

BREATHING DEVICE

The invention relates to a breathing device, for example for use in an emergency situation. It is well known that exhaled breath still contains sufficient oxygen for a person to breathe in and out several times the same breath. In an emergency situation it can be of vital importance for such person to have a breathing device at his disposition, which device allows the person to exhale and subsequently inhale his breath several times until conditions are safe for normal breathing. Such an emergency situation can for example occur when a person in an aircraft cast in the sea following an accident is carried underwater before being able to free himself from the aircraft, or in case of a fire when a person has to escape through smoke which prevents normal breathing.

A known breathing device consists of a bag to which a flexible hose provided with a mouthpiece is connected. During normal circumstances the bag is empty, whereas in case of an emergency the wearer uses the bag to exhale and inhale the same breath several times by breathing through the mouthpiece. A problem of the known device is that during a submerged position of the wearer the flexible hose can become shut-off at the connection to the bag due to the water pressure acting on the bag. Another problem of the known device is that water which has entered the bag can block fluid communication between the air in the bag and the mouthpiece.

It is an object of the invention to provide a breathing device which overcomes the problems of the known device and which allows a wearer to breath in and out the same breath several times.

In accordance with the invention there is provided a breathing device comprising a bag of flexible material and a flexible hose in fluid communication with the interior of the bag, the flexible hose being provided with a mouthpiece so as to allow a wearer of the device to exhale into the bag and to inhale from the bag via said mouthpiece and said flexible hose, wherein the hose is in fluid communication with the interior of the bag at a plurality of locations mutually spaced across the bag. The feature that the hose is in fluid communication with the bag at said plurality of locations ensures that an amount of air present in the bag remains in fluid communication with the mouthpiece even when the bag becomes partially flattened due to external pressure, or when water has entered the bag.

Preferably, the flexible hose is in fluid communication with the interior of the bag via a manifold having a plurality of passages, each passage being in fluid communication with the interior of the bag at a respective one of said locations mutually spaced across the bag.

In a preferred embodiment of the breathing device, the manifold extends externally from the bag and comprises a main conduit which is at one end thereof connected to the flexible hose and which is at the other end thereof closed, and a plurality of branch conduits, each branch conduit extending from the main conduit to the bag and forming a respective one of said passages.

In another preferred embodiment of the breathing device, the manifold includes a conduit extending within the bag, said passages of the manifold being formed by a plurality of openings provided in the wall of said conduit.

The invention will now be described by way of example in more detail with reference to the Figures in which:

Figure 1 shows schematically a cross-section of an embodiment of the breathing device according to the invention; and

Figure 2 shows schematically a plan view of another embodiment of the breathing device according to the invention.

The breathing device of Fig. 1 includes a flexible watertight bag 1 arranged at the interior of an immersion suit 3 of a wearer (not shown). The bag 1 is attached to the immersion suit by attachment means (not shown) which keep the bag 1 close to the lung centroid position of the wearer. The maximum air volume in the bag 1 when inflated is limited to approximately the lung capacity of the wearer.

A flexible watertight hose 4 is at one end thereof connected to the bag 1 via a manifold 5 and at the other end provided with a mouthpiece 6. The mouthpiece 6 is in fluid communication with the interior of the bag 1 via the flexible hose 4 and the manifold 5.

The manifold 5 includes a main conduit 7 arranged exterior from the immersion suit 3, which main conduit is at one end connected to the flexible hose 4 and at the other end provided with a relief valve 9. Three branch conduits 10, 11, 13 extend from the main conduit 7 through the immersion suit 3 into the bag 1 at mutually spaced locations thereof. The immersion suit 3 is sealed with respect to each branch conduit 10, 11, 13 to prevent seawater entering the immersion suit 3 at the locations of the branch conduits 10, 11, 13. Each branch conduit 10, 11, 13 has an end part 15, 17, 19 extending in the bag, the end part 15, 17, 19 having an open end 21, 23, 25 and a plurality of openings 27, 29, 31 in the wall thereof. Each end part 15, 17, 19 is provided with an annular shoulder in the form of a primary ring 33, 35, 37 adjacent said open end 21, 23, 25 and a secondary ring

39, 41, 43 adjacent the wall of the bag 1, each ring 33, 35, 37, 39, 41, 43 extending around the end part, the rings being located such that the openings 27, 29, 31 are arranged between the primary ring 33, 35, 37 and the secondary ring 39, 41, 43.

The mouthpiece 6 is provided with a directional valve (not shown) which can be operated by means of a handle 50 to switch the valve between a first and a second mode of operation. In the first mode of operation the valve provides fluid communication between the breathing opening (not shown) of the mouthpiece 6 and the flexible hose 5 so as to allow the wearer to exhale into the bag 1 and to inhale from the bag 1, and in the second mode of operation the valve provides fluid communication between the breathing opening and atmosphere.

During normal travelling circumstances the bag 1 is attached to the interior of the immersion suit of the wearer in a deflated state. The flexible hose 5 and the mouthpiece 6 are attached to the exterior of the immersion suit. The rings 39, 41, 43 prevent the manifold 5 from being accidentally pulled out of the immersion suit. When the wearer becomes cast in the sea, for example following an accident to an aircraft in which he is travelling and is carried underwater before being able to free himself from the aircraft, he will apply the mouthpiece 6 to his mouth, switch the directional valve to the first mode of operation thereof, and starts breathing through the mouthpiece 6. By inhaling and exhaling the same breath from the bag 1 several times, the wearer is able to breathe while he escapes to the water surface. In case the bag 1 becomes partially flattened by the pressure of the water acting thereon, one or more of the openings 21, 23, 25 may become shut-off by the wall of the bag opposite the branch conduits 10, 11, 13. In such case the wearer is able to breathe in

