July 20, 1948. P. E. MEIDENBAUER, JR 2,445,359

VALVE MECHANISM FOR BREATHING APPARATUS

Original Filed Nov. 19, 1942

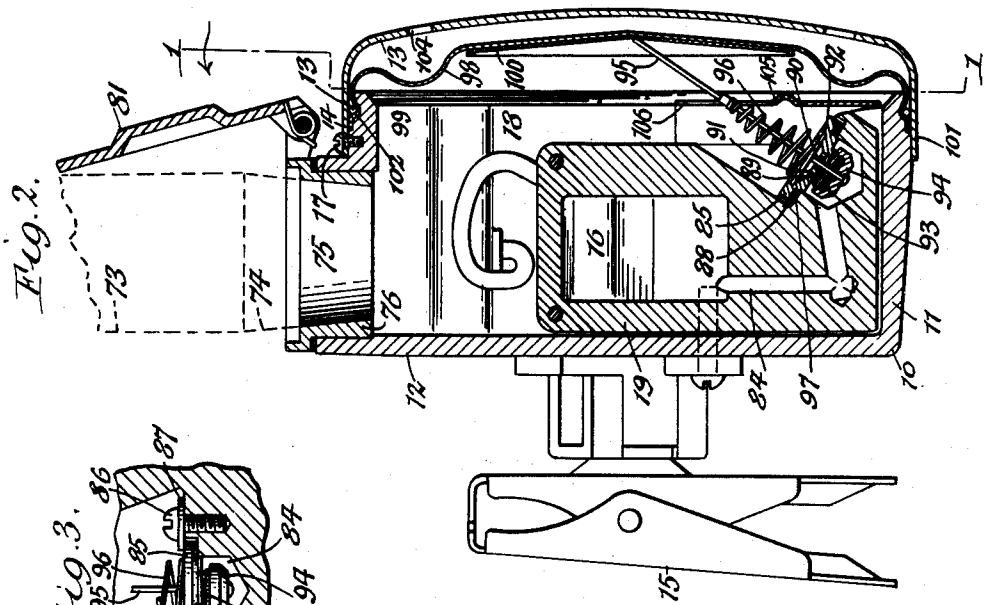


Fig. 2.

Fig. 3.

