March 1, 1960 H. SEELER 2,926,659

BLOWER RESUSCITATOR

Filed June 22, 1955 2 Sheets-Sheet 1

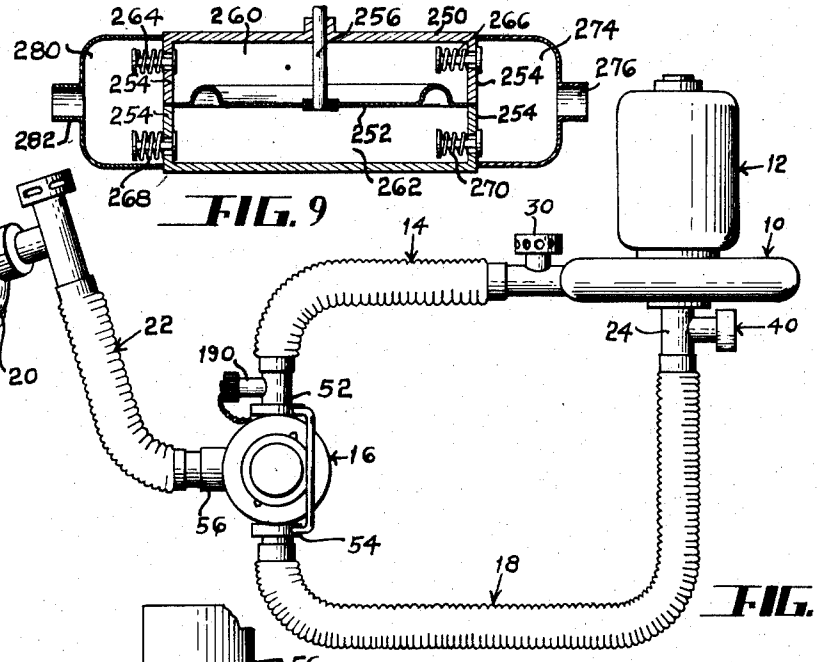


FIG. 9

FIG. 1

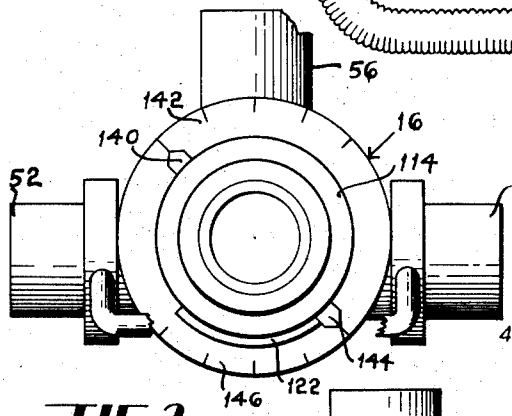


FIG. 2

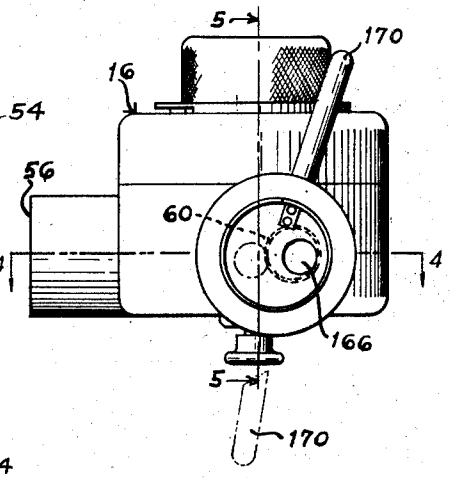


FIG. 3

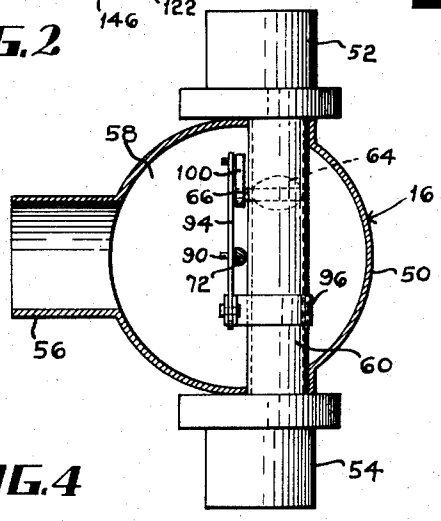


FIG. 4

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BLOWER RESUSCITATOR

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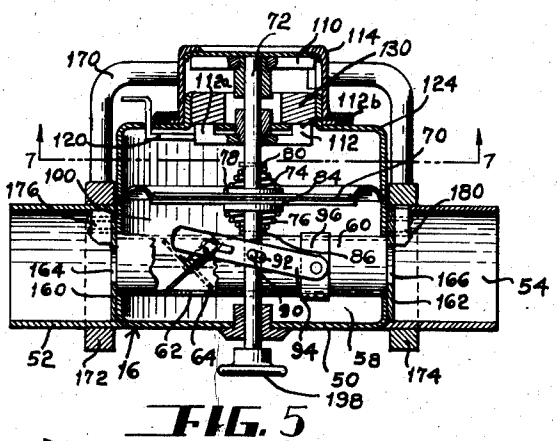


FIG. 5

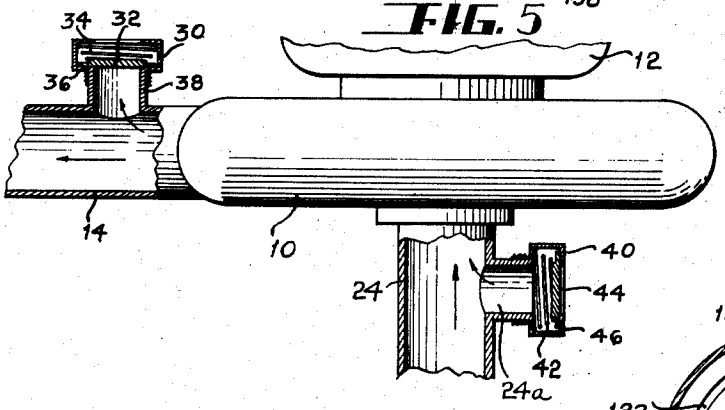


FIG. 6

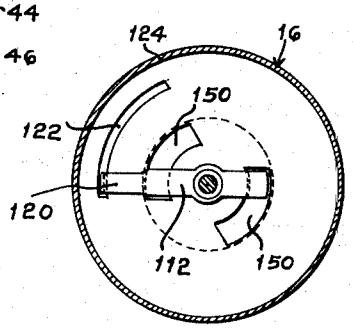


FIG. 7

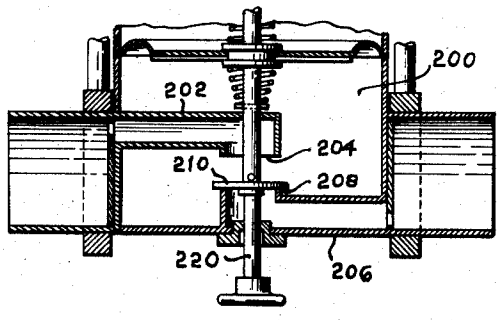


FIG. 8

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2,926,659

BLOWER RESUSCITATOR

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Application June 22, 1955, Serial No. 517,406

9 Claims. (Cl. 128—29)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

This invention relates to a blower type resuscitator and more particularly to a blower type resuscitator wherein both the intakes and outlets of the blower are used in supplying differential air pressures to a face mask used in supplying fluid pressures to a patient.

In the past, resuscitators have been used that are provided with a valve mechanism and a control therefor used in association with a venturi to alternately supply air or a fluid under pressure during one portion of a cycle and then during another portion a negative pressure as compared to the ambient pressure. This may be accomplished by a suitable valve mechanism.

