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AIR DEMAND EQUIPMENT

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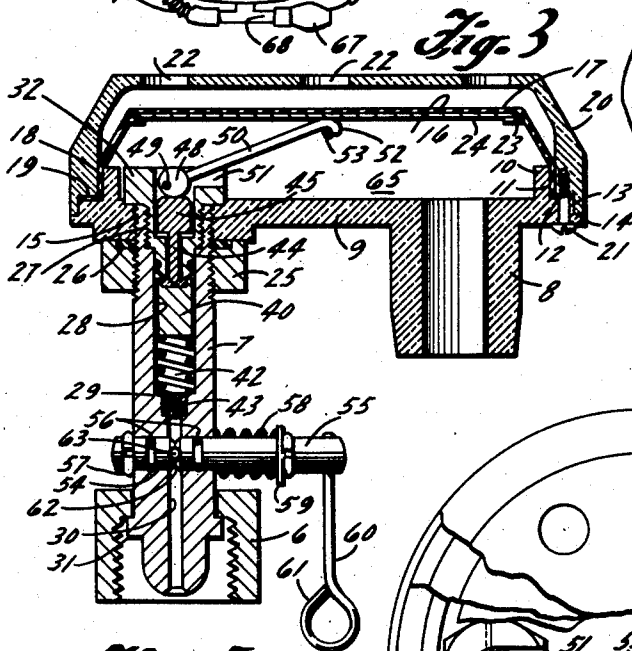
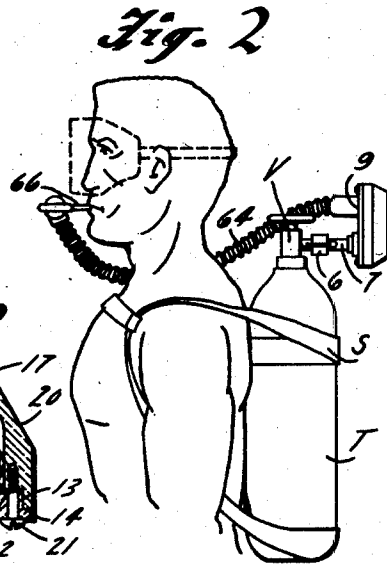
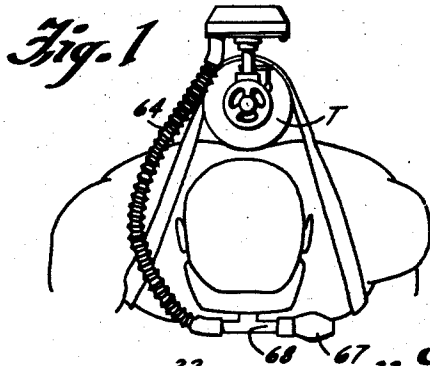
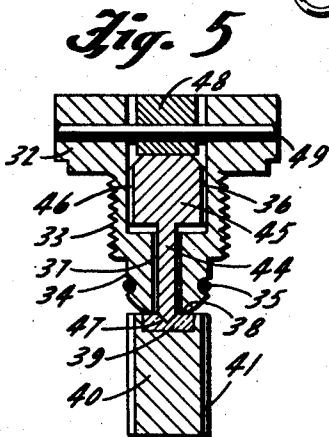
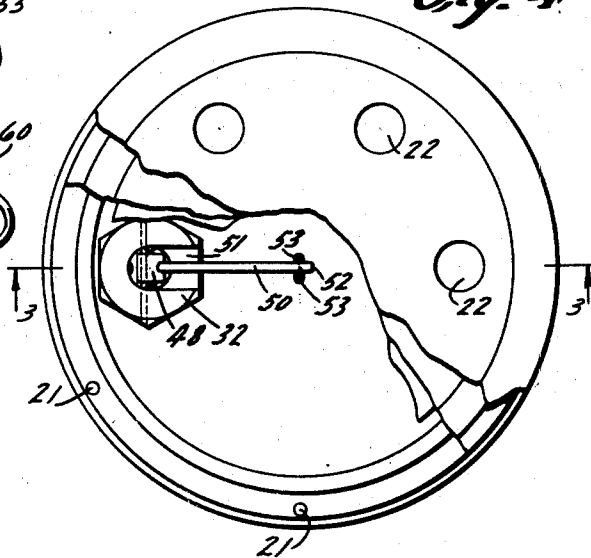


Fig. 4



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AIR DEMAND EQUIPMENT

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2 Claims. (Cl. 128—142)

The invention relates to air demand equipment especially where such equipment is used by divers in under water work.

