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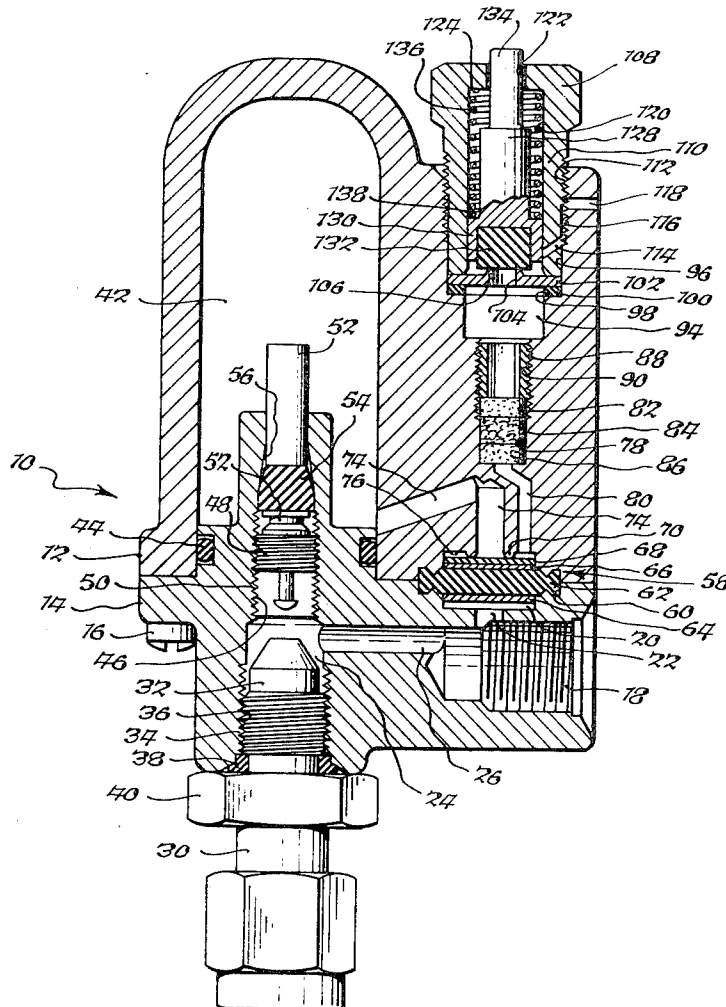
[54] LOW PRESSURE WARNING DEVICE
8 Claims, 4 Drawing Figs.

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128/142.3, 137/557, 222/3 |
| [51] | Int. Cl..... | G011 19/12 |
| [50] | Field of Search..... | 116/65,
112, 67, 117, 70, 22, 25, 55; 137/557; 128/142.2,
142.3; 222/3 |

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ABSTRACT: A low pressure warning apparatus having a valve body in which fluid under pressure from a container or supply line being sensed is admitted through a spring-loaded check valve into a fluid pressure storage chamber within the valve body. Upon a reduction in supply line pressure, the check valve is closed to trap fluid under predetermined pressure in said storage chamber. The trapped fluid under pressure is utilized to unseat a valve means, preferably upon a further reduction in supply line pressure, whereby communication is established from said storage chamber to a fluid pressure responsive means in the valve body. The fluid pressure responsive means includes a piston having a striker operable to ring a bell upon the admission of pressure fluid to said piston from said storage chamber.



