

Dec. 30, 1941.

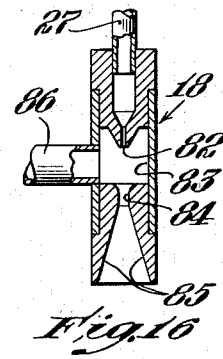
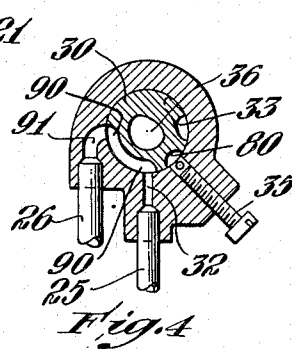
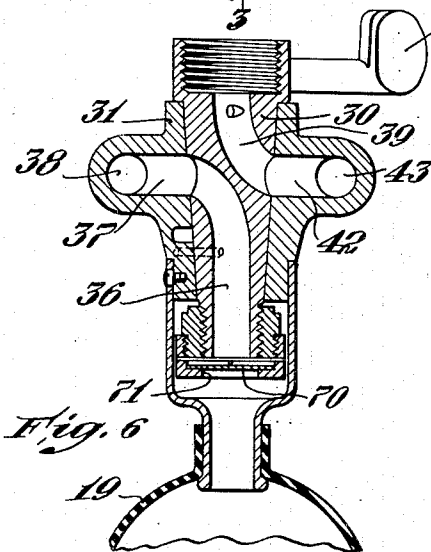
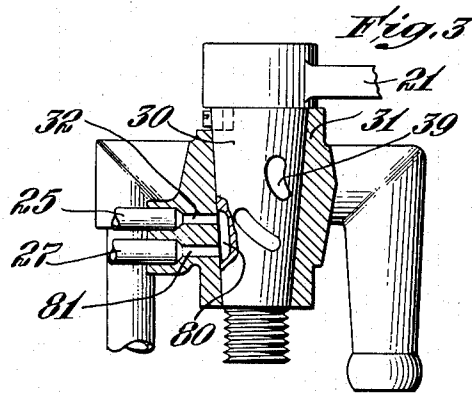
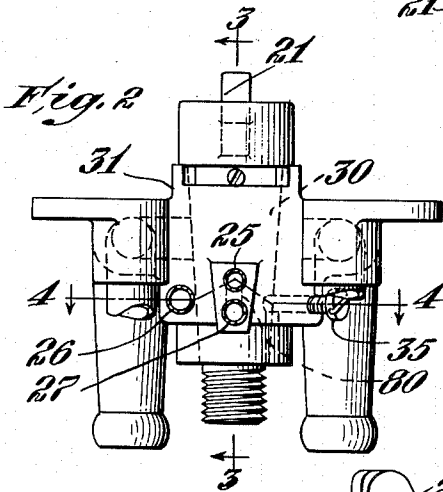
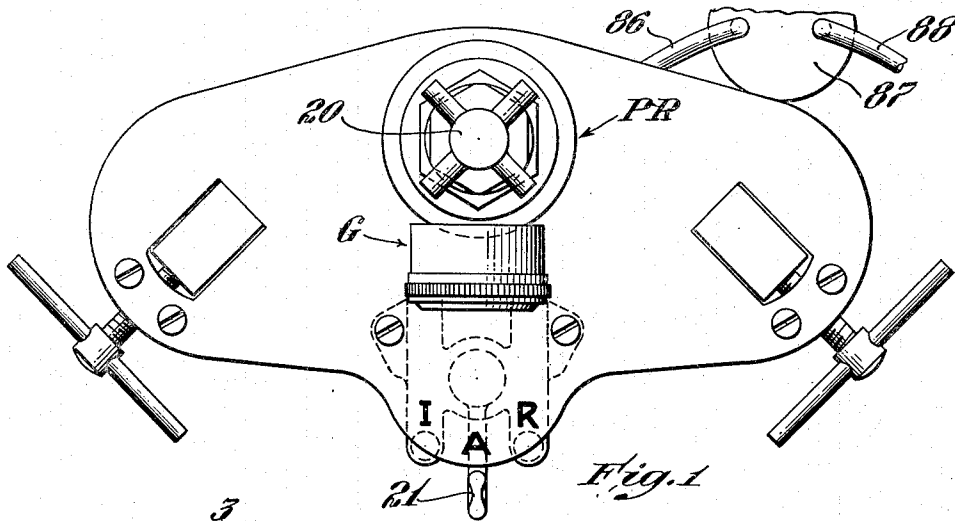
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2,268,172

