United States Patent

Schuler et al.

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[54] **SCUBA VALVE**

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[52] **U.S. Cl.**.....**137/599,** 137/63 R, 141/18, 128/145.8, 222/3

[51] **Int. Cl.**.....**A62b 9/02**

[58] **Field of Search**....137/63 R, 599; 222/3, 402.16; 128/145.8; 141/2, 4, 18, 21

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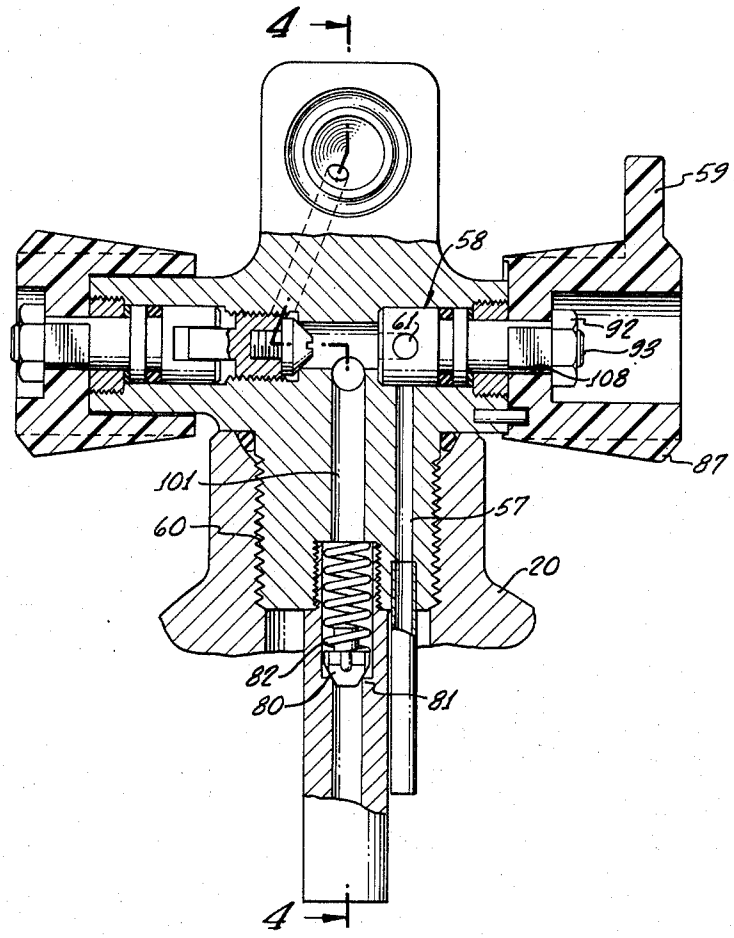
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[57] **ABSTRACT**

The reliability of a reserve air supply for underwater diving can be greatly improved by using a rotary valve arrangement for releasing air through a parallel passage. The actuation of such a valve can also be made independent of the mechanism which detects the condition that the supply of air remaining in the tank is low.