In the past, a number of resuscitators have been used, wherein the positive air pressure is supplied to the resuscitator and a venturi mechanism, or some other mechanism, is used for creating a negative pressure, illustrative of which is disclosed in my United States Letters Patent Re. 23,845, patented June 29, 1954, for Resuscitator.

An object of this invention is to provide a valve mechanism used in connection with a blower, wherein positive pressure is supplied from the outlet of the blower and negative pressure is supplied from the intake of the blower.

Other objects and advantages reside in the construction of parts, the combination thereof and the mode of operation, as will become more apparent from the following description.

In the drawings, Figure 1 discloses a plan view of a resuscitator.

Figure 2 is an enlarged top plan view of the valve mechanism with parts broken away.

Figure 3 is a side elevational view of the valve mechanism disclosed in Figure 2.

Figure 4 is a cross sectional view taken substantially on the line 4—4 of Figure 3.

Figure 5 is another cross sectional view taken substantially on the line 5—5 of Figure 3.

Figure 6 discloses fragmentary, sectional views of the conduits and the intake and outlet valves in the vicinity of the blower.

Figure 7 is a cross sectional view taken substantially on the line 7—7 of Figure 5.

Figure 8 is a cross sectional view of a modification.

Figure 9 is a cross sectional view of a diaphragm type of air compressor or blower.

The resuscitator assembly includes a blower **10**, a motor **12** for driving the blower, a conduit **14** connected to a valve mechanism or assembly **16**, a suction conduit **18** connected to the suction side of the blower and a breathing device in the form of a face mask **20** connected by a conduit **22** to the valve assembly **16**. Each of these devices will now be described in detail.

The blower **10** is a centrifugal or diaphragm type

blower driven either manually or by an electric motor **12**. The high pressure side of the blower **10** is connected by the conduit **14** to the valve assembly **16**. The suction side, that is, the center of the housing, is connected through a nipple **24** and the conduit **18** to the valve mechanism **16**.

The conduit **14** has mounted therein a relief or exhaust valve **30**, best seen in Figure 6, that includes a valve member **32** urged by means of a spring **34** against a valve seat **36** at the outlet of a short conduit **38** connected to the conduit **14**. The tension of the spring **34** may be adjusted by adjusting the valve **30** threadedly engaging the conduit **38**. In view of the fact that the conduit **14** is connected to the high pressure side of the blower, it may be readily seen that the pressure within the conduit **14** is greater than the ambient air pressure when the blower is in use. In the event the air pressure in the conduit **14** increases beyond a predetermined pressure, the valve **30** opens automatically to provide an escape passage for the air, thereby preventing the air pressure in the conduit from increasing above a predetermined value. This will be described more fully when explaining the operation of the resuscitator.

As best seen in Figure 6, in the nipple **24** is mounted an intake valve **40** biased into closed position by means of a spring **42** engaging a valve member **44** seated against a valve seat **46**, so that when the negative pressure in the nipple **24** drops below a predetermined value, air is admitted to the intake valve **40**. The tension of the spring **42** may be adjusted by rotating the valve mechanism **40**, threadedly engaging the tubular projection **24***a*. The pressures in the conduits **14** and **18** are in part controlled by the valve mechanism **16**, which will now be described.

The valve mechanism **16** includes a housing **50** provided with an intake opening **52**, a suction opening **54** and a suction opening **56**, all of these communicating with a chamber **58** within the housing **50**. The intake opening **52** is connected to the conduit **14** and the suction opening **56** is connected to the conduit **18**. A tubular conduit **60** extends across the chamber **58**. One terminal of the conduit **60** is fixedly secured in an opening in the wall of the chamber **58** and communicates with the intake opening **52**. The other end of the tubular conduit **60** is fixedly seated in a diametrically disposed opening in the wall of the chamber **58** and communicates with the suction opening **54**, as best illustrated in Figure 5. As clearly seen in this figure, the conduit **60** is provided with an opening **62** communicating with the chamber **58**. A butterfly valve **64** is mounted in the conduit **60** upon a transversely disposed pintle **66**. The butterfly valve **64**, when in the position shown in Figure 5, provides a passage from the chamber **58** through the opening **62** to the suction passage **54** connected by means of the conduit **18** to the low pressure side of the blower.

