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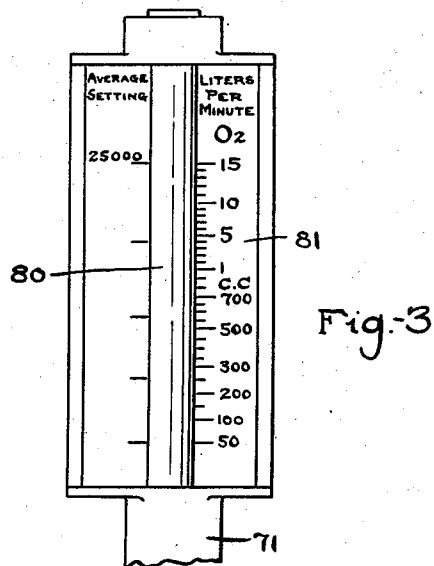
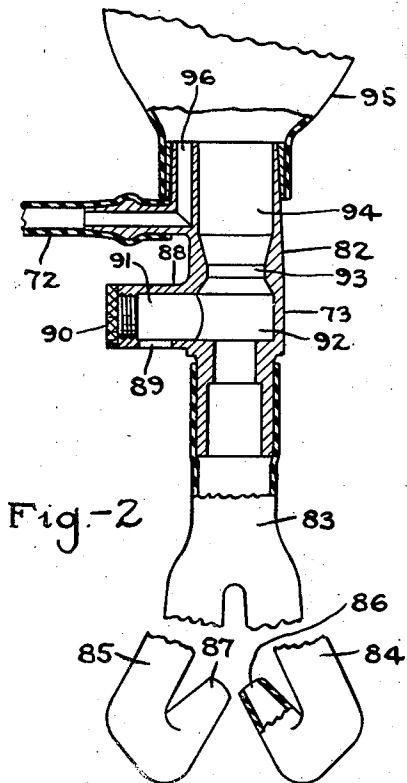
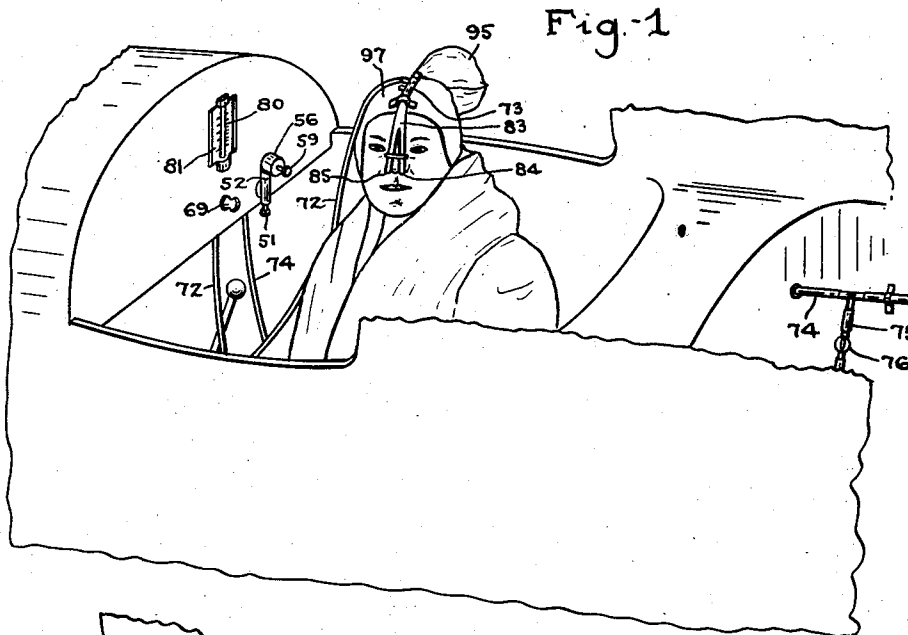
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2,185,997

