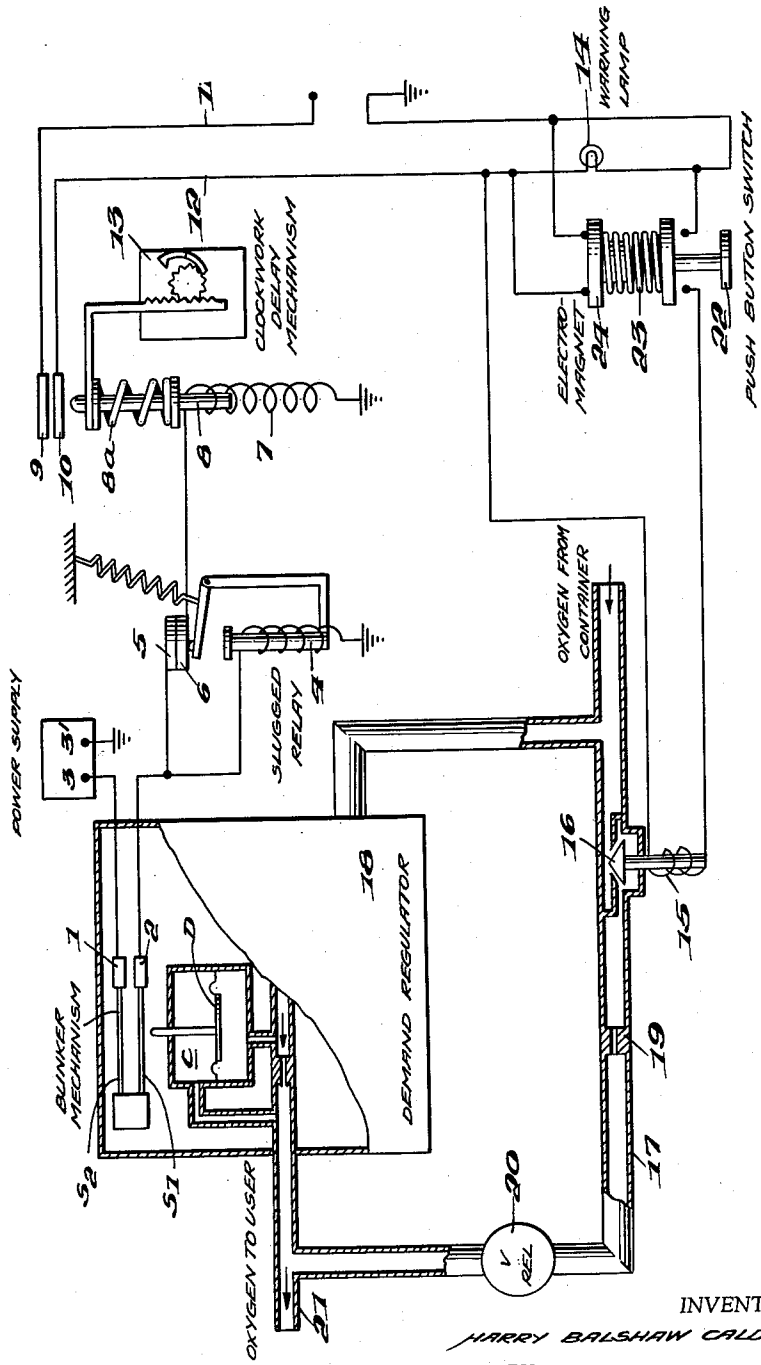
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BREATHING APPARATUS

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BREATHING APPARATUS

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This invention relates to oxygen breathing systems of the kind employing a warning system brought into operation when irregularities occur in the systems.

Such warning systems usually comprise an electrical circuit which operates an audible or visible warning device; and an important object of this invention is in the provision of a supply of oxygen independent of the breathing apparatus whenever the aforesaid warning system comes into operation.

The invention accordingly consists in a device wherein closing of an electrical warning system actuated by breathing irregularities operates a valve controlling a supply of oxygen by-passing a demand regulator of a breathing apparatus.

The invention and other objects or advantages thereof will be more completely understood from the following detailed description, in which the accompanying drawing illustrates a preferred embodiment.

A pair of contacts 1, 2 are provided in a blinker mechanism of a demand regulator 18. The demand regulator 18 and included blinker mechanism are of a type known per se and form no part of the present invention. The blinker mechanism is operated periodically by the inhaling sequences in the use of a breathing mask (not shown). When the user of the mask inhales, oxygen flows from a container (not shown) under the control of the demand regulator 18. This action causes a pressure differential to be set up between the sides of a diaphragm D situated in a chamber C forming an integral part of the blinker mechanism. The diaphragm D is associated with a leaf spring member S_1 upon which the contact 2 is mounted. The pressure differential causes the diaphragm D to move the leaf spring S_1 upwards and close contact 2 with the contact 1 mounted on a further leaf spring S_2. Numerals 3, 3' are the supply voltage terminals which are connected to the contacts 1, 2. A slugged relay 4 is provided, the circuit of which is controlled by the contacts 1, 2 situated in the blinker mechanism. The term "slugged" as used to describe a relay, may be defined as a relay, which upon excitement, is actuated for a predetermined time. Contacts 5 and 6, controlled by the slugged relay 4, lead to a solenoid 7. Upon actuation of the slugged relay 4, contacts 5 and 6 are closed for a predetermined period of time. The solenoid 7 has a spring loaded core 8 which functions as the emergency system activator and which controls contacts 9, 10 of a warning circuit 11, 12 provided with a warning lamp 14. The spring-loaded core 8 is under the control of a clockwork delay mechanism 13.