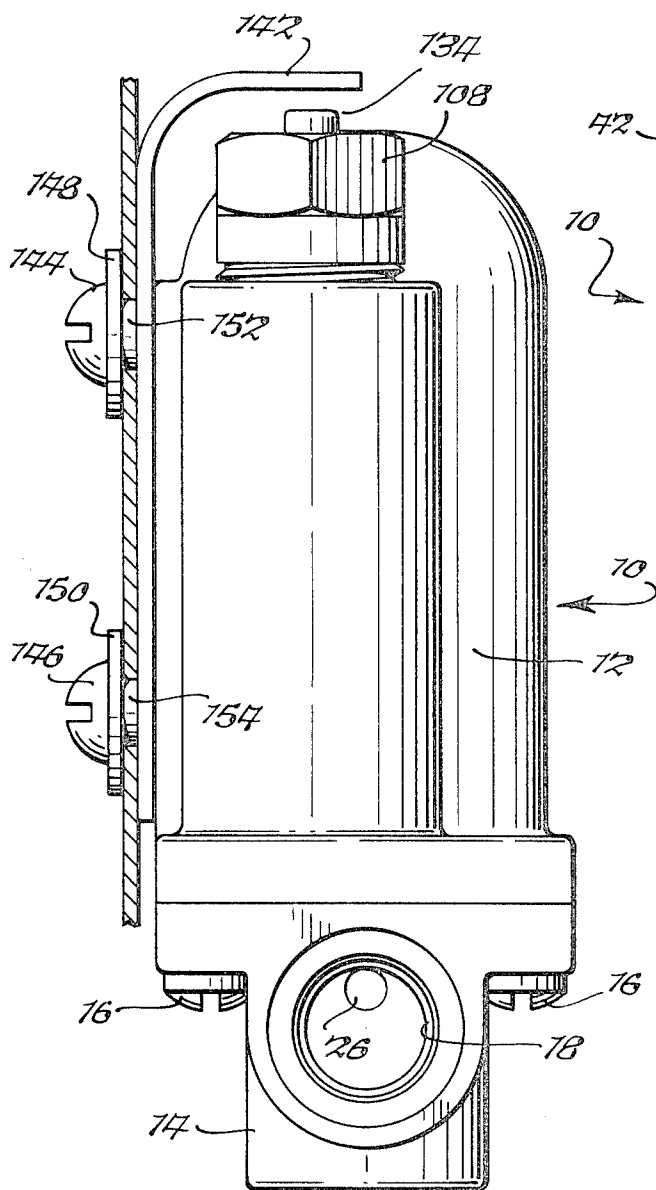


Fig. 1.

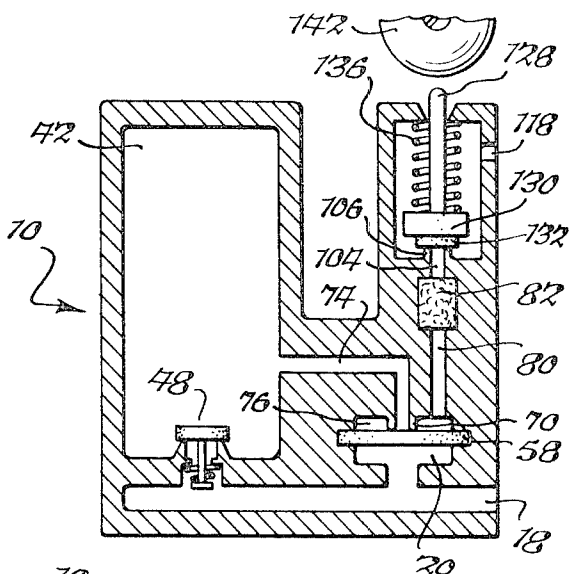


Fig. 3.

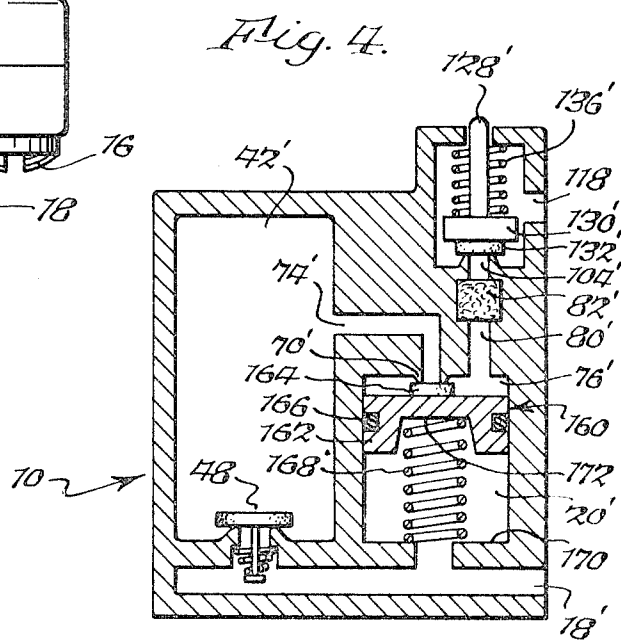


Fig. 4.