It can readily be seen that the pressure in the chamber **58** increases unless the air is permitted to freely escape through the conduit **22** to the face mask **20**. When the face mask is applied to a person's face, the flow of air is limited to the capacity of the respiratory organs of the body, which organs constitute a closed volume. When the pressure within the chamber reaches a predetermined positive pressure when the butterfly valve is in the full line position shown in Figure 5, a mechanism is provided for rapidly flipping the butterfly valve **64** from the full line position shown in Figure 5 to the dotted position shown in this figure, so as to connect the opening **62** to the suction opening **54**, the opening **62** then being disconnected or shut off from the intake opening **52**. The mechanism for actuating the valve will now be described.

One wall of the chamber **58** is provided with a flexible diaphragm **70**, the periphery of which is sealed to the

housing 50. A slidably mounted armature 72 is resiliently connected to the diaphragm 70 by means of a pair of springs 74 and 76, the spring 74 being positioned between a washer 78 seated against the diaphragm and a pin 80 extending through the armature. The spring 76 is positioned between a washer 84 seated against the opposite side of the diaphragm and a transverse pin 86 extending through the armature. The armature 72 is provided with a pin 90 located in the slot 92 in a lever 94 having one end pivotally attached to a collar 96 fixedly secured to the transversely disposed tubular conduit 60. The opposite end of the lever 94 is connected to a crank arm 100 fixedly attached to the pintle 66.

The armature 72 has mounted thereon a pair of ferro-magnetic bars 110 and 112. These bars are mounted for rotary adjustment on the armature 72 without axial adjustment thereof. The bar 110 is non-rotatably mounted in a cap member 114; but is mounted for longitudinal movement therein, so that the bar 110 may be angularly adjusted. The bar 112 is connected by means of a lever 120 and has one end projecting outwardly through a slot 122 in a capping member 124 attached to the housing 50. The ferro-magnetic bar 112 may be adjusted angularly by actuating the lever 120.

A permanent magnet 130 is provided with north and south poles diametrically disposed with respect to the armature 72. Either the bar 110 or the bar 112 is in contact with the magnet 130 at all times excepting during the period of time that the butterfly valve 64 is flipped from one position to another. The force required to release the ferro-magnetic bar engaging the magnet, whether it be the bar 110 or the bar 112, is dependent upon the angular adjustment of the two bars. If bar 110 is aligned with the north and south poles of the magnet 130, the maximum force will be required to release this bar. If it is found desirable to release the bar with a lesser force, it is merely necessary to actuate or rotate the cap member 114 provided with an indicant 140 registering with graduations 142 on cap member 124. Likewise, if it is found desirable to change the force required to release the bar 112 from the magnet when it is in contact with the magnet, the lever 120, provided with an indicant 144, may be adjusted along the graduated scale 146 to obtain the proper force for the release of the magnet.

The bar 112, as clearly seen in Figure 5, is provided with a pair of projections 112*a* and 112*b*, projecting through a pair of slots 150, as clearly shown in Figure 7, so as to permit the bar 112 to come into direct contact with the permanent magnet 130.

The rate of flow of air to the chamber 58 from the blower and from the chamber 58 through the suction conduit may be adjusted by an auxiliary valve mechanism, which will now be described. As best seen in Figure 5, a pair of discs 160 and 162, provided with apertures of air passages 164 and 166 respectively, are aligned with the ends of the transverse conduit 60. The apertures or air passages 164 and 166 are eccentrically mounted, so that by rotating the discs the size of the air passage to and from the conduit 60 may be adjusted. This is accomplished by adjusting the handle or bail 170 fixedly attached to a pair of collars 172 and 174 mounted for rotation upon the tubular extensions forming the intake opening 52 to the suction opening 54. These collars 172 and 174 are each provided with an inwardly directed lug 176 and 180 respectively fixedly attached to the discs 160 and 162 respectively and projecting through slots underlying the collars 172 and 174, so as to adjust the discs 160 and 162 to open or restrict the flow of air from and to the blower, as the case may be.

