April 23, 1968 R. CROSE 3,379,023

UNDERWATER DIVING APPARATUS

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Fig. 1

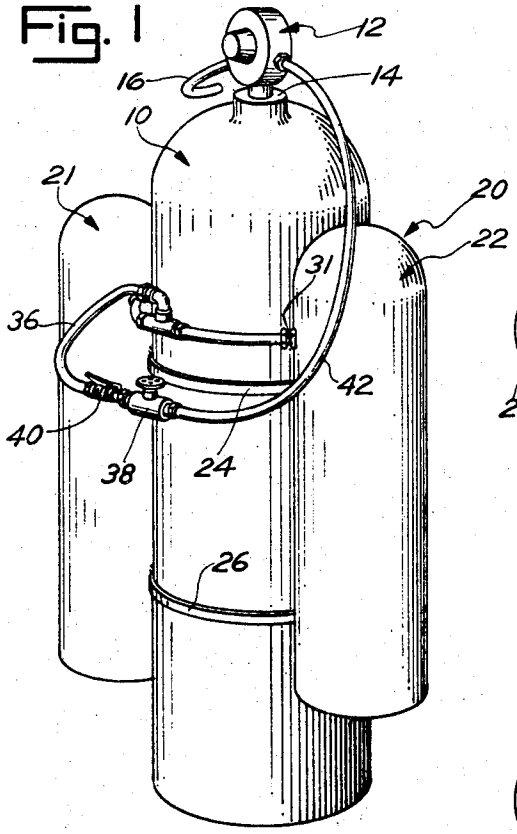


Fig. 2

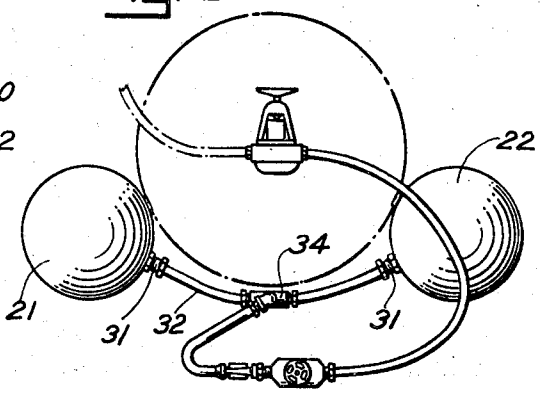
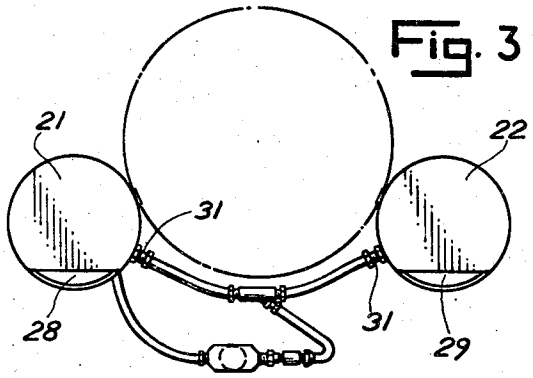


