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WARNING DEVICE FOR BREATHING APPARATUS

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Fig. 1

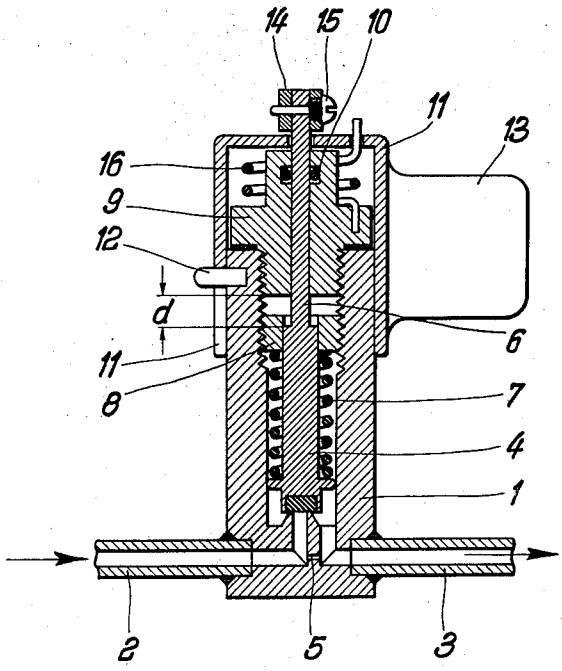
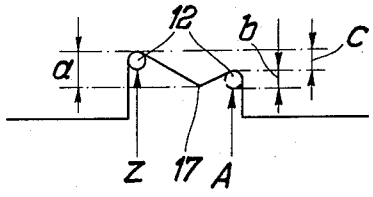


Fig. 2



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WARNING DEVICE FOR BREATHING APPARATUS

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The present invention relates to a breathing apparatus which is provided with a portable supply of pressure gas, and to indicating means for warning the carrier of the apparatus of an early depletion of the gas supply.

Conventional breathing apparatus of this type has been provided with a valve which automatically interrupted the flow of gas to the breathing apparatus when the gas pressure had dropped to a certain value. The carrier of the apparatus then had to operate a control handle which again opened the valve so that the gas would flow again from the remaining reserve. The automatic valve was held open by the normal pressure of the gas supply and was closed by a spring of a tension in accordance with a certain minimum pressure of the gas supply. The valve was opened manually by means of a pin which was connected in a suitable manner to the control handle and extended gastight into the valve housing, and was either designed to push or pull the valve into the open position. Another prior apparatus provided a by-pass valve between the inlet and outlet line of the breathing apparatus which valve had to be opened and closed by hand.

These warning devices could be effective only if the control handle was in the closed position. Since the force for operating the valve was transmitted from the control handle to the valve within the housing thereof, there had to be a difference in pressure between the inlet and outlet lines which corresponded substantially to the mentioned opening pressure.

Such warning devices have the disadvantage that their effectiveness depends upon the attention or alertness of the carrier of the apparatus since they are inoperative if the carrier forgets to move the control handle into the closing position. Another disadvantage consists in the fact that the period extending from the moment when the gas supply is being throttled to the complete interruption thereof is too long and that the warning is therefore indistinct. It could easily occur that the carrier of the apparatus might not notice the gradual increase in the breathing resistance at the proper time, or that he might misunderstand or misjudge the same with the result that he might suffer a lack of breath. It was a further disadvantage of such apparatus that after a certain period the gas supply was interrupted entirely. The effect upon the carrier of the apparatus was the same whether at a correct position of the control handle the gas was consumed down to the reserve supply or whether at a wrong position of the control handle the gas supply was exhausted entirely. There was always the possibility of errors which could bring the carrier of the apparatus into a dangerous position.

It is an object of the present invention to provide a warning device for breathing apparatus which overcomes all of the above-mentioned disadvantages. The invention provides an automatic valve with a valve shaft extending in a gastight manner from the valve housing toward the outside means for manually opening the valve so that a valve control handle will snap automatically back into its closing position as soon as the gas supply pressure is higher than the adjustable closing pressure of the valve. A by-pass is provided between the inlet and outlet lines to supply the carrier of the apparatus with a minimum amount of gas to permit him to breathe.

