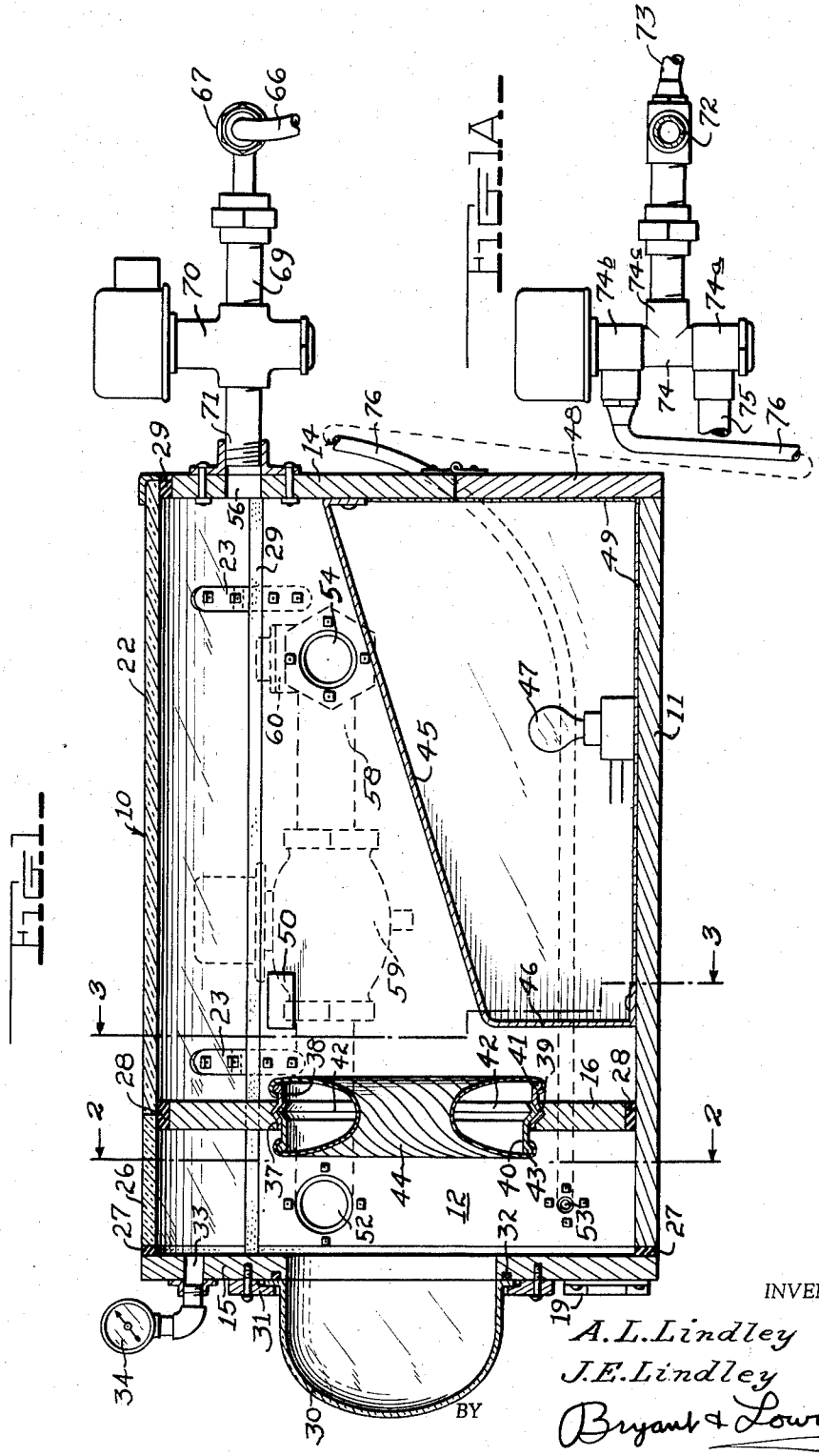
Dec. 9, 1958 A. L. LINDLEY ET AL 2,863,447