MEANS FOR SUPPLYING TO INDIVIDUAL PERSONS AN OXYGENATED GAS MIXTURE

Filed Nov. 22, 1937

2 Sheets-Sheet 1



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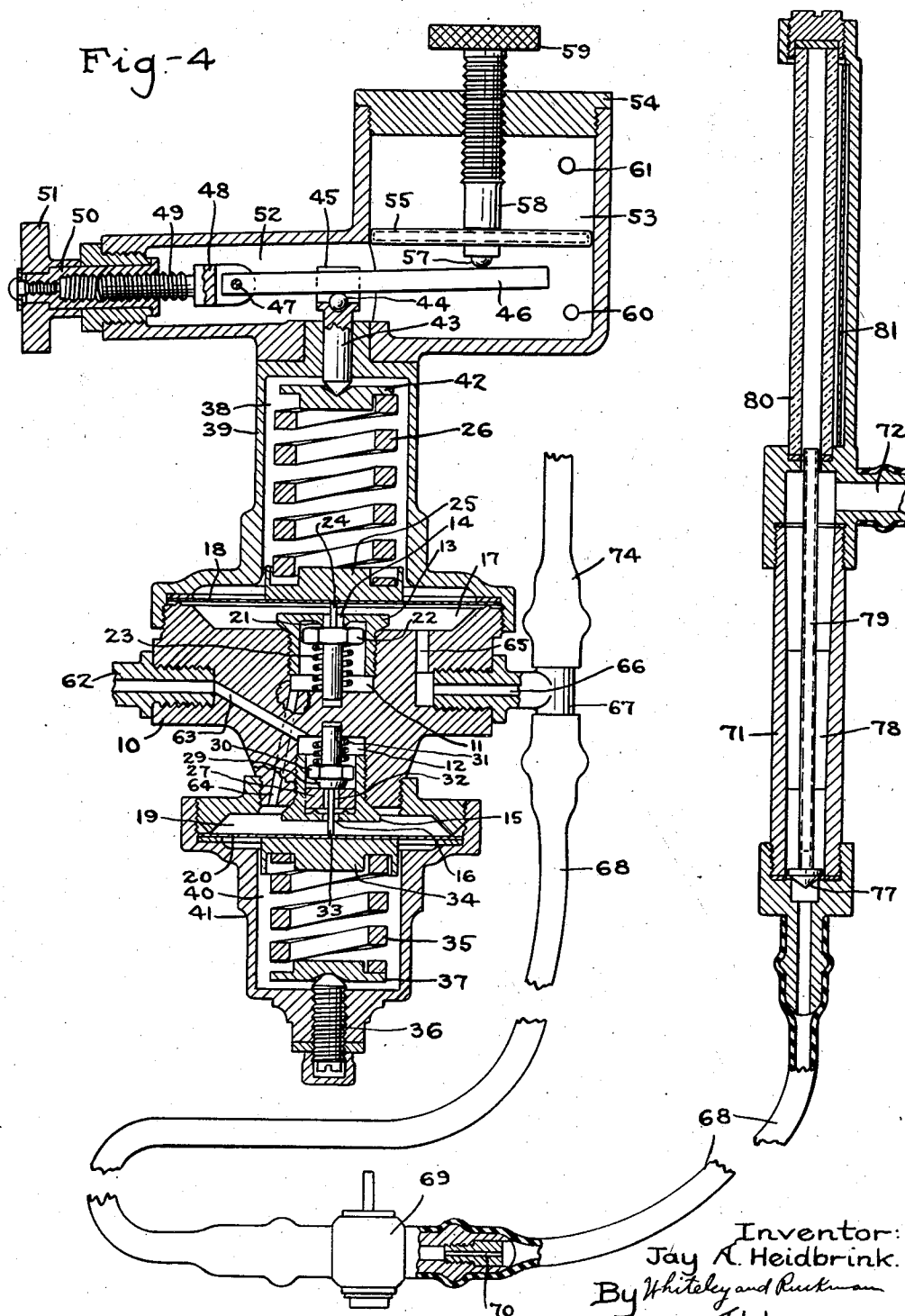
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2 Sheets-Sheet 2

Fig-4



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UNITED STATES PATENT OFFICE

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MEANS FOR SUPPLYING TO INDIVIDUAL PERSONS AN OXYGENATED GAS MIXTURE

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10 Claims. (Cl. 128—203)

My invention relates to means for supplying to individual persons an oxygenated gas mixture in an attenuated atmosphere, such, for example, as is encountered in airplane travel at high altitudes or in ascending high mountains.