5 Claims, 6 Drawing Figures



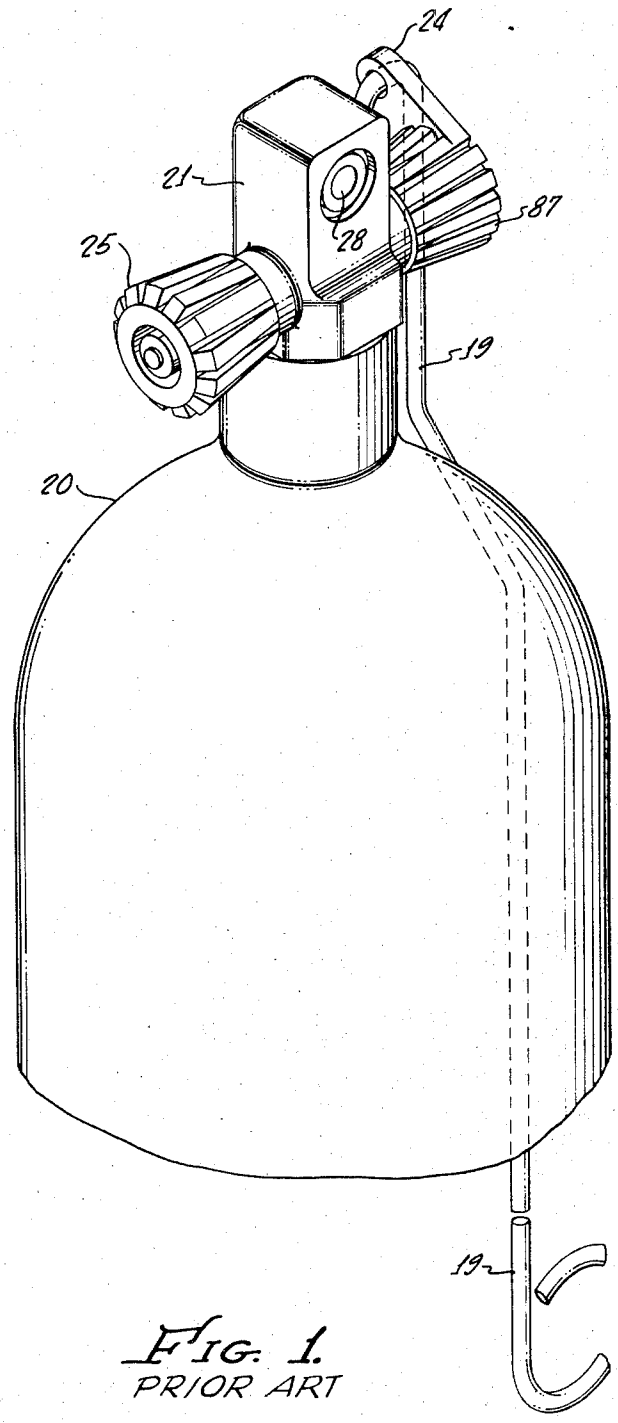


FIG. 1.
PRIOR ART

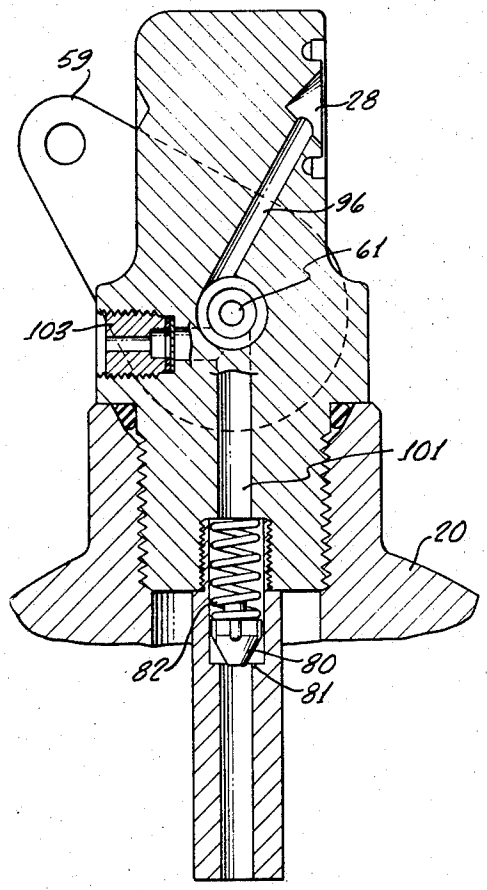


FIG. 4.

