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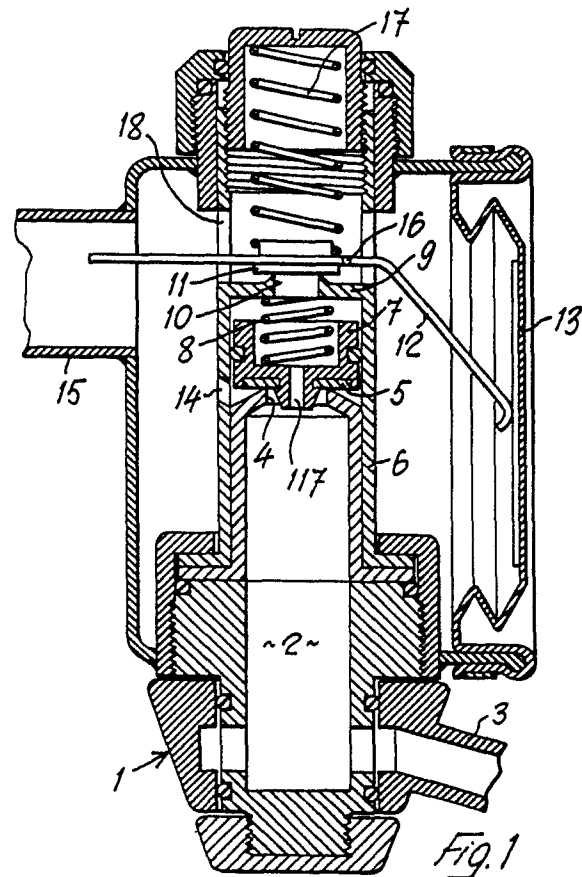
71 Applicant: **Bozano, Enrico Domenico**
Via N. Oderico 4/f
I-16145 Genova(IT)

72 Inventor: **Bozano, Enrico Domenico**
Via N. Oderico 4/f
I-16145 Genova(IT)

73 Representative: **Porsia, Attilio et al**
c/o Succ. Ing. Fischetti & Weber-Dr. Porsia
Via Caffaro 3/2
I-16124 Genova(IT)

54 Air regulator for breathing apparatus.

57 The second stage of the regulator comprises a first airflow circuit (117-10), controlled by a manostat diaphragm in a conventional manner which permits the assumption of the minimum required amount of air upon each act of breathing, with a minimum effort; and a second airflow circuit (4-14) combined with said first circuit, which permits to supply - in case of increased demand of air - a supplementary amount of air to meet any additional need of the user.



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"Air regulator for breathing apparatus"

This invention relates to an air regulator for breathing apparatus, particularly for underwater breathing apparatus.

One of the most serious problems in the field of underwater breathing apparatus is to regulate the air flowrate supplied to a scuba-diver under particular conditions of oxygen requirements, such as when the scuba-diver is panting.

It is known that conventional regulators comprise a first stage for reducing the pressure of the air from the bottles, communicating with a second-stage reducing device which feeds the air into a hose to a mouthpiece for the user, the regulation of the amount of air supplied by said second-stage device upon each breathing act of the user being effected by valve-controlled devices under the action of a manostat diaphragm. These conventional devices supply, upon each breathing act, an amount of air which is independent of the actual need of a user, said amount being limited by the diameter of the holes through which the air is passed.

The main object of this invention, therefore, is to provide a regulator of the type mentioned above, wherein the second stage comprises a first airflow circuit, controlled by a manostat diaphragm in a conventional manner, which permits the assumption of the minimum required amount of air upon each act of breathing; and a second airflow circuit combined with said first circuit and in parallel therewith, which permits to supply - in case of deep or panting breathing of the user - a supplementary amount of air to meet any requirement of the user.

Further characteristics and advantages of this invention will become apparent from the following detailed description of some preferred embodiments thereof, made with reference to the accompanying drawing which shows, by way of non-limiting examples, some preferred embodiments of the device according to the invention, and wherein:

Figure 1 is a diagrammatic, longitudinal sectional view of the second-stage device of a regulator according to the invention; and

Figures 2 to 4 show some modifications of the valve member for the device according to the invention.

