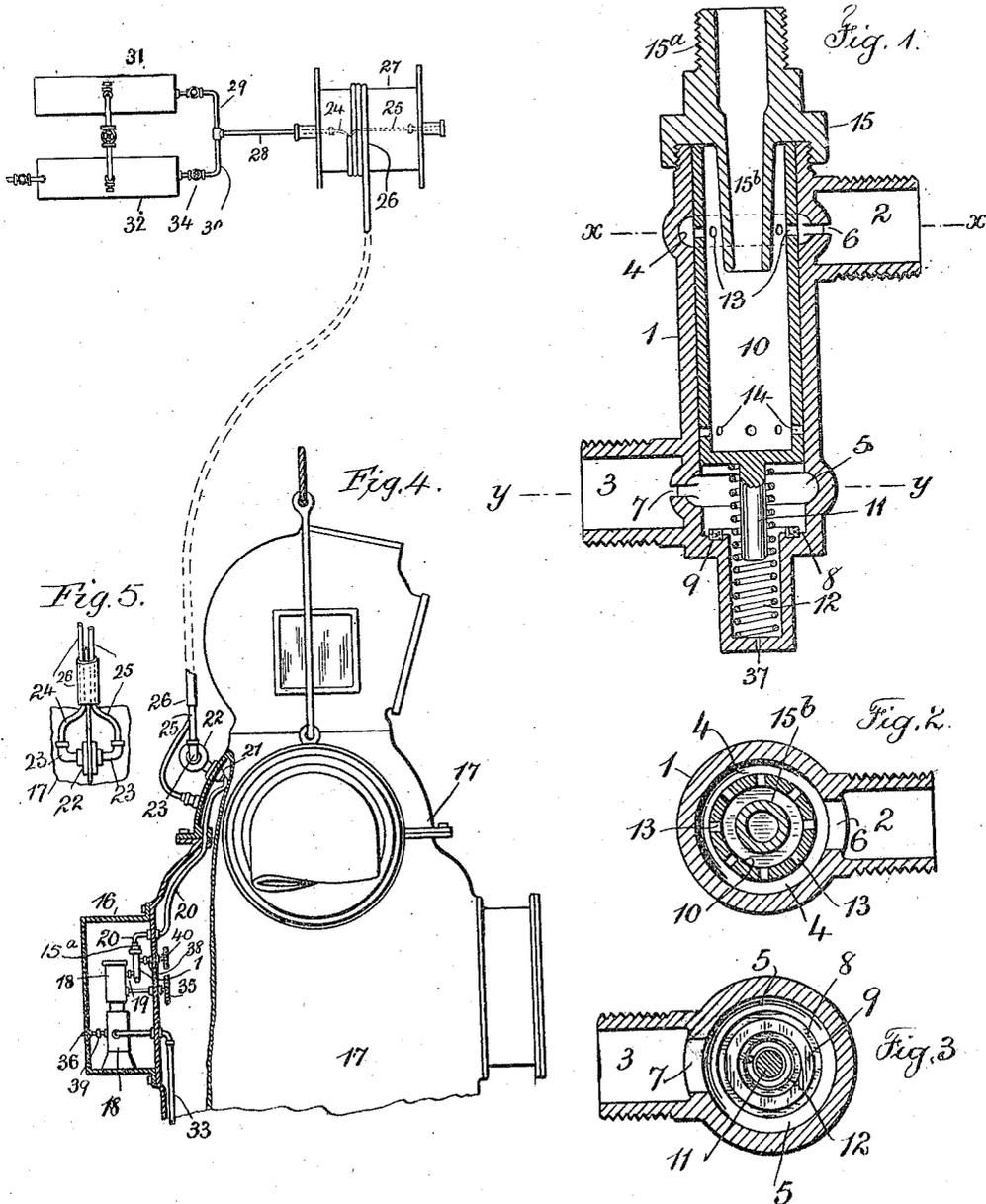


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 VALVE FOR USE WITH SUBMARINE DIVING APPARATUS.
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Witnesses
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UNITED STATES PATENT OFFICE.

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VALVE FOR USE WITH SUBMARINE DIVING APPARATUS.

989,533.

Specification of Letters Patent. Patented Apr. 11, 1911.

Application filed December 6, 1910. Serial No. 595,850.

To all whom it may concern:

Be it known that I, CHESTER E. MACDUFFEE, a citizen of the United States, residing at the borough of Manhattan, city, county, and State of New York, have invented an Improvement in Valves for Use with Submarine Diving Apparatus, of which the following is a specification.