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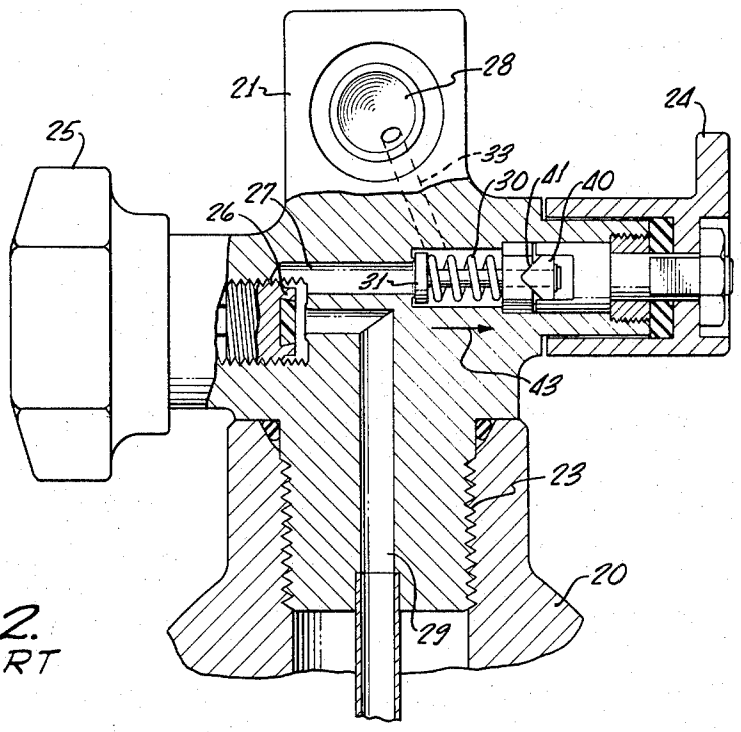


FIG. 2.
PRIOR ART

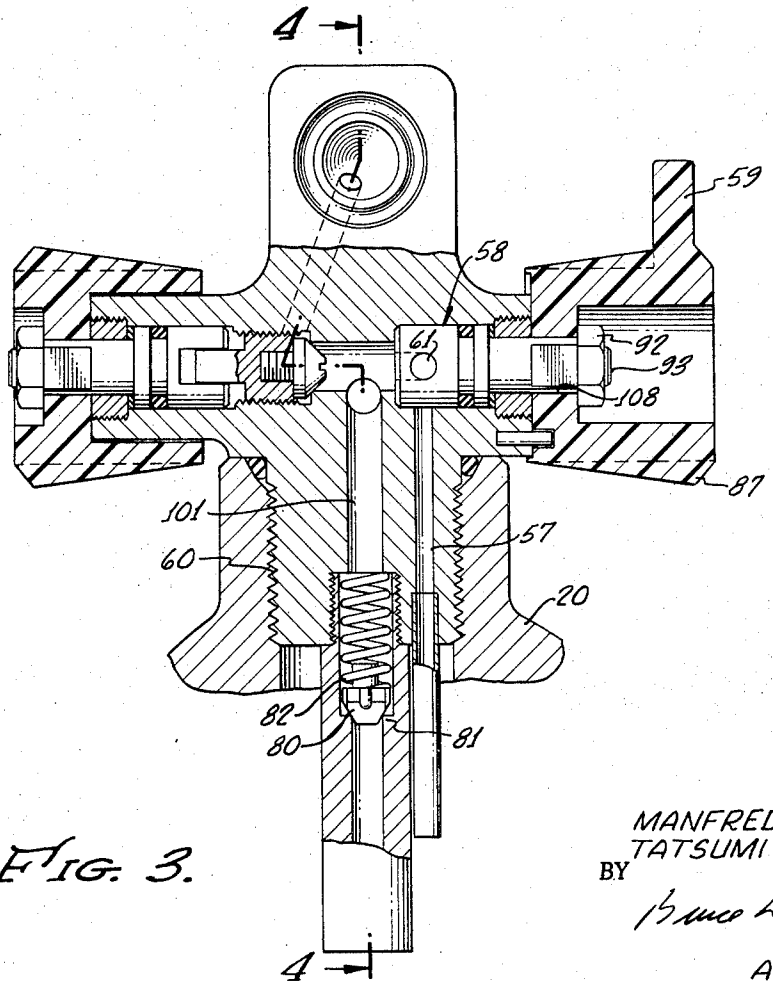


FIG. 3.

