

June 27, 1944.

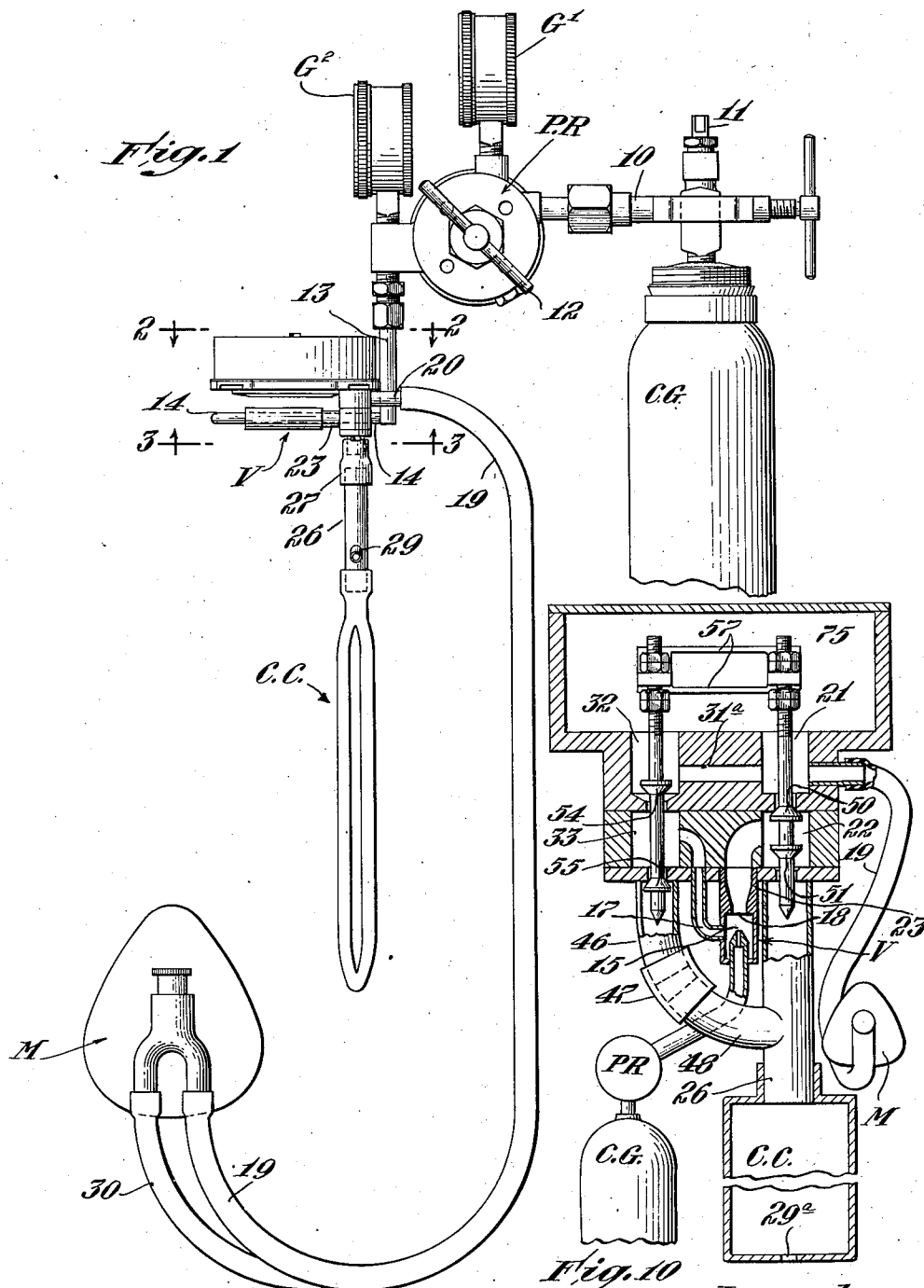
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2,352,523

