

May 3, 1949.

J. H. EMERSON
BREATHING APPARATUS

2,468,741

Filed Dec. 12, 1944

3 Sheets-Sheet 1

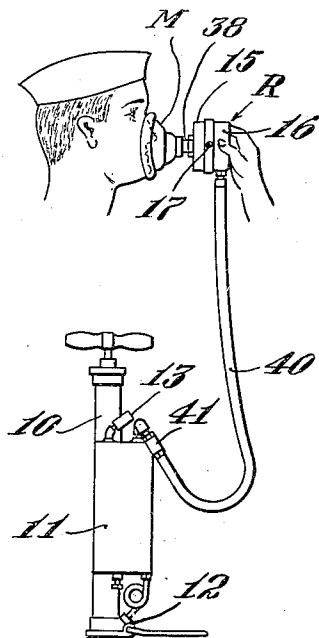


Fig. 1

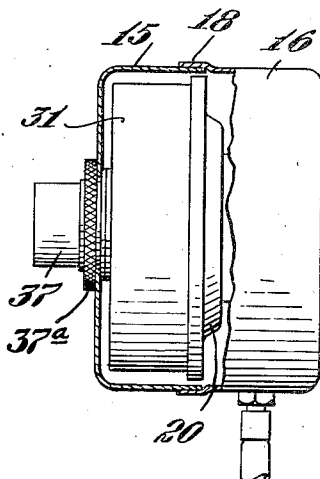


Fig. 2

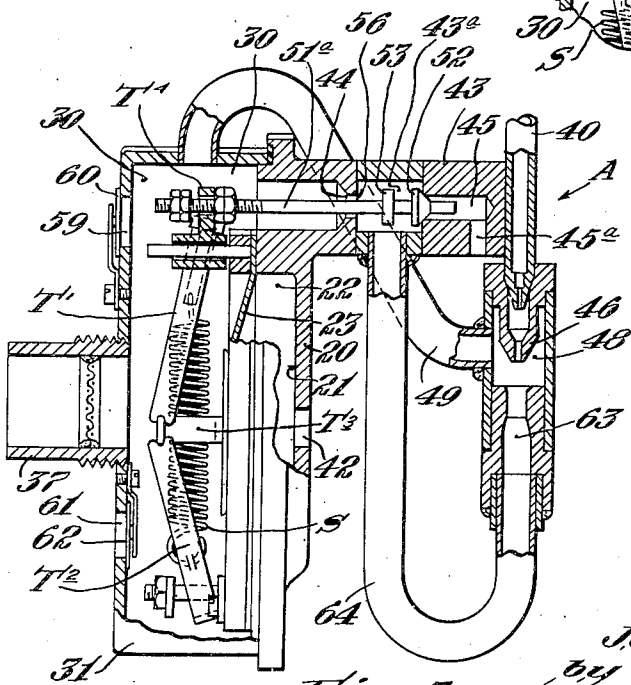


Fig. 3

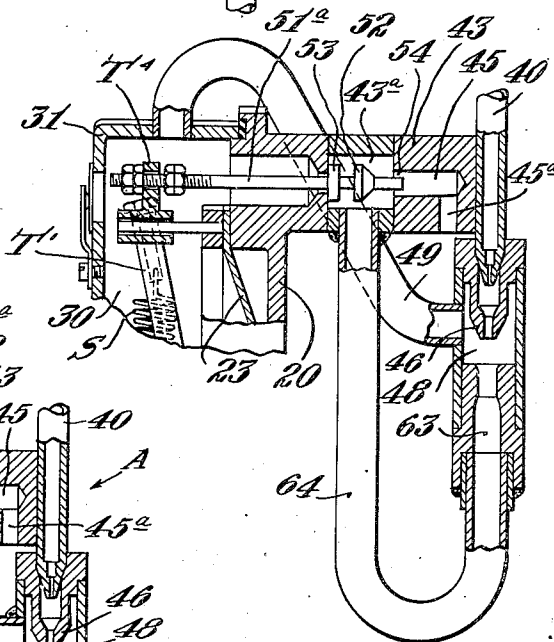


Fig. 4

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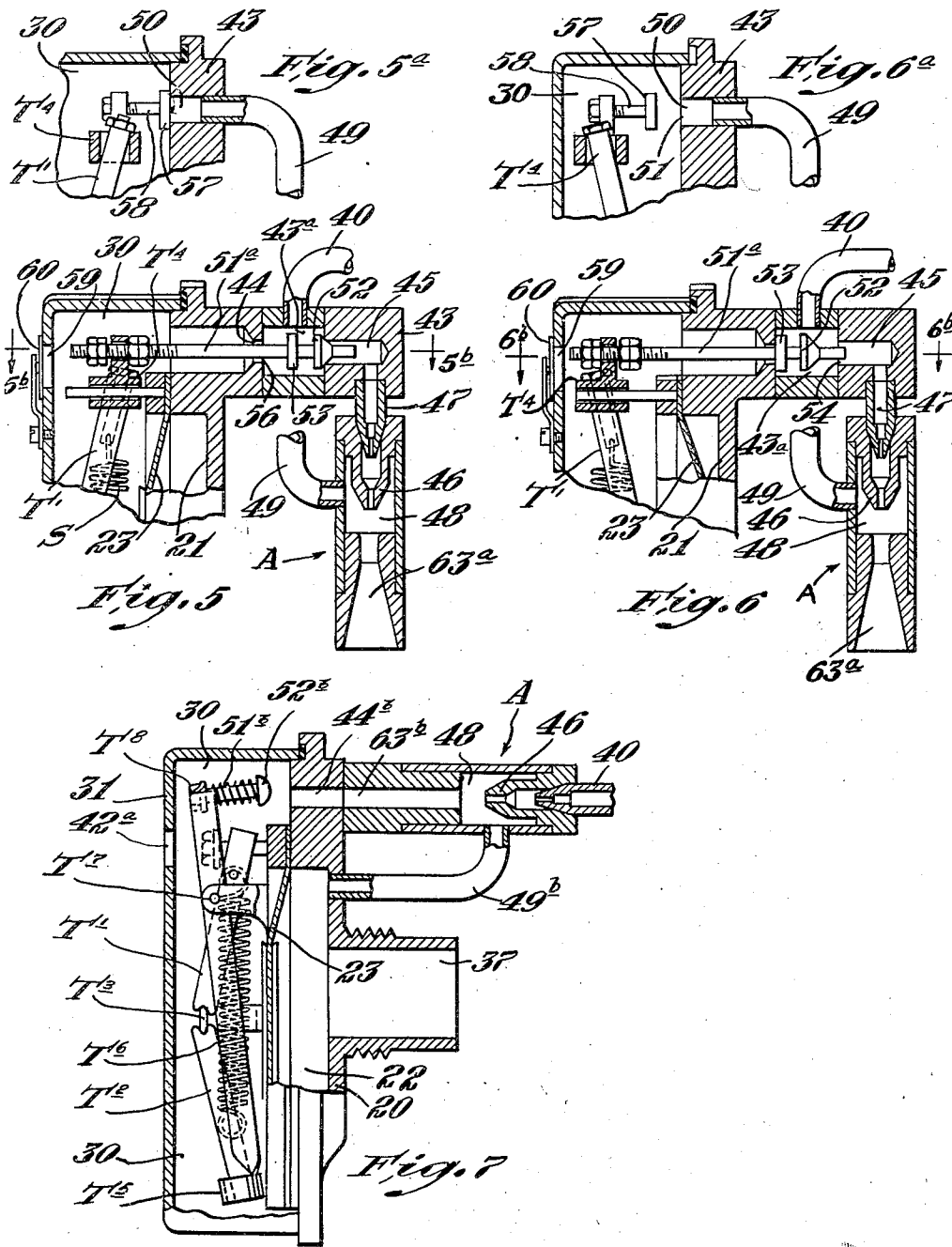