Further objects, features and advantages of the present invention will be apparent from the following detailed description thereof, particularly when read with reference to the accompanying drawings of a preferred embodiment of the invention, in which

Figure 1 shows a cross section of the warning device according to the invention; while

Figure 2 shows a developed projection of a part of the jacket of the valve housing shown in Figure 1.

The gas pressure responsive warning device according to the invention, which may be installed in the usual manner between or within the valve of the gas container and the pressure reducer, comprises a valve housing 1 defining a valve chamber in communication with an inlet line 2 and an outlet line 3. Valve housing 1 is closed gastight by means of a threaded member 9 which is screwed into the valve housing. The inlet and outlet lines 2 and 3 communicate with each other through a narrow bore 5.

Valve housing 1 contains a spring-loaded valve member 4 with a shaft 6 thereon which is longitudinally movable within member 9 and extends to the outside of the housing, being sealed by a sealing ring or packing 10. Valve member 4 is axially biased by a compression spring 7, the tension of which may be adjusted by a threaded member 8.

A jacket 11 having a handle 13 thereon is rotatably mounted on the upper part of the valve housing 1 and provided with a cutout of a shape as illustrated diagrammatically in Figure 2. Under the action of spring 7, a setting ring 14 which may be secured to valve shaft 6, for example, by a screw 15, presses jacket 11 in the downward direction. A pin 12 which is secured to valve housing 1 engages the cutout in jacket 11 so that the latter will be pressed by spring 7 against pin 12. If jacket 11 is turned so that pin 12 is located at the point Z of the cutout, it will be in its lowest position. Setting ring 14 will then be spaced at a certain distance from jacket 11 depending upon the position of valve member 4. If the jackets as seen from above in Figure 1 is turned in a clockwise direction, the edge of the jacket will slide over pin 12 and the jacket will at first be raised by the distance *a* and the projection 17 thereof will then slide over pin 12. If jacket 11 is further turned, it will again be lowered by the distance *b* so that pin 12 will finally arrive at point A. There will thus be a difference in elevation *c* between the points Z and A.

A tangentially acting spring 16 is secured at one end to the threaded member 9 and at the other end to jacket 11, and tends to turn jacket 11 in a counterclockwise direction. Consequently, if setting ring 14 is raised from jacket 11, the latter will be turned to the position Z under the action of spring 16. If, however, setting ring 14 presses upon jacket 11 under the action of spring 7, the jacket will be arrested in position A since the tangential force of spring 16 is insufficient to lift the jacket above projection 17 inasmuch as spring 7 would then have to be compressed for the distance *b*.

The position of valve member 4 is dependent upon the difference in pressure between the inside and outside of the valve housing. The longitudinal force opposing spring 7 is the product of the cross-sectional area of shaft 6 and the differential pressure. In order to prevent spring 7 from being unduly compressed, shaft 6 is made of a smaller cross section than valve member 4 so that spring 7 cannot be compressed more than by the distance *d*.

This distance must be at least as great as the distance *a* since jacket **11** could otherwise not be turned to pass over the projection **17**. Shaft **6** is sealed in a suitable manner toward the outside, for example, by the rubber ring **10**.

The device according to the invention operates as follows:

If the gas in the container has a pressure higher than the desired warning pressure, valve **4** will be lifted due to the difference in pressure between the inside and outside of the valve housing whereby spring **7** will be compressed and setting ring **14** will be lifted from jacket **11** and, under the action of spring **16**, the jacket will snap into the position Z. Control handle **13** will thus be moved automatically to the proper position, while in the apparatus known prior to this invention, this handle had to be turned by hand to the position Z. The operation of the device according to the invention therefore does not depend upon the attention of the carrier of the apparatus, which considerably increases its value as a warning device.