APPARATUS AND METHOD FOR ARTIFICIALLY INDUCING BREATHING

Filed Aug. 13, 1941

3 Sheets-Sheet 1



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3 Sheets-Sheet 3

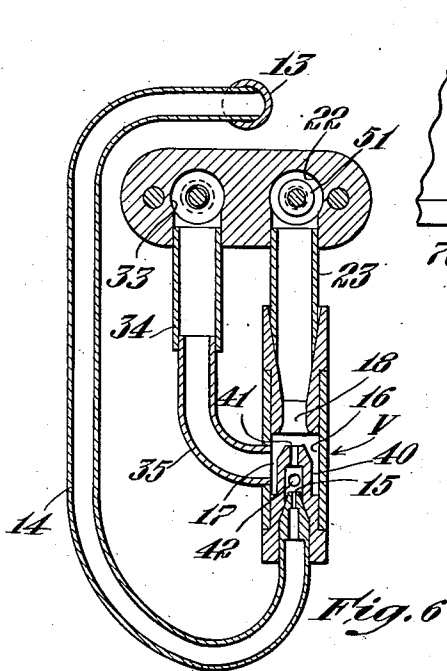


Fig. 6

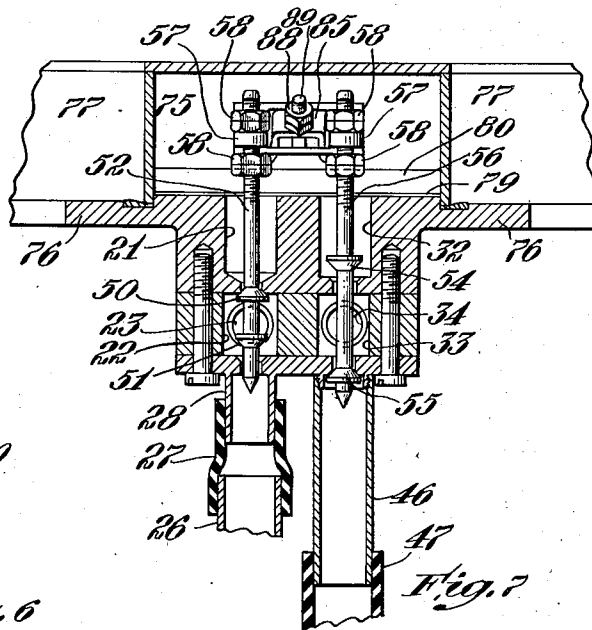


Fig. 7

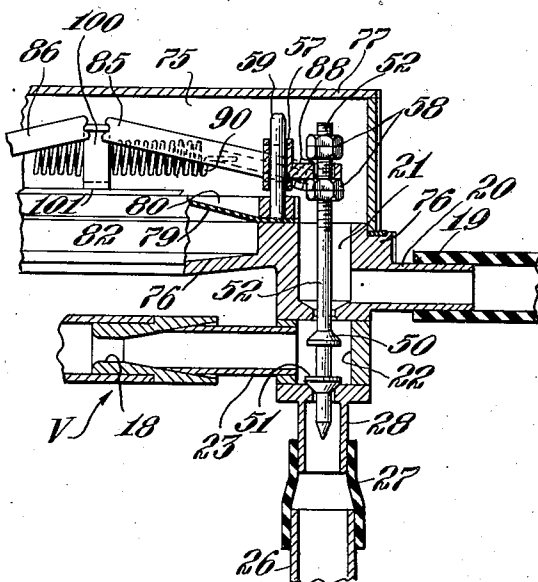


Fig. 8

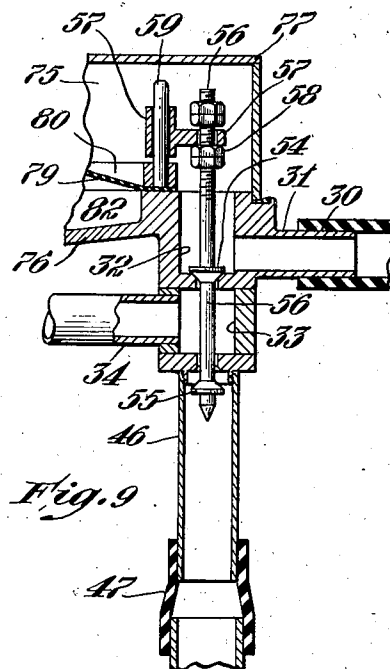


Fig. 9

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UNITED STATES PATENT OFFICE

2,352,523

APPARATUS AND METHOD FOR ARTIFICIALLY INDUCING BREATHING

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8 Claims. (Cl. 128—30)

This invention relates to an apparatus and method for artificially inducing breathing in human beings. One use of the apparatus and method is for treating patients who are unable to breathe normally, such as patients suffering from asphyxiation, drowning, or the like. Another use is for administering an anaesthesia gas to a patient.