My invention relates to air distributing valves, and is particularly designed for use in connection with deep sea diving apparatus, embodying a metallic armor in which the diver is completely incased, and constructed to withstand the pressure of water at great depth, such as that illustrated in my co-pending application Serial No. 595,847 of like date herewith. With armor of such character it is desirable to provide an air pump attached within a suitable casing, so that in case the water pressure outside the armor is of sufficient force to cause a leakage of water through the joints of the armor, such water as may enter the armor from such cause can be pumped out; and the object of my present invention is to provide a uniform supply of air to the diver at all times under normal conditions, and to admit a sufficient pressure of air to the pump to work the same for the discharge of water from the armor should leakage of the joints occur; in which case, and while the pump is working, the diver is supplied with a sufficient quantity of air from the exhaust which is discharged into the armor through a suitable spreader or muffler.

In the accompanying drawing: Figure 1 is a vertical section of my improved valve. Figs. 2 and 3 are sections of the same at the lines *x, x*, and *y, y*, respectively. Fig. 4 is a diagrammatic view illustrating the use of my invention, there being shown in this figure a sectional elevation of the upper part of a submarine diving armor, and a plan view of the air tanks and reel employed with said armor. Fig. 5 is an elevation of the attachment for the air pipes shown in Fig. 4.

Similar reference numerals refer to like parts throughout the several views.

1 is the cylindrical valve casing having two lateral tubular projections 2 and 3 exteriorly screw-threaded, and also having interior annular recesses 4 and 5 forming air

spaces in line with the respective tubular projections, there being ports 6 and 7 communicating between said air spaces and the interior of said projections. A tube 38 is attached to the screw threaded end of the projection 2 and passes into the interior of the armor 17 through an opening therein made for that purpose, see Fig. 4.

The bottom of the valve casing 1 extends in reduced diameter below the tubular projection 3 forming an annular shoulder 8, which is provided with an annular recess to receive and hold a circular ring 9 of rubber or other suitable elastic substance.

Within the valve casing 1 there is a cylindrical cup 10, with closed bottom and open top. A pin 11 projects downwardly from the under surface of the cup 10 at the center, and is surrounded by a spiral spring 12 which spring has a bearing at its top against the under surface of the cup 10, and at its bottom against the interior surface at the bottom of the extension to the valve casing. The cup 10 is of a diameter to fit closely within the valve casing 1, but has vertical movement therein without undue friction. This cup 10 is provided with openings 13 and 14 spaced apart in circular range. The spring 12 is of a tension to normally maintain the cup 10 in such position that the openings 13 therein are in line with the annular recess or air space 4 in the valve casing, and the port 6 therein.

The upper end of the valve casing is exteriorly screw-threaded to receive the interiorly screw-threaded cap piece 15 which has a circular hub 15^a on the top exteriorly screw-threaded with a central opening, and a tubular cylindrical projection 15^b extending within the casing 1 to a point slightly below the annular recess 4. This tubular projection 15^b is open at its end within the casing 1. This valve is preferably located within the casing 16 attached to the back of the armor 17 which casing contains a pump 18; the valve being connected to the pump by a coupling 19 screwed upon the screw-threaded end of the projection 3 of the valve casing. A pipe or tubing 20 is connected to the screw-threaded hub 15^a of the cap 15, and passes into the interior of the armor 17 through an opening therein provided for such purpose, and is coupled or otherwise

connected to a boss 21 on the interior of the armor through which boss and armor there is an opening communicating with an air port in an attachment 22 on the back of the armor 5 17, which attachment is provided with connections 23 for the air supply tube 24 and exhaled air tube 25. These air tubes 24 and 25 beyond their connection with the attachment 22 are preferably carried within a 10 flexible tubular casing 26, which is wound and unrolled upon a reel 27 located upon the deck of a boat or tender above water, the upper end of the air supply pipe 24 being connected with a pipe 28 which pipe is in 15 turn connected with branch pipes 29 and 30 communicating with a low pressure tank 31 and high pressure tank 32. The exhaled air passes from within the armor 17 out through an opening therein communicating with the 20 attachment 22 from which it enters the tube 25, by which it is carried above water and discharged into the atmosphere. Suction tubes 33 are connected with the pump 18 and extend down within each leg section of 25 the armor to the feet.