and out from the bag via the openings 27, 29, 31 provided in the branch conduits 10, 11, 13. The rings 33, 35, 37 serve to prevent shut-off of the openings 27, 29, 31 by the wall of the bag 1 opposite the branch conduits 10, 11, 13. In case an amount of water has entered the bag 1 and partly fills the bag 1, the wearer is still able to breathe since the spaced arrangement of the branch conduits 10, 11, 13 ensures that the remaining air in the bag 1 is still in fluid communication with the mouthpiece 6. When the pressure in the bag 1 exceeds a predetermined magnitude, the relief valve 9 opens automatically and thereby allows some of the contents of the bag 1 to escape. When the wearer reaches the water surface and floats with his face clear from the water surface he can operate the handle 50 to switch the two way valve to the second mode of operation thereby providing fluid communication between the breathing opening of the mouthpiece 6 and atmosphere.

In Fig. 2 is shown another embodiment of a breathing device according to the invention, including a flexible watertight bag 60 having along its outer circumference a seam which is provided with openings 64 for attaching the breathing device to an immersion suit of a wearer. A flexible watertight hose 66 is at one end 68 thereof sealingly connected to the bag 60 and at the other end 70 to a mouthpiece 72 which is similar to the mouthpiece 6 described with reference to Fig. 1.

A manifold in the form of a conduit 74 extends through the interior of the bag 60, said conduit 74 being provided with a plurality of openings 76 at mutually spaced locations along the conduit 74. The conduit 74 is at one end thereof connected to the end 68 of the flexible hose 66 via an opening (not shown) in the wall of the bag 60, and rests in an elastically deformed state against the inner surface of the wall of the bag 60.

Normal operation of the breathing device shown in Fig. 2 is similar to normal operation of the breathing device described with reference to Fig. 1. When the bag 60 becomes partially flattened by the pressure of the water acting thereon, some of the openings 76 of the conduit 74 may become shut-off by the wall of the bag being pressed against the conduit. In such case the wearer is able to breathe in and out from the bag via remaining openings 76 which are not shut-off. Equally, when an amount of water has entered the bag and partly fills the bag, breathing is still possible via openings 76 in a part of the conduit 74 which is not in contact with the water.

In view of the foregoing it will be clear that the breathing device according to the invention allows the wearer to breathe during an emergency situation whereby overpressuring of the bag is prevented by the limited internal volume of the bag and by the position of the bag as close to the lung centroid position of the wearer as possible. Furthermore, shut-off of the air passage between the mouthpiece and the interior of the bag due to partial flattening of the bag is prevented. When used in water, the hydrostatic pressure acting on the bag is well within physiological limits with regard to breathing resistance and lung overpressure.

The above described breathing device can suitably be combined with an enclosed respiratory system including a substance which reacts with carbon dioxide and water present in the exhaled air to liberate oxygen therefrom.

Since the breathing device is of relatively small size, it can suitably be combined with an inflatable life jacket to provide buoyancy to the wearer. Suitably, a life jacket is applied which is asymmetrically shaped by being provided with a small lobe and a large lobe, the lobes being interconnected by a collar which fits around

the neck of the wearer. The lobes and the collar enclose a common buoyancy chamber so that upon inflation of the jacket, the lobes and the collar are inflated simultaneously. During normal use of the life jacket, the collar is arranged around the neck of the wearer, and the lobes are located substantially in front of the wearer and at opposite sides of an imaginary line of symmetry of the wearer. Since in the inflated state of the jacket the small lobe and the large lobe provide unequal buoyancy forces to the wearer when said lobes are submerged, the wearer rotates until the lobes float substantially on the water surface so that the wearer becomes in a face-upward position.

C L A I M S

1. A breathing device comprising a bag of flexible material and a flexible hose in fluid communication with the interior of the bag, the flexible hose being provided with a mouthpiece so as to allow a wearer of the device to exhale into the bag and to inhale from the bag via said mouthpiece and said flexible hose, wherein the hose is in fluid communication with the interior of the bag at a plurality of locations mutually spaced across the bag.
2. The breathing device of claim 1, wherein the flexible hose is in fluid communication with the interior of the bag via a manifold having a plurality of passages, each passage being in fluid communication with the interior of the bag at a respective one of said locations mutually spaced across the bag.
3. The breathing device of claim 2, wherein said manifold extends externally from the bag and comprises a main conduit which is at one end thereof connected to the flexible hose and which is at the other end thereof closed, and a plurality of branch conduits, each branch conduit extending from the main conduit to the bag and forming a respective one of said passages.
4. The breathing device of claim 3, wherein at least one branch conduit has an end part extending within the bag, which end part has at least one opening provided in the wall thereof.
5. The breathing bag of claim 4, wherein said end part of the branch conduit is provided with an annular shoulder surrounding the passage formed by the branch conduit and located at the inward end of said branch conduit.
6. The breathing device of claim 2, wherein said



manifold includes a conduit extending within the bag, said passages of the manifold being formed by a plurality of openings provided in the wall of said conduit.

7. The breathing bag of claim 6, wherein said conduit rests in an elastically deformed state against the inner surface of the wall of the bag.

8. The breathing device of any one of claims 2-7, wherein the flexible hose and the manifold are integrally formed.

9. The breathing device of any one of claims 1-8, wherein said mouthpiece is provided with a directional valve which in a first mode of operation thereof allows the wearer to exhale into the bag and to inhale from the bag, and in a second mode of operation thereof allows the wearer to breathe from atmosphere.

10. The breathing device of any one of claims 1-9, further comprising means for attaching the bag to an immersion suit of the wearer.

11. The breathing device substantially as described hereinbefore with reference to the drawings.