RESUSCITATOR

Filed Sept. 7, 1955 4 Sheets-Sheet 1



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RESUSCITATOR

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FIG. 3

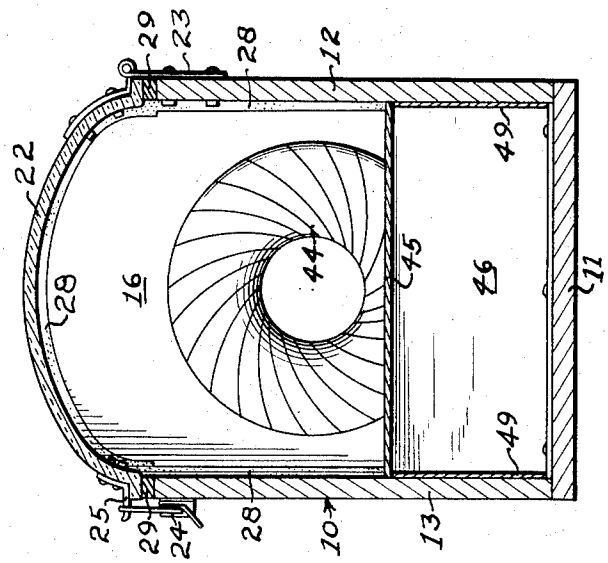
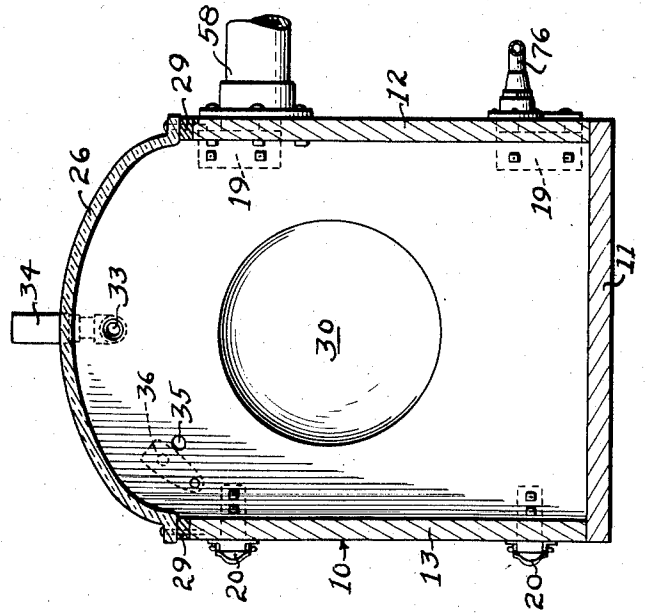


FIG. 2



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RESUSCITATOR

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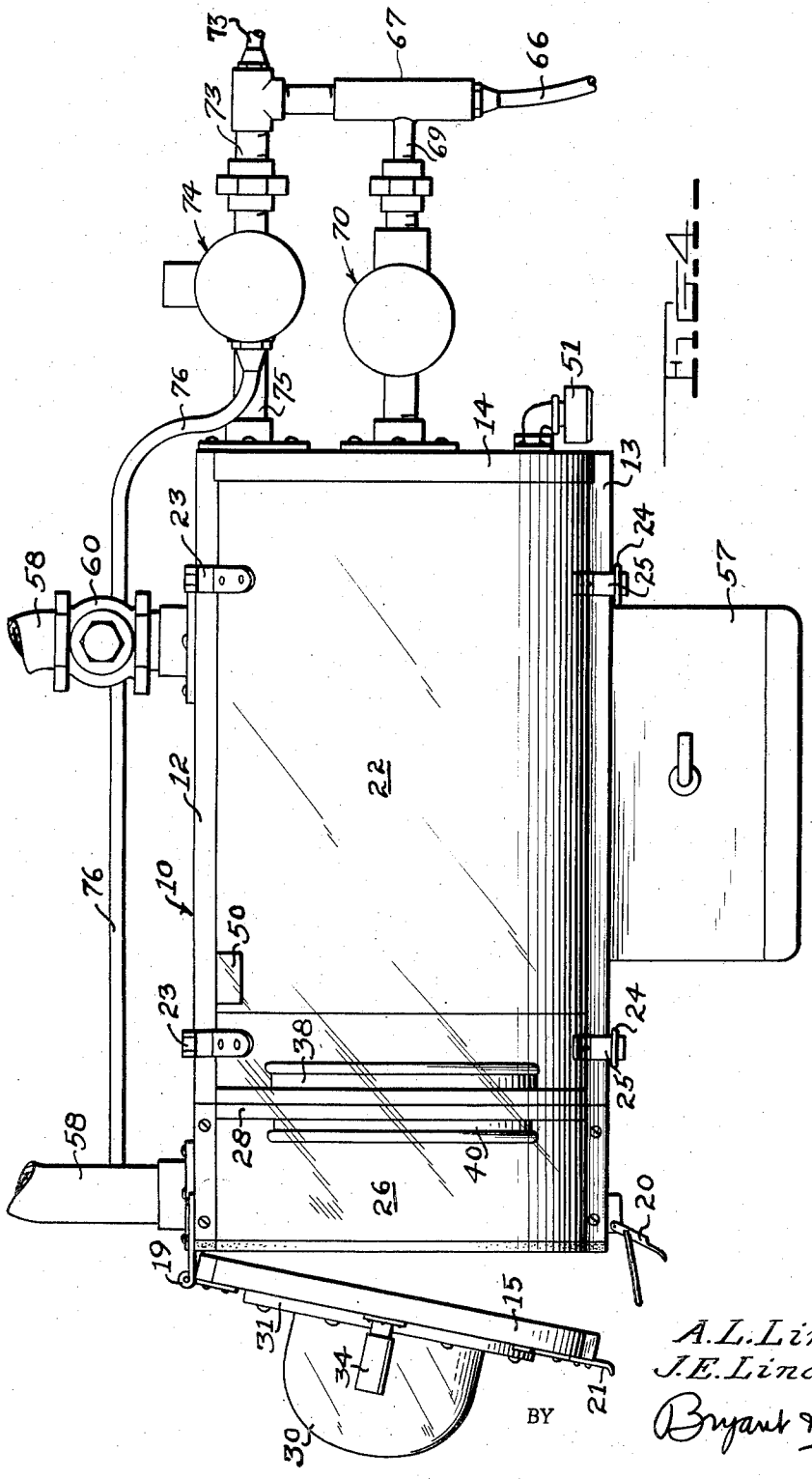