A solenoid 15 tapped off the circuit 11, 12 opens a valve 16 in an oxygen by-pass line 17 whenever the contacts 9, 10 close. The by-pass line 17 by-passes the demand regulator 18, and has a flow restrictor 19 on the downstream side of the valve 16. A relief valve 20 prevents excessive pressure of oxygen being delivered to the breathing mask (not shown) by way of outlet 21.

A push-button switch 22 provides a manual control of the solenoid 15, the switch normally held in the closed position by a spring 23, but when depressed, may be held in the open position (providing the circuit 11, 12 is closed) by an electro-magnet 24.

In operation, when oxygen is inhaled and flows from

the container to the mask, the blinker mechanism contacts 1, 2 are closed and current is accordingly supplied to the slugged relay 4. Relay 4 closes the contacts 5, 6 and current flows to the solenoid 7. After the predetermined delay time of the relay 4 has elapsed, the contacts 5, 6 are broken thereby cutting off the current to the solenoid 7. In this manner, a pulse of predetermined duration in which current is supplied to the solenoid is formed. The duration of the pulse is thus governed by the delay time of the relay 4 and not by the time during which the blinker mechanism contacts 1, 2 are made. When current is supplied to the solenoid 7 the core 8 is caused to retract to a preactuation position compressing its spring 8*a*. When each pulse ceases, i.e. when the contacts 5 and 6 are broken, the spring 8*a* urges the core 8 towards an actuation position and the contacts 9, 10 of the warning system circuit 11, 12. This core is, however, under the control of a time delay mechanism 13 and before the core 8 reaches the actuation position where the contacts 9, 10 would be made, the next inhalation normally occurs. The solenoid 7 is again energised, and the core 8 is drawn away from the contacts 9, 10.

In the case of an irregularity resulting in constant oxygen flow, which would be caused by a broken oxygen supply pipe between the regulator 18 and mask, the blinker electrical contacts 1, 2 will remain closed. The initial current pulse will be received by the slugged relay 4 and the solenoid 7 as before, but the relay 4 will remain energised with its contacts 5, 6 open and no further pulses will be produced. The solenoid 7 is thus de-energised and the core 8 is urged towards the warning contacts 9, 10 by the spring. Contacts 9, 10 are closed as soon as the time delay period imposed by the mechanism 13 expires, thus completing the warning circuit.

In the case of the regulator 18 failing to deliver oxygen due to mechanical failure, the contacts 1, 2 will remain open. In this case no current pulse will be received by the solenoid 7 as relay 4 will never be energised. The result is that the solenoid core 8 will again act upon the contacts 9, 10 to complete the warning circuit.

In the event of the user's breathing rate falling to a dangerous frequency, the time elasping between the pulses supplied to the solenoid 7 will increase until this time is greater than that required for the solenoid core 8 to reach and operate the warning contacts 9, 10. In this case a warning will again be given by the lighting of the lamp 14.

Whenever the warning circuit is closed, the solenoid 15 energises, opening valve 16 in the by-pass line 17 and allowing an emergency supply of oxygen to flow directly to the breathing mask (not shown). Restrictor 19 limits the pressure of the oxygen supplied.

It will thus be readily seen that should the warning system function due to insufficient oxygen being delivered to the mask, the additional or emergency supply of oxygen released by the valve 16 will ensure that the wearer of the mask remains conscious and able to rectify the fault.

Due to mechanical fault in the demand regulator 18, for example, it is possible that the regulator 18 may be allowing a constant flow of oxygen through the regulator to the mask, while at the same time the valve 16 is open. This, however, may be rectified by operating the push-button switch 22, thus opening the circuit of the solenoid 15 and allowing the valve 16 to close. The electro-magnet, energised by the closing of warning contacts 9, 10, will then "hold in" the switch 22 until the contacts 9, 10 re-open to allow spring 23 to restore the switch to its original position. Furthermore, the provision of relief valve 20 vents excess pressure of oxygen in the wearer's breathing tube, as may be the case when the valve 16 and the demand regulator 18 are discharging oxygen.

Although a condition may also exist wherein a user's

breathing mask or tube may leak sufficiently to operate the warning contacts 9, 10, thereby opening the valve 16 and allowing further oxygen to escape, it is felt that this disadvantage is outweighed by the provision of a system enabling a user to remain conscious and alert under most conditions of oxygen supply irregularities.