This invention is an improvement upon prior art artificial breathing devices and methods of the jet or ejector type such as that disclosed in the Dräger United States Patent No. 1,049,346, which utilizes a source of compressed oxygen or other gas. During periods of inhalation, gas from said source is transmitted to the patient's lungs and during periods of exhalation, gas from said source is passed through a restricted orifice in the jet chamber thereby to create negative pressure in a passage which leads to the patient's lungs. In use of the apparatus as a resuscitator, i. e., to induce breathing in patients whose condition is such that they are unable to breathe, oxygen is generally used for the source of compressed gas so that the patient is supplied with oxygen enriched gas during inhalation. When the device is used for administering anaesthesia, the anaesthesia gas is added to the oxygen which passes from the device to the patient's lungs.

In the prior art, so far as I am aware, that part of the gas which during periods of exhalation enters the jet chamber from the source of compressed gas, passes out to the atmosphere and is lost. Consequently in use of said prior art devices and methods, a substantial amount of the compressed oxygen or anaesthesia gas is lost.

The principal object of this invention is to provide a novel apparatus and method utilizing the jet or ejector principle in which at least a portion of the normally escaping compressed gas is collected during periods of exhalation and is conducted to the patient during periods of inhalation.

A further object is the provision of an expandible collection chamber for the collection of said normally escaping compressed gas.

Other objects relate to the construction and mode of operation and will be apparent from a consideration of the following description and the accompanying drawings, which exemplify two embodiments of my apparatus chosen for the purposes of illustration.

In the drawings:

Fig. 1 is a side elevational view of an apparatus embodying my invention;

Fig. 2 is an enlarged top plan view taken on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged bottom plan view taken on the line 3—3 of Fig. 1;

Fig. 4 is a partial, enlarged side elevational view looking from left to right in Fig. 1;

Fig. 5 is an enlarged top plan view similar to Fig. 2 but with the cover of the toggle chamber removed;

Fig. 6 is an enlarged section on the line 6—6 of Fig. 4;

Fig. 7 is an enlarged section on the line 7—7 of Fig. 5;

Fig. 8 is an enlarged section on the line 8—8 of Fig. 5;

Fig. 9 is an enlarged section on the line 9—9 of Fig. 5; and

Fig. 10 is a diagrammatic view showing a slightly modified form of apparatus embodying my invention.

Referring to the apparatus shown in Figs. 1 to 9 inclusive, the tank CG (Fig. 1) contains a supply of oxygen under high pressure. This compressed gas is led through the pipe 10 to the pressure regulator PR, such communication being opened and closed by a valve (not shown) operated by applying a wrench (not shown) to the nut 11. The pressure regulator PR is preferably a two-stage regulator and it functions to reduce the pressure of the oxygen to approximately fifteen pounds per square inch. By turning the handle 12 the pressure of the gas emerging from the pressure regulator may be varied. The gauge G—1 registers the pressure of the gas in the tank CG and the gauge G—2 registers the pressure of the gas emerging from the pressure regulator.

The gas under positive and substantially uniform pressure which emerges from the pressure regulator is conducted to the aspirator device V by the pipes 13 and 14. The delivery end of the pipe 14 is connected to the primary nozzle 15 of the aspirator device, the latter having a casing which defines the chamber 16 (Fig. 6). The casing of the aspirator device has a port 17 in its side wall intermediate the ends of the chamber 16 and also has a divergent throat or exit port 18 coaxial with the nozzle and at the opposite end of the chamber 16 from the delivery end of the nozzle.

A valve device hereinafter more fully described houses valve means and a long pressure-actuated valve-operating motor. The valve device includes a rigid housing having projecting tubular nipples 28 and 46 (Fig. 7); 31 and 34 (Fig. 9);

and 20 and 23 (Fig. 8) for the attachment of conduits, etc., designed to conduct gaseous fluid to or from the valve device.