As may readily be seen from Figure 3, when the handle 170 is in the position shown in full line, the entire air passage 166 communicates with the conduit 60. When actuating the handle 170 into the dotted position shown in Figure 3, the air passage 166 can then be adjusted so as to practically eliminate all flow of air through the conduit 60.

In the event it is found desirable to supply oxygen or some other gas to the resuscitator, this may be done by connecting an oxygen tank to the conduit 190, so as to supply oxygen to the air intake.

In the modification disclosed in Figure 8, a valve mechanism has been shown eliminating the use of the butterfly valve. The chamber 200 is provided with an intake conduit 202 opening downwardly, as viewed in Figure 8 at 204, this providing a valve seat. A suction conduit 206 terminates in a valve seat 208 closed by a valve 210, as shown in this figure. This valve 210 is mounted upon an armature 220 provided with magnetic bars associated with a magnet like that disclosed in the preferred embodiment. However, in shifting the valve 210, it is carried directly by the armature, so as to be seated on the valve seat 204 or on the valve seat 208, as the case may be.

The air compressor or blower shown in Figure 9 includes a housing 250 having mounted therein a diaphragm 252, the margins of which are sealed in the sides 254 of the housing. The diaphragm is reciprocated by means of member 256 driven through any suitable mechanism. As member 250 is reciprocated, it moves the diaphragm up and down, as viewed in Figure 9. When the diaphragm moves downwardly, a suction is created in the upper chamber 260 and the air in the lower chamber 262 is then compressed. By creating a partial vacuum in the chamber 260, the intake valve 264 is opened. An outlet valve 266 is held in closed position. Due to the fact that the air in the chamber 262 is then compressed, the intake valve 268 is then held closed and the outlet or exhaust valve 270 is then opened, forcing the air from the chamber 262 into the end chamber 274, connected by a nipple 276 to the flexible tubular member 14. Due to the fact that a vacuum is created in a chamber 280, the nozzle 282 may then be referred to as a suction nozzle and is adapted to be connected to the tube 18 and a suitable intake valve 40, like that disclosed in connection with the preferred embodiment. In other words, the air compressor disclosed in Figure 9 could then be substituted for the blower 10. The resuscitator disclosed herein may be used with any suitable type of air compressor or blower.

Mode of operation

This resuscitator may be used for reviving persons suffering from asphyxiation, drowning or other mishaps. The device will first be described in its normal use as a resuscitator.

In reviving a patient, the face mask 20 is placed over the nose and the mouth of the patient. In the case of a drowning, it is first desirable to use the device as an aspirator to withdraw water from the lungs. Continuous suction may be supplied to the patient by holding the armature 72 so that the butterfly valve 64 is in the dotted position, as shown in Figure 5, by merely manually engaging the knob 198 attached to the armature 72. By holding the armature, suction may be applied for a sufficient period of time to remove water from the lungs of the patient.

After this has been done, or in the case of asphyxiation or suffocation, the resuscitator is permitted to operate in the normal mode of operation. It is preferable to first adjust the position of the magnetic bars 110 and 112, so as to obtain the desired pressures, which may be determined from the graduations 142 and 146. Furthermore, the length of each cycle or the rate of flow of air may be adjusted by adjusting the bail or handle 170. The larger the capacity of the lungs, the greater the quantity of air and higher pressure may be used. For example, an adult may use a larger volume than an infant.

