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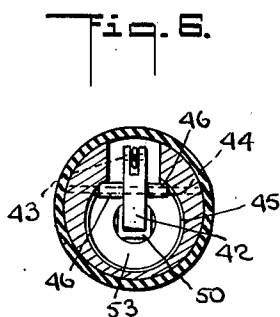
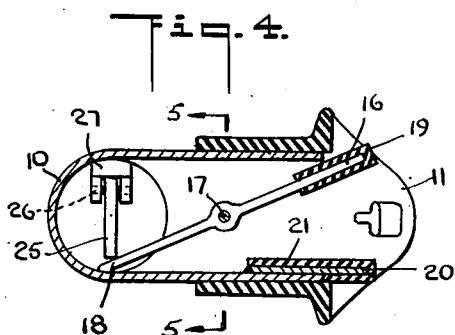
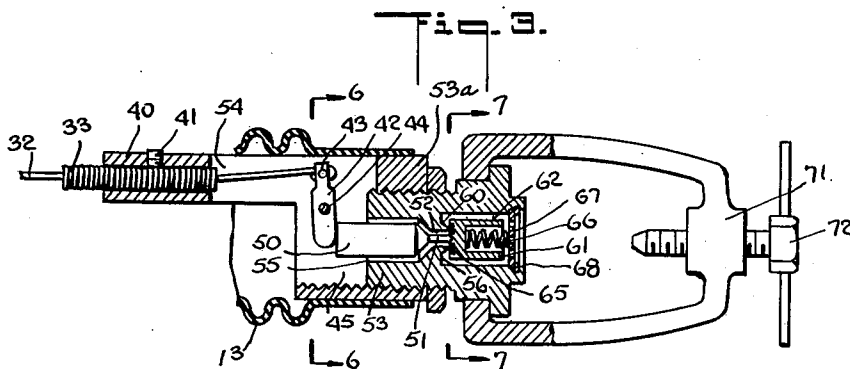
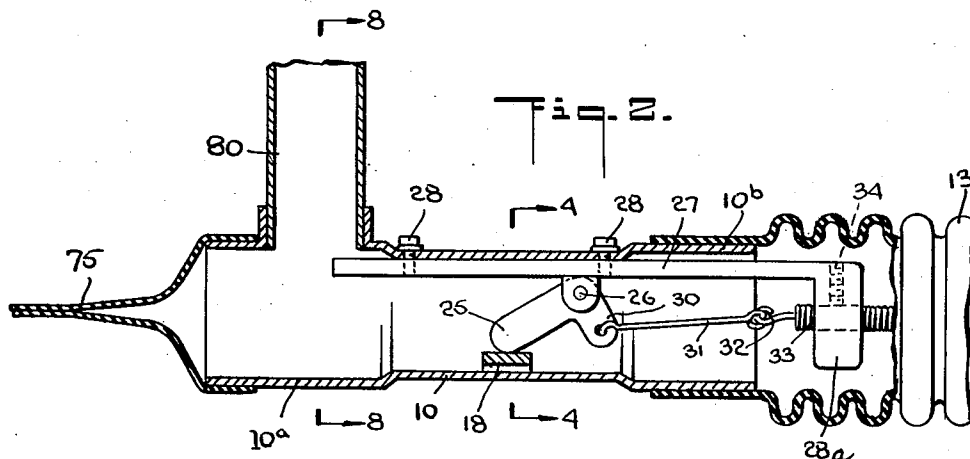
L. G. ARPIN ET AL

