexible member having an upper part secured at the top in an air tight manner to the bottom of the shoulder portion. Integrally formed with the upper part of the dress portion is a lower portion constricted about the hips of the diver by the pressure of water which prevents the passage of the air for inflation in the upper portion from passing downwardly into the lower portion. Thus, the helmet **20**, the shoulder portion **21** and the upper part of the dress portion are designed as a receptacle for the air of inflation, that is the air for balancing the weight of the diver with the upward thrust.

Secured to one end of the mask **1** is an exhaust tube the free end of which is connected to the inlet of the valve **3**. The outlet of the valve **3** is connected by another exhaust tube **7** to a point outside of the diving suit, actually to a point on the outside of the shoulder portion **21** which is above the line **5** separating the inflated upper part of the dress portion from the non-inflated lower part which clings to the body of the diver when submerged. On the free end extremity of the tube **7** is a non-return valve **4** discharging the exhaled air into the sea. The pressure of the inflated air will correspond substantially to the pressure of the water at the depth to which the line **5** is submerged. Hence, the non-return valve **4** being above the line **5** will be in an area of lower pressure relative to the pressure of the inflated air.

Referring now to the first form of the exhalation valve shown in Figures 2, 2A, and 3, reference numeral **3** indicates the exhalation valve, **2** the exhaust tube from the mask **1** to one end of the valve, and **7** the second exhaust tube connecting the opposite end of the valve **3** to the non-return valve **4**, located on the outside of the shoulder portion **21** and above the line **5**.

If there were no exhalation valve **3**, the air in the lungs of the diver, at the same pressure as the inflated air, would discharge directly into the sea and cause a dangerous drop in the pressure within the lungs. However, the valve **3** is designed to prevent such undesired drop in pressure by permitting the passage of the exhaled air as soon as the pressure in the tube **2** is increased above that within the diving suit.

The valve **3** is constituted of the flexible lip members **8** and **23** which prevent the exhaled air from passing from the tube **2** in the direction of the arrows in the closed position. One end of the lips **8** and **23** are secured to opposite sides of the tube **7** by the flexible envelope **9** interconnecting the tubes **2** and **7** and preferably having a greater surface area than that of the lips so that a hollow space **12** is created. The free ends of the lips **8** and **23** extend toward the tube **2** and are fastened to the inner surfaces of the flexible envelope by the blocks **10**. When the walls of the envelope **9** are in equilibrium relative to the internal and external pressures, that is the interval between two successive acts of exhalation, the valve **3** acts in the usual way, that is the lips **8** and **23** are closed. However, when exhaling, the pressure of the exhaled air acts on the envelope **9**, on the side of the tube **2**, to urge the walls outwardly (Fig. 2A) and to separate the lips **8** and **23** to permit the passage of air until the act of exhaling ceases.

In the second form of the exhalation valve shown in Figures 4 and 4A, the valve is constituted of a member **13**, preferably of disc form with elastic lips in coaction with a stationary annular member **25** having a central opening communicating with the interior of the tube **7**. The disc and annular member are enclosed in a casing the top of which is open and covered by a membrane **14** responsive to the pressure in the inflated area, the membrane having a greater surface area than the disc **13**. Between successive acts of exhaling, the disc will be superposed over the annular member (Fig. 4) but when the diver exhales, the exhaled air from the tube **2** will have a greater pressure than the pressure on the outside of the membrane **14** so that the membrane **14** will bulge outwardly and draw the disc **13**, secured to the membrane **14** by the blocks **26**, to the position shown in Figure 4A for the discharge of the exhaled air.

Of course, in either form, more than one exhaust tube may be provided for the discharge of the exhaled air into the sea, each terminating in a non-return valve at a different level so that in whatever position the diver may be one of the non-return valves will always be at a level where the pressure is lower than the pressure of the inflated air.

While there is above disclosed but two embodiments of the exhalation valve, it is possible to produce still other embodiments without departing from the inventive concept herein disclosed, and it is desired, therefore, that only such limitations be imposed on the appended claims as are stated therein, or required by the prior art.