It is an object of my invention to provide means for delivering to a stream of gas going to a patient, such as air, a quantity of oxygen in combination with automatically actuated means to increase the flow of oxygen to the gas mixture as the external air pressure diminishes.

It is a further object of my invention to provide means such that an operator can regulate manually the rate of flow of oxygen to the mixture of gases in atmospheres of varying densities.

It is a further object of my invention to provide means adapted to be worn on the heads of each individual person in, for example, an airplane with means connected therewith for breathing through the nose, means for supplying oxygen thereto, means for rebreathing the mixture of oxygen and air and means for injecting air into the mixture.

It is a further object of my invention to provide means for supplying a mixture of gases to the pilot and his passengers and solely under the control of the pilot for regulating the amount of oxygen going to the passengers.

The full objects and advantages of my invention will appear in connection with the detailed description thereof, and its novel features are pointed out in the appended claims.

In the drawings, illustrating an application of my invention in one form—

Fig. 1 illustrates a fragmentary portion of the pilot and passenger compartments of an airplane showing a figure therein and my invention applied thereto. Fig. 2 is a part sectional view of the air oxygen mixing and rebreathing device and the nasal inhalers employed in connection therewith. Fig. 3 is a front illustration of a gauge for showing the delivery of oxygen gas per minute. Fig. 4 is an enlarged sectional detail view of the oxygen flow control mechanism and the gauge for illustrating it.

Referring particularly to Fig. 4, a casting member 10 is provided with oppositely-disposed upper and lower valve chambers 11 and 12. Valve chamber 11 is closed by a tubular threaded member 13 except for an orifice 14 at the center thereof. In like manner valve chamber 12 is closed by a tubular member 15 except for a centrally-disposed orifice 16. Above valve chamber 11 is an expanded chamber 17 having its top closed by a diaphragm 18. Below valve cham-

ber 12 is an expanded chamber 19 having its bottom closed by a diaphragm 20. A valve seat 21 is formed about the central opening 14 from valve chamber 11. The inner wall of valve chamber 11 is cylindrical, and within it moves a valve head 22 which is hexagonal in shape, so there are passages along the six faces of the plunger from below to above it. A coil spring 23 tends to force the plunger 22 against the valve seat 21 with a moderate pressure. The diaphragm 18 is provided with a thrust pin 24 and has resting upon the diaphragm a head 25 which is engaged by a strong compression spring 26. The spring 26 tends to move the diaphragm 18 and the pin 24 downwardly, and the pin in turn will move the valve head 22 away from the valve seat 21 so as to permit gas to flow past it through opening 14 into chamber 17. The valve chamber 12 has toward its bottom a valve block 27 which is engaged by a valve seat 29 on a hexagonal valve head 30 in chamber 12. A compression spring 31 tends to move the valve head 30 so as to cause the valve seat 29 thereon to engage the valve seat 28 and close communication between valve chamber 12 and expanded chamber 19. But a circular port 32 leads through valve block 27 to permit gas to pass the hexagonal faces of the valve head 30 and from thence to flow through openings 32 and 16 into chamber 19.

The diaphragm 20 is engaged by a pusher pin 33 which extends from the center of the valve head 30, and a head 34 is caused to engage the diaphragm 20 by means of a strong compression spring 35. The pressure of compression spring 35 is regulated by means of an adjusting screw 36 which engages a piece 37 located between the end of the adjusting screw and the spring 35. The spring 26 is held within a chamber 38 in a casing member 39, and the spring 35 is held within a chamber 40 inside of a casing member 41.

To regulate the degree of compression upon spring 26 in chamber 38 the following means is employed: A plunger piece 42 upon the top of spring 26 is engaged by a plunger pin 43 upon a ball 44 riding on a seat in the upper part of plunger pin 43, and held in position by keeper arms 45 is a bar 46 which is pivotally connected at 47 with a movable head 48. The head 48 has a portion 49 threaded into an internally-threaded rotatable nut 50 controlled by a thumb screw 51 by which means the head 48 and the bar 46 connected therewith may be moved longitudinally, as desired, within the chamber 52 which houses the bar 46 and the head 48. With-

in an upward extension 53 of chamber 52, closed by a cap 54, is located a pressurestat 55, which, as shown, comprises a cylindrical hollow disc-like member with flexible walls, the interior of said member being filled with an expansible gas such as air. Upon the lower side of the pressurestat 55 is a head 56 in which is mounted a ball 57 which engages the pivoted bar 46. Engaging the upper side of the pressurestat 55 and threaded through the cap 54 is a member 58 whereby the pressurestat itself and with it the members 56 and 57 and pivoted bar 46 may be moved in either direction to put more or less pressure upon the strong spring 26.