With reference to the drawing, and particularly to the figure 1 thereof, the illustrated device comprises, as known per se, a body member 1 formed with an interior cylindrical chamber 2 communicating at an end thereof with an air inlet conduit 3 connected to the first stage of the regulator, and including at the other end thereof an opening 4 which constitutes a valve seat on the outer side

thereof. Concentric with the chamber 2 is a cylindrical conduit 6 slidably accommodating a small piston 7. Said piston 7 is formed with an axial exactly-dimensioned hole 117 and comprises, on the end facing towards the valve seat 4 of said chamber 2, an annular seal 5 which normally rests against said valve seat to close it. Said piston 7 is constantly urged against the valve seat 4 by a spring 8 abutting at an end thereof against said piston 7 and at the other end thereof against an apertured partition 9 arranged across the conduit 6. Said partition 9 is provided with a central hole 10 which is formed as a valve seat on its side far from said piston 7. The valve seat on the hole 10 co-operates with a valve member 11 mounted on a pivotable lever 12 which co-operates with a manostat diaphragm 13 mounted on the body member 1 of the regulator. Said conduit 6, upstream of the piston 7, is formed with a hole 14 for communicating with a conduit 15 which is connected to the mouthpiece for the user.

Said lever 12 is pivotably mounted on a fulcrum 16 and is constantly urged by a spring 17 housed within the body member 1, so as to seat the valve member 11 against the valve seat 10.

The operation of the device is now apparent.

In the position shown in figure 1, i.e. with the valve member 11 matched against the valve seat 10, and with the valve member 5 matched against the valve seat 4, the regulator prevents any flow of air from the conduit 3 to the conduit 15.

As soon as a user effects a breathing act (normal breathing condition), the reduced pressure created within the body member 1 causes, through the displacement of the diaphragm 13, the lever 12 to pivot against the action of the spring 17, whereby the valve member 11 is moved away from its valve seat permitting the air to flow from the conduit 3 to the chamber 2 and successively through the hole 4, the hole 117 of the piston 7, the valve seat 10 and the hole 18 in the wall of the conduit 6, downstream of the piston 7, to the conduit 15.

Whenever a larger amount of oxygen is required, for example, due to a panting condition, a still more reduced pressure is created and causes the piston 7 to be lifted from the seat 4 against the action of the spring 8. In this instance, the air from the chamber 2 flows directly into the conduit 15 through the openings 4 and 14. A double flow of air to the conduit 15 is thus established to meet the user's increased demand of oxygen. As soon as this increased demand ceases, the valve member 5 of said piston 7 is urged back against its seat 4 to close it, whereby the supply of air will be regulated again by the valve member 11 under the control of

the diaphragm 13.

In the embodiment shown in the figures 2 and 4, the piston 7 is replaced by a valve member 7' comprising a metallic tubular element 107' enveloped circumferentially by a rubber shell 207' extending radially inwards at one end thereof so as to form a diaphragm 307' having a central hole wherein a metal nozzle 407' with a central exactly-dimensioned through-hole 117 is sealingly embedded. According to this embodiment, the valve member 7' is not slidable in the tubular conduit 6 as its upper end abuts against the partition 9 and its opposite end rests against the valve seat 4 through said diaphragm 307'. The operation of the just-described device is apparent. In the condition of increased air demand, the diaphragm 307' is lifted from said seat 4 by virtue of its resiliency, thus permitting the air to pass from the seat 4 through the by-pass hole 14 to the conduit 15.

Figure 3 shows a modification of the valve member 7' of the figures 2 and 4.

According to this modification, the valve member comprises a cylindrical metallic body 507' provided with a sealing O-ring 607' on its outer surface. The bottom end of the body 507' is closed by a rubber diaphragm 707' having a central hole wherein a nozzle 407' with an exactly-dimensioned through-hole 117 is embedded.

The arrangement and operation of this valve member are exactly the same as those described above in connection with the embodiment of the figures 2 and 4.

The advantages of the device of the invention are apparent.