RESUSCITATOR

Filed June 12, 1941

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

Fig. 5

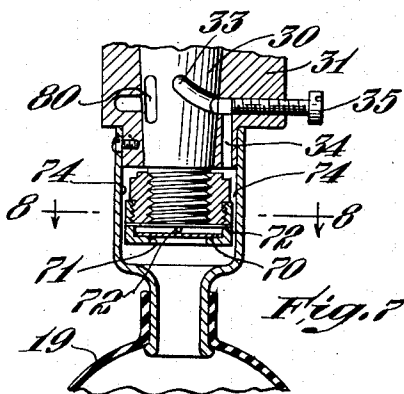
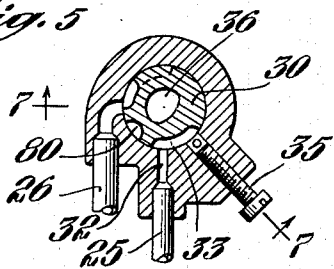


Fig. 7

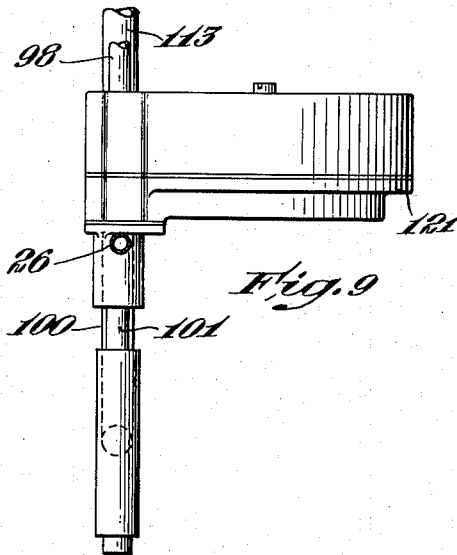


Fig. 9

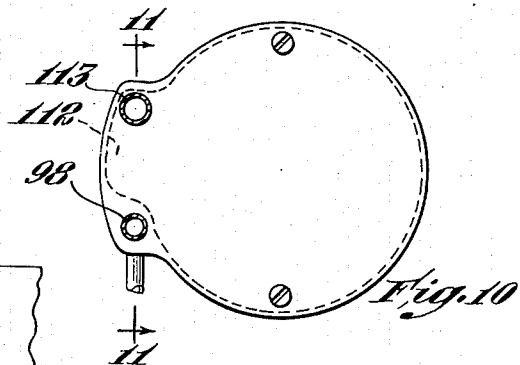


Fig. 10

