Nov. 26, 1963 R. GALEAZZI 3,111,946

BREATHING EQUIPMENT PARTICULARLY FOR DIVERS

Filed Oct. 24, 1960 3 Sheets-Sheet 1

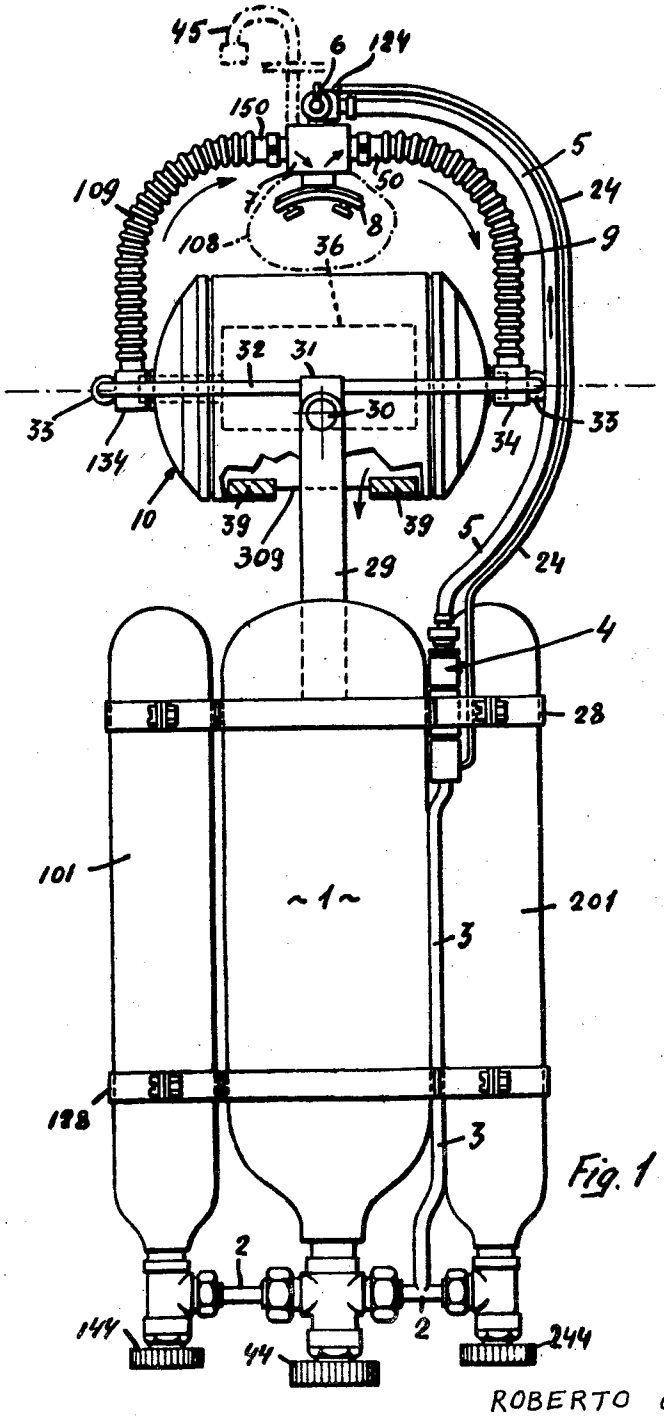

Fig. 1

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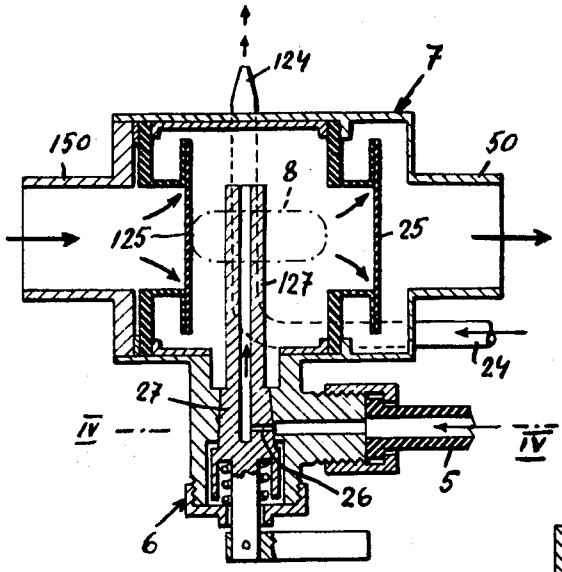