Fig. 3



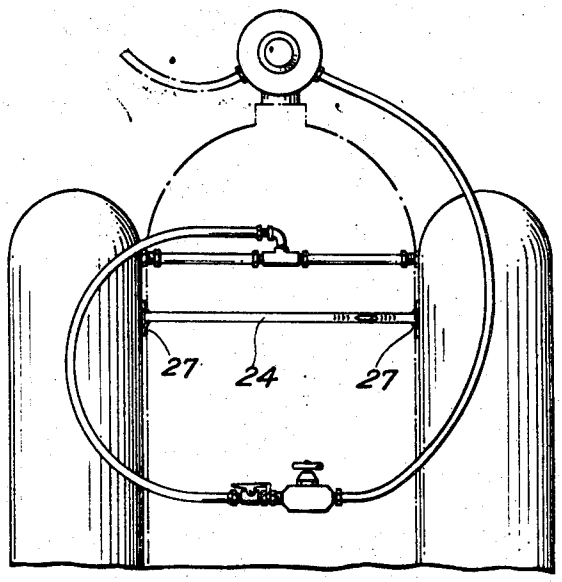


Fig. 4

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UNDERWATER DIVING APPARATUS

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Fig. 5

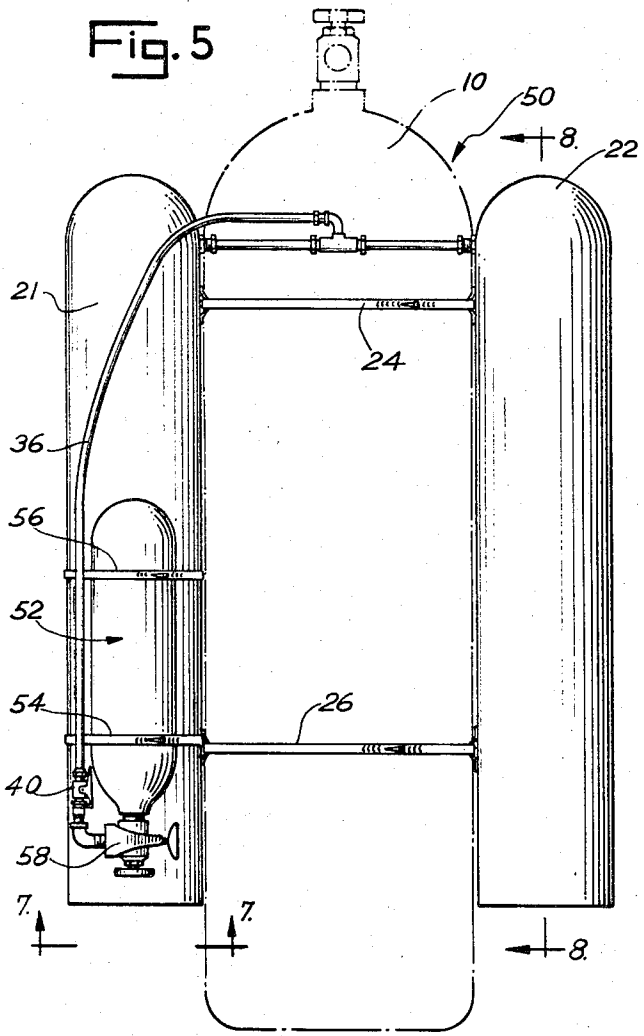


Fig. 7

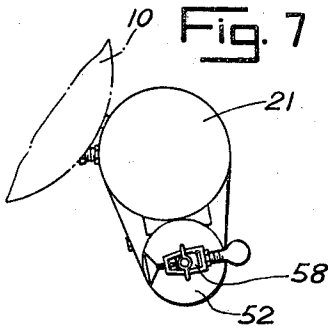


Fig. 8

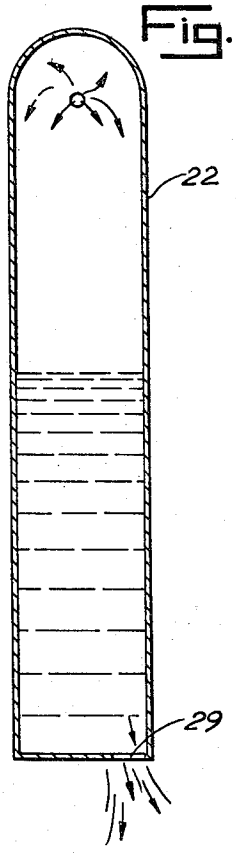
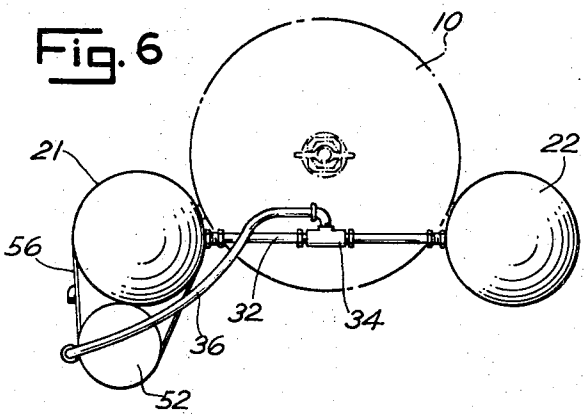


Fig. 6



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UNDERWATER DIVING APPARATUS

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ABSTRACT OF THE DISCLOSURE

A scuba diver equalizer in the form of two balance tanks which are adapted to be removably affixed to the diver's air tank and which are adapted to be filled and depleted of water, by displacing it with air. Air is supplied to the balance tanks in a controlled manner, directly from the diver's air tank or, alternatively, from an auxiliary air tank which is affixed to one of the balance tanks.

This invention relates to underwater diving equipment and in particular to improved equipment for effectively controlling and varying the weight carried by a diver, to overcome the buoyancy of himself and his equipment.