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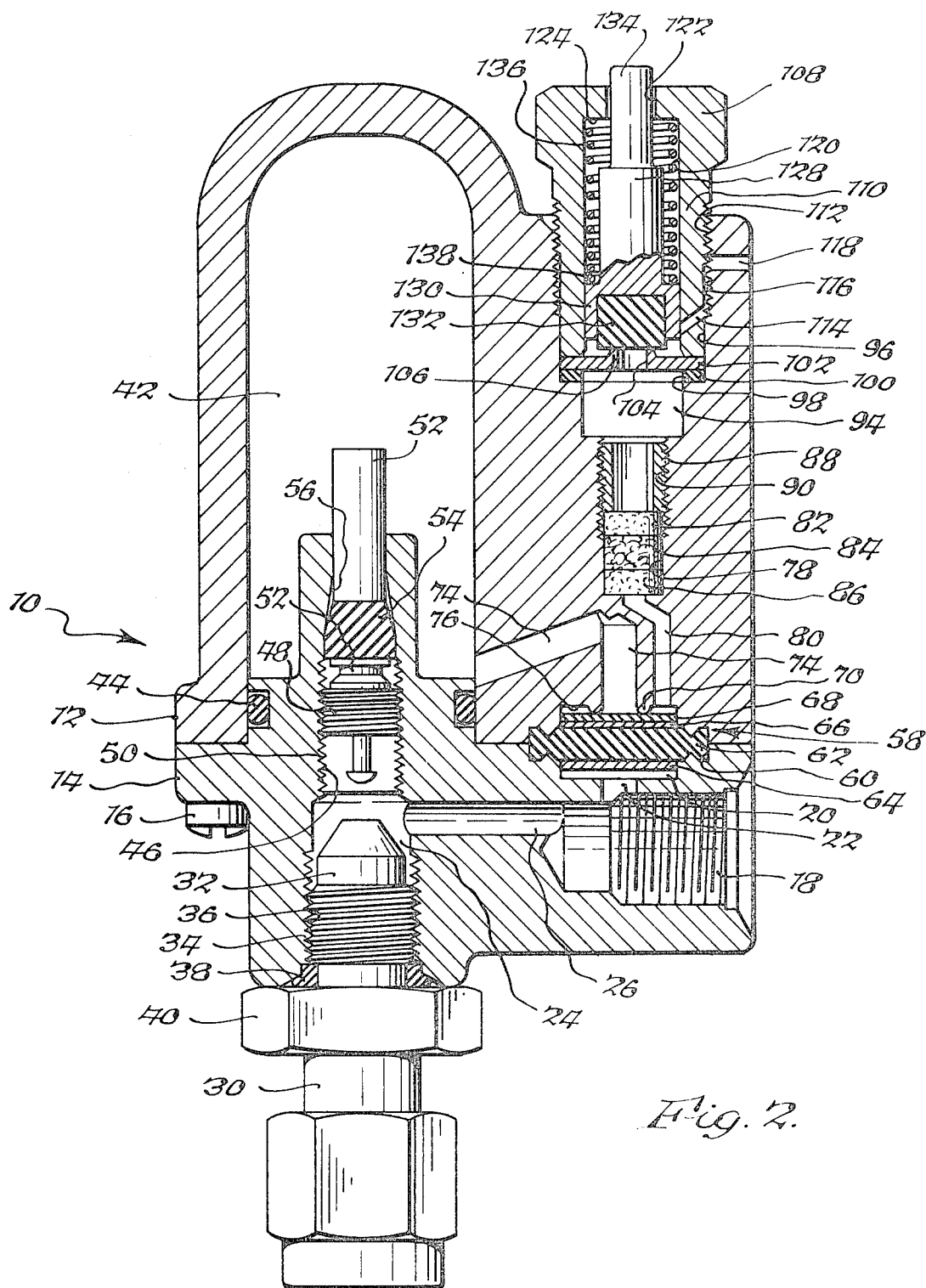


Fig. 2.