One object of the invention is to provide an improved means controlled by the pressure sensitive diaphragm for opening and closing the valve controlling the passage of air from the supply tank, this means being in the form of a lever operated cam to permit a greater mechanical advantage in a small space than could be obtained by prior and usually more complicated arrangements. Since the valve operating means is more sensitive, a smaller control diaphragm may be used therewith and thus the over all dimensions of the air demand unit may be reduced.

A further object of the invention is to provide a novel arrangement of air supply and breathing connections for the housing of the air demand unit, these connections being made with the back of the unit so that the breathing hose may extend forward along one side of the diver's head or neck to his mouth and without right angle bends, and without interfering with or restricting the diver's head movements. Also this arrangement of hose connections allows the diver to reach the tank shut off valve without interference from the regulator or hoses.

A further object of the invention is to provide an improved form of valve controlling diaphragm.

A further object of the invention is to provide a reserve supply valve which while permitting the normal supply of air under ordinary working tank pressure will, on adjustment, allow of an increased supply of air when the tank pressure drops, for example, to two hundred pounds per square inch or lower so that the diver can use the low pressure air left in the tank to get to the surface.

The invention further consists in the several features hereinafter set forth and more particularly defined by claims at the conclusion hereof.

In the drawings:

Fig. 1 is a top plan view of equipment embodying the invention shown in an applied position;

Fig. 2 is a side elevation view of the equipment in its applied position;

Fig. 3 is a vertical sectional view through the air demand unit taken on the line 3—3 of Fig. 4;

Fig. 4 is a front elevation view of the air demand unit, parts being broken away;

Fig. 5 is an enlarged vertical sectional view of the valve and part of its actuator.

Referring to the drawings, the letter T designates a tank containing compressed air or other breathable gas and having the usual shut off valve V mounted thereon, said tank being hung from the diver in any suitable manner as by shoulder straps S. While only one tank is shown, it will be noted that two or three tanks may be carried by the diver and suitably connected to supply air to the air demand unit. As shown, the outlet of the valve V is connected by a union coupling 6 with a short pipe 7 that extends forwardly from a base member 9

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forming the back end of the unit. A hose boss 8 also extends forwardly from the base member 9.

The base member 9 may be of metal but is preferably formed of a strong, tough water resistant plastic of generally cylindrical plate form having a laterally projecting annular ring portion 10 on its front side providing shoulders 11 and 12 and having peripheral recesses providing shoulders 13 and 14. It also has a threaded opening 15 diametrically opposite the boss 8.

A diaphragm 16 of soft rubber or other suitable waterproof material is formed in the shape of a conically sided cup with a flat bottom 17 and annular side portions 18 that connect with an annular flange 19. The diaphragm 16 is held in fluid-tight relation with the base member by a flanged cylindrical cover 20, the bottom edge of the flange being of stepped formation to provide shoulders that abut the shoulders 13 and 14, and a shoulder acting in conjunction with the shoulder 12 to clamp the flange 19 of the diaphragm between them, the sides of the cover also closely disposed relative to the side portions 18 of the diaphragm to act in conjunction with the shoulder 11 to reinforce the diaphragm adjacent its point of anchorage. Screws 21 clamp and secure the cover and diaphragm to the base member. The cover has a series of openings 22 therein to permit the surrounding fluid media to act on the diaphragm.

The bottom 17 of diaphragm acts in conjunction with an annular inwardly extending integral flange 23 to hold a reinforcing plate 24 of metal or other suitable stiff material to the bottom of the diaphragm.

A pipe 7 is threaded at one end to engage the threaded opening 15 and the threads of a clamping nut 25 which acts to clamp a flexible sealing gasket 26 for the joint between said pipe and the base member. Pipe 7 has differential bores including a threaded bore 27 and bores 28, 29, and 30 and an annular shoulder 31 engaged by the nut of coupling 6.

A valve seat member 32 has differential diameter portions 33 and 34 fitting the threaded bore 27 and bore 28, respectively, the portion 34 being grooved to take a sealing O-ring 35. Member 32 has axially aligned differential diameter bores 36 and 37. The lower end of the portion 34 is preferably cone shaped to form an annular seat 38 that has a line contact with a nylon insert 39 in the head of the valve element 40. Element 40 is a cylindrical member slidably mounted in the bore 28 and provided with a series of air outlet grooves 41 in its outer surface and is normally held in contact with the seat 38 by a spring 42 interposed between said valve and the shoulder formed between the bores 28 and 29. A filter element 43 may be disposed in the bore 29.