Fig. 3

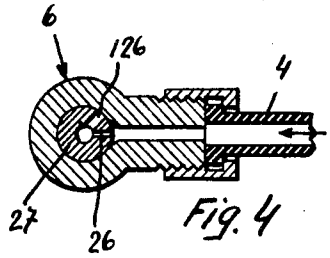

Fig. 4

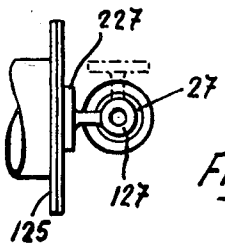

Fig. 5

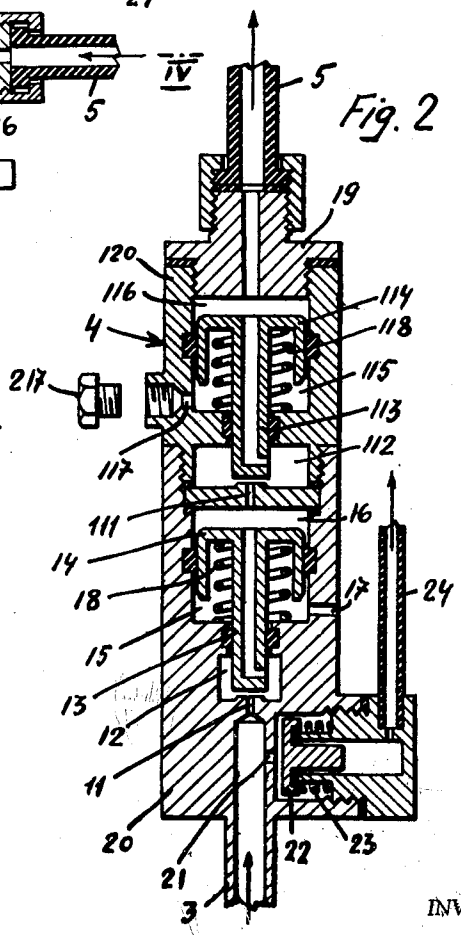

Fig. 2

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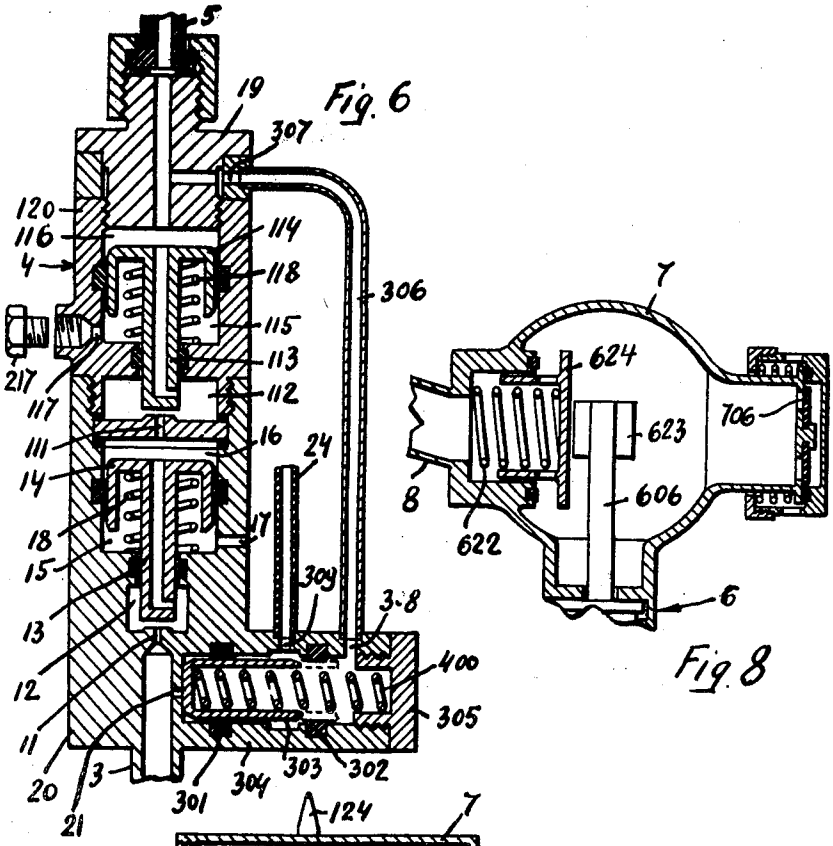