In the past, divers have generally used weight belts, that is, slotted lead blocks carried on a belt, about their waist to overcome their buoyancy so that they could submerge. While such weight belts effectively sink the diver, they are not altogether practical and safe. For example, the weight can be varied only by jettisoning some of the lead blocks, or the entire weight belt, in which case they are generally lost and not recoverable. Also, the diver must overcome the effect of the weight belt while surfacing, unless he first jettisons it. The fact that the weight is generally fixed, in the sense that additional weight cannot be added once the diver is submerged or has jettisoned some of the lead blocks, also renders the weight belts ineffective to establish and maintain the diver at several different depths during one dive, as explained more fully below.

In U.S. Patent 3,269,129, there is disclosed a weighted back pack for divers' air tanks which includes a pair of tubes in which weights are slidably and releasably retained. The tubes also contain ejector means for expelling the weights when a pin or key is removed from the ends of the tubes. While the disclosed weighted back pack is a substantial improvement over weight belts, it can be seen that it suffers the same disadvantages outlined above. The weights must still be jettisoned to eliminate their added weight, and the weight cannot be varied to establish and maintain a diver at a desired depth or depths. Accordingly, this back pack also is ineffective to establish and maintain the diver at several different depths during one dive, by adding to and subtracting from the weight carried by him, for this purpose

Divers often wear wet suits of neoprene and the like, which suits have floatation ability. These wet suits are compressed during deep dives and, as a result, they lose some of this floatation. This loss of floatation effectively increases the diver's weight, making it more difficult for him to surface.

During deep dives, there is also the problem of the pressure from above pushing the diver deeper. Accordingly, not only does a diver have to overcome the added weight resulting from the loss of floatation of his wet suit upon surfacing, he also has to overcome the pressure from above which tends to push or hold him down.

The equipment of the present invention, hereinafter referred to as a scuba diving equalizer or simply an equalizer, permits a diver to add and subtract weight, at will, to overcome the buoyancy of himself and his equipment. A diver therefore can establish and maintain himself at

any desired depth or depths underwater, and can eliminate the weight altogether, if desired, so that he can easily ascend to the surface. In addition, the equalizer can function to provide sufficient floatation ability, to overcome the loss of the same by a diver's wet suit and to overcome the pressure from above which tends to push or hold him down.

The equalizer includes, generally, a pair of tanks which can be easily and quickly removably affixed to a diver's air tank and which can be filled with water to add sufficient, or the necessary, weight for a diver to overcome his buoyancy and that of his equipment to permit him to submerge and maintain himself at a desired depth. The tanks are further adapted to be depleted, partially or completely, of the water by blowing air into them to vary the weight of the water in the tanks. Accordingly, a diver can take on or eliminate weight, as desired, and as often as he wants to, within limits, during a single dive.

Air is supplied to the tanks, from the diver's air tank or, alternatively, from an auxiliary air tank carried solely for this purpose. Control valves included in the coupling between the air tanks and the water-fillable tanks permit easy operation and control of the water flow into and out of the latter.

Accordingly, it is an object of the present invention to provide improved underwater diving equipment.

Another object is to provide improved underwater diving equipment for effectively controlling and varying the added weight carried by a diver, for overcoming his buoyancy and that of his equipment.

Still another object is to provide improved underwater diving equipment which does not include lead blocks for weight. In this respect, it is contemplated that water be used for weight, the water being retained within and expelled from a pair of tanks.

Another object is to provide improved underwater diving equipment of the above-described type which uses air to expel and to control the amount of water within the pair of tanks.

Another object is to provide improved underwater diving equipment of the above type which can be used as a floatation device.

A still further object is to provide improved underwater diving equipment of the above-described type which can be easily and quickly removably affixed to a diver's air tank.

A still further object is to provide improved underwater diving equipment for equalizing the buoyancy of a diver and his equipment.

A still further object is to provide improved underwater diving equipment for equalizing the buoyancy of a diver and his equipment which is easy and economical to manufracture and of a construction which is highly effective and dependable in operation.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings in which:

FIG. 1 is a perspective view of an equalizer exemplary of a first embodiment of the invention, illustrating the manner in which it is removably affixed to a diver's air tank;

FIG. 2 is a top plan view of the apparatus of FIG. 1;

FIG. 3 is a bottom plan view of the apparatus of FIG. 1;

FIG. 4 is a partial front plan view of the top upper portion of the apparatus of FIG. 1;

FIG. 5 is a front plan view of an equalizer exemplary of a second embodiment of the invention, and further illustrating the manner in which it is removably affixed to a diver's air tank;

FIG. 6 is a top plan view of the apparatus of FIG. 5;

FIG. 7 is a partial bottom plan view of the apparatus of FIG. 5; and

FIG. 8 is a sectional view taken transversely through one of the equalizer's tanks, illustrating the manner in which air is blown into the tanks to expel the water therein through apertures in the bottoms of the tanks.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Referring now to the drawings, in FIGS. 1–4 there is illustrated an elongated cylindrical air tank **10** which has compressed air in it and which is of the type generally used by scuba divers and the like. A suitable harness and/or rack (not shown) is generally affixed to the air tank **10**, so that a diver can strap the air tank on his back. A pressure control valve **12** is affixed to the outlet **14** of the air tank **10** and is operable to control the supply of air coupled to the diver's breathing apparatus (not shown), via the flexible hose **16**, in the well-known fashion.