For convenience in description and with reference to the device as herein illustrated, but without intent thereby to limit the position in which the device may be used or the reversal of the relative positions of the parts, that portion of the apparatus including the elements 76, 77, etc., which houses the controlling valves and the valve-actuating motor, will be referred to as the valve device, and the several chambers or cavities with which the valves cooperate are referred to as follows: The chamber 32 (Fig. 7) is called the upper inlet chamber; the space within the nipple 46 is referred to as the lower inlet chamber; the space 33 is termed the intermediate delivery chamber; the space 21 is designated the upper delivery chamber; the space within the nipple 28 is referred to as the lower delivery chamber; the space 22 is termed the intermediate receiving chamber; and the space 15 is referred to as the motor chamber.

A rubber tube 19 connects the mask M (Fig. 1) with the nipple 20 thus providing communication between the interior mask and the chamber 21. The latter communicates by means of a port with the intermediate receiving chamber 22 which in turn communicates by means of a port with the lower delivery chamber within the nipple 28, and a pipe 26 connects this nipple with a reservoir CC hereinafter more fully described. The ports between the chambers 21, 22 and the chamber within the nipple 28 are controlled by valves 50 and 51. When the valve 50 is open as shown in Fig. 8, gas emerging from the primary nozzle 15 passes through the port 18, the nipple 23, the chamber 22, the chamber 21, the nipple 20, the tube 19, to the mask M and thence to the patient's lungs. This gas being under positive pressure expands the lungs thus creating a forced inhalation.

To permit exhalation, this communication through the tube 19 is periodically closed by elevating the valve 50 (Fig. 8) to the seated position shown in Fig. 7, thereby closing communication between the chambers 22 and 21. The valve 51 is simultaneously opened, as shown in Fig. 7, so that the gas which then passes through the divergent throat 18 of the jet chamber into the chamber 22 is directed downwardly past the then open valve 51 into the pipe 26, the lower end of which communicates with the collection chamber CC (Figs. 1 and 4) which is preferably made of vulcanized rubber. The short length of rubber tubing 27 serves to connect the upper end of the pipe 26 with the lower end of the nipple 28. A vent leading to the atmosphere is provided by the restricted safety vent 29 (Figs. 1 and 4), the inner end of which communicates with the interior of the pipe 26. Thus when the valves 50 and 51 are in the position of Fig. 7, the gas which enters the jet chamber 16 through the primary nozzle 15, passes to the chamber 22, and thence downwardly to the rubber collection chamber CC, causing the walls of the collection chamber to expand. When the pressure of this gas in the collection chamber reaches a predetermined intensity, any further gas passing through the pipe 26 is resisted by the pressure in the collection chamber and consequently passes out to the atmosphere through the vent 29. Accordingly there is no danger of rupturing the walls of the collection chamber nor of building up excessive gas pressure therein.

Communication between the mask M (Fig. 1)

and the second entrance port 17 (Fig. 6) is provided by the rubber tube 30 (Figs. 1, 5 and 9), the upper end of which communicates with the nipple 31 (Fig. 9) leading to the chamber 32 which, when the valve 54 is elevated (as shown in Fig. 7), communicates with the chamber 33 from which the pipe 34 leads to the pipe 35 which terminates at the second entrance port 17 (Fig. 6). Thus, when the valve 54 is in the elevated position shown in Fig. 7, communication between the port 17 and the patient's lungs is open so that gases may pass freely from the lungs to said port 17 during each period of exhalation.

Referring to Fig. 6, a forcer nozzle 40 having a delivery orifice 41 is arranged coaxially with and so as to receive the jet from the primary nozzle 15. This forcer nozzle 40 is provided with two oppositely disposed perforations 42 which communicate with the interior of the aspirator chamber 16. The speed or velocity of oxygen passing from the tube 14 through the primary nozzle 15 is greatly accelerated and this high speed jet sucks gas from the aspirator chamber 16 through the perforations 42 and forces that gas, together with the oxygen, through the port 41 and thence through the divergent throat 18 into the pipe 23. This action also draws gas from the pipe 35 through the port 17 so that negative pressure is created in the pipe 35 and gas is withdrawn from the patient's lungs, causing an exhalation. When the valve 54 is open (Fig. 7), affording communication between the port 17 and the patient's lungs, the valve 51 is also open, affording communication between the divergent throat 18 and the rubber collection chamber CC. Thus during periods of exhalation the mixture of exhaled gas from the patient's lungs (including anaesthesia gas if anaesthesia is being administered) and the oxygen from the nozzle 15 passes through the exit throat 18 and thence to the collection chamber CC where it is retained.