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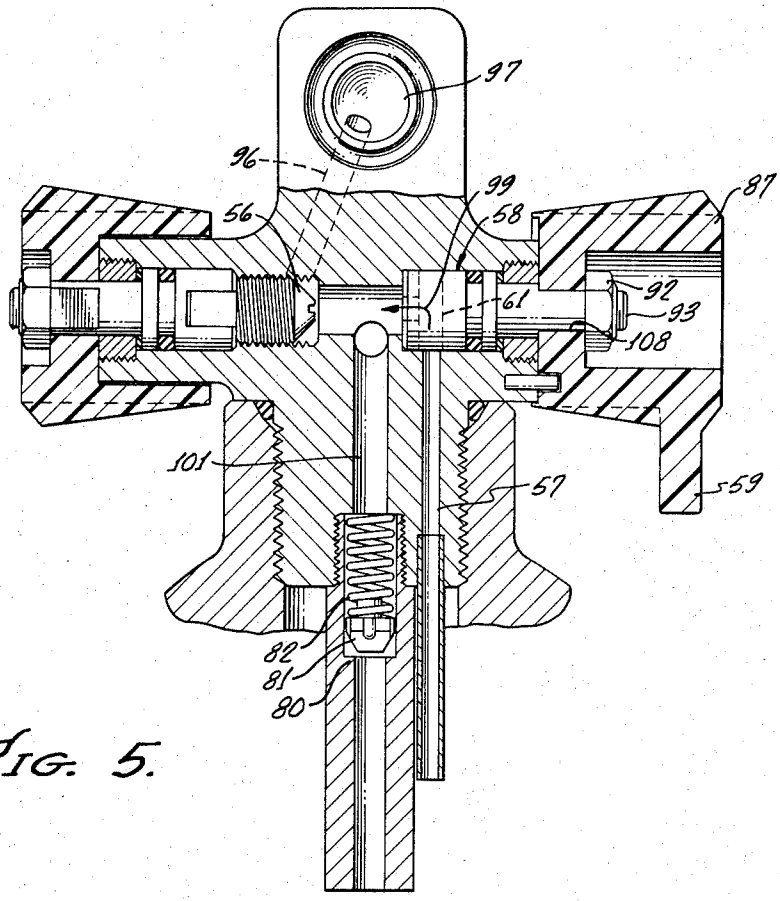


FIG. 5.

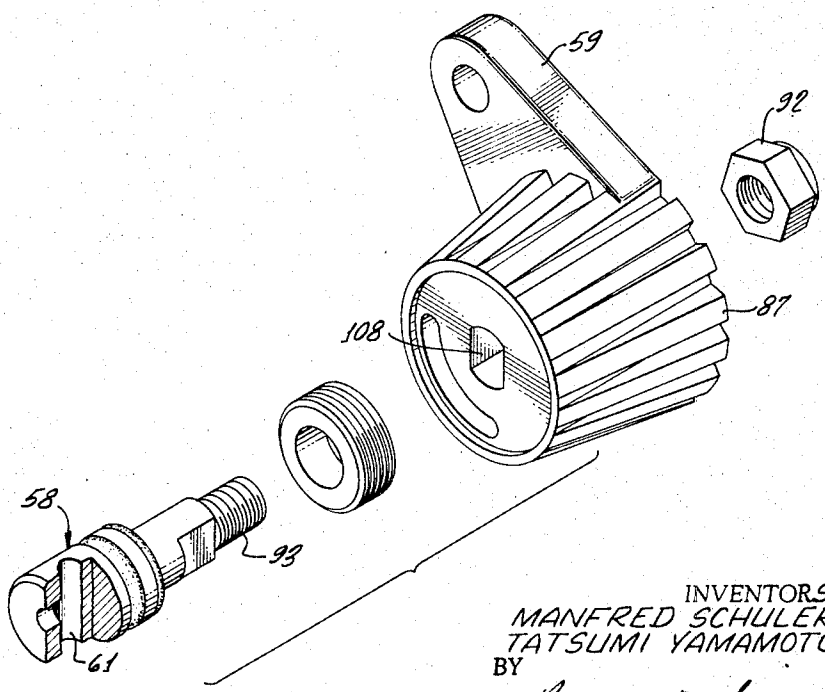


FIG. 6.