An equalizer **20** including a pair of balance tanks **21** and **22** and the coupling described below is removably and fixedly secured to the air tank **10**, by means of a pair of adjustable straps **24** and **26** which may be tightened to securely clamp about the air tank. The straps **24** and **26** may be affixed to the balance tanks **21** and **22** in any suitable fashion, such as by extending them through brackets **27** (FIG. 4) affixed to the balance tanks. If the straps **24** and **26** are of metal, they can be welded directly to the balance tanks, if desired, to provide a substantial integral construction.

The balance tanks **21** and **22** are of an elongated cylindrical construction and have openings **28** and **29** (FIG. 3) formed in the bottom walls thereof, respectively. The balance tanks are preferably of a relatively lightweight material, such as aluminum, and also are preferably substantially smaller in diameter and length than the air tank **10**. With this construction, the weight of the air tank will not be substantially increased with the equalizer **20** affixed to it, and the overall assembly will not be excessively bulky or clumsy to handle.

Each of the balance tanks **21** and **22** has a threaded opening in its side wall near the top thereof, for threadably receiving a hose coupler **31**. A hose **32** having a T-coupler **34** centrally disposed therein is coupled between the two hose couplers **31**, to couple the balance tanks to one another. Another hose **36** has one end thereof connected to the T-coupler **34**, and its opposite end is coupled to a control valve **38**, preferably by means of a quick-release coupler **40**. The control valve **38** is connected to a hose **42** which is, in turn, coupled to the pressure control valve **12** affixed to the air tank **10**. The hoses **32**, **36** and **42** may be flexible, low pressure hoses, and the hoses **36** and **42** preferably are of sufficient length to extend around the diver's chest so that the control valve **38** can be positioned in front of the diver, for convenience and ease of operating it.

The equalizer **20** is easily and quickly removably affixed to the air tank **10**, by merely slipping the latter through the straps **24** and **26** and tightening them to securely clamp them about the air tank. The balance tanks **21** and **22** preferably are equally spaced about the periphery of the air tank **10**, so that the balance of the diver is not upset when the balance tanks are filled with water. Accordingly, the balance tanks **21** and **22** advantageously are fixedly secured together in spaced relation, in some suitable manner, for example, by welding the straps **24** and **26** to them, so that they are pre-established in proper spaced relation. A diver, upon affixing the equalizer **20** to the air tank **10**, need not therefore positionably adjust the balance tanks each time.

After affixing the balance tanks **21** and **22** to the air tank **10**, the end of the hose **42** is coupled to the pressure control valve **12**.

In operation, the bottom walls of the balance tanks **21** and **22** function as baffles to trap air in the balance tanks when the diver is on the surface and in a horizontal position. In this respect, the balance tanks function as floatation devices and, accordingly, assist the diver in staying on the surface. If he positions himself vertically in the water thereafter, some air remains trapped in the balance tanks so that they still provide some buoyancy to remain on the surface.

Upon diving, and with the bottoms of the balance tanks **21** and **22** extending vertically upward, the air trapped in the balance tanks is slowly replaced by water, thereby adding weight to the diver to assist him in descending, by equalizing or overcoming his own buoyancy and that of his equipment.

For a more rapid descent, either head or feet first, the hose **36** can be dis-connected by means of the quick-release coupler **40**. The air trapped in the balance tanks **21** and **22** will be displaced or expelled through the hoses **32** and **36**, so that the balance tanks will fill more rapidy and, in turn, add weight to the diver more rapidy.

When the diver has reached a desired depth, he can establish himself in equilibrium at that depth, by expelling a sufficient amount of water from the balance tanks **21** and **22** so as to equalize his buoyancy in the water. This is accomplished by operating the control valve **38** to permit air from the air tank **10** to enter the balance tanks **21** and **22**, via the hose **42**, the control valve **38** and the hoses **36** and **32**. Equal amounts of air simultaneously enter each of the balance tanks **21** and **22**, thereby causing an equl amount of water to be expelled from each of them, through the openings **28** and **29** in their bottoms, as illustrated in FIG. 8. The balance or weight of the two balance tanks therefore remains the same so that the balance of the diver is not upset.