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LOW PRESSURE WARNING DEVICE

BACKGROUND OF THE INVENTION

This invention relates to a warning apparatus, and more particularly, to an improved fluid actuated warning apparatus operable in response to a predetermined low pressure in a fluid line to provide an audible alarm signal.

It is often desirable to provide a warning device in a fluid supply line to indicate an insufficiency or near depletion of a fluid supply. For example, a warning device can be employed in a supply line to the breathing apparatus used by a person working in a toxic or oxygen deficient environment to signal to the user thereof that his fluid supply is nearly exhausted or insufficient. It is also desirable to provide such a signal while the user has sufficient time to leave the environment or obtain a fresh air supply for his breathing apparatus. Warning devices of this type must therefore be accurately responsive to low pressures and be compact to provide unencumbering portability.

Some prior known warning devices have employed fluid pressure means incorporating various fluid motors and valve arrangements responsive to a reduction in fluid pressure in the main line to a predetermined level to actuate a suitable signal device, such as an audible alarm for example. Although such prior known devices have served the purposes for which they are designed, they have not been entirely satisfactory because they waste oxygen at a time when it is being depleted at the source. Such waste of oxygen is permissive in an open circuit system, but is intolerable in a closed circuit system wherein the supply of oxygen is limited and partially reused and the warning device could consume more oxygen than that consumed and/or available for the wearer.

SUMMARY OF THE INVENTION

The apparatus of the present invention, as hereinafter described obviates the above disadvantage by providing a new and improved low pressure warning apparatus which is simple and strong in construction, low in cost, rugged and durable in use, and includes means responsive to a reduction in pressure to a predetermined level to effect an audible, clearly distinguishable alarm signal without expending any appreciable amount of the fluid supply.

The low pressure warning apparatus of the present invention is characterized by the provision of a separate fluid pressure chamber within the housing for supplying the necessary fluid pressure to an alarm mechanism for actuating the same for a predetermined duration in response to a reduction in main line fluid pressure without excessively wasting or depleting the main line fluid pressure supply.

Various other novel features of construction and advantages inherent in the low pressure warning construction of the present invention are pointed out in the following detailed description of a typical embodiment thereof considered in conjunction with the accompanying drawings depicting the same wherein like numerals represent like parts throughout the various views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a low pressure warning apparatus of the present invention;

FIG. 2 is a vertical sectional view of the low pressure warning apparatus of FIG. 1;

FIG. 3 is a schematic sectional view of the warning apparatus of FIG. 1; and

FIG. 4 is a view similar to FIG. 3 illustrating a modified form of the apparatus of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, it will be seen that a fluid actuated, low pressure warning apparatus of the present invention comprises a body 10 having an upper housing 12 and a lower

housing 14 suitably secured together as by means of a plurality of screws 16. The terms upper, lower, top, bottom, upwardly, downwardly, and the like, as used herein, are applied only for convenience of description with reference to FIG. 2 and should not be taken as limiting the scope of this invention.

The lower housing 14 has a laterally extending passage 18 communicating with a chamber 20 via passage 22 and a chamber 24 via passage 26. Passage 18 is adapted to receive a suitable filter element and a pipe fitting connected to a fluid pressurized main line, which is connected to a suitable source of fluid under pressure, such as a pressurized tank by way of example, not shown. The main line also can be connected to a breathing apparatus, also not shown, that can be worn by a person working in a toxic or oxygen deficient environment. The low pressure warning apparatus of the present invention provides a continuous audible alarm of a preselected duration whenever the fluid pressure being sensed drops below a predetermined pressure level. In the above instance, it would provide warning to the wearer of the breathing apparatus that his fluid supply is nearly exhausted, and that he should abandon the environment or obtain another source of breathing fluid. Although the present invention is particularly advantageous in a closed circuit system because of the limited supply of breathing fluid, it should be appreciated that this invention is in no manner restricted thereto but also has utility in open circuit systems.