FIG. 4

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RESUSCITATOR

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FIG. 5

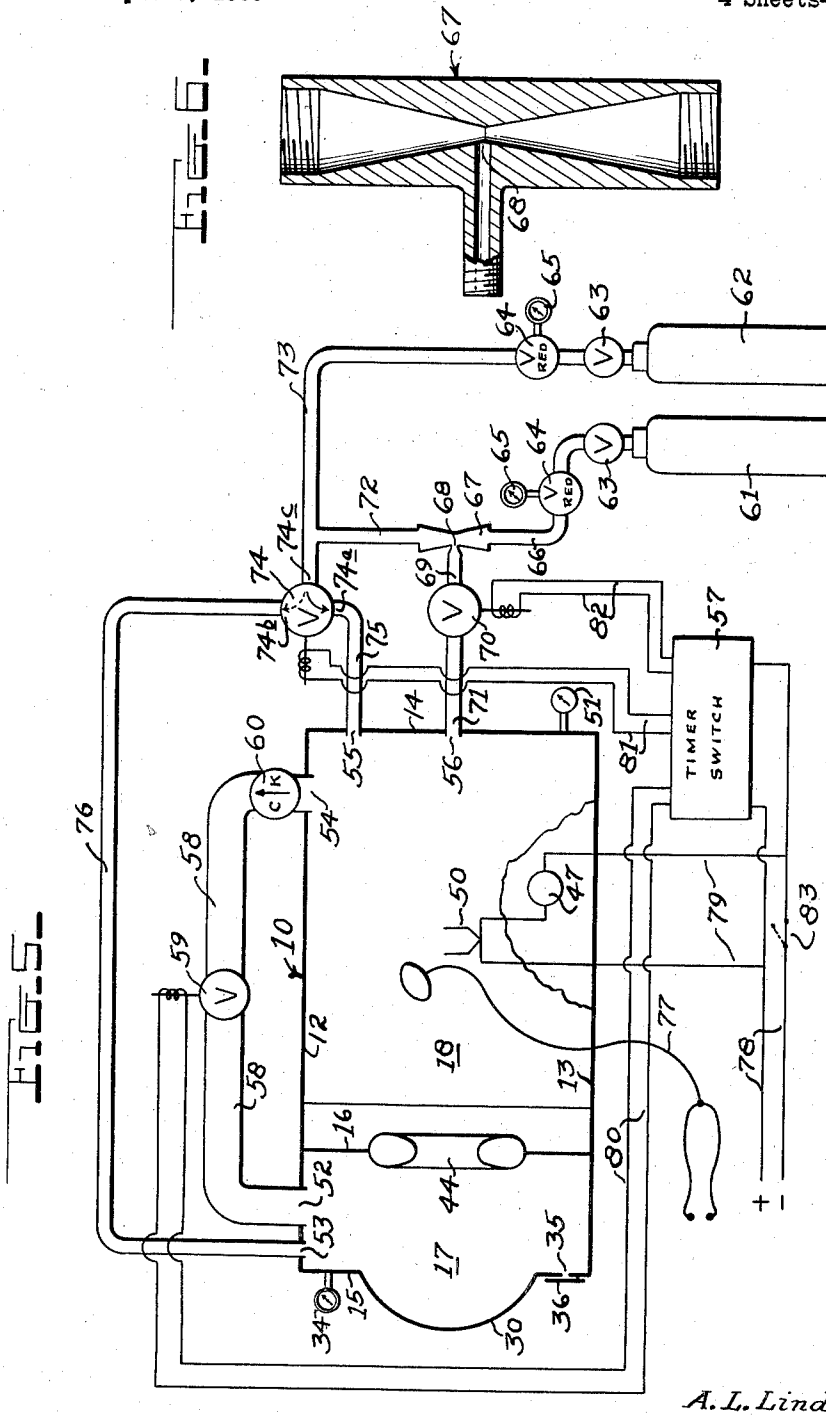


FIG. 6

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2,863,447

RESUSCITATOR

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Application September 7, 1955, Serial No. 532,866

13 Claims. (Cl. 128—30)

This invention relates to resuscitators and particularly to resuscitators primarily designed for the treatment of asphyxia in newborn infants, both premature and full term.

The condition of asphyxia in a newborn infant normally presents a serious problem in the delivery room. The procedure for handling such asphyxia includes a series of steps which must be started immediately and executed with considerable skill if permanent damage to the brain of the infant is to be avoided. This requires the full attention of the attending physician. However, the presence of asphyxia in most cases involves dangerous complications in the condition of the mother, which likewise demand the timely attention of the physician, and the attending staff.

It is an object of the invention, therefore, to provide a resuscitator of such safety and simplicity that it may be applied to the treatment of asphyxia in a newborn infant by a person not highly skilled in resuscitation while the physician may be free to devote his full time and attention to complications of the mother.