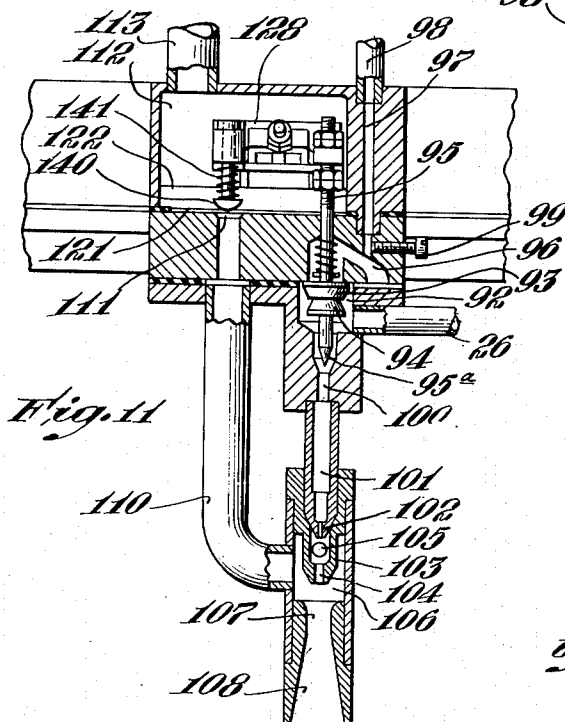


Fig. 11

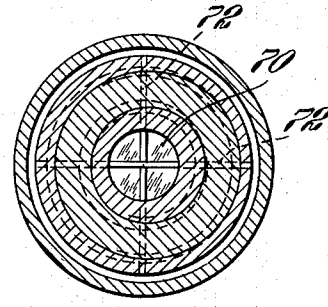


Fig. 8

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3 Sheets-Sheet 3

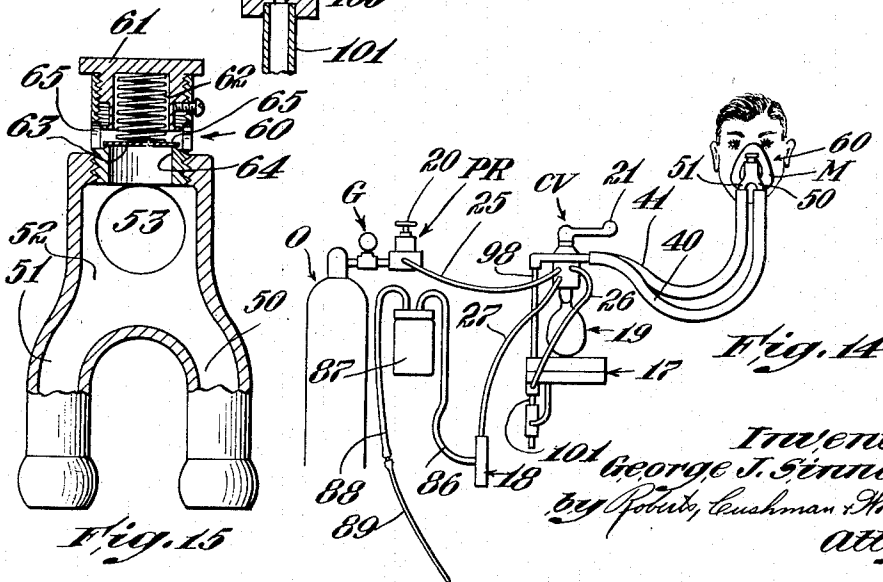
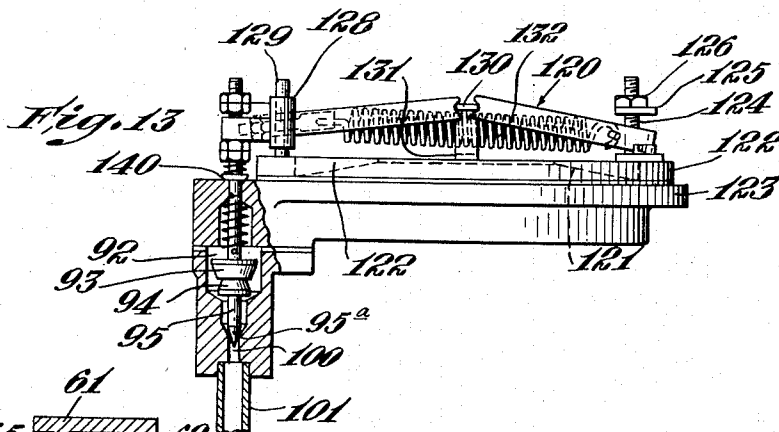
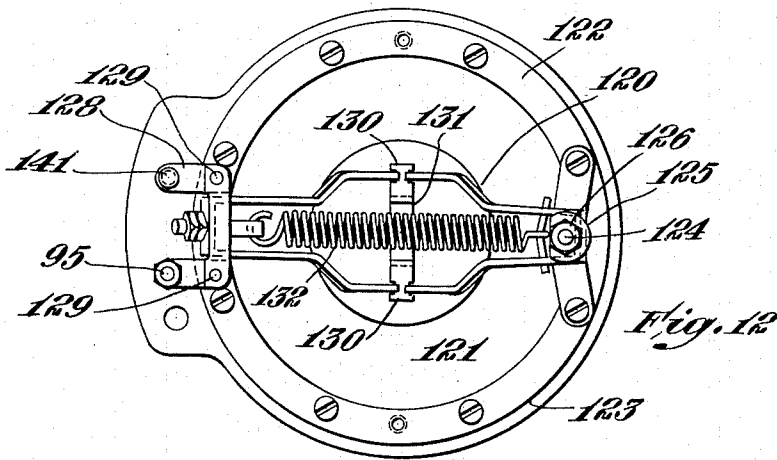