I claim as my invention:

1. In combination with an oxygen demand regulator having means operatively pulsating at intervals commensurate with the user's breathing rate, means operating emergency oxygen equipment when the intervals exceed a predetermined time and comprising an activator for said equipment movable between pre-actuation and actuation positions, means urging the activator to move from its pre-actuation position to its actuation position and activate the emergency oxygen equipment, means responsive to each pulsation of the regulator to place the activator in its pre-actuation position and delay release of the activator from its pre-actuation position for a given period less than said predetermined time, means for retarding movement of the activator toward its actuation position following said given period such that the next succeeding pulsation of the regulator causes the movement of the activator towards the actuation position to be interrupted and the activator placed in its pre-actuation position unless the interval separating said pulsation exceeds the said predetermined time, and manual switch means for selectively deactivating the emergency oxygen equipment during the intervals exceeding the said predetermined time.

2. The combination according to claim 1 wherein the means responsive to each pulsation of the regulator to place the activator in its pre-actuation position includes a solenoid, the solenoid operating the activator to place it in its pre-actuation position when energized.

3. The combination according to claim 1 wherein the manual switch means includes an electromagnet energized for maintaining the deactivation of the said emergency equipment, the said electromagnet being de-energized when the interval separating the said pulsations is less than the said predetermined time.

4. The combination according to claim 2 wherein the means urging the activator comprises a spring biased to move the activator from its pre-actuation position to its actuation position.

5. The combination according to claim 2 wherein the means placing the activator in its pre-actuation position and delaying release of the activator further includes electrical relay means energizing the solenoid, the said relay means being responsive to the said pulsation to transmit an electrical pulse for the given period to the solenoid to delay the release of the activator from its pre-actuation position for the said given period.

6. The combination according to claim 2 wherein the means retarding the movement of the activator comprises a time delay mechanism controlling the activator in its movement toward the actuation position.

7. The combination according to claim 2 wherein the activator comprises a core for the said solenoid.

8. In combination with a demand regulator of an oxygen supply system, the said regulator having means operatively pulsating at intervals commensurate with the user's breathing rate, means operational to effect an emergency oxygen supply bypassing the demand regulator when the intervals exceed a predetermined time and comprising means defining a flow path of the emergency oxygen supply, valve means in the flow path means for selectively controlling the emergency oxygen and supplying the oxygen when activated, a valve activator movable between a pre-actuation position and a valve actuating position, means urging the activator to move from its pre-actuation position to its valve actuation position, means

responsive to each pulsation of the regulator to place the activator in its pre-actuation position and delay release of the activator from its pre-actuation position for a given period less than said predetermined time, means for retarding movement of the activator toward its valve actuation position following the said given period such that the next succeeding pulsation of the regulator causes the movement of the activator toward its valve actuation position to be interrupted and the activator placed in its pre-actuation position unless the interval separating said pulsations exceeds said predetermined time, manual switch means operable for selectively deactivating the valve means during the intervals succeeding the said predetermined time.

9. The combination according to claim 8 wherein the means placing the activator in its pre-actuation position includes solenoid means, and the said valve activator closes a pair of electrical contacts when the activator is in its valve actuation position.

10. The combination according to claim 8 wherein the manual switch means includes an electromagnet energized for maintaining the deactivation of said valve means and terminating the emergency oxygen supply, said electromagnet being energized only when the interval separating said pulsations exceeds the said predetermined time.

11. In combination with an oxygen demand regulator of an oxygen supply system, said regulator having means operatively pulsating at intervals commensurate with the user's breathing rate, means operational to effect an emergency oxygen supply bypassing the demand regulator and producing a warning signal when the intervals exceed a predetermined time, the said operational means comprising signal means, means defining an emergency oxygen supply path bypassing the demand regulator, valve means associated with the emergency oxygen bypass path means for effecting selective emergency supply when activated, means for activating the signal and valve means when the intervals exceed said predetermined time including an activator movable between pre-actuation and actuation positions, means urging the activator to move from its pre-actuation position to its actuation position, means responsive to each pulsation of the regulator to place the activator in its pre-actuation position and to delay release of the activator from its pre-actuation position for a given period less than said predetermined time, means for retarding the movement of the activator toward its actuation position following said given period such that the next succeeding pulsation of the regulator causes the movement of the activator toward its actuation position to be interrupted and the activator placed in its pre-actuation position unless the interval separating said pulsation exceeds said predetermined time, and manual switch means for selectively deactivating the valve means to terminate the emergency oxygen supply during the said intervals exceeding the said predetermined time.

12. The combination according to claim 11 wherein the manual switch means includes an electromagnet energized for maintaining deactivation of the valve means, the said electromagnet being energized only when the interval separating the said pulsation exceeds the said predetermined time.

References Cited in the file of this patent

UNITED STATES PATENTS

2,391,877	Cahan	Jan. 1, 1946
2,473,922	Tobias	June 21, 1949
2,828,741	Delest	Apr. 1, 1958
3,019,423	Glover et al.	Jan. 30, 1962

FOREIGN PATENTS

1,078,669	France	May 12, 1954