Fig. 6

Fig. 8

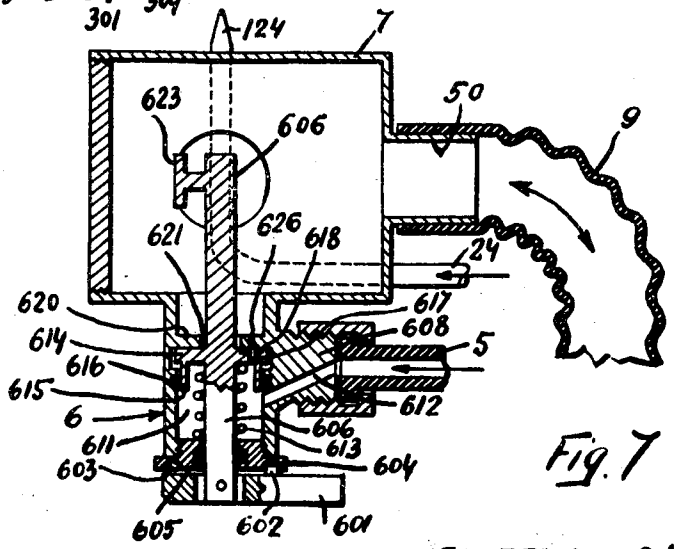

Fig. 7

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3,111,946

BREATHING EQUIPMENT PARTICULARLY FOR DIVERS

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Filed Oct. 24, 1960, Ser. No. 64,498
Claims priority, application Italy Oct. 28, 1959
5 Claims. (Cl. 128—142)

This invention relates to underwater breathing equipment and aims to provide a universal breathing apparatus for divers and frogmen which permits of employing as breathing gas either compressed air, or a mixture of oxygen aid air, or mixtures of oxygen and a neutral gas (nitrogen, helium, hydrogen, argon or other gases), or even pure oxygen.

The universal breathing equipment according to the invention is designed in such a manner as to permit its operation in a multiplicity of ways and avoids the premixing of the oxygen with the air or neutral gas and of regenerating a part of the polluted breathing mixture.

This has been rendered possible by the asknowledgment, in a number of trials, that if a plurality of containers, for example conventional steel cylinders, containing different gases at the same pressure, are discharged simultaneously into a common outlet duct, the volume of the gases discharged from each container in a time unit is proportional to the capacity of the containers which are discharged simultaneously into the same duct, and in the said duct—if the gases are miscible—a mixture containing each gas in a percentage proportional to the capacity of the relative container is formed.

Thus, assuming to have two cylinders, having a relative predeterminate capacity of 1 and 2, respectively and filled the first with oxygen and the second with nitrogen at the same pressure, if the cylinders are allowed to be discharged simultaneously into the same duct, in this a mixture of ⅔ of nitrogen and ⅓ volume of oxygen is formed. If, as in the embodiment which will be described, there are two small cylinders having a like capacity and containing O_2 and one large cylinder having twice the capacity of the small cylinders and containing N_2, by simultaneously discharging all three cylinders, a breathable mixture containing 1 volume of O_2 and 1 volume of N_2 will be formed in the duct connecting the three cylinders in parallel.

A breathing equipment thus constructed, assuming the larger cylinder be charged with compressed air, can be used at any moment either as oxygen equipment (by opening only the valve or valves of the oxygen cylinders), or as breathable mixture equipment (by opening the valves of one or both oxygen cylinders and of the compressed air cylinder), or also as compressed air breathing equipment, by opening only the valve of the compressed air cylinder.

The only care to be taken when using the equipment in one of the described ways is to have the various cylinders all charged at the same pressure and to use for feeding the breathable gas to the diver a feed cock having a nozzle or passage duct gauged for the particular breathable gas to be employed.

Thus the breathing equipment according to the invention, which will be described hereinafter, due to its ability of operating both with oxygen and with air or any breathable mixture permits of employing it as best suitable for the requirements of any case.

The invention substantially comprises the combination and arrangement of suitable improved parts forming together the universal breathing equipment now to be described by way of a non-limiting example, with reference to the attached drawings, in which:

FIGURE 1 shows diagrammatically a preferred embodiment of an improved underwater equipment according to the invention;

FIGURE 2 is an axial section in enlarged scale through a two-step gas pressure reducer forming part of the equipment shown in FIGURE 1 and provided with an older type of adviser of the imminent exhaustion of breathable gas;

FIGURE 3 is a vertical cross section through a mouthpiece unit forming part of the equipment shown in FIGURE 1;

FIGURE 4 is an enlarged cross section through a stop cock, on line IV—IV of FIGURE 3;

FIGURE 5 is a plan view of the plug of the cock shown in FIGURES 3 and 4, and adjoining non-return valve shown in FIGURE 3;

FIGURE 6 is an axial section through a gas pressure reducer like that shown in FIGURE 2, but provided with an improved adviser of imminent exhaustion of breathable gas;

FIGURE 7 is a vertical cross section through a second embodiment of mouthpiece unit, and

FIGURE 8 is a vertical cross section at right angles to FIGURE 7 and showing a mouthpiece unit provided with a sleeve valve at the mouthpiece inlet and with a blow-off valve.