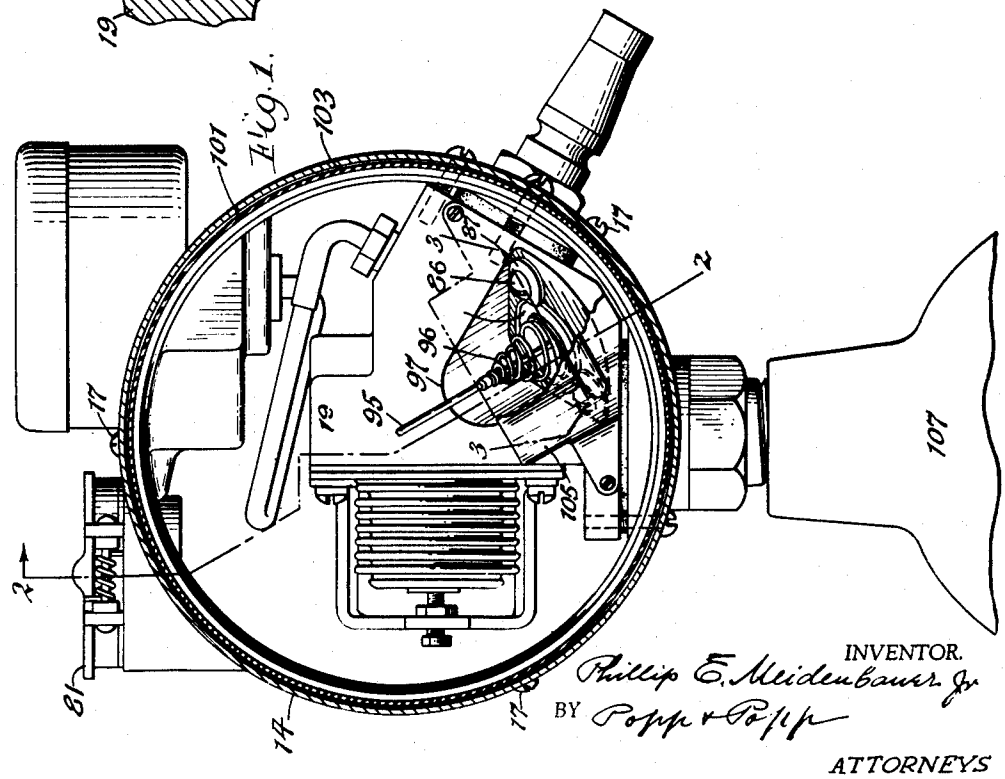


Fig. 1.

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Patented July 20, 1948 2,445,359

UNITED STATES PATENT OFFICE

2,445,359

VALVE MECHANISM FOR BREATHING APPARATUS

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Original application November 19, 1942, Serial No. 466,165, now Patent No. 2,399,054, dated April 23, 1946. Divided and this application December 24, 1943, Serial No. 515,549

2 Claims. (Cl. 137—153)

1

This invention relates to a breathing apparatus which is more particularly designed for use by aviators or aeronauts to supply oxygen when flying in high altitudes, but this apparatus may also be employed advantageously by miners, firemen and others for supplying oxygen or other life preserving fluid when operating in an atmosphere containing noxious or poisonous gases.

One of the objects of this invention is to provide an improved apparatus of this character in which the oxygen which is supplied from a suitable source is delivered to the user by a gas demand valve mechanism which operates in response to the breathing action of the user.

A further object of this invention is to provide an improved means for mounting the diaphragm of this mechanism on the body of the apparatus.

This application is a division of application Serial No. 466,165, filed November 19, 1942, now Patent No. 2,399,054, granted April 23, 1946.

In the accompanying drawings:

Fig. 1 is a vertical transverse section of the apparatus, taken on line 1—1, Fig. 3 looking rearwardly.

Fig. 2 is a vertical longitudinal section, taken on line 2—2, Fig. 1 and showing the inlet of the delivery chamber closed and its outlet open.

Fig. 3 is a fragmentary cross section of the demand valve mechanism taken generally on line 3—3, Fig. 1.

In the following description the reference numerals indicate corresponding parts in the several figures of the drawings.

The numeral 10 represents the main hollow enclosing case or housing of the apparatus upon which the various working elements of the apparatus are mounted and which preferably has the form of a cylinder the front side of which is open and comprises a cylindrical side wall 11, a flat rear wall 12 arranged at the rear edge of the side wall and formed integrally therewith by casting or otherwise, and a front wall or cover 13 preferably constructed of sheet metal and detachably connected with the respective part of the side wall by an annular flange 14 projecting rearwardly from the edge of the front wall and engaging with the cylindrical periphery of the side wall to which it is secured by screws 17.

Any suitable means may be employed for releasably mounting this body on the harness worn by the aviator such, for example, as the clip 15 attached to the rear wall of the body and adapted to grasp a belt or strap on the body of the aviator.

2

The space within the enclosing case is divided by a partition having the form of a body 19 into a receiving or reducing chamber 16 which receives the oxygen at low or reduced pressure from a high pressure source and a delivery or respiration chamber 18 into which the oxygen is transferred at atmospheric pressure from the receiving chamber and from which the oxygen is delivered to the aviator in accordance with his demand for the same.

The oxygen is withdrawn from the delivery chamber by inhalation of the aviator through the medium of an inhaling apparatus or mask which is applied to the face of the aviator and which is provided with an inhaling tube 73 of the usual character. When the aviator wishes to inhale oxygen from the delivery chamber the inlet or nozzle 74 of this inhaling apparatus is inserted in a tubular socket 75 which is formed in the bore of a bushing or sleeve 76 mounted on the case of the breathing apparatus. When the breathing apparatus is not in use the outlet opening in this sleeve is closed by a lid 81 which is connected at one part of its edge to the adjacent part of the sleeve by means of a hinge.

In order to use the breathing apparatus the lid is lifted and the nozzle of the inhaler inserted into the gas outlet of the delivery chamber.