2,810,387

UNDERWATER BREATHING DEVICES

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3 Sheets-Sheet 2



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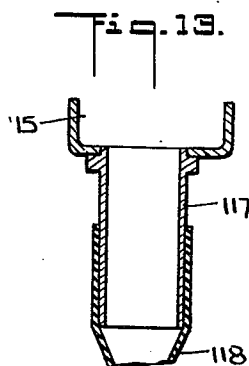
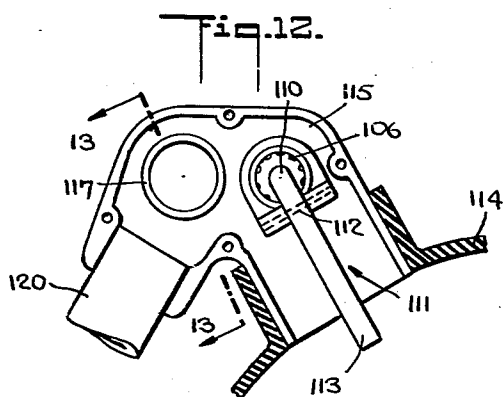
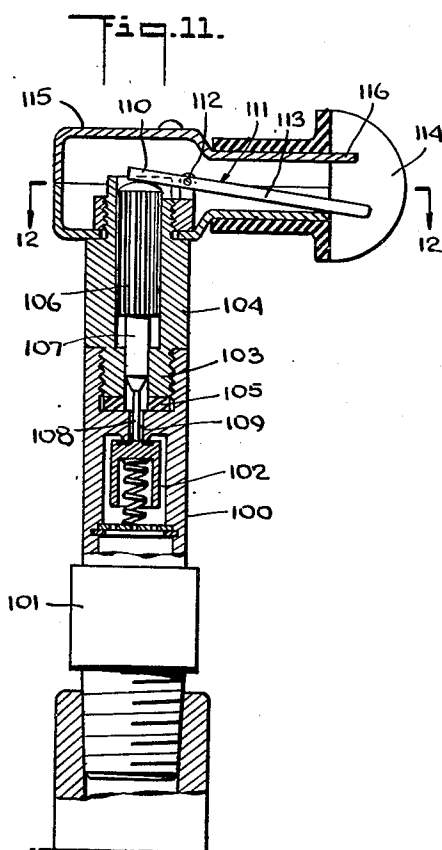
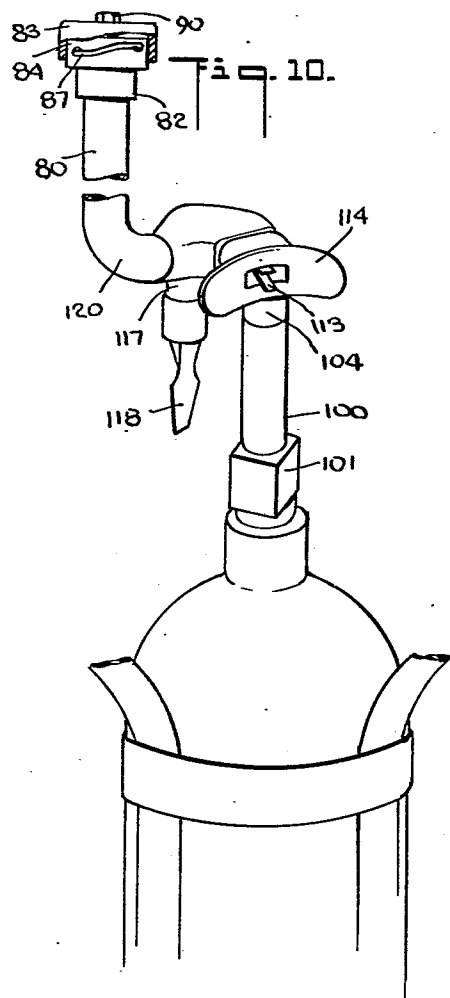
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UNDERWATER BREATHING DEVICES

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15 Claims. (Cl. 128—142)

This invention relates to a breathing regulator used with a self-contained underwater breathing unit.

The use of a breathing regulator which is used under water in connection with a source of compressed air in a tank carried with the user is well known. Such a regulator permits the breathing of a required quantity of air from the tank and provides means for exhaling exhaust air into the water. The object of this invention is to provide a highly efficient although simplified unit wherein the furnishing of air of the tank to the mouth of the user is controlled by the user's teeth. This is considered of great advantage since the action of the teeth can be very accurately correlated with mouth breathing so that when the user requires air he may simply clench his teeth on a lever structure which serves to feed air as required from the tank of the unit directly to his mouth. The improved unit further employs an improved exhaust valve.