A further object of the invention is to provide a mechanism for both pulmonary ventilation and oxygenation of the blood that is automatic in its operation once the procedure has been started, and which can be placed in operation within a few seconds without trauma to the infant and brain damage due to delay in supplying oxygen to the brain.

Another object of the invention is to provide for adequate and complete pulmonary ventilation in a manner that closely resembles the initial natural respiratory pattern of a newborn infant, using relatively low pressures, rather than the high pressures developed by the known mechanical pump systems which often cause rupture of the lung tissues.

Still another object of the invention is to provide a resuscitator wherein the inspiration and expiration pressures are supplied by compressed oxygen or air and there are no motors or motor-driven parts to cause sparks which are capable of exploding anesthetic gases in use in the delivery room.

A further object of the device is to provide a combination of positive pressure expiration with both positive and negative pressure inspiration so coordinated and timed that there is a sudden lung expanding initial gasp, followed by a lower pressure longer maintained period which further inflates the more distant, peripheral areas of the lungs.

Another object is to provide a resuscitator having separate air-tight head and body compartments which may be opened, if necessary, for access to either head or body compartment, without complete interruption of the pulmonary and oxygenation cycles.

A further object is to provide a resuscitator designed to rid the bronchial tree of excess fluids by both postural drainage and positive pressure on the chest during expiration, and which further permits access for fluid removal

by aspiration without completely stopping the resuscitation procedure.

Another object is to provide heat for the infant's body by a simple and safe method that is automatically regulated at the optimum temperature.

Yet another object of the invention is to provide a device which may be used as an incubator once the respiratory pattern has been established.

Another object is to provide a resuscitator which provides full visualization of the infant and accessibility to the heart and lung sounds at all times.

A final object is to provide a resuscitator which is simple, portable, inexpensive to manufacture, and available to smaller institutions with limited budgets.

With the above and other objects in view as will be presently apparent, the invention consists in general of certain novel details of construction and combinations of parts hereinafter fully described, illustrated in the accompanying drawings and particularly claimed.

In the accompanying drawings like characters of reference denote like parts in the several views, and

Fig. 1 is a longitudinal vertical sectional view taken at the centerline of the resuscitator pressure chamber;

Fig. 1A is a fragmentary side elevational view of a portion of the oxygen pressure system, which is normally positioned behind the valve and fittings at the right hand side of Fig. 1, but which is herein shown as a separate view for greater clarity;

Fig. 2 is a fragmentary cross-sectional view of the resuscitator pressure chamber taken on the line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary top elevational view of the resuscitator showing the pressure chamber and a portion of the gas pressure system;

Fig. 5 is a schematic view showing the complete resuscitator structure, including the gas pressure and electrical systems; and

Fig. 6 is a longitudinal section of the Venturi tube fitting which provides the negative pressures at predetermined intervals in the pressure chamber.

Pressure chamber

In the drawings, the reference numeral **10** designates the pressure chamber of the resuscitator unit. This chamber is defined by the bottom wall **11**, the side walls **12** and **13**, and the end walls **14** and **15**. These walls are of any desired material, such as sheet metal or plastic and are preferably opaque. The end walls **14** and **15** respectively have arcuate upper edges.

The pressure chamber is provided with a partition **16** which divides the chamber into a head compartment **17** and a body compartment **18**. The partition **16**, as shown in Fig. 3, is also provided with a curved or arcuate upper edge.

The end wall **15** forms a door to the head compartment **17** and is hingedly attached to the side wall **12** by the hinges **19**. For drawing up the end wall **15** in pressure-tight relation, there is provided a pair of toggle latches **20**, the said latches engaging keepers **21** on the end wall. Any other suitable latching means could be used.

The body compartment **18** is provided with a curved cover **22** which is preferably made of a transparent plastic so that a full view of the compartment and the infant placed therein may be had at all times. This cover is hingedly attached to the side wall **12** by the hinges **23**, and on the opposite side the toggle latches **24** engage with keepers **25** for clamping the top to the chamber.

A fixed cover **26** is provided for the head compartment, and this is screwed or otherwise fastened to the

side walls 12 and 13. The end wall 15 abuts the ends of the bottom and side walls 11, 12 and 13, respectively, and the cover 26, and to insure sealing a gasket 27 is placed therebetween. A gasket strip 28 is placed at the bottom, top and side edges of the partition 16 and a gasket strip 29 is placed at the top edge of the side walls 12 and 13 and end wall 14. It will be noted that the sealing gaskets insure that when the end wall 15 and cover 22 are closed and latched the two compartments will be completely air tight. However, when necessary, full access may be instantly had to either the head or body of the infant patient.

The end wall 15 is further provided with a dome 30 of clear transparent plastic or other suitable material, which receives the head of the patient and which gives the attending staff an unobstructed and clear view of the head. This dome 30 is fastened to the end wall 15 by any suitable means, such as the ring 31. A gasket 32 insures an air tight seal between the dome 30 and the end wall 15. Adjacent the top of the end wall 15 is formed an aperture 33 which communicates by suitable fittings with a pressure gauge 34, this gauge reflecting at all times the positive gas pressure within the head compartment.