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

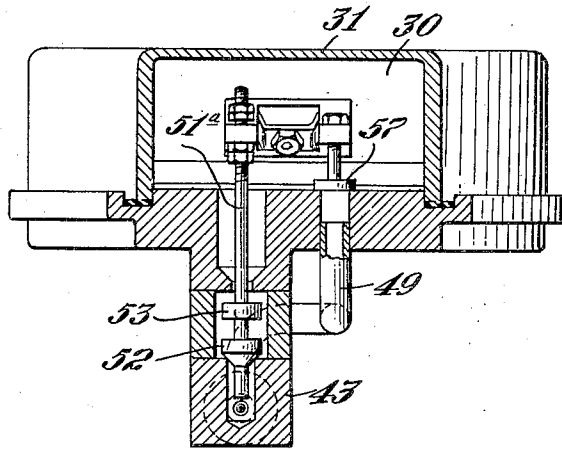


Fig. 5

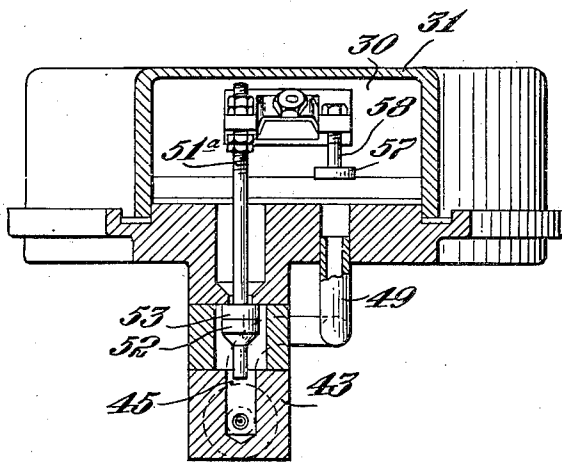


Fig. 6

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UNITED STATES PATENT OFFICE

2,468,741

BREATHING APPARATUS

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18 Claims. (Cl. 128—29)