With the above construction the length of fulcrum of lever arm 46 from pivot point 47 to thrust ball 44 is varied at will by the operator, and this has the effect of increasing or decreasing the throw of the plunger pin 43 produced either by operating the pin 58 by thumb nut 59 or by the automatic action of the pressurestat 55. Thus, the pilot or operator can vary the rate of change of delivery of oxygen effected automatically according to conditions encountered.

Apertures 60 and 61 into chambers 52 and 53, respectively, equalize the pressure in these chambers on each side of the pressurestat 55. It follows that as the air pressure in chambers 52 and 53 changes, say decreases upon an airplane's going into higher altitudes, the expansion of the gas within the pressurestat 55 will cause the member 56 and the ball 57 to push upon the pivoted bar 46 and increase the pressure of spring 26 upon diaphragm 18 for a purpose hereinafter described.

A tubular member 62 conveys oxygen gas from a source of oxygen supply such as a tank of compressed oxygen of common commercial use, not shown, through a passageway 63 in the valve block 10 and into the valve chamber 12, and, in turn, when the gas is released to flow as hereinafter described, it will enter expanded chamber 19 and flow therefrom through a passageway 64 into valve chamber 11, and from thence, when the valve 21, 22 opens, into expanded chamber 17. From chamber 17 the gas will flow through passageway 65 and passageway 66 to a delivery chamber 67. From delivery chamber 67 a tube and piping 68 will carry the gas past a close-off pet cock 69 and a proportioning bore 70 to a flow meter 71 and thence through pipe and connecting tubing 72 to inhaler mechanism 73 on the head of the pilot or operator as shown in Fig. 1. At the same time from chamber 67 piping 74, comprising a manifold, will have branches 75 each controlled by a pet cock 76 and having a proportioning orifice similar to orifice 70, which will go to inhaler mechanism on the heads of the several passengers in the same manner as shown in Fig. 1 applied to the head of the pilot or operator.

These proportioning orifices determine the volume of oxygen delivered at any constant pressure, and as the pressure increases or decreases, from the operation of the regulating mechanism heretofore described, that volume will be correspondingly increased or decreased. Also in the arrangement above described, since the gas goes to the several passengers through proportioning orifices the same as the proportioning orifice 70 which conducts the gas through the flow meter 71 and by passageway 72 to the pilot, the passengers will get the same volume of gas at any given pressure as comes to the pilot and is shown

on the flow meter. Hence, the control of the flow of gas by the pilot from inspection of the flow meter controls the supply of gas to the passengers.

The flow meter 71 is of well-known construction wherein a piston 77 is subject to the moving gas under pressure and is moved upwardly more or less in a conical chamber 78 toward the gas outlet 72. The piston 77 carries a rod 79 which is visible, when gas is flowing, through closed tube 80, Fig. 3, and the end of the rod will indicate on scale 81 the volume of gas flowing through delivery pipe 72. This will be the volume of gas going to the pilot or operator. However, since that volume passes through the bore 70, and the gas going to each of the passengers passes through a similar bore, the flow of gas to the pilot and to the passengers at any given pressure will be in equal volume.

The pressure at which gas is delivered, and consequently the volume of gas which passes the orifices 70 to the pilot and to the passengers, is determined generally by the pressure exerted by spring 26 upon diaphragm 18 and spring 35 upon diaphragm 20. Obviously, since the pressure of these springs tends to open the valves, and the pressure of the gas in chambers 17 and 19 upon diaphragms 18 and 20 tends to close the valves, increasing the pressure of the springs will increase the necessary pressure upon the diaphragms to close the valves and will increase the pressure at which the gas will flow through opening 66 to chamber 67 and conveying tubes 68 and 74. The pressure of spring 35 will generally be fixed in advance and not changed, but the pressure of spring 26 is subject to change and adjustment from time to time through thumb nuts 51 and 59 in front of the pilot or operator, as shown in Fig. 1, and also will be subject to change through the effect of atmospheric pressure on the pressurestat 25 steadily increasing as the atmospheric pressure decreases.