Also formed in the end wall 15 is an escape aperture 35. A cover 36 is pivotally attached to the end wall 15 adjacent the aperture 35, and by controlled pivotal movement can be made to cover as much of the aperture as desired. Thus, the gases inside the head compartment are allowed to escape at a controlled, adjustable rate.

The partition 16 is provided with a large circular opening 37 which receives a spiral twist neck collar which is known in the art and which in itself does not form a part of the present invention. A stationary outer rim 38 is fixed in the circular opening 37 and a V-shaped annular groove is formed therein, which holds the rim against axial movement and also provides a guide for a rotatable inner rim 40. The outer rim 38 extends outwardly into the body compartment and is provided with an annular bead 41. The inner rim 40 is journaled within the rim 38 and is also provided with an annular groove 42 which fits within the groove 39. This permits rotation of the rim 40 but holds it against axial movement. The inner rim 40 extends outwardly into the head compartment, and is provided with an annualr bead 43. One end of a large, soft plastic tube 44 is placed over the annular bead 41 of the outer rim 38 and the opposite end is placed over the annular bead 43 of the inner rim 40. Both ends fit air-tight on the rims, and when the inner rim is rotated it produces a spiral twisting movement that forms numerous folds in the plastic tube and tightens the tube down to an adjustable air-tight fit on the patient's neck. This seals the body compartment from the head compartment.

The body compartment is provided with a fixed partition 45 which is preferably set at an angle of 20° with the horizontal and which is preferably made of a heat conducting metal. This partition is fitted in an air tight manner to the side walls 12 and 13 and the end wall 14. The inner end 46 of the partition is bent downwardly short of the partition 16, so that access is had to the plastic tube 44 when a change is necessary, and the end 46 is fastened to the bottom wall 11. The partition 45 thus forms with the bottom wall 11 and end wall 14 a compartment within which is placed a light bulb 47 used for heating the resuscitator to a desired temperature.

The bottom portion of the end wall 14 is in the form of a door 48 which is hingedly connected to the end wall. This door provides access to the bulb 47 for replacement. The inner surfaces of the outwardly positioned walls of the heating compartment are covered with a reflective layer of metal foil 49 or the like so that the heat will be reflected inwardly toward the body compartment through the conductive partition 45.

On the inner face of the side wall 12 is placed a thermostat 50 which controls the heating effect of the bulb 47 in a manner which will be later described.

On the end wall 14 is placed a pressure gauge 51 which is in communication with the body compartment and reflects the pressures there at all times. The gauge measures both positive and negative pressures.

The side wall 12 adjacent the head compartment is provided with a large aperture 52 and smaller aperture 53, which are in communication with fittings of the pressure system to be later described. The side wall 12 adjacent the body compartment has a large aperture 54 therethrough. The end wall has two smaller apertures 55 and 56 respectively formed therein. On the outer face of the side wall 13 is positioned the casing of a timer switch 57.

For listening to the heart and lung sounds of the patient without opening the resuscitator, a stethoscope 77 is placed through the side wall 13. The receiving end of the stethoscope is normally taped to the chest of the infant.

Gas pressure and control valve system

A large metal tube 58 connects the head and body compartments via the apertures 52 and 54 respectively. Approximately midway of the tube 58 is a large direct acting solenoid operated valve 59, which controls the flow of oxygen from the body compartment to the head compartment. This valve is normally closed when its solenoid is not energized, but when current is applied the valve opens fully to pass oxygen from the body compartment 18 to the head compartment 17.

Located in the tube 58 between the aperture 54 and the valve 59 is a large one-way check valve 60. This valve is biased to allow flow from the body compartment to the head compartment, but not in the reverse direction.

The oxygen supply used for developing operating pressures and for oxygenation comes from a pair of conventional oxygen cylinders 61 and 62. Each of these cylinders has the conventional shut-off valve 63, pressure reducing valve 64, and pressure gauge 65.

Oxygen from the cylinder 61 passed through a conduit 66 into one end of a Venturi fitting 67, shown in section in Fig. 6. The flow is past a suction port 68. The suction port 68 is connected by a conduit 69 to a solenoid operated valve 70, and the opposite port of this valve is connected by a conduit 71 to the aperture 56 in the body compartment. This valve is normally closed when its solenoid is not energized, and neither suction nor positive pressure can be applied through it to the body compartment. When current is applied the valve will be held open and the flow of gas through the Venturi tube will aspirate and induce a negative pressure in the body compartment. The discharge end of the Venturi tube 67 is connected by a conduit 72 to a conduit 73 which leads from the second cylinder 62.

The discharge from conduits 72 and 73 is directed to the inlet 74*c* of a two-way solenoid operated valve 74. One outlet 74*a* of the two-way valve 74 is connected by a conduit 75 to the aperture 55 in the body compartment. The other outlet 74*b* is connected by a conduit 76 which leads to the aperture 53 in the head compartment. When the current is off and the solenoid of the valve 74 is not energized, the flow is through the conduit 75 into the body compartment 18. When the solenoid is energized flow is through the conduit 76 into the head compartment 17.

Electrical control and heating system

The three solenoid valves 59, 70, and 74 are controlled by the electronic timer switch 57 which is secured to the outer face of the side wall 13. The timer switch is of any known internal construction and the structural details thereof do not form any part of this invention.