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This invention relates to apparatus of automatic type, wherein gas supplied under pressure acts alternately to inflate and deflate the lungs, designed in particular for treating patients who are unable to breathe normally, as, for example, when suffering from gas asphyxiation, drowning or the like. The principal object of this invention is to provide a small, compact, portable resuscitator which is light and may be conveniently used in the field for first aid purposes, the present application being a continuation-in-part of my copending application for Letters Patent, Serial No. 464,948, filed November 9, 1942, which issued December 12, 1944, as Patent No. 2,364,626.

A further object is to provide a resuscitator which may be manipulated by a single attendant.

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 side elevation of the complete apparatus, with the face mask in place on a patient's face;

Fig. 2 is a side elevation, partly in diametrical section, showing the case of the resuscitator mechanism, to larger scale, the face mask being removed, and illustrating one form of resuscitator mechanism of the present invention;

Fig. 3 is a diagrammatic diametrical section with parts in side elevation and broken away, illustrating one embodiment of the present invention in which two controlling valves are employed, the parts being shown as in the inhaling position;

Fig. 4 is a fragmentary view generally similar to Fig. 3 but showing the parts in the exhaling position;

Fig. 5 is a fragmentary view generally similar to Fig. 3 but illustrating an embodiment of the invention which employs three controlling valves, the parts being in the inhaling position;

Fig. 5^a is a fragmentary section on a radial plane to the rear of the plane of Fig. 5, showing one of the controlling valves;

Fig. 5^b is a horizontal section substantially on the line 5^b—5^b of Fig. 5;

Fig. 6 is a view similar to Fig. 5 but showing the parts in the exhaling position;

Fig. 6^a is a view similar to Fig. 5^a, but with the valve in the exhaling position;

Fig. 6^b is a horizontal section substantially on the line 6^b—6^b of Fig. 6; and

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Fig. 7 is a view of the same general type as Fig. 3, but showing an embodiment of the invention in which but a single controlling valve is employed.

For effective operation the apparatus requires a source of gas under super-atmospheric, preferably substantially constant pressure. When herein reference is made to a gas, gaseous fluid or the like, such terms are used without limiting intent, being broadly inclusive of pure gases, for example O₂, mixtures of gases, for example atmospheric air; water vapor, etc. As here illustrated, a source of gas under super-atmospheric pressure is provided by the hand-operated plunger type pump 10 (Fig. 1). This pump is provided with a gas storage reservoir 11, the compressed gas from the pump 10 being forced through the check valve 12 on each stroke of the plunger and stored in the reservoir 11. The pressure gauge 13 indicates the gas pressure in the reservoir 11. Such a pump serves as a convenient light and portable source of gas under positive pressure for field use of the improved resuscitator device. It should be understood, however, that any other source of gas may be used, such as a cylinder of compressed oxygen.

The operative parts of the resuscitator R (Fig. 1) are all contained in the housing 15, 16 (Fig. 2). This housing or casing is hollow and externally shaped and dimensioned to permit it to be held in the palm of one hand, in effect constituting a handle for the mask M which is attached directly to the housing or casing by a short, preferably rigid tubular connection, thus leaving the other hand free to operate the plunger of the pump. Preferably this connection between the face mask M and the resuscitator R is of telescopic type, and such as to permit ready disconnection of the parts. The weight of the resuscitator is so small that when a patient reclines, his head can comfortably support the entire resuscitator (exclusive of the pump), its weight being distributed over the area of his face which is in contact with the face mask M.

The two housing parts 15 and 16 are detachably secured together by two screws 17 (Fig. 1) which pass through the flange 18 of the member 16 and the edge portion of the member 15 which slidably fits within said flange.

All of the operative mechanism of the device is supported by a rigid casting 20 within which certain at least of the fluid flow passages and valve seats are conveniently formed. This casting 20 is provided with a depressed portion 21 which forms one wall of a chamber 22 (Fig. 3).

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The other wall of said chamber is formed by the flexible diaphragm disk 23 constituting the pressure-actuated element of a fluid-pressure motor which is sensitively responsive to lung pressure. The edges of this disk-shaped diaphragm 23 are secured to the casting 20 by a clamping ring which is held in place by screws which pass through the ring and the margin of the diaphragm 23, and into the casting 20.