The inhaler mechanism (identically the same for pilot and passengers) is shown in position in Fig. 1 and in its details in Fig. 2. This inhaler mechanism comprises a casing 82 from which extends in one direction tubing 83 with nasal branches 84 and 85 and nasal plugs 86 and 87. The casing 82 is provided with an offset member 88 having a port or opening 89 and closed by a cap 90. If desired the port 89 may be made adjustable in size. The port 89 opens into a passageway 91, which in turn opens into a passageway 92 in the casing 82 adjacent a venturi 93 leading through a passageway 94 to a rebreathing bag 95. The oxygen from conveyor 72 goes through a passageway 96 directly into rebreathing bag 95.

The entire arrangement will be secured by a cap 97 or other securing means upon the head of the individual in such manner that the nasal plugs 86 and 87 will be securely held in the nostrils of the wearer. The wearer will be advised to breathe entirely through the nose. Upon inhalation oxygen mixed with exhaled gas and air will be drawn into the lungs of the individual wearer. Upon exhalation part of the exhaled gases will go to the rebreathing bag and carry along with them some air to be mixed therewith by reason of the action of the venturi 93. When, however, the pressure in the rebreathing bag builds up sufficiently, part of the exhaled gases will discharge through the orifice 89 to atmosphere. In this manner the carbon dioxide which otherwise would accumulate in the rebreathing

bag is disseminated, and it is also true that some air will join the stream of mixed oxygen and rebreathed gases to go to the lungs on inhalation.

The advantages of my invention have been quite fully pointed out in connection with the detailed description thereof. The primary purpose to be served in its use is to furnish an adequate amount of oxygen to pilot and passengers in airplanes at high altitudes. At the present time in passing over the Rocky Mountains pilots have endeavored to keep as low down as possible in order that passengers might not be rendered too uncomfortable from breathing attenuated atmosphere due to elevation. This has been the cause of a good many accidents in which the planes have struck mountain sides and pilots and passengers have been killed. With my invention in the airplane it will be possible as planes are operated now to go up several thousand feet higher than at present is the practice and obviate the danger of grounding on the mountains and at the same time keep the passengers and pilot properly supplied with oxygen. It is generally believed, too, that a time is coming when airplane travel will at all times be at higher altitudes, perhaps as high as the lower stratosphere, and, of course, some means of supplying sufficiently oxygenated air will be essential under such conditions. It is a highly important feature of my invention, and one of its chief advantages that the regulation of oxygen supply to the passengers is both automatically determined by the air pressure, or, which is substantially the same thing, by the elevation, and at the same time is subject to regulation by a single trained and expert operator, and who may be, and in most cases will be, the airplane pilot. The arrangement of small bore tubes through which the oxygen flows alike to pilot and passengers with flow gauge available to the inspection of the pilot, makes it possible for the pilot at all times to know just the volume of oxygen going to the passengers and to adjust that volume from time to time as changing conditions may require. In the drawings I have shown but one aneroid or pressurestat, which obviously can be made of any form or size, and filled with any desired type of gas to produce the most efficient results. It is also obvious that several of such aneroids or pressurestats may be placed in series so that the throw of each is transmitted to a succeeding one, and in that way a throw of any length may be obtained.

I claim:

1. A device for delivering oxygen to an operator and other individuals, comprising a supply of oxygen, means including separate connections to the operator and to each of the other individuals for delivering to the operator and such individuals oxygen under pressure from said supply, means controlled by the operator to change the delivery pressure and thus to change the rate of delivery of said oxygen, and means in each of said separate connections including a proportioning orifice of predetermined small size for effecting the same rate of delivery to both the operator and the other individuals at any constant pressure.

2. A device for delivering oxygen to an operator and other individuals, comprising a supply of oxygen, means including separate connections to the operator and to each of the other individuals for delivering to the operator and such individuals oxygen under pressure from

said supply, means controlled by the operator to change the delivery pressure and thus to change the rate of delivery of said oxygen, means in each of said separate connections including a proportioning orifice of predetermined small size for effecting the same rate of delivery to both the operator and the other individuals at any constant pressure, and means including a flow gauge adapted to indicate rate of flow to the operator, whereby the operator can change said pressures and so change volumes of flow as indicated by said flow gauge.