The function of the timer switch is to simultaneously energize and de-energize the three solenoid valves at a

given adjustable interval through a continuous cycle, and any known switch capable of performing this function is satisfactory. The time periods may be varied if desired, but for all practical purposes the periods are set so that the solenoids are simultaneously energized for 1.5 seconds and simultaneously deenergized for 1.5 seconds. This timing gives approximately 20 complete respiratory cycles each minute which is the preferred rate.

The main circuit leads **78** of the time switch are connected to a standard 110 volt, 60 cycle current supply. The sub-circuit leads **79** from the supply circuit **78** extend to the thermostat **50** and bulb **47** respectively. The thermostat **50** being in series with the bulb, senses the temperature in the body compartment **18** and the bulb **47** will be intermittently energized to maintain the desired temperature in the body compartment.

The leads **80** extend from the switch **57** and form a branch circuit for the solenoid of the valve **59**. In like manner, the sub-circuit wires **81** and **82** are connected to the solenoids of the valves **74** and **70**, respectively.

A manually operated switch **83** in the main circuit **78** is provided for on and off control of the electrical system.

Operation

The preliminary steps to the operation of the device are as follows:

(1) The electronic timer switch **57** and light bulb **47** are turned on by means of the switch **83**.

(2) The infant is placed in the resuscitator through the opened top, and the head is inserted through the spiral twist collar **44**, care being taken that an airtight seal is formed at the neck of the patient.

(3) The stethoscope **77** is taped over the infant's left chest.

(4) The top **22** of the body compartment is closed and the latches **24** clamp down on the top, forming an airtight seal.

(5) The valves **63** of the oxygen tanks **61** and **62** are turned on to start the flow of oxygen.

(6) A small oral airway of well known construction is placed in the infant's mouth.

(7) The door **15** of the head compartment is closed tight.

(8) The cover **36** to the escape aperture **35** is set at a proper mark determined from prior test and operation.

At this point the operation of the resuscitator will be as follows:

It is assumed that the position of the timer switch **57** is at the beginning of the "off" period of its cycle. The solenoids of the valves **74**, **59** and **70** are not energized. Forced expiration of the infant takes place by the oxygen from both tanks **61** and **62** going through the valve **74** and conduit **75** into the body compartment **18** through the aperture **55**. At this time valves **59** and **70** being "off" are closed. The pressure in the body compartment, by prior adjustment of valves **64** gradually rises to 15 cm. of water, compressing the thoracic cage of the infant and forcing the carbon dioxide and oxygen from its lungs, as there is at this time no resistance to the escape of these gases from the head compartment **17** through the escape aperture **35**. Also, this same positive pressure on the thorax plus the "head down" position due to the slope of the partition **45** tends to force excess fluids from the bronchial tree and into the pharynx where they can be easily aspirated by opening the head compartment and using a rubber bulb or endotracheal catheter.

When the valve solenoids have been de-energized for 1.5 seconds and the body compartment **18** is at 15 cm. of water, the timer switch **57** moves to the "on" part of its cycle and suddenly and simultaneously energizes the solenoids of the valves **59**, **70** and **74**, and this period is maintained for 1.5 seconds.

The valve **59**, opening suddenly as indicated, allows a quick surge of oxygen under a pressure of 15 cm. of water to rush through the large conduit **58** into the head compartment **17**. Because the escape aperture **35** is of such small size the pressure in the head compartment **17** rises suddenly to 10 cm. of water, and oxygen moves down the infant's trachea, giving it a sudden inspiratory gasp. At the same instant the sudden release of positive pressure on the infant's chest gives a recoil expansion of the chest due to the inherent elasticity of the thoracic cage. This aids the positive pressure down the trachea in expanding the lungs. The 10 cm. positive pressure in the head compartment **17** is prevented from flowing back into the body compartment **18** by the check valve **60**. At the instant that the above is happening the energizing of the solenoid of valve **74** has diverted gas flow from the conduit **75** to the conduit **76** and into the head compartment **17** through the aperture **53**. This furnishes a sustained positive pressure to the head compartment **17** and hence down the infant's trachea of 7 cm. of water throughout the 1.5 seconds of inspiration. This pressure of 7 cm. of water has been preregulated by adjustment of the pivoted cover **36** over the escape aperture **35**. This sustained positive pressure of 7 cm. of water also maintains closure of the check valve **60**.

It should be pointed out that the pressure values named are not absolute, but represent those pressures which from experiment have proved to be most satisfactory. They may be varied by adjustment of the valves **64**, the cover **36**, and the length of the "off-on" cycles of the timer swtich **57**.

At the instant valves **59** and **74** have been energized, valve **70** had likewise been energized and opens. This opened the suction port **68** to communication with the body compartment **18** through the aperture **56**. The action of the Venturi fitting **67** quickly aspirates the body compartment **18** down to a negative pressure of 2 cm. of water, allowing for and aiding more complete expansion of the chest. The oxygen aspirated from the body compartment **18** joins with the primary flow from the tanks **61** and **62** and aids in maintaining the sustained positive pressure in the head compartment.