Fig. 15

Fig. 14

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UNITED STATES PATENT OFFICE

2,268,172

RESUSCITATOR

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Application June 12, 1941, Serial No. 397,689

4 Claims. (Cl. 128—29)

This invention relates to apparatus for treating patients who are unable to breathe normally, such as persons suffering from gas asphyxiation, drowning or the like.

The apparatus illustrated in the drawings may be selectively used either as a resuscitator functioning to alternately deliver oxygen to the patient's lungs and to remove exhaled gases therefrom, or as an aspirator functioning to remove mucus from the patient's mouth and throat or as an inhalator functioning to permit the patient to inhale from a supply of oxygen. The claimed invention, however, relates to an improvement in the resuscitator phase of the apparatus and it may be incorporated in a device which is not provided with either the aspirator or the inhalator devices. In my improved resuscitator, the oxygen forced into the patient's lungs during resuscitation passes through a part of the resuscitator which is contacted only by pure oxygen and it does not touch any parts of the resuscitator which are contacted by exhaled gases or mucus.

One object of this invention is to provide an improved resuscitator of the Venturi type in which the oxygen while passing to the patient's lungs during inhalation does not come in contact with any part of the mechanism through which exhaled gases have passed. In this aspect the invention is an improvement upon the apparatus shown in United States Patent No. 1,049,346 to J. H. Dräger.

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 one embodiment of the invention chosen for the purpose of illustration.

In the drawings:

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

Fig. 2 is an enlarged side elevation of the control valve and associated parts removed from the apparatus of Fig. 1;

Fig. 3 is a partial section on the line 3—3 of Fig. 2, and showing the control valve in aspirator position;

Fig. 4 is a section on the line 4—4 of Fig. 2, showing the control valve in resuscitator position;

Fig. 5 is a section like that of Fig. 4, but showing the control valve in inhalator position;

Fig. 6 is a vertical section of the control valve in inhalator position;

Fig. 7 is a partial vertical section of the control

valve on the line 7—7 of Fig. 5, showing the valve in inhalator position;

Fig. 8 is an enlarged section on the line 8—8 of Fig. 7;

Fig. 9 is an enlarged side elevation of the removed resuscitator mechanism;

Fig. 10 is a plan view of the removed resuscitator mechanism;

Fig. 11 is an enlarged section on the line 11—11 of Fig. 10;

Fig. 12 is an enlarged plan view of the resuscitator toggle mechanism for controlling the inhalation and exhalation periods;

Fig. 13 is a side elevation of the toggle mechanism with parts broken away and shown in section;

Fig. 14 is a diagrammatic view showing the source of oxygen, the control valve, the resuscitator mechanism, the aspirator mechanism, the inhalation bag and the face mask in position on the patient;

Fig. 15 is an enlarged vertical section through the face mask valve; and

Fig. 16 is an enlarged vertical section through the aspirator mechanism.

Referring to Fig. 14 the tank O contains a source of oxygen normally under high pressure. This oxygen is led from the tank through the pressure gauge G which registers the pressure of the oxygen in the tank, thence to a pressure regulator PR which reduces the pressure of the oxygen to approximately 15 lbs. per square inch, and thence to the control valve C. V. The pressure regulator is preferably a two-stage regulator but a one-stage regulator may be used if desired. The handle 20 is used to vary the pressure of the oxygen emerging from the regulator and by turning this handle the pressure may be varied above or below the aforesaid 15 lbs. per square inch.