Another and most important object of this invention is to combine a compressed air tank unit as above described with an atmospheric air breathing tube integrated into the structure and which is employed when atmospheric air may be breathed as when the user is near the surface. Such a tube extends upwardly and is often referred to as a snorkle tube. It is usable when the regulator is closer to the surface of the water than the length of the tube and conserves the supply of air in the tank. The snorkle tube comprises means for shutting it off from the outside media when recourse is had to the supply of air in the tank. The mouthpiece of the unit, since it serves to supply compressed air to the mouth of the user, may also serve as the mouthpiece of the snorkle tube.

The invention will be further understood from the following description and drawings in which:

Figure 1 is a perspective view of one form of the improved regulator as connected to the tank of air;

Figure 2 is a cross-sectional view of the forward or mouthpiece end of the regulator;

Figure 3 is a cross-sectional view of the remote or valve end of the regulator;

Figure 4 is a cross-sectional view as taken along the line 4—4 of Figure 2;

Figure 5 is a cross-sectional view as taken along the line 5—5 of Figure 4;

Figure 6 is a cross-sectional view as taken along the line 6—6 of Figure 3;

Figure 7 is a cross-sectional view as taken along the line 7—7 of Figure 3;

Figure 8 is an enlarged cross-sectional view as taken along the line 8—8 of Figure 2;

Figure 9 is a cross-sectional view as taken along the line 9—9 of Figure 8;

Figure 10 is a fragmentary, perspective view of a modified embodiment;

Figure 11 is an enlarged longitudinal cross-sectional view thereof, some parts being removed for purposes of clarity;

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Figure 12 is a cross-sectional view taken along the line 12—12 of Figure 11; and

Figure 13 is a cross-sectional view taken along the line 13—13 of Figure 12.

In the first form, the device comprises a T-shaped connector or coupling 10 having lateral arms 10a and 10b. A rubber or flexible plastic mouthpiece 11 is connected to the central arm 10c. The T-shaped member 10 may be of metal or it may be of rubber and integral with the mouthpiece. The mouthpiece 11 includes a rubber sleeve 12 which is hollow and slipped over the central hollow arm 10c of the T-shaped member so as to establish communication with the hollow interior thereof. The mouthpiece 11 is formed with side wings which are engaged by the lips for securely holding the mouthpiece against the gums.

To arm 10b of member 10 is connected a flexible corrugated rubber hose 13 so as to effectively constitute a flexible extension of the member 10. The remote end of the hose 13 extends to the valve structure for regulating the flow of air from the tank 14 as will hereinafter be made clear.

Disposed within central arm 10c of member 10 is the mouth actuated lever mechanism which in turn actuates the air valve structure. Such lever mechanism comprises a rockable lever arm 16 (Figure 4) which is pivoted on pin 17 extending from one side to the other of the central arm 10c of member 10. Arm 16 is normally disposed in an upwardly biased position in respect to the teeth of the user, the lower end 18 being downwardly inclined.

The upper end of lever 16 is provided with soft rubber sleeve 19 so as to be comfortable for biting or clenching purposes. An opposed or abutment bite member 20 is provided and it is secured in place on the floor of arm 10c of the T-shaped member 10. Bite member 20 is also covered with a rubber sleeve 21 so that the user may bite with his upper teeth depressing the lever 16 in respect to the arm 20 and so as to swing the lever about the pin 17 so as to raise the lower end 18 thereof.

Referring to Figure 2, it will be noted that the lower end 18 of lever 16 abuts bell crank lever 25 which is pivoted at 26 to a cross bar 27 which is secured as by bolts 28 to the member 10. Bar 27 extends across arms 10a and 10b and is provided with a downwardly offset extension 28a having a central, transverse opening there-through. Arm 30 of bell crank lever 25 is provided with a link 31 connected to elongated flexible cable. The elongated flexible cable is of conventional form and includes a central wire 32 and a tubular sheath 33, such a cable being often referred to as a Bowden wire. Sheath 33 is firmly clamped within the central opening of offset extension 28a as by the set screw 34.