With particular reference to FIGURE 1 of the drawings, the improved breathing equipment according to the invention may comprise substantially the following parts:

(*a*) A source of breathing gas, usually in the form of one or more compressed gas cylinders or steel bottles. In the embodiment as shown, the cylinders are three in number, one of which 1, of larger predeterminate capacity, contains a compressed neutral gas (usualiy nitrogen) or compressed air and the other two 101 and 201 are of lesser predeterminate capacity and filled with compressed oxygen. The cylinders, which are provided with conventional control valves 44, 144, 244 are connected (in parallel when they are more than one, as in the case as shown) to a mixing and distributing conduit 2 connected to a feed pipe 3 which is connected to a pressure reducer 4.

(*b*) The pressure reducer 4 is an improvement of my pressure reducer disclosed in my co-pending application Ser. No. 26,197, dated May 2, 1960, now abandoned, and which is so designed as to deliver the gas at a substantially constant predetermined pressure, independently of the amount of pressure in the gas cylinder or cylinders 1, 101, 201, and is provided with a valve 22, FIG. 2, which opens when the gas pressure in the cylinders falls under a predetermined minimum and signals the imminent exhaustion of the breathable gas.

(*c*) A hydraulic air bell 10 of the kind described and shown in my prior U.S. patent specification No. 2,693,179, but modified as described in my co-pending application, Serial No. 64,333, of even date so as to permit of mounting therein a gas filter in such conditions as required on a universal underwater breathing equipment.

(*d*) A breathable gas distributing chamber provided with a mouthpiece or mask unit, 7—8 provided with the necessary feed cock 6 and valves as well as with the connections to the gas sources, to the air bell 10 and, if desired, to a snorkel or the like 45 (if a mask 108 is employed) and the means 127, FIGS. 3 and 5, 227 for closing the inlet from the air bell when the cock 6 is closed.

(*e*) The means for connecting the various parts into a unitary structure.

The above-indicated parts of the improved universal breathing equipment will be now described in detail.

In this equipment, the gases that shall successively form the breathable mixture in the mixing and distributing conduit are contained, compressed to a suitable high pressure, in a number—which in practice may be one, two or

three—of steel bottles or cylinders of a relative predeterminate capacity. Whenever the compressed gas cylinders fitted to the equipment are two or three, connected in parallel, the gas in all the cylinders must be at the same pressure.

With particular reference to the embodiment as shown in FIGURE 1, the breathing equipment is provided with a large cylinder 1 containing compressed air or a neutral gas (usually nitrogen) and a pair of small cylinders containing compressed oxygen. The cylinders are mounted in suitable holding means (not shown) including the metallic straps 28—128 and the conventional means for carrying the whole as a knapsack, as it is known in the art. The cylinders are connected in parallel by means of a conduit 2 which is connected to a pipe 3 which feeds the gas under high pressure (for example up to 150 at.) to a multi-step pressure reducer 4, from which the gas is led by means of a flexible hose 5 to a stop cock or valve 6 mounted on a unit comprising a distributing chamber 7 provided with one or a pair of tubular necks 50—150 and a mouthpiece 8 (which latter might be replaced by a conventional breathing mask 108). In the distributing chamber 7 opens the outlet of said cock 6 and on the necks 50—150 a pair of corrugated flexible hoses 9—109 are fitted, whose opposite ends are provided with rotatable air-tight joints on the inlet and outlet ends (as will be better explained hereinafter) of a hydraulic air bell 10, which may be considered an improvement or adaptation of the bell disclosed in my said prior Patent No. 2,693,179 and of which some embodiments are described in my co-pending application of even date.

The air bell 10 is attached to the unit mounting the gas cylinders, including the straps 28—128 by means of a strut 29 attached to a rigid member, for example to strap 28, and connected by means of a pivot 30, at right angles to the vertical plane passing through the longitudinal axis of the bell 10, to a strut extension 31 fastened to the base of U-shaped bracket 32 whose arm ends are fastened to the bell end attachment sockets 34 of the said corrugated hoses 9—109. Thus the bell 10, which possesses a certain buoyancy, is allowed to rock about two horizontal axes contained in two planes at right angles and is urged by the weights 39 to dispose itself with its mouth downwardly, as clearly shown in FIGURE 1.