If the diver wants to ascend to a lesser depth, he merely operates the control valve **38** to again blow more air into the balance tanks **21** and **22**. When a sufficient amount of water has been expelled from the balance tanks to reach the desired depth, the diver then closes the control valve **38** to shut-off the supply of air to them. If he wants he now descend to a greater depth, the hose **36** is disconnected, using the quick-release coupler **40**, to permit water to enter the balance tanks **21** and **22**. The air within the balance tanks is expelled through the hose **36**. When sufficient water, or weight, has been added to carry the diver to the desired depth, the hose **36** is again connected to the control valve **38**. This will prevent any more air from being expelled which action, in turn, prevents any more water from entering the balance tanks. It can therefore be seen that a diver can easily descend, ascend and establish himself in equilibrium at any desired depth, by merely controlling the amount of water taken into or expelled from the balance tanks **21** and **22**.

If a diver is at a depth such that the pressure of the water above him tends to push him deeper in the water, he can blow sufficient air into the balance tanks to provide himself enough buoyancy to counter-act this effect. Accordingly, the need for a diver to physically exert himself to overcome the pressure pushing him down is completely eliminated.

A diver also can gradually blow and maintain a sufficient amount of air in the balance tanks **21** and **22** to equalize his buoyancy and the weight of his equipment so that he can easily ascend to the surface. In this fashion, his rate of ascent can be easily controlled so that he does not surface too quickly. In this case also, the diver can ascend to the surface without physically exerting himself.

In FIGS. 5–7, there is shown an equalizer **50** which is like the equalizer **20** only it has its own source of air, supplied from an auxiliary air tank **52**.

In this case, the auxiliary air tank **52** is clamped to

one of the two balance tanks **21** and **22**, by means of adjustable straps **54** and **56**. The auxiliary air tank **52** is substantially smaller than the air tank **10** and the balance tanks **21** and **22**, and is preferably mounted near the lower end of the balance tank. The auxiliary air tank also is preferably mounted in an inverted position so that its pressure control valve **58** extends downward and is readily accessible to the diver. The hose **36** is coupled directly to the pressure control valve **58**, by means of the quick-release coupler **40**. If desired, the base **36** can be arranged to extend across the chest of the diver and a control valve included in it. Such an arrangement would eliminate the need for the diver to reach behind himself to operate the pressure control valve **58**.

The equalizer **50** operates in the same manner as the equalizer **20**, but its air is supplied from the auxiliary air tank **52** rather than the air tank **10**. This arrangement has the advantage that the diver's source of air is independent of that of the equalizer. Accordingly, it will not be depleted as quickly as in the case of the equalizer **20**. It has the disadvantage of being more bulky and slightly heavier, however.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention, which, as a matter of language, might be said to fall therebetween.

Now that the invention has been described, what is claimed as new and desired to be secured by Letters Patent is:

1. Underwater diving apparatus for equalizing the buoyancy of a diver and/or his equipment comprising: at least one tubular balance tank having an air inlet opening therein for permitting air to be blown into it and a single continually open water inlet and outlet therein through which water can enter said balance tank and be expelled; a source of air coupled to said balance tank; control valve means included in the coupling between said source of air and said balance tank for controlling the supply of air to said balance tank whereby air entering said tank expels water through said continually opened inlet and outlet; and means for affixing said apparatus to a diver.

2. Underwater diving apparatus, as claimed in claim **1**, further including disconnect means in the coupling between said balance tank and said control valve means.

3. Underwater diving apparatus, as claimed in claim **2**, wherein said disconnect means comprises a quick-release coupler.

4. Underwater diving apparatus, as claimed in claim **2**, wherein said source of air coupled to said balance tank comprises the air tank generally used by a diver for his source of air.

5. Underwater diving apparatus, as claimed in claim **4**, wherein said balance tank is adapted to be removably affixed to said air tank.

6. Underwater diving apparatus, as claimed in claim **2**, wherein said balance tank is adapted to be removably affixed to the air tank generally used by a diver for his source of air, said source of air coupled to said balance tank comprising an auxiliary air tank which is independent of said air tank used by said diver for his source of air and which is adapted to be removably affixed to said balance tank.

7. Underwater diving apparatus, as claimed in claim **2**, including a pair of said balance tanks adapted to be removably affixed about the peripheral surface of the air tank generally used by a diver for his source of air, said source of air being coupled to both said balance tanks and adapted to couple equal amounts of air to them.

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