When the 1.5 second period of energization is complete, the switch **57** suddenly cuts off the current to the solenoids of the valves **59**, **70** and **74**. Valve **70** closes, cutting off aspiration of the body compartment. Valve **74** switches oxygen flow from conduit **76** to conduit **75**, starting the build-up of pressure in the body compartment **18**. Valve **59** closes to prevent flow through the conduit **58** to the head compartment **17**. The remaining positive pressure in the head compartment, as well as carbon dioxide from the infant's lungs during expiration, escapes through the aperture **35**. This marks the beginning of the new cycle, and the complete cycle occurs twenty times a minute.

By means of the stethoscope **77** taped to the infant's chest, the character and rate of the heart beat as well as the breath sounds can be under constant observation without opening the resuscitator or ceasing its operation.

Should it be necessary at any time to gain access to the infant's head to maintain or improve its airway, the head compartment can be immediately swung completely open while the positive pressure expiration, and thoracic recoil and negative pressure expansion of the chest for inspiration are still taking place, as usual in a cyclic manner. Therefore, the patient still has pulmonary ventilation while the head is being treated.

Should it be necessary to gain access to the infant's body, the entire top **22** of the body compartment can be completely opened for this purpose. If at the same time, as the top of the body compartment is opened, the escape aperture **35** is almost completely closed, the amount of positive pressure in the head compartment can be increased as desired, so that more oxygen is forced down the trachea during the inspiratory period and expiration would take place by positive collapse of the lungs and thoracic cage, with escape of the oxygen and carbon dioxide through the partially occluded escape aperture

during the expiration period. Thus pulmonary ventilation would continue to take place by pressure changes in the head compartment alone.

While there is herein shown and described the preferred embodiments of the invention, it is nevertheless to be understood that minor changes may be made therein without departing from the spirit and scope of the invention as claimed. While the preferred form of the invention has been largely described as pertaining to the treatment of asphyxia in newborn infants, it is to be understood that with appropriate changes in the size of parts the device may be applied to the resuscitation of any patient.

What is claimed is:

1. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas-tight head and body compartments, a neck receiving aperture between said head and body compartments, neck engaging sealing means for said aperture, means for supplying gas under pressure to said resuscitator, means for admitting an expiratory gas pressure to said body compartment for a given time interval, means for discharging said pressure at the end of said interval, means for admitting a sudden, relatively heavy inspiratory gas pressure to said head compartment simultaneously with the discharge of gas in said body compartment, means for subsequently admitting a steady, reduced gas pressure to said head compartment for a given time interval, and means for exhausting the gases in said head compartment as the pressure is again built up in said body compartment.

2. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas-tight head and body compartments, a neck receiving aperture between said head and body compartment, neck engaging sealing means for said aperture, means for supplying gas under pressure to said resuscitator, means for admitting an expiratory gas pressure to said body compartment for a given time interval, means for discharging said pressure at the end of said interval, means for admitting a sudden, relatively high inspiratory gas pressure to said head compartment simultaneously with the discharge of the gas in said body compartment, means for subsequently admitting a steady reduced gas pressure to said head compartment for a given time interval, means for exhausting the gases in said head compartment as the pressure is again built up in said body compartment and timing means for cyclic regulation of said time intervals.

3. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas-tight head and body compartments, a neck receiving aperture between said head and body compartments, neck engaging sealing means for said aperture, means for applying an expiratory gas pressure to said body compartment for a given time interval, means at the end of said interval for suddenly discharging said gas pressure into said head compartment thereby inducing an inspiratory gasp, means for subsequently applying a steady reduced gas pressure to said head compartment for a given time interval, and means for exhausting the gases in said head compartment as the pressure is again built up in said body compartment.

4. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas-tight head and body compartments, a neck receiving aperture between said head and body compartments, neck engaging sealing means for said aperture, means for supplying gas under pressure to said resuscitator, means for admitting an expiratory gas pressure to said body compartment for a given time interval, means for discharging said pressure at the end of said interval and for creating a negative pressure in said body compartment, means for admitting a sudden relatively heavy inspiratory gas pressure to said head compartment simultaneously with the creation of the negative pressure in said body compartment, means for subsequently admitting a steady, reduced gas pressure to said head compartment for a given time interval, and means for exhausting the gases in said head compartment as the pressure is again built up in said body compartment.

5. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas tight head and body compartments, a neck receiving aperture between said head and body compartments, neck engaging sealing means for said aperture, means for supplying gas under pressure to said resuscitator, means for admitting an expiratory gas pressure to said body compartment for a given time interval, means for discharging said pressure at the end of said interval and for creating a negative pressure in said body compartment, means for admitting a sudden, relatively high inspiratory gas pressure to said head compartment simultaneously with the discharge of the gas pressure in said body compartment, means for subsequently admitting a steady reduced gas pressure to said head compartment for a given time interval, means for exhausting the pressure in said head compartment as the pressure is again built up in said body compartment, and timing means for cyclic regulation of said time intervals.

6. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas-tight head and body compartments, a neck receiving aperture between said head and body compartments, neck engaging sealing means for said aperture, means for applying an expiratory gas pressure to said body compartment for a given time interval, means at the end of said interval for suddenly discharging said gas pressure into said head compartment thereby inducing an inspiratory gasp, means for creating a negative pressure in said body compartment immediately after discharge of the gas pressure into said head compartment, means for subsequently applying a steady, reduced gas pressure to said head compartment for a given time interval, and means for exhausting the gases in said head compartment as the pressure is again built up in said body compartment.

7. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas-tight head and body compartments, a neck receiving aperture between said head and body compartments, neck engaging sealing means for said aperture, a relatively large conduit connecting said head and body compartments, valve means interposed in said conduit, means for applying an expiratory gas pressure to said body compartment for a given time interval, means at the end of said interval for opening said valve means thereby suddenly discharging the gas pressure in said body compartment into said head compartment to induce an inspiratory gasp, means for subsequently applying a steady, reduced gas pressure in said head compartment for a given time interval, and means for exhausting the gases in said head compartment as the pressure is again built up in said body compartment.

8. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas-tight head and body compartments, a neck receiving aperture between said compartments, neck engaging sealing means for said aperture, bottled gas means for applying an expiratory gas pressure to said body compartment for a given time interval, means at the end of said interval for suddenly discharging said gas pressure into said head compartment thereby inducing an inspiratory gasp, bottled gas means for subsequently applying a steady, reduced gas pressure to said head compartment for a given time interval, means for exhausting the gases in said head compartment as the pressure is again built up in said body compartment, and automatic timing means for cyclic regulation of said time intervals.

9. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas-tight head and body compartments, a neck receiving aperture between said compartments, neck engaging sealing means

for said aperture, bottled gas means for applying an expiratory gas pressure to said body compartment for a given time interval, means at the end of said interval for suddenly discharging said gas pressure into said head compartment thereby inducing an inspiratory gasp, aspirator means operated by bottled gas pressure for creating a negative pressure in said body compartment after the discharge of pressure from the body compartment, bottled gas means for subsequently applying a steady, reduced gas pressure to said head compartment for a given time interval, means for exhausting the gases in said head compartment, and automatic timing means for cyclic regulation of said time intervals.

10. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas-tight head and body compartments, a neck receiving aperture between said compartments, neck engaging sealing means for said aperture, a relatively large conduit connecting said head and body compartments, a cut-off valve interposed in said conduit, a check valve interposed in said conduit biased to allow flow only from said body compartment to said head compartment, a two-way valve, conduit means connecting one outlet port of said two-way valve to said head compartment, conduit means connecting the other outlet port of said two-way valve to said body compartment, means supplying gas under pressure to the inlet port of said two-way valve, an adjustable gas escape aperture in said head compartment opening to the atmosphere, and automatic timing means simultaneously operating said cut-off valve and said two-way valve for cyclic alternation at timed intervals.

11. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas-tight head and body compartments, a neck receiving aperture between said compartments, neck engaging sealing means for said aperture, a relatively large conduit connecting said head and body compartments, a cut-off valve interposed in said conduit, a check valve interposed in said conduit biased to allow flow from the body compartment to the head compartment only, a two-way valve, conduit means connecting one outlet port of said two-way valve to said head compartment, conduit means connecting the other outlet port to said body compartment, means supplying gas under pressure to the inlet port of said two-way valve, a Venturi tube, means supplying gas under pressure through said tube and into the inlet port of said two-way valve, a suction port in said Venturi tube, a conduit connecting said suction port to said body compartment, a second cut-off valve in said conduit, an adjustable escape aperture in said head compartment opening to the atmosphere, and automatic timing means simultaneously changing each of said first and second cut-off valves and said two-way valve in a cyclic manner after a given time interval.

12. In a resuscitator for the treatment of asphyxia, a pressure chamber having separate, adjacent, gas-tight head and body compartments, a neck receiving aperture between said compartments, neck engaging sealing means for said aperture, a relatively large conduit connecting said head and body compartments, a solenoid operated cut-off valve interposed in said conduit normally biased into closed position, a check valve interposed in said conduit biased to allow flow only from the body compartment to the head compartment, a solenoid operated two-way valve, a conduit connecting one outlet port of said two-way valve to the head compartment, a conduit connecting the other outlet port of said two-way valve to the body compartment, said two-way valve normally being biased to discharge into said body compartment, means supplying gas under pressure to the inlet port of said two-way valve, a Venturi tube, means supplying gas under pressure through said tube and into the inlet port of said two-way valve, a suction port in said Venturi tube, a conduit connecting said suction port to said body compartment, a solenoid operated valve interposed in said conduit, said valve being normally biased in closed position, cyclic electrical timing means for simultaneously energizing the solenoids of each of said cut-off valves and said two-way valve for a selected time interval, followed by a de-energized period of a selected time interval.

13. A resuscitator as set forth in claim 12, wherein the said means applying gas under pressure to said two-way valve is a cylinder of oxygen and wherein the said means for supplying gas under pressure through said Venturi tube is a cylinder of oxygen.

References Cited in the file of this patent

UNITED STATES PATENTS

1,282,908	Miller	Oct. 29, 1918
1,906,844	Drinker	May 2, 1933
2,263,844	Hammond	Nov. 25, 1941
2,543,426	Terhaar	Feb. 27, 1951
2,588,192	Akerman	Mar. 4, 1952