After the resuscitator has been set and the face mask applied to the patient, air will first be withdrawn from

the lungs of the patient, in that the valve 64 has closed the passage to the high pressure side of the blower and opened the passage to the suction side of the blower. The air pressure will open the valve 32, so as to exhaust air into the open. Suction will continue until the diaphragm 70 is drawn inwardly by a force sufficient to release the magnetic bar 112 from the permanent magnet 130. As soon as the bar 112 lets go from the magnet 130, the valve 64 is moved from the full line position shown in Figure 5 to the dotted position shown therein, closing the conduit connected to the suction side of the blower and opening into the chamber 58 the conduit 14 connected to the high pressure side of the blower. The valve 32 will then close and the valve 44 will open, so as to admit sufficient air to cause inhalation. This continues until a predetermined pressure is built up within the chamber 58 and at the same time within the lungs of the patient. The diaphragm will then tend to push outwardly and eventually the force exerted by the diaphragm 70 is sufficient to release the magnetic bar 110 from the magnet 130, at which time the magnetic bar 112 will be attracted to the magnet 130 and again flip the valve into the full line position shown in Figure 5. These operations continue. The timing of each cycle, as stated above may be adjusted by means of the handle 170, so as to restrict the flow of the air to the proper rate.

In the preferred embodiment, the blower has been disclosed as a centrifugal type blower. It has been found that a diaphragm type of blower, or other types of low pressure blowers or air compressors have certain advantages. For one thing, the noise level is greatly reduced by the use of a diaphragm. A compressor that may be either motor driven or manually driven has the advantage of use when power is not available or out of order. Throughout the specification blower and air compressor have been used interchangeably.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

Having thus described my invention, I claim:

1. A resuscitator assembly for use with a blower having an intake opening having air pressure less than the ambient air and an exhaust opening having air pressure higher than the ambient air, said resuscitator assembly including a valve mechanism provided with a chamber, a conduit for connecting the valve mechanism to the exhaust opening of the blower, a second conduit for connecting the valve mechanism to the intake opening of the blower, each of said conduits terminating in a port within the chamber, a diaphragm forming one wall of the chamber, a magnet arranged in spaced relation from the diaphragm, an armature connected to the diaphragm, ferro-magnetic bars mounted upon the armature, there being one ferro-magnetic bar on one side of the magnet and another bar on the opposite side of the magnet, said bars being arranged in spaced relation so that when one ferro-magnetic bar contacts the magnet the other bar is arranged in spaced relation from the magnet, the movement of the diaphragm in one direction exerting a force upon the armature tending to release the bar in contact with the magnet urging the armature to actuate the other bar into contact with the magnet, a a valve member driven by said armature, said valve member closing one of the ports to the conduits and opening the other port to the other conduit when the armature shifts one bar out of contact with the magnet and another bar into contact with the magnet, to thereby alternately supply positive air pressure to the chamber and negative air pressure to the chamber, and means for connecting the chamber through a conduit to a mask.

2. An aspirator and resuscitator for use with a low pressure compressor provided with a high pressure outlet opening and a low pressure intake opening, said aspirator and resuscitator including a housing having an air chamber and provided with an intake opening and an outlet opening, a high pressure conduit for connecting the high pressure outlet opening of the compressor to the intake opening of the air chamber, a pressure responsive exhaust valve connecting said conduit to the ambient air, a second conduit for connecting the outlet opening of the air chamber to the low pressure intake opening of the compressor, a pressure responsive intake valve connecting said second conduit to the ambient air, pressure responsive means for alternately opening and closing the high pressure conduit and simultaneously closing and opening the low pressure conduit, said last named means including a tube extending through the air chamber from the intake opening to the outlet opening, said tube having an opening communicating with the air chamber, a butterfly valve mounted in said tube, said butterfly valve having two positions, one of which connects the opening in the tube to the outlet opening and the intake opening of the blower, the other position connects the opening in the tube to the intake opening and to the high pressure conduit extending to the blower, and pressure responsive means for actuating the valve from one position to the other and vice versa, said air chamber having a third opening, and air delivery means for connecting the air chamber to a patient.