What is claimed is:

1. In a diving suit having an inflatable portion above the waist line and a mask for the mouth and nose of the diver; the improvements comprising an exhaust tube for the mask, means for connecting one end of said tube to one end of said mask and the opposite end of said tube to a point outside of the diving suit and above the waist line, a non-return valve for the end of the tube outside of the diving suit, an exhalation valve disposed in said exhaust tube and within the inflatable portion, said valve comprising a member subjected to the internal pressure of the inflated portion to maintain said valve in the closed position and to open said valve when exhalation pressure overcomes said internal pressure.

2. In a diving suit having an inflatable portion above the waist line and a mask for the mouth and nose of the diver; the improvements comprising an exhaust tube, said tube extending from one side of the mask and terminating within the inflatable portion, a second exhaust tube the outer end of which extends from a point without the suit and above the waist line and the inner end of which terminates within the inflatable portion, a non-return valve for the outer end of said second mentioned tube, two coacting lips disposed on opposite sides of said second mentioned tube and extending toward the first mentioned tube, a flexible member disposed around said lips and interconnecting said tubes, the extended ends of said lips being adapted to be superposed in the closed position of said valve, and a block interconnecting each lip and the opposed surface of said flexible member.

3. In a diving suit having an inflatable portion above the waist line and a mask for the mouth and nose of the diver; the improvements comprising an exhaust tube extending from one side of the mask, the free end of said tube terminating within the inflatable portion, a second exhaust tube the outer end of which extends from a point without the suit and above the waist line and the inner end of which terminates within the inflatable portion; a non-return valve for said outer end, an exhalation valve for the ends of the tubes terminating within the inflatable portion, said valve comprising a casing, said casing having an opening formed therein, an elastic diaphragm disposed over said opening, a disc with flexible lips disposed in the casing, means for securing the disc to the flexible member, an annular member disposed in the casing and coacting with said disc, means for securing the second mentioned tube in the casing, the annular member having an opening communicating with said second mentioned tube, and means for securing the free end of the first mentioned tube in the casing adjacent said disc.

4. In a diving suit having an inflatable portion above the waist line and a mask for the diver's mouth and nose, improvements comprising an exhaust tube for the mask, means for connecting one end of said tube to one end of said mask, the opposite end of said tube terminating within the inflatable portion, a second exhaust tube having an outer end which extends from a point without the suit and above the waist line and an inner end which terminates within the inflatable portion, a non-return valve for the outer end of the second-mentioned tube, an exhalation valve disposed between the ends of said exhaust tubes within the inflatable portion, said valve comprising flexible lips, said lips being normally closed, and a shell having an elastic wall connected with the lips and subjected to the internal pressure of the inflated portion of the suit on the external side and to the pressure of the exhaled air on the internal side, whereby said valve is responsive to the exhaled air pressure and to the internal pressure of the inflated portion of the suit and is adapted to be maintained in a closed position between successive intervals of exhalation when the pressure on the internal side of the shell is the same as the pressure inside the inflated portion of the suit, said valve opening during intervals of exhalation when pressure of the exhaled air on the internal side of the shell is higher than the pressure of the inflated portion of the suit, the pressure of the exhaust into the sea being less than the pressure of the inflated portion.

5. In a diving suit having an inflatable portion above the waist line and a mask for the diver's mouth and nose, improvements comprising an exhaust tube extending from one side of the mask, the free end of said tube terminating within the inflatable portion, a second exhaust tube having an outer end which extends from a point without the suit and above the waist line and an inner end which terminates within the inflatable portion, a non-return valve for said outer end, a partially flexible member inter-connecting the ends of said tubes and terminating within the inflatable portion, a disc, said member being disposed around said disc, flexible lips connected with said disc and coacting with the annular end of the second-mentioned tube, said lips being adapted to be superposed in the closed position of said valve, and blocks connecting the lips of said disc and the flexible portion of said member.

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