The valve 55 is closed during exhalation, as shown in Fig. 7. However, when each period of exhalation has ended, the valve 54 is closed and the valve 55 is opened, as shown in Fig. 9, and they remain in that position during each period of inhalation. This closes communication between the chamber 33 and the mask M and opens communication between the chamber 33 and the rubber collection chamber CC. This communication is afforded (Figs. 4, 7 and 8) by the pipe 46, the rubber tubing 47, and the nipple 48, the latter branching from the pipe 26 to the lower end of which the collection chamber is secured. Thus, during each period of inhalation when the valves 50, 51, 54 and 55 are in the respective positions shown in Figs. 8 and 9, the oxygen which is delivered by the primary nozzle 15 into the exit throat 18 and thence to the patient's lungs sucks a mixture of exhaled gases and oxygen from the collection chamber CC through the nipple 48, tube 47, pipe 46, chamber 33, pipe 34, pipe 35 and the second entrance port 17, and forces said gaseous mixture to the patient's lungs. Consequently the pure oxygen which passes to the collection chamber or reservoir CC with exhaled gases during exhalation is not wasted but is used during the next inhalation, and when anaesthesia is being administered the anaesthesia gas included in the exhaled gases is also used during the next inhalation. During inhalation the vent 29 in the collection chamber system permits air to enter the pipe 26 and to be drawn to the port 17 after the gases have been withdrawn from the collection chamber CC and said vent thereby pre-

vents the formation of excessive negative pressure in the collection chamber system.

It will be observed that during exhalation the collection chamber CC is filled with the first gases which are withdrawn from the patient's lungs, said gases being enriched by oxygen which mixes with them in the jet chamber 16. During the latter part of the exhalation, the collection chamber being normally filled, the exhalation gases pass out to the atmosphere through the vent 29. The exhalation gases which are first withdrawn from the lungs are not as contaminated with carbon dioxide as the gases which are withdrawn at the end of the exhalation period, so that the gases which pass to the collection chamber contain less CO₂ than those which thereafter pass out to the atmosphere. If it is desired, a body of carbon dioxide absorbent, such as soda lime, may be arranged at the entrance to the collection chamber CC so as to remove substantially all carbon dioxide from the mixture of exhaled gas and oxygen as said mixture enters the collection chamber. During use of the machine solely for resuscitation it is advantageous to have some carbon dioxide returned to the patient's lungs during inhalation as a stimulant to the resumption of normal breathing, but in use of the machine for administering anaesthesia it is considered advantageous to remove substantially all the carbon dioxide before the gaseous mixture is returned to the patient's lungs.

During inhalation it is necessary that communication between the exit throat 18 and the mask be open, communication between said throat or port and the collection chamber be closed, and communication between the collection chamber and the second entrance port 17 be open so that gases will be withdrawn from the collection chamber and forced to the patient with the oxygen which emerges from the primary nozzle 15. This is accomplished by the valves 50, 51, 54 and 55 which, during inhalation, are in the positions shown in Figs. 8 and 9. During exhalation it is necessary that communication be open between the second entrance port 17 and the mask, communication be closed between the exit throat 18 and the mask, and communication be open between the collection chamber and the exit throat 18. This is also accomplished by the valves 54, 55, 50 and 51 which, during exhalation, are in the position shown in Fig. 7.

As shown in Figs. 5, 7, 8 and 9, the valves 50 and 51 are secured to the vertical valve stem 52, and the valves 54 and 55 are secured to the vertical valve stem 56. The upper ends of the valve stems 52 and 56 are secured to the yoke 57 by the four nuts 58. The yoke 57 is mounted for vertical sliding movement along the parallel pins 59. Thus, when the yoke 57 is in the elevated position of Fig. 7, the valves 50 and 55 are closed and the valves 51 and 54 are open; and when the yoke 57 is in the lowered position of Figs. 8 and 9, the valves 51 and 54 are closed and the valves 50 and 55 are open.