The handle 21 of the control valve C.V. may be moved to the three positions indicated respectively by the letters R, A and I in Fig. 1. When moved to the position R (Fig. 1) the oxygen entering the control valve C.V. (Fig. 14) through the conduit 25 is directed by the valve through the conduit 26 directly to the resuscitator mechanism 17. When the handle 21 is moved to the position A, the oxygen entering the control valve through the conduit 25 is directed by said valve through the conduit 27 directly to the aspirator mechanism 18. When the handle 21 is moved to the position I the oxygen entering the control valve is directed by the control valve to the rubber inhalation bag 19.

Referring to Figs. 2, 3, 5 and 6, the handle 21

is secured to the upper end of the tapered control valve member 30 which is freely rotatable in the casting 31. The oxygen at approximately 15 lbs. pressure per square inch enters the valve from the conduit 25 through the port 32. When the handle 21 points to I (Fig. 1) the control valve member 30 is in the position shown in Figs. 5 and 7, and the oxygen entering the port 32 is conducted by the inclined valve channel 33 to the conduit 34 and thence directly downwardly to the inhalation bag 19. The screw 35 serves to adjust the size of the end of the passage 34 to control the rate of flow of oxygen into the inhalation bag 19, depending upon how much the inner end of the screw obstructs the entrance to the passage 34.

As shown by Fig. 6, when the control valve is in said inhalation position the upper end of the internal valve passage 36 registers with the passage 37 which communicates with the inhalation passage 38, to which the inhalation tube 40 is attached. The other internal valve passage 39 then registers with the passage 42 which communicates with the exhalation passage 43 to which the exhalation tube 41 is attached. The tube 40 communicates with the face mask tube 50 (Figs. 14 and 15) and the tube 41 communicates with the face mask tube 51. These tubes communicate with a chamber 52 having an orifice 53 which communicates with the mask M enclosing the patient's nose and mouth.

The valve 60 (Figs. 14 and 15) operates as a check valve on inhalation. The screw-threaded cap 61 is loosened so that the coil spring 62 exerts no pressure on the valve disk 63; thus the disk 63 rests lightly upon the valve seat 64. When the patient exhales the exhaled gases force the disk 63 upwardly against the slight force of gravity and the weight of the spring and the gases pass out to the atmosphere through the ports 65. When the patient inhales, the disk 63 is sucked downwardly against the seat 64 so that no air enters the valve during inhalation. Any exhaled gases which do not pass out to the atmosphere through this valve 65 pass through the exhalation tube 41, the passage 42 and thence out to the atmosphere through the valve passage 39 (Fig. 6).

A flap valve 70 (Figs. 6, 7 and 8) serves to permit oxygen to pass out of the inhalation bag 19 into the valve channel 36 but prevents exhaled gases from entering said bag. This flap valve rests upon the valve seat 71 but is free to move upwardly a short distance until it contacts the crossed wires 72. Thus when the patient inhales, a slight negative pressure is created in the inhalation tube 40 (Fig. 14) and is communicated through the passages 38, 37 and 36 (Fig. 6) to the flap valve. This negative pressure raises the flap valve 70 until it contacts the wires 72 and permits oxygen to flow from the inhalation bag 19 around the edges of the flap valve 70 into the passage 36 and thence to the patient. As soon as the patient ceases an inhalation, the flap valve drops down against the valve seat 71 and remains there until the next inhalation. This flap valve does not obstruct the flow of oxygen from the control valve passage 33, through the passage 34 to the inhalation bag, since that oxygen flows around the edge of the flap valve mechanism through the passage 74 which surrounds said mechanism. When the patient inhales, removing oxygen from the inhalation bag 19, it is slightly deflated so that the depth and duration of each inhalation may be observed. The oxygen flowing

from the tank O through the control valve C.V. fills the inhalation bag during each period of exhalation.