As depletion of oxygen occurs in the delivery chamber the volume of oxygen withdrawn is automatically replenished by oxygen restoring means which form a part of the present improvement and which, in the preferred form, are constructed as follows:

The numeral 84 represents a gas restoring passage formed in the partition body 19 and extending from the receiving chamber 16 to the delivery chamber 18. This restoring passage is controlled by a demand or control valve mechanism which responds to the suction or vacuum effect produced in the delivery chamber by the inhalation of the aviator so that when the aviator withdraws gas from the delivery chamber a corresponding amount of gas will be automatically permitted to flow from the receiving chamber 16 into the delivery chamber 18 and when the withdrawal of gas from the delivery chamber ceases then the flow of gas from the receiving chamber to the delivery chamber will be automatically arrested.

This demand or restoring valve mechanism includes a valve plate 85 which extends across the outlet end of the restoring passage 84 and is secured to the partition by means of screws 86

threaded into the partition body and having washers 87 overlapping this valve plate, as shown in Fig. 1. A gasket 88 is clamped between the margin of this valve plate and the partition body to form an air-tight joint between these members. On its inner side the valve plate is provided with an annular valve seat 89, and its central part has a valve stem guide opening 90. Between the latter and the valve seat 89 this plate has a plurality of gas ports or openings 91. On its outer side the valve plate has a cavity forming a spring seat 92. The numeral 93 represents a control, demand or restoring valve having preferably the form of a disk made of rubber or the like and secured in a cup-shaped head 94 of metal. The numeral 95 represents a valve stem which has its inner part secured to the head 94 and passing through the valve 93 and also loosely through the central opening in the valve plate 85 while the outer part of this valve stem projects outwardly into the central part of the delivery chamber 18. The demand valve 93 is yieldingly held by a return spring 96 in a position in which this valve engages all parts of the seat 89 and thus closes the restoring passage 84. This spring preferably has the form of a helical cone which surrounds the inner part of the stem 95 and has its large inner end engaging the seat 92 while its small outer end is secured to the valve stem 95, as shown in Fig. 2. In the closed position of the controlling or restoring valve 93 the stem 95 is arranged axially in line with the center of the valve seat 89. For securing compactness the partition body 19 is provided with a recess 97 on its outer side in which the valve plate 85, the restoring valve and the inner or rear parts of the valve stem and return spring 96 are located. These parts are also so arranged that the axes of the same are inclined and the valve stem projects upwardly and outwardly relative to the lower part of the partition body, as shown in Fig. 2. Upon moving the valve stem 95 laterally inward relative to the axis of the valve seat 89, the demand valve 93 is rocked so that it turns with the outer part of its edge as a fulcrum on the outer part of the seat 89 and the diametrically opposite inner part of this valve is moved away from its seat, thereby uncovering the outlet of the restoring passage 84 and permitting gas to pass from the receiving chamber 16 to the delivery chamber 18. During this tilting movement of the demand valve 93 and valve stem 95, the return spring 96 is distorted so that when the valve stem is released the resilience of the spring 96 again returns the valve stem and restoring valve so that this stem is arranged in its central or normal position and the restoring valve is closed.

For the purpose of causing withdrawal of gas from the delivery chamber to automatically tilt the restoring or demand valve and open the same a movable wall is provided which moves inwardly in response to atmospheric pressure against its outer side while a vacuum is created on the inner side thereof by inhalation of the aviator and thereby actuates the valve stem 95 for opening the restoring valve. This movable wall preferably has the form of a flexible diaphragm 98 of thin rubber, impervious silk or the like which is arranged within the cover 13 and extends across the open end 99 in the corresponding side of the case or housing so that this diaphragm forms a wall of the delivery chamber 18. On the central part of the inner side of this diaphragm it is provided with a bearing plate 100 having the form of an outwardly dished disk which bears against the outer end of the valve stem. The flexible diaphragm is detachably secured to the peripheral surface of the case around its opening 99 by lapping the marginal flange 101 of this diaphragm over an annular groove 102 in this peripheral surface and holding this marginal part in said groove by means of an annular retaining member 103 which may consist of a rubber band, as shown in Figs. 1 and 2, or by a cord, a split spring ring or the like.