In order to ensure a constant flow of breathable gas through the cock 6 to the mouthpiece 8 at any immersion depth and whatever the pressure of the gas in the cylinders may be, a multi-step pressure reducer 4 has been devised, an embodiment of which is shown by way of example in FIGURE 2.

The pressure reducer 4 shown in detail in FIGURE 2, is a two-step reducer. The first reduction to about 20 at. (in practice from 18 to 22 at., according to pressure of gas in the cylinders) is effected in the first or lower reducer section which is housed in the casing 20 connected to the high-pressure gas cylinders by pipe 3 from which through a gauged nozzle 11, the gas is led into a high-pressure chamber 12 where there projects a part of a through-bored stem 13 attached to a differential cup-shaped piston 14 slidably mounted in a cylinder. The bored stem 13 is slidably mounted with a gas-tight fit through a bore provided in a partition between the chamber 12 and the said cylinder, which is divided by the piston 14 into a lower chamber 15 and an upper chamber 16. The piston is urged upwardly, i.e. away from the high pressure chamber 12, by a spring 18 and by the pressure of the outside water when the lower cylinder chamber 15 is put into communication with the exterior through a hole 17 in the casing 20. The unperforated bottom end of the piston stem 13 lies opposite the outlet end of the nozzle 11 and when it is urged towards this nozzle 11 by an excess of gas pressure acting against the top face of the piston 14, it acts as throttle valve and tends to close said nozzle and thus the pressure in the chamber 16 is automatically maintained at the predetermined level.

The upper cylinder chamber 16 is closed by a plate provided with a nozzle 111 which opens in a medium pressure chamber 12 which is bounded by said nozzled plate and by a cavity on the bottom end of a reducer valve casing 120. The said casing 120 is connected, as by screwing, to the top of the corresponding lower casing 20 and contains, like the lower casing, a differential piston 114 provided with a bored stem 113 having an unperforated end acting as throttle valve of nozzle 111. The piston 114 divides the corresponding cylinder, in which is slidably mounted, into a lower chamber 115 and an upper chamber 116 in which the low pressure gas is contained. This chamber may be closed at its top either by a perforated plug 19 adapted to be connected to the gas feed pipe 5, or even by another nozzle forming the bottom of a third reducing unit.

The reduced pressure may be variable, viz. depending in part upon the pressure of the outside water if the cylinder chamber on the stem side of the differential piston (chamber 115) is put in communication with the outside water (through hole 117) or may be independent from the outside pressure if the hole 117 leading to said cylinder chamber 115 is closed as by a screw plug 217.

The advantages of the just described multi-step pressure reducer are apparent:

It is known that the amount of gas flow through the low-pressure nozzle of a pressure reducer is substantially proportional to the difference of pressure existing between the high-pressure chamber 12 (respectively 112) and the low-pressure chamber 16 (respectively 116). Now, if it were desired to reduce a high pressure varying from say 150 to less than 20 at. to a low pressure of the order of 3 at., assuming the nozzle 111 to be the outlet nozzle attached to pipe 5, the maximum amount of gas passing per time unit through this pipe would vary approximately in the same proportion of say 7.5:1, which would be a great inconvenience in the practical use of the breathing equipment. If, on the contrary the pressure is reduced in a first step to a medium pressure of say about 20 at., with a tolerance of 10% more or less, when this medium pressure were further reduced to the desired low pressure of say 3 at., the flow of the low pressure gas would remain practically constant.

According to a known warning device, in order to signal when the pressure of the gas in the cylinders is falling below a predetermined minimum, a bypass 21 is provided at the inlet end of the pressure reducer which opens in a chamber containing a vent valve 22 which is urged to open position by a spring 23 and is maintained closed by the gas, when its pressure is sufficiently high. When this pressure falls under a predetermined limit, the vent valve 22 is lifted by the spring 23 and the gas is allowed to escape through a capillary flexible tube 24 ending with a very restricted bubble-up nozzle 124, FIGURE 3, opening a little above the mouthpiece and from which the escape of air is rendered visible in form of bubbles passing in proximity of the diver's eyes. In addition to, or instead of this signal, other signals (for example electric signals) may be generated for example by the shifting of the valve 22.

The just-described adviser of imminent exhaustion of the breathable gas in the bottles, due to the fact that the vent valve 22 opens when the high pressure has fallen under a predetermined limit, and through the tube 24 flows gas under relatively high pressure, presents the inconvenience that the bubbling of air through the nozzle 124 may be excessive at the beginning of the opening of said vent valve and may undergo excessive variations until the bottles are nearly empty.