When the control valve handle 21 is turned to the letter A (Fig. 1) the control valve member 30 assumes the position shown in Fig. 3. In this position the oxygen entering the valve through the tube 25 and port 32 is directed by the valve passage 80 vertically downwardly into the port 81 and outwardly into the tube 27. The tube 27 communicates with the aspirator mechanism 18 (Figs. 14 and 16). The tube 27 terminates in an orifice 82 of restricted cross section leading into the chamber 83. The orifice 84 is located substantially opposite the restricted orifice 82 and it extends outwardly from the chamber to the atmosphere. The walls 85 diverge outwardly as shown in Fig. 16. The tube 86 leads to a jar 87 (Fig. 14) and the tube 88 leads to the aspirator tube 89 which has a restricted opening at its end.

When used as an aspirator the face mask M is removed and the end of aspirator tube 89 is inserted in the patient's mouth. The oxygen passes from the tank O through the control valve C.V., the tube 27 and the restricted orifice 82. As it passes from the orifice 82 through the chamber 83, and through the orifice 84 to the atmosphere, its speed is greatly accelerated and it rapidly sucks air from the tube 86 and carries it out through the orifice 84 to the atmosphere. This action continuously creates negative pressure in the tube 86 so long as the control valve remains in aspirator position permitting the oxygen to be forced through the tube 27. The negative pressure in the tube 86 (Fig. 14) is transmitted to the jar 87, to the tube 88 and to the opening in the aspirator tube 89 where it functions to suck mucus and other fluids from the patient's mouth and throat to the jar 87 where they are deposited. Thus the aspirator serves to withdraw mucus and fluids continuously and rapidly until the breathing passages are free. It is then shut off by rotating the control valve handle 21 or the pressure regulator handle 20.

When the control valve handle 21 is turned to the letter R (Fig. 1) the control valve member 30 assumes the position shown in Fig. 4. In this position the oxygen entering the control valve C.V. through the tube 25 and port 32 is directed by the inclined control valve passage 90 downwardly into the port 91 and outwardly into the tube 26. The tube 26 communicates with the oxygen distributing chamber or valve chamber 92 (Fig. 11) in which the is located a vertically movable two-part valve 93, 94, the member 94 being secured to the valve stem 95 and the member 93 being made of fiber and being slidable longitudinally of the stem 95. The tapered end 95^a of the valve stem 95 serves to prevent the oxygen from passing downwardly into the passage 100 when the valve stem 95 is lowered as shown in Fig. 13. When the valve stem is in this lowered position the member 93 of the valve is spaced downwardly from its seat (as shown in Fig. 13) permitting oxygen to flow upwardly into the passages 96 and 97 (Fig. 11) and thence through the tube 98 and the inhalation tube 40 (Fig. 14) to the patient's lungs. Hence on inhalation the oxygen is passed at a pressure of about 15 lbs. per square inch directly from the control valve C.V. to the valve chamber 92 and thence to the patient. The screw 99 (Fig. 11) may be used to adjust the size of the entrance to the tube 97.

When the valve stem 95 is elevated to the position shown in Fig. 11, the valve member 93 is

seated preventing the flow of oxygen upwardly to the inhalation tube and the tapered end 95^a of the valve stem 95 is elevated permitting oxygen to pass downwardly into the passage 100. The passage 100 communicates with the tube 101 which has an orifice 102 of restricted cross section so that the speed of the oxygen passing through this orifice is accelerated. The orifice 102 communicates with a tube 103 which has an orifice 104 of slightly larger cross section than that of the orifice 102. A port 105 affords communication between the interior of the tube 103 and the chamber 106. This port is of larger cross section than that of the orifice 104. As the jet of oxygen passes through tube 103 it sucks air from the chamber 106 through the port 105 and forces that air together with the oxygen through the orifice 104. An orifice 107 affords communication between the chamber 106 and the passage 108 which leads to the atmosphere. The lower end of the negative pressure tube 110 communicates with the chamber 106. Some of the air is sucked from the chamber 106 through the port 105 as described above and the jet of combined oxygen and air which emerges from the orifice 104 sucks considerably more air from the chamber 106 and forces it out to the atmosphere through the orifice 107 and the Venturi passage 108. This action creates suction in the tube 110.