During the normal use, the lever 12 is subjected to a minimum pressure and opens the valve member 11, thus permitting the flow of air through the exactly-dimensioned hole 117 and the opening 10 to the conduit 15 so as to permit a good breathing. If, due to any reason, the demand of air increases, the servo-control mechanism is activated whereby the larger valve 4 is opened and an additional flow of air is delivered to the conduit 15, through said by-pass circuit, so as to eliminate any damping condition immediately.

Claims

1. An air regulator for two-stage pressure reduction breathing apparatus, characterized in that the second stage of the regulator comprises a first airflow circuit controlled by a manostat diaphragm so as to permit the assumption of the minimum required amount of air upon each act of breathing, with a minimum effort; and a second airflow circuit in parallel with and in combination with the first airflow circuit, which permits to supply - in case of

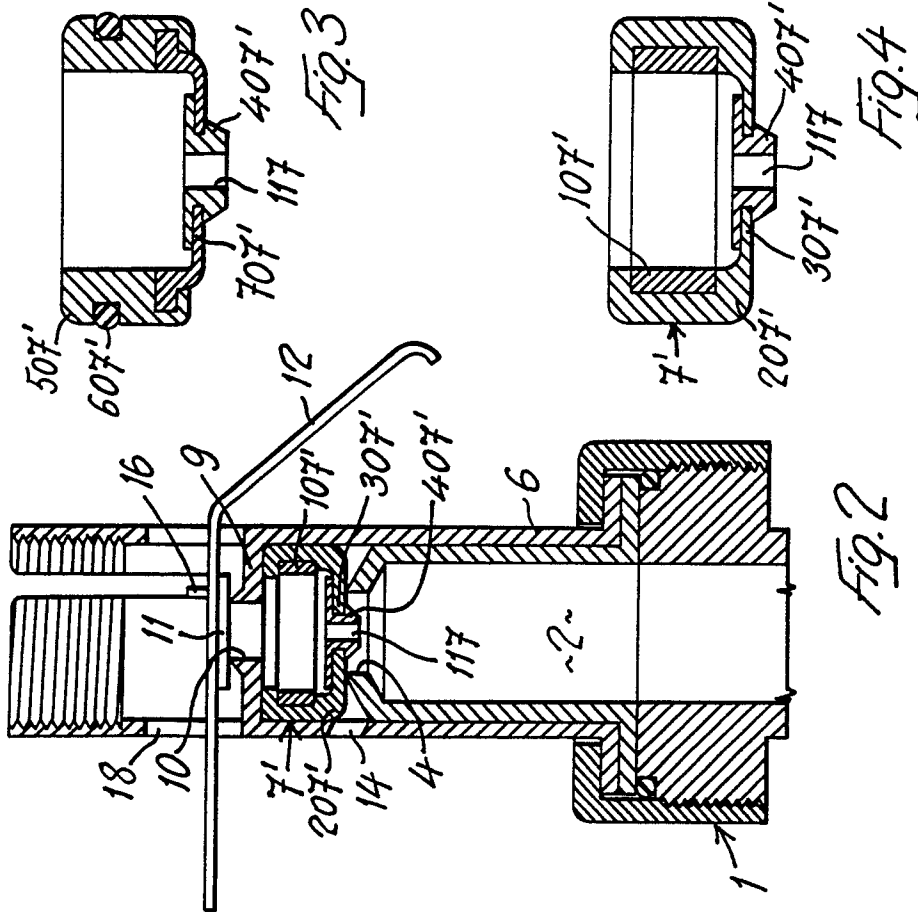
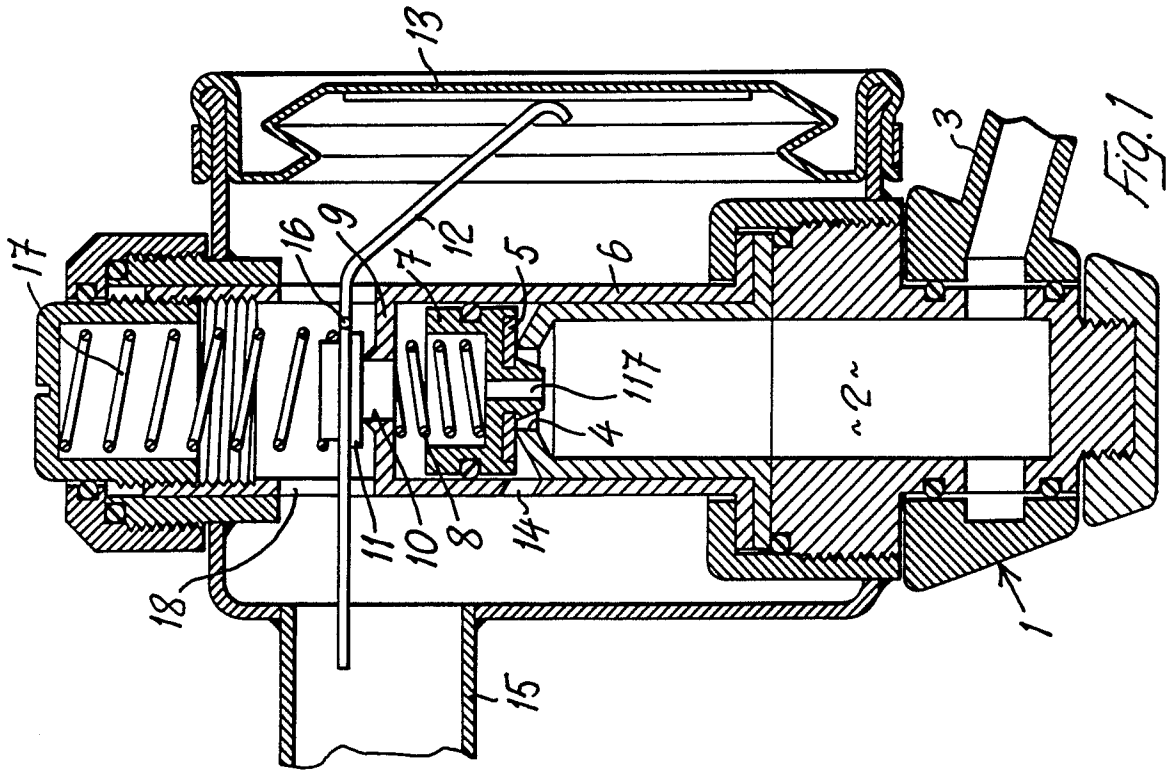
forced or damping inhalation by the user - directly to the breathing conduit leading to the user's mouthpiece a supplementary amount of air to meet any additional need of air of the user.