As a result of the foregoing structure, it will be understood that when the user clamps his teeth down on lever 16, he actuates the bell crank lever 25 so as to draw lever arm 30 laterally thus, drawing upon link 31 and wire 32. As will hereinafter be shown, the tension applied to wire 32 moves it bodily and operates the air valve to supply air to the user's mouth.

The remote end of the flexible hose and flexible cable is shown in Figure 3. Such remote end includes a frame structure 40 to which the end of sheath 33 is secured as by set screw 41. The wire 32 is, of course, at all times slidable within the sheath 33 and its remote end is pivotally connected to a lever 42 at pivot point 43. Lever 42 is pivoted upon pin 44 extending from one side of the tubular piece 45 to the other side thereof as illustrated in Figure 6. Tubular piece 45 is integral with frame structure 40 as illustrated in Figure 3. A pair of tubular side pieces 46 serve to center the lever 42 on the pin 44.

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The free end of lever 42 bears against a valve body 50 which terminates in a valve pin 51. Valve pin 51 is disposed within throat 52 formed in coupling 53 which is screwed into tubular piece 45. It will be observed that the extreme end 53a of tubular piece 45 is threaded so as to receive the coupling 53, the upper central portion of frame 40 being cut away at 54 so as to provide operating space for the lever 42.

The throat 52 of coupling 53 communicates with chamber 55 in which the valve body 50 is slidably disposed and which communicates with the interior of flexible hose 13. Valve body 50 is substantially square in cross section but with rounded corner edges to fit snugly although slidably in round chamber 55. The air flow is between the flat sides of valve body 50 and the round walls of chamber 55. The wall 56 of coupling 53 is formed with an annular boss 60 which partially defines throat 52. Valve pin 51 is arranged to slide through throat 52 and beyond boss 60 as will hereinafter be made clear.

Normally disposed in abutting relation against annular boss 60 is a high pressure block 61, which is substantially square in transverse cross section, the corners thereof being rounded and slidably received within chamber 62 of coupling 53. The end face of block 61 is closed and is provided with an annular, hard plastic washer 65 which may be of "Teflon" or the like. The annular boss 60 is adapted to seat against washer 65 so as to normally close off chamber 62 from throat 52. A coil spring 66 bears against block 61 for this purpose. The spring 66 abuts a perforated screen 67 which is maintained in place by the C-shaped clip 68 which normally fits into an annular recess and maintains the parts in place.

It will be understood that the construction of the feed valve represented by the valve body 50 and high pressure block 61 is not the subject of this invention but represents more or less conventional structure for metering breathable air from a tank where the air pressure may be up to 2500 or more pounds. However, the actuation of the valve body 50 in the manner described is an important part of this invention. It may be further noted that since spring 66 effectively urges valve body 50 to a valve closing position, it functions as a restoring spring for the wire 32, returning the lever arm 16 to a closed valve position. Of course, an additional, conventional restoring spring may be employed as on the bell crank lever 25. It will be understood by those skilled in the art that the foregoing feed valve structure is connected to an output valve 70 of tank 14 by means of the yoke 71 which embraces said output valve structure and the device is tightened on such output valve by manually operated screw member 72. The air from such output valve is controlled by a tank valve member 73 which is turned to the open position when it is to be made available to the breathing regulator.

The device as described hereinabove is operated as follows:

The tank 14 is strapped to the user's back as by the harness 74 which may encircle his arms, the tank valve member 73 having been turned to the open position. The user inserts the mouthpiece 11 in his mouth, his teeth being slightly open so as to embrace the members 16 and 20. When submerged, he will require air to be fed to him and he bites downwardly upon the lever 16. This pivots the bell crank 25 and, as above described, draws upon wire 32 so as to pivot the lever 42 about its axis 44. The free end of lever 42 then actuates valve body 50 inwardly so as to depress high pressure block 61 correspondingly inwardly against the action of compression spring 66. This separates the annular boss 60 from the washer 65 and provides a path for compressed air through chamber 62, throat 52, chamber 55 and hose 13 up to the mouth of the user. He may thus breathe the air supplied pursuant to the biting of lever 16 by his teeth and will release his bite when he exhales.