The yoke 57 is moved from elevated position to lowered position and back again to elevated position, etc., by a toggle mechanism which is located in the toggle or motor chamber 75 formed by the base plate 76 and the cover 77, the cover and base plate being detachably secured together by the screws 78. The edge of a circular diaphragm 79 constitutes the pressure-responsive element of a pressure motor and is clamped to the upper face of the plate 76 by the clamping ring 80, said ring being secured in position by

the screws 81. This leaves a chamber 82 (Figs. 8 and 9) below the central portion of the diaphragm.

The toggle consists of two separate members 85 and 86 each of substantially hairpin shape. The outer or closed end of the member 85 passes loosely through a slot in the yoke 57 and also passes loosely between the pins 59 (Figs. 5, 7 and 8), and it is secured by the lock nuts 88 and the bolt 89 to the end of a coil spring 90. The outer or closed end of the other toggle member 86 passes loosely around the vertical pin 92 (Fig. 5), the lower end of which is secured to the horizontal plate 93 which is secured to the clamping ring 80. The nut 95 and washer 96 serve to prevent the end of the toggle member 86 from being removed vertically from the upper end of the pin 92. The adjacent end of the coil spring 90 is secured to the crossbar 97 which in turn is secured to the toggle member 86.

The adjacent open ends of the toggle members 85 and 86 are notched and bear against the edges of horizontal flanges which extend outwardly at opposite sides of the upstanding member 100, and said notched ends of the toggle members being held against the edges of said flanges by the tension of the coil spring 90 which tends to force said ends of the toggle members toward each other. The upstanding member 100 is secured to a metal plate 101 which is secured to the central area of the diaphragm 79. Thus as the center of the diaphragm 79 is forced downwardly from its elevated position (shown in Fig. 8), it also carries downwardly the adjacent notched ends of the toggle members 85 and 86, and the outer or closed ends of the toggle members are thereby caused to spring upwardly, forcing the yoke 57 to slide upwardly on the pins 59 and thus causing the valves 50 and 55 to seat and the valves 51 and 54 to open. As the diaphragm 79 is forced from its lowered position upwardly to the position shown in Fig. 8, the central ends of the toggle members are elevated, the slide 57 is lowered, and the positions of the valves are reversed.

The upper ends of the chambers 21 and 32 communicate at all times with the toggle or motor chamber 75 and the diaphragm 79 is alternately moved up and down respectively by the negative and positive pressures created in the patient's lungs respectively during exhalation and inhalation. When the valves are in the position of Figs. 8 and 9, oxygen or gas mixture is being forced to the patient's lungs and an inhalation is taking place. The diaphragm is then in elevated position. When a sufficient volume of gas has been forced into the patient's lungs to fill them, increasing positive pressure is built up in the lungs and also in the mask M, the tube 19, or motor chamber 21, and toggle chamber 75. When this positive pressure reaches the required intensity, it forces the center of the diaphragm 79 downwardly, thereby automatically elevating the yoke 57 and closing the valve 50, which shuts off the flow of further gas from the nozzle 15 to the patient's lungs. This same movement of the yoke 57 closes the valve 55, shutting off the flow of gases from the collection chamber, opens the valve 54, thereby opening communication between the patient's lungs and the second entrance port 17, and opens the valve 51, thereby opening communication between the exit throat 18 and the collection chamber. The jet of oxygen emerging from the primary nozzle 15 immediately begins to suck exhalation gases from the

patient's lungs through the port 17 and to force them together with the oxygen to the collection chamber. As the gases become exhausted from the patient's lungs, increasingly strong suction or negative pressure is built up therein, and that negative pressure is transmitted to the chamber 32 and the toggle chamber 75. When the negative pressure has reached sufficient intensity, it elevates the central portion of the diaphragm 79, thereby changing the position of the valves 50, 51, 54 and 55 from the positions shown in Fig. 7 to the positions shown in Figs. 8 and 9. This movement of the valves terminates the period of exhalation and starts the next period of inhalation.

While one embodiment of the apparatus aspect of the invention is shown in Figs. 1 to 9 inclusive, various changes may be made without departing from the scope of this invention.

Another embodiment of the invention is shown diagrammatically in Fig. 10. In this embodiment the collection chamber CC consists of a rigid cylinder which is provided with a vent 29^a at one end, said vent leading to the atmosphere. Also in this embodiment the rubber tube 30 (Fig. 1) and the pipe 31 (Fig. 9) leading between the mask and the chamber 32 are completely eliminated, and a conduit 31^a connects the chamber 32 directly with the chamber 21. Thus in this embodiment only one tube 19 leads from the mask to the apparatus. The same motor and aspirator mechanisms are used.