The cover or front wall 13 of the main housing is provided with a plurality of vent openings 104 to permit the external air to act on the outer side of the diaphragm.

In order to cause the gas as it issues from the restoring passage 84 to be deflected upwardly toward the outlet tube 75 of the delivery chamber, a deflector 105 is secured in an upright position on the lower part of the partition and across the space along the outer side of the restoring valve, thereby preventing this stream of gas, as it issues from the restoring passage 84, from striking the lower part of the diaphragm and interfering with the uniform operation of the same around its entire surface. This deflector is preferably high enough to cover all parts of this control valve mechanism except the upper part of the valve stem 95 and is provided with a notch or slot 106 through which this stem projects outwardly, as shown in Fig. 2.

In using this apparatus the aviator attaches the same to the breast portion of his harness by means of the clip 15 and then temporarily admits oxygen into the receiving chamber 16 from a bottle 107 or other source of supply until the required pressure has been attained in this chamber.

Upon reaching the higher altitudes in his flight and when the air becomes rarified or deficient in oxygen the aviator inserts the nozzle 73 of his inhaling tube into the outlet 75 of the delivery chamber and then, by inhaling, withdraws oxygen from the delivery chamber to the interior of the aviator's mask. While oxygen is withdrawn by inhalation from the delivery chamber 18 the latter is replenished from the receiving chamber 16 in the same measure as the aviator's demand or necessity requires by the automatic opening of the restoring or control valve 93 which results from the inward movement of the diaphragm 100 under atmospheric pressure so long as the aviator continues to inhale oxygen from the delivery chamber. When this inhalation ceases the recoil or resilience of the spring 96 causes the valve stem 95 to push the diaphragm outwardly and to close the controlling or restoring valve 93, thereby stopping the further flow of oxygen gas from the receiving chamber 16 to the delivery chamber 18. This operation is repeated as often as is found necessary to maintain the aviator in safe and comfortable condition.

I claim as my invention:

1. A breathing apparatus comprising a respiration chamber, a flexible diaphragm which forms a wall of said chamber and is moved by variations in pressure in said chamber, a fluid conduit leading to said chamber and having a valve seat the plane of which is arranged at an oblique angle relative to the plane of said diaphragm and a shoulder adjacent to said seat, and valve means for controlling the flow of fluid through said conduit into said chamber including a closure member engaging said seat, an inclined stem secured at one end to said closure member and bearing at its opposite end against said diaphragm, and

a spring connected at one end with said stem and bearing at its opposite end against said shoulder.

2. A breathing apparatus comprising a respiration chamber having a fluid inlet and a fluid outlet, a flexible diaphragm which forms a wall of said chamber and is adapted to move in response to variations in pressure within and without said chamber, a valve plate having a port which connects said fluid inlet with the interior of said chamber and is provided on its outer side around said port with a valve seat and on its inner side around said port with a shoulder, said seat and shoulder being arranged in planes which are at an oblique angle to the plane of said diaphragm, a closure member engaging said valve seat, an inclined valve stem extending through said port and connected at one end with said closure member and bearing at its opposite end against the inner side of said diaphragm, and a conical helical spring which surrounds said stem and has its small end secured to said stem and its large end engaging said shoulder and which tends to turn said stem and closure member in the direction for fully engaging said closure member with said seat.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,079,904	Perkins	Nov. 25, 1913
1,466,243	Neal	Aug. 28, 1923
1,630,408	Rosenthall	May 31, 1927
1,789,388	McMillan	Jan. 30, 1931
1,880,948	Evennett	Oct. 4, 1932
1,945,834	Terry	Feb. 6, 1934
2,075,029	Duncan	Mar. 30, 1937
2,149,584	Davis	Mar. 7, 1939
2,223,137	Tyden	Nov. 26, 1940
2,224,643	Calini	Dec. 10, 1940
2,263,611	Carnes	Nov. 25, 1941
2,242,367	Naab	May 20, 1941
2,314,553	Palm	May 23, 1943
2,318,827	Yant	May 11, 1943
2,328,214	Holmes	Aug. 31, 1943

FOREIGN PATENTS

Number	Country	Date
231,847	Germany	Feb. 28, 1911
340,145	Great Britain	Dec. 24, 1930