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It will be observed that the arm 10a of member 10 is provided with a normally closed exhaust valve 75 which is of the rubber flapper type. Exhaust valve 75 comprises an elongated flattened thin rubber tube which is slotted along sides 76 and 77 and operates unidirectionally to enable air to be exhausted therefrom. Accordingly, when the user expires exhaust air, such air will be exhausted through exhaust valve 75. The function of the exhaust valve is most important in view of the extremely high pressures in the tank. Thus, should the user withdraw excessive air from the tank, the excess will merely drain off through the exhaust valve which is in parallel with his lungs. In this way, the exhaust valve serves as a safety valve and avoids injury to the lungs of the user.

We have discovered that the use of the teeth to supply air directly to the mouth instead of to the nose or to a face mask is of great advantage since the up and down action of the jaws is best effected with the mouth open sufficiently to engage the mouthpiece 11.

The mouth breathing device described further makes it possible to employ a so-called snorkle tube when the user is near the surface and wishes to conserve air from the tank. Accordingly, a tube 80 of relatively rigid rubber or plastic is connected into section 10a and extends upwardly, the tube 80 communicating with the interior of member 10.

When the user is near the surface he will not clench the teeth operated levers but will merely breathe normally from mouthpiece 11 so as to draw atmospheric air through the tube 80. It will be recognized that tube 80 might ordinarily act as a discharge pipe for air from tank 14 when the user is submerged. Such action is prevented by means of a valve structure provided in tube 80.

The snorkle tube 80 is provided with an upper valve structure comprising a lower, stationary member 82 and an upper, rotatable member 83. Of course, if desired, lower member 82 may be integral with tube 80. Member 82 includes an annular enlargement 84 having a plurality of holes 85 peripherally arranged around the floor thereof. It is also formed with an annular boss 86 which extends upwardly over the mouth of tube 80. Enlargement 84 is also formed with a bayonet type of cam slot 87 in its outer wall.

Upper member 83 serves as a cap, being provided with a closed upper wall. It telescopes enlargement 84 and is provided with a pin 88 which rides in cam slot 87. Cap 83 is provided with a central protuberance 89 to which is attached, as by bolt 90, a rubber disk valve 91.

The action of the snorkle valve is as follows:

By means of the bayonet cam slot, the cap 83 may be rotated to an upward position relative to enlargement 84 so that the rubber disk 91 is out of contact with the lip of annular boss 86. Accordingly, it may be breathed from by the user directly through holes 85 around boss 86 and through tube 80 to his mouth. Of course, he will not employ his teeth at this time. When he desires to draw air from the tank, he reaches up and turns cap 83 downwardly so as to engage the pin 88 in a lower portion of slot 87. This brings the rubber disk 91 tightly against the mouth of annular boss 86 and closes off tube 80 both from air and from water. Accordingly, the user may now employ his tank supply of air as above mentioned and the tank air will not be diverted through the snorkle tube 80 but will be supplied to the user through mouthpiece 11.

In Figures 10 to 13 is disclosed a modified embodiment which is considered to be of further utility with particular regard to its simplicity. Thus, the breathing mechanism is disposed directly upon the tank and simplified valve means are shown. In this embodiment, an elongated hollow tube 100 is screwed into the tank mouth, a rectangular portion 101 facilitating the use of a wrench for this purpose. A high pressure valve mechanism 102 which duplicates that of the prior described embodiment

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as illustrated in Figure 3, is disposed within tube 100. Tube 100 is further formed with an upper, internally threaded chamber which receives and engages the reduced portion 103 of tube portion 104, a gasket 105 providing an air-tight engagement so that tubes 100 and 104 actually function as a unitary tube.

Within tube portion 104 is freely slidably disposed a valve actuating body member 106 of rigid metal and having a first reduced portion 107 terminating in a pin 108. Pin 108, being disposed in throat 109 performs the same function as valve pin 51 of the previous embodiment.