In order to overcome this drawback, according to the improvement shown in FIGURE 6, the vent valve is a piston valve which is put on one side under the influence

of the reduced-pressure gas, if necessary in combination with a spring. Thus the said valve opens when the difference of pressure between the high-pressure and the reduced-pressure gas falls under a certain limit and through the vent tube 24 and nozzle 124 passes only reduced-pressure gas.

In fact, in the pressure reducer shown in said FIGURE 6, the bypass 21 provided at the high-pressure or inlet end of the pressure reducer opens in the bottom of a small side cylinder 304 closed at its opposite end by a plug 305 and provided with a port 308 near the plug end and a port 309 in an intermediate position, where the cylinder walls present a circumferential groove.

The port 308 is put in communication by means of a small tube 306 with a bypass duct 307 formed at the outlet or low-pressure side of the pressure reducer while on the port 309 the tube 24 is attached, which is connected to the bubble-up nozzle 124, FIGURES 3 and 7.

In the cylinder 304 two packing rings 301 and 302 are mounted, one ahead and the other behind the port 309. In said cylinder a cup-shaped piston valve 303 is slidably mounted, whose walls extend for such a length as to be capable of bridging over the gap between the two packing rings 301 and 302 and to prevent the communication between the port 308 and 309, when it is shifted by a certain stroke towards the plug 305.

The piston 303 is urged toward the intermediate position (shown by dotted lines) by the high-pressure gas which through the port 21 acts against the bottom of the piston valve and shifts same away from the cylinder bottom, by overcoming the combining action of a spring 400 inserted between the piston 303 and the plug 305 and of the low-pressure gas, which through the tube 306 and port 308 flows into the plug end of the cylinder 304. When however the pressure on the high-pressure side falls under a certain limit, the combined action of the low-pressure gas and the spring 400 overcome the action of the high-pressure gas and shift the piston valve in the position as shown by full lines, thus uncovering the port 309 and allowing the flow of the low-pressure gas through the tube 24 and the bubble-up nozzle 124, FIGURES 3 and 7.

Referring now to FIGURES 1 and 3 through 5, the gas at the desired low pressure is fed through pipe 5 and a cock 6 into the distributing chamber 7. In this chamber opens the inlet end of the mouthpiece 8 from which the breathable gas may be inhaled. The cock 6 is preferably a three-way cock (FIG. 4) provided with a narrow calibrated passage 26 for normal operation and with a wide passage 126 for the cases in which a greater flow of breathable gas is desired. The cock may be also turned to gas stop position, whenever the outside air is available for respiration (for example via snorkel 45, FIG. 1, when the equipment is provided with a mask 108, FIG. 1).

The distributing chamber 7 is further provided with two tubular necks 50—150 on which two corrugated flexible hoses 9—109 are fitted leading to the rotatable joint sockets 34—134 mounted with a gas tight fit onto the tubular necks of the air bell 10. An outlet valve 25 in the chamber 7 is provided in proximity of the neck 50. This valve opens towards the exterior of said chamber 7 so as to permit the discharge of the polluted gases into the air bell.

On the opposite side of the chamber 7, in proximity of the neck 150, an inlet valve 125 is provided through which the gases purified in the air bell 10 may be inhaled, together with the fresh breathable gases flowing into the chamber from the cock 6.

In order, however, to avoid that the diver by inadvertence inhales only the air contained in the bell, while the cock 6 is closed, and has the impression of breathing while he is rapidly suffocating, means are provided for closing the said inlet valve 125 whenever the cock 6 is closed, thus giving the diver the immediate sensation of the impossibility of breathing.

In the embodiment as shown in FIGURES 3 to 5, the cock plug has a co-axial bored extension 127 which projects into the chamber 7 and carries at the height of valve 125 an arm projecting from said extension and preferably provided with a flattened end 227, FIG. 5. The arm is so dimensioned and fitted in such a position that when the cock plug 27 comes to be in closed position, the arm end 227 comes to lie against the said inlet valve 125 (full line position in FIGURE 5) thus preventing its opening until the arm end 227 is clear of the valve 125. Conventional means (not shown) such as a snap device are provided for avoiding that the cock plug remains in an intermediate position, viz. a position between the conduits 26 and 126, and abutment means are provided for limiting the rotation of the cock to 90° (or another angle), so as to guarantee that the arm end 227 abuts against the valve 125 whenever the cock plug 27 is in closed position.

A variation of the mouthpiece unit, comprising the distributing chamber, a multiway cock and annexed parts particularly adapted for use in combination with air bells having one tubular connection only, is shown in FIGURES 7 and 8.