A valve reversing or motor chamber 30 (Figs. 3 and 4) is provided by a rigid cap member 31 which is detachably secured leak-tight to the casting 20. A rigid, tubular, externally screw-threaded projection or nipple 37 affords communication between the motor chamber 30 (Fig. 3) and the interior of the mask M (Fig. 1). A ring 37^a engages the screw threads of nipple 37 and clamps the part 20 to the casing member 15. The mask has a tubular member 33 (Fig. 1) which telescopes over the outer surface of the tubular member 37, thus permitting the separation of the mask and casing when desired.

Within the motor chamber 30 the snap-action valve operating mechanism actuated by the diaphragm 23 is arranged. This mechanism, together with the diaphragm or equivalent pressure-responsive element, is hereinafter referred to for convenience as a "pressure motor" and may be substantially identical with the corresponding mechanism more fully disclosed in my aforesaid copending application or in the patent to Sinnett No. 2,268,172, dated December 30, 1931.

Briefly this mechanism comprises a toggle linkage including toggle levers T¹ and T² having their adjacent ends united by a joint, the joined ends being connected to the central part of the diaphragm 23 by a rigid strut T³. The remote ends of the toggle levers are guided for movement toward and from the casting 20 and connected by a tension spring S. In the embodiments of the invention illustrated in Figs. 3 and 5, the end T⁴ of the lever T is connected to the stem or stems of the fluid control valve or valves hereinafter described, the pressure motor being so designed that when the diaphragm flexes inwardly, the end T⁴ of the lever T snaps suddenly in one direction to the full limit of its throw, and when the diaphragm flexes outwardly the end T⁴ of the lever T snaps suddenly in the opposite direction.

One desirable embodiment of the automatic flow controlling mechanism is illustrated in Figs. 3 and 4. In this arrangement the casting 20 is provided with an open port 42 leading from the chamber 22 to the outer atmosphere. To the outer surface, that is to say, the right-hand surface, as viewed in Figs. 3 and 4, of the casting 20, there is attached in any suitable manner, for instance by welding, a housing 43, which may be a casting, having within it a cavity 43^a which communicates by means of a passage 44, in the casting 20, with the chamber 30. A passage 45 in the part 43 leads from the cavity 43^a and opens at 45^a to the atmosphere. An aspirator device A is fixed to the outer end of part 43. This aspirator device comprises a casing within which is arranged the nozzle 46 designed to discharge a jet of pressure fluid, received through pipe 49, into the delivery throat 63 and thereby to aspirate fluid from the space 48. A pipe 64 conducts fluid discharged from the delivery throat 63 to the space 43^a. The chamber 48 communicates by means of a tube 49 with the chamber 30. A valve stem 51^a is connected at one end to a bracket T⁴ attached to the outer end of the toggle lever T¹, the stem passing freely through the passage 44

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and having a valve head 52 secured to its opposite end within the cavity 43^a. A second valve head 53 is arranged within the cavity 43^a, being mounted on the stem 51^a and being operative at times to close the port 56 at the point where the passage 44 enters the cavity 43^a. The valve head 52 is designed at times to close the port 54 where the passage 45 leaves the cavity 43^a. The casing 31 is provided with a port 59 leading to the outer atmosphere, this port being normally closed by a spring pressed outlet or safety valve 60. The case 31 is also preferably provided with a second port 61 normally closed by a spring pressed inlet valve 62.

During the inhalation period the parts occupy the position shown in Fig. 3, the valve 52 being seated and the valve 53 being unseated. Gas or air under pressure, supplied through the conduit 49, enters the nozzle 46 of the aspirator, is delivered into the tube 64 and thence through cavity 43^a and passage 44 into the chamber 30. Since the tube 49 leads from the chamber 30 to the suction space 48 of the aspirator a circulation of air through this tube 49 may result, but the delivery pressure at the throat 63 is such as gradually to build up pressure in the chamber 30, thus inflating the lungs. When the lung pressure has reached a predetermined value, any further increase causes the diaphragm to assume the position shown in Fig. 4, thus moving the valve head 52 to uncover the port 54 while at the same time causing the valve head 53 to close the passage 44. The gas now passing through the aspirator nozzle causes a partial vacuum in the space 48, thus withdrawing gaseous material through the tube 49 from the chamber 30 and thus from the lungs of the patient, the mingled gas and material exhausted from the lungs passing through the tube 64 to the cavity 43^a and thence through the open port 54 and passages 45 and 45^a to the atmosphere. When the pressure in the chamber 30 has thus been reduced to a predetermined amount, the diaphragm moves in the other direction, thus restoring the parts to the position of Fig. 3 for the resumption of inhalation.