Body member 106 is elongated and fluted so as to pass air and is normally maintained in an upward or valve closing position by means of the coil spring in the high pressure valve mechanism. The upper end of body member 106 is rounded off and is actuated by the short arm 110 of a lever 111 which is fulcrumed at 112. The long arm 113 extends outwardly into mouthpiece 114 and is biased downwardly by the action of the spring in valve member 102. The lever and upper end of the body member 106 are enclosed in a hollow chamber 115 which serves as a coupling between the tubes and the mouthpiece. An extension 116 is integral with chamber 115 and serves as an upper abutment, the outer end of lever arm 113 being actuated by the lower teeth of the user.

Referring to Figure 10, it will be noted that chamber 115 is formed with a downward hollow arm 117 which supports the exhaust valve 118. This downward disposition of the valve 118 relative to the mouthpiece 114 is desirable since it avoids the annoyance of bubbling exhaust air around the ears of the user. The snorkle tube 119 follows that of the previous embodiment, a flexible conduit portion 120 connecting the tube to an outlet of chamber 115.

The device of the modified embodiment is employed by strapping the tank directly to the chest of the user whereupon the mouthpiece 14 may be inserted in his mouth and the lever arm 113 actuated upwardly by the lower teeth of the user so as to depress body member 106 and open the valve mechanism 102 to supply air pursuant to the user's requirements. It is, in fact, found that the lower teeth are most suitable for serving this function since it is the lower jaw which is hinged to the head and a more natural action is achieved by actuating the lower member 113 rather than the upper member 116.

What is claimed is:

1. An underwater breathing regulator comprising a hollow tube, means for connecting the tube to a tank of compressed air, a valve member in one end of said tube for admitting air from the tank into the tube, a mouthpiece connected to the other end of the tube, a lever arm within said mouthpiece and positioned so as to be engageable by the teeth of a user when the mouthpiece is in his mouth, and motion transmission means between said lever arm and said valve member for actuating said valve member by closing the teeth so as to supply compressed air from said tank into said mouthpiece.

2. An underwater breathing regulator according to claim 1 and including a spring in said valve member normally urging it to a closed position and also actuating said lever arm to its open lever position.

3. An underwater breathing regulator according to claim 1 and including an atmospheric air breathing tube communicating with said first-named tube and with said mouthpiece, said breathing tube extending upwardly in use so as to have its upper end in the atmosphere when the submerged regulator is closer to the surface of water than the length of said breathing tube, means on said breathing tube for closing it off against both air and water when compressed air is to be drawn from said tank, and an exhaust valve communicating with both said breathing tube and said mouthpiece.

4. An underwater breathing regulator according to claim 3 and wherein said last named means comprises a

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manually operable valve structure on the upper end of said breathing tube, said valve structure comprising a lower, stationary annular member embracing the upper end of said breathing tube, a central annular boss on said lower member, said lower member being formed with a plurality of air holes, said boss being disposed directly around the outlet of said upper end, a rotatable upper member telescoping said lower member, bayonet slot means for maintaining said upper member in either a partial telescoping position or a full telescoping position in respect to said lower member, and a resilient disk secured to said upper member and adapted to be seated against said boss so as to close off said breathing tube from said air holes when said upper member is disposed in a completely telescoped position relative to said lower member.

5. An underwater breathing regulator according to claim 4 and wherein said exhaust valve is a rubber flapper having two opposite side slots for exhausting air.

6. An underwater breathing regulator comprising a hollow, rigid tube adapted to be connected to a tank of compressed air, a valve member in one end of said tube for admitting air from the tank into and through the tube, a valve actuating body member within said tube and terminating at one end in a pin which bears against said valve member for actuating said valve member to an open position, a spring normally maintaining said valve member closed, a mouthpiece connected to the other end of said tube, a lever arm within said mouthpiece and having one end thereof bearing against the other end of said valve actuating body member, said valve actuating body member being a unitary metallic piece, the other end of said lever arm being adapted to be engaged by the teeth of the user so as to depress said valve actuating body member against the action of said spring and supply compressed air from said tank into said mouthpiece.