If desired, passage 18 may be blocked off by a suitable plug and the vertically extending passage 30 may be connected to the fluid pressurized main line to supply fluid under pressure to chambers 20 and 24, respectively, or alternatively, the body 10 may be interposed between the pressurized fluid supply source and the breathing apparatus so that fluid pressure flows from the source through passages 18 and 30 and ultimately to the breathing apparatus.

The lower end of chamber 24 is provided with a suitable filter element 32 having an externally threaded member 34 engaged with an internally threaded portion 36 of chamber 24. A suitable annular packing element 38 is deformed by a jam nut 40 into sealing engagement between filter element 32 and the internal wall surface of chamber 24.

Upper housing 12 is provided with a fluid pressure storage chamber 42 and the upper end of lower housing 14 is received in said chamber and is sealed by a suitable peripheral packing ring 44 engaging the wall of chamber 42. Housing 14 has a central opening or bore 46 communicating with chamber 24, said bore 46 receiving a conventional spring-loaded check valve 48 threaded into an internally threaded portion 50 of bore 46. A tubular valve core 52 is connected at its lower end to the check valve 48 and extends upwardly through bore 46 into storage chamber 42. A conically shaped sealing element 54 surrounds the valve core 52 and is jammed against a conically shaped portion 56 of bore 46 for providing pressure sealing between the bore 46 and storage chamber 42. It should be understood that the check valve is unseated by the presence of fluid pressure in chamber 24 and bore 46 against the urging of a spring (FIG. 3) to permit flow of such pressure fluid into storage chamber 42 to maintain the pressure of fluid therein approximately equal to main line fluid pressure. A reduction in fluid pressure in the chamber 24 and bore 46 will cause check valve 48 to seat or close due to the greater combined force of the spring and fluid pressure in storage chamber 43 acting on the upper side of the check valve. Thus, pressure fluid is contained or trapped in storage chamber 42 for a purpose hereinafter explained.

Chamber 20, communicating with main line pressure fluid via passage 22, has an enlarged diameter portion 60 for receiving a flexible diaphragm 62 of a diaphragm valve, generally designated 58, said diaphragm 62 being sandwiched between a pair of support plates 64 and 66 slidably received in the narrower portion of chamber 20. A resilient sealing element 68 is disposed on the upper surface of support plate 66 and is engageable with an annular seat 70 projecting axially from the upper side of chamber 20 toward said diaphragm 62. A

passage 74 connects storage chamber 42 to the upper side of sealing element 68. Diaphragm valve 58 is self biasing to a closed position, i.e. sealing element 68 is normally seated against annular seat 70.

Annular seat 70 defined an annular chamber 76 with the upper surface of sealing element 68, which chamber 76 is in communication with a bore 78 via passage 80. Mounted in bore 78 is a packed orifice element 82 of any suitable construction, such as a porous filter having an asbestos packing 84 therein, which provides a resistance to reduce the flow of fluid under pressure to the desired rate. Element 82 is secured in place against an annular shoulder 86 by means of an externally threaded screw 88 adjustably mounted in an internally threaded portion 90 of bore 78. Bore 78 is connected to a chamber 94 which is counterbored as at 96 forming an annular abutment shoulder 98 for receiving an annular packing element 100. A plate member 102 having a central opening 104 together with a surrounding annular seat 106 projecting from one side thereof away from said packing element 100 is seated in bore 96 and abuts packing element 100 whereby bore 96 is sealed except for opening 104.

A striker retainer 108 having a reduced diameter sleeve portion 110 projecting axially inwardly threads in to an internally threaded portion 112 of bore 96 with the end of sleeve portion 110 bearing against plate member 102 to maintain plate member 102 in sealed engagement with packing element 100. A lateral vent passage 114 extends through sleeve portion 110 and opens into a cavity 116 which leads to atmosphere through a plurality of openings 118 formed in the body 10.

Retainer 108 has a central stepped bore 120 reduced at its outer end as indicated at 122 to provide an inwardly and axially facing shoulder 124 therebetween. A plunger member or striker 128 is slidably received within bore 120 and comprises a piston 130 carrying a resilient sealing end portion 132 engageable against seat 106 and having a reduced diameter stem portion 134 slidable through bore 122 in the end of retainer 108. Striker 128 is biased into sealing engagement with seat 106 by a helical compression spring 136 disposed about striker 128 and which extends between an annular shoulder 138 on the piston 130 and shoulder 124 of retainer 108.