If the pressure in the gas container drops to the desired warning point, valve member **4** will be closed under the action of spring **7**. Setting ring **14** will then be spaced at a small distance from jacket **11**. If jacket **11** is then turned in the clockwise direction to the position A, valve member **4** will be lifted by the distance *c* and spring **7** will be compressed accordingly. Jacket **11** will then be arrested in this position since the tangential spring **16** cannot turn the jacket back over the projection **17** inasmuch as in turning it back to the position Z, spring **7** would have to be compressed by the distance *a*. Spring **16** should for this purpose be designed so as not to be able to turn back the jacket against the pressure of spring **7**.

Since contrary to similar devices known prior to this invention valve **4** reacts upon the difference in pressure between the inside and outside of the valve, another important advantage will be attained when the device is used under water, for example, in diving apparatus, since the responsive pressure increases with an increase in depth so that the warning to the diver will occur the sooner the deeper the diver will be below the water surface.

In order to avoid the danger that the breathing resistance might increase too rapidly, a small bore **5** should preferably be provided between the inlet **2** and the outlet **3** so that a small amount of gas will remain available for breathing when valve member **4** is closed. Bore **5** is preferably made of such a size that the warning signal, that is, the increase in breathing resistance, will be clearly noticeable, but the amount of gas passing through the bore will still be sufficient for breathing at a considerably slower rhythm. It is undesirable to cut off the gas supply entirely since the carrier of the apparatus may sometimes be prevented from turning the control handle immediately into the position A.

Although my invention has been illustrated and described with reference to the preferred embodiments thereof, I wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed my invention, what I claim is:

1. A gas pressure responsive warning device for a breathing apparatus, comprising a throttle valve means having a gas inlet and outlet, the inlet and the outlet being in communication through a restricted bore permitting a minimum amount of gas required for breathing to pass therethrough, and the throttle valve means including a valve housing defining a valve chamber in communication with said gas inlet and outlet, a valve seat between said inlet and said chamber, a spring-loaded valve member slidably mounted in said chamber, said valve member being biased into a closed position relative to said valve seat but movable into an open position under a gas pressure in excess of the spring bias, a valve shaft extending outwardly from said valve member, a manually operable control member mounted on said valve housing and operably connected with the valve member for moving the valve member into the open position, cam means for moving the control member from a lowest to a highest and then to an intermediate position relative to the housing upon turning the control member on the housing, and another spring biased to move the control member into a position wherein the control member causes the valve member to assume the closed position when the gas pressure in the valve chamber exceeds a predetermined warning pressure, the first-named spring maintaining the valve member in the open position when the gas pressure in the valve chamber is lower than said warning pressure.

2. A gas pressure responsive warning device for a breathing apparatus, comprising a throttle valve means having a gas inlet and outlet, the inlet and the outlet being in communication through a restricted bore permitting a minimum amount of gas required for breathing to pass therethrough, and the throttle valve means including a valve housing defining a valve chamber in communication with said gas inlet and outlet, a valve seat between said inlet and said chamber, a spring-loaded valve member slidably mounted in said chamber, said valve member being biased into a closed position relative to said valve seat but movable into an open position under a gas pressure in excess of the spring bias, a valve shaft extending outwardly from said valve member outside the valve housing, a gas-tight seal for said valve shaft, an outer jacket mounted on the valve housing coaxially therewith and with the valve shaft, the outer end of said valve shaft passing through an opening in said jacket and having a setting ring secured thereto, a control handle on the jacket for manually moving the jacket in an axial direction relative to said valve shaft to move the shaft and the valve member into the open position when the gas pressure drops below the spring bias, a pin secured to said valve housing and projecting into a cam-shaped cutout in the jacket, the pin and cam-shaped cutout cooperating to move the jacket from a lowest to a highest and then to an intermediate position relative to the housing upon turning of the jacket on the housing, and another spring interposed between the jacket and the housing, said second spring acting tangentially to return the jacket to the closed position when the gas pressure in the valve chamber exceeds a predetermined warning pressure, the first-named spring maintaining the valve member in the open position when the gas pressure in the valve chamber is lower than said warning pressure and said control handle has been actuated to set the cam.

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