7. An underwater breathing regulator according to claim 6 and including an upper, hollow chamber to which said mouthpiece is connected, said lever arm being pivotally connected to the walls of said chamber and being biased downwardly through the action of said spring so as to be engageable by the lower teeth of the user, and a projection on said chamber serving as an abutment to be engaged by the upper teeth of the user.

8. A breathing regulator according to claim 7 and including an integral tube on said chamber and extending downwardly therefrom, and a rubber flapper exhaust valve connected to said downwardly extending tube and extending downwardly relative to said chamber.

9. A regulator according to claim 8 and including an upwardly extending tube connected to said chamber and communicating with the interior thereof, and a closure cap member on the upper end of said upwardly extending tube, said closure cap member comprising a pair of body members, one of said closure cap body members being adjustable over the other closure cap body member, and a valve between said closure cap body members and adapted to enclose the upper end of said upwardly extending tube in one position of adjustment of said closure cap body members so as to close off said upper end of said tube from atmospheric air, one of said closure cap body members being formed with air holes for admitting air to the upper end of the tube when it is not closed off by said valve.

10. An underwater breathing regulator according to claim 9 and wherein said closure cap body members comprise an upper cap, a lower body member embracing the upper end of the tube and telescoped by said upper cap, said air holes being formed in said lower body member, a boss formed on said lower body member and directly surrounding said upper end of said tube, said last-named valve comprising a resilient disk valve connected to said cap and adapted to be firmly seated against said boss when said upper cap and said lower body members are completely telescoped, and a bayonet slot connection be-

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tween said upper cap and said lower body member for adjusting the telescoping position of said upper cap relative to said lower body member.

11. An underwater breathing regulator comprising an elongated, flexible hose, an air valve member at one end of said hose, said air valve member being adapted to be connected to a source of compressed air, a mouthpiece connected to the other end of said hose, a valve control member extending through said hose from said mouthpiece to said valve member, said valve control member including a movable lever extending outwardly of said mouthpiece and adapted to be engaged by the teeth of a user, an elongated wire connected from said movable lever to said valve member for actuating said valve member so as to supply compressed air from said source through said hose and to said mouthpiece, and an exhaust valve connected to said other end of said hose adjacent to said mouthpiece and communicating with said mouthpiece.

12. An underwater breathing regulator according to claim 11 and wherein said movable lever comprises a rocking lever arm extending in a direction substantially perpendicular to said hose where it is connected to said mouthpiece, a bell crank lever operated by said rocking lever arm, said elongated wire being connected to said bell crank lever so as to be reciprocated through said hose as said rocking lever arm is actuated by the teeth, a stationary abutment member adjacent to the biting end of said rocking lever arm so as to be engageable by the teeth of the user and spring means normally actuating said wire to a valve member closing position, actuation of said rocking lever arm being against the normal action of said spring means.

13. A breathing regulator according to claim 12 and wherein said rockable lever arm normally having its biting end in an upward position and drawing said cable inwardly when bitten upon downwardly so as to draw said cable inwardly and open said valve member.

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14. An underwater breathing regulator, comprising an elongated, flexible hose, a valve member on one end of said hose, said valve member being adapted to be connected to a source of compressed air, a mouthpiece connected to the other end of said hose, a valve control member extending coextensively with said hose and connected at one end thereof to said valve member for actuating said valve member so as to supply compressed air from said source to said mouthpiece, an exhaust valve connected to said hose and communicating with said mouthpiece and a substantially vertical tube connected to said hose in communication with both said hose and said exhaust valve, said vertical tube having air flow means therethrough from said mouthpiece to the surrounding fluid media and means to close off said vertical tube so as to close off said air flow.

15. An underwater breathing regulator according to claim 14 and wherein said valve control member includes a movable lever in said mouthpiece and adapted to be actuated by the teeth of a user, an elongated, bodily shiftable wire connected at one end thereof to said movable lever and at its other end to said valve member, and means normally maintaining said valve member closed, said actuation of said movable lever being against the action of said last named means.

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