2. A device according to claim 1, characterized by valve means which opens or closes said second airflow circuit, said valve means being arranged upstream of the control valve means of the first airflow circuit.

3. A device according to the preceding claims, characterized in that said control valve means of said second airflow circuit comprises a valve member provided with an axial exactly-dimensioned through-hole, co-operating with the air inlet conduit and communicating downstream with the feeding conduit to the valve of the first airflow circuit of the regulator, said valve member being urged with a pre-established elastic force against a valve seat of said air inlet conduit, so as to be lifted from said valve seat when upstream thereof is present a demand of air exceeding the flowrate of said exactly-dimensioned hole, whereby the air conduit is put in direct communication with the conduit feeding the air to the user, through a suitable by-pass opening.

4. A device according to claim 3, wherein said valve member comprises a small movable piston, urged by resilient means against said valve seat.

5. A device according to claim 3, wherein said valve member is a stationary member provided with a resilient diaphragm for closing said valve seat.





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	FR-A-2 050 809 (J. BRONNEC et al.) * Page 3, lines 27-40; page 4; page 5, lines 1-12; figures 1,2 * ---	1-3,5	B 63 C 11/22
A	GB-A-2 014 047 (M. ISAACSON) * Figure 2; page 1, lines 31-47; page 3, lines 32-67 * ---	1,3	
A	US-A-3 456 642 (C. CUPP) * Abstract; column 1, lines 25-35; column 4, lines 5-44; figures 2,3 * ---	1	
A	US-A-3 783 891 (R. CHRISTIANSON) * Column 4, lines 16-68; figure 3 * -----	1,3,4	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			B 63 C A 62 B 9/02
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24-02-1988	Examiner VISENTIN, M.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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