3. A device for delivering oxygen to an operator and other individuals, comprising a supply of oxygen, means including separate connections to the operator and to each of the other individuals for delivering to the operator and such individuals oxygen from said supply, means automatically operated through changes of external air pressure to change delivery pressure and thus change the rate of delivery of said oxygen, and means in each of said separate connections including a proportioning orifice of predetermined small size for effecting the same rate of delivery to both the operator and the other individuals at any constant pressure.

4. A device for delivering oxygen to an operator and other individuals, comprising a supply of oxygen, means including separate connections to the operator and to each of the other individuals for delivering to the operator and such individuals oxygen under pressure from said supply, means controlled by the operator and other means automatically operated through changes of external air pressure to change delivery pressure and thus change the rate of delivery of said oxygen, and means in each of said separate connections including a proportioning orifice of predetermined small size for effecting the same rate of delivery to both the operator and the other individuals at any constant pressure.

5. In combination with an airplane and the pilot and passenger compartments therein, a source of oxygen supply, individual sets of inhalers and rebreathing bags adapted to be supported on the heads of pilot and passengers, a manifold and connections thereto from said oxygen supply for delivering a stream of oxygen directly to each of said head-supported rebreathing bags, said connections including proportioning orifices of predetermined small size and the same size for each individual inhaler, means controlled solely by the pilot for regulating the volume of gas delivered to each individual, and a flow meter and gauge for use of the pilot or operator in governing the said rate of delivery.

6. A device for delivering oxygenated gas mixture to individuals, comprising inhaler and rebreathing mechanism adapted to be supported on the head, means for delivering a stream of oxygen directly to the rebreathing mechanism, means automatically operative through changes of air pressure to vary the rate of delivery of said oxygen including an aneroid and a swinging bar operated thereby engaging a thrust point, means controlled by the operator for moving the bar endwise relatively to said thrust point to change the length of fulcrum of said bar to vary the rate of change of delivery rate of oxygen effected by said aneroid.

7. A device for delivering oxygenated gas mixture to individuals comprising a source of oxygen supply and means for conveying oxygen therefrom, valve mechanism including a diaphragm, a

spring positioned to exert force against said diaphragm against the pressure of gas upon the diaphragm to open said valve mechanism, a swinging bar connected to engage said spring, and means engageable with said bar including an aneroid to hold it against the force of said spring.

8. A device for delivering oxygenated gas mixture to individuals comprising a source of oxygen supply and means for conveying oxygen therefrom, valve mechanism including a diaphragm, a spring positioned to exert force against said diaphragm against the pressure of gas upon the diaphragm to open said valve mechanism, a swinging bar connected to engage said spring, means engageable with said bar including an aneroid to hold it against the force of said spring, and means to operate said last-named means to swing the bar to vary the pressure exerted by the spring on the diaphragm.

9. A device for delivering oxygenated gas mixture to individuals comprising a source of oxygen supply and means for conveying oxygen therefrom, valve mechanism including a diaphragm, a spring positioned to exert force against said diaphragm against the pressure of gas upon the diaphragm to open said valve mechanism, a

swinging bar having a pivot fulcrum connected to engage said spring, means engageable with said bar including an aneroid to hold it against the force of said spring, and means to move the bar and its pivot endwise for varying the effective length of the lever arm from the fulcrum pivot to its point of thrust on the spring.

10. A device for delivering oxygenated gas mixture to individuals comprising a source of oxygen supply and means for conveying oxygen therefrom, valve mechanism including a diaphragm, a spring positioned to exert force against said diaphragm against the pressure of gas upon the diaphragm to open said valve mechanism, a swinging bar having a pivot fulcrum connected to engage said spring, means engageable with said bar including an aneroid to hold it against the force of said spring, means to operate said last-named means to swing the bar on its pivot to vary the pressure exerted on the spring on the diaphragm, and means to move the bar and its pivot endwise for varying the effective length of the lever arm from the fulcrum pivot to its point of thrust on the spring.

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