This negative pressure resuscitator mechanism is designed to move about two litres of gas through the tube 110 in a four second interval when the oxygen enters the tube 100 at a pressure of 15 lbs. per square inch and two litres of exhaled gas each four seconds is the average rate of exhalation of a human being. The intensity of the negative pressure in the tube 110 may be varied by rotating the handle 20 (Figs. 1 and 14) to either increase or decrease the pressure at which the oxygen is delivered to the tube 100.

The negative pressure created in the tube 110 is transmitted to the patient through the port 111, the chamber 112 and tube 113, which communicates with the mask exhalation tube 41 through the passage 43. Thus when negative pressure is created in the tube 110 it sucks exhaled gases from the patient's lungs and they are expelled to the atmosphere through the port 107 and passage 108. It will be observed that the oxygen which reaches the patient during inhalation through the tube 26, the chamber 92 and passages 96, 97, 98 and 40 does not come in contact with any part of the mechanism through which the exhaled gases pass. This permits thorough cleansing of the machine by merely disinfecting the mask.

The operation of the valve stem 95 which controls the change from suction in the tube 110 to positive pressure of oxygen in the tubes 96, 97 is accomplished by a toggle 120 and diaphragm 121 (Figs. 11, 12 and 13) located in the chamber 112.

The edge of the diaphragm is clamped against the upper face of the member 123 by the clamping ring 122. One end of the toggle 120 passes loosely around the bolt 124 and this end of the toggle is prevented from sliding over the end of the bolt by the washer 125 and nut 126. The other end of the toggle 120 passes loosely through the yoke 128 which is mounted for vertical sliding movement on the two pins 129. At its center the two adjacent central ends of the toggle are pivotally mounted on the horizontal flange pieces 130. The spring 132 serves to force the adjacent central ends of the toggle toward each

other at all times, thereby keeping them in engagement with the flange pieces 130, as shown in Figs. 12 and 13. These flange pieces 130 are an integral part of a U-shaped member 131, the base of which is secured to the center of the diaphragm. Thus as the center of the diaphragm 121 is forced downwardly from the position shown in Fig. 13, the U-shaped member 131 is also forced downwardly and carries the center of the toggle 120 downwardly. This causes the two outer ends of the toggle to spring upwardly and the yoke 128 being secured to one end of the toggle is also carried upwardly along the pins 129. Since the valve stem 95 is secured to the yoke 128 the valve stem is also carried upwardly to the position of Fig. 11, seating the valve member 93 and elevating the tapered end 95^a of the stem 95. Conversely when the diaphragm 121 is moved upwardly to the position shown in Fig. 13 the ends of the toggle are forced downwardly and the valve stem 95 is forced downwardly from the position shown in Fig. 11 to the position shown in Fig. 13, seating the tapered end 95^a of the valve stem and opening the valve member 93. A separate valve 140 (Fig. 11) is secured to the yoke 128 by the stem 141 and when the yoke is forced downwardly from the position of Fig. 11 to the position of Fig. 13, the valve 140 seats in the port 111 closing communication through the negative pressure tube 110.

The diaphragm 121 is alternately moved up and down by the positive pressure created in the patient's lungs by the oxygen and by the negative pressure created in his lungs during exhalation. When the toggle is in the position of Fig. 11 the oxygen entering through the conduit 26 is forced down through the tube 101 creating negative pressure or suction in the tube 110. This negative pressure is transmitted to the patient's lungs through the chamber 112 and tube 113 and gradually exhausts the gases from his lungs. When the gases have been exhausted from the patient's lungs the negative pressure in the chamber 112 is increased to such an extent that it elevates the diaphragm 121 causing the toggle to trip and to close the valves 140 and the tapered end 95^a of the valve stem 95. This shuts off the flow of oxygen through the passage 100 and discontinues the creation of negative pressure in the tube 110. As the tapered end 95^a is closed the valve 93 is simultaneously opened and the oxygen entering through the tube 26 begins to flow to the patient's lungs by way of the passages 96 and 97 and the tube 98. When the oxygen has filled the lungs to cause a normal inhalation it builds up positive pressure in the exhalation tube 41, the connected tube 113 and the toggle chamber 112. This positive pressure forces the diaphragm 121 downwardly and thereby elevates the valves 140 and 93. The oxygen then is forced downwardly again through the passage 100 to again create suction in the tube 110 which causes the next period of exhalation.