The operation of my improved valve is as follows:—When the diver is below the water surface, air will be supplied to him from the low pressure tank 31 at slightly above 30 atmospheric pressure. The air will pass through the pipes 29 and 28, supply tube 24, attachment 22, pipe 20, and enter the cup 10 through the hub 15^a and tubular projection 15^b on the cap 15, from whence it will escape 35 through the openings 13, into the annular recess 4 and pass through the port 6 into the armor 17, through the pipe or tubing 38 and spreader 40. These conditions will prevail unless there is leakage of water into the armor, when if it rises to an uncomfortable or dangerous height, the diver will signal 40 by telephone (with which I propose to equip the armor) when the attendant above will open the cock 34 in the branch pipe 30 leading 45 from the high pressure tank 32 when the air will pass through the same channels as from the low pressure tank 31, but owing to the high pressure when it enters the cup 10, its force will overcome the tension of 50 the spring 12, and force the cup down upon the rubber ring 9 in the shoulder 8 of the casing 1 bringing the openings 14 in the cup within the annular recess 5 in the casing 1, and in communication with the port 7 there- 55 in, when the air will be conveyed to the pump 18 through the coupling or connection 19 and start the pump. In this position of the cup 10, the annular recess 4 and the port 6 will be closed, but while the pump is 60 working the exhaust therefrom is discharged into the armor through a suitable spreader 35, and the diver is thereby supplied with air. When the pump is at work any water in the armor is drawn up through the suction tubes 33 in the leg sections of the armor

and is discharged into the open water through a pipe 36 provided with a check valve 39. When the armor is freed from water, the diver will so inform the attendant above who will shut off the high pressure supply, when the spring 12 will expand and raise the cup 10 to the normal position, thus opening communication for the low pressure supply of air through the openings 13 and port 6. The cushion or rubber ring 9 prevents jar when the cup 10 is forced down and provides an elastic seat for the same while the high pressure is on. It is preferable to provide a vent hole 37 in the bottom of the casing 1 to avoid the possibility of a vacuum forming and retarding the operation of the cup 10. 70 75 80

The pump 18, suction tubes 33, discharge pipe 36 and check valve therein may be of any suitable character as the same form no part of my present invention. 85

The reel, the conveyer for the air tubes and the attachment for the same to the armor, are all of peculiar construction, and form the subject matter of separate co-pending applications Serial Nos. 595,851; 595,849 and 595,848, respectively, of like date herewith. 90

I claim as my invention:

1. The combination with an armor for submarine divers, having an attached pump and a source of air supply with means for regulating the supply, of a valve connected with the armor in the line of air supply and adapted to supply a regulated quantity of air to the diver under normal conditions and also adapted to supply air to the pump for working the same when required. 95 100

2. The combination with an armor for submarine divers, having an attached pump, and a source of air supply with means for regulating such supply, of a valve connected with the armor in the line of air supply, said valve being provided within its case with an air cup capable of vertical movement therein and having an upper and lower circular range of openings, an upper port in the valve case communicating between the upper range of openings in said cup and the interior of the armor under a low pressure supply of air, and a lower port in the valve case communicating between the lower range of openings in said cup and the pump under a high pressure supply of air. 105 110 115

3. The combination with an armor for submarine divers, having an attached pump and a source of air supply with means for regulating such supply, of a valve connected with the armor in the line of air supply, said valve being provided within its case with an air cup capable of vertical movement therein and having an upper and lower circular range of openings, an upper port in the valve case communicating between the upper range of openings in said cup and the interior of 120 125 130

the armor under a low pressure supply of air, and a lower port in the valve case communicating between the lower range of openings in said cup and the pump under a high pressure supply of air, and means for returning the air cup into communication with the said upper port in the valve case when the high pressure supply of air is shut off.

4. The combination with an armor for submarine divers, having an attached pump, and a source of air supply with means for regulating the supply, of a valve connected with the armor in the line of air supply, said valve being provided within its case with an air cup capable of vertical movement therein and having an upper and lower circular range of openings; an upper port in the valve case communicating between the upper range of openings in said air cup and the interior of the armor under a low pressure supply of air, and a lower port in the valve case communicating between the lower range of openings in said air cup and the pump under a high pressure supply of air, and a spring arranged in a lower extension of the valve case and acting upon the bottom of said air cup by which said air cup is returned into communication with the said upper port in the valve case when the high pressure supply of air is shut off or discontinued.

5. An air valve comprising in combination, a casing, an air cup vertically movable therein, a port in the casing communicating with said air cup for the distribution of a given quantity of air under a low pressure

supply, and another port in said casing which communicates with said air cup under a high pressure supply for the distribution of an increased volume of air for the purposes described.

6. An air valve comprising in combination, a casing, an air cup vertically movable therein, a port in the casing communicating with said air cup for the distribution of a given quantity of air under a low pressure supply, another port in said casing which communicates with said air cup under a high pressure supply for the distribution of an increased volume of air, and means for returning the air cup into communication with the first aforesaid port, when the high pressure supply is discontinued.

7. The combination with an armor for submarine divers, having an attached pump and a source of air supply with means for regulating the supply, of a valve connected with the armor in the line of air supply and having series of spaced air discharge openings, normally spring held and so adapted for a predetermined air pressure, and automatically movable under excess air pressure and which movement closes off the normal discharge openings to supply air to the pump when required.

Signed by me this first day of December 1910.

CHESTER E. MACDUFFEE.

Witnesses:

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GEO. T. PINCKNEY.