An arcuately curved resounding stop or bell 142 is secured to body 10 as by a pair of screws 144 and 146 (FIG. 1) extending through washers 148 and 150 and spacers 152 and 154, respectively, and threaded into the upper housing 12 of body 10. Bell 142 can be a gong, as shown in FIG. 2, or plate provided with a curved tongue portion extending above the path of outward movement of striker 128 so that the end of striker 128 strikes the curved tongue portion to ring bell 142 and provide an audible signal or alarm while simultaneously piston 130 uncovers vent passage 114.

In operation, assuming that fluid under normal pressure from a storage cylinder flows through passage 18, the fluid pressure acting on the underside of check valve 48 unseats said valve against the urging of its spring to admit fluid under pressure into fluid pressure storage chamber 42 and maintain approximately the same pressure therein as in passage 18. Fluid pressure in storage chamber 42 acts on the upper surface of sealing element 68 via passage 74. However, the main line fluid pressure acting on the larger effective area on the undersurface of diaphragm valve 58 maintains sealing element 68 seated against seat 70, thus preventing any fluid pressure from entering into passage 80.

When the main line fluid pressure in passage 18 drops below a predetermined level, which can be selected to reflect any predetermined fraction of the initial main line pressure, the spring-loaded check valve 48 closes against its seat and fluid at said predetermined pressure is trapped in storage chamber 42. The pressure fluid in storage chamber 42 remains trapped until the decreasing main line pressure acting on the larger effective area of diaphragm valve 58 can no longer overcome the trapped fluid pressure acting on the smaller effective area of the upper surface of sealing element 68 via passage 74.

When this occurs, the pressure differential moves diaphragm valve 58 to unseat sealing element 68 and admit pressure fluid from chamber 42 into chamber 76, passage 80, through packed orifice element 82, into chamber 94, and into the central opening 104 of plate member 102. Fluid pressure thus acts through opening 104 against the exposed area of striker seal 132 and when it builds up to a predetermined level, it overcomes the bias of spring 136 whereupon striker 128 is moved axially outwardly toward the tongue portion of bell 142 and away from opening 104. Upon unseating of seal 132, the entire end area of piston 130 is exposed to the pressure in chamber 94 and striker 128 is driven upwardly against the tongue to ring bell 142. Striking movement of piston 130 uncovers vent passage 114 whereupon the fluid pressure driving striker 128 exhausts into cavity 116 and through opening 118 to the ambient atmosphere. Vent passages 114, 118 are arranged to vent pressure fluid from core 120 faster than it is replenished from storage chamber 42, whereby the fluid pressure acting on the end area of piston 130 rapidly decreases when vent passage 114 is uncovered with the result that spring 136 returns striker 128 against seat 106 with piston 130 covering vent passage 114. Fluid pressure in chamber 94 thereupon builds up and again acts against striker 128 as described above, causing the same to strike bell 142. In this manner, striker 128 is reciprocated and strikes bell 142 repeatedly to provide a continuous ringing alarm for a duration dictated by the capacity of storage chamber 42. The signalling stops when the pressure fluid trapped in chamber 42 is used up.

When the fluid pressure in passage 18 rises above the predetermined pressure level, for example by providing a fresh tank of breathing fluid or connecting the lines with another fluid supply line, the increased fluid pressure in chambers 24 and 20 unseats check valve 48 and seats diaphragm valve 58. With diaphragm valve 58 seated, the passage 80 is blocked off, thereby inactivating striker 128. Thus, as long as a fluid pressure above the predetermined fluid pressure level is maintained in passage 18, the differential fluid pressure acting on diaphragm valve 58 maintains it seated and striker 128 is inoperative to sound bell 142. The ratio of diaphragm area in chamber 20 to seat area 70 of diaphragm 58 is so designed as to unseat sealing element 68 at a substantially lower main line pressure level than that which closes check valve 48. Preferably check valve 48 closes while supply line pressure is relatively high, trapping a predetermined supply of fluid under such relatively high pressure for activating the alarm when the supply line pressure has dropped to a dangerously low level.