3. An aspirator and resuscitator for use with a low pressure compressor provided with a high pressure outlet opening and a low pressure intake opening, said aspirator and resuscitator including a housing having an air chamber and provided with an intake opening and an outlet opening, a high pressure conduit for connecting the high pressure outlet opening of the compressor to the intake opening of the air chamber, a pressure responsive exhaust valve connecting said conduit to the ambient air, a second conduit for connecting the outlet opening of the air chamber to the low pressure intake opening of the compressor, a pressure responsive intake valve connecting said second conduit to the ambient air, pressure responsive means for alternately opening and closing the high pressure conduit and simultaneously closing and opening the low pressure conduit, said last named means including a valve for opening one conduit and closing the other, a diaphragm forming one wall of the air chamber, an armature, means for connecting the armature to the valve and means for connecting the armature to the diaphragm, a pair of ferro-magnetic bars mounted upon the armature, and a permanent magnet positioned between the two ferro-magnetic bars, the movement of the armature being limited by the bars engaging the magnet, one of the bars being held by the magnet during inhalation and the other bar being held by the magnet during exhalation, said air chamber having a third opening, and air delivery means for connecting the air chamber to a patient.

4. An aspirator and resuscitator for use with a low pressure compressor provided with a high pressure outlet opening and a low pressure intake opening, said aspirator and resuscitator including a housing having an air chamber and provided with an intake opening and an outlet opening, a high pressure conduit for connecting the high pressure outlet opening of the compressor to the intake opening of the air chamber, a pressure responsive exhaust valve connecting said conduit to the ambient air, a second conduit for connecting the outlet opening of the air chamber to the low pressure intake opening of the compressor, a pressure responsive intake valve connecting said second conduit to the ambient air, pressure responsive means for alternately opening and closing the high pressure conduit and simultaneously closing

and opening the low pressure conduit, said air chamber having a third opening, air delivery means for connecting the air chamber to a patient, and adjustable means for varying the rate of flow of air through the conduits, thereby changing the length of the exhalation and inhalation cycles.

5. An assembly adapted for coupling to a blower having a high pressure outlet opening and a low pressure intake opening and adapted to utilize said blower in producing intermittent high and low pressures within a closed volume, said assembly including a housing having a chamber provided with an intake opening, an outlet opening and a third opening adapted to communicate with a closed volume, a tube extending through the air chamber from the intake opening to the outlet opening, said tube having an opening communicating with the air chamber, first conduit means for connecting the intake opening of said chamber to the high pressure outlet of said blower, pressure responsive exhaust valve means communicating with said first conduit means, second conduit means for connecting the outlet opening of said chamber to the low pressure intake opening of said blower, pressure responsive intake valve means communicating with said second conduit means, and pressure responsive means for alternately opening and closing the first conduit means and simultaneously closing and opening the second conduit means whereby said chamber is alternately in communication with sources of high and low pressure, said pressure responsive means including a diaphragm forming a wall of said chamber, an armature engaging said diaphragm, restraining means arranged in spaced relation from said diaphragm, said restraining means biasing said armature into either of two spaced positions, the movement of said armature in one direction exerting a force for shifting said armature from on position to the other and vice versa, and a valve member driven by said armature for simultaneously opening and closing said first and second conduit means, said valve member comprising a butterfly valve having two positions, one of which connects the opening in the tube to the outlet opening, the other of which connects the opening in the tube to the intake opening.