In Fig. 10 the valves are shown in position for exhalation. In operation of the device on exhalation, the jet of oxygen emerging from the nozzle 15 sucks exhalation gases from the patient's lungs through the mask M, the tube 19, chamber 21, pipe 31^a, chamber 32, chamber 33, and port 17, mixing such exhalation gases with the oxygen and transmitting them through the exit throat 18, chamber 22, pipe 26 to the collection chamber CC. The vent 29^a permits air to be forced through the end of the rigid collection chamber and thereby prevents the building up of excessive positive pressure therein.

In operation on inhalation, the valves having been reversed by the toggle mechanism, the jet emerging from the nozzle 15 sucks gases from the collection chamber through pipe 48, pipe 46, chamber 33 and port 17, mixes said gases with the oxygen emerging from the nozzle 15, and forces said mixture through the exit throat 18, pipe 23, chamber 22, chamber 21 and tube 19 to the mask M. When sufficient positive pressure has been built up in the patient's lungs, the toggle mechanism reverses the valves and starts the next period of exhalation.

While I have shown and described two desirable embodiments of the invention, it is to be understood that this disclosure is for the purposes of illustration and that various changes in shape, proportion, and arrangement of parts, and the substitution of equivalent elements may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. In automatic resuscitator apparatus of the class described wherein a jet of gas supplied from a source at substantially constant super-atmospheric pressure constitutes power means for alternately inflating and deflating the lungs and including automatic valves and passages so designed and arranged that a portion of the gas from the jet enters the lungs at each inflation, a reservoir of variable capacity operative to receive

gas directly from the jet during lung deflation and to hold it for delivery to the lungs during succeeding inflations.

2. In combination in automatic resuscitator apparatus of the class described wherein an aspirator device receives gas at substantially constant super-atmospheric pressure from a source of supply and constitutes power means for alternately inflating and deflating the lungs, a valve device including an upper and a lower inlet chamber and an intermediate delivery chamber and also an upper and lower delivery chamber and an intermediate receiving chamber, two pairs of valves, said pairs of valves being so relatively arranged and connected that when the valves of one pair shut off the lower inlet chamber from and open the upper inlet chamber to the intermediate delivery chamber the valves of the other pair shut off the upper delivery chamber from and open the lower delivery chamber to the intermediate receiving chamber and vice versa, a motor device, responsive to lung pressure, operative automatically to shift said pairs of valves, said motor device comprising a part which is always exposed to and which moves in response to variations in the pressure subsisting in the upper inlet chamber and in the upper delivery chamber of the valve device, the aspirator device comprising a casing into which is delivered a jet of gas from the source of supply, said aspirator casing having an exit throat communicating with the intermediate receiving chamber of the valve device, a conduit leading from the intermediate delivery chamber of the valve device to the casing of the aspirator and into the latter at such a point that the gaseous jet creates a suction effect tending to withdraw gas from the intermediate delivery chamber of the valve device, an expansible reservoir, conduit means connecting said reservoir with the lower inlet chamber and with the lower delivery chamber of the valve device, means providing an exit passage of small capacity leading from said conduit means to the atmosphere, a mask, and conduits connecting the mask with the upper inlet and delivery chambers respectively of the valve device.

3. In combination in automatic resuscitator apparatus of the class described wherein an aspirator device receives gas at substantially constant super-atmospheric pressure from a source of supply and constitutes power means for alternately inflating and deflating the lungs, a valve device including an upper and a lower inlet chamber and an intermediate delivery chamber and also an upper and lower delivery chamber and an intermediate receiving chamber, valve means so constructed and arranged as to shut off the lower inlet chamber from and open the upper inlet chamber to the intermediate delivery chamber while concomitantly shutting off the upper delivery chamber from and opening the lower delivery chamber to the intermediate receiving chamber and vice versa, the valve device also including a motor chamber which is in constant communication with the upper inlet and delivery chambers, motor means automatically operative to actuate said valve means, said motor means comprising a movable pressure-actuated member which forms a part of the wall of the motor chamber and lever means for transmitting motion from the pressure-actuated member to the valve means, the aspirator device comprising a casing into which a jet of gas is delivered from the source of supply, said casing having an exit throat communicating with the intermediate re-