A valve operating member has a pin shank 44 working loosely in the bore 37 and a head 45 working in the bore 36 and provided with outlet grooves 46. The shank 45 has a pointed end 47 that engages the insert 39. This operating member through its connection with the valve engages at its head end with a force multiplying cam 48 mounted on a shaft 49 journaled in the upper portion of the seat member 32. The cam 48 is here shown in the form of an eccentrically mounted disk which has a force multiplying lever 50 anchored on the opposite side of its pivotal connection and adapted to extend upwardly through a slot 51 in member 32 to a point of operative connection with the central portion of diaphragm 16. Preferably, this connection includes a hook 52 formed on the outer end of lever 50 and engaging in an eye member 53 secured to the central part of the metal reinforcing plate 24 so that the lever 50 and consequently the cam 48 follows the in and out movements of the diaphragm 16 and plate 24 under the action of water pressure and air pressure acting on the dia-

phragm so that a positive operating connection is provided between the diaphragm and the valve 40.

The pipe 7 has a cross bore 54 that intersects the bore 30. A cylindrical metering valve 55 is mounted in the bore 54 and is provided with O-ring sealing rings 56. Valve 55 has a split retainer ring 57 at one end forming a stop and a spring 58 interposed between the opposite side of the pipe, and a washer 59 on the valve holds the valve in different positions of adjustment. A crank arm or handle 60 is secured to the exposed outer end of the valve 55 and may have an eyed end 61 for connection with a cord that may be operated by the diver. The valve has an annular groove 62 that connects at all times with the bore 30 and a bore 63 that may be positioned either at right angles to the bore 30 so that it has no effect on the air flow through the bore 30, or it may be positioned in line with said bore 30 to allow a non-restricted flow of air through the bore 30 for purposes hereinafter referred to.

A flexible breathing hose 64 of rubber or other suitable material is adapted to be forced over the boss 8 to connect the chamber 65 with the usual mouthpiece 66. A flexible rubber flap valve 67 of known construction connects by a branch 68 with the mouthpiece and acts as an exhalation valve. Other forms of exhalation valves and connections for this valve may be used, if desired. Since the boss 8 is diametrically disposed relative to the air inlet pipe 7 and both project from the back of base member 9, the connection of member 9 may be readily made, and the air hose 64 can come straight out from the unit and extend forward along one side of the diver's head or neck to his mouth as shown in Figs. 1 and 2 so that the diver's head movements are not interfered with or restricted. Also the diver can reach the tank shut off valve V, if necessary, without interference from the regulator unit or hose.

As in all devices of this kind, the water pressure acting on the outer surface of the diaphragm 16 is opposed by air pressure from the supply tank introduced into the chamber 65 past the valve 40. As the air in the chamber 65 is used up by the diver, the pressure in chamber 65 is decreased so that the water pressure acting on the outside of the diaphragm acts to move it inwardly, thus swinging the hooked end of lever 50 inwardly and turning the cam 48 so as to depress the actuator 45 and thus move the valve 40 off its seat 38 to admit more air into the chamber 65 and equalize the pressure therein with the pressure of the surrounding water media. Thus the valve 40 is opened and closed in accordance with the diver's requirements, and the valve operating mechanism follows the movements of the diaphragm under

the action of the forces acting on the opposite sides thereof.

Until the pressure in the tank T is reduced to a relatively low value where breathing becomes difficult, for example, two hundred pounds per square inch, the valve 55 is in a position of normally restricted flow determined by the cross section of the annular groove 62. When, however, the tank pressure drops to the low pressure, the operator may turn the valve 55 so as to bring the bore 63 into line with the bore 30 and thus permit a free flow of air through said bore, past the inlet valve 40 and passages 37, 36 to the chamber 65 so that the diver can use the low pressure air left in the tank to get to the surface.

I desire it to be understood that this invention is not to be limited to any particular form or arrangement of parts except in so far as such limitations are included in the claims.

What I claim as my invention is:

1. In a breathing regulator, the combination of a housing including a base member and a diaphragm forming an air supply chamber, a pressure air inlet pipe for said chamber, an inlet valve in said pipe, means controlled by said diaphragm for controlling said valve, an oscillatory metering valve in said pipe having a passage for normally restricting the flow of pressure air to said inlet valve, said metering valve also having a passage acting in an out of normal position to permit free flow of pressure air through said pipe.

2. In a breathing regulator, the combination of a housing including a base member and a diaphragm forming an air supply chamber, a pressure air inlet pipe for said chamber, an inlet valve in said pipe, means controlled by said diaphragm for controlling said valve, a metering valve having an annular groove in communication with the air passage in said inlet pipe to provide a restricted flow therethrough under high pressure air supply conditions, said valve having a diametrically disposed opening connecting with opposite sides of said groove to establish a free air flow through said pipe when said opening is aligned with said air passage to supply more air to said passage under low pressure supply conditions.

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