In this embodiment, the distributing chamber proper 7, may be provided with one or two necks for connecting same to one or two corrugated hoses 9 in communication with an hydraulic air bell of the kind disclosed in my said co-pending application.

The only variation of this distributing chamber consists in its simplification (as it is not provided with the non-return valves 25 and 125 shown in FIGURE 3), by provision of; a multi-way cock of improved construction, means for preventing the passage of air through the mouthpiece unit, when the multi-way cock is closed, and a valve for blowing out the liquids collected in the distributing chamber.

In the embodiment as shown in FIGURE 7, the distributing chamber 7, in which opens the tubular connection 9 to the bell, is provided with a conventional mouthpiece 8, FIG. 8 (or a mask, as the case may be).

In said distributing chamber the fresh breathing mixture is fed by the pipe 5 across an improved multi-way cock 6 now to be described.

Said cock comprises a casing 6 forming substantially a cylindrical extension of said distributing chamber 7 and whose interior is separated from the distributing chamber proper by means of a valve seat flange 620 having a central bore 621 and one or more gauged peripheral ports, one of which, 626, is visible in the drawing. The said ports 626, when there are more than one, as usual, are of different gauge in order to permit of regulating the feed of fresh breathable mixture, according to circumstances.

Said flange forms a disk seat for a rotary valve member comprising a disk valve 614 provided with a port 617 bored in such position as to come, by rotating, in correspondence with the peripheral ports 626 of the said valve seat flange. The disk valve is provided with a cylindrical skirt 615 which revolves in contact with a packing ring 616 inserted in a groove of the cock casing 6 and thus constitutes a gas-tight rotary joint.

Said disk valve 614 is fitted on a stem 606 which projects on both sides of said valve and extends upwardly into the distributing chamber 7 and downwardly across and out the chamber 611 of the cock casing.

The said disk valve, whose port 617 is surrounded by packing ring 618, is urged against its seat by a spring 613 reacting against a closure screw plug 604 having a bore provided with a packing 605 through which the outer end of the stem 606 passes.

On said end a cock control lever 601 is mounted which is provided with a projecting pin 602 snapping into hollow cavities 603 provided in the screw plug 604 and cor-

responding to the positions in which the port 617 and one of the ports 626 are in line.

A duct 612 formed in a side nipple 608 adapted to be connected to the end of the breathable gas feed tube 5 feeds the breathable gas into the chamber 611 from which through ports 617 and 626 flows into the distributing chamber 7.

In order to avoid that the diver continues to breathe when the cock 6 is closed, the mouthpiece 8 opens into a sleeve valve 624 urged to open position (as shown) by a spring 622 and which is pushed in closed position when the cock is closed, by a sidewise projecting member 623 carried by the stem 606.

The mouthpiece unit is also provided with a non-return valve 706 for blowing off from time to time the liquid collected within the distributing chamber 7.

I claim:

1. A breathing equipment comprising a cylinder holder, a number of cylinders containing breathable gases under pressure dismountably held in said holder, a breathing unit, a pressure reducer, means for feeding fresh breathable gases from said cylinders through the pressure reducer to the breathing unit, a bell having an inlet and an outlet port, and a filter in said bell connected to the said outlet port, said breathing unit including a distributing chamber provided with a mouthpiece, a tubular connection between said distributing chamber and the low pressure side of said pressure reducer, a stopcock on said tubular connection mounted on said distributing chamber, and ducts connecting said distributing chamber with said bell inlet and outlet ports to provide an air regenerating circuit from the distributing chamber through the bell which is independent from the fresh breathable gases feed means, said gas-pressure reducer being a multi-step gas pressure reducer comprising a casing holding a plurality of reducing members arranged in series and having an inlet passage to the first reducing member and an outlet passage from the last reducing member, a side-cylinder fitted on said casing having an inlet port communicating with said inlet passage and containing a piston, spring means in said side-cylinder urging said piston in an opposite direction to that in which it is urged by the gases flowing into the side-cylinder through said inlet port, a second port in said side cylinder remote from said inlet port, means connecting said second port with the said outlet passage of the last reducing member, and a third port in said side cylinder intermediate said first and second ports and connected to a capillary tube and a bubble-up nozzle arranged in proximity of said breathing unit, whereby when the difference of pressure between the inlet and outlet passages of said pressure reducer is in excess of a predetermined minimum, the piston in the side cylinder is urged to an intermediate position covering the said third port, but when the said difference of pressure falls below said minimum, the piston is urged towards said inlet port and the third port is uncovered.

