

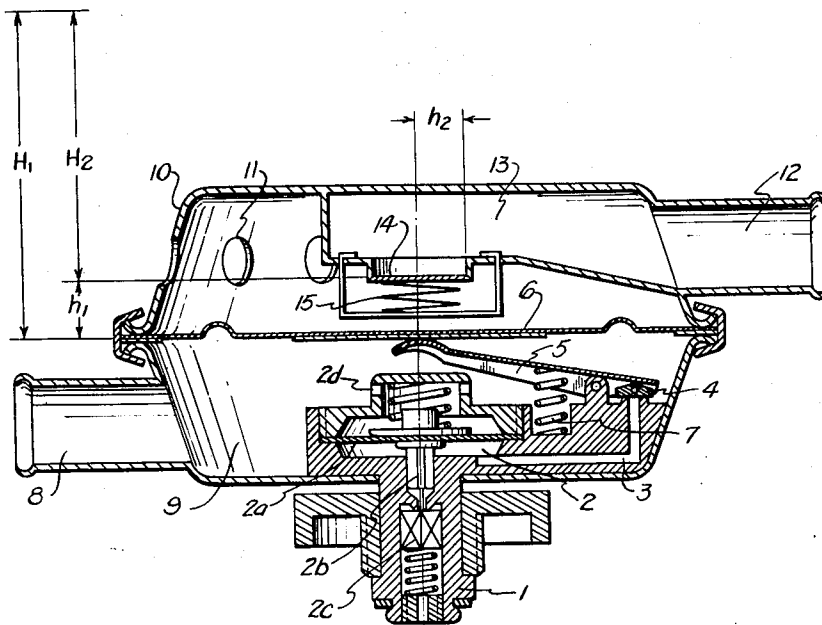
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# LUNG-CONTROLLED BREATHING VALVE

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## LUNG-CONTROLLED BREATHING VALVE

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1 Claim. (Cl. 137—63)

This invention relates to a breathing valve for a diving apparatus. In particular, the invention is directed to a lung-controlled diaphragm valve to be used in underwater work, as by skin divers.

Lung-controlled diaphragm valves are known in which the breathing mixture intake from gas pressure flasks is supplied to the swimmer at a pressure and volume corresponding to the depth of water above the swimmer. In such apparatus, the exhale or air exhaust valve has its opening pressure set as close as possible to the operating pressure of the control diaphragm or its neutral pressure center so as to make sure that the exhaust valve will not leak whatever the water depth may be. In this arrangement, the difference in operating pressures between the exhaust valve and the neutral position of the diaphragm is less than the height of the water column or pressure necessary for initiating the starting opening of the lung-controlled valve. This has the disadvantage in that the opening pressure for the control diaphragm cannot be decreased at will because the construction of the exhaust valve makes it difficult to give it an opening pressure near that of the control diaphragm. Moreover, consideration must be given to the fact that the pressure range movements of the control diaphragm are so large that they cannot be disregarded with respect to the difference in operating pressures between the control diaphragm and the exhaust valve.

The object of the present invention is to overcome the disadvantages of the prior lung-controlled valves by making the difference in opening pressures between the diaphragm and the exhaust valve as small as possible.

In general, this and other objects of the invention are accomplished in that the pressure required for opening the exhaust valve is close to the water pressure needed for actuating the diaphragm in the horizontal or inclined positions of the lung-controlled diaphragm valve.

The means by which the objects of the invention are obtained are described more fully with reference to the accompanying drawing which is a cross-sectional view through a lung-controlled valve.

Pipe fitting 1 is adapted to be connected to the air or gas pressure flasks and contains a pressure reducer 2 which is of any conventional structure. Reducer 2 has a control membrane 2a which is exposed to the gas pressure from the flasks on one side and indirectly to the effective transmitted water pressure on the other side. Thus with a constant pressure difference on both sides of membrane 2a, a volume-wise constant air inflow through the pressure reducer is insured. Cross-shaped valve stem 2b controls piston valve 2c against the action of a spring. The other side of membrane 2a is open through ports 2d.

Outlet duct 3 of pressure reducer 2 is open and closable by valve 4 operated by lever 5 extending to and contacting one surface at the center of control diaphragm 6. Lever 5 is loaded by spring 7. Duct 8 communicates with an intake tube leading to a face mask. When air is inhaled through duct 8, a drop in pressure takes place in chamber 9, and diaphragm 6 is pulled downwardly, thus depressing lever 5 and opening valve 4 so that air or gas can flow through duct 3 into chamber 9.

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A casing 10 covers the other side of diaphragm 6, and is exposed to the water pressure through ports 11. Pipe 12 communicates with the air exhaust tube coming from a face mask, and is continued into a chamber 13 within container 10. Centered over membrane 2a is the exhaust valve 14 held in closed position by the pressure of spring 15. Valve 14 may be constructed to give it an adjustable operating pressure. The valve can consist of mica, sheet steel, hard synthetic material, or the like. It can also be composed of a disk of flexible material such as rubber or synthetic material resting on the valve seat under a pre-determined pressure. Thus the valve can be spring-loaded or pre-stressed by an appropriate shape. The valve is preferably cone-shaped.

When the unit is immersed in water in a horizontal position as shown in the drawing, membrane 6 is placed under water pressure, deflecting lever 5 to open valve 4. Valve 4 stays open until the air pressure in chamber 9, and by reason of the air passing through the face mask into chamber 13, reaches a pressure which corresponds to the water pressure at the center or middle point of diaphragm 6 minus a pressure sufficient to overcome spring 7, which latter pressure is approximately equal to the pressure head represented by the difference

$$H_1 - H_2 = h_1$$

in the water depth of the center or mid-point of diaphragm 6 and the center of exhaust valve disk 14 and, when the valve is turned ninety degrees to be on its side, is approximately equal to the pressure head represented by the radial distance  $h_2$  of the disk valve 14 and which is the difference in the water depth of the center point of diaphragm 6 as well as the center point of exhaust valve disk 14, and the uppermost point of the exhaust opening controlled by disk 14. The advantage of this construction is in that the operating pressures for diaphragm 6 and exhaust valve 14 can be kept at about the same value when the diaphragm valve is inclined between the horizontal and vertical. In other words the diaphragm valve retains its sensitivity of operation even when inclined.

Having now described the means by which the objects of the invention are obtained, we claim:

A lung-controlled diaphragm breathing valve comprising a housing containing an air inlet valve, a disk exhaust valve, an air inlet control diaphragm separating said inlet and disk exhaust valves and spaced from said exhaust valve a distance substantially equal to the effective radius of said disk valve, ports in said container for exposing the exhaust valve side of said diaphragm to water pressure, a lever extending between the center point of said diaphragm and said inlet valve for opening said inlet valve upon deflection of said diaphragm by water pressure, and spring means for urging said lever against said diaphragm, and said disk exhaust valve being axially aligned with the center point of said diaphragm so that the pressure required for opening said exhaust valve is substantially constant for the horizontal and inclined positions of the lung-controlled diaphragm valve.

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