The arrangement illustrated in Figs. 5 and 6 is in general similar to that shown in Figs. 3 and 4 and just described, corresponding parts being similarly numbered. However, in the arrangement of Figs. 5 and 6 the passage 45 connects the cavity 43^a with the inlet 47 of the aspirator. The aspirator device discharges directly to the atmosphere through the delivery throat 63. In this case the tube 49 leads from the suction space 48 to a recess 50 (Fig. 5^a) in the part 43, the recess 50 opening by means of a port 51 into the chamber 30.

In this device, a valve head 57 is connected (Fig. 5^a) by a stem 58 to the end T⁴ of the lever T¹ and at times closes the port 51 between the recess 50 and the chamber 30.

Assuming that the parts are in the relative positions shown in Figs. 5 and 5^a and that pressure fluid, for example atmospheric air or oxygen, is being supplied by the tube 40 to the space 43^a, this air or gas will pass through the port 56 and passage 44 into the chamber 30 and thence through the tubular connection 37 to the mask M. Pressure is thus built up in the lungs to a predetermined amount, whereupon any further increase in pressure causes the diaphragm to assume the position shown in Fig. 6. In moving to this position, the valve stem member 51^a is moved to the left so that the valve head 52 uncovers

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the port 54 and carries the valve head 53 into a position where it closes the port 56. By the same movement of the lever T¹ the valve stem 58 (Fig. 6^a) is actuated to move the valve head 57 away from the port 51. Air or gas under pressure now passes from the space 43^a through passage 45 and into the convergent inlet throat 47 of the aspirator. In passing through the nozzle 46 it produces a partial vacuum in the space 48, thus inducing the flow of gaseous material through the tube 49 from the recess 50 and thence from the chamber 30 and thus from the mask and from the patient's lungs. This gaseous material mingles with the gas supplied from the pipe 40 and is discharged to the atmosphere from the divergent delivery throat 63 of the aspirator. This aspirating action continues until the pressure in the lungs and in the chamber 30 has dropped to a predetermined amount, whereupon any further decrease in pressure in the chamber 30 results in a movement of the diaphragm 23 back to the position shown in Fig. 3, thus returning the several valves to the positions shown in the latter figure and re-establishing the inhalation period.

The arrangement shown in Fig. 7 employs but a single moving valve part. Similarly numbered parts in this view correspond to those of Fig. 3. In this arrangement the chamber 22 is connected by a tube 49^b to the suction space 48 of the aspirator. The delivery throat 63^b of this aspirator is aligned with a port or passage 44^b in the part 20, the passage 44^b opening into the chamber 30 and being controlled by a valve head 52^b secured to a stem 51^b. In this arrangement the toggle linkage is similar to that previously described, but instead of connecting the valve stem 51^b directly to one of the toggle levers, it is connected to the end T⁶ of a motion-reversing lever T⁶ fulcrumed at T⁷ and connected to the toggle link T² at point T⁵.

During exhalation, the diaphragm 23 and the valve 52^b occupy the position shown in Fig. 7. Air or gas under pressure entering through the pipe 40, causes a partial vacuum in the suction space 48 of the aspirator, thus withdrawing air from the lungs through the mask M, the tubular connection 37, the chamber 22 and the tube 49^b, and delivering this mixture through the delivery throat of the aspirator nozzle and through the passage 44^b into the chamber 30 from which it is discharged to the atmosphere through the open port 42^a in casing 1. When the pressure has dropped sufficiently in the chamber 22, the diaphragm moves to the right as viewed in Fig. 7, thus causing the toggle linkage to swing the lever T⁶ clockwise and thus seat the valve head 52^b to close the passage 44^b. There is now no outlet through the delivery throat 63 of the aspirator nozzle, and consequently the gas supplied through the tube 40 backs up in the space 48 of the aspirator and passes through the tube 49^b into the chamber 22 and thence through the tubular connection 37 to the mask M so as to inflate the lungs. When the lung pressure reaches a predetermined amount, the diaphragm again reverses its position, the valve 52^b is opened, and the exhalation period begins.

While I have shown and described certain desirable embodiments of the invention, it is to be understood that this disclosure is for the purpose of illustration only 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

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scope of the invention as set forth in the appended claims.