FIG. 3 illustrated the preferred embodiment of the invention, described above, whereas FIG. 4 illustrates a modified form of the present invention. The modified form of the present invention (FIG. 4) is similar in every respect to the first embodiment with the exception of employing a piston valve, generally designated 160, in lieu of the diaphragm valve 58 of the first embodiment. The same numbers primed are used to indicate parts similar to those employed in the first embodiment. Piston 160 comprises a cup-shaped piston head 162 carrying a sealing element 164 engageable with an annular seat 70' and a suitable peripheral packing ring 166 engaging the wall of chamber 20'. A spring 168 disposed between an end wall 170 of chamber 20' and an internally recessed portion 172 of piston head 162 urges sealing element 164 into engagement with annular seat 70'. The operation of this embodiment is similar to that described in connection with the first embodiment whereby no further explanation is believed necessary. The relative effective areas of piston 160 exposed to pressure fluid through seat 70' and in chamber 20' can be varied, and the force of spring 168 can be selected, to unseat piston 160 and sound the alarm at a main pressure level lower than the level causing check valve 48 to close, in which case pressure fluid trapped in chamber 42' is available at the higher level to activate the striker.

Thus it is seen that the present invention provides novel and simple low pressure warning apparatus automatically operable in response to a reduction in fluid pressure to a predetermined

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level to produce an audible alarm of a predetermined duration. By the provision of a pressure fluid storage chamber within the apparatus, only a nominal, predetermined volume of breathing fluid is consumed by the apparatus to provide an audible alarm substantially without waste or depletion of the supply of breathing fluid available, and this is provided in a compact, unitary apparatus. While the alarms are shown as being a gong or a curved plate in FIGS. 3 and 2 by way of illustration, it should be understood that other types of alarms are contemplated within the purview of this invention.

Preferred embodiments of this invention having been hereinabove described and illustrated, it is to be understood that this has been done by way of illustration only.

We claim:

1. A warning apparatus for sensing a predetermined low fluid pressure in a first conduit means supplying a breathing fluid to a user, comprising: a housing forming a fluid pressure storage chamber, check valve means interposed between said storage chamber and said first conduit means, said first conduit means charging said storage chamber with a fluid at a first predetermined pressure level, alarm means mounted adjacent said housing, fluid pressure responsive means mounted in said housing and operable to actuate said alarm means, second conduit means interposed between said storage chamber and said fluid pressure responsive means, second valve means disposed in said second conduit means and responsive to the pressure in said storage chamber and means placing said second valve means in fluid communication with said first conduit means, whereby said second valve means is operable to permit fluid flow from said storage chamber to said pressure responsive means to actuate the alarm means when the fluid pressure being sensed in said first conduit means falls below a

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second predetermined pressure level lower than said first predetermined pressure level in the storage chamber.

2. A warning apparatus as defined in claim 1 wherein said second valve means comprising a resilient sealing element engageable with a seat in said housing for blocking fluid pressure flow between said storage chamber and said pressure responsive means.

3. A warning apparatus as defined in claim 2 wherein said second valve means is a diaphragm valve.

4. A warning apparatus as defined in claim 3 wherein said diaphragm valve has opposite sides; one of said sides having a large effective area exposed to pressure in said first conduit means and the other side having a lesser effective area exposed to fluid under pressure in said storage chamber.

5. A warning apparatus as defined in claim 2 wherein said second valve means is a piston valve.

6. A warning apparatus as defined in claim 5 wherein said piston valve has opposite sides; one of said sides having a large effective area exposed to pressure in said first conduit means and the other side having a lesser effective area exposed to fluid under pressure in said storage chamber.

7. A warning apparatus as defined in claim 1 wherein said pressure responsive means includes a bore, a plate in said bore having an opening connected to said means, a seat surrounding said opening in said plate, a plunger slidable in said bore having a piston at one end engageable with said seat, and vent passage means connecting said bore to atmosphere when said plunger moves away from said seat.

8. A warning apparatus as defined in claim 7 wherein the other end of said plunger is engageable with said alarm.

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