2. A breathing equipment comprising a cylinder holder, a number of cylinders containing breathable gases under pressure dismountably held in said holder, a breathing unit, a pressure reducer, means for feeding fresh breathable gases from said cylinders through the pressure reducer to the breathing unit, a bell having an inlet and an outlet port, and a filter in said bell connected to the said outlet port, said breathing unit including a distributing chamber provided with a mouthpiece, a tubular connection between said distributing chamber and the low pressure side of said pressure reducer, a stopcock on said tubular connection mounted on said distributing chamber, and ducts connecting said distributing chamber with said bell inlet and outlet ports to provide an air regenerating circuit from the distributing chamber through the bell which is independent from the fresh breathable gases feed means, said stopcock being provided with a co-axial stem projecting into the said distributing chamber, a laterally projecting member on said co-axial stem, said mouthpiece being provided wtih a valve, a spring urging said valve to open position, said valve having a movable member which in the said open position of the valve projects into the said distributing chamber, the said laterally projecting member on the co-axial stem being arranged to engage and push the said mouthpiece valve to its closed position when the said stopcock is closed.

3. A breathing equipment comprising a cylinder holder, a number of cylinders containing breathable gases under pressure dismountably held in said holder, a breathing unit, a pressure reducer, means for feeding fresh breathable gases from said cylinders through the pressure reducer to the breathing unit, a bell having an inlet and an outlet port, and a filter in said bell connected to the said outlet port, said breathing unit including a distributing chamber provided with a mouthpiece, a tubular connection between said distributing chamber and the low pressure side of said pressure reducer, a stopcock on said tubular connection mounted on said distributing chamber, and ducts connecting said distributing chamber with said bell inlet and outlet ports to provide an air regenerating circuit from the distributing chamber through the bell which is independent from the fresh breathable gases feed means, said stopcock being provided with a co-axial stem projecting into said distributing chamber and having a laterally projecting member, the duct of said distributing chamber in communication with the said outlet port of the bell having an inlet valve, and the said laterally projecting member on the co-axial stem being arranged to engage and push the said inlet valve to closed position when the stopcock is closed.

4. A breathing equipment comprising a cylinder holder, a number of cylinders containing breathable gases under pressure dismountably held in said holder, a breathing unit, a bubble-up nozzle, a pressure reducer, means for feeding fresh breathable gases from said cylinders through the pressure reducer to the breathing unit, a bell having an inlet and an outlet port, and a filter in said bell connected to the said outlet port, said breathing unit including a distributing chamber provided with a mouthpiece, a tubular connection between said distributing chamber and the low pressure side of said pressure reducer, a stopcock on said tubular connection mounted on said distributing chamber, and ducts connecting said distributing chamber with said bell inlet and outlet ports to provide an air regenerating circuit from the distributing chamber through the bell which is independent from the fresh breathable gases feed means, said pressure reducer including a piston vent valve having a cylindrical body, a first port at one end of the body, a second port near the other end of the body and an intermediate port in the body, a piston slidably mounted in said cylindrical body and adapted in an intermediate position to cover said intermediate port, means for normally urging said piston towards said first port, means for connecting said first port to the high pressure side of said pressure reducer, means for connecting said second port to the low pressure side of said pressure reducer and a pipe connecting said intermediate port to said bubble-up nozzle, whereby above a predetermined high pressure at said pressure reducer the valve piston is urged by said high pressure to close the intermediate port but when the said high pressure falls below a predetermined value, the piston is urged towards said first port and uncovers said intermediate port permitting communication thereof with said second port to provide an indication by escape of gas to said bubble-up nozzle.

5. A breathing equipment comprising a cylinder holder, a number of cylinders containing breathable gases under pressure dismountably held in said holder, a breathing unit, a pressure reducer, means for feeding fresh breathable gases from said cylinders through the pressure reducer to the breathing unit, a bell having an inlet and an outlet port, and a filter in said bell connected to the said

outlet port, said breathing unit including a distributing chamber provided with a mouthpiece, a tubular connection between said distributing chamber and the low pressure side of said pressure reducer, a stopcock on said tubular connection mounted on said distributing chamber, and ducts connecting said distributing chamber with said bell inlet and outlet ports to provide an air regenerating circuit from the distributing chamber through the bell which is independent from the fresh breathable gases feed means, said distributing chamber including valve means mounted in the interior thereof and arranged to open and close the duct connected to said bell outlet, a co-axial valve stem on the said stopcock projecting into the said distributing chamber, and means on the said stem for cooperation with the said valve means so as to prevent inhaling of the regenerated air from the said bell through the said mouthpiece when the said stopcock is turned to a position in which it prevents communication between the mouthpiece and the air cylinders.

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