I claim:

1. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a movable element which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a single, rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device within the case, said aspirator device having a nozzle and a delivery throat, a conduit leading to the interior of the case for supplying pressure fluid, the case also housing reciprocating valves and snap-action means for transmitting motion from said movable motor element to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, and means within the case defining flow passages controlled by the aforesaid valves, one of said passages being so arranged as to deliver gaseous medium from the source of supply directly to the motor chamber, and another passage being so arranged as to deliver gaseous medium from the source of supply to the inlet of the aspirator nozzle, the passages, valves and motion-transmitting mechanism being so constructed and arranged that during inhalation fluid medium flows through said motor chamber in one direction and during exhalation fluid medium flows through the motor chamber in the opposite direction.

2. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device within the case, said aspirator device having a nozzle and a delivery throat, a conduit leading to the interior of the case for supplying pressure fluid, the case also housing reciprocating valves and snap-action means for transmitting motion from said diaphragm to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means providing a cavity within the case from which gaseous medium from the supply may flow alternatively directly to the motor chamber or to the inlet of the aspirator nozzle, certain of the aforesaid valves being operative to control the outlets from said cavity, the passages, valves, and motion-transmitting mechanism being so constructed and arranged that when the pressure in the motor chamber is positive to a predetermined amount, gaseous medium is withdrawn by the aspirator from the motor chamber and from the lungs and when the pressure in the motor chamber reaches a predetermined negative, gaseous medium is delivered to said chamber and to the lungs.

3. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a movable element which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device, said aspirator device having a nozzle and a delivery throat, a conduit for supplying pressure fluid, the case also housing reciprocating valves and snap-action means for transmitting motion from said movable motor element to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means within the case defining a cavity to which gas is supplied from the source under pressure, means within the case providing a duct connecting said cavity and the motor chamber, and means within the case defining a discharge passage leading from said cavity to the aspirator nozzle, the aforesaid valves being operative to control communication between said cavity and the duct and discharge passage respectively, the valves, passages, and motion-transmitting means being so constructed and arranged that during exhalation gaseous medium is withdrawn from said motor chamber by the aspirator nozzle and during inhalation gaseous medium under pressure is delivered directly to the motor chamber.

4. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device, said aspirator device having a nozzle and a delivery throat, a conduit for supplying pressure fluid, the case also housing reciprocating valves and snap-action means for transmitting motion from said diaphragm to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means within the case defining a cavity to which gas under pressure is constantly delivered, means providing a duct connecting said cavity with the motor chamber, means defining a passage leading from said cavity to the inlet to the aspirator nozzle, a pair of the aforesaid valves being operative alternatively to close communication between the case and the duct and passage respectively, said valves and the motion-transmitting means being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber by the aspirator nozzle and during inhalation gaseous medium under pressure is delivered directly to the motor chamber.

5. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a flexible diaphragm which

is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device within the case, said aspirator device having a nozzle and a delivery throat, a conduit leading to the interior of the case for supplying pressure fluid, the case also housing reciprocating valves and means for transmitting motion from said flexible diaphragm to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means defining a cavity to which gaseous medium under pressure is constantly supplied, means providing a duct connecting said cavity and motor chamber, means defining a discharge passage leading from said cavity to the inlet of the aspirator nozzle, the aforesaid valves including a pair of axially arranged valve heads operative respectively to close communication between the cavity and the duct and the discharge passage respectively, said valves moving in opposite directions in approaching their closed positions, and a stem on which said valve heads are mounted, the motion-transmitting means being arranged to move said valve stem axially, movement of the stem in one direction disposing one valve head in closed position and movement of the stem in the opposite direction disposing the other valve head in closed position, and means providing a duct leading from the motor chamber to the suction side of the nozzle the parts being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber by the aspirator nozzle and during inhalation gaseous medium under pressure is delivered to the motor chamber.

6. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device within the case, said aspirator device having a nozzle and a delivery throat, a conduit leading to the interior of the case for supplying pressure fluid, the case also housing reciprocating valves and means for transmitting motion from said diaphragm to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means defining a cavity to which pressure fluid is constantly delivered, means providing a duct connecting said cavity with the motor chamber, means defining a passage leading from said cavity to the inlet to the aspirator nozzle, said duct and passage entering the cavity at opposite sides of the latter and being coaxial where they enter the cavity, a valve stem extending loosely through the duct from the cavity to the motor

chamber, the aforesaid valves including valve heads mounted on said stem within the cavity, one of said heads being operative at times to close the passage and the other head being operative at times to close the duct, the motion-transmitting means including a toggle arranged within the motor chamber and actuable by the movable motor part to move the valve stem, thereby alternatively to move one or the other of the valve heads to closed position, the valves and motion-transmitting means being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber by the aspirator nozzle and during inhalation gaseous medium is delivered directly to the motor chamber.

7. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a flexible diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device, said aspirator device having a nozzle and a delivery throat, a conduit for supplying pressure fluid, the case also housing reciprocating valves and means for transmitting motion from said diaphragm to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means within the case defining a cavity which at all times communicates with the supply conduit and from which passages lead to the motor chamber and to the inlet of the aspirator nozzle, respectively, means defining a duct providing communication between the motor chamber and the suction side of the nozzle, and means defining an educt passage which receives the pressure medium discharged by the delivery end of the nozzle and which leads to the atmosphere, one of the aforesaid valves being operative to determine whether or not pressure medium from the supply shall discharge to the atmosphere through said educt passage, the valves and passages being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber by the aspirator nozzle and during inhalation gaseous medium under pressure is delivered to the motor chamber.

8. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device within the case, said aspirator device having a nozzle and a delivery throat, a conduit leading to the interior of the case for supplying pressure fluid, the case also housing reciprocating valves and snap-action means for transmitting motion from said diaphragm to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for

operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means within the case defining a cavity which at all times communicates with the supply conduit and from which passages lead to the motor chamber and to the inlet of the aspirator nozzle, respectively, means defining a duct providing communication between the motor chamber and the suction side of the nozzle, means defining an educt passage which receives the pressure medium discharge by the delivery end of the nozzle and which opens to the atmosphere, the aforesaid valves including a valve operative to control the delivery of pressure fluid to the motor chamber, the motion-transmitting mechanism including a toggle actuated motion-reversing lever operative by the movable member of the lever to move said last-named valve to and from closed position, the parts being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber by the aspirator nozzle and during inhalation gaseous medium under pressure is delivered directly from said cavity to the motor chamber.

9. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a movable element which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device, said aspirator device having a nozzle and a delivery throat, a conduit for supplying pressure fluid, the case also housing at least one reciprocating valve and snap-action means for transmitting motion from said movable motor element to said valve, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means within the casing defining a cavity which is in constant communication with the supply conduit, a duct leading therefrom to the motor chamber, a tube, one end of which is fixed in an opening in the wall of the suction space of the nozzle, and the other end of which is fixed in an opening in the wall of the motor chamber, the aforesaid reciprocating valve being operative to determine whether the pressure medium shall flow from said cavity to the motor chamber, said valve and motion-transmitting means being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber by the aspirator nozzle and during inhalation gaseous medium under pressure is delivered directly from said cavity to the motor chamber.

10. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device, said aspirator device having

a nozzle and a delivery throat, a conduit for supplying pressure fluid, the case also housing reciprocating valves and snap-action means for transmitting motion from said diaphragm to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, and means defining a cavity which receives pressure fluid from the supply, a duct providing communication between the motor chamber and the suction side of the nozzle, a valve controlled port providing direct communication between said cavity and the motor chamber, a valve controlled passage providing communication between said cavity and the inlet of the aspirator nozzle, the aforesaid valves including valves operative to determine whether pressure medium shall flow through said duct or through said port, the valves and motion-transmitting means being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber by the aspirator nozzle and during inhalation gaseous medium under pressure is delivered directly from said cavity to the motor chamber.

11. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a flexible diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device within the case, said aspirator device having a nozzle, a suction space and a delivery throat, a conduit leading to the interior of the case for supplying pressure fluid, the case also housing at least one reciprocating valve and means for transmitting motion from said flexible diaphragm to said valve, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means within the casing defining a cavity which receives pressure fluid from the supply conduit, valve controlled passages leading from said cavity to the motor chamber and to the inlet of the aspirator nozzle respectively, a duct providing communication between the motor chamber and the suction space of the nozzle, the aforesaid reciprocating valve being operative to determine whether or not the nozzle shall discharge gaseous medium from its delivery throat, the valve and motion-transmitting means being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber by the aspirator nozzle and during inhalation atmospheric pressure subsists in the suction space of the nozzle while gaseous medium under pressure is delivered to the motor chamber from the supply.

12. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said

connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device within the case, said aspirator device having a nozzle, a suction space and a delivery throat, a conduit leading to the interior of the case for supplying pressure fluid, the case also housing at least one reciprocating valve and means for transmitting motion from said diaphragm to said valve, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means defining a duct providing communication between the motor chamber and the suction space of the nozzle, the aforesaid reciprocating valve being operative to determine whether or not the nozzle shall function as an aspirator, the valve and motion-transmitting means being so constructed and arranged that during exhalation gaseous medium is withdrawn from said chamber by the aspirator nozzle and during inhalation atmospheric pressure subsists in the suction space of the nozzle while gaseous medium under pressure is delivered to the motor chamber from the supply.

13. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a flexible diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device, said aspirator device having a nozzle and a delivery throat, a conduit for supplying pressure fluid, the case also housing reciprocating valves and means for transmitting motion from said diaphragm to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means defining a duct providing communication between the motor chamber and the suction side of the nozzle, one of the aforesaid valves being operative at times to close said duct, means providing a cavity to which pressure medium is constantly supplied, there being ports affording communication between said cavity and the motor chamber and the inlet end of the nozzle respectively, certain of the aforesaid valves being operative alternatively to close said ports, the valves and motion-transmitting means being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber by the aspirator nozzle and during inhalation gaseous medium under pressure is delivered directly to the motor chamber.

14. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a movable element which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a single, rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said

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motor chamber, an aspirator device within the case, said aspirator device having a nozzle and a delivery throat, a conduit leading to the interior of the case for supplying pressure fluid, the case also housing reciprocating valves and snap-action means for transmitting motion from said movable motor element to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means defining a duct providing communication between the motor chamber and the suction side of the nozzle, one of the aforesaid valves being operative at times to close said duct, certain of the aforesaid valves constituting distributing means operative to determine whether pressure medium shall enter the inlet of the nozzle or pass directly into the motor chamber respectively, the motion-transmitting means being operative so to actuate said valves that during exhalation gaseous medium is withdrawn from the motor chamber and during inhalation gaseous medium is delivered directly to the motor chamber.

15. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device within the case, said aspirator device having a nozzle and a delivery throat, a conduit leading to the interior of the case for supplying pressure fluid, the case also housing reciprocating valves and snap-action means for transmitting motion from said diaphragm to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means defining a duct providing communication between the inlet chamber and the suction side of the nozzle, one of the aforesaid valves being operative at times to close said duct, a pair of the aforesaid valves being operative to determine whether the pressure medium supplied by the conduit shall enter the inlet chamber directly or flow into the inlet end of the nozzle, the motion transmitting means being operative to move the valves so that when the first-named valve is closed the valve which controls the nozzle inlet is also closed while the valve controlling communication with the motor chamber is open, the parts being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber and during inhalation gaseous medium under pressure is delivered directly to the motor chamber.

16. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a movable element which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the

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interior of the mask and said motor chamber, an aspirator device, said aspirator device having a nozzle and a delivery throat, a conduit for supplying pressure fluid, the case also housing reciprocating valves and snap-action means for transmitting motion from said movable motor element to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means providing a cavity with which the fluid supply conduit communicates, passages leading from said cavity to the motor chamber and to the inlet of the aspirator nozzle respectively, certain of the aforesaid valves being arranged to close said passages alternatively, means providing a passage connecting the motor chamber with the suction side of the aspirator, and another of the aforesaid valves being arranged to close said latter passage at times, the parts being so constructed and arranged that when the last-named valve is open the passage leading from said cavity to the motor chamber is closed.

17. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device, said aspirator device having a nozzle and a delivery throat, a conduit for supplying pressure fluid, the case also housing reciprocating valves and snap-action means for transmitting motion from said diaphragm to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means providing a cavity which at all times communicates with the fluid supply conduit, means providing a passage leading from said cavity to the motor chamber, means providing a passage leading from said cavity to the inlet of the aspirator nozzle, certain of the aforesaid valves being operative alternatively to close said passages, means providing a duct connecting the motor chamber with the suction side of the aspirator, the valves and motion-transmitting means being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber by the aspirator nozzle and during inhalation gaseous medium under pressure is delivered from said cavity to the motor chamber.

18. An artificial resuscitator of the kind which includes a face mask, a case which houses a pressure motor including a flexible diaphragm which is sensitively responsive to lung pressure and which defines one wall of a motor chamber, a rigid tubular connection uniting the mask and case, said connection having a single constantly open passage affording communication between the interior of the mask and said motor chamber, an aspirator device within the case, said aspirator device having a nozzle and a delivery

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throat, a conduit leading to the interior of the case for supplying pressure fluid, the case also housing reciprocating valves and means for transmitting motion from said flexible diaphragm to the valves, the resuscitator being of the kind wherein gas under pressure supplies the energy for inflating and for deflating the lungs and for operating the pressure motor, characterized in that the case which houses the aspirator, pressure motor, and motion-transmitting means is of a size such that it may be held in the palm of one hand, means providing a cavity which at all times communicates with the fluid supply conduit, means providing a passage leading from said cavity to the motor chamber, means providing a passage leading from said chamber to the inlet of the aspirator nozzle, two of the aforesaid valves being located within said cavity and operative alternatively to close the respective passages, means providing a duct connecting the motor chamber with the suction side of the aspirator, the valves and motion-transmitting means being so constructed and arranged that during exhalation gaseous medium is withdrawn from the motor chamber by the aspirator and during inhalation gaseous medium under pressure is delivered from said cavity to the motor chamber.

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