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SCUBA VALVE

BACKGROUND OF THE INVENTION

In recent years the phenomenal increase in the sales of scuba diving equipment for both pleasure as well as underwater research and exploration is due in a large part to emphasis by equipment manufacturers in providing certain safety features which materially reduce the risk of accidental injury or death resulting from diver error or unforeseeable circumstances. As divers tend to rely more and more on such devices, the reliability of the design becomes increasingly important. As is often the case in a hazardous environment, a safety device which is not dependable may present more problems than no safety device at all. Thus, in the safety apparatus to which the subject of the present invention is directed, the diver is provided with a reserve supply of air for reaching the surface after he has been warned that his air supply is nearly exhausted. If the diver begins to depend totally on this reserve, he may forget to check his watch (or other metering devices) which provide information as to his stay underwater. The importance of a reserve system with high reliability will thus be appreciated.

Almost all prior art reserve systems, employ a spring biased poppet valve in series with the air path between the air tank and the regulator. When the pressure in the tank exceeds the spring force, the valve opens allowing air to pass from the tank to the regulator. When the pressure in the tank drops below some predetermined value (usually 300 lbs/in.^{2}) the spring force will be equal to the force produced by the remaining quantity of air in the tank. At this point, the air flow to the regulator is restricted to a point where it becomes impossible for a diver to obtain an adequate air supply. When the diver senses this fact, he opens the poppet valve by pulling on the reserve pull rod which actuates a cam to open the poppet valve by mechanically overriding the force of its bias spring. The remaining quantity of air in the tank is then theoretically available to the diver.

Several problems however, have been known to occur. First, because the poppet valve is in series with the air path, any leakage past the poppet valve will result in air escaping into the regulator. As a consequence, the diver will be given no indication when the air pressure drops below the pre-established warning point and will discover this fact only after he runs out of air and no additional air is supplied when he pulls the reserve pull rod. Secondly, because of the manner in which the poppet valve is operated in conventional reserve units, any accidental jarrying or bumping of the trip rod (e.g. due to snagging on kelp, brushing against the walls of caves, etc.) will tend to cause leakage. In most cases this will only decrease the amount of reserve. In some cases, however, the poppet valve may be totally tripped to the open position by such contacts. A further problem regarding the conventional reserve system lies in the fact that the poppet valve is in series with the line between the tank and regulator and must open and close each time the diver demands air from the regulator. It must also be urged to the open position during the filling cycle (ei.e., when the tank is charged with air). This, of course, puts additional strain on the critical elements - and greatly increases the probability of their failure if this valve fails (i.e., all air to the diver will be cut off.) What is actually desired is a reliable diving reserve

system wherein air passage to the regulator is not dependent upon the reserve valve and the reserve valve is not subject to leakage resulting from accidental contact. Accordingly, a primary object of the present invention is to provide a reserve diving valve which does not obstruct the free passage of reserve air from the tank to the regulator.

Another object of the invention is to provide a reserve air system which is not subject to leakage due to accidental contact with the underwater environment.

A further object of the present invention is to provide a simple and inexpensive reserve system having a high degree of reliability.

Another object of the invention is to provide an improved apparatus for filling the tank.

Other objects and advantages of the present invention will be obvious from the detailed description of a preferred embodiment given herein below.

SUMMARY OF THE INVENTION

The aforementioned objects can be realized by an arrangement comprising a rotary reserve valve which can be externally actuated to release air through a bypass between the tank and the regulator. In essence, the reserve valve is in parallel with the poppet valve so that the latter is in no way affected when the reserve air is released. Since the reserve release is of a rotary type, it is not subject to intermittent jarring or accidental contact with the trip rod as is the case with prior art cam systems which actuate the reserve poppet valve.