celving chamber of the valve device, a conduit leading from the intermediate delivery chamber of the valve device to the casing of the aspirator and into the latter at such a point that the gaseous jet creates a suction effect tending to withdraw gas from the intermediate delivery chamber of the valve device, an expansible reservoir which constantly tends to contract, conduit means connecting said reservoir with the lower inlet chamber and with the lower delivery chamber of the valve device, and means providing an exit passage of small capacity leading to the atmosphere from said conduit means at a point adjacent to the connection of the latter to the reservoir, a mask, and flexible conduits connecting the mask with the upper inlet and delivery chamber respectively of the valve device.

4. In combination in automatic resuscitator apparatus of the class described wherein an aspirator device receives gas at substantially constant super-atmospheric pressure from a source of supply and constitutes power means for alternately inflating and deflating the lungs, a valve device including an upper and a lower inlet chamber and an intermediate delivery chamber and also an upper and lower delivery chamber and an intermediate receiving chamber, valve means operative to control communication between the intermediate delivery chamber and the upper and lower inlet chambers and also between the intermediate receiving chamber and the upper and lower delivery chambers, the valve device also including a motor chamber which is in constant communication with the upper inlet and delivery chambers, a motor device comprising a diaphragm which forms a part of the wall of the motor chamber, and means including connected toggle levers and a spring operative to transmit motion from the diaphragm to the valve means, said diaphragm being arranged to move in response to variations in lung pressure, the aspirator device comprising a casing having a chamber into which a jet of gas from the source of supply is delivered, the aspirator casing having an exit throat coaxial with said jet and which communicates with the intermediate receiving chamber of the valve device, a conduit leading from the intermediate delivery chamber of the valve device to such a point in the chamber of the aspirator that the gaseous jet creates a suction effect in said conduit tending to withdraw gas from the intermediate delivery chamber of the valve device, a reservoir, conduit means connecting the reservoir with the lower inlet chamber and also with the lower delivery chamber of the valve device, and means providing an exit passage of small capacity leading from said conduit means to the atmosphere at a point adjacent the entrance to the reservoir, a mask and

conduits connecting the mask with the upper inlet and delivery chambers respectively of the valve device.

5. Method of artificially causing a patient to breathe, which comprises as steps providing a jet of gas at a substantially constant super-atmospheric pressure, utilizing the power of the jet alternately to inflate and deflate the lungs, causing a portion of the gas from the jet to enter the lungs at each inflation, storing the gas issuing from the jet during a portion at least of the period of deflation, and delivering the stored gas to the lungs during subsequent periods of inflation.

6. Method of artificially causing a patient to breathe, which comprises as steps providing a jet of gas at a substantially constant super-atmospheric pressure, utilizing the power of the jet alternately to inflate and deflate the lungs, causing a portion of the gas from the jet to enter the lungs at each inflation, storing fresh gas issuing from the jet together with the gaseous material exhaled from the lungs during a portion at least of each period of deflation, and delivering the stored gas and gaseous material to the lungs during subsequent periods of inflation.

7. Method of artificially causing a patient to breathe, which comprises as steps providing a jet of gas at a substantially constant super-atmospheric pressure, utilizing the power of the jet alternately to inflate and deflate the lungs, causing a portion of the gas from the jet to enter the lungs at each inflation, storing fresh gas issuing from the jet together with the gaseous material exhaled from the lungs during the early part of each period of deflation, discharging to the atmosphere gas from the jet mingled with gaseous material exhaled from the lungs during the final portion of said period of deflation, and delivering the stored gas and gaseous material to the lungs during succeeding periods of inflation.

8. Method of artificially causing a patient to breathe, which comprises as steps providing a jet of gas at a substantially constant super-atmospheric pressure, utilizing the power of the jet alternately to inflate and deflate the lungs, causing a portion of the gas from the jet to enter the lungs at each inflation, storing the first portion of the gaseous material which is exhaled from the lungs during each period of deflation together with gas issuing from the jet during said period, discharging to the atmosphere the later portion of the gaseous material exhaled from the lungs during each deflation, and conducting at least a portion of the stored gas and gaseous material to the patient's lungs during succeeding periods of inflation.

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