6. An assembly adapted for coupling to a blower having a high pressure outlet opening and a low pressure intake opening and adapted to utilize said blower in producing intermittent high and low pressures within a closed volume, said assembly including a housing having a chamber provided with an intake opening, an outlet opening and a third opening adapted to communicate with a closed volume, first conduit means for connecting the intake opening of said chamber to the high pressure outlet of said blower, pressure responsive exhaust valve means communicating with said first conduit means, second conduit means for connecting the outlet opening of said chamber to the low pressure intake opening of said blower, pressure responsive intake valve means communicating with said second conduit means, and pressure responsive means for alternately opening and closing the first conduit means and simultaneously closing and opening the second conduit means whereby said chamber is alternately in communication with sources of high and low pressure, said pressure responsive means including a diaphragm forming a wall of said chamber, an armature engaging said diaphragm, restraining means arranged in spaced relation from said diaphragm, said restraining means including a pair of ferro-magnetic bars mounted upon the armature, and a permanent magnet positioned between the two ferro-magnetic bars, said restraining means biasing said armature into either of two spaced positions, the movement of the armature being limited by the bars engaging the magnet, the movement of said diaphragm in one direction exerting a force for shifting said armature from one position to the other and vice versa, and a valve member driven by said armature for simultaneously opening and closing said first and second conduit means.

7. An assembly adapted for coupling to a blower having a high pressure outlet opening and a low pressure intake opening and adapted to utilize said blower in producing intermittent high and low pressures within a closed volume, said assembly including a housing having a chamber provided with an intake opening, an outlet opening and a third opening adapted to communicate with a closed volume, first conduit means for connecting the intake opening of said chamber to the high pressure outlet of said blower, second conduit means for connecting the outlet opening of said chamber to the low pressure intake opening of said blower, a tube extending through said chamber from the intake opening to the outlet opening, said tube having an opening communicating with the air chamber, a butterfly valve disposed within said tube and having two positions, one of which connects the opening in the tube to the outlet opening, the other of which connects the opening in the tube to the intake opening, and pressure responsive means for driving the butterfly valve between said two positions.

8. An assembly adapted for coupling to a blower having a high pressure outlet opening and a low pressure intake opening and adapted to utilize said blower in producing intermittent high and low pressures within a closed volume, said assembly including a housing having a chamber provided with an intake opening, an outlet opening and a third opening adapted to communicate with a closed volume, a tube extending through said chamber from the intake opening to the outlet opening, said tube having an opening communicating with the chamber, a butterfly valve disposed within said tube, said valve having two positions, one of which connects the opening in the tube to the outlet opening of said chamber, and the other of which connects the opening in the tube to the intake opening of said chamber, first conduit means for connecting the intake opening of said chamber to the high pressure outlet opening of said blower, second conduit means for connecting the outlet opening of said chamber to the low pressure intake opening of said blower, and pressure responsive means for moving said butterfly valve between its two positions, said pressure responsive means including a diaphragm forming a wall of said chamber, restraining means arranged in spaced relation from said diaphragm, said restraining means being biased into either of two spaced positions, the movement of said diaphragm in one direction exerting a force upon the restraining means for shifting the restraining means from one position to the other and vice versa, and means for transmitting the movement of said restraining means to said butterfly valve.

9. An assembly adapted for coupling to a blower having a high pressure outlet opening and a low pressure intake opening and adapted to utilize said blower in producing intermittent high and low pressures within a closed volume, said assembly including a housing having a chamber provided with an intake opening, an outlet opening and a third opening adapted to communicate with a closed volume, first conduit means for connecting the intake opening of said chamber to the high pressure outlet opening of said blower, second conduit means for connecting the outlet opening of said chamber to the low pressure intake opening of said blower, and pressure responsive means for alternately opening and closing the first conduit means and simultaneously closing and opening the second conduit means whereby said chamber is alternately in communication with sources of high and low pressure, said pressure responsive means including a diaphragm forming a wall of said chamber, an armature mounted in said housing for reciprocal movement, means for connecting said armature to said diaphragm, a pair of magnetic bars mounted upon said armature, and a permanent magnet fixedly attached to said housing positioned between the two pairs of magnetic bars, the move-

ment of the armature being limited by the bars engaging the magnet, said magnet biasing said armature into either of two spaced positions, the movement of said diaphragm in one direction exerting a force for shifting said armature from one position to the other and vice versa, and a valve member driven by said armature for simultaneously opening and closing said first and second conduit means.

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