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows in perspective the location of the main tank valve and reserve valve handles relative to the air tank and reserve rod pull.

FIG. 2 shows a cross section view of a conventional reserve valve arrangement.

FIG. 3 shows a cross section view with the cutting plane parallel to the axis of rotation of the valves of a preferred embodiment of the reserve valve system which comprises the present invention (reserve valve closed).

FIG. 4 is a cross section with the cutting plane at right angles to the axis of rotation of the valves of the reserve valve system shown in FIG. 3.

FIG. 5 shows the same view as FIG. 3 except with the reserve valve open.

FIG. 6 shows the details of the rotary valve and handle.

DESCRIPTION OF A PREFERRED EMBODIMENT

Adverting to the drawings, an explanation of a prior art reserve system can be illustrated with FIGS. 1 and 2 which shows a typical Scuba tank **20** with a conventional reserve valve system **21**. The entire assembly shown in FIG. 1 is normally mounted on the diver's back so that he will have access to the rod reserve pull **19** when the necessity for reserve air arises. As shown in FIG. 2 the reserve valve arrangement **21** is typically attached to the tank **20** via accordant threads **23** in the neck of the tank and the valve **21**. This prior art reserve system operates as follows:

When the main valve handle **25** is rotated so that the valve **26** is closed, air flow from the tank **20** is shut off. When handle **25** is rotated to open valve **26**, air is allowed to escape from the tank **20** via passage **29** into the passage **27**. If the force of the air pressure in the tank exceeds the force of the compression spring **30** which holds the reserve poppet valve **31** closed, air will escape from the passage **27** into the passage **33** - and from there out the opening **28** to which the regulator (not shown) is normally connected. If, however, the air pressure drops below that which is necessary to compress the spring **30** (typically this is 300 lbs/in.^{2}), air to the regulator will be shut off. When the diver senses this fact, he pulls on the reserve pull rod **19** causing the reserve handle arm **24** to rotate. When this happens, the detent **40** "rides up" on the seat **41** causing the valve **31** to be pulled back in the direction of the arrow **43**. This allows air to escape past the poppet **31** into the regulator via passage **33** and the diver is given a reserve supply of air.

While this warning and release arrangement appears satisfactory in theory, several practical problems arise. First, if the poppet jams shut (for example due to a malfunctioning cam assembly), all air to the diver is "cut off." Secondly, because even very slight contact with the rod will cause the detent **40** to rotate off of the seat **41**, the poppet **31** is subject to accidental leakage. As a result, the valve **31** may leak (unbeknownst to the diver) even though the reserve rod has never been pulled intentionally.

The above referred to shortcomings of the typical prior art reserve valve system are obviated by the reserve system shown in FIG. **3** which comprises a parallel reserve passage **57** for releasing air from the tank through a main valve **56** to a regulator and a rotary reserve valve **58** for opening passage **57** when the reserve air is required. Except for these changes, the assembly shown in FIG. **3** is the same as that shown in FIG. **2** — it being attached to the tank **20** in a like manner (threads **60**) with the main valve **56** serving the same function as in the prior art system. The present invention also looks basically the same externally — with a reserve pull rod being attached to the reserve arm handle **59** in the manner illustrated in FIG. **1**. It will be seen, however, that the problems posed by the prior art system are no longer present. The rotary valve **58** must be rotated a complete 90° in order to bypass air around the pressure sensing poppet valve **80**. The system is therefore not subject to leakage due to accidental contact with the reserve pull rod. Furthermore, since there is no detent seating problem as there was in the system shown in FIG. **2**, (element **40** and **41**), there is nothing which will tend to unseat the valve **80** from its seat **81**. In addition, there is no problem regarding component failures in the reserve systems which might tend to cut off air to the regulator. For example, even if the compression spring **82** would break so as to jam the valve **80** in the closed position, the diver may still obtain air through the rotary reserve valve **58**.