During use of the apparatus as a resuscitator the cap 61 of the face mask valve 60 (Figs. 15 and 14) is screwed down to the position shown in Fig. 15. This causes the coil spring 62 to exert pressure on the valve disk 63 tending to keep it closed at all times. However, if the positive pressure in the mask becomes higher than can safely be withstood by the patient, this increased pressure in the mask causes the valve disk 63 to move upwardly slightly compressing the spring 62 and the oxygen rushes out between the edge of the disk 63 and its seat. Consequently

the mask valve 60 operates as a safety valve during use of the apparatus as a resuscitator to prevent the creation of excessive positive pressure in the patient's mouth, nose and lungs.

While I have shown and described one desirable embodiment of the invention, it is to be understood that this disclosure is for the purpose 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 a resuscitator of the Venturi type operated by oxygen under pressure, the improvement which comprises a valve chamber, an oxygen inlet conduit connected to said valve chamber, an inhalation conduit leading directly from said valve chamber to the patient, a Venturi conduit leading directly from said valve chamber to a Venturi chamber and a valve in said valve chamber adapted to open communication between said oxygen inlet conduit and said inhalation conduit during inhalation by the patient and to open communication between said oxygen inlet conduit and said Venturi conduit during exhalation by the patient, whereby the oxygen which is conducted to the patient during inhalation does not come in contact with any part of the mechanism through which exhaled gases have passed.

2. In a resuscitator of the Venturi type operated by oxygen under pressure, the improvement which comprises a valve chamber, an oxygen inlet conduit connected to said valve chamber, an inhalation conduit leading directly from said valve chamber to the patient, a Venturi conduit leading directly from said valve chamber to a Venturi chamber, an exhalation conduit leading from said Venturi chamber to the patient and a valve in said valve chamber adapted to open communication between said oxygen inlet conduit and said Venturi conduit during exhalation by the patient and to open communication between said oxygen inlet conduit and said inhalation conduit during inhalation by the patient whereby the oxygen which is conducted to the patient

during inhalation does not come in contact with any part of the mechanism through which exhaled gases have passed.

3. In a resuscitator of the Venturi type having a source of oxygen under positive pressure, a Venturi chamber, an exhalation conduit affording communication between said Venturi chamber and the patient, and an oxygen inlet conduit leading from said source of oxygen, the improvement which comprises an oxygen distributing chamber continuously communicating with said oxygen inlet conduit during operation of the apparatus as a resuscitator, a Venturi conduit leading from said oxygen distributing chamber to said Venturi chamber, an inhalation conduit leading from said oxygen distributing chamber to the patient, and valve means adapted throughout each period of exhalation to open communication between said oxygen distributing chamber and said Venturi chamber, and throughout each period of inhalation to open communication between said oxygen distributing chamber and the patient through said inhalation conduit.

4. In a resuscitator of the Venturi type having a source of oxygen under positive pressure, a Venturi chamber, an oxygen inlet conduit affording communication between said source of oxygen and said Venturi chamber and an exhalation conduit affording communication between said Venturi chamber and the patient, the improvement which comprises an inhalation conduit leading from said oxygen inlet conduit prior to the junction of said oxygen inlet conduit with said Venturi chamber, said inhalation conduit affording communication between said oxygen inlet conduit and the patient, and valve means constructed and arranged to open communication between said oxygen inlet conduit and said Venturi chamber throughout each period of exhalation and to open communication between said oxygen inlet conduit and the patient through said inhalation conduit throughout each period of inhalation, whereby the oxygen which passes to the patient during inhalation does not pass through said Venturi chamber.

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