A collateral advantage of the present system results from the utilization of the reserve passage **57** during the filling cycle. In either system, the tank is charged by connecting the high pressure source to the opening **28**. In the prior art system however, the reserve poppet **31** is opened by the reserve handle, but the force exerted by the air flow around the poppet causes the poppet to flutter. This undulation not only increases the time required to fill the tank, but in addition, produces spurious wear on the reserve poppet assembly. In extreme cases the suction will cause the poppet **31** to completely close (against the force of the spring **30**) so as to halt the filling operation. In the present system, air is bypassed around the reserve poppet **80** during filling — thus obviating the aforementioned problems.

Most of the parts including the housing can be made of stainless steel. The valve **80** is typically teflon and the rotary valve **58** may be brass or teflon. As shown in FIG. **6**, the square shank of the rotary valve is keyed by a square opening **108** in the reserve handle **87**. The nut **92** screws onto the shank **93** of the valve **58** so that the valve **58** and handle **87** rotate as an integral unit. Thus, if the reserve rod (not shown) which is attached to the arm **59** of handle **87** is pulled down, the valve **58** will be opened as illustrated in FIG. **5**. In this position, air can move through the passage **57** through the ports **61** in the valve **58** as indicated by the arrow **99**. If the main valve **56** is also open (as shown in FIG. **5**) air will be supplied to the regulator (via passage **96** and opening **97**). Normally, of course, the rotary valve **58** will be in the closed position (as shown in FIG. **3**) so that the air pressure in the tank must overcome the force of the spring **82** — in which case air will flow past the poppet **81** and up through passage **101** — and then through passage **96** (if the valve **56** is opened).

FIG. **4** shows a cross sectional view of the rotary reserve system with the cutting plane at right angles to the axis of rotation of the rotary valve. The blow out plug **103** is used to provide safety in the event the internal pressure exceeds the rated safe pressure of the tank. This is typically a gold plated copper disc which is designed to rupture at 2,900 ± 100 p.s.i. to relieve internal pressure which might otherwise cause the tank to explode.

The basic concept of the invention is, of course, not limited to use with the particular valve assembly shown. It is equally applicable to twin manifold (i.e., two tanks), as well as other systems. Thus, although a preferred embodiment of the present invention has been shown and described, it will be understood that the invention is not limited thereto, and that numerous changes, modifications and substitutions may be made without departing from the spirit of the invention.

I claim:

1. In a Scuba diving air reserve system of the type having a spring biased poppet valve for cutting off air to the regulator when the tank pressure falls below a predetermined value, the improvement which comprises:

a bypass passage around said spring biased poppet valve;

reserve valve means for opening said bypass passage;

means for externally actuating said reserve valve means whereby a diver may obtain air after said poppet valve has closed to warn the diver that his air supply is low; and

means for filling the air tank through said bypass passage whereby said tank may be charged independently of said spring biased poppet valve.

2. The reserve air system recited in claim **1** wherein said reserve valve is a rotary valve.

3. The reserve air system recited in claim 1 wherein said means for externally actuating said reserve valve comprises a lever arm attached to said rotary valve at right angles to the axis of rotation of said rotary valve;

a reserve pull rod attached to said lever arm at a point displaced from the axis of rotation of said rotary valve whereby said rotary valve may be rotated by pulling on said reserve pull rod.

4. A Scuba diving valve comprising:

a housing having a threaded neck adapted to screw into the accordant threads of a conventional Scuba tank, an opening for filling the tank, and

a first air channel within said housing connecting said tank with the opening through which the tank is filled;

a main valve for closing said first channel, said main valve being located between the tank and the filling opening;

a spring biased poppet valve in said first channel, said poppet valve being located between said main valve and the tank;

a second air channel within said housing for bypassing air around said poppet valve;

a rotary valve for closing said second channel;

means for opening said rotary valve and means for opening said main valve whereby the tank can be charged through said filling opening.

5. The apparatus recited in claim 4 wherein is included:

means for attaching a regulator to the opening through which said tank is charged, and

means for actuating said rotary valve to the open position when the tank